REPORT

Site Characterization Plan

Coffee Gold Mine

Prepared for:

Goldcorp Kaminak Ltd.
3260-666 Burrard Street
Vancouver, BC V6C 2X8

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REVISION TRACKING LOG

Revision Tracking Log			
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1	March 2024	General	Updated in response to Type A WUL SIR4
2	July 2025	Various	Updated in response to Type A WUL IR7 and Type A WUL IR8.

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Appendix A Environmental Baseline Report, Mine Site Study Area: Surficial Geology, Permafrost and Terrain Stability
Appendix B 2021 Hydrometeorology Baseline Report
Appendix C Baseline Water Quality Report 2010 to 2020
Appendix D Baseline Hydrogeological Assessment 2019 Update
Appendix E Fish and Aquatic Resources Baseline Reports (2013-2016)
Appendix F Supplemental Fish and Aquatic Resource Reports (2017-2021)
Appendix G Vegetation Baseline Report
Appendix H Wildlife Baseline Reports
Appendix I Seismic Design Report
Appendix J Geochemical Source Term Report

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
AFDM	ash-free dry mass
ALS	ALS Environmental
BC	British Columbia
BC MOE	British Columbia Ministry of Environment
BCR	Bird Conservation Region
BEM	Broad Ecosystem Mapping
CABIN	Canadian Aquatic Biomonitoring Network
CCME	Canadian Council of Ministers of the Environment
CDC	Conservation Data Centre (Yukon)
CMUS	Coffee Mine Update Study
CN	Cyanides
CoPCs	chemicals of potential concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DO	dissolved oxygen
EBA TT	EBA Tetra Tech
EBR	Electrochemical Biological Reactor
eDNA	environmental DNA
ELC	Ecological and Landscape Classification
EOM	End-of-mine
EPT	Ephemeroptera-Plecoptera-Trichoptera
FHAP	Fish Habitat Assessment Procedure
GMS	Game Management Subzone
GTCs	Ground Temperature (a.k.a. Thermistor) Cables
HE	Habitat Evaluation
HLF	Heap Leach Facility
H_2O_2	hydrogen peroxide
HSC	Habitat Site Card
K	hydraulic conductivity
LAA	Local Assessment Area
LiDAR	Light Detection and Ranging
LOM	life of mine
Lorax	Lorax Environmental Services Ltd.
LSA	Local Study Area
MAP	mean annual precipitation
MAT	Mean annual air temperature
Maxxam	Maxxam Analytics
MDL	Method detection limit
MSA	mine site area

Acronym / Abbreviation	Definition
NAR	Northern Access Route
NaCN	Sodium Cyanide
NBCC	National Building Code of Canada
Newmont	Goldcorp Kaminak Ltd., a wholly owned subsidiary of Newmont Corporation
NGOs	Non-governmental organizations
ORP	oxidation- reduction potential
PE	potential evapotranspiration
PEL	Probable Effects Level
PMP	Permafrost monitoring program
PTS	Passive Treatment System
Project	Coffee Gold Mine
ROM	run-of-mine
RSA	Regional Study Area
Sa	Spectral acceleration
SARA	*Species at Risk Act*
SBTSs	Single-Bead Thermistor Strings
SC	Specific conductance
SCP	Site Characterization Plan
SE	Standard error
SQG	Sediment Quality Guidelines
SER	Social and Environmental Standard
SFE	Shake Flask Extraction
SHA	seismic hazard analysis
SNAP	Scenarios Network for Alaska and Arctic Planning
TK	Traditional Knowledge
TSS	total suspended solids
US EPA	US Environmental Protection Agency's
VWP	vibrating wire piezometer
WBM	Water balance model
WQG	Water quality guidelines
WQM	Water quality model
WRSF	Waste Rock Storage Facility
YESAB	Yukon Environmental and Socio-economic Board
YG	Yukon Government
YOY	young of the year
YTT	Yukon-Tanana Terrane
YWB	Yukon Water Board

LIST OF SYMBOLS AND UNITS OF MEASURE

Symbol / Unit of Measure	Definition
%	percent
±	plus or minus
°C	degrees Celsius
µS/cm	micro-Seimens per centimeter (unit of specific conductance)
µg	microgram
µg/g ww	microgram per gram wet weight
µg/g dw	microgram per gram dry weight
$CaCO^3/t$	calcium carbonate per tonne
dw	dry weight
g	gravity
ha	hectares
kg	kilogram
km	kilometre
km^2	square kilometre
kW/m^2	kilowatt per square metre
L	litre
$L/s/km^2$	litres per second per square kilometre
m	metre
m^2	Square metre
m^3/s	cubic metres per second
m/s	metres per second
masl	metres above sea level
mb	millibar
mbgs	Metres below ground surface
mg	milligram
Mg#	magnesium number
mm	millimeter
Mt	million tonnes
s	period
Sa	Spectral acceleration
t	tonne
t/d	tonnes per day
vmbgs	vertical metres below ground surface
wt. %	percent weight

1.0 INTRODUCTION

This Site Characterization Plan (SCP) has been prepared to meet the requirements of an application for a Quartz Mining License for the Coffee Gold Mine. It follows the guidance in the Plan Requirement Guidance for Quartz Mining Projects (Yukon Water Board and EMR 2013).

The proposed Coffee Gold Mine (the Project) is an open-pit gold mine owned by Goldcorp Kaminak Ltd, a subsidiary of Newmont, located on the south side of the Yukon River in the White Gold District of west-central Yukon, approximately 130 km south of the City of Dawson, 140 km west of Pelly Crossing, 95 km north-east of Beaver Creek, and 340 km northwest of Whitehorse. The Project is located wholly within the traditional territory of Tr'ondëk Hwëch'in, partially within the traditional territory of Selkirk First Nation and First Nation of Na-cho Nyäk Dun, and partially within the asserted territory of White River First Nation. The Project contains several gold occurrences within an exploration concession covering an area of more than 600 km^2. The Mine Site will be accessed by road from Dawson via a 16-km stretch of Klondike Highway and 192-km all-season road, referred to as the Northern Access Route (NAR) (Figure 1-1). The NAR will be comprised of 61 km of existing road, 5 km of winter road, and 126 km of road modifications, including approximately 31 km of new single-lane, forestry-type access road. The NAR includes seasonal barge crossings on both the Stewart and Yukon rivers, with ice bridges and a seasonal winter road in the winter months.

The Government of Yukon and the Government of Canada, in partnership with Yukon First Nations, have come to a joint decision to accept the Yukon Environmental and Socio-economic Assessment Board (YESAB) Executive Committee's recommendation that the Coffee Gold Mine project be allowed to proceed. This SCP provides information from the Project Proposal submitted to YESAB as well as information collected during and subsequently to the Project approval process.

Concordance of the SCP to the Plan Requirements Guidance for Quartz Mining Projects is shown in Table 1-1.

Table 1-1 Concordance with Plan Requirements

Section in Guidance Document		Corresponding Section(s) in this Plan
4.1	Introduction	1.0 Introduction
4.2	Geology	2.2 Regional Geology 2.3 Coffee Property Geology 2.4 Deposit Mineralization
4.3	Climate and Hydrology	3.0 Climate 3.10 Climate Change 4.3 Surface Water Hydrology
4.4	Surface Water	4.0 Surface Water Quality
4.5	Groundwater	5.0 Groundwater 5.5 Groundwater Quality 5.6 Groundwater Model

Section in Guidance Document		Corresponding Section(s) in this Plan
4.6	Vegetation and Wildlife	6.0 Fish and Aquatic Resources 7.0 Vegetation 8.0 Wildlife
4.7	Soils and Bedrock	9.0 Soil and Bedrock 9.2 Permafrost
4.8	Seismicity	10.0 Seismicity
4.9	Geochemistry and Geotechnical Information	11.0 Geochemistry and Geotechnical Information

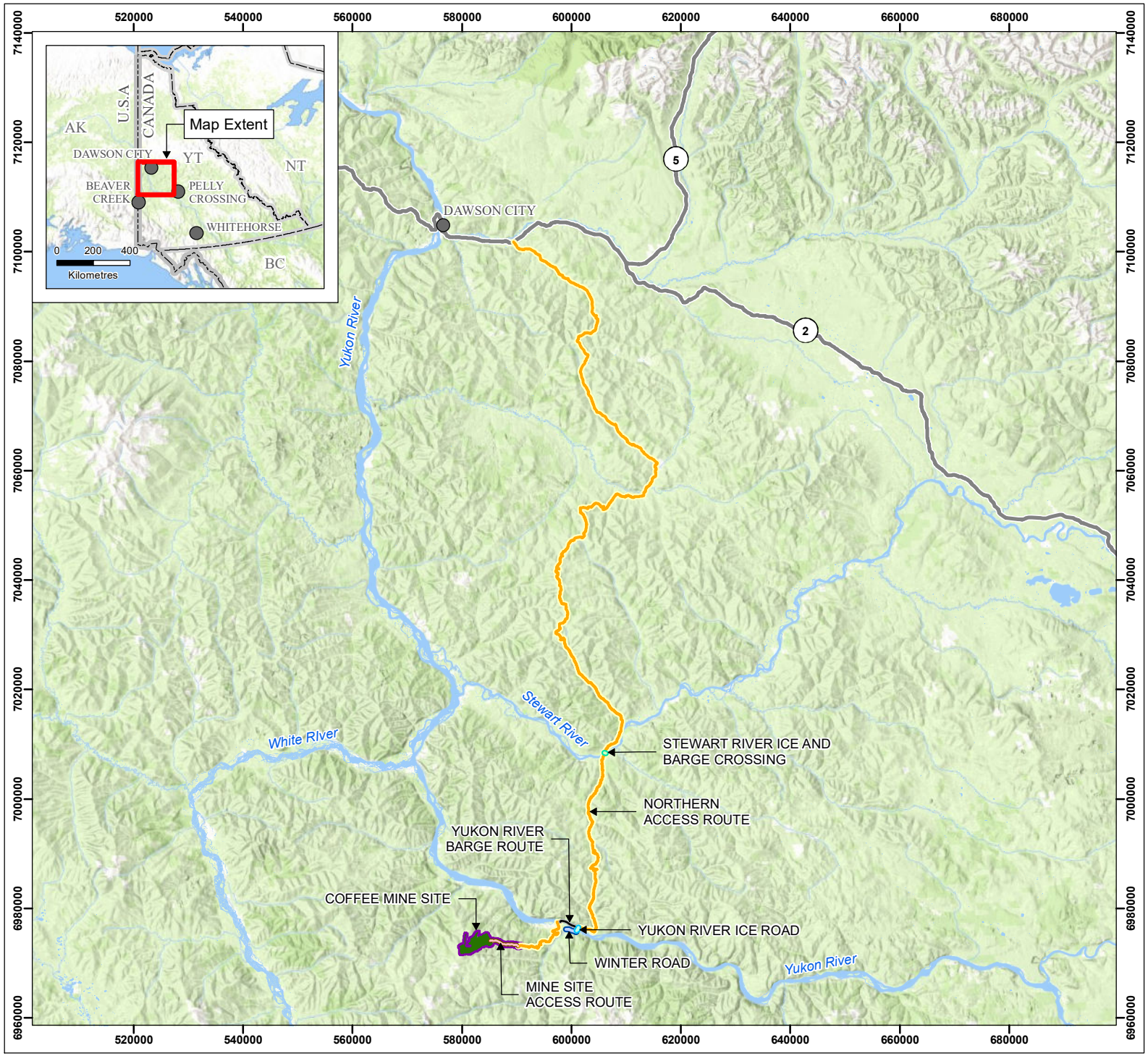
1.1 Project Summary

The Project is comprised of four open pits: Supremo, Latte, Double Double, and Kona. Waste rock is proposed to be permanently stored in the Alpha Waste Rock Storage Facility (WRSF) (Figure 1-2). The ore production rate is proposed to be up to approximately 9.0 million tonnes (Mt) per year, producing an estimated total of 67 Mt of heap leach feed over the 10-year Operation Phase. The conceptual-level estimate for waste material to be moved over the life of mine (LOM) is up to approximately 330 Mt based on an average strip ratio of 5.0:1. The ore will be crushed and transported to the Heap Leach Facility (HLF) via overland conveyor or trucks for nine months of the year. During the three coldest months of winter, run-of-mine (ROM) ore will be stockpiled in the ROM stockpile. Gold will be extracted from gold-bearing leach solution by a six tonnes per day (t/d) adsorption, desorption, recovery carbon plant with mercury retorting to produce a final gold doré product. A total of 2.6 million ounces of gold is planned to be recovered over a 10-year mine life.

The Project phases are defined as follows:

- Construction Phase: Q2 Year –3 to end of Year –1 (30 months)
- Operation Phase: Year –1 to end of Year 9 (10 years)
- Reclamation and Closure Phase: Year 10 to end of Year 21, including a 6-year Post-Mining Closure Stage and a 5-year Active Closure Stage (11 years)
- Post-Closure Phase: Year 21 onwards as determined to be required.

These phases broadly describe the activities occurring within a particular time period; however, some activities will continue from one phase to another as mine site development advances with operational activities (e.g., Open Pits, WRSF). When areas that support mine operations are no longer required, they will be progressively reclaimed. The overall Project schedule is the general expected scenario for mine construction and operation; detailed activities are subject to change depending on detailed mine planning and the timing of receipt of authorizations.



COFFEE GOLD MINE

Coffee Project Location and Northern Access Route

Legend

- Stewart River Ice and Barge Crossing
- Yukon River Barge Route
- Yukon River Ice Road
- Winter Road
- Mine Site Access Route
- Northern Access Route
- Project Area
- Project Footprint
- Highway
- Waterbody

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Contains information licensed under the Open Government Licence - Yukon Territory
3. Basemap: ESRI World Topographic Map
4. Inset Basemap: ESRI World Topographic Map

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Kilometres

NAD 1983 UTM Zone 7N

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Figure 1.1	Date: Mar 2, 2023	Drawn by: AS	Reviewed: KP

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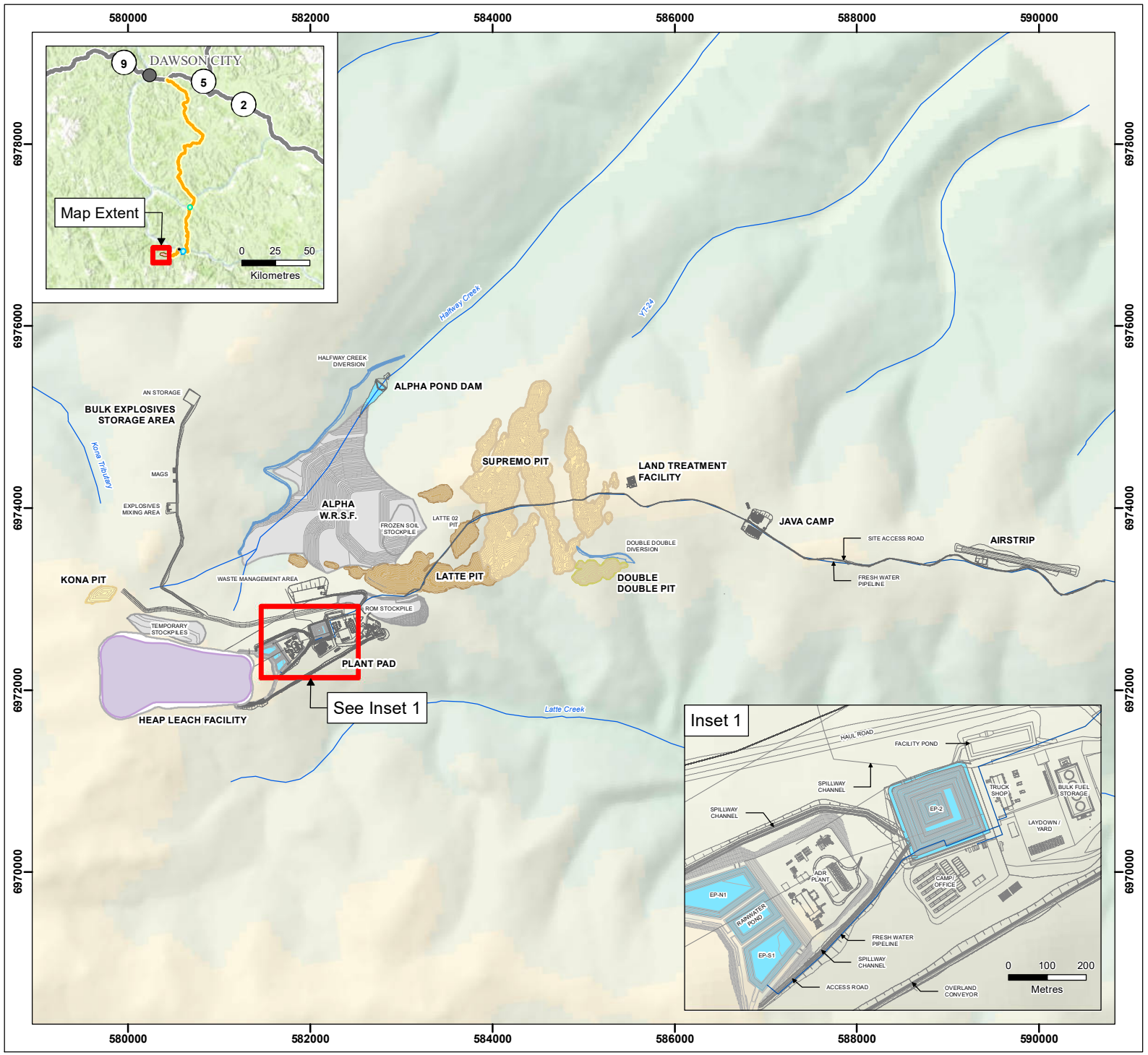

COFFEE GOLD MINE

General Arrangement - Mine Site

Legend

- Double Double Pit
- Kona Pit
- Latte Pit
- Supremo Pit

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
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3. Inset Basemap: ESRI World Topographic Map

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Kilometres

NAD 1983 UTM Zone 7N

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Figure 1.2	Date: Oct 6, 2023	Drawn by: AS	Reviewed: CH

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1.2 Scope and Objectives

This Plan is provided in conjunction with several other plans as part of a package to meet the requirements for quartz mine applications for a Quartz Mining License and a Water Use Licence under the *Quartz Mining Act* and the *Waters Act*, respectively. Other applicable plans identified in the guidelines are submitted separately.

This plan addresses the site environmental baseline conditions for the Coffee Gold Mine in sufficient detail to support the required plans within the overall application. It includes descriptions of the footprint areas of the mine and the surrounding environment that may be affected by mine activities. Mitigation measures to avoid and reduce potential effects of the mine on the environment have been approved by YESAB and are included in the scope of other submitted plans.

The Plan includes a description of the pre-disturbance and existing conditions of the Project footprint and reference areas. This description of pre-disturbance and existing conditions following exploration activities is based on scientific data collected during baseline programs conducted by Newmont in parallel to the Project feasibility and advanced exploration activities. These baseline programs include meteorology, hydrology, hydrogeology, geotechnical, soils, air, noise, aquatic, and terrestrial wildlife, and were initiated in 2010 or earlier. The purpose of baseline programs was to collect data to support the assessment of potential effects of the Project and develop mitigation measures, and to describe the pre-Project conditions that will inform the basis for future monitoring programs that will be required as part of required Project authorizations. Environmental baseline programs continue to be implemented at the Project site to collect ongoing environmental information and inform exploration activities.

Reference areas defined as areas within the boundaries of regional study but outside the zones of potential Project-related influence, are also described herein. In this case, the reference areas are defined by water quality monitoring stations located where the proposed Project will not have an influence – on Dan Man Creek and the Yukon River upstream of all Project related discharges (Section 4.2). These reference areas provide local background context for the development of future monitoring programs.

1.3 Summary and Record of Consultation

First Nation engagement and consultation is ongoing, and any feedback that is received or concerns that are heard during consultation will be incorporated into this plan, where applicable.

1.4 Synergies with Newmont Standards and Requirements and Other Project Documents

As an important part of Newmont's internal governance process, Newmont has implemented a Global Policies and Standards (Global Standards), that are reviewed and preliminarily approved by a Global Policies & Standards Committee. The Global Standards provides the framework and standards for Newmont sustainability management and ensures a consistency of approach for implementing these global policies across the Company.

The scope of the Social and Environmental Standards (SER) is global, and they apply to all directors, officers and employees of Newmont Corporation, its subsidiaries, and any other entities that it controls. A variance request process for existing or future conditions is in place for SER standards. The process provides an alternative mechanism for those instances where a Newmont site/operation cannot logistically or feasibly conform to a requirement established in a Standard due to special conditions or unique hardships. The Newmont SER standards is straightforward in design and is capable of being implemented globally. The SER standards is intended to be fully integrated into all core business functions, and it emphasizes sustainability responsibility and accountability at all organizational levels.

The SER contains overarching standards applicable to all sustainability functions (Global Standards), as listed below:

- Air Emissions Management Standard
- Biodiversity Management Standard
- Closure and Reclamation Management Standard
- Community Investment and Development Standard
- Cultural Resource and Management Standard
- Hazardous Materials Management Standard
- Human Rights Standard
- Indigenous Peoples Standard
- Land Acquisition and Involuntary Resettlement Standard
- Local Procurement and Employment Standard
- Product Stewardship Standard
- Social Baseline and Impact Assessment Standard
- Stakeholder Relationship Management Standard
- Tailings Storage Facility and Heap Leach Facility Environmental Standard
- Tailings Storage Facilities Technical and Operations Standard
- Waste Management Standard
- Waste Rock and Ore Stockpile Management Standard
- Water Management Standard.

While this Plan can be reviewed in isolation to inform a review of the specific actions for Project management and monitoring, this plan should be viewed in concert with the management plans listed in Table 1-2 in order to attain a holistic understanding of the Project.

Table 1-2 Management Plans

Plan	Description
Air Quality and Greenhouse Gas Management Plan	This plan intended to identify and demonstrate how appropriate management techniques will reduce the potential for any Project-related adverse effects to air quality and human health, and to describe the measures that will be undertaken to control gas air emissions generated by Project activities.
Access Route Construction Management Plan	Describes the procedures and protocols for construction of the access road, barge crossings, and seasonal ice roads (i.e., the NAR) between Dawson, Yukon, and the Project Site
Access Route Operational Management Plan	Describes the procedures and protocols for use of the NAR. The NAR will be used during both the Construction and Operation Phases to transport fuel, equipment, and other supplies
Cyanide Management Plan	Describes the measures Newmont will implement to minimize the risk to the public, employees, contractors, and the environment from the use of cyanide in the recovery of gold from ore.
Emergency Response Plan	The purpose of this plan is to protect the health and safety of all personnel by ensuring an appropriate response is in place (and sets out guidelines to be followed) in the event of reasonably foreseeable emergencies and incidents.
Erosion and Sediment Control Plan	Erosion and sedimentation associated with ground disturbances such as vegetation clearing, earthworks (cuts and fills), excavations, and slope failures, have the potential to affect the surrounding environment if not properly mitigated. The objective of this Erosion and Sediment Control Plan (Plan) is to provide guidance and protocols that aim to minimize water erosion and prevent sediment mobilization into the receiving environment, specifically areas with fish and aquatic biota values that can be affected by increased turbidity or sediment deposition.
Explosives Management Plan	The purpose of this plan is to provide guidance on the handling, storage, and use of explosives, which is regulated at the federal and territorial level. The objective of the plan is to describe management practices that the Project will employ to ensure the safe storage and use of explosives in mine operations while minimizing the risk to employees, contractors, and the environment.
General Mine Development Plan	This plan serves to describe the development of the mining property to support operational mining. It describes the facilities which will be constructed, and preparations required before the commencement of normal mine operations.
Waste and Hazardous Materials Management Plan	The objective of this plan is to address the responsible handling, storage, transportation, and disposal of all hazardous and non-hazardous waste at the Mine Site.
Heap Leach and Process Facilities Plan	This plan outlines the design and construction information for the Heap Leach Facility (HLF), which is comprised of the crushing plant, heap leach pad (HLP), and process facilities. The Plan also details the procedures and protocols for management of the crushing plant, HLP and process facilities once constructed. The Plan discusses the safety measures implemented to provide safe handling practices, containment requirements, and disposal and treatment of solutions.
Heritage Resources Protection Plan	The objective of this plan is to provide protection measures to reduce any significant or adverse effects for known and previously unrecorded heritage resources throughout the life of the Project.

Plan	Description
Mine Operations Plan	This Mine Operations Plan describes the design criteria, open pit mine design, material scheduling, and general operations of the four Open Pits at the Project.
Noise Management Plan	This Noise Management Plan presents details on the relevant noise effects assessment criteria, compliance procedures and controls relating to Project activities. The objective of the Noise Management Plan is to describe the appropriate management techniques that will reduce the potential for noise-related adverse impacts to human health or the environment
Reclamation and Closure Plan	Newmont will develop and implement a Reclamation and Closure Plan that contains commitments related to: salvageable material, socio-economic aspects of closure, care and maintenance, revegetation, project facilities, social reclamation
Spill Contingency Plan	The purpose of this plan is to minimize the impacts of spills through the establishment of pre-determined lines of response and plans of action, and to protect the safety of workers, contractors and the environment in the event of a spill.
Vegetation Protection Plan	The purpose of the Vegetation Protection Plan (the Plan) is to reduce the effects of Project Construction and Operation-phase activities on vegetation. The Plan outlines measures to maintain the integrity of vegetation and ecological communities and prevent the introduction and spread of invasive plant species.
Water Management Plan	The water management plan describes water management practices and procedures to minimize adverse effects on water resources resulting from mining operations and activities.
Waste Rock and Overburden Management Plan	This plan describes the types of waste rock, soil overburden and ROM stockpiles that will be constructed and how their materials will be characterized, segregated, and stored to ensure long-term stability; and how frozen materials will be handled and stored to support closure and reclamation objectives
Wildlife Protection Plan	The purpose of the Wildlife Protection Plan is to minimize the effects of the Project's Construction and Operation-phase activities on wildlife and wildlife habitat. The Wildlife Protection Plan is intended to ensure that wildlife continue to use habitat in areas adjacent to the Project footprint and within the broader Project area while reducing the potential for Project-related injury or mortality to wildlife and accommodating operational and human health and safety requirements

2.0 GEOLOGY

2.1 Regional Geology

The Project is located in the Yukon-Tanana Terrane (YTT), an accreted pericratonic rock sequence that covers a large portion of the Omineca Belt in Yukon and extends into Alaska and British Columbia (BC). The YTT underlies part of the Tintina gold belt and hosts multiple gold deposits, including the Sonora Gulch gold deposit, the Casino copper-gold-molybdenum porphyry, the Boulevard gold prospect, and the Golden Saddle gold deposit (Bennett et al., 2010; Allan et al., 2013). The YTT also hosts volcanogenic massive sulphide and Mississippi Valley-type deposits (Figure 2-1).

The YTT is composed of a basal metasiliclastic sequence overlain by three subsequent volcanic arcs. The oldest component of the YTT is the Late Devonian Snowcap assemblage, which consists of metasediments including psammitic schist, quartzite, and carbonaceous schist in addition to local amphibolite, greenstone, and ultramafic rocks (Piercey and Colpron 2009). The Snowcap assemblage was deposited on the ancient Laurentian margin in a passive marine setting (Piercey and Colpron 2009). The beginning of eastward subduction of the paleo-Pacific plate led to the formation of a magmatic arc, at approximately 365 million years ago (Colpron et al. 2006a). Rapid westward slab rollback caused significant extension, which initiated the formation of the Slide Mountain Ocean back-arc basin by approximately 360 million years ago (Colpron et al. 2007). Arc volcanism during the Wolverine-Finlayson magmatic cycle (365 to 342 million years ago) deposited submarine mafic and felsic volcanic rocks of the widespread Finlayson assemblage onto the Snowcap assemblage (Colpron et al. 2006b).

A reversal of subduction polarity during the Late Permian resulted in the western margin of the Slide Mountain Ocean back-arc subducting beneath the evolving YTT (Erdmer et al. 1998). This subduction initiated a magmatic arc which was active from 269 to 253 million years ago and formed the Klondike arc assemblage, the youngest member of the outboard YTT (Allan et al. 2013; Colpron et al. 2006a). Closure of the Slide Mountain Ocean, by the Late Permian to Early Jurassic periods, led to the obduction of the YTT onto the Laurentian margin, causing a collisional event responsible for lower amphibolite facies metamorphism in the Project area (Beranek and Mortensen 2011). In addition, collision resulted in the development of a low-angle transpositional foliation, recognized throughout the YTT (Berman et al. 2007).

Following accretion of the YTT onto Laurentia, easterly subduction caused intra-arc shortening and compressional deformation. In the Klondike and the area of the Project, thrust fault-bounded panels of the Slide Mountain Ocean assemblage greenstone and serpentinized ultramafic occur within the tectonic stratigraphy of the YTT (Buitenhuis 2014; MacKenzie et al. 2008). These thrust-emplaced slices are generally less than 100 metres (m) in thickness, dip to the southwest, and persist for tens of kilometres in some areas (MacKenzie and Craw 2010, 2012). The emplacement of these slices is contemporaneous with northeast-vergent, open to tight folding dated between 195 and 187 million years ago (Berman et al. 2007).

Beginning in the early- to mid-Cretaceous, localized rapid uplift and exhumation occurred throughout the YTT in Yukon and Alaska, including the Dawson Range (McCausland et al. 2006). Extension and unroofing of the rocks of the Dawson Range was accompanied by the emplacement of the Coffee Creek granite and Dawson Range batholith (approximately 110 to 90 million years ago; Colpron et al. 2006a). This localized extension and exhumation is recorded by an apparent age-resetting event observed in white mica in western Yukon Tanana at roughly 90 million years ago (Douglas et al. 2002), in rhenium-osmium dates in molybdenite (92.4 million years ago), and uranium-lead dates in monazite (92.5 million years ago) from

plutons in east-central Alaskan YTT (Selby et al. 2002). At the Coffee property, this extension resulted in the activation of the Coffee Creek fault system, a set of dextral strike-slip faults and associated north-to-northeast brittle faults, interpreted as splays, off of the regional Big Creek fault to the southeast (Sánchez et al. 2013; Johnston 1999).

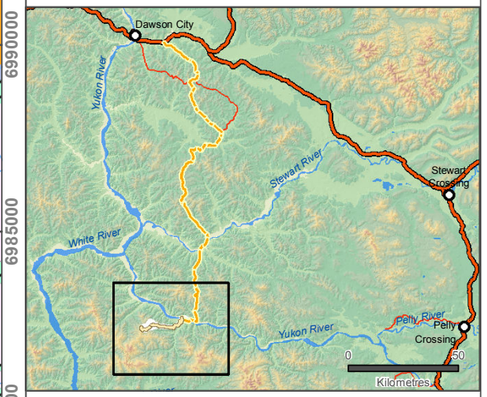
570000 575000 580000 585000 590000 595000 600000 605000 610000 615000

6990000 6985000 6980000 6975000 6970000 6965000 6960000 6955000

Coffee - Project Footprint (white boundary)

Coffee Camp

Geological Setting of the Project



Legend

- Coffee Creek Fault
- Faults
- Folds

Property Geology

Paleocene to lower Eocene

- PRC1: Rhyolite Ck: rhyolite and dacite

Mid-Cretaceous

- mKhW: Whitehorse Suite
- mKgW: Whitehorse Suite: Bt-Hbl granodiorite
- mKqW: Whitehorse Suite: Bt quartz monzonite

Upper Cretaceous

- uKC2: Carmacks: andesite, porphyry

Mid-Late Permian

- Ultramafics
- PqS: Sulphur Ck Suite: K-feldspar augen granite
- PK1: Klondike Schist: quartz-musc-chl schist

Mississippian

- MgSR: Simpson Range Suite: metagranodiorite

Devonian-Mississippian

- DMF1: Finlayson: int. to mafic volcanic
- DMF6: Finlayson: ultramafic rocks

Mid-Devonian

- Metabasalt

Neoproterozoic and Paleozoic

- PDS1: Snowcap: quartzite, psammite
- PDS2: SNOWCAP: light grey marble

N

0 2 4 6 8 10

Kilometers

NAD 1983 UTM Zone 7N

1:160,000

Figure 2-1	Date: Feb 20, 2018	Drawn by: TB	Page Size: 11" x 17"

Newmont COFFEE

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2.2 Coffee Property Geology

The Project area is underlain by a package of metamorphosed Paleozoic rocks of the YTT that was intruded by a large granitic body in the Late Cretaceous. The Paleozoic rock package consists of a mafic schistose to gneissic panel which overlies the Sulphur Creek orthogneiss. Both packages form the southwestern limb of a northwest-trending antiformal fold with limbs dipping shallowly to the northeast and southwest.

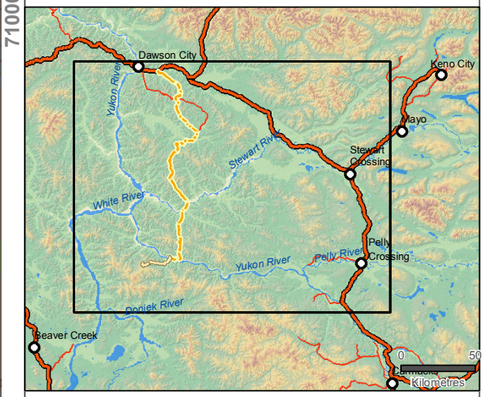
The schistose and gneissic mafic rock package comprises a thick panel of biotite (+ feldspar + quartz + muscovite ± carbonate) schist, with rare lenses of amphibolite, which overlies a panel of amphibolite and metagabbro with arc-derived geochemical signatures. Within the schistose panel, slices of 20-m thick serpentinized ultramafic are in tectonic contact with the surrounding rocks. This rock sequence overlies the augen orthogneiss. These rocks are in contact to the southwest with the 98.2 ± 1.3 million years ago Coffee Creek granite. Both the Paleozoic metamorphic rocks and Cretaceous granite are cut by intermediate to felsic dykes of andesitic to dacitic composition.

Due to only rare outcrop exposure on the property (less than 5%), the geological map (Figure 2-2) has been compiled from a combination of geological traverses, bedrock mapping, borehole data, soil geochemistry, and geophysics (magnetic and radiometric). The magnesium number (Mg#) from soil samples (Mg# = Mg/Mg+Fe) was used to discern mafic from felsic units with the granite being the most felsic, followed by the felsic gneiss. The mafic schist unit was further subdivided into felsic-intermediate schist, biotite schist, amphibolite, and ultramafic rocks (Table 2-1).

Table 2-1 Main Rock Units in the Coffee Property

Rock Unit	Description
Felsic Gneiss	Variable quartz + feldspar augen + biotite + muscovite. Typical Mg# 2-28. Low in potassium. Host to gold mineralized zones at Supremo.
Biotite Schist	Biotite +/- feldspar +/- quartz +/- muscovite +/- amphibole. Commonly carbonate-rich. High in potassium. Typical Mg#20 – 40. Locally mylonitic. Host to gold mineralized zones at Latte.
Muscovite Schist	Mainly quartz + muscovite. Typical Mg#10 – 20. Locally mylonitic.
Biotite Amphibolite	Amphibole + feldspar + biotite. Typical Mg# 20 - 40. Biotite and amphibole both iron-rich. Contains up to 20% biotite.
Amphibolite	Found within the lower mafic footwall. Amphibole + feldspar ± biotite. Typical Mg# 30-50, biotite and amphibole more magnesium-rich than biotite amphibolite. Contains up to 15% biotite.
Metagabbro / Amphibolite	Interleaved metagabbro with coarse magnesiohornblende + feldspar, and fine-grained, massive amphibolite with greater than 95% magnesiohornblende. Moderate to strong retrogression to actinolite. High magnesium content of biotite, amphibole.
Ultramafics	Serpentinite, pyroxenite or listwaenite. Typical Mg# 50 - 73, higher than all amphibolites and metagabbro. Very high in chromium and nickel.
Granite	Coffee Creek granite and Dawson Range batholith. Both are phases of the Whitehorse Plutonic suite and are uranium-rich. Dawson Range batholith higher in thorium. Both are identifiable using airborne radiometrics.
Dacite Dykes	Quartz + feldspar phenocryst porphyry. Generally, strongly silicified and sericitized. Strong spatial association with mineralized gold zones.
Andesite Dykes	Feldspar phenocrystic. Aphanitic in gold-bearing structures where all original textures are destroyed by intense silicification and sericitization. Strong spatial association with mineralized gold zones.

Geological Map of the Coffee Gold Mine Project Area



Legend

- Mineral prospects
- Dawson route
- Highways
- Road

Property Geology

Paleocene to lower Eocene
- PRC1: Rhyolite Ck: rhyolite and dacite

Mid-Cretaceous
- mKhW: Whitehorse Suite
- mKgW: Whitehorse Suite: Bt-Hbl granodiorite
- mKqW: Whitehorse Suite: Bt quartz monzonite

Upper Cretaceous
- uKC2: Carmacks: andesite, porphyry

Mid-Late Permian
- Ultramafics
- PqS: Sulphur Ck Suite: K-feldspar augen granite
- PK1: Klondike Schist: quartz-musc-chl schist

Mississippian
- MgSR: Simpson Range Suite: metagranodiorite

Devonian-Mississippian
- DMF1: Finlayson: int. to mafic volcanic
- DMF6: Finlayson: ultramafic rocks

Mid-Devonian
- Metabasalt

Neoproterozoic and Paleozoic
- PDS1: Snowcap: quartzite, psammite
- PDS2: SNOWCAP: light grey marble
- Coffee Creek Fault
- Faults
- Folds

N

0 10 20 30 40

Kilometres

NAD 1983 UTM Zone 7N

1:650,000

Figure 2-2	Date: Feb 20, 2018	Drawn by: TB	Page Size: 11" x 17"

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2.3 Deposit Mineralization

Exploration drilling completed between 2010 and 2015 identified significant gold mineralization in over 15 separate areas of the Coffee property: Supremo, Latte, Sumatra, Arabica, Double Double, Americano West, Americano, Espresso, Kona, Kona North, Macchiato, Cappuccino, French Press, Dolce, and Sugar. Mineralization textures for the four Project resource and reserve deposits: Supremo, Latte, Double Double, and Kona, are described in Table 2-2 and are further detailed below.

Table 2-2 Main Mineralized Zones of the Project

Zone	Host Rocks	Description
Supremo	Augen Gneiss	Narrow gold-bearing brittle fault structures with gold hosted in intense fracture zones, immature clast supported breccia and in zones of most intense deformation matrix supported breccia. Mineralization commonly on the margin of and within dacite dykes which intruded along the fracture zones pre-mineralization. Gold mineralization and accompanying quartz-sericite-pyrite alteration are associated with later reactivation of structures. Complete oxidation up to 250 m below surface.
Latte	Biotite-feldspar Schist, Augen Gneiss	Gold is hosted in zones of brecciation and strong fracturing as well as areas with pervasive sericite alteration and strongly disseminated sulphides. Some high-grade zones are associated with quartz vein breccias. Dolomite-illite/sericite-arsenian pyrite sulphidizes foliaform biotite laths. Potential remobilization of gold to other structures. Complete oxidation up to 75 m below surface
Double Double	Augen Gneiss, Biotite-feldspar Schist	Narrow gold-bearing brittle structures hosted in matrix-supported breccia including dacite porphyry fragment breccia. Anastomosing quartz vein networks and microbreccia associated with high-grade. Local intense silicification and strong disseminated sulphide mineralization. Complete oxidation up to 350 m below surface.
Kona	Granite	Broad zones of fracture-controlled and disseminated pyrite associated with dacite dykes. Gold hosted in quartz-sericite altered granite. Iron oxides after disseminated pyrite, pyrite veinlets, stockworks and sooty-pyrite rich shear zones.

2.3.1 Supremo Zone

The Supremo zone is hosted in the augen gneiss package and consists of a number of interconnected north-to-northeast trending, steeply dipping structures (T1 to T8). The structures are variably spaced and are known to splay and merge into one another over their strike length. The geometry of the structural zones is defined by linear gold-in-soil anomalies, topographic lineaments, and magnetic linear breaks, and ultimately subsurface via extensive drilling and three-dimensional interpretation of lode geometries supported by core-oriented structural measurements.

The gold mineralization at Supremo is generally characterized by two distinct styles: brecciated mineralization and biotite replacement mineralization. The highest grades are associated with polyphase hydrothermal breccias. Breccia textures range from mature matrix-dominant phases with rounded fragments to immature wall rock crackle breccias. Matrix compositions range from incompetent limonite-clay material to strongly silicified material. Angular-to-sub-rounded clasts range from 0.5 centimetres to 3 centimetres in diameter and consist predominantly of highly silicified fragments and subordinate altered wall rock and dacite porphyry fragments. Brecciated lasts occur locally, indicating multiple phases of brecciation. The lower grade gold mineralization is associated with pervasive hydrothermal alteration of

non-brecciated gneissic host rock. Biotite is pseudomorphously replaced by pyrite and the hydrothermal alteration is characterized by an overall removal of potassium and aluminum with the addition of sulphide, carbonate, and silica. Andesite and dacite dykes appear to have utilized the same structures as mineralizing fluids, but they are themselves altered and locally auriferous, therefore they predate mineralization. In other cases, altered dykes with elevated arsenic and antimony are barren. Some dyke margins appear to focus brecciation, potentially due to rheological contrast. The relationship between dykes and the auriferous hydrothermal system remains poorly constrained.

2.3.2 Latte Zone

Drilling across an east-west trend of gold-in-soil anomalies at Latte has intersected gold mineralization 0.5 m to 1 m below surficial colluvium and soil. Latte zone consists of a stacked set of moderately to steeply south-southwest dipping, east-southeast striking brittle ductile structures, whereas the Latte North structure splays off from the main Latte structure and dips moderately to steeply to the southeast with a north-easterly strike. No shear fabric or observable high strain indicators are visible in association with the steep and mineralized Latte structures. Drilling has intersected mineralization at depths of up to 450 m below surface, and all structures remain open at depth.

The western portion of the Latte zone is dominated by broad regions of disseminated mineralization found throughout a wide panel of biotite schist. The western structures strike approximately 100˚ and contain five or more mineralized shoots which merge and separate along strike. The structures continue to the east and eventually merge into the connector zone, where the Supremo north-south structures and the east-west Latte and Double Double structures converge. Total traceable length of the mineralized Latte structure is currently in excess of 2,100 m. Latte North displays identical mineralization textures as the main Latte structure. However, the structures strike at approximately 045˚ and dip approximately 60˚ to the southeast. Latte North splays away from the main Latte corridor for a minimum strike length of 275 m. Mineralization at Latte consists of disseminated gold-bearing arsenian pyrite, overprinted by later brecciation and late fluid ingress. Mica-rich rocks are the main host for gold, with a three-phase mineral reaction resulting in gold precipitation. Gold-bearing mineralizing fluid, rich in carbon dioxide-arsenic-antimony and sulphur, reacted strongly with iron-bearing biotite within the biotite schist at Latte. A sulphidation reaction proceeds, in which iron within the biotite is leached to form fine-grained arsenian pyrite, illite, and dolomite which pseudomorphously replace the parent biotite grain. Titanium within the parent biotite is removed and incorporated within hydrothermal illite and rutile. In high-grade intervals, this reaction has run to completion with no biotite preserved. Areas which did not experience the same levels of fluid-rock interaction retain relict biotite laths.

2.3.3 Double Double Zone

The Double Double zone trends east-northeast with a known strike length of 600 m. It dips steeply to the north and consists of a number of discrete, high-grade strands of mineralization up to several metres wide. Host rocks are augen-bearing gneissic rocks with interleaved biotite-feldspar-quartz (± muscovite ± amphibole) schist. The gold mineralization at Double Double is structurally controlled and may be associated with a north-easterly trending splay off the main Latte structure. Gold-rich intervals at Double Double are characterized by relict schistose to mylonitic textures overprinted by mottled silica and sericite alteration in addition to limonite-filled micro fracture networks and oxidized pyrite cubes. Breccia domains locally exceed 50% by volume within gold zones, characterized by silicified fragments as well as strongly altered wall rock and porphyry dyke clasts. Some of these fragments exhibit rounding and imbrication in

addition to textures consistent with re-fragmentation of earlier breccia events (i.e., polyphase breccia). Networks of anastomosing chalcedonic silica veins with local microbreccia domains within the veins have been noted in the high-grade intervals. Similar to the Supremo zone, gold at Double Double is micron-scale, and illite has been detected by infrared spectroscopy within the mineralized intervals. Other alteration minerals observed at Double Double include sericite, epidote, leucoxene, hematite, and carbonate.

2.3.4 Kona Zone

Drilling in the Kona zone encountered both biotite replacement and breccia hosted mineralization within the Coffee Creek granite. The Kona zone is hosted within coarse grained equigranular biotite monzogranite, and consists of one to three east-northeast trending, steeply south-dipping fault structures. The gold structures are associated with narrow, less than 5-m-wide, sparsely feldspar phenocrystic to aphanitic andesite to dacite dykes. Alteration typically consists of sericite, clay, and limonite, with illite being detected during reconnaissance work at Kona. Sulphide is dominated by sooty arsenian pyrite, which typically replaces ferromagnesian minerals, and also occurs as veins, veinlets or fracture fill, and in sulphide-matrix fault breccias.

2.4 Geotechnical Considerations

Mine planning considered the northern climate environment, permafrost, and the physical characteristics of the ore and waste rock in the geotechnical considerations for Project design. Newmont carried out field investigations and analyses designed to characterize geotechnical and hydrogeological conditions required for feasibility-level open pit designs. Based on the location and characteristics of the geomechanical domains and the pit shells, design sectors were identified for each of the proposed pits.

Geotechnical investigations have been conducted to characterize the subsoil conditions within the Alpha WRSF foundation footprint including sonic core drilling of soils, test pit excavation, diamond core drilling and laboratory test programs. The results of these investigations and subsequent analyses were used to provide the basis for geotechnical design recommendations. The Alpha WRSF will be constructed in mid to upper slope areas which are generally dominated by in-situ residual soils and colluvium derived from weathering of bedrock. Relatively competent bedrock is typically encountered within approximately 3 m of the ground surface. The colluvial material is variable and typically contains mixtures of gravels, sands, and silts with a thin veneer of organics in the upper approximately 20 to 30 cm. The depth of soil beneath is typically between 0.5 m and 2 m on the slopes with depths of up to approximately 10-m deep in the valley bottoms. Foundation soils are typically ice-poor. The thickness of the strongly weather bedrock is variable but is generally less than a metre. In general, the foundation conditions are considered conducive to construction of the Alpha WRSF.

Permafrost is deep beneath the Alpha WRSFs. The active zone is generally shallow across the site (less than 2 m), except in areas where vegetation has been stripped (i.e., road cuts) (Tetra Tech 2017). Additional details regarding permafrost conditions can be found in Section 9.2. The Alpha WRSF will be constructed on permafrost soils. Permafrost soils are expected to provide suitable foundation conditions for the Alpha WRSF, provided the foundation soils remains frozen.

Pit slope design involves analysis of the three major components of an open pit slope, i.e., bench configuration, interramp slope angle and overall slope angle. The overall slope angle consists of interramp slope sections separated by wide step-outs for haul roads, mine infrastructure or geotechnical.

2.4.1 Overburden Test Pitting

Surficial materials exposed in the testpits at the Coffee Mine Site revealed several surficial units which were described in detail and sampled. The testpits were infilled immediately following logging and sampling. A total of fifty-seven testpits were logged and representative samples of various overburden types were collected during Phase 1 for analysis in Tetra Tech Canada Inc.'s geotechnical laboratory in Whitehorse. Thirty additional samples of surficial deposits and fractured bedrock from selected testpits were taken during Phase 1 for Lorax Environmental Services Ltd. These were sent to ALS laboratories in Vancouver, B.C., for geochemical analysis. Phase 2 commenced upon completion of Phase 1. Various types of overburden were identified within the testpits. These include loess, weathered bedrock, colluvium, peat, and surface moss cover. Approximate volumes of each were calculated for various site facilities. Permafrost conditions, including ground ice, were identified in many of the testpits.

2.4.2 Surficial Geology

Colluvial blanket and veneer (thick and thin deposits) are dominant. The colluvial apron/muck deposits cannot be identified definitively from air photo interpretation alone. As a result, at slope breaks near valley bottoms, units mapped as Ca (colluvial apron), may in fact contain some amount of eolian material. Colluvial aprons are generally poorly to very poorly drained due to the presence of permafrost. It is also possible that silt-dominated colluvial deposits also contain some component of wind-blown silt. Although colluvium dominates the mine site area, a few other units are present as well. Weathered bedrock is exposed in places, mainly on the ridge tops, while limited areas of fluvial and organic deposits are found in valley bottoms. In some tributary valleys, thin fluvial deposits are present, but are too small to map. The mapping for surficial geology is shown in Appendix A.

3.0 CLIMATE

3.1 Site Meteorological Data

The locations of automated weather stations, standalone tipping bucket rain gauges and snow courses at the Coffee Gold Mine Project are summarized by Figure 3-1 and Table 3-1. At present, there are two active- and continuously recording climate stations, and two standalone tipping bucket rain gauge stations, the latter two gauges being in operation until 2018. There is also a comprehensive network of snow course stations at the property, positioned to capture variability in snow accumulation across a range of elevations and aspects.

Newmont intends to operate the Kona weather station in parallel with the original baseline climate station for several years. Overlapping climate data from these two weather stations, as well as any supplementary precipitation data collected at standalone rain gauges and snow courses, will be used to update the characterization of the site climatic regime as it becomes available, and refine the water balance models accordingly.

Details related to the automated weather station installations at the Coffee Gold Mine Project can be found in Appendix B (Coffee Gold Project 2021 Hydro-meteorology Baseline Report).

Key climatic variables recorded at the two Project site weather stations includes:

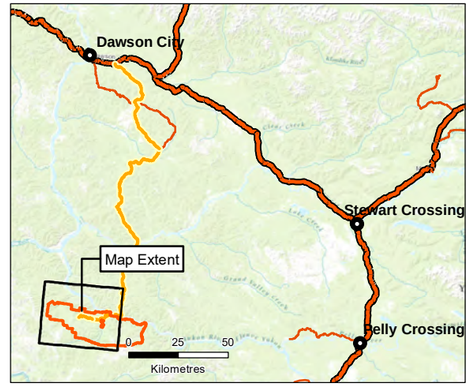
- Air temperature and relative humidity
- Wind speed and direction
- Incoming solar radiation
- Precipitation
- Atmospheric pressure
- Snow depth and snow water equivalent.

With the exception of the occasional winter riming event which affects the anemometer, the instrumental record for Km 11 climate station now exceeds 9 years in duration and is essentially continuous, while the Kona climate record is approximately 3-years in duration.



COFFEE GOLD MINE

Weather Stations and Snow Course Locations, Coffee Gold Project



Legend

- Automated Weather Station
- Snow Course
- Tipping Bucket Rain Gauge
- Watercourse

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein..

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Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 3-1	Date: Dec 2, 2021	Drawn by: AL	Reviewed: SJ

Newmont COFFEE

Table 3-1 Weather Station and Active Snow Course Stations, Coffee Gold Project

Station	Type	Latitude (°)	Longitude (°)	Elevation (m)	Parameters
IC-1.5	Snow Course	62.915	-139.579	524	SD, SWE, Density
CC-EAST-1	Snow Course	62.872	-139.394	1,220	SD, SWE, Density
KAM-SS-WX (Km 11)	Snow Course	62.873	-139.180	996	SD, SWE, Density
KAM-WX (Km 11) Climate Station	Automated Weather Station	62.873	-139.180	975	T, RH, P, PR, WSp, WDir, SolR
Mid-Elev-SS	Snow Course	62.894	-139.097	638	SD, SWE, Density
Kona-SS-WX	Snow Course	62.874	-139.434	1,340	SD, SWE, Density
Kona-WX Climate Station	Automated Weather Station	62.874	-139.434	1,340	T, RH, P, PR, WSp, WDir, SDpt, SolR
Camp Tipping Bucket	Tipping Bucket Rain Gauge	62.911	-139.070	430	RF, T
High-Elevation Tipping Bucket	Tipping Bucket Rain Gauge	62.888	-139.331	1250	RF, T

Notes:
SD - snow depth; SWE – snow water equivalent; T – air temperature; RH – relative humidity; P – atmospheric pressure; PR – precipitation (as either rain or snow); WSp – wind speed; WDir – wind direction; SolR – solar radiation; SDpt – snow depth; and RF – rainfall.

3.2 Air Temperature

Mean annual air temperature (MAT) recorded at the majority of the regional climate stations near the Coffee Gold project range from -5 to -2°C. At the Km 11 station, record period MAT is -2.2°C, and -2.6°C at the Kona climate station. On a monthly basis, average air temperatures for the Project site also show similar patterns and magnitude as the nearest regional climate stations (Figure 3-3). Minimum (maximum) recorded temperatures are - 38.2°C (29.7°C) and -36.2°C (23.7°C) at the Km 11 and Kona climate stations, respectively (Table 3-2). Average monthly air temperature ranges are as follows (with reference to Figure 3-2):

- Minimum monthly air temperatures range from -32.6 to 6.0°C at the Km 11 station, and -31.6 to 4.1°C at the Kona station.
- Mean monthly air temperatures range from -16.8 to 13.9°C at the Km 11 station, and -15.4 to 11.7°C at the Kona station.
- Maximum monthly air temperatures range from -2.0 to 25.3°C at the Km 11 station, and -1.8 to 22.9°C at the Kona station.

Table 3-2 Monthly Minimum, Mean and Maximum Air Temperatures at the Km 11 and Kona Climate Stations. All Values are in °C.

Station	Year	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Km 11 (975 m)	2012	Min.	--	--	--	--	--	--	8.0	1.7	-4.0	-19.4	-31.7	-35.8	--
		Mean	--	--	--	--	--	--	14.9	11.5	6.3	-7.1	-19.7	-24.0	--
		Max.	--	--	--	--	--	--	22.4	21.4	17.4	7.8	-10.8	-4.9	--
	2013	Min.	-37.6	-20.4	-24.4	-18.6	-8.7	2.8	6.0	2.8	-4.3	-7.8	-36.2	-33.1	-37.6
		Mean	-17.7	-12.3	-11.6	-7.8	4.9	14.3	13.8	13.0	4.6	-0.2	-15.8	-21.1	-3.0
		Max.	3.6	-0.3	3.2	4.1	19.5	27.2	24.2	26.0	15.8	8.8	0.3	2.6	27.2
	2014	Min.	-29.3	-33.7	-22.1	-16.9	-2.8	2.2	5.0	1.5	-3.9	-13.5	-29.6	-24.0	-33.7
		Mean	-10.1	-18.6	-10.4	-0.6	8.2	10.4	12.9	11.1	4.6	-4.2	-12.6	-12.9	-1.9
		Max.	6.8	-4.9	3.2	8.9	18.8	21.3	21.4	22.6	18.9	7.8	-3.7	-2.6	22.6
	2015	Min.	-33.9	-34.6	-27.4	-7.6	-1.6	3.0	5.8	-1.8	-5.3	-11.9	-28.5	-28.5	-34.6
		Mean	-17.3	-14.7	-8.3	0.4	11.9	12.1	12.5	9.3	3.7	-1.6	-13.2	-15.6	-1.7
		Max.	-0.5	4.4	5.0	10.6	26.2	23.4	25.9	25.1	16.7	6.7	1.0	-1.2	26.2
	2016	Min.	-21.3	-22.4	-12.3	-3.0	-0.3	3.3	7.3	3.8	-3.5	-16.9	-27.7	-30.0	-30.0
		Mean	-11.1	-10.2	-3.9	3.2	8.8	12.3	13.4	12.5	6.6	-6.4	-12.7	-18.7	-0.5
		Max.	0.4	2.3	11.1	12.9	23.5	24.9	24.7	24.0	17.2	5.7	1.8	-4.0	24.9
	2017	Min.	-32.6	-25.1	-29.4	-10.7	-1.2	2.4	7.0	2.7	-3.0	-11.9	-33.4	-33.7	-33.7
		Mean	-15.6	-12.6	-16.0	0.6	7.2	12.1	14.4	12.4	7.2	-2.9	-18.3	-12.2	-2.0
		Max.	0.6	5.2	4.5	11.8	19.4	29.7	24.9	26.7	16.2	8.4	-0.7	2.2	29.7
	2018	Min.	-34.0	-31.4	-25.1	-18.8	-3.7	2.3	5.6	2.6	-1.3	-13.8	-22.4	-25.7	-34.0
		Mean	-17.1	-16.9	-9.3	-2.0	7.1	11.4	15.2	10.4	5.3	-0.3	-12.3	-14.6	-1.9
		Max.	4.8	-2.9	5.2	9.5	20.6	26.5	28.6	25.9	12.7	12.2	-2.4	-1.6	28.6
	2019	Min.	-34.6	-33.2	-19.8	-15.1	-6.3	4.3	6.1	-1.1	-3.1	-10.3	-24.1	-31.2	-34.6
		Mean	-18.4	-17.1	-3.0	0.6	9.6	13.4	15.0	10.0	7.4	-2.6	-12.1	-18.2	-1.3
		Max.	-2.0	-3.0	10.2	13.6	24.5	27.3	24.6	25.6	19.4	7.5	1.3	-3.4	27.3
	2020	Min.	-38.2	-33.1	-28.4	-16.9	-1.7	2.8	5.4	3.8	-2.0	-20.7	-29.4	-27.5	-38.2
		Mean	-24.3	-18.0	-13.2	-1.5	8.6	10.0	12.1	10.1	5.7	-5.8	-16.2	-14.4	-3.9
		Max.	-6.0	-1.9	2.6	12.8	21.2	20.9	25.8	19.4	19.6	14.1	-5.1	1.4	25.8
	2021	Min.	-32.1	-36.9	-25.8	-28.3	-2.7	1.4	4.0	1.2	-6.6	--	--	--	--
		Mean	-13.1	-21.3	-13.2	-3.2	6.3	13.2	14.5	11.1	6.1	--	--	--	--
		Max.	-0.4	-8.6	1.1	12.8	15.7	26.1	28.8	27.7	18.8	--	--	--	--
	Record Period	Min.	-38.2	-36.9	-29.4	-28.3	-8.7	1.4	4.0	-1.8	-6.6	-20.7	-36.2	-35.8	-38.2
		Mean	-16.1	-15.8	-9.9	-1.2	8.1	12.2	13.9	11.1	5.8	-3.4	-14.8	-16.8	-2.2
		Max.	6.8	5.2	11.1	13.6	26.2	29.7	28.8	27.7	19.6	14.1	1.8	2.6	29.7
Kona (1,340 m)	2018	Min.	--	--	--	--	--	--	--	--	--	-15.4	-20.2	-21.1	--
		Mean	--	--	--	--	--	--	--	--	--	-1.4	-8.7	-10.2	--
		Max.	--	--	--	--	--	--	--	--	--	10.1	2.8	-1.5	--
	2019	Min.	-27.8	-27.7	-16.7	-17.3	-8.1	1.9	5.8	-2.2	-3.8	-12.5	-20.5	-31.3	-31.3
		Mean	-13.9	-11.7	-3.6	-1.9	7.0	11.0	12.9	8.0	6.0	-3.6	-9.1	-12.8	-1.0
		Max.	1.3	2.8	7.5	9.5	19.7	22.7	22.7	21.0	15.6	5.6	1.2	-0.6	22.7
	2020	Min.	-32.3	-31.0	-28.2	-17.0	-4.1	1.6	2.8	2.8	-4.4	-20.8	-25.8	-29.9	-32.3
		Mean	-20.8	-15.6	-13.5	-3.5	5.6	7.6	9.8	8.2	4.0	-6.5	-14.0	-12.3	-4.3
		Max.	-2.5	-3.7	-0.7	9.7	15.1	15.9	22.2	20.5	16.1	10.6	-3.9	0.5	22.2
	2021	Min.	-23.0	-36.2	-25.7	-31.6	-6.1	-0.5	3.7	0.7	-11.0	-10.4	--	--	--
		Mean	-11.3	-18.4	-13.8	-5.2	3.4	10.7	12.4	9.4	1.8	-4.9	--	--	--
		Max.	-1.8	-4.5	-2.2	12.6	11.9	21.6	23.7	23.1	13.6	0.9	--	--	--
	Record Period	Min.	-32.3	-36.2	-28.2	-31.6	-8.1	-0.5	2.8	-2.2	-11.0	-20.8	-25.8	-31.3	-36.2
		Mean	-15.4	-15.2	-10.3	-3.5	5.3	9.8	11.7	8.5	3.9	-4.1	-10.6	-11.8	-2.6
		Max.	1.3	2.8	7.5	12.6	19.7	22.7	23.7	23.1	16.1	10.6	2.8	0.5	23.7

Note: All values calculated from hourly data.

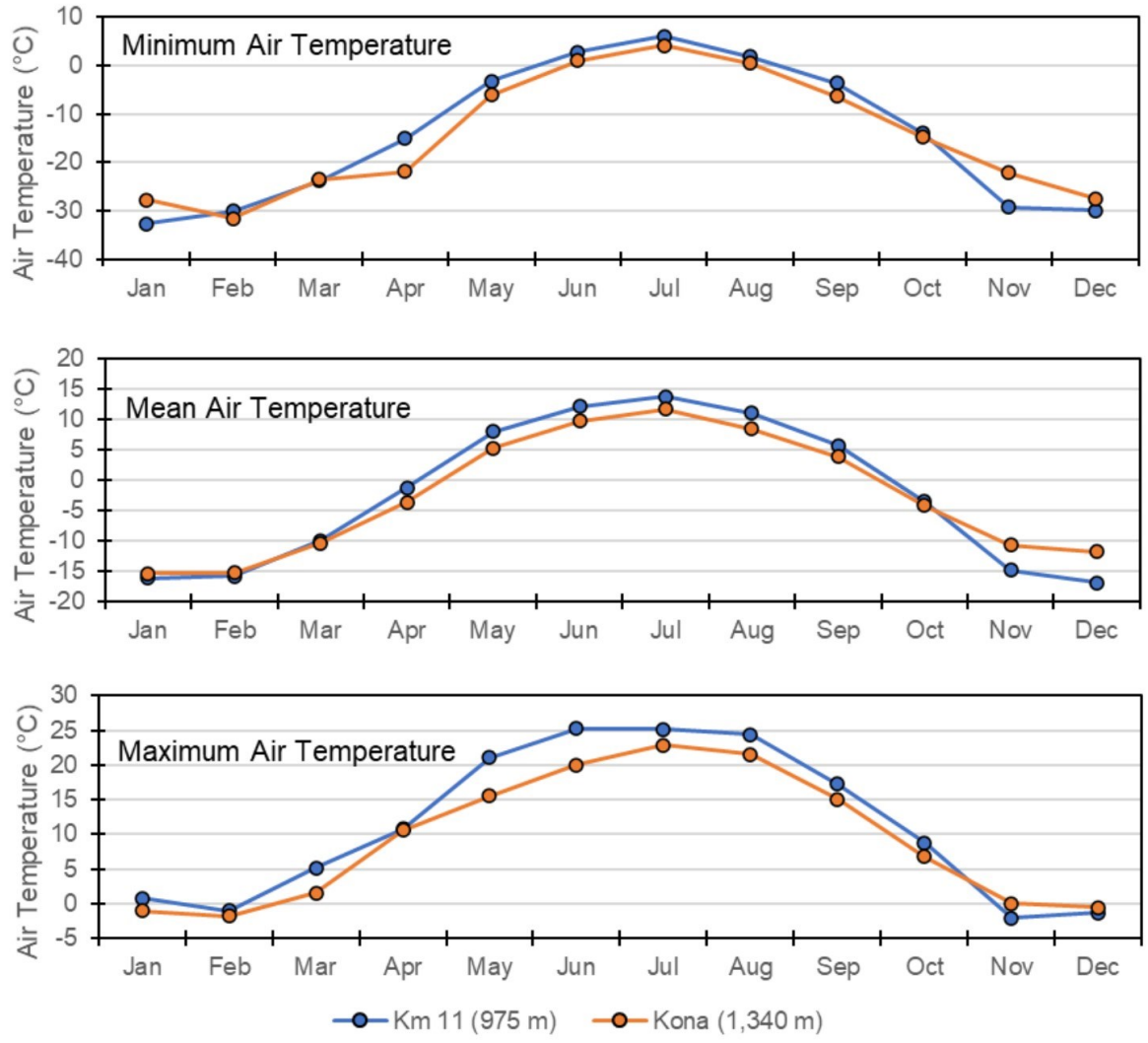


Figure 3-2 Mean Monthly Minimum (top panel), Mean (middle panel) and Maximum (bottom panel) Air Temperature Records for the Km 11 and Kona Climate Stations.

The lowest air temperatures are often experienced in December through February, while the highest air temperatures usually occur in July at both stations, noting that there is evidence of inversion events during the winter months. Detailed information on air temperature inversions can be found in the 2021 Hydro-meteorology Baseline Report (Appendix B)

3.3 Precipitation

Precipitation has been measured on-site since July 2012 at the Km 11 climate station, and at several snow courses located at various elevations around the Project site. Tipping bucket precipitation gauges were also installed at the camp (425 m) and at ridgetop (>1,200 m) in 2015 and operated until 2018 to refine assumptions related to precipitation accumulation with elevation at the Project site. The Kona climate station was installed at an elevation of 1,340 m in October 2018 to gather data representative of the planned HLF location and has a reliable precipitation record.

Precipitation and snow course data gathered during the baseline study indicate mean annual precipitation (MAP) averages 331 mm at 975 m and 398 mm at 1,340 m, with approximately 30% of this amount falling as snow between October and April, and 70% falling as rain from May to September (Table 3-3 and Table 3-4). These measured MAP values for the Project site do not necessarily account for the effects of gauge under-catch or sublimation, which will result in measured precipitation values (winter values in particular) being lower than actual values. These are well-documented issues in northern regions (e.g., Yang et al., 2005 and Pomeroy et al., 1999) and corrections are required to obtain a true MAP estimate. Detailed information can be found in the 2021 Hydro-meteorology Baseline Report (Appendix B)

Figure 3-3 also shows regional precipitation data from nearby climate stations. Overall, site and regional precipitation measurements show similar magnitudes and monthly patterns. Like air temperature, the local precipitation signature closely approximates the patterns returned by regional climate station. Further, the seasonal precipitation distribution calculated from valley bottom climate records also strongly resembles the proportions measured during the baseline study (i.e., regional data return proportions of snow and rain to be 35% and 65% of total annual precipitation respectively).

Table 3-3 Summary of Measured Precipitation Data for the Km 11 Climate Station (July 2012-June 2019).

Year	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2012	Rain (mm)	--	--	--	--	--	--	*4.8*	37.8	17.8	4.3	0.0	0.0	---
	% Rain	--	--	--	--	--	--	*100%*	100%	64%	19%	0%	0%	---
	Snow (mm)	--	--	--	--	--	--	*0.0*	0.0	10.0	18.8	23.4	33.3	---
	% Snow	--	--	--	--	--	--	*0%*	0%	36%	81%	100%	100%	---
2013	Rain (mm)	0.0	0.0	9.9	20.9	49.3	57.9	89.7	58.7	25.7	5.3	0.0	0.0	317.3
	% Rain	0%	0%	96%	99%	100%	100%	100%	100%	54%	26%	0%	0%	74%
	Snow (mm)	20.1	14.7	0.4	0.3	0.0	0.0	0.0	0.0	21.6	15.0	23.4	16.0	111.4
	% Snow	100%	100%	4%	1%	0%	0%	0%	0%	46%	74%	100%	100%	26%
2014	Rain (mm)	0.0	0.0	0.0	0.0	23.0	3.0	80.0	0.0	16.5	0.0	0.0	0.0	122.5
	% Rain	0%	0%	0%	0%	67%	100%	100%	0%	77%	0%	0%	0%	58%
	Snow (mm)	46.7	23.6	0.3	0.0	11.2	0.0	0.0	0.0	4.8	0.0	0.5	2.0	89.2
	% Snow	100%	100%	100%	0%	33%	0%	0%	0%	23%	0%	100%	100%	42%
2015	Rain (mm)	0.0	0.0	0.0	0.0	24.9	48.8	99.3	73.7	32.0	17.3	0.0	0.0	295.9
	% Rain	0%	0%	0%	0%	100%	100%	100%	100%	79%	52%	0%	0%	77%
	Snow (mm)	19.3	19.3	0.3	0.3	0.0	0.0	0.0	0.0	8.3	15.9	20.6	6.0	89.9
	% Snow	100%	100%	100%	100%	0%	0%	0%	0%	21%	48%	100%	100%	23%
2016	Rain (mm)	5.1	0.5	2.5	14.0	48.8	71.1	68.3	46.0	14.2	0.0	0.5	0.0	271.0
	% Rain	14%	8%	41%	100%	91%	100%	100%	100%	98%	0%	10%	0%	71%
	Snow (mm)	31.0	6.1	3.6	0.0	4.6	0.0	0.0	0.0	0.3	34.8	4.6	23.5	108.5
	% Snow	86%	92%	59%	0%	9%	0%	0%	0%	2%	100%	90%	100%	29%
2017	Rain (mm)	0.0	0.0	0.0	9.1	49.5	43.4	91.7	22.6	13.2	6.9	0.0	0.0	236.5
	% Rain	0%	0%	0%	100%	96%	100%	100%	100%	93%	13%	0%	0%	74%
	Snow (mm)	9.7	7.2	0.5	0.0	1.8	0.0	0.0	0.0	1.0	46.3	10.0	7.9	84.4
	% Snow	100%	100%	100%	0%	4%	0%	0%	0%	7%	87%	100%	100%	26%
2018	Rain (mm)	3.0	0.0	2.3	2.0	36.1	81.0	26.4	115.8	20.6	*0.5*	*0.0*	*0.0*	287.8
	% Rain	63%	0%	16%	46%	100%	100%	100%	100%	100%	*5%*	*0%*	*0%*	84%
	Snow (mm)	1.8	17.6	11.6	2.4	0.0	0.0	0.0	0.0	0.0	*9.6*	*9.2*	*2.4*	54.6
	% Snow	37%	100%	84%	54%	0%	0%	0%	0%	0%	*95%*	*100%*	*100%*	16%
2019	Rain (mm)	*0.0*	*0.0*	*0.0*	*0.0*	19.3	56.4	97.3	56.1	30.7	9.4	0.0	0.0	269.2
	% Rain	*0%*	*0%*	*0%*	*0%*	100%	100%	100%	100%	100%	95%	--	--	92%
	Snow (mm)	*3.9*	*6.0*	*2.7*	*11.8*	0.0	0.0	0.0	0.0	0.0	0.5	0	0	25.0
	% Snow	*100%*	*100%*	*100%*	*100%*	0%	0%	0%	0%	0%	5%	--	--	8%
All Years	Rain (mm)	1.2	0.1	2.1	6.6	35.8	51.7	69.7	51.3	21.3	5.5	0.1	0.0	245.3
	% Rain	6%	1%	43%	76%	93%	100%	100%	100%	79%	24%	1%	0%	74%
	Snow (mm)	18.9	13.5	2.8	2.1	2.5	0.0	0.0	0.0	5.7	17.6	11.4	11.4	86.0
	% Snow	94%	99%	57%	24%	7%	0%	0%	0%	21%	76%	99%	100%	26%
	Total P (mm)	20.1	13.6	4.9	8.7	38.3	51.7	69.7	51.3	27.1	23.1	11.5	11.4	331.3

Notes: Values for 2018-19 in italics infilled based on Kona climate station gauge data and gradient 8%/100 m elevation gain between Kona (1,340 m asl) and Km 11 (975 m asl) stations.

Table 3-4 Summary of Measured Precipitation Data for the Kona Climate Station (October 2018 – October 2021).

Year	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2018	Rain (mm)	--	--	--	--	--	--	--	--	--	*2.0*	0.0	0.0	---
	% Rain	--	--	--	--	--	--	--	--	--	*16%*	0%	0%	---
	Snow (mm)	--	--	--	--	--	--	--	--	--	*10.8*	12.1	3.2	---
	% Snow	--	--	--	--	--	--	--	--	--	*84%*	100%	100%	---
2019	Rain (mm)	0.0	0.0	0.0	0.1	26.3	66.1	102.2	61.8	19.5	4.2	0.0	0.0	280.1
	% Rain	0%	0%	0%	1%	88%	100%	100%	100%	66%	16%	0%	0%	73%
	Snow (mm)	5.2	7.9	3.6	15.6	3.7	0.0	0.0	0.0	10.2	22.5	19.8	15.4	104.0
	% Snow	100%	100%	100%	99%	12%	0%	0%	0%	34%	84%	100%	100%	27%
2020	Rain (mm)	*0.0*	*0.0*	*0.0*	*1.9*	14.0	93.2	109.3	81.8	12.2	0.2	0.0	0.0	312.4
	% Rain	*0%*	*0%*	*0%*	*0%*	85%	100%	100%	100%	60%	1%	0%	0%	72%
	Snow (mm)	9.5	6.1	13.2	32.9	2.5	0.0	0.0	0.0	8.2	28.1	14.3	6.0	120.6
	% Snow	*100%*	*100%*	*100%*	*95%*	15%	0%	0%	0%	40%	99%	100%	100%	28%
2021	Rain (mm)	*0.0*	*0.0*	*0.0*	*2.1*	35.0	56.6	44.7	76.2	33.1	0.0	--	--	---
	% Rain	*0%*	*0%*	*0%*	*0%*	81%	100%	100%	100%	46%	0%	--	--	---
	Snow (mm)	*6.2*	*11.9*	*20.4*	*15.5*	8.5	0.0	0.0	0.0	38.9	20.6	--	--	---
	% Snow	*100%*	*100%*	*100%*	*88%*	19%	0%	0%	0%	54%	100%	--	--	---
All Years	Rain (mm)	0.0	0.0	0.0	1.4	25.1	72.0	85.4	73.3	21.6	1.6	0.0	0.0	280.2
	% Rain	0%	0%	0%	6%	84%	100%	100%	100%	53%	7%	0%	0%	70%
	Snow (mm)	6.9	8.7	12.4	21.3	4.9	0.0	0.0	0.0	19.1	20.5	15.4	8.2	117.3
	% Snow	100%	100%	100%	94%	16%	0%	0%	0%	47%	93%	100%	100%	30%
	Total P (mm)	6.9	8.7	12.4	22.7	29.9	72.0	85.4	73.3	40.7	22.1	15.4	8.2	397.5

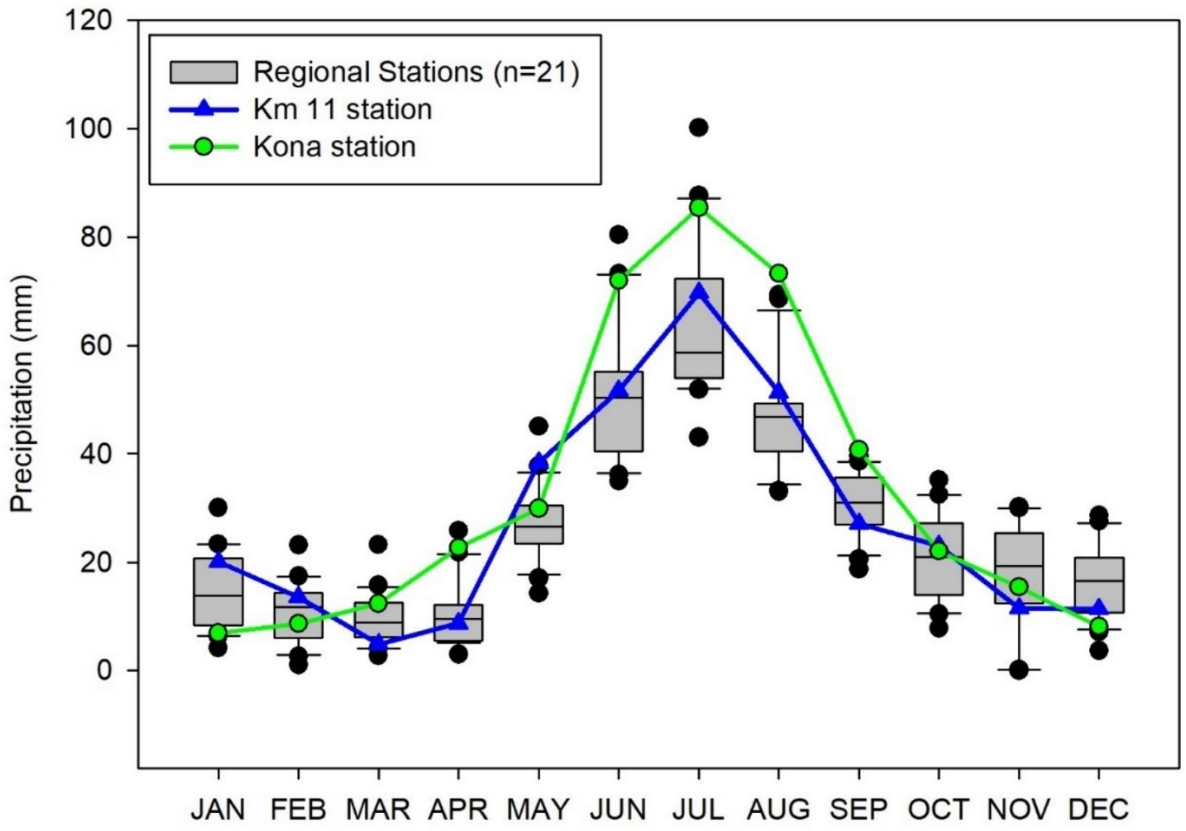


Figure 3-3 **Comparison of the Monthly Precipitation Signature for the Coffee Gold Km 11 and Kona Climate Stations to Nearest Regional Stations (n = 21) with Long-term Records**

Note: The box and whisker plots show the following statistics for the regional stations: median and quartiles (grey box), 5th and 95th percentile values (tails) and outliers (black circles).

3.4 Relative Humidity

Relative humidity generally varies between 50% and 85% on an average monthly basis, with March to October values showing close correspondence between the two climate stations at site (Figure 3-4). At a monthly time-step and on average, relative humidity values are highest in the winter at the Km 11 station and range from 76-83% between November and February. The relative humidity signatures at Km 11 display a notable departure at the Kona station, with winter values at Kona tracking lower than the Km 11 values by approximately 10%. This is due in part to the noted temperature inversions at site. Detailed information on air temperature inversions can be found in the 2021 Hydro-meteorology Baseline Report (Appendix B)

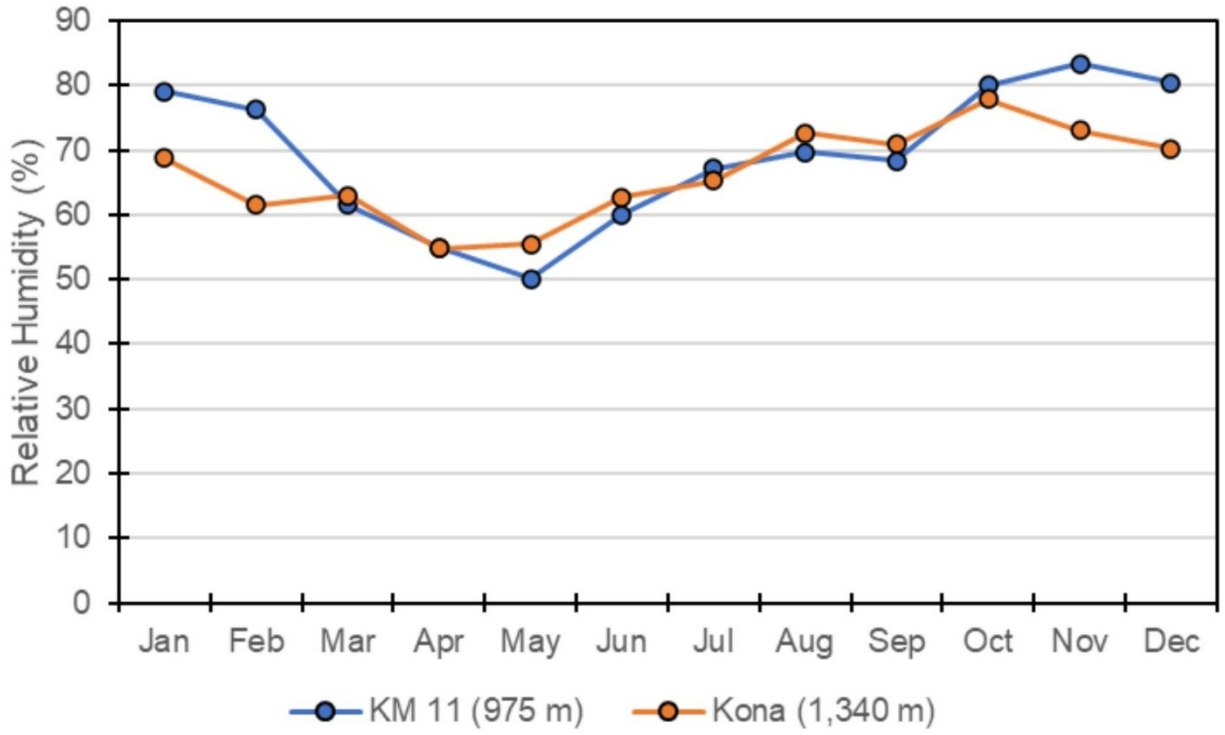


Figure 3-4 Average Monthly Relative Humidity for the Km 11 and Kona Climate Stations

3.5 Wind Speed and Direction

Monthly average wind speeds range from 0.9 to 2.8 m/s at the Km 11 station, with maximum recorded wind gusts of > 14 m/s occurring in all months. Wind speeds are higher in the months of April through September compared to October through March (Table 3-5, Figure 3-5). By comparison, the higher elevation Kona station experiences monthly average wind speeds of 3.7 to 5.1 m/s, gusting in excess of 20 m/s in all months, with a similar seasonal pattern as noted for the Km 11 record, although maximum wind gust speeds are more often noted in the winter and spring months. The dominant annual wind vector at the Km 11 station is from the south (blowing from), with secondary vectors from the northwest and northeast. At the Kona station, the dominant annual wind vector is from the southwest, with secondary vectors from the southeast through east.

Table 3-5 Measured Wind Speed (average and gust) Data for the KM 11 and Kona Climate Stations

Station	Years	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Km 11 (975 m)	2012	Average Wind Speed	--	--	--	--	--	--	2.4	2.7	3.1	1.9	1.5	1.1	--
		Maximum Gust	--	--	--	--	--	--	8.3	14.3	13.9	10.6	10.4	7.6	--
	2013	Average Wind Speed	1.9	2.0	2.6	3.4	2.4	2.7	2.6	2.0	2.1	2.5	1.2	1.3	2.2
		Maximum Gust	13.1	11.5	18.0	14.3	11.7	13.4	11.3	10.2	11.3	15.1	17.5	8.7	18.0
	2014	Average Wind Speed	0.6	1.5	2.5	2.2	3.0	2.8	2.8	2.3	2.4	1.5	0.4	0.8	1.9
		Maximum Gust	15.9	11.7	12.1	10.3	14.4	15.2	10.1	12.3	11.8	10.1	7.5	7.3	15.9
	2015	Average Wind Speed	1.0	1.9	2.7	2.7	2.9	2.7	2.3	2.7	2.5	1.9	1.4	0.3	2.1
		Maximum Gust	9.4	10.5	17.7	13.4	12.0	13.3	15.9	13.1	17.3	8.8	8.1	12.4	17.7
	2016	Average Wind Speed	0.8	1.8	2.3	2.7	2.9	2.5	2.2	2.3	2.6	1.4	0.7	1.0	1.9
		Maximum Gust	13.2	10.0	11.2	12.0	13.0	12.3	11.5	11.7	13.2	7.5	10.3	18.3	18.3
	2017	Average Wind Speed	2.2	2.6	2.3	2.5	2.8	2.4	2.4	2.3	2.3	2.2	1.1	1.9	2.2
		Maximum Gust	14.4	16.4	9.5	9.4	13.2	14.0	11.7	11.4	9.5	13.0	10.5	14.0	16.4
	2018	Average Wind Speed	0.6	2.5	2.8	2.9	3.3	2.5	2.4	2.6	2.3	2.5	0.5	0.6	2.1
		Maximum Gust	14.2	16.9	16.1	11.0	15.1	10.7	10.7	12.4	12.2	11.4	5.2	9.6	16.9
	2019	Average Wind Speed	1.0	1.8	2.6	2.6	2.9	2.6	2.5	2.6	2.0	2.3	1.2	0.0	2.0
		Maximum Gust	12.3	8.4	12.5	12.2	15.1	10.8	11.0	14.0	11.5	9.5	8.9	1.8	15.1
	2020	Average Wind Speed	0.1	2.2	3.2	3.0	2.9	2.4	2.3	2.1	2.1	2.0	1.5	1.3	2.1
		Maximum Gust	7.3	11.6	16.4	13.1	11.8	12.3	11.7	10.8	11.2	10.5	13.9	9.1	16.4
	2021	Average Wind Speed	1.9	2.0	2.4	2.9	2.5	2.6	2.3	2.3	2.0	--	--	--	--
		Maximum Gust	10.5	16.3	12.5	14.6	10.9	12.7	10.3	13.4	7.4	--	--	--	--
	Record Period	Average Wind Speed	1.1	2.0	2.6	2.8	2.8	2.6	2.4	2.4	2.3	2.0	1.1	0.9	2.1
		Maximum Gust	15.9	16.9	18.0	14.6	15.1	15.2	15.9	14.3	17.3	15.1	17.5	18.3	18.3
Kona (1,340 m)	2018	Average Wind Speed	--	--	--	--	--	--	--	--	--	6.0	3.1	5.2	--
		Maximum Gust	--	--	--	--	--	--	--	--	--	22.5	12.6	20.0	--
	2019	Average Wind Speed	3.5	3.7	5.6	4.7	5.4	4.2	4.0	5.0	4.0	4.0	4.3	3.8	4.4
		Maximum Gust	26.2	15.7	21.3	27.2	24.1	19.9	21.6	22.8	18.5	18.5	20.0	16.9	27.2
	2020	Average Wind Speed	2.6	5.1	6.0	5.0	5.2	4.7	4.3	4.0	4.6	3.1	4.2	5.3	4.5
		Maximum Gust	23.3	28.6	24.1	18.4	19.6	22.1	17.9	15.8	18.0	18.9	20.6	20.6	28.6
	2021	Average Wind Speed	4.9	5.2	3.7	5.3	4.3	4.2	3.9	4.4	3.2	--	--	--	--
		Maximum Gust	24.9	23.1	16.4	20.5	16.6	21.5	19.0	19.8	13.5	--	--	--	--
	Record Period	Average Wind Speed	3.7	4.7	5.1	5.0	5.0	4.4	4.1	4.5	3.9	4.4	3.9	4.8	4.4
		Maximum Gust	26.2	28.6	24.1	27.2	24.1	22.1	21.6	22.8	18.5	22.5	20.6	20.6	28.6

Note: All values are in m/s

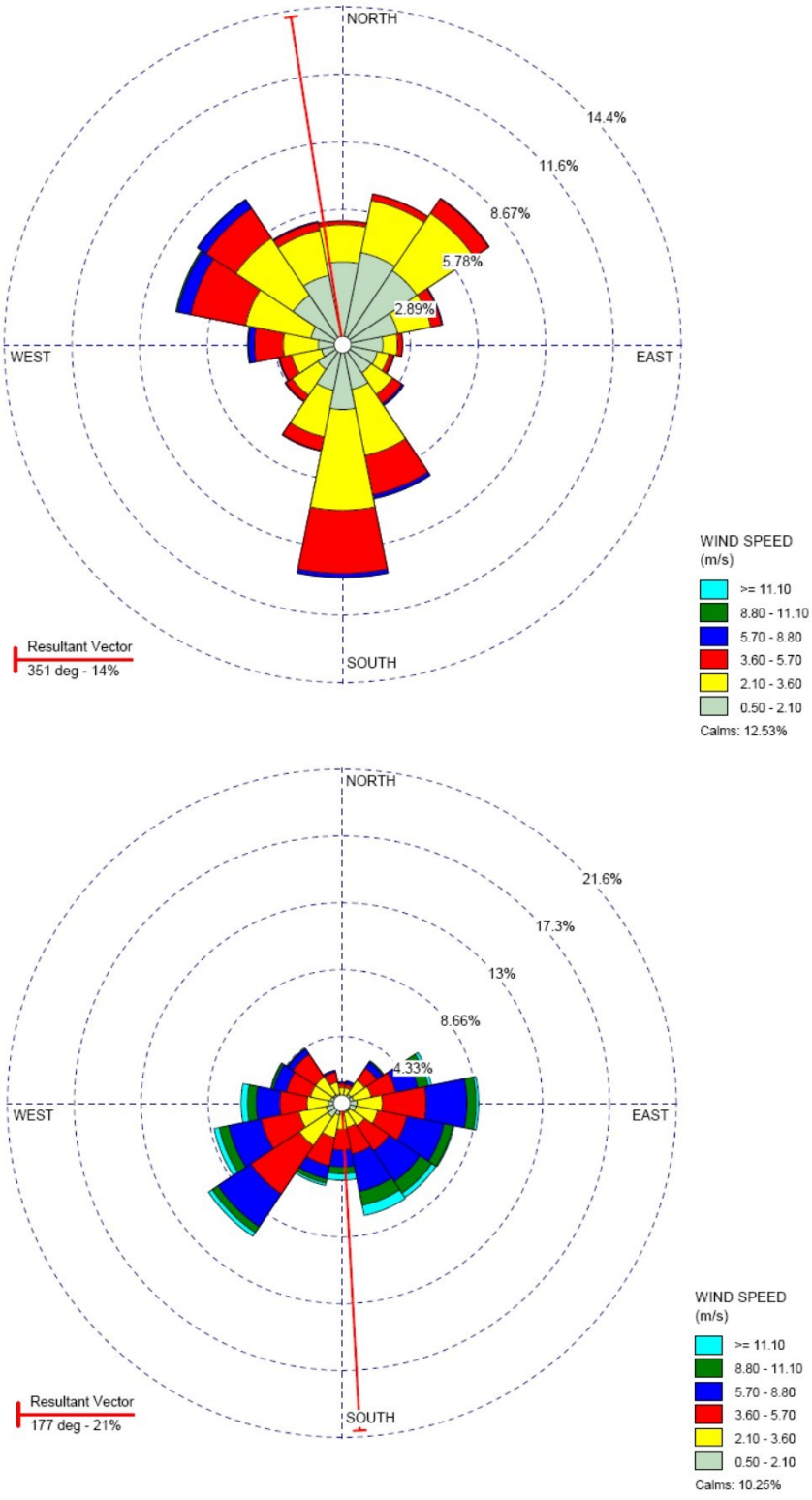


Figure 3-5 Annual Wind Roses for the KM 11 (top panel) and Kona (bottom panel) Climate Stations. Wind directions are 'blowing from'.

3.6 Potential Evaporation and Evapotranspiration

Potential evapotranspiration estimates for both the Km 11 and Kona climate stations were derived using the Penman-Monteith and Priestly-Taylor methods and show average April-October totals of 469 mm and 452 mm, respectively (Table 3-6). The estimates are 10% and 20% higher for the Kona station over the common period of record (2019-2021), due to elevated wind speeds and higher solar radiation at the upper station.

As a point of comparison, potential evapotranspiration (PE) estimates for Coffee Gold derived using Km 11 and Kona weather station data and the Hargreaves-Samani method are reported in Table 3-7. Processing of the data returned average PE estimates on the order of 463 mm at 975 m, and 425 mm at 1,340 m, which are slightly higher than those derived from the ClimateWNA software package (2021 Hydro-meteorology Baseline report Figure 3-7). Like evapotranspiration, monthly PE rates are highest in May, June, and July each year, compared to other months of the year.

As a final comparison, the Km 11 estimates for April to October derived using the three methods are plotted in Figure 3-6 for the 2013-2021 period. Overall, there is close correspondence between the more data intensive formulations (Penman-Monteith and Priestly-Taylor) and the simpler temperature-based method (Hargreaves-Samani).

Table 3-6 Potential Evaporation Estimates for the Coffee Gold Project based on Data collected at the Km 11 and Kona Climate Stations and the Penman-Monteith and Priestly-Taylor Equations

Station		Apr		May		Jun		Jul		Aug		Sep		Oct		Apr-Oct	
	Year	ASCE	P-T	ASCE	P-T	ASCE	P-T	ASCE	P-T	ASCE	P-T	ASCE	P-T	ASCE	P-T	ASCE	P-T
Km 11 (975 m)	2012	---	---	---	---	---	---	---	---	76	72	43	28	9	4	---	---
	2013	37	39	85	88	127	128	93	95	75	75	26	23	16	7	459	454
	2014	50	50	99	91	104	103	93	96	73	72	35	31	5	5	458	449
	2015	53	52	128	114	112	109	87	92	58	59	34	28	8	6	478	461
	2016	55	51	100	96	104	106	84	93	73	72	46	33	8	7	470	458
	2017	56	55	92	89	102	104	98	103	81	79	41	32	10	4	480	465
	2018	57	53	103	92	96	96	113	110	61	62	41	34	25	5	496	452
	2019	58	53	110	96	118	117	101	101	65	61	40	34	12	4	504	467
	2020	49	47	106	96	84	92	87	93	52	57	32	26	12	5	421	416
	2021	58	56	75	74	115	117	109	110	61	61	27	27	12	5	458	450
	Record Period	53	51	100	93	107	108	96	99	67	67	36	30	12	5	469	452
Kona (1,340 m)	2019	59	61	111	105	122	127	107	112	71	80	55	54	20	7	546	546
	2020	56	71	112	113	81	94	94	106	58	72	50	44	18	6	470	506
	2021	68	80	76	87	121	124	119	122	74	81	40	44	13	7	511	543
	Record Period	61	71	100	101	108	115	107	113	68	78	48	47	17	7	509	532

Note: Potential evapotranspiration values calculated using the Standardized form of the ASCE Penman-Monteith (ASCE 2005) method, and the Priestly-Taylor (P-T) method.

Table 3-7 Potential Evaporation Estimates for the Coffee Gold Project based on Data collected at Km 11 and Kona Climate Stations and the Hargreaves-Samani Equation

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Km 11 (975 m)	2013	0	3	8	23	72	108	105	80	36	14	1	0	447
	2014	2	0	11	39	80	95	101	74	35	11	1	0	449
	2015	0	3	13	40	93	102	100	70	34	12	1	0	469
	2016	1	4	19	46	83	103	103	77	39	9	2	0	487
	2017	1	3	4	41	79	102	106	78	39	12	0	1	465
	2018	0	1	12	35	78	99	109	73	36	14	1	0	459
	2019	0	1	21	40	87	106	109	72	40	12	1	0	489
	2020	-1	0	7	37	84	95	98	71	38	10	0	0	440
	2021	1	-1	7	34	74	112	113	75	30	--	--	--	--
	Record Period	0	2	11	37	81	102	105	74	36	12	1	0	463
Kona (1,340 m)	2019	1	4	20	35	77	99	102	67	39	11	2	0	457
	2020	0	1	6	33	74	88	91	67	34	9	1	1	404
	2021	1	0	6	31	67	97	100	70	32	10	1	--	415
	Record Period	0	2	11	33	73	94	98	68	35	10	1	1	425

Note: Potential evapotranspiration values calculated using the Hargreaves-Samani method.

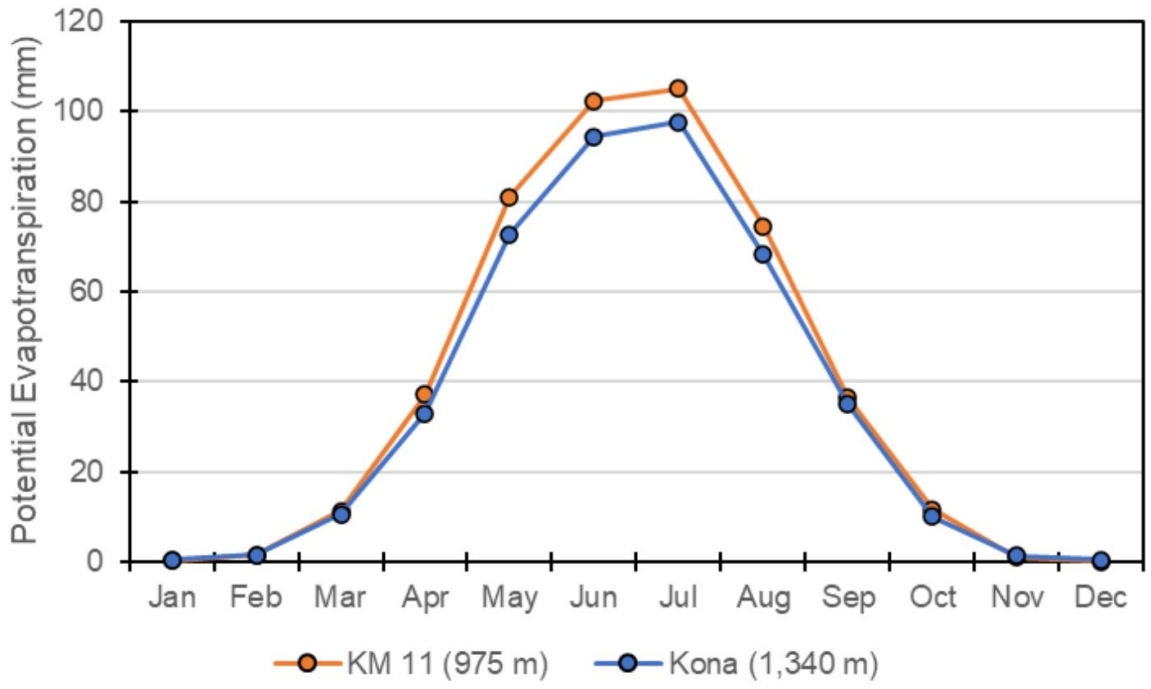


Figure 3-6 Average Monthly Potential Evapotranspiration for the Km 11 and Kona Climate Stations, calculated using the Hargreaves-Samani Method

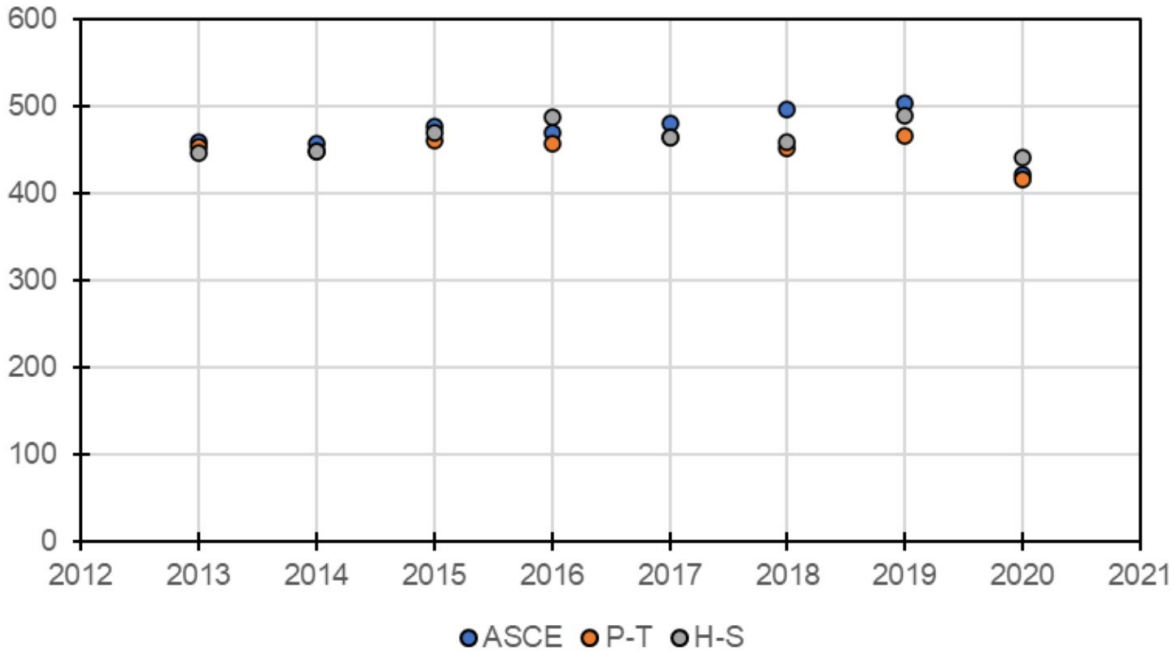


Figure 3-7 Comparison of April-October Potential Evapotranspiration Estimates for the Km 11 Climate Station

Note: ASCE = Penman-Monteith; P-T = Priestly-Taylor; H-S = Hargreaves-Samani.

3.7 Climate Change

3.7.1 Climate Change Scenario Data for State of Alaska and the Canadian North

Climate change scenario data from Scenarios Network for Alaska and Arctic Planning (SNAP) was used as the basis of the climate change assessment presented in detail in the 2021 Hydro-meteorology Baseline Report (Appendix B).

The influence of a changing climate on the hydrologic regime of the discontinuous permafrost zone is well documented in Appendix B of the 2021 Hydro-meteorology Baseline Report (Appendix B) for a detailed summary of historical climatic trends and projected changes in temperature and precipitation). Average annual temperatures are projected to rise significantly in the region over the next century. Present day annual average temperature is approximately -2°C at the Project site, and the annual average is forecasted to rise by 2.5 to 5°C by the end of the century (Table 3-8). Net precipitation in the vicinity of the Coffee Gold Mine is projected to increase by 20% to 35% over the course of this century (Table 3-8), where summer and winter can be expected to be slightly wetter in the future, and spring and fall seasons are projected to see little net change in precipitation abundance.

A trend analysis conducted on the regional historic climate records (Appendix B1 of the 2021 Hydro-meteorology Baseline Report) indicates that recent climate trends are in line with future projections. Average winter temperatures are increasing by 1°C/decade, while the trend in summer temperatures is of

lower magnitude at 0.3°C/decade. Seasonal precipitation trends show a mixed signal in summer, and a strong regional trend towards increased autumn precipitation (4-6 mm/decade). Streamflow metrics are consistently increasing in the Yukon, with significant trends noted for winter low flows (increasing), and the timing of freshet onset (moving earlier).

Table 3-8 Decadal Statistics for the Coffee Gold Project (mean annual air temperature and precipitation) for the RCP4.5, RCP6.0 and RCP8.5 Climate Change Scenarios

Decade	Mean Air Temperature (°C)			Precipitation (mm)		
	RCP4.5	RCP6.0	RCP8.5	RCP4.5	RCP6.0	RCP8.5
2010-2019	-2.9	-2.8	-2.7	603	592	615
2020-2029	-2.4	-2.3	-2.0	617	626	640
2030-2039	-1.7	-2.0	-1.5	638	635	651
2040-2049	-1.3	-1.7	-1.0	662	630	650
2050-2059	-1.2	-1.2	-0.2	678	647	681
2060-2069	-0.9	-0.8	0.3	683	659	716
2070-2079	-0.6	-0.2	0.9	671	667	726
2080-2089	-0.7	0.0	1.6	688	698	771
2090-2099	-0.4	0.3	2.3	688	719	788
Change (from 2015 to 2095)	2.5	3.1	5.0	14%	22%	28%

4.0 SURFACE WATER

Hydrological and water quality information has been collected at the Project site since fall 2010 at stations shown in Figure 4-1. Data collected from the Project site is compared to regional monitoring programs available from federal and territorial hydrometric programs. Hydrological and water quality information is used to inform the water balance and water quality model. Monitoring during construction and operation will be used to confirm model predictions.

Local patterns of streamflow are dominated by a snowmelt freshet that typically occurs between late April and early June. Following freshet, patterns of streamflow are punctuated by several rainfall-induced runoff events which occur throughout summer and autumn. In general, these high flow events are short duration, persisting usually for a one or two-day time period. Flows in local creeks and streams abate in October in response to freezing temperatures, and it is notable that local watersheds typically experience zero flow conditions throughout the winter (i.e., November through end March). Aufeis (i.e., frozen groundwater seepage that accumulates within- and adjacent to local watercourses) is pervasive in creeks and streams at the Project site and melts during the freshet but may persist into the early summer.

Water chemistry in Project drainages is influenced by varying proportions of snowmelt-driven surface runoff and groundwater inputs to surface flow, based on the seasonal water balance. This seasonality in water chemistry is more pronounced higher in catchments. Surface water quality is characterized by soft to moderately soft water that is low in major ions during freshet periods, and hard to very hard waters, with high levels of major ions during winter low-flow periods. Lower in catchments, water chemistry shows a similar seasonality, though annual minimum and maximum amounts are less pronounced. Dissolved major ion levels during the open water period of May to September are generally low. During low-flow periods, water chemistry is dominated by hard to very hard waters with high levels of dissolved solids. In contrast, pH remains relatively uniform throughout drainages on an annual basis (7.0 to 8.0). Peak summer flows typically coincide with annual maximum amounts of total suspended solids (TSS), dissolved organic carbon, dissolved aluminum, total iron (Fe), and particulate-bound metals; however, mean monthly concentrations of total and dissolved trace elements are generally low. During winter low-flow periods, the total uranium (U) concentration is consistently well above its Canadian Council of Ministers of the Environment (CCME) long-term guideline on an annual basis. Total arsenic (As) and total selenium (Se) are typically below their water quality guidelines (WQG) year-round, although sporadic increases are observed in association with high-TSS events.

In the Yukon River, water chemistry is characterized by moderately soft to moderately hard waters with low to moderate levels of major ions. Measurements for pH are generally circumneutral to slightly basic. The strong seasonal water quality signature evident in Project drainages is largely absent from the Yukon River, presumably due to its large catchment. The Yukon River shows concentration peaks for certain organic parameters during summer high flows. Despite annual concentration peaks for certain parameters during summer high flows, mean monthly concentrations of total and dissolved trace elements are typically low, falling below CCME and BC long-term guidelines.

4.1 Surface Water Local Study Area

The immediate local study area (LSA) includes Latte Creek, Halfway Creek and YT-24 – basins that contain project mining components. In addition, the LSA also includes sampling stations in Coffee Creek (located

immediately upstream and downstream of the confluence with Latte Creek) and selected reaches of the Yukon River (from upstream of the Coffee Creek confluence to immediately downstream of the Independence Creek confluence) (Table 4-1, Figure 4-1, Figure 4-2).

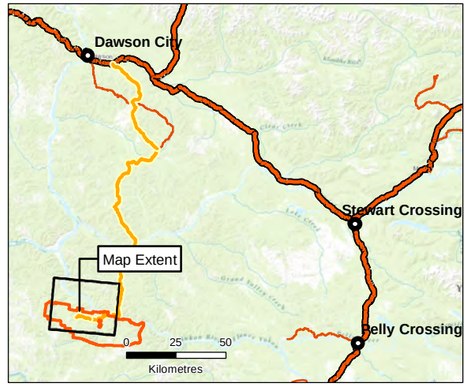
Table 4-1 Water Quality Sampling Stations, Coordinates and Rationale

Former ID	Current ID	Drainage	Coordinates		Site	Sampling
			North	East	Type	Start Date
Independence Creek						
IC-0.5	ICT14-0.4	Independence Creek – main stem	6976911	572012	Reference	Oct-2010
IC-1.5	IC-16.1	Un-named larger tributary to Independence Creek	6976835	572260	Reference	Oct-2010
IC-2.5	IC-14.6	Small un-named tributary to Independence Creek	6978044	572771	Reference	Oct-2010
IC-3.0	KT-0.3	Small un-named tributary to Independence Creek	6979357	575334	Reference	Oct-2010
IC-4.5	IC-2.7	Independence Creek - mouth	6983237	579358	Reference	Oct-2010
Latte Creek						
CC-6.0	LC-15.5	Upper Latte Creek	6971061	581317	Exposure	June-2014
CC-1.0	LCT20-0.1	Small tributary to Latte Creek below Supremo South	6971733	584890	Exposure	June-2014
CC-1.5	LC-11.4	Latte Creek downstream of LCT20-0.1 drainage	6971654	585071	Exposure	Oct-2010
CC-3.5	LC-0.2	Latte Creek before confluence with Coffee Creek	6970375	594319	Exposure	Oct-2010
Halfway Creek						
HC-2.5	HC-6.8	Halfway Creek midway below proposed Alpha Pond	6976548	584089	Exposure	Oct-2010
	HC-1.0	Halfway Creek	6980137	588049	Exposure	July-2017
HC-5.0	HC-0.1	Halfway Creek mouth	6980536	588823	Exposure	Oct-2010
YT-24						
YT-24	YT24-0.1	Mouth of YT-24, small tributary to Yukon River	6979073	589526	Exposure	June-2014
YT-24-2	YT24-4.9	Upper reach of YT-24	6976472	585922	Exposure	June 2016
Coffee Creek						
CC-0.5	CC-11.6	Coffee Creek upstream of confluence with Latte Creek	6970225	594719	Reference	Oct-2010
Latte Mix	CC-10.9	Coffee Creek downstream of confluence with Latte Creek	6970589	594735	Mixing zone	July-2017
CC-4.5	CC-3.2	Lower Coffee Creek	6975084	598330	Exposure	Oct-2010
Yukon River						
YUK-2.0	YUK-51.3	Yukon River upstream of Coffee Creek confluence	6975946	601011	Reference	Oct-2010
YUK-5.0	YUK-26.1	Yukon River downstream of Independence Creek confluence	6985228	579624	Exposure	Oct-2010
Coffee Mix	YUK-49.3	Coffee Creek confluence with Yukon River – clear water plume	6977180	599397	Exposure	Jul-2017
Halfway Mix	YUK-37.6	Halfway Creek confluence with the Yukon River – clear water plume	6980651	588962	Exposure	Jul-2017

Water quality monitoring is ongoing at the Project site and is planned to continue throughout the permitting phase. Upon issuance of mine licenses, an approved water quality program will continue throughout the mine development, operation and into closure phases.

COFFEE GOLD MINE

Surface Water Quality Monitoring Locations



Legend

- Municipalities
- Waterbody
- Watercourse
- Pit
- WRSF/Backfill
- Halfway Creek Catchment
- Latte Creek Catchment
- YT-24 Creek Catchment

N

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0 400 800 1,200

Meters

NAD 1983 UTM Zone 8N

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Figure 4-1	Date: Nov 14, 2023	Drawn by: AL	Reviewed: SJ/DF

Newmont COFFEE

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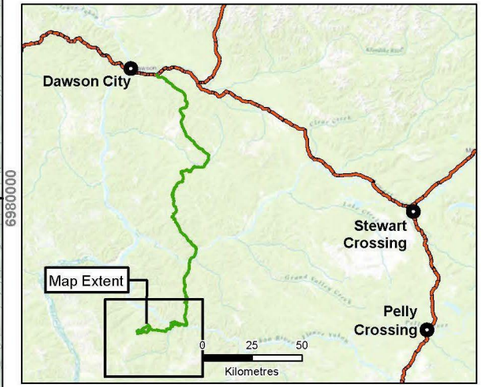
COFFEE GOLD MINE

Baseline Water Quality Local Assessment and Regional Assessment Area



Legend

- Water Quality Regional Assessment
- Water Quality Local Assessment
- Waterbodies
- Watercourses
- Surface Contours (100m)

N

1:150,000

0 2 4 6

Kilometers

NAD 1983 UTM Zone 7N

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Figure 4-2	Date: Feb 8, 2022	Drawn by: AL	Reviewed: DF

Newmont COFFEE

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4.2 Baseline Water Quality

This section presents a characterization of baseline water quality in the drainages of Latte Creek, Coffee Creek, Halfway Creek, Yukon River, and the Independence Creek (reference stream). The Baseline Water Quality Report 2010 to 2020 is provided in Appendix C. Compiled raw water quality results data for all stations sampled during the period of 2010 to 2020 is provided electronically in excel format (Appendix C).

Baseline water quality characterization is presented and described by catchment:

- Section 4.2.1 characterizes baseline water quality in Latte Creek utilizing monitoring data primarily from stations LC-15.5 for upper Latte Creek and stations LC-11.4 and LC-0.2 for mid-reach and lower-reach of Latte Creek
- Section 4.2.2 provides a summary of water quality in Coffee Creek at locations both upstream and downstream of the project area. Data from station CC-11.6 (upstream of project influences) and CC-3.2 (downstream of confluence with Latte Creek) are utilized to characterize baseline conditions in Coffee Creek
- Baseline water quality in the Halfway Creek drainage (Section 4.2.3) is characterized using data from stations HC-6.8 and HC-1.0
- Section 4.2.4 provides a brief description of water quality in Yukon River upstream of the project area at YUK-51.3 and downstream of project influence at YUK-26.1
- Section 4.2.5 provides a description of water quality in the Independence Creek catchment using data from station IC-2.7 (mainstem) and KT-0.4 (tributary to Independence and downgradient of Kona deposit).

Monthly summary statistics for each catchment area are briefly discussed below and fully compiled in Appendix C.

4.2.1 Latte Creek

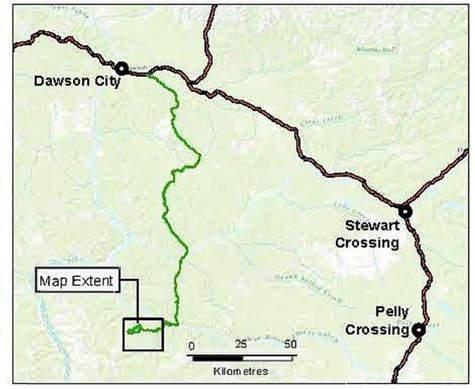
Background water chemistry in Latte Creek can be divided between upper Latte Creek and mid to lower Latte Creek. In general, upper Latte Creek water chemistry is dominated by surface runoff whereas mid to lower Latte Creek water chemistry is influenced by both groundwater discharge, as well as surface runoff during the ice-free periods. No measurable flow has been observed in upper Latte Creek during winter sampling campaigns (e.g., November to March), suggesting little to no groundwater baseflow contributions during these periods. Conversely, mid to lower Latte Creek monitoring stations LC-11.4 and LC-0.2 are more routinely sampled during low-flow periods of the winter owing to groundwater baseflow discharge to these reaches of Latte Creek.

4.2.1.1 Upper Latte Creek- Station LC-15.5

Upper Latte Creek is characterized by water quality samples taken at Station LC-15.5 (Figure 4-3), which includes contributions from two small tributaries (represented by stations CC-5.5 and CC-5.0) in the headwaters. Upper Latte Creek sampling locations were established in 2014 in the baseline surface water quality monitoring program due to adjustments in mine planning. As previously mentioned, flow is not observed during winter months in this section of the creek, therefore limited water samples have been collected at these locations. Given that seasonal variability in Latte Creek has been well characterised, the water quality dataset is considered reliable and robust. More details on major ions, nutrients (mean monthly values), trace elements in Upper Latte Creek can be found in Appendix C.

COFFEE GOLD MINE

Details o□Latte Cree□Drainage
Illustrating □ey Monitoring Station Locations



HC-6.8 (HC-2.5)
LC-11.4 (CC-1.5)
CC-5.5
LC-15.5 (CC-6.0)
CC-5.0
LC-0.2 (CC-3.5)
CC-10.9 (Latte-Mix)
CC-11.6 (CC-0.5)
Halfway Cree
YT-2.4
Latte Creek
Coffee Creek
580000
590000
6970000

Legend

- Surface WQ Monitoring Stations
- Surface and Hydrology Monitoring Stations
- Latte Creek Catchment
- Watercourses
- Waterbodies
- Surface Contours (100m)

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Meters

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Figure 4-3	Date: Dec 9, 2021	Drawn by: AL	Reviewed: DF

Newmont COFFEE

4.2.1.2 Mid and Lower Latte Creek- Stations LC-11.4 and LC-0.2

Water quality in mid-reach and lower-reach Latte Creek is distinctly different from the conditions previously described for upper Latte Creek. Groundwater baseflow contributions produce a more pronounced seasonal signature in water chemistry. In addition, with more significant groundwater contributions, periods with little to no surface flow still result in measurable streamflow within Latte Creek. As a result, monitoring of water quality has been possible through all months of the year. Mid-reach Latte Creek is characterized by water quality data collected at station LC-11.4 for the period of October 2010 to December 2020 (Figure 4-3). This station in Latte Creek is located approximately 50 m downstream of the confluence of a small ephemeral tributary that has been monitored at station LCT20-0.1 since June 2014. Lower Latte Creek is characterized by water quality data collected at station LC-0.2 for the period of October 2010 to December 2020. More details on major ions, nutrients (mean monthly values), trace elements in Mid and Lower Latte Creek can be found in Appendix C.

4.2.2 Coffee Creek

Background water chemistry in Coffee Creek can be divided between upper Coffee Creek (e.g., above the confluence with Latte Creek) and lower Coffee Creek (Figure 4-4). Upper Coffee Creek is represented by data collected from CC-11.6 and lower Coffee Creek is represented by data collected at station CC-3.2. Station CC-10.9 located immediately downstream of the confluence with Latte Creek was added in 2017 to evaluate mixing with Coffee Creek. Monthly water quality monitoring at both stations commenced in October 2010 and continues to present. More details on major ions, nutrients (mean monthly values), trace elements in Upper Coffee Creek, Lower Coffee Creek and CC-10.9 Coffee Creek can be found in Appendix C.

4.2.2.1 Upper Coffee Creek- Station CC-11.6

Upper Coffee Creek is characterized by water quality measured at Station CC-11.6 (Figure 4-4) which reflects contributions from a large watershed of approximately 385 km^2. This compares to the Latte Creek watershed area at LC-0.2 of approximately 70 km^2 described in Section 4.2.1.

4.2.2.2 Lower Coffee Creek- Station CC-3.2

Lower Coffee Creek is characterized by water quality measured at Station CC-3.2 (Figure 4-4) which reflects contributions from Latte Creek that enters Coffee Creek immediately downstream of previously described station CC-11.6 on upper Coffee Creek.

4.2.2.3 CC-10.9 Coffee Creek

This station reflects the contributions from Latte Creek that enters Coffee Creek immediately upstream of this station (Figure 4-5).

4.2.3 Halfway Creek and YT-24

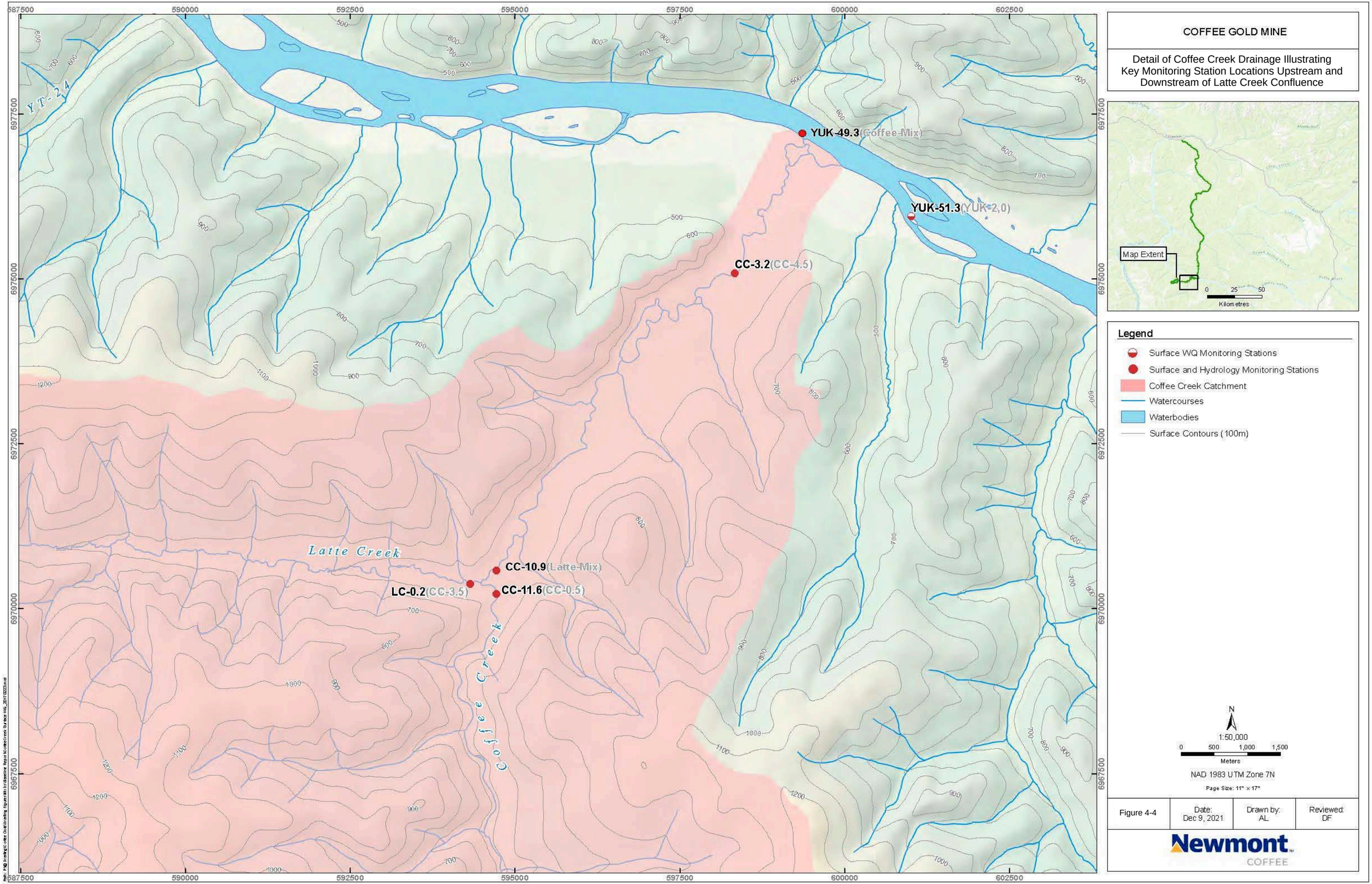
Halfway Creek contains two water quality monitoring stations at HC-6.8, approximately mid-way down the watershed, and at station HC-1.0, at the mouth of Halfway Creek prior to entering the Yukon River (Figure 4-5). Water quality in YT-24 is characterized by data collected at YT24-0.1 at the mouth of the creek prior to entering the Yukon River (Figure 4-5). More details on major ions, nutrients (mean monthly values), trace elements in Halfway Creek Stations HC-6.8 and HC-1.0, and YT-24 can be found in Appendix C.

4.2.4 Halfway Creek – Stations HC-6.8 and HC-1.0

Water quality at stations HC-6.8 and HC-1.0 has been collected since October 2010 and continues to present. Data for HC-6.8 represents a nearly continuous monthly record for the period of October 2010 to December 2020. For station HC-1.0, monthly sampling in the winter period has proved sporadic as a result of freezing conditions and during the low flow periods, the lower reaches of Halfway Creek do not contain flow.

4.2.5 YT-24 Stations

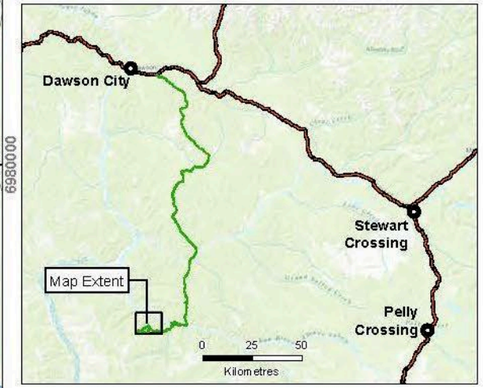
A relatively small, ephemeral drainage named YT-24, drains the northern slopes of the Coffee Project area and enters the Yukon River. Monitoring of this drainage occurs at two stations YT24-4.9 (mid-creek) and near the mouth at station at YT24-0.1.



COFFEE GOLD MINE
Detail of Coffee Creek Drainage Illustrating Key Monitoring Station Locations Upstream and Downstream of Latte Creek Confluence
YUK-49.3(Coffee-Mix)
YUK-51.3(YUK-2,0)
CC-3.2(CC-4.5)
CC-10.9(Latte-Mix)
LC-0.2(CC-3.5)
CC-11.6(CC-0.5)
Latte Creek
Coffee Creek
YT-24
Map Extent
Kilometres
Legend
Surface WQ Monitoring Stations
Surface and Hydrology Monitoring Stations
Coffee Creek Catchment
Watercourses
Waterbodies
Surface Contours (100m)
1:50,000
Meters
NAD 1983 UTM Zone 7N
Page Size: 11" x 17"
Figure 4-4
Date: Dec 9, 2021
Drawn by: AL
Reviewed: DF
Newmont
COFFEE

COFFEE GOLD MINE

Detail of Halfway Creek and YT-24 Drainages
Illustrating Key Monitoring Station Locations



HC-0.1 (HC-5.0)
HC-1.0
YT24-0.1 (YT-24)
HC-6.8 (HC-2.5)
YT24-4.9 (YT24-2)
Dan Man Creek
Halfway Creek
YT-24

Legend

- Surface WQ Monitoring Stations
- Surface and Hydrology Monitoring Stations
- Halfway Creek Catchment
- YT-24 Catchment
- Watercourses
- Waterbodies
- Surface Contours (100m)

N

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0 500 1,000 1,500

Meters

NAD 1983 UTM Zone 7N

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Figure 4-5	Date: Feb 8, 2022	Drawn by: AL	Reviewed: DF

Newmont COFFEE

4.2.6 Yukon River Stations

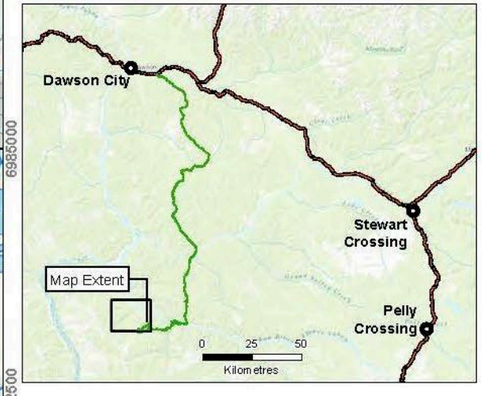
The baseline water quality results for the Yukon River in the immediate vicinity of the proposed project is summarized for stations YUK-51.3 and YUK-26.1 (see Figure 4-1) that are located immediately upstream of Coffee Creek and downstream of Independence Creek, respectively. More details on major ions, nutrients (mean monthly values), trace elements in YUK-51.3, YUK-26.1, YUK-49.3 and YUK-37.6 can be found in Appendix C.

4.2.7 Independence Creek

Independence Creek is not affected by proposed mining operations and therefore serves as a reference monitoring watershed. Independence Creek is characterized by water quality measured at Station IC-2.7 (Figure 4-7) which reflects water quality conditions in lower Independence Creek and downstream of contributions from three small catchments that drain the east slope of the drainage divide between upper Latte Creek and Independence Creek (IC-16.1 and IC-14.6) and the eastern slope of the drainage divide of Halfway Creek and Independence Creek (KT-0.4) in Kona Creek (see Figure 4-1 and Figure 4-7). Results are presented for station IC4.5 (mainstem of Independence Creek) and KT-0.4 in Kona Creek, a tributary to Independence Creek (Figure 4-6); complete results for all other stations are presented in Appendix C along with summary statistics for all stations. More details on major ions, nutrients (mean monthly values), trace elements in Station IC-2.7 and Station KT-0.4 can be found in Appendix C.

COFFEE GOLD MINE

Detail of Independence Creek Drainage Illustrating Key Monitoring Station Locations



Legend

- Surface WQ Monitoring Stations
- Surface and Hydrology Monitoring Stations
- Independence Creek Catchment
- Watercourses
- Waterbodies
- Surface Contours (100m)

N

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0 500 1,000 1,500

Meters

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Figure 4-6	Date: Dec 9, 2021	Drawn by: AL	Reviewed: DF

Newmont COFFEE

4.3 Surface Water Hydrology

Streamflow monitoring at the Coffee Gold Project site has been in progress since 2010, with significant network upgrades completed in 2014 and 2016 to increase the spatial coverage of monitoring. Streamflow data consist of a combination of manual measurements made using current meters or salt dilution techniques, and continuously recording stations with water level sensors and fully developed rating curves.

Table 4-2 and Table 4-3 summarize station nomenclature and drainage characteristics for the sixteen stations which comprise the existing baseline hydrology network for the Coffee Gold Project. Figure 4-7 shows the location of these monitoring stations with respect to proposed Project infrastructure and mine site footprints. Detailed information on drainage basin characterization and hydrometric data collection methods are described fully in Appendix B.

Table 4-2 Cross Reference Table Summarizing New and Previous Names for Streamflow Monitoring Stations at Coffee Gold*

Drainage Basin	Watercourse	New Station Name	Previous Station Name
Coffee Creek	Coffee Creek (CC)	CC-3.2	CC-4.5
		CC-11.6	CC-0.5
	Latte Creek (LC)	LC-0.2*	CC-3.5
		LC-11.4	CC-1.5
		LC-15.5	CC-6.0
	Latte Creek Trib 20	LCT20-0.1	CC-1.0
YT-24	YT-24 (YT24)	YT24-0.1	YT-24
		YT24-4.9	YT-24-2
Halfway Creek	Halfway Creek (HC)	HC-0.1	HC-5.0
		HC-6.8	HC-2.5
Independence Creek	Independence Creek (IC)	IC-2.7	IC-4.5
		ICT15-0.1	IC-2.5
		IC-16.1	IC-1.5
	Kona Tributary (KT)	KT-0.3	IC-3.0
	Independence Creek Trib 14 (ICT14)	ICT14-0.4	IC-0.5

* This table is referenced from the 2021 Hydro-meteorology Baseline Report which erroneously labels Station LC-0.2 as LC-0.1. This Station ID is corrected to LC-0.2 here.

Notes:

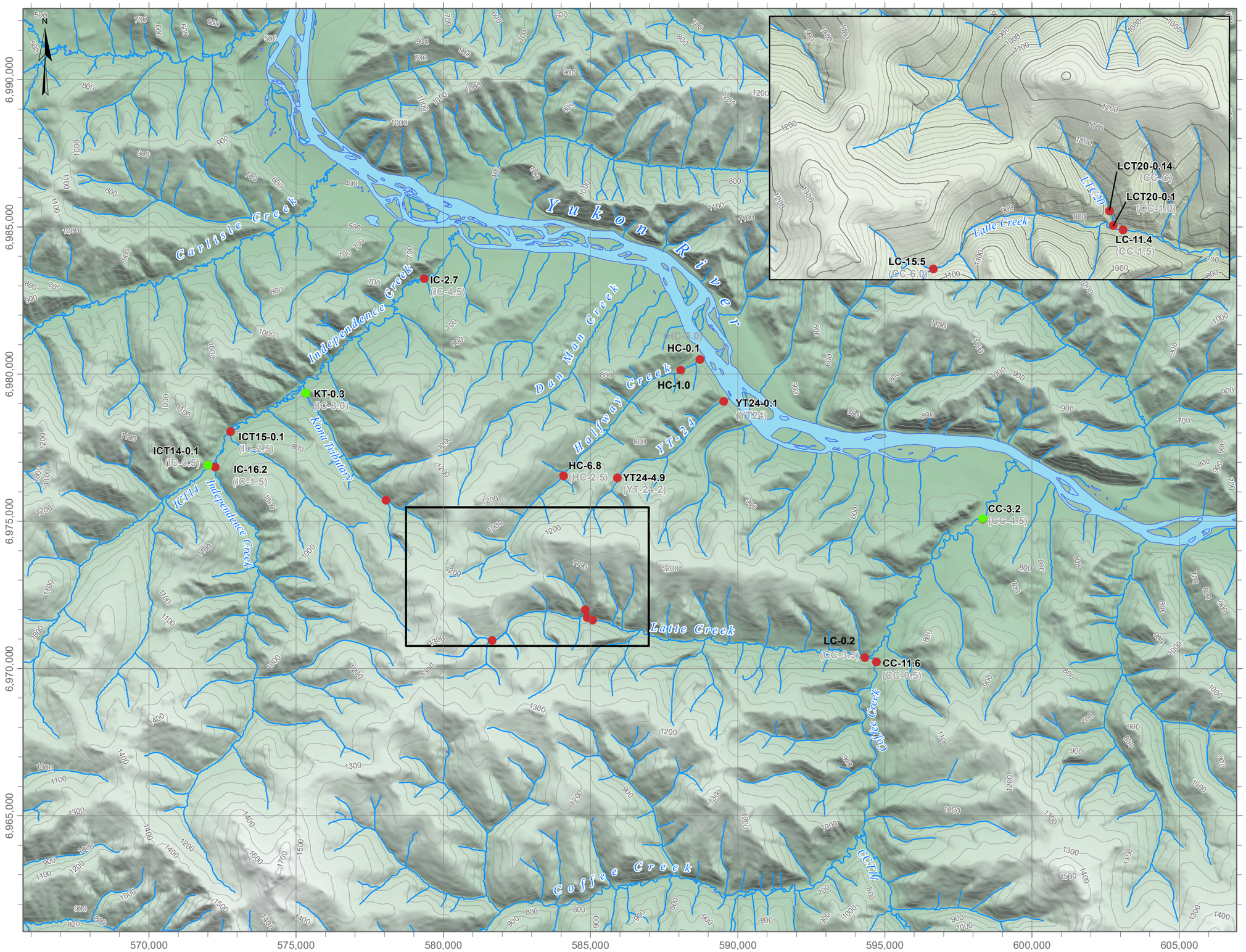
Station nomenclature for tributaries is as follows: numbering begins at confluence with next larger stream and moves upstream with even numbers on river left, and odd numbers on river right (looking downstream).

All numerical designations for stations are the distance in kilometers upstream from the confluence with the next largest stream.

Table 4-3 Coffee Gold Project, Surface Hydrology Stations, and Drainage Basin Characteristics

Station ID	Drainage	UTM N	UTM E	Drainage Area (km2)	Frequency	Record Period
LCT20-0.1[W]	Small tributary to Latte Creek draining proposed South WRSF	6,971,733	584,890	3.4	Flow - continuous	Jun 2014 – present
LC-11.4	Latte Creek downstream of CC-1.0 drainage	6,971,654	585,071	23.1	Flow - continuous	Oct 2010 – present
LC-0.2*	Latte Creek immediately upstream of confluence with Coffee Creek	6,970,375	594,319	69.8	Flow - continuous	Oct 2010 – present
LC-15.5	Upper Latte Creek	6,970,960	581,317	9.6	Flow - continuous	Jun 2014 – Aug 2019
CC-11.6	Coffee Creek immediately upstream of confluence with Latte Creek	6,970,225	594,719	385.6	Flow - continuous	Oct 2010 - present
CC-3.2	Coffee Creek	6,975,084	598,330	484.0	Flow – monthly	Oct 2010 - present
HC-6.8	Halfway Creek – midway	6,976,548	584,089	14.8	Flow - continuous	Oct 2010 - present
HC-0.1	Halfway Creek – mouth	6,980,536	588,823	27.0	Flow - continuous	Oct 2010 - present
ICT14-0.4[S]	Independence Creek – unnamed large tributary	6,976,911	572,012	68.9	Flow – monthly	Oct 2010 - present
IC-16.1	Mainstem of Independence Creek	6,976,835	572,260	81.1	Flow - continuous	Oct 2010 – Aug 2019
ICT15-0.1	Unnamed small tributary to Independence Creek	6,978,044	572,771	17.3	Flow - continuous	Oct 2010 – Aug 2019
KT-0.3[S]	Kona Creek, small tributary to Independence Creek	6,979,357	575,334	18.3	Flow – monthly	Oct 2010 - present
IC-2.7	Independence Creek – mouth	6,983,237	579,358	222.3	Flow - continuous	Oct 2010 - present
YT24-0.1	Mouth of YT-24, small tributary to Yukon River and draining North WRSF	6,979,073	589,526	11.8	Flow - continuous	Jun 2014 – present
YT24-4.9	YT-24 tributary – midway	6,976,472	585,922	4.0	Flow - continuous	Jun 2016 – present

* This table is referenced from the 2021 Hydro-meteorology Baseline Report which erroneously labels Station LC-0.2 as LC-0.1. This Station ID is corrected to LC-0.2 here.
Notes:
All UTM coordinates in Zone 7
[W] Discharge measured by V-notch weir
[S] Spot flow monitoring station only



LEGEND

- Continuous Flow Monitoring
- Monthly Flow Monitoring
- Watercourses
- Waterbodies
- Surface Contours (100m)

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:125,000

0 2 4 km

DATE SAVED:	Sep 24, 2019
DRAWN BY:	AL
REVIEWED:	SJ
VERSION:	1

CLIENT:

Newmont™ COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Mine

TITLE:

Flow Monitoring Locations

PROJECT #: A362-3 *FIGURE:* 4-7

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4.3.1 Hydrometric Monitoring

Gauged watersheds at the Coffee Creek site range in size from ~3 to 500 km^2, with nine of these having drainage areas of less than 25 km^2. In addition to capturing a range of drainage areas, the watersheds gauged for the baseline hydrology study differ in elevation characteristics (i.e., mean catchment elevations range 800 to 1,300 m asl) and represent varying aspects as well. Mean elevation, basin area, a detailed basin map, aspect and hypsometry information are presented per hydrometric station in (Appendix C of the Hydro-meteorology Baseline Report 2021 (Appendix B).

Twelve of the surface water monitoring stations at the property are instrumented with metric staff gauges and continuously recording water level recorders set in stilling wells. These stations allow high-resolution (i.e., 15-minute) data records at each site. Streamflow was measured several different ways for this study, including wading with a current meter, salt dilution gauging, using an acoustic Doppler current profiler, and slope-area approaches. Rating curves are well constrained, with all but one of the stations (YT24-4.9) based on 10 or more paired stage: discharge measurements, and a site-wide average error of -2%.

Based on measurements at Coffee Creek hydrometric stations, average unit yields across the Project site are 10.6 L/s/km^2 for the open water season (May to October) and range from 4 to 16 L/s/km^2, with specifics of the runoff regime for each monitoring station being dependent on drainage characteristics (i.e., basin area, shape, mean elevation, extent of permafrost, etc.). Unit yields range from 2.0 - 5.1 L/s/km^2 in October and decrease steadily to annual minima in March (i.e., 0 - 0.7 L/s/km^2), before increasing again in April in response to low-elevation snow melt and spring rains. At Coffee Creek, instantaneous peak flows, expressed as unit yields, are typically between 120 and 200 L/s/km^2, but measurements vary widely across the site (from 60 to >300 L/s/km^2).

In similar fashion to the derivation of the synthetic climate dataset, the site hydrometric data were extended using a piece-wise ranked regression approach, based on the Big Creek (WSC; 09AH003) streamflow record. This allowed daily streamflow time-series to be derived for eleven of the Project site stations, which were then used to generate recurrence interval estimates of mean annual runoff and summer low-flows.

4.3.2 Mean Annual Runoff

Based on the measured streamflow data and the synthetic streamflow records, MAR varied by roughly a factor of four in Project site basins (from 48 mm to 205 mm) and when regressed against mean basin elevation (m), basin area (km^2) and dominant aspect within the drainage, showed strong correlation with elevation, and indicate that MAR increases an average of 7%/100 m, which is comparable to the average annual orographic precipitation gradient of 6%/100 m. Results of the annual runoff recurrence interval analysis indicate that the spread between the 1:200 dry- and wet-years is substantial in the Project area drainages, and generally, an extreme wet-year are expected to produce ten times more runoff than an extreme dry-year.

4.3.3 Instantaneous Peak Flows

At the Project site, instantaneous peak flows, expressed as unit yields, are typically between 120 and 200 L/s/km^2, but measurements range widely across the site (from 60 to >300 L/s/km^2). Recurrence interval estimates of annual instantaneous peak flows from a suite of regional records were plotted against drainage

area, and an enveloping power law function was then fit to the data. The enveloping power law functions derived from the regional data for each recurrence interval (e.g., 1:100-year peak flow) were used to estimate the corresponding peak flow for all Project drainages. The results of this analysis indicate that the 1:100-year instantaneous peak flow is expected to generate unit yield flows of 327 L/s/km^2 for a basin of 100 km^2.

4.3.4 Summer and Annual Low Flows

Following freshet, baseflows in the lower reaches of the Project site creeks are enhanced by active layer melt and soil moisture recharge. At the upper elevation stations (e.g., LC-15.5) and those situated in alluvial deposits (e.g., LCT20-0.1) effective yields can drop to near zero flow conditions. Summer (June-September) low flow estimates were derived based on a combination of regional and synthetic site records. Based on the regional stations assumed most representative of Project site conditions, the analysis returned summer 7Q10 yields that range from 0.7 to 1.11 L/s/km^2. A parallel analysis conducted using the synthetic streamflow data returned estimated summer 7Q10 values for the Project stations ranging from 0.04 to 0.78 L/s/km^2. The summer 7Q10 low flow value based on an average of the eleven Project station synthetic records is 0.34 L/s/km^2.

Site data show that yields range from 2.0 – 5.1 L/s/km^2 in October and decrease steadily to their annual minima by March (0 – 0.7 L/s/km^2), before increasing again in April in response to low-elevation snow melt and spring rainfall. Based on the site data alone, winter low flows are expected to range from 0 to 0.7 L/s/km^2.

An important component of the winter flow regime at the Project site is the extensive icing of the local channels. This ice growth, or aufeis, is the result of shallow groundwater discharge and/or baseflow in the stream channel freezing. This ice impedes subsequent flow, which is forced on top of the existing ice sheet, where it freezes. This process repeats continuously throughout the winter, and results in laminated ice sheets that can approach 2 m in thickness and 50+ m in width in the Project channels.

4.4 Water Balance Model

The water balance model (WBM) is a detailed interpretation of the mine and water management plans, with consideration of baseline climate, hydrometric, water quality and hydrogeological data collected for the Project. The WBM overlays the mine plan and all associated major Project footprints (e.g., open pit, heap leach facility and waste rock storage facility footprints) and water-related activities (i.e., pit dewatering, diversions, storage, and release of water (and loads) from sediment control ponds) associated with the Construction, Operation, Reclamation and Closure and Post-closure phases of the Project onto calibrated local watercourse streamflow and water quality conditions.

The WBM is strongly informed by hydrological and climatological monitoring data and modelling exercises, including:

- Seven to ten years of baseline streamflow data (11 stations)
- Nine years of site climate record
- Reconstructed site climate record (30 years in length) and daily discharge records (33 years in length)
- Regional climate change analyses to inform closure water balance scenarios.

The WBM is configured to represent all relevant physical processes at the Project site that drive streamflow and water quality, which are closely linked. Surface runoff, baseflow, aufeis formation, snowfall and snowmelt processes are represented, as are the elevational dependence of the temperature and precipitation inputs. The watershed model used to predict Project area streamflows on a daily basis was calibrated to both the measured and synthetic streamflow datasets as described in the 2021 Hydrometeorology Baseline Report. Potential evapotranspiration is included as a function of daily mean temperature, plus a stochastic adjustment to represent the observed variability of potential evapotranspiration at the site. The current configuration of the site-wide water balance predicts flows at the 10 receiving environment monitoring stations, accounting for variability based on a 30-year synthetic climate record and the effect of climate change on air temperature and precipitation.

With respect to the Yukon River, the WBM assumes flow from Coffee Creek, YT24-0.1 and Halfway Creek to the Yukon River is partially mixed at each respective monitoring station. Given the measurable dilution afforded by the Yukon River relative to Project area creeks, this approach yielded a conservative estimate of potential water quality in creek mixing zones within the Yukon River. The WBM therefore assumes water discharging from each creek into the Yukon River mixes with only 2% of the Yukon River flow at the modelled downstream locations. Full mixing is assumed to occur in the Yukon River between Coffee Creek's confluence and YT24-0.1's confluence, and partial mixing (25%) inferred between YT24-0.1 confluence and Halfway Creek's confluence.

4.5 Water Quality Model

The water quality model (WQM) developed for the Project predicts water quality for key locations within the receiving environment throughout all phases of the Project. The model generally employs a mass balance approach that combines the loadings associated with background flows and mine-affected flows for a series of climate realizations (i.e., climate scenarios that were developed based on a 30-year climate record and described more fully in Appendix B). The WQM was developed in GoldSim, and accounts for background water quality, runoff volumes reporting from undisturbed portions of watersheds, and regional groundwater, as well as chemical loads emanating from mine-related facilities (e.g., Open Pits and Waste Rock Management Facilities) and Site Water Management Infrastructure (e.g., contact water ponds and ditches). The WQM incorporates the site-wide mitigation strategies developed for the Project, in the sense that intended mitigation has been considered in deriving source terms for specific mine components. The WQM accounts for mine-related activities associated with four distinct phases of the Project: Construction, Operation, Reclamation and Closure, and Post-closure. It is assumed that the mine will be fully reclaimed with no active treatment or mitigation required during the Post-closure Phase (commencing Year 24 onwards as determined to be required). The modelled Post-closure Phase incorporates the effect of a conservative climate change scenario (RCP-8.5) as defined by the Intergovernmental Panel on Climate Change.

5.0 GROUNDWATER

The baseline hydrogeological assessment of the Project was detailed in 2017 Coffee Gold Baseline Hydrogeological Assessment (Lorax, 2017c) and submitted in support of the Project Proposal. Physical and chemical hydrogeological data collected up to August 2019 are summarized. An updated Coffee Gold Baseline Hydrogeological Assessment 2019 Update report is presented in Appendix D. Collection of baseline groundwater quality and water levels is ongoing and will be continued through the licensing process.

5.1 Groundwater Study Area

Groundwater flow systems occur on various scales. At the largest scale, deep groundwater drains towards major regional water bodies. At smaller scales, groundwater that originates in local catchments will drain towards local creeks and streams which ultimately feed into larger surface water systems.

The study area for groundwater includes areas directly underlying mine units and nearby reaches of downgradient creeks where changes to groundwater may result in measurable changes to the surface water regime (Figure 5-5). It was determined that Project-related development and use of the NAR would result only in minor interactions with groundwater and these interactions would be limited to localized shallow groundwater in seasonably active groundwater systems. Therefore, baseline groundwater data along the proposed NAR was not collected.

Multiple hydrogeological and geotechnical field programs have been undertaken at the Mine Site between 2013 and 2017 (Table 5-1).

Table 5-1 Hydrogeological Monitoring Locations Showing End of Mine Layout

Date	Study Objective	Installation	Hydraulic testing
Fall 2013	Preliminary hydrogeological data collection to support a detailed workplan for the hydrogeological baseline assessment	• Four vibrating wire piezometer installations in the Supremo and Latte Pit footprints	Yes
Summer 2014	Geotechnical site investigations and laboratory testing to assess: • Subsurface conditions within the footprint of the HLF, and stockpile; and • Geotechnical engineering material properties of the materials encountered	• Two thermistor strings in previously proposed valley HLF footprint area	No
Summer/Fall 2014	First phase of detailed hydrogeological baseline program establishing groundwater sampling locations in and around the proposed Open Pits	• Conventional monitoring wells and thermistor in pit area • Thermistor/vibrating wire piezometer in former valley HLF footprint	Yes

Date	Study Objective	Installation	Hydraulic testing
March 2015	Second phase of detailed hydrogeological baseline program establishing ground conditions, permafrost conditions, and groundwater pressures downgradient of waste facilities ahead of a larger field program	• Thermistor/vibrating wire piezometer installation downgradient of Alpha WRSF and former South WRSF	No
May – June 2015	Third phase of a detailed hydrogeological field program establish remaining groundwater quality, groundwater pressure and ground temperature stations downgradient of mine facilities	• Thermistor/vibrating wire piezometer, Westbay groundwater monitoring systems (sub-permafrost), and shallow monitoring wells (overburden)	Yes
June – July 2015	Hydrogeological investigation targeting principal geologic structures that will be mined in the open pits, combined with a geotechnical program characterizing permafrost in proposed facility footprints	• Thermistor/vibrating wire piezometer installations in proposed WRSF and stockpile footprints	Yes
August-September 2016	Hydrogeological field program aimed at establishing groundwater quality, groundwater pressure and ground temperature downgradient of the HLF.	• Thermistor/VWP installation along NW margin of HLF.	Yes
Spring-Fall 2017	Geotechnical site investigation to acquire geotechnical and permafrost data, including frozen and unfrozen overburden and bedrock conditions, to inform design of the mine infrastructure	• Thermistor installations in and around Alpha WRSF, Alpha Pond; Beta WRSF; Frozen Soil Stockpile, HLF; Organics Stockpile; and other surface infrastructure	Yes
August 2017	Hydrogeological field program aimed at establishing depth of permafrost, depth of overburden, groundwater pressures, and groundwater occurrence NW of the proposed Kona Pit, as part of the larger 2017 geotechnical investigation.	• Thermistor/VWP installation downgradient of the proposed Kona Pit.	Yes

Note: masl – metres above sea level, mbgs – metres below ground surface

Many of the drilling programs have incorporated hydraulic testing of bedrock, predominantly through a combination of packer testing and airlift testing. Limited slug testing has also been conducted. In conjunction with monitoring well installations, multiple groundwater sampling events have been undertaken to characterize baseline groundwater quality and its range of variability.

Groundwater monitoring events were conducted in September/October 2014, and three to four times annually from 2015 to 2019 (Table 5-2). The monitoring events occur between April/May and October. This modified quarterly sampling frequency is often employed in the Yukon to capture the range of seasonal variability accounting for extended winters and compressed spring/summer/fall season.

Table 5-2 Summary of Groundwater Sampling Program (2014 to 2019)

Station	2014	2015				2016			2017				2018				2019			Count	True Count [5]
	Sep./ Oct.	May/Jun.	Jul.	Aug.	Sep.	May	Jul.	Sep./ Oct.	Apr.	Jun.	Jul.	Oct.	Apr.	Jun.	Aug.	Oct.	Apr./May	Jun.	Aug.		
MW14-02A	IP	IP	IP	IP	PP	IP	PP	PP	IP	IP	IP	PP	IP	IP	PP	PP	IP	IP	IP	19	19
MW14-02B	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	19	19
MW14-03A	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	19	18
MW14-03B	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	19	18
MW14-05A	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	19	18
MW14-05B	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	19	14
MW14-06A	freezing[1]	damaged[2]	decommissioned[3]																	-	-
MW14-06B	freezing[1]	damaged[2]	decommissioned[3]																	-	-
MW15-01AZ	-	dry	frozen	frozen	frozen	frozen	frozen	frozen	frozen	frozen	damaged[4]									0	0
MW15-01WB (Port 4)	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	18
MW15-02AZ	-	PP	PP	PP	PP	PP	PP	PP	frozen	frozen	PP	PP	frozen	frozen	PP	frozen	frozen	frozen	frozen	10	10
MW15-02WB (Port 3)	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	18
MW15-03AZ	-	PP	PP	PP	PP	PP	PP	PP	frozen	frozen	PP	PP	frozen	frozen	PP	PP	frozen	frozen	PP	12	12
MW15-03WB (Port 6 & 4) [6]	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	18
MW15-04AZ	-	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	0	0
MW15-04WB (Port 4)	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	18
MW15-05AZ	-	dry	dry	dry	PP	frozen	frozen	frozen	frozen	frozen	damaged[4]									1	1
MW15-05WB (Port 3)	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	18
MW15-06WB (Port 6)	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	17
MW16-01WB (Port 6)	-	-	-	-	-	-	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	12	12

Notes:
BP = bladder pump, IP = inertial pump actuated with a Hydrolift-II, PP = peristaltic pump, WB = Westbay sampler; D/S = downstream
1. Water inside monitoring well had started freezing at time of well development.
2. Monitoring well riser pipe collapsed near surface, likley due to freeze/thaw action in the active layer. Consequently, well screen could not be accessed.
3. Monitoring well decommissioned by Kaminak.
4. Monitoring wells MW15-01AZ and MW15-05AZ were damaged in July 2019 due to channel and stream bank erosion caused by a summer precipitation event in the Project area.
5. True Count - reflects the number of samples believed to be representative, collected at each station (samples screened-out due to drilling and well installation artifacts discussed in Lorax (2017c) and in Appendix 5-D of this report are not included in this count, and are highlighted in yellow).
6. At MW15-03WB, Port 6 (~47 m) was sampled between June 2015 and May 2016, and Port 4 (~82 m) was sampled thereafter between July 2016 and August 2019. Groundwater quality results corresponding to the two sample depths indicate that there is no apparent difference in the major ion compositions, and concentrations of field parameters, redox parameters, trace element parameters, and stable isotopes.

5.2 Groundwater Environmental Setting

A combination of hydrogeological, geotechnical and geocryological field programs have established a robust network of hydrogeological monitoring installations in, around and downgradient of major mine facilities. The instrumentation includes eleven conventional monitoring wells, seven Westbay multilevel groundwater monitoring systems, nine combination vibrating wire piezometer (VWP)/thermistor strings, plus twelve stand-alone thermistor strings, twenty-five stand-alone shallow thermistor beads, and four stand-alone VWP strings. Groundwater level information is available from selected sites from as early as 2013, with all installations recording high frequency (sub-daily) water level and ground temperature information from mid-2015 onward.

Ground temperature data obtained from thermistors, as well as observations from drilling and monitoring well sampling indicate that permafrost is discontinuous but extensive across the project area. The thickest permafrost at site is measured on the north-facing slopes, a thermistor string at the north end of the proposed Supremo pit reports ~168 metres of permafrost. Permafrost appears to decrease in thickness with declining ground surface elevation. Permafrost in the project area is relatively warm (between 0 and -2°C) and is coolest (-1.4^{o}C to -1.9^{o}C) on north-facing slopes.

At several higher elevation installations, the water table resides below the base of permafrost. The deepest water level at site, more than 220 meters below ground surface is found along the northwest extent of the proposed Supremo pit. At high elevation installations near the proposed Kona and Latte pits, water levels are on the order of 110 to 150 m deep. A high elevation installation on the margins of the proposed heap leach facility, however, registers artesian pressures in a faulted area confined by permafrost.

Artesian groundwater pressures are reported at many lower elevation installations in both permafrost and permafrost-free areas. While groundwater pressures may be artesian adjacent to creek traces, often vertical gradients are downwards, suggesting groundwater is under-drained by the intercepted faults. This is particularly true at installations along Latte Creek. Upward hydraulic gradients are measured in the lower reaches of Halfway Creek near the intersection of a crosscutting fault.

Most groundwater hydrographs are smooth and broadly sinusoidal with one annual maximum that occurs weeks to months after freshet. A few recorded hydrographs from low elevation installations adjacent to creeks show flashier records that respond to rainfall events. Groundwater hydrographs fluctuate from less than 2 meters per year to over 30 metres at one location. Drier-than-average conditions in 2017 manifest as a smaller annual fluctuation compared to other years.

5.3 Hydraulic Conductivity

Sixty successful measurements of bedrock hydraulic conductivity (K) have been collected during field programs executed between 2013 and 2017. Most measurements were acquired through packer testing, but airlift yield recovery tests and slug tests were also performed. Slug tests were performed on two overburden wells (MW15-03AZ and MW15-02AZ), however, the tests recovered so quickly (i.e., within seconds) that they could not be interpreted.

Bedrock K values are plotted versus vertical depth below ground surface in Figure 5-1 and are color coded according to lithology. Ranges in bedrock K values for different depth intervals are also shown in a box and whisker plot in Figure 5-2 with median values summarized in Table 5-3. The hydraulic conductivity data

range over several orders of magnitude with values exceeding 1E-06 m/s and others below the resolution of the testing method. A broad range in K values is typical of a fractured bedrock system (Golder, 2010). A regression line though the data points (Figure 5-1) indicate a broad trend of decreasing hydraulic conductivity with depth.

Median K values decrease by an order of magnitude or more below 150 m depth and again below 250 m depth (Figure 5-2, Table 5-3).

Rock type does not appear to play a large control on hydraulic properties (Figure 5-1). Rather, structural features, which crosscut all lithologies, impart the dominant control on hydraulic conductivity. Hydraulic tests performed on pit structures (SRK, 2015), along valley traces and in the currently proposed HLF footprint (MW16-01T/WB) have been grouped together as ‘structures’. Some of these test results comprise the cluster of the higher hydraulic conductivity values between 150 m and 300 m depth (Figure 5-1). While not mapped as such, the YT-24 and Halfway Creek drainages are inferred to coincide with fault structures. Reverse circulation drillholes advanced below permafrost in these drainages returned airlift yields on the order of 30 US GPM (~1.9 L/s). Latte Creek coincides with the mapped Coffee Creek Fault.

The two boreholes advanced near the proposed HLF (MW16-01T and MW16-01WB) happened to intercept a previously identified NNW-SSE trending magnetic anomaly. Ground conditions and the hydraulic response of this feature (K values exceeding 5E-7 m/s) suggest that this is a fault structure. The median K of structures is 2E-07 m/s with tests ranging up to 275 m depth. This K value is one to two orders of magnitude higher than other bedrock tests over the same depth interval (Figure 5-2, Table 5-3).

Tetra Tech (2017) conducted packer tests on shallow, frozen bedrock in the Halfway Creek to determine foundation conditions in a proposed sediment pond location. Nine out of thirteen tests had no discernible flow and were assigned maximum values based on the resolution of the test. The median K value estimated for shallow, frozen bedrock is 2E-08 m/s (Figure 5-2, Table 5-3). Field and analytical methods for hydraulic testing have been provided in Appendix D along with detailed results.

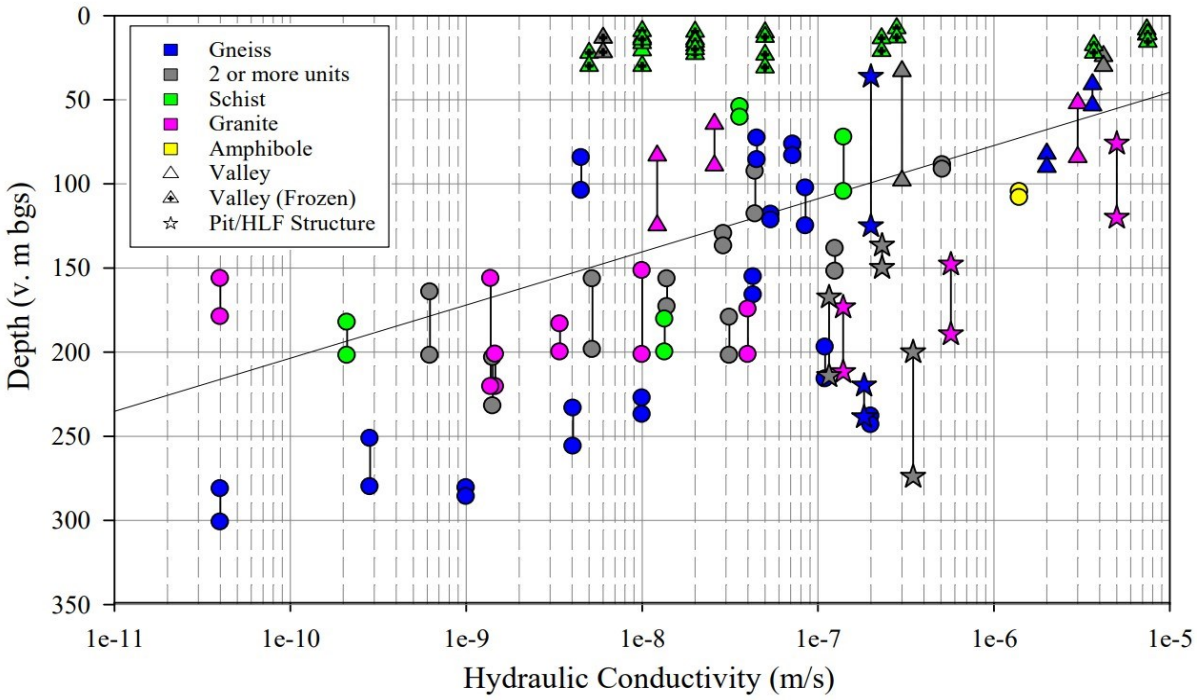


Figure 5-1 **Bedrock Hydraulic Conductivity versus Vertical Depth Below Ground Surface at the Coffee Gold Project (organized by lithology)**

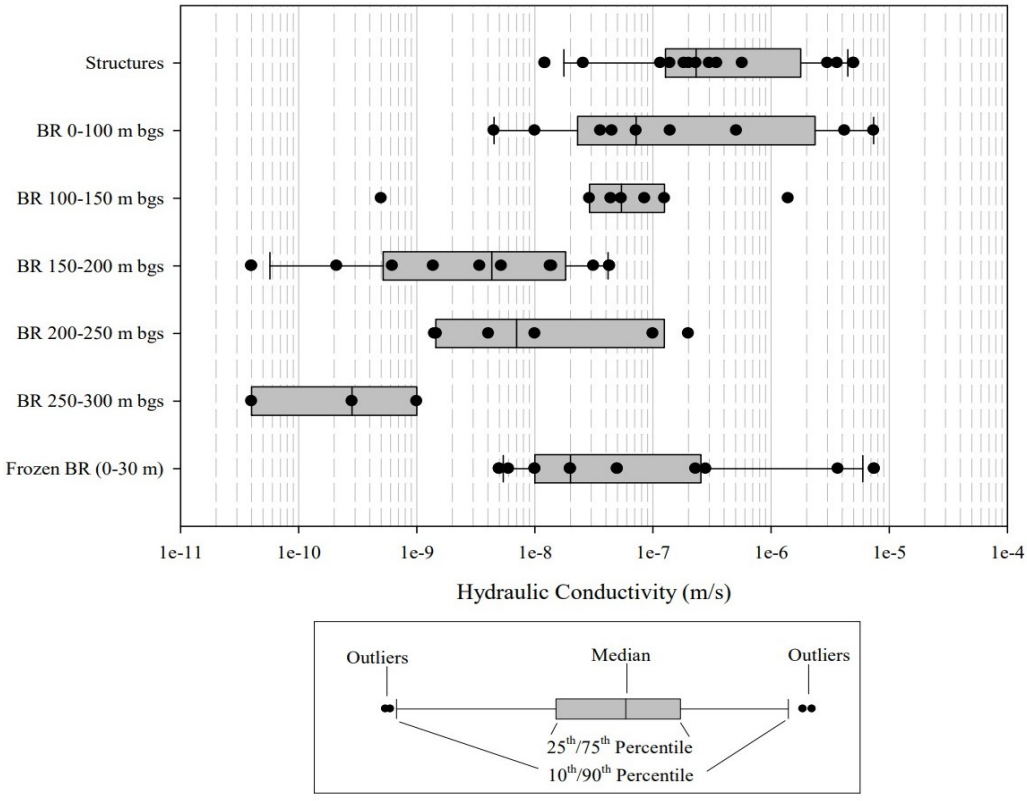


Figure 5-2 **Box and Whisker Plot of Hydraulic Testing Results with Legend in Bottom Panel**

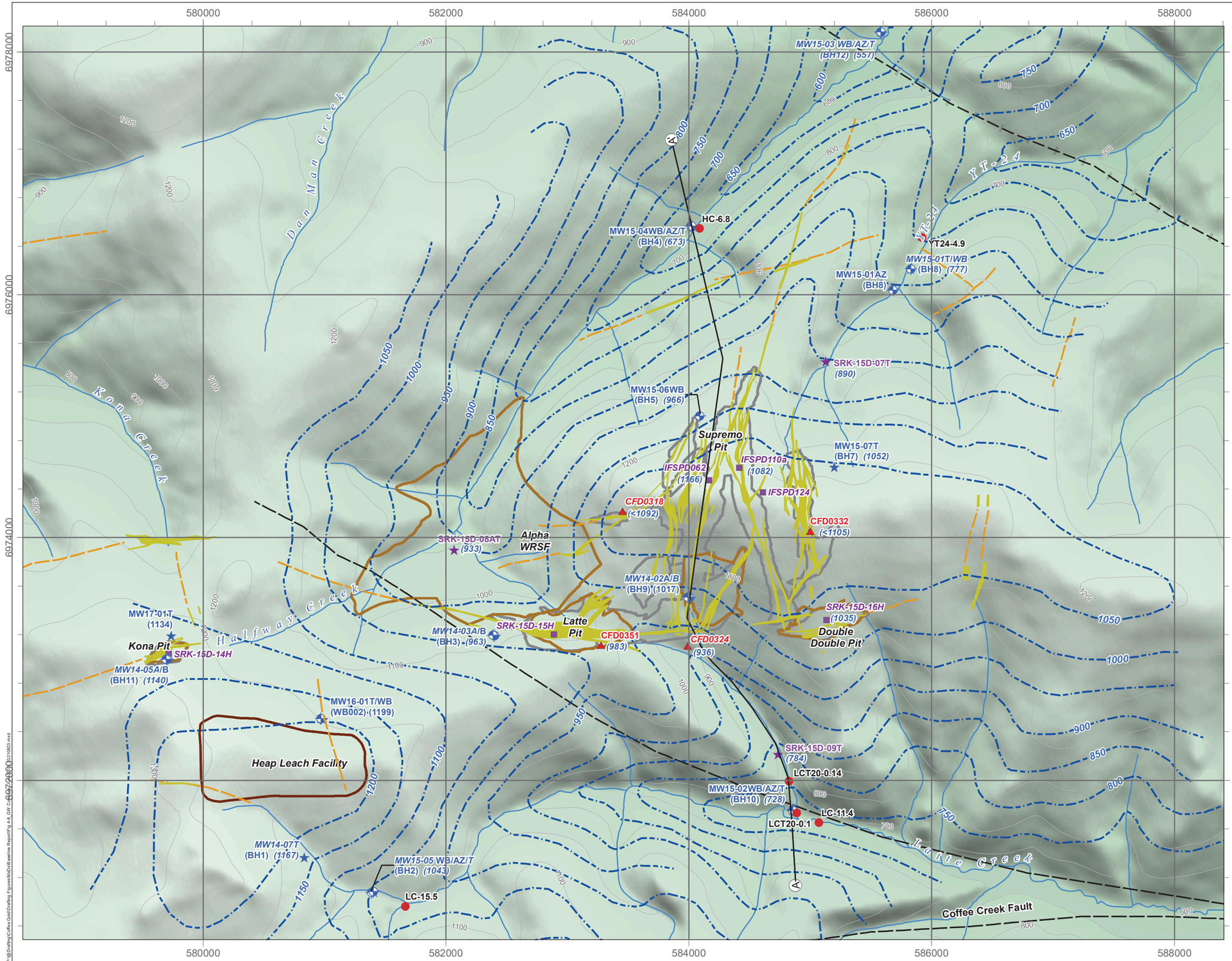
Table 5-3 Median Bedrock Hydraulic Conductivity

Bedrock Unit	Median K (m/s)
Structures & Valley Traces	2E-07
0-100 m deep	7E-08
100-150 m deep	5E-08
150-200 m deep	4E-09
200-250 m deep	7E-09
250-300 m deep	3E-10
Frozen (0-30 m deep)	2E-08

5.4 Water Levels and Gradients

Groundwater sampling was conducted on nineteen occasions between 2014 and 2019 (see Table 5-2). Sampling was conducted at monitoring wells installed by Lorax between 2014 and 2016 and covers the period from September 2014 to August 2019. Data from these sampling events are included in the evaluation of groundwater quality, although several results were discounted due to potential influences from drilling and well installation artifacts. Bedrock water levels measured in June 2018 are presented in Figure 5-3. More details on the magnitude of seasonal water level fluctuations, vertical and horizontal hydraulic gradients measured can be found in Appendix D.

Water levels are highly variable across the site with the deepest water levels (from 130 to over 220 metres below ground surface) measured in ridge areas and flowing artesian conditions often measured in the drainages. However, the presence of permafrost and faults/structures can create unexpected hydrogeological conditions. For instance, artesian water levels are measured near the height of land in the Halfway Creek drainage while downward hydraulic gradients are observed near Latte Creek. The transient water level data show distinct responses to seasonal recharge. The first type is a broad sinusoidal response to seasonal recharge with a single water level maximum per annum. The maxima appear as smooth to slightly sharp peaks in the hydrograph record. Seasonal maxima and minima may vary annually in both magnitude and timing on account of the variable climate.



LEGEND

(1082) Static water level elevation (m asl) June, 2018 except the water level elevations for packer test locations by SRK (2015) are from June/July 2015.

- Surface WQ Monitoring Stations
- Surface and Hydrology Monitoring Stations
- Monitoring Well — *AZ = active zone, WB = Westbay, A = deep conventional (200+m), B = shallow coventional (150+m), T = thermistor/VWP, BH = original drill pad name*
- Thermistor/VWP (Lorax 2014-2017)
- Thermistor/VWP (SRK 2015)
- Vibrating Wire Piezometer (VWP) (EBA 2013)
- Packer Tests (SRK 2015)
- Cross-Section Trace
- Inferred Groundwater Equipotentials
- Linament (Huscroft, 2002)
- Fault (Approximate) (Grodzicki et. al, 2015).
- Drilled Structure
- Inferred Structure

Proposed Infrastructure

- WRSF/Backfill
- Open Pit
- Heap Leach Pad Base

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:30,000

0 500 1,000 Meters

DATE SAVED:	Aug 26, 2021
DRAWN BY:	GM/AL
REVIEWED:	LF
VERSION:	1

CLIENT:

Newmont™ COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE: Hydrogeological Monitoring Network and June 2018 Bedrock Groundwater Head Contours

PROJECT #: A362-4 *FIGURE:* 5-3

Path: P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Baseline Report\Fig 4-8_GW Contours_June2018_20210823.mxd

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Table 5-4 Median Bedrock Hydraulic Conductivity

Mine Area	Permafrost Depth (vmbgs)	Monitoring Depth (vmbgs)[1]	Water Level			Water Level Fluctuation (m)[2]		
			Date	mbgs	masl	2015	2016	2017
South Supremo	34.0	188.2		11.9	1017.7	13.0		
South Supremo	34.0	146.6		21.4	1009.6	12.2		
Latte	62 ≤ x ≤ 133	191.3		137.8	959.8	5.4		
Latte	62 ≤ x ≤ 133	145.7		135.3	959.8	5.4		
Kona	<134	206.4		132.3	1136.2	0.5		
Kona	<134	171.0		134.1	1136.2	0.5		
North Supremo	70	3.4		dry	n/a	n/a		
Double Double	None	5.6		6.1	731.2	-0.9		
Alpha WRSF	10 ≤ x ≤ 20	3.3		1.6	556.3	0.0		
Alpha WRSF	10 ≤ x ≤ 20	3.7		dry	n/a	n/a		
Heap Leach	47	3.2						
Heap Leach	140.0	124.4		-8.0	1164.2	1.3		
North Supremo	70.0	76.0		37.4	766.6	4.8		
		89.1						
Double Double	Not present	33.9		10.3	726.8	1.3		
Alpha WRSF	10 ≤ x ≤ 20	48.8		0.0	557.0	-0.9		
		94.7						
Alpha WRSF	31	38.8						
		51.6		-0.6	670.9	2.7		
Heap Leach	47	55.4		24.3	1042.7	0.8		
		81.4						
Supremo	140	239.0						
		267.8		136.8	1046.4	10.7		
Heap Leach	67	97.5						
		131.5						
Kona	98	170.9						
		200.9						
North Supremo	85.0	103.6						
		149.2		50.5	898.4	0.0		
Alpha WRSF	75	103.6						
		149.2		-2.2	927.3	3.9		

Mine Area	Permafrost Depth (vmbgs)	Monitoring Depth (vmbgs)[1]	Water Level			Water Level Fluctuation (m)[2]		
			Date	mbgs	masl	2015	2016	2017
Double Double		99.7		1.4	782.9	3.3		
Sumatra	NM	118.0		118.0	1092.0	28.0		
Supremo	NM	178.3		61.3	931.6	5.0		
Supremo	NM	116.6		dry	n/a	n/a		
Latte	NM	184.4		155.9	967.8	32.0		

Note: masl – metres above sea level, vmbgs – vertical metres below ground surface, n/a – not applicable, NM – not measured

1.VWP sensor depth or midpoint of conventional monitoring well slotted interval.

2. Difference measured between first minimum of year and subsequent maximum (can fall in subsequent year).

5.4.1 Halfway Creek

There are several installations located within the Halfway Creek catchment. Water level time series for higher elevations stations are MW14-05A/B, MW17-01T, MW16- 01T and MW14-03A/B while lower elevation installations are SRK15D-08AT, MW15-04T, MW15-03T. In 2019, hydrometric and surface water quality monitoring stations underwent a name change. Current station names are referenced, followed by the former station name in parentheses. Groundwater level hydrographs measured in Halfway Creek catchment for each station and its results can be found in Appendix D.

A combination of water level responses is displayed at stations near the proposed Kona pit (MW14-05A/B, MW17-01T) and HLF footprint (MW16-01T). Water levels at MW14-05A/B track closely together and have continuously climbed between 2015 and 2019, gaining several meters over this period. A very subdued seasonal fluctuation is observed in the trend, but annual minima and maxima are difficult to extract given the overwhelming increasing trend. Vertical gradients are minimal.

5.4.2 YT24-0.1

Groundwater is well-confined along the upper reaches of the YT24-0.1 drainage. Thermal data collected from these instruments indicates that groundwater is confined by permafrost in this drainage, with higher confining pressures experienced farther downstream. The groundwater level hydrographs are distinct at each of the installations. The installation at MW15-07T, at the headwaters of YT-24, has two deep water level sensors at 239 m bgs and 267.8 m bgs. Permafrost depth is between 140 to 150 m and confines water levels that range between 120 m bgs and 138 m bgs. The water level hydrographs are broadly sinusoidal, with annual maxima occurring in November or December and annual minima occurring in June or July. Upward hydraulic gradients (<5%) were measured at this station prior to 2017 but have remained consistently downward since then. The hydrograph clearly demonstrates the below average recharge in 2017.

5.4.3 Latte Creek Tributary

The Latte Creek Tributary drainage is instrumented in its upper reaches with a conventional monitoring well pair (MW14-02A/B) on the north fork and VWP CFD0351 on the west fork. Both locations demonstrate a strong response to seasonal recharge. Seasonal water level fluctuations measured at CFD0351 have exceeded 30 metres and are the largest recorded across the site. The water level hydrograph is broadly

sinusoidal with seasonal maxima occurring in September or October. CFD0351 is not equipped with a thermistor string and permafrost conditions are not constrained. The current permafrost map has it located on the margin, but outside of permafrost coverage. Water levels at the single VWP sensor range from 111 m bgs to 153.5 m bgs. Groundwater level hydrographs measured in Latte Creek tributary drainage at each station and its results can be found in Appendix D.

5.4.4 Latte Creek

There are three hydrogeological installations along Latte Creek (Figure 5-1). The highest elevation station, MW14-07T, was established in September 2014. The thermistor string installed in this hole indicates a permafrost depth of approximately 60 metres. The water level recorded at the single VWP is flowing artesian and consistently several metres above ground. While there have been interruptions in data collection at this station, the record indicates that annual maxima occur in the early fall. Groundwater level hydrographs measured in Latte Creek catchment at each station and its results can be found in Appendix D.

5.4.5 Baseflow

Characterization of the baseflow regime at the Project presents numerous challenges. Accurate measurement of winter streamflow is challenging in drainages at the site on account of extensive icing that forms in local channels over the winter months. This icing, sometimes termed aufeis, is the result of shallow groundwater discharge and/or baseflow in the stream channel freezing. This ice impedes subsequent flow, which is forced on top of the existing ice cover, where it freezes. This process repeats continuously throughout the winter, and results in laminated ice layers that have been measured close to 1.5 m in thickness and greater than 50 m in width in channels at the Project.

5.5 Groundwater Quality

Groundwater in the Project area is predominantly circum-neutral (pH 6 to 8), with most groundwater samples between pH 6.5 and 8. Groundwater quality shows variable influence from weathering of sulphide minerals and/or dissolution of sulphate minerals, either from the deposits or other disseminated mineralization across the Project area. Sulphate concentrations range from low to substantial (7 to 1,120 mg/L) and salinity is variable (field specific conductance readings between 28 and 2390 µS/cm).

Major ion chemistry in overburden wells is calcium-bicarbonate-type. The bedrock groundwater in gneiss has a major ion chemical signature which ranges widely from calcium-bicarbonate to mixed magnesium-calcium-sodium-sulphate-type water, reflecting variable influence of sulphide weathering. Groundwater in the granite is calcium-bicarbonate-type but is generally more sodic than other groundwater on site. The groundwater sampled from the hydrothermal breccia and schist tends to be calcium-bicarbonate to magnesium-sulphate-type.

Baseline groundwater quality in the Project area is characterized by the presence of elevated dissolved arsenic and uranium. Dissolved arsenic and uranium concentrations were generally highest in the bedrock groundwater, ranging from 0.12 to 2650 µg/L and 1.2 to 589 µg/L, respectively.

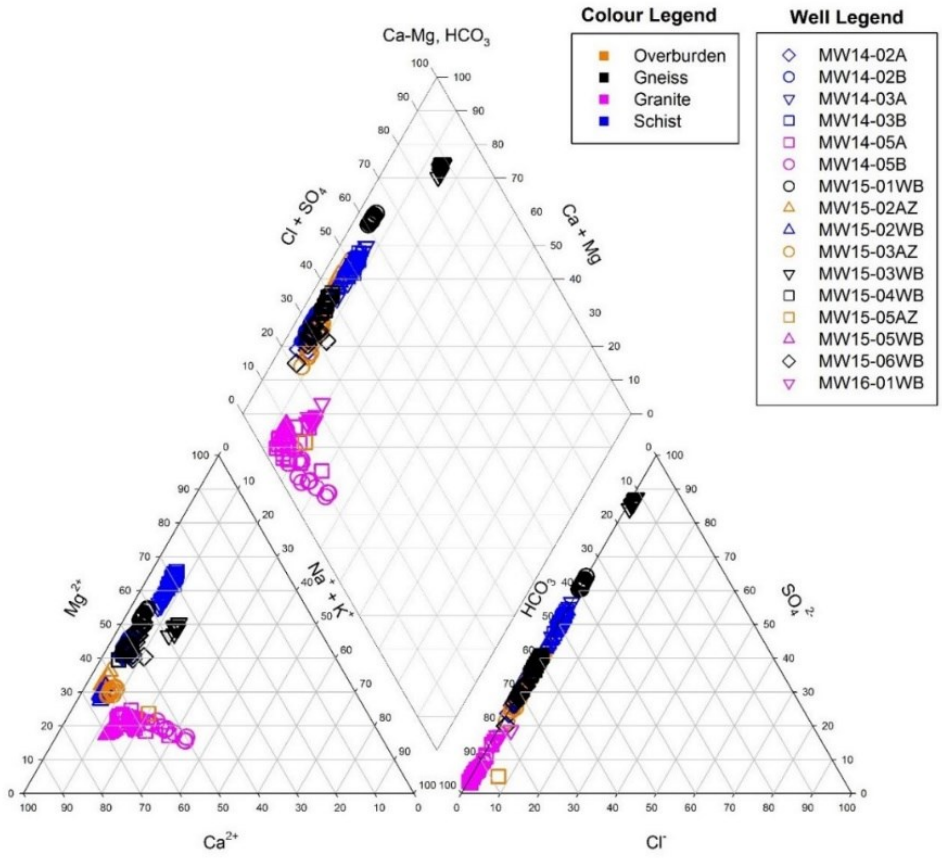

Figure 5-4 Piper Plot of Groundwater Quality Data (2014 and 2019)

5.5.1 Trace Elements

This section presents a review of trace element concentrations across the Project site. Selected dissolved metal parameters of concern (arsenic (As), antimony (Sb), cadmium (Cd), cobalt (Co), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), selenium (Se), uranium (U) and zinc (Zn)) are discussed in this section. These parameters were selected based on geochemical test results and potential for complexation with cyanide. Dissolved metals are presented and discussed since guidelines, standards and regulations generally apply to dissolved substance concentrations for inorganics in groundwater.

- Overburden groundwater samples were generally characterized by low TSS with concentrations close to or below the method detection limit (MDL) of 1.0 mg/L.
- TSS levels in bedrock groundwater samples were generally higher, ranging from below MDL to 64 mg/L. Dissolved arsenic was measured in all groundwater samples.
- Concentrations of dissolved arsenic were generally lowest in overburden groundwater (0.43 to 2.3 µg/L) and higher in bedrock groundwater (0.27 to 1860 µg/L). The highest concentrations of dissolved arsenic were in granite (1480 to 1860 µg/L).
- Concentrations of dissolved antimony were generally below 1 µg/L in overburden and bedrock groundwater. Dissolved antimony was highest in schist (3.3 to 6.6 µg/L).

- Dissolved cadmium measured in overburden and bedrock groundwater was predominantly in the 0.006 to 0.06 µg/L range. Dissolved cadmium concentrations in overburden were quite variable (<0.005 to 0.125 µg/L), while concentrations in gneiss were more consistent (0.04 to 0.01 µg/L).
- Dissolved cobalt concentrations were generally higher in bedrock groundwater than in overburden groundwater. Concentrations of dissolved cobalt were highest in schist (6.1 to 7.6 µg/L). Dissolved cobalt concentrations in overburden groundwater were generally below 0.25 µg/L.
- Concentrations of dissolved copper was generally highest in overburden groundwater (0.95 to 2.0 µg/L). Concentrations in bedrock groundwater ranged from below MDL (0.05 µg/L) to 2.5 µg/L.
- Dissolved lead concentrations were low in the overburden and bedrock groundwater. Concentrations were lowest in the overburden (<0.005 to 0.033 µg/L) and more variable in bedrock, ranging from below MDL (0.005 µg/L) to 0.34 µg/L.
- Dissolved mercury concentrations were below MDL in the majority of overburden and bedrock groundwater samples. All wells with measurable dissolved mercury were characterized by concentrations <0.01 µg/L, in gneiss (0.02 to 0.10 µg/L) where the highest concentrations were detected.
- Concentrations of dissolved nickel in groundwater were generally below 5 µg/L. Dissolved nickel concentrations were highest and most variable in schist (17 to 22 µg/L).
- Dissolved selenium was generally low in overburden and bedrock groundwater, with concentrations ranging from below MDL (0.04 µg/L) to 0.5 µg/L. The highest Se concentration of any overburden or bedrock well was recorded as 1.1 µg/L.
- Concentrations of dissolved uranium were consistently elevated (>15 µg/L) at most wells. Dissolved uranium concentrations were highest in gneiss (530 to 589 µg/L). Dissolved uranium levels were lowest in the overburden groundwater (0.90 to 35 µg/L).
- Dissolved zinc was consistently measured across the Project area with higher and more variable concentrations measured in the bedrock. Dissolved zinc levels were lowest in the overburden and bedrock groundwater with concentrations ranging between 0.27 and 16.5 µg/L. In contrast, groundwater concentrations in gneiss ranged between 4.9 and 253 µg/L.

5.5.2 Isotopes

Groundwater, surface water and aufeis samples were collected from the Project area between 2014 and 2019 for the analysis of stable isotopes (2 H, 18O, 13C) and radioisotopes (3 H, 14C) (Table 3-7). Water stable isotopes of hydrogen (2 H) and oxygen (18O) are used to assess groundwater sources and recharge history, while the radioisotopes tritium (3 H) and radiocarbon (14C) are used to estimate groundwater age (i.e., mean residence time), which is an indication of how long water is circulating within a groundwater system. A summary of the key findings is presented herein, with a detailed discussion of the isotopic data and results provided in Appendix D.

5.6 Influence of Permafrost on Groundwater Regime

Permafrost is an important consideration in the conceptualization groundwater systems as it imparts controls on groundwater movement. When ground temperatures fall below the freezing point, the hydraulic conductivity sharply decreases as unfrozen water content drops and pores and cracks are increasingly filled with ice (Woo 2012). Permafrost is considered to behave like an aquiclude (impermeable layer) or an aquitard (semi-permeable layer) and can confine sub-permafrost groundwater such that it exhibits artesian

conditions (Woo 2012). Active groundwater circulation can occur above (supra), within (intra) and beneath (sub) permafrost.

The Project is located in an area classified as extensive discontinuous permafrost with low to medium ice content (NRCan 1995). Extensive discontinuous permafrost is defined as 50% to 90% of the land area underlain by permafrost, while low to medium ice content is defined as less than 10% to 20% by volume of visible ice content. Recharge of sub-permafrost groundwater in discontinuous regions can be directly from adjacent non-permafrost uplands or through supra and intra-permafrost connections (Woo 2012).

Overall, permafrost is widespread across the Project site. It extends to greatest depths in ridge areas and appears to thin towards areas of lower elevation; north facing slopes tend to have thicker permafrost than south-facing slopes. The only drilling locations where permafrost was absent were the two instruments established in the lower reaches of the Alpha WRSF drainage. The thickest permafrost (approximately 165 m) is encountered near the north end of the proposed Supremo Pit. Permafrost in the Project area is relatively warm (between 0 and -2°C) and is coolest (-1.4°C to -1.9°C) on north-facing slopes.

5.7 Hydrogeological Field Investigation

Multiple hydrogeological field programs have been undertaken at the Project between 2013 and 2019 (Table 4-1). The field programs have established a robust network of hydrogeological installations in, adjacent to and downstream of proposed major mine facilities (Figure 5-5). The location and configuration of some mine facilities (e.g., Heap Leach Facility (HLF), WRSF) has evolved since hydrogeological field investigations were initiated, with the mine plan layout shown in Figure 5-5 current to date.

The groundwater field installations are as summarized as follows:

- Eleven conventional monitoring wells (five wells less than 10 meters deep; six wells between 150 and 220 metres deep).
- Seven individual multi-port Westbay installations monitoring groundwater 10 to 286 metres deep.
- Twenty-six stand-alone thermistor strings, 14 multi-bead thermistors strings ranging from 20 to 300 metres deep and 26 single bead shallow thermistor strings installed between 4 and 10 metres deep.
- Four stand-alone VWP installations ranging from 120 to 185 metres deep.
- Twelve combination VWP/thermistor installations ranging from 52 to 268 metres deep.

Completion details of the conventional monitoring wells, Westbay systems, VWP and thermistor are provided in Coffee Gold Baseline Hydrogeological Assessment 2019 Update. Borehole logs and instrumentation documentation are provided in Appendix D.

Many of the drilling programs have incorporated hydraulic testing of bedrock, predominantly through a combination of packer testing and airlift testing. Limited slug testing has also been conducted. In conjunction with monitoring well installations, multiple groundwater sampling events have been undertaken to characterize baseline groundwater quality and its range of variability. The discussion below provides a high-level overview of the field programs with emphasis on those conducted by Lorax.

580,000 582,500 585,000 587,500

6,977,500 6,975,000 6,972,500

N

Dan Man Creek

Halfway Creek

YT-24

Kona Creek

Late Creek

Coffee Creek Fault

MW15-03 WB/AZ/T (BH12)

MW15-04WB/AZ/T (BH4)

HC-6.8

YT24-4.9

MW15-01AZ (BH8)

MW15-01T/WB (BH8)

KT-5.2

GT17-35

GT17-34T

GT17-37T

GT17-33

GT17-36T

SRK-15D-07T

MW15-06WB (BH5)

MW14-01A/B

MW14-04T (BH6)

GT-14

CFD0402

Supremo Pit

GT17-39T

MW15-07T (BH7)

IFSPD062

IFSPD110a

CFD0334

CFD0439

MW14-06A/B

CFD0336

IFSPD124

CFD0318

CFD0319

CFD0332

GT17-41

GT17-26T

GT17-27

GT17-40B

SRK-15D-08AT

GT17-31

GT17-32

CFD0323

GT17-40

Alpha WRSF

GT17-28T

MW14-02A/B (BH9)

CFD0327

SRK-15D-10T

GT17-30

SRK-15D-16H

MW17-01T

GT17-02

GT-63

GT-66

SRK-15D-15H

Latte Pit

CFD0324

Double Double Pit

Kona Pit

SRK-15D-14H

MW14-03A/B (BH3)

CFD0351

SRK-15D-13T

MW14-05A/B (BH11)

GT17-03

GT17-21

Soil Stockpile

GT17-16

GT17-19

GT17-22

GT17-06

GT17-10T

MW16-01T/WB

GT17-20

GT17-17

GT17-11

GT17-15

GT17-06B

GT17-08

Heap Leach Facility

Event Pond

GT17-14

SRK-15D-09T

GT17-12

LCT20-0.14

MW15-02WB/AZ/T (BH10)

GT17-07

LC-11.4

LCT20-0.1

MW14-07T (BH1)

KPBH1

MW15-05 WB/AZ/T (BH2)

LC-15.5

KPBH4

LEGEND

- Surface WQ Monitoring Stations
- Surface and Hydrology Monitoring Stations
- Monitoring Well (AZ = active zone, WB = Westbay, A = deep conventional (200+m), B = shallow coventional (150+m), T = thermistor/VWP, BH = original drillpad name)
- Monitoring Well (collapsed)
- Thermistor (Lorax 2014)
- Thermistor (KP 2014)
- Thermistor (SRK 2015)
- Thermistor (TT/SRK, 2016,2017,2020)
- Thermistor/VWP (Lorax 2015,2016,2017)
- Thermistor/VWP (SRK 2015)
- Vibrating Wire Piezometer (VWP) (EBA 2013)
- Packer Tests (EBA 2013)
- Packer/Slug Tests (Lorax 2014)
- Packer Tests (SRK 2015)
- Drilled Mineralized Structure
- Inferred Mineralized Structure
- Linament (Huscroft, 2002)
- Fault (Approximate) (Grodzicki et. al, 2015).

Proposed Infrastructure

- WRSF/Backfill
- Pit
- Heap Leach Pad Base
- Event Pond
- Stockpile Pad
- Soil Stockpile

Italics in name indicates location was hydraulic tested (packer or airlift)

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

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DATE SAVED:	Feb 03, 2021
DRAWN BY:	GM/AL
REVIEWED:	LF
VERSION:	1

CLIENT:

Newmont COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE:

Coffee Mine General Arrangement and Hydrogeological Monitoring Network

PROJECT #: A362-4 *FIGURE:* 5-5

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Baseline Report\Fig 1-2_monitoring network_20210201.mxd

5.7.1 Previous Groundwater Studies

5.7.2 *Groundwater Sampling*

All monitoring wells were developed after installation and prior to groundwater sampling. Well development was conducted using several methods, including purging with a bailer- winch system, inertial pump actuated with a Hydrolift-II, Westbay sampler, and air-lift pumping. The available well development method(s) depended on the type of well installation and depth to groundwater. Details regarding the development of MW14-series (completed in 2014), MW15-series wells (completed in 2015), and MW16-01WB (completed in 2016) are described in Lorax (2017c).

Groundwater monitoring events were conducted in September/October 2014, and four times annually since 2015, except in 2016 and 2019 when three monitoring events were completed. The groundwater monitoring events have been conducted between April and October annually ; this modified quarterly sampling frequency is often employed in the Yukon to capture the range of seasonal variability accounting for extended winters and compressed spring/summer/fall seasons.

All new monitoring wells installed between 2014 and 2016 have been sampled for groundwater quality with the exception of MW14-06A, MW14-06B, MW15-01AZ, and MW15-04 AZ which could not be sampled due to damage or water limitations (e.g., frozen or dry) (Table 5-2). Table 5-2 presents a summary of the groundwater sampling programs between 2014 and 2019, including sampling methods used at each monitoring well.

Groundwater sampling was conducted in accordance with methods outlined in the BC Field Sampling Manual (BC MOE, 2013). Sampling was conducted using several different types of pumps. The pump employed at each well depended on the type of well installation, permeability of the geological unit being sampled, and depth to groundwater. Inertial pumps actuated with a Hydrolift-II mechanical actuator and peristaltic pumps were used to sample monitoring wells screened in permeable formations. Bladder pumps were used to collect groundwater samples from deep wells screened in low permeability bedrock which would not permit sampling with conventional methods (*e.g.,* inertial pump), while the Westbay sampler was necessarily used to collect groundwater samples from the Westbay installations. In general, low-flow sampling methods were employed, and groundwater samples were collected after water levels in monitoring wells and purge water field parameters had stabilized. Field parameters were continuously monitored with a multi- parameter probe (YSI 556 MPS or YSI Professional Plus) coupled to an in-line flow- through cell during groundwater purging. Field parameters were monitored to ensure collection of representative samples and to provide reliable field-based estimates of temperature, pH, specific conductance (SC), dissolved oxygen (DO), and oxidation- reduction potential (ORP).

De-icing was required at monitoring wells MW14-02A and MW14-02B prior to groundwater sampling. Artesian conditions at both wells resulted in the top of the water column freezing inside the well casing installed through permafrost. De-icing was conducted with a hot water pressure washer equipped with high-pressure hoses and a drain jetting nozzle. Groundwater sampling was conducted after the volume of injected de-icing water plus a minimum of one well volume had been purged and purge water field parameters had stabilized.

Low water levels and low yields at monitoring well MW14-05B challenged the equipment capabilities and sampling procedures. Consequently, a modified purging/sampling procedure was employed to obtain the

most representative formation groundwater at MW14-05B. The water level was drawn down to the lowest possible level (pump elevation) to maximize the amount of purged groundwater. The well was then allowed to recover overnight prior to sampling the next day, to ensure the greatest displacement and the largest buffer between 'new' formation water and 'old' residual standing water.

Since Westbay sample zones are isolated (i.e., not in direct contact) from atmospheric conditions, collecting representative groundwater samples does not require the use of typical sampling methods whereby large volumes of water are purged. Westbay installations MW15-01WB to MW15-06WB were sampled after completion of well development and purging in June 2015, while MW16-01WB was sampled after completion of development in October 2016. Additional well development was conducted at MW15-06WB in July and August 2015 due to the suspected presence of drilling additives observed during sampling in June 2015. Subsequent groundwater sampling of all Westbay installations was conducted after purging a minimum of 4 L. Additional detail regarding groundwater sampling methods is included in Lorax (2017c).

The data record at MW15-03WB consists of samples collected from Port 6 (~47 m bgs) between June 2015 and May 2016, while subsequent sampling was completed at Port 4 (~82 m) between July 2016 and August 2019 due to a transcription error. However, both sampling depths intersect similar geology (i.e., mixed mafic gneiss and mixed felsic gneiss) and a strong upward hydraulic gradient was measured by MW15-03T between VWP sensors at 95 and 49 m bgs. The groundwater quality results corresponding to the two sampling depths indicate that there is no apparent difference in major ion compositions, and concentrations of field parameters, redox parameters, trace element parameters, and stable isotopes.

Groundwater samples were collected and preserved in the field with the appropriate laboratory supplied bottles and preservatives, with the exception of select dissolved samples collected in 2015 which were not preserved in the field when filtered at the lab. Samples analyzed for dissolved parameters were filtered in the field with disposable in- line 0.45-micron filters, except for groundwater samples collected from Westbay installations in 2015 which were filtered in the lab. Quality control sampling was conducted in the field and included the collection of field blank, trip blank, and field replicate samples. After collection, samples were kept cool in the field and during shipping until delivery to the laboratory. Groundwater samples were submitted for chemical analysis to the ALS Environmental (ALS) laboratory in Burnaby, BC in 2014, and to the Maxxam Analytics (Maxxam) laboratory in Burnaby, BC in 2015. In 2016, groundwater samples were submitted to Maxxam for all analyses, except cyanide species analyses which were completed by ALS. Since 2017, samples have been submitted to Maxxam (later becoming Bureau Veritas) for all analyses. Groundwater samples were analyzed for physical parameters, anions, nutrients, organic and inorganic carbon, total and dissolved metals, and cyanide species. Groundwater quality parameters and the corresponding detection limits are presented in Table 3-6.

6.0 FISH AND AQUATIC RESOURCES

Fisheries and aquatic baseline studies (Appendix E) for the Project were conducted from 2013 to 2016; some additional information is available from data collected for other projects prior to 2013. Additional fish and aquatic resource studies (Appendix F) were conducted in 2017 2018, 2019, 2020 and 2021. Studies undertaken to date have included the compilation of existing information, fish habitat assessments, and sampling for fish (summer, fall and winter), environmental DNA (eDNA), benthic invertebrates, periphyton and stream sediments.

6.1 Fish and Aquatic Habitat Study Areas

The study area for Fish and Aquatic studies included a large area around the proposed mine site and NAR. For the YESAB submission, the Local Assessment Area (LAA) was 527 km^2 and includes the area around the Mine Site, including portions of the Yukon River, Coffee, Latte, Halfway, and YT-24 creeks, and a 214-km long corridor along the NAR (Figure 6-1).

The Mine Site Assessment Area includes 17 km of the Yukon River as well as tributaries of the Yukon River comprised of four watersheds (Figure 6-1). These include:

- Coffee Creek
- Latte Creek, which flows into Coffee Creek
- Halfway Creek
- YT-24 Creek.

Other watersheds that have been sampled in the general area and may serve as future reference sites include:

- Coffee Creek, upstream of Latte
- Independence Creek immediately to the west
- Carlisle Creek, to the west of Independence
- SYT, a small unnamed stream to the southeast of YT24
- Dan Man Creek
- Los Angeles Creek (downstream reference) watershed located 27 km to the northwest
- Isaac Creek (upstream reference) watershed located 43 km to the southeast
- Excelsior Creek (east of Coffee Creek).

COFFEE GOLD MINE

Fish and Aquatic Habitat Local Assessment Area



Legend

- City/Town
- Highway
- Northern Access Route (Existing)
- Northern Access Route (New)
- Mine Road
- Project Footprint
- Local Assessment Area Boundary

Notes

1. Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.
2. Digital Elevation Models provided by Geomatics Yukon.
3. Project data displayed is site specific.
4. This document is not an official land survey and the spatial data presented is subject to change.
5. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

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Kilometres

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 6-1	Date: Jan 28, 2019	Drawn by: MP/HG	Reviewed: AM/PT

Newmont COFFEE

Baseline fish and aquatic resources studies were conducted from 2013 to 2016 in watersheds associated with the proposed Mine Site, and in 2015, 2016 and 2019 for the proposed NAR. Baseline studies include 18 fish sampling sites; 17 fish habitat sites; and 12 benthic invertebrate, periphyton and sediment sites (Table 6-1). Additional studies were conducted in 2017, 2018, 2019, 2020, and 2021 to add to the baseline and provide additional pre-project monitoring data for future comparisons.

The preliminary baseline study (2013) focused on describing the fish habitat near the proposed Mine Site and documenting potential salmon spawning and the distribution of fish species within the tributary streams of the Yukon River. Sampling included:

- minnow trapping in the tributary streams and collection of standard insitu water quality data (temperature, dissolved oxygen, pH and specific conductivity).
- aerial salmon spawning surveys via helicopter to document any chinook salmon and chum salmon spawning in the Yukon River in the vicinity of the Project.

The 2014 baseline study (Table 6-1) expanded on the previous year's survey:

- August: fish communities
- August: fish habitat; benthic invertebrate; periphyton; and sediment data; and
- October: additional fish community data.

The 2015 surveys (Table 6-1) included:

- March: a winter fish habitat survey
- June: spring fish and fish habitat data
- July and August: summer fish community, fish habitat, benthic invertebrate, periphyton, and sediment data
- September: additional fish and fish habitat data.

The 2016 surveys (Table 6-1) included:

- March: Fish and fish habitat sampling including eDNA
- March and August: benthic invertebrate sampling
- March, July, and August: fish habitat investigations and fish sampling
- August: chlorophyll-a sampling
- August: spawning surveys for chinook salmon on Independence and Coffee Creeks
- August: stream gradient modelling and analysis for small streams within the Mine Site
- July: fish and fish habitat investigations at stream crossings along the NAR
- July: fish sampling and habitat characterization at proposed barge landings and the Stewart River back channel
- October: spawning surveys for chum salmon in the Yukon and Stewart River channels.

The 2017 surveys (Table 6-1) included:

- March, August and October: environmental DNA (eDNA)
- August: fish sampling

- August: fish and fish habitat investigations (Halfway Creek)
- August: drainage assessments for headwater tributaries in the mine footprint
- July and August: spawning surveys for Chinook salmon
- August: fish tissue sampling for metals
- August: benthic invertebrate and periphyton tissue sampling for metals
- August: Canadian Aquatic Biomonitoring Network (CABIN) invertebrate sampling
- August: periphyton sampling and analysis for chlorophyll-a and ash free dry mass
- August: sediment sampling for metals.

The 2018 surveys (Table 6-1) included:

- July: fish sampling
- July: Chinook salmon aerial spawning survey (Coffee and Independence Creeks)
- July: Yukon and Stewart River back channel investigation fish sampling
- August: fish sampling
- August: Chinook salmon aerial spawning survey (Coffee and Independence Creeks)
- August; Yukon River back channel investigation fish sampling
- August: Hess invertebrate sampling
- August: environmental DNA (eDNA) sampling
- August: Fish Habitat Assessment Procedure surveys (Halfway, YT-24, and Latte creeks)
- October: Yukon and Stewart rivers Chum salmon spawning survey.

The 2019 surveys (Table 6-1) included:

- May: fish sampling
- May: fish habitat investigations in a back channel of the Stewart River
- July: fish sampling
- July: Chinook salmon aerial spawning survey (Coffee Creeks)
- July: fish sampling on various creeks in the mine site area (MSA), and within mixing zones of the Yukon River
- July: barge landing fish sampling and investigations
- August: fish sampling
- August: Chinook salmon aerial spawning survey (Coffee Creeks)
- August: Fish Habitat Assessment
- August: fish sampling on various creeks in the MSA, and within mixing zones of the Yukon River.

The 2020 surveys (Table 6-1) included:

- June: Stewart River back-channel investigation
- August: Stewart River back-channel investigation and baseline fish and fish habitat data collection

The 2021 surveys (Table 6-1) included:

- August: fish sampling (Halfway Creek)
- September: fish sampling (Halfway Creek).

Table 6-1 Fish and Aquatic Resources Baseline Program Sampling Locations

Watershed	Creek Name	Site ID	Year(s)[1]	Sample Collection Types*[2]	Description
Mine Site					
Coffee Creek	Latte Creek	LC13.7	2014-2015	MT, H, EF	Upper watershed
		LC12.3	2014-2015	MT, H, BI, P, S	Upper watershed
		LC11.7	2014-2017	EF, H, BI, P, S, eDNA, AV	Upper watershed
		LC11.3	2018	FHAP	Upper watershed
		LC3.5	2014-2015, 2017	FN, H, P, EF, MT, S, BI	Middle Latte Creek
		LC0.5	2013-2017	FN, H, EF, MT, eDNA	Just upstream of Coffee Creek mainstem
	Coffee Creek	CC13.5	2017	eDNA, BI, P, S	Mainstream Coffee Creek upstream of Latte Creek
		CC13.0	2017	eDNA	Mainstem Coffee Creek just downstream of Latte Creek
		CC12.9	2013-2017	MT, EF, FN, H, AG, BI, P, S, eDNA, AV	Mainstem Coffee Creek just downstream of Latte Creek
		C9.9	2014-2016	MT, H, A, FN, eDNA, AV	Mainstem Coffee Creek
		CC5.6	2014-2018	MT, EF, FN, AG, H, BI, P, S, eDNA, AV, BS	Mainstem Coffee Creek
		CC3.7	2017	eDNA	Mainstream Coffee Creek
		CC0.1	2017	eDNA	Just upstream of Yukon River
Halfway Creek	Halfway Creek (Cont'd)	HC9.9	2014-2015	MT, H, EF	Upper watershed
		HF6.8	2013, 2016-2018	MT, H, EF, eDNA, AV, P, S, BI	Upper watershed
		HF4.9	2017	EF	Mid watershed
		HC4.0	2017	eDNA, EF	Mid watershed
		HC2.3	2017	EF	Lower watershed
		HC2.2	2017,2018	eDNA, EF	Lower watershed
		HC1.7	2017	EF	Lower watershed
		HC1.1	2017, 2018,2019, 2021	eDNA, EF	Lower watershed
		HC1.0	2017	EF	Lower watershed

Watershed	Creek Name	Site ID	Year(s)[1]	Sample Collection Types*[2]	Description
Halfway Creek	Halfway Creek (Cont'd)	HC2.0	2021	EF	Lower watershed
		HC6.8	2021	EF	Lower watershed
		HC0.7	2017, 2018,2019, 2021	EF	Lower watershed
		HC0.5	2017	eDNA, EF	Lower watershed
		HC0.3	2017	EF	Lower watershed
		HC0.2	2014, 2015, 2017, 2018, 2019, 2021	EF, BI, P.S. eDNA	Lower watershed
		HC0.1	2017, 2018	eDNA, EF	Lower watershed
		HC0.0	2013-2016, 2018	EF, H, BI, P, S, eDNA, FHAP	Just upstream of Yukon River
YT24-0.1	YT24-0.1	YT5.3	2014-2015, 2017	MT, H, EF, P, S, BI	Upper watershed
		YT2.0	2017	eDNA	Mid watershed
		YT1.9	2017	EF	Mid watershed
		YT1.0	2017, 2018	eDNA, EF	Lower watershed
		YT0.6	2017, 2018	EF	Lower watershed
		YT0.2	2014, 2015,2017	BI, P, S	Lower watershed
		YT0.1	2017, 2018	eDNA	Lower watershed
		YT0.05	2017, 2018	EF, FHAP	Lower watershed
		YT0.0	2014-2015, 2017, 2018	MT, H, EF, BI, P, S	Just upstream up Yukon River
Stream south of TY24	SYT	SYT3.5	2017	BI	Mid watershed
		SYT0.6	2017	BI	Lower watershed
Independence Creek	Unnamed Tributary 2	IT2-0.6	2018	EF	Lower watershed
		IT2-0.2	2018	eDNA, EF	Lower watershed
	Kona Tributary	KT5.7	2014-2015	MT, H, EF, BI, P, S	Upper Kona Tributary
		KT4.0	2018	eDNA	Mid Kona Trubutary
		KT0.2	2018	eDNA	Lower watershed
		KT0.1	2013	MT, EF, H	Just upstream of confluence with mainstem Independence Creek
	Independence Creek	IC15.6	2018	EF	Upper watershed
		ID9.2	2014-2015	MT, EF, H, AG, BI, P, S	Mainstem upper Independence Creek
		ID20.6	2013-2018	MT, EF, H, BI, P, S, eDNA, AV	Mainstem lower Independence Creek
Dan Man Creek	Dan Man Creek	DM4.7	2017	BI	Upper watershed
		DM2.2	2018	eDNA	Mid watershed
		DM1.4	2017	BI	Lower watershed
		DM0.2	2018	eDNA	Lower watershed

Watershed	Creek Name	Site ID	Year(s)[1]	Sample Collection Types*[2]	Description
Excelsior Creek	Tributary of Excelsior Creek	ET6.0	2017	BI	Lower watershed
	Excelsior Creek	EC2.1	2017	BI	Lower watershed
Isaac Creek	Isaac Creek	IS0.1	2014-2015	MT, EF, H, BI, P, S	Reference site in Isaac Creek
Los Angeles Creek	Los Angeles Creek	LA8.5	2015, 2017	MT, EF, AG, H, BI, P, S	Reference site in Los Angeles Creek added in 2015.
Yukon River	Yukon River	YUK16.9	2017	eDNA	Yukon River downstream of LAA
		YUK27.311.0	2016-2017	eDNA	Yukon River downstream of Independence Creek
		YUK37.8	-2018	eDNA	Yukon River at Halfway Creek
		YUK38.4	2017	eDNA	Yukon River between Halfway Creek and YT24 Creek
		YUK39.0	2017,2018	BS	Yukon Ruver at YT24 Creek
		YUL53.9	2016	eDNA	Yukon River upstream of Coffee Creek
		YUK52.4	2016	eDNA	Yukon River at Ballarat Creek

Notes:

[1]For sites with multiple years, not all types of sampling listed have necessarily been completed in each year.
[2]Codes: BI = MT = Minnow Trapping, EF = Electrofishing, FN = Fyke Netting, AG = Angling, H = Fish Habitat Assessment, BI= Benthic Invertebrate, P = Periphyton, S = Sediment, UC = underwater camera, AV = aerial video, eDNA = environmental DNA, BS = Beach Sein Netting, HSC = Habitat Site Card investigation, HE = Habitat Evaluation, FHAP = Fish Habitat Assessment Procedure survey.

6.1.1 Fish and Aquatic Habitats Supplementary Study (2017-2022)

6.1.1.1 Fish and Aquatic Habitats Supplementary Study 2019

Fish sampling was conducted on several creeks and rivers within the MSA. Fish sampling occurred during two field events, spanning July 8 to 14 and August 7 to 13, 2019. The objective of fish sampling was to add to existing baseline fisheries information, particularly for fish distribution and assemblages in several select streams within the MSA. The fish sampling method used at each site depended on physical stream features and suitability of the method for the targeted species. The sampling methods used included electrofishing, beach seining, and minnow trapping. Captured fish were identified to species, with the remaining fish enumerated before all fish were released back at their site of capture.

Yukon River Mixing Zones

As suggested by the Selkirk First Nation, fish sampling was completed for the second year at the mixing zones of both Halfway and YT-24 creeks with the Yukon River. Sampling at the Halfway Creek mixing zone occurred on July 12 and August 9, and at YT-24 on July 14 and August 10, 2019. The mixing zone is defined as the immediate area where the creek flows into the Yukon River and the two water masses mix. Sampling involved three successive beach seine hauls, beginning in the Yukon River at the creek mouths and continuing downstream. During each sampling event, three seine hauls were completed, beginning at the mouth of the creek, and going progressively downstream on the Yukon River. Beach seine hauls were conducted with field crews of two members for a length of approximately 15 m, although lengths ranged depending on conditions and riverbed morphology (mean = 15.5 ± 1.5 m; range = 8 – 25 m). Fish captured were enumerated, and a subset of ten fish per species had their length and weight taken from each seine haul. Fish measurement metrics were summarized (fork length and weight, ± SE) for all species captured.

Fish Habitat Assessments

Fish habitat surveys were conducted on three drainages during July and August 2019 following the FHAP survey methodology. The FHAP survey documents the characteristics and frequency of different fish habitats by enumerating different habitat units (e.g., pool, riffle, glide), and measuring various parameters (e.g., average depth, width, length). A detailed methodology is outlined in the FHAP guide (Johnston and Slaney 1996). The length of habitat units was measured using a laser range finder for all creeks assessed, whereas wetted widths, bankfull widths, and depths were measured with a measuring tape and/or metre stick for the unnamed tributary upstream of YT-24 (herein referred to as ‘Unnamed Tributary’) and both Carlisle Creek sites; Coffee Creek used the range finder for wetted and bankfull widths due to its size. Results were considered as average ± standard error (SE).

Chinook Salmon Spawning Surveys

Chinook salmon spawning surveys were completed in areas where Traditional Knowledge indicated past presence (Tr’ondëk Hwëch’in 2012) and in watersheds that appear to have habitat to support spawning Chinook salmon; as such, Coffee Creek and Independence Creek have been investigated and surveyed for spawning Chinook salmon annually since 2014. During the 2019 field season, Coffee and Independence creeks had two aerial surveys completed. Coffee Creek investigations also included a ground survey (stream walk) to record any evidence of Chinook salmon spawning.

NAR Study Area

During the 2019 field season, fish sampling occurred at the proposed barge landings in the Yukon and Stewart rivers. Sampling was completed using a beach seine and several species were captured. Additional opportunistic barge wake investigations were completed to determine the impacts of the wave runout caused by the barge wake at the existing barge landings. The Stewart River back channel was also further investigated for the presence of spawning northern pike. Two adult northern pike were captured in the back channel in May when water levels were high.

6.1.1.2 Fish and Aquatic Habitats Supplementary Study 2020

The June 2020 water levels on the Stewart River were very high at the time (28.505 m) and there was flow through the back channel (WSC 2020). Due to the high-water and associated unwadable conditions, the

crew could not complete the planned fish sampling. In situ water quality measurements and field observations were collected, in situ measurements were collected using a YSI Pro Solo multimeter, Oakton pH Testr pen, and an Oakton T-100 turbidimeter.

The August 2020 water level in the Stewart River was still relatively high (27.493 m; WSC 2020), and the back channel was wetted for its entire length where it parallels the base of the hillside. There was no discernable flow in the back channel during sampling.

In situ water quality measurements were recorded using a YSI Pro Solo multimeter, an Oakton pH Testr pen, and an Oakton T-100 turbidimeter at some of the sampling locations along the length of the back channel. Orange-brown algae was present in the upper half of the back channel. In situ water quality reflected poor habitat conditions in the top half of the back channel (low dissolved oxygen) and conditions improved closer to the mouth of the back channel and the Stewart River. Water clarity (turbidity) improved and then decreased as the influence of the Stewart River backwatering the back channel became more pronounced.

Fish sampling involved seining with a 10 m long by 1.5 m deep beach seine constructed of 5 mm mesh. Seining sampled the wetted width of the Stewart River back channel at regular intervals. A total of eight seine hauls were conducted starting at the top of the back channel, where isolated pools were previously identified (EDI 2019) and working back towards the mouth of the back channel. Northern pike (Esox Lucius), burbot (Lota lota), and lake whitefish (Coregonus culpeaformis) were captured during sampling. Fish were only captured in the lower half of the Stewart River back channel. An adult and juvenile Northern pike were captured in the lower half of the Stewart River back channel. Juvenile burbot and lake whitefish were also captured in the lower half of the back channel. No fish were captured or observed in the portion of the back channel with orange-brown algae.

6.1.1.3 2021 Halfway Creek Fish Investigations

Electrofishing was conducted at three locations in Halfway Creek on August 14 and at two additional locations on September 5. Fish sampling was completed with a Smith-Root LR-24 electrofisher. Electrofishing effort was counted on the electrofisher in total seconds of active electrofishing as well as by the approximate distance from the electrofishing starting GPS point. All captured fish were enumerated and identified to species, and ten of each species were weighed (g) and measured to fork length (mm; Arctic grayling) or total length (mm; slimy sculpin [Cottus cognatus]). A calibrated YSI water quality meter was used to collect in situ water quality parameters (temperature and dissolved oxygen in August; temperature, dissolved oxygen, pH, and specific conductivity in September) at each fish sampling location.

On August 14, photos and measurements were taken at the suspected fish barrier located approximately 1 km upstream of the mouth of Halfway Creek (HC1.0).

Given that no fish had previously been captured this far up in Halfway Creek, additional sampling was completed on September 5 at sites HC2.0 and HC6.8 to investigate fish distribution higher in the watershed; however, no fish were captured nor did the crew make any visual observations of fish. All sampling durations ranged from 1044–1219 seconds.

6.2 Fish and Aquatic Habitat Overview

A total of 14 species of fish can be found in the streams and rivers adjacent to or downstream of the Mine Site, including two species of salmon and 12 species of resident freshwater fish (Table 6-2). The majority of these species are found only in the Yukon and Stewart rivers, with three of these species documented in the small/medium sized streams downstream of the Mine Site. These species include slimy sculpin (*Cottus cognatus*), Arctic grayling (*Thymallus arcticus*), and juvenile Chinook salmon (*Oncorhynchus tshawytscha*). These three species were also the most common species encountered along the NAR (Table 6-3). The Yukon and Stewart rivers are migratory corridors for both Chinook and Chum salmon *(Oncorhynchus keta*) and spawning areas for Chum salmon have been documented within the LAA on the Yukon River and downstream of the LAA on the Stewart River in groundwater fed side channels. = Baseline studies have not found chinook salmon spawning within the LAA Among the tributary creeks, the highest species diversity and abundance of fish have been documented in Coffee Creek, the largest creek in the Mine LAA. Independence Creek, a reference watershed, located just west of the Mine Site has similar species diversity and abundance (Figure 6-2).

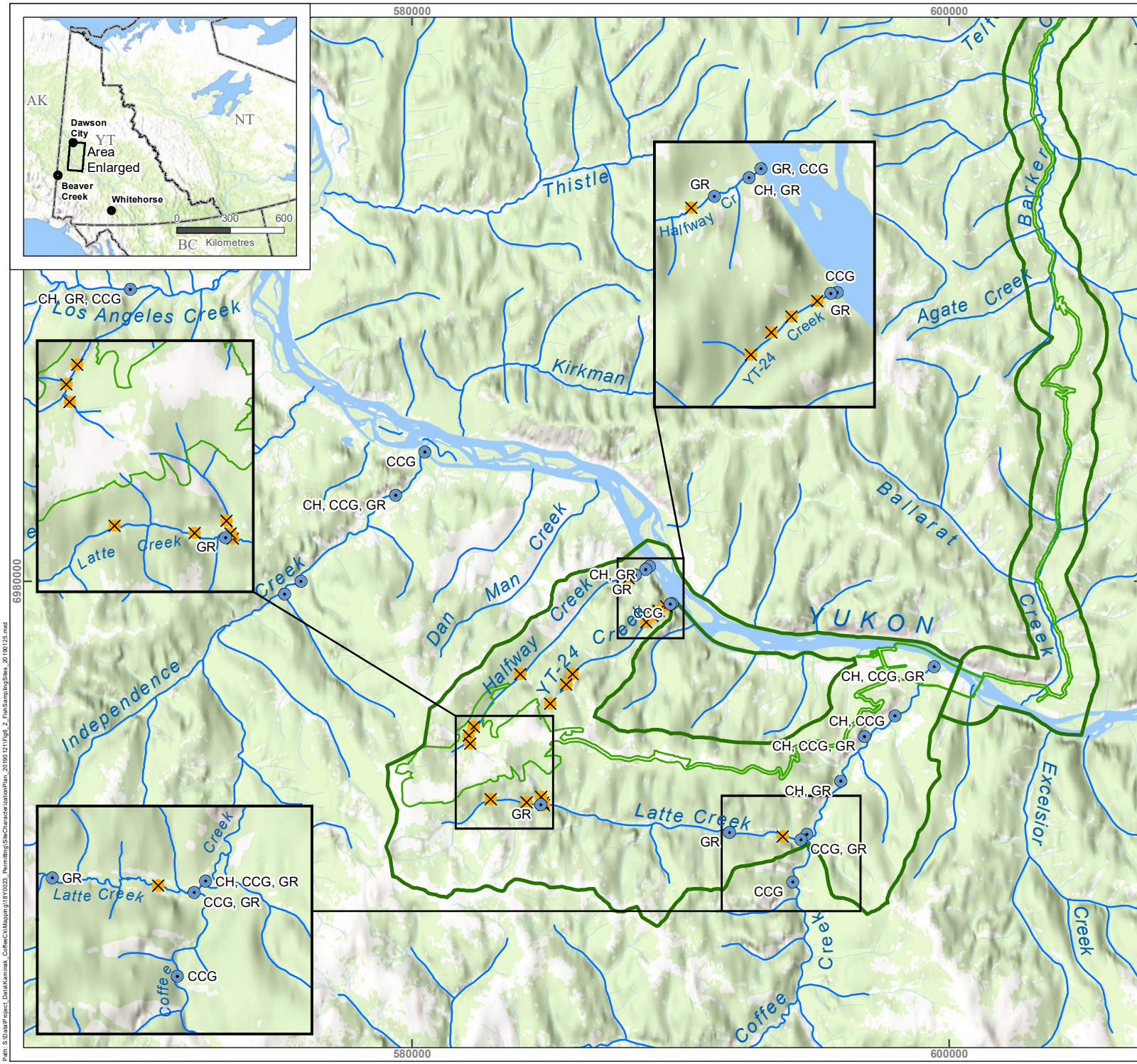
Coffee, Independence, and occasionally Halfway creeks are used by juvenile chinook salmon as non-natal rearing habitat, and Coffee Creek provides confirmed overwintering habitat for this species. Arctic grayling use the creeks primarily for summer rearing; eDNA data from March 2016 and 2017 confirmed Arctic grayling overwintering in Coffee Creek and the Yukon River but not in any other streams within the Mine study area. It is common for Arctic grayling to use different streams for important life history periods such as spawning, summer rearing and overwintering. Moderate densities of Arctic grayling have been documented in the lower reaches of Latte Creek during the summer months; however, overwintering habitat for fish within this stream appears poor and eDNA samples collected in this creek in March 2016 and 2017 tested negative for both Arctic grayling and juvenile Chinook salmon. Slimy sculpin are year round residents in Coffee Creek, the lower portion of Independence Creek, and the Yukon River.

The headwater streams within the Mine footprint are small and steep, with poor habitat and are located significant distances from documented fish bearing locations. Lower down in the watersheds, these streams eventually provide fish habitat or flow into areas that are seasonally used by fish (Latee, Halfway and YT24). Along the NAR, fish presence is typically associated with the larger streams that are crossed with likelihood of fish presence decreasing with distance from mainstem habitat.

Table 6-2 Summary of Fish Species Documented in the Streams in the Mine Study Area

Common Name	Scientific Name	Yukon River	Coffee Creek	Latte Creek	YT24-0.1 Creek	Halfway Creek
Chum Salmon	*Oncorhynchus keta*	X				
Chinook Salmon	*O. tshawytscha*	X	X			X
Longnose Sucker	*Catostomus catostomus*	X				
Lake Whitefish	*Coregonus clupeaformis*	X				
Broad Whitefish	*C. nasus*	X				
Least Cisco	*C. sardinella*	X				
Lake Chub	*Couesius plumbeus*	X				
Slimy Sculpin	*Cottus cognatus*	X	X	X [1]	X [1]	X[1]
Northern Pike	*Esox lucius*	X				
Arctic Lamprey	*Lethenteron camtschaticum*	X				
Burbot	*Lota lota*	X				
Round Whitefish	*Prosopium cylindraceum*	X				
Inconnu	*Stenodus leucichthys*	X				
Arctic Grayling	*Thymallus arcticus*	X	X	X	X[2]	X

[1] Captured near mouths of streams only, at the confluence with Coffee Creek and the Yukon River, respectively. [2]Only one grayling captured despite multiple sampling events in this stream.



COFFEE GOLD MINE

Fish Sampling Results in Vicinity of the Mine LAA

Legend

- City/Town
- Project Footprint
- Study Area
- Fish Captured
- No Fish Captured

Fish Sampling Codes

GR – Arctic Grayling
CCG – Slimy Sculpin
CH – Chinook Salmon

Sources

1. Sources: Esri, HERE, DeLorme, increment P Corp., NPS, NRCan, Ordnance Survey, © OpenStreetMap contributors, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatastyrelsen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community
2. Project access and infrastructure provided by Goldcorp Inc. (2017).

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Figure 6-2	Date: Jan 25, 2019	Drawn by: HG/MP	Reviewed: AM/PT

Newmont COFFEE

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Table 6-3 Summary of Fish Species Documented in the Streams along the Northern Access Route

Common Name	Scientific Name	Stewart River	Indian River	Sulphur Creek	Maisy May Creek	Barker Creek	Ballarat Creek	Hunker Creek
Chum Salmon	*Oncorhynchus keta*	X						
Chinook Salmon	*O. tshawytscha*	X	X[1]		X	X	X	X
Longnose Sucker	*Catostomus catostomus*	X	X					X
Lake Whitefish	*Coregonus clupeaformis*	X						
Lake Chub	*Couesius plumbeus*	X	X					
Slimy Sculpin	*Cottus cognatus*	X	X		X		X	X
Northern Pike	*Esox lucius*	X						
Arctic Lamprey	*Lethenteron camtschaticum*	X						
Burbot	*Lota lota*	X			X			X
Round Whitefish	*Prosopium cylindraceum*	X	X	X				X
Inconnu	*Stenodus leucichthys*	X						
Arctic Grayling	*Thymallus arcticus*	X	X	X	X	X	X	X

[1] Chinook have been historically documented in the Indian River downstream of the NAR (PECG 2016).

Table 6-4 Summary of Biophysical Characteristics of Small Watersheds within the Mine Site

Stream Name (Sampling Station)	Mean Channel Width (m)	Mean Channel Gradient (%)	Deep Pools (<1 m)	Substrate Type		Total Stream Cover
				Dominant	Subdominant	
Yukon River	~500	0	Y	-	-	-
Coffee Creek (CC5.6)	14.90	1	Y	Gravel	Cobble/Fines	Moderate
Coffee Creek (CC10.3)	22.08	2	Y	Gravel	Cobble	Moderate
Coffee Creek (CC12.9)	18.43	2	Y	Gravel	Cobble	Abundant
Coffee Creek (CC13.5)	24.55	2.5	Y	Cobble	Gravel	Moderate
Latte Creek (LC3.5)	5.86	2	N	Cobble	Gravel	Moderate
Latte Creek (LC11.7)	2.83	3	N	Boulder	Cobble	Moderate
Latte Creek (LC12.3)	3.81	7	N	Cobble	Boulder	Moderate

Stream Name (Sampling Station)	Mean Channel Width (m)	Mean Channel Gradient (%)	Deep Pools (<1 m)	Substrate Type		Total Stream Cover
				Dominant	Subdominant	
Latte Creek (LC13.7)	4.00	1	N	Boulder	Cobble	Abundant
Latte Creek Tributary C (LCT20-0.1)	1.01	13.5	N	Fines	Gravel	Moderate
Independence Creek (ID2.6)	12.21	2	Y	Gravel	Gobble	Abundant
Independence Creek (ID9.2)	23.23	2	Y	Gravel	Cobble	Moderate
Kona Tributary (KT0.1)	3.05	1	N	Gravel	Fines	Abundant
Kona Tributary (KT5.7)	2.23	8	N	Boulder	Cobble	Abundant
Halfway Creek (HC0.0)	4.03	2	N	Cobble	Gravel	Moderate
Halfway Creek (HC0.2)	4.08	2.3	N	Cobble	Gravel	Moderate
Halfway Creek (HC9.5)	2.60	10.5	N	Boulder	Cobble	Trace
Halfway Creek (HC9.9)	2.47	10	N	Boulder	Cobble	Moderate
YT24 Creek (YT0.0)	4.20	8	N	Cobble	Boulder	Moderate
YT24 Creek (YT0.2)	4.08	4	N	Cobble	Gravel	Moderate
YT24 Creek (YT4.8)	2.83	9	N	Cobble	Boulder	Trace
YT24 Creek (YT5.3)	1.87	11	N	Boulder	Cobble	Moderate

6.3 Periphyton

Mean chlorophyll-a and ash-free dry mass (AFDM) measured in 2014, 2015, and 2017 were low for all stations, which is typical of northern, nutrient poor aquatic habitats (PECG 2017). There was little variation among the stations and there was no relationship between chlorophyll-a and ash-free periphyton mass; differences in chlorophyll-a content may have been due to varying light conditions, nutrient availability, and periphyton taxonomy, which results in different proportions of photosynthetic and non-photosynthetic organisms that comprise periphyton. In 2014 and 2015 samples missed laboratory holding times and therefore samples may have experienced degradation prior to being analyzed in the laboratory, this combined with the low nutrient status of these streams may have underestimated the chlorophyll-a concentrations. Therefore, all streams within the Project area as well as reference sites were re-sampled for chlorophyll-a concentration in August 2016. The 2016 data indicated higher concentrations of chlorophyll-a throughout the sampling locations when compared with 2014,2015, and 2017 data. This may have been due to a warmer winter season in 2015/2016 followed by an earlier, warmer spring.

Community composition included blue-green algae (Cyanophyta), which comprised approximately 80% of the overall community composition and was the most dominant algal group in the study area; diatoms were the second most dominant group, followed by small percentages of green algae (chlorophyte). Blue-green

algae tended to dominate at higher elevation stations within the Mine Site area, whereas higher proportions of diatoms were present further downstream, at lower elevations. The large diatom *Didymosphenia geminata* (Didymo) was confirmed at station IC2.6 in Independence Creek in 2014; this invasive species has become increasingly prolific in BC and Yukon in recent years and is commonly referred to as rock snot (YISC 2014).

6.4 Benthic Invertebrate Communities

Benthic invertebrate sampling conducted in 2010, 2014, 2015, 2016 and 2017 (see Section 6.1) followed the standardized Canadian Aquatic Biomonitoring Network (CABIN) protocols and focused on total abundance and diversity. The CABIN protocols provide a standardized method to sample benthic invertebrate communities (NWRI 2008) and allows for robust data analysis by leveraging a large, nationwide database of invertebrate community data. The benthic invertebrate sampling conducted in March and August 2016 focused on collecting samples for metals analysis only and was not analyzed for benthic invertebrate abundance and diversity. A summary of results is provided below:

- In 2014 and 2015, Mean total abundance of benthic invertebrates ranged from 247 to 3,885 individuals per kick-net in 2014 and 2015, and from 221 to 5,967 individuals per kick-net in 2017, within watersheds in the Mine Site area.
- In 2014 and 2015 Los Angeles Creek displayed the highest total abundance, followed by Independence Creek, YT24, Coffee Creek, Halfway Creek, and then Isaac Creek. In 2017, total abundance was highest in Los Angeles Creed and Dan Man Creek, and lowest in creek YT24.
- In 2014 and 2015 total abundance generally increased in an upstream direction within watersheds, whereas in 2017 total abundance decreased in an upstream direction on Coffee, Latte, and YT24 creeks, and increased in an upstream direction on Dan Man and Halfway creeks.

Ephemeroptera-Plecoptera-Trichoptera (EPT) abundances within the Mine Site study area demonstrated similar patterns to overall abundance. During 2014 and 2015 samplings, Dipterans were the most dominant benthic invertebrate group, making up approximately 50% of the overall community composition. Conversely in 2017 Dipterans, along with Ephemeroptera and non-insects each comprised approximately 34% of overall abundance. Plecopteran comprised 31% of overall abundance and Trichopteran comprised less than 1% of overall community abundance.In Coffee and Independence creeks, EPT organisms typically dominated stations higher in the watershed; dipteran species dominated further downstream.

- Some stations, such as at IC2.6 in lower Independence Creek, had high between-year variability.
- In 2014 and 2015, after Dipterans, the second most dominant group was the mayflies (Ephemeroptera), followed by the stoneflies (Plecoptera), which contributed approximately 26% and 21% to the overall community composition, respectively.
- Small percentages of ringed worms (Annelids), and caddisflies (Trichoptera) were also present at the majority of stations.
- In 2014 and 2015, benthic invertebrate taxonomic richness was highest in the Coffee Creek watershed and lowest at the Kona Tributary to Independence Creek. In 2017, richness was highest in the Coffee Creek watershed and lowest in Dan Man Creek. There were no apparent inter-watershed patterns for taxonomic richness values in comparison with headwaters.
- Hess sampling results have proved to provide a statistically robust method for project effects monitoring.

6.5 Focal Species

The fish and aquatic baseline program included a broad review of the species and habitats present, as well as more detailed focus on specific species. Focal species selected for field surveys and baseline reporting include both species of conservation concern and species with social, cultural, or economic value. They reflect recommendations received during Project consultation with Environment Canada, Environment Yukon, local First Nations, and other stakeholders, as well as a review of relevant TK. Consideration for the selection of focal species or species groups included:

- Species of conservation concern including both federal and territorial listings
- Species harvested by First Nations or other local harvesters in the region
- Species selected as focal species for previous environmental assessments in Yukon
- Species raised as a concern during Project consultation
- Species with the potential to interact with the Project.

Table 6-5 Fish and Aquatic Habitat Focal Species

Focal Species	Representative of	Rationale for Selection
Arctic Grayling	Non-salmon species; recreational fish species and food species for First Nations	Widespread; important recreational/food fish species.
Chinook Salmon	Salmonids; target species for First Nation fishery. Also targeted by recreational and commercial fisheries.	Importance to local First Nations, present as juveniles in the LAA.
Chum Salmon	Salmonids; important species for First Nation and commercial fisheries	Importance to local First Nations and return to the Yukon River and Stewart River to spawn

6.5.1 Arctic Grayling

Arctic grayling are an important recreational fish species in the Yukon River watershed, and are an important food source for local First Nations (Bates and DeRoy. 2014). Arctic grayling are present within the LAA, and; have only been documented in the lower portions of the streams within the Mine Study area, including YT24 Creek, Halfway Creek, Coffee Creek, and Latte Creek.

- Arctic grayling have been captured in Coffee Creek and in the lower reaches of Halfway, YT24 and Latte creeks
- Along the NAR, Arctic grayling have been captured in Hunker, Maisy May, Ballarat, and Barker creeks, and are known to reside in the Stewart, Yukon, and Indian rivers, and historically in Sulphur Creek
- Smaller tributary streams along the NAR also have potential to provide summer rearing habitat for Arctic grayling.

The temporal characteristics of Arctic grayling life-history include seasonal migrations between overwintering, spawning, and summer rearing habitats with the largest individuals often being found the furthest upstream during the summer months (McPhail 2007). Spawning typically occurs during the spring, shortly after ice-out and typically takes place in larger creeks or small rivers over substrates dominated by

gravels and cobbles (McPhail 2007). Eggs incubate in the gravel for less than a month before hatching. In terms of sensitivities, deposition of fine sediments over the spawning grounds can result in habitat alteration and/or covering or smothering of eggs (mortality) during the incubation period.

Summer rearing habitat for Arctic grayling is typically widespread and includes the use of clear water creeks and rivers, including small tributary streams for summer feeding and rearing. Food items taken by Arctic grayling include a wide variety of aquatic and terrestrial insects and may include small fish and/or eggs (McPhail 2007). Rearing Arctic grayling are sensitive to changes in habitat suitability, accessibility, and stream productivity/food availability. Summer rearing by Arctic grayling was documented in the following creeks:

- Coffee,Latte, Halfway, and YT24 creeks downstream of the mine
- Hunker, Sulphur, Maisey May, Barker, Agate, and Ballarat creeks along the NAR
- Indian, Steward and Yukon rivers.

Arctic grayling typically overwinter in larger streams with groundwater inputs. Winter 2016 and 2017 fish and eDNA sampling in creeks in the vicinity of the Mine Site confirmed Arctic grayling overwintering in Coffee Creek and the Yukon River, but not in any other streams within the vicinity of the Mine Site. Overwintering on the NAR was not investigated; however, is likely limited to the larger streams such as Maisy May Creek, the Stewart River, and the Indian River.

Biomonitoring of fish species provides valuable information about the health of a watershed, as fish are long-lived and have specific habitat requirements that may be sensitive to environmental disturbances. In addition, fish are often positioned at the top of the aquatic food web, allowing them to integrate environmental variability experienced by species at the base of the food web, and increasing the likelihood of detecting environmental impacts (BCMOE 2012). In the baseline program, tissue sampling was undertaken to determine overall health via measurements of metal concentrations. Analysis of Arctic grayling tissue metal concentrations was conducted on samples collected in the vicinity of the Mine Site in the summer of 2014 and 2015 (PECG 2017), 2016, and in 2017. Arctic grayling were captured in Coffee, Latte, YT24 and Halfway creeks, and at reference sites in Independence and Los Angeles creeks.

- In all streams where samples were collected, baseline total mercury concentrations in all muscle tissue samples did not exceed the Canadian Food and Inspection Agency guideline (0.5 micrograms per gram wet weight (µg/g ww)).
- In contrast, estimated methylmercury concentrations (95% of total mercury concentrations, Jewett et. Al. 2003) in nearly all Arctic Grayling sampled in Coffee, Latte, Halfway, Independence, and Los Angeles creeks (both muscle tissue and whole-body samples) exceeded the CCME guideline for the protection of piscivorous wildlife (0.033 µg/g ww). Higher methylmercury concentrations were noted in Coffee and Latte creeks.
- Mean concentrations of methylmercury were lowest in Halfway, YT24, Los Angeles and Independence creeks.
- Selenium concentrations in muscle tissue did not exceed the US Environmental Protection Agency's (US EPA) interim guideline for fish muscle tissue (11.3 µg/g dry weight (dw), US EPA 2016); however, nearly all samples from all sites, with the exception of five samples from Latte Creek exceeded the BC tissue and whole-body guidelines for selenium (4 µg/g dw, BC MOE 2014).

6.5.2 Chinook Salmon

Chinook salmon are an anadromous fish species and an important food source for local First Nations (Bates et al. 2014, DRPC 2013). Juvenile Chinook salmon use the larger streams in the Project area as non-natal rearing habitat:

- Juvenile Chinook salmon were captured during the summer months in Coffee Creek, in the lower Halfway Creek and in lower Maisy May Creek.
- Potential rearing habitat was inferred based on suitable habitat in portions of Maisy May, Barker and Ballarat creeks in the vicinity of the NAR.
- Winter use by juvenile chinook salmon has been confirmed in Coffee Creek through direct fish capture (minnow trapping) and via eDNA sampling in March 2016 and 2017.
- Halfway Creek does not provide overwintering habitat.

In the Yukon River watershed, the temporal characteristics of chinook salmon life-history includes usage of freshwater habitats by young of the year (YOY), juveniles, and adults (spawning only). Chinook salmon spawn from late July to late August in clear, fast flowing streams and rivers, where large and clean cobble substrates are present. Eggs are deposited in stream gravels and hatch in winter as alevin[1]. Chinook salmon alevin remain in the gravels through the duration of the winter and live off stored energy reserves during this time before emerging as fry in late spring (May and June). Juvenile Chinook salmon rear in freshwater streams for up to one year after emerging from the stream gravels. Juvenile Chinook salmon can migrate many kilometres in order to find high quality rearing habitat; this can include the use of both natal and non-natal streams. Chinook salmon generally leave rearing habitats in the early spring of the following year, spend three to five years in the ocean, and return as adults to spawn.

Analysis of juvenile chinook salmon tissue metal concentrations was conducted on samples collected in March and August 2016, and in 2017. Samples were collected from Coffee Creek at CC0.5, CC3., from Halfway Creek at HC0.2 in 2016, and from Coffee Creek at CC6.6 and Halfway Creek at HC0.2 in 2017.

- Samples from Coffee Creek exceed CCME guidelines for the protection of piscivorous wildlife (0.033ug/g ww); samples from halfway creek are below the guidelines for all sampling events.
- The Canadian Food and Inspection Agency tissue concentration guideline for total mercury does not apply to juvenile chinook salmon, as they are not consumed by humans.
- Selenium concentrations in Coffee Creek did not exceed US EPA guidelines for muscle tissue (11.3 ug/g dw: US EPA 2015) or BC MOE selenium tissue guideline (4.0 ug/g dw) for all sampling events.
- One sample form Halfway Creek in 2016 and 2017 had selenium tissue concentrations in excess of the BC MOE guideline.

6.5.3 Chum Salmon

Chum salmon are an anadromous fish species and an important food source for local First Nations (Bates et al. 2014, DRPC 2013; Interview 14, pers. comm. 2016). Chum salmon life-history characteristics restrict their use of the creeks and river around the Project area to spawning and egg/alevin development only. Chum salmon do not rear in Yukon freshwater environments.

[1] A newly spawned salmon still carrying the yolk sac

- Chum salmon spawning has been documented in the Yukon River, with confirmed spawning locations near the Mine Site area in small side channels and sloughs that appear to be groundwater-fed
- Chum salmon spawning in the Stewart River has been documented in similar groundwater-fed side channels, approximately 6, 10 km and 18 km downstream of the NAR crossing
- Chum salmon migrate through the portions of the Yukon and Stewart rivers to reach spawning areas further upstream
- No chum salmon spawning has been documented in any of the smaller creeks (or near these stream mouths) within the Mine Study area, nor has any spawning been documented in the immediate vicinity of the proposed barge crossings or barge landings on the Yukon and Stewart rivers.

In the Yukon River watershed, chum salmon spawning occurs from September to November and is almost exclusively associated with areas of upwelling groundwater discharge. As with Chinook salmon, the eggs hatch as alevin during the winter and remain in the gravel until emergence during the spring. Juvenile Chum salmon migrate downstream to near the ocean after emergence. Chum salmon typically spend three to four years in the ocean before returning as adults to spawn.

6.6 Aquatic Environmental Setting

The Coffee Gold Mine Project mine infrastructure is located along a ridgetop straddling three watersheds (Figure 1-2). Two of the watersheds (Halfway Creek and YT-24), drain directly to the Yukon River. The third watershed (Latte Creek) drains to Coffee Creek, then on to the Yukon River. While all three watersheds have the potential to be influenced by the Coffee Gold Mine Project through changes in water quantity and/or water quality, only Halfway Creek will receive direct discharge of treated water from the Coffee Gold Mine Project. The potential effects of the Project on hydrology, water quality, and aquatic life were evaluated in detail in the Project Proposal and have been the subject of refinement through the YESAB review and screening (e.g., Lorax 2017a, b; EDI 2017a; Minnow and EDI 2017). Briefly, the physical presence of the Coffee Gold Mine Project within these three watersheds will result in modest loss of watershed area and consequent changes in water flow, principally confined to the upper reaches of Halfway Creek, YT-24 Creek, and Latte Creek. Flow changes in Latte Creek are negligible, while those in Halfway Creek are modest (i.e., maximum 15% change in mean annual discharge; Lorax 2017a). Project operations will have some influence on water quality of Halfway Creek, YT-24 Creek, and Latte Creek through erosion and sedimentation, leaching from disturbed mine materials and waste, leaching of nitrogen residues from blasting, discharge of treated camp water, heap leach facility residues, groundwater and surface water interactions and seepage, and atmospheric deposition (Lorax 2017b). Direct discharge of treated water from the WRSF will be limited to Halfway Creek, although small volumes of pit dewatering will be routed to YT-24 Creek, and small volumes of pit dewatering, plant site runoff, and sewage treatment plant effluent will be routed to Latte Creek (Lorax 2019). Detailed evaluation of the influence of the project on water quality indicated some modest Project-associated influences on concentrations of aluminum, chromium, copper, uranium and zinc in Halfway Creek, aluminum, arsenic, and copper in YT-24 Creek, and aluminum, copper, and uranium in Latte Creek and Coffee Creek (Lorax 2017b). Most recent evaluation of water quality under the Coffee Mine Update Study (CMUS) indicated a potential for sulphate concentrations in Halfway Creek to exceed water quality objectives (WQO), but no exceedances for any other parameter (Lorax 2019). This evaluation also indicated no exceedances of any WQO in YT-24 Creek or Latte Creek (Lorax 2019).

Evaluation of the potential influence of the Project on aquatic biology indicated no major expected changes to fish or fish habitat (EDI 2017a), and only very subtle changes in the taxonomic composition and/or productivity of periphyton and benthic invertebrate communities (Minnow and EDI 2017). The latter differ slightly by water body, with changes deemed most likely to occur in Halfway Creek, in the form of subtle changes in periphyton community composition, a modest increase in periphyton productivity (in association with nitrogen input and temperature changes), subtle changes in benthic invertebrate community composition, and a modest increase in benthic invertebrate productivity (Minnow and EDI 2017). In YT-24 Creek and Latte Creek, the only predicted changes are minor, low probability changes in periphyton community composition (Minnow and EDI 2017).

6.7 Aquatic Baseline Studies

6.7.1 Previous Aquatic Baseline Studies (2014-2017)

Baseline aquatic data collections in support of the Coffee Gold Mine Project were initiated as early as 2010. Intensive baseline data collection was completed from 2014 to 2017 in support of the Project Proposal (Table 6-1; Figure 6-1) and submitted with the Project Proposal (Appendix14A Fish Baseline Update, Appendix 14D Fish and Aquatic Resources Baseline). This included focused collection of aquatic biological baseline data in 2014 and 2015 (PECG 2017), and in 2016 and 2017 (EDI 2017a, 2018; Minnow and EDI 2017). Aquatic environmental baseline data collection included:

- habitat and water quality
- sediment quality
- periphyton / primary productivity
- benthic invertebrate community
- benthic invertebrate tissue quality
- fish community and populations
- fish habitat and habitat use evaluations.

With the exception of fish and fish habitat data (which are presented in a separate report), the results of the 2014 to 2017 aquatic baseline studies are briefly reviewed in the Coffee Aquatic Life Baseline Update Draft Report 2021.

6.7.2 Fish and Aquatic Resources Post-Baseline (2017-2021)

Since the submission of the Project Proposal, fish and fish habitat data has been collected on an annual basis to further develop the understanding of baseline conditions as well as provide pre-project monitoring data. The studies are listed below and in Table 6-6, discussed in Sections 7.2.2.1 to 7.2.2.5 and key findings are summarized in Section 7.2.2.6.

- Coffee Gold Mine Project: Fish and Aquatic Resources – 2017
- Coffee Gold Mine Project: Fish and Aquatic Resources – 2018
- Coffee Gold Mine Project: 2019 Fish and Aquatic Resources Studies
- memo addressed to Newmont Corporation from EDI titled Re: Summer 2020 – Stewart River Back Channel Fieldwork

- memo addressed to Newmont Corporation from EDI titled Re: Halfway Creek Fish Investigations (2021).
- Most findings from the 2017 to 2021 field programs are generally consistent with studies completed prior to submission of the baseline report to YESAB. While some new findings were documented they were not expected to have substantial implications to the effects assessment completed as part of the YESAB assessment. The post-baseline studies do provide more in-depth aquatic resource information and provide valuable information on unstudied areas. This additional knowledge will assist monitoring and management programs as they develop throughout future Project operations.

Table 6-6 Fish and Fish Habitat Sampling and Analysis Conducted 2017-2021

Study Area	Survey	Years
Mine	eDNA sampling within various creeks and Yukon River	2017, 2018
Mine	Fish sampling and habitat investigations (FHAP) within various creeks[1]	2017, 2018, 2019, 2021
Mine	Chinook spawning surveys	2017, 2018, 2019
Mine	Fish Tissue Sampling	2017
Mine	Benthic invertebrate and periphyton tissue metals	2017
Mine	Invertebrate community sampling	2017
Mine	Periphyton – chlorophyl and AFDM	2017
Mine	Sediment – texture and metal concentration	2017
NAR	Fish sampling and habitat investigations at barge landings	2017, 2018, 2019
NAR	Fish sampling and habitat investigation in the Stewart River back channel	2017, 2018, 2019, 2020
NAR	Opportunistic barge wake investigation	2018, 2019
NAR	Chum spawning survey	2017, 2018

AFDM = Ash Free Dry Mass

[1]Fish sampling in smaller creeks was primarily completed via electrofishing and in the Yukon and Stewart rivers via beach seining.

6.7.2.1 2017 Studies

During the 2017 field season, EDI conducted: eDNA sampling; fish sampling; fish habitat assessments; Chinook salmon (Oncorhynchus tshawytscha) spawning surveys; fish tissues metal analysis; benthic invertebrate community sampling and sediment analysis. The sampling and monitoring program was conducted on various streams within the Mine Study Area Table 6-7.

Table 6-7 Sampling and Analysis Conducted within the Mine Study Area in 2017

Type of Sampling	Streams Sampled	Results/Analysis
eDNA	Coffee Creek Latte Creek Independence Creek Halfway Creek Yukon River YT-24Creek	Results were generally consistent with past and current fish sampling events.
Fish Sampling	Coffee Creek Halfway Creek Latte Creek Independence Creek YT-24 Creek	Provided a better understanding of distribution, abundance, habitat usage, aging structure analysis, tissue metals, and percent moisture analysis. Fish distribution and species assemblages were similar to previous knowledge.
Fish Habitat Assessments Procedures (FHAP)	Halfway Creek Halfway, Latte, and YT-24 drainages within mine footprint	Pre-project data that can be used for later comparisons.
Chinook Spawning Surveys	Coffee Creek Independence Creek	No evidence of Chinook spawning was found in either creek.
Benthic Invertebrate and Periphyton Tissue Metals	Coffee Creek Independence Creek Latte Creek Los Angeles Creek Halfway Creek	Baseline tissue metals and percent moisture analysis were collected that can be used for future comparisons.
Canadian Aquatic Biomonitoring Network (CABIN) invertebrate sampling	Coffee Creek Halfway Creek Latte Creek YT-24 Creek Dan Man Creek Excelsior Creek Independence Creek Los Angeles Creek Stream South of YT-24 Creek Tributary to Excelsior Creek	BEAST and RIVPACS analyses were completed that can be used for future comparisons.
Periphyton	Coffee Creek Latte Creek Independence Creek YT-24 Creek Halfway Creek Los Angeles Creek	Chlorophyl-a and AFDM were completed that can be used for future comparisons.
Sediment	Coffee Creek Latte Creek Independence Creek Los Angeles Creek YT-24 Creek Halfway Creek	Texture assessment and metal concentration analysis were completed that can be used for future comparisons.

BEAST = Benthic Assessment of Sediment

RIVPACS = River Invertebrate Prediction and Classification Scheme

6.7.2.2 2018 Studies

Additional studies were undertaken in 2018 to add to the baseline and pre-project monitoring data within the study areas. Streams outside of the study areas were also investigated to provide a better understanding of fish and fish habitat in exploration areas.

EDI conducted a sampling program in 2018 to further assess the aquatic habitat and resources within the Project footprint. The 2018 sampling program completed by EDI included: eDNA sampling; fish sampling and habitat investigations; fish sampling in Yukon River confluences (mixing zones) of YT-24 and Halfway creeks; fish habitat assessments and Chinook salmon spawning surveys.

6.7.2.3 2019 Study

Studies completed in 2019 were mainly focused on collection of pre-project monitoring data including trying to find control streams outside of the study areas.

The 2019 program in the Mine Study Area included only fish sampling and habitat investigations, and Chinook spawning surveys. In addition to overlapping sampling and habitat investigations on creeks from previous years, EDI also conducted this on Carlisle, Excelsior, and Los Angeles Creeks. No eDNA sampling was completed in 2019.

6.7.2.4 2020 Study

The works completed in 2020 involved only further investigations in the Stewart River back channel. Similar to previous years, the investigation involved sampling in-situ water quality parameters and fish sampling via beach seining. Northern pike, burbot, and lake whitefish were captured. No sampling or monitoring was conducted during the 2020 field season within the MSA.

6.7.2.5 2021 Study

The works completed in 2021 involved fish sampling in Halfway Creek via electrofishing. Prior to 2021, no fish were captured above an expected fish barrier. A large log jam complex appeared to impede fish from migrating past with inadequate plunge pools for fish to jump over the features; however, two Arctic grayling (Thymallus arcticus) were captured above the log jam during the 2021 field study. In addition to capturing fish in this upper reach, 2021 was also the first year that slimy sculpin (Cottus cognatus) were captured above the downstream confluence. Winter surveys have confirmed that Halfway creek freezes to bed in the lower portions so slimy sculpin will not likely remain in this portion of the stream.

6.7.2.6 Key Findings 2017-2021

Findings from post-baseline data collected between 2017 and 2020 are generally consistent with findings in the baseline studies that were submitted to YESAB. The ongoing data collection programs are collecting new information and knowledge that can support the future licencing and permitting stages as well as setting the stage for future monitoring and adaptive management. Key highlights of the new knowledge gained by the recent studies are summarized in this section.

6.7.2.6.1 Halfway Creek

The extent of fish distribution in Halfway Creek has been dynamic from year to year. The baseline studies conducted prior to 2017 found that fish presence was limited to the lower 350 meters of Halfway Creek and documented a log jam 1 km upstream from the stream mouth that was suspected to be a barrier to fish. The 2017 report found fish presence to up to 600 meters from the mouth and documented many impediments to fish passage between the logjam and the upper watershed/project footprint (approximately 6.8 km upstream from mouth). In 2018, only one Arctic grayling was captured in the stream 200 m upstream

of the mouth. In 2019, grayling were documented up to the log jam but not upstream. The most recent field study completed in 2021 revealed changes to the log jam and resulted in the capture of two Arctic grayling just above the suspected fish barrier but no fish were captured further upstream.

6.7.2.7 YT-24

An Arctic grayling was captured during the 2017 field season in YT-24 Creek beyond the back flooded area at the mouth of the creek (50 m upstream). This was the first fish documented in this creek (beyond the back flooded portion adjacent to the Yukon River), and no fish were captured during the 2018 sampling event. A noticeable change in stream channel morphology was identified on YT-24 Creek and was determined to have been caused by a localized flood event in 2017. Low water was observed during the 2019 field study in YT24 Creek, resulting in loss of aquatic connectivity within regions of the creek and at the confluence to Yukon River. The combined information on YT-24 indicates the stream has limited fisheries values.

6.7.2.8 Mixing Zones

During the YESAB process, Selkirk First Nation expressed interest in the mixing zones at the mouth of Halfway and YT-24 creeks. As such, fish sampling was conducted at the mixing zones of both creeks where they enter the Yukon River. Species diversity and capture numbers were compared to other areas of the Yukon River with variable results.

6.7.2.9 Exploration Creeks

Additional creeks were sampled by electrofishing or eDNA sampling. Sampling determined fish presence in IC tributaries A and B, Dan Man Creek, and Kona Creek. A habitat assessment of IC tributary A indicated that fish presence is likely limited to the lower ~500m of the watercourse.

6.7.2.10 Spawning Surveys

Chum and Chinook spawning surveys were completed in 2017, 2018, and 2019. Chinook salmon surveys were completed on Coffee and Independence creeks, whereas chum spawning surveys were completed on the Yukon and Stewart rivers. No Chinook were observed in Coffee or Independence creeks throughout any of the field study years. Chum were observed spawning in many locations in the Yukon River and a few locations in the Stewart River in all years that the area was surveyed. No spawning has been documented at any of the barge landing or winter road ramp locations.

6.7.2.11 Stewart River Back Channel

The Stewart River back channel was assessed every year from 2017 to 2020 for fish habitat and presence. Although this area is ephemeral and tends to dry up when Stewart River water levels go below approximately 27.0 m, it does provide seasonal habitat for fish species including northern pike, burbot, lake whitefish, and longnose sucker (Catostomus catostomus).

6.7.3 Other Studies

In 2017 fish tissue, invertebrate sampling, chlorophyl-a, Ash Free Dry Mass (AFDM), and sediment texture and metal concentration analyses were conducted. The chlorophyl-a and AFDM confirmed that streams throughout the Project Area are oligotrophic. The sediment metal analysis indicated naturally elevated

levels of arsenic and chromium. Levels of these metals exceed the Interim Sediment Quality Guidelines (ISQG) at many sites and exceed the Probable Effects Level (PEL) at some sites. Although the analysis of sediments at most sites were consistent with baseline data, some sites resulted in significantly different results than baseline which can be found in the Fish and Aquatic Resource Studies - 2017 (EDI, 2018). Minnow Environmental Inc. also has collected additional invertebrate information within the study area. In summary, there has been a substantial amount of fish and fish habitat data that has been collected since the YESAB submission. This data has strengthened the knowledge of fish and habitat within the study area. Please refer to the specific reports for additional information on any of these studies.

7.0 VEGETATION

Detailed baseline studies on the vegetation present within the Project area for Goldcorp Kaminak Ltd. (now Newmont) have been conducted since 2014 in anticipation of regulatory requirements associated with the Project's approval. The Project was submitted to the YESAB Executive Committee for review in 2017.

The summary of vegetation resources for the Project area that may be affected by the mining operations provided below is a summary of the Vegetation Baseline Report submitted for the Project Proposal in 2017 and subsequent updates (Appendix G). The Project area is located within the Klondike Plateau Ecoregion, within the Boreal Cordillera Ecozone.

7.1 Vegetation Study Areas

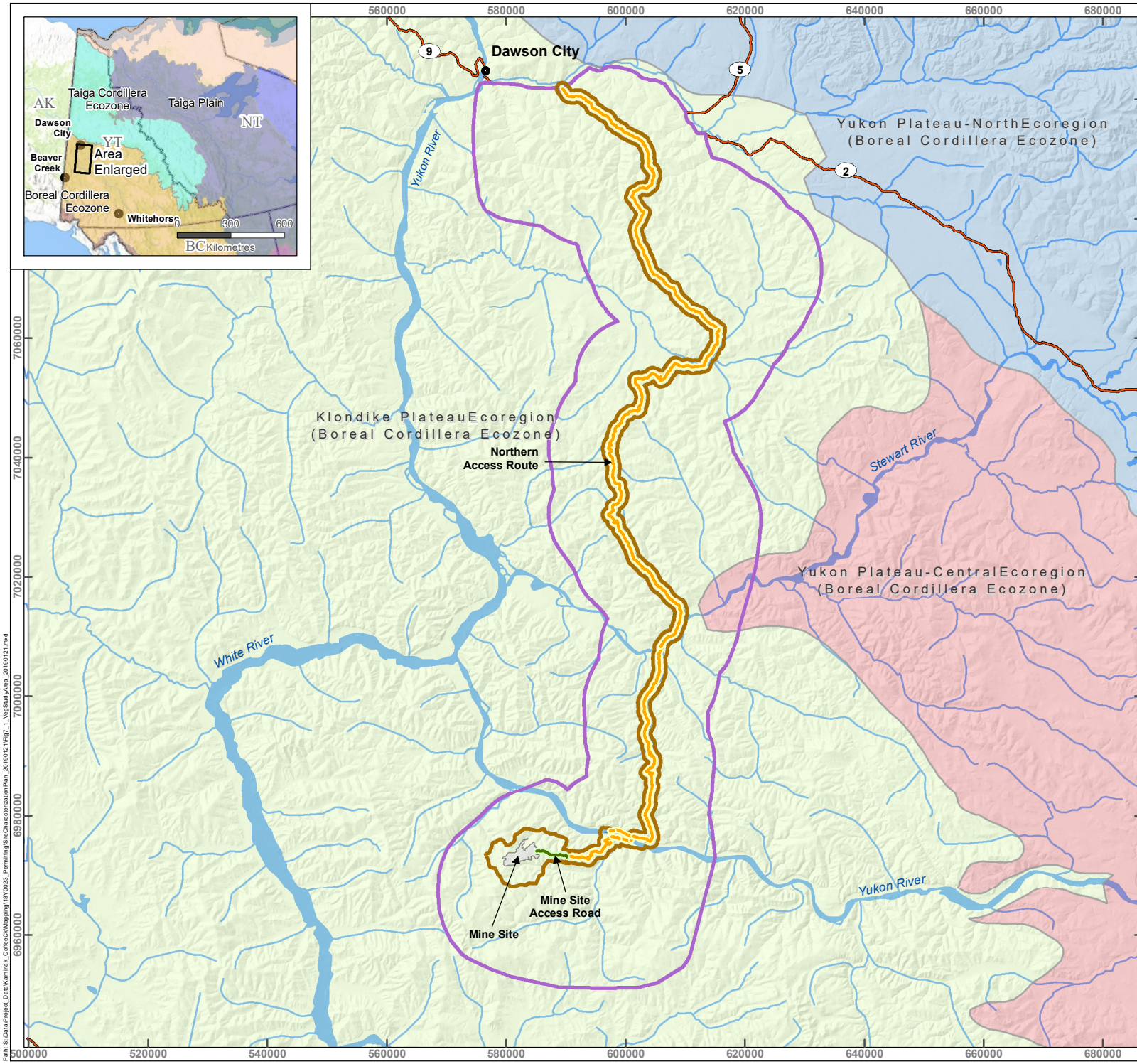
Vegetation was studied in the Project area and its surroundings. The LSA used for Site Characterization Plan was derived based on the LAA used in the Effects Assessment and is different that the study area described in the baseline study. The LSA includes the proposed mine site and the proposed NAR to the junction with the North Klondike Highway. Around the mine site, the LSA is delineated based on the height of land while encompassing a minimum buffer of 1 km radius around the proposed mine footprint. Along the access route, the LSA includes a 1 km radius buffer from the centreline of the proposed or existing road.

7.2 Vegetation Environmental Setting

According to Yukon bioclimate zone mapping, the study area encompasses four bioclimate zones: the Boreal Low, the Boreal High, the Subalpine, and Alpine zones (Rowe and Sheard 1981). Overall, approximately 90% of the study area occurs within the Boreal Bioclimate zones (Boreal Low and High), while the remaining area occurs predominantly in the Subalpine Bioclimate zone. The Alpine Bioclimate zone is found only in a small area (less than 0.1% of the study area) in the southeastern extent of the study area, along a previously considered road alignment (proposed Casino Connecter) that has since been excluded from the Project.

The vegetation baseline study focused on describing the vegetation near the proposed Mine Site, and along the proposed NAR. Vegetation baseline studies included:

- Ecosystem and Landscape Classification (ELC) mapping (2014 to 2016) using pre-existing data and ELC field sampling within the Mine Site.
- Broad ecosystem Mapping (2016) using existing data and field ELC sampling along the NAR.
- Rare plant surveys (2014 to 2016) focusing on areas with high rare plant potential, based on a desktop review, within 500 m of the Project footprint.
- Invasive plant surveys (2015 to 2016) focused on areas with high invasive plant potential identified during a desktop review.



COFFEE GOLD MINE

Vegetation Study Boundaries and Ecoregions near the Project

Legend

- Mine Site Access Road
- Northern Access Route

Ecoregions in Vicinity to or Overlapping the Vegetation RSA

- Klondike Plateau Ecoregion
- Yukon Plateau-Central Ecoregion
- Yukon Plateau-North Ecoregion
- Vegetation Local Study Area
- Vegetation Regional Study Area

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.

Sources

1. Canadian Council on Ecological Areas. <2010>. Conservation Areas Reporting and Tracking System. Digital database developed by Environment Canada, Gatineau

2. Inset Basemap: ESRI World Topographic Map

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Figure 7-1	Date: Jan 28, 2019	Drawn by: HG/MP	Reviewed: AM

Newmont COFFEE

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Within the Project Area, the subalpine landscape is dominated by shrub communities overlaying a well-developed feathermoss and lichen layer. Communities of scrub birch (*Betula glandulosa*), Labrador-tea (*Rhododendron groenlandicum*), bog blueberry (*Vaccinium uliginosum*), lowbush cranberry (*V. vitis-idaea*), and crowberry (*Empetrum nigrum*) are common. The widely distributed dry, shallow hillcrests throughout the Project Area commonly support communities of low-growing shrubs and/or ground shrubs, including scrub birch, mountain avens (*Dryas* spp.*),* crowberry, Arctic white heather (*Cassiope tetragona*), and lowbush cranberry. A sparse conifer canopy (approximately 15% cover) develops over the shrub layer at the lower elevation edges of the subalpine near the treeline and the boreal transition.

Between the treeline of the Boreal High and the valley bottoms of the Boreal Low Bioclimate zone, the vegetation patterns reflect the discontinuous distribution of permafrost throughout the region. Closed canopy pure or mixed stands of hybrid white spruce (*Picea glauca*), black spruce (*Picea mariana*), Alaska birch (*Betula neoalaskana*), and trembling aspen (*Populus tremuloides*) occur on neutral and warm, gentle-to-moderate slopes. Understory species typically include Labrador tea, prickly rose (*Rosa acicularis*), lowbush cranberry, tall bluebells (*Mertensia paniculata*), bastard toadflax (*Comandra umbellata*), and feathermosses. Dry, moderate-to steep, south-facing slopes support grasslands and aspen forests, overlaying kinnikinnick (*Arctostaphylos uva-ursi*), soapberry (*Shepherdia canadensis*), and grasses. In contrast, stunted black spruce forests occur on cold, north-facing slopes with imperfect-to-poor drainage due to near surface permafrost. Understory species typically include Labrador-tea, sedges, cottongrass (*Eriophorum vaginatum*), and cloudberry (*Rubus chamaemorus*). On gentle toe-slopes underlain by permafrost, black spruce communities containing Labrador-tea, sedges, red bearberry (*Arctous rubra*), and lichens predominate. Black spruce forests with high lichen cover also occur on better drained, coarser-textured upland, north-facing, lower-to-upper slopes. Wetland and floodplain ecosystems exist in valley bottoms throughout the PROJECT AREA; however, they represent a small component of overall area. This region has frequent fires, therefore young, deciduous-dominated, and mixedwood stands are more common than mature conifer-dominated stands. Additionally, the region has a long history of placer gold mining; subsequently, many valley bottoms within the Project area include historic or active placer mines.

7.3 Early Baseline Studies

Baseline vegetation studies conducted in 2014-2017 are listed in Table 7-1.

Table 7-1 Vegetation Studies Conducted for the Coffee Mine Project between 2014 and 2017.

Year	Study
2014, 2015,2016	Ecosystem Mapping
2014, 2015, 2016	Rare Plant Surveys
2015, 2016	Exotic and Invasive Plant Surveys
2014-2016	Vegetation and Soils Trace Metals Sampling

7.3.1 Ecosystem Mapping and Ecological Communities

Ecosystem mapping is typically used as a method of describing vegetation across a landscape. By grouping plant species into communities, it facilitates describing possible effects such as loss of vegetation habitat. Ecosystem mapping was initiated in the spring of 2014 and completed in February 2016 to provide information and document plant communities including wetlands and other land cover types. The

ecosystem mapping and survey extent included the Mine Site area, the existing road between Coffee exploration camp and the deposit (i.e., the Mine Site access road), the current airstrip and Coffee exploration camp, the NAR to the junction with the Klondike Highway, as well as a few previous road alignment options, including the previous Casino Connector Road option and alternate alignments through the Dawson Goldfields EDI 2017b.

Ecosystems within the baseline study area were mapped at two levels: Ecological and Landscape Classification (ELC) and Broad Ecosystem Mapping (BEM). The more detailed ELC mapping was completed around the proposed Mine Site and along new sections of the proposed NAR and was divided into two zones, boreal and subalpine/alpine. BEM was completed along the proposed NAR in sections with existing roads and was not divided into zones. Approximately 23,844 ha of the study area was mapped following ELC methods and approximately 36,582 ha was mapped following BEM methods. The mapping extent identified 34 unique ELC ecosites (24 ecosites in boreal zones, 10 ecosites in the subalpine/alpine zones), 11 non-vegetative/anthropogenic units, and 13 vegetative BEM units. The ELC mapping identified seven unique wetland ecosites and the BEM identified four units (bog, fen, marsh, and swamp). A summary of the mapped communities is presented in Table 7-2.

The ecosystem mapping area (47,422 ha) contains the Boreal Bioclimate (Boreal Low and High) and Subalpine Bioclimate zones. Approximately 92% of the study area occurs in the Boreal Bioclimate zones, while the remaining 8% occurs within Subalpine Bioclimate zone (Table 7-2). The LSA does not extend into the Alpine Bioclimate zone and does not contain any alpine ecological communities.

Table 7-2 Ecological Community Area within the Project Area

Mapped Feature	Code	LSA (ha)	% LSA
ELC-Boreal Ecological Communities			
Purple Reedgrass – Lichen	20Capu	137	0.3
Kinnikinnick	20Aruv	142	0.3
Aspen – Kinnikinnick – Purple Reedgrass	21	1,201	2.5
Aspen – Soapberry – Purple Reedgrass	01A	360	0.8
Alaska Birch – Labrador Tea – Tall Bluebells – Step Moss	01W	1,321	2.8
Alaska Birch – White Spruce – Labrador-tea – Lowbush Cranberry – Feathermoss	01WSw	2,383	5.0
White spruce – Rose – Bastard Toadflax – Feathermoss	01Sw	293	0.6
Spruce – Labrador-tea – Lowbush Cranberry – Feathermoss	01Sw(Sb)	1,349	2.8
Spruce – Feathermoss (early successional sites due to fire)	01	2,402	5.1
Black spruce – Labrador-tea – Reindeer Lichen	30	930	2.0
Spruce – Birch – Lowbush Cranberry – Feathermoss	31	1,048	2.2
Black spruce – Scrub birch – Labrador-tea – Cloudberry	32Sb1	190	0.4
Black spruce – Labrador-ea – Cottongrass	32Sb2	134	0.3
Black spruce – Labrador-tea – Cloudberry – Sedge	32	2,012	4.2
Black spruce – Labrador-tea – Sedge – Brown Moss – Reindeer Lichen	33	603	1.2
White spruce – Horsetail	40	529	1.1

Mapped Feature	Code	LSA (ha)	% LSA
Balsam Poplar – Rose – Horsetail	41	349	0.7
Alaska Birch – Alder – Reedgrass	42	174	0.4
Tall shrub Balsam Poplar – Willow	43	71	0.1
Total Area of upland Boreal Ecological Communities		**15,627**	**33**
ELC=Subalpine Ecological Communities			
Tors	10	0.5	<0.1
Felsenmeer	11	0.6	<0.1
Scrub Birch – Mountain Avens – Lichen	12	90	0.2
Scrub Birch – Crowberry – Lowbush Cranberry	13	190	0.4
Scrub Birch – Willow – Mountain Avens	14	79	0.2
Scrub Birch – Lowbush cranberry – Feathermoss	01	1,825	3.9
Scrub Birch – Sedge – Feathermoss	30	318	0.7
Spruce – Scrub Birch – Feathermoss	31	610	1.3
Black Spruce – Labrador-tea – Lowbush Cranberry – Sedge	32	473	1.0
Willow – Horsetail – Peatmoss	40	55	0.1
Total Area of upland Subalpine Ecological Communities		**3,641**	**7.7**
Broad Ecological Communities			
Felsenmeer	Fe	<0.1	<0.1
Subalpine / Alpine Shrub	Ss	74	0.2
High Elevation Sparse Coniferous Forest	Fcs	842	1.8
High Elevation Shrubby Riparian	HSr	<0.1	<0.1
Grassland	Gg	281	0.6
Upland / Closed Canopy Forest	UpF	18,815	39.7
Riparian Forest	RF	1,002	2.1
Stunted Coniferous Forest	Stcs	1,838	3.9
Low Elevation Shrubby Riparian	LSr	256	0.5
Total Area of upland Broad Vegetation Communities		**23,108**	**49**
Wetland Habitats (mix of ELC & BEM			
Spruce – Willow – Labrador Tea – Sedge Fen	F1	255	0.5
Spruce – Red Bearberry – Brown Moss Fen	F2	65	0.1
Birch – Leatherleaf – Sedge Fen	F3	194	0.4
Willow – Horsetail Swamp	S1	206	0.4
Willow – Reedgrass Swamp	S2	12	<0.1
Beaked Sedge Marsh	M1	6	<0.1
Horsetail – Sedge Marsh	M2	1	<0.1
Marsh	M	27	0.1
Bog	B	<0.1	<0.1

Mapped Feature	Code	LSA (ha)	% LSA
Fen	F	412	0.9
Swamp	S	11	<0.1
Total Area of Wetland Habitats		**1,190**	**2.5**
Non-vegetated/Anthropogenic Communities			
Anthropogenic	An	56	0.1
Gravel bar	Gb	20	<0.1
Placer mine	Mp / Pm	2,770	5.9
Pond	Pd	4	<0.1
Placer mining pond	Ppd	160	0.3
Road surface	Rd	49	0.1
River	Ri	693	1.5
Rock	Ro	68	0.1
Talus	Rt	37	0.1
Total Area of Non-Vegetated / Anthropogenic		**3,856**	**8.0**
Total Ecosystem Mapping Area (ha)		**47,422**	**100**

Wetlands are found scattered across the region, but no detailed wetland mapping or classification is available regionally. The most common wetland type found within the LSA was fens (approximately 926 ha scattered across the LSA in pockets of various sizes), and swamps (approximately 230 ha of willow-dominated (*Salix spp.*) swamps were mapped within the LSA). No bogs were mapped within the LSA, and few small marshes were mapped throughout the Project area.

Less than 4% of the overall ELC survey extent was mapped as wetland ecosystems (codes F1, F2, F3, S1, S2, M, M1, M2, B, F, and S in Table 7-2). Floodplains are found throughout the ELC survey extent of the LSA and make up 6% of the area mapped. In addition, small pockets of natural wetland communities are likely to exist within the matrix of heavy placer mining activity.

7.4 Traditional and Medicinal Species

Berry-producing plants were selected to represent traditional and medicinal use plants, as berries are a diverse and important food source and were reported to be harvested in the Coffee Creek area by members of the Tr'ondëk Hwëch'in and White River First Nation (Tr'ondëk Hwëch'in 2012, Bates and DeRoy 2014) and continue to be an important source of food for local First Nations (InterGroup Consultants Ltd. 2009).

Many of the berry-producing species traditionally harvested by First Nation communities are present in one or more of the ecological communities surveyed in the Project area.

The occurrence of plants important for traditional and medicinal use was assessed using the ELC and BEM vegetation community classification mapping and quantified as sites likely to contain important berry-producing plants. Edible berry-producing species, including bog blueberry (*Vaccinium uliginosum*), lowbush cranberry (*Vaccinium vitis-idaea*), crowberry (*Empetrum nigrum*), high-bush cranberry (*Viburnum edule*), bog cranberry (*Vaccinium oxycoccos*), cloudberry (*Rubus chamaemorus*), currants and gooseberries

(*Ribes* spp.), and soopolallie (*Shepherdia canadensis*) were commonly found throughout the LSA during baseline vegetation studies. The majority of ecosystems identified within the LSA support, at minimum, one berry-producing species, and commonly support multiple species. All identified ecosystems in the LSA were rated for berry-producing potential using five categories (high, medium, low, very low, and nil potential). Table 7-3 lists the mapped berry-producing communities within the Project Proposal LSA that are considered to have high and moderate potential by Bioclimate zone.

Table 7-3 Area of High and Moderate Potential Berry-producing Sites

Traditional Use Berry Potential Class	Ecological Communities (Code)	LSA (ha)
Boreal Zone		
High Potential	• Spruce – Birch – Lowbush Cranberry – Feathermoss (31) • Black Spruce – Scrub Birch – Labrador Tea – Cloudberry (32Sb1)	1,238
Moderate Potential	• Alaska Birch – Labrador Tea – Tall Bluebells – Step Moss (01W) • Alaska – Birch – White Spruce – Labrador Tea – Lowbush Cranberry – Feathermoss (01WSw) • Spruce – Labrador Tea, Lowbush Cranberry – Feathermoss (01Sw(Sb)) • Spruce – Feathermoss (01) • Black Spruce – Labrador Tea – Reindeer Lichen (30) • Black Spruce – Labrador Tea – Cottongrass (32Sb2) • Black Spruce – Labrador tea – Cloudberry – Sedge (32) • Spruce – Willow – Labrador Tea – Sedge (F1) • Birch – Leatherleaf – Sedge (F3) • Willow – Horsetail (S1) • Willow – Reedgrass (S2).	11,198
Subalpine Zone		
High Potential	• Scrub Birch – Crowberry – Lowbush Cranberry (13) • Shrub Birch – Lowbush Cranberry – Feathermoss (01) • Scrub Birch – Sedge – Feathermoss (30) • Spruce – Scrub Birch – Feathermoss (31) • Black Spruce – Labrador Tea, Lowbush Cranberry – Sedge (32).	3,416
Moderate Potential	• Scrub Birch – Willow – Mountain Avens (14) • Willow – Horsetail – Peatmoss (40).	134
Broad Ecosystems		
High Potential	• Subalpine / Alpine Shrub (Ss) • High Elevation Sparse Coniferous Forest (Fcs) • Stunted Coniferous Forest (Stcs).	2,754
Moderate Potential	• Upland/Closed Canopy Forest (UpF) • Low Elevation Shrubby Riparian (LSr) • Fen (F) • Swamp (S).	19,494
	Total (ha)	**38,233**

7.5 Rare Plant Species

The baseline plant surveys documented 411 plant species including seven tree, 60 shrub, 188 forb, 63 grass, 18 fern/horsetail/clubmoss, 2 aquatic, 36 mosses/liverworts, and 37 lichens (a complete list of all species can be found in Appendix G). Many of the species documented during the different surveys are considered traditional and medicinal plants including such plants as bear root (*Hedysarum alpinum*), raspberry (*Rubus ideaus*) or high-bush cranberry (*Vibernum edule*).

No Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or *Species at Risk Act, S.C. 2002, c. 29* (*SARA*)-listed plant species were observed during rare plant surveys; however, populations of four Yukon Watch List plant species were found. At the time of the Vegetation Baseline Report (EDI 2017) development, Coffee Creek Scorpionweed (*Phacelia mollis*) was included on the Yukon Watch List; however, it has since been removed from the list (highlighted grey in Table 7-4). The Watch List represents taxa for which more information is needed before a conservation status can be determined but may be threatened or endangered in Yukon or throughout their range (YCDC 2019b). Watch-list plant species found during rare plant surveys are listed in Table 7-4.

Table 7-4 Locations, Abundance, and Habitat of Watch-list Plant Species Found in the LSA

Site[1]	Species Name	Abundance and Distribution	Habitat
PM-1	Coffee Creek Scorpionweed[2]	2 individuals in a patch	Open mixed forest on a moderate slope with well-developed dwarf shrub/forb understory and tufted grasses
PM-2	Coffee Creek Scorpionweed[2]	1 patch of 4 individuals	Disturbed, exposed soil along the edge of adjacent forest
PM-3	Coffee Creek Scorpionweed[2]	1 individual	Disturbed, exposed soil along the edge of adjacent forest
PM-4	Coffee Creek Scorpionweed[2]	6 individuals scattered linearly for 80 m	Open Trembling Aspen forest on moderate slope with well-developed dwarf shrub/forb understory and some leaf litter
PM-5	Coffee Creek Scorpionweed[2]	24 individuals scattered linearly for 100 m	Disturbed, exposed soil with few associated forb species
PM-6	Coffee Creek Scorpionweed[2]	17 individuals in a patch of approximately 20 m radius	Open Trembling Aspen forest on a moderate slope with dwarf shrub/forb understory and high leaf litter
CG-1	Spotted Lady's Slipper	4 scattered patches each with 11 individuals	Edge of open, Trembling Aspen forest at the crest of the bank with well-developed dwarf shrub/forb understory and tufted grasses
CG-2	Spotted Lady's Slipper	Approximately 3000 individuals in several patches within a larger patch about 1318 m²	Open Trembling Aspen forest on moderate slope with well-developed dwarf shrub/forb understory and tufted grasses
CG-6	Spotted Lady's Slipper	Approximately 3,000 individuals in two patches	Open Trembling Aspen forest on moderate slope with well-developed dwarf shrub and forb understory and tufted grass.
CA-1	Small Enchanter's Nightshade	1 patch, 1 m² of approximately 150 individuals	Transitional habitat between upland and sedge meadow, moist shaded area below deciduous shrubbery
CS-1	Dry-spike sedge	Approximately 100 individuals scattered within a somewhat linear patch about 600m in length	Open Trembling Aspen to mixed wood forest on flat to moderate slope with well-developed shrub and forb understory.

[1]Site number is unique to the species name proceeded by a number. For example, "CA" = Circaea alpina ssp. Alpina and "1" = site 1.

[2] When the Vegetation Baseline Report (EDI 2017) was developed, Coffee Creek Scorpionweed (*Phacelia mollis*) was also listed on the Yukon Watch List; however, it has since been removed from the list. These rows are highlighted grey.

7.6 Vegetation Trace Metals Sampling

Trace metals sampling for the Coffee Project characterizes baseline trace metal concentrations in soil and vegetation to anticipate future monitoring for vegetation health. Baseline data were initially collected in 2014, 2015 and 2016 focussed on the proposed mine site and within four distance categories relative to the mine footprint: adjacent (≤100 m), near (101–1,000 m), far (5.5–7.5 km) and control (≥15 km).

In 2019, supplemental sampling was implemented in response to concerns regarding five sites in the control distance category (≥15 km) at Thistle Mountain. Previously sampled sites at Thistle Mountain were removed from the dataset due to the possibility that they may have been compromised by previous disturbance, based on their proximity to an exploration road/quad track. The 2019 sampling was completed following the baseline study design and power analysis. The analyses determined that eight samples per distance category would be sufficient to detect a change in median metal concentrations before exceeding the recommended threshold for most chemicals of potential concern (CoPCs) in soil and vegetation (EDI 2017b).

As a baseline assessment of vegetation health, trace metal levels in soil and plants were sampled in July 2014, July to August 2015 and 2016. Sampling for trace metals focused on four plant species or species groups: willow, lowbush cranberry, horsetail (*Equisetum arvense, Equisetum pratense*, and *Equisetum sylvaticum*), and fruticose lichen (*Cladina* spp.). The plant species were chosen based on importance to First Nations (Bates and DeRoy 2014; Mishler and Simeone 2004), value as wildlife forage, and comparability to other studies. The vegetation health sites were considered as two areas: the Coffee Area (which includes the Mine Site, Mine Site access road, existing Coffee exploration camp and the proposed Casino Connector (no longer considered)), and the NAR. Vegetation health sample collection sites were based on variable distance from the Project footprint: adjacent (100 m), near (1,000 m), far (5.5 km to 7.5 km), and control (greater than 15 km). Adjacent sites are expected to fall within the Project footprint, while control sites represent locations unaffected by Project activities. From 2014 to 2016, a total of 89 vegetation health sites were sampled. Seventy-seven sites were located in the Mine Site and twelve sites were located along the NAR.

In the Coffee Area, trace metal concentrations in soil were low, with the exception of arsenic and chromium. Arsenic and chromium concentrations were above CCME soil quality guidelines in 24 (27%) and 4 (4%) samples, respectively. Arsenic samples above CCME guidelines were generally found within close proximity to the Mine Site, including adjacent (100 m) and near (1000 m) distances from the Project footprint. These high background levels could be due to the presence of arsenic associated with complex ores, mined primarily for their copper, lead, zinc, silver, and gold content (CCME 1997), which may be present in the Coffee Area.

Chromium samples above CCME guidelines were found at near (1,000 m) and control sites (greater than 15 km) relative to the Project footprint. Chromium rarely occurs naturally and is often introduced to the environment through anthropogenic sources (CCME 1999). All other trace metals consistently showed concentrations in soil well below the CCME guidelines. Relatively few soil samples reported mercury and selenium above the laboratory reported detection limit. The pH was below the recommended range in 71 (79%) samples at various distances from the Project footprint.

Soil samples collected along the NAR contained low concentrations of all but two of the targeted trace metals. Arsenic concentrations were higher than CCME guidelines in two out of 12 sites sampled. Zinc concentrations were well below CCME soil quality guidelines; however, two sites had higher than average concentrations and some of the highest recorded concentrations of zinc in soil across all sample sites. These sites also correspond to above average concentrations of zinc in willow. All three sites are near areas with existing anthropogenic disturbances. All other trace metals were consistently present at concentrations well below the CCME guidelines.

The vegetation and soils trace metals sampling program also informed the Human Health Risk Assessment (HHRA) completed as part of 2017 effects assessment for the Coffee Gold Project. The HHRA prioritized airborne contaminants associated with Project emissions, and a risk assessment of the impact of dust deposition on plants that are ingested by humans and animals with a specific focus on arsenic, chromium, iron and thallium. The HHRA focuses on the amount of trace metals specifically associated with waste rock disposal areas and not the whole area around any Project related activities. The Human Health Risk Assessment Technical Report and the Addendum Report are provided in Hemmera Envirochem Inc. 2017, 2018.

7.7 Invasive Plant Species

Invasive plants are ranked in degree of invasiveness (i.e., concern) from high priority (1) to least concern (7) (EDI 2017b). Yukon ranks are based on general abundance, persistence, invasiveness rank in neighbouring jurisdictions, climate projections, and expert opinion of the Yukon CDC (Environment Yukon 2012). High priority species are those that are of most concern to the economy, environment, and human health (YISC 2015). During field surveys in 2015 and 2016, 18 invasive plant species were documented including five rank 1 species (Table 7-5).

Locations within the survey extent where invasive plants were found included roadsides, pullouts, junctions and other previously disturbed areas. In general, concentrations of invasive plants were less frequent in the southern portion of the survey extent (i.e., NAR south of Stewart River, including the Mine Site) compared to the northern portion (north of Stewart River to Klondike Highway). Prior to Newmont's exploration work, human habitation at Coffee Creek (e.g., farming) led to relatively few invasive plant introductions, such as smooth brome and other lower priority species. Narrow-leaved hawksbeard and perennial sow-thistle are high priority species and were found in the vicinity of Coffee exploration camp but appear to be relatively new introductions because of the few plants found in single locations.

Table 7-5 Rank 1 Invasive Plant Species Located during Project Baseline Field Surveys

Invasiveness Rank[1]	Species Name	Common Name	Habitat	General Location		
				Northern Portion[2]	Southern Portion[2]	
				Existing Roads/ Disturbance	Existing Roads Outside of Coffee Property	Coffee Property
1	*Bromus inermis*	Smooth Brome	Roadside, Clearing	√		√
1	*Crepis tectorum*	Narrow-leaved Hawksbeard	Roadside, Clearing	√	√	√

Invasiveness Rank[1]	Species Name	Common Name	Habitat	General Location		
				Northern Portion[2]	Southern Portion[2]	
				Existing Roads/ Disturbance	Existing Roads Outside of Coffee Property	Coffee Property
1	*Melilotus albus*	White Sweetclover	Roadside, Clearing	√	√	
1	*Melilotus officinalis*	Yellow Sweetclover	Roadside	√		
1	*Sonchus arvensis* spp. *uliginosus*	Perennial Sow-thistle	Clearing			√

1 Yukon invasiveness rank (YG 2012).

2 For invasive plant surveys the study area was divided into two areas: the northern portion which included existing roads accessible by truck, north of the Stewart River, and the southern portion which included existing roads accessible by foot or UTV between the Stewart River and the current airstrip.

7.8 Post-Application Baseline Studies

Since the submission of the Project Proposal to YESAB in 2017, additional trace metals studies were completed for vegetation to supplement baseline information previously provided for the Project, address questions that were raised during the Project review, and refine proposed monitoring programs in anticipation of future Project monitoring requirements.

The 2019 Terrestrial Studies report EDI 2020 in Appendix G summarizes the environmental studies completed by EDI between October 2018 and November 2019, including the continuation of trace metals sampling. In 2019, supplemental sampling was implemented in response to concerns regarding five sites in the control distance category (≥15 km) at Thistle Mountain EDI 2020. Previously sampled sites at Thistle Mountain were removed from the dataset due to the possibility that they may have been compromised by previous disturbance, based on their proximity to an exploration road/quad track. The 2019 sampling was completed following the baseline study design and power analysis. The analyses determined that eight samples per distance category would be sufficient to detect a change in median metal concentrations before exceeding the recommended threshold for most chemicals of potential concern (CoPCs) in soil and vegetation (EDI 2017b). The 2019 trace metals program involved the collection of soil and vegetation samples at three sites in the control distance category (see Table 2-1, Map 2 of the 2019 Terrestrial Studies (Appendix G)). Vegetation sampling included three focal species or species groups: willow, fruticose lichen, and lowbush cranberry. Horsetail (*Equisetum* spp.) was not collected due to insufficient sample size determined during previous baseline sampling.

The baseline analysis was updated to include new sites collected in 2019. The 2019 baseline trace metals analysis results were generally consistent with the initial baseline assessment; mean metal concentrations of chemicals of potential concern in soil were below relevant CCME guidelines for agricultural standards in soil EDI 2020. All metal concentrations in vegetation were well below maximum tolerable levels, apart from cadmium in willow. No distinct patterns for metal concentrations in soil and vegetation were identified among distance categories, although some metals were naturally high at individual locations near the proposed mine site. Generally, metal concentrations in soil and vegetation samples were low with some high data outliers EDI 2020. No additional vegetation studies were reported in 2021.

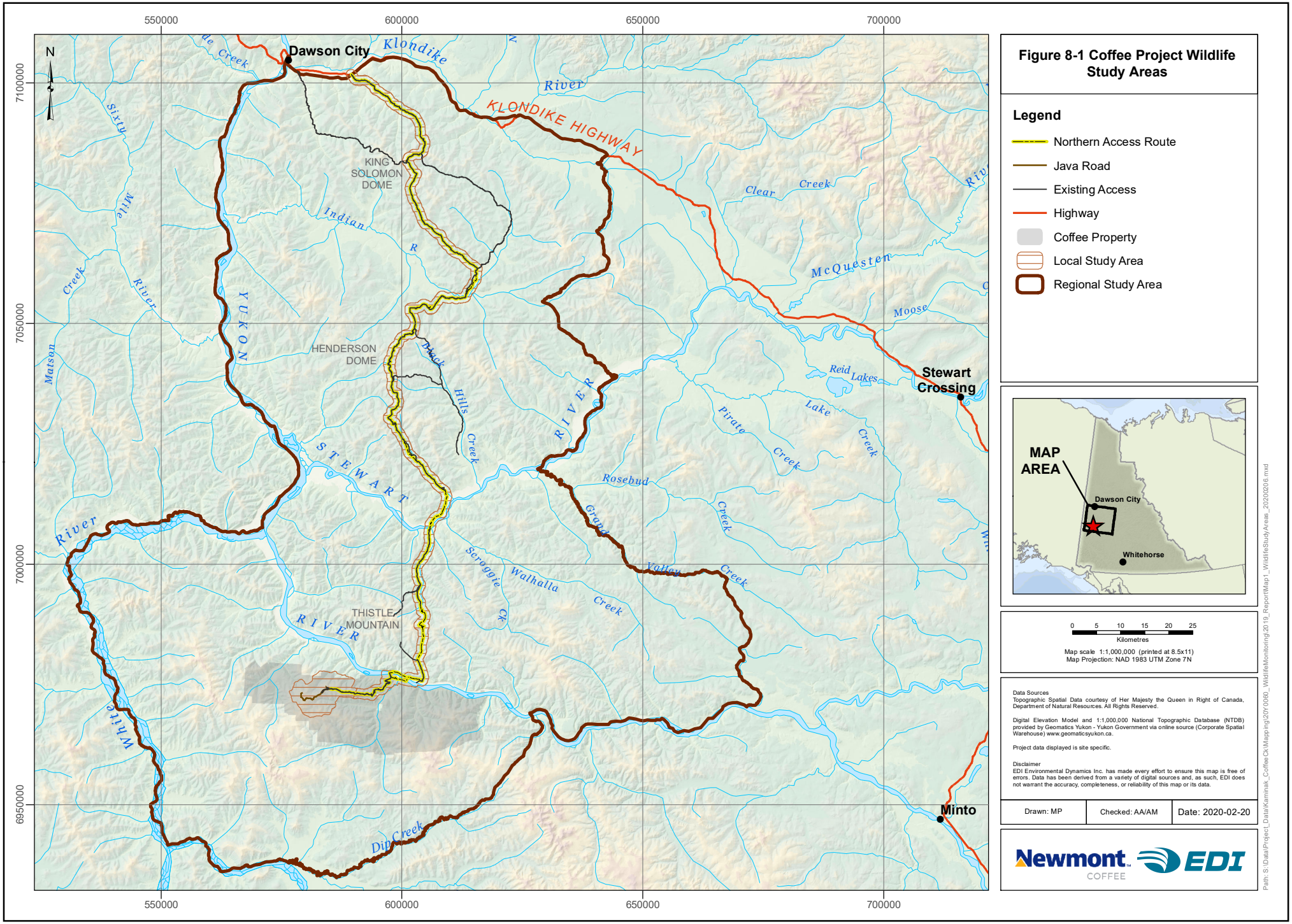
8.0 WILDLIFE

For the purposes of this report, 'wildlife' is defined as native bird and mammal species. Wildlife assessments were completed within, or near, the Project area. This section summarizes the results of wildlife surveys conducted in the area to date, identifies species of concern, and lists ongoing and/or near-future surveys to be completed. The last update on the number and types of wildlife studies that have been conducted in the Coffee Gold Mine Project area was in a comprehensive 2021 report produced by EDI, titled Environmental, titled *Terrestrial Studies Report.*

8.1 Wildlife Study Areas

The LSA used for Site Characterization Plan was derived based on the LAA used in the Effects Assessment. The LSA includes the proposed mine site and the proposed NAR to the junction with the North Klondike Highway. Around the mine site, the LSA is delineated based on the height of land while encompassing a minimum buffer of 1 km radius around the proposed mine footprint. Along the access route, the LSA includes a 1 km radius buffer from the centreline of the proposed or existing road.

The RSA is defined as the watershed drainages overlapping the Project footprint and a 10 km buffer around the various road alignment options.


550000
600000
650000
700000
7100000
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7000000
6950000
N
Dawson City
Klondike River
KLONDIKE HIGHWAY
Clear Creek
McQuesten
Moose
Stewart Crossing
Reid Lakes
Pirate Creek
Lake Creek
Rosebud Creek
Ground Hog Valley Creek
Walhalla Creek
Scraggie Ck
Dip Creek
KING SOLOMON DOME
HENDERSON DOME
THISTLE MOUNTAIN
Indian R
Black Hills Creek
YUKON RIVER
STEWART River
White RIVER
Matson Creek
Matson River
Minto
Figure 8-1 Coffee Project Wildlife Study Areas
Legend
Northern Access Route
Java Road
Existing Access
Highway
Coffee Property
Local Study Area
Regional Study Area
MAP AREA
Dawson City
Whitehorse
0 5 10 15 20 25
Kilometres
Map scale 1:1,000,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N
Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.
Digital Elevation Model and 1:1,000,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.
Project data displayed is site specific.
Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.
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8.2 Wildlife Environmental Setting

The Project footprint is situated within the boreal forest of the Yukon, which provides suitable habitats for multiple bird and mammal species. Habitat types present in the surrounding RSA range from sparsely vegetated alpine areas to dense lowland riparian forest (EDI 2017d). Large waterbodies such as lakes are not present although smaller wetlands and streams exist.

The Project is located within the range of the Klaza and Fortymile caribou (*Rangifer tarandus*) herds (EDI 2017d). Other large ungulates present in the vicinity of the Project (EDI 2017d) include moose (*Alces alces*), mule deer (*Odocoileus hemionus*), and thinhorn sheep (*Ovis dalli*). Grey wolves (*Canis lupus*) and grizzly (*Ursus arctos*) and black bears (*U. americanus*) are the largest predators. Smaller carnivores include red fox (*Vulpes vulpes*), coyote (*Canis latrans*), wolverine (*Gulo gulo*), Canada lynx (*Lynx canadensis*), American marten (*Martes americana*), mink (*Neovison vison*), ermine (*Mustela richardsonii*) and least weasel (*M. nivalis*). Rodents, lagomorphs and insectivores are represented by beaver *(Castor canadensis*), snowshoe hare (*Lepus americanus*), red squirrel (*Tamiasciurus hudsonicus*), northern flying squirrel (*Glaucomys sabrinus*), muskrat (*Ondatra zibethicus*), and multiple species of voles, mice and shrews (EDI 2017d). Little brown myotis (*Myotis lucifugus*) has been confirmed present in the lower elevations of the LSA (EDI 2017d). The wood frog (*Lithobates sylvaticus*) is the only amphibian species expected to occur (EDI 2017d).

The Coffee Gold Project is located within the Northwest Boreal Forest Bird Conservation Region (BCR4). EDI 2017d states that 119 bird species may potentially occur in the Project Proposal RSA including: songbirds, raptors, shorebirds and upland game birds. Waterfowl and waterbirds are relatively rare due to the lack of large waterbodies in the RSA. Wildlife Key Areas defined by the Yukon government for Sharp-tailed Grouse (*Tympanuchus phasianellus*), Peregrine Falcon (*Falco peregrinus*), Golden Eagle (*Aquila chrysaetos*) and Gyrfalcon (*Falco rusticolus*) are present in the vicinity of the Coffee Gold Project.

Baseline surveys have confirmed the presence of several wildlife species federally listed as at risk by COSEWIC or Schedule 1 of SARA. Wildlife species on the Yukon Conservation Data Centre's Track List or Watch List of species of conservation concern (YCDC 2019a), or afforded special protection under the Yukon *Wildlife Act* may also be present in the vicinity of the Project. A list of wildlife species at risk known present or potentially present in the Project Proposal RSA (EDI 2017d) is presented in Table 8-1.

Table 8-1 Wildlife Species at Risk Known Present or Potential Present in the Project Proposal RSA

English Name	Scientific Name	COSEWIC Status	*SARA* Schedule 1 Status	Yukon *Wildlife Act* Status	Yukon List	Confirmed in Wildlife RSA
Woodland Caribou, Northern Mountain population	*Rangifer tarandus caribou*	Special Concern	Special Concern	none	No	Yes
Grizzly Bear	*Ursus arctos*	Special Concern	Special Concern	None	No	Yes
Wolverine	*Gulo gulo*	Special Concern	Special Concern	None	No	Yes
Cougar	*Puma concolor*	No status	No status	Specially Protected	No	No
Collared Pika	*Ochotona collaris*	Special Concern	Special Concern	None	Watch List	Yes
Little Brown Myotis	*Myotis lucifugus*	Endangered	Endangered	none	Watch List	Yes
Horned Grebe	*Podiceps auratus*	Special Concern	Special Concern	None	No	Yes
Trumpeter Swan	*Cygnus buccinator*	none	none	Specially Protected	No	Yes
Golden Eagle	*Aquila chrysaetos*	Not at Risk	none	Specially protected	Watch List	Yes
American Kestrel	*Falco sparverius*	none	none	None	Track List	Yes
Gyrfalcon	*Falco rusticola*	Not at Risk	none	None	Watch List	No
Peregrine Falcon	*Falco peregrinus*	Special Concern	Special Concern	Specially protected	Track List	Yes
Sharp-tailed Grouse	*Tympanchus phasianellus*	none	none	None	Track List	Yes
American Golden-Plover	*Pluvialis dominica*	none	none	None	Watch List	No
Wandering Tattler	*Heteroscelus incanus*	none	none	None	Track List	No
Whimbrel	*Numenius phaeopus*	none	none	None	Track List	No
Surfbird	*Calidris virgate*	none	none	None	Track List	Yes
Short-eared Owl	*Asio flammeus*	Threatened	Special Concern	None	Track List	Yes
Common Nighthawk	*Chordeiles minor*	Special Concern	Threatened	None	Track List	Yes
Olive-sided Flycatcher	*Contopus cooperi*	Special Concern	Threatened	None	Watch List	Yes
Northern Shrike	*Lanius excubitor*	none	none	None	Watch List	No

English Name	Scientific Name	COSEWIC Status	*SARA* Schedule 1 Status	Yukon *Wildlife Act* Status	Yukon List	Confirmed in Wildlife RSA
Bank Swallow	*Riparia riparia*	Threatened	Threatened	none	no	Yes
Barn Swallow	*Hirundo rustica*	Special concern	Threatened	None	Track List	No
Mountain Bluebird	*Sialia currucoides*	None	none	None	Watch List	No
Townsend's Warbler	*Setophaga townsendi*	none	none	None	Watch List	Yes
Smith's Longspur	*Calcarius pictus*	none	none	None	Watch List	No
Rusty Blackbird	*Eophagus carolinus*	Special Concern	Special Concern	none	Track List	Yes

8.3 Focal Species

Focal species and species groups identified id 2017 by EDI Environmental Dynamics Inc. (2017d, 2017e) are listed in Table 8-2. Focal species and species groups were identified as those of conservation concern, those that are harvested by Indigenous or non-Indigenous hunters, those raised as a concern during Project consultation, those selected as focal species for previous Yukon environmental assessments, and those with the potential to interact with the proposed Project.

Table 8-2 Focal Mammal and Bird Species and Species Groups Identified in the 2017 Coffee Gold Proposal

English Name	Scientific Name
Caribou	*Rangifer tarandus*
Moose	*Alces americana*
Thinhorn Sheep	*Ovis dalli*
Mule Deer	*Odocoileus hemionus*
Grizzly Bear	*Ursus arctos*
Black Bear	*Ursus americanus*
Grey Wolf	*Canis lupus*
Wolverine	*Gulo gulo*
Furbearers	multiple
Collared Pika	*Ochotona collaris*
Bats	Chiroptera
Golden Eagle	*Aquila chrysaetos*
American Kestrel	*Falco sparverius*
Gyrfalcon	*Falco rusticola*
Peregrine Falcon	*Falco peregrinus*
Short-eared Owl	*Asio flammeus*

English Name	Scientific Name
Horned Grebe	*Podiceps auritis*
Red-necked Phalarope	*Phalaropus lobatus*
Sharp-tailed Grouse	*Tympanuchus phasianellus*
Upland Game Birds	mutliple
Common Nighthawk	*Chordeiles minor*
Olive-sided Flycatcher	*Contopus cooperi*
Bank Swallow	*Riparia riparia*
Barn Swallow	*Hirundo rustica*
Rusty Blackbird	*Euphagus carolinus*

8.4 Wildlife Baseline Studies

Baseline studies have been conducted for the Coffee Gold Project since 2011. Wildlife baseline studies are described below. Supplementary studies and monitoring programs have been conducted since 2013 to add to baseline information, address questions raised during the review, and refine wildlife monitoring programs in anticipation of future monitoring requirements.

8.4.1 Early Baseline Studies

Early baseline wildlife surveys for the Coffee Project began in 2011 and ungulate and bird studies were carried out into 2014 (Access Consulting Group 2011, 2013b, 2013a, 2014). Since 2014, EDI has conducted detailed baseline studies on the wildlife and wildlife habitats present within the Project area for Goldcorp Kaminak Ltd. (now Newmont) in anticipation of regulatory requirements associated with the Project's approval. Previous studies were generally conducted within a Regional Study Area (RSA) described as follows (EDI 2017d, 2018, 2019, 2020):

- The RSA encompassed 13,661 km² of terrain, including the proposed mine site, the NAR, and the surrounding areas (Figure 1-2). It included all game management subzones (GMS) that are near, or intersect, the proposed Project footprint.

Summaries of work completed for the 2017 Coffee Gold Project Proposal are included in the Wildlife Baseline Report (Appendix H, EDI 2017d). Studies completed for mammals included aerial surveys for ungulates, bear den surveys, sheep surveys, snow tracking surveys, remote camera studies, ground-based investigations of wildlife trails and habitat features, pellet plots, and targeted surveys for collared pika (*Ochotona collaris*), bats and small mammals. A small mammal trapping program was combined with trace metal analysis of small mammal tissue. Bird studies conducted included point count bird surveys, surveys for cliff-nesting raptors, and targeted surveys for Common Nighthawk (*Chordeiles minor*), Short-eared Owl (*Asio flammeus*), and Sharp-tailed Grouse (*Tympanuchus phasianellus*). Wildlife studies completed between 2014 and 2017 are listed in Table 8-3.

Table 8-3 Wildlife Studies Completed 2014 to 2017 for the Coffee Gold Project

Year	Target Species	Study	Report
2013, 2014, 2015	Upland birds	Bird Point Counts	EDI Environmental Dynamics Inc.(2017f)
2014, 2015, 2016	Common Nighthawk	Stand-watch Surveys	EDI Environmental Dynamics Inc.(2017f)
2014	Caribou	Pellet Collection and Dietary Analysis	EDI Environmental Dynamics Inc. (2017e)
2014	Bats	Acoustic Surveys	EDI Environmental Dynamics Inc. (2017e)
2014	Waterfowl	Aerial Survey	EDI Environmental Dynamics Inc.(2017f)
2014, 2015, 2016	Caribou	Summer Pellet Removal Plots	EDI Environmental Dynamics Inc. (2017e)
2014, 2015, 2016	Moose, Caribou	Late Winter Ungulate Aerial Surveys	EDI Environmental Dynamics Inc. (2017e)
2014, 2015, 2016	Cliff-nesting Raptors	Aerial Surveys	EDI Environmental Dynamics Inc.(2017f)
2015	Moose	Early winter moose Surveys	EDI Environmental Dynamics Inc. (2017e)
2015, 2016	Sharp-tailed Grouse, Ruffed Grouse	Lek Aerial Surveys, Point Count Surveys	EDI Environmental Dynamics Inc.(2017f)
2015	Collared Pika	Pika Surveys	EDI Environmental Dynamics Inc. (2017e)
2015	Small mammals	Mammal Trapping and Trace Metals Analysis	EDI Environmental Dynamics Inc. (2017e)
2015, 2016	Thinhorn Sheep	Thinhorn Sheep Aerial Surveys	EDI Environmental Dynamics Inc. (2017e)
2015, 2016	Thinhorn sheep, moose, caribou, wolves	Remote Camera Studies	EDI Environmental Dynamics Inc. (2017e)
2015, 2016	Thinhorn Sheep	Ground-based Surveys	EDI Environmental Dynamics Inc. (2017e)
2015, 2016	Caribou, Moose, Wolves, Wolverine, Furbearers	Snow-tracking Surveys	EDI Environmental Dynamics Inc. (2017e)
2015, 2016	Ungulates	Mineral Lick Investigation	EDI Environmental Dynamics Inc. (2017e)
2016	Moose	Moose Late Winter Habitat Suitability Modelling	EDI Environmental Dynamics Inc. (2016b)
2016	Thinhorn Sheep	Thinhorn Sheep Habitat Suitability Modelling	EDI Environmental Dynamics Inc.(2016c)
2016	Grizzly Bear	Den Surveys	EDI Environmental Dynamics Inc. (2017e)
2016	Grizzly Bear	Grizzly Bear Habitat Modelling	EDI Environmental Dynamics Inc.(2016a)
2016	Wolverine	Wolverine Denning Habitat Modelling	EDI Environmental Dynamics Inc.(2016d)
2017	Caribou	Resource Selection Model for the Fortymile Caribou Herd	Muhly (2017)
2017	Birds		EDI Environmental Dynamics Inc. (2017f)

8.4.2 Post-Application Baseline Studies

Additional wildlife surveys were carried out between 2017 and 2019, and descriptions of those surveys are included in the following reports:

- Coffee Gold Project: 2017 Bird and Wildlife Studies Report (EDI 2018)
- Coffee Gold Project: 2018 Wildlife Studies Report (EDI 2019)
- Coffee Gold Project: 2019 Terrestrial Studies Report (EDI 2020).

8.4.2.1 2020 Baseline Studies

Further data collection occurred through winter 2019/2020 and summer 2021 (EDI 2021) to support future monitoring programs. The 2020 study areas are generally the same as those described for the Project mine site and NAR in previous years (EDI 2017d, 2018, 2019, 2020). Some of the 2020 field studies (e.g., thinhorn sheep aerial survey) were conducted within a species-specific survey extent.

Field studies completed by EDI between October 2019 and September 2020 are summarized in Table 8-4. Field monitoring programs continued to focus on target species such as caribou, moose, thinhorn sheep, and wolves. The results of the 2020 wildlife studies are generally consistent with previous baseline surveys. These results do not change the conclusions of the Wildlife and Wildlife Habitat Valued Component Report (EDI 2017c).

Table 8-4 Wildlife Studies Conducted for the Coffee Project, October 2019 to September 2020

Study	2020 Component	Target Species	Dates Conducted
Summer Sheep Aerial Survey	Baseline field survey	Thinhorn sheep	July 15, 2020
Remote Camera Studies	Baseline field survey	Thinhorn sheep, moose, caribou, wolves	October 1, 2019-September 21, 2020
Mineral Lick Monitoring	Baseline field survey	Moose	
Wildlife Camp Log	Surveillance monitoring	All species	

The 2021 report (Appendix H) provides a full description and data analysis of the field studies completed between October 2019 and September 2020. Brief summaries of the 2020 work are provided below. Studies were conducted for the area included in the Project Proposal, which includes the mine site (subject of this application) and the NAR (permitted under separate application). The descriptions of the studies focus on the mine site, however some results for the NAR are included for context, such as studies near Ballarat Creek, the northern Yukon barge staging area.

One thinhorn sheep aerial survey was conducted in July 2020. Observations included one group of three unclassified sheep on a cliff west of Ballarat Creek and a solitary unclassified sheep east of Ballarat Creek. Remote camera monitoring showed that at least two ewes and one ram use the Ballarat area.

The remote camera program continued in 2020 to monitor wildlife and wildlife habitat features throughout the Regional Study Area and traffic along the proposed Northern Access Route. There were 24 active sites, although theft and wildlife damage shortened the operating windows of several cameras. Commonly

documented species in 2020 included black bear, lynx, moose, and wolf. Focal species for the remote camera programs include thinhorn sheep, moose, caribou, and wolves. As this program focussed on the NAR, it is not discussed further.

In 2020, monitoring the Northern Access Route mineral lick between the Stewart and Yukon rivers consisted of continuing the remote camera monitoring program and collecting a water quality sample. A review of the remote camera photos showed that results were consistent between 2017 and 2020 and with other mineral lick studies. Moose were the primary users of the lick; lynx, wolves, grizzly bears, black bears, wolverine, and small mammals were observed travelling through the site. Moose used the lick between May and October annually, with the highest activity occurring between June and August. Moose use was highest in the early morning hours, and cows used the lick more frequently than bulls. The mineral lick water sample showed similar patterns in elevated nutrients compared to 2019; however, some were detected at higher concentrations than in 2019.

The 2020 camp wildlife log recorded observations for two months while the camp was open. The shorter data collection period correlates to fewer documented wildlife sightings. Fourteen species, including seven mammals, were recorded. As in previous years, black bear and moose were the most common species reported.

9.0 SOIL AND BEDROCK

This section provides the environmental setting for surface conditions (physiography and surficial materials) and permafrost. The environmental baseline report for surficial geology, permafrost, and terrain stability is provided in Appendix A.

9.1 Physiography Environmental Setting

The Project is located in the northern Dawson Range of the Yukon-Tanana terrane, forming a moderate plateau that escaped Pleistocene glaciation. The landscape evolved through erosional and periglacial processes. The dominant periglacial processes at the Coffee Gold site are cryoturbation, solifluction, slope wash and thermal erosion. The topography generally consists of rounded ridges with incised v-shaped valleys (AECOM, 2012). Elevations across the property range from 400 to 1,500 m asl with the majority of the property above the tree line and supporting short shrubby vegetation (JDS, 2016). The property has local mature pine forests with thick moss cover on the ground. Bedrock exposures on the property are rare (<5%).

9.1.1 Previous Studies

A surficial geology map of the Coffee Creek area has been compiled by the Geological Survey of Canada (Huscroft, 2002). AECOM (2012) was retained by Kaminak Gold Corporation (Kaminak), a previous owner of the Project, to compile a detailed geomorphological map to aid in the selection of appropriate sampling sites for soil geochemical characterization. Both maps identify colluvium as the most widespread surficial material within the project area. The ridgetops and upper slopes are generally dominated by in-situ residual soils and colluvium derived from weathering of bedrock. The colluvial material is variable and typically contains mixtures of gravels, sands, and silts with organic materials in the upper 0.1 to 0.2 m layer. The ridgetop soils are up to approximately 1.8 m deep and generally ice-poor. The thickness of the strongly weathered bedrock is variable but is generally less than a metre. The build up of colluvium is greatest on lower slopes, which tend to be steeper than upper slopes. Dominant colluvial processes include slope creep, debris slides and minor rock fall.

9.1.2 Bedrock Geology

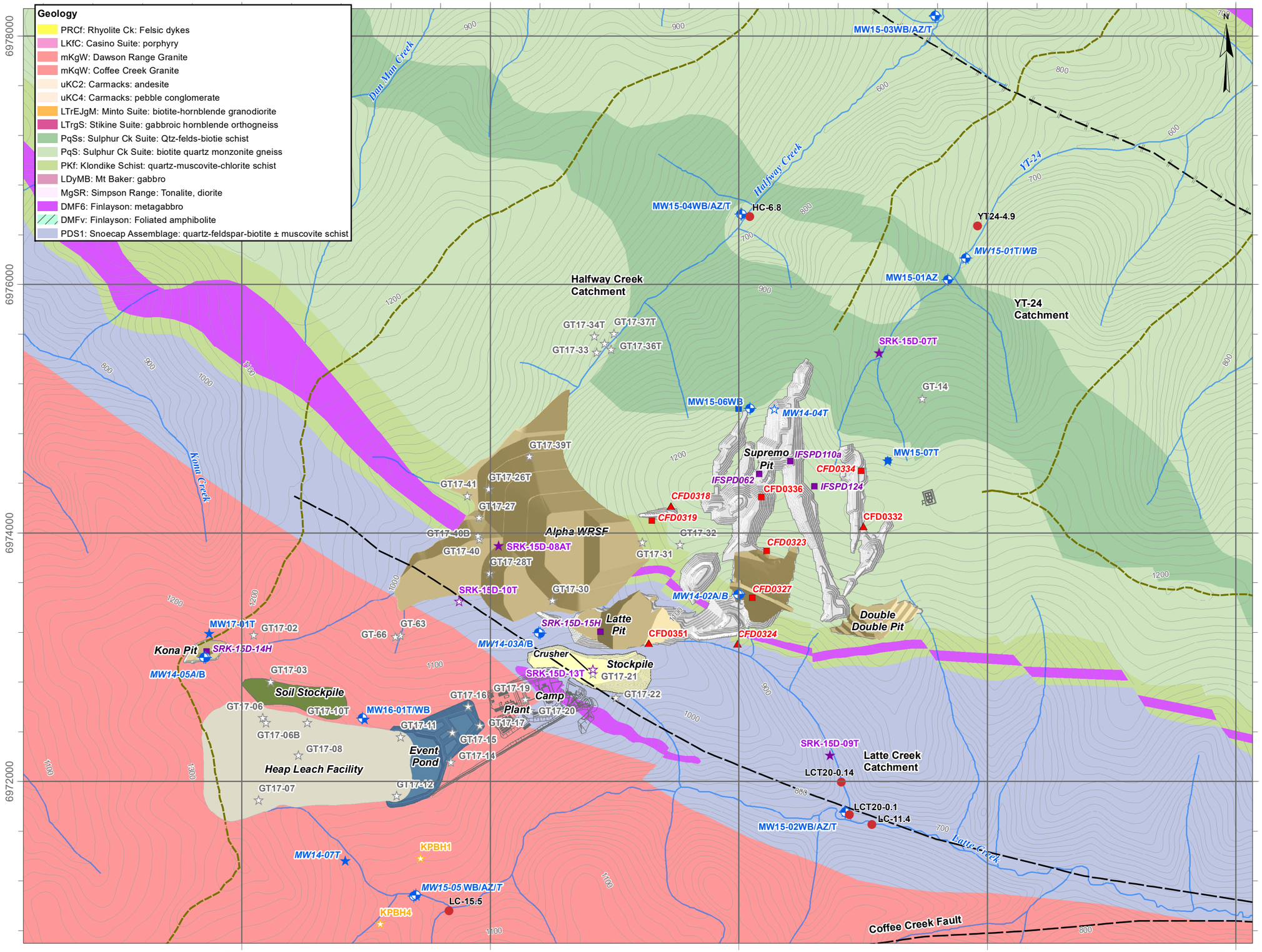
A detailed account of the geologic setting and mineralization of the Coffee Gold Mine Project is provided in the 2016 Feasibility Study (JDS, 2016). The Project is underlain by a package of metamorphosed Paleozoic rocks of the Yukon-Tanana terrane that was intruded by a large granitic body in the Late Cretaceous. The Paleozoic rock package is predominantly a biotite (+ feldspar + quartz + muscovite ± carbonate) schist that overlies an augen orthogneiss. Both the Paleozoic metamorphic rocks and Cretaceous granite are cut by intermediate to felsic dykes of andesitic to dacitic composition. Grodziki *et. al.* (2015) have compiled the most recent geological map of the Coffee Gold deposit area, informed by a combination of geological traverses, bedrock mapping, borehole data, soil geochemistry, and geophysics. This map has been used as the base map for Figure 9-1, which also shows mine facilities and instrument locations for reference.

The main Coffee Gold mineralization is associated with an extensional deformation event that occurred during the Cretaceous. This event resulted in formation of steep-to-vertical brittle fractures and normal faults crosscutting all lithologies at the Project area (Berman et al., 2007). A CO_2-rich fluid flowed through the region and travelled upwards in the system into the epizonal domain of the Coffee Gold Mine Project, where

it was controlled by the structural framework of the Coffee fault system and reacted with favorable host rocks (Buitenhuis *et. al.*, 2015; Buitenhuis, 2014). The fluid travelled along brittle structures and deposited gold-rich arsenian pyrite through sulphidation, and in high-energy pulses, formed gold-rich hydrothermal breccias (Buitenhuis, 2014). The planar gold mineralized zones at the Project exhibit a number of strike orientations, dominated by east-west, north- south, and east-northeast–west-southwest strike directions.

The Supremo zone is housed in several drill-tested T-structure gold corridors which are 5 to 30 m wide. The Latte zone consists of a stacked set of moderately-to-steeply south- southwest dipping, east-southeast striking brittle-ductile structures. The Double Double zone consists of a number of discrete, high-grade strands of mineralization up to several metres wide, trends east-northeast steeply dipping to the north and consists of a number of discrete, high-grade strands of mineralization up to several metres wide. The Kona zone is hosted in equigranular granite and consists of east-northeast trending, steeply south- dipping stacked structures. The gold structures are associated with narrow, less than 5 m wide, sparsely feldspar phenocrystic to aphanitic andesite to dacite dykes.

Kaminak (2015) prepared a map of all confirmed mineralized structures identified on the property. The map identifies structures confirmed by drilling, trenching, or soil sampling and does not include regional-scale inferred faults. Structures identified in this map have been included in hydrogeologic maps provided in subsequent sections of this report due to their relevance as potential groundwater conveyance pathways.



LEGEND

Monitoring Well:
AZ = active zone, WB = Westbay,
A = deep conventional (200+m)
B = shallow coventional (150+m)
T = thermistor/VWP
BH = original drillpad name

- Thermistor (Lorax 2014)
- Thermistor (KP 2014)
- Thermistor (SRK 2015)
- Thermistor (TT/SRK, 2016,2017, 2020)
- Thermistor/VWP (Lorax 2015,2016,2017)
- Thermistor/VWP (SRK 2015)
- Vibrating Wire Piezometer (VWP) (EBA 2013)
- Packer Tests (EBA 2013)
- Packer/Slug Tests (Lorax 2014)
- Packer Tests (SRK 2015)
- Surface WQ Monitoring Stations
- Surface and Hydrology Monitoring Stations
- Linament (Huscroft, 2002)
- Fault (Approximate) (Grodzicki et. al, 2015).
- Catchment Boundary
- Elevation Contours (20m)

Proposed Infrastructure

- WRSF/Backfill
- Pit
- Heap Leach Pad
- Event Pond
- Soil Stockpile
- Stockpile Pad

Italics in name indicates location was hydraulic tested (packer or airlift)

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:30,000

0 500 1,000 Meters

DATE SAVED:	Feb 03, 2021
DRAWN BY:	GM/AL
REVIEWED:	LF
VERSION:	1

CLIENT:

Newmont COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE:

Bedrock Geology of the Coffee Gold Project

PROJECT #: A362-4 *FIGURE:* 9-1

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9.2 Permafrost

9.2.1 Permafrost Environmental Setting

The Project is located in an area classified by Natural Resources Canada (1995) as extensive discontinuous permafrost (i.e., 50% to 90% of the land underlain by permafrost). The most recent estimates of permafrost distribution at the site indicate that approximately 61% of the mine area is underlain by permafrost with 34% of the area estimated to be permafrost free (Tetra Tech 2019b). Of the 61% underlain by permafrost, 29.5% is underlain by predominantly ice-poor permafrost, 31% by predominantly ice-rich permafrost; and approximately 0.5% by very ice-rich permafrost. The permafrost-free area of the mine site is estimated at 39%.

9.2.2 Permafrost Studies

Frozen ground has been mapped at the Project using a variety of methods. AECOM (2012) first mapped frozen ground on the property for a geomorphological mapping study supporting strategic soil sampling for exploration purposes. EBA Tetra Tech (EBA TT) further investigated permafrost occurrence through field mapping and air photo interpretation (2016). A terrain stability/geohazard map was produced by Palmer (2016). Various investigations to characterize permafrost occurrence and extent have been completed for the Project which have resulted in the establishment of numerous thermistor installations (e.g., EBA TT in 2013, Knight Piésold in 2014, SRK in 2015, Lorax in 2014, 2015, 2016, 2017, Tetra Tech and SRK in 2016 and Tetra Tech in 2017). Additional information regarding permafrost distribution at the Mine Site are provided in Waste Rock and Overburden Management Plan (WROMP) and the General Mine Development Plan.

9.2.2.1 Ground Temperature Monitoring

As permafrost is defined based on temperature, the key method of its monitoring is a regular collection of ground temperatures. It is especially important for the zone of discontinuous permafrost (<90% of land area underlain by permafrost), such as the Project Area with 61% of it underlain by permafrost, because the collected ground temperature data allows for delineating perennially frozen and permafrost-free areas and applying different design solutions for these areas. Although various techniques and equipment are available for collecting ground temperature data, thermistors are the most widely used, reliable and accurate sensors. Multi-bead (16 beads) Ground Temperature (a.k.a. Thermistor) Cables (GTCs) and Single-Bead Thermistor Strings (SBTSs) were installed in completed boreholes throughout the Project Area. In 2022, a review of recent ground temperature data from the Coffee Mine Project Area was carried out, including updated ground temperature monitoring profiles, covering the period from 2016 to 2022 (Tetra Tech 2023).

9.2.2.2 Site Inspection

Annual helicopter-supported inspection of the permafrost conditions in the Project Area will be a part of the Permafrost Monitoring Program (PMP). The program will include Tetra Tech's permafrost specialist's site visit in early September to observe the permafrost terrain conditions and document changes that have occurred since the last inspection site visit. This will be accomplished by traversing the Project Area on foot, truck, ATV, and/or using helicopter-support. Previously identified geomorphic features indicative of permafrost degradation (such as thermokarst, thermal erosion, slope movement processes) will be re-visited, and newly identified ones will be mapped.

9.2.2.3 Drone-Supported Aerial Geospatial Data Collection

Tetra Tech will use its industrial multirotor drone (a DJI Matrice 600 Pro) along with a Light Detection and Ranging (LiDAR) sensor package developed in-house at Tetra Tech to monitor stability of permafrost terrain features in the Project Area. This sensor package is light-weight, permitting extended flight times for data collection, relative to larger, heavier sensors. The sensor acquires 100,000 shots per second across a 120° swath (i.e., 60° to either side of the drone), in 16 different sweep planes. The drone is programmed to fly in a back-and-forth pattern over the area of interest, at a constant altitude offset from the ground, typically 50 m to 60 m. Whenever possible, a series of retroreflective ground control targets should be laid down in the flight area prior to the flights, and their exact position measured with a survey system (typically an RTK GPS survey unit). The point cloud can then be corrected to these points, anchoring the LiDAR data to the "real world".

Permafrost Distribution Mapping Permafrost map polygons were delineated per the following available information:

- Geobotanical indicators: − Stunted black spruce stands on shallow permafrost; and − Deciduous (dominantly aspen and birch) stands on predominantly permafrost-free terrain
- Slope aspect: − North-facing slopes indicate predominantly permafrost terrain; whereas − South-facing slopes suggest predominantly permafrost-free terrain
- Extrapolated ground surface appearance (texture, colour, hue etc.) of those terrain units where permafrost conditions were identified and confirmed by ground temperature measurements with GTCs and SBTSs installed in selected boreholes to verify presence or absence of permafrost. The instrumentation borehole locations are shown on Figure 9.2. The latest ground temperature profiles, as of March 30, 2019, are presented in Appendix B of the Permafrost Monitoring Program Report (Tetra Tech 2022).

9.2.2.4 Permafrost Distribution Modelling

Detailed information collected on an annual basis which will include ground temperature data (Section 4.1), site inspection and aerial geospatial data (Sections 4.2 and 4.3) as well as detailed permafrost mapping update (Section 4.4) will be compiled on an annual basis to train models for permafrost distribution and refine the mapping. Mean annual air temperature, potential incoming solar radiation, soil type (organic vs. mineral; fine- vs. coarse-grained), predominant vegetation type, slope gradient, and aspect are principal factors that affect and regulate the presence and absence of permafrost. These principal factors along with annual data collection will be used to train and develop ML models for large scale permafrost distribution mapping.

9.2.2.5 Monitoring Data Analysis and Reporting

An annual Permafrost Monitoring Data Analysis Report will be prepared. The report will include:

- The ground temperature profiles updated with the latest GTC data received from Newmont and a summary of the data analysis and interpretation
- The results of annual site inspection of permafrost conditions throughout the Project Area
- Geospatial data collected annually with a drone
- Updated permafrost map of the Project Area

- Permafrost distribution model of the Project proposed expansion areas where presently no ground temperature or other geotechnical borehole data is available
- A summary of the annual climatic data review.

9.2.2.6 Permafrost Adaptive Management

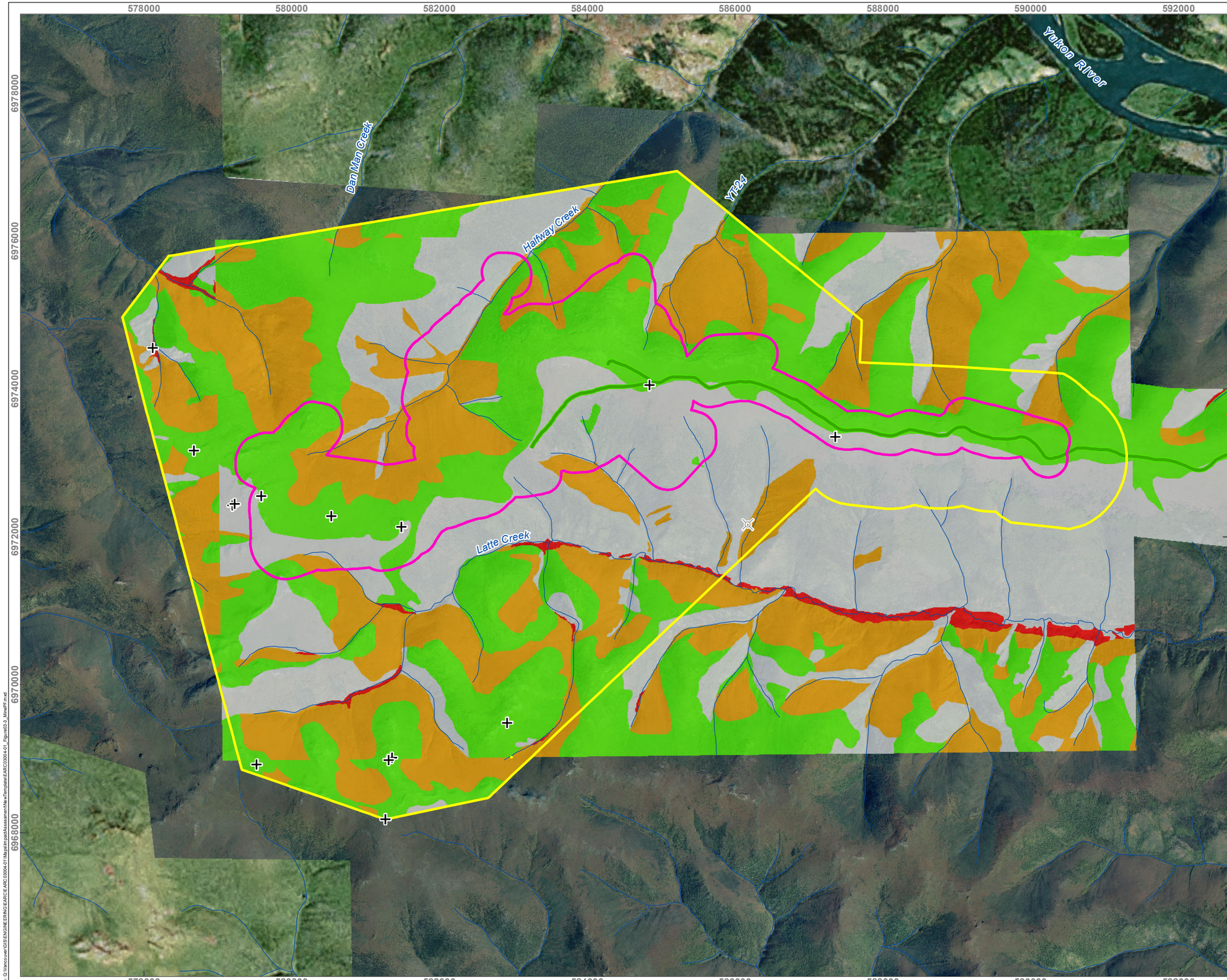
Adaptive management of permafrost underlying the Project Area will be a systematic approach that links ground temperature monitoring and observations made during annual site inspections with response actions to reduce potential permafrost degradation. Possible changes in the permafrost regime, due to mine development and climate change, require triggers and planned responses to mitigate future permafrost degradation. Adaptive management will also help to evaluate the long-term success of permafrost preservation and will confirm that disturbed areas throughout the Project Area have stabilized and are performing as expected.

9.2.2.7 Permafrost Response Action Plan

The permafrost response framework includes the following:

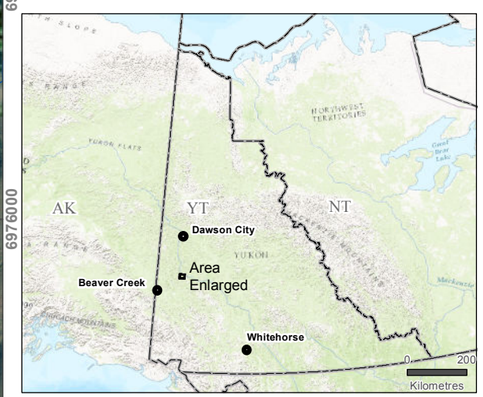
- Triggers to identify signs of potential permafrost degradation
- Response actions to reduce or mitigate permafrost degradation.

The objective of the Permafrost Response Framework is to define best management actions, to the greatest extents possible, in response to changes documented through the PMP implemented for the Project Area. The Permafrost Response Framework will be a clearly defined and timely process that is responsive to the results of the PMP. It provides the means to respond to all reasonable monitoring outcomes, without the need to develop specific management responses to all possible (i.e., theoretical) outcomes before they occur.



COFFEE GOLD MINE

Existing Permafrost Conditions within the Mine Site Area



Legend

- Local Assessment Area
- Regional Assessment Area
- Mine Site Access Road
- Pingo (collapsed)
- Tor
- Watercourse

Permafrost Classification

- Unfrozen
- Frozen, no visible ice (Fn)
- Frozen, visible ice (Fv)
- Frozen, ice-rich (Fi)

Notes

1. This map is not intended to be a "stand-alone" document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Imagery from Kaminak. Additional imagery from ESRI; Earthstar Geographics (1999)
3. Permafrost data from Tetra Tech EBA (April 2016) and Palmer Environmental Consulting Group (March 2016)

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Figure 9-2	Date: Mar 16, 2017	Drawn by: MEZ	Reviewed: TP

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10.0 SEISMICITY

10.1 Regional Seismicity

The Project is located in an area of relatively low seismic activity northeast of the seismically active St. Elias region, which includes southwestern Yukon Territory, northwestern BC, and southeastern Alaska. The Project is located between the Denali and Tintina fault systems, where the rates of seismic activity decrease dramatically (NRC 2016a). In the St. Elias region, the Pacific tectonic plate is being forced underneath the North American tectonic plate through subduction.

The seismic hazard for the Project area predominantly consists of shallow crustal earthquakes (with magnitudes of up to 7.0 on the Richter Scale) that may occur in the region south of the Project (greater than 100 km) (NRC 2016a). Seismic hazards are influenced by the potential for larger-magnitude earthquakes (with magnitudes from 7.5 to 8.0) occurring further from the Project site (greater than 100 km) on the East Denali fault zone, near the Alaska-Yukon border (NRC 2016a).

Newmont completed a review of the regional tectonics and historical seismicity in the southwest Yukon region to enable the selection of appropriate design earthquake events for key Project components, such as the HLF. The closest seismograph stations to the Project area are located in Dawson and Beaver Creek (NRC 2016b). The closest historical earthquakes have occurred near Beaver Creek, the most recent being a magnitude 4.2 earthquake in 2012, which is characterized as a light earthquake, slightly felt, but during which zero to minimal damage occurs (Belik 2013, NRC 2016c). Other stronger earthquakes have occurred recently in the southwestern part of the territory causing power outages and minor building damage in Whitehorse (Barton and Tukker 2017).

Regional seismic source zones were assigned to a map of historic earthquake events for the specific purpose of evaluating potential seismic loads for the Mine Site. Six seismic source zones were identified, which (proceeding from northeast to southwest) are as follows:

1. Tintina North Zone.
2. Inland Alaska Zone.
3. Tintina Trench Zone.
4. Denali Fault Zone.
5. Aleutian Megathrust Zone.
6. Fairweather-Queen Charlotte, Transition Fault Zone.

The purpose of identifying discrete seismic source zones is to characterize and quantify the nature of the largest earthquake that is likely to occur within the zone. In factoring in the largest earthquake that could reasonably be expected to occur within the zone, is the mean rate recurrence interval, and the location of the earthquake. Seismic source zones come in two varieties:

1. Aerial Seismic Source – where the earthquakes are uniformly distributed throughout the area and assumed to be equally likely to occur anywhere within the area.
2. Linear Seismic Source – where the earthquake occurs along a narrow linear band (fault) but are again assumed to be equally likely to occur anywhere along the fault line.

This information can be utilized in either a deterministic seismic hazard analysis (SHA) or a probabilistic seismic SHA. The results of both the deterministic and probabilistic SHAs completed for the Project are described in Appendix I.

A deterministic SHA estimates the largest earthquake event that could occur within the zone, and then relocates it to the position that most closely approaches the Project (either along the fault in a narrow linear source zone or within the area boundaries in an aerial source zone). Site-specific ground motion parameters are then estimated by attenuating ground motion between the earthquake location and the site. Although this may seem like a logical worst-case type of approach, it can lead to unrealistically severe design criteria.

The probabilistic SHA can be performed using the same seismic source zones as the deterministic SHA and replacing the maximum credible earthquake with the probability distribution of earthquake events, the site distance with the probability distribution of site distances, adding a random component to the attenuated spectral acceleration values, and using a Monte Carlo-type sampling model to compile a new distribution of spectral accelerations associated with an exceedance probability. The design ground motions from the deterministic SHA are similar but more conservative, at least for natural periods less than 0.8 seconds. The reduced probability of larger earthquakes occurring in very close proximity to the site moderates the distribution of spectral accelerations resulting in reduced short period spectral acceleration values from the probabilistic SHA. Beyond the natural period of 0.8 seconds, the design spectral acceleration (Sa) is slightly less than both the 2% and 5% exceedance earthquakes (return periods of 2,475 years and 1,000 years, respectively), implying that these rare, large earthquakes occurring at larger radial distances have a magnitude higher than the maximum credible earthquake selected for the deterministic SHA.

Table 10-1 Summary of Probabilistic Seismic Hazard Analysis Results

Annual Exceedance Probability	0.01	0.0021	0.001	0.000404
Recurrence Interval (years)	100	475	1000	2475
Probability of Exceedance in 50 Years	40%	10%	5%	2%
Period (*s*)	Sa (*g*)	Sa (*g*)	Sa (*g*)	Sa (*g*)
PGA	0.038	0.067	0.086	0.0116
0.2	0.068	0.123	0.161	0.225
0.5	0.049	0.087	0.112	0.151
1	0.034	0.062	0.078	0.103
2	0.22	0.039	0.048	0.063
4*	0.011	0.0195	0.024	0.0315

Notes; * - per the 2010 NBCC the 4s Sa = (2s Sa)/2

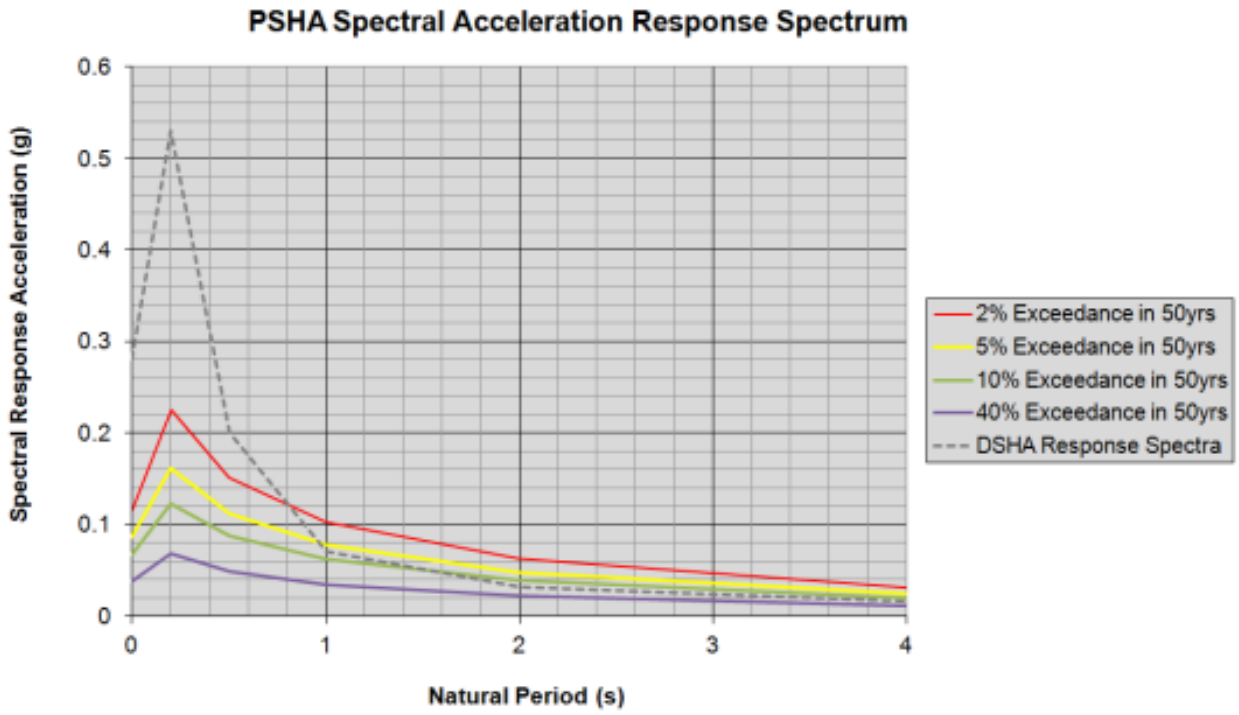

Figure 10-1 Plot of the Probabilistic Seismic Hazard Analysis Results

For the structural design of buildings and other structures at the Mine Site, the probabilistic SHA in the 2010 National Building Code of Canada (NBCC) are applied, based on the results shown in Table 10-1 and Figure 10-1, for the earthquake event having a 2% probability of exceedance in 50 years.

11.0 GEOCHEMISTRY AND GEOTECHNICAL INFORMATION

11.1 Geotechnical Hazards

The Mine Site is located in an area with gentle to moderate slopes that are typical of lower valley sides and in uplands. Geohazards identified within the Mine Site area include rockfall, debris slides, rock creep, gullying, solifluction, thermokarst, and slopewash. The majority of the Mine Site area (~85%) is considered to be relatively stable (terrain stability classes 0 to II) (Table 11-1;Figure 11-2). When combined with areas that are considered to be generally stable with minor potential for instability (class III), this increases to approximately 97%. Areas that are considered relatively unstable (terrain stability classes IV and V) within the Mine Site area are minor (Figure 11-2).

Along the NAR (including areas requiring new construction), ~80% is considered to be relatively stable (stability classes 0 to II) (Table 11-1). When terrain stability class III is included, the proportion increases to 93%. Approximately 7% has been classified as relatively unstable (classes IV and V), owing primarily to steep, gullied slopes and areas underlain by permafrost displaying thermokarst activity. Approximately 14% of the NAR area has no terrain stability rating assigned (class 0) and is associated with anthropogenic disturbances, largely from placer mining activity along the valleys of larger tributaries.

Table 11-1 Distribution of Terrain Stability Classes within the Mine Site Area and Northern Access Route

Existing Terrain Stability Class	Terrain Stability Class Description	Mine Site Area		Northern Access Route	
		(ha)	(%)	(ha)	(%)
0	N/A, Anthropogenic	-	-	2,823	14
I	Stable	-	-	509	3
II	Generally Stable	1,561	85	12,422	63
III	Generally Stable with Minor Potential for Instability	214	12	2,621	13
IV	Potentially Unstable	18	1	199	1
V	Unstable	44	2	1,199	6
	Total	**1,837**	**100**	**19,773**	**100**

The primary hazards requiring consideration during construction of the mine facilities and access road include rockfall, debris slides, icing, slope failure, active layer detachments and thermokarst activity. Infrastructure has been sited to maximize stability and minimize exposure to geotechnical hazards. Further, careful site preparation, and mitigation during construction will minimize exposure to these hazards, where unavoidable. Erosion protection, such as riprap, will be required along sections of the NAR near migrating meanders and river crossings. Special consideration will be given to the design and maintenance of drainage crossings prone to icing.

578000 580000 582000 584000 586000 588000 590000 592000

6978000 6976000 6974000 6972000 6970000 6968000

Dan Main Creek

Halfway Creek

YT-24

Yukon River

Latte Creek

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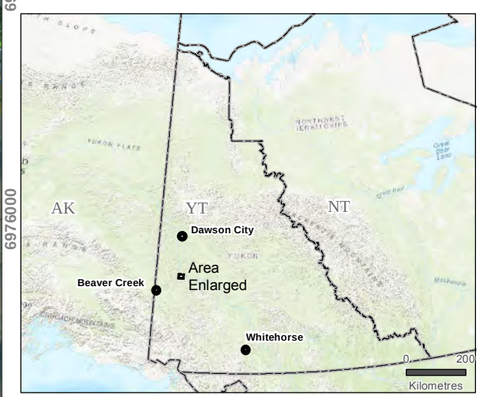
Existing Terrain Stability Conditions within the Mine Site



Legend

- Study Area
- Mine Site Access Road
- Pingo (collapsed)
- Tor
- Watercourse

Existing Terrain Stability Class

- 0 - N/A, Anthropogenic
- I - Stable
- II - Generally Stable
- III - Generally Stable with Minor Potential for Instability
- IV - Potentially Unstable
- V - Unstable

Notes

1. This map is not intended to be a “stand-alone” document, but a visual aid of the information contained within the referenced Report. It is intended to be used in conjunction with the scope of services and limitations described therein.
2. Imagery from Kaminak. Additional imagery from ESRI; Earthstar Geographics (1999)
3.Terrain data provided by Palmer Environmental Consulting Group (March 3, 2016)

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Figure 11-1	Date: Feb 21, 2018	Drawn by: MEZ	Reviewed: TP

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11.2 Geochemical Source Term

Geochemical source terms have been developed for the major mine components, taking into account mine-related activities throughout the Construction, Operations, Reclamation and Closure and Post-closure phases. The source terms are based on site-specific static and kinetic geochemical test results, as well as data from analogue sites. The approach and assumptions used to develop the geochemical source terms are discussed in detail in Geochemical Source Term Report (Appendix J).

Coffee Mine Project Geochemical Source Term Report describes geochemical source terms used in the Coffee Mine project water quality model (WQM). Geochemical source terms are water quality predictions for water in contact with geologic material disturbed by mining activities. Individual source terms are developed on an annual basis for each year of mine life at for post-closure. The report describes source terms for:

- WRSFs
- Pit Wall Rock
- Haul Roads
- ROM Stockpiles
- Active and Passive Treated Heap Leach Solutions.

All source term inputs used in the current version of the WQM, including those related to the HLF, are presented in Appendix J. For each mine component, an upper case and a base case source term has been calculated. The base case source term is meant to reflect a best estimate, while the upper case is meant to reflect a reasonably conservative upper estimate. These predictions become inputs to the site wide water quality model used to assess potential effects of the Project on the receiving environment. The source terms developed in this report are compared to the previous iteration of source terms (Lorax, 2018) in Appendix J. Source terms presented herein reflect updated mine configuration and changes to the proposed mine waste management practices.

11.2.1 Waste Rock Storage Facilities

Approximately 300-330 Mt of waste rock will be excavated from the Supremo Pit, Double Double Pit, Latte Pit and Kona Pit over the life of the Project. Waste rock will be stored in one out of pit waste rock facilities (Alpha WRSF) and four in-pit WRSFs (In-Pit Supremo, In-Pit Latte, In-Pit Double Double and In-Pit Kona). An annualized progression of WRSF footprints and volumes has been provided by JDS for the 300 MT CMUS (Shape file reference). The lithologic composition of each waste rock facility is estimated by assuming; no re-handling of waste rock take place, and waste rock is deposited in the WRSF nearest the origin of excavation; and the proportion of different weathering states is the same as what was anticipated in the Project Proposal. This assumption results in waste rock from the Latte Pit and Kona Pit being stored in the Alpha WRSF, while waste rock from the Supremo Pit and Double Double pits are placed in the Alpha WRSF and all four In-pit dumps. This results in the Alpha WRSF being the only facility which contains a mixture of different lithologies. The other waste rock dumps will be composed of exclusively gneiss waste rock. The tonnage and geologic composition of the five WRSFs can be found in Appendix J. The annualized footprint of WRSF's is provided in Table 11-2. Additional information regarding design criteria and WRSF construction and material management at the Mine Site are provided in WROMP.

At the end of mine life, the mine pits will begin to flood. The ultimate pit lake volume will be controlled by the spillway elevation of each backfilled pit. The percentage of each backfill dump below the spillway elevation, and the percentage of the dump footprint occupied by saturated waste rock, is provided in Table 11-3.

Table 11-2 Surface Area of Mine Facilities in each Year of Mine Life

	Alpha WRSF	In-Pit Kona	In-Pit Latte	In-Pit Supremo	In-Pit Double Double
Year	ha	ha	m2	ha	ha
Y1	57.4	-	-	-	-
Y2	96.8	-	-	-	-
Y3	109.7	-	10.1	-	-
Y4	145.4	-	10.1	10.1	-
Y5	161.4	-	10.1	19.7	-
Y6	170.8	-	17.3	19.7	-
Y7	179.0	-	25.6	19.7	-
Y8	179.8	3.2	25.6	19.7	8.4
Y9	187.9	3.2	25.6	19.7	11.9

Table 11-3 Percentage of Footprint and Mass Submerged Once Pits Flood to Spillway Elevation

	Alpha WRSF	In-Pit Kona	Latte In-Pit	Supremo In-Pit	DD Backfill In-Pit
Footprint	0%	77%	37%	43%	45%
Mass	0%	39%	13%	17%	14%

11.2.2 Pit Wall Rock

Pit wall rock refers to rock exposures within the mining pit itself. This includes the pit floor, benches, and blast damaged fractured rock. Fracturing and slope ravelling of the pit walls exposes a greater proportion of the wall rock to weathering. The WQM includes two types of geochemical loading released from pit wall rock: meteoric runoff from unsaturated pit wall rock exposures; and submergence of pit wall exposures. Pit wall runoff source term represents weathering from sub-aerially exposed pit wall. The second type of pit wall loading is from submergence of pit wall by pit lake formation. This source terms represents the flushing of oxidation products which may accumulate on mineral surfaces while the wall rock is unsaturated.

The pit wall source term assumes that 75% of rock surfaces in the blast damaged zone and 50% of the blast fractured zone are flushed by meteoric water when subaerially exposed. When the pit wall becomes inundated by a pit lake, the blast-fractured and blast-influenced zone will be entirely flushed, and the accumulated load will be released at that time. That is, 25% of the rock surface in the blast damaged zone and 50% of the surface in the blast fractured zone accumulates oxidation products, which are released once the pit wall is submerged.

The same assumptions regarding wall rock geochemical loading rates and solubility controls developed for the end-of-mine (EOM) model described in Appendix J are applied to the Project Operations source terms.

11.2.3 ROM Pad and Stockpile

Approximately 60 Mt of ore mined from the open pits will either be taken directly to the HLF or temporarily stockpiled on the ROM pad. The maximum capacity of the ROM stockpile is 3 Mt, with the actual value fluctuating seasonally. The mass of ore on the ROM pad will fluctuate widely, with a mass ranging from 3.0 Mt to 0.33 Mt during Project Operations (Figure 11-2). Peak volumes occur during the winter months when ore is still being produced from the pits, but no new material is stacked on the HLF, and minimum volumes occur during summer or fall months when ROM material is being removed to the HLF.

No granite ore from the Kona Pit will be placed in the ROM stockpile due to the elevated ML potential and mildly acidic pH associated with this ore type. The granite ore will be immediately directed to the HLF, where it will be mixed with lime and stored with other non-potentially acid generating ore types.

Stockpiled ore will be placed upon a pad constructed with waste rock. The pad will be constructed exclusively of schist waste rock in order to utilize the metal attenuating attributes of this rock type. The ability of schist waste rock to attenuate As and U is related to the relatively high Fe content of this rock type and has been demonstrated in column experiments.

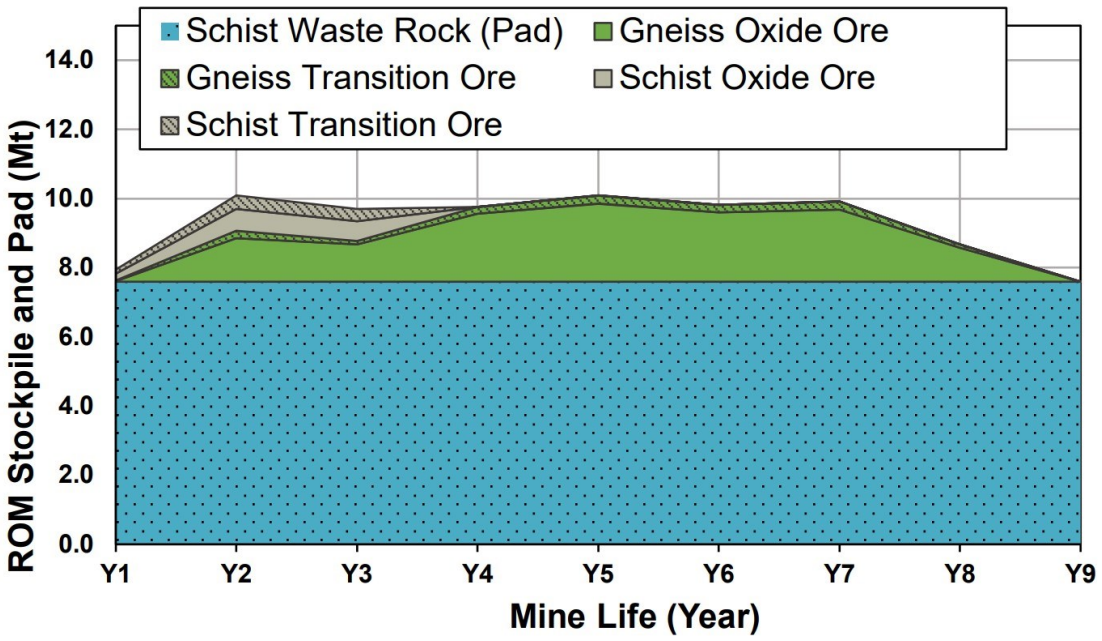

Figure 11-2 Mass and Composition of ROM Ore Stockpile and Waste Rock used in Pad Construction

The ROM pad source terms are calculated by upscaling geochemical loading rates from ore unsaturated columns and waste rock field bins to estimate the loading generated from these two components of the facility. The loading rate from ore on the stockpile is calculated using the median and 75th percentile loading rates measured in unsaturated column work.

The annual surplus water of the ROM stockpile is used to convert loading rates to concentrations.

The ROM stockpile source terms are calculated by upscaling kinetic test loading rates. A number of parameters are affected by thermodynamic solubility controls and scaleindependent release mechanisms. Concentrations of As and 226Ra are calculated using the same approach that was applied in Lorax (2018).

Ore stockpiled on the ROM pad will be placed on a pad of schist waste rock. Infiltration of ore contact water through schist waste rock will attenuate a portion of the As and U load associated with the ore material. To quantify this effect, the solubility of As and U parameters is calculated assuming that ROM pad pore water is in contact with schist waste rock prior to discharge. An example of calculated infiltration for the ore stockpile, waste rock pad, and Rom Pad which combines the two source terms is shown for two conservative parameters (SO4 and Zn) and two non-conservative parameters (As and U) in Table 11-4.

Table 11-4 Example of Infiltration Chemistry Calculated for the Ore Stockpile, Waste Rock Pad and Combined Source Term for Y2 Base Case Scenario.

	SO_4	As	U	Zn
	mg/L	mg/L	mg/L	mg/L
Ore Stockpile Component	159	0.151	0.055	0.014
Waste Rock Component	146	0.002	0.021	0.015
Combined Source Term	305	0.018	0.024	0.029

11.2.4 Haul Roads

Haul roads will be constructed from ROM waste rock and represent a potential source of geochemical loading. The significance of the geochemical loading associated with haul roads will in large part depend on the ML/ARD screening criteria used to select construction material. For the purpose of source term calculation, it is assumed that no screening protocols are in place, and that the haul roads are constructed with gneiss waste rock, which represents the dominant waste rock type produced by the mine. The length of out-of-pit haul roads connecting mine facilities is available for the end of mine life.

The length of haul roads in the Halfway Creek, Latte Creek and YT24 catchments are shown in Table 11-5. It is assumed that the length and distribution of haul roads shown in Table 11-5 are present throughout the Project Operations. Haul roads are assumed to have an average fill thickness of 1.5 m and average width of 12 m.

Table 11-5 Length of Haul Roads at End of Operations by Catchment

Scaling Factors	Haul Road Length (km)
Latte Catchment	0.89
Halfway Catchment	13.6
YT-24 Catchment	0.69

Haul roads will be constructed primarily with waste rock. The lithology of waste rock that will be used in haul road construction is not yet defined. For the purpose of source term calculation, it is assumed that haul roads are constructed entirely of gneiss waste rock. This is the dominant rock type (~80%) of waste rock that will be produced over mine life. In the base case scenario, the loading rate assigned to haul road construction material is weighted based on the relative proportion of gneiss oxide, gneiss transition, and gneiss fresh waste rock that will be produced over mine life (13% oxide, 56% transition and 31% fresh).

Roads will be constructed using gravel and sand particle size fraction of waste rock. Only the relatively fine grain size fraction will be used for road construction, with boulders and cobbles being excluded.

11.2.5 Active and Passive Treated Heap Leach Solution Source Terms

A cyanide heap leaching facility is planned for extraction and recovery of Au from oxide and transition ore. Ore will be leached with lime buffered sodium cyanide (NaCN) solution applied with drip emitters. The leach solution will drain into collection pipes that will direct the gold-bearing solution to the process plant where precious metals will be recovered. The resulting barren solution will be amended with additional lime and NaCN as required and then recirculated to the heap to continue the leaching cycle.

The HLF will be constructed in stages and gold recovery from certain areas of the pad will be completed while other areas are undergoing leaching. For those areas where leaching is completed, progressive reclamation will be able to commence.

During operations and early closure, discharge of any excess HLF solution will undergo active treatment prior to release to the Alpha Pond and ultimately, Halfway Creek. Active treatment will consist of a two-step process, where cyanides (CN) is first destroyed by hydrogen peroxide (H_2O_2) and then residual nitrate, sulphate, metalloids, and metals are treated with a biological system termed the Electrochemical Biological Reactor (EBR) system.

Once active treatment is terminated and closure of the HLF is completed and stabilized, it may be necessary to direct residual HLF seepage waters through the events ponds converted to passive systems prior to discharge to Halfway Creek. Conceptually, the passive treatment system (PTS) would target, primarily, the reduction of nitrate, arsenic, and uranium concentrations in HLF drainage using a matrix of zero valent iron, coarse organic composted wood chips and suitable geologic material; other potential contaminants of concern could also be treated with this system.

11.2.6 Leach Tailings

Leach tailings will be generated when ore placed in the HLF is mixed with lime (CaO) and irrigated with NaCN solution which will change the character of metal leaching by raising pore water pH and by the formation of CN-metal complexes. At the end of mine life, the HLF will be rinsed to remove residual CN from HLF pore water. Lime that remains in the HLF will eventually be rinsed or re-precipitate as calcite, resulting in a decline in pH from the alkaline values required to support CN stability to more neutral values. The goal of this geochemical characterization test work is to describe HLF drainage at the end of mine life and in the long term after rinsing and detoxification is complete.

Leach tailings have a lower ARD potential compared to ore due to the increased NP from lime that is added to maintain CN stability. Geochemical test work completed for tailings samples are consistent with results for ore (and waste rock), whereby tailings samples derived from granite ore have a lower NP content and, therefore, a greater potential to be PAG. Elements of potential concern from the HLF process water include Sb, As, Cr, Cu, Hg and possibly Cd and Zn from each of the ore units, sulphate and Se from the schist unit, and U from the granite and gneiss units. Metal solubility in process solution is supported by the high pH (>9.8) and presence of CN.

Kinetic testing on leach tailings sampled produced from metallurgical testing showed an immediate decline in pH from rinsing of residual lime, with pH values stabilizing at slightly alkaline values.

The mineralogy of leach tailings is expected to be generally similar to that of ore. During the CN leaching process, some water-soluble minerals, such as sulphates (i.e., gypsum) or other secondary oxidation

products (i.e., oxides) may be rinsed from particle surfaces. The addition of lime may also result in the precipitation of secondary oxides and carbonates.

11.3 Source Term Calculations

Geochemical source terms are calculated by upscaling kinetic test geochemical loading rates to reflect site conditions. The scaled loading rates are then applied to incorporate the mass, footprint, hydrology and rock types present in a given mine facility. Solubility controls are then derived for certain parameters that are not expected to behave conservatively in the geochemical conditions of a given mine waste environment. These solubility controls are based on a combination of first principles, thermodynamic equilibrium, and experimental data or field monitoring data. Overall, the approach to source term calculation is consistent with what has been done in past iterations of source term developments for the Coffee Gold Mine Project.

A variety of updates have been made to source term model inputs in the current source term iteration. These updates include kinetic test results; solubility controls; and assumptions regarding release of a geochemical load from saturated waste rock and pit wall. Updated kinetic test results are used to update loading rates and estimate metal release from sub-aqueously stored mine rock. The updated kinetic test results are shown in Appendix J. Solubility calculations have been updated to incorporate the geochemical modelling program PHREEQC to calculate solubility constraints for surface sorption of U to Fe-oxide mineral surfaces, and mineral solubility controls for certain major ions (Ca, Mg and P). More details on the Source Term Calculation results can be found in Appendix J.

Major ion loading rates are predicted based on geochemical test results for metallurgical columns and leach tailings kinetic tests. Metallurgical column and leach tailings kinetic testing samples used in source term development are shown in Table 11-6. Data for solubility constraints are generated from empirical observations of analogue mines described above or using the geochemical modelling program PHREEQC coupled to the llnl.dat database.

Table 11-6 Metallurgical Columns and Kinetic Test

Lithology	Weathering	Met Columns	Kinetic Tests
		Head ID (*Column IDs*)	**Column ID (*Composition*)**
Schist	Oxide	72133 (*73001*), 72136 (*72153, 72156*)	Column 15 (*100% Schist*)
Schist	Transition	72137 (*72759, 72162*), 72138 (*72165, 72168*)	
Granite	Oxide	72139 (*72717, 72174*)	Column 17 (*90% Gneiss, 10% Granite*)
Granite	Transition	72177 (*72177, 72180*)	
Gneiss	Oxide	72134 (*73004*), 72142 (*73010, 73013, 73007*), 72143 (*73019, 73022, 73016*), 72144 (*73025, 73028*), 72145 (*73031, 73034*)	
Gneiss	Transition	72146 (*73037, 73040*)	

The major ions SO4, Na and Cl are modeled to behave conservatively and accumulate in the process solution during operations. Two types of loading are used to predict these concentrations; a water-soluble load that will be released shortly after ore is stacked on the heap and irrigated with process solution; and a kinetic weathering rate representing gradual release of major ions from primary minerals in the spent leach tailings.

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APPENDIX A

Environmental Baseline Report, Mine Site Study Area: Surficial Geology, Permafrost and Terrain Stability

TETRA TECH EBA

COFFEE GOLD PROJECT
Environmental Baseline Report, Mine Site Study Area: Surficial Geology, Permafrost, and Terrain Stability



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CONSULTING ENGINEERS & SCIENTISTS · www.eba.ca

Tetra Tech EBA Inc.
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
Tel 780.451.2121 Fax 780.454.5688

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EXECUTIVE SUMMARY

Tetra Tech EBA Inc. (Tetra Tech EBA) was retained by Kaminak Gold Corporation (Kaminak) to provide surficial geology, permafrost, terrain, and soils baseline information for the Coffee Gold Project, in preparation for submission of an Environmental Assessment to the Yukon Environmental and Socio-Economic Assessment Board (YESAB).

This report presents summary background information, methods, and results for baseline conditions for the purposes of an environmental assessment. The baseline conditions covered include surficial geology, physiography, permafrost, and terrain stability studies conducted for the Coffee Gold Project from 2011 to 2016. These baseline studies provide important input for the Effects Assessment portion of the Environmental Assessment. The soils portion of the report will be submitted under separate cover.

The study area for this baseline report encompasses the conceptual Coffee mine development area (the mine site study area), as it was proposed at the time of writing. The mine site study area is situated on the divide between the headwaters of Latte Creek and Halfway Creek, in the northern Dawson Range.

First, a literature review was completed to summarize the known conditions at site to date. It shows that the area has not been glaciated, resulting in a landscape consisting of rounded ridges separated by deep, V-shaped valleys. Climate is characterized by warm, short summers and long, cold winters. Weathered bedrock, colluvium derived from weathered bedrock and loess, and fluvial deposits are found in the mine site study area, but colluvial deposits are by far the most common. These deposits are affected by gullying, cryoturbation, solifluction, permafrost processes, periglacial processes, landslides, and snow avalanches. The mine site study area is located within the zone of extensive discontinuous permafrost. Permafrost is most common on north-facing slopes with thick organic cover and in colluvial apron/muck deposits located on lower slopes and at valley bottoms. South-facing slopes are typically permafrost-free. Permafrost-related processes include cryoturbation, solifluction, active layer detachments, slope creep, frost heave, and thermal erosion. Open-system pingos are present locally.

Since 2011, ten field investigation programs have been completed for the baseline studies. These include soils, hydrogeology, permafrost, and geotechnical studies. Drilling, instrument installation in boreholes, testpitting, ground investigations on foot, and helicopter flyovers were all included in these studies.

Evaluations of surficial geology, permafrost, and terrain stability were undertaken for this report. The first two used PurVIEW software for the analysis, while the latter used PurVIEW and DAT/EM Summit Lite software. The desktop mapping draws heavily on the data supplied by the many field investigations; these were used as ground-truthing points for the mapping.

Various permafrost maps, a map of the surficial geology of the mine site, terrain maps, and terrain stability/hazard maps were generated from these studies; these are included at the end of this report. Geohazards and organic soil surface layers were also described.

Results from this study conclude that colluvium is indeed pervasive, and that ridge tops may have exposed weathered bedrock, some of which form tors. Colluvium is dominated by silt and sand, but also contains angular pebbles, cobbles, and boulders. Organic material interbedded with the colluvium at a few sites shows that downslope creep or possibly sliding of some colluvial deposits may be fairly recent (Holocene in age). Thin fluvial deposits consisting of gravelly silt are found in the narrow valley bottoms and a few fluvial fans are present at the mouths of small tributary valleys. Organic deposits are rare; they are found in the Latte Creek valley and overlying colluvial apron/muck deposits at the base of some slopes.

The only rare landforms in the mine site study area are tors and one collapsed open-system pingo.

Permafrost distribution determined from the mapping shows that approximately 62% of the mine site study area is underlain by permafrost. Permafrost thicknesses range from approximately 30 m to 165 m. The active layer is highly variable: it is usually thin (approximately 0.3 m to 0.6 m), but it can be several metres thick in bedrock areas or where coarse surficial sediments are present. Ground temperatures range from close to 0ºC to approximately -2ºC, indicating warm permafrost conditions. Ground containing permafrost is therefore sensitive to disturbance. Ground ice has been classified as non-visible, visible, or forming significant accumulations, such as massive ice bodies, although the latter is rare. The spatial distribution of these across the mine site was determined to be 34% for ice-poor permafrost with non-visible ice; 27% for permafrost with visible excess ice; and 1% for very ice-rich permafrost, which is mainly found at the bottom of the Latte Creek valley.

Five terrain stability classes (stable; generally stable; generally stable with minor instability; potentially unstable; and unstable) were mapped by Palmer Environmental Consulting Group (PECG) within the mine site. These classes were differentiated for both the existing and disturbed condition because of the complexity of the permafrost terrain in the mine site study area. The “existing terrain stability” class represents current conditions, in the absence of any project-related activity; whereas the “disturbed terrain stability” class represents conditions following disturbance to ground conditions from exploration activities and road/mine facility construction without mitigation. This format of mapping, in PECG’s opinion (Appendix B), distinguishes natural hazards, which may be triggered by occurrences such as wildfire, from those potentially exacerbated or initiated by project-related disturbance.

Calculations of the areas occupied by each of the five terrain stability classes using ArcGIS technology show that prior to the proposed construction activities (existing undisturbed terrain) the majority (approximately 78%) of the mine site study area has an existing terrain stability class of “generally stable” (Class II). Approximately 15% is considered “generally stable with isolated minor instability” (Class III). Approximately 1% of the mine site study area is considered “potentially unstable” (Class IV) and approximately 6% - “unstable” (Class V).

According to the disturbed terrain stability class, the proportion of terrain stability polygons in the mine site study area with a “generally stable” (Class II) rating drops from 78% to 27% (disturbed). The majority (approximately 42%) becomes “generally stable with isolated minor instability” (Class III). Approximately 24% of the mine site study area becomes “potentially unstable” (Class IV) and approximately 7% - “unstable” (Class V).

Various hazards were identified and described by magnitude, frequency, and considerations for mitigation of each. These include rockfall, debris slides, rock creep, gullying, solifluction, thermokarst, and slopewash. The various geohazards within each proposed infrastructure footprint were also described.

Finally, the organic surface soil was described. It is generally 0.2 m thick, but is slightly thinner on ridge tops, and is thicker in areas of non-visible ground ice or areas of very ice-rich permafrost. Organic silt is most common on north-facing slopes and is found only in areas of visible or non-visible ground ice. The presence of silt within the organics may be caused by a combination of more active slope creep in permafrost areas, cryoturbation or loess capture by permafrost-bearing units, which are wetter in summer.

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GLOSSARY OF TERMS

Term	Definition
Active Layer	The top layer of ground above the permafrost table that is subject to annual thawing and freezing.
Active Layer Detachment	Shallow slope failure in which the thawed or thawing active layer and vegetation mat detach from the underlying frozen material. Common on colluvial slopes in areas of fine-grained, ice-rich deposits.
Apron	Coalesced fans which occur at foot of bluffs, escarpments, or steep slopes. They are formed by materials transported from the steeper slope and form wedge-shaped deposits with concave to planar surfaces. Deposition of materials typically occurs during extreme storm or runoff events.
Blanket	A mantle of surficial materials thicker than about 1 metre, which reflects the topography of the bedrock or older surficial materials upon which it rests, although minor details of the topography may be masked.
Colluvial Deposits/Colluvium	Materials deposited as a result of downslope movements due to gravity, such as rockfall, soil creep, and debris flows, including talus slopes and mantles of weathered bedrock. Colluvial deposits are composed of rock fragments of all sizes derived from the local bedrock and reworked loess, as well as finer textured material derived from in place weathering of the rock fragments. These deposits are generally poorly sorted and poorly consolidated.
Creep	The imperceptibly slow downward movement of soil or rock on slopes or slow deformation of frozen ground; caused by gravity or long-term application of a stress too small to produce failure in the frozen material.
Cryoplanation	Alteration by intense frost action that effectively reduces slope steepness and lowers mountain and hill peaks, modifying landscapes into cryoplanation terraces, i.e. step-like benches cut in bedrock.
Cryoturbation	Heaving, churning, and sorting of soil and surficial materials due to repeated freezing and thawing; results in the development of convoluted and flame-like structures in the soil and patterned ground.
Debris Flow	A sudden and destructive landslide where loose material on a slope, with more than 50% of particles larger than sand size, is mobilized by saturation and flows down a channel or canyon. The flow contains a combination of or all of the following: soil, surficial materials, bedrock, and plant material. Whether saturated or dry, a debris flow behaves much like a viscous fluid when moving.
Debris Slide	A shallow slide consisting of a mass of soil, vegetation, and surficial material; initial displacement is along one or several surfaces of rupture. Composed of comparatively dry and largely unconsolidated surficial material and results in an irregular, hummocky deposit.
Dendritic	Surface drainage pattern where streams branch out in an irregular tree-like fashion.
Depth of Zero Annual Amplitude	The distance from the ground surface downward to the level beneath which there is practically no annual fluctuation in ground temperature.

Eolian	Well sorted materials, predominantly silt and fine to medium sand, which have been eroded, transported, and deposited by wind.
Excess Ice	The volume of ice in the ground, which exceeds the total pore volume that the ground would have under natural unfrozen conditions.
Felsenmeer	An accumulation of angular boulders on a level or gently sloping surface, comprising local rocks broken up by frost action, generally located in high altitude or high latitude regions.
Fluvial Deposits	Sediments transported and deposited by streams and rivers, including floodplain deposits, river terraces, and fluvial fans. “Alluvial” is an older term meaning the same.
Fluvial Fan	A fan-shaped deposit built by streams, usually located at the mouth of a tributary valley. The sediment flows start at the apex of the fan, and over time move to occupy many positions on the fan surface. Sediments generally consist of sand and gravel, and are formed by a combination of stream flood and debris flow activity. Fluvial fans typically have gradients of less than 10%.
Friable Permafrost	Permafrost in which the soil particles are not held together by ice; the material is easily broken up under light to moderate finger pressure.
Frost Action	The process of alternate freezing and thawing of moisture in soil, rock, and other materials, and the resulting effects on materials, and on structures placed on, or in, the ground.
Frost Heave	The upward or outward movement of the ground surface (or objects on, or in, the ground) caused by the formation of ice in the soil.
Glaciofluvial Deposits	Sediments formed by meltwater issuing from, or within, a glacier. The deposits are stratified and may form outwash plains, or terraces.
Ground Ice	Ice in pores, cracks, and other openings in surface sediments or rock, which forms in permafrost terrain. A general term referring to all types of ice formed in freezing or frozen ground.
Ice Wedge	A massive, generally wedge-shaped body of ground ice with its apex pointing downward, composed of foliated or vertically banded, commonly white, ice; forms in permafrost environments.
Loess	A homogeneous massive deposit formed by wind consisting mainly of silt. Loess sediment sources include glaciofluvial and glaciolacustrine deposits or fine-grained colluvium.
Muskeg	A North American term frequently used for peatlands. The word is of Algonquin Indian origin and is applied in ordinary speech to natural and undisturbed areas covered more or less with *Sphagnum* mosses, tussocky sedges, and an open growth of scrubby trees. (The terms peatland and muskeg are commonly used interchangeably).
Peat	Unconsolidated compressible material consisting largely of undecomposed, or slightly decomposed, organic matter accumulated under water-saturated conditions. Peat is commonly formed by the slow decay of successive layers of aquatic and semi-aquatic plants in swampy or water-logged areas, where oxygen is absent.

Periglacial	Pertaining to cold climates, in proximity to the margin of a continental ice sheet, such as in arctic and alpine areas, where frost action is an important feature.
Permafrost	Ground (soil or rock) that remains at or below 0ºC for at least two years.
Pingo	A large perennial frost mound consisting of a core of massive ice, formed primarily by injection of water, and covered with soil and vegetation. Pingos occur in the zones of continuous and discontinuous permafrost. There are two varieties of pingos: closed-system and open-system.
Pingo, Closed-System	A pingo formed by doming of frozen ground due to freezing of injected water supplied by expulsion of pore water during permafrost growth. Found mainly in the zone of continuous permafrost, in flat, poorly-drained terrain.
Pingo, Collapsed	A pingo remnant represented by a low or arcuate ridge of material resulting from the slumping of the sides of the pingo during thawing. The former centre is marked by a depression which may be filled with water.
Pingo, Open-System	A pingo formed by doming of frozen ground due to freezing of injected water supplied by groundwater moving downslope through taliks to the site of the pingo, where it moves towards the surface. Found mainly in the zone of discontinuous permafrost, in areas of marked relief.
Rockfall	The process, associated sediments or resultant landform characterized by very rapid downslope movement of newly detached pieces of bedrock that fall freely from a cliff or cascade down a steep slope.
Rotational Slide	The process, associated sediments or resultant landforms characterized by an extremely slow to moderately rapid landslide, in which movement occurs along a well-defined, spoon-shaped shear surface; produces a backward rotation of the displaced block or blocks; sometimes referred to as a slump.
Segregated Ice	Ice in discrete layers or ice lenses, formed by ice segregation; commonly occurs in alternating layers of ice and soil. Segregated ice layers can range from hairline to more than 10 m in thickness.
Solifluction	Slow downslope movement of saturated unfrozen (in non-permafrost regions) or thawed (associated with frozen ground) earth materials across a frozen (in permafrost regions) or otherwise impermeable substrate.
Talik	A layer or body of unfrozen ground in a permafrost area.
Thermal Erosion	The general process whereby frozen soils thaw and then are removed by moving water or remain in place in waterlogged conditions.
Tor	A high, isolated pinnacle, or rocky peak; or a pile of rocks, heavily jointed and usually granitic, exposed to intense weathering, and often assuming peculiar shapes.
Veneer	A cover of surficial material with a thickness less than 1 metre.
Well-Bonded	A condition in which soil particles are strongly held together by ice, so that the frozen soil possesses relatively high resistance to chipping or breaking.

ACRONYMS & ABBREVIATIONS

HLF	Heap Leach Facility
PECG	Palmer Environmental Consulting Group
TK	Traditional Knowledge
VWP	Vibrating Wire Piezometer
WRSF	Waste Rock Storage Facility
YESAB	Yukon Environmental and Socio-Economic Assessment Board
YG	Yukon Government
YGS	Yukon Geological Survey

CONFIDENTIALITY STATEMENT

LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Kaminak Gold Corporation and their agents. Tetra Tech EBA Inc. (Tetra Tech EBA) does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Kaminak Gold Corporation, or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in Tetra Tech EBA's Services Agreement. Tetra Tech EBA's General Conditions are provided in Appendix A of this report.

1.0 INTRODUCTION

Tetra Tech EBA Inc. (Tetra Tech EBA) was retained by Kaminak Gold Corporation (Kaminak) to provide surficial geology, permafrost, terrain, and soils baseline information for the Coffee Gold Project, in preparation for submission of an Environmental Assessment to the Yukon Environmental and Socio-Economic Assessment Board (YESAB).

This report presents summary background information, methods, and results for the baseline physiography, surficial geology, permafrost, and terrain stability studies conducted for the Coffee Gold Project from 2011 to 2016. The soils portion of the report will be submitted under separate cover.

The baseline study provides important input for the Effects Assessment portion of the Environmental Assessment. The study area for this baseline report encompasses the proposed Coffee mine development area (the mine site study area), and is shown in Figure 1. The mine site study area is situated on the divide between the headwaters of the Latte Creek and the Halfway Creek, in the northern Dawson Range, and has a slightly different extent than the study area used for the terrain stability study by Palmer Environmental Consulting Group Inc. (PECG Appendix B).

Work completed for the baseline report for the proposed access road is outside the scope of this study.

2.0 METHODS

2.1 Literature Review

A literature review was undertaken to summarize existing information on surficial geology, permafrost, physiography, and terrain stability for the mine site study area. Surficial geology maps, unpublished reports, and published journal articles were reviewed to determine general information for the area, as it was known at the time of this study. Maps and other documents are referenced accordingly within the Literature Review section.

2.2 Previous Field Programs

Ten field investigation programs have been completed for the baseline study since 2011. These are described below.

Ground Truthing Program (AECOM, August 2011)

Results of the soils field investigations conducted within the mine site study area in August 2011 (AECOM 2012) were used to confirm surficial geology and permafrost mapping, where possible.

Hydrogeological Field Program (Tetra Tech EBA, Fall 2013)

This first hydrogeological field program (Tetra Tech EBA 2014) consisted of installing four single-point vibrating wire piezometers (VWPs) in NQ2-sized boreholes to collect hydraulic testing and ground temperature data. This information was referred to while compiling the permafrost map of the mine site study area.

Hydrogeological Drilling Program (Lorax, August-September 2014)

The 2014 hydrogeological drilling program was implemented within upland areas in and around proposed pits and the formerly proposed valley-fill Heap Leach Facility (HLF) footprint. This data was mainly used to confirm surficial geology mapping, permafrost mapping, and soil texture.

Geotechnical Field Program (Knight Piesold, August-September 2014)

This geotechnical field investigation (Knight Piesold 2015) was conducted in the formerly proposed valley-fill HLF footprint area. The investigation comprised a combination of test pits and borings to assess shallow and deeper subsurface conditions. This information aided with the compilation of the permafrost map of the mine site study area.

Hydrogeological Drilling Program (Lorax, March 2015)

This hydrogeological field investigation consisted of drilling vertical boreholes and installing thermistor and VWP strings downgradient of the proposed North and South Waste Rock Storage Facilities (WRSF). This information aided with the compilation of the permafrost map.

Geotechnical Field Investigation Sonic Drilling Program (SRK, April 2015)

The April 2015 geotechnical investigation included field and laboratory tests to characterize the proposed waste rock dump, HLF pad, and plant site footprints. This data was mainly used to confirm surficial geology, permafrost mapping, and soil texture.

Hydrogeological Drilling Program (Lorax, April-June 2015)

The hydrogeological investigation consisted of drilling vertical and angled boreholes and installing thermistor and VWP strings. This information aided with the compilation of the permafrost map.

Geotechnical Field Investigation Supplementary Test Pitting Program (SRK, June-July 2015)

The June 2015 supplementary test pitting program confirmed findings of the sonic drilling program and provided additional bulk samples for laboratory testing and analyses. This data was mainly used to confirm surficial geology, permafrost mapping, and soil texture.

Terrain Stability Field Investigation (PECG, August 2015)

The August 2015 field investigation focused on the terrain stability of the mine site study area, albeit with slightly different study area boundaries. The investigation included documenting terrain characteristics, permafrost, and drainage conditions. Observations regarding permafrost conditions and terrain hazards were also recorded.

Geotechnical Site Reconnaissance Program (Tetra Tech EBA, September 2015)

The Tetra Tech EBA field program is described in detail in Section 2.4.

2.3 Data Analysis

2.3.1 Surficial Geology Mapping

Mapping of surficial geology was completed using PurVIEW software, which is an add-on to ArcGIS. PurVIEW is a 3D mapping tool that allows stereo pair air photos to be viewed on a computer screen with 3D glasses. High-resolution digital images provided by Kaminak were loaded into PurVIEW and analyzed. Polygons, lines, and point symbols were mapped in ArcGIS/PurVIEW and map figures were created in ArcGIS.

Surficial geology was mapped (Figures 2a to 2f) according to the Yukon Digital Surficial Geology Compilation and Terrain Classification System (YG 2016). However, only the surficial units and expressions (e.g. colluvial veneer)

were mapped for simplicity, as requested by Kaminak. Textures of the materials were recorded only for mapped polygons in which ground data describing soil texture was available.

A number of additional data sources were used to confirm mapping for this study and to determine sediment texture for applicable portions of the mapped area. These include:

- Borehole data (KP 2015), (Lorax 2016), and (SRK 2016a);
- Terrain field data supplied by PECG;
- Soils field data supplied by AECOM (2012); and
- Terrain field data collected by Tetra Tech EBA during field reconnaissance for permafrost studies.

The above field site and borehole locations were loaded into ArcGIS and were referred to while mapping.

2.4 Permafrost Mapping

Reconnaissance of permafrost conditions in the mine site study area was completed between September 5 and September 8, 2015, by Vladislav E. Roujanski, Ph.D., P. Geol., of Tetra Tech EBA and Chalsie Warren of Kaminak. Fieldwork involved measurement of active layer thickness with a permafrost probe, hand-dug testpit excavation, and acquisition of georeferenced field photographs of terrain features indicative of various permafrost conditions. Some areas were accessed by pickup truck, while others were accessed by helicopter or on foot. Several helicopter overview flights were also completed.

Permafrost and related geohazard mapping within the mine site study area was carried out by Vladislav E. Roujanski and Shirley McCuaig, Ph.D., P. Geol. in November-December 2015, and was subsequently updated in February 2016 as new data became available. Digital colour air photos covering the mine site study area were acquired by Kaminak in August 2011 at a nominal scale of 1:20,000. These were provided to Tetra Tech EBA in November 2015 and were used to generate 3D digital models of the landscape in PurVIEW. Permafrost mapping was initially carried out at 1:20,000 scale, based on stereoscopic interpretation (using a Sokkia MS27 stereoscope) of the colour air photo printouts. The permafrost distribution linework was then refined using the PurVIEW system. This software allowed the mappers to zoom in and out of the 3D air photos, which increased mapping accuracy. The PurVIEW-based mapping was done at 1:5,000 to 1:20,000 scale, but is presented in this report at a scale of 1:20,000.

Permafrost terrain units (map polygons) were delineated according to geobotanical indicators, e.g. stunted black spruce stands on shallow permafrost vs. deciduous (dominantly aspen) stands on unfrozen soils, slope aspect (north-facing vs. south-facing slopes), and extrapolated surface appearance (texture, colour, hue etc.). Where possible, mapped permafrost conditions were confirmed by ground temperature measurements acquired from thermistor-instrumented boreholes. In addition, intrusive exploration data and detailed ground/soil/terrain/ permafrost observation site logs were used to inform the mapping, as described in Section 2.3.1. Limited ground temperature data, frozen soil condition information, and other relevant data contained therein were useful data points for the permafrost mapping effort.

Hazardous permafrost-related geomorphic processes and landforms that may pose a challenge to mine site construction and operations were mapped as point and line symbols.

Two versions of the permafrost map were compiled (Figures 3a to 3d): one with permafrost polygons colour-coded according to ground ice occurrence in perennially frozen ground (Figure 3a) and one with transparent labelled polygons overlaid on the orthophotographs (Figure 3b). Figure 3c shows the mine facility layout plan overlaid on

Figure 3b. Figure 3d shows the as-drilled borehole locations along with the mine facility footprints and permafrost distribution.

2.5 Terrain, Terrain Stability and Hazard Mapping

The terrain, terrain stability, and hazard mapping was completed by PECG and the results are summarized in a report dated March 19, 2016. This work is included as Appendix B of this report; the map figures have been edited to include only those that pertain to the mine site study area.

The work completed by PECG included the following tasks:

- Background review and consultation;
- Field investigation;
- Terrain and terrain stability mapping;
- Hazard identification; and
- Assessment of soil erosion potential[1].

Terrain, terrain stability, and geohazard methods described by PECG are summarized below.

2.5.1 Background review and consultation

PECG reviewed aerial photography, LiDAR-derived elevation data, satellite imagery, surficial and geomorphological mapping, previous investigations, and peer-reviewed literature. They also consulted with senior members of the Yukon Geological Survey (YGS) regarding their field experience with the paleo-landslides in the area and members of Yukon Highways to discuss mass movement and icing hazards in the mine site study area.

2.5.2 Field Investigation

A field investigation was completed in August 2015. There were at least 15 sites investigated within the PECG mine site study area, including both helicopter reconnaissance and detailed ground investigations. Site characteristics, terrain characteristics and hazards, drainage conditions, permafrost conditions, and vegetation were recorded at each site. Hand-dug soil pits were used to examine subsurface materials and the active layer thickness was determined by making a minimum of five frost-probing measurements at each ground investigation site.

2.5.3 Terrain and Terrain Stability Mapping

The terrain and terrain stability mapping was completed in accordance with YESAB's mapping requirements (Guthrie and Cuervo 2015). However, the terrain stability classes were modified to include disturbances that may result from thermokarst processes and have been tailored to consider the presence or absence of warm permafrost with variable ground ice content (not to be confused with "existing" and "disturbed" terrain stability classes).

Terrain mapping was completed by dividing the terrain into polygons according to surficial materials, landform characteristics, and geomorphological processes. Each polygon was assessed to be stable, potentially unstable, or unstable. The terrain maps of the mine site study area are provided in Appendix B (Map 1).

[1] Soil erosion potential will be discussed in the Soils portion of this Environmental Assessment.

The delineation of the polygons was completed using either PurVIEW or DAT/EM Summit Lite software with digital air photos having a scale of 1:10,000. Photos having a scale of 1:2,500 were used when additional details were required. The polygons were delineated based on eight attributes: surficial material, surface expression, texture, geomorphological process, and drainage class, depth to permafrost, ice content, and slope class.

Additional point or linear features, such as thermokarst ponds or slope failures that are too small to be mapped as polygons are identified with point and line symbols.

The terrain stability maps were compiled with the aid of AECOM's (2012) geomorphological maps.

PECG assessed terrain stability both before and after disturbance ("existing" and "disturbed" classes) to provide design engineers with all potential hazard information in the area of development, particularly as the mine site study area is characterized by extensive discontinuous permafrost.

2.5.4 Hazard Identification

Terrain polygons were categorized by the dominant hazard type to depict the nature of the hazard governing the terrain stability class of each polygon. Three categories were used to classify the stability class of each polygon:

i. Slope failure potential is dominant;

ii. Thermokarst potential is dominant; or

iii. Slope failure and thermokarst potential are co-dominant.

2.6 Organic Soils Analysis

The organic surface layer analysis was completed by reviewing borehole logs recorded in Lorax (2016) and SRK (2016a). The thickness and composition of organic cover at each borehole was summarized and uploaded to an ArcGIS database. A topographic map was created in ArcGIS and the organic thicknesses labelled for each borehole, but it was not necessary to present this map as a figure in this report.

The organic thickness map was reviewed to determine if elevation or aspect had any effect on the amount or type of organic material present on the ground surface within the mine site study area. The surficial geology/permafrost map was also reviewed in the context of the organic soil thicknesses to check for relationships to sediment type and ground ice content.

3.0 RESULTS

The following sections begin with the literature review, and then present results for surficial geology and permafrost mapping completed by Tetra Tech EBA, followed by a summary of the terrain and terrain stability mapping completed by PECG (full report is provided in Appendix B).

3.1 Literature Review

3.1.1 Physiography and Climate

The mine site study area is located within the Klondike Plateau physiographic region. The Klondike Plateau is a Tertiary-age upland that has undergone variable uplift and stream dissection, resulting in rounded summits and ridges, and deep V-shaped valleys hosting **dendritic** streams (Mathews 1986; Huscroft 2002). Most valley sides exhibit convex profiles (Photo 1), with concave profiles restricted to localized bench or gully features and valley bottoms filled with material derived from upslope erosion (PECG Appendix B). The mine site study area, which is

situated within the Coffee Creek and Yukon River watershed, was not glaciated during the last Wisconsin glaciation (Duk-Rodkin 1999) and has since been modified by frost action and permafrost-related processes.



Photo 1: Latte Creek valley exhibiting convex valley slopes, looking east. Sparse stunted black spruce on the north-facing slope (on right side of photo) is indicative of shallow ice-rich permafrost; whereas the south-facing slope (left side), covered with moderately dense aspen and aspen/white spruce mixed forest, is predominantly permafrost-free.

There is little traditional knowledge related to terrain in the region: most traditional uses pertain only to topography. Trails used by First Nation groups tend to be located on gently sloping or flat “easy passage” areas, such as ridge tops and valley bottoms. Some high elevation areas are used as lookouts.

The climate of the Klondike Plateau is continental: it is characterized by warm, short summers and long, cold winters. Mean annual air temperature is near -5ºC, mean January temperatures range from -23ºC to -32ºC and mean July temperatures from 10ºC to 15ºC (Yukon Ecoregions Working Group 2004). Strong thermal inversions are common from December to February, in association with prolonged atmospheric stability (Williams 1995). During this period, air temperatures on valley bottoms can be tens of degrees lower than surrounding higher-elevation areas (PECG Appendix B). Mean annual precipitation ranges from about 300 mm to 500 mm, giving the region a semi-arid classification (Yukon Ecoregions Working Group 2004). The wettest period occurs in summer, when most precipitation falls as rain during convective rain showers and thunderstorms (PECG Appendix B).

3.1.2 Surficial Geology

Although the mine site and most of its access road fall within the unglaciated portion of the Yukon, glaciers occupied the Stewart River valley to the north and a few small glaciers were present east and west of the mine site study area in Pliocene to early Pleistocene time (3 million to 1.8 million years ago) (Duk-Rodkin 1999). Glacial Lake Yukon was dammed by this ice sheet (Duk-Rodkin 1996).

The lack of glaciation in the mine site study area means that the area has experienced a significant period of weathering. Surficial deposits comprise weathered bedrock, **colluvium** derived from weathered bedrock and **loess**, and **fluvial** deposits (Huscroft 2002; AECOM 2012). Colluvium is expected to be coarser grained on steeper slopes, while colluvial aprons on lower slopes commonly include ice-rich resedimented loess and **peat** (informally called "muck" when taken together) (Huscroft 2002; McKenna and Lipovsky 2014). Colluvial deposits dominate high elevation areas and valley slopes, while fluvial deposits are found in valley bottoms. These deposits may be affected by gullying, **cryoturbation**, **solifluction**, permafrost processes, **periglacial** processes, landslides, and snow avalanches (AECOM 2012; McKenna and Lipovsky 2014; KP 2015).

Weathered bedrock is exposed on several ridge tops in the mine site study area; it locally exhibits **cryoplanation** terraces or granitic **tors** (Huscroft 2002; AECOM 2012). Weathered bedrock consists of fractured and jointed bedrock exposures covered with less than 1 m of **felsenmeer** or residual soil, which commonly forms a yellowish sand consisting of quartz, feldspar, plagioclase, biotite, and hornblende derived from the disintegration of the Coffee Creek granite (AECOM 2012; KP 2015). Bedrock terraces are present in some valley bottoms and bedrock is exposed in a few valleys where it has been cut by stream erosion (AECOM 2012).

Most of the area is covered with colluvium. **Creep, debris slides, rockfall**, and one **rotational slide** have been identified within the mine site study area (AECOM 2012). Colluvial deposits comprise loose, poorly sorted angular gravel, and boulders with a sandy silt to silty sand matrix (KP 2015; SRK 2016a, b). Colluvial apron/muck deposits consist of **eolian** fine sand and silt reworked with organic silt, organic deposits, colluvium, and locally, fluvial fan gravel and sand. The colluvial apron/muck deposits are most common on north-facing lower valley slopes and commonly contain **segregated ice** bodies and buried **ice wedges** (Huscroft 2002). Colluvium thickness is estimated at less than 1 m on ridge tops, less than 1 m to 2 m on valley slopes and up to 10 m on valley bottoms and lower slopes (Huscroft 2002; AECOM 2012; KP 2015; SRK 2016b). Organic soils 0.2 m to 0.3 m thick typically cover the colluvial deposits (SRK 2016b).

Fluvial deposits consist of beds of sand, silt, and organic layers in slow-moving reaches, or gravel and cobbles in faster-moving reaches or underlying the finer-grained units (AECOM 2012; KP 2015). Fluvial deposits may also contain reworked eolian silt and sand (McKenna and Lipovsky 2014).

Eolian deposits formed when parts of the surrounding region were vegetation-free, shortly after the Pliocene-Pleistocene deglaciation and other younger, less extensive glaciations. Fine sand and silt (loess), derived from **glaciofluvial** deposits in the Donjek and White River valleys, has coated the surficial deposits within the mine site area, but has since been eroded, redeposited and reworked (Huscroft 2002; AECOM 2012).

Organic deposits are typically poorly drained due to the presence of permafrost and consist mainly of moss (AECOM 2012).

Numerous boreholes and testpits have been completed within the mine site study area (Lorax 2016; SRK 2016a). These were referenced while mapping and rather than summarizing them here, individual areas of interest are highlighted in the surficial geology descriptions.

3.1.3 Permafrost

The mine site study area is located within the zone of extensive discontinuous permafrost, where 50% to 90% of the area is expected to be perennially frozen (Heginbottom et al. 1995). Locally, permafrost distribution is related to slope aspect, angle and shape, soil texture and moisture, and the presence, thickness, and type of organic cover (Williams 1995; Williams and Burn 1996; PECG Appendix B). Permafrost is most common on north-facing slopes with thick organic cover and within the colluvial apron/muck deposits (Bond and Lipovsky 2011). Steep, well drained, south-facing slopes are invariably permafrost-free (PECG Appendix B).

Although initially permafrost was thought to be thickest on lower slope aprons with northerly aspects and to thin toward ridge tops (AECOM 2012), recent data suggests that permafrost extends to its greatest depths in ridge areas and appears to thin towards areas of lower elevation (Lorax 2016) (with the notable exception of colluvial apron/muck units). Permafrost was found to be 135 m to 165 m thick on Supremo Ridge, with temperatures of approximately -1.1°C at those depths (SRK 2016b). Permafrost depths were 75 m to 83 m below the West WRSF and the toe of the North WRSF (SRK 2016b). Permafrost was absent at two boreholes within the South WRSF (SRK 2016b).

Active layer thickness primarily depends on elevation, aspect, soil texture, drainage, snow pack, vegetation cover, and wildfire history (Williams and Burn 1996; McKillop et al. 2013). The active layer is generally 1 m to 2 m thick within the region encompassing the mine site study area (Yukon Ecoregions Working Group 2004; Bond and Lipovsky 2011), except in areas where vegetation has been stripped, i.e. in road cuts (Lorax 2016). Well drained, coarse-grained soils tend to have a thicker active layer than poorly drained, fine-grained ones (PECG Appendix B). The active layer is suggested to be about 1 m thick in the HLF area (KP 2015). Permafrost temperatures within the mine site study area are measured with thermistor strings installed by Lorax (2016) and SRK (2016a). While most thermistor installations indicate sub-zero temperatures in bedrock, observations of ice in bedrock are limited (Lorax 2016).

The ice content of permafrost across the mine site study area is highly variable. Areas of perennially frozen intact or weathered bedrock and well drained, coarse-grained colluvial mantles generally contain little to no visible ice. Such ice-poor permafrost is common in upland settings, on summits, along ridges and spurs, and on moderate to moderately steep valley sides with convex or straight slopes (PECG Appendix B). Permafrost more commonly contains excess ice in the form of thin seams and lenses in silt-rich colluvial blankets, on solifluction slopes and in inactive portions of fluvial plains. Ice-rich permafrost containing massive ice bodies is most commonly encountered in organic terrain and silt-rich colluvial complexes in fluvial valley bottoms (PECG Appendix B). Lorax (2016) reports on three large bodies of ground ice intercepted between 8 m and 13 m below ground surface in Borehole MW15-01T (Figure 3d, this report). The drill pad was located on a slope classified as poorly drained colluvial veneer modified by solifluction (AECOM 2012). In general, perennially frozen deposits contain visible and non-visible ice, largely in the form of ice crystals, inclusions and/or coatings on soil particles (KP 2015).

Permafrost-related processes and landforms within the mine site study area include cryoturbation, solifluction, **active layer detachments**, slope creep, **frost heave**, and **thermal erosion** (AECOM 2012; McKillop et al. 2013; KP 2015). Open-system **pingos** are present locally, commonly in slope-toe settings of small drainages where groundwater discharges to surface through discontinuities in the permafrost table (Hughes 1969; Bond and Lipovsky 2011; Huscroft 2002; AECOM 2012; McKillop et al. 2013). Saturation of fine-grained colluvial soils in summer is caused by the underlying permafrost; these soils are referred to as “thaw unstable” (SRK 2016b).

3.2 Surficial Geology

The mapping done for this report is given in Figures 2a to 2f. The maps show that the mine site study area is dominated by the colluvium described in Section 3.1.2. Colluvial blanket and veneer (thick and thin deposits) are dominant. The colluvial apron/muck deposits cannot be identified definitively from air photo interpretation alone. As a result, at slope breaks near valley bottoms, units mapped as Ca (colluvial apron), may in fact contain some amount of eolian material. Colluvial aprons are generally poorly to very poorly-drained due to the presence of permafrost. It is also possible that silt-dominated colluvial deposits also contain some component of wind-blown silt.

Although colluvium dominates the mine site area, a few other units are present as well. Weathered bedrock is exposed in places, mainly on the ridge tops, while limited areas of fluvial and organic deposits are found in valley bottoms. In some tributary valleys, thin fluvial deposits are present, but are too small to map.

3.2.1 Weathered Bedrock

In the borehole and testpit logs, bedrock exposed at surface is described as coarse-grained granite or felsic gneiss with clay alteration and fracture-controlled hematite and limonite (Lorax 2016). Weathered bedrock consists of coarse angular gravel with silt and sand or heavily fractured bedrock. The angular gravel fragments are weak and can be broken apart by hand (SRK 2016a). Areas mapped as weathered bedrock may contain local patches of fresher-looking rock. They are mainly found on ridge tops and include the tors, which are mapped with point symbols (Figures 2a to 2f). Bedrock exposed on slopes in valley bottoms appears to be less weathered on the air photos.

3.2.2 Colluvial Deposits

Colluvium is pervasive across the mine site area. It is described in the borehole/testpit data as comprising nonplastic, non-cohesive deposits of angular pebbles, cobbles and boulders (rubble), silt and/or sand. Silt and sand are generally the main components, but some areas are dominated by cobbles (Lorax 2016; SRK 2016a). Rubble lithologies in the areas covered by the boreholes are local: felsic or mafic gneiss, granite and schist (Lorax 2016). Beds of silt, sand, or both may be interspersed with otherwise non-bedded material. Less commonly, organic soil layers may be interbedded with colluvium near the surface (SRK 2016a). Tetra Tech EBA interprets this surface layering as recording previous downslope movement of the upper portions of the colluvium.

Boreholes SRK-15S-07 and -09 and testpit SRK-15TP-38 all contain organic material within the colluvium that can be dated to determine the timing of slope activity in these locations. The material at Boreholes SRK-15S-07 and SRK-15TP-38 consists of organic gravelly silt with large woody pieces at 1.4 m depth and organic woody material at 0.2 m depth, respectively. Borehole SRK-15S-07 records a piece of wood at about 0.2 m depth, as well as organic layers at 1.22 m and 3.96 m. This site could potentially give an approximate return frequency for slope movement at this location. These organic pieces are suspected to be Holocene in age.

3.2.3 Fluvial Deposits

Fluvial deposits are generally thin and are found in narrow valley bottoms. The Latte Creek valley is an exception – here fluvial sediments are thicker and are overlain by organic deposits.

At the confluence of two small streams in the northern part of the mine site area, Borehole SRK-15S-02 describes the fluvial deposit as silty sand with subangular pebbles and cobbles, while nearby Testpit SRK-15TP-36A describes the unit as gravelly silt with cobbles, overlying cobbles. This testpit may be located within thin fluvial sediments overlying colluvium. Further south at the bottom of another tributary valley, Boreholes SRK-15S-12 and SRK-15S-35 identified thin deposits of sandy silt with gravel, containing angular to subangular clasts.

A few fluvial fans are present in the Latte creek valley. One fan has a borehole within it (MW15-02T), which describes the deposit as colluvium ranging from silty sand to boulders. Rounding is not described so it is possible the deposit represents the debris flow portion of the fan; however, the tributary valley is short, so fluvial deposits are unlikely to be well sorted or well-rounded and thus would likely resemble colluvium.

3.2.4 Organic Deposits

Organic deposits are the primary unit in only four locations within the mine site study area; three of these are in the Latte Creek valley and one is in an unnamed valley in the northeast. Organics make up the second or third component of mapped surficial geology units in the bottom of Latte Creek valley, where the primary units are either valley floor fluvial deposits or colluvial aprons.

Unfortunately, there is no field data for organic deposits. Tetra Tech EBA assumes that they consist of peat and/or organic silt as described in Huscroft (2002).

3.2.5 Landforms

The geomorphic processes and landforms within the mine site study area include mass-wasting features (landslide failure scars and headscarps; retrogressive thaw flow scars and headscarps; active layer detachment scars and headscarps; solifluction); thermal erosion, gullying, a collapsed open-system pingo, cryoplanation terraces, and tors (Figures 2a to 2f; 3a and 3b). Two of these landform types are considered rare landforms: the pingo and the tors.

The collapsed pingo is located in the central portion of the mine site study area, in a small creek valley that is a tributary of Latte Creek (Photo 2). It indicates the former presence of massive ground ice and ice-rich permafrost underlying the lower slope of northwesterly aspect at that location.



Photo 2: Collapsed open-system pingo in in a small tributary valley of Latte Creek, looking south.

The tors, erosional remnants of a higher plateau level, are found on ridge tops in the western, southwestern, and central parts of the mine site study area (Figures 2a to 2f; Photos 3 and 4), towering over otherwise smooth rounded ridges underlain by granitic bedrock. Tors are surrounded by either a thick colluvial halo or weathered bedrock. Some of the tors are located within the HLF footprint and there are quad trails visible on the air and field photos in this area on the ridge top (Photo 4).



Photo 3: Ground view of a tor located within the HLF footprint in the western part of the mine site study area.



Photo 4: Aerial photograph of the same tor. Note quad tracks to left of the tor.

Although pingos and tors are not specifically mentioned in the Traditional Knowledge (TK) data collected to date for the Coffee Project, the importance of these features is inferred through views that expressed traditional ways of life being tied to “healthy and intact ecosystems” (Bates et al 2014). The importance of terrain features, possibly including tors and pingos, has been identified with respect to the use of elevated landforms as lookouts (Dobrowolsky 2014; Tr'ondëk Hwëch'in 2012).

There are no trails leading to the collapsed pingo; it is therefore not suspected to be used by First Nations peoples. The quad tracks on the ridge tops may or may not be of First Nations origin.

3.3 Permafrost

3.3.1 Permafrost Distribution

Our calculations of spatial distribution of permafrost within the mine site study area using ArcGIS technology show that approximately 62% of the mapped area is underlain by permafrost (Tetra Tech EBA 2016; Figures 3a and 3b), which is in agreement with Heginbottom et al. (1995). Approximately 38% of the mine site study area is therefore estimated to be permafrost-free. However, permafrost-free areas may contain patches of permafrost in locations where conditions are favourable for its formation.

Relationships between permafrost distribution, slope aspect, and vegetation in the mine site study area are illustrated in Photo 5. In the South WRSF area located within the small creek valley, shallow permafrost underlies the northeast-facing slope, which is vegetated with sparse, stunted black spruce and thick moss; whereas the southwest-facing slope is permafrost-free and covered by almost pure stands of trembling aspen. Aspen requires warmer air temperatures and deeper root penetration; it is therefore unable to grow in shallow permafrost conditions.



Photo 5: South WRSF, Perennially frozen northeast-facing slope (right) and permafrost-free southwest-facing slope (left), looking south towards the Latte Creek valley.

3.3.2 Permafrost Thickness

Permafrost thicknesses within the mine site study area are highly variable, ranging from approximately 30 m (MW15-04T and MW14-02B) to approximately 165 m near the north end of the proposed Supremo open pit (MW14-04T, Figures 3c and 3d). Permafrost thickness measurements are shown in Figures 3a and 3b (borehole locations shown in Figure 3d).

3.3.3 Active Layer

Active layer thickness in the mine site study area varies spatially and temporally. In areas with thicker insulating organic cover, it is usually thin (approximately 0.3 m to 0.6 m), whereas it can be several metres thick within partially exposed bedrock or within coarse surficial material with a high clast content.

3.3.4 Ground Temperatures

Ground temperatures within the mine site study area have been monitored since 2013 by the companies listed in Section 2.2. Permafrost temperatures measured at the **depth of zero annual amplitude** range from temperatures near the freezing point to approximately -2ºC. These temperatures are indicative of warm permafrost conditions; the ground is therefore sensitive to disturbance. The spatial distribution of permafrost temperatures and the measurement locations are shown in Figures 3a and 3b.

The depth of zero annual amplitude within the permafrost interval was estimated from the ground temperature profiles plotted by Lorax (2016). It varies across the mine site study area, but generally lies between approximately 10 m (MW15-07T) and 15 m (MW14-04T) below the ground surface.

3.3.5 Ground Ice

Ground ice content in the perennially frozen surficial materials is highly variable and was mapped accordingly based on the limited information on volumetric ice content (percent by volume) currently available. The mine site study area was found to be underlain by perennially frozen ground with ground ice that is predominantly:

- Non-visible (Nf, Nbn, Nbe) labeled as "**Fn**";
- Visible (Vx, Vc, Vr, Vs) labeled as "**Fv**"; or
- Forms significant accumulations, such as massive ice bodies, labeled as "**Fi**".

The following describes each of the three permafrost types mapped in Figures 3a to 3d (**Fn**, **Fv**, and **Fi**) in detail:

- Areas labelled as **"Fn"** are generally ice-poor (Frozen, Non-Visible Ice). These consist of perennially frozen ground that is **well-bonded** to **friable** and typically does not contain visible excess ice. However, these areas may include patches of permafrost with visible ground ice (Fv), having ice contents ranging from 1% to 5% by volume, as well as patches of unfrozen ground.
- Areas labelled as **"Fv"** contain visible excess ground ice (Frozen, Visible Ice). This ice-rich permafrost is well-bonded but rarely includes large ground ice bodies. The ice-rich areas may include patches of ice-poor permafrost with ground ice that is not visible to the unaided eye (**Fn**) and patches of permafrost-free ground. Ice content is estimated to range from 1% to 30% by volume (SRK, 2016a). The visible excess ice content (percent by volume) within areas designated as "**Fv**" may exceed 30% (e.g. Borehole SRK-15S-08, West WRSF (SRK, 2016a)).
- Areas labelled as **"Fi"** (Frozen, Ice-Rich) are generally very ice-rich and may include large accumulations of ground ice, such as ice wedges and other massive ice bodies.

In the mine site study area, distribution of these three permafrost types characterized by ground ice content can be broken down as follows:

- 34% is underlain by predominantly ice-poor permafrost with predominantly non-visible ice (**Fn**);
- 27% is underlain by permafrost with visible excess ice (**Fv**); and
- Approximately 1% is underlain by very ice-rich permafrost (**Fi**), which is located at the bottom of some of the creek valleys, e.g. the Latte Creek and the May Lady Creek.

3.4 Terrain Stability

The terrain stability mapping of a mine site study area with slightly different boundaries conducted by PECG is given in Appendix B and is summarized in this section.

PECG's mapping was based on delineating five standard terrain stability classes which are as follows:

- I – stable;
- II – generally stable;
- III – generally stable with isolated minor instability;
- IV – potentially unstable; and
- V – Unstable.

However, because of the complexity of the landscape, which is within the zone of widespread discontinuous permafrost with variable ground ice content and warm permafrost temperatures, PECG differentiated the terrain stability classes in both the existing and disturbed condition. The “existing terrain stability” class represents current conditions, in the absence of any project-related activity; whereas, the “disturbed terrain stability” class represents conditions following disturbance to ground conditions during exploration and from road/mine facility construction without mitigation. This format of mapping, in PECG’s opinion, distinguishes natural hazards, which may be triggered by occurrences such as wildfire, from those potentially exacerbated or initiated by project-related disturbance.

Calculations of the areas occupied by each of the five terrain stability classes using ArcGIS technology show that prior to the proposed construction activities (the existing undisturbed terrain), the majority (approximately 78%) of the mine site study area has an existing terrain stability class of “generally stable” (Class II). Approximately 15% of the mine site study area is considered “generally stable with isolated minor instability” (Class III). Approximately 1% of the mine site study area is considered “potentially unstable” (Class IV) and approximately 6% - “unstable” (Class V).

According to the disturbed terrain stability class, the proportion of terrain stability polygons in the mine site study area with a “generally stable” (Class II) rating drops from 78% to 27% (disturbed). The majority (approximately 42%) of the mine site study area becomes “generally stable with isolated minor instability” (Class III). Approximately 24% of the mine site study area becomes “potentially unstable” (Class IV) and approximately 7% - “unstable” (Class V).

PECG’s mapping of terrain and terrain stability and hazards, together, identify various geohazards through the assignment of geomorphic process codes (polygon-scale) and discrete geomorphologic processes (point or linear features) in addition to the terrain stability classes (Appendix B, Maps 1 and 2). Table 3-1 outlines the likelihood and potential magnitude of hazard occurrence over the mine life, generalized according to each of the identified hazards with the potential to affect proposed mine infrastructure footprints. The hazards identified and shown in Table 3-1 vary in likelihood and magnitude, and carry with them different project concerns for avoidance and/or mitigation.

Table 3-1. Hazards with the Potential to Affect the Proposed Mine Site Study Area (Summarized from Tables 5-1 and 5-2, PECG Appendix B)

Hazard	Likelihood (over mine life)	Magnitude	Project Considerations
Rockfall	High – typically recurrent and frequent, where present, freshness of talus at base of bluff indicate recent activity	Moderate – generally small in volume, but rapid and dense	Plan for rockfall below bluffs, especially in areas of fresh deposits (avoid or mitigate) and on steep slopes with small bedrock outcrops
Debris slide	Moderate – most likely to occur on steep slopes with a history of debris sliding, especially within areas adjacent to scars	High – generally small to moderate in volume, but rapid and moderately dense	Avoid debris slide slopes and runout zones
Rock creep	High – periodic movement expected; freshness of patches of rock debris indicate recent activity	Low – small volume, short distance, slow movements of angular rock debris	Expect increased maintenance and allow for minor settlement and shifting of rock debris
Gullying	High – periodic and localized gully erosion processes (e.g. fluvial incision, side wall mass-wasting)	Low – generally incremental and localized incision, minor surface sloughing	Minimize crossings of gullied slopes, especially where underlain by permafrost, and expect increased maintenance

Table 3-1. Hazards with the Potential to Affect the Proposed Mine Site Study Area (Summarized from Tables 5-1 and 5-2, PECG Appendix B)

Hazard	Likelihood (over mine life)	Magnitude	Project Considerations
Solifluction	High – near-continuous, incremental movement	Low – small volume, short distance, slow movements of silt-rich debris	Expect increased maintenance and allow for minor settlement and shifting of surficial material
Thermokarst	Moderate – gradual or periodic settlement, especially in areas of ice-rich permafrost	Low – isolated, slow deepening of ground surface depressions, formation and expansion of tension cracks, possible slow, inward slumping	Minimize disturbance to surface organics and drainage in areas of ice-moderate to ice-rich permafrost through use of appropriate gravel embankments/pads and water management. Expect increased maintenance that could involve localized road reconstruction; consider monitoring settlement
Slopewash	High – seasonal slopewash and transport of fine sediments within runnels; near continuous seepage	Low – localized, slow transport of fine sediments; seepage and icing, especially in runnels	Accommodate seepage-induced icing accumulation especially within intercepted runnels, expect increased maintenance due to fine sediment delivery adjacent to road, manage downslope drainage

3.4.1 Geohazards by Footprint

The hazards identified by PECG include those that have the potential to affect the various infrastructure footprints of the mine site. These are detailed in this section.

3.4.1.1 Open Pits

Deep, ice-poor permafrost is present in the vicinity of most of the proposed open pit areas. There are a few slopes with active rock creep, some ice-moderate permafrost on the west side of the Latte pit, and gullied terrain on the south side of the Supremo pit.

Surface runoff should be managed around the rim of the pits to prevent retrogressive gullying and settlement of the overburden cap.

3.4.1.2 West WRSF

The West WRSF footprint is on a laterally-convex hillside that is covered with thin colluvium. Here, continuous, ice-poor permafrost is shallow to deep. There is an area of potentially ice-rich permafrost and a fringing colluvial blanket in the southwest portion of the WRSF.

In September 2015, Tetra Tech EBA observed human-induced **thermal erosion** developing along the recent access trail within the area of potentially ice-rich permafrost mentioned above (Figures 3a and 3b; Photos 6 and 7).

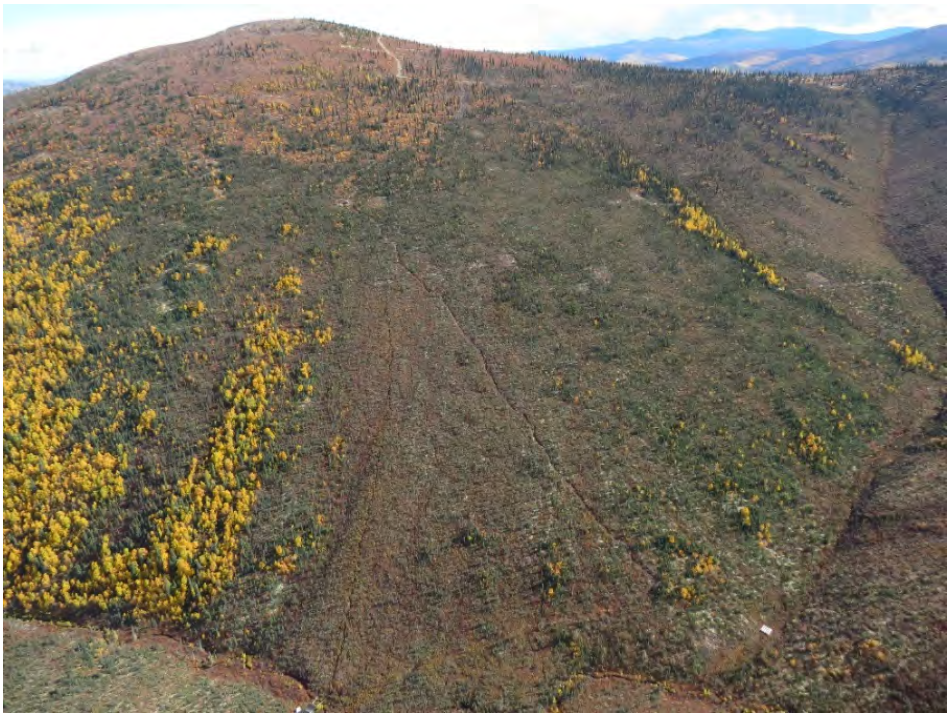

Photo 6: West WRSF, Recent access trail along west-northwest-facing perennially frozen slope, looking southeast. Drillers' access trail crosses photo from the hill top in the upper left to the base of the slope on the lower right.



Photo 7: West WRSF, west-northwest-facing slope. Thermal erosion along recent access trail, looking west.

3.4.1.3 South WRSF

This WRSF is located in a small, first order tributary valley. The west side of the valley contains shallow, ice-moderate permafrost. Slopewash was the only geomorphological process mapped. There are a few subdued gullies on the east side of the valley and permafrost is suspected at lower elevations.

3.4.1.4 North WRSF

The North WRSF partially fills a headwater basin mostly covered with colluvial veneer, but areas of thicker colluvium are also present. All of the colluvium contains permafrost; it is ice-moderate[2] in places. There is potential for thermokarst, rock creep, and slopewash.

3.4.1.5 Unnamed WRSF

This WRSF is located in an area of weathered bedrock and colluvial veneer with shallow to deep, ice-poor permafrost. There is an area of infilled colluvial and fluvial material at the valley bottom that may contain ground ice at depth.

3.4.1.6 HLF Area

A gentle ridge of weathered bedrock with colluvial veneer hosts the proposed HLF. Shallow to deep, ice-poor permafrost is present throughout the footprint. An area of colluvial blanket in the northwest corner may contain ice-moderate permafrost. There is a small active layer detachment on the slope in this area, which indicates permafrost thaw. Solifluction and related rock creep are also evident within the footprint.

3.4.1.7 Plant Site Area

The plant site footprint is located on a broad, near level section of a ridge. It is covered with a veneer of weathered bedrock and colluvium and ice-poor permafrost is shallow to deep. There are no stability concerns in this area.

3.5 Organic Soils

No organic cover was observed at boreholes SRK-15S-05 (disturbed), 15S-26 to 15S-28, 15TP-68, 15TP-69, 15TP-75A, and 15TP-82A (SRK 2016a). Organic deposits were not described in the Lorax boreholes (Lorax 2016), with the exception of MW15-04WB, MW15-01AZ, and MW15-01T. At the latter site, 2 m of muddy brown organics and colluvium were observed, but the thickness of the organics is not given.

The organic surface soil layer typically ranges from 0.1 m to 0.3 m thick, but is most commonly 0.2 m in thickness. Thicknesses of 0.1 m are more common on, but are not limited to, the ridge tops, and thicknesses of 0.3 m or greater tend to be found in areas of non-visible ground ice (Fn). The greatest organic layer thickness recorded (0.6 m) is located in an area of very ice-rich permafrost (Fi).

The organic soils were generally described as moist, dark brown organics containing moss and fibrous lichens (SRK 2016a) or simply as moss with root inclusions (KP 2015). However, a few were described as organic silt or organic silt with sand, gravel, and/or cobbles (Lorax 2016; SRK 2016a), one was described as topsoil/**muskeg** (Lorax 2016), and two were described as green moss (SRK 2016a).

[2] See Appendix B for definition

Organic silt is most common on north-facing slopes and is found only in areas of visible or non-visible ground ice. The presence of silt within the organics may be caused by a combination of more active slope creep in permafrost areas, cryoturbation, or loess capture by permafrost-bearing units, which are wetter in summer.

Very few holes were drilled in valley bottoms, so the wet fluvial units are under-represented in the borehole and testpit data. The topsoil/muskeg site is found adjacent to one of the fluvial units (MW15-05T, Lorax 2016) in an area of very ice-rich permafrost.

4.0 SUMMARY AND CONCLUSIONS

This report elucidates the Coffee Gold Project mine site study area's surficial geology, physiography, permafrost, and terrain stability baseline conditions for the purposes of an environmental assessment.

First, a literature review was completed to summarize the conditions at site to date. It shows that the area has not been glaciated, resulting in a landscape consisting of rounded ridges separated by deep, V-shaped valleys. Climate is characterized by warm, short summers and long, cold winters. Weathered bedrock, colluvium derived from weathered bedrock and loess, and fluvial deposits are found within the mine site study area, but colluvial deposits are by far the most common. These deposits are affected by gullying, cryoturbation, solifluction, permafrost processes, periglacial processes, landslides, and snow avalanches. The mine site study area is located within the zone of extensive discontinuous permafrost. Permafrost is most common on north-facing slopes with thick organic cover and in colluvial apron/muck deposits on lower slopes and on creek bottoms. South-facing slopes are permafrost-free. Permafrost-related processes include cryoturbation, solifluction, active layer detachments, slope creep, frost heave, and thermal erosion. Open-system pingos are present locally.

Since 2011, ten field investigation programs have been completed, each of which provides useful information for this baseline study. These field programs include soils, hydrogeology, permafrost, and geotechnical studies. Drilling, instrument installation in boreholes, testpitting, ground investigations on foot, and helicopter flyovers were all included in these studies.

Surficial geology, permafrost, and terrain stability mapping were undertaken for this report. The first two were completed by Tetra Tech EBA and the third by PECG. The desktop mapping draws heavily on data supplied by the many field investigations; these were used as ground truthing points for three types of mapping.

Various permafrost maps, a map of the general surficial geology of the mine site, and terrain stability/hazard maps were generated for this baseline study; these are included at the end of this report. Geohazards and organic surface soils were also described.

Results from this baseline study conclude that colluvium is indeed pervasive, and that ridge tops may have exposed weathered bedrock, some of which forms tors. Colluvium is dominated by silt and sand, but also contains angular pebbles, cobbles, and boulders. Organic material interbedded with the colluvium at a few sites shows that downslope creep or possibly sliding of some colluvial deposits may be fairly recent. Thin fluvial deposits consisting of gravelly silt are found in the narrow valley bottoms and a few fluvial fans are present at the mouths of small tributary valleys. Thick organic deposits are rare; they are found in the Latte Creek valley and overlying colluvial apron/muck deposits at the base of some slopes.

The only rare landforms in the mine site study area are the tors and one collapsed open-system pingo.

Permafrost distribution determined from the mapping shows that approximately 62% of the mine site study area is underlain by permafrost. Permafrost thicknesses range from approximately 30 m to 165 m. The active layer is highly variable: it is usually thin (approximately 0.3 m to 0.6 m), but it can be several metres thick in bedrock areas or where coarse surficial sediments are present. Ground temperatures range from close to 0ºC to approximately -2ºC,

indicating warm permafrost conditions. Ground containing permafrost is therefore sensitive to disturbance. Ground ice has been classified as non-visible, visible, or forming significant accumulations, such as massive ice bodies, although the latter is rare. The spatial distribution of these across the mine site was determined to be 34% for ice-poor permafrost with non-visible ice; 27% for permafrost with visible excess ice; and 1% for very ice-rich permafrost, which is mainly located at the bottom of the Latte Creek valley.

Five terrain stability classes (stable; generally stable; generally stable with minor instability; potentially unstable; and unstable) were mapped within the mine site. These classes were differentiated in both the existing and disturbed condition because of the complexity of the mine site study area permafrost terrain. The “existing terrain stability” class represents current conditions, in the absence of any project-related activity; whereas, the “disturbed terrain stability” class represents conditions following disturbance to ground conditions from road/mine facility construction without mitigation.

Calculations of the areas occupied by each of the five terrain stability classes using ArcGIS technology show that prior to the proposed construction activities (the existing undisturbed terrain) the majority (approximately 78%) of the mine site study area has an existing terrain stability class of “generally stable” (Class II). Approximately 15% of is considered “generally stable with isolated minor instability” (Class III). Approximately 1% of the mine site study area is considered “potentially unstable” (Class IV) and approximately 6% - “unstable” (Class V).

According to the disturbed terrain stability class, the proportion of terrain stability polygons in the mine site study area with a “generally stable” (Class II) rating drops from 78% to 27%. The majority (approximately 42%) of the mine site study area becomes “generally stable with isolated minor instability” (Class III). Approximately 24% becomes “potentially unstable” (Class IV) and approximately 7% - “unstable” (Class V).

Various hazards were identified and described by magnitude, frequency, and considerations for mitigation of each. These include rockfall, debris slides, rock creep, gullying, solifluction, thermokarst, and slopewash. The various geohazards within each proposed infrastructure footprint were also described.

Finally, the organic surface soil was described. It is generally 0.2 m thick, but is slightly thinner on ridge tops, and is thicker in areas of non-visible ground ice or where very ice-rich permafrost is found. Organic silt is most common on north-facing slopes and is found only in areas of visible or non-visible ground ice. The presence of silt within the organics may be caused by a combination of more active slope creep in permafrost areas, cryoturbation, or loess capture by permafrost-bearing units, which are wetter in summer.

5.0 CLOSURE

We trust this report meets your present requirements. If you have any questions or comments, please contact the undersigned.

Respectfully submitted,
Tetra Tech EBA Inc.

Signature REDACTED

Signature REDACTED

Prepared by:
Shirley McCuaig, Ph.D., P.Geo. (NWT/NU/AB)
Senior Terrain Geologist, Geotechnical Engineering
Email Address REDACTED

Signature REDACTED

Prepared by:
Vladislav Roujanski, Ph.D., P.Geol. (NWT/NU/AB)
Senior Geologist-Geocryologist, Arctic Group
Email Address REDACTED

KEVIN W. JONES
TERRITORY
May 2, 2016
ENGINEER

Reviewed by:
Kevin Jones, P.Eng.
Vice President, Arctic Development
Email Address REDACTED

Signature REDACTED

Date May 4/16
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

/jf

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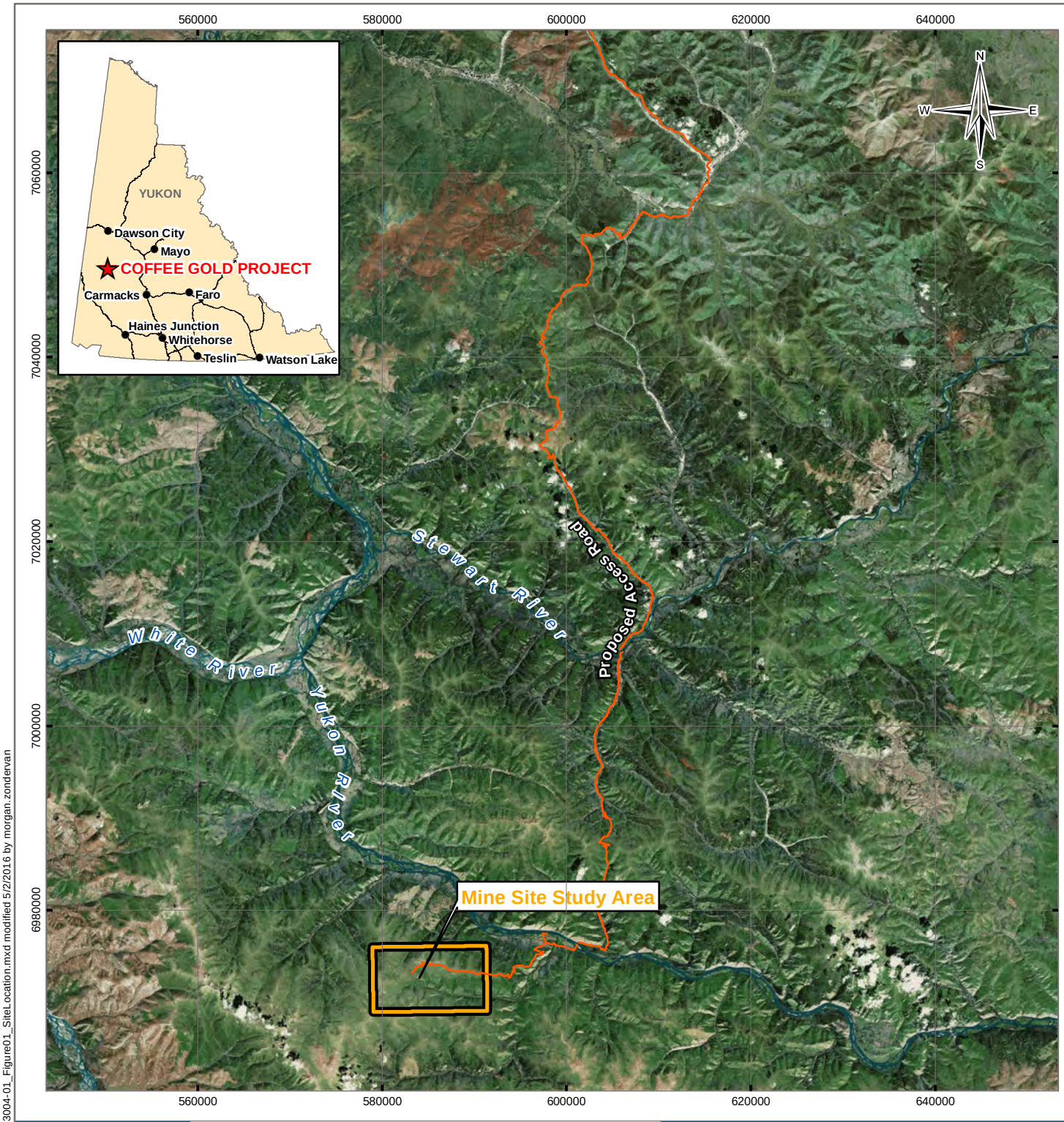
FIGURES

Figure 1 Site Location
Figure 2a Surficial Geology and Permafrost
Figure 2b Surficial Geology and Permafrost
Figure 2c Surficial Geology and Permafrost
Figure 2d Surficial Geology and Permafrost
Figure 2e Surficial Geology and Permafrost
Figure 2f Surficial Geology and Permafrost
Figure 3a Permafrost Distribution and Related Geohazards
Figure 3b Permafrost Distribution and Related Geohazards
Figure 3c Permafrost Distribution and Proposed Mine Site Layout
Figure 3d Permafrost Distribution and As-Drilled Borehole Layout



LEGEND

- Mine Site Study Area
- Proposed Access Road

NOTES
Base data source:
Imagery from ESRI;
Earthstar Geographics (1999)
Road data from Kaminak (February 2016)

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
ENVIRONMENTAL BASELINE REPORT

Site Location

PROJECTION	DATUM	CLIENT
UTM Zone 7	NAD83	KAMINAK GOLD CORPORATION

Scale: 1:600,000
10 5 0 10
Kilometres

FILE NO. EARC03004-01_Figure01_SiteLocation.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03004-01	MEZ	SL	SMC	0

OFFICE	DATE
Tt EBA-VANC	May 2, 2016

TETRA TECH EBA

Figure 1

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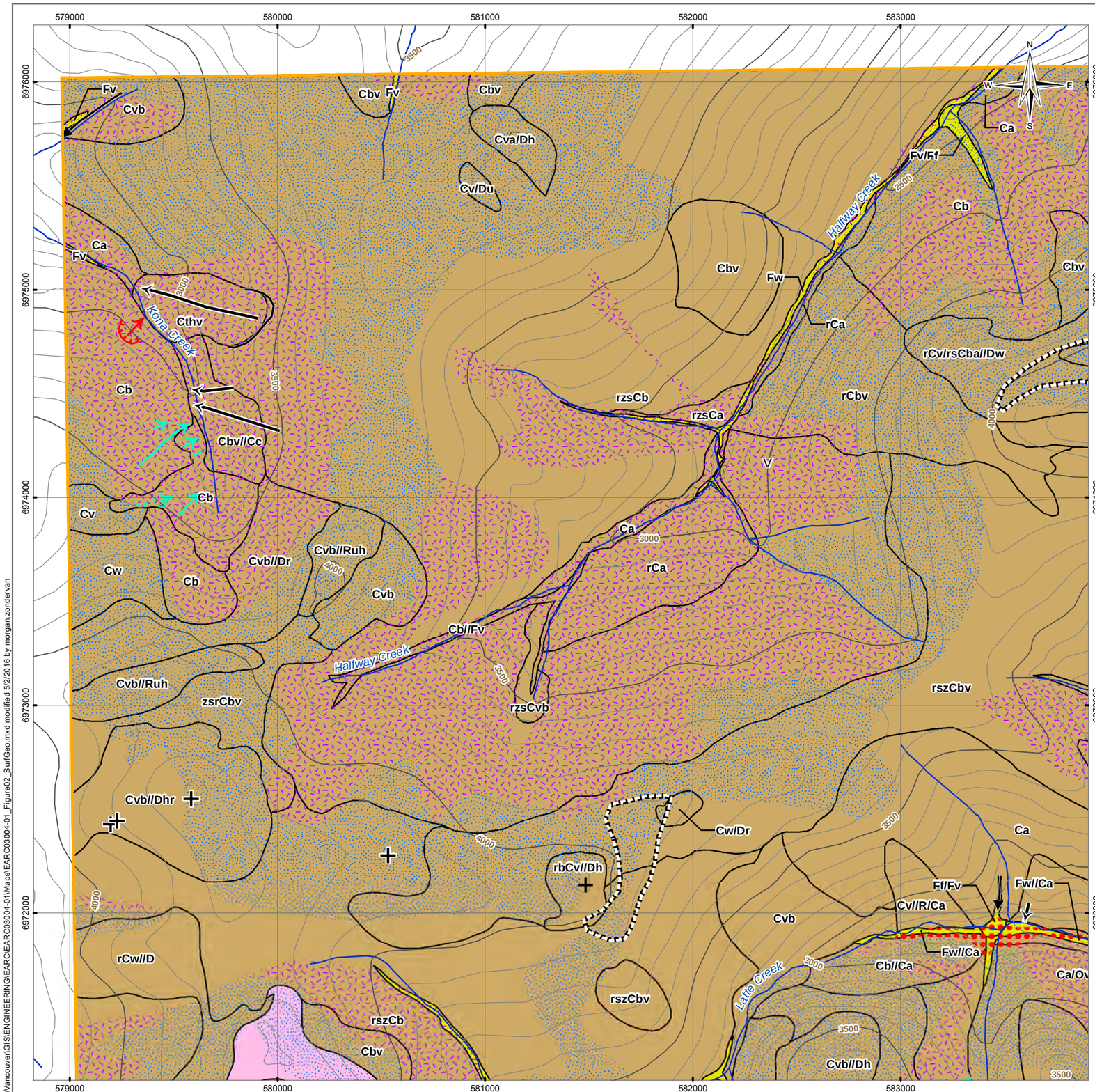

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LEGEND

- Mine Site Study Area
- Collapsed Pingo
- Solifluction Feature
- Thermal Erosion Feature
- Tor
- Cryoplanation Terrace
- Gully
- Landslide Failure Scar
- Landslide Headscarp
- Recent Landslide Failure Scar
- Recent Landslide Headscarp
- Retrogressive Thaw Flow Scar
- Retrogressive Thaw Flow Headscarp
- Active Layer Detachment Scar
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Permafrost Characterization by Ground Ice Content

- Perennially Frozen Ground – very ice-rich
- Perennially Frozen Ground – visible excess ice
- Perennially Frozen Ground – ice not visible
- Unfrozen
- Intermediate Contour (100 ft)
- Index Contour (500 ft)
- Watercourse

NOTES
Base data source: CanVec 1:50,000
PECG (2016)

TERRAIN CODE

TEXTURE(S)
SURFICIAL MATERIAL
SURFACE EXPRESSION(S)

rszCbv

TEXTURE

- **b** boulders (>256 mm, rounded)
- **k** cobble (64-256 mm, rounded)
- **s** sand (0.062 - 2 mm)
- **z** silt (0.002 - 0.062 mm)
- **g** gravel (rounded; 2 to > 256 mm)
- **x** angular fragments (2 to > 256 mm)
- **r** rubble (2-256 mm, angular particles)

SURFICIAL MATERIAL

- **C** Colluvium
- **D** Weathered Bedrock
- **E** Eolian
- **F** Fluvial
- **FA** Active Fluvial
- **O** Organic
- **R** Bedrock

SURFICIAL EXPRESSION

- **a** apron
- **b** blanket (>1 m thick)
- **c** cone(s)
- **f** fan(s)
- **h** hummock(s)
- **p** plain
- **r** ridge(s)
- **t** terrace(s)
- **u** undulating
- **v** veneer (0.1 - 1 m thick)
- **w** mantle of variable thickness

DELIMITERS

- **.** components on either side of the "." symbol are of approximately equal proportion
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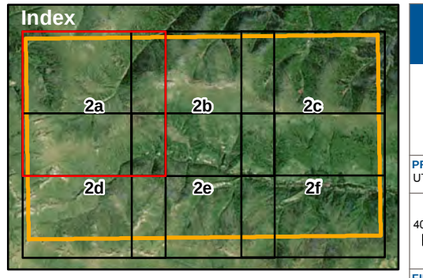
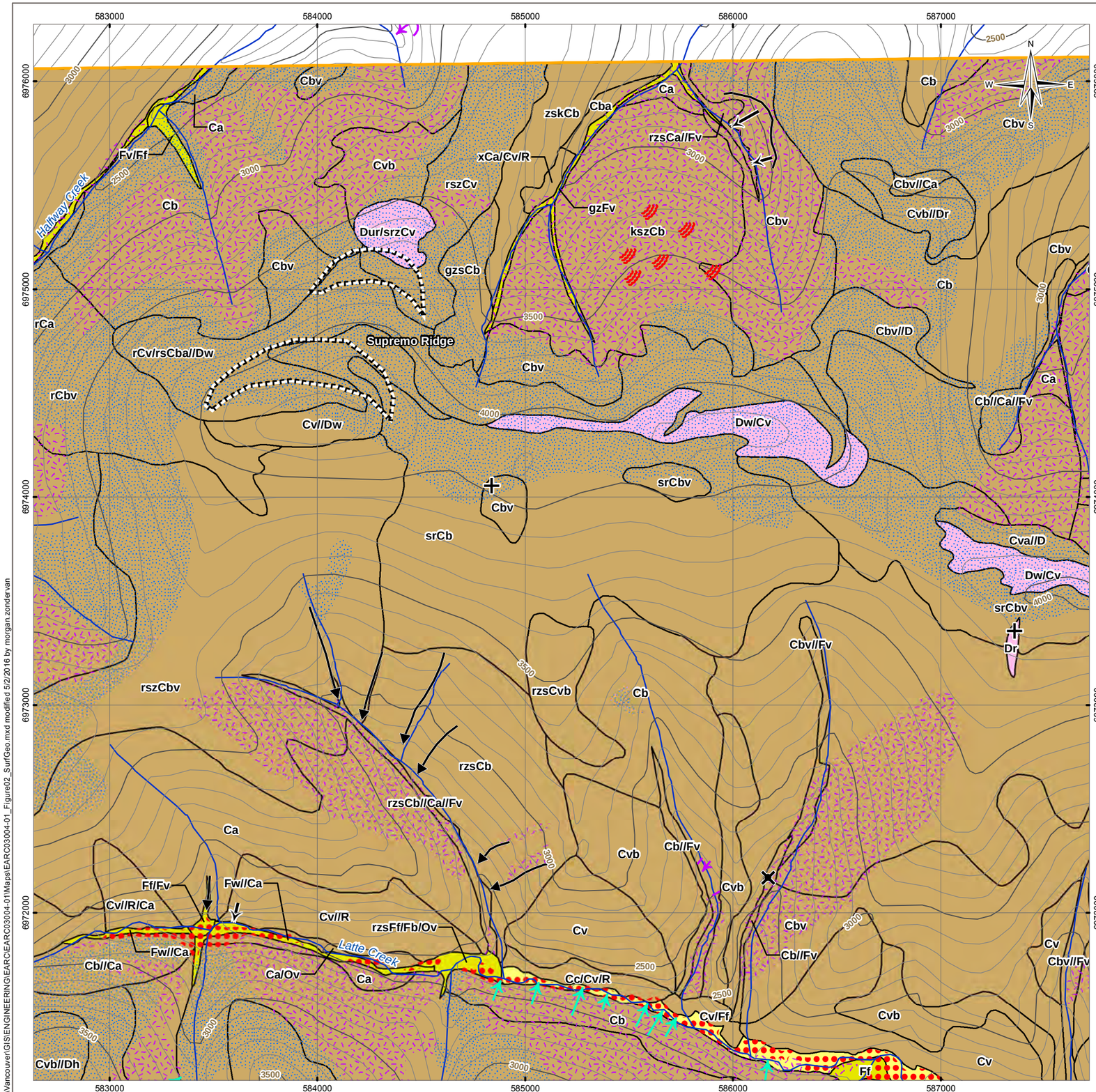


STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
ENVIRONMENTAL BASELINE REPORT

Surficial Geology and Permafrost

PROJECTION UTM Zone 7		**DATUM** NAD83			**CLIENT** KAMINAK GOLD CORPORATION
Scale: 1:20,000 — 400 200 0 400 Metres					
FILE NO. EARC03004-01_Figure02_SurfGeo.mxd					TETRA TECH EBA
PROJECT NO. ENG.EARC03004-01	**DWN** MEZ	**CKD** SL	**APVD** SMC	**REV** 0	**Figure 2a**
OFFICE Tt EBA-VANC	**DATE** May 2, 2016				



LEGEND

- Mine Site Study Area
- Collapsed Pingo
- Solifluction Feature
- Thermal Erosion Feature
- Tor
- Cryoplanation Terrace
- Gully
- Landslide Failure Scar
- Landslide Headscarp
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NOTES
Base data source: CanVec 1:50,000
PECG (2016)

TERRAIN CODE

TEXTURE(S)
SURFICIAL MATERIAL
SURFACE EXPRESSION(S)

rszCbv

TEXTURE

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- **x** angular fragments (2 to > 256 mm)
- **r** rubble (2-256 mm, angular particles)

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- **p** plain
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- **t** terrace(s)
- **u** undulating
- **v** veneer (0.1 - 1 m thick)
- **w** mantle of variable thickness

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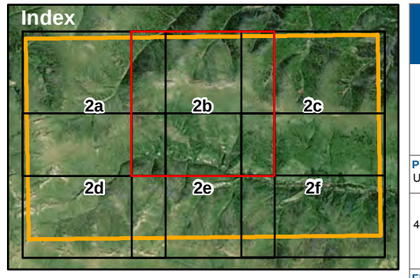

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
ENVIRONMENTAL BASELINE REPORT

Surficial Geology and Permafrost

PROJECTION UTM Zone 7	**DATUM** NAD83				**CLIENT** KAMINAK GOLD CORPORATION
Scale: 1:20,000 (400 200 0 400 Metres)					
FILE NO. EARC03004-01_Figure02_SurfGeo.mxd					TETRA TECH EBA
PROJECT NO. ENG.EARC03004-01	**DWN** MEZ	**CKD** SL	**APVD** SMC	**REV** 0	**Figure 2b**
OFFICE Tt EBA-VANC	**DATE** May 2, 2016				

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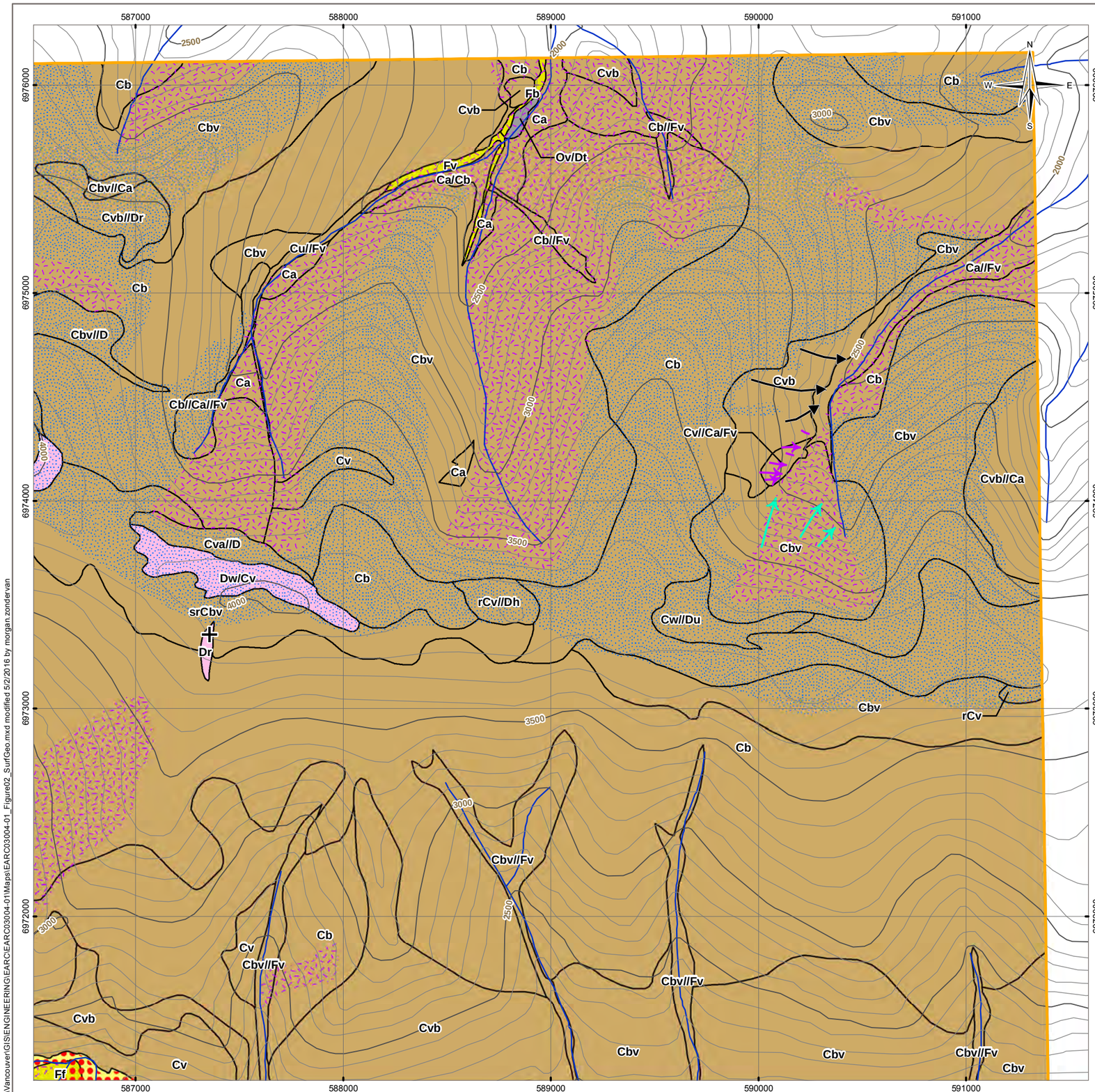

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LEGEND

- Mine Site Study Area
- Collapsed Pingo
- Solifluction Feature
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NOTES
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PECG (2016)

TERRAIN CODE

TEXTURE(S)
SURFICIAL MATERIAL
SURFACE EXPRESSION(S)

rszCbv

TEXTURE

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SURFICIAL MATERIAL

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SURFICIAL EXPRESSION

a	apron
b	blanket (>1 m thick)
c	cone(s)
f	fan(s)
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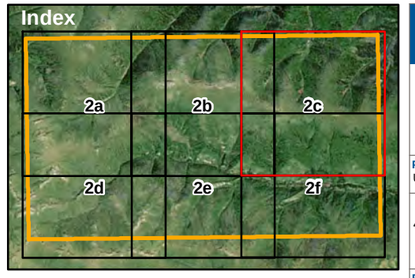
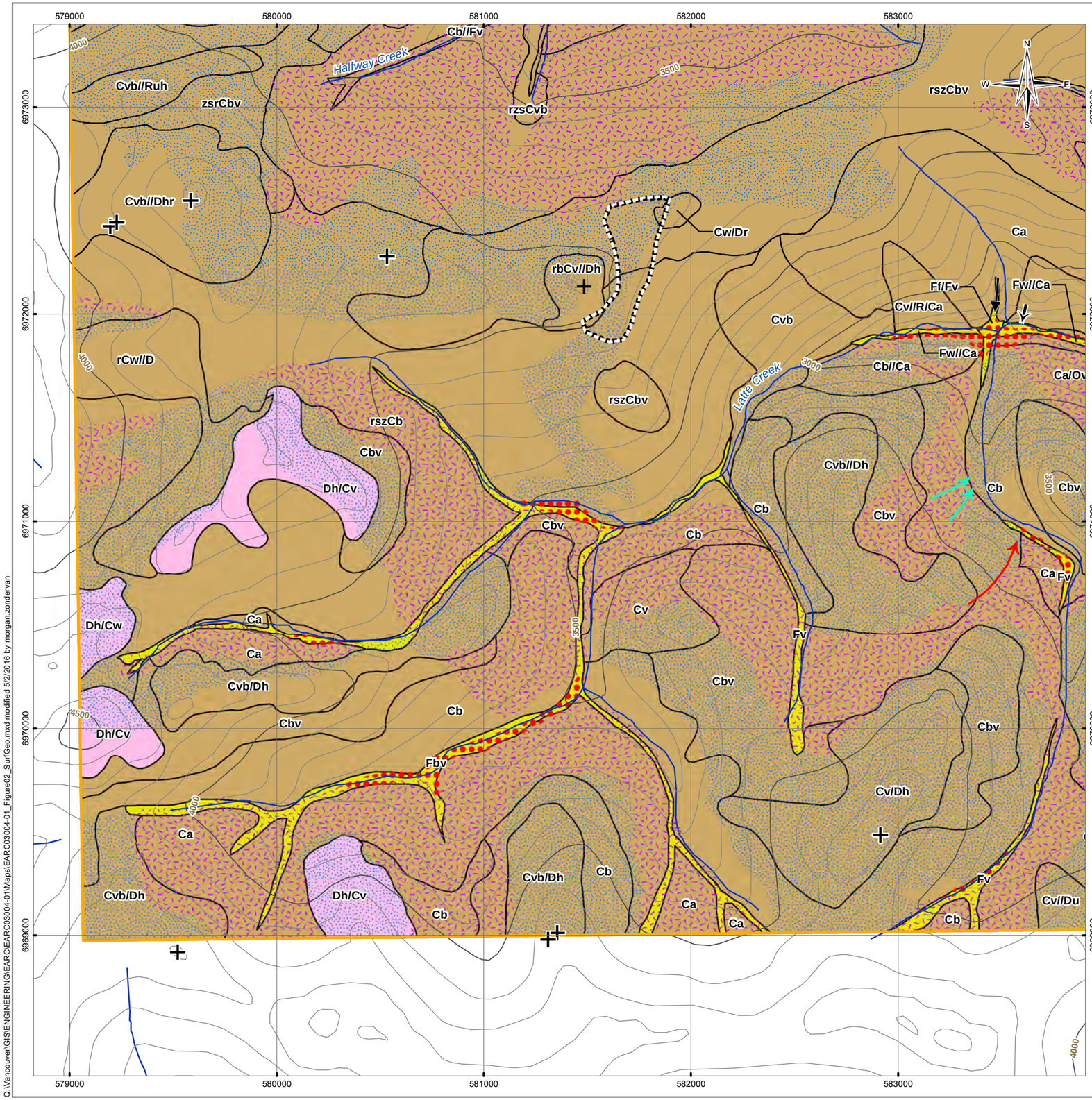


COFFEE GOLD PROJECT
ENVIRONMENTAL BASELINE REPORT

Surficial Geology and Permafrost

PROJECTION: UTM Zone 7	DATUM: NAD83	CLIENT: KAMINAK GOLD CORPORATION			
Scale: 1:20,000 (400 200 0 400 Metres)					
FILE NO.: EARC03004-01_Figure02_SurfGeo.mxd		TETRA TECH EBA			
PROJECT NO.: ENG.EARC03004-01	DWN: MEZ	CKD: SL	APVD: SMC	REV: 0	Figure 2c
OFFICE: Tt EBA-VANC	DATE: May 2, 2016				

STATUS
ISSUED FOR USE



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LEGEND

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TERRAIN CODE

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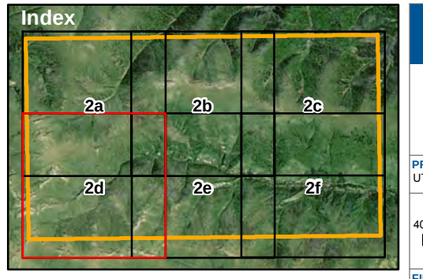
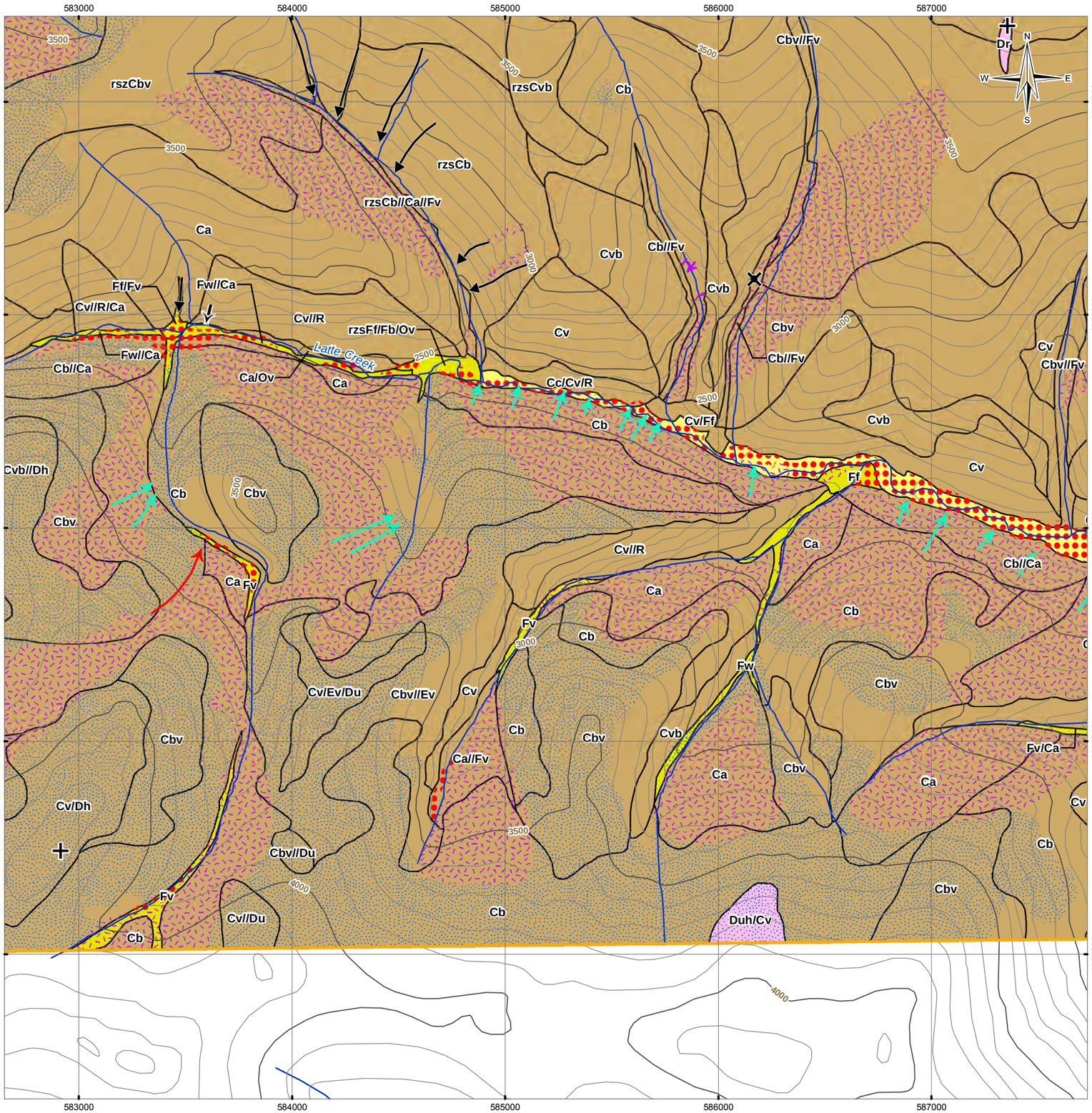


STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
ENVIRONMENTAL BASELINE REPORT

Surficial Geology and Permafrost

PROJECTION: UTM Zone 7	DATUM: NAD83				CLIENT: KAMINAK GOLD CORPORATION
Scale: 1:20,000 (400 200 0 400 Metres)					TETRA TECH EBA
FILE NO.: EARC03004-01_Figure02_SurfGeo.mxd					
PROJECT NO.: ENG.EARC03004-01	DWN: MEZ	CKD: SL	APVD: SMC	REV: 0	Figure 2d
OFFICE: Tt EBA-VANC	DATE: May 2, 2016				



LEGEND

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PECG (2016)

TERRAIN CODE

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rszCbv

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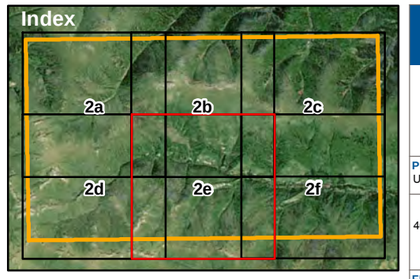
//	the component in front of the "//" symbol is considerably more extensive than the one that follows
\	the component(s) in front of the "\" symbol stratigraphically overlies the component(s) that follows



COFFEE GOLD PROJECT ENVIRONMENTAL BASELINE REPORT

Surficial Geology and Permafrost

PROJECTION	DATUM	CLIENT
UTM Zone 7	NAD83	KAMINAK GOLD CORPORATION

Scale: 1:20,000
400 200 0 400
Metres

TETRA TECH EBA

FILE NO.
EARC03004-01_Figure02_SurfGeo.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03004-01	MEZ	SL	SMC	0

OFFICE	DATE
Tt EBA-VANC	May 2, 2016

STATUS
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Figure 2e

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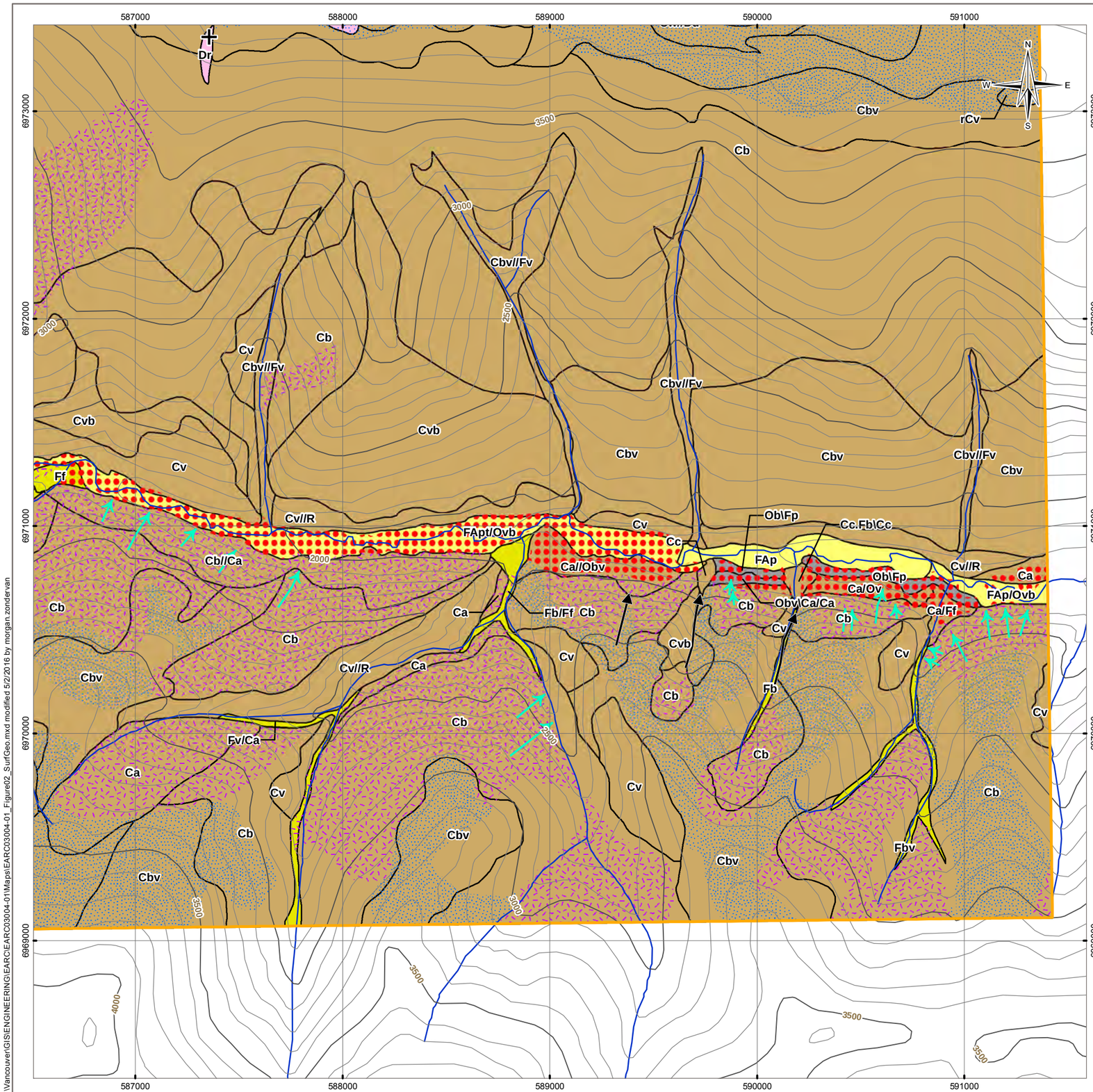


LEGEND

- Mine Site Study Area
- Collapsed Pingo
- Solifluction Feature
- Thermal Erosion Feature
- Tor
- Cryoplanation Terrace
- Gully
- Landslide Failure Scar
- Landslide Headscarp
- Recent Landslide Failure Scar
- Recent Landslide Headscarp
- Retrogressive Thaw Flow Scar
- Retrogressive Thaw Flow Headscarp
- Active Layer Detachment Scar
- Active Layer Detachment Headscarp

Permafrost Characterization by Ground Ice Content

- Perennially Frozen Ground – very ice-rich
- Perennially Frozen Ground – visible excess ice
- Perennially Frozen Ground – ice not visible
- Unfrozen
- Intermediate Contour (100 ft)
- Index Contour (500 ft)
- Watercourse

NOTES
Base data source: CanVec 1:50,000
PECG (2016)

TERRAIN CODE

TEXTURE(S)
SURFICIAL MATERIAL
SURFACE EXPRESSION(S)

rszCbv

TEXTURE

- **b** boulders (>256 mm, rounded)
- **k** cobble (64-256 mm, rounded)
- **s** sand (0.062 - 2 mm)
- **z** silt (0.002 - 0.062 mm)
- **g** gravel (rounded; 2 to > 256 mm)
- **x** angular fragments (2 to > 256 mm)
- **r** rubble (2-256 mm, angular particles)

SURFICIAL MATERIAL

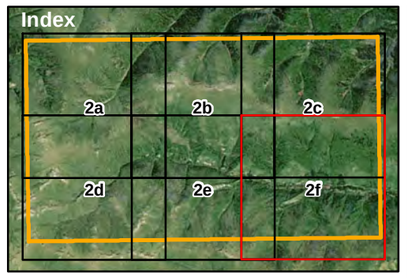
- **C** Colluvium
- **D** Weathered Bedrock
- **E** Eolian
- **F** Fluvial
- **FA** Active Fluvial
- **O** Organic
- **R** Bedrock

SURFICIAL EXPRESSION

- **a** apron
- **b** blanket (>1 m thick)
- **c** cone(s)
- **f** fan(s)
- **h** hummock(s)
- **p** plain
- **r** ridge(s)
- **t** terrace(s)
- **u** undulating
- **v** veneer (0.1 - 1 m thick)
- **w** mantle of variable thickness

DELIMITERS

- **.** components on either side of the "." symbol are of approximately equal proportion
- **/** the component in front of the "/" symbol is more extensive than the one that follows
- **//** the component in front of the "//" symbol is considerably more extensive than the one that follows
- **** the component(s) in front of the "\" symbol stratigraphically overlies the component(s) that follows



STATUS
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COFFEE GOLD PROJECT
ENVIRONMENTAL BASELINE REPORT

Surficial Geology and Permafrost

PROJECTION UTM Zone 7		**DATUM** NAD83			**CLIENT** KAMINAK GOLD CORPORATION
Scale: 1:20,000 (400 200 0 400 Metres)					TETRA TECH EBA
FILE NO. EARC03004-01_Figure02_SurfGeo.mxd					
PROJECT NO. ENG.EARC03004-01	**DWN** MEZ	**CKD** SL	**APVD** SMC	**REV** 0	**Figure 2f**
OFFICE Tt EBA-VANC	**DATE** May 2, 2016				

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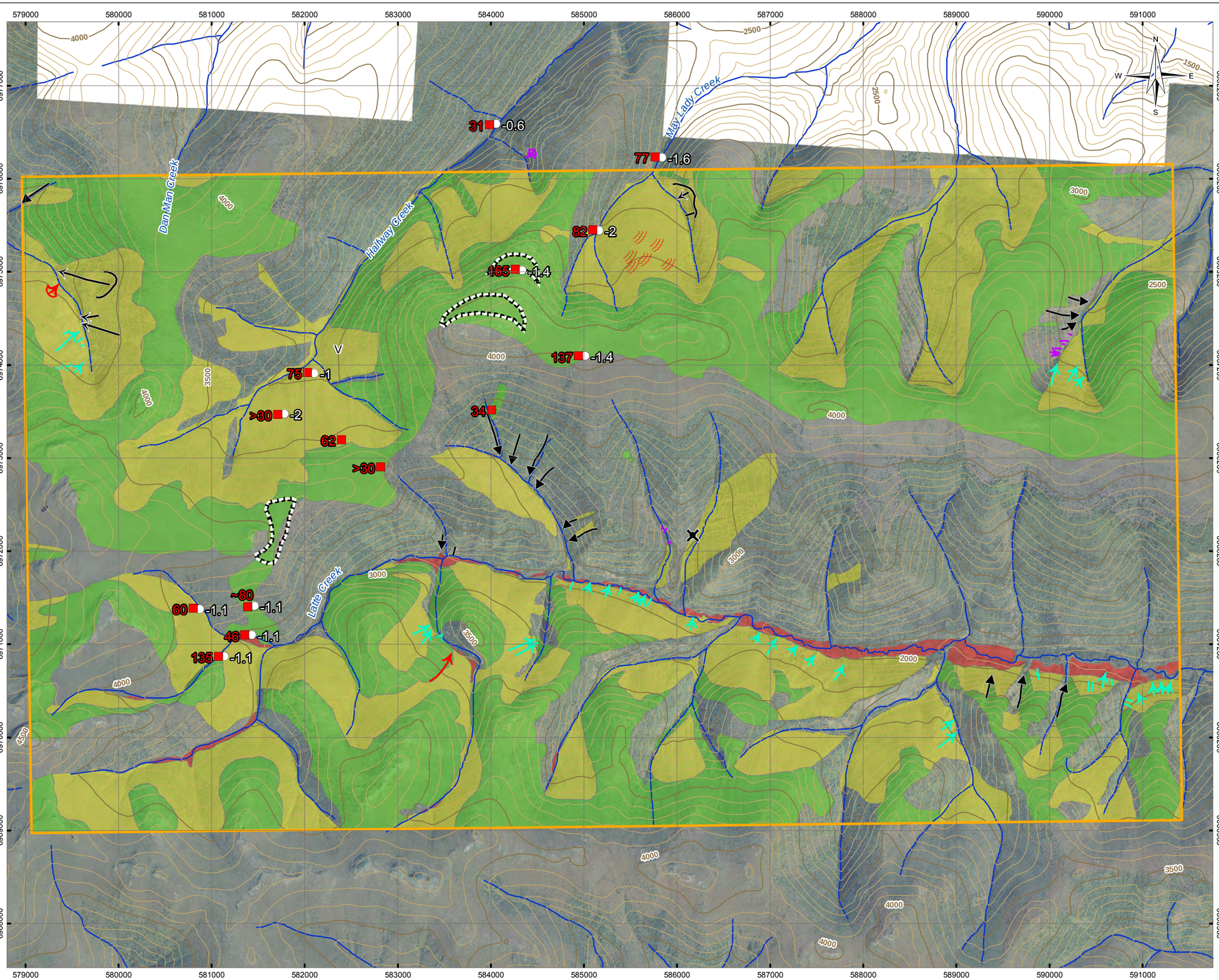

LEGEND

Permafrost Characterization by Ground Ice Content

- Perennially Frozen Ground – very ice-rich (Fi)
- Perennially Frozen Ground – visible excess ice (Fv)
- Perennially Frozen Ground – ice not visible (Fn)
- Unfrozen
- Mine Site Study
- Permafrost Temperature (°C)
- Permafrost Thickness (m)
- Collapsed Pingo
- Solifluction Feature
- Thermal Erosion Feature
- Cryoplanation Terrace
- Gully
- Landslide Failure Scar
- Landslide Headscarp
- Recent Landslide Failure Scar
- Recent Landslide Headscarp
- Retrogressive Thaw Flow Scar
- Retrogressive Thaw Flow Headscarp
- Active Layer Detachment Scar
- Active Layer Detachment Headscarp
- Intermediate Contour (100 ft)
- Index Contour (500 ft)
- Watercourse

NOTES
Base data source:
Imagery provided by Kaminak (2011)
CanVec 1:50,000

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
ENVIRONMENTAL BASELINE REPORT

Permafrost Distribution and Related Geohazards

PROJECTION UTM Zone 7		**DATUM** NAD83			**CLIENT** KAMINAK GOLD CORPORATION
Scale: 1:40,000 500 250 0 500 Metres					TETRA TECH EBA
FILE NO. EARC03004-01_Figure03a_MinePermafrost.mxd					
PROJECT NO. ENG.EARC03004-01	**DWN** MEZ	**CKD** SL	**APVD** VR/SMC	**REV** 0	**Figure 3a**
OFFICE Tt EBA-VANC	**DATE** May 2, 2016				

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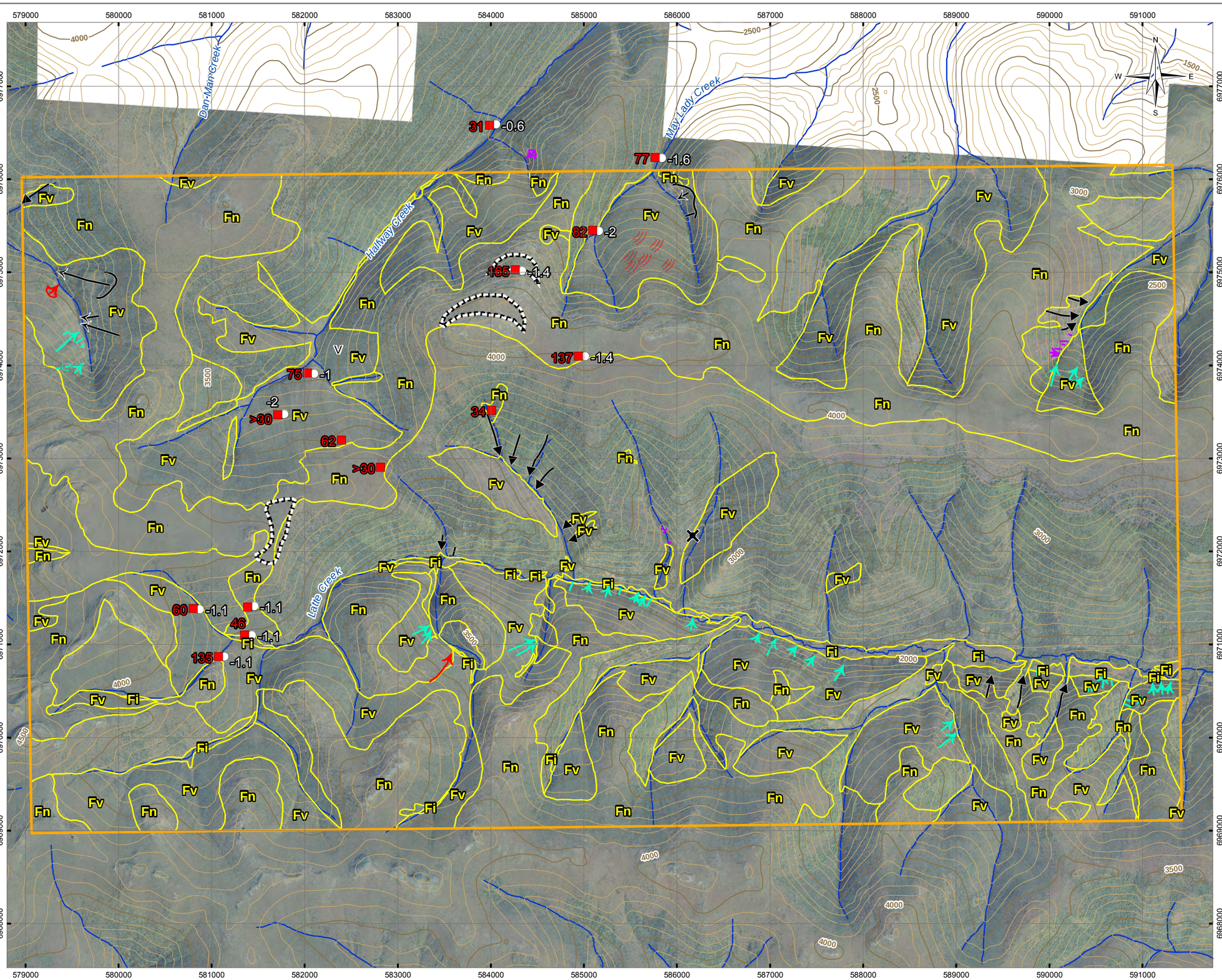

LEGEND

- Fi — Perennially Frozen Ground – very ice-rich
- Fv — Perennially Frozen Ground – visible excess ice
- Fn — Perennially Frozen Ground – ice not visible
- Unfrozen
- Mine Site Study
- Permafrost Temperature (°C)
- Permafrost Thickness (m)
- Collapsed Pingo
- Solifluction Feature
- V — Thermal Erosion Feature
- Cryoplanation Terrace
- Gully
- Landslide Failure Scar
- Landslide Headscarp
- Recent Landslide Failure Scar
- Recent Landslide Headscarp
- Retrogressive Thaw Flow Scar
- Retrogressive Thaw Flow Headscarp
- Active Layer Detachment Scar
- Active Layer Detachment Headscarp
- Intermediate Contour (100 ft)
- Index Contour (500 ft)
- Watercourse

NOTES
Base data source:
Imagery provided by Kaminak (2011)
CanVec 1:50,000

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
ENVIRONMENTAL BASELINE REPORT

Permafrost Distribution and Related Geohazards

PROJECTION	DATUM	CLIENT
UTM Zone 7	NAD83	KAMINAK GOLD CORPORATION

Scale: 1:40,000
500 250 0 500
Metres

TETRA TECH EBA

FILE NO. EARC03004-01_Figure03b_MinePF_Image.mxd

PROJECT NO.	DWN	CKD	APVD	REV
ENG.EARC03004-01	MEZ	SL	VR/SMC	0

OFFICE Tt EBA-VANC
DATE May 2, 2016

Figure 3b

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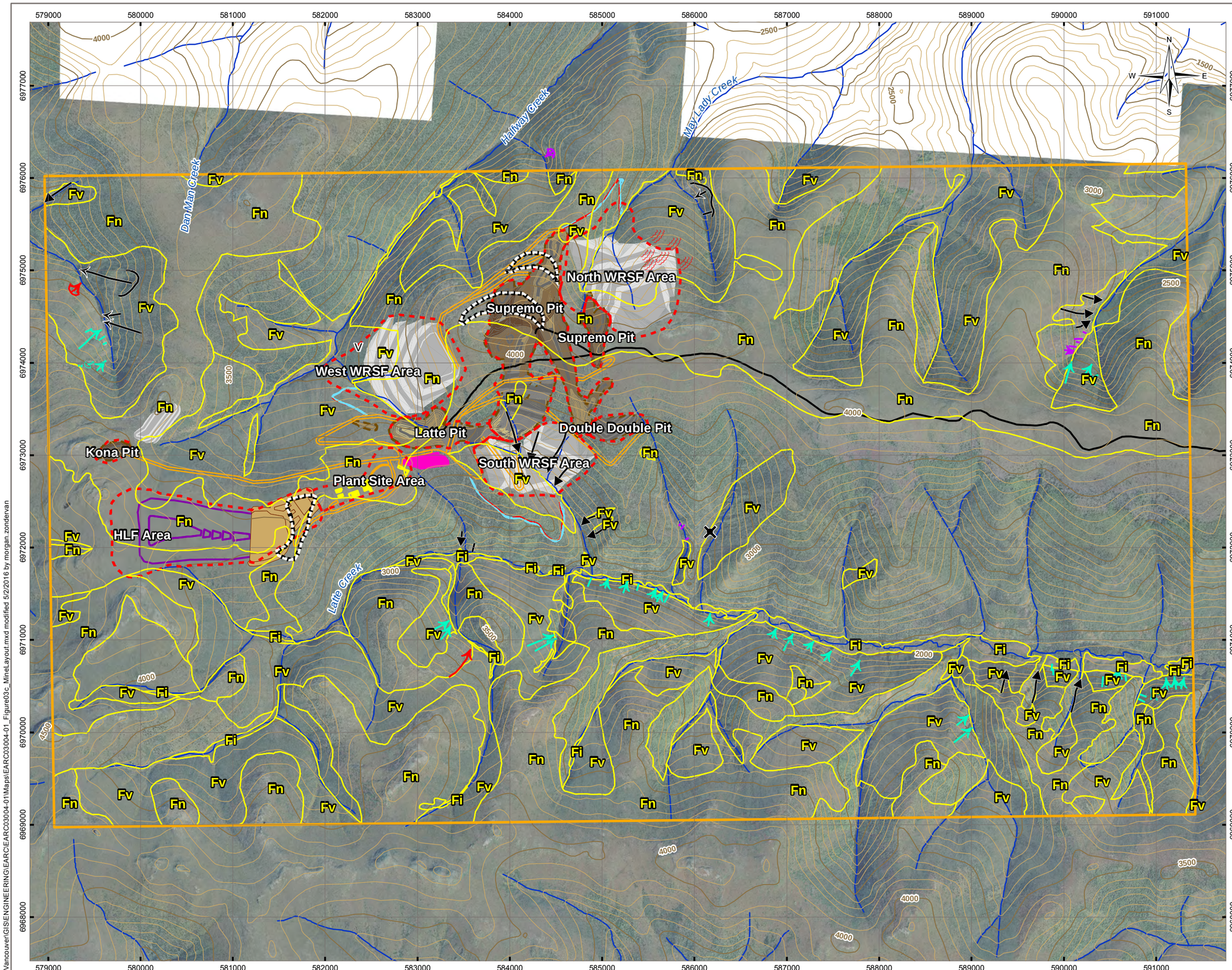

LEGEND

- Perennially Frozen Ground – very ice-rich
- Perennially Frozen Ground – visible excess ice
- Perennially Frozen Ground – ice not visible
- Unfrozen
- Mine Site Study Area
- Mine Site Facility Areas
- Collapsed Pingo
- Solifluction Feature
- Thermal Erosion Feature
- Cryoplanation Terrace
- Gully
- Landslide Failure Scar
- Landslide Headscarp
- Recent Landslide Failure Scar
- Recent Landslide Headscarp
- Retrogressive Thaw Flow Scar
- Retrogressive Thaw Flow Headscarp
- Active Layer Detachment Scar
- Active Layer Detachment Headscarp

Proposed Mine Site Layout

- Plant
- Leach Pad
- Stockpile
- Event Pond
- Pit Outline

Pit Backfill

- 0 m
- 1 m - 1250 m

Pit Surface

- 0 m
- 1 m - 1000 m
- 1000 m - 1100 m
- 1100 m - 1200 m
- 1200 m - 1300 m

Waste Dumps

- 0 m
- 1 m - 1250 m
- WRSF Access Road (cut)
- WRSF Access Road (fill)
- Access to Coffee Deposits from Barge Landing
- Haul Road
- Intermediate Contour (100 ft)
- Index Contour (500 ft)
- Watercourse

NOTES

Base Data Source:
Access road provided by Kaminak (August 2015).
WRSF roads from JDS Mining (March 2016)
Project Footprint provided by Hemerra (December 14, 2015).
Imagery provided by Kaminak (2011).
CanVec 1:50,000

STATUS
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COFFEE GOLD PROJECT ENVIRONMENTAL BASELINE REPORT

Permafrost Distribution and Proposed Mine Site Layout

PROJECTION UTM Zone 7		**DATUM** NAD83			**CLIENT** KAMINAK GOLD CORPORATION
Scale: 1:40,000 — 500 250 0 500 Metres					TETRA TECH EBA
FILE NO. EARC03004-01_Figure03c_MineLayout.mxd					
PROJECT NO. ENG.EARC03004-01	**DWN** MEZ	**CKD** SL	**APVD** VR/SMC	**REV** 0	**Figure 3c**
OFFICE Tt EBA-VANC	**DATE** May 2, 2016				

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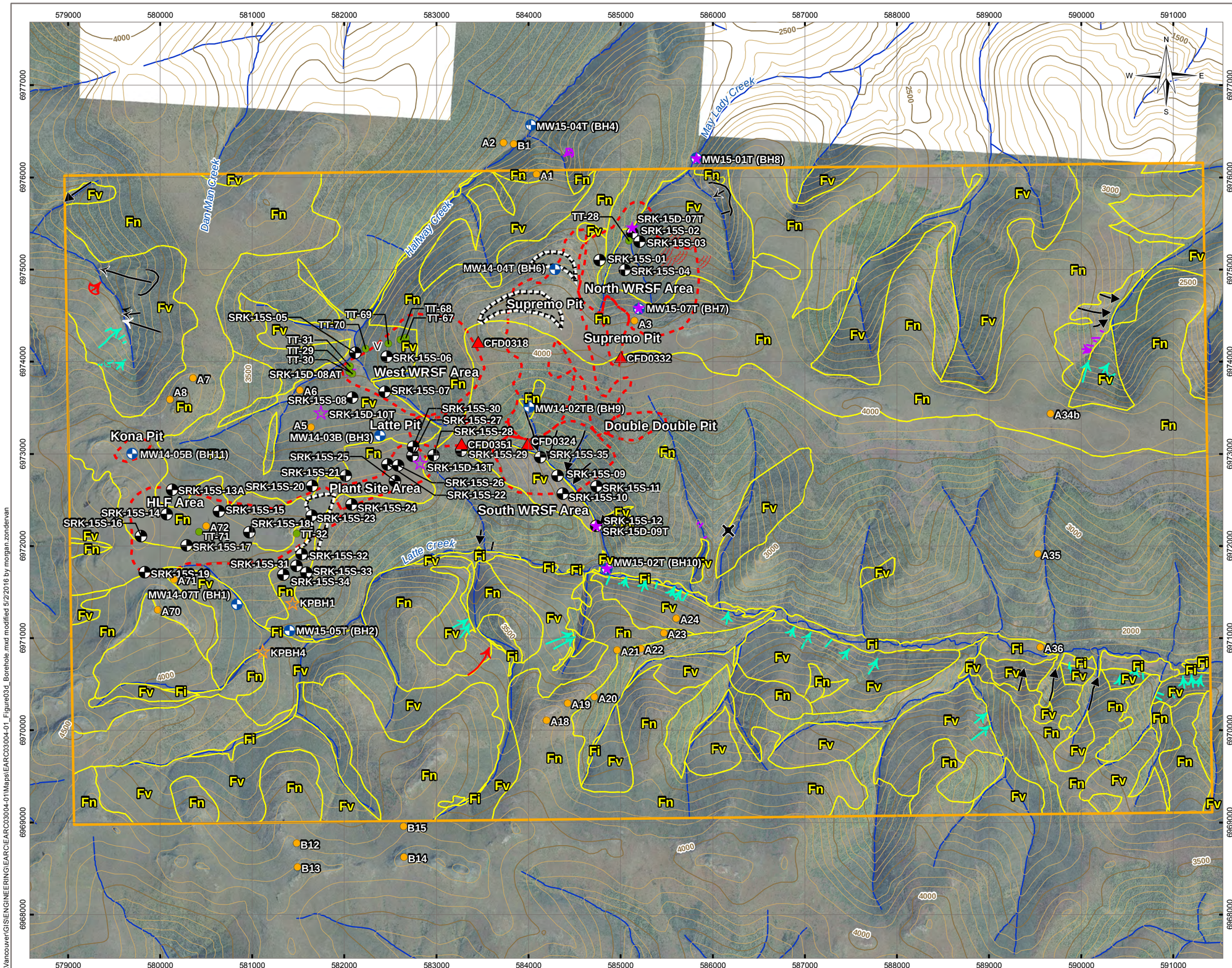

LEGEND

- Fi Perennially Frozen Ground – very ice-rich
- Fv Perennially Frozen Ground – visible excess ice
- Fn Perennially Frozen Ground – ice not visible
- Unfrozen
- Mine Site Study Area
- Mine Site Facility Areas
- Collapsed Pingo
- Solifluction Feature
- V Thermal Erosion Feature
- Cryoplanation Terrace
- Gully
- Landslide Failure Scar
- Landslide Headscarp
- Recent Landslide Failure Scar
- Recent Landslide Headscarp
- Retrogressive Thaw Flow Scar
- Retrogressive Thaw Flow Headscarp
- Active Layer Detachment Scar
- Active Layer Detachment Headscarp
- Borehole (SRK, 2015)
- Borehole (Lorax, 2015)
- Vibrating Wire Piezometer (VWP) (TT EBA, 2013)
- Thermistor (SRK, 2015)
- Thermistor/VWP (SRK, 2015)
- Thermistor (Knight Piesold, 2014)
- Terrain/Permafrost Observation Sites (TT EBA, 2015)
- Detailed Soil Observation Site (PECG, 2012)
- Intermediate Contour (100 ft)
- Index Contour (500 ft)
- Watercourse

NOTES
Base Data Source:
Imagery provided by Kaminak (2011).
CanVec 1:50,000

STATUS
ISSUED FOR USE

COFFEE GOLD PROJECT
ENVIRONMENTAL BASELINE REPORT

Permafrost Distribution and As-Drilled Borehole Layout

PROJECTION: UTM Zone 7	DATUM: NAD83			CLIENT: KAMINAK GOLD CORPORATION
Scale: 1:40,000 (500 250 0 500 Metres)				TETRA TECH EBA
FILE NO.: EARC03004-01_Figure03d_Borehole.mxd				
PROJECT NO.: ENG.EARC03004-01	DWN: MEZ	CKD: SL	APVD: VR/SMC	REV: 0
OFFICE: Tt EBA-VANC	DATE: May 2, 2016			Figure 3d

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APPENDIX A
TETRA TECH'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these “General Conditions”.

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of Tetra Tech EBA’s Client. Tetra Tech EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than Tetra Tech EBA’s Client unless otherwise authorized in writing by Tetra Tech EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of Tetra Tech EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where Tetra Tech EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed Tetra Tech EBA’s instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by Tetra Tech EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of Tetra Tech EBA’s instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except Tetra Tech EBA. Tetra Tech EBA’s instruments of professional service will be used only and exactly as submitted by Tetra Tech EBA.

Electronic files submitted by Tetra Tech EBA have been prepared and submitted using specific software and hardware systems. Tetra Tech EBA makes no representation about the compatibility of these files with the Client’s current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, Tetra Tech EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. Tetra Tech EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of testholes and/or soil/rock exposures. Stratigraphy is known only at the locations of the testhole or exposure. Actual geology and stratigraphy between testholes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. Tetra Tech EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

Tetra Tech EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO TETRA TECH EBA BY OTHERS

During the performance of the work and the preparation of the report, Tetra Tech EBA may rely on information provided by persons other than the Client. While Tetra Tech EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, Tetra Tech EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B

PECG'S 2016 REPORT "TERRAIN STABILITY AND HAZARD MAPPING FOR THE COFFEE GOLD PROJECT"

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Terrain Stability and Hazard Mapping for the Coffee Gold Project

PN 13103

Prepared for

Kaminak Gold Corporation

March 19, 2016

PALMER
ENVIRONMENTAL
CONSULTING
GROUP INC.

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5 t 604-629-9075

March 19, 2016

Tim Smith, P.Geo.
Vice President Exploration
Kaminak Gold Corporation
1020 – 800 West Pender Street
Vancouver, BC V6C 2V6

Dear Mr. Smith,

Re: Terrain Stability and Hazard Mapping for the Coffee Gold Project

Palmer Environmental Consulting Group Inc. is pleased to provide Kaminak Gold Corporation with the results of the terrain stability and hazard mapping we completed for the Coffee Gold Project in west-central Yukon.

This report, in combination with the appended mapping of terrain (Map 1), terrain stability and hazards (Map 2) and soil erosion potential (Map 3), provides the information necessary to inform engineering and environmental studies being completed in support of project proposal submission to the Yukon Environmental and Socio-economic Assessment Board. It characterizes the types and distribution of terrain hazards in the vicinity of proposed project infrastructure, as a basis for evaluating risks and prioritizing opportunities for avoidance and mitigation.

Should you or technical reviewers have any questions or require additional information, please feel free to contact Robin McKillop at 604-629-9075 (ext. 106) or via email at robin@pecg.ca.

Yours truly,

Palmer Environmental Consulting Group Inc.

Signature REDACTED

Robin McKillop, M.Sc., P.Geo.
Partner, Geomorphologist

Distribution List

# of Hard Copies	PDF Required	Association / Company Name
1	Yes	Kaminak Gold Corporation
	Yes	Onsite Engineering Ltd.
	Yes	Tetra Tech EBA

Revision Log

Revision #	Revised By	Date	Issue / Revision Description

Signatures

Signature REDACTED

Robin McKillop, M.Sc., P.Geo.
Partner, Geomorphologist
Palmer Environmental Consulting Group Inc.

David Sacco, M.Sc.
Surficial Mapping and Exploration Specialist
Palmer Environmental Consulting Group Inc.

Signature REDACTED

Courtenay Brown, M.Sc., G.I.T.
Terrain Mapping Specialist
Palmer Environmental Consulting Group Inc.

Signature REDACTED

Jim Coates, M.Sc.
Permafrost Specialist
Kryotek Arctic Innovation Inc.

Executive Summary

Kaminak Gold Corporation is proposing to develop its Coffee Gold Project, located approximately 130 km south of Dawson, in Yukon's White Gold District. A service road, approximately 215 km in length and comprising existing and new sections, is proposed to provide access from Dawson. Kaminak retained PECG to complete terrain stability and hazard mapping within a 526 km^2 study area that encompasses the proposed mine facilities and access road corridor. The objective of the mapping is to inform engineering and environmental studies advancing in support of project proposal submission to the Yukon Environmental and Socio-economic Assessment Board.

The study area is within the zone of discontinuous permafrost in an unglaciated region of rolling mountains in Yukon's Klondike Plateau. The proposed mine area straddles a broad subalpine ridge south of Yukon River. The proposed access road from Dawson traverses several large valleys, gently undulating ridge systems, rounded mountain passes, and crosses the Stewart and Yukon rivers. Ten main terrain units occur within the study area, the majority of which are colluvial mantles of varying thicknesses on slopes with (45%) and without (24%) permafrost. Comparatively small portions of the study area are dominated by intact or weathered bedrock (3%), mixed weathered bedrock and colluvium (14%), fluvial (6%) or glaciofluvial (<1%) deposits, or organic terrain (1%). Anthropogenic disturbance from placer mining is common (6%) within most of the valleys along which the road is proposed. Mass movement and slope erosion processes that contribute to the geomorphology of the landscape include rockfall, debris slides, rock slumps, rock creep, gullying, solifluction, active layer detachments, thermokarst subsidence, thermal erosion, slopewash and pingos. The fluvial processes with the greatest potential to affect the project are meander migration and icing.

The study area was divided into areas (polygons) based on their terrain stability class prior to (existing state) and following (disturbed state) conventional facility/road construction without mitigation. In its existing state, approximately 85% of the study area is considered stable (Class I), generally stable (Class II) or generally stable with minor potential for instability (Class III), with approximately 8% considered potentially unstable (Class IV) or unstable (Class V). The remaining approximately 7% is unclassified anthropogenic disturbances or open water. In a disturbed state, the proportion of Class I to III polygons would decrease to 64% and correspondingly increase the proportion of Class IV and V polygons to 29%. This elevation in terrain stability class mainly reflects increased potential for permafrost-related slope failures or thermokarst activity if facility/road construction proceeded without regard for the sensitivity of ground underlain by permafrost. The distinction between existing and disturbed terrain stability classes facilitates accurate recognition of upslope or downslope hazards unaffected by project activities.

The primary hazards requiring consideration in the final siting and design of the mine facilities and access road include rockfall, debris slides, active layer detachments and thermokarst activity. Careful site preparation, construction and mitigation will minimize exposure to these hazards, where unavoidable. Erosion protection, such as riprap, will be required along sections of the access road near migrating meanders and river crossings. Special consideration will need to be given to the design and maintenance of drainage crossings prone to icing.

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1 Introduction

Palmer Environmental Consulting Group Inc. (PECG) is pleased to provide Kaminak Gold Corporation (Kaminak) with the results of our terrain stability and hazard mapping for the Coffee Gold Project (the Project). Our work aligns with the hazard mapping expectations of Yukon Environmental and Socio-economic Assessment Board (YESAB). The landscape encompassing the proposed mine area and access route was mapped to support engineering planning, including risk assessment, and environmental studies such as terrestrial ecosystem mapping, aquatic risk assessment and acid rock drainage potential evaluations. This report and its appended maps inform the routing and design of the access road, and the footprint and site preparation for mine facilities. We provide a comprehensive description of the distribution, characteristics and implications of different terrain units and geomorphological processes, as a basis for minimizing construction and maintenance costs, and avoiding and mitigating risks to infrastructure and the natural environment.

Following provision of important background information (Section 1), the physical setting of the region encompassing the study area is described (Section 2). The methods used for field work, mapping and hazard identification are outlined in Section 3. Dominant terrain units and geomorphological processes encountered within the study area are characterized in Section 4. Section 5 presents the results of the terrain stability and hazard mapping, and summarizes the distribution, characteristics and implications of potential hazards to project infrastructure footprints. Considerations for hazard avoidance and mitigation and highlighted in Section 6. Key conclusions are stated in Section 7, followed by acknowledgment of study limitations in Section 8. References cited throughout the report are provided in Section 9.

Mapping of terrain (Map 1), terrain stability and hazards (Map 2), and soil erosion potential (Map 3) is provided in **Appendices A**, **B** and **C**, respectively. **Appendix D**, submitted digitally, includes data collected by PECG at detailed field sites throughout the study area. A technical memorandum prepared by Tetra Tech EBA (TT-EBA) on geotechnical considerations for road design in areas underlain by permafrost is included in **Appendix E**.

1.1 Background

Kaminak is proposing to develop a gold mine, comprising four open pits known as Latte, Double Double, Supremo and Kona, using conventional shovel and truck methods at an average rate of 5 million tonnes per year of heap leach feed (JDS Energy & Mining Inc., 2016). The ore will be crushed and placed in a heap leach facility for nine months of the year. During the coldest winter months, run-of-mine ore will be stockpiled. Gold will be extracted from pregnant leach solution by a 5 tonnes per day Adsorption-Desorption Recovery carbon plant with mercury retorting to produce a final gold doré product. A total of 1.9 million ounces of gold is planned to be recovered over a ten-year mine life. The mine is proposed to be accessed from Dawson along a 215 km-long, upgraded and extended existing road. Stewart and Yukon Rivers are proposed to be crossed by barge in summer and ice road in winter.

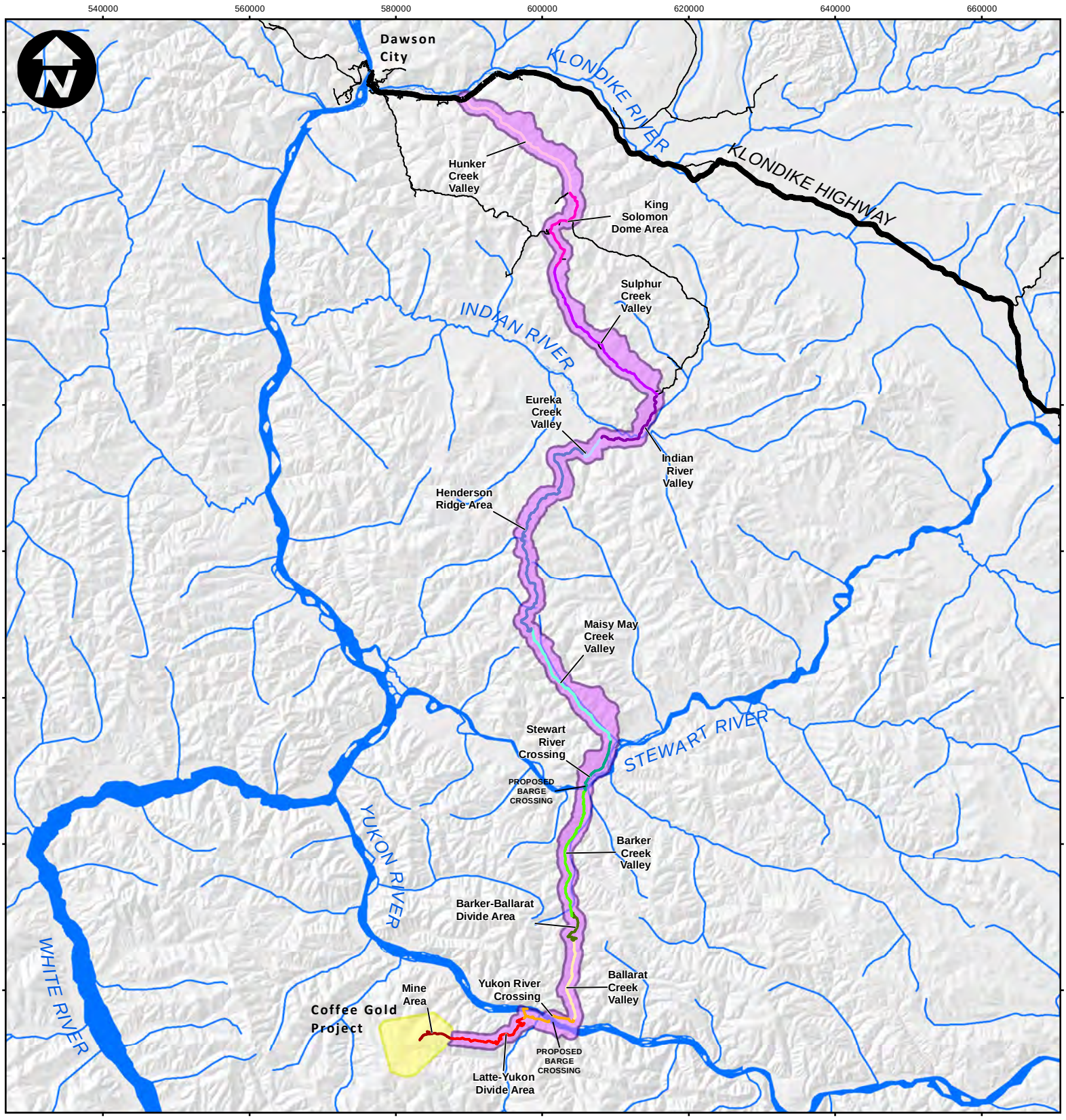
In order to inform mine facility and access road planning, Kaminak retained PECG, working in association with Kryotek Arctic Innovation Inc. (Kryotek), to complete terrain stability mapping and hazard mapping for the Project area. PECG's recognized experts in terrain and terrain stability mapping led all aspects of the mapping assignment, applying knowledge of permafrost conditions and associated hazards specific to the valleys south of Dawson gained through extensive drilling and geophysical surveys by Kryotek. PECG's mapping also benefited from collaboration with TT-EBA, which concurrently mapped permafrost distribution and related geohazards along a 200 m-wide corridor along the proposed access road centreline (TT-EBA, 2016b) and within the mine site area (TT-EBA, 2016c).

PECG recognized that accurate terrain stability mapping in the unglaciated region south of Dawson requires an understanding of the distribution and implications of permafrost, in addition to mass movement processes. Permafrost is extensive, occurring on all aspects and underlying approximately two-thirds of the ground (Hegginbottom et al., 1995; Bonnaventure et al., 2012; McKillop et al., 2013). Permafrost terrain exhibits unique challenges for road construction and maintenance, particularly where it contains significant ground ice, due to its sensitivity to changes in ground thermal regime. The potential for permafrost-related mass movements, whether on slopes or in valley bottoms rich in ice, must be considered. Other hazards that warrant attention in the valleys south of Dawson relate to icing, mostly at stream crossings, and meander migration, alongside sections of road traversing valley bottoms.

1.2 Study Area

The Project is located in the White Gold District of west-central Yukon, approximately 130 km south of Dawson. Detailed terrain stability and hazard mapping were completed to encompass all proposed mine site facilities and the access route from Dawson (**Figure 1-1**). The 526 km^2 study area consists of two main sections:

1. **Access Road Corridor** – The proposed access road corridor extends from KP 700 of the North Klondike Highway, 16 km east of Dawson, southward to the proposed mine site. It has a minimum width of 2 km, roughly centred along the proposed road alignment, with local widenings up to 5 km to encompass heights of land where processes upslope could potentially affect infrastructure (**Figure 1-1)**. From north to south, the route initially follows existing government-maintained roads ascending Hunker Creek, over the divide near King Solomon Dome and descending Sulphur Creek. Along and south of the Indian River valley, the route generally follows existing roads used by placer miners, with some upgrades, realignments and extensions required to meet design criteria and make the road suitable for year-round access. After crossing Indian River, the route ascends Eureka Creek, follows a ridge system at the headwaters of Henderson Creek, and then descends Maisy May Creek to Stewart River, which is proposed to be crossed by barge in summer and ice road in winter. Crossing will not be possible during spring break-up and fall freeze-up each year. South of Stewart River, the route ascends Barker Creek, climbs over a divide and descends lower Ballarat Creek to its confluence with Yukon River, which is also only proposed to be crossed by barge in summer and ice road in winter. The route follows the south side of Yukon River until it crosses Coffee Creek to Coffee Camp, after which it ascends a ridge above "Latte Creek" to the proposed mine site.





Legend

- Place name
- Existing main roads
- Klondike Highway
- Watercourse
- Waterbody

Terrain stability mapping and hazard assessment study area

- Access road corridor
- Mine site area

Road centreline segments

- Hunker Creek Valley
- King Solomon Dome Area
- Sulphur Creek Valley
- Indian River Valley
- Eureka Creek Valley
- Henderson Ridge Area
- Maisy May Creek Valley
- Stewart River Crossing
- Barker Creek Valley
- Barker-Ballarat Divide Area
- Ballarat Creek Valley
- Yukon River Crossing
- Latte-Yukon Divide Area
- Mine Area

COFFEE GOLD PROJECT
Study Area

0 2.5 5 10 15 20 25 km

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Original page size: 11.00 x 8.50 in

Base mapping from Geomatic Yukon (http://www.geomaticsyukon.ca/data).

Project number: 13103

Projection: UTM Zone 7
Datum: NAD 1983
Units: metre

KAMINAK GOLD CORPORATION

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Figure 1-1

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2. **Mine Site Area** – The proposed mine site is situated on the divide between the headwaters of "Latte Creek" and Halfway Creek, in the northern Dawson Range. The mine site study area encompasses the footprints of all proposed mine infrastructure, with a surrounding buffer of at least about 1 km. Key infrastructure within the overall mine footprint includes four open pits, waste rock storage facilities, a heap leach facility, ore stockpiles and processing facilities.

Mapping and assessment of the buffer around the overall Project footprint was completed such that any upslope instabilities or hazards were identified, minor adjustments in site or route selection were accommodated, and environmental studies had a foundation on which their potential effects assessments could be based. A geographic division of the study area into 14 contiguous sections is depicted on **Figure 1-1** as a basis for reference throughout the report.

The Black Hills Creek and upper Ballarat Creek valleys were investigated as possible route options (as described further in Section 3.2). Both route options, however, were excluded from further mapping and consideration due to the extent and distribution of less favourable conditions for road construction and maintenance.

1.3 Objective

PECG completed project-specific terrain stability and hazard mapping to inform the siting and design of mine site facilities and the access road, in general accordance with YESAB's hazard mapping expectations for Project proposal submission. Three supporting objectives facilitated this ultimate goal: (1) delineate and characterize distinct terrain units and geomorphological processes within the study area; (2) identify potential hazards posed by the environment on the Project, and by the Project on the environment; and (3) provide a basis for project engineers to evaluate and mitigate risks to project infrastructure.

2 Physical Setting

Understanding the regional setting is critical to accurate representation of terrain stability and hazards within the Project area. The following sections describe the physical setting, largely drawing on summaries from McKillop et al. (2013) that were prepared for the same Klondike Plateau study region.

2.1 Physiography

The Project is entirely within the Klondike Plateau physiographic region (Mathews, 1986) and ecoregion (Smith et al., 2004). The Klondike Plateau is a Tertiary-age upland that has undergone variable uplift and stream dissection, resulting in rounded summits and ridges, and deep, V-shaped valleys (Mathews, 1986). Accordant hill crests represent an approximation of the former plateau surface. Most valley sides exhibit convex profiles, with concave terrain restricted to localized bench or gully features and valley bottoms filled with material derived from upslope erosion. Elevations within the study area range from just under 370 m above sea level at the Stewart River to about 1,250 m along "Henderson Ridge" (**Figure 1-1**). Local relief is typically between 300 and 450 m.

The proposed access road crosses the Indian, Stewart and Yukon rivers, which have incised deeply into the plateau surface. The Indian and Stewart rivers are both major tributaries to Yukon River; all three rivers meander westward across the access road corridor. Valley reaches of the rivers and major tributaries become more deeply incised with increased proximity to the Yukon River (Bond and Lipovsky, 2011). Reaches in close proximity to the Yukon River commonly contain stream-cut bedrock terraces, along one or both sides of the valley, which are typically capped by fluvial sand and gravel. Bedrock terraces are thought to be formed by accelerated down-cutting initiated by the reversal of the Yukon River from a south to north-flowing drainage during the late Pliocene to early Pleistocene (Tempelman-Kluit, 1980; Jackson et al., 2008). Some headwater tributaries also exhibit anomalously steep toe slopes that may correspond to this base level change.

The climate of the Klondike Plateau is continental; summers are warm and short, and winters are long and cold. Mean annual temperature is near -5°C, with mean January temperatures of -23 to -32°C and mean July temperatures of 10 to 15°C (Yukon Ecoregions Working Group, 2004). Strong thermal inversions are common from December to February, in association with prolonged atmospheric stability (Williams, 1995). During this period, valley bottom temperatures can be tens of degrees Celsius lower than surrounding higher-elevation areas. Mean annual precipitation ranges from about 300 to 500 mm, giving the region a semi-arid classification (Yukon Ecoregions Working Group, 2004). The wettest period is in the summer, when most precipitation falls as rain during convective rainshowers and thunderstorms.

Thunderstorms trigger wildfires throughout the region, which exhibits the highest frequency of lightning strikes in Yukon (Yukon Ecoregions Working Group, 2004). Yoshikawa et al. (2003) estimate natural wildfire recurrence of 50 to 300 years in the similar boreal forest of interior Alaska. **Figure 2-1** depicts the fire history within the region encompassing the study area. As described below in Section 2.4, fire has important implications for ground stability in areas of permafrost, such as observed in a recently burned area along Barker Creek that post-dates the fire inventory depicted on this figure.

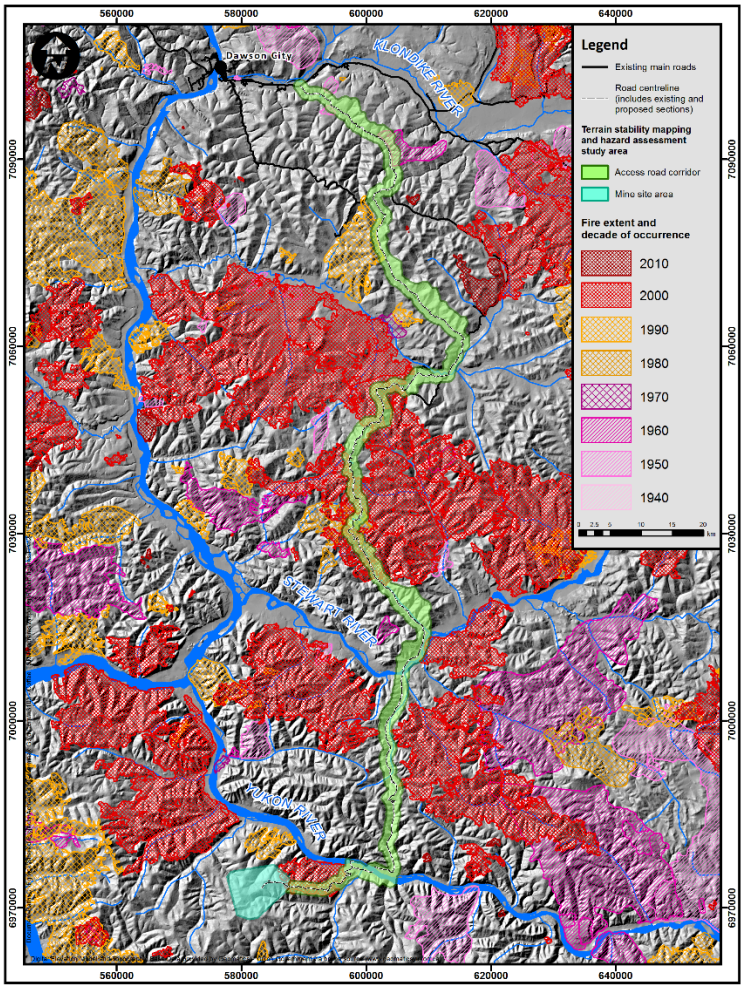
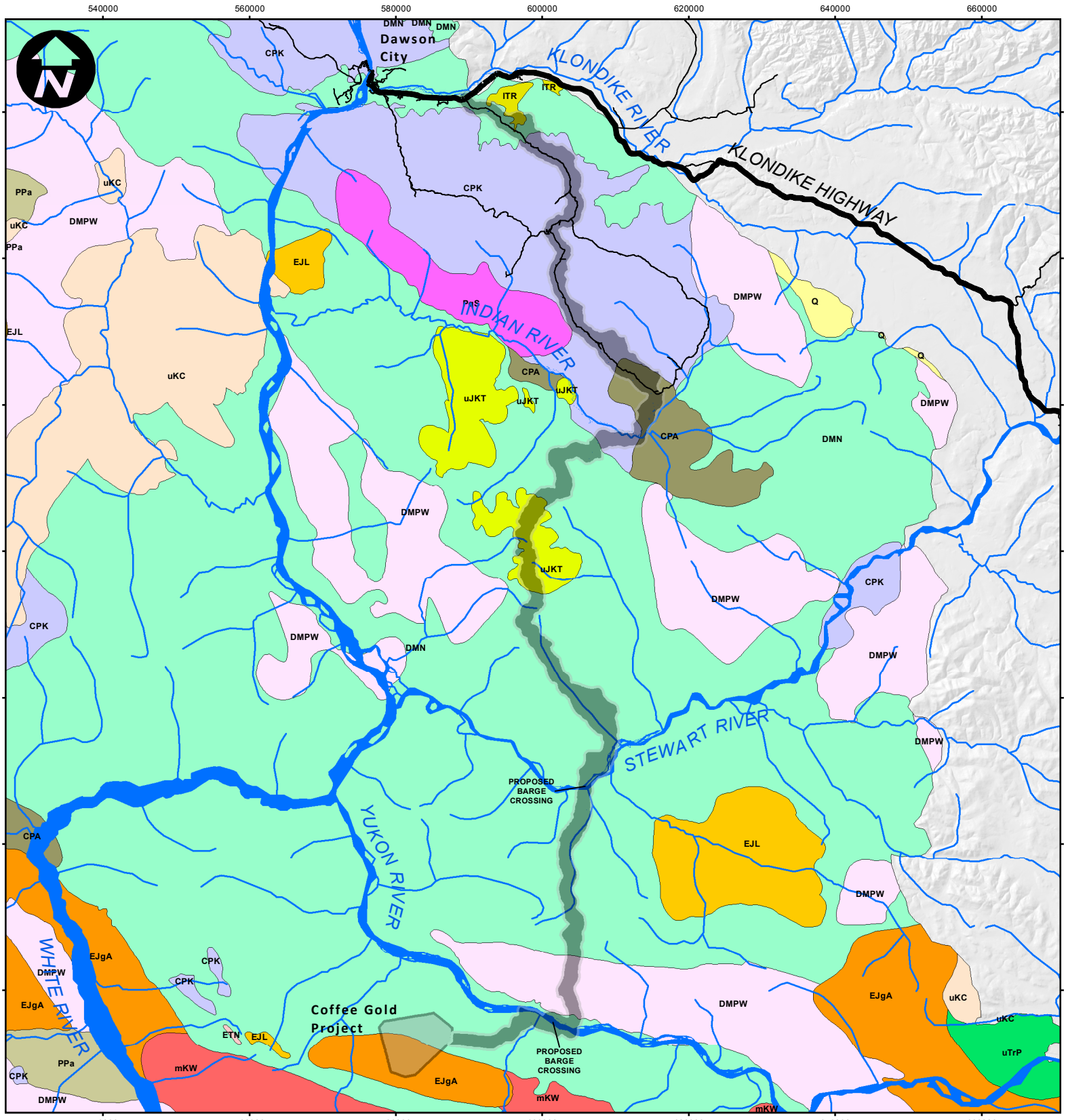


Figure 2-1. Fire history in the region encompassing the study area

2.2 Bedrock Geology

The Project area occurs mainly within the Yukon-Tanana Terrane, an accretionary sequence including former volcanic island arcs and continental shelf depositional environments (Mortensen, 1992) (**Figure 2-2**). This terrane comprises metamorphosed Paleozoic-aged schists and gneisses, intruded by Mesozoic-aged granitic rocks, and locally overlapped by volcanic rocks (Colpron et al., 2006). Devonian to Mississippian-aged quartzite and muscovite quartz-rich schist of the Nasina assemblage are the most extensive (Gordey and Makepeace, 2003). The Late Devonian- to Mississippian-aged Pelly Gneiss Suite of granitic gneisses with localized amphibolite, quartz-mica schist and phyllite occurs throughout the region. The Klondike Schist, a Carboniferous to Permian-aged assemblage of metamorphosed pelitic and volcanic rocks, with bands of marble and inclusions of phyllite, is widespread in the vicinity of Dawson. The Dawson Range Batholith intruded the schist-dominated metamorphic rocks in the mid-Cretaceous. Its Whitehorse Suite consists of granitic rocks of felsic to mafic composition; granodiorites, granites and quartz monzonites are common. During the Late Cretaceous, the andesitic Carmacks formation was emplaced across portions of the region.





Legend

- Place name
- Existing main roads
- Klondike Highway
- Watercourse
- Waterbody

Terrain stability mapping and hazard assessment study area

- Access road corridor
- Mine site area

Q	QUATERNARY: unconsolidated glacial and fluvial deposits
ITR	ROSS: terrestrial clastics
ETN	NISLING RANGE SUITE: equigranular to porphyritic rocks of intermediate to felsic composition
uKC	CARMACKS: basic volcanic strata
mKW	WHITEHORSE SUITE: equigranular felsic to intermediate granitic rocks
uJKT	TANTALUS: pebble conglomerate and quartz-chert-feldspar sandstone
EJgA	AISHIHIK SUITE: biotite-hornblende granodiorite
EJL	LONG LAKE SUITE: felsic granitic rocks
uTrP	POVOS: andesitic basalt flows, breccia, tuff, sandstone and argillite
PqS	SULPHUR CREEK SUITE: biotite quartz monzonite gneiss
CPK	KLONDIKE SCHIST: metamorphosed pelitic/volcanic rocks
CPA	ANVIL: mafic volcanics and ultramafics
PPa	AMPHIBOLITE: metamorphosed mafic rocks
DMPW	PELLY GNEISS SUITE - SW: felsic to intermediate granitic rocks
DMN	NASINA: graphitic quartzite and muscovite quartz-rich schist

COFFEE GOLD PROJECT
Bedrock Geology

0 2.5 5 10 15 20 25 km

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Original page size: 11.00 x 8.50 in

Base mapping from Geomatic Yukon (http://www.geomaticsyukon.ca/data).

Project number: 13103

Projection: UTM Zone 7
Datum: NAD 1983
Units: metre

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Figure 2-2

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Outcrops of intact bedrock are rare across the region. The most prominent bedrock outcrops form tors, which are erosional, castellated towers from former plateau surfaces. Tors typically form in granitic lithologies and punctuate several high summits and ridges in the mine area. Ridges and spurs composed of metamorphic rocks are typically overlain by mantles of weathered fragments of bedrock, resulting in few intact outcrops. Bedrock is also exposed in lower-slope settings, where fluvial incision has over-steepened valley walls and outpaced compensatory hillslope adjustments. This is most common within the major river valleys and in tributaries near Yukon River.

The study area is situated within an area of low seismic activity between the Denali and Tintina faults, with only several mapped earthquake epicentres occurring north of the Stewart River (Hyndman et al., 2005) (**Figure 2-3**). As such, most mass movements in the study area are triggered by processes other than earthquakes (as described further in Section 2.5).

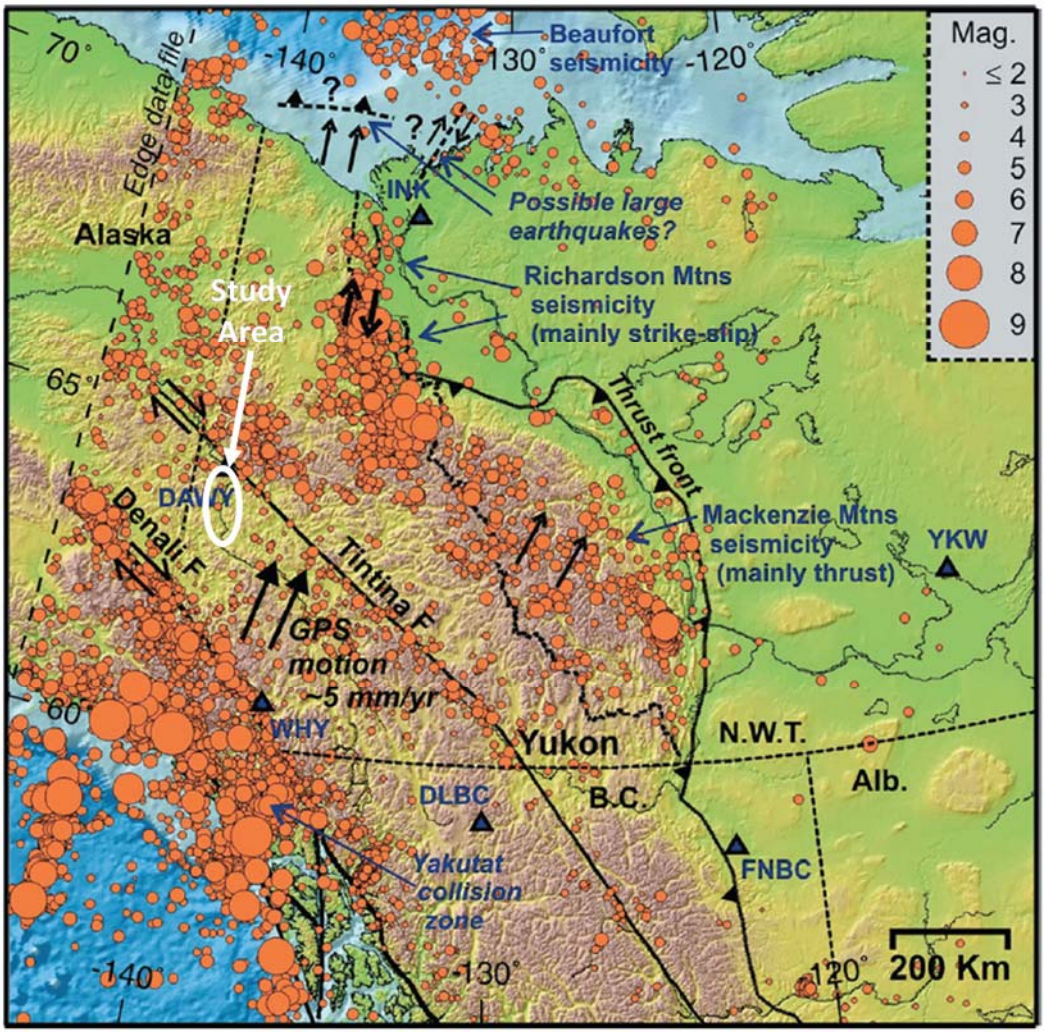


Figure 2-3. Historical instrumental seismicity in northwestern Canada (seismographs shown as triangles; modified from Hydman et al., 2005).

2.3 Surficial Geology

Nearly all of the study area remained unglaciated throughout the Pleistocene, with the exception of a few cirque glaciers that once occupied the high, north-facing, alpine headwaters of Coffee Creek, and portions of the Stewart River valley and its adjacent tributaries that were ice-covered during the pre-Reid glaciation (>200 ka) (Duk-Rodkin, 1999). Periglacial weathering and colluvial, fluvial and eolian processes have largely modified and redistributed any remnant glacial sediments. Thus, areas within the pre-Reid glacial limit, which may once have been mantled by glacial deposits (e.g., till), are mapped primarily as colluvium.

Discontinuous glaciofluvial terraces occur along the Yukon River valley, which was a major meltwater channel during pre-Reid glaciations. These terraces may be observed at several elevations, up to 250 m above the current level of the Yukon River (Huscroft, 2002; Huscroft et al., 2006). Recognition of glaciofluvial terraces is difficult in areas where fine-grained colluvium blankets the terrace surfaces.

Loess, windblown silt and fine sand, is widespread throughout the Klondike Plateau. Most loess in the region was mobilized from unvegetated outwash plains along the Donjek, White and Yukon River valleys. It was dominantly active during glacial and deglacial periods of the Pleistocene, transported by prevailing southerly winds, and katabatic winds draining off the former ice sheets (Bond and Lipovsky, 2011). Significant loess deposits accumulated in valley bottoms directly down-wind of the major outwash plains (Bond and Lipovsky, 2011), on the lee (north) side of hills (Birkeland, 1984), and in other areas where topography, vegetation and soil moisture provide suitable environments for trapping loess (Tsoar and Pye, 1987). Loess is best preserved on northerly aspects where it is effectively anchored in place by shallow permafrost, and on relatively level ground in hollows amongst boulder-sized blocks. *In situ* loess was observed in at least one road cut along the proposed access route. Much of the loess in the region has been redistributed and concentrated through periglacial, colluvial and fluvial processes. Resedimented loess mixes with organic material to form aprons on lower slopes and in valley bottoms that rival in thickness the >20 m *in situ* loess deposits preserved near the mouths of tributaries of the Donjek River (Bond and Lipovsky, 2011).

In the absence of glacial erosion, a mantle of *in situ* weathered bedrock known as felsenmeer has accumulated on level to gently sloping ground. The character of the felsenmeer depends primarily on the bedrock lithology and the intensity and depth of periglacial weathering. Large, angular clasts that detach from the underlying fractured bedrock gradually weather to cobble, gravel and eventually sand or silt-sized particles. A metre-thick, fining-upward gradation is commonly visible in pits or trenches dug within felsenmeer. Deep horizons have a jigsaw puzzle-like fit to the clasts, commonly preserving original bedrock structures. Shallow horizons have undergone sufficient disaggregation and cryoturbation to destroy any structure, and they contain a higher matrix content.

Colluvium is the most widespread surficial material within the study area and broader Klondike Plateau. Typically, it is composed of weathered bedrock and loess reworked by gravitational processes. It covers almost all slopes with thicknesses ranging from less than a metre, near ridge crests and on steep slopes, to more than ten metres in slope concavities and valley bottoms. The texture of colluvium reflects the local bedrock lithology and the amount of loess and organics intermixed with it. Colluvium derived from the weathering and entrainment of granitic rocks tends to be blocky to pebbly, with a silty-sand matrix, whereas

colluvium derived from schists and gneisses is generally finer-grained, comprising cobble-sized angular fragments and a more silt-rich matrix (Schaetzl and Anderson, 2005). Slopes underlain by permafrost tend to have a higher silt content than those without permafrost, and aprons in toe-slope positions are dominated by silt and organics. These aprons are locally referred to as 'muck' (Tyrrell, 1917; Fraser and Burn, 1997). Colluviation occurs mainly through soil creep, solifluction, slopewash and landsliding, the relative importance of each depending on slope steepness and permafrost distribution.

Fluvial deposits occupy valley bottoms throughout the region. Headwater streams are typically confined to narrow, V-shaped valleys and have beds of cobbly gravel veneered by sand. Channel bed and bank material along meandering lower reaches are typically composed of sandy gravels overlain by silty flood deposits. Floodplains are typically absent in headwater reaches, but are hundreds of metres wide along the lower reaches of major tributaries. Inactive floodplains may be overlain by loess, and interbedded with, or overlain by, organic material.

Organic deposits are common throughout the Klondike Plateau. On well drained forested slopes free of permafrost, organic deposits are relatively thin (<15 cm) and composed predominantly of fibrous woody forest litter. On slopes with shallow permafrost and in depressions with poor drainage, poorly to moderately decomposed peaty organic material is commonly 30-40 cm thick and may exceed 100 cm. The type and thickness of organic material is closely associated with permafrost distribution and drainage conditions.

2.4 Permafrost

2.4.1 Distribution

Permafrost is ground that remains below 0°C for more than one year. The study area is within the zone of extensive discontinuous permafrost, in which 50 to 90% of the ground is underlain by permafrost (Heginbottom, 1995). Recent permafrost modelling completed by Bonnaventure et al. (2012) for southern Yukon indicates that the distribution of permafrost within the region exhibits characteristics of both subarctic and mountain permafrost, being prevalent in valley bottoms and on northern aspects. Locally, permafrost distribution is related to slope aspect, angle and shape, soil texture and moisture, and the thickness and type of organic cover (Williams, 1995; Williams and Burn, 1996). Permafrost is most common on north-facing slopes with thick organic cover and in fine-grained colluvial aprons extending into valley bottoms (Bond and Lipovsky, 2011). Steep, well drained, south-facing slopes are invariably permafrost-free.

A variety of landforms indicates the presence of permafrost within the study area, including pingos (**Figure 2-4**). Open-system pingos are scattered across the region, commonly in slope-toe settings of small drainages where groundwater discharges to surface through discontinuities in the permafrost table (Hughes, 1969; Bond and Lipovsky, 2011). Most are collapsed and distinguished based on the ramparts encircling a small pond. Other indicators of permafrost in valley settings include thermokarst ponds and gullies, ice-wedge polygons, active layer detachments, cryoplanation terraces, solifluction lobes, stone stripes and slopewash runnels (**Figure 2-4**).

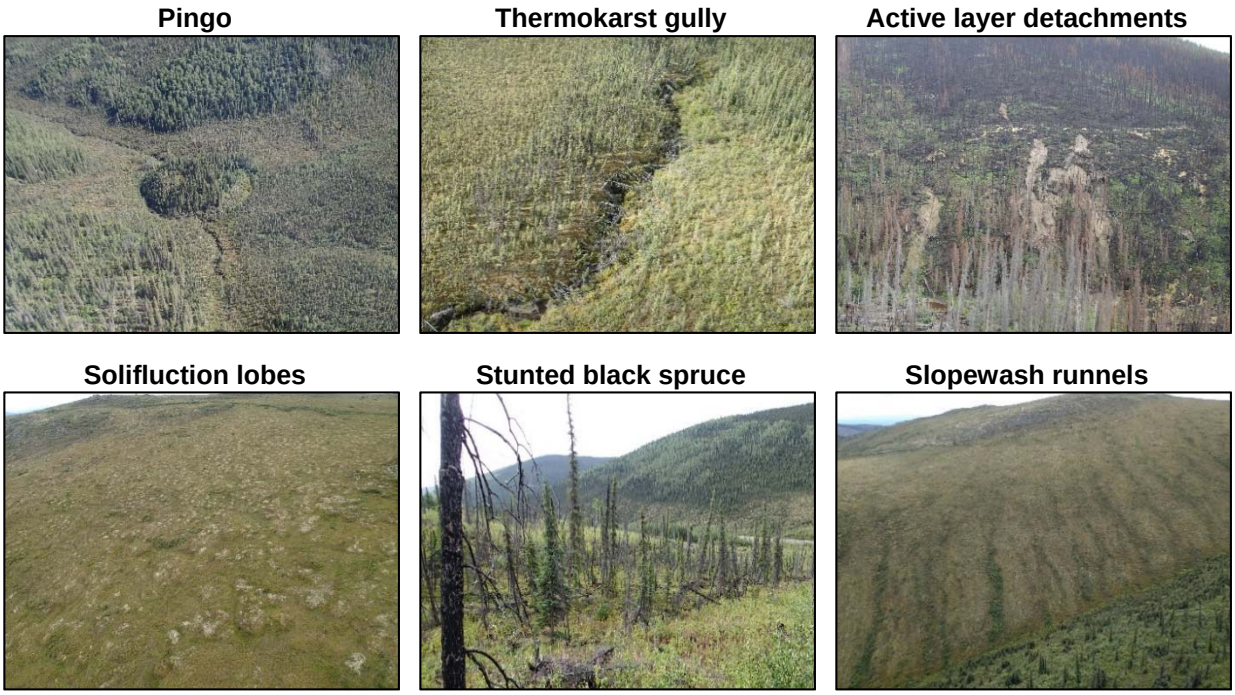


Figure 2-4. Example of features indicative of permafrost in the study area

Vegetation distribution and health can be reasonable predictors of permafrost presence or absence, although local disequilibrium of permafrost and present climate can mislead inferences. In general, deciduous trees root more deeply than coniferous trees, and are unable to grow in thin active layers where soils are permanently wet or saturated. Stands of trembling aspen are invariably restricted to permafrost-free ground (Zoltai and Pettapiece, 1973; Williams, 1995). Conversely, black spruce is tolerant of cool, saturated soils and commonly grows in areas underlain by permafrost. A sparse, stunted canopy of black spruce with thick moss cover or sedge tussocks is a reliable indicator of shallow permafrost. Mixed coniferous and deciduous forests, including Alaska birch, may or may not be underlain by permafrost. In riparian zones, vegetation patterns reflect the frequency of flooding and presence of permafrost. The most frequently flooded areas are permafrost-free and dominated by willow, alder and balsam poplar. Irregular species composition and stand structure within the valleys south of Dawson commonly reflects a combination of regrowth from forest fire and other disturbances since the Yukon gold rush (Naldrett, 1981), which complicates interpretations of permafrost distribution.

Maximum thicknesses of permafrost within the study area and broader Klondike Plateau are highly variable. Thicknesses of 60 to 85 m have been reported from the Dawson area and valley bottoms in the nearby Klondike goldfields (McConnell, 1905; Brown, 1967; Milner, 1976; EBA, 1977, 1978). Drilling in the vicinity of the Project mine area in association with hydrogeological investigations penetrated permafrost with a wide range in thickness, up to about 165 m (Lorax Environmental Services Ltd., 2016).

2.4.2 Active Layer and Depth of Permafrost

The active layer is the upper layer of ground that freezes and thaws seasonally above the permafrost table. It may be restricted to soils and unconsolidated surficial materials, or it may extend into underlying, weathered or intact bedrock. At a local scale, its thickness primarily depends on elevation, aspect, soil texture, drainage, snow pack, vegetation cover and wildfire history (Williams and Burn, 1996; McKillop et al., 2013). The active layer is generally 1 to 2 m thick within the region encompassing the study area (Yukon Ecoregions Working Group, 2004; Bond and Lipovsky, 2011). Well drained, coarse-grained soils tend to have thicker active layers than poorly drained and fine-grained areas. In areas of thick, mossy organic cover, permafrost may be encountered at depths as shallow as just a few tens of centimetres. Areas with thick organic cover and variable moisture contents exhibit the greatest spatial variability in active layer thickness (Smith et al., 2009).

Active layer thickness varies seasonally and in response to natural and anthropogenic disturbances. Each year active layer thickness increases following spring snowmelt and typically peaks in late summer, before refreezing in the autumn. Active layers thicken by up to several times their original thickness following wildfire, which burns most or all of the insulating surface organic mat, reduces interception of snow by trees (where present), lowers the surface albedo, increases exposure to solar radiation, and decreases evapotranspiration (e.g., Burn, 1998; Smith et al., 2015).

2.4.3 Ground Ice

Permafrost may or may not contain ice. The ice content of permafrost is highly variable at both the regional and local scale. Areas of intact or weathered bedrock and well drained, coarse-grained colluvial mantles with permafrost generally contain little to no visible ice. Such ice-poor permafrost is common in upland settings, on summits and along ridges and spurs, and on moderate to moderately steep valley sides with convex or straight slopes. Permafrost more commonly contains excess ice[1] in the form of thin seams and lenses in silt-rich colluvial blankets, on solifluction slopes and in inactive portions of fluvial plains. Ice-rich permafrost with massive bodies of ice is most commonly encountered in organic terrain and silt-rich colluvial complexes in valleys. Enlarging thaw lakes in silt-rich valley bottom deposits provide evidence of locally high ice contents, perhaps as high as 50% by volume (Bond and Lipovsky, 2011).

Ground ice is sensitive to melting in response to permafrost degradation (thaw). Permafrost degradation occurs naturally over different time scales in response to localized surface disturbances such as wildfire or windthrow, which alter the ground thermal regime by removing the insulating surface organics, and climate change, which can result in anomalously high late-summer rainfalls or anomalously deep winter snowpacks. Anthropogenic disturbances also alter the ground thermal regime and are a common trigger for permafrost degradation. Permafrost degradation has little to no effect on ground surface topography or stability in areas of ice-poor permafrost where the permafrost table is commonly deep within coarse-grained colluvium or weathered bedrock. Areas of ice-rich permafrost within fine-grained materials, in contrast, are susceptible to irregular subsidence and thermokarst pond formation in response to permafrost degradation.

[1] The term excess ice is used throughout the report to represent the condition in which the volume of ice in the ground exceeds the total pore volume the ground would have under natural, unfrozen conditions.

2.5 Mass Movement Processes

Most mass movements within the study area are influenced, either directly or indirectly, by permafrost or related periglacial processes. Climatic warming is contributing to the degradation of permafrost, especially on southerly aspects and in broad valley bottoms exposed to prolonged sunlight during the summer. Permafrost degradation results in an increase in the volume (mass) of surficial material available for downslope transport and degree of soil saturation provided by the release of water from thawing ground ice. Shallow landsliding (e.g., active layer detachment) occurs once the shear stress exceeds the shear strength of the material. Thermokarst subsidence and gullying may occur in gentler terrain with excess ground ice. Deep-seated failures within thick overburden or weathered bedrock occur in response to failures of weak layers or thawing of ice bodies at depth. Deep-seated permafrost failures may result from movement of groundwater within unfrozen zones (taliks) in or beneath permafrost.

In the YGS' compilation of regional-scale surficial geology mapping (Lipovsky and Bond (compilers), 2014), a number of features interpreted as paleo-landslides are identified. All were assessed in the field and/or using the high-resolution spatial data acquired specifically for this project (as described below in Section 3.1). Some of the features may have evolved over millennia of differential erosion and mass wastage, as opposed to coherent mass movements. Most exhibit subdued topography with no evidence of recent movement in ground or vegetation disturbance patterns. Only those with possible evidence of continued instability have been included in the project-specific mapping of terrain stability and hazards (Map 2, **Appendix B**).

The most common triggers for both shallow and deep-seated failures are intense or prolonged rainfall, or heat events and wildfires (**Figure 2-1**). Seasons of increased mass movements include the period from late July to early September, when active layers are thickest, permafrost is warmest and rainfall is greatest, as well as late May or early June, when erosion during snowmelt freshet freshly exposes permafrost to fluvio-thermal erosion and slumping. Slopes underlain by permafrost that have not experienced recent wildfires are more prone to active layer detachment failures immediately following a fire (Coates, 2008).

2.6 Anthropogenic Disturbance

Anthropogenic disturbances related to placer mining dating back to the Yukon gold rush of the late 19th century are widespread within most of the valleys in the study area. Valley bottoms and adjacent terraces have been most severely altered, commonly having all their surficial material mined for placer gold before being deposited in hummocky piles of placer tailings (**Photo 2-1**). Valley sides and uplands have been locally disturbed by construction of access roads and exploration teams searching for gravel terraces and the bedrock source of the placer gold. A more detailed characterization of the disturbances and their implications for project infrastructure is provided below in reference to the specific terrain unit, Anthropogenic Disturbances (Section 4.1.10).



Photo 2-1. Hummocky tailings piles from placer mining in the Indian River valley

3 Methods

PECG employed a systematic approach for completing terrain stability and hazard mapping for the Project, leveraging local knowledge of permafrost conditions and extensive experience mapping mass movement and fluvial hazards in this unglaciated region. Each main phase of work is described below.

3.1 Background Review and Consultation

PECG strengthened our pre-existing understanding of terrain characteristics and related hazards within the study area by reviewing several important data sources: aerial photography; LiDAR-derived elevation data; satellite imagery; existing bedrock, surficial and geomorphological mapping; previously collected field data; and peer-reviewed literature (**Table 3-1**).

PECG also took advantage of our existing collaborative working relationships with senior staff at Yukon Geological Survey (YGS) and Yukon Highways & Public Works (Yukon Highways) to acquire local knowledge from their field experience in the study area. We consulted Jeff Bond (Manager, Surficial Geology, YGS) about his knowledge of the stability of paleo-landslides within the study area. Our team met with staff at Yukon Highways, in Dawson, to discuss their experience with mass movement and icing hazards along the government-maintained section of the proposed access road south of Dawson. Stream crossings prone to icing, according to Yukon Highways' staff, have been included in the map inventory of potential icing hazard sites (Map 2, **Appendix B**).

3.2 Field Investigations

Field work was completed prior to completion of the terrain stability mapping due to concurrent acquisition and processing of the high-resolution aerial photography and LiDAR-derived elevation data on which the mapping of the access road corridor is now based. A thorough review of available data sources identified above in Section 3.1 in advance of field work ensured field investigations provided satisfactory representation of the diversity of terrain and hazards within the study area. Areas with the greatest potential for instability were prioritized for investigation.

Field investigations were conducted throughout the study area by a two- to three-person crew over a two-week period in mid-August 2015 (**Figure 3-1**). Jim Coates (Kryotek) additionally participated in the early phases of the field program, including an initial helicopter reconnaissance of the entire study area, in order to share his local knowledge. Conditions were mostly favourable for field work: the ground was free of frost and snow, active layer thicknesses were likely near their maxima, and weather conditions had little to no effect on progress or site access. A helicopter was used strategically for reconnaissance and site access purposes during the program, with priority for landing sites given to areas inaccessible from existing roads or trails. A 4WD pick-up truck was used for site access along existing sections of government-maintained road, as well as other sections of placer mining roads in reasonable condition. A helicopter-dropped UTV facilitated access along rougher sections of road or trail in the southern portion of the study area. Foot traverses from vehicle drop-off locations enabled access to sites inaccessible to vehicles and better afforded understandings of transitional conditions.

Table 3-1. Select data sources used for background review and project deliverables

Remotely Sensed Data	**Type**	**Acquisition date**	**Scale/resolution**	**Source**
	Black-and-white stereo aerial photography	1948	1:40,000	Yukon Government archives
	Black-and-white stereo aerial photography	1949	1:40,000 & 1:20,000	Yukon Government archives
	Black-and-white stereo aerial photography	1961	1:30,000 & 1:40,000	Yukon Government archives
	Black-and-white stereo aerial photography	1995/96	1:25,000	Yukon Government archives
	Colour stereo aerial photography (mine area)	2011	1:20,000	Kaminak
	Colour stereo aerial photography (corridor)	2015	1:30,000	Kaminak
	LiDAR-derived elevation data	2012 (mine); 2015 (corridor)	20 cm	Kaminak (McElhanney)
	Satellite imagery (GeoEye-1)	2000-2014	50 cm	Geomaticsyukon.ca

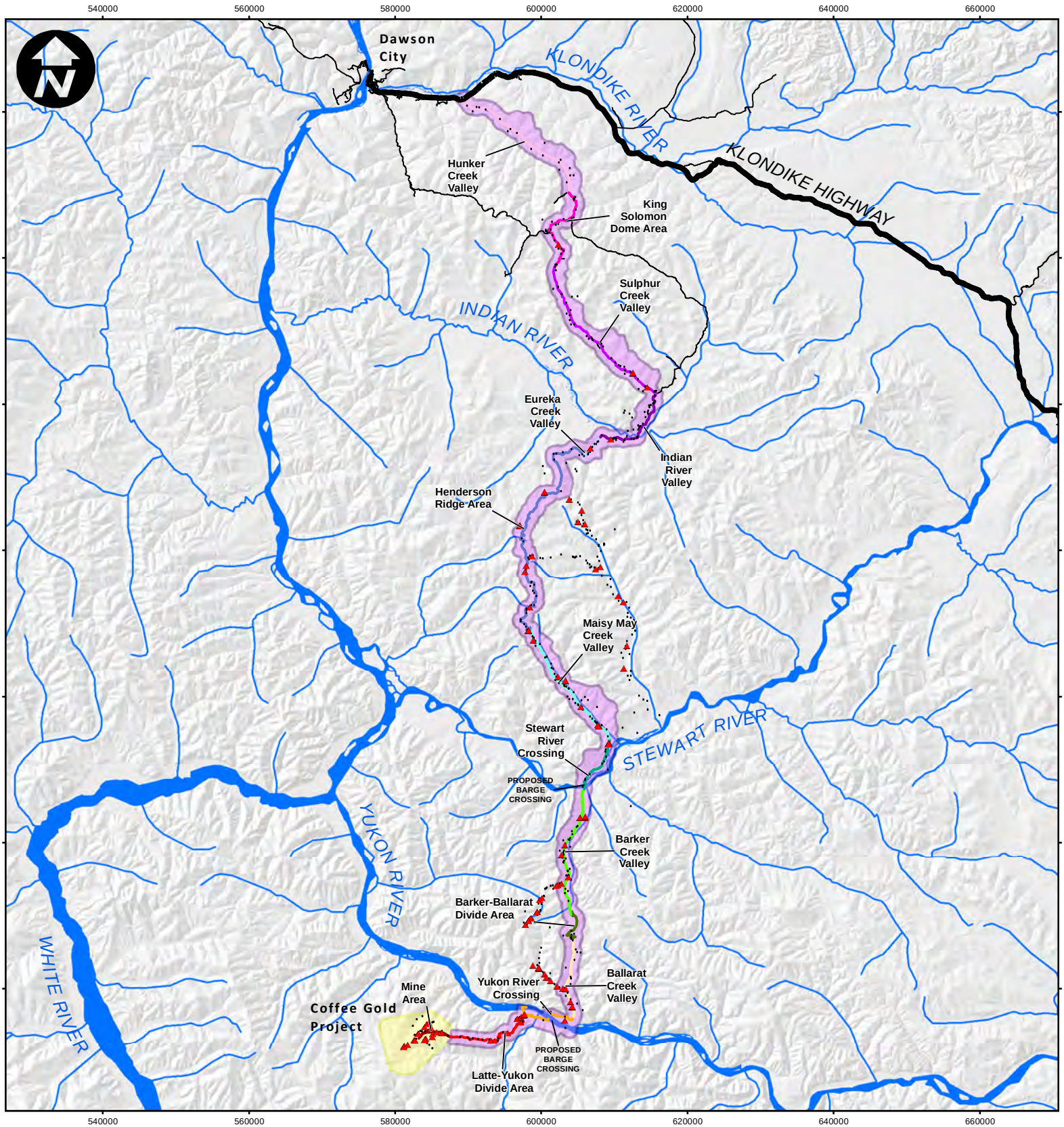
Derived Data	**Type**	**Original data source**	**Resolution**
	Hillshade model (PECG)	2014 LiDAR (Kaminak)	20 cm
	Slope surface model (PECG)	2012/2015 LiDAR (Kaminak)	100 cm
	Orthophotography	2015 air photos (Kaminak)	30 cm

Digital Base Data	**Type**	**Source**
	Wildfire database	Geomaticsyukon.ca
	CanVec	Geomaticsyukon.ca
	Historical earthquakes	Geomaticsyukon.ca

Existing Mapping	**Type**	**Scale**	**Source**
	Glacial limits	1:1,000,000	Duk-Rodkin, 1999
	Bedrock geology	1:50 000 – 1:250 000	Gordey and Makepeace (compilers), 1999
	Surficial geology	1: 50 000	Lipovsky and Bond (compilers), 2014
	Geomorphological (terrain) mapping within Coffee Gold Project claim boundary	1:20,000	AECOM, 2012

Select Peer-Reviewed Literature (full reference list in Section 9)	**Title**	**Reference**
	Evolution of Surprise Rapids landslide, Yukon Territory	Ward et al., 1992
	Stability of Frozen and Thawing Slopes in the Mackenzie Valley, Northwest Territories	Dyke, 2004
	Earthquakes and seismic hazard in the Yukon-Beaufort-Mackenzie	Hyndman et al., 2005
	Effect of forest fire on landsliding over permafrost, Steele Creek, Yukon Territory	Coates and Lewkowicz, 2005
	Morphology and geotechnique of active-layer detachment failures in discontinuous and continuous permafrost, northern Canada	Lewkowicz and Harris, 2005
	Active layer detachments following the summer 2004 forest fires near Dawson City, Yukon	Lipovsky et al., 2006
	Significant Canadian Earthquakes of the Period 1600–2006	Lamontagne et al., 2007
	A permafrost probability model for the southern Yukon and northern British Columbia, Canada	Bonnaventure et al., 2012
	Property-scale classification of surficial geology for soil geochemical sampling in the unglaciated Klondike Plateau, west-central Yukon	McKillop et al., 2013

Field Data	**Type**	**Collector**	**Date**	**Project**
	Permafrost and soil data	TT-EBA	2016	Coffee Gold Project permafrost distribution and permafrost-related geohazard mapping
	Permafrost and soil data	AECOM	2012	Coffee Gold Project geomorphological mapping study





Legend

- Place name
- Existing main roads
- Klondike Highway
- Watercourse
- Waterbody
- Visual reconnaissance field site
- Detailed field site

Terrain stability mapping and hazard assessment study area

- Access road corridor
- Mine site area

Road centreline segments

- Hunker Creek Valley
- King Solomon Dome
- Sulphur Creek Valley
- Indian River Valley
- Eureka Creek Valley
- Henderson Ridge Area
- Maisy May Creek Valley
- Stewart River Crossing
- Barker Creek Valley
- Barker-Ballarat Divide
- Ballarat Creek Valley
- Yukon River Crossing
- Latte-Yukon Divide
- Mine Area

COFFEE GOLD PROJECT
Distribution of Field Sites

0 2.5 5 10 15 20 25 km

1:700,000

Original page size: 11.00 x 8.50 in

Base mapping from Geomatic Yukon (http://www.geomaticsyukon.ca/data).
Field reconnaissance conducted by D. Sacco, C. Brown and R. McKillop in association with J. Coates (Kryotek Arctic Innovation) in August 2015.
Observations made by PECG's field crews were supplemented by observations made by other project team members at additional field sites (not shown). Refer to appendices for identification and data from detailed field sites.

Project number: 13103

Projection: UTM Zone 7
Datum: NAD 1983
Units: metre

KAMINAK GOLD CORPORATION

Figure 3-1

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Document Path: C:\Egnyte\Shared\Projects\Active\1310 - Kaminak Gold Corp\13103 - Coffee TSM\Programs\Mapping\Report figures\Field sites\Figure 3-1.mxd

Drawn by: CEB Checked by: RM 17/03/2016

In total, 96 sites were investigated on the ground in detail, including along candidate sections of access road corridor no longer under consideration ('detailed field sites' in **Figure 3-1**). At each site, a hand-dug soil pit or existing exposure (e.g., road cut) was used to examine the sub-surface. Standardized field sheets were used to record data on site characteristics (e.g., coordinates; elevation and aspect; slope position, shape and steepness), terrain characteristics (e.g., surficial material, texture, surface expression and geomorphological process), drainage conditions (e.g., drainage class; seepage depth) and vegetation (e.g., dominant tree species and ground cover), based on pertinent sections and standards of the *Field Manual for Describing Terrestrial Ecosystems* (BC Ministry of Forests and Range and BC Ministry of Environment, 2010), with an additional allowance for observations related to permafrost conditions (e.g., active layer thickness; ground ice observations) and terrain hazards. Active layer thickness was determined through a minimum of five frost probing measurements at each site. At sites most representative of common terrain units, soil horizons were examined, documented and classified to at least the Great Group level according to *The Canadian System of Soil Classification* (Soil Classification Work Group, 1998) in order to support terrestrial ecosystem mapping being completed by other project team members. A basic sketch of the soil profile, along with photographs of both the soil profile and the surrounding area, accompanied all observations. Photographs were taken of all field sites, as well as of any features of interest. Field data from all detailed sites are included in **Appendix D**.

Pertinent observations from several hundred additional sites were recorded based on visual reconnaissance during short stops along a foot traverse, vehicle drive-by or helicopter fly-over (**Figure 3-1**). Most observations related to surficial material thickness, vegetation associations, drainage and evidence of instability or permafrost characteristics. Accompanying photographic documentation was collected at the majority of observation sites. Basic field notes from visual reconnaissance sites were referenced during mapping, but are not appended due to inconsistency in their contents and formats.

3.3 Terrain and Terrain Stability Mapping

PECG completed terrain and terrain stability mapping within the 526 km^2 study area to support project engineering and environmental studies[2], in accordance with YESAB's recent publication, *Geohazards and Risk: A Proponent's Guide to Linear Infrastructure* (Guthrie and Cuervo, 2015). Terrain mapping is the process of dividing the landscape into areas (polygons) according to surficial materials, landform characteristics and geomorphological processes. Terrain stability mapping involves further consideration of drainage, slope and, in this case, permafrost characteristics, resulting in the classification of each polygon as stable, potentially unstable or unstable.

3.3.1 Mapping Protocols and Attributes

PECG completed all mapping based on field-calibrated interpretations of high-resolution digital aerial photography and LiDAR-derived elevation data (acquired at a flight scale of approximately 1:30,000), using

[2] In addition to supporting the siting and design of the proposed mine facilities and access road, mapping was completed in general accordance with bioterrain mapping protocols (e.g., includes drainage and aspect considerations) in order to support terrestrial ecosystem mapping being completed by other project team members.

softcopy photo-interpretation workstations with either PurVIEW or DAT/EM Summit Lite software packages. Polygon delineation was typically completed at a scale of 1:10,000, although larger scales (e.g., 1:2,500) were used as necessary to delineate important details. Previous geomorphological (terrain) mapping completed by AECOM (2012) within Kaminak's property south of Yukon River was adapted and refined for terrain stability mapping purposes, and to ensure consistency with mapping protocols used north of Yukon River.

Terrain (stability) polygons were delineated primarily based on the YGS' adaptation of the *Terrain Classification System for British Columbia* (Howes and Kenk, 1997) and the *Mapping and Assessing Terrain Stability Guidebook* (BC Ministry of Forests, 1999). We also consulted *A User's Guide to Terrain Stability Mapping in British Columbia* (J.M. Ryder and Associates, Terrain Analysis Inc., 2002) and *A Guide for Management of Landslide-Prone Terrain in the Pacific Northwest* (BC Ministry of Forests, 1994). Certain refinements were made based on unique conditions encountered in the study area and to better meet project-specific objectives.

Terrain stability polygons were delineated with consideration for eight main attributes, each of which is defined below, in addition to the terrain stability classes described below in Section 3.3.2. Complete explanations and descriptions of attribute values are available on the terrain mapping (Map 1) and its cover page of code definitions (**Appendix A**).

- **Surficial Material** – e.g., colluvium (C), weathered bedrock (D), alluvium (F)

  This attribute defines the surficial material present and its depositional (genetic) origin. The surficial material represents the core element of a particular terrain unit and label.

- **Surface Expression** – e.g., veneer (v), blanket (b), terrace (t)

  This attribute refers to the form, or pattern of forms, expressed by the surficial material. Up to two surface expressions describe a particular surficial material.

- **Texture** – e.g., silty (z) sand (s), mixed angular fragments (x), gravel (g)

  This attribute refers to the size, sorting and shape of the particles comprising the surficial material. Textures were assigned to all polygons, including those not investigated in the field, based on typical conditions observed at field sites and documented in previous investigations in the region (e.g., Bond and Lipovsky, 2011; McKillop et al., 2013). Such an approach is consistent with textural characterization in YGS' surficial geology mapping (Lipovsky and Bond (compilers), 2014) and aids standardization of terrain units. Up to three textures describe a particular surficial material, in order of increasing proportion[3].

- **Geomorphological Process** – e.g., gully erosion (-V), active layer detachment (-Xf)

  This attribute refers to geomorphological processes that are either occurring, or have occurred, within a polygon. Up to three geomorphological processes and respective subclasses can be identified.

[3] This convention is used in place of YGS' opposite convention – in order of decreasing proportion – due to its consistency with verbal description (e.g., sgF is a sandy gravel fluvial deposit dominated by gravel).

- **Drainage Class** – e.g., well drained (w), imperfectly drained (i), poorly drained (p)

  This attribute refers to the speed and extent to which water is removed from the soil in relation to additions. It considers both the rate at which water is able to be removed from an area as a result of landscape characteristics (e.g., slope), and the permeability of the surficial materials themselves. In this study area, drainage class is strongly influenced by the depth to permafrost, where present. Drainage class is represented by a single value, or a range between two values.

- **Depth to Permafrost** – e.g., near-surface (n, <0.4 m), shallow (s, 0.4-1 m), deep (d, >1 m)

  This attribute refers to the estimated maximum (end of summer) depth to permafrost, inferred from vegetation and drainage indicators, and landform associations characterized based on field measurements. Depth to permafrost is locally variable, so this is considered an average for the polygon.

- **Permafrost Ice Content** – e.g., ice-poor (p), ice-moderate (m), ice-rich (r)

  This attribute refers to the relative volumetric ice content of permafrost, interpreted based on field observations of ground ice in different hydrogeomorphic settings; Kryotek's previous permafrost-related drilling and geophysical survey experience in the region; and recent research in this unglaciated region (e.g., Bond and Lipovsky, 2011; McKillop et al., 2013). Project-specific permafrost mapping and characterization undertaken concurrently by TT-EBA along the access road centreline (2016b) and within the mine area (2016c), which references geotechnical/hydrogeological drilling results from the mine area (Lorax Environmental Services Ltd., 2016), also informed ice content interpretation. This classification is not intended to apply any particular volumetric ice content (%); rather, its purpose is to distinguish areas relatively and according to distinct forms of ground ice. With approximate correlations with TT-EBA's (2016b,c) ice content classification identified in parentheses, ice-poor permafrost typically contains no visible ice (~Fn: ice not visible); ice-moderate permafrost typically contains segregated ice in the form of seams and lenses, but rarely any large ground ice bodies (~Fv: visible excess ice); and ice-rich permafrost typically contains large accumulations of segregated ice in the form of ice wedges and other massive bodies, in addition to seams and lenses (~Fi: very ice-rich)[4]. Localized differences between TT-EBA's (2016b,c) and PECG's (this study) interpretations of permafrost distribution and ice content have been reviewed, are generally minor, and are expected in light of limited ground data.

- **Slope Class** – e.g., 2 (gentle, 6-26%), 4 (moderately steep, 50-70%)

  This attribute refers to the dominant, typically average, range in slope steepness. Slope class was visually assigned based on a five-level raster model of slope class generated from the LiDAR-derived elevation data.

[4] The terms ice-poor, ice-moderate and ice-rich, as defined here, are used throughout the report.

Additional point and linear features too small to be mapped as polygons were identified using on-site symbols. Examples include thermokarst ponds (point) and slope failures (line). Whether or not a polygon encompassing an on-site symbol that represents a geomorphological process (e.g., gully erosion) was attributed as such (e.g., -V) depended on the proportional area of the polygon that is affected by the process. For example, a single gully did not necessarily require inclusion of the gullying process in the polygon label. Point or linear features occurring entirely within anthropogenic disturbance polygons were not mapped.

3.3.2 Terrain Stability Classification

Terrain stability mapping in British Columbia typically involves the assignment of a single terrain stability class to each polygon, in order to provide a relative ranking of the likelihood of a landslide occurring after timber harvesting or road construction (BC Ministry of Forests, 1999). This protocol yields a map depicting terrain stability classes after a disturbance – for example, following road construction – but does not readily distinguish the stability of polygons in the absence of disturbance. The hazards posed by a slope above and unaffected by road construction (i.e., potential effects of the environment on the Project), for example, could be inaccurately represented on a conventional terrain stability map. Particularly in this landscape of discontinuous permafrost, some of which is ice-rich and prone to thermokarst activity, it is important to differentiate terrain stability classes in both the existing and disturbed condition. As such, both existing and disturbed terrain stability classes were assigned to each polygon to enable mine facility and road design engineers to accurately evaluate risks posed locally and by hazards upslope or downslope of the proposed infrastructure.

The ‘existing terrain stability’ class represents current conditions, in the absence of any project-related activity; the ‘disturbed terrain stability’ class represents conditions following disturbance to ground conditions from road/facility construction without mitigation (**Table 3-2**). As a conservative base case, the disturbed stability class assumes typical cut-and-fill road construction without any measures to mitigate potential instability on steep slopes or from disturbance to permafrost with excess ice. Stripping or compaction of organics, and only regular surface water management, would be typical disturbances. Full details for both the existing and disturbed terrain stability classes are provided on the mapping of terrain stability and hazards (Map 2) and its cover page of code definitions (**Appendix B**).

Further modification of conventional terrain stability classes used in British Columbia was necessary to accommodate the potential for instability related to thermokarst processes. If overlooked in the siting and design of project infrastructure, thermokarst could significantly increase infrastructure (e.g., road) maintenance costs and potentially affect worker safety through its potential influence on ground stability (e.g., road surface grade) (McGregor et al., 2010). Therefore, the assignment of terrain stability classes additionally considers the presence or absence of permafrost (as shown on the cover page of the mapping of terrain stability and hazards (Map 2) in **Appendix B**).

Table 3-2. Terrain stability classification system developed for the Coffee Gold Project

Symbol	Class	Condition	Interpretation		Common terrain characteristics	
			Existing	Disturbed	Existing	Disturbed
I	stable	permafrost	No significant stability problems.		Planar to gently sloping bedrock and weathered bedrock; active fluvial units.	Planar to gently sloping bedrock, weathered bedrock and active fluvial units with deep, ice-poor permafrost.
		no permafrost			Planar to low sloping bedrock and weathered bedrock; active fluvial units.	
II	generally stable	permafrost	Very low likelihood of slope instability.	Very low likelihood of slope instability; no thermokarst subsidence or erosion expected.	Colluvial mantles on gentle slopes; gently sloping colluvial complexes; gently sloping fluvial units; organic deposits; moderately steep bedrock and weathered bedrock.	Colluvial mantles on gentle slopes with deep, ice-poor permafrost; gently to moderately sloping fluvial units with deep, ice-poor permafrost.
		no permafrost	Very low likelihood of slope instability.		Gently to moderately sloping colluvial mantles and fluvial units; moderately steep bedrock and weathered bedrock.	
III	generally stable with minor potential for instability	permafrost	Low to moderate likelihood of slope instability.	Low to moderate likelihood of slope instability and/or minor thermokarst subsidence or erosion possible.	Poorly drained colluvial mantles on moderate slopes; moderately sloping colluvial complexes; imperfectly drained colluvial mantles on moderately steep slopes; ice-poor to ice-moderate permafrost.	Poorly drained colluvial mantles on gentle slopes; imperfectly drained colluvial mantles on moderate slopes; ice-poor to ice-moderate permafrost.
		no permafrost	Low to moderate likelihood of slope instability.		Colluvial mantles on moderately steep slopes.	
IV	potentially unstable	permafrost	Expected to contain areas with a high likelihood of slope instability.	Expected to contain areas with a high likelihood of slope instability and/or moderate thermokarst subsidence or erosion.	Poorly drained colluvial mantles on moderately steep slopes; moderately steep colluvial complexes.	Any surficial unit thicker than a veneer with ice-moderate permafrost; poorly drained colluvial mantles on moderate slopes; imperfectly drained colluvial mantles on moderately steep slopes.
		no permafrost	Expected to contain areas with a high likelihood of slope instability.		Colluvial units on moderately steep to steep slopes.	
V	unstable	permafrost	Expected to contain areas with a very high likelihood of slope instability and/or thermokarst; may or may not exhibit evidence of previous slope failure and/or thermokarst.	Expected to contain areas with a very high likelihood of slope instability and/or major thermokarst subsidence or thermal erosion; typically exhibits evidence of previous slope failure and/or thermokarst.	Any unit with evidence of slope failure and/or thermokarst subsidence or thermal erosion.	Any unit with evidence of slope failure or ice-rich permafrost; poorly drained colluvial mantles on moderately steep slopes.
		no permafrost	Expected to contain areas with a very high likelihood of slope instability; typically exhibits evidence of previous slope failure.		Any unit with evidence of slope failure; typically occur on moderately steep to steep slopes.	

3.4 Hazard Identification

Hazards posed by mass movements and fluvial processes were identified and characterized in this study.

3.4.1 Slope Failure and Thermokarst

The type and distribution of mass movement (slope failure) and thermokarst hazards within the study area were identified by assessing geomorphological process codes (polygon label), on-site symbols (point or linear features) and terrain characteristics (Map 2, **Appendix X**; see Section 4.2 for hazard process descriptions). Mass movements involve the downslope transport of material, such as soil and/or rock, under the influence of gravity. Mass movements may or may not be associated with water, snow or ice[5]. Within the study area, mass movements occur through a variety of processes in addition to landsliding. Landslide terminology used in this report follows the standards defined by Hungr et al. (2014), a recent update to the classic classifications established by Varnes (1978) and Cruden and Varnes (1996), which describe the process as well as the type of material involved in the mass movement. Where two modes of failure contribute to movement, terminology was assigned based on the apparent dominant mode. The landslide terms applied in this report are illustrated schematically in **Figure 3-2**.

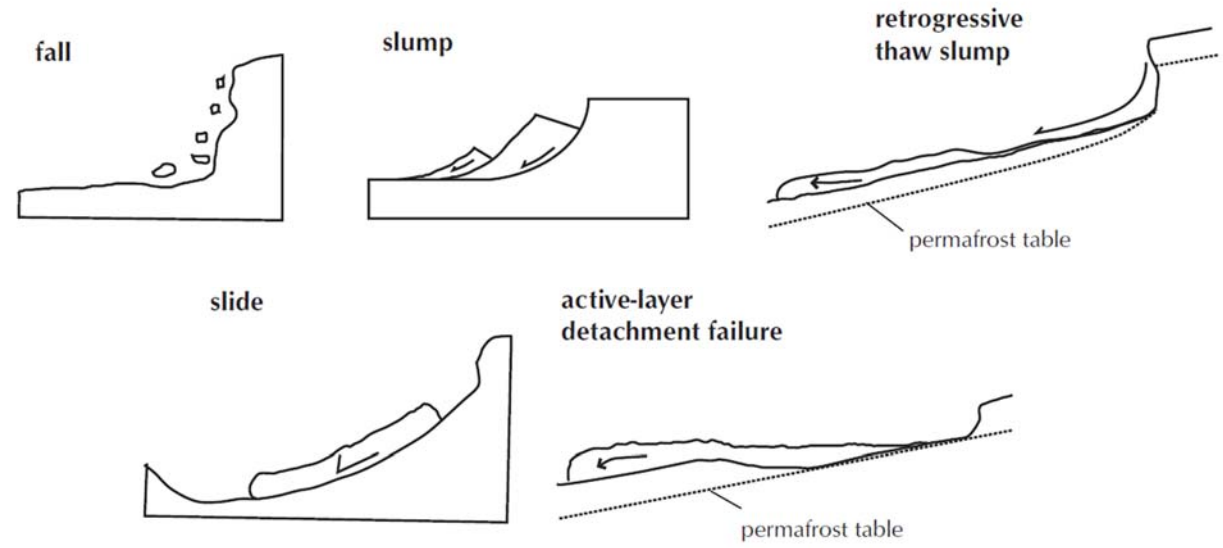


Figure 3-2. Schematic of landslide types in the study area (adapted from Huscroft et al., 2004)

[5] Snow avalanches were not included in this description of mass movement processes because there is no mappable evidence (e.g., vegetation patterns) of their occurrence within the study area; small loose snow or slab avalanches may occur on moderate to steep slopes in wind-loaded alpine areas.

Where more accurate representation of the role of permafrost was required, refinements to standardized landslide terminology were made based on the *Multi-language glossary of permafrost and related ground-ice terms* (van Everdingen, 2005), which is consistent with the approach applied in the regional characterization of landslides along Yukon's Alaska Highway corridor (Huscroft et al., 2004). For example, permafrost environments also uniquely include "active layer detachments" and "retrogressive thaw slumps" (also known as retrogressive thaw flows) (**Figure 3-2**), each of which is described below. Also mapped and described below as part of this assessment are rock creep (*cf*. Blais-Stevens, 2010), gullying, thermokarst subsidence, thermokarst gullying, slopewash, solifluction and pingos.

Each polygon was broadly categorized according to its dominant hazard potential in order to clearly depict the nature of hazard governing the terrain stability class of each polygon. One of three categories was used: (i) slope failure potential is dominant, (ii) thermokarst potential is dominant, or (iii) slope failure and thermokarst potential are co-dominant. A hatch pattern was overlaid to indicate the 'applicable hazard category' in mapping of terrain stability and hazards (Map 2, **Appendix B**). This designation does not indicate whether or not the polygon exhibits any evidence of such hazards; the geomorphological process codes or on-site symbols serve that purpose. The 'slope failure potential is dominant' category is the default, thus all units that do not pose a thermokarst hazard (e.g., gentle, ice-poor colluvium and even flat, permafrost-free fluvial plains) are represented by this category. A terrain unit generally must exhibit ice-moderate or ice-rich permafrost to be considered for the 'thermokarst potential is dominant' category. Polygons with ice-moderate or ice-rich permafrost and slope classes of 3 or higher are candidates for the 'slope failure and thermokarst potential are co-dominant' category.

A generalized characterization was made of the nature of hazard posed by different geomorphological processes – in terms of likelihood, magnitude and project considerations – based on review of historical aerial photography in conjunction with field observations, in addition to professional experience in the region.

3.4.2 Meander Migration

Creek and river meanders that migrate through progressive bank erosion may pose a hazard to adjacent sections of the proposed access road (see Section 5.4 for hazard details). A systematic review was completed using the 2015, high-resolution aerial photography and LiDAR-derived elevation data to identify areas subject to erosion. Road segments proposed in close proximity to the outer bank of a meander, especially if separated by alluvial or fine-textured colluvial soils, or where meandering watercourses are crossed, were identified as sites of meander migration hazard.

A more detailed, time-transgressive assessment of meander migration hazard was completed for the proposed crossings of Indian, Stewart and Yukon rivers. These locations will have important project infrastructure, and minor shifts in the river thalwegs can trigger considerable erosion of unconsolidated banks. Historical river bank locations were digitized from georeferenced, historical aerial photographs and 2015 orthophotography, and then compared to estimate bank erosion trajectories and rates.

3.4.3 Icing

Icing, which refers to wintertime accumulation of aufeis, may pose a hazard and increase road maintenance requirements at certain stream crossings and draws (see Section 5.5 for hazard details). Sites along the proposed access road interpreted to be prone to icing in winter were identified based on consultation with Yukon Highways' staff and Jim Coates (Kryotek) for the government-maintained section of road. These identified sites were used to calibrate interpretations and identify potential icing hazards along the remainder of the proposed road alignment. In general, draws that contain fluvial veneers underlain by permafrost, are densely covered with willows, and are shaded by adjacent valley sides are commonly subject to icing. No attempt was made to estimate the width or thickness of icing at particular road crossings.

3.5 Soil Erosion Potential

Soil erosion potential represents the combined likelihood and magnitude of soil erosion as a result of surface runoff over exposed soils. Knowledge of soil erosion potential in advance of construction facilitates design of erosion and sediment control measures that are commensurate with site-specific risks to project infrastructure and adjacent ecological features (e.g., fish habitat). A five-level classification was developed to rank polygons according to their soil erosion potential (**Table 3-3**), based on the general approach and criteria outlined by BC Ministry of Forests (1999) and the erosion and sedimentation risk mapping completed by PECG (2013) for Casino Mining Corporation's proposed extension to the nearby Freegold Road. In general, soil erosion potential is directly proportional to silt and/or organic content, slope gradient, ground ice content and the severity of pre-existing gullying (mapping of soil erosion potential (Map 3, **Appendix C**).

Table 3-3. Soil erosion potential classification developed for the Coffee Gold Project

Symbol	Class	General criteria	Common terrain characteristics	Management implications
VL	very low	Increasing silt and/or organic content Increasing slope gradient Increasing ground ice content Increasing severity of pre-existing gullying ↓	Bedrock; planar weathered bedrock; planar fluvial deposits without permafrost.	No or only very minor surface erosion within small areas of exposed soil on locally steeply sloping ground (e.g., creek banks); conventional surface runoff management appropriate.
L	low		Gently to moderately sloping weathered bedrock; gently to moderately sloping, permafrost free colluvial mantles; gently to moderately sloping, permafrost-free fluvial deposits.	Expect minor erosion of fine sediments along ditch lines, cut slopes and across disturbed soils; avoid channelling water toward more sensitive downslope units.
M	moderate		Planar to gently sloping organic material; gently to moderately sloping colluvial veneers with shallow or near-surface permafrost; gently sloping colluvial blankets with shallow or near-surface permafrost; moderately steep to steeply sloping, permafrost-free veneers and thin veneers; fluvial deposits with shallow or near-surface permafrost.	Expect moderate erosion when water is channelled down road surfaces or ditches (minor thermal erosion possible in areas of permafrost); plan for preventative and remedial actions in disturbed areas, including measures to minimize concentrated surface runoff in areas of permafrost and to trap sediments.
H	high		Moderately steeply sloping colluvial veneers; moderately to moderately steeply sloping colluvial blankets with shallow to near-surface permafrost; gently sloping colluvial complexes; ridgetop saddles with silt-rich colluvial veneer.	Significant erosion problems are expected when water is channelled onto or over exposed soil on these sites (moderate thermal erosion possible in areas of permafrost), particularly on cut slopes; plan for preventative and remedial actions in disturbed areas, including measures to minimize concentrated surface runoff in areas of permafrost and to trap sediments.
VH	very high		Steeply sloping colluvial mantles with shallow or near-surface permafrost; moderate to steeply sloping colluvial complexes.	Severe surface and gully erosion problems can be created when water is channelled onto or over these sites (major thermal erosion possible in areas of permafrost), particularly on cut slopes; erosion is commonly evident in natural conditions. If area not avoidable, minimize concentrated surface runoff in areas of permafrost, minimize extent and duration of soil exposure, and promptly stabilize soils with salvaged vegetation (e.g., moss) cover or appropriate erosion control measures.

4 Terrain Description

The following sections describe the main terrain units (Section 4.1) and geomorphological processes (Section 4.2) encountered within the study area.

4.1 Terrain Units

Terrain units are defined based on a particular combination of surficial material(s), texture(s), surface expression(s) and geomorphological process(es), as well as drainage class(es), permafrost conditions and slope class. The diversity of terrain characteristics within the study area can be organized into ten terrain units for descriptive (**Table 4-1**) and geostatistical analysis purposes (**Figure 4-1**). Each terrain unit is described below according to its typical distribution, material composition, landform characteristics, permafrost conditions and geomorphological processes, and summarized in table form with standardized photographic perspectives. The descriptions incorporate directly applicable characterizations of corresponding 'landform-soil types' (LSTs) established for the unglaciated Klondike Plateau (McKillop et al., 2013) (**Table 4-1**). Colluvial terrain is subdivided into several distinct units due to significant differences in their composition, stability classification and sensitivity to disturbance. **Table 4-2** identifies standardized textures assigned to distinct colluvial terrain units based on field observations and in accordance with regional surficial geology mapping (Lipovsky and Bond (compilers), 2014).

Table 4-1. Cross-reference between main terrain units within the study area and established 'Landform-Soil Types' (McKillop et al., 2013)

Report Section	Terrain Unit	Corresponding Landform-Soil Type (LST) Number and Name
4.1.1	Bedrock and Weathered Bedrock	LST1: intact and weathered bedrock
4.1.2	Mixed Weathered Bedrock and Colluvium	LST2: mixed weathered bedrock and colluvium
4.1.3	Colluvial Mantles without Permafrost	LST10, LST11 & LST12: clast-rich colluvial blanket, veneer & thin veneer
4.1.4	Colluvial Veneers with Permafrost	LST3 & LST4: loess-rich & landslide-affected colluvial veneer
4.1.5	Colluvial Blankets with Permafrost	LST5: loess-rich colluvial blanket
4.1.6	Colluvial Complexes with Permafrost	LST6: loess-rich colluvial apron
4.1.7	Fluvial Landforms	LST8: fluvial plain
4.1.8	Glaciofluvial Terraces	LST9: glaciofluvial terrace
4.1.9	Organic Terrain	LST7: organic plain
4.1.10	Anthropogenic Disturbances	n/a

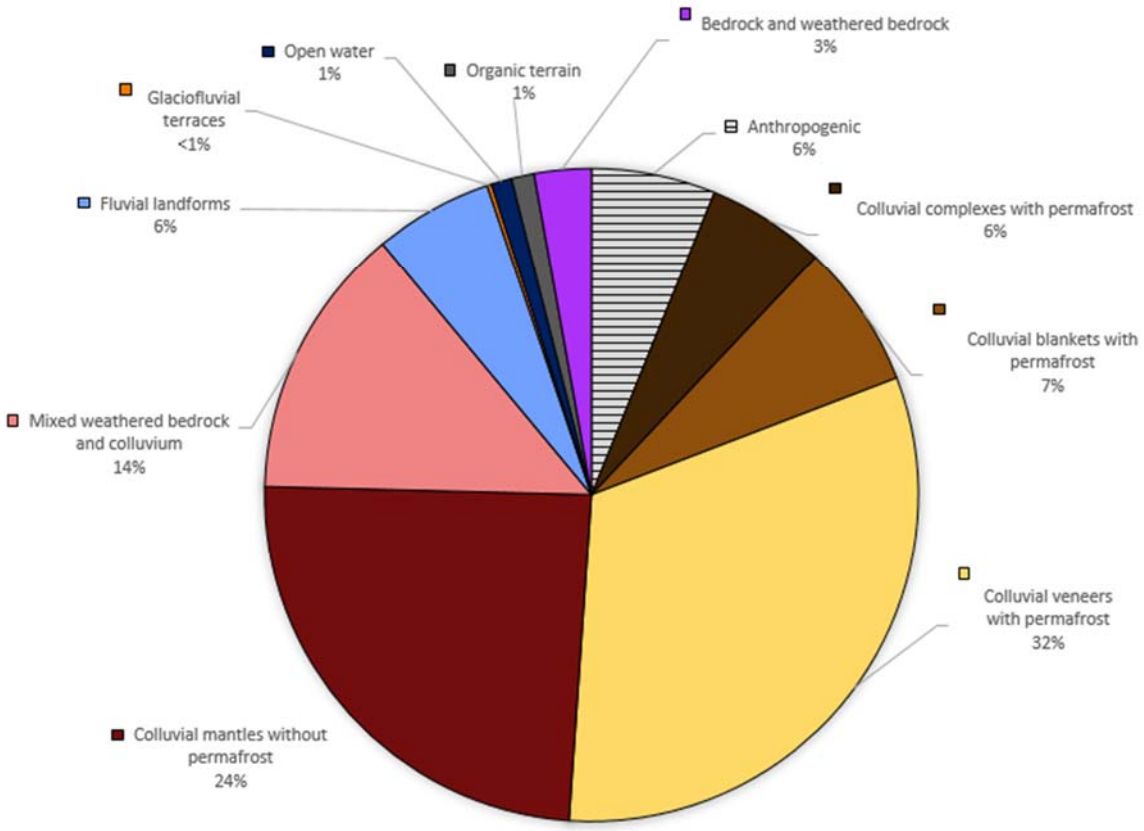


Figure 4-1. Areal proportion (%) of terrain units within the study area

Table 4-2. Standardized textures used for colluvial terrain units

Condition	Typical Texture and Landform
Colluvial mantles without permafrost	zsxCx; zsxCv; zsxCb
Colluvial veneers with permafrost	szxCv
Colluvial blankets with permafrost	sxzCb
Colluvial complexes with permafrost	xszC1a; xszC1b

Note: Lower-case letters preceding the colluvial surficial material (C) represent particular textures (i.e., z: silt; s: sand; x: angular fragments; d: mixed fragments); the lower-case letters that follow represent surface expressions (i.e., x: thin veneer; v: veneer; b: blanket; a: apron). Textural dominance increases from left to right. The replacement of x with d in the texture signifies the suspected incorporation of rounded clasts from an upslope or underlying source of water-transported deposits.

4.1.1 Bedrock and Weathered Bedrock

Intact (R) and weathered (D) bedrock is dominant within approximately 3% of the study area (**Figure 4-1**, **Table 4-3**). It is extensive on summits, ridges and spurs throughout the region, and small areas of it occur on isolated hills and over-steepened slope-toe scarps in some valley settings. It typically occupies crest and upper slope positions, with convex slope profiles and variable aspect and steepness.

Table 4-3. Typical characteristics of bedrock and weathered bedrock in the study area[6]

<table>
<tr><td colspan="2">Map example
  </td><td colspan="2">Oblique aerial view
  </td></tr>
<tr><td colspan="2" rowspan="8">Soil pit
  </td><td>General distribution</td><td>Summits; ridges and spurs; over-steepened valley sides</td></tr>
<tr><td>Common terrain units</td><td>zsxDv/Rh
Rs/zsxCv-R”bV</td></tr>
<tr><td>Dominant processes</td><td>In-situ weathering; rockfall; gullying; cryoplanation; nivation</td></tr>
<tr><td>Drainage range</td><td>Well to rapid</td></tr>
<tr><td>Dominant slope range</td><td>Gentle to steep</td></tr>
<tr><td>Permafrost</td><td>Deep and ice-poor on northerly aspects; ice-moderate within saddles</td></tr>
<tr><td>Other characteristics</td><td>Tors and outcrop may be present; variable aspect and slopes</td></tr>
<tr><td>Hazard considerations</td><td>Localized rockfall; thermokarst subsidence in saddles</td></tr>
</table>

The character of landforms and associated surficial materials within this terrain unit depends on local bedrock lithology and micro-topography. Summits and ridges underlain by intrusive (granitic) bedrock, such as within the mine site area, are commonly veneered with angular blocks of felsenmeer and punctuated by tors. Tors commonly occur in clusters, surrounded by a halo of angular, weathered blocks derived from rockfall. The residual soils that accumulate within areas of granitic bedrock tend to be pebbly to sandy

[6] Terrain labels and slope classes used in this and all other summary tables in Section 4.1 defined in Howes and Kenk (1997); drainage classes defined in BC Ministry of Forests and Range and BC Ministry of Environment (2010).

(grus), except where locally overlain or intermixed with loess. In contrast, areas underlain by finer-grained schists and gneisses are commonly featureless and rounded. These rocks are more susceptible to physical and chemical weathering, thus local relief tends to be lower. Residual soils that accumulate over metamorphic rocks tend to be sandy silt with traces of clay.

Permafrost may or may not be present within this terrain unit. Where present, the permafrost table is generally deep (>1 m), ice-poor and within intact or weathered bedrock, having little influence on ground stability. Exceptions occur in isolated fractures and hollows within the bedrock surface, and in gentle saddles along broad ridges, where enough loess has been preserved to maintain shallow permafrost that may contain segregated ice. Periglacial processes such as cryoturbation, cryoplanation and nivation are widespread in this terrain unit and have not been explicitly mapped. Soil drainage ranges from rapid to very rapid on bedrock outcrops, to well to poorly drained in silt-enriched hollows amongst weathered bedrock.

4.1.2 Mixed Weathered Bedrock and Colluvium

Mixed weathered bedrock (D) and colluvium (C) is dominant within approximately 14% of the study area (**Figure 4-1, Table 4-4**). It is predominant immediately below summit areas, on the shoulders of major ridges, and along rounded, steeper spurs. Most occurrences of this terrain unit are in crest and upper slope positions, with convex slope profiles and variable aspect and steepness.

Gentle slopes of this terrain unit, particularly in areas underlain by granitic bedrock, are commonly punctuated by subdued, bedrock-controlled steps formed by differential erosion. These ‘knickpoints’ may be recognized by conspicuous patches of boulder-sized felsenmeer with a slight slope-break. Over time, material originating from these knickpoints is transported downslope by a combination of soil creep and solifluction, typically forming veneers (<1 m) on underlying bedrock. In areas underlain by metamorphic bedrock, the soils tend to have smaller clasts and a finer-grained matrix, and knickpoints are rare. A jigsaw puzzle-like arrangement of clasts distinguishes *in situ* weathered bedrock from surrounding colluviated material. Silt-rich hollows and colluvial veneers may be susceptible to instability, particularly following wildfire.

Permafrost, where present, is most common in subalpine and alpine settings and on rounded spurs with northerly aspects, and may be indicated by ponded water at surface. Soils are well drained in areas of felsenmeer to poorly drained in finer grained colluvial soils with shallow, ice-poor permafrost.

Geomorphological processes are rare in permafrost-free occurrences of this terrain unit. Some higher elevation occurrences with deep permafrost exhibit conspicuously irregular micro-topography and patches of lichen-free, angular stones indicative of the process of rock creep. The potential for small active layer detachments is restricted to localized convexities with silty colluvium, most likely following wildfire.

Table 4-4. Typical characteristics of mixed weathered bedrock and colluvium in the study area

<table>
<tr><td colspan="2">Map example
  </td><td colspan="2">Oblique aerial view
  </td></tr>
<tr><td colspan="2" rowspan="8">Soil pit
  </td><td>General distribution</td><td>Heavily weathered ridgetops; ridge and spur shoulders</td></tr>
<tr><td>Common terrain units</td><td>zsxDv/szxCv
szxCv/zsxDv-Fg</td></tr>
<tr><td>Dominant processes</td><td>In-situ weathering; soil/rock creep</td></tr>
<tr><td>Drainage range</td><td>Imperfect to well</td></tr>
<tr><td>Dominant slope range</td><td>Gentle to moderate</td></tr>
<tr><td>Permafrost</td><td>Deep and ice-poor where dominantly D; shallow where dominantly C</td></tr>
<tr><td>Other characteristics</td><td>Smooth convex slopes; scrub vegetation; may contain knickpoints</td></tr>
<tr><td>Hazard considerations</td><td>Soil/rock creep; active layer detachments possible where silty colluvium is dominant</td></tr>
</table>

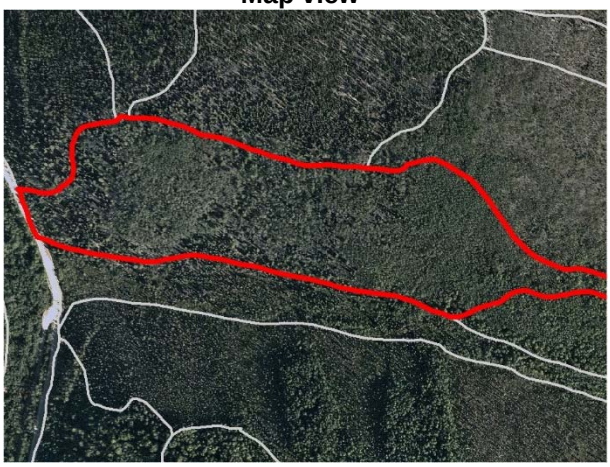
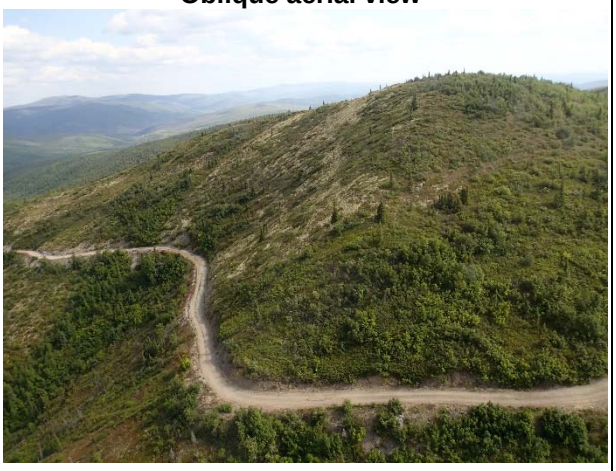
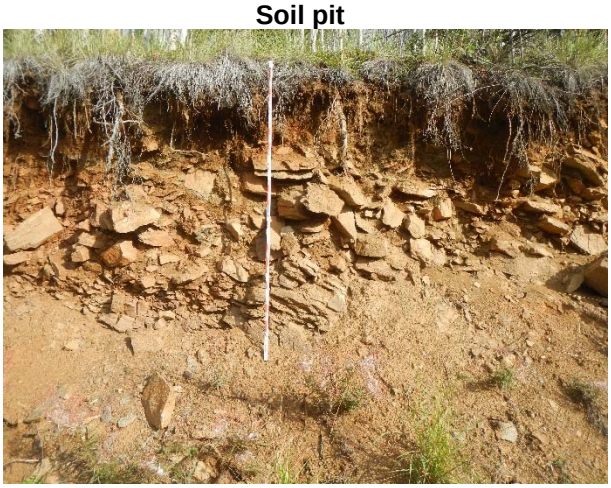
4.1.3 Colluvial Mantles without Permafrost

Colluvial mantles without permafrost are the second most common terrain unit, dominant within about 24% of the study area (**Figure 4-1, Table 4-5**). This terrain unit is most commonly represented by a colluvial veneer (Cv). Less commonly, it is represented by a thin colluvial veneer (Cx), colluvial blanket (Cb) or colluvial mantle of variable thickness (Cw). It generally occurs in mid slope positions with moderate to steep gradients. This terrain unit can occur on all aspects but is dominantly found on southerly, convex or straight slopes.

Permafrost-free colluvium is typically derived from bedrock and dominated by angular clasts and a sandy to silty-sand matrix. It is locally overlain by a thin veneer of loess (Bond and Lipovsky, 2011). The thickness of colluvium in this terrain unit ranges from <0.2 m (thin colluvial veneer), to <1 m (colluvial veneer), to >1 m (colluvial blanket). Permafrost-free colluvial blankets rarely accumulate more than a few metres of material. Small outcrops are common, particularly at convex slope-breaks and on steep, south-facing slopes mapped as thin colluvial veneers (Cx).

Soil creep and sheetwash are the principal mechanisms transporting material downslope in this terrain unit and locally impart a crude stratification, although rockfall and debris slides also have rare occurrences in steep or gullied terrain. Soils are generally moderately well to rapidly drained.

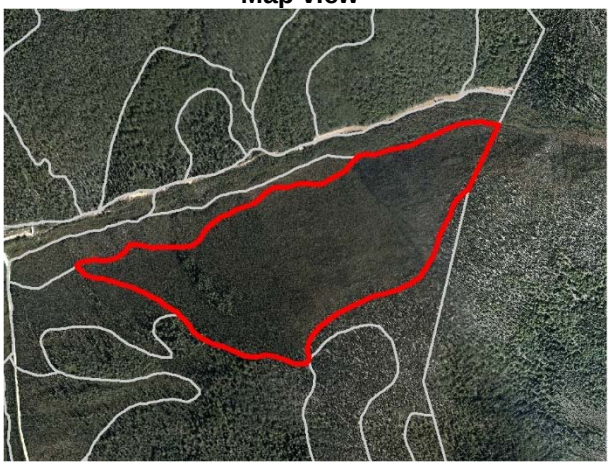
Table 4-5. Typical characteristics of colluvial mantles without permafrost in the study area

<table>
<tr><td colspan="2">Map view
  </td><td colspan="2">Oblique aerial view
  </td></tr>
<tr><td colspan="2" rowspan="8">Soil pit
  </td><td>General distribution</td><td>Slopes with southerly aspects</td></tr>
<tr><td>Common terrain units</td><td>zsxCx; zsxCv; zsxCb; zsxCw-V</td></tr>
<tr><td>Dominant processes</td><td>Soil creep</td></tr>
<tr><td>Drainage range</td><td>Imperfect to rapid</td></tr>
<tr><td>Dominant slope range</td><td>Gentle to moderately steep</td></tr>
<tr><td>Permafrost</td><td>n/a</td></tr>
<tr><td>Other characteristics</td><td>Typically convex slopes; dominated by deciduous or mixed forest</td></tr>
<tr><td>Hazard considerations</td><td>Soil creep; gullying</td></tr>
</table>

4.1.4 Colluvial Veneers with Permafrost

Colluvial veneers (Cv) with permafrost are the most extensive terrain unit, dominant within about 32% of the study area (**Figure 4-1, Table 4-6**). They most commonly occur on gentle to steep slopes with convex upper-slope or straight mid-slope positions. This terrain unit occurs on slopes with all aspects, although it is dominantly on northerly aspects.

Table 4-6. Typical characteristics of colluvial veneers with permafrost in the study area

<table>
<tr><td colspan="2">Map view
  </td><td colspan="2">Oblique aerial view
  </td></tr>
<tr><td colspan="2" rowspan="8">Soil pit
  </td><td>General distribution</td><td>Upper and mid-slopes with northerly aspects</td></tr>
<tr><td>Common terrain units</td><td>szxCv
szxCv-SX”f</td></tr>
<tr><td>Dominant processes</td><td>Active layer detachments; solifluction; slopewash; cryoturbation</td></tr>
<tr><td>Drainage range</td><td>Imperfect to poor</td></tr>
<tr><td>Dominant slope range</td><td>Gentle to moderately steep</td></tr>
<tr><td>Permafrost</td><td>Typically ice-poor and shallow</td></tr>
<tr><td>Other characteristics</td><td>Convex to straight slopes; dominantly stunted black spruce</td></tr>
<tr><td>Hazard considerations</td><td>Active layer detachments; slumping; slope wash; soil creep</td></tr>
</table>

The colluvium in this terrain unit is generally less than one metre thick (Cv), may contain isolated patches of weathered bedrock (Cw), and follows underlying topography. It is typically derived from detachment and entrainment of angular, weathered bedrock clasts, except below some terraces where it may contain rounded clasts of fluvial or glaciofluvial origin. Silt derived from loess is intermixed with the bedrock-derived material, with a decreasing concentration with depth (**Table 4-2**).

Permafrost within this terrain unit contributes to the higher silt content in comparison to permafrost-free colluvial veneers (Section 4.1.3) by inhibiting its erosion from regular surface runoff processes. Permafrost is typically shallow (0.4 to 1 m), but can be near-surface (<0.4 m) on poorly drained slopes with northerly aspects, or deep (>1 m) on convex rolls and spurs. Permafrost is generally ice-poor, containing little to no visible (segregated) ice, but may be ice-moderate and contain minor seams and lenses of ground ice on poorly drained slopes with northerly aspects. Soils are typically imperfectly to poorly drained, depending on the silt content and depth to permafrost.

A number of permafrost and periglacial processes commonly occur in association with this terrain unit, as described below in Section 4.2: active layer detachments, slumps, rock creep, slopewash and solifluction. Although active layer detachments can occur within all colluvial terrain units with permafrost, they are most common in colluvial veneers on moderate to moderately steep slopes.

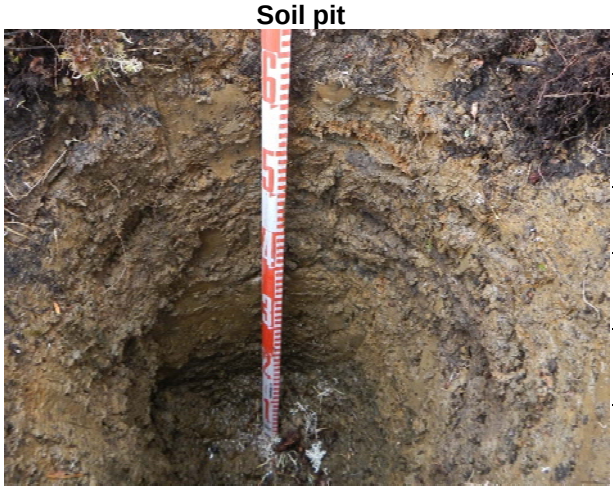
4.1.5 Colluvial Blankets with Permafrost

Colluvial blankets (Cb) with permafrost are dominant within about 7% of the study area (**Figure 4-1, Table 4-7**). They typically occur in concavities in mid- to lower-slope positions. Although this terrain unit occurs on all aspects, it is most common on gentle to moderate slopes with northerly aspects.

Colluvial blankets with have a higher silt content than colluvial veneers with permafrost because they generally form in concavities that trap silt (**Table 4-2**). Blankets generally follow underlying bedrock topography and may be in the order of 10 m deep in concavities on gentle slopes. This terrain unit has a distinctly smooth surface expression, with no abrupt breaks-in-slope or gullies. Upper soil horizons are commonly dominated by loess-derived silt; the proportion of silt intermixed with bedrock-derived colluvium decreases with depth.

Permafrost within this terrain unit is generally shallow (0.4 to 1 m) or near-surface (<0.4 m). It typically exhibits moderate ice content in the form of pore ice and segregated seams and lenses, particularly in the siltier upper horizons. Soils are typically imperfectly to poorly drained, in some cases with discrete differences due to the presence of slopewash runnels, also known as water tracks. Dwarf willows growing along the runnels have a different appearance from the dwarf birches dominating the shrub cover, giving the slopes a distinct lineated, flow-like pattern. Active layer detachments occur, albeit less commonly than on steeper veneers.

Table 4-7. Typical characteristics of colluvial blankets with permafrost in the study area

<table>
<tr><td colspan="2">Map view
  </td><td colspan="2">Oblique aerial view
  </td></tr>
<tr><td colspan="2" rowspan="8">Soil pit
  </td><td>General distribution</td><td>Mid to lower slopes and within concavities</td></tr>
<tr><td>Common terrain units</td><td>sxzCb
sxzCb-S</td></tr>
<tr><td>Dominant processes</td><td>Slow downslope creep; thermokarst subsidence; solifluction; slopewash</td></tr>
<tr><td>Drainage range</td><td>Imperfect to poor</td></tr>
<tr><td>Dominant slope range</td><td>Gentle to moderate</td></tr>
<tr><td>Permafrost</td><td>Typically ice-moderate and shallow</td></tr>
<tr><td>Other characteristics</td><td>Smooth surface; occurs on concave slopes; dominated by stunted spruce</td></tr>
<tr><td>Hazard considerations</td><td>Thermokarst subsidence; active layer detachments</td></tr>
</table>

4.1.6 Colluvial Complexes with Permafrost

Colluvial complexes (C1) occur mainly as blankets (b) and aprons (a), and represent an important, project-specific classification of terrain that occupies approximately 6% of the study area (**Figure 4-1, Table 4-8**). This terrain unit has a straight or concave profile and occurs on all aspects. Aprons and blankets predominantly occur in toe slope positions and lower-slope hollows, respectively. Commonly demarcating the upper limits of an apron is a conspicuous concave slope-break that typically coincides with an abrupt downslope reduction in soil drainage. In cross-section, aprons form a wedge, with the thickest portion in

the valley bottom and thinner material up-slope, while blankets generally conform to the underlying topography.

This terrain unit is well described by Huscroft (2002) as “colluvial eolian complexes”, owing to their complex sedimentology and origin, and represents the main occurrence of Klondike ‘muck’ (Tyrrell, 1917; Fraser and Burn, 1997). It is an aggradational landform, built up over time through the delivery of sediments from upslope by minor incremental and episodic colluvial and fluvial additions. These aprons consist of primary and redeposited loess, fluvial and slopewash sediments, bedrock-derived colluvium and organic material. Many, if not all, colluvial complexes are still active based on observation of the recent deposition of sediment and woody debris from upper valley sides.

The sedimentology of this terrain unit is highly variable, depending primarily on steepness and upslope drainage area. The slope of the aprons is an indicator of their internal composition. In general, colluvial complexes with gentler slopes in the lower portions of larger basins have higher silt and organic contents than slightly steeper ones in narrow headwater tributaries, where inclusions of mass movement deposits may be encountered (**Table 4-2**).

Aggradation of permafrost within the colluvial complexes generally kept pace with the deposition and accumulation of loess during the late Pleistocene (Fraser, 1995). A thick cover of mosses with high insulating value has enabled the permafrost to persist near-surface, even during the relatively warm Holocene. Surface organics in this terrain unit are relatively thick and commonly extend beneath the permafrost table. Soil drainage is imperfect to very poor, due to shallow or near-surface permafrost, loess-rich soil and gentle gradients.

This terrain unit typically contains ice-rich permafrost with ground ice in the form of excess pore ice, segregated seams and lenses, and massive bodies (Bond and Lipovsky, 2011). One such body of ground ice was observed during field reconnaissance in a recent placer mining excavation in a tributary to Maisy May Creek (**Photo 4-1**). Gentle colluvial complex aprons may have ice-rich permafrost up to 30 m thick, such as observed in boreholes within 20 km of the proposed mine area (J. Coates, Kryotek, 2015). Thermokarst activity occurs through both natural and anthropogenic disturbance in some of these ice-rich complexes.



Photo 4-1. Massive ice exposed by recent placer mining in a tributary to Maisy May Creek (2 m-long stadia rod for scale)

Table 4-8. Typical characteristics of colluvial complexes in the study area

<table>
<tr><td colspan="2">Map view
  </td><td colspan="2">Oblique aerial view
  </td></tr>
<tr><td colspan="2" rowspan="8">Soil pit
  </td><td>General distribution</td><td>Toe-slope position on all aspects</td></tr>
<tr><td>Common terrain units</td><td>xszC1a-Xt
xszC1b</td></tr>
<tr><td>Dominant processes</td><td>Thermokarst subsidence and thermal erosion</td></tr>
<tr><td>Drainage range</td><td>Imperfect to very poor</td></tr>
<tr><td>Dominant slope range</td><td>Gentle to moderate</td></tr>
<tr><td>Permafrost</td><td>Typically near surface and ice-rich</td></tr>
<tr><td>Other characteristics</td><td>Dominated by stunted spruce; contain Klondike ‘muck’</td></tr>
<tr><td>Hazard considerations</td><td>Thermokarst subsidence; slumping if debuttressed</td></tr>
</table>

4.1.7 Fluvial Landforms

Fluvial landforms, including channels and floodplains (FAp or Fp), terraces (Ft) and fans (Ff), occupy approximately 6% of the study area (**Figure 4-1**, **Table 4-9**). The characteristics of this terrain unit transition from headwater reaches to main branches. In headwater reaches within V-shaped valleys (i.e., first- to second-order streams), fluvial sands and subangular to subrounded clasts commonly veneer colluvial blankets. Along streams of intermediate size (i.e., second- to third-order streams), subrounded to rounded gravel forms the bed of the meandering channel, and banks may include sand and silt deposited during flood events. Floodplains are narrow and discontinuous. Along the largest meandering watercourses (i.e., third to fourth-order streams), bed material consists of rounded to well-rounded gravel and sand, and bank exposures indicate that the wide, continuous floodplains are composed of sand, silt and locally interbedded

organics. Organic deposits are commonly associated with broad floodplains alongside Yukon River and its major tributaries.

Fluvial terraces, commonly perched on bedrock terraces adjacent to some of the larger tributaries such as Indian River, Barker Creek and Coffee Creek, are a testament to the marked incision that occurred during the Pleistocene (Bond and Lipovsky, 2011). Many of these terraces are blanketed in loess and colluvium, making their recognition in the field challenging. However, the sharp break-in-slope formed by the terrace scarp is usually recognizable in aerial photographs and LiDAR-derived elevation models. Years of modification and downslope transport have resulted in a modification from planar to gentle slopes. The stream-deposited sediment in these fluvial terraces is generally a mixture of sand and rounded gravel.

Fluvial fans exist at the mouths of moderate to large tributaries, where they are less confined and channel gradients decrease abruptly. Where they exhibit steeper gradients than regular fluvial plains and terraces, they contain coarser-grained sand and gravel and less silt. Clasts may be subangular at the apices of the fans of small, steep drainages, due to the relatively short transport distance and duration. Some low-gradient fans exhibit similarities to the silt-dominated colluvial complexes describe above (Section 4.1.6).

Plains typically exhibit negligible slope with variable or no aspect, except along the bottoms of headwater tributaries with gentle to moderate slopes. The Stewart and Yukon rivers have the widest and most continuous fluvial plains within the region, but narrower, discontinuous fluvial plains also occur in association with its tributaries. In general, the width and continuity of fluvial plains increases proportionally with stream order (Strahler, 1952).

Most fluvial environments are subject to meander migration through progressive bank erosion or avulsion. Numerous oxbows alongside meandering streams indicate periods of instability; some enlarge through thermokarst processes. Areas of the floodplain farther from the active channel may be sufficiently stable that organic material can accumulate at the surface. Unless buried by flood sediments, these organics thicken and may promote the growth of underlying permafrost.

The depth to permafrost varies spatially and temporally within this terrain unit as a function of organic matter thickness and proximity to permanently flowing streams. Permafrost is generally absent or deep in frequently flooded sites, because an appreciable organic layer is unable to accumulate in areas prone to erosion and sedimentation. Sites with an intermediate flooding regime typically have no permafrost, or deep permafrost below the rooting zone of riparian vegetation. Stable terraces accumulate enough organics, which act as an insulator, that permafrost commonly aggrades (Viereck, 1973; Zoltai and Pettapiece, 1973).

Soils within this terrain unit are well drained in areas of active fluvial processes to very poorly drained in oxbows and areas of shallow or near-surface permafrost. An abrupt change in vegetation from a tall, dense canopy of trees to stunted or no trees commonly signifies the edge of shallow permafrost.

Table 4-9. Typical characteristics of fluvial landforms in the study area

<table>
<tr><td colspan="2">Map view
  </td><td colspan="2">Oblique aerial view
  </td></tr>
<tr><td colspan="2" rowspan="8">Soil pit
  </td><td>General distribution</td><td>Valley bottoms; elevated terraces</td></tr>
<tr><td>Common terrain units</td><td>zsgFAp-M
zsgFt</td></tr>
<tr><td>Dominant processes</td><td>Thermokarst subsidence; meandering</td></tr>
<tr><td>Drainage range</td><td>Well to very poor</td></tr>
<tr><td>Dominant slope range</td><td>Planar to gentle</td></tr>
<tr><td>Permafrost</td><td>Presence, ice content and depth vary depending on location</td></tr>
<tr><td>Other characteristics</td><td>May be interbedded with organic deposits on inactive floodplains</td></tr>
<tr><td>Hazard considerations</td><td>Thermokarst subsidence; meander migration</td></tr>
</table>

4.1.8 Glaciofluvial Terraces

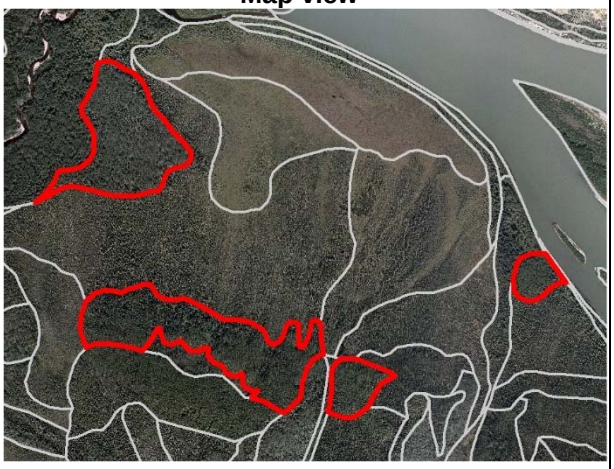
Glaciofluvial terraces (FGt) are rare within the study area, representing less than 1% (**Figure 4-1**, **Table 4-10**). They only occur above the modern Yukon River, which was filled to varying elevations with a braided meltwater channel through most of the Pleistocene glaciations. Glaciofluvial terraces are distinguished from fluvial terraces based on their landscape position, thickness and the inclusion of well rounded cobbles with lithologies foreign to the local watershed.

Glaciofluvial terraces can be identified both in aerial photographs and during helicopter fly-overs. Glaciofluvial sand and gravel overlies some of the rock benches alongside the modern Yukon River, which formed in response to its flow reversal (Tempelman-Kluit, 1980; Jackson et al., 2008). Colluviation from

upslope areas and along the terrace scarp has made the terrace forms almost unrecognizable (oblique aerial view in **Table 4-10**). The subtle slope-break and linearity in vegetation patterns are the key diagnostic characteristics.

Broader glaciofluvial terraces parallel the Yukon River at lower elevations. The Coffee Creek airstrip is built on a terrace less than 10 m above the modern river level. Its coarse sand and gravel base is overlain by a discontinuous veneer of fine-grained flood deposits and loess. Although glaciofluvial terraces tend to be well drained, permafrost was encountered during gravel extraction at a depth of about 5 m.

Table 4-10. Typical characteristics of glaciofluvial terraces in the study area

<table>
<tr><td colspan="2">Map view
  </td><td colspan="2">Oblique aerial view
  </td></tr>
<tr><td colspan="2" rowspan="8">Soil pit
  </td><td>General distribution</td><td>Elevated benches above the Yukon River</td></tr>
<tr><td>Common terrain units</td><td>zsgFGt</td></tr>
<tr><td>Dominant processes</td><td>Gullying</td></tr>
<tr><td>Drainage range</td><td>Moderate to well</td></tr>
<tr><td>Dominant slope range</td><td>Planar to gentle</td></tr>
<tr><td>Permafrost</td><td>Deep and ice-poor</td></tr>
<tr><td>Other characteristics</td><td>Typically contain rounded clasts of foreign lithology</td></tr>
<tr><td>Hazard considerations</td><td>Gully processes along terrace scarps</td></tr>
</table>

4.1.9 Organic Terrain

Organic terrain, defined by its flat surface and infilling of shallow depressions with organic material (mostly peat moss), occupies only about 1% of the study area (**Figure 4-1**, **Table 4-11**). It exhibits different thicknesses – veneer (<1 m; Ov), blanket (>1 m; Ob) and plain (variable; Op) – depending on micro-topography, drainage and local disturbance history. Organic terrain is most commonly mapped on inactive portions of floodplains and terraces alongside the major watercourses. In this landscape, nearly all surfaces have some accumulation of organics; however, thin veneers (x) were not mapped.

Table 4-11. Typical characteristics of organic terrain in the study area

<table>
<tr><td colspan="2">Map view
  </td><td colspan="2">Oblique aerial view
  </td></tr>
<tr><td colspan="2" rowspan="8">Soil pit
  </td><td>General distribution</td><td>Floodplains and valley bottoms</td></tr>
<tr><td>Common terrain units</td><td>eOp-Xt</td></tr>
<tr><td>Dominant processes</td><td>Thermokarst subsidence; inundation</td></tr>
<tr><td>Drainage</td><td>Poor to very poor</td></tr>
<tr><td>Dominant slope range</td><td>Planar</td></tr>
<tr><td>Permafrost</td><td>Typically shallow and ice-rich</td></tr>
<tr><td>Other characteristics</td><td>Surface water common</td></tr>
<tr><td>Hazard considerations</td><td>Thermokarst subsidence; flooding</td></tr>
</table>

Organic terrain is commonly underlain by fine-grained flood deposits, typically overlying fluvial sand and gravel. The degree of decomposition of organic material within the study area varies, but is dominantly relatively low. Fibric organics are most common, and used as the standard texture (**Table 4-11**).

Permafrost is ubiquitous with organic terrain. It is commonly near-surface (<0.4 m) or shallow (0.4 to 1 m), and ice-rich. Natural and anthropogenic thermokarst subsidence within wetlands indicate massive bodies of ice are likely present. Drainage is poor to very poor throughout organic terrain due to the shallowness of permafrost and topographic position.

4.1.10 Anthropogenic Disturbances

Anthropogenic disturbance from placer mining activity is widespread along the valleys of the larger tributaries, occupying approximately 6% of the study area (**Figure 4-1**, **Table 4-12**). The access road has been proposed along these valleys to avoid disturbing and potentially impacting other, more pristine terrain. The severity of disturbance ranges from the stripping of surface organics to complete excavation (mining) and displacement of surficial materials down to bedrock. Linear disturbances such as roads and minor surface disturbances such as ATV tracks were not discretely mapped.

Alterations to the ground thermal regime in association with placer mining are deliberate and intended to promote thawing of silt-rich shallow permafrost to allow mining of underlying fluvial gravels. The process of placer mining and tailings pile formation so drastically alters the thermal and hydrogeological properties of the materials that permafrost is unlikely to re-establish itself under current climate conditions.

Notwithstanding the widespread removal of permafrost in association with placer mining activity, remnant areas of ground with ice-rich permafrost may occur in some areas, especially underlying sections of valleys that were less severely disturbed. Numerous ponds amongst the placer tailings are generally inferred to be present and controlled by local groundwater, which flows readily through the permeable gravels, but some may be prone to enlargement through thermokarst subsidence and gullying (TT-EBA, 2016b,c).

The unreliability of interpretations of material properties and permafrost conditions within areas of anthropogenic disturbance precludes assignment of terrain stability, hazard or soil erosion potential classes. Field investigation is required to properly assess ground conditions and their implications for road alignment and design. Therefore, such areas have been excluded from interpretive mapping and depicted with a neutral hatch pattern without a label (Maps 1 to 3, **Appendices A** to **C**).

Table 4-12. Typical characteristics of anthropogenic disturbances in the study area

<table>
<tr><td colspan="2">Map view
  </td><td colspan="2">Oblique aerial view
  </td></tr>
<tr><td rowspan="8">Soil pit
(n/a due to variability)</td><td>General distribution</td><td>Valley bottoms and terraces</td></tr>
<tr><td>Common terrain units</td><td>A</td></tr>
<tr><td>Dominant processes</td><td>n/a</td></tr>
<tr><td>Drainage</td><td>n/a</td></tr>
<tr><td>Dominant slope range</td><td>n/a</td></tr>
<tr><td>Permafrost</td><td>Typically degraded due to disturbance; deep and potentially ice-rich where it remains</td></tr>
<tr><td>Other characteristics</td><td>Deciduous vegetation</td></tr>
<tr><td>Hazard considerations</td><td>Unpredictability requires site-specific investigation</td></tr>
</table>

4.2 Geomorphological Processes

A variety of geomorphological processes were mapped within the study area, including mass movement, erosional, fluvial and periglacial processes (Howes and Kenk, 1997). Subclasses of these primary processes were distinguished where necessary to more accurately represent different potential hazard characteristics and implications.

4.2.1 Rockfall (-Rb)

Rockfall is the rapid detachment, fall, rolling and bouncing of rock fragments (Hungr et al., 2014). Rockfall occurrences within the study area are restricted to bedrock bluffs (**Photo 4-2**) and steep colluvial slopes with bedrock outcrops. Active rockfall zones are recognized by the presence of an unweathered patch of bedrock bluff upslope and/or a pile of lichen-free rubbly debris at the base of the bluff. Rockfall is typically recurrent and most likely to occur during periods of freeze-thaw (frost shatter) or rapid and prolonged warming (thermal cracking).



Photo 4-2. Recent rockfall on bluff adjacent to proposed road alignment north of Stewart River

4.2.2 Debris Slides (-Rs)

A debris slide is the slow to rapid sliding of a mass of surficial material on a shallow, planar surface parallel with the ground (Hungr et al., 2014). Debris slides are distinguished from the more specific process of active layer detachment, which occurs only on slopes underlain by permafrost. Debris slides within the study area most commonly occur on steep, south-facing slopes at the over-steepened base of valley sides, typically in association with thin colluvial veneers.

4.2.3 Rock Slumps (-Fm)

A rock slump, or rotational slide, is the slow sliding of a mass of weak rock on a cylindrical or other rotational rupture surface that is not structurally controlled (Hungr et al., 2014). Rock slumps within the study area occur on slopes with and without permafrost, showing little relation to aspect or topographic characteristics. Rock slumps tend to occur as discrete, albeit slow, events, and they may advance upslope over time through retrogressive failures. Virtually all mapped examples of rock slumps appear old or dormant, and are likely no longer sensitive to disturbance. Occurring in areas without the potential to affect proposed infrastructure footprints, mapped rock slumps do not represent hazards to the project (as noted below in Section 5.3).

4.2.4 Rock Creep (-Fg)

Rock creep is the slow movement of angular debris under periglacial conditions (Howes and Kenk, 1997). Within the study area, rock creep occurs on the northerly shoulders of summits and ridges in subalpine to alpine settings with mostly ice-poor permafrost. It is recognized by a conspicuously irregular, undulating slope typified by patches of fresh talus amongst intact and weathered bedrock (**Photo 4-3**). Slopes prone to rock creep are likely only slightly sensitive to surface disturbance, due to their skeletal and typically ice-poor composition.



Photo 4-3. Henderson Ridge Road traversing a slope exhibiting rock creep

4.2.5 Gullying (-V)

Gullying is the modification of unconsolidated (surficial material) and consolidated (bedrock) surfaces by various processes such as surface runoff, mass movement and snow avalanching, resulting in the formation of parallel and sub-parallel long, narrow ravines (Howes and Kenk, 1997). The gullying process has been applied to terrain units (polygons) that exhibit such morphology to an extent that distinguishes them from surrounding, more uniform slopes. Gullies occur in all surficial materials and on bedrock slopes, typically elevating the potential for instability. Most gullies are formed through fluvial incision over millennia and, in this semi-arid, unglaciated setting, are not subject to debris flows (except in association with active layer detachments on slopes underlain by permafrost). The most conspicuous gullies are delineated on the maps with line symbols.

4.2.6 Solifluction (-S)

Solifluction is the slow, gravitational downslope movement of saturated, non-frozen overburden across a frozen or otherwise impermeable substrate. More accurately, in this study area, gelifluction is the form of solifluction that has been mapped due to the movement of material within the active layer on the permafrost table. Solifluction occurs most commonly on convex northerly slopes veneered or blanketed in colluvium in subalpine or alpine environments within the study area (**Figure 2-4**). The solifluction lobes that typify this form of mass movement may comprise silty material rich in organics or clast-rich material bound together by ground ice. Solifluction slopes have generally been mapped as having ice-moderate, shallow permafrost.

4.2.7 Active Layer Detachments (-Xf)

An active layer detachment, referred to more generically for mapping purposes by Howes and Kenk (1997) as a thaw flow slide, is a shallow form of debris slide that occurs within the active layer on top of the permafrost table (**Photo 4-4**). Active layer detachments typically occur in response to intense or prolonged rainfall or snowmelt, high air temperatures, or surface disturbances (e.g., wildfire, windthrow, anthropogenic ground alteration). Active layer detachments exhibit widespread coverage throughout the study area, but are restricted to initiation on slopes underlain by permafrost. They initiate on gentle to steep slopes, commonly just above a convex roll much like a snow avalanche. They have runout distances of up to several hundreds of metres and can transport woody vegetation and underlying colluvial material from ridge shoulders to slope-toe aprons. Following their initial occurrence, permafrost exposed on their sliding surface begins to thaw, and the active layer thickens. Continued slides, flows and gullying are common, until active layer thickening ceases. The headscarps of active layer detachments may migrate retrogressively upslope through gradual thawing and sloughing. The paths of former active layer detachments are commonly recognized by the anomalous stripe of deciduous trees (e.g., alder, birch) that colonize above the locally depressed permafrost table.

Terrain units (polygons) that exhibit a history of active layer detachments are assigned this process label (-Xf); discrete failures are also delineated with line symbols. Retrogressive thaw flows, also known as retrogressive thaw slumps (**Figure 3-2**), are commonly initiated by small active layer detachments and have been mapped with line symbols due to their small size within the study area.



Photo 4-4. Active layer detachments on recently burned east valley side of Barker Creek

4.2.8 Thermokarst Subsidence (-Xt)

Thermokarst subsidence is the formation of ground-surface depressions created by the thawing of ice-rich permafrost and associated soil subsidence (Howes and Kenk, 1997). Terrain units (polygons) inferred to have ice-moderate or ice-rich permafrost are generally susceptible to thermokarst, although the form and severity of such thermokarst also depends on material properties, depth to permafrost and the form of ground ice. The melting of massive ice bodies produces the most conspicuous thermokarst depressions, which may or may not contain standing water. Thermokarst occurs naturally, such as in response to windthrow or wildfire, but is accelerated through anthropogenic disturbance to surface organic cover and drainage patterns. Thermokarst subsidence is most common on planar to gentle slopes, but can occur on moderate slopes. Discrete thermokarst subsidence features, whether or not filled with water, are mapped using point symbols.

4.2.9 Thermal Erosion (-Xe)

Thermal erosion is the process of gully formation initiated by heat transfer from water bodies, typically flowing streams, to underlying permafrost. Thermal erosion can also occur due to heat transfer along the shorelines of standing water bodies. Thermokarst gullies are commonly distinguished by anomalously low width-to-depth ratios, indicative of relatively rapid incision into ice-moderate or ice-rich permafrost, and tension cracks along the crests of their side walls. Trees growing along the edges of such gullies gradually tilt inward toward the gully; straight trunks that have not had an opportunity to adjust their growth habitat

upward are indicative of relatively rapid gully enlargement (**Photo 4-5**). Retrogressive erosion of thermokarst gullies is common and can lengthen gullies that initiate on over-steepened slope toes by orders of magnitude upslope. Within the study area, thermokarst gullying is most commonly associated with ice-rich colluvial complexes and ice-moderate colluvial blankets. Natural and anthropogenic alterations in surface runoff patterns, especially where surface runoff becomes concentrated, can trigger thermokarst gullying. Significant thermokarst gullies are mapped using line symbols.



Photo 4-5. Thermokarst gully with inward-tilting trees on collapsing sidewalls

4.2.10 Slopewash (-Xs)

Slopewash, sometimes referred to as sheetwash, is the mobilization and redistribution of fine material by water flowing down the surface or within the shallow subsurface of smooth slopes that are typically underlain by permafrost. Slopewash exhibits widespread occurrence in permafrost terrain, but is most prevalent on slopes demarcated by downslope, parallel to sub-parallel runnels also known as water tracks. Such slopes that are distinguishable on the basis of these runnels have been mapped with this process label (-Xs) (**Figure 2-4**). The runnels are readily distinguished by the growth of dwarf willows, which contrast with surrounding dominance of dwarf birch. The concentration of surface runoff in slopewash runnels leads to local depression of the permafrost table, which in some cases can trigger thermokarst gullying. Slopewash runnels require consideration in drainage management strategies along roadways, as their thicker active layer allows seepage to continue well into winter, when icing can occur.

4.2.11 Pingo (-Xn)

Pingo development, in an 'open system' in this study area, is the process by which groundwater discharge (seepage) through permafrost freezes and accumulates at or close to the ground surface, forming an ice-cored and earth-covered mound (**Figure 2-4**). Intact and collapsed pingos, typified by a small pond enclosed by a hummocky rampart, are scattered throughout the study area and the broader Klondike Plateau region. They range in size from only several metres in diameter and less than a metre high, to several tens of metres in diameter and roughly ten metres high. They occur most commonly in the narrow valley bottoms of headwater tributaries infilled with silt-rich colluvium. The conditions that allow pingos to form – a continuous source of groundwater upwelling beneath and through permafrost – are best avoided by road construction. Pingos provide definitive evidence of locally ice-rich permafrost.

4.2.12 Meander Migration (-M or -I)

Much of the existing and proposed access road follows valley bottoms with meandering streams (-M) or irregularly sinuous channels (-I) and crosses the lowermost reaches of headwater drainages. Stream channels adjust their planform geometry naturally through bank erosion and meander processes including loop extension, down-valley migration and cut-off (avulsion). Where existing or proposed sections of road encroach within the meander belt of rivers and their major tributaries within the study area, they may be exposed to meander migration hazard. The rate of progression of meanders depends on a variety of factors, including stream power (a function of discharge and slope), meander geometry (e.g., radius of curvature) and the composition and topography of bank areas. Anthropogenic disturbances can accelerate bank erosion through perturbations to natural channel patterns. Segments of the proposed road centreline potentially subject to meander migration processes are identified in the mapping of terrain stability and hazards (Map 2, **Appendix B**).

5 Terrain Stability and Hazards

5.1 Terrain Stability

As discussed in Section 3.2.2, each polygon was attributed with an 'existing' or 'disturbed' stability class. The terrain stability mapping (Map 2) in **Appendix B** reveals that the majority (70%) of the study area has an existing terrain stability class[7] of 'generally stable' (Class II) (**Figure 5-1**). This is expected given the gentle to moderate slopes that predominate on lower valley sides and in uplands. Approximately 8% of the study area is considered 'potentially unstable' (Class IV, 1%) or 'unstable' (Class V, 7%), mostly represented by steep, gullied slopes and areas of permafrost with visible (excess) ground ice already exhibiting thermokarst activity.

The disturbed terrain stability class is defined in terms of the worst case scenario of ground disturbances in association with conventional cut-and-fill road construction, without any mitigation measures to address potential instabilities related to permafrost or sidecast on steep slopes. This allows for the establishment of improved baseline references, and better highlights areas that warrant special design consideration. This approach for communicating terrain hazard conditions enables engineers responsible for designing the mine facilities and access road to make more informed and site-specific decisions about appropriate construction techniques. Furthermore, it allows project risk assessments to be specifically tailored to different circumstances.

According to the disturbed terrain stability class, the proportion of terrain stability polygons with a 'generally stable' (Class II) rating drops from 70% (existing) to 33% (disturbed) (**Figure 5-1**). Many of these polygons become 'generally stable with minor potential for instability' (Class III, 30%) or 'potentially unstable' (Class IV, 16%) if disturbed without mitigation. This notable increase in terrain stability class reflects the sensitivity of permafrost terrain to active layer detachments and/or thermokarst following disturbance. The 13% areal coverage of 'unstable' (Class V) polygons in the disturbed condition is largely attributable to enhanced potential for thermokarst subsidence or gullying in areas with ice-rich permafrost.

The distinction between existing and disturbed terrain stability classes allows accurate representation of potential upslope (e.g., active layer detachments) or downslope (e.g., thermokarst gullying) hazards that are unaffected by proposed infrastructure footprints. This format of mapping distinguishes natural hazards, which may be triggered by occurrences such as wildfire, from those potentially exacerbated or initiated by project-related disturbance. For example, a particular polygon crossed by the proposed road may have a disturbed terrain stability class of IV (potentially unstable). Its existing terrain stability class, however, may only be II (generally stable). Therefore, the potential hazard posed by terrain conditions within this polygon could be recognized as being appreciably lower if the road passes beneath it than if it actually crosses it.

[7] The existing terrain stability class is included in the label, as shown in the legend, but the polygons are colour-symbolized according to the disturbed terrain stability class.

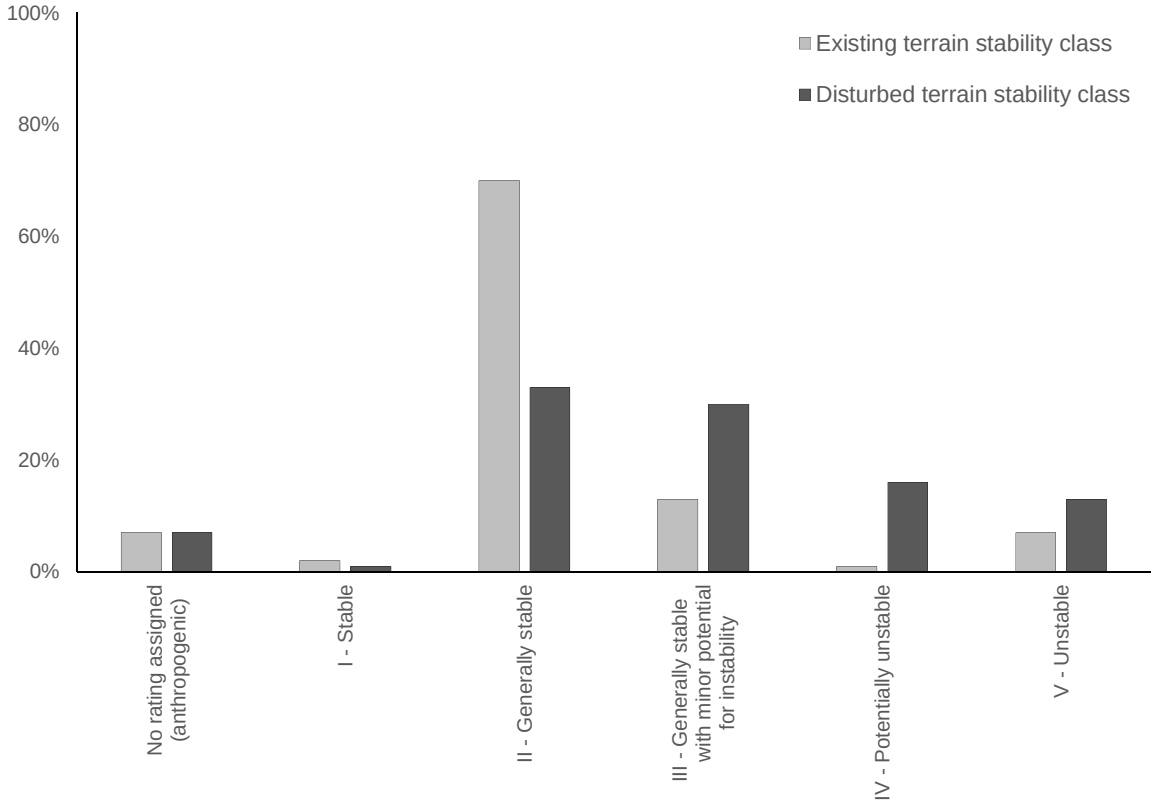


Figure 5-1. Histogram of existing and disturbed terrain stability classification in the study area

5.2 Hazards Overview

The mapping of terrain (Map 1, **Appendix A**) and terrain stability and hazards (Map 2, **Appendix B**), together, identify various forms of hazards through the assignment of geomorphological process codes (polygon-scale) and discrete geomorphological processes (point or linear features) in addition to the actual terrain stability classes. **Table 5-1** outlines the likelihood and potential magnitude of hazard occurrence over the mine life, generalized according to each of the identified hazards with the potential to affect proposed project infrastructure footprints[8]. Project considerations are also included in order to better communicate the implications of different processes for infrastructure design and future maintenance requirements. A geographic breakdown of hazard distribution within each of the 14 study area sections identified in **Figure 1-1** is provided in **Table 5-2**, followed by a descriptive summary of hazard distribution within main physiographic settings in sections 5.3.1 to 5.3.3.

[8] Only terrain characteristics and processes that may pose hazards to project infrastructure footprints are considered in this and following sections; rock slumps, which have only been mapped well beyond areas of proposed infrastructure (Map 1, **Appendix A**), are excluded.

Table 5-1. Generalized characteristics and considerations for hazards with the potential to affect proposed project infrastructure footprints

Hazard	Likelihood (over mine life)	Magnitude	Project considerations
Rockfall	High – typically recurrent and frequent, where present; freshness of talus at base of bluff indicative of recency	Moderate – generally small in volume, but rapid and dense	Plan for rockfall below bluffs, especially in areas of fresh deposits (avoid or mitigate), and on steep slopes with small bedrock outcrops
Debris slide	Moderate – most likely to occur on steep slopes exhibiting history of debris sliding, especially within or adjacent to recent scars	High – generally small to moderate in volume, but rapid and moderately dense	Avoid debris slide slopes and runout zones
Rock creep	High – periodic movement expected; freshness of patches of rock debris indicative of recency	Low – small volume, short distance, slow movements of angular rock debris	Expect increased maintenance and allow for minor settlement and shifting of rock debris
Gullying	High – periodic and localized gully erosion processes (e.g., fluvial incision, side wall mass wastage)	Low – generally incremental and localized incision, and minor surface sloughing	Minimize crossings of gullied slopes, especially where underlain by permafrost, and expect increased maintenance
Solifluction	High – near-continuous, incremental movement	Low – small volume, short distance, slow movements of silt-rich debris	Expect increased maintenance and allow for minor settlement and shifting of surficial material
Active layer detachment	Moderate – most likely to occur on recently disturbed or burned slopes, slopes with previous failures (including within existing scars), or in steep and/or gullied terrain especially downslope of any sites of newly concentrated surface runoff	Moderate – small to moderate in volume; generally rapidly transports organic-rich surficial material tens to hundreds of metres downslope	Avoid slopes that exhibit a history of active layer detachments, or otherwise accommodate their possible occurrence, minimize disturbance to surface organics and drainage, and expect increased maintenance for debris removal
Thermokarst subsidence	Moderate – gradual or periodic settlement, especially in areas of ice-rich permafrost	Low – isolated, slow deepening of ground surface depressions, formation and expansion of ringing tension cracks, and possible slow, inward slumping	Minimize disturbance to surface organics and drainage in areas of ice-moderate to ice-rich permafrost through appropriate gravel embankments/pads and water management, and expect increased maintenance that could involve localized road reconstruction; consider monitoring settlement
Thermal erosion	Moderate – gradual or periodic incision, especially in areas of ice-rich permafrost	Low – localized, slow, commonly retrogressive incision of rills or gullies, formation and expansion of adjacent tension cracks, and possible slow, inward slumping	Avoid or minimize concentrating surface runoff in areas of ice-moderate to ice-rich permafrost, especially into pre-existing gullies, and expect increased maintenance that could involve localized road reconstruction; consider monitoring incision
Slopewash	High – seasonal slopewash and transport of fine sediments within runnels; near-continuous seepage	Low – localized, slow transport of fine sediments, and seepage and icing especially in runnels	Accommodate seepage-induced icing accumulation especially within intercepted runnels, expect increased maintenance due to fine sediment delivery adjacent to road, and manage downslope drainage
Pingo	High – continuous upwelling and freezing of groundwater through permafrost forming ice-cored mound(s)	Moderate – isolated, slow heaving (growth) or subsidence (melting) of ice core, with potential for ringing tension crack formation and expansion, and possible slumping	Avoid the limits and immediate vicinities of pingos, due to the potential for long-term and locally severe ground instability if disturbed
Meander migration	High – episodic erosion of banks, mainly along the outside of meanders, in association with high flow events	Moderate – destabilization of road by incremental erosion or undercutting and slumping	Accommodate natural meander migration processes, where possible, by maintaining setbacks appropriate to the site; otherwise, proactively protect the road from erosion using appropriately sized riprap or alternative measures
Icing	High – annual formation of ice (aufeis), mainly in streams and seepage areas, from as early as October to as late as June	Low – incremental, seepage-induced accumulation and persistence of ice (aufeis) with maximum thicknesses of up to several metres and typical widths of tens of metres	Each year, accommodate at least six months of seepage-induced icing accumulation and persistence, especially at stream and slopewash runnel crossings, and across low-lying floodplains, and plan for associated maintenance

Note: Hazards within the broader study area but without the potential to affect proposed project infrastructure footprints (e.g., rock slumps) are not included

Table 5-2. Geographic distribution of hazards with the potential to affect proposed project infrastructure footprints

Geographic section (as identified in Figure 1-1)	Associated map sheets (Appendices A & B)	Hazard process with potential to affect project infrastructure footprints											Special considerations (mapping polygon ID referenced in parentheses)
		Rockfall	Debris slide	Rock creep	Gullying	Solifluction	Active layer	Thermokarst	Slopewash	Pingo	Meander migration	Icing	
Hunker Creek Valley[c]	1-4						x	x			x	x	Narrow section of valley with instability above road alignment (4446)
King Solomon Dome Area[u]	4-6					x		x	x			x	
Sulphur Creek Valley[c]	6-10							x			x	x	Tributary crossing affected by severe thermokarst gullying and icing (3993); parts of road along Sulphur Creek valley that cross ice-rich aprons have caused downslope thermokarst gullying
Indian River Valley[r]	10-12				x			x			x	x	
Eureka Creek Valley[c]	12,13							x			x	x	
Henderson Ridge Area[u]	13-18			x				x				x	
Maisy May Creek Valley[c]	18-21		x				x	x			x	x	Debris slide affecting road alignment (1681)
Stewart River Crossing[r]	21,22	x			x			x			x		
Barker Creek Valley[c]	22-25						x	x			x	x	Tributary crossing affected by severe thermokarst gullying and icing (1310,1311)
Barker-Ballarat Divide Area[u]	25,26						x	x	x			x	
Ballarat Creek Valley[c]	26-28		x					x		x	x	x	Debris slides initiated above road alignment (1681); road alignment very close to pingo (1598)
Yukon River Crossing[r]	28,29	x	x		x			x			x		Active rockfall and rock slides above road alignment (1816)
Latte-Yukon Divide Area[u]	29,30, 31						x	x					
Mine Area[u]	31,32	x	x	x	x	x		x	x				

Notes:

Physiographic setting indicated by lower-case letter superscript: [u] = upland; [c] = creek valley; [r] = river valley

Thermokarst includes subsidence and related gullying

Hazards within the broader study area but without the potential to affect proposed project infrastructure footprints (e.g., rock slumps) are not included

5.3 Slope Failure and Thermokarst

As discussed in Section 3.4.1, each polygon was more broadly categorized according to its dominant potential hazard – slope failure, thermokarst or both – in order to highlight those areas where thermokarst activity is possible in addition to default instability related to slope failure. This hazard category is not intended to represent the existing or imminence of thermokarst (or slope failure); its aim is to rule out certain areas from the possibility of thermokarst activity. 'Thermokarst potential' dominates the applicable hazard category within approximately 15% of the study area (**Figure 5-2**). Such areas are generally characterized by planar to gentle topography with ice-moderate or ice-rich permafrost. The potential for thermokarst outweighs the remote possibility of slope failure in these areas. Approximately 4% of the study area has been categorized co-dominantly with 'slope failure and thermokarst potential'. Such areas are distinguished from those dominated only by thermokarst potential by their slope class of moderate (class 3) or higher. A category of 'slope failure potential dominant' applies to all other areas (74%), except anthropogenic and open water areas (not applicable, 7%), irrespective of the possibility of slope failure (e.g., fluvial plains).

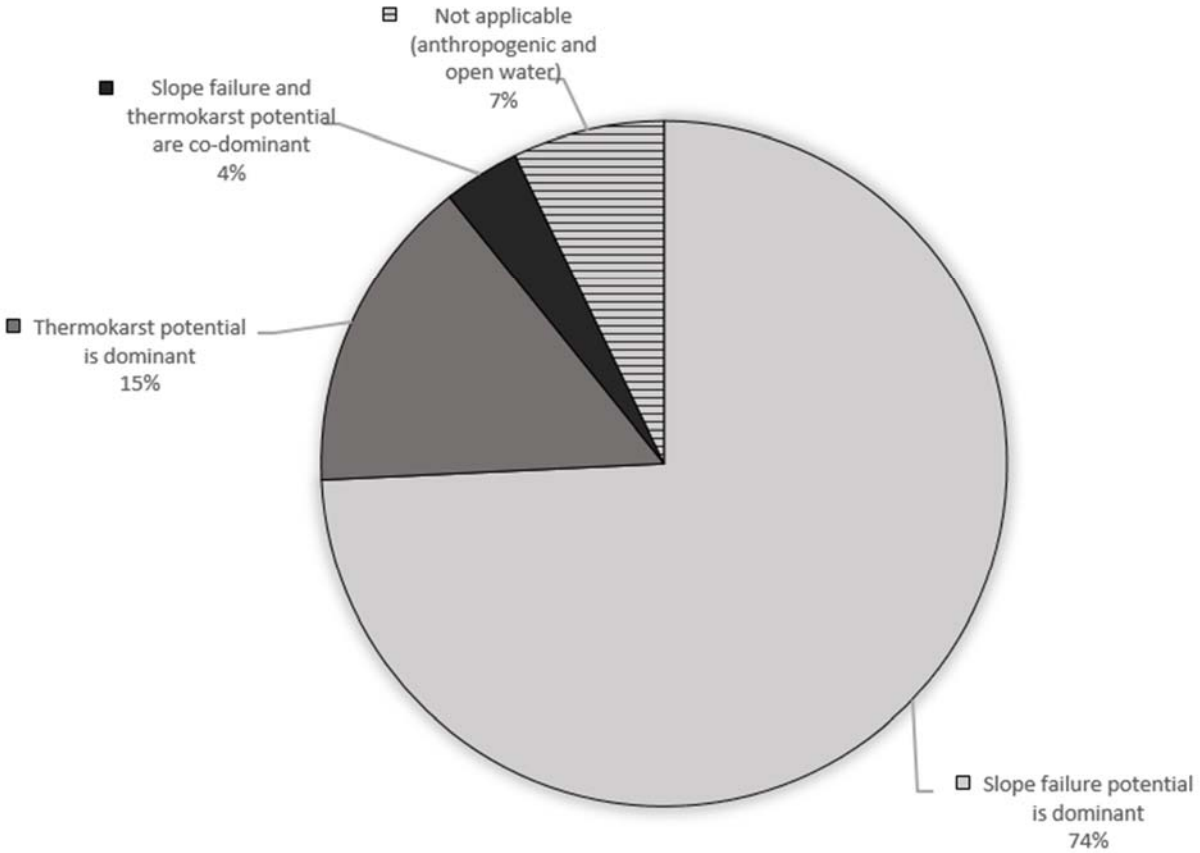


Figure 5-2. Areal proportion (%) of applicable hazard categories in the study area

The distribution of terrain hazards within and immediately surrounding the footprints of proposed project infrastructure is characterized below in relation to three physiographic settings: uplands (Section 5.3.1), creek valleys (Section 5.3.2) and river valleys (Section 5.3.3). A geographic breakdown (based on the sections defined in **Figure 1-1**) of the dominant geomorphological processes that may pose hazards to the footprints of proposed project infrastructure, including any special considerations, is provided in **Table 5-2**. This inventory specifically considers hazards with the potential to affect the footprints of proposed road or mine facilities due to their relative proximity and position. Hazards may affect the footprints locally (e.g., thermokarst subsidence), upslope (e.g., active layer detachment running out into or across footprint) or downslope (e.g., retrogressive erosion of thermokarst gullies) of the footprints. Hazards within the broader study area but without the potential to affect the proposed project infrastructure are not included.

5.3.1 Uplands

Uplands encompass summits, ridges and spurs that are generally composed of weathered and intact bedrock with colluvium in ridge-shoulder and upper-slope positions. Summits composed of granitic bedrock commonly exhibit tors, while metamorphic units generally form rounded smooth surfaces. Loess-derived colluvium becomes trapped within depressions and saddles along ridges resulting in a veneer of silt-rich colluvium. The fine-grained nature of these deposits commonly preserves permafrost with moderate ice content. Thermokarst subsidence is likely if disturbed. Rockfall commonly occurs from tors and steep-sided bedrock summits; however, no immediate rockfall hazards have been identified adjacent to the proposed road alignment in this physiographic setting. In general, uplands pose minimal hazards to infrastructure.

The following sections of the study area (**Figure 1-1**) exhibit terrain units, processes and hazards associated with upland settings:

- King Solomon Dome Area
- Henderson Ridge Area
- Barker-Ballarat Divide Area
- Latte-Yukon Divide Area
- Mine Area

5.3.1.1 Proposed Mine Facilities

A brief characterization of the specific terrain conditions and hazards in the vicinity of each of the main proposed mine facilities (Maps 1 and 2 in **Appendices A** and **B**, respectively) is provided below:

- **Open pit** – The open pit straddles the drainage divide separating the headwaters of Halfway Creek (north) and “Latte Creek” (south). It will be excavated mainly within terrain units in summit, ridge and spur settings, and will extend into colluvial veneers slopes with a southerly aspect. Most of the pit limits are within terrain with deep, ice-poor permafrost, which has little effect on ground stability or the ultimate rim of the pit. Portions of the pit will extend onto slopes with active rock creep (similar to solifluction) (northern limit), ice-moderate permafrost (western limit) and gullied terrain

(southern limit). Care will need to be taken in managing surface runoff and designing the rim of the pit in such areas, to avoid retrogressive gullying and settlement of the thin overburden cap.

- **Waste Rock Dumps** – Kaminak is proposing to dump waste rock in three primary areas known as the west, south and north waste rock storage facilities (WRSFs), and in a smaller dump farther west:
    - The West WRSF is proposed on a laterally-convex hillside veneered with colluvium above upper Halfway Creek. Permafrost is interpreted to be continuous throughout the area encompassing this facility, but ice-poor and shallow to deep. The southwestern portion of the facility extends into a terrain unit subject to minor gullying and a fringing colluvial complex blanket with shallow, potentially ice-rich permafrost. The design of the lower toe of the West WRSF will need to consider the possibility of several metres of ice-rich permafrost in the draw at its southwestern limit.
    - The South WRSF is proposed to fill the upper portion of a small, first order tributary valley with an overall southerly aspect. The design of this facility will require careful planning and site preparation, as the western valley side has shallow, ice-moderate permafrost, although slopewash is the only active geomorphological process mapped. The eastern valley side exhibits subdued gullies with permafrost suspected in some of their lower portions.
    - The North WRSF is proposed to partly fill a moderately sloping, north-facing headwater basin. Although most of the footprint is within colluvial veneer terrain units, some areas have thicker colluvium and all have permafrost, some of which is ice-moderate. Site preparation will need to be conducted carefully given the localized potential for thermokarst, rock creep and slopewash.
    - A much smaller, unnamed waste rock dump is proposed on an east-southeasterly aspect opposite the West WRSF. It is situated mostly on weathered bedrock or a colluvial veneer with shallow to deep, ice-poor permafrost, except at its southern limit where it extends into the bottom of a draw infilled with fluvial and colluvial material that may contain some ground ice at depth.
- **Heap Leach Facility (HLF) Area** – The HLF Area, which includes the heap leach pad and event pond, is proposed to be situated on a gentle, broad ridge separating the headwaters of Halfway Creek and “Latte Creek”. The footprint is dominantly within weathered bedrock that transitions to gentle colluvial slopes along its margin; permafrost is shallow to deep and mostly ice-poor. Small portions of the footprint exhibit evidence of solifluction and related rock creep, which will need to be factored into the design. The northwestern corner of the footprint extends onto a gentle colluvial blanket inferred to have ice-moderate permafrost. A small active layer detachment occurred recently on this gentle slope.
- **Stockpiles** – Two main ore stockpiles are proposed, mainly on rounded ridges or their shoulders. The eastern stockpile is situated on the shoulder of a rounded ridge, where permafrost is inferred to be shallow but ice-poor. The stockpile immediately north of the HLF straddles a colluvial veneer exhibiting evidence of solifluction and a colluvial blanket dissected by a headwater draw with minor fluvial deposits, all of which is inferred to be underlain by ice-moderate permafrost. Solifluction is a slow (mm to cm/yr) process through which material moves downslope on the permafrost table, but its presence warrants consideration in the site preparation for this stockpile.

- **Plant Site Area** – The processing plant is proposed on the crest of a broad, near-level section of ridge dividing Halfway Creek and "Latte Creek". The ground is a veneer of weathered bedrock and colluvium, with shallow to deep, ice-poor permafrost. There are no significant stability concerns within its footprint.

5.3.2 Creek Valleys

Creek valleys can be divided into valley side and valley bottom positions. Valley sides are dominantly composed of colluvial mantles. Convex slopes are typically mantled by veneers, whereas convex slopes are mantled by blankets. Draws occurring on valley sides typically contain colluvial blankets overlain by a veneer of fluvial material. On southerly aspect slopes (i.e., permafrost free), the dominant hazards are associated with rockfall, debris slides and gullying. Northerly aspect slopes (i.e., permafrost) are prone to active layer detachments, especially after fire or anthropogenic disturbance. Downslope movement of material may also occur through solifluction and slopewash. Draws are susceptible to thermokarst subsidence and may pose an icing hazard when roads are constructed across them.

Creek valley bottoms are typified by colluvial complexes that overlie fluvial deposits, active and inactive fluvial deposits with varying amounts of organic covers, and anthropogenic material. Disturbance of colluvial complexes without explicit regard for the protection of ice-rich permafrost may trigger thermokarst subsidence or gullying. Steeper complexes may additionally be susceptible to active layer detachments. Active fluvial units may be subject to bank erosion and meander migration. Fluvial units covered by organics can have significant amounts of ground ice, making them susceptible to thermokarst subsidence.

The following sections of the study area (**Figure 1-1**) exhibit terrain units, processes and hazards associated with creek valley settings:

- Hunker Creek Valley
- Sulphur Creek Valley
- Eureka Creek Valley
- Maisy May Creek Valley
- Barker Creek Valley
- Ballarat Creek Valley

5.3.3 River Valleys

River valleys are distinguished from creek valleys based on their larger size (width and depth) and more benched topography. Similar to creek valleys, river valleys can be separated into valley sides and bottoms. Valley sides are typically high and locally steep. Southerly aspects are prone to rockfall, rock slides, debris slides and gullying. Active layer detachments can occur on slopes with northerly aspects, although such hazards are not posed to proposed infrastructure footprints.

River valley bottoms are dominantly composed of wide fluvial plains, large fans aggraded from the mouths of tributaries, and colluvial complexes. Thick organic deposits and organic mantles are common on flood plains and fans, and typically signify ice-rich permafrost and increased potential for thermokarst subsidence or erosion. Fluvial deposits in the toe-slope position are commonly overlain by ice-rich colluvial complexes and are also at risk of thermokarst subsidence or erosion. Fluvial deposits closer to the rivers do not typically contain extensive permafrost and are not susceptible to subsidence; however, they may be subject to bank erosion.

The following sections of the study area (**Figure 1-1**) exhibit terrain units, processes and hazards associated with river valley settings:

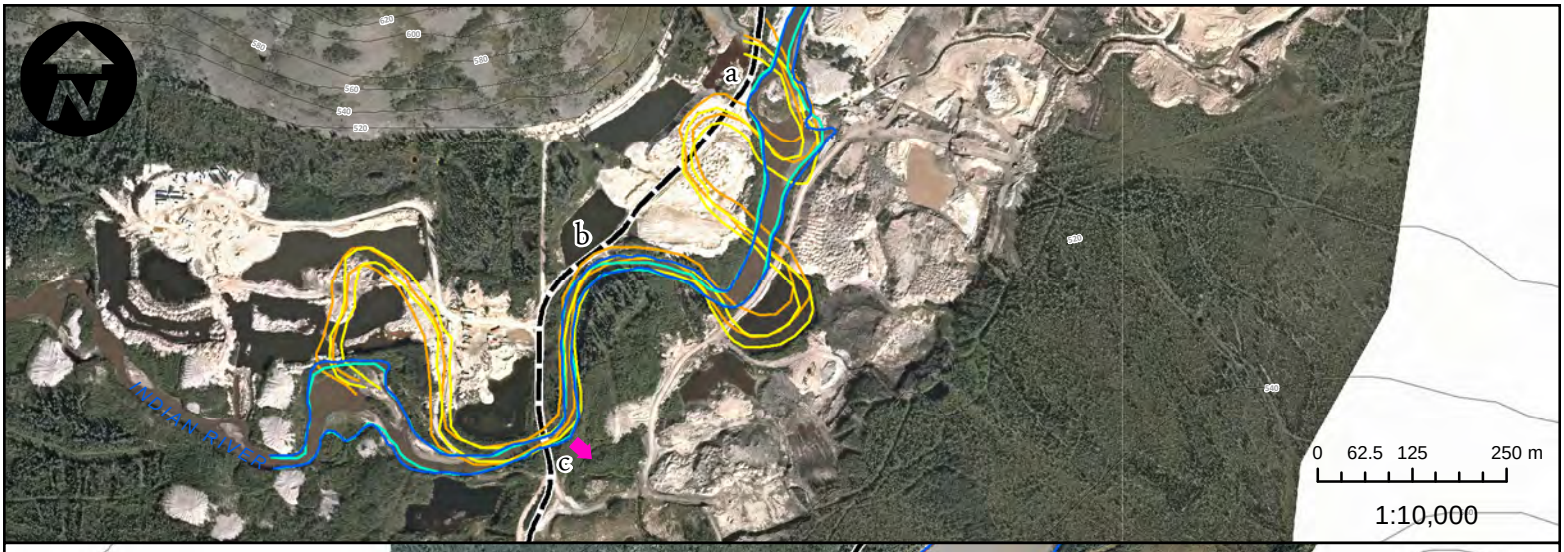
- Indian River Valley
- Stewart River Crossing
- Yukon River Crossing

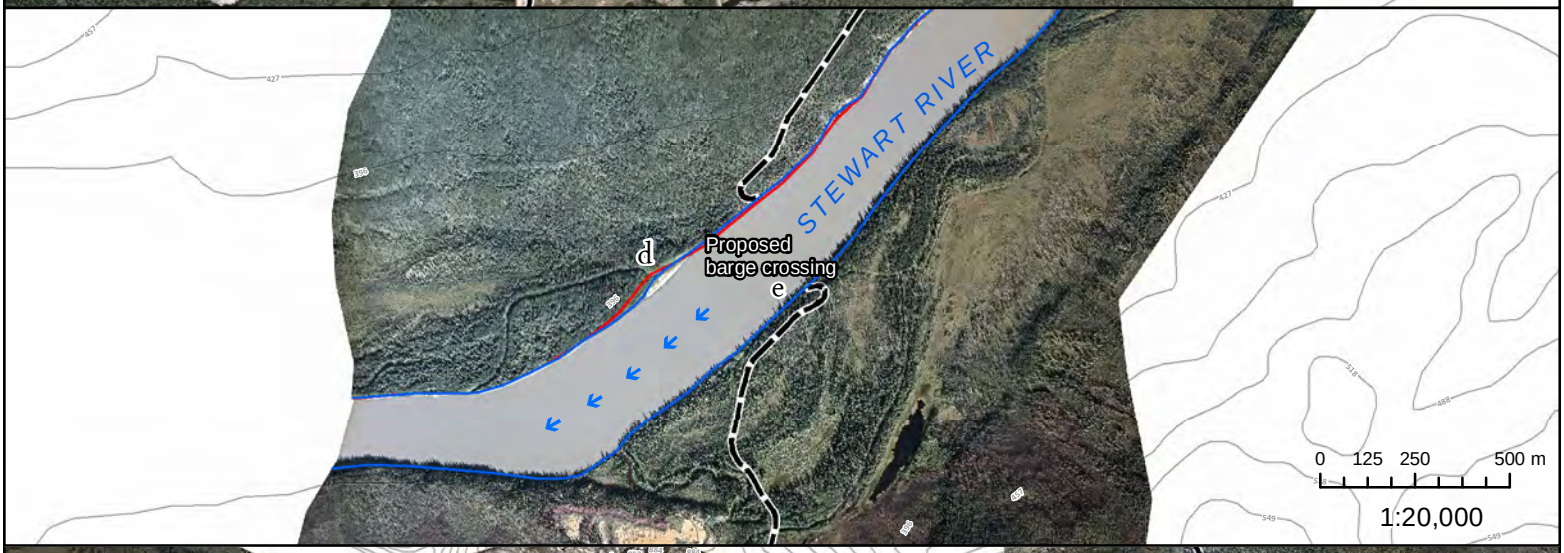
5.4 Meander Migration

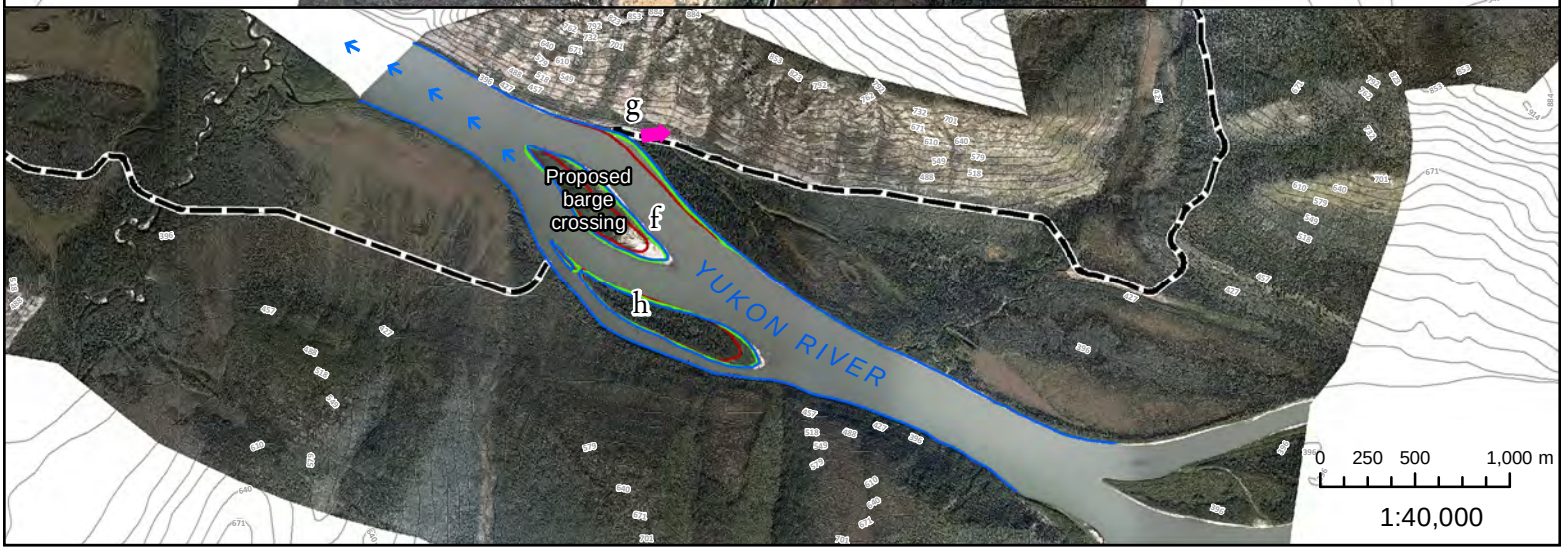
A total of 44 meander-road encroachment sites constituting meander migration hazards were identified along the proposed access road (Map 2, **Appendix B**). Some of these sites already exhibit undercut and collapsing road embankments in need of maintenance and erosion protection. The results of the more detailed assessments of each of the three river crossings are provided in the following sections and in **Figure 5-3**.

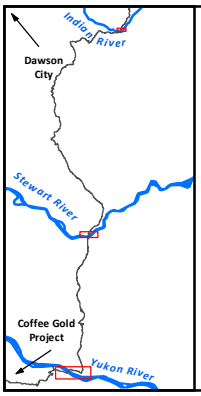
5.4.1 Indian River Bridge

Indian River exhibits a tortuous meander pattern within a broad, flat valley with widespread disturbance from placer mining (**Figure 5-3**). Its meander pattern in the vicinity of the existing bridge crossing was altered sometime between 1977 and 2009 through local channel realignment, presumably to accommodate different stages of placer mining within the valley bottom. The river encroaches alongside the existing road at two locations upstream of the crossing (a and b in **Figure 5-3**), where previous riprap placement or maintenance appears to have inhibited erosion of the road embankment. The historical channel overlays at these two locations do not indicate any systematic migration of the meanders. Immediately upstream of the crossing, at the apex of another meander (c in **Figure 5-3**), the historical channel overlays reveal bank erosion occurring with a southeastward trajectory at an average rate of 0.3 m/yr (between 1961 and 2015). Without intervention, this trend could result in undermining or outflanking of the southern abutment of the existing bridge. The position, span and abutment protection of the crossing structure should account for the erosion hazard posed by this actively migrating meander. An allowance should also be made for flooding and scour caused by ice jam failure.









Legend

- Road centreline (includes existing and proposed sections)
- ~30 m topographic contour
- Meander trajectory
- a Locations referenced in the report

River banks (year)

- 1948
- 1949
- 1961
- 1977
- 2004
- 2009
- 2010
- 2015

COFFEE GOLD PROJECT
River Meander Migration Hazards

Original page size: 8.50 x 11.00 in

Meander delineation completed by R. McKillop and C. Brown using softcopy photo-interpretation.
Base mapping from Geomatic Yukon (http://www.geomaticsyukon.ca/data)

Project number: 13103

Projection: UTM Zone 7
Datum: NAD 1983
Units: metre

Figure 5-3

KAMINAK GOLD CORPORATION

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Drawn by: CEB Checked by: RM 18/03/2016

Document Path: C:\Eng\net\Shared\Projects\Active\1310 - Kaminak Gold Corp\13103 - Coffee TSM\Programs\Meander migration hazard\Figure 5-3.mxd

5.4.2 Stewart River Barge Crossing

Stewart River exhibits a sinuous channel pattern in the vicinity of its proposed barge crossing, immediately upstream of the confluence with Barker Creek (**Figure 5-3**). The northern bank is defined by a relatively stable bedrock bluff east of the proposed northern barge landing. The amount of bank erosion suggested by the historical overlay analysis is negligible and within the error of georeferencing the historical aerial photographs on which the overlays are based. Minor deposition and stabilization of a side bar occurred between 1949 and 2015 a few hundred metres downstream of the proposed northern barge landing (d in **Figure 5-3**). The proposed southern barge landing is situated along the edge of a low fluvial terrace, or inactive portion of floodplain (e in **Figure 5-3**). Although field reconnaissance documented at least some erosion along this southern bank, based on leaning trees and localized undercutting and slumping, the coincidence of historical bank positions with that delineated based on the 2015 aerial photography indicates that observed bank instability is localized and has not resulted in systematic erosion. Given the size of the river, and the erodibility of the bank materials, some degree of localized bank failure and retreat should be accommodated in the design of the southern barge landing. An allowance should also be made for flooding and scour caused by ice jams, which form annually.

5.4.3 Yukon River Barge Crossing

Yukon River exhibits a sinuous to anastomosing channel pattern in the vicinity of its proposed barge crossing, just upstream of the confluence with Coffee Creek (**Figure 5-3**). The river has numerous side and mid-channel bars, exhibiting varying degrees of stability, as well as back channels that may only convey water during floods. The existence and distribution of bars along the main channel affect bank erosion patterns through their localized deflection and/or splitting of the thalweg. The persistence and slight growth of a relatively large mid-channel bar at the proposed barge crossing (f in **Figure 5-3**), since at least 1948, may have contributed to the systematic erosion of the northern river bank that is documented through the historical overlay analysis. Erosion of the northern bank immediately upstream of the proposed northern barge landing (g in **Figure 5-3**), which is situated at the interface between fluvial deposits and the toe of a steep, rocky hillside, has occurred at an average rate of 1.3 m/yr between 1948 and 2015. Depending on the exact positioning and design of the proposed northern barge landing, continued erosion of this bank may necessitate proactive riprap placement to mitigate the hazard. No significant erosion appears to have occurred along the southern bank in the vicinity of the proposed barge landing, likely due to partial protection afforded by the adjacent vegetated bar (h in **Figure 5-3**) from the more erosive thalweg. An allowance should also be made for flooding and scour caused by ice jams, which form annually.

5.5 Icing

Icing, locally known as ‘glaciation’, is the accumulation of ice (aufeis) during winter along streams and large slopewash runnels that receive near-continuous groundwater seepage from unfrozen portions of active layers or adjacent permafrost-free ground (**Photo 5-1**). Icings form through the accretion of layers of ice, attaining thicknesses of up to several metres and widths of several tens of metres. Icings within the study area locally initiate in October and may persist until early June where thickest and most shaded. Lorax Environmental Services Ltd.’s (2015) wintertime monitoring of ice along streams draining the proposed mine area confirm that thicknesses of more than 1 m are common, particularly along headwater reaches.



Photo 5-1. Example of icing spanning the bottom of a headwater drainage in the Klondike Plateau

A total of 77 sites known or inferred to be prone to wintertime icing were identified along the proposed access road (Map 2, **Appendix B**). Some of these sites, as reported by Yukon Highways and Jim Coates (Kryotek), require significant efforts to break up and remove the ice in the spring before the road is drivable by regular vehicles. Large accumulations of aufeis along stream beds and low-lying areas of floodplains can also increase the width (and height) of flooding if intense rainfall or snowmelt occurs before the ice has thinned and broken up. Allowances should be made in the design of crossings of icing-prone drainages for both the formation and failure of aufeis, as well as potential flooding in excess of that predicted by regular hydrological analysis.

5.6 Other Hazard Considerations

Several other processes were noted as potential hazards through the mapping process, but delineation of their limits requires site-specific investigation and analysis of detailed hydrological and topographic data beyond the scope of this assessment:

- **Flooding** – Sections of road crossing or traversing low-lying areas alongside modern streams may be subject to temporary flooding (inundation) during intense or prolonged rainfall or snowmelt. Ice jams, which can also significantly raise water levels, are common along the rivers and their major tributaries. Riparian vegetation patterns and soil profiles provide indicators of the approximate limits and frequency of flooding.

- **Ice Jams and Scour** – Virtually continuous covers of ice form during the winter months along creeks and rivers within the study area. Thicknesses vary spatially and temporally, but locally can exceed one metre. Small areas of open water that punctuate otherwise continuous ice cover occur in areas of sustained groundwater discharge, along the toes of terraces or valley sides. Open water commonly also persists locally in the Stewart and Yukon rivers, in areas of hyporheic exchange near the downstream limits of large gravel bars. During the winter, the ice flexes and buckles, continually shifting under the hydraulic influence of water flowing beneath. Ice jams form in local constrictions within the channel, or at abrupt bends, commonly at similar locations each year. Water impounded by ice jams can flood extensive areas of the valley bottom not normally exposed to flooding due solely to meteoric (hydrologic) events. In the spring, the ice jams break up and release thick slabs of ice downstream. Depending on the size of the ice jams, and the timing, duration and mechanisms of ice jam failure, breaches can result in widespread scour and ice block stranding along banks and riparian zones downstream.
- **Degradation and Aggradation** – Degradation, also known as channel down-cutting, is the lowering of stream bed elevation due to erosion overwhelming deposition at a reach scale. Aggradation, or channel infilling, is the raising of stream bed elevation due to deposition outpacing erosion at a reach scale. Both degradation and aggradation along streams may pose hazards to crossing structures (e.g., culverts or bridges) if not recognized and accommodated in the design. Degradation can lead to undermining of abutments, potentially destabilizing crossing structures, and perching of culverts, forming barriers to upstream fish migration. Aggradation can reduce the hydraulic capacity of the channel or crossing structures by partial infilling, which in turn can increase the frequency of overbank flooding and the potential for road overtopping.

5.7 Soil Erosion Potential

Soil erosion potential was an attribute interpreted in association with terrain and terrain stability mapping, as outlined above in Section 3.5. Nearly half (49%) of the study area was assigned a soil erosion potential ranking of moderate (**Figure 5-4**), which reflects the counterbalancing effects of silt within the soil (i.e., highly erodible) with the predominantly gentle to moderate slopes (i.e., less prone to erosion). Approximately 13% of the study area exhibits high or very high soil erosion potential, due to their ground ice contents and appreciable proportions of silt intermixed with organics. Thermal erosion was considered in association with areas of ice-moderate or ice-rich permafrost.

The management of surface runoff and sediment during the construction of the proposed mine facilities and access road will be particularly important in areas directly upslope of fish habitat. Consideration will also need to be given to swales or gullies with the potential to transport sediments into downstream fish-bearing watercourses. Erosion and sediment control measures should be designed, implemented, monitored and maintained with the greatest attention given to erosion-prone slopes upslope of fish habitat.

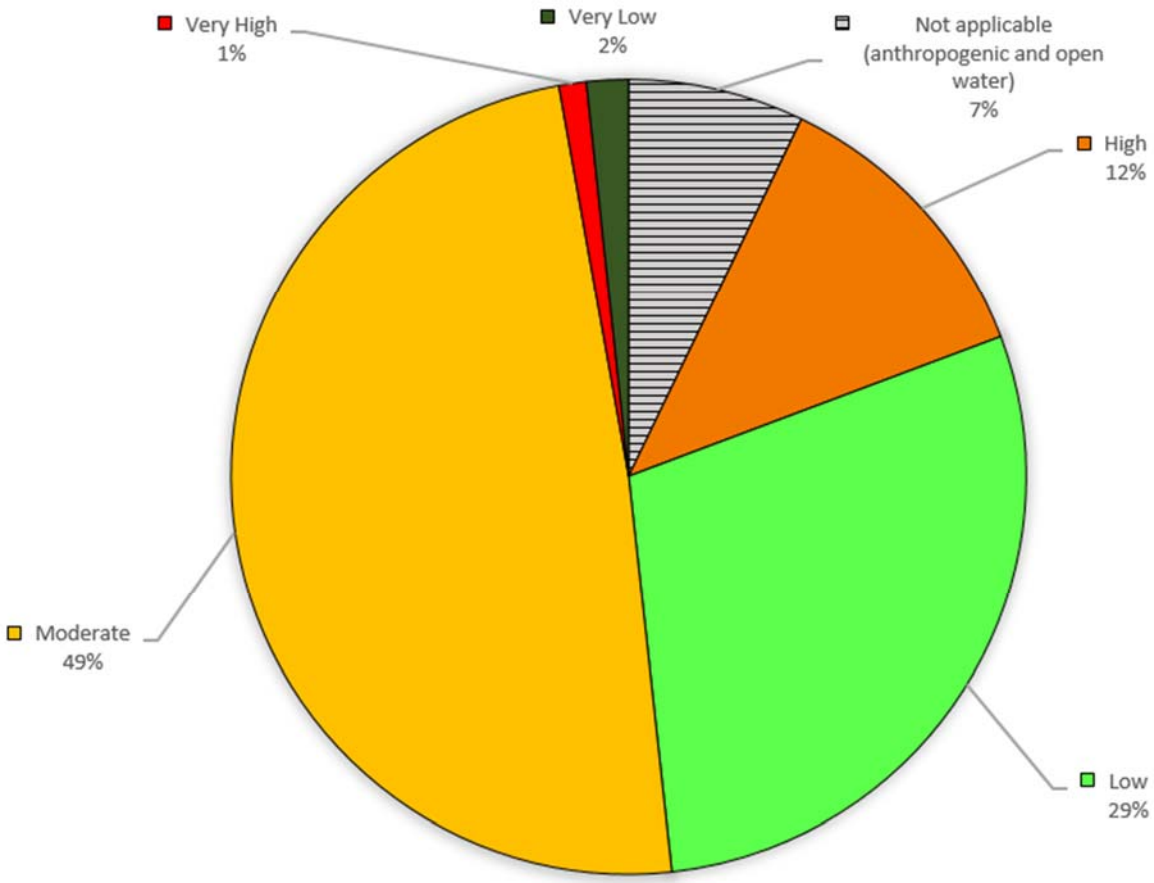


Figure 5-4. Areal proportion (%) of soil erosion potential

6 Project Design Considerations

The information presented in this report and its accompanying maps (**Appendices A** to **C**) provides a basis for planning, designing, constructing and maintaining project infrastructure in ways that minimize long-term costs and potential effects on the environment. It also informs rehabilitation practices during and following operations. The identification and characterization of geomorphological processes and the potential hazards they pose to the Project facilitate assessment of site-specific risks and measures to avoid or mitigate these risks. The following two sections highlight opportunities to avoid or minimize risks based on advance knowledge of terrain and permafrost conditions.

6.1 Hazard Avoidance

Hazard avoidance is a guiding principle Kaminak has embraced in the siting and routing of its mine facilities and access road, respectively. The final footprints of the proposed mine facilities and access road should be located to avoid areas prone to mass movement, slope erosion or fluvial processes, where feasible. Project infrastructure should avoid crossing, or upslope and downslope exposure to, areas mapped as having an existing terrain stability class of V due to past or imminent slope failure. Careful site preparation and design will be required in areas where project infrastructure unavoidably crosses areas with an existing terrain stability class of V due to existing thermokarst activity (as described further below in Section 6.2). Such terrain occurs locally in some valley bottoms along which the access road is proposed. Similar attention should be given to areas with a disturbed terrain stability class of V but with a lower existing terrain stability class (e.g., gentle colluvial complex apron with ice-rich permafrost), in order to avoid triggering instability.

In some cases, hazard avoidance may also be achieved through careful site preparation that eliminates or alters the conditions responsible for the hazard. For example, in rare situations where key mine facilities cannot reasonably avoid encroachment into areas with ice-rich permafrost, thawing and excavation of the ice-rich surficial material could be considered prior to construction.

6.2 Effective Hazard Mitigation

In areas where hazard avoidance is not possible or practicable, Kaminak will apply hazard mitigation measures applicable to site-specific conditions and commensurate with associated risks to the Project. Examples of general strategies for mitigating the main forms of hazard within the study area, if and where subsequent risk assessment establishes the need, are identified in the following sections.

6.2.1 Slope failure

Reducing the likelihood or magnitude of slope failures may or may not be possible in areas where the hazard cannot be avoided. The management of surface runoff will be critical on slopes underlain by permafrost; unnatural concentrations can quickly saturate the active layer and reduce its effective shear strength resulting in active layer detachments, or cause subsidence in ice-moderate or ice-rich settings. In addition, consideration could be given to modifying slope geometry to lessen initiation potential, altering

surface and groundwater drainage patterns in an attempt to reduce the water content of the surficial material, or introducing active or passive external forces to increase shear strength. Monitoring changes to the morphology of disturbed slopes is recommended at locations of suspected instability.

Opportunities to limit and manage the runout of potential slope failures should also be considered where the hazard is likely and unavoidable. Measures exist for controlling the trajectory of the mass movement, such as deflection berms. In order to help control the runout limits, passive or active measures could be considered individually or in combination. For example, ditching alongside a section of road exposed to rockfall represents a passive measure to accommodate (and accumulate) rockfall debris. Constructing physical barriers to intercept rockfall debris, such as an earthen berm, represents more active mitigation.

Considerations for addressing minor hazards posed by geomorphological processes such as solifluction and slopewash are included above in **Table 5-1**.

6.2.2 Thermokarst

Minimizing the potential for initiating or exacerbating thermokarst is one of the most important engineering objectives in the routing and design of the proposed access road. The over-arching principle is to protect the integrity of the core of the road embankment through the maintenance of the local ground thermal regime (McGregor et al., 2010). Specific design, construction and maintenance techniques aimed at maintaining or minimizing change to the ground thermal regime are available for areas where ice-moderate or ice-rich permafrost cannot reasonably be avoided. Below is a summarized list of effective mitigation measures from the technical memorandum prepared for this project by TT-EBA (2016a) (**Appendix E**):

- Avoiding cuts and ditches wherever possible to limit disturbance to the active layer;
- Restricting the movement of equipment used to clear the right-of-way, in order to minimize disturbance to surface organics;
- Removing snow cover prior to construction of the road embankment, if constructed in winter, to reduce settlement during the thaw period;
- Using an end-dumping method to construct the road embankment to avoid unnecessary damage to vegetation;
- Avoiding high fills and side-slopes wherever possible to limit potential for mass movement within the road embankment;
- Constructing a road embankment with a thickness sufficient to maintain or even slightly decrease existing active layer thickness;
- Avoiding concentration and ponding of water alongside the road embankment, by doing so, if necessary, a reasonable distance from the embankment (in order to avoid degrading permafrost at the edge of the embankment); and
- Preventing snow accumulation on the lee side of the embankment, which can inhibit cold penetration during winter and increase active layer thickness.

Careful planning of road maintenance is required. Judgment must be used to determine when routine maintenance will suffice, and when to escalate activities to rehabilitation (McGregor et al., 2010). If localized thermokarst subsidence or gullying becomes particularly severe, consideration may need to be given to thawing and removing the underlying ice-rich permafrost and reconstructing the section of road. This technique, although not preferred, is commonly used by placer miners in the region.

6.2.3 Meander migration

Sections of the proposed access road exposed to meander migration hazards may require erosion protection in order to avoid impact to the embankment. Riprap is the most common and straightforward measure to inhibit the erosion of a road embankment, although other more proactive measures such as in-stream flow 'training' (e.g., rock veins or steam barbs to shift thalweg position) or local channel realignment are options worth considering, especially if riprap continues to be undermined and collapse. Banks should be stabilized prior to impingement along the road embankment, although additional riprap placement may also be required following major floods.

The exact positioning and design of the barge landings at proposed crossings of the Stewart and Yukon Rivers should account for the trajectories and rates of bank erosion documented above in sections 5.4.2 and 5.4.3. Consideration should also be given to the implications of ice formation, jamming, scouring and break-up in the vicinity of the landing sites.

6.2.4 Icing

The design of crossing structures along the proposed access road at streams and seepage areas prone to icing should accommodate ice accumulation and springtime flooding before or during break-up as best as possible. Pre-construction monitoring of the stream crossings of greatest concern would valuably inform crossing design, providing insight on site-specific icing thickness and extent. Measures to mitigate potential effects of icing may include locally enlarged entrance areas to culverts; installation of multiple culverts, some raised relative to the others; and local drainage diversions. Considering the implications of any contemplated measures to underlying or adjacent ice-rich permafrost will be necessary.

7 Conclusions

Terrain stability and hazard mapping completed for the Coffee Gold Project depicts the distribution and characteristics of terrain units, processes and hazards within a 526 km^2 study area that encompasses the proposed mine area and its access road from Dawson. This report and its accompanying maps support engineering and environmental studies being completed as the project advances its proposal submission to YESAB. Several key results warrant highlighting:

1. The siting and design of proposed mine facilities and the access road should account for the widespread occurrence of permafrost in valley bottoms, on northerly aspects and within hillside hollows;
2. The primary mass movement hazards that may affect the footprints of the proposed mine facilities and access road, where not avoided, are rockfall, debris slides, active layer detachments and thermokarst;
3. Disturbance to the ground thermal regime of colluvial complexes rich in silt, organics and segregated ground ice, as well as silty mantles with excess ground ice in saddles and on concave slopes, should be minimized in order to inhibit thermokarst;
4. Active layer detachments commonly initiate on moderate slopes, just above a convex slope-break, with increased likelihood after fire or other surface disturbances;
5. The potential for thermokarst gullies to retrogressively erode upslope should be accommodated in the road alignment and design;
6. Erosion protection (e.g., riprap) will likely be required along sections of the proposed access road where a meandering channel encroaches, including at the three proposed river crossings; and
7. Special consideration is needed in the design of drainage crossings along the proposed access road that are prone to icing, which can form as early as October and persist as late as June.

8 Statement of Limitations

This report (including its appended maps) has been prepared by the Consultant (Palmer Environmental Consulting Group Inc. (PECG)) for the benefit of the Client (Kaminak Gold Corporation) in accordance with the agreement between Consultant and Client, including the scope of work detailed therein (the "Agreement"). The report and the information it provides may be used and relied upon only by Client, except (1) as agreed to in writing by Consultant and Client, (2) as required by-law, or (3) to the extent used by governmental reviewing agencies for the purpose of obtaining permits or approvals.

The extent of this study was limited to the specific scope of work for which we were retained and that is described in this report. PECG has assumed that the information and data provided by the client or any secondary sources of information are factual and accurate. PECG accepts no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omissions, misinterpretations or negligent acts from relied-upon data. Judgment has been used by PECG in interpreting terrain stability and hazards based on desktop-based interpretation calibrated by field observations at sites representative of the diversity of conditions within the study area. Ground conditions may differ from those interpreted at a polygon scale, even where investigated in the field, due to inherent variability in terrain characteristics.

PECG is not a guarantor of the terrain, permafrost or hazard conditions within each of the mapped polygons, but warrants only that its work was undertaken and its report prepared in a manner consistent with the level of skill and diligence normally exercised by competent geoscience professionals practicing in Yukon. Our findings, conclusions and recommendations should be evaluated in light of the limited scope of our work.

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Appendix A

Map 1 – Terrain

Coffee Gold Project Terrain Map Code Definitions

KAMINAK GOLD CORPORATION

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Textures

Symbol	Name	Size (mm)	Description
a	blocks	>256	Angular particles.
b	boulders	>256	Rounded and subrounded particles.
k	cobbles	64 - 256	Rounded and subrounded particles.
p	pebbles	2 - 64	Rounded and subrounded particles.
s	sand	2 - .062	
z	silt	.062 - .002	
c	clay	<.002	
d	mixed fragments	>2	Mix of rounded and angular particles.
g	gravel	>2	Mix of boulders, cobbles and pebbles.
x	angular fragments	>2	Mix of rubble and blocks.
r	rubble	2 - 256	Angular particles.
e	fibric		Well-preserved fibre (40% or more) that can be identified as to botanical origin upon rubbing.

Surficial Materials

Symbol	Name	Assumed status	Description
A	anthropogenic	(A)	Artificial materials, or geological materials so modified by human activities that their original physical properties (e.g. structure, cohesion, compaction) have been drastically altered. Typically related to placer mining activity in valleys, where the extent and severity of disturbance varies from stripping of surface organics to complete excavation of material to bedrock.
C	colluvial	(A)	Materials that have reached their present position as a result of direct, gravity-induced movement. Generally consists of massive to moderately well-stratified, non-sorted to poorly sorted sediments. Veneers are dominantly composed of angular fragments with lesser amounts of silt and sand, while blankets and aprons that most commonly form in concave or slope toe positions generally have higher contents of silt.
C1	colluvial complex	(A)	A mixture of sand, silt, organic materials and minor amounts of angular fragments that has reached its present position as a result of direct, gravity-induced movement. Typically forms aprons or blankets along the base of valley sides and valley bottoms, and consists dominantly of sandy silt with ice-rich permafrost. Locally known in the Klondike region as “black muck”.
D	weathered bedrock	(A)	Bedrock decomposed or disintegrated *in situ* by mechanical and/or chemical weathering processes. Generally consists of angular rock fragments ranging in size from coarse sand to blocks. Typically occurs on ridge crests and gentle upper slopes.
F	fluvial	(I)	Materials transported and deposited by streams and rivers. Generally consists of rounded gravels with interstitial sand and silt. Thick deposits typically occur on valley bottom floodplains/fans and terraces. Thin deposits occur within draws or on slopes where water is flowing over the permafrost table.
FG	glaciofluvial	(I)	Materials transported and deposited by glacial meltwater. Deposits range from non-sorted, massive gravels to well-sorted, stratified gravels, and only occur as terraces alongside the Yukon River.
O	organic	(A)	Organic materials resulting from the accumulation and decay of vegetative matter. Contains at least 30% organic matter by weight. Saturated deposits of accumulated mosses, sedges, or other hydrophytic vegetation are typical. Accumulations of leaf litter, twigs, branches and mosses are found in drier areas. Thin organic deposits are widespread in the area, occur in many different environments, and are only included in the map label where they influence the physical properties of the unit.
R	bedrock	n/a	Intact rock outcrops that may be covered by a thin mantle (<10 cm thick) of unconsolidated or organic materials. Typically occur on ridge crests (e.g. tors) and along the base of over-steepened slopes.

Qualifiers

Symbol	Name	Description
A	active	Used to qualify surficial materials and geomorphological processes with regard to their current states of activity
I	inactive	

Surface Expressions

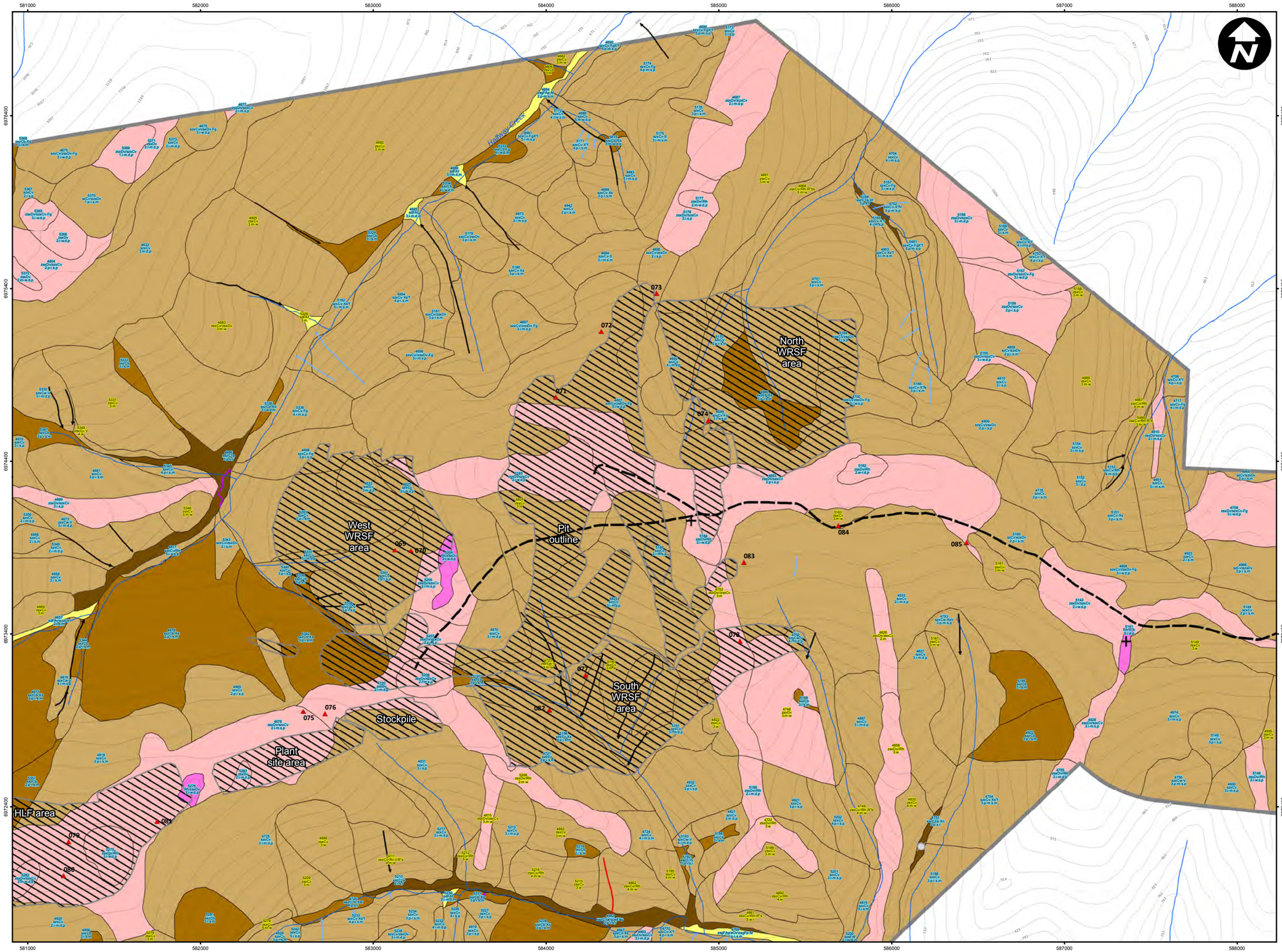
Symbol	Name	Description
a	moderate slope	A unidirectional surface with a slope of 27-50%; longitudinal profile is either straight, or slightly concave or convex; relief of local surface irregularities is less than 1 m.
b	blanket	A mantle of unconsolidated materials >1 m thick; blankets are thick enough to mask minor irregularities of the underlying surface, but still conform to general underlying topography.
c	cone	A cone-shaped accumulation of sediment with a relatively smooth surface and a slope steeper than 26%; longitudinal profile is either straight, or slightly concave or convex.
f	fan	A relatively smooth sector of a cone exhibiting a slope gradient less than or equal to 26%; longitudinal profile is either straight, or slightly concave or convex.
a	apron (colluvium only)	Complex of coalescent cones, fans or constructional sloping surfaces, usually in a slope toe position.
h	hummocky	Steep-sided hillocks and hollows with multidirectional slopes, dominantly between 26 and 70%, and relief greater than 1 m; bedrock slopes may be locally steeper.
j	gentle slope	A unidirectional surface with a slope of 6-25%; longitudinal profile is either straight, or slightly concave or convex; relief of local surface irregularities is less than 1 m.
k	moderately steep slope	A unidirectional surface with a slope of 50-70%; longitudinal profile is either straight, or slightly concave or convex; relief of local surface irregularities is less than 1 m.
p	plain	A level or very gently sloping unidirectional surface with a gradient of 0 to 5%; longitudinal profile is either straight, or slightly concave or convex; relief of local surface irregularities is less then 1 m.
r	ridged	Assemblage of parallel or sub-parallel elongate hillocks with slopes dominantly between 26 and 70% and relief greater than 1 m; bedrock slopes may be locally steeper.
s	steep slope	A unidirectional surface with a slope of >70%; the longitudinal profile is either straight, or slightly concave or convex; local surface irregularities have a relief less than 1 m.
t	terraced	A single feature or assemblage of step-like forms where each step consists of a scarp face and a horizontal or gently inclined surface above it.
u	undulating	Gently sloping hillocks and hollows with multidirectional slopes up to 26% and relief greater than 1 m.
v	veneer	A layer of unconsolidated material 10 cm to 1 m thick; too thin to mask the minor irregularities of the surface of the underlying material.
w	mantle of variable thickness	A layer or discontinuous layer of surficial material of variable thickness (0 to about 3 m) that fills or partially fills depressions in an irregular substrate. It is generally too thin to mask prominent irregularities in the underlying material.
x	thin veneer	Similar to veneer; 2 to 20 cm thick.

Geomorphological Processes

Symbol	Name	Assumed Status	Description
F	slow mass movements	(A)	Slow downslope movement of masses of cohesive or non-cohesive surficial material by creeping, flowing, or sliding.
I	irregularly sinuous channels	(A)	A clearly defined main channel displaying irregular turns and bends without repetition of similar features. Back channels may be common, and minor side channels and a few bars and islands may be present, but regular and irregular meanders are absent.
M	meandering channels	(A)	A clearly defined channel characterized by regular patterns of bends.
R	rapid mass movements	(A)	Rapid downslope movement by falling, rolling, sliding or flowing of dry, moist or saturated surficial materials and/or bedrock.
S	solifluction	(A)	Slow gravitational downslope movement of lobate forms composed of saturated surficial materials across a frozen or otherwise impermeable substrate.
V	gully erosion	(A)	Parallel/subparallel long, narrow ravines due to erosion by various processes.
X	permafrost	(A)	Processes controlled by the presence of permafrost.

Geomorphological Process Subclass

Symbol	Name	Description
"	initiation zone	Polygon includes sites or zones where mass movement processes initiate; used to distinguish initiation zones from runout zones.
Permafrost Processes		
e	thermal erosion	Gullies and depressions created by melting of permafrost due to heat transfer from water bodies, typically flowing streams.
f	thaw flow slides	Shallow slope failures within the active layer caused by the thawing of permafrost.
n	pingos	A mound of earth-covered ice where groundwater discharge (seepage) through permafrost freezes and accumulates at or close to the ground surface.
s	sheetwash	The mobilization and redistribution of fine material by water flowing down the surface or within the shallow subsurface of smooth slopes, typically underlain by permafrost.
t	thermokarst subsidence	Surface depressions created by thawing of permafrost, typically containing standing water.
Mass Movement Processes		
b	rockfall	Descent of masses of bedrock by falling, bouncing and rolling.
g	rock creep	Slow down-slope movement of angular debris under periglacial conditions.
m	slump in bedrock	Sliding of internally cohesive masses of bedrock along a slip plane that is concave upward or planar.
r	rockslide	Descent of large masses of disintegrating bedrock by sliding.
s	debris slide	Sliding of disintegrating mass of surficial material.
u	slump in surficial material	Sliding of internally cohesive masses of surficial material along a slip plane that is concave upward or planar.



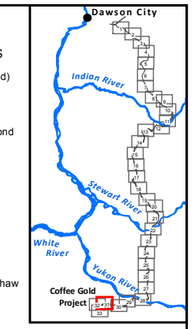
Legend

ON-SITE SYMBOLS

- Pingo (collapsed)
- Pingo
- Thermokarst pond
- Tor
- Active layer detachment
- Debris slide
- Gully
- Retrogressive thaw flow
- Rock slide
- Slump
- Thermokarst gully

Permafrost absent (inferred)
Permafrost present (inferred)

- Study area
- Palmer Environmental detailed field site and ID
- Road centreline (includes existing and proposed sections)
- Proposed mine facilities
- Waterbody
- ~30 m topographic contour



SURFICIAL MATERIAL (DOMINANT)

- Anthropogenic (A)
- Organic (O)
- Fluvial (F)
- Thin colluvial veneer (Cx)
- Colluvial veneer (Cv) or mantle of variable thickness (Cw)
- Colluvial blanket (Cb or C1b)
- Colluvial apron (Ca or C1a), fan (Cf), cone (Cc); undulating (Cu), or hummocky (Ch) deposits
- Glaciofluvial (FG)
- Weathered bedrock (D)
- Bedrock (R)

LABEL FORMAT

Texture of terrain component 2 (increasing order of dominance)
Unique polygon identifier
Terrain component delimiter
Surficial material of terrain component 2
Surficial material of terrain component 1
Activity qualifier of terrain component 2
Texture of terrain component 1 (increasing order of dominance)
Geomorphological process and subclass code for whole polygon
Surface expression(s) of terrain component 1
Surface expression(s) of terrain component 2
Drainage class(es)
Permafrost ice content
Slope class
Depth to permafrost

1
sxzCb/sdFAv-Xe
2.i-p.s,m

SURFACE EXPRESSION
- a moderate slope
- b blanket
- c cone
- f fan
- a apron (colluvial polygons only)
- h hummocky
- j gentle slope
- k moderately steep slope
- m rolling
- p plain
- r ridge(s)
- s steep slope
- t terrace(s)
- u undulating
- v veneer
- w mantle of variable thickness
- x thin veneer

GEOMORPHOLOGICAL PROCESS AND SUBCLASS
- F Slow mass movements
  - g – rock creep
  - m – slump (bedrock)
  - u – slump (surficial material)
  - ˚ – initiation zone
- I Irregularly sinuous channels
- M Meandering channels
- R Rapid mass movements
  - b – rockfall
  - m – slump (bedrock)
  - r – rockslide
  - s – debris slide
  - ˚ – initiation zone
- S Solifluction
- V Gully erosion
- X Permafrost processes
  - e – thermokarst (thermal erosion)
  - f – thaw flow slides
  - s – sheetwash
  - t – thermokarst (subsidence)
  - n – pingo
  - ˚ – initiation zone

TEXTURE
- a blocks
- b boulders
- k cobbles
- p pebbles
- s sand
- z silt
- c clay
- d mixed fragments
- g gravel
- x angular fragments
- r rubble
- e fibric

DELIMITER AND MATERIAL SUBTYPE
- / the component in front of this symbol is more extensive than the component that follows
- // the component in front this symbol is much more extensive than the component that follows
- \ the component in front of this symbol overlies the component that follows
- 1 project-specific subtype of colluvial complex

DRAINAGE CLASS
- x very rapid
- r rapid
- w well
- m moderately well
- i imperfect
- p poor
- v very poor

DEPTH TO PERMAFROST
- n near surface
- s shallow
- d deep

DOMINANT SLOPE CLASS
- 1 planar
- 2 gentle
- 3 moderate
- 4 moderately steep
- 5 steep

PERMAFROST ICE CONTENT
- p ice-poor
- m ice-moderate
- r ice-rich

ACTIVITY QUALIFIER
- A active
- I inactive

Refer to "Terrain Codes Definitions" at beginning of map book for definitions of all terminology

COFFEE GOLD PROJECT

Terrain

0 87.5 175 350 525 700 m

1:20,000

Original page size: 11.00 x 17.00 in

Base mapping from Geomatics Yukon and Natural Resources Canada
Terrain mapping completed by D. Sacco, C. Brown and R. McKillop using softcopy photo-interpretation systems at a view (zoom) scale of 1:10,000, following field reconnaissance conducted in association with J. Coates (Krycitek Arctic Innovation) in August 2015. Terrain codes are from the Yukon Geological Survey's adaptation of the Terrain Classification System for British Columbia (Howes and Kenk, 1997). Typical textures inferred based on observed landform associations.

Project number: 13103

Projection: UTM Zone 7
Datum: NAD 1983
Units: metre

KAMINAK GOLD CORPORATION

Map 1

Sheet 31 of 33

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Drawn by: CEB Checked by: RM 03/03/2016

Document Path: C:\Egnyte\Shared\Projects\Active\1310 - Kaminak Gold Corp\13103 - Coffee TSM\Programs\Mapping\Report figures\Terrain map\Terrain map_11x17_landscape.mxd

578000 579000 580000 581000 582000 583000 584000

6975400 6974400 6973400 6972400 6971400

Dan Man Creek

Halfway Creek

North WRSF area

West WRSF area

Pit outline

South WRSF area

Stockpile

Plant site area

Soil stockpile

HLF area

069 070 071 072 073 075 076 077 079 080 081 082

Legend

ON-SITE SYMBOLS

- Pingo (collapsed)
- Pingo
- Thermokarst pond
- Tor
- Active layer detachment
- Debris slide
- Gully
- Retrogressive thaw flow
- Rock slide
- Slump
- Thermokarst gully

Permafrost absent (inferred)

Permafrost present (inferred)

- Study area
- Palmer Environmental detailed field site and ID
- Road centreline (includes existing and proposed sections)
- Proposed mine facilities
- Waterbody
- ~30 m topographic contour

Dawson City

Indian River

Stewart River

White River

Yukon River

Coffee Gold Project

SURFICIAL MATERIAL (DOMINANT)

- Anthropogenic (A)
- Organic (O)
- Fluvial (F)
- Thin colluvial veneer (Cx)
- Colluvial veneer (Cv) or mantle of variable thickness (Cw)
- Colluvial blanket (Cb or C1b)
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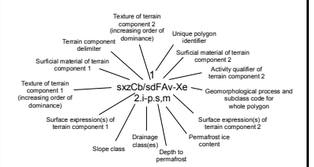
- Glaciofluvial (FG)
- Weathered bedrock (D)
- Bedrock (R)

LABEL FORMAT



SURFACE EXPRESSION

- a moderate slope
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- c cone
- f fan
- g apron (colluvial polygons only)
- h hummocky
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- k moderately steep slope
- m rolling
- p plain
- r ridge(s)
- s steep slope
- t terrace(s)
- u undulating
- v veneer
- w mantle of variable thickness
- x thin veneer

GEOMORPHOLOGICAL PROCESS AND SUBCLASS

- F Slow mass movements: g – rock creep; m – slump (bedrock); u – slump (surficial material); – initiation zone
- I Irregularly sinuous channels
- M Meandering channels
- R Rapid mass movements: b – rockfall; m – slump (bedrock); r – rockslide; s – debris slide; – initiation zone
- S Solifluction
- V Gully erosion
- X Permafrost processes: e – thermokarst (thermal erosion); f – thaw flow slides; g – sheetwash; t – thermokarst (subsidence); n – pingo; – initiation zone

TEXTURE

- a blocks
- b boulders
- k cobbles
- p pebbles
- s sand
- z silt
- c clay
- d mixed fragments
- g gravel
- x angular fragments
- r rubble
- e fibric

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DRAINAGE CLASS

- x very rapid
- r rapid
- w well
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- i imperfect
- p poor
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DEPTH TO PERMAFROST

- n near surface
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PERMAFROST ICE CONTENT

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ACTIVITY QUALIFIER

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Project number: 13103

Projection: UTM Zone 7
Datum: NAD 1983
Units: metre

KAMINAK GOLD CORPORATION

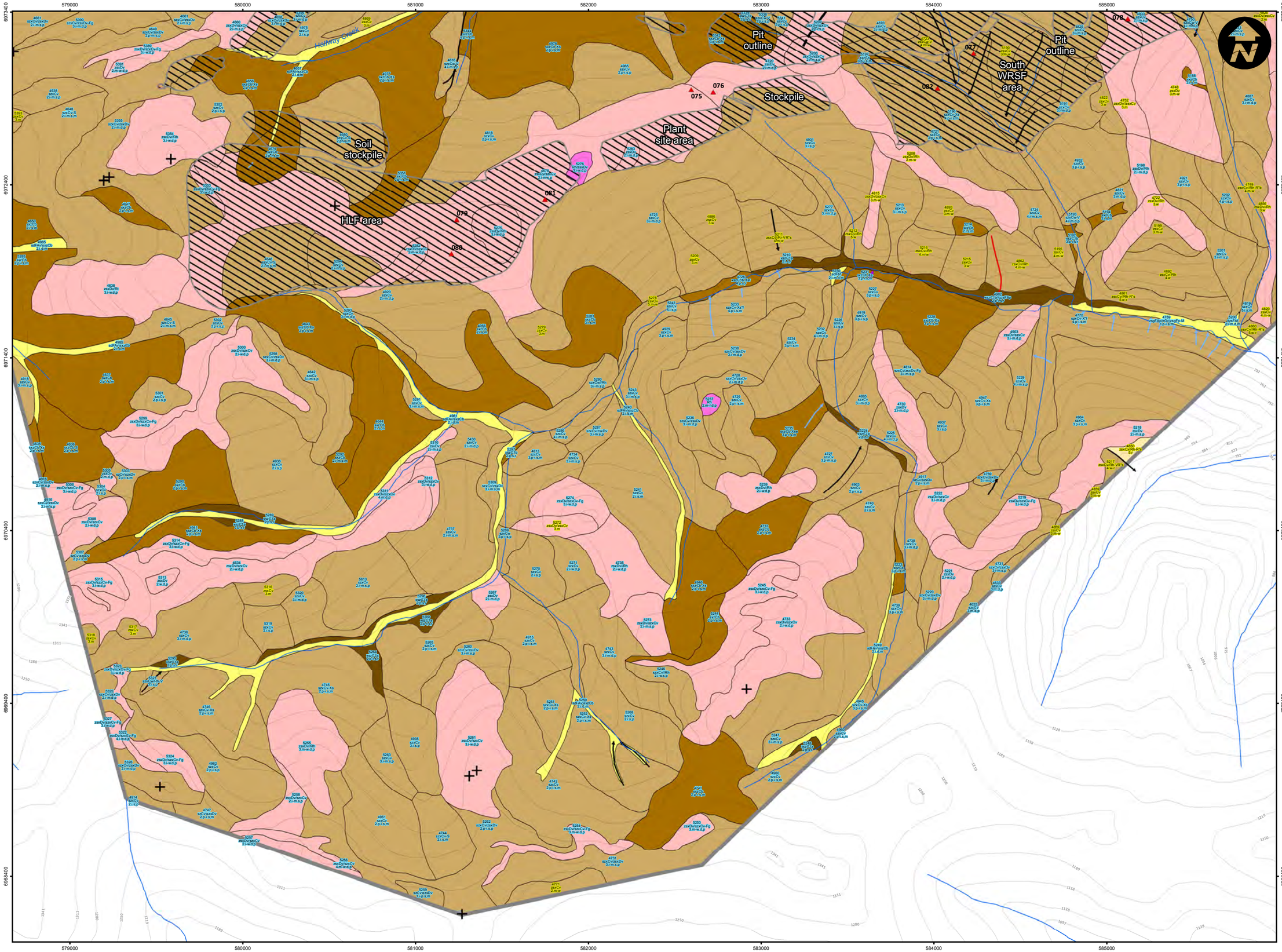
Map 1

Sheet 32 of 33

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Drawn by: CEB Checked by: RM 03/03/2016

Document Path: C:\Esyri\Shared\Projects\Active\13103 - Kaminak Gold Corp\13103 - Coffee TSM\Programs\Mapping\Report figures\Terrain map_11x17_landscape.mxd



Legend

ON-SITE SYMBOLS

- Pingo (collapsed)
- Pingo
- Thermokarst pond
- Tor
- Active layer detachment
- Debris slide
- Gully
- Retrogressive thaw flow
- Rock slide
- Slump
- Thermokarst gully

Permafrost absent (inferred)
Permafrost present (inferred)

- Study area
- Palmer Environmental detailed field site and ID
- Road centreline (includes existing and proposed sections)
- Proposed mine facilities
- Waterbody
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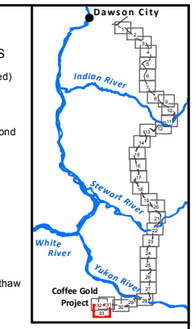

SURFICIAL MATERIAL (DOMINANT)

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LABEL FORMAT

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Permafrost ice content
Slope class
Depth to permafrost

1
sxzCb/sdFAv-Xe
2.i-p.s,m

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GEOMORPHOLOGICAL PROCESS AND SUBCLASS

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DRAINAGE CLASS

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ACTIVITY QUALIFIER

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- I inactive

Refer to "Terrain Codes Definitions" at beginning of map book for definitions of all terminology

COFFEE GOLD PROJECT

Terrain

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Project number: 13103

Projection: UTM Zone 7
Datum: NAD 1983
Units: metre

KAMINAK GOLD CORPORATION

Map 1

Sheet 33 of 33

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Drawn by: CEB Checked by: RM 03/03/2016

Document Path: C:\Egnyte\Shared\Projects\Active\1310 - Kaminak Gold Corp\13103 - Coffee TSM\Programs\Mapping\Report figures\Terrain map\Terrain map_11x17_landscape.mxd

Appendix B

Map 2 – Terrain Stability and Hazards

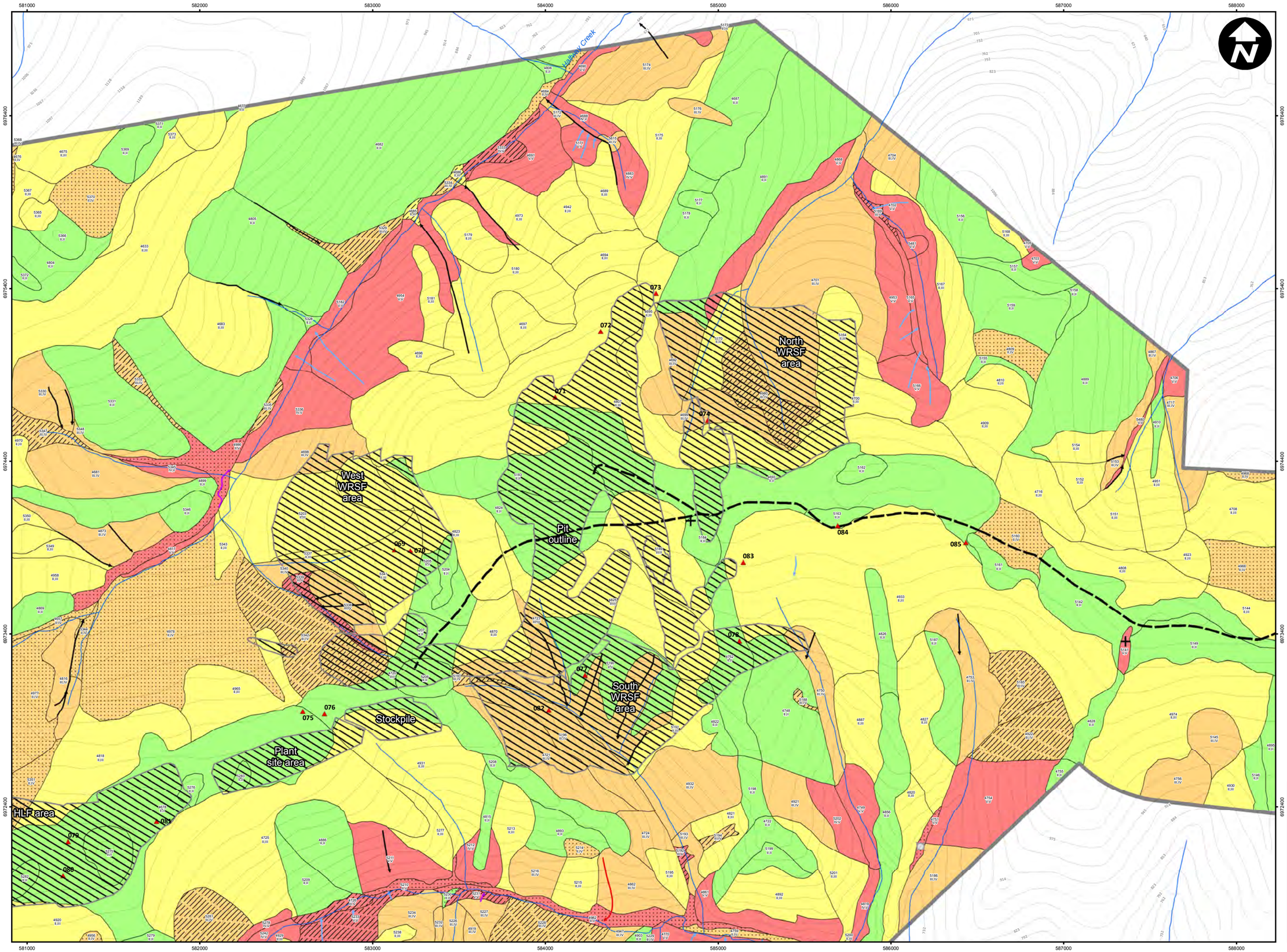
Coffee Gold Project Terrain Stability and Hazards Map Code Definitions

Terrain Stability Class

Symbol	Class	Condition	Interpretation		Common terrain characteristics	
			Existing (current conditions)	Disturbed (following disturbance to ground conditions from road/facility construction without mitigation)	Existing (current conditions)	Disturbed (following disturbance to ground conditions from road/facility construction without mitigation)
I	stable	permafrost	No significant stability problems.		Planar to gently sloping bedrock and weathered bedrock; active fluvial units.	Planar to gently sloping bedrock, weathered bedrock and active fluvial units with deep, ice-poor permafrost.
		no permafrost			Planar to low sloping bedrock and weathered bedrock; active fluvial units.	
II	generally stable	permafrost	Very low likelihood of slope instability.	Very low likelihood of slope instability; no thermokarst subsidence or erosion expected.	Colluvial mantles on gentle slopes; gently sloping colluvial complexes; gently sloping fluvial units; organic deposits; moderately steep bedrock and weathered bedrock.	Colluvial mantles on gentle slopes with deep, ice-poor permafrost; gently to moderately sloping fluvial units with deep, ice-poor permafrost.
		no permafrost	Very low likelihood of slope instability.		Gently to moderately sloping colluvial mantles and fluvial units; moderately steep bedrock and weathered bedrock.	
III	generally stable with minor potential for instability	permafrost	Low to moderate likelihood of slope instability.	Low to moderate likelihood of slope instability and/or minor thermokarst subsidence or erosion possible.	Poorly drained colluvial mantles on moderate slopes; moderately sloping colluvial complexes; imperfectly drained colluvial mantles on moderately steep slopes; ice-poor to ice-moderate permafrost.	Poorly drained colluvial mantles on gentle slopes; imperfectly drained colluvial mantles on moderate slopes; ice-poor to ice-moderate permafrost.
		no permafrost	Low to moderate likelihood of slope instability.		Colluvial mantles on moderately steep slopes.	
IV	potentially unstable	permafrost	Expected to contain areas with a high likelihood of slope instability.	Expected to contain areas with a high likelihood of slope instability and/or moderate thermokarst subsidence or erosion.	Poorly drained colluvial mantles on moderately steep slopes; moderately steep colluvial complexes.	Any surficial unit thicker than a veneer with ice-moderate permafrost; poorly drained colluvial mantles on moderate slopes; imperfectly drained colluvial mantles on moderately steep slopes.
		no permafrost	Expected to contain areas with a high likelihood of slope instability.		Colluvial units on moderately steep to steep slopes.	
V	unstable	permafrost	Expected to contain areas with a very high likelihood of slope instability and/or thermokarst; may or may not exhibit evidence of previous slope failure and/or thermokarst.	Expected to contain areas with a very high likelihood of slope instability and/or major thermokarst subsidence or thermal erosion; typically exhibits evidence of previous slope failure and/or thermokarst.	Any unit with evidence of slope failure and/or thermokarst subsidence or thermal erosion.	Any unit with evidence of slope failure or ice-rich permafrost; poorly drained colluvial mantles on moderately steep slopes.
		no permafrost	Expected to contain areas with a very high likelihood of slope instability; typically exhibits evidence of previous slope failure.		Any unit with evidence of slope failure; typically occur on moderately steep to steep slopes.	

Applicable Hazard Category

Symbol	Class	Description
s	slope failure potential is dominant	Dominant hazard potential category related to gravity induced slope failure. May or may not include existing failures. Represents default category.
t	thermokarst potential is dominant	Dominant hazard potential category related to thermokarst subsidence or erosion. May or may not include existing failures.
b	both slope failure & thermokarst potential are co-dominant	Hazard potential category related to gravity induced slope failure and thermokarst subsidence or erosion. May or may not include existing failures.



Legend

ON-SITE SYMBOLS

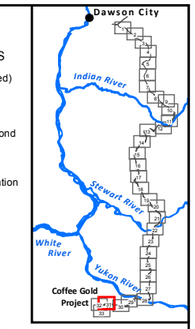
- Pingo (collapsed)
- Pingo
- Thermokarst pond
- Tor
- Meander migration hazard
- Icing hazard
- Active layer detachment
- Debris slide
- Gully
- Retrogressive thaw flow
- Rock slide
- Slump
- Thermokarst gully
- Study area
- Palmer Environmental detailed field site and ID
- Road centreline (includes existing and proposed sections)
- Proposed mine facilities
- Waterbody
- ~30 m topographic contours

TERRAIN STABILITY CLASS

- No rating assigned (anthropogenic)
- I - Stable
- II - Generally stable
- III - Generally stable with isolated minor instability
- IV - Potentially unstable
- V - Unstable

APPLICABLE HAZARD CATEGORY

- Slope failure potential is dominant
- Thermokarst potential is dominant
- Slope failure and thermokarst potential are co-dominant



LABEL FORMAT

Unique polygon identifier

1

III,IV

Existing terrain stability class (current conditions)

Disturbed terrain stability class (following disturbance to ground conditions from road/facility construction without mitigation)

Refer to "Terrain Stability and Hazards Code Definitions" at beginning of map book for definitions of all terminology, and refer to Terrain map (Map 1) for complete terrain polygon labels (including drainage, permafrost and slope classes).

COFFEE GOLD PROJECT

Terrain Stability and Hazards

0 87.5 175 350 525 700 m

1:20,000

Original page size: 11.00 x 17.00 in

Base mapping from Geomatics Yukon and Natural Resources Canada
Terrain stability mapping completed by D. Sacco, C. Brown and R. McKillop using softcopy photo-interpretation systems at a view (zoom) scale of 1:10,000, following field reconnaissance conducted in association with J. Coates (Kryotek Arctic Innovation) in August 2015.

Project number: 13103

Projection: UTM Zone 7
Datum: NAD 1983
Units: metre

Map 2

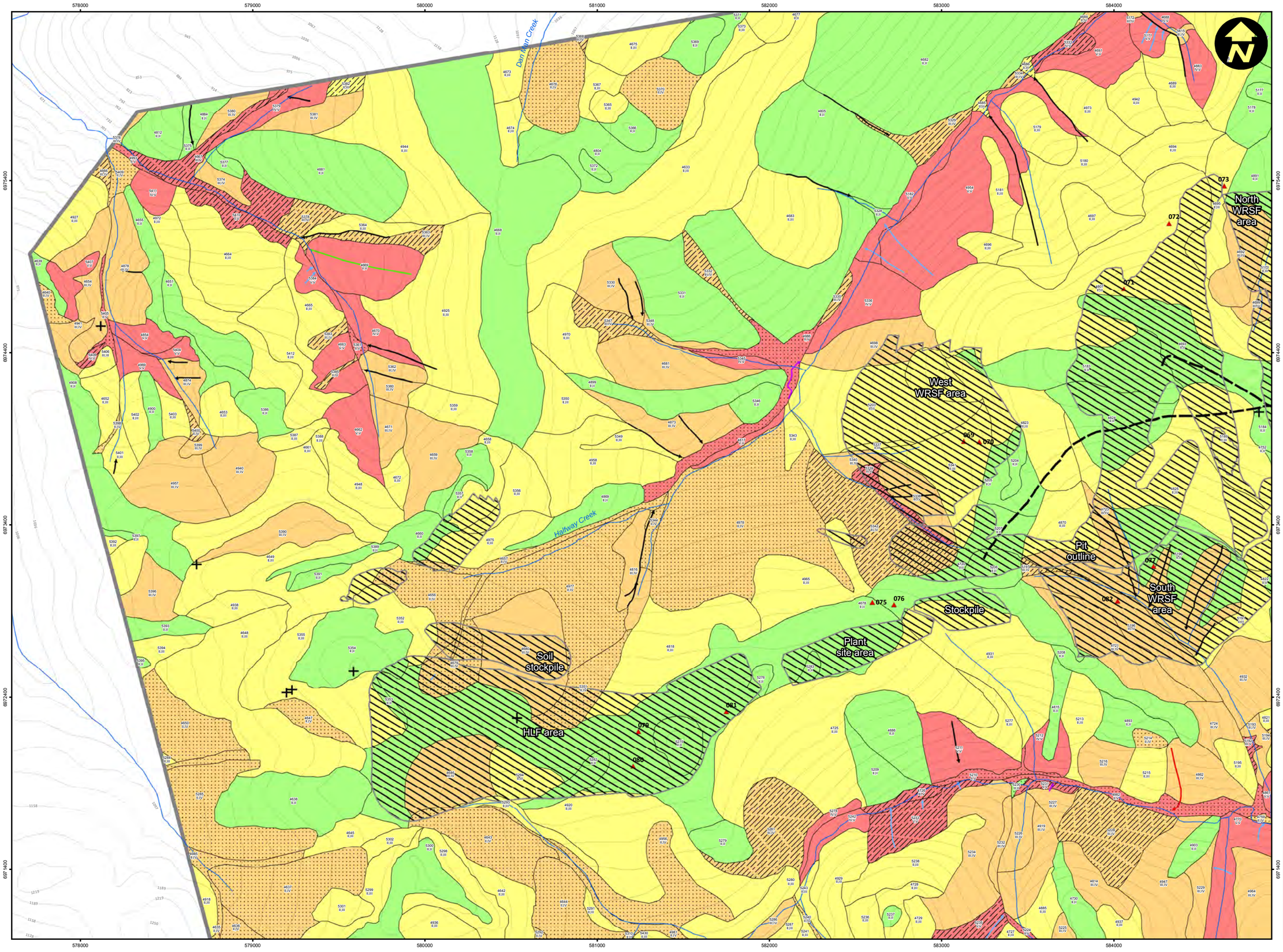
Sheet 31 of 33

KAMINAK GOLD CORPORATION

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Drawn by: CEB Checked by: RM 03/03/2016

Document Path: C:\Eghyte\Shared\Projects\Active\1310 - Kaminak Gold Corp\13103 - Coffee TSM\Programs\Mapping\Report figures\Terrain stability map\Terrain stability map_11x17_landscape.mxd



Legend

ON-SITE SYMBOLS

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APPLICABLE HAZARD CATEGORY

- Slope failure potential is dominant
- Thermokarst potential is dominant
- Slope failure and thermokarst potential are co-dominant

LABEL FORMAT

Unique polygon identifier

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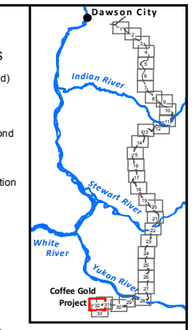

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Project number: 13103

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Map 2

Sheet 32 of 33

KAMINAK GOLD CORPORATION

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

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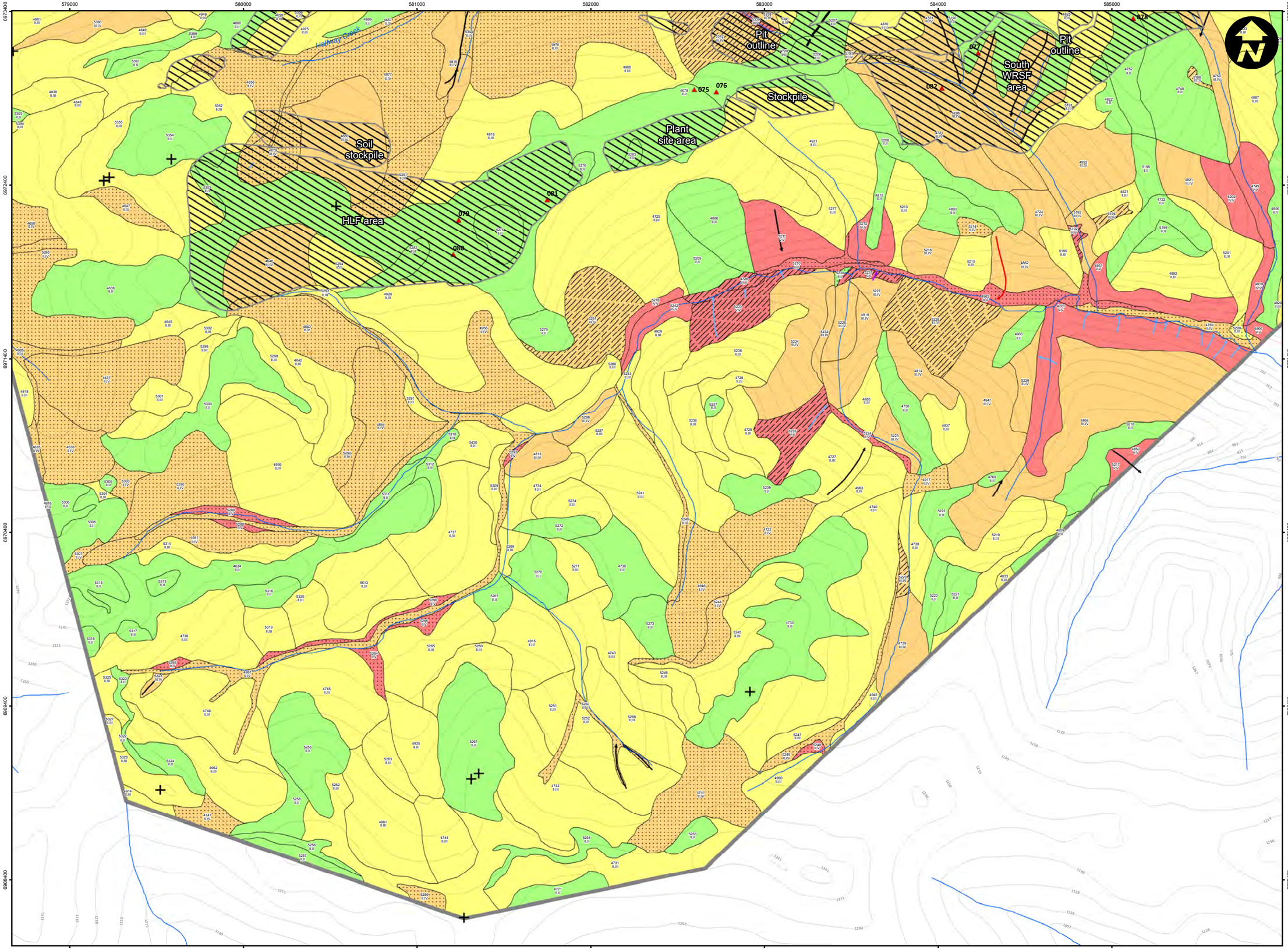

Legend

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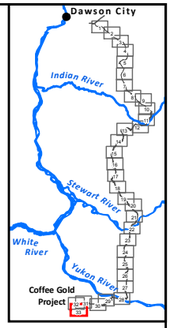

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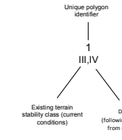

Refer to "Terrain Stability and Hazards Code Definitions" at beginning of map book for definitions of all terminology, and refer to Terrain map (Map 1) for complete terrain polygon labels (including drainage, permafrost and slope classes).

COFFEE GOLD PROJECT

Terrain Stability and Hazards

0 87.5 175 350 525 700 m

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Project number: 13103	KAMINAK GOLD CORPORATION
Projection: UTM Zone 7 Datum: NAD 1983 Units: metre	
Map 2	PALMER ENVIRONMENTAL CONSULTING GROUP INC.
Sheet 33 of 33	

Drawn by: CEB Checked by: RM 03/03/2016

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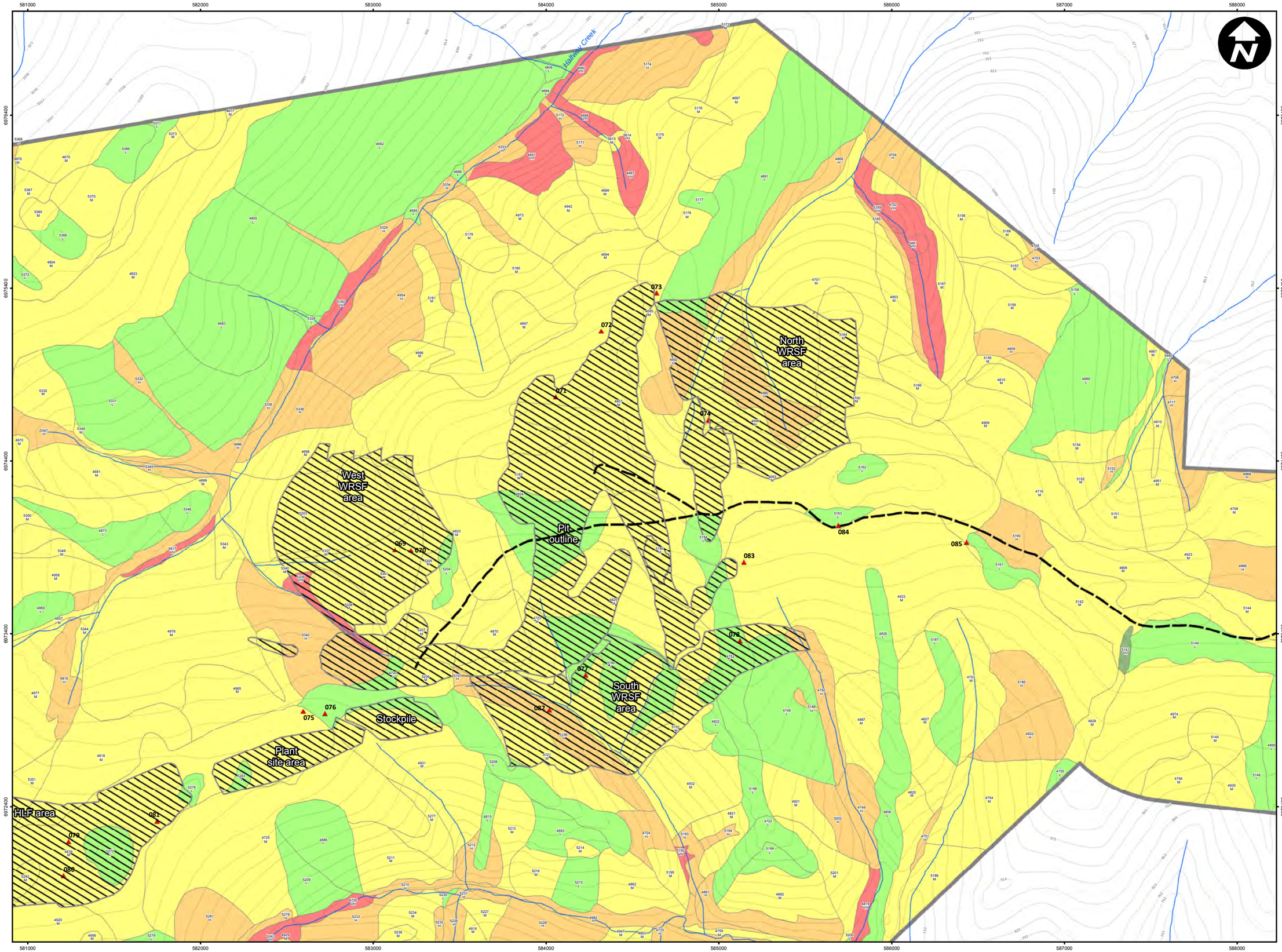
Appendix C

Map 3 – Soil Erosion Potential

Coffee Gold Project Soil Erosion Potential Map Code Definitions

Soil Erosion Potential Class

Symbol	Class	General criteria	Common terrain characteristics	Management implications
VL	very low		Bedrock; planar weathered bedrock; planar fluvial deposits without permafrost.	No or only very minor surface erosion within small areas of exposed soil on locally steeply sloping ground (e.g., creek banks); conventional surface runoff management appropriate.
L	low		Gently to moderately sloping weathered bedrock; gently to moderately sloping, permafrost free colluvial mantles; gently to moderately sloping, permafrost-free fluvial deposits.	Expect minor erosion of fine sediments along ditch lines, cut slopes and across disturbed soils; avoid channelling water toward more sensitive downslope units.
M	moderate		Planar to gently sloping organic material; gently to moderately sloping colluvial veneers with shallow or near-surface permafrost; gently sloping colluvial blankets with shallow or near-surface permafrost; moderately steep to steeply sloping, permafrost-free veneers and thin veneers; fluvial deposits with shallow or near-surface permafrost.	Expect moderate erosion when water is channelled down road surfaces or ditches (minor thermal erosion possible in areas of permafrost); plan for preventative and remedial actions in disturbed areas, including measures to minimize concentrated surface runoff in areas of permafrost and to trap sediments.
H	high		Moderately steeply sloping colluvial veneers; moderately to moderately steeply sloping colluvial blankets with shallow to near-surface permafrost; gently sloping colluvial complexes; ridgetop saddles with silt-rich colluvial veneer.	Significant erosion problems are expected when water is channelled onto or over exposed soil on these sites (moderate thermal erosion possible in areas of permafrost), particularly on cut slopes; plan for preventative and remedial actions in disturbed areas, including measures to minimize concentrated surface runoff in areas of permafrost and to trap sediments.
VH	very high		Steeply sloping colluvial mantles with shallow or near-surface permafrost; moderate to steeply sloping colluvial complexes.	Severe surface and gully erosion problems can be created when water is channelled onto or over these sites (major thermal erosion possible in areas of permafrost), particularly on cut slopes; erosion is commonly evident in natural conditions. If area not avoidable, minimize concentrated surface runoff in areas of permafrost, minimize extent and duration of soil exposure, and promptly stabilize soils with salvaged vegetation (e.g., moss) cover or appropriate erosion control measures.



Legend

SOIL EROSION POTENTIAL

- No rating assigned (anthropogenic)
- Very Low (VL)
- Low (L)
- Moderate (M)
- High (H)
- Very High (VH)

LABEL FORMAT

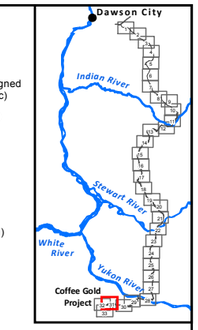
Unique polygon identifier

1

M

Soil erosion potential

- Study area
- Palmer Environmental detailed field site and ID
- Road centreline (includes existing and proposed sections)
- Proposed mine facilities
- Waterbody
- ~30 m topographic contour



Refer to "Soil Erosion Potential Code Definitions" at beginning of map book for definitions of all terminology, and refer to Terrain map (Map 1) for complete terrain polygon labels (including drainage, permafrost and slope classes).

COFFEE GOLD PROJECT

Soil Erosion Potential

0 87.5 175 350 525 700 m

1:20,000

Original page size: 11.00 x 17.00 in

Base mapping from Geomatics Yukon and Natural Resources Canada
Soil erosion potential mapping completed by D. Sacco, C. Brown and R. McKillop using softcopy photo-interpretation systems at a view (zoom) scale of 1:10,000, following field reconnaissance conducted in association with J. Coates (Krystek Arctic Innovation) in August 2015.

Project number: 13103

Projection: UTM Zone 7
Datum: NAD 1983
Units: metre

Map 3

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KAMINAK GOLD CORPORATION

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

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578000 579000 580000 581000 582000 583000 584000

6975400 6974400 6973400 6972400 6971400

Dan Keyan Creek

Halfway Creek

North WRSF area

West WRSF area

Pit outline

South WRSF area

Stockpile

Plant site area

Soil stockpile

HLF area

069 070 071 072 073 075 076 077 078 079 080 081 082

Legend

SOIL EROSION POTENTIAL

- No rating assigned (anthropogenic)
- Very Low (VL)
- Low (L)
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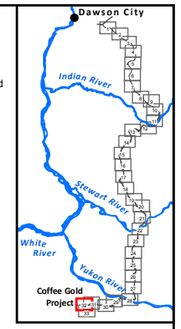

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Project number: 13103
Projection: UTM Zone 7
Datum: NAD 1983
Units: metre

KAMINAK GOLD CORPORATION

Map 3

Sheet 32 of 33

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

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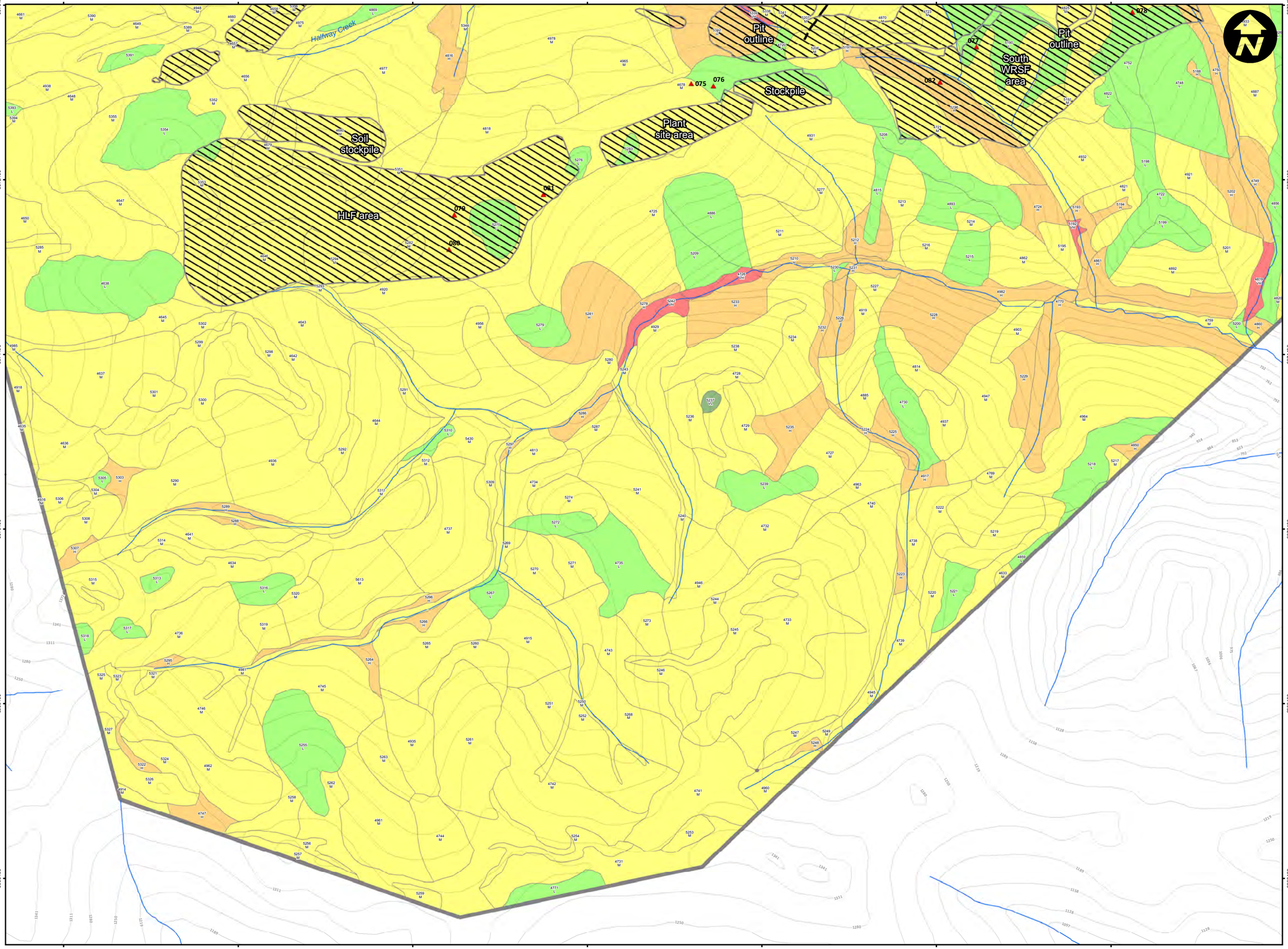

Legend

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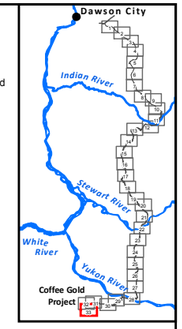

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Project number: 13103
Projection: UTM Zone 7
Datum: NAD 1983
Units: metre

Map 3

Sheet 33 of 33

KAMINAK GOLD CORPORATION

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Drawn by: CEB Checked by: RM 03/03/2016

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Appendix D

Terrain, Terrain Stability and Soils Field Data (Excel file submitted separately)

An electronic copy of this file has been provided with the digital version of the Project Proposal. The digital file is an Excel spreadsheet and contains 3 tabs as described below:

1. Site Tab - 98 rows (including header rows) and 25 columns describing general site conditions at each assessed location;
2. Terrain Tab - 98 rows (including header rows) and 10 columns describing terrain hazards and processes at each assessed location; and
3. Permafrost Tab - 98 rows (including header rows) and 8 columns describing permafrost conditions at each assessed location.

This document is available in digitial version only.

Appendix E

Tetra Tech EBA Technical Memo: Road Design Considerations in Areas of Permafrost

TETRA TECH EBA

TECHNICAL MEMO

ISSUED FOR REVIEW

To:	Robin McKillop, P. Geo.	**Date:**	March 3, 2016
c:	K. Jones, P. Eng., VP Arctic Development	**Memo No.:**	3
From:	V. Roujanski, P. Geol.	**File:**	704-ENG.EARC03004-01
Subject:	Geotechnical Considerations for Road Design in Areas Underlain by Permafrost		

This 'Issued for Review' document is provided solely for the purpose of client review and presents our interim findings and recommendations to date. Our usable findings and recommendations are provided only through an 'Issued for Use' document, which will be issued subsequent to this review. Final design should not be undertaken based on the interim recommendations made herein. Once our report is issued for use, the 'Issued for Review' document should be either returned to Tetra Tech EBA or destroyed.

1.0 INTRODUCTION

Tetra Tech EBA Inc. (Tetra Tech EBA) is pleased to submit this Memo to Palmer Environmental Consulting Group (PECG) regarding geotechnical considerations for the proposed all-season access road design in areas underlain by permafrost.

The proposed Kaminak access road route runs approximately 214 km from the Klondike Highway junction (Bear Creek) near Dawson City southward to the Coffee Property mine area.

2.0 PERMAFROST ALONG THE PROPOSED KAMINAK ROAD ALIGNMENT AND IN THE MINE AREA

2.1 Permafrost Distribution, Temperatures, Ice Content, and Related Geohazards

According to the Permafrost Map of Canada (Heginbottom, 1995) the proposed Kaminak road alignment is located within the zone of extensive discontinuous permafrost, in which 50 to 90% of the area is expected to be underlain by permafrost. Our calculations of permafrost distribution within the 200 m-wide proposed road corridor using ArcGIS technology show that approximately 56% of **the corridor area** is underlain by permafrost (9% - by very ice-rich permafrost, 12% - by permafrost with visible excess ice, and 17% - by predominantly ice-poor permafrost). Approximately 18% of **the corridor are**a is covered by placer tailings deposits and may include pockets of ice-rich material buried by the tailings and where the ground thermal regime was affected by mining. Approximately 44% of **the corridor area** is therefore estimated to be permafrost-free.

Permafrost thicknesses were measured with thermistor cables at the south end of the proposed access road, within the Coffee Mine area. The results are highly variable, ranging from approximately 30 m to 165 m thick.

Active layer thickness varies spatially and temporally. In areas with thicker insulating organic cover, it is usually thin (approximately 0.3 m to 0.6 m), whereas it can be several metres thick within partially exposed bedrock or within coarse surficial material with a high clast content.

At the south end of the proposed Kaminak road alignment, within the Coffee Mine area, permafrost temperatures were measured with thermistor cables, as well as with temperature sensors on vibrating wire piezometers. At the

Tetra Tech EBA Inc.
14940 - 123 Avenue
Edmonton, AB T5V 1B4 CANADA
Tel 780.451.2121 Fax 780.454.5688

depth of zero seasonal temperature variation, ground temperatures range from -0.6ºC to -2ºC. The permafrost classification for the road within the Coffee Mine area is thus “warm”.

Ground ice content (percent by volume) of the perennially frozen surficial materials along the proposed road alignment is highly variable, i.e. ground ice that is predominantly:

- not visible (Nf, Nbn, Nbe): This is generally ice-poor permafrost;
- visible excess ice (Vx, Vc, Vr, Vs): This moderately to ice-rich permafrost is well-bonded but rarely includes large ground ice bodies; or
- forming significant accumulations, such as ice wedges and other massive ice bodies: This is very ice-rich permafrost.

Warm permafrost temperatures along the proposed road alignment mean that areas underlain by ice-rich perennially frozen ground are sensitive to any kind of natural or manmade disturbance. As a consequence, one of the permafrost-related geohazards within the project area is thermokarst, which could be triggered by construction activities or by natural processes, such as forest fires. Development of thermokarst can be accompanied by thermal erosion, subsidence, and mass wasting of thawing ice-rich organic and fine-grained mineral soils.

2.2 Permafrost and Geotechnical Considerations for Road Design and Construction

Although every effort was made to avoid areas of thaw-sensitive perennially frozen soils when selecting the proposed road route, in some cases this was not possible and some sections of the selected road alignment cross areas underlain by warm ice-rich permafrost as shown on the Map of Permafrost Distribution Along Proposed Kaminak Road Alignment (Roujanski and McCuaig, 2016). Approximately 14 km of the 214 km-long road is founded on very ice-rich permafrost and approximately 24 km – on ice-rich permafrost. Road construction in such areas can cause a change in heat exchange at the ground surface and a change in the existing thermal regime of the ground. This may lead to thaw degradation of ice-rich permafrost in the subgrade, i.e. gradual melting of ground ice beneath the road. The resulting differential settlement may cause sharp dips in the road surface, progressively widening cracks and, less commonly, sinkholes where massive ice bodies previously existed. Thawing and settlement may continue for years until the ice has melted, thawing has stopped, or road fill bridges the resulting voids (Andersland and Ladanyi, 2004).

Within the areas of active or recent placer mining in the valley bottoms, the proposed alignment often follows existing mining access roads or crosses extensive areas covered by placer mining tailings. The ice-rich material within these disturbed sections has been mostly removed and the road maintenance costs are expected to be low. However, pockets of the ice-rich material may exist and will require special consideration for design.

In general, there are two approaches for the design of roads in permafrost areas (Johnston, 1981; Crory, 1991, McGregor et al., 2010):

1. **Passive Approach**: Provide full thermal protection to maintain permafrost in its frozen condition; or
2. **Active Approach**: Provide for limited thaw penetration into the underlying subgrade where preservation of permafrost is not possible or practicable and the consequences of thaw are allowed for in the design.

Both approaches may be employed on any appreciable length of the proposed road alignment.

A passive approach should be employed along those sections of the proposed road alignment that cross areas underlain by ice-rich permafrost, such as bottoms of creek valleys infilled with perennially frozen very ice-rich silt

(loess), interbedded with, and/or overlain by, organic material, known as “black muck”. Geotechnical considerations for the road design within such sections are as follows:

- Cuts and ditches are avoided wherever possible;
- Movement of equipment used for clearing the Right-of-Way (ROW) should be controlled or prohibited to keep the terrain disturbance to a minimum and to preserve the organic mat;
- The snow cover is carefully removed before construction of the embankment in a winter operation to reduce settlement of the fill during the thaw period;
- The embankment should be constructed by the end dumping method so that the vegetation cover will not be damaged by hauling equipment;
- High fills and sideslope alignments are avoided wherever possible;
- For conceptual design purposes, embankment thickness should be at least 2.0 m, placed on heavy weight, non-woven geotextile, to protect the subgrade from thawing;
- Flat horizontal and vertical curves and gradients not exceeding 8% are highly desirable;
- Drainage should be controlled to prevent water ponding along the toe of the embankment. This will allow the thermal regime of the frozen subgrade to be maintained. If runoff water must be collected and channelized, it should be done at a reasonable distance from the embankment (>10 m); and
- Snow accumulation should be prevented on the lee side of higher sections of the road embankment to maintain thermal regime of the frozen subgrade.

Basic principles for thermal design of embankments to preserve the permafrost include the following (McGregor et al., 2010):

- Favourable thermal conditions should be imposed and maintained underneath the structural core of the embankment; and
- Thermal design is required to ensure raised or at least maintained permafrost levels beneath the core of the embankment.

3.0 CONCLUSIONS

The proposed Kaminak access road route runs approximately 214 km across the zone of extensive discontinuous permafrost, in which approximately 21% of **the corridor area** is underlain by ice-rich to very ice-rich permafrost. Approximately 14 km of the 214 km-long road founded on very ice-rich permafrost and approximately 24 km – on ice-rich permafrost. Sections of the proposed alignment crossing thaw sensitive permafrost terrain will require special geotechnical considerations.

These include adequate thermal protection of ice-rich permafrost in the subgrade by avoiding cuts and ditching, minimizing terrain disturbance during clearing ROW, preserving the insulating organic mat, using special road construction methods (the end dumping), removing snow, and drainage control along the embankment.

4.0 REFERENCES

Andersland, O.B. and Ladanyi, B. 2004. *Frozen Ground Engineering, 2nd ed*., John Wiley & Sons, Hoboken, New Jersey.

Crory, F.E., 1991. Construction Guidelines for Oil and Gas Exploration in Northern Alaska. U.S. Army Cold Regions Research and Engineering Laboratory CRREL Report 91-21.

Heginbottom, J.A. (compiler). 1995. *Canada Permafrost.* Canada Centre for Mapping, Geomatics Canada and Geological Survey of Canada, Map MCR 4177, scale 1:7,500,000.

Johnston, G.H., ed. 1981. *Permafrost Engineering Design and Construction.* Toronto: John Wiley & Sons.

McGregor, R., Hayley, D.W., Wilkins, G., Hoeve, E., Grozic, E., Roujanski, V., and Jansen, A. 2010. *Guidelines for Development and Management of Transportation Infrastructure in Permafrost Regions.* Transportation Association of Canada.

Roujanski, V.E. and McCuaig, S. 2016. Map of Permafrost Distribution Along Proposed Kaminak Road Alignment (15 sheets), Scale 1:15 000, Tetra Tech EBA, Submitted to Kaminak Gold Corporation.

APPENDIX B

2021 Hydrometeorology Baseline Report

Newmont
COFFEE



Coffee Gold Project: 2021 Hydro-meteorology Baseline Report

Project No. A362-3
January 27, 2022

LORAX ENVIRONMENTAL

Executive Summary

Newmont™
COFFEE

Executive Summary

The prevailing climate conditions at the Project site are typical for central Yukon. Average annual temperature at the proposed undertaking (~1,300 m above sea level) is -2.6 °C, with average monthly air temperatures that range from -15°C (December) to +14°C (July). Locally, the Project site experiences notable temperature inversions in the winter months, with observed ridgetop temperatures up to 10°C higher than measurements recorded at valley bottom locations.

Mean annual precipitation at 1,300 m is estimated to be 504 mm, with rainfall comprising 67% of this total precipitation during the months of April through mid-October, and the remaining 33% occurring as snow from late-October through March. Precipitation gradients were ascertained by inspecting site and regional precipitation data and were established as follows: 4%/100 m elevation gain for rainfall; and 7%/100 m elevation gain for snow.

Annual potential evaporation (PE) for the Project area is estimated to be approximately 460-480 mm, with monthly rates highest in May, June, July, and August (roughly 70 to 110 mm per month) and considerably lower for autumn, winter, and spring months. Consistent with other studies in the Yukon, the evapotranspiration estimate for the Coffee Gold site is roughly 40% of the assumed PE value or 170 mm per year. Results for other climate/weather parameters, including wind speed and direction, relative humidity, solar radiation, and atmospheric pressure are presented in Section 4 of this report.

Local patterns of streamflow are dominated by a snowmelt freshet that typically occurs between late April and early June. Following freshet, patterns of streamflow are punctuated by several rainfall-induced runoff events which occur throughout the summer and autumn. In general, these high flow events are short duration, persisting usually for a 1 or 2-day time period. Flows in local creeks and streams abate in October in response to freezing temperatures and it is notable that local watersheds typically experience zero flow conditions throughout the winter (*i.e.,* November through end March). Aufeis (*i.e.,* frozen groundwater seepage that accumulates within, and adjacent to, local watercourses) is pervasive in creeks and streams at the Project site and melts during the freshet but can persist into the early summer.

Based on measurements at Coffee Creek hydrometric stations, average unit yields across the Project site are 10.6 L/s/km^2 for the open water season (May to October) and range from 4 to 16 L/s/km^2, with specifics of the runoff regime for each monitoring station being dependent on drainage characteristics (*i.e.,* basin area, shape, mean elevation, extent of

permafrost, *etc.*). Unit yields range from 2.0 - 5.1 L/s/km^2 in October and decrease steadily to annual minima in March (*i.e.,* 0 - 0.7 L/s/km^2), before increasing again in April in response to low-elevation snow melt and spring rains. At Coffee Creek, instantaneous peak flows, expressed as unit yields, are typically between 120 and 200 L/s/km^2, but measurements vary widely across the site (from 60 to >300 L/s/km^2).

As part of the baseline study, site-specific and regional hydrometric data were analyzed in combination to: (1) place the relatively short period of record for Coffee Creek into a broader context; (2) generate long-term (*i.e.*, 30+ year) synthetic climate and discharge records for the Project area; and (3) to compute robust climate and flow metrics (*e.g.*, extreme rainfall depths; instantaneous peak flows; low flows for various return periods) from the combined site and regional information. Methods related to these hydrometeorological analyses are presented in Section 2 and Section 3. Results are presented in Section 4 and Section 4.5 of the report and are carried forward to inform engineering and design studies related to the mine and water management plan and to construct and calibrate a site-wide water balance and water quality model for the Coffee Gold Project.

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Newmont™
COFFEE

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1. Introduction

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COFFEE

1. Introduction

1.1 Project Background

Newmont Corporation (Newmont) is in the process of developing and permitting the Coffee Gold Project (the "Project"), a proposed heap leach operation located in west-central Yukon, approximately 130 km south of Dawson City (Figure 1-1). The Project is located in the Yukon-Tanana Terrane (YTT), an accreted pericratonic rock sequence that covers a large portion of the Omineca Belt in the Yukon and extends into Alaska and British Columbia. The Project has undergone a detailed Feasibility Study (Coffee Gold 43-101 FS) with project engineering and mine design progressing forward with full consideration of the environmental conditions at the property.

The Coffee Gold Project is amenable to development as an open pit mine with gold recovery recommended by heap leach mining methods. The general arrangement for the Coffee Project, includes the following major infrastructure: primary and secondary crushing facilities; a carbon adsorption plant; a gold refinery; the heap leach facilities; waste rock storage facilities (WRSF); open and backfilled pits; water drainage structures and storage ponds; haul roads; an accommodations complex; and an all-weather airstrip.

The open pits associated with the Project are the Latte, Double, Supremo and Kona pits (Figure 1-2). Waste rock associated with the undertaking is proposed to be placed in one main facility (Alpha WRSF), with additional backfill of waste in Latte, Double, Kona, and Supremo (SU1) pits. Proposed pits and WRSFs are all situated at high elevation (*i.e.*, median drainage basin elevations range from 945 to 1,220 m asl), and are proposed to be situated either on, or adjacent to, headwater tributaries of the Halfway Creek, Latte Creek and YT-24 (an unnamed tributary of the Yukon River) watersheds.

In parallel to exploration activities and feasibility studies, Newmont has resourced a full suite of baseline programs (*e.g.*, meteorology, hydrology, surface water quality, groundwater, soils, air, fish and fish habitat, wildlife) to support the preparation of an already submitted Project Proposal and related regulatory submissions to the Government of Yukon. Each year since 2010, monthly site visits have been undertaken that focus on the core activities comprising the baseline climate and hydrology monitoring programs, including: downloading data from automated weather stations; completing snow course surveys; collecting stage and discharge measurements to validate and enhance rating curves; undertaking hydrometric station data download and maintenance tasks; completion of benchmarking and levelling surveys; and, expanding the monitoring programs over time to include new stations, as required.

1.2 Climate and Streamflow Study Objectives

The objectives of the baseline meteorology and surface hydrology studies are as follows:

- To collect high-quality climate/streamflow data from a representative suite of Project area watersheds/locations;
- To describe runoff generation processes in the context of local climate conditions (*e.g.,* snow accumulation, timing of snowmelt, basin response to summer rainfall) and physiography (*e.g.,* basin size, basin storage, the influence of permafrost, land cover, elevation, and aspect).
- To present relevant metrics for local watersheds including low flow, peak flow, and unit yield estimates for Project site streams; annual and monthly precipitation depth summaries, including snow survey results; and annual and monthly air temperature records and typical rates of evaporation.
- To combine site-specific climate/hydrometric data with regional data sources (*i.e.,* Alaska/Yukon climate and flow monitoring data) to estimate inter-annual streamflow variability, recurrence intervals for low and peak flows, and to quantify extreme precipitation depths (*e.g.*, 1:100 year, 24-hour rainfall event).
- To generate the climate/hydrology datasets that will inform economic/engineering studies (*e.g.*, heap leach facility design) and be used to construct and calibrate the site-wide water balance and water quality model (Lorax, 2021) developed to advance Project permitting.

1.3 Overview of the Climate and Streamflow Monitoring Networks

The baseline surface hydrology monitoring study was initiated at Coffee Creek in autumn 2010, with the baseline meteorology study commencing later, in July 2012. These two monitoring programs remain fully operational, with data collection scheduled to continue through the assessment and licensing phases of the Project timeline. As of December 2021, Newmont possesses 9+ years of climate data and more than eight years of hydrometric data from the Project site.

Prior to 2014, baseline data collection for the meteorology and hydrology disciplines was led by Access Consulting Group, an environmental services firm operating out of Whitehorse, YT. Access Consulting Group established a high-elevation automated weather station (975 m asl), established snow courses at various elevations/aspects around the study site and selected eleven surface monitoring stations for flow and water quality measurement.

In spring of 2014, Lorax Environmental Services Ltd. (Vancouver) and Laberge Environmental Services (Whitehorse) assumed responsibility for the baseline meteorology and hydrology programs. Lorax and Laberge enhanced the existing baseline hydrology study by adding five new hydrometric stations to the monitoring network and by upgrading several of the flow monitoring stations with instrumentation to estimate continuous stream. The monitoring stations added to the network gauge streamflow from headwater tributaries, with several of the gauges sited at locations downstream of proposed open pits, waste rock storage and heap leach facilities.

In 2015, several additional flow monitoring sites were added on Halfway Creek, on YT-24 tributary and on Upper Latte Creek. Sampling of these sites was initiated to further refine the apparent chemical attenuation of certain parameters along these reaches, as well to determine whether reaches were gaining (streamflow increases from groundwater inputs) or losing (streamflow reductions due to infiltration to groundwater) tributaries. Monthly water quality samples and manual flow measurements (when possible) were taken from 2015 through present at these stations. In the summer of 2016, staff gauges, benchmarks, stilling wells and continuous water level recorders were installed at two of the stations.

As a complement to the automated station weather station installed in 2012, Newmont installed a second weather station adjacent the proposed heap leach facility in autumn 2018. The new weather station includes a full suite of climate sensors (*e.g.*, air temperature, relative humidity, wind speed and direction, precipitation, atmospheric pressure, solar radiation) and is situated at an elevation of approximately 1,340 m asl.

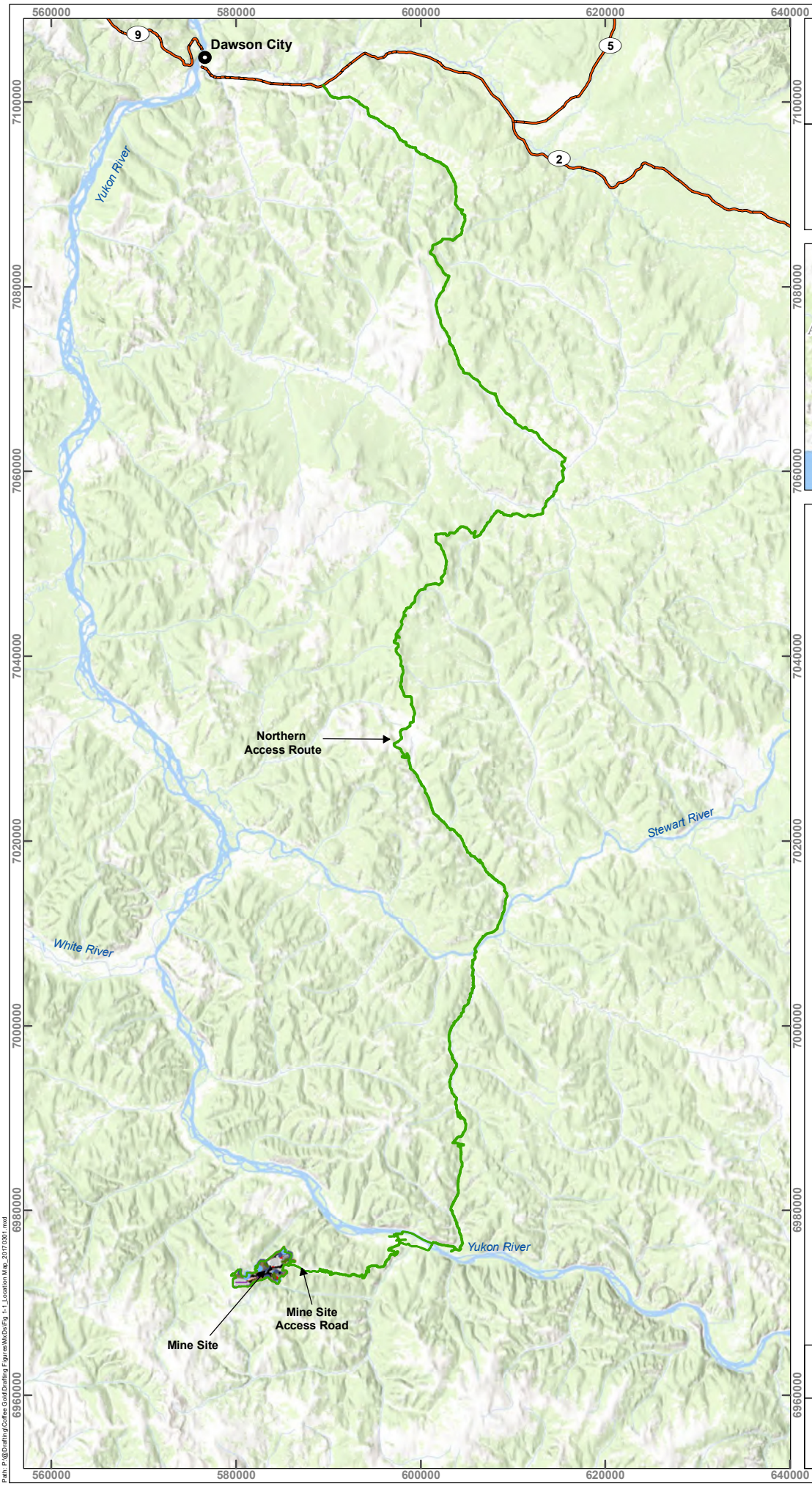
Given the large volume and long duration of the baseline hydrometeorological datasets, and due in part to the onset of the COVID-19 pandemic, site visits were scaled back to quarterly trips in the winter of 2020 and have continued at this frequency throughout 2021.

1.4 Report Structure

Sections of the report that follow build upon and update the baseline hydrometeorology report submitted in March 2017 as part of the Project Proposal submission (Lorax, 2017). The layout of the report is as follows:

- Sources of information, monitoring methods and any discussion related to derived outputs for the meteorology and hydrology disciplines are presented in Section 2 and Section 3 of the report, respectively.
- Section 4 and Section 4.5 presents baseline study results for the climate and streamflow disciplines, respectively.
- Main findings and a summary are presented in Section 6.

- Appended to the report are several technical memos and data summaries (see Appendix A through Appendix E) that contain the following information:
  - Appendix A presents summaries of the synthetic climate data assembled for the Project site, derived by combing site- and regional data sources. These synthetic climate data are direct inputs to the site-wide water balance and water quality models for the Project.
  - Climate change scenario data and results relevant to the Project site are summarized in Appendix B.
  - Appendix C is the primary repository for measured hydrometric data and associated metadata collected at the Project site.
  - Appendix D presents synthetic streamflow data for eleven baseline monitoring stations at the Project site.
  - Summaries of regional streamflow data relevant to the Coffee Gold Project are summarized in Appendix E.



COFFEE PROJECT

Location Map, General Arrangement for the Coffee Project



Legend

- Highway
- Coffee Gold Project Footprint

N

1:600,000

0 5 10 15

Kilometres

NAD 1983 UTM Zone 8N

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Figure 1-1	Date: Mar 1, 2017	Drawn by: G.M.	Reviewed: J.S./L.F.

Newmont™ COFFEE

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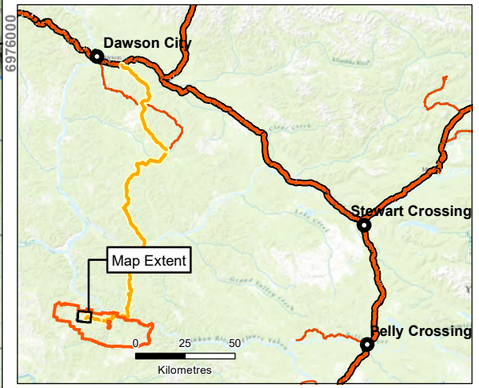
COFFEE GOLD MINE

Mine Plan



Legend

- Municipalities
- Highways
- Existing Road
- Coffee Property
- Waterbody
- Watercourse

Proposed Infrastructure

- WRSF/Backfill
- Pit
- Heap Leach
- Soil Stockpile
- Northern Access Route

N

1:20,000

0 400 800 1,200

Meters

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 1-2	Date: Jun 19, 2019	Drawn by: AL	Reviewed: SJ/DF

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2. Climate Monitoring and Methods

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2. Climate Monitoring and Methods

2.1 Site Meteorological Data

The locations of automated weather stations, standalone tipping bucket rain gauges and snow courses at the Coffee Gold Project are summarized by Figure 2-1 and Table 2-1. At present, there are two active- and continuously recording climate stations, and two standalone tipping bucket rain gauge stations, the latter two gauges being in operation until 2018. There is also a comprehensive network of snow course stations at the property, with sample stations positioned to capture variability in snow accumulation with elevation and aspect change.

2.1.1 Automated Weather Stations and Rainfall Gauges

Details related to the automated weather station installations at the Coffee Gold Project include the following:

- A weather station was installed adjacent to the mine acess road, between Camp and the proposed heap leach facility in July 2012. Referred to as the Km 11 weather station, this installation is situated at elevation 975 m asl (Figure 2-2).
    - Climate monitoring at this station includes sensors deployed to measure air temperature (min, max, avg), relative humidity (min, max), wind speed (average, gust) and direction, incoming solar radiation, barometric pressure, and precipitation.
        - Rainfall data are measured at the station using a tipping bucket rain gauge.
        - In the winter, a snowfall conversion adaptor is deployed at the gauge to measure snowfall. An alter shield surrounds the precitation gauge to minimize wind turbulence and reduce gauge undercatch.
    - Climate sensors are sampled at 10-second frequency with observations recorded to the central Campbell Scientific datalogger at an hourly time step.
- Two standalone tipping bucket rain gauges were installed at the property in 2015 and operated through 2018. The gauges were installed at Coffee Camp (elevation 450 m asl) and adjacent to the high-elevation laydown (approximately 1,250 m asl) for the purpose of collecting supplementary rainfall depth data (May-October) and quantifying rainfall gradients (*i.e.*, percent increase in rainfall per 100 m elevation gain) at the mine site.

- A second automated weather station was installed at high elevation (~1,340 m asl) and adjacent the proposed heap leach pad footprint (*i.e.*, ~400 m to the northwest of the HLF) in October 2018. This station is equipped with a satellite transmitter, which uploads the climate data to a web server on an hourly basis. This will allow real-time assessment of station performance (*e.g.*, battery health and reliable sensor behaviour) and upper elevation climate conditions in support of exploration and mining operations.
    - Measured parameters at the Kona climate station include air temperature, relative humidity, wind speed/direction, precipitation, snow depth, solar radiation and barometric pressure (Table 2-2, Figure 2-3).
    - The central datalogger is equipped with a satellite transceiver, which enables real-time communication with the climate station.

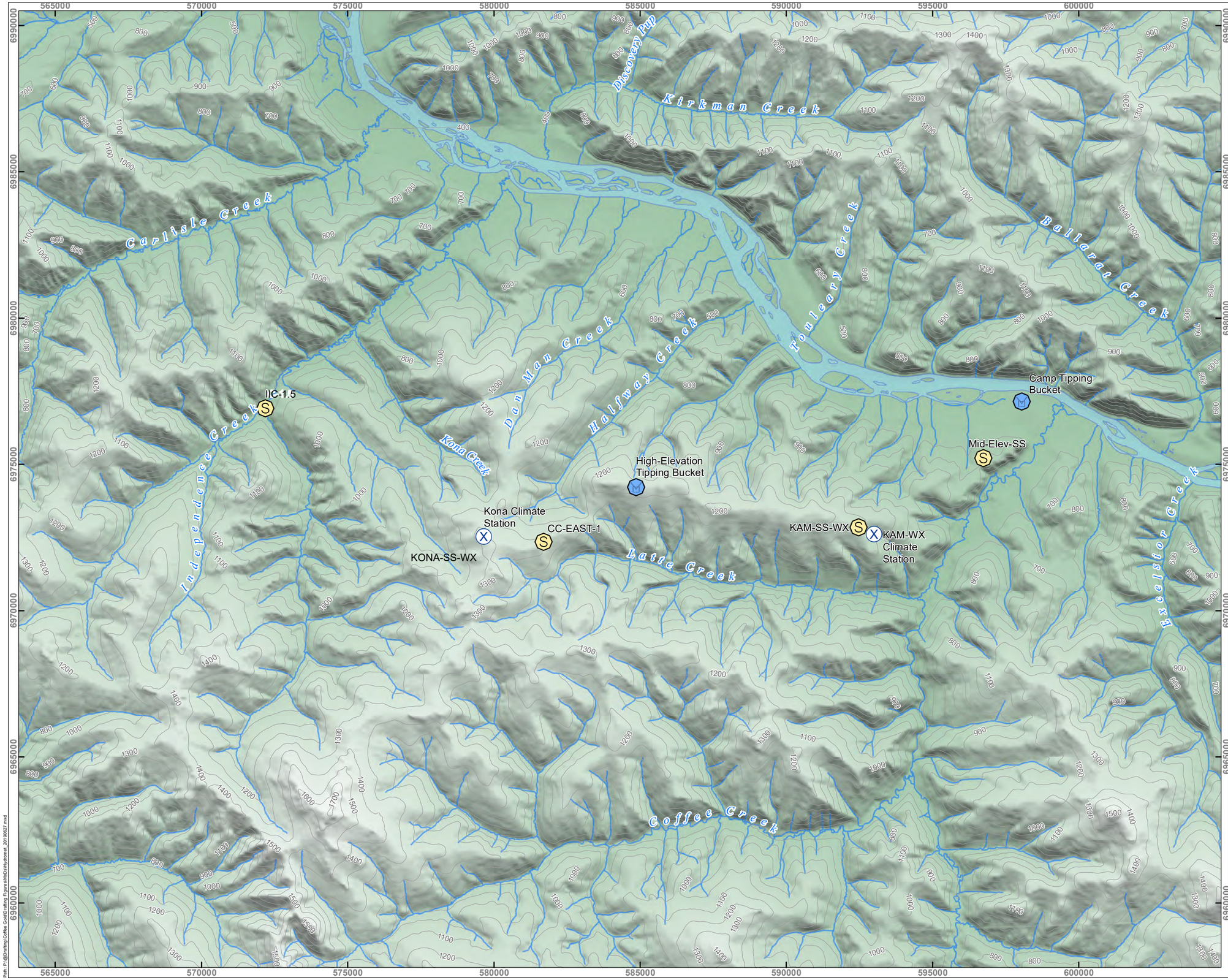
Newmont intends to operate the Kona weather station in parallel with the original baseline climate station for several years. Overlapping climate data from these two weather stations, as well as any supplementary precipitation data collected at standalone rain gauges and snow courses, will be used to update the characterization of the site climatic regime, and refine the water balance models accordingly.

2.1.2 Snow Course Sampling

Each year of the baseline meteorology study snow course measurements were carried out at the property following Territory protocols. As shown in Figure 2-1, site snow courses were established at various elevations (*i.e.*, low, mid and high elevation) and oriented to discern effects of aspect on local snow accumulation (Table 2-3).

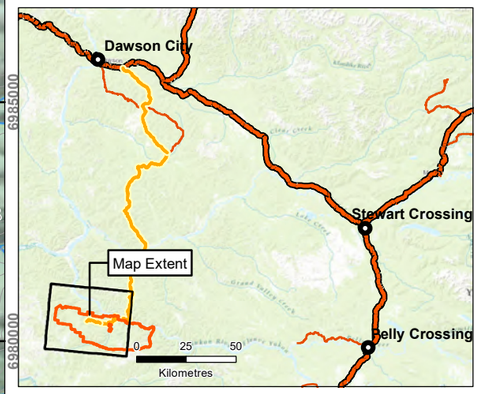
Sampling involves recording measurements of snow depth and snow water equivalent (SWE) along a 10-point transect (Figure 2-4). Snow courses were surveyed at, or near, peak seasonal accumulation (*i.e.*, Feb. 1, Mar. 1, Apr. 1) with surveys timed to coincide with regional monitoring undertaken by agencies in Alaska and Yukon. Field measurements are taken using a Federal Snow Sampling kit, which is comprised of several sampling tubes, a driving handle, calibrated spring scale (with graduated units in centimeters of water) and weighing cradle.

As a complement to the baseline snow monitoring stations, short duration but intensive snow sampling studies have been undertaken at Project area. Data collection of this nature typically informs specific engineering or modelling assumptions related to mine/water management facilities. For example, five snow course stations were established and sampled in 2018 and 2019 to resolve the spatial variability of snowpack conditions in the Halfway Creek drainage near the proposed footprint of the Alpha waste rock storage facility (WRSF; Table 2-4).



COFFEE GOLD MINE

Weather Stations and Snow Course Locations, Coffee Gold Project



Legend

- Automated Weather Station
- Snow Course
- Tipping Bucket Rain Gauge
- Watercourse

N

1:125,000

0 400800 1,200

Meters

NAD 1983 UTM Zone 7N

Page Size: 11" x 17"

Figure 2-1	Date: Jun 27, 2019	Drawn by: AL	Reviewed: CF

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Table 2-1:
Weather Station and Active Snow Course Stations, Coffee Gold Project

Station	Type	Latitude (°)	Longitude (°)	Elevation (m)	Parameters
IC-1.5	Snow Course	62.915	-139.579	524	SD, SWE, Density
CC-EAST-1	Snow Course	62.872	-139.394	1,220	SD, SWE, Density
KAM-SS-WX (Km 11)	Snow Course	62.873	-139.180	996	SD, SWE, Density
KAM-WX (Km 11) Climate Station	Automated Weather Station	62.873	-139.180	975	T, RH, P, PR, WSp, WDir, SolR
Mid-Elev-SS	Snow Course	62.894	-139.097	638	SD, SWE, Density
Kona-SS-WX	Snow Course	62.874	-139.434	1,340	SD, SWE, Density
Kona-WX Climate Station	Automated Weather Station	62.874	-139.434	1,340	T, RH, P, PR, WSp, WDir, SDpt, SolR
Camp Tipping Bucket	Tipping Bucket Rain Gauge	62.911	-139.070	430	RF, T
High-Elevation Tipping Bucket	Tipping Bucket Rain Gauge	62.888	-139.331	1250	RF, T

Notes:
SD - snow depth; SWE – snow water equivalent; T – air temperature; RH – relative humidity; P – atmospheric pressure; PR – precipitation (as either rain or snow); WSp – wind speed; WDir – wind direction; SolR – solar radiation; SDpt – snow depth; and RF – rainfall.



Figure 2-2: Km 11 climate station (elevation 975 m asl) – Coffee Gold Project.



Figure 2-3: Kona climate station (elevation 1,340 m asl)



Figure 2-4: Snow course sampling in April 2015.

Table 2-2:
Sensor specifications, Kona Climate Station, Coffee Gold Project.

System Component	Description	Make/Model	Unit of Measure
Datalogger, Tower, Power	H2 Datalogger	H2-TLM-2	--
	Solar Panel Kit, 20W, Mount plus cable to datalogger	SPS-20W-F6H2	--
	Tower – Tri-leg, Self Supporting, 10m mast	TOWER-TRILEG-10M	--
	Portable winch for 10 m mast	TRILEG-TOWER-10M WINCH	--
Sensors	Wind Speed & Direction, SDI, Alpine, 50ft Armoured	SDI-WS-RMY-A	m/s, deg (0 to 360)
	Wind Sensor Mount, RM Young, Trileg & Handar Tower	SS-RMY-TRI	%
	Temp Humidity Sensor, Shield	THS-3-10	°C. %
	Barometric Pressure Sensor	SDI-BP-1	m
	Snow Depth Sensor, Acoustic, Mount, 35 ft Cable	SDI-SR50	m
	All Weather Precipitation Gauge, 400cm/750mm	SDI-AWP-400	mm
	Wind Shield for AWP Gauge	AWP-WS-1.5M Wind Shield	--
	AWP Gauge, 1.5m Pedestal	19072 Pedestal	--
	Solar Radiation Sensor	SDI-SR-CMP10-M	W/m^2

Table 2-3:
Coffee Gold Project, Snow course monitoring locations (2012-2021).

Station	Record Period	Months	Elevation (m	Aspect	Latitude	Longitude
IC-4.5-SS Flat	2012-2015	Jan, Feb, Mar,	399	VB	62.969	-139.434
IC-1.5-SS	2012-2013, 2015-	Feb, Mar, Apr	524	VB	62.915	-139.579
CC-1.5-SS	2012-2013, 2015	Feb, Mar, Apr	733	N	62.865	-139.328
CC-north-1	2012-2013, 2015	Feb, Mar, Apr	1,227	N	62.891	-139.31
CC-north-2	2012-2013	Mar, Apr	1,220	S	62.891	-139.31
CC-east-1	2012-2013, 2015-	Feb, Mar, Apr	1,220	E	62.872	-139.394
CC-east-2	2012-2013	Feb, Mar, Apr	1,197	E	62.871	-139.392
CC-east-3	2012-2013	Feb, Mar, Apr	1,193	N	62.871	-139.391
CC-South-1	2012-2013, 2015	Feb, Mar, Apr	1,260	S	62.887	-139.311
CC-South-2	2012-2013	Feb, Mar, Apr	1,246	S	62.886	-139.311
CC-west-1	2012-2013, 2015	Feb, Mar, Apr	1,278	W	62.89	-139.356
CC-west-2	2012-2013	Mar, Apr	1,257	W	62.89	-139.358
CC-west-3	2012-2013	Apr	1,232	W	62.891	-139.36
KAM-SS-	2014	Apr	987	ENE	62.885	-139.585
KAM-SS-	2014	Apr	994	N	62.883	-139.386
KAM-SS-WX	2014-2021	Jan, Mar, Apr	996	SSE	62.873	-139.18
KONA-	2021	Mar, Apr,	1,340	FLAT	62.875	-139.435
KAM-SS-	2014	Apr	1,020	W	62.889	-139.374
KAM-SS-	2014	Apr	1,184	N	62.874	-139.389
Mid-Elev-SS	2015-2021	Mar, Apr	638	NW	62.894	-139.097

Notes:
VB – indicates valley bottom

Table 2-4:
Halfway Creek monitoring investigation (2018) - snow course stations.

Snow Course #	Northing (m)	Easting (m)	Elevation (m asl)
HC-1_SS	6,974,215	581,845	935
HC-3_SS	6,974,327	582,614	945
HC-2_SS	6,973,978	582,494	984
HC-4_SS	6,973,456	582,506	1,033
HC-5_SS	6,973,927	583,223	1,150

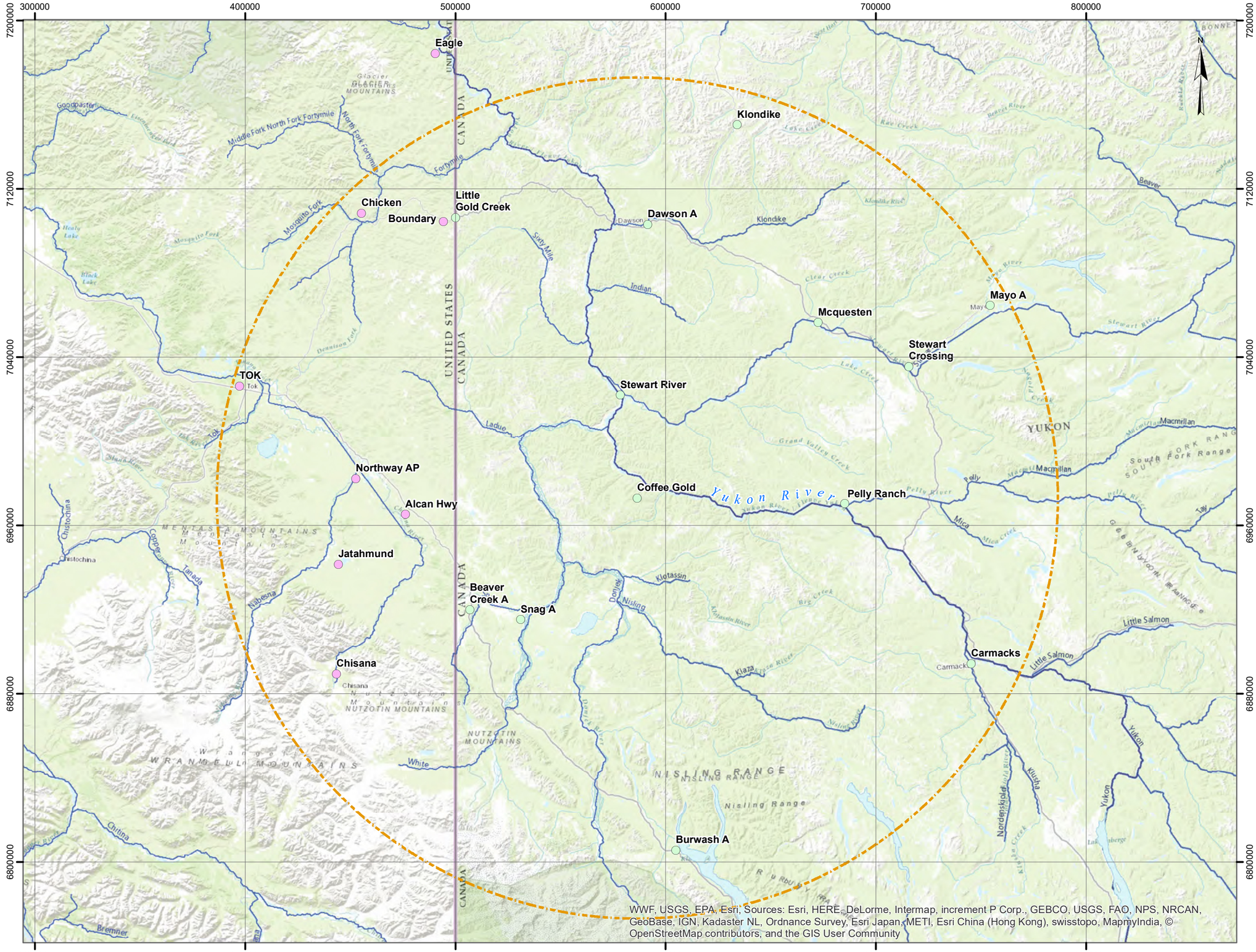
2.2 Regional Climate Data

Climate data relevant to the Coffee Gold Project is available from a suite of monitoring networks operated by both Federal and State/Territorial governments in the Yukon and Alaska (refer to Table 2-5 and Figure 2-5). For example, weather stations operated by Environment Canada in the Yukon and the National Oceanic and Atmosphere Administration (NOAA) in Alaska were assessed to verify site measurements of precipitation and conduct frequency analyses (*e.g.*, recurrence interval estimates of 24-hr rainfall). Additionally, snow data from stations operated by the Yukon Snow Survey Network and the SNOTEL network operated by the Natural Resources Conservation Service (NRCS) in Alaska were used to provide context and validate site data; conduct frequency analyses and resolve average and extreme snowpack melt rates.

Table 2-5:
Regional climate stations near the Coffee Gold Project

Station Name	ID	Elev.	Dist. From Project	Record Period	Territory /State	Lat.	Long.	Mean Annual Temperature	Mean Annual Precipitation	Rain / Snow
		(m asl)	(km)			(°)	(°)	(°C)	(mm)	%
COFFEE GOLD, Km11		975	0	2012-2021	YT	62.8745	-139.1819	-2.2	331	74 / 26
COFFEE GOLD, Kona		1,340	0	2018-2021	YT	62.874	-139.434	-2.6	398	70 / 30
CASINO CREEK	2100310	1100	30	1969-1995	YT	62.7167	-138.8167	-4.4	399.0	65 / 35
STEWART RIVER	2101033	358	50	1976-1993	YT	63.3170	-139.4330	-2.3	321.0	62 / 38
PELLY RANCH[1]	2100880	454	81	1952-2021	YT	62.8167	-137.3667	-3.1	320.5	64 / 36
PORT ALCAN[1]	507513	585	91	1985-2021	AK	62.6167	-141.0000	-4.2	294.4	74 /26
BEAVER CREEK	2100160	649	96	1968-2015	YT	62.4103	-140.8675	-4.9	417.3	--[4]
ALCAN HWY	500726	549	111	1990-2021	AK	62.8167	-141.4667	-0.5	259.8	--[4]
MCQUESTEN[1]	2100719	458	118	1987-2014	YT	63.5942	-137.5225	-3.3	344.1	61 / 39
DAWSON A[1]	2100402	370	130	1901-2021	YT	64.0431	-139.1278	-4.1	324.4	62 / 38
SNAG	2101000	587	131	1943-1966	YT	62.0333	-137.5167	-5.8	362.0	65 / 35
NORTHWAY[1]	506586	522	132	1940-2021	AK	62.9617	-141.9380	-4.8	267.5	80 /20
JATAHMUND	500936	701	146	1990-2021	AK	62.6000	-142.0833	-0.4	334.8	--[4]
STEWART CROSSING	2101030	480	150	1963-2008	YT	63.3830	-136.6830	-4.2	299.0	65 / 35
LITTLE GOLD CREEK	2100690	1257	155	1974-1999	YT	64.0830	-141.0000	--[4]	--[4]	--[4]
BOUNDARY	500910	793	161	1949-1957	AK	64.0667	-141.1167	-5.3	340.6	--[4]
CHISANA	500933	1011	165	1988-2021	AK	62.1333	-142.0833	-4.3	236.2	--[4]
BURWASH[1]	2100182	807	173	1967-2021	YT	61.3667	-139.0500	-3.2	274.7	71 / 29
CARMACKS	2100300	525	180	1963-2007	YT	62.1000	-136.3000	-2.7	278.2	68 / 32
MAYO[1]	2100700	504	180	1925-2021	YT	63.6167	-135.8667	-2.4	313.5	65 / 35
KLONDIKE	2100679	973	185	1966-2010	YT	64.4530	-138.2160	-6.2	354.0	50 / 50
CHICKEN	500747	548	190	1998-2021	AK	64.1000	-141.9167	-3.5	359.5	--[4]
TOK 70 SE[1,3]	509313	495	193	2005-2021	AK	63.3337	-143.0370	-3.9	240.0	72 / 28
EAGLE[2]	502607	256	225	1901-2021	AK	64.1000	-141.9170	-3.9	305.1	67 / 33

[1]Temperature and precipitation data based on climate normal calculations for period 1981-2010
[2]Temperature and precipitation data based on climate normal calculations for period 1971-2000
[3]Included in the US Climate Reference Network
[4]Insufficient data



WWF, USGS, EPA, Esri, Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

LEGEND

Regional Precipitation Stations

- Alaska
- Yukon
- 200KM Radius Around Coffee Gold

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:1,750,000

DATE SAVED:	Feb 28, 2017
DRAWN BY:	GM
REVIEWED:	CF
VERSION:	1

CLIENT:

Newmont COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE: Regional Precipitation Stations

PROJECT #: A362-3 | *FIGURE:* 2-5

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Baseline Report\Regional Precipitation Stations_20160302.mxd

Several gridded climate re-analysis products are also available for the Coffee Gold Project area, providing information about the historic, contemporary, and future (climate change) climate conditions of the mine site:

- Outputs from the ClimateWNA program (v7.20; see Wang *et al.*, 2016) are utilized in this assessment to provide a check and verification on the site-specific precipitation and orographic gradients derived from measured data at the Project site.

  https://cfcg.forestry.ubc.ca/projects/climate-data/climatebcwna/#ClimateWNA.

- Data and outputs provided by the Scenario Network for Alaska and Arctic Planning (SNAP), were the main information source utilized to frame the future water balance conditions for the Project site under a changed climate.

  https://www.snap.uaf.edu/

The previous baseline report (Lorax 2017) included a climate change analysis for the Coffee Gold Project. The analysis, appended to this report (Appendix B), was prepared by Dr. Thomas Pedersen. The main findings and recommendations of Appendix B remain unchanged. However, new air temperature and precipitation results specific to the Representative Concentration Pathway (RCP) scenarios are presented in Section 4.5, since the RCP scenarios now supersede the SRES (Special Report on Emissions Scenarios – IPCC, 2000) vintage scenarios used prior.

2.3 Climate Analysis Methods

This section outlines the methodology used to analyse site-specific and regional climate records to derive representative metrics for use in engineering design and modelling efforts (*e.g.*, heap leach facility and site-wide water balance models). In addition to the site-specific and regional data sources outlined below, gridded outputs from the ClimateWNA tool (Wang *et al*., 2016) were used to supplement analyses where necessary.

2.3.1 Air Temperature and Precipitation

Temperature and precipitation (solid and liquid phase) data were summarized for the Project site and regional climate stations. Monthly average daily- minimum, average and maximum temperatures were computed, as well as extreme minimum and maximum temperatures for the period of record, for each station. Daily and monthly precipitation totals were also computed for the AK and YT stations near the Project. For extremes, values for air temperature and precipitation were gleaned from the Canadian climatic normal database or analogous databases for Alaskan climate stations.

2.3.2 Snow Water Equivalent (SWE) Measurements

Winter precipitation data are subject to several types of error which make reliable winter measurements difficult to obtain:

- Gauge undercatch resulting from turbulence effects around the gauge orifice (*e.g.*, Yang *et al*., 2005);
- Gauge capping due to snow falling at or near the triple point temperature that bridges the orifice and effectively seals the gauge; and,
- High spatial variability of snowfall (and subsequent redistribution) in mountainous areas (Pomeroy *et al*., 1999).

Furthermore, sublimation losses (from the existing snowpack) form an important component of the water balance in sub-arctic environments, with losses occurring predominantly from forest canopy interception and wind suspension and re-distribution (*e.g*., Hedstrom and Pomeroy, 1998).

The use of the maximum winter SWE value (*i.e.,* a value measured by the April 1st snow survey) effectively integrates sublimation losses up to the time of measurement, and thus winter snow course readings are highly informative with regard to total potential water available for melt (*i.e.*, SWE) and therefore freshet generation. More than twenty snow survey sites have been sampled with varying frequency at Coffee Gold from 2012 to present (Table 2-3) with five stations (Table 2-1) selected at the Project site to characterize SWE in this context.

Additionally, the Government of Yukon maintains an extensive snow survey network for flood and water supply forecasting purposes (http://www.env.gov.yk.ca/air-water-waste/snow_survey.php). The nearest territorial stations to the Coffee Gold Project are Casino Creek (elevation 1,065 m) and Pelly Farm (elevation 472m asl), with the two regional stations providing high-elevation (Casino Creek) and valley bottom (Pelly Farm) context for the Project site (Table 2-6).

The regional snow course records have long-term data (>30 years in length) and provide context to assess long-term variability in SWE at the Project site. The site and regional snow course data can also be combined to compute annual recurrence intervals for snowpack variables using standard frequency analysis techniques.

Table 2-6:
Regional Snow Survey Sites

Station Name	ID	Elevation (m asl)	Dist. From Project (km)	Record Period	Territory/ State	Latitude (°)	Longitude (°)	Mean Annual SWE (mm)
CASINO CREEK	09CD-SC01	1,065	32	1977-2021	YT	62.7333	-138.8	142
PELLY FARM	09CD-SC03	472	81	1986-2021	YT	62.8167	-137.3667	82

2.3.3 Synthetic Temperature and Precipitation Record

The development of a synthetic climate series for the Project Proposal was originally detailed in Appendix 8-A of the YESAB submission (Lorax, 2017) and was based on a site climate record that spanned 2012-2014 and the McQuesten regional climate station. Critical parameters that must vary in concert are:

- Air temperature (daily maximums, means and minimums). In particular, the winter inversions that result in higher ridgetop temperatures than valley bottom must be accurately reproduced.
- Daily precipitation totals, the annual distribution of precipitation between snow and rain, and the duration and magnitude of multi-day events and trace (<1 mm) events, must be well represented.
- Evaporation, on an annual and daily scale (*i.e.*, lower on days with precipitation, higher on warm days with additional wind and radiation inputs).
- Correspondence of wet- and dry-years between site and regional stations.

The synthetic climate record described below builds upon the Project Proposal submission and remains a foundational input to both the heap leach and site-wide water balance models. The additional site climate data collected since 2015 allows for more robust comparisons to be made between site and predictor stations. Further, the additional monitoring data provide the opportunity to confirm and revise assumptions related to winter temperature inversions, seasonal orographic precipitation gradients, maximum annual snowpack, and the importance of gauge undercatch of winter precipitation and snowpack sublimation.

2.3.3.1 Screening of Regional Stations

The first screening step involved correlating the monthly average temperatures and precipitation from the regional stations with the site record. The six closest stations to the Coffee Gold Project were assessed in the initial screening.

The second step involved correlating both monthly and daily variables to determine which regional stations best represented the intra-annual and sub-monthly variability in Project site climate. In addition to the correlation coefficients, the completeness of the regional record was taken into consideration as well. Preference was given to stations with the most complete records to reduce the need to infill missing data using other regional stations. Finally, those stations deemed to be most representative of the Project area were given priority (*i.e.*, similar elevation, comparable longitude, situated close to the Coffee Gold property).

Since the initial Project Proposal submission, two factors now require that this synthetic climate record be updated: an additional 4.5 years of site climate data are now available; and the McQuesten climate station was decommissioned by Environment Canada in September 2014. Based on the initial screening process described above, the Dawson A climate record (1897-2021) was selected as the predictor to derive the updated synthetic climate record.

The Dawson A station is located 130 km to the north of the Project site at an elevation of 370 m (Table 2-5, Figure 2-5). Over the corresponding period of record between the Project site and Dawson A records (2012-2021), the Dawson A climate station has recorded wetter than average (105% of MAP; 1945-2021) conditions.

2.3.3.2 Estimating Missing Data – Regional Record

The Dawson A daily air temperature record is 99.9% complete (37 missing days) over the period from January 1, 1945, to November 2021. Missing temperature data largely consisted of single day occurrences and these missing values were estimated with an average of the preceding and following days' values.

The precipitation record is mostly complete for the period of 1945 to 2002, but the subsequent years have more frequent data gaps. The 2002-2021 period is missing precipitation data for 7% of all days in this period. Missing winter precipitation values were infilled using the daily snowfall totals and assuming a fresh snow density of 10%. Any remaining missing values were infilled using the data from the nearby Pelly Ranch climate station.

2.3.3.3 Site Climate Data Adjustments

The issue of gauge undercatch for solid phase precipitation in cold regions is well documented in the primary literature and can account for up to 5-20% loss of the actual precipitation amount (Goodison *et al*. 1998; Yang *et al*. 2005;). This undercatch is largely attributed to high wind speeds transporting lower density snow particles away from the

gauge orifice, and thus the primary correction for this process requires reliable wind speed data. During the period of 2012-2014, the wind speed data collected at site were unreliable, due largely to the development of rime ice on the sensor. Thus, it was not possible to apply the gauge undercatch procedures outlined in Yang *et al.* (2005) and described in detail in Goodison *et al*. (1998).

Instead, the SWE data from the snow course co-located with the Km 11 meteorological station (975 m) were used to benchmark the winter precipitation data recorded by the gauge. Snowfall was calculated by summing gauged precipitation if hourly average air temperature < 0°C. Melt events were assumed to be negligible between October and the end-of-March, based on the air temperature record. An update of this comparison is presented in Table 2-7. Note that the gauge data for the period of Oct. 2014 to Mar. 2015 are considered unreliable and were excluded from this analysis.

Table 2-7:
Comparison of annual maximum measured SWE and estimated cumulative snowfall depths based on undercatch corrected precipitation record for elevation 975 m.

Station	Year	April 1st SWE (mm)	SWE corrected for sublimation (mm)	Oct-Mar precipitation (mm)
Km 11 (975 m)	2012[1]	110	132	--
	2013[1]	117	141	121
	2014	88	106	147
	2015	104	125	46
	2016	98	118	92
	2017[2]	68	82	81
	2018	115	138	99
	2019	72	86	*46*
	Average	100	120	97
Kona (1,340 m)[3]	2019[2]	60	72	58
	2020[2]	69	83	130
	2021[2]	113	136	110
	Average	81	97	99

Notes:
[1]KAM-SS-WX snow course not active, values provided are average of all high-elevation measurements.
[2]Value is from March snow survey

The wind sensor issues were satisfactorily resolved in autumn 2015, which allowed the effect of wind speeds on gauge undercatch to be calculated following Goodison *et al.* (1998). For the purposes of this analysis, wind speed was assumed to be the primary

determinant of gauge undercatch, and correction for wetting losses and evaporation were assumed to be negligible. When applied to the average annual snowfall total (assumed to be all gauged precipitation that fell from October to March), this correction provided an average snowfall estimate of 97 mm for elevation 975 m, and 99 mm for elevation 1,340 m. While a true maximum SWE value is not available for the climate station snow course (due to the monthly sampling interval), the average April 1st value is 100 mm, which is comparable to the gauged precipitation estimate. The same analysis was conducted with the precipitation and snow survey data collected at the Kona climate station (1,340 m), noting that there is only a single year of overlap between the two precipitation records due to gauge malfunction at the Km 11 station. Notably, the maximum annual SWE values were lower at the higher elevation station (on average), but the average winter precipitation accumulations are comparable, noting again the limited overlap in the two datasets.

On average, the undercatch corrected snowfall amounts were comparable to the maximum annual SWE measured at the snow course (Table 2-7). The snow course data are also likely biased low due to sublimation losses, which can result in an average SWE loss of 20% over the course of the winter season (*e.g.*, Janowicz *et al.*, 2004), comparable to the estimated magnitude of gauge undercatch. However, for the purposes of the water balance models, it is the volume of water contained in the snowpack available for melt that is the primary parameter of interest. Therefore, any estimate of sublimation is applied to the gauged precipitation adjusted for undercatch, and the reasonable benchmark for comparison is the measured SWE data from the snow course. As a result, the endpoint (volume of water available for melt during freshet) would be expected to be approximately the same.

2.3.4 Extreme Precipitation and Snowmelt

Design of water management infrastructure necessitates an understanding of the volume of water that might be delivered by a storm of given frequency and duration (*e.g.*, 1:100 year, 24-hour rain event). A detailed analysis was undertaken of the long-term precipitation records available from the regional climate networks, and the resulting frequency-duration storm magnitude estimates were scaled to the Project site using local precipitation gradients. The full analysis and results of this effort was originally presented in Lorax (2017) and is updated and summarized in Section 4.4.1.

To inform the required design capacity for the heap leach facility event ponds an estimate was also required of the probable maximum precipitation (PMP) for a 24-hour period. The probable maximum precipitation is defined as the greatest depth of precipitation for a given duration meteorologically possible for a design watershed or a given storm area at a particular location at a particular time of year, with no allowance made for long-term climatic trends (WMO, 2009). The statistical procedure used follows the methodology

presented in Hershfield (1961) and WMO (2009) and results are presented in full in Section 4.4.2.

2.3.5 Evaporation Estimates

Hourly potential evaporation rates were computed using Coffee Gold weather station data and the Ref-ET calculator – a compiled, stand-alone computer program that calculates reference evapotranspiration (ASCE, 2005). For the period of available record, an hourly climate input file was prepared from the Coffee Gold weather station database. The input variables required by Ref-ET are: Maximum air temperature, minimum air temperature, relative humidity, incoming solar radiation, atmospheric pressure, and wind speed.

From the assembled climate inputs, Ref-ET returned potential evaporation (PE) computations at hourly and daily time-steps based on an array of evaporation models (*e.g.,* Penman-Monteith model, Priestley-Taylor formulation; Section 4.1.7). An additional check on the derived PET estimates was run using the Hargreaves-Samani method (Hargreaves and Samani, 1985), which requires daily minimum, mean and maximum air temperatures and station latitude as inputs.

3. Hydrology Monitoring and Methods

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3. Hydrology Monitoring and Methods

3.1 Baseline Monitoring Network at the Project Site

Table 3-1 and Table 3-2 summarize station nomenclature and drainage characteristics for the sixteen stations which comprise the existing baseline hydrology network for the Coffee Gold Project. Figure 3-1 shows the location of these monitoring stations with respect to proposed Project infrastructure and mine site footprints. Gauged watersheds at the Coffee Gold site range in size from ~3 to >500 km^2, noting that nine of the watersheds being monitored have drainage areas of less than 25 km^2. Furthermore, gauged watersheds differ in elevation characteristics (*i.e.,* mean catchment values for drainage basins range from 800 to 1,300 m asl).

The naming system for flow and water quality stations established at Coffee Gold in 2010 is not intuitive. Accordingly, new station IDs were recently prescribed for stations and utilized throughout this version of the baseline report (Table 3-1) as follows:

i. The station name begins with two or three letters which are based on the name of the drainage basin the station is situated within (*e.g.*, Latte Creek drainage basin = LC);

ii. If the gauge is on a tributary of the drainage basin mainstem, the tributary is given a number (even number for river left and odd number for river right *i.e.*, looking downstream), with numbers beginning at the confluence with the downstream watercourse (*e.g.*, the first tributary on Latte Creek above the confluence with Coffee Creek on river left looking downstream is LCT2); and,

iii. Numerical designations for stations that follow reference a distance in kilometres upstream from the confluence with the next largest stream (*e.g.*, for a station established 100 m above the LCT2 confluence with LC mainstem is LCT2-0.1).

3.2 Drainage Basin Characteristics

To place the streamflow dataset into the broader context of the Project site and to assist with the attribution of various physiological drivers of the streamflow regime in each basin, several spatial analyses were carried out. Specifically, the area and elevation characteristics (*i.e.*, drainage area, aspect, area-elevation relationships) of local drainages were described.

- Drainage areas for surface water monitoring stations were delineated using Surfer 12. The 1:50,000 Grid NRCAN Canadian Digital Elevation Model was used as the source of topographic data utilized for drainage basin delineations.

- Aspect, which is the measure of the direction that a slope faces, was computed with Global Mapper 12 using the NRCAN Canadian DEM as the elevation grid input. Aspect was calculated for each cell in the raster dataset, with output reported for each watershed counter clockwise in degrees from 0 (due north) to 360. Cells with no slope were assigned a value of -1. The proportion of each drainage comprised of the four cardinal direction aspects (North, 315°-45°; East, 45°-135°; South, 135°-225°; West, 225°-315°) is presented in the hydrometric station summaries in Appendix C.
- A hypsometric curve for a drainage basin summarizes the relative proportion of drainage area below (or above) a given elevation. Topographic relief within a drainage basin is commonly summarized in this format, with plots allowing easy comparison of topographic data between adjacent basins. For the Project area watersheds, hypsometric curves were generated using Scripter BASIC programming language and Surfer 12. For each basin, areas were calculated per 10 m interval from the minimum to the maximum elevation. These areas were standardized as the percentage of the basin area below that elevation (out of 100%) for plotting purposes. Hypsometric curves are presented for each station in Appendix C.

Table 3-1:
Cross reference table summarizing new and previous names for streamflow monitoring stations at Coffee Gold.

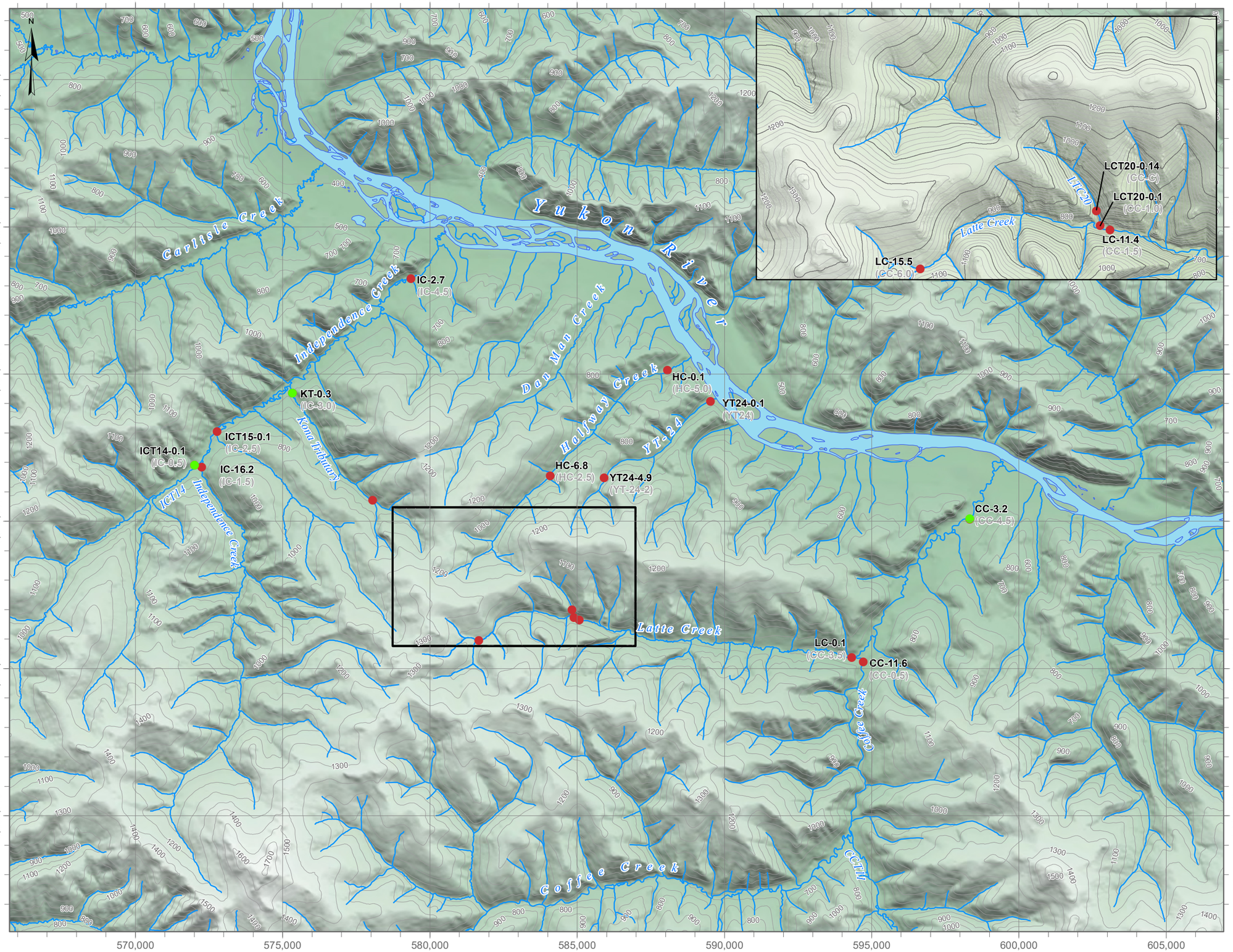
Drainage Basin	Watercourse	New Station Name	Previous Station Name
Coffee Creek	Coffee Creek (CC)	CC-3.2	CC-4.5
		CC-11.6	CC-0.5
	Latte Creek (LC)	LC-0.1	CC-3.5
		LC-11.4	CC-1.5
		LC-15.5	CC-6.0
	Latte Creek Trib 20	LCT20-0.1	CC-1.0
YT-24	YT-24 (YT24)	YT24-0.1	YT-24
		YT24-4.9	YT-24-2
Halfway Creek	Halfway Creek (HC)	HC-0.1	HC-5.0
		HC-6.8	HC-2.5
Independence Creek	Independence Creek (IC)	IC-2.7	IC-4.5
		ICT15-0.1	IC-2.5
		IC-16.1	IC-1.5
	Kona Tributary (KT)	KT-0.3	IC-3.0
	Independence Creek Trib 14 (ICT14)	ICT14-0.4	IC-0.5

Notes:
Station nomenclature for tributaries is as follows: numbering begins at confluence with next larger stream, and moves upstream, with even numbers on river left, and odd numbers on river right (looking downstream).
All numerical designations for stations are the distance in kilometres upstream from the confluence with the next largest stream.

Table 3-2:
Coffee Gold Project, Surface Hydrology Stations and Drainage Basin Characteristics

Station ID	Drainage	UTM N*	UTM E*	Drainage Area (km^2)	Frequency	Record Period
LCT20-0.1[w]	Small tributary to Latte Creek draining proposed South WRSF	6,971,733	584,890	3.4	Flow - continuous	June 2014 - present
LC-11.4	Latte Creek downstream of CC-1.0 drainage	6,971,654	585,071	23.1	Flow - continuous	Oct. 2010 - present
LC-0.1	Latte Creek immediately upstream of confluence with Coffee Creek	6,970,375	594,319	69.8	Flow - continuous	Oct. 2010 - present
LC-15.5	Upper Latte Creek	6,970,960	581,317	9.6	Flow - continuous	June 2014 – Aug. 2019
CC-11.6	Coffee Creek immediately upstream of confluence with Latte Creek	6,970,225	594,719	385.6	Flow - continuous	Oct. 2010 - present
CC-3.2	Coffee Creek	6,975,084	598,330	484.0	Flow - monthly	Oct. 2010 - present
HC-6.8	Halfway Creek - midway	6,976,548	584,089	14.8	Flow - continuous	Oct. 2010 - present
HC-0.1	Halfway Creek - mouth	6,980,536	588,823	27.0	Flow - continuous	Oct. 2010 - present
ICT14-0.4[s]	Independence Creek – unnamed large tributary	6,976,911	572,012	68.9	Flow - monthly	Oct. 2010 - present
IC-16.1	Mainstem of Independence Creek	6,976,835	572,260	81.1	Flow - continuous	Oct. 2010 – Aug. 2019
ICT15-0.1	Unnamed small tributary to Independence Creek	6,978,044	572,771	17.3	Flow - continuous	Oct. 2010 – Aug. 2019
KT-0.3[s]	Kona Creek, small tributary to Independence Creek	6,979,357	575,334	18.3	Flow - monthly	October 2010 - present
IC-2.7	Independence Creek - mouth	6,983,237	579,358	222.3	Flow - continuous	October 2010 - present
YT24-0.1	Mouth of YT-24, small tributary to Yukon River and draining North WRSF	6,979,073	589,526	11.8	Flow - continuous	June 2014 - present
YT24-4.9	YT-24 tributary – midway	6,976,472	585,922	4.0	Flow - continuous	June 2016 - present

Notes:
[w] Discharge measured by V-notch weir
[s] Spot flow monitoring station only.
* All UTM coordinates in Zone 7.



LEGEND

- Continuous Flow Monitoring
- Monthly Flow Monitoring
- Watercourses
- Waterbodies
- Surface Contours (100m)

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:125,000

0 2 4 km

DATE SAVED:	Sep 24, 2019
DRAWN BY:	AL
REVIEWED:	SJ
VERSION:	1

CLIENT:

Newmont™ COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Mine

TITLE:

Flow Monitoring Locations

PROJECT #: A362-3 *FIGURE:* 3-1

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3.3 Hydrometric Data Collection Methods

3.3.1 RISC Standards

The methods adopted for the baseline hydrology study are aligned with standards and procedures outlined in the Manual of British Columbia Hydrometric Standards - Version 2.0 (RISC, 2018). This document defines standards and detailed procedures for the acquisition of streamflow data and provides specific direction on the following topics: monitoring site selection; station construction and benchmarking; recording discharge measurements; developing stage-discharge relationships; and reporting and presenting hydrometric data. The BC RISC standards also summarize best practices and minimum requirements for stage (Table 3-3) and discharge (Table 3-4) measurements in order to achieve acceptable data capture, or data grades (Grade A, Grade B, Grade C) for the hydrology discipline.

Table 3-3:
Summary of BC RISC Standards for Stage (or Level) Data

Data Quality Indicator	Standard Grade for Stage/Level data				
	Grade A	**Grade B**	**Grade C**	**Grade E (estimated)**	**Grade U (unknown)**
Instrumentation					
Water level gauge reading/sensor accuracy	Greater of either 3 mm or 0.2% of effective stage	Greater of either 5 mm or 0.2% of effective stage	1 cm or better	See notes below	Undefined
Field Procedures					
Minimum number of benchmarks	3	3	3	See notes below	Undefined
Number of benchmark checks per year	2 or more, or at least once per year, if gauge is stable	2 or more, or at least once per year, if gauge is stable	1 or more	See notes below	Undefined
Data Calculation and Assessment					
Data and calculations reviewed for anomalies	Yes	Yes	Yes	See notes below	Undefined
Results compared to other station and years for consistency	Yes	Yes	Yes	See notes below	Undefined

Notes:
Hydrometric data should be graded as "E" (Estimated) if stations are operated using RISC standards (targeting Grade A, B or C), but data were estimated because of instrument anomalies, shift correction issues, missing data, or rating-curve extrapolation beyond maximum or minimum validated discharge level. Hydrometric data should be graded as "U" (Unknown data quality) when RISC standards not followed for data collection and/or data quality is not known.

Table 3-4:
Summary of BC RISC Standards for Discharge Data

Data Quality Indicator	Standard Grade for Discharge Data					
	Grade A/RS	**Grade A**	**Grade B**	**Grade C**	**Grade E (estimated)**	**Grade U (unknown)**
Instrumentation						
Meter calibration (when applicable)	*n/a*	Valid calibration confirmed	Valid calibration confirmed	Valid calibration confirmed	Valid calibration not confirmed	Undefined
Meter field verification (when applicable)	*n/a*	At least annually	At least annually	Less often than annually	See notes below	Undefined
Water level gauge reading/sensor accuracy	Greater of either 3 mm or 0.2% of effective stage	Greater of either 3 mm or 0.2% of effective stage	Greater of either 5 mm or 0.2% of effective stage	1 cm or better	See notes below	Undefined
Field Procedures						
Minimum number of benchmarks	3	3	3	3	See notes below	Undefined
Number of verticals in manual flow measurements when current meter used	*n/a*	20 or more, if channel width sufficient and not more than 10% of flow in any panel	20 or more, if channel width sufficient and not more than 10% of flow in any panel	10 or more, if channel width sufficient and not more than 10% of flow in any panel	See notes below	Undefined
Number of manual flow measurements per year	Minimum of one field measurement for rating verification	5 or more over adequate range of flow conditions	3 or more over adequate range of flow conditions	2 or more over adequate range of flow conditions	See notes below	Undefined
Number of benchmark checks per year	2 or more, or at least once per year, if gauge is stable	2 or more, or at least once per year, if gauge is stable	2 or more, or at least once per year, if gauge is stable	1 or more	See notes below	Undefined
Data Calculation and Assessment						
Discharge rating accuracy/ rating curve shift deviation threshold	<5%	<7%	<15%	<25%	See notes below	Undefined
Data and calculations reviewed for anomalies	Yes	Yes	Yes	Yes	See notes below	Undefined
Results compared to other station and years for consistency	Yes	Yes	Yes	Yes	See notes below	Undefined

Notes:
Hydrometric data should be graded as "E" (Estimated) if stations are operated using RISC standards (targeting Grade A/RS, A, B or C), but data were estimated because of instrument anomalies, shift correction issues, missing data, or rating-curve extrapolation beyond maximum or minimum validated discharge level. Hydrometric data should be graded as "U" (Unknown data quality) when RISC standards not followed for data collection and/or data quality is not known.

3.3.2 Station Instrumentation

Coffee Gold Project hydrometric stations are instrumented with metric staff gauges which are surveyed to three nearby benchmarks (Figure 3-2). At most stations, continuously recording water level recorders (*i.e.,* Solinst Levelogger Edge, Solinst LTC) are housed inside protective stilling wells to record continuously (*i.e.,* 15-minute frequency). Direct read cables are attached to the Solinst Leveloggers to minimize disturbance of sensors when monthly data downloads are scheduled.

Since Leveloggers are not vented to atmosphere and collect the combination of water level and atmospheric pressure change, it is necessary to collect an independent record of atmospheric pressure such that raw water level data can be pressure adjusted. Three Solinst Barologger recorders are deployed at the property for the collection of this information. Leveloggers and barologgers utilized in the baseline hydrology program are programmed for data collection at 15-minute frequency.

Relevant technical specifications for Solinst Leveloggers and Barologgers are provided in Table 3-5.



Figure 3-2: A typical hydrometric station installation at the Coffee Gold Project (LC-11.4) including metric staff gauge, stilling well, direct read cable attached to a water level recorder. Angle iron and bracing is used to anchor and secure the station.

Table 3-5:
Summary of Sensor Specifications for Solinst Leveloggers and Solinst Barologgers

Level Sensor	
Sensor Type:	Piezoresistive Silicon with Hastelloy Sensor
Accuracy:	±0.05% FS (Barologger Edge: ±0.05 kPa)
Resolution:	0.001% FS (M5)
	0.002% FS (Barologger)
Normalization:	Automatic Temperature Compensation
Temperature Compensation Range:	0 to 50 °C (M5)
	-10 to 50 °C (Barologger)
Submergence Range (m)	M5 (5 m), Barologger (air only)
Temperature Sensor	
Temperature Sensor Accuracy:	± 0.05 °C
Temperature Sensor Resolution:	0.003 °C
Datalogger Specifications	
Battery Life:	10 years based on 1 reading/minute
Clock Accuracy:	±1 minute per year
Operating Temperature:	-20 to 80 °C
Maximum Number of Readings:	40,000 readings typically, but up to 120,000 using linear data compression
Memory Modes:	Slate and Continuous
Communication:	Optical Infrared Interface (pedestal and direct read cable)
Sampling Modes:	Linear, Event, Future Start, Future Stop, Real-time View
Measurement Rate:	From 0.125 seconds to 99 hours
Barometric Compensation:	Solinst Software
Warranty:	3 years under normal use

Note: Barologger placement recommended to be within 30 km radius of Levelogger installations and within 300 m elevation.

3.3.3 Field Measurements of Stage and Discharge

Measurements of stage are recorded manually at station staff gauges during monthly site visits, with the point and continuous water level measurements used eventually to create a detailed record of stage height fluctuation at each monitoring location over time. Coinciding with manual stage readings, spot measurements of discharge are collected at Project hydrometric stations primarily by wading with a current meter and salt dilution gauging, while other measurement methods (*e.g.*, bucket-stopwatch tests, slope-area approach) were utilized upon occasion in the baseline study.

3.3.3.1 Discharge Measurements by Wading with Current Meter

The mid-section method is a widely used technique for calculating stream discharge that involves wading with a current meter to measure discharge in individual measurement cells or panels across a section (Figure 3-3, Figure 3-4). Using a top-setting wading rod and current meter, depth (m), width (m) and velocity (m/s) readings are used to compute a component discharge for each panel. Ultimately, total discharge (Q) is computed by summing the individual panel discharges.

The bullet points below outline monitoring methods utilized at the Coffee Gold Project with respect to this method:

- At each site visit, the measurement section is assessed to ensure the reach remains a suitable location for the measurements (*i.e.*, a straight section of the river, free of large boulders and other obstructions, stable banks, relatively even distribution of streamflow across the watercourse).
- The section is photographed. Photos are taken looking upstream and downstream to document site conditions and section/reach controls governing flow at the measurement location.
- Next, a measuring tape is secured across the section, perpendicular to the flow. The wetted width and maximum depth across the section are noted.
- If the watercourse is wide (*e.g.*, >2 m), the wetted width is divided into approximately 20 sections (between 16 and 24 being optimal to achieve a high grading in terms of measurement quality (Table 3-4).
    - The concept of panels (or verticals) for a mid-section method discharge measurement is shown in Figure 3-3. At each vertical across the stream a depth, width and velocity are recorded.
    - For narrow streams, velocity measurements are completed at a minimum distance of about 10-15 cm from one another, or at a distance that is practical to ideally establish 20 panels across the channel.
- Since local watercourses are generally shallow (*i.e.*, less than 1.0 m deep), the 0.6-depth mid-section method (*i.e.*, velocity readings are made at 0.6 of the depth below the water surface in the vertical is used as the mean velocity in the vertical) when water depths of <1.0 m are encountered.
    - If stream depth exceeds 1.0 m, a two-point method of measuring velocities is adopted with velocity measurements recorded at 0.2 and 0.8 of the depth below the surface – then averaged to a composite reading.

- Once the step of recording depth and velocity readings across the measurement section is complete, field staff then record a stage height reading from the manual staff gauge, so the station rating curve can be updated.

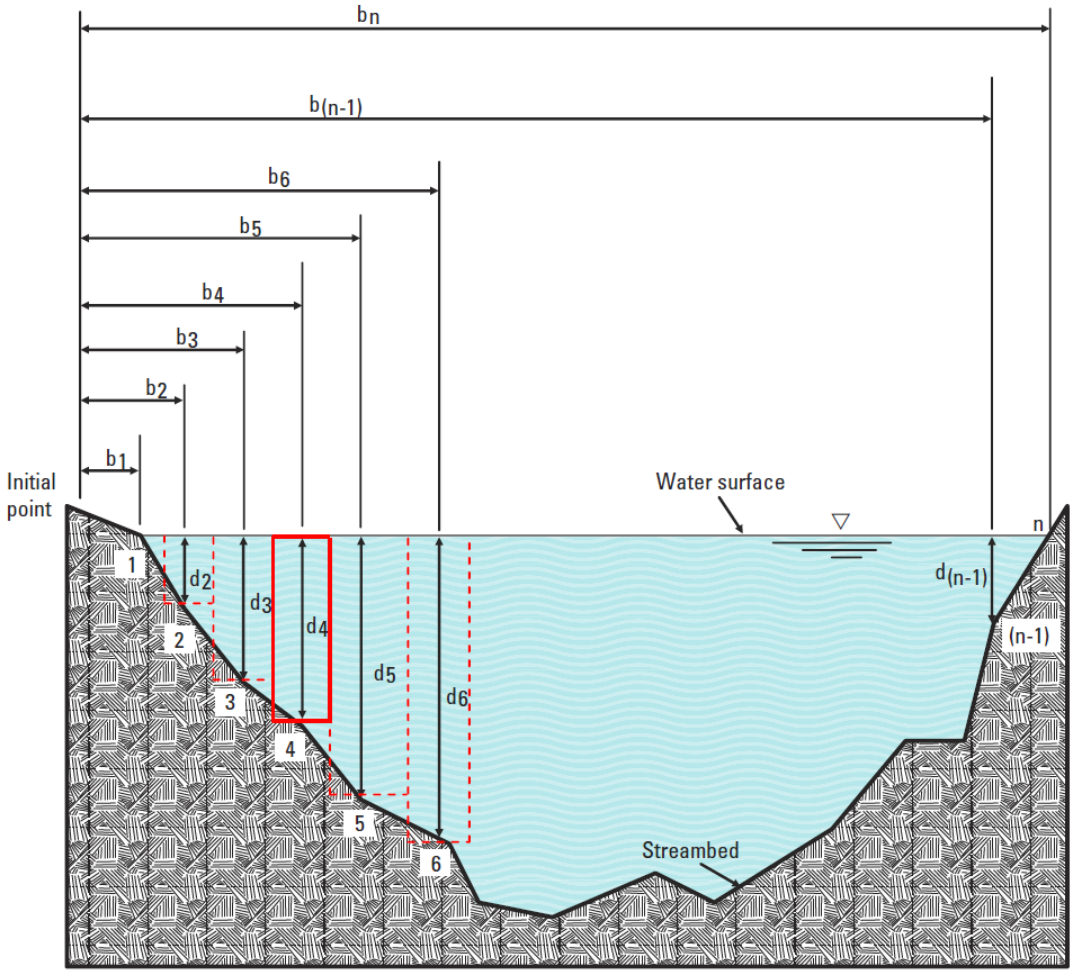

Figure 3-3: Definition sketch of the mid-section method of measuring stream discharge by current meter and wading (modified from USGS 2010) at a stream section by a hydrometric station. Terms b, d and n refer to widths, depths, and number, respectively.



Figure 3-4: Discharge measurement by wading using a current meter and top-setting wading rod at LC-0.1.

3.3.3.2 Discharge Measurements by Salt Dilution Gauging

Another common method of stream gauging involves the injection of a chemical tracer (*e.g.*, table salt, rhodamine dye) into a stream and determining its dilution following complete mixing into the flow. In concept, the injection of tracer creates a peak or wave that dissipates to background (pre-injection) levels with time as shown in Figure 3-5. By recording background conductivity, the mass of salt introduced and calculating the area under the tracer wave, an estimate of stream discharge can be computed very accurately using this method. Field methods for this measurement approach are well documented in the open literature (*e.g.*, Fraser and Hudson, 2002; Moore, 2004; Moore 2005).

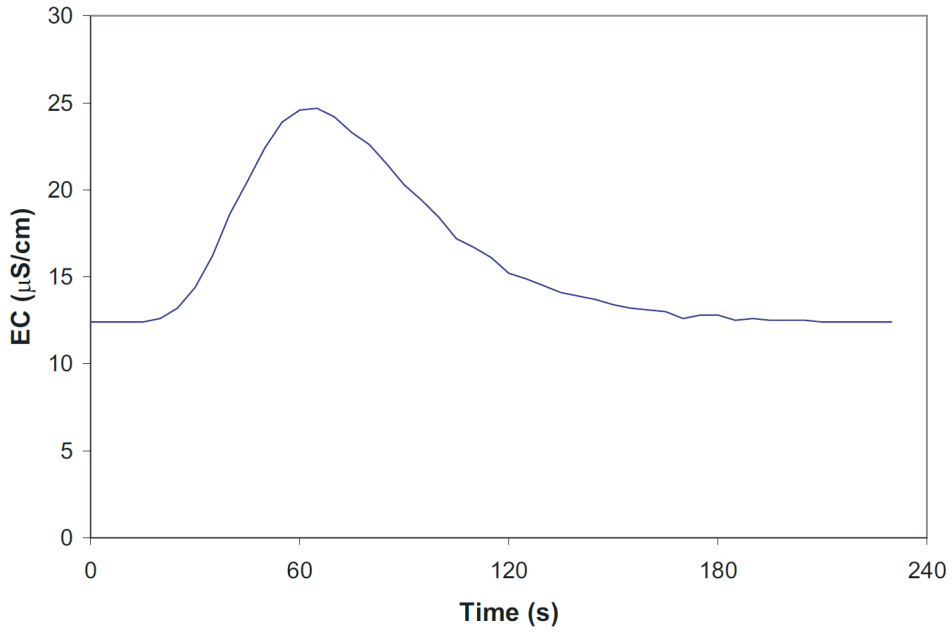

Figure 3-5: Example of a salt wave or 'peak' following injection of tracer to a watercourse.

3.3.4 Data Processing

3.3.4.1 Determining Points of Zero Flow

It is standard hydrometric practice to extend the rating curve through the zero-flow point (h_0) on the plot to ensure that the rating equation accurately estimates streamflow values that fall below the lowest measured discharge on record. This is particularly important since accurate definition of the low-flow condition plays a critical role in determining the available dilutive capacity in the receiving streams during ecologically sensitive periods (*i.e.*, summer low flows), and the use of open water season low flows as a calibration target for the numerical groundwater model developed in support of the Project Proposal effects assessment. In the absence of field measurements documenting zero flow stage, curve fitting and survey approaches were used to establish zero-flow stages for rating curve development.

Surveys to the benchmarks established at each hydrometric station are undertaken on an annual basis. Appendix C provides a detailed accounting of benchmarks per site and annual surveys conducted over the baseline study period. Using a level and survey rod, a typical survey involves tying into BM #1 at the hydrometric station. A 10 m arbitrary elevation is assumed for BM #1. Next, the relative elevation of the staff gauge, the water surface, and the creek bottom (including at the deepest section) are measured. The level is then repositioned, and relative elevations are taken to BM#2, the staff gauge, the water surface,

the creek bottom, and BM#1 – with closing of the survey aimed to be within 3 mm. With a frame of reference established between staff gauge readings and the lowest elevation in the creek (theoretical zero-flow stage), rating curve data may be adjusted (horizontal, x-axis transformation) to a theoretical zero-flow stage using survey data.

As illustrated in Figure 3-6 below, a graphical technique for determining the gauge height for zero flow is outlined in RISC (2018). As shown in the figure, field measurements of stage (Y axis) and discharge (X axis) are plotted and three discharges in geographic progression are selected. Horizontal and vertical lines plotted through selected discharges create points of intersection, and diagonal lines drawn through points of intersection indicate a zero-flow stage. This curve fitting approach was applied to field measurements collected per hydrometric station and zero flow stages were isolated. As a final step and subsequent to curve fitting, available stage data were appropriately adjusted to a new frame of reference and rating curve equations were computed per station using the SigmaPlot 12.0 software package.

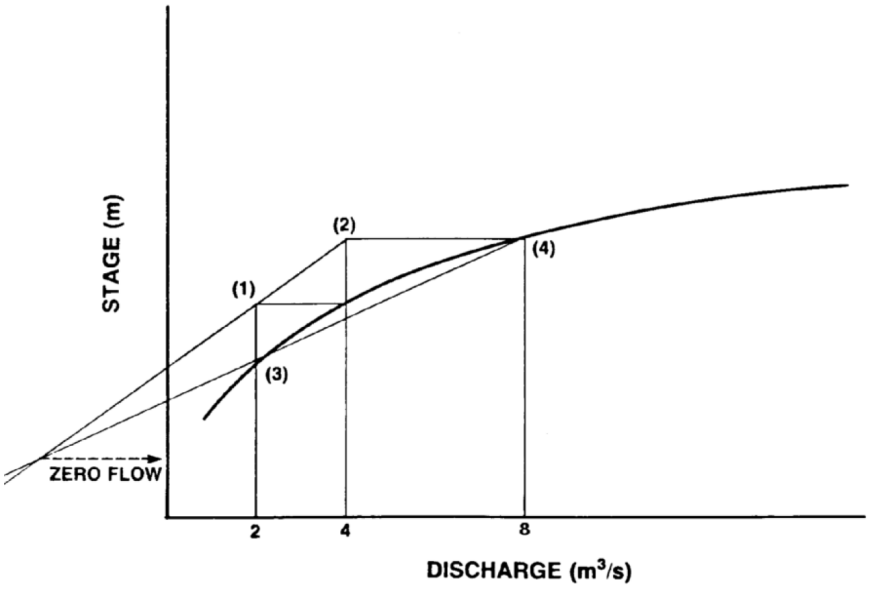

Figure 3-6: Conceptual diagram illustrating a curve-fitting approach to assign zero flow stage (from RISC, 2018).

Zero-flow fit curves were applied to the full stage data record for applicable hydrometric stations, and it is these estimates of discharge that are carried forward for the subsequent analyses. An example of the zero-flow fit rating curve for the LC-11.4 (previously CC-1.5) hydrometric station is presented in Figure 3-7. All manual measurements, rating curve error calculations and rating curve plots for baseline hydrometric stations are provided for review in Appendix C.

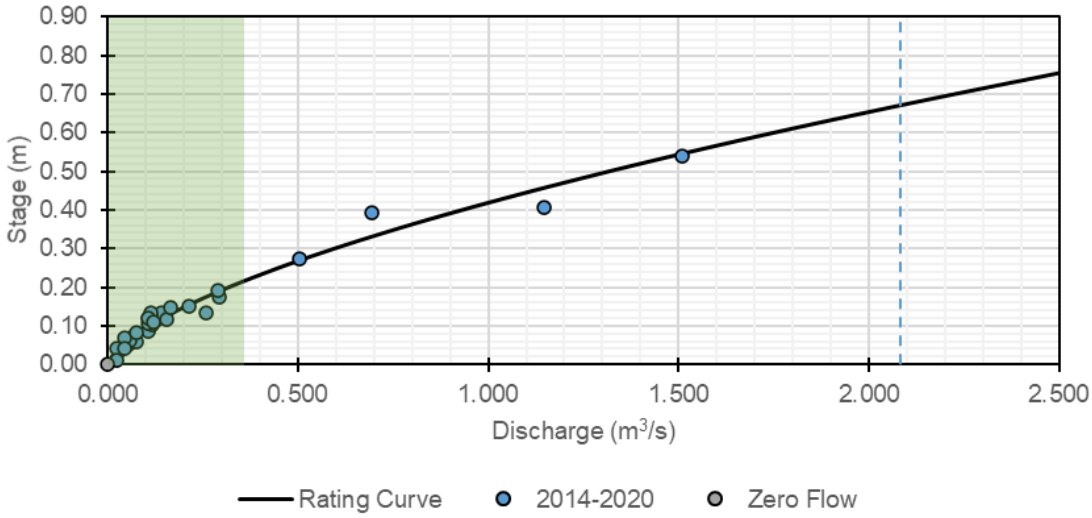

Figure 3-7: Zero-flow fit rating curve for the HC-6.8 hydrometric station. Dashed line indicates highest continuous discharge value estimated from rating curve, and green shaded area indicates 90th percentile of all calculated discharge values.

3.3.4.2 Rating Curves

Given the substantial amount of effort required to make manual measurements of streamflow, it is common practice to measure water level (stage height) on a continuous basis and convert these level readings to a discharge value. This requires that a relationship between stage height and discharge be developed that is unique to each hydrometric station, as this relationship is defined by the channel geometry.

Rating curves were developed for Coffee Gold hydrometric stations using the standard rating equation, and the coefficient, offset and exponent were selected to conform to hydraulic theory (*e.g.*, Maidment, 1993) and the stream channel properties.

$$Q = C(h - h_0)^n$$

Where:

Q = discharge (m^3/s)
C = coefficient (function of channel geometry)
h = stage (m)
h_0 = stage at point of zero flow, offset (m)
n = exponent (function of channel geometry)

The term C is usually 0.5 to 2.5 times the channel width at the control section, and n is often between 1.6 and 3 for moderate gradient streams. The BC RISC standards (RISC, 2009) state that ideally a rating curve will be based on a minimum of 10 stage-discharge measurements. Given the long duration of monitoring activities at the Project site, all Coffee Gold hydrometric stations meet this guidance criteria, with all station rating curves

based upon a minimum of 13 measurements. Average rating curve errors range from -11% to 3%, but generally fall between -4% and 3% (Table 3-6).

Table 3-6:
Summary of Project area hydrometric station rating curves

Station	Measurements (n)	2021 Rating Equation	Average Error (%)	Standard Error (%)
CC-11.6	16	$17.508*(h-0.22)^{1.664}$	-4%	13%
LC-11.4	24	$13.559*(h-0.27)^{2.536}$	3%	32%
LC-0.1	41	$5.390*(h-0.11)^{1.628}$	-11%	39%
LC-15.5	21	$2.488*(h-0.075)^{1.612}$	-1%	26%
HC-6.8	30	$3.889*(h-0.29)^{1.562}$	0%	33%
HC-0.1	36	$2.873*(h-0.2)^{1.345}$	-4%	21%
IC-16.1	14	$8.107*(h-0.36)^{1.721}$	-1%	14%
ICT15-0.1	18	$2.122*(h-0.22)^{1.696}$	3%	20%
KT-0.3	20	$7.000*(h-0.22)^{2.100}$	0%	46%
IC-2.7	21	$9.148*(h-0.06)^{2.302}$	-1%	19%
YT24-0.1	27	$6.081*(h-0.33)^{2.040}$	-4%	22%
YT24-4.9	13	$5.400*(h-0.220)^{2.100}$	-11%	33%
Average	23	--	-2%	26%

3.3.4.3 Computing Final Discharge Series

To acquire continuous discharge data, paired stage and discharge measurements are used to develop a stage-discharge relationship specific for each hydrometric station. A continuous discharge record is then computed from the stage-discharge relation and a continuous water level record.

To assemble discharge records, the following data processing steps were followed:

- Stage measurements from staff gauges and corresponding discharge measurements were assembled into site-specific rating curves (Appendix C).
- Compensated water level records were plotted alongside independent measurements of stage recorded at each monitoring station. Because the staff gauges were carefully benchmarked, these independent readings were assumed fixed and true, and water level records were adjusted as required to best fit the staff gauge record time series.
- Once adjusted to an elevation reference consistent with staff gauge measurements, site-specific rating curves were used to compute continuous discharge estimates from the continuous water level readings.

Plots and tabular summaries of all hydrometric information collected at Coffee Creek are presented by Station ID in Appendix C. Data for the LCT20-0.14 hydrometric station have not been compiled and tabulated in this report, as the rating curve is not well defined. Further, the YT24-4.9 station was destroyed in the July 2017 flood and had to be rebuilt; thus, the record is not sufficiently continuous to warrant inclusion at this point.

3.3.5 Regional Hydrometric Data

As a complement to the hydrometeorological datasets available for the Coffee Gold Project site, there are several regional flow monitoring stations near the mine site (Table 3-7; Figure 3-8). Several of these regional stations show extended period of record (*i.e.*, >30 years of daily streamflow data) and situated in close proximity (*i.e.*, within 75 km) to the Project site.

Site climate and hydrometric data overlap with regional climate and streamflow monitoring activities, and therefore, regional data sources are summarized in this baseline study. Overall, regional data are well suited for the following: to verify the reasonableness of site measurements; to characterize the period of baseline study in terms of range of natural variability and long-term trends; and, to create synthetic climate records by generating site-regional station relationships and then computing long-duration site datasets using these relationships and a predictor station(s). Regional streamflow data for ten representative Water Survey of Canada (WSC) hydrometric stations are presented in Appendix E.

3.3.5.1 Regional Streamflow Statistics

To obtain the input data required for the regional streamflow analyses (peak and low flows, annual runoff, trend analyses, *etc.*), the daily time-series (in m^3/s) from the hydrometric stations listed in Table 3-7 were run through a customized routine to extract the relevant metrics. Extracted metrics included the following:

- Average annual (calendar year and water year [October to September]) discharge;
- Annual maximum and minimum daily discharge;
- Annual and June-September minimum 7-day average discharge;
- Average monthly discharge (m^3/s) and runoff (mm);
- Date of freshet initiation (pulse date; after Cayan *et al.*, 2001);
- Date of freshet peak discharge, and;
- Date of centre of hydrograph mass (calendar year; after Stewart *et al*., 2005).

Summaries of extracted metrics from regional datasets are provided in table format in Appendix E.

Table 3-7:
Regional Hydrometric Stations near Coffee Gold Project. Stations highlighted in gray are summarized in Appendix E.

Station ID	Station Name	Drainage Area (km^2)	Period of Record	Data Frequency	Agency	Comments, Notes
09EB003	Indian River above the Mouth	2,210	1981 to 2018	Daily	WSC	Used as the regional predictor station to generate long-term, site-specific synthetic discharge records for the Project area, and in the regional peak and low flow analyses
09DD003	Stewart River at the mouth	51,000	1951 to 2018	Daily	WSC	This station is situated ~35 km downstream of the proposed barge location across the Stewart River, and was used in the regional peak and low flow analyses
09CD001	Yukon River above White River	149,000	1956 to 2018	Daily	WSC	This station is situated ~45 km downstream of the proposed barge location across the Yukon River, and was used in the regional peak and low flow analyses
09AH003	Big Creek near the Mouth	1,800	1974 to 2018	Daily	WSC	Used as the regional predictor station to generate long-term, site-specific synthetic discharge records for the Project area, and in the regional peak and low flow analyses
09CA003	Donjek River below Kluane River	12,400	1979 to 1994	Daily	WSC	Used for the regional peak and low flow analyses
09DD004	McQuesten River near the Mouth	4,750	1979 to 2018	Daily	WSC	Used for the regional peak and low flow analyses
09CA006	Nisling River below Onion Creek	7,910	1995 to 2018	Daily	WSC	Used for the regional peak and low flow analyses
09AH004	Nordenskiold River below Rowlinson Creek	6,410	1982 to 2018	Daily	WSC	Used for the regional peak and low flow analyses
09EA004	North Klondike River near the Mouth	1,090	1974 to 2018	Daily	WSC	Used for the regional peak and low flow analyses
09BC001	Pelly River at Pelly Crossing	48,900	1951 to 2018	Daily	WSC	Used for the regional peak and low flow analyses
09EB004	Sixty Mile River near the Mouth	3,060	1996 to 2018	Daily	WSC	Used for the regional peak and low flow analyses
09DD002	Stewart River at Stewart Crossing	35,000	1960 to 1973	Daily	WSC	Used for the regional peak and low flow analyses
29CD001	Thistle Creek above Yukon River	210	1981 to 1996	Daily	YHN	Used for the regional peak flow analyses
29DD003	Scroggie Creek above Stewart River	730	1981 to 1997	Daily	YHN	Used for the regional peak flow analyses
29DD002	Clear Creek above Barlow Creek	340	1980 to 2011	Daily	YHN	Used for the regional peak flow analyses
29EC001	Clinton Creek above Fortymile River	206	1978 to 1991	Daily	YHN	Used for the regional peak flow analyses

500000 600000 700000 800000

7120000 7040000 6960000 6880000

UNITED STATES CANADA

29EC001
09EA004
09EB003
09EB004
29DD002
09DD004
09DD002
09DD003
29DD003
09CD001
29CD001
Coffee Gold Project
09BC001
09AH003
09CA006
09CA003
09AH004

Yukon River

N

LEGEND

Regional Hydrometric Stations

Network

- WSC
- YHN

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:1,250,000

0 25 50 Km

DATE SAVED:	Jan 27, 2016
DRAWN BY:	GM
REVIEWED:	CF
VERSION:	1

CLIENT:

Newmont™ COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Feasibility Study

TITLE: Regional Hydrometric Stations

PROJECT #: A362-3 | *FIGURE:* 3-8

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Regional Hydrology Stations_20160126.mxd

3.3.5.2 Regional Peak Flow Analysis

A frequency analysis was previously conducted to estimate the recurrence of discharges of a particular magnitude for all regional hydrometric stations within a 200 km radius of the Project (Lorax, 2017). In a frequency analysis, a time-series of annual flow events are viewed as being a set of events sampled from a population of all events that is infinitely long and therefore continuous. Continuous probability distributions (*e.g.*, Log Pearson 3, Generalized Extreme Value, Log Logistic 3P) are then fitted to the observations and future and/or extreme events (*e.g.*, 1:200-year flood) are estimated from best fitting probability distributions. Statistical tests (*e.g.*, Kolmogorov Smirnov; Anderson Darling) can be used to isolate the probability distributions that best fit the observations or return a conservative result (Meylan *et al.*, 2012). Alternatively, results of the frequency analysis may be based a priori on a probability distribution conventionally applied in hydrology studies (*e.g.*, Log Pearson Type III).

At the time Lorax (2017) was prepared, annual time-series of instantaneous maximum discharge values from the regional stations listed in Table 3-7 were compiled for all years with data to 2014. Where the instantaneous maximum value was missing, the maximum daily discharge for that year (assuming a complete record was available) was scaled by the average ratio of instantaneous to daily peak flow from the other years in the station record (*per* Ahmed and Jackson, 2013). This ratio ranged from 1.01 to 1.17.

Final datasets were then input to the EasyFit Professional (v5.5) software to fit a range of distributions. The Log Pearson (Type III) distribution was used for most stations, with the Log Logistic 3P distribution providing the best fit (using the Anderson Darling test) for several of the smaller drainage basins. Best fitting probability distributions were then fitted to the unit discharge values and the following recurrence intervals were estimated: 1:2-year, 1:5-year, 1:10-year, 1:20-year, 1:50-year, 1:100-year and 1:200-year floods. To complete the analysis, peak flow estimates for each station and recurrence interval were plotted against drainage area. Best fit and conservative fitting envelope curves were then derived from the data with the information plotted in this format.

For this updated analysis, annual extreme discharges were obtained for regional stations through to the end of 2020. Data for 2015, 2016 and 2017 were then compared to values utilized in the previous frequency analysis to determine whether recent extreme events fall within (or outside) the range of variability presented in Lorax (2017). Since recent extreme values were all low magnitude compared to the annual extreme discharge series of the earlier dataset, it was concluded the results of the previous peak flow analysis remain valid. Data for Big Creek near the Mouth (09AH003) are shown in Figure 3-9 to illustrate the low magnitude of extreme discharges recorded in recent years in Yukon.

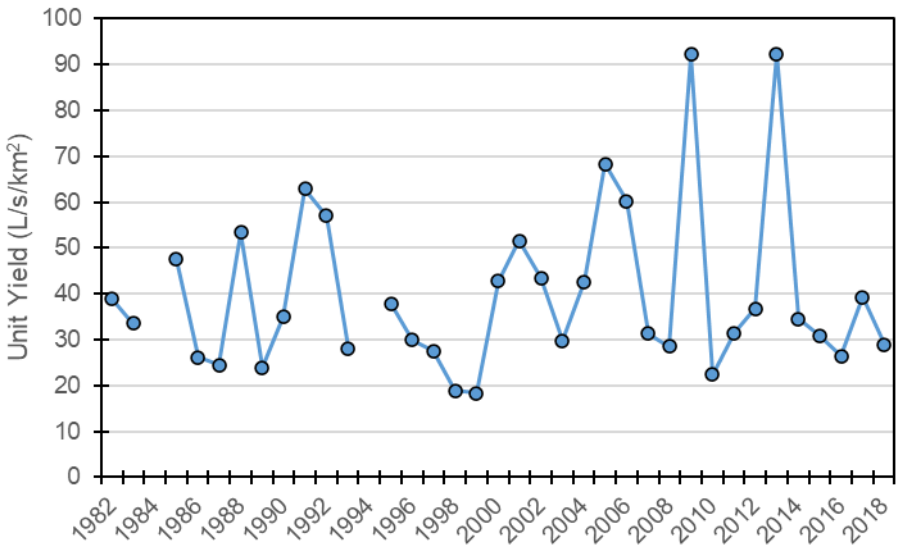

Figure 3-9: Maximum annual peak discharge series for Indian River above the Mouth (09EB003).

3.3.5.3 Regional Low Flow Analysis

The same set of regional stations (Table 3-7) were also assessed in a low flow analysis. To process datasets for the low flow analysis, daily discharge data from eleven of the selected regional hydrometric stations were downloaded from the Water Survey of Canada data portal and seven-day rolling averages were computed from the daily discharge data. Next, annual minima time-series of the winter and June-September 7-day average low flows were assembled for each station. These data were then exported to the EasyFit software for further evaluation.

Through an inspection of the statistics and ranking data output by EasyFit, no single probability distribution could be identified that consistently provided a best fit to the station observations of low flow. However, the Log Pearson (Type III), Weibull and Log Normal distributions were, in general, high-ranking distributions for each hydrometric station inspected. Furthermore, estimated low flows based on these three probability distributions were very similar. Consistent with guidance from the BC Ministry of Environment (see BC MOE, 2012), low flow values returned by the Log Pearson (Type III) distribution are reported in Section 3.2, noting that recurrence interval estimates were derived for the $7Q_2$ (median), $7Q_5$, $7Q_{10}$ and $7Q_{20}$ events. Where the Log Pearson (Type III) distribution did not provide a good fit to the data, the Weibull distribution was used following the guidance provided in WMO (2009).

As a final step in the low flow analysis, estimated low flows for each station were plotted against their respective drainage areas. This plot in effect allows a low flow metric to be

estimated for a location of interest based on drainage area information alone. Summer and winter manual low flow measurements collected from the Project area drainages were added to these regression plots, to validate the low flow-drainage area relationship for the smaller spatial scale (*i.e.*, drainage areas on the order of 10 to 400 km^2).

3.3.5.4 Synthetic Streamflow Records

The high-quality discharge records available for the Project site allowed synthetic discharge time series to be constructed for eleven Project hydrometric stations using regional streamflow data as a driver. Synthetic streamflow records allow the site-specific characteristics of the Project basins to be retained in long-term record, while preserving any regional inter-annual variability in discharge. This allows for more robust recurrence interval estimates of critical discharge regime metrics (*e.g.*, mean annual runoff, seasonal runoff distribution, June-September $7Q_{10}$, *etc*.), and maintains the regional inter-annual variability in streamflow resulting from multi-decadal climate cycles (*e.g.*, PDO, AO) and trends (*e.g.*, increasing winter low flows).

Following the Empirical Frequency Pairing (EFP) methodology described by Butt (2013), the overlapping periods of record were selected for the site station and the representative regional stations. Data were discretized by month, and all available daily average flows for each month were ranked. For example, if there were data available for the month of April over five years, then the number of paired observations was 150. The paired and ranked observations were then plotted, with the regional station set as the predictor variable (x-axis). Due to the limited availability of continuous winter flow data, all data for the months of October through April were grouped to represent the winter low-flow regime. Additionally, all available spot flow measurements were included in the analysis.

The methodology described in Butt (2013) was modified to improve the predictive power of the EFP method. A piece-wise linear regression approach was employed to estimate flow values that fall between each site-regional data pair. For cases where the minimum/maximum daily flow in the record fell outside of the site data record, the relationships were extrapolated using a linear relationship between at least 10 data pairs, and an understanding of the regional peak and low flow unit yields. An example of the EFP relationship for the LC-11.4 hydrometric station is provided in Figure 3-10 for the month of May.

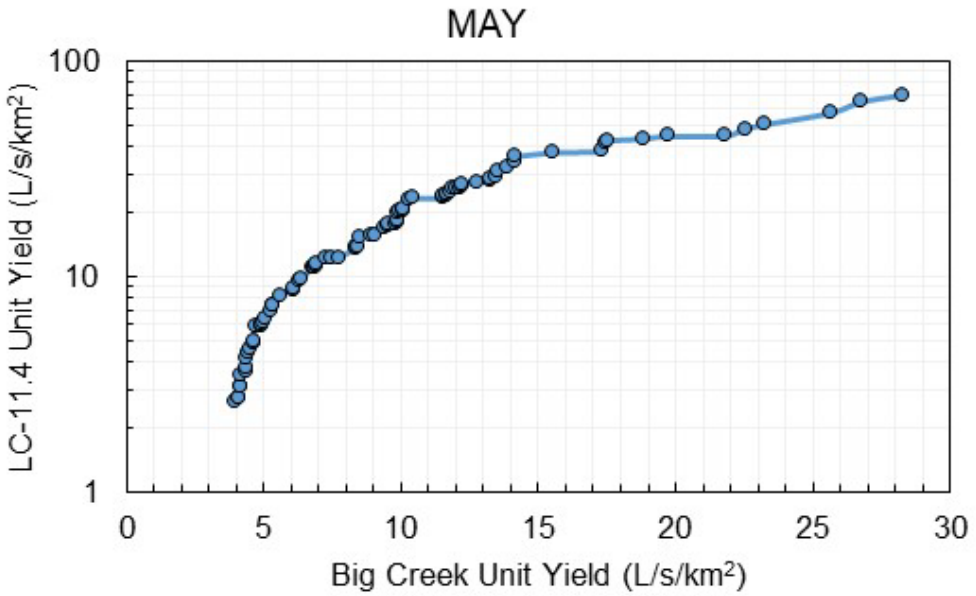

Figure 3-10: Example of an empirical frequency pairing relationship for May at hydrometric station LC-11.4.

Based on the streamflow data available when the Lorax (2017) baseline hydrometeorology report was prepared, the hydrometric record from the Indian River above the Mouth WSC gauge (09EB003) was originally used as the predictor basin for all synthetic hydrographs. This station was selected based on the following criteria:

- The drainage basin is situated north of Coffee Creek, but south of Dawson City.
- Record period of sufficient length and completeness to capture the full-range of inter-annual streamflow variability over the last 30 years;
- The record provides a reasonable representation of all relevant components of the site hydrographs (*i.e.*, rapid freshet, multiple rainfall driven peaks during the summer and early fall, and extended winter base flows of <1 L/s/km^2).

The Big Creek near the Mouth regional hydrometric station also meets the above criteria with the added benefit of several more years of site hydrometric data that overlap with regional values so the regional predictor station for the synthetic streamflow update was switched to the Big Creek station. Plots of all monthly and low flow EFP relationships are provided in Appendix D for all Project hydrometric stations. Also included in Appendix D are flow duration curves for the overlapping period of record (site and synthetic time-series), the full synthetic daily streamflow time-series, plots of annual runoff anomalies and tables summarizing the monthly average synthetic discharge values.

3.3.5.5 Supplementary Recurrence Interval Analyses: Annual Runoff Recurrence Intervals and June-September 7Qmin Flows

The synthetic streamflow time series created using the EFP method were used to estimate several metrics for the 11 Project site stations analysed. The full synthetic time-series for the Project stations are presented in time series format and as standardized anomalies in Appendix D. Standardized anomalies relating to synthetic hydrometric data were calculated as follows:

$$k=\frac{\mu-\bar{X}}{\sigma} \qquad \text{[Equation 5]}$$

where k is the standardized anomaly (dimensionless);

μ is the annual runoff value in mm;

σ is the standard deviation of the annual runoff series in mm;

$\bar{X}$ is the mean annual runoff in mm for the period of record.

Similarly, to the regional data, time series of June-September minimum 7-day average streamflow (*i.e.*, 7Qs) were analysed using the EasyFit 5.6 statistical package. Annual runoff recurrence interval estimates were derived for the 1:2 (median), 1:10, 1:25, 1:50, 1:100 and 1:200 wet and dry years using the Generalized Extreme Value (GEV) distribution. June-September 7-day minimum streamflow recurrence interval estimates were derived using the Log-Pearson (Type III) (LP3) distribution for the $7Q_2$ (median), $7Q_5$, $7Q_{10}$ and $7Q_{20}$ events as recommended by MOE (2012). Where the LP3 distribution did not provide a good fit to the data, the LogNormal distribution was used instead (WMO, 2009). The synthetic data were not used for the peak flow analyses, as the extrapolation procedure used for the upper end of the regional-site relationship may introduce bias into the results.

4. Climate Regime Characterization

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4. Climate Regime Characterization

The sections below provide a summary of site and regional climate data relevant to the Coffee Gold Project. Period of record data are presented for the Km 11 weather station, the Kona weather stations, standalone tipping bucket rainfall gauges (Camp, Laydown), local snow courses and the nearest regional climate stations. In addition to the information presented in Section 4, supporting information in the form of data tables and plots is presented in the following data appendices: Appendix A (synthetic climate data), and Appendix B (climate change scenario data and trends for the Project site).

The prevailing climate conditions at the Project site are typical for central Yukon. Average annual temperature is approximately -2.2 °C at 1,000 m asl, with average monthly air temperatures that range from -16.0°C (December and January) to +14.0°C (July). Locally, the Project site experiences notable temperature inversions in the winter months, with observed ridgetop temperatures up to 10°C higher than measurements recorded at valley bottom regional stations. With the installation of the second climate station in autumn 2018, the occurrence and permanence of temperature inversions between the Km 11 (975 m) and Kona (1,340 m) monitoring station can now be evaluated at hourly, daily and monthly timestep.

Mean annual precipitation (MAP) at the Project site (~1,300 m above sea level) is estimated to be 504 mm over the 1991-2020 climate normal period, a value consistent with precipitation depths reported by Brabets (2000) and ClimateWNA (Wang *et al*., 2016). Approximately 68% of the annual precipitation is expected, on average, as rainfall during the months of May through September, with the remaining 32% expected as snow reporting between October and April. Site-specific precipitation gradients were ascertained through an inspection of site- and regional precipitation data with the analysis returning the following orographic gradients for the Coffee Gold Project: 4% increase in precipitation per 100 m elevation gain for rainfall (4%/100 m); and 7%/100 m elevation gain for snowfall.

Annual potential evaporation (PE) for the Project area is estimated to be ~500 mm which is roughly equal to the MAP estimate for the Project site. On an annual basis, monthly evaporation rates are highest in May, June, July, and August (*i.e.*, 70 to 110 mm per month). In contrast, potential evaporation rates for autumn, winter and spring months are generally low or negligible. Consistent with other studies in the Yukon, the evapotranspiration estimate for the Coffee Gold site is roughly 40% of the assumed PE value, or roughly, 190 mm per year.

4.1 Project Site Climate Records

This section presents tabular and graphical summaries of key climatic records collected at the two Project site climate stations, including:

- Air temperature;
- Precipitation;
- Relative humidity;
- Wind speed and direction;
- Atmospheric pressure;
- Solar radiation;
- Potential evapotranspiration; and,
- Snow depth and snow water equivalent.

With the exception of the occasional winter riming event which affects climate station sensors (*e.g.*, anemometer, wind vane), the instrumental record for Km 11 climate station now exceeds 9 years in duration and is essentially continuous, while the Kona climate record is approximately 3-years in duration.

4.1.1 Air Temperatures

Mean annual air temperature (MAT) for the bulk of the regional climate stations near Coffee Gold range from -5 to -2°C (Table 2-5). At the Km 11 station, record period MAT is -2.2°C, and -2.6°C at the Kona climate station (Table 4-1). On a monthly basis, average air temperatures for the Project site also show similar patterns and magnitude as the nearest regional climate stations (Figure 4-2). Minimum (maximum) recorded temperatures are -38.2°C (29.7°C) and -36.2°C (23.7°C) at the Km 11 and Kona climate stations, respectively (Table 4-1). Average monthly air temperature ranges are as follows (with reference to Figure 4-1):

- Minimum monthly air temperatures range from -32.6 to 6.0°C at the Km 11 station, and -31.6 to 4.1°C at the Kona station;
- Mean monthly air temperatures range from -16.8 to 13.9°C at the Km 11 station, and -15.4 to 11.7°C at the Kona station; and
- Maximum monthly air temperatures range from -2.0 to 25.3°C at the Km 11 station, and -1.8 to 22.9°C at the Kona station.

Table 4-1:
Monthly minimum, mean and maximum air temperatures at the Km 11 and Kona climate stations. All values are in °C.

Station	Year	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Km 11 (975 m)	2012	Min.	--	--	--	--	--	--	8.0	1.7	-4.0	-19.4	-31.7	-35.8	--
		Mean	--	--	--	--	--	--	14.9	11.5	6.3	-7.1	-19.7	-24.0	--
		Max.	--	--	--	--	--	--	22.4	21.4	17.4	7.8	-10.8	-4.9	--
	2013	Min.	-37.6	-20.4	-24.4	-18.6	-8.7	2.8	6.0	2.8	-4.3	-7.8	-36.2	-33.1	-37.6
		Mean	-17.7	-12.3	-11.6	-7.8	4.9	14.3	13.8	13.0	4.6	-0.2	-15.8	-21.1	-3.0
		Max.	3.6	-0.3	3.2	4.1	19.5	27.2	24.2	26.0	15.8	8.8	0.3	2.6	27.2
	2014	Min.	-29.3	-33.7	-22.1	-16.9	-2.8	2.2	5.0	1.5	-3.9	-13.5	-29.6	-24.0	-33.7
		Mean	-10.1	-18.6	-10.4	-0.6	8.2	10.4	12.9	11.1	4.6	-4.2	-12.6	-12.9	-1.9
		Max.	6.8	-4.9	3.2	8.9	18.8	21.3	21.4	22.6	18.9	7.8	-3.7	-2.6	22.6
	2015	Min.	-33.9	-34.6	-27.4	-7.6	-1.6	3.0	5.8	-1.8	-5.3	-11.9	-28.5	-28.5	-34.6
		Mean	-17.3	-14.7	-8.3	0.4	11.9	12.1	12.5	9.3	3.7	-1.6	-13.2	-15.6	-1.7
		Max.	-0.5	4.4	5.0	10.6	26.2	23.4	25.9	25.1	16.7	6.7	1.0	-1.2	26.2
	2016	Min.	-21.3	-22.4	-12.3	-3.0	-0.3	3.3	7.3	3.8	-3.5	-16.9	-27.7	-30.0	-30.0
		Mean	-11.1	-10.2	-3.9	3.2	8.8	12.3	13.4	12.5	6.6	-6.4	-12.7	-18.7	-0.5
		Max.	0.4	2.3	11.1	12.9	23.5	24.9	24.7	24.0	17.2	5.7	1.8	-4.0	24.9
	2017	Min.	-32.6	-25.1	-29.4	-10.7	-1.2	2.4	7.0	2.7	-3.0	-11.9	-33.4	-33.7	-33.7
		Mean	-15.6	-12.6	-16.0	0.6	7.2	12.1	14.4	12.4	7.2	-2.9	-18.3	-12.2	-2.0
		Max.	0.6	5.2	4.5	11.8	19.4	29.7	24.9	26.7	16.2	8.4	-0.7	2.2	29.7
	2018	Min.	-34.0	-31.4	-25.1	-18.8	-3.7	2.3	5.6	2.6	-1.3	-13.8	-22.4	-25.7	-34.0
		Mean	-17.1	-16.9	-9.3	-2.0	7.1	11.4	15.2	10.4	5.3	-0.3	-12.3	-14.6	-1.9
		Max.	4.8	-2.9	5.2	9.5	20.6	26.5	28.6	25.9	12.7	12.2	-2.4	-1.6	28.6
	2019	Min.	-34.6	-33.2	-19.8	-15.1	-6.3	4.3	6.1	-1.1	-3.1	-10.3	-24.1	-31.2	-34.6
		Mean	-18.4	-17.1	-3.0	0.6	9.6	13.4	15.0	10.0	7.4	-2.6	-12.1	-18.2	-1.3
		Max.	-2.0	-3.0	10.2	13.6	24.5	27.3	24.6	25.6	19.4	7.5	1.3	-3.4	27.3
	2020	Min.	-38.2	-33.1	-28.4	-16.9	-1.7	2.8	5.4	3.8	-2.0	-20.7	-29.4	-27.5	-38.2
		Mean	-24.3	-18.0	-13.2	-1.5	8.6	10.0	12.1	10.1	5.7	-5.8	-16.2	-14.4	-3.9
		Max.	-6.0	-1.9	2.6	12.8	21.2	20.9	25.8	19.4	19.6	14.1	-5.1	1.4	25.8
	2021	Min.	-32.1	-36.9	-25.8	-28.3	-2.7	1.4	4.0	1.2	-6.6	--	--	--	--
		Mean	-13.1	-21.3	-13.2	-3.2	6.3	13.2	14.5	11.1	6.1	--	--	--	--
		Max.	-0.4	-8.6	1.1	12.8	15.7	26.1	28.8	27.7	18.8	--	--	--	--
	Record Period	Min.	-38.2	-36.9	-29.4	-28.3	-8.7	1.4	4.0	-1.8	-6.6	-20.7	-36.2	-35.8	-38.2
		Mean	-16.1	-15.8	-9.9	-1.2	8.1	12.2	13.9	11.1	5.8	-3.4	-14.8	-16.8	-2.2
		Max.	6.8	5.2	11.1	13.6	26.2	29.7	28.8	27.7	19.6	14.1	1.8	2.6	29.7
Kona (1,340 m)	2018	Min.	--	--	--	--	--	--	--	--	--	-15.4	-20.2	-21.1	--
		Mean	--	--	--	--	--	--	--	--	--	-1.4	-8.7	-10.2	--
		Max.	--	--	--	--	--	--	--	--	--	10.1	2.8	-1.5	--
	2019	Min.	-27.8	-27.7	-16.7	-17.3	-8.1	1.9	5.8	-2.2	-3.8	-12.5	-20.5	-31.3	-31.3
		Mean	-13.9	-11.7	-3.6	-1.9	7.0	11.0	12.9	8.0	6.0	-3.6	-9.1	-12.8	-1.0
		Max.	1.3	2.8	7.5	9.5	19.7	22.7	22.7	21.0	15.6	5.6	1.2	-0.6	22.7
	2020	Min.	-32.3	-31.0	-28.2	-17.0	-4.1	1.6	2.8	2.8	-4.4	-20.8	-25.8	-29.9	-32.3
		Mean	-20.8	-15.6	-13.5	-3.5	5.6	7.6	9.8	8.2	4.0	-6.5	-14.0	-12.3	-4.3
		Max.	-2.5	-3.7	-0.7	9.7	15.1	15.9	22.2	20.5	16.1	10.6	-3.9	0.5	22.2
	2021	Min.	-23.0	-36.2	-25.7	-31.6	-6.1	-0.5	3.7	0.7	-11.0	-10.4	--	--	--
		Mean	-11.3	-18.4	-13.8	-5.2	3.4	10.7	12.4	9.4	1.8	-4.9	--	--	--
		Max.	-1.8	-4.5	-2.2	12.6	11.9	21.6	23.7	23.1	13.6	0.9	--	--	--
	Record Period	Min.	-32.3	-36.2	-28.2	-31.6	-8.1	-0.5	2.8	-2.2	-11.0	-20.8	-25.8	-31.3	-36.2
		Mean	-15.4	-15.2	-10.3	-3.5	5.3	9.8	11.7	8.5	3.9	-4.1	-10.6	-11.8	-2.6
		Max.	1.3	2.8	7.5	12.6	19.7	22.7	23.7	23.1	16.1	10.6	2.8	0.5	23.7

Note: All values calculated from hourly data.

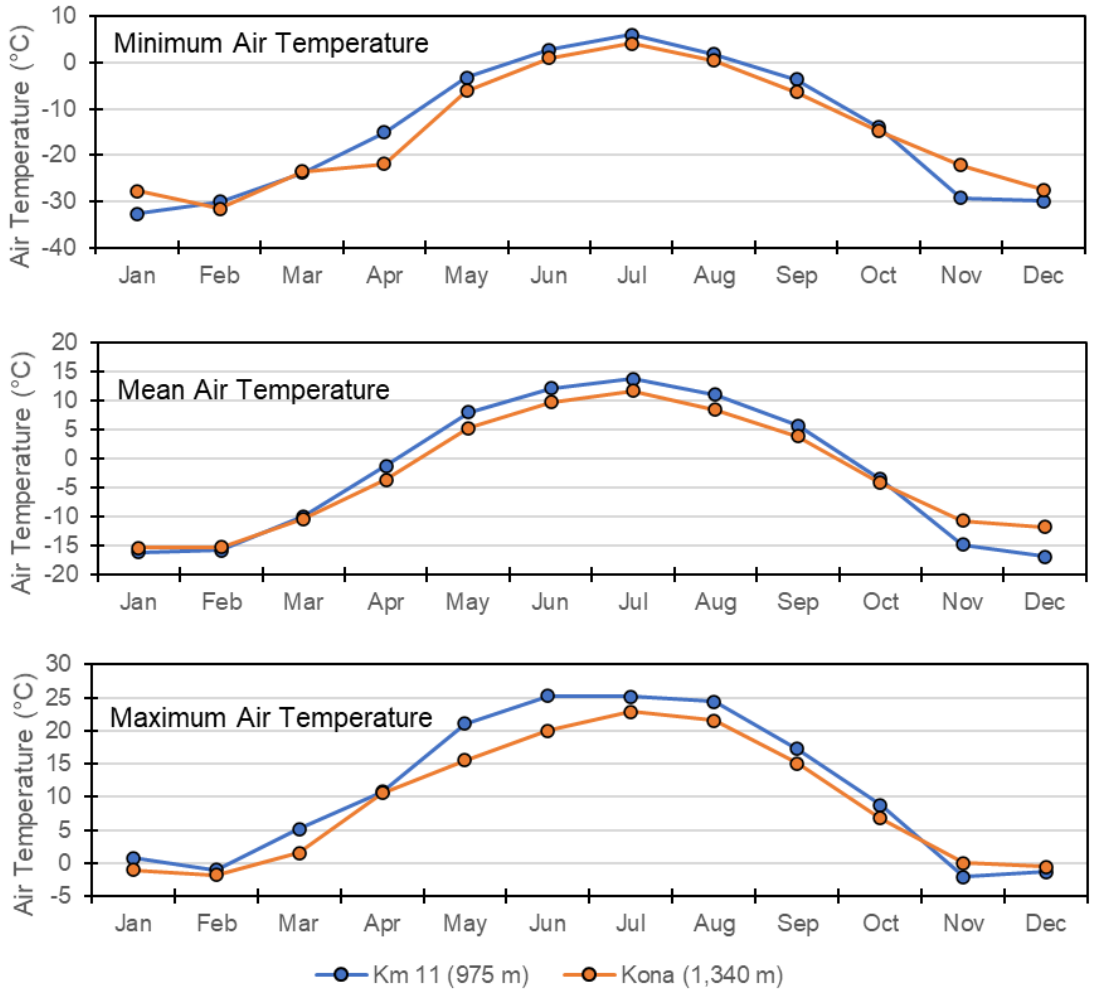

Figure 4-1: Mean monthly minimum (top panel), mean (middle panel) and maximum (bottom panel) air temperature records for the Km 11 and Kona climate stations.

The lowest air temperatures are often experienced in December through February, while the highest air temperatures usually occur in July at both stations, noting that there is evidence of inversion events during the winter months (see Section 4.1.1.1).

4.1.1.1 Air Temperature Inversions

At the upper elevations of the Project site, a notable departure from the regional temperature signal occurs during winter months (Figure 4-2). Valley bottom temperature inversions occur during winter months and ridgetop temperatures may be 10°C higher than measurements recorded at valley bottom stations. These inversions result in a reversal of the normal lapse rate (decreasing temperature with increasing elevation) and are typically caused by cold Arctic air masses pooling in the valley bottoms from late October to early March.

Wahl (1987) reports that during a temperature inversion, lapse rates can range from 3-5°C/1000 m of elevation gain. Based on a comparison of data between nearby Pelly Ranch (elevation 445 m) and Km 11, the average lapse rate is 5.8°C/1000 m over the winter (October through April). During summer months (June, July, August), the local lapse rate is -3.3°C/1000 m which is similar to the standard adiabatic lapse rate (-6.4°C/1000 m) and the saturated adiabatic lapse rate (-5.0°C/1000 m). These site:regional lapse rates are supported by values calculated from the two Project site air temperature records, with lapse rates averaging 5.5°C/1000 m during the winter months, and -5.8°C/1000 m during the summer. Note that air temperature inversions at the Project site appear to be most pronounced during the months of November and December (Figure 4-2).

Much of the annual precipitation total for the Project site reports as rainfall during summer months. The occurrence of warmer and wetter air masses at the Project (versus lower elevation) may explain the difference in lapse rate noted for the summer months.

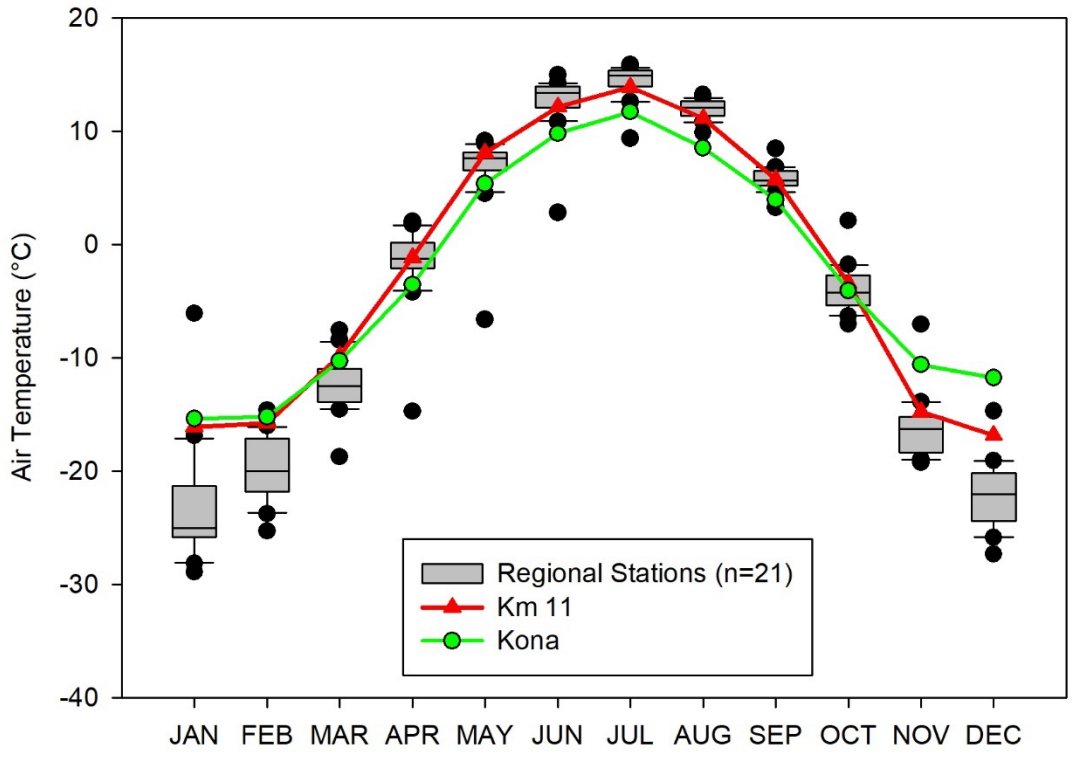

Figure 4-2: Comparison of the monthly average air temperature signature for the Km 11 and Kona climate stations to nearest regional stations (n = 21) with long-term records. The box and whisker plots show the following statistics for the regional stations: median and quartiles (grey box), 5th and 95th percentile values (tails) and outliers (black circles).

4.1.2 Precipitation

4.1.2.1 Regional Setting

The study area is characterized by a cold, continental climate. Large frontal systems generated by the Aleutian Low are blocked by the high topography along the coast, and hence the Project lies in the leeward rain-shadow (Figure 4-3 and Figure 4-4). Cassano and Cassano (2010) analysed sea level pressure patterns for the Yukon River basin and found that the winter circulation patterns are dominated by the strong Aleutian Low. In contrast, summer patterns are characterized by low pressure systems over land and the Beaufort/Chukchi Sea, and weak high-pressure cells to the north, resulting in easterly/north-easterly flows into the Basin.

Cassano and Cassano (2010) report that largest daily precipitation events (*i.e.*, top 10th and 1st percentile daily totals, on an annual basis) were attributable to over-land convective events that occur with increased frequency during the summer months. Evapotranspiration rates are highest during the summer, and therefore additional moisture is recycled and available to precipitate. During the winter, the largest precipitation events result from southerly winds caused by a low-pressure centre located to the southwest of the Yukon Basin and north of the Aleutian Islands. This brings moisture past the higher mountains on the southern edge of the basin and results in appreciable accumulation of precipitation.

The general patterns and trends reported by Cassano and Cassano (2010) are reflected in the mapping results of Brabets *et al.* (2000). Evident in Figure 4-4 are the bands of high precipitation in the southern extent of the Yukon River basin and the drying trend in annual precipitation northward from the southern portion of the basin. Figure 4-4 after Brabets also indicates annual precipitation in the vicinity of the Coffee Gold Project ranges from 250-375 mm for valley bottom location to 375-500 mm for high relief terrain similar to that which characterizes the Project site.

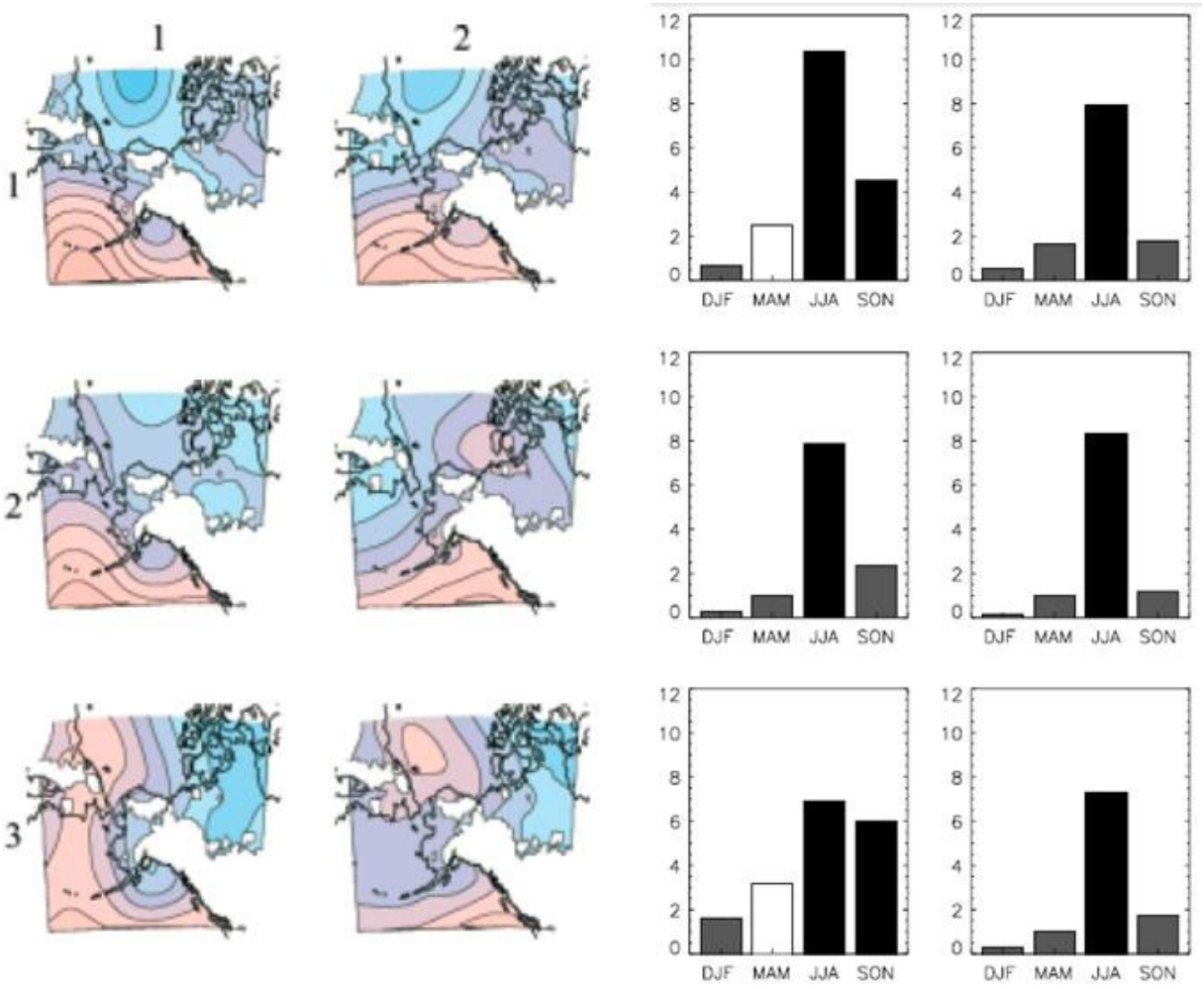

Figure 4-3: **Left: Daily sea level pressure anomaly patterns for the period 1957-2002. Blue shading indicates negative anomalies (low pressure), and red shading represents positive anomalies (high pressure). Right: Corresponding frequency of days that map to each pattern seasonally. Each bar represents the percentage of days that the pattern occurs in a season. Black and grey bars represent positive and negative statistical significance, respectively. Source: Figures 2 and 5 in Cassano and Cassano (2010).**

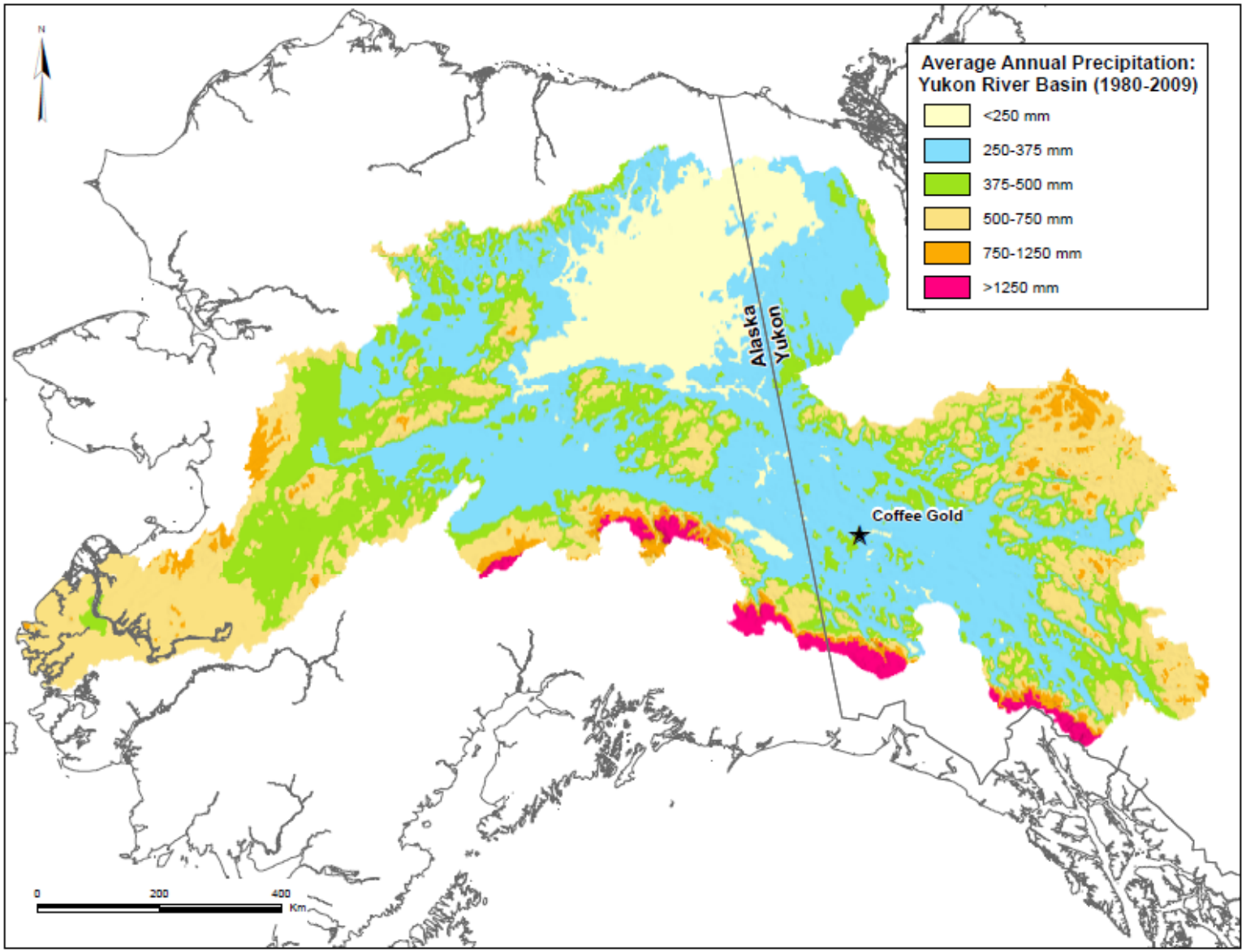

Figure 4-4: Annual precipitation (1980-2009) for the Yukon River Basin (from Brabets *et al.*, 2000).

4.1.2.2 Precipitation – Site Data

Precipitation has been measured on-site since July 2012 at the Km 11 climate station, and at several snow courses located at various elevations around the Project site. Tipping bucket precipitation gauges were also installed at the camp (425 m) and at ridgetop (>1,200 m) in 2015 to refine assumptions related to precipitation accumulation with elevation at the Project site. The Kona climate station was installed at an elevation of 1,340 m in October 2018 to gather data representative of the planned HLF location and has a reliable precipitation record.

Gauge and snow course data gathered during the baseline study indicate mean annual precipitation (MAP) averages 331 mm at 975 m and 398 mm at 1,340 m, with approximately 30% of this amount falling as snow between October and April, and 70% falling as rain from May to September (Table 4-2 and Table 4-3). These measured MAP values for the Project site do not necessarily account for the effects of gauge under-catch or sublimation, which will result in measured precipitation values (winter values in particular) being lower than actual values. These are well-documented issues in northern regions (*e.g.*, Yang *et al*., 2005 and Pomeroy *et al*., 1999) and corrections are required to obtain a true MAP estimate (see Section 2.3.3.3 and Section 4.4.4.2).

Figure 4-5 also shows regional precipitation data from nearby climate stations. Overall, site and regional precipitation measurements show similar magnitudes and monthly patterns. Like air temperature, the local precipitation signature closely approximates the patterns returned by regional climate station. Further, the seasonal precipitation distribution calculated from valley bottom climate records also strongly resembles the proportions measured during the baseline study (*i.e.,* regional data return proportions of snow and rain to be 35% and 65% respectively).

Table 4-2:
Summary of measured precipitation data for the Km 11 climate station (July 2012-June 2019).

Year	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2012	Rain (mm)	--	--	--	--	--	--	*4.8*	37.8	17.8	4.3	0.0	0.0	---
	% Rain	--	--	--	--	--	--	*100%*	100%	64%	19%	0%	0%	---
	Snow (mm)	--	--	--	--	--	--	*0.0*	0.0	10.0	18.8	23.4	33.3	---
	% Snow	--	--	--	--	--	--	*0%*	0%	36%	81%	100%	100%	---
2013	Rain (mm)	0.0	0.0	9.9	20.9	49.3	57.9	89.7	58.7	25.7	5.3	0.0	0.0	317.3
	% Rain	0%	0%	96%	99%	100%	100%	100%	100%	54%	26%	0%	0%	74%
	Snow (mm)	20.1	14.7	0.4	0.3	0.0	0.0	0.0	0.0	21.6	15.0	23.4	16.0	111.4
	% Snow	100%	100%	4%	1%	0%	0%	0%	0%	46%	74%	100%	100%	26%
2014	Rain (mm)	0.0	0.0	0.0	0.0	23.0	3.0	80.0	0.0	16.5	0.0	0.0	0.0	122.5
	% Rain	0%	0%	0%	0%	67%	100%	100%	0%	77%	0%	0%	0%	58%
	Snow (mm)	46.7	23.6	0.3	0.0	11.2	0.0	0.0	0.0	4.8	0.0	0.5	2.0	89.2
	% Snow	100%	100%	100%	0%	33%	0%	0%	0%	23%	0%	100%	100%	42%
2015	Rain (mm)	0.0	0.0	0.0	0.0	24.9	48.8	99.3	73.7	32.0	17.3	0.0	0.0	295.9
	% Rain	0%	0%	0%	0%	100%	100%	100%	100%	79%	52%	0%	0%	77%
	Snow (mm)	19.3	19.3	0.3	0.3	0.0	0.0	0.0	0.0	8.3	15.9	20.6	6.0	89.9
	% Snow	100%	100%	100%	100%	0%	0%	0%	0%	21%	48%	100%	100%	23%
2016	Rain (mm)	5.1	0.5	2.5	14.0	48.8	71.1	68.3	46.0	14.2	0.0	0.5	0.0	271.0
	% Rain	14%	8%	41%	100%	91%	100%	100%	100%	98%	0%	10%	0%	71%
	Snow (mm)	31.0	6.1	3.6	0.0	4.6	0.0	0.0	0.0	0.3	34.8	4.6	23.5	108.5
	% Snow	86%	92%	59%	0%	9%	0%	0%	0%	2%	100%	90%	100%	29%
2017	Rain (mm)	0.0	0.0	0.0	9.1	49.5	43.4	91.7	22.6	13.2	6.9	0.0	0.0	236.5
	% Rain	0%	0%	0%	100%	96%	100%	100%	100%	93%	13%	0%	0%	74%
	Snow (mm)	9.7	7.2	0.5	0.0	1.8	0.0	0.0	0.0	1.0	46.3	10.0	7.9	84.4
	% Snow	100%	100%	100%	0%	4%	0%	0%	0%	7%	87%	100%	100%	26%
2018	Rain (mm)	3.0	0.0	2.3	2.0	36.1	81.0	26.4	115.8	20.6	*0.5*	*0.0*	*0.0*	287.8
	% Rain	63%	0%	16%	46%	100%	100%	100%	100%	100%	*5%*	*0%*	*0%*	84%
	Snow (mm)	1.8	17.6	11.6	2.4	0.0	0.0	0.0	0.0	0.0	*9.6*	*9.2*	*2.4*	54.6
	% Snow	37%	100%	84%	54%	0%	0%	0%	0%	0%	*95%*	*100%*	*100%*	16%
2019	Rain (mm)	*0.0*	*0.0*	*0.0*	*0.0*	19.3	56.4	97.3	56.1	30.7	9.4	0.0	0.0	269.2
	% Rain	*0%*	*0%*	*0%*	*0%*	100%	100%	100%	100%	100%	95%	--	--	92%
	Snow (mm)	*3.9*	*6.0*	*2.7*	*11.8*	0.0	0.0	0.0	0.0	0.0	0.5	0	0	25.0
	% Snow	*100%*	*100%*	*100%*	*100%*	0%	0%	0%	0%	0%	5%	--	--	8%
All Years	Rain (mm)	1.2	0.1	2.1	6.6	35.8	51.7	69.7	51.3	21.3	5.5	0.1	0.0	245.3
	% Rain	6%	1%	43%	76%	93%	100%	100%	100%	79%	24%	1%	0%	74%
	Snow (mm)	18.9	13.5	2.8	2.1	2.5	0.0	0.0	0.0	5.7	17.6	11.4	11.4	86.0
	% Snow	94%	99%	57%	24%	7%	0%	0%	0%	21%	76%	99%	100%	26%
	Total P (mm)	20.1	13.6	4.9	8.7	38.3	51.7	69.7	51.3	27.1	23.1	11.5	11.4	331.3

Notes: Values for 2018-19 in italics infilled based on Kona climate station gauge data and gradient 8%/100 m elevation gain between Kona (1,340 m asl) and Km 11 (975 m asl) stations.

Table 4-3:
Summary of measured precipitation data for the Kona climate station (October 2018 – October 2021).

Year	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
2018	Rain (mm)	--	--	--	--	--	--	--	--	--	*2.0*	0.0	0.0	---
	% Rain	--	--	--	--	--	--	--	--	--	*16%*	0%	0%	---
	Snow (mm)	--	--	--	--	--	--	--	--	--	*10.8*	12.1	3.2	---
	% Snow	--	--	--	--	--	--	--	--	--	*84%*	100%	100%	---
2019	Rain (mm)	0.0	0.0	0.0	0.1	26.3	66.1	102.2	61.8	19.5	4.2	0.0	0.0	280.1
	% Rain	0%	0%	0%	1%	88%	100%	100%	100%	66%	16%	0%	0%	73%
	Snow (mm)	5.2	7.9	3.6	15.6	3.7	0.0	0.0	0.0	10.2	22.5	19.8	15.4	104.0
	% Snow	100%	100%	100%	99%	12%	0%	0%	0%	34%	84%	100%	100%	27%
2020	Rain (mm)	*0.0*	*0.0*	*0.0*	*1.9*	14.0	93.2	109.3	81.8	12.2	0.2	0.0	0.0	312.4
	% Rain	*0%*	*0%*	*0%*	*0%*	85%	100%	100%	100%	60%	1%	0%	0%	72%
	Snow (mm)	9.5	6.1	13.2	32.9	2.5	0.0	0.0	0.0	8.2	28.1	14.3	6.0	120.6
	% Snow	*100%*	*100%*	*100%*	*95%*	15%	0%	0%	0%	40%	99%	100%	100%	28%
2021	Rain (mm)	*0.0*	*0.0*	*0.0*	*2.1*	35.0	56.6	44.7	76.2	33.1	0.0	--	--	---
	% Rain	*0%*	*0%*	*0%*	*0%*	81%	100%	100%	100%	46%	0%	--	--	---
	Snow (mm)	*6.2*	*11.9*	*20.4*	*15.5*	8.5	0.0	0.0	0.0	38.9	20.6	--	--	---
	% Snow	*100%*	*100%*	*100%*	*88%*	19%	0%	0%	0%	54%	100%	--	--	---
All Years	Rain (mm)	0.0	0.0	0.0	1.4	25.1	72.0	85.4	73.3	21.6	1.6	0.0	0.0	280.2
	% Rain	0%	0%	0%	6%	84%	100%	100%	100%	53%	7%	0%	0%	70%
	Snow (mm)	6.9	8.7	12.4	21.3	4.9	0.0	0.0	0.0	19.1	20.5	15.4	8.2	117.3
	% Snow	100%	100%	100%	94%	16%	0%	0%	0%	47%	93%	100%	100%	30%
	Total P (mm)	6.9	8.7	12.4	22.7	29.9	72.0	85.4	73.3	40.7	22.1	15.4	8.2	397.5

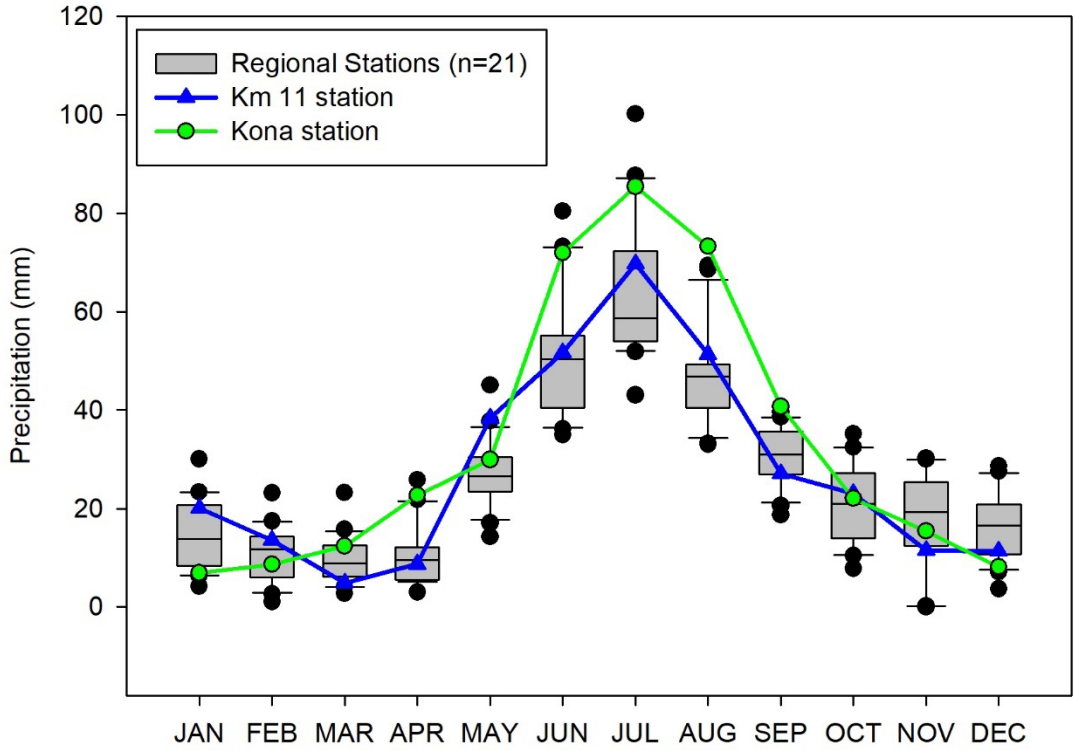

Figure 4-5: Comparison of the monthly precipitation signature for the Coffee Gold Km 11 and Kona climate stations to nearest regional stations (n = 21) with long-term records. The box and whisker plots show the following statistics for the regional stations: median and quartiles (grey box), 5th and 95th percentile values (tails) and outliers (black circles).

4.1.2.3 Snow Depth

The Kona climate station is equipped with an acoustic snow depth sensor which provides a high-resolution interpretation of snow depth in the immediate vicinity of the climate tower.

Data shown in Figure 4-6 confirms snowpack accumulation typically begins in earnest in mid- to late-October each year, and typically melts over a one- to two-week period between late-March and late-April.

The continuous snow course record for Kona differs from the snow course data over the period of record, which is not surprising since the tower measurements are based on a single point of observation. Snow depth measurements from the 10-point snow course are consistently higher than those recorded by the snow depth sensor by 0.1 to 0.3 m, which may reflect localized snow accumulation and ablation patterns, or calibration issues with the snow depth sensor. With respect to snow data, the primary metric of interest from a site water balance perspective is snow water equivalent (SWE), discussed below.

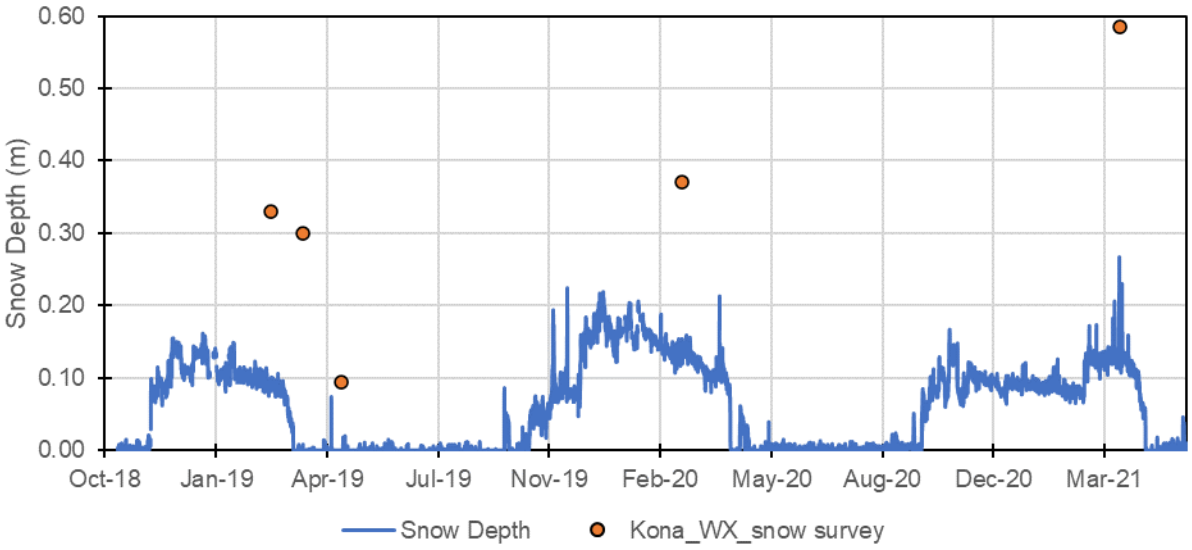

Figure 4-6: Continuous snow depth record measured at the Kona climate station (October 2018 to June 2021).

4.1.2.4 Snow Surveys

Snow surveys are conducted at the Coffee Gold Project along courses established with varying aspects and elevations (Table 2-3; Table 2-4). Period of record measurements are summarized for these monitoring sites in Table 4-4 and Table 4-5.

Snow course measurements are recorded to ground-truth gauge precipitation recorded at automated climate stations as well to understand the spatial variability in snow accumulation at the Project site and elucidate how orographic gradients affect snowfall magnitude. While several stations have been sampled over the years, the following four locations are considered the long-term monitoring stations for site: IC-1.5-SS, CC-east-1, KAM-WX-SS and Mid-Elev-SS. Following installation of the Kona weather station, a snow course was established at KONA-WX-SS, thus increasing the number of long-term snow monitoring stations at Coffee Gold to five locations.

Annual maximum measured SWE values are typically between 60 mm and 120 mm at the upper elevations of the Project site, however, there is substantial variability between sites due to differences in aspect and surrounding vegetation , both of which impact sublimation and melt rates, and wind redistribution patterns.

Table 4-4:
Snow water equivalent data reported in mm SWE, Coffee Gold Project (2012-2021).

Station	Elevation (m)	2012		2013			2014				2015			2016					2017			2018			2019			2020			2021		
		Mar	Apr	Feb	Mar	Apr	Jan	Feb	Mar	Apr	Feb	Mar	Apr	Jan	Feb	Mar	Apr	May	Mar	Apr	May	Mar	Apr	May	Mar	Apr	May	Mar	Apr	May	Mar	Apr	May
IC-4.5-SS Flat	399	123	--	100	--	113	--	--	--	--	--	--	49	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
IC-1.5-SS	524	143	--	157	117	97	71	55	83	84	--	--	45	--	--	58	58	--	57	--	--	45	--	--	46	35	--	97	--	--	79.5	--	--
CC-1.5-SS	733	97	--	63	--	110	--	--	--	--	--	50	51	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CC-north-1	1227	320	156	77	140	220	--	--	--	--	--	--	99	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CC-north-2	1220	470	--	--	200	87	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CC-east-1	1220	200	116	93	133	100	--	--	--	--	--	130	88	--	--	107	130	86	90	--	124	123	--	149	68	61	--	82	--	--	76.3	--	--
CC-east-2	1197	95	116	147	140	127	--	--	--	--	--	125	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CC-east-3	1193	130	72	110	133	97	--	--	--	--	--	115	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CC-South-1	1260	130	--	130	140	113	--	--	--	--	--	--	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CC-South-2	1246	190	--	113	120	107	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CC-west-1	1278	--	92	--	177	90	--	--	--	--	--	--	73	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CC-west-2	1257	--	--	--	87	167	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CC-west-3	1232	--	108	--	107	67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KAM-SS-EAST	987	--	--	--	--	--	--	--	--	78	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KAM-SS-NORTH	994	--	--	--	--	--	--	--	--	76.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KAM-SS-WX	996	--	--	--	--	--	--	--	--	88	--	90	104	66	--	81	98	--	68	--	--	89	115	66	72	53	--	105	--	--	59.8	--	--
KONA-WX_SS	1340	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60	50	23	69	--	--	113	--	--
KAM-SS-WEST	1020	--	--	--	--	--	--	--	--	75.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KAM-SS-HIGH	1184	--	--	--	--	--	--	--	--	117	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mid-Elev-SS	638	--	--	--	--	--	--	--	--	--	--	--	86	--	--	81	93	--	67	--	--	80	99	31.4	58	36	--	105	--	--	53.8	--	--

Table 4-5:
Snow water equivalent data for Alpha WRSF footprint (2018-2021).

Station	2018			2019			2020			2021		
	Mar	Apr	May	Mar	Apr	May	Mar	Apr	May	Mar	Apr	May
HC-1 SS	86	124	88	58	46	--	112	--	--	108	--	--
HC-2 SS	64	128	54	56	42	--	126	--	--	119	--	--
HC-3 SS	74	104	64	56	36	--	94	--	--	124	--	--
HC-4 SS	100	140	112	62	54	48	120	--	--	126	--	--
HC-5 SS	120	114	102	56	44	--	118	--	--	124	--	--

4.1.3 Relative Humidity

Relative humidity generally varies between 50% and 85% on an average monthly basis, with March to October values showing close correspondence between the two climate stations at site (Figure 4-7). At a monthly time-step and on average, relative humidity values are highest in the winter at the Km 11 station and range from 76-83% between November and February (Table 4-6). The relative humidity signatures at Km 11 display a notable departure at the Kona station, with winter values at Kona tracking lower than the Km 11 values by approximately 10%. This is due in part to the noted temperature inversions at site (see Section 4.1.1.1).

Table 4-6:
Average monthly relative humidity for the KM 11 and Kona climate stations. All values are in %.

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Km 11 (975 m)	2012	--	--	--	--	--	--	63.5	64.4	63.9	85.4	82.7	73.6	--
	2013	75.9	79.5	61.1	58.2	57.5	56.1	66.7	68.3	81.1	77.1	81.5	78.1	70.1
	2014	83.9	76.3	53.1	54.9	48.8	56.3	68.2	68.2	71.7	88.6	86.4	84.9	70.1
	2015	81.0	79.1	62.5	55.8	40.9	56.3	70.3	73.7	72.9	85.8	83.4	83.7	70.4
	2016	85.0	79.9	70.2	61.8	53.6	61.1	74.4	67.4	61.6	76.0	83.3	79.8	71.2
	2017	71.9	70.5	62.2	52.6	56.3	60.5	69.4	64.3	66.5	81.7	79.5	78.2	67.8
	2018	79.4	74.7	60.5	48.2	48.8	63.3	55.6	74.3	62.3	64.1	85.9	83.6	66.7
	2019	77.6	74.6	58.0	50.1	46.9	55.8	65.5	66.6	68.0	81.2	83.9	81.7	67.5
	2020	77.1	75.4	65.0	57.3	47.8	70.8	70.2	79.8	69.4	81.8	81.0	80.0	71.3
	2021	79.8	75.3	70.7	46.1	58.4	58.2	61.2	73.6	76.5	--	--	--	--
	Record Period	79.1	76.1	62.6	53.9	51.0	59.8	66.5	70.1	69.4	80.2	83.1	80.4	69.4
Kona (1,340 m)	2018	--	--	--	--	--	--	--	--	--	72.0	76.3	70.9	73.1
	2019	64.9	60.0	59.3	55.2	52.0	57.4	67.1	68.8	67.6	79.3	73.0	71.6	64.7
	2020	72.0	64.5	62.0	61.2	51.8	73.1	69.6	78.9	67.6	76.7	71.7	68.2	68.1
	2021	69.3	59.9	67.6	47.8	62.8	57.9	58.9	70.3	77.7	83.4	71.1	--	66.1
	Record Period	68.7	61.5	63.0	54.7	55.5	62.8	65.2	72.7	70.9	77.9	73.1	70.2	68.0

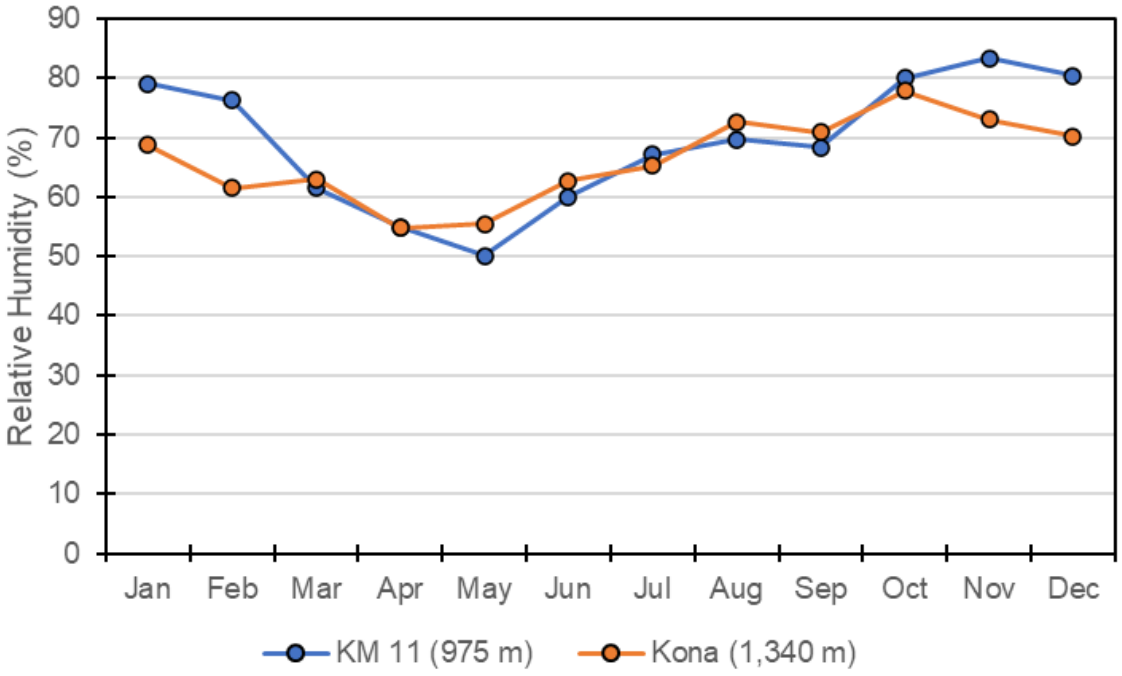

Figure 4-7: Average monthly relative humidity for the Km 11 and Kona climate stations.

4.1.4 Wind Speed and Direction

Monthly average wind speeds range from 0.9 to 2.8 m/s at the Km 11 station, with maximum recorded wind gusts of > 14 m/s occurring in all months. Wind speeds are higher in the months of April through September compared to October through March (Table 4-7, Figure 4-8). By comparison, the higher elevation Kona station experiences monthly average wind speeds of 3.7 to 5.1 m/s, gusting in excess of 20 m/s in all months, with a similar seasonal pattern as noted for the Km 11 record, although maximum wind gust speeds are more often noted in the winter and spring months. The dominant annual wind vector at the Km 11 station is from the south (blowing from), with secondary vectors from the northwest and northeast. At the Kona station, the dominant annual wind vector is from the southwest, with secondary vectors from the southeast through east.

Table 4-7:
Measured wind speed (average and gust) data for the KM 11 and Kona climate stations. All values are in m/s.

Station	Years	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Km 11 (975 m)	2012	Average Wind Speed	--	--	--	--	--	--	2.4	2.7	3.1	1.9	1.5	1.1	--
		Maximum Gust	--	--	--	--	--	--	8.3	14.3	13.9	10.6	10.4	7.6	--
	2013	Average Wind Speed	1.9	2.0	2.6	3.4	2.4	2.7	2.6	2.0	2.1	2.5	1.2	1.3	2.2
		Maximum Gust	13.1	11.5	18.0	14.3	11.7	13.4	11.3	10.2	11.3	15.1	17.5	8.7	18.0
	2014	Average Wind Speed	0.6	1.5	2.5	2.2	3.0	2.8	2.8	2.3	2.4	1.5	0.4	0.8	1.9
		Maximum Gust	15.9	11.7	12.1	10.3	14.4	15.2	10.1	12.3	11.8	10.1	7.5	7.3	15.9
	2015	Average Wind Speed	1.0	1.9	2.7	2.7	2.9	2.7	2.3	2.7	2.5	1.9	1.4	0.3	2.1
		Maximum Gust	9.4	10.5	17.7	13.4	12.0	13.3	15.9	13.1	17.3	8.8	8.1	12.4	17.7
	2016	Average Wind Speed	0.8	1.8	2.3	2.7	2.9	2.5	2.2	2.3	2.6	1.4	0.7	1.0	1.9
		Maximum Gust	13.2	10.0	11.2	12.0	13.0	12.3	11.5	11.7	13.2	7.5	10.3	18.3	18.3
	2017	Average Wind Speed	2.2	2.6	2.3	2.5	2.8	2.4	2.4	2.3	2.3	2.2	1.1	1.9	2.2
		Maximum Gust	14.4	16.4	9.5	9.4	13.2	14.0	11.7	11.4	9.5	13.0	10.5	14.0	16.4
	2018	Average Wind Speed	0.6	2.5	2.8	2.9	3.3	2.5	2.4	2.6	2.3	2.5	0.5	0.6	2.1
		Maximum Gust	14.2	16.9	16.1	11.0	15.1	10.7	10.7	12.4	12.2	11.4	5.2	9.6	16.9
	2019	Average Wind Speed	1.0	1.8	2.6	2.6	2.9	2.6	2.5	2.6	2.0	2.3	1.2	0.0	2.0
		Maximum Gust	12.3	8.4	12.5	12.2	15.1	10.8	11.0	14.0	11.5	9.5	8.9	1.8	15.1
	2020	Average Wind Speed	0.1	2.2	3.2	3.0	2.9	2.4	2.3	2.1	2.1	2.0	1.5	1.3	2.1
		Maximum Gust	7.3	11.6	16.4	13.1	11.8	12.3	11.7	10.8	11.2	10.5	13.9	9.1	16.4
	2021	Average Wind Speed	1.9	2.0	2.4	2.9	2.5	2.6	2.3	2.3	2.0	--	--	--	--
		Maximum Gust	10.5	16.3	12.5	14.6	10.9	12.7	10.3	13.4	7.4	--	--	--	--
	Record Period	Average Wind Speed	1.1	2.0	2.6	2.8	2.8	2.6	2.4	2.4	2.3	2.0	1.1	0.9	2.1
		Maximum Gust	15.9	16.9	18.0	14.6	15.1	15.2	15.9	14.3	17.3	15.1	17.5	18.3	18.3
Kona (1,340 m)	2018	Average Wind Speed	--	--	--	--	--	--	--	--	--	6.0	3.1	5.2	--
		Maximum Gust	--	--	--	--	--	--	--	--	--	22.5	12.6	20.0	--
	2019	Average Wind Speed	3.5	3.7	5.6	4.7	5.4	4.2	4.0	5.0	4.0	4.0	4.3	3.8	4.4
		Maximum Gust	26.2	15.7	21.3	27.2	24.1	19.9	21.6	22.8	18.5	18.5	20.0	16.9	27.2
	2020	Average Wind Speed	2.6	5.1	6.0	5.0	5.2	4.7	4.3	4.0	4.6	3.1	4.2	5.3	4.5
		Maximum Gust	23.3	28.6	24.1	18.4	19.6	22.1	17.9	15.8	18.0	18.9	20.6	20.6	28.6
	2021	Average Wind Speed	4.9	5.2	3.7	5.3	4.3	4.2	3.9	4.4	3.2	--	--	--	--
		Maximum Gust	24.9	23.1	16.4	20.5	16.6	21.5	19.0	19.8	13.5	--	--	--	--
	Record Period	Average Wind Speed	3.7	4.7	5.1	5.0	5.0	4.4	4.1	4.5	3.9	4.4	3.9	4.8	4.4
		Maximum Gust	26.2	28.6	24.1	27.2	24.1	22.1	21.6	22.8	18.5	22.5	20.6	20.6	28.6

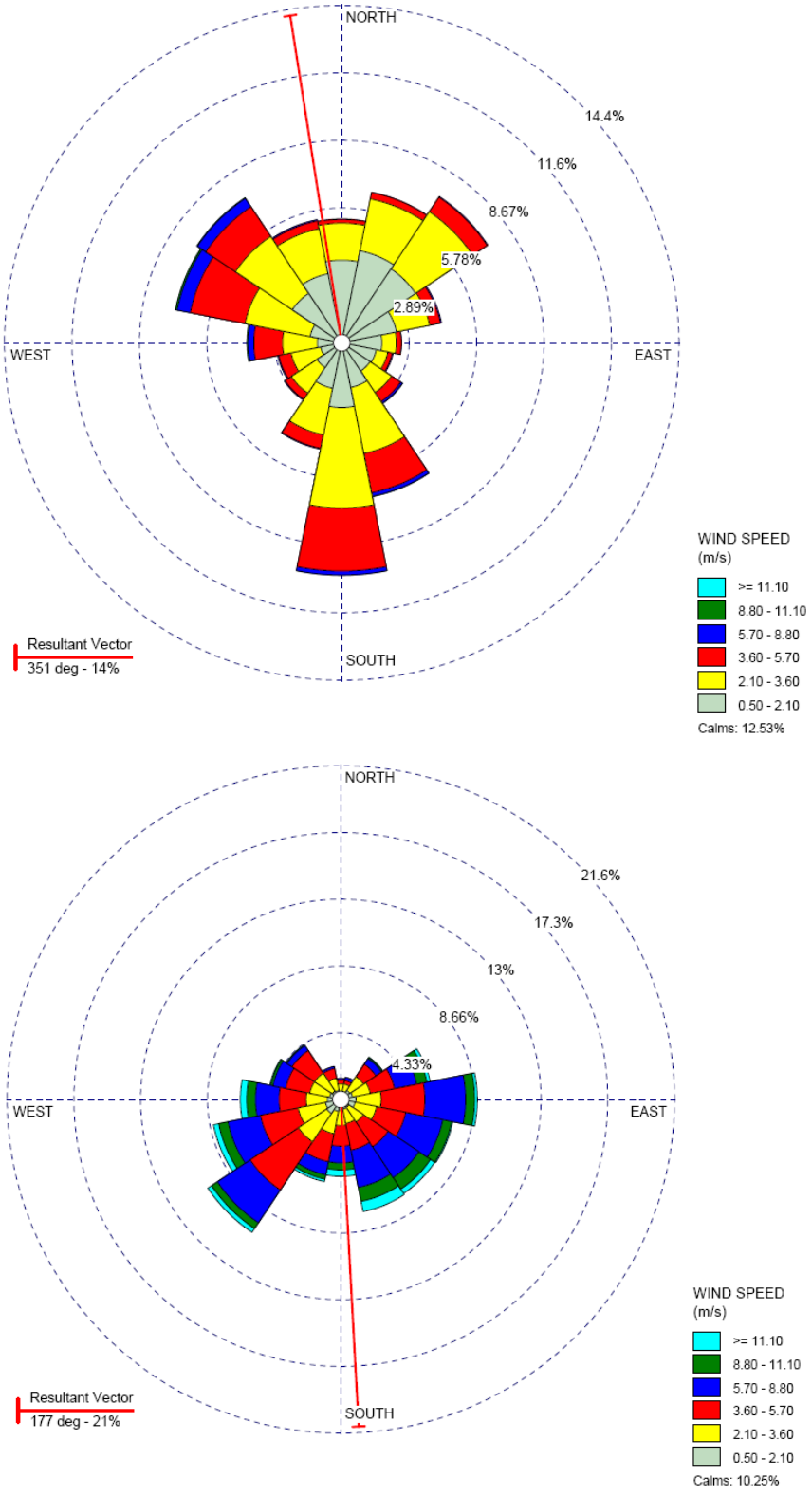

Figure 4-8: Annual wind roses for the KM 11 (top panel) and Kona (bottom panel) climate stations. Wind directions are 'blowing from'.

4.1.5 Atmospheric Pressure

For the baseline study period, monthly average barometric pressure measured at Km 11 climate station ranged from lows of 1003 mb in December to highs of approximately 1015 mb in July (Table 4-8; Figure 4-9). At the Kona climate station, atmospheric pressures track the monthly pattern observed in the Km 11 record, but are approximately 155 mb lower, reflective of this station's higher elevation.

Table 4-8:
Average monthly atmospheric pressure for the KM 11 and Kona climate stations.
All values are in mb.

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Km 11 (975 m)	2012	--	--	--	--	--	--	1015	1013	1007	1014	1009	1002	1010
	2013	1007	1000	1011	1012	1012	1015	1017	1011	1004	1009	1010	1012	1010
	2014	1005	1010	1008	1006	1015	1010	1014	1011	1010	1002	1010	1003	1009
	2015	1009	1013	1007	1003	1015	1013	1012	1011	1005	1006	1001	998	1008
	2016	1001	1003	1003	1007	1014	1012	1014	1016	1010	1010	999	1008	1008
	2017	1006	1006	1008	1009	1009	1010	1014	1009	1008	1006	1009	1011	1009
	2018	1006	1015	1011	1008	1008	1010	1018	1011	1018	1007	1006	999	1010
	2019	1006	1016	1011	1007	1011	1014	1015	1017	1009	1008	1007	997	1010
	2020	1002	1003	1012	1011	1012	1009	1012	1008	1011	1011	1002	1000	1008
	2021	999	1008	1004	1013	1011	1011	1015	1011	1005	--	--	--	--
	Record Period	1005	1008	1008	1008	1012	1012	1015	1012	1009	1008	1006	1003	1009
Kona (1,340 m)	2018	--	--	--	--	--	--	--	--	--	850	852	845	849
	2019	851	861	857	853	858	862	863	864	856	854	852	842	856
	2020	846	848	856	857	859	856	860	856	857	857	847	844	854
	2021	844	852	849	858	858	858	862	858	851	845	846	--	853
	Record Period	847	853	854	856	858	859	862	859	855	851	849	844	853

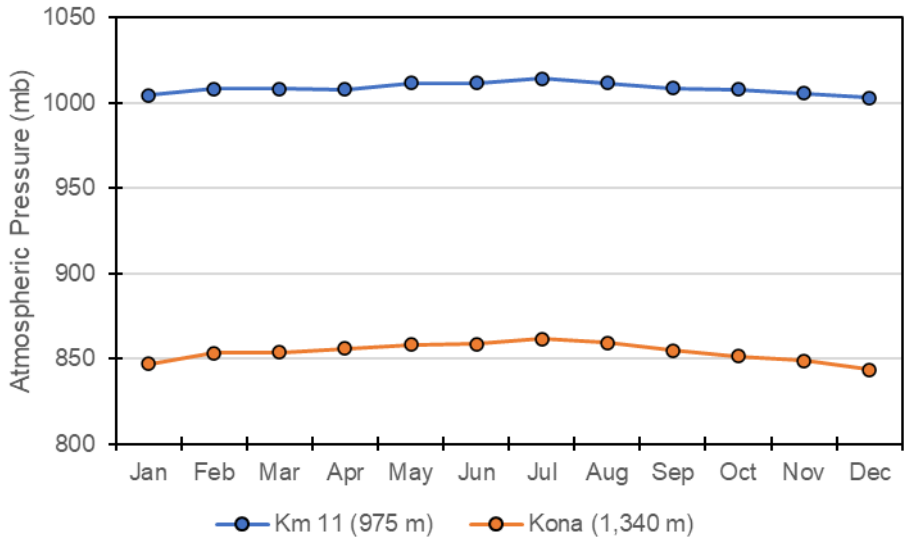

Figure 4-9: Average monthly atmospheric pressure for the Km 11 and Kona climate stations.

4.1.6 Solar Radiation

When data are summarized monthly for the available period of record, solar radiation varies from a monthly average high in June of 0.240 kW/m^2 and 0.256 kW/m^2 to a low of 0.003 kW/m^2 and 0.005 kW/m^2 in December, at the Km 11 and Kona climate stations, respectively (Table 4-9; Figure 4-10). Since July 2012, the highest recorded hourly solar radiation value is 0.991 kW/m^2 at the Km 11 station, and 1.043 kW/m^2 at the Kona station, reflective of the latter stations higher elevation.

Table 4-9:
Average and maximum monthly solar radiation for the Km 11 and Kona climate stations. All values are in kW/m^2.

Station	Years	Values	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Km 11 (975 m)	2012	Average	--	--	--	--	--	--	0.216	0.176	0.111	0.037	0.010	0.004	--
		Maximum	--	--	--	--	--	--	0.833	0.714	0.649	0.406	0.228	0.217	--
	2013	Average	0.005	0.036	0.118	0.200	0.240	0.275	0.204	0.169	0.080	0.045	0.009	0.003	0.115
		Maximum	0.400	0.486	0.671	0.762	0.991	0.979	0.894	0.766	0.630	0.421	0.142	0.076	0.991
	2014	Average	0.010	0.035	0.128	0.191	0.234	0.245	0.208	0.172	0.108	0.035	0.006	0.002	0.115
		Maximum	0.265	0.542	0.582	0.818	0.893	0.900	0.847	0.825	0.614	0.444	0.115	0.059	0.900
	2015	Average	0.012	0.045	0.116	0.186	0.266	0.245	0.199	0.146	0.105	0.042	0.009	0.002	0.114
		Maximum	0.350	0.389	0.629	0.784	0.835	0.911	0.896	0.728	0.599	0.418	0.258	0.037	0.911
	2016	Average	0.008	0.041	0.103	0.168	0.232	0.235	0.194	0.169	0.116	0.051	0.011	0.003	0.111
		Maximum	0.268	0.352	0.591	0.831	0.953	0.928	0.896	0.773	0.623	0.444	0.171	0.082	0.953
	2017	Average	0.012	0.045	0.114	0.202	0.222	0.232	0.208	0.176	0.106	0.028	0.010	0.007	0.113
		Maximum	0.189	0.367	0.632	0.717	0.849	0.884	0.893	0.836	0.577	0.415	0.191	0.121	0.893
	2018	Average	0.007	0.032	0.116	0.203	0.228	0.212	0.220	0.139	0.118	0.059	0.005	0.002	0.112
		Maximum	0.125	0.367	0.576	0.724	0.802	0.849	0.839	0.761	0.640	0.418	0.104	0.101	0.849
	2019	Average	0.007	0.028	0.107	0.184	0.223	0.253	0.207	0.152	0.109	0.038	0.009	0.001	0.110
		Maximum	0.227	0.345	0.631	0.773	0.914	0.956	0.811	0.746	0.603	0.380	0.171	0.036	0.956
	2020	Average	0.003	0.028	0.086	0.184	0.237	0.211	0.204	0.139	0.096	0.038	0.008	0.004	0.103
		Maximum	0.044	0.312	0.585	0.750	0.954	0.915	0.827	0.791	0.707	0.452	0.159	0.233	0.954
	2021	Average	0.009	0.015	0.096	0.215	0.194	0.253	0.226	0.147	0.117	--	--	--	--
		Maximum	0.160	0.279	0.568	0.748	0.821	0.878	0.929	0.735	0.591	--	--	--	--
	Record Period	Average	0.008	0.034	0.109	0.192	0.231	0.240	0.209	0.158	0.106	0.041	0.009	0.003	0.112
		Maximum	0.400	0.542	0.671	0.831	0.991	0.979	0.929	0.836	0.707	0.452	0.258	0.233	0.991
Kona (1,340 m)	2018	Average	--	--	--	--	--	--	--	--	--	0.050	0.023	0.006	--
		Maximum	--	--	--	--	--	--	--	--	--	0.371	0.393	0.102	--
	2019	Average	0.014	0.058	0.130	0.212	0.251	0.278	0.225	0.176	0.122	0.045	0.018	0.005	0.128
		Maximum	0.335	0.444	0.751	0.892	0.954	0.979	0.883	0.855	0.704	0.567	0.307	0.148	0.979
	2020	Average	0.008	0.046	0.130	0.217	0.272	0.223	0.228	0.156	0.112	0.045	0.015	0.005	0.121
		Maximum	0.192	0.448	0.753	0.955	0.978	0.979	0.974	0.774	0.691	0.625	0.266	0.092	0.979
	2021	Average	0.014	0.042	0.122	0.250	0.227	0.267	0.248	0.171	0.107	0.049	--	--	--
		Maximum	0.227	0.419	0.770	0.913	0.982	1.043	0.956	0.911	0.713	0.586	--	--	--
	Record Period	Average	0.012	0.048	0.127	0.227	0.250	0.256	0.234	0.168	0.113	0.047	0.019	0.005	0.125
		Maximum	0.335	0.448	0.770	0.955	0.982	1.043	0.974	0.911	0.713	0.625	0.393	0.148	1.043

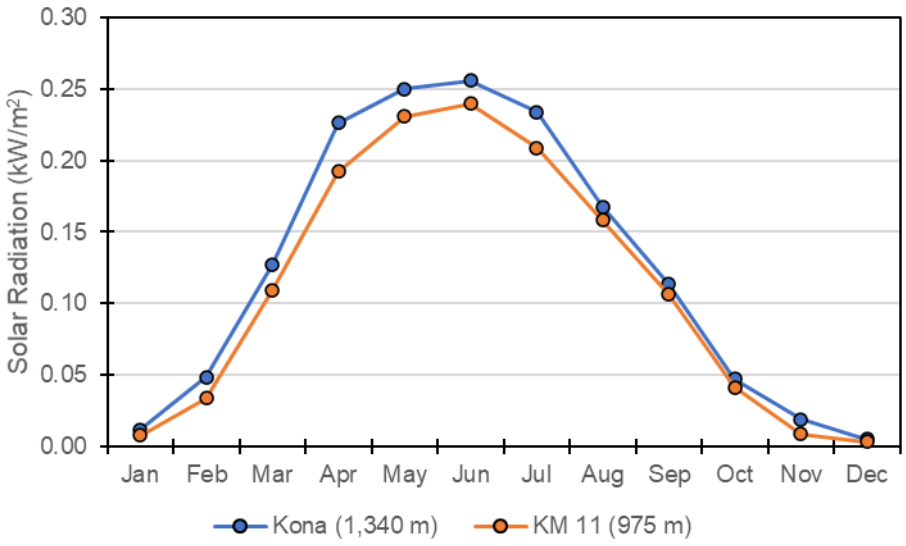

Figure 4-10: Average monthly solar radiation for the Km 11 and Kona climate stations.

4.1.7 Potential Evaporation and Evapotranspiration

Potential evapotranspiration estimates for both the Km 11 and Kona climate stations were derived using the Penman-Monteith and Priestly-Taylor methods and show average April-October totals of 469 mm and 452 mm, respectively (Table 4-10). The estimates are 10% and 20% higher for the Kona station over the common period of record (2019-2021), due to elevated wind speeds and higher solar radiation at the upper station.

As a point of comparison, potential evapotranspiration (PE) estimates for Coffee Gold derived using Km 11 and Kona weather station data and the Hargreaves-Samani method are reported in Table 4-11. Processing of the data returned average PE estimates on the order of 463 mm at 975 m, and 425 mm at 1,340 m, which are slightly higher than those derived from the ClimateWNA software package (Figure 4-13). Like evapotranspiration, monthly PE rates are highest in May, June, and July each year, compared to other months of the year.

As a final comparison, the Km 11 estimates for April to October derived using the three methods are plotted in Figure 4-12 for the 2013-2021 period. Overall, there is close correspondence between the more data intensive formulations (Penman-Monteith and Priestly-Taylor) and the simpler temperature-based method (Hargreaves-Samani).

Actual evapotranspiration estimates are computed using a Campbell Scientific proprietary climate program with Coffee Gold weather station measurements. Average annual evapotranspiration calculated with this methodology was 171 mm for the record period

(2012-2021). At a daily time-step, average evapotranspiration rates are highest in May, June, and July at approximately 3.0 mm/day.

Table 4-10:
Potential evaporation estimates for the Coffee Gold Project based on data collected at the Km 11 and Kona climate stations and the Penman-Monteith and Priestly-Taylor equations.

Station		Apr		May		Jun		Jul		Aug		Sep		Oct		Apr-Oct	
	Year	ASCE	P-T	ASCE	P-T	ASCE	P-T	ASCE	P-T	ASCE	P-T	ASCE	P-T	ASCE	P-T	ASCE	P-T
Km 11 (975 m)	2012	---	---	---	---	---	---	---	---	76	72	43	28	9	4	---	---
	2013	37	39	85	88	127	128	93	95	75	75	26	23	16	7	459	454
	2014	50	50	99	91	104	103	93	96	73	72	35	31	5	5	458	449
	2015	53	52	128	114	112	109	87	92	58	59	34	28	8	6	478	461
	2016	55	51	100	96	104	106	84	93	73	72	46	33	8	7	470	458
	2017	56	55	92	89	102	104	98	103	81	79	41	32	10	4	480	465
	2018	57	53	103	92	96	96	113	110	61	62	41	34	25	5	496	452
	2019	58	53	110	96	118	117	101	101	65	61	40	34	12	4	504	467
	2020	49	47	106	96	84	92	87	93	52	57	32	26	12	5	421	416
	2021	58	56	75	74	115	117	109	110	61	61	27	27	12	5	458	450
	Record Period	53	51	100	93	107	108	96	99	67	67	36	30	12	5	469	452
Kona (1,340 m)	2019	59	61	111	105	122	127	107	112	71	80	55	54	20	7	546	546
	2020	56	71	112	113	81	94	94	106	58	72	50	44	18	6	470	506
	2021	68	80	76	87	121	124	119	122	74	81	40	44	13	7	511	543
	Record Period	61	71	100	101	108	115	107	113	68	78	48	47	17	7	509	532

Note: Potential evapotranspiration values calculated using the Standardized form of the ASCE Penman-Monteith (ASCE 2005) method, and the Priestly-Taylor (P-T) method.

Table 4-11:
Potential evaporation estimates for the Coffee Gold Project based on data collected at Km 11 and Kona climate stations and the Hargreaves-Samani equation.

Station	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Km 11 (975 m)	2013	0	3	8	23	72	108	105	80	36	14	1	0	447
	2014	2	0	11	39	80	95	101	74	35	11	1	0	449
	2015	0	3	13	40	93	102	100	70	34	12	1	0	469
	2016	1	4	19	46	83	103	103	77	39	9	2	0	487
	2017	1	3	4	41	79	102	106	78	39	12	0	1	465
	2018	0	1	12	35	78	99	109	73	36	14	1	0	459
	2019	0	1	21	40	87	106	109	72	40	12	1	0	489
	2020	-1	0	7	37	84	95	98	71	38	10	0	0	440
	2021	1	-1	7	34	74	112	113	75	30	--	--	--	--
	Record Period	0	2	11	37	81	102	105	74	36	12	1	0	463
Kona (1,340 m)	2019	1	4	20	35	77	99	102	67	39	11	2	0	457
	2020	0	1	6	33	74	88	91	67	34	9	1	1	404
	2021	1	0	6	31	67	97	100	70	32	10	1	--	415
	Record Period	0	2	11	33	73	94	98	68	35	10	1	1	425

Note: Potential evapotranspiration values calculated using the Hargreaves-Samani method.

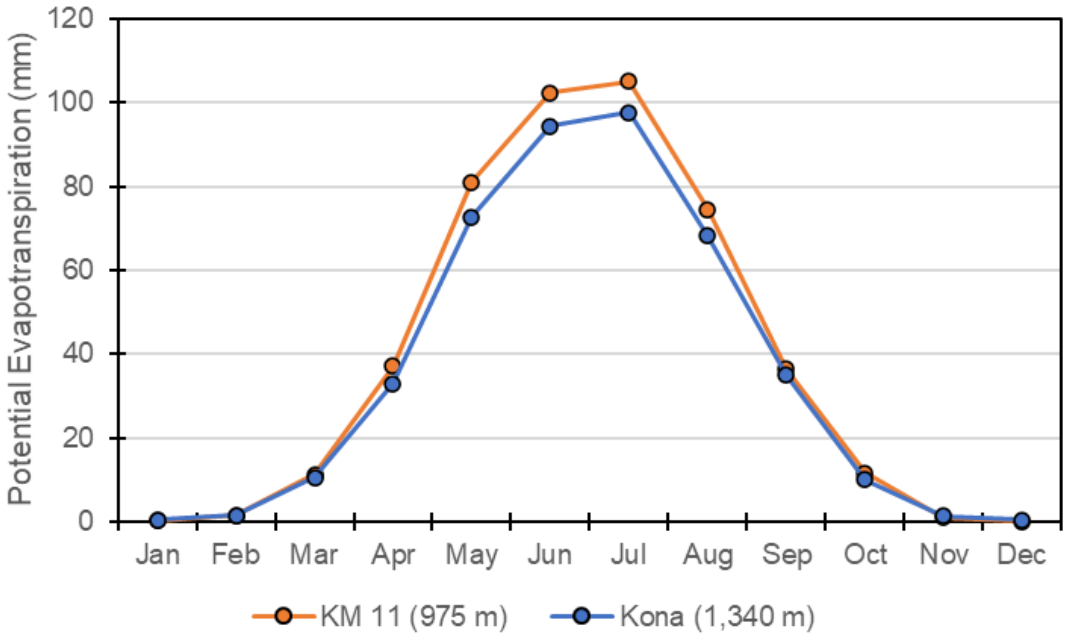

Figure 4-11: Average monthly potential evapotranspiration for the Km 11 and Kona climate stations, calculated using the Hargreaves-Samani method.

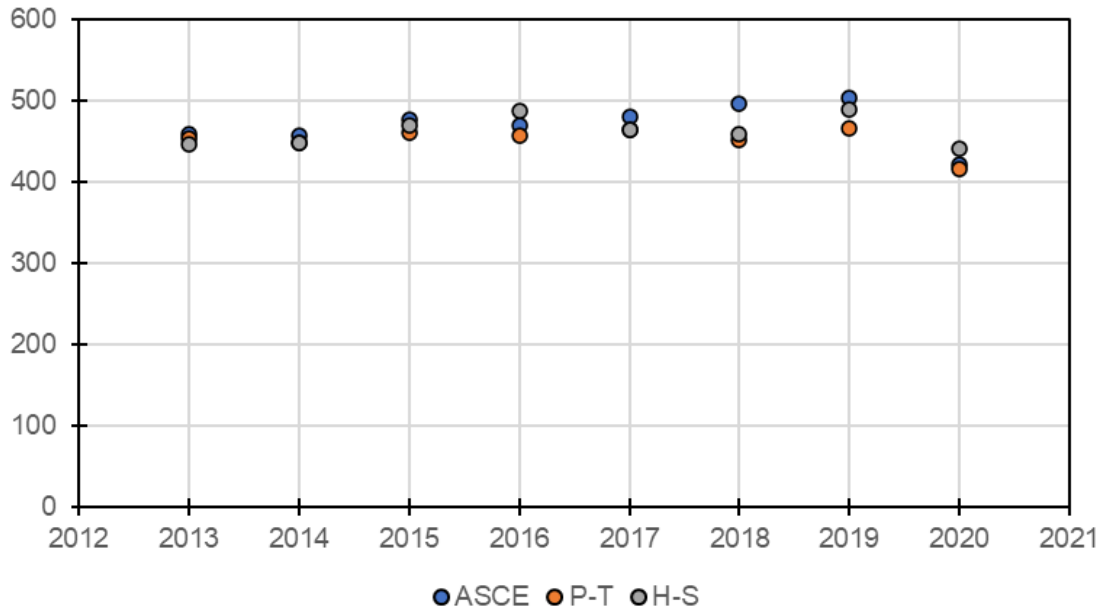

Figure 4-12: Comparison of April-October potential evapotranspiration estimates for the Km 11 climate station. ASCE = Penman-Monteith; P-T = Priestly-Taylor; H-S = Hargreaves-Samani.

4.2 ClimateWNA Gridded Data

The ClimateWNA software (Wang *et al*., 2016; v7.10) generates scale-free point estimates of key climatic parameters (*e.g.*, air temperature, precipitation, potential evapotranspiration) at monthly resolution for multiple reference periods, including the standard climate normal periods (30-year duration). Estimates are scaled from regional data, including the climate stations referenced in Section 2.2, and orographic effects on precipitation are incorporated, allowing the orographic gradients noted in the site data to be verified. For grid points corresponding to the Project site, mean annual precipitation varies from 304 mm at 600 m to 472 mm at 1,300 m, with a 60%/40% split between rain and snow, respectively, and monthly precipitation gradients range from 4%/100 m to 8%/100 m (Table 4-12). Peak monthly precipitation and PET are concentrated during the open water season (May to September), ranging from 400 mm/year at 600 m to 344 mm at 1,300 m (Figure 4-13).

Table 4-12:
ClimateWNA estimates of precipitation for representative elevations at the Coffee Gold Project.

Elevation (m)	600	900	1,300	Gradient (%/100 m)
Jan	15	19	24	7%
Feb	12	13	16	4%
Mar	11	12	15	5%
Apr	9	11	14	7%
May	22	27	35	7%
Jun	40	50	63	7%
Jul	64	81	104	7%
Aug	38	49	64	8%
Sep	32	37	45	5%
Oct	19	23	28	6%
Nov	24	31	40	8%
Dec	18	21	24	4%
Annual	304	374	472	6%
Rain	184	226	277	6%
Snow	120	150	194	7%

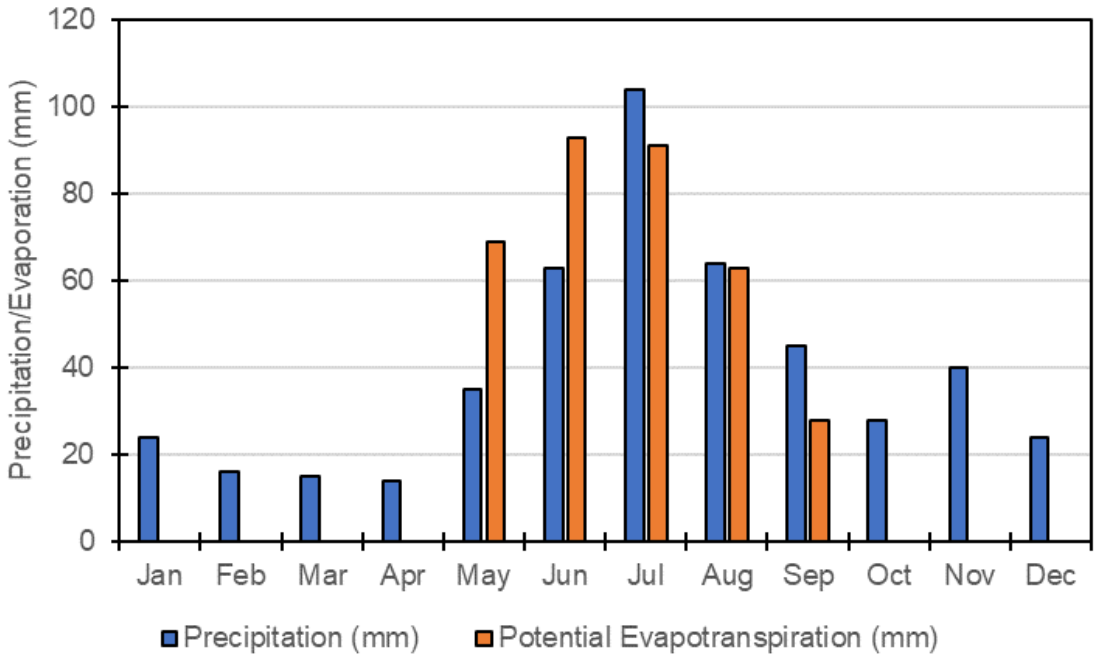

Figure 4-13: Monthly average precipitation and potential evapotranspiration at 1,300 m (Climate WNA).

4.3 Orographic Precipitation Gradients

It is common in areas with high topographic relief for precipitation amounts (annual, low-frequency/high-magnitude events, *etc*.) to increase with elevation due to orographic effects - primarily cooling of the air mass as it is forced upward by topography and subsequent condensation of the entrained water vapour. Most of the available long-term climate records for the Project area are from stations located at lower elevations than the Project site. Therefore, any estimate of precipitation derived from the regional stations must take potential orographic effects into account. The orographic precipitation gradients used to inform all water balance modeling and water management infrastructure design are based on statistical relationships between the climate and SWE data collected at site and the regional climate and snow survey data. These gradients are then applied within the site-wide water balance and water quality model (WBWQM) to adjust the synthetic precipitation series for elevation-related changes within the Project area.

Updated site-specific orographic gradients for rainfall were derived using measured data from the Km 11 climate station, tipping bucket gauges and the Kona climate station through to October 2021 (Table 2-1). These gradients were confirmed with regional climate and snow course data (including the ClimateWNA estimates).

Additional snow course data for the Project site (Table 2-1, Appendix A) through to spring 2021, and the undercatch corrected Km 11 and Kona winter precipitation data (Section 2.3.3.3) were used to refine assumptions related to snowfall gradients. Since 2014, snow course measurements have been recorded consistently at four snow courses designated as long-term monitoring stations.

4.3.1 Winter Precipitation Measurements

The Project site snow courses span a wide range of elevations and provide a useful starting point to identify local gradients. Table 4-13 presents the variation in SWE with elevation for the maximum measured snowpacks of 2013-2021. Precipitation-elevation gradients (% increase with 100 m increase in elevation) are variable, depending on the elevation difference of the stations used in the calculation. As shown in Figure 4-14, the gradients calculated from stations with elevation differences of less then 200 m are confounded by variation in aspect, forest cover and wind redistribution. Therefore, only stations with elevation differences > 200 m were used to calculate an average SWE gradient of 6%/ 100 m for the available period of record at site.

This is comparable to the calculated gradient of 8%/100 m for gauge undercatch corrected winter precipitation measured at the Km 11 and Kona climate stations for the Oct. 2019 to April 2020 period, and the average winter gradient of 7%/100 m evident in the ClimateWNA estimates for site (Table 4-12).

Table 4-13:
Summary of orographic gradient estimates based on Coffee Gold snow course sampling.

Elevation Difference (m)	Measurements (n)	Gradient[a]
<200	11	24.7%
200-300 m	10	7.1%
300-400 m	11	4.0%
400-500 m	10	7.4%
500-600 m	9	4.3%
600-700m	9	7.2%
Total/Avg[b]	**60**	**6.0%**

[a]Orographic gradients are expressed as % increase per 100 m elevation gain.
[b]An average gradient was computed from orographic gradients computed from 2014-21 snow course measurements at four long-term monitoring stations. As shown in Figure 4-9 (lower panel), the average gradient was computed using data based on elevation differences of 200 m or more.

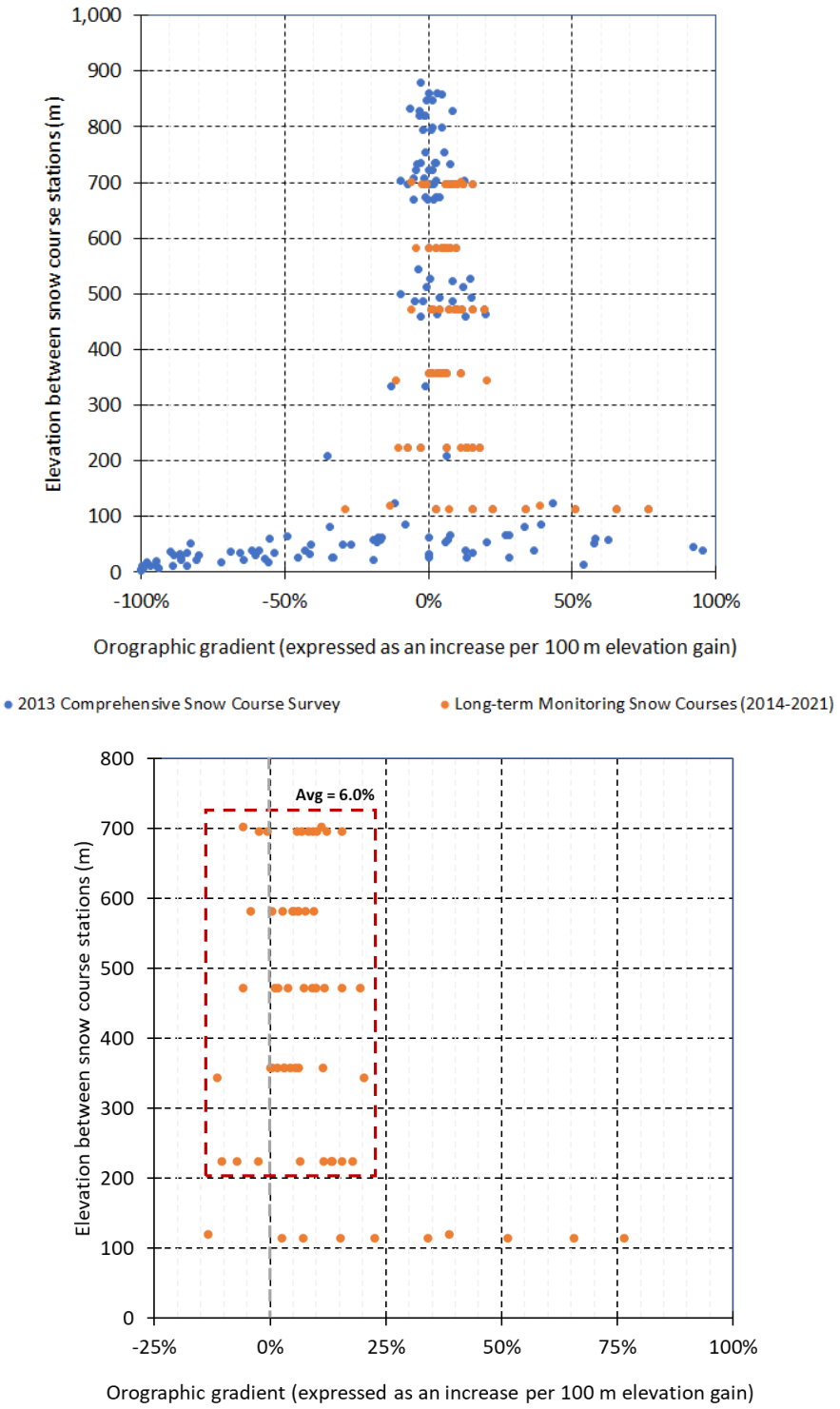

Figure 4-14: The upper plot shows 2013 orographic gradients derived from snow course network (blue dots) alongside gradients for 2014-21 measurements which are based on data collected at four long-term monitoring stations. The lower plot shows data for 2014-21 only and the average gradient computed from a subset of the measurements.

4.3.2 Summer Precipitation Measurements

Two additional tipping bucket rain gauges were installed in 2015 to further resolve the summer precipitation elevation gradient at site. While there is a large degree of variability in the calculated gradients, over the period of May to September (2015-2018), the average gradient from the camp elevation (425 m) to ridge-top (1,300 m) was 4%/100 m (Table 4-14). There is some evidence that this gradient is reduced somewhat at the higher elevations (*i.e.*, does not scale linearly above the hypsometric mid-point of the basin; Loukas and Quick, 1996), but the conservative assumption of a constant gradient was used for all storm event scaling. This assumption is further supported by the overlapping rainfall data collected at the Km 11 and Kona climate stations from May-September 2019 (Table 4-15).

Table 4-14:
Orographic Gradients Computed from Measured Rainfall Data.

Year	Month	Camp (mm)	Met Stn (mm)	High Elev (mm)	Gradient (camp to Met Stn)	Gradient (camp to High Elev)	Gradient (Met Stn to High Elev)
					(%↑/100m)	*(%↑/100m)*	*(%↑/100m)*
	Elev (m)	425	975	1300			
2015	May-15	16.0	24.9	16.6	8%	0%	-12%
	Jun-15	39.8	48.8	47.8	4%	2%	-1%
	Jul-15	82.2	99.3	110.8	3%	3%	3%
	Aug-15	56.4	73.66	57.2	5%	0%	-7%
	Sep-15	17.0	40.1	28.2	17%	6%	-10%
	Oct-15	18.4	22.9	---	4%		
	Annual Average	229.8	309.6	260.6	6%	1%	-5.2%
2016	Jun-16	---	71.1	50.5	---	---	-10%
	Jul-16	60.2	68.3	---	2%	---	---
	Aug-16	37.4	46.0	---	4%	---	---
	Sep-16	---	14.5	---	---	---	---
	Annual Average	97.6	128.8	0.0	3%	---	-10.0%
2017	May-17	---	51.3	49.2	---	---	-1%
	Jun-17	---	43.4	37.2	---	---	-5%
	Jul-17	---	91.7	97.4	---	---	2%
	Aug-17	---	22.6	28.2	---	---	7%
	Annual Average	0.0	209.0	212.0	---	---	0.7%
2018	May-18	---	36.1	---	---	---	---
	Jun-18	---	81.0	93.6	---	---	5%
	Jul-18	7.8	26.4	22.6	25%	13%	-5%
	Aug-18	50.9	115.8	127.6	16%	11%	3%
	Sep-18	---	20.6	18.6	---	---	-3%
	Annual Average	58.7	279.9	262.4	20%	12%	0%
Average - All Years		96.5	231.8	183.8	10%	7%	-4%

4.3.2.1 May and June Rainfall Data

A comparison of corresponding precipitation records for Kona and Km 11 climate stations was undertaken. Overlapping data collected thus far show the Km 11 gauge did not collect snowfall data in winter 2018-19 (Figure A2.3). Accordingly, missing snowfall data at Km 11 were infilled by adjusting Kona measurements downward assuming that an 8%/100 m snow gradient applies between the stations. The limited rainfall data collected thus far also confirms the presence of a local orographic gradient on the order of 6%/100 m elevation gain for the two stations (Table 4-15).

Table 4-15:
Orographic gradients computed for Km 11 and Kona climate stations (2019).

	Rainfall (mm)		
Period	**Kona**	**Km 11**	**Gradient (%, per 100 m gain)**
May[a]	26	19	10%
June	66	56	4%
July	102	97	1%
August	62	56	3%
September	20	31	-1%
Total	276	260	4%

[a]Indicates data are for a partial month.

4.3.3 Regional Stations

To validate the winter precipitation gradient estimate, the two nearest snow survey stations to Coffee Creek were chosen to represent valley bottom (Pelly Farm) and ridge-top (Casino Creek) snowpack regimes. From the available data for these two stations, the elevation gradient calculated from the April 1st SWE data was found to be ~8%/100 m. This gradient is slightly higher than the average value calculated from the available site SWE data (6%/100 m) and the ClimateWNA estimates (7%/100 m), but comparable to that calculated based on the Coffee Gold climate station data, and therefore a median value of 7%/100 m was carried forward to represent the winter precipitation elevation gradient.

4.3.4 Summary of Precipitation Gradient Assessment

Overall, regional findings are consistent with the site data, and therefore the following seasonal orographic gradients were carried forward into subsequent analyses:

- Summer (April to September) gradient is 4%/ 100 m increase in elevation;
- Winter (October to March) gradient is 7%/100 m increase in elevation.

4.4 Design Rainfall and Snowmelt Rates

Estimates of rainfall recurrence intervals (*e.g.,* 1:100 year, 24-hour rainfall) including an estimate of probable maximum precipitation (PMP) for the Project area are required for input to water management infrastructure design. The values presented in Lorax (2017) were updated to include an additional 5-years of data from the regional climate stations.

The daily precipitation records from the regional climate station network (Table 2-5) were screened to remove stations with less than 10-years of complete spring and summer (April to September) rainfall data (Table 4-16). For the PMP estimate, stations with less than 30-years of complete data were excluded, following the WMO guidance (WMO, 2009b). Following this screening process, ten stations had sufficient record lengths to be carried forward for statistical analysis in the rainfall recurrence interval analysis, and nine stations were carried forward for the PMP analysis.

For years of record showing prolonged data gaps (*e.g.*, >10 days of missing data; <80% complete) during May – September – the year of record was considered incomplete and excluded from the frequency analysis. This screening reduced available data entered into the frequency analysis by a small amount (*e.g.,* a year or two of annual maxima data excluded for a 50-year long climate record).

Table 4-16:
Regional climate stations included in rainfall recurrence interval and PMP estimates. Shaded grey stations were excluded from the PMP analysis.

Station	Elevation (m)	Latitude (°)	Longitude (°)	Record Period	Record Length (years)
BEAVER CREEK A	649	62.41	-140.87	1968 - 2015	38
SNAG A	587	62.37	-140.40	1943 - 1966	24
STEWART RIVER	358	63.32	-139.43	1976 - 1993	17
BURWASH A	807	61.37	-139.04	1966 - 2021	55
CARMACKS	525	62.10	-136.30	1963 - 2021	53
DAWSON A	350	64.04	-139.13	1897 - 2021	121
KLONDIKE	973	64.45	-138.22	1966 -2010	40
MAYO A	504	63.62	-135.87	1925 - 2021	97
MCQUESTEN	458	63.59	-137.52	1986 - 2014	28
PELLY RANCH	445	62.82	-137.37	1952 - 2017	64

Cassano and Cassano (2010) analyzed sea level pressure patterns for the Yukon River basin and found that the winter circulation patterns are dominated by the strong Aleutian Low.

The authors found that in the summer, largest daily precipitation events (*i.e.*, top 10th and 1st percentile daily totals, on an annual basis) were associated with an increased frequency of cyclones and over-land convective events. Evapotranspiration rates are highest during the summer, and therefore additional moisture is recycled and available to precipitate. Synoptic patterns and mechanisms governing summer and winter precipitation near the Coffee Creek property are discussed further in Section 4.1.2.1. The highest magnitude rainfall events in the Project site vicinity are likely to be realized in June, July, and August, and often are associated with convective summer storms (Figure 4-15). Regardless of month, climate station or record length, no 1-day rainfall events have been recorded in the Project area that exceed 53 mm.

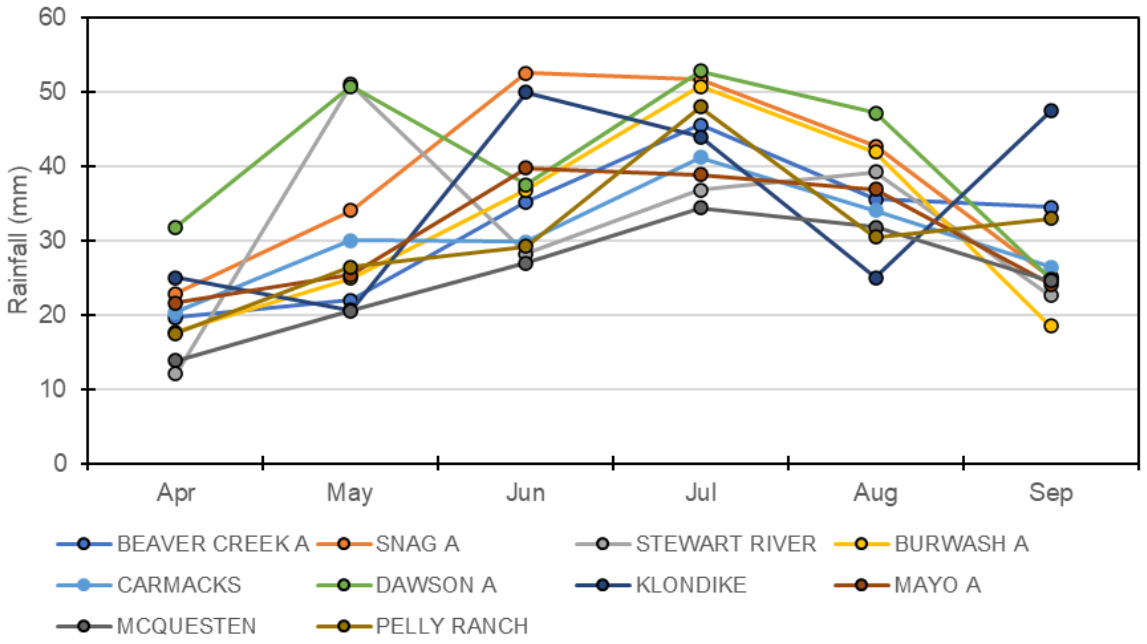

Figure 4-15: Monthly distribution of period of record maximum 1-day precipitation at climate stations near Coffee Gold.

The tabulated 1-day annual maximum precipitation amounts from the climate stations in Table 4-16 were adjusted upward by a factor of 1.13, as recommended by Hershfield (1961), and consistent with NOAA (2012). This scalar accounts for the fact that daily precipitation amounts calculated based on a fixed start and end of a 24-hour period (*i.e.*, midnight) will be lower than a rolling 24-hour total of the same event.

Prior to conducting the rainfall recurrence interval and PMP analyses on the available datasets, raw climate data files were inspected and explored to identify spatial, temporal, and orographic patterns within. Figure 4-16 shows the 24-hour annual maxima series for

the Dawson A, Eagle, Mayo A and Northway AP stations. These data show evidence for inter-decadal variability in annual maxima. There are two periods with generally larger precipitation events: 1) 1930 to 1960; and 2) 1990 to the present. Currently, the timing and phase of long-term climate cycles (*e.g.*, Pacific Decadal Oscillation [PDO], Arctic Oscillation [AO], and El Niño Southern Oscillation [ENSO]) are thought to influence the magnitude and frequency of extreme precipitation events in this region (*e.g.*, Papineau, 2015).

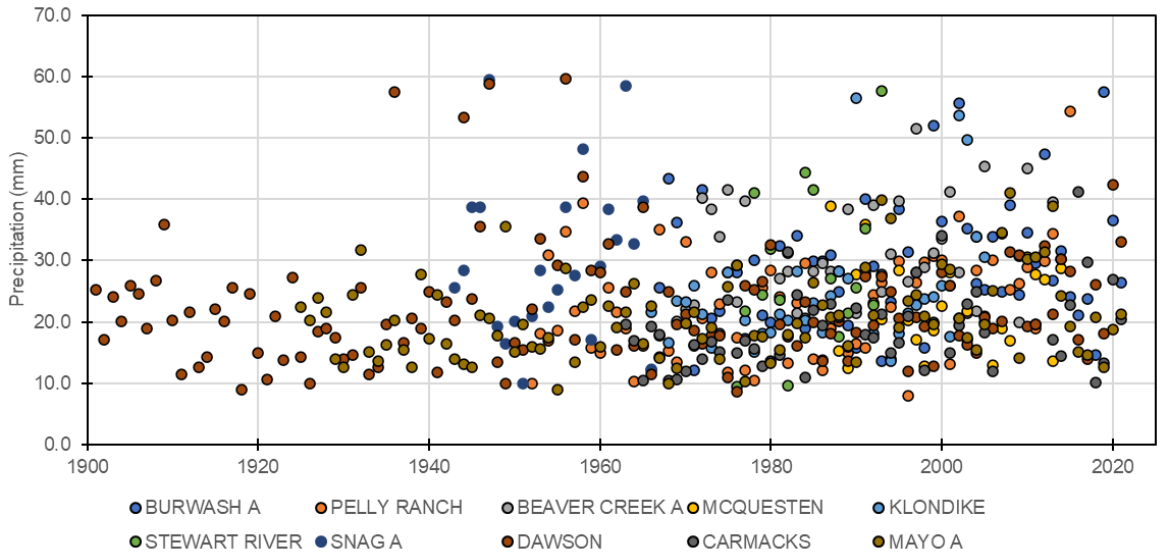

Figure 4-16: Time-series of annual maximum rainfall for regional stations screened into the recurrence interval analysis.

As noted in Lorax (2017), a strong latitudinal gradient in high-magnitude rainfall is evident from eastern Alaska across the Yukon Territory. To confirm that this longitudinal gradient remained when considering the updated data, the maximum recorded 24-hr rainfall value for each station was scaled to the reference elevation of 1,300 m by the 4%/100 m summer precipitation gradient (Section 4.3.2), and plotted against station longitude (Figure 4-17). The gradient is unaltered, and therefore the subsequent analyses placed greater weight on the Stewart River, Burwash A and Dawson A precipitation records.

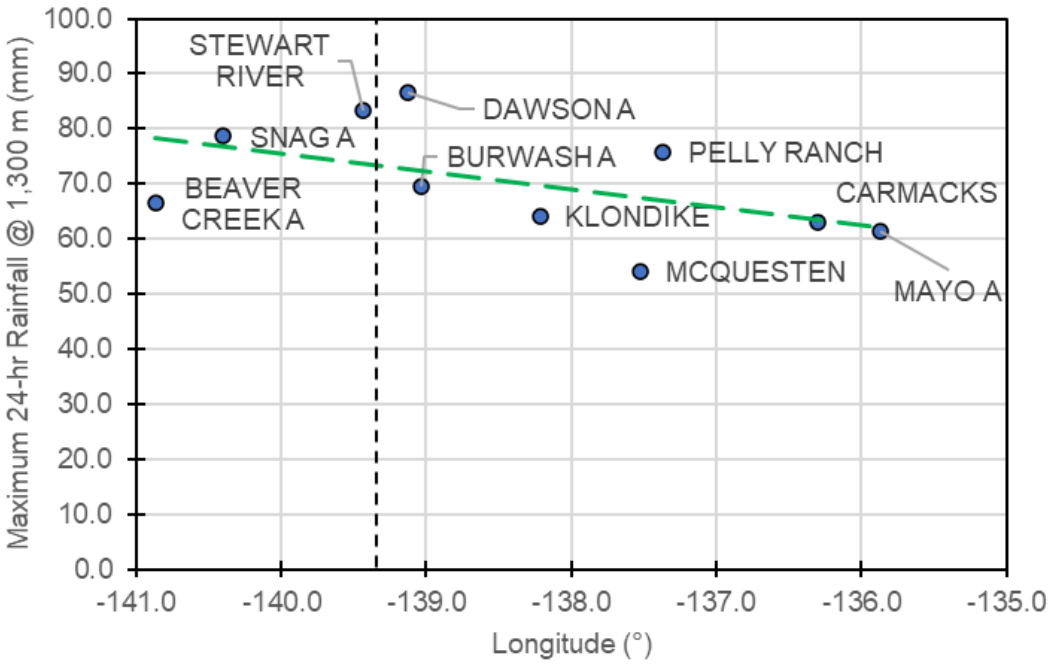

Figure 4-17: Maximum recorded 24-hr rainfall, scaled to 1,300 m elevation, and plotted by longitude. The longitude of the Coffee Gold Project is shown by the dashed black line.

4.4.1 Rainfall Recurrence Interval Estimates

Annual maximum 24-hour rainfall series per station were imported to EasyFit Statistical Software and continuous probability distributions were fitted to the data. Similar to NOAA (2012) and through an inspection of the statistics and ranking data outputted by EasyFit - several distributions were found to fit the input data well. For purposes of consistency with the NOAA (2012) assessment, the GEV distribution was adopted as the *de facto* distribution for the Yukon assessment. The following return periods were estimated for the climate stations and events of interest: 1:2-year (median), 1:5-year, 1:10-year, 1:25-year, 1:50-year, 1:100-year and 1:200-year. Maximum recorded 1-day, 24-hour and 24-hour scaled to 1,300 m are reported for the regional stations screened into the analysis (Table 4-17). The Stewart River and Dawson A records contain the highest recorded rainfall values when controlled for elevation, and therefore, the representative rainfall recurrence interval estimates are based on these stations. Recommended 24-hr rainfall event values for representative elevations (scaled by 4%/100 m) at the Project site are reported in (Table 4-18), noting that the maximum recorded values in Table 4-17 fall between the 1:25- and 1:50-year recurrence interval estimates (Table 4-18).

Table 4-17:
Period of record 1-day and 24-hour maximum estimates for near-Project stations

Station	Elevation (m)	Record Length (years)	Maximum Recorded 1-day Rainfall (mm)	Maximum Recorded 24-hr Rainfall (mm)[1]	24-hr Maximum Scaled to 1,300 m[2]
BEAVER CREEK A	649	38	45.6	51.5	66.5
SNAG A	587	24	52.6	59.4	78.6
STEWART RIVER	358	17	51	57.6	83.4
BURWASH A	807	55	50.8	57.4	69.6
CARMACKS	525	53	41.2	46.6	63.1
DAWSON A	350	121	52.8	59.7	86.6
KLONDIKE	973	40	50	56.5	64.2
MAYO A	504	53	39.8	45.0	61.5
MCQUESTEN	458	28	34.4	38.9	54.1
PELLY RANCH	445	64	48	54.2	75.8

Notes:
[1]Daily rainfall values scaled to 24-hour values by factor of 1.13 after Hershfield (1961)
[2]24-hour totals scaled to 1,300 m elevation using orographic gradient of 4%/100m

Table 4-18:
24-hour rainfall recurrence interval estimates for the Coffee Gold Project, scaled to representative elevations

Elevation (m)	1:2 yr	1:5 yr	1:10 yr	1:25 yr	1:50 yr	1:100 yr	1:200 yr
600	29	43	51	61	68	74	80
700	30	44	53	63	70	77	83
800	32	46	55	66	73	80	87
900	33	48	57	68	76	83	90
1,000	34	50	60	71	79	87	94
1,100	36	52	62	74	82	90	98
1,200	37	54	65	77	86	94	102
1,300	38	56	67	80	89	98	106

4.4.2 Probable Maximum Precipitation Estimate

The probable maximum precipitation is defined as the greatest depth of precipitation for a given duration meteorologically possible for a design watershed or a given storm area at a particular location at a particular time of year, with no allowance made for long-term climatic trends (WMO, 2009b). Estimation methods are categorized as either statistical, or

hydrometeorological (moisture maximization and storm transposition). The statistical method is much simpler than the hydrometeorological method and does not have the same data requirements (*e.g.*, dewpoints and wind vectors). It is based on extensive analyses of thousands of station records, which provide the enveloping value (K_m) on which the method is based. It should be noted that the procedure will only provide a point estimate (as opposed to a basin-wide average), and so must be scaled using an area-reduction curve for application to basins larger than 1,000 km^2 (WMO, 2009b). Given that the contributing areas for Project infrastructure are much lower than this, the application of area-reduction curves is not necessary.

The statistical procedure follows the methodology presented in Hershfield (1961), and as summarized by the WMO (2009b). It is based on the general frequency equation:

$$X_t = \bar{X}_n + K\sigma_n \quad [1]$$

Where X_t is the rainfall for return period t, $\bar{X}_n$ and σ_n are the mean and standard deviation (respectively) of the series (n) of annual daily precipitation maxima, and K is a variable that varies with the frequency distribution fit to the annual maxima series.

K_m represents the empirical factor that substitutes for K in Equation 1 to estimate the point PMP. Originally, it was thought that $K_m = 15$, but was later found to be a function of event duration and the mean annual maximum rainfall (Hershfield, 1997). The function to derive K_m for a 24-hour storm duration is presented in Hogg and Carr (1985):

$$K_{m24} = 19(10)^{-0.000965\bar{X}} \quad [2]$$

K_{m24} was calculated for all regional stations (range of 17.3 to 18.2), and then inserted into Equation 1 to calculate the PMP value for each station. For reference, the K_{m24} value calculated from the isoline map in Hogg and Carr (1985) is 18.2. Finally, all estimates of the 24-hour PMP derived from the regional climate records were scaled from the station elevation to the reference elevation of 1,300 m by 4%/100 m (Table 4-19).

The average estimate for the eight stations considered is 243 ± 49 mm, which is slightly higher than the estimate derived from Hogg and Carr (1985), and comparable to the value derived from the NOAA No. 47 guidance document.

Table 4-19:
24-hour PMP estimates for near-Project stations (scaled to 1,300 m).

Station	24-hour PMP (mm)
SNAG A	346
DAWSON A	283
PELLY RANCH	254
BURWASH A	251
BEAVER CREEK A	236
KLONDIKE	224
MCQUESTEN	218
MAYO A	197
CARMACKS	182
AVERAGE	243
σ	49
Hogg and Carr (1985)	221*
NOAA No.47 (1963)	254

*The value derived from the isolines was adjusted by a factor of 1.5 to account for orographic enhancement in mountainous terrain (in non-coastal mountains above 800 m and for events >12 hours), as recommended.

The value for the Snag A station (346 mm) is notably higher than that for the others. This is due to the relatively short record (24 years), and the fact that this record represents an unusually wet period (1943-1966). When plotted alongside the Dawson A record, it's clear that the two stations display similar variability in rainfall magnitude (Figure 4-18). Given the very low frequency of the PMP event, a longer record is preferable when developing the estimate, and therefore the estimate from the Dawson A climate station is recommended for use in water management infrastructure design (283 mm). The Dawson A estimate is based on 121 years of data and is notably higher than all other estimates derived from the nearby station records.

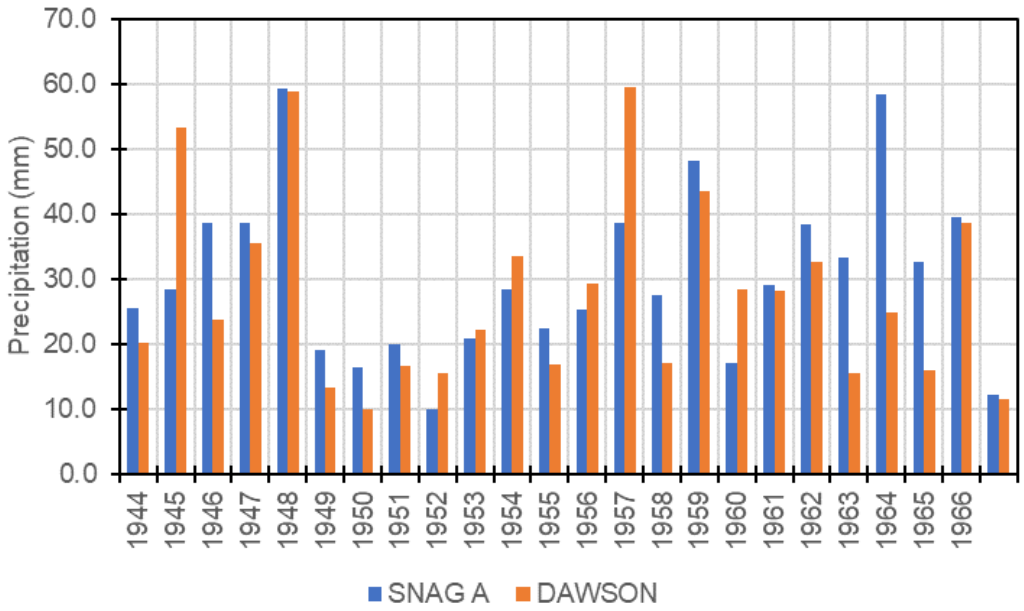

Figure 4-18: Overlapping records of maximum recorded 24-hr rainfall for the Snag A and Dawson A climate stations

4.4.2.1 Monthly Probable Maximum Precipitation Estimates

Large volumes of water are expected to report to the HLF water management system during the months of May and June in response to snowmelt, and thus the potential for a similar magnitude PMP event to the annual event could occur in the months of May of June, which were identified by the heap leach water balance model as being potentially problematic from the standpoint of encroaching on emergency storage capacity in the event ponds.

To address this question, the annual maximum precipitation data were updated to the end of 2021, and the maximum values were tabulated for the months of May through September. The annual value of 283 mm remains higher than any of the month specific PMP estimates (Table 3-3), and notably, the annual value is higher than the July value by 13 mm. This is due to the fact that the annual maximum precipitation in any year does not always occur in the same month, and thus the K_m scalar is slightly different. In fact, 30% of the annual maxima occur in July, 28% in August, 21% in June, and only 5% in May.

The results of this updated analysis confirm that the estimated 24-hour PMP for the freshet months, when event pond volumes are expected to be highest, are lower than the design estimate.

Table 3-3:
Updated Monthly PMP estimates for the Coffee Gold Project at elevation 1,300 m.

Month	24-hr PMP (mm)	% Total Maximum Annual Events
May	185	5%
June	198	21%
July	270	30%
August	252	28%
September	166	17%
Annual Maximum	**283**	**100%**

4.4.3 Maximum Snowmelt Estimates

Representative snowmelt rates (*i.e.*, daily minimum, average and maximum rates) were derived from the series of annual maximum melt rates for nearest snow pillow stations in Alaska and the Yukon (Table 4-20). The analysis found that in a typical year, peak melt rates of an accumulated snowpack are likely to proceed at rates on the order of 10-20 mm/day (Table 4-20). However, the highest rates calculated from regional data are much larger and range from 30 to >50 mm/day, noting that the highest values are associated with snowpacks that persist later in the melt season, and thus are subjected to higher solar radiation inputs.

Table 4-20:
Summary of snow melt rates from snow pillow stations near Coffee Creek

	Parameter	American Creek	Chisana	Granite Creek	May Creek	Teuchet Creek	Upper Chena
Station Information	*Latitude*	64.79	62.07	63.94	61.35	64.95	65.1
	Longitude	-141.23	-142.05	-145.4	-142.71	-145.52	-144.93
	Elevation (m)	320	1012	378	491	500	867
	Period of Record	2012-2021	2008-2021	1998-2021	2007-2021	1981-2021	1987-2021
	Complete years (n)	9	13	23	14	40	34
Snow water equivalent (SWE)	*Min SWE (mm)*	41	58	48	66	48	41
	Avg SWE (mm)	95	98	109	125	121	182
	Max SWE (mm)	145	147	198	173	196	338*
[A]**Snow melt rates**	*Min (mm/day)*	15	10	10	15	8	13
	Avg (mm/day)	17	19	20	19	23	27
	Max (mm/day)	26	28	30	30	33	53*

* Measurements reflect late May melting of a deep snowpack (year 1993).
[A] Statistics computed on the annual series of maximum melt rates (per station and for period of record).

Recurrence interval estimates of maximum annual SWE accumulation are presented in Table 4-21. Maximum annual SWE values were determined based on snow survey data from the March 1st, April 1st and May 1st snow survey conducted at nearby snow courses. The three best fitting statistical distributions were applied, and the recurrence interval estimates presented in Table 4-21 are an average of the three estimates for each interval.

Table 4-21:
Recurrence Interval Estimates for Maximum Annual SWE

			Maximum Annual SWE (mm)		
	Recurrence Interval (yrs)	**Probability of Exceedance**	**Pelly Farm (472 m)**	**Casino Creek (1,065 m)**	**Casino Creek scaled to 1,300 m**
Dry	200	0.995	26	67	79
	100	0.99	31	72	84
	50	0.98	37	78	91
	25	0.96	44	85	100
	10	0.9	54	97	114
	5	0.8	63	109	128
Mean	2	0.5	81	136	159
Wet	5	0.2	100	171	200
	10	0.1	110	192	225
	25	0.04	122	218	256
	50	0.02	130	236	277
	100	0.01	138	254	298
	200	0.005	145	272	319

4.4.4 Synthetic Climate Dataset

Following the adjustments to site data and the revised selection of a regional analogues described in Section 2.3.3, the air temperature lapse rates and orographic precipitation gradients derived from both site and regional data were applied to the Dawson A climate record to develop a multi-decadal synthetic climate dataset for the Project site.

4.4.4.1 Synthetic Temperature Record

To generate a synthetic daily temperature record for the Project site, the Dawson A station temperature record (minimum, mean and maximum daily air temperatures) were compared to the Km 11 climate station data for the overlapping period of record (2012-2021). A total of 36 monthly lapse rates were calculated based on this comparison, based on an elevational difference of 605 m (Table 4-22). Over the comparison period, the average summer (April to September) lapse rate is -2.6°C/1000 m, and the average winter (October to March) lapse

rate is 6.6°C/1000 m. These lapse rates were then used to adjust the Dawson A temperature record to the 975 m and 1,300 m elevations. A comparison of the measured and synthetic monthly records shows close correspondence for all months, including the period where inversions are commonplace (December through February; Figure 4-19).

Table 4-22:
Calculated monthly lapse rates between Dawson A and Km 11 climate stations for the period 2012-2018.

Month	Lapse Rate (°C/1,000 m)		
	MinT	MeanT	MaxT
January	11.8	10.2	8.6
February	14.8	10.4	6.7
March	12.5	3.3	-5.0
April	5.0	-1.4	-7.1
May	3.0	-2.8	-7.8
June	1.8	-3.6	-7.9
July	1.6	-3.8	-7.8
August	2.5	-2.2	-5.8
September	2.7	-1.9	-5.2
October	3.2	0.2	-2.0
November	9.4	6.8	4.5
December	10.3	8.5	6.6
Annual	**6.6**	**2.0**	**-1.9**
Summer	**2.8**	**-2.6**	**-6.9**
Winter	**10.3**	**6.6**	**3.2**

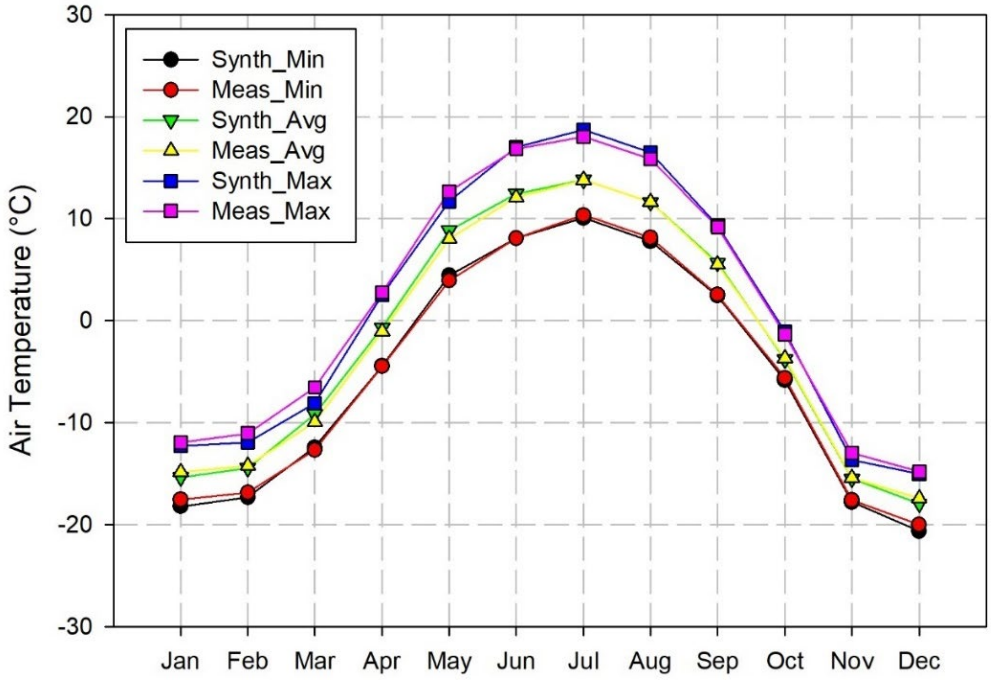

Figure 4-19: Measured and synthetic monthly average minimum, mean and maximum air temperatures for the Coffee Gold Project site.

4.4.4.2 Synthetic Precipitation Record

Consistent with the development of the synthetic temperature record, the Dawson A precipitation record was used as the basis for generating the synthetic precipitation record for the Project site. In this instance, the seasonal orographic gradients described in Section 4.3 were used to scale the Dawson A climate station precipitation record to the site elevation of interest (*i.e.*, Km 11 – 975 m; Kona – 1,300 m). The average monthly measured and synthetic precipitation values were compared over their corresponding periods of record to assess the ability of the seasonal and annual synthetic precipitation estimates to replicate the precipitation regime at the Project site (Table 4-23; Figure 4-20).

Noting that the monitoring record periods are relatively short (10 years and 3 years, respectively), the synthetic April to September rainfall totals generally align with the measured data at both climate stations, both in terms of magnitude and the monthly pattern. Summer precipitation is slightly overestimated relative to measured values at Km 11 and underestimated at Kona. The synthetic estimate for July is notably lower than the measured data at the Kona station, but the 1991-2020 average is much closer to both the measured values, and the estimated values derived from ClimateWNA (Figure 4-20), providing further confidence in the synthetic series ability to replicate the long-term pattern of rainfall variability at the Project site.

Table 4-23:
Comparison of average monthly measured and synthetic precipitation for the Km 11 and Kona climate stations.

Elevation. (m)	975	975	975	1,300	1,300	1,300	1,300
Period	2012-2019	2012-2019	1991-2020	2018-2021	2018-2021	1991-2020	1981-2010
Month	**Measured**	**Synthetic[1]**	**Synthetic[1]**	**Measured**	**Synthetic[1]**	**Synthetic[1]**	**ClimateWNA[2]**
Jan	20	39	30	7	36	37	23
Feb	14	19	14	9	14	18	18
Mar	5	18	17	12	17	21	13
Apr	9	21	12	23	19	14	12
May	38	38	32	30	24	36	38
Jun	52	69	55	72	62	63	67
Jul	70	76	65	85	43	74	94
Aug	51	67	58	73	89	66	67
Sep	27	41	38	41	51	43	43
Oct	23	54	38	22	61	47	32
Nov	12	43	36	15	96	44	35
Dec	11	40	33	8	42	41	22
SUM	**331**	**524**	**428**	**398**	**554**	**504**	**464**
Apr-Sep	247	311	261	324	288	296	321
Oct-Mar	85	213	167	74	266	207	143
Apr. 1 SWE[3]	89	147	135	81	179	167	191

Notes:
[1]Synthetic precipitation data scaled from Dawson A record using orographic gradients of 7%/100 m (Oct-Mar) and 4%/100 m (Apr-Sep)
[2]1991-2020 climate normal not available from ClimateWNA at time of writing
[3]April 1st SWE value measured at co-located snow course for the 'Measured' columns, and calculated using a simple temperature based algorithm based on the synthetic climate data for the 'Synthetic' columns.

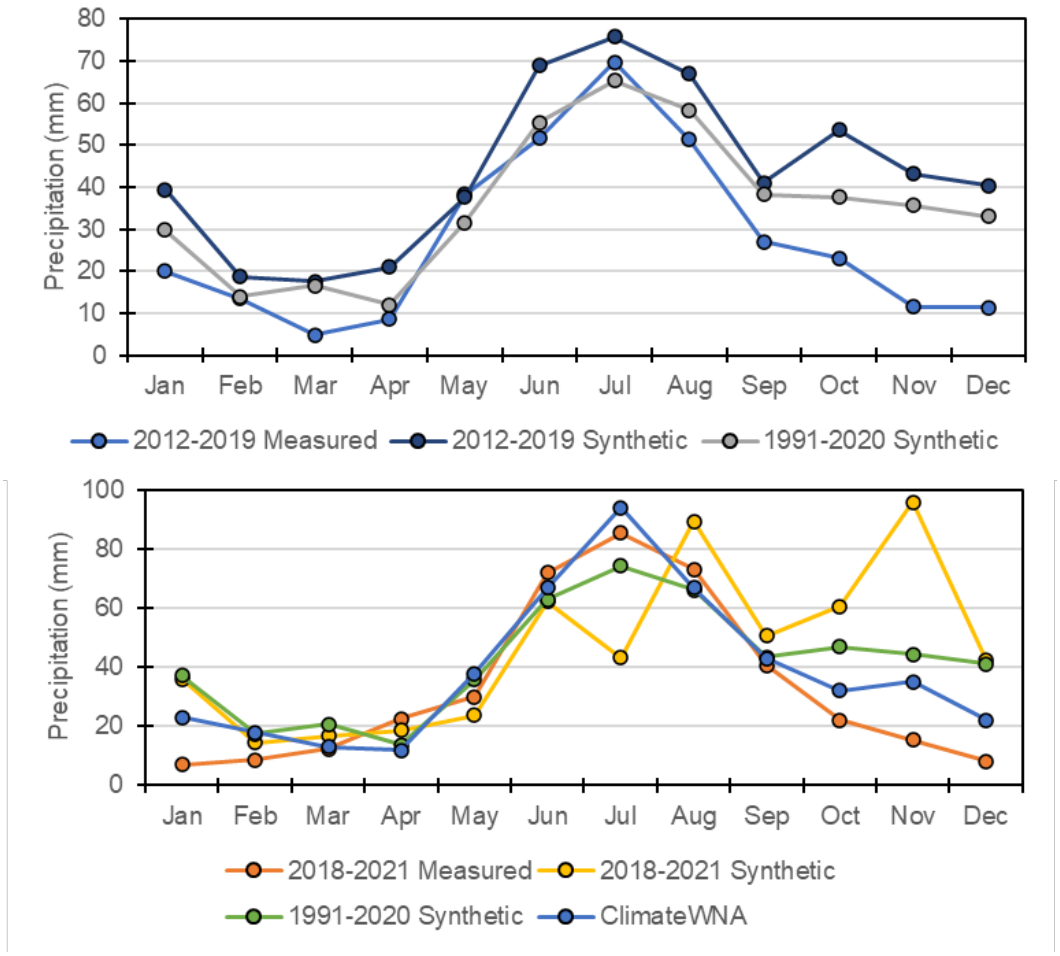

Figure 4-20: Measured and synthetic monthly average precipitation for the overlapping periods of record for the Km 11 (top) and Kona (bottom) climate stations

Deviations between the measured and synthetic series are more pronounced for the early winter months (*i.e.*, October through December), with the synthetic series consistently producing higher precipitation totals than the measured data, but generally aligning for the months of January through March at both stations. This is likely due to gauge undercatch, which the measured data has been corrected for (Section 2.3.3.3), however this correction process is not able to completely remove the influence of local turbulence on undercatch. Comparison with SWE measurements made at co-located snow courses is complicated by wind redistribution due to the limited vegetation at elevation, and sublimation, both of which serve to reduce the total end-of-winter SWE values relative to the total snowfall.

Sublimation is the process whereby water changes phase from solid to vapour, without first passing through the liquid phase. Sublimation typically occurs directly from the snow surface (Cline, 1997), and can be accelerated during blowing snow events, where the time and surface area exposure of a snow particle is greatly increased (Pomeroy and Gray,

1995). The Wolf Creek Research Basin provides the nearest and most representative detailed information on the expected sublimation losses at the Project site, where sublimation loss rates of 0.15 to 0.25 mm/day were reported for the winter accumulation season by Pomeroy *et al.* (1999b) and 0.35 to 1.08 mm/day for the snowmelt period by Pomeroy *et al*. (2006) and Janowicz *et al.* (1995).

Assuming winter accumulation and snowmelt season durations of approximately 160 and 30 days, respectively, these sublimation rates translate to average potential SWE losses of:

- Winter season – 42 mm
- Snowmelt period – 20 mm

The total estimated sublimation loss of approximately 60 mm is comparable to the 58 mm difference between the measured and synthetic SWE values at the Km 11 station (Table 4-23), and slightly lower than the 98 mm difference at Kona, noting again the very short record period and the average higher winter wind speeds (2.7 m/s; Table 4-7) for the latter climate station. Higher windspeeds are understood to increase sublimation rates, with multiple studies concluding that orographic effects play an important role, as wind speed and solar radiation vary with slope angle, elevation, and aspect, leading to relatively higher sublimation and melt rates on steep south facing slopes, and at higher elevations (*e.g.*, Pomeroy *et al*., 2003; Zhang *et al*., 2004). Therefore, there is support for assuming that sublimation losses are higher at the Kona station relative to the Km 11 station.

As a final check on the synthetic winter precipitation estimates, the maximum annual SWE values from the nearby Casino Creek snow course (09CD-SC01; 1,065 m) were scaled to the reference elevation of 1,300 m, and compared to the synthetic winter SWE totals, for the overlapping period of record (1977-2019; Figure 4-21). Regional snow courses are typically situated in protected areas, where wind redistribution and wind-induced sublimation effects on maximum winter SWE values are minimal. Therefore, both the scaled Casino Creek and synthetic SWE data can be considered comparable, assuming that sublimation has not substantially impacted the annual maximum SWE values in either series. While there is substantial inter-annual variability between the two series on an annual basis, the long-term averages are closely aligned (*i.e.*, within 3%), providing further confirmation that the synthetic precipitation dataset adequately represents the long-term snowfall accumulation signal.

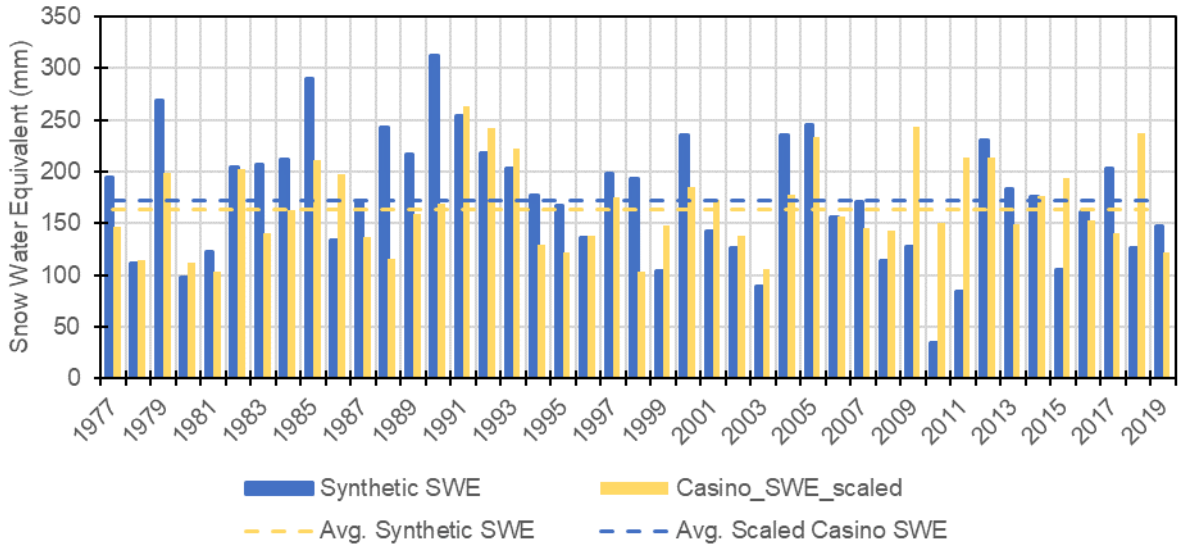

Figure 4-21: Maximum annual snow water equivalent for the synthetic climate data and Casino snow course, scaled to 1,300 m.

In summary, mean annual precipitation (MAP) is estimated to be 504 mm at the reference elevation of 1,300 m over the 1991-2020 period. This synthetic precipitation record will be used as a driving input to the site wide WBQM and is adjusted within the WBQM by the orographic gradients presented in Section 4.3 to represent the influence of elevation on precipitation depths at the Project site.

4.5 Climate Change

The influence of a changing climate on the hydrologic regime of the discontinuous permafrost zone is well documented (see Appendix B for a detailed summary of historical climatic trends and projected changes in temperature and precipitation). Average annual temperatures are projected to rise significantly in the region over the next century. Present day annual average temperature is approximately -2°C at the Project site, and the annual average is forecasted to rise by 2.5 to 5°C by the end of the century (Table 4-24). Net precipitation in the vicinity of the Coffee Gold Mine is projected to increase by 20% to 35% over the course of this century (Table 4-24), where summer and winter can be expected to be slightly wetter in the future, and spring and fall seasons are projected to see little net change in precipitation abundance.

A trend analysis conducted on the regional historic climate records (Appendix B1) indicates that recent climate trends are in line with future projections. Average winter temperatures are increasing by 1°C/decade, while the trend in summer temperatures is of lower magnitude at 0.3°C/decade. Seasonal precipitation trends show a mixed signal in summer, and a strong regional trend towards increased autumn precipitation

(4-6 mm/decade). Streamflow metrics are consistently increasing in the Yukon, with significant trends noted for winter low flows (increasing), and the timing of freshet onset (moving earlier).

4.5.1 Climate Change Scenario Data for State of Alaska and the Canadian North

The Scenarios Network for Alaska and Arctic Planning (SNAP) is a collaborative network of the University of Alaska, state, federal, and local agencies, NGOs, and industry partners. SNAPs mission is to provide timely access to scenarios of future conditions in Alaska and the Arctic for more effective planning by decision- makers, communities, and industry.

Climate change scenario data from this network was used as the basis of the climate change assessment presented in this section (see https://www.snap.uaf.edu/). SNAP provides several platforms for looking at historic climate trends and climate projections in Alaska and western Canada:

- Downloadable datasets for historic climate data and projected climate data (temperature and precipitation).
- Options to use an interactive mapping interface that provides climate projections for Alaska and western Canada for each decade through 2100. Within the mapping interface there are user options to select variables, time periods, seasonal averages, and emissions scenarios of interest.
- The option to view Community Charts which are already completed air temperature and precipitation analyses for cities, towns and hamlets across Alaska and Western Canada, including Yukon and British Columbia.

4.5.1.1 Available Scenarios

Climate change scenario data are available at SNAP for three of the 4 Representative Concentration Pathways (RCPs) (*i.e.*, RCP4.5, RCP6.0 and RCP8.5, noting each RCP is resolved out to the year 2100 (Figure 4-22). For context, the RCP4.5 pathway assumes global emissions peak around 2040, and that radiative forcing is stabilized shortly after 2100. RCP4.5 is likely optimistic, and as such SNAP refers to it as a "low" scenario (*i.e.*, typically associated with smaller incremental changes in air temperature compared to other RCPs.

The RCP6.0 (middle or SNAP "medium" scenario) assumes that a range of technologies and strategies for reducing greenhouse gas emissions are developed, allowing emissions to peak around 2080, then decline, with total radiative forcing stabilized shortly after 2100. Finally, the RCP8.5 ("high" scenario) is a potential future characterized by continuous increases in greenhouse gas emissions throughout the 21st century.

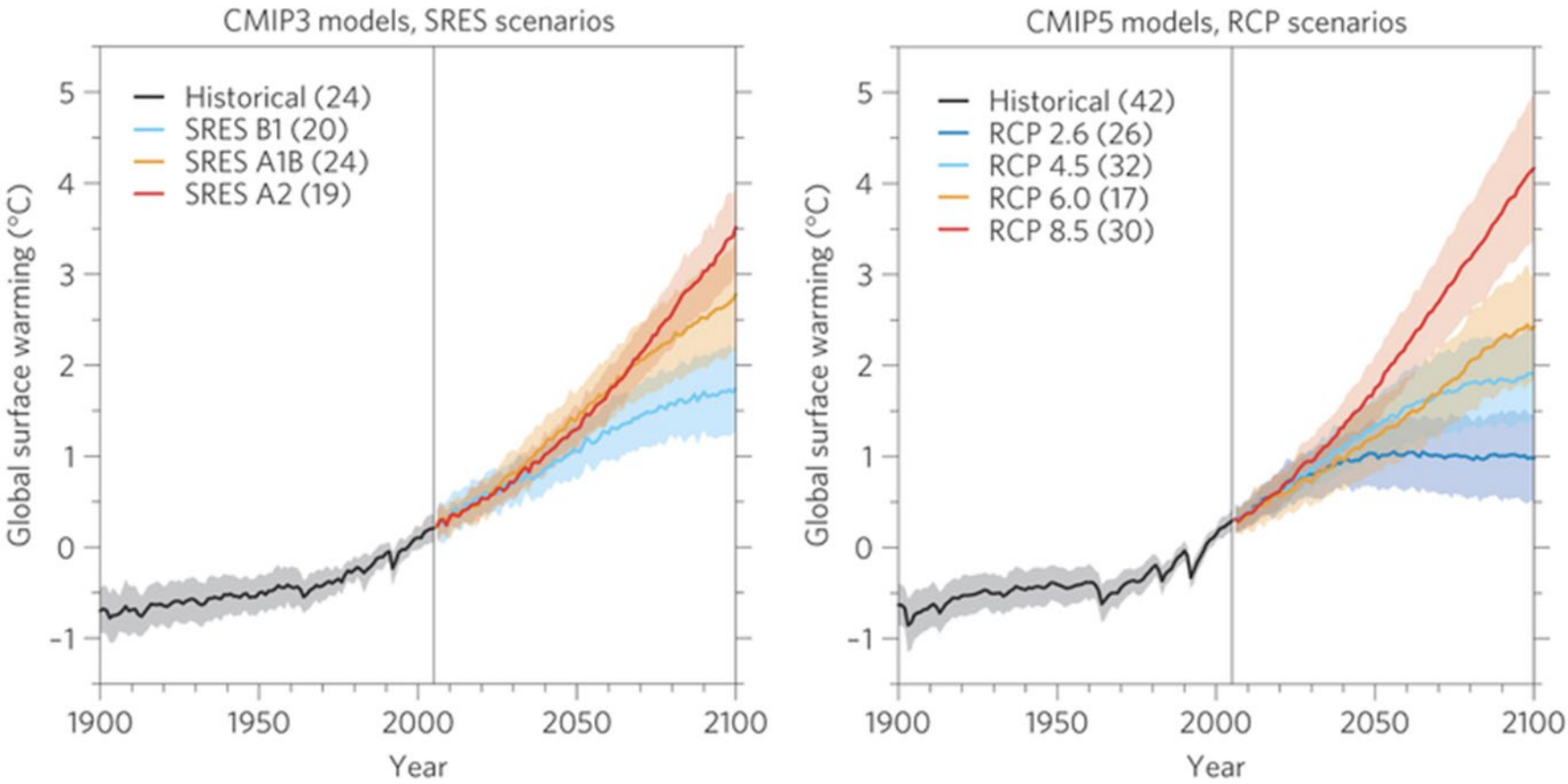

Figure 4-22: Global temperature change projections for SRES scenarios run by CMIP3 (left) and the RCP scenarios run by CMIP5 (right). Mean global temperature change relative to 1986–2005 is shown as a colored line and one standard deviation shown with colored shading. The number of models run is given in parentheses. Figure reprinted from Knutti and Sedláček (2013).

As described at SNAP (refer to https://www.snap.uaf.edu/methods/data), available data summaries and/or downloadable datasets for high latitude stations in North America, including the entire Yukon Territory, are based on CMIP5 model outputs for the first ensemble model run.

4.5.1.2 SNAP Downscaling Method

Referencing the website (see https://www.snap.uaf.edu/methods/downscaling), GCM output variables of surface temperature and precipitation were downscaled for Yukon Territory via the delta method (Hayhoe 2010, Hay *et al*. 2000) using PRISM 2 km resolution climate normals as baseline climate across three future climate scenarios (*i.e.*, RCP4.5, RCP6.0, RCP8.5). The delta method of downscaling was implemented by calculating climate anomalies applied as differences for temperature or quotients for precipitation between monthly future GCM data and calculated GCM climate normals (*i.e.*, the delta) at a monthly time step. These coarse resolution anomalies were then interpolated to PRISM spatial resolution (*i.e.*, 2 km) via a spline technique, and then added to (temperature) or multiplied by (precipitation) the PRISM climate normals.

The representative downscaled projections for each of the three RCP scenarios were downloaded from the SNAP website, for the four grid points that overlap the Coffee Gold Project site. Average values were then calculated from these four-grid point time-series, and trend lines fitted to the monthly projections (Figure 4-23). The slope of the trend line for each parameter (*i.e.*, minimum, mean and maximum air temperature and precipitation) was then used to determine the delta from the baseline reference period (2006-2020) on a monthly basis over the full prediction period out to the year 2100. These parameter specific scalars are intended for input to the site-wide water balance and water quality model to generate climate inputs that can be scaled to account for the projected effects of climate change on the Project site climate series.

Table 4-24:
Decadal statistics for the Coffee Gold Project (mean annual air temperature and precipitation) for the RCP4.5, RCP6.0 and RCP8.5 climate change scenarios.

Decade	Mean Air Temperature (°C)			Precipitation (mm)		
	RCP4.5	RCP6.0	RCP8.5	RCP4.5	RCP6.0	RCP8.5
2010-2019	-2.9	-2.8	-2.7	603	592	615
2020-2029	-2.4	-2.3	-2.0	617	626	640
2030-2039	-1.7	-2.0	-1.5	638	635	651
2040-2049	-1.3	-1.7	-1.0	662	630	650
2050-2059	-1.2	-1.2	-0.2	678	647	681
2060-2069	-0.9	-0.8	0.3	683	659	716
2070-2079	-0.6	-0.2	0.9	671	667	726
2080-2089	-0.7	0.0	1.6	688	698	771
2090-2099	-0.4	0.3	2.3	688	719	788
Change (from 2015 to 2095)	2.5	3.1	5.0	14%	22%	28%

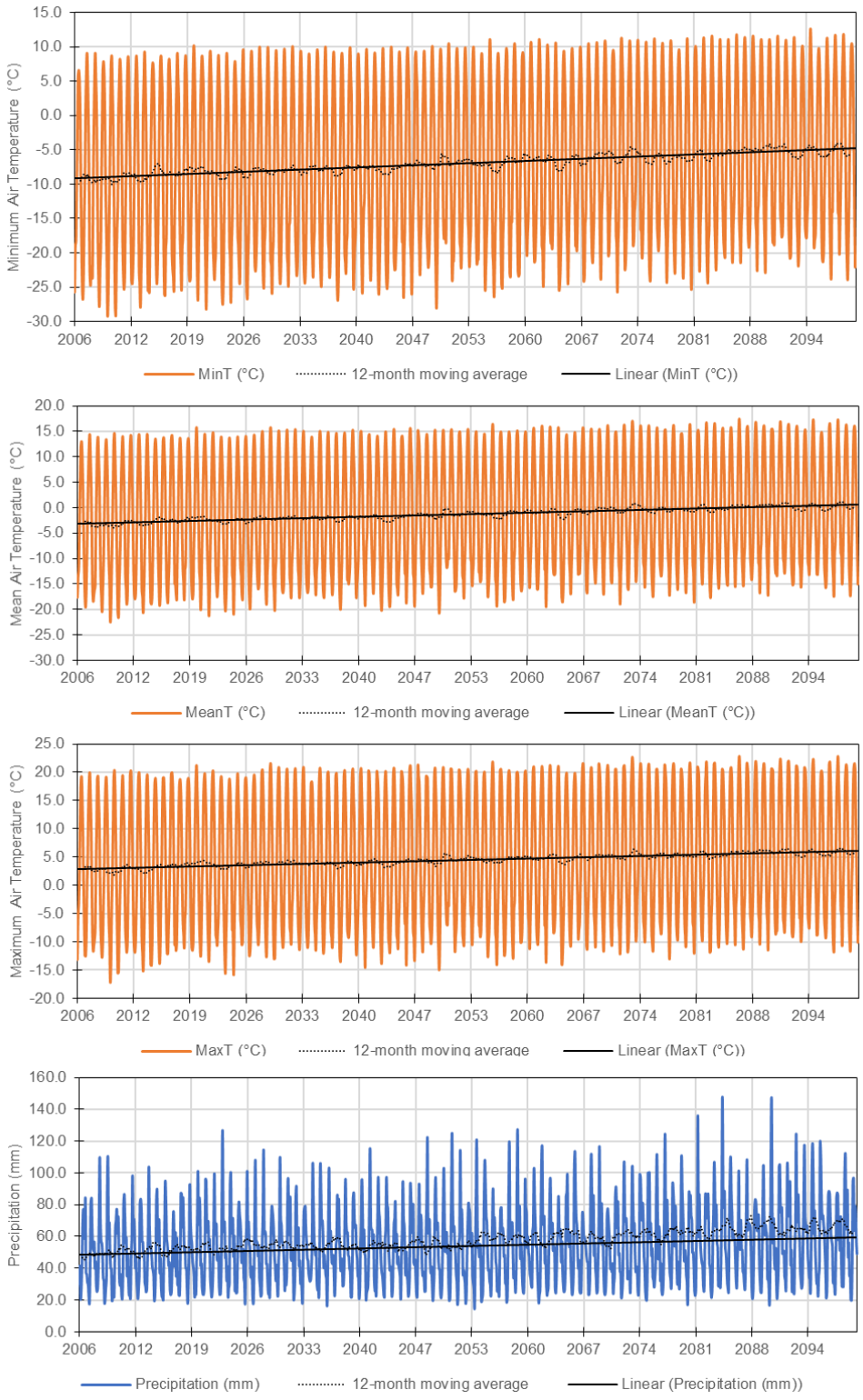

Figure 4-23: Monthly minimum, mean and maximum air temperature and precipitation projections (shown with long-term trend and 12-month rolling averages) for the Coffee Gold Project site for the RCP6.0 climate change scenario.

5. Streamflow Regime Characterization

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5. Streamflow Regime Characterization

5.1 Coffee Creek Hydrometric Data

From the extensive hydrometric network at Coffee Creek, combined with the monthly sampling trips conducted since autumn 2010, a high-quality and high-resolution streamflow dataset has been assembled. These data are presented in full in Appendix C and have been used to: inform project feasibility studies; complete design and engineering studies related to the Project; and they have also been used to build and calibrate a site-wide water balance and water quality model for the proposed undertaking. As a complement to the information presented in Appendix C, this section presents examples of the available hydrometric data to illustrate overall quality, and also presents roll up tables (*e.g.,* for unit yields, peak flows, low flows) and discussion in an effort to synthesize the data.

5.1.1 Drainage Basin Characteristics, Rating Curves and Discharge Records

Hydrometric data and outputs are presented in Appendix C for 2010 to 2020. Appendix C is separated into fourteen sub-sections or data reports, each sub-section reporting out baseline hydrometric data for monitoring locations at Coffee Creek. For each monitoring station, an assortment of information is presented in Appendix C, including:

Drainage Basin Information

Mean elevation, basin area, a detailed basin map, aspect and hypsometry information are presented per hydrometric station in Appendix C. Figure 5-1 shows an example of a drainage area map included in Appendix C (for hydrometric station LC-0.1 (Latte Creek), upper plot), as well as a summary of available hypsometric data for the Coffee Creek monitoring station (lower plot).

Station Information

Summary reports list all pertinent station information for the various monitoring station. Included in Appendix C are the following: (new) Station ID, previous Station ID, period of record, instrumentation (type of water level logger) and sampling frequency, and benchmark survey results.

Photos of the stations and watercourses, under various flow conditions, are also included in Appendix C.

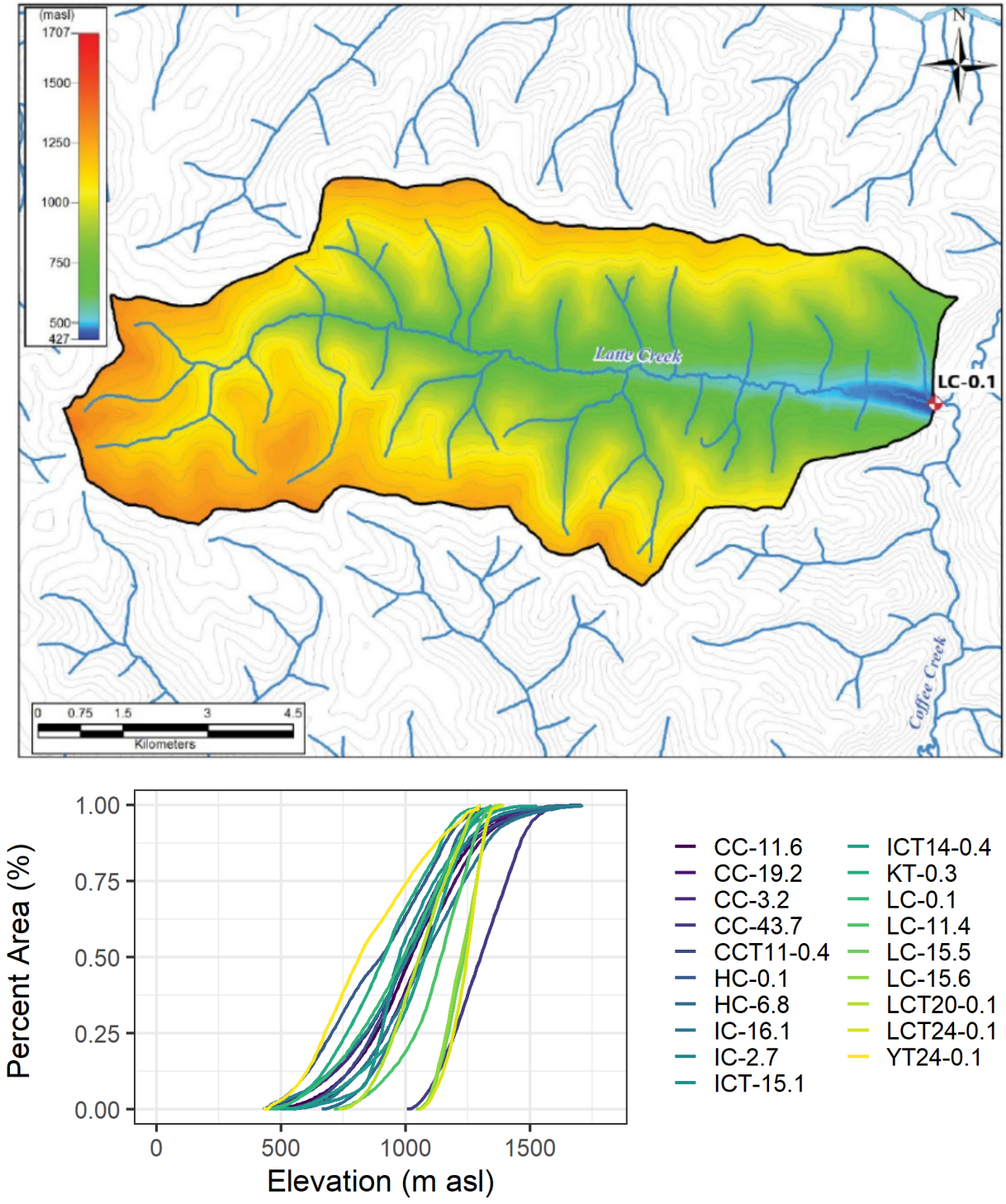


Figure 5-1: Drainage basin map for hydrometric station LC-0.1 (upper plot) and plot showing hypsometric curves (basin area vs. elevation) for all hydrometric stations (lower plot).

Rating Curves

Appendix C shows active rating curves for the Coffee Creek hydrometric stations, which have been adjusted and validated annually from 2011 to 2020. An example is shown for the LC-11.4 hydrometric station in Figure 5-2, where the highest 15-minute discharge calculated from the rating curve is represented by a vertical dashed blue line, and the green highlighted area indicating the 90th percentile of all calculated discharge values for that station. Appendix C also summarizes, by station, all spot measurements of discharge recorded at the property since 2010, the calculated discharge based on the current rating curve and staff gauge reading, and the relative error of the rating curve with respect to the measured discharges.

Measured Time Series Data

Period of record discharge data are shown for hydrometric stations in time series format. Discharge data are also presented in summary table format (by month, as yields, discharges, and runoff depths) per station for the period of record. Included on time series plots are continuous discharge data estimated from rating curves, and spot measurements of discharge. Discharge data for Halfway Creek stations HC-6.8 and HC-0.1 are shown below (Figure 5-3) as representative examples.

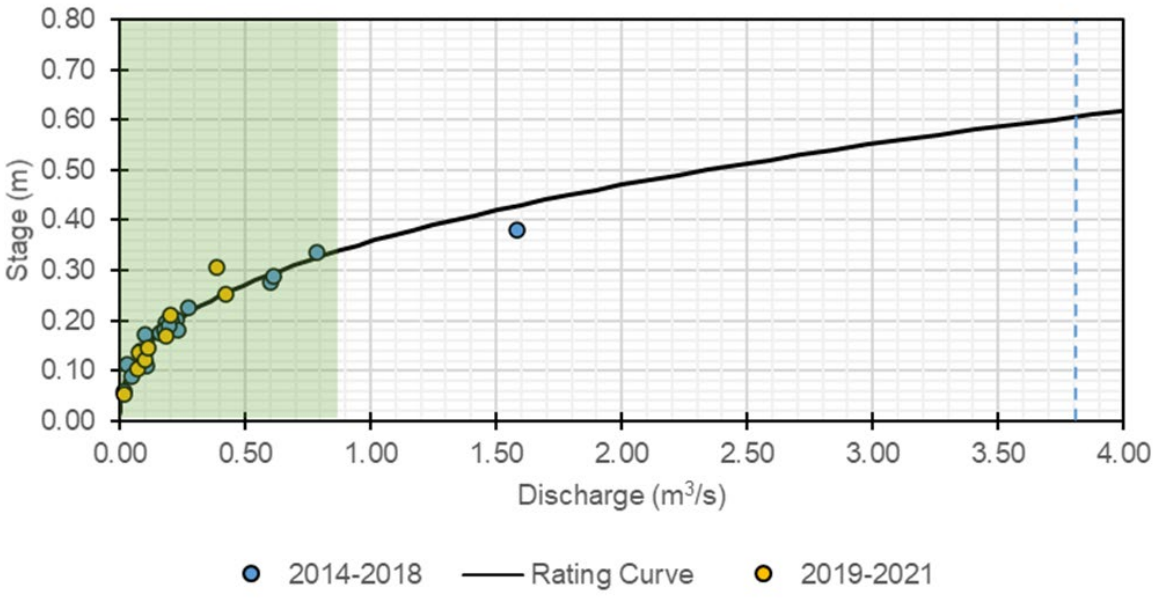


Figure 5-2: Rating curve for LC-11.4 hydrometric station. Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

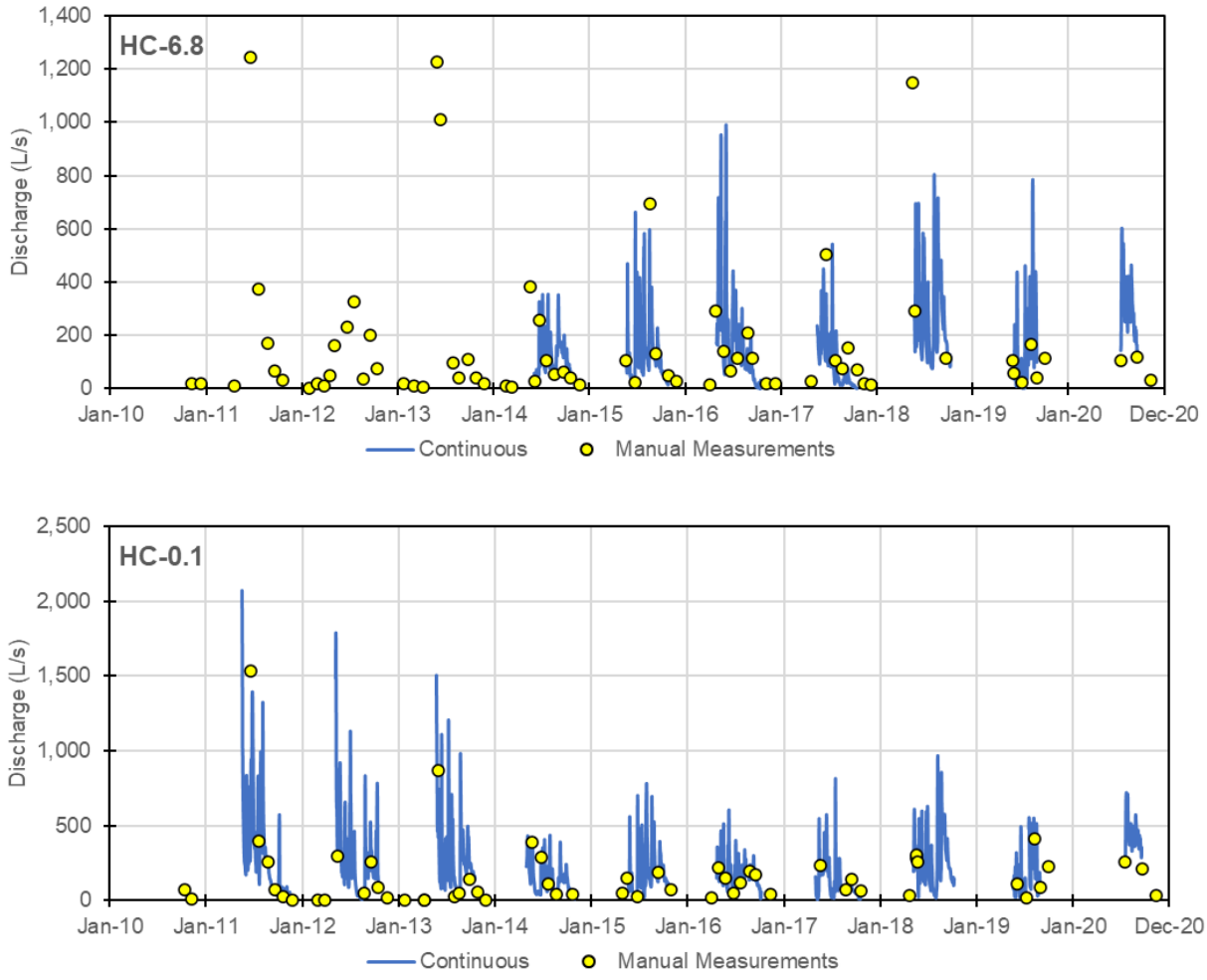


Figure 5-3: Time series discharge data for hydrometric stations on Halfway Creek. The upper panel shows discharge data (blue line) and spot measurements of discharge (green circles) for HC-6.8. The lower panel shows the same information for HC-0.1.

5.1.1.1 Unit Yields

Local patterns of streamflow are dominated by a snowmelt freshet that typically occurs late-April to mid-June and punctuated by multiple rainfall-induced high flow events that occur throughout the summer and autumn. In general, these high flow events are short lived, often persisting for a duration of 1 or 2 days. A plot showing the unit yields for all Project drainages, for their periods of record, is presented as Figure 5-4.

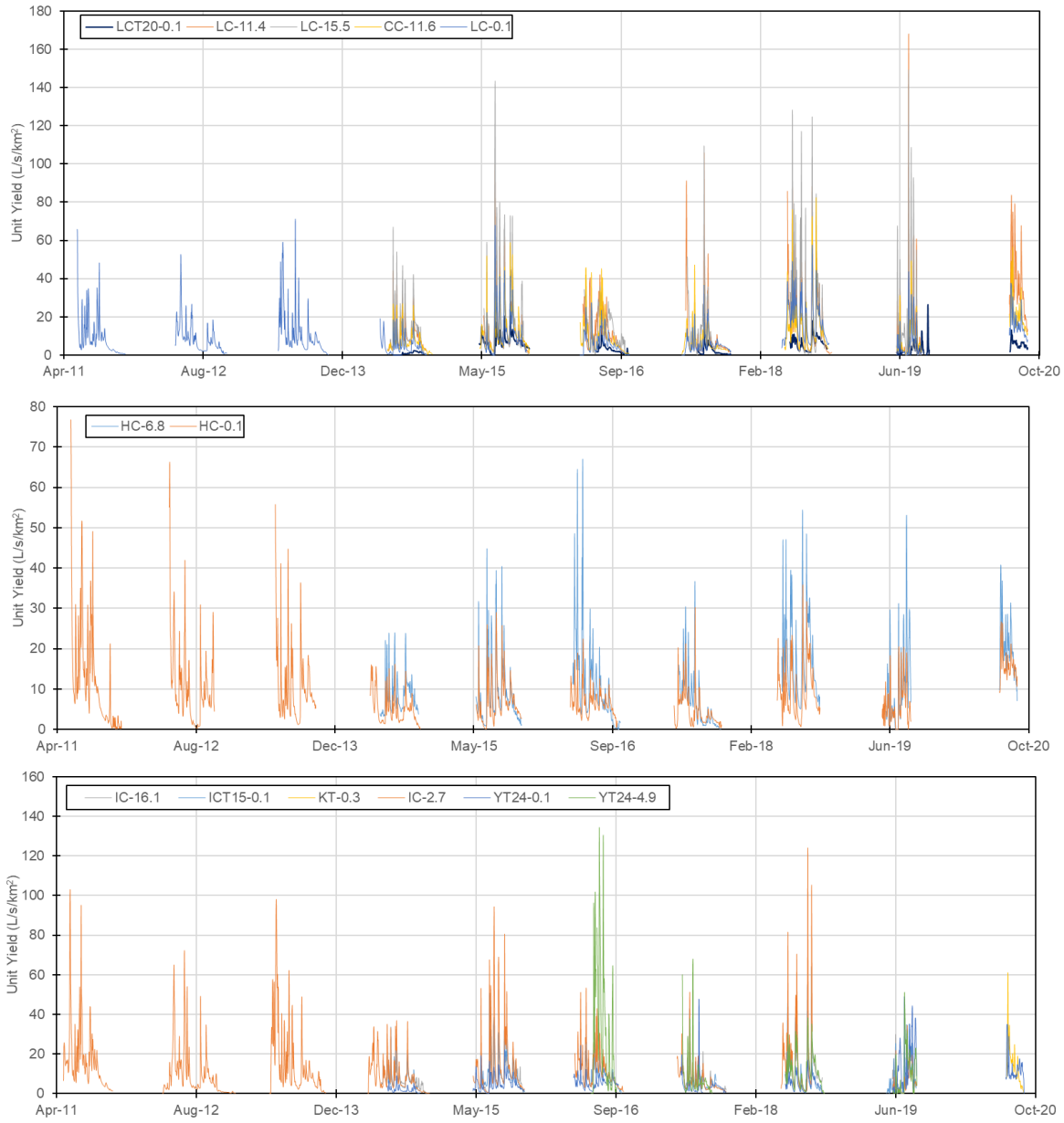


Figure 5-4: Unit yield hydrographs for gauged Project basins.

In general, average unit yields across the Project site are 10.6 L/s/km^2 for the open water season (May to October) and range from 4 to 16 L/s/km^2, depending on the drainage and noting the variation in record lengths between stations. The YT-24 (YT24-0.1) and LCT20-0.1 tributaries that drain the Supremo North and Upper Latte Creek development (respectively) have the lowest yields, while Upper Latte Creek (LC-15.5 and LC-11.4) and Halfway Creek (HC-6.8) have the highest yields (Table 5-1). Note that the YT24-4.9 station shows much higher yields than the YT24-0.1 station. This is due to several factors, including the preliminary rating curve used to generate the YT24-4.9 continuous discharge series, and the known losing reach that YT24-0.1 is located in.

Table 5-1:
Average unit yields by month (L/s/km^2)

Station	Area (km^2)	Record	May	June	July	Aug	Sept	Oct	May-Oct Average
CC-11.6	385.6	2014-2020	12.3	9.5	12.1	13.3	8.9	3.5	9.9
LCT20-0.1	3.4	2014-2020	7.6	3.2	4.1	4.9	3.9	2.0	4.3
LC-11.4	23.1	2014-2020	21.3	12.3	20.4	19.0	10.5	3.3	14.5
LC-0.1	69.8	2011-2020	13.2	9.7	12.4	11.0	7.6	2.7	9.4
LC-15.5	9.6	2014-2019	23.8	15.6	22.8	18.1	11.7	5.1	16.2
HC-6.8	14.8	2014-2020	18.6	13.5	13.7	13.9	9.8	3.9	12.2
HC-0.1	27	2011-2020	8.6	7.3	8.2	8.1	6.9	3.8	7.1
IC-16.1	81.1	2014-2019	10.1	9.8	10.6	10.0	7.8	5.1	8.9
ICT15-0.1	17.3	2014-2019	7.7	10.1	10.8	9.2	7.0	3.3	8.0
KT-0.3	18.3	2020	--	--	27.2	13.8	3.8	--	15.0
IC-2.7	222.3	2011-2019	17.3	12.6	12.3	10.7	7.2	3.4	10.6
YT24-0.1	11.8	2014-2020	5.0	3.7	6.8	8.7	5.3	2.0	5.3
YT24-4.9	4.0	2016-2019	37.6	7.3	23.6	16.2	8.4	0.8	15.7
Average			13.2	9.8	13.5	11.7	7.5	3.5	10.6

Note: Unit yield estimates for station YT24-4.9 are considered preliminary, due to the incomplete rating curves for this station.

5.1.1.2 Peak Flows

Peak flows are driven primarily by the intense convective rainfall events that are common in the summer months, with secondary peaks occurring in late-May, as a result of melting snowpacks. Measured peak flows are summarized in Table 5-2 for Coffee Creek stations.

Instantaneous peak flow unit yields are typically between 120 and 200 L/s/km^2, although the ICT15-0.1 station has only recorded an instantaneous peak flow of 60 L/s/km^2 range (Table 5-2). Upper Latte Creek experiences relatively larger instantaneous peak flow yields, on the order of 200 to 270 L/s/km^2.

Table 5-2:
Instantaneous peak yields by month from 15-min measurements (L/s/km^2)

Station	Area (km^2)	Record	May	June	July	Aug	Sept	Oct	Annual Maximum
CC-11.6	385.6	2014-2018	100.1	65.3	59.7	135.5	29.13	13.9	136
LCT20-0.1	3.4	2014-2018	--	30.4	129.6	40.9	12.7	7.4	130
LC-11.4	23.1	2014-2018	109.1	195.2	183.6	119.2	53.7	18.2	195
LC-0.1	69.8	2011-2018	89.8	127.2	104.6	74.7	30.0	14.2	127
LC-15.5	9.6	2014-2018	144.6	246.9	267.8	135.0	52.6	53.3	268
HC-6.8	14.8	2014-2018	117.4	107.4	172.8	67.3	40.4	19.8	173
HC-0.1	27.0	2011-2018	94.6	68.0	68.7	70.0	21.7	30.5	95
IC-16.1	81.1	2014-2018	51.4	94.3	160.8	111.9	39.7	23.9	161
ICT15-0.1	17.3	2014-2018	53.8	62.2	47.3	47.1	23.0	15.0	62
IC-2.7	222.3	2011-2018	140.4	141.3	115.7	207.2	44.9	15.3	140
YT24-0.1	11.8	2014-2018	39.9	26.8	400.0	29.8	14.4	15.7	400

Note: Peak flows for station YT24-4.9 are not reported due to the preliminary nature of the rating curve, and associated higher error in peak flow estimates.

5.1.1.3 Low Flows

During the open water season, the recession limbs of local hydrographs are often steep following the passage of a large rain event and the associated peak flows. Low flow conditions can occur intermittently during the summer and early autumn across the Project site, with unit yields during early summer often approaching those measured during the winter months. Measured low flows are summarized in Table 5-3.

Low flows measured in June 2015 at valley bottom stations (~1 L/s/km^2) formed a critical input to the site-wide groundwater model calibration. As the summer progresses, baseflows in the lower reaches of the Project site creeks are enhanced by active layer melt and soil moisture recharge. At the upper elevation stations (*e.g.*, LC-15.5) and those situated in alluvial deposits (*e.g.*, LCT20-0.1) effective yields can drop to near zero flow conditions (Table 5-3). By November, unit yields were observed to drop to 0.5 to 1.5 L/s/km^2 in all Project drainages, and zero flow conditions become widespread by late January and are accompanied by extensive aufeis formation. Aufeis (*i.e.*, frozen groundwater seepage that accumulates within- and adjacent to local watercourses) is pervasive in creeks and streams at the Project site. Aufeis melts during the freshet but may persist into the early summer (mid- to late-June). It is discussed in more detail below.

Table 5-3:
Minimum recorded low flow yields by month from daily averages (L/s/km^2)

Station	Area (km^2)	Record	May	June	July	Aug	Sept	Oct	Open Water Minimum
CC-11.6	385.6	2014-2018	1.81	1.44	2.20	1.97	2.01	0.29	0.29
LCT20-0.1	3.4	2014-2018	3.71	0.00	0.00	0.45	0.45	0.21	0.00
LC-11.4	23.1	2014-2018	2.47	2.10	1.65	2.05	1.41	0.65	0.65
LC-0.1	69.8	2011-2018	0.03	0.33	1.38	1.42	1.27	0.07	0.03
LC-15.5	9.6	2014-2018	1.63	0.00	0.46	0.72	2.83	0.10	0.00
HC-6.8	14.8	2014-2018	4.73	2.72	4.12	3.01	0.54	0.12	0.12
HC-0.1	27.0	2011-2018	0.20	0.05	0.49	0.19	1.96	0.04	0.04
IC-16.1	81.1	2014-2018	2.12	0.26	1.04	0.88	2.83	1.49	0.26
ICT15-0.1	17.3	2014-2018	2.11	2.22	1.26	0.91	1.36	0.21	0.21
IC-2.7	222.3	2011-2018	0.26	0.86	1.65	2.05	1.41	0.65	0.26
YT24-0.1	11.8	2014-2018	0.58	0.03	0.33	0.40	0.40	0.00	0.00

Note: Low flows for station YT24-4.9 are not reported due to the preliminary nature of the rating curve, and associated higher error in low flow estimates.

Annual Low Flow Regime and Aufeis

Over the course of the 8+ years of baseline study, all available winter spot flow measurements (October through April) were averaged by month then presented in Table 5-4 below. Low flow plots (*i.e.,* spot flow measurements and synthetic discharge estimates) are also presented for the hydrometric stations in Appendix A.

Site data show that yields range from 0.6 – 3.4 L/s/km^2 in October and decrease steadily to their annual minima by March (0 – 0.7 L/s/km^2), before increasing again in April in response to low-elevation snow melt and spring rainfall. Based on the site data alone, winter low flows are expected to range from 0 to 0.7 L/s/km^2.

An important component of the winter flow regime at the Project site is the extensive icing of the local channels. This ice growth, or aufeis, is the result of shallow groundwater discharge and/or baseflow in the stream channel freezing. This ice impedes subsequent flow, which is forced on top of the existing ice sheet, where it freezes (see Figure 5-5). This process repeats continuously throughout the winter, and results in laminated ice sheets that have been measured close to 1.5 m in thickness and 50+ m in width in the Project channels (Figure 5-6). Liquid flow is thus either not present, or it can still occur between these laminae, and at the edges of the stream channel. It is these flows that the water quality samples are taken from during the winter. The aufeis process also acts as a storage reservoir for winter baseflows and can store up to a third of the cumulative annual baseflow in sub-Arctic watersheds (Yoshikawa *et al*., 2007).

Table 5-4:
Winter spot flow measurements presented as monthly averages for Project area hydrometric stations. Values are unit yields (L/s/km^2).

Month	CC-11.6	LCT20-0.1	LC-11.4	LC-0.1	LC-15.5	HC-6.8	HC-0.1	IC-16.1	ICT15-0.1	IC-2.7	YT24-0.1
JAN	0.1	N/A	0.5	0.1*	N/A	1.3*	0.0	0.6*	N/A	N/A	0.0
FEB	0.1	N/A	0.4	0.0*	N/A	0.7	0.0	0.3*	0.0*	N/A	0.0
MAR	0.0*	N/A	0.4	0.0	N/A	0.7	0.0	N/A	N/A	N/A	0.0
APR	1.2	N/A	2.8	3.8	28.1*	4.6	0.0	10.8*	N/A	10.9*	5.1
MAY	--	--	--	--	--	--	--	--	--	--	--
JUN	--	--	--	--	--	--	--	--	--	--	--
JUL	--	--	--	--	--	--	--	--	--	--	--
AUG	--	--	--	--	--	--	--	--	--	--	--
SEP	--	--	--	--	--	--	--	--	--	--	--
OCT	3.5	2.1	3.3	2.7	4.1	4.1	3.0	5.1	1.8	3.4	2.0
NOV	1.3	1.8	0.8	0.7	N/A	1.5	0.6	0.9	0.0	0.9	0.0
DEC	N/A	N/A	0.5	0.1	N/A	1.1*	0.0	0.8*	N/A	0.5*	0.0

Notes:
*Value is based on a single measurement.
No winter flow measurements are available for YT24-4.9

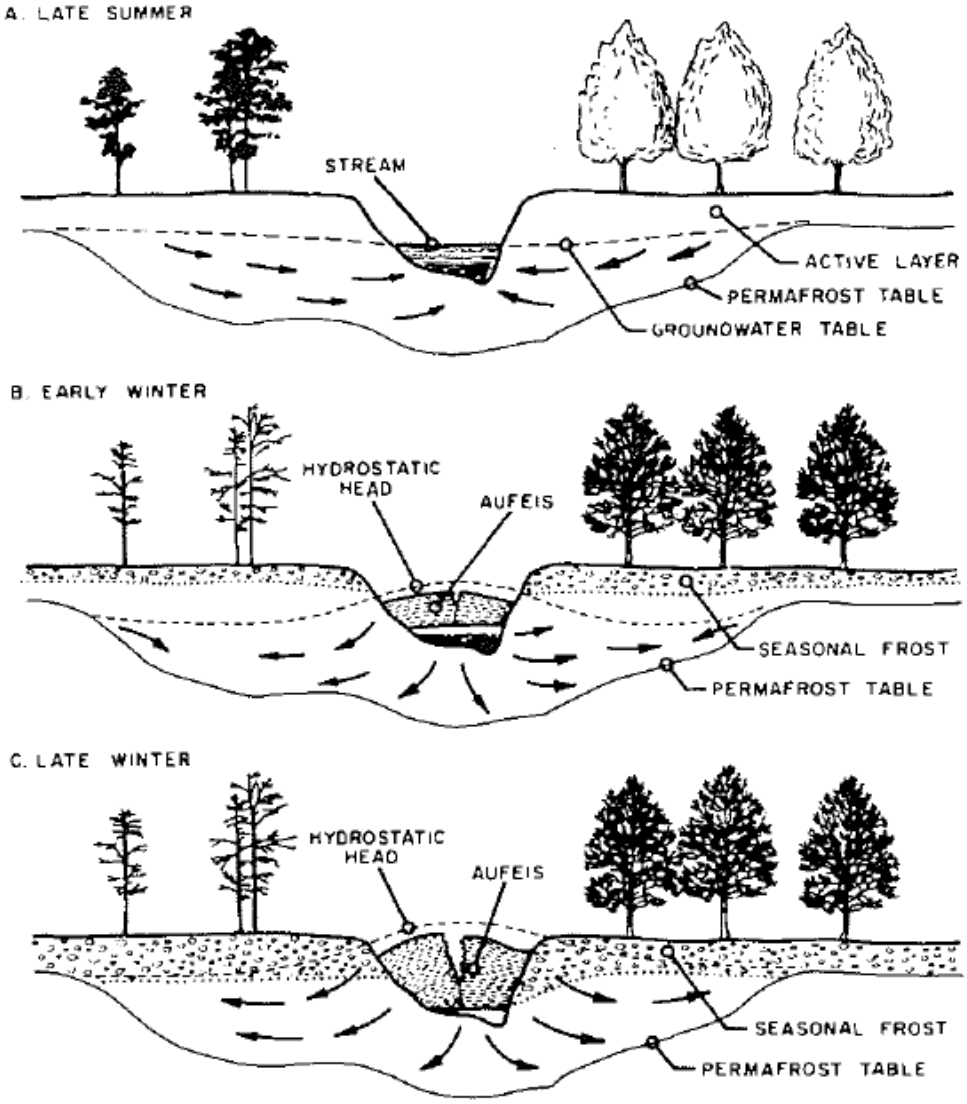


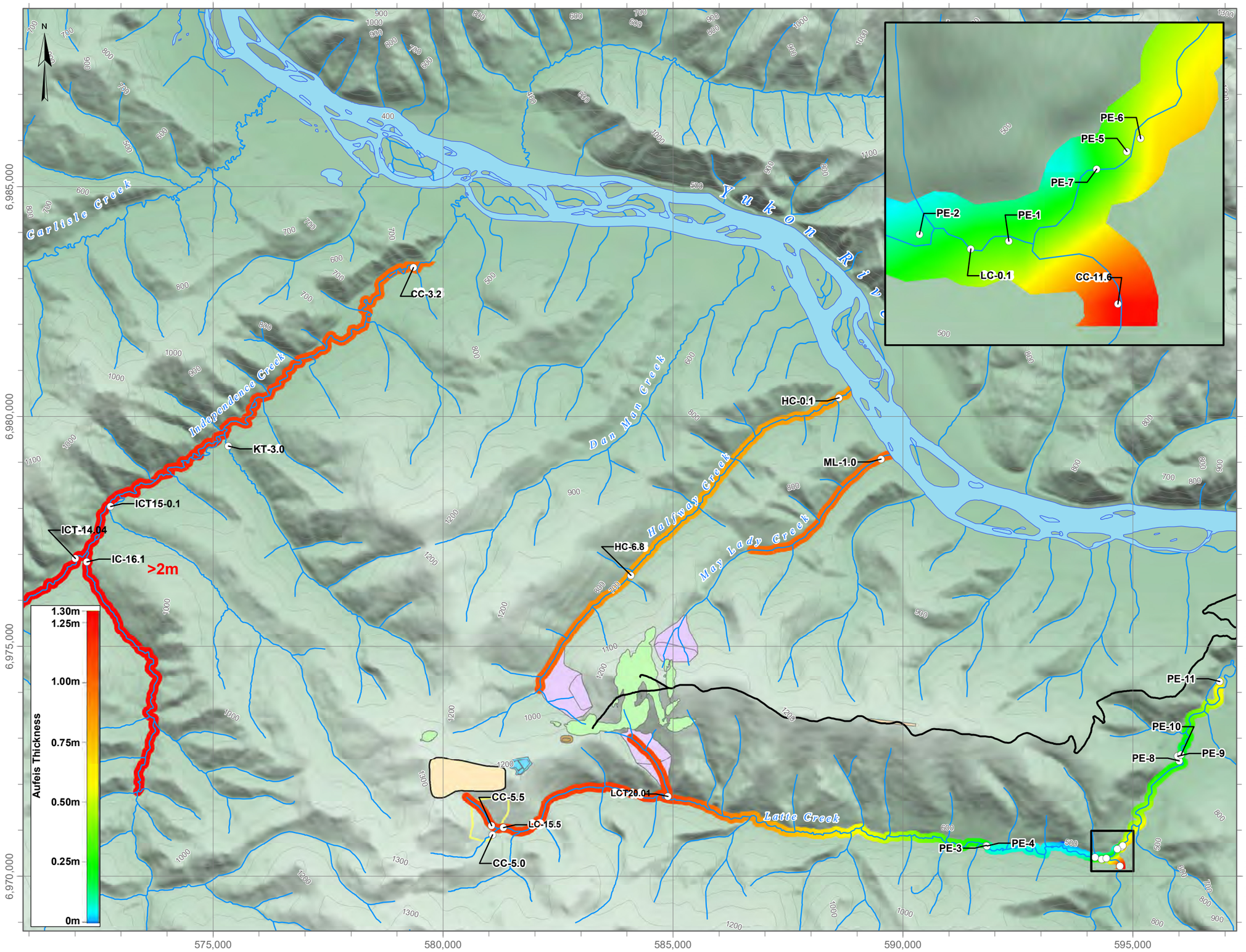
Figure 5-5: Groundwater flow patterns and aufeis formation (from Kane, 1981).



Figure 5-6: Extensive aufeis (~50 m wide) at HC-6.8. For reference, the stream channel is typically 2 m wide at this point.

Aufeis often far exceeds the natural stream channel width in the smaller tributaries, and as ice melts much more slowly than the snowpack, much of the freshet occurs while extensive aufeis is still present. This makes accurate measurement of streamflows (where they exist) challenging or impossible during the winter season at most hydrometric stations, and dangerous during the initiation of freshet. This process also influences the distribution of annual streamflow, as the baseflow stored in aufeis during the winter months is released during the freshet and early summer periods. This means that proportionately even more of the total annual runoff is expressed during the months of May through October.

A map of the Project site drainages with measured and inferred aufeis extents and thicknesses is presented in Figure 5-7.



LEGEND

- Measurement Locations
- Watercourses
- Waterbodies
- Surface Contours (100m)

Proposed Mine Infrastructure

- Pits
- Waste Rock Storage Facility
- Airstrip
- Event Pond
- Stockpile
- Heap Leach Pad
- Heap Leach Pad (Proposed 2014 Location)
- Access Road

Aufeis thickness along May Lady Creek is assumed to be 1m. No data collected.

Aufeis depths in headwater tributaries are extrapolated, extents are based on field reports

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:80,000

0 1 2 Km

DATE SAVED:	Aug 31, 2015
DRAWN BY:	GM
REVIEWED:	DHF
VERSION:	1

CLIENT:

Newmont COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE:

Aufeis Thickness

PROJECT #: A362-3 *FIGURE:* 5-7

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5.1.1.4 Mean Annual Runoff (MAR) and Elevation

Hydrometric data tabled in Appendix C is presented in runoff depth format. Estimates for each station are presented monthly, annually and as an average (mean annual runoff, MAR) per station, for the available period of record. MAR estimates for the Project area creeks vary from basin to basin. For example, the runoff generated by YT-24 is low and approximately 50 mm based on the 2014-2018 open water season average (Appendix C). Measured runoff data for 2019-2020 were not included in this analysis due to the more limited coverage, including the lack of freshet discharge data. In contrast, runoff generated in the headwaters of Latte Creek are comparatively high and estimated to be 180 mm based on the same period. MAR for LC-15.5, a high-elevation headwater station within the Latte Creek drainage shows an even higher MAR value 205 mm). Note that these estimates are based on the measured data for the open water season only, and thus do not include additional runoff generated during early freshet and the winter months, where present. The MAR values presented in Section 5.1.2.1 are based on the synthetic streamflow time-series, and explicitly include estimates of runoff for these periods.

To explore relationships between runoff generation and basin characteristics, MAR estimates were regressed against mean basin elevation (m), basin area (km^2) and dominant aspect within the drainage. While resulting relationships were weak or poor for the basin area and aspect assessments, a robust relationship between runoff and elevation was ascertained. This relationship is shown for Project site drainages in Figure 5-8.

With the exception of the LCT20-0.1 basin, a small (3.4 km^2) catchment in the headwaters of Latte Creek, MAR increases linearly with increase in median basin elevation at the Project site. Compared to other basins, the uniqueness of the LCT20-0.1 flow regime is assumed attributable to its basin outlet configuration (*i.e.*, small, wide, permeable surficial geology) that returns lower than expected surface water flow (especially in 2014) and presumably higher groundwater discharge than other gauged basins.

The line of best fit through the MAR:median elevation points [MAR (mm) = 0.314*elevation (m) - 195.77] returns an annual runoff elevation gradient of 7%/100 m, which is equal to the annual average orographic precipitation gradient of 7%/100 m. The strong correlation between median basin elevation and runoff is likely influenced in part by more extensive permafrost coverage at higher elevations but is also driven by higher precipitation at the upper elevations of the Project area, further supporting the conceptual model of orographic precipitation gradients at site (Section 4.3).

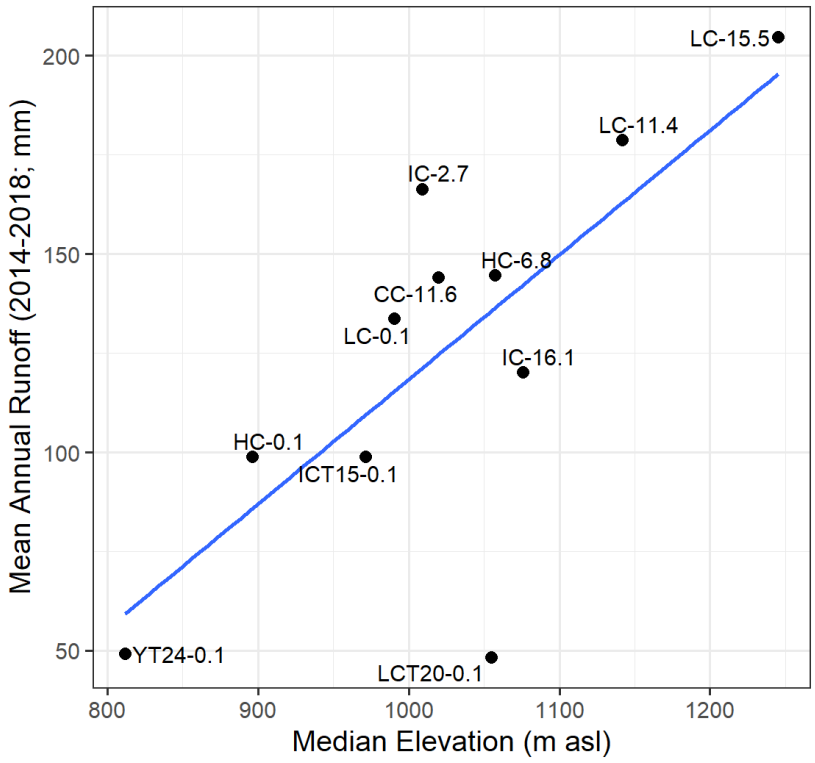

Figure 5-8: Mean annual runoff for the open water season plotted against median basin elevation (2014-2018).

5.1.2 Synthetic Discharge Data and Streamflow Metrics

The creation of synthetic hydrographs for all Project stations resulted in a 44-year record (1975-2018) of daily discharge being created for the Project site drainage basins. Extension of the synthetic record beyond 2018 was not possible due to the lack of QA/QC'd hydrometric data from regional WSC stations beyond this date. Ultimately, these records allow the short-term site data to be placed in a broader historical context. An example synthetic record is shown in Figure 5-9 for Latte Creek hydrometric station LC-11.4. The upper plot of this figure shows the synthetically estimated discharge data for this station. The lower plot compares measured and synthetic discharge data for LC-11.4 (for the overlapping record of 2014-2018) in flow duration curve format. The strong similarity of these flow duration curves gives an indication that the magnitude of the discharges and the range of variability for discharge in the measured record is appropriately replicated in the synthetic series.

Figure 5-10 depicts the long-term annual runoff time-series for stations LC-11.4, HC-6.8 and YT24-0.1. Given the general arrangement for the proposed mine (refer to Figure 1-2), these three basins may see modification and/or alteration to surface flow, surface water quality and/or groundwater condition (quantity, quality) as Project footprints advance.

Runoff data in this figure show that overall, range in inter-annual variability for each station is substantial, and the relative magnitude of variation differs between basins. The differences in magnitude are assumed attributable to site-specific differences in mean basin elevation (Figure 5-8), that have been correctly embedded into the respective synthetic discharge series.

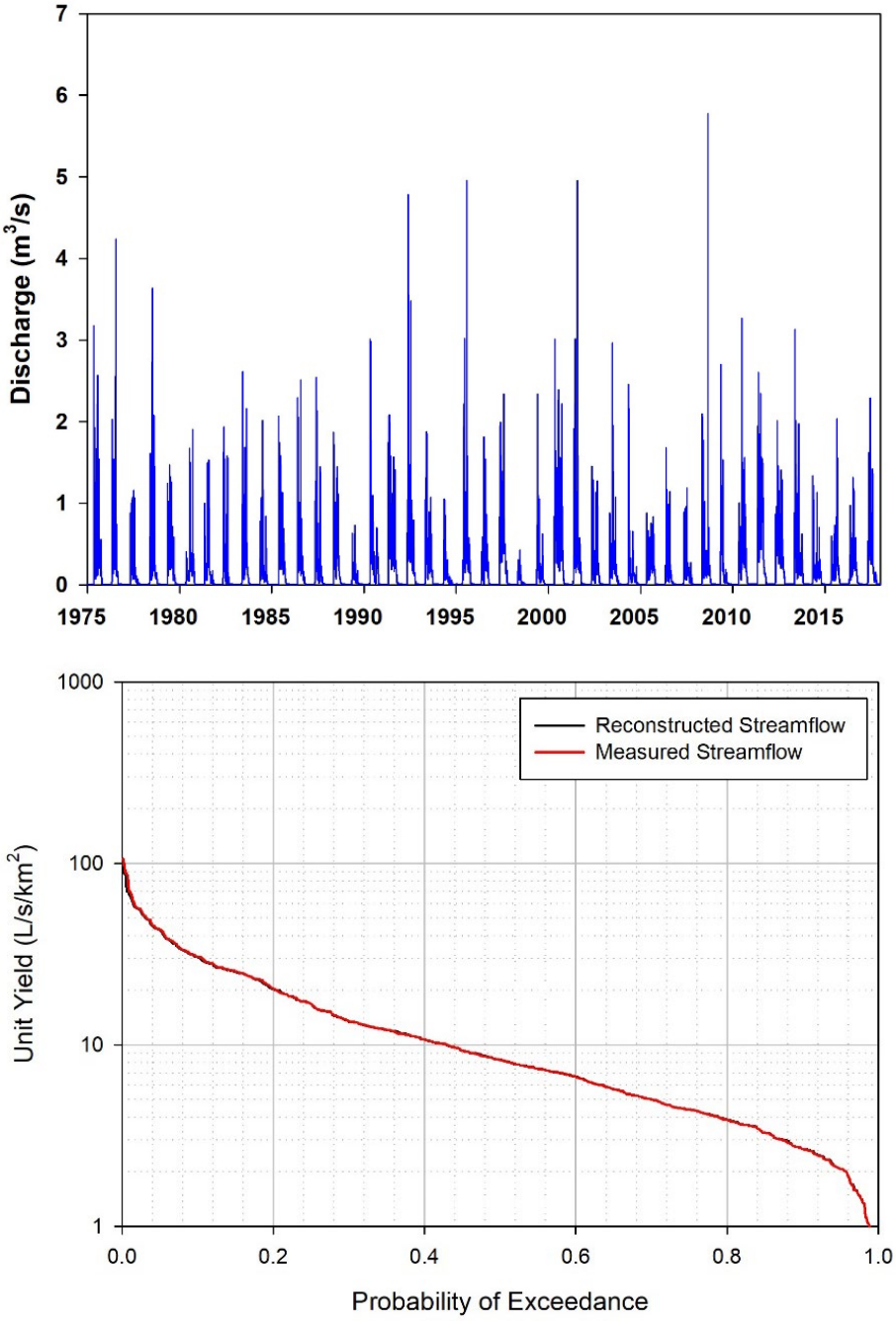

Figure 5-9: Time-series of daily discharge for the LC-11.4 synthetic discharge record (upper panel). The lower panel shows LC-11.4 discharge data (measured and synthetic) in flow duration curve format.

The long-term variability in natural runoff contained within each synthetic dataset can be shown in standardized anomaly plot format. An example anomaly plot is shown for LC-11.4 in Figure 5-11, where positive Y-axis and negative Y-axis scaling indicate progressively higher and lower deviations from long-term average runoff respectively. From Figure 5-11, it is apparent that the baseline study period (*i.e.*, autumn 2010 to end 2018) captured five years that were wetter than average (2010 through 2013 and 2018), and four years that were average or slightly drier than average (2014 through 2017). This is critical information, as a series of wet- or dry-years occurring during a short baseline data collection period can heavily bias estimates of streamflow metrics.

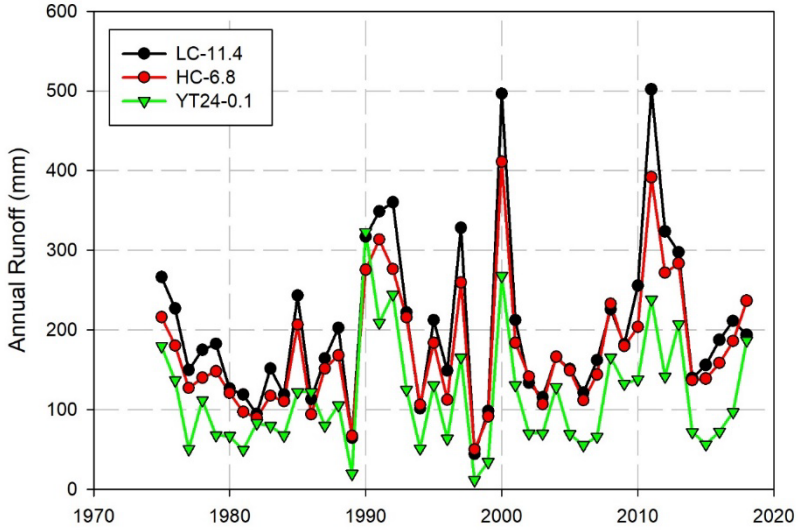

Figure 5-10: Annual runoff time-series for stations LC-11.4, HC-6.8 and YT24-0.1.

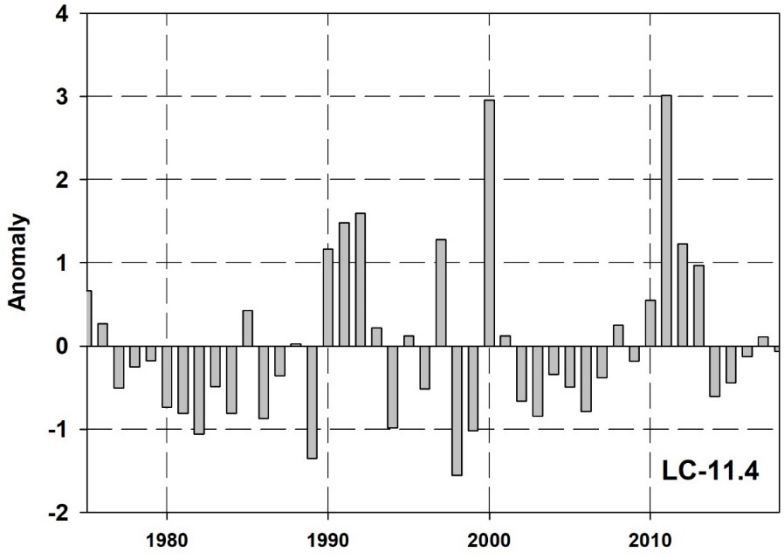

Figure 5-11: Standardized anomaly plot for annual runoff at LC-11.4.

5.1.2.1 Annual Runoff: Wet- and Dry-year Recurrence Intervals

Results of the annual runoff recurrence interval analysis are presented in Table 5-5, along with the average runoff ascertained from the measured site data. Agreement is generally good for all basins, although the average runoff calculated from site data are biased toward the 2014-2018 period of common record, and by the lack of continuous data throughout the winter low-flow season. The spread between the 1:200 dry- and wet-years is confirmed to be substantial at Coffee Creek, and generally, wet-years are expected to produce an order of magnitude higher runoff than an extreme dry-year. As a point of reference for the wet- and dry recurrence interval data presented in Table 5-5, the synthetic discharge records vary by factors of 8-9 over the 44 years of record, with much higher variability at LCT20-0.1 and YT24-0.1, where the wettest year has 16 and 84 times the runoff of the driest year, respectively.

The average runoff for all site stations is presented alongside the corresponding annual precipitation estimate for each recurrence interval in Table 5-6. Average runoff coefficients for each interval are presented in this table as well. These data show that the proportion of annual precipitation converted to runoff increases in proportion to the total annual precipitation estimated, which is consistent with the expected basin response. For a wet year, soil moisture storage would likely be fully recharged, and would have limited additional capacity to store infiltrated precipitation. Conversely and for a dry-year, a below average snowpack or prolonged summer drought combined with evaporation, may require appreciable precipitation to replenish basin storage and soil moisture deficit, and only then will surface runoff be produced.

Table 5-5:
Annual runoff recurrence interval estimates for Project site basins (all values in mm/year).

Exceedance Probability	Return Period	CC-11.6	LCT20-0.1	LC-11.4	LC-0.1	LC-15.5	HC-6.8	HC-0.1	IC-16.1	ICT15-0.1	IC-2.7	YT24-0.1
		GEV	GEV	GEV	GEV	GEV	GEV	GEV	GEV	GEV	GEV	GEV
0.005	1:200 dry	35	15	47	24	43	45	21	44	31	33	5
0.01	1:100 dry	40	18	55	28	51	52	24	50	36	39	11
0.02	1:50 dry	47	23	65	32	62	61	28	57	42	45	18
0.04	1:25 dry	55	28	76	38	76	71	33	66	49	53	27
0.1	1:10 dry	69	36	97	48	104	90	42	81	61	66	42
0.5	1:2 (median)	126	70	178	87	233	160	77	139	108	119	100
	Synthetic Average	143	78	200	98	273	176	86	156	119	133	115
	Site average	144	48	179	134	205	145	89	120	103	167	49
0.9	1:10 wet	234	128	328	159	481	282	140	250	192	216	206
0.96	1:25 wet	300	161	417	202	615	349	176	316	239	271	266
0.98	1:50 wet	355	187	490	237	717	403	205	369	277	316	315
0.99	1:100 wet	414	214	567	274	820	458	235	427	317	363	366
0.995	1:200 wet	479	242	651	314	924	516	267	489	359	413	421

Table 5-6:
Annual precipitation and average annual runoff recurrence interval estimates.

	Recurrence Interval (1:years)	Annual Precipitation (mm)	Average Runoff (mm)	Average Runoff Coefficient
Dry-year	1:200	248	31	0.13
	1:100	267	37	0.14
	1:50	288	43	0.15
	1:25	311	52	0.17
	1:10	349	66	0.19
Median	1:2	459	122	0.27
Wet-year	1:10	573	231	0.40
	1:25	611	297	0.49
	1:50	634	352	0.56
	1:100	652	412	0.63
	1:200	668	478	0.72

5.1.2.2 Peak Flows

As an extension to the peak flow analysis presented using measured data from site, a regional peak flow analysis was conducted using the stations listed in Table 3-7. Recurrence interval estimates of annual instantaneous peak flows were plotted against drainage area, and an enveloping power law function was then fit to the data. For reference, the measured peak flows from the site data were also plotted, with a separate function fit to these data. The enveloping power law functions derived from the regional data for each recurrence interval (*e.g.*, 1:100-year peak flow) were used to estimate the corresponding peak flow for all Project drainages. The results of this analysis are presented as unit yields in Table 5-7 and plot of the regional- and site- peak flow data is provided in Figure 5-12.

Table 5-7:
Instantaneous peak yield recurrence interval estimates for Project basins derived from regional analysis (L/s/km^2)

Station	Drainage Area (km^2)	1:2 year	1:5 year	1:10 year	1:25 year	1:50 year	1:100 year	1:200 year	Measured Peak Yield
CC-11.6	385.6	102	136	156	185	226	264	309	136
LCT20-0.1	3.4	139	213	266	345	452	560	697	129
LC-11.4	23.1	122	178	214	268	341	413	501	388
LC-0.1	69.8	114	160	189	231	291	346	414	127
LC-15.5	9.6	129	193	236	300	388	475	583	268
HC-6.8	14.8	126	185	225	284	364	443	541	173
HC-0.1	27	121	175	210	262	334	403	488	95
IC-16.1	81.1	113	157	186	227	284	338	404	109
ICT15-0.1	17.3	125	183	221	278	356	432	527	62
IC-2.7	222.3	106	143	166	198	245	288	339	207
YT24-0.1	11.8	128	189	231	292	377	459	563	400*

Note:
*Estimated discharge value, hydrometric station was destroyed during July 15, 2017 flood event. Highest recorded water level prior to record interruption returned a unit yield value of 400 L/s/km^2, albeit with a high degree of uncertainty.

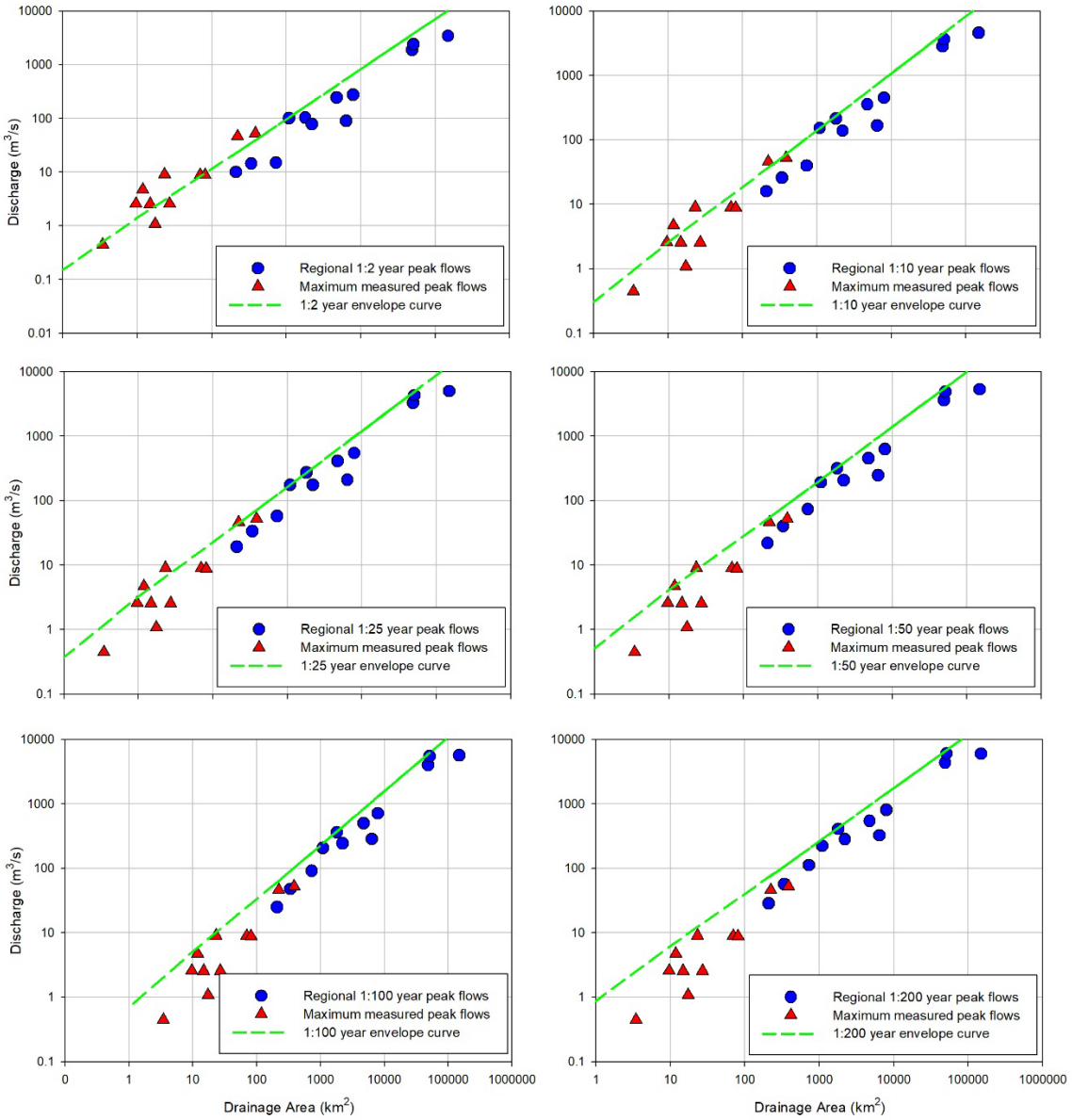

Figure 5-12: Peak flow estimates for regional stations (blue) and maximum recorded instantaneous site discharges (red).

For basins under 1,000 km^2, there is overlap between the regional- and site data for the 1:5 year and 1:10 year envelope curves shown in Figure 5-12, and this is not unexpected given that period of record for Coffee Creek is approximately ten years. By comparison, peak flows returned from the regional analysis are higher in magnitude and therefore more conservative that an estimate returned from site- measurements alone for the most extreme peak flow events (*i.e.*, 1:50 year, 1:100 year and 1:100 year). To validate the reasonableness of the peak flows returned from the envelope curves, regional guidance documents published by state and territorial governments on the estimation of peak streamflows in ungauged basins were consulted (Curran *et al.*, 2003; Janowicz, 1989). Table 5-8 list the

proposed peak flow equations for Project area basins and reports peak flow estimates for a 100 km^2 drainage using envelope curves and the data models proposed by Curran *et al.,* 2003. It is notable that the peak flow estimates for the site drainages are comparable to those developed using the Curran *et al.* method for high frequency peak flow events but are substantially lower for lower frequency events (*i.e.*, > 1:10 year recurrence intervals). This is due to the pronounced west-east precipitation gradient noted in Section 4.4.1.

Table 5-8:
Summary of predictive equations for select peak flow events

Event	Envelope Curve Equation	Peak Flow Comparison (Envelope Curve, Curran *et al.,* 2003)
1:2 year	$y = 150A^{-0.065}$	11, 8
1:5 year	$y = 240A^{-0.096}$	15, 18
1:10 year	$y = 305A^{-0.113}$	18, 28
1:25 year	$y = 405A^{-0.132}$	22, 44
1:50 year	$y = 540A^{-0.146}$	28, 58
1:100 year	$y = 680A^{-0.159}$	33, 75
1:200 year	$y = 860A^{-0.172}$	39, 94

Notes: The Envelope Curve Equations in the table above are shown graphically in Figure 3-26. In the right most column above, peak flows (in m^3/s) from the Envelope Curve Equations are compared to estimates after Curran *et al.,* 2003. The values reported are for a hypothetical drainage basin with area 100 km^2. The Envelope Curve Equation uses *A* (basin area in km^2) as the predictor variable for the peak flow value and the equation returns a value in units of L/s/km^2. For the Curran *et al.* peak flows the following was assumed: 1) peak flow equations for Region 5 were applied; 2) mean basin elevation (E) was assumed to be 1,067 m asl (3,500 ft); 3) forest cover (F) was set to 75% in the data model; and 4) storage (S) was conservatively set to a value of 1%.

July 15, 2017 Flood Event

A high magnitude rainfall event occurred on July 15th, 2017 at the Project site, resulting in highly localized and short duration peak flows in the YT-24 basin. The rainfall totals were highly variable across the Project site and increased strongly with elevation, with the high elevation tipping bucket recording 45.1 mm of rain in 1.5 hours, which is approximately equal to the 1:5 year 24-hour recurrence interval estimate for 1,300 m (Table 5-9). The effects of this rainfall event were highly localized, and while high flows occurred in Halfway Creek and Latte Creek in response, the YT-24 basin bore the brunt of the event.

This rainfall event resulted in an estimated peak flow of approximately 8.1 m^3/s, which corresponds to a discharge event exceeding a 1:200-year recurrence interval, as calculated from the regional data. This discharge estimate was derived from a survey of the high-water marks to obtain a stage estimate (1.495 m). It is notable that there is a high degree of uncertainty in this estimate, however it indicates that very high-magnitude peak flow events

resulting from high-intensity localized convection cells are possible at the Project site. In any event, given the extent of damage to the YT-24 channel caused by this event, it appears that the peak flow magnitude recurrence interval likely exceeded the corresponding recurrence interval calculated for the rainfall event depth, indicating that the rainfall estimates carried forward for engineering design are conservative.

Table 5-9:
July 15, 2017 rainfall totals and recurrence interval estimates

Station	Camp Tipping Bucket	Climate Station	High Elevation Tipping Bucket
Elevation (m asl)	430	975	1,300
Rainfall Depth (mm)	3.9	18.3	45.1
1:5-year 24 hour (mm)	40	44	56
1:100-year 24 hour (mm)	69	75	98
1:200-year 24 hour (mm)	77	84	106
24-hour PMP (mm)	--	--	283

Post-event photos of the YT-24 channel at the hydrometric station location are provided below (Figure 5-13 through Figure 5-16) to show the extent of the instream changes that resulted from this event.



Figure 5-13: YT24-0.1 looking upstream. Evidence of overbank flow and sediment deposition is apparent, behind the survey benchmarks (tree with orange flagging tape).



Figure 5-14: YT-24 looking upstream



Figure 5-15: Aerial photo of YT-24 showing extensive erosion resulting from July 15th rainfall event.



Figure 5-16: Post-event sediment deposition in upper YT-24 catchment.

5.1.2.3 Low Flows

A robust characterization of the low flow regime is required to inform potential water quality sensitivities, as well as the potential for shortfalls in water required for process makeup or dust control, for example. A low flow analysis is presented below that considered inspection of regional- and site-specific hydrometric data. Consistent with provincial guidance (see BC MOE, 2012), low flow values returned by the Log Pearson (Type III) (LP3) distribution are reported in this section. In some instances, the LP3 distribution did not fit the data, in which case the Weibull distribution was used.

Both annual and summer (June-September) low flow events ($7Q_2$ [median], $7Q_5$, $7Q_{10}$ and $7Q_{20}$) were considered in this assessment, where recurrence interval estimates for summer low flows were derived from the synthetic discharge records. Due to limited site data available for the winter period, and extensive aufeis conditions documented in Project basins, the same approach was not taken for the annual low flow metrics. Instead, all available spot flow measurements for the winter months are presented for the site stations to give indication of expected annual low flow condition.

Summer Low Flow Regime

The low flow recurrence interval estimates for the summer period (June to September) are presented in Table 5-10 (regional) and Table 5-11 (site). The values are presented as unit yields to allow for easy comparison between basins.

The regional stations represent basins that span three orders of magnitude for area (km^2), and therefore, there is substantial variation in the calculated low flow yields. The most representative regional basins are assumed to be those with drainage areas <10,000 km^2. With the exception of 09EA004, which has anomalously high yields for a basin of this size, and to a lesser extent 09DD004, remaining basins (*i.e.*, 09AH003, 09AH004, 09CA006, 09EB003 and 09EB004) return summer $7Q_{10}$ yields that range from 0.7 to 1.2 L/s/km^2 (Table 5-10). For a parallel analysis conducted using the synthetic streamflow data, these data returned estimated summer $7Q_{10}$ values for the Project stations ranging from 0.03 to 0.78 L/s/km^2 (Table 5-11), with average of the summer $7Q_{10}$ values for the eleven Project stations being 0.38 L/s/km^2.

Table 5-10:
June – September minimum 7-day low flow recurrence interval estimates for regional stations. Values are unit yields (L/s/km^2).

Exceed. Prob.	Return Period	09AH003	09AH004	09BC001	09CA003	09CA006	09CD001	09DD003	09DD004	09EA004	09EB003	09EB004
		LP3	LP3	Weibull	LP3	LP3	LP3	LP3	LP3	LP3	LP3	LP3
	Basin Area (km^2)	1,800	6,410	48,900	12,400	7,910	149,000	51,000	4,750	1,090	2,210	3,060
0.5	1:2 (median)	2.08	1.50	7.21	11.66	2.52	9.50	8.14	5.96	10.10	1.42	2.14
0.2	1:5	1.36	0.96	5.38	8.48	1.54	8.17	6.16	4.63	8.11	0.92	1.35
0.1	1:10	1.11	0.76	4.43	7.11	1.20	7.51	5.27	4.06	7.15	0.72	1.05
0.05	1:20	0.94	0.63	3.67	6.11	0.97	6.98	4.62	3.65	6.41	0.58	0.85

Table 5-11:
June – September minimum 7-day low flow recurrence interval estimates from synthetic site records. Values are unit yields (L/s/km^2).

Exceed. Prob.	Return Period	June-September 7Q recurrence intervals (L/s/km^2)										
		CC-11.6	LCT20-0.1	LC-11.4	LC-0.1	LC-15.5	HC-6.8	HC-0.1	IC-16.1	IC-14.6	IC-2.7	YT24-0.1
		LP3	LP3	LP3	LP3	Weibull	LP3	LP3	LP3	LP3	LP3	Weibull
0.5	1:2 (median)	2.235	2.014	1.030	1.467	0.476	1.056	0.711	1.879	1.794	1.734	0.382
0.2	1:5 dry	1.147	0.878	0.469	0.471	0.114	0.399	0.204	0.845	0.899	0.915	0.087
0.1	1:10 dry	0.777	0.547	0.312	0.245	0.044	0.244	0.099	0.553	0.617	0.668	0.033
0.05	1:20 dry	0.552	0.363	0.224	0.139	0.018	0.164	0.053	0.388	0.449	0.515	0.013

5.1.3 Regional Flow Data

5.1.3.1 Regional Flow Summaries

To obtain the input data required for the regional streamflow analyses (peak and low flows, annual runoff, trend analyses, *etc*.), the daily time-series (in m^3/s) for ten of the hydrometric stations listed in Table 3-7 were run through a customized routine to extract the relevant metrics. As indicated in Section 3.3.5.1 the extracted metrics included the following:

- Average annual (calendar year and water year [October to September]) discharge;
- Annual maximum and minimum daily discharge;
- Annual and June-September minimum 7-day average discharge;
- Average monthly discharge (m^3/s) and runoff (mm);
- Date of freshet initiation (pulse date; after Cayan *et al.*, 2001);
- Date of freshet peak discharge, and;
- Date of centre of hydrograph mass (calendar year; after Stewart *et al*., 2005).

Summaries of the extracted metrics from regional monitoring locations are provided in table format in Appendix E.

5.1.3.2 Yukon River Flow Data

As described in Section 1.4, contact waters associated with the Coffee Gold Project will report passively to Halfway Creek, YT24-0.1 (unnamed tributary) or Latte Creek – a headwater tributary of Coffee Creek. Ultimately, these three receiving creeks (*i.e.,* Halfway, Latte, YT24-0.1) report to the Yukon River, and therefore, an understanding of the Yukon River flow regime is critical.

The Yukon River is gauged at several locations in the Yukon Territory and Alaska. The Water Survey of Canada hydrometric station Yukon River above White River (09CD001) is situated a short distance downstream of the Coffee Gold Project (~15 km). Period of record for this station is 65 years (1956-2021), and the drainage area for the basin at the location of the gauge is 149,000 km^2.

The drainage area of the Yukon River at locations relevant to the Project are essentially identical in magnitude. For example, the estimated drainage of the Yukon River above Coffee Creek is 147,317 km^2 (*i.e*., an area 1.2% less than that area at 09CD001). The Yukon River downstream of Halfway Creek compares within 0.8% of the drainage at 09CD001 and is 147,839 km^2.

Average, minimum, and maximum discharge data (period of record, daily) for the Yukon River above White River are shown in Figure 5-17. These data show that winter flows for the Yukon River are typically 400-500 m^3/s but may reach winter minima on the order of 250 m^3/s upon occasion. Flows for months May through November, can reasonably be expected to range between 1,000 and 3,000 m^3/s at the Project site. Period of record daily flow data are also presented for the Big Creek near the Mouth station in Figure 5-17 – the record upon which the synthetic streamflow series are based. In Appendix E, available stage data are presented for the Yukon River above White River. So too are hydrometric data (stage, flow) for the Stewart River, as they are relevant to barging and ice-road passage proposed for the Project.

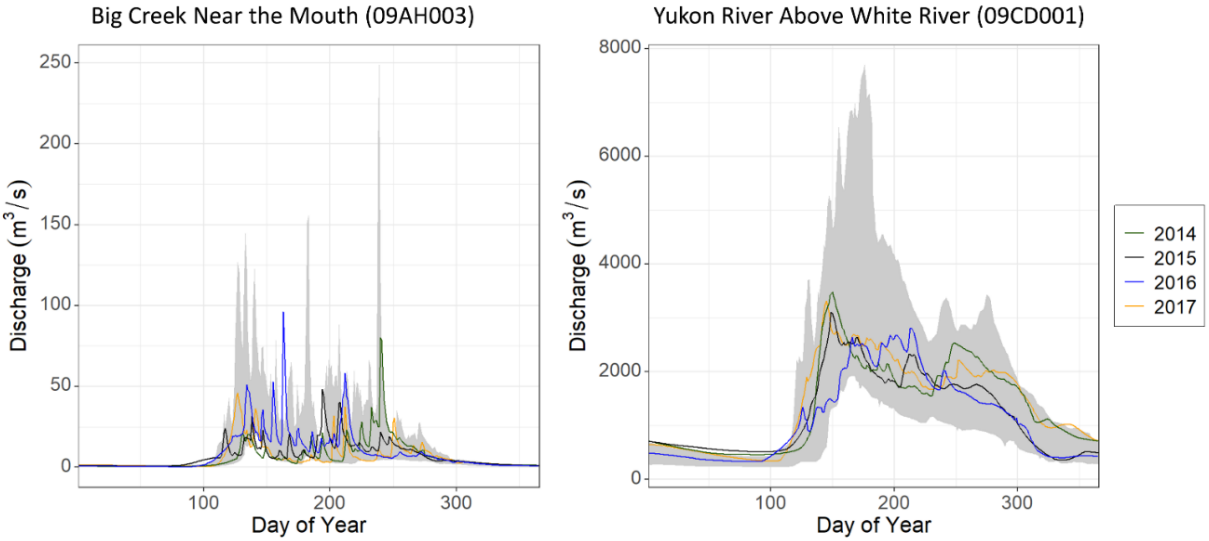

Figure 5-17: Recent years of data (2014 - Green; 2015 - Black; 2016 - Blue; 2017 - Orange) from Water Survey of Canada stations Big Creek Near the Mouth (left) and Yukon River Above White River (right). Historical minimum and maximum discharge data for Big Creek (1975-2013) and Yukon River (1956-2013) are shown in grey.

6. Conclusions

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6. Conclusions

6.1 Site Climate Characterization

The baseline climate record for the Project site covers the period from 2012 to present, and the data for the 2012-2021 period are summarized in this report. A Campbell Scientific climate station has been in continuous operation for this period at an elevation of 975 m and was complemented by tipping bucket rain gauges installed in 2015 at the Coffee Creek exploration camp (430 m) and at the ridge-top laydown (1,300 m). Another research grade climate station was installed at 1,340 m near the proposed HLF in October 2018 to further refine the understanding of site climate conditions. Snow course measurements were carried out at various elevations (*i.e.*, low, mid, and high elevation) and oriented to discern effects of aspect on local snow accumulation. There are currently five snow courses surveyed according to Territory protocols within a 10-day window centred on the 1st of March, April, and May.

To allow robust estimates of site climate metrics (*e.g.*, recurrence interval estimates of annual precipitation) to be made, the daily Dawson A climate station record was adjusted using the site-specific air temperature lapse rates and orographic precipitation gradients to generate a daily record of minimum, mean and maximum daily air temperature and daily precipitation, extending from 1945 to 2018.

6.1.1 Air Temperature

Over the period of record at Coffee Creek (2012-2021), measured average annual temperature is -2.2°C, and monthly average air temperatures range from -16.8°C (December) to +13.9°C (July) at 975 m while the hourly minimum and maximum air temperatures recorded are -38.2°C (measured January 2020) and the maximum temperature is 29.7°C (June 2017). At the Kona station (1,340 m), measured average annual temperature is -2.6°C, and monthly average air temperatures range from -15.4°C (January) to +11.7°C (July), while the hourly minimum and maximum air temperatures recorded are -36.2°C (measured February 2021) and the maximum temperature is 23.7°C (July 2021). During the summer months, the local lapse rate is -3.3°C/1000 m.

At the elevation of the Km 11 climate station, a notable departure from the regional temperature signal occurs during winter months. Valley bottom temperature inversions during winter months and ridgetop temperatures may be 10°C higher than measurements recorded at valley bottom stations with the lapse rate averaging 5.8°C/1000 m from October through April. These inversions result in a reversal of the normal lapse rate (decreasing

temperature with increasing elevation) and are commonly caused by cold Arctic air masses pooling in the valley bottoms from late October to early March.

6.1.2 Precipitation

The period of record mean annual precipitation (MAP) is 331 mm at the 975 m elevation, with 72% of this falling as rain, and 28% realized as snow. Based on the extended synthetic precipitation record, MAP at the proposed undertaking (~1,300 m above sea level) is estimated to be 504 mm, with 67% of this total precipitation realized as rain during the months of May through September, and the remaining 33% occurring as snow from October through March. This estimate of MAP combined site-measurements of rainfall and snow accumulation assessed along with regional precipitation data (*i.e.*, from Federal/State weather stations, snow courses, snow pillows).

It is common in areas with high topographic relief for precipitation amounts (annual, low-frequency/high-magnitude events, *etc*.) to increase with elevation due to orographic effects - primarily cooling of the air mass as it is forced upward by topography and subsequent condensation of the entrained water vapour. Precipitation gradients were ascertained through an inspection of site and regional precipitation data and were established at Coffee Creek as follows: 4%/100 m elevation gain for rainfall; and 7%/100 m elevation gain for snow.

Recurrence interval estimates for rainfall (various durations), annual maximum SWE and snowmelt rates are presented in Section 4.4. The 24-hour duration rainfall events are estimated to be 67 mm for the 1:10-year event and 98 mm for the 1:100-year event. The 1:100-year annual maximum SWE at 1,300 m is estimated to be 272 mm, and maximum daily snowmelt rates are estimated to lie between 30-50 mm/day based on regional snow pillow data. Finally, the Probable Maximum Precipitation for a 24-hour duration at 1,300 m informs the design criteria for the HLF event ponds, and is estimated to be 283 mm, or 56% of the MAP value.

6.1.3 Potential Evaporation

Annual potential evaporation (PE) for the Project area is estimated to be 460-480 mm with monthly rates being highest in May, June, July, and August and considerably lower for autumn, winter, and spring months. Consistent with other studies in the Yukon, the evapotranspiration estimate for the Coffee Gold site is roughly 40% of the assumed PE value or 170 mm per year. At a daily time-step, average evapotranspiration rates are highest in May, June, and July and roughly 3.0 mm/day.

6.2 Hydrometric Monitoring

Gauged watersheds at the Coffee Creek site range in size from ~3 to 500 km^2, with nine of these having drainage areas of less than 25 km^2. In addition to capturing a range of drainage areas, the watersheds gauged for the baseline hydrology study differ in elevation characteristics (*i.e.,* mean catchment elevations range 800 to 1,300 m asl) and represent varying aspects as well. Mean elevation, basin area, a detailed basin map, aspect and hypsometry information are presented per hydrometric station in Appendix C.

Twelve of the surface water monitoring stations at the property are instrumented with metric staff gauges and continuously recording water level recorders set in stilling wells. These stations allow high-resolution (*i.e.*, 15-minute) data records at each site. Streamflow was measured several different ways for this study, including: Wading with a current meter, salt dilution gauging, using an acoustic Doppler current profiler, and slope-area approaches. Rating curves are well constrained, with all but one of the stations (YT24-4.9) based on 10 or more paired stage:discharge measurements, and a site-wide average error of -2%.

In similar fashion to the derivation of the synthetic climate dataset, the site hydrometric data were extended using a piece-wise ranked regression approach, based on the Big Creek (WSC; 09AH003) streamflow record. This allowed daily streamflow time-series to be derived for eleven of the Project site stations, which were then used to generate recurrence interval estimates of mean annual runoff and summer low-flows.

6.2.1 Local Streamflow Measurements

At Coffee Creek, patterns of streamflow are dominated by a snowmelt freshet that typically occurs between late April and early June. Following freshet, patterns of streamflow are punctuated by several rainfall-induced runoff events which occur throughout the summer and autumn. In general, these high flow events are short duration, typically persisting for a 1 or 2-day time period. Flows in local creeks and streams abate in October in response to freezing temperatures and it is notable that local watersheds typically experience zero flow conditions throughout the winter (*i.e.,* November through end March). Aufeis (*i.e.,* frozen groundwater seepage that accumulates within- and adjacent to- local watercourses) is common in creeks and streams at the Project site and melts during the freshet but may persist into the early summer.

Based on measurements at Coffee Creek hydrometric stations, average unit yields across the Project site are 10.6 L/s/km^2 for the open water season (May to October) and range from 4 to 16 L/s/km^2, with specifics of the runoff regime for each monitoring station being dependent on drainage characteristics (*i.e.,* basin area, shape, mean elevation, extent of

permafrost, *etc.*). Unit yields range from 2.0 - 5.1 L/s/km^2 in October and decrease steadily to annual minima in March (*i.e.,* 0 - 0.7 L/s/km^2), before increasing again in April in response to low-elevation snow melt and spring rains. At Coffee Creek, instantaneous peak flows, expressed as unit yields, are typically between 120 and 200 L/s/km^2, but measurements vary widely across the site (from 60 to >300 L/s/km^2).

6.2.2 Mean Annual Runoff

Based on the measured streamflow data and the synthetic streamflow records, MAR varied by roughly a factor of four in Project site basins (from 48 mm to 205 mm) and when regressed against mean basin elevation (m), basin area (km^2) and dominant aspect within the drainage, showed strong correlation with elevation, and indicate that MAR increases an average of 7%/100 m, which is comparable to the average annual orographic precipitation gradient of 6%/100 m. Results of the annual runoff recurrence interval analysis indicate that the spread between the 1:200 dry- and wet-years is substantial in the Project area drainages, and generally, an extreme wet-year are expected to produce ten times more runoff than an extreme dry-year.

6.2.3 Instantaneous Peak Flows

At Coffee Creek, instantaneous peak flows, expressed as unit yields, are typically between 120 and 200 L/s/km^2, but measurements range widely across the site (from 60 to >300 L/s/km^2). Recurrence interval estimates of annual instantaneous peak flows from a suite of regional records were plotted against drainage area, and an enveloping power law function was then fit to the data. The enveloping power law functions derived from the regional data for each recurrence interval (*e.g.*, 1:100-year peak flow) were used to estimate the corresponding peak flow for all Project drainages. The results of this analysis indicate that the 1:100-year instantaneous peak flow is expected to generate unit yield flows of 327 L/s/km^2 for a basin of 100 km^2.

6.2.4 Summer and Annual Low Flows

Following freshet, baseflows in the lower reaches of the Project site creeks are enhanced by active layer melt and soil moisture recharge. At the upper elevation stations (*e.g.*, LC-15.5) and those situated in alluvial deposits (*e.g.*, LCT20-0.1) effective yields can drop to near zero flow conditions. Summer (June-September) low flow estimates were derived based on a combination of regional and synthetic site records. Based on the regional stations assumed most representative of Project site conditions, the analysis returned summer 7Q$_{10}$ yields that range from 0.7 to 1.11 L/s/km^2. A parallel analysis conducted using the synthetic streamflow data returned estimated summer 7Q$_{10}$ values for the Project

stations ranging from 0.04 to 0.78 L/s/km^2 (Table 5-11). The summer 7Q_{10} low flow value based on an average of the eleven Project station synthetic records is 0.34 L/s/km^2.

Site data show that yields range from 2.0 – 5.1 L/s/km^2 in October and decrease steadily to their annual minima by March (0 – 0.7 L/s/km^2), before increasing again in April in response to low-elevation snow melt and spring rainfall. Based on the site data alone, winter low flows are expected to range from 0 to 0.7 L/s/km^2

An important component of the winter flow regime at the Project site is the extensive icing of the local channels. This ice growth, or aufeis, is the result of shallow groundwater discharge and/or baseflow in the stream channel freezing. This ice impedes subsequent flow, which is forced on top of the existing ice sheet, where it freezes. This process repeats continuously throughout the winter, and results in laminated ice sheets that can approach 2 m in thickness and 50+ m in width in the Project channels.

7. Closure

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We trust that this plan meets your requirements at this time. Please contact us should you have any questions or concerns or require additional information in support of this work.

Yours sincerely,
Lorax Environmental Services

Prepared By:

Scott Jackson, M.Sc., P.Geo.
Senior Hydrologist
Lorax Environmental Services Ltd.

Reviewed By:

Colin Fraser, M.Sc., P.Geo.
Senior Hydrologist
Lorax Environmental Services Ltd.

Professional Geoscientists BC Certificate of Authorization Number: 1001840

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Appendix A: Synthetic Climate Data, Coffee Gold Project

A1. AIR TEMPERATURE

A2. PRECIPITATION

Newmont™
COFFEE

Table A1.1:
Monthly average minimum air temperature from synthetic climate record for 1,300 m elevation.

Average Minimum Air Temperature (°C)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1945	-7.9	-9.5	-10.6	-7.8	0.1	5.2	8.2	7.6	1.7	-1.4	-20.8	-14.9
1946	-11.5	-11.1	-12.2	-2.6	2.3	8.4	8.6	5.5	1.2	-1.7	-18.1	-25.5
1947	-19.1	-15.7	-3.4	-2.2	2.4	4.7	8.6	4.3	1.5	-0.2	-5.8	-8.2
1948	-8.3	-17.6	-13.5	-6.4	2.0	6.9	8.6	5.0	0.8	-0.2	-15.5	-24.8
1949	-16.0	-23.0	-8.0	-2.2	0.3	5.5	7.8	7.0	3.6	-1.7	-3.8	-20.6
1950	-18.4	-22.6	-8.0	-4.3	2.0	8.3	8.8	5.3	2.0	-2.3	-25.1	-13.0
1951	-21.0	-19.6	-17.3	-1.2	2.0	5.4	8.1	7.2	3.7	-8.4	-12.0	-21.5
1952	-25.3	-8.3	-11.3	-3.6	0.4	6.1	8.8	6.9	1.4	0.8	-4.4	-13.6
1953	-20.4	-9.7	-13.9	0.7	3.2	7.2	7.7	7.0	1.5	-2.5	-10.3	-10.4
1954	9.9	-20.9	-11.0	-9.2	0.7	5.2	8.3	6.2	-0.6	-2.7	-7.8	-21.3
1955	-8.7	-15.8	-13.1	-3.4	1.0	5.0	8.3	6.3	0.1	-3.0	-24.0	-23.9
1956	-21.2	-18.0	-15.1	-3.4	1.8	6.0	8.2	8.2	-0.5	-5.7	-15.0	-26.3
1957	-15.4	-16.3	-10.7	-4.5	1.2	6.1	7.7	8.2	1.8	-2.9	-6.7	-18.4
1958	-8.2	-17.3	-11.7	0.2	2.1	8.0	9.4	6.7	0.1	-8.6	-14.6	-15.8
1959	-26.3	-12.7	-17.3	-5.1	0.0	5.7	7.1	3.1	1.4	-6.7	-15.2	-15.6
1960	-12.6	-9.1	-14.5	-3.3	1.8	5.4	8.0	6.3	1.3	-0.9	-15.1	-11.0
1961	-10.1	-14.8	-14.9	-6.9	2.8	6.2	8.9	6.6	0.9	-4.3	-17.9	-28.4
1962	-17.3	-11.6	-14.7	-3.0	0.4	5.3	8.8	9.3	0.2	1.0	-9.1	-14.6
1963	-10.1	-9.7	-14.0	-3.0	1.5	4.9	8.5	6.6	2.7	1.1	-17.6	-10.0
1964	-16.9	-10.5	-17.1	-5.2	-3.2	6.8	7.7	6.9	1.2	1.7	-13.6	-30.8
1965	-20.7	-21.7	-4.8	-2.3	-0.3	5.2	8.8	6.5	2.4	-5.7	-19.2	-18.1
1966	-30.0	-12.0	-14.2	-5.1	0.8	6.2	7.2	4.8	1.7	-4.5	-18.8	-19.6
1967	-18.5	-15.1	-14.9	-4.5	-0.2	7.0	7.9	8.2	1.5	-1.0	-12.2	-15.8
1968	-18.3	-13.4	-7.6	-2.8	1.5	6.7	8.5	6.7	0.6	-2.9	-11.4	-25.9
1969	-26.5	-15.7	-10.8	1.3	1.1	7.6	7.4	2.4	0.7	-1.2	-14.0	-10.0
1970	-17.3	-9.4	-4.1	-2.4	1.2	6.4	8.0	6.7	-0.2	-5.5	-13.0	-20.1
1971	-30.0	-13.1	-16.8	-3.6	1.1	6.6	8.3	6.9	1.2	-4.2	-15.2	-22.1
1972	-24.5	-23.0	-17.6	-10.8	-0.5	6.4	8.0	7.8	-0.8	-5.4	-12.5	-19.3
1973	-22.5	-18.5	-9.5	-0.9	1.6	6.3	8.4	6.4	0.2	-2.6	-24.2	-17.1
1974	-24.0	-18.8	-15.1	-3.6	-1.2	4.9	7.9	6.3	0.7	-3.6	-12.3	-13.1
1975	-17.9	-18.6	-10.8	-0.9	2.6	7.2	9.9	5.7	2.3	-2.3	-21.8	-25.5
1976	-15.5	-20.0	-12.2	-0.8	2.2	6.1	9.6	7.7	1.8	-3.0	-7.2	-16.5
1977	-5.1	-4.5	-10.8	-1.3	2.4	7.1	7.9	8.3	1.8	-1.6	-21.4	-23.9
1978	-12.1	-13.9	-9.8	-2.4	2.1	6.0	9.1	6.1	3.3	-5.4	-17.9	-14.7
1979	-18.8	-33.2	-10.9	-4.6	0.7	4.6	8.7	5.6	0.7	0.6	-7.8	-20.7
1980	-22.0	-10.9	-9.9	1.4	2.1	6.4	6.7	4.4	-0.9	0.0	-9.2	-31.1
1981	-0.9	-11.0	-5.7	-6.6	3.6	3.1	7.4	5.0	-0.2	-1.3	-8.2	-14.9
1982	-27.5	-19.1	-14.5	-3.3	0.4	5.7	7.4	4.1	0.3	-8.3	-17.1	-13.8

Average Minimum Air Temperature (°C)													
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	
1983	-18.5	-11.8	-14.5	-0.2	0.4	6.5	8.1	5.5	-3.5	-5.7	-11.2	-25.9	
1984	-13.6	-13.9	-3.0	1.7	0.8	5.2	7.0	3.2	-1.9	-5.9	-14.8	-22.3	
1985	-2.4	-20.1	-10.7	-6.8	-0.4	3.9	6.4	3.7	-0.8	-5.4	-23.8	-9.0	
1986	-6.3	-14.2	-12.3	-8.4	0.5	5.0	7.2	4.2	-1.6	-4.1	-23.5	-13.2	
1987	-11.6	-10.3	-13.2	-1.9	0.8	5.6	8.2	4.3	0.0	0.0	-9.6	-14.5	
1988	-15.6	-14.0	-5.6	-1.4	2.3	5.9	7.5	5.4	-1.1	-7.2	-16.2	-13.9	
1989	-20.2	-17.0	-18.5	-1.1	2.2	6.6	7.6	6.0	0.2	-6.2	-20.1	-12.0	
1990	-17.7	-24.9	-7.9	-0.2	2.1	6.5	7.5	6.7	1.6	-4.8	-24.8	-22.0	
1991	-15.6	-11.1	-10.2	-0.2	1.9	5.3	6.6	4.6	1.6	-7.6	-17.1	-20.8	
1992	-7.8	-13.8	-5.6	-3.7	0.8	5.9	8.3	6.3	-6.7	-8.5	-12.1	-22.3	
1993	-17.6	-13.8	-8.3	0.9	2.1	5.1	7.3	6.1	-0.1	-1.4	-14.9	-12.6	
1994	-17.5	-20.5	-7.2	0.2	1.6	5.4	8.3	7.4	-0.2	-2.0	-16.5	-20.7	
1995	-12.0	-12.6	-13.6	2.7	2.4	7.9	8.2	4.7	2.7	-1.5	-22.9	-19.8	
1996	-22.6	-13.0	-12.2	-3.0	-0.4	4.3	7.0	4.9	-2.0	-11.9	-20.9	-23.0	
1997	-20.8	-7.9	-17.1	-3.3	1.3	6.2	8.8	7.1	0.8	-9.6	-11.7	-12.4	
1998	-14.0	-9.3	-9.1	1.2	2.9	6.6	7.9	5.0	0.9	-5.4	-12.5	-18.4	
1999	-18.7	-16.9	-9.6	0.1	0.0	7.3	7.7	7.0	0.7	-3.8	-15.2	-15.3	
2000	-16.6	-4.4	-4.6	-4.3	0.9	6.9	8.9	3.9	-0.2	-4.6	-9.8	-17.3	
2001	-6.4	-10.5	-9.2	-0.4	-0.2	6.1	8.2	6.9	0.7	-3.6	-13.6	-18.2	
2002	-10.0	-12.7	-16.5	-8.4	-0.2	5.5	7.2	5.3	0.6	1.4	-4.4	-5.5	
2003	-10.2	-7.5	-12.1	-3.4	-0.2	4.7	8.7	5.1	-2.6	-1.7	-17.8	-17.3	
2004	-20.2	-9.3	-12.8	-0.7	1.0	8.2	8.6	4.6	-2.7	-2.8	-13.5	-15.6	
2005	-16.1	-13.0	-4.4	-0.8	4.8	5.3	6.1	5.2	2.7	-0.3	-16.4	-11.6	
2006	-11.8	-10.6	-16.0	-2.1	0.7	6.4	7.5	5.9	1.6	-3.5	-26.1	-14.5	
2007	-11.9	-20.4	-19.3	-0.5	2.2	7.1	8.9	5.8	0.1	-4.8	-9.9	-16.0	
2008	-14.4	-17.1	-10.1	-1.1	1.5	5.2	7.0	4.4	0.5	-5.0	-13.0	-22.9	
2009	-17.8	-16.2	-15.2	-2.5	0.6	5.6	6.2	6.3	1.4	-1.7	-16.2	-12.4	
2010	-11.1	-9.6	-7.4	1.7	0.9	7.3	8.6	6.3	-1.0	-2.5	-10.3	-20.6	
2011	-16.4	-15.8	-16.6	-2.4	2.5	6.9	8.4	5.1	1.1	-1.4	-20.4	-13.2	
2012	-19.0	-7.6	-11.6	0.2	1.4	7.5	7.7	5.3	2.4	-8.5	-23.7	-24.3	
2013	-12.4	-9.1	-14.0	-10.7	-0.1	7.6	8.5	7.4	1.4	0.3	-18.3	-22.2	
2014	-4.6	-18.7	-15.1	-2.9	2.2	5.5	8.7	7.0	-0.1	-1.6	-13.2	-10.4	
2015	-9.7	-11.7	-8.4	1.4	3.0	5.5	7.4	5.4	0.5	1.4	-13.5	-9.3	
2016	-3.3	-7.3	-2.4	3.6	2.7	6.7	10.1	7.6	0.2	-9.1	-14.0	-18.6	
2017	-13.7	-13.7	-18.0	-1.1	2.8	5.8	9.5	7.5	3.0	-1.1	-21.9	-12.8	
2018	-11.7	-17.2	-8.5	-3.7	2.1	7.1	8.4	5.3	-3.8	-6.2	-15.7	-21.2	
2019	-12.8	-17.6	-3.2	0.5	4.5	7.1	10.5	4.5	1.0	-1.6	-12.9	-15.5	
2020	-19.6	-17.5	-12.1	-3.5	2.8	7.1	7.7	7.7	2.8	-5.0	-21.9	-17.0	

Table A1.2:
Monthly average air temperature from synthetic climate record for 1,300 m elevation.

Average Air Temperature (°C)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1945	-5.7	-7.6	-7.4	-4.2	4.2	9.0	10.9	10.5	3.7	0.6	-19.1	-12.7
1946	-9.2	-9.4	-9.8	0.2	6.0	13.4	12.9	9.7	4.2	-0.1	-16.8	-23.7
1947	-16.6	-14.2	-1.5	0.3	6.0	8.5	13.0	7.7	3.6	1.4	-4.4	-5.9
1948	-5.9	-15.9	-11.8	-3.8	5.5	10.9	12.2	8.3	3.2	2.0	-13.8	-21.9
1949	-12.4	-21.0	-5.8	1.0	3.4	8.0	11.8	11.0	6.9	0.8	-2.6	-18.4
1950	-14.8	-20.4	-5.8	-0.4	5.4	13.0	12.5	10.5	5.4	-0.9	-23.0	-10.5
1951	-18.5	-17.7	-14.9	1.8	5.9	9.1	12.8	11.6	6.4	-6.1	-10.3	-17.7
1952	-22.2	-6.6	-9.3	-0.4	3.0	10.7	12.1	9.7	3.1	2.8	-2.5	-11.7
1953	-18.7	-6.8	-10.2	3.9	6.5	11.6	12.2	10.1	4.0	-0.4	-9.4	-8.6
1954	11.4	-18.8	-7.9	-5.4	4.8	9.8	11.8	10.9	3.3	0.0	-6.1	-19.1
1955	-5.6	-13.9	-10.6	-0.6	3.7	8.5	12.9	9.0	3.5	-0.3	-22.5	-21.5
1956	-18.1	-16.2	-12.6	0.3	5.2	9.4	12.0	10.3	2.3	-4.4	-12.4	-24.4
1957	-13.0	-13.7	-8.4	-0.6	3.8	11.1	11.7	13.0	4.6	-0.8	-5.4	-16.3
1958	-5.1	-15.6	-9.3	3.8	5.1	12.1	12.7	10.5	3.6	-6.4	-12.9	-14.2
1959	-24.0	-10.5	-13.9	-1.9	3.1	10.6	9.6	7.7	3.2	-3.5	-13.0	-13.3
1960	-9.9	-6.7	-12.4	0.5	6.3	9.7	11.2	9.9	3.4	0.7	-13.2	-7.7
1961	-8.0	-12.4	-11.9	-3.3	6.5	10.1	12.1	10.0	3.9	-2.4	-16.3	-25.8
1962	-13.5	-9.0	-12.1	-0.2	3.3	8.9	12.1	12.0	3.2	2.4	-7.5	-12.0
1963	-7.5	-7.5	-11.3	0.4	5.4	7.9	11.7	11.2	5.2	2.4	-16.4	-7.6
1964	-13.8	-8.7	-14.5	-2.1	-0.3	10.3	10.8	9.9	4.0	2.8	-12.1	-28.5
1965	-18.0	-19.2	-2.6	0.6	3.1	8.7	12.1	9.9	5.2	-3.6	-17.0	-14.8
1966	-28.4	-10.0	-11.5	-1.1	3.3	10.7	12.0	9.2	5.3	-2.3	-17.0	-17.5
1967	-15.6	-12.9	-11.8	-0.6	3.3	11.1	11.5	11.5	4.8	0.9	-10.2	-13.5
1968	-14.8	-11.7	-4.5	0.4	4.6	10.4	12.9	10.8	3.6	-1.1	-9.3	-23.4
1969	-25.0	-13.5	-8.5	3.7	4.5	13.2	11.0	6.4	4.4	1.5	-12.0	-7.8
1970	-14.7	-7.6	-2.2	0.5	4.3	9.3	11.8	9.8	1.5	-3.6	-10.7	-16.8
1971	-27.5	-11.0	-13.5	-1.3	4.3	11.4	12.2	10.2	3.5	-2.3	-13.1	-19.1
1972	-21.9	-20.5	-14.7	-5.9	3.4	10.4	12.3	11.5	1.5	-3.3	-10.6	-16.7
1973	-19.6	-16.1	-7.2	1.7	5.1	9.9	12.1	9.1	4.2	-1.1	-22.5	-14.5
1974	-21.5	-16.9	-12.5	0.6	3.7	9.1	11.9	9.8	5.2	-2.0	-10.5	-11.0
1975	-15.5	-15.9	-8.1	1.2	5.9	11.0	13.8	10.0	4.6	-0.5	-19.6	-22.3
1976	-12.7	-16.3	-8.7	2.9	5.7	10.6	13.5	12.2	5.9	-1.0	-5.4	-13.5
1977	-3.0	-2.5	-7.7	1.7	5.8	10.6	12.3	13.2	4.9	0.5	-19.1	-22.2
1978	-9.2	-10.7	-6.7	1.8	5.8	9.4	13.9	11.4	6.6	-2.6	-15.2	-12.0
1979	-15.6	-29.2	-8.7	-0.5	4.9	9.2	12.2	11.2	4.7	3.0	-3.9	-17.3
1980	-17.2	-6.4	-6.7	4.1	6.6	10.9	11.1	8.9	1.8	3.0	-6.5	-29.3
1981	3.4	-8.1	-2.2	-2.2	7.9	7.7	10.5	9.4	3.0	0.4	-6.0	-12.2
1982	-25.3	-15.5	-10.9	-0.7	3.2	10.0	12.2	9.2	4.7	-5.4	-15.0	-11.0
1983	-15.3	-9.3	-10.8	3.3	4.5	10.7	12.4	9.0	0.3	-3.0	-9.5	-24.3

Average Air Temperature (°C)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1984	-10.2	-10.8	-1.0	4.1	4.8	10.0	10.5	8.1	3.4	-2.6	-13.1	-18.8
1985	0.9	-16.7	-7.0	-3.3	3.3	8.2	11.0	8.2	2.4	-3.7	-21.0	-6.5
1986	-3.2	-11.2	-9.4	-4.5	3.8	10.2	12.2	8.5	3.7	-1.0	-20.5	-10.1
1987	-7.5	-7.6	-9.4	1.2	4.8	9.7	12.1	9.2	3.5	2.2	-7.5	-11.4
1988	-13.1	-10.7	-3.1	2.4	6.0	10.9	12.1	9.7	3.3	-4.0	-14.0	-10.0
1989	-17.1	-13.3	-14.0	3.6	6.2	10.8	13.2	12.3	4.0	-2.4	-17.4	-8.6
1990	-15.2	-21.5	-4.6	3.9	6.7	10.8	12.8	10.7	4.2	-2.4	-22.5	-18.7
1991	-11.8	-8.7	-7.2	4.0	6.4	10.7	11.1	8.1	5.1	-4.5	-14.2	-16.2
1992	-4.8	-10.9	-3.2	-0.2	3.1	10.7	12.6	9.8	-3.3	-5.6	-9.3	-19.2
1993	-13.6	-9.9	-4.6	4.7	6.3	10.5	12.4	10.2	3.5	0.9	-12.5	-9.2
1994	-14.4	-17.6	-4.7	3.6	5.6	9.8	13.1	12.8	3.0	0.0	-14.5	-17.5
1995	-9.6	-9.0	-10.2	6.1	6.9	12.1	12.1	9.3	7.5	0.6	-20.7	-16.6
1996	-20.8	-9.0	-8.0	1.9	3.9	9.2	12.5	8.8	2.4	-7.9	-19.2	-20.3
1997	-17.3	-5.3	-12.9	1.2	5.2	10.3	13.2	10.8	5.5	-5.7	-8.5	-9.2
1998	-11.3	-6.9	-5.7	4.7	7.0	10.9	12.9	9.4	4.3	-2.0	-10.7	-15.3
1999	-15.7	-13.8	-6.7	2.9	3.7	12.1	12.0	11.5	4.1	-1.2	-12.4	-12.2
2000	-13.2	-2.3	-2.0	-0.3	3.9	11.2	12.2	7.8	2.3	-2.1	-7.6	-13.8
2001	-1.5	-7.4	-5.8	2.3	3.2	11.1	11.8	11.5	5.2	-1.2	-12.0	-14.8
2002	-6.4	-9.1	-11.4	-3.5	4.5	9.9	11.8	8.6	4.6	3.5	-2.6	-3.5
2003	-6.8	-5.0	-8.4	1.5	3.9	9.5	12.8	9.6	0.8	1.7	-15.2	-13.6
2004	-18.1	-6.1	-9.5	2.9	5.9	14.4	13.1	11.0	0.9	-0.8	-11.3	-12.9
2005	-12.5	-10.2	-1.8	3.1	8.7	10.8	10.7	10.0	5.4	1.6	-14.3	-8.5
2006	-9.1	-6.8	-12.2	0.7	5.1	10.8	12.4	9.7	5.3	-0.3	-24.0	-10.4
2007	-8.2	-17.6	-15.9	3.2	6.2	12.1	13.5	11.3	3.6	-2.4	-7.6	-13.5
2008	-11.7	-13.9	-7.2	2.2	5.6	9.9	10.2	8.0	3.9	-2.8	-10.7	-20.1
2009	-14.7	-13.1	-12.4	1.3	5.7	10.5	12.5	9.8	5.2	0.8	-12.8	-9.8
2010	-8.4	-6.2	-4.0	4.7	6.5	10.8	12.3	10.8	3.6	-0.2	-7.9	-17.8
2011	-12.8	-12.8	-12.3	1.1	6.7	10.5	11.7	9.3	5.0	1.1	-17.9	-9.3
2012	-15.6	-3.4	-9.1	4.0	4.7	11.7	11.4	10.2	5.7	-5.5	-21.7	-22.0
2013	-9.4	-6.4	-10.4	-5.8	3.9	12.9	13.3	12.3	4.1	2.2	-15.2	-18.7
2014	-1.6	-15.2	-9.5	1.4	6.7	9.6	11.8	10.4	3.6	-0.1	-11.3	-7.5
2015	-8.0	-9.7	-5.5	4.1	9.1	10.3	11.1	8.9	3.6	2.5	-10.9	-7.1
2016	-0.9	-4.0	-0.2	6.5	7.1	11.0	12.8	11.5	4.6	-4.7	-11.5	-15.8
2017	-9.9	-10.6	-14.0	2.5	6.3	10.7	13.8	11.8	6.2	0.9	-19.4	-10.3
2018	-8.4	-14.6	-5.3	0.1	6.0	10.8	13.2	10.9	3.6	-0.1	-12.1	-16.9
2019	-10.1	-14.2	0.6	4.3	9.8	12.0	14.6	8.7	5.8	0.2	-10.2	-13.2
2020	-16.9	-14.0	-8.6	0.6	8.3	10.5	11.1	11.2	5.4	-2.4	-18.4	-13.4

Table A1.3:
Monthly average maximum air temperature from synthetic climate record for 1,300 m elevation.

Average Maximum Air Temperature (°C)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1945	-3.4	-5.7	-4.3	-0.6	8.3	12.7	13.7	13.4	5.7	2.6	-17.5	-10.5
1946	-6.9	-7.8	-7.5	3.1	9.7	18.4	17.2	13.9	7.2	1.6	-15.5	-21.9
1947	-14.2	-12.7	0.3	2.8	9.6	12.3	17.4	11.1	5.6	2.9	-3.0	-3.6
1948	-3.4	-14.1	-10.1	-1.2	8.9	14.9	15.7	11.7	5.6	4.2	-12.1	-18.9
1949	-8.7	-19.0	-3.5	4.2	6.6	10.5	15.7	15.1	10.2	3.2	-1.4	-16.1
1950	-11.3	-18.2	-3.5	3.6	8.8	17.7	16.3	15.8	8.9	0.5	-20.8	-8.0
1951	-15.9	-15.8	-12.5	4.8	9.8	12.9	17.6	16.1	9.1	-3.9	-8.5	-14.0
1952	-19.2	-5.0	-7.3	2.9	5.7	15.2	15.4	12.4	4.9	4.7	-0.6	-9.7
1953	-17.0	-3.8	-6.4	7.1	9.8	16.0	16.7	13.3	6.5	1.6	-8.5	-6.8
1954	13.0	-16.6	-4.8	-1.5	9.0	14.4	15.3	15.7	7.3	2.6	-4.3	-16.9
1955	-2.4	-12.1	-8.0	2.1	6.4	12.1	17.4	11.8	6.9	2.3	-21.0	-19.1
1956	-15.0	-14.4	-10.2	3.9	8.6	12.8	15.8	12.3	5.2	-3.2	-9.9	-22.4
1957	-10.6	-11.1	-6.1	3.3	6.5	16.0	15.6	17.8	7.4	1.3	-4.0	-14.2
1958	-2.0	-13.8	-6.9	7.3	8.2	16.3	15.9	14.3	7.1	-4.2	-11.1	-12.5
1959	-21.7	-8.3	-10.5	1.3	6.3	15.4	12.0	12.4	5.0	-0.3	-10.9	-10.9
1960	-7.2	-4.4	-10.3	4.2	10.8	13.9	14.5	13.6	5.6	2.3	-11.2	-4.4
1961	-5.9	-10.0	-9.0	0.2	10.2	13.9	15.2	13.4	6.9	-0.4	-14.8	-23.3
1962	-9.6	-6.4	-9.5	2.6	6.2	12.5	15.4	14.6	6.3	3.8	-5.9	-9.4
1963	-4.9	-5.4	-8.5	3.8	9.4	10.8	15.0	15.7	7.7	3.6	-15.3	-5.3
1964	-10.6	-6.8	-12.0	1.0	2.6	13.8	14.0	13.0	6.8	3.9	-10.6	-26.3
1965	-15.4	-16.7	-0.3	3.5	6.5	12.2	15.3	13.4	8.0	-1.6	-14.8	-11.5
1966	-26.9	-8.0	-8.9	3.0	5.9	15.2	16.7	13.6	8.9	-0.1	-15.2	-15.5
1967	-12.7	-10.7	-8.7	3.4	6.8	15.2	15.0	14.8	8.2	2.7	-8.3	-11.3
1968	-11.3	-10.0	-1.4	3.6	7.7	14.1	17.3	14.9	6.6	0.8	-7.1	-20.9
1969	-23.4	-11.4	-6.1	6.1	7.9	18.9	14.5	10.4	8.2	4.2	-10.1	-5.5
1970	-12.1	-5.9	-0.2	3.4	7.4	12.3	15.7	12.9	3.3	-1.7	-8.5	-13.5
1971	-24.9	-8.8	-10.2	1.0	7.5	16.1	16.1	13.5	5.8	-0.3	-10.9	-16.2
1972	-19.2	-18.1	-11.7	-1.1	7.2	14.3	16.5	15.1	3.9	-1.2	-8.6	-14.1
1973	-16.7	-13.6	-4.9	4.3	8.6	13.5	15.8	11.8	8.1	0.4	-20.8	-11.8
1974	-19.0	-15.1	-9.9	4.8	8.5	13.3	15.9	13.3	9.6	-0.3	-8.8	-9.0
1975	-13.2	-13.2	-5.4	3.4	9.1	14.8	17.7	14.3	7.0	1.2	-17.5	-19.1
1976	-10.0	-12.6	-5.2	6.6	9.2	15.2	17.4	16.8	10.1	1.0	-3.6	-10.6
1977	-0.9	-0.5	-4.6	4.8	9.1	14.1	16.8	18.2	8.0	2.6	-16.8	-20.6
1978	-6.3	-7.4	-3.6	6.0	9.5	12.9	18.7	16.7	10.0	0.3	-12.5	-9.3
1979	-12.5	-25.2	-6.5	3.5	9.1	13.8	15.7	16.9	8.6	5.5	-0.1	-13.9
1980	-12.5	-1.9	-3.4	6.9	11.1	15.4	15.5	13.5	4.4	6.0	-3.8	-27.4
1981	7.7	-5.1	1.3	2.2	12.2	12.3	13.5	13.8	6.1	2.1	-3.8	-9.5
1982	-23.2	-12.0	-7.2	2.0	6.1	14.3	17.0	14.3	9.2	-2.5	-12.9	-8.3

Average Maximum Air Temperature (°C)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1983	-12.2	-6.8	-7.1	6.9	8.6	15.0	16.6	12.5	4.1	-0.4	-7.7	-22.7
1984	-6.8	-7.7	0.9	6.5	8.8	14.9	14.0	13.1	8.6	0.7	-11.3	-15.2
1985	4.3	-13.4	-3.4	0.1	6.9	12.4	15.6	12.7	5.6	-2.0	-18.2	-4.1
1986	-0.1	-8.1	-6.5	-0.6	7.0	15.5	17.2	12.7	9.1	2.2	-17.5	-7.0
1987	-3.4	-5.0	-5.5	4.3	8.8	13.9	16.1	14.1	6.9	4.5	-5.4	-8.3
1988	-10.6	-7.4	-0.5	6.1	9.6	15.8	16.7	13.9	7.7	-0.9	-11.8	-6.0
1989	-14.0	-9.5	-9.5	8.2	10.3	15.1	18.8	18.5	7.8	1.3	-14.7	-5.2
1990	-12.6	-18.2	-1.3	7.9	11.2	15.1	18.1	14.7	6.9	-0.1	-20.2	-15.4
1991	-8.0	-6.3	-4.2	8.1	10.8	16.1	15.6	11.6	8.7	-1.5	-11.3	-11.5
1992	-1.7	-7.9	-0.8	3.2	5.4	15.6	16.8	13.3	0.1	-2.7	-6.6	-16.1
1993	-9.6	-6.1	-0.9	8.5	10.4	15.9	17.6	14.4	7.1	3.3	-10.1	-5.8
1994	-11.4	-14.6	-2.2	7.0	9.6	14.1	18.0	18.2	6.3	2.0	-12.6	-14.3
1995	-7.2	-5.5	-6.7	9.6	11.3	16.4	16.1	13.9	12.3	2.7	-18.5	-13.5
1996	-19.1	-4.9	-3.8	6.9	8.3	14.1	17.9	12.6	6.7	-3.9	-17.5	-17.6
1997	-13.7	-2.6	-8.8	5.8	9.1	14.3	17.5	14.6	10.3	-1.9	-5.3	-6.0
1998	-8.6	-4.5	-2.2	8.2	11.1	15.3	17.8	13.7	7.6	1.4	-8.9	-12.2
1999	-12.8	-10.6	-3.8	5.6	7.3	16.9	16.3	16.1	7.6	1.4	-9.6	-9.1
2000	-9.8	-0.1	0.5	3.6	6.8	15.6	15.4	11.7	4.9	0.4	-5.5	-10.4
2001	3.3	-4.2	-2.5	5.1	6.6	16.1	15.3	16.0	9.6	1.2	-10.5	-11.4
2002	-2.7	-5.4	-6.4	1.3	9.1	14.3	16.4	12.0	8.6	5.6	-0.8	-1.6
2003	-3.4	-2.6	-4.7	6.3	8.0	14.3	16.9	14.2	4.3	5.0	-12.5	-9.9
2004	-16.0	-2.8	-6.2	6.5	10.7	20.6	17.7	17.5	4.4	1.2	-9.0	-10.3
2005	-9.0	-7.5	0.8	7.1	12.7	16.3	15.3	14.9	8.1	3.5	-12.2	-5.5
2006	-6.3	-3.1	-8.4	3.6	9.4	15.2	17.3	13.4	9.1	2.8	-21.9	-6.4
2007	-4.4	-14.7	-12.5	6.8	10.1	17.1	18.1	16.7	7.0	0.0	-5.4	-11.0
2008	-8.9	-10.6	-4.4	5.5	9.6	14.6	13.4	11.6	7.2	-0.7	-8.5	-17.3
2009	-11.6	-10.0	-9.5	5.1	10.8	15.3	18.8	13.3	8.9	3.3	-9.4	-7.1
2010	-5.6	-2.9	-0.7	7.6	12.1	14.3	16.0	15.4	8.1	2.0	-5.5	-15.0
2011	-9.3	-9.8	-8.0	4.5	11.0	14.0	14.9	13.5	8.9	3.6	-15.4	-5.5
2012	-12.1	0.7	-6.6	7.8	8.0	15.8	15.1	15.2	9.1	-2.5	-19.7	-19.7
2013	-6.4	-3.8	-6.8	-0.9	7.9	18.2	18.0	17.1	6.9	4.0	-12.2	-15.3
2014	1.3	-11.7	-4.0	5.6	11.2	13.8	14.9	13.9	7.3	1.4	-9.4	-4.7
2015	-6.2	-7.6	-2.6	6.8	15.1	15.0	14.9	12.5	6.8	3.7	-8.3	-4.8
2016	1.6	-0.6	2.0	9.4	11.4	15.2	15.6	15.4	8.9	-0.3	-9.0	-13.1
2017	-6.2	-7.6	-10.0	6.2	9.8	15.5	18.2	16.0	9.4	2.8	-16.9	-7.9
2018	-5.0	-12.0	-2.1	3.9	9.8	14.5	18.0	16.5	11.1	6.1	-8.5	-12.5
2019	-7.1	-11.1	2.6	7.6	13.8	17.2	19.8	13.9	11.0	2.5	-8.0	-10.7
2020	-13.9	-10.8	-6.8	4.2	12.4	14.1	15.6	15.9	8.4	1.0	-15.2	-9.7

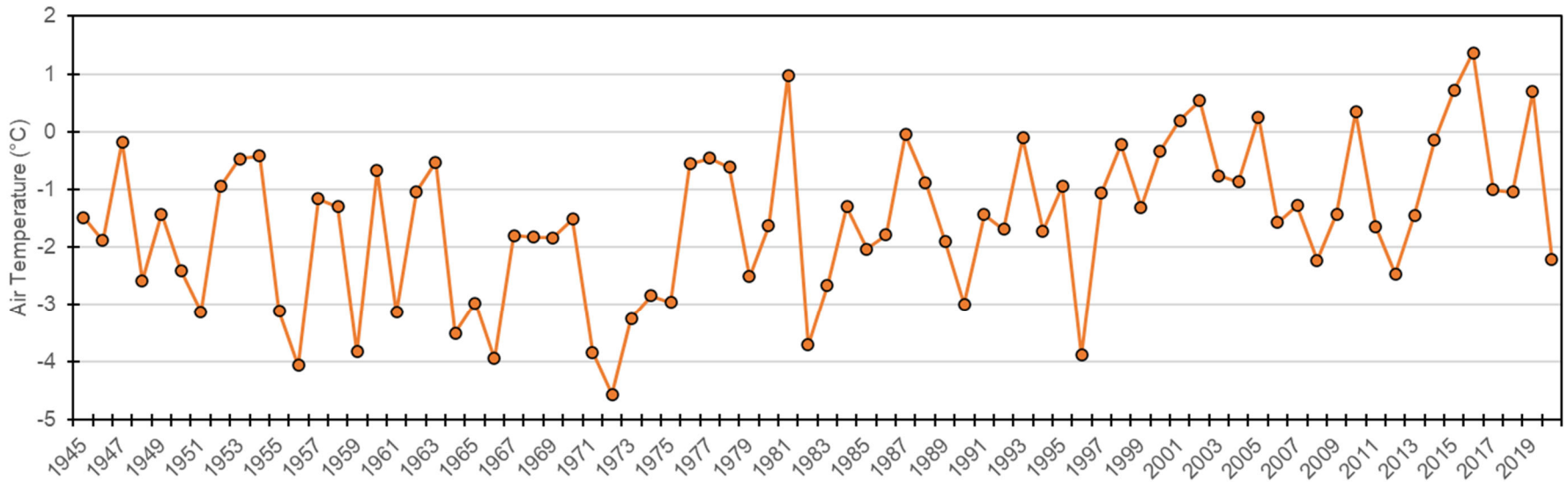

Figure A1.1: Synthetic mean annual temperature time-series for the Coffee Gold Project site (1,300 m).

Table A2.1:
Monthly precipitation from synthetic climate record for 1,300 m elevation.

Precipitation (mm)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1945	10.9	34.3	55.7	11.5	25.3	46.9	89.3	109.5	24.3	63.6	39.2	94.6
1946	25.7	67.0	61.5	7.5	48.5	17.6	42.5	109.6	25.3	58.7	68.1	46.9
1947	78.0	3.9	2.1	2.2	14.3	63.2	141.7	75.6	80.5	37.7	74.3	88.2
1948	38.1	19.5	2.1	13.5	23.6	87.3	74.5	56.9	45.4	49.9	110.1	64.4
1949	84.2	41.3	11.3	14.3	24.6	90.7	37.7	34.0	16.1	42.0	33.8	33.2
1950	60.4	42.2	45.4	0.7	59.0	4.0	83.4	7.1	40.8	26.6	75.2	60.8
1951	14.1	24.6	8.8	5.2	32.1	44.6	42.5	38.5	51.3	35.1	45.2	54.6
1952	27.2	40.5	30.4	10.9	42.2	66.1	81.8	56.0	54.6	29.3	18.8	57.8
1953	12.9	33.8	12.6	14.0	46.2	46.4	60.9	106.3	36.3	16.7	8.8	36.2
1954	18.6	13.7	10.1	8.6	24.9	46.2	53.4	45.9	11.4	89.3	43.0	93.8
1955	73.2	15.4	17.4	9.5	4.0	55.0	47.1	104.7	10.8	21.4	28.0	29.1
1956	15.6	20.1	8.6	4.5	28.7	37.4	143.4	83.7	34.7	86.5	48.6	19.1
1957	31.9	34.0	9.4	5.0	35.6	9.4	26.1	56.3	45.2	28.3	49.2	43.9
1958	35.1	18.6	2.6	5.0	43.8	67.3	158.6	119.1	13.0	87.6	12.2	40.1
1959	9.9	25.3	37.9	14.8	17.0	48.1	131.9	10.1	59.2	49.7	82.6	85.7
1960	61.5	26.5	29.3	10.9	15.8	35.1	121.7	47.8	43.2	33.6	65.7	35.5
1961	39.4	37.1	34.1	9.8	76.9	52.0	82.4	121.5	40.8	64.7	50.7	40.0
1962	39.0	65.1	8.3	54.6	23.2	80.1	86.3	95.5	20.0	30.0	43.0	57.4
1963	103.0	24.8	45.4	9.4	8.1	103.8	67.1	24.2	53.7	82.6	26.6	53.5
1964	38.1	30.4	8.6	19.9	28.5	81.4	84.0	57.0	20.0	68.7	28.9	51.8
1965	26.3	41.1	21.6	18.4	48.2	71.3	106.3	154.8	58.8	111.8	40.5	65.7
1966	4.7	41.1	24.4	18.1	39.9	45.4	11.7	50.3	30.5	46.9	74.9	25.5
1967	35.5	50.8	27.4	7.2	26.1	45.8	57.2	95.6	71.9	55.7	50.8	59.8
1968	63.6	19.3	6.2	18.1	39.2	76.9	62.6	48.2	14.4	31.0	45.6	20.3
1969	19.3	12.4	16.7	23.6	27.8	25.9	40.6	22.5	47.7	16.7	49.0	21.2
1970	20.3	62.3	21.6	21.9	36.0	90.0	55.9	74.9	71.0	69.6	60.0	86.7
1971	6.9	54.6	31.3	15.8	17.6	35.4	63.5	45.1	65.5	58.0	28.0	55.7
1972	22.1	27.2	39.2	9.6	16.4	61.6	39.6	46.8	59.8	100.9	24.4	26.5
1973	34.5	10.9	30.0	27.5	14.0	73.3	94.6	85.1	18.9	63.2	33.8	35.5
1974	10.7	69.0	11.1	29.7	10.5	39.5	51.4	79.6	23.3	114.8	52.0	79.4
1975	24.6	9.8	1.7	19.9	28.5	29.8	78.3	38.9	66.5	50.1	36.2	19.9
1976	49.9	23.1	27.0	17.7	33.8	48.5	48.2	46.8	10.2	44.8	57.0	43.7
1977	40.7	28.0	21.4	25.8	31.3	67.3	42.1	14.1	51.0	30.0	38.3	18.2
1978	24.6	10.7	9.0	1.0	21.7	63.1	34.1	16.4	88.0	68.5	60.0	91.4
1979	30.0	10.5	79.5	2.9	15.4	73.2	137.0	50.4	73.9	18.0	51.0	53.3
1980	22.9	7.7	5.8	18.4	35.4	70.4	67.0	120.1	73.6	66.2	27.2	23.1
1981	16.5	56.1	7.7	2.0	52.1	63.8	88.3	77.0	103.5	134.1	82.4	20.5
1982	16.3	31.9	3.8	6.9	23.0	62.2	73.0	48.1	45.1	33.2	71.5	28.9
1983	58.2	24.8	18.0	4.9	52.6	56.0	92.6	83.4	69.0	123.8	17.8	11.1

Precipitation (mm)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1984	33.4	49.5	7.7	19.2	23.9	28.9	131.3	45.8	11.5	24.0	51.6	67.2
1985	77.1	64.0	25.5	36.3	70.4	73.2	53.6	78.9	71.9	58.5	24.4	35.6
1986	55.0	12.0	6.2	16.3	38.0	13.5	60.5	45.5	13.8	30.4	72.4	61.7
1987	22.1	6.8	14.1	33.0	30.5	74.6	78.6	49.1	41.8	54.4	102.8	42.6
1988	35.5	5.6	64.9	11.1	81.8	26.4	46.7	94.0	12.4	86.3	73.9	18.9
1989	25.9	7.5	3.0	2.6	40.9	56.2	24.5	32.0	40.0	54.6	67.2	72.0
1990	67.4	48.8	21.8	3.7	68.1	52.1	91.9	85.0	87.3	61.0	33.8	56.7
1991	64.5	42.0	37.9	1.2	15.8	31.4	81.5	103.4	71.4	43.2	59.3	35.6
1992	70.2	33.0	13.5	17.1	53.0	71.7	79.8	70.9	36.0	38.6	46.2	33.4
1993	46.7	23.1	22.9	1.7	38.0	58.8	32.3	71.3	51.6	26.1	65.3	29.1
1994	12.4	6.0	54.4	13.2	19.0	80.5	75.8	47.8	34.6	81.4	52.2	15.4
1995	21.4	24.8	22.1	8.4	88.4	29.1	93.3	51.0	59.3	51.0	17.6	35.8
1996	15.6	26.6	18.8	9.8	16.6	44.9	15.4	59.0	50.1	57.0	33.8	61.5
1997	33.0	11.3	10.1	10.1	34.9	121.8	87.6	77.9	23.6	71.3	33.0	60.0
1998	22.0	7.5	0.0	0.3	61.1	76.9	23.0	37.2	31.4	13.3	15.6	30.0
1999	20.6	27.4	20.3	19.6	48.0	24.1	46.1	82.8	41.2	108.1	38.3	105.3
2000	43.3	12.8	9.0	8.1	30.1	87.3	143.0	44.1	73.7	66.6	27.6	21.6
2001	50.8	34.1	11.3	8.6	39.7	33.6	131.2	33.8	40.5	41.7	29.6	24.8
2002	28.5	19.9	19.1	18.3	65.1	35.0	75.5	113.1	13.5	50.7	29.3	63.4
2003	9.9	19.7	19.3	0.6	61.8	45.8	55.2	57.6	30.6	19.1	68.1	57.2
2004	48.0	23.5	22.0	11.5	28.8	18.9	46.9	12.1	36.3	79.5	39.2	80.1
2005	38.8	29.1	28.9	8.2	27.4	74.3	68.0	55.6	73.3	34.9	92.7	33.8
2006	12.9	8.8	4.1	36.3	31.4	70.4	43.6	72.6	58.5	54.6	9.9	49.6
2007	21.6	5.6	73.0	17.0	18.0	20.7	77.2	68.3	57.8	9.4	17.6	18.0
2008	34.1	6.0	16.5	11.8	22.8	39.3	232.8	60.8	55.0	33.2	52.9	23.6
2009	0.0	0.0	25.9	0.6	16.4	83.5	13.2	91.6	39.5	1.7	22.1	5.1
2010	2.6	1.3	11.6	19.0	27.9	79.1	75.2	66.2	18.4	23.6	39.0	22.9
2011	34.0	12.9	10.1	7.2	26.8	127.0	74.3	65.2	36.9	8.1	4.5	64.4
2012	139.8	1.1	23.6	20.7	32.5	39.0	76.9	50.8	48.0	16.5	30.4	32.8
2013	108.4	1.9	0.0	20.3	51.8	82.7	30.2	27.9	78.9	62.3	52.5	41.7
2014	39.0	11.8	2.3	14.5	13.4	60.6	130.8	91.2	35.0	86.9	7.7	31.5
2015	21.0	34.0	31.3	27.8	41.8	63.7	140.2	62.1	35.3	64.0	57.2	40.9
2016	33.6	13.1	49.2	31.0	36.9	101.5	78.8	100.7	45.5	14.1	75.6	49.0
2017	42.4	23.1	6.0	13.0	52.6	59.7	70.6	46.2	41.3	72.2	25.1	40.0
2018	8.1	39.6	15.9	6.0	41.2	84.0	13.1	131.9	10.5	39.0	53.3	46.3
2019	22.7	9.0	18.0	34.4	24.3	32.4	65.5	24.8	33.6	74.3	115.0	55.2
2020	63.4	18.8	20.5	14.3	9.2	115.4	50.0	106.0	44.8	62.3	119.3	26.3

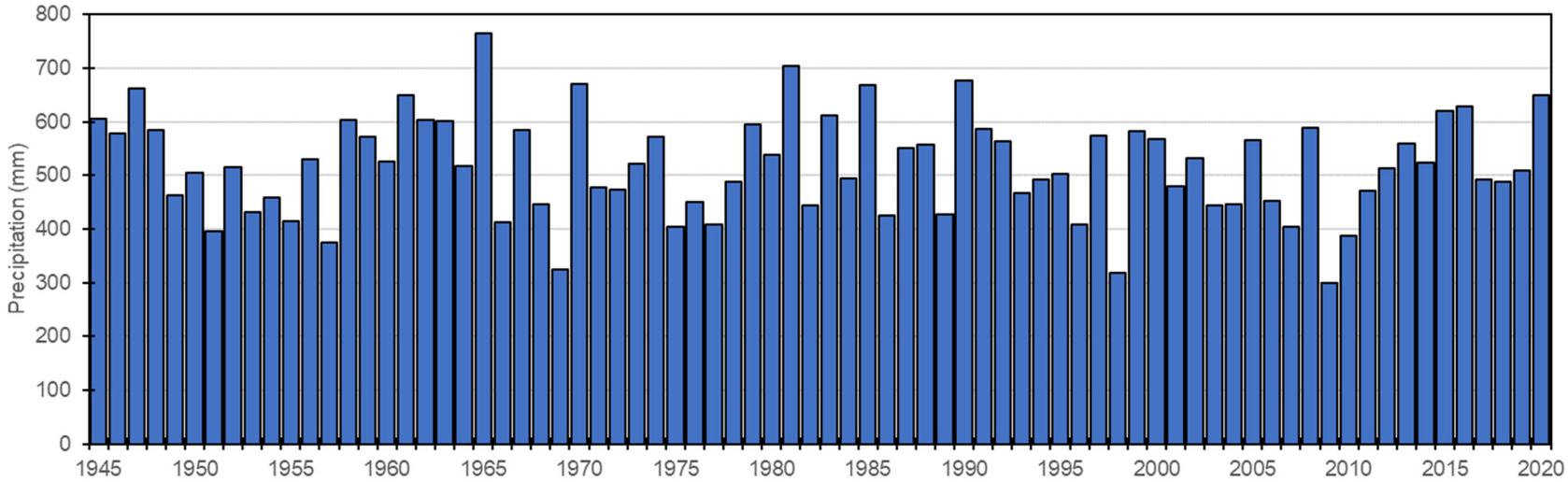

Figure A2.1: Synthetic annual precipitation time-series for the Coffee Gold Project site (1,300 m).

Appendix B: Climate Trends and Climate Change Scenario Data

B1. Regional Hydrometeorology Trend Analysis, Coffee Gold Project

B2. PCIC Climate Change Assessment for Coffee Gold Project

B3. Climate Change Scenario Data for the Project Site

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TECHNICAL MEMORANDUM

To:	**Allison Rippon Armstrong, Kaminak Gold Corp**	**Date: March 1, 2016**
From:	**Scott Jackson and Colin Fraser**	**Project #: A362-3**
Subject:	**Regional Hydro-meteorological Trend Analysis – Coffee Creek**	

1. Introduction

1.1 Memo Objectives and Layout

This memo presents the results of a trend analysis exercise carried out to characterize current rates of change for hydro-meteorological parameters relevant to the Coffee Gold Project (hereafter, 'the Project').

Many operational and regulatory decisions related to water quantity, and secondarily water quality (*e.g.*, loading calculations) are based on limited site-specific streamflow and climate data. Such decisions then often necessitate the review of, and integration, of long-term regional hydrometric and climate data analogues showing longer record periods. This approach is commonly adopted for a regional frequency analysis that targets pertinent hydro-meteorology variables (*e.g.*, mean annual precipitation and runoff, 7-day low flow, peak flows).

Two important questions related to usage of regional data are: 1) the regional hydro-meteorological record(s) are transferable to the site being studied; and 2) are the regional (and site specific) data of sufficient length to adequately represent long-term variability. The latter assumption often implies that the streamflow records being utilized are statistically stationary. In other words, a metric calculated from the historic record will retain the same value when re-calculated from future data.

As the understanding of anthropogenic and climatic influences on hydro-meteorological variables improves, it is apparent that this latter assumption is often not valid. An assessment of the potential influences of long-term change in climate/streamflow metrics was undertaken to ensure that estimates of future streamflow conditions are as robust as possible. The goal of this analysis is to present the current trends for several ($n = 45$) streamflow and climate variables of interest, where the objectives are two-fold:

1. Calculate trends in various streamflow and climate variables for the region in which the Project is situated, and;
2. Determine whether the calculated trends are statistically significant at $p < 0.05$;

2. Methods

2.1 Sources of Data

2.1.1 Climate Data

The Coffee Creek property is situated ~80 km from the Alaska border. Two main sources of climate data were used to assemble this memo:

1) Environment Canada daily climate station data (within 200 km radius of proposed heap leach facility) from the Adjusted and Homogenized Canadian Climate Dataset.
2) Daily average streamflow data from hydrometric stations located within the same radius of the Project. Data were sourced from the Water Survey of Canada and the United States Geological Survey hydrometric networks.

Further details on the datasets, information used in the frequency analyses and assumptions are provided in Lorax (2016).

State of Alaska and Yukon Territory climate stations situated near the Coffee Creek property are listed in Table 2-1 of the EIA Baseline Hydro-meteorology report (Lorax, 2016). Of these 20 stations (*i.e.*, Coffee Creek location excluded), three were selected for the climate trend analysis. The Pelly Ranch and Dawson A stations are located close to the property and possess long-term, high quality records. For comparative purposes, the Dawson A record was truncated to 1955 and 1952, for temperature and precipitation, respectively, to match the available record from the Pelly Ranch station.

Also selected was the McQuesten station record which is shorter, beginning in 1982, and therefore, a corrected AHCCD dataset was not available. However, as this station's record forms the basis of the reconstructed climate data set used as the primary input to the site-wide water balance model, it was necessary to determine the extent of non-stationarity present in the temperature and precipitation data.

2.1.2 Streamflow Data

Streamflow records of average daily discharge were downloaded from HYDAT (WSC, 2015), for the twelve stations listed in Table 2-4 in Lorax (2016). The criteria used in the station selection were as follows:

- Station active as of 2010;
- Record period of >10 consecutive years;
- Basin is non-regulated (*i.e.*, no major diversions or impoundments).

Missing data or incomplete records were accounted for using the following methods:

- Discharge time-series were truncated to ensure annual time-series was continuous (*i.e.*, a minimum of 5 years of data was present before and after a missing year, gaps greater than one year were disallowed);
- Where a month had > 5 days of missing data, this month was removed from the time-series, and;
- No missing data were estimated or infilled.

The following streamflow timing metrics were calculated in addition to the various discharge metrics:

- PULSE_DATE – The date of freshet initiation calculated as the day when the cumulative departure from that years mean annual discharge is most negative (Cayan *et al.*, 2001). The cut-off date is set as August 31, to ensure that autumn rain events in mixed rainfall/snowmelt driven regimes are not inadvertently counted as the freshet date.
- DATE_CM – Date of centre of hydrograph mass (calendar year), calculated following Stewart *et al.* (2005).

In the context of mine effluent management, regulatory criteria are often based on concentrations in the effluent and the receiving environment. Concentration is a mass of a given contaminant in a given volume of water, and thus any reduction in the volume of water without a concurrent reduction in loadings will result in higher concentrations. This means that periods of sustained low flows in the receiving environment are often the constraining factor in an effluent discharge regime.

Low flows are most commonly assessed for two time periods: annual (usually representative of winter flows in nival and glacial regimes); and summer (*e.g.,* June-September). Low flow indices are commonly based on a rolling 7-day average of discharge (7Q) or, less commonly, a rolling 30-day average (30Q) (Smakhtin, 2001). The minimum 7- or 30-day averages are then tabulated on an annual basis, and recurrence interval analyses conducted (*e.g.*, $7Q_{10}$). In this assessment, time series for low flow indices were examined, to determine whether water balance estimates may need to consider potential shifts in these metrics over time. In some cases, where winter flow data was limited or non-existent (*e.g.*, Wade Creek Tributary near Chicken, AK), the winter metrics were not calculated.

While every attempt has been made to ensure that the identified trends are reflective of long-term changes in streamflow, trends may be influenced by several complicating factors, including, but not limited to:

- Land cover change (*e.g.*, urbanization, forestry, linear development, *etc.*);

- Large scale climate cycles (*e.g.*, Pacific Decadal Oscillation [PDO], El Niño Southern Oscillation [ENSO]; Cayan and Peterson, 1989; Stewart *et al*., 2005), and;
- Changes in measurement techniques, QA/QC practices, rating curves, *etc.*

These impact of these factors must be carefully contemplated when results are assessed and conclusions drawn.

2.2 Trend Analysis Methodology

Annual time-series of these parameters were analysed for trend using the *zyp* package in R (Bronaugh and Werner, 2013). The full details of the calculations performed by this package are provided in the reference above, but in brief, initial trend slopes were estimated using the Theil-Sen approach. To address serial correlation effects on statistical hypothesis tests for trend, if a trend was noted, the time-series was detrended using the slope (Yue *et al*., 2002). The trend and residuals are then blended, and the Mann-Kendall's test for trend significance (p-value) is then applied. The *zyp* package re-inflates the values that trend significance are calculated by dividing by (1-AR(1)). All trends are presented as annual values (*i.e.*, rate of change per year in the variable of interest).

Discharge trends (calculated in m^3/s) were converted to unit runoff (in $L/s/km^2$) prior to plotting to account for the influence of basin area on relative trend magnitude. Table 1 lists the complete suite of variables considered in this assessment.

3. Results

3.1 Temperature

The results of the temperature trend analysis are presented in Table 2.

All trends are positive (*i.e*., warming over time), and significant at $p < 0.05$. For the Dawson A and Pelly Ranch climate stations (1955-2013; 59 years), the largest positive trends are noted in the winter season (December through February), and are on the order of 1°C/decade. The smallest positive trends occur in the summer and autumn seasons (0.3°C/decade), and for autumn, only the trend in minimum temperatures is significant at all stations. The results for the Dawson A and Pelly Ranch stations are presented in Figure 1.

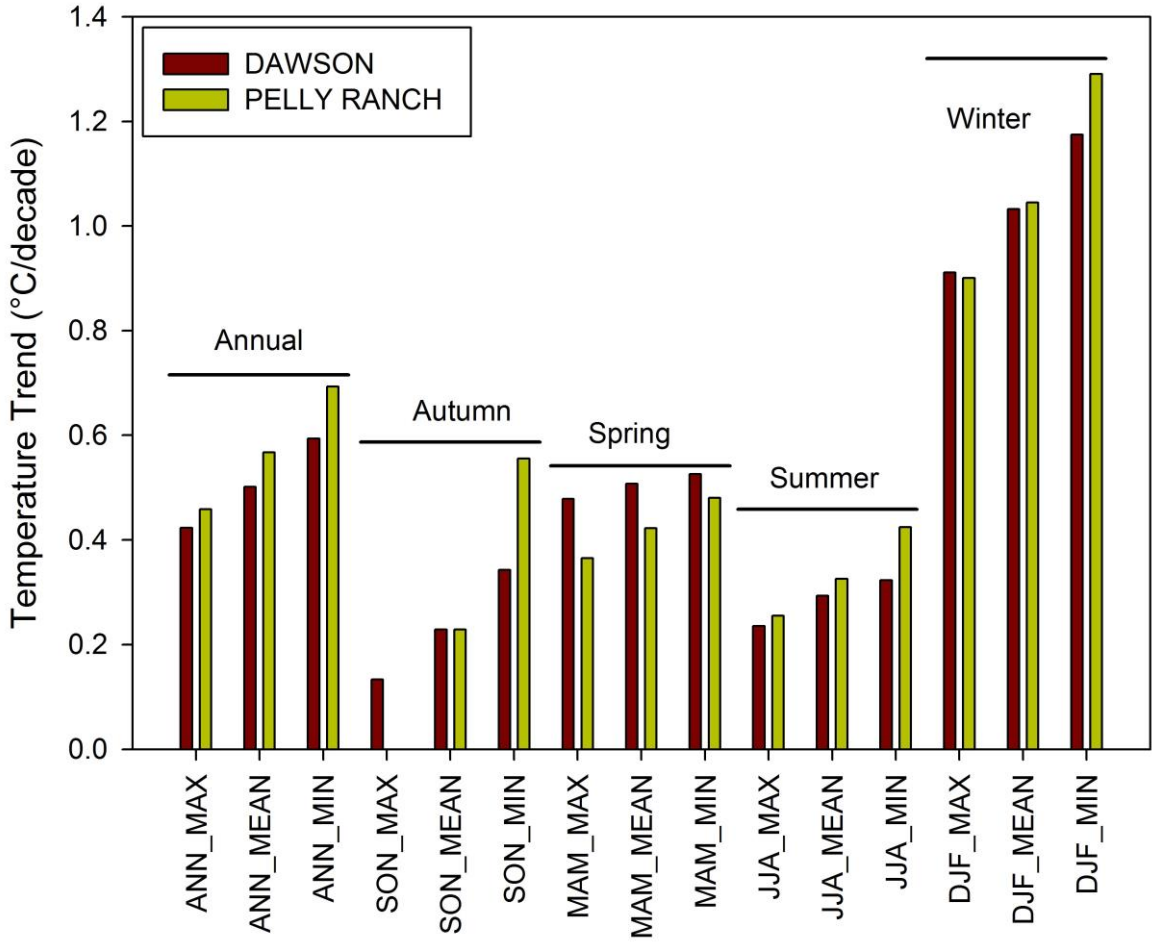

Figure 1: Temperature trends by season for the Dawson A and Pelly Ranch climate stations.

3.2 Precipitation

The results of the temperature trend analysis are presented in Table 3. The trends in seasonal and annual precipitation totals are mixed, although in general, precipitation is increasing across the Project area. For the Dawson A and Pelly Ranch climate stations (1952-2013; 62 years), the largest seasonal trends are noted in the autumn season (September through November), and are on the order of +4-6 mm/decade. The signal is mixed for summer precipitation, with the Dawson A station recording a negative trend of -6 mm/decade, and the Pelly Ranch summer totals increasing by +5 mm/decade. The annual precipitation trends for the Dawson A and Pelly Ranch stations are presented in Figure 2. Only one of the seasonal trends was significant at $p < 0.05$ (autumn total precipitation at Dawson A), while three more trends were significant at $p < 0.10$ (summer total precipitation at Dawson A, and annual and autumn total precipitation at Pelly Ranch).

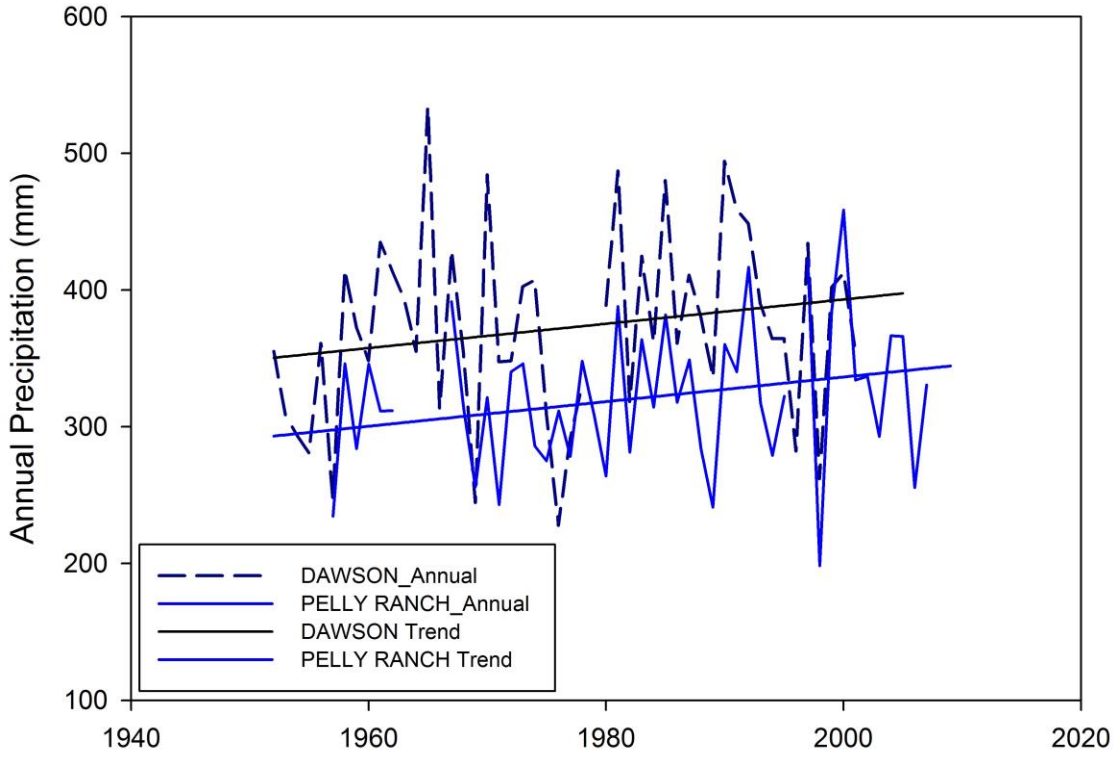

Figure 2: Annual total precipitation trends for the Dawson A and Pelly Ranch climate stations.

3.3 McQuesten Climate Record

The data from the McQuesten climate station was used as the basis for the reconstructed site climate data time-series described in the Hydro-meteorological Baseline Report. The results for the McQuesten climate record are presented in Table 4.

It is notable that this record does not show any evidence of significant trends ($p < 0.10$) for the parameters analysed, which is not consistent with the longer records from the Dawson A and Pelly Ranch stations. The reason for this is not clear, but it is possible that it is an artefact of the shorter record available for this station (28 years).

3.4 Streamflow

The results of the streamflow trend analysis are presented in Table 5. The regional basins analysed have basin areas that span five orders of magnitude (11 – 149,000 km^2). In general, streamflow is increasing across the region, regardless of the metric analysed, which is consistent with the precipitation trends presented here. Low-flows in particular are increasing, and the slope of the trends in summer low-flows are approximately four times higher than those for winter baseflows. An example of the winter baseflow trends is presented in Figure 3.

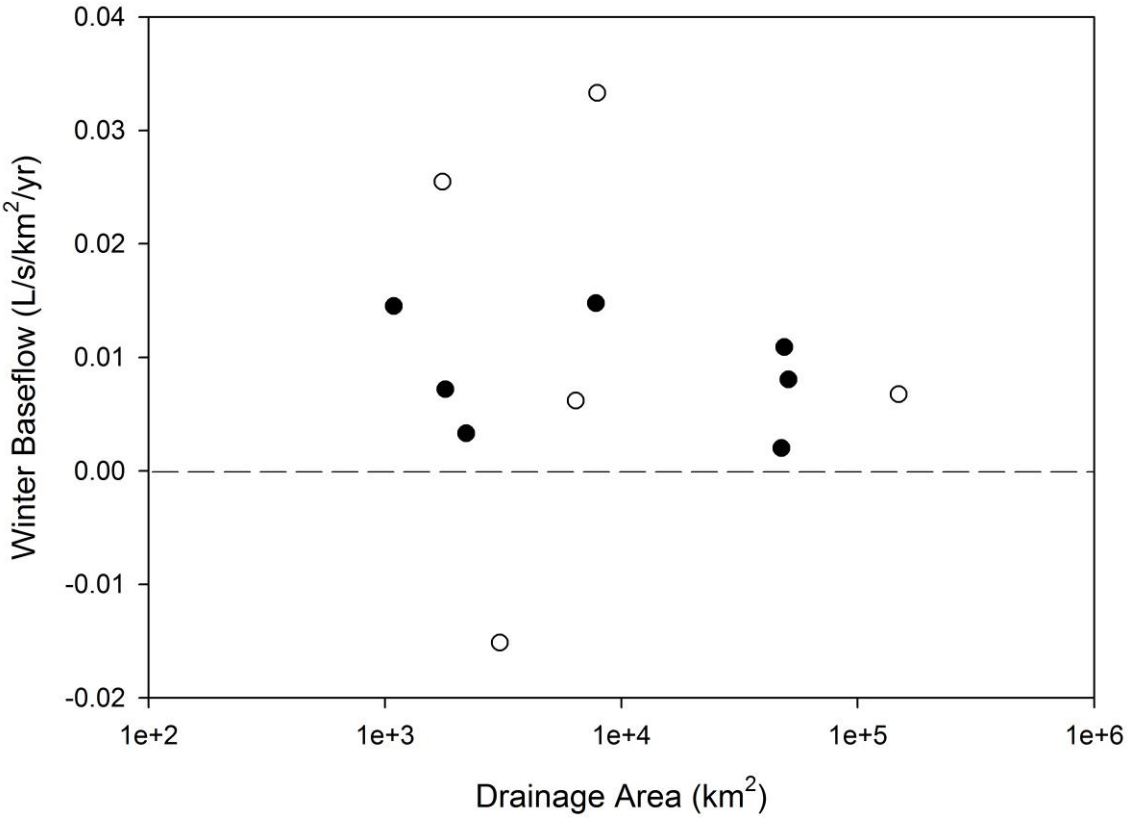

Figure 3: Winter baseflow trends for the regional hydrometric stations. Trends that are significant at p < 0.05 are denoted by black markers, and those stations that do not show a significant trend are shown with open circles.

In addition to the broad ranging increases in winter and early spring streamflows, the only other metric that showed a significant trend (at $p < 0.05$) was the date of freshet initiation (PULSE DATE). Freshet is occurring earlier at several stations (negative trend), which is consistent with similar studies conducted in snowmelt and mixed snow/rain dominated streamflow regimes in North America (Cayan *et al*., 2001, Stewart *et al*., 2005), and likely a result of warming spring temperatures.

It is possible that the increase in winter baseflows is a result of both increased autumn precipitation and warmer winter temperatures, although the fact that winter temperatures are still often well below freezing would add support to the former mechanism. However, the most likely cause is the increased rate of permafrost melt that has been observed throughout the discontinuous permafrost zone (*e.g.,* Walvoord and Striegl, 2007; Janowicz, 2008; and Brabets and Walvoord, 2009).

4. Summary

A suite of hydro-meteorological parameters were analysed for trends using standard statistical tests. Statistical significance of the trends was identified where present.

Overall, temperatures are warming across the Project area, and with the greatest warming occurring during the winter months. Precipitation is increasing on an annual basis, and most strongly in the autumn, but the signal is somewhat mixed for the other seasons, and summer in particular. The climate record used as the basis for the reconstructed site climate data time-series (McQuesten) does not show any evidence of significant trends for the parameters analysed, but it is not clear whether this is an artefact of the shorter record.

Annual streamflow minima are increasing at almost every hydrometric station included in this analysis, and several stations show evidence of an earlier start to the freshet over time. These results are consistent with those presented in Appendix D.1 of the Hydro-meteorological Baseline Report (Lorax, 2016), and with similar analyses conducted in the region.

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Table 1:
Hydro-meteorological metrics analysed for trends

Variable[1]	Description
Streamflow (m^3/s)	
MIN_Q	Minimum annual average daily discharge
MAX_Q	Maximum annual average daily discharge
AVG_Q	Average annual average daily discharge (calendar year)
MED_Q	Median annual average daily discharge (calendar year)
AVG_WAT_YR	Average water year discharge (Oct. 1 - Sept. 30)
MED_WAT_YR	Median water year discharge (Oct. 1 - Sept. 30
MAX_Q_DATE	Date of maximum annual average daily discharge
PULSE_DATE	Date of freshet pulse initiation
DATE_CM	Date of hydrograph centre of mass - calendar year
ANN_7Q_MIN	Annual minimum 7-day average low flow
ANN_30Q_MIN	Annual minimum 30-day average low flow
BASEFLOW	Average winter flow (Dec. 1 – Mar. 31)
JUN-SEP_7Q_MIN	Annual June-September minimum 7-day average low flow
JUN-SEP_30Q_MIN	Annual June-September minimum 30-day average low flow
All months (n = 12)	Median daily discharge
Temperature (°C)	
ANN_MAX	Annual maximum daily temperature
ANN_MEAN	Annual mean daily temperature
ANN_MIN	Annual minimum daily temperature
DJF_MAX	Winter (Dec.-Jan.) maximum daily temperature
DJF_MEAN	Winter (Dec.-Jan.) mean daily temperature
DJF_MIN	Winter (Dec.-Jan.) minimum daily temperature
MAM_MAX	Spring (Mar.-May) maximum daily temperature
MAM_MEAN	Spring (Mar.-May) mean daily temperature
MAM_MIN	Spring (Mar.-May) minimum daily temperature
JJA_MAX	Summer (Jun.-Jul.) maximum daily temperature
JJA_MEAN	Summer (Jun.-Jul.) mean daily temperature
JJA_MIN	Summer (Jun.-Jul.) minimum daily temperature
SON_MAX	Autumn (Sept.-Nov.) maximum daily temperature
SON_MEAN	Autumn (Sept.-Nov.) mean daily temperature
SON_MIN	Autumn (Sept.-Nov.) minimum daily temperature
Precipitation (mm)	
ANN_TOT	Annual total precipitation
DJF_TOT	Winter (Dec.-Jan.) total precipitation
MAM_TOT	Spring (Mar.-May) total precipitation
JJA_TOT	Summer (Jun.-Jul.) total precipitation
SON_TOT	Autumn (Sept.-Nov.) total precipitation

[1] *All streamflow variables calculated from the mean daily discharge values provided in the HYDAT database.*

Table 2:
Seasonal and annual trends in air temperature for the Dawson A and Pelly Ranch climate stations.

Station	Variable	Lower Bound	Trend Slope	Upper Bound	Significance (p)	nruns	autocor	valid_frac	linear	intercept
Dawson A	ANN_MIN	0.0320	0.0594	0.0898	0.0001	4	0.1908	0.9322	0.0583	-12.96
	DJF_MIN	0.0591	0.1175	0.1762	0.0007	2	0.0483	1.0000	0.1116	-34.60
	MAM_MIN	0.0173	0.0526	0.0941	0.0065	4	0.0773	1.0000	0.0555	-11.52
	JJA_MIN	0.0214	0.0323	0.0427	0.0000	3	-0.0192	1.0000	0.0324	5.31
	SON_MIN	-0.0059	0.0343	0.0696	0.0822	1	0.0188	0.9667	0.0271	-11.91
	ANN_MEAN	0.0257	0.0501	0.0775	0.0001	4	0.1227	0.9322	0.0509	-6.23
	DJF_MEAN	0.0461	0.1032	0.1637	0.0017	2	0.0289	1.0000	0.0970	-29.17
	MAM_MEAN	0.0138	0.0508	0.0872	0.0060	3	0.0378	1.0000	0.0530	-3.83
	JJA_MEAN	0.0168	0.0293	0.0427	0.0000	3	-0.0097	1.0000	0.0296	12.90
	SON_MEAN	-0.0111	0.0229	0.0571	0.1668	1	-0.0365	0.9667	0.0156	-6.40
	ANN_MAX	0.0200	0.0423	0.0661	0.0001	3	0.0369	0.9322	0.0440	0.61
	DJF_MAX	0.0266	0.0911	0.1520	0.0051	3	0.0147	1.0000	0.0828	-23.45
	MAM_MAX	0.0150	0.0478	0.0784	0.0035	3	-0.0252	1.0000	0.0508	4.25
	JJA_MAX	0.0064	0.0235	0.0430	0.0038	3	0.0407	1.0000	0.0262	20.52
	SON_MAX	-0.0212	0.0133	0.0409	0.4129	1	-0.0905	0.9667	0.0045	-1.23
Pelly Ranch	ANN_MIN	0.0417	0.0693	0.1026	0.0000	4	0.0819	0.8475	0.0722	-12.32
	DJF_MIN	0.0523	0.1291	0.2089	0.0019	3	0.0549	0.9322	0.1351	-33.72
	MAM_MIN	0.0075	0.0480	0.0871	0.0198	3	-0.0453	0.9322	0.0545	-10.24
	JJA_MIN	0.0310	0.0424	0.0530	0.0000	3	0.0024	0.9492	0.0412	5.17
	SON_MIN	0.0115	0.0556	0.0903	0.0179	1	0.0005	0.9167	0.0500	-10.78
	ANN_MEAN	0.0280	0.0568	0.0862	0.0004	4	0.0621	0.7797	0.0542	-5.44
	DJF_MEAN	0.0299	0.1045	0.1953	0.0168	3	0.0189	0.8814	0.1106	-27.31
	MAM_MEAN	0.0070	0.0422	0.0796	0.0178	3	-0.0509	0.8983	0.0514	-2.19
	JJA_MEAN	0.0191	0.0326	0.0472	0.0000	4	0.0726	0.9492	0.0320	12.99
	SON_MEAN	-0.0192	0.0229	0.0621	0.2726	1	-0.1000	0.9000	0.0209	-4.56
	ANN_MAX	0.0154	0.0459	0.0748	0.0060	4	0.0722	0.7797	0.0399	1.55
	DJF_MAX	0.0117	0.0901	0.1718	0.0325	3	0.0088	0.8814	0.0911	-20.78
	MAM_MAX	0.0047	0.0365	0.0661	0.0227	3	-0.0713	0.8983	0.0467	5.87
	JJA_MAX	0.0040	0.0255	0.0442	0.0119	5	0.0703	0.9492	0.0227	20.54
	SON_MAX	-0.0357	0.0000	0.0378	0.9702	1	-0.1137	0.9000	-0.0032	1.25

***NOTE**: Variables highlighted in green are significant at $p < 0.05$, and those highlighted in yellow are significant at $p < 0.10$.*

Table 3:
Seasonal and annual trends in total precipitation for the Dawson A and Pelly Ranch climate stations.

Station	Variable	Lower Bound	Trend Slope	Upper Bound	Significance (p)	nruns	autocor	valid_frac	linear	intercept
Dawson A	ANN_TOT	-0.4172	0.8893	2.2452	0.1754	1	-0.0336	0.7937	0.8886	349.87
	DJF_TOT	-0.1707	0.3320	0.8625	0.1769	4	0.1304	0.8871	0.3161	61.25
	MAM_TOT	-0.0621	0.1750	0.4111	0.1559	1	0.0433	0.9365	0.1675	43.33
	JJA_TOT	-1.2583	-0.6139	0.0517	0.0757	1	-0.1336	0.9048	-0.5812	163.32
	SON_TOT	0.0905	0.5892	1.1082	0.0260	2	-0.0449	0.8226	0.5016	85.57
Pelly Ranch	ANN_TOT	-0.0071	0.9000	1.9350	0.0533	1	-0.2002	0.7937	0.8997	289.15
	DJF_TOT	-0.4364	-0.0798	0.2779	0.4950	4	0.1542	0.8871	0.0838	55.76
	MAM_TOT	-0.2692	0.0217	0.3333	0.9168	1	-0.1134	0.8571	0.0877	43.37
	JJA_TOT	-0.1333	0.4857	1.1789	0.1276	1	-0.0384	0.9365	0.5887	114.13
	SON_TOT	-0.0800	0.3676	0.7867	0.0898	1	0.0210	0.8889	0.3610	63.19

***NOTE**: Variables highlighted in green are significant at $p < 0.05$, and those highlighted in yellow are significant at $p < 0.10$.*

Table 4:
Seasonal and annual trends in total precipitation for the McQuesten climate station.

Station	Variable	Lower Bound	Trend Slope	Upper Bound	Significance (p)	nruns	autocor	valid_frac	linear	intercept
MCQUESTEN Temperature	ANN_MAX	-0.0882	-0.0274	0.0610	0.4158	1	-0.2807	1.0000	-0.0032	22.93
	ANN_MEAN	-0.0392	0.0158	0.0740	0.6593	3	0.0726	0.9630	0.0084	-2.75
	ANN_MIN	-0.1469	0.0769	0.2157	0.3780	4	0.3082	0.9630	0.0143	-38.31
	DJF_MAX	-0.1242	0.0559	0.2714	0.4655	4	0.0369	1.0000	0.2106	2.01
	DJF_MEAN	-0.0736	0.0529	0.1581	0.3137	1	0.0262	1.0000	0.0572	-18.50
	DJF_MIN	-0.0792	0.0575	0.1894	0.5454	4	0.0644	1.0000	0.0235	-36.67
	MAM_MAX	-0.0248	0.0577	0.1488	0.1581	1	-0.0957	1.0000	0.0498	16.09
	MAM_MEAN	-0.1438	-0.0696	0.0158	0.1607	1	-0.0201	1.0000	-0.0570	0.53
	MAM_MIN	-0.2331	0.0000	0.2092	0.9842	1	-0.4160	1.0000	-0.0238	-26.63
	JJA_MAX	-0.0882	-0.0274	0.0529	0.4389	1	-0.3702	1.0000	-0.0195	22.93
	JJA_MEAN	-0.0430	-0.0110	0.0200	0.6495	1	-0.2841	1.0000	-0.0071	11.49
	JJA_MIN	-0.0324	0.0000	0.0832	0.6450	1	-0.1365	1.0000	0.0383	-0.02
	SON_MAX	-0.0882	0.0265	0.1323	0.6600	1	0.0161	0.9643	-0.0080	13.35
	SON_MEAN	-0.0453	0.0463	0.1294	0.2430	1	-0.0421	0.9643	0.0320	-4.25
MCQUESTEN Precipitation	SON_MIN	-0.2590	0.0583	0.3885	0.8185	1	0.0404	0.9643	0.0328	-28.09
	ANN_TOT	-5.0082	0.1657	5.9974	1.0000	3	0.1493	0.9630	-1.0927	481.48
	DJF_TOT	-2.3662	-0.0229	2.7550	1.0000	8	0.3685	1.0000	0.1207	91.83
	MAM_TOT	-2.4830	-0.8375	0.3643	0.1689	3	-0.0203	1.0000	-1.4003	73.05
	JJA_TOT	-1.8226	1.6158	5.0188	0.4283	3	0.2238	1.0000	1.5693	159.44
	SON_TOT	-3.1768	-1.4068	0.3498	0.1334	1	-0.0086	0.9643	-1.6095	138.49
	ANN_TOT	-5.0082	0.1657	5.9974	1.0000	3	0.1493	0.9630	-1.0927	481.48

***NOTE**: Variables highlighted in green are significant at $p < 0.05$, and those highlighted in yellow are significant at $p < 0.10$.*

Table 5:
Streamflow trends for the Coffee Gold Project area.

Station	Variable	Lower Bound	Trend Slope	Upper Bound	Significance (p)	nruns	autocor	valid_frac	linear	intercept
15320100 - Wade Creek Tributary near Chicken AK	AVG_Q	-0.0093	-0.0030	0.0034	0.4047	5	0.3576	0.3529	-0.0031	0.19
	MAX_Q	-0.0749	0.0178	0.1222	0.6494	4	0.2033	0.3529	0.0429	0.01
	MAX_Q_DATE	-3.0000	0.7222	3.0000	0.6746	1	-0.0965	0.3654	0.3158	138.61
	MAY	-0.0161	-0.0056	0.0030	0.1978	4	0.0603	0.3529	-0.0076	0.33
	JUNE	-0.0056	-0.0012	0.0025	0.7049	4	0.0904	0.3529	-0.0009	0.09
	JULY	-0.0019	0.0010	0.0065	0.4954	7	0.1592	0.3529	0.0030	-0.02
	AUGUST	-0.0030	0.0008	0.0051	0.4415	1	-0.0457	0.3654	0.0012	0.00
	SEPTEMBER	-0.0031	-0.0005	0.0032	0.8796	4	0.1887	0.3529	0.0006	0.07
	OCTOBER	-0.0005	0.0002	0.0011	0.6192	1	-0.1827	0.2692	0.0004	0.00
	JUN-SEP_30Q_MIN	-0.0014	0.0011	0.0029	0.2758	4	-0.1095	0.2157	0.0011	-0.03
	JUN-SEP_7Q_MIN	-0.0008	0.0001	0.0016	0.7317	3	0.1256	0.2353	0.0006	0.00
	MIN_Q	-0.0003	0.0000	0.0000	0.1433	3	0.2602	0.3529	-0.0005	0.00
09AH003 - Big Creek near the Mouth	AVG_Q	-0.0541	0.0384	0.1647	0.3738	4	0.1540	0.6667	0.0622	5.98
	WAT_YR_Q	-14.1293	20.6307	62.5923	0.2328	4	0.1713	0.6471	23.3875	1975.52
	MIN_Q	-0.0013	0.0053	0.0208	0.1463	5	0.4906	0.6667	0.0127	-0.06
	MAX_Q	-1.0267	0.7000	2.2130	0.4138	1	-0.1431	0.7308	0.5362	78.50
	MAX_Q_DATE	-2.0622	-0.8512	0.4924	0.1920	4	0.1348	0.6667	-0.7947	184.41
	DATE_CM	-1.0000	-0.4464	0.2692	0.2389	1	-0.0661	0.7115	-0.4109	194.71
	PULSE_DATE	-0.4988	-0.2540	-0.0428	0.0216	4	0.0260	0.6667	-0.5786	130.57
	ANN_30Q_MIN	-0.0025	0.0053	0.0210	0.2850	5	0.4489	0.6471	0.0134	-0.02
	ANN_7Q_MIN	-0.0019	0.0061	0.0218	0.2328	6	0.4459	0.6471	0.0135	-0.05
	BASEFLOW	0.0049	0.0129	0.0231	0.0019	1	-0.0111	0.7115	0.0276	-0.07
	JUN-SEP_30Q_MIN	-0.0201	0.0645	0.1481	0.1410	2	0.0359	0.6471	0.0518	3.11
	JUN-SEP_7Q_MIN	-0.0272	0.0383	0.1217	0.2580	3	0.0298	0.6471	0.0427	2.62
	JANUARY	0.0008	0.0093	0.0252	0.0372	6	0.2575	0.7059	0.0166	-0.05
	FEBRUARY	-0.0003	0.0066	0.0177	0.0701	4	0.3552	0.7059	0.0150	-0.01
	MARCH	-0.0016	0.0064	0.0204	0.1606	7	0.4400	0.7059	0.0132	-0.06
	APRIL	0.0011	0.0153	0.0516	0.0283	4	0.4133	0.7059	0.0348	-0.22
	MAY	0.0553	0.4689	0.8371	0.0192	4	0.0741	0.6667	0.3722	5.28
	JUNE	-0.1954	0.0355	0.2571	0.8821	3	0.0875	0.6667	0.0371	9.60
	JULY	-0.4192	-0.1254	0.1450	0.2943	8	0.2231	0.7059	-0.0128	14.85
	AUGUST	-0.1776	0.0239	0.2098	0.8595	4	0.0859	0.7059	0.0619	9.29
	SEPTEMBER	-0.0139	0.1225	0.2781	0.0696	1	0.0369	0.7500	0.1325	5.49
	OCTOBER	-0.0109	0.0478	0.1149	0.1077	4	0.1811	0.7255	0.0582	2.28
	NOVEMBER	0.0207	0.0468	0.0657	0.0007	4	0.0920	0.7255	0.0437	0.10
	DECEMBER	0.0077	0.0243	0.0390	0.0030	4	0.1459	0.7255	0.0252	-0.14
09AH004 - Nordenskiold River below Rowlinson Creek	AVG_Q	-0.3381	0.0444	0.4385	0.6833	3	0.3266	0.6078	0.0401	12.18
	WAT_YR_Q	-113.1329	24.6199	178.2945	0.7481	6	0.3895	0.5882	9.0834	3678.08
	MIN_Q	-0.0160	0.0619	0.1391	0.1179	6	0.4933	0.6078	0.0213	0.61
	MAX_Q	-1.5900	0.3533	2.0556	0.5593	1	-0.0698	0.6154	0.2737	76.73
	MAX_Q_DATE	-1.3333	-0.5000	0.2500	0.1775	1	-0.0190	0.6154	-0.5189	160.50
	DATE_CM	-0.8750	-0.1064	1.0000	0.8839	1	-0.1821	0.6154	-0.2150	176.37
	PULSE_DATE	-0.3750	-0.0455	0.2500	0.6961	1	-0.0080	0.6154	-0.5299	121.52
	ANN_30Q_MIN	-0.0304	0.0340	0.1234	0.3008	3	0.3960	0.5882	0.0305	1.66
	ANN_7Q_MIN	-0.0252	0.0364	0.1219	0.2687	3	0.3859	0.5882	0.0337	1.48
	BASEFLOW	-0.0676	0.0397	0.1624	0.6174	4	0.3936	0.5882	0.0214	2.20
	JUN-SEP_30Q_MIN	-0.2810	0.0939	0.4778	0.5925	3	0.2951	0.5882	0.0431	6.60
	JUN-SEP_7Q_MIN	-0.1688	0.1395	0.4275	0.3177	4	0.3367	0.5882	0.0655	2.69
	JANUARY	-0.0760	0.0626	0.1963	0.4118	5	0.3960	0.5882	0.0289	1.13
	FEBRUARY	-0.0423	0.0417	0.1282	0.3177	6	0.3603	0.5882	0.0195	1.51
	MARCH	-0.0408	0.0093	0.1098	0.7212	5	0.4273	0.5882	0.0193	2.64
	APRIL	-0.0475	0.0143	0.1330	0.6174	4	0.1551	0.5882	0.0248	3.60
	MAY	-0.2083	0.5545	1.3609	0.1392	1	-0.0310	0.5962	0.6003	19.54
	JUNE	-0.5313	0.4247	1.4203	0.5207	500	0.3242	0.5882	0.0932	6.03
	JULY	-0.4756	-0.1300	0.3383	0.6101	3	0.0910	0.6078	-0.1221	20.92
	AUGUST	-0.3884	0.0405	0.4105	0.8650	3	0.0677	0.6078	0.0468	10.01
	SEPTEMBER	-0.4247	-0.0318	0.4091	0.8119	4	0.0652	0.6078	0.0714	17.09
	OCTOBER	-0.2777	0.0387	0.4069	0.7857	3	0.1629	0.6078	0.0585	10.15
	NOVEMBER	-0.1604	0.0661	0.2795	0.6586	4	0.2215	0.6078	0.0491	4.82
	DECEMBER	-0.0903	0.0336	0.2285	0.6586	4	0.3407	0.6078	0.0380	3.46

Station	Variable	Lower Bound	Trend Slope	Upper Bound	Significance (p)	nruns	autocor	valid_frac	linear	intercept
09BC001 - Pelly River at Pelly Crossing	AVG_Q	-2.3932	0.5408	3.2187	0.6328	3	0.1818	0.7451	0.6519	358.37
	WAT_YR_Q	-833.8041	474.3745	1641.7874	0.3809	5	0.2666	0.7255	186.9035	133683.12
	MIN_Q	-0.0601	0.3198	0.7021	0.1076	4	0.2116	0.7451	0.2451	40.47
	MAX_Q	-17.1429	0.0000	15.8065	1.0000	1	-0.0353	0.7500	0.1812	1740.00
	MAX_Q_DATE	-0.3007	0.0677	0.4035	0.7724	5	0.1798	0.7451	-0.0532	152.95
	DATE_CM	-0.3750	0.0000	0.2667	0.9807	1	-0.0410	0.7500	-0.1385	181.00
	PULSE_DATE	-0.2051	-0.0322	0.1443	0.7533	4	0.1060	0.7451	-0.2383	126.52
	ANN_30Q_MIN	-0.1038	0.2965	0.7140	0.1326	4	0.1954	0.7255	0.2809	43.41
	ANN_7Q_MIN	-0.0749	0.3359	0.7449	0.0967	4	0.1942	0.7255	0.3047	40.06
	BASEFLOW	0.1175	0.5327	1.0192	0.0125	3	0.0022	0.7255	0.6148	57.61
	JUN-SEP_30Q_MIN	-1.9877	1.6473	5.4841	0.4250	2	0.0400	0.7255	1.6058	336.56
	JUN-SEP_7Q_MIN	-2.1152	1.7156	5.2961	0.4719	3	0.0406	0.7255	1.5819	298.62
	JANUARY	0.0288	0.5648	1.0939	0.0400	4	0.0582	0.7255	0.6689	56.85
	FEBRUARY	-0.0928	0.3125	0.7246	0.1135	5	0.0639	0.7255	0.3761	48.73
	MARCH	-0.1780	0.2292	0.6439	0.2552	3	0.1562	0.7255	0.2415	46.94
	APRIL	-0.0784	0.3806	0.8830	0.1021	5	0.2804	0.7255	0.3246	48.37
	MAY	-13.2500	-6.5385	1.5714	0.1590	1	-0.0527	0.7308	-3.4597	915.19
	JUNE	-9.1000	2.0833	10.4688	0.6897	1	-0.0250	0.7500	1.6349	1112.92
	JULY	-10.4610	-0.7873	8.8269	0.8015	500	0.2427	0.7451	0.1662	715.92
	AUGUST	-6.4181	-1.0206	4.1506	0.8015	4	0.0718	0.7451	-1.0468	507.21
	SEPTEMBER	-1.4664	2.8509	7.8566	0.1745	2	0.0075	0.7451	3.9114	359.58
	OCTOBER	-2.4737	0.3636	3.2727	0.8465	1	-0.0669	0.7500	0.9901	320.55
	NOVEMBER	-0.5469	0.5227	1.6944	0.4532	1	-0.0092	0.7500	0.6356	129.07
	DECEMBER	0.4514	1.0093	1.6069	0.0026	3	-0.1309	0.7451	1.0525	75.48
09CA006 - Nisling River below Onion Creek	AVG_Q	-0.4119	1.6234	3.1692	0.0957	6	0.1577	0.3137	1.1035	-31.25
	WAT_YR_Q	-209.6904	717.9317	1272.5607	0.1982	6	0.2464	0.2941	433.6255	-17980.09
	MIN_Q	0.0967	0.2993	0.5224	0.0046	7	0.2394	0.3137	0.1671	-6.69
	MAX_Q	-8.8594	3.5110	19.6825	0.6494	6	0.1084	0.3529	8.8949	138.44
	MAX_Q_DATE	-4.0000	-0.6000	2.6250	0.6217	1	-0.2680	0.3462	-0.6930	216.70
	DATE_CM	-3.0909	-0.7143	1.8571	0.3240	1	-0.1991	0.3462	-0.5474	237.21
	PULSE_DATE	-3.6058	-0.8194	1.5631	0.6204	5	0.2198	0.3137	-2.3105	154.36
	ANN_30Q_MIN	0.0097	0.2327	0.4951	0.0294	4	0.1386	0.2941	0.2265	-2.86
	ANN_7Q_MIN	0.0046	0.1974	0.4034	0.0478	4	0.1194	0.2941	0.2075	-1.75
	BASEFLOW	-0.1191	0.2635	0.7261	0.2661	4	0.3133	0.3333	0.2234	-2.20
	JUN-SEP_30Q_MIN	-1.3836	1.7639	3.6562	0.2763	8	0.2030	0.2941	0.8544	-49.62
	JUN-SEP_7Q_MIN	-1.1991	0.9243	2.1235	0.3731	5	0.1832	0.2941	0.9385	-19.16
	JANUARY	-0.1208	0.3114	0.7576	0.1740	8	0.3538	0.3333	0.2067	-4.63
	FEBRUARY	-0.0379	0.3666	0.7435	0.1275	13	0.3663	0.3333	0.2603	-8.20
	MARCH	0.0070	0.2966	0.5728	0.0357	6	0.2051	0.3333	0.2600	-5.64
	APRIL	0.1957	0.3538	0.5118	0.0002	4	-0.2622	0.3333	0.4118	-7.28
	MAY	1.0333	5.1000	8.0333	0.0064	1	-0.1827	0.3462	4.5102	-142.90
	JUNE	-2.9086	0.9407	4.5653	0.7731	2	0.0370	0.3333	1.6096	7.74
	JULY	-1.1145	2.6263	5.9702	0.1376	4	0.1027	0.2941	2.0387	-73.54
	AUGUST	-4.2947	1.3223	6.3127	0.5584	4	0.0502	0.3137	0.5056	7.79
	SEPTEMBER	-1.6250	1.7385	4.0000	0.2889	1	-0.0100	0.3462	1.2076	-18.90
	OCTOBER	0.2944	1.2149	2.0615	0.0124	4	0.1196	0.3529	0.9131	-24.07
	NOVEMBER	-0.2981	0.4216	1.0513	0.1978	6	0.2682	0.3529	0.3322	-3.62
	DECEMBER	-0.2375	0.3434	0.9130	0.2558	5	0.3207	0.3529	0.2372	-3.53
09CD001 - Yukon River above White River	AVG_Q	-5.0671	2.7650	9.8908	0.5462	5	0.3075	0.7451	0.0689	1125.10
	WAT_YR_Q	-1610.2818	1165.1951	3855.3601	0.5562	6	0.3475	0.7255	425.8179	415434.73
	MIN_Q	-1.5889	-0.1955	0.9964	0.6691	5	0.1015	0.7451	-0.7202	323.78
	MAX_Q	-30.0316	1.5709	28.4204	0.9599	4	0.1718	0.7451	3.0324	3499.17
	MAX_Q_DATE	-0.5000	0.0000	0.3077	0.9132	1	-0.0360	0.7500	-0.1121	162.00
	DATE_CM	-0.3750	-0.1000	0.1111	0.3828	1	-0.0028	0.7500	-0.2024	200.50
	PULSE_DATE	-0.2181	0.0817	0.3563	0.6151	6	0.1220	0.7451	-0.1498	129.54
	ANN_30Q_MIN	-1.8620	-0.4531	0.9209	0.5738	3	0.0855	0.7255	-0.3891	343.21
	ANN_7Q_MIN	-1.9641	-0.5557	0.8050	0.4560	3	0.0955	0.7255	-0.4099	344.07
	BASEFLOW	-0.5808	1.0064	2.8585	0.1779	4	0.0576	0.7255	1.3383	377.06
	JUN-SEP_30Q_MIN	-1.3048	8.2549	17.6865	0.0867	4	0.1690	0.7255	5.9467	1159.48
	JUN-SEP_7Q_MIN	0.1864	9.3486	17.9110	0.0454	9	0.1590	0.7255	6.6441	1138.41
	JANUARY	-0.3773	2.2013	4.3956	0.1135	4	0.1897	0.7255	2.2193	346.04
	FEBRUARY	-1.0000	0.9583	2.5682	0.3205	1	0.0438	0.7308	0.8898	354.02

Station	Variable	Lower Bound	Trend Slope	Upper Bound	Significance (p)	nruns	autocor	valid_frac	linear	intercept
	MARCH	-1.8792	-0.4426	1.2517	0.5562	4	0.1384	0.7255	-0.3438	354.47
	APRIL	-1.5000	-0.2708	1.3333	0.6874	1	0.0456	0.7308	-0.1932	366.91
	MAY	-19.4737	-4.0000	15.4545	0.6238	1	0.0137	0.7308	0.4902	1519.00
	JUNE	-17.6893	4.0183	26.6525	0.7061	3	0.1104	0.7451	5.4615	2798.44
	JULY	-25.1732	-4.7113	18.2735	0.7248	4	0.2017	0.7451	-4.8300	2343.56
	AUGUST	-17.2722	-4.9608	9.6567	0.4814	4	0.1866	0.7451	-5.3785	1880.56
	SEPTEMBER	-5.9583	4.7906	17.2834	0.3522	4	0.0874	0.7451	7.1078	1455.56
	OCTOBER	-3.7515	4.2796	12.0706	0.3268	3	0.0669	0.7451	3.8759	1136.93
	NOVEMBER	-6.2879	-2.3167	1.4000	0.2084	1	0.0013	0.7500	-3.6204	738.18
	DECEMBER	-0.2222	2.1875	4.7692	0.0575	1	0.0270	0.7500	2.5455	409.69
09DD003 - Stewart River at the mouth	AVG_Q	0.0565	1.8415	3.4799	0.0412	1	-0.1660	0.9615	1.4550	420.86
	WAT_YR_Q	-138.8900	468.2052	1072.9032	0.1033	1	0.0404	0.9423	337.8059	158900.45
	MIN_Q	-0.0215	0.2409	0.5120	0.0740	3	0.1782	0.9412	0.0214	55.96
	MAX_Q	-10.0000	5.1351	20.7317	0.5087	1	-0.2492	0.9615	2.0739	2163.78
	MAX_Q_DATE	-0.1860	0.0000	0.2333	0.8868	1	0.0471	0.9615	-0.0845	159.50
	DATE_CM	-0.2400	-0.0400	0.1667	0.6876	1	-0.0197	0.9615	-0.2434	183.06
	PULSE_DATE	-0.3736	-0.2289	-0.0543	0.0128	4	0.1061	0.9412	-0.4353	132.20
	ANN_30Q_MIN	0.0329	0.2526	0.4768	0.0265	4	0.0717	0.9216	0.2064	56.57
	ANN_7Q_MIN	0.0236	0.2775	0.5057	0.0252	5	0.0672	0.9216	0.2232	54.89
	BASEFLOW	0.1329	0.4106	0.6895	0.0043	2	0.0219	0.9608	0.3392	72.90
	JUN-SEP_30Q_MIN	-0.1000	2.3532	4.8833	0.0568	1	-0.0591	0.9423	2.3799	406.00
	JUN-SEP_7Q_MIN	-1.0882	1.5393	4.0714	0.2376	1	0.0104	0.9423	1.6973	380.66
	JANUARY	0.2422	0.5284	0.8564	0.0011	3	0.0177	0.9608	0.4523	70.83
	FEBRUARY	0.1221	0.4311	0.6485	0.0026	3	0.0483	0.9608	0.2911	61.73
	MARCH	0.0536	0.2829	0.4990	0.0151	5	0.0562	0.9608	0.2058	57.70
	APRIL	-0.0521	0.2760	0.6083	0.0962	3	0.0727	0.9608	0.2474	62.75
	MAY	-5.0455	2.1297	9.6667	0.5693	1	-0.0422	0.9423	4.2022	782.15
	JUNE	-9.2308	-1.7054	5.9524	0.5989	1	-0.0414	0.9423	-4.3566	1559.46
	JULY	-6.2941	-0.4615	4.7045	0.8606	1	0.0429	0.9615	-0.9441	804.88
	AUGUST	-4.2000	0.1111	3.9259	0.9600	1	-0.1254	0.9615	0.6572	621.39
	SEPTEMBER	0.4677	4.2083	8.0429	0.0329	1	-0.0457	0.9615	3.8942	503.92
	OCTOBER	-0.6667	1.6053	3.7143	0.2022	1	-0.1211	0.9808	2.3479	280.24
	NOVEMBER	-0.1190	0.7632	1.4444	0.1008	1	0.0169	0.9808	0.8365	139.24
	DECEMBER	-0.0614	0.4717	1.0656	0.0790	4	0.0536	0.9804	0.4387	100.44
09DD004 - McQuesten River near the Mouth	AVG_Q	-0.0066	0.1980	0.4390	0.0827	4	0.0671	0.6275	0.1670	30.89
	WAT_YR_Q	-5.9012	89.2532	152.2741	0.0716	4	0.0294	0.6078	84.4263	11079.69
	MIN_Q	0.0335	0.0814	0.1344	0.0041	4	0.0409	0.6275	0.0773	3.98
	MAX_Q	-2.8473	0.0980	3.2693	0.9527	3	0.0665	0.6667	0.2216	260.90
	MAX_Q_DATE	-0.5118	-0.0690	0.3834	0.8840	4	0.2462	0.6275	-0.0730	147.57
	DATE_CM	-0.4286	0.0000	0.4167	0.9172	1	0.0477	0.6538	0.0936	167.50
	PULSE_DATE	-0.3636	-0.0870	0.1053	0.3723	1	-0.0269	0.6538	-0.1251	124.33
	ANN_30Q_MIN	0.0290	0.0945	0.1363	0.0039	5	0.0321	0.6078	0.0660	4.00
	ANN_7Q_MIN	0.0299	0.0834	0.1301	0.0037	4	-0.0021	0.6275	0.0731	4.05
	BASEFLOW	0.0208	0.0954	0.1401	0.0088	5	0.1307	0.6471	0.0728	5.37
	JUN-SEP_30Q_MIN	-0.2320	0.1990	0.6978	0.2773	4	0.1699	0.6275	0.1975	23.10
	JUN-SEP_7Q_MIN	-0.1669	0.1816	0.5406	0.2365	4	0.1504	0.6275	0.1734	22.00
	JANUARY	-0.0051	0.0670	0.1228	0.0660	4	0.1052	0.6667	0.0667	6.26
	FEBRUARY	-0.0026	0.0667	0.1224	0.0540	3	0.0339	0.6667	0.0747	5.24
	MARCH	-0.0061	0.0522	0.1180	0.0802	4	0.0933	0.6667	0.0508	5.23
	APRIL	-0.0186	0.0463	0.1243	0.1683	1	-0.1135	0.6731	0.0436	6.69
	MAY	-0.5198	0.7829	2.7330	0.2726	5	0.1534	0.6667	0.6367	84.31
	JUNE	-1.7001	-0.2176	1.1468	0.8821	4	0.2243	0.6667	-0.1465	90.07
	JULY	-0.2702	0.3911	1.0536	0.1583	2	0.0323	0.6275	0.1931	35.84
	AUGUST	-0.3211	0.1857	0.8000	0.4408	1	-0.0408	0.6538	0.3904	29.86
	SEPTEMBER	-0.0732	0.4983	1.0687	0.0949	3	-0.0456	0.6275	0.4308	26.69
	OCTOBER	-0.1594	0.2678	0.7098	0.1726	4	0.1430	0.6667	0.1379	16.39
	NOVEMBER	-0.0308	0.1406	0.3143	0.1231	3	0.2348	0.6667	0.0575	10.67
	DECEMBER	0.0523	0.1330	0.2157	0.0049	5	0.1545	0.6667	0.0999	6.30
09EA003 - Klondike River above Bonanza Creek	AVG_Q	-0.0607	0.1987	0.4366	0.1331	1	-0.1353	0.9231	0.1182	59.91
	WAT_YR_Q	2.8455	85.1145	161.9826	0.0436	1	-0.0843	0.9038	85.7311	21435.88
	MIN_Q	0.0361	0.0932	0.1468	0.0023	5	0.3042	0.9020	0.0741	6.15
	MAX_Q	-1.9750	0.2113	2.4118	0.8428	1	0.0154	0.9423	0.7792	411.77

Station	Variable	Lower Bound	Trend Slope	Upper Bound	Significance (p)	nruns	autocor	valid_frac	linear	intercept
	MAX_Q_DATE	-0.3846	-0.0728	0.1333	0.3970	1	-0.0425	0.9231	-0.0987	155.60
	DATE_CM	-0.2308	0.0000	0.2727	0.9361	1	-0.0407	0.9231	-0.0272	171.00
	PULSE_DATE	-0.1843	-0.0467	0.0997	0.4717	3	0.0414	0.9020	-0.1447	123.11
	ANN_30Q_MIN	0.0366	0.0868	0.1367	0.0012	4	0.1560	0.8824	0.0835	6.90
	ANN_7Q_MIN	0.0402	0.0920	0.1441	0.0005	4	0.1453	0.8824	0.0891	6.46
	BASEFLOW	0.0637	0.1152	0.1602	0.0001	5	0.1380	0.9216	0.1014	8.73
	JUN-SEP_30Q_MIN	-0.1427	0.1781	0.5422	0.3416	1	-0.1153	0.9231	0.1498	48.71
	JUN-SEP_7Q_MIN	-0.0181	0.2414	0.5365	0.0783	1	-0.1024	0.9038	0.2507	42.51
	JANUARY	0.0622	0.1186	0.1773	0.0002	4	0.1321	0.9216	0.1094	8.39
	FEBRUARY	0.0577	0.1026	0.1504	0.0001	4	0.0881	0.9216	0.0971	7.73
	MARCH	0.0357	0.0863	0.1412	0.0012	4	0.1101	0.9216	0.0770	7.78
	APRIL	0.0143	0.0805	0.1433	0.0135	1	0.0026	0.9231	0.0803	9.37
	MAY	-0.6111	0.4404	1.5600	0.4392	1	-0.0575	0.9231	0.6071	143.69
	JUNE	-2.5442	-0.8746	0.4438	0.1728	5	0.0582	0.9020	-0.9675	216.31
	JULY	-0.5200	0.2384	0.9412	0.4770	1	-0.0730	0.9231	0.2537	81.54
	AUGUST	-0.4480	0.2180	0.8480	0.4937	1	-0.1768	0.9231	0.2037	66.07
	SEPTEMBER	0.0581	0.6200	1.1405	0.0336	1	-0.1471	0.9231	0.4259	57.14
	OCTOBER	-0.0261	0.2639	0.6310	0.0944	1	0.0389	0.9423	0.2998	32.46
	NOVEMBER	-0.0106	0.1189	0.2466	0.0965	4	0.0748	0.9412	0.1280	17.60
	DECEMBER	0.0661	0.1420	0.2169	0.0006	3	0.0183	0.9412	0.1186	10.95
09EA004 - North Klondike River near the Mouth	AVG_Q	-0.0756	0.0013	0.0847	0.9099	1	-0.2544	0.7308	0.0110	12.52
	WAT_YR_Q	-29.2878	-7.2135	18.0694	0.5387	1	-0.1957	0.7115	-3.5656	4959.24
	MIN_Q	0.0065	0.0153	0.0211	0.0003	3	-0.0842	0.7059	0.0124	1.51
	MAX_Q	-1.0065	-0.0154	0.9778	0.9699	1	-0.0568	0.7308	0.0031	87.49
	MAX_Q_DATE	-0.5882	-0.3077	0.0526	0.1098	1	-0.0423	0.7308	-0.2726	169.54
	DATE_CM	-0.4000	0.0000	0.2222	0.8010	1	-0.0303	0.7308	-0.2152	178.00
	PULSE_DATE	-0.4211	-0.1176	0.1613	0.4425	1	-0.0355	0.7308	-0.2533	131.91
	ANN_30Q_MIN	0.0035	0.0130	0.0206	0.0062	1	-0.0838	0.6923	0.0118	1.71
	ANN_7Q_MIN	0.0045	0.0140	0.0215	0.0073	1	-0.0303	0.7115	0.0126	1.61
	BASEFLOW	0.0058	0.0158	0.0247	0.0021	5	0.0617	0.7255	0.0147	2.24
	JUN-SEP_30Q_MIN	-0.1107	0.0055	0.1125	0.9479	1	-0.0928	0.7115	-0.0153	11.28
	JUN-SEP_7Q_MIN	-0.0827	0.0212	0.0986	0.7436	1	-0.0776	0.7115	-0.0024	10.21
	JANUARY	-0.0008	0.0119	0.0240	0.0775	4	0.1253	0.7255	0.0134	2.39
	FEBRUARY	0.0070	0.0177	0.0250	0.0030	3	0.0373	0.7255	0.0156	1.94
	MARCH	0.0009	0.0100	0.0181	0.0357	1	-0.0367	0.7308	0.0080	1.92
	APRIL	-0.0019	0.0133	0.0234	0.0916	3	0.0812	0.7255	0.0146	2.04
	MAY	-0.1455	0.1363	0.3322	0.3138	1	0.0144	0.7115	0.1530	16.29
	JUNE	-1.0197	-0.5886	-0.1680	0.0093	5	0.1535	0.7059	-0.3781	56.19
	JULY	-0.2955	-0.0462	0.1706	0.6782	1	-0.1737	0.7308	-0.0134	22.77
	AUGUST	-0.1293	0.0526	0.2202	0.5953	3	0.0854	0.7059	0.0539	13.65
	SEPTEMBER	-0.0269	0.0990	0.2217	0.1413	1	-0.0180	0.7308	0.0892	10.13
	OCTOBER	-0.0800	0.0100	0.0835	0.8370	1	-0.0480	0.7500	-0.0033	7.97
	NOVEMBER	-0.0178	0.0170	0.0473	0.2310	1	-0.0997	0.7500	0.0155	4.00
	DECEMBER	0.0030	0.0221	0.0425	0.0252	1	-0.0777	0.7500	0.0191	2.69
09EB003 - Indian River above the Mouth	AVG_Q	-0.0243	0.0900	0.1985	0.1718	6	0.1020	0.5098	0.0582	3.07
	WAT_YR_Q	-14.0840	29.3177	70.7212	0.2525	4	0.1361	0.4902	19.8422	1337.70
	MIN_Q	-0.0010	0.0008	0.0028	0.3319	3	0.3594	0.5098	0.0026	-0.02
	MAX_Q	-0.9154	0.4842	2.1667	0.4243	1	-0.0066	0.5962	1.0093	58.44
	MAX_Q_DATE	-1.0000	-0.5385	0.1538	0.0984	1	-0.0887	0.5577	-0.3760	151.77
	DATE_CM	-0.4737	0.4000	1.1739	0.3673	1	-0.3950	0.5577	0.3552	148.60
	PULSE_DATE	-0.6713	-0.2285	0.2419	0.2901	4	0.0670	0.5098	-0.3552	124.06
	ANN_30Q_MIN	-0.0008	0.0011	0.0047	0.3383	3	0.1371	0.4902	0.0030	-0.02
	ANN_7Q_MIN	-0.0006	0.0007	0.0037	0.3431	3	0.1403	0.5098	0.0036	-0.01
	BASEFLOW	0.0010	0.0073	0.0152	0.0185	3	-0.0459	0.5882	0.0097	-0.14
	JUN-SEP_30Q_MIN	-0.0478	0.0569	0.1429	0.3780	1	-0.0280	0.5577	0.0466	1.90
	JUN-SEP_7Q_MIN	-0.0145	0.0761	0.1537	0.0778	3	0.0287	0.5098	0.0516	0.51
	JANUARY	0.0005	0.0056	0.0120	0.0271	5	-0.0219	0.6078	0.0087	-0.10
	FEBRUARY	0.0000	0.0026	0.0070	0.0527	5	0.0876	0.6078	0.0059	-0.04
	MARCH	-0.0004	0.0012	0.0046	0.1634	4	0.1134	0.6078	0.0041	-0.02
	APRIL	0.0003	0.0127	0.0409	0.0379	1	-0.0616	0.6154	0.0491	-0.18
	MAY	-0.6582	-0.0441	0.6997	0.9005	4	0.1351	0.5294	0.3700	24.73
	JUNE	-0.1645	0.0429	0.1681	0.6833	500	0.1095	0.6078	-0.1126	7.34

Station	Variable	Lower Bound	Trend Slope	Upper Bound	Significance (p)	nruns	autocor	valid_frac	linear	intercept
	JULY	-0.0500	0.0748	0.2150	0.2365	1	-0.0191	0.6154	0.1003	4.20
	AUGUST	-0.0376	0.1317	0.3350	0.1534	1	-0.0248	0.5962	0.1393	1.90
	SEPTEMBER	-0.0107	0.1367	0.2655	0.0744	3	-0.0077	0.5882	0.1497	2.56
	OCTOBER	0.0288	0.1015	0.1774	0.0144	3	-0.0130	0.6078	0.1076	-0.17
	NOVEMBER	0.0237	0.0505	0.0728	0.0011	3	-0.2668	0.6078	0.0492	-0.69
	DECEMBER	0.0050	0.0166	0.0281	0.0075	1	0.0118	0.6154	0.0187	-0.33
09EB004 - Sixty Mile River near the Mouth	AVG_Q	-0.1539	0.3885	0.7603	0.1501	1	0.0047	0.3462	0.2959	-1.63
	WAT_YR_Q	-122.3009	176.1795	317.5928	0.2241	9	0.2176	0.3137	53.9088	-1763.39
	MIN_Q	-0.0538	0.0184	0.0620	0.7108	16	0.3548	0.3333	-0.0061	-0.60
	MAX_Q	-8.5000	2.0000	9.1538	0.8202	1	-0.2973	0.3462	0.7033	89.00
	MAX_Q_DATE	-2.3333	-0.2500	1.2500	0.6485	1	-0.2277	0.3462	-0.1517	158.00
	DATE_CM	-2.9293	-0.3674	1.8620	0.7731	4	0.0572	0.3333	-0.1548	178.29
	PULSE_DATE	-1.1429	-0.5000	0.2727	0.4247	1	-0.1719	0.3462	-0.3013	140.50
	ANN_30Q_MIN	-0.0772	-0.0192	0.0465	0.5584	6	0.2176	0.3137	-0.0150	1.24
	ANN_7Q_MIN	-0.0851	-0.0006	0.0565	0.9016	5	0.3351	0.3333	-0.0067	0.43
	BASEFLOW	-0.0943	-0.0463	0.0166	0.1151	3	0.2710	0.3137	-0.0210	3.01
	JUN-SEP_30Q_MIN	-0.5665	0.0217	0.6507	0.7731	4	0.1448	0.3333	0.1670	11.76
	JUN-SEP_7Q_MIN	-0.3248	0.1756	0.6455	0.4838	7	0.1061	0.3333	0.2578	-0.19
	JANUARY	-0.1121	-0.0389	0.0558	0.3434	5	0.3842	0.3333	-0.0026	2.62
	FEBRUARY	-0.0830	-0.0210	0.0482	0.5923	5	0.3164	0.3333	-0.0037	1.41
	MARCH	-0.0873	-0.0079	0.0584	0.7731	6	0.3342	0.3333	-0.0070	0.78
	APRIL	-0.0420	0.0464	0.1667	0.1978	1	-0.1237	0.3462	0.1427	-0.76
	MAY	-1.2286	0.4667	2.3933	0.5445	1	-0.0061	0.3462	0.7908	30.87
	JUNE	-1.6887	0.0764	1.3564	0.9016	7	0.3138	0.3333	-0.2075	19.99
	JULY	-0.2277	0.7000	2.1929	0.1501	1	0.0276	0.3462	1.1257	-15.63
	AUGUST	-0.9820	0.4036	1.6850	0.4260	1	-0.1693	0.3462	0.2984	-2.94
	SEPTEMBER	-0.9573	-0.2899	0.8582	0.7108	9	0.1734	0.3333	0.3134	31.42
	OCTOBER	-0.3272	-0.1223	0.0579	0.3031	6	0.1379	0.3333	0.0234	12.43
	NOVEMBER	-0.3682	-0.2074	0.0395	0.1275	5	0.1782	0.3333	-0.0644	12.01
	DECEMBER	-0.1668	-0.1060	-0.0284	0.0074	7	0.2757	0.3333	-0.0396	6.27

***NOTE**: Variables highlighted in green are significant at $p < 0.05$, and those highlighted in yellow are significant at $p < 0.10$.*



Coffee Gold Project

Climate Change Projections for Coffee Creek Region, Yukon

September 2015

Prepared for:

KAMINAK GOLD CORPORATION

Prepared by:

Lorax Environmental Services
2289 Burrard St, Vancouver BC

LORAX ENVIRONMENTAL

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September 2015

LORAX ENVIRONMENTAL

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1. Introduction

Kaminak Gold Corporation (Kaminak) is in the process of developing and permitting the Coffee Gold Project (Project), a proposed heap leach operation located in west-central Yukon, approximately 180 km south of Dawson City. The Project is located within the traditional territory of the Tr´ondëk Hwëch´in and the asserted traditional territory of the White River First Nation. A portion of Kaminak's claim block is located in Selkirk First Nation's traditional territory. Currently the Project is undergoing a detailed Feasibility Study with project engineering and design progressing with full consideration of environmental conditions within the project area.

Climate, meteorological conditions and attendant hydrological systems at the Coffee Gold Project influence engineering design parameters, in particular the heap leach design, heap leach water balance, site wide water balance and ultimately comprehensive site wide water management systems. Existing climate conditions at the Coffee Gold Project are unlikely to remain static and consideration of potential climate change scenarios are being incorporated into project planning. Kaminak commissioned Lorax Environmental Services Ltd. (Lorax) to conduct a climate change analysis for the Coffee Gold Project. The analysis, the subject of the following report, was prepared by Dr. Thomas Pedersen, Director, Lorax and current Director, Pacific Institute for Climate Solutions, University of Victoria; Dr. Pedersen also serves as Chair, Canadian Climate Forum.

Within a few to several decades global warming is projected to have a profound impact at high latitudes in both hemispheres. Impacts are already being widely felt: in the polar and sub-polar regions of northern Canada, average annual temperatures are rising—dramatically in some areas; regional snow cover is declining; glaciers are retreating; permafrost is thawing, particularly at lower elevations; and the areal coverage and frequency of wildfires are both on the rise. Such phenomena are summarized in the 2014 Yukon State of the Environment Report (http://www.env.gov.yk.ca/publications-maps/documents/SOE_2014_Web.pdf).

Climate-model projections suggest that the character of seasonal climate will also change significantly over the course of this century: winters on the whole will be warmer and wetter in the North while summers will be hotter and drier. Weather extremes, including heat waves and intense rainfall events are projected to become more frequent. There will also be, and already are, associated biological and ecological changes. Biomes are moving north, while optimal habitats for some plant and animal species are moving upward to higher-elevation (thus, cooler) areas. Each of these physical and biological impacts will

have effects across the Coffee Creek region that need to be considered in planning over the longer term.

As discussed in the following sections, if human society continues to follow the greenhouse-gas emissions pathway that is currently in place, within several decades the climate of the North, including the south-central Yukon, will be notably different. By the year 2100, average temperatures at the Coffee Creek Project site can reasonably be expected to be 3°C to 5°C warmer relative to the waning decades of the last century. Average annual precipitation at Coffee Creek may not change so notably. However, summer and winter can be expected to be slightly wetter in the future, with spring and fall seasons projected to see little net change in precipitation abundance.

Overall, warming is anticipated to be particularly pronounced in the summer at Coffee Creek and this will lead to a later freeze-up in fall and an earlier thaw in spring, according to the model results. In tandem, this yields a growing season that is as much as one month longer by the end of the century and implies a significantly lengthened duration for above-zero temperatures and consequent negative implications for permafrost integrity in the region.

2. Background to Climate Change Projections

Global climate models (GCMs) use a physical representation of the ocean-land-atmosphere system under various climate-forcing scenarios to project future mean climatic states. Over the last two decades, the international modeling community has established two sets of potential emissions pathways, the first published in 2000 by the Intergovernmental Panel on Climate Change (IPCC), as a Special Report on Emissions Scenarios (SRES). Four 'scenario families' (A1, A2, B1, B2) were outlined in that report that spanned possible 21st Century (and beyond) emissions pathways resulting from different global population and economic growth trajectories, varying emphases on energy sources (renewables versus fossil fuels) and materials energy intensities, and variable emphasis on local to global solutions (IPCC SRES, 2000). The A2 scenarios encompassed continuously increasing population and regional economic development in a world of independent, self-reliant nations. These defined the most rapid increases in emissions trajectories over the next 100 years.

A more recent set of scenarios, 'Representative Concentration Pathways' (RCPs) was produced for the Fifth Assessment Report of the IPCC released in 2014. RCPs describe four potential emissions trajectories (RCP2.6, RCP4.5, RCP6.0 and RCP8.5, Figure 2-1) that, like SRES pathways, could be possible depending on future international climate mitigation policies and primary socioeconomic influences including economic and population growth, fossil-fuel-derived energy intensity per unit of GDP, and technological advances.

The number associated with each RCP refers to an assumed change in radiative forcing by the year 2100 in Watts/m^2, relative to pre-industrial time. RCP 8.5 (*i.e.,* 8.5 W/m^2 of additional forcing by 2100) represents the "worst-case" scenario, and includes all greenhouse gas contributions, not just that from carbon dioxide. Two key points emerge when all four RCP scenarios are considered. First, regardless of which pathway is chosen, there is little difference in impact on global average surface temperature prior to mid-century, but after that point, the divergence is progressive and striking. By the year 2100, for example, should we follow the RCP 8.5 scenario, global average surface temperature increases relative to pre-industrial time will be on the order of 4-5°C (Figure 2-2). This outcome is very similar to that projected by the SRES A2 scenario. In contrast, temperature change can be held to <2°C by 2100 (Figure 2-2) if global society instead follows the RCP 2.6 pathway (the green curve in Figure 2-1, and the royal blue curve in Figure 2-2). Second, current emissions rates define a trajectory that is actually slightly *worse* than the RCP 8.5

pathway (note the labelled star in Figure 2-1). Given that, and considering the need to be conservative in forecasting potential future climatic changes, we adopt the worst-case scenario here. The SRES A2 pathway is very similar to the more recent RCP 8.5 trajectory, and is used in the future-climate projections that follow.

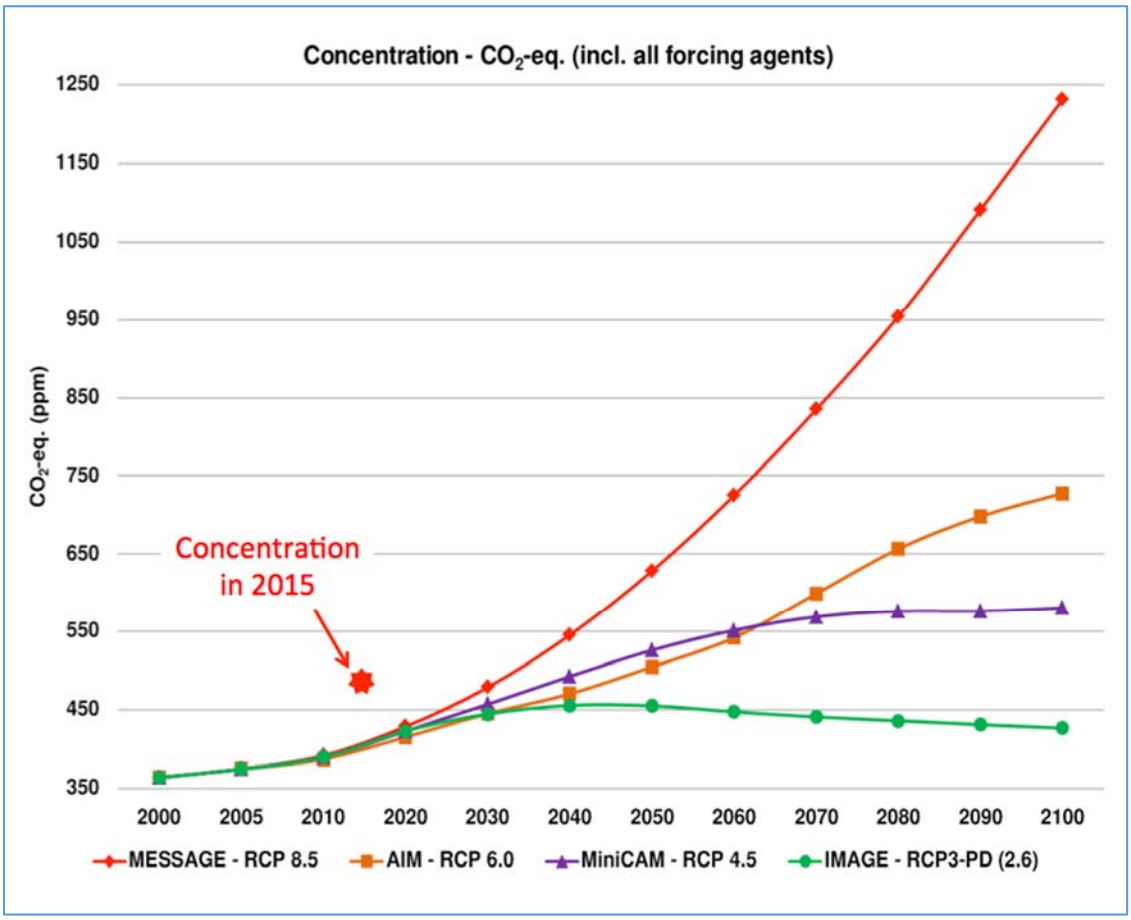


Figure 2-1: **Adapted from Moss et al. (2008), and https://en.wikipedia.org/wiki/Representative_Concentration_Pathways#/media/File:All_forcing_agents_CO2_equivalent_concentration.png. The red star illustrates the approximate concentration of all greenhouse gases at present, scaled as CO2-equivalent, equal to about 480 ppm of carbon dioxide in the atmosphere. The four IPCC Representative Concentration Pathways are shown to the year 2100 by the four coloured lines, each of which was calculated based on sets of socioeconomic and population growth assumptions**

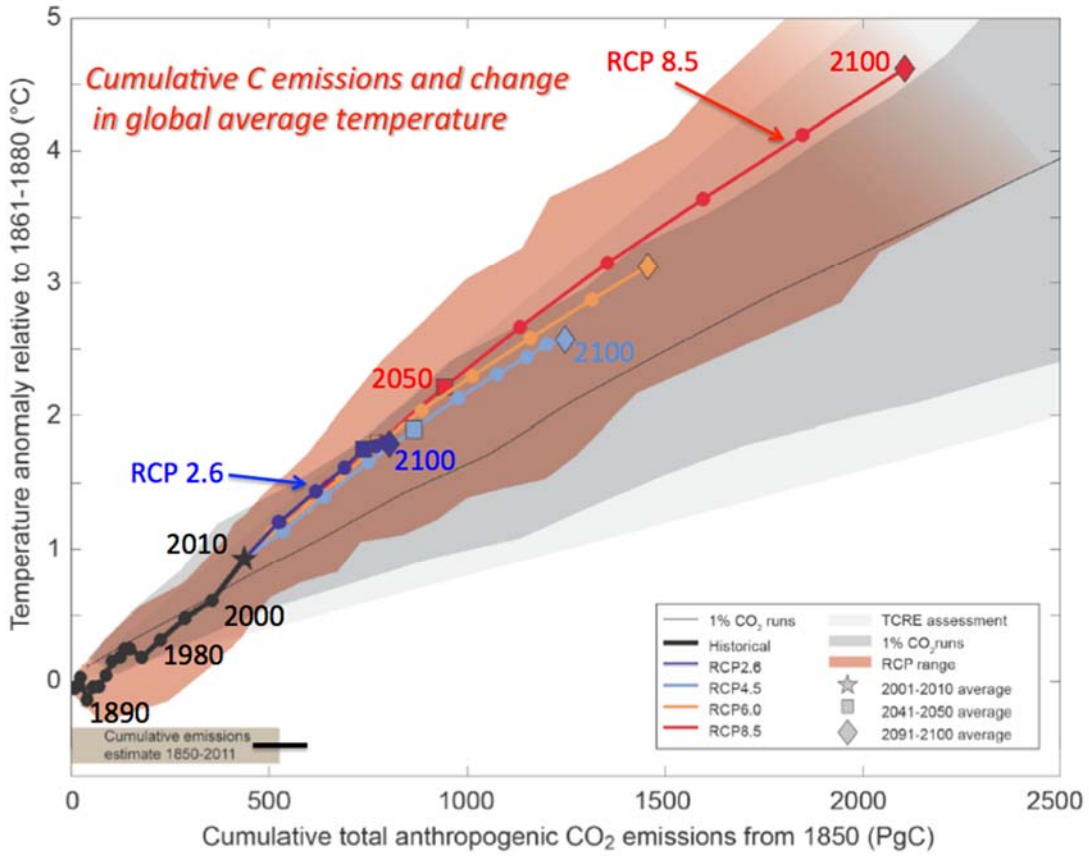


Figure 2-2: Projected global average temperature changes to the end of the Twenty-first Century relative to the late 19th Century, as a function of CO_2 emissions and time. Change in global temperature from 1870 to 2010 as a function of estimate emissions is shown by the black line. Dots for each pathway mark decade endpoints. If humanity follows the RCP 8.5 pathway, average global temperature at the end of this century will be ~4.5 ± 1.5 °C higher than in the 1861-1880 period. The figure has been modified from Figure 10 of: www.ipcc.ch/pdf/presentations/ar5/wg1/pc270913_appr_spm_stocker.pdf.

3. Methods and Data Sources

The two principal climate variables, temperature and precipitation, are discussed here for the region approximately bounded by longitudes 138.6 and 139.8°W and 62.7 and 63.0°N. The Coffee Creek heap leach site sits near the centre of this ~2300 km^2 quadrant. Projected dates of spring thaw and fall freeze are also included in the following discussion.

Modeled historical climate averages and future projections were obtained from the Scenarios Network for Alaska and Arctic Planning (SNAP) at the University of Alaska, Fairbanks, which produces climate information for Alaska and the Yukon region. All parameters specified for the projections that follow (Figure 4-1 through Figure 6-3). The following periods have been selected from the SNAP data to represent key phases of the proposed Coffee Gold Project:

- Historical (1961-1990)
- End of operations/closure (2030-2039)
- Post-closure (2060-2069)
- End of projections (2090-2099)

SNAP uses a statistical downscaling approach to apply baseline climate states projected by general circulation models (GCMs) onto high-resolution topography. The approach used– –"the delta method", descriptions of which can be found at https://www.snap.uaf.edu/methods/downscaling and http://www.ccafs-climate.org/statistical_downscaling_delta/ - draws on a suite of five top-ranked climate models of both past and future climate. Outputs discussed here are based on downscaled five-model averages.

Data sources, described at https://www.snap.uaf.edu/methods/data, yield a 2 km spatial resolution for the Yukon region that relies on PRISM (Parameter-Elevation Relationships on Independent Slopes Model) data and technology developed originally by Daly *et al.* (2008) at Oregon State University. PRISM technology is considered by regional climate modelers internationally to be state of the art. As noted above, the projections below are based on the IPCC SRES (2000) A2 scenario, which can be considered to be the 'worst case' future emissions trajectory. It must be emphasized, however, that global emissions today and over the previous decade *exceed* the pathway assigned by the constructed A2 scenario. "Worst case" may, therefore, prove to be an understatement.

4. Temperature Projections

Average annual temperatures are projected to rise significantly in the Coffee Creek region over the course of this century. The current annual average, about -3°C at the Coffee Gold Project site (Lorax, 2015), is forecast to rise by 3 to 5 degrees C by the end of the century, to on the order of +1 ± 1°C (Figure 4-1).

Average seasonal temperatures are projected to increase by a similar amount in spring, fall and winter, but will likely rise more dramatically in summer (compare Figure 4-2, Figure 4-4 and Figure 4-5 with Figure 4-3). Lorax (2015) estimated that June-July-August temperature for the project site at present is +11.3°C. By the end of the century, that 'summer average' temperature is projected to be between 14.9 and 16.5°C using the A2 scenario (Figure 4-3), an increase of some 3 to 5°C relative to average conditions today. Note that this projection is scenario dependent and therefore uncertain. Should greenhouse gas emissions increase at a rate less than that proscribed by SRES A2, end-of-century temperature increases in all seasons across the North would likely be lower. However, current global practices, as described above, do not support grounds for optimism: it is certain to warm at Coffee Creek over the course of this century, with a high probability that the increase will be several degrees across all seasons, with summer showing the largest change.

There is one caveat that applies at the seasonal level: episodic temperature inversions are common in Yukon valleys in winter, particularly January, as noted by Lorax (2015). Anecdotally, these can lower temperatures by as much as 15°C on a valley floor relative to nearby elevations upslope (personal communications, S. Mooney, Yukon Research Centre, Whitehorse, and Prof. David Atkinson, University of Victoria). PRISM-based reconstructions take into account such abrupt climatic shifts with elevation across Alaska and the Yukon by assigning two layers to the atmosphere: the boundary layer and the free atmosphere above it (Simpson *et al.*, 2005). Inversions are determined in the PRISM database by comparing surface station data with the Global Gridded Upper Air Statistics data set, as noted by Simpson *et al* (2005), and are taken into account in the SNAP projections (personal communication, Dr. Faron Anslow, Pacific Climate Impacts Consortium, University of Victoria). Thus, winter average temperatures along the Yukon River projected by SNAP for the Coffee Creek region incorporate the statistical likelihood that inversions will continue to occur episodically.

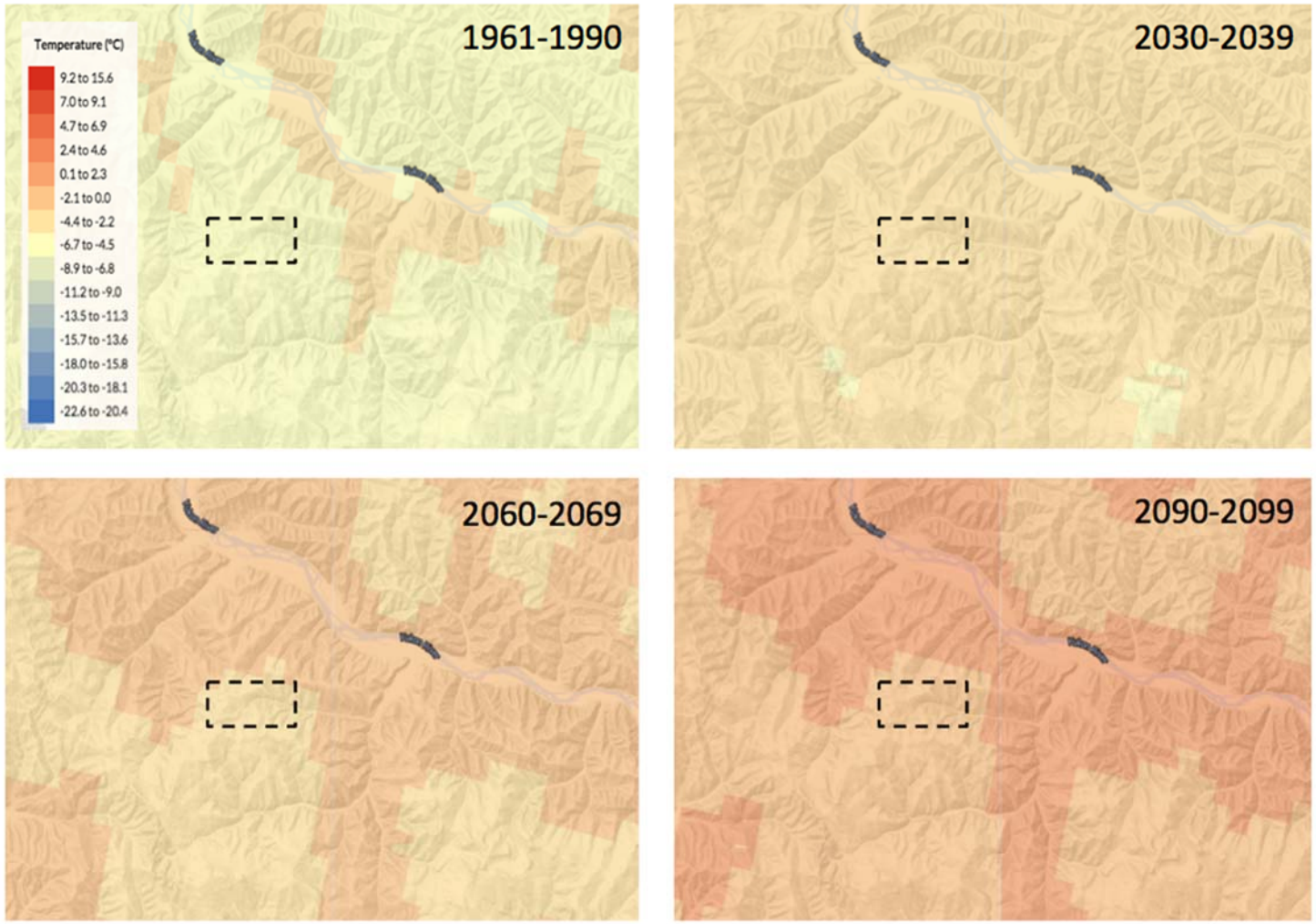


Figure 4-1: Temperature averages modeled using SNAP (see text) across the Coffee Creek region for both the past (1961-1990) and three future decades (2030-2039 – End of operations/Closure; 2060-2069 – Post-closure; and 2090-2099 – End of projections). The dashed rectangle marks the project site. The Yukon River (labelled) runs across the northeast corner of each panel. The 1961-1990 average is scaled using PRISM technology (see text) from data collected at multiple Yukon weather stations, and the constructions for three future decades are based on the SRES A2 scenario (see text). Spatial resolution of the model output is 2 km, as illustrated by the square grid cells (2 km per side).

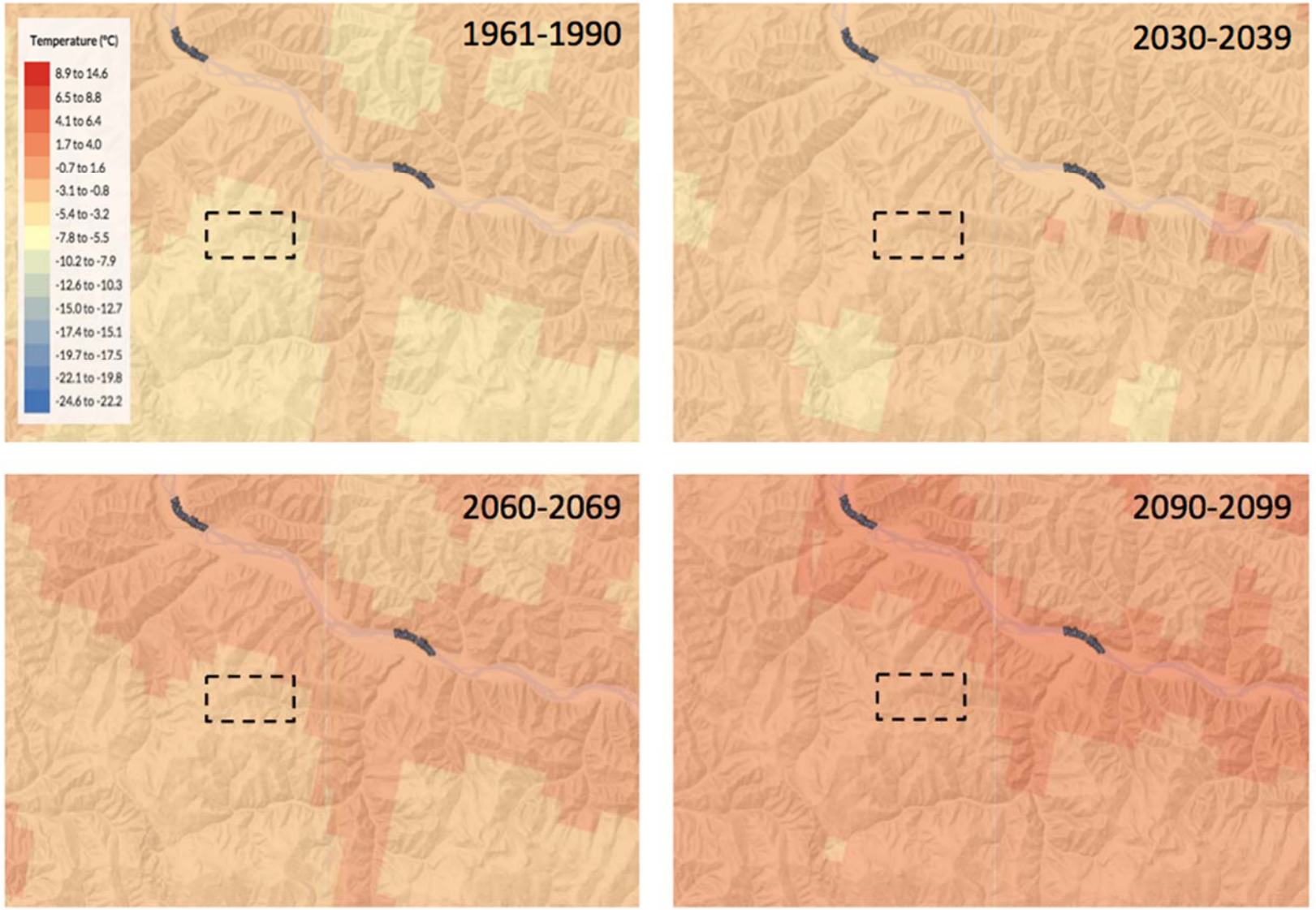


Figure 4-2: Temperature averages for Spring across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP. See Figure 4-1 caption for additional details.

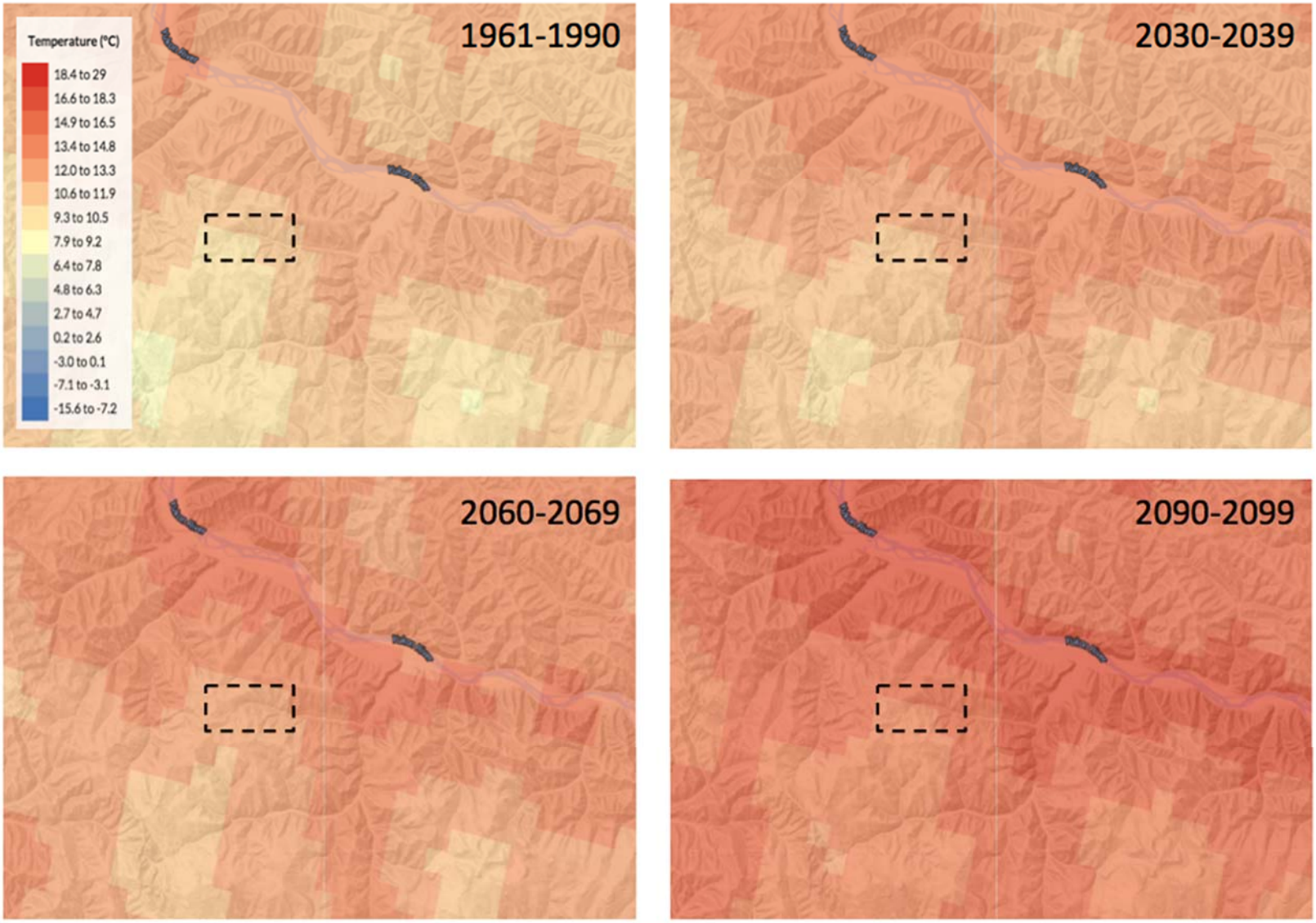


Figure 4-3: Temperature averages for Summer across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP. See Figure 4-1 caption for additional details.

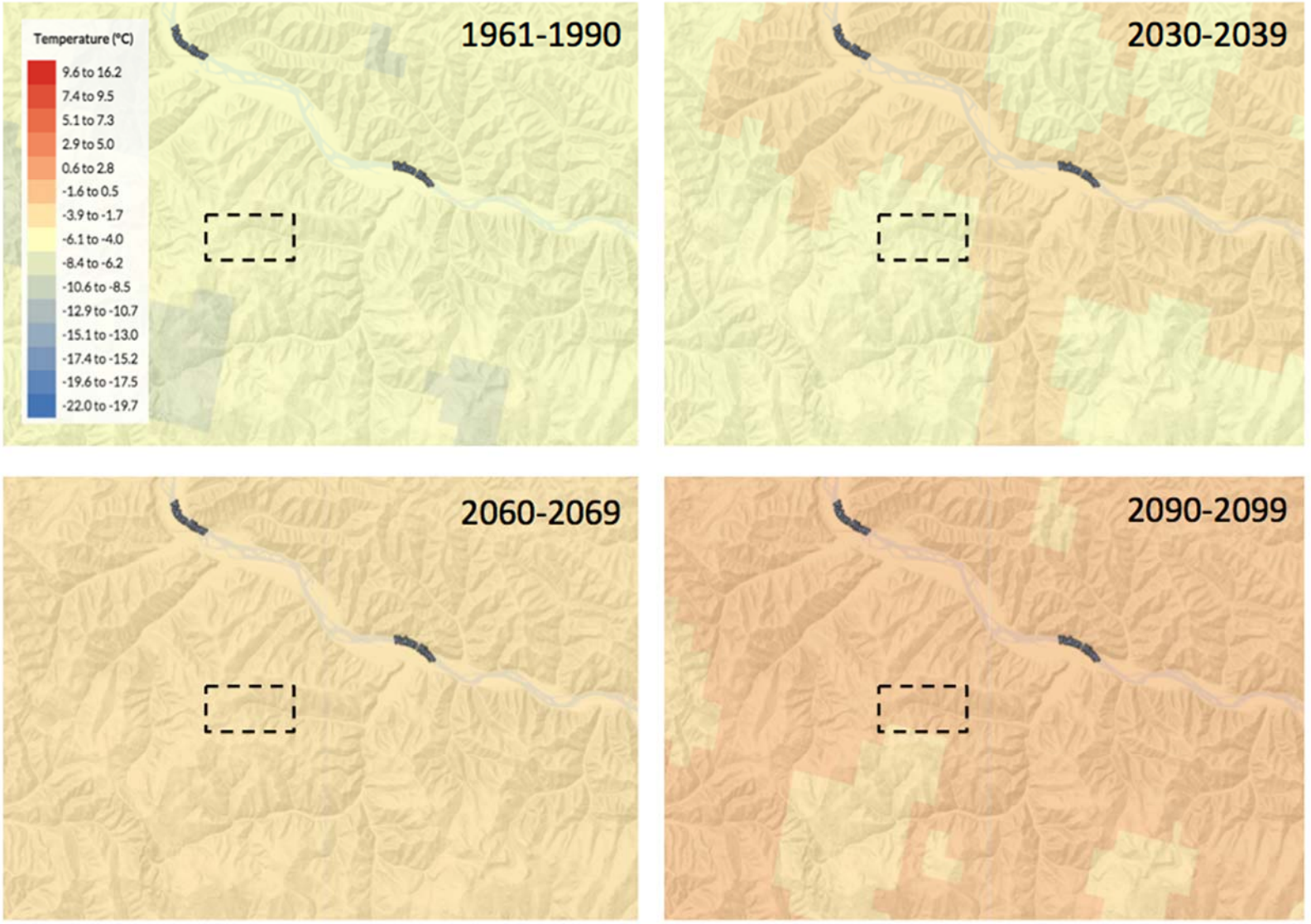


Figure 4-4: Temperature averages for Fall across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP. See Figure 4-1 caption for additional details.

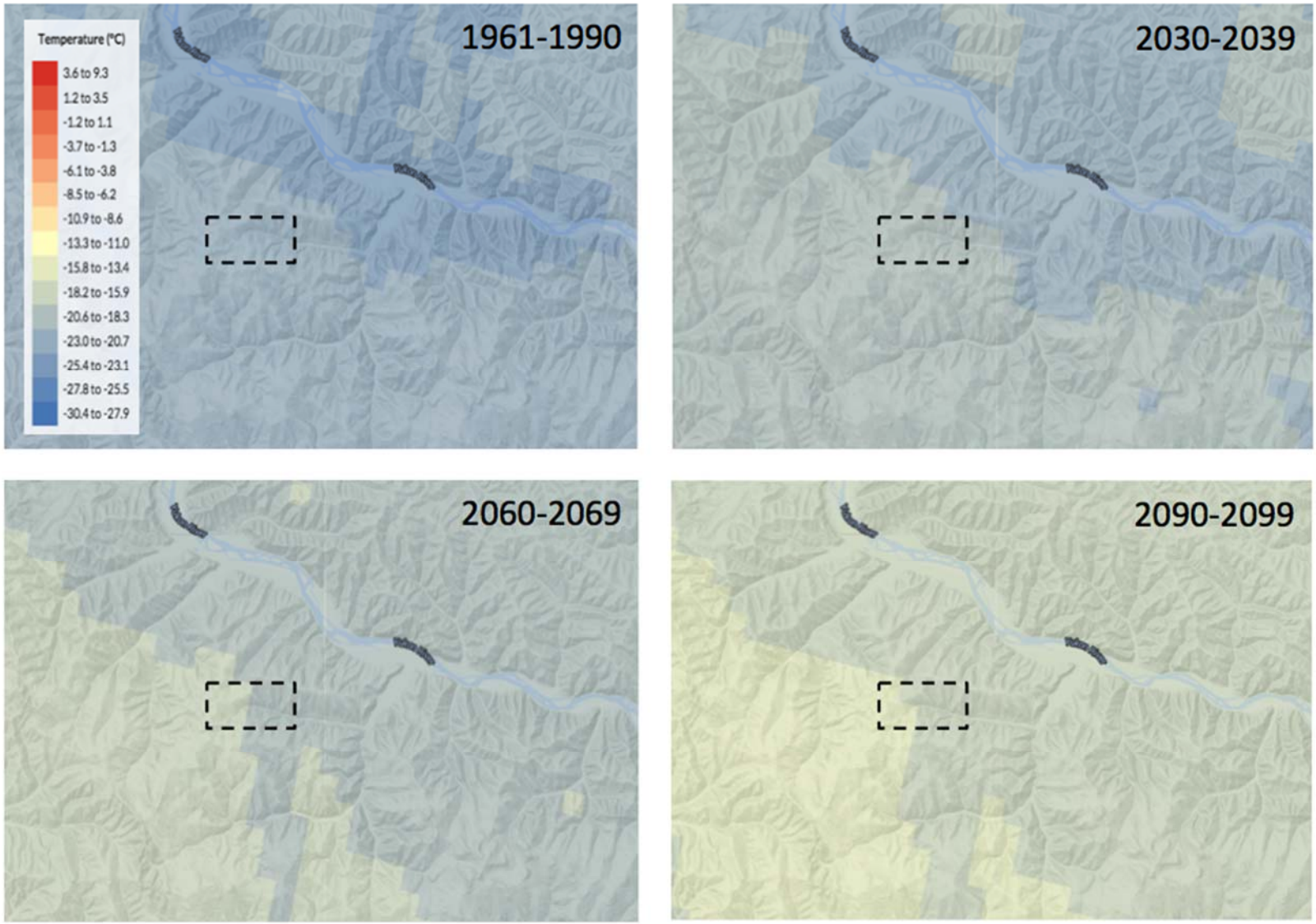


Figure 4-5: Temperature averages for Winter across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

Colder valley-bottom temperatures in winter notwithstanding, implications of the projected temperature increases for permafrost integrity in the region are obvious. The active layer can be expected to grow in thickness in the warmer months of coming decades, while the depth to intersection with permanently frozen ground will slowly increase. But how fast such changes will be witnessed remains a question largely dependent on the rate of change in radiative forcing with time.

5. Precipitation Projections

As for mean temperature, net precipitation in the Coffee Creek region overall is projected to increase over the course of this century (Figure 5-1). Lorax (2015) computed an average precipitation rate of 485 mm yr^{-1} for the project site at present, slightly higher than the 428-476 mm yr^{-1} modeled at the valley floor as the average over the 1961-1990 interval (Figure 5-1). At that same valley-floor elevation, average annual precipitation by the end of this century is projected to increase marginally to 477-525 mm yr^{-1}, while across much of the broader region, an increase of some 20% to some 574-670 mm yr^{-1} can be anticipated by the year 2100 (compare the lower right and upper left panels of Figure 5-1), given the emissions pathway specified by the SRES A2 scenario.

At present, the bulk of annual precipitation at Coffee Creek falls between May and September, with March and April, being particularly dry months (Lorax, 2015, Table 3-1). This contrasting pattern is projected to persist over the course of the century, albeit with Summer and Winter receiving greater precipitation than historically at the project site (compare Figure 5-2 through Figure 5-5; note that legend scales differ for each season), and little change being witnessed in Spring or Fall.

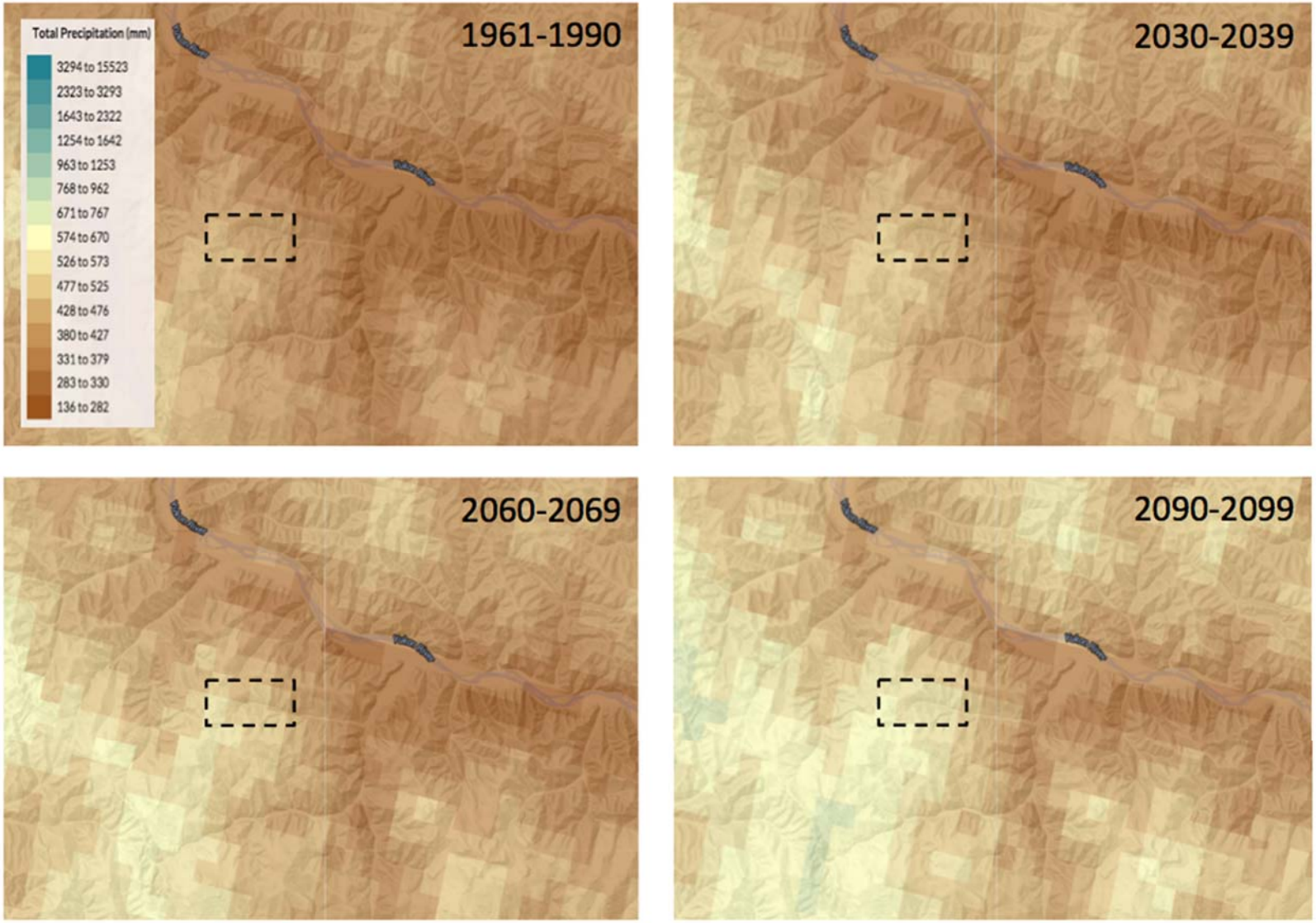


Figure 5-1: Annual precipitation averages in millimeters of water equivalent modeled using SNAP (see text) across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP. See Figure 4-1 caption for additional details.

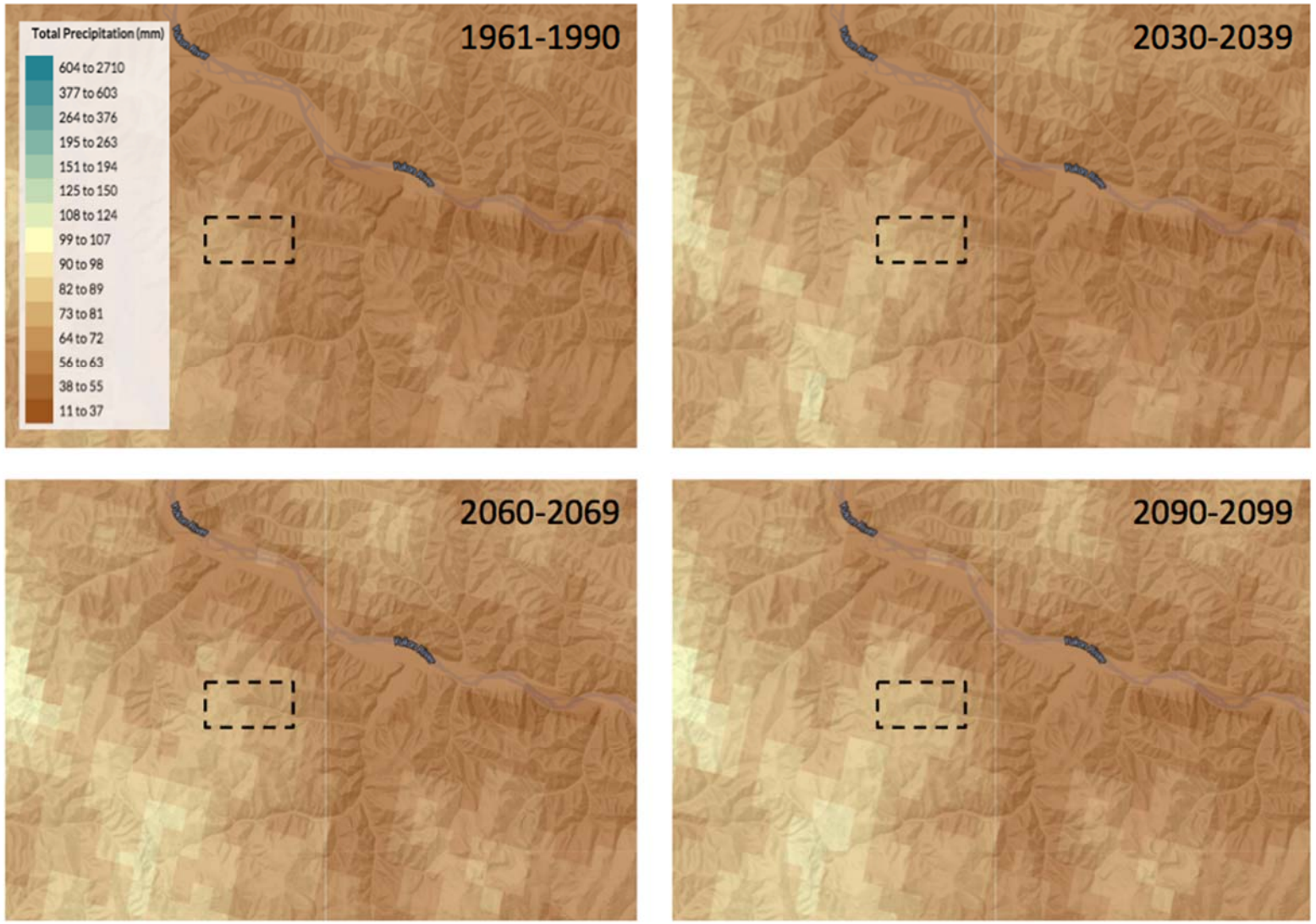


Figure 5-2: Precipitation averages for Spring in millimeters of water equivalent across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

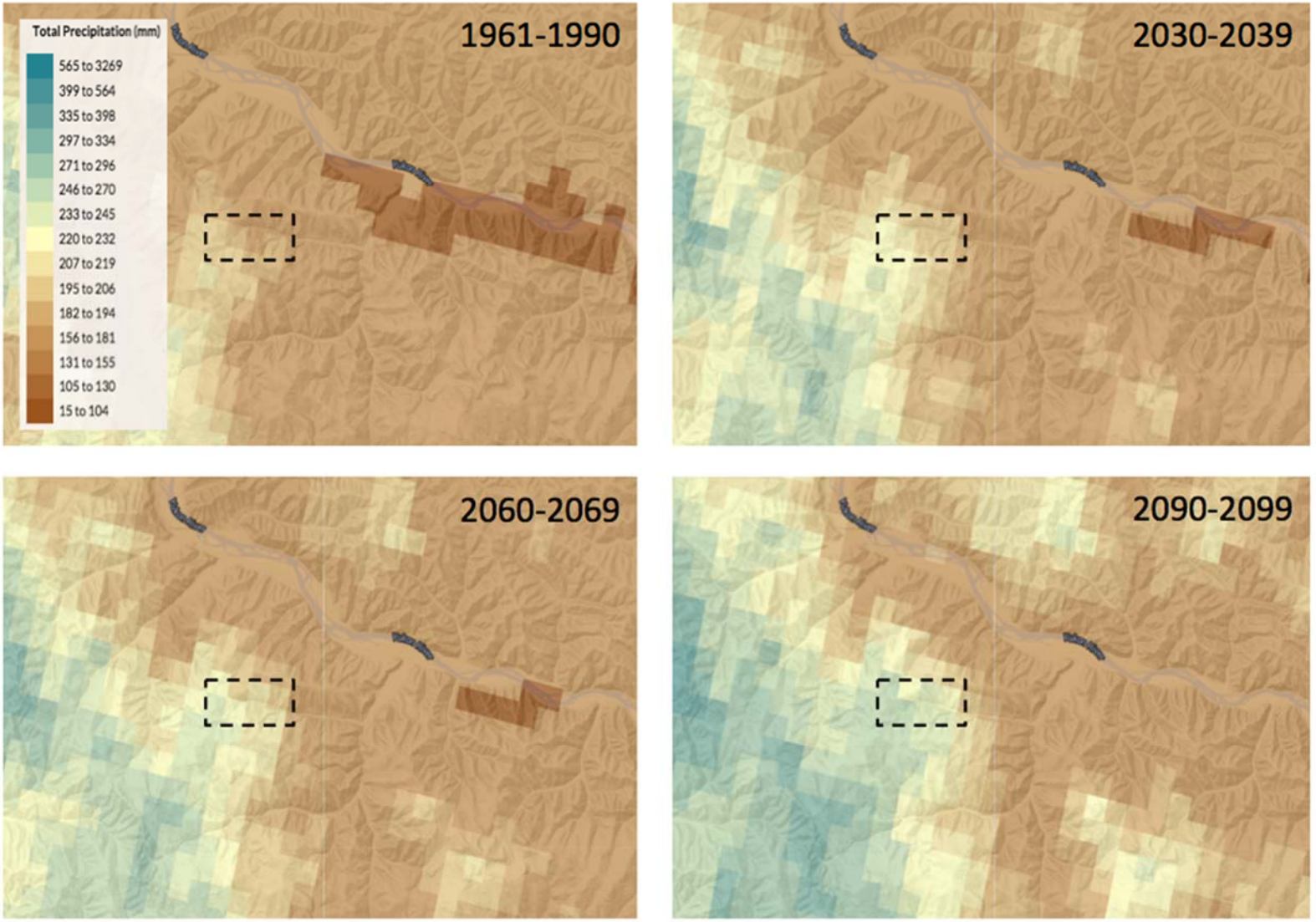


Figure 5-3: Precipitation averages for Summer in millimeters of water equivalent across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

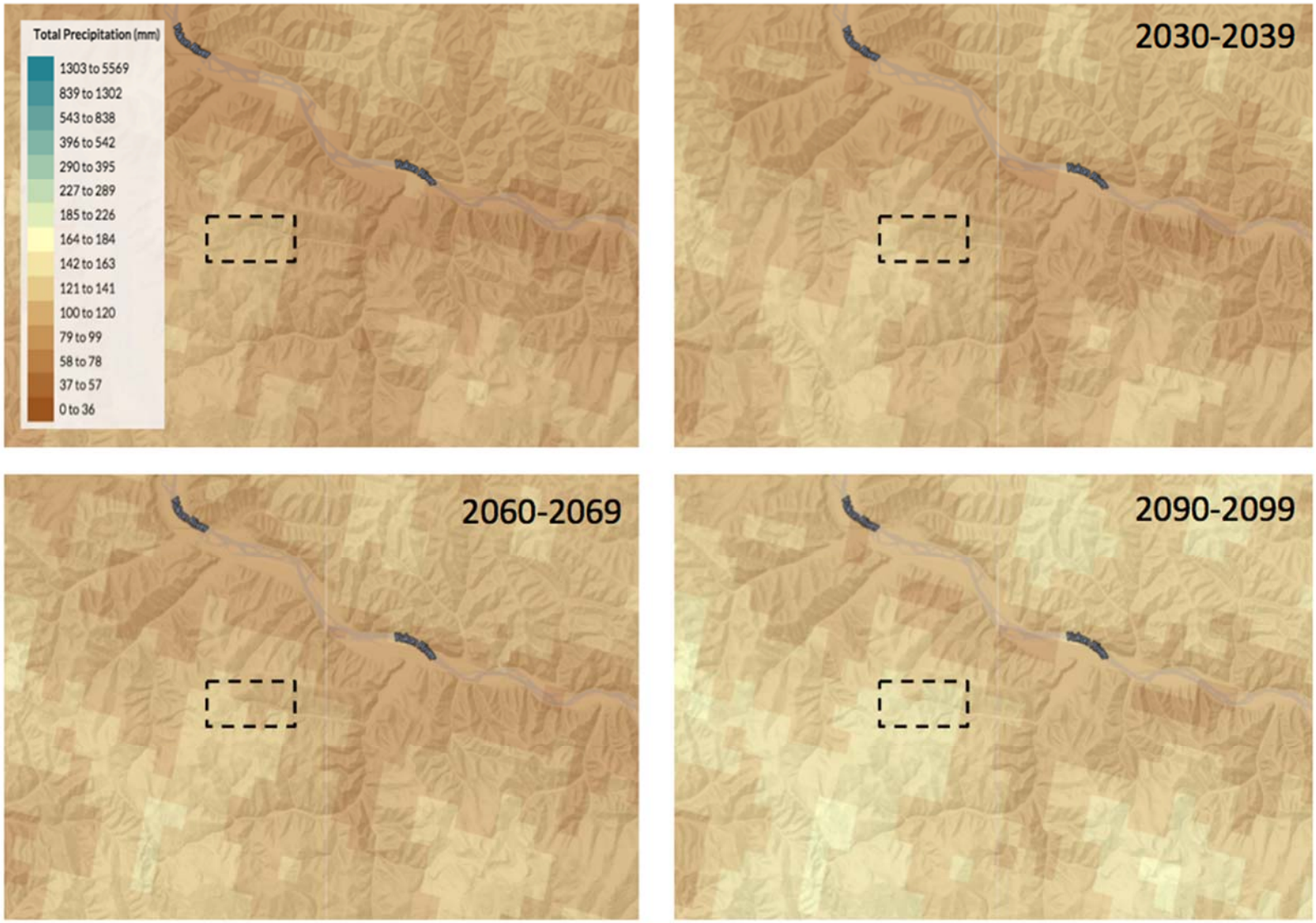


Figure 5-4: Precipitation averages for Fall in millimeters of water equivalent across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Modeled using SNAP.

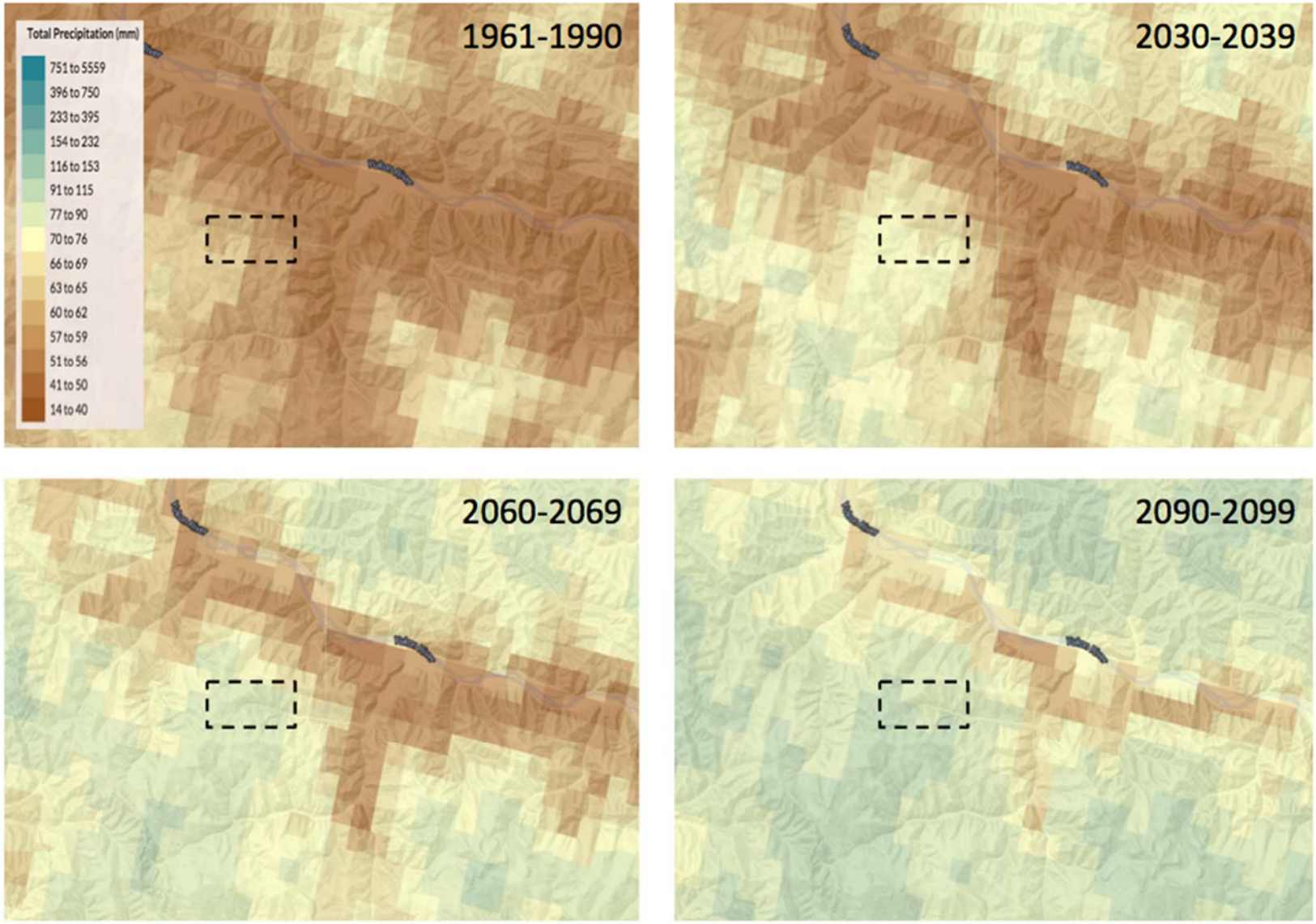


Figure 5-5: Precipitation averages for Winter in millimetres of water equivalent across the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

6. Freeze and Thaw Dates and Growing-Season Length Projections

SNAP defines the Day of Freeze (Day of Thaw) as "the day when consecutive monthly mid-point temperatures transition from positive to negative (negative to positive)." As average annual and seasonal temperatures rise as the century progresses, the projections under SRES A2 indicate that the historical Day of Freeze at the elevation of the Yukon River will shift from about the first to the third week of October by the 2030s (Figure 6-1). Similarly, as mean conditions warm, by the year 2100 the Day of Thaw is projected to shift about a fortnight earlier to near the beginning of April (Figure 6-2). These changes—later freeze-up and earlier thaw—increase the length of the growing season (*i.e.*, the number of days between the Day of Thaw and Day of Freeze) in the Coffee Creek region by nearly a month by the end of this century (Figure 6-3).

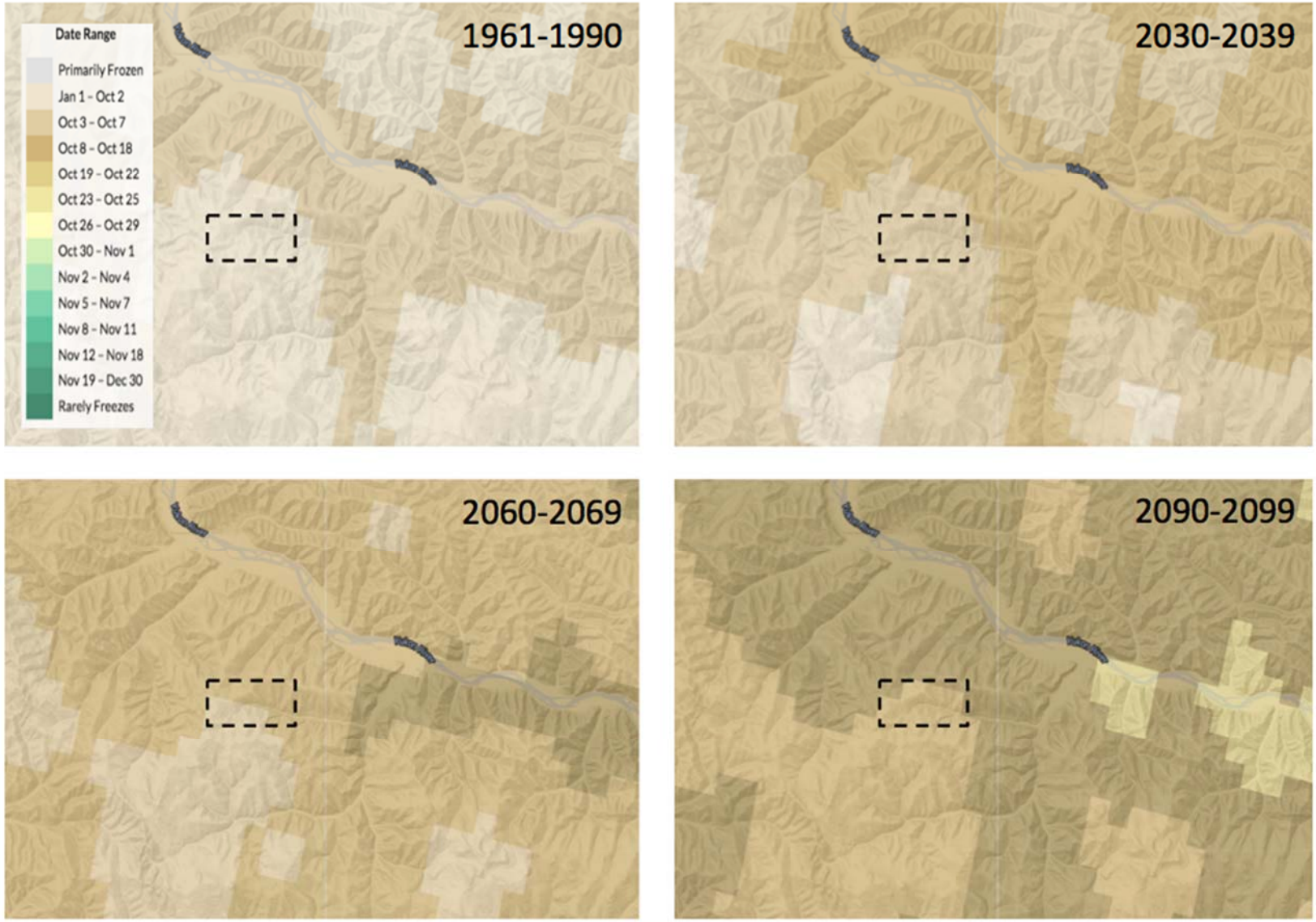


Figure 6-1: Estimated Day of Freeze for the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

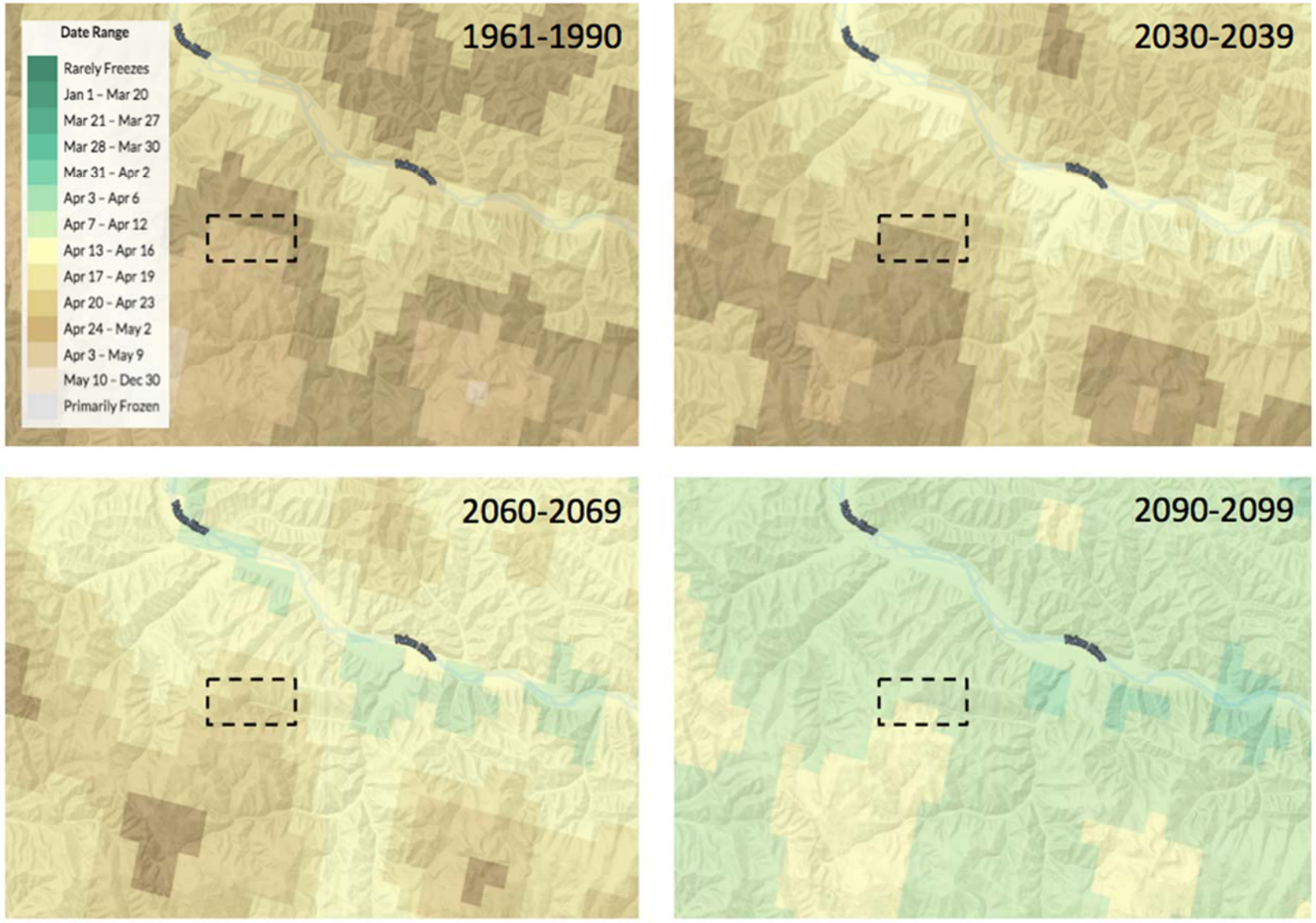


Figure 6-2: Estimated Day of Thaw for the Coffee Creek region for both the past (1961-1990) and three future decades. The dashed rectangle marks the project site. Spatial resolution of the model output is 2 km. Data shown are from SNAP.

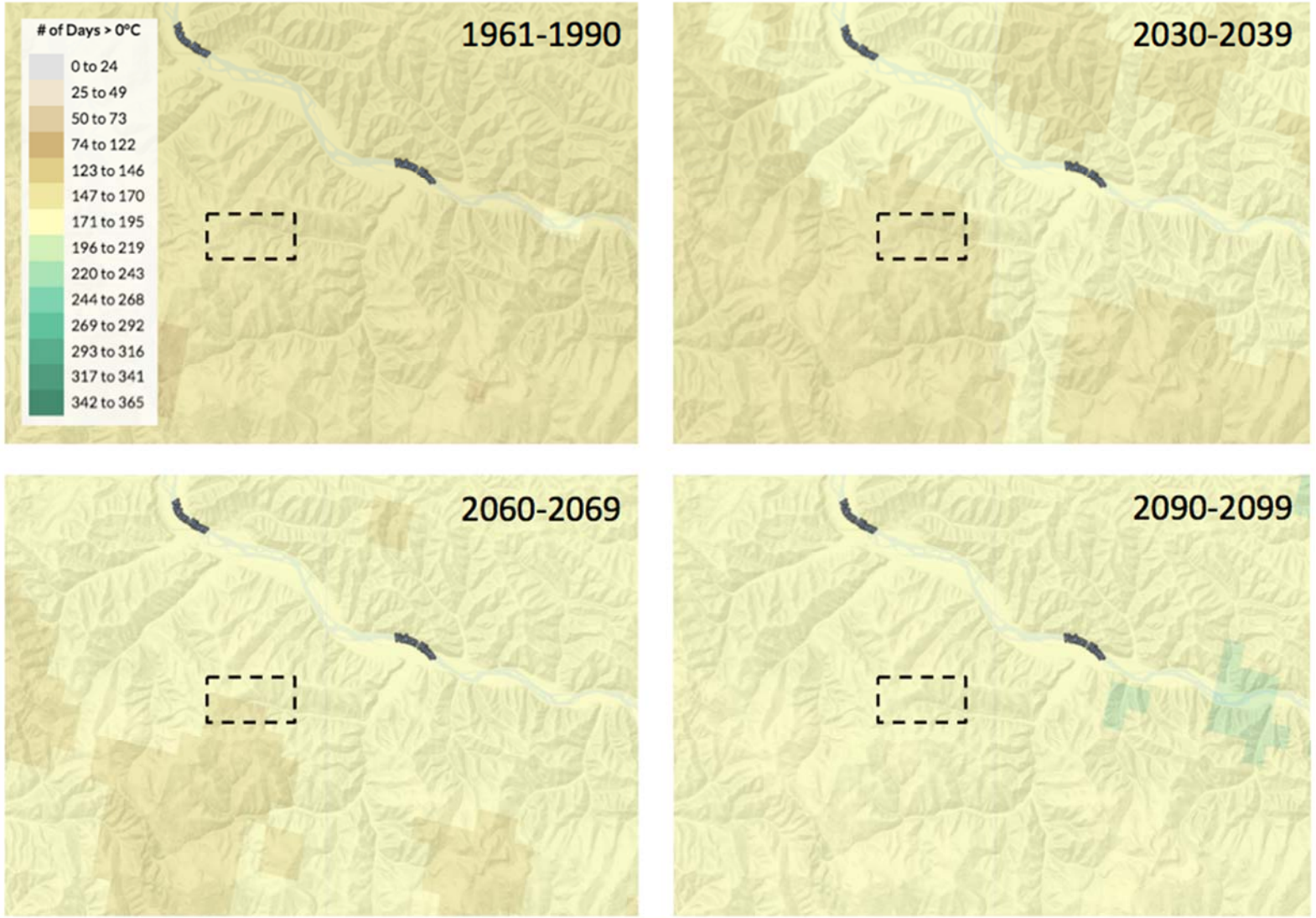


Figure 6-3: Estimated length of the growing season for the Coffee Creek region for both the past (1961-1990) and three future decades. The growing season length is defined as the number of days where the average temperature exceeds 0°C, and is equal to the number of days between the Day of Thaw and the Day of Freeze, shown respectively in Figures 6-1 and 6-2.

7. Summary and Conclusions

The pace at which climate is changing in the high latitudes of the Northern Hemisphere North is already amongst the highest in the world. There is every reason to believe that this trend will continue. Without exception, the best global climate models project ongoing warming and a progressively wetter climate at these latitudes. Seasonality will also be enhanced with, on average, drier summers and wetter conditions in the colder half of the year.

By the year 2100, average temperatures at the Coffee Creek Project site can reasonably be expected to be 3 to 5°C warmer relative to the waning decades of the last century. The warming is anticipated to be particularly pronounced in the summer. In contrast, average annual precipitation at Coffee Creek may not change dramatically. Summer and Winter can be expected to be slightly wetter, but the Spring and Fall seasons are projected to see little net change in precipitation abundance.

The warming will lead to a later freeze-up in fall and an earlier thaw in spring, according to the model results. In tandem, this will yield a growing season that is as much as one month longer by the end of the century. This implies a significantly lengthened duration for above-zero temperatures, with consequent negative implications for permafrost integrity in the region.

References

Daly, C., M. Halbleib *et al.* (2008) Physiographically sensitive mapping of climatological temperature and precipitation across the conterminous United States. Int. J. Climatol. (2008) Published online in Wiley InterScience (www.interscience.wiley.com) DOI: 10.1002/joc.1688.

IPCC SRES (2000), Nakićenović, N., and Swart, R., ed., Special Report on Emissions Scenarios: A special report of Working Group III of the Intergovernmental Panel on Climate Change, Cambridge University Press, ISBN 0-521-80081-1, 978-052180081-5 (pb: 0-521-80493-0, 978-052180493-6).

Lorax (2015). Synthetic Daily Climate Records for the Coffee Gold Project. Lorax memo to Kaminak Gold Corp., April 2, 2015.

Moss, R., M. Babiker *et al.* (2008). Towards New Scenarios for Analysis of Emissions, Climate Change, Impacts, and Response Strategies. Intergovernmental Panel on Climate Change, Geneva, 132 pp.

Simpson, J.J., G. L. Hufford *et al.* (2005). Comparing Maps of Mean Monthly Surface Temperature and Precipitation for Alaska and Adjacent Areas of Canada Produced by Two Different Methods, Arctic 58, 137– 161.

Appendix A: SNAP Scenario URLs

All climate projections and historical climate maps used in this document were obtained from:

Scenarios Network for Alaska and Arctic Planning (SNAP), University of Alaska. [2015]. Retrieved on August 21, 25, 25 and September 2, 3, and 8, 2015.

Average Temperature, Historical, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedTemperature&zoom=10

Average Temperature, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=temperature&zoom=10

Average Temperature, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=temperature&zoom=10

Average Temperature, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=temperature&zoom=10

Average Precipitation, Historical Annual, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedPrecipitation&zoom=10

Average Precipitation, Annual, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Annual, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Annual, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Historical Spring, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=spring&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedPrecipitation&zoom=10

Average Precipitation, Spring, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=spring&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Spring, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=spring&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Spring, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=spring&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Historical Summer, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=summer&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedPrecipitation&zoom=10

Average Precipitation, Summer, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=summer&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Summer, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=summer&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Summer, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=summer&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Historical Fall, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=fall&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedPrecipitation&zoom=10

Average Precipitation, Fall, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=fall&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Fall, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=fall&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Fall, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=fall&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Historical Winter, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=winter&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedPrecipitation&zoom=10

Average Precipitation, Winter, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=winter&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Winter, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=winter&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=precipitation&zoom=10

Average Precipitation, Winter, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=winter&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=precipitation&zoom=10

Day of Freeze, Historical, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedDayOfFreeze&zoom=10

Day of Freeze, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=dayOfFreeze&zoom=10

Day of Freeze, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=dayOfFreeze&zoom=10

Day of Freeze, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=dayOfFreeze&zoom=10

Day of Thaw, Historical, 1961-1990:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedDayOfThaw&zoom=10

Day of Thaw, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=dayOfThaw&zoom=10

Day of Thaw, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=dayOfThaw&zoom=10

Day of Thaw, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=dayOfThaw&zoom=10

Length of Growing Season, Historical:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.84103923632299&longitude=-139.1300392150879&range=&scenario=&variable=observedLengthOfGrowingSeason&zoom=10

Length of Growing Season, 2030-2039, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2030-2039&scenario=A2&variable=lengthOfGrowingSeason&zoom=10

Length of Growing Season, 2060-2069, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2060-2069&scenario=A2&variable=lengthOfGrowingSeason&zoom=10

Length of Growing Season, 2090-2099, A2:

https://www.snap.uaf.edu/sites/all/modules/snap_map_tool/maps.html#interval=decadalAverages&latitude=62.85420021129549&longitude=-139.1300392150879&range=2090-2099&scenario=A2&variable=lengthOfGrowingSeason&zoom=10

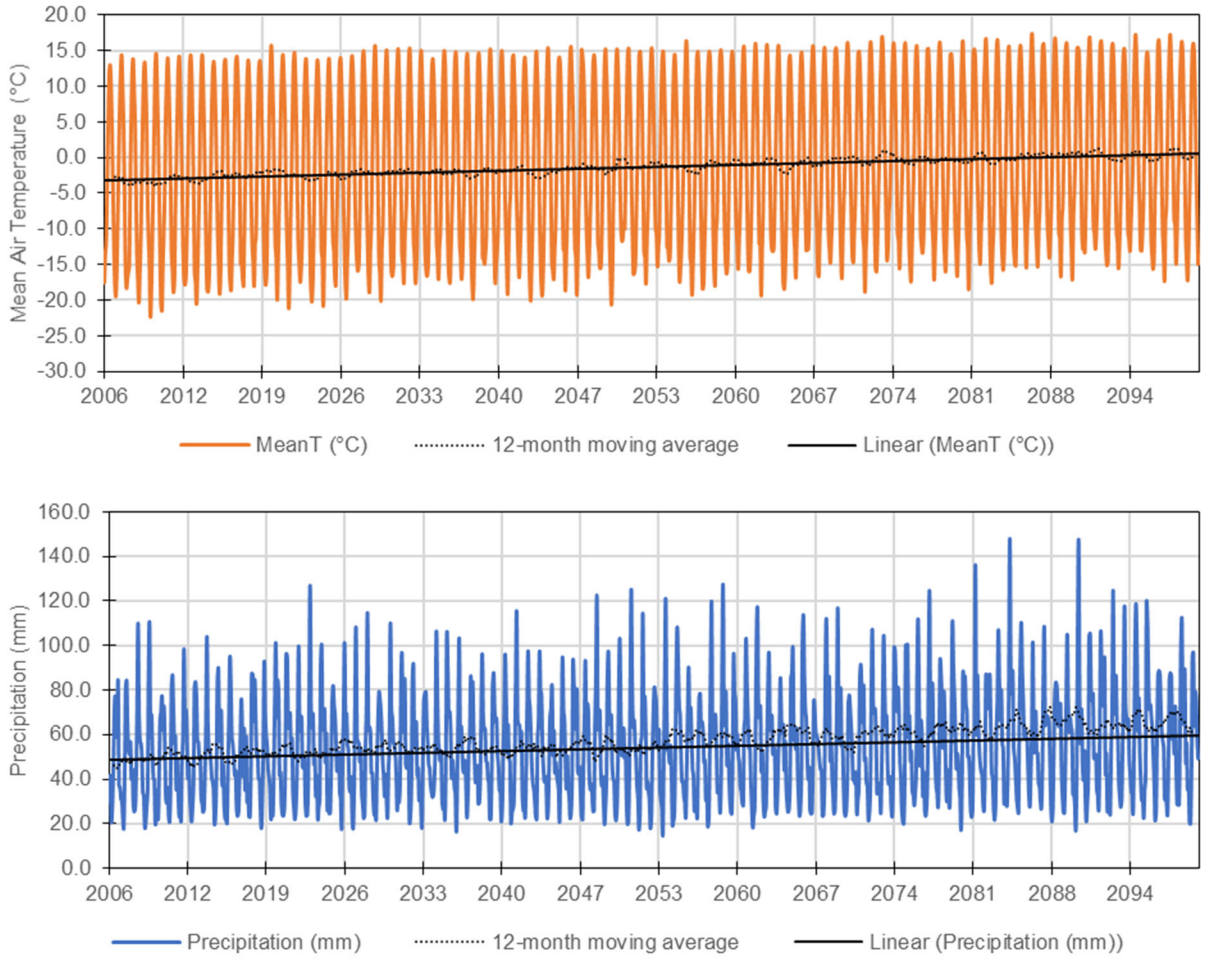


Figure B3.1: Mean monthly air temperature and precipitation inputs (shown with long-term trend and 12-month rolling averages) to the Coffee Gold Water Balance Model. These values are representative of the RCP6.0 climate change scenario.

Notes: Temperature and precipitation variables were trended using 2-km gridded climate change scenario for the RCP6.0 emission scenario.

Table B3.1:
Decadal statistics for the Coffee Gold Project (mean annual air temperature and precipitation) for the RCP4.5, RCP6.0 and RCP8.5 climate change scenarios.

Decade	Mean Air Temperature (°C)			Precipitation (mm)		
	RCP4.5	RCP6.0	RCP8.5	RCP4.5	RCP6.0	RCP8.5
2010-2019	-2.9	-2.8	-2.7	603	592	615
2020-2029	-2.4	-2.3	-2.0	617	626	640
2030-2039	-1.7	-2.0	-1.5	638	635	651
2040-2049	-1.3	-1.7	-1.0	662	630	650
2050-2059	-1.2	-1.2	-0.2	678	647	681
2060-2069	-0.9	-0.8	0.3	683	659	716
2070-2079	-0.6	-0.2	0.9	671	667	726
2080-2089	-0.7	0.0	1.6	688	698	771
2090-2099	-0.4	0.3	2.3	688	719	788
Change (from 2015 to 2095)	2.5	3.1	5.0	14%	22%	28%

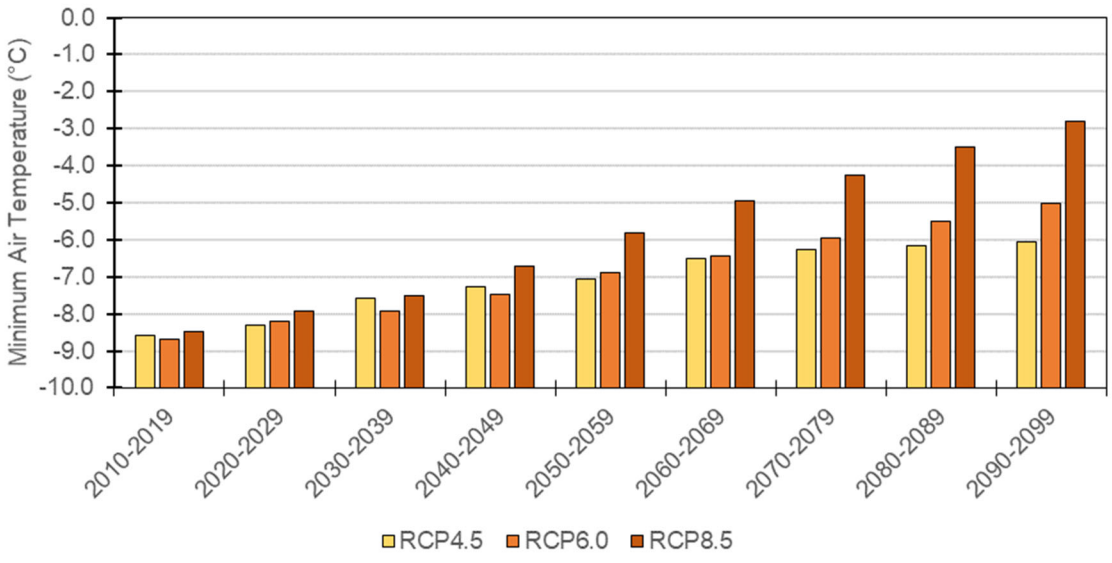


Figure B3.2: Comparison of decadal minimum annual air temperature predictions for the Coffee Gold Project. Climate change scenario data provided by the Scenario Network for Alaskan and Arctic Planning (www.snap.uaf.edu) are shown for the RCP4.5, RCP6.0, and RCP8.5 scenarios.

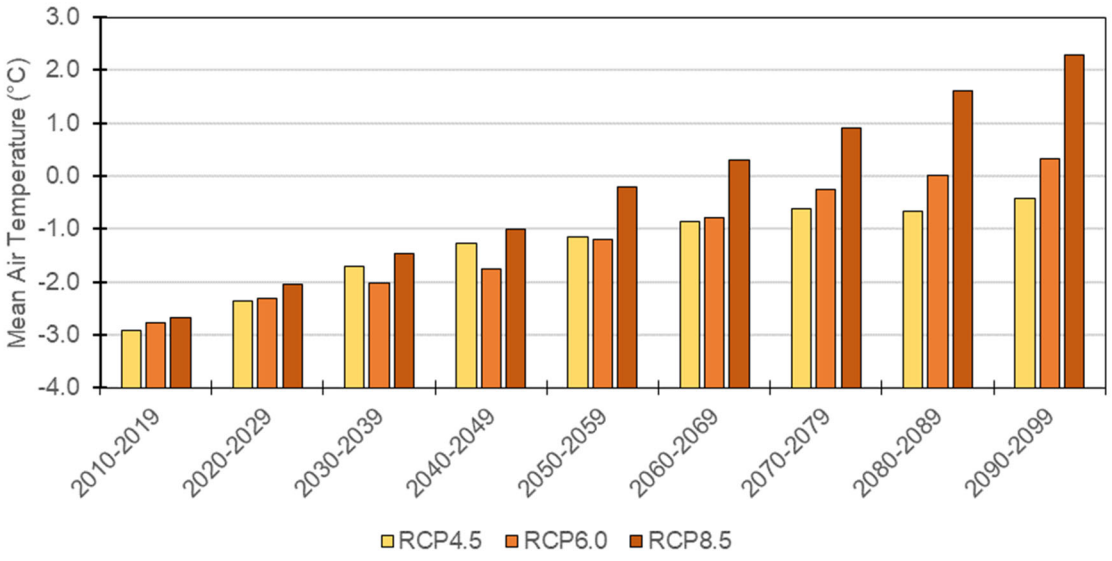


Figure B3.3: Comparison of decadal mean annual air temperature predictions for the Coffee Gold Project. Climate change scenario data provided by the Scenario Network for Alaskan and Arctic Planning (www.snap.uaf.edu) are shown for the RCP4.5, RCP6.0, and RCP8.5 scenarios.

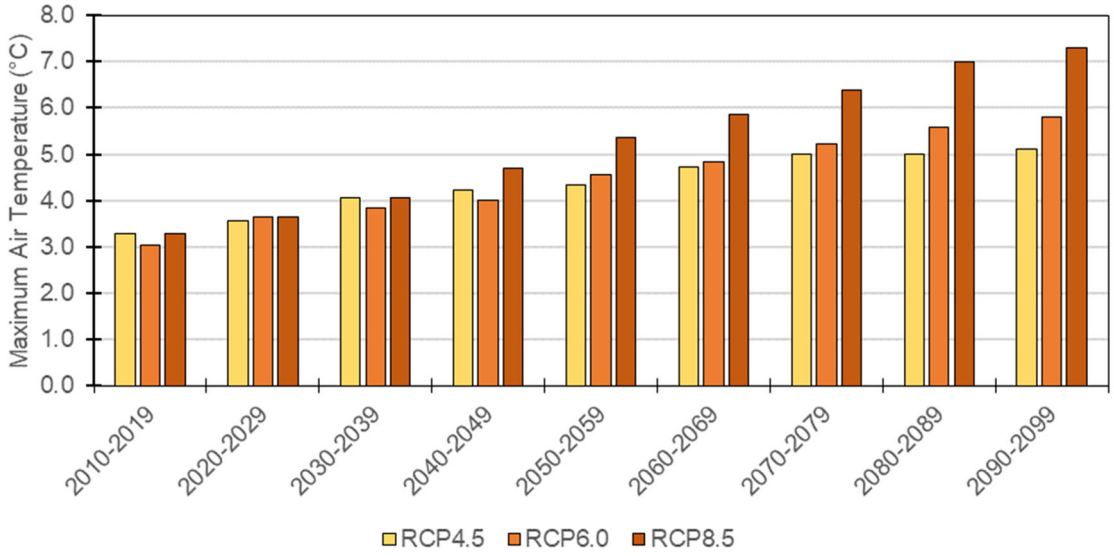


Figure B3.4: Comparison of decadal maximum annual air temperature predictions for the Coffee Gold Project. Climate change scenario data provided by the Scenario Network for Alaskan and Arctic Planning (www.snap.uaf.edu) are shown for the RCP4.5, RCP6.0, and RCP8.5 scenarios.

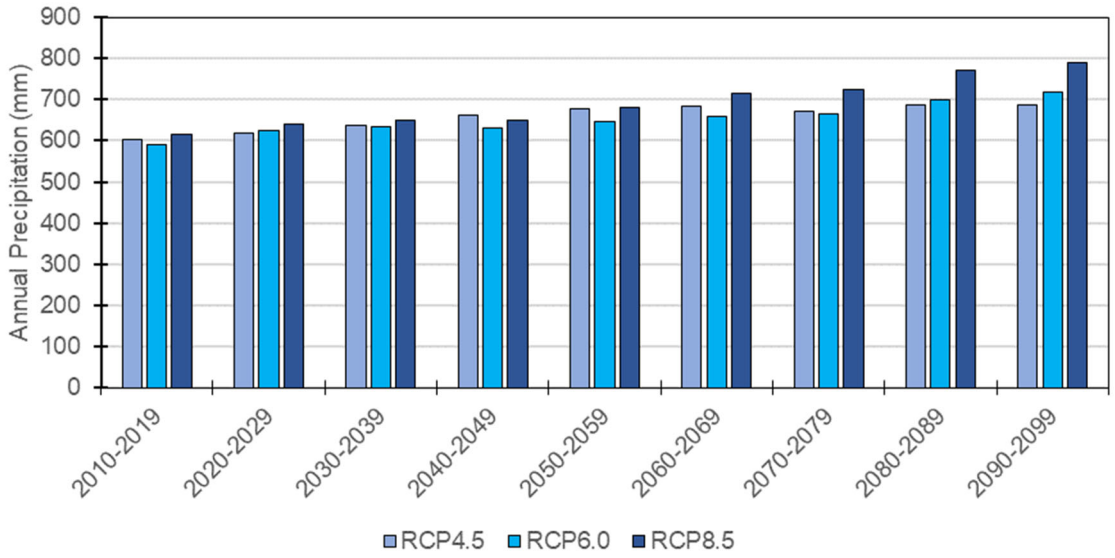


Figure B3.5: Comparison of decadal annual precipitation predictions for the Coffee Gold Project. Climate change scenario data provided by the Scenario Network for Alaskan and Arctic Planning (www.snap.uaf.edu) are shown for the RCP4.5, RCP6.0, and RCP8.5 scenarios.

Appendix C: Hydrology Data, Coffee Gold Project

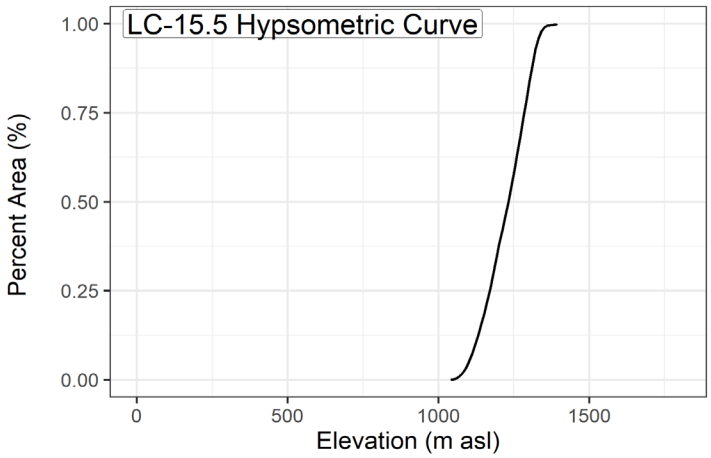
C.1. TO C.14. SUMMARY TABLES – PROJECT SITE HYDROMETRIC STATION METADATA

Newmont™
COFFEE

Appendix C1: LC-15.5

Station Name:	LC-15.5
Previous Station Name:	CC-6.0
Location:	Upper Latte Creek
Basin Area (km²):	9.6
UTM Easting:	581,667
UTM Northing:	6,970,960
Median Elevation (m asl):	1,233
Record Period:	
Spot Measurements	2014-2019
Continuous Record	2014-2019

Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	Yes
Measurement Interval:	
Summer	15-minute
Winter	Removed



Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2014-09-14	96.677		
2015-09-13	96.677	0.000	No movement
2016-05-26	96.674	-0.003	No movement
2017-05-18	96.598	-0.076	SG lowered
2018-07-21	98.196	-1.519	benchmarks moving
2019-06-06	98.500	-1.823	benchmarks moving

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
27%	29%	43%	0%

Open Water Photo



Winter Photo



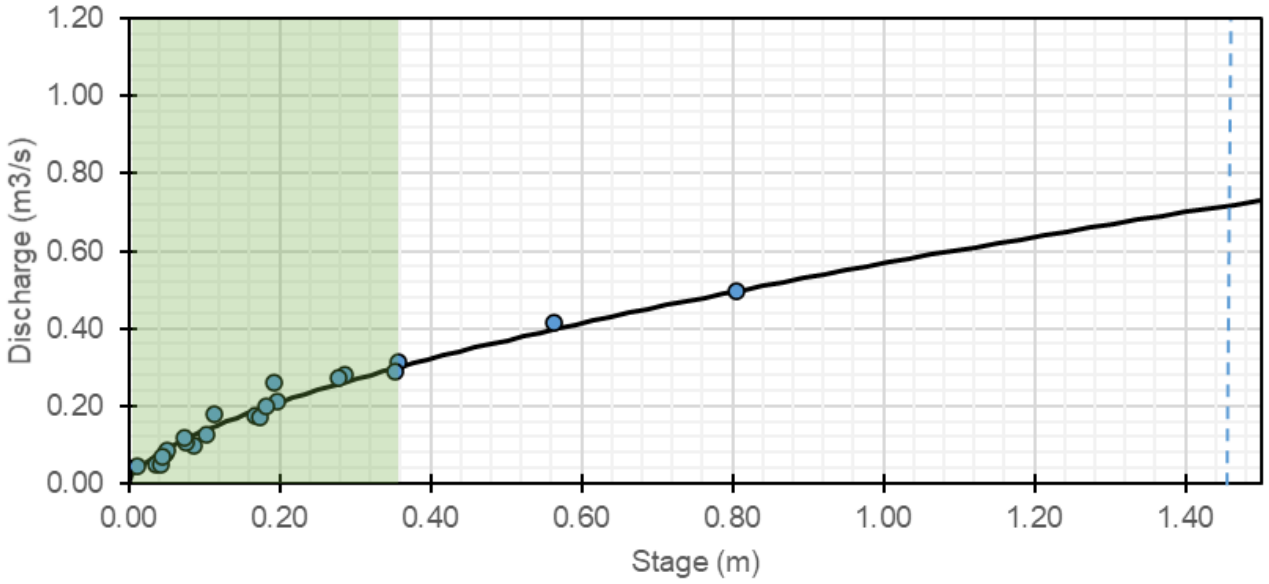
Table C1-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2014-06-26	0.570	0.804	0.801	0%
2014-07-24	--	0.104	--	--
2014-08-21	0.174	0.087	0.060	-31%
2014-09-25	0.255	0.113	0.157	39%
2014-10-24	--	0.005	--	--
2015-05-18	0.285	0.196	0.201	3%
2015-06-25	0.488	0.563	0.598	6%
2015-07-23	0.217	--	--	--
2015-08-22	0.390	0.356	0.386	9%
2015-09-13	0.192	--	--	--
2015-10-28	0.120	0.011	0.017	53%
2016-04-26	--	0.270	--	--
2016-05-26	0.249	0.168	0.148	-12%
2016-06-22	0.125	0.035	0.020	-43%
2016-07-21	0.245	0.173	0.143	-17%
2016-08-25	0.182	0.077	0.068	-12%
2016-09-15	0.191	0.073	0.077	6%
2017-05-18	0.362	0.352	0.333	-6%
2017-06-23	0.275	0.182	0.186	2%
2017-07-27	0.336	0.192	0.285	49%
2017-08-23	0.124	0.043	0.019	-55%
2017-09-15	0.138	--	--	--
2018-05-20	0.355	0.287	0.320	11%
2018-06-16	0.209	--	--	--
2018-07-22	0.152	--	--	--
2019-06-06	0.154	0.049	0.042	-15%
2019-07-07	0.084	--	--	--
2019-08-08	0.348	0.278	0.307	10%
2019-09-03	0.162	0.051	0.049	-5%
2019-10-02	0.200	0.103	0.087	-15%
Average Error (%)				-1%
Standard Error (%)				26%

Table C1-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2014	Average	--	--	*0.09*	0.18	0.12	0.16	*0.03*	--	0.12
	Maximum	--	--	*0.78*	0.80	0.63	0.51	*0.21*	--	0.80
	Minimum	--	--	*0.02*	0.04	0.05	0.07	*0.00*	--	0.00
2015	Average	--	*0.16*	0.19	0.29	0.26	0.11	0.06	--	0.18
	Maximum	--	*0.72*	2.37	1.06	0.89	0.39	0.51	--	2.37
	Minimum	--	*0.03*	0.00	0.02	0.03	0.03	0.00	--	0.00
2016	Average	--	*0.13*	0.08	0.23	0.16	0.06	*0.05*	--	0.12
	Maximum	--	*0.44*	0.47	0.42	0.37	0.19	*0.46*	--	0.47
	Minimum	--	*0.01*	0.00	0.11	0.04	0.02	*0.00*	--	0.00
2017	Average	--	*0.18*	0.08	0.24	0.07	*0.04*	--	--	0.12
	Maximum	--	*0.59*	0.41	2.57	0.20	*0.08*	--	--	2.57
	Minimum	--	*0.00*	0.00	0.02	0.01	*0.01*	--	--	0.00
2018	Average	--	*0.45*	0.31	0.14	0.28	*0.16*	--	--	0.27
	Maximum	--	*1.39*	1.36	1.27	1.30	*0.50*	--	--	1.39
	Minimum	--	*0.16*	0.01	0.00	0.00	*0.01*	--	--	0.00
2019	Average	--	--	*0.14*	0.23	0.14	--	--	--	0.17
	Maximum	--	--	*1.07*	1.95	1.44	--	--	--	1.95
	Minimum	--	--	*0.00*	0.00	0.00	--	--	--	0.00
Unit Yield ($L/s/km^2$)										
2014	Average	--	--	*8.9*	18.5	12.9	16.6	*3.4*	--	12.0
	Maximum	--	--	*81.6*	83.7	65.7	52.6	*22.2*	--	83.7
	Minimum	--	--	*2.3*	4.1	5.4	6.8	*0.0*	--	0.0
2015	Average	--	*17.0*	19.9	30.0	26.7	11.8	6.6	--	18.7
	Maximum	--	*74.6*	246.9	110.2	92.5	40.1	53.3	--	246.9
	Minimum	--	*3.2*	0.0	2.6	2.9	2.9	0.2	--	0.0
2016	Average	--	*13.0*	8.3	23.9	17.1	6.6	*5.5*	--	12.39
	Maximum	--	*45.6*	48.4	43.6	38.0	20.1	*48.3*	--	48.43
	Minimum	--	*0.6*	0.0	11.7	4.2	1.9	*0.3*	--	0.00
2017	Average	--	*18.6*	8.0	25.0	7.2	*4.5*	--	--	12.65
	Maximum	--	*61.1*	42.5	267.8	21.2	*8.1*	--	--	267.76
	Minimum	--	*0.4*	0.0	2.2	1.3	*1.0*	--	--	0.00
2018	Average	--	*46.7*	32.8	15.0	29.5	*16.5*	--	--	28.08
	Maximum	--	*144.5*	141.3	132.5	135.0	*51.9*	--	--	144.55
	Minimum	--	*16.4*	0.6	0.0	0.3	*0.9*	--	--	0.00
2019	Average	--	--	*14.8*	24.4	14.9	--	--	--	18.02
	Maximum	--	--	*110.9*	203.1	149.4	--	--	--	203.13
	Minimum	--	--	*0.2*	0.1	0.0	--	--	--	0.02
Runoff (mm)										
2014		--	--	*20*	50	35	43	*7*	--	154
2015		--	*21*	52	80	71	31	18	--	272
2016		--	*25*	21	64	46	17	*2*	--	175
2017		--	*24*	21	67	19	*6*	--	--	137
2018		--	*48*	85	40	79	*33*	--	--	285
2019		--	--	*32*	65	40	--	--	--	137

Note: Values in italics indicate that data for that month is not complete.



Note: Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

Figure C1-1: Rating Curve

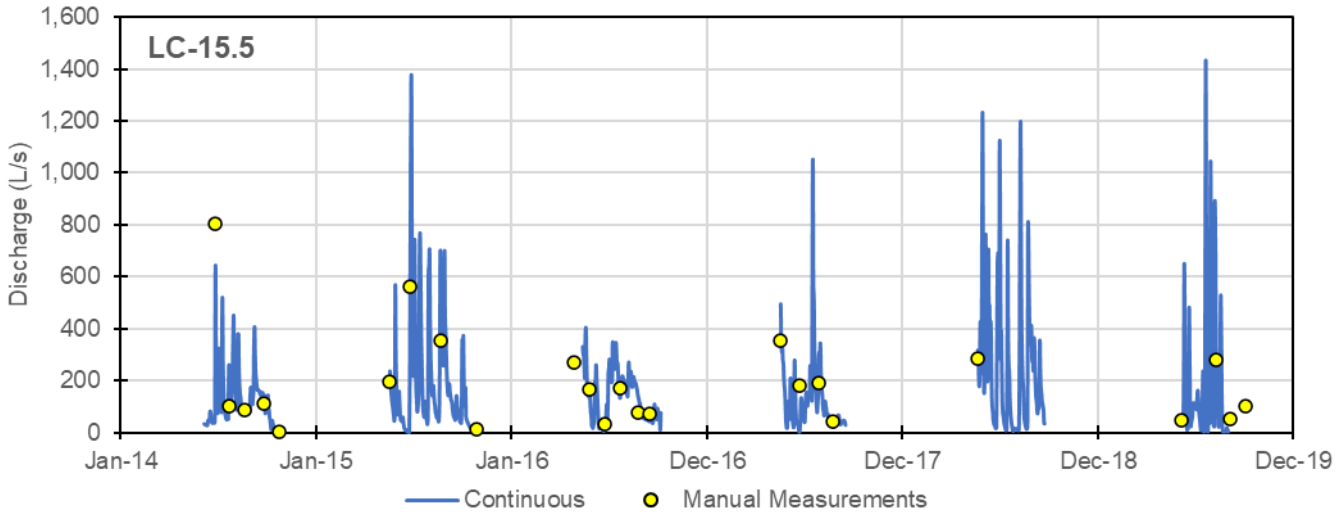
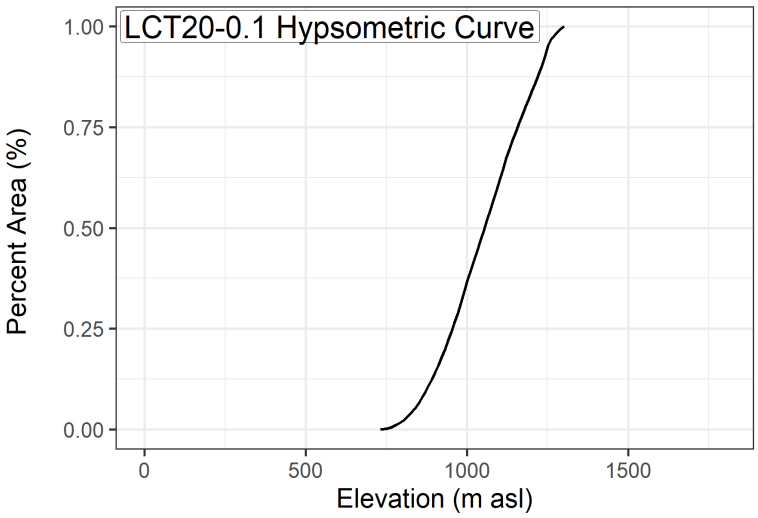


Figure C1-2: Time-series plot of discharge and manual measurements

Appendix C2: LCT20-0.1

Station Name:	LCT20-0.1
Previous Station Name:	CC-1.0
Location:	South WRSF basin
Basin Area (km²):	3.4
UTM Easting:	584,956
UTM Northing:	6,971,726
Median Elevation (m asl):	1,055
Record Period:	
Spot Measurements	2014-Present
Continuous Record	2014-Present

Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	No
Measurement Interval:	
Summer	15-minute
Winter	Removed



Benchmark surveys N/A			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
1%	23%	61%	15%

Open Water Photo



Winter Photo



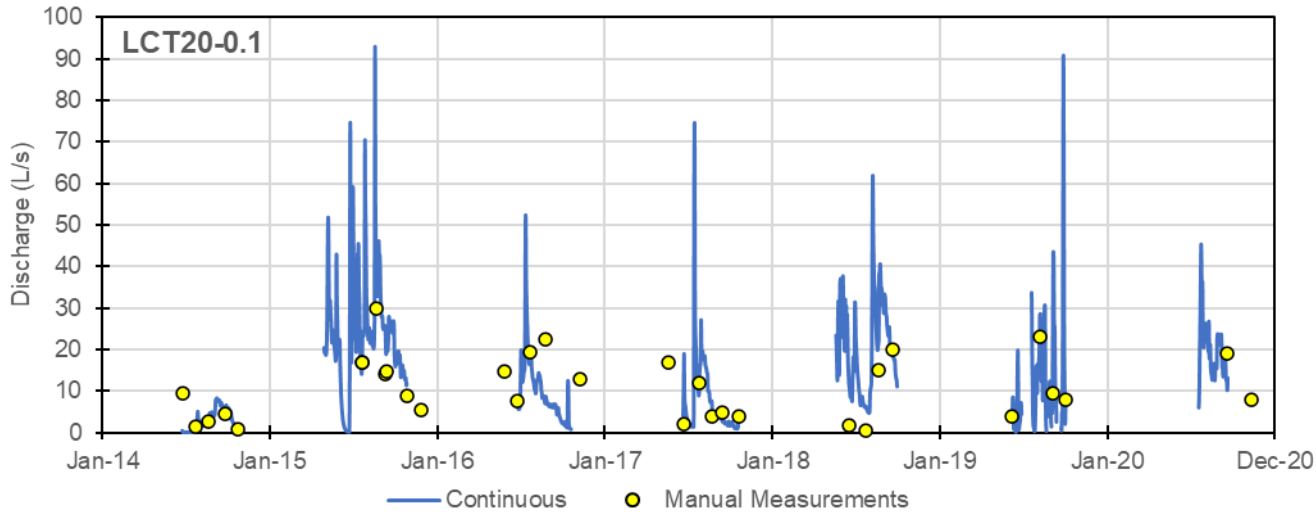
Table C2-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Salt Dilution	Weir Equation
26-06-2014	0.209	0.009		x
24-07-2014	0.215	0.001		x
21-08-2014	0.262	0.003	x	x
25-09-2014	0.282	0.005	x	x
23-10-2014	0.231	0.001		x
23-07-2015	--	0.017	x	x
23-07-2015	--	0.017		x
23-07-2015	0.170	--	--	--
19-08-2015	0.199	--	--	--
21-08-2015	0.430	0.030	x	x
10-09-2015	0.376	0.014		x
12-09-2015	0.368	0.015	x	x
28-10-2015	0.339	0.009	x	x
27-11-2015	0.314	0.006	x	x
26-05-2016	--	0.015	x	
22-06-2016	0.126	0.008	x	
20-07-2016	0.182	0.019	x	
25-08-2016	--	0.023	x	
08-11-2016	0.155	0.013	x	
18-05-2017	--	0.017	x	
21-06-2017	0.076	0.002		x
26-07-2017	0.130	0.012		x
23-08-2017	0.098	0.004		x
13-09-2017	0.105	0.005		x
19-10-2017	0.095	0.004		x
2018-06-16		0.002		x
2018-07-22	0.017	0.001		x
2018-08-19	0.165	0.015		x
2018-09-21		0.020		x
2019-06-07	0.506	0.004	x	
2019-08-08	0.610	0.023	x	
2019-09-03	0.560	0.010	x	
2019-10-02	0.566	0.008	x	
2020-07-17	0.586	--	--	--
2020-09-19	0.592	0.019	x	
2020-11-11	--	0.008	x	

Table C2-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2014	Average	--	--	*0.000*	0.000	0.003	0.006	*0.003*	--	0.00
	Maximum	--	--	*0.001*	0.010	0.006	0.010	*0.010*	--	0.01
	Minimum	--	--	*0.000*	0.000	0.001	0.002	*0.000*	--	0.00
2015	Average	--	0.026	0.011	0.032	0.032	0.025	0.016	--	0.02
	Maximum	--	0.077	0.105	0.172	0.141	0.044	0.026	--	0.17
	Minimum	--	0.016	0.000	0.011	0.018	0.015	0.008	--	0.00
2016	Average	--	--	*0.006*	0.019	0.01	0.0053	*0.003*	--	0.01
	Maximum	--	--	*0.009*	0.081	0.0171	0.0083	*0.022*	--	0.08
	Minimum	--	--	*0.004*	0.005	0.0051	0.0017	*0.000*	--	0.00
2017	Average	--	--	*0.007*	0.013	0.0108	0.003	*0.002*	--	0.01
	Maximum	--	--	*0.029*	0.446	0.0264	0.0056	*0.006*	--	0.45
	Minimum	--	--	*0.002*	0.001	0.0021	0.0011	*0.000*	--	0.00
2018	Average	--	*0.025*	0.020	0.010	0.029	0.022	--	--	0.02
	Maximum	--	*0.039*	0.047	0.038	0.075	0.037	--	--	0.08
	Minimum	--	*0.011*	0.006	0.004	0.004	0.010	--	--	0.00
2019	Average	--	--	*0.004*	0.004	0.013	0.015	*0.005*	--	0.01
	Maximum	--	--	*0.025*	0.057	0.045	0.105	*0.017*	--	0.10
	Minimum	--	--	*0.000*	0.000	0.000	0.000	*0.001*	--	0.00
2020	Average	--	--	--	*0.026*	0.019	*0.017*	--	--	0.02
	Maximum	--	--	--	*0.066*	0.043	*0.039*	--	--	0.07
	Minimum	--	--	--	*0.003*	0.002	*0.004*	--	--	0.00
Unit Yield ($L/s/km^2$)										
2014	Average	--	--	*0.0*	0.1	0.9	1.8	*1.0*	--	0.8
	Maximum	--	--	*0.2*	3.0	1.8	2.9	*2.8*	--	3.0
	Minimum	--	--	*0.0*	0.0	0.3	0.5	*0.1*	--	0.0
2015	Average	--	7.7	3.2	9.4	9.4	7.3	4.6	--	6.9
	Maximum	--	22.4	30.4	50.1	40.9	12.7	7.4	--	50.1
	Minimum	--	4.6	0.0	3.3	5.2	4.5	2.3	--	0.0
2016	Average	--	--	*1.8*	5.4	2.9	1.5	*0.8*	--	2.5
	Maximum	--	--	*2.8*	23.6	5.0	2.4	*6.4*	--	23.6
	Minimum	--	--	*1.2*	1.4	1.5	0.5	*0.1*	--	0.1
2017	Average	--	--	*2.1*	3.9	3.1	0.9	*0.4*	--	2.1
	Maximum	--	--	*8.5*	129.6	7.7	1.6	*1.6*	--	129.6
	Minimum	--	--	*0.6*	0.2	0.6	0.3	*0.0*	--	0.0
2018	Average	--	*7.1*	5.8	2.8	8.5	6.4	--	--	6.1
	Maximum	--	*11.3*	13.7	11.0	21.9	10.8	--	--	21.9
	Minimum	--	*3.2*	1.8	1.1	1.2	3.0	--	--	1.1
2019	Average	--	--	*1.2*	1.2	3.7	4.4	--	--	2.6
	Maximum	--	--	*7.2*	16.7	13.2	30.5	--	--	30.5
	Minimum	--	--	*0.0*	0.0	0.0	0.0	--	--	0.0
2020	Average	--	--	--	*7.6*	5.6	*5.0*	--	--	6.0
	Maximum	--	--	--	*19.3*	12.6	*11.5*	--	--	19.3
	Minimum	--	--	--	*0.8*	0.7	*1.3*	--	--	0.7
Runoff (mm)										
2014		--	--	*0*	0	2	5	*2*	--	9
2015		--	21	8	25	25	19	12	--	110
2016		--	--	*1*	15	8	4	*1*	--	29
2017		--	--	*2*	10	8	2	*1*	--	24
2018		--	*7*	15	7	23	17	--	--	69
2019		--	--	*3*	3	10	*11*	--	--	27
2020		--	--	--	*9*	14	*8*	--	--	32

Note: Values in italics indicate that data for that month is not complete.



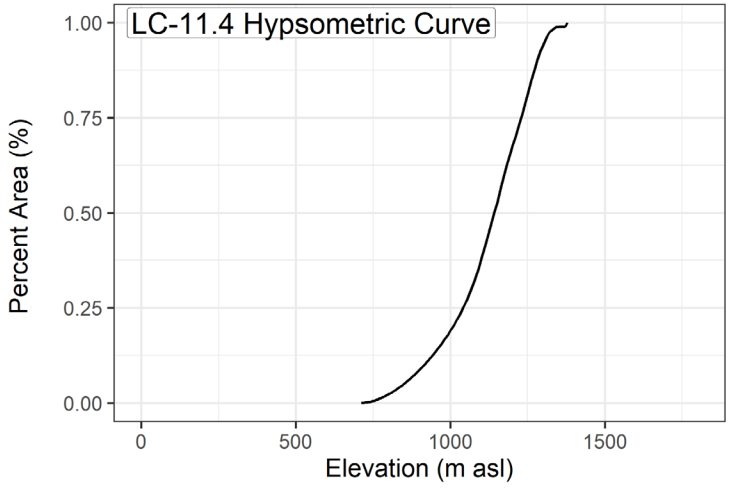
Note:
This site has a V-notch weir installed; therefore no rating curve was necessary.
Rating equation is $Q=1362.9*(h)^{2.5}$.

Figure C2-1: Time-series plot of discharge and manual measurements

Appendix C3: LC-11.4

Station Name:	LC-11.4
Previous Station Name	CC-1.5
Location:	Latte Creek
Basin Area (km²):	23.1
UTM Easting:	584,944
UTM Northing:	6,971,695
Median Elevation (m asl):	1,142
Record Period:	
Spot Measurements	2010-Present
Continuous Record	2014-Present

Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	No
Measurement Interval:	
Summer	15-minute
Winter	Removed



Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2014-06-05	98.589		
2015-09-12	98.590	0.001	No movement
2016-05-26	98.590	0.001	No movement
2017-06-21	98.598	0.009	SG moved up
2018-05-19	98.589	0.000	No movement
2019-06-07	98.638		Station rebuilt u/s
2020-07-16	98.636	0.000	no movement

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
44%	14%	36%	6%

Open Water Photo



Winter Photo

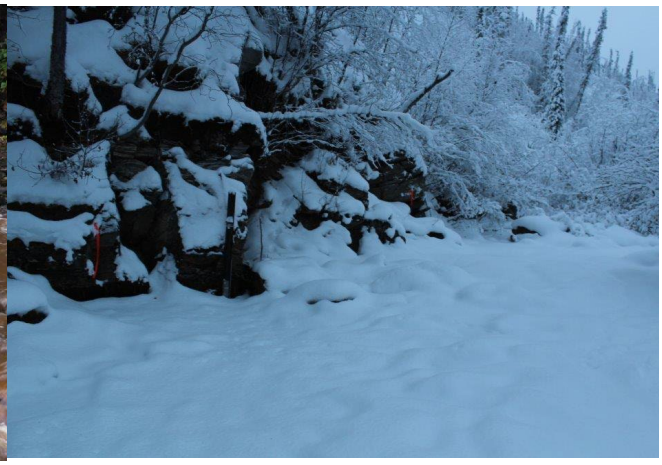


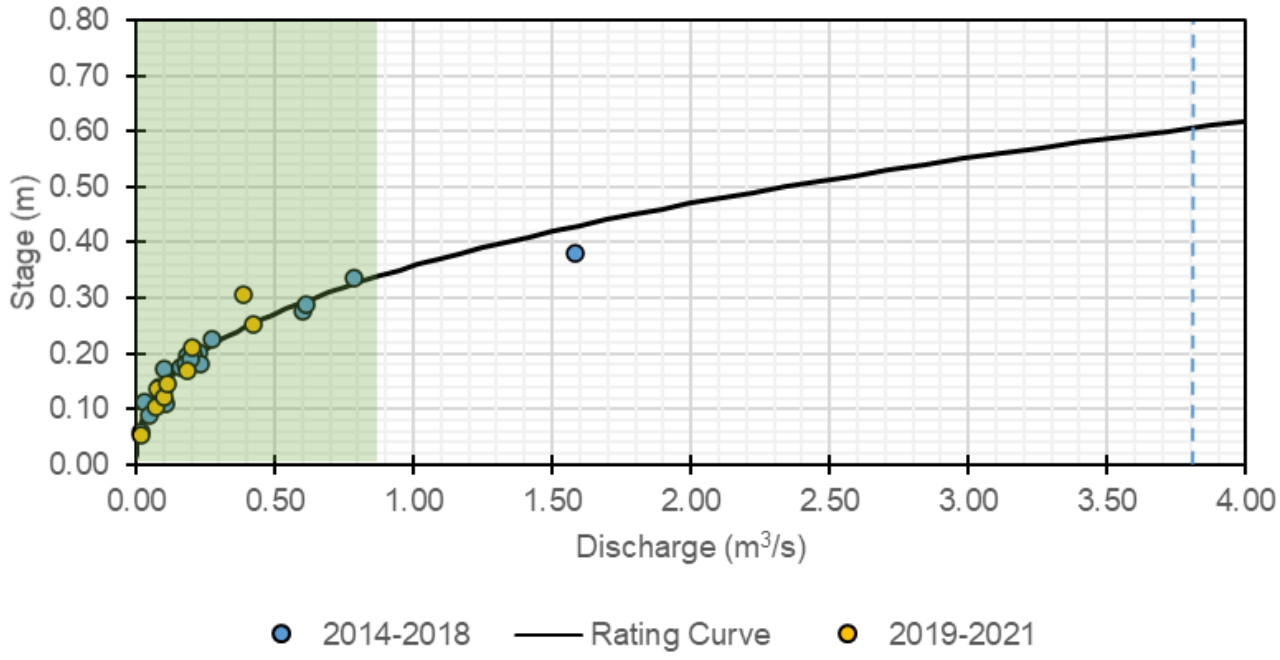
Table C3-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2014-06-26	0.650	1.584	1.166	-26%
2014-07-24	0.465	0.185	0.215	16%
2014-08-21	0.441	0.103	0.154	49%
2014-09-25	0.472	0.225	0.235	4%
2014-10-23	0.384	0.031	0.055	77%
2014-11-24	--	0.013	--	--
2015-05-17	0.545	0.604	0.513	-15%
2015-06-25	0.607	0.783	0.860	10%
2015-07-23	0.467	--	--	--
2015-08-19	0.565	--	--	--
2015-09-12	0.465	0.211	0.215	2%
2015-11-27	0.38	0.018	0.050	NA
2016-04-02	0.330	0.013	--	--
2016-04-26	--	0.285	--	--
2016-05-26	--	0.276	--	--
2016-06-22	0.405	--	--	--
2016-07-20	0.495	0.277	0.309	11%
2016-08-25	0.45	0.232	0.175	-24%
2016-09-15	0.445	0.163	0.163	0%
2016-10-20	0.344	--	--	--
2016-11-08	--	0.021	--	--
2016-12-10	--	0.015	--	--
2017-01-23	--	0.012	--	--
2017-02-27	--	0.011	--	--
2017-03-22	--	0.011	--	--
2017-04-26	--	0.022	--	--
2017-05-18	0.525	--	0.424	--
2017-06-21	0.406	0.099	0.086	-13%
2017-07-26	0.440	--	0.152	--
2017-08-23	0.410	0.082	0.093	13%
2017-09-13	0.450	0.178	0.175	-2%
2017-10-19	--	0.064	--	--
2017-12-09	--	0.010	--	--
2018-05-16	--	0.780	--	--
2018-05-19	0.557	0.611	0.572	-6%
2018-05-22	0.470	--	--	--
2018-05-24	0.520	--	--	--
2018-06-16	0.500	--	--	--
2018-07-22	0.410	--	--	--
2018-09-21	0.460	0.199	0.201	1%
2018-10-18	0.360	0.045	0.030	-33%
Station re-installed 8 m upstream				
2019-06-06	--	0.087	--	--
2019-06-07	0.374	0.070	0.044	-38%
2019-07-07	0.322	0.018	0.008	-58%
2019-08-08	0.576	0.386	0.673	74%
2019-09-03	0.406	0.078	0.086	10%
2019-10-02	0.482	0.203	0.265	31%
2020-07-16	0.522	0.425	0.411	-3%
2020-09-19	0.440	0.184	0.152	-18%
2020-11-11	--	0.023	--	--
Average Error (%)				3%
Standard Error (%)				32%

Table C3-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2014	Average	--	--	*0.17*	0.34	0.24	0.31	*0.11*	--	0.23
	Maximum	--	--	*1.18*	1.20	0.86	0.83	*0.21*	--	1.20
	Minimum	--	--	*0.04*	0.09	0.14	0.13	*0.05*	--	0.04
2015	Average	--	*0.31*	0.33	0.50	0.44	0.24	0.09	--	0.32
	Maximum	--	*1.34*	4.51	2.17	1.77	0.75	0.42	--	4.51
	Minimum	--	*0.08*	0.04	0.06	0.08	0.09	0.01	--	0.01
2016	Average	--	*0.39*	0.30	0.49	0.28	0.13	--	--	0.32
	Maximum	--	*0.75*	1.86	1.34	1.02	0.26	--	--	1.86
	Minimum	--	*0.05*	0.04	0.22	0.13	0.02	--	--	0.02
2017	Average	--	*0.48*	0.13	0.42	0.15	0.11	0.06	--	0.23
	Maximum	--	*2.26*	0.44	4.24	0.49	0.25	0.11	--	4.24
	Minimum	--	*0.04*	0.04	0.03	0.07	0.07	0.02	--	0.02
2018	Average	--	*0.75*	0.54	0.27	0.59	0.28	*0.03*	--	*0.41*
	Maximum	--	*2.52*	2.02	1.87	2.75	1.24	*0.07*	--	*2.75*
	Minimum	--	*0.18*	0.05	0.04	0.04	0.03	*0.01*	--	*0.01*
2019	Average	--	--	*0.21*	0.48	0.44	*0.02*	--	--	0.28
	Maximum	--	--	*0.96*	8.97	2.80	*0.06*	--	--	8.97
	Minimum	--	--	*0.02*	0.00	0.00	*0.00*	--	--	0.00
2020	Average	--	--	--	*1.13*	0.93	*0.50*	--	--	*0.85*
	Maximum	--	--	--	*2.61*	2.27	*0.99*	--	--	*2.61*
	Minimum	--	--	--	*0.22*	0.28	*0.16*	--	--	*0.16*
Unit Yield ($L/s/km^2$)										
2014	Average	--	--	*7.3*	14.9	10.5	13.3	*4.6*	--	10.1
	Maximum	--	--	*51.0*	51.9	37.2	36.1	*8.9*	--	51.9
	Minimum	--	--	*1.7*	3.7	6.0	5.8	*2.2*	--	1.7
2015	Average	--	*13.6*	14.3	21.7	19.2	10.3	4.0	--	13.9
	Maximum	--	*58.1*	195.2	94.1	76.8	32.3	18.2	--	195.2
	Minimum	--	*3.3*	1.7	2.8	3.3	4.1	0.5	--	0.5
2016	Average	--	*17.0*	12.8	21.0	12.0	5.7	--	--	13.7
	Maximum	--	*32.6*	80.6	58.0	44.0	11.3	--	--	80.6
	Minimum	--	*2.0*	1.8	9.5	5.8	0.9	--	--	0.9
2017	Average	--	*20.8*	5.7	18.3	6.7	4.8	2.7	--	9.8
	Maximum	--	*97.7*	19.2	183.6	21.4	10.9	4.6	--	183.6
	Minimum	--	*1.9*	1.9	1.4	2.8	2.9	*1.0*	--	1.0
2018	Average	--	*32.5*	23.2	11.9	25.7	12.3	*1.2*	--	17.8
	Maximum	--	*109.1*	87.5	80.8	119.2	53.7	*3.0*	--	119.2
	Minimum	--	*7.8*	2.0	1.6	1.5	1.1	*0.5*	--	0.5
2019	Average	--	--	*8.9*	20.6	18.8	*0.7*	--	--	12.3
	Maximum	--	--	*41.6*	388.2	121.2	*2.5*	--	--	388.2
	Minimum	--	--	*0.7*	0.0	0.1	*0.0*	--	--	0.0
2020	Average	--	--	--	*48.8*	40.3	*21.6*	--	--	36.9
	Maximum	--	--	--	*113.2*	98.2	*42.7*	--	--	113.2
	Minimum	--	--	--	*9.6*	12.2	*7.0*	--	--	7.0
Runoff (mm)										
2014		--	--	*16*	40	28	34	*12*	--	131
2015		--	*15*	37	58	51	27	10	--	198
2016		--	*38*	33	56	32	15	--	--	175
2017		--	*38*	15	49	18	12	5	--	136
2018		--	*59*	60	32	69	32	2	--	254
2019		--	--	*19*	55	50	*0*	--	--	124
2020		--	--	--	68	108	*35*	--	--	211

Note: Values in italics indicate that data for that month is not complete.



Note: Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

Figure C3-1: Rating Curve

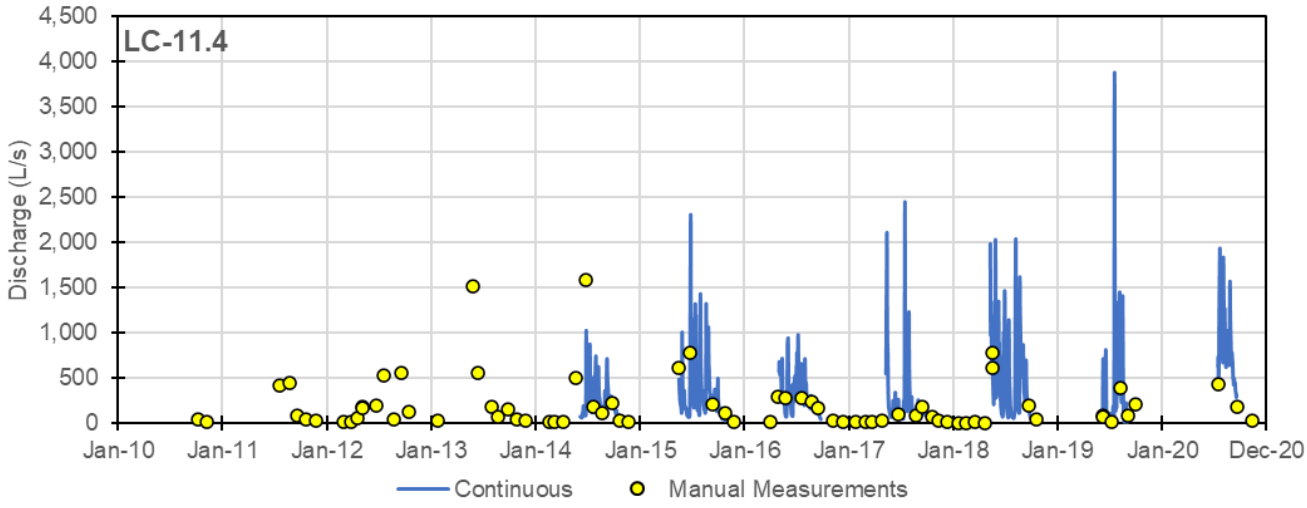
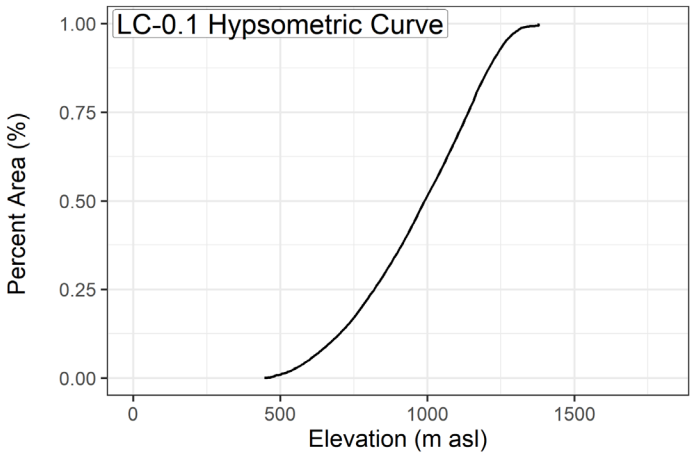


Figure C3-2: Time-series plot of discharge and manual measurements

Appendix C4: LC-0.1

Station Name:	LC-0.1
Previous Station Name:	CC-3.5
Location:	Lower Latte Creek
Basin Area (km²):	69.8
UTM Easting:	594,433
UTM Northing:	6,970,376
Median Elevation (m asl):	990
Record Period:	
Spot Measurements	2010-Present
Continuous Record	2011-Present



Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	Yes
Measurement Interval:	
Summer	15-minute
Winter	Removed

Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2011-09-22	98.565		
2012-06-22	98.630	0.065	
2012-09-21	98.566	-0.064	
2013-05-29	99.580	1.014	
2013-09-25	99.781	0.201	SG reinstalled
2014-05-22	99.825	0.044	SG moved up
2015-09-12	99.847	0.022	SG moved up
2016-05-25	98.875	0.094	SG moved up
2017-06-21	98.898	0.117	SG moved up
2018-05-19	98.936	0.155	SG moved up
2019-06-07	98.942	0.161	SG moved higher
2020-07-16	98.956	0.175	SG moved higher

Note: rating curve has been corrected for staff gauge movement due to frost jacking.

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
41%	13%	41%	5%

Open Water Photo



Winter Photo



Table C4-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2010-10-11	--	0.095	--	--
2010-10-12	0.321	--	--	--
2010-11-11	--	0.021	--	--
2010-12-15	--	0.014	--	--
2011-04-19	0.282	--	--	--
2011-05-19	0.755	--	--	--
2011-06-22	0.840	5.339	5.194	-3%
2011-07-20	0.582	1.206	0.887	-26%
2011-08-26	0.584	0.965	0.902	-7%
2011-09-22	0.412	0.286	0.168	-41%
2011-10-20	0.332	--	--	--
2011-11-28	0.330	0.008	NA	NA
2011-12-20	0.310	--	--	--
2012-02-29	--	0.000	--	--
2012-03-26	--	0.000	--	--
2012-04-19	0.560	0.069	NA	NA
2012-05-07	0.475	0.410	0.333	-19%
2012-05-07	0.478	--	--	--
2012-06-22	0.530	0.809	0.565	-30%
2012-07-18	0.592	1.257	0.963	-23%
2012-08-23	0.380	0.109	0.114	4%
2012-09-21	0.556	0.800	0.712	-11%
2012-10-16	0.344	0.203	NA	NA
2012-11-20	--	0.036	--	--
2013-04-10	--	0.000	--	--
2013-05-29	0.736	2.352	2.748	17%
2013-06-13	0.533	0.534	0.578	8%
2013-08-01	0.593	0.491	0.967	97%
2013-08-21	0.427	0.134	0.198	48%
2013-09-26	0.337	0.337	0.431	28%
2013-10-28	0.197	0.094	NA	NA
2013-11-25	--	0.017	--	--
2014-01-08	--	0.010	--	--
2014-03-10	--	0.001	--	--
2014-05-22	0.450	0.884	1.072	21%
2014-06-05	0.178	0.090	0.028	-68%
2014-06-25	0.178	0.078	0.028	-63%
2014-07-23	0.306	0.322	0.310	-4%
2014-08-21	0.233	0.171	0.108	-37%
2014-09-26	0.243	--	--	--
2014-10-23	0.155	0.058	NA	NA
2014-11-24	0.144	0.023	0.006	-74%
2015-04-30	0.276	0.13	0.213	64%
2015-05-17	0.391	0.681	0.698	2%
2015-06-24	0.127	0.04	0.001	-97%
2015-08-19	0.353	--	--	--
2015-09-12	0.275	0.447	0.210	-53%
2015-10-28	0.178	0.113	NA	NA
2016-04-25	0.412	0.865	0.821	-5%
2016-05-25	0.337	0.583	0.431	-26%
2016-07-20	0.313	--	--	--
2016-08-25	0.263	0.186	0.177	-5%
2016-09-14	0.256	0.156	0.159	2%
2016-10-20	0.146	--	--	--
2017-05-18	0.365	--	--	--
2017-06-21	0.21	0.201	0.068	-66%

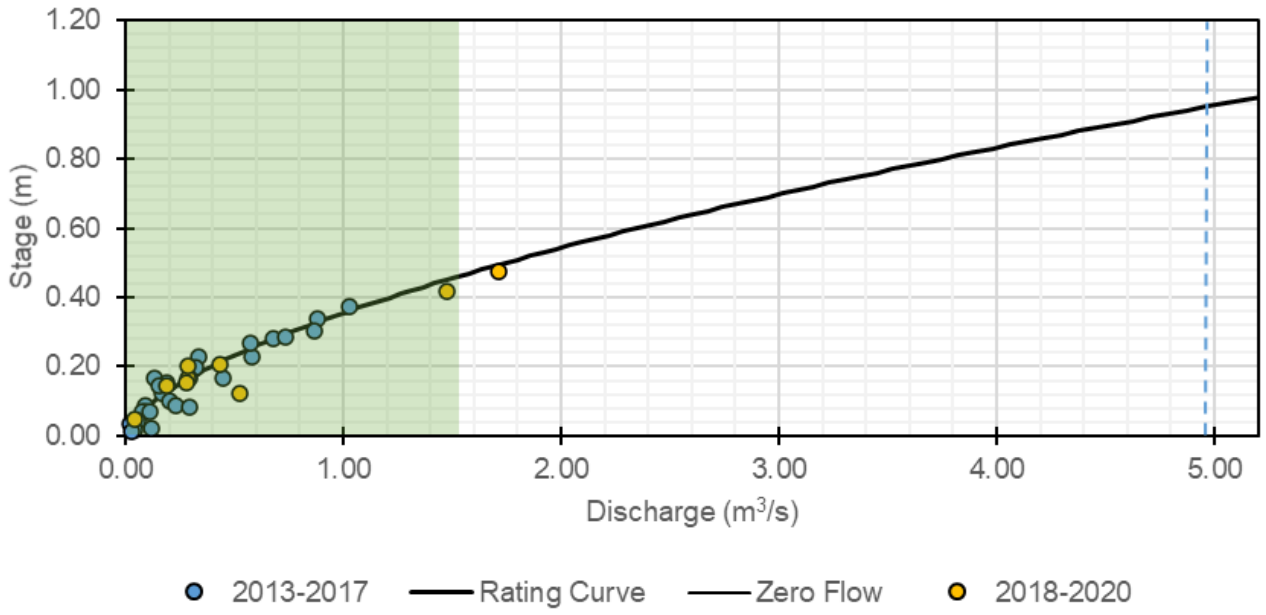
2017-07-27	0.394	0.733	0.714	-3%
2017-08-23	0.132	0.121	0.002	NA
2017-09-14	0.196	0.233	0.048	-79%
2017-10-20	--	0.043	--	--
2017-11-11	--	0.011	--	--
2018-05-16	0.484	1.031	1.087	5%
2018-05-19	0.377	0.572	0.628	10%
2018-05-22	0.289	--	--	--
2018-05-24	0.278	0.293	0.295	1%
2018-06-16	0.297	--	--	--
2018-08-18	0.19	--	--	--
2018-09-21	0.195	0.291	0.096	NA
2019-06-07	0.124	0.030	0.005	NA
New stilling well and staff gauge installed following ice damage				
2019-06-09	0.276	0.288	0.290	1%
2019-07-08	0.158	0.045	0.038	-15%
2019-08-08	0.526	1.474	1.293	-12%
2019-09-03	0.254	0.191	0.230	20%
2019-10-01	0.310	0.289	0.392	36%
2020-07-16	0.397	1.716	0.706	-59%
2020-09-19	0.316	0.434	0.412	-5%
2020-11-10	--	0.034	--	--
Average Error (%)				-11%
Standard Error (%)				39%

Table C4-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2011	Average	--	*1.28*	1.05	0.74	0.88	0.23	0.08	*0.04*	0.62
	Maximum	--	*6.27*	4.86	3.19	5.21	0.41	0.18	*0.05*	6.27
	Minimum	--	*0.24*	0.17	0.27	0.39	0.14	0.05	*0.01*	0.01
2012	Average	--	*1.31*	0.69	0.62	0.26	0.55	0.20	*0.08*	0.53
	Maximum	--	*4.05*	2.66	2.57	1.73	1.40	0.54	*0.09*	4.05
	Minimum	--	*0.28*	0.32	0.16	0.12	0.28	0.04	*0.04*	0.04
2013	Average	--	*2.01*	0.69	1.06	0.51	0.56	0.23	*0.03*	0.73
	Maximum	--	*5.92*	3.64	7.30	3.26	0.96	0.54	*0.05*	7.30
	Minimum	--	*0.15*	0.25	0.32	0.17	0.35	0.04	*0.01*	0.01
2014	Average	--	*0.60*	0.16	0.53	0.29	0.44	*0.11*	--	0.36
	Maximum	--	*1.68*	1.72	1.66	1.23	1.44	*0.65*	--	1.72
	Minimum	--	*0.15*	0.02	0.07	0.09	0.14	*0.01*	--	0.01
2015	Average	--	*0.43*	0.61	1.25	1.15	0.66	0.33	--	0.74
	Maximum	--	*2.13*	8.88	4.50	3.75	1.54	0.99	--	8.88
	Minimum	--	*0.05*	0.01	0.29	0.32	0.28	0.04	--	0.01
2016	Average	*0.59*	*0.67*	0.48	0.79	0.40	0.20	*0.03*	--	0.45
	Maximum	*1.15*	*1.88*	2.89	1.81	1.09	0.35	*0.10*	--	2.89
	Minimum	*0.24*	*0.11*	0.08	0.35	0.23	0.07	*0.00*	--	0.00
2017	Average	--	*0.36*	0.40	0.63	0.39	0.37	*0.21*	--	0.39
	Maximum	--	*1.29*	1.84	3.80	1.03	0.61	*0.30*	--	3.80
	Minimum	--	*0.00*	0.15	0.11	0.21	0.30	*0.08*	--	0.00
2018	Average	*0.47*	1.52	1.51	0.96	1.51	0.99	*0.41*	--	1.05
	Maximum	*0.69*	4.02	3.49	3.27	4.60	2.10	*0.53*	--	4.60
	Minimum	*0.23*	0.30	0.48	0.36	0.34	0.41	*0.32*	--	0.23
2019	Average	--	--	*0.33*	0.55	0.65	*0.04*	--	--	0.40
	Maximum	--	--	*1.39*	3.92	3.01	*0.14*	--	--	3.92
	Minimum	--	--	*0.00*	0.00	0.01	*0.00*	--	--	0.00
2020	Average	--	--	--	*1.53*	1.12	*0.73*	--	--	1.13
	Maximum	--	--	--	*3.18*	2.44	*1.19*	--	--	3.18
	Minimum	--	--	--	*0.51*	0.49	*0.34*	--	--	0.34
Unit Yield ($L/s/km^2$)										
2011	Average	--	*18.3*	15.0	10.7	12.6	3.3	1.2	*0.6*	8.8
	Maximum	--	*89.8*	69.7	45.7	74.7	5.9	2.5	*0.8*	89.8
	Minimum	--	*3.5*	2.4	3.8	5.6	2.0	0.70	*0.2*	0.2
2012	Average	--	*18.7*	9.9	8.9	3.8	7.9	2.9	*1.1*	7.6
	Maximum	--	*58.0*	38.1	36.8	24.7	20.0	7.8	*1.3*	58.0
	Minimum	--	*4.1*	4.6	2.3	1.7	3.9	0.5	*0.5*	0.5
2013	Average	--	*28.8*	9.9	15.2	7.3	8.0	3.3	*0.4*	10.4
	Maximum	--	*84.8*	52.2	104.6	46.6	13.7	7.7	*0.7*	104.6
	Minimum	--	*2.1*	3.6	4.5	2.5	5.0	0.6	*0.2*	0.2
2014	Average	--	*8.6*	2.4	7.6	4.1	6.3	*1.6*	--	5.1
	Maximum	--	*24.0*	24.6	23.7	17.7	20.7	*9.4*	--	24.6
	Minimum	--	*2.2*	0.2	1.0	1.2	2.0	*0.1*	--	0.1
2015	Average	--	*6.1*	8.7	17.9	16.4	9.4	4.8	--	10.6
	Maximum	--	*30.5*	127.2	64.4	53.7	22.0	14.2	--	127.2
	Minimum	--	*0.7*	0.08	4.2	4.6	4.0	0.6	--	0.1
2016	Average	--	*9.6*	6.9	11.4	5.7	2.9	*0.4*	--	6.1
	Maximum	--	*27.0*	41.4	25.9	15.6	5.0	*1.5*	--	41.4
	Minimum	--	*1.6*	1.2	5.0	3.2	0.9	*0.0*	--	0.0

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2017	Average	--	*5.1*	5.7	9.1	5.6	5.3	*3.1*	--	5.6
	Maximum	--	*18.5*	26.4	54.5	14.8	8.8	*4.3*	--	54.5
	Minimum	--	*0.0*	2.1	1.6	3.0	4.3	*1.2*	--	0.0
2018	Average	*6.7*	21.8	21.6	13.7	21.7	14.1	*5.9*	--	15.1
	Maximum	*9.9*	57.6	50.0	46.8	65.9	30.0	*7.6*	--	65.9
	Minimum	*3.3*	4.3	6.9	5.2	4.9	5.8	*4.6*	--	3.3
2019	Average	--	--	*4.8*	7.9	9.4	*0.6*	--	--	5.7
	Maximum	--	--	*19.9*	56.2	43.1	*2.0*	--	--	56.2
	Minimum	--	--	*0.0*	0.0	0.1	*0.0*	--	--	0.0
2020	Average	--	--	--	*21.9*	16.0	*10.5*	--	--	16.1
	Maximum	--	--	--	*45.5*	35.0	*17.1*	--	--	45.5
	Minimum	--	--	--	*7.4*	7.0	*4.9*	--	--	4.9
Runoff (mm)										
2011		--	*21*	*39*	29	34	8	3	*0*	134
2012		--	*44*	*26*	24	10	20	*8*	*1*	132
2013		--	*55*	*26*	41	20	21	9	*0*	170
2014		--	*16*	*6*	20	11	16	*3*	--	73
2015		--	*8*	23	48	44	24	12	--	158
2016		--	26	18	30	15	8	*1*	--	98
2017		--	11	15	24	15	14	*5*	--	84
2018		*4*	58	56	37	58	37	*5*	--	255
2019		--	--	*10*	21	25	*0*	--	--	56
2020		--	--	--	*30*	43	*17*	--	--	90

Note: Values in italics indicate that data for that month is not complete.



Note: Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

Figure C4-1: Rating Curve

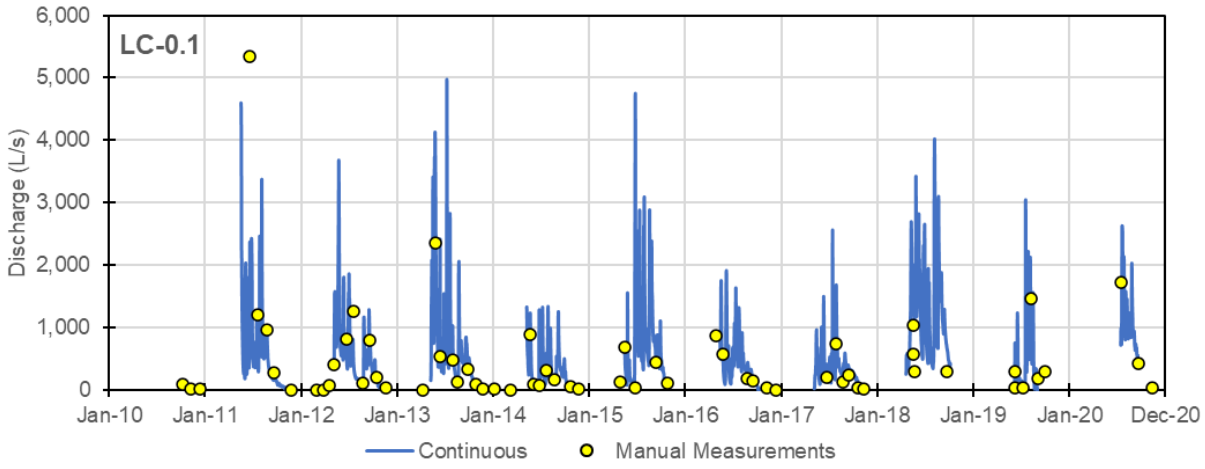
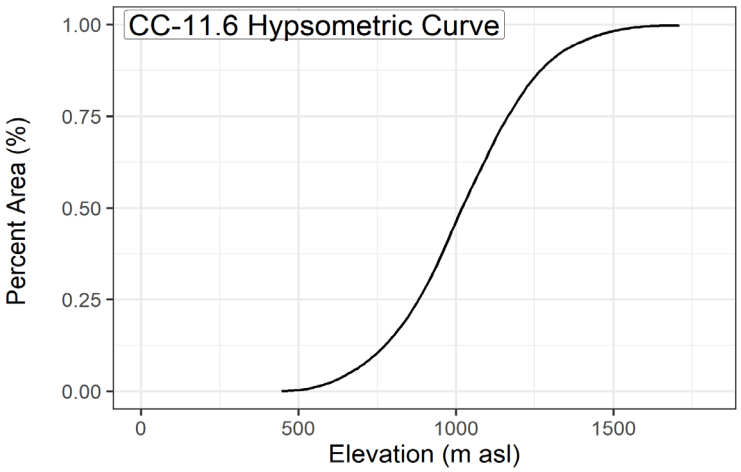


Figure C4-2: Time-series plot of discharge and manual measurements

Appendix C5: CC-11.6

Station Name:	CC-11.6
Previous Station Name:	CC-0.5
Location:	Upper Coffee Creek
Basin Area (km^2):	385.6
UTM Easting:	594,515
UTM Northing:	6,970,359
Median Elevation (m asl):	1,019
Record Period:	
Spot Measurements	2010-Present
Continuous Record	2014-Present

Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	No
Measurement Interval:	
Summer	15-minute
Winter	Removed



Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2014-06-05	97.260		
2015-06-25	97.260	0.000	
2015-09-12	97.262	0.002	No movement
2016-05-25	97.262	0.002	No movement
2017-06-21	97.277	0.017	SG moved up
2018-06-16	97.278	0.018	No movement
2019-06-07	97.284	0.024	SG moved higher

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
35%	15%	35%	15%

Open Water Photo



Winter Photo



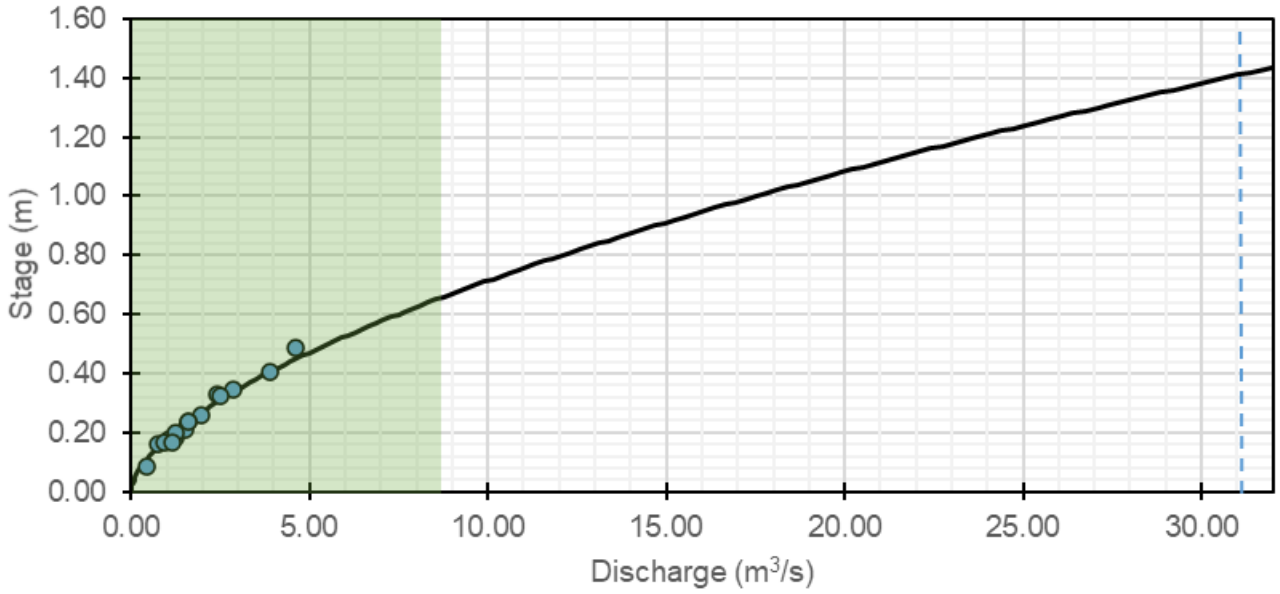
Table C5-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2014-06-05	0.403	1.233	1.033	-16%
2014-06-25	0.382	0.745	0.847	14%
2014-07-23	0.563	2.848	2.951	4%
2014-08-21	0.480	1.960	1.861	-5%
2014-09-26	0.458	1.616	1.606	-1%
2014-10-23	0.395	1.063	0.963	-9%
2014-11-24	--	0.050	--	--
2015-02-25	--	0.004	--	--
2015-04-30	0.385	0.954	0.873	-8%
2015-06-24	0.428	1.506	1.284	-15%
2015-07-22	0.492	--	--	--
2015-08-19	0.692	--	--	--
2015-10-28	0.399	--	--	--
2016-06-22	--	1.634	--	--
2016-08-25	0.551	2.432	2.767	14%
2016-09-14	0.487	--	1.993	--
2016-10-20	0.343	--	0.555	--
2016-11-08	0.31	--	0.332	--
2016-12-10	0.31	--	0.332	--
2017-04-26	0.404	1.225	1.212	-1%
2017-05-18	0.609	3.899	3.906	0%
2017-06-21	0.432	--	1.506	--
2017-07-27	0.718	--	5.803	--
2017-08-23	0.37	--	0.891	--
2017-09-14	0.41	--	1.273	--
2018-04-21	--	0.021	--	--
2018-05-02	0.489	--	1.969	--
2018-05-19	0.709	4.630	5.324	15%
2018-05-22	0.538	--	2.602	--
2018-05-24	0.542	2.521	2.656	5%
2018-06-16	0.580	--	3.198	--
2019-06-07	0.389	1.140	0.909	-20%
2019-07-08	0.306	0.448	0.295	-34%
2019-09-03	0.455	1.584	1.573	-1%
2019-10-01	0.534	--	--	--
2020-07-16	0.876	--	--	--
2020-09-19	--	4.843	--	--
Average Error (%)				-4%
Standard Error (%)				13%

Table C5-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2014	Average	--	--	*2.18*	3.62	2.58	3.69	1.39	*0.49*	2.33
	Maximum	--	--	*18.37*	12.37	6.08	11.23	4.52	*0.96*	18.37
	Minimum	--	--	*0.69*	0.95	1.39	1.37	0.04	*0.09*	0.04
2015	Average	--	*3.79*	2.87	5.88	7.95	5.04	2.35	--	4.65
	Maximum	--	*33.24*	24.97	20.98	28.98	10.54	5.35	--	33.24
	Minimum	--	*0.60*	0.45	1.54	2.24	3.19	0.09	--	0.09
2016	Average	*3.84*	5.45	2.98	7.14	2.83	1.50	0.40	--	3.45
	Maximum	*7.02*	22.30	22.75	23.04	4.32	2.23	1.02	--	23.04
	Minimum	*2.00*	1.06	0.83	2.77	1.93	0.62	0.03	--	0.03
2017	Average	--	*2.83*	3.74	4.01	1.61	1.30	*1.05*	--	2.42
	Maximum	--	*9.71*	25.18	20.13	3.99	2.20	*1.19*	--	25.18
	Minimum	--	*0.27*	1.11	1.07	0.96	1.06	*0.73*	--	0.27
2018	Average	--	6.66	5.93	3.08	9.20	4.29	*1.43*	--	5.10
	Maximum	--	38.80	14.48	16.13	52.26	10.35	*2.38*	--	52.26
	Minimum	--	0.41	1.06	0.74	0.65	1.06	*0.77*	--	0.41
2019	Average	--	--	*2.69*	3.62	4.14	*0.89*	--	--	2.83
	Maximum	--	--	*14.40*	26.05	11.62	*1.54*	--	--	26.05
	Minimum	--	--	*0.46*	0.00	0.93	*0.45*	--	--	0.00
2020	Average	--	--	--	*11.52*	7.89	*5.42*	--	--	8.28
	Maximum	--	--	--	*26.58*	16.11	*7.43*	--	--	26.58
	Minimum	--	--	--	*5.22*	4.18	*3.36*	--	--	3.36
Unit Yield ($L/s/km^2$)										
2014	Average	--	--	*5.7*	9.4	6.7	9.6	3.6	*1.3*	6.0
	Maximum	--	--	*47.6*	32.1	15.8	29.1	11.7	*2.5*	47.6
	Minimum	--	--	*1.8*	2.5	3.6	3.6	0.1	*0.2*	0.1
2015	Average	--	*9.8*	7.4	15.2	20.6	13.1	6.1	--	12.0
	Maximum	--	*86.2*	64.8	54.4	75.2	27.3	13.9	--	86.2
	Minimum	--	*1.5*	1.2	4.0	5.8	8.3	0.2	--	0.2
2016	Average	*9.9*	*14.1*	7.7	18.5	7.3	3.9	*1.0*	--	8.9
	Maximum	*18.2*	*57.8*	59.0	59.7	11.2	5.8	*2.6*	--	59.7
	Minimum	*5.2*	*2.7*	2.2	7.2	5.0	1.6	*0.1*	--	0.1
2017	Average	--	*7.3*	9.7	10.4	4.2	3.4	*2.7*	--	6.3
	Maximum	--	*25.2*	65.3	52.2	10.4	5.7	*3.1*	--	65.3
	Minimum	--	*0.7*	2.9	2.8	2.5	2.7	*1.9*	--	0.7
2018	Average	--	*17.3*	15.4	8.0	23.9	11.1	*3.7*	--	13.2
	Maximum	--	*100.6*	37.6	41.8	135.5	26.8	*6.2*	--	135.5
	Minimum	--	*1.1*	2.7	1.9	1.7	2.7	*2.0*	--	1.1
2019	Average	--	--	*7.0*	9.4	10.7	*2.3*	--	--	7.4
	Maximum	--	--	*37.3*	67.6	30.1	*4.0*	--	--	67.6
	Minimum	--	--	*1.2*	0.0	2.4	*1.2*	--	--	0.0
2020	Average	--	--	--	*29.9*	20.5	*14.1*	--	--	21.5
	Maximum	--	--	--	*68.9*	41.8	*19.3*	--	--	68.9
	Minimum	--	--	--	*13.5*	10.9	*8.7*	--	--	8.7
Runoff (mm)										
2014		--	--	*13*	25	18	25	10	*2*	92
2015		--	*24*	19	41	55	34	16	--	189
2016		*3*	38	*20*	50	20	10	*2*	--	142
2017		--	20	*25*	28	11	9	*3*	--	96
2018		--	46	40	21	64	29	*2*	--	202
2019		--	--	*14*	25	29	*1*	--	--	69
2020		--	--	--	*41*	55	*23*	--	--	119

Note: *Values in italics indicate that data for that month is not complete.*



Note: Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

Figure C5-1: Rating Curve

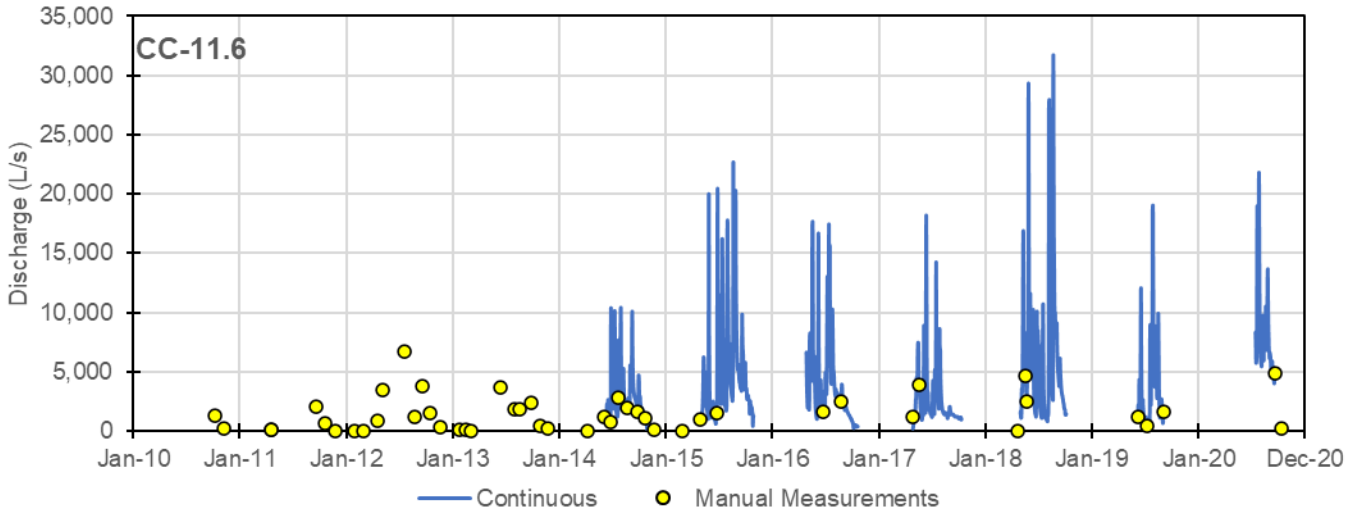
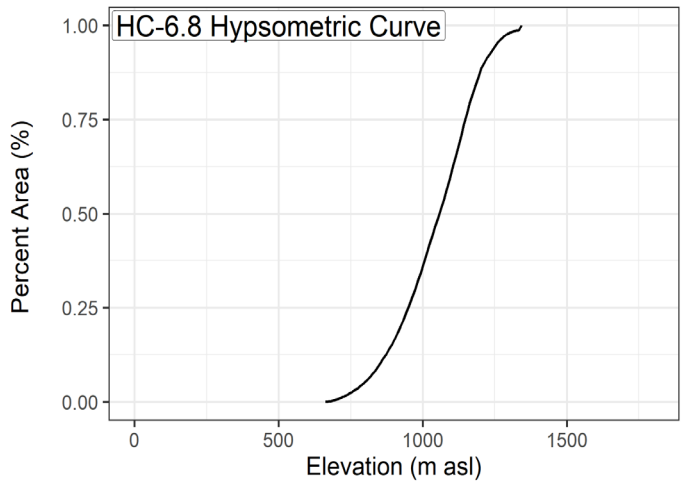


Figure C5 2: Time-series plot of discharge and manual measurements

Appendix C6: HC-6.8

Station Name:	HC-6.8
Previous Station Name:	HC-2.5
Location:	Upper Halfway Creek
Basin Area (km^2):	14.8
UTM Easting:	584,058
UTM Northing:	6,976,584
Median Elevation (m asl):	1,057
Record Period:	
Spot Measurements	2010-Present
Continuous Record	2014-Present

Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	No
Measurement Interval:	
Summer	15-minute
Winter	Removed



Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2014-06-07	98.695		
2015-09-14	98.732	0.037	SG moved up
2016-05-26	98.709	0.014	SG moved up
2017-06-23	98.737	0.042	SG moved up
2017-07-26	98.750	0.055	SG moved up
2018-07-22	98.750	0.055	No movement
2019-06-05	98.740	0.045	SG moved lower
2020-07-18	98.747	0.052	SG moved up

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
48%	16%	27%	8%

Open Water Photo



Winter Photo



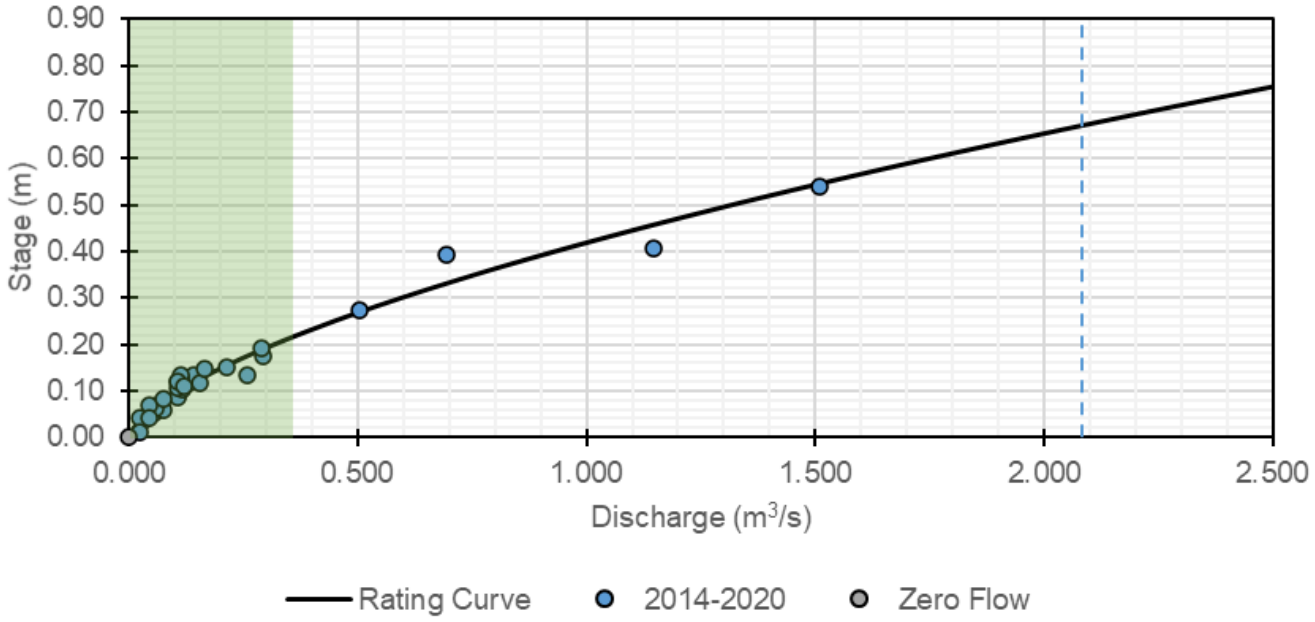
Table C6-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2014-06-07	0.325	0.029	0.048	66%
2014-06-27	0.425	0.257	0.214	-17%
2014-07-23	0.380	0.106	0.129	21%
2014-08-21	0.342	0.053	0.070	32%
2014-09-26	0.358	0.062	0.093	50%
2014-10-24	0.334	0.041	NA	NA
2014-11-25	--	0.014	--	--
2015-05-19	0.374	0.106	0.118	12%
2015-06-26	0.296	0.024	0.019	-22%
2015-07-23	0.328	--	--	--
2015-08-20	0.645	0.693	0.732	6%
2015-09-13	0.368	0.132	0.064	-51%
2015-10-30	--	0.051	--	--
2015-11-28	--	0.030	--	--
2016-04-03	--	0.015	--	--
2016-04-26	0.463	0.292	0.231	-21%
2016-04-27	0.444	--	--	--
2016-05-26	0.422	0.140	0.150	7%
2016-06-24	0.356	0.067	0.049	-26%
2016-07-21	0.400	0.114	0.112	-2%
2016-08-26	0.439	0.212	0.182	-14%
2016-09-16	0.416	0.114	0.139	22%
2016-11-08	--	0.019	--	--
2016-12-11	--	0.019	--	--
2017-05-19	0.519	--	--	--
2017-06-23	0.562	0.505	0.478	-5%
2017-07-26	0.375	0.106	0.074	-30%
2017-08-24	0.350	0.076	0.042	-44%
2017-09-13	0.406	0.155	0.122	-21%
2017-10-19	--	0.072	--	--
2017-11-12	--	0.018	--	--
2017-12-10	--	0.014	--	--
2018-05-17	0.695	1.148	0.904	-21%
2018-05-19	0.532	--	--	--
2018-05-22	0.398	--	--	--
2018-05-24	0.480	0.291	0.291	0%
2018-06-17	0.384	--	--	--
2018-07-22	0.355	--	--	--
2018-08-19	0.367	--	--	--
2018-09-21	0.393	0.115	0.111	-4%
2019-06-05	0.396	0.106	0.117	11%
2019-06-09	0.353	0.057	0.052	-9%
2019-07-08	0.301	0.024	0.003	-86%
2019-08-10	0.436	0.166	0.193	16%
2019-09-02	0.359	0.043	0.060	39%
2019-10-03	0.425	0.114	0.171	50%
2020-07-18	0.411	0.106	0.144	36%
2020-09-20	0.400	0.119	0.124	4%
Average Error (%)				0%
Standard Error (%)				33%

Table C6-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2014	Average	--	--	*0.08*	0.16	0.11	0.17	*0.09*	--	0.12
	Maximum	--	--	*0.41*	0.52	0.26	0.41	*0.29*	--	0.52
	Minimum	--	--	*0.03*	0.06	0.06	0.09	*0.05*	--	0.03
2015	Average	--	*0.14*	0.09	0.21	0.19	0.12	0.05	--	0.13
	Maximum	--	*0.63*	0.87	0.94	0.86	0.26	0.17	--	0.94
	Minimum	--	*0.04*	0.00	0.04	0.05	0.05	0.01	--	0.00
2016	Average	--	0.23	0.16	0.18	0.12	0.08	*0.04*	--	0.14
	Maximum	--	0.55	0.95	0.51	0.31	0.20	*0.08*	--	0.95
	Minimum	--	0.05	0.05	0.10	0.07	0.00	*0.02*	--	0.00
2017	Average	--	0.26	0.31	0.25	0.11	0.10	*0.07*	--	0.18
	Maximum	--	0.39	0.73	2.56	0.36	0.15	*0.09*	--	2.56
	Minimum	--	0.16	0.16	0.09	0.07	0.07	*0.05*	--	0.05
2018	Average	--	0.43	0.31	0.18	0.33	0.24	*0.11*	--	0.27
	Maximum	--	1.74	1.59	0.62	1.00	0.60	*0.17*	--	1.74
	Minimum	--	0.13	0.08	0.06	0.06	0.09	*0.06*	--	0.06
2019	Average	--	--	*0.1*	0.1	0.3	*0.2*	--	--	0.16
	Maximum	--	--	*0.5*	0.7	1.1	*0.3*	--	--	1.06
	Minimum	--	--	*0.0*	0.0	0.0	*0.1*	--	--	0.00
2020	Average	--	--	--	*0.4*	0.3	*0.2*	--	--	0.31
	Maximum	--	--	--	*0.8*	0.6	*0.4*	--	--	0.80
	Minimum	--	--	--	*0.1*	0.1	*0.1*	--	--	0.08
Unit Yield ($L/s/km^2$)										
2014	Average	--	--	*5.5*	11.1	7.1	11.8	*6.4*	--	8.4
	Maximum	--	--	*27.4*	35.2	17.8	27.6	*19.8*	--	35.2
	Minimum	--	--	*2.0*	3.8	3.8	5.9	*3.1*	--	2.0
2015	Average	--	*9.8*	5.8	13.9	13.1	8.2	3.3	--	9.0
	Maximum	--	*42.9*	59.1	63.4	57.8	17.6	11.2	--	63.4
	Minimum	--	*2.6*	0.3	2.7	3.2	3.2	0.5	--	0.3
2016	Average	--	15.4	11.1	12.3	8.3	5.2	*2.9*	--	9.20
	Maximum	--	37.3	63.9	34.5	20.9	13.6	*5.6*	--	63.90
	Minimum	--	3.5	3.2	6.5	4.4	0.0	*1.5*	--	0.00
2017	Average	--	17.4	20.7	16.9	7.2	6.7	*4.8*	--	12.26
	Maximum	--	26.2	49.4	172.8	24.5	10.3	*5.9*	--	172.78
	Minimum	--	10.5	11.1	6.1	5.1	5.0	*3.3*	--	3.34
2018	Average	--	28.76	20.8	12.1	22.2	16.4	*7.5*	--	17.97
	Maximum	--	117.4	107.4	42.2	67.3	40.4	*11.6*	--	117.38
	Minimum	--	9.0	5.7	4.2	4.3	6.2	*4.0*	--	3.96
2019	Average	--	--	*7.2*	6.1	19.2	*10.7*	--	--	10.80
	Maximum	--	--	*35.2*	45.1	71.8	*19.1*	--	--	71.85
	Minimum	--	--	*0.1*	0.1	3.2	*4.2*	--	--	0.05
2020	Average	--	--	--	*27.1*	21.5	*14.6*	--	--	21.05
	Maximum	--	--	--	*53.9*	40.0	*26.8*	--	--	53.95
	Minimum	--	--	--	*8.2*	7.9	*5.6*	--	--	5.56
Runoff (mm)										
2014		--	--	*11*	30	19	31	*13*	--	104
2015		--	*11*	15	37	35	21	9	--	128
2016		--	41	29	33	22	14	*3*	--	142
2017		--	*20*	54	45	19	17	11	--	166
2018		--	17	54	32	60	14	*6*	--	183
2019		--	--	*16*	16	51	*2*	--	--	86
2020		--	--	--	*33*	58	*25*	--	--	115

Note: Values in italics indicate that data for that month is not complete.



Notes:
Rating curve extended using the slope-area method from a channel survey conducted in 2015.
Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

Figure C6-1: Rating Curve

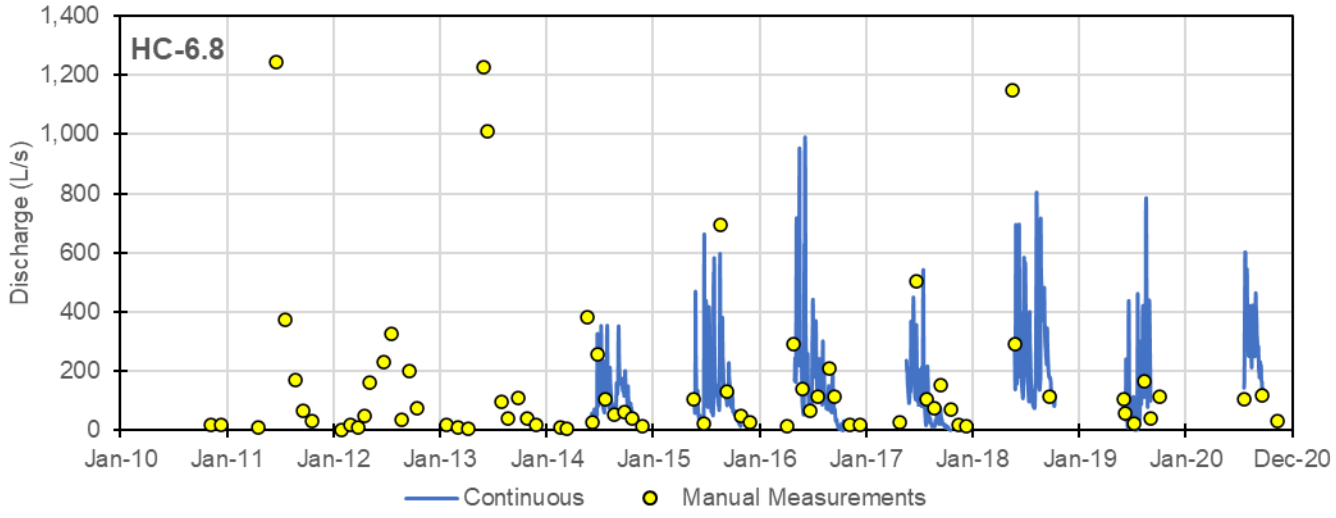
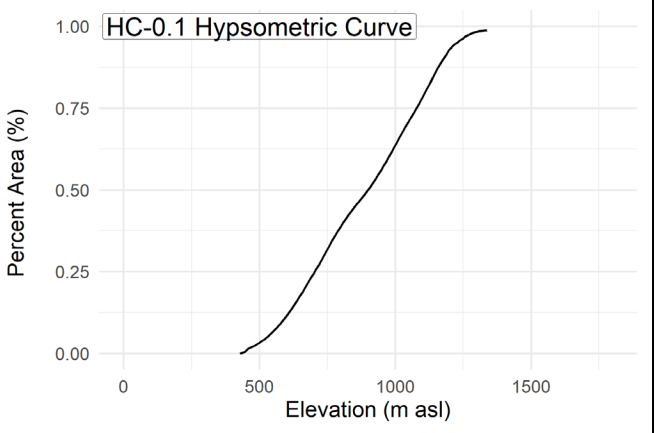


Figure C6-2: Time-series plot of discharge and manual measurements

Appendix C7: HC-0.1

Station Name:	HC-0.1
Previous Station Name:	HC-5.0
Location:	Lower Halfway Creek
Basin Area (km²):	27.0
UTM Easting:	588,839
UTM Northing:	6,980,553
Median Elevation (m asl):	896
Record Period:	
Spot Measurements	2010-Present
Continuous Record	2011-Present

Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	No
Measurement Interval:	
Summer	15-minute
Winter	Removed



Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2011-09-21	98.619		
2012-09-19	98.616	-0.003	
2013-05-30	99.621	1.005	
2013-09-25	99.378	-0.243	Staff gauge relocated
2014-07-23	99.384	0.006	
2015-09-13	99.392	0.008	No movement
2017-06-23	98.396	0.018	SG moved up
2018-07-21	98.398	0.020	No movement
2019-06-05	98.396	0.018	No movement
2020-07-17	98.422	0.044	SG moved higher

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
45%	17%	31%	7%

Open Water Photo



Winter Photo



Table C7-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2010-10-12	0.366	0.076	NA	NA
2010-11-10	--	0.008	--	--
2011-05-19	0.750	--	--	--
2011-06-22	0.750	1.532	1.567	2%
2011-07-20	0.520	0.397	0.460	16%
2011-08-26	0.468	0.258	0.284	10%
2011-09-21	0.390	0.071	0.086	21%
2011-10-20	0.380	0.025	NA	NA
2011-11-28	--	0.000	--	--
2012-02-29	--	0.000	--	--
2012-03-26	--	0.000	--	--
2013-04-10	--	0.000	--	--
2012-05-16	0.485	0.300	0.338	13%
2012-08-23	0.350	0.049	NA	NA
2012-09-19	0.475	--	0.306	--
2012-09-19	--	0.254	--	--
2012-10-17	0.398	0.089	0.102	14%
2012-11-20	--	0.015	--	--
2013-01-24	--	0.000	--	--
2013-04-10	--	0.000	--	--
2013-05-30	0.580	0.866	0.700	-19%
2013-07-31	0.429	0.023	NA	NA
2013-08-21	0.385	0.048	0.076	58%
2013-09-26	0.323	0.142	0.171	21%
2013-10-29	--	0.054	--	--
2013-11-26	--	0.000	--	--
2014-05-22	0.395	0.392	0.319	-19%
2014-06-27	0.351	0.288	0.226	-22%
2014-07-23	0.292	0.112	0.116	4%
2014-08-21	0.248	0.045	0.048	7%
2014-09-25	0.282	--	--	--
2014-10-24	0.228	0.041	0.023	-43%
2015-04-29	--	0.046	--	--
2015-05-19	0.303	0.151	0.134	-11%
2015-06-26	0.224	0.028	0.019	-32%
2015-07-23	0.266	--	--	--
2015-08-20	0.590	--	--	--
2015-09-13	0.295	0.189	0.121	-36%
2015-10-30	0.248	0.071	0.048	-32%
2016-04-03	--	0.017	--	--
2016-04-26	0.359	0.216	0.242	12%
2016-05-26	0.306	0.152	0.140	-8%
2016-06-24	0.239	0.052	0.036	-31%
2016-07-21	0.280	0.116	0.096	-17%
2016-08-26	0.310	0.199	0.148	-26%
2016-09-16	0.292	0.172	0.116	-33%
2017-05-19	0.347	0.236	0.218	-8%
2017-06-23	0.374	--	0.273	--
2017-07-28	0.332	--	0.189	--
2017-08-24	0.269	0.071	0.079	11%
2017-09-15	0.306	0.145	0.140	-3%
2017-10-20	--	0.066	--	--
2018-04-21	--	0.037	--	--
2018-05-17	0.370	0.279	0.265	-5%
2018-05-19	0.378	0.301	0.282	-6%
2018-05-22	0.323	--	--	--

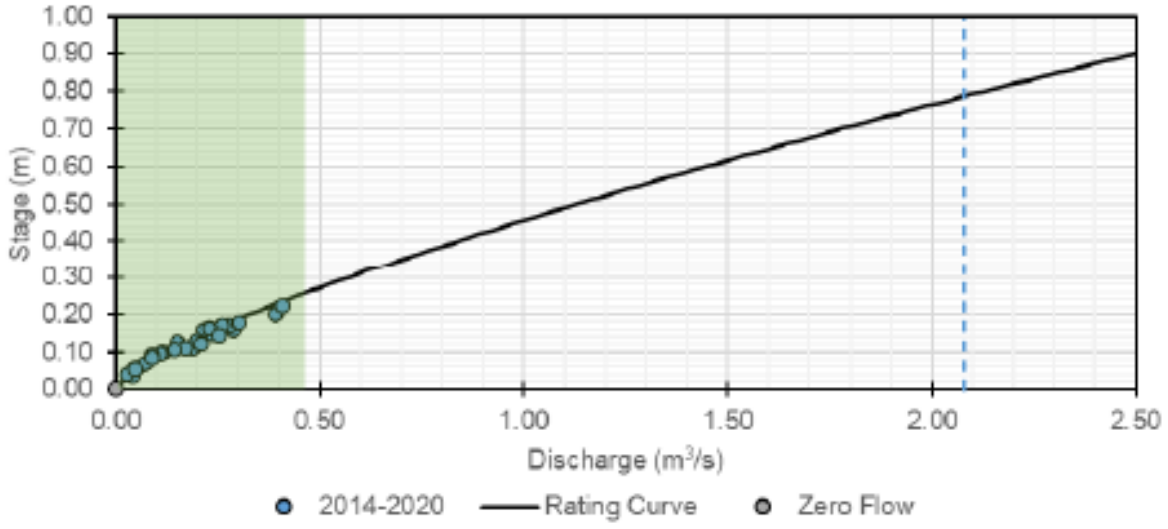
Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2018-05-24	0.368	0.261	0.261	0%
2018-06-17	0.307	--	--	--
2018-07-21	0.282	--	--	--
2018-08-19	0.310	--	--	--
2019-06-05	0.294	0.110	0.119	9%
2019-07-08	0.201	0.017	0.000	--
2019-08-07	0.422	0.409	0.380	-7%
2019-09-01	0.290	0.091	0.113	24%
2019-10-02	0.362	0.229	0.248	8%
2020-07-17	0.344	0.255	0.212	-17%
2020-09-20	0.322	0.208	0.170	-18%
2020-11-11	--	0.033	--	--
Average Error (%)				-4%
Standard Error (%)				21%

Table C7-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Discharge (m^3/s)										
Year		**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Annual**
2011	Average	--	*0.651*	0.57	0.44	0.38	0.09	0.08	*0.025*	0.32
	Maximum	--	*2.555*	1.73	1.35	1.89	0.16	0.67	*0.113*	2.56
	Minimum	--	*0.205*	0.16	0.09	0.15	0.03	0.00	*2E-04*	0.00
2012	Average	--	*0.652*	0.25	0.28	0.09	0.24	*0.32*	--	0.30
	Maximum	--	*2.225*	1.06	1.50	1.16	0.58	*0.82*	--	2.23
	Minimum	--	*0.162*	0.08	0.02	0.00	0.14	*0.10*	--	0.00
2013	Average	--	*0.775*	0.26	0.33	0.18	0.30	*0.19*	--	0.34
	Maximum	--	*1.874*	1.84	1.85	1.49	0.57	*0.25*	--	1.87
	Minimum	--	*0.287*	0.05	0.07	0.02	0.17	*0.13*	--	0.02
2014	Average	--	*0.263*	0.09	0.18	0.08	0.17	*0.06*	--	0.14
	Maximum	--	*0.563*	0.44	0.59	0.25	0.45	*0.22*	--	0.59
	Minimum	--	*0.086*	0.03	0.04	0.04	0.10	*0.00*	--	0.00
2015	Average	--	*0.17*	0.09	0.24	0.26	0.20	0.13	--	0.18
	Maximum	--	*0.75*	0.86	1.03	0.85	0.42	0.31	--	1.03
	Minimum	--	*0.03*	0.00	0.01	0.06	0.10	0.06	--	0.00
2016	Average	*0.243*	*0.19*	0.17	0.20	0.19	0.15	*0.13*	--	0.2
	Maximum	*0.459*	*0.56*	0.88	0.52	0.37	0.31	*0.47*	--	0.9
	Minimum	*0.11*	*0.06*	0.04	0.10	0.11	0.05	*0.00*	--	0.0
2017	Average	*0.296*	0.15	0.22	0.13	0.08	0.08	*0.04*	--	0.1
	Maximum	*0.378*	0.68	0.63	1.60	0.36	0.15	*0.07*	--	1.6
	Minimum	*0.186*	0.00	0.02	0.01	0.03	0.05	*0.00*	--	0.0
2018	Average	--	*0.28*	0.27	0.14	*0.27*	--	--	--	0.2
	Maximum	--	*0.74*	0.93	0.73	*1.14*	--	--	--	1.1
	Minimum	--	*0.01*	0.08	0.01	*0.01*	--	--	--	0.0
2019	Average	--	--	*0.11*	0.14	0.21	0.24	*0.05*	--	0.2
	Maximum	--	--	*0.28*	0.55	0.68	0.62	*0.07*	--	0.7
	Minimum	--	--	*0.02*	0.01	0.01	0.02	*0.01*	--	0.0
2020	Average	--	--	--	*0.49*	0.42	*0.39*	--	--	0.4
	Maximum	--	--	--	*0.92*	0.68	*0.59*	--	--	0.9
	Minimum	--	--	--	*0.21*	0.23	*0.20*	--	--	0.2
Unit Yield ($L/s/km^2$)										
2011	Average	--	*24.09*	21.0	16.3	14.2	3.4	2.8	*0.926*	11.8
	Maximum	--	*94.64*	64.0	50.1	69.9	5.9	24.7	*4.19*	94.6
	Minimum	--	*7.609*	5.9	3.4	5.4	1.0	0.0	*0.006*	0.0
2012	Average	--	*24.14*	9.3	10.3	3.2	8.9	*11.7*	--	11.3
	Maximum	--	*82.42*	39.2	55.6	43.0	21.7	*30.5*	--	82.4
	Minimum	--	*5.988*	2.8	0.7	0.1	5.1	*3.8*	--	0.1

Discharge (m^3/s)										
Year		**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Annual**
2013	Average	--	*28.72*	9.6	12.3	6.7	11.1	*6.9*	--	12.6
	Maximum	--	*69.42*	68.0	68.7	55.3	20.9	*9.3*	--	69.4
	Minimum	--	*10.63*	1.9	2.8	0.8	6.3	*4.7*	--	0.8
2014	Average	--	*9.732*	3.4	6.7	3.1	6.2	*2.4*	--	5.3
	Maximum	--	*20.84*	16.5	21.9	9.1	16.8	*8.1*	--	21.9
	Minimum	--	*3.172*	1.0	1.4	1.3	3.6	*0.0*	--	0.0
2015	Average	--	*6.1*	3.3	8.8	9.7	7.5	4.7	--	6.7
	Maximum	--	*27.9*	31.9	38.0	31.3	15.7	11.6	--	38.0
	Minimum	--	*0.9*	0.0	0.3	2.4	3.6	2.1	--	0.0
2016	Average	*9.0*	*7.0*	6.4	7.5	7.0	5.7	*4.8*	--	6.8
	Maximum	*17.01*	*20.8*	32.5	19.4	13.8	11.7	*17.5*	--	32.5
	Minimum	*4.129*	*2.4*	1.6	3.8	4.0	2.0	*0.0*	--	0.0
2017	Average	--	*10.9*	5.4	8.3	5.0	2.9	*3.0*	--	5.9
	Maximum	--	*14.0*	25.1	23.3	59.4	13.4	*5.5*	--	59.4
	Minimum	--	*6.9*	0.0	0.8	0.3	1.2	*1.8*	--	0.0
2018	Average	--	*10.4*	10.0	5.1	*9.9*	--	--	--	8.8
	Maximum	--	*27.4*	34.3	27.1	*42.3*	--	--	--	42.3
	Minimum	--	*0.4*	2.9	0.5	*0.3*	--	--	--	0.3
2019	Average	--	--	*4.1*	5.3	7.8	9.0	*1.9*	--	5.6
	Maximum	--	--	*10.3*	20.3	25.2	22.9	*2.6*	--	25.2
	Minimum	--	--	*0.7*	0.3	0.4	0.8	*0.4*	--	0.3
2020	Average	--	--	--	*18.2*	*15.5*	*14.5*	--	--	16.1
	Maximum	--	--	--	*34.0*	*25.2*	*21.8*	--	--	34.0
	Minimum	--	--	--	*7.8*	*8.3*	*7.5*	--	--	7.5
Runoff (mm)										
2011		--	*27*	*54*	44	38	9	8	*1*	181
2012		--	*52*	*24*	28	8	23	*17*	--	153
2013		--	*17*	*25*	33	18	29	*11*	--	133
2014		--	*26*	9	18	8	16	*6*	--	83
2015		--	*7*	9	24	26	20	13	--	97
2016		*15*	19	17	20	19	15	*3*	--	107
2017		*18*	14	22	13	8	8	*1*	--	84
2018		--	*17*	26	14	35	28	*4*	--	123
2019		--	--	*4*	14	14	24	*0*	--	56
2020		--	--	--	*24*	42	*24*	--	--	89

Note: Values in italics indicate that data for that month is not complete.



Note: Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

Figure C7-1: Rating Curve

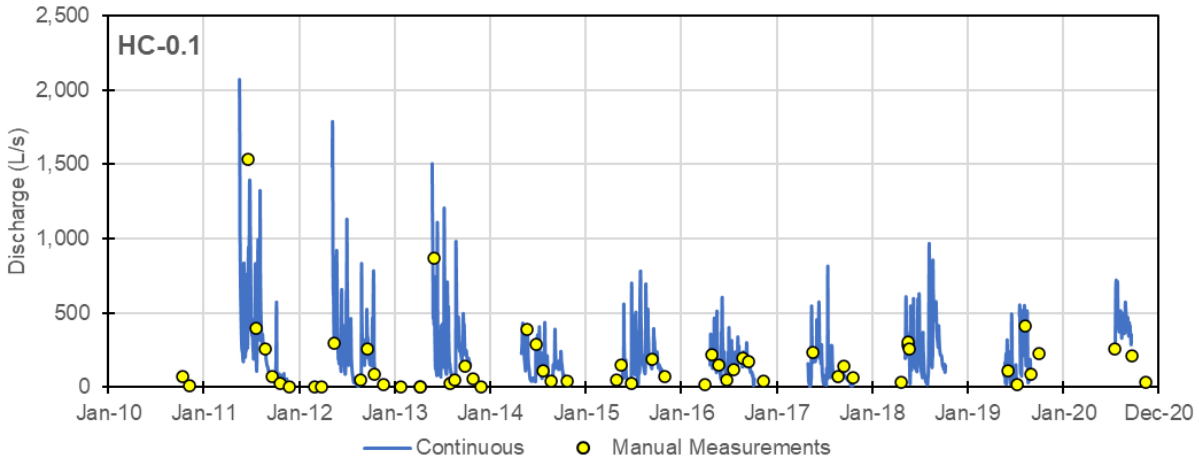
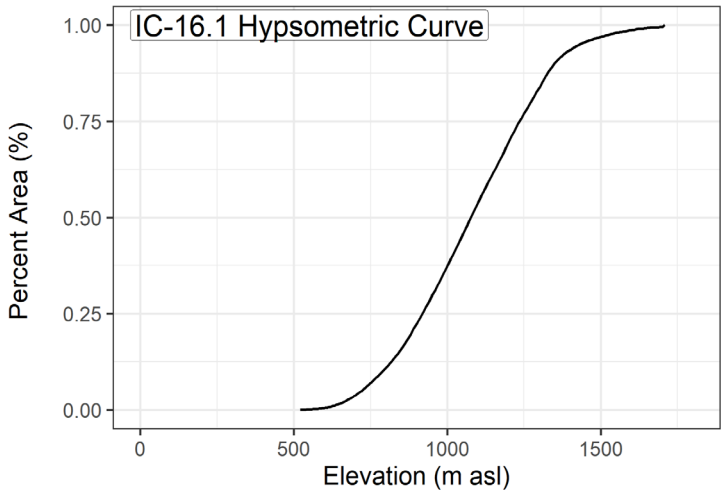


Figure C7-2: Time-series plot of discharge and manual measurements

Appendix C8: IC-16.1

Station Name:	IC-16.1
Previous Station Name:	IC-1.5
Location:	Independence Creek
Basin Area (km²):	81.1
UTM Easting:	572,258
UTM Northing:	6,976,969
Median Elevation (m asl):	1,076
Record Period:	
Spot Measurements	2010-2019
Continuous Record	2014-2019

Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	No
Measurement Interval:	
Summer	15-minute
Winter	Removed



Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2015-06-06	97.898		
2016-05-27	97.950	0.052	Suspect survey
2017-06-22	98.897	-0.001	No movement
2018-06-17	97.896	-0.002	No movement
2019-06-08	97.949	0.051	shifted up

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
46%	12%	24%	18%

Open Water Photo



Winter Photo



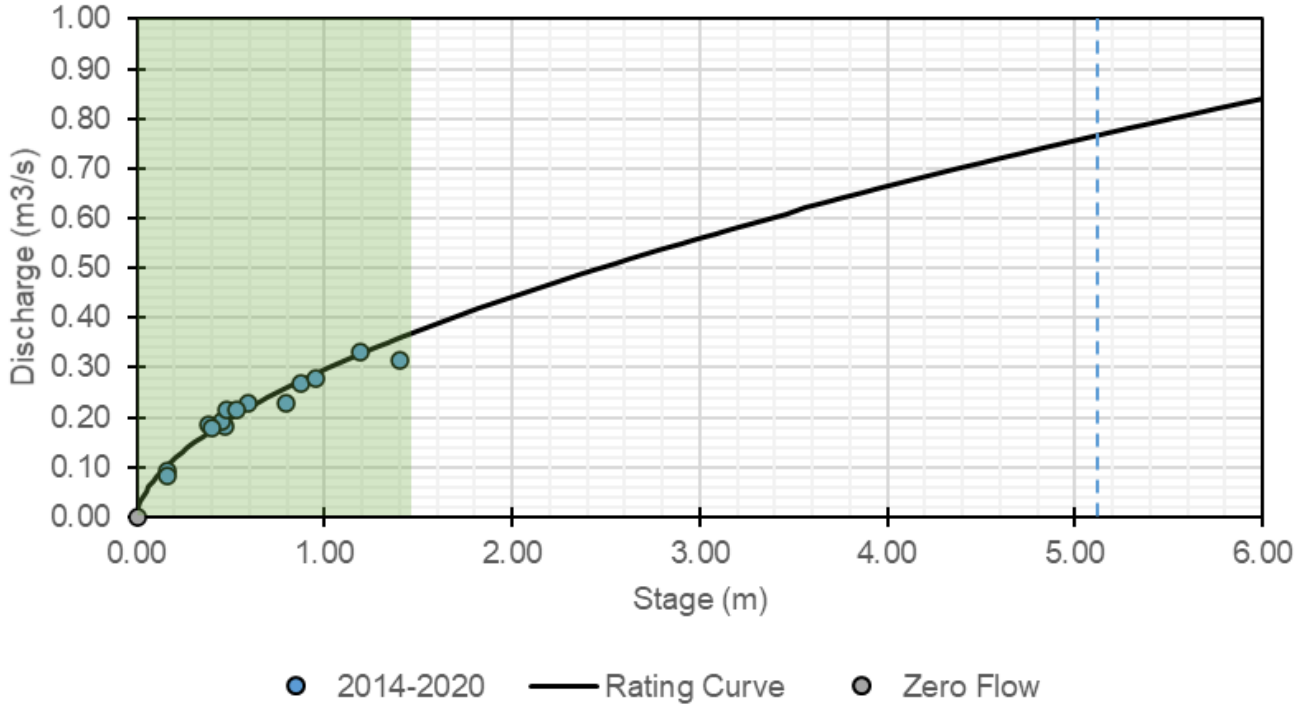
Table C8-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2014-06-06	0.543	0.468	0.438	-6%
2014-06-27	0.791	--	--	--
2014-07-24	0.589	0.596	0.601	1%
2014-08-20	0.552	0.448	0.469	5%
2014-09-25	0.546	0.378	0.448	19%
2014-10-23	0.454	0.164	0.171	4%
2015-04-30	--	--	--	--
2015-05-18	0.690	1.186	1.008	-15%
2015-06-25	0.443	0.158	0.143	-9%
2015-07-23	0.575	--	--	--
2015-08-20	1.050	--	--	--
2015-09-14	0.603	--	--	--
2016-04-25	0.698	0.875	1.043	19%
2016-05-27	0.625	--	--	--
2016-06-24	0.519	--	--	--
2016-07-22	0.660	--	--	--
2016-09-15	0.575	0.475	0.550	16%
2016-10-21	0.700	--	--	--
2017-05-19	0.863	--	--	--
2017-06-22	0.637	0.955	0.787	-18%
2017-07-28	0.655	--	--	--
2017-09-15	0.500	--	--	--
2018-05-20	0.796	--	--	--
2018-06-17	0.558	--	--	--
2018-07-22	0.482	--	--	--
2018-08-19	0.505	--	--	--
2019-06-08	0.576	0.530	0.580	9%
2019-07-06	0.429	--	--	--
2019-08-09	0.674	1.404	1.104	-21%
2019-09-01	0.539	0.394	0.420	7%
2019-10-03	0.589	0.797	0.641	-20%
Average Error (%)				-1%
Standard Error (%)				14%

Table C8-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2014	Average	--	--	*0.79*	0.78	0.54	0.73	0.40	*0.11*	0.56
	Maximum	--	--	*2.24*	1.80	1.26	1.83	0.92	*0.567*	2.24
	Minimum	--	--	*0.31*	0.28	0.36	0.41	0.12	*0.01*	0.01
2015	Average	--	*0.62*	0.40	1.19	1.10	0.90	0.63	--	0.81
	Maximum	--	*2.10*	2.86	3.67	3.10	1.80	1.37	--	3.67
	Minimum	--	*0.10*	0.01	0.33	0.40	0.58	0.32	--	0.01
2016	Average	0.741	*0.73*	0.77	1.24	0.78	0.51	--	--	0.79
	Maximum	1.233	*1.43*	2.47	3.29	1.62	0.73	--	--	3.29
	Minimum	0.42	*0.34*	0.25	0.75	0.57	0.18	--	--	0.18
2017	Average	--	*0.41*	0.86	0.67	0.34	0.32	*0.202*	--	0.47
	Maximum	--	*0.99*	4.50	2.22	1.13	0.60	*0.585*	--	4.50
	Minimum	--	*0.11*	0.24	0.15	0.12	0.21	*0.024*	--	0.02
2018	Average	--	*1.52*	1.19	0.47	1.29	0.73	--	--	1.04
	Maximum	--	*4.15*	3.98	3.09	8.83	1.41	--	--	8.83
	Minimum	--	*0.49*	0.19	0.07	0.06	0.05	--	--	0.05
2019	Average	--	--	*0.75*	0.76	0.84	--	--	--	0.78
	Maximum	--	--	*2.80*	3.12	2.97	--	--	--	3.12
	Minimum	--	--	*0.11*	0.00	0.04	--	--	--	0.00
Unit Yield ($L/s/km^2$)										
2014	Average	--	--	*11.7*	11.3	6.7	9.8	4.8	*1.8*	7.7
	Maximum	--	--	*57.9*	38.5	20.7	39.7	12.9	*6.8*	57.9
	Minimum	--	--	*3.7*	3.3	4.2	4.8	1.9	*1.0*	1.0
2015	Average	--	*9.5*	7.1	26.8	19.6	13.0	8.2	--	14.0
	Maximum	--	*51.4*	94.3	160.8	111.9	38.4	23.9	--	160.8
	Minimum	--	*1.7*	0.9	3.8	4.6	6.9	3.7	--	0.9
2016	Average	9.1	*9.0*	9.5	15.3	9.6	6.2	--	--	9.79
	Maximum	15.2	*17.6*	30.4	40.5	19.9	8.9	--	--	40.53
	Minimum	5.2	*4.2*	3.1	9.3	7.0	2.2	--	--	2.23
2017	Average	--	*5.0*	10.7	8.3	4.1	3.9	*2.5*	--	5.75
	Maximum	--	*12.3*	55.5	27.4	13.9	7.4	*7.2*	--	55.54
	Minimum	--	*1.3*	3.0	1.8	1.4	2.6	*0.3*	--	0.30
2018	Average	--	*18.8*	14.7	5.7	15.9	*8.9*	--	--	12.80
	Maximum	--	*51.2*	49.1	38.1	108.9	*17.4*	--	--	108.90
	Minimum	--	*6.0*	2.3	0.9	0.7	*0.6*	--	--	0.62
2019	Average	--	--	*9.3*	9.3	10.4	--	--	--	9.66
	Maximum	--	--	*34.5*	38.4	36.6	--	--	--	38.41
	Minimum	--	--	*1.4*	0.0	0.5	--	--	--	0.02
Runoff (mm)										
2014		--	--	*21*	26	18	23	13	*2*	103
2015		--	*7*	13	39	36	29	21	--	145
2016		*5*	*24*	25	41	26	16	--	--	136
2017		--	*4*	28	22	11	10	*5*	--	80
2018		--	*18*	38	15	43	23	--	--	137
2019		--	--	*18*	25	28	--	--	--	71

Note: Values in italics indicate that data for that month is not complete.



Note: Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

Figure C8-1: Rating Curve

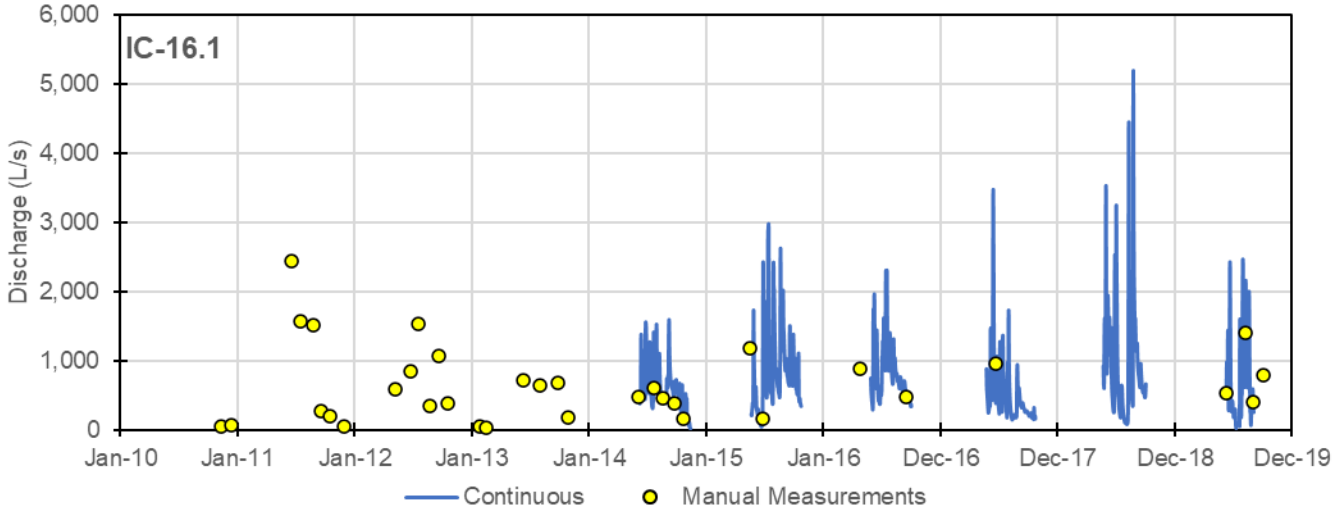
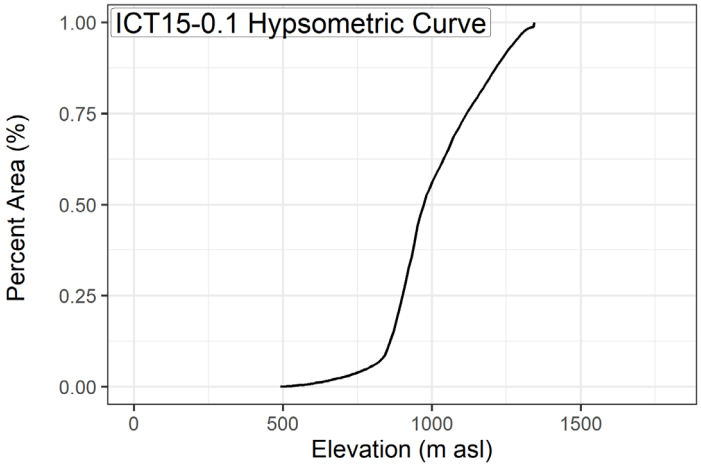


Figure C8 2: Time-series plot of discharge and manual measurements

Appendix C9: ICT15-0.1

Station Name:	ICT15-0.1
Previous Station Name:	IC-2.5
Location:	Independence Creek
Basin Area (km²):	17.3
UTM Easting:	572,782
UTM Northing:	6,978,036
Median Elevation (m asl):	971
Record Period:	
Spot Measurements	2011-2019
Continuous Record	2014-2019



Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	No
Measurement Interval:	
Summer	15-minute
Winter	Removed

Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2014-06-07	99.412		
2015-09-14	99.413	0.001	No movement
2016-06-14	98.407	-0.005	No movement
2017-06-22	98.411	-0.001	No movement
2018-06-22	98.406	-0.006	SG moved lower
2019-06-08	98.420	0.008	SG shifted up

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
43%	10%	19%	28%

Open Water Photo



Winter Photo



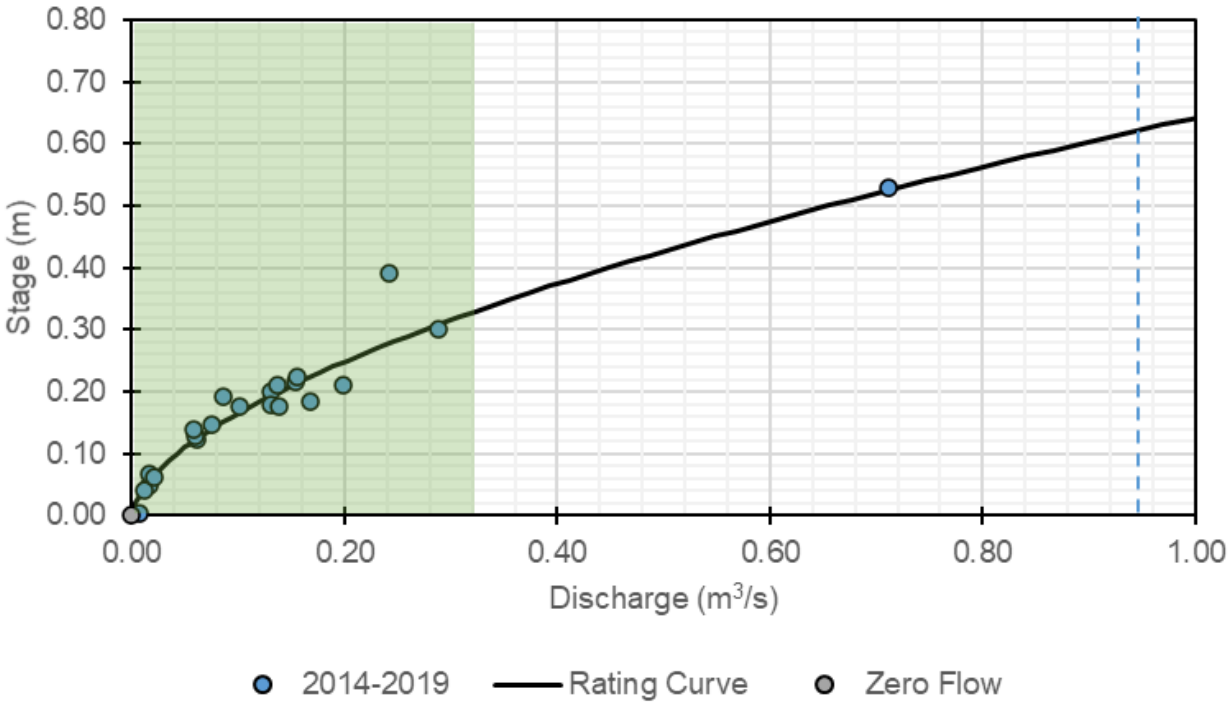
Table C9-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2014-06-07	0.270	0.016	0.018	12%
2014-06-27	0.610	0.242	0.422	N/A
2014-07-24	0.421	0.131	0.140	7%
2014-08-20	0.344	0.061	0.062	2%
2014-09-25	0.413	0.086	0.130	51%
2014-10-22	0.287	0.016	0.022	38%
2015-05-18	--	0.095	--	--
2015-06-25	0.223	0.007	0.001	N/A
2015-07-22	0.370	--	--	--
2015-08-20	0.800	0.712	0.723	2%
2015-09-14	0.403	0.167	0.119	-29%
2015-10-30	0.260	0.012	0.009	-25%
2016-05-27	0.384	0.136	0.153	12%
2016-06-24	0.301	0.059	0.066	12%
2016-07-22	0.387	0.154	0.156	2%
2016-08-26	0.396	0.155	0.168	8%
2016-09-15	0.347	0.101	0.110	9%
2017-05-19	0.400	0.131	0.116	-12%
2017-06-22	0.432	0.199	0.153	-23%
2017-07-28	0.395	0.139	0.110	-21%
2017-08-25	0.342	--	--	--
2017-09-15	0.390	--	--	--
2018-05-20	0.427	--	--	--
2018-06-17	0.398	--	--	--
2018-07-22	0.377	--	--	--
2018-08-19	0.384	--	--	--
2019-06-08	0.283	0.021	0.020	-7%
2019-07-06	0.253	--	--	--
2019-08-09	0.520	0.288	0.275	-4%
2019-09-01	0.358	0.058	0.074	27%
2019-10-03	0.366	0.075	0.081	8%
Average Error (%)				3%
Standard Error (%)				20%

Table C9-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Annual
Discharge (m^3/s)									
2014	Average	--	--	*0.17*	0.20	0.10	0.15	*0.05*	0.13
	Maximum	--	--	*0.31*	0.73	0.26	0.40	*0.17*	0.73
	Minimum	--	--	*0.08*	0.05	0.04	0.08	*0.00*	0.00
2015	Average	--	--	0.18	0.27	0.24	0.17	0.07	0.19
	Maximum	--	--	1.08	0.82	0.75	0.38	0.26	1.08
	Minimum	--	--	0.04	0.04	0.06	0.07	0.00	0.00
2016	Average	--	*0.09*	0.16	0.25	0.16	*0.11*	0.025	0.13
	Maximum	--	*0.17*	0.69	0.50	0.30	*0.23*	0.064	0.69
	Minimum	--	*0.06*	0.04	0.12	0.10	*0.00*	0.001	0.00
2017	Average	--	*0.10*	0.15	0.14	0.07	*0.10*	--	0.11
	Maximum	--	*0.29*	0.55	0.35	0.13	*0.19*	--	0.55
	Minimum	--	*0.01*	0.02	0.04	0.03	*0.06*	--	0.01
2018	Average	--	*0.31*	0.28	0.13	0.18	*0.06*	--	0.19
	Maximum	--	*0.93*	0.96	0.74	0.82	*0.15*	--	0.96
	Minimum	--	*0.08*	0.05	0.02	0.01	*0.01*	--	0.01
2019	Average	--	*0.03*	0.11	0.13	0.21	--	--	0.12
	Maximum	--	*0.16*	0.51	0.66	0.71	--	--	0.71
	Minimum	--	*0.00*	0.01	0.00	0.00	--	--	0.00
Unit Yield ($L/s/km^2$)									
2014	Average	--	--	*9.7*	11.5	5.6	8.7	*3.1*	7.7
	Maximum	--	--	*17.9*	42.1	15.1	23.0	*10.1*	42.1
	Minimum	--	--	*4.4*	3.0	2.6	4.8	*0.0*	0.0
2015	Average	--	--	10.3	15.9	14.0	9.6	4.0	10.8
	Maximum	--	--	62.2	47.3	43.1	21.7	15.0	62.2
	Minimum	--	--	2.5	2.5	3.4	3.9	0.0	0.0
2016	Average	--	*5.47*	9.44	14.27	9.18	*6.21*	1.444	7.67
	Maximum	--	*9.57*	40.05	28.83	17.32	*13.31*	3.715	40.05
	Minimum	--	*3.47*	2.15	7.00	6.07	*0.19*	0.059	0.06
2017	Average	--	*5.78*	8.72	8.01	3.89	*6.01*	--	6.48
	Maximum	--	*16.76*	31.75	20.48	7.65	*10.97*	--	31.75
	Minimum	--	*0.31*	1.42	2.30	1.98	*3.68*	--	0.31
2018	Average	--	*17.83*	16.08	7.65	10.48	*3.54*	--	11.12
	Maximum	--	*53.75*	55.51	42.62	47.14	*8.86*	--	55.51
	Minimum	--	*4.88*	2.94	1.07	0.73	*0.33*	--	0.33
2019	Average	--	*1.91*	6.15	7.38	12.23	--	--	6.92
	Maximum	--	*9.28*	29.50	38.28	40.78	--	--	40.78
	Minimum	--	*0.00*	0.68	0.00	0.20	--	--	0.00
Runoff (mm)									
2014		--	--	*3*	31	15	23	*6*	78
2015		--	--	27	42	38	25	11	142
2016		--	*2*	24	38	25	16	*1*	107
2017		--	*6*	23	21	10	*8*	--	69
2018		--	*18*	42	20	28	*9*	--	117
2019		--	*2*	16	20	33	--	--	71

Note: Values in italics indicate that data for that month is not complete.



Note: Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

Figure C9-1: Rating Curve

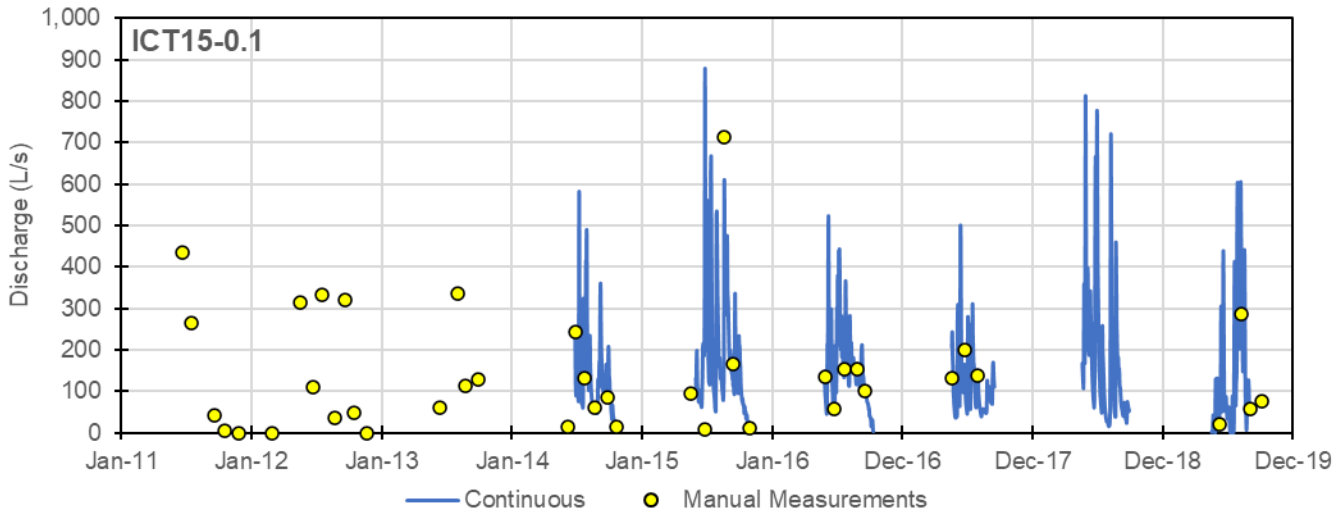


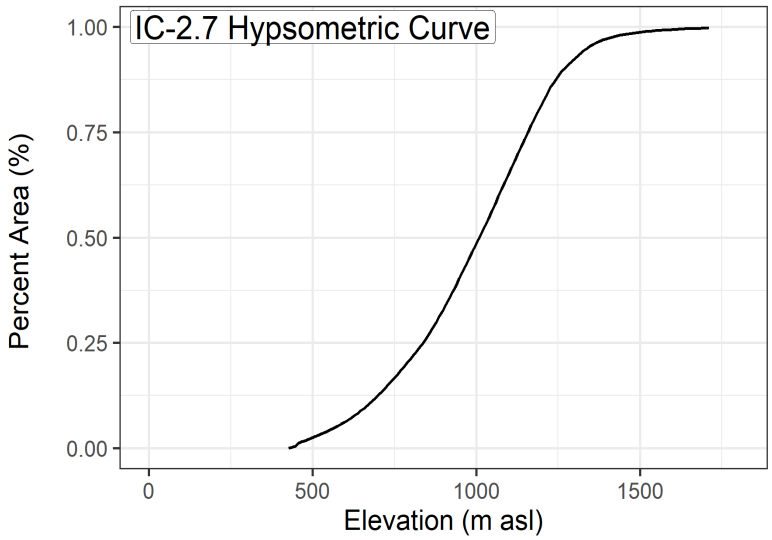
Figure C9-2: Time-series plot of discharge and manual measurements

Appendix C10: IC-2.7

Station Name:	IC-2.7
Previous Station Name:	IC-4.5
Location:	Independence Creek
Basin Area (km²):	222.3
UTM Easting:	579,384
UTM Northing:	6,983,229
Median Elevation (m asl):	1,009
Record Period:	
Spot Measurements	2010-2019
Continuous Record	2011-2019

Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	Yes
Measurement Interval:	
Summer	15-minute
Winter	Removed

Hypsometric Curve



Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2011-09-21	97.705		
2012-06-23	97.721	0.016	Staff gauge reinstalled
2012-09-19	97.724	0.003	
2013-05-30	99.713	1.989	
2013-09-26	99.826	0.113	Staff gauge reinstalled
2015-09-13	99.851	0.025	SG moved up
2017-06-22	97.857	0.031	SG moved up
2018-07-22	97.879	0.053	SG moved up
2019-06-08	98.153		Station rebuilt u/s

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
42%	14%	28%	16%

Open Water Photo



Winter Photo



Table C10-1:
Manual flow measurements summary

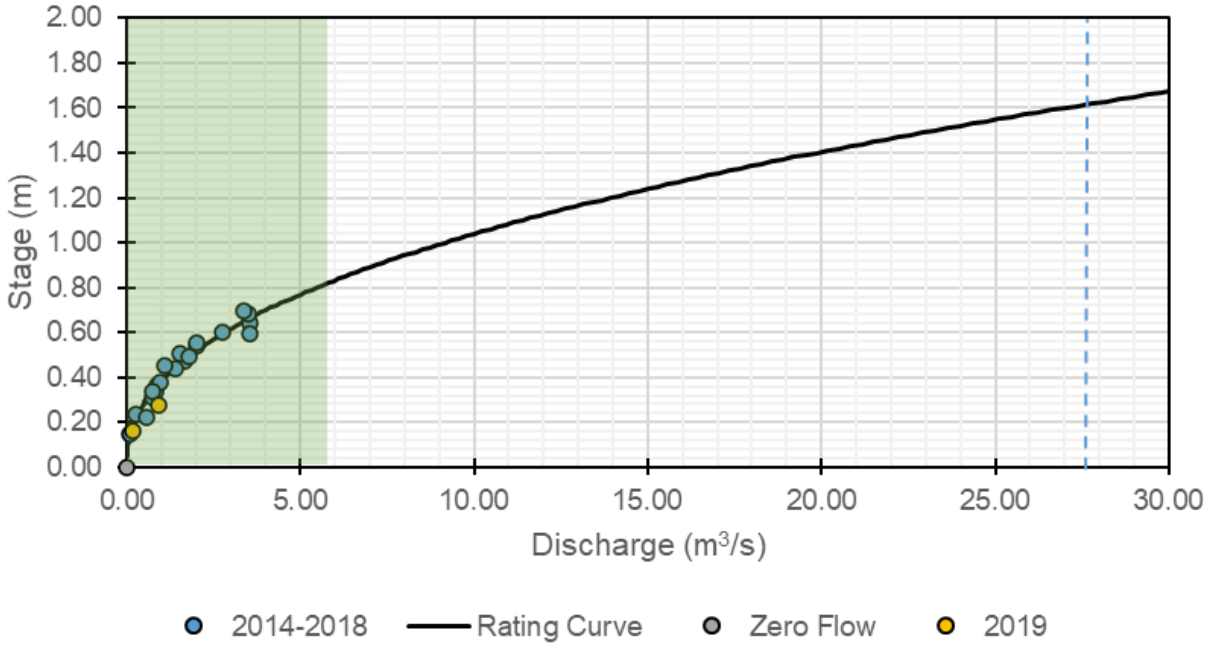
Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2010-11-09	--	0.132	--	--
2010-12-14	--	0.076	--	--
2011-04-20	0.058	--	--	--
2011-07-20	0.598	2.032	2.196	8%
2011-08-26	0.702	3.555	3.298	-7%
2011-09-21	0.422	0.890	0.882	-1%
2011-10-19	0.295	0.258	0.326	27%
2011-11-29	--	0.002	--	--
2012-04-20	--	0.775	--	--
2012-05-16	0.655	3.546	2.769	-22%
2012-06-23	0.530	1.662	1.609	-3%
2012-07-18	--	1.802	--	--
2012-08-23	0.371	0.739	0.622	-16%
2012-09-19	0.746	3.492	3.835	10%
2012-10-17	0.395	0.842	0.735	-13%
2013-06-12	0.499	1.423	1.375	-3%
2013-07-31	--	0.522	--	--
2013-08-21	0.439	0.961	0.980	2%
2013-09-26	0.567	1.521	1.915	26%
2013-10-28	--	0.268	--	--
2013-11-26	--	0.011	--	--
2014-05-21	0.663	2.770	2.850	3%
2014-08-20	0.398	0.763	0.753	-1%
2014-09-25	0.509	1.091	1.448	33%
2014-10-22	0.285	0.556	NA	NA
2014-11-25	--	0.033	--	--
2015-04-29	--	0.302	--	--
2015-05-19	0.551	1.810	1.775	-2%
2015-06-26	0.209	0.115	0.114	-1%
2016-05-27	0.592	2.035	2.140	5%
2016-06-24	0.401	--	--	--
2016-09-15	0.510	--	--	--
2016-10-19	--	0.236	--	--
2017-05-19	0.593	--	--	--
2017-06-22	0.757	3.3624	3.985	19%
2017-07-28	0.637	--	--	--
2017-08-25	0.446	--	--	--
2018-06-17	0.521	--	--	--
2018-07-21	0.394	--	--	--
2018-08-19	0.453	--	--	--
Station rebuilt ~200 m u/s of old station				
2019-06-08	0.335	0.910	0.468	-49%
2019-07-07	0.224	0.196	0.143	-27%
2019-09-01	0.404	--	0.784	--
2019-10-03	0.498	--	1.368	--
Average Error (%)				-1%
Standard Error (%)				19%

Table C10-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2011	Average	*2.19*	5.836	5.54	3.92	3.85	1.18	*0.45*	--	3.28
	Maximum	*6.66*	31.21	31.40	13.42	8.98	2.15	*0.88*	--	31.40
	Minimum	*0.00*	1.88	1.20	0.97	1.70	0.62	*0.24*	--	0.00
2012	Average	*0.58*	4.039	2.98	3.99	1.37	2.51	1.16	*0.221*	2.1
	Maximum	*1.95*	16.68	10.88	24.57	15.33	9.12	2.94	*0.423*	24.6
	Minimum	*0.01*	0.318	0.75	0.64	0.43	1.16	0.26	*0.133*	0.0
2013	Average	--	8.062	3.64	4.13	1.88	2.23	1.37	*0.234*	3.08
	Maximum	--	28.61	15.18	16.63	17.86	4.39	2.95	*0.692*	28.61
	Minimum	--	0.013	0.68	0.85	0.45	1.27	0.50	*0.062*	0.01
2014	Average	*2.165*	3.638	2.61	2.88	1.28	2.28	0.56	*0.119*	1.94
	Maximum	*5.066*	12.96	10.74	10.16	4.06	9.99	1.97	*0.335*	12.96
	Minimum	*0.002*	0.605	0.54	0.59	0.66	0.85	0.12	*0.017*	0.00
2015	Average	*1.961*	2.44	1.39	5.78	4.63	2.76	1.03	--	2.86
	Maximum	*2.137*	18.49	19.33	25.72	23.01	6.51	3.40	--	25.72
	Minimum	*1.72*	0.38	0.10	0.73	1.04	1.52	0.22	--	0.10
2016	Average	*3.008*	3.59	2.55	4.62	2.52	*1.37*	--	--	2.94
	Maximum	*4.856*	13.98	16.04	11.91	5.50	*2.48*	--	--	16.04
	Minimum	*2.023*	0.75	0.59	2.26	1.57	*0.55*	--	--	0.55
2017	Average	*4.015*	2.24	2.30	1.86	0.80	*0.70*	0.372	--	1.76
	Maximum	*4.383*	8.50	13.53	5.26	2.44	*1.18*	0.517	--	13.53
	Minimum	*3.339*	0.43	0.46	0.53	0.42	*0.51*	0.147	--	0.15
2018	Average	--	*4.65*	4.38	1.67	*5.35*	--	--	--	4.01
	Maximum	--	*22.73*	18.23	15.93	*46.05*	--	--	--	46.05
	Minimum	--	*0.46*	0.60	0.30	*0.27*	--	--	--	0.27
2019	Average	--	--	*1.07*	6.77	0.29	--	--	--	2.71
	Maximum	--	--	*0.95*	10.88	0.02	--	--	--	10.88
	Minimum	--	--	*2.07*	7.56	0.47	--	--	--	0.47
Unit Yield ($L/s/km^2$)										
2011	Average	*9.8*	26.3	24.9	17.6	17.3	5.3	*2.0*	--	14.8
	Maximum	*30.0*	140.4	141.3	60.4	40.4	9.7	*4.0*	--	141.3
	Minimum	*0.0*	8.5	5.4	4.3	7.6	2.8	*1.1*	--	0.0
2012	Average	*2.6*	18.2	13.4	17.9	6.2	11.3	5.2	*1.0*	9.5
	Maximum	*8.8*	75.1	48.9	110.5	69.0	41.0	13.2	*1.9*	110.5
	Minimum	*0.0*	1.4	3.4	2.9	1.9	5.2	1.2	*0.6*	0.0
2013	Average	--	36.3	16.4	18.6	8.4	10.0	6.2	*1.1*	13.8
	Maximum	--	128.7	68.3	74.8	80.3	19.7	13.3	*3.1*	128.7
	Minimum	--	0.1	3.1	3.8	2.0	5.7	2.2	*0.3*	0.1
2014	Average	*9.7*	16.4	11.7	12.9	5.8	10.3	2.5	*0.5*	8.7
	Maximum	*22.8*	58.3	48.3	45.7	18.3	44.9	8.9	*1.5*	58.3
	Minimum	*0.0*	2.7	2.4	2.7	3.0	3.8	0.5	*0.1*	0.0
2015	Average	*8.8*	11.0	6.3	26.0	20.8	12.4	4.6	--	12.8
	Maximum	*9.6*	83.2	87.0	115.7	103.5	29.3	15.3	--	115.7
	Minimum	*7.7*	1.7	0.4	3.3	4.7	6.9	1.0	--	0.4
2016	Average	*13.5*	16.2	11.5	20.8	11.3	*6.2*	--	--	13.25
	Maximum	*21.8*	62.9	72.1	53.6	24.7	*11.1*	--	--	72.15
	Minimum	*9.1*	3.4	2.7	10.2	7.1	*2.5*	--	--	2.46
2017	Average	*18.1*	10.1	10.4	8.4	3.6	3.1	*1.7*	--	7.90
	Maximum	*19.7*	38.2	60.9	23.7	11.0	5.3	*2.3*	--	60.88
	Minimum	*15.0*	1.9	2.1	2.4	1.9	2.3	*0.7*	--	0.66
2018	Average	--	*20.9*	19.7	7.5	*24.1*	--	--	--	18.04
	Maximum	--	*102.2*	82.0	71.7	*207.2*	--	--	--	207.16
	Minimum	--	*2.1*	*2.7*	1.4	*1.2*	--	--	--	1.23
2019	Average	--	--	*4.8*	30.5	1.3	--	--	--	12.20
	Maximum	--	--	*4.3*	48.9	0.1	--	--	--	48.93
	Minimum	--	--	*9.3*	34.0	2.1	--	--	--	2.13

Discharge (m^3/s)										
Year		**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Annual**
Runoff (mm)										
2011		*9*	69.94	*64*	46	45	14	*4*	--	253
2012		*4*	48.29	*34*	48	17	29	14	*4*	198
2013		--	97.25	*42*	49	23	25	17	*2*	255
2014		*11*	43.01	*30*	34	16	26	7	*2*	169
2015		*1*	29	17	70	55	31	13	--	216
2016		*5*	43	30	56	30	*10*	--	--	174
2017		*5*	27	27	22	10	*8*	*3*	--	102
2018		--	*49*	53	19	*50*	--	--	--	171
2019		--	--	*10*	11	25	--	--	--	46

Note: Values in italics indicate that data for that month is not complete.



Note: Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

Figure C10-1: Rating Curve

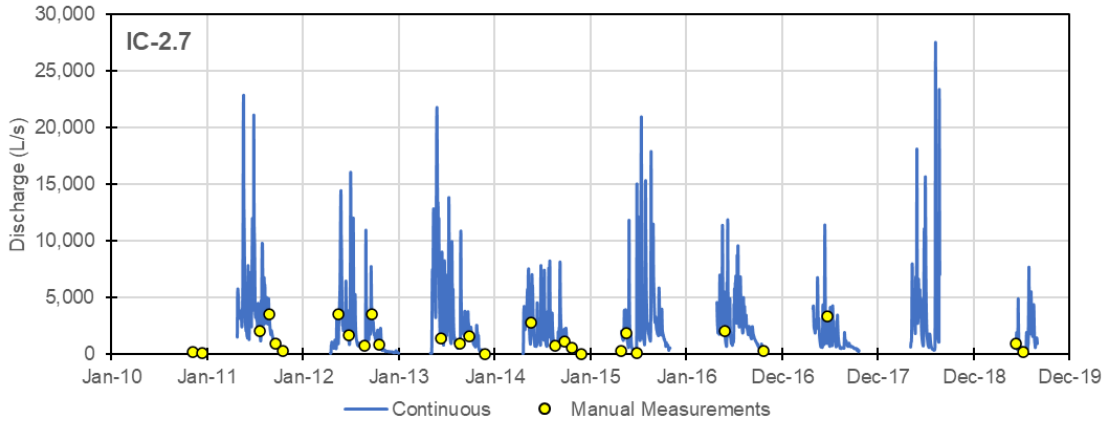
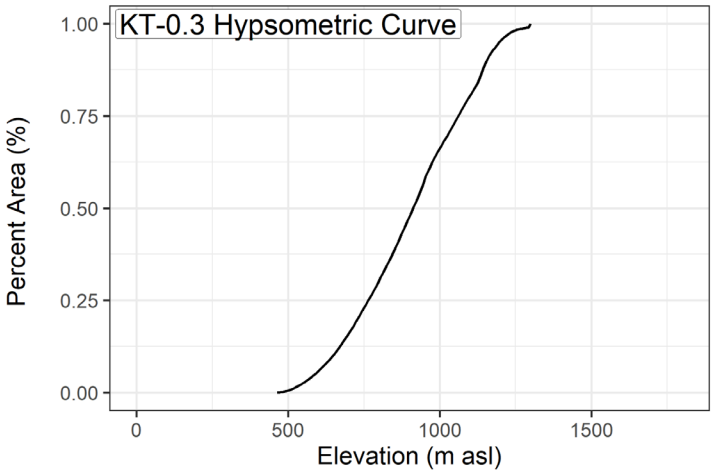


Figure C10-2: Time-series plot of discharge and manual measurements

Appendix C11: KT-0.3

Station Name:	KT-0.3
Previous Station Name:	IC-3.0
Location:	Kona Tributary
Basin Area (km²):	18.3
UTM Easting:	575,334
UTM Northing:	6,979,357
Median Elevation (m asl):	884
Record Period:	
Spot Measurements	2010-Present
Continuous Record	2020-Present

Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	No
Barologger:	No
Measurement Interval:	
Summer	15-minute
Winter	Removed



Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2020-07-10	98.732	N/A	Top of PVC stilling well

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
45%	4%	31%	20%

Winter Season Photo



Open Water Season Photo



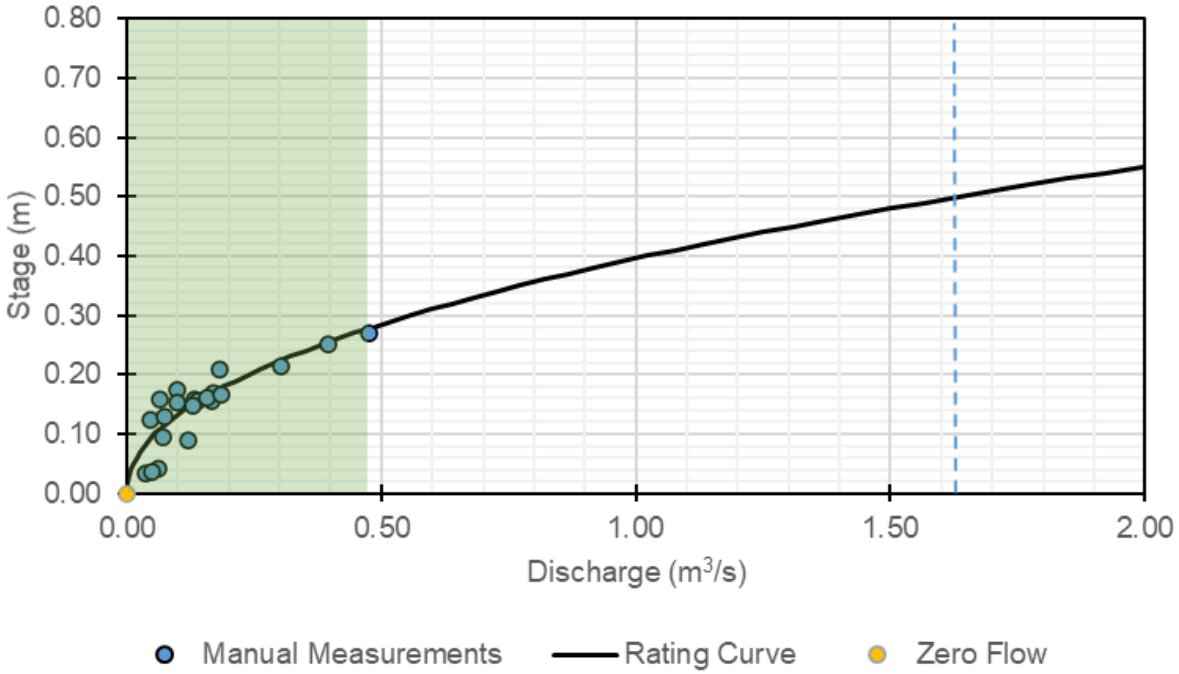
Note: This site goes dry during the winter, and therefore no winter photo is available

Table C11-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2014-06-06	0.253	0.038	0.005	-86%
2014-06-26	0.490	0.476	0.448	-6%
2014-08-20	0.261	0.062	0.009	-86%
2014-09-25	0.315	0.072	0.050	-31%
2014-10-22	0.255	0.050	--	--
2015-05-18	0.309	0.120	0.044	-64%
2015-06-25	0.335	--	--	--
2015-07-23	0.379	0.133	0.147	11%
2015-08-20	0.830	--	--	--
2015-09-14	0.390	0.169	0.169	0%
2015-10-31	0.343	0.045	0.086	91%
2015-11-28	--	0.002	--	--
2016-04-25	0.472	0.396	0.387	-2%
2016-05-27	0.375	0.140	0.140	0%
2016-06-24	0.348	0.073	0.093	28%
2016-07-22	0.375	0.168	0.140	-17%
2016-09-15	0.368	0.130	0.127	-3%
2017-05-19	--	0.129	--	--
2017-06-22	0.433	0.304	0.272	-10%
2017-07-28	0.378	--	--	--
2017-08-25	0.342	--	--	--
2018-05-20	0.380	0.159	0.149	-6%
2018-06-17	0.393	--	--	--
2018-07-22	0.395	--	--	--
2018-08-19	0.401	--	--	--
2019-06-08	--	0.030	--	--
2019-08-09	0.430	0.183	0.264	44%
2019-09-01	0.394	0.100	0.178	78%
2019-10-03	0.385	0.186	0.159	-14%
2020-07-17	0.374	0.098	0.138	40%
2020-09-20	0.339	0.064	0.080	25%
2020-11-12	--	0.019	--	--
2021-07-10	--	0.031	--	--
Average Error (%)				0%
Standard Error (%)				46%

Table C11-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2020	Average	--	--	--	*0.50*	0.25	*0.07*	--	--	0.27
	Maximum	--	--	--	*1.64*	0.61	*0.21*	--	--	1.64
	Minimum	--	--	--	*0.12*	0.06	*0.00*	--	--	0.00
Unit Yield ($L/s/km^2$)										
2020	Average	--	--	--	*27.2*	13.8	*3.8*	--	--	15.0
	Maximum	--	--	--	*89.5*	33.3	*11.7*	--	--	89.5
	Minimum	--	--	--	*6.6*	3.0	*0.0*	--	--	0.0
Runoff (mm)										
2020		--	--	--	*33*	37	*6*	--	--	76



Notes:
Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

Figure C11-1:Rating Curve

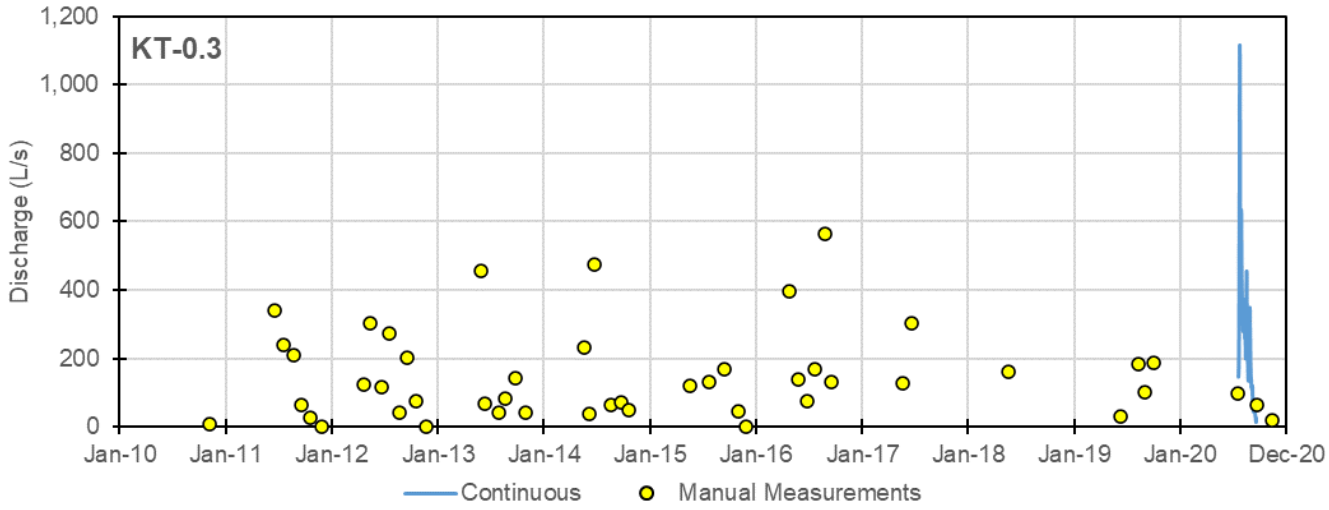
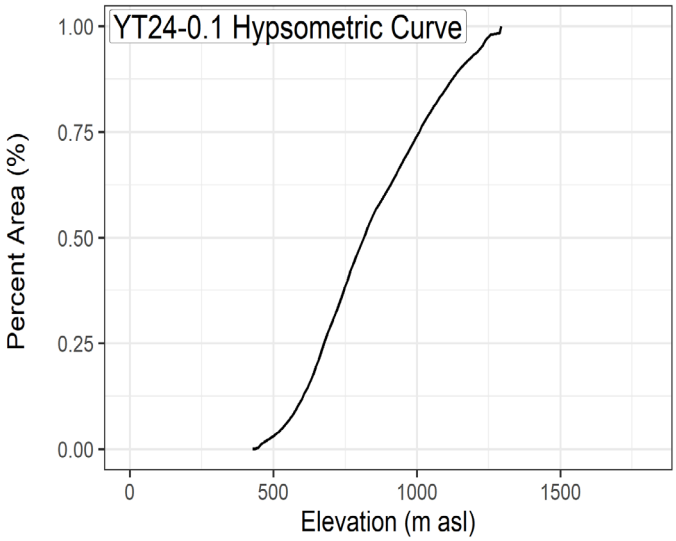


Figure C11-2: Time-series plot of discharge and manual measurements

Appendix C12: YT24-0.1

Station Name:	YT24-0.1
Previous Station Name:	YT-24
Location:	Yukon R. Trib. 24
Basin Area (km²):	11.8
UTM Easting:	589,677
UTM Northing:	6,979,153
Median Elevation (m asl):	812
Record Period:	
Spot Measurements	2014-Present
Continuous Record	2014-Present

Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	No
Measurement Interval:	
Summer	15-minute
Winter	Removed



Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2015-09-15	98.200		
2016-05-27	98.205	0.005	no movement
2017-05-18	98.200	-0.005	no movement
2017-08-24	97.194	-1.006	new SG
2018-07-21	97.196	0.002	no movement
2019-06-09	97.192	-0.002	no movement
2020-07-17	97.195	0.001	no movement

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**
54%	21%	20%	5%

High Flow Photo



Low Flow Photo



Note: This site goes dry during the winter, and therefore no winter photo is available

Table C12-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2014-07-06	--	0.003	--	--
2014-06-27	0.431	0.087	0.053	-39%
2014-07-23	0.390	0.030	0.018	-40%
2014-08-22	0.380	0.016	0.012	-22%
2014-09-26	0.395	0.019	0.021	13%
2014-10-24	0.348	0.002	NA	NA
2015-04-29	0.344	0.005	NA	NA
2015-05-19	0.401	0.030	0.026	-14%
2015-06-26	0.377	0.009	0.011	22%
2015-07-23	0.410	--	--	--
2015-09-11	0.436	0.071	0.059	-17%
2015-09-13	0.429	0.060	0.051	-15%
2015-10-30	0.388	0.011	NA	NA
2016-04-16	0.489	0.163	0.136	-17%
2016-05-26	0.432	0.058	0.054	-6%
2016-06-24	0.393	0.021	0.020	-4%
2016-07-21	0.424	0.060	0.046	-23%
2016-08-25	0.428	0.058	0.050	-13%
2016-09-16	0.435	0.052	0.058	11%
2017-05-18	0.438	0.097	0.061	-37%
2017-06-23	--	0.330	--	--
2017-07-28	--	0.330	--	--
2017-08-24	0.409	0.026	0.032	23%
2017-09-14	0.407	0.040	0.030	-24%
2017-10-21	--	0.009	--	--
2018-05-16	0.485	0.194	0.129	-34%
2018-05-19	0.470	--	--	--
2018-05-24	0.450	0.054	0.076	41%
2018-06-17	0.485	--	--	--
2018-08-19	0.481	--	--	--
2018-09-21	0.413	0.032	0.038	18%
2019-06-09	0.371	0.009	0.009	0%
2019-07-09	0.358	0.004	0.004	3%
2019-08-07	0.510	0.186	0.184	-1%
2019-09-02	0.418	0.033	0.043	32%
2019-10-02	0.458	0.079	0.092	16%
2020-07-17	0.468	0.088	0.107	22%
2020-09-20	0.425	0.046	0.050	9%
Average Error (%)				-4%
Standard Error (%)				22%

Table C12-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2014	Average	--	--	*0.02*	0.03	0.02	0.02	*0.01*	--	0.02
	Maximum	--	--	*0.05*	0.19	0.06	0.07	*0.19*	--	0.19
	Minimum	--	--	*0.01*	0.00	0.01	0.00	*0.00*	--	0.00
2015	Average	*0.025*	0.05	0.02	0.07	0.08	0.07	*0.03*	--	0.05
	Maximum	*0.051*	0.47	0.32	0.40	0.35	0.17	*0.10*	--	0.47
	Minimum	*0.003*	0.00	0.00	0.02	0.01	0.02	*0.01*	--	0.00
2016	Average	*0.088*	0.06	0.04	0.06	0.07	0.07	--	--	0.06
	Maximum	*0.154*	0.47	0.25	0.30	0.14	0.14	--	--	0.47
	Minimum	*0.038*	0.02	0.01	0.01	0.04	0.03	--	--	0.01
2017	Average	--	*0.06*	0.03	0.07	0.04	0.05	*0.02*	--	0.04
	Maximum	--	*0.30*	0.12	4.72	0.06	0.07	*0.042*	--	4.72
	Minimum	--	*0.00*	0.01	0.00	0.03	0.03	*0.002*	--	0.00
2018	Average	--	*0.07*	0.07	0.03	0.09	0.05	--	--	0.06
	Maximum	--	*0.20*	0.22	0.15	0.25	0.12	--	--	0.25
	Minimum	--	*0.02*	0.00	0.00	0.00	0.00	--	--	0.00
2019	Average	--	--	*0.06*	0.16	0.26	*0.17*	--	--	0.16
	Maximum	--	--	*0.29*	1.13	0.64	*0.29*	--	--	1.13
	Minimum	--	--	*0.00*	0.00	0.01	*0.09*	--	--	0.00
2020	Average	--	--	--	*0.20*	0.12	*0.14*	--	--	0.15
	Maximum	--	--	--	*0.74*	0.29	*0.32*	--	--	0.74
	Minimum	--	--	--	*0.02*	0.02	*0.00*	--	--	0.00
Unit Yield ($L/s/km^2$)										
2014	Average	--	--	*2.0*	2.5	1.7	1.8	*0.9*	--	1.8
	Maximum	--	--	*4.5*	16.5	5.3	6.0	*15.7*	--	16.5
	Minimum	--	--	*0.6*	0.1	0.7	0.3	*0.0*	--	0.0
2015	Average	*2.1*	4.6	2.0	6.3	6.9	6.1	2.8	--	4.4
	Maximum	*4.3*	39.9	26.8	33.7	29.8	14.4	8.6	--	39.9
	Minimum	*0.2*	0.0	0.0	1.3	1.2	1.9	0.8	--	0.0
2016	Average	*7.4*	4.9	3.2	5.3	5.5	5.6	--	--	5.3
	Maximum	*13.1*	39.6	21.5	25.6	11.9	12.0	--	--	39.6
	Minimum	*3.2*	1.4	0.5	1.0	3.4	3.0	--	--	0.5
2017	Average	--	5.2	2.5	5.6	3.2	4.1	1.7	--	3.7
	Maximum	--	25.1	9.8	399.8	5.4	6.1	3.5	--	399.8
	Minimum	--	0.4	0.6	0.3	2.4	2.8	0.2	--	0.2
2018	Average	--	*6.0*	6.1	2.6	7.8	4.0	--	--	5.3
	Maximum	--	*17.2*	18.7	12.6	21.2	9.9	--	--	21.2
	Minimum	--	*1.6*	0.3	0.0	0.0	0.0	--	--	0.0
2019	Average	--	--	*5.5*	13.4	21.7	*14.6*	--	--	13.8
	Maximum	--	--	*24.6*	96.1	53.8	*24.3*	--	--	96.1
	Minimum	--	--	*0.0*	0.0	1.1	*7.9*	--	--	0.0
2020	Average	--	--	--	*17.3*	9.9	*12.1*	--	--	13.1
	Maximum	--	--	--	*63.0*	24.3	*27.0*	--	--	63.0
	Minimum	--	--	--	*1.9*	1.4	*0.0*	--	--	0.0
Runoff (mm)										
2014		--	--	*1*	7	5	5	*2*	--	19
2015		*0.4*	12	5	17	12	16	8	--	70
2016		*5.1*	13	8	14	15	14	--	--	70
2017		--	9	6	14	2	11	*3*	--	44
2018		--	6	15	6	5	10	--	--	44
2019		--	--	*10*	32	15	*3*	--	--	60
2020		--	--	--	*22*	7	*21*	--	--	50

Note: Values in italics indicate that data for that month is not complete.



Notes:
Dashed blue line represents highest estimated discharge using rating curve. Green shaded area represents 90% of all estimated discharges using rating curve.

Figure C12-1:Rating Curve

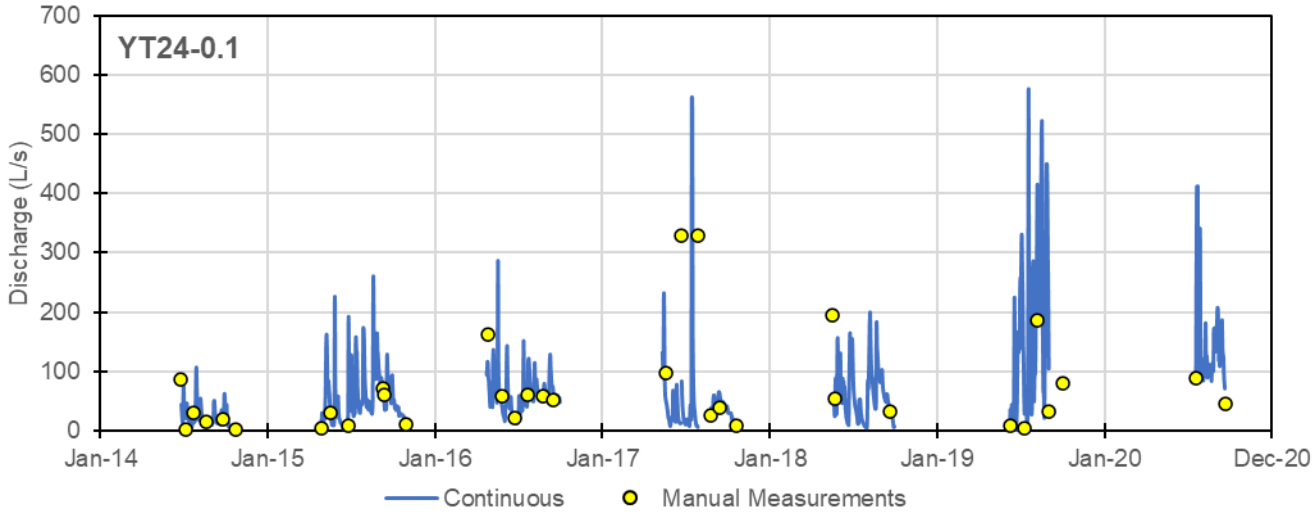
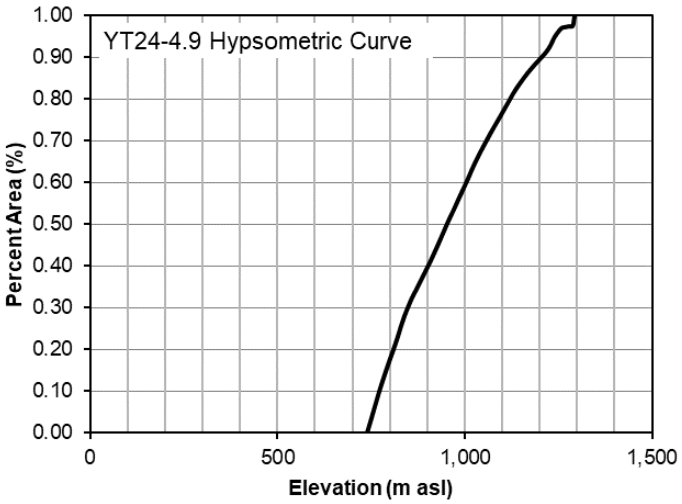


Figure C12-2:Time-series plot of discharge and manual measurements

Appendix C13: YT24-4.9

Station Name:	YT24-4.9
Previous Station Name:	YT-24-2
Location:	Yukon R. Trib. 24
Basin Area (km²):	4.0
UTM Easting:	585,922
UTM Northing:	6,976,472
Median Elevation (m asl):	1,018
Record Period:	
Spot Measurements	2016-2019
Continuous Record	2016-2019

Pressure Transducer:	Solinst
Temperature Sensor:	Yes
Conductivity Sensor:	Yes
Barologger:	No
Measurement Interval:	
Summer	15-minute
Winter	Removed



Benchmark surveys			
Date	**Gauge Height (m)**	**Change (m)**	**Notes**
2016-06-23	97.489	--	--
2017-05-19	97.495	0.006	no movement
2017-08-24	97.619	0.124	new SG
2018-05-20	100.920	3.301	new SG
2019-06-09	97.112	-0.377	SG moved down

Catchment Slope Aspects (Quadrants in degrees)			
North (315-45)	**East (45-135)**	**South (135-225)**	**West (225-315)**

High Flow Photo



Low Flow Photo



Note: This site goes dry during the winter, and therefore no winter photo is available

Table C13-1:
Manual flow measurements summary

Date	Stage (m)	Discharge (m^3/s)	Rating Curve Discharge (m^3/s)	Rating Curve Error (%)
2016-06-23	0.260	0.014	0.012	-13%
2016-07-21	0.309	0.041	0.038	-8%
2016-08-25	0.298	0.031	0.032	5%
2016-09-16	0.298	0.029	0.032	11%
2017-05-19	0.304		0.035	--
2017-06-23	0.389	0.249	0.083	-67%
Station re-installed following flood event of July 2017				
2017-08-24	0.260	0.012	0.006	-48%
2017-09-14	0.304	0.023	0.030	29%
2018-05-20	0.311	0.034	0.035	3%
2018-06-17	0.275		0.012	--
2018-09-21	0.270	0.012	0.010	-14%
2019-06-09	0.237	0.003	0.001	-60%
2019-08-07	0.383	0.119	0.120	-33%
2019-09-02	0.271	0.014	0.010	27%
2019-10-02	0.365	0.054	0.094	28%
Average Error (%)				-11%
Standard Error (%)				33%

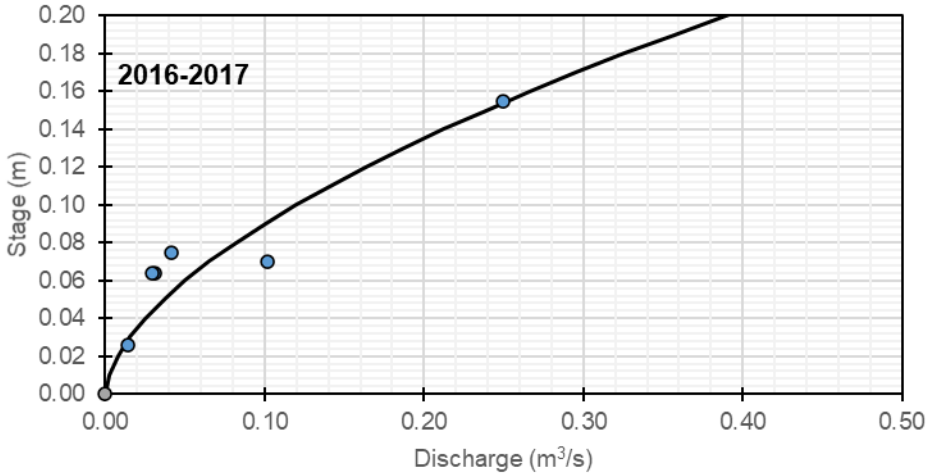


Figure C13-1: Preliminary Rating Curve for 2016-2017

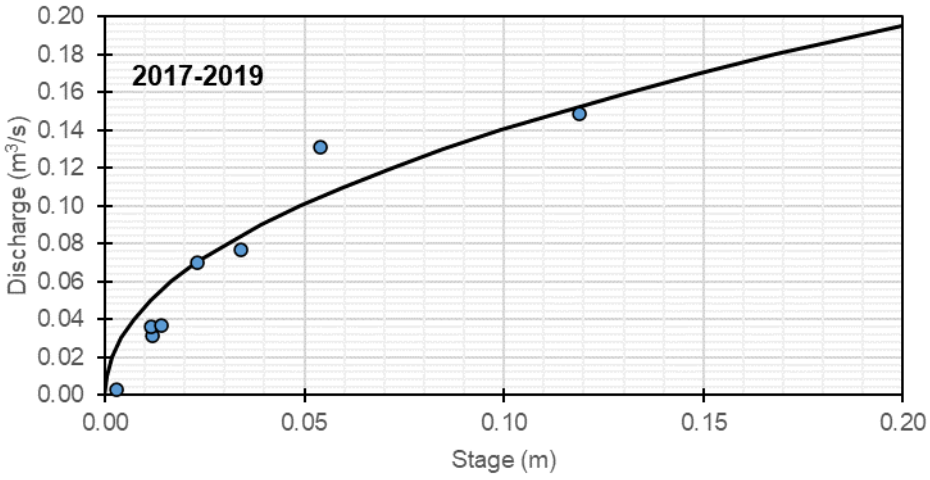


Figure C13-2: Preliminary Rating Curve for 2017-2019

Table C13-2:
Monthly Summaries of Measured Discharge, Unit Yield and Runoff

Year		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Annual
Discharge (m^3/s)										
2016	Average	--	--	*0.00*	0.28	0.12	*0.05*	--	--	0.11
	Maximum	--	--	*0.00*	2.47	0.76	*0.35*	--	--	2.47
	Minimum	--	--	*0.00*	0.00	0.00	*0.00*	--	--	0.00
2017	Average	--	*0.25*	0.05	0.02	0.02	0.02	*0.00*	--	0.06
	Maximum	--	*1.63*	0.73	0.11	0.04	0.04	*0.01*	--	1.63
	Minimum	--	*0.00*	0.00	0.00	0.01	0.00	*0.00*	--	0.00
2018	Average	--	*0.05*	0.06	0.02	0.07	0.04	*0.00*	--	0.04
	Maximum	--	*0.16*	0.17	0.11	0.19	0.09	*0.01*	--	0.19
	Minimum	--	*0.01*	0.00	0.00	0.00	0.00	*0.00*	--	0.00
2019	Average	--	--	*0.01*	0.05	0.05	*0.03*	--	--	0.03
	Maximum	--	--	*0.09*	0.24	0.10	*0.07*	--	--	0.24
	Minimum	--	--	*0.00*	0.00	0.00	*0.00*	--	--	0.00
Unit Yield ($L/s/km^2$)										
2016	Average	--	--	*0.0*	70.6	29.2	*13.1*	--	--	28.2
	Maximum	--	--	*0.0*	617.5	190.2	*87.0*	--	--	617.5
	Minimum	--	--	*0.0*	0.0	0.2	*0.1*	--	--	0.0
2017	Average	--	*61.8*	12.8	5.2	5.6	4.7	*1.0*	--	15.2
	Maximum	--	*406.6*	182.9	27.0	10.3	9.8	*3.5*	--	406.6
	Minimum	--	*0.0*	0.5	0.7	2.6	0.7	*0.0*	--	0.0
2018	Average	--	*13.5*	13.9	6.0	17.7	9.0	*0.6*	--	10.1
	Maximum	--	*39.0*	42.4	28.6	48.2	22.5	*3.3*	--	48.2
	Minimum	--	*3.6*	0.6	0.0	0.1	0.0	*0.0*	--	0.0
2019	Average	--	--	*2.4*	12.6	12.4	*6.9*	--	--	8.6
	Maximum	--	--	*21.6*	58.9	24.8	*17.8*	--	--	58.9
	Minimum	--	--	*0.0*	0.0	0.0	*1.0*	--	--	0.0
Runoff (mm)										
2016		--	--	0	189	76	26	--	--	291
2017		--	112	33	14	14	12	*1*	--	187
2018		--	14	36	16	46	23	0.382	--	136
2019		--	--	*5*	34	32	*1*	--	--	72

Note: Values in italics indicate that data for that month is not complete.

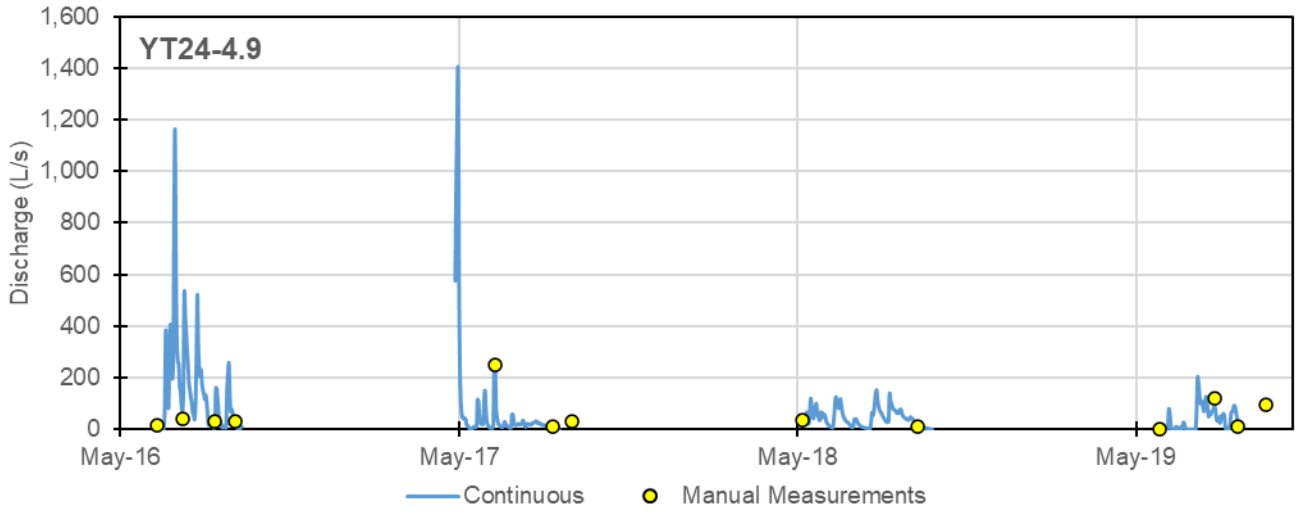


Figure C12-3: Time-series plot of discharge and manual measurements

Appendix C14: Accretion Site Discharge Measurements

Table C14-1:
Manual flow measurements for Latte Creek accretion sites

CC-A		CC-B		CC-C		CC-D	
Date	Discharge (L/s)	Date	Discharge (L/s)	Date	Discharge (L/s)	Date	Discharge (L/s)
2016-02-27	2	2015-10-29	70	2016-04-27	25	2016-07-21	48
2016-04-02	1	2016-01-22	17	2016-07-20	35	2016-09-15	24
2017-05-18	331	2016-04-02	16	2016-10-20	12	2016-09-15	24
2017-06-23	240	2016-04-27	392	2017-05-18	18	2016-11-08	12
		2016-05-26	378	2017-06-23	19	2017-05-18	18.7
		2016-06-22	113	2017-07-26	15		
		2016-07-20	312	2017-08-23	11		
		2016-08-25	193	2017-09-13	14		
		2016-09-14	188	2017-10-19	13		
		2017-06-23	210				
		2017-09-14	145				
		2017-10-20	85				
		2017-11-11	23				
		2019-07-06	33				
		2019-08-08	462				
		2019-09-03	89				
		2019-10-01	177				

Table C14-2:
Manual flow measurements for Halfway Creek accretion sites

HC-A		HC-B		HC-C	
Date	Discharge (L/s)	Date	Discharge (L/s)	Date	Discharge (L/s)
2016-09-16	171	2016-02-26	19	2016-04-03	23
2017-08-24	89	2016-09-16	133	2016-07-21	154
2019-08-10	236	2016-11-08	21	2017-02-28	3
2019-09-01	86	2017-07-26	104	2017-07-26	101
2020-07-17	173	2017-08-24	82	2017-08-24	85
2020-09-20	264	2019-08-10	160	2017-10-20	78
2021-07-09	80	2019-09-01	84	2018-05-20	130
2021-09-24	105	2019-10-02	169		
2021-11-10	24				

Table C14-3:
Manual flow measurements for YT-24 Creek accretion sites

ML-A		ML-B	
Date	Discharge (L/s)	Date	Discharge (L/s)
2016-05-26	54	2016-05-26	41
2016-06-24	24	2016-06-24	17
2016-08-25	57	2016-08-25	45
2016-09-16	65	2016-09-16	44
2016-09-16	65	2016-09-16	44
2019-06-09	15	2017-05-18	67
2019-07-06	9	2019-06-09	9
2019-08-07	158		
2019-09-02	34		
2019-10-02	96		
2020-09-20	98		
2021-07-09	20		
2021-09-24	36		
2021-11-09	4		

Appendix D: Synthetic Streamflow Records

D.1. TO D.11. SUMMARY TABLES AND PLOTS

Newmont™ COFFEE

D1. LC-0.1 Synthetic Streamflow Record

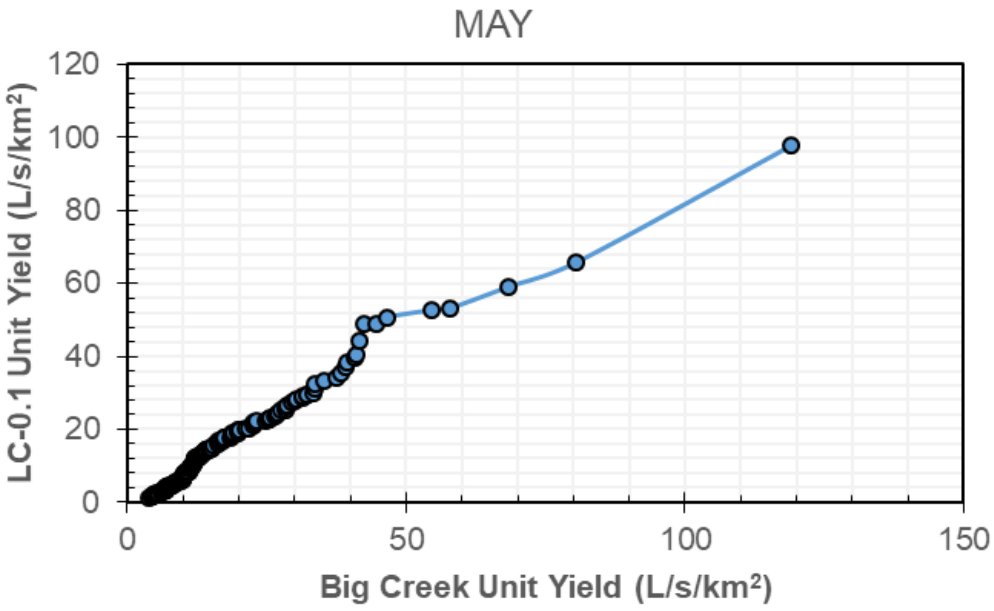


Figure D1.1: LC-0.1 Ranked regression relationship – May

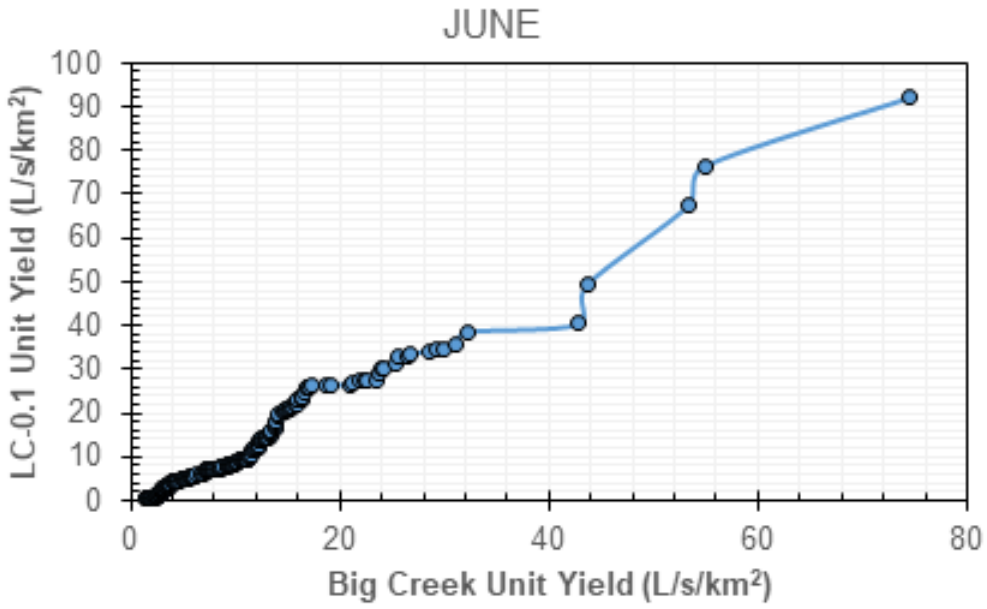


Figure D1.2: LC-0.1 Ranked regression relationship – June

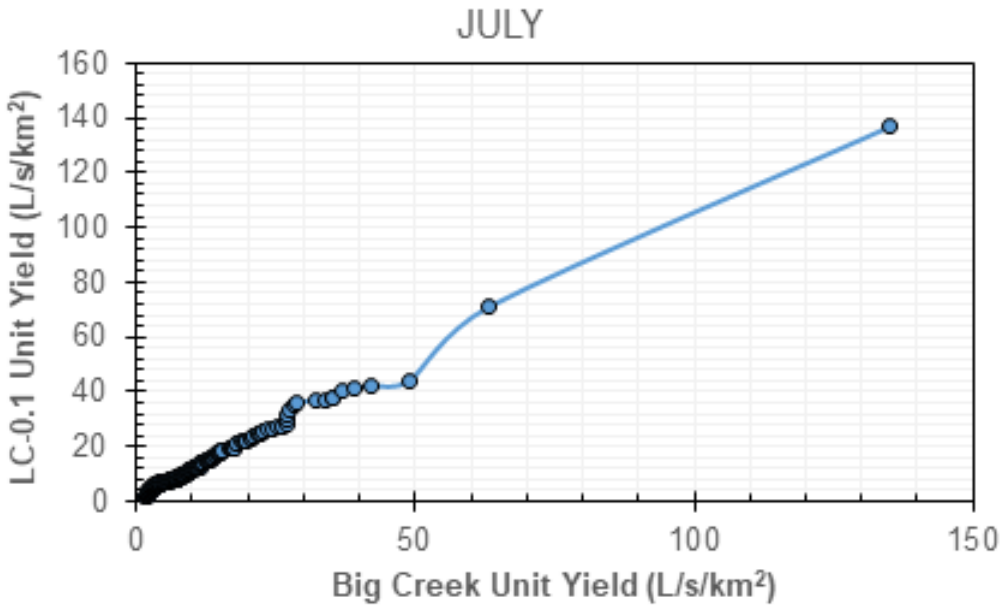


Figure D1.3: LC-0.1 Ranked regression relationship – July

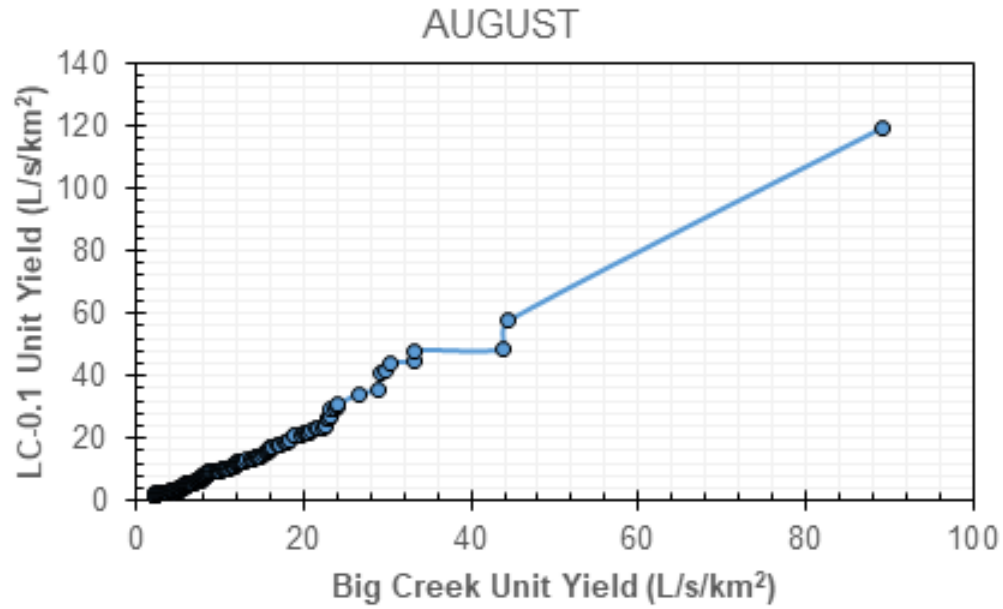


Figure D1.4: LC-0.1 Ranked regression relationship – August

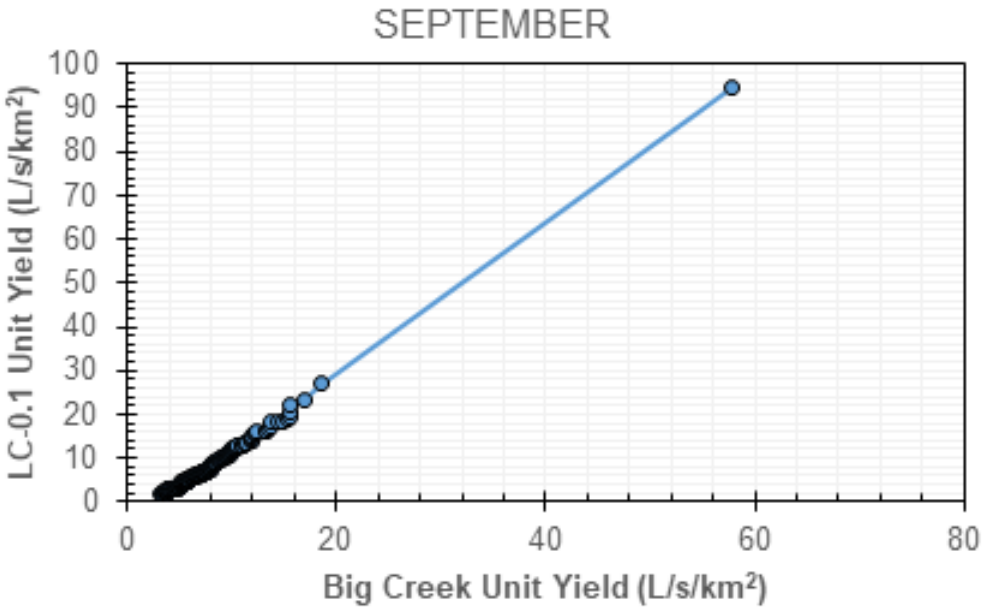


Figure D1.5: LC-0.1 Ranked regression relationship – September

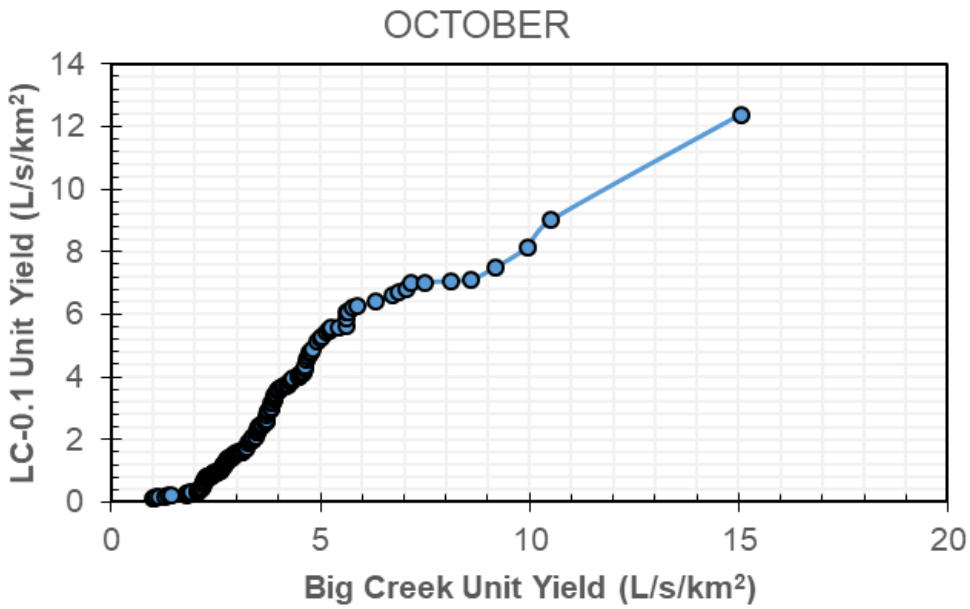


Figure D1.6: LC-0.1 Ranked regression relationship – October

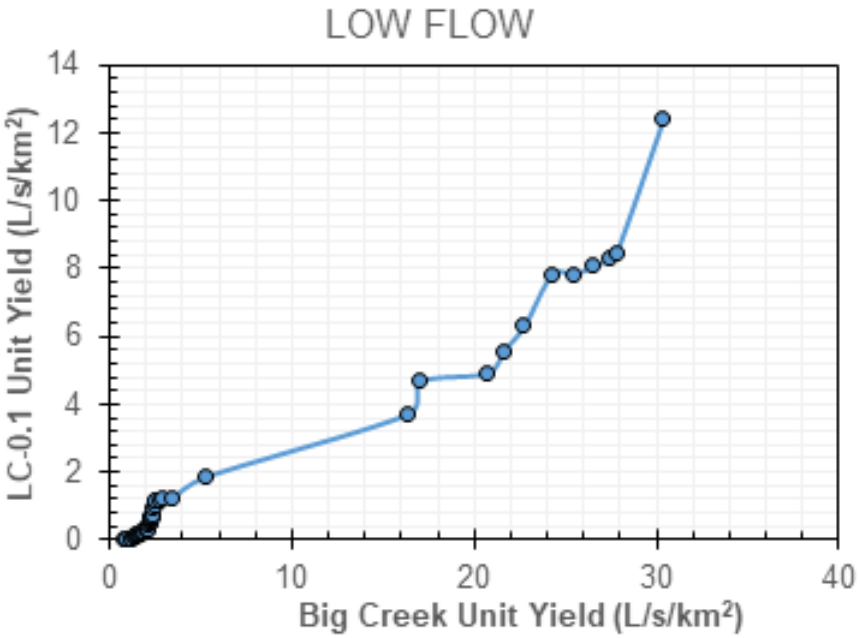


Figure D1.7: LC-0.1 Ranked regression relationship – Low Flows (November to April)

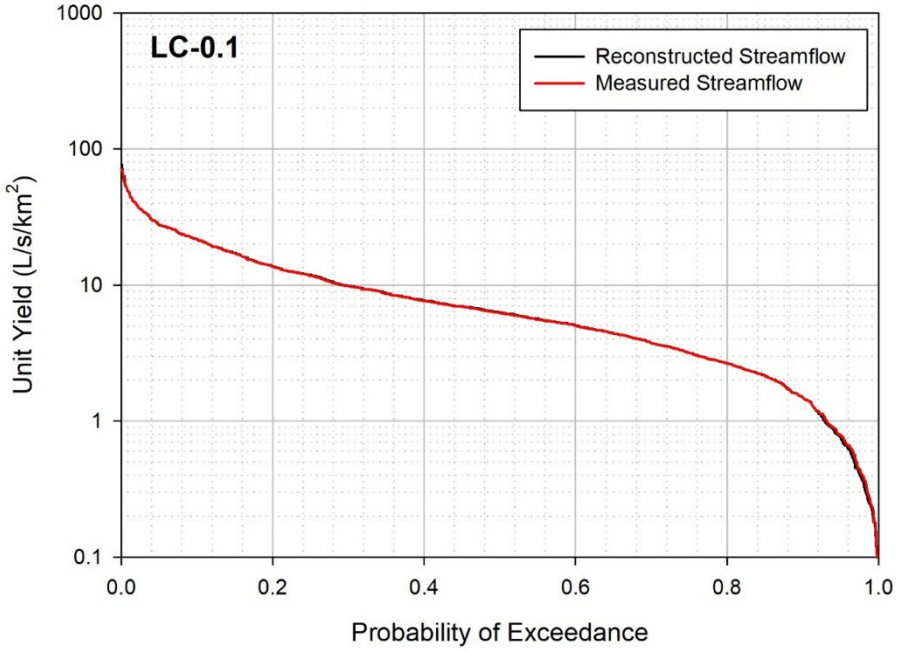


Figure F18: LC-0.1 Flow duration curves – measured vs. synthetic for concurrent period of record

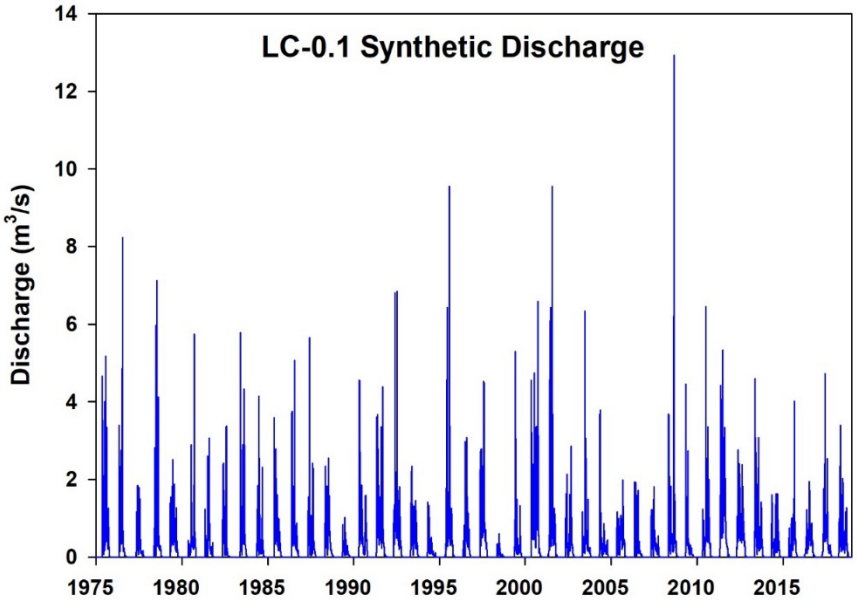


Figure D1.9: LC-0.1 Synthetic streamflow daily time-series

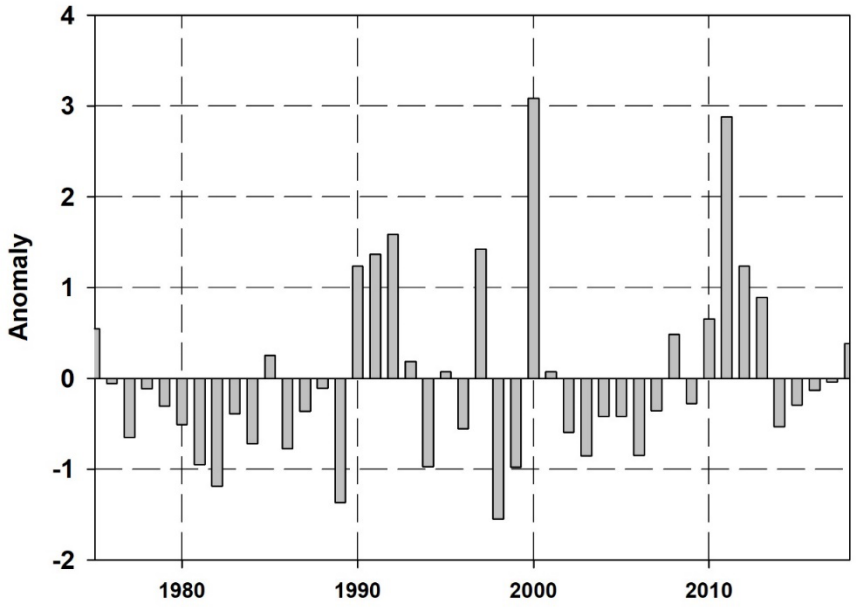
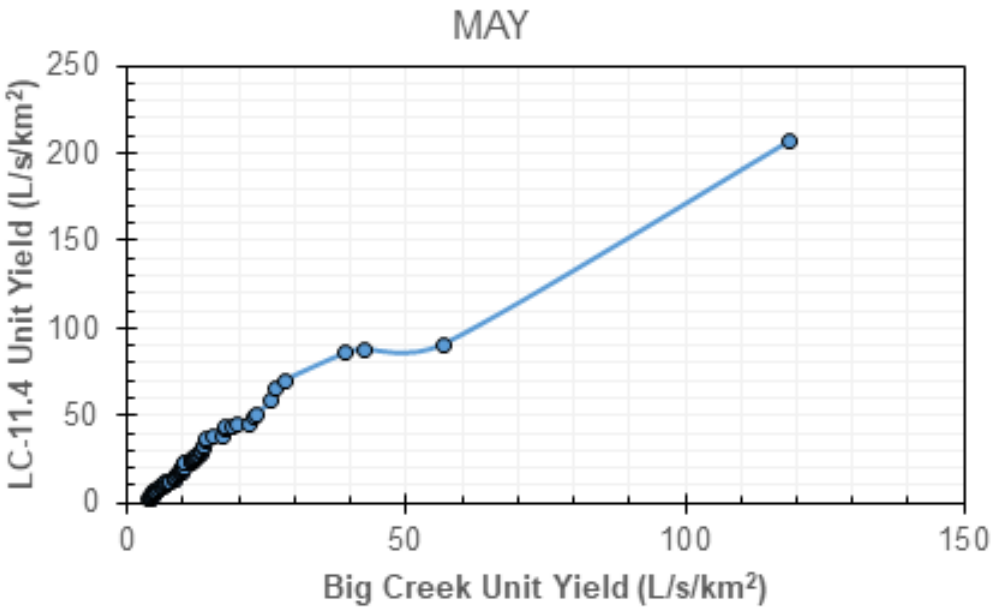


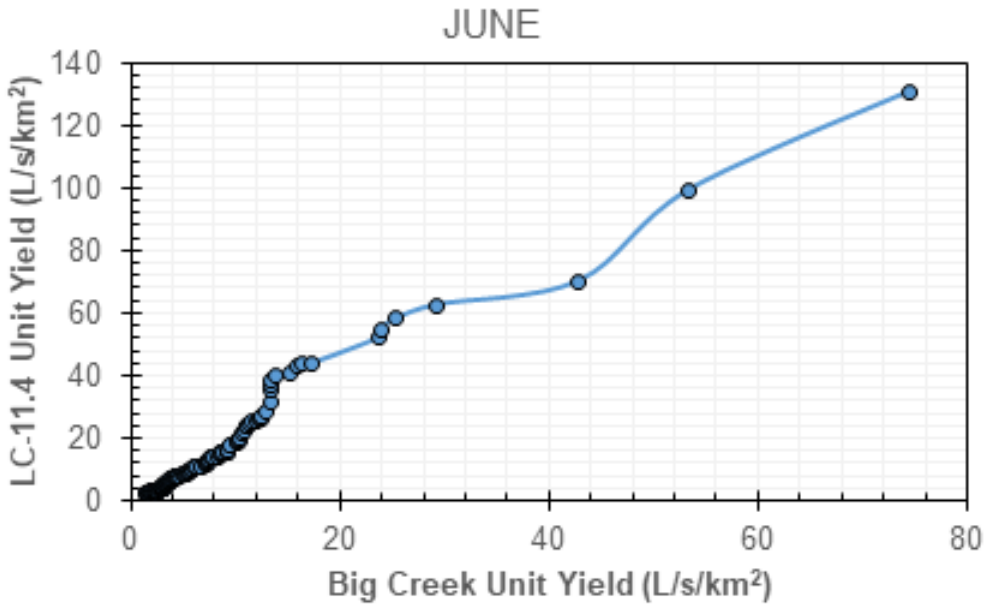
Figure D1.10: LC-0.1 Annual runoff anomalies

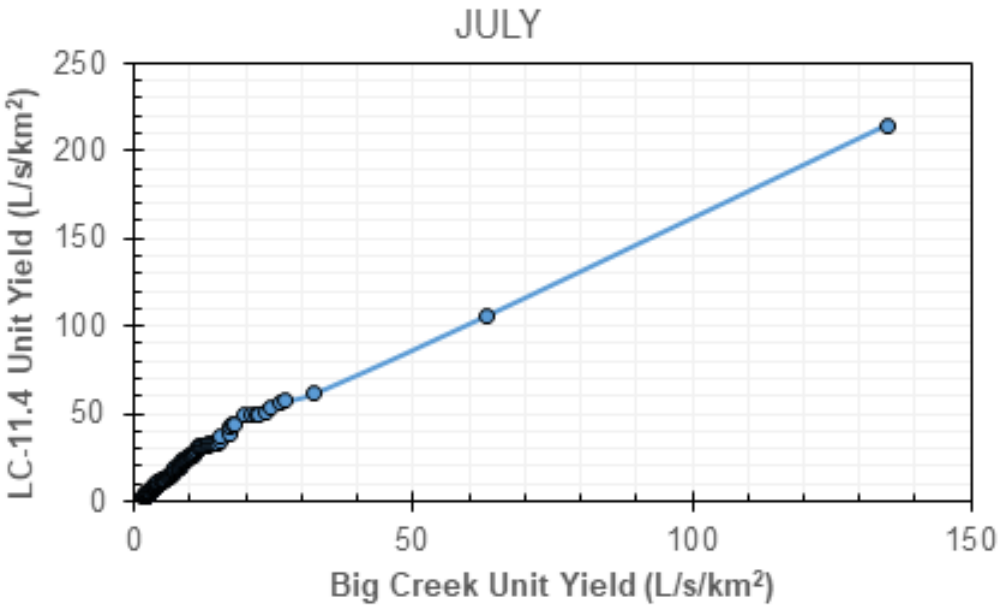
Table D1.11:
LC-0.1 Monthly synthetic streamflows (1975-2018)

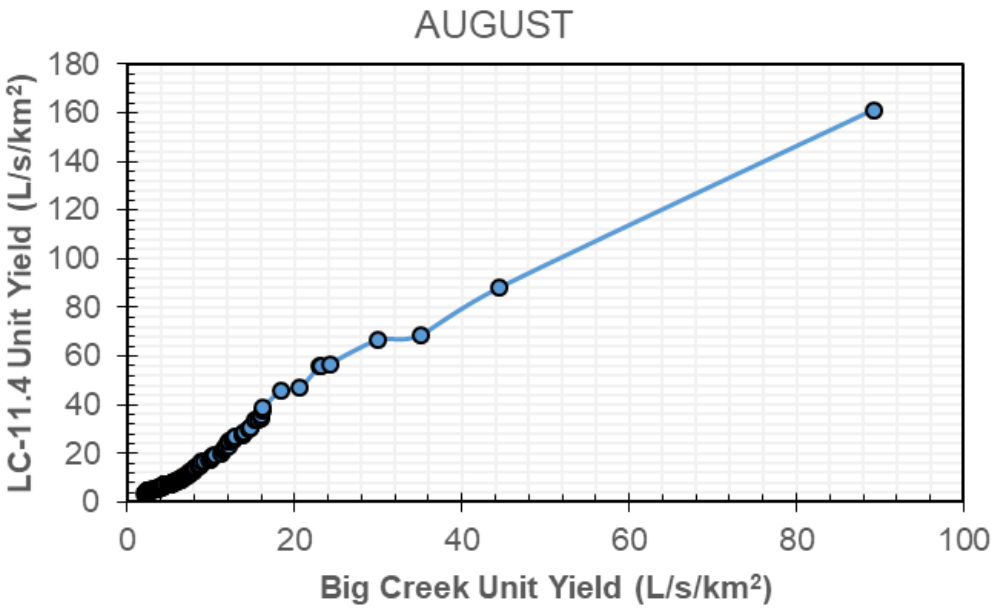
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.000	0.000	0.000	0.000	1.346	0.583	1.077	0.938	0.547	0.093	0.000	0.000	0.386
1976	0.000	0.000	0.000	0.001	0.782	1.160	1.796	0.168	0.032	0.008	0.000	0.000	0.331
1977	0.000	0.000	0.000	0.000	0.553	0.803	0.750	0.123	0.069	0.021	0.000	0.000	0.195
1978	0.000	0.000	0.000	0.000	0.153	0.866	1.714	0.976	0.207	0.097	0.002	0.000	0.338
1979	0.000	0.000	0.000	0.000	0.543	0.754	0.888	0.410	0.355	0.044	0.000	0.000	0.251
1980	0.000	0.000	0.000	0.000	0.137	0.091	0.752	0.350	1.094	0.254	0.000	0.000	0.224
1981	0.000	0.000	0.000	0.000	0.347	0.104	0.844	0.529	0.121	0.089	0.002	0.000	0.172
1982	0.000	0.000	0.000	0.000	0.805	0.900	0.205	0.655	0.028	0.009	0.000	0.000	0.218
1983	0.000	0.000	0.000	0.000	0.276	0.941	0.821	1.129	0.266	0.033	0.000	0.000	0.291
1984	0.000	0.000	0.000	0.000	0.387	0.836	0.913	0.127	0.574	0.020	0.000	0.000	0.238
1985	0.000	0.000	0.000	0.000	0.946	1.030	0.901	0.399	0.365	0.037	0.000	0.000	0.309
1986	0.000	0.000	0.000	0.000	0.784	0.840	0.833	0.358	0.300	0.049	0.000	0.000	0.266
1987	0.000	0.000	0.000	0.000	0.967	0.808	0.336	0.451	0.214	0.041	0.000	0.000	0.236
1988	0.000	0.000	0.000	0.000	0.875	0.412	1.025	0.569	0.140	0.026	0.001	0.000	0.257
1989	0.000	0.000	0.000	0.000	0.239	0.246	0.301	0.141	0.055	0.014	0.000	0.000	0.084
1990	0.000	0.000	0.000	0.312	2.689	0.683	0.424	0.131	0.858	0.166	0.000	0.000	0.442
1991	0.000	0.000	0.000	0.025	1.860	0.987	0.835	0.705	0.983	0.146	0.030	0.004	0.468
1992	0.000	0.000	0.000	0.009	1.761	1.561	1.551	0.419	0.718	0.111	0.003	0.000	0.513
1993	0.000	0.000	0.000	0.054	1.332	0.340	0.610	0.465	0.191	0.011	0.000	0.000	0.253
1994	0.000	0.000	0.000	0.081	0.601	0.318	0.325	0.083	0.034	0.019	0.000	0.000	0.123
1995	0.000	0.000	0.000	0.013	0.407	1.580	1.436	0.755	0.611	0.139	0.008	0.000	0.414
1996	0.000	0.000	0.000	0.000	0.106	0.167	1.002	0.844	0.443	0.037	0.000	0.000	0.218
1997	0.000	0.000	0.000	0.000	0.977	1.835	1.169	1.037	0.379	0.063	0.000	0.000	0.458
1998	0.000	0.000	0.000	0.000	0.149	0.268	0.094	0.068	0.020	0.004	0.000	0.000	0.050
1999	0.000	0.000	0.000	0.000	0.254	0.935	0.322	0.128	0.281	0.036	0.000	0.000	0.163
2000	0.000	0.000	0.000	0.005	1.904	1.274	1.199	1.377	1.887	0.407	0.048	0.007	0.678
2001	0.000	0.000	0.000	0.013	0.407	1.580	1.436	0.755	0.611	0.139	0.008	0.000	0.414
2002	0.000	0.000	0.000	0.000	0.644	0.337	0.431	0.532	0.737	0.080	0.001	0.000	0.232
2003	0.000	0.000	0.000	0.038	0.280	0.801	0.912	0.385	0.175	0.091	0.001	0.000	0.225
2004	0.000	0.000	0.000	0.020	1.402	0.186	0.236	0.223	0.131	0.104	0.000	0.000	0.194
2005	0.000	0.000	0.000	0.068	0.382	0.282	0.574	0.429	0.694	0.181	0.007	0.000	0.219
2006	0.000	0.000	0.000	0.000	0.680	0.437	0.487	0.177	0.086	0.024	0.000	0.000	0.159
2007	0.000	0.000	0.000	0.029	0.823	0.312	0.568	0.201	0.204	0.062	0.000	0.000	0.185
2008	0.000	0.000	0.000	0.012	1.551	0.446	0.406	1.484	0.716	0.158	0.007	0.000	0.402
2009	0.000	0.000	0.000	0.013	1.630	0.778	0.165	0.136	0.082	0.017	0.000	0.000	0.237
2010	0.000	0.000	0.000	0.090	0.510	0.235	1.663	0.943	0.731	0.110	0.007	0.000	0.361
2011	0.000	0.000	0.000	0.039	1.632	1.487	1.621	1.639	0.439	0.127	0.019	0.000	0.589
2012	0.000	0.000	0.000	0.081	0.986	1.147	0.857	0.797	0.671	0.193	0.009	0.000	0.396
2013	0.000	0.000	0.000	0.000	1.641	0.780	0.819	0.342	0.614	0.299	0.021	0.000	0.380
2014	0.000	0.000	0.000	0.029	0.811	0.110	0.437	0.218	0.465	0.175	0.008	0.000	0.190
2015	0.000	0.000	0.000	0.003	0.257	0.141	0.430	1.014	0.710	0.107	0.006	0.000	0.224
2016	0.000	0.000	0.001	0.092	0.331	0.297	0.932	0.461	0.426	0.059	0.008	0.000	0.219
2017	0.000	0.000	0.000	0.055	0.868	1.075	0.840	0.468	0.190	0.105	0.005	0.000	0.303
2018	0.000	0.000	0.011	0.466	1.054	0.675	0.492	0.467	0.493	0.070	0.005	0.000	0.312
Average	**0.000**	**0.000**	**0.000**	**0.035**	**0.843**	**0.714**	**0.805**	**0.546**	**0.431**	**0.093**	**0.005**	**0.000**	**0.291**

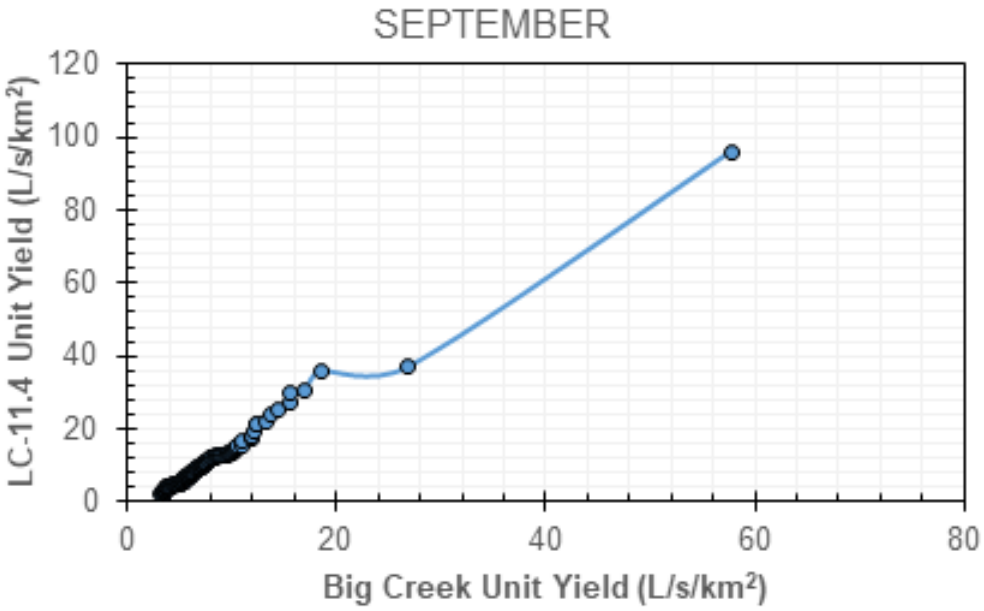
D2. LC-11.4 Synthetic Streamflow Record

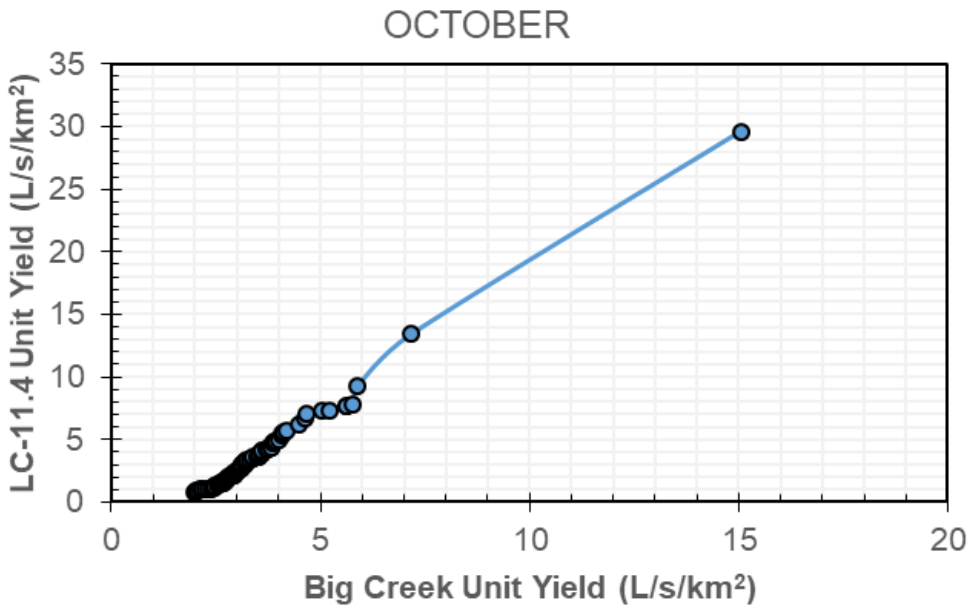


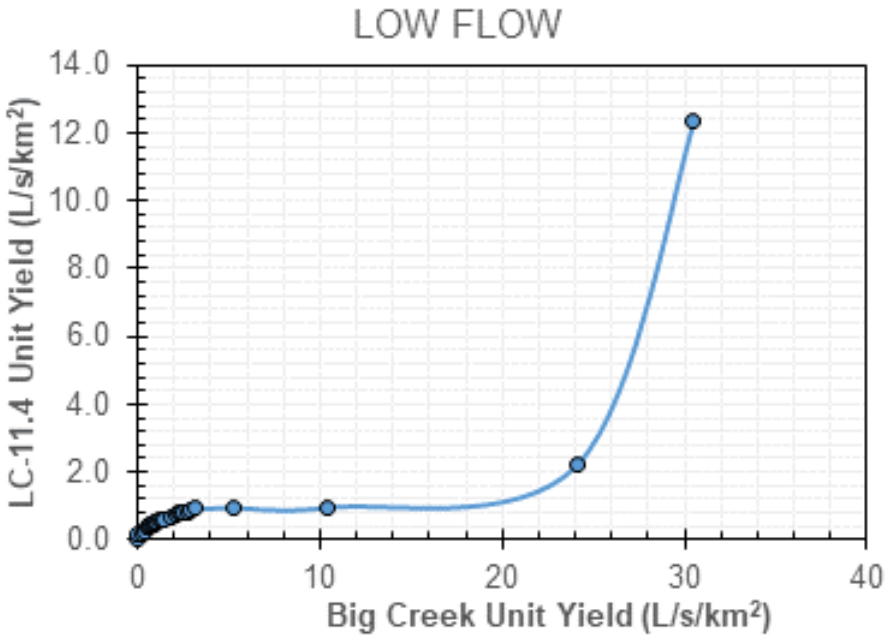


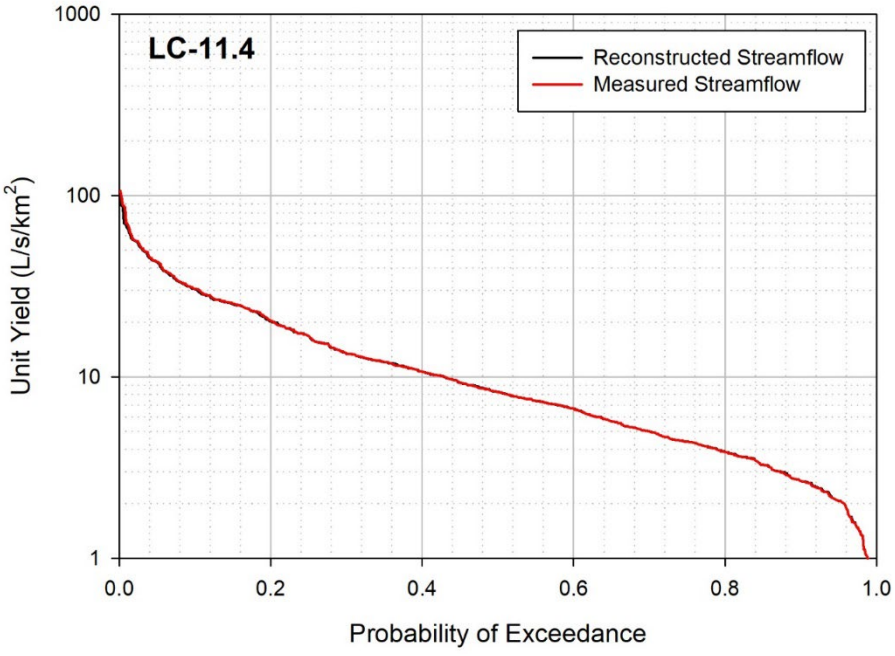

JULY
LC-11.4 Unit Yield (L/s/km²)
Big Creek Unit Yield (L/s/km²)
0
50
100
150
200
250

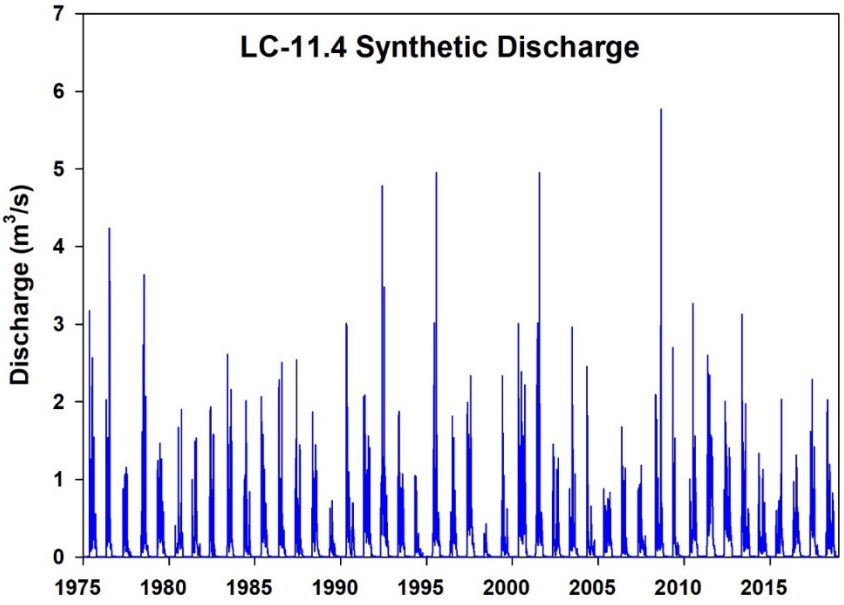

AUGUST
LC-11.4 Unit Yield (L/s/km²)
Big Creek Unit Yield (L/s/km²)
0
20
40
60
80
100
120
140
160
180


SEPTEMBER
LC-11.4 Unit Yield (L/s/km²)
Big Creek Unit Yield (L/s/km²)
0
20
40
60
80
100
120


OCTOBER
LC-11.4 Unit Yield (L/s/km²)
Big Creek Unit Yield (L/s/km²)
0
5
10
15
20
25
30
35


LOW FLOW
LC-11.4 Unit Yield (L/s/km²)
Big Creek Unit Yield (L/s/km²)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
0
10
20
30
40


LC-11.4
Reconstructed Streamflow
Measured Streamflow
Unit Yield (L/s/km²)
Probability of Exceedance
1000
100
10
1
0.0
0.2
0.4
0.6
0.8
1.0


LC-11.4 Synthetic Discharge
Discharge (m3/s)
0
1
2
3
4
5
6
7
1975
1980
1985
1990
1995
2000
2005
2010
2015

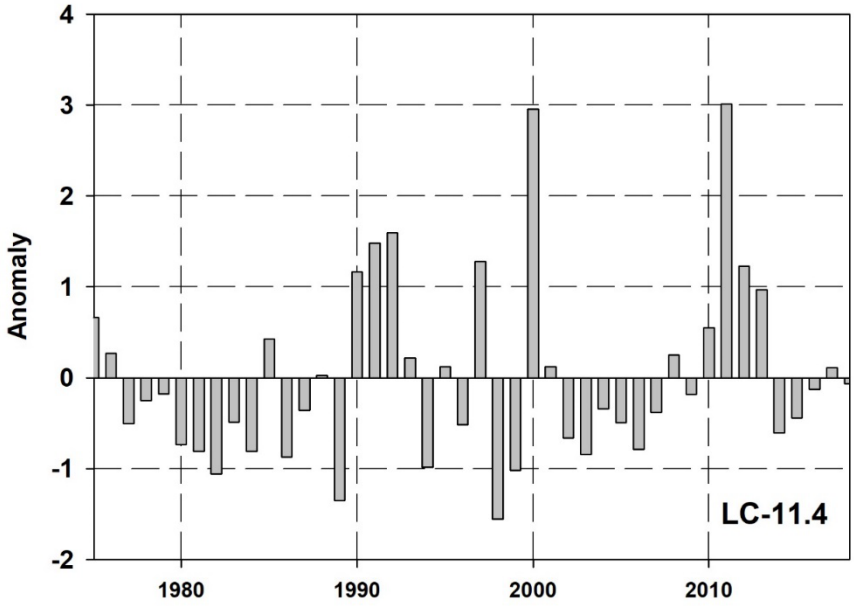

Anomaly
4
3
2
1
0
-1
-2
1980
1990
2000
2010
LC-11.4

Table D2.11:
LC-11.4 Monthly synthetic streamflows (1975-2018)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.003	0.004	0.004	0.005	0.963	0.372	0.666	0.611	0.247	0.049	0.005	0.004	0.247
1976	0.004	0.004	0.003	0.005	0.625	0.726	1.033	0.121	0.011	0.008	0.007	0.004	0.214
1977	0.004	0.004	0.004	0.006	0.457	0.510	0.485	0.079	0.028	0.015	0.007	0.004	0.134
1978	0.003	0.003	0.003	0.003	0.145	0.487	1.009	0.566	0.101	0.052	0.012	0.006	0.201
1979	0.004	0.004	0.004	0.004	0.454	0.483	0.605	0.271	0.164	0.025	0.009	0.005	0.171
1980	0.004	0.004	0.004	0.004	0.138	0.080	0.440	0.210	0.430	0.141	0.007	0.004	0.123
1981	0.004	0.004	0.004	0.004	0.303	0.089	0.546	0.332	0.052	0.047	0.011	0.005	0.118
1982	0.004	0.004	0.004	0.004	0.673	0.556	0.111	0.383	0.010	0.009	0.008	0.004	0.149
1983	0.004	0.004	0.003	0.003	0.232	0.538	0.506	0.709	0.128	0.019	0.005	0.003	0.181
1984	0.003	0.003	0.003	0.004	0.323	0.496	0.542	0.082	0.251	0.014	0.005	0.004	0.144
1985	0.003	0.003	0.003	0.004	0.725	0.638	0.621	0.255	0.179	0.022	0.010	0.007	0.208
1986	0.005	0.004	0.004	0.003	0.507	0.523	0.475	0.224	0.135	0.028	0.006	0.006	0.161
1987	0.005	0.004	0.004	0.007	0.768	0.456	0.188	0.294	0.103	0.024	0.009	0.005	0.157
1988	0.004	0.004	0.004	0.005	0.737	0.250	0.703	0.374	0.064	0.016	0.012	0.007	0.184
1989	0.005	0.004	0.004	0.004	0.220	0.163	0.160	0.094	0.020	0.012	0.009	0.005	0.059
1990	0.004	0.004	0.003	0.095	1.813	0.438	0.239	0.071	0.383	0.092	0.008	0.004	0.265
1991	0.004	0.004	0.004	0.009	1.367	0.635	0.558	0.418	0.401	0.074	0.016	0.013	0.295
1992	0.009	0.005	0.005	0.008	1.250	0.934	0.976	0.264	0.322	0.059	0.013	0.009	0.323
1993	0.005	0.004	0.004	0.013	1.053	0.214	0.387	0.303	0.091	0.010	0.012	0.010	0.178
1994	0.007	0.004	0.004	0.016	0.500	0.193	0.153	0.042	0.012	0.013	0.005	0.004	0.080
1995	0.010	0.007	0.006	0.010	0.359	0.868	0.894	0.442	0.276	0.070	0.014	0.009	0.249
1996	0.004	0.003	0.003	0.003	0.112	0.125	0.660	0.537	0.201	0.022	0.007	0.004	0.141
1997	0.003	0.003	0.003	0.003	0.818	1.110	0.754	0.616	0.177	0.035	0.012	0.006	0.297
1998	0.004	0.004	0.004	0.004	0.142	0.174	0.035	0.027	0.007	0.006	0.004	0.003	0.035
1999	0.003	0.003	0.003	0.004	0.224	0.556	0.167	0.085	0.129	0.021	0.004	0.004	0.100
2000	0.003	0.003	0.003	0.005	1.343	0.776	0.760	0.805	0.725	0.252	0.018	0.013	0.395
2001	0.010	0.007	0.006	0.010	0.359	0.868	0.894	0.442	0.276	0.070	0.014	0.009	0.249
2002	0.005	0.004	0.004	0.007	0.527	0.217	0.258	0.348	0.289	0.042	0.012	0.009	0.145
2003	0.005	0.004	0.004	0.010	0.261	0.435	0.556	0.262	0.082	0.049	0.011	0.006	0.142
2004	0.004	0.004	0.005	0.011	1.092	0.125	0.111	0.154	0.056	0.055	0.010	0.006	0.138
2005	0.005	0.004	0.004	0.014	0.340	0.188	0.363	0.284	0.319	0.088	0.012	0.005	0.137
2006	0.004	0.004	0.004	0.006	0.556	0.286	0.277	0.124	0.034	0.015	0.010	0.004	0.111
2007	0.003	0.003	0.003	0.009	0.671	0.203	0.320	0.138	0.097	0.035	0.008	0.004	0.126
2008	0.004	0.004	0.004	0.007	1.176	0.273	0.186	0.774	0.313	0.075	0.013	0.010	0.239
2009	0.008	0.006	0.006	0.010	1.175	0.470	0.067	0.091	0.033	0.014	0.011	0.007	0.160
2010	0.005	0.004	0.004	0.016	0.447	0.159	1.010	0.582	0.318	0.056	0.013	0.010	0.221
2011	0.010	0.010	0.009	0.015	1.188	0.892	1.031	1.071	0.198	0.063	0.015	0.012	0.380
2012	0.009	0.009	0.009	0.018	0.804	0.749	0.606	0.515	0.302	0.097	0.014	0.011	0.263
2013	0.011	0.010	0.010	0.009	1.221	0.489	0.483	0.219	0.271	0.175	0.015	0.012	0.246
2014	0.011	0.009	0.007	0.010	0.650	0.086	0.250	0.150	0.213	0.087	0.014	0.010	0.126
2015	0.006	0.004	0.005	0.010	0.235	0.100	0.234	0.626	0.315	0.056	0.013	0.011	0.136
2016	0.009	0.008	0.010	0.020	0.293	0.182	0.628	0.279	0.198	0.032	0.013	0.010	0.141
2017	0.007	0.005	0.004	0.015	0.719	0.670	0.566	0.316	0.091	0.055	0.013	0.009	0.208
2018	0.007	0.006	0.007	0.106	0.827	0.446	0.273	0.311	0.225	0.039	0.013	0.009	0.190
Average	**0.005**	**0.005**	**0.005**	**0.012**	**0.654**	**0.437**	**0.495**	**0.339**	**0.188**	**0.051**	**0.010**	**0.007**	**0.186**

D3. LCT20-0.1 Synthetic Streamflow Record

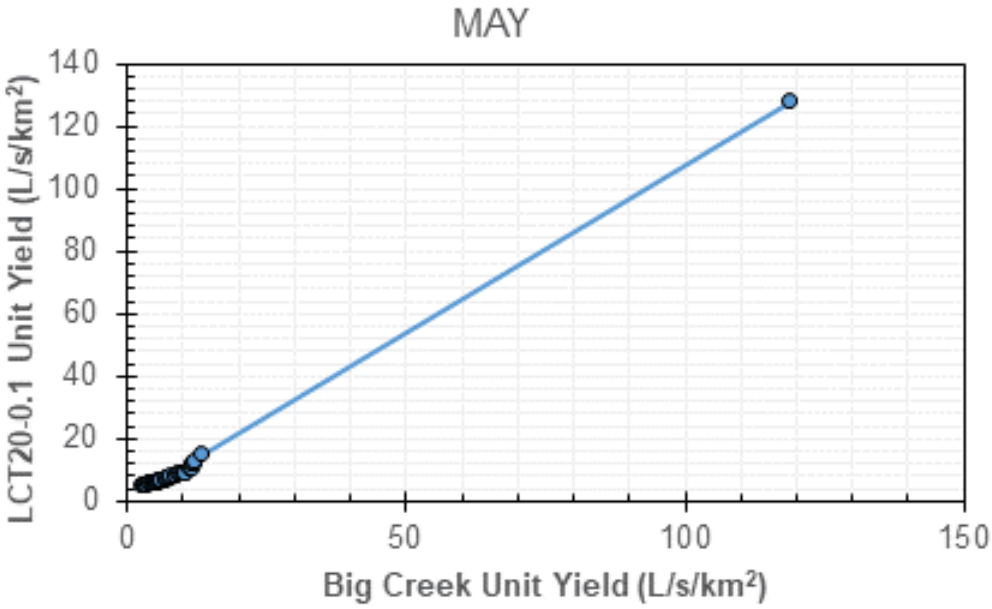


Figure D3.1: LCT20-0.1 Ranked regression relationship – May

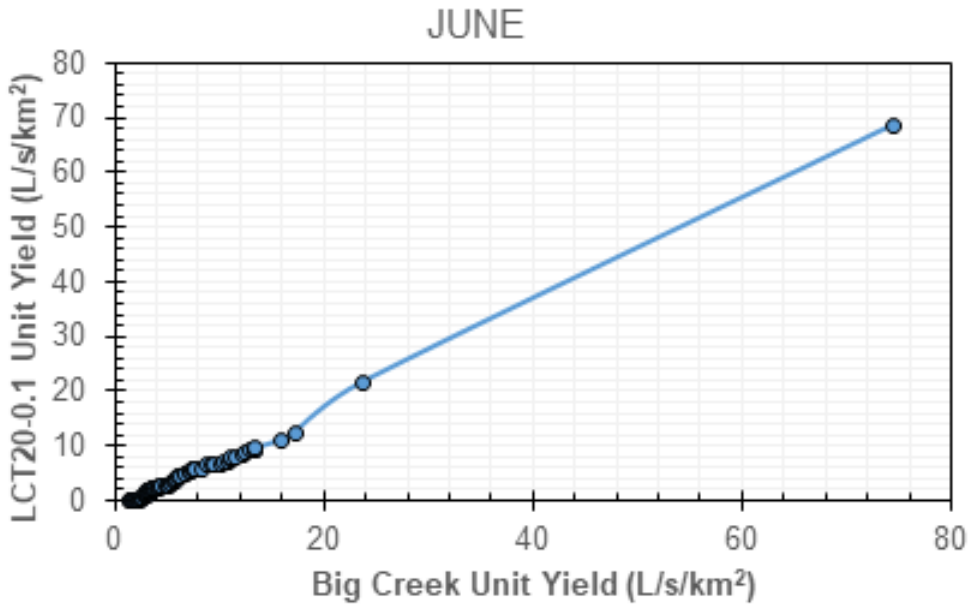


Figure D3.2: LCT20-0.1 Ranked regression relationship – June

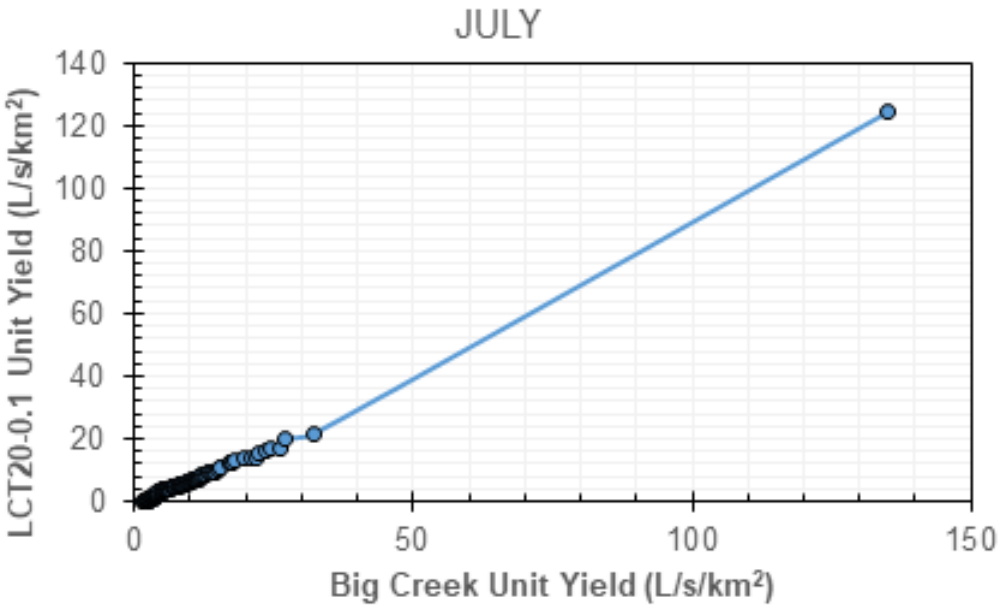


Figure D3.3: LCT20-0.1 Ranked regression relationship – July

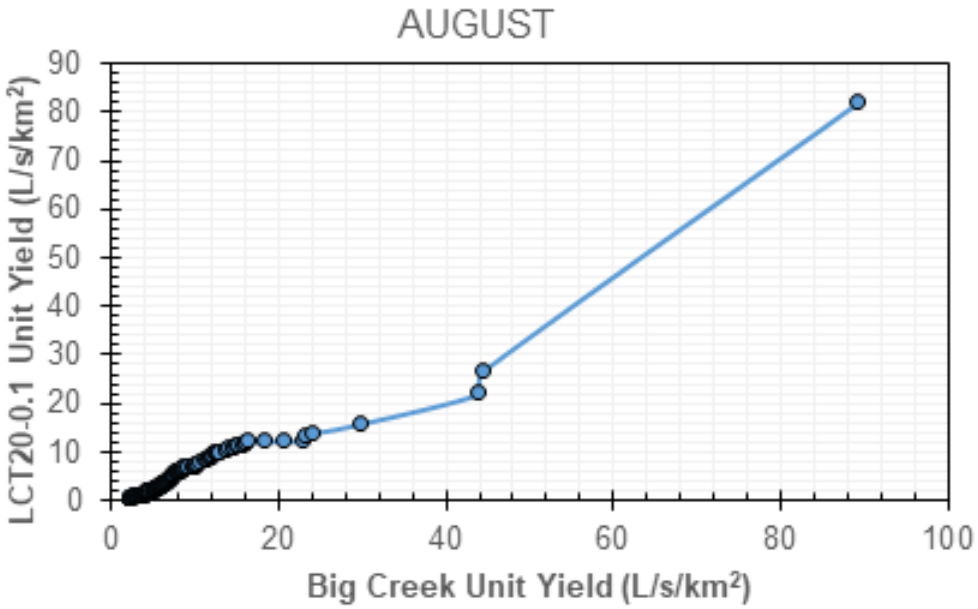


Figure D3.4: LCT20-0.1 Ranked regression relationship – August

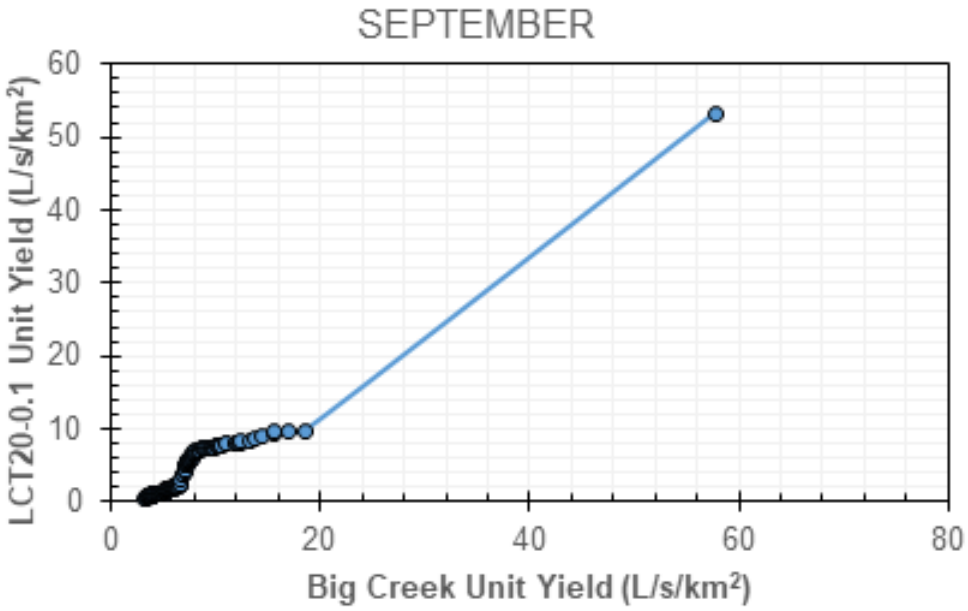


Figure D3.5: LCT20-0.1 Ranked regression relationship – September

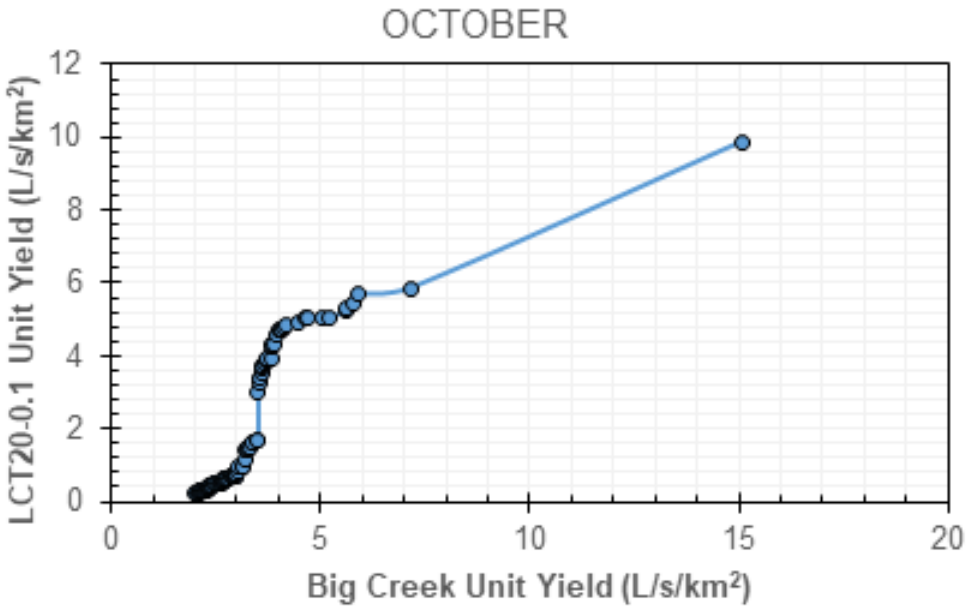


Figure D3.6: LCT20-0.1 Ranked regression relationship – October

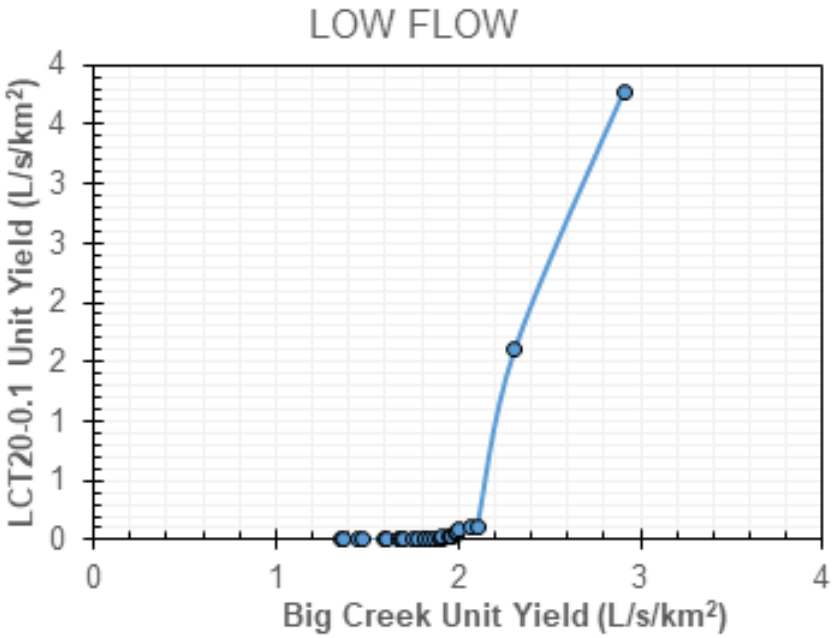


Figure D3.7: LCT20-0.1 Ranked regression relationship – Low Flows (November to April)

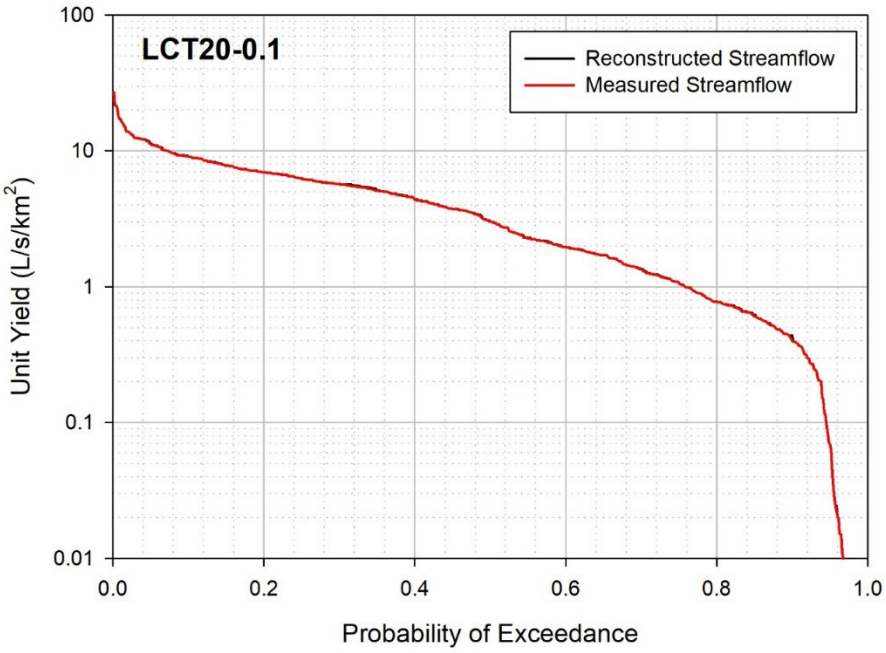


Figure D3.8: LCT20-0.1 Flow duration curves – measured vs. synthetic for concurrent period of record

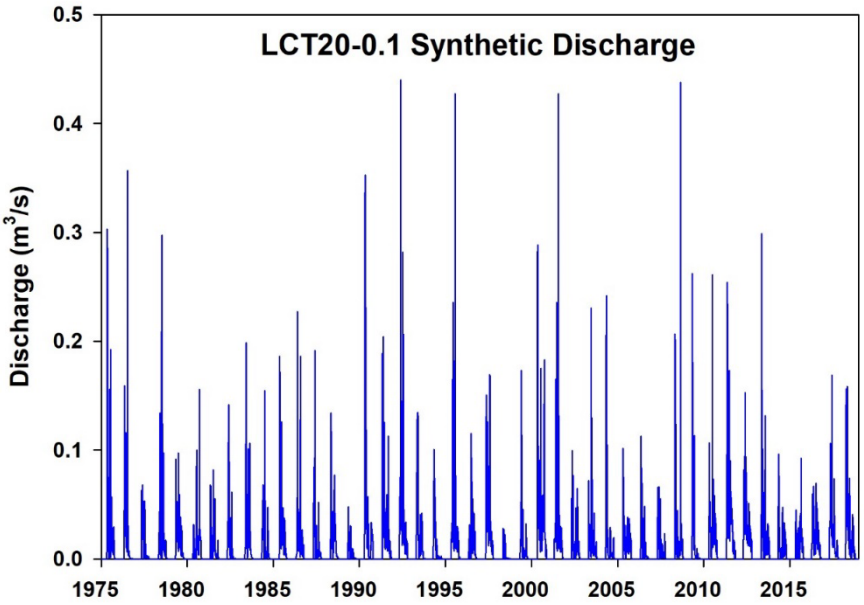


Figure D3.9: LCT20-0.1 Synthetic streamflow daily time-series

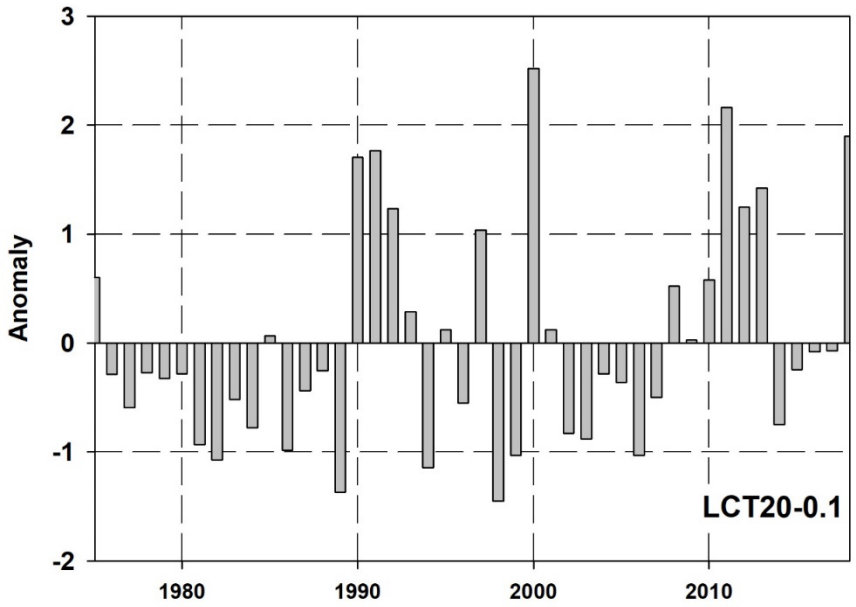


Figure D3.10: LCT20-0.1 Annual runoff anomalies

Table D3.11:
LCT20-0.1 Monthly synthetic streamflows (1975-2018)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.000	0.000	0.000	0.000	0.078	0.019	0.031	0.030	0.015	0.005	0.000	0.000	0.015
1976	0.000	0.000	0.000	0.000	0.048	0.038	0.064	0.004	0.000	0.000	0.000	0.000	0.013
1977	0.000	0.000	0.000	0.000	0.037	0.023	0.019	0.002	0.001	0.001	0.000	0.000	0.007
1978	0.000	0.000	0.000	0.000	0.016	0.031	0.056	0.027	0.004	0.005	0.000	0.000	0.012
1979	0.000	0.000	0.000	0.000	0.036	0.025	0.025	0.014	0.009	0.001	0.000	0.000	0.009
1980	0.000	0.000	0.000	0.000	0.019	0.002	0.019	0.012	0.030	0.012	0.000	0.000	0.008
1981	0.000	0.000	0.000	0.000	0.027	0.002	0.023	0.015	0.002	0.003	0.000	0.000	0.006
1982	0.000	0.000	0.000	0.000	0.051	0.029	0.003	0.015	0.000	0.000	0.000	0.000	0.008
1983	0.000	0.000	0.000	0.000	0.021	0.031	0.022	0.035	0.006	0.001	0.000	0.000	0.010
1984	0.000	0.000	0.000	0.000	0.029	0.027	0.023	0.002	0.014	0.001	0.000	0.000	0.008
1985	0.000	0.000	0.000	0.000	0.055	0.034	0.025	0.014	0.012	0.001	0.000	0.000	0.012
1986	0.000	0.000	0.000	0.000	0.047	0.024	0.022	0.012	0.008	0.002	0.000	0.000	0.010
1987	0.000	0.000	0.000	0.000	0.056	0.026	0.006	0.013	0.004	0.001	0.000	0.000	0.009
1988	0.000	0.000	0.000	0.000	0.054	0.013	0.029	0.020	0.002	0.001	0.000	0.000	0.010
1989	0.000	0.000	0.000	0.000	0.023	0.008	0.005	0.003	0.001	0.000	0.000	0.000	0.003
1990	0.000	0.000	0.000	0.052	0.158	0.022	0.008	0.003	0.025	0.008	0.000	0.000	0.023
1991	0.000	0.000	0.000	0.005	0.103	0.033	0.022	0.022	0.027	0.008	0.002	0.000	0.019
1992	0.000	0.000	0.000	0.001	0.106	0.051	0.050	0.015	0.018	0.006	0.000	0.000	0.021
1993	0.000	0.000	0.000	0.011	0.075	0.012	0.015	0.016	0.003	0.000	0.000	0.000	0.011
1994	0.000	0.000	0.000	0.017	0.039	0.010	0.004	0.001	0.000	0.001	0.000	0.000	0.006
1995	0.000	0.000	0.000	0.002	0.034	0.057	0.048	0.023	0.017	0.007	0.000	0.000	0.016
1996	0.000	0.000	0.000	0.000	0.016	0.005	0.028	0.027	0.012	0.001	0.000	0.000	0.007
1997	0.000	0.000	0.000	0.000	0.060	0.061	0.035	0.031	0.009	0.003	0.000	0.000	0.017
1998	0.000	0.000	0.000	0.000	0.020	0.008	0.000	0.001	0.000	0.000	0.000	0.000	0.003
1999	0.000	0.000	0.000	0.000	0.021	0.032	0.005	0.002	0.006	0.001	0.000	0.000	0.006
2000	0.000	0.000	0.000	0.001	0.109	0.038	0.037	0.032	0.046	0.017	0.005	0.000	0.024
2001	0.000	0.000	0.000	0.002	0.034	0.057	0.048	0.023	0.017	0.007	0.000	0.000	0.016
2002	0.000	0.000	0.000	0.000	0.041	0.010	0.009	0.017	0.017	0.003	0.000	0.000	0.008
2003	0.000	0.000	0.000	0.009	0.026	0.027	0.025	0.012	0.003	0.005	0.000	0.000	0.009
2004	0.000	0.000	0.000	0.003	0.082	0.005	0.003	0.006	0.002	0.004	0.000	0.000	0.009
2005	0.000	0.000	0.000	0.015	0.029	0.009	0.014	0.015	0.020	0.008	0.000	0.000	0.009
2006	0.000	0.000	0.000	0.000	0.044	0.013	0.010	0.004	0.001	0.001	0.000	0.000	0.006
2007	0.000	0.000	0.000	0.006	0.047	0.009	0.011	0.005	0.004	0.003	0.000	0.000	0.007
2008	0.000	0.000	0.000	0.002	0.087	0.014	0.005	0.044	0.020	0.007	0.000	0.000	0.015
2009	0.000	0.000	0.000	0.002	0.092	0.027	0.001	0.003	0.001	0.001	0.000	0.000	0.011
2010	0.000	0.000	0.000	0.020	0.034	0.008	0.053	0.029	0.020	0.005	0.000	0.000	0.014
2011	0.000	0.000	0.000	0.006	0.091	0.048	0.049	0.042	0.012	0.007	0.001	0.000	0.022
2012	0.000	0.000	0.000	0.018	0.056	0.034	0.023	0.026	0.021	0.010	0.000	0.000	0.016
2013	0.000	0.000	0.000	0.000	0.096	0.025	0.021	0.011	0.017	0.013	0.001	0.000	0.016
2014	0.000	0.000	0.000	0.005	0.049	0.002	0.008	0.006	0.012	0.008	0.000	0.000	0.008
2015	0.000	0.000	0.000	0.000	0.025	0.004	0.008	0.031	0.020	0.005	0.000	0.000	0.008
2016	0.000	0.000	0.000	0.016	0.027	0.009	0.025	0.017	0.012	0.002	0.000	0.000	0.009
2017	0.000	0.000	0.000	0.010	0.051	0.038	0.023	0.014	0.003	0.005	0.000	0.000	0.012
2018	0.000	0.000	0.002	0.093	0.061	0.021	0.009	0.017	0.014	0.002	0.000	0.000	0.018
Average	**0.000**	**0.000**	**0.000**	**0.007**	**0.052**	**0.023**	**0.022**	**0.016**	**0.011**	**0.004**	**0.000**	**0.000**	**0.011**

D4. LC-15.5 Synthetic Streamflow Record

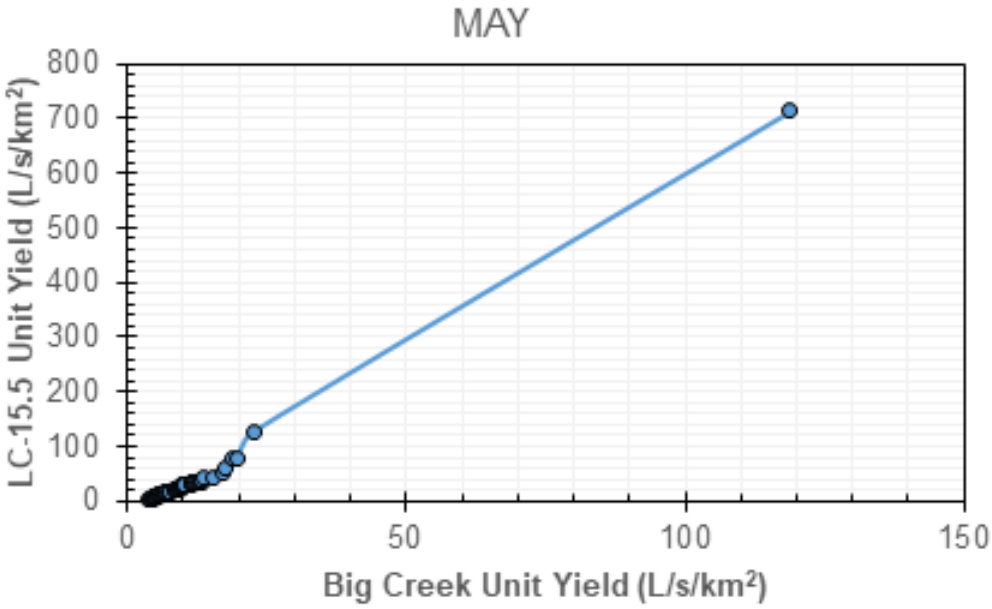


Figure D4.1: LC-15.5 Ranked regression relationship – May

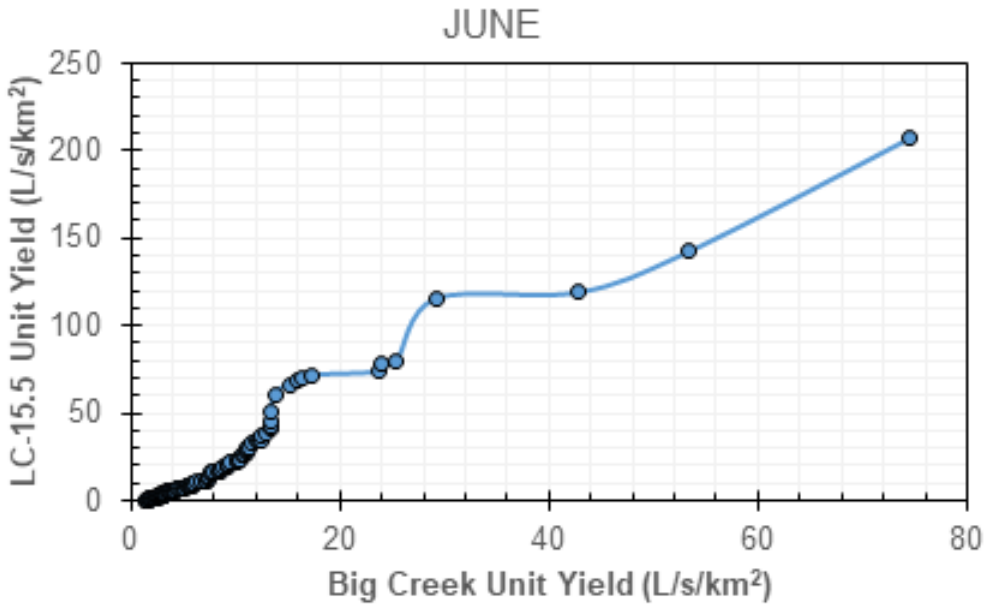


Figure D4.2: LC-15.5 Ranked regression relationship – June

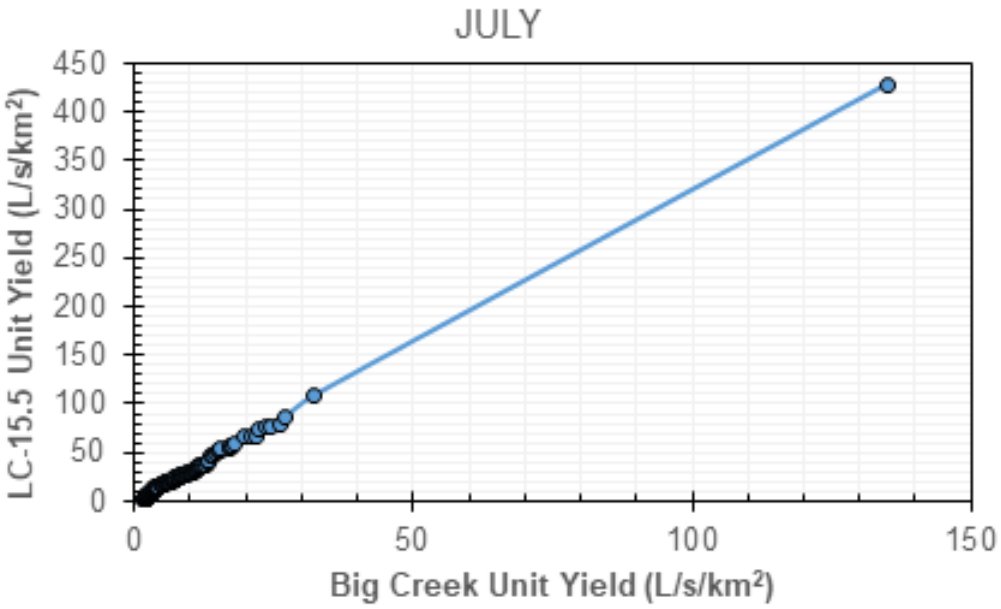


Figure D4.3: LC-15.5 Ranked regression relationship – July

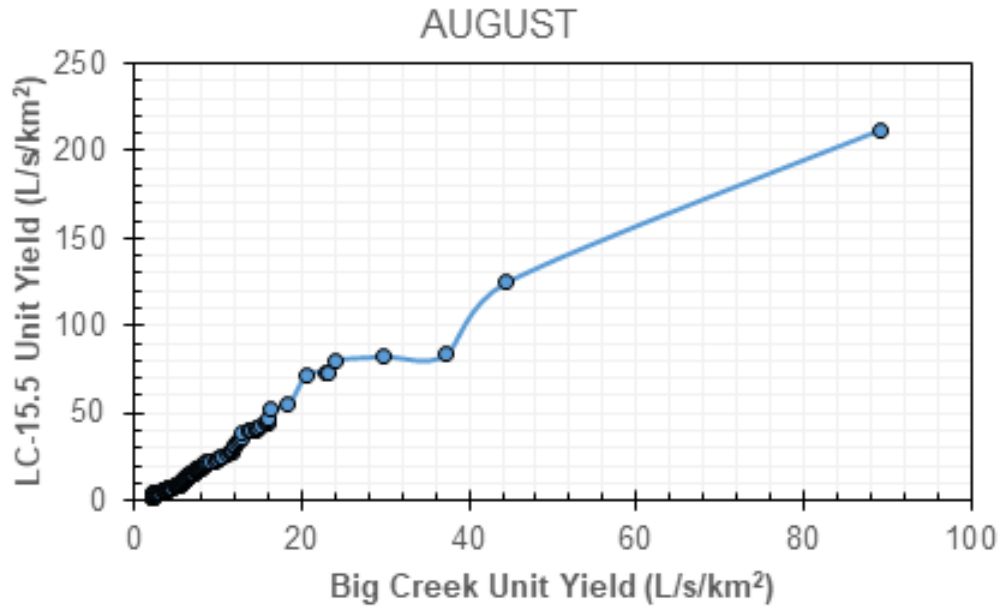


Figure D4.4: LC-15.5 Ranked regression relationship – August

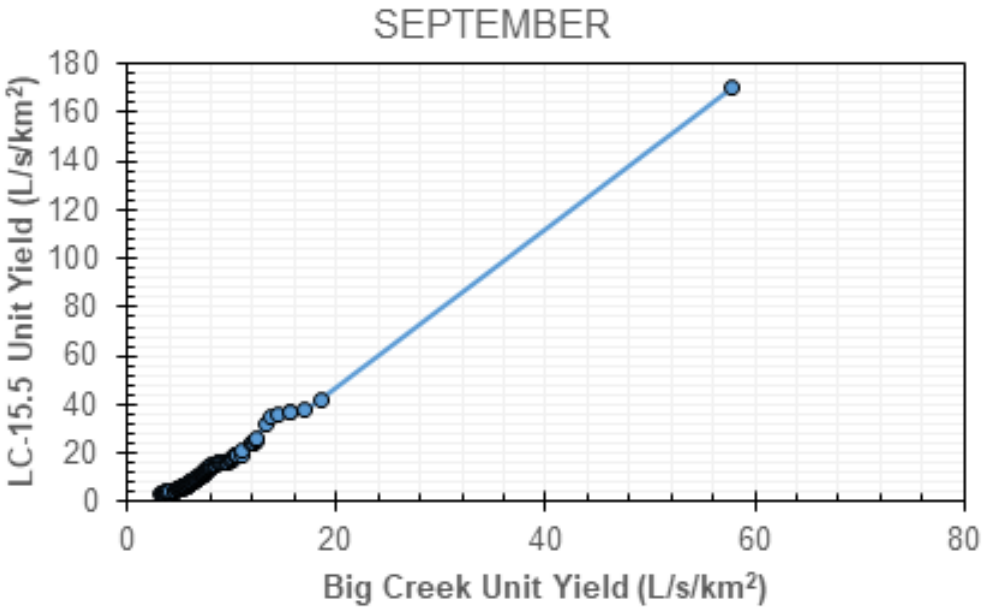


Figure D4.5: LC-15.5 Ranked regression relationship – September

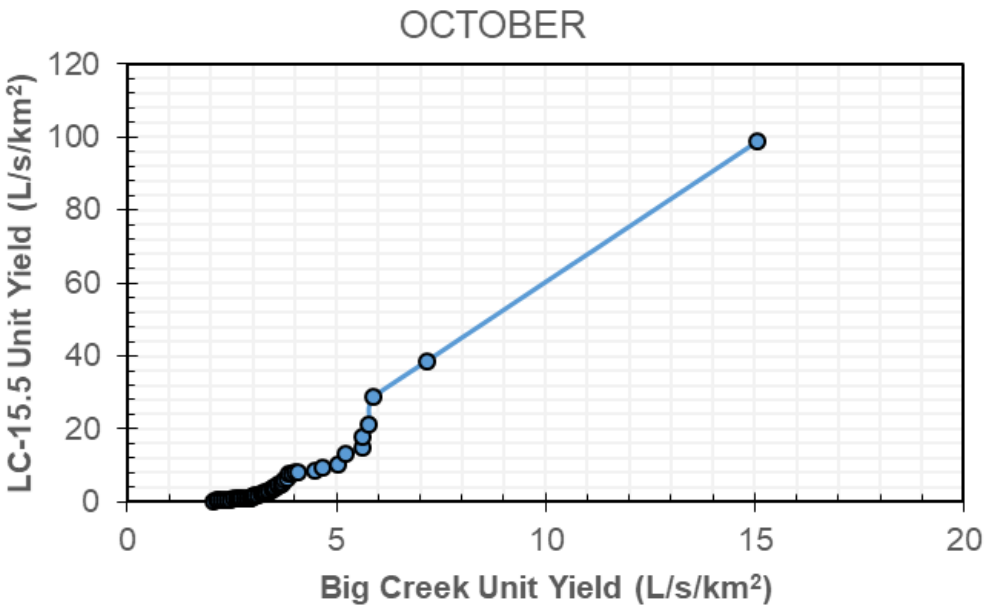


Figure D4.6: LC-15.5 Ranked regression relationship – October

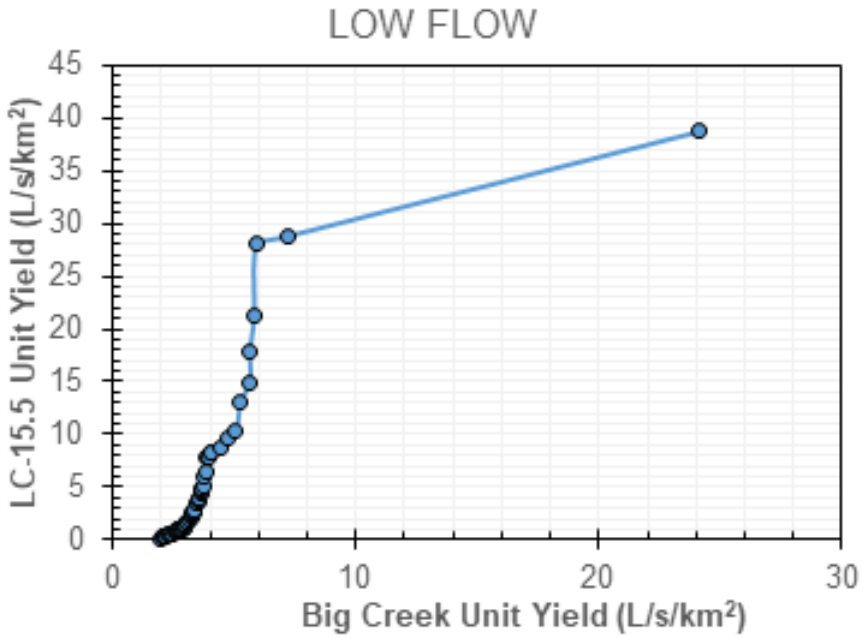


Figure D4.7: LC-15.5 Ranked regression relationship – Low Flows (November to April)

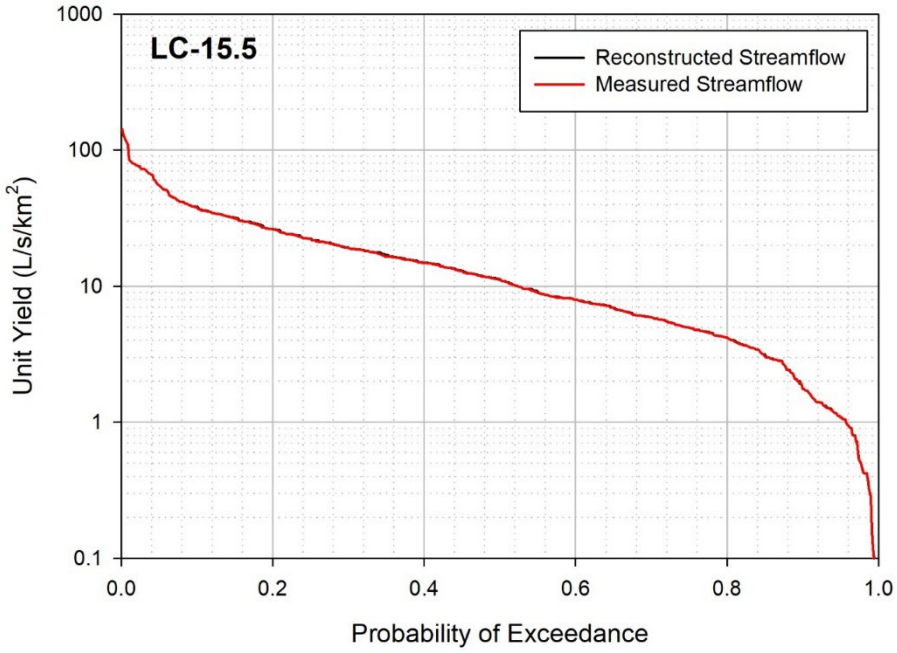


Figure D4.8: LC-15.5 Flow duration curves – measured vs. synthetic for concurrent period of record

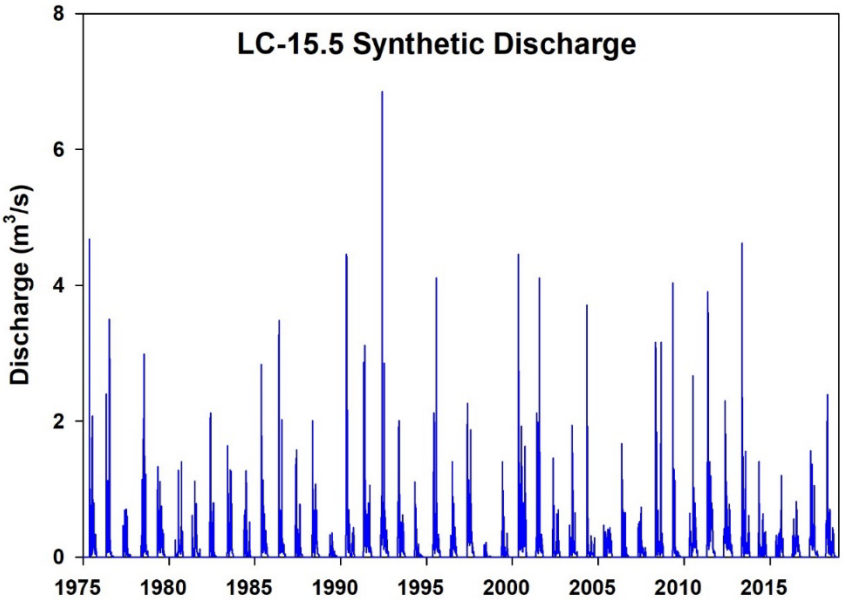


Figure D4.9: LC-15.5 Synthetic streamflow daily time-series

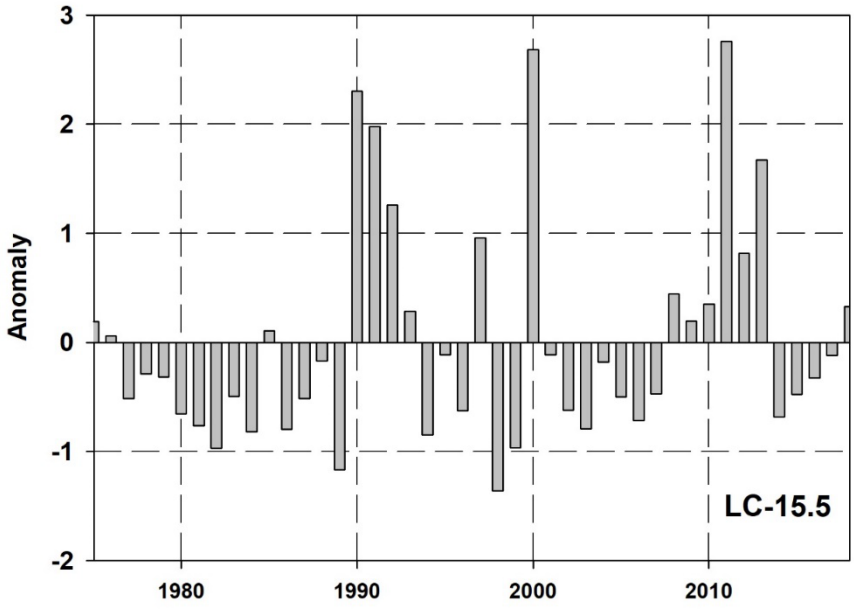


Figure D4.10: LC-15.5 Annual runoff anomalies

Table D4.11:
LC-15.5 Monthly synthetic streamflows (1975-2018)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.000	0.000	0.000	0.000	0.974	0.191	0.409	0.340	0.123	0.025	0.000	0.000	0.174
1976	0.000	0.000	0.000	0.000	0.472	0.441	0.729	0.047	0.016	0.001	0.000	0.000	0.143
1977	0.000	0.000	0.000	0.000	0.246	0.301	0.270	0.023	0.023	0.002	0.000	0.000	0.072
1978	0.000	0.000	0.000	0.000	0.080	0.287	0.689	0.314	0.044	0.023	0.000	0.000	0.121
1979	0.000	0.000	0.000	0.000	0.292	0.272	0.328	0.141	0.082	0.005	0.000	0.000	0.094
1980	0.000	0.000	0.000	0.000	0.073	0.021	0.273	0.117	0.258	0.141	0.000	0.000	0.074
1981	0.000	0.000	0.000	0.000	0.173	0.023	0.317	0.176	0.031	0.017	0.000	0.000	0.063
1982	0.000	0.000	0.000	0.000	0.608	0.328	0.056	0.193	0.015	0.001	0.000	0.000	0.101
1983	0.000	0.000	0.000	0.000	0.157	0.309	0.307	0.400	0.058	0.003	0.000	0.000	0.104
1984	0.000	0.000	0.000	0.000	0.176	0.289	0.334	0.025	0.132	0.002	0.000	0.000	0.080
1985	0.000	0.000	0.000	0.000	0.712	0.375	0.342	0.135	0.085	0.004	0.000	0.000	0.139
1986	0.000	0.000	0.000	0.000	0.652	0.301	0.297	0.118	0.066	0.007	0.000	0.000	0.121
1987	0.000	0.000	0.000	0.000	0.597	0.266	0.097	0.152	0.046	0.005	0.000	0.000	0.098
1988	0.000	0.000	0.000	0.000	0.602	0.114	0.387	0.207	0.034	0.002	0.000	0.000	0.114
1989	0.000	0.000	0.000	0.000	0.122	0.065	0.082	0.032	0.020	0.001	0.000	0.000	0.027
1990	0.000	0.000	0.000	0.202	2.320	0.235	0.128	0.027	0.204	0.074	0.000	0.000	0.269
1991	0.000	0.000	0.000	0.026	1.408	0.382	0.308	0.229	0.230	0.038	0.003	0.001	0.221
1992	0.000	0.000	0.000	0.003	1.402	0.585	0.627	0.142	0.164	0.030	0.001	0.000	0.248
1993	0.000	0.000	0.000	0.060	0.850	0.091	0.211	0.167	0.042	0.001	0.001	0.000	0.120
1994	0.000	0.000	0.000	0.091	0.294	0.074	0.088	0.009	0.016	0.002	0.000	0.000	0.048
1995	0.000	0.000	0.000	0.002	0.285	0.535	0.577	0.246	0.139	0.037	0.001	0.000	0.153
1996	0.000	0.000	0.000	0.000	0.059	0.043	0.381	0.292	0.098	0.004	0.000	0.000	0.074
1997	0.000	0.000	0.000	0.000	0.757	0.725	0.451	0.342	0.081	0.013	0.000	0.000	0.199
1998	0.000	0.000	0.000	0.000	0.076	0.068	0.015	0.004	0.013	0.000	0.000	0.000	0.015
1999	0.000	0.000	0.000	0.000	0.123	0.316	0.090	0.025	0.065	0.004	0.000	0.000	0.052
2000	0.000	0.000	0.000	0.006	1.460	0.484	0.474	0.434	0.449	0.289	0.005	0.001	0.302
2001	0.000	0.000	0.000	0.002	0.285	0.535	0.577	0.246	0.139	0.037	0.001	0.000	0.153
2002	0.000	0.000	0.000	0.000	0.328	0.098	0.137	0.190	0.164	0.014	0.001	0.000	0.079
2003	0.000	0.000	0.000	0.047	0.141	0.243	0.348	0.138	0.040	0.022	0.000	0.000	0.082
2004	0.000	0.000	0.000	0.018	1.087	0.042	0.056	0.069	0.033	0.028	0.000	0.000	0.113
2005	0.000	0.000	0.000	0.064	0.192	0.082	0.202	0.150	0.165	0.054	0.001	0.000	0.076
2006	0.000	0.000	0.000	0.000	0.428	0.153	0.153	0.049	0.026	0.002	0.000	0.000	0.068
2007	0.000	0.000	0.000	0.037	0.354	0.090	0.185	0.060	0.046	0.013	0.000	0.000	0.066
2008	0.000	0.000	0.000	0.012	1.141	0.128	0.115	0.409	0.162	0.047	0.001	0.000	0.170
2009	0.000	0.000	0.000	0.008	1.211	0.278	0.032	0.032	0.025	0.001	0.000	0.000	0.134
2010	0.000	0.000	0.000	0.107	0.254	0.059	0.652	0.321	0.163	0.026	0.001	0.000	0.134
2011	0.000	0.000	0.000	0.019	1.166	0.552	0.647	0.588	0.093	0.032	0.002	0.000	0.261
2012	0.000	0.000	0.000	0.093	0.593	0.461	0.317	0.295	0.157	0.057	0.001	0.000	0.165
2013	0.000	0.000	0.000	0.000	1.332	0.279	0.305	0.112	0.139	0.178	0.002	0.000	0.198
2014	0.000	0.000	0.000	0.032	0.457	0.024	0.133	0.064	0.103	0.058	0.001	0.000	0.074
2015	0.000	0.000	0.000	0.000	0.128	0.030	0.130	0.348	0.160	0.027	0.001	0.000	0.070
2016	0.000	0.000	0.000	0.072	0.164	0.071	0.346	0.160	0.093	0.008	0.001	0.000	0.077
2017	0.000	0.000	0.000	0.061	0.505	0.391	0.315	0.164	0.042	0.023	0.001	0.000	0.126
2018	0.000	0.000	0.012	0.375	0.701	0.230	0.155	0.165	0.112	0.010	0.001	0.000	0.148
Average	**0.000**	**0.000**	**0.000**	**0.030**	**0.578**	**0.247**	**0.297**	**0.179**	**0.100**	**0.031**	**0.001**	**0.000**	**0.123**

D5. CC-11.6 Synthetic Streamflow Record

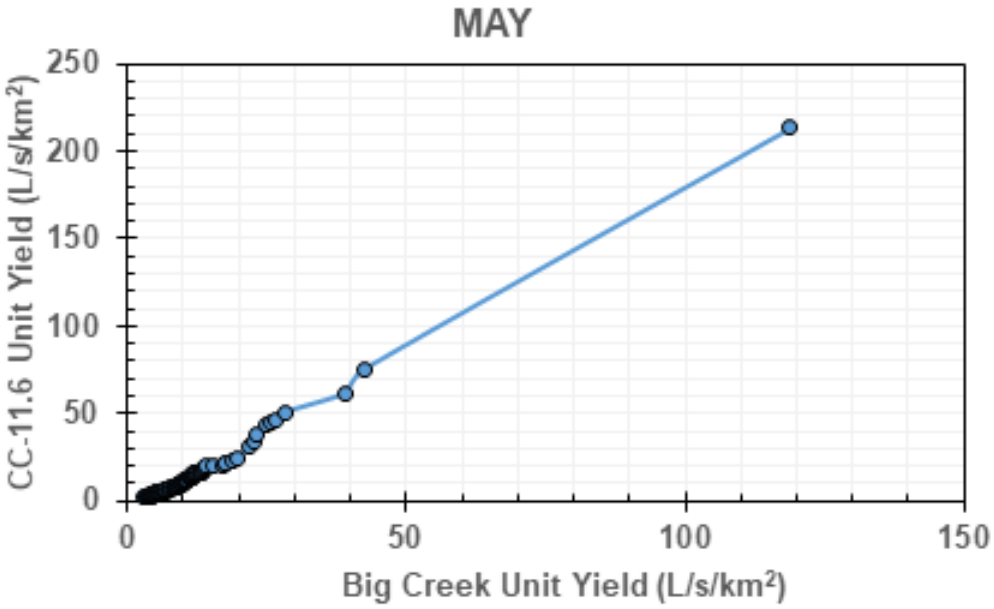


Figure D5.1: CC-11.6 Ranked regression relationship – May

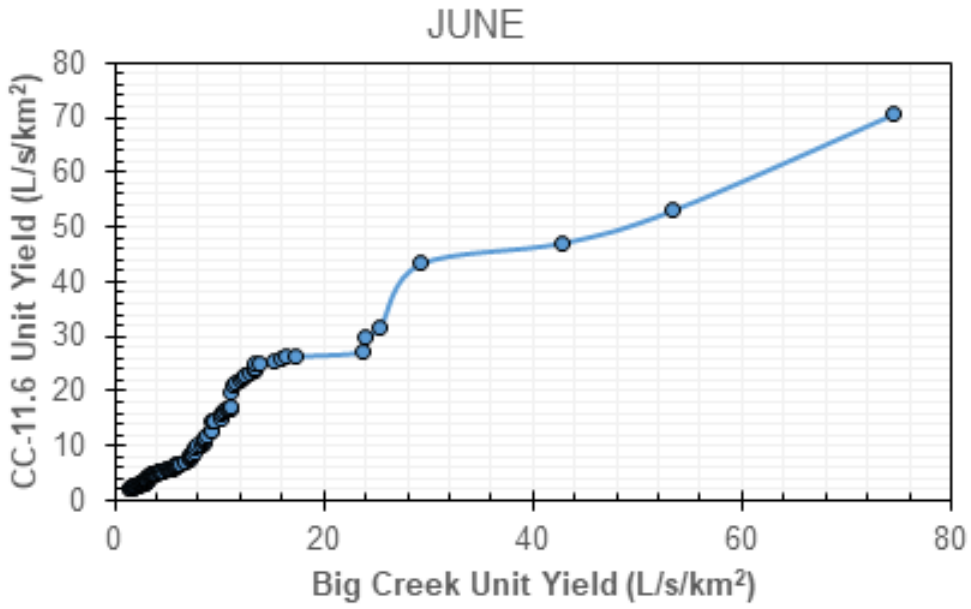


Figure D5.2: CC-11.6 Ranked regression relationship – June

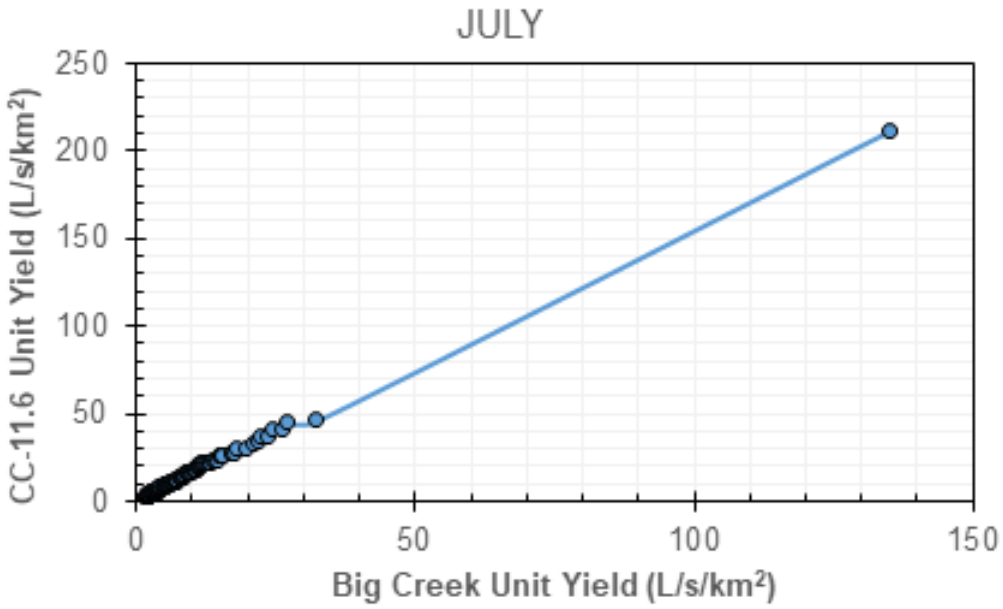


Figure D5.3: CC-11.6 Ranked regression relationship – July

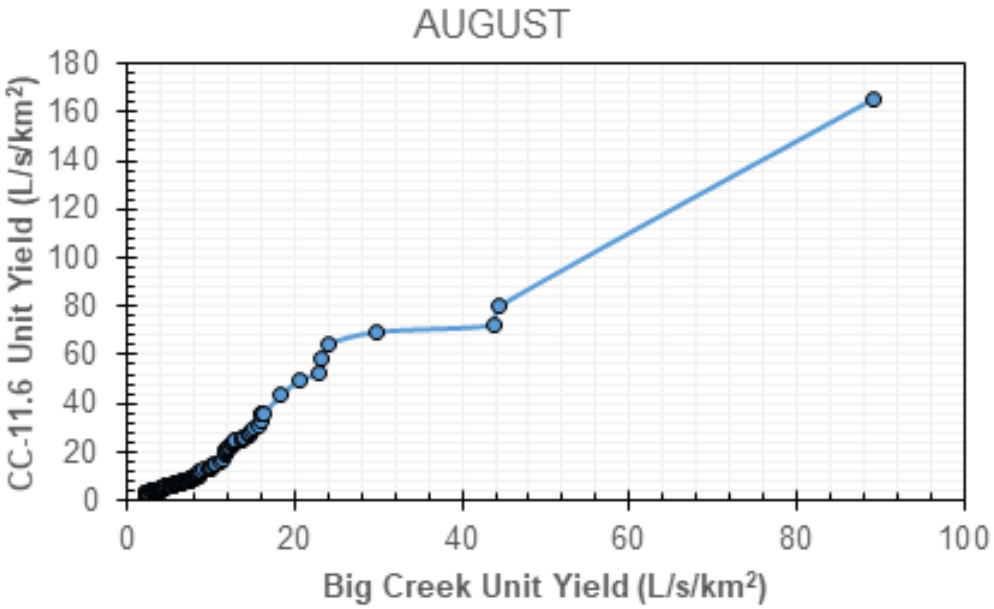


Figure D5.4: CC-11.6 Ranked regression relationship – August

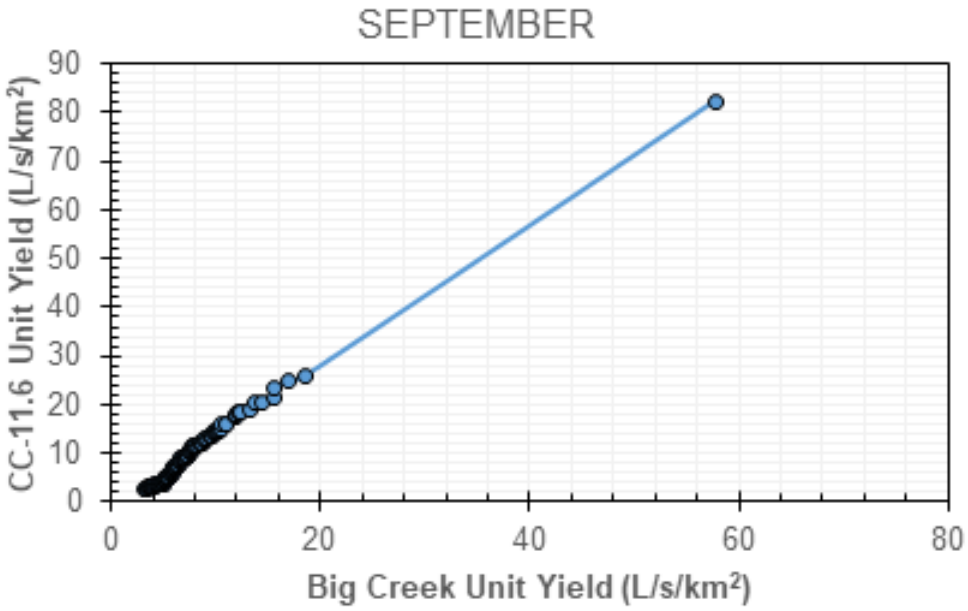


Figure D5.5: CC-11.6 Ranked regression relationship – September

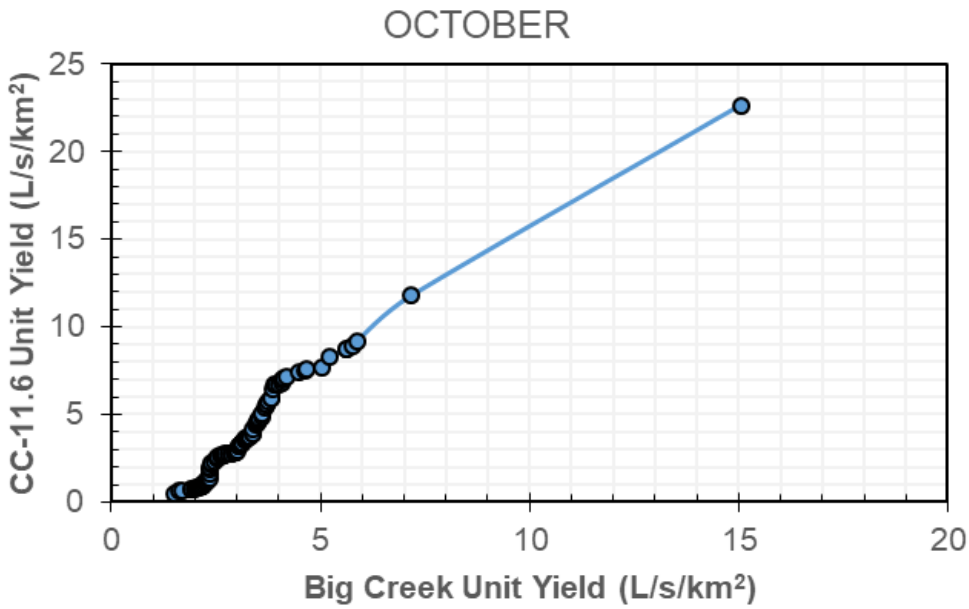


Figure D5.6: CC-11.6 Ranked regression relationship – October

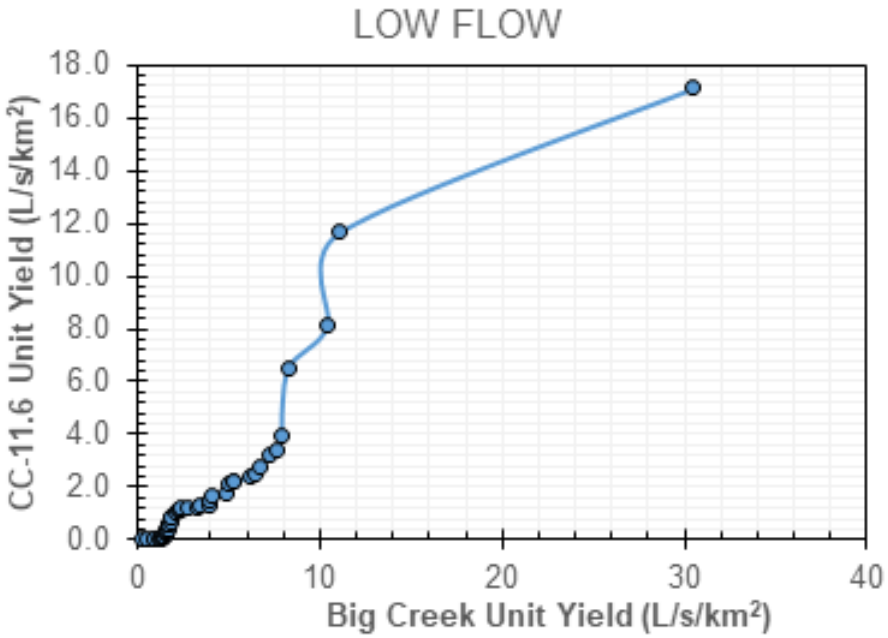


Figure D5.7: CC-11.6 Ranked regression relationship – Low Flows (November to April)

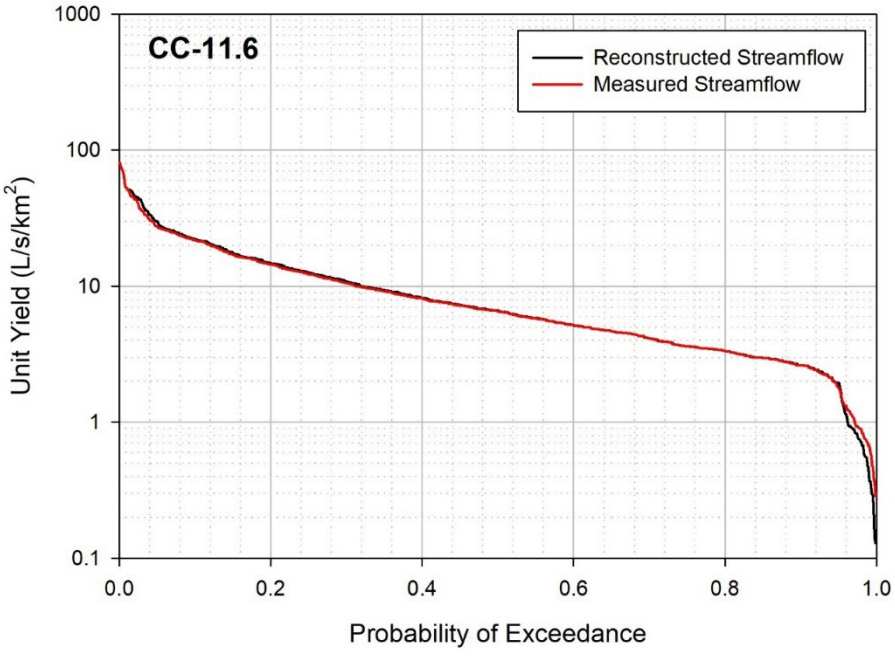


Figure D5.8: CC-11.6 Flow duration curves – measured vs. synthetic for concurrent period of record

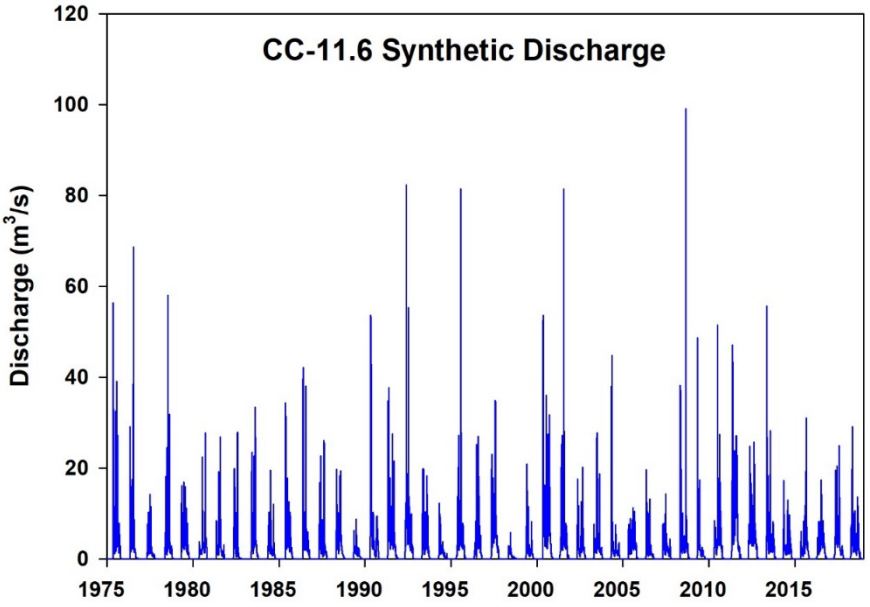


Figure D5.9: CC-11.6 Synthetic streamflow daily time-series

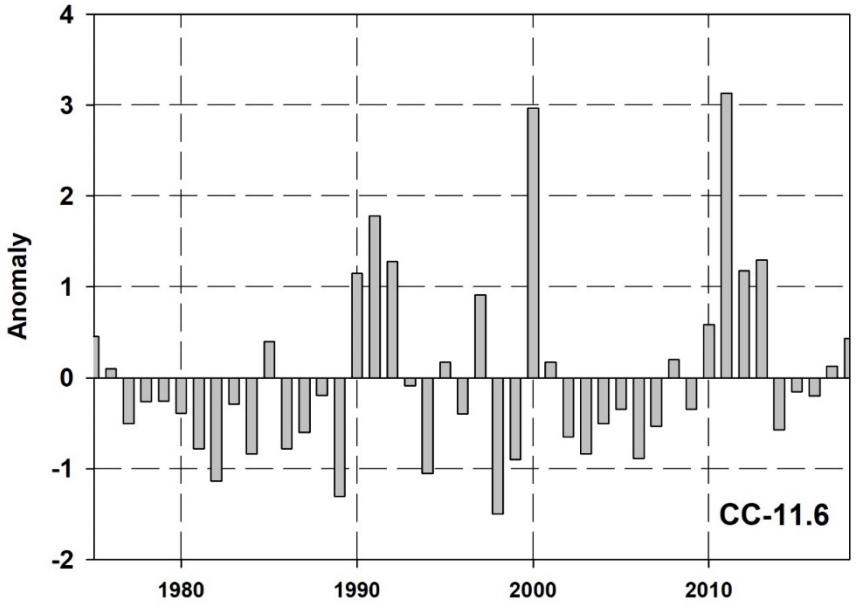


Figure D5.10: CC-11.6 Annual runoff anomalies

Table D5.11:
CC-11.6 Monthly synthetic streamflows (1975-2018)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.000	0.000	0.000	0.000	12.580	4.371	8.315	9.209	3.837	0.945	0.000	0.000	3.312
1976	0.000	0.000	0.000	0.014	6.522	7.769	14.381	1.562	0.295	0.068	0.000	0.000	2.571
1977	0.000	0.000	0.000	0.002	4.246	5.834	5.713	1.081	0.584	0.257	0.000	0.000	1.487
1978	0.000	0.000	0.000	0.000	1.416	5.214	13.409	8.715	1.343	1.084	0.014	0.000	2.631
1979	0.000	0.000	0.000	0.000	4.480	5.452	6.989	3.667	2.423	0.520	0.001	0.000	1.977
1980	0.000	0.000	0.000	0.000	1.486	1.217	5.676	2.762	6.585	2.383	0.000	0.000	1.682
1981	0.000	0.000	0.000	0.000	2.826	1.254	6.552	4.939	0.907	1.002	0.013	0.000	1.480
1982	0.000	0.000	0.000	0.000	7.391	5.885	1.571	6.178	0.259	0.096	0.000	0.000	1.799
1983	0.000	0.000	0.000	0.000	2.386	5.632	6.249	11.075	1.902	0.428	0.000	0.000	2.330
1984	0.000	0.000	0.000	0.000	3.049	5.676	6.654	1.120	3.721	0.224	0.000	0.000	1.706
1985	0.000	0.000	0.000	0.000	8.407	6.870	7.246	3.309	2.776	0.432	0.003	0.000	2.440
1986	0.000	0.000	0.000	0.000	7.765	5.747	6.089	2.892	2.120	0.576	0.000	0.000	2.118
1987	0.000	0.000	0.000	0.000	7.925	4.940	2.470	4.578	1.447	0.477	0.001	0.000	1.837
1988	0.000	0.000	0.000	0.002	7.643	2.899	8.215	5.224	1.008	0.271	0.006	0.000	2.129
1989	0.000	0.000	0.000	0.000	2.181	2.124	2.138	1.256	0.487	0.151	0.001	0.000	0.701
1990	0.000	0.000	0.000	2.718	28.059	5.147	3.073	1.001	5.810	1.608	0.001	0.000	3.990
1991	0.000	0.000	0.000	0.335	16.833	7.244	6.535	6.065	6.130	1.546	0.340	0.029	3.788
1992	0.001	0.000	0.000	0.063	17.734	10.314	12.314	3.522	4.656	1.202	0.017	0.001	4.179
1993	0.000	0.000	0.000	0.725	10.666	2.665	4.611	4.278	1.281	0.104	0.008	0.001	2.054
1994	0.000	0.000	0.000	1.077	4.739	2.284	2.090	0.673	0.315	0.206	0.000	0.000	0.957
1995	0.002	0.000	0.000	0.097	3.753	8.933	11.635	6.405	4.238	1.382	0.119	0.001	3.069
1996	0.000	0.000	0.000	0.000	1.168	1.664	7.879	8.232	3.071	0.433	0.000	0.000	1.888
1997	0.000	0.000	0.000	0.000	8.903	11.431	9.270	9.190	2.705	0.702	0.006	0.000	3.546
1998	0.000	0.000	0.000	0.000	1.568	2.180	0.684	0.513	0.192	0.045	0.000	0.000	0.434
1999	0.000	0.000	0.000	0.000	2.169	6.221	2.226	1.144	1.921	0.434	0.000	0.000	1.177
2000	0.000	0.000	0.000	0.032	18.247	8.245	9.573	13.498	10.504	3.821	0.393	0.053	5.399
2001	0.002	0.000	0.000	0.097	3.753	8.933	11.635	6.405	4.238	1.382	0.119	0.001	3.069
2002	0.000	0.000	0.000	0.001	5.095	2.470	3.195	4.982	4.393	0.927	0.010	0.000	1.771
2003	0.000	0.000	0.000	0.591	2.509	4.647	6.970	3.725	1.210	1.025	0.008	0.000	1.739
2004	0.000	0.000	0.000	0.154	13.106	1.621	1.628	1.961	0.989	1.058	0.002	0.000	1.730
2005	0.000	0.000	0.000	0.930	3.262	2.529	4.328	3.964	4.822	1.648	0.102	0.000	1.810
2006	0.000	0.000	0.000	0.000	5.835	3.187	3.445	1.607	0.715	0.270	0.001	0.000	1.268
2007	0.000	0.000	0.000	0.368	6.047	2.499	3.984	1.797	1.436	0.674	0.000	0.000	1.415
2008	0.000	0.000	0.000	0.083	14.103	3.075	2.474	12.704	4.903	1.526	0.089	0.002	3.278
2009	0.000	0.000	0.000	0.086	14.937	5.432	1.119	1.227	0.664	0.187	0.005	0.000	1.992
2010	0.000	0.000	0.000	1.261	4.151	1.975	12.927	8.769	4.859	1.056	0.061	0.002	2.955
2011	0.001	0.001	0.000	0.259	14.368	9.607	12.600	17.908	3.112	1.404	0.198	0.005	5.014
2012	0.001	0.000	0.000	1.258	8.058	8.438	6.918	7.527	4.758	1.850	0.124	0.002	3.258
2013	0.001	0.001	0.001	0.001	15.922	5.792	6.131	2.877	4.189	2.832	0.242	0.005	3.199
2014	0.001	0.000	0.000	0.238	6.411	1.254	3.146	1.988	3.173	1.690	0.094	0.002	1.516
2015	0.000	0.000	0.000	0.036	2.394	1.373	2.988	9.631	4.867	1.156	0.062	0.002	1.894
2016	0.000	0.000	0.005	0.973	2.835	2.278	7.423	3.524	3.098	0.661	0.094	0.002	1.752
2017	0.000	0.000	0.000	0.392	7.270	7.576	6.680	4.685	1.271	1.185	0.058	0.000	2.447
2018	0.000	0.000	0.072	5.460	9.028	5.225	3.413	4.392	3.457	0.821	0.058	0.000	2.673
Average	**0.000**	**0.000**	**0.002**	**0.392**	**7.573**	**4.889**	**6.195**	**5.040**	**2.879**	**0.949**	**0.051**	**0.002**	**2.352**

D6. HC-0.1 Synthetic Streamflow Record

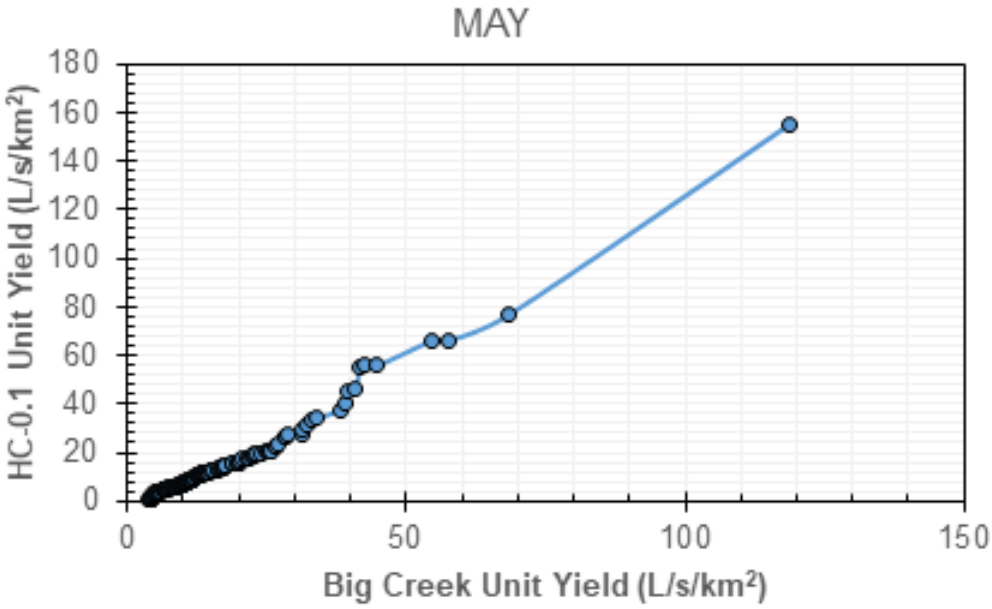


Figure D6.1: HC-0.1 Ranked regression relationship – May

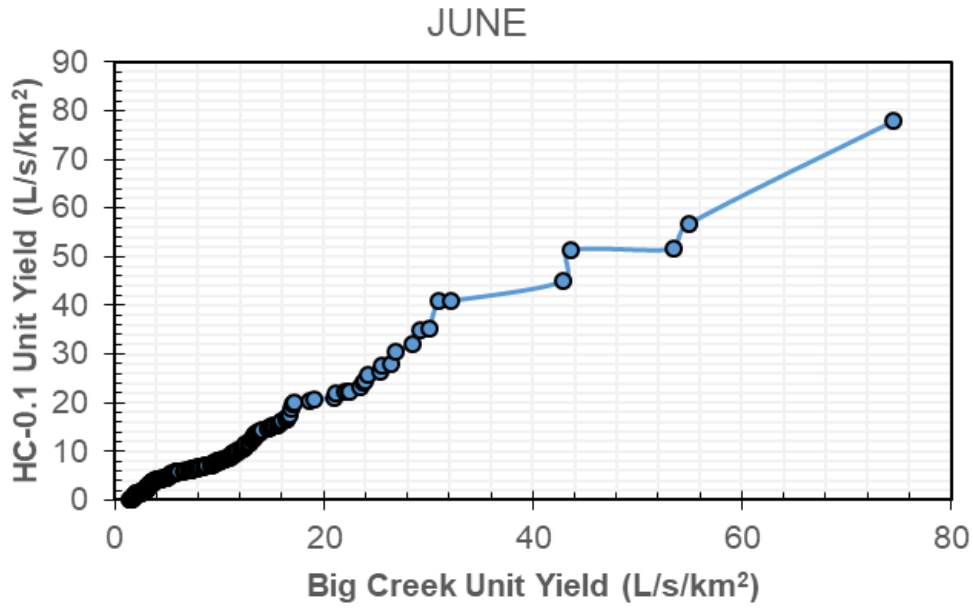


Figure D6.2: HC-0.1 Ranked regression relationship – June

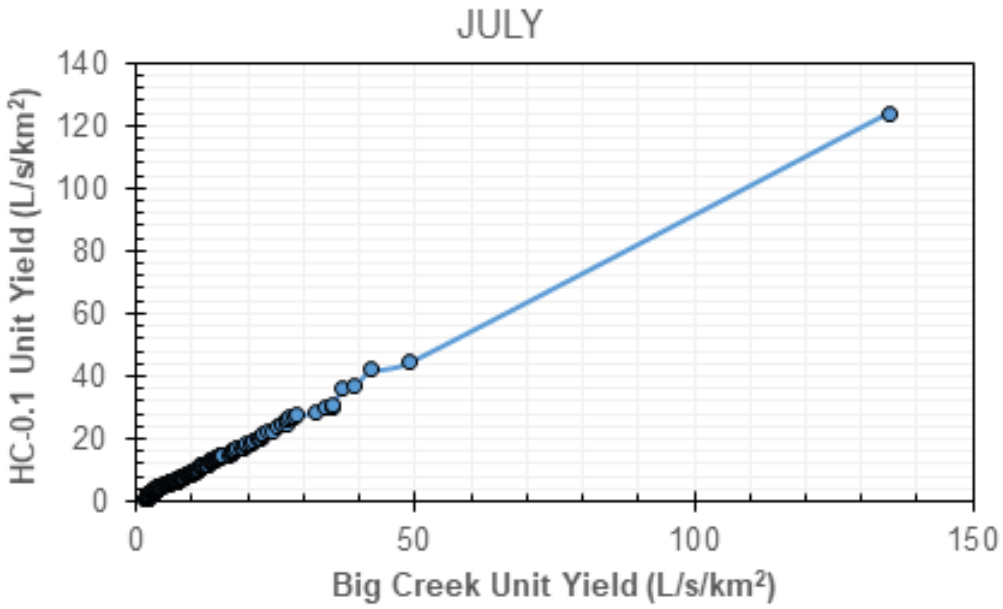


Figure D6.3: HC-0.1 Ranked regression relationship – July

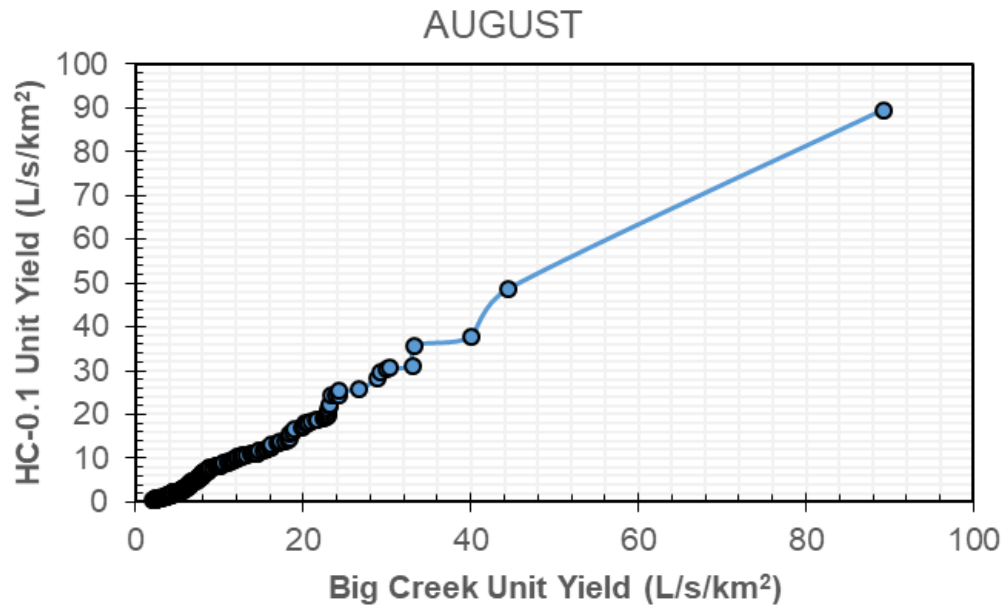


Figure D6.4: HC-0.1 Ranked regression relationship – August

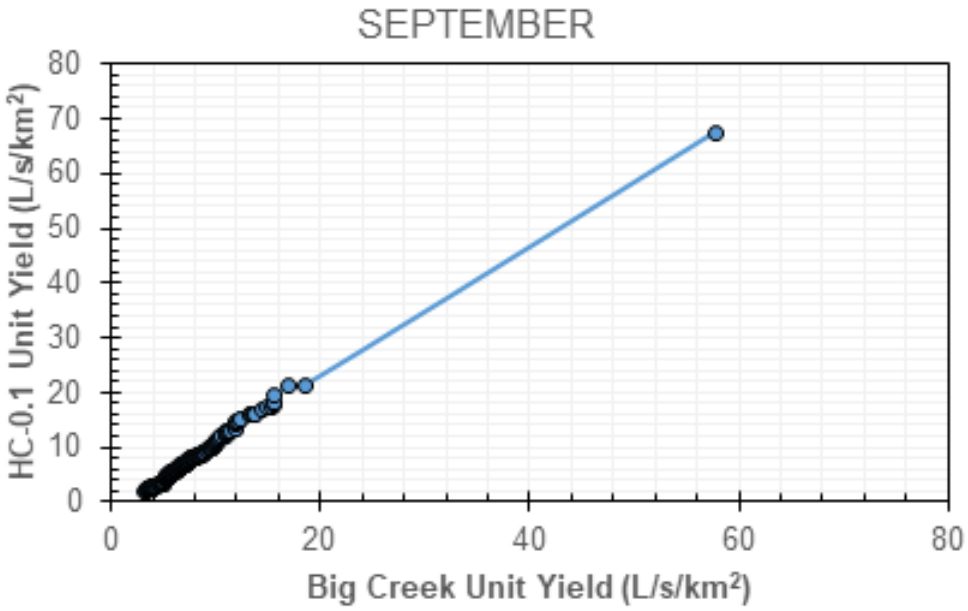


Figure D6.5: HC-0.1 Ranked regression relationship – September

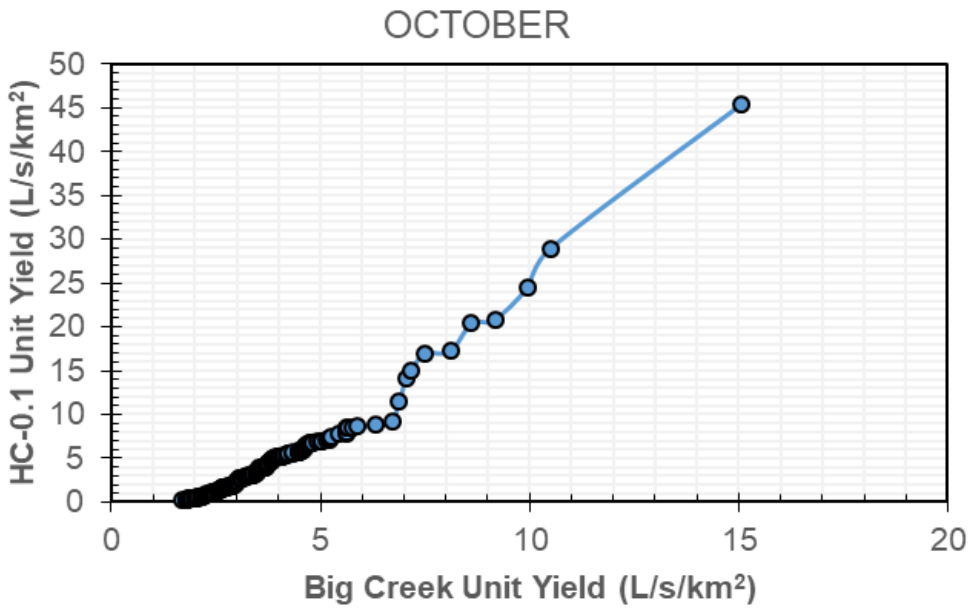


Figure D6.6: HC-0.1 Ranked regression relationship – October

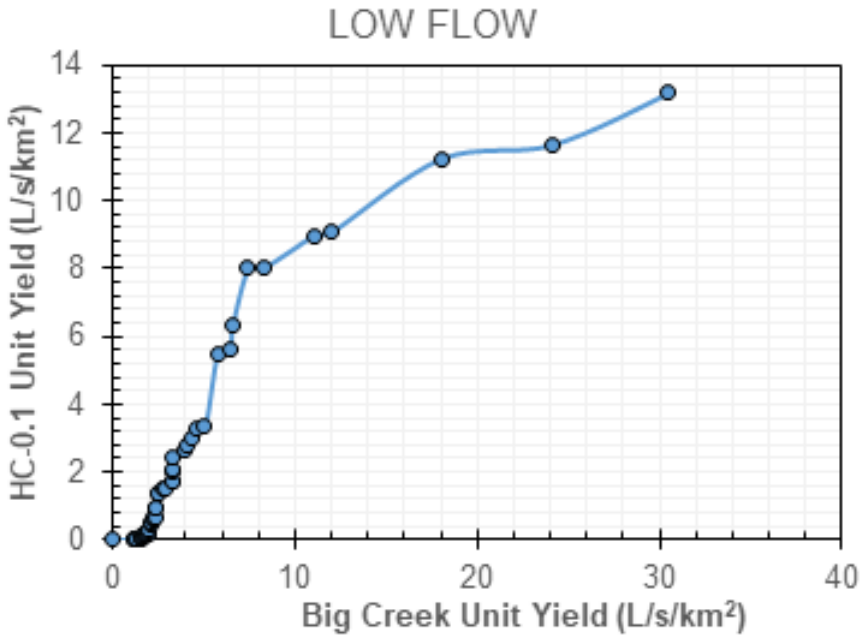


Figure D6.7: HC-0.1 Ranked regression relationship – Low Flows (November to April)

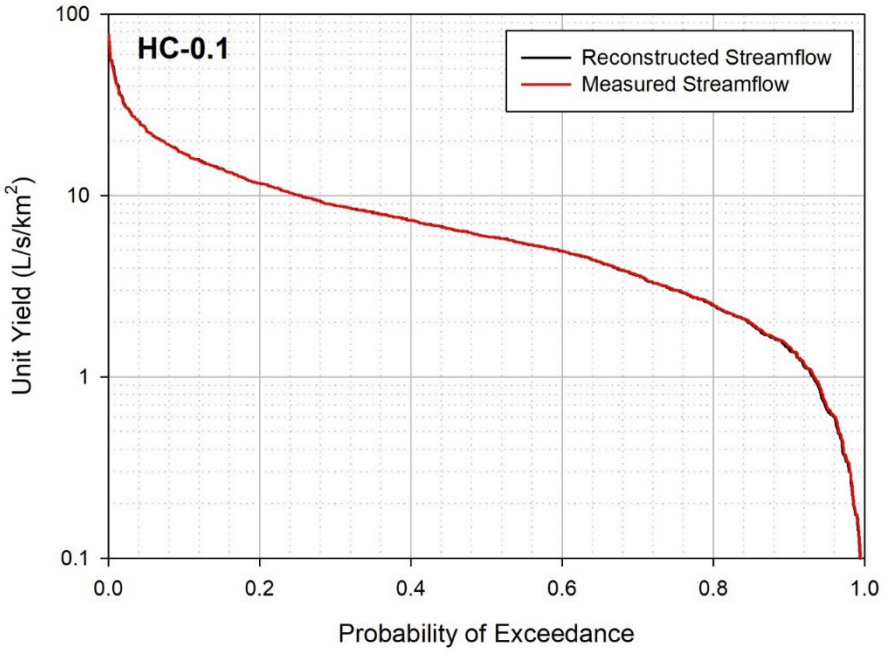


Figure D6.8: HC-0.1 Flow duration curves – measured vs. synthetic for concurrent period of record

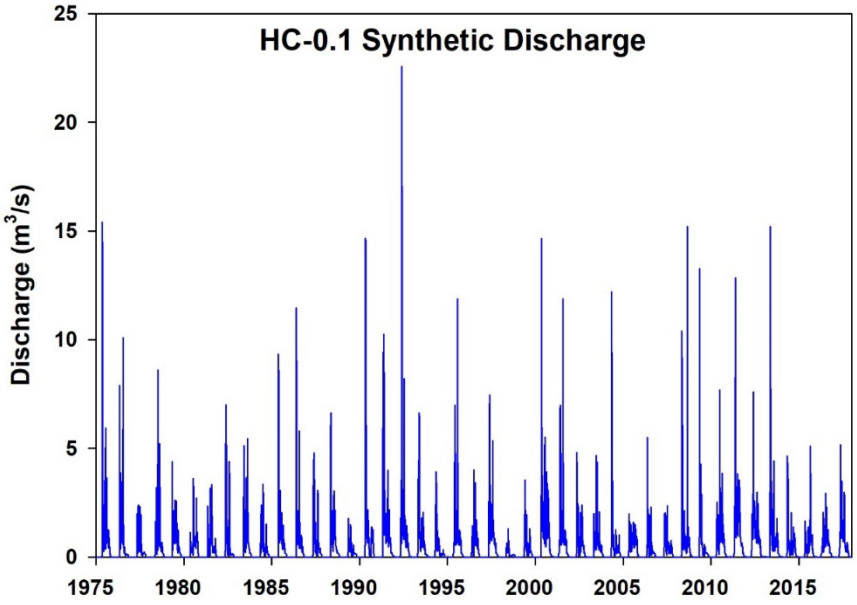


Figure D6.9: HC-0.1 Synthetic streamflow daily time-series

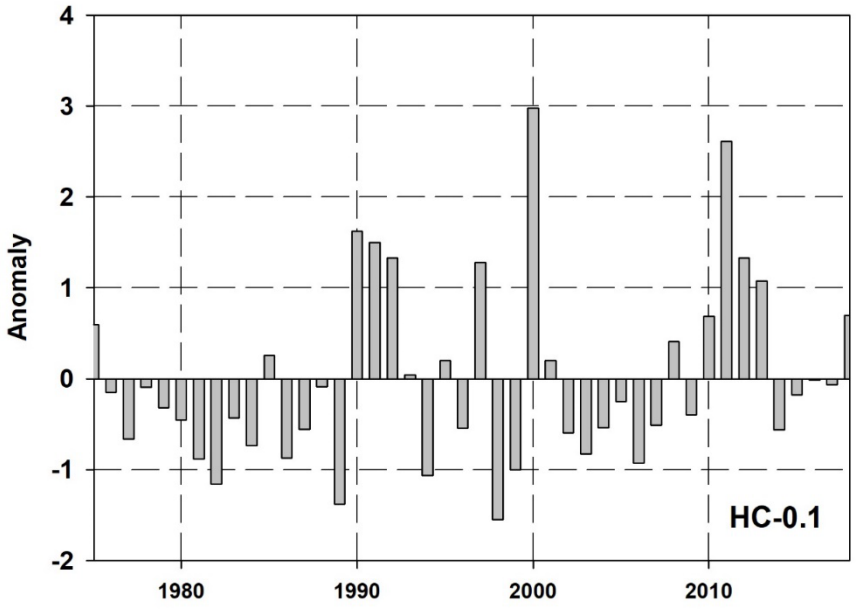


Figure D6.10: HC-0.1 Annual runoff anomalies

Table D6.11:
HC-0.1 Monthly synthetic streamflows (1975-2018)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.000	0.000	0.000	0.000	0.564	0.202	0.332	0.294	0.211	0.049	0.000	0.000	0.139
1976	0.000	0.000	0.000	0.000	0.291	0.391	0.591	0.032	0.025	0.001	0.000	0.000	0.112
1977	0.000	0.000	0.000	0.000	0.196	0.255	0.222	0.014	0.040	0.007	0.000	0.000	0.062
1978	0.000	0.000	0.000	0.000	0.070	0.314	0.558	0.300	0.081	0.053	0.000	0.000	0.116
1979	0.000	0.000	0.000	0.000	0.202	0.264	0.272	0.122	0.136	0.021	0.000	0.000	0.085
1980	0.000	0.000	0.000	0.000	0.056	0.049	0.228	0.097	0.362	0.157	0.000	0.000	0.079
1981	0.000	0.000	0.000	0.000	0.137	0.046	0.258	0.153	0.058	0.047	0.000	0.000	0.059
1982	0.000	0.000	0.000	0.000	0.300	0.308	0.051	0.180	0.023	0.001	0.000	0.000	0.072
1983	0.000	0.000	0.000	0.000	0.097	0.314	0.254	0.354	0.108	0.015	0.000	0.000	0.096
1984	0.000	0.000	0.000	0.000	0.141	0.284	0.270	0.017	0.211	0.008	0.000	0.000	0.078
1985	0.000	0.000	0.000	0.000	0.369	0.339	0.279	0.119	0.149	0.016	0.000	0.000	0.107
1986	0.000	0.000	0.000	0.000	0.357	0.272	0.246	0.103	0.118	0.025	0.000	0.000	0.094
1987	0.000	0.000	0.000	0.000	0.323	0.282	0.089	0.127	0.085	0.019	0.000	0.000	0.078
1988	0.000	0.000	0.000	0.000	0.330	0.152	0.319	0.175	0.060	0.009	0.000	0.000	0.088
1989	0.000	0.000	0.000	0.000	0.106	0.100	0.076	0.022	0.036	0.002	0.000	0.000	0.029
1990	0.000	0.000	0.000	0.162	1.250	0.230	0.114	0.023	0.316	0.104	0.000	0.000	0.185
1991	0.000	0.000	0.000	0.027	0.727	0.335	0.255	0.212	0.336	0.080	0.012	0.000	0.167
1992	0.000	0.000	0.000	0.005	0.840	0.524	0.498	0.125	0.262	0.060	0.000	0.000	0.194
1993	0.000	0.000	0.000	0.056	0.459	0.132	0.178	0.138	0.079	0.002	0.000	0.000	0.088
1994	0.000	0.000	0.000	0.081	0.216	0.122	0.081	0.005	0.026	0.007	0.000	0.000	0.045
1995	0.000	0.000	0.000	0.006	0.167	0.545	0.469	0.233	0.231	0.074	0.002	0.000	0.145
1996	0.000	0.000	0.000	0.000	0.051	0.067	0.313	0.256	0.171	0.019	0.000	0.000	0.074
1997	0.000	0.000	0.000	0.000	0.380	0.607	0.366	0.329	0.151	0.032	0.000	0.000	0.156
1998	0.000	0.000	0.000	0.000	0.075	0.107	0.016	0.002	0.019	0.000	0.000	0.000	0.018
1999	0.000	0.000	0.000	0.000	0.098	0.317	0.081	0.017	0.111	0.018	0.000	0.000	0.053
2000	0.000	0.000	0.000	0.005	0.807	0.401	0.387	0.404	0.596	0.359	0.022	0.000	0.250
2001	0.000	0.000	0.000	0.006	0.167	0.545	0.469	0.233	0.231	0.074	0.002	0.000	0.145
2002	0.000	0.000	0.000	0.000	0.221	0.121	0.118	0.162	0.251	0.043	0.000	0.000	0.077
2003	0.000	0.000	0.000	0.044	0.128	0.276	0.286	0.110	0.071	0.052	0.000	0.000	0.081
2004	0.000	0.000	0.000	0.018	0.570	0.077	0.054	0.053	0.061	0.056	0.000	0.000	0.075
2005	0.000	0.000	0.000	0.058	0.155	0.108	0.168	0.126	0.260	0.095	0.002	0.000	0.081
2006	0.000	0.000	0.000	0.000	0.232	0.141	0.134	0.034	0.046	0.008	0.000	0.000	0.050
2007	0.000	0.000	0.000	0.032	0.276	0.115	0.158	0.043	0.086	0.032	0.000	0.000	0.062
2008	0.000	0.000	0.000	0.009	0.608	0.162	0.102	0.426	0.267	0.085	0.001	0.000	0.139
2009	0.000	0.000	0.000	0.009	0.650	0.289	0.034	0.020	0.045	0.005	0.000	0.000	0.088
2010	0.000	0.000	0.000	0.090	0.196	0.095	0.529	0.293	0.266	0.057	0.001	0.000	0.128
2011	0.000	0.000	0.000	0.025	0.634	0.485	0.518	0.500	0.172	0.071	0.007	0.000	0.203
2012	0.000	0.000	0.000	0.088	0.358	0.361	0.264	0.250	0.253	0.105	0.002	0.000	0.140
2013	0.000	0.000	0.000	0.000	0.700	0.271	0.252	0.097	0.233	0.219	0.007	0.000	0.150
2014	0.000	0.000	0.000	0.028	0.282	0.049	0.119	0.049	0.179	0.100	0.001	0.000	0.068
2015	0.000	0.000	0.000	0.000	0.104	0.060	0.116	0.310	0.264	0.060	0.001	0.000	0.077
2016	0.000	0.000	0.000	0.074	0.132	0.117	0.286	0.143	0.168	0.031	0.001	0.000	0.080
2017	0.000	0.000	0.000	0.053	0.306	0.362	0.260	0.138	0.076	0.059	0.001	0.000	0.105
2018	0.000	0.000	0.011	0.308	0.400	0.231	0.134	0.139	0.190	0.039	0.000	0.000	0.121
Average	**0.000**	**0.000**	**0.000**	**0.027**	**0.335**	**0.246**	**0.246**	**0.159**	**0.162**	**0.054**	**0.001**	**0.000**	**0.103**

D7. HC-6.8 Synthetic Streamflow Record

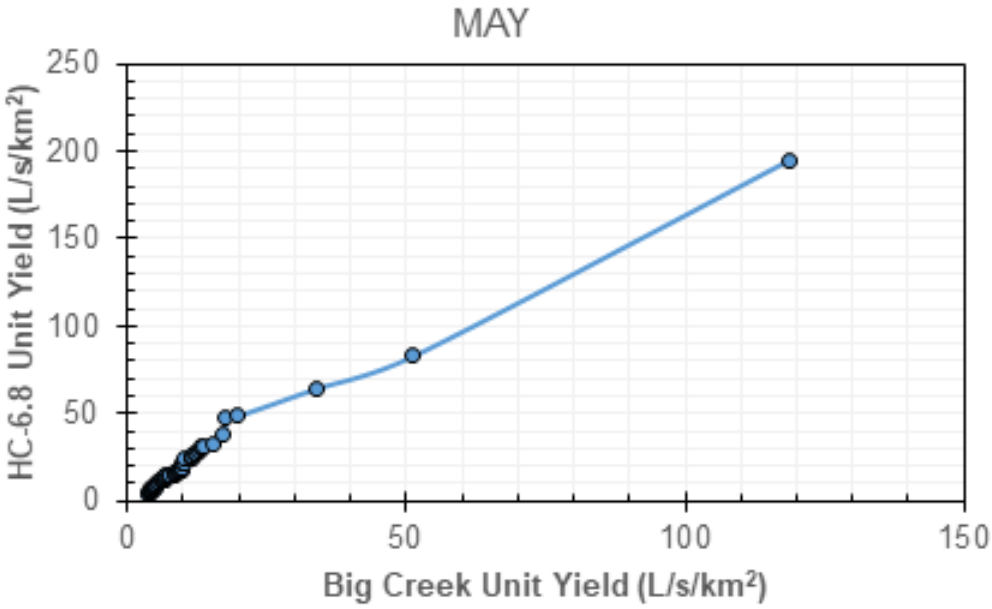


Figure D7.1: HC-6.8 Ranked regression relationship – May

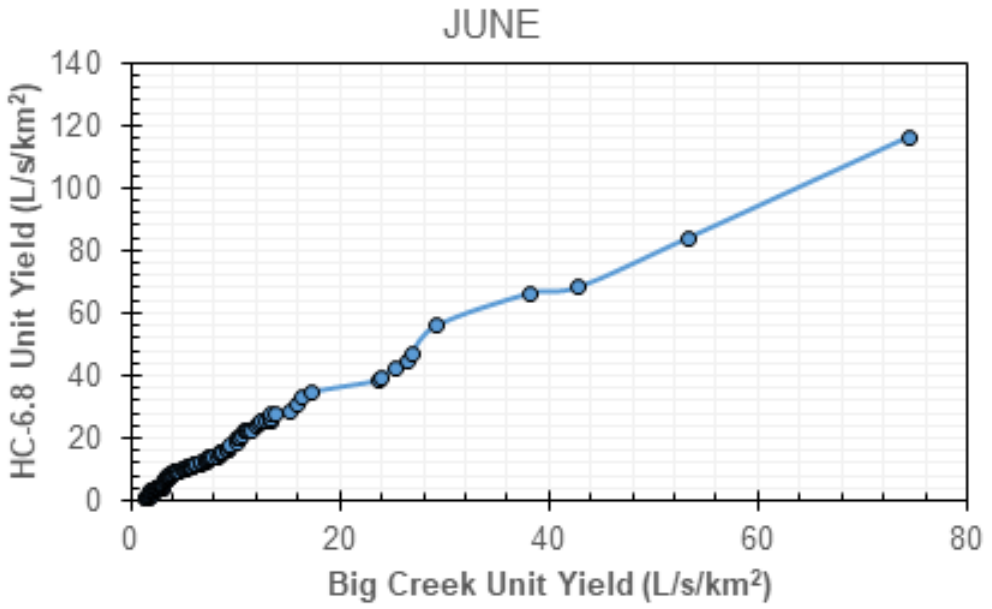


Figure D7.2: HC-6.8 Ranked regression relationship – June

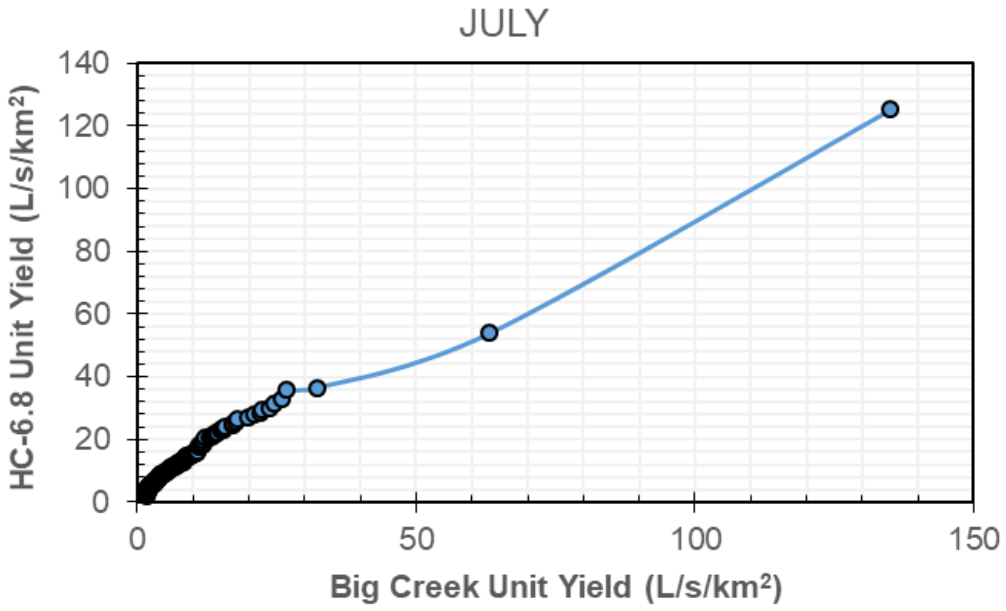


Figure D7.3: HC-6.8 Ranked regression relationship – July

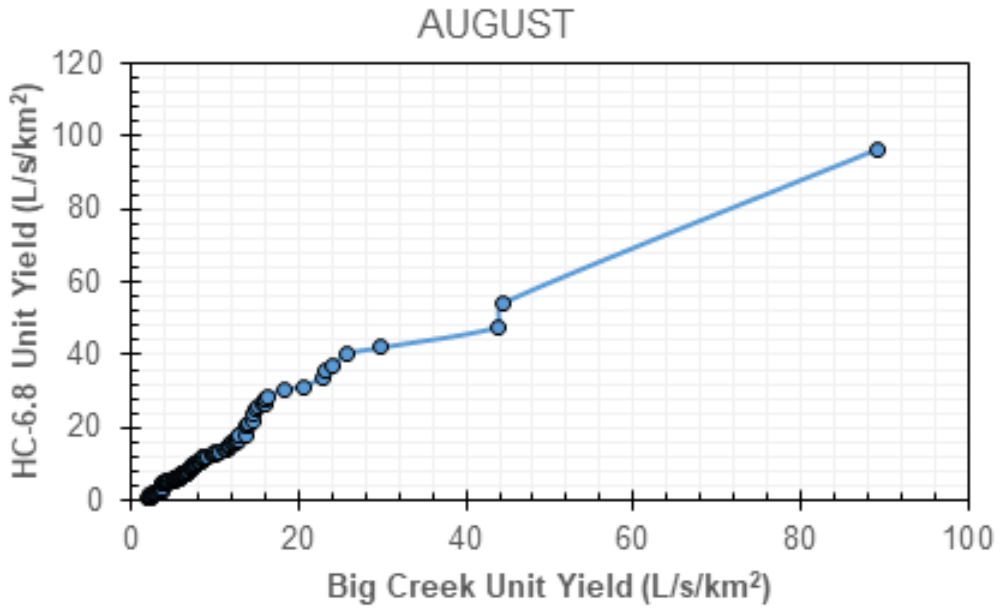


Figure D7.4: HC-6.8 Ranked regression relationship – August

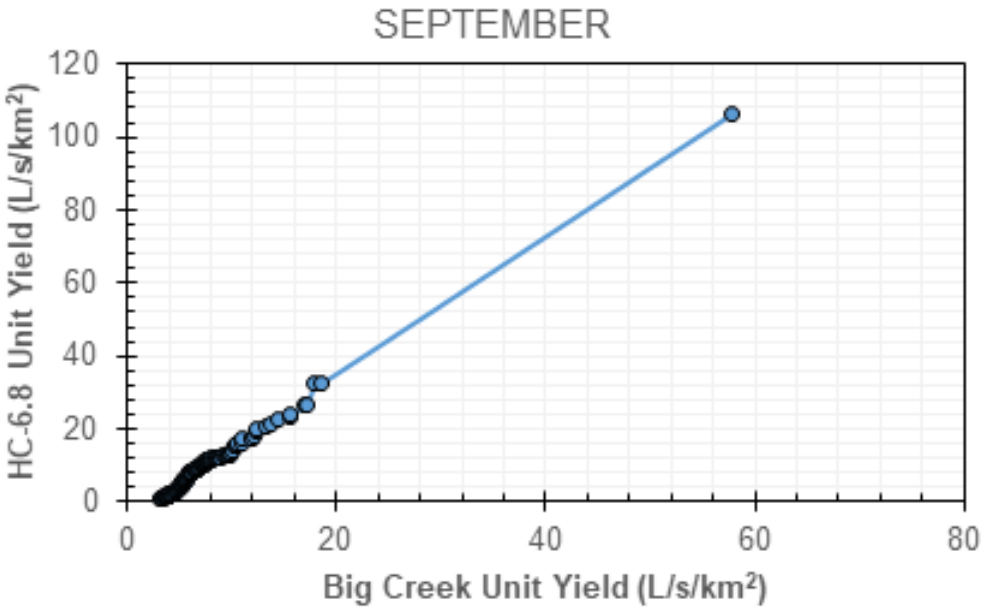


Figure D7.5: HC-6.8 Ranked regression relationship – September

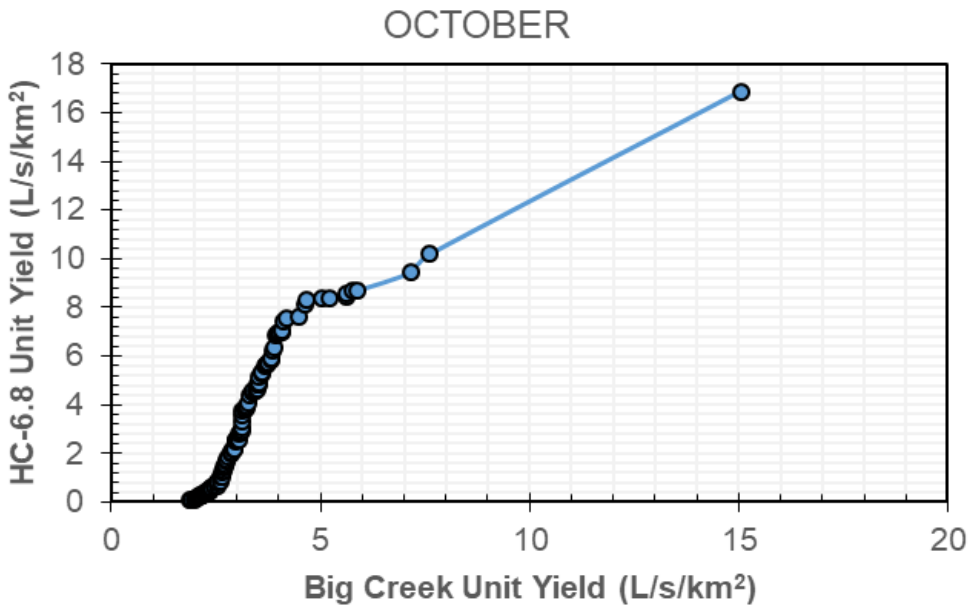


Figure D7.6: HC-6.8 Ranked regression relationship – October

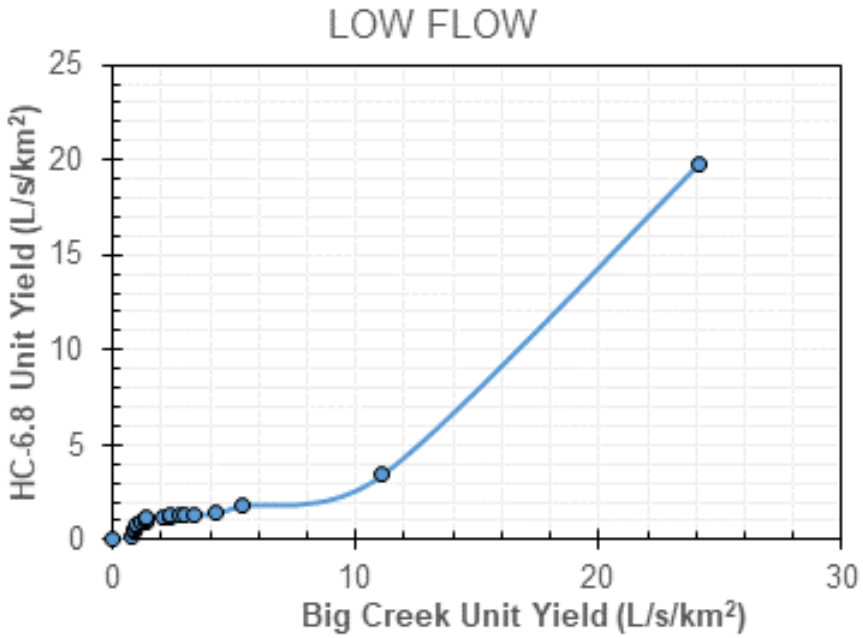


Figure D7.7: HC-6.8 Ranked regression relationship – Low Flows (November to April)

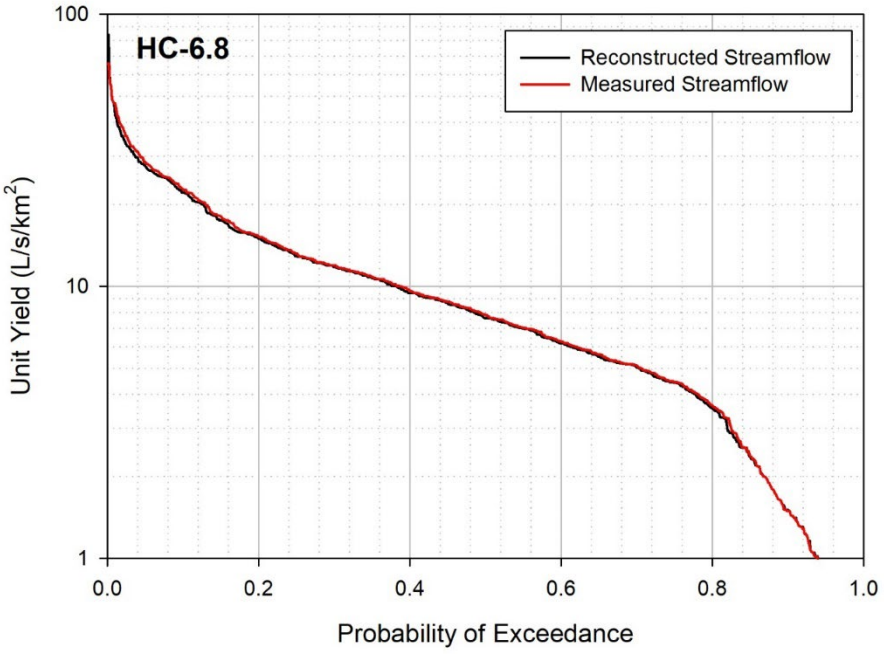


Figure D7.8: HC-6.8 Flow duration curves – measured vs. synthetic for concurrent period of record

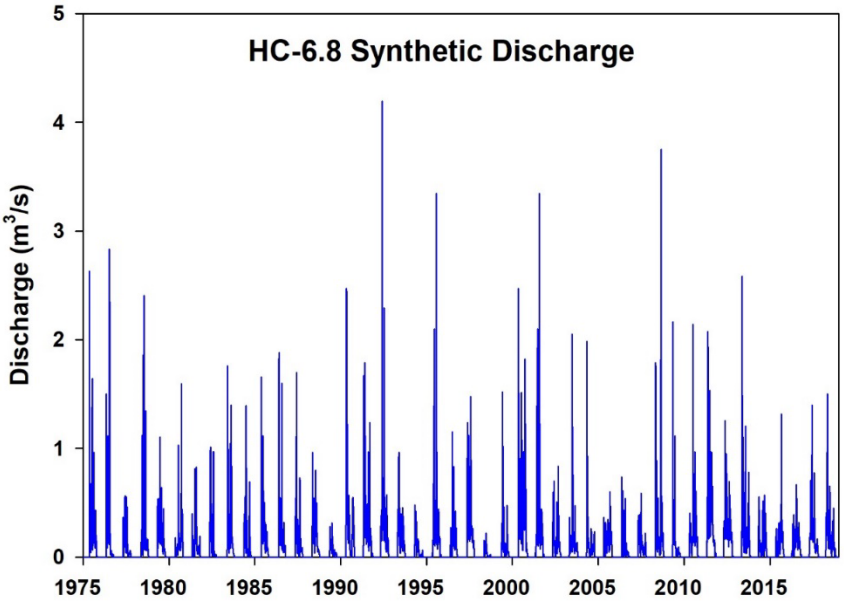


Figure D7.9: HC-6.8 Synthetic streamflow daily time-series

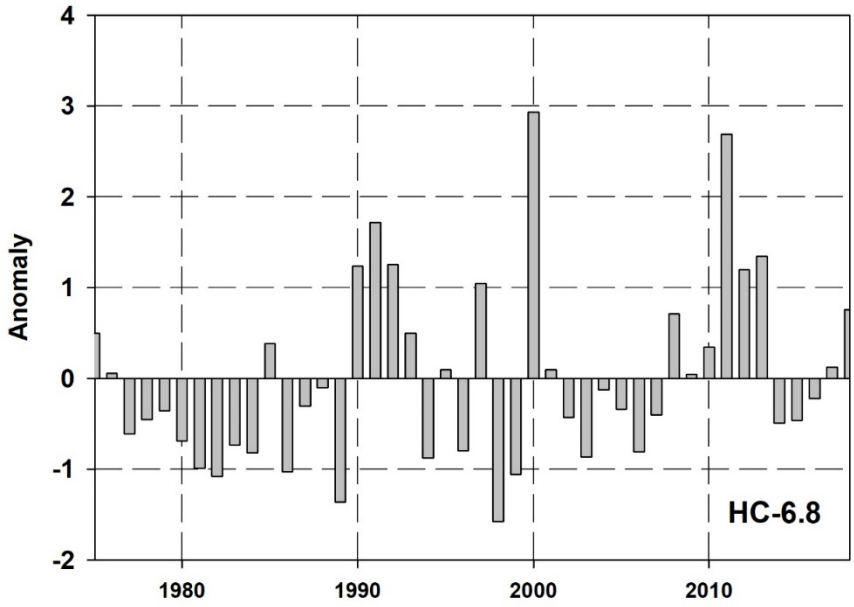


Figure D7.10: HC-6.8 Annual runoff anomalies

Table D7.11:
HC-6.8 Monthly synthetic streamflows (1975-2018)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.000	0.000	0.000	0.001	0.585	0.225	0.252	0.273	0.154	0.033	0.001	0.000	0.128
1976	0.000	0.000	0.000	0.001	0.404	0.389	0.379	0.045	0.004	0.002	0.001	0.000	0.103
1977	0.000	0.000	0.000	0.002	0.308	0.277	0.210	0.021	0.007	0.003	0.001	0.000	0.070
1978	0.000	0.000	0.000	0.000	0.110	0.289	0.360	0.255	0.039	0.035	0.009	0.001	0.092
1979	0.000	0.000	0.000	0.000	0.313	0.279	0.248	0.119	0.087	0.012	0.002	0.000	0.089
1980	0.000	0.000	0.000	0.000	0.105	0.059	0.191	0.107	0.282	0.082	0.001	0.000	0.069
1981	0.000	0.000	0.000	0.000	0.223	0.056	0.234	0.147	0.016	0.028	0.007	0.001	0.060
1982	0.000	0.000	0.000	0.000	0.404	0.299	0.057	0.158	0.004	0.002	0.001	0.000	0.078
1983	0.000	0.000	0.000	0.000	0.151	0.305	0.215	0.313	0.069	0.005	0.001	0.000	0.089
1984	0.000	0.000	0.000	0.000	0.227	0.290	0.230	0.026	0.148	0.004	0.000	0.000	0.077
1985	0.000	0.000	0.000	0.000	0.432	0.349	0.257	0.120	0.106	0.008	0.005	0.001	0.107
1986	0.001	0.000	0.000	0.000	0.307	0.288	0.202	0.110	0.073	0.015	0.001	0.001	0.084
1987	0.001	0.000	0.000	0.001	0.503	0.265	0.099	0.127	0.044	0.011	0.002	0.001	0.089
1988	0.000	0.000	0.000	0.001	0.448	0.169	0.281	0.174	0.017	0.003	0.008	0.001	0.093
1989	0.001	0.000	0.000	0.000	0.170	0.115	0.084	0.030	0.005	0.001	0.003	0.001	0.035
1990	0.000	0.000	0.000	0.134	1.117	0.262	0.119	0.027	0.230	0.056	0.002	0.000	0.164
1991	0.000	0.000	0.000	0.009	0.817	0.350	0.238	0.192	0.260	0.054	0.018	0.013	0.164
1992	0.002	0.001	0.001	0.004	0.784	0.504	0.363	0.129	0.191	0.041	0.012	0.002	0.170
1993	0.001	0.000	0.000	0.020	0.659	0.149	0.177	0.142	0.040	0.002	0.012	0.003	0.102
1994	0.001	0.000	0.000	0.033	0.335	0.139	0.090	0.012	0.004	0.004	0.001	0.000	0.052
1995	0.004	0.001	0.001	0.006	0.232	0.495	0.334	0.208	0.172	0.049	0.015	0.002	0.127
1996	0.000	0.000	0.000	0.000	0.091	0.080	0.264	0.243	0.117	0.011	0.001	0.000	0.068
1997	0.000	0.000	0.000	0.000	0.469	0.572	0.285	0.270	0.109	0.021	0.010	0.001	0.146
1998	0.000	0.000	0.000	0.000	0.126	0.123	0.025	0.010	0.003	0.002	0.000	0.000	0.024
1999	0.000	0.000	0.000	0.000	0.159	0.322	0.090	0.025	0.063	0.008	0.000	0.000	0.056
2000	0.000	0.000	0.000	0.002	0.839	0.407	0.283	0.351	0.474	0.126	0.018	0.015	0.211
2001	0.004	0.001	0.001	0.006	0.232	0.495	0.334	0.208	0.172	0.049	0.015	0.002	0.127
2002	0.001	0.000	0.000	0.002	0.347	0.131	0.123	0.157	0.191	0.025	0.011	0.001	0.083
2003	0.001	0.000	0.000	0.014	0.199	0.268	0.228	0.120	0.030	0.034	0.007	0.001	0.076
2004	0.000	0.000	0.001	0.008	0.658	0.088	0.064	0.056	0.017	0.036	0.004	0.001	0.079
2005	0.001	0.000	0.000	0.037	0.244	0.127	0.170	0.132	0.197	0.061	0.011	0.001	0.082
2006	0.000	0.000	0.000	0.001	0.366	0.154	0.137	0.041	0.008	0.003	0.002	0.000	0.060
2007	0.000	0.000	0.000	0.008	0.417	0.133	0.155	0.055	0.045	0.022	0.001	0.000	0.071
2008	0.000	0.000	0.000	0.004	0.699	0.177	0.111	0.304	0.192	0.051	0.015	0.003	0.131
2009	0.001	0.001	0.001	0.005	0.747	0.286	0.046	0.027	0.009	0.002	0.008	0.001	0.095
2010	0.001	0.000	0.000	0.037	0.304	0.109	0.377	0.264	0.193	0.037	0.015	0.004	0.113
2011	0.002	0.002	0.001	0.014	0.734	0.475	0.396	0.452	0.126	0.046	0.016	0.009	0.191
2012	0.001	0.001	0.001	0.036	0.495	0.388	0.245	0.236	0.188	0.073	0.016	0.006	0.141
2013	0.003	0.002	0.002	0.002	0.717	0.280	0.205	0.104	0.168	0.094	0.017	0.009	0.135
2014	0.003	0.001	0.001	0.009	0.435	0.057	0.125	0.056	0.125	0.060	0.016	0.004	0.075
2015	0.001	0.000	0.001	0.006	0.179	0.069	0.126	0.280	0.195	0.037	0.015	0.004	0.077
2016	0.001	0.001	0.004	0.026	0.217	0.131	0.258	0.137	0.124	0.014	0.015	0.003	0.078
2017	0.001	0.001	0.000	0.015	0.464	0.380	0.235	0.142	0.032	0.038	0.012	0.001	0.111
2018	0.001	0.001	0.003	0.227	0.505	0.257	0.140	0.143	0.137	0.025	0.036	0.039	0.127
Average	**0.001**	**0.000**	**0.000**	**0.015**	**0.415**	**0.251**	**0.205**	**0.149**	**0.111**	**0.030**	**0.008**	**0.003**	**0.100**

D8. IC-2.7 Synthetic Streamflow Record

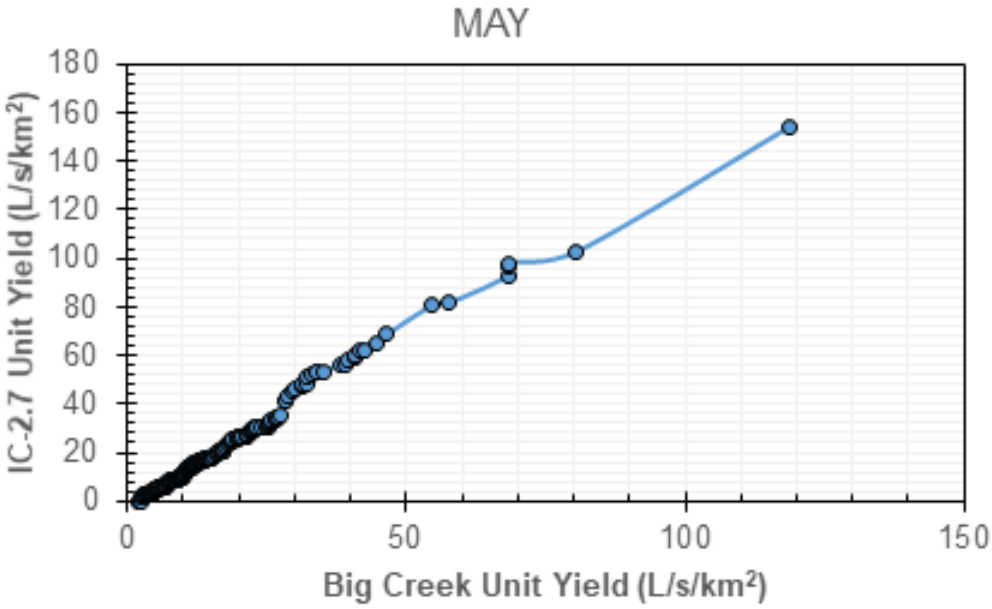


Figure D8.1: IC-2.7 Ranked regression relationship – May

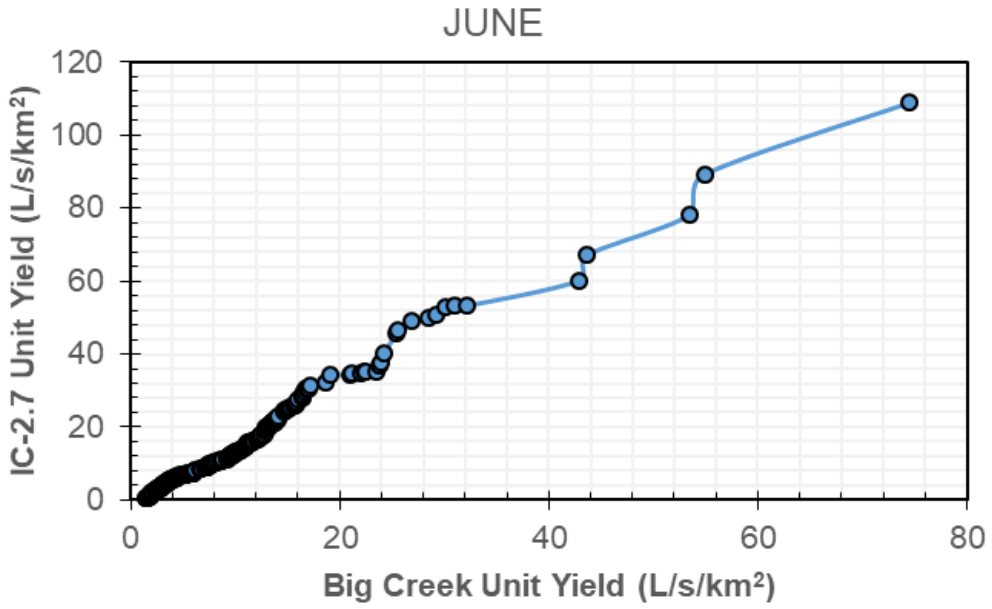


Figure D8.2: IC-2.7 Ranked regression relationship – June

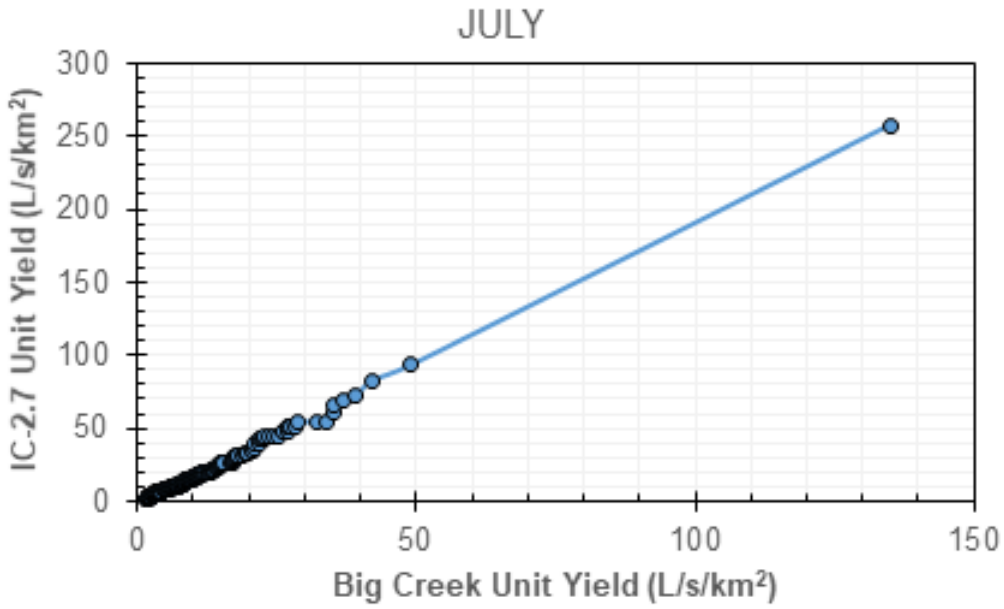


Figure D8.3: IC-2.7 Ranked regression relationship – July

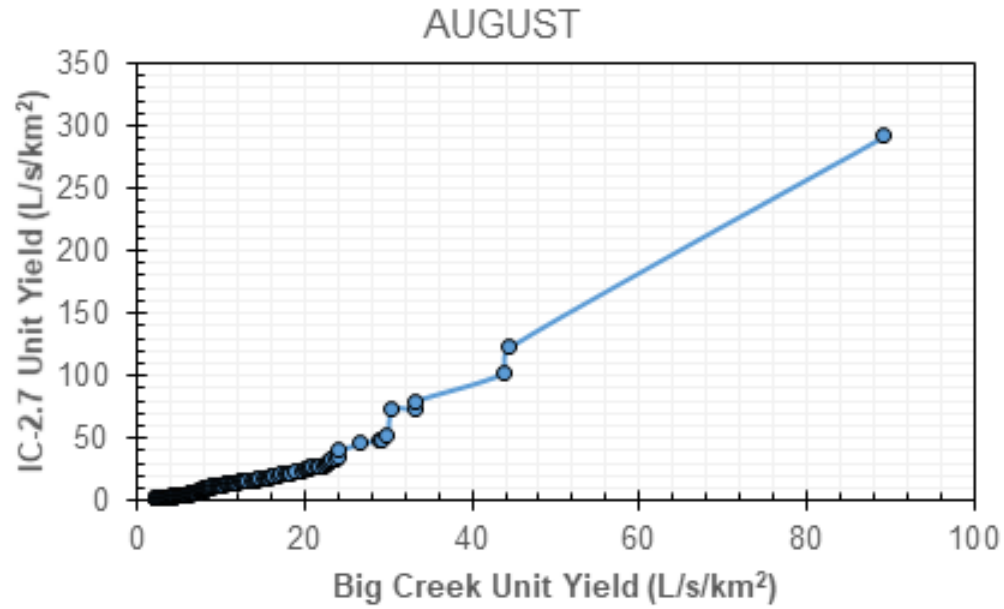


Figure D8.4: IC-2.7 Ranked regression relationship – August

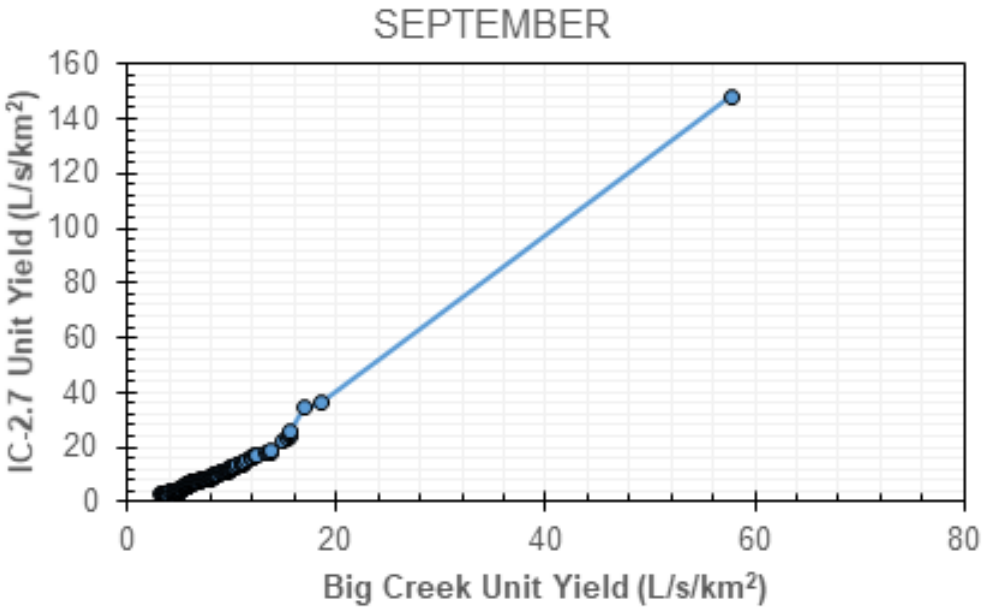


Figure D8.5: IC-2.7 Ranked regression relationship – September

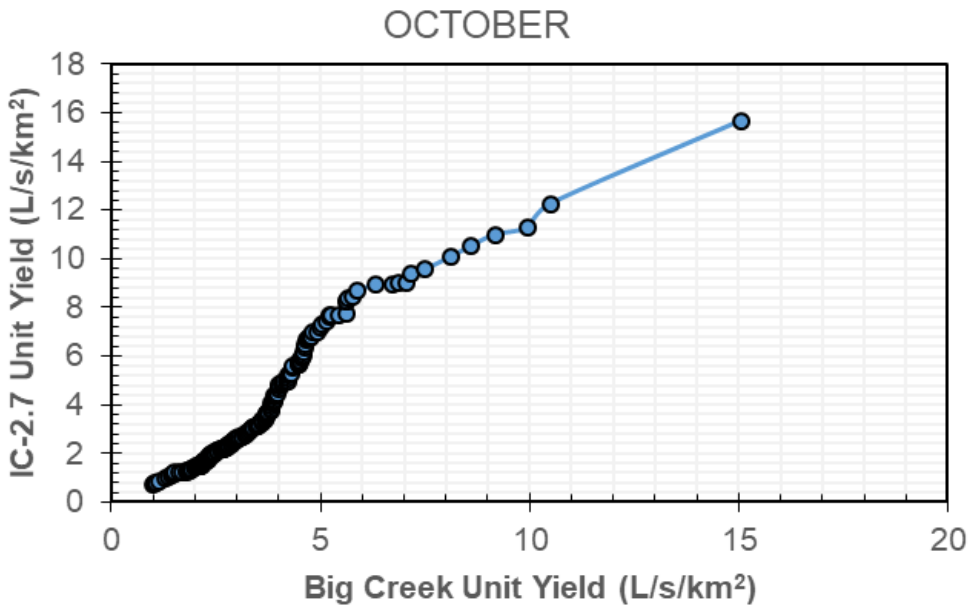


Figure D8.6: IC-2.7 Ranked regression relationship – October

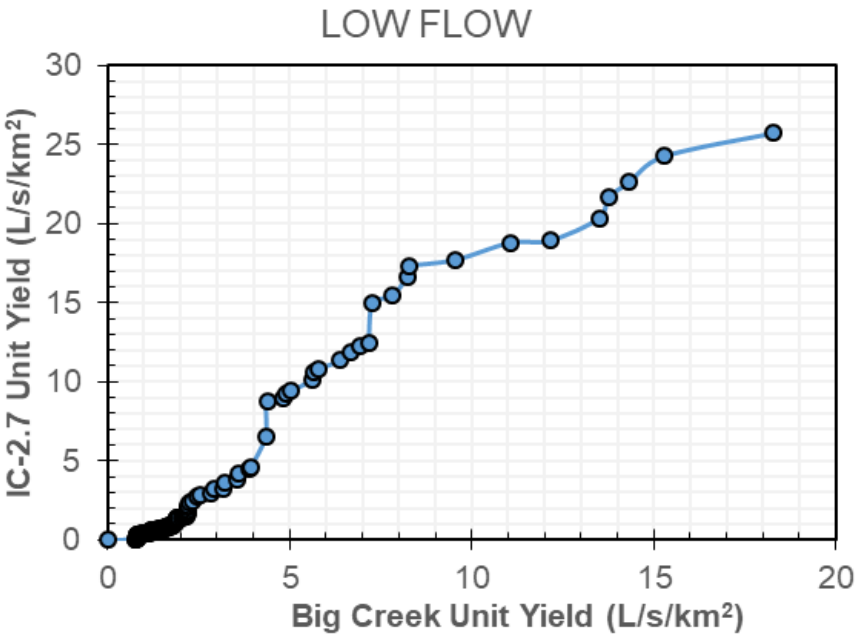


Figure D8.7: IC-2.7 Ranked regression relationship – Low Flows (November to April)

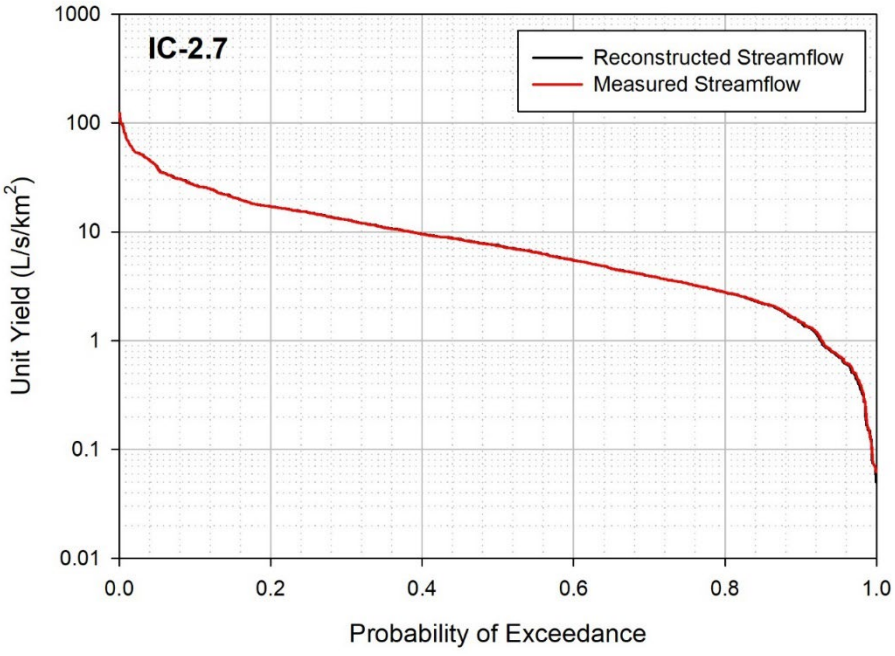


Figure D8.8: IC-2.7 Flow duration curves – measured vs. synthetic for concurrent period of record

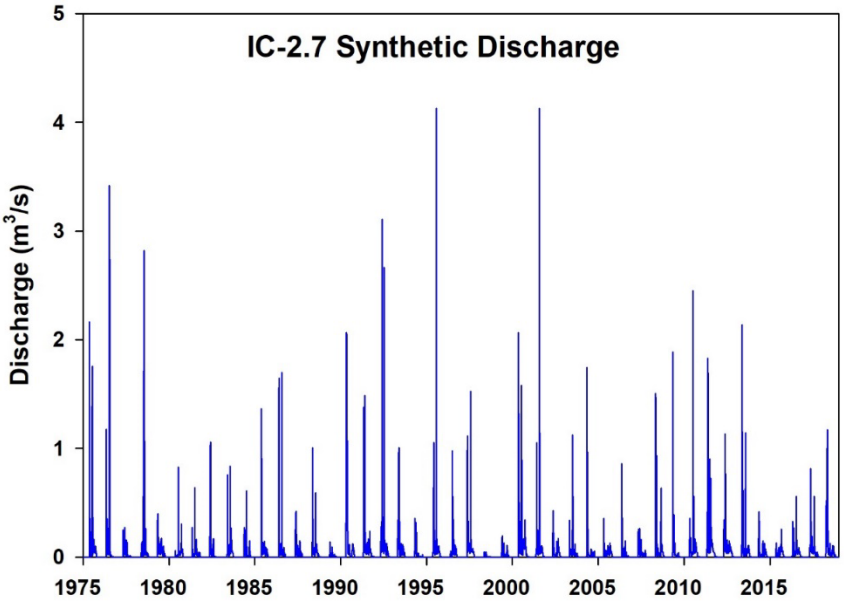


Figure D8.9: IC-2.7 Synthetic streamflow daily time-series

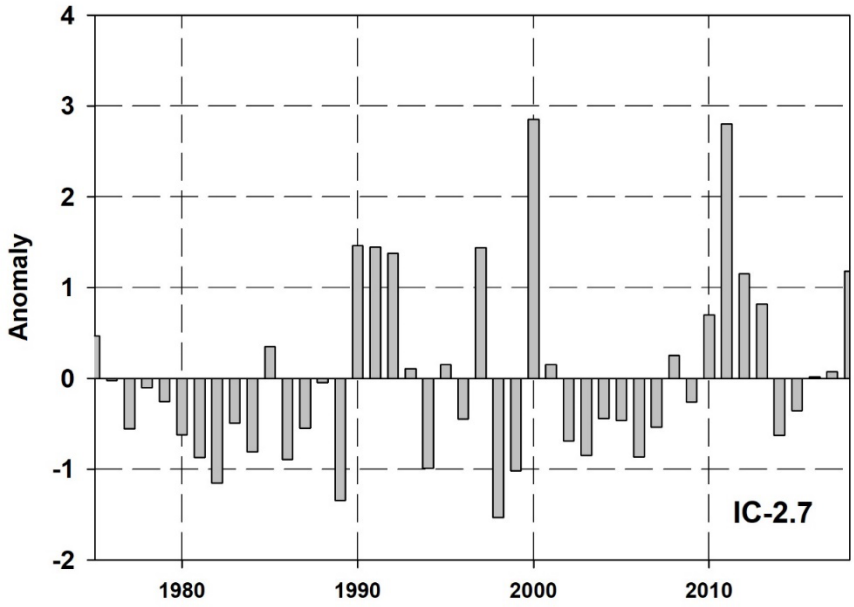


Figure D8.10: IC-2.7 Annual runoff anomalies

Table D8.11:
IC-2.7 Monthly synthetic streamflows (1975-2018)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.000	0.001	0.001	0.004	6.183	2.596	5.095	3.774	1.984	0.517	0.003	0.002	1.700
1976	0.001	0.001	0.000	0.019	3.554	4.882	9.496	0.551	0.280	0.149	0.006	0.002	1.590
1977	0.002	0.002	0.001	0.014	2.474	3.352	3.211	0.377	0.413	0.259	0.006	0.001	0.848
1978	0.000	0.000	0.000	0.000	0.849	3.742	8.901	4.620	0.784	0.554	0.076	0.005	1.646
1979	0.003	0.001	0.001	0.001	2.573	3.306	3.945	1.526	1.308	0.341	0.013	0.003	1.093
1980	0.001	0.001	0.001	0.002	0.860	0.686	3.457	1.159	4.579	1.162	0.009	0.001	0.995
1981	0.001	0.001	0.001	0.002	1.694	0.611	3.697	2.112	0.582	0.533	0.061	0.003	0.786
1982	0.001	0.001	0.001	0.002	3.874	3.987	0.809	3.095	0.262	0.168	0.007	0.002	1.025
1983	0.001	0.001	0.000	0.000	1.233	3.954	3.751	5.079	1.048	0.308	0.003	0.000	1.292
1984	0.000	0.000	0.000	0.001	1.787	3.498	4.088	0.391	2.278	0.234	0.003	0.001	1.024
1985	0.000	0.000	0.000	0.001	4.454	4.368	4.039	1.464	1.389	0.334	0.042	0.006	1.351
1986	0.004	0.002	0.001	0.000	3.786	3.470	3.647	1.258	1.138	0.345	0.005	0.005	1.148
1987	0.003	0.002	0.001	0.007	4.136	3.465	1.273	1.700	0.839	0.323	0.017	0.003	0.988
1988	0.002	0.001	0.002	0.011	4.288	1.864	4.775	2.123	0.603	0.300	0.067	0.006	1.182
1989	0.003	0.001	0.001	0.001	1.325	1.256	1.104	0.446	0.381	0.229	0.028	0.004	0.401
1990	0.002	0.001	0.001	3.850	12.939	2.969	1.598	0.417	3.139	0.817	0.015	0.003	2.160
1991	0.002	0.002	0.003	0.441	8.457	4.258	3.596	3.041	3.970	0.738	0.334	0.120	2.095
1992	0.016	0.004	0.004	0.125	8.322	6.480	7.776	1.519	2.797	0.614	0.111	0.021	2.328
1993	0.004	0.002	0.002	0.949	5.894	1.622	2.452	1.663	0.773	0.184	0.096	0.030	1.152
1994	0.005	0.002	0.001	1.444	2.701	1.485	1.074	0.227	0.291	0.211	0.004	0.002	0.624
1995	0.033	0.006	0.005	0.133	2.181	6.527	7.394	3.343	2.204	0.724	0.162	0.015	1.905
1996	0.002	0.000	0.000	0.000	0.684	0.869	4.736	3.321	1.609	0.280	0.006	0.001	0.968
1997	0.000	0.000	0.000	0.000	4.842	7.582	5.580	4.750	1.430	0.415	0.091	0.007	2.073
1998	0.001	0.001	0.001	0.002	0.930	1.323	0.357	0.172	0.226	0.095	0.002	0.000	0.260
1999	0.000	0.000	0.000	0.001	1.243	4.003	1.163	0.394	1.095	0.294	0.003	0.001	0.682
2000	0.000	0.000	0.000	0.087	8.806	5.250	6.002	6.253	8.159	1.704	0.451	0.139	3.083
2001	0.033	0.006	0.005	0.133	2.181	6.527	7.394	3.343	2.204	0.724	0.162	0.015	1.905
2002	0.004	0.002	0.002	0.017	2.801	1.541	1.754	1.961	3.020	0.489	0.099	0.009	0.981
2003	0.004	0.002	0.001	0.717	1.503	3.293	4.311	1.369	0.700	0.510	0.063	0.005	1.047
2004	0.003	0.003	0.003	0.312	6.800	0.966	0.811	0.786	0.606	0.581	0.030	0.005	0.918
2005	0.003	0.003	0.003	1.152	1.959	1.416	2.288	1.555	2.610	0.897	0.113	0.004	1.005
2006	0.002	0.001	0.001	0.008	3.031	1.871	1.887	0.588	0.473	0.267	0.020	0.002	0.686
2007	0.000	0.000	0.000	0.531	3.420	1.474	2.279	0.660	0.833	0.390	0.009	0.002	0.807
2008	0.001	0.001	0.001	0.161	7.149	1.983	1.333	9.594	2.613	0.778	0.146	0.028	2.001
2009	0.007	0.005	0.005	0.167	7.458	3.449	0.552	0.436	0.463	0.250	0.066	0.006	1.081
2010	0.003	0.002	0.002	1.672	2.465	1.182	8.287	4.043	2.720	0.605	0.141	0.033	1.781
2011	0.010	0.011	0.007	0.471	7.424	6.283	8.091	6.712	1.625	0.641	0.246	0.074	2.660
2012	0.009	0.007	0.008	1.520	4.437	4.742	3.841	3.071	2.403	0.916	0.167	0.053	1.769
2013	0.011	0.010	0.010	0.012	7.998	3.442	3.794	1.205	2.242	1.353	0.257	0.084	1.718
2014	0.018	0.008	0.005	0.467	3.591	0.673	1.698	0.753	1.791	0.838	0.151	0.036	0.843
2015	0.005	0.002	0.003	0.062	1.396	0.782	1.577	4.530	2.592	0.582	0.137	0.037	0.984
2016	0.008	0.007	0.032	1.268	1.692	1.417	4.280	1.680	1.598	0.421	0.151	0.028	1.054
2017	0.006	0.004	0.002	0.870	3.961	4.535	3.787	1.737	0.739	0.575	0.113	0.008	1.370
2018	0.006	0.005	0.172	6.833	4.825	2.954	1.853	1.731	1.800	0.457	0.113	0.008	1.731
Average	**0.005**	**0.003**	**0.007**	**0.533**	**3.958**	**3.089**	**3.701**	**2.285**	**1.695**	**0.525**	**0.086**	**0.019**	**1.335**

D9. ICT15-0.1 Synthetic Streamflow Record

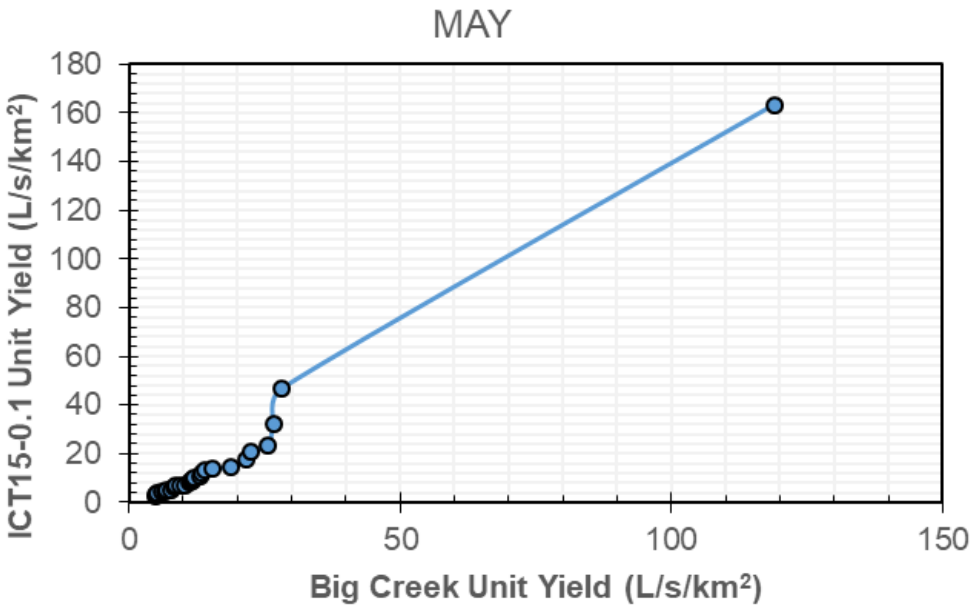


Figure D9.1: ICT15-0.1 Ranked regression relationship – May

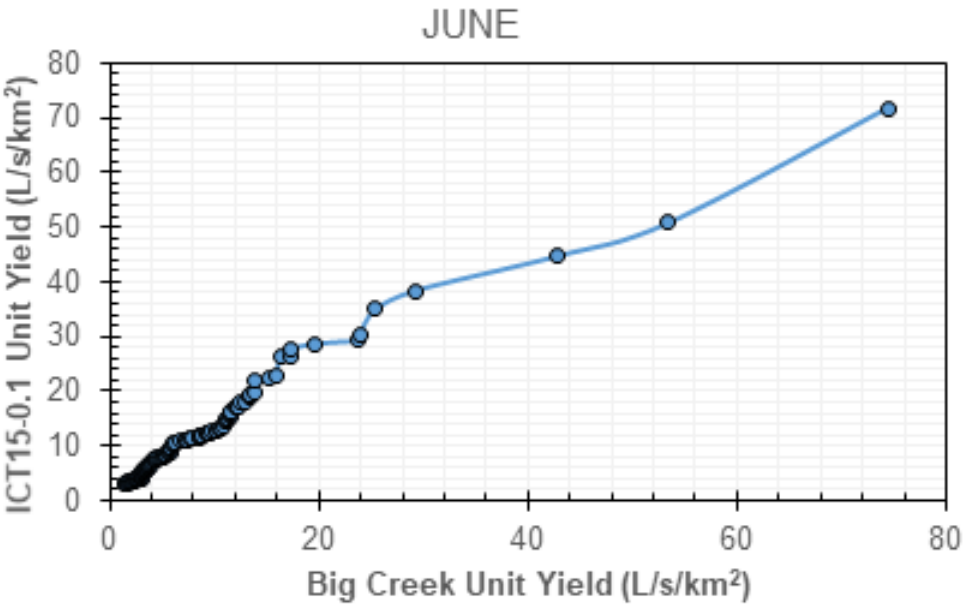


Figure D9.2: ICT15-0.1 Ranked regression relationship – June

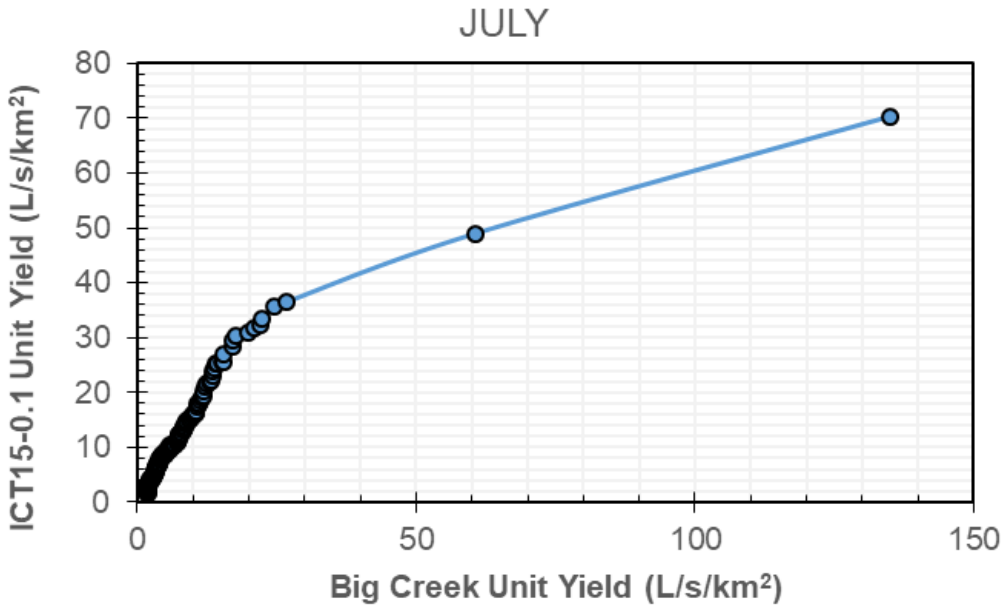


Figure D9.3: ICT15-0.1 Ranked regression relationship – July

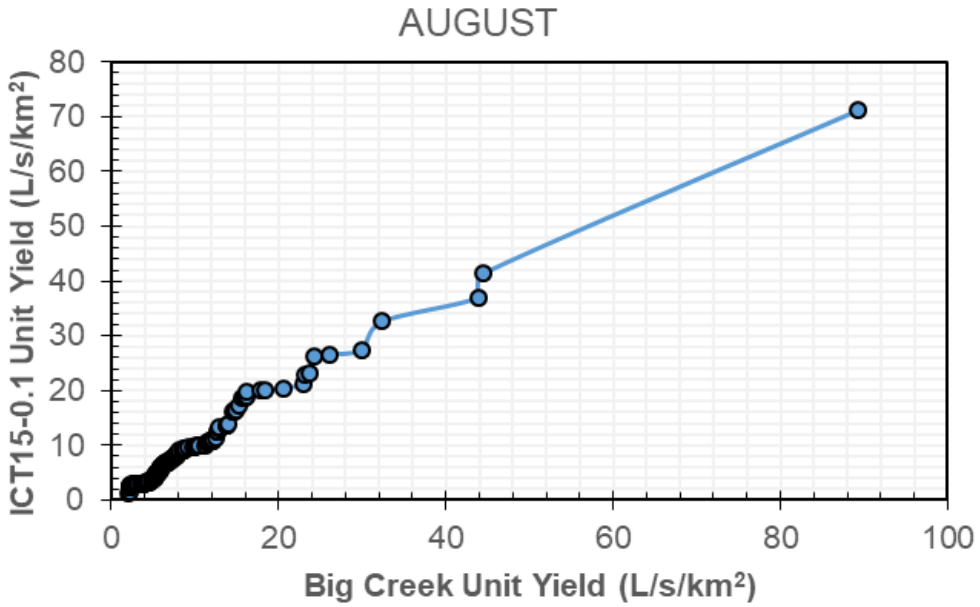


Figure D9.4: ICT15-0.1 Ranked regression relationship – August

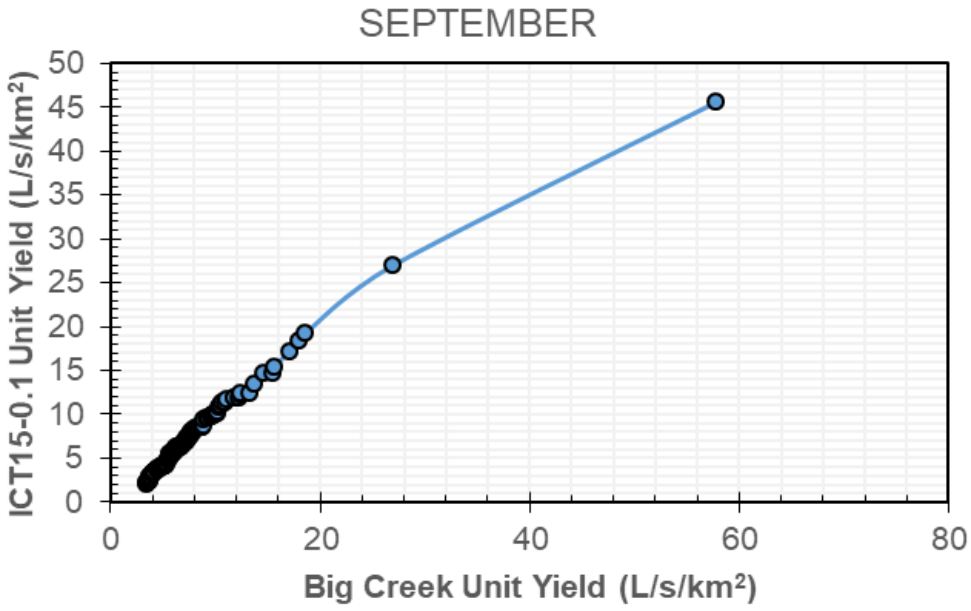


Figure D9.5: ICT15-0.1 Ranked regression relationship – September

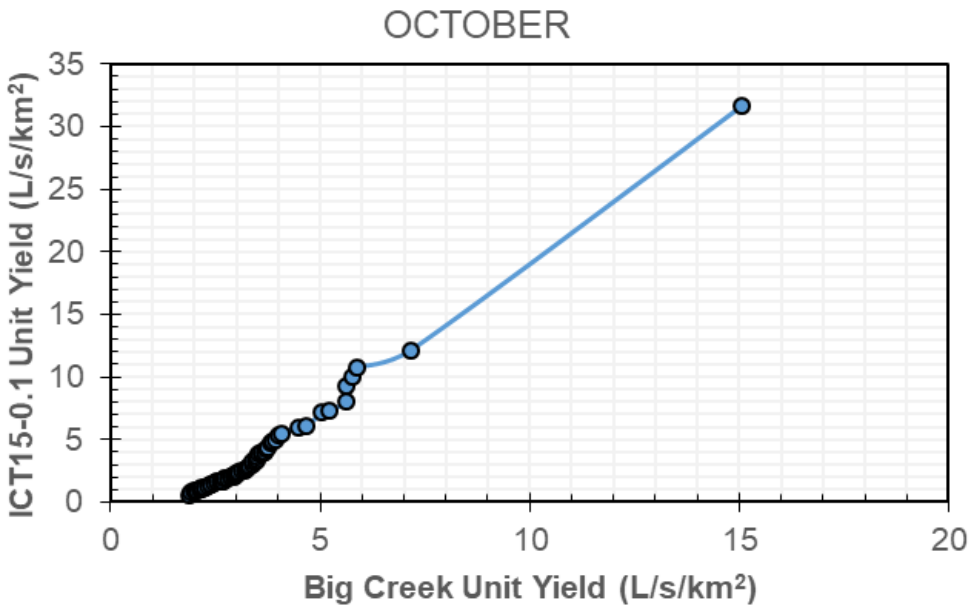


Figure D9.6: ICT15-0.1 Ranked regression relationship – October

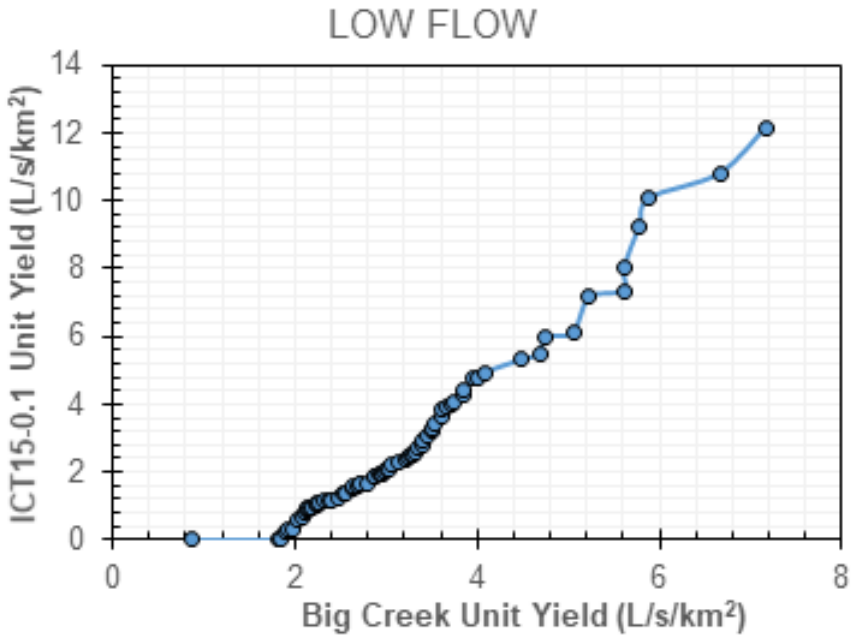


Figure D9.7: ICT15-0.1 Ranked regression relationship – Low Flows (November to April)

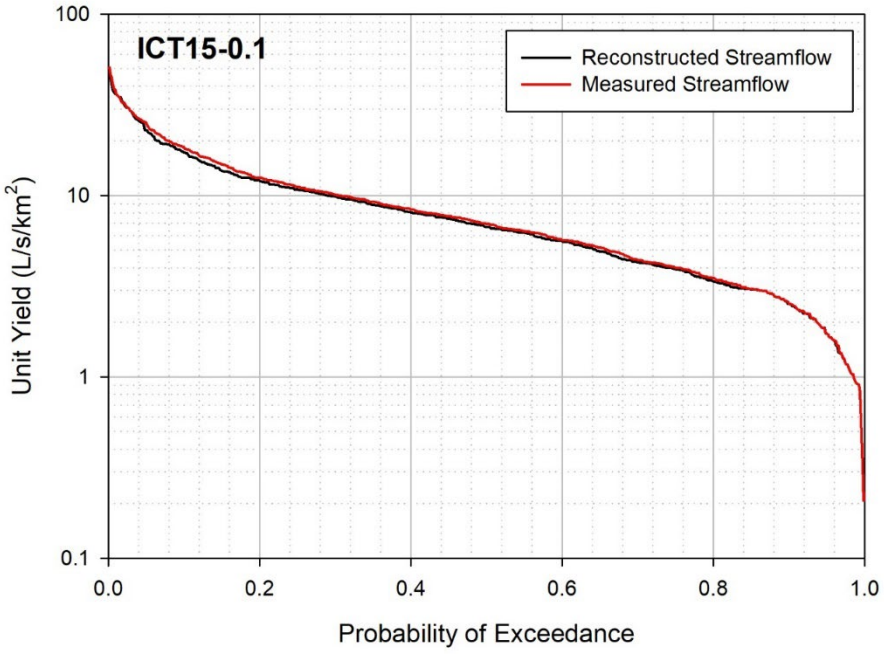


Figure D9.8: ICT15-0.1 Flow duration curves – measured vs. synthetic for concurrent period of record

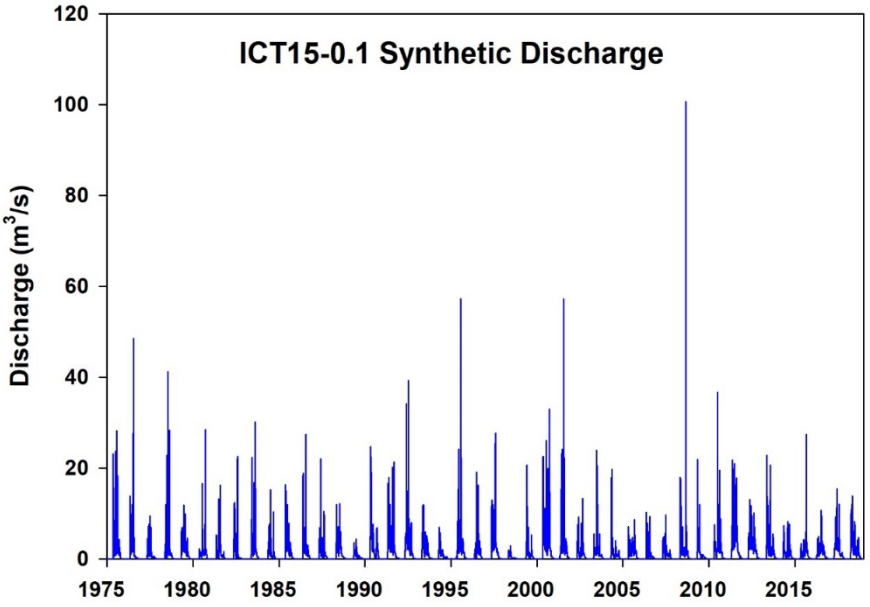


Figure D9.9: ICT15-0.1 Synthetic streamflow daily time-series

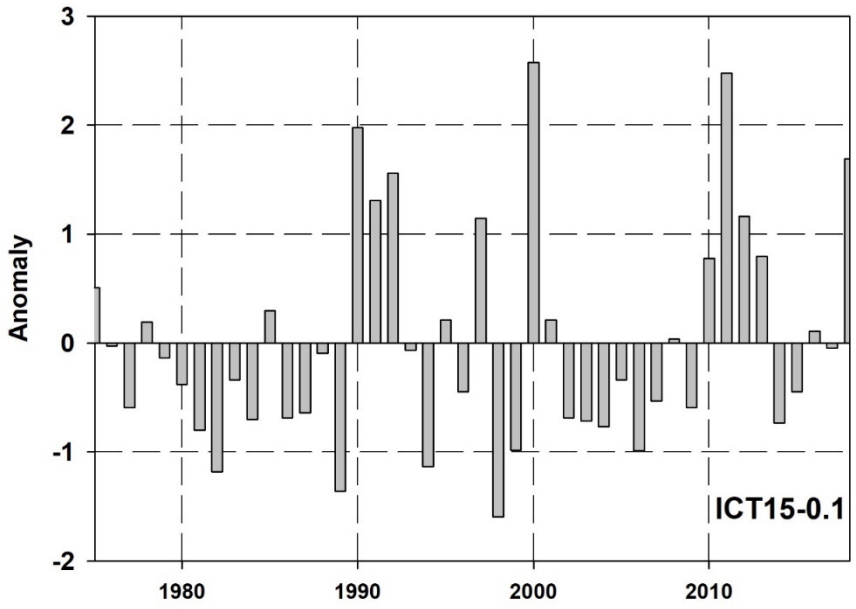


Figure D9.10: ICT15-0.1 Annual runoff anomalies

Table D9.11:
ICT15-0.1 Monthly synthetic streamflows (1975-2018)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.000	0.000	0.000	0.000	0.449	0.204	0.300	0.231	0.130	0.034	0.000	0.000	0.113
1976	0.000	0.000	0.000	0.000	0.209	0.342	0.391	0.049	0.014	0.002	0.000	0.000	0.084
1977	0.000	0.000	0.000	0.000	0.133	0.252	0.254	0.031	0.021	0.007	0.000	0.000	0.059
1978	0.000	0.000	0.000	0.000	0.048	0.249	0.417	0.221	0.061	0.037	0.000	0.000	0.087
1979	0.000	0.000	0.000	0.000	0.132	0.252	0.306	0.111	0.089	0.016	0.000	0.000	0.076
1980	0.000	0.000	0.000	0.000	0.049	0.071	0.216	0.102	0.198	0.104	0.000	0.000	0.062
1981	0.000	0.000	0.000	0.000	0.088	0.076	0.286	0.130	0.034	0.034	0.000	0.000	0.055
1982	0.000	0.000	0.000	0.000	0.271	0.273	0.065	0.142	0.014	0.002	0.000	0.000	0.064
1983	0.000	0.000	0.000	0.000	0.076	0.268	0.253	0.263	0.075	0.013	0.000	0.000	0.080
1984	0.000	0.000	0.000	0.000	0.096	0.253	0.273	0.030	0.123	0.008	0.000	0.000	0.065
1985	0.000	0.000	0.000	0.000	0.312	0.312	0.316	0.109	0.099	0.013	0.000	0.000	0.097
1986	0.000	0.000	0.000	0.000	0.296	0.263	0.233	0.098	0.078	0.019	0.000	0.000	0.083
1987	0.000	0.000	0.000	0.000	0.220	0.230	0.107	0.108	0.062	0.015	0.000	0.000	0.062
1988	0.000	0.000	0.000	0.000	0.289	0.164	0.349	0.151	0.039	0.010	0.000	0.000	0.084
1989	0.000	0.000	0.000	0.000	0.071	0.117	0.091	0.037	0.018	0.004	0.000	0.000	0.028
1990	0.000	0.000	0.000	0.343	1.004	0.235	0.132	0.029	0.184	0.065	0.000	0.000	0.167
1991	0.000	0.000	0.000	0.030	0.592	0.307	0.293	0.170	0.188	0.055	0.009	0.000	0.138
1992	0.000	0.000	0.000	0.005	0.613	0.428	0.439	0.114	0.156	0.041	0.000	0.000	0.150
1993	0.000	0.000	0.000	0.068	0.354	0.146	0.204	0.125	0.056	0.004	0.000	0.000	0.080
1994	0.000	0.000	0.000	0.109	0.145	0.137	0.093	0.015	0.015	0.007	0.000	0.000	0.044
1995	0.000	0.000	0.000	0.005	0.153	0.406	0.375	0.185	0.143	0.049	0.001	0.000	0.110
1996	0.000	0.000	0.000	0.000	0.040	0.094	0.322	0.207	0.111	0.015	0.000	0.000	0.066
1997	0.000	0.000	0.000	0.000	0.360	0.492	0.347	0.234	0.101	0.022	0.000	0.000	0.131
1998	0.000	0.000	0.000	0.000	0.052	0.123	0.028	0.010	0.012	0.002	0.000	0.000	0.019
1999	0.000	0.000	0.000	0.000	0.068	0.268	0.096	0.031	0.071	0.015	0.000	0.000	0.046
2000	0.000	0.000	0.000	0.005	0.624	0.366	0.340	0.289	0.302	0.189	0.016	0.000	0.179
2001	0.000	0.000	0.000	0.005	0.153	0.406	0.375	0.185	0.143	0.049	0.001	0.000	0.110
2002	0.000	0.000	0.000	0.000	0.155	0.135	0.138	0.138	0.142	0.031	0.000	0.000	0.062
2003	0.000	0.000	0.000	0.054	0.083	0.229	0.271	0.104	0.051	0.035	0.000	0.000	0.069
2004	0.000	0.000	0.000	0.017	0.490	0.098	0.067	0.067	0.036	0.038	0.000	0.000	0.068
2005	0.000	0.000	0.000	0.099	0.103	0.125	0.193	0.113	0.159	0.063	0.000	0.000	0.072
2006	0.000	0.000	0.000	0.000	0.171	0.155	0.151	0.055	0.024	0.008	0.000	0.000	0.047
2007	0.000	0.000	0.000	0.036	0.187	0.132	0.174	0.061	0.059	0.023	0.000	0.000	0.056
2008	0.000	0.000	0.000	0.010	0.505	0.169	0.115	0.264	0.160	0.059	0.000	0.000	0.108
2009	0.000	0.000	0.000	0.009	0.492	0.251	0.046	0.040	0.025	0.006	0.000	0.000	0.073
2010	0.000	0.000	0.000	0.129	0.129	0.116	0.447	0.227	0.160	0.038	0.000	0.000	0.105
2011	0.000	0.000	0.000	0.023	0.496	0.403	0.497	0.356	0.113	0.047	0.005	0.000	0.163
2012	0.000	0.000	0.000	0.114	0.272	0.338	0.299	0.202	0.155	0.068	0.000	0.000	0.121
2013	0.000	0.000	0.000	0.000	0.605	0.248	0.240	0.093	0.142	0.129	0.006	0.000	0.123
2014	0.000	0.000	0.000	0.028	0.186	0.074	0.137	0.064	0.112	0.065	0.000	0.000	0.056
2015	0.000	0.000	0.000	0.000	0.074	0.082	0.133	0.237	0.159	0.042	0.000	0.000	0.061
2016	0.000	0.000	0.000	0.081	0.089	0.128	0.318	0.130	0.111	0.025	0.000	0.000	0.074
2017	0.000	0.000	0.000	0.052	0.216	0.321	0.281	0.120	0.054	0.041	0.000	0.000	0.091
2018	0.000	0.000	0.010	0.619	0.323	0.228	0.156	0.124	0.121	0.028	0.000	0.000	0.134
Average	**0.000**	**0.000**	**0.000**	**0.042**	**0.261**	**0.227**	**0.240**	**0.132**	**0.098**	**0.036**	**0.001**	**0.000**	**0.087**

D10. IC-16.1 Synthetic Streamflow Record

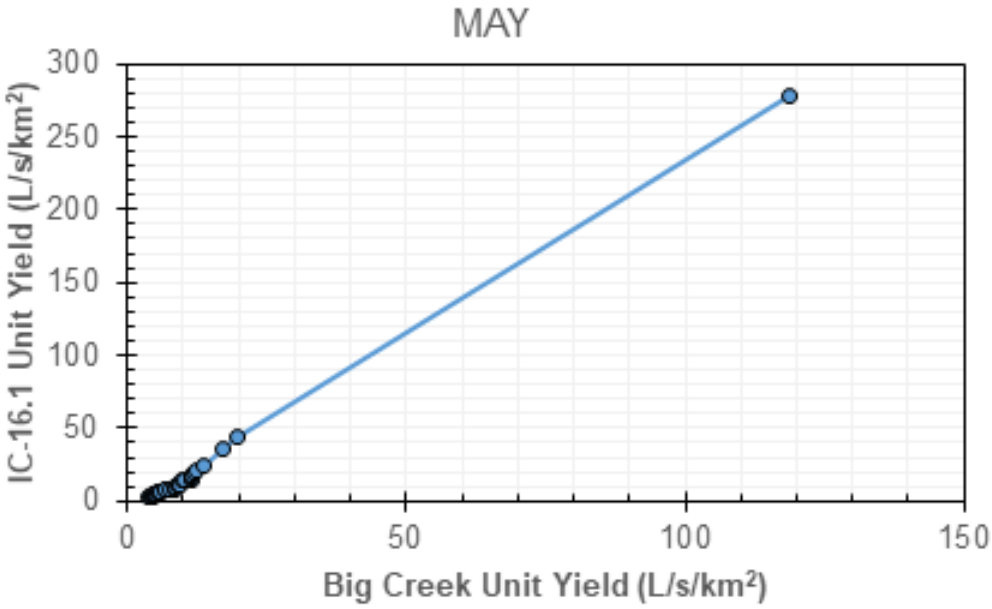


Figure D10.1: IC-16.1 Ranked regression relationship – May

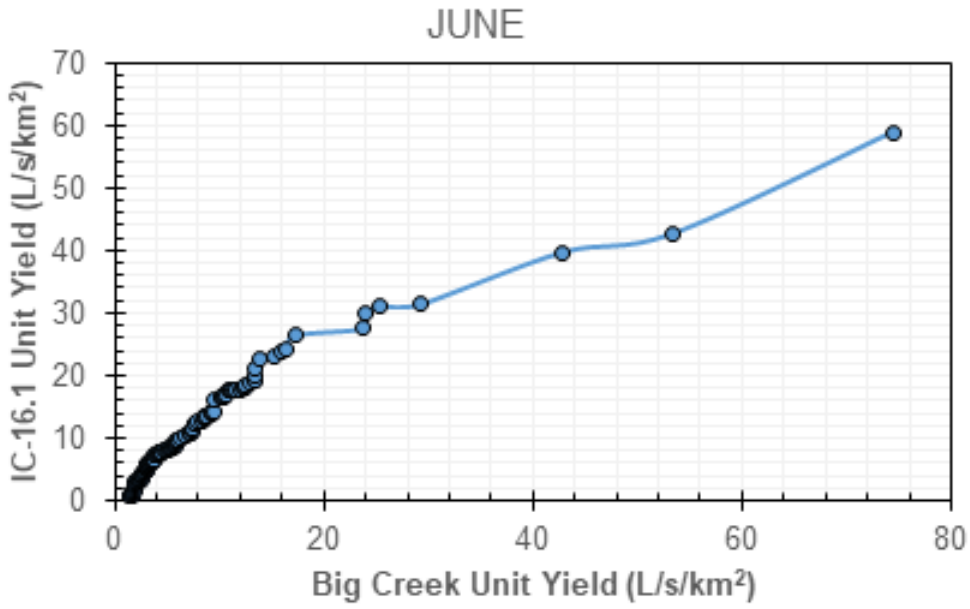


Figure D10.2: IC-16.1 Ranked regression relationship – June

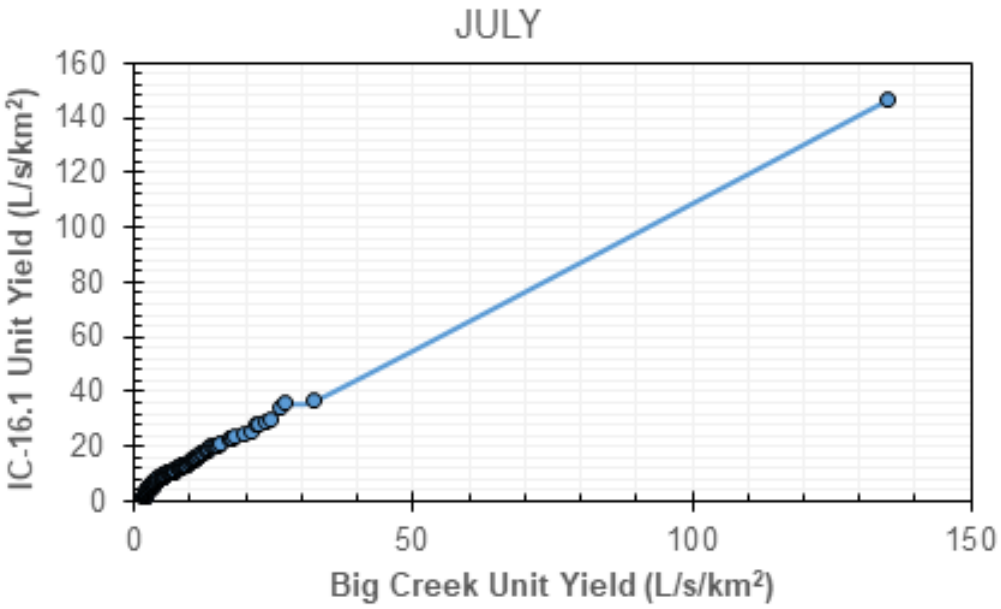


Figure D10.3: IC-16.1 Ranked regression relationship – July

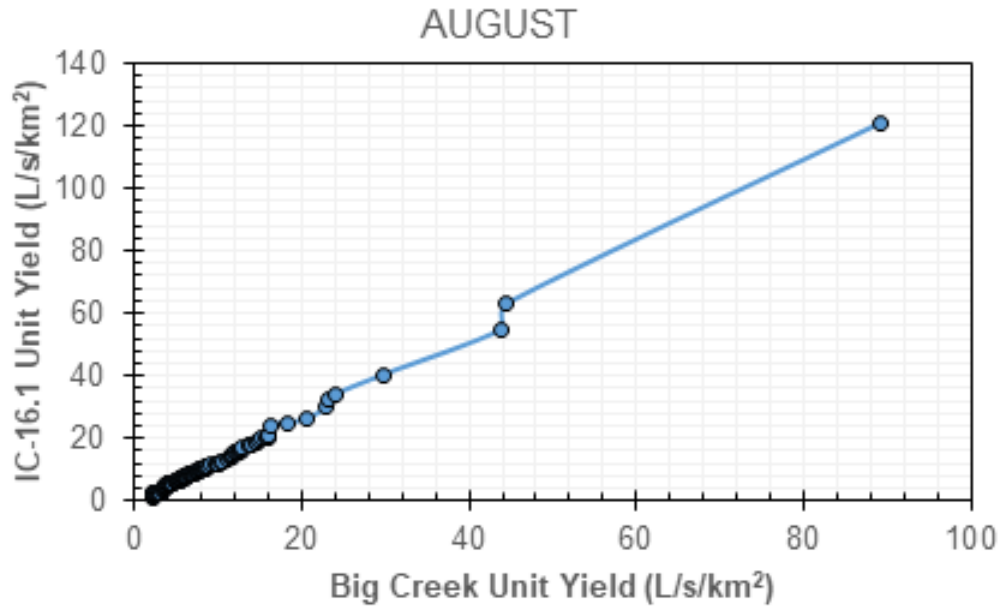


Figure D10.4: IC-16.1 Ranked regression relationship – August

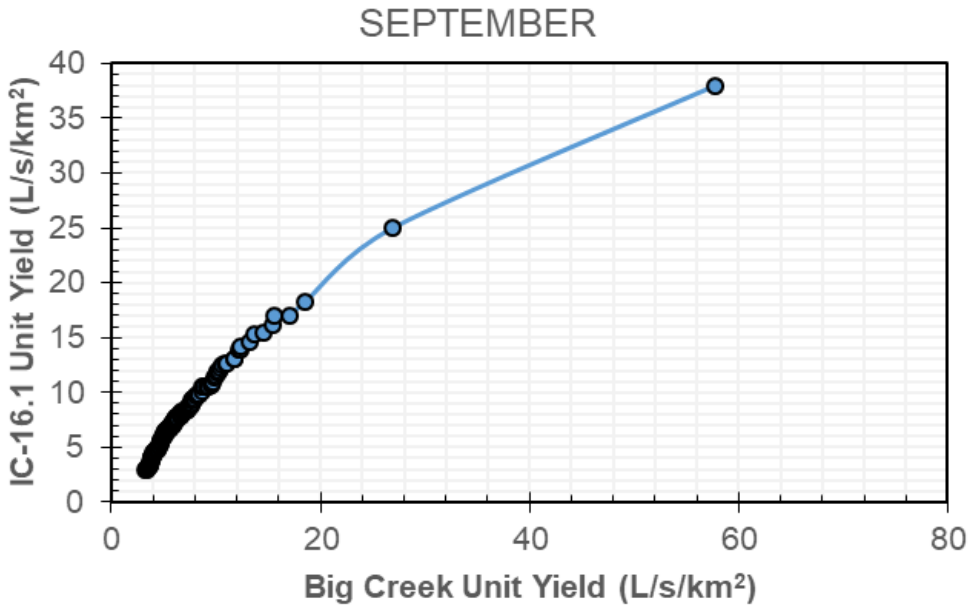


Figure D10.5: IC-16.1 Ranked regression relationship – September

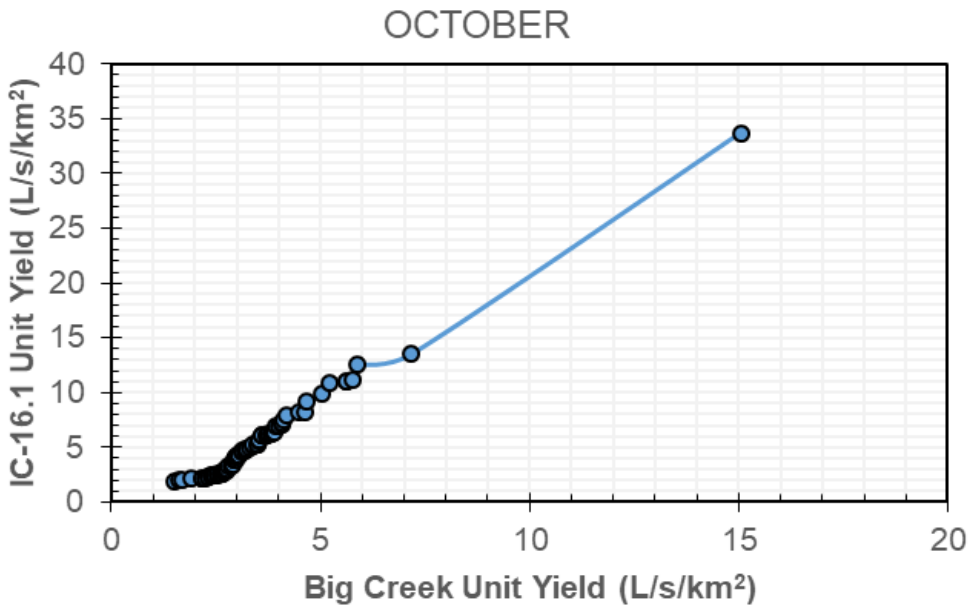


Figure D10.6: IC-16.1 Ranked regression relationship – October

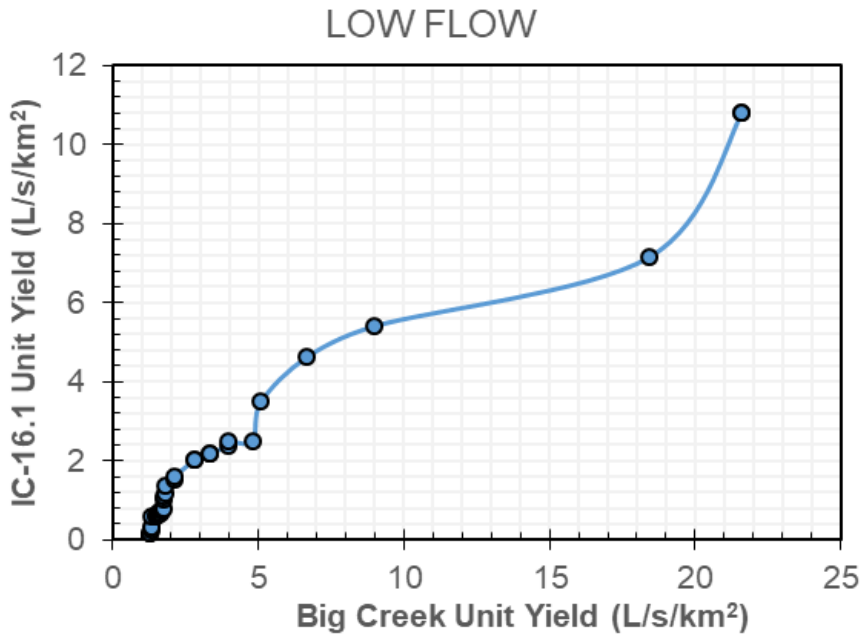


Figure D10.7: IC-16.1 Ranked regression relationship – Low Flows (November to April)

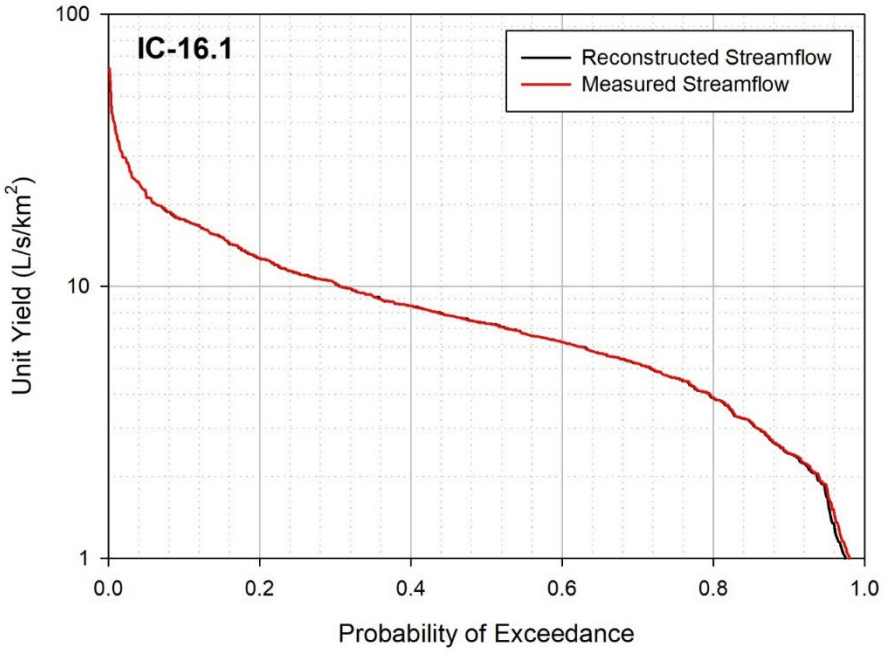


Figure D10.8: IC-16.1 Flow duration curves – measured vs. synthetic for concurrent period of record

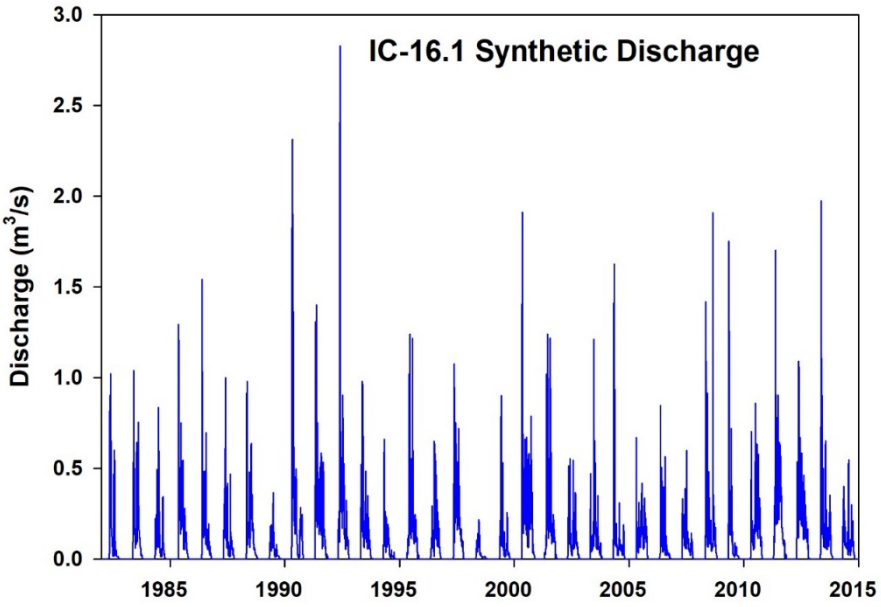


Figure D10.9: IC-16.1 Synthetic streamflow daily time-series

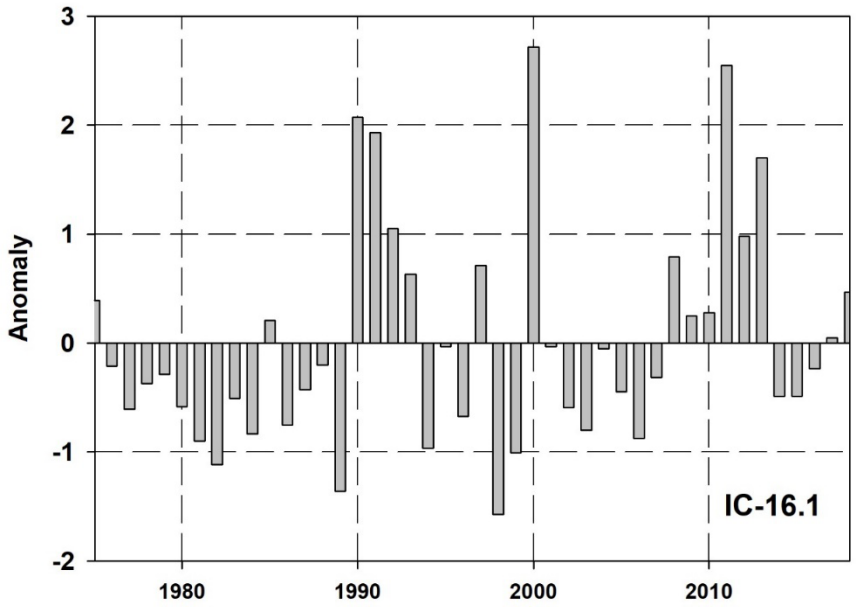


Figure D10.10: IC-16.1 Annual runoff anomalies

Table D10.11:
IC-16.1 Monthly synthetic streamflows (1975-2018)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.000	0.000	0.001	0.003	3.499	0.999	1.422	1.356	0.731	0.289	0.002	0.001	0.701
1976	0.001	0.000	0.000	0.006	1.834	1.587	2.334	0.281	0.122	0.122	0.004	0.001	0.528
1977	0.001	0.001	0.001	0.004	1.144	1.231	1.037	0.133	0.178	0.154	0.004	0.001	0.326
1978	0.000	0.000	0.000	0.000	0.353	1.077	2.212	1.367	0.382	0.305	0.014	0.004	0.481
1979	0.002	0.001	0.001	0.001	1.180	1.221	1.246	0.644	0.520	0.190	0.006	0.002	0.421
1980	0.001	0.001	0.001	0.002	0.367	0.320	0.995	0.624	0.976	0.624	0.004	0.001	0.328
1981	0.001	0.001	0.001	0.001	0.729	0.285	1.198	0.787	0.264	0.281	0.012	0.002	0.301
1982	0.001	0.001	0.001	0.001	2.125	1.229	0.268	0.891	0.114	0.128	0.005	0.002	0.401
1983	0.001	0.000	0.000	0.000	0.646	1.208	1.137	1.613	0.464	0.166	0.002	0.000	0.440
1984	0.000	0.000	0.000	0.001	0.825	1.188	1.170	0.161	0.674	0.148	0.002	0.000	0.348
1985	0.000	0.000	0.000	0.001	2.455	1.451	1.281	0.661	0.562	0.184	0.008	0.004	0.556
1986	0.003	0.002	0.001	0.000	2.167	1.271	1.118	0.618	0.470	0.201	0.004	0.003	0.493
1987	0.002	0.001	0.000	0.004	2.294	1.026	0.448	0.662	0.389	0.186	0.006	0.002	0.423
1988	0.001	0.001	0.001	0.004	2.210	0.781	1.424	0.895	0.271	0.163	0.010	0.005	0.485
1989	0.002	0.001	0.000	0.001	0.530	0.556	0.394	0.193	0.165	0.144	0.006	0.003	0.168
1990	0.002	0.001	0.000	0.500	7.793	1.169	0.570	0.139	0.964	0.449	0.006	0.002	0.978
1991	0.001	0.001	0.002	0.066	4.841	1.465	1.196	1.020	0.956	0.394	0.106	0.023	0.848
1992	0.006	0.003	0.003	0.025	4.905	1.940	2.048	0.699	0.832	0.339	0.017	0.006	0.909
1993	0.003	0.001	0.001	0.129	3.300	0.711	0.889	0.773	0.364	0.131	0.011	0.008	0.533
1994	0.004	0.002	0.001	0.192	1.294	0.662	0.426	0.062	0.127	0.142	0.003	0.002	0.245
1995	0.007	0.004	0.003	0.037	1.064	1.763	1.929	1.105	0.783	0.381	0.047	0.006	0.598
1996	0.001	0.000	0.000	0.000	0.284	0.388	1.382	1.227	0.630	0.174	0.004	0.001	0.344
1997	0.000	0.000	0.000	0.000	2.652	2.181	1.579	1.417	0.596	0.238	0.010	0.004	0.729
1998	0.001	0.001	0.001	0.001	0.374	0.598	0.112	0.041	0.099	0.109	0.001	0.000	0.112
1999	0.000	0.000	0.000	0.001	0.548	1.292	0.417	0.152	0.439	0.167	0.002	0.000	0.252
2000	0.000	0.000	0.000	0.016	5.140	1.708	1.631	1.824	1.403	1.041	0.128	0.033	1.086
2001	0.007	0.004	0.003	0.037	1.064	1.763	1.929	1.105	0.783	0.381	0.047	0.006	0.598
2002	0.003	0.002	0.001	0.004	1.391	0.586	0.564	0.830	0.763	0.259	0.012	0.006	0.372
2003	0.003	0.002	0.001	0.094	0.628	1.024	1.245	0.662	0.334	0.298	0.012	0.004	0.362
2004	0.002	0.002	0.002	0.057	3.770	0.439	0.295	0.336	0.271	0.324	0.007	0.004	0.465
2005	0.002	0.002	0.002	0.152	0.813	0.609	0.862	0.725	0.841	0.470	0.037	0.003	0.379
2006	0.001	0.001	0.001	0.004	1.667	0.685	0.670	0.276	0.204	0.155	0.007	0.002	0.309
2007	0.000	0.000	0.000	0.076	1.574	0.633	0.766	0.345	0.380	0.232	0.005	0.002	0.338
2008	0.001	0.001	0.001	0.032	3.997	0.818	0.542	1.877	0.856	0.411	0.040	0.008	0.722
2009	0.005	0.004	0.003	0.035	4.258	1.170	0.195	0.175	0.206	0.151	0.009	0.004	0.524
2010	0.002	0.001	0.001	0.212	1.070	0.529	2.141	1.340	0.850	0.322	0.034	0.008	0.549
2011	0.007	0.007	0.005	0.100	4.165	1.851	2.130	2.203	0.649	0.345	0.070	0.010	0.973
2012	0.006	0.005	0.006	0.193	2.286	1.649	1.232	1.167	0.838	0.488	0.049	0.009	0.664
2013	0.008	0.007	0.007	0.007	4.546	1.179	1.101	0.595	0.779	0.745	0.082	0.010	0.764
2014	0.008	0.006	0.004	0.075	1.847	0.319	0.576	0.352	0.632	0.449	0.042	0.008	0.364
2015	0.003	0.002	0.002	0.018	0.583	0.362	0.594	1.456	0.850	0.321	0.032	0.008	0.356
2016	0.006	0.005	0.009	0.219	0.737	0.635	1.311	0.746	0.637	0.218	0.042	0.007	0.383
2017	0.004	0.003	0.002	0.147	1.989	1.533	1.208	0.762	0.352	0.314	0.029	0.006	0.533
2018	0.004	0.003	0.028	0.849	2.571	1.132	0.663	0.735	0.678	0.250	0.029	0.006	0.583
Average	**0.003**	**0.002**	**0.002**	**0.075**	**2.125**	**1.051**	**1.088**	**0.796**	**0.554**	**0.295**	**0.023**	**0.005**	**0.506**

D11. YT24-0.1 Synthetic Streamflow Record

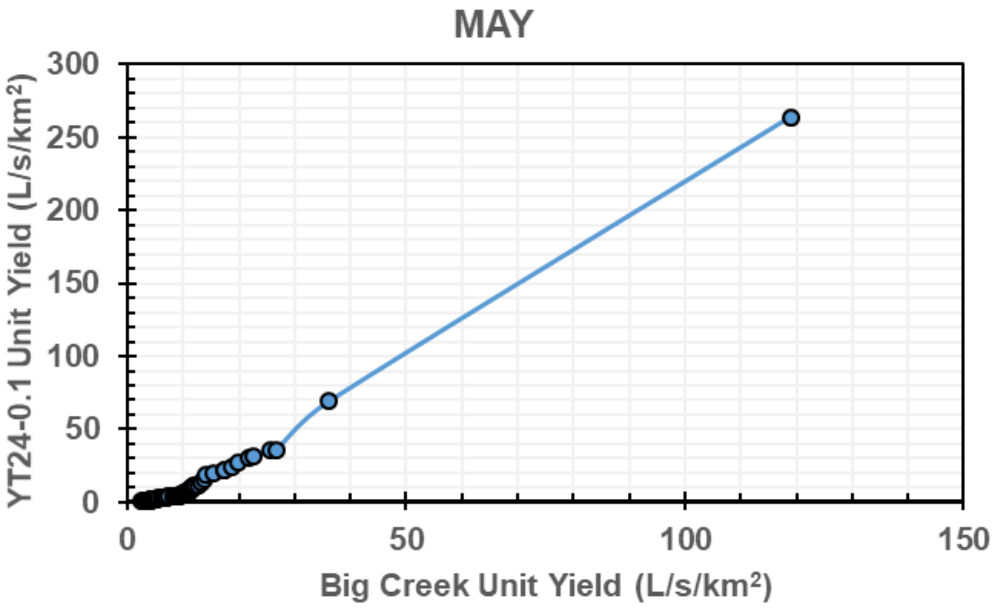


Figure D11.1: YT24-0.1 Ranked regression relationship – May

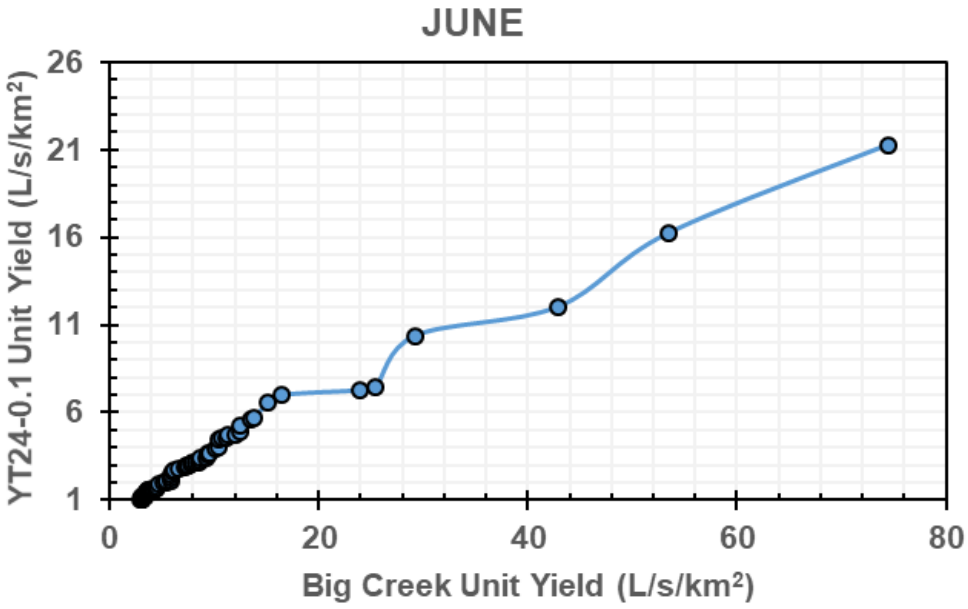


Figure D11.2: YT24-0.1 Ranked regression relationship – June

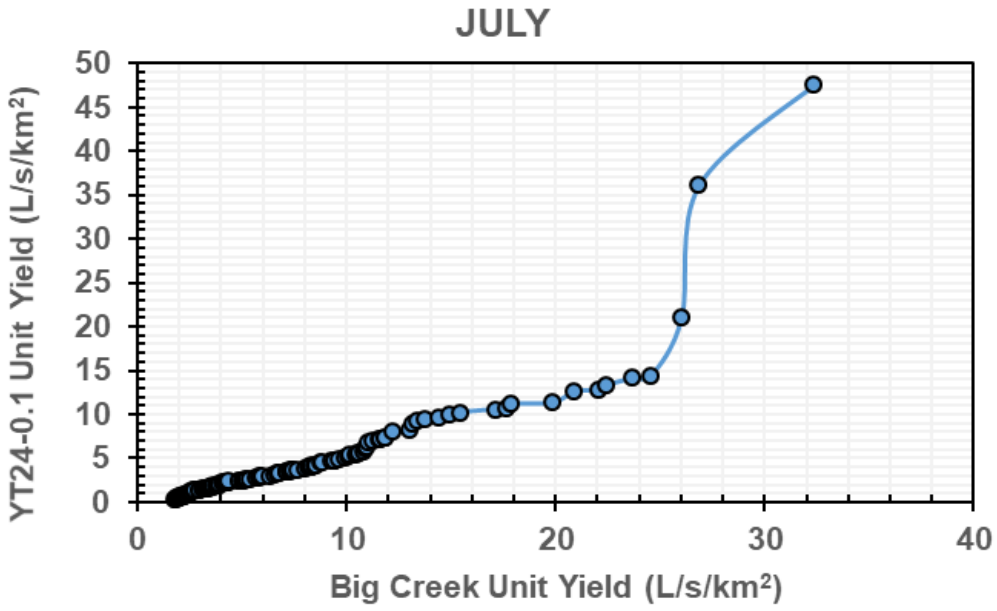


Figure D11.3: YT24-0.1 Ranked regression relationship – July

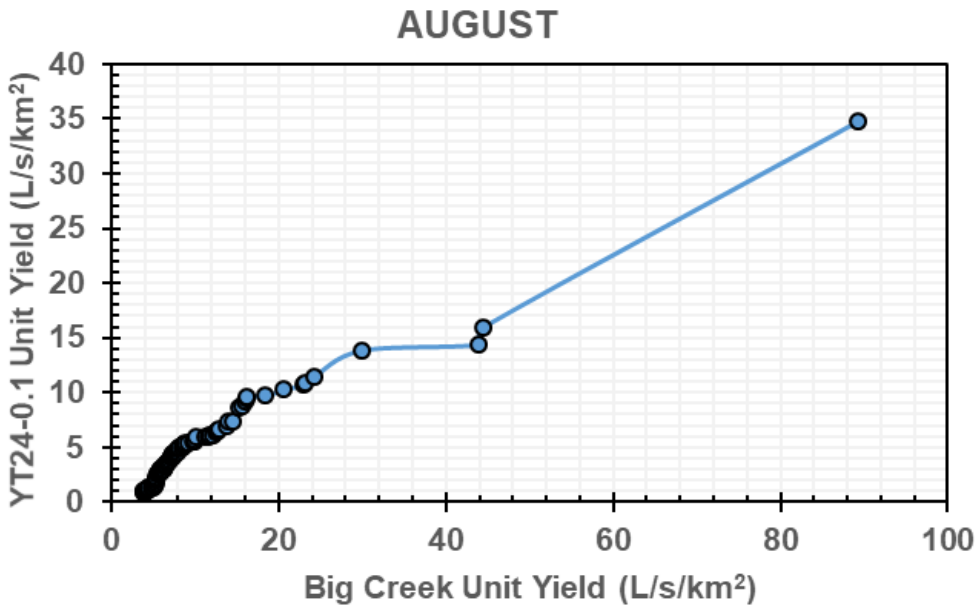


Figure D11.4: YT24-0.1 Ranked regression relationship – August

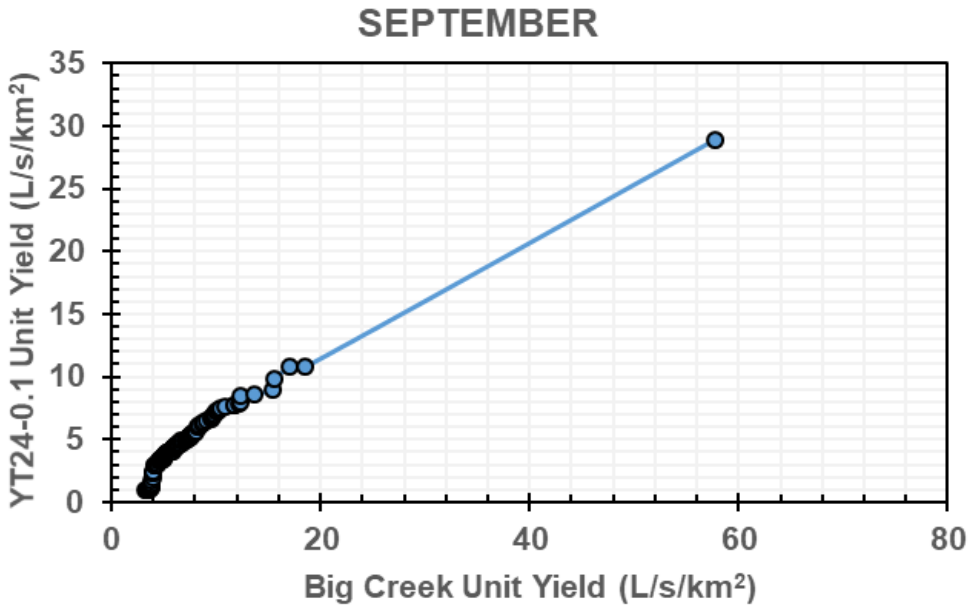


Figure D11.5: YT24-0.1 Ranked regression relationship – September

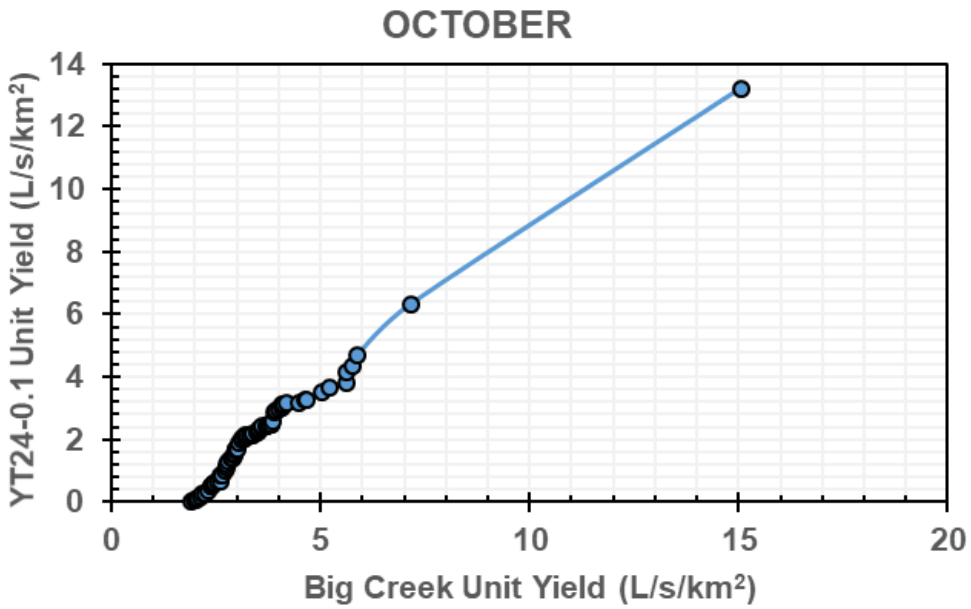


Figure D11.6: YT24-0.1 Ranked regression relationship – October

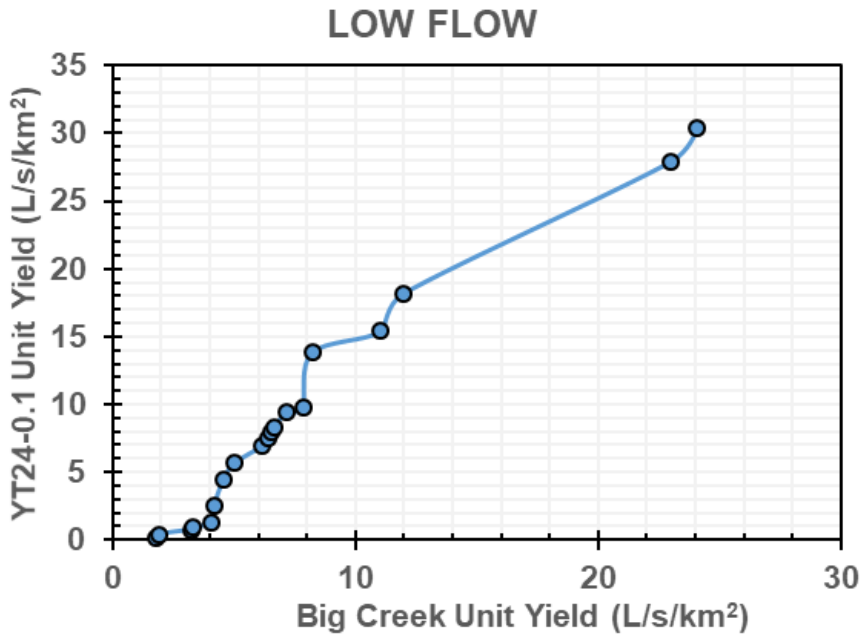


Figure D11.7: YT24-0.1 Ranked regression relationship – Low Flows (November to April)

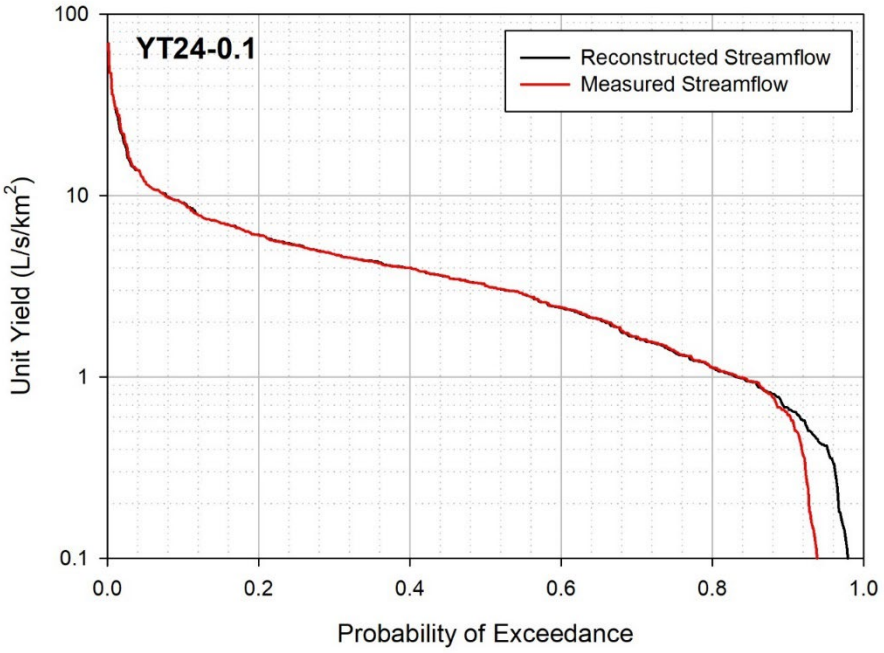


Figure D11.8: YT24-0.1 Flow duration curves – measured vs. synthetic for concurrent period of record. Gauge is located in a known losing reach, therefore the synthetic record reflects the estimated total flow signature at this location.

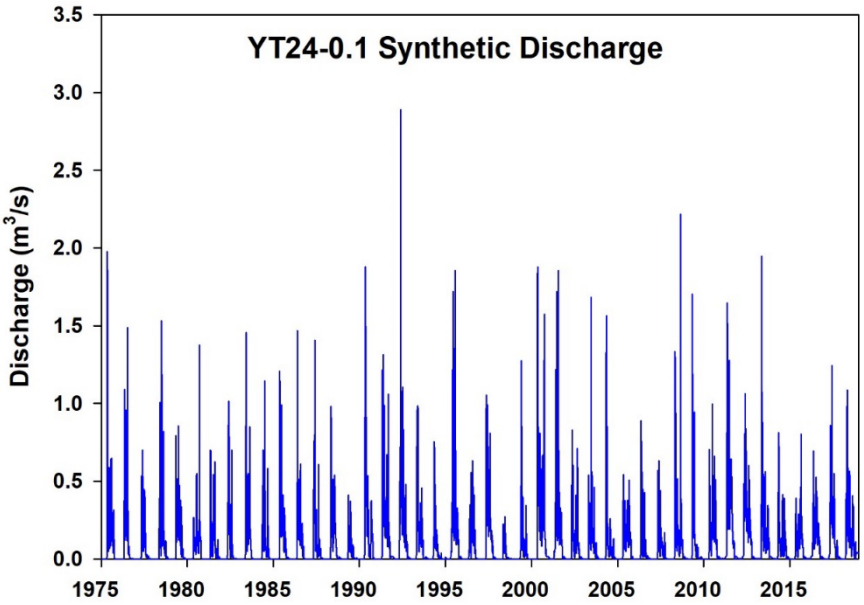


Figure D11.9: YT24-0.1 Synthetic streamflow daily time-series

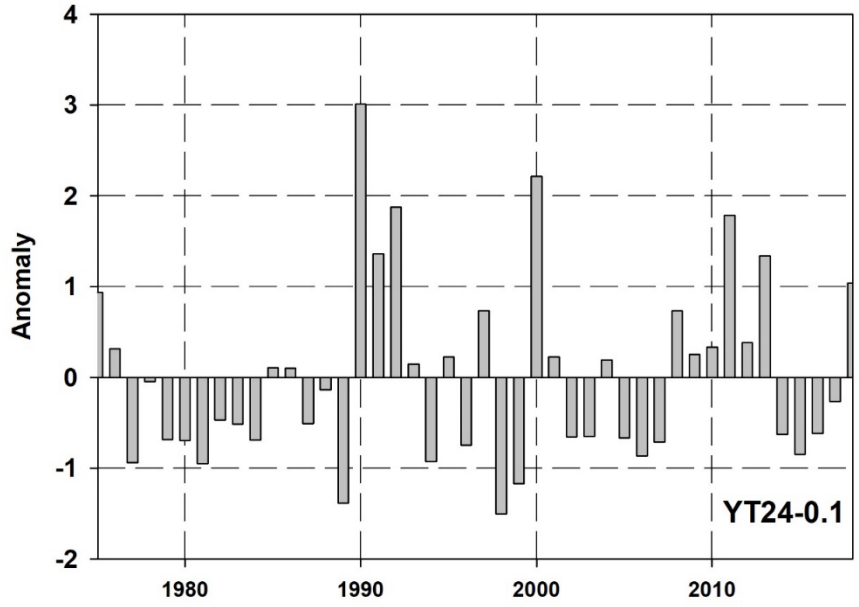


Figure D11.10: YT24-0.1 Annual runoff anomalies

Table D11.11:
YT24-0.1 Monthly synthetic streamflows (1975-2018)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
1975	0.000	0.000	0.000	0.000	0.460	0.037	0.175	0.081	0.063	0.011	0.000	0.000	0.070
1976	0.000	0.000	0.000	0.000	0.189	0.062	0.499	0.009	0.003	0.000	0.000	0.000	0.064
1977	0.000	0.000	0.000	0.000	0.104	0.047	0.059	0.005	0.006	0.001	0.000	0.000	0.019
1978	0.000	0.000	0.000	0.000	0.023	0.043	0.401	0.076	0.030	0.013	0.001	0.000	0.050
1979	0.000	0.000	0.000	0.000	0.096	0.047	0.073	0.036	0.042	0.006	0.001	0.000	0.025
1980	0.000	0.000	0.000	0.000	0.020	0.007	0.118	0.034	0.091	0.036	0.000	0.000	0.026
1981	0.000	0.000	0.000	0.000	0.060	0.007	0.083	0.041	0.015	0.012	0.001	0.000	0.019
1982	0.000	0.000	0.000	0.000	0.262	0.046	0.013	0.042	0.002	0.000	0.001	0.000	0.031
1983	0.000	0.000	0.000	0.000	0.068	0.048	0.113	0.091	0.038	0.003	0.000	0.000	0.030
1984	0.000	0.000	0.000	0.000	0.072	0.047	0.119	0.006	0.056	0.001	0.000	0.000	0.025
1985	0.000	0.000	0.000	0.000	0.320	0.057	0.077	0.037	0.047	0.004	0.001	0.000	0.046
1986	0.000	0.000	0.000	0.000	0.307	0.048	0.127	0.033	0.036	0.007	0.000	0.000	0.047
1987	0.000	0.000	0.000	0.000	0.219	0.040	0.023	0.034	0.032	0.005	0.001	0.000	0.030
1988	0.000	0.000	0.000	0.000	0.264	0.028	0.104	0.053	0.015	0.001	0.001	0.000	0.039
1989	0.000	0.000	0.000	0.000	0.036	0.018	0.018	0.007	0.005	0.000	0.001	0.000	0.007
1990	0.000	0.000	0.000	0.182	1.063	0.045	0.029	0.008	0.083	0.023	0.001	0.000	0.121
1991	0.000	0.000	0.000	0.020	0.610	0.057	0.069	0.058	0.086	0.020	0.004	0.001	0.078
1992	0.001	0.000	0.000	0.002	0.632	0.079	0.296	0.039	0.072	0.014	0.001	0.001	0.096
1993	0.000	0.000	0.000	0.043	0.369	0.025	0.043	0.042	0.029	0.000	0.001	0.001	0.047
1994	0.000	0.000	0.000	0.066	0.115	0.023	0.017	0.002	0.003	0.002	0.000	0.000	0.019
1995	0.001	0.000	0.000	0.002	0.126	0.076	0.311	0.065	0.067	0.017	0.002	0.001	0.056
1996	0.000	0.000	0.000	0.000	0.017	0.012	0.129	0.072	0.055	0.005	0.000	0.000	0.024
1997	0.000	0.000	0.000	0.000	0.348	0.089	0.183	0.084	0.052	0.008	0.001	0.000	0.065
1998	0.000	0.000	0.000	0.000	0.024	0.020	0.004	0.001	0.001	0.000	0.000	0.000	0.004
1999	0.000	0.000	0.000	0.000	0.040	0.052	0.019	0.006	0.033	0.004	0.000	0.000	0.013
2000	0.000	0.000	0.000	0.003	0.652	0.066	0.212	0.092	0.131	0.063	0.005	0.002	0.103
2001	0.001	0.000	0.000	0.002	0.126	0.076	0.311	0.065	0.067	0.017	0.002	0.001	0.056
2002	0.000	0.000	0.000	0.000	0.130	0.020	0.030	0.048	0.069	0.011	0.001	0.001	0.026
2003	0.000	0.000	0.000	0.035	0.049	0.042	0.128	0.033	0.024	0.013	0.001	0.000	0.027
2004	0.000	0.000	0.000	0.008	0.485	0.014	0.013	0.016	0.015	0.015	0.001	0.000	0.048
2005	0.000	0.000	0.000	0.056	0.058	0.021	0.040	0.038	0.073	0.021	0.001	0.000	0.026
2006	0.000	0.000	0.000	0.000	0.166	0.025	0.032	0.011	0.008	0.001	0.001	0.000	0.021
2007	0.000	0.000	0.000	0.019	0.161	0.021	0.039	0.014	0.030	0.009	0.001	0.000	0.025
2008	0.000	0.000	0.000	0.004	0.498	0.030	0.022	0.083	0.075	0.021	0.002	0.001	0.062
2009	0.001	0.000	0.000	0.004	0.511	0.046	0.007	0.006	0.009	0.000	0.001	0.000	0.050
2010	0.000	0.000	0.000	0.079	0.083	0.017	0.329	0.079	0.074	0.013	0.002	0.001	0.057
2011	0.001	0.001	0.001	0.009	0.514	0.076	0.269	0.118	0.056	0.017	0.003	0.001	0.090
2012	0.001	0.001	0.001	0.078	0.243	0.065	0.070	0.072	0.072	0.025	0.002	0.001	0.053
2013	0.001	0.001	0.001	0.001	0.616	0.045	0.121	0.030	0.068	0.043	0.003	0.001	0.079
2014	0.001	0.001	0.000	0.015	0.169	0.009	0.030	0.015	0.053	0.024	0.002	0.001	0.027
2015	0.000	0.000	0.000	0.001	0.039	0.011	0.026	0.082	0.074	0.015	0.001	0.001	0.021
2016	0.001	0.001	0.001	0.044	0.053	0.022	0.091	0.048	0.055	0.007	0.002	0.001	0.027
2017	0.000	0.000	0.000	0.026	0.185	0.062	0.078	0.037	0.025	0.015	0.001	0.001	0.036
2018	0.000	0.000	0.005	0.339	0.304	0.043	0.033	0.042	0.058	0.011	0.001	0.001	0.070
Average	**0.000**	**0.000**	**0.000**	**0.024**	**0.247**	**0.040**	**0.113**	**0.043**	**0.045**	**0.012**	**0.001**	**0.000**	**0.044**

Appendix E: Streamflow Statistics for Regional Monitoring Stations

Newmont™
COFFEE

09AH003 - Big Creek near the Mouth

YEAR	MAX	MIN	AVG	START FRESHET	MAX Q DATE	DATE CM[1]	ANN 7QMIN	JUN-SEP 7QMIN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL RUNOFF*
1974	--	0.1	--	--	--	105	--	2.9	--	--	--	--	--	--	--	19.6	4.5	2.2	0.6	0.1	--
1975	147.0	0.0	10.0	128	131	188	0.0	6.4	0.1	0.1	0.1	0.4	37.3	14.6	23.9	23.1	13.8	4.1	0.4	0.2	174.5
1976	206.0	0.1	8.7	123	197	187	0.1	2.4	0.1	0.1	0.1	0.4	23.4	25.7	42.5	5.9	2.9	1.7	0.8	0.3	153.1
1977	40.8	0.1	5.4	121	185	176	0.1	2.7	0.2	0.2	0.2	0.5	17.6	17.9	15.8	3.9	4.3	2.8	0.7	0.1	94.4
1978	175.0	0.0	9.0	135	195	199	0.0	3.7	0.0	0.0	0.0	0.0	7.0	20.8	40.1	23.4	7.7	4.8	1.8	0.6	156.8
1979	55.9	0.1	7.0	122	174	191	0.1	5.4	0.3	0.1	0.1	0.2	18.0	18.4	19.6	12.0	10.3	3.5	1.1	0.4	123.5
1980	91.2	0.1	6.0	129	260	228	0.1	3.4	0.2	0.2	0.2	0.3	7.8	4.7	16.6	11.0	22.1	7.7	0.8	0.2	105.2
1981	62.3	0.2	5.3	126	185	200	0.2	3.2	0.2	0.2	0.2	0.2	12.8	4.7	18.4	14.0	5.9	4.8	1.6	0.4	93.7
1982	78.1	0.1	6.0	130	214	160	0.1	2.3	0.2	0.1	0.1	0.2	24.0	20.1	4.9	16.0	2.7	1.9	0.8	0.3	105.1
1983	113.0	0.0	7.4	141	154	204	0.0	4.2	0.1	0.1	0.1	0.1	8.5	21.3	17.9	27.3	8.9	3.3	0.4	0.0	129.3
1984	--	--	--	131	132	148	0.0	2.6	0.0	0.0	0.0	0.1	--	--	19.6	4.3	13.8	2.6	0.4	0.1	--
1985	90.0	0.0	8.2	134	139	180	0.0	6.0	0.0	0.0	0.0	0.1	25.9	23.4	20.1	11.7	10.8	3.5	1.3	0.8	143.8
1986	117.0	0.0	7.0	142	209	184	0.0	5.1	0.5	0.3	0.1	0.1	21.6	18.4	17.2	10.9	9.3	3.5	0.7	0.6	122.4
1987	109.0	0.0	6.6	125	156	157	0.0	2.6	0.4	0.2	0.1	0.7	26.8	18.6	7.0	12.0	7.8	3.3	1.0	0.4	115.2
1988	64.5	0.2	7.5	122	130	193	0.2	4.3	0.2	0.2	0.2	0.5	26.7	11.0	23.0	15.7	6.1	3.2	1.7	0.8	131.8
1989	22.7	0.1	3.2	124	134	181	0.1	2.4	0.4	0.2	0.1	0.2	10.6	7.9	6.1	4.7	4.0	2.5	1.1	0.5	56.3
1990	142.0	0.0	12.9	110	120	135	0.0	1.4	0.3	0.1	0.1	21.8	76.8	17.0	8.5	3.7	19.0	5.9	1.0	0.3	226.8
1991	98.7	0.2	12.1	118	141	172	0.2	8.8	0.2	0.3	0.4	2.8	49.6	23.1	18.1	18.0	20.5	5.7	3.6	2.2	212.5
1992	214.0	0.3	13.6	122	148	173	0.3	7.8	1.1	0.4	0.5	1.4	52.2	33.7	36.2	12.4	16.5	4.9	2.0	1.1	239.1
1993	64.6	0.2	7.6	113	138	157	0.2	3.5	0.5	0.2	0.2	5.3	36.0	10.0	12.6	13.5	7.2	2.0	1.9	1.3	133.9
1994	--	0.2	--	188	189	213	0.2	2.3	0.7	0.3	0.2	7.9	19.1	9.0	--	--	3.0	2.3	0.5	0.3	--
1995	--	--	--	--	--	183	0.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
1996	79.7	0.0	6.1	139	185	214	0.0	2.4	0.2	0.0	0.0	0.0	6.3	6.0	22.5	21.2	12.1	2.9	0.7	0.1	106.3
1997	108.0	0.0	11.4	129	211	183	0.0	8.4	0.0	0.0	0.0	0.0	28.7	38.8	26.5	24.4	11.0	3.8	1.8	0.7	199.6
1998	18.0	0.0	2.2	122	170	168	0.1	1.7	0.2	0.1	0.1	0.2	8.6	8.3	2.7	1.9	2.4	1.2	0.2	0.0	38.0
1999	98.6	0.0	4.6	133	156	172	0.0	2.4	0.0	0.0	0.0	0.2	9.6	22.0	6.3	4.2	8.9	3.1	0.4	0.1	80.1
2000	140.0	0.0	16.0	121	129	198	0.0	10.5	0.0	0.0	0.0	0.7	53.2	26.6	27.8	30.6	34.2	11.8	4.1	2.4	281.6
2001	243.0	0.6	11.1	135	208	198	0.6	8.5	1.3	0.7	0.6	1.8	15.3	35.4	33.9	19.5	14.8	5.4	2.5	1.1	194.1
2002	48.1	0.2	6.6	127	244	212	0.2	2.5	0.5	0.3	0.2	0.7	19.4	9.1	9.2	14.8	16.4	4.6	1.9	1.0	115.0
2003	131.0	0.1	6.8	115	170	186	0.1	5.8	0.5	0.3	0.1	4.0	12.3	18.5	20.1	11.7	7.1	4.7	1.6	0.7	119.8
2004	117.0	0.3	6.3	118	129	140	0.3	2.7	0.4	0.4	0.4	2.4	40.2	6.3	4.8	7.1	6.1	4.8	1.3	0.6	110.5
2005	41.0	0.3	6.8	114	118	206	0.3	4.5	0.4	0.4	0.3	7.0	14.8	8.6	11.8	12.8	16.4	6.1	2.1	0.4	119.2
2006	54.0	0.0	4.8	129	135	163	0.2	2.0	0.2	0.2	0.2	0.6	20.2	10.6	9.6	5.9	4.9	2.9	1.2	0.3	83.5
2007	42.3	0.0	5.5	115	185	173	0.0	4.3	0.0	0.0	0.0	2.8	23.3	8.9	11.0	6.8	7.6	3.7	0.9	0.3	96.2
2008	249.0	0.1	10.1	120	239	204	0.1	4.2	0.1	0.1	0.1	1.3	42.4	11.6	6.7	31.8	16.6	5.9	2.4	1.3	177.9
2009	127.0	0.5	7.2	119	127	145	0.6	2.2	0.9	0.7	0.6	1.7	45.1	19.0	3.6	4.3	4.8	2.8	1.6	0.8	126.2
2010	156.0	0.2	10.2	110	183	202	0.2	3.5	0.4	0.3	0.2	8.7	17.7	7.7	38.0	23.0	16.7	4.7	2.4	1.3	178.6
2011	123.0	0.8	15.1	121	140	186	0.8	8.7	1.2	1.3	0.9	3.7	44.2	31.8	37.2	36.8	12.0	5.4	3.0	1.7	263.9
2012	73.6	0.9	10.9	113	146	184	0.9	9.9	1.1	0.9	1.0	8.7	28.2	24.9	19.2	20.2	16.0	6.1	2.6	1.5	191.3
2013	145.0	1.1	10.7	126	133	164	1.1	4.7	1.4	1.3	1.2	1.2	46.3	18.3	17.7	10.6	15.0	9.1	3.2	1.7	186.7
2014	46.0	0.5	6.1	115	127	191	0.5	3.2	1.3	1.0	0.7	2.8	23.9	4.8	8.8	7.0	12.3	6.2	2.5	1.3	107.0
2015	80.1	0.3	6.5	126	240	233	0.3	2.9	0.6	0.3	0.4	1.2	9.9	5.3	6.5	21.3	14.8	4.9	2.3	1.4	114.5
2016	48.3	0.8	7.2	113	194	199	0.8	6.0	1.0	0.8	0.9	5.6	12.3	7.4	19.6	13.2	11.3	4.1	2.5	1.3	126.8
2017	96.2	0.2	8.8	113	163	173	0.2	5.8	0.7	0.5	0.3	3.3	21.0	18.7	14.9	8.6	7.0	4.8	2.1	1.0	154.2

*All values in m 3 /s, except Start Freshet, Max Q Date and Date CM - in Julian Days, and Annual Runoff - in mm.
[1]Date of centre of hydrograph mass (Stewart *et al.,* 2001)

09AH004 - Nordenskiold River below Rowlinson Creek

YEAR	MAX	MIN	AVG	START FRESHET	MAX Q DATE	DATE CM[1]	ANN 7QMIN	JUN-SEP 7QMIN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL RUNOFF*
1982	--	4.2	--	--	--	92	--	8.8	--	--	--	--	--	--	11.2	25.0	16.4	11.6	8.0	4.8	--
1983	185.0	2.3	18.6	117	155	163	2.5	14.4	3.6	3.4	2.7	8.4	58.6	51.4	24.8	28.5	19.2	11.3	6.6	3.4	91.5
1984	55.5	2.2	9.0	126	157	173	2.2	6.9	2.3	2.7	2.9	3.7	21.4	25.9	16.3	7.4	10.3	7.1	4.0	3.3	44.2
1985	96.7	2.4	14.9	133	147	174	2.4	11.9	3.1	2.6	3.0	4.0	42.6	42.2	18.7	18.8	19.6	12.7	6.8	4.3	73.4
1986	118.0	2.8	19.1	132	151	177	2.8	16.0	4.5	4.4	3.0	3.5	45.3	58.3	23.8	20.7	23.7	23.8	9.7	7.3	93.8
1987	71.2	2.0	10.9	119	138	160	2.0	6.5	3.7	2.6	2.1	5.0	38.1	29.3	13.0	9.9	9.6	7.7	5.1	4.2	53.6
1988	103.0	2.3	20.1	124	199	205	2.3	15.9	2.8	2.6	4.0	5.1	43.1	26.2	56.6	43.9	21.6	16.3	9.5	7.1	98.9
1989	119.0	3.5	14.3	112	121	144	3.6	7.5	4.1	4.0	4.7	20.4	58.3	19.1	22.4	11.1	8.0	8.1	6.0	4.8	70.5
1990	59.0	3.1	14.0	116	121	172	3.1	7.4	3.5	3.3	3.7	8.0	44.3	28.8	20.3	8.9	21.0	13.8	6.8	4.7	68.8
1991	114.0	2.7	23.2	116	126	207	2.7	17.1	3.1	2.9	3.6	10.5	64.0	28.7	32.8	29.8	48.0	27.2	15.5	10.9	114.3
1992	199.0	5.5	27.0	122	149	171	5.5	20.8	8.5	6.8	6.1	8.4	71.4	79.3	45.5	26.6	32.3	18.9	12.2	7.8	133.3
1993	94.0	4.3	18.8	114	150	173	4.3	14.6	5.8	4.6	4.4	16.2	56.9	31.2	16.8	21.1	22.6	19.9	15.1	10.3	92.6
1994	39.6	2.9	9.3	109	136	150	3.2	5.2	6.9	4.8	3.5	9.5	32.4	16.2	9.8	5.6	7.9	7.8	4.0	3.1	45.9
1995	35.9	1.7	8.0	116	123	211	1.7	4.2	2.7	2.1	1.8	4.1	24.0	5.8	7.8	10.7	16.1	9.9	5.7	5.1	39.6
1996	47.7	2.5	9.4	115	199	199	2.5	5.6	3.9	3.1	2.7	6.0	21.4	9.3	21.3	19.1	11.6	6.0	4.9	3.2	46.5
1997	89.1	2.0	12.3	122	140	158	2.0	6.3	2.7	2.4	2.1	3.3	52.1	32.0	11.9	16.7	9.0	6.5	4.4	3.5	60.5
1998	39.6	1.3	5.8	112	126	148	2.7	3.2	3.1	2.8	2.7	5.2	23.8	12.8	5.0	3.5	4.1	3.4	1.7	1.3	28.6
1999	83.7	1.2	8.8	125	157	166	1.2	5.0	1.2	1.2	1.3	2.8	24.5	35.6	14.3	5.5	8.1	5.5	3.0	1.9	43.1
2000	120.0	1.4	28.5	127	236	238	1.4	22.1	1.5	1.4	1.4	5.6	39.7	40.1	36.1	63.8	84.9	41.6	16.6	8.2	140.5
2001	90.5	4.4	20.4	128	155	195	4.4	22.2	5.9	4.8	4.4	7.2	29.4	56.7	36.5	35.2	25.6	17.9	11.6	8.3	100.3
2002	71.7	2.6	11.6	128	138	168	2.6	9.3	6.2	4.2	2.7	3.5	37.6	21.8	11.7	14.2	17.5	9.5	5.9	3.9	57.2
2003	46.0	2.6	7.9	113	121	175	2.8	5.9	3.0	2.8	2.8	8.0	17.7	17.5	16.7	7.4	6.4	5.2	4.0	2.9	38.9
2004	96.3	1.5	10.2	120	130	147	2.2	5.3	2.3	2.3	2.5	4.1	57.3	18.7	6.6	6.3	8.5	7.1	4.7	2.0	50.6
2005	59.6	1.4	10.2	116	119	195	1.4	10.3	1.4	1.4	2.5	8.9	22.0	15.6	17.8	12.2	16.1	10.9	8.5	4.4	50.2
2006	71.9	2.4	9.9	127	142	161	2.4	6.8	2.9	2.5	2.5	4.1	34.5	25.7	17.6	9.5	7.4	5.4	3.1	3.0	48.7
2007	63.7	2.6	11.2	118	139	175	2.7	8.8	3.0	2.7	2.7	5.3	37.3	19.5	17.9	11.4	12.5	12.4	5.9	3.0	55.1
2008	115.0	2.5	19.7	122	240	199	2.5	13.8	2.6	2.5	2.9	4.4	56.2	34.5	24.8	33.2	36.4	17.9	13.0	7.8	97.4
2009	206.0	3.8	16.7	119	128	139	4.2	7.4	5.1	4.3	4.2	7.7	108.1	26.9	10.7	7.9	8.0	6.6	5.1	4.1	82.2
2010	47.1	3.2	10.8	116	121	193	3.2	9.5	3.5	3.3	3.3	7.2	27.9	12.4	16.5	11.3	16.4	11.4	9.2	6.9	53.2
2011	131.0	3.8	23.0	125	141	197	3.8	21.3	4.9	4.3	4.0	3.9	66.3	40.3	28.8	47.9	31.5	20.9	12.4	9.2	113.3
2012	96.4	5.0	22.2	115	147	181	5.0	23.6	6.6	5.3	5.2	13.2	57.5	46.8	32.0	30.6	29.1	18.1	12.1	8.7	109.3
2013	144.0	5.6	21.8	129	134	169	5.6	12.3	7.5	6.6	6.0	5.7	64.4	53.4	28.5	27.4	23.1	18.6	10.2	9.3	107.4
2014	95.7	4.1	16.5	118	126	160	4.1	10.6	8.1	6.5	4.9	6.5	64.7	19.8	12.4	12.2	21.3	20.7	10.7	9.4	81.3
2015	71.3	5.0	14.7	125	241	230	5.0	9.6	6.7	5.0	5.2	7.2	24.8	12.0	12.1	15.3	32.9	21.1	12.1	10.3	72.4
2016	46.2	5.8	15.3	99	133	185	5.8	11.2	7.4	5.8	5.8	22.9	26.3	17.9	25.1	17.6	24.0	9.4	8.8	6.8	75.6
2017	86.6	4.1	19.8	118	200	197	4.1	18.7	5.2	4.3	4.1	5.1	44.6	36.0	49.4	27.8	20.3	15.2	9.5	7.1	228.6

*All values in m 3 /s, except Start Freshet, Max Q Date and Date CM - in Julian Days, and Annual Runoff - in mm.
[1]Date of centre of hydrograph mass (Stewart *et al.,* 2001)

09BC001 - Pelly River at Pelly Crossing

YEAR	MAX	MIN	AVG	START FRESHET	MAX Q DATE	DATE CM[1]	ANN 7QMIN	JUN-SEP 7QMIN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL RUNOFF*
1974	--	62.6	--	--	--	119	--	281.6	--	--	--	--	--	980.3	508.3	598.1	343.4	221.4	112.8	75.7	--
1975	2590.0	50.4	458.6	131	158	178	50.7	344.7	55.5	55.0	51.4	60.9	883.2	1827.7	916.0	456.6	478.9	428.5	167.9	105.7	295.8
1976	1420.0	56.4	380.0	125	159	180	56.4	303.4	71.5	60.5	57.2	59.7	935.6	1194.0	940.0	463.0	323.1	250.5	108.8	81.0	245.6
1977	1980.0	48.4	370.8	127	151	178	49.0	321.9	68.1	62.0	53.6	54.4	878.0	1214.8	671.5	435.5	416.5	344.0	156.9	76.4	239.2
1978	1510.0	35.1	352.5	128	158	195	35.6	289.4	57.1	43.9	36.5	40.5	547.0	1082.0	726.3	655.4	346.1	368.0	197.4	108.0	227.3
1979	2180.0	44.7	419.1	121	159	177	45.7	250.7	61.8	49.8	54.0	60.2	869.6	1629.0	933.9	607.1	281.5	260.1	118.5	81.5	270.3
1980	1270.0	47.9	313.4	131	140	200	48.4	371.6	64.2	52.1	50.8	70.8	626.5	760.7	557.6	455.6	442.1	376.4	198.8	95.3	202.7
1981	1440.0	55.4	316.4	122	150	177	55.8	240.6	71.1	61.2	57.4	69.3	931.6	801.3	540.5	338.8	351.8	315.2	146.1	90.9	204.0
1982	1740.0	28.0	305.7	133	163	177	28.5	257.4	46.6	32.6	33.6	38.6	527.6	1260.1	544.5	368.2	284.1	291.1	140.2	90.4	197.1
1983	2700.0	39.9	410.4	126	158	177	40.4	406.7	66.7	62.5	47.8	66.1	793.3	1583.7	666.0	571.1	547.3	299.6	135.1	73.8	264.6
1984	1610.0	35.5	343.7	130	166	183	36.1	290.4	50.8	43.7	38.0	62.0	684.8	1160.5	738.4	429.1	440.6	243.3	142.8	84.8	222.2
1985	2480.0	44.0	421.5	137	159	186	44.8	446.3	64.8	51.1	46.4	49.5	559.0	1582.4	1035.9	623.8	476.1	335.5	116.5	98.5	271.8
1986	2360.0	38.6	488.5	133	162	185	39.1	463.3	81.0	62.0	46.4	41.4	707.1	1872.0	910.8	674.6	619.6	481.8	234.6	115.7	315.0
1987	2110.0	54.2	412.3	129	155	182	55.0	426.7	84.4	70.7	56.7	68.1	789.1	1387.5	769.3	509.6	499.6	424.7	150.1	119.9	265.9
1988	1910.0	57.0	430.3	125	139	186	57.2	392.4	85.6	67.4	61.4	79.3	1033.6	1164.6	969.6	600.5	420.7	361.3	163.6	135.5	278.2
1989	1620.0	46.5	287.7	119	132	161	46.5	163.0	98.8	64.4	49.0	78.8	1093.0	900.9	401.4	243.7	174.5	159.0	95.3	75.5	185.6
1990	1980.0	39.0	431.9	122	155	185	39.0	347.7	65.2	43.0	43.5	75.8	954.4	1274.0	673.8	405.1	898.0	497.9	142.2	93.1	278.5
1991	1520.0	60.0	522.0	120	142	197	60.0	577.1	72.6	62.9	60.5	89.7	1250.1	1172.7	992.4	838.4	790.5	514.0	237.5	145.5	336.7
1992	2830.0	80.0	506.4	129	160	178	80.1	380.3	107.0	90.1	81.9	103.8	652.8	2308.3	1240.8	560.5	455.9	256.1	121.7	102.7	327.5
1993	2910.0	55.0	474.7	124	156	166	55.3	378.7	82.1	67.2	59.9	90.5	1364.5	1777.2	764.5	473.6	419.5	322.3	127.2	124.9	306.1
1994	1490.0	67.3	351.1	120	146	172	67.6	217.7	91.9	73.7	68.3	122.4	900.7	1143.3	542.5	262.1	262.7	438.6	164.0	125.6	226.4
1995	1020.0	53.9	323.7	119	136	192	54.1	374.6	91.0	71.6	58.0	118.2	771.4	663.1	447.8	480.8	613.3	326.5	133.8	92.4	208.8
1996	1590.0	47.4	398.5	121	150	194	47.6	472.0	72.8	58.5	50.0	88.1	795.1	1049.2	766.1	686.9	635.2	293.2	174.5	101.7	257.7
1997	1570.0	39.5	342.0	126	146	181	39.7	326.3	69.9	51.1	41.0	60.6	867.9	966.3	627.7	604.7	382.2	173.6	132.4	103.6	220.5
1998	1550.0	37.1	261.0	120	151	167	37.2	207.3	64.3	44.3	37.7	84.3	788.8	817.1	345.7	262.4	254.3	213.8	124.8	80.6	168.3
1999	1430.0	39.0	354.2	129	168	192	39.0	428.3	53.2	41.3	39.3	60.2	579.0	1097.8	595.0	579.3	496.3	362.5	205.3	125.6	228.5
2000	1440.0	49.8	496.5	129	163	223	50.6	567.3	75.2	55.0	51.9	53.4	535.5	1194.4	766.0	904.9	930.2	847.4	352.4	181.2	321.1
2001	2300.0	65.3	416.6	136	159	179	65.7	359.6	124.1	91.1	70.3	79.1	466.0	1783.0	888.0	449.5	460.2	314.8	150.0	117.9	268.7
2002	1300.0	37.3	334.8	130	144	202	37.5	313.0	81.6	55.7	40.1	44.2	746.1	769.9	385.9	562.7	712.9	312.2	157.5	133.5	215.9
2003	1210.0	58.3	282.0	121	164	181	58.4	242.7	95.6	72.1	61.9	78.5	494.4	909.0	549.6	277.5	318.3	304.8	97.9	112.6	181.8
2004	2390.0	58.2	351.5	125	153	164	58.2	204.9	82.1	61.3	58.5	61.7	1048.7	1531.1	459.1	256.9	228.4	230.9	116.9	81.1	227.3
2005	2340.0	60.0	452.5	120	142	172	60.0	424.9	67.4	61.8	60.0	92.7	1504.9	1159.0	647.2	517.2	535.2	407.0	184.7	160.2	291.8
2006	1490.0	53.0	356.2	132	149	179	53.0	369.1	95.0	65.9	54.4	66.1	698.5	1235.9	569.7	418.8	448.7	369.7	124.1	114.3	229.7
2007	1860.0	44.5	372.8	124	160	186	44.5	356.3	89.0	60.1	45.5	84.6	681.8	1172.6	788.6	506.9	464.0	319.0	140.6	102.1	240.4
2008	2090.0	54.0	514.5	127	152	200	54.0	519.3	70.1	58.0	54.6	79.7	1094.6	1192.4	914.6	708.7	977.6	619.2	226.4	162.6	332.7
2009	2000.0	67.4	400.4	125	160	166	67.4	259.3	111.0	85.6	71.4	73.6	1151.3	1511.9	532.7	312.1	402.2	285.7	140.8	112.5	258.2
2010	920.0	55.4	257.6	118	163	179	55.4	210.4	69.7	58.7	55.8	91.6	569.9	750.3	568.8	266.4	253.3	189.6	115.0	88.6	166.1
2011	2100.0	46.1	461.2	133	148	190	46.4	541.9	66.4	56.9	49.5	50.7	878.6	1291.1	1046.9	793.3	615.2	363.5	158.4	134.0	297.5
2012	2460.0	64.5	495.2	130	170	183	65.1	438.9	93.9	74.8	68.3	95.9	701.9	1955.0	1264.8	632.7	493.1	279.6	163.3	116.0	320.3
2013	3320.0	65.6	451.2	135	155	174	66.0	345.6	97.6	84.4	75.9	68.6	873.5	1756.9	594.7	441.8	637.1	424.8	210.2	140.9	291.0
2014	1660.0	54.7	396.9	124	144	183	55.6	427.7	110.7	87.7	69.2	66.9	1074.4	912.8	632.2	463.5	514.8	479.6	184.0	139.7	255.9
2005	2340.0	60.0	452.3	120	142	172	60.0	424.9	67.5	61.8	60.0	60.6	1740.0	1265.0	647.0	482.0	546.0	426.0	186.5	160.0	292.5
2006	1490.0	53.0	356.2	132	149	179	53.0	369.1	93.0	65.6	53.8	60.6	492.0	1315.0	589.0	390.0	470.0	378.0	131.0	114.0	229.7
2007	1860.0	44.5	372.7	124	160	186	44.5	356.3	89.0	59.5	44.9	61.5	568.0	1260.0	811.0	481.0	494.0	349.0	147.5	99.0	241.0
2008	2090.0	54.0	514.5	127	152	200	54.0	519.3	69.3	57.7	54.3	70.7	1000.0	1115.0	874.0	562.0	947.0	660.0	234.0	160.0	332.7
2009	2000.0	67.4	400.3	125	160	166	67.4	259.3	110.0	85.7	70.8	68.1	1120.0	1580.0	510.0	276.0	390.5	202.0	144.0	110.0	258.8
2010	920.0	55.4	257.1	118	163	179	55.4	210.4	68.4	58.5	55.8	58.2	504.0	765.0	521.0	259.0	257.0	208.0	115.0	88.0	166.3
2011	2100.0	46.1	461.0	133	148	191	46.4	541.9	66.1	56.9	49.5	48.5	491.0	1215.0	1010.0	801.0	623.5	374.0	167.0	133.0	298.1
2012	2460.0	64.5	495.2	130	170	183	65.1	438.9	93.5	74.8	68.3	81.8	590.0	1840.0	1300.0	618.0	485.5	310.0	166.0	116.0	320.3
2013	3320.0	65.6	450.9	135	155	174	66.0	345.6	97.5	84.4	75.9	68.6	605.0	1515.0	558.0	401.0	632.5	429.0	218.0	140.0	291.6
2014	1660.0	54.7	396.9	124	144	183	55.6	427.7	110.0	87.6	69.0	60.3	1200.0	896.0	640.0	448.0	507.5	509.0	186.5	134.0	255.9
2015	1910.0	77.1	427.5	132	143	196	77.5	401.7	109.0	91.5	82.9	83.6	1080.0	762.5	569.0	473.0	776.0	582.0	235.5	182.0	276.5
2016	1630.0	89.4	408.0	119	149	182	90.0	444.0	132.0	101.0	93.3	184.5	852.0	989.5	577.0	702.0	519.5	198.0	183.5	131.0	263.9
2017	1150.0	52.3	375.8	132	189	197	52.4	375.6	91.2	72.4	54.7	74.9	644.0	1015.0	982.0	684.0	458.0	342.0	159.0	106.0	243.0

*All values in m^3/s, except Start Freshet, Max Q Date and Date CM - in Julian Days, and Annual Runoff - in mm.
[1]Date of centre of hydrograph mass (Stewart *et al.,* 2001)

09CA006 - Nisling River below Onion Creek

YEAR	MAX	MIN	AVG	START FRESHET	MAX Q DATE	DATE CM[1]	ANN 7QMIN	JUN-SEP 7QMIN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL RUNOFF*
1995	--	9.2	--	--	--	113	--	39.5	--	--	--	--	--	--	--	--	59.7	23.7	13.4	10.1	--
1996	160.0	4.6	26.8	184	199	217	4.6	8.7	8.5	6.4	5.2	5.4	23.7	18.0	77.4	92.6	45.3	17.7	10.7	8.4	107.1
1997	334.0	6.1	40.0	129	213	209	6.1	28.8	7.4	6.6	6.2	7.4	80.0	73.7	86.1	115.2	42.7	23.8	15.3	11.6	159.4
1998	39.6	1.9	9.3	115	126	148	6.0	7.4	8.6	6.7	6.1	7.7	29.0	18.2	9.4	7.8	7.4	5.6	2.8	2.1	37.1
1999	215.0	1.7	17.1	123	158	169	1.7	9.5	1.8	1.7	2.0	5.3	41.5	65.4	21.1	14.4	21.6	16.3	8.5	5.7	68.3
2000	384.0	3.6	65.6	140	197	233	3.6	51.3	4.3	3.8	3.7	4.7	68.1	103.8	123.8	181.5	180.9	74.4	20.6	15.1	262.2
2001	455.0	8.2	50.5	148	208	210	8.2	34.6	11.5	9.3	8.3	12.4	39.0	116.4	126.6	106.7	92.1	35.4	27.2	19.0	201.5
2002	354.0	7.2	35.3	128	210	210	7.2	16.2	14.1	10.4	7.7	7.7	89.6	41.8	59.1	67.2	66.2	28.4	16.0	13.1	140.8
2003	370.0	6.1	31.6	169	186	193	6.1	18.1	10.2	8.5	7.4	10.7	30.8	56.1	95.4	60.2	37.6	22.9	21.5	15.2	125.8
2004	--	5.5	--	184	185	217	5.5	17.5	8.4	6.3	5.6	7.9	115.6	38.9	--	--	--	28.0	16.3	9.3	--
2005	229.0	5.6	38.5	114	119	210	5.6	24.9	6.7	5.9	5.7	40.3	55.3	42.8	81.2	66.2	91.0	40.6	15.0	9.3	153.5
2006	197.0	5.9	23.0	129	180	190	5.9	12.7	7.3	6.3	6.0	8.2	52.5	47.1	40.0	33.3	30.7	22.0	12.1	8.5	91.5
2007	194.0	6.0	29.2	119	185	188	6.0	19.1	7.0	6.4	6.1	11.2	87.3	27.1	60.0	43.5	44.3	30.8	14.5	9.6	116.5
2008	572.0	7.0	43.2	118	240	236	7.0	21.8	8.1	7.4	7.1	16.5	84.9	57.7	49.8	126.1	101.2	29.7	16.1	12.0	172.6
2009	360.0	7.5	30.0	119	127	145	7.8	14.4	9.4	8.3	7.8	9.7	171.2	57.1	21.9	18.0	19.9	14.6	10.3	8.5	119.5
2010	253.0	5.4	39.2	181	232	231	5.4	11.1	6.8	6.0	5.5	15.5	38.5	15.6	106.8	102.6	102.0	35.0	18.3	13.7	156.1
2011	310.0	7.2	64.3	123	141	200	7.4	47.4	11.6	10.5	10.1	9.6	149.5	124.0	135.7	185.9	66.7	30.7	17.5	13.6	256.4
2012	242.0	9.7	50.5	113	187	207	9.7	51.0	11.0	10.1	9.8	29.5	78.7	77.4	101.1	107.8	104.9	44.1	16.6	13.0	201.8
2013	435.0	8.5	56.1	129	208	204	8.5	35.8	12.9	12.6	10.6	8.7	142.8	97.4	140.1	86.5	65.6	49.3	23.8	17.0	223.5
2014	170.0	7.8	31.4	114	143	190	7.8	19.5	12.0	9.9	8.5	18.6	102.6	27.9	41.1	38.4	51.8	32.9	17.9	12.4	125.1
2015	211.0	8.2	30.9	211	242	242	8.2	12.7	9.7	8.4	9.6	12.0	27.0	15.6	19.1	61.0	96.4	40.1	18.2	12.9	123.0
2016	147.0	8.8	31.5	106	208	206	8.8	26.7	9.7	9.0	9.0	28.6	33.6	34.1	81.0	53.3	52.5	18.1	17.4	12.5	125.8
2017	173.0	5.8	33.5	118	213	197	5.9	29.5	9.6	7.9	6.2	11.2	69.3	56.4	84.5	42.4	30.8	24.1	15.7	11.6	133.5

*All values in m^3/s, except Start Freshet, Max Q Date and Date CM - in Julian Days, and Annual Runoff - in mm.
[1]Date of centre of hydrograph mass (Stewart *et al.,* 2001)

09CD001 - Yukon River above White River

YEAR	MAX	MIN	AVG	START FRESHET	MAX Q DATE	DATE CM[1]	ANN 7QMIN	JUN-SEP 7QMIN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL RUNOFF*
1974	2660.0	436.0	--	177	221	200	--	--	--	--	--	--	--	1192.8	2142.9	2248.1	1603.3	1205.5	932.6	508.6	--
1975	3790.0	317.0	1316.4	132	157	199	317.0	1614.3	411.7	389.5	347.9	328.5	1590.1	3109.7	2978.1	2055.5	1815.7	1587.1	691.3	424.5	278.6
1976	3850.0	345.0	1236.7	125	198	194	345.9	1105.7	367.5	360.0	351.2	374.8	1835.6	2976.0	3038.7	1929.7	1404.7	988.3	703.8	470.3	262.3
1977	3230.0	371.0	1234.2	130	157	195	373.4	1501.4	440.5	421.9	392.1	433.0	1516.8	3005.7	2568.1	2008.7	1627.3	1250.5	630.6	461.4	261.2
1978	2680.0	276.0	1044.1	128	160	202	278.4	1067.1	390.8	341.9	296.0	299.5	1267.5	2300.3	2122.3	1896.8	1254.7	1050.0	808.2	449.2	221.0
1979	3750.0	320.0	1279.9	123	160	196	323.3	1255.7	375.7	337.1	339.1	367.9	1546.0	3264.3	3119.0	2231.9	1421.0	1159.0	683.9	442.7	270.9
1980	2490.0	377.0	1109.7	135	201	210	381.0	1461.4	416.2	401.7	389.6	420.8	1184.7	2099.0	1944.8	1839.7	1625.7	1427.1	998.5	545.6	235.5
1981	3010.0	348.0	1173.6	130	154	199	350.4	1352.9	452.2	381.7	367.1	399.8	1706.9	2410.3	2129.0	1599.0	1529.0	1461.9	1036.5	554.5	248.4
1982	3310.0	360.0	969.1	138	164	192	364.3	1101.4	443.5	455.5	380.8	369.2	906.7	2648.0	1784.5	1389.0	1160.0	1027.6	618.7	425.1	205.1
1983	4210.0	320.0	1105.4	132	158	195	324.3	1292.9	367.2	354.0	332.7	354.0	1311.3	3051.3	1976.5	1685.5	1551.0	1075.3	714.6	458.8	234.0
1984	3030.0	310.0	1009.3	145	168	200	310.0	1228.6	390.4	356.4	315.8	359.3	788.2	2491.7	2187.7	1495.5	1515.3	1066.8	615.2	517.4	214.2
1985	4850.0	400.0	1259.0	141	160	195	400.9	1325.7	464.5	419.9	418.3	417.8	1090.4	3385.3	3029.0	2065.5	1511.3	1133.7	658.6	462.6	266.5
1986	4200.0	307.0	1512.8	142	161	207	308.3	1648.6	420.5	401.2	359.6	318.1	1115.7	3767.3	3229.4	2471.9	2086.3	1672.6	1349.3	902.0	320.2
1987	4280.0	347.0	1242.3	135	156	193	347.9	1474.3	595.3	443.4	362.6	382.8	1417.0	3267.0	2488.7	1782.9	1580.3	1360.6	735.9	446.3	262.9
1988	4050.0	295.0	1339.7	133	201	201	340.9	1450.0	406.5	357.6	342.9	399.7	1761.3	3027.7	3277.7	2506.8	1665.3	1265.8	683.5	331.9	284.3
1989	2820.0	295.0	1040.3	122	162	188	295.0	1182.9	306.8	379.5	375.0	382.3	2079.0	2358.0	1659.7	1434.2	1231.3	1074.5	678.2	476.7	220.2
1990	4000.0	296.0	1299.7	128	180	193	296.9	1521.4	375.0	317.5	303.0	418.1	1728.9	3487.7	2525.5	1618.7	2124.7	1482.7	700.5	469.0	275.1
1991	3230.0	316.0	1384.2	132	214	209	317.3	1914.3	370.0	328.2	324.8	424.0	1761.6	2722.0	2685.8	2368.7	2434.7	1844.2	707.4	561.4	293.0
1992	5440.0	362.0	1603.7	144	174	192	365.3	1624.3	467.4	385.1	392.2	470.3	1446.1	5100.3	4104.5	2517.1	1932.7	1262.3	655.2	488.7	340.4
1993	4330.0	356.0	1296.4	134	156	188	356.9	1364.3	440.7	426.9	394.6	445.5	2107.1	3463.3	2324.8	1768.7	1494.7	1304.2	785.5	548.6	274.4
1994	2980.0	385.0	1195.9	127	166	193	387.9	1335.7	493.9	451.0	406.3	539.3	1650.0	2725.7	2184.2	1536.5	1380.7	1648.1	758.2	525.2	253.1
1995	2060.0	300.0	969.1	121	138	200	300.9	1330.0	412.8	320.9	302.5	407.2	1656.1	1781.3	1509.4	1450.0	1590.0	1179.8	496.1	473.3	205.1
1996	2460.0	285.0	952.7	138	154	203	286.4	1311.4	407.6	329.9	291.9	353.7	1144.2	1981.7	1809.4	1520.0	1538.7	932.1	642.6	463.5	202.2
1997	3030.0	259.0	1104.3	128	162	197	260.1	1288.6	334.3	283.7	262.3	290.7	1850.6	2584.7	2068.4	1912.9	1446.3	988.0	795.0	378.5	233.7
1998	2680.0	271.0	831.9	130	153	184	276.1	886.4	344.8	411.4	317.8	350.2	1363.9	2072.3	1354.2	1094.8	940.2	753.8	514.2	442.5	176.1
1999	2720.0	300.0	971.1	130	170	205	300.0	1340.0	319.0	302.1	300.5	324.6	1099.7	2158.3	1731.3	1728.4	1440.0	1097.8	652.2	456.6	205.5
2000	3430.0	307.0	1476.8	149	275	227	307.1	1687.1	344.3	314.8	308.3	334.1	1254.3	2559.0	2661.6	2705.8	2944.3	2444.5	1081.6	726.2	313.4
2001	4320.0	380.0	1288.4	140	170	194	381.1	1584.3	557.5	471.0	394.5	435.8	1124.7	3512.7	2853.2	1948.7	1626.7	1192.0	740.1	562.4	272.7
2002	2740.0	328.0	1154.1	130	247	212	328.0	1467.1	426.5	361.3	337.2	330.4	1581.2	2237.7	1681.3	1837.1	2157.0	1310.3	890.8	654.3	244.3
2003	2220.0	288.0	936.7	132	165	199	289.7	1137.1	480.1	379.6	307.1	359.5	1061.7	1941.0	1865.5	1368.4	1211.0	1150.1	558.9	514.0	198.3
2004	4050.0	318.0	1180.6	135	163	189	319.0	1288.6	434.8	368.6	329.0	375.4	1856.2	3294.0	1970.6	1468.7	1307.0	1222.9	734.2	785.7	250.6
2005	4110.0	366.0	1393.2	120	143	186	366.9	1694.3	600.6	480.0	384.2	502.1	2833.9	3208.0	2312.6	1847.7	1826.0	1460.3	603.3	589.4	294.9
2006	3640.0	307.0	1196.6	137	171	197	307.0	1505.7	465.8	405.5	331.9	315.7	1244.7	3125.0	2434.8	1788.7	1680.3	1391.5	670.0	461.0	253.3
2007	3900.0	295.0	1267.1	138	160	200	318.4	1745.7	400.4	368.9	337.8	334.5	1352.0	3128.3	2648.1	2235.8	1813.3	1506.8	645.2	374.5	268.2
2008	3610.0	313.0	1437.2	130	153	204	297.3	1781.4	463.0	409.4	333.0	413.5	1886.9	3042.7	2866.1	2165.2	2401.3	1722.3	820.8	686.0	305.0
2009	3990.0	378.0	1319.2	123	161	182	378.7	1430.0	601.4	510.2	439.5	405.6	2363.1	3563.0	2148.7	1491.3	1566.3	1477.7	770.7	447.5	279.2
2010	2340.0	346.0	986.9	117	184	194	346.4	1120.0	495.1	425.3	362.7	506.0	1394.5	1880.7	1905.2	1335.8	1256.3	997.4	635.5	604.3	208.9
2011	3390.0	304.0	1279.4	138	157	199	304.9	1802.9	482.8	383.6	321.0	419.8	1624.5	2897.7	2542.3	2126.5	1930.0	1391.2	653.9	518.6	270.8
2012	4780.0	352.0	1393.8	146	168	196	352.3	1731.4	458.9	414.0	378.2	443.6	1311.0	3781.3	3475.5	2157.4	1833.3	1359.1	602.4	482.2	295.8
2013	5750.0	350.0	1388.3	135	156	190	350.0	1665.7	462.0	441.0	380.0	351.0	1400.0	3910.0	2360.0	1820.0	1955.0	1570.0	518.0	623.0	293.8
2014	3310.0	344.0	1409.9	125	145	203	344.0	1681.4	614.0	499.0	392.0	352.0	2370.0	2595.0	2340.0	1740.0	1945.0	1980.0	1040.0	924.0	298.4
2015	3480.0	458.0	1355.0	135	150	209	459.0	1578.6	637.0	509.0	463.0	474.5	1470.0	2310.0	2010.0	1720.0	2385.0	1860.0	1095.0	771.0	286.8
2016	3100.0	363.0	1203.4	130	149	193	513.4	1670.0	658.0	581.0	524.0	533.0	1590.0	2520.0	1870.0	1910.0	1740.0	1280.0	512.0	475.0	255.4
2017	2810.0	330.0	1132.7	135	214	202	330.3	1410.0	456.0	370.5	332.0	528.5	1260.0	2360.0	2480.0	1960.0	1590.0	1280.0	488.0	431.0	239.7

*All values in m^3/s, except Start Freshet, Max Q Date and Date CM - in Julian Days, and Annual Runoff - in mm.
[1]Date of centre of hydrograph mass (Stewart *et al.,* 2001)

09DD003 - Stewart River at the Mouth

YEAR	MAX	MIN	AVG	START FRESHET	MAX Q DATE	DATE CM[1]	ANN 7QMIN	JUN-SEP 7QMIN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL RUNOFF*
1974	1280.0	105.0	--	--	221	130	--	368.6	--	--	--	--	--	992.2	643.2	890.6	443.5	247.7	166.9	123.1	--
1975	3960.0	58.6	595.4	130	159	176	59.2	446.1	85.2	73.8	65.8	60.9	1090.0	2552.3	1140.7	635.0	598.7	516.5	186.0	122.5	368.2
1976	1760.0	59.2	369.8	124	128	179	59.5	292.4	90.4	73.7	62.8	64.2	992.5	1062.3	758.0	494.1	337.3	299.3	115.8	70.9	229.2
1977	2570.0	57.2	407.0	128	155	170	58.8	286.7	64.1	74.7	63.0	68.7	0.7	1673.3	674.4	480.9	353.9	259.7	79.0	78.1	199.2
1978	2160.0	43.3	396.4	128	163	190	44.2	299.3	62.8	55.4	48.4	53.3	509.8	1303.4	1102.6	603.9	324.6	351.9	194.1	122.7	245.1
1979	2110.0	53.5	519.7	121	155	185	53.8	386.0	82.5	60.7	63.4	66.2	1079.3	1629.0	1245.1	758.8	460.9	422.6	209.9	122.3	321.3
1980	2040.0	66.5	441.2	126	164	191	67.3	458.1	82.4	70.4	71.9	90.9	834.0	1288.0	761.1	740.6	565.1	453.1	197.8	127.1	273.6
1981	1530.0	62.0	420.6	127	152	191	62.9	378.9	92.8	76.7	67.2	77.9	961.4	947.5	847.7	643.1	626.2	420.5	150.3	106.1	260.1
1982	1850.0	45.5	390.7	134	167	181	46.0	277.7	89.5	54.5	48.9	56.3	601.5	1525.0	853.7	638.3	320.6	250.2	143.8	88.4	241.6
1983	3840.0	57.0	466.3	126	158	181	58.1	440.3	79.3	77.0	61.9	71.7	709.0	1836.7	724.4	798.4	608.3	319.4	188.5	111.1	288.4
1984	1680.0	58.5	374.2	123	169	178	59.5	245.1	69.8	61.8	68.0	108.9	885.2	1222.2	820.9	450.1	325.6	222.5	139.5	105.9	232.0
1985	3740.0	53.5	482.2	135	161	182	53.8	460.9	88.9	74.5	56.3	58.5	687.9	1916.7	1167.3	645.1	536.1	339.9	122.8	75.6	298.2
1986	3030.0	64.0	516.4	132	163	181	64.0	376.1	70.9	67.2	66.7	66.4	745.4	2122.3	1032.5	906.9	631.1	271.4	110.5	90.3	319.3
1987	3300.0	40.8	461.0	130	156	183	41.1	419.1	83.3	74.5	52.0	56.8	747.2	1714.7	813.4	531.0	647.7	545.7	140.5	111.1	285.1
1988	2370.0	65.5	548.1	124	139	185	65.7	519.3	80.3	71.2	68.3	116.3	1357.6	1512.7	1036.6	856.0	665.4	436.2	215.7	139.8	339.8
1989	1950.0	65.9	364.7	120	162	163	66.0	224.0	99.9	76.9	67.0	101.5	1212.9	1334.9	571.0	304.1	233.6	160.4	114.9	82.4	225.5
1990	2670.0	53.5	495.8	124	156	186	53.6	382.3	65.7	56.9	54.4	100.0	971.7	1577.7	660.4	578.0	1047.2	594.1	134.8	94.7	306.6
1991	1830.0	63.8	527.5	121	142	180	64.1	414.4	86.4	80.3	71.1	80.9	1376.5	1539.7	1070.5	788.1	597.4	388.6	123.5	90.8	326.2
1992	3870.0	83.2	645.5	146	174	182	83.4	474.3	87.3	84.3	89.5	118.9	578.9	2992.0	1558.4	878.0	765.8	336.3	161.5	105.9	400.2
1993	3600.0	60.8	554.9	120	154	165	60.8	396.0	81.5	66.8	62.6	147.7	1573.2	2182.0	878.6	469.3	470.2	331.4	216.9	156.5	343.1
1994	2030.0	49.8	430.5	118	146	170	50.0	242.1	93.3	56.8	51.0	152.3	1234.5	1560.3	840.6	393.2	275.3	298.2	100.9	85.3	266.2
1995	1620.0	63.0	399.4	119	137	187	63.1	461.3	71.4	65.4	63.4	128.0	1040.9	919.2	532.9	554.2	764.6	370.8	174.1	88.4	247.0
1996	1840.0	52.5	416.4	142	152	198	52.7	537.6	63.0	54.4	54.2	77.7	603.0	1302.5	793.0	705.2	753.3	290.1	190.1	108.3	258.2
1997	2270.0	47.5	492.1	120	162	179	47.6	516.6	74.0	57.2	48.9	80.1	1281.3	1501.9	801.1	829.6	560.6	310.5	205.6	124.4	304.3
1998	2240.0	68.0	359.0	124	152	169	68.1	318.0	89.7	76.2	69.4	106.9	946.5	1249.0	502.0	373.6	344.3	267.3	163.3	106.3	222.0
1999	1760.0	47.1	403.2	128	168	189	47.2	465.1	62.5	51.9	48.5	55.0	733.4	1312.9	619.5	578.9	667.2	418.8	160.9	113.3	249.3
2000	2710.0	76.4	624.0	128	169	197	76.4	836.0	88.3	80.4	77.1	80.4	800.8	1990.0	1227.6	1200.1	898.6	593.7	262.8	176.3	386.9
2001	3830.0	72.3	587.5	136	171	178	72.5	501.4	121.5	93.1	75.4	84.5	678.0	2665.0	1275.7	737.9	695.4	326.8	166.6	123.4	363.3
2002	2310.0	60.0	--	120	240	211	60.0	486.6	90.4	74.0	64.3	60.9	--	--	706.1	1245.2	910.2	361.6	187.9	174.5	--
2003	2280.0	75.0	421.8	131	164	186	75.0	367.1	113.5	88.9	76.8	98.1	646.7	1368.8	793.1	490.4	655.1	390.8	182.4	145.1	260.8
2004	2870.0	73.8	371.4	128	151	164	74.0	199.4	108.3	84.5	76.2	77.3	1012.1	1637.6	464.4	335.3	212.9	176.8	147.4	123.9	230.3
2005	3160.0	61.4	609.5	122	141	170	61.5	598.6	96.4	77.1	63.0	99.5	2022.3	1673.3	850.6	716.2	704.2	561.0	229.1	178.4	376.9
2006	2400.0	51.0	473.6	132	172	182	51.2	510.0	127.2	91.3	65.6	53.5	893.7	1615.3	856.7	576.6	674.0	452.0	151.6	107.4	292.8
2007	2940.0	56.5	492.9	120	161	186	57.0	425.9	78.2	64.2	58.1	92.1	1034.1	1457.6	1144.9	668.4	691.9	335.7	155.1	106.9	304.8
2008	1830.0	60.7	519.1	127	242	217	60.7	672.3	78.3	63.5	61.9	102.7	929.1	863.9	899.5	1053.3	1024.2	773.5	220.7	133.1	321.8
2009	2370.0	75.8	499.5	123	161	173	75.9	350.3	102.6	88.2	80.1	80.0	1296.9	1758.0	608.0	521.1	754.5	415.0	159.0	115.3	308.9
2010	1640.0	72.7	374.7	114	162	177	72.7	255.4	96.4	85.2	74.8	186.1	823.3	1141.1	831.4	492.1	356.2	198.7	100.3	92.4	231.7
2011	2790.0	61.0	596.9	130	147	194	61.0	654.6	87.5	78.0	68.0	70.2	1163.0	1519.7	1470.6	1068.9	785.3	468.3	187.8	151.0	369.1
2012	2880.0	84.8	538.4	116	165	179	85.0	547.9	125.3	106.9	92.8	240.5	978.6	1869.3	1154.0	654.1	599.5	351.8	165.4	118.4	333.8
2013	3480.0	71.7	532.7	137	153	187	71.7	466.0	98.5	84.8	74.8	72.2	934.3	1769.0	781.6	613.6	950.1	607.0	263.5	129.7	329.4
2014	1390.0	71.4	467.7	122	133	196	71.5	556.7	111.0	91.4	76.2	109.9	1022.8	982.5	724.3	802.8	722.9	598.9	183.7	154.2	289.2
2015	2620.0	96.9	602.2	130	143	196	97.0	799.1	119.0	109.5	101.0	104.5	1440.0	1125.0	973.0	870.0	1110.0	657.0	153.0	190.0	372.4
2016	2190.0	52.1	549.8	119	150	180	131.9	589.3	167.0	153.0	152.0	207.0	1170.0	1310.0	850.0	1060.0	688.5	283.0	74.5	150.0	340.9
2017	1750.0	76.6	379.0	123	159	178	53.3	326.3	119.0	99.7	85.0	78.8	1120.0	1055.0	580.0	371.0	489.5	424.0	149.0	122.0	234.4

*All values in m^3/s, except Start Freshet, Max Q Date and Date CM - in Julian Days, and Annual Runoff - in mm.
[1]Date of centre of hydrograph mass (Stewart *et al.,* 2001)

09DD004 - McQuesten River near the Mouth

YEAR	MAX	MIN	AVG	START FRESHET	MAX Q DATE	DATE CM[1]	ANN 7QMIN	JUN-SEP 7QMIN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL RUNOFF*
1979	229.0	5.6	50.3	122	146	189	--	43.5	7.6	5.8	6.8	8.1	143.0	110.5	109.4	56.6	52.9	50.7	33.2	14.5	333.9
1980	183.0	6.9	38.7	123	139	179	7.4	37.4	8.9	8.5	8.7	12.4	109.8	89.2	45.5	50.0	46.3	42.7	27.5	13.4	257.5
1981	152.0	5.0	33.6	131	139	191	5.1	35.8	10.4	5.9	5.4	6.3	75.9	71.4	56.5	42.9	58.8	38.7	18.2	10.3	222.8
1982	237.0	5.2	32.6	131	150	164	5.3	21.0	6.7	6.1	5.6	5.7	93.0	130.0	53.1	28.2	22.3	18.2	11.8	9.2	216.4
1983	269.0	5.6	34.4	121	152	173	5.7	22.6	7.8	7.4	6.0	7.7	99.5	97.8	43.5	57.1	42.8	18.7	13.9	9.4	228.7
1984	192.0	5.8	31.3	120	141	165	5.8	21.9	7.3	6.7	7.7	12.0	109.4	94.6	48.1	25.5	26.2	17.7	10.2	8.9	208.3
1985	290.0	5.9	37.9	135	159	167	6.0	27.6	7.7	6.5	6.2	6.3	95.2	163.8	49.2	38.4	34.2	24.7	13.3	7.8	251.3
1986	314.0	6.6	35.9	132	149	161	6.6	22.1	7.6	7.2	6.8	6.8	105.3	153.9	40.4	37.3	29.8	16.7	10.0	7.6	238.1
1987	315.0	7.2	39.7	125	152	167	7.2	21.6	7.5	7.3	7.2	7.8	118.1	130.7	41.9	24.2	54.9	41.8	18.1	15.2	263.5
1988	--	8.1	--	175	176	219	8.1	35.2	10.8	8.5	8.3	19.7	--	--	--	--	--	29.6	14.4	10.2	--
1989	205.0	6.2	29.5	115	130	152	6.3	17.1	8.2	7.3	6.6	17.8	132.3	74.8	32.0	21.8	18.2	14.2	11.0	8.2	196.1
1990	162.0	5.2	30.6	119	139	169	5.2	18.8	6.2	5.5	5.9	11.4	115.5	62.5	24.4	28.4	45.0	33.8	16.6	10.0	203.1
1991	420.0	5.5	38.7	117	125	160	6.5	31.2	7.8	6.8	6.9	17.0	165.0	76.3	51.7	55.4	36.0	19.6	8.3	9.7	256.8
1992	404.0	6.3	45.5	143	150	167	5.7	24.7	8.0	7.4	7.1	18.1	110.1	213.8	66.4	36.7	34.9	17.7	15.7	11.3	303.2
1993	334.0	6.9	37.9	119	138	156	6.9	23.5	8.6	7.3	7.1	13.9	164.6	99.9	49.8	29.0	30.2	18.1	12.7	10.8	251.6
1994	270.0	7.0	33.5	122	145	159	7.0	20.0	8.5	7.3	7.0	9.3	143.6	78.6	47.0	24.9	27.3	21.5	14.1	9.9	222.3
1995	190.0	4.8	31.2	112	135	169	4.8	28.5	7.0	5.3	5.1	23.7	104.5	64.5	36.3	36.2	44.1	28.3	11.3	6.3	207.3
1996	221.0	5.5	34.3	127	149	191	5.5	29.8	5.8	5.5	5.7	8.8	79.7	91.8	49.5	42.0	64.6	27.3	18.7	11.7	228.2
1997	334.0	4.7	46.5	121	136	170	4.7	43.1	7.7	5.8	4.8	9.6	161.8	128.7	75.3	58.5	48.3	24.0	19.3	10.8	308.6
1998	175.0	5.8	23.6	117	147	156	6.0	16.3	8.0	6.6	6.1	12.6	91.4	62.6	25.8	17.2	19.9	13.0	11.2	7.8	156.8
1999	226.0	4.2	32.6	125	156	165	4.2	23.3	5.1	4.4	4.2	7.9	99.5	115.4	34.1	26.3	39.8	28.3	14.1	10.6	216.2
2000	273.0	6.2	55.5	125	162	178	6.2	50.5	7.7	6.6	6.2	8.8	121.5	205.6	104.3	72.0	65.0	37.0	16.6	13.7	369.4
2001	268.0	9.5	48.9	133	160	174	9.5	44.5	11.8	10.7	9.7	10.3	91.7	185.6	82.8	53.9	59.4	33.0	22.5	14.4	324.7
2002	162.0	6.0	35.4	126	141	189	6.0	32.3	9.7	7.4	6.3	7.1	99.3	73.3	39.3	66.4	55.6	27.3	18.3	13.1	235.3
2003	224.0	8.2	36.7	122	146	176	8.2	33.1	10.0	8.8	8.3	13.8	97.6	90.4	49.3	38.0	57.1	34.6	16.8	13.6	243.3
2004	277.0	8.5	33.1	124	140	156	8.5	20.5	11.6	10.1	9.0	9.3	136.8	87.6	32.0	31.9	22.8	21.3	13.3	9.8	220.2
2005	335.0	5.8	51.9	118	137	161	5.8	43.4	7.7	6.4	5.8	14.1	224.2	108.2	56.0	58.1	57.5	49.2	18.5	12.5	344.7
2006	223.0	8.9	43.9	128	142	173	8.9	32.6	9.9	9.2	9.0	10.3	122.9	129.1	60.0	36.4	62.2	46.3	17.6	12.3	291.6
2007	265.0	6.9	42.9	121	148	168	6.9	37.9	11.1	9.5	7.4	9.3	147.1	99.0	83.3	45.0	48.6	27.2	13.0	10.9	284.7
2008	160.0	6.2	41.8	120	142	218	6.2	30.6	8.5	6.8	6.3	15.4	110.7	42.0	51.1	83.3	62.4	63.0	33.0	16.4	278.3
2009	257.0	7.9	39.4	121	127	162	7.9	22.1	8.9	8.1	8.3	10.7	153.9	94.1	34.3	26.4	57.6	35.6	19.7	12.7	261.4
2010	162.0	8.8	33.7	114	141	171	8.8	24.9	9.7	8.9	8.9	23.3	97.8	78.1	61.3	39.1	31.4	18.0	14.8	10.9	223.6
2011	--	6.7	67.5	135	358	242	6.7	45.8	7.7	7.0	6.9	6.9	131.3	72.2	87.3	86.5	72.0	38.8	15.0	269.6	448.4
2012	191.0	9.4	41.8	120	147	170	9.4	35.4	13.6	11.9	10.3	13.5	112.6	123.9	77.4	45.4	39.7	22.6	16.4	12.9	278.1
2013	413.0	9.0	38.0	133	150	161	9.0	21.5	10.6	9.3	9.1	9.0	118.7	123.4	40.2	25.7	44.7	29.2	20.3	13.9	252.0
2014	195.0	6.5	35.9	121	128	196	6.5	32.2	11.2	8.9	7.1	7.9	95.9	62.1	40.0	63.3	51.8	45.0	18.8	16.5	238.6
2015	267.0	9.1	47.5	127	138	190	9.1	44.7	12.7	9.8	9.3	11.8	169.0	64.8	53.2	57.1	80.7	51.9	26.1	19.7	315.5
2016	170.0	14.2	47.0	115	137	176	14.5	54.0	15.6	14.6	14.6	17.7	128.0	93.3	61.1	76.4	59.1	17.5	20.7	16.2	313.1
2017	184.0	9.3	36.7	122	136	178	9.3	23.9	12.3	10.1	9.3	11.9	118.0	48.5	36.3	26.6	54.5	56.9	20.4	15.0	243.5

*All values in m^3/s, except Start Freshet, Max Q Date and Date CM - in Julian Days, and Annual Runoff - in mm.
[1]Date of centre of hydrograph mass (Stewart *et al.,* 2001)

09EA004 - North Klondike River near the Mouth

YEAR	MAX	MIN	AVG	START FRESHET	MAX Q DATE	DATE CM[1]	ANN 7QMIN	JUN-SEP 7QMIN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL RUNOFF*
1974	--	2.2	--	--	--	90	--	7.4	--	--	--	--	--	--	9.9	11.6	9.1	4.8	3.3	2.6	--
1975	85.8	1.8	15.0	123	155	177	1.8	14.6	2.0	2.2	2.1	2.0	28.9	59.7	26.7	18.6	17.8	11.2	5.3	3.1	434.0
1976	80.1	1.6	10.5	120	171	174	1.7	7.5	2.7	2.2	1.8	2.3	18.5	47.1	18.1	13.6	8.5	5.8	3.2	1.9	303.6
1977	77.9	1.8	12.2	123	154	170	1.8	8.1	2.3	2.7	2.1	2.7	22.2	59.3	20.1	11.9	9.3	7.7	4.0	2.6	353.9
1978	52.7	1.9	9.8	137	168	181	1.9	8.6	2.5	2.2	2.0	2.6	12.4	38.6	19.4	10.4	11.2	8.7	4.5	3.2	284.7
1979	83.6	1.7	15.5	121	189	186	1.7	13.2	2.4	1.8	1.9	2.3	27.9	51.4	43.4	19.1	14.8	11.0	5.5	3.4	447.9
1980	96.7	1.7	13.3	130	159	183	1.9	12.6	2.6	2.2	2.1	2.1	24.5	46.4	22.8	24.0	15.5	10.6	4.7	2.0	386.3
1981	87.2	1.7	15.1	132	148	202	1.7	17.6	2.4	2.3	2.9	2.8	28.2	29.1	32.2	26.5	23.8	15.7	8.4	5.4	436.3
1982	137.0	2.2	12.5	134	159	172	2.2	8.8	2.7	2.4	2.3	2.6	16.2	63.6	22.6	12.0	11.4	6.6	4.2	3.0	360.2
1983	140.0	2.1	10.8	144	152	182	2.1	10.1	2.5	2.3	2.2	2.3	14.1	41.7	17.9	15.1	12.1	8.6	6.5	4.1	312.1
1984	68.4	1.8	10.4	136	165	177	1.8	7.7	2.9	1.9	1.9	2.4	16.6	42.3	21.6	13.4	9.2	6.0	3.4	2.7	300.3
1985	131.0	1.8	14.3	134	156	176	1.8	13.2	2.2	2.0	2.2	2.2	22.4	63.8	28.9	18.3	14.3	8.5	3.6	2.6	413.1
1986	113.0	2.1	11.8	133	159	186	2.1	8.2	2.6	2.5	2.3	2.2	11.4	46.4	23.5	23.6	12.2	6.7	4.6	3.3	341.1
1987	90.7	2.1	11.5	139	151	180	2.1	10.8	2.7	2.4	2.1	2.2	17.8	44.2	17.2	13.8	12.5	12.2	6.8	4.5	334.2
1988	94.0	2.1	17.2	122	134	173	2.1	10.0	3.1	2.3	2.1	4.4	46.8	58.1	27.5	20.8	20.3	10.6	6.1	4.0	499.1
1989	45.2	1.9	9.0	117	176	172	1.9	7.5	2.9	2.3	1.9	4.4	24.8	25.5	13.1	9.8	8.3	6.5	4.5	3.5	260.2
1990	118.0	2.2	15.6	133	152	180	2.2	14.1	2.9	2.5	2.2	4.1	32.2	51.5	18.8	26.6	25.9	11.7	4.6	3.2	450.1
1991	60.8	1.5	12.6	119	217	193	2.6	13.7	2.8	2.6	2.6	4.0	26.1	29.4	19.1	30.0	19.2	9.9	2.1	2.2	363.4
1992	176.0	1.5	17.4	143	165	178	1.5	9.4	1.7	1.7	2.3	3.9	21.0	82.3	35.1	27.5	18.4	7.1	4.7	3.4	504.8
1993	118.0	2.2	14.9	118	148	167	2.2	12.4	2.6	2.5	2.3	4.7	40.7	52.8	21.8	14.0	15.3	11.1	6.6	3.8	431.0
1994	65.3	2.2	13.0	117	164	184	2.2	14.2	2.7	2.3	2.2	4.7	21.5	42.3	26.2	15.8	18.2	9.7	6.1	3.4	375.2
1995	103.0	1.7	15.0	109	162	172	1.7	12.6	2.1	1.7	1.8	10.0	37.2	47.5	21.9	16.6	20.5	13.2	4.2	2.9	434.7
1996	36.3	2.5	8.0	140	149	184	2.6	9.7	2.7	2.7	2.7	3.3	12.1	24.4	12.6	11.1	12.5	5.6	4.0	3.1	233.5
1997	126.0	1.5	12.6	122	161	173	1.5	11.0	2.6	2.2	1.8	2.6	28.0	46.0	17.9	20.4	15.5	5.4	4.7	3.5	363.6
1998	--	1.9	--	111	112	188	2.4	11.1	2.9	2.6	2.5	--	--	--	--	--	--	6.9	3.7	2.5	--
1999	84.8	1.5	10.9	128	162	176	1.5	11.6	1.7	1.5	1.6	2.5	16.0	46.8	14.3	15.9	13.2	8.8	5.1	3.7	316.4
2000	122.0	2.0	18.6	126	163	179	2.0	9.8	2.9	2.4	2.0	2.6	23.0	87.8	46.5	25.1	12.5	9.5	5.6	3.4	539.5
2001	115.0	2.5	13.8	136	166	180	2.5	10.8	2.9	2.7	2.5	2.6	10.7	64.2	32.4	18.6	14.3	7.1	4.3	3.4	399.7
2002	65.5	2.5	13.8	129	162	196	2.5	15.6	2.9	2.8	2.7	2.7	22.8	38.9	19.8	27.0	21.9	11.5	7.1	5.1	399.7
2003	88.6	2.1	14.0	143	159	191	2.1	14.8	3.6	2.7	2.2	3.7	15.7	47.7	26.4	17.3	24.7	12.9	6.9	4.4	405.7
2004	111.0	2.5	10.8	122	147	162	2.6	5.8	3.7	3.3	2.9	2.6	34.7	38.2	12.3	10.6	7.0	5.5	4.7	3.4	311.9
2005	80.7	2.1	14.3	116	136	164	2.1	11.6	3.5	2.9	2.4	5.3	49.3	39.6	17.6	14.4	15.2	12.4	5.0	3.3	414.0
2006	84.9	1.8	12.2	129	167	179	1.8	11.7	3.0	2.8	2.1	2.2	21.3	46.3	18.8	13.4	15.3	11.7	5.7	4.0	353.9
2007	86.8	2.2	10.0	122	157	167	2.2	10.5	3.3	2.9	2.4	3.5	23.6	31.8	13.6	12.0	12.8	7.8	3.2	2.4	288.5
2008	78.8	2.2	13.0	128	190	209	2.2	13.7	2.3	2.5	2.4	3.9	16.9	17.4	37.6	27.7	17.0	14.5	8.2	4.5	376.3
2009	52.0	2.0	11.1	118	157	185	2.0	6.6	2.8	2.5	2.1	3.5	25.9	28.2	10.6	12.6	25.5	10.8	4.9	4.0	321.9
2010	52.4	2.6	11.4	135	150	184	2.6	8.8	2.9	2.6	2.6	4.2	22.5	31.2	24.7	18.6	13.3	5.8	4.1	3.4	328.5
2011	93.4	2.5	12.9	137	143	187	2.5	12.0	2.7	2.6	2.6	2.5	31.1	30.4	28.4	20.0	16.9	7.8	4.7	3.9	372.4
2012	97.4	2.2	12.0	139	160	179	2.2	10.8	2.9	2.4	2.2	4.5	18.7	44.9	22.4	15.8	12.2	8.9	5.6	3.6	348.0
2013	148.0	1.8	13.1	136	153	174	1.8	11.1	2.7	2.3	2.0	1.8	26.1	51.8	15.7	13.5	19.7	11.3	6.0	4.4	380.3
2014	65.6	1.8	12.2	122	177	205	1.9	12.4	3.3	2.6	2.2	3.4	15.4	28.4	24.7	28.7	17.5	9.4	6.2	3.7	352.6
2015	109.0	1.9	15.1	129	147	195	1.9	17.4	2.5	2.2	2.0	2.0	36.5	26.3	23.4	20.7	21.0	17.9	8.7	5.2	437.0
2016	85.1	2.9	18.6	131	167	191	2.9	21.9	3.6	3.0	2.9	4.3	26.9	56.8	31.6	30.1	25.6	9.9	6.9	6.4	539.8

*All values in m^3/s, except Start Freshet, Max Q Date and Date CM - in Julian Days, and Annual Runoff - in mm.
[1]Date of centre of hydrograph mass (Stewart *et al.,* 2001)

09EB003 - Indian River above the Mouth

YEAR	MAX	MIN	AVG	START FRESHET	MAX Q DATE	DATE CM[1]	ANN 7QMIN	JUN-SEP 7QMIN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL RUNOFF*
1982	79.9	0.0	4.8	134	141	160	0.0	2.3	0.0	0.0	0.0	0.0	22.9	21.8	4.5	3.2	2.7	1.6	0.5	0.1	68.7
1983	71.1	0.0	5.4	116	119	150	0.0	3.5	0.0	0.0	0.0	7.3	25.7	9.4	5.9	7.9	5.7	1.9	0.5	0.1	77.3
1984	--	0.0	--	127	128	143	0.0	2.3	0.0	0.0	0.0	1.7	--	--	8.3	4.0	6.1	1.7	0.4	0.0	--
1985	102.0	0.0	8.6	135	142	167	0.0	5.9	0.0	0.0	0.0	0.0	33.5	26.3	11.8	15.3	9.7	5.6	0.4	0.0	123.0
1986	53.9	0.0	3.2	135	148	160	0.0	1.8	0.0	0.0	0.0	0.0	13.6	11.7	4.6	4.5	3.0	0.4	0.0	0.0	45.4
1987	51.2	0.0	6.0	127	142	164	0.0	2.8	0.0	0.0	0.0	0.0	27.6	12.9	9.8	7.5	5.7	5.3	1.3	0.7	85.1
1988	106.0	0.0	7.5	114	136	150	0.0	4.3	0.1	0.0	0.0	6.0	40.7	11.2	9.1	8.5	9.1	3.6	0.4	0.1	106.8
1989	46.9	0.0	3.9	107	130	138	0.0	1.2	0.0	0.0	0.0	6.2	21.9	8.8	2.4	2.7	2.5	1.8	0.3	0.1	55.8
1990	72.0	0.0	6.0	111	124	139	0.0	1.5	0.1	0.0	0.0	10.3	30.2	8.9	3.4	6.9	9.6	1.5	0.2	0.0	85.1
1991	130.0	0.0	7.9	119	217	217	0.0	3.2	0.0	0.0	0.0	0.8	27.6	9.2	6.9	24.7	16.5	6.3	2.0	0.6	113.4
1992	123.0	0.4	9.2	123	148	153	0.3	4.7	0.6	0.5	0.7	1.5	49.2	23.7	11.7	9.0	7.9	3.1	0.9	0.5	131.1
1993	58.0	0.3	7.0	109	135	149	0.3	2.6	0.3	0.3	0.3	6.8	35.4	11.9	5.5	4.2	8.8	5.7	3.2	1.2	100.2
1994	--	0.1	--	120	121	136	0.0	2.2	0.4	0.1	0.1	2.5	--	10.8	13.7	3.0	4.3	2.8	0.5	0.2	--
1995	78.4	0.0	5.7	114	135	160	0.0	3.9	0.1	0.0	0.1	5.4	24.2	8.5	8.4	7.7	7.0	4.9	1.0	0.2	80.9
1996	59.8	0.0	3.7	115	164	165	0.0	2.0	0.0	0.0	0.0	3.2	12.6	12.8	7.5	2.4	3.4	1.6	0.6	0.1	52.8
1997	58.0	0.0	5.1	122	165	166	0.0	2.6	0.0	0.0	0.0	0.0	18.1	17.9	5.1	10.0	4.9	2.1	1.7	0.7	72.4
1998	40.2	0.0	3.4	106	129	143	0.0	1.2	0.2	0.1	0.1	4.2	17.9	11.0	2.4	1.5	1.9	0.8	0.3	0.0	48.4
1999	39.7	0.0	3.6	130	142	170	0.0	1.8	0.0	0.0	0.0	0.0	14.2	10.9	3.5	5.6	5.8	2.6	0.3	0.1	51.4
2000	89.1	0.0	9.5	119	130	174	0.0	7.5	0.0	0.0	0.0	1.8	42.0	16.8	18.1	10.5	14.0	5.4	2.4	1.6	135.2
2001	110.0	0.1	8.1	131	138	164	0.5	3.9	1.2	0.9	0.7	0.6	32.5	18.1	12.0	13.0	11.9	4.4	1.0	0.3	115.8
2002	89.4	0.0	7.7	124	163	175	0.0	3.7	0.1	0.0	0.0	0.1	25.3	21.8	7.7	17.1	11.2	5.0	2.6	1.1	110.3
2003	54.4	0.3	5.4	112	146	166	0.3	2.7	0.7	0.4	0.3	3.3	22.7	7.0	10.0	4.0	5.9	6.3	2.9	1.1	77.3
2004	83.7	0.3	5.8	121	129	150	0.4	2.3	0.6	0.4	0.4	0.8	33.6	6.7	4.8	8.2	4.7	7.2	1.3	0.4	83.2
2005	146.0	0.1	10.6	114	119	184	0.1	5.2	0.2	0.1	0.1	13.9	33.3	15.3	13.3	16.7	20.0	9.5	2.9	1.2	151.4
2006	124.0	0.0	7.0	129	136	152	0.0	5.0	0.5	0.1	0.0	0.0	40.3	12.5	8.1	7.7	9.3	4.2	0.3	0.0	99.7
2007	64.2	0.0	6.2	113	125	148	0.0	3.0	0.0	0.0	0.0	7.9	30.9	6.6	6.1	4.7	12.6	3.6	1.2	0.4	88.4
2008	56.1	0.0	6.4	120	190	204	0.0	3.4	0.2	0.1	0.0	1.1	20.2	4.4	17.8	13.1	9.9	5.9	3.0	0.5	91.4
2009	190.0	0.0	6.6	115	124	131	0.0	1.1	0.1	0.0	0.0	4.0	44.5	9.9	2.5	2.4	9.3	3.1	1.6	0.6	93.7
2010	46.0	0.0	5.0	114	120	204	0.0	4.4	0.1	0.0	0.0	5.1	11.5	7.4	9.5	11.2	10.2	2.8	1.5	0.5	71.7
2011	65.7	0.0	9.4	114	140	178	0.0	7.2	0.2	0.1	0.1	5.2	37.4	19.3	16.1	15.8	10.8	4.1	1.9	0.9	134.3
2012	75.5	0.3	8.0	107	114	143	0.3	5.1	0.4	0.3	0.4	23.5	29.6	11.9	9.2	5.9	6.2	5.2	2.8	0.7	114.7
2013	--	0.3	--	225	226	244	0.3	3.9	0.3	0.3	0.3	0.7	68.1	16.6	8.3	--	--	8.2	1.8	0.8	--
2014	71.6	0.2	7.5	110	123	173	0.2	4.8	0.6	0.4	0.2	13.6	26.1	8.6	8.2	9.6	8.8	9.4	2.6	1.1	107.1
2015	59.7	0.6	7.8	110	241	196	0.6	4.1	0.7	0.6	0.6	2.9	21.2	6.4	6.8	6.2	13.8	7.7	3.8	1.6	110.7
2016	54.9	0.7	9.8	96	110	165	0.7	5.5	0.9	0.8	0.7	28.7	17.6	8.8	11.2	16.8	11.5	5.4	2.2	1.4	140.1
2017	84.0	0.2	6.4	111	125	138	0.2	3.6	0.9	0.5	0.2	0.8	31.0	5.1	7.5	4.3	5.3	3.7	1.4	0.3	91.0

*All values in m^3/s, except Start Freshet, Max Q Date and Date CM - in Julian Days, and Annual Runoff - in mm.
[1]Date of centre of hydrograph mass (Stewart *et al.,* 2001)

09EB004 - Sixty Mile River near the Mouth

YEAR	MAX	MIN	AVG	START FRESHET	MAX Q DATE	DATE CM[1]	ANN 7QMIN	JUN-SEP 7QMIN	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL RUNOFF*
1996	97.5	0.0	5.2	111	162	163	0.0	2.4	0.0	0.0	0.0	4.8	17.6	20.0	10.4	3.7	3.5	1.2	0.4	0.0	53.3
1997	386.0	0.0	19.0	125	161	166	0.0	4.9	0.0	0.0	0.0	0.2	50.0	85.0	29.6	34.3	17.0	6.1	3.3	1.8	196.1
1998	125.0	0.8	11.3	117	143	155	0.8	4.5	1.1	0.8	0.9	5.2	56.4	27.8	6.3	7.6	14.1	5.6	5.9	2.8	116.3
1999	106.0	0.0	12.0	129	146	205	0.0	6.0	0.5	0.0	0.0	0.0	38.0	25.0	12.5	20.8	25.5	10.7	7.0	2.6	123.3
2000	210.0	0.4	20.5	122	145	167	0.4	13.4	0.9	0.5	0.4	2.5	78.9	79.4	22.6	22.2	23.8	8.6	3.9	2.5	212.3
2001	262.0	1.1	23.4	126	206	189	1.1	9.8	1.8	1.3	1.1	1.9	74.4	53.0	62.8	31.7	34.6	9.2	4.6	2.4	241.2
2002	167.0	0.6	16.2	127	162	207	0.6	7.9	1.4	0.9	0.7	0.7	54.1	28.2	22.8	39.7	26.1	9.3	5.4	3.1	166.6
2003	83.5	1.2	8.8	113	145	158	1.2	3.1	1.9	1.4	1.2	5.0	37.2	21.3	11.4	3.9	9.2	6.7	4.1	2.2	91.1
2004	235.0	0.3	13.8	121	147	145	0.8	3.5	1.2	0.8	1.1	3.0	98.0	14.6	11.7	13.2	9.1	8.0	2.3	0.6	142.3
2005	200.0	0.1	15.3	112	119	146	0.1	8.4	0.3	0.1	0.1	34.5	63.2	18.5	18.2	12.2	21.7	9.7	3.1	1.5	158.1
2006	203.0	0.0	15.6	122	137	148	0.1	6.8	0.9	0.5	0.1	0.5	95.6	26.4	14.9	21.8	16.0	8.0	0.9	0.1	161.2
2007	95.3	0.0	11.6	114	159	160	0.0	5.4	0.0	0.0	0.0	8.2	51.0	18.7	16.2	12.8	22.9	5.6	2.3	1.1	120.0
2008	154.0	0.1	17.7	117	203	198	0.1	10.8	0.5	0.2	0.2	6.7	55.7	16.3	58.5	37.2	18.9	9.2	5.0	1.6	182.4
2009	185.0	0.2	13.2	113	124	153	0.2	3.8	0.5	0.3	0.2	10.0	65.6	29.3	5.9	7.8	27.8	6.2	2.4	1.6	135.9
2010	211.0	0.4	21.4	114	205	204	0.4	13.4	0.8	0.5	0.4	19.3	41.6	39.4	48.9	52.7	37.8	7.3	5.0	1.9	220.8
2011	149.0	0.3	19.4	118	140	183	0.3	13.6	0.7	0.4	0.3	5.2	55.9	51.1	49.0	36.7	21.2	7.2	2.6	1.2	200.4
2012	139.0	0.4	16.7	108	146	169	0.4	10.7	0.8	0.6	0.4	21.1	57.7	30.8	39.7	16.6	13.8	12.0	4.1	2.1	172.8
2013	329.0	0.4	17.7	129	147	150	0.4	4.6	0.8	0.4	0.4	0.4	111.7	49.6	14.1	8.8	16.9	8.3	1.9	0.9	185.5
2014	176.0	--	--	67	177	--	--	11.7	0.7	0.5	0.1	0.1	41.3	17.0	17.8	28.8	17.0	6.8	3.1	1.1	--
2015	114.0	0.1	14.8	115	130	196	0.1	7.8	0.4	0.2	0.1	1.5	31.2	13.2	24.6	28.9	18.6	10.3	4.9	2.8	152.3
2016	111.0	1.4	21.9	107	117	190	1.4	12.7	1.8	1.5	1.6	17.0	59.7	19.3	52.9	43.4	27.4	8.9	3.8	2.1	226.2
2017	117.0	0.3	10.3	116	135	152	0.3	6.4	1.8	1.0	0.3	2.0	48.0	11.3	15.2	7.7	9.9	6.9	2.7	0.8	105.7

*All values in m^3/s, except Start Freshet, Max Q Date and Date CM - in Julian Days, and Annual Runoff - in mm.
[1]Date of centre of hydrograph mass (Stewart *et al.,* 2001)

APPENDIX C

Baseline Water Quality Report 2010 to 2020

Newmont™
COFFEE



Coffee Gold Project
Baseline Water Quality Report
2010 to 2020

Project No. A362-2
9 February 2022

LORAX ENVIRONMENTAL

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Newmont™
COFFEE

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1. Introduction

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1. Introduction

1.1 Background

The Coffee Gold Project (the Project) is an open pit gold heap leach operation, located in west-central Yukon, approximately 130 km south of Dawson City and operated by Newmont/Goldcorp Corp. (NG) (Figure 1.1-1). The Project contains several gold occurrences within an exploration concession covering an approximate area of more than 600 km^2.

The Project is located within the Yukon-Tanana Terrane (YTT), an accreted pericratonic rock sequence that covers a large portion of the Omineca Belt in the Yukon and extends into Alaska and British Columbia (BC). The YTT underlies part of the Tintina gold belt and hosts multiple gold deposits, including the Sonora Gulch gold deposit, the Casino copper-gold-molybdenum porphyry, the Boulevard gold prospect, and the Golden Saddle gold deposit.

Under the direction of NG (former Kaminak Gold Corporation [Kaminak]), the Project underwent a detailed Feasibility Study (Coffee Gold 43-101 FS) in 2015 with engineering and design progressing with full consideration of environmental conditions within the Project area. Prior to, and coincident with, exploration activities and feasibility studies, NG commenced several baseline programs (*e.g.*, meteorology, hydrology, surface water quality, groundwater, soils, air, fish and fish habitat, and wildlife) to characterize background site conditions. The overarching objective of these baseline programs is to provide detailed characterization of the pre-mine condition to be used to define environmental benchmarks that potential Project effects may be measured against during Operations and Closure mine Phases. The surface water quality program was initiated by Kaminak in October 2010. In 2014, Lorax Environmental Services Ltd. (Lorax) was retained by NG (former Kaminak) to further advance the surface water quality baseline program and as a result, a number of additional surface water quality stations were added to the existing monitoring program

Since acquisition of the Project by Goldcorp in 2016, the surface water quality baseline monitoring program has continued uninterrupted on a monthly basis to present.

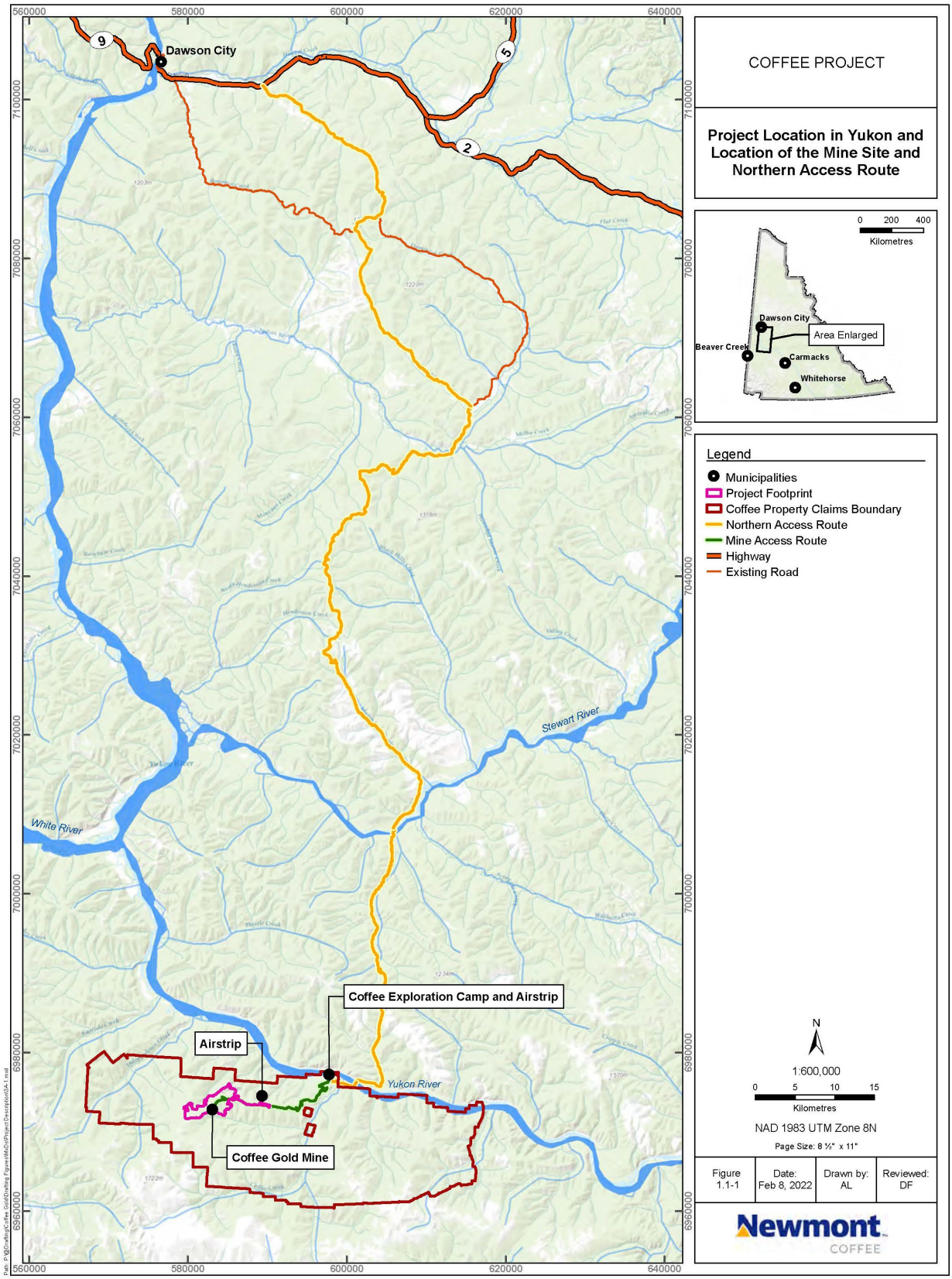

Figure 1.1-1: Coffee Gold Project Location Map

The following report summarizes the baseline surface water quality conditions from 2010 to December 2020 in three catchments proximal to the Project (Figure 1.1-2):

- Halfway Creek;
- Latte Creek; and
- YT-24

Major infrastructure related to the proposed mining and processing operations at the site includes: the primary and secondary crushing facilities; a carbon adsorption plant; a gold refinery; the heap leach facilities; waste rock storage areas (WRSA); water drainage structures and storage ponds; haul roads; the accommodations complex; and an all-weather airstrip.

This baseline report characterizes water quality in receiving environment watercourses with the potential to be affected by project development and operation. In addition, baseline water quality in Independence Creek, which is unaffected by project development and therefore serves as a reference stream, is also characterized. The local study area (LSA) and primary focus of this report is on the following drainages:

- Latte Creek;
- Coffee Creek;
- Halfway Creek;
- YT-24;
- Independence Creek; and
- Yukon River

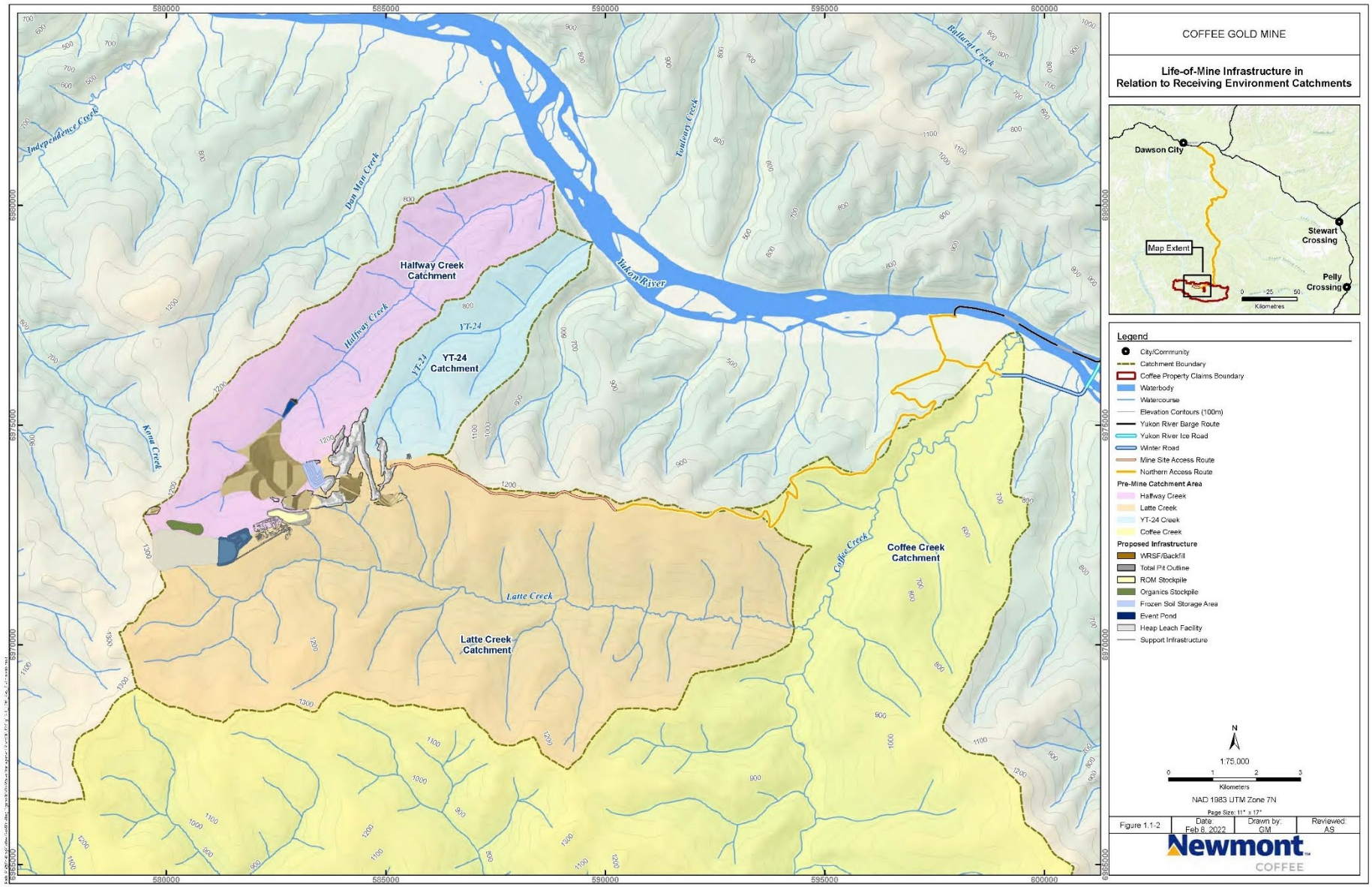

Figure 1.1-2: Life of Mine Coffee Gold Project Infrastructure Layout in Relation to Receiving Environment Catchments

1.2 Report Structure

Section 2 outlines the overarching objectives of the baseline water quality program and provides a description of the sampling stations and locations for each station monitored from 2010 to 2020. In addition, sampling and analytical methods are described along with a brief description of data analysis methods and quality assurance/quality control (QA/QC) programs. Section 3 presents the water quality baseline results for key project drainages on Latte Creek, Coffee Creek, Halfway Creek, YT-24, Independence Creek (reference stream) and Yukon River. The complete datasets for water quality data for each sampling station are provided in Appendix A.

2. Baseline Water Quality Program

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2. Baseline Water Quality Program

2.1 Overview and Objectives

The Coffee Gold Project water quality program has been developed to fulfill the following objectives:

- Obtain (pre-mining) baseline data on water quality that can be used to assess potential changes in receiving aquatic environments related to Construction, Operation, Closure, and Post-closure Phases;
- Identify parameters that may naturally exceed water quality guideliens (WQGs) and therefore may require special management and/or site-specific water quality objectives (SSWQOs); and
- Provide baseline surface water quality data to be used as input for the water quality model (WQM) to derive predictions for key mining phases of the project.

As previously stated, the report characterizes surface water quality in receiving environment watercourses that may be affected by the Project, in addition to Independence Creek, which will remained unaffected by project activities and will be used as a reference stream. The immediate LSA includes Latte Creek, Halfway Creek and YT-24 – basins that contain project mining components. In addition, the LSA also includes sampling stations in Coffee Creek (located immediately upstream and downstream of the confluence with Latte Creek) and selected reaches of the Yukon River (from upstream of the Coffee Creek confluence to immediately downstream of the Independence Creek confluence) (Figure 2.1-1,Figure 2.1-2,Table 2.1-1).

Water quality monitoring is ongoing at the Project site and is planned to continue throughout the permitting phase. Upon issuance of mine licenses, an approved water quality program will continue throughout the mine development, operation and into closure phases.

Photographic records of key monitoring stations are provided in Plate 2.1-1 through Plate 2.1-5. Specifically, monitoring stations within Independence Creek are presented in Plate 2.1-1; Latte Creek stations are shown in Plate 2.1-2; Halfway Creek and YT-24 stations are illustrated in Plate 2.1-3; Coffee Creek stations are presented in Plate 2.1-4; and Yukon River stations are illustrated in Plate 2.1-5.

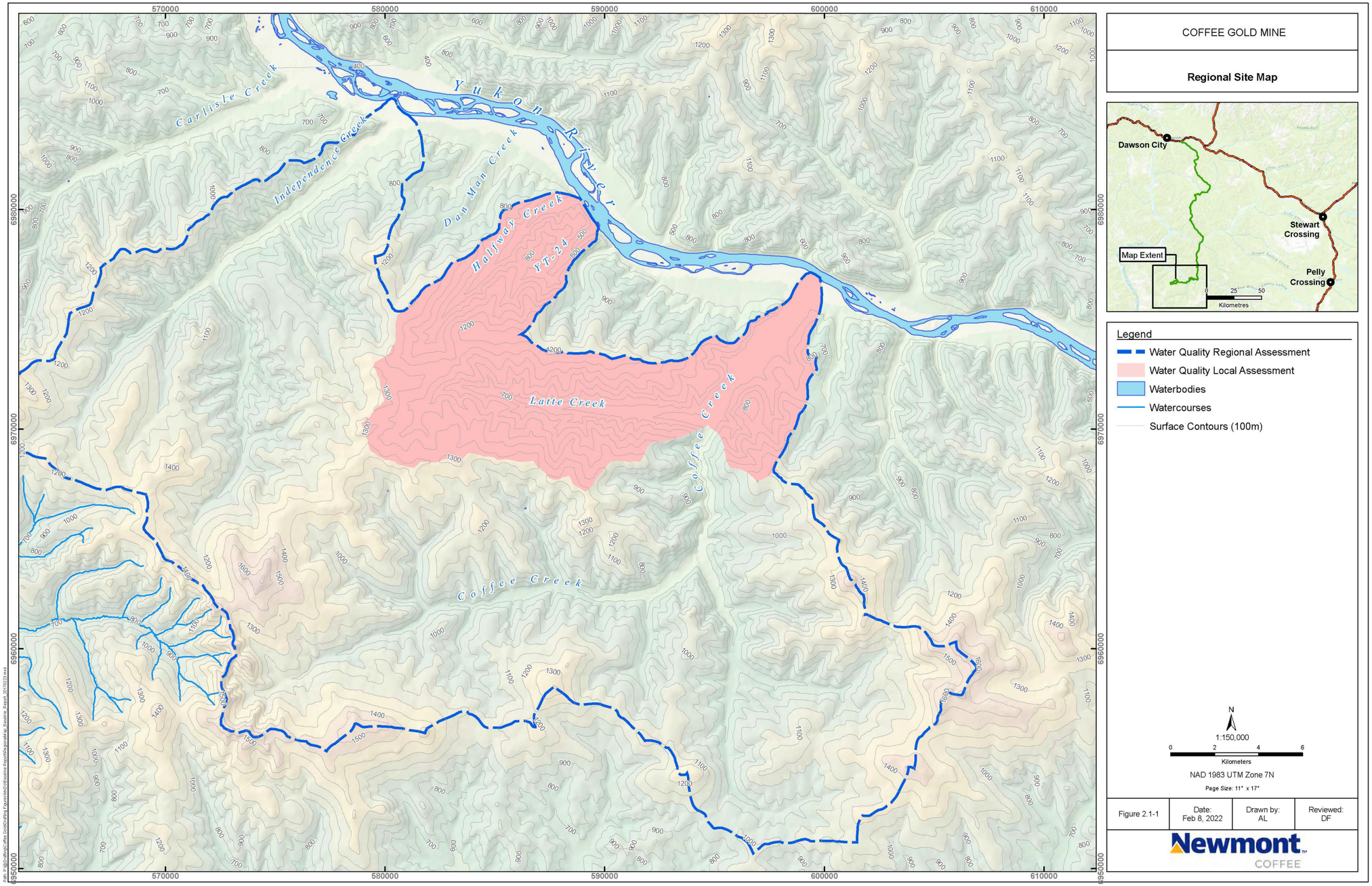
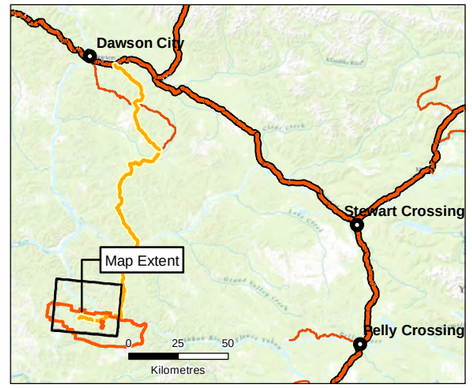


Figure 2.1-1: Baseline Water Quality Local Assessment and Regional Assessment Areas

COFFEE GOLD MINE

Surface Water Quality Monitoring Locations



Legend

- Municipalities
- Waterbody
- Watercourse
- Pit
- WRSF/Backfill
- Halfway Creek Catchment
- Latte Creek Catchment
- YT-24 Creek Catchment

N

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Meters

NAD 1983 UTM Zone 7N

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Table 2.1-1:
Water Quality Sampling Stations, Coordinates and Rationale

Former ID	Current ID	Drainage	Coordinates		Site Type	Sampling Start Date	Rationale
			North	East			
Independence Creek							
IC-0.5	ICT14-0.4	Independence Creek – main stem	6976911	572012	Reference	Oct-2010	Outside Project influence
IC-1.5	IC-16.1	Un-named larger tributary to Independence Creek	6976835	572260	Reference	Oct-2010	Outside Project influence
IC-2.5	IC-14.6	Small un-named tributary to Independence Creek	6978044	572771	Reference	Oct-2010	Outside Project influence
IC-3.0	KT-0.3	Small un-named tributary to Independence Creek	6979357	575334	Reference	Oct-2010	Outside Project influence
IC-4.5	IC-2.7	Independence Creek - mouth	6983237	579358	Reference	Oct-2010	Outside Project influence
Latte Creek							
CC-6.0	LC-15.5	Upper Latte Creek	6971061	581317	Exposure	June-2014	Below Project influence
CC-1.0	LCT20-0.1	Small tributary to Latte Creek below Supremo South	6971733	584890	Exposure	June-2014	Below Project influence
CC-1.5	LC-11.4	Latte Creek downstream of LCT20-0.1 drainage	6971654	585071	Exposure	Oct-2010	Below Project influence
CC-3.5	LC-0.2	Latte Creek before confluence with Coffee Creek	6970375	594319	Exposure	Oct-2010	Below Project influence
Halfway Creek							
HC-2.5	HC-6.8	Halfway Creek midway below proposed Alpha Pond	6976548	584089	Exposure	Oct-2010	Below Project influence
	HC-1.0	Halfway Creek	6980137	588049	Exposure	July-2017	Below Project influence
HC-5.0	HC-0.1	Halfway Creek mouth	6980536	588823	Exposure	Oct-2010	Below Project influence
YT-24							
YT-24	YT24-0.1	Mouth of YT-24, small tributary to Yukon River	6979073	589526	Exposure	June-2014	Below Project influence
YT-24-2	YT24-4.9	Upper reach of YT-24	6976472	585922	Exposure	June 2016	Below Project influence
Coffee Creek							
CC-0.5	CC-11.6	Coffee Creek upstream of confluence with Latte Creek	6970225	594719	Reference	Oct-2010	Above Project influence
Latte Mix	CC-10.9	Coffee Creek downstream of confluence with Latte Creek	6970589	594735	Mixing zone	July-2017	Below Project influence
CC-4.5	CC-3.2	Lower Coffee Creek	6975084	598330	Exposure	Oct-2010	Below Project influence
Yukon River							
YUK-2.0	YUK-51.3	Yukon River upstream of Coffee Creek confluence	6975946	601011	Reference	Oct-2010	No Project influence
YUK-5.0	YUK-26.1	Yukon River downstream of Independence Creek confluence	6985228	579624	Exposure	Oct-2010	Below Project influence
Coffee Mix	YUK-49.3	Coffee Creek confluence with Yukon River – clear water plume	6977180	599397	Exposure	Jul-2017	Below Project influence
Halfway Mix	YUK-37.6	Halfway Creek confluence with the Yukon River – clear water plume	6980651	588962	Exposure	Jul-2017	Below Project influence



Plate 2.1-1: Photos of monitoring stations within Independence Creek (August 2014)



Plate 2.1-2: Photos of monitoring stations within Latte Creek drainage (August 2014)









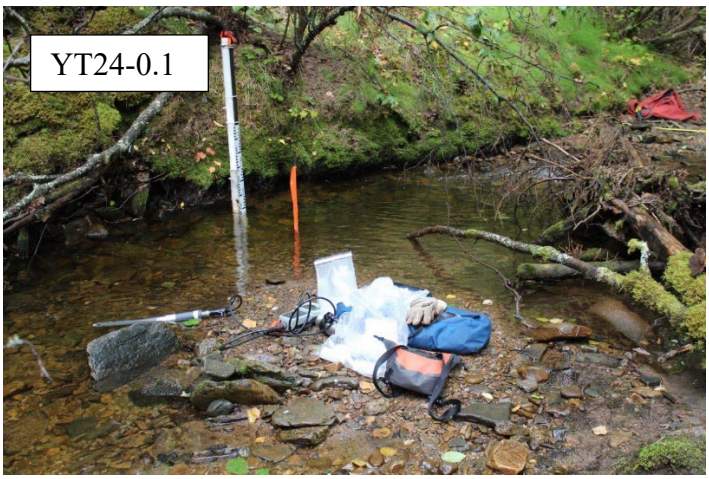



Plate 2.1-3: Photos of monitoring stations within Halfway Creek (HC-6.8 and IC-2.7) and YT24-0.1 (August 2014)









Plate 2.1-4: Photos of monitoring stations within Coffee Creek (August 2014)









Plate 2.1-5: Photos of monitoring stations within Yukon River (August 2014)

2.2 Field and Analytical Methods

2.2.1 Sampling Frequency and Locations

Figure 2.1-2 illustrates water quality sampling stations within the LSA sampled during the period of 2010 to present. Information pertinent to each station is provided in Table 2.1-1 including, coordinates; type (*e.g.*, reference or exposure); date of initial monthly sampling; and, rationale for selection. Although sampling is attempted on a monthly basis, site access and/or lack of flow (particularly during winter months) prevented sample collection at some stations. A new station on Coffee Creek named CC-10.9, was initiated in July 2017 aimed to characterize the immediate mixing zone of Latte Creek and Coffee Creek. During the month of October 2017, monitoring stations HC-6.8, LC-11.4, CC-10.9 and CC-3.2 were subjected to a 5 in 30 sampling event to better define water quality variability at these key monitoring stations.

2.2.2 Field Sampling Methods

During the period of October 2010 to May 2014, Access Consulting Group conducted the surface water quality sampling program for the Coffee Project. In June 2014, Lorax assumed responsibility for the surface water quality program and commissioned Laberge Environmental Services (Laberge) to perform monthly water quality sampling. Since June 2014, Laberge has collected all the surface water quality samples on a monthly basis. All collected water samples followed the protocols described in the *British Columbia Field Sampling Manual* (BC MOE 2013).

During open water periods, samples were collected by wading into the small streams to the thal-weg and filling bottles with gloved hands while facing upstream into the current. For larger streams and rivers, the same procedure was followed only closer to the bank and usually in not more than 0.2 m depth. During open water periods, field filtering and sample preservation are completed at the collection site. Water samples collected during winter time are sometimes obtained by drilling or chiseling through the ice, an additional 1-L bottle is filled for processing at the end of the day at room temperature in a clean room.

After samples were collected, a YSI Sonde was placed in the water to log *in-situ* water quality parameters such as temperature, pH, specific conductance, Dissolved Oxygen (DO) and Oxidation-Reduction Potential (ORP).

2.2.3 Laboratory Methods

Collected samples were analyzed for a suite of parameters listed in Table 2.2-1, which include physical parameters (*e.g.*, pH, conductivity, hardness, total suspended solids [TSS], total dissolved solids [TDS], turbidity), major ions, nutrients (*e.g.*, ammonia), total organic

carbon (TOC) and dissolved organic carbon (DOC), weak acid dissociable cyanide (WAD-CN), and total and dissolved metals. Elemental analyses were performed by Maxxam Analytics Laboratory (Burnaby, BC; [Maxxam]) a Canadian Association for Laboratory Accreditation (CALA) certified laboratory. Maxxam also provided all sampling containers and bottles, including the preservative required, and parameter specific sampling instructions.

Conventional parameters, major ions, nutrients, and metals were analyzed using procedures described in APHA Standard Methods for the Examination of Water and Wastewater (2005). Cyanide analysis was carried out using procedures adapted from APHA Method 4500-CN "Cyanide", whereas WAD cyanide was determined by sample distillation and analysis using the chloramine-t colourimetric method. The lowest available limit of detection for metals was achieved by using inductively coupled plasma/mass spectrometry ([ICP/MS]; EPA Method 6020). Mercury analysis in water was carried out by cold vapor atomic fluorescence spectrophotometry (EPA Method 245.7). This procedure involves a cold-oxidation of the acidified sample using bromine monochloride prior to reduction of the sample with stannous chloride.

For the baseline period of 2010 to 2020, laboratory detection limits have been excellent and very low allowing for comparison of monitoring results with applicable water quality guidelines, including Canadian Council of Ministers of the Environment (CCME 1999) and British Columbia Ministry of Environment & Climate Change Strategy ([BC ENV]; 2021).

Table 2.2-1:
Analytical Parameter List and Reportable Detection Limits

Analysis		Reportable Detection Limit
Physical Parameters		
Conductivity	µS/cm	1.0
Hardness (as $CaCO_3$)	mg/L	0.5
pH	pH	0.01 unit
Total Suspended Solids (TSS)	mg/L	1.0
Total Dissolved Solids (TDS)	mg/L	10.0
Turbidity	NTU	0.1
Major Ions and Nutrients		
$Alkalinity_{Total}$ (as $CaCO_3$)	mg/L	0.5
$Alkalinity_{PP}$ (as $CaCO_3$)	mg/L	0.5
Bicarbonate (HCO_3)	mg/L	0.5
Cabonate (CO_3)	mg/L	0.5
Chloride (Cl)	mg/L	0. 5
Sulphate (SO_4)	mg/L	0.5
Fluoride (F)	mg/L	0.01
Nitrate (as N)	mg/L	0.002
Nitrite (as N)	mg/L	0.002
Total Ammonia (as N)	mg/L	0.005
Nitrate plus Nitrite (as N)	mg/L	0.002
Total Phosphorus as P	µg/L	0.002
Cyanide and Organic Carbon		
Weak acid dissociable cyanide (CN_{WAD})	mg/L	0.0005
Total Organic Carbon (TOC)	mg/L	0.5
Dissolved Organic Carbon (DOC)	mg/L	0.5
Total and Dissolved Metals		
Aluminum (Al)	µg/L	0.5
Antimony (Sb)	µg/L	0.02
Arsenic (As)	µg/L	0.02
Barium (Ba)	µg/L	0.02
Beryllium (Be)	µg/L	0.02
Bismuth (Bi)	µg/L	0.01
Boron (B)	µg/L	10
Cadmium (Cd)	µg/L	0.005
Calcium (Ca)	mg/L	0.05
Chromium (Cr)	µg/L	0.1
Cobalt (Co)	µg/L	0.005
Copper (Cu)	µg/L	0.05
Iron (Fe)	µg/L	1.0
Lead (Pb)	µg/L	0.005
Lithium (Li)	µg/L	0.5
Magnesium (Mg)	mg/L	0.05
Manganese (Mn)	µg/L	0.05
Mercury (Hg)	µg/L	0.002
Molybdenum (Mo)	µg/L	0.5
Nickel (Ni)	µg/L	0.02
Potassium (K)	mg/L	0.05
Selenium (Se)	µg/L	0.04
Silicon (Si)	mg/L	50
Silver (Ag)	µg/L	0.005
Sodium (Na)	mg/L	0.05
Strontium (Sr)	µg/L	0.05
Thallium (Tl)	µg/L	0.002
Tin (Sn)	µg/L	0.2
Titanium (Ti)	µg/L	0.5
Uranium (U)	µg/L	0.002
Vanadium (V)	µg/L	0.2
Zinc (Zn)	µg/L	0.1

2.2.4 Data Analysis

Laboratory results data for all monitoring sites have been compiled into summary data sheets for the period of 2010 to December 2020 (Appendix A). Where applicable, water quality parameters were screened against available CCME guidelines (CCME 1999) and approved and working BC guidelines (BC ENV 2021) for the protection of aquatic life. Most of the CCME guidelines are defined for long-term exposure, although chloride, nitrate and uranium have both short-term (maximum) and long-term (chronic) guidelines.

Parameters that reported *below detection limits* were assumed as full value to perform statistical analysis (*e.g.*, <0.05 µg/L is assumed to be 0.05 µg/L). Following the conversion of below detection limit values for all parameters, monthly and annual summary statistics were compiled for selected sites within all the project drainage basins. Minimum, maximum, mean, 5th percentile, 25th percentile, 50th percentile, 75th percentile and 95th percentile values were calculated for key stations in each basin (Appendix C).

2.2.5 Quality Assurance/Quality Control

Quality Assurance/Quality Control protocols were implemented and designed to provide reliable monitoring data by reducing sampling error, preventing contamination due to sample handling, and quantifying any bias in the results. In the field, nitrile gloves were worn while sampling and changed regularly, particularly between stations. Chain of custody forms describing sampling location, date, time and analytical requirements were submitted with each sample set.

For each monthly sampling event a field blank was prepared using distilled-deionized water (DDW) supplied by Maxxam. Field blank bottles were filled with DDW in the laboratory and were treated similarly to field-collected samples (*i.e.,* exposed to the air for the same amount of time it took to collect and preserve a sample). This allows the evaluation of potential contamination from sources such as airborne dust, sample preservation, or sample handling. To assess the potential variability arising from the collection of field samples, duplicate samples were collected at roughly 10% of surface water quality sites. Travel blanks were collected to provide an assessment of potential contamination associated with travel, storage, or the analytical laboratory. Travel blank bottles were filled with DDW at the analytical laboratory and were stored with field-collected samples without being opened. All samples and blanks were kept cold (~ 4 °C) until analysis. Duplicates, field and travel blanks were analyzed for the same suite of water quality parameters than collected samples (Table 2.2-1).

3. Water Quality Results

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3. Water Quality Results

This section presents a characterization of baseline water quality in the drainages of Latte Creek, Coffee Creek, Halfway Creek, Yukon River and the Independence Creek (reference stream). Compiled raw water quality results data for all stations sampled during the period of 2010 to 2020 is provided electronically in excel format (Appendix A).

Baseline water quality characterization is presented and described by catchment:

- Section 3.1 characterizes baseline water quality in Latte Creek utilizing monitoring data primarily from stations LC-15.5 for upper Latte Creek and stations LC-11.4 and LC-0.2 for mid-reach and lower-reach of Latte Creek;
- Section 3.2 provides a summary of water quality in Coffee Creek at locations both upstream and downstream of the project area. Data from station CC-11.6 (upstream of project influences) and CC-3.2 (downstream of confluence with Latte Creek) are utilized to characterize baseline conditions in Coffee Creek;
- Baseline water quality in the Halfway Creek drainage (Section 3.3) is characterized using data from stations HC-6.8 and HC-1.0;
- Section 3.4 provides a brief description of water quality in Yukon River upstream of the project area at YUK-51.3 and downstream of project influence at YUK-26.1; and
- Section 3.5 provides a description of water quality in the Independence Creek catchment using data from station IC-2.7 (mainstem) and KT-0.4 (tributary to Independence and downgradient of Kona deposit).

Monthly summary statistics for each drainage are briefly discussed below and fully compiled in Appendix C.

3.1 Latte Creek

Background water chemistry in Latte Creek can be divided between upper Latte Creek and mid to lower Latte Creek. In general, upper Latte Creek water chemistry is dominated by surface runoff whereas mid to lower Latte Creek water chemistry is influenced by both groundwater discharge, as well as surface runoff during the ice-free periods. No measurable flow has been observed in upper Latte Creek during winter sampling campaigns (*e.g.*, November to March), suggesting little to no groundwater baseflow contributions during these periods. Conversely, mid to lower Latte Creek monitoring stations LC-11.4 and LC-0.2 are more routinely sampled during low-flow periods of the winter owing to groundwater baseflow discharge to these reaches of Latte Creek.

3.1.1 Upper Latte Creek – Station LC-15.5

Upper Latte Creek is characterized by water quality samples taken at Station LC-15.5 (Figure 3.1-1), which includes contributions from two small tributaries (represented by stations CC-5.5 and CC-5.0) in the headwaters.

Upper Latte Creek sampling locations were established in 2014 in the baseline surface water quality monitoring program due to adjustments in mine planning. As previously mentioned, flow is not observed during winter months in this section of the creek, therefore limited water samples have been collected at these locations. Given that seasonal variability in Latte Creek has been well characterised, the water quality dataset is considered reliable and robust.

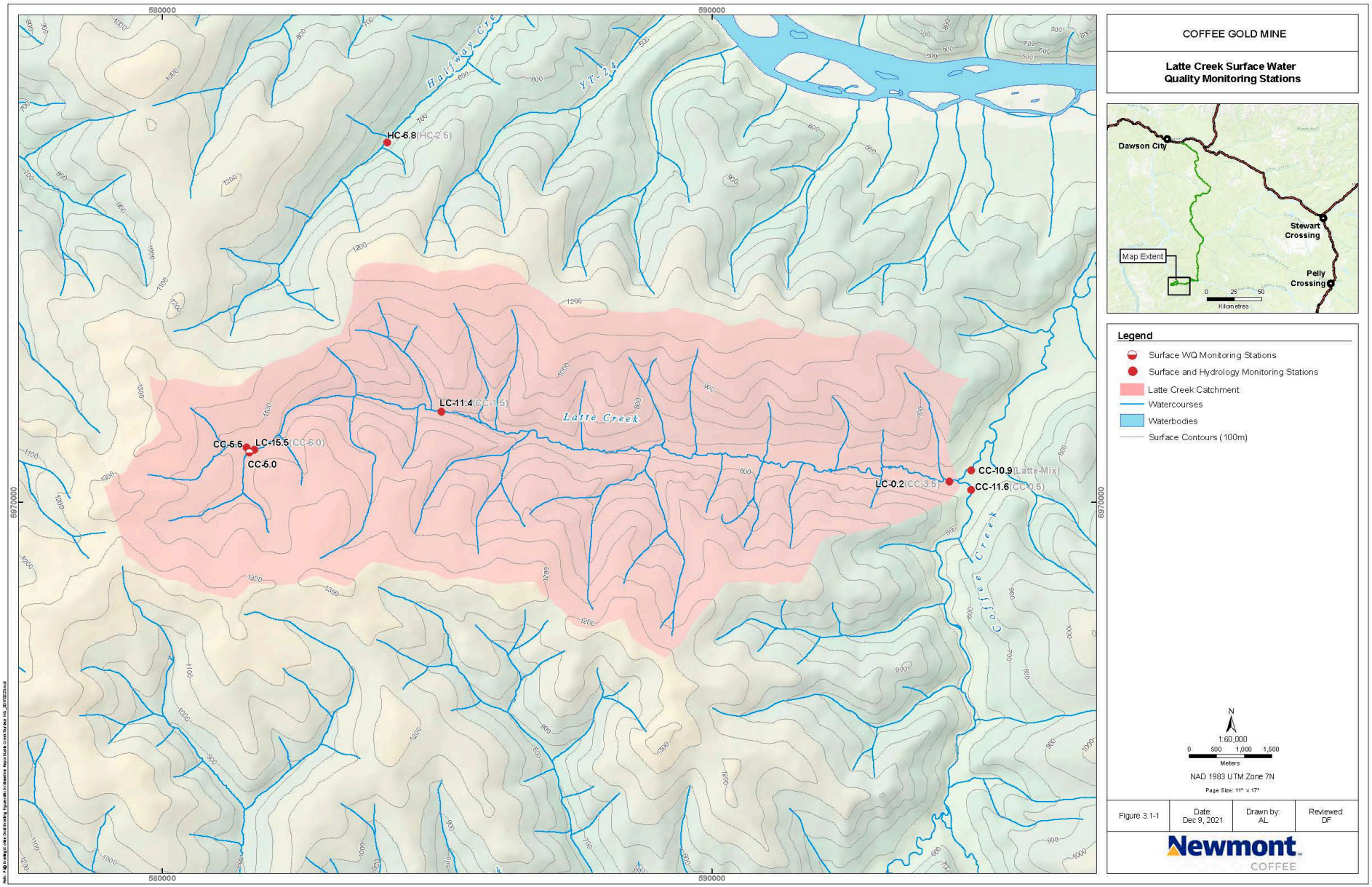

Figure 3.1-1: Detail of Latte Creek drainage illustrating key monitoring station locations

3.1.1.1 Summary Statistics

Table 3.1-1 summarizes the mean monthly values for a suite of the key parameters for station LC-15.5 for the period of June 2014 to December 2020.

3.1.1.2 Major Ions

The major ion chemistry of upper Latte Creek is assessed with respect to conductivity, hardness, alkalinity, sulphate and pH. Upper Latte Creek is characterized by very soft waters, with monthly mean hardness values ranging from only 11 to approximately 21 mg/L (as $CaCO_3$) at station LC-15.5 (Table 3.1-1; Appendix B). Similarly, conductivity values measured at LC-15.5 are very low with values generally < 31 µS/cm (except in April, where mean conductivity values are 57 µS/cm). The low hardness and conductivity values in LC-15.5 are clear characteristics of a system dominated by snow-melt and surface run-off. Indeed, sample collection during the period of November to March has not occurred due to the absence of flow (Table 3.1-1).

The pH in upper Latte Creek is dominantly circumneutral to mildly acidic with values generally ranging between pH 6.1 to 6.9. Observed pH values reported to date have largely remained within the CCME freshwater guideline range for pH of 6.5 to 9.0.

Baseline concentrations for sulphate in upper Latte Creek are very low and generally present at concentrations very near or below the analytical detection limit of 0.5 mg/L (Table 3.1-1). Measured TSS concentrations in upper Latte Creek are generally low with mean values ranging from 1.4 to 17 mg/L (Table 3.1-1).

3.1.1.3 Nutrients

Nutrients quantified in upper Latte Creek include nitrate, nitrite, ammonia, and dissolved phosphorus. In overview, nutrient parameters show low values in upper Latte Creek. Ammonia-Nitrogen (N) concentrations are low with mean monthly values typically below 0.034 mg/L (Table 3.1-1). Similar to ammonia, baseline nitrite-N and nitrate-N concentrations in upper Latte Creek are also low, with mean monthly values ranging from approximately 0.002 to 0.1 mg/L.

Primary productivity in freshwaters is typically limited by available phosphorus. Accordingly, measurements of phosphorus compounds in surface waters can provide an indication of potential changes in trophic status (*i.e.*, productivity regime). Baseline concentrations for mean monthly dissolved phosphorus in upper Latte Creek are low, ranging from approximately 0.004 to a maximum of 0.017 mg/L (Table 3.1-1). Mean dissolved phosphorus for all sampling events at LC-15.5 was 0.0068 mg/L indicative of oligotrophic conditions in upper Latte Creek waters (Appendix C).

Table 3.1-1:
LC-15.5 Mean Monthly Values

	LC-15.5 - Mean											
	Jan	Feb	Mar	Apr (n=3)	May (n=5)	Jun (n=6)	Jul (n=7)	Aug (n=5)	Sep (n=6)	Oct (n=4)	Nov (n=1)	Dec
Physical Parameters												
pH (s.u.)	-	-	-	6.5	6.1	6.6	6.7	6.8	6.9	6.9	6.3	-
Cond-L (uS/cm)	-	-	-	57	20	21	22	23	24	27	31	-
TSS (mg/L)	-	-	-	3.0	6.3	5.1	4.9	8.6	3.5	17	1.4	-
TDS (mg/L)	-	-	-	63	46	43	45	30	33	38	30	-
T-Alk (mg/L)	-	-	-	13	3.8	5.3	6.0	6.9	7.4	8.4	7.8	-
T-Hard (mg/L)	-	-	-	21	11	11	11	11	11	12	13	-
Anions												
Sulphate (mg/L)	-	-	-	5.5	0.50	1.3	0.50	0.60	0.81	0.56	1.3	-
Cl (mg/L)	-	-	-	1.4	1.1	0.83	0.63	0.68	0.57	0.55	0.50	-
F (mg/L)	-	-	-	0.031	0.022	0.026	0.028	0.027	0.028	0.027	0.028	-
Nutrients												
T-NH3 (mg/L)	-	-	-	0.034	0.023	0.018	0.024	0.023	0.02	0.019	0.0089	-
NO2+NO3 (mg/L)	-	-	-	0.014	0.01	0.015	0.014	0.023	0.049	0.089	0.12	-
NO2 (mg/L)	-	-	-	0.014	0.014	0.0025	0.0020	0.0020	0.0019	0.0020	0.0020	-
NO3 (mg/L)	-	-	-	0.014	0.0092	0.014	0.014	0.023	0.046	0.089	0.12	-
D-P (mg/L)	-	-	-	0.017	0.014	0.0082	0.0061	0.0052	0.013	0.0053	0.0044	-
TOC (mg/L)	-	-	-	23	22	18	13	12	11	10	7.4	-
DOC (mg/L)	-	-	-	20	19	17	13	12	11	10	7.8	-
WAD-CN (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Total Metals												
T-Al (ug/L)	-	-	-	239	350	320	290	400	180	170	107	-
T-Sb (ug/L)	-	-	-	0.14	0.058	0.075	0.079	0.087	0.075	0.071	0.059	-
T-As (ug/L)	-	-	-	0.49	0.38	0.52	0.56	0.81	0.55	0.52	0.41	-
T-Ba (ug/L)	-	-	-	21	18	15	14	15	12	13	12	-
T-Be (ug/L)	-	-	-	0.03	0.047	0.041	0.032	0.03	0.035	0.022	0.016	-
T-Bi (ug/L)	-	-	-	0.012	0.014	0.010	0.011	0.010	0.013	0.0075	0.0050	-
T-B (ug/L)	-	-	-	23	26	23	17	20	12	13	10	-
T-Cd (ug/L)	-	-	-	0.11	0.032	0.019	0.011	0.015	0.0096	0.0094	0.0052	-
T-Ca (mg/L)	-	-	-	4.9	2.9	2.9	2.9	3.0	3.0	3.3	3.4	-
T-Cr (ug/L)	-	-	-	0.40	0.45	0.57	0.67	0.81	0.52	0.51	0.39	-
T-Co (ug/L)	-	-	-	0.23	0.22	0.14	0.16	0.31	0.17	0.14	0.049	-
T-Cu (ug/L)	-	-	-	2.1	2.3	2.0	1.8	1.7	1.4	1.3	1.1	-
T-Fe (ug/L)	-	-	-	210	351	390	330	624	280	296	150	-
T-Pb (ug/L)	-	-	-	1.1	0.054	0.054	0.075	0.19	0.033	0.043	0.0073	-
T-Li (ug/L)	-	-	-	0.98	0.50	0.50	0.50	0.50	0.58	0.50	0.50	-
T-Mg (mg/L)	-	-	-	2.1	0.86	0.86	0.88	0.94	0.93	1.0	1.0	-
T-Mn (ug/L)	-	-	-	180	85	41	41	97	66	50	16	-
T-Hg (ug/L)	-	-	-	0.0085	0.01	0.0078	0.0052	0.0055	0.0044	0.0045	0.0041	-
T-Mo (ug/L)	-	-	-	0.059	0.055	0.052	0.077	0.056	0.051	0.061	0.050	-
T-Ni (ug/L)	-	-	-	1.3	1.4	1.2	0.98	1.1	0.82	0.77	0.66	-
T-K (mg/L)	-	-	-	1.6	0.6	0.21	0.22	0.18	0.087	0.17	0.11	-
T-Se (ug/L)	-	-	-	0.04	0.042	0.047	0.045	0.047	0.044	0.042	0.040	-
T-Si (ug/L)	-	-	-	4100	1752	3500	5000	5876	6200	6700	6650	-
T-Ag (ug/L)	-	-	-	0.0067	0.011	0.0080	0.0092	0.0072	0.0058	0.0075	0.0050	-
T-Na (mg/L)	-	-	-	2.6	0.67	0.77	0.91	0.9	1.0	1.2	1.2	-
T-Sr (ug/L)	-	-	-	27	17	17	16	17	16	19	18	-
T-Tl (ug/L)	-	-	-	0.0030	0.0046	0.0025	0.0029	0.0046	0.0033	0.0023	0.0020	-
T-U (ug/L)	-	-	-	0.46	0.62	0.56	0.53	0.52	0.43	0.42	0.34	-
T-Zn (ug/L)	-	-	-	-	-	-	-	-	-	-	-	-
Dissolve Metals												
D-Al (ug/L)	-	-	-	210	300	280	200	170	140	130	97	-
D-Sb (ug/L)	-	-	-	0.080	0.045	0.062	0.067	0.068	0.075	0.06	0.069	-
D-As (ug/L)	-	-	-	0.45	0.28	0.45	0.48	0.5	0.47	0.41	0.38	-
D-Ba (ug/L)	-	-	-	20	16	14	12	11	11	12	12	-
D-Be (ug/L)	-	-	-	0.029	0.04	0.034	0.025	0.024	0.033	0.018	0.016	-
D-Bi (ug/L)	-	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.013	0.0050	0.0050	-
D-B (ug/L)	-	-	-	10	10	17	11	12	12	13	10	-
D-Cd (ug/L)	-	-	-	0.058	0.023	0.016	0.0088	0.0091	0.0078	0.008	0.0068	-
D-Ca (mg/L)	-	-	-	5.0	3.0	3.0	2.8	2.9	2.9	3.3	3.4	-
D-Cr (ug/L)	-	-	-	0.33	0.42	0.49	0.49	0.49	0.47	0.46	0.39	-
D-Co (ug/L)	-	-	-	0.14	0.08	0.086	0.092	0.11	0.14	0.1	0.051	-
D-Cu (ug/L)	-	-	-	1.8	2.1	2.0	1.6	1.5	1.4	1.2	1.0	-
D-Fe (ug/L)	-	-	-	140	243	288	166	170	150	150	82	-
D-Pb (ug/L)	-	-	-	0.092	0.0084	0.012	0.011	0.0099	0.015	0.0053	0.0050	-
D-Li (ug/L)	-	-	-	1.2	0.50	0.50	0.50	0.50	0.58	0.50	0.50	-
D-Mg (mg/L)	-	-	-	2.2	0.81	0.84	0.84	0.88	0.87	1.0	1.1	-
D-Mn (ug/L)	-	-	-	110	32	23	24	37	52	42	15	-
D-Hg (ug/L)	-	-	-	0.0089	0.010	0.0085	0.0054	0.0054	0.0043	0.0043	0.0025	-
D-Mo (ug/L)	-	-	-	0.054	0.050	0.078	0.050	0.052	0.068	0.050	0.050	-
D-Ni (ug/L)	-	-	-	1.2	1.4	1.1	0.87	0.84	0.78	0.74	0.65	-
D-K (mg/L)	-	-	-	1.7	0.58	0.15	0.073	0.088	0.092	0.086	0.11	-
D-Se (ug/L)	-	-	-	0.040	0.040	0.042	0.049	0.046	0.046	0.045	0.040	-
D-Si (ug/L)	-	-	-	4400	1652	3470	4700	5430	5800	6530	6830	-
D-Ag (ug/L)	-	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.006	0.0050	0.0050	-
D-Na (mg/L)	-	-	-	2.8	0.58	0.94	0.9	0.91	1.0	1.1	1.2	-
D-Sr (ug/L)	-	-	-	27	16	17	16	17	17	19	18	-
D-Tl (ug/L)	-	-	-	0.0023	0.0026	0.0020	0.0020	0.0020	0.0035	0.0027	0.0020	-
D-U (ug/L)	-	-	-	0.43	0.61	0.54	0.47	0.42	0.4	0.4	0.3	-
D-Zn (ug/L)	-	-	-	5.8	2.0	1.2	1.4	0.85	0.8	0.83	0.59	-

Total organic carbon reflects a combination of DOC and particulate phases associated with both aquatic and terrestrial organic matter. Highest values of TOC and DOC are typically observed during high flow periods, likely reflecting contributions of particulate carbon associated with terrestrial runoff. Mean monthly TOC and DOC levels in upper Latte Creek are relatively high, ranging between approximately 7.8 to 20 mg/L, with highest values observed during peak flow periods.

3.1.1.4 Trace Elements

Baseline trace element concentrations in upper Latte Creek were derived from data collected from June 2014 to December 2020 at LC-15.5. In general, mean monthly concentrations of total and dissolved trace elements are low (*e.g.,* Arsenic [As], antimony [Sb], cobalt [Co], copper [Cu], chromium [Cr], lead [Pb], mercury [Hg], nickel [Ni], selenium [Se], uranium [U] and zinc [Zn]). For example, total As and total U concentrations at LC-15.5 are typically well below 1.0 µg/L (Table 3.1-1). Conversely, dissolved aluminum (Al) is consistently observed to be elevated well above BC ENV guideline for the protection of aquatic life of 100 µg/L, with highest concentrations coinciding with higher flow conditions (Figure 3.1-2) during freshet (*e.g.*, May and June).

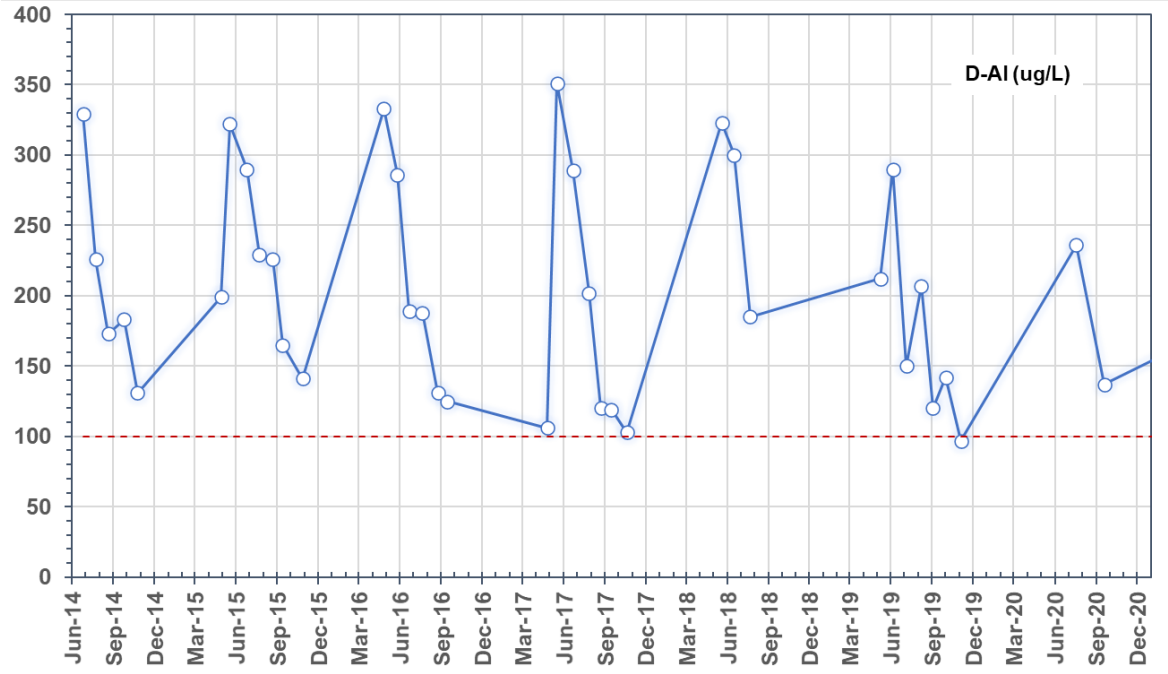

Figure 3.1-2: Dissolved aluminum (D-Al) concentrations (µg/L) at LC-15.5 in upper Latte Creek for the period June 2014 to December 2020 compared to the British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines for protection of aquatic life (dashed red lines).

Concentrations of total Cu show seasonal maxima associated with peak runoff periods (April-May) marginally exceeded the CCME hardness-based total Cu guideline for the protection of aquatic life of 2.0 µg/L (Figure 3.1-3).

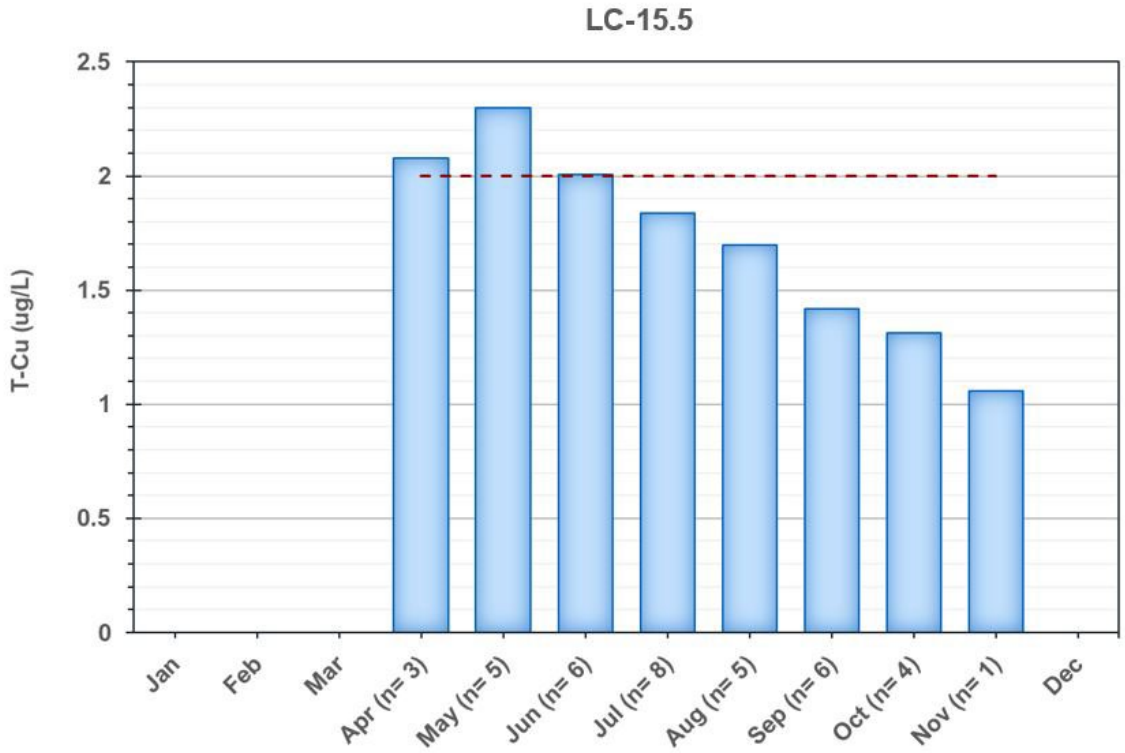

Figure 3.1-3: Total copper (T-Cu) concentrations (µg/L) at LC-15.5 in upper Latte Creek for the period June 2014 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness-dependent guideline value (red dashed line) for the protection of aquatic life.

Similar to copper, total Cd concentrations slightly exceed the CCME hardness-dependent chronic guideline (long-term) for protection of aquatic life during peak flow periods in April and May (Figure 3.1-4). However, Cd concentrations did not exceed the CCME acute (or short-term) water quality guidelines for the protection of aquatic life.

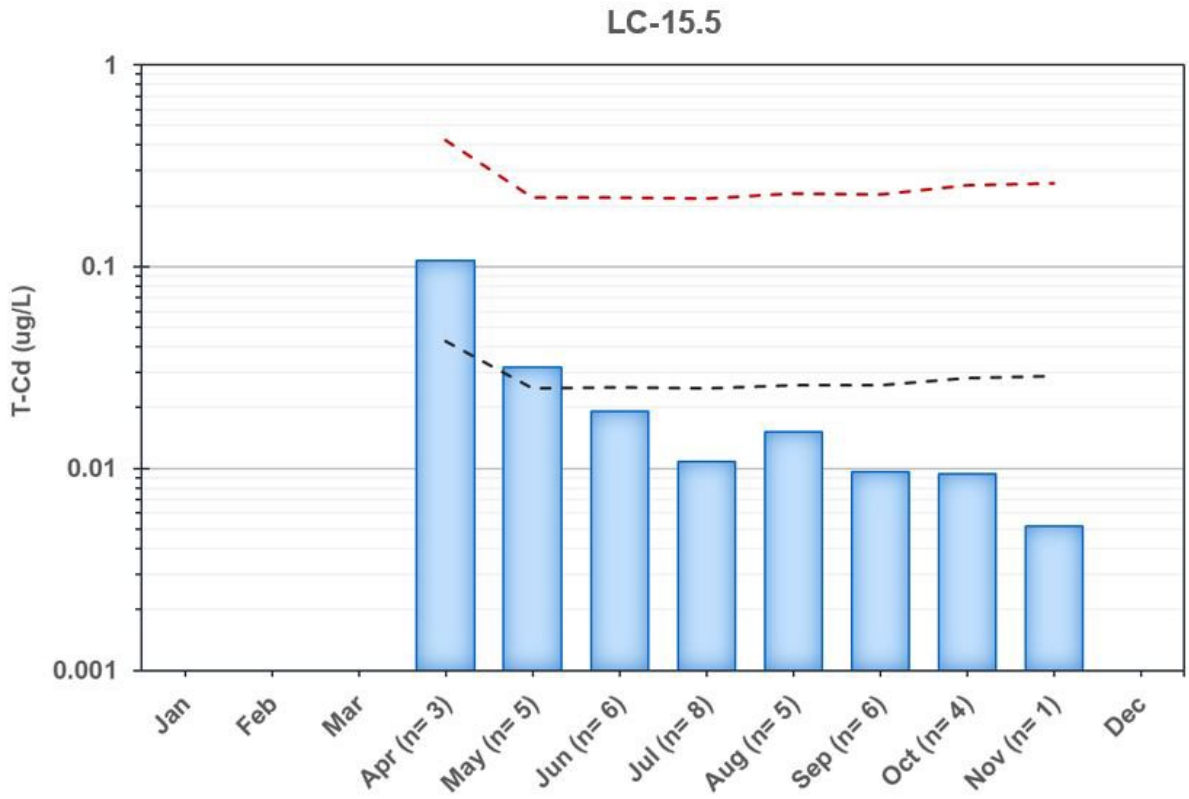

Figure 3.1-4: Total cadmium (T-Cd) concentrations (µg/L) at LC-15.5 in upper Latte Creek for the period June 2014 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness-dependent guideline value for the protection of aquatic life.

3.1.2 Mid and Lower Latte Creek – Stations LC-11.4 and LC-0.2

Water quality in mid-reach and lower-reach Latte Creek is distinctly different from the conditions previously described for upper Latte Creek. Groundwater baseflow contributions produce a more pronounced seasonal signature in water chemistry. In addition, with more significant groundwater contributions, periods with little to no surface flow still result in measurable streamflow within Latte Creek. As a result, monitoring of water quality has been possible through all months of the year.

Mid-reach Latte Creek is characterized by water quality data collected at station LC-11.4 for the period of October 2010 to December 2020 (Figure 3.1-1). This station in Latte Creek is located approximately 50 m downstream of the confluence of a small ephemeral tributary that has been monitored at station LCT20-0.1 since June 2014. Lower Latte Creek is characterized by water quality data collected at station LC-0.2 for the period of October 2010 to December 2020.

3.1.2.1 Summary Statistics

Table 3.1-2 and Table 3.1-3 summarize the mean monthly values for a suite of the key parameters for station LC-11.4 and LC-0.2, respectively.

Table 3.1-2:
LC-11.4 Mean Monthly Values

	LC-11.4 - Mean											
	Jan (n=9)	Feb (n=7)	Mar (n=5)	Apr (n=10)	May (n=8)	Jun (n=9)	Jul (n=9)	Aug (n=10)	Sep (n=10)	Oct (n=10)	Nov (n=10)	Dec (n=6)
Physical Parameters												
pH (s.u.)	8.1	8.0	8.0	8.0	7.4	7.6	7.7	7.8	7.8	8.0	8.0	8.1
Cond-L (uS/cm)	750	800	770	620	110	180	230	270	250	470	670	710
TSS (mg/L)	1.4	7.3	15	16	5.9	8.4	2.5	19	2.0	1.6	1.3	1.9
TDS (mg/L)	490	540	510	420	98	130	170	180	180	310	440	470
T-Alk (mg/L)	200	210	200	150	29	46	60	68	64	120	170	190
T-Hard (mg/L)	390	420	400	320	55	87	110	130	120	240	350	370
Anions												
Sulphate (mg/L)	190	210	210	170	20	40	54	63	55	120	170	190
Cl (mg/L)	0.7	0.65	0.72	0.97	1.1	1.2	0.76	0.94	0.61	0.59	1.5	0.61
F (mg/L)	0.1	0.11	0.12	0.082	0.038	0.047	0.052	0.057	0.053	0.074	0.083	0.098
Nutrients												
T-NH3 (mg/L)	0.017	0.033	0.020	0.023	0.078	0.018	0.022	0.023	0.034	0.016	0.026	0.011
NO2+NO3 (mg/L)	0.32	0.29	0.25	0.12	0.067	0.14	0.2	0.27	0.3	0.41	0.37	0.33
NO2 (mg/L)	0.0080	0.0093	0.0026	0.0047	0.02	0.0081	0.0077	0.0079	0.0071	0.0074	0.003	0.0020
NO3 (mg/L)	0.29	0.29	0.24	0.13	0.044	0.13	0.2	0.26	0.3	0.38	0.34	0.31
D-P (mg/L)	0.0031	0.0043	0.0042	0.0071	0.012	0.0065	0.0055	0.007	0.0087	0.0037	0.0035	0.0029
TOC (mg/L)	4.5	5.2	4.8	9.4	22	16	12	10	9.8	7.1	4.9	4.6
DOC (mg/L)	4.5	4.8	4.3	9.5	20	15	12	9.9	10	6.7	4.8	4.7
WAD-CN (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Total Metals												
T-Al (ug/L)	16	52	280	130	390	320	200	370	130	76	18	17
T-Sb (ug/L)	0.12	0.11	0.18	0.097	0.076	0.11	0.11	0.12	0.11	0.11	0.11	0.1
T-As (ug/L)	1.1	1.4	2.4	1.5	0.75	0.76	0.65	0.88	0.63	0.73	0.79	0.93
T-Ba (ug/L)	84	87	79	69	29	32	35	41	35	61	81	82
T-Be (ug/L)	0.010	0.011	0.022	0.019	0.05	0.036	0.028	0.031	0.031	0.013	0.010	0.010
T-Bi (ug/L)	0.01	0.0064	0.0078	0.0070	0.010	0.012	0.0089	0.0073	0.010	0.0080	0.0050	0.0058
T-B (ug/L)	28	21	26	26	35	37	24	31	23	31	26	17
T-Cd (ug/L)	0.015	0.013	0.023	0.026	0.034	0.2	0.014	0.014	0.0099	0.0081	0.01	0.0089
T-Ca (mg/L)	100	110	110	84	15	23	29	34	32	62	92	97
T-Cr (ug/L)	0.24	0.21	0.54	0.26	0.58	0.68	0.51	0.81	0.39	0.26	0.15	0.13
T-Co (ug/L)	0.028	0.069	0.31	0.14	0.27	0.17	0.093	0.21	0.087	0.06	0.025	0.026
T-Cu (ug/L)	1.0	1.0	1.4	1.6	2.3	2.1	1.8	1.9	1.6	1.3	1.1	0.98
T-Fe (ug/L)	15	70	400	150	370	320	180	450	100	83	13	14
T-Pb (ug/L)	0.04	0.048	2.7	0.12	0.11	0.12	0.064	0.23	0.032	0.07	0.029	0.014
T-Li (ug/L)	2.9	3.0	3.1	2.7	0.9	1.3	1.4	1.8	1.6	2.2	2.6	2.4
T-Mg (mg/L)	32	35	33	26	4.6	7.2	9.3	11	10	20	28	31
T-Mn (ug/L)	8.8	30	160	70	74	21	11	18	9.4	9.1	3.4	6.8
T-Hg (ug/L)	0.0047	0.0035	0.0038	0.0056	0.011	0.0078	0.0060	0.0072	0.0056	0.0054	0.0045	0.0034
T-Mo (ug/L)	0.41	0.42	0.39	0.33	0.081	0.17	0.14	0.18	0.15	0.26	0.35	0.37
T-Ni (ug/L)	0.49	0.49	0.73	0.67	1.4	1.0	0.76	0.87	0.72	0.5	0.46	0.42
T-K (mg/L)	5.5	5.7	5.7	4.6	1.2	1.4	1.7	1.9	1.8	3.4	4.6	5.0
T-Se (ug/L)	0.27	0.28	0.26	0.16	0.061	0.071	0.085	0.097	0.11	0.15	0.21	0.23
T-Si (ug/L)	5300	5300	5570	5198	2390	3900	4900	5602	6000	5616	5316	5000
T-Ag (ug/L)	0.006	0.0064	0.0070	0.0056	0.0081	0.013	0.0076	0.0069	0.0060	0.0066	0.0059	0.0058
T-Na (mg/L)	6.2	6.3	6.3	6.0	1.2	2.1	2.4	3.0	2.7	4.3	5.7	6.3
T-Sr (ug/L)	869	930	867	680	120	180	230	280	270	500	740	790
T-Tl (ug/L)	0.0031	0.0041	0.0074	0.0052	0.0061	0.0049	0.0036	0.0061	0.0038	0.003	0.003	0.0028
T-U (ug/L)	30	31	30	20	3.7	5.0	6.3	7.2	6.6	14	23	29
T-Zn (ug/L)	-	-	-	-	-	-	-	-	-	-	-	-
Dissolve Metals												
D-Al (ug/L)	10	7.9	7.3	56	280	210	140	100	100	41	17	11
D-Sb (ug/L)	0.11	0.1	0.089	0.093	0.074	0.095	0.1	0.11	0.11	0.11	0.11	0.1
D-As (ug/L)	1.1	1.3	1.5	1.1	0.58	0.58	0.58	0.6	0.59	0.65	0.80	0.9
D-Ba (ug/L)	83	84	72	68	27	30	33	38	34	60	81	82
D-Be (ug/L)	0.010	0.010	0.010	0.014	0.042	0.032	0.022	0.022	0.029	0.012	0.010	0.010
D-Bi (ug/L)	0.0052	0.0050	0.0050	0.0050	0.0050	0.0053	0.0050	0.0050	0.0095	0.0050	0.0051	0.0050
D-B (ug/L)	28	21	26	22	30	28	20	27	23	27	26	17
D-Cd (ug/L)	0.018	0.013	0.011	0.017	0.029	0.11	0.014	0.012	0.0086	0.01	0.021	0.0093
D-Ca (mg/L)	100	110	110	83	15	23	29	34	32	61	91	96
D-Cr (ug/L)	0.12	0.2	0.12	0.17	0.39	0.47	0.4	0.38	0.37	0.19	0.14	0.13
D-Co (ug/L)	0.025	0.025	0.024	0.068	0.18	0.081	0.061	0.067	0.058	0.037	0.025	0.023
D-Cu (ug/L)	1.1	1.0	0.95	1.3	2.0	1.9	1.7	1.6	1.6	1.2	1.2	1.0
D-Fe (ug/L)	5.5	4.1	4.4	42	210	160	99	85	66	26	10	5.0
D-Pb (ug/L)	0.021	0.015	0.053	0.026	0.024	0.025	0.033	0.011	0.031	0.11	0.1	0.0074
D-Li (ug/L)	2.7	3.1	2.8	2.6	0.84	1.3	1.4	1.6	1.6	2.2	2.6	2.6
D-Mg (mg/L)	32	35	32	26	4.6	7.2	9.2	11	9.8	20	29	31
D-Mn (ug/L)	6.9	10	9.7	31	56	6.9	6.3	7.6	7.4	4.3	3.2	5.5
D-Hg (ug/L)	0.0041	0.0034	0.0036	0.0049	0.0081	0.0079	0.0053	0.0061	0.0058	0.0050	0.0038	0.0035
D-Mo (ug/L)	0.42	0.39	0.36	0.25	0.086	0.13	0.21	0.16	0.15	0.25	0.33	0.44
D-Ni (ug/L)	0.45	0.43	0.42	0.62	1.2	0.9	0.71	0.64	0.62	0.47	0.43	0.45
D-K (mg/L)	5.5	5.7	5.7	4.6	1.2	1.4	1.7	1.9	1.8	3.4	4.6	5.1
D-Se (ug/L)	0.26	0.27	0.25	0.16	0.064	0.068	0.087	0.098	0.11	0.15	0.23	0.23
D-Si (ug/L)	5000	5300	5014	5149	2300	3900	4800	5351	5798	5513	5346	5070
D-Ag (ug/L)	0.0050	0.0050	0.0050	0.0050	0.0050	0.0052	0.0050	0.0053	0.0058	0.0050	0.0050	0.0050
D-Na (mg/L)	6.2	6.4	6.3	5.4	1.5	2.1	2.5	3.0	2.6	4.3	6.6	6.4
D-Sr (ug/L)	850	910	868	680	120	180	230	280	260	520	740	810
D-Tl (ug/L)	0.0029	0.0037	0.0039	0.004	0.0032	0.0028	0.0028	0.0025	0.0034	0.0026	0.0029	0.0029
D-U (ug/L)	31	30	28	20	3.7	4.8	6.1	7.0	6.5	14	23	29
D-Zn (ug/L)	0.65	0.95	0.48	1.5	2.5	1.8	1.2	0.66	0.84	0.98	1.9	0.58

Table 3.1-3:
LC-0.2 Mean Monthly Values

	LC-0.2 - Mean											
	Jan (n=6)	Feb (n=6)	Mar (n=3)	Apr (n=8)	May (n=8)	Jun (n=9)	Jul (n=9)	Aug (n=9)	Sep (n=10)	Oct (n=10)	Nov (n=11)	Dec (n=7)
Physical Parameters												
pH (s.u.)	7.9	7.9	8.0	8.1	7.6	7.8	7.8	7.8	7.9	7.9	7.9	7.9
Cond-L (uS/cm)	430	440	480	470	170	262	220	270	270	350	400	403
TSS (mg/L)	1.5	6.0	5.2	2.5	7.7	14	1.3	2.4	1.2	1.6	1.5	1.5
TDS (mg/L)	270	271	310	310	128	180	160	190	190	230	250	260
T-Alk (mg/L)	120	120	146	130	41	67	59	69	71	88	100	100
T-Hard (mg/L)	213	210	240	230	79	130	110	120	130	170	190	200
Anions												
Sulphate (mg/L)	100	99	110	110	37	61	49	61	62	87	100	97
Cl (mg/L)	0.87	0.72	0.85	1.4	1.4	0.9	0.69	0.84	0.66	0.66	0.71	0.69
F (mg/L)	0.054	0.051	0.058	0.081	0.045	0.06	0.058	0.059	0.059	0.063	0.060	0.06
Nutrients												
T-NH3 (mg/L)	0.018	0.018	0.044	0.031	0.03	0.027	0.018	0.03	0.021	0.015	0.023	0.015
NO2+NO3 (mg/L)	0.4	0.33	0.049	0.075	0.075	0.13	0.21	0.27	0.32	0.43	0.47	0.47
NO2 (mg/L)	0.011	0.011	0.0032	0.0028	0.015	0.008	0.008	0.0080	0.0070	0.0074	0.0027	0.0093
NO3 (mg/L)	0.43	0.41	0.36	0.14	0.054	0.14	0.21	0.26	0.33	0.43	0.46	0.45
D-P (mg/L)	0.0027	0.0041	0.0027	0.0080	0.0095	0.0032	0.0041	0.0042	0.0077	0.0033	0.0072	0.0024
TOC (mg/L)	4.8	5.4	4.8	12	20	12	13	11	10	11	6.0	5.3
DOC (mg/L)	4.5	4.5	4.6	11	19	12	13	11	9.9	7.8	6.1	5.4
WAD-CN (mg/L)	0.00051	0.00061	0.00060	0.00064	0.0011	0.00092	0.00093	0.00076	0.0013	0.0007	0.0011	0.0006
Total Metals												
T-Al (ug/L)	18	35	17	52	314	320	120	110	65	60	20	19
T-Sb (ug/L)	0.062	0.067	0.085	0.095	0.07	0.094	0.11	0.1	0.1	0.091	0.078	0.067
T-As (ug/L)	0.26	0.31	0.33	0.39	0.57	0.55	0.41	0.4	0.37	0.34	0.27	0.26
T-Ba (ug/L)	90	93	100	79	38	53	41	51	49	67	80	85
T-Be (ug/L)	0.01	0.011	0.010	0.013	0.034	0.025	0.019	0.018	0.022	0.012	0.018	0.010
T-Bi (ug/L)	0.0050	0.0058	0.0050	0.0088	0.010	0.0078	0.0067	0.0072	0.010	0.0075	0.0095	0.0050
T-B (ug/L)	37	37	37	25	35	28	24	29	23	31	25	21
T-Cd (ug/L)	0.0080	0.011	0.027	0.028	0.022	0.017	0.011	0.0093	0.0063	0.0072	0.007	0.0067
T-Ca (mg/L)	61	62	70	62	21	35	28	34	36	46	53	54
T-Cr (ug/L)	0.11	0.15	0.13	0.19	0.56	1.1	0.5	0.39	0.31	0.25	0.13	0.11
T-Co (ug/L)	0.028	0.05	0.044	0.078	0.29	0.21	0.069	0.076	0.052	0.052	0.037	0.029
T-Cu (ug/L)	0.83	0.95	3.4	1.1	2.1	1.9	1.8	1.6	1.5	1.3	0.96	0.87
T-Fe (ug/L)	13	42	23	63	360	350	100	100	45	61	11	13
T-Pb (ug/L)	0.012	0.062	0.11	0.062	0.13	0.17	0.02	0.035	0.015	0.05	0.018	0.0088
T-Li (ug/L)	0.57	0.53	0.65	1.8	0.77	0.89	0.73	0.79	0.77	0.61	0.60	0.60
T-Mg (mg/L)	15	15	16	19	6.5	10	8.4	9.8	11	13	15	15
T-Mn (ug/L)	1.7	6.2	17	24	57	20	3.5	4.5	2.4	2.2	0.51	0.62
T-Hg (ug/L)	0.0062	0.0062	0.0047	0.0051	0.0078	0.0065	0.006	0.0064	0.0058	0.0054	0.0048	0.0047
T-Mo (ug/L)	0.27	0.26	0.25	0.69	0.23	0.34	0.24	0.26	0.24	0.31	0.34	0.3
T-Ni (ug/L)	0.47	0.52	0.52	1.2	1.1	1.2	0.69	0.65	0.57	0.82	0.5	0.48
T-K (mg/L)	2.4	2.3	2.5	4.0	1.4	1.9	1.7	1.9	2.1	2.3	2.4	2.4
T-Se (ug/L)	0.085	0.066	0.083	0.13	0.071	0.078	0.084	0.079	0.092	0.087	0.1	0.079
T-Si (ug/L)	4865	4840	5170	6600	2900	4200	4600	4900	5427	4915	4800	4600
T-Ag (ug/L)	0.0050	0.0058	0.0050	0.0069	0.0073	0.0080	0.0073	0.0057	0.0060	0.0063	0.015	0.0050
T-Na (mg/L)	4.1	4.4	4.4	7.2	2.1	3.3	2.8	3.1	3.3	3.9	4.2	4.1
T-Sr (ug/L)	358	360	400	370	150	230	201	250	260	320	340	350
T-Tl (ug/L)	0.0022	0.0020	0.0027	0.0023	0.006	0.0066	0.0029	0.0026	0.0035	0.0022	0.0027	0.0020
T-U (ug/L)	11	11	12	31	5.6	8.3	4.9	6.1	6.2	9.9	11	9.9
T-Zn (ug/L)	0.65	1.2	1.2	2.7	2.1	1.7	0.63	0.8	0.88	1.7	0.81	0.33
Dissolve Metals												
D-Al (ug/L)	15	14	11	32	190	100	100	77	58	30	19	15
D-Sb (ug/L)	0.066	0.06	0.071	0.067	0.068	0.085	0.092	0.098	0.099	0.088	0.077	0.069
D-As (ug/L)	0.26	0.26	0.3	0.36	0.43	0.36	0.38	0.36	0.36	0.29	0.27	0.24
D-Ba (ug/L)	93	92	100	77	35	50	41	50	49	65	80	86
D-Be (ug/L)	0.010	0.010	0.010	0.011	0.030	0.018	0.018	0.016	0.023	0.01	0.018	0.010
D-Bi (ug/L)	0.0050	0.0050	0.0050	0.0050	0.0050	0.0054	0.0050	0.0050	0.0095	0.0050	0.0091	0.0050
D-B (ug/L)	37	37	37	20	30	28	24	24	23	27	25	21
D-Cd (ug/L)	0.0087	0.0098	0.013	0.014	0.02	0.011	0.014	0.0064	0.0058	0.0062	0.0084	0.01
D-Ca (mg/L)	60	61	75	62	21	35	29	34	36	44	54	55
D-Cr (ug/L)	0.11	0.10	0.1	0.15	0.36	0.34	0.38	0.34	0.29	0.18	0.13	0.11
D-Co (ug/L)	0.026	0.027	0.035	0.065	0.19	0.067	0.062	0.057	0.048	0.03	0.037	0.026
D-Cu (ug/L)	0.83	0.79	2.2	0.96	1.8	1.7	1.7	1.5	1.4	1.2	0.98	0.88
D-Fe (ug/L)	7.9	7.5	12	36	190	85	82	59	35	13	9.3	6.5
D-Pb (ug/L)	0.019	0.019	0.026	0.02	0.037	0.013	0.034	0.0086	0.012	0.016	0.026	0.01
D-Li (ug/L)	0.55	0.62	0.59	1.7	0.63	0.74	0.8	0.79	0.74	0.56	0.64	0.59
D-Mg (mg/L)	15	15	15	19	6.3	10	8.5	10	10	13	15	15
D-Mn (ug/L)	1.0	2.9	14	19	43	3.9	2.3	2.7	1.8	0.54	0.42	0.26
D-Hg (ug/L)	0.0053	0.0055	0.0047	0.0047	0.0066	0.0055	0.006	0.0069	0.0053	0.0044	0.0042	0.004
D-Mo (ug/L)	0.29	0.25	0.24	0.63	0.23	0.32	0.22	0.24	0.25	0.32	0.35	0.3
D-Ni (ug/L)	0.47	0.49	0.52	0.59	0.92	0.72	0.66	0.62	0.55	0.48	0.49	0.5
D-K (mg/L)	2.4	2.4	2.5	4.0	1.5	1.9	1.8	2.0	2.0	2.3	2.4	2.4
D-Se (ug/L)	0.095	0.081	0.051	0.11	0.065	0.076	0.075	0.073	0.088	0.081	0.097	0.083
D-Si (ug/L)	4700	4800	5300	6400	2700	3900	4500	4970	5257	4696	4900	4500
D-Ag (ug/L)	0.0050	0.0050	0.0050	0.0050	0.0050	0.0053	0.0050	0.0050	0.0055	0.005	0.0055	0.0050
D-Na (mg/L)	4.2	4.1	4.3	6.8	2.1	3.5	2.9	3.3	3.2	3.8	4.2	4.1
D-Sr (ug/L)	370	360	400	360	140	240	210	250	260	310	350	350
D-Tl (ug/L)	0.0020	0.0020	0.0027	0.0021	0.0031	0.0031	0.0025	0.0022	0.0033	0.0020	0.0028	0.0020
D-U (ug/L)	12	11	11	31	5.5	8.1	4.9	6.1	6.0	9.9	11	9.8
D-Zn (ug/L)	0.75	0.64	0.97	1.8	1.5	0.54	0.6	0.63	0.56	0.7	0.64	0.54

3.1.2.2 Major Ions

The major ion chemistry of mid-reach and lower-reach Latte Creek is assessed with respect to conductivity, hardness, alkalinity, sulphate and pH. Station LC-11.4 is characterized by seasonally soft waters (approximately < 90 mg/L [as $CaCO_3$]) during freshet months (May to June) and hard to very hard waters (ranging from 110 mg/L to > 420 mg/L [as $CaCO_3$]) during lower flow periods and winter low flows (Figure 3.1-5).

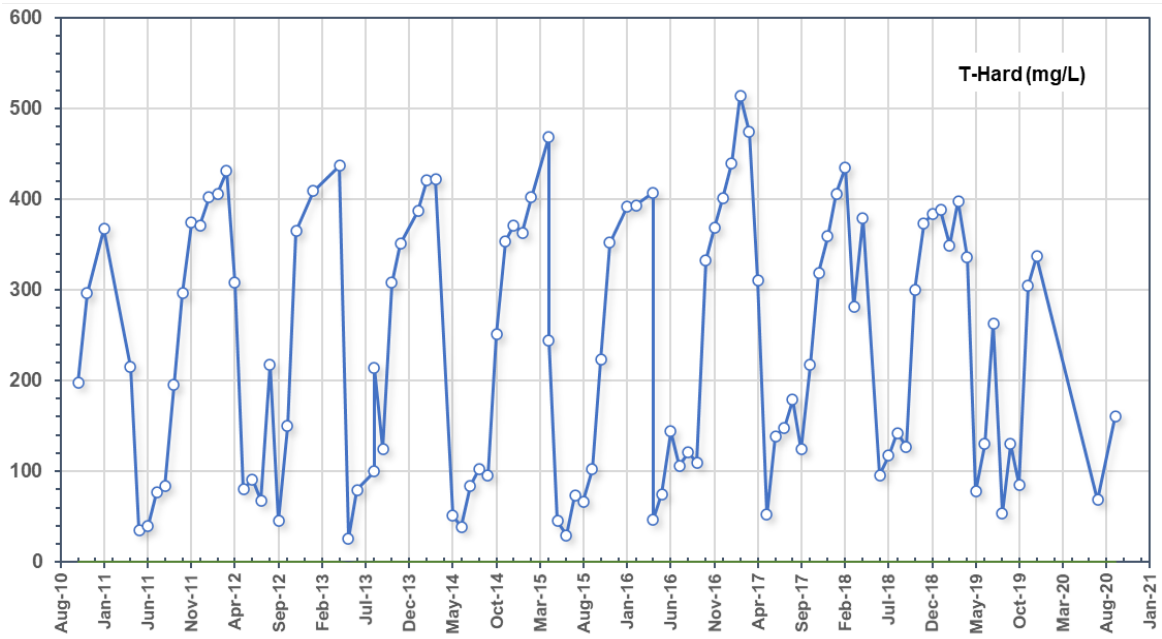

Figure 3.1-5: Total Hardness (T-Hard., as mg/L $CaCO_3$) in mid Latte Creek (LC-11.4) for the period October 2010 to December 2020.

In lower Latte Creek, hardness values show a similar seasonal trend, with minima occurring during freshet or following precipitation runoff events. Hard to very hard waters dominate the fall and winter flow conditions with mean values ranging between approximately 170 mg/L to 240 mg/L $CaCO_3$ (Table 3.1-3; Figure 3.1-6).

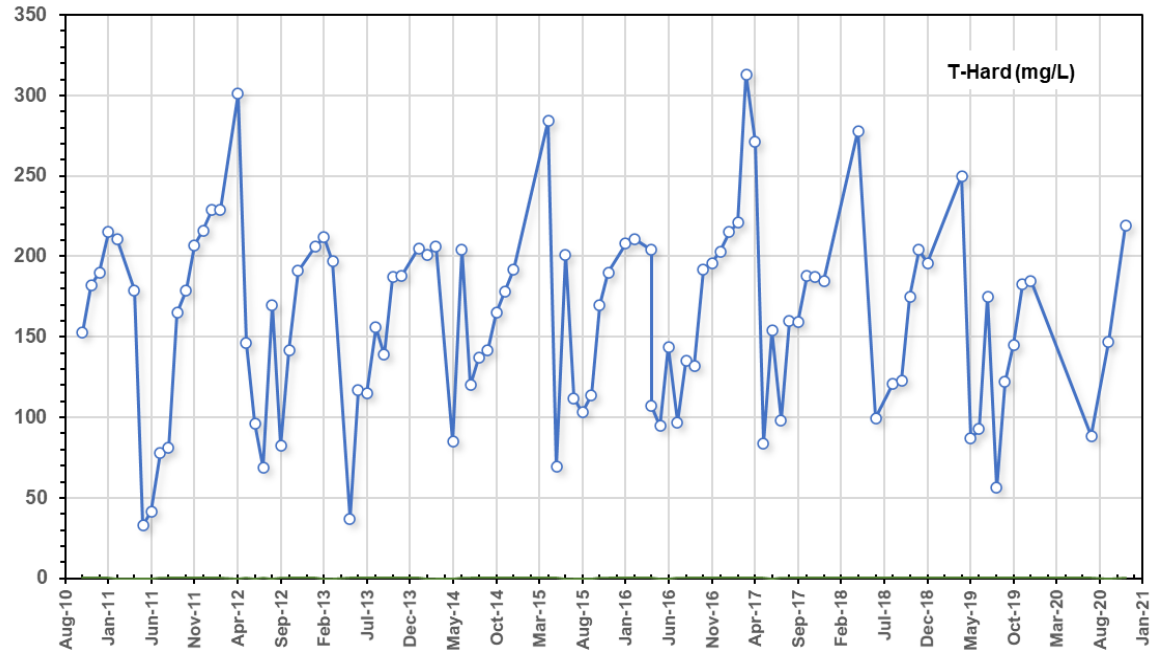

Figure 3.1-6: Total Hardness (T-Hard., as mg/L $CaCO_3$) in lower Latte Creek (LC-0.2) for the period October 2010 to December 2020.

Similar trends for conductivity and alkalinity are also observed with pronounced seasonal fluctuations, with minima coinciding with freshet periods in May and June (Table 3.1-2 and Table 3.1-3). Overall, such trends in stream salinity reflect varying proportions of snow-melt driven surface runoff (lower ionic strength) and groundwater inputs (higher ionic strength) as driven by the seasonal water balance. The stronger seasonal signature observed in mid Latte Creek at LC-11.4 reflects the influence of waters entering Latte Creek from the small tributary monitored at station LCT20-0.1 (Appendix B).

The pH in mid and lower Latte Creek remains relatively uniform throughout the year with values generally ranging between 7.0 and 8.0. The neutral to slightly basic pH conditions can be linked to bicarbonate alkalinity. All pH values reported to date have remained within the CCME freshwater guideline range for pH of 6.5 to 9.0.

Baseline concentrations for sulphate in mid and lower Latte Creek are notably much higher than in upper Latte Creek. While upper Latte Creek had very low sulphate concentrations the reported concentrations in mid to lower Latte Creek (LC-11.4) ranged between 20 to 210 mg/L, and approximately 37 to 110 mg/L in lower Latte Creek (LC-0.2; Table 3.1-2 and Table 3.1-3). Sulphate minima during high flow can be attributed to the influence of low ionic strength melt waters, while higher values during the low-flow periods reflect an increased proportion of groundwater inputs.

Unlike the dissolved ions, higher TSS concentrations in mid and lower Latte Creek generally coincide with the peak snowmelt months or during intense rainfall events in summer months (Table 3.1-2 and Table 3.1-3). At most other flow periods of the year, TSS values in Latte Creek were generally below 3.0 mg/L.

3.1.2.3 Nutrients

Nutrients are found in low concentrations in mid and lower Latte Creek. Ammonia-N concentrations are low with mean monthly values typically between roughly 0.01 to 0.08 mg/L for LC-11.4 and 0.01 to 0.04 mg/L for LC-0.2 (Table 3.1-2 and Table 3.1-3). Nitrate-N and nitrite-N concentrations in mid and lower Latte Creek were comparably higher than upper Latte Creek. Baseline mean nitrate-N concentrations in mid Latte Creek (LC-11.4) ranged from 0.1 to 0.4 mg/L, with highest monthly means observed during winter low flows. Similarly, monthly mean nitrate-N concentrations in lower Latte Creek (LC-0.2) ranged from 0.06 to 0.5 mg/L, again with highest monthly means observed during winter low flow conditions. Dissolved phosphorus concentrations at both stations were low (LC-11.4 mean of 0.0058 mg/L and LC-0.2 mean of 0.0052 mg/L) and indicative of oligotrophic conditions.

Similar to upper Latte Creek, TOC and DOC exhibit a marked seasonal signature with highest values observed during peak runoff periods. The DOC concentrations range from less than 5.0 mg/L during baseflow periods, dominated by groundwater inputs, to upwards of 22 mg/L during higher flow periods reflecting carbon contributions associated with terrestrial runoff (Figure 3.1-7 and Figure 3.1-8).

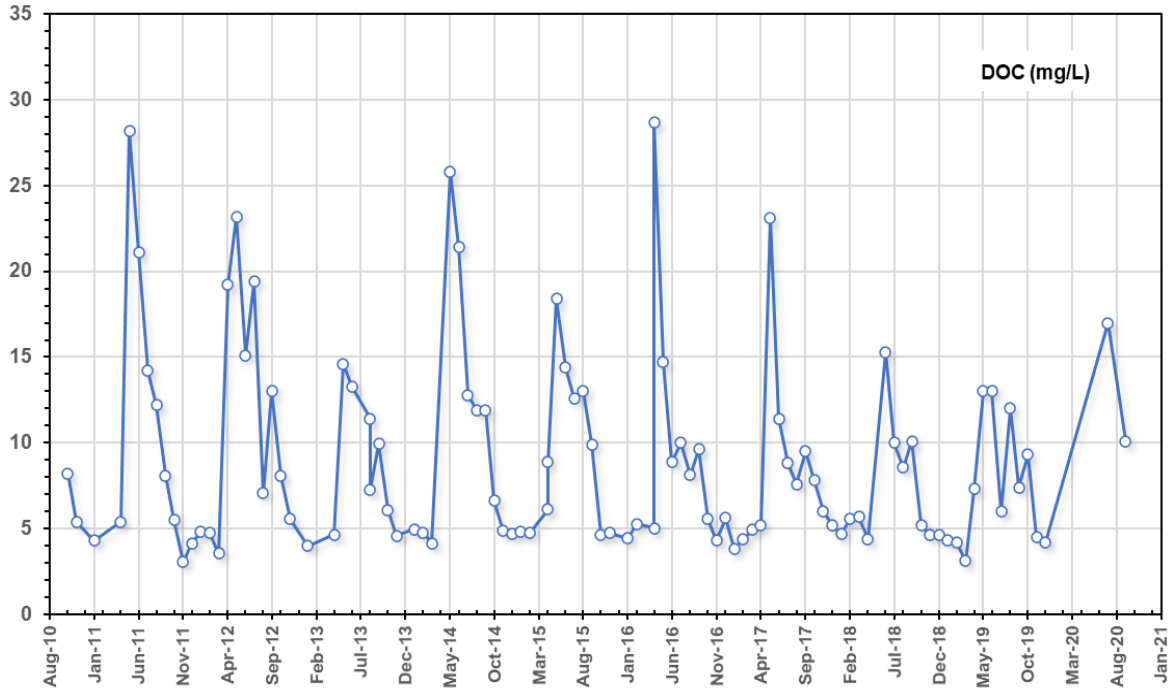

Figure 3.1-7: Dissolved organic carbon (DOC mg/L) in mid Latte Creek (LC-11.4) for the period October 2010 to December 2020.

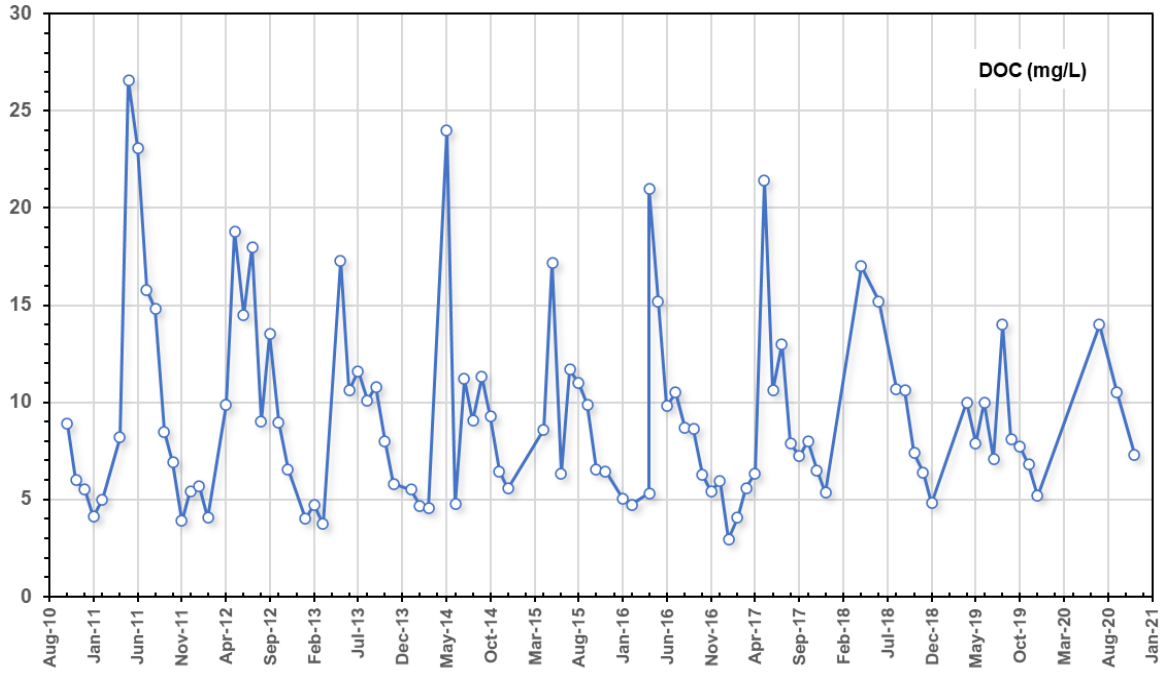

Figure 3.1-8: Dissolved organic carbon (DOC mg/L) in lower Latte Creek (LC-0.2) for the period October 2010 to December 2020.

3.1.2.4 Trace Elements

Baseline trace element concentrations in mid (LC-11.4) and lower Latte Creek (LC-0.2) were derived from data collected from October 2010 to December 2020. For most parameters, mean monthly concentrations of total and dissolved trace elements are considered to be low (*e.g.*, As, Sb, Co, Cr, Pb, Hg, Ni, Se, and Zn). Total As concentrations in mid Latte Creek at LC-11.4 are typically around 0.6 to 2.4 µg/L with maximum concentrations of total As observed coincident with high flow events (Figure 3.1-9).

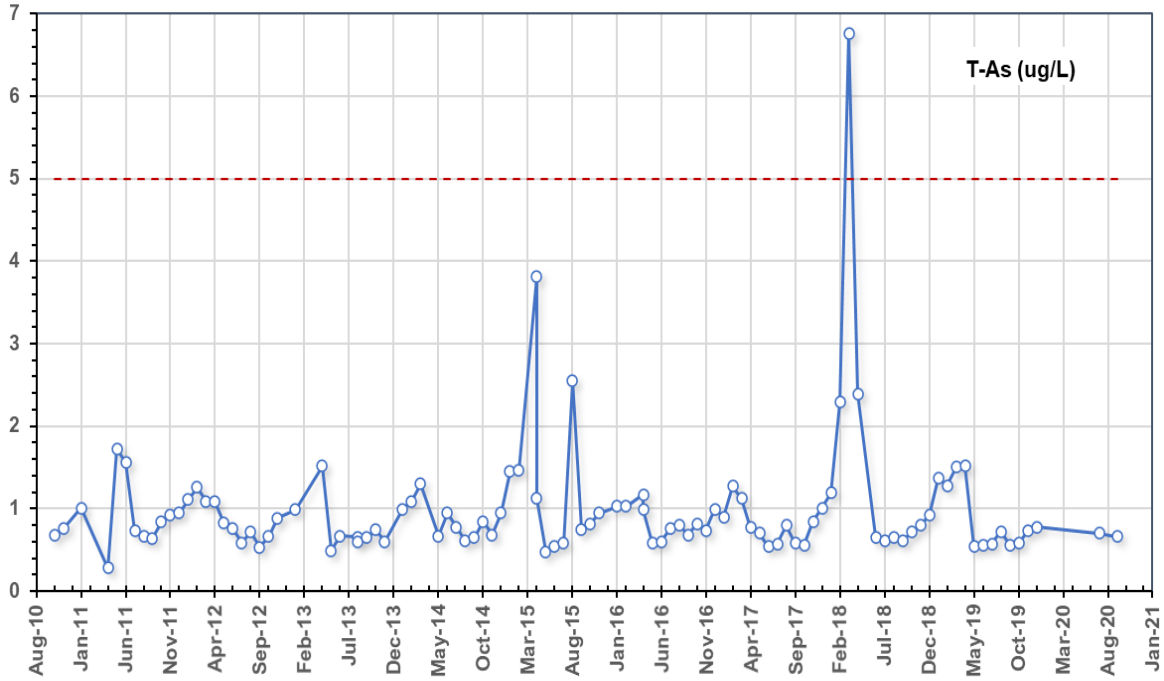

Figure 3.1-9: Total arsenic (T-As) in mid Latte Creek (LC-11.4) for the period October 2010 to December 2020 compared to Canadian Council of Ministers of the Environment (CCME) water quality guidelines (red dashed line) for the protection of aquatic life.

In lower Latte Creek at station LC-0.2, total As concentrations are lower and consistently below 0.6 µg/L (Table 3.1-3 and Figure 3.1-10) and well below the CCME guideline of 5.0 µg/L for the protection of aquatic life.

Total Se concentrations in mid (LC-11.4) and lower (LC-0.2) Latte Creek are typically less than 0.3 µg/L (Table 3.1-2 and Table 3.1-3).

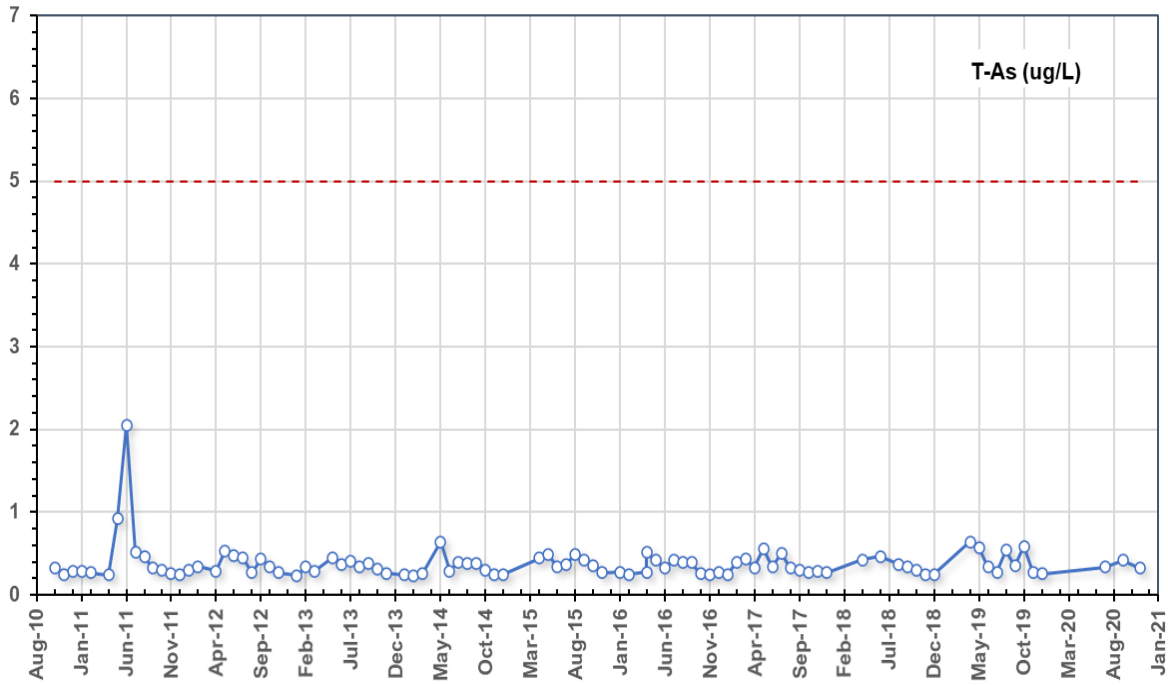

Figure 3.1-10: Total arsenic (T-As) in lower Latte Creek (LC-0.2) for the period October 2010 to December 2020 compared to Canadian Council of Ministers of the Environment (CCME) water quality guidelines (red dashed line) for protection of aquatic life.

Similar to upper Latte Creek, dissolved Al is consistently observed to be elevated well above BC ENV guideline for the protection of aquatic life of 100 µg/L throughout Latte Creek, with peak concentrations coinciding with higher flow conditions (Figure 3.1-11 and Figure 3.1-12). During baseflow periods, dissolved Al concentrations throughout Latte Creek are generally below 40 µg/L (Figure 3.1-11 and Figure 3.1-12).

Concentrations of total Cu in mid (LC-11.4) and lower (LC-0.2) Latte Creek show seasonal maxima associated with peak runoff periods that can episodically exceed the CCME hardness-dependent Cu guideline for the protection of aquatic life (Figure 3.1-13 and Figure 3.1-14.

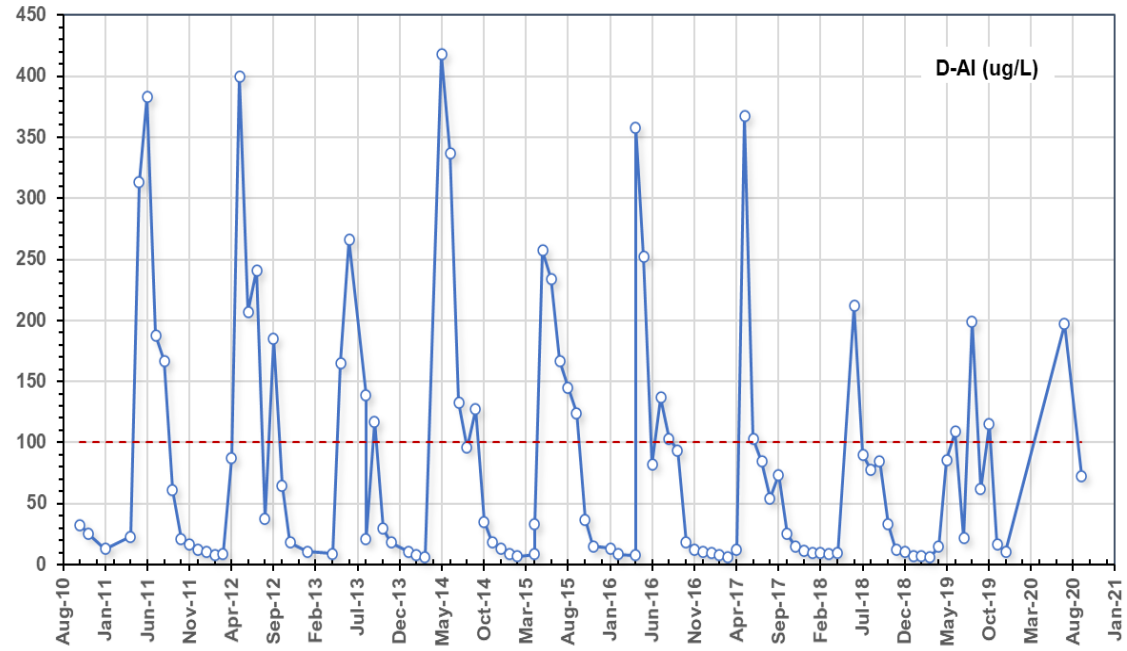

Figure 3.1-11: Dissolved aluminum (D-Al) in mid Latte Creek (LC-11.4) for the period October 2010 to December 2020 compared to the British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dashed line) for protection of aquatic life.

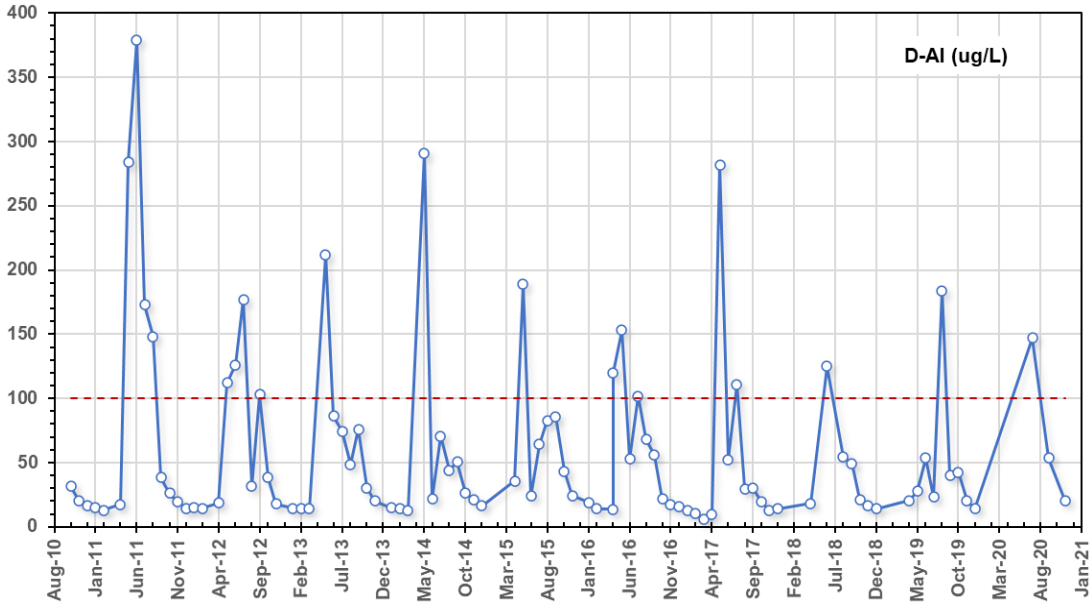

Figure 3.1-12: Dissolved aluminum (D-Al) in lower Latte Creek (LC-0.2) for the period October 2010 to December 2020 compared to British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dashed line) for protection of aquatic life

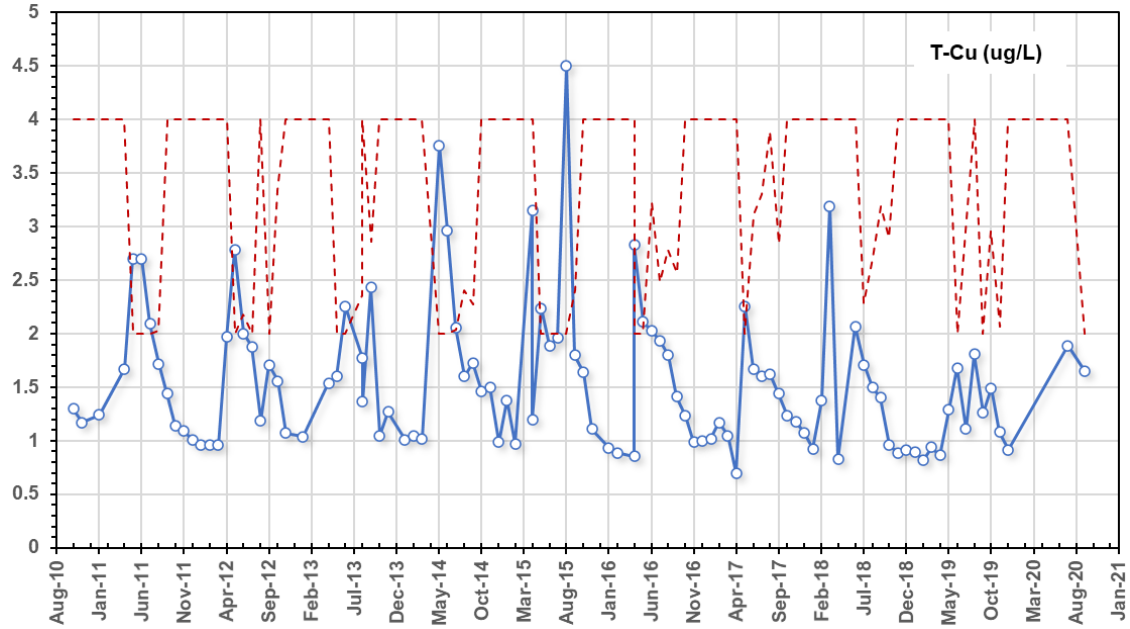

Figure 3.1-13: Total copper (T-Cu) in mid Latte Creek (LC-11.4) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness dependent water quality guidelines (red dashed line) for the protection of aquatic life.

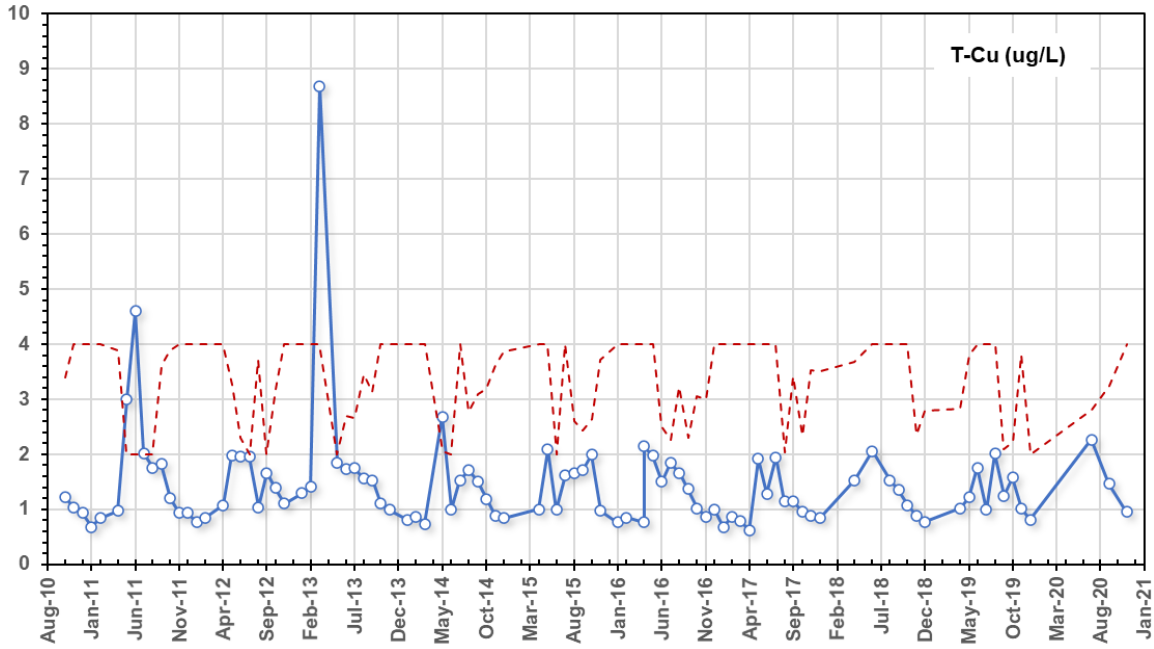

Figure 3.1-14: Total Cu in lower Latte Creek (LC-0.2) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness dependent water quality guidelines (red dashed line) for the protection of aquatic life.

With the exception of one instance in May 2016, mid (LC-11.4) and lower (LC-0.2) Latte Creek, total Cd concentrations do not exceed the chronic or acute CCME hardness-dependent guidelines for protection of aquatic life (Figure 3.1-15 and Figure 3.1-16).

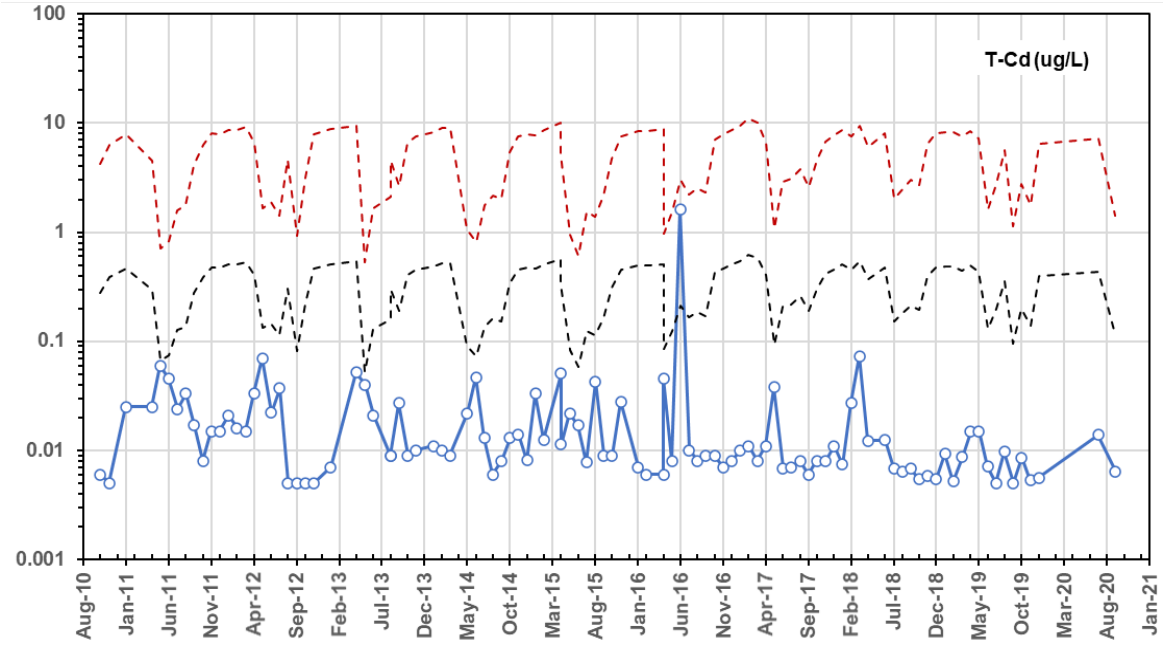

Figure 3.1-15: Total cadmium (T-Cd) concentrations in mid Latte Creek (LC-11.4) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness dependent water quality guidelines for the protection of aquatic life.

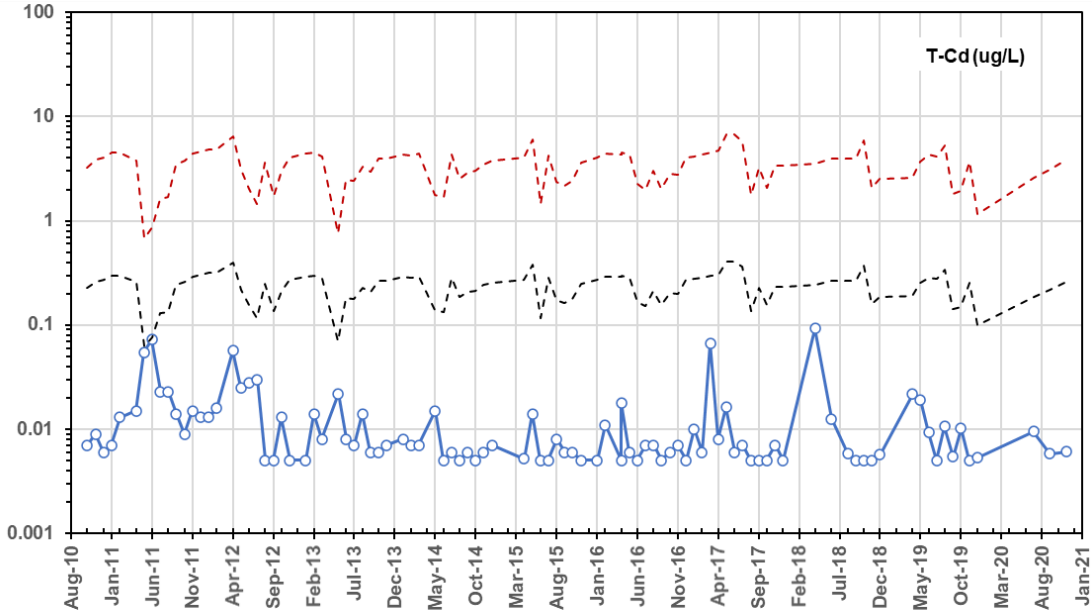

Figure 3.1-16: Total cadmium (T-Cd) concentrations in lower Latte Creek (LC-0.2) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness dependent water quality guidelines for the protection of aquatic life.

The most notable parameter of interest in mid and lower Latte Creek is U. Total and dissolved U concentrations in mid Latte Creek at station LC-11.4 show a distinct seasonal signature with maxima observed during winter low flow periods and coinciding with baseflow conditions. Concentrations during low flow periods can reach 35 µg/L and are often well above the CCME water quality guideline of 15 µg/L for the protection of aquatic life (Figure 3.1-17).

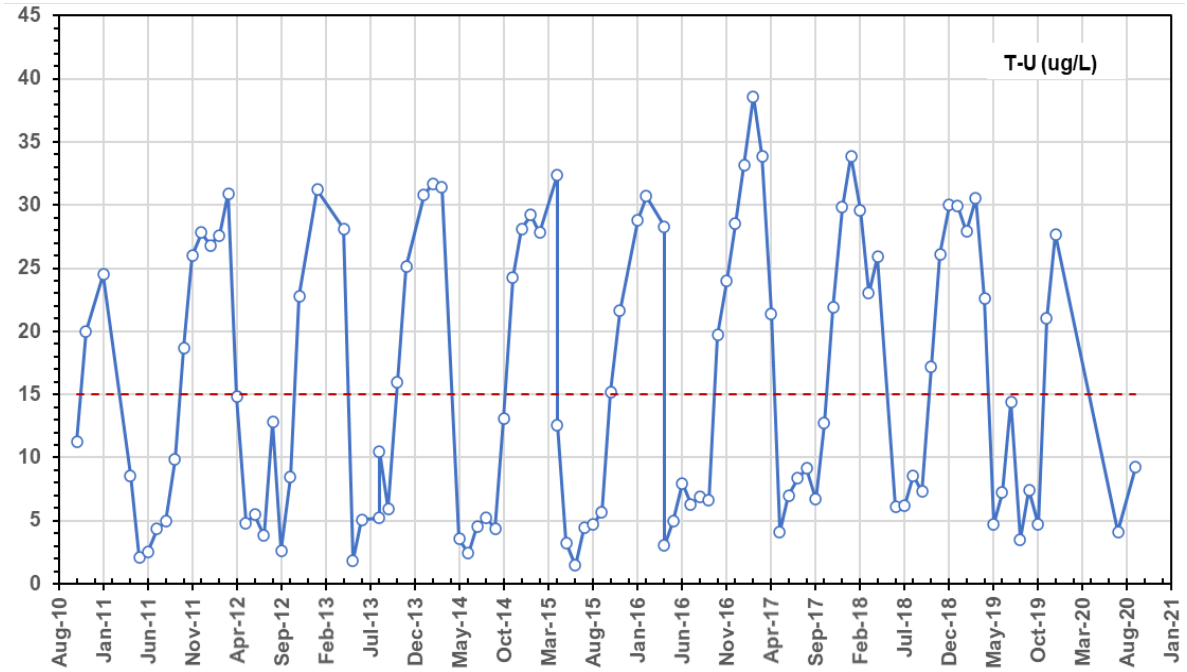

Figure 3.1-17: Total uranium (T-U) in mid Latte Creek (LC-11.4) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guideline (red dashed line) for the protection of aquatic life.

A strong inverse relationship ($r^2 = 0.86$) between total U and flow exists in mid Latte Creek at station LC-11.4 and is illustrated in Figure 3.1-18.

Graphical representation of monthly mean total U data at LC-11.4 illustrates concentrations in excess of the CCME guideline of 15 µg/L for U typically occurs from November to April (Figure 3.1-19).

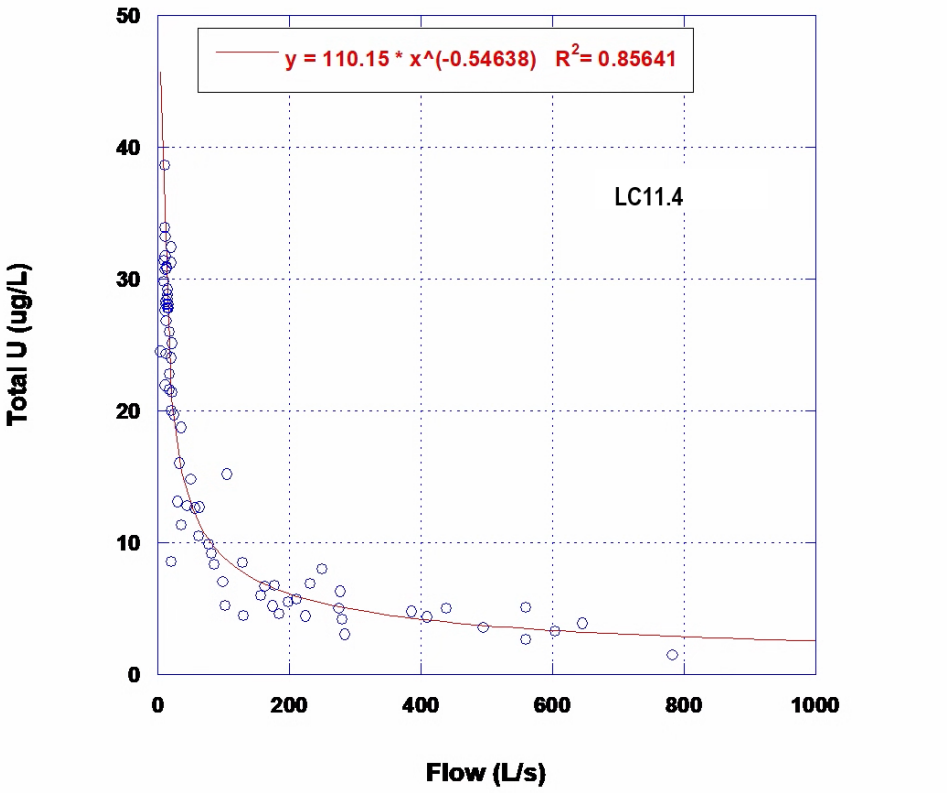

Figure 3.1-18: Relationship between total U and flow in mid Latte Creek (LC-11.4) for the period October 2010 to December 2020

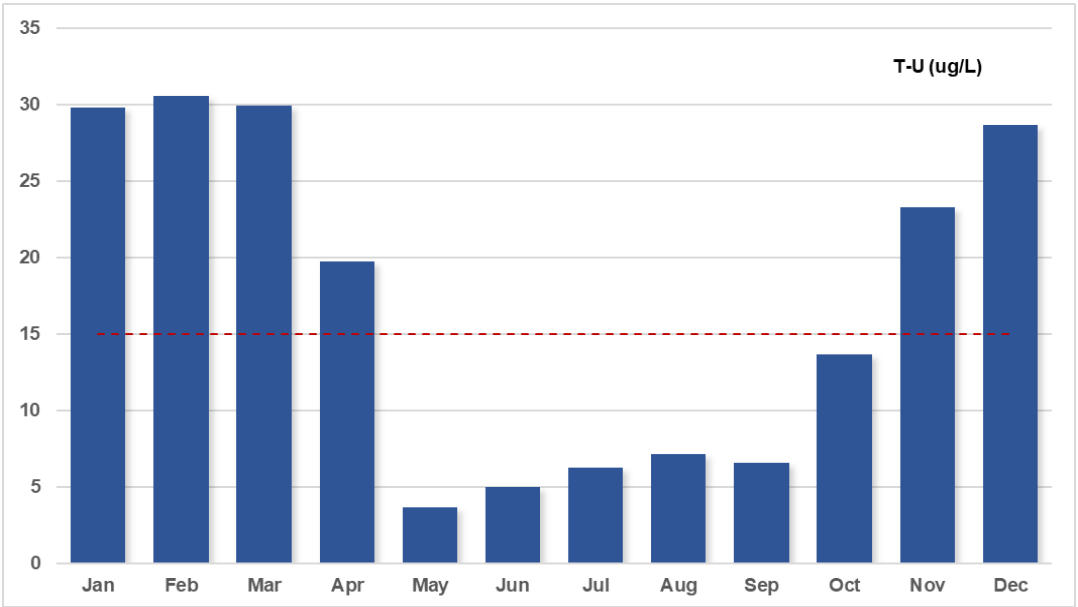

Figure 3.1-19: Mean monthly total uranium (T-U) concentrations at LC-11.4 mid Latte Creek for the period October 2010 to December 2020 and compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guidelines (dashed red line) for protection of aquatic life.

A similar, yet less pronounced seasonal trend of total U concentrations is observed in lower Latte Creek at station LC-0.2. Peak concentrations generally between 30 µg/L to 35 µg/L occur in late winter low flow periods; observed concentrations in most other months are less than the CCME guideline of 15 µg/L for the protection of aquatic life (Figure 3.1-20 and Figure 3.1-21). The highest U concentration is recorded in February of 2018, with values up to 75 µg/L (Figure 3.1-20).

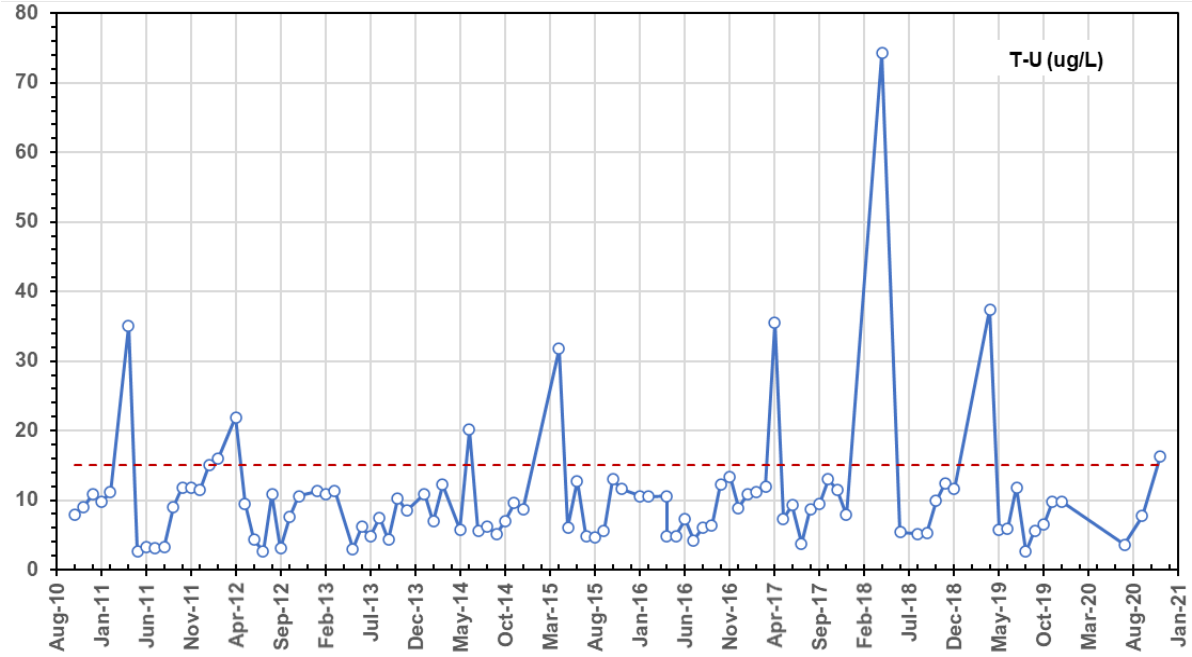

Figure 3.1-20: Total uranium (T-U) in lower Latte Creek (LC-0.2) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guidelines (red dashed line) for the protection of aquatic life.

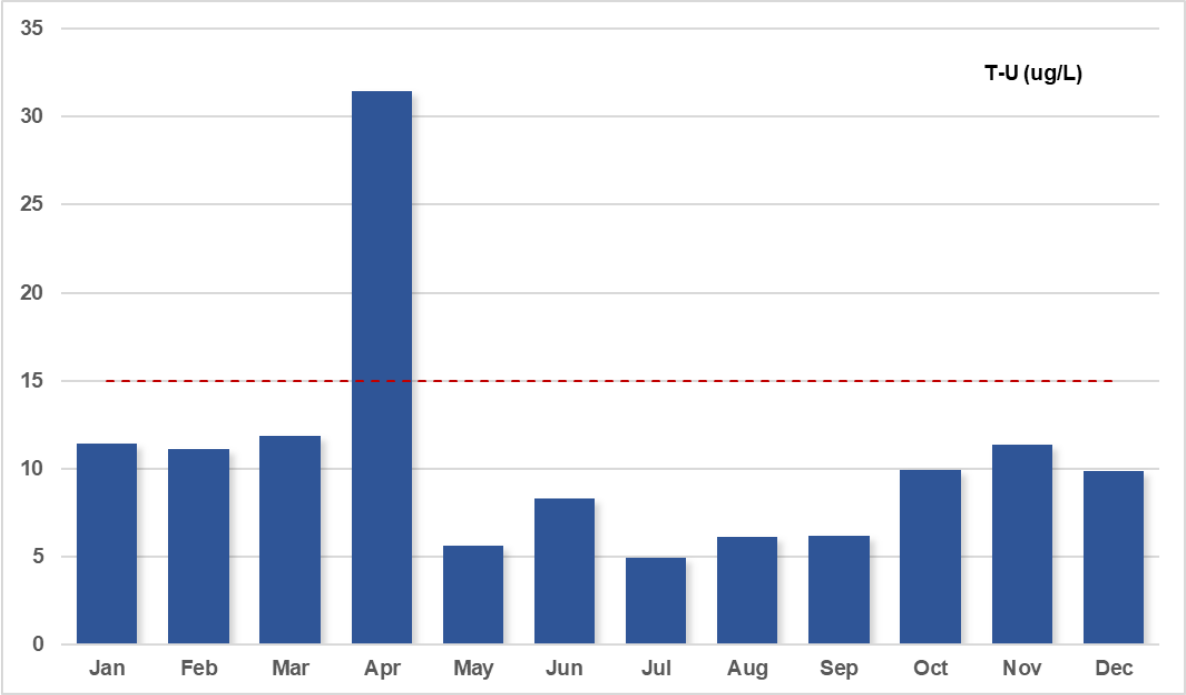

Figure 3.1-21: Mean monthly total uranium (T-U) concentrations at LC-0.2 in lower Latte Creek for the period October 2010 to December 2020 and compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guidelines (dashed red line) for protection of aquatic life.

3.1.2.5 5 in 30 Sampling Results Station LC-11.4

Weekly sampling occurred at LC-11.4 during the period of October 4 to October 28, 2017 to assess short-term variability in water quality and results are presented in Table 3.1-4; full results are presented in Appendix A.

Table 3.1-4:
LC-11.4 Weekly 5 in 30 Sampling Results for Select Parameters

Parameter	Sampling Date				
	10/4/2017	*10/9/2017*	*10/19/2017*	*10/23/2017*	*10/28/2017*
Cond-L (uS/cm)	376	409	494	551	572
D-Hard (mg/L)	194	210	256	277	308
T-Hard (mg/L)	198	212	217	294	302
pH-L (pH)	8.02	7.99	8.07	8.17	8.05
TDS (mg/L)	222	246	316	334	340
TSS (mg/L)	<1.1	<1.0	<1.0	<1.0	<4.0
DOC (mg/L)	7.05	7.64	7.85	4.18	7.15
TOC (mg/L)	6.54	7.82	7.67	3.94	6.97
T-Alk (mg/L)	94.1	100	120	136	143
SO_4 (mg/L)	95.3	105	127	144	168
NO_2 (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
NO_3 (mg/L)	0.408	0.411	0.383	0.371	0.371
NH_3 (mg/L)	<0.0050	<0.0050	0.037	0.007	<0.0050
T-Al (ug/L)	53.1	40.4	35.7	24.1	19.3
T-Sb (ug/L)	0.107	0.099	0.100	0.105	0.107
T-As (ug/L)	0.572	0.602	0.560	0.676	0.698
T-Cd (ug/L)	0.0062	0.0057	0.0080	0.0071	0.007
T-Cu (ug/L)	1.39	1.3	1.23	1.07	0.992
T-Fe (ug/L)	33.6	26.7	29.8	14.3	8.9
T-Pb (ug/L)	0.0085	0.0084	0.113	<0.0050	<0.0050
T-Hg (ug/L)	0.0026	0.0026	0.0024	0.0023	0.0022
T-U (ug/L)	9.52	11.1	12.7	16.6	17.3
T-Zn (ug/L)	0.56	0.37	<1.0	0.37	0.23
D-Al (ug/L)	41.1	36.5	25.0	20.9	20.2
D-Sb (ug/L)	0.104	0.113	0.109	0.1	0.108
D-As (ug/L)	0.544	0.616	0.559	0.657	0.716
D-Cd (ug/L)	0.0052	0.0055	0.0060	0.0059	0.007
D-Cu (ug/L)	1.25	1.3	1.09	1.1	1.11
D-Fe (ug/L)	18.7	16.3	11.3	10.3	10.1
D-Pb (ug/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
D-Hg (ug/L)	0.0079	0.0041	0.0024	0.0027	0.0022
D-U (ug/L)	9.32	11.1	13.7	15.7	17.4
D-Zn (ug/L)	0.27	0.39	0.34	0.45	0.25

Data for those parameters whose concentrations in Latte Creek are inversely related to flow conditions, including conductivity, hardness, alkalinity, sulphate and U show an increasing concentration trend over the sampling period. This can be readily explained by decreasing flow in Latte Creek through the sampling period (Figure 3.1-22). Flow data collected at LC-11.4 indicates decreasing flow from October 4, 2017 (~80 L/s) to October 19, 2017 (~20 L/s); flow after that date required extrapolation owing to freezing conditions occurring at the station and erroneous pressure transducer data.

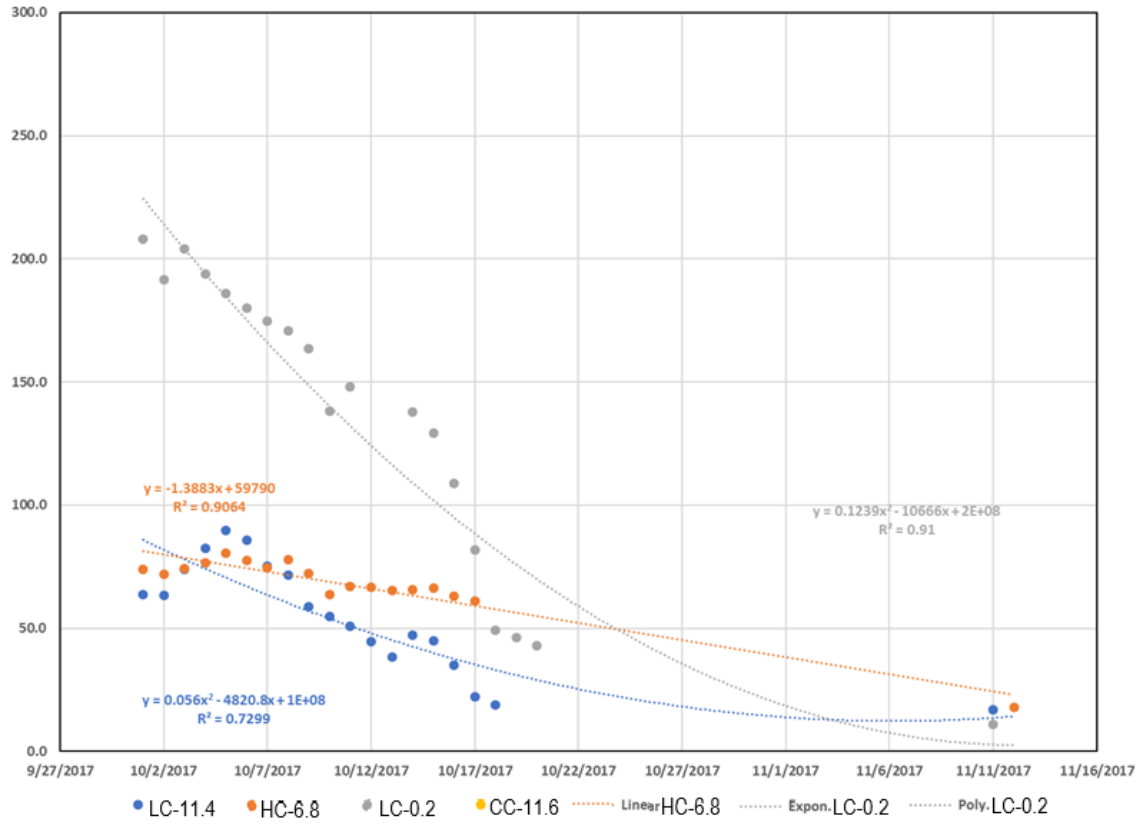

Figure 3.1-22: Flow measurements and extrapolations for LC-11.4 and LC-0.2 in Latte Creek and HC-6.8 in Halfway Creek for the period covering the 5 in 30 sampling from October 4 to October 28, 2017

For example, total U concentrations increased roughly 2-fold throughout the sampling period from a concentration of approximately 9.5 µg/L on October 4, 2017 to 17 µg/L on October 28, 2017.

By contrast, parameters that are positively correlated to flow, such as dissolved Al, show a roughly 2-fold decrease in concentration over the 5 in 30 sampling period. Parameters that have been shown to have very little correlation to flow, including As and Cu, were present at similar concentrations throughout the sampling period.

3.2 Coffee Creek

Background water chemistry in Coffee Creek can be divided between upper Coffee Creek (*e.g.,* above the confluence with Latte Creek) and lower Coffee Creek (Figure 3.1-21). Upper Coffee Creek is represented by data collected from CC-11.6 and lower Coffee Creek is represented by data collected at station CC-3.2. Station CC-10.9 located immediately downstream of the confluence with Latte Creek was added in 2017 to evaluate mixing with

Coffee Creek. Monthly water quality monitoring at both stations commenced in October 2010 and continue to present.

3.2.1 Upper Coffee Creek – Station CC-11.6

Upper Coffee Creek is characterized by water quality measured at Station CC-11.6 (Figure 3.2-1) which reflects contributions from a large watershed of approximately 385 km^2. This compares to the Latte Creek watershed area at LC-0.2 of approximately 70 km^2 described in Section 3.1.

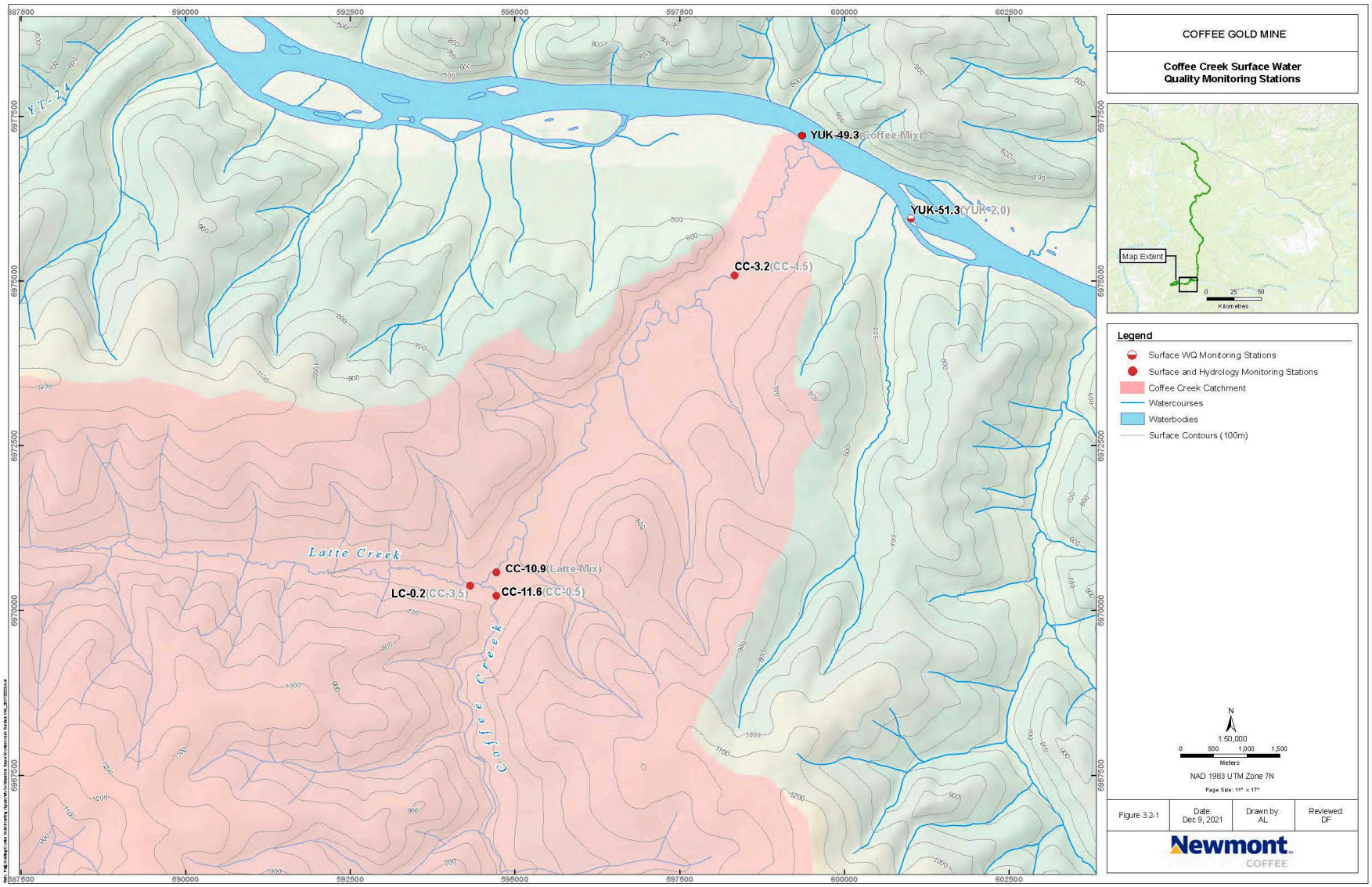

Figure 3.2-1: Detail of Coffee Creek drainage illustrating key monitoring station locations upstream and downstream of Latte Creek confluence

3.2.1.1 Summary Statistics

Table 3.2-1 summarizes the mean monthly values for a suite of the key parameters for station CC-11.6 in Coffee Creek.

Table 3.2-1:
Station CC-11.6 Monthly Mean Values

	CC-11.6 - Mean											
	Jan (n=8)	Feb (n=8)	Mar (n=5)	Apr (n=10)	May (n=8)	Jun (n=9)	Jul (n=9)	Aug (n=9)	Sep (n=10)	Oct (n=10)	Nov (n=10)	Dec (n=6)
Physical Parameters												
pH (s.u.)	7.9	7.9	7.9	7.9	7.2	7.6	7.5	7.6	7.6	7.7	7.7	7.8
Cond-L (uS/cm)	410	440	440	550	120	160	120	150	150	200	291	350
TSS (mg/L)	1.9	1.2	1.6	5.7	23	17	18	6.5	1.4	2.6	2.4	2.6
TDS (mg/L)	260	277	268	390	100	130	100	110	120	140	180	230
T-Alk (mg/L)	110	120	130	110	29	39	32	39	38	46	62	84
T-Hard (mg/L)	190	220	220	280	60	72	56	66	69	91	130	160
Anions												
Sulphate (mg/L)	97	100	97	180	24	35	25	30	31	48	76	88
Cl (mg/L)	1.0	0.89	1.1	1.6	1.2	1.4	0.84	0.82	0.67	0.85	0.93	1.0
F (mg/L)	0.075	0.073	0.069	0.098	0.045	0.065	0.065	0.069	0.059	0.073	0.083	0.089
Nutrients												
T-NH3 (mg/L)	0.02	0.029	0.022	0.026	0.039	0.021	0.029	0.024	0.026	0.014	0.019	0.027
NO2+NO3 (mg/L)	0.13	0.12	0.039	0.02	0.036	0.1	0.16	0.23	0.27	0.36	0.40	0.35
NO2 (mg/L)	0.0088	0.0088	0.0038	0.0047	0.014	0.0080	0.0080	0.008	0.0070	0.0074	0.0028	0.011
NO3 (mg/L)	0.2	0.15	0.085	0.025	0.047	0.11	0.17	0.22	0.28	0.36	0.4	0.33
D-P (mg/L)	0.0030	0.0032	0.0024	0.0084	0.0099	0.0053	0.0046	0.0041	0.0085	0.0032	0.008	0.0024
TOC (mg/L)	4.9	4.9	4.1	13	20	15	16	12	12	9.3	6.8	5.9
DOC (mg/L)	4.9	4.9	3.8	12	20	15	15	12	12	8.6	6.8	6.1
WAD-CN (mg/L)	0.00073	0.00062	0.00061	0.00069	0.0011	0.0012	0.00092	0.00079	0.0013	0.00082	0.0011	0.00061
Total Metals												
T-Al (ug/L)	27	14	13	77	700	330	530	190	130	79	42	31
T-Sb (ug/L)	0.42	0.058	0.047	0.12	0.1	0.12	0.13	0.12	0.12	0.12	0.11	0.30
T-As (ug/L)	0.37	0.35	0.34	0.64	0.86	0.6	0.68	0.54	0.47	0.41	0.34	0.31
T-Ba (ug/L)	88	98	99	84	44	43	41	41	38	46	61	76
T-Be (ug/L)	0.010	0.010	0.010	0.014	0.036	0.025	0.026	0.017	0.024	0.01	0.019	0.010
T-Bi (ug/L)	0.02	0.0050	0.0050	0.0077	0.012	0.0094	0.011	0.0072	0.011	0.0075	0.010	0.0050
T-B (ug/L)	30	30	42	26	40	32	29	29	23	31	26	23
T-Cd (ug/L)	0.026	0.0098	0.0074	0.034	0.038	0.021	0.024	0.021	0.014	0.011	0.01	0.012
T-Ca (mg/L)	55	65	64	71	16	19	14	17	18	23	33	43
T-Cr (ug/L)	0.38	0.16	0.10	0.24	1.0	0.76	1.1	0.52	0.44	0.3	0.21	0.24
T-Co (ug/L)	0.094	0.11	0.11	0.2	0.54	0.24	0.33	0.14	0.1	0.073	0.061	0.056
T-Cu (ug/L)	1.0	0.77	0.75	1.4	3.4	3.0	4.4	2.6	2.5	2.0	1.5	1.2
T-Fe (ug/L)	130	140	140	140	880	390	650	230	140	87	59	48
T-Pb (ug/L)	0.093	0.017	0.0094	0.042	0.27	0.13	0.21	0.065	0.04	0.043	0.032	0.02
T-Li (ug/L)	1.6	1.4	1.2	4.1	0.93	0.99	1.1	1.1	0.94	1.2	1.9	1.8
T-Mg (mg/L)	14	14	14	26	5.0	6.2	4.9	5.8	6.1	8.4	11	14
T-Mn (ug/L)	49	63	77	110	54	16	19	12	12	12	18	23
T-Hg (ug/L)	0.0050	0.0051	0.0068	0.0055	0.0078	0.0055	0.0059	0.0062	0.0049	0.0054	0.0051	0.0051
T-Mo (ug/L)	0.46	0.35	0.28	0.59	0.47	0.6	0.81	0.71	0.8	0.75	0.66	0.52
T-Ni (ug/L)	0.69	0.62	0.61	1.1	1.8	1.4	1.5	1.2	1.1	0.93	0.78	0.71
T-K (mg/L)	1.8	1.9	2.0	3.2	1.3	1.2	0.95	1.1	1.1	1.2	1.4	1.6
T-Se (ug/L)	0.11	0.07	0.063	0.43	0.072	0.086	0.099	0.1	0.1	0.1	0.13	0.12
T-Si (ug/L)	5500	5535	5060	6160	3100	4200	5300	5500	6020	5542	6020	5700
T-Ag (ug/L)	0.0087	0.0050	0.0050	0.006	0.012	0.0076	0.010	0.0058	0.0070	0.0073	0.0060	0.0050
T-Na (mg/L)	5.9	5.4	5.0	8.5	2.0	3.0	2.6	3.2	3.2	4.0	5.3	5.9
T-Sr (ug/L)	260	310	321	320	99	110	72	85	88	110	170	220
T-Tl (ug/L)	0.0024	0.0025	0.0022	0.0032	0.013	0.0075	0.011	0.0057	0.0056	0.0041	0.0036	0.0022
T-U (ug/L)	17	14	8.7	30	5.8	5.6	3.1	3.7	3.8	6.7	15	17
T-Zn (ug/L)	1.8	1.1	0.37	3.1	3.9	2.0	2.8	1.4	2.3	1.2	1.5	0.69
Dissolve Metals												
D-Al (ug/L)	14	10	11	54	250	160	150	100	94	53	30	20
D-Sb (ug/L)	0.073	0.053	0.048	0.079	0.066	0.1	0.12	0.12	0.12	0.11	0.11	0.093
D-As (ug/L)	0.32	0.33	0.28	0.55	0.45	0.45	0.47	0.46	0.42	0.38	0.33	0.28
D-Ba (ug/L)	93	96	99	83	35	41	35	38	37	44	62	77
D-Be (ug/L)	0.010	0.010	0.010	0.012	0.021	0.019	0.014	0.014	0.021	0.011	0.019	0.010
D-Bi (ug/L)	0.006	0.0050	0.0050	0.0050	0.0050	0.0056	0.0050	0.0050	0.0095	0.0050	0.0095	0.0050
D-B (ug/L)	30	30	42	22	30	28	24	24	23	27	26	23
D-Cd (ug/L)	0.016	0.0089	0.015	0.028	0.023	0.014	0.015	0.0093	0.0098	0.008	0.011	0.012
D-Ca (mg/L)	56	61	66	69	16	19	14	17	17	22	33	43
D-Cr (ug/L)	0.18	0.10	0.10	0.18	0.39	0.41	0.47	0.4	0.36	0.26	0.19	0.13
D-Co (ug/L)	0.085	0.11	0.11	0.17	0.19	0.093	0.1	0.079	0.075	0.053	0.053	0.045
D-Cu (ug/L)	0.93	0.69	0.87	1.2	2.6	2.6	2.6	2.4	2.3	1.8	1.4	1.1
D-Fe (ug/L)	60	75	79	73	220	140	140	96	82	46	33	25
D-Pb (ug/L)	0.037	0.0085	0.0088	0.018	0.035	0.013	0.05	0.0095	0.013	0.018	0.022	0.0085
D-Li (ug/L)	1.7	1.5	1.2	4.0	0.63	0.93	0.89	0.99	0.94	1.2	1.9	1.9
D-Mg (mg/L)	14	14	14	26	4.8	6.5	4.8	6.0	5.9	8.1	12	14
D-Mn (ug/L)	52	61	74	100	24	9.2	6.4	6.5	8.2	10	18	21
D-Hg (ug/L)	0.0043	0.0044	0.0060	0.0053	0.0071	0.0058	0.0062	0.0056	0.0052	0.0043	0.0042	0.0039
D-Mo (ug/L)	0.48	0.41	0.29	0.59	0.38	0.55	0.63	0.69	0.81	0.76	0.68	0.52
D-Ni (ug/L)	0.65	0.59	0.64	1.1	1.3	1.2	1.2	1.1	1.0	0.87	0.77	0.68
D-K (mg/L)	1.9	1.9	2.0	3.1	1.2	1.2	0.93	1.1	1.1	1.2	1.4	1.6
D-Se (ug/L)	0.098	0.07	0.065	0.41	0.059	0.079	0.092	0.092	0.11	0.1	0.12	0.12
D-Si (ug/L)	5400	5200	5266	6008	2500	4200	4800	5300	5659	5391	5931	5600
D-Ag (ug/L)	0.0050	0.0050	0.0050	0.0053	0.0054	0.0053	0.0050	0.0054	0.0055	0.0050	0.0055	0.0050
D-Na (mg/L)	5.8	5.3	5.0	8.4	1.8	3.0	2.7	3.1	3.1	3.9	5.6	5.8
D-Sr (ug/L)	280	300	320	350	93	110	73	85	87	110	170	220
D-Tl (ug/L)	0.0020	0.0020	0.0022	0.003	0.0045	0.0045	0.0047	0.004	0.0048	0.0033	0.0034	0.0022
D-U (ug/L)	18	14	8.0	30	5.5	5.6	2.8	3.4	3.6	6.6	15	17
D-Zn (ug/L)	1.6	1.2	0.63	2.8	2.0	0.92	2.0	0.76	0.83	0.58	1.1	0.81

3.2.1.2 Major Ions

The major ion chemistry of upper Coffee Creek is assessed with respect to conductivity, hardness, alkalinity, sulphate and pH. Station CC-11.6 is characterized by seasonally comparatively soft to moderately soft waters (approximately between 50 mg/L and 70 mg/L [as $CaCO_3$] during open water periods of May to September) and hard to very hard waters (ranging from approximately 91 mg/L to 280 mg/L [as $CaCO_3$]) during lower flow periods and winter low flows (Table 3.2-1; Figure 3.2-2.).

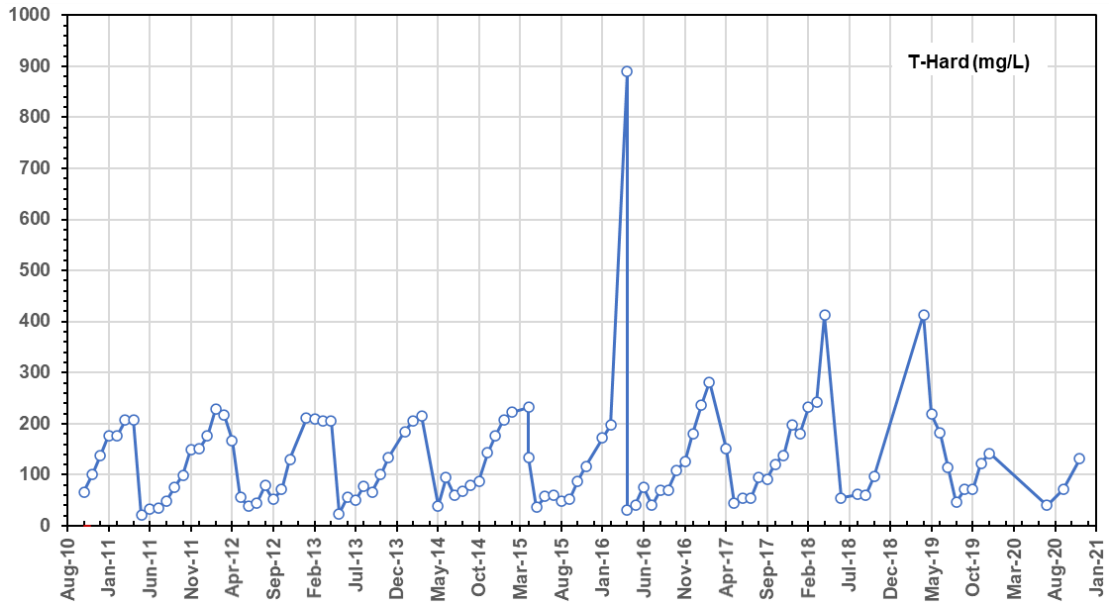

Figure 3.2-2: Total Hardness (T-Hard., as mg/L $CaCO_3$) in upper Coffee Creek (CC-11.6) for the period October 2010 to December 2020.

The pH in upper Coffee Creek remains relatively uniform throughout the year with values generally ranging between 7.2 and 7.9. All pH values reported to date have remained within the CCME freshwater guideline range for pH of 6.5 to 9.0.

Baseline concentrations for sulphate in upper Coffee Creek also exhibit a strong seasonal signature with lowest concentrations occurring during peak runoff conditions. During low flow periods, mean sulphate concentrations at CC-11.6 range from 48 mg/L to 180 mg/L (Table 3.2-1). As described previously, sulphate minima during high flow can be attributed to the influence of low ionic strength melt waters, while higher values during the low-flow periods reflect an increased proportion of groundwater inputs.

Unlike the dissolved ions, higher TSS concentrations in upper Coffee Creek generally coincide with the peak snowmelt months or during intense rainfall events (Table 3.2-1). At most other flow periods of the year, TSS values in upper Coffee Creek at CC-11.6 were generally below 3.0 mg/L.

3.2.1.3 Nutrients

Nutrient parameters have been observed at low concentrations in Coffee Creek at station CC-11.6. Ammonia-N concentrations are low with mean monthly values typically below 0.04 mg/L (Table 3.2-1). Nitrate-N monthly mean concentrations in upper Coffee Creek ranged from 0.02 mg/L to 0.4 mg/L with higher nitrate-N associated with winter low flows. Monthly mean dissolved phosphorus concentrations at CC-11.6 range between 0.002 mg/L to 0.01 mg/L and are indicative of oligotrophic to ultra-oligotrophic conditions.

The TOC and DOC concentrations exhibit a marked seasonal signature with highest values observed during peak runoff periods in Coffee Creek at station CC-11.6. Observed DOC concentrations are generally < 7 mg/L during baseflow periods when groundwater inputs dominate the flow regime. During the open water period, DOC values typically range between 12 mg/L and 20 mg/L during higher flow periods reflecting carbon inputs from terrestrial runoff (Figure 3.2-3).

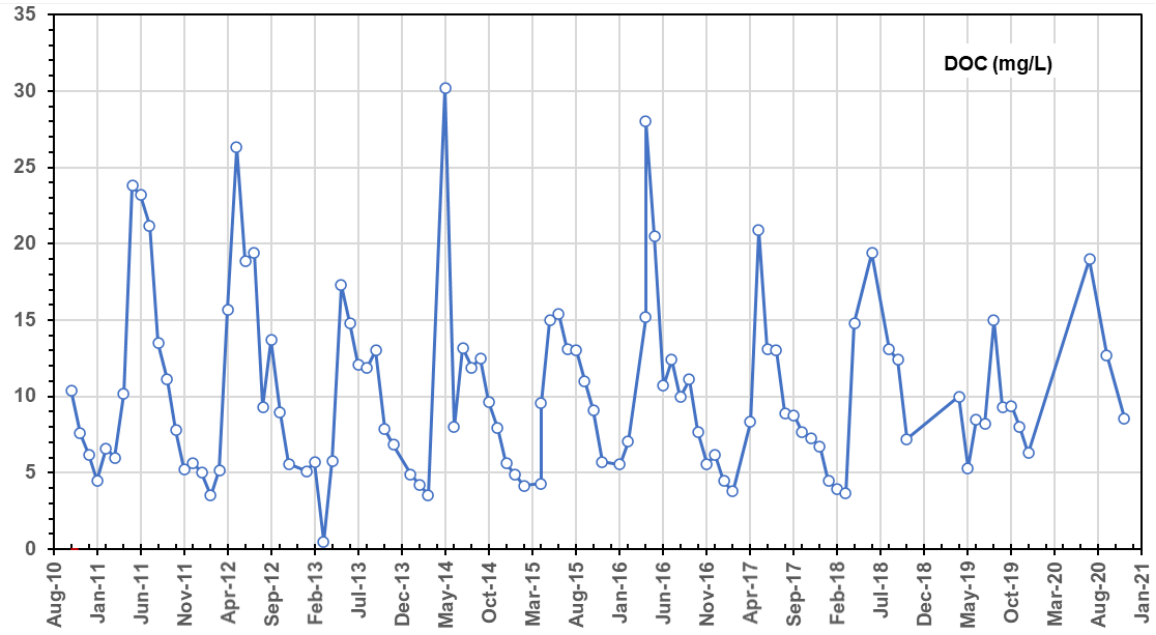

Figure 3.2-3: Dissolved organic carbon (DOC) in upper Coffee Creek (CC-11.6) for the period October 2010 to December 2020.

3.2.1.4 Trace Elements

Baseline trace element concentrations in upper Coffee Creek were derived from data collected from October 2010 to December 2020 at CC-11.6. For most parameters, mean monthly concentrations of total and dissolved trace elements are low (*e.g.*, As, Sb, Co, Cr, Pb, Hg, Ni, Se, and Zn). Mean monthly total As concentrations in upper Coffee Creek at CC-11.6 are generally below 1.0 µg/L (Figure 3.2-4).

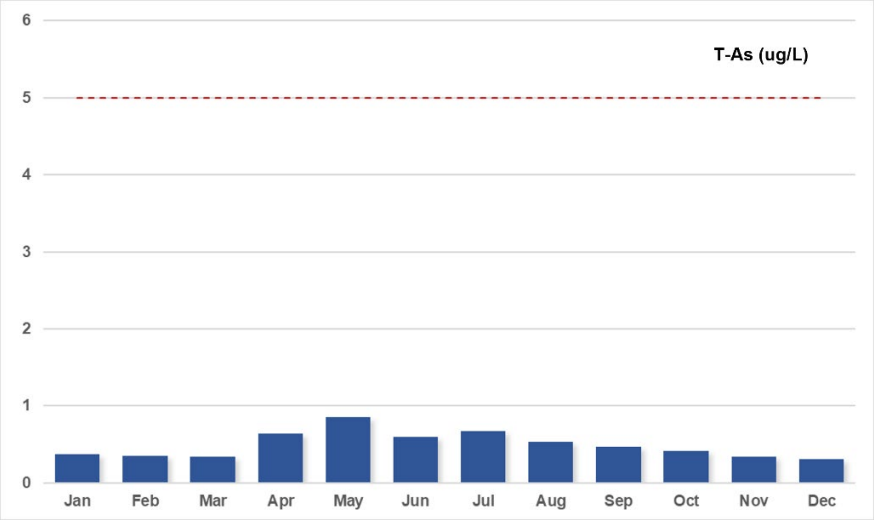

Figure 3.2-4: Mean monthly total arsenic (T-As) in upper Coffee Creek (CC-11.6) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) water quality guidelines (red dashed line) for protection of aquatic life.

Mean monthly total Se concentrations in upper Coffee Creek are typically less than 0.10 µg/L (Table 3.2-1).

Dissolved Al is seasonally elevated in upper Coffee Creek and consistently observed to be elevated well above BC ENV guideline for the protection of aquatic life of 100 µg/L during peak runoff periods (Figure 3.2-5).

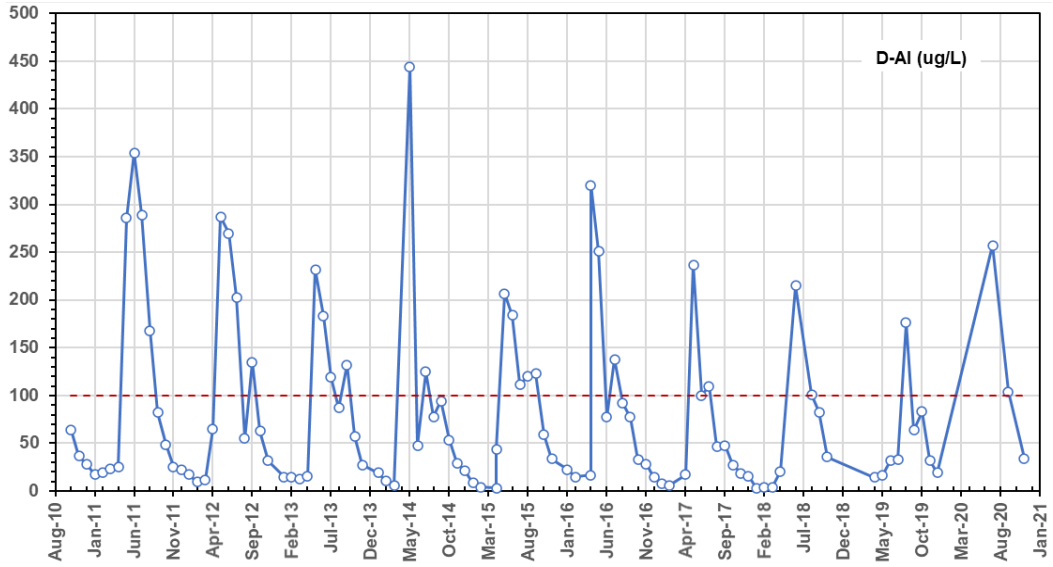

Figure 3.2-5: Dissolved Aluminum (D-Al) in upper Coffee Creek (CC-11.6) for the period October 2010 to December 2020 compared to the British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dashed line) for protection of aquatic life.

During baseflow periods, dissolved Al concentrations in upper Coffee Creek are typically between 10 and 90 µg/L (Table 3.2-1).

Concentrations of total Cu in upper Coffee Creek exhibit a strong seasonal signature with maxima associated with peak runoff periods that exceed the CCME hardness-dependent Cu guideline for the protection of aquatic life (Figure 3.2-6 and Figure 3.2-7). During most months of the open water period (*e.g.*, May to September), mean monthly total Cu concentrations are naturally elevated above the CCME guideline for Cu (Figure 3.2-7).

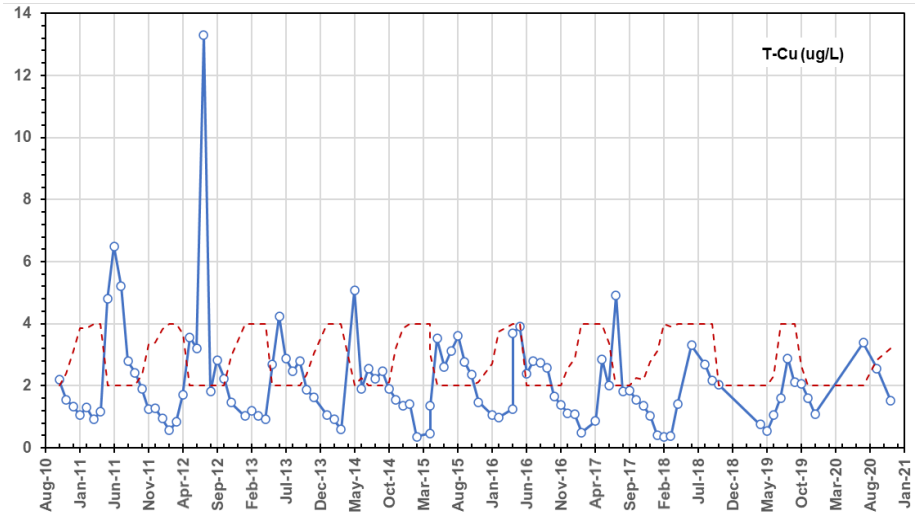

Figure 3.2-6: Total copper (T-Cu) in upper Coffee Creek (CC-11.6) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness dependent water quality guidelines (red dashed line) for the protection of aquatic life.

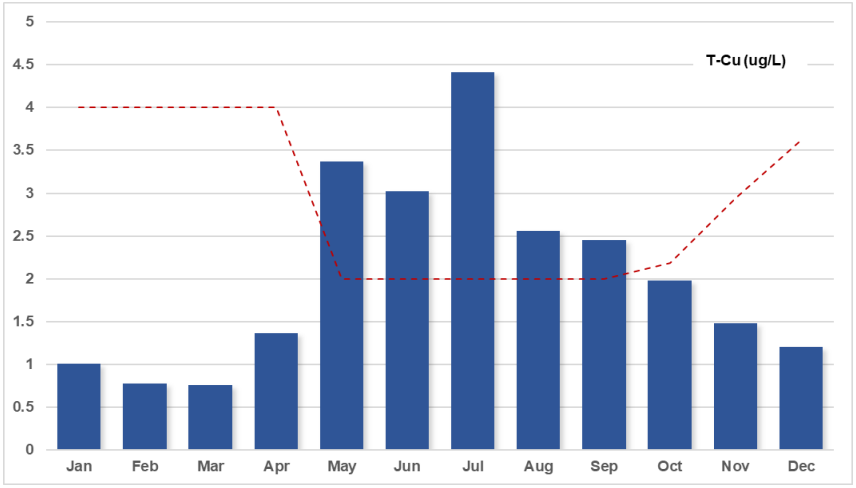

Figure 3.2-7: Monthly mean total copper (T-Cu) in upper Coffee Creek (CC-11.6) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness dependent water quality guidelines (red dashed line) for the protection of aquatic life.

In upper Coffee Creek, total Cd concentrations generally do not exceed the chronic or acute CCME hardness-dependent guidelines for protection of aquatic life (Figure 3.2-8).

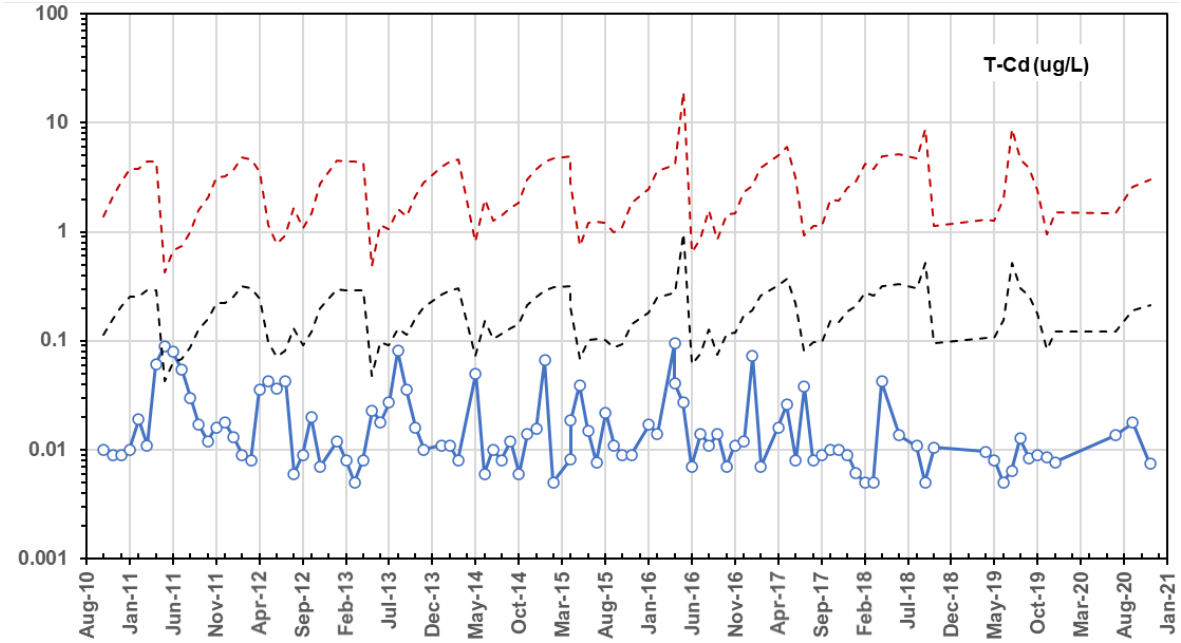

Figure 3.2-8: Total cadmium (T-Cd) concentrations in upper Coffee Creek (CC-11.6) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness dependent water quality guidelines for the protection of aquatic life.

Similar to the monitoring observations in Latte Creek, total U concentrations in Coffee Creek at CC-11.6 show a distinct seasonal signature with maxima observed during winter low flow periods and coinciding with baseflow conditions. Concentrations during low flow periods often exceed the CCME chronic water quality guideline of 15 µg/L with peak concentrations of 45 µg/L (January 2013), 40 µg/L (February 2016), 178 µg/L (April 2018) and 61 µg/L observed in April 2019 (Figure 3.2-9). While the April 2018 total U value of 178 µg/L is the highest recorded for this station, the measured concentration was not associated with TSS as dissolved U for that sample was 176 µg/L (Appendix A).

Graphical representation of monthly mean total U data at CC-11.6 illustrates that concentrations exceeding the CCME water quality guideline of 15 µg/L typically occur from November to January (Figure 3.2-10) although specific sampling events have also measured concentrations well above CCME guidelines in February and March (Figure 3.2-9).

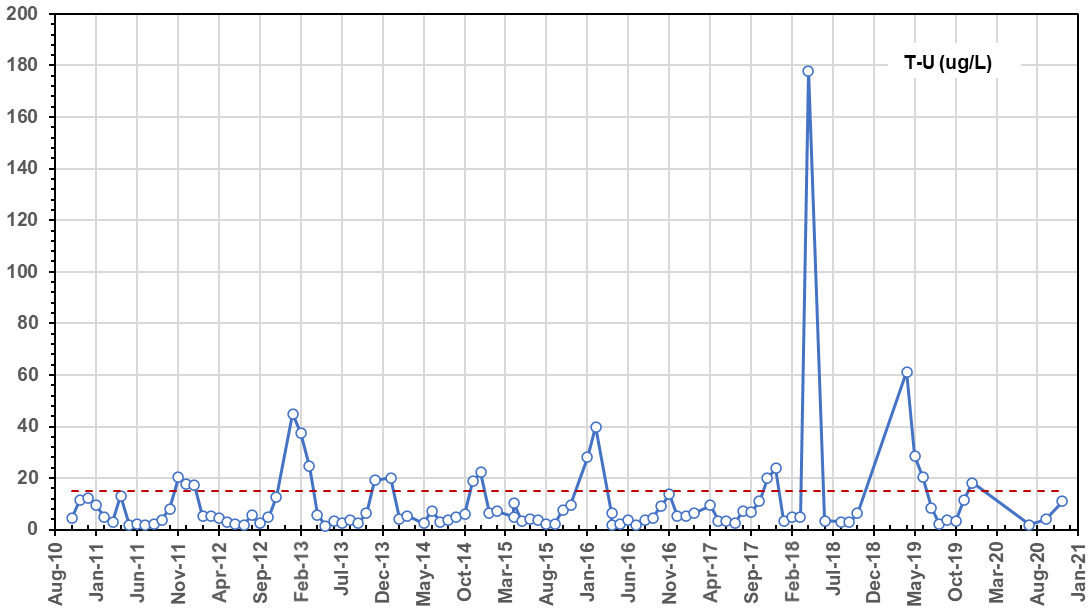

Figure 3.2-9: Total uranium (T-U) in upper Coffee Creek (CC-11.6) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guidelines (red dashed line) for the protection of aquatic life.

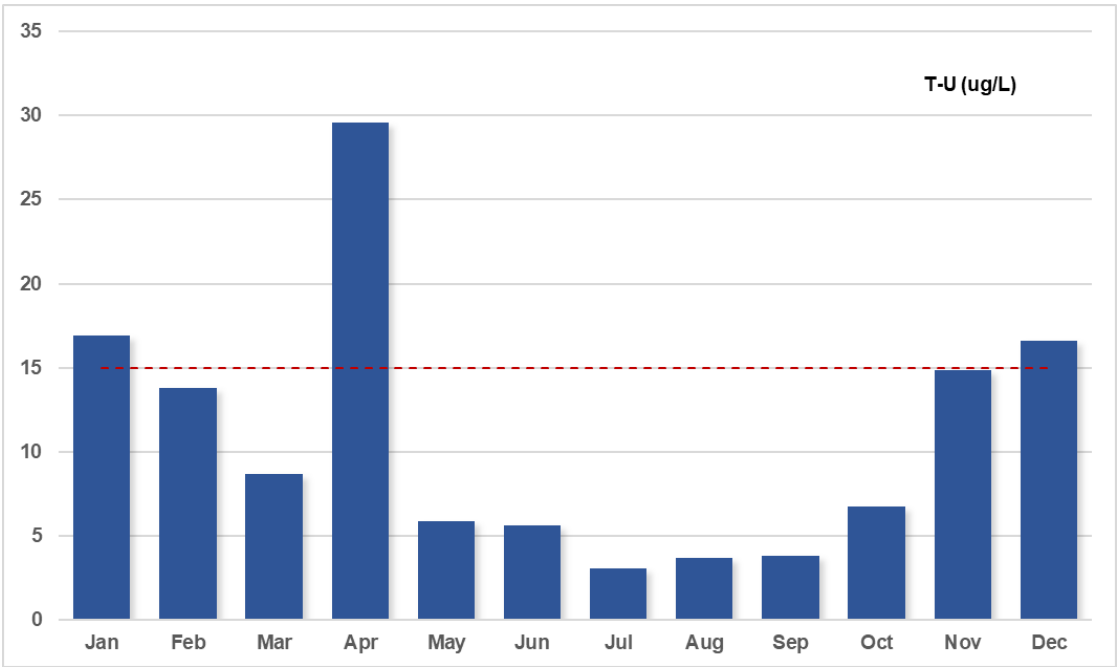

Figure 3.2-10: Mean monthly total uranium (T-U) concentrations at CC-11.6 in upper Coffee Creek for the period October 2010 to December 2020 and compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guidelines (dashed red line) for protection of aquatic life.

3.2.2 Lower Coffee Creek – Station CC-3.2

Lower Coffee Creek is characterized by water quality measured at Station CC-3.2 (Figure 3.2-1) which reflects contributions from Latte Creek that enters Coffee Creek immediately downstream of previously described station CC-11.6 on upper Coffee Creek.

3.2.2.1 Summary Statistics

Table 3.2 summarizes the mean monthly values for a suite of the key parameters for station CC-3.2 in Coffee Creek.

3.2.2.2 Major Ions

The major ion chemistry of lower Coffee Creek is assessed with respect to hardness, sulphate and pH. Station CC-3.2 is characterized by seasonally comparatively soft waters (approximately between 40 mg/L and 80 mg/L [as $CaCO_3$] during open water periods [May to September]) and hard waters (ranging from approximately 90 mg/L to 140 mg/L [as $CaCO_3$]) during low flow periods such as winter (Table 3.2-2; Figure 3.2-11).

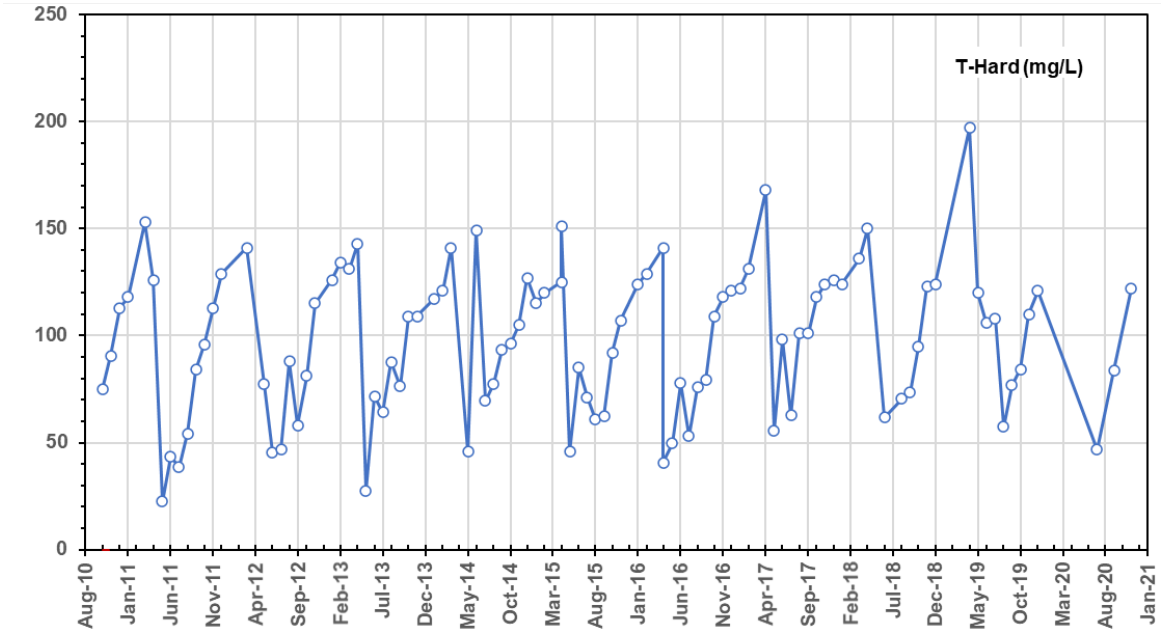

Figure 3.2-11: Total Hardness (T-Hard., as mg/L of $CaCO_3$) in lower Coffee Creek (CC-3.2) for the period October 2010 to December 2020.

Table 3.2-2:
Station CC-3.2 Monthly Mean Values

	CC-3.2 - Mean											
	Jan (n=7)	Feb (n=5)	Mar (n=5)	Apr (n=9)	May (n=8)	Jun (n=9)	Jul (n=9)	Aug (n=9)	Sep (n=10)	Oct (n=10)	Nov (n=11)	Dec (n=7)
Physical Parameters												
pH (s.u.)	7.7	7.7	7.5	7.8	7.3	7.6	7.5	7.6	7.6	7.7	7.7	7.2
Cond-L (uS/cm)	270	280	310	300	120	160	140	167	170	210	250	270
TSS (mg/L)	2.3	9.4	1.4	5.2	20	24	9.1	2.4	3.9	1.5	2.3	2.9
TDS (mg/L)	170	180	190	200	100	120	100	120	130	140	160	177
T-Alk (mg/L)	58	61	68	65	27	40	37	45	44	50	56	59
T-Hard (mg/L)	120	127	140	140	56	82	62	75	79	96	110	123
Anions												
Sulphate (mg/L)	69	72	80	82	23	35	28	34	34	45	62	68
Cl (mg/L)	0.95	1.1	1.2	1.5	1.1	1.3	0.85	0.84	0.72	0.72	0.76	0.81
F (mg/L)	0.056	0.053	0.054	0.053	0.043	0.062	0.062	0.066	0.063	0.066	0.064	0.063
Nutrients												
T-NH3 (mg/L)	0.014	0.013	0.018	0.028	0.031	0.018	0.024	0.017	0.028	0.013	0.016	0.034
NO2+NO3 (mg/L)	0.54	0.52	0.75	0.34	0.052	0.097	0.15	0.21	0.25	0.33	0.39	0.45
NO2 (mg/L)	0.0029	0.0026	0.0038	0.0047	0.014	0.0080	0.008	0.0080	0.007	0.0074	0.0027	0.0093
NO3 (mg/L)	0.52	0.53	0.69	0.41	0.056	0.1	0.17	0.2	0.27	0.32	0.38	0.43
D-P (mg/L)	0.0034	0.0034	0.0026	0.0055	0.0096	0.0048	0.0048	0.0041	0.0085	0.0034	0.0077	0.0035
TOC (mg/L)	6.9	6.9	5.5	8.9	21	14	15	12	11	8.6	7.2	6.5
DOC (mg/L)	6.0	6.3	5.1	9.2	20	14	14	11	11	8.7	7.3	6.6
WAD-CN (mg/L)	0.00054	0.00066	0.00071	0.00067	0.0012	0.0011	0.00091	0.0008	0.0013	0.00072	0.0011	0.00072
Total Metals												
T-Al (ug/L)	36	49	32	91	520	590	320	130	99	62	44	30
T-Sb (ug/L)	0.11	0.083	0.084	0.078	0.14	0.19	0.11	0.11	0.11	0.11	0.092	0.088
T-As (ug/L)	0.27	0.26	0.27	0.39	0.74	0.71	0.55	0.47	0.43	0.36	0.3	0.26
T-Ba (ug/L)	78	82	92	77	43	52	42	45	44	52	64	72
T-Be (ug/L)	0.010	0.010	0.010	0.013	0.033	0.029	0.021	0.016	0.023	0.011	0.018	0.01
T-Bi (ug/L)	0.013	0.0060	0.0050	0.0072	0.013	0.012	0.036	0.0072	0.010	0.0060	0.0095	0.0057
T-B (ug/L)	27	26	42	23	40	32	24	29	23	27	25	21
T-Cd (ug/L)	0.021	0.012	0.023	0.021	0.033	0.039	0.018	0.011	0.01	0.011	0.011	0.014
T-Ca (mg/L)	31	33	36	35	14	22	16	19	20	24	29	31
T-Cr (ug/L)	0.25	0.22	0.16	0.27	0.83	1.4	0.72	0.41	0.39	0.27	0.22	0.17
T-Co (ug/L)	0.039	0.038	0.028	0.099	0.42	0.37	0.2	0.099	0.079	0.059	0.051	0.034
T-Cu (ug/L)	1.7	1.4	1.4	1.4	3.2	3.1	2.8	2.4	2.3	1.9	1.5	1.4
T-Fe (ug/L)	23	39	14	110	650	680	370	140	97	59	38	17
T-Pb (ug/L)	0.059	0.028	0.018	0.057	0.21	0.25	0.11	0.034	0.024	0.033	0.065	0.015
T-Li (ug/L)	0.51	0.59	0.50	0.83	0.78	1.1	0.79	0.85	0.82	0.67	0.63	0.54
T-Mg (mg/L)	11	11	12	12	4.8	6.8	5.4	6.5	6.9	8.5	9.8	11
T-Mn (ug/L)	2.3	2.6	1.0	16	42	24	12	9.7	8.7	7.5	6.4	3.6
T-Hg (ug/L)	0.0043	0.0038	0.0069	0.0065	0.009	0.0074	0.0056	0.0067	0.0057	0.0067	0.0046	0.0043
T-Mo (ug/L)	0.52	0.6	0.47	0.57	0.56	0.75	0.6	0.64	0.7	0.65	0.57	0.57
T-Ni (ug/L)	0.69	0.72	0.65	0.85	1.6	1.8	1.3	1.0	1.0	0.87	0.74	0.72
T-K (mg/L)	1.5	1.5	1.6	1.8	1.2	1.3	1.1	1.2	1.2	1.3	1.4	1.4
T-Se (ug/L)	0.065	0.056	0.087	0.085	0.079	0.085	0.095	0.088	0.097	0.086	0.079	0.072
T-Si (ug/L)	4900	5080	4812	4740	3045	4800	4900	5200	5647	5261	5150	4900
T-Ag (ug/L)	0.0058	0.0060	0.0050	0.0059	0.01	0.014	0.0087	0.0056	0.0060	0.0060	0.0059	0.0057
T-Na (mg/L)	4.3	4.7	4.4	4.8	2.3	3.6	2.7	3.2	3.3	3.7	4.1	4.3
T-Sr (ug/L)	170	170	180	190	80	110	87	100	110	130	150	170
T-Tl (ug/L)	0.0021	0.0022	0.0020	0.0030	0.0095	0.012	0.0073	0.0041	0.0045	0.0027	0.003	0.0023
T-U (ug/L)	1.3	1.2	1.4	5.5	3.3	3.4	2.3	2.9	3.1	4.0	3.4	2.5
T-Zn (ug/L)	2.4	1.6	0.98	1.4	3.2	3.8	1.4	2.5	1.1	1.3	0.89	1.1
Dissolve Metals												
D-Al (ug/L)	29	27	27	53	220	140	130	86	79	45	32	27
D-Sb (ug/L)	0.085	0.074	0.085	0.073	0.10	0.099	0.11	0.12	0.11	0.1	0.089	0.084
D-As (ug/L)	0.25	0.25	0.27	0.3	0.43	0.42	0.43	0.42	0.4	0.32	0.28	0.26
D-Ba (ug/L)	78	80	93	77	36	45	38	45	42	51	66	74
D-Be (ug/L)	0.010	0.010	0.010	0.012	0.023	0.017	0.016	0.013	0.021	0.01	0.018	0.010
D-Bi (ug/L)	0.0052	0.0050	0.0050	0.0050	0.0050	0.0052	0.0050	0.0050	0.0096	0.0050	0.0091	0.0050
D-B (ug/L)	27	26	42	19	30	28	24	24	23	27	25	21
D-Cd (ug/L)	0.013	0.011	0.033	0.015	0.022	0.015	0.014	0.0087	0.0091	0.01	0.01	0.012
D-Ca (mg/L)	32	33	39	36	14	20	16	20	20	24	30	32
D-Cr (ug/L)	0.17	0.14	0.15	0.17	0.4	0.38	0.4	0.39	0.33	0.26	0.18	0.14
D-Co (ug/L)	0.03	0.026	0.029	0.042	0.16	0.084	0.084	0.066	0.064	0.043	0.043	0.031
D-Cu (ug/L)	1.3	1.5	2.0	1.5	2.5	2.5	2.4	2.2	2.1	1.8	1.5	1.3
D-Fe (ug/L)	11	9.4	11	43	210	120	120	76	64	32	19	12
D-Pb (ug/L)	0.023	0.01	0.028	0.017	0.028	0.017	0.15	0.0092	0.013	0.012	0.013	0.0084
D-Li (ug/L)	0.50	0.53	0.51	0.81	0.6	0.73	0.66	0.77	0.76	0.67	0.63	0.60
D-Mg (mg/L)	11	11	12	12	4.6	6.7	5.4	6.7	6.6	8.2	10	11
D-Mn (ug/L)	1.5	0.96	1.0	8.7	19	4.9	4.8	5.8	6.9	6.0	5.1	3.3
D-Hg (ug/L)	0.0034	0.0039	0.0060	0.004	0.0058	0.0056	0.0057	0.0055	0.0049	0.0039	0.0041	0.0034
D-Mo (ug/L)	0.52	0.48	0.46	0.58	0.46	0.55	0.59	0.66	0.71	0.65	0.6	0.57
D-Ni (ug/L)	0.69	0.68	0.71	0.7	1.2	1.1	1.1	0.98	0.98	0.8	0.71	0.63
D-K (mg/L)	1.5	1.5	1.7	1.8	1.2	1.2	1.0	1.2	1.2	1.3	1.4	1.4
D-Se (ug/L)	0.067	0.073	0.076	0.074	0.07	0.077	0.088	0.089	0.099	0.085	0.08	0.073
D-Si (ug/L)	4870	4896	5318	4700	2660	4200	4600	5300	5454	5075	5100	4790
D-Ag (ug/L)	0.0051	0.0050	0.0050	0.0050	0.0050	0.0050	0.0054	0.0050	0.0055	0.0050	0.0066	0.0050
D-Na (mg/L)	4.2	4.2	4.6	4.9	2.1	3.1	2.6	3.2	3.1	3.7	4.3	4.2
D-Sr (ug/L)	160	170	190	190	76	110	88	110	109	130	150	170
D-Tl (ug/L)	0.0020	0.0020	0.0020	0.0025	0.0047	0.004	0.0036	0.0038	0.004	0.0026	0.0029	0.0020
D-U (ug/L)	1.2	1.1	1.3	5.6	3.0	3.1	2.2	2.8	2.9	4.0	3.4	2.5
D-Zn (ug/L)	0.81	1.2	1.7	0.97	1.7	0.98	0.74	0.51	0.77	0.65	0.66	0.65

The pH in lower Coffee Creek remains relatively uniform throughout the year with values generally ranging between 7.2 and 7.8 (Table 3.2-2). All pH values reported to date have remained within the CCME freshwater guideline range for pH of 6.5 to 9.0.

Baseline concentrations for sulphate in lower Coffee Creek also exhibit a strong seasonal signature with lowest concentrations occurring during peak runoff conditions. During low flow periods, mean sulphate concentrations at CC-3.2 range from 45 mg/L to 72 mg/L (October to February; Table 3.2-2). Sulphate concentrations during freshet (March to June) and the open water (July to September) period range from roughly 20 mg/L to 80 mg/L.

As with the other stations monitored, TSS concentrations in lower Coffee Creek exhibit maxima coincident with the peak snowmelt months (Table 3.2-2). At most other flow periods of the year, TSS values in lower Coffee Creek at CC-3.2were generally below 3.0 mg/L.

3.2.2.3 Nutrients

As with upper Coffee Creek, nutrient parameters are found in low concentrations in lower Coffee Creek at station CC-3.2. Ammonia-N concentrations are low with mean monthly values typically less than 0.04 mg/L (Table 3.2-2). Mean monthly nitrate-N concentrations in lower Coffee Creek are higher than observed in upper Coffee Creek. Mean monthly nitrate-N at CC-3.2 ranged approximately an order of magnitude, with peak flow minima of 0.06 mg/L and winter low flow maxima of 0.7 mg/L. Lower Coffee Creek waters are oligotrophic to ultra-oligotrophic with monthly mean dissolved phosphorus concentrations at CC-3.2 ranging between 0.003 mg/L to 0.01 mg/L (Table 3.2-2).

As with upper Coffee Creek, TOC and DOC exhibit a marked seasonal signature with highest values observed during peak runoff periods at station CC-3.2. DOC accounts for virtually all of the TOC. Mean monthly DOC concentrations range from approximately 7.0 mg/L during baseflow periods to up to 20 mg/L during higher flow periods (Figure 3.2-12).

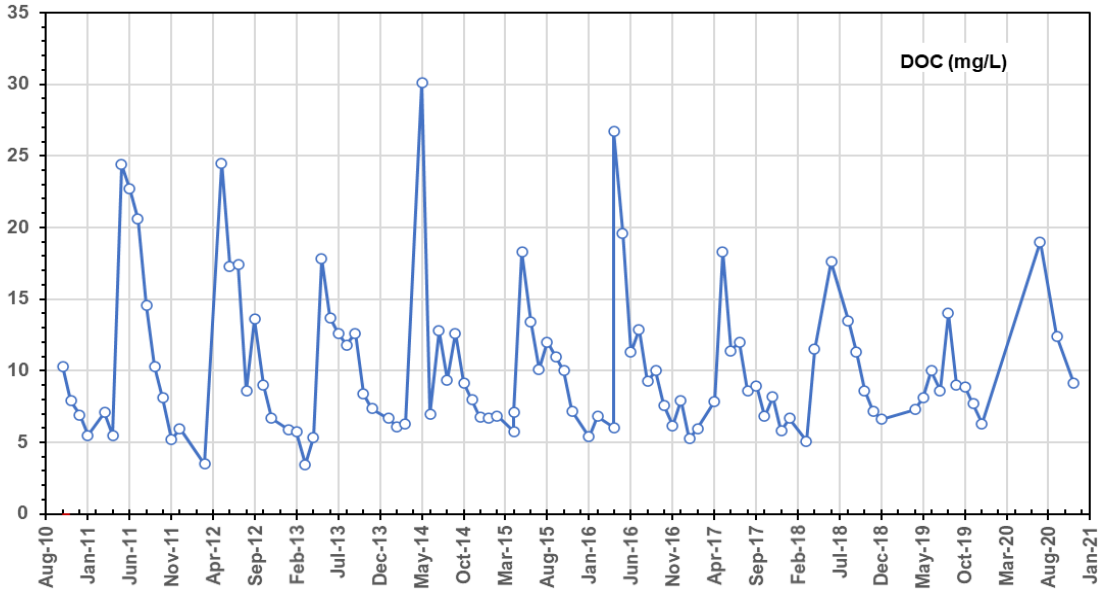

Figure 3.2-12: Dissolved organic carbon (DOC) in lower Coffee Creek CC-3.2 for the period October 2010 to December 2020.

3.2.2.4 Trace Elements

Baseline trace element concentrations in lower Coffee Creek were derived from data collected from October 2010 to December 2020 at CC-3.2 (Figure 3.2-1). For most parameters monitored, mean monthly concentrations of total and dissolved trace elements are low; the sole exceptions to this observation are for dissolved Al and total Cu. Of particular note is the absence of elevated total U in lower Coffee Creek and this result marks a departure of the trend observed at the other stations monitored in the immediate project area (Table 3.2-2).

Dissolved Al at CC-3.2 is seasonally elevated in lower Coffee Creek and consistently observed to be elevated well above BC ENV guideline for the protection of aquatic life of 100 µg/L during peak runoff periods (Figure 3.2-13).

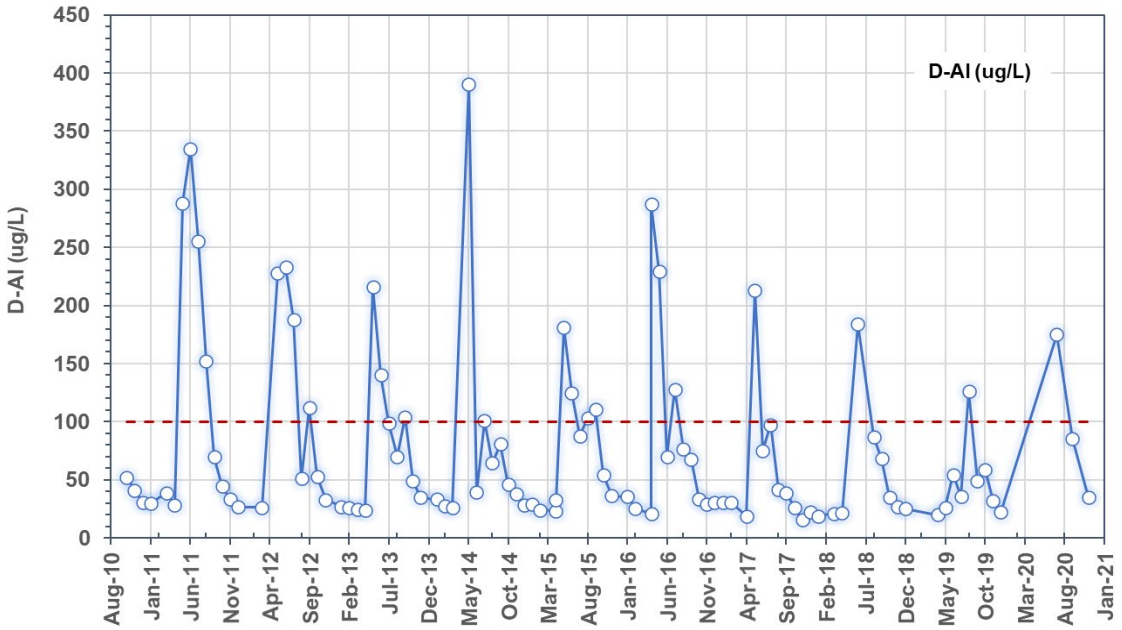

Figure 3.2-13: Dissolved aluminum (D-Al) in lower Coffee Creek (CC-3.2) for the period October 2010 to December 2020 compared to the British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dashed line) for protection of aquatic life.

During baseflow periods, dissolved Al concentrations in lower Coffee Creek are typically roughly between 30 and 90 µg/L (Table 3.2-2).

Concentrations of total Cu in lower Coffee Creek exhibit the same strong seasonal signature observed at CC-11.6, with maxima associated with peak runoff periods that exceed the CCME hardness-dependent Cu guideline for the protection of aquatic life (Figure 3.2-14 and Figure 3.2-15). During most months of the open water period including May to September, mean monthly total Cu concentrations are naturally elevated above the CCME guideline for copper (Figure 3.2-15).

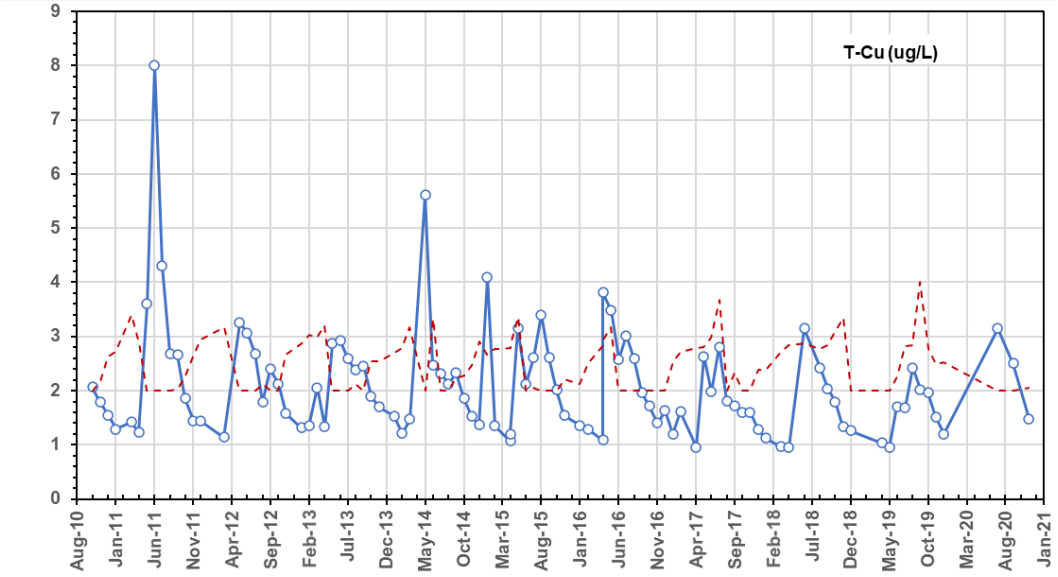

Figure 3.2-14: Total copper (T-Cu) in lower Coffee Creek (CC-3.2) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness-dependent water quality guidelines (red dashed line) for the protection of aquatic life.

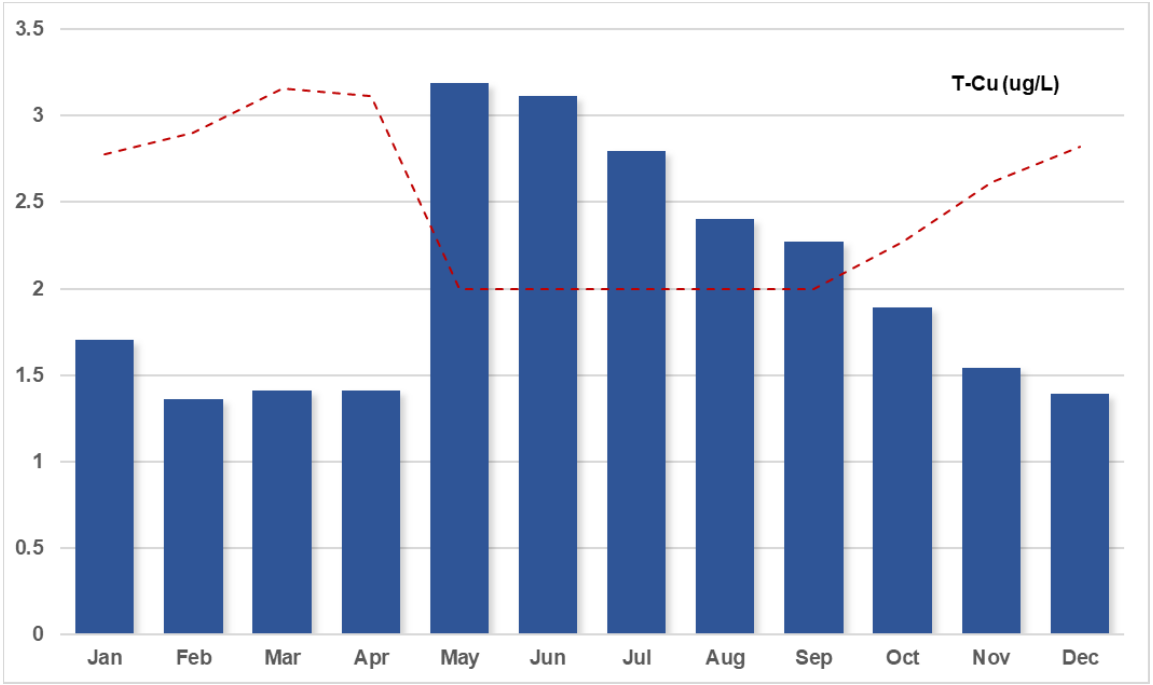

Figure 3.2-15: Monthly mean total copper (T-Cu) in lower Coffee Creek for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness-dependent water quality guidelines (red dashed line) for the protection of aquatic life.

Similar to that observed in upper Coffee Creek, total Cd concentrations in lower Coffee Creek at CC-3.2 generally do not exceed the chronic or acute CCME hardness-dependent guidelines for protection of aquatic life for Cd (Figure 3.2-16).

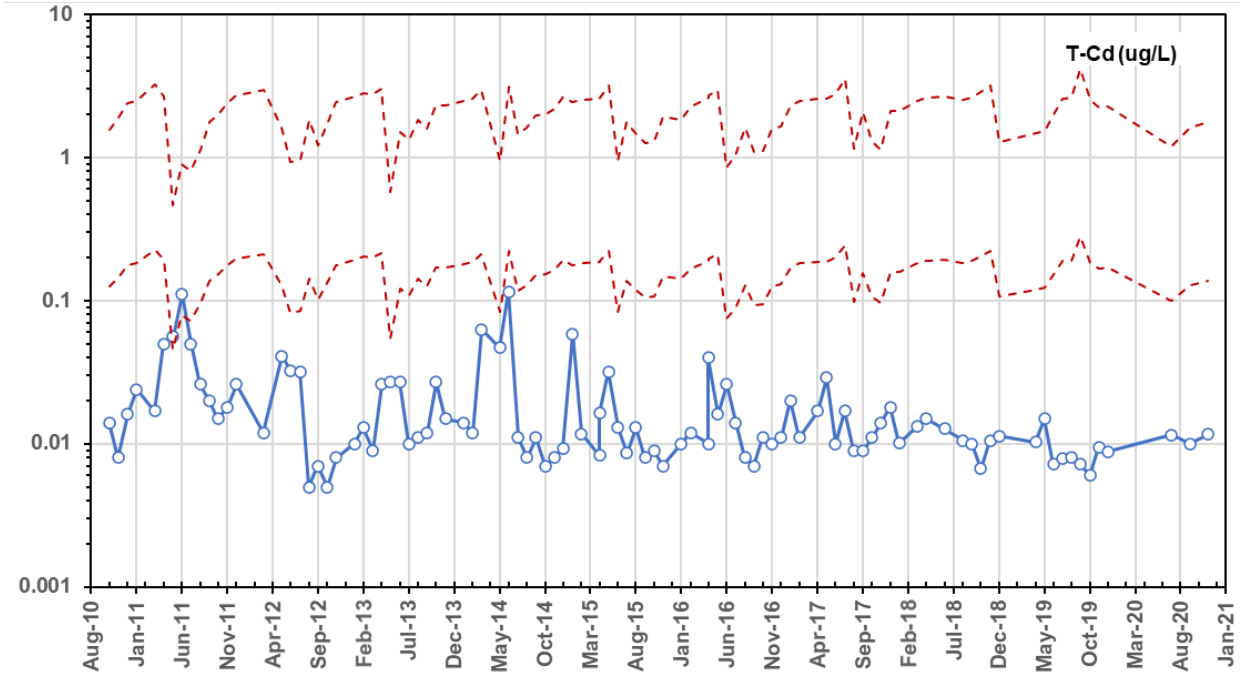

Figure 3.2-16: Total cadmium (T-Cd) concentrations in lower Coffee Creek (CC-3.2) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness-dependent water quality guideline for the protection of aquatic life.

As previously introduced, total U concentrations in lower Coffee Creek do not exhibit the same pronounced seasonal signature observed in upper Coffee Creek or Latte Creek. Total U concentrations at CC-3.2 have never exceeded the CCME guideline of 15 µg/L for the protection of aquatic life since the inception of monitoring in October 2010 (Figure 3.2-17). Interestingly, the lowest mean monthly total U concentrations at CC-3.2 occur during winter low flows, a notable departure from observations in upper Coffee Creek and may indicate a different groundwater source or input into lower Coffee Creek that is comparatively deplete in U. Mean monthly total U concentrations at CC-3.2typically are on the order of only 1.0 to 4.0 µg/L (Figure 3.2-18).

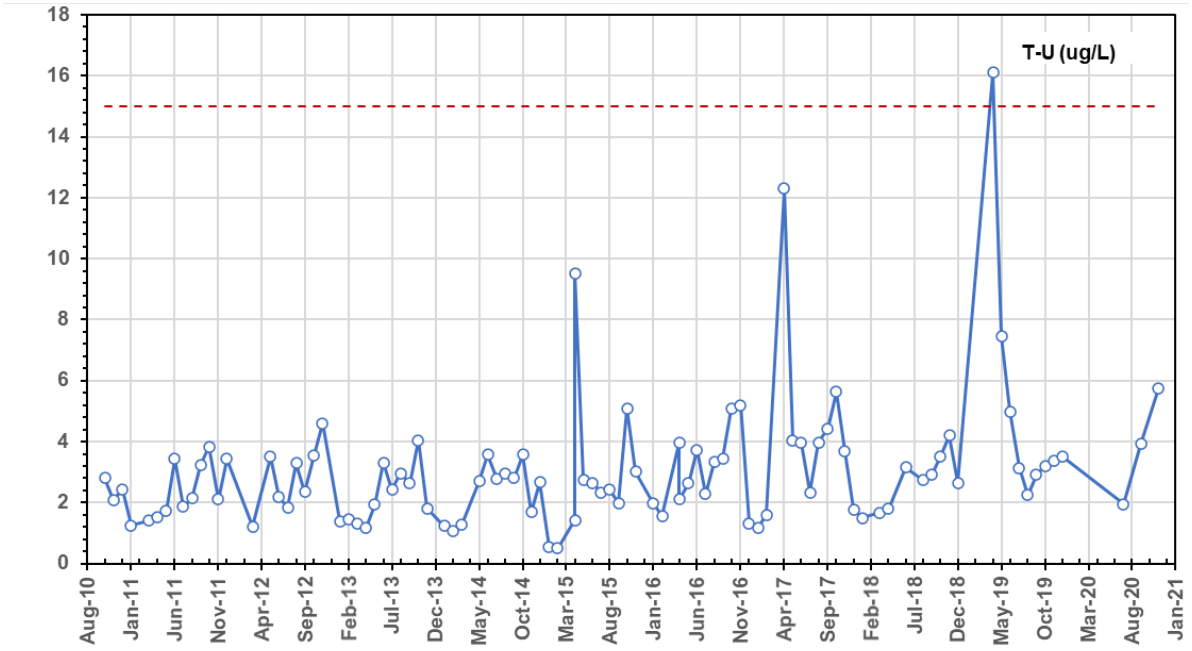

Figure 3.2-17: Total uranium (T-U) in lower Coffee Creek (CC-3.2) for the period October 2010 to December 2020 compared to Canadian Council of Ministers of the Environment (CCME) chronic water quality guidelines (red dashed line) for the protection of aquatic life.

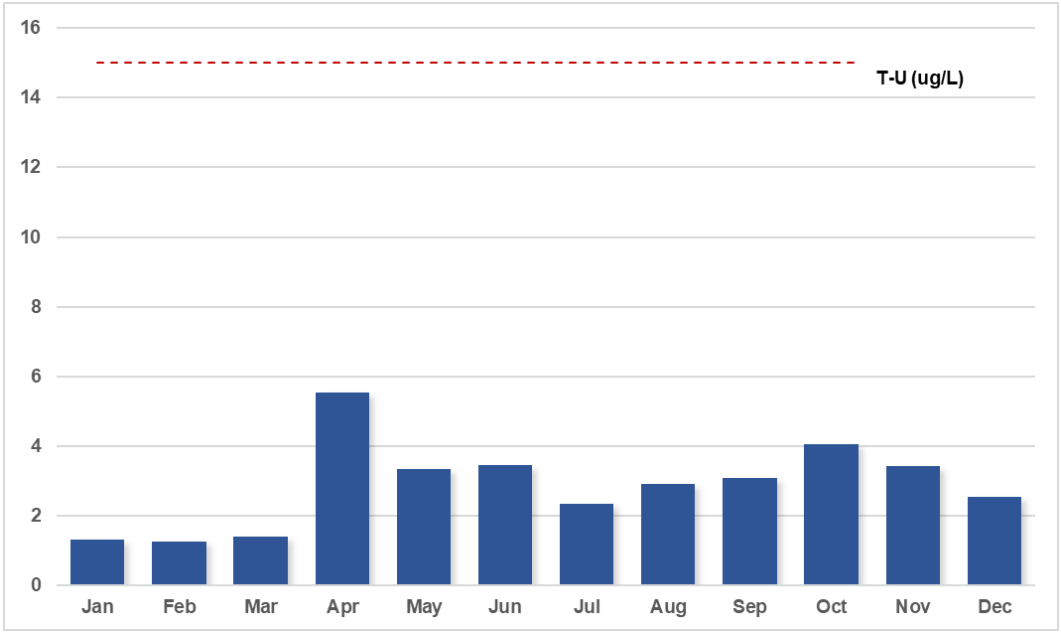

Figure 3.2-18: Mean monthly total uranium (T-U) concentrations at CC-3.2 in lower Coffee Creek for the period October 2010 to December 2020 and compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guideline (dashed red line) for protection of aquatic life.

3.2.2.5 5 in 30 Sampling at CC-3.2

Weekly sampling occurred at CC-3.2 during the period of October 4 to October 28, 2017 to assess short-term variability in water quality and results are presented in Table 3.2-3; full results are presented in Appendix A.

Table 3.2-3:
CC-3.2 Weekly 5 in 30 Sampling Results for Select Parameters

Parameter	Sampling Date				
	10/4/2017	*10/9/2017*	*10/19/2017*	*10/23/2017*	*10/28/2017*
Cond-L (uS/cm)	242	249	260	266	270
D-Hard (mg/L)	117	115	120	121	131
T-Hard (mg/L)	123	116	118	128	129
pH-L (pH)	7.92	7.8	7.92	7.88	7.79
TDS (mg/L)	146	132	172	154	168
TSS (mg/L)	<1.1	<1.0	1.9	<1.0	<4.0
DOC (mg/L)	7.27	7.93	6.8	5.57	9.28
TOC (mg/L)	6.98	8.43	8.16	5.27	8.41
T-Alk (mg/L)	59	59.6	59.8	57.2	59.6
SO_4 (mg/L)	55.5	60.2	62.3	65.8	71.2
NO_2 (mg/L)	0.002	0.0027	<0.0020	<0.0020	<0.0020
NO_3 (mg/L)	0.348	0.377	0.358	0.387	0.43
NH_3 (mg/L)	<0.0050	<0.0050	0.024	0.029	<0.0050
T-Al (ug/L)	54.8	32	96.2	42.3	26.1
T-Sb (ug/L)	0.093	0.101	0.094	0.09	0.091
T-As (ug/L)	0.331	0.357	0.372	0.288	0.298
T-Cd (ug/L)	0.0074	0.0086	0.0110	0.0086	0.0084
T-Cu (ug/L)	1.56	1.42	1.6	1.35	1.3
T-Fe (ug/L)	51.9	20.7	112	41.9	18.2
T-Pb (ug/L)	0.0108	<0.0050	0.059	0.0057	<0.0050
T-Hg (ug/L)	<0.0020	0.0026	<0.0020	<0.0020	<0.0020
T-U (ug/L)	4.64	4.05	5.63	4.73	5.44
T-Zn (ug/L)	0.44	0.31	<1.0	0.28	0.31
D-Al (ug/L)	32.6	31.6	26.4	24.3	25.7
D-Sb (ug/L)	0.092	0.099	0.085	0.087	0.093
D-As (ug/L)	0.314	0.341	0.271	0.279	0.298
D-Cd (ug/L)	0.0078	0.0069	0.0083	0.0076	0.0086
D-Cu (ug/L)	1.5	1.54	1.32	1.42	1.4
D-Fe (ug/L)	22.2	22.4	16.1	17.4	18.5
D-Pb (ug/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
D-Hg (ug/L)	0.0024	0.0022	<0.0020	0.0021	<0.0020
D-U (ug/L)	4.46	4.79	5.18	5.07	5.63
D-Zn (ug/L)	0.3	0.38	0.4	0.3	0.36

3.2.3 CC-10.9 Coffee Creek

This station reflects the contributions from Latte Creek that enters Coffee Creek immediately upstream of this station (Figure 3.2-1).

3.2.3.1 Summary Statistics

Table 3.2-4 summarizes the mean monthly values for a suite of the key parameters for station CC-10.9 in Coffee Creek.

3.2.3.2 Major Ions

Station CC-10.9 is characterized by moderately hard waters (~ 100 mg/L [as $CaCO_3$]) during open water periods (May to September) and hard waters (up to 358 mg/L [as $CaCO_3$]) during low flow periods, such as winter (Table 3.2-4; Figure 3.2-19).

The pH in CC-10.9 remains relatively uniform throughout the year with values roughly around 8 (Table 3.2-4). All pH values reported to date have remained within the CCME freshwater guideline range for pH of 6.5 to 9.0.

Baseline concentrations for sulphate in lower Coffee Creek shows signature highest concentrations during peak runoff conditions in April, with mean sulphate concentrations ranging from 50 mg/L to 90 mg/L for the remaining months (Table 3.2-4). As with the other stations monitored, TSS concentrations in this station exhibit maxima coincident with the peak snowmelt months (May-July; Table 3.2-4). At most other flow periods of the year, TSS values in lower Coffee Creek at CC-10.9 were generally below 3.0 mg/L.

Table 3.2-4:
Station CC-10.9 Monthly Mean Values

	CC-10.9											
	Jan (n=1)	Feb (n=1)	Mar (n=1)	Apr (n=2)	May (n=1)	Jun (n=2)	Jul (n=3)	Aug (n=3)	Sep (n=4)	Oct (n=3)	Nov (n=4)	Dec (n=3)
Physical Parameters												
pH (s.u.)	8.2	8.2	8.1	8.2	7.8	7.7	8.0	7.9	7.9	8.0	8.1	8.1
Cond-L (uS/cm)	460	486	478	691	233	230	263	232	224	285	334	419
TSS (mg/L)	1.5	1.0	1.1	1.0	11	2.5	45	4.4	1.3	1.7	1.1	1.0
TDS (mg/L)	264	288	292	426	168	168	218	154	160	184	198	282
T-Alk (mg/L)	154	168	181	178	51	50	58	57	57	64	81	127
T-Hard (mg/L)	265	254	260	356	100	101	114	103	104	119	149	203
Anions												
Sulphate (mg/L)	89	89	86	198	56	56	68	55	50	70	85	98
Cl (mg/L)	0.56	0.64	0.94	2.5	0.86	1.3	0.88	1.0	0.99	1.1	0.90	0.97
F (mg/L)	0.077	0.078	0.069	0.18	0.051	0.072	0.085	0.075	0.076	0.085	0.091	0.096
Nutrients												
T-NH3 (mg/L)	0.0050	0.010	0.018	0.047	0.041	0.071	0.034	0.043	0.022	0.028	0.0064	0.028
NO2+NO3 (mg/L)	0.3	0.41	0.34	0.036	0.0020	0.10	0.28	0.3	0.35	0.45	0.47	0.44
NO2 (mg/L)	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
NO3 (mg/L)	0.3	0.41	0.34	0.036	0.0020	0.10	0.28	0.3	0.35	0.45	0.47	0.44
D-P (mg/L)	0.0033	0.032	0.0020	0.014	0.0089	0.0069	0.0086	0.0074	0.050	0.0093	0.050	0.0050
TOC (mg/L)	3.7	3.3	2.6	13	8.0	23	19	14	12	10	7.5	5.1
DOC (mg/L)	3.7	3.3	2.9	14	8.1	20	14	15	13	9.1	9.3	5.7
WAD-CN (mg/L)	0.00065	0.00050	0.00065	0.00050	0.00050	0.00092	0.0013	0.0011	0.0050	0.001	0.0050	0.00050
Total Metals												
T-Al (ug/L)	10	8.4	8.3	36	172	250	1000	250	158	101	44	21
T-Sb (ug/L)	0.040	0.058	0.064	0.096	0.048	0.093	0.13	0.12	0.13	0.11	0.11	0.085
T-As (ug/L)	0.27	0.3	0.35	0.95	0.53	0.47	0.89	0.56	0.46	0.49	0.39	0.29
T-Ba (ug/L)	100	104	104	106	45	44	56	51	48	54	71	91
T-Be (ug/L)	0.010	0.010	0.010	0.010	0.010	0.023	0.045	0.020	0.10	0.017	0.10	0.010
T-Bi (ug/L)	0.0050	0.0050	0.0050	0.010	0.010	0.010	0.011	0.010	0.050	0.010	0.050	0.0050
T-B (ug/L)	10	10	10	10	10	10	10	10	10	10	10	10
T-Cd (ug/L)	0.0054	0.0050	0.0056	0.032	0.023	0.013	0.026	0.011	0.0096	0.0097	0.0091	0.0086
T-Ca (mg/L)	80	72	69	86	25	26	29	26	27	30	37	54
T-Cr (ug/L)	0.10	0.19	0.18	0.52	0.37	0.51	1.7	0.69	0.48	0.42	0.20	0.13
T-Co (ug/L)	0.06	0.016	0.021	0.34	0.28	0.11	0.61	0.15	0.18	0.079	0.10	0.040
T-Cu (ug/L)	0.53	0.58	0.62	1.1	1.2	3.2	3.9	2.8	2.5	2.0	1.5	1.0
T-Fe (ug/L)	50	13	5.3	139	296	219	1380	271	148	125	40	29
T-Pb (ug/L)	0.0050	0.0050	0.0050	0.020	0.12	0.027	0.41	0.070	0.050	0.020	0.050	0.0050
T-Li (ug/L)	1.0	1.0	1.2	7.8	0.91	1.0	1.4	1.4	1.1	1.5	1.8	1.9
T-Mg (mg/L)	16	18	22	35	9.0	8.8	10	9.5	9.0	11	14	17
T-Mn (ug/L)	29	1.7	1.9	370	47	6.8	31	12	14	15	20	15
T-Hg (ug/L)	0.0020	0.0020	0.0020	0.0021	0.0020	0.0080	0.0079	0.0055	0.0074	0.0043	0.0050	0.0028
T-Mo (ug/L)	0.48	0.67	0.69	1.2	0.74	0.6	0.85	0.75	0.93	0.85	0.72	0.63
T-Ni (ug/L)	0.39	0.29	0.39	1.1	0.89	1.5	1.8	1.2	1.6	0.87	1.1	0.61
T-K (mg/L)	2.5	2.6	3.2	4.1	1.5	1.3	1.5	1.4	1.4	1.5	1.6	2.1
T-Se (ug/L)	0.16	0.24	0.18	0.22	0.067	0.075	0.11	0.12	0.17	0.11	0.19	0.14
T-Si (ug/L)	5820	4850	3680	9570	3190	4170	5330	5590	6100	5680	5680	5640
T-Ag (ug/L)	0.0050	0.0050	0.0050	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.0050
T-Na (mg/L)	4.3	4.7	5.5	16	3.6	3.8	4.5	4.1	4.2	4.8	6.0	6.0
T-Sr (ug/L)	382	375	432	469	142	143	158	146	141	160	225	309
T-Tl (ug/L)	0.0020	0.0020	0.0020	0.0041	0.0060	0.0062	0.018	0.0050	0.010	0.0034	0.010	0.0020
T-U (ug/L)	17	20	23	124	8.0	7.6	7.8	6.9	6.4	12	20	18
T-Zn (ug/L)	0.20	0.16	0.18	2.4	1.6	1.0	5.3	1.1	3.0	1.0	3.0	0.37
Dissolve Metals												
D-Al (ug/L)	5.1	7.1	5.6	20	27	201	247	172	97	85	34	19
D-Sb (ug/L)	0.048	0.056	0.042	0.11	0.063	0.099	0.11	0.13	0.12	0.11	0.12	0.090
D-As (ug/L)	0.25	0.3	0.25	0.88	0.39	0.43	0.46	0.47	0.42	0.34	0.39	0.31
D-Ba (ug/L)	99	101	88	105	41	43	54	51	47	56	68	93
D-Be (ug/L)	0.010	0.010	0.010	0.010	0.010	0.023	0.019	0.017	0.10	0.010	0.10	0.010
D-Bi (ug/L)	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.050	0.0050	0.050	0.0050
D-B (ug/L)	10	10	10	10	10	10	10	10	10	10	10	10
D-Cd (ug/L)	0.0050	0.0056	0.0050	0.032	0.011	0.0095	0.016	0.0070	0.0096	0.0085	0.0084	0.0068
D-Ca (mg/L)	68	71	63	85	26	26	29	26	25	32	41	57
D-Cr (ug/L)	0.10	0.15	0.14	0.15	0.20	0.45	0.61	0.60	0.36	0.40	0.23	0.16
D-Co (ug/L)	0.053	0.018	0.014	0.34	0.12	0.081	0.11	0.11	0.12	0.06	0.10	0.042
D-Cu (ug/L)	0.54	0.62	0.46	1.2	0.81	3.0	3.0	2.7	2.2	2.0	1.6	1.1
D-Fe (ug/L)	17	2.6	2.8	70	68	157	212	158	88	71	30	22
D-Pb (ug/L)	0.0050	0.0050	0.0050	0.0050	0.0050	0.0074	0.016	0.010	0.050	0.013	0.050	0.0050
D-Li (ug/L)	0.77	1.3	1.0	7.9	0.97	1.1	1.5	1.4	1.2	1.5	1.8	1.7
D-Mg (mg/L)	17	21	18	37	8.8	9.0	10	8.8	8.8	12	14	16
D-Mn (ug/L)	29	0.73	1.1	392	38	5.7	5.8	7.8	11	15	18	16
D-Hg (ug/L)	0.0020	0.0020	0.0020	0.0027	0.0020	0.0088	0.0059	0.0058	0.0056	0.0050	0.0050	0.0020
D-Mo (ug/L)	0.49	0.7	0.60	1.1	0.78	0.66	0.81	0.76	0.88	0.89	0.84	0.64
D-Ni (ug/L)	0.43	0.34	0.28	1.2	0.65	1.3	1.3	1.2	1.2	0.91	0.83	0.61
D-K (mg/L)	2.4	2.8	2.6	4.1	1.6	1.4	1.5	1.5	1.4	1.5	1.7	2.2
D-Se (ug/L)	0.11	0.25	0.18	0.22	0.070	0.080	0.11	0.11	0.12	0.098	0.17	0.14
D-Si (ug/L)	4820	5280	3950	9370	2900	3930	4690	5430	5710	5350	6760	5570
D-Ag (ug/L)	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.010	0.0050	0.010	0.0050
D-Na (mg/L)	4.8	5.4	4.4	17	3.6	3.9	4.6	4.2	4.1	5.3	5.7	5.8
D-Sr (ug/L)	353	370	389	471	138	151	164	147	138	170	206	333
D-Tl (ug/L)	0.0020	0.0020	0.0020	0.0045	0.0030	0.0051	0.0040	0.0051	0.010	0.0035	0.010	0.0027
D-U (ug/L)	18	23	19	129	8.0	7.7	8.1	7.1	6.6	12	19	20
D-Zn (ug/L)	0.16	0.16	0.16	2.0	0.67	0.66	0.96	0.58	1.0	2.8	1.0	0.35

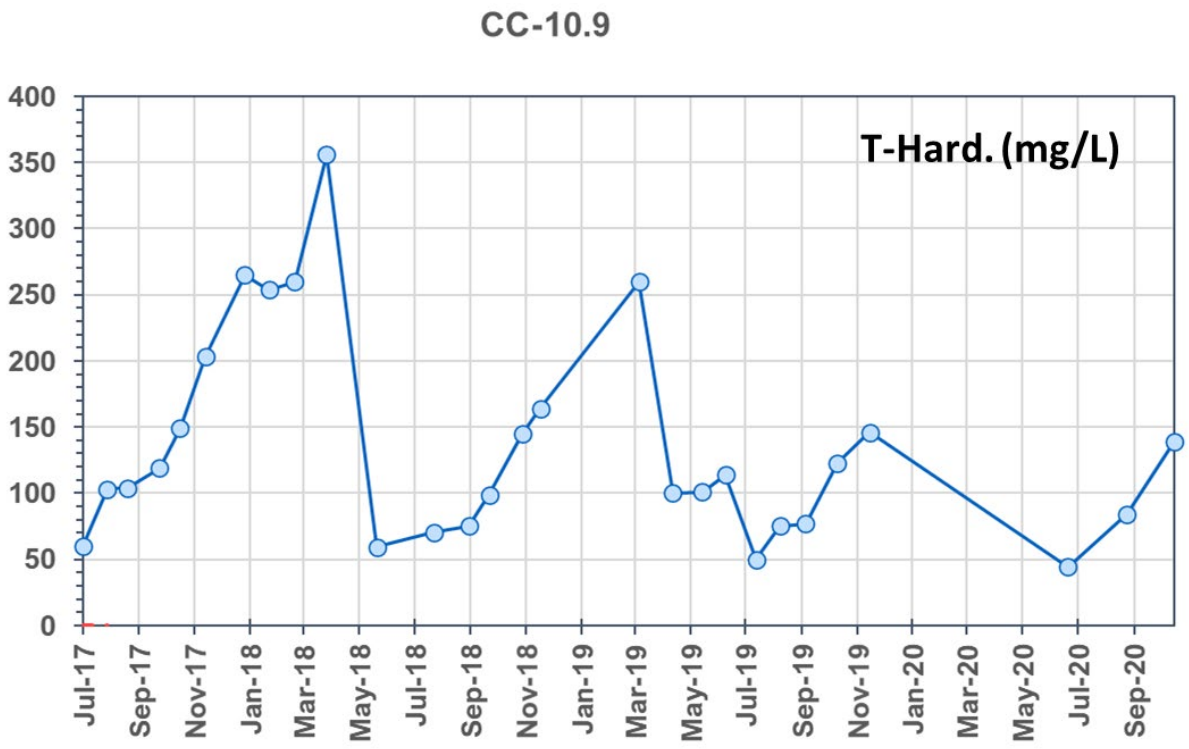

Figure 3.2-19: Total Hardness (T-Hard., as mg/L of $CaCO_3$) in CC-10.9 located in Coffee Creek for the period October 2017 to December 2020.

3.2.3.3 Nutrients

Nutrient parameters are found in low concentrations in Coffee Creek at station CC-10.9. Ammonia-N and nitrate-N concentrations are low with mean monthly values typically around 0.04 mg/L and 0.3 mg/L, respectively (Table 3.2-4). In regards to trophic status, waters at this station are oligotrophic to ultra-oligotrophic with monthly mean dissolved phosphorus concentrations at CC-10.9 ranging between 0.003 mg/L to 0.03 mg/L (Table 3.2-4). As with other stations in Coffee Creek, TOC and DOC exhibit a marked seasonal signature with highest values observed during peak runoff periods at station CC-10.9. Mean monthly DOC concentrations remain < 9.0 mg/L during baseflow periods to up to 20 mg/L during higher flow periods (Figure 3.2-20).

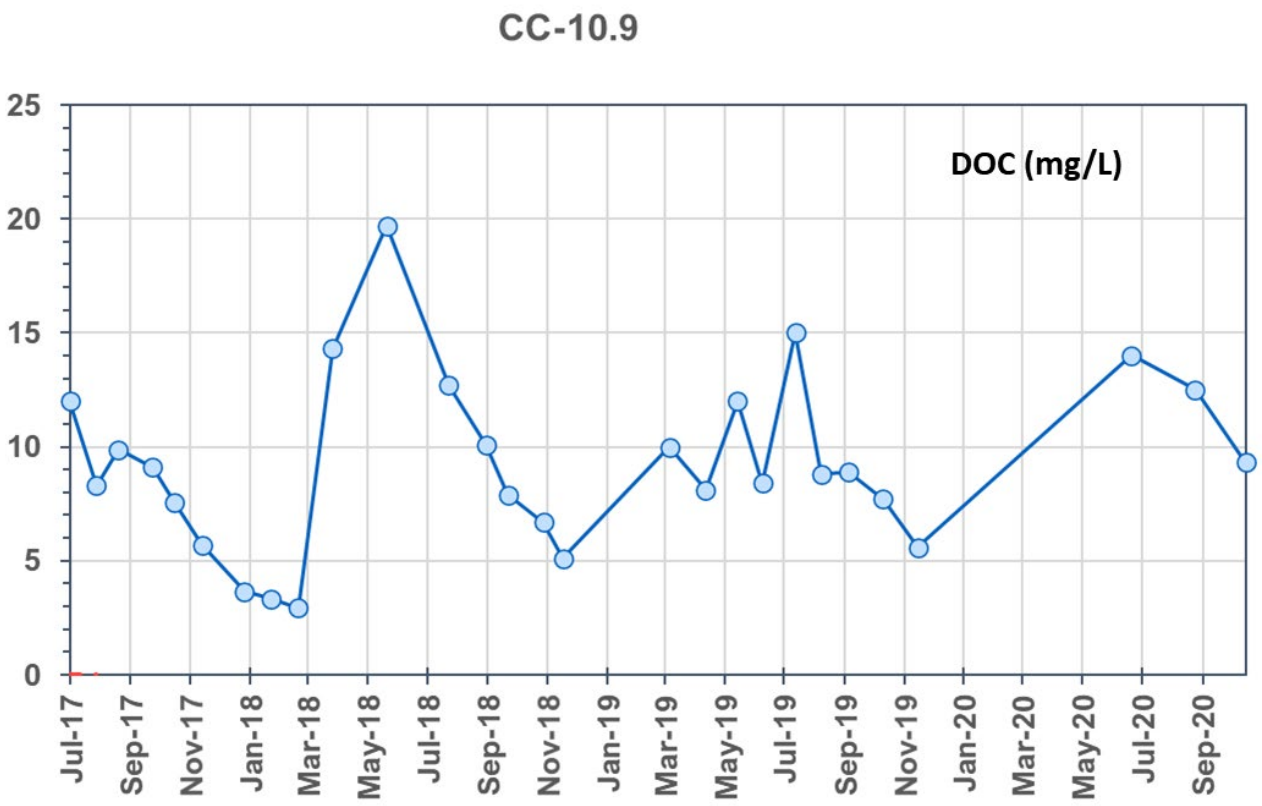

Figure 3.2-20: Dissolved organic carbon (DOC) in Coffee Creek CC-10.9 for the period October 2017 to December 2020.

3.2.3.4 Trace Elements

Baseline trace element concentrations in CC-10.9 were derived from data collected from October 2017 to December 2020. For most parameters monitored, mean monthly concentrations of total and dissolved trace elements are low (Table 3.2-4). Total arsenic in this station remained well below the applicable WQG for the protection of aquatic life (Figure 3.2-21).

Dissolved Al at CC-10.9 is seasonally elevated and observed to exceed the BC ENV guideline for the protection of aquatic life of 100 µg/L during peak runoff periods (Figure 3.2-22).

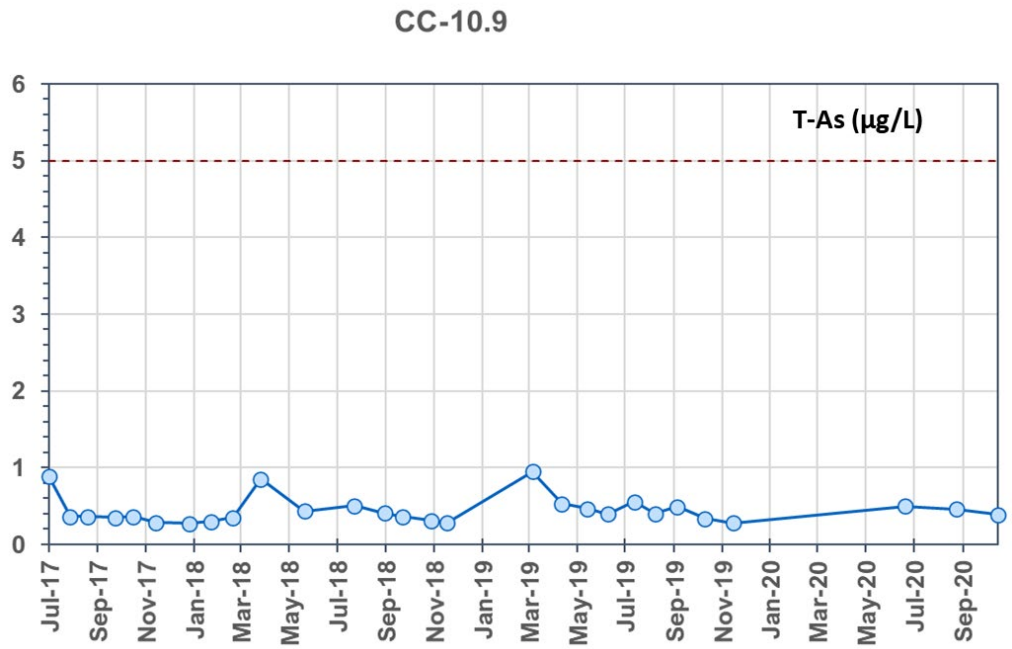

Figure 3.2-21: Total arsenic (T-As) in Coffee Creek (CC-10.9) for the period October 2017 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) water quality guidelines (red dashed line) for protection of aquatic life.

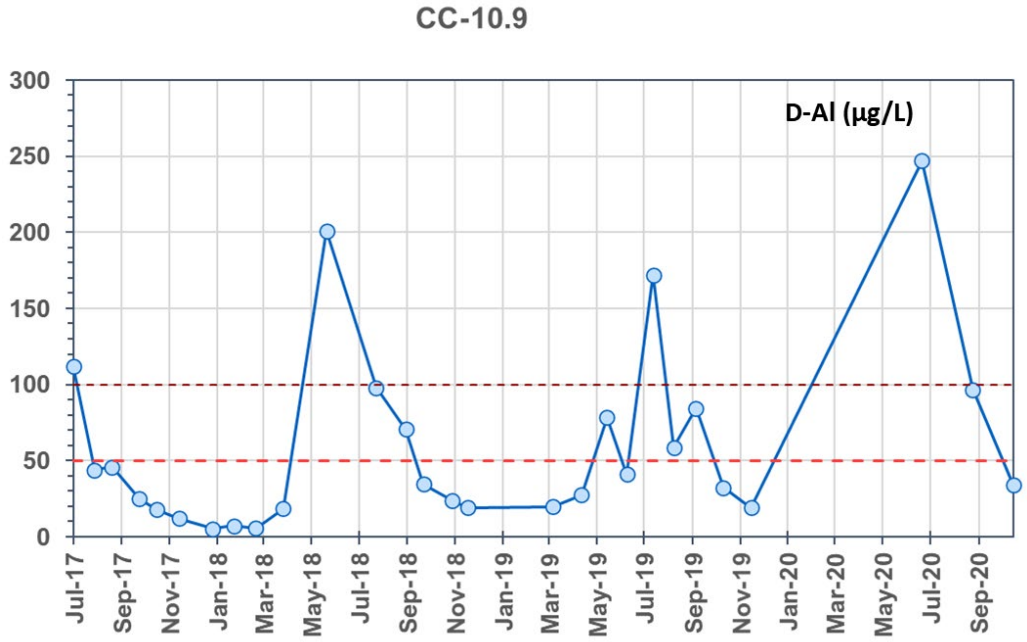

Figure 3.2-22: Dissolved aluminum (D-Al) concentrations at CC-10.9 for the period October 2017 to December 2020 compared to British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dashed line) for protection of aquatic life.

Total Se concentrations in CC-10.9 are very low and typically less than 0.2 µg/L (Table 3.2-4). Concentrations of total Cu in CC-10.4 exceeds the CCME hardness-dependent Cu guideline for the protection of aquatic life during most months of the open water period (*e.g.*, May to September; Figure 3.2-23).

Concentrations of total cadmium in CC-10.9 remained well below acute and chronic WQG for the protection of aquatic life (Figure 3.2-24).

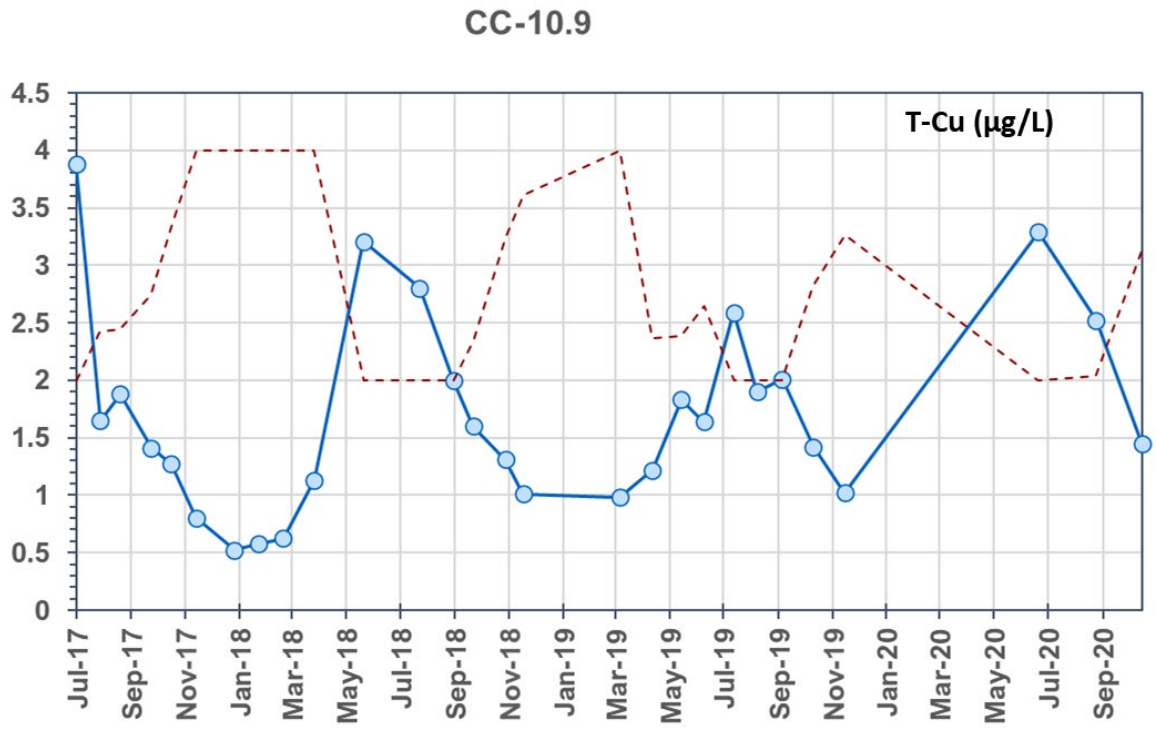

Figure 3.2-23: Total copper (T-Cu) in CC-10.9 located in Coffee Creek for the period October 2017 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness dependent water quality guidelines (red dashed line) for the protection of aquatic life.

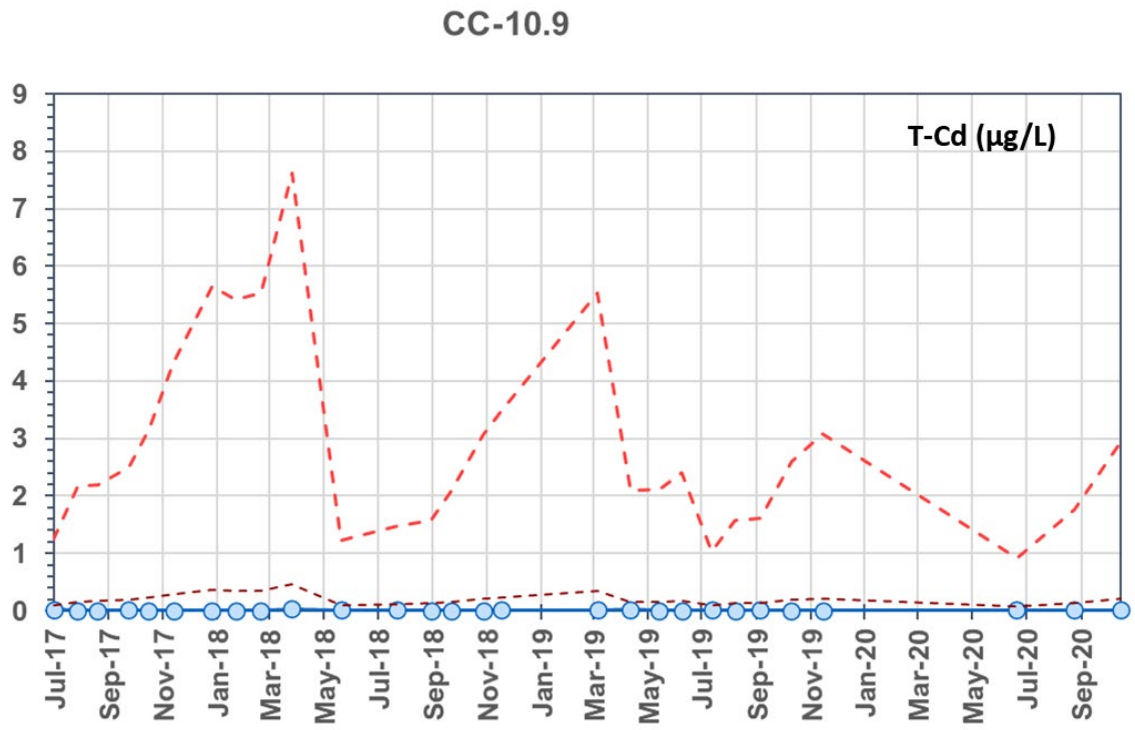

Figure 3.2-24: Total cadmium (T-Cd) concentrations in CC-10.9 located in Coffee Creek for the period October 2017 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness dependent water quality guidelines for the protection of aquatic life.

Similar to other observations in Coffee Creek, total U concentrations in CC-10.9 show a distinct seasonal signature with maxima observed during winter low flow periods and coinciding with baseflow conditions. Concentrations during low flow periods often exceed the CCME chronic water quality guideline of 15 µg/L with concentrations ranging from 30 to 80 µg/L (Figure 3.2-25).

Graphical representation of monthly mean total U data at CC-10.9 illustrates that concentrations exceeding the CCME water quality guideline of 15 µg/L typically occur from November to January (Figure 3.2-26).

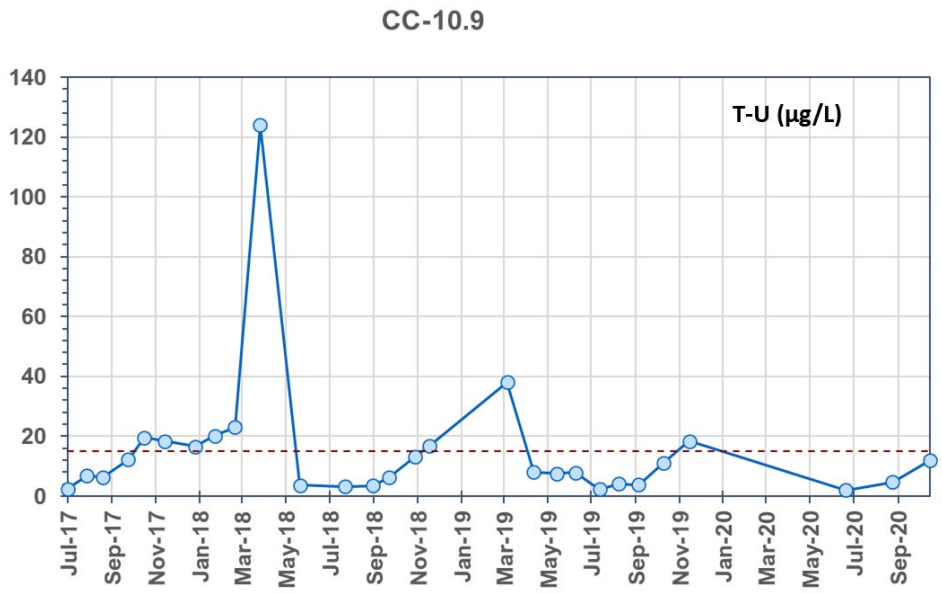

Figure 3.2-25: Total uranium (T-U) in CC-10.9 located in Coffee Creek for the period October 2017 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guidelines (red dashed line) for the protection of aquatic life.

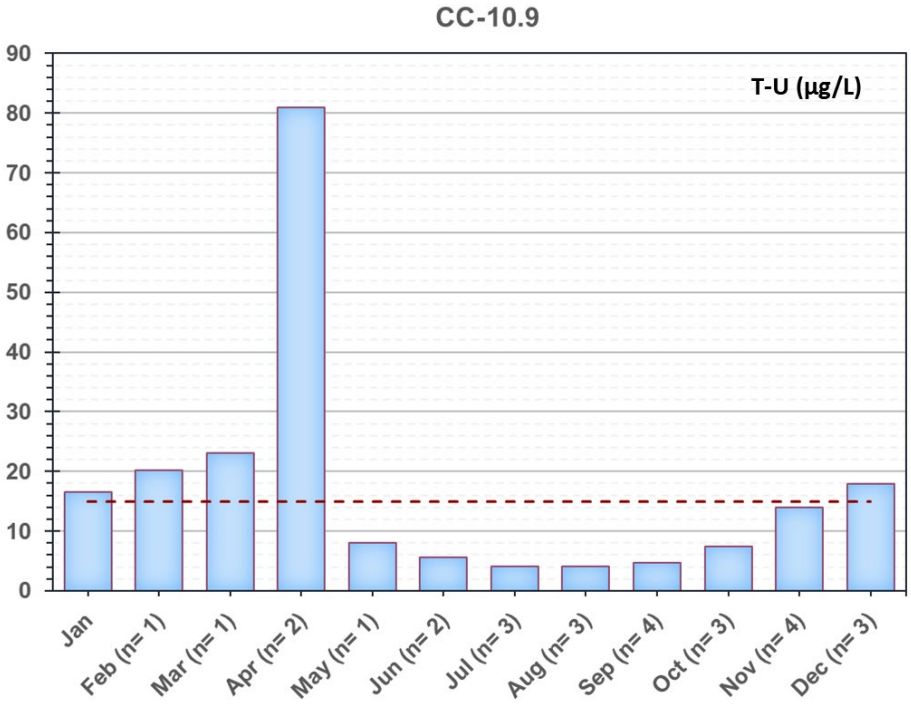

Figure 3.2-26: Mean monthly total uranium (T-U) concentrations at CC-10.9 in Coffee Creek for the period October 2017 to December 2020 and compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guidelines (dashed red line) for protection of aquatic life.

3.2.3.5 5 in 30 Sampling of CC-10.9

Weekly sampling occurred at CC-10.9 during the period of October 4 to October 28, 2017 to assess short-term variability in water quality and results are presented in Table 3.2-5; full results are presented in Appendix A.

Table 3.2-5:
CC-10.9 Weekly 5 in 30 Sampling Results for Select Parameters

Parameter	Sampling Date				
	10/4/2017	*10/9/2017*	*10/19/2017*	*10/23/2017*	*10/28/2017*
Cond-L (uS/cm)	246	245	285	293	283
D-Hard (mg/L)	121	115	129	135	137
T-Hard (mg/L)	122	115	119	139	134
pH-L (pH)	7.97	7.89	7.95	8	7.82
TDS (mg/L)	144	148	184	178	180
TSS (mg/L)	<1.3	<1.0	<1.0	<1.0	<4.0
DOC (mg/L)	7.36	9.08	9.09	6.72	8.8
TOC (mg/L)	8.41	8.4	9.25	7.05	8.55
T-Alk (mg/L)	59.1	56.7	63.6	63.3	61.4
SO_4 (mg/L)	57.5	58.9	70.4	73.6	75.8
NO_2 (mg/L)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
NO_3 (mg/L)	0.388	0.405	0.422	0.438	0.466
NH_3 (mg/L)	<0.0050	0.044	<0.020	0.008	<0.0050
T-Al (ug/L)	43.1	195	29.9	31	29.3
T-Sb (ug/L)	0.096	0.1	0.106	0.098	0.091
T-As (ug/L)	0.35	0.505	0.352	0.318	0.331
T-Cd (ug/L)	0.0071	0.0112	0.0083	0.0073	0.007
T-Cu (ug/L)	1.57	2.15	1.41	1.36	1.35
T-Fe (ug/L)	38	319	30.7	35.8	29
T-Pb (ug/L)	0.198	0.106	<0.020	<0.0050	<0.0050
T-Hg (ug/L)	0.0021	0.0022	<0.0020	<0.0020	0.0048
T-U (ug/L)	7.69	8.04	12.2	11.5	10.5
T-Zn (ug/L)	0.37	1.34	<1.0	0.29	0.34
D-Al (ug/L)	38.9	38.1	24.8	26	26.7
D-Sb (ug/L)	0.099	0.108	0.093	0.094	0.101
D-As (ug/L)	0.334	0.375	0.329	0.316	0.332
D-Cd (ug/L)	0.0065	0.0056	0.0085	0.0073	0.008
D-Cu (ug/L)	1.54	1.55	1.42	1.44	1.42
D-Fe (ug/L)	30.2	31.4	26.2	26.5	28.1
D-Pb (ug/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
D-Hg (ug/L)	0.0024	0.0026	0.0025	0.0025	<0.0020
D-U (ug/L)	7.67	7.8	12.2	11.2	10.6
D-Zn (ug/L)	0.29	0.39	0.4	0.41	0.41

Less variability occurred throughout the 5 in 30 sampling period at CC-10.9 as compared to LC-11.4 described previously and likely reflects the well mixed conditions within Coffee Creek. Sulphate, a conservative parameter (*e.g.*, changes in concentration would only arise from dilution and not geochemical adsorption or precipitation reactions), was present at CC-10.9 on October 19, 2017 at concentrations of approximately 70 mg/L (Table 3.2-5) which corresponded to sulphate concentrations at CC-11.6, immediately upstream of the confluence of Latte Creek and Coffee Creek of 69 mg/L for the same date (Appendix A). Sulphate concentrations in lower Latte Creek at LC-0.2, immediately before entering Coffee Creek, on the same date was approximately 100 mg/L, suggesting that station CC-10.9 indeed represents a well-mixed condition of Latte Creek water with Coffee Creek waters.

A slight increasing trend in concentration was observed for those parameters inversely related to flow, most notably conductivity, hardness, sulphate and uranium.

3.3 Halfway Creek and YT-24

The following section describes baseline water quality results for Halfway Creek and the small, ephemeral creek named YT-24.

Halfway Creek contains two water quality monitoring stations at HC-6.8, approximately mid-way down the watershed, and at station HC-1.0, at the mouth of Halfway Creek prior to entering the Yukon River (Figure 3.3-1).

Water quality in YT-24 is characterized by data collected at YT24-0.1 at the mouth of the creek prior to entering the Yukon River (Figure 3.3-1).

3.3.1 Halfway Creek – Stations HC-6.8 and HC-1.0

3.3.1.1 Summary Statistics

Water quality at stations HC-6.8 and HC-1.0 has been collected since October 2010 and continues to present. Data for HC-6.8 represents a nearly continuous monthly record for the period of October 2010 to December 2020. For station HC-1.0, monthly sampling in the winter period has proved sporadic as a result of freezing conditions and during the low-low flow periods, the lower reaches of Halfway Creek do not contain flow.

Table 3.3-1 and Table 3.3-2 summarize monthly mean concentrations for a suite of key parameters at station HC-6.8 and HC-1.0, respectively.

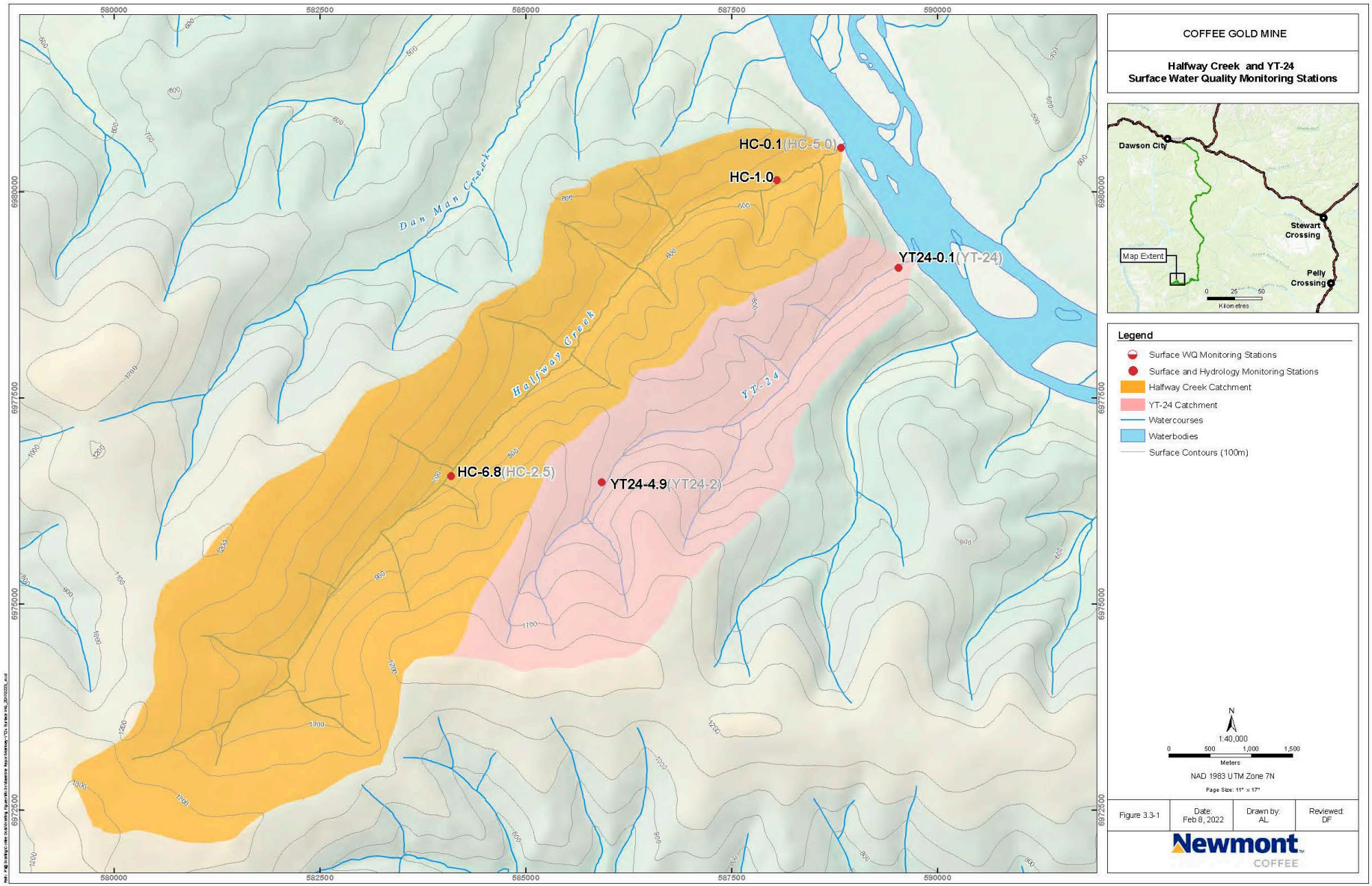

Figure 3.3-1: Detail of Halfway Creek and YT-24 drainages illustrating key monitoring station locations

Table 3.3-1:
Station HC-6.8 Monthly Mean Values

	HC-6.8 - Mean											
	Jan (n=8)	Feb (n=7)	Mar (n=7)	Apr (n=11)	May (n=8)	Jun (n=9)	Jul (n=10)	Aug (n=9)	Sep (n=10)	Oct (n=10)	Nov (n=10)	Dec (n=6)
Physical Parameters												
pH (s.u.)	7.9	7.9	7.9	8.0	7.2	7.5	7.7	7.7	7.8	7.9	7.9	8.0
Cond-L (uS/cm)	390	400	410	360	100	120	150	160	160	250	330	355
TSS (mg/L)	1.5	1.0	1.2	1.8	6.3	13	3.0	14	1.7	1.3	1.7	1.1
TDS (mg/L)	228	230	240	230	96	97	110	110	120	160	200	220
T-Alk (mg/L)	130	140	140	110	31	38	51	55	56	82	110	120
T-Hard (mg/L)	190	189	200	180	51	58	73	79	81	120	160	180
Anions												
Sulphate (mg/L)	72	75	76	72	12	17	22	23	23	39	56	62
Cl (mg/L)	0.65	0.57	0.96	0.83	1.2	1.3	0.61	0.74	0.68	0.55	3.1	0.54
F (mg/L)	0.069	0.072	0.072	0.069	0.043	0.048	0.051	0.054	0.054	0.064	0.064	0.07
Nutrients												
T-NH3 (mg/L)	0.016	0.023	0.025	0.023	0.026	0.02	0.027	0.022	0.019	0.016	0.018	0.029
NO2+NO3 (mg/L)	0.48	0.44	0.47	0.22	0.11	0.22	0.33	0.4	0.51	0.56	0.51	0.52
NO2 (mg/L)	0.0088	0.0097	0.0033	0.0065	0.012	0.0080	0.0074	0.0083	0.007	0.0074	0.0029	0.011
NO3 (mg/L)	0.45	0.43	0.41	0.24	0.092	0.2	0.34	0.39	0.52	0.55	0.5	0.46
D-P (mg/L)	0.0032	0.004	0.0029	0.0071	0.0097	0.0061	0.0042	0.0047	0.0084	0.0036	0.0037	0.0023
TOC (mg/L)	4.0	3.9	3.9	9.9	23	18	14	12	11	7.8	5.0	4.2
DOC (mg/L)	3.7	3.6	3.2	9.4	21	17	13	11	11	7.4	4.7	4.2
WAD-CN (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Total Metals												
T-Al (ug/L)	16	13	12	85	410	390	190	370	150	65	28	16
T-Sb (ug/L)	0.57	0.56	0.51	0.57	0.2	0.3	0.39	0.47	0.42	0.62	0.69	0.6
T-As (ug/L)	0.7	0.68	0.6	1.1	1.2	1.5	1.2	1.5	1.1	1.1	0.91	0.73
T-Ba (ug/L)	57	57	57	53	30	31	32	36	33	41	49	55
T-Be (ug/L)	0.010	0.010	0.010	0.017	0.048	0.040	0.022	0.03	0.03	0.012	0.010	0.010
T-Bi (ug/L)	0.0073	0.0057	0.0057	0.0090	0.0094	0.0084	0.0070	0.0096	0.010	0.0060	0.0055	0.0058
T-B (ug/L)	30	33	33	30	35	32	23	29	23	27	26	23
T-Cd (ug/L)	0.012	0.0078	0.011	0.014	0.025	0.02	0.013	0.013	0.0078	0.0069	0.0072	0.0084
T-Ca (mg/L)	46	45	47	44	13	15	18	20	21	29	39	43
T-Cr (ug/L)	0.21	0.12	0.1	0.27	0.75	0.91	0.57	1.0	0.52	0.31	0.19	0.12
T-Co (ug/L)	0.025	0.025	0.024	0.088	0.34	0.3	0.11	0.25	0.091	0.051	0.032	0.022
T-Cu (ug/L)	0.77	0.71	0.7	1.1	2.3	2.1	1.7	1.9	1.7	1.3	0.88	0.8
T-Fe (ug/L)	14	12	8.1	79	440	420	170	430	120	49	23	11
T-Pb (ug/L)	0.033	0.014	0.014	0.035	0.11	0.13	0.039	0.24	0.035	0.038	0.032	0.017
T-Li (ug/L)	1.7	1.6	1.7	1.9	1.0	0.91	0.98	1.1	1.1	1.3	1.5	1.5
T-Mg (mg/L)	18	18	19	17	4.4	5.1	6.5	6.8	7.0	11	15	17
T-Mn (ug/L)	19	16	28	18	44	26	7.3	17	5.8	3.1	5.9	8.7
T-Hg (ug/L)	0.0050	0.0059	0.0054	0.0058	0.01	0.0071	0.0056	0.0064	0.006	0.0057	0.0054	0.0047
T-Mo (ug/L)	1.8	1.9	1.7	1.9	0.55	0.7	0.98	1.0	1.1	1.6	1.9	1.8
T-Ni (ug/L)	0.37	0.34	0.38	0.6	3.6	1.2	0.83	1.1	0.77	0.55	0.38	0.36
T-K (mg/L)	2.7	2.7	2.7	3.0	1.3	1.2	1.4	1.6	1.7	2.1	2.4	2.5
T-Se (ug/L)	0.11	0.12	0.1	0.14	0.067	0.066	0.072	0.067	0.085	0.09	0.1	0.097
T-Si (ug/L)	5700	5200	5300	5531	3100	3970	4902	5400	5849	5634	5578	5595
T-Ag (ug/L)	0.0063	0.0057	0.0059	0.0061	0.0071	0.0072	0.0071	0.0084	0.0060	0.0060	0.0058	0.0058
T-Na (mg/L)	4.2	4.2	4.3	4.7	1.5	1.7	2.1	2.2	2.3	3.1	3.7	4.0
T-Sr (ug/L)	460	450	460	470	150	160	200	220	230	320	400	430
T-Tl (ug/L)	0.0020	0.0023	0.0021	0.0027	0.0057	0.0059	0.003	0.0065	0.0042	0.0022	0.002	0.0020
T-U (ug/L)	70	80	84	72	16	15	19	20	20	37	53	60
T-Zn (ug/L)	-	-	-	-	-	-	-	-	-	-	-	-
Dissolve Metals												
D-Al (ug/L)	10	8.9	8.2	67	310	280	150	120	110	52	18	12
D-Sb (ug/L)	0.53	0.56	0.49	0.55	0.19	0.3	0.38	0.44	0.43	0.6	0.7	0.61
D-As (ug/L)	0.66	0.68	0.59	1.0	0.97	1.1	1.1	1.1	1.1	1.1	0.9	0.73
D-Ba (ug/L)	55	56	56	53	27	29	32	33	33	41	50	55
D-Be (ug/L)	0.010	0.010	0.010	0.015	0.042	0.032	0.021	0.019	0.026	0.011	0.010	0.010
D-Bi (ug/L)	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0095	0.0050	0.0050	0.0050
D-B (ug/L)	30	33	33	22	30	28	23	24	23	27	26	23
D-Cd (ug/L)	0.011	0.0073	0.0084	0.012	0.021	0.014	0.012	0.0078	0.0084	0.0057	0.011	0.0071
D-Ca (mg/L)	45	47	48	42	13	15	18	20	21	29	40	43
D-Cr (ug/L)	0.11	0.14	0.1	0.21	0.52	0.64	0.5	0.48	0.45	0.28	0.18	0.13
D-Co (ug/L)	0.023	0.02	0.021	0.064	0.25	0.2	0.093	0.097	0.079	0.044	0.026	0.023
D-Cu (ug/L)	0.85	0.69	0.79	0.97	2.0	1.9	1.6	1.6	1.9	1.2	0.92	0.8
D-Fe (ug/L)	5.0	4.4	4.5	50	280	260	120	100	85	34	10	5.9
D-Pb (ug/L)	0.029	0.0066	0.0086	0.016	0.027	0.022	0.013	0.012	0.031	0.011	0.028	0.0058
D-Li (ug/L)	1.5	1.7	1.6	1.8	0.8	0.88	0.99	1.1	0.97	1.3	1.6	1.6
D-Mg (mg/L)	18	19	19	17	4.2	5.1	6.5	7.0	6.8	11	15	17
D-Mn (ug/L)	16	15	27	12	36	15	5.2	7.1	4.6	2.4	4.9	7.9
D-Hg (ug/L)	0.0043	0.0048	0.0047	0.0054	0.011	0.0074	0.0064	0.0061	0.0056	0.0047	0.0039	0.0036
D-Mo (ug/L)	1.8	1.9	1.7	1.9	0.55	0.69	0.98	1.0	1.1	1.6	1.9	1.9
D-Ni (ug/L)	0.36	0.36	0.37	0.47	1.2	1.0	0.78	0.76	0.76	0.51	0.38	0.36
D-K (mg/L)	2.6	2.7	2.7	2.9	1.2	1.2	1.5	1.6	1.6	2.1	2.5	2.5
D-Se (ug/L)	0.1	0.12	0.1	0.13	0.069	0.064	0.069	0.064	0.077	0.089	0.097	0.094
D-Si (ug/L)	5300	5680	5300	5507	2900	4000	4805	5300	5624	5569	5840	5390
D-Ag (ug/L)	0.0050	0.0050	0.0050	0.0050	0.0054	0.0050	0.0050	0.0050	0.0055	0.0050	0.0051	0.0050
D-Na (mg/L)	4.2	4.2	4.3	4.3	1.4	1.7	2.1	2.3	2.2	3.1	4.0	3.9
D-Sr (ug/L)	440	460	470	470	140	170	210	220	230	320	410	440
D-Tl (ug/L)	0.0022	0.002	0.0020	0.0024	0.0035	0.0031	0.0029	0.0025	0.0035	0.002	0.002	0.0020
D-U (ug/L)	71	82	85	73	16	14	18	19	19	37	55	61
D-Zn (ug/L)	0.72	0.62	0.79	0.96	3.2	0.87	0.62	0.66	0.67	0.67	0.71	0.48

Table 3.3-2:
Station HC-1.0 Monthly Mean Values

	HC-1.0 - Mean											
	Jan (n=1)	Feb (n=1)	Mar	Apr (n=8)	May (n=8)	Jun (n=7)	Jul (n=8)	Aug (n=9)	Sep (n=10)	Oct (n=9)	Nov (n=4)	Dec (n=1)
Physical Parameters												
pH (s.u.)	8.0	8.1	-	8.0	7.5	7.7	7.9	7.8	7.9	7.9	7.9	7.5
Cond-L (uS/cm)	337	382	-	350	140	170	200	180	190	220	260	276
TSS (mg/L)	17	3.3	-	1.5	11	12	1.5	40	1.3	1.4	1.8	1.0
TDS (mg/L)	224	256	-	230	112	120	140	122	130	150	176	180
T-Alk (mg/L)	104	117	-	99	42	54	65	60	63	71	82	86
T-Hard (mg/L)	134	175	-	170	66	89	96	87	92	110	120	136
Anions												
Sulphate (mg/L)	64	77	-	79	20	28	32	25	28	34	43	47
Cl (mg/L)	1.1	0.70	-	1.1	1.2	1.4	0.63	0.74	0.79	0.76	1.4	0.50
F (mg/L)	0.070	0.057	-	0.077	0.047	0.064	0.068	0.066	0.067	0.072	0.07	0.070
Nutrients												
T-NH3 (mg/L)	0.045	0.017	-	0.028	0.025	0.023	0.02	0.033	0.022	0.019	0.018	0.10
NO2+NO3 (mg/L)	0.44	0.41	-	0.037	0.066	0.15	0.22	0.31	0.39	0.47	0.49	-
NO2 (mg/L)	0.0020	0.0020	-	0.0050	0.02	0.0025	0.0024	0.0083	0.007	0.0080	0.0035	0.0050
NO3 (mg/L)	0.44	0.41	-	0.032	0.072	0.15	0.22	0.28	0.4	0.47	0.48	0.34
D-P (mg/L)	0.0036	0.011	-	0.0083	0.0092	0.0047	0.0036	0.0041	0.0082	0.0038	0.0034	-
TOC (mg/L)	9.4	9.5	-	12	21	15	11	13	12	10	8.4	9.0
DOC (mg/L)	10	9.7	-	12	20	15	11	12	12	10	8.6	9.2
WAD-CN (mg/L)	0.00050	0.00087	-	0.00071	0.0016	0.0012	0.00088	0.0011	0.0014	0.00071	0.00079	0.00090
Total Metals												
T-Al (ug/L)	36	43	-	42	300	300	66	800	58	39	28	34
T-Sb (ug/L)	0.23	0.22	-	0.18	0.18	0.22	0.26	0.27	0.26	0.25	0.27	0.20
T-As (ug/L)	0.43	0.46	-	0.64	1.1	1.1	0.72	1.6	0.69	0.6	0.51	0.51
T-Ba (ug/L)	63	78	-	61	34	41	42	52	39	45	52	58
T-Be (ug/L)	0.010	0.010	-	0.013	0.041	0.029	0.014	0.043	0.023	0.011	0.011	0.010
T-Bi (ug/L)	0.020	0.0050	-	0.0075	0.012	0.011	0.0069	0.014	0.0095	0.0061	0.0063	0.0050
T-B (ug/L)	50	10	-	25	40	27	16	29	23	29	30	50
T-Cd (ug/L)	0.065	0.028	-	0.01	0.016	0.012	0.0051	0.018	0.0059	0.011	0.0076	0.072
T-Ca (mg/L)	36	46	-	44	17	24	25	23	24	28	33	37
T-Cr (ug/L)	0.50	0.23	-	0.19	0.7	1.9	0.39	2.1	0.35	0.29	0.25	0.30
T-Co (ug/L)	0.050	0.058	-	0.051	0.27	0.25	0.069	0.62	0.063	0.049	0.043	0.047
T-Cu (ug/L)	2.7	1.8	-	1.2	2.2	2.4	1.9	3.1	1.9	1.8	1.6	3.4
T-Fe (ug/L)	42	35	-	42	350	350	62	1000	52	31	21	29
T-Pb (ug/L)	0.1	0.066	-	0.019	0.13	0.14	0.02	0.45	0.017	0.064	0.039	0.42
T-Li (ug/L)	0.50	0.96	-	1.4	0.86	0.91	0.93	1.4	0.87	0.81	0.84	0.80
T-Mg (mg/L)	11	15	-	15	5.6	6.8	8.0	7.1	7.5	8.8	9.6	11
T-Mn (ug/L)	4.5	4.8	-	5.2	30	14	1.8	29	1.3	0.72	0.48	1.3
T-Hg (ug/L)	0.0020	0.0024	-	0.0049	0.008	0.0053	0.004	0.0058	0.0055	0.0053	0.0061	0.010
T-Mo (ug/L)	0.52	0.59	-	0.61	0.44	0.63	0.62	0.55	0.62	0.61	0.58	0.67
T-Ni (ug/L)	0.95	1.1	-	0.67	1.3	1.7	0.82	2.1	0.82	0.89	0.89	1.1
T-K (mg/L)	2.5	3.0	-	3.2	1.5	1.9	2.0	1.9	2.0	2.2	2.2	2.3
T-Se (ug/L)	0.087	0.11	-	0.11	0.06	0.071	0.072	0.073	0.067	0.076	0.068	0.060
T-Si (ug/L)	4590	5210	-	5170	3200	4200	4700	5700	5204	5100	4725	5020
T-Ag (ug/L)	0.0050	0.0050	-	0.0056	0.0078	0.0093	0.0091	0.0096	0.0055	0.0061	0.0063	0.0050
T-Na (mg/L)	3.8	4.8	-	5.2	1.9	3.3	3.0	2.6	2.8	3.2	3.3	4.8
T-Sr (ug/L)	296	390	-	350	160	190	210	190	210	230	250	260
T-Tl (ug/L)	0.0020	0.0030	-	0.0021	0.0049	0.0063	0.0035	0.012	0.0035	0.0026	0.0021	0.0020
T-U (ug/L)	17	30	-	18	12	9.3	9.5	8.0	9.0	10	11	14
T-Zn (ug/L)	8.7	1.8	-	1.5	1.5	1.7	0.71	3.5	0.75	1.4	0.76	20
Dissolve Metals												
D-Al (ug/L)	18	15	-	35	190	130	50	71	50	34	23	23
D-Sb (ug/L)	0.25	0.2	-	0.18	0.19	0.21	0.25	0.24	0.26	0.23	0.21	0.18
D-As (ug/L)	0.46	0.44	-	0.59	0.86	0.81	0.69	0.73	0.68	0.58	0.47	0.48
D-Ba (ug/L)	73	85	-	61	31	38	42	40	39	44	53	58
D-Be (ug/L)	0.010	0.010	-	0.013	0.03	0.022	0.014	0.016	0.023	0.011	0.01	0.010
D-Bi (ug/L)	0.0050	0.0050	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.0095	0.0050	0.0050	0.0050
D-B (ug/L)	10	10	-	20	30	21	16	24	23	29	30	50
D-Cd (ug/L)	0.065	0.019	-	0.0083	0.012	0.0081	0.0050	0.0062	0.0063	0.0062	0.0068	0.010
D-Ca (mg/L)	43	48	-	45	17	22	26	23	24	27	34	36
D-Cr (ug/L)	0.29	0.17	-	0.19	0.45	0.43	0.3	0.39	0.32	0.28	0.2	0.20
D-Co (ug/L)	0.039	0.030	-	0.047	0.16	0.086	0.052	0.066	0.057	0.046	0.038	0.039
D-Cu (ug/L)	2.6	1.6	-	1.1	1.9	1.9	1.8	1.9	1.8	1.7	1.6	1.5
D-Fe (ug/L)	16	11	-	33	180	120	39	70	39	24	13	14
D-Pb (ug/L)	0.025	0.0080	-	0.0077	0.026	0.012	0.0056	0.01	0.014	0.016	0.013	0.011
D-Li (ug/L)	0.64	1.0	-	1.4	0.73	0.86	0.89	0.86	0.81	0.86	0.92	0.70
D-Mg (mg/L)	13	15	-	15	5.6	6.7	8.0	7.1	7.3	8.5	10	9.9
D-Mn (ug/L)	1.1	0.28	-	3.2	20	2.3	0.56	1.3	0.97	0.39	0.14	0.21
D-Hg (ug/L)	0.0020	0.0023	-	0.0042	0.0078	0.0046	0.0044	0.0066	0.0051	0.0035	0.005	-
D-Mo (ug/L)	0.62	0.61	-	0.61	0.52	0.52	0.65	0.55	0.64	0.61	0.58	0.57
D-Ni (ug/L)	1.0	1.0	-	0.66	0.96	0.92	0.76	0.85	0.79	0.77	0.81	0.92
D-K (mg/L)	2.8	3.0	-	3.2	1.5	1.8	2.0	1.8	1.9	2.1	2.3	2.2
D-Se (ug/L)	0.084	0.10	-	0.1	0.056	0.059	0.071	0.067	0.067	0.074	0.064	0.070
D-Si (ug/L)	5130	5300	-	5200	3065	4100	4700	4900	5094	4900	4960	4870
D-Ag (ug/L)	0.0050	0.0050	-	0.0053	0.0051	0.0050	0.0050	0.0050	0.0055	0.0050	0.0050	0.0050
D-Na (mg/L)	4.6	4.7	-	5.0	2.1	2.5	3.0	2.7	2.7	3.1	3.7	3.3
D-Sr (ug/L)	349	383	-	360	160	190	220	190	210	230	270	259
D-Tl (ug/L)	0.0020	0.0020	-	0.0021	0.0032	0.0033	0.0026	0.0028	0.0035	0.0023	0.0023	0.0020
D-U (ug/L)	20	32	-	19	12	9.0	9.4	6.9	8.9	10	12	14
D-Zn (ug/L)	8.8	1.3	-	0.98	1.0	0.35	0.28	0.3	0.52	0.63	0.6	0.80

3.3.1.1 Major Ions

The major ion chemistry of mid-reach and lower-reach Halfway Creek is assessed with respect to hardness, sulphate and pH. Station HC-6.8 is characterized by seasonally soft waters (~50 mg/L [as $CaCO_3$]) during freshet periods (May-June) and moderately hard to hard waters (ranging from 70 mg/L to ~200 mg/L [as $CaCO_3$]) during low flow periods such as winter (Table 3.3-1; Figure 3.3-2).

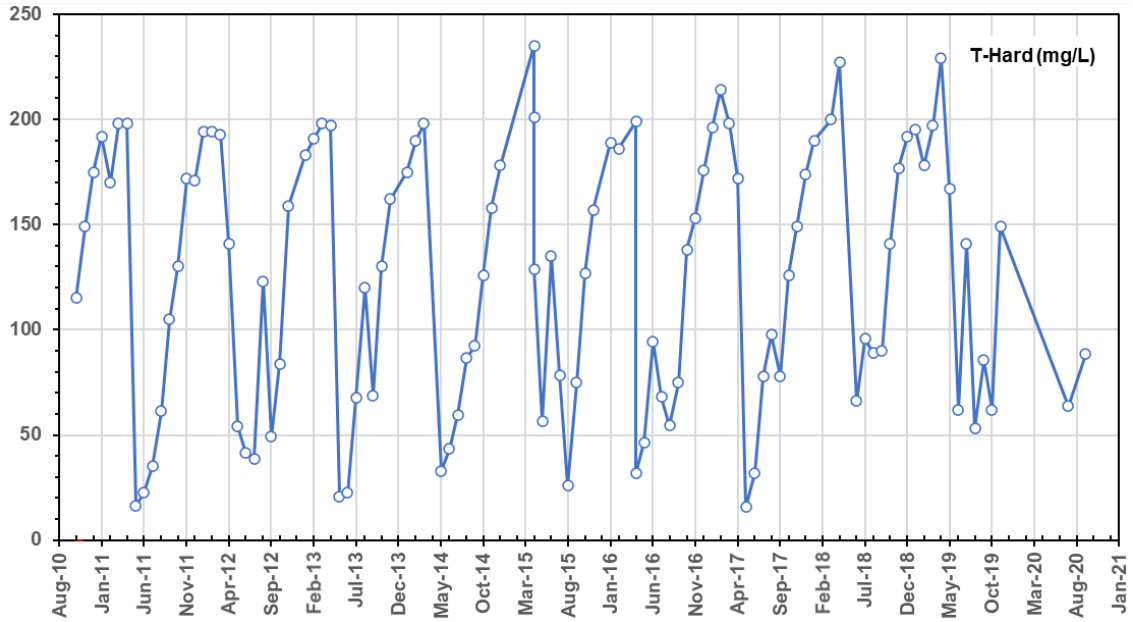

Figure 3.3-2: Total hardness (T-Hard., as mg/L $CaCO_3$) in mid Halfway Creek (HC-6.8) for the period October 2010 to December 2020

In lower Halfway Creek, hardness values range typically between roughly 66 mg/L to 175 mg/L (as $CaCO_3$) (Table 3.3-2.; Figure 3.3-3).

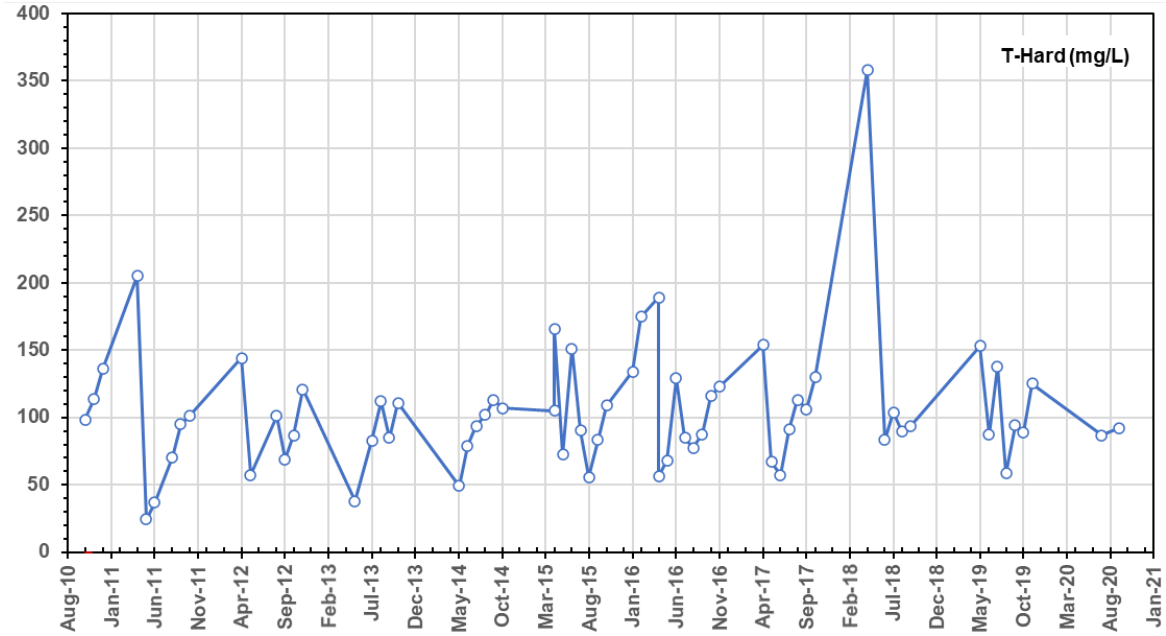

Figure 3.3-3: Total hardness (T-Hard., as mg/L $CaCO_3$)in lower Halfway Creek (HC-1.0) for the period October 2010 to December 2020.

Similar trends for conductivity and alkalinity are also observed at stations HC-6.8 and HC-1.0 with pronounced seasonal fluctuations, with minima coinciding with freshet periods in May and June (Table 3.3-1 and Table 3.3-2). As observed in the other drainages at the project site, these trends in stream salinity reflect varying proportions of low ionic strength snow-melt driven surface runoff and groundwater inputs (higher ionic strength). The stronger seasonal signature observed in mid Halfway Creek at HC-6.8 reflects a more pronounced groundwater influence in the winter low flow periods as compared to HC-1.0.

The pH in mid and lower Halfway Creek remains relatively uniform throughout the year with values generally ranging between 7.0 and 8.0 with the lower pH occurring during peak snow-melt periods. All pH values reported to date have remained within the CCME freshwater guideline range for pH of 6.5 to 9.0.

Baseline concentrations for sulphate in mid and lower Halfway Creek exhibit similar trends and concentrations with lower values occurring in peak freshet periods (12 to 28 mg/L; May to June) and high values during lower flow conditions (22 to 76 mg/L; October to February) (Table 3.3-1 and Table 3.3-2).

Unlike the dissolved ions, higher TSS concentrations in mid and lower Halfway Creek coincide with the peak snowmelt months or during intense summer rainfall events (Table 3.3-1 and Table 3.3-2). At most other flow periods of the year, TSS values in Halfway Creek were generally below 2.0 mg/L.

3.3.1.2 Nutrients

As with other Project catchments, nutrient parameters are found in low concentrations in mid and lower Halfway Creek. Ammonia-N concentrations are low with mean monthly values typically below 0.03 mg/L for HC-6.8 and HC-1.0 (Table 3.3-1 and Table 3.3-2). Baseline mean nitrate-N concentrations in mid Halfway Creek ranged from 0.09 to 0.5 mg/L, with highest monthly means observed during late fall-early winter low flows. Similarly, mean nitrate-N concentrations in lower Halfway Creek ranged from 0.03 to 0.5 mg/L, again with highest monthly means observed during late fall-early winter low flow conditions. Dissolved phosphorus concentrations at both stations were low with values ranging from 0.004 to < 0.01 mg/L, indicative of ultra-oligotrophic and oligotrophic conditions (Table 3.3-1 and Table 3.3-2).

As with other streams monitored for the project, TOC and DOC exhibit a marked seasonal signature with highest values observed during peak runoff periods. For HC-6.8, DOC concentrations range from less than 5.0 mg/L during baseflow periods, dominated by groundwater inputs, to upwards of 12 to 23 mg/L during higher flow periods reflecting carbon contributions associated with terrestrial runoff (Figure 3.3-4). For HC-1.0, DOC values ranged from < 10 mg/L during baseflow periods up to 20 mg/L during higher flow periods (Figure 3.3-5).

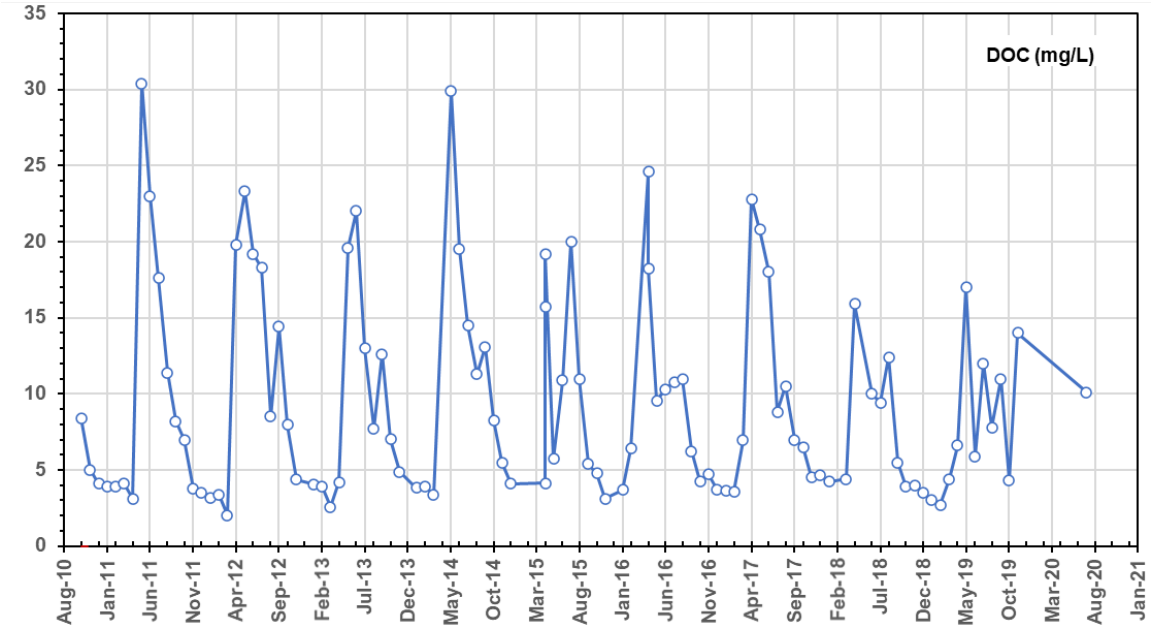

Figure 3.3-4: Dissolved organic carbon (DOC) in mid Halfway Creek (HC-6.8) for the period October 2010 to December 2020.

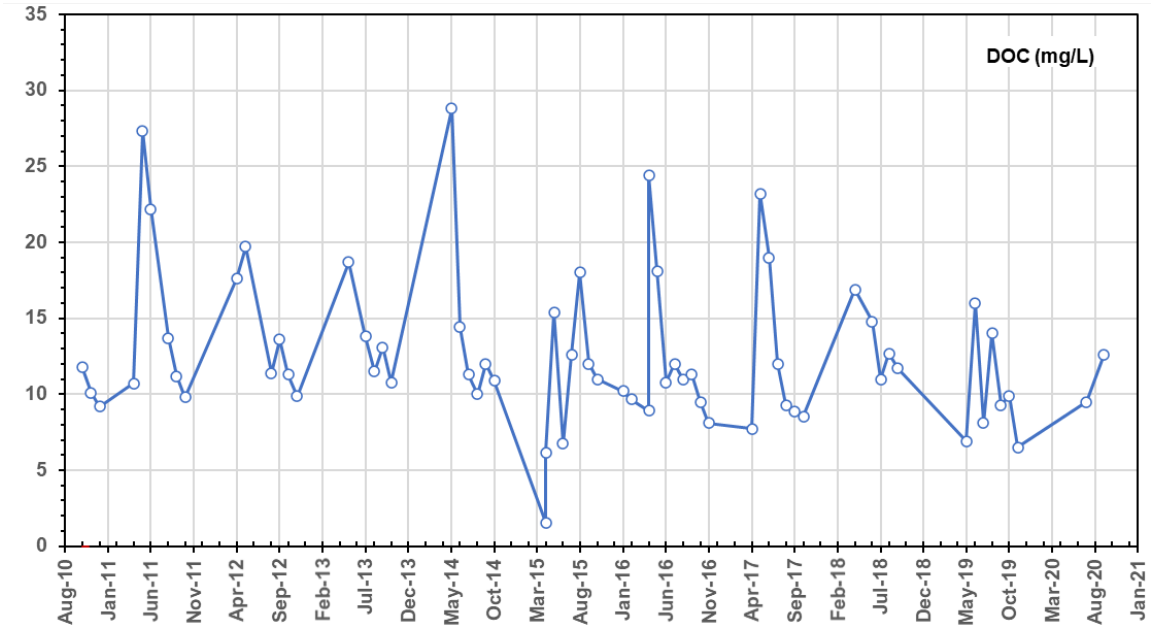

Figure 3.3-5: Dissolved organic carbon (DOC) in lower Halfway Creek (HC-1.0) for the period October 2010 to December 2020

3.3.1.3 Trace Elements

Characterization of baseline trace element concentrations in mid and lower Halfway Creek was developed from data collected from October 2010 to December 2020 at HC-6.8 and HC-1.0. For most parameters, mean monthly concentrations of total and dissolved trace elements are low (*e.g.*, As, Sb, Co, Cr, Pb, Hg, Ni, Se, and Zn). Total As concentrations in mid Halfway Creek at HC-6.8 and HC-1.0 are roughly between 0.6 to 1.5 µg/L with maximum concentrations of total As observed coincident with high flow events and elevated TSS (Figure 3.3-6 and Figure 3.3-7; Appendix A).

Total As concentrations remained well below the CCME guideline of 5.0 µg/L for the protection of aquatic life at both sampling stations. However, precipitation events that produce elevated TSS in these stations also produce elevated total As concentrations (*e.g.*, August 2015 event; TSS = 333 mg/L; total As = 8.4 µg/L at HC-1.0; see Appendix A).

Total Se concentrations in mid and lower Halfway Creek are very low and typically less than 0.15 µg/L (Table 3.3-1 and Table 3.3-2).

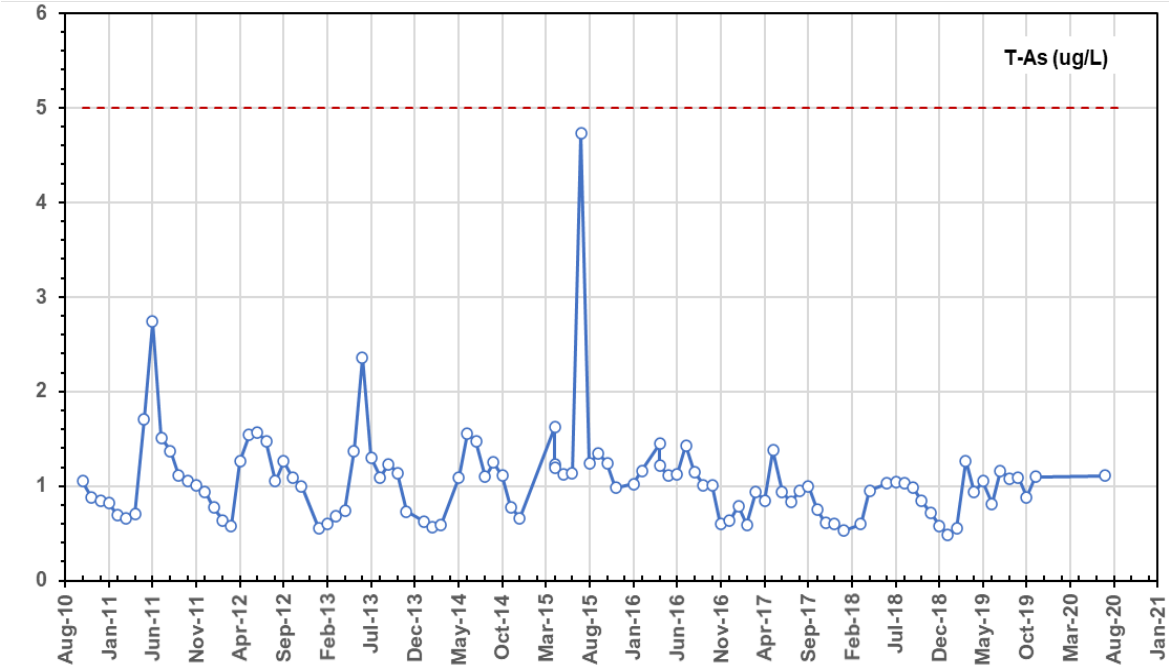

Figure 3.3-6: Total arsenic (T-As) in mid Halfway Creek (HC-6.8) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) water quality guidelines (red dashed line) for protection of aquatic life.

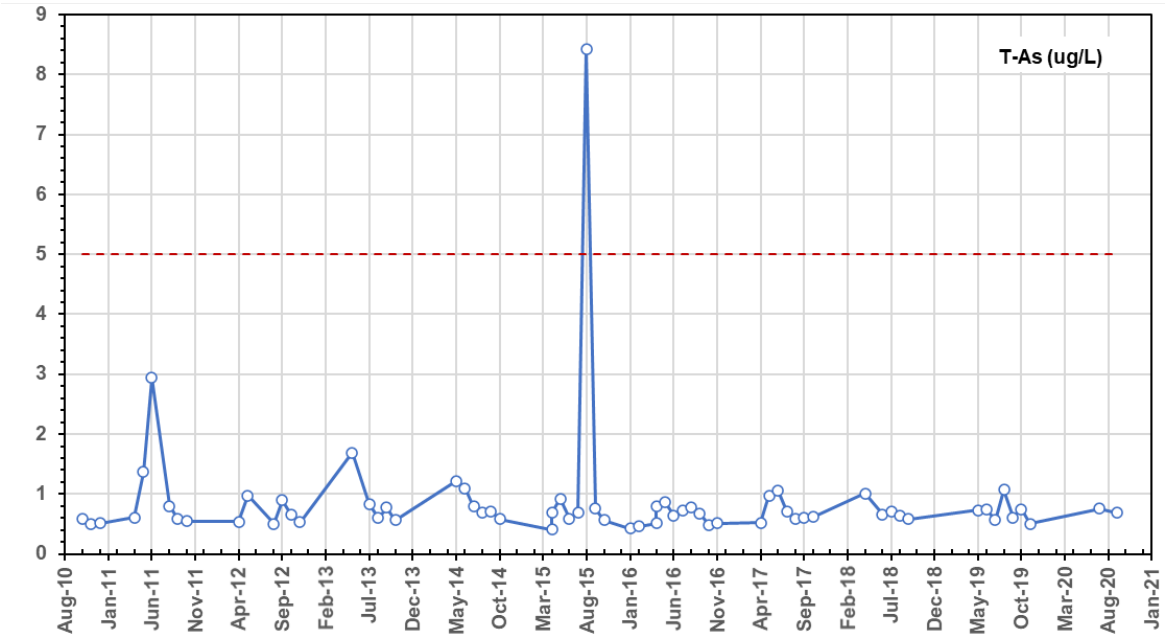

Figure 3.3-7: Total arsenic (T-As) in lower Halfway Creek (HC-1.0) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) water quality guidelines (red dashed line) for protection of aquatic life.

Dissolved Al is consistently observed to be elevated well above BC ENV guideline for the protection of aquatic life of 100 µg/L throughout Halfway Creek, with peak concentrations coinciding with higher flow conditions (Figure 3.3-8 and Figure 3.3-9). The highest dissolved Al values are observed at HC-6.8 with peak concentrations on the order of 300 µg/L (Figure 3.3-8). During baseflow periods, dissolved Al concentrations throughout Halfway Creek are generally below 30 µg/L (Figure 3.3-8 and Figure 3.3-9).

Concentrations of total Cu in mid and lower Halfway Creek show seasonal maxima associated with peak runoff periods that can slightly exceed the CCME hardness-dependent Cu guideline for the protection of aquatic life (Figure 3.3-10and Figure 3.3-11).

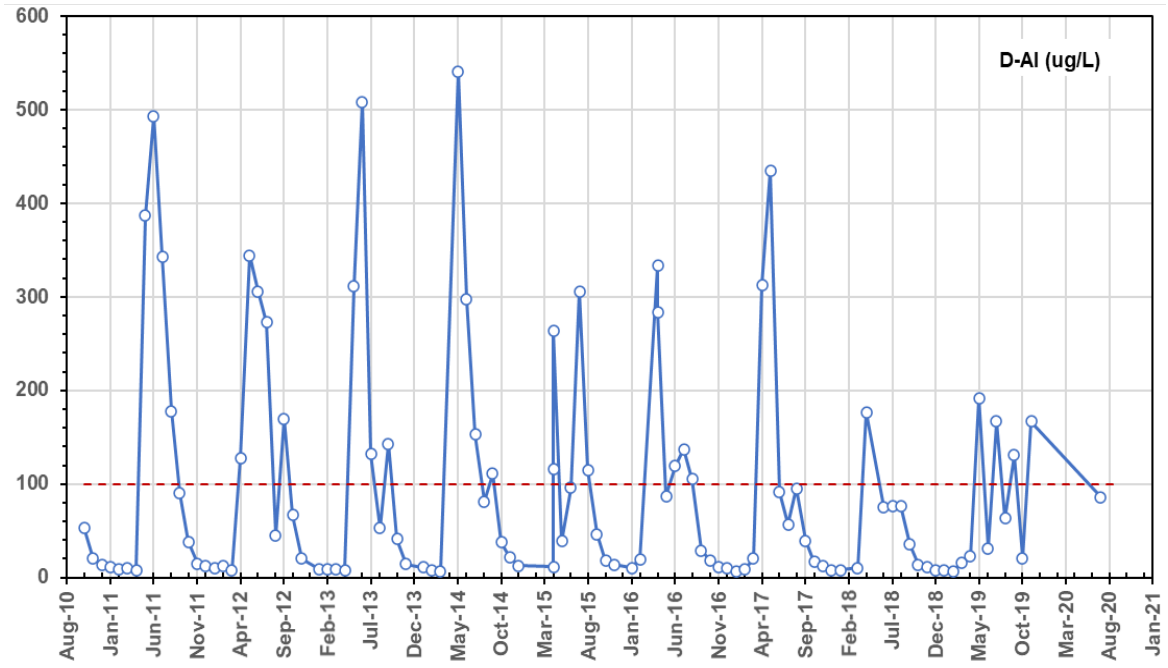

Figure 3.3-8: Dissolved aluminum (D-Al) in mid Halfway Creek (HC-6.8) for the period October 2010 to December 2020 compared to the British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dashed line) for protection of aquatic life.

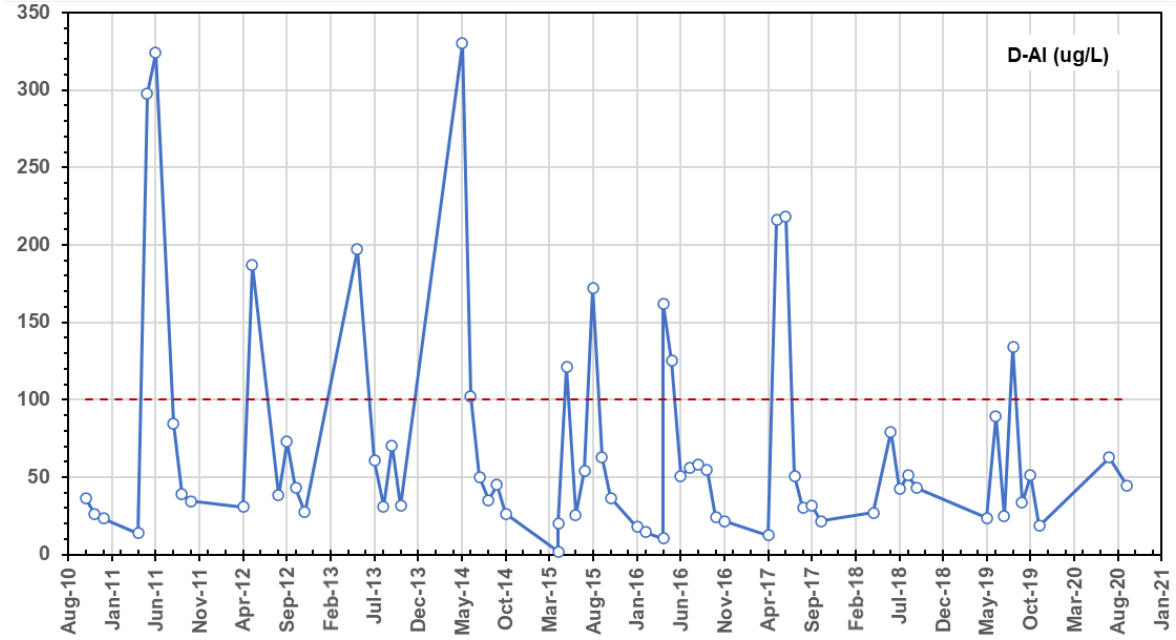

Figure 3.3-9: Dissolved aluminum (D-Al) in lower Halfway Creek (HC-1.0) for the period October 2010 to December 2020 compared to British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dashed line) for protection of aquatic life.

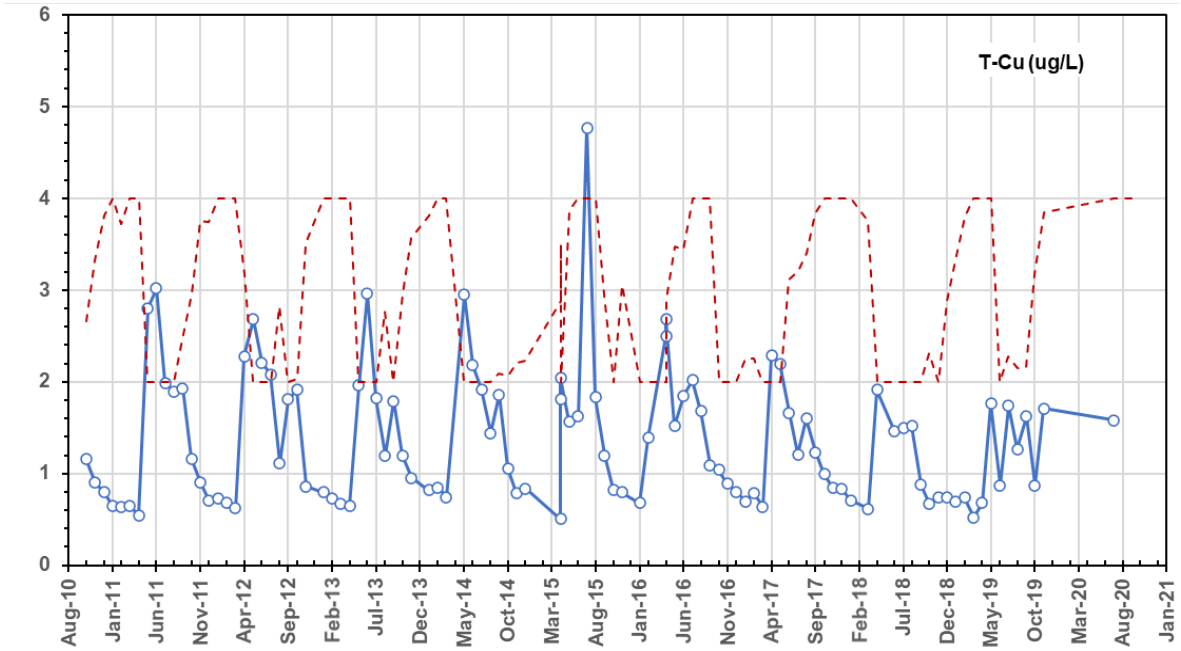

Figure 3.3-10: Total copper (T-Cu) in mid Halfway Creek (HC-6.8) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness dependent water quality guidelines (red dashed line) for the protection of aquatic life.

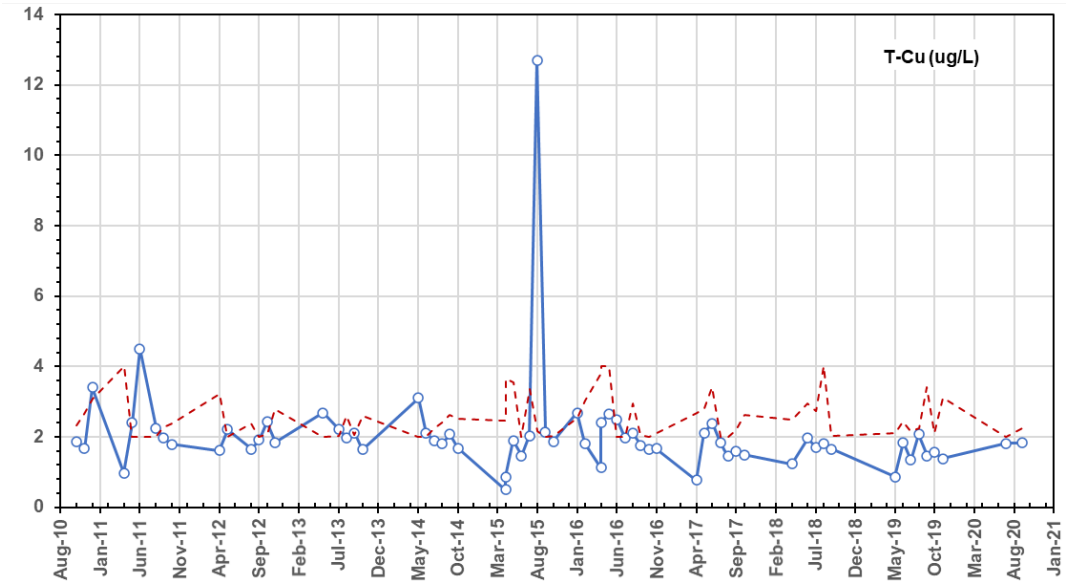

Figure 3.3-11: Total copper (T-Cu) in lower Halfway Creek (HC-1.0) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness-dependent water quality guidelines (red dashed line) for the protection of aquatic life.

In mid and lower Halfway Creek, total Cd concentrations do not exceed the chronic or acute CCME hardness-dependent guidelines for protection of aquatic life (Figure 3.3-12 and Figure 3.3-13).

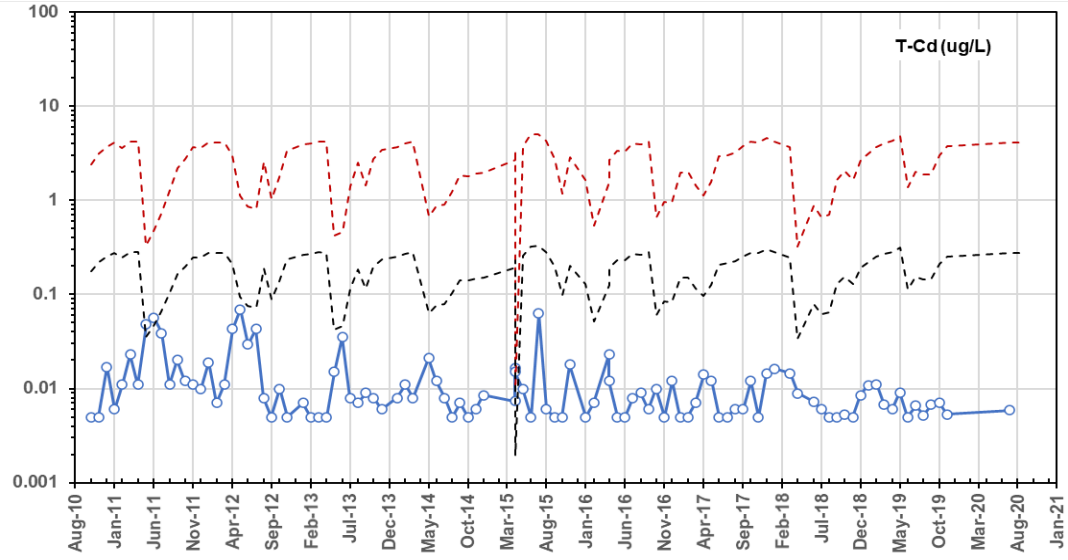

Figure 3.3-12: Total cadmium (T-Cd) concentrations in mid Halfway Creek (HC-6.8) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness-dependent water quality guideline for the protection of aquatic life.

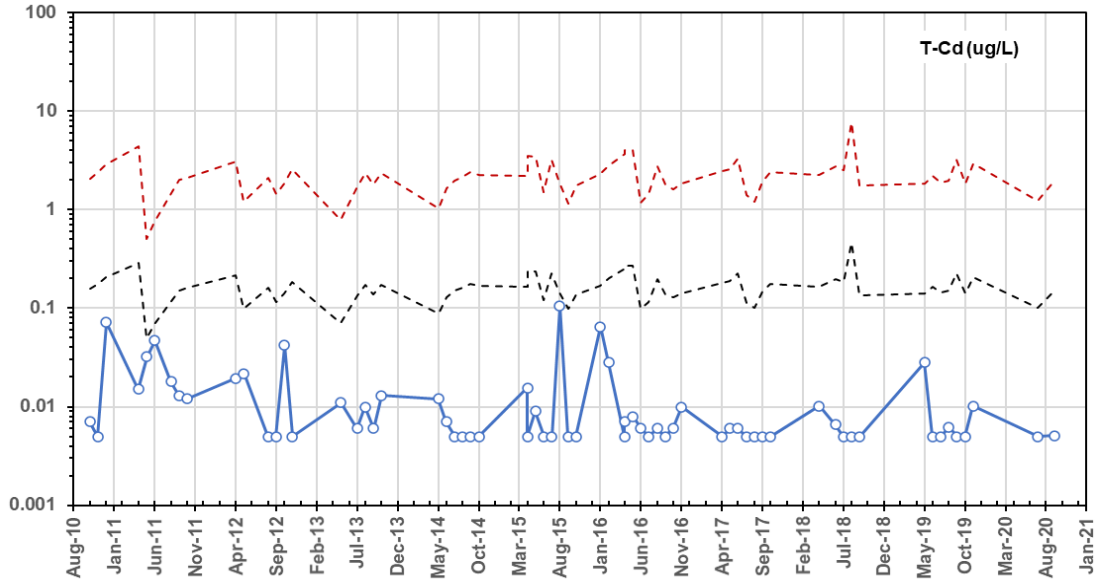

Figure 3.3-13: Total cadmium (T-Cd) concentrations in lower Halfway Creek (HC-1.0) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness-dependent dashed line) water quality guideline for the protection of aquatic life.

Like Latte Creek and upper Coffee Creek, total U concentrations in Halfway Creek exhibit a distinct seasonality at station HC-6.8. Total U concentrations in mid Halfway Creek at station HC-6.8 were above the chronic CCME water quality guideline of 15 µg/L during fall and winter periods with mean monthly concentrations ranging from 37 to 84 µg/L (Table 3.3-1 and Figure 3.3-14). The high magnitude of the winter values can be attributed to the input of U-enriched groundwater which sustains baseflow conditions during the ice-up period. During the freshet and summer periods, the introduction of surface runoff dilutes the groundwater signature, resulting in considerably lower mean monthly U concentrations (roughly 15 to 20 µg/L; Table 3.3-1). The strong inverse relationship ($r^2 = 0.83$) between total U and flow in mid Halfway Creek at station HC-6.8 is illustrated in Figure 3.3-15.

Graphical representation of monthly mean total U data at HC-6.8 illustrates that monthly mean concentrations generally exceed the CCME guideline of 15 µg/L for U (Figure 3.3-16).

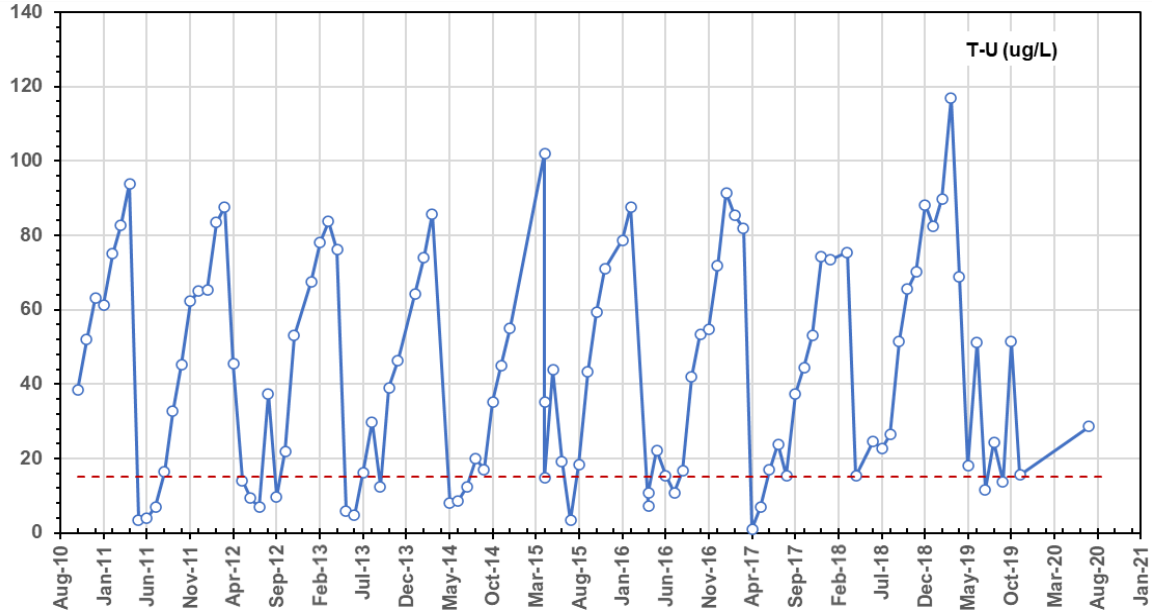

Figure 3.3-14: Total uranium (T-U) in mid Halfway Creek (HC-6.8) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guideline (red dashed line) for the protection of aquatic life.

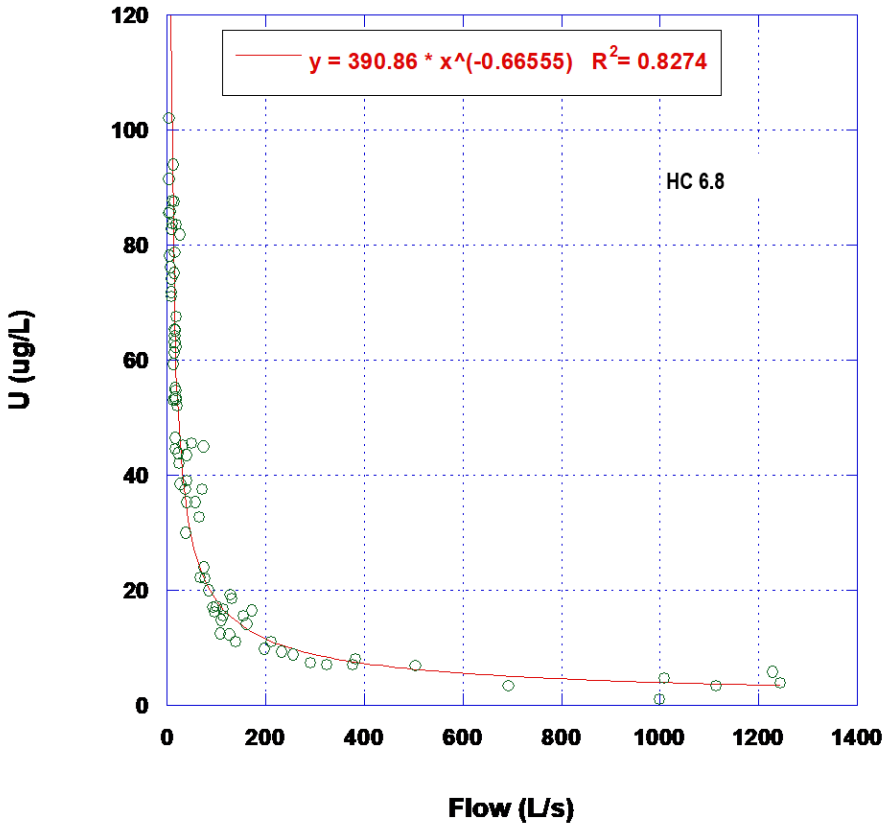

Figure 3.3-15: Relationship between total U and flow in mid Halfway Creek for the period October 2010 to December 2020

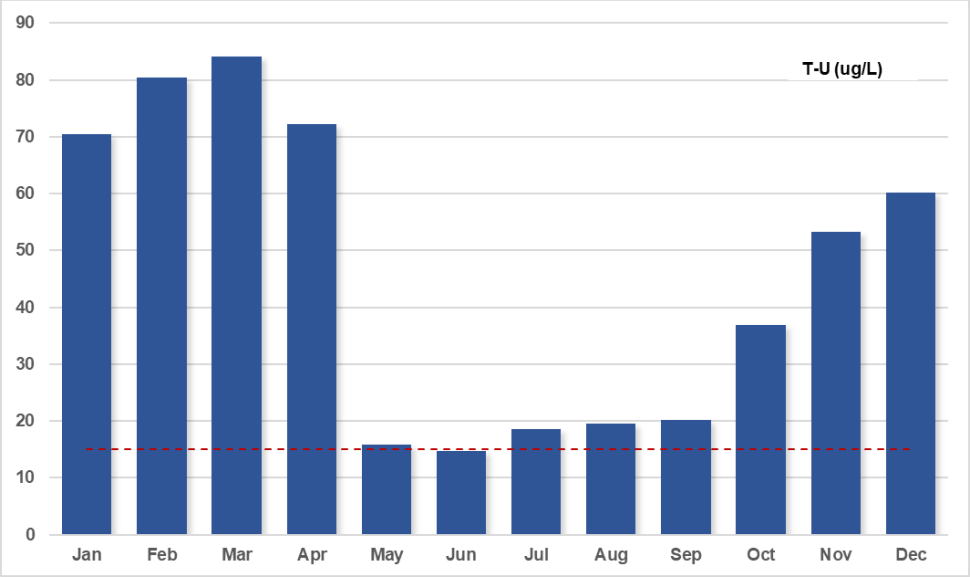

Figure 3.3-16: Mean monthly total uranium (T-U) concentrations at HC-6.8 in mid Halfway Creek for the period October 2010 to December 2020 and compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guidelines (dashed red line) for protection of aquatic life.

In lower Halfway Creek this same seasonal trend for total U is less prominent and may be an artifact of the dataset being biased to the open water period (*i.e.*, minimal baseflow representation due to absence of flow in lower Halfway Creek). However, low flow conditions were observed in Halfway Creek in June 2015, February 2016 and April 2017 that coincided with peak total U concentrations on the order of 30 µg/L at station HC-1.0. In 2018 and 2019, the lowest flows recorded in March and February also coincided with the highest U concentrations. However, it should be noted that flow regimes in HC-1.0 is highly variable. Measured concentrations in most other months are less than the CCME guideline of 15 µg/L for the protection of aquatic life (Figure 3.3-17and Figure 3.3-18).

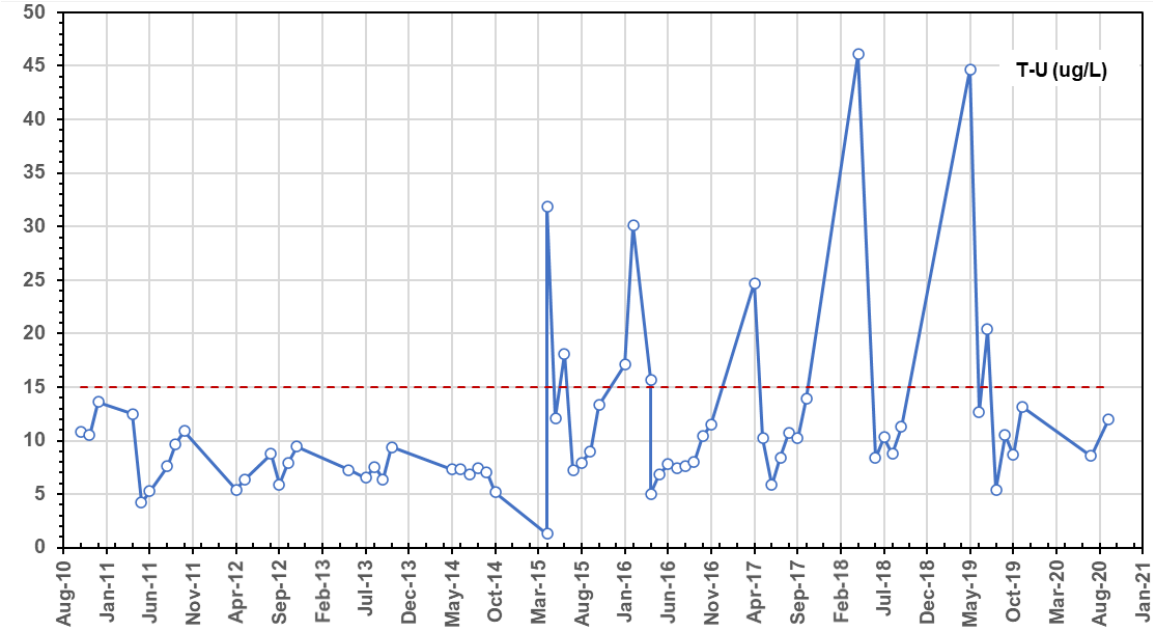

Figure 3.3-17: Total uranium (T-U) in lower Halfway Creek (HC-1.0) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guidelines (red dashed line) for the protection of aquatic life.

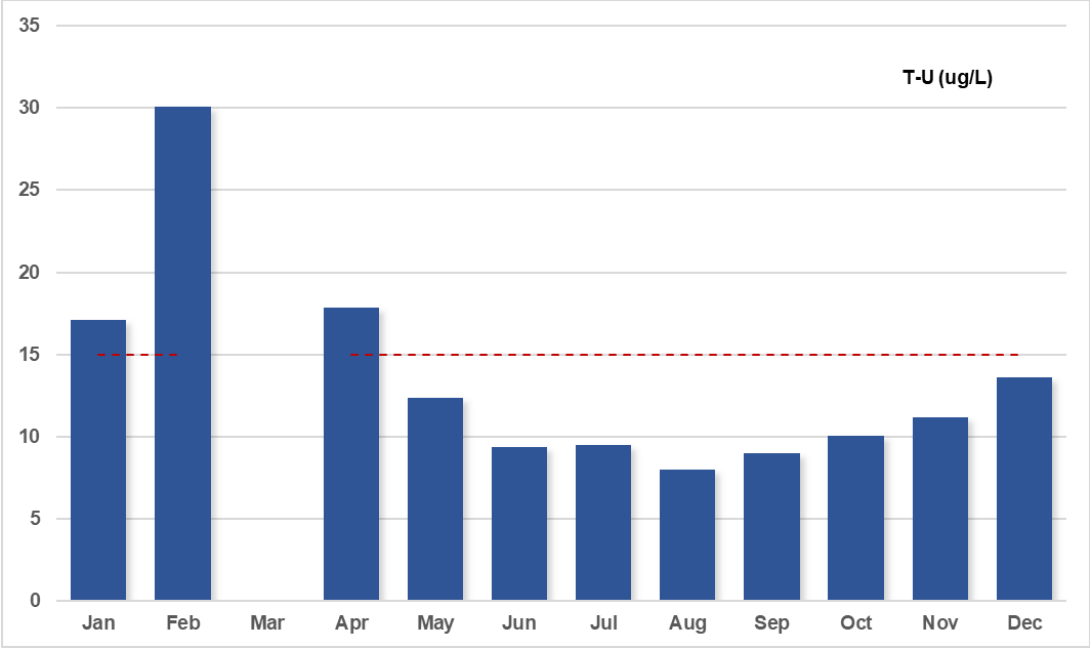

Figure 3.3-18: Mean monthly total uranium (T-U) concentrations at HC-1.0 in lower Halfway Creek for the period October 2010 to December 2020 and compared to the Canadian Council of Ministers of the Environment (CCME) chronic water quality guidelines (dashed red line) for protection of aquatic life.

3.3.1.4 5 in 30 Sampling Results Station HC-6.8

Weekly sampling occurred at HC-6.8 during the period of October 4 to October 28, 2017 to assess short-term variability in water quality and results are presented in Table 3.3-3; full results are presented in Appendix A.

Table 3.3-3:
HC-6.8 Weekly 5 in 30 Sampling Results for Select Parameters

Parameter	Sampling Date				
	10/4/2017	*10/9/2017*	*10/19/2017*	*10/23/2017*	*10/28/2017*
Cond-L (uS/cm)	226	225	258	274	281
D-Hard (mg/L)	112	112	131	132	139
T-Hard (mg/L)	114	110	126	139	140
pH-L (pH)	8.03	7.99	8.03	8.1	7.94
TDS (mg/L)	126	148	168	146	172
TSS (mg/L)	<1.1	<1.0	<1.0	<1.0	<4.0
DOC (mg/L)	8.73	9.34	6.97	3.69	6.21
TOC (mg/L)	7.7	9.06	7.6	4.07	7.36
T-Alk (mg/L)	74.7	74.2	82.9	88.8	95.5
SO_4 (mg/L)	34.1	36.1	39.5	43.2	48.6
NO_2 (mg/L)	<0.0020	<0.0020	<0.0020	0.002	<0.0020
NO_3 (mg/L)	0.694	0.682	0.651	0.611	0.628
NH_3 (mg/L)	<0.0050	<0.0050	0.038	<0.0050	<0.0050
T-Al (ug/L)	59.2	81.5	40.5	34.7	31.8
T-Sb (ug/L)	0.429	0.44	0.552	0.529	0.552
T-As (ug/L)	0.903	1.09	1.000	0.881	0.882
T-Cd (ug/L)	<0.0050	0.0063	0.0060	<0.0050	<0.0050
T-Cu (ug/L)	1.28	1.34	1.23	1.06	1.08
T-Fe (ug/L)	32.5	71.8	23.7	19.3	19.6
T-Pb (ug/L)	0.0067	0.0311	0.076	<0.0050	0.0058
T-Hg (ug/L)	0.003	0.0036	<0.0020	0.0021	0.0023
T-U (ug/L)	27.6	29.3	37.5	41.1	43.3
T-Zn (ug/L)	0.16	0.92	<1.0	1.04	0.18
D-Al (ug/L)	50.2	46.2	39.6	29.9	27.5
D-Sb (ug/L)	0.455	0.488	0.511	0.547	0.554
D-As (ug/L)	0.901	0.963	0.843	0.838	0.894
D-Cd (ug/L)	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
D-Cu (ug/L)	1.22	1.22	1.05	1.09	0.983
D-Fe (ug/L)	25.9	22.9	16.8	16	14.4
D-Pb (ug/L)	0.027	<0.0050	0.0083	<0.0050	<0.0050
D-Hg (ug/L)	0.0033	0.0035	0.0044	0.0029	0.0028
D-U (ug/L)	27.2	28.9	35.8	38.1	43.9
D-Zn (ug/L)	0.3	0.21	0.36	0.46	0.25

Data for those parameters whose concentrations in Halfway Creek are inversely related to flow conditions, including conductivity, hardness, alkalinity, sulphate and uranium show an increasing concentration trend over the sampling period. This is likely the result of decreasing flow in Halfway Creek through the sampling period (Figure 3.3-22). Flow data collected at HC-6.8 indicates decreasing flow from October 4, 2017 (~72 L/s) to October 19, 2017 (~57 L/s); flow after that date required extrapolation owing to freezing conditions occurring at the station and erroneous pressure transducer data.

For example, total U concentrations increased roughly 2-fold throughout the sampling period from a concentration of approximately 27 µg/L on October 4, 2017 to 43 µg/L on October 28, 2017.

By contrast, parameters that are positively correlated to flow, such as dissolved Al, show a roughly 2-fold decrease in concentration over the 5 in 30 sampling period. Parameters that have been shown to have very little correlation to flow, including As and Cu, were present at similar concentrations throughout the sampling period.

3.3.2 YT-24 Stations

A relatively small, ephemeral drainage named YT-24, drains the northern slopes of the Coffee Project area and enters the Yukon River. Monitoring of this drainage occurs at two stations YT24-4.9 (mid-creek) and near the mouth at station at YT24-0.1 (Figure 3.3-1).

3.3.2.1 Summary Statistics

Table 3.3-4 summarizes the mean monthly values for a suite of the key parameters for stations YT24-0.1 and YT24-4.9; baseline monitoring at this station commenced in June 2014. Data is not available for the period of November to March owing to an absence of flow.

3.3.2.2 Major Ions

The major ion chemistry for these two stations in YT-24 is assessed with respect to conductivity, hardness, alkalinity, sulphate and pH. Hardness in YT-24 stations was different with values ranging from 77 to 310 mg/L ($CaCO_3$, moderately hard to very hard water) and from 18 to 32 mg/L ($CaCO_3$, soft water) for YT24-4.6 and YT24-0.1, respectively. Table 3.3-4 and Table 3.3-5; Appendix B). The pH in YT-24 is consistently circumneutral with pH values ranging from 6.3 to 7.8. Generally observed pH values have remained within the CCME freshwater guideline range for pH of 6.5 to 9.0, however some exceedances were recorded for YT24-4.9 specifically in May. These exceedances are mainly related to the input of slightly acidic snowmelt water to the creek.

Table 3.3-4:
Station YT24-4.9 Monthly Mean Values

	YT24-4.9 - Mean											
	Jan	Feb	Mar	Apr	May (n=2)	Jun (n=2)	Jul (n=1)	Aug (n=1)	Sep (n=2)	Oct (n=2)	Nov	Dec
Physical Parameters												
pH (s.u.)	-	-	-	-	6.3	7.1	7.3	6.8	7.3	7.1	-	-
Cond-L (uS/cm)	-	-	-	-	34	46	69	45	70	67	-	-
TSS (mg/L)	-	-	-	-	8.1	1.6	1.0	12	6.6	16	-	-
TDS (mg/L)	-	-	-	-	76	60	62	42	69	42	-	-
T-Alk (mg/L)	-	-	-	-	6.0	13	22	13	27	17	-	-
T-Hard (mg/L)	-	-	-	-	18	24	30	21	32	30	-	-
Anions												
Sulphate (mg/L)	-	-	-	-	2.8	0.50	0.95	0.50	2.1	2.7	-	-
Cl (mg/L)	-	-	-	-	1.6	0.88	0.50	1.1	0.50	0.90	-	-
F (mg/L)	-	-	-	-	0.033	0.039	0.041	0.033	0.041	0.040	-	-
Nutrients												
T-NH3 (mg/L)	-	-	-	-	0.043	0.043	0.061	0.080	0.036	0.025	-	-
NO2+NO3 (mg/L)	-	-	-	-	0.51	0.71	1.3	0.69	1.2	1.6	-	-
NO2 (mg/L)	-	-	-	-	0.0020	0.0023	0.0020	0.0020	0.0020	0.0020	-	-
NO3 (mg/L)	-	-	-	-	0.51	0.71	1.3	0.69	1.2	1.6	-	-
D-P (mg/L)	-	-	-	-	0.023	0.0086	0.0072	0.0099	0.0063	0.0066	-	-
TOC (mg/L)	-	-	-	-	28	19	11	15	10	9.8	-	-
DOC (mg/L)	-	-	-	-	27	18	11	14	10	10	-	-
WAD-CN (mg/L)	-	-	-	-	0.001	0.0015	0.00050	0.00078	-	0.00083	-	-
Total Metals												
T-Al (ug/L)	-	-	-	-	520	280	105	431	150	190	-	-
T-Sb (ug/L)	-	-	-	-	0.31	0.42	0.44	0.37	0.52	0.47	-	-
T-As (ug/L)	-	-	-	-	1.2	0.98	0.79	1.2	0.99	1.5	-	-
T-Ba (ug/L)	-	-	-	-	26	24	25	24	25	26	-	-
T-Be (ug/L)	-	-	-	-	0.046	0.037	0.025	0.033	0.026	0.030	-	-
T-Bi (ug/L)	-	-	-	-	0.010	0.010	0.010	0.010	0.010	0.010	-	-
T-B (ug/L)	-	-	-	-	10	10	10	10	10	10	-	-
T-Cd (ug/L)	-	-	-	-	0.023	0.01	0.0069	0.013	0.0086	0.011	-	-
T-Ca (mg/L)	-	-	-	-	5.4	7.2	9.3	6.4	9.7	9.2	-	-
T-Cr (ug/L)	-	-	-	-	0.89	0.76	0.40	1.0	0.50	0.63	-	-
T-Co (ug/L)	-	-	-	-	0.38	0.13	0.065	0.29	0.11	0.12	-	-
T-Cu (ug/L)	-	-	-	-	2.8	2.6	1.9	2.1	1.7	1.9	-	-
T-Fe (ug/L)	-	-	-	-	508	200	52	498	140	201	-	-
T-Pb (ug/L)	-	-	-	-	0.17	0.042	0.020	0.16	0.078	0.18	-	-
T-Li (ug/L)	-	-	-	-	0.50	0.50	0.50	0.50	0.50	0.50	-	-
T-Mg (mg/L)	-	-	-	-	1.0	1.3	1.7	1.3	1.8	1.8	-	-
T-Mn (ug/L)	-	-	-	-	39	3.8	0.97	18	5.4	7.2	-	-
T-Hg (ug/L)	-	-	-	-	0.013	0.014	0.0080	0.0033	0.0054	0.0043	-	-
T-Mo (ug/L)	-	-	-	-	0.099	0.13	0.14	0.16	0.19	0.17	-	-
T-Ni (ug/L)	-	-	-	-	1.3	1.1	0.84	1.1	0.81	0.85	-	-
T-K (mg/L)	-	-	-	-	0.91	0.61	0.60	0.54	0.63	0.6	-	-
T-Se (ug/L)	-	-	-	-	0.049	0.062	0.062	0.065	0.054	0.056	-	-
T-Si (ug/L)	-	-	-	-	2185	3520	4090	4630	4690	4990	-	-
T-Ag (ug/L)	-	-	-	-	0.010	0.010	0.010	0.010	0.010	0.010	-	-
T-Na (mg/L)	-	-	-	-	0.8	0.97	1.2	1.0	1.2	1.2	-	-
T-Sr (ug/L)	-	-	-	-	17	23	29	22	32	32	-	-
T-Tl (ug/L)	-	-	-	-	0.0067	0.0044	0.0038	0.0062	0.0044	0.0039	-	-
T-U (ug/L)	-	-	-	-	0.36	0.41	0.36	0.36	0.31	0.39	-	-
T-Zn (ug/L)	-	-	-	-	1.8	1.0	1.0	1.3	1.0	1.0	-	-
Dissolve Metals												
D-Al (ug/L)	-	-	-	-	422	258	103	218	79	97	-	-
D-Sb (ug/L)	-	-	-	-	0.3	0.44	0.44	0.34	0.49	0.45	-	-
D-As (ug/L)	-	-	-	-	0.99	0.92	0.78	0.9	0.86	1.0	-	-
D-Ba (ug/L)	-	-	-	-	23	23	26	19	24	24	-	-
D-Be (ug/L)	-	-	-	-	0.046	0.044	0.023	0.031	0.024	0.018	-	-
D-Bi (ug/L)	-	-	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	-	-
D-B (ug/L)	-	-	-	-	10	10	10	10	10	10	-	-
D-Cd (ug/L)	-	-	-	-	0.017	0.0095	0.0084	0.0091	0.0051	0.0065	-	-
D-Ca (mg/L)	-	-	-	-	5.6	7.3	9.5	7.5	9.5	9.1	-	-
D-Cr (ug/L)	-	-	-	-	0.74	0.68	0.43	0.76	0.42	0.50	-	-
D-Co (ug/L)	-	-	-	-	0.3	0.11	0.064	0.18	0.06	0.082	-	-
D-Cu (ug/L)	-	-	-	-	2.5	2.4	1.8	1.8	1.6	1.7	-	-
D-Fe (ug/L)	-	-	-	-	324	169	46	282	46	83	-	-
D-Pb (ug/L)	-	-	-	-	0.043	0.019	0.013	0.018	0.0064	0.0071	-	-
D-Li (ug/L)	-	-	-	-	0.50	0.50	0.50	0.50	0.50	0.50	-	-
D-Mg (mg/L)	-	-	-	-	1.0	1.3	1.7	1.2	1.8	1.7	-	-
D-Mn (ug/L)	-	-	-	-	33	3.1	0.68	14	2.8	3.6	-	-
D-Hg (ug/L)	-	-	-	-	0.014	0.0065	0.0077	0.0066	0.0057	0.0050	-	-
D-Mo (ug/L)	-	-	-	-	0.082	0.13	0.14	0.15	0.17	0.17	-	-
D-Ni (ug/L)	-	-	-	-	1.1	1.1	0.9	0.76	0.67	0.74	-	-
D-K (mg/L)	-	-	-	-	0.94	0.59	0.64	0.51	0.62	0.58	-	-
D-Se (ug/L)	-	-	-	-	0.047	0.063	0.074	0.071	0.054	0.053	-	-
D-Si (ug/L)	-	-	-	-	2225	3655	4160	4390	4370	4505	-	-
D-Ag (ug/L)	-	-	-	-	0.0060	0.0052	0.0050	0.0050	0.0050	0.0050	-	-
D-Na (mg/L)	-	-	-	-	0.78	0.95	1.2	1.0	1.2	1.2	-	-
D-Sr (ug/L)	-	-	-	-	18	24	32	21	31	31	-	-
D-Tl (ug/L)	-	-	-	-	0.0038	0.0032	0.0020	0.0031	0.0026	0.0041	-	-
D-U (ug/L)	-	-	-	-	0.32	0.4	0.37	0.31	0.27	0.29	-	-
D-Zn (ug/L)	-	-	-	-	1.1	0.54	0.43	0.40	0.29	0.52	-	-

Table 3.3-5:
Station YT24-0.1 Monthly Mean Values

	YT24-0.1 - Mean											
	Jan	Feb	Mar	Apr (n=3)	May (n=4)	Jun (n=6)	Jul (n=7)	Aug (n=6)	Sep (n=7)	Oct (n=5)	Nov	Dec
Physical Parameters												
pH (s.u.)	-	-	-	7.7	7.7	7.7	7.8	7.6	7.8	7.7	-	-
Cond-L (uS/cm)	-	-	-	580	230	180	200	170	190	210	-	-
TSS (mg/L)	-	-	-	2.8	3.7	13	3.6	14	1.1	4.4	-	-
TDS (mg/L)	-	-	-	454	180	140	140	120	130	130	-	-
T-Alk (mg/L)	-	-	-	150	50	46	50	44	50	52	-	-
T-Hard (mg/L)	-	-	-	310	110	86	91	77	90	95	-	-
Anions												
Sulphate (mg/L)	-	-	-	190	63	40	43	32	37	42	-	-
Cl (mg/L)	-	-	-	1.6	1.1	0.95	0.75	1.1	0.88	1.2	-	-
F (mg/L)	-	-	-	0.071	0.053	0.07	0.074	0.064	0.072	0.074	-	-
Nutrients												
T-NH3 (mg/L)	-	-	-	0.036	0.026	0.024	0.015	0.02	0.014	0.020	-	-
NO2+NO3 (mg/L)	-	-	-	0.058	0.26	0.43	0.61	0.62	0.73	0.84	-	-
NO2 (mg/L)	-	-	-	0.014	0.019	0.0050	0.0022	0.0020	0.0019	0.0020	-	-
NO3 (mg/L)	-	-	-	0.058	0.25	0.43	0.61	0.62	0.74	0.84	-	-
D-P (mg/L)	-	-	-	0.013	0.014	0.0051	0.0050	0.0051	0.011	0.0043	-	-
TOC (mg/L)	-	-	-	18	21	15	11	14	12	11	-	-
DOC (mg/L)	-	-	-	17	19	14	12	13	12	10	-	-
WAD-CN (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Total Metals												
T-Al (ug/L)	-	-	-	160	196	160	120	250	62	76	-	-
T-Sb (ug/L)	-	-	-	0.091	0.16	0.18	0.2	0.24	0.2	0.19	-	-
T-As (ug/L)	-	-	-	0.6	0.68	0.63	0.55	0.72	0.47	0.46	-	-
T-Ba (ug/L)	-	-	-	80	49	50	50	48	48	55	-	-
T-Be (ug/L)	-	-	-	0.026	0.032	0.024	0.02	0.026	0.03	0.016	-	-
T-Bi (ug/L)	-	-	-	0.012	0.0075	0.0075	0.010	0.0092	0.012	0.0060	-	-
T-B (ug/L)	-	-	-	23	10	17	17	18	11	12	-	-
T-Cd (ug/L)	-	-	-	0.021	0.017	0.0098	0.0074	0.012	0.0054	0.0086	-	-
T-Ca (mg/L)	-	-	-	66	27	24	26	22	25	27	-	-
T-Cr (ug/L)	-	-	-	0.31	0.51	0.5	0.46	0.72	0.35	0.33	-	-
T-Co (ug/L)	-	-	-	0.26	0.29	0.13	0.11	0.22	0.076	0.089	-	-
T-Cu (ug/L)	-	-	-	1.8	2.4	2.1	2.2	2.4	2.0	1.8	-	-
T-Fe (ug/L)	-	-	-	140	190	150	130	320	47	79	-	-
T-Pb (ug/L)	-	-	-	0.044	0.05	0.05	0.062	0.16	0.019	0.047	-	-
T-Li (ug/L)	-	-	-	2.8	0.82	0.55	0.54	0.56	0.58	0.51	-	-
T-Mg (mg/L)	-	-	-	36	10	6.4	6.7	5.7	6.5	6.7	-	-
T-Mn (ug/L)	-	-	-	110	77	5.4	6.0	11	2.8	2.8	-	-
T-Hg (ug/L)	-	-	-	0.0066	0.0071	0.0056	0.0039	0.0037	0.0037	0.0032	-	-
T-Mo (ug/L)	-	-	-	0.91	0.36	0.39	0.46	0.43	0.49	0.45	-	-
T-Ni (ug/L)	-	-	-	0.89	1.1	0.88	0.81	1.0	0.78	0.75	-	-
T-K (mg/L)	-	-	-	2.8	1.7	1.6	1.6	1.4	1.7	1.7	-	-
T-Se (ug/L)	-	-	-	0.097	0.075	0.067	0.071	0.070	0.084	0.085	-	-
T-Si (ug/L)	-	-	-	3900	3325	3800	4100	4400	4610	4384	-	-
T-Ag (ug/L)	-	-	-	0.0067	0.0075	0.008	0.0084	0.0090	0.0064	0.0060	-	-
T-Na (mg/L)	-	-	-	7.1	2.6	2.6	2.8	2.4	2.7	2.9	-	-
T-Sr (ug/L)	-	-	-	540	180	150	150	130	150	170	-	-
T-Tl (ug/L)	-	-	-	0.0027	0.006	0.0043	0.0032	0.0046	0.0038	0.0027	-	-
T-U (ug/L)	-	-	-	94	16	2.3	2.0	1.8	1.9	1.2	-	-
T-Zn (ug/L)	-	-	-	-	-	-	-	-	-	-	-	-
Dissolve Metals												
D-Al (ug/L)	-	-	-	180	160	110	64	93	51	42	-	-
D-Sb (ug/L)	-	-	-	0.1	0.16	0.18	0.2	0.21	0.2	0.18	-	-
D-As (ug/L)	-	-	-	0.59	0.61	0.56	0.51	0.56	0.44	0.39	-	-
D-Ba (ug/L)	-	-	-	88	46	48	50	44	48	53	-	-
D-Be (ug/L)	-	-	-	0.028	0.03	0.021	0.015	0.019	0.029	0.013	-	-
D-Bi (ug/L)	-	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.011	0.0054	-	-
D-B (ug/L)	-	-	-	10	10	17	11	12	11	12	-	-
D-Cd (ug/L)	-	-	-	0.02	0.012	0.0076	0.0055	0.007	0.0056	0.0083	-	-
D-Ca (mg/L)	-	-	-	72	27	24	26	22	25	27	-	-
D-Cr (ug/L)	-	-	-	0.36	0.47	0.4	0.34	0.43	0.31	0.29	-	-
D-Co (ug/L)	-	-	-	0.27	0.27	0.092	0.076	0.097	0.068	0.062	-	-
D-Cu (ug/L)	-	-	-	1.9	2.6	2.0	1.9	2.0	1.9	1.8	-	-
D-Fe (ug/L)	-	-	-	142	140	88	46	81	31	23	-	-
D-Pb (ug/L)	-	-	-	0.032	0.037	0.0087	0.0081	0.012	0.011	0.0092	-	-
D-Li (ug/L)	-	-	-	3.1	0.75	0.5	0.55	0.52	0.58	0.50	-	-
D-Mg (mg/L)	-	-	-	37	9.9	6.4	6.7	5.7	6.2	6.6	-	-
D-Mn (ug/L)	-	-	-	120	74	2.6	3.7	4.1	2.3	0.79	-	-
D-Hg (ug/L)	-	-	-	0.0068	0.0074	0.0058	0.0048	0.0047	0.0038	0.0034	-	-
D-Mo (ug/L)	-	-	-	1.0	0.4	0.37	0.5	0.43	0.49	0.48	-	-
D-Ni (ug/L)	-	-	-	0.99	1.1	0.82	0.73	0.82	0.73	0.71	-	-
D-K (mg/L)	-	-	-	3.0	1.6	1.6	1.7	1.4	1.6	1.7	-	-
D-Se (ug/L)	-	-	-	0.087	0.069	0.069	0.073	0.068	0.078	0.079	-	-
D-Si (ug/L)	-	-	-	4200	3200	3800	4100	4300	4300	4346	-	-
D-Ag (ug/L)	-	-	-	0.0050	0.0057	0.0050	0.0050	0.0050	0.0057	0.0050	-	-
D-Na (mg/L)	-	-	-	7.5	2.7	2.6	2.9	2.4	2.5	2.9	-	-
D-Sr (ug/L)	-	-	-	570	170	150	160	130	150	170	-	-
D-Tl (ug/L)	-	-	-	0.0027	0.0036	0.0033	0.0027	0.0027	0.0035	0.0026	-	-
D-U (ug/L)	-	-	-	100	16	2.2	1.9	1.7	1.9	1.2	-	-
D-Zn (ug/L)	-	-	-	1.5	0.97	0.39	0.34	0.46	0.39	0.31	-	-

Baseline concentrations for sulphate in YT24-4.9 are low and remained < 3 mg/L (Table 3.3-4). Contrarily, YT24-0.1 showed sulphate concentrations ranging from 32 to 190 mg/L (Table 3.3-5). Measured TSS concentrations in both stations are generally low, however peak flow events are associated with elevated TSS above 10 mg/L occurred in some months (Table 3.3-4 and Table 3.3-5).

3.3.2.3 Nutrients

Nutrient concentrations quantified in YT-24 include those for nitrate, nitrite, ammonia, and dissolved phosphorus. Like all the other project drainages, nutrients are present at low concentrations in YT-24. Ammonia-N concentrations are low with mean monthly values typically between 0.025 and 0.06 mg/L (Table 3.3-4 and Table 3.3-5). Mean monthly nitrate-N values ranged from 0.25 mg/L to approximately 1.6 mg/L with higher values observed for YT24-0.1 compared to YT24-4.9 Table 3.3-4 and Table 3.3-5).

Baseline concentrations for dissolved phosphorus in YT-24 are low, ranging from approximately 0.004 to a maximum of 0.02 mg/L (Table 3.3-4 and Table 3.3-5) and indicative of indicative of oligotrophic to mesotrophic conditions. (Appendix C)

TOC and DOC values were relatively consistent throughout the open water period. Mean monthly TOC and DOC levels in YT-24 are relatively high, ranging between approximately 9.8 to 28 mg/L, with highest values observed during peak flow periods (Table 3.3-4 and Table 3.3-5).

3.3.2.4 Trace Elements

Baseline trace element concentrations were derived from data collected from June 2014 to December 2020 at YT24-0.1. In general, mean monthly concentrations of total and dissolved trace elements are low (*e.g.*, As, Sb, Co, Cr, Pb, Hg, Ni, Se, U and Zn). For example, total As concentrations at YT24-0.1 and YT24-4.9 are typically well below 2.0 µg/L (Table 3.3-4 and Table 3.3-5). Unlike nearby Halfway Creek, total U concentrations in YT24-0.1 and YT24-4.9 are generally much lower and are below 3.0 µg/L for most of the open water period. However, mean U concentrations in YT24-0.1 during freshet (April and May), exceed the CCME chronic water quality guideline of 15 µg U/L.

Dissolved Al in YT24-0.1 is episodically observed to be elevated above BC ENV guideline for the protection of aquatic life of 100 µg/L and appears to coincide with peak flow periods and elevated TSS (Figure 3.3-19; see Appendix A). For YT24-4.9 dissolved Al mean concentrations ranged from 79 to 422 µg/L with values generally exceeding the BC ENV WQG of 100 µg/L in early Spring and Summer periods.

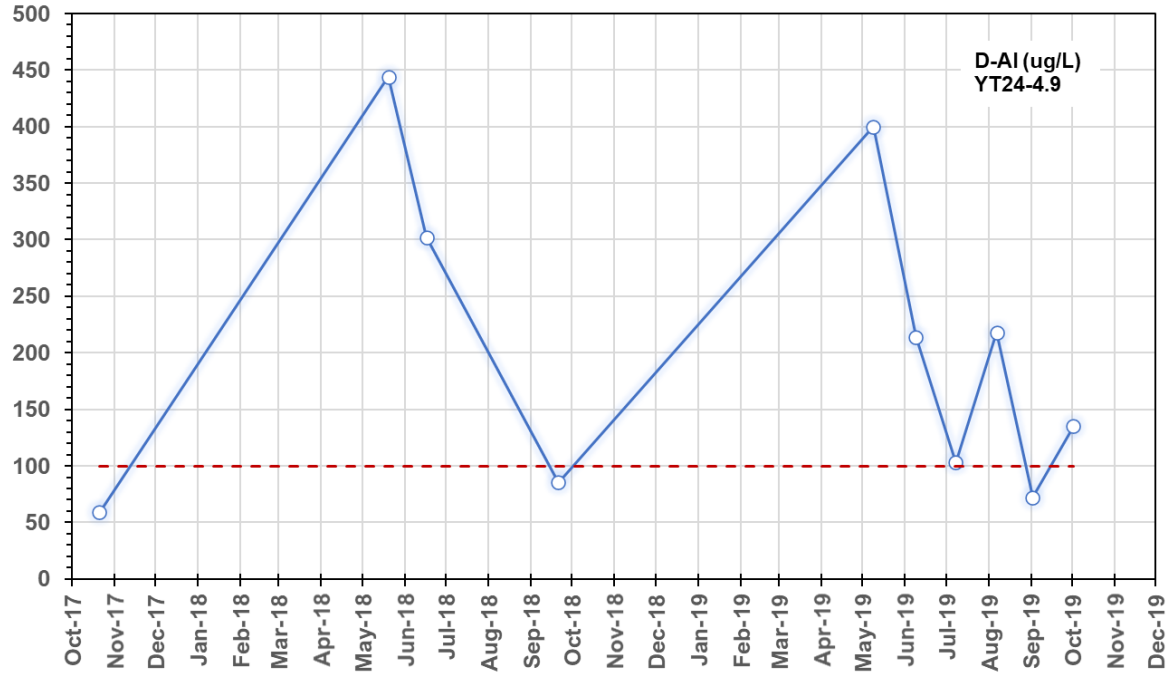

Figure 3.3-19: Dissolved aluminum (D-Al) concentrations at YT24-4.9 for the period October 2017 to October 2019 compared to British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dashed line) for protection of aquatic life.

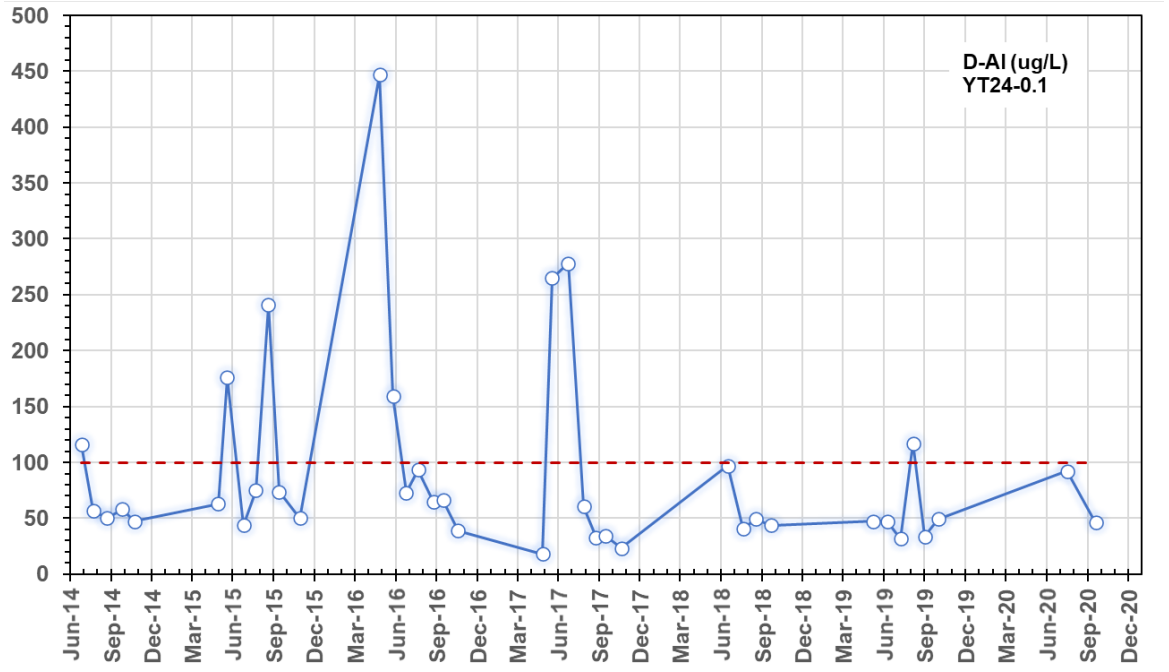

Figure 3.3-20: Dissolved aluminum (D-Al) concentrations at YT24-0.1 for the period June 2014 to December 2020 compared to British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dashed line) for protection of aquatic life.

Concentrations of total Cu in YT24-4.9 consistently exceeded applicable CCME WQG, specifically prior to 2019 (Figure 3.3-21). For YT24-0.1 concentrations of total Cu exceed the CCME hardness-dependent guideline for the protection of aquatic life, particularly in 2016. However, these exceedances are not evident in more recent years (2017, 2018, 2019), as shown in Figure 3.3-22. Low magnitude exceedances to the CCME WQG are once again noted in 2020.

Total Cd concentrations do not exceed either of the CCME hardness-dependent chronic or acute WQG for protection of aquatic life for any of these two YT-24 stations (Figure 3.3-23 and Figure 3.3-24).

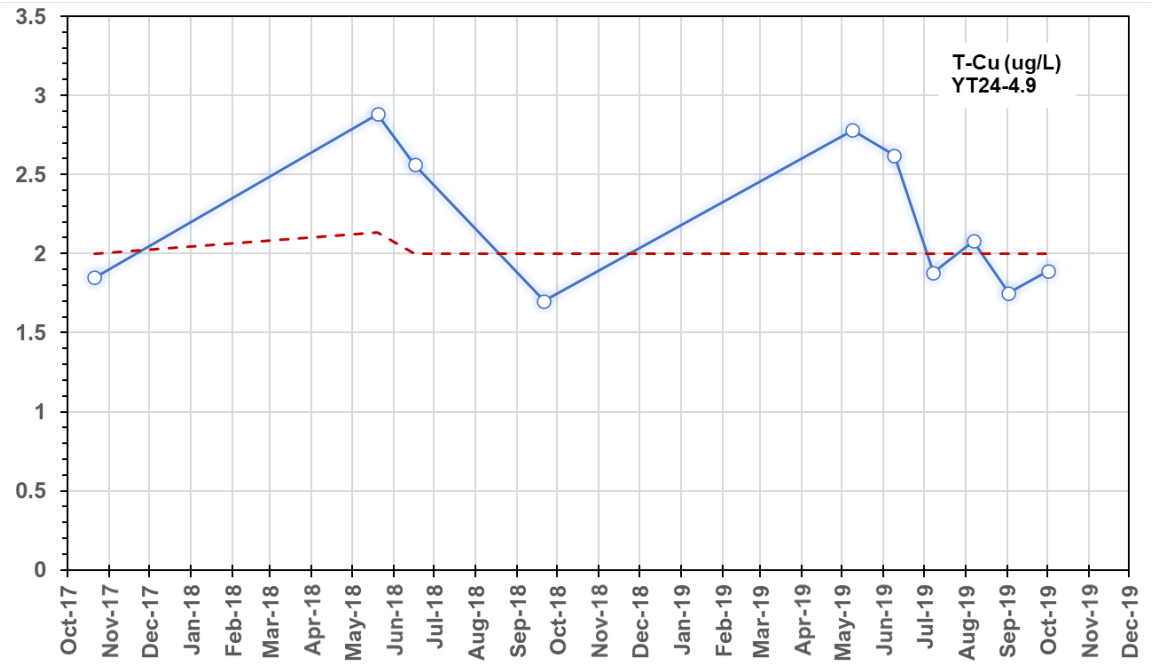

Figure 3.3-21: Total copper (T-Cu) concentrations at YT24-4.9 for the period October 2017 to October 2019 compared to the Canadian Council of Ministers of the Environment (CCME) hardness-dependent water quality guidelines (red dashed line) for the protection of aquatic life

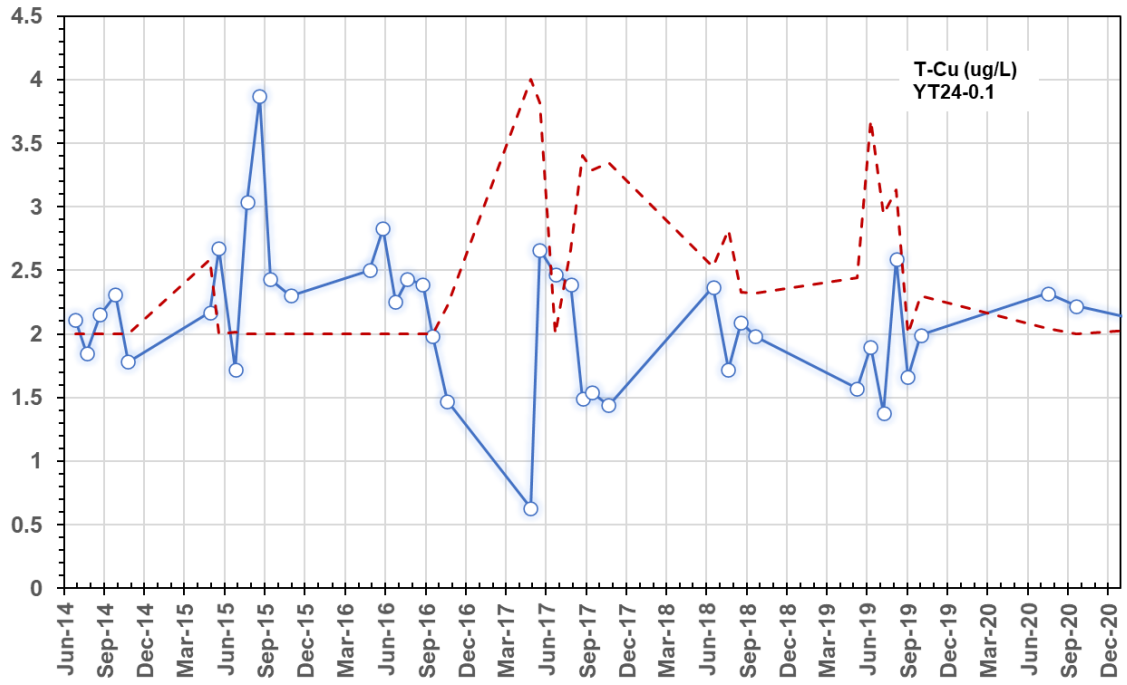

Figure 3.3-22: Total copper (T-Cu) concentrations at YT24-0.1 for the period June 2014 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness-dependent water quality guidelines (red dashed line) for the protection of aquatic life

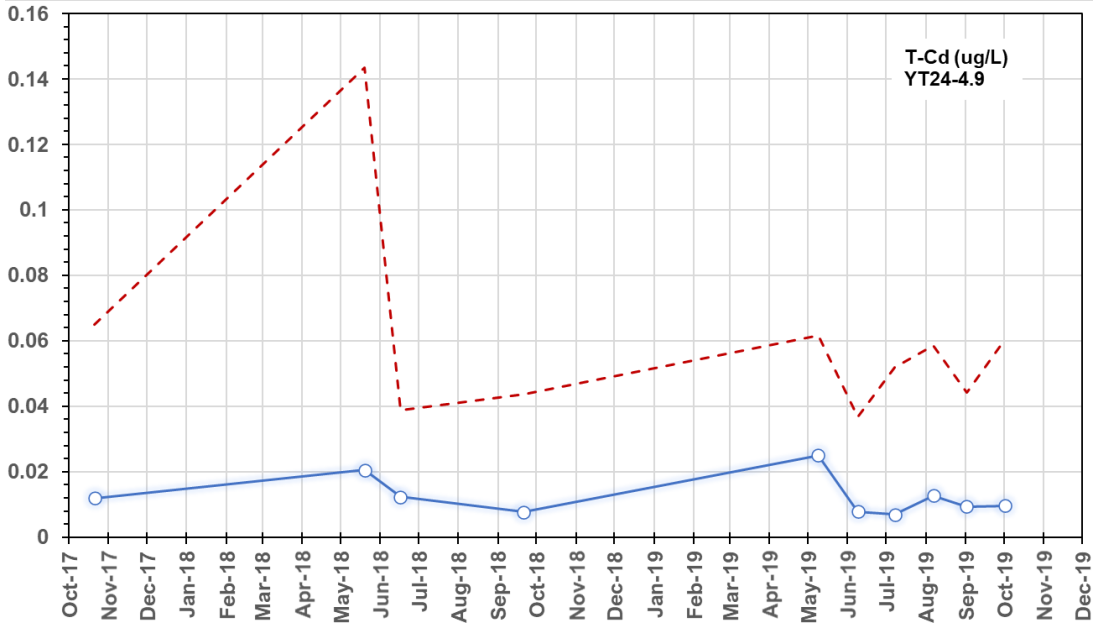

Figure 3.3-23: Total cadmium concentrations at YT24-4.9 for the period October 2017 to October 2019 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness-dependent water quality guidelines for the protection of aquatic life.

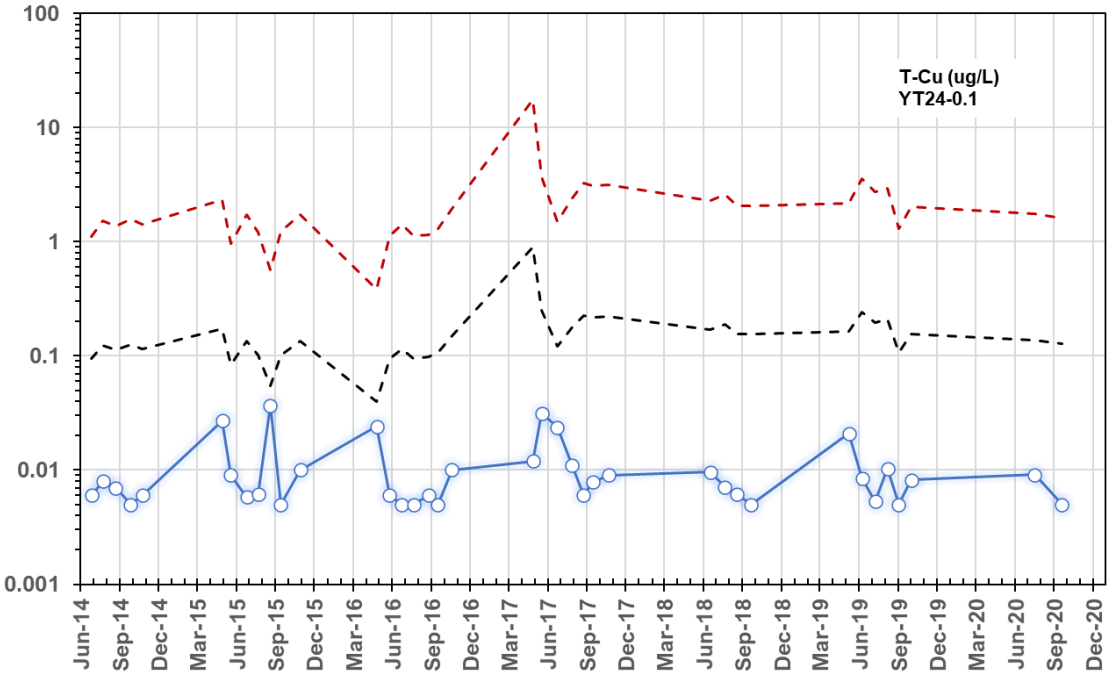

Figure 3.3-24: Total cadmium concentrations at YT24-0.1 for the period June 2014 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness-dependent water quality guidelines for the protection of aquatic life.

3.4 Yukon River Stations

3.4.1 YUK-51.3 and YUK-26.1

The following section describes baseline water quality results for the Yukon River in the immediate vicinity of the proposed project. Specifically, data are summarized for stations YUK-51.3 and YUK-26.1 (see Figure 2.1-2) that are located immediately upstream of Coffee Creek and downstream of Independence Creek, respectively.

3.4.1.1 Summary Statistics

Table 3.4-1 and Table 3.4-2 summarize the mean monthly values for a suite of the key parameters for station YUK-51.3 and YUK-26.1, respectively.

3.4.1.2 Major Ions

Yukon River major ion chemistry at stations YUK-51.3 and YUK-26.1 is assessed with respect to hardness, sulphate and pH. The Yukon River is characterized as dominantly hard waters with mean monthly hardness values for both stations ranging primarily

between approximately 83 mg/L and 120 mg/L (as $CaCO_3$) (Table 3.4-1 and Table 3.4-2; Figure 3.4-1)

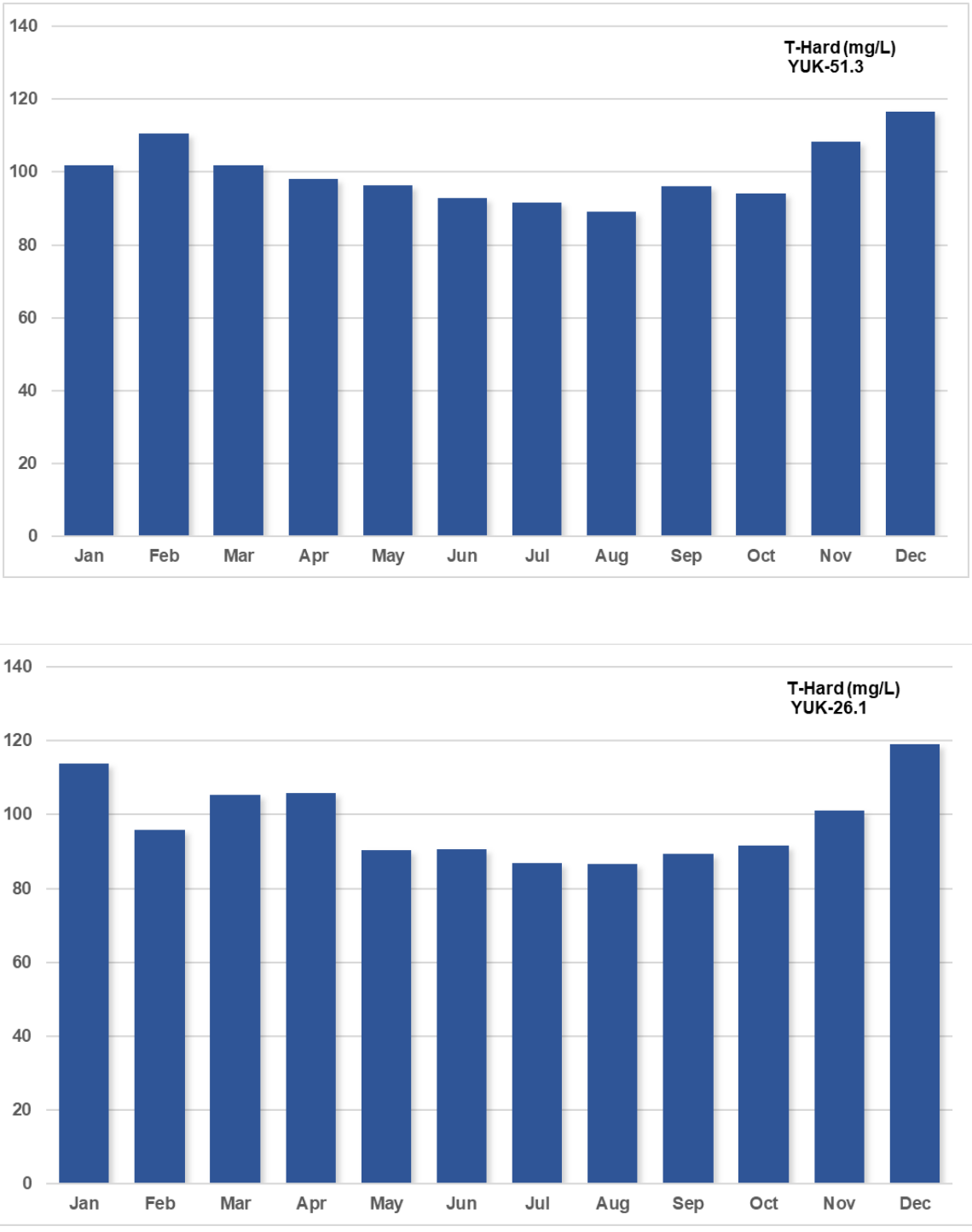

Figure 3.4-1: Mean monthly total hardness (T-Hard., as mg/L $CaCO_3$) in the Yukon River at YUK-51.3 and YUK-26.1 for the period October 2010 to December 2020.

Table 3.4-1:
Station YUK-51.3 Monthly Mean Values

	YUK-51.3 - Mean											
	Jan (n=4)	Feb (n=6)	Mar (n=3)	Apr (n=7)	May (n=9)	Jun (n=9)	Jul (n=9)	Aug (n=10)	Sep (n=10)	Oct (n=9)	Nov (n=6)	Dec (n=3)
Physical Parameters												
pH (s.u.)	8.0	8.0	8.0	8.0	7.9	7.9	8.0	7.9	8.0	8.0	7.9	7.9
Cond-L (uS/cm)	211	220	220	200	190	190	190	187	190	200	230	230
TSS (mg/L)	2.5	1.1	2.3	22	150	44	25	16	9.7	5.7	2.1	6.9
TDS (mg/L)	130	130	120	120	130	110	110	111	120	120	131	130
T-Alk (mg/L)	84	89	90	78	69	69	70	71	73	76	88	90
T-Hard (mg/L)	100	110	100	98	96	93	92	89	96	94	110	120
Anions												
Sulphate (mg/L)	23	25	23	23	24	25	24	24	24	23	26	27
Cl (mg/L)	0.53	0.55	0.65	0.81	0.92	3.0	0.69	0.66	0.6	0.57	2.2	0.62
F (mg/L)	0.11	0.11	0.11	0.090	0.095	0.11	0.11	0.12	0.12	0.11	0.12	0.11
Nutrients												
T-NH3 (mg/L)	0.018	0.021	0.019	0.018	0.021	0.013	0.022	0.016	0.015	0.013	0.014	0.0086
NO2+NO3 (mg/L)	0.072	0.078	0.088	0.042	0.025	0.018	0.0076	0.0071	0.0084	0.026	0.043	0.07
NO2 (mg/L)	0.0020	0.0025	0.0030	0.0025	0.013	0.0087	0.008	0.0079	0.0073	0.0079	0.0030	0.0020
NO3 (mg/L)	0.074	0.084	0.095	0.051	0.039	0.038	0.037	0.03	0.029	0.044	0.047	0.07
D-P (mg/L)	0.0022	0.0029	0.0022	0.0024	0.0056	0.0034	0.0035	0.0024	0.0073	0.0025	0.0030	0.01
TOC (mg/L)	2.0	2.2	2.4	2.2	9.0	4.0	3.2	3.0	3.0	2.4	2.5	2.5
DOC (mg/L)	2.0	2.4	1.2	2.1	8.0	3.6	2.9	2.8	2.6	2.2	2.1	2.2
WAD-CN (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Total Metals												
T-Al (ug/L)	27	16	19	200	1200	340	350	250	170	91	35	35
T-Sb (ug/L)	0.15	0.12	0.092	0.87	0.23	0.17	0.14	0.12	0.12	0.093	0.11	0.14
T-As (ug/L)	0.39	0.37	0.36	0.58	1.9	0.88	0.79	0.67	0.54	0.46	0.44	0.41
T-Ba (ug/L)	48	56	62	62	120	68	58	53	48	45	48	53
T-Be (ug/L)	0.012	0.010	0.010	0.019	0.08	0.025	0.017	0.017	0.021	0.011	0.010	0.011
T-Bi (ug/L)	0.0068	0.0050	0.0050	0.0079	0.023	0.011	0.011	0.0086	0.013	0.0083	0.0050	0.0067
T-B (ug/L)	20	23	37	21	37	32	24	31	27	29	30	10
T-Cd (ug/L)	0.055	0.035	0.024	0.072	0.4	0.12	0.078	0.069	0.051	0.071	0.032	0.067
T-Ca (mg/L)	28	31	28	27	26	25	25	24	26	26	30	32
T-Cr (ug/L)	0.95	0.23	0.13	0.47	2.1	0.67	0.73	0.49	0.31	0.25	0.15	0.31
T-Co (ug/L)	0.032	0.025	0.029	0.23	1.4	0.43	0.31	0.21	0.13	0.083	0.036	0.041
T-Cu (ug/L)	1.1	0.65	0.47	1.4	6.3	2.5	1.8	1.4	1.2	1.4	0.93	1.0
T-Fe (ug/L)	52	42	41	410	2400	630	570	360	220	150	66	67
T-Pb (ug/L)	0.12	0.078	0.051	0.3	1.7	0.61	0.36	0.25	0.16	0.14	0.11	0.091
T-Li (ug/L)	1.6	1.5	1.4	1.4	2.8	1.9	1.8	1.8	1.8	1.5	1.7	1.8
T-Mg (mg/L)	7.7	8.2	8.0	7.6	7.9	7.3	7.2	6.9	7.5	7.3	8.2	9.1
T-Mn (ug/L)	3.4	5.0	9.3	30	130	41	26	19	12	9.3	4.1	5.6
T-Hg (ug/L)	0.0020	0.0033	0.0047	0.0031	0.0051	0.0047	0.0038	0.0052	0.0047	0.0039	0.0047	0.0020
T-Mo (ug/L)	1.2	1.3	1.2	1.0	0.97	0.94	1.1	1.2	1.1	1.2	1.3	1.3
T-Ni (ug/L)	1.1	0.83	0.62	1.6	7.9	2.9	2.2	1.7	1.6	1.4	1.3	1.5
T-K (mg/L)	0.88	0.95	0.95	0.88	1.2	0.82	0.81	0.8	0.82	0.82	0.92	0.92
T-Se (ug/L)	0.34	0.39	0.39	0.34	0.44	0.48	0.38	0.36	0.39	0.34	0.37	0.42
T-Si (ug/L)	3035	3300	3100	3000	4250	3500	3400	3097	3215	2900	3200	3320
T-Ag (ug/L)	0.0068	0.0050	0.0050	0.0081	0.035	0.014	0.01	0.0088	0.0073	0.0067	0.0075	0.0067
T-Na (mg/L)	2.2	2.5	2.2	2.1	2.0	1.7	1.8	1.8	2.0	2.0	2.4	2.8
T-Sr (ug/L)	140	140	140	130	130	120	120	120	130	130	140	150
T-Tl (ug/L)	0.0021	0.0020	0.0020	0.0041	0.025	0.0089	0.0079	0.0059	0.0047	0.0025	0.0020	0.0030
T-U (ug/L)	1.1	1.2	1.1	1.1	1.1	0.88	0.93	0.96	1.0	1.0	1.2	1.2
T-Zn (ug/L)	-	-	-	-	-	-	-	-	-	-	-	-
Dissolve Metals												
D-Al (ug/L)	4.7	2.1	1.6	4.8	43	28	21	24	20	13	11	3.3
D-Sb (ug/L)	0.096	0.091	0.08	0.098	0.13	0.12	0.12	0.11	0.1	0.091	0.1	0.1
D-As (ug/L)	0.37	0.33	0.31	0.32	0.5	0.47	0.48	0.47	0.42	0.36	0.42	0.38
D-Ba (ug/L)	45	55	60	50	45	43	42	42	41	42	48	52
D-Be (ug/L)	0.010	0.010	0.010	0.010	0.01	0.010	0.010	0.010	0.019	0.010	0.010	0.010
D-Bi (ug/L)	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0095	0.0050	0.0050	0.0050
D-B (ug/L)	20	23	37	16	28	29	20	27	23	24	30	10
D-Cd (ug/L)	0.041	0.03	0.019	0.027	0.065	0.034	0.025	0.02	0.028	0.024	0.026	0.054
D-Ca (mg/L)	29	30	30	26	25	25	25	25	26	26	30	32
D-Cr (ug/L)	0.17	0.10	0.10	0.11	0.12	0.11	0.12	0.1	0.10	0.10	0.13	0.14
D-Co (ug/L)	0.0092	0.011	0.011	0.021	0.04	0.021	0.014	0.012	0.023	0.011	0.017	0.0094
D-Cu (ug/L)	0.66	0.51	0.37	0.57	2.1	1.1	0.83	0.77	0.73	0.6	0.66	0.75
D-Fe (ug/L)	6.3	4.8	4.6	10	77	26	13	11	14	11	22	4.4
D-Pb (ug/L)	0.013	0.011	0.0067	0.013	0.054	0.032	0.022	0.013	0.018	0.0088	0.042	0.0082
D-Li (ug/L)	1.4	1.5	1.4	1.3	1.6	1.7	1.6	1.7	1.6	1.5	1.7	1.7
D-Mg (mg/L)	7.8	8.3	7.8	7.4	7.1	7.1	7.0	6.9	7.2	7.2	8.5	9.1
D-Mn (ug/L)	1.5	3.9	7.8	8.0	5.4	2.2	1.7	0.88	1.3	1.3	2.5	1.5
D-Hg (ug/L)	0.0020	0.0034	0.0047	0.0031	0.0047	0.004	0.0032	0.0048	0.0041	0.0031	0.0041	0.0021
D-Mo (ug/L)	1.2	1.2	1.1	1.0	0.93	1.0	1.1	1.2	1.2	1.2	1.4	1.3
D-Ni (ug/L)	0.94	0.82	0.57	0.79	2.5	1.4	0.91	0.87	1.1	1.1	1.1	1.4
D-K (mg/L)	0.88	0.92	0.92	0.85	0.98	0.77	0.76	0.77	0.78	0.79	0.94	0.94
D-Se (ug/L)	0.33	0.38	0.4	0.32	0.38	0.45	0.39	0.35	0.37	0.31	0.38	0.39
D-Si (ug/L)	3000	3300	2900	2700	2700	3100	2900	2793	2848	2700	3280	3160
D-Ag (ug/L)	0.0068	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0055	0.0050	0.0050	0.0050
D-Na (mg/L)	2.2	2.4	2.1	2.1	1.8	1.7	1.8	1.9	1.9	2.0	2.6	2.5
D-Sr (ug/L)	140	141	142	130	120	110	120	120	130	130	150	150
D-Tl (ug/L)	0.0020	0.0020	0.0020	0.0020	0.0033	0.0030	0.0028	0.0022	0.0029	0.002	0.0020	0.0021
D-U (ug/L)	1.1	1.2	1.1	1.0	0.86	0.89	0.91	0.95	0.98	1.0	1.2	1.2
D-Zn (ug/L)	3.9	2.9	1.5	1.7	3.0	2.7	1.0	1.3	1.0	1.3	1.2	5.0

Table 3.4-2:
Station YUK-26.1 Monthly Mean Values

	YUK-26.1 - Mean											
	Jan (n=6)	Feb (n=6)	Mar (n=5)	Apr (n=8)	May (n=8)	Jun (n=9)	Jul (n=8)	Aug (n=10)	Sep (n=9)	Oct (n=9)	Nov (n=6)	Dec (n=3)
Physical Parameters												
pH (s.u.)	8.0	8.0	7.9	8.0	7.9	8.0	8.0	7.9	8.0	7.9	7.9	7.9
Cond-L (uS/cm)	228	230	219	210	181	180	170	180	180	190	210	230
TSS (mg/L)	10	22	1.2	5.4	71	48	25	22	7.1	2.9	5.0	1.0
TDS (mg/L)	120	130	110	120	119	110	96	106	110	110	122	130
T-Alk (mg/L)	91	92	89	84	63	69	67	67	70	75	85	91
T-Hard (mg/L)	110	96	110	110	90	91	87	87	89	92	100	119
Anions												
Sulphate (mg/L)	24	25	23	24	26	22	21	22	21	22	23	28
Cl (mg/L)	0.61	0.57	0.54	0.61	0.99	0.67	0.73	0.68	0.62	0.56	0.86	0.7
F (mg/L)	0.12	0.1	0.1	0.092	0.088	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Nutrients												
T-NH3 (mg/L)	0.014	0.015	0.021	0.017	0.020	0.024	0.019	0.02	0.017	0.029	0.013	0.011
NO2+NO3 (mg/L)	0.09	0.098	0.099	0.056	0.033	0.02	0.014	0.03	0.016	0.03	0.057	0.082
NO2 (mg/L)	0.0025	0.0028	0.0032	0.0028	0.0088	0.0086	0.0087	0.0081	0.0077	0.0078	0.0030	0.0020
NO3 (mg/L)	0.093	0.096	0.11	0.065	0.051	0.041	0.037	0.043	0.037	0.048	0.055	0.081
D-P (mg/L)	0.0022	0.003	0.0068	0.0036	0.007	0.0038	0.0039	0.0029	0.0028	0.0053	0.0021	0.0021
TOC (mg/L)	1.8	1.7	0.83	2.1	9.0	4.1	3.7	3.7	3.1	2.4	2.0	2.0
DOC (mg/L)	1.8	1.7	1.0	1.9	8.5	3.4	3.5	3.3	3.0	1.8	2.5	2.1
WAD-CN (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Total Metals												
T-Al (ug/L)	52	110	8.8	68	970	359	340	350	110	72	54	12
T-Sb (ug/L)	0.1	0.19	0.097	0.33	0.21	0.14	0.19	0.12	0.12	0.092	0.098	0.094
T-As (ug/L)	0.38	0.33	0.19	0.38	1.5	0.87	0.79	0.74	0.5	0.44	0.43	0.32
T-Ba (ug/L)	66	79	83	65	93	65	57	53	43	42	51	63
T-Be (ug/L)	0.011	0.012	0.010	0.013	0.058	0.025	0.02	0.018	0.011	0.01	0.010	0.010
T-Bi (ug/L)	0.0071	0.0063	0.0060	0.0088	0.022	0.0099	0.013	0.0087	0.0089	0.0083	0.0068	0.0050
T-B (ug/L)	23	23	34	30	35	32	26	31	29	29	23	10
T-Cd (ug/L)	0.043	0.056	0.031	0.04	0.26	0.11	0.075	0.061	0.036	0.054	0.027	0.026
T-Ca (mg/L)	31	27	29	29	24	25	24	24	25	25	28	32
T-Cr (ug/L)	0.19	0.31	0.11	0.24	1.8	0.72	0.66	0.73	0.26	0.44	0.17	0.10
T-Co (ug/L)	0.068	0.14	0.02	0.087	1.0	0.42	0.31	0.33	0.091	0.059	0.067	0.019
T-Cu (ug/L)	0.76	0.75	0.45	0.83	5.0	2.4	1.8	1.7	1.0	0.9	0.76	0.57
T-Fe (ug/L)	110	230	26	140	1900	640	540	530	160	110	100	24
T-Pb (ug/L)	0.072	0.27	0.05	0.1	1.1	0.54	0.37	0.29	0.1	0.092	0.067	0.015
T-Li (ug/L)	1.7	1.2	1.0	1.3	2.4	1.7	1.7	1.8	1.5	1.4	1.3	1.6
T-Mg (mg/L)	8.6	7.1	7.9	8.0	7.4	7.1	6.7	6.6	6.8	7.1	7.7	9.2
T-Mn (ug/L)	15	12	2.9	18	87	39	32	25	9.8	6.7	10	4.3
T-Hg (ug/L)	0.0033	0.0033	0.0058	0.0040	0.0057	0.0051	0.0040	0.0059	0.0047	0.0042	0.0047	0.0020
T-Mo (ug/L)	1.3	0.88	1.1	1.0	0.9	0.98	1.1	1.2	1.2	1.2	1.2	1.2
T-Ni (ug/L)	0.98	0.92	0.36	0.9	6.1	2.7	1.9	1.9	1.2	1.2	0.97	0.86
T-K (mg/L)	1.0	0.79	0.88	0.93	1.2	0.84	0.83	0.82	0.81	0.81	0.83	0.91
T-Se (ug/L)	0.38	0.44	0.47	0.38	0.39	0.42	0.31	0.35	0.31	0.31	0.3	0.44
T-Si (ug/L)	3400	2800	2922	3000	4095	3600	3400	3355	3100	2900	3000	3100
T-Ag (ug/L)	0.0050	0.0065	0.0060	0.0054	0.028	0.011	0.011	0.0095	0.0077	0.0068	0.0067	0.0050
T-Na (mg/L)	2.8	1.9	2.1	2.2	2.1	1.8	1.9	1.8	2.0	2.0	2.6	2.4
T-Sr (ug/L)	150	120	130	140	120	110	110	120	120	120	130	150
T-Tl (ug/L)	0.0022	0.0032	0.0020	0.0028	0.021	0.0085	0.0077	0.0073	0.0038	0.0024	0.0029	0.0020
T-U (ug/L)	1.3	1.0	1.3	1.3	1.3	0.92	0.97	0.99	1.1	1.0	1.2	1.2
T-Zn (ug/L)	2.7	4.7	1.7	2.5	22	8.9	6.1	5.4	2.7	3.0	1.6	1.7
Dissolve Metals												
D-Al (ug/L)	2.3	2.3	1.4	5.1	55	28	23	30	18	14	6.0	2.5
D-Sb (ug/L)	0.092	0.092	0.087	0.091	0.14	0.11	0.1	0.11	0.095	0.082	0.1	0.1
D-As (ug/L)	0.35	0.2	0.17	0.31	0.5	0.48	0.48	0.47	0.42	0.38	0.36	0.28
D-Ba (ug/L)	62	80	81	60	45	42	41	41	39	41	50	65
D-Be (ug/L)	0.010	0.010	0.010	0.010	0.012	0.010	0.010	0.010	0.010	0.010	0.010	0.010
D-Bi (ug/L)	0.0050	0.0050	0.0050	0.0050	0.0053	0.0050	0.0050	0.0050	0.0050	0.0050	0.0052	0.0050
D-B (ug/L)	23	23	34	20	25	28	21	27	24	24	23	10
D-Cd (ug/L)	0.023	0.035	0.021	0.026	0.066	0.03	0.024	0.019	0.019	0.031	0.032	0.024
D-Ca (mg/L)	31	31	29	29	23	24	24	24	25	26	29	33
D-Cr (ug/L)	0.11	0.11	0.10	0.10	0.13	0.11	0.1	0.13	0.11	0.1	0.10	0.10
D-Co (ug/L)	0.0087	0.013	0.0095	0.019	0.056	0.023	0.015	0.02	0.017	0.013	0.012	0.011
D-Cu (ug/L)	0.57	0.44	0.36	0.57	2.0	1.1	0.88	0.9	0.75	0.62	0.66	0.48
D-Fe (ug/L)	6.3	6.4	4.1	13	82	26	14	23	14	12	10	4.4
D-Pb (ug/L)	0.013	0.012	0.0091	0.013	0.048	0.031	0.014	0.011	0.011	0.014	0.025	0.0050
D-Li (ug/L)	1.4	1.2	1.1	1.2	1.4	1.5	1.4	1.5	1.3	1.4	1.4	1.6
D-Mg (mg/L)	8.8	8.6	7.9	7.9	6.8	6.9	6.5	6.5	6.7	7.0	7.8	8.9
D-Mn (ug/L)	3.4	3.0	1.9	9.4	8.2	2.5	3.1	1.1	1.9	2.1	4.6	4.1
D-Hg (ug/L)	0.0033	0.0033	0.0052	0.0040	0.0035	0.0042	0.0031	0.0054	0.0040	0.0030	0.0037	0.0020
D-Mo (ug/L)	1.3	1.6	1.1	1.0	0.88	0.99	1.1	1.2	1.2	1.8	1.3	1.3
D-Ni (ug/L)	0.84	0.55	0.32	0.65	2.2	1.2	0.8	0.89	0.89	1.0	0.86	0.91
D-K (mg/L)	0.99	0.93	0.88	0.92	1.0	0.78	0.77	0.79	0.8	0.81	0.88	0.92
D-Se (ug/L)	0.4	0.47	0.46	0.36	0.32	0.39	0.3	0.3	0.3	0.31	0.31	0.38
D-Si (ug/L)	3290	3210	2844	2810	2900	3100	2900	2915	2800	2800	3100	3100
D-Ag (ug/L)	0.0058	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
D-Na (mg/L)	2.4	2.2	2.1	2.3	2.2	1.7	1.8	1.8	2.0	2.0	2.4	2.4
D-Sr (ug/L)	150	140	140	135	120	110	113	110	120	130	140	150
D-Tl (ug/L)	0.0020	0.0020	0.0020	0.0020	0.004	0.0028	0.0026	0.0022	0.0022	0.0020	0.002	0.0020
D-U (ug/L)	1.3	1.1	1.2	1.3	1.1	0.93	0.95	0.93	1.0	1.0	1.2	1.4
D-Zn (ug/L)	2.0	2.3	1.2	1.4	2.4	1.2	0.78	0.81	0.85	1.9	1.4	1.8

Baseline concentrations of sulphate in the Yukon River are consistent throughout the year and don't exhibit a pronounced seasonal signature. Mean monthly sulphate values for both stations narrowly range between 21 and 28 mg/L (Table 3.4-1 and Table 3.4-2).

The pH remains roughly at 8.0 and is relatively uniform throughout the year at both stations. The neutral to slightly basic pH conditions can be linked to bicarbonate alkalinity. All pH values reported to date have remained within the CCME freshwater guideline range for pH of 6.5 to 9.0.

TSS concentrations in the Yukon River show maxima coinciding with the peak snowmelt months (*e.g.*, May and June). Elevated TSS also occurs during summer flow periods and generally decrease to values less than 10 mg/L during the late fall and winter low flow conditions (Table 3.4-1 and Table 3.4-2).

3.4.1.3 Nutrients

Nutrient parameters are found in low concentrations in the Yukon River at stations YUK-51.3 and YUK-26.1. Ammonia-N concentrations are low with mean monthly values roughly between 0.01 to 0.03 mg/L. Mean monthly nitrate-N concentrations at both Yukon River stations were low and ranged between 0.03 mg/L and 0.11 mg/L. Dissolved phosphorus concentrations at both stations were low with mean monthly values narrowly ranging between 0.002 mg/L and 0.01 mg/L and indicative of oligotrophic to ultra-oligotrophic conditions (Appendix B).

Unlike the other project streams, TOC and DOC are present in lower concentrations in the Yukon River. Mean monthly DOC concentrations ranged from less than 3.0 mg/L during baseflow periods, to roughly 9.0 mg/L (Table 3.4-1 and Table 3.4-2).

3.4.1.4 Trace Elements

Baseline trace element concentrations in the Yukon River were derived from data collected from October 2010 to December 2020 at YUK-51.3 and YUK-26.1. In general, mean monthly concentrations of total and dissolved trace elements are low (*e.g.*, Al, As, Sb, Co, Cr, Pb, Hg, Ni, Se, U and Zn). Mean monthly total As concentrations in the Yukon River are typically well below 1.0 µg/L for most flow periods of the year with maximum values coincident with elevated TSS (Table 3.4-1 and Table 3.4-2). Similarly, total U concentrations in the Yukon River are also low with mean monthly values roughly around 1.0 µg/L.

In contrast to all the other monitoring locations in the vicinity of the project site, dissolved Al in the Yukon River never exceed the BC ENV guideline for the protection of aquatic life of 100 µg/L.

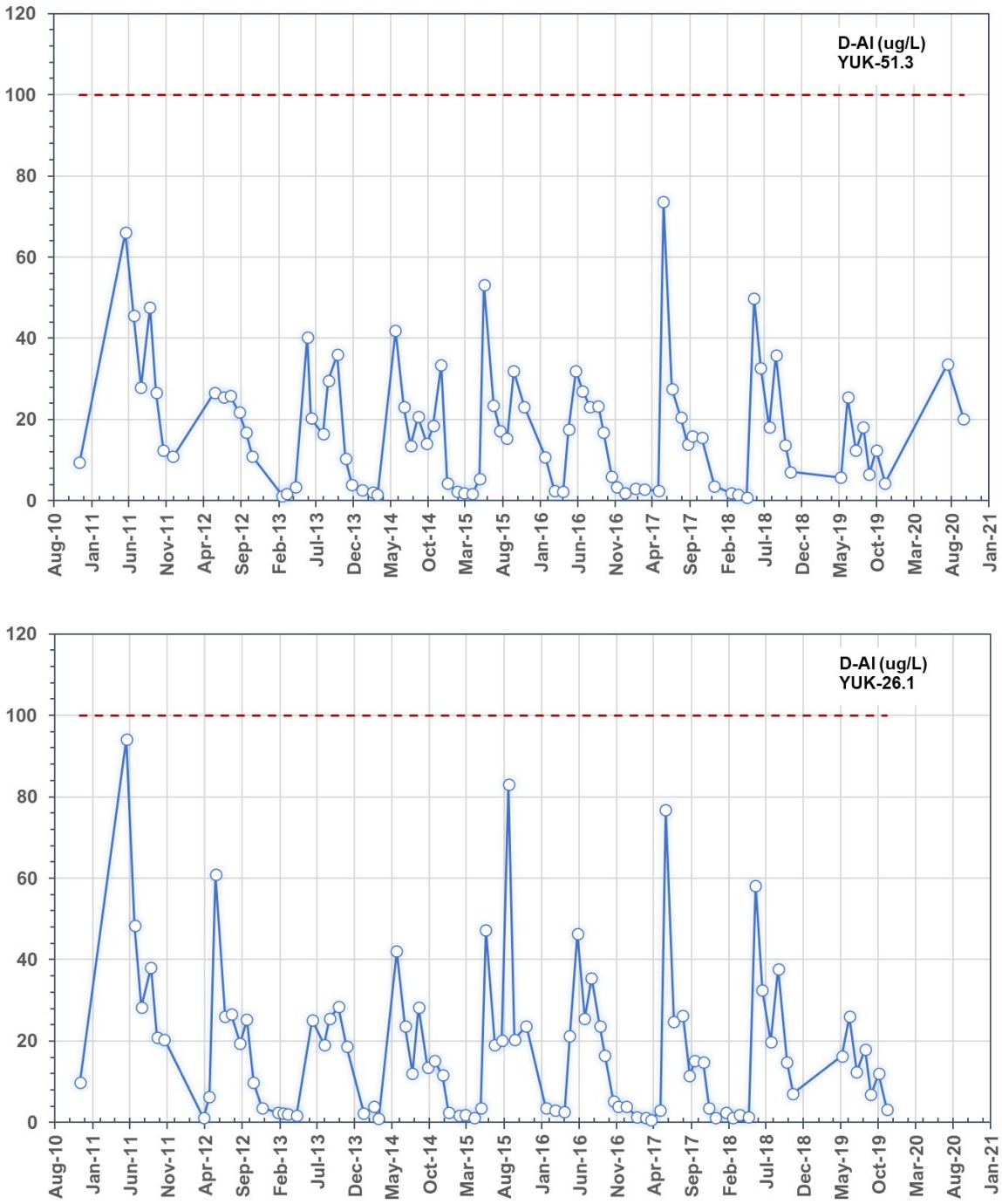

Figure 3.4-2: Dissolved aluminum (D-Al) concentrations at YUK-51.3 and YUK-26.1 in the Yukon River for the period October 2010 to December 2020 compared to British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dashed line) for protection of aquatic life.

Interestingly, concentrations of total Cu in the Yukon River at station YUK-51.3 and YUK-26.1 routinely exceeded the CCME hardness-dependent Cu guideline for the protection of aquatic life even in these moderately hard to hard waters Figure 3.4-3). Mean monthly total Cu concentrations at both Yukon River stations indicate that elevated total Cu concentrations are associated with the peak flow months of May and June (Figure 3.4-4).

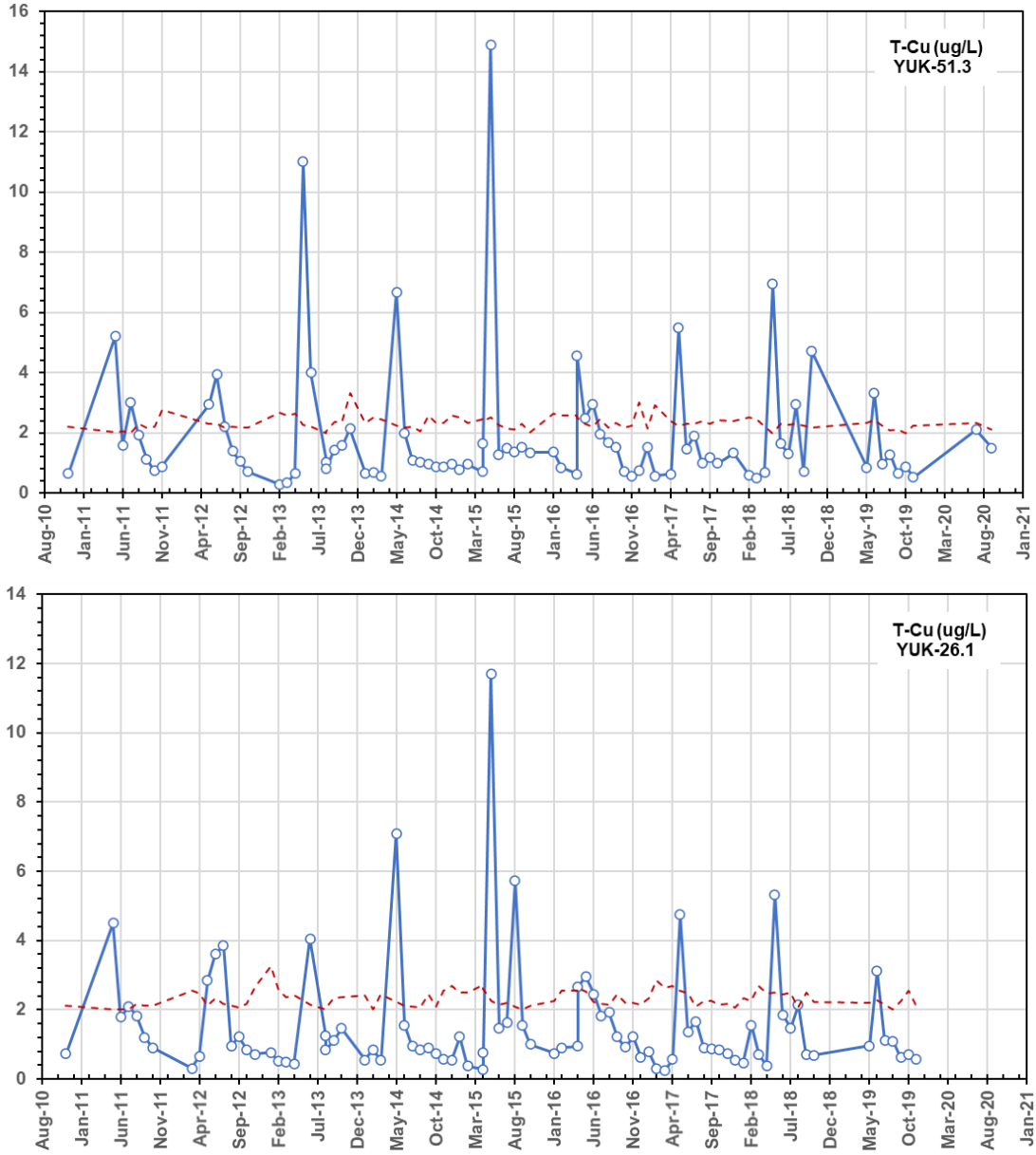

Figure 3.4-3: Total copper (T-Cu) concentrations at YUK-51.3 and YUK-26.1 in the Yukon River for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness-dependent guidelines (red dashed line) for the protection of aquatic life.

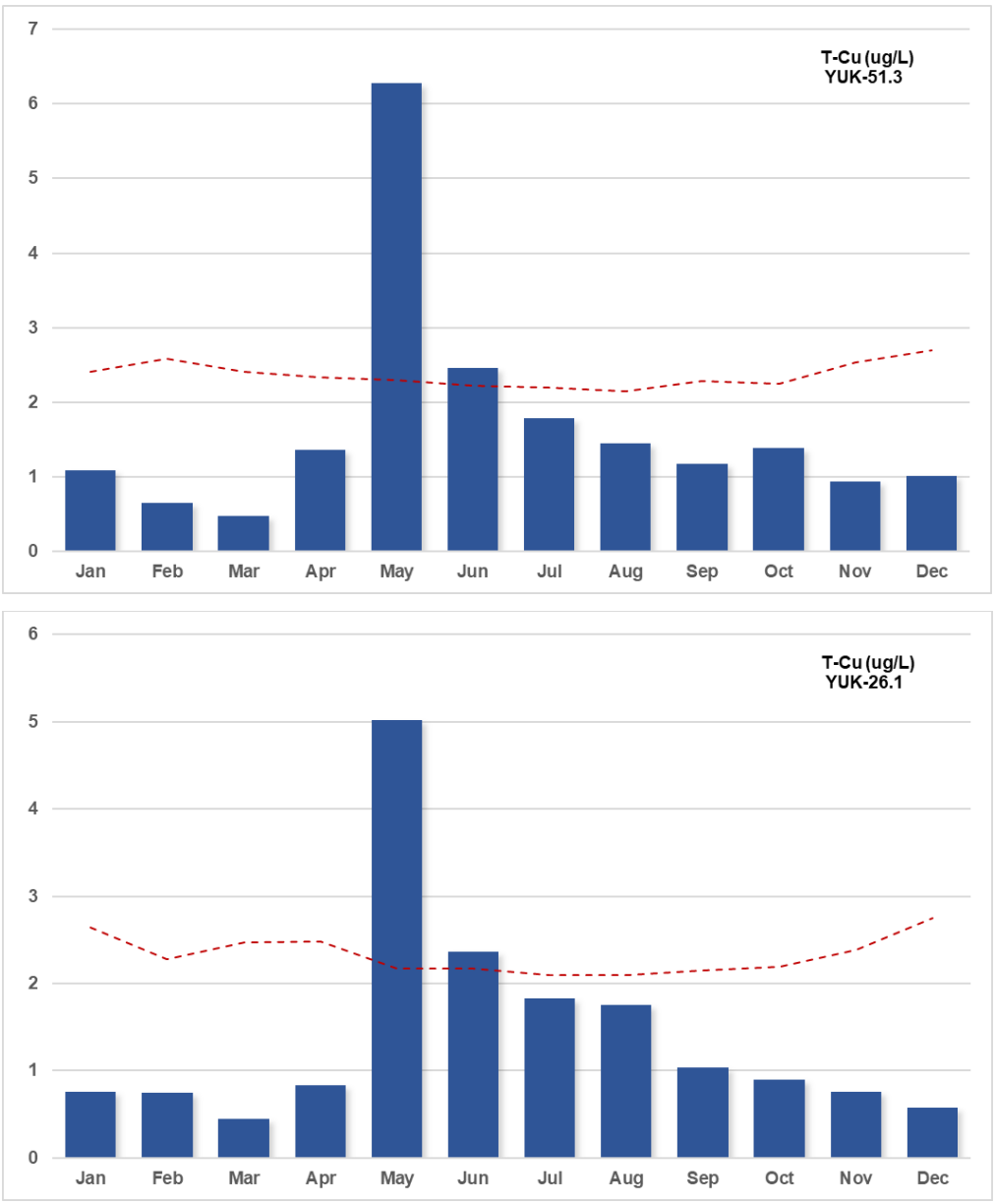

Figure 3.4-4: Monthly mean total copper (T-Cu) in the Yukon River at station YUK-51.3 and YUK-26.1 for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness-dependent water quality guidelines (red dashed line) for the protection of aquatic life.

Similar to Cu, total Cd concentrations slightly exceeded the CCME hardness-based chronic guideline for protection of aquatic life for Cd during peak flow periods (Figure 3.4-5). However, observed Cd concentrations do not exceed the CCME acute exposure guidelines for the protection of aquatic life for Cd at stations YUK-51.3 and YUK-26.1.

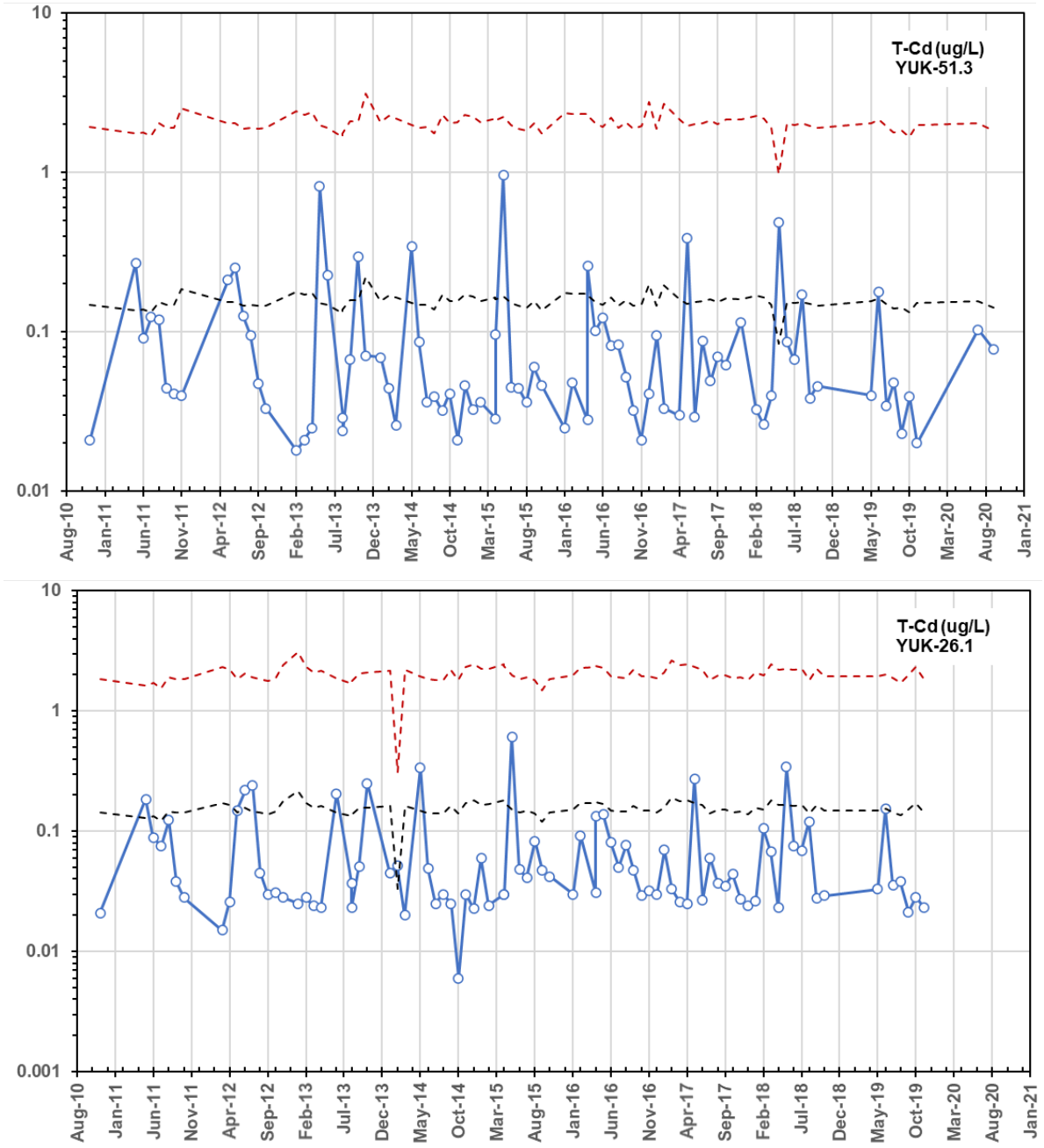

Figure 3.4-5 Total cadmium (T-Cd) concentrations at YUK-51.3 and YUK-26.1 in the Yukon River for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness-dependent guidelines for the protection of aquatic life.

3.4.2 YUK -49.3 and YUK-37.6

The following section describes baseline water quality results for the Yukon River in the immediate vicinity of the proposed project. Specifically, data are summarized for stations YUK-49.3 and YUK-37.6 (see Figure 2.1-2) specifically located in the confluence of Coffee Creek and Halfway Creek, respectively. Collection from these stations occurred only during the open water period (July to October) owing to safety issues around ice in the Yukon River.

3.4.2.1 Summary Statistics

Table 3.4-3 and Table 3.4-4 summarize the mean monthly values for a suite of the key parameters for station YUK-49.3 and YUK37.6, respectively.

3.4.2.2 Major Ions

Yukon River major ion chemistry at stations YUK-49.3 and YUK-37.6 is assessed with respect to hardness, sulphate and pH. The Yukon River at these stations is characterized by moderately hard waters with mean monthly hardness values for both stations remaining below 100 mg/L (as $CaCO_3$) (Figure 3.4-6; Table 3.4-3 and Table 3.4-4)

Table 3.4-3:
Station YUK-49.3 Monthly Mean Values

	YUK-49.3 - Mean											
	Jan	Feb	Mar	Apr	May	Jun (n=2)	Jul (n=4)	Aug (n=3)	Sep (n=4)	Oct (n=2)	Nov (n=1)	Dec
Physical Parameters												
pH (s.u.)	-	-	-	-	-	7.8	7.8	7.6	7.7	7.7	7.3	-
Cond-L (uS/cm)	-	-	-	-	-	199	170	170	190	200	213	-
TSS (mg/L)	-	-	-	-	-	18	10	15	3.0	3.1	3.1	-
TDS (mg/L)	-	-	-	-	-	120	110	104	130	121	120	-
T-Alk (mg/L)	-	-	-	-	-	65	59	55	57	57	73	-
T-Hard (mg/L)	-	-	-	-	-	90	78	79	84	90	100	-
Anions												
Sulphate (mg/L)	-	-	-	-	-	33	23	27	32	42	30	-
Cl (mg/L)	-	-	-	-	-	0.75	0.63	0.81	0.90	0.50	0.50	-
F (mg/L)	-	-	-	-	-	0.089	0.094	0.091	0.082	0.088	0.11	-
Nutrients												
T-NH3 (mg/L)	-	-	-	-	-	0.041	0.023	0.023	0.032	0.014	0.0050	-
NO2+NO3 (mg/L)	-	-	-	-	-	0.046	0.046	0.11	0.15	0.24	0.14	-
NO2 (mg/L)	-	-	-	-	-	0.0029	0.0022	0.0023	0.0018	0.0020	0.0020	-
NO3 (mg/L)	-	-	-	-	-	0.044	0.046	0.1	0.18	0.24	0.14	-
D-P (mg/L)	-	-	-	-	-	0.0035	0.0080	0.0084	0.015	0.0045	0.0028	-
TOC (mg/L)	-	-	-	-	-	5.5	6.9	7.3	8.3	6.2	2.5	-
DOC (mg/L)	-	-	-	-	-	5.0	6.2	6.9	8.6	6.0	3.1	-
WAD-CN (mg/L)	-	-	-	-	-	0.00067	0.00062	0.00064	0.0028	0.00050	0.00050	-
Total Metals												
T-Al (ug/L)	-	-	-	-	-	234	244	330	96	64	39	-
T-Sb (ug/L)	-	-	-	-	-	0.11	0.14	0.16	0.13	0.1	0.094	-
T-As (ug/L)	-	-	-	-	-	0.6	0.61	0.72	0.5	0.42	0.38	-
T-Ba (ug/L)	-	-	-	-	-	52	44	53	45	48	50	-
T-Be (ug/L)	-	-	-	-	-	0.018	0.017	0.02	0.033	0.010	0.010	-
T-Bi (ug/L)	-	-	-	-	-	0.010	0.010	0.0083	0.020	0.0075	0.010	-
T-B (ug/L)	-	-	-	-	-	10	10	10	10	10	10	-
T-Cd (ug/L)	-	-	-	-	-	0.061	0.039	0.061	0.028	0.016	0.023	-
T-Ca (mg/L)	-	-	-	-	-	24	21	21	22	24	27	-
T-Cr (ug/L)	-	-	-	-	-	0.49	0.52	0.66	0.33	0.28	0.17	-
T-Co (ug/L)	-	-	-	-	-	0.24	0.17	0.28	0.088	0.06	0.047	-
T-Cu (ug/L)	-	-	-	-	-	1.9	1.8	2.3	2.0	1.5	0.88	-
T-Fe (ug/L)	-	-	-	-	-	370	310	450	120	84	60	-
T-Pb (ug/L)	-	-	-	-	-	0.23	0.16	0.27	0.073	0.026	0.033	-
T-Li (ug/L)	-	-	-	-	-	1.3	1.3	1.3	1.1	0.83	1.3	-
T-Mg (mg/L)	-	-	-	-	-	7.4	6.1	6.1	7.0	7.4	7.9	-
T-Mn (ug/L)	-	-	-	-	-	23	15	23	11	7.3	8.3	-
T-Hg (ug/L)	-	-	-	-	-	0.003	0.003	0.0029	0.003	0.004	0.0020	-
T-Mo (ug/L)	-	-	-	-	-	0.88	0.98	0.96	0.94	0.89	1.2	-
T-Ni (ug/L)	-	-	-	-	-	1.9	1.3	2.0	1.1	0.92	0.98	-
T-K (mg/L)	-	-	-	-	-	0.99	0.86	0.99	1.3	1.1	0.96	-
T-Se (ug/L)	-	-	-	-	-	0.26	0.23	0.25	0.18	0.16	0.24	-
T-Si (ug/L)	-	-	-	-	-	3580	3500	4330	4500	4415	3550	-
T-Ag (ug/L)	-	-	-	-	-	0.010	0.010	0.019	0.017	0.0075	0.010	-
T-Na (mg/L)	-	-	-	-	-	2.5	2.1	2.2	2.9	2.9	2.6	-
T-Sr (ug/L)	-	-	-	-	-	123	100	110	117	130	135	-
T-Tl (ug/L)	-	-	-	-	-	0.0065	0.0064	0.0072	0.0057	0.0034	0.0020	-
T-U (ug/L)	-	-	-	-	-	1.8	1.3	1.5	2.4	2.3	1.4	-
T-Zn (ug/L)	-	-	-	-	-	8.0	4.5	7.1	5.2	0.94	1.2	-
Dissolve Metals												
D-Al (ug/L)	-	-	-	-	-	31	65	68	45	30	9.3	-
D-Sb (ug/L)	-	-	-	-	-	0.086	0.1	0.11	0.12	0.096	0.11	-
D-As (ug/L)	-	-	-	-	-	0.39	0.46	0.46	0.37	0.33	0.39	-
D-Ba (ug/L)	-	-	-	-	-	43	40	41	41	44	53	-
D-Be (ug/L)	-	-	-	-	-	0.010	0.014	0.012	0.033	0.010	0.010	-
D-Bi (ug/L)	-	-	-	-	-	0.0050	0.0050	0.0050	0.016	0.0050	0.0050	-
D-B (ug/L)	-	-	-	-	-	10	10	10	10	10	10	-
D-Cd (ug/L)	-	-	-	-	-	0.028	0.023	0.022	0.022	0.012	0.018	-
D-Ca (mg/L)	-	-	-	-	-	24	21	22	22	23	32	-
D-Cr (ug/L)	-	-	-	-	-	0.11	0.21	0.25	0.23	0.2	0.11	-
D-Co (ug/L)	-	-	-	-	-	0.03	0.036	0.047	0.05	0.029	0.023	-
D-Cu (ug/L)	-	-	-	-	-	1.2	1.4	1.5	1.6	1.3	0.75	-
D-Fe (ug/L)	-	-	-	-	-	29	54	56	35	24	7.8	-
D-Pb (ug/L)	-	-	-	-	-	0.017	0.01	0.0091	0.02	0.0050	0.0050	-
D-Li (ug/L)	-	-	-	-	-	1.1	1.1	1.1	0.99	0.84	1.5	-
D-Mg (mg/L)	-	-	-	-	-	7.2	6.0	6.3	6.5	7.3	9.1	-
D-Mn (ug/L)	-	-	-	-	-	3.6	4.0	4.3	7.0	5.1	8.1	-
D-Hg (ug/L)	-	-	-	-	-	0.0024	0.0033	0.003	0.0033	0.0020	0.0020	-
D-Mo (ug/L)	-	-	-	-	-	0.9	0.94	0.95	0.92	0.88	1.4	-
D-Ni (ug/L)	-	-	-	-	-	1.0	0.84	1.0	0.86	0.83	0.96	-
D-K (mg/L)	-	-	-	-	-	0.93	0.83	0.98	1.2	1.1	1.1	-
D-Se (ug/L)	-	-	-	-	-	0.24	0.22	0.2	0.16	0.15	0.26	-
D-Si (ug/L)	-	-	-	-	-	3150	3270	3700	4300	3940	3610	-
D-Ag (ug/L)	-	-	-	-	-	0.0050	0.0050	0.0050	0.0071	0.0050	0.0050	-
D-Na (mg/L)	-	-	-	-	-	2.4	2.2	2.3	2.8	2.9	2.8	-
D-Sr (ug/L)	-	-	-	-	-	120	100	109	120	120	154	-
D-Tl (ug/L)	-	-	-	-	-	0.0029	0.0027	0.0032	0.0044	0.0025	0.0020	-
D-U (ug/L)	-	-	-	-	-	1.7	1.2	1.5	2.2	2.1	1.5	-
D-Zn (ug/L)	-	-	-	-	-	2.4	1.6	1.3	3.1	0.54	0.65	-

Table 3.4-4:
Station YUK-37.6 Monthly Mean Values

	YUK-37.6 - Mean											
	Jan	Feb	Mar	Apr	May	Jun (n=2)	Jul (n=4)	Aug (n=3)	Sep (n=4)	Oct (n=2)	Nov	Dec
Physical Parameters												
pH (s.u.)	-	-	-	-	-	7.9	8.0	7.7	7.9	7.6	-	-
Cond-L (uS/cm)	-	-	-	-	-	191	180	170	197	210	-	-
TSS (mg/L)	-	-	-	-	-	24	12	13	4.7	1.5	-	-
TDS (mg/L)	-	-	-	-	-	110	107	100	130	129	-	-
T-Alk (mg/L)	-	-	-	-	-	69	69	63	73	69	-	-
T-Hard (mg/L)	-	-	-	-	-	92	87	82	91	93	-	-
Anions												
Sulphate (mg/L)	-	-	-	-	-	26	22	23	26	29	-	-
Cl (mg/L)	-	-	-	-	-	0.80	0.56	0.93	0.61	0.50	-	-
F (mg/L)	-	-	-	-	-	0.095	0.11	0.094	0.099	0.088	-	-
Nutrients												
T-NH3 (mg/L)	-	-	-	-	-	0.020	0.015	0.02	0.018	0.019	-	-
NO2+NO3 (mg/L)	-	-	-	-	-	0.038	0.02	0.14	0.16	0.44	-	-
NO2 (mg/L)	-	-	-	-	-	0.0021	0.0021	0.0029	0.0018	0.0020	-	-
NO3 (mg/L)	-	-	-	-	-	0.037	0.019	0.14	0.13	0.44	-	-
D-P (mg/L)	-	-	-	-	-	0.0044	0.0091	0.012	0.016	0.0029	-	-
TOC (mg/L)	-	-	-	-	-	5.7	3.3	6.5	5.1	6.3	-	-
DOC (mg/L)	-	-	-	-	-	5.4	3.3	6.9	4.7	6.2	-	-
WAD-CN (mg/L)	-	-	-	-	-	0.00076	0.00050	0.00065	0.0029	0.00050	-	-
Total Metals												
T-Al (ug/L)	-	-	-	-	-	210	310	356	120	66	-	-
T-Sb (ug/L)	-	-	-	-	-	0.13	0.16	0.19	0.14	0.16	-	-
T-As (ug/L)	-	-	-	-	-	0.7	0.75	0.91	0.57	0.61	-	-
T-Ba (ug/L)	-	-	-	-	-	50	52	50	45	41	-	-
T-Be (ug/L)	-	-	-	-	-	0.016	0.019	0.025	0.033	0.012	-	-
T-Bi (ug/L)	-	-	-	-	-	0.010	0.011	0.010	0.019	0.010	-	-
T-B (ug/L)	-	-	-	-	-	10	10	10	10	10	-	-
T-Cd (ug/L)	-	-	-	-	-	0.065	0.062	0.049	0.031	0.017	-	-
T-Ca (mg/L)	-	-	-	-	-	25	24	22	25	25	-	-
T-Cr (ug/L)	-	-	-	-	-	0.45	0.68	0.75	0.32	0.3	-	-
T-Co (ug/L)	-	-	-	-	-	0.24	0.24	0.26	0.099	0.062	-	-
T-Cu (ug/L)	-	-	-	-	-	1.8	1.7	1.8	1.2	1.2	-	-
T-Fe (ug/L)	-	-	-	-	-	360	490	449	160	96	-	-
T-Pb (ug/L)	-	-	-	-	-	0.24	0.29	0.23	0.095	0.039	-	-
T-Li (ug/L)	-	-	-	-	-	1.4	1.6	1.4	1.4	1.1	-	-
T-Mg (mg/L)	-	-	-	-	-	7.3	6.7	6.5	7.2	7.3	-	-
T-Mn (ug/L)	-	-	-	-	-	23	22	20	8.6	5.7	-	-
T-Hg (ug/L)	-	-	-	-	-	0.0020	0.002	0.0026	0.0028	0.0024	-	-
T-Mo (ug/L)	-	-	-	-	-	0.9	1.1	0.95	1.0	0.96	-	-
T-Ni (ug/L)	-	-	-	-	-	1.9	1.7	1.7	1.1	0.93	-	-
T-K (mg/L)	-	-	-	-	-	1.1	0.87	1.1	1.2	1.3	-	-
T-Se (ug/L)	-	-	-	-	-	0.25	0.3	0.24	0.25	0.19	-	-
T-Si (ug/L)	-	-	-	-	-	3500	3300	4000	3540	3980	-	-
T-Ag (ug/L)	-	-	-	-	-	0.010	0.011	0.011	0.0088	0.010	-	-
T-Na (mg/L)	-	-	-	-	-	2.2	2.1	2.2	2.3	2.4	-	-
T-Sr (ug/L)	-	-	-	-	-	144	110	139	150	180	-	-
T-Tl (ug/L)	-	-	-	-	-	0.0067	0.0069	0.0067	0.0052	0.0032	-	-
T-U (ug/L)	-	-	-	-	-	5.0	1.2	3.2	3.7	5.0	-	-
T-Zn (ug/L)	-	-	-	-	-	5.6	7.5	6.5	3.4	1.4	-	-
Dissolve Metals												
D-Al (ug/L)	-	-	-	-	-	33	23	57	21	22	-	-
D-Sb (ug/L)	-	-	-	-	-	0.1	0.11	0.16	0.14	0.15	-	-
D-As (ug/L)	-	-	-	-	-	0.48	0.48	0.61	0.43	0.53	-	-
D-Ba (ug/L)	-	-	-	-	-	41	40	38	40	40	-	-
D-Be (ug/L)	-	-	-	-	-	0.010	0.010	0.014	0.033	0.011	-	-
D-Bi (ug/L)	-	-	-	-	-	0.0050	0.0050	0.0050	0.016	0.0050	-	-
D-B (ug/L)	-	-	-	-	-	10	10	10	10	10	-	-
D-Cd (ug/L)	-	-	-	-	-	0.034	0.026	0.021	0.017	0.013	-	-
D-Ca (mg/L)	-	-	-	-	-	24	23	22	25	25	-	-
D-Cr (ug/L)	-	-	-	-	-	0.13	0.2	0.27	0.15	0.22	-	-
D-Co (ug/L)	-	-	-	-	-	0.036	0.016	0.042	0.039	0.028	-	-
D-Cu (ug/L)	-	-	-	-	-	1.2	1.0	1.3	0.89	0.91	-	-
D-Fe (ug/L)	-	-	-	-	-	32	17	47	14	21	-	-
D-Pb (ug/L)	-	-	-	-	-	0.02	0.016	0.01	0.018	0.0050	-	-
D-Li (ug/L)	-	-	-	-	-	1.3	1.3	1.2	1.3	1.0	-	-
D-Mg (mg/L)	-	-	-	-	-	7.1	6.4	6.3	6.9	6.9	-	-
D-Mn (ug/L)	-	-	-	-	-	4.0	2.8	2.2	1.3	3.0	-	-
D-Hg (ug/L)	-	-	-	-	-	0.0025	0.002	0.0031	0.0029	0.0025	-	-
D-Mo (ug/L)	-	-	-	-	-	0.95	1.2	0.94	1.1	1.0	-	-
D-Ni (ug/L)	-	-	-	-	-	1.1	0.81	0.9	0.82	0.75	-	-
D-K (mg/L)	-	-	-	-	-	0.97	0.8	1.0	1.2	1.2	-	-
D-Se (ug/L)	-	-	-	-	-	0.27	0.29	0.21	0.23	0.2	-	-
D-Si (ug/L)	-	-	-	-	-	3080	2825	3580	3300	3570	-	-
D-Ag (ug/L)	-	-	-	-	-	0.0050	0.0050	0.0050	0.0063	0.0050	-	-
D-Na (mg/L)	-	-	-	-	-	2.1	2.1	2.2	2.2	2.2	-	-
D-Sr (ug/L)	-	-	-	-	-	140	110	134	150	160	-	-
D-Tl (ug/L)	-	-	-	-	-	0.0028	0.0024	0.0028	0.0043	0.0021	-	-
D-U (ug/L)	-	-	-	-	-	3.7	1.1	2.9	3.5	4.3	-	-
D-Zn (ug/L)	-	-	-	-	-	1.4	2.5	1.5	1.4	0.49	-	-

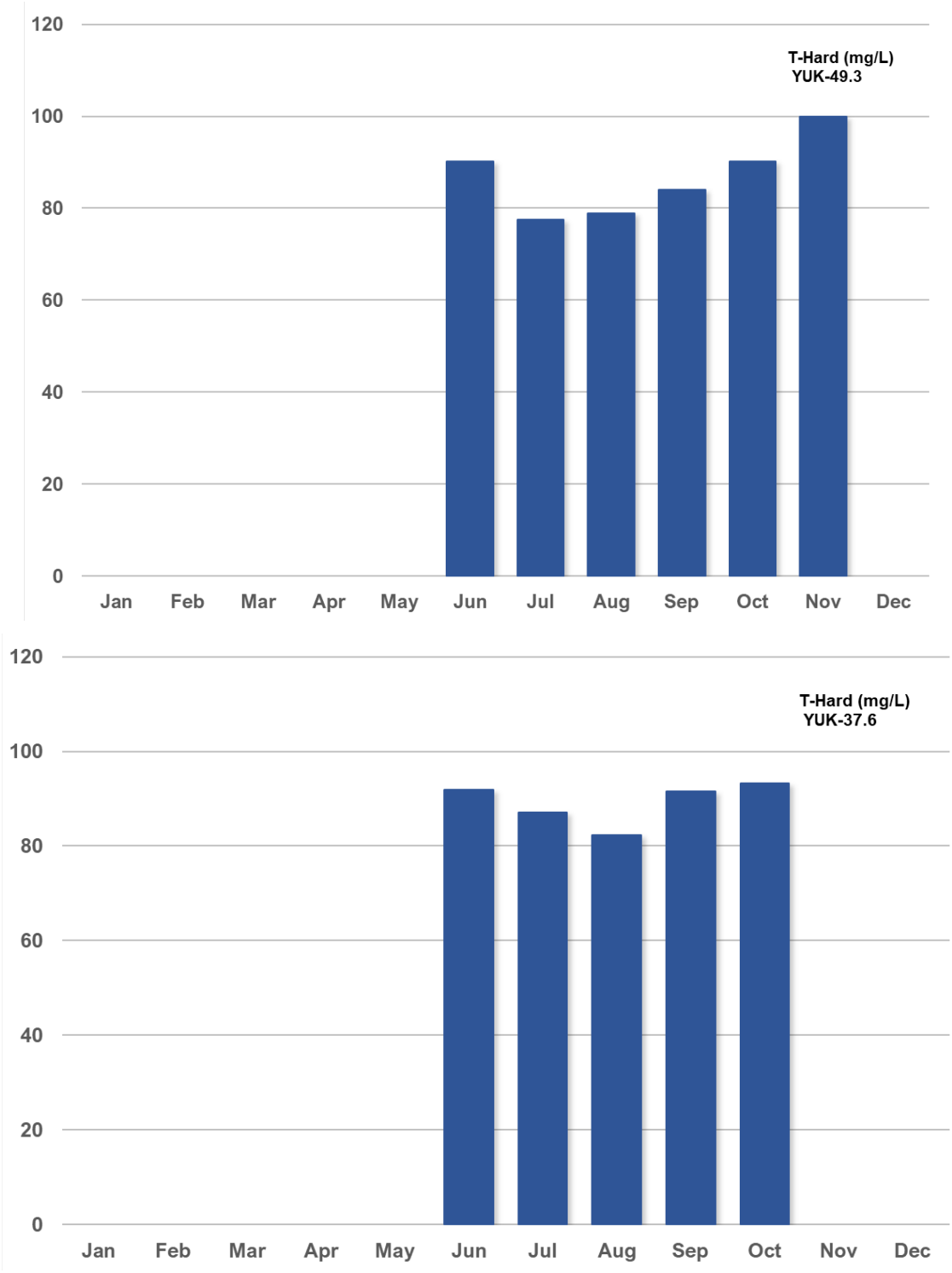

Figure 3.4-6: Mean monthly total hardness (T-Hard., as mg/L $CaCO_3$) in the Yukon River at YUK-49.3 and YUK-37.6 for the period July 2017 to September 2020.

Baseline concentrations of sulphate in the Yukon River are consistent throughout the year and don't exhibit a pronounced seasonal signature with values remaining < 40 mg/L. (Table 3.4-3 and Table 3.4-4). The pH is relatively uniform throughout the year at both stations remains with values roughly between 7 and 8.0. All pH values reported to date have remained within the CCME freshwater guideline range for pH of 6.5 to 9.0.

Concentrations of TSS in the Yukon River show maxima coinciding with the peak snowmelt months (*e.g.,* June). Elevated TSS also occurs during summer flow periods (*e.g.*, July, August) and generally decrease to values less than 5 mg/L during late fall (Table 3.4-3 and Table 3.4-4).

3.4.2.3 Nutrients

Nutrient parameters are found in low concentrations in the Yukon River at stations YUK-49.3 and YUK-37.6. Ammonia-N concentrations are low with mean monthly values roughly between 0.005 to 0.2 mg/L. Mean monthly nitrate-N concentrations at both Yukon River stations were low and ranged between 0.04 mg/L and 0.2 mg/L. Dissolved phosphorus concentrations at both stations were low with mean monthly values roughly between 0.003 mg/L and 0.01 mg/L and indicative of ultra-eutrophic to oligotrophic conditions (Appendix B). Concentration of TOC and DOC in both Yukon River stations ranged from 3.3 to 8.3 mg/L and from 4.7 to 8.6 mg/L, respectively (Table 3.4-3 and Table 3.4-4).

3.4.2.4 Trace Elements

Baseline trace element concentrations in this section of the Yukon River were derived from data collected from July 2017 to December 2020 at YUK-49.3 and YUK-37.6. In general, mean monthly concentrations of total and dissolved trace elements are low (*e.g.*, Al, As, Sb, Co, Cr, Pb, Hg, Ni, Se, U and Zn). Mean monthly total As concentrations in the Yukon River ranged from 66 to 356 mg/L, with noticeable lower values in late fall (Table 3.4-3 and Table 3.4 -4). In contrast to all the other monitoring locations in the vicinity of the project site, dissolved Al concentrations in the Yukon River exceeded the BC ENV guideline of 100 µg/L only in a few instances during the summer flow period (Figure 3.4-7). U concentrations in the Yukon River are also low with mean monthly values roughly below 5 µg/L (Table 3.4-3 and Table 3.4-4).

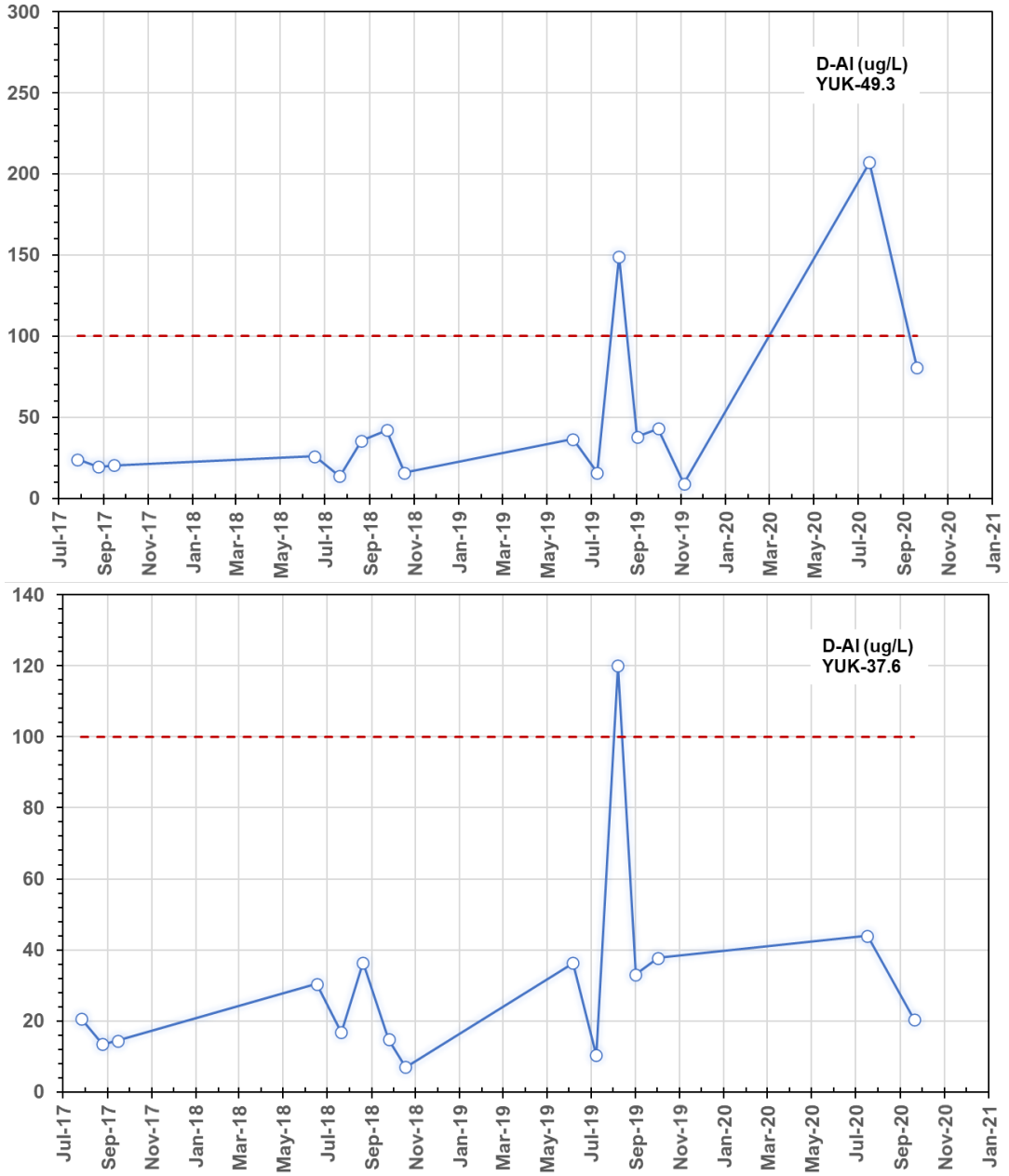

Figure 3.4-7: Dissolved aluminum (D-Al) concentrations at YUK-49.3 and YUK-37.6 in the Yukon River for the period July 2017 to September 2020 compared to British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dashed line) for protection of aquatic life.

Concentrations of total Cu in the Yukon River at station YUK-49.3 and YUK-37.6 rarely exceeded the CCME hardness-dependent Cu guideline for the protection of aquatic life most likely due to the moderately hardness in water (Figure 3.4-8). Mean monthly total Cu concentrations at both Yukon River stations indicate that elevated total Cu

concentrations are associated with the peak TSS events (*e.g.,* May-July). Cadmium concentrations remained below hardness dependent WQGs, with only one exceedance slightly above WQGs during summer flows (Figure 3.4-9).

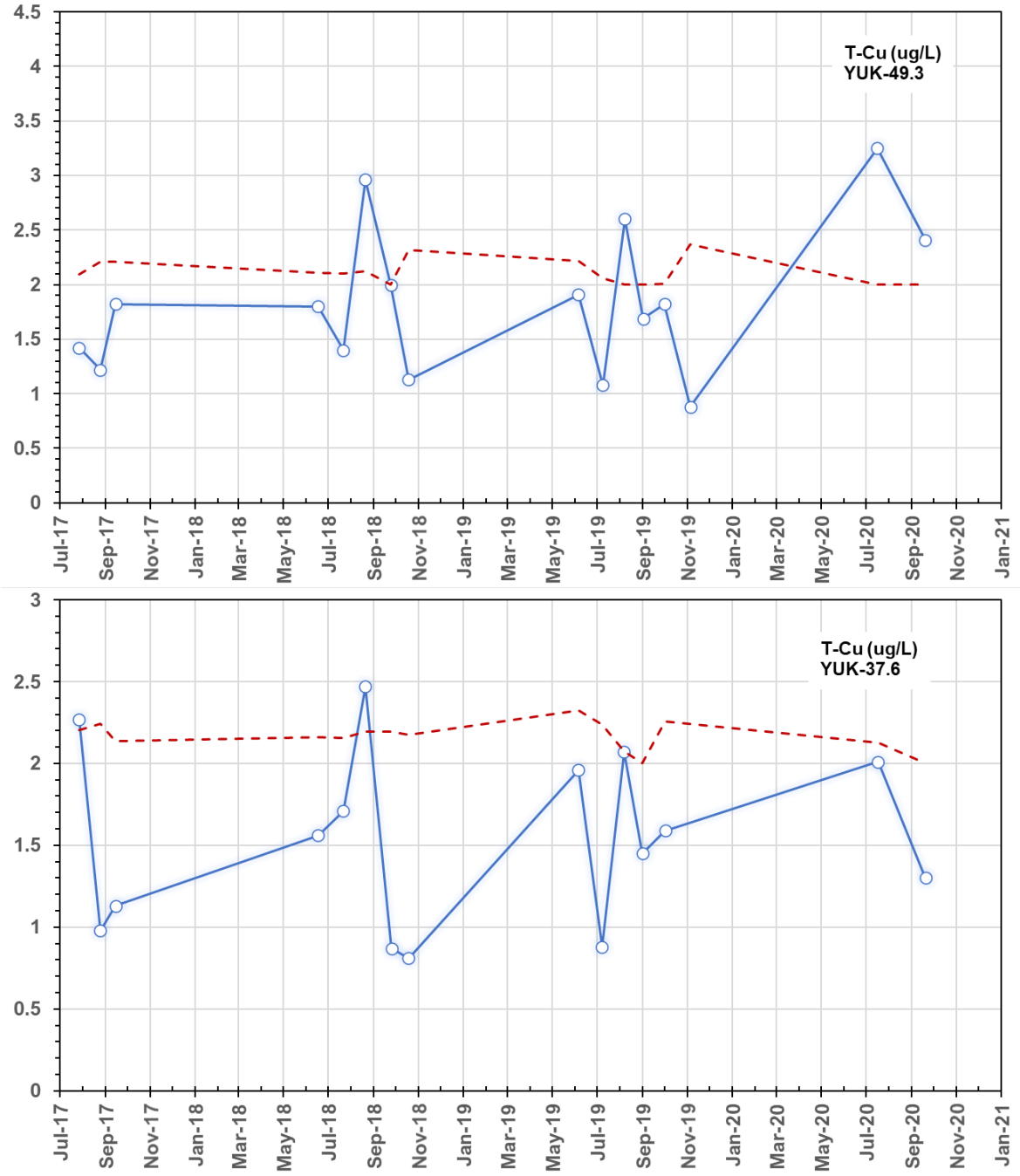

Figure 3.4-8: Total copper (T-Cu) concentrations at YUK49.3 and YUK-37.6 in the Yukon River for the period July 2017 to September 2020 compared to the Canadian Council of Ministers of the Environment (CCME) hardness-dependent guidelines (red dashed line) for the protection of aquatic life.

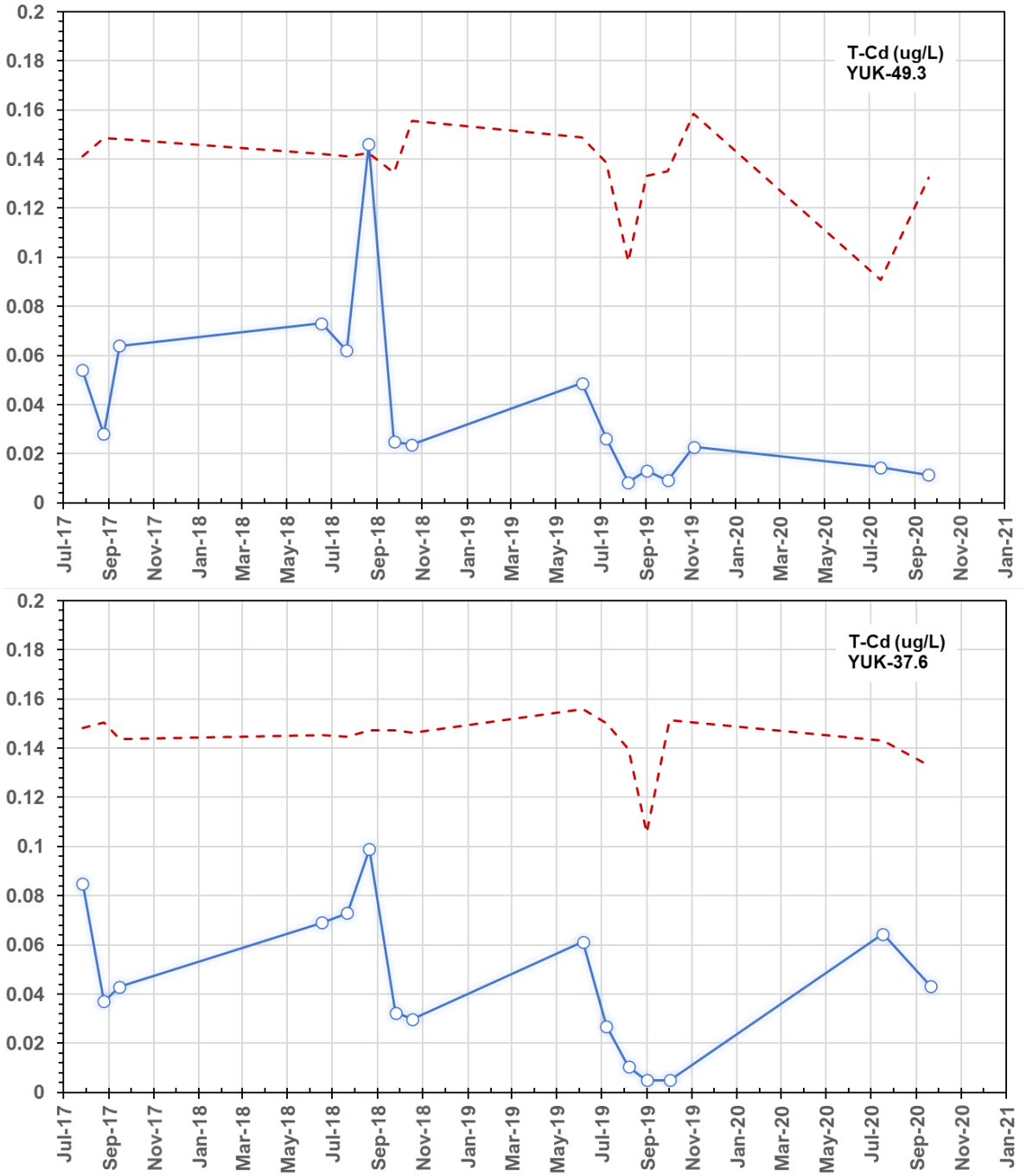

Figure 3.4-9: Total cadmium (T-Cd) concentrations at YUK-49.3 and YUK-37.6 in the Yukon River for the period July 2017 to September 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed line) hardness-dependent guidelines for the protection of aquatic life.

3.5 Independence Creek

This section describes baseline water quality results for Independence Creek. Independence Creek is not affected by proposed mining operations and therefore serves as a reference monitoring watershed.

Independence Creek is characterized by water quality measured at Station IC-2.7 (Figure 3.5-1) which reflects water quality conditions in lower Independence Creek and downstream of contributions from three small catchments that drain the east slope of the drainage divide between upper Latte Creek and Independence Creek (IC-16.1 and IC-14.6) and the eastern slope of the drainage divide of Halfway Creek and Independence Creek (KT-0.4) in Kona Creek (see Figure 2.1-2 and Figure 3.5-1).

Results are presented for station IC4.5 (mainstem of Independence Creek) and KT-0.4 in Kona Creek, a tributary to Independence Creek (Figure 3.5-1); complete results for all other stations are presented in Appendix A along with summary statistics for all stations in Appendix C.

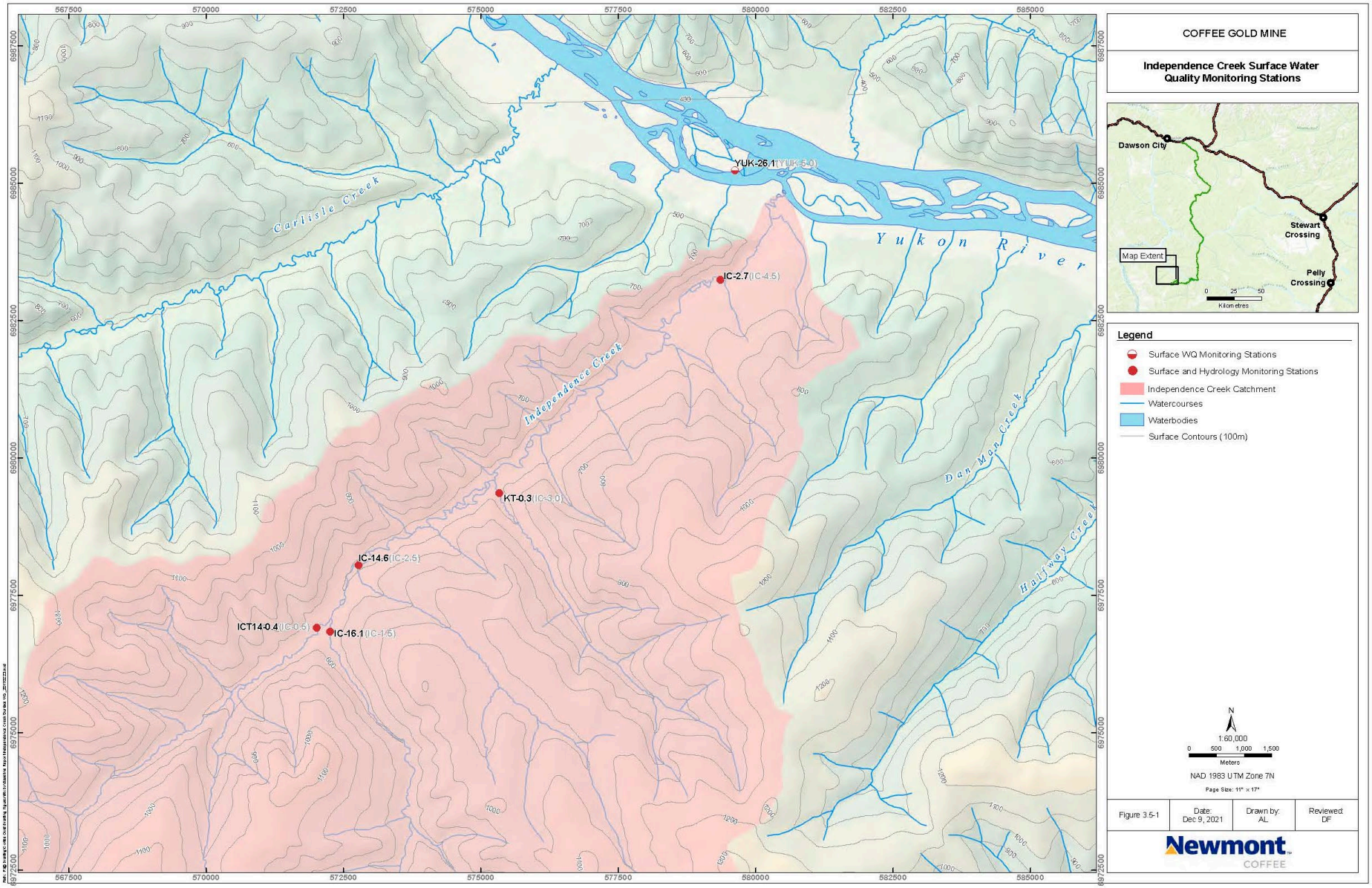

Figure 3.5-1: Detail of Independence Creek drainage illustrating key monitoring station locations

3.5.1 Station IC-2.7

3.5.1.1 Summary Statistics

Table 3.5-1 summarizes the mean monthly values for a suite of the key parameters for station IC-2.7 in Independence Creek.

3.5.1.2 Major Ions

The major ion chemistry of Independence Creek is assessed with respect to hardness, sulphate and pH. Station IC-2.7 is characterized by seasonally moderately soft waters (roughly 50 to 60 mg/L as $CaCO_3$) during open water periods of May to September) and moderately hard to hard waters (ranging from approximately 80 mg/L to 120 mg/L [as $CaCO_3$]) during lower flow periods and winter low flows (Table 3.5-1; Figure 3.5-2).

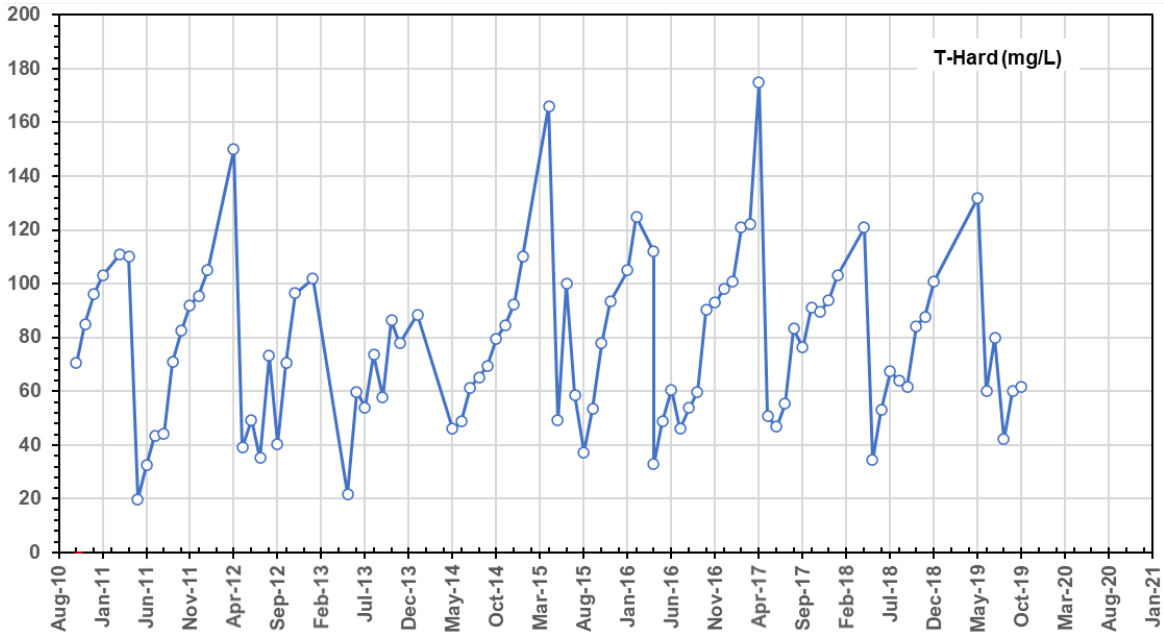

Figure 3.5-2: Total Hardness (T-Hard., as mg/L $CaCO_3$) in Independence Creek (IC-2.7) for the period October 2010 to December 2020.

Table 3.5-1:
Station IC-2.7 Monthly Mean Values

	IC-2.7 - Mean											
	Jan (n=8)	Feb (n=2)	Mar (n=2)	Apr (n=7)	May (n=9)	Jun (n=9)	Jul (n=9)	Aug (n=9)	Sep (n=9)	Oct (n=10)	Nov (n=9)	Dec (n=6)
Physical Parameters												
pH (s.u.)	7.5	7.7	7.3	7.7	7.3	7.5	7.6	7.6	7.6	7.6	7.6	7.5
Cond-L (uS/cm)	225	240	260	260	100	120	120	130	140	180	200	220
TSS (mg/L)	6.1	1.0	2.7	4.4	11	19	2.7	28	1.3	1.3	1.6	1.3
TDS (mg/L)	150	157	159	170	92	100	94	100	99	121	130	150
T-Alk (mg/L)	50	56	60	58	26	33	36	36	42	45	48	48
T-Hard (mg/L)	100	123	120	120	49	57	56	60	61	80	89	96
Anions												
Sulphate (mg/L)	54	55	62	68	18	22	21	21	21	35	46	48
Cl (mg/L)	0.9	0.80	1.2	1.2	1.3	1.4	0.82	0.95	0.62	0.76	0.69	0.63
F (mg/L)	0.054	0.047	0.051	0.06	0.047	0.063	0.065	0.066	0.066	0.067	0.057	0.06
Nutrients												
T-NH3 (mg/L)	0.036	0.024	0.037	0.025	0.026	0.027	0.032	0.022	0.022	0.014	0.017	0.021
NO2+NO3 (mg/L)	0.59	0.56	0.67	0.2	0.062	0.11	0.17	0.26	0.3	0.39	0.42	0.5
NO2 (mg/L)	0.0088	0.0021	0.0035	0.0055	0.017	0.0089	0.0089	0.0083	0.0077	0.0075	0.0030	0.011
NO3 (mg/L)	0.54	0.56	0.63	0.18	0.062	0.11	0.17	0.25	0.31	0.4	0.42	0.46
D-P (mg/L)	0.0029	0.0031	0.0057	0.0086	0.0095	0.0045	0.0051	0.0047	0.0042	0.0042	0.0025	0.0031
TOC (mg/L)	7.6	7.2	7.2	12	21	17	14	14	13	9.9	8.7	7.3
DOC (mg/L)	7.2	7.2	7.4	10	20	15	14	13	13	10	8.4	7.8
WAD-CN (mg/L)	0.00057	0.00077	0.00050	0.00076	0.0013	0.00098	0.00096	0.0011	0.00082	0.00073	0.00077	0.00054
Total Metals												
T-Al (ug/L)	110	43	66	100	420	370	160	690	130	62	49	47
T-Sb (ug/L)	0.12	0.081	0.12	0.085	0.07	0.11	0.12	0.14	0.13	0.11	0.091	0.09
T-As (ug/L)	0.37	0.29	0.3	0.41	0.61	0.69	0.53	0.97	0.5	0.4	0.32	0.29
T-Ba (ug/L)	63	66	70	57	31	36	32	40	30	39	49	55
T-Be (ug/L)	0.014	0.010	0.012	0.017	0.037	0.034	0.02	0.039	0.023	0.015	0.011	0.011
T-Bi (ug/L)	0.0099	0.0050	0.0075	0.073	0.011	0.0098	0.0067	0.013	0.0050	0.0055	0.0056	0.0067
T-B (ug/L)	30	10	30	27	37	32	24	29	24	27	28	23
T-Cd (ug/L)	0.043	0.014	0.046	0.037	0.037	0.028	0.021	0.031	0.014	0.011	0.019	0.02
T-Ca (mg/L)	27	34	31	33	13	15	15	16	17	21	24	26
T-Cr (ug/L)	0.52	0.21	0.52	0.26	0.76	0.97	0.5	1.6	0.48	0.31	0.26	0.21
T-Co (ug/L)	0.11	0.029	0.055	0.15	0.37	0.28	0.095	0.48	0.086	0.056	0.040	0.038
T-Cu (ug/L)	2.0	1.3	1.6	1.5	2.7	3.0	2.4	3.1	2.3	1.8	1.7	1.5
T-Fe (ug/L)	130	17	53	120	510	460	160	920	140	58	28	22
T-Pb (ug/L)	0.19	0.0075	0.079	0.06	0.21	0.21	0.055	0.5	0.032	0.016	0.053	0.016
T-Li (ug/L)	0.88	0.92	0.89	1.6	1.3	1.3	1.2	1.7	1.3	1.2	0.87	0.87
T-Mg (mg/L)	8.4	9.2	9.7	10	4.0	4.5	4.4	4.7	4.8	6.4	7.2	7.8
T-Mn (ug/L)	17	0.3	5.2	35	40	21	7.0	31	8.0	5.9	7.6	10
T-Hg (ug/L)	0.0051	0.0020	0.0060	0.0053	0.009	0.0066	0.0060	0.0059	0.0052	0.0062	0.0048	0.0048
T-Mo (ug/L)	0.24	0.2	0.19	0.21	0.18	0.22	0.23	0.28	0.26	0.27	0.22	0.22
T-Ni (ug/L)	1.1	0.87	1.1	1.2	1.8	1.7	1.3	2.0	1.2	1.2	1.0	0.98
T-K (mg/L)	1.4	1.3	1.5	1.8	1.1	0.98	0.95	1.0	0.98	1.2	1.2	1.2
T-Se (ug/L)	0.089	0.088	0.072	0.13	0.082	0.084	0.088	0.092	0.089	0.083	0.073	0.08
T-Si (ug/L)	5200	5395	5475	4900	2900	4300	4900	6000	5700	5440	5200	5000
T-Ag (ug/L)	0.0078	0.0050	0.0075	0.0051	0.0088	0.0083	0.0071	0.01	0.0050	0.0058	0.0056	0.0067
T-Na (mg/L)	4.1	4.0	4.3	4.4	1.8	2.4	2.5	2.6	2.6	3.3	3.6	3.7
T-Sr (ug/L)	140	160	160	160	66	80	80	85	83	110	130	140
T-Tl (ug/L)	0.0030	0.0020	0.0025	0.0031	0.0073	0.0062	0.0037	0.012	0.003	0.0025	0.0021	0.0026
T-U (ug/L)	0.51	0.44	0.46	2.4	1.8	1.5	1.2	1.3	1.3	1.2	0.67	0.5
T-Zn (ug/L)	3.2	0.52	3.7	2.3	3.1	2.5	1.9	3.4	0.98	0.69	1.2	0.86
Dissolve Metals												
D-Al (ug/L)	42	41	44	71	210	160	120	120	110	59	48	41
D-Sb (ug/L)	0.094	0.078	0.12	0.068	0.058	0.098	0.11	0.11	0.11	0.1	0.094	0.09
D-As (ug/L)	0.27	0.24	0.27	0.36	0.4	0.45	0.48	0.52	0.49	0.39	0.3	0.3
D-Ba (ug/L)	61	69	75	56	27	31	31	32	30	38	50	57
D-Be (ug/L)	0.010	0.010	0.011	0.015	0.028	0.024	0.018	0.02	0.019	0.013	0.011	0.010
D-Bi (ug/L)	0.0050	0.0050	0.0050	0.014	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
D-B (ug/L)	30	10	30	21	28	28	24	24	24	27	28	23
D-Cd (ug/L)	0.029	0.013	0.037	0.028	0.024	0.016	0.017	0.013	0.012	0.021	0.019	0.019
D-Ca (mg/L)	26	30	35	32	13	15	15	16	16	21	24	26
D-Cr (ug/L)	0.21	0.17	0.33	0.21	0.37	0.51	0.43	0.54	0.45	0.34	0.25	0.21
D-Co (ug/L)	0.033	0.027	0.027	0.081	0.17	0.079	0.073	0.077	0.067	0.051	0.039	0.033
D-Cu (ug/L)	1.9	1.3	1.6	1.4	2.2	2.5	2.7	2.3	2.2	1.9	1.7	1.4
D-Fe (ug/L)	18	12	19	62	210	140	100	120	100	49	24	15
D-Pb (ug/L)	0.049	0.0050	0.024	0.015	0.026	0.024	0.032	0.016	0.01	0.082	0.02	0.012
D-Li (ug/L)	0.79	0.97	0.8	1.7	0.92	1.1	1.3	1.3	1.3	1.2	0.94	0.91
D-Mg (mg/L)	8.4	9.1	10	10	3.8	4.3	4.4	4.7	4.7	6.2	7.2	7.9
D-Mn (ug/L)	2.6	0.24	3.2	26	21	4.2	4.4	5.2	6.0	5.4	7.2	9.8
D-Hg (ug/L)	0.0049	0.0029	0.0020	0.0046	0.0073	0.0066	0.0057	0.006	0.0055	0.0058	0.0044	0.0038
D-Mo (ug/L)	0.21	0.2	0.18	0.24	0.16	0.21	0.24	0.26	0.25	0.28	0.24	0.23
D-Ni (ug/L)	0.99	0.86	1.1	1.2	1.5	1.4	1.3	1.3	1.2	1.0	1.0	0.98
D-K (mg/L)	1.4	1.3	1.6	1.8	1.0	0.95	0.96	0.99	0.97	1.1	1.2	1.2
D-Se (ug/L)	0.084	0.074	0.080	0.13	0.074	0.078	0.084	0.083	0.091	0.086	0.072	0.078
D-Si (ug/L)	4900	5685	5895	4900	2600	4200	4740	5300	5600	5197	5100	5000
D-Ag (ug/L)	0.0066	0.0050	0.0050	0.0050	0.0053	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
D-Na (mg/L)	3.8	3.9	4.5	4.5	1.7	2.3	2.4	2.6	2.5	3.3	3.6	3.7
D-Sr (ug/L)	140	157	170	170	64	80	81	86	84	110	130	142
D-Tl (ug/L)	0.0021	0.0020	0.0020	0.0028	0.0037	0.0031	0.0035	0.0032	0.003	0.0023	0.0025	0.0021
D-U (ug/L)	0.42	0.42	0.46	2.5	1.6	1.3	1.1	1.1	1.3	1.2	0.65	0.49
D-Zn (ug/L)	1.8	0.6	3.6	1.9	1.8	1.2	0.93	0.72	0.96	2.0	1.1	0.92

The pH in Independence Creek remains relatively uniform throughout the year with values generally ranging between 7.3 and 7.7 (Table 3.5-1). All pH values reported to date have remained within the CCME freshwater guideline range for pH of 6.5 to 9.0.

Baseline concentrations for sulphate in Independence Creek also exhibit a strong seasonal signature with lowest concentrations occurring during peak runoff conditions. During peak flow periods, mean sulphate concentrations at IC-2.7 is approximately 20 mg/L (Table 3.5-1). Mean monthly sulphate concentrations during late fall and winter low flows range from roughly 35 mg/L to 68 mg/L.

As with the other stations monitored, TSS concentrations in Independence Creek exhibit maxima coincident with the peak snowmelt months (Table 3.5-1). At most other flow periods of the year, TSS values in Independence Creek at IC-2.7 are generally below 2.0 mg/L.

3.5.1.3 Nutrients

As with all other stations monitored, nutrient parameters are found in low concentrations in Independence Creek at station IC-2.7. Ammonia-N concentrations are low with mean monthly values typically less than 0.04 mg/L (Table 3.5-1). Mean monthly nitrate-N concentrations in Independence Creek are ranged almost an order of magnitude, with peak flow minima of 0.06 mg/L and winter low flow maxima of 0.60 mg/L. Independence Creek waters are oligotrophic to ultra-oligotrophic with monthly mean dissolved phosphorus concentrations at IC-2.7 ranging between 0.002 mg/L to 0.01 mg/L (Table 3.5-1).

Total organic carbon and DOC exhibit a similar marked seasonal signature as observed in other catchments within the project area. The highest DOC values are observed during peak runoff periods at station IC-2.7. DOC accounts for virtually all of the TOC. DOC concentrations range from approximately 7.0 mg/L during baseflow periods to concentrations in excess of 15 mg/L during higher flow periods (Figure 3.5-3).

3.5.1.4 Trace Elements

Baseline trace element concentrations in Independence Creek were derived from data collected from October 2010 to December 2020 at IC-2.7 (Figure 3.5-1). For most parameters monitored, mean monthly concentrations of total and dissolved trace elements are low; the sole exceptions to this observation are for dissolved Al and total Cu. Of note is the absence of elevated total U in Independence Creek (Table 3.5-1; Figure 3.5-4).

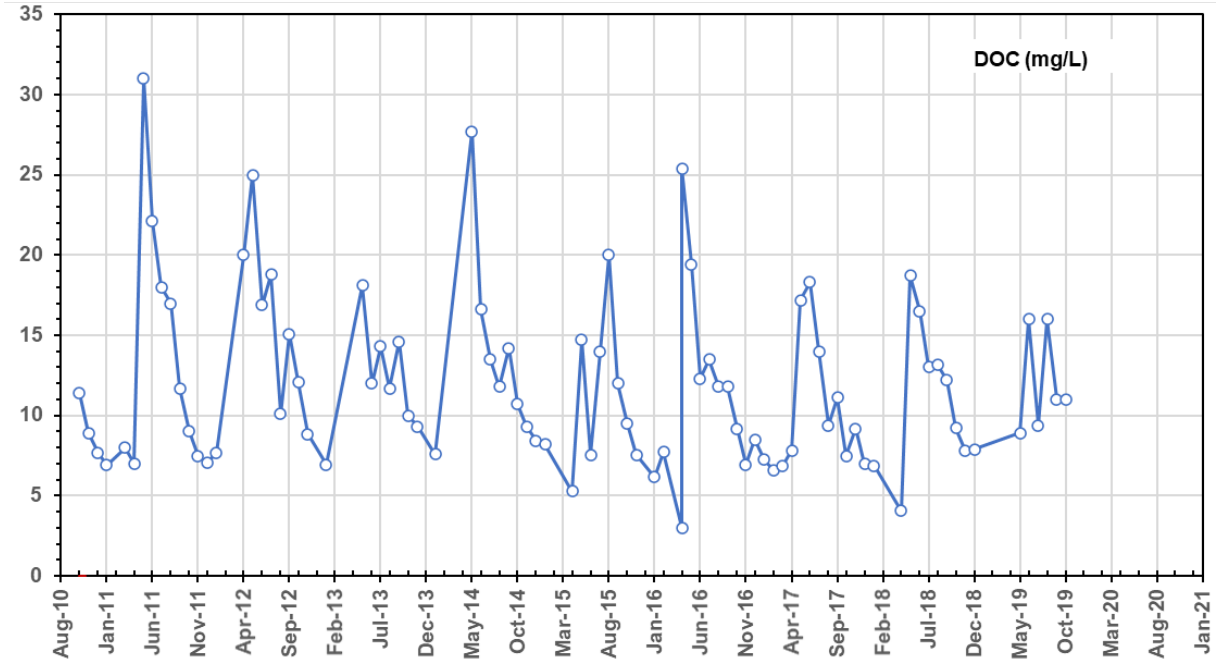

Figure 3.5-3: Dissolved organic carbon (DOC) in Independence Creek (IC-2.7) for the period October 2010 to December 2020.

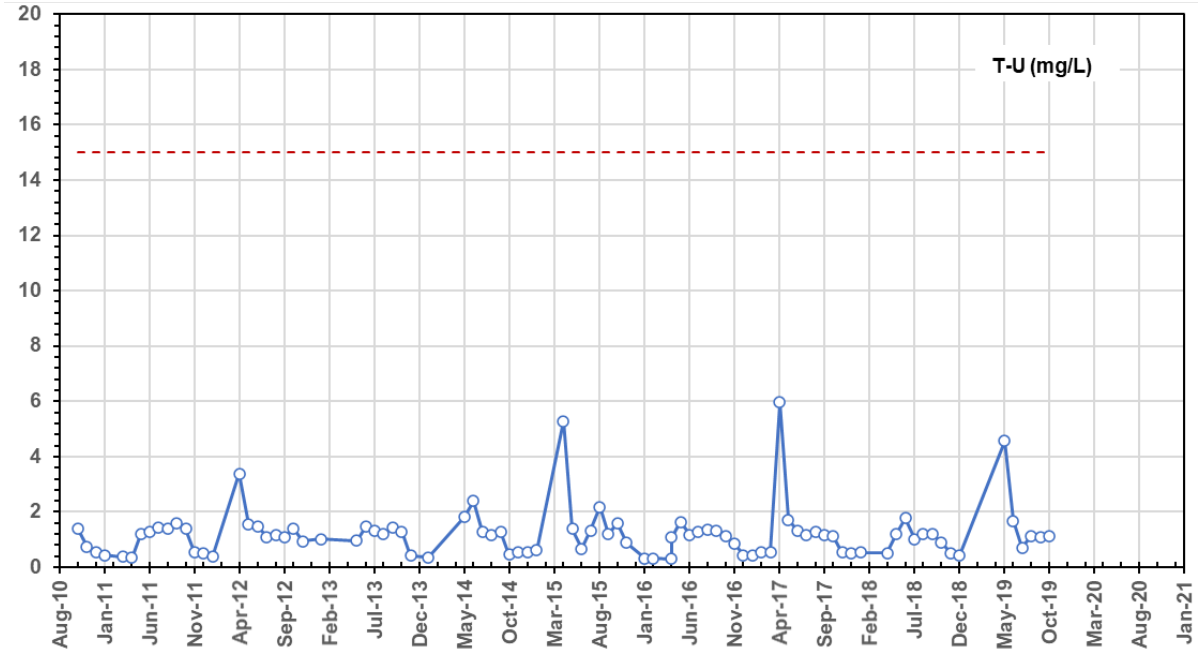

Figure 3.5-4: Total uranium (T-U) in Independence Creek (IC-2.7) for the period October 2010 to December 2020.

Dissolved Al at IC-2.7 is seasonally elevated in Independence Creek and consistently observed to be elevated well above BC ENV guideline for the protection of aquatic life of 100 µg/L during peak runoff periods (Figure 3.5-5).

During baseflow periods, dissolved Al concentrations in Independence Creek are roughly between 40 and 70 µg/L (Table 3.5-1 and Figure 3.5-5).

Concentrations of total Cu in Independence Creek exhibit a strong seasonal signature with maxima associated with peak runoff periods that exceed the CCME hardness-dependent Cu guideline for the protection of aquatic life (Figure 3.5-6). During most months of the open water period including May to September, mean monthly total Cu concentrations are naturally above CCME guidelines (Figure 3.5-7).

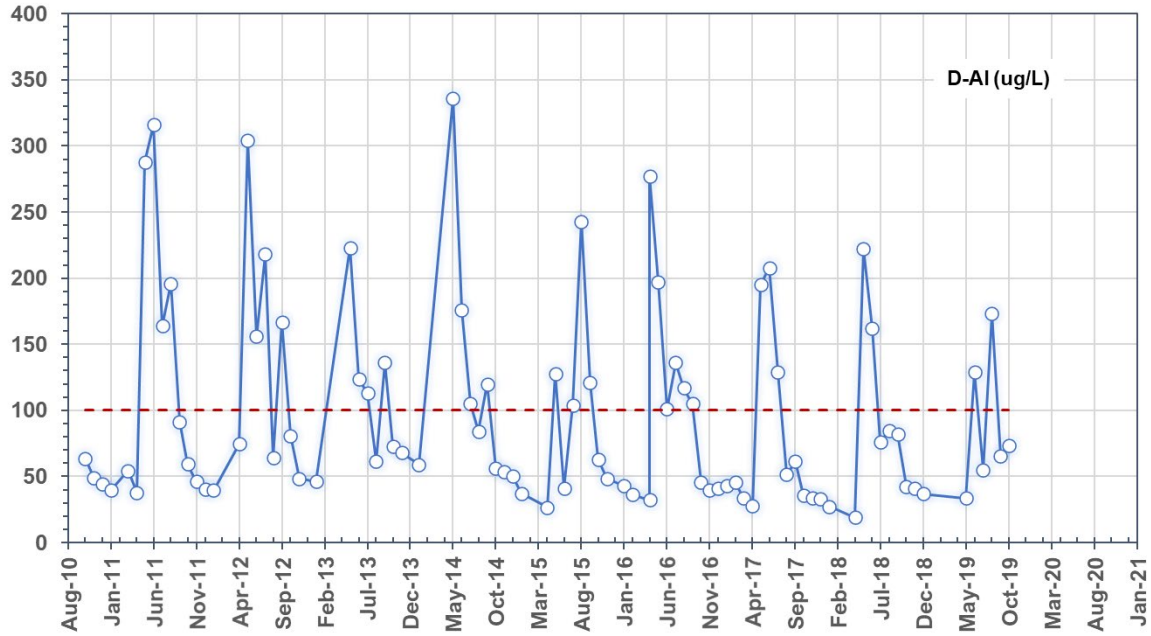

Figure 3.5-5: Dissolved aluminum (D-Al) in Independence Creek (IC-2.7) for the period October 2010 to December 2020 compared to the British Columbia Ministry of Environment and Climate Change Strategy (BC ENV) water quality guidelines (red dahsed lines) for the protection of aquatic life.

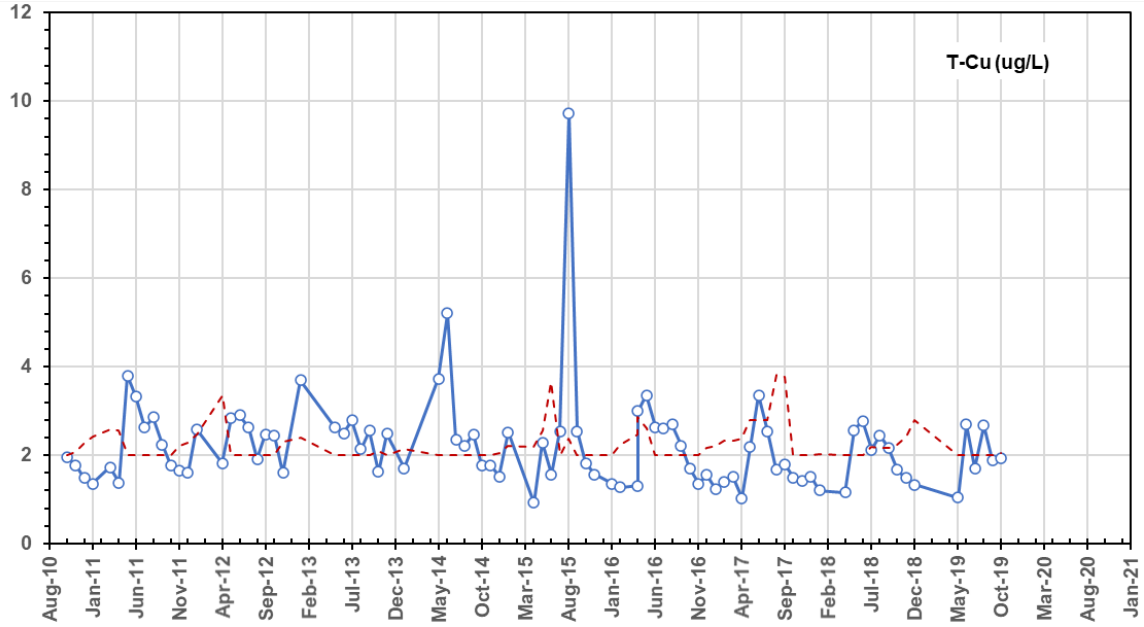

Figure 3.5-6: Total copper (T-Cu) in Independence Creek (IC-2.7) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (red dashed line) hardness-dependent guidelines for the protection of aquatic life.

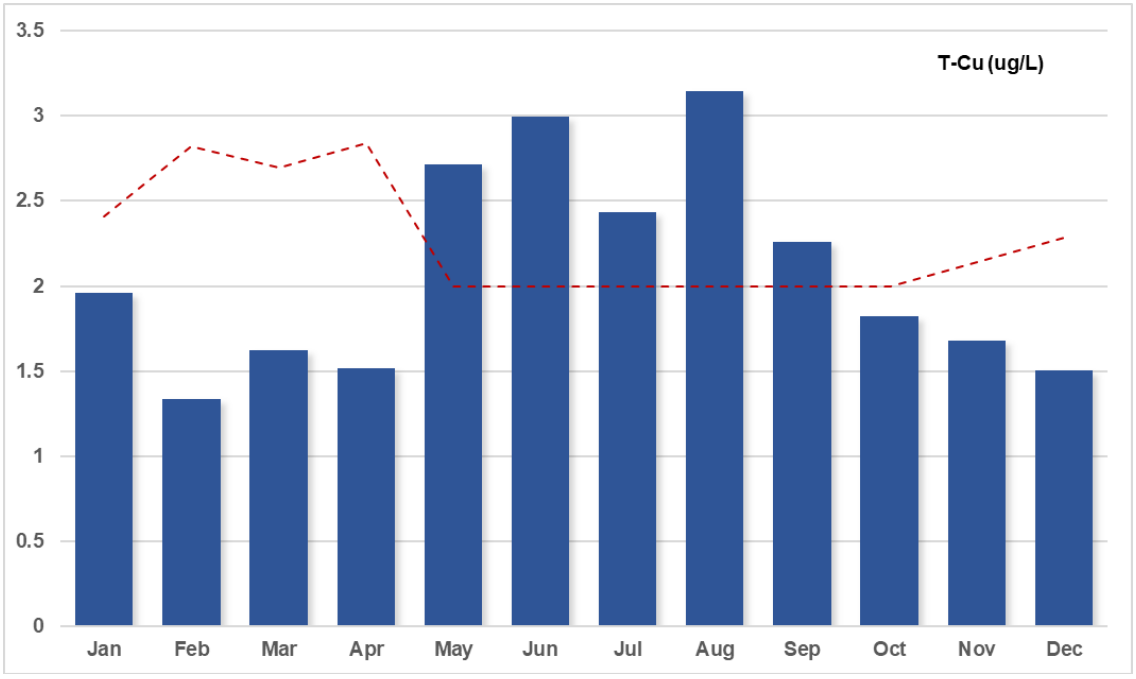

Figure 3.5-7: Mean monthly total copper (T-Cu) in Independence Creek (IC-2.7) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (red dashed line) hardness-dependent guidelines for the protection of aquatic life.

Total Cd concentrations in Independence Creek at IC-2.7 generally do not exceed the chronic or short-term CCME hardness-dependent guidelines for protection of aquatic life (Figure 3.5-8).

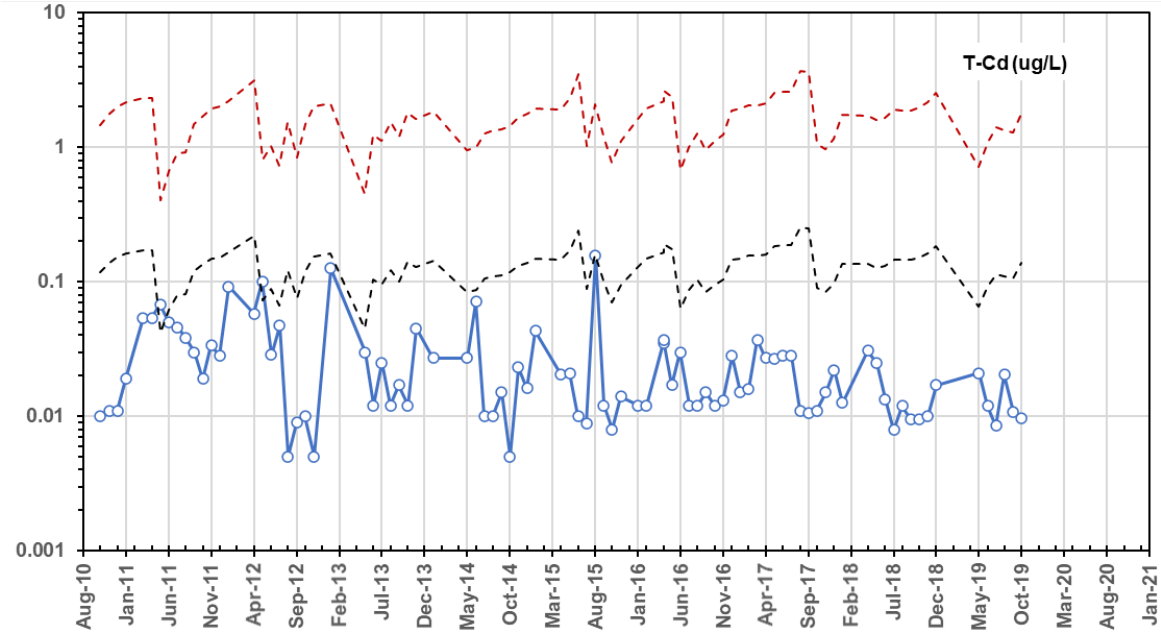

Figure 3.5-8: Total cadmium (T-Cd) in Independence Creek (IC-2.7) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed line) and acute (red dashed lines) hardness-dependent guidelines for the protection of aquatic life.

3.5.2 Station KT-0.4

3.5.2.1 Summary Statistics

Table 3.5-2 summarizes the mean monthly values for a suite of the key parameters for station KT-0.3 in Kona Creek.

Table 3.5-2:
Station KT-0.3 Monthly Mean Values

	Jan	Feb	Mar	Apr (n=5)	May (n=9)	Jun (n=9)	Jul (n=10)	Aug (n=9)	Sep (n=9)	Oct (n=10)	Nov (n=2)	Dec (n=1)
Physical Parameters												
pH (s.u.)	-	-	-	7.9	7.4	7.7	7.7	7.7	7.8	7.8	7.7	7.2
Cond-L (uS/cm)	-	-	-	380	140	210	180	170	180	230	250	280
TSS (mg/L)	-	-	-	2.1	7.5	33	3.1	41	1.5	1.8	2.5	1.0
TDS (mg/L)	-	-	-	200	116	160	130	130	130	160	183	200
T-Alk (mg/L)	-	-	-	85	33	52	49	51	55	64	64	71
T-Hard (mg/L)	-	-	-	190	65	100	84	84	85	110	110	141
Anions												
Sulphate (mg/L)	-	-	-	120	27	47	34	30	28	42	51	62
Cl (mg/L)	-	-	-	0.87	1.2	1.3	0.64	0.8	0.68	0.62	0.60	0.50
F (mg/L)	-	-	-	0.057	0.045	0.064	0.062	0.064	0.068	0.067	0.054	0.070
Nutrients												
T-NH3 (mg/L)	-	-	-	0.032	0.025	0.024	0.02	0.028	0.022	0.017	0.015	0.10
NO2+NO3 (mg/L)	-	-	-	0.02	0.16	0.28	0.37	0.51	0.63	0.72	0.62	-
NO2 (mg/L)	-	-	-	0.0062	0.023	0.0081	0.0075	0.0082	0.0078	0.0074	0.0035	0.0050
NO3 (mg/L)	-	-	-	0.02	0.14	0.27	0.37	0.48	0.63	0.71	0.64	0.49
D-P (mg/L)	-	-	-	0.0088	0.0079	0.0042	0.0047	0.0038	0.004	0.0038	0.0040	-
TOC (mg/L)	-	-	-	16	21	15	15	14	13	12	11	11
DOC (mg/L)	-	-	-	15	20	15	13	13	13	11	11	11
WAD-CN (mg/L)	-	-	-	-	-	-	-	-	-	-	-	-
Total Metals												
T-Al (ug/L)	-	-	-	94	380	520	210	860	88	52	47	25
T-Sb (ug/L)	-	-	-	0.4	0.19	0.3	0.32	0.37	0.36	0.37	0.32	0.17
T-As (ug/L)	-	-	-	1.2	1.4	2.1	1.4	2.6	1.2	1.1	0.77	0.72
T-Ba (ug/L)	-	-	-	51	25	39	32	37	26	35	42	32
T-Be (ug/L)	-	-	-	0.017	0.041	0.046	0.029	0.057	0.024	0.019	0.010	0.010
T-Bi (ug/L)	-	-	-	0.010	0.012	0.0087	0.0085	0.015	0.0050	0.0055	0.0050	0.0050
T-B (ug/L)	-	-	-	26	37	28	27	29	24	27	30	50
T-Cd (ug/L)	-	-	-	0.035	0.02	0.019	0.012	0.018	0.0066	0.012	0.0050	0.012
T-Ca (mg/L)	-	-	-	59	20	31	26	26	26	33	35	45
T-Cr (ug/L)	-	-	-	0.31	0.85	1.5	0.69	2.5	0.41	0.3	0.27	0.30
T-Co (ug/L)	-	-	-	0.1	0.28	0.46	0.16	0.64	0.078	0.064	0.058	0.059
T-Cu (ug/L)	-	-	-	1.5	2.2	2.8	2.3	3.1	2.2	2.0	2.0	1.9
T-Fe (ug/L)	-	-	-	110	350	610	230	1200	75	39	30	22
T-Pb (ug/L)	-	-	-	0.78	0.11	0.33	0.081	0.53	0.02	0.046	0.013	0.0070
T-Li (ug/L)	-	-	-	0.79	0.54	0.74	0.55	1.0	0.54	0.50	0.55	0.50
T-Mg (mg/L)	-	-	-	10	3.5	5.6	4.8	4.7	4.6	5.8	6.4	7.2
T-Mn (ug/L)	-	-	-	13	39	31	10	39	3.1	1.2	0.81	0.35
T-Hg (ug/L)	-	-	-	0.0045	0.0075	0.006	0.0057	0.0061	0.0059	0.0060	0.0062	0.010
T-Mo (ug/L)	-	-	-	0.34	0.25	0.36	0.38	0.42	0.42	0.43	0.35	0.20
T-Ni (ug/L)	-	-	-	0.81	1.7	1.6	1.1	2.1	0.84	0.83	0.79	0.83
T-K (mg/L)	-	-	-	3.3	1.5	1.9	1.6	1.8	1.8	2.0	2.0	2.1
T-Se (ug/L)	-	-	-	0.048	0.054	0.066	0.069	0.065	0.067	0.072	0.051	0.060
T-Si (ug/L)	-	-	-	5030	3000	4700	4912	6000	5200	5010	5110	5530
T-Ag (ug/L)	-	-	-	0.0070	0.0097	0.0066	0.0070	0.01	0.0050	0.0071	0.0050	0.0050
T-Na (mg/L)	-	-	-	4.8	1.8	2.9	2.7	2.6	2.7	3.1	3.2	3.3
T-Sr (ug/L)	-	-	-	330	110	170	140	150	140	180	195	131
T-Tl (ug/L)	-	-	-	0.0028	0.0069	0.01	0.0057	0.017	0.0043	0.0033	0.0025	0.0020
T-U (ug/L)	-	-	-	10	4.4	7.0	4.2	4.0	4.0	4.8	2.8	1.4
T-Zn (ug/L)	-	-	-	4.0	2.0	2.1	1.0	4.2	0.38	2.2	0.34	1.4
Dissolve Metals												
D-Al (ug/L)	-	-	-	54	220	100	96	85	67	43	41	43
D-Sb (ug/L)	-	-	-	0.32	0.18	0.29	0.32	0.34	0.36	0.35	0.32	0.31
D-As (ug/L)	-	-	-	0.96	1.2	1.2	1.1	1.2	1.2	1.0	0.74	0.71
D-Ba (ug/L)	-	-	-	51	23	33	30	27	26	35	42	51
D-Be (ug/L)	-	-	-	0.014	0.034	0.022	0.022	0.022	0.02	0.014	0.015	0.020
D-Bi (ug/L)	-	-	-	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
D-B (ug/L)	-	-	-	18	28	28	23	24	24	27	30	50
D-Cd (ug/L)	-	-	-	0.023	0.012	0.0089	0.012	0.0073	0.0086	0.0065	0.0060	0.014
D-Ca (mg/L)	-	-	-	57	20	31	25	26	26	33	40	45
D-Cr (ug/L)	-	-	-	0.21	0.45	0.38	0.4	0.4	0.37	0.28	0.22	0.20
D-Co (ug/L)	-	-	-	0.064	0.17	0.079	0.082	0.076	0.064	0.055	0.055	0.050
D-Cu (ug/L)	-	-	-	1.3	1.9	2.0	2.1	2.1	2.1	1.9	1.9	1.9
D-Fe (ug/L)	-	-	-	54	180	88	75	71	46	27	25	21
D-Pb (ug/L)	-	-	-	0.25	0.03	0.014	0.013	0.012	0.014	0.01	0.011	0.025
D-Li (ug/L)	-	-	-	0.65	0.5	0.50	0.53	0.51	0.50	0.51	0.54	0.50
D-Mg (mg/L)	-	-	-	10	3.3	5.3	4.6	4.5	4.6	5.6	6.3	7.0
D-Mn (ug/L)	-	-	-	8.0	27	3.3	5.1	4.0	2.1	0.85	0.48	0.41
D-Hg (ug/L)	-	-	-	0.0044	0.0075	0.0059	0.0058	0.0063	0.0061	0.005	0.0026	-
D-Mo (ug/L)	-	-	-	0.33	0.26	0.35	0.42	0.39	0.45	0.45	0.33	0.28
D-Ni (ug/L)	-	-	-	0.66	0.96	0.85	0.91	0.82	0.81	0.76	0.82	0.80
D-K (mg/L)	-	-	-	3.4	1.5	1.8	1.6	1.7	1.8	2.0	2.1	2.0
D-Se (ug/L)	-	-	-	0.048	0.046	0.061	0.064	0.062	0.063	0.059	0.059	0.060
D-Si (ug/L)	-	-	-	4834	2800	4300	4701	4990	5180	4936	5355	5580
D-Ag (ug/L)	-	-	-	0.0050	0.0064	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050	0.0050
D-Na (mg/L)	-	-	-	4.8	1.9	2.9	2.6	2.7	2.7	3.2	3.2	4.4
D-Sr (ug/L)	-	-	-	330	110	170	140	140	140	180	196	221
D-Tl (ug/L)	-	-	-	0.0020	0.0041	0.0038	0.0038	0.0039	0.0036	0.0028	0.0025	0.0030
D-U (ug/L)	-	-	-	10	4.1	6.5	4.0	3.6	4.1	4.7	2.6	2.1
D-Zn (ug/L)	-	-	-	3.0	1.5	0.54	0.35	0.47	0.39	0.86	0.93	1.5

3.5.2.2 Major Ions

The major ion chemistry of Kona Creek is assessed with respect to hardness, sulphate and pH. Station KT-0.3 is characterized by seasonally moderately soft waters (between 65 mg/L and 100 mg/L [as $CaCO_3$]) during open water periods of May to September) and moderately hard to hard waters (ranging from approximately 110 mg/L to 190 mg/L [as $CaCO_3$]) during lower flow periods and winter low flows (Table 3.5-2; Figure 3.5-11).

The pH in Kona Creek remains relatively circumneutral throughout the year with values generally ranging between 7.2 and 7.9 (Table 3.5-2). All pH values reported to date have remained within the CCME freshwater guideline range for pH of 6.5 to 9.0.

Baseline concentrations for sulphate in Kona Creek also exhibit a strong seasonal signature with lowest concentrations occurring during peak runoff conditions. During peak flow periods, mean sulphate concentrations at KT-0.3 range from less than 28 mg/L to approximately 47 mg/L (Table 3.5-2). Mean monthly sulphate concentrations during late fall and winter low flows range from 42 mg/L to 120 mg/L.

As with the other stations monitored, TSS concentrations in Kona Creek exhibit maxima coincident with the peak snowmelt months and high summer rainfall events (Table 3.5-2; Figure 3.5-10). At most other flow periods of the year, TSS values in Kona Creek at KT-0.3 are generally below 2.0 mg/L.

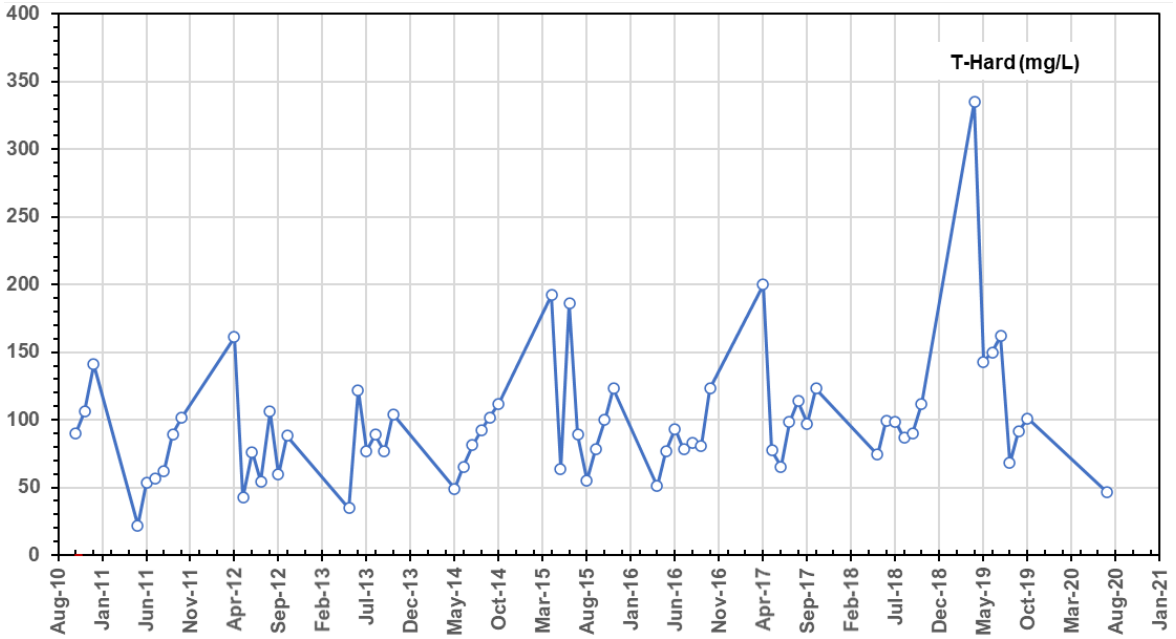

Figure 3.5-9: Total Hardness (T-Hard., as mg/L of $CaCO_3$) in Kona Creek (KT-0.3) for the period October 2010 to December 2020.

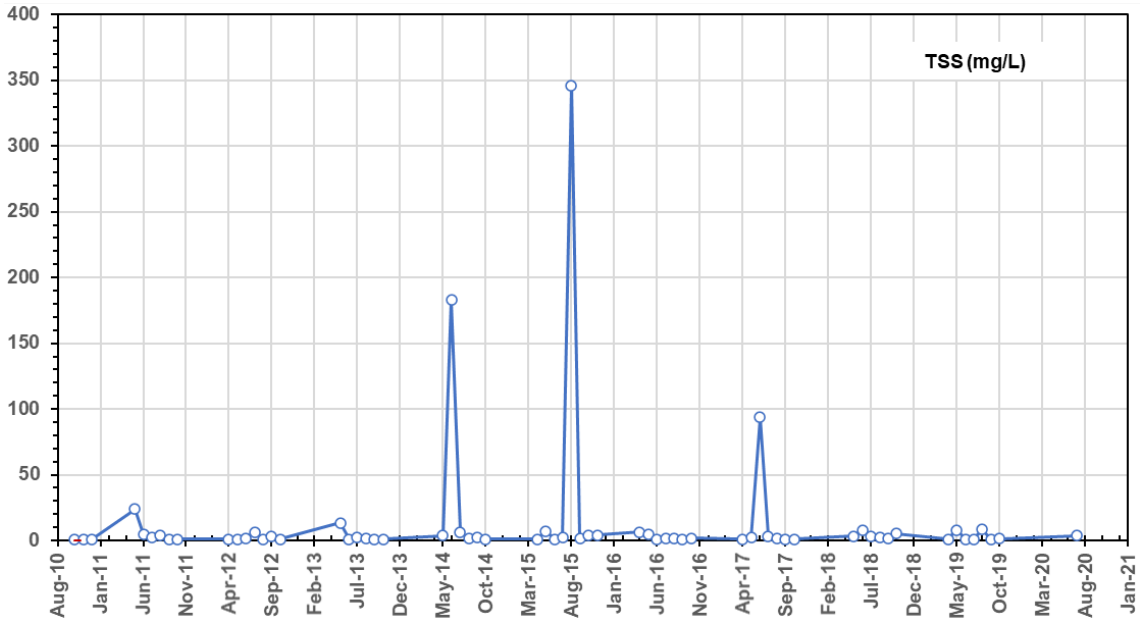

Figure 3.5-10: Total Suspended Solids (TSS) in Kona Creek (KT-0.4) for the period October 2010 to December 2020.

3.5.2.3 Nutrients

As with all other stations monitored, nutrient parameters are found in low concentrations in Kona Creek at station KT-0.3. Ammonia-N concentrations are low with mean monthly values typically less than 0.03 mg/L (Table 3.5-2). Mean monthly nitrate-N concentrations in Kona Creek ranged from a minima of 0.02 mg/L and winter low flow maxima of roughly 0.7 mg/L. Kona Creek waters are oligotrophic to ultra-oligotrophic with monthly mean dissolved phosphorus concentrations at KT-0.3 ranging between 0.003 mg/L to 0.009 mg/L (Table 3.5-2).

Total organic carbon and DOC exhibit a similar marked seasonal signature as observed in other catchments within the project area. The highest DOC values are observed during peak runoff periods at station KT-0.3. DOC accounts for virtually all of the TOC. DOC concentrations range from approximately 11 mg/L to 20 mg/L (Figure 3.5-11).

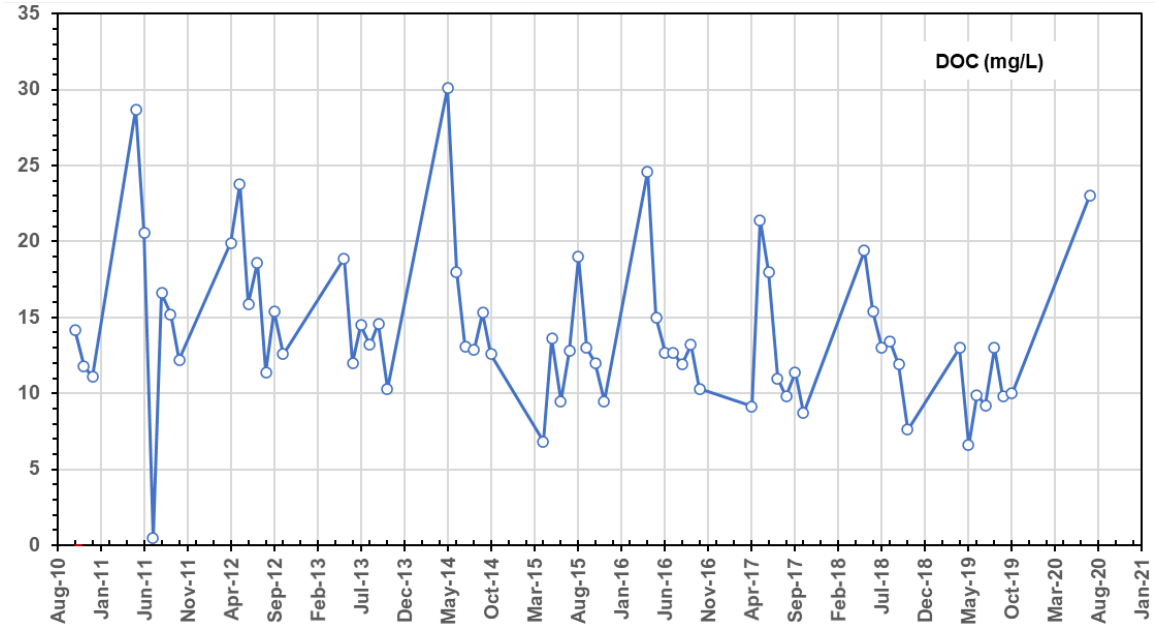

Figure 3.5-11: Dissolved organic carbon (DOC) in Kona Creek (KT-0.4) for the period October 2010 to December 2020.

3.5.2.4 Trace Elements

Baseline trace element concentrations in Kona Creek were derived from data collected from October 2010 to December 2020 at KT-0.3 (Figure 3.5-1). For most parameters monitored, mean monthly concentrations of total and dissolved trace elements are low; the sole exceptions to this observation are for dissolved Al and total Cu (Figure 3.5-12 and Figure 3.5-13, respectively).

Dissolved Al at KT-0.3 is seasonally elevated in Kona Creek and consistently observed to be elevated well above BC ENV guideline for the protection of aquatic life of 100 µg/L during peak runoff periods with concentrations up to 220 mg/L during freshet (Figure 3.5-12). During baseflow periods, dissolved Al concentrations in Kona Creek are roughly 45 µg/L (Table 3.5-2 and Figure 3.5-12).

Concentrations of total Cu in Kona Creek exhibit a seasonal and flow signature with maxima associated with peak runoff periods that exceed the CCME hardness-dependent Cu guideline for the protection of aquatic life (Figure 3.5-6). During most months of the open water period including May to September, mean monthly total Cu concentrations are naturally above CCME guidelines (Table 3.5-2).

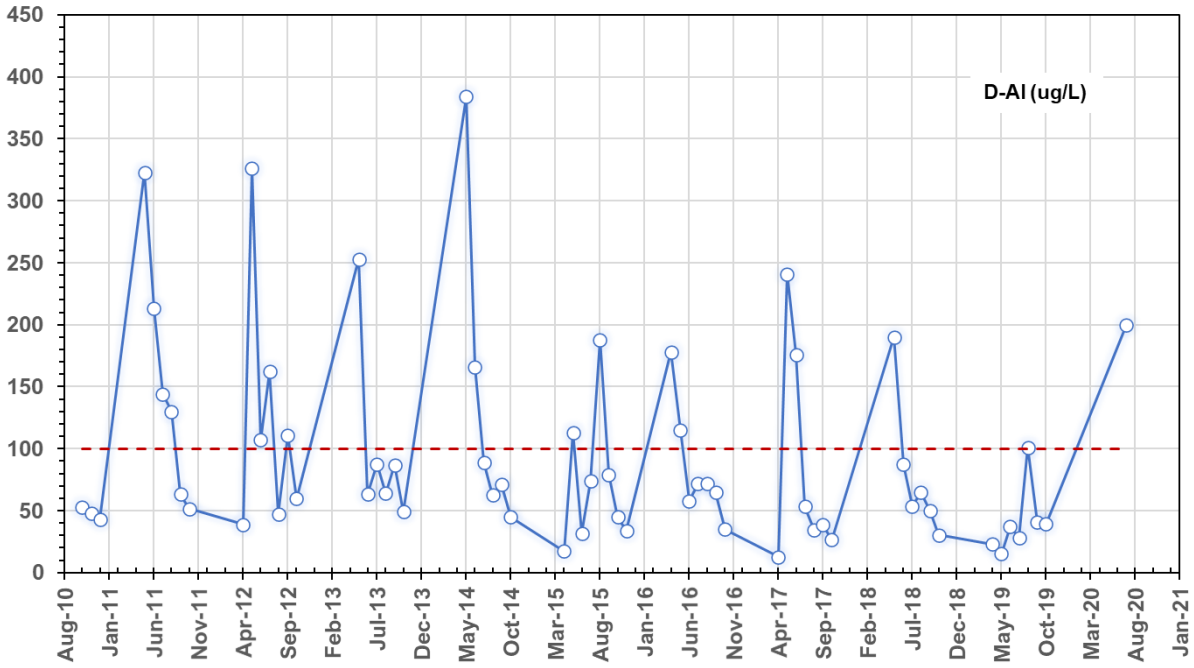

Figure 3.5-12: Dissolved aluminum (D-Al) in Kona Creek (KT-0.3) for the period October 2010 to December 2020.

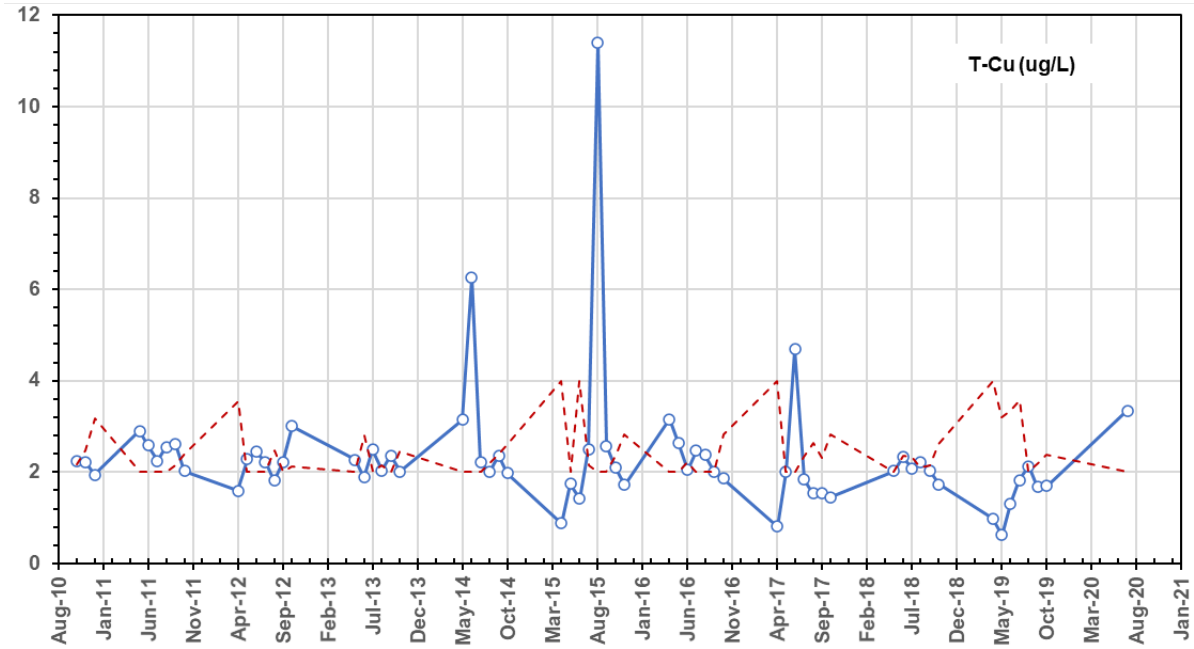

Figure 3.5-13: Total copper (T-Cu) in Kona Creek (KT-0.3) for the period October 2010 to December 2020.

Despite being downgradient of elevated As in groundwater in the vicinity of the Kona deposit, concentrations of total and dissolved As are low in Kona Creek. The posit for this absence of As in surface waters receiving groundwater elevated in As is due to changing

redox conditions. As, is a redox sensitive species. For As under circumneutral pH conditions, this metalloid is more soluble under suboxic or reducing conditions. Conversely, under more oxic conditions, As is less soluble and strongly sorbs onto Fe/Mn oxyhydroxide surfaces. Dissolved As in groundwater near the ridgetop at Kona is on the order of 2,000 µg/L, whereas the maximum dissolved As measured to date in Kona Creek at KT-0.3 is 1.2 µg/L (Figure 3.5-14; Appendix C).

Total As concentrations in Kona Creek are influenced by elevated TSS and peak As concentrations above the CCME guideline of 5.0 µg/L are coincident with high flow and elevated TSS (see Figure 3.5-10).

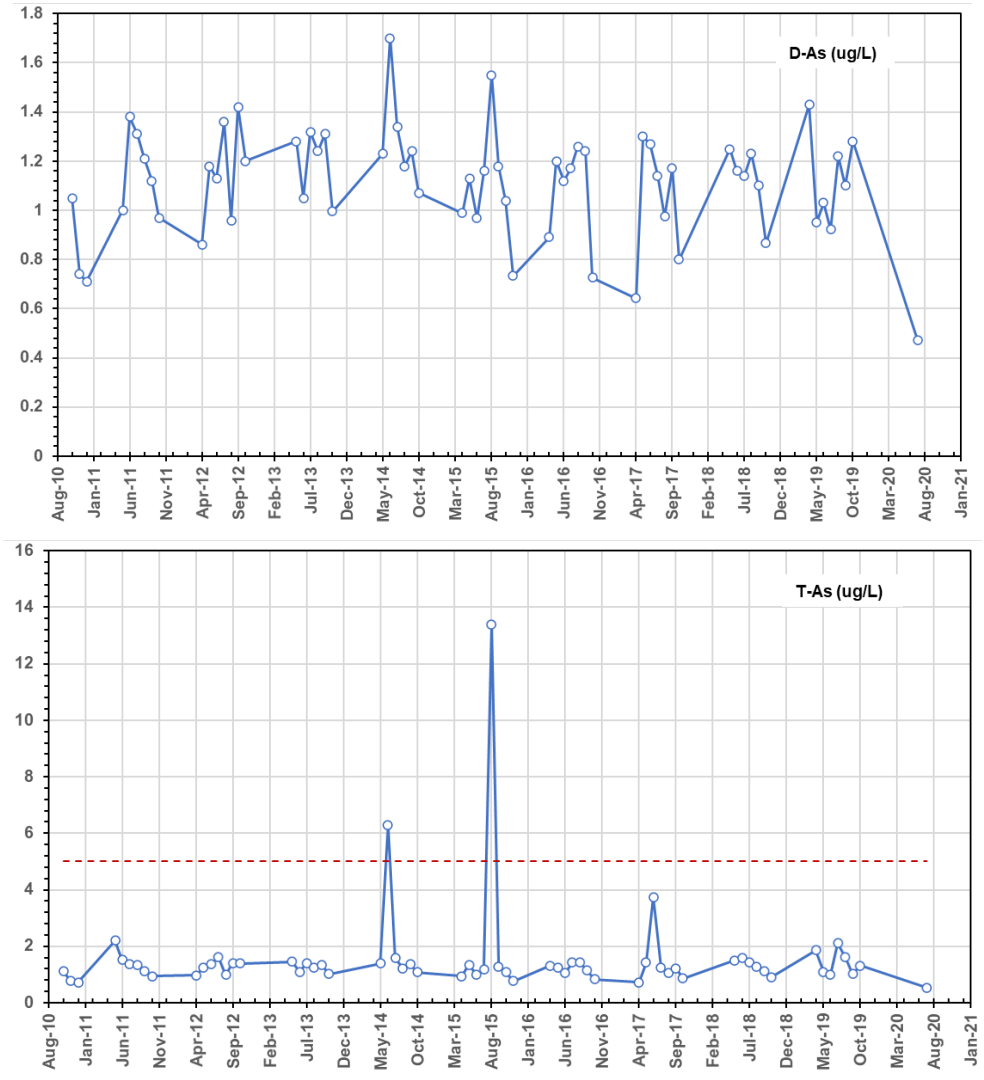

Figure 3.5-14: Comparison of Dissolved arsenic (D-As) and Total arsenic (T-As) in Kona Creek (KT-0.3) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) water quality guidelines (red dashed lines) for the protection of aquatic life.

Total Cd concentrations in Independence Creek at KT-0.3 generally do not exceed the chronic or short-term CCME hardness-dependent guidelines for protection of aquatic life (Figure 3.5-15).

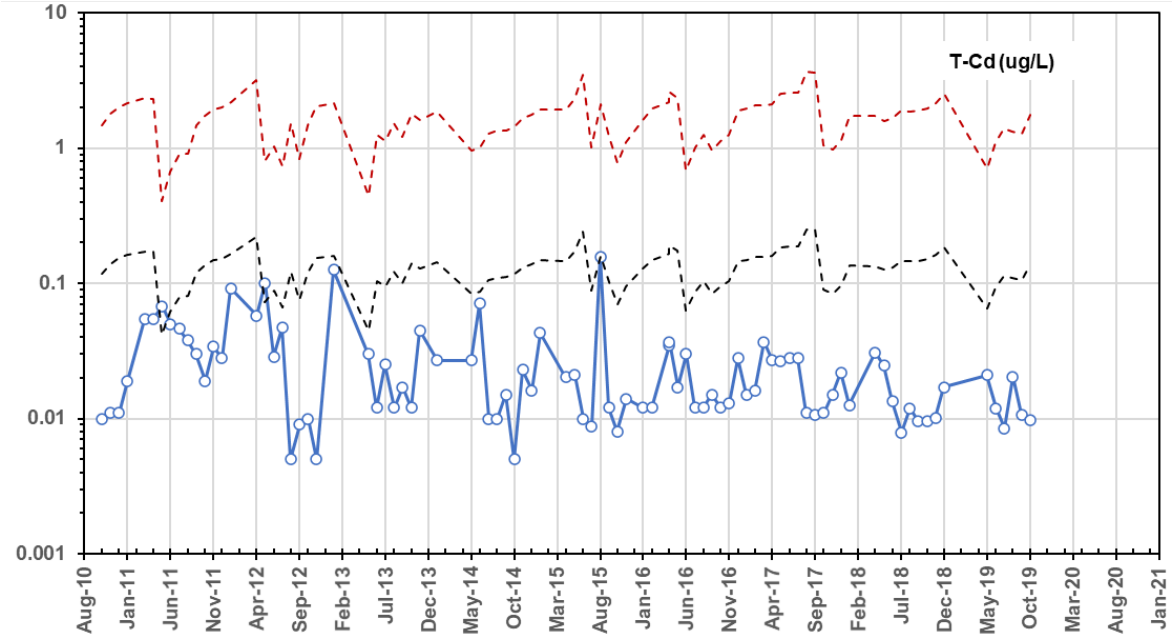

Figure 3.5-15: Total cadmium (T-Cd) in Independence Creek (KT-0.3) for the period October 2010 to December 2020 compared to the Canadian Council of Ministers of the Environment (CCME) chronic (black dashed lines) and acute (red dashed lines) water quality guidelines for the protection of aquatic life.

4. Closure

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4. Closure

We hope this report addresses your current needs. Please do not hesitate to contact the undersigned if you have further questions or concerns.

Respectfully submitted,

Lorax Environmental Services Ltd.

Prepared by:	*Reviewed by:*
Jorgelina Muscatello M.Sc., Ph.D., R.P.Bio., P. Bio.	**David Flather, M.Sc.**

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Appendix A: Unprocessed Data

An electronic copy of this file has been provided with the digital version of the 2022 Baseline Surface Water Quality Report. The digital file is an Excel spreadsheet and is named:

Appendix_A_ RAW DATA Updated_2021.xlsx

This document is available in digital version only.

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Appendix B: Monthly Data per Station

An electronic copy of this file has been provided with the digital version of the 2022 Baseline Surface Water Quality Report. The digital file is an Excel spreadsheet and is named:

Appendix_B_ MonthlyStatistics_2021Update.xlsx

This document is available in digital version only.

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Appendix C: Statistical Summary by Station

An electronic copy of this file has been provided with the digital version of the 2022 Baseline Surface Water Quality Report. The digital file is an Excel spreadsheet and is named:

Appendix_C_StatsSummaries_2021.xlsx

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APPENDIX D

Baseline Hydrogeological Assessment 2019 Update

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Coffee Gold Baseline Hydrogeological Assessment 2019 Update

Project No. A362-4
14 December 2021

LORAX ENVIRONMENTAL

Executive Summary

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Executive Summary

The Coffee Gold Project (the Project) is a proposed open-pit heap leach mine development located in west-central Yukon, 130 kilometers (km) south of Dawson City. The Project is subject to an assessment under the *Yukon Environmental and Socio-economic Assessment Act*. A Project Proposal and other related documents have been submitted to the Government of Yukon. This report constitutes an update to the baseline hydrogeological assessment of the Project that was submitted in support of the Project Proposal. Physical and chemical hydrogeological data collected up to August 2019 are summarized.

A combination of hydrogeological, geotechnical and geocryological field programs have established a robust network of hydrogeological monitoring installations in, around and downgradient of major mine facilities. The instrumentation includes eleven conventional monitoring wells, seven Westbay multilevel groundwater monitoring systems, nine combination vibrating wire piezometer (VWP)/thermistor strings, plus twelve stand-alone thermistor strings, twenty-five stand-alone shallow thermistor beads, and four stand-alone VWP strings. Groundwater level information is available from selected sites from as early as 2013, with all installations recording high frequency (sub-daily) water level and ground temperature information from mid-2015 onward.

Ground temperature data obtained from thermistors, as well as observations from drilling and monitoring well sampling indicate that permafrost is discontinuous but extensive across the project area. The thickest permafrost at site is measured on the north-facing slopes, a thermistor string at the north end of the proposed Supremo pit reports ~168 metres of permafrost. Permafrost appears to decrease in thickness with declining ground surface elevation. Permafrost in the project area is relatively warm (between 0 and -2ºC) and is coolest (-1.4ºC to -1.9ºC) on north-facing slopes.

Sixty successful measurements of bedrock hydraulic conductivity (K) have been obtained through a combination of different hydraulic testing methods. Bedrock hydraulic conductivity ranges over several orders of magnitude, from below test resolution (<1E-10 m/s) to over 1E-06 m/s, consistent with expectations for a fractured bedrock system. Hydraulic conductivity broadly decreases with depth and does not appear correlated to lithology. The median hydraulic conductivity of mineralized structures and faulted rock is 2E-07m/s with tests ranging up to 275 m depth.

At several higher elevation installations, the water table resides below the base of permafrost. The deepest water level at site, more than 220 meters below ground surface is found along the northwest extent of the proposed Supremo pit. At high elevation

installations near the proposed Kona and Latte pits, water levels are on the order of 110 to 150 m deep. A high elevation installation on the margins of the proposed heap leach facility, however, registers artesian pressures in a faulted area confined by permafrost.

Artesian groundwater pressures are reported at many lower elevation installations in both permafrost and permafrost-free areas. While groundwater pressures may be artesian adjacent to creek traces, often vertical gradients are downwards, suggesting groundwater is under-drained by the intercepted faults. This is particularly true at installations along Latte Creek. Upward hydraulic gradients are measured in the lower reaches of Halfway Creek near the intersection of a crosscutting fault.

Most groundwater hydrographs are smooth and broadly sinusoidal with one annual maximum that occurs weeks to months after freshet. A few recorded hydrographs from low elevation installations adjacent to creeks show flashier records that respond to rainfall events. Groundwater hydrographs fluctuate from less than 2 meters per year to over 30 metres at one location. Drier-than-average conditions in 2017 manifest as a smaller annual fluctuation compared to other years.

Groundwater sampling was conducted on nineteen occasions between 2014 and 2019. Sampling was conducted at monitoring wells installed by Lorax between 2014 and 2016 and covers the period from September 2014 to August 2019. Data from these sampling events are included in the evaluation of groundwater quality, although several results were discounted due to potential influences from drilling and well installation artifacts.

Groundwater in the Project area is predominantly circum-neutral (pH 6 to 8), with most groundwater samples between pH 6.5 and 8. Groundwater quality shows variable influence from weathering of sulphide minerals and/or dissolution of sulphate minerals, either from the deposits or other disseminated mineralization across the Project area. Sulphate concentrations range from low to substantial (7 to 1120 mg/L) and salinity is variable (field specific conductance readings between 28 and 2390 µS/cm). Major ion chemistry in overburden wells is calcium-bicarbonate-type. The bedrock groundwater in gneiss has a major ion chemical signature which ranges widely from calcium-bicarbonate to mixed magnesium-calcium-sodium-sulphate-type water, reflecting variable influence of sulphide weathering. Groundwater in the granite is calcium-bicarbonate-type but is generally more sodic than other groundwater on site. The groundwater sampled from the hydrothermal breccia and schist tends to be calcium-bicarbonate to magnesium-sulphate-type.

Baseline groundwater quality in the Project area is characterized by the presence of elevated dissolved arsenic and uranium. Dissolved arsenic and uranium concentrations were generally highest in the bedrock groundwater, ranging from 0.12 to 2650 µg/L and 1.2 to 589 µg/L, respectively.

Authorship

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Authorship

This update to the Coffee Gold Mine groundwater baseline report was prepared by Lorax Environmental Services Ltd. (Lorax) for Newmont. The report was written by Laura-Lee Findlater, B.Sc., P.Geo. and Jordi Helsen, M.Sc., P.Geo.; and reviewed by Steven Momeyer, P.Geo. Lorax has relied on information available in scientific literature and information supplied by Newmont in preparing this report.

Lorax Environmental Services, Ltd.
per:



"for physical hydrogeology aspects"

Laura-Lee Findlater, B.Sc., P.Geo.
Senior Hydrogeologist
Lorax Environmental Services Ltd.



"for groundwater quality and isotope aspects"

Jordi Helsen, M.Sc., P.Geo.
Environmental Hydrogeologist
Lorax Environmental Services Ltd.

Reviewed by:



Steven Momeyer, M.Sc., P.Geo.
Project Hydrogeologist
Lorax Environmental Services Ltd.

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Glossary and Abbreviations

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Glossary and Abbreviations

Terminology used in this document is defined where it is first used. The following list will assist readers who may choose to review only portions of the document.

DO	dissolved oxygen
EBA TT	EBA Tetra Tech
F_{paleo}	fraction of young groundwater (that recharged since 1953)
F_{young}	fraction of paleo groundwater (that recharged prior to ~11,700 years ago)
HCO_3	bicarbonate
HLF	heap leach facility
K	hydraulic conductivity
km	kilometre
KP	Knight Piésold
LMWL	local meteoric water line
$L/s/km^2$	litres per second per square kilometre
m	metre
m asl	metres above sea level
m bgs	metres below ground surface
m/s	metres per second, unit of hydraulic conductivity
mg/L	milligram per litre, unit of concentration
mm	millimetre
mm/yr	millimetres per year
Mt	megatonne
mV	millivolt
NH_3	ammonia
NO_3	nitrate
NTU	Nephelometric Turbidity Unit, unit of turbidity
O_2	oxygen
^oC	degrees Celsius
ORP	oxidation-reduction potential
the Project	the Coffee Gold Project
RC	reverse circulation

RDL	reportable detection limit
S^{2-}	sulphide
SC	specific conductance
SO_4	sulphate
TDS	total dissolved solids
TSS	total suspended solids
TU	tritium units
U/S	upstream
µg/L	micrograms per litre, unit of concentration
µS/cm	microsiemens/centimetre, unit of specific conductance
v m bgs	vertical metres below ground surface
VWP	vibrating wire piezometer
^{2}H	hydrogen-2, a stable isotope of hydrogen
^{3}H	tritium (or hydrogen-3), a radioactive isotope of hydrogen
^{13}C	carbon-13, a stable isotope of carbon
^{14}C	carbon-14 (or radiocarbon), a radioactive isotope of carbon
^{18}O	oxygen-18, a stable isotope of oxygen
δ	delta notation used to describe the stable isotope composition of a sample by normalizing the ratio of heavy to light isotopes (*eg.*, $^{2}H/^{1}H$, $^{13}C/^{12}C$, $^{18}O/^{16}O$) in a sample relative to that of a standard
‰	per-mil units, used to express the normalized difference between an isotope sample and its standard

1. Introduction

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1. Introduction

1.1 Project overview

The Coffee Gold Project (Project) is a proposed open-pit heap leach mine development located in west-central Yukon, approximately 130 km south of Dawson City (Figure 1-1). The Project is located in the Yukon-Tanana Terrane, an accreted pericratonic rock sequence that covers a large portion of the Omineca Belt in the Yukon and extends into Alaska and British Columbia. The Project has undergone a detailed Feasibility Study (Coffee Gold 43-101 FS) with project engineering and mine design progressing forward with full consideration of the environmental conditions at the property.

The Coffee Gold Project is amenable to development as an open pit mine with gold recovery recommended by heap leach mining methods. The general arrangement for the Project includes the following major infrastructure: primary and secondary crushing facilities; a carbon adsorption plant; a gold refinery; the heap leach facilities; waste rock storage facilities (WRSF); open and backfilled pits; water drainage structures and storage ponds; haul roads; an accommodations complex; and an all-weather airstrip.

The open pits associated with the Project are the Latte, Double Double, Supremo and Kona pits (Figure 1-2). Waste rock associated with the undertaking is proposed to be placed in one main facility (the Alpha WRSF), with additional backfill of waste in Latte, Double Double, Kona, and Supremo (SU1) pits. Proposed pits and WRSFs are all situated at high elevation (*i.e.*, median drainage basin elevations range from 945 to 1,220 m above sea level (m asl), and are proposed to be situated either on, or adjacent to, headwater tributaries of the Halfway Creek, Latte Creek, YT-24 (an unnamed tributary of the Yukon River) and Kona Creek (a tributary of Independence Creek) watersheds.

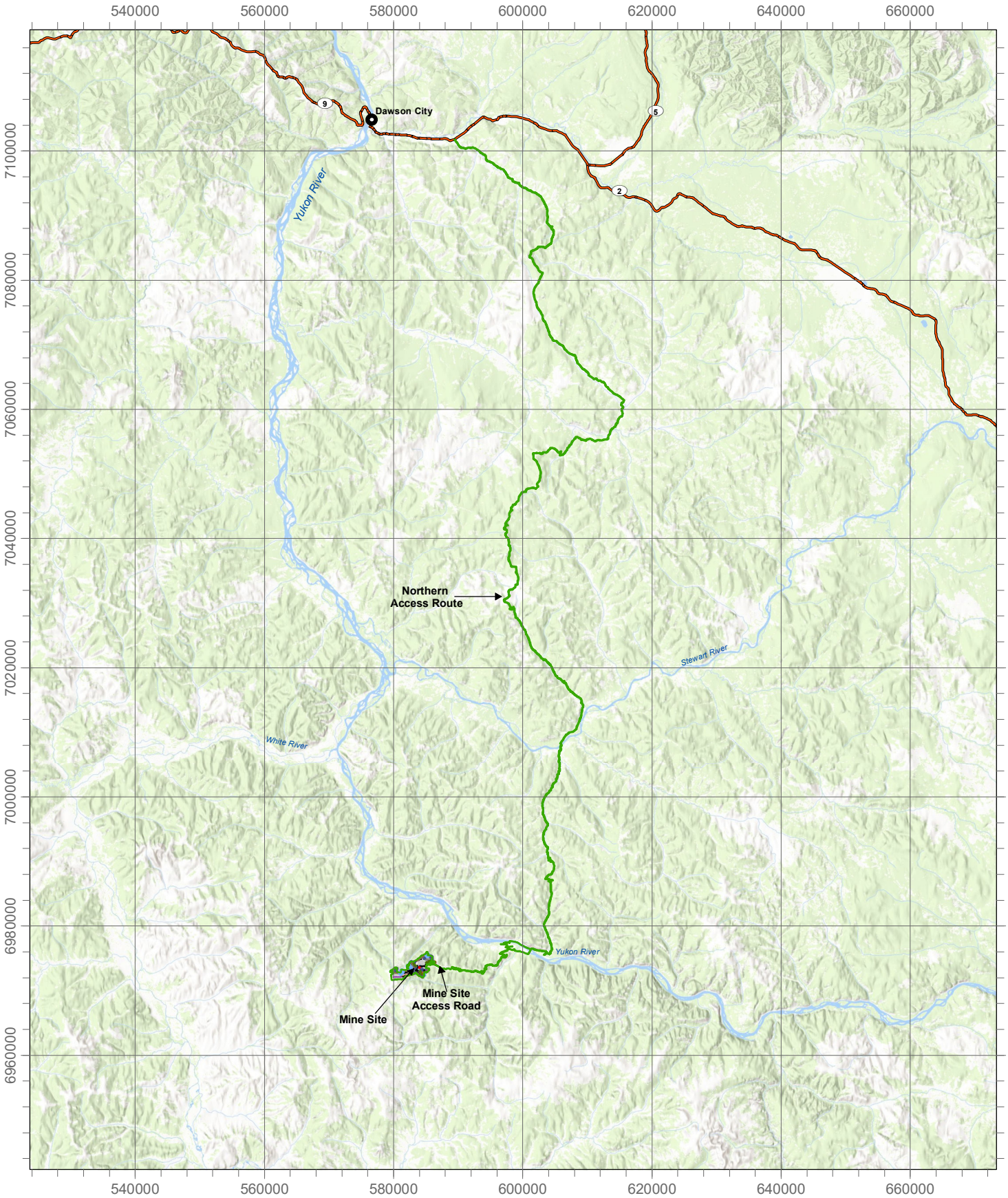
In parallel to exploration activities and feasibility studies, Newmont has resourced a full suite of baseline programs (*e.g.*, meteorology, hydrology, surface water quality, groundwater, soils, air, fish and fish habitat, wildlife) to support the preparation of an already submitted Project Proposal and related regulatory submissions to the Government of Yukon, as required by the *Yukon Environmental and Socio-economic Assessment Act*.

1.2 Scope of this document

This report constitutes the assessment of baseline groundwater conditions at the Project. This report updates the 2017 Coffee Gold Baseline Hydrogeological Assessment (Lorax, 2017c) submitted as part of the Yukon Environmental and Socio-economic Assessment Board assessment. It presents data collected in multiple hydrogeological field investigations completed between 2013 and 2019. This report presents data collected

through August 2019, which corresponds to the last monitoring round conducted by Lorax personnel. Collection of baseline groundwater quality and water levels is ongoing and will be continued through the licensing process.

Section 2 of this report provides background information from other disciplines which inform interpretation of the groundwater system. Section 3 describes hydrogeological and geotechnical studies undertaken at the site that have contributed to the baseline hydrogeological characterization. Section 4 presents the results of physical groundwater data collection including permafrost occurrence, hydraulic testing and water levels. Section 5 presents groundwater quality results and an interpretation of isotope samples collected from groundwater. Section 6 presents main findings and a summary of the baseline groundwater monitoring program.



LEGEND

- Highway
- Coffee Gold Project Footprint

DATE SAVED:	Nov 02, 2020
DRAWN BY:	AL
REVIEWED:	BM
VERSION:	1

Coordinate System: NAD 1983 UTM Zone 7N
Projection: Transverse Mercator
Datum: North American 1983
Units: Meter

1:805,288

0 5 10 Kilometers

CLIENT: Newmont COFFEE

LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Location Map, General Arrangement for the Coffee Project

PROJECT #: A362-4

FIGURE: 1-1

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580,000 582,500 585,000 587,500

6,977,500 6,975,000 6,972,500

N

Dan Man Creek

Halfway Creek

YT-24

Kona Creek

Late Creek

Coffee Creek Fault

MW15-03 WB/AZ/T (BH12)

MW15-04WB/AZ/T (BH4)

HC-6.8

YT24-4.9

MW15-01AZ (BH8)

MW15-01T/WB (BH8)

KT-5.2

GT17-35

GT17-34T

GT17-37T

GT17-33

GT17-36T

SRK-15D-07T

MW15-06WB (BH5)

MW14-01A/B

MW14-04T (BH6)

GT-14

CFD0402

Supremo Pit

GT17-39T

MW15-07T (BH7)

IFSPD062

IFSPD110a

CFD0334

CFD0439

MW14-06A/B

GT17-41

GT17-26T

CFD0336

IFSPD124

GT17-27

CFD0318

CFD0319

CFD0332

GT17-40B

SRK-15D-08AT

GT17-31

GT17-32

GT17-40

Alpha WRSF

GT17-28T

CFD0323

SRK-15D-10T

GT17-30

MW14-02A/B (BH9)

CFD0327

SRK-15D-16H

MW17-01T

GT17-02

GT-63

GT-66

SRK-15D-15H

Latte Pit

CFD0324

Double Double Pit

Kona Pit

SRK-15D-14H

MW14-03A/B (BH3)

CFD0351

MW14-05A/B (BH11)

GT17-03

SRK-15D-13T

GT17-21

Soil Stockpile

GT17-16

GT17-19

GT17-22

GT17-06

GT17-10T

MW16-01T/WB

GT17-20

GT17-17

GT17-11

GT17-15

GT17-06B

GT17-08

Heap Leach Facility

Event Pond

GT17-14

SRK-15D-09T

GT17-12

LCT20-0.14

MW15-02WB/AZ/T (BH10)

GT17-07

LC-11.4

LCT20-0.1

MW14-07T (BH1)

KPBH1

MW15-05 WB/AZ/T (BH2)

LC-15.5

KPBH4

LEGEND

- Surface WQ Monitoring Stations
- Surface and Hydrology Monitoring Stations
- Monitoring Well (AZ = active zone, WB = Westbay, A = deep conventional (200+m), B = shallow coventional (150+m), T = thermistor/VWP, BH = original drillpad name)
- Monitoring Well (collapsed)
- Thermistor (Lorax 2014)
- Thermistor (KP 2014)
- Thermistor (SRK 2015)
- Thermistor (TT/SRK, 2016,2017,2020)
- Thermistor/VWP (Lorax 2015,2016,2017)
- Thermistor/VWP (SRK 2015)
- Vibrating Wire Piezometer (VWP) (EBA 2013)
- Packer Tests (EBA 2013)
- Packer/Slug Tests (Lorax 2014)
- Packer Tests (SRK 2015)
- Drilled Mineralized Structure
- Inferred Mineralized Structure
- Linament (Huscroft, 2002)
- Fault (Approximate) (Grodzicki et. al, 2015).

Proposed Infrastructure

- WRSF/Backfill
- Pit
- Heap Leach Pad Base
- Event Pond
- Stockpile Pad
- Soil Stockpile

Italics in name indicates location was hydraulic tested (packer or airlift)

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:32,000

0 500 1,000 Meters

DATE SAVED:	Feb 03, 2021
DRAWN BY:	GM/AL
REVIEWED:	LF
VERSION:	1

CLIENT:

Newmont COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE:

Coffee Mine General Arrangement and Hydrogeological Monitoring Network

PROJECT #: A362-4 *FIGURE:* 1-2

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Baseline Report\Fig 1-2_monitoring network_20210201.mxd

2. Background

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2. Background

The following section provides a high-level summary of climatic, hydrologic and geological information relevant to the groundwater system at the Coffee Gold Project. Detailed baseline reports for each discipline below are presented under separate cover.

2.1 Climate

A baseline meteorological program was initiated at the Project in July 2012. Baseline hydrometeorological data have most recently been summarized in Lorax (2019). The prevailing climate conditions at the Project site are typical for central Yukon. The average annual temperature is -2.0°C, with average monthly air temperatures that range from -17°C (December) to +14°C (July). Locally, the Project site experiences notable temperature inversions in the winter months, with observed ridgetop temperatures up to 10°C higher than measurements recorded at valley bottom locations.

Mean annual precipitation at the proposed undertaking (~1,300 m asl) is estimated to be 499 mm, with rainfall comprising 65% of this total precipitation during the months of May through September, and the remaining 35% occurring as snow from October through April. Precipitation gradients were ascertained by inspecting site and regional precipitation data and were established as follows: 4%/100 m elevation gain for rainfall; and 7.5%/100 m elevation gain for snowfall. Annual site evapotranspiration is estimated to be 190 mm/yr, roughly 40% of the estimated potential evaporation which is consistent with other studies of the Yukon.

Precipitation data measured at the lower elevation site weather station (at kilometer 11) during the 2013 to 2018 water years is presented as a percent anomaly from the six-year trend in Figure 2-1. For this interpretation, the water year extends from October of the previous year to the end of September of the current year. Data for 2019 are not included as the most recent interpretation (Lorax, 2019) predates collection of the full water year data. Average runoff anomalies computed for site hydrometric stations are also included in Figure 2-1. At a cursory level, the runoff data indicate that 2014 and 2017 were drier years while 2013, 2015 and 2018 were wetter years and 2016 was an average year. The implication is that less water may have been available to recharge groundwater in 2014 and 2017, while the opposite would be true for 2013, 2015, and 2018.



Figure 2-1: Snow, rain and total precipitation anomaly for 2013-2018 water years (October-September)

2.2 Hydrology

A baseline surface water hydrology monitoring program was initiated in the autumn of 2010 and augmented with enhanced instrumentation and additional stations in the spring of 2014. The result is an extensive hydrometric network with a high quality and high-resolution streamflow data set. The most recent hydrometric data have been summarized in Lorax (2019).

Local patterns of streamflow are dominated by a snowmelt freshet that typically occurs between late April and early June. Following freshet, patterns of streamflow are punctuated by several rainfall-induced runoff events which occur throughout the summer and autumn. In general, these high flow events are short duration, persisting usually for a 1 or 2-day period. Flows in local creeks and streams abate in October in response to freezing temperatures and it is notable that local watersheds typically experience zero flow conditions throughout the winter (*i.e.,* November through end March). Aufeis (*i.e.,* frozen

groundwater seepage that accumulates within, and adjacent to, local watercourses) is pervasive in creeks and streams at the Project site and melts during the freshet but can persist into the early summer.

Based on measurements at Coffee Creek hydrometric stations, average unit yields across the Project site are 8 L/s/km^2 for the open water season (May to October), and range from 3 to 13 L/s/km^2, with specifics of the runoff regime for each monitoring station being dependent on drainage characteristics (*i.e.,* basin area, shape, mean elevation, extent of permafrost, *etc.*). Unit yields range from 0.6 –3.4 L/s/km^2 in October and decrease steadily to annual minima in March (*i.e.,* 0 – 0.7 L/s/km^2), before increasing again in April in response to low-elevation snow melt and spring rains. At Coffee Creek, instantaneous peak flows, expressed as unit yields, are typically between 120 and 200 L/s/km^2, but measurements vary widely across the site (from 60 to >300 L/s/km^2).

2.3 Physiography

The Project is located in the northern Dawson Range of the Yukon-Tanana terrane, forming a moderate plateau that escaped Pleistocene glaciation. The landscape evolved through erosional and periglacial processes. The dominant periglacial processes at the Coffee Gold site are cryoturbation, solifluction, slope wash and thermal erosion. The topography generally consists of rounded ridges with incised v-shaped valleys (AECOM, 2012). Elevations across the property range from 400 to 1,500 m asl with the majority of the property above the tree line and supporting short shrubby vegetation (JDS, 2016). The property has local mature pine forests with thick moss cover on the ground. Bedrock exposures on the property are rare (<5%).

A surficial geology map of the Coffee Creek area has been compiled by the Geological Survey of Canada (Huscroft, 2002). AECOM (2012) was retained by Kaminak Gold Corporation (Kaminak), a previous owner of the Project, to compile a detailed geomorphological map to aid in the selection of appropriate sampling sites for soil geochemical characterization. Both maps identify colluvium as the most widespread surficial material within the project area. The ridgetops and upper slopes are generally dominated by in-situ residual soils and colluvium derived from weathering of bedrock. The colluvial material is variable and typically contains mixtures of gravels, sands and silts with organic materials in the upper 0.1 to 0.2 m layer. The ridgetop soils are up to approximately 1.8 m deep and generally ice-poor. The thickness of the strongly-weathered bedrock is variable but is generally less than a metre. The build up of colluvium is greatest on lower slopes, which tend to be steeper than upper slopes. Dominant colluvial processes include slope creep, debris slides and minor rock fall.

2.4 Permafrost

The Project is located in an area classified by Natural Resources Canada (1995) as extensive discontinuous permafrost (*i.e.,* 50% to 90% of the land underlain by permafrost). The most recent estimates of permafrost distribution at the site indicate that approximately 66% of the mine area is underlain by permafrost with 34% of the area estimated to be permafrost free (Tetra Tech, 2017). Of the 66% underlain by permafrost, 35% is underlain by predominantly ice-poor permafrost, 30% by predominantly ice-rich permafrost; and approximately 1% by very ice-rich permafrost.

Permafrost is an important consideration in the conceptualization of groundwater systems as it imparts controls on groundwater movement. Active groundwater circulation can occur above, within and beneath permafrost (supra, intra and sub-permafrost groundwater). When ground temperatures fall below the freezing point, the hydraulic conductivity sharply decreases as unfrozen water content drops and pores and cracks are increasingly filled with ice (Woo, 2012). Permafrost is considered to behave like an aquiclude or an aquitard and can confine sub-permafrost groundwater such that it exhibits artesian conditions (Woo, 2012). Recharge of sub-permafrost groundwater in discontinuous regions can be directly from adjacent non-permafrost uplands or through supra and intra-permafrost connections (Woo, 2012). Multiple studies have indicated that some recharge can occur through frozen ground (Kane *et al.,* 2013; Niu and Yang, 2006; Bosson *et al*., 2013; Gruber and Haeberliem, 2007; Scheidegger, 2013).

Frozen ground has been mapped at the Project using a variety of methods. AECOM (2012) first mapped frozen ground on the property for a geomorphological mapping study supporting strategic soil sampling for exploration purposes. EBA Tetra Tech (EBA TT) further investigated permafrost occurrence through field mapping and air photo interpretation (2016). A terrain stability/geohazard map was produced by Palmer (2016). As described in Section 3, various investigations to characterize permafrost occurrence and extent have been completed for the Project which have resulted in the establishment of numerous thermistor installations (*e.g.,* EBA TT in 2013, Knight Piésold in 2014, SRK in 2015, Lorax in 2014, 2015, 2016, 2017, Tetra Tech and SRK in 2016 and Tetra Tech in 2017).

2.5 Geology

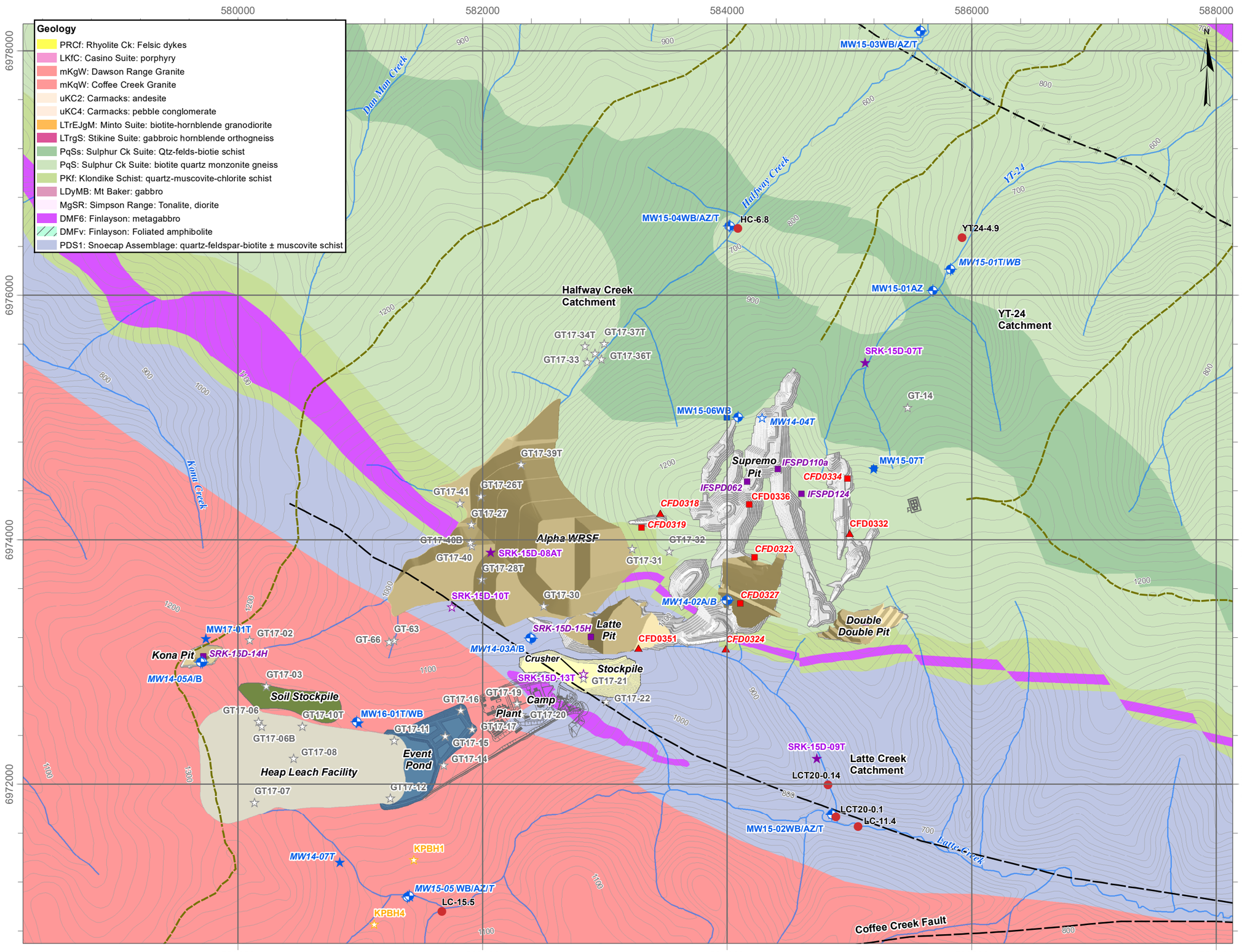
A detailed account of the geologic setting and mineralization of the Coffee Gold Project is provided in the 2016 Feasibility Study (JDS, 2016). The Project is underlain by a package of metamorphosed Paleozoic rocks of the Yukon-Tanana terrane that was intruded by a large granitic body in the Late Cretaceous. The Paleozoic rock package is predominantly a biotite (+ feldspar + quartz + muscovite ± carbonate) schist that overlies an augen

orthogneiss. Both the Paleozoic metamorphic rocks and Cretaceous granite are cut by intermediate to felsic dykes of andesitic to dacitic composition. Grodziki *et. al.* (2015) have compiled the most recent geological map of the Coffee Gold deposit area, informed by a combination of geological traverses, bedrock mapping, borehole data, soil geochemistry, and geophysics. This map has been used as the base map for Figure 2-2, which also shows mine facilities and instrument locations for reference.

The main Coffee Gold mineralization is associated with an extensional deformation event that occurred during the Cretaceous. This event resulted in formation of steep-to-vertical brittle fractures and normal faults crosscutting all lithologies at the Project area (Berman et al*.,* 2007). A CO_2-rich fluid flowed through the region and travelled upwards in the system into the epizonal domain of the Coffee Gold Project, where it was controlled by the structural framework of the Coffee fault system and reacted with favorable host rocks (Buitenhuis *et. al.*, 2015; Buitenhuis, 2014). The fluid travelled along brittle structures and deposited gold-rich arsenian pyrite through sulphidation, and in high-energy pulses, formed gold-rich hydrothermal breccias (Buitenhuis, 2014). The planar gold mineralized zones at the Project exhibit a number of strike orientations, dominated by east-west, north-south, and east-northeast–west-southwest strike directions.

The Supremo zone is housed in several drill-tested T-structure gold corridors which are 5 to 30 m wide. The Latte zone consists of a stacked set of moderately-to-steeply south-southwest dipping, east-southeast striking brittle-ductile structures. The Double Double zone consists of a number of discrete, high-grade strands of mineralization up to several metres wide, trends east-northeast steeply dipping to the north and consists of a number of discrete, high-grade strands of mineralization up to several metres wide. The Kona zone is hosted in equigranular granite and consists of east-northeast trending, steeply south-dipping stacked structures. The gold structures are associated with narrow, less than 5 m wide, sparsely feldspar phenocrystic to aphanitic andesite to dacite dykes.

Kaminak (2015) prepared a map of all confirmed mineralized structures identified on the property. The map identifies structures confirmed by drilling, trenching, or soil sampling and does not include regional-scale inferred faults. Structures identified in this map have been included in hydrogeologic maps provided in subsequent sections of this report due to their relevance as potential groundwater conveyance pathways.


580000
582000
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588000
6978000
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6972000
Geology
PRCf: Rhyolite Ck: Felsic dykes
LKfC: Casino Suite: porphyry
mKgW: Dawson Range Granite
mKqW: Coffee Creek Granite
uKC2: Carmacks: andesite
uKC4: Carmacks: pebble conglomerate
LTrEJgM: Minto Suite: biotite-hornblende granodiorite
LTrgS: Stikine Suite: gabbroic hornblende orthogneiss
PqSs: Sulphur Ck Suite: Qtz-felds-biotie schist
PqS: Sulphur Ck Suite: biotite quartz monzonite gneiss
PKf: Klondike Schist: quartz-muscovite-chlorite schist
LDyMB: Mt Baker: gabbro
MgSR: Simpson Range: Tonalite, diorite
DMF6: Finlayson: metagabbro
DMFv: Finlayson: Foliated amphibolite
PDS1: Snoecap Assemblage: quartz-feldspar-biotite ± muscovite schist
Dun Mun Creek
Halfway Creek
Kona Creek
Latte Creek
YT-24
Halfway Creek Catchment
YT-24 Catchment
Latte Creek Catchment
Coffee Creek Fault
MW15-03WB/AZ/T
MW15-04WB/AZ/T
HC-6.8
YT24-4.9
MW15-01T/WB
MW15-01AZ
SRK-15D-07T
GT-14
MW15-06WB
MW14-04T
Supremo Pit
IFSPD110a
IFSPD062
CFD0334
CFD0336
IFSPD124
MW15-07T
CFD0318
CFD0319
CFD0332
CFD0323
GT17-34T
GT17-37T
GT17-33
GT17-36T
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GT17-28T
Alpha WRSF
GT17-32
GT17-31
SRK-15D-10T
GT17-30
MW14-02A/B
CFD0327
SRK-15D-15H
Latte Pit
CFD0351
CFD0324
Double Double Pit
MW14-03A/B
Crusher
Stockpile
GT17-21
SRK-15D-13T
GT17-19
GT17-16
Camp
GT17-22
Plant
GT17-20
GT17-17
MW17-01T
GT17-02
GT-66
GT-63
Kona Pit
SRK-15D-14H
MW14-05A/B
GT17-03
Soil Stockpile
GT17-06
GT17-10T
MW16-01T/WB
GT17-11
GT17-06B
GT17-15
GT17-08
Event Pond
GT17-14
Heap Leach Facility
GT17-12
GT17-07
SRK-15D-09T
LCT20-0.14
LCT20-0.1
LC-11.4
MW15-02WB/AZ/T
MW14-07T
KPBH1
MW15-05 WB/AZ/T
LC-15.5
KPBH4
LEGEND
Monitoring Well:
AZ = active zone, WB = Westbay,
A = deep conventional (200+m)
B = shallow coventional (150+m)
T = thermistor/VWP
BH = original drillpad name
Thermistor (Lorax 2014)
Thermistor (KP 2014)
Thermistor (SRK 2015)
Thermistor (TT/SRK, 2016,2017, 2020)
Thermistor/VWP (Lorax 2015,2016,2017)
Thermistor/VWP (SRK 2015)
Vibrating Wire Piezometer (VWP) (EBA 2013)
Packer Tests (EBA 2013)
Packer/Slug Tests (Lorax 2014)
Packer Tests (SRK 2015)
Surface WQ Monitoring Stations
Surface and Hydrology Monitoring Stations
Linament (Huscroft, 2002)
Fault (Approximate) (Grodzicki et. al, 2015).
Catchment Boundary
Elevation Contours (20m)
Proposed Infrastructure
WRSF/Backfill
Pit
Heap Leach Pad
Event Pond
Soil Stockpile
Stockpile Pad
Italics in name indicates location was hydraulic tested (packer or airlift)
Coordinate System: NAD 1983 UTM Zone 7N
Projection: Transverse Mercator
Datum: North American 1983
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1:30,000
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Meters
DATE SAVED: Feb 03, 2021
DRAWN BY: GM/AL
REVIEWED: LF
VERSION: 1
CLIENT:
Newmont COFFEE
LORAX ENVIRONMENTAL
PROJECT:
Coffee Gold Project
TITLE:
Bedrock Geology of the Coffee Gold Project
PROJECT #: A362-4
FIGURE: 2-2
P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Baseline Report\Fig 2-2_Bedrock Geology_20210203.mxd

3. Hydrogeological Field Investigations

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3. Hydrogeological Field Investigations

Multiple hydrogeological field programs have been undertaken at the Project between 2013 and 2019 (Table 3-1). The field programs have established a robust network of hydrogeological installations in, adjacent to and downstream of proposed major mine facilities (Figure 1-2). The location and configuration of some mine facilities (*e.g.* Heap Leach Facility (HLF), WRSF) has evolved since hydrogeological field investigations were initiated, with the mine plan layout shown in Figure 1-2 current to date. The groundwater field installations are as summarized as follows:

- Eleven conventional monitoring wells (five wells less than 10 meters deep; six wells between 150 and 220 metres deep);
- Seven individual multi-port Westbay installations monitoring groundwater 10 to 286 metres deep;
- Twenty-six stand-alone thermistor strings, 14 multi-bead thermistors strings ranging from 20 to 300 metres deep and 26 single bead shallow thermistor strings installed between 4 and 10 metres deep;
- Four stand-alone vibrating wire piezometer (VWP) installations ranging from 120 to 185 metres deep; and,
- Twelve combination VWP/thermistor installations ranging from 52 to 268 metres deep.

Completion details of the conventional monitoring wells, Westbay systems, VWP and thermistor are provided in Table 3-2 through Table 3-6. Borehole logs and instrumentation documentation are provided in Appendices 3-A through 3-C.

Many of the drilling programs have incorporated hydraulic testing of bedrock, predominantly through a combination of packer testing and airlift testing. Limited slug testing has also been conducted. In conjunction with monitoring well installations, multiple groundwater sampling events have been undertaken to characterize baseline groundwater quality and its range of variability. The discussion below provides a high-level overview of the field programs with emphasis on those conducted by Lorax.

3.1 EBA Tetra Tech 2013 Program

The first hydrogeological field program, supervised by EBA TT in the fall of 2013, collected hydraulic testing data from, and installed, four single-point VWPs in NQ2-sized (75.7 mm diameter) boreholes advanced as a part of the exploration program. The program utilized a diamond drill rig owned and operated by Cyr Drilling International Ltd. of Manitoba. The majority of the field work was conducted by Kaminak staff, with training

from EBA TT. A total of four VWPs (Table 3-4, Figure 1-2) manufactured by RST Instruments, were installed with readings taken on a monthly basis with a manual readout unit (as these installations were not equipped with dataloggers).

3.2 Lorax 2014 Drilling Program

The data from the EBA TT 2013 program were used to inform the design of detailed hydrogeological baseline program conducted by Lorax between August 10th and September 25th, 2014. The primary goals of the 2014 program were to collect additional hydraulic testing data downgradient of mine facilities and to establish long-term groundwater monitoring and sampling locations. The program was undertaken using both skid-mounted and heli-portable diamond drill rigs (Boyles 37, Duralite D-10 and Silver Bear A5) owned and operated by Cyr Drilling. Two drill rigs were run concurrently for the majority of the program. Most drillholes were HQ-sized (96 mm) with the exception of two PQ-sized (122.6 mm) holes (MW14-06A and MW14-06B). The use of drilling additives was initially avoided to minimize potential impacts to groundwater quality following well installation, but drilling conditions necessitated their use in holes numbered MW14-03A/B and higher. Drilling additives used included AMC Pure-Vis, AMC Corewell, MATEX Ultra-Vis and Di-Corp G-Stop. All drilling and installations were supervised by Lorax personnel.

The 2014 program was limited to upland areas in and around planned pits and the formerly proposed valley-fill HLF footprint on account of challenging ground conditions including permafrost. Three deep (>150 m) 2-inch conventional well pairs were established at Kona (MW14-05A/B), Latte (MW14-03A/B) and southern Supremo (MW14-02A/B) pit areas. Two additional monitoring well pairs were established north of the Supremo pit complex (MW14-01A/B and MW14-06A/B locations, Figure 1-2); however, both wells in both pairs later became blocked, presumably due to ice-jacking. Logs for the 2014 monitoring wells are provided in Appendix 3-A with construction details summarized in Table 3-2. Note that construction details for MW14-01A/B and MW14-06A/B are not included in Table 3-2 since these became blocked and are not part of the baseline monitoring dataset.

A 300-metre, grouted-in thermistor string was established in the northern portion of Supremo Pit (MW14-04T) and a combination thermistor/VWP string was established in the valley-fill HLF footprint (MW14-07T) (Appendix 3-A). A variation on the Mikkelson mix (Mikkelson, 2002) was used for the grouting the combination thermistor/VWP string. Both locations were equipped with a dedicated datalogger housed inside a steel enclosure at surface for acquisition of high resolution (hourly) data (Figure 3-1). Similar dataloggers were also installed at the four VWPs installed by EBA TT in 2013. All instrumentation was manufactured by RST Instruments with documentation provided in Appendix 3-C. VWP and thermistor construction details are summarized in Table 3-4.

Table 3-1:
Summary of hydrogeological drilling programs undertaken at the Coffee Gold Project

Date	Consultant	Study Objective	Installations	Hydraulic Testing	Reference
Fall 2013	EBA Tetra Tech	Preliminary hydrogeological data collection to support a detailed work plan for the hydrogeological baseline assessment.	Vibrating wire piezometer (VWP) installations (4) in the Supremo and Latte pit footprints	✓	2013 Hydrogeological Data Collection, Coffee Gold Project, Yukon (EBA, 2013).
Summer 2014	Knight Piésold	Geotechnical site investigations and laboratory testing to assess: (1) subsurface conditions within the footprint of the Heap Leach Facility (HLF) (former valley fill location) and stockpile and (2) the geotechnical engineering material properties of the materials encountered.	Thermistor string installation (2) in formerly proposed valley-fill HLF footprint area in Latte Creek headwaters.		Kaminak Gold Corporation Coffee Gold Project: Report on Feasibility Study Level Geotechnical Investigations, March 12, 2015 (Knight Piésold, 2015)
Summer/Fall 2014	Lorax	First phase of a detailed hydrogeological baseline program establishing groundwater sampling locations in and around proposed pits.	Conventional monitoring well (10) and thermistor (1) installations in pit areas and thermistor/VWP installation (1) in the formerly proposed valley-fill HLF area	✓	Coffee Creek Hydrogeological Drilling Program – Program Summary, Memorandum to Kaminak Gold. October 17, 2014 (Lorax, 2014).
March 2015	Lorax	Second phase of a detailed hydrogeological baseline program establishing ground conditions, permafrost conditions and groundwater pressures downgradient of waste facilities ahead of a larger, subsequent field program.	Thermistor/VWP installations (2) in YT-24 and Latte Tributary drainages		2015 Phase l Baseline Hydrogeology Field Program – Program Summary, Memorandum to Kaminak Gold. April 7, 2015 (Lorax, 2015).
April - June 2015	Lorax	Third phase of a detailed hydrogeological field program establishing supplemental groundwater quality, groundwater pressure and ground temperature stations downgradient of mine facilities.	Thermistor/VWP (6), Westbay groundwater monitoring systems (sub-permafrost groundwater) (6); shallow monitoring wells (overburden) (5) installations.	✓	2016 Coffee Gold Mine Hydrogeology Drilling Program Summary, Memorandum to Goldcorp. March 13, 2017 (Lorax, 2017b)
					This report.
June/July 2015	SRK	Hydrogeological investigation targeting principal geologic structures that will be mined in the open pits, combined with a geotechnical program characterizing permafrost in proposed facility footprint areas.	Thermistor/VWP (4) and thermistor (2) installations in proposed waste rock storage facility (WRSFs) and stockpile locations.	✓	Hydrogeologic Investigations Report Coffee Project, Yukon, December 18, 2015 (SRK, 2015)
					2015 Geotechnical Field Investigation Report Coffee Gold Project, Yukon, Canada, January 4, 2016.
August/September 2016	Lorax	Hydrogeological field program aimed at establishing groundwater quality, groundwater pressure and ground temperature downgradient of the hilltop HLF.	Thermistor/VWP installation (1) along NW margin of hilltop HLF.	✓	2016 Coffee Gold Mine Hydrogeology Drilling Program Summary. Memorandum to Goldcorp. March 13, 2017. (Lorax, 2017b).
					This report.
Fall 2016	Tetra Tech/ SRK	Geotechnical site investigation to acquire geotechnical and permafrost data, to inform the design of the WRSF and sedimentation pond dams.	Thermistor installation (2 multi-bead thermistor strings and 1 single thermistor bead) in proposed WRSFs and sedimentation pond footprints.		Fall 2016 Geotechnical Investigation Data Report, Coffee Mine Site, Coffee Gold Project. March 20, 2017 (Tetra Tech and SRK, 2017)
Summer 2017	Tetra Tech	Geotechnical site investigation to acquire geotechnical and permafrost data, including frozen and unfrozen overburden and bedrock conditions, to inform design of the mine infrastructure, in particular to support the modified design of the Alpha WRSF and its respective components.	Thermistor installation (8 multi-bead thermistor strings and 25 single thermistor beads) in proximity to the Alpha WRSF and other mine infrastructure.	✓	Summer 2017 Geotechnical Investigation Data Report, Coffee Mine Site, Coffee Gold Project. November 30, 2017 (Tetra Tech, 2017).
August 2017	Lorax	Hydrogeological field program aimed at establishing depth of permafrost, depth of overburden, groundwater pressures, and groundwater occurrence NW of the proposed Kona Pit, as part of the larger Tetra Tech geotechnical investigation.	Thermistor/VWP installation (1) downgradient of the proposed Kona Pit.	✓	2017 Coffee Gold Mine Hydrogeology - Drilling Program Summary. Memorandum to JDS Energy and Mining. October 20, 2017. (Lorax, 2017a).
					This report.

Notes:
VWP – vibrating wire piezometer, HLF – heap leach facility, WRSF – waste rock storage facility.

Table 3-2:
Summary of conventional monitoring well installations at the Project

Pad ID	**Units**	**BH9**	**BH9**	**BH3**	**BH3**	**BH11**	**BH11**	**BH8-AZ**	**BH10-AZ**	**BH12-AZ**	**BH04-AZ**	**BH02-AZ**
Mine ID		**CFD-0428**	**CFD-0418**	**CFD-0432**	**CFD-0442**	**CFD-0444**	**CFD-0455**	**CFR-0982**	**CFR-0998**	**CFR-0986**	**CFR-0992**	**CFR-0995**
Monitoring Well ID		**MW14-02A**	**MW14-02B**	**MW14-03A**	**MW14-03B**	**MW14-05A**	**MW14-05B**	**MW15-01AZ**	**MW15-02AZ**	**MW15-03AZ**	**MW15-04AZ**	**MW15-05AZ**
Mine Area		Supremo	Supremo	Latte	Latte	Kona	Kona	Supremo	Supremo	Alpha WRSF D/S	Alpha WRSF D/S	Heap Leach D/S
Pre-Mine Catchment Area		Latte Creek	Latte Creek	Halfway Creek	Halfway Creek	Halfway Creek	Halfway Creek	YT-24	Latte Creek	Halfway Creek	Halfway Creek	Latte Creek
Installation Status		Open/frozen	Open/frozen	Open	Open	Open	Open	Open/frozen	Functioning	Functioning	Functioning	Open/frozen
Drilling Completion Date		28-Aug-2014	24-Aug-2014	05-Sep-2015	12-Sep-2014	16-Sep-2014	19-Sep-2014	05-May-2015	24-May-2015	09-May-2015	14-May-2015	20-May-2015
Easting[1]	m	583,994	584,008	582,401	582,388	579,708	579,695	585,683	584,858	585,583	584,016	581,387
Northing[1]	m	6,973,508	6,973,507	6,973,191	6,973,197	6,972,998	6,972,999	6,976,038	6,971,754	6,978,157	6,976,566	6,971,079
Ground Elevation[1]	m asl	1029.5	1030.9	1097.6	1095.2	1268.5	1270.3	809.8	737.2	557.9	672.5	1068.9
Estimated depth to bedrock	m bgs	5	5	surface	surface			4.7	8.8	not encountered	5.1	4.8
Casing Depth	m bgs	6.0	6.5	6.0	5.0	2.0	2.0	n/a	n/a	n/a	n/a	n/a
Casing ID/OD	inch							4.5 OD	4.5 OD	4.5 OD	4.5 OD	4.5 OD
Casing Method								ODEX	ODEX	ODEX	ODEX	ODEX
Borehole ID	inch	3.78	3.78	3.78	3.78	3.78	3.78	4.5	4.5	4.5	4.5	4.5
Drill Method[2]		DDH/HQ	DDH/HQ	DDH/HQ	DDH/HQ	DDH/HQ	DDH/HQ	ODEX	ODEX	ODEX	ODEX	ODEX
Borehole Drilled Depth	m bgs							5.9	10.3	5.6	5.7	5.7
Borehole Measured Depth	m bgs	197.0	200.0	198.5	152.0	220.5	179.5	5.9	10.3	5.5	5.7	5.7
Stickup (Steel Surface Casing)	m ags			0.37	0.48		-		0.68	0.6		
Installations												
Completion Date		28-Aug-14	24-Aug-14	07-Sep-14	12-Sep	17-Sep-14	20-Sep-14	05-May-15	24-May-15	09-May-15	14-May-15	20-May-15
2" PVC Install		Sch. 40	Sch. 40	Sch. 40	Sch. 80	Sch. 80	Sch. 80	Sch. 40	Sch. 40	Sch. 40	Sch. 40	Sch. 80
stickup (PVC)	m	1.0	1.3	1.0	0.9	1.1	0.7	0.6	0.7	0.7	0.5	0.6
Screened lithology		Hydrothermally altered rock/Crackle Breccia	Biotite Feldspar Schist	Biotite Feldspar Schist & Shear Zone	Biotite Feldspar Schist with Weak Zone	Granite	Granite	Colluvium	Colluvium	Colluvuim / Alluvium	Colluvium	Colluvium
bottom of screen (installed)	m bgs	195.5	150.8	198.5	150.6	220.5	179.2	4.9	10.3	5.5	5.7	4.7
top of screen	m bgs	186.4	144.7	189.4	144.5	202.2	160.8	1.8	2.3	2.5	2.7	1.7
bottom of screen (installed)	m asl	834.0	880.1	899.1	944.6	1048.0	1091.1	804.9	726.9	552.4	666.8	1064.1
top of screen	m asl	843.2	886.2	908.2	950.7	1066.3	1109.5	807.9	735.0	555.4	669.8	1067.2
depth to bottom (measured)	m btoc	196.8	148.4	199.8	154.2	221.6	180.4	5.2	10.7	6.2	6.3	5.3
bottom of sand	m bgs	196.1	150.8	198.5	151.1	220.5	179.5	5.9	10.3	5.6	5.7	5.7
top of sand	m bgs	180.4	142.4	184.0	140.2	192.3	162.5	0.8	0.8	1.0	1.7	0.6
bottom of sand	m asl	833.5	880.1	899.1	944.1	1048.0	1090.8	803.8	726.9	552.3	666.8	1063.1
top of sand	m asl	849.1	888.5	913.6	955.0	1076.2	1107.8	809.0	736.4	556.9	670.8	1068.2
bottom of bentonite chips/pellets	m bgs	180.4	142.4	*184.0*	140.2	192.3	158.9	0.8	0.8		1.7	
top of bentonite chips/pellets	m bgs	176.5	140.3	*172.0*	136.7	190.3	156.1	0.0	0.0		0.0	
bottom of grout	m bgs	176.5	140.3	172.0	140.2	190.3	156.1			1.0		
top of grout	m bgs			0.5	1.2	0.9	3.0			0.0		

Notes:
m = metres; m bgs – metres below ground surface, m asl – metres above sea level; m ags = metres above ground surface; m btoc = metres below top of casing; ID = inside diameter; OD = outside diameter; SU = Supremo Pit; D/S = downstream; WRSF =waste rock storage facility; N = North; S = South; W = West
1. Measured by RTK (real time kinematic) (UTM NAD83 Zone 7). All holes drilled vertical.
2. DDH = diamond drill hole; HQ = borehole diameter of 96.0 mm.

Table 3-3:
Summary of Westbay system installations at the Project

Pad ID	**Units**	**BH8**	**BH10**	**BH12**	**BH4**	**BH2**	**BH5**	**BH14**
Mine ID		**CFR-0977**	**CFR-0997**	**CFR-0987**	**CFR-0993**	**CFR-0996**	**CFR-0999**	**CFR-1206**
Monitoring Well ID		**MW15-01WB**	**MW15-02WB**	**MW15-03WB**	**MW15-04WB**	**MW15-05WB**	**MW15-06WB**	**MW16-01WB**
Mine Area		SU3N, 4N, 5S D/S	SU1, SU4S D/S	Alpha WRSF D/S	Alpha WRSF, D/S	Heap Leach D/S	SU3W, SU3N	Heap Leach
Pre Mine Catchment Area		YT-24	Latte Creek	Halfway Creek	Halfway Creek	Latte Creek	Halfway Creek	Halfway Creek
Easting[1]	m	585,829	584,858	585,581	584,024	581,402	584,090	580,971.30
Northing[1]	m	6,976,212	6,971,758	6,978,165	6,976,566	6,971,084	6,975,003	6,972,510.50
Ground Elevation[1]	m asl	803.6	737.1	557.9	671.5	1067.7	1184.9	1203.91
Estimated depth to bedrock	m bgs	not logged	9.0	4.27	2.4	5.49	1.22	3.5
Surface Casing Depth	m bgs	21.3	10.1	10.36	7.0	6.7	162.0	4.8
Surface Casing ID/OD	inch	5.07/ 5.5	5.07/ 5.5	5.07/ 5.5	5.07/ 5.5	5.07/ 5.5	4.0/4.5 (HWT)	5.07/ 5.5
Protective Casing Depth[2]	m bgs	78	none	33.5	30.4	56.3	203.6	68.4
Protective Casing ID/OD[2]	inch	3.06/3.5 (HQ)	(-)	3.06/3.5 (HQ)	3.06/3.5 (HQ)	3.06/3.5 (HQ)	3.06/3.5 (HQ)	3.06/3.5 (HQ)
Borehole ID	inch	4.5	4.5	4.5	4.5	4.5	4.5" to 200.3 /3.78" to 293	4.5
Borehole Depth	m bgs	116.7	66.2	99.5	61.1	82.9	291.8	120.1
Completion Date		05-May-15	24-May-15	05-Dec-15	19-May-15	22-May-15	05-Jun-15	03-Oct-16
Westbay Primary Sampling Zones								
Zone 1	m bgs	109 to 112	60.8 to 65.7	93.9 to 96.7	54.5 to 56.7	77.9 to 82.7	280.7 to 285.9	110.1 to 113.8
Zone 1 Lithology		Felsic Gneiss	Biotite Schist	Gneiss	Felsic Gneiss	Fresh Granite	Mixed Mafic Gneiss	Fresh Granite
Zone 2	m bgs	82 to 87.5	25.7 to 30.9	81.7 to 86.9	38.1 to 40.2	63.6 to 67.3	247.1 to 250.8	85.7 to 89.4
Zone 2 Lithology		Mixed Mafic Gneiss	Biotite Schist with chlorite alteration	Mixed Felsic Gneiss	Mixed Felsic Gneiss	Mod. to weakly oxidized Granite	Mixed Felsic Gneiss	Fresh Granite
Zone 3	m bgs	-	-	46.7 to 50.3	-	-	238 to 243.2	71.4 to 73.5
Zone 3 Lithology		-	-	Mixed Mafic Gneiss	-	-	Mixed Felsic Gneiss	very weakly oxidized Granite
Zone 4	m bgs	-	-	-	-	-	221.2 to 226.4	66.8 to 70.5
Zone 4 Lithology		-	-	-	-	-	Mixed Felsic Gneiss	Fresh Granite
Zone 5	m bgs	-	-	-	-	-	210.6 to 220.3	-
Zone 5 Lithology		-	-	-	-	-	Mixed Felsic Gneiss	-

Notes
m = metres; m bgs – metres below ground surface, m asl – metres above sea level; ID = inside diameter; OD = outside diameter; SU = Supremo Pit; D/S = downstream; WRSF =waste rock storage facility; N = North; S = South; W = West
1. Measured by RTK (real time kinematic) (UTM NAD83 Zone 7). All holes drilled vertical.
2. Protective steel casing (HQ rods) left in hole to blind off permafrost zones.

Table 3-4:
Standalone VWP and combination VWP/thermistor installations at the Project

Installation ID		**CFD0318**	**CFD0324**	**CFD0332**	**CFD0351**	**MW14-07T**	**MW15-01T**	**MW15-02T**	**MW15-03T**	**MW15-04T**	**MW15-05T**	**MW15-07T**	**SRK-15D-07**	**SRK-15D-08**	**SRK-15D-09**	**MW16-01T**	**MW17-01T**
Mine Area		Supremo	Supremo	Supremo	Latte	HLF D/S	Supremo	Supremo	Alpha WRSF D/S	Alpha WRSF D/S	HLF D/S	Supremo	Supremo	Alpha WRSF	Supremo	HLF D/S	Kona
Catchment Area		Halfway Ck	Latte Ck	Latte Ck	Latte Tr	Latte Ck	YT-24	Latte Ck	Halfway Ck	Halfway Ck	Latte Ck	YT-24	YT-24	Halfway Ck	Latte Ck	Halfway Ck	Kona Creek
Consultant		EBA	EBA	EBA	EBA	Lorax	Lorax	Lorax	Lorax	Lorax	Lorax	Lorax/SRK	SRK	SRK	SRK	Lorax	Lorax
Easting[1]	m	583,450	583,993	585,000	583,275	580,832	585,826	584,855	585,584	584,027	581,406	585,198	585,124	582,057	584,734	580,988	579,736
Northing[1]	m	6,974,220	6,973,100	6,974,050	6,973,115	6,971,365	6,976,210	6,971,756	6,978,168	6,976,568	6,971,083	6,974,583	6,975,415	6,973,891	6,972,215	6,972,503	6,973,195
Ground Elevation[1]	m asl	1233.0	956.0	1246.6	1120.5	1,156.3	803.9	737.1	557.7	670.9	1,067.1	1,183.1	948.9	925.1	784.3	1203.67	1245.75
Azimuth	degrees	175	280	275	0	0	0	0	39	40	125	0	0	0	0	0	0
Dip	degrees	-45	-45	-45	-65	-90	-90	-90	-80	-80	-80	-90	-90	-90	-90	-90	-90
Borehole ID	inch	2.99	2.99	2.99	2.99	3.78	4.5	4.5	4.5	4.5	4.5	3.78	3.78	3.78	3.78	4.5 / 3.5	4.5
Drill Method[2]		DDH	DDH	DDH	DDH	DDH	DC OH	DC OH	RC OH	RC OH	RC OH	DDH/HQ	DDH/HQ	DDH/HQ	DDH/HQ	RC OH	RC OH
Borehole Depth	m along hole	200	200	200	200	124.7	89.3	33.7	97.97	53.3	83.82	268	149	149	101	188	201
Installation Date		01-Jul-13	01-Aug-15	01-Aug-15	01-Oct-13	24-Sep-14	24-Mar-15	26-Mar-15	10-May-15	14-May-15	20-May-15	06-Jul-15	09-Jul-15	03-Jul-15	07-Jul-15	27-Aug-16	09-Aug-17
Thermistor Sensor Depth																	
Therm 1-1	v. m bgs	-	-	-	-	0.6	0.5	1.2	0.53	1.7	0.75	7	0.7	1	1.1	0.3	0.5
Therm 1-2	v. m bgs	-	-	-	-	1.4	1.3	3.2	1.2	13.8	1.5	8	2.2	4	2.6	0.9	1
Therm 1-3	v. m bgs	-	-	-	-	2.1	2.0	5.2	1.9	26.1	2.2	11	3.7	9	4.1	1.8	2
Therm 1-4	v. m bgs	-	-	-	-	2.9	2.8	10.2	2.6	38.1	3.0	26	5.2	16	7.1	3.8	4
Therm 1-5	v. m bgs	-	-	-	-	3.7	3.5	15.2	3.4	50.3	3.7	41	6.7	26	10.1	7.8	8
Therm 1-6	v. m bgs	-	-	-	-	4.4	4.3	24.2	4.1	-	4.5	56	8.2	41	15.1	12.8	13
Therm 1-7	v. m bgs	-	-	-	-	5.1	5.0	-	4.9	-	5.2	86	9.7	61	22.1	20	20
Therm 1-8	v. m bgs	-	-	-	-	17.4	12.3	-	16.9	-	17.2	106	12.7	81	32.1	29.7	30
Therm 1-9	v. m bgs	-	-	-	-	29.7	19.8	-	28.9	-	29.5	121	17.7	101	47.1	56.6	60
Therm 1-10	v. m bgs	-	-	-	-	42.5	27.3	-	41.0	-	41.8	136	24.7	121	77.1	89.5	90
Therm 1-11	v. m bgs	-	-	-	-	54.9	34.8	-	53.1	-	54.0	151	34.7	-	97.1	119.5	120
Therm 1-12	v. m bgs	-	-	-	-	67.4	42.3	-	65.1	-	66.3	166	49.7	-	-	149.5	150
Therm 1-13	v. m bgs	-	-	-	-	80.0	49.8	-	77.2	-	78.4	181	69.7	-	-	179.5	180
Therm 1-14	v. m bgs	-	-	-	-	-	-	-	-	-	-	-	89.7	-	-	-	-
Therm 1-15	v. m bgs	-	-	-	-	-	-	-	-	-	-	-	109.7	-	-	-	-
Therm 1-16	v. m bgs	-	-	-	-	-	-	-	-	-	-	-	129.7	-	-	-	-
Therm 2-1	v. m bgs	-	-	-	-	99.96	-	-	-	-	-	-	-	-	-	-1.2	-
VWP Sensor Depth																	
VWP 1	v. m bgs	118	178	117	184	124.36	76.0	33.9	49.5	38.8	55.4	239.0	103.6	103.6	99.7	97.5	200.9
VWP 2	v. m bgs	-	-	-	-	-	89.1	-	96.2	51.62	81.37	267.8	149.2	149.2	-	131.5	170.9

Notes:
m = metres; m asl – metres above sea level; v. m bgs = vertical metres below ground surface; SU = Supremo Pit; D/S = downstream; WRSF =waste rock storage facility; HLF = heap leach facility
1. Measured by RTK (real time kinematic) (UTM NAD83 Zone 7).
2. DDH = diamond drill hole; DC = direct circulation, RC = reverse circulation, OH = open hole

Table 3-5:
Standalone multi-bead thermistor string installations at the Project

Thermistor ID		**KPBH-01**	**KPBH-04**	**MW14-04T**	**SRK-15D-10T**	**SRK-15D-13T**	**GT-14**	**GT-63**	**GT17-10T**	**GT17-26T**	**GT17-28T**	**GT17-34T**	**GT17-36T**	**GT17-37T**	**GT17-39T**
Mine Area		Heap Leach D/S	Heap Leach D/S	SU3N	Alpha WRSF	Stockpile	SU5S	Alpha WRSF	Heap Leach	Alpha WRSF	Alpha WRSF	Alpha Pond	Alpha Pond	Alpha Pond	Alpha WRSF
Catchment Area		Latte Ck	Latte Ck	Halfway Ck	Halfway Ck	Latte	YT-24	Halfway Ck	Halfway Ck	Halfway Ck	Halfway Ck	Halfway Ck	Halfway Ck	Halfway Ck	Halfway Ck
Consultant		Knight Piésold	Knight Piésold	Lorax	SRK	SRK	Tetra Tech	Tetra Tech	Tetra Tech	Tetra Tech	Tetra Tech	Tetra Tech	Tetra Tech	Tetra Tech	Tetra Tech
Easting[1]	m	581,438	581,115	584,287	581,752	582,825	585,457	581,283	580,535	581,989	581,997	582,837	582,975	582,995	582,315
Northing[1]	m	6,971,384	6,970,857	6,975,001	6,973,455	6,972,904	6,975,088	6,973,176	6,972,476	6,974,357	6,973,678	6,975,585	6,975,474	6,975,607	6,974,617
Ground Elevation[1]	m asl	1122.7	1121.3	1,185.8	1008.2	1136.9	1082.2	1028.67	1260.13	844.2	970.03	801.27	804.44	765.37	837.22
Azimuth	degrees	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dip	degrees	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90	-90
Borehole ID	inch	3.78	3.78	3.78	3.78	3.78	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98	2.98
Drill Method[2]		DDH	DDH	DDH	DDH	DDH	DDH	DDH	DDH	DDH	DDH	DDH	DDH	DDH	DDH
Borehole Depth	m along hole	50	50	301	26	26	20.5	21.2	20.5	20.5	35.3	30.85	29.85	30.2	20.45
Installation Date		01-Sep-14	01-Sep-14	12-Sep-14	Jun/Jul 2015	Jun/Jul 2015	30-Aug-16	23-Sep-16	08-Aug-17	08-Aug-17	06-Aug-17	06-Aug-17	06-Aug-17	06-Aug-17	07-Aug-17
Logger Deployed		Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
Thermistor Sensor Depth															
Therm 1-1	v. m bgs	-1.5	-1.5	3.1	0.5	0.5	0.25	-0.22	0.75	0.85	0.5	0.5	0.5	0.5	0.1
Therm 1-2	v. m bgs	0.0	0.0	26.1	3.0	3.0	0.75	0.03	1.25	1.35	1	1	1	1	0.6
Therm 1-3	v. m bgs	0.8	0.8	51.1	5.5	5.5	1.25	0.28	1.75	1.85	1.5	1.5	1.5	1.5	1.1
Therm 1-4	v. m bgs	1.5	1.5	76.1	8.0	8.0	2.00	1.03	2.5	2.6	2.25	2.25	2.25	2.25	1.85
Therm 1-5	v. m bgs	2.3	2.3	101.1	13.0	13.0	2.75	1.78	3.25	3.35	3	3	3	3	2.6
Therm 1-6	v. m bgs	3.1	3.1	126.1	15.5	15.5	3.50	2.53	4	4.1	3.75	3.75	3.75	3.75	3.35
Therm 1-7	v. m bgs	4.6	4.6	151.1	18.0	18.0	4.25	3.28	4.75	4.85	4.5	4.5	4.5	4.5	4.1
Therm 1-8	v. m bgs	7.6	7.6	176.1	20.5	20.5	5.25	4.28	5.75	5.85	5.5	5.5	5.5	5.5	5.1
Therm 1-9	v. m bgs	13.7	13.7	201.1	23.0	23.0	6.75	5.78	7.25	7.35	7	7	7	7	6.6
Therm 1-10	v. m bgs	19.8	19.8	226.1	25.5	25.5	8.25	7.28	8.75	8.85	8.5	8.5	8.5	8.5	8.1
Therm 1-11	v. m bgs	29.0	29.0	251.1	-	-	9.75	8.78	10.25	10.35	10	10	10	10	9.6
Therm 1-12	v. m bgs	38.1	38.1	276.1	-	-	11.25	10.28	11.75	11.85	11.5	11.5	11.5	11.5	11.1
Therm 1-13	v. m bgs	48.8	48.8	301.1	-	-	12.75	11.78	13.25	13.35	13	13	13	13	12.6
Therm 1-14	v. m bgs	-	-	-	-	-	14.75	13.78	15.25	15.35	15	15	15	15	14.6
Therm 1-15	v. m bgs	-	-	-	-	-	16.75	15.78	17.25	17.35	17	17	17	17	16.6
Therm 1-16	v. m bgs	-	-	-	-	-	19.75	18.78	20.25	20.35	20	20	20	20	19.6

Notes:
m = metres; m asl – metres above sea level; v. m bgs = vertical metres below ground surface; SU = Supremo Pit; D/S = downstream; WRSF =waste rock storage facility; HLF = heap leach facility
1. Measured by RTK (real time kinematic) (UTM NAD83 Zone 7).
2. DDH = diamond drill hole

Table 3-6:
Single-bead thermistors installed at the Project

Thermistor ID	Mine Area	Catchment Area	Easting[1]	Northing[1]	Ground Elevation[1]	Azimuth/Dip	Depth to bedrock	Borehole ID[2]	Drilled Depth	Installation Date	Thermistor Depth
			m	m	m asl	degrees	m bgs	inch	m ah		v m bgs
GT-66	Alpha WRSF	Halfway Ck	581,235	6,973,166	1023.4	0/-90	7.7	2.98	11	24-Sep-16	1.8
GT17-02	Beta WRSF	Halfway Ck	580,095	6,973,183	1203.1	0/-90	3.4	2.98	9.00	15-Aug-17	8.25
GT17-03	Organics Stockpile	Halfway Ck	580,233	6,972,805	1218.3	0/-90	2.2	2.98	7.10	10-Aug-17	7.10
GT17-06	HLF	Halfway Ck	580,170	6,972,513	1267.3	0/-90	2.6	2.98	6.25	16-Jul-17	6.25
GT17-06B	HLF	Halfway Ck	580,194	6,972,472	1272.6	0/-90	2.7	2.98	8.00	13-Aug-17	8.00
GT17-07	HLF	Latte Ck	580,135	6,971,853	1281.0	0/-90	1.3	2.98	7.00	15-Jul-17	6.70
GT17-08	HLF	Dvde Latte / Halfway	580,455	6,972,212	1287.0	0/-90	0.8	2.98	4.60	16-Jul-17	4.60
GT17-11	HLF	Halfway Ck	581,280	6,972,360	1222.1	0/-90	1.3	2.98	4.60	14-Jul-17	4.60
GT17-12	HLF	Latte Ck	581,245	6,971,886	1227.8	0/-90	1.6	2.98	7.00	14-Jul-17	4.65
GT17-14	Event Pond	Halfway Ck	581,684	6,972,157	1210.2	0/-90	2.76	2.98	6.70	12-Jul-17	6.70
GT17-15	Event Pond	Dvde Latte / Halfway	581,696	6,972,395	1213.2	0/-90	1.2	2.98	4.50	11-Jul-17	4.50
GT17-16	Event Pond	Halfway Ck	581,822	6,972,604	1187.6	0/-90	2.3	2.98	6.00	10-Jul-17	6.00
GT17-17	Event Pond	Dvde Latte / Halfway	581,917	6,972,451	1198.4	0/-90	1.4	2.98	5.10	09-Jul-17	5.10
GT17-19	Plant Site	Dvde Latte / Halfway	582,283	6,972,661	1174.5	0/-90	2.4	2.98	6.60	08-Jul-17	6.60
GT17-20	Fuel Tanks	Latte Ck	582,322	6,972,569	1168.0	0/-90	1.1	2.98	6.10	08-Jul-17	6.10
GT17-21	Crusher F	Dvde Latte / Halfway	582,825	6,972,867	1136.9	295/-70	3.5	3.77	30.25	24-Jul-17	7.90
GT17-22	Facility Pond	Latte Ck	583,011	6,972,677	1082.9	0/-90	2.7	2.98	7.30	06-Jul-17	7.30
GT17-27	Alpha WRSF	Halfway Ck	581,908	6,974,124	923.7	0/-90	1	2.98	6.00	18-Jul-17	5.60
GT17-30	Alpha WRSF	Halfway Ck	582,500	6,973,458	1032.6	0/-90	2.4	2.98	5.70	04-Jul-17	4.30
GT17-31	Frozen Soil Stockpile	Halfway Ck	583,224	6,973,929	1154.1	0/-90	1.4	2.98	6.65	07-Jul-17	6.00
GT17-32	Frozen Soil Stockpile	Halfway Ck	583,526	6,973,908	1188.5	0/-90	3	2.98	7.25	01-Jul-17	7.25
GT17-33	Alpha Pond	Halfway Ck	582,857	6,975,455	776.2	0/-90	4.9	2.98	30.00	26-Jul-17	9.50
GT17-35	Alpha Pond	Halfway Ck	582,919	6,975,525	770.8	0/-90	4.1	2.98	29.90	30-Jul-17	9.00
GT17-40	Alpha Underdrain	Halfway Ck	581,913	6,973,952	897.8	0/-90	4.9	2.98	9.00	17-Jul-17	9.00
GT17-40B	Alpha Underdrain	Halfway Ck	581,901	6,973,980	902.0	0/-90	7.8	2.98	12.20	17-Aug-17	9.20
GT17-41	Diversion Channel	Halfway Ck	581,814	6,974,302	929.9	0/-90	2.6	2.98	7.20	16-Aug-17	6.70

Notes:
m = metres; m asl – metres above sea level; v. m bgs = vertical metres below ground surface; m ah = metres along hole; WRSF = waste rock storage facility; HLF = heap leach facility; Dvde = divide
1. Measured by RTK (real time kinematic) (UTM NAD83 Zone 7). All drillholes vertical.
2. All diamond drillholes advanced using NQ3 tools except GT17-21 (HQ3).



Figure 3-1: Thermistor installation at MW14-04T (left) and VWP installation at CFD-0318 (right).

One borehole at each drilling location was packer tested using a single packer setup. Both a hydraulic packer (Inflatable Packers International) and pneumatic packer (RST Instruments) were utilized during the 2014 drilling program. The 2014 packer testing comprised constant head or step tests.

3.3 Knight Piésold 2014 Program

Between August 28th and September 21st, 2014, Knight Piésold (KP) conducted a geotechnical field program comprised of test pits and boreholes in the formerly proposed valley-fill HLF footprint area. KP established two 50-metre thermistor strings (manufactured by RST Instruments) in the valley-fill HLF footprint area. The thermistors strings are inserted into sealed 1" PVC standpipes that have been cemented in place and are connected to dedicated loggers at surface. Details of the KP thermistor installations are provided in Table 3-5.

3.4 Lorax 2015 Drilling Programs

The widespread occurrence of permafrost encountered during the 2014 field programs prompted a refinement of the instrumentation required to collect water quality samples

from sub-permafrost groundwater. This led to the selection of Westbay technology for this purpose. Illustrated in Figure 3-2, the Westbay system is comprised of a versatile, modular, sealed custom-manufactured PVC pipe with sampling zones located at the discretion of the hydrogeologist in the field. The pipe is lowered down the hole and packer elements bracketing each zone of interest are inflated with a specialized tool. Figure 3-3 shows a photograph of the Westbay pipe and a packer element as it is being lowered into a borehole during installation. Groundwater is monitored/sampled using a specialized tool deployed from surface which docks into valved monitoring ports located within the sampling zone. In permafrost environments, a steel guide tube (typically HQ rods) is left in place which blinds off the frozen ground. A packer element resides inside the HQ rods, near the base, to prevent water ingress (and thus ice formation) in the annular space between the steel casing and Westbay system. The inside of the Westbay pipe and the annulus between the Westbay and steel protective casing is filled with a 3:1 mixture of water to propylene glycol to prevent ice formation inside and outside of the Westbay pipe. Westbay's custom-built sampling tool docks with the sampling ports in the assembly, opening the ports only after a seal has been established to prevent any exchange between the glycol inside the assembly and the groundwater outside.

Given the complexity and costs associated with Westbay system installations, the approach for installations in low-lying valleys was to first establish a thermistor/VWP installation at each drilling location and use the drilling and thermistor data to inform the Westbay installation at a second hole located off the same drill pad. A third, shallow (5 to 10 metres deep) conventional monitoring well was installed from an adjacent, smaller drill pad to screen shallow groundwater in overburden/weathered bedrock.

The 2015 baseline hydrogeological program was implemented by Lorax in two phases. The first program was undertaken between March 18th and March 26th, 2015 and utilized a heli-portable Hornet reverse circulation (RC) rig owned and operated by Northspan Explorations Ltd. (Northspan). Two combination thermistor/VWP strings were installed in the YT-24 and Latte tributary drainages, at locations MW15-01T and MW15-02T, respectively (Figure 1-2). The boreholes were drilled vertically; 5-inch casing was keyed into competent bedrock followed by direct circulation open hole drilling using a 4.5-inch bit. Borehole logs are found in Appendix 3-A. The VWP calibration sheets and thermistor wire diagrams provided by the manufacturer, RST Instruments, are found in Appendix 3-C with installation details summarized in Table 3-4.

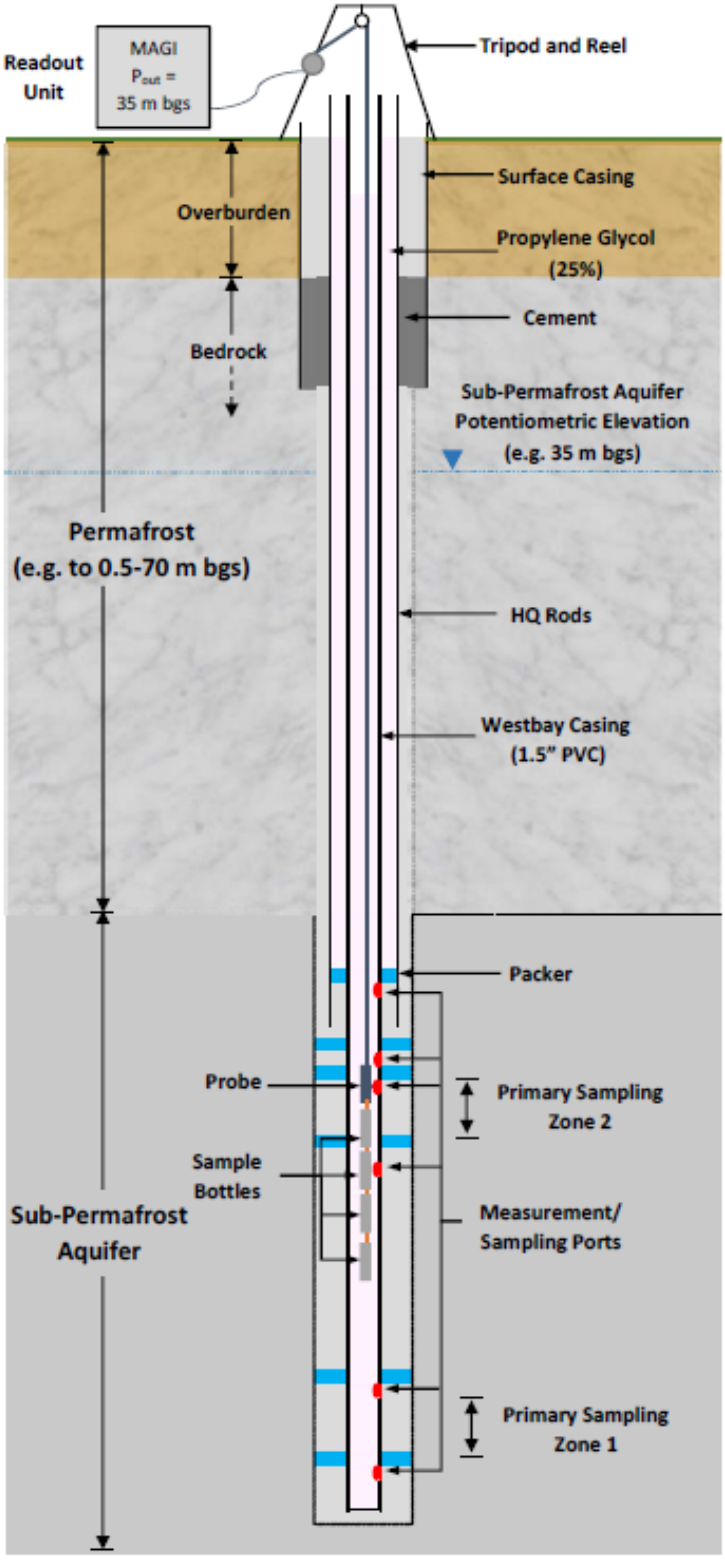

Figure 3-2: Schematic of an example Westbay system installed in permafrost (drawing not to scale).



Figure 3-3: Westbay installation at MW15-06T (BH5) using the Boyles 37 diamond drill rig. Blue gland is packer element which is inflated downhole with diluted propylene glycol. PVC is 1.5" Sched 80 with ends machined to mate with Westbay System couplings incorporating a shear-rod connection and an o-ring seal (no glue).

The initial drilling campaign in March provided critical information on permafrost depth for the planning of a subsequent, larger field program undertaken by Lorax between April 30th and June 9th, 2015. All drillholes were advanced using the Hornet RC rig operated by Northspan, with exception to MW15-06WB, which is discussed separately below. No drilling additives were used on the RC holes. Westbay systems were installed in vertical holes at all valley drilling locations. Each Westbay installation was preceded by thermistor/VWP installations in sub-vertical angled holes (80° dip) advanced from the

same pad. The thermistor holes were located on the downgradient edge of the pad and pointed in the downgradient direction to maximize the separation between the grouted VWP/thermistor hole and the Westbay completion. The grout backfill securing each thermistor/VWP installation was allowed to cure for 24 hours before drilling of the adjacent Westbay hole was initiated.

During advancement of each Westbay hole, formation water reporting to the cyclone was regularly field-tested for pH and electrical conductivity (EC) to assess whether grout from the adjacent hole had influenced water quality. Where there was suspicion of grout influence (*e.g.,* high pH), the Westbay zones were configured to avoid each potentially impacted area. Generally, two primary Westbay sampling zones were implemented at each installation. The zones were situated to intercept the first occurrence of substantial water and a second productive zone at depth (Table 3-3). The intention was to have a back-up zone should one zone become compromised or inaccessible. Westbay field technicians installed the Westbay instrumentation with assistance from Lorax and Northspan personnel. The Westbay completion report is provided in Appendix 3-B. Westbay installation details are summarized in Table 3-3.

Shallow conventional wells (>4.5 m to 10 m deep) were initiated at valley drilling locations to characterize potential groundwater flow in the active zone in areas of permafrost, or groundwater flow in the overburden where permafrost is absent. Most of the 'active zone' wells were advanced from a separate pad ~25 metres away from the thermistor/VWP and Westbay pad. These holes were advanced using 4.5" ODEX casing which was withdrawn as the installation was completed.

A combination of drilling methods was used to establish MW15-06WB, a Westbay system north of Supremo pit implemented to replace the 2014 conventional well pair (MW14-01A/B) that ice-jacked at the previous BH5 location. A 4.5" ODEX drillhole was first advanced using the Hornet RC rig to 200 metres, the depth limit of the rig, and found to be dry. A Boyles 37 diamond rig operated by Cyr was then mobilized onto the hole and HWT casing (4.5" OD) was reamed down to 162 m bgs. The hole was then deepened to 293 m bgs using HQ coring methods. A heavy mud (using AMC drilling additives Pure-Vis, Corewell and CR-650) was used during reaming and drilling. The hole was flushed for three hours prior to the commencement of the Westbay installation. HQ rods were left in the hole to a depth of ~ 204 m to act as a protective guard against permafrost.

Hydraulic testing during the Lorax 2015 field program consisted of airlift yield measurements at regular intervals during drilling plus an extended airlift yield test with monitored water level recovery on selected boreholes. A shut-in, constant head test was also conducted on MW15-04T, an artesian hole in Halfway Creek (Figure 1-2).

3.5 SRK 2015 Program

In the summer of 2015, SRK conducted a hydrogeological program targeting geologic structures intersecting the pits and led a site-wide geotechnical program characterizing ground conditions in mine facility footprint areas (SRK, 2015). Airlift tests and/or packer tests were performed on the structures and thermistor/VWP strings were installed directly beneath or near proposed waste rock and ore stockpile footprint areas. VWP/thermistor construction details are summarized in Table 3-4.

3.6 Lorax 2016 Drilling Program

In the summer/fall of 2016, Lorax conducted a hydrogeological program providing information on groundwater characteristics below the base of permafrost downgradient of the proposed HLF, which had been relocated to its currently proposed hilltop location (Figure 1-2). Two boreholes and accompanying instrumentation were installed. Details of the 2016 field program are outlined in Lorax (2017b) and summarized here.

Both vertical boreholes were advanced using a Hornet RC drill operated by Northspan. Five-inch ID casing was advanced into competent bedrock using a double-sided casing advancer system. Once the casing was keyed into bedrock, the casing advance system was exchanged for a COP44 hammer with 4.5-inch bit and open hole drilling ensued using reverse circulation. Significant formation water was encountered at each hole which impeded bit advancement. The drill bit was switched out for a 3.5-inch hammer and MW16-01T was advanced several meters further to a total depth of 189. 3 m, while MW16-01WB was terminated at 120 m.

The first borehole, MW16-01T, was advanced and completed in mid-August to gain insight on depth of permafrost, depth of overburden, ground conditions and groundwater pressures ahead of the drilling and installation of a Westbay system. Two thermistor strings and two VWPs were installed in MW16-01T. One thermistor string, 185 meters long and consisting of 13 individual sensors, was grouted in while a second individual thermistor was deployed above ground and above the grout level in the surface casing to measure ambient air temperature.

The Westbay well, MW16-01WB, was drilled and installed over a month later. HQ rods were permanently deployed from the surface casing to a depth of 68.4 m to protect the Westbay from permafrost. Westbay personnel supervised the installation which followed procedures outlined in Section 3.4. Borehole logs are available for both MW16-01T and MW16-01WB in Appendix 3-A, with installation details summarized in Table 3-4 and Table 3-3, respectively. The Westbay installation report is included in Appendix 3-B while VWP calibration sheets and thermistor configuration diagrams are found in Appendix 3-C.

Spot airlift yields were measured at regular intervals during drilling on both MW16-01T and MW16-01WB. Two constant rate injection packer tests and a pumping and recovery test were conducted on MW16-01T.

3.7 Tetra Tech 2016 Geotechnical Program

Between August 24 and October 5, 2016, Tetra Tech Canada Inc. (Tetra Tech) and SRK Consulting Inc. (SRK) conducted a geotechnical field program to acquire data on frozen and unfrozen overburden and bedrock conditions to inform design of proposed waste rock storage areas and respective sedimentation dams (Tetra Tech and SRK, 2017). The program consisted of advancing 35 vertical boreholes using a diamond-drill rig to depths ranging from 4.0 m to 21.2 m. Boreholes were advanced using chilled drilling fluid comprised of Perma-Drill ES or propylene glycol to preserve frozen conditions in the core.

Of significance to hydrogeological assessment of the Project, Tetra Tech established two multi-bead thermistor strings; GT-14 in the footprint of the formerly contemplated North WRSF area and GT-63, located north of the HLF in the upper portion of the Halfway Creek drainage within the footprint of the formerly contemplated Halfway Pond. A single bead thermistor was installed at GT-66, located near GT-63.

3.8 Lorax 2017 Program

In August 2017, Lorax conducted a hydrogeological investigation to gain insight on the extent of permafrost along the northwest margin of the proposed Kona Pit. One borehole, MW17-01T, also referenced as GT17-01 in Tetra Tech (2017), was advanced and completed with a multi-bead thermistor string and VWP sensors (Table 3-4). The field investigation was described in Lorax (2017a), appended to Tetra Tech (2017), and is summarized here.

MW17-01T was advanced as a vertical hole using a Hornet RC drill operated by Northspan. Drilling methods followed those described in Section 3.6, with the exception that minimal formation water was returned, allowing the borehole to be advanced to total depth (201.5 m) using the 4.5” bit. Hydraulic testing consisted of two constant head packer tests followed by recovery tests after the borehole had reached target depth. The borehole was completed with a 13-bead thermistor string installed to a depth of 181 meters and two VWP sensors targeting fracture zones (Appendix 3-A, 3-C).

3.9 Tetra Tech 2017 Geotechnical Program

Between June 28 and August 21, 2017, Tetra Tech conducted a second phase of the geotechnical field investigation initiated in 2016. The purpose of the program was to acquire geotechnical and permafrost data, including frozen and unfrozen overburden and

bedrock conditions to inform design of the Alpha WRSF and other mine facilities (*e.g.,* HLF, event ponds, stockpiles, plant site and infrastructure) (Tetra Tech, 2017).

The program consisted of advancing 43 vertical boreholes using a diamond-drill rig to depths ranging from 4.5 m to 201.5 m. These holes were advanced using chilled propylene glycol to produce undisturbed frozen core samples. Five shallow testpits were also hand dug to further characterize shallow subsurface conditions. Tetra Tech established seven multi-bead thermistor strings as well as twenty-five single bead thermistor strings. The multi-bead thermistors are summarized in Table 3-5 while the single bead thermistors are summarized in Table 3-6. In addition, hydraulic tests (packer tests) were conducted in six boreholes within the proposed footprint of the Alpha Pond.

3.10 Groundwater Sampling

All monitoring wells were developed after installation and prior to groundwater sampling. Well development was conducted using several methods, including purging with a bailer-winch system, inertial pump actuated with a Hydrolift-II, Westbay sampler, and air-lift pumping. The available well development method(s) depended on the type of well installation and depth to groundwater. Details regarding the development of MW14-series (completed in 2014), MW15-series wells (completed in 2015), and MW16-01WB (completed in 2016) are described in Lorax (2017c).

Groundwater monitoring events were conducted in September/October 2014, and four times annually since 2015, except in 2016 and 2019 when three monitoring events were completed (Table 3-7). The groundwater monitoring events have been conducted between April and October annually; this modified quarterly sampling frequency is often employed in the Yukon to capture the range of seasonal variability accounting for extended winters and compressed spring/summer/fall seasons.

All new monitoring wells installed between 2014 and 2016 have been sampled for groundwater quality with the exception of MW14-06A, MW14-06B, MW15-01AZ, and MW15-04 AZ which could not be sampled due to damage or water limitations (*e.g.,* frozen or dry) (Table 3-7). Table 3-7 presents a summary of the groundwater sampling programs between 2014 and 2019, including sampling methods used at each monitoring well.

Groundwater sampling was conducted in accordance with methods outlined in the BC Field Sampling Manual (BC MOE, 2013). Sampling was conducted using several different types of pumps. The pump employed at each well depended on the type of well installation, permeability of the geological unit being sampled, and depth to groundwater. Inertial pumps actuated with a Hydrolift-II mechanical actuator and peristaltic pumps were used to sample monitoring wells screened in permeable formations. Bladder pumps were used to

collect groundwater samples from deep wells screened in low permeability bedrock which would not permit sampling with conventional methods (*e.g.,* inertial pump), while the Westbay sampler was necessarily used to collect groundwater samples from the Westbay installations. In general, low-flow sampling methods were employed, and groundwater samples were collected after water levels in monitoring wells and purge water field parameters had stabilized. Field parameters were continuously monitored with a multi-parameter probe (YSI 556 MPS or YSI Professional Plus) coupled to an in-line flow-through cell during groundwater purging. Field parameters were monitored to ensure collection of representative samples and to provide reliable field-based estimates of temperature, pH, specific conductance (SC), dissolved oxygen (DO), and oxidation-reduction potential (ORP).

De-icing was required at monitoring wells MW14-02A and MW14-02B prior to groundwater sampling. Artesian conditions at both wells resulted in the top of the water column freezing inside the well casing installed through permafrost. De-icing was conducted with a hot water pressure washer equipped with high-pressure hoses and a drain jetting nozzle. Groundwater sampling was conducted after the volume of injected de-icing water plus a minimum of one well volume had been purged and purge water field parameters had stabilized.

Low water levels and low yields at monitoring well MW14-05B challenged the equipment capabilities and sampling procedures. Consequently, a modified purging/sampling procedure was employed to obtain the most representative formation groundwater at MW14-05B. The water level was drawn down to the lowest possible level (pump elevation) to maximize the amount of purged groundwater. The well was then allowed to recover overnight prior to sampling the next day, to ensure the greatest displacement and the largest buffer between ‘new’ formation water and ‘old’ residual standing water.

Table 3-7:
Summary of Groundwater Sampling Programs (2014 to 2019)

Station	2014	2015				2016			2017				2018				2019			Count	True Count [5]
	Sep./ Oct.	May/Jun.	Jul.	Aug.	Sep.	May	Jul.	Sep./ Oct.	Apr.	Jun.	Jul.	Oct.	Apr.	Jun.	Aug.	Oct.	Apr./May	Jun.	Aug.		
MW14-02A	IP	IP	IP	IP	PP	IP	PP	PP	IP	IP	IP	PP	IP	IP	PP	PP	IP	IP	IP	19	19
MW14-02B	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	IP	19	19
MW14-03A	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	19	18
MW14-03B	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	19	18
MW14-05A	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	19	18
MW14-05B	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	BP	19	14
MW14-06A	freezing[1]	damaged[2]	decommissioned[3]																	-	-
MW14-06B	freezing[1]	damaged[2]	decommissioned[3]																	-	-
MW15-01AZ	-	dry	frozen	frozen	frozen	frozen	frozen	frozen	frozen	frozen	damaged[4]									0	0
MW15-01WB (Port 4)	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	18
MW15-02AZ	-	PP	PP	PP	PP	PP	PP	PP	frozen	frozen	PP	PP	frozen	frozen	PP	frozen	frozen	frozen	frozen	10	10
MW15-02WB (Port 3)	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	18
MW15-03AZ	-	PP	PP	PP	PP	PP	PP	PP	frozen	frozen	PP	PP	frozen	frozen	PP	PP	frozen	frozen	PP	12	12
MW15-03WB (Port 6 & 4) [6]	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	18
MW15-04AZ	-	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	0	0
MW15-04WB (Port 4)	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	18
MW15-05AZ	-	dry	dry	dry	PP	frozen	frozen	frozen	frozen	frozen	damaged[4]									1	1
MW15-05WB (Port 3)	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	18
MW15-06WB (Port 6)	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	18	17
MW16-01WB (Port 6)	-	-	-	-	-	-	-	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	WB	12	12

Notes:
BP = bladder pump, IP = inertial pump actuated with a Hydrolift-II, PP = peristaltic pump, WB = Westbay sampler; D/S = downstream
1. Water inside monitoring well had started freezing at time of well development.
2. Monitoring well riser pipe collapsed near surface, likley due to freeze/thaw action in the active layer. Consequently, well screen could not be accessed.
3. Monitoring well decommissioned by Kaminak.
4. Monitoring wells MW15-01AZ and MW15-05AZ were damaged in July 2019 due to channel and stream bank erosion caused by a summer precipitation event in the Project area.
5. True Count - reflects the number of samples believed to be representative, collected at each station (samples screened-out due to drilling and well installation artifacts discussed in Lorax (2017c) and in Appendix 5-D of this report are not included in this count, and are highlighted in yellow).
6. At MW15-03WB, Port 6 (~47 m) was sampled between June 2015 and May 2016, and Port 4 (~82 m) was sampled thereafter between July 2016 and August 2019. Groundwater quality results corresponding to the two sample depths indicate that there is no apparent difference in the major ion compositions, and concentrations of field parameters, redox parameters, trace element parameters, and stable isotopes.

Since Westbay sample zones are isolated (*i.e.* not in direct contact) from atmospheric conditions, collecting representative groundwater samples does not require the use of typical sampling methods whereby large volumes of water are purged. Westbay installations MW15-01WB to MW15-06WB were sampled after completion of well development and purging in June 2015, while MW16-01WB was sampled after completion of development in October 2016. Additional well development was conducted at MW15-06WB in July and August 2015 due to the suspected presence of drilling additives observed during sampling in June 2015. Subsequent groundwater sampling of all Westbay installations was conducted after purging a minimum of 4 L. Additional detail regarding groundwater sampling methods is included in Lorax (2017c).

The data record at MW15-03WB consists of samples collected from Port 6 (~47 m bgs) between June 2015 and May 2016, while subsequent sampling was completed at Port 4 (~82 m) between July 2016 and August 2019 due to a transcription error. However, both sampling depths intersect similar geology (*i.e.*, mixed mafic gneiss and mixed felsic gneiss) and a strong upward hydraulic gradient was measured by MW15-03T between VWP sensors at 95 and 49 m bgs. The groundwater quality results corresponding to the two sampling depths indicate that there is no apparent difference in major ion compositions, and concentrations of field parameters, redox parameters, trace element parameters, and stable isotopes.

Groundwater samples were collected and preserved in the field with the appropriate laboratory supplied bottles and preservatives, with the exception of select dissolved samples collected in 2015 which were not preserved in the field when filtered at the lab. Samples analyzed for dissolved parameters were filtered in the field with disposable in-line 0.45-micron filters, except for groundwater samples collected from Westbay installations in 2015 which were filtered in the lab. Quality control sampling was conducted in the field and included the collection of field blank, trip blank, and field replicate samples. After collection, samples were kept cool in the field and during shipping until delivery to the laboratory. Groundwater samples were submitted for chemical analysis to the ALS Environmental (ALS) laboratory in Burnaby, BC in 2014, and to the Maxxam Analytics (Maxxam) laboratory in Burnaby, BC in 2015. In 2016, groundwater samples were submitted to Maxxam for all analyses, except cyanide species analyses which were completed by ALS. Since 2017, samples have been submitted to Maxxam (later becoming Bureau Veritas) for all analyses. Groundwater samples were analyzed for physical parameters, anions, nutrients, organic and inorganic carbon, total and dissolved metals, and cyanide species. Groundwater quality parameters and the corresponding detection limits are presented in Table 3-8.

Table 3-8:
Groundwater Quality Parameters and Detection Limits (2014-2019)

Parameter	Symbol	Unit	Reportable Detection Limit						
			ALS		Maxxam				
Physical Properties			**2014**	**2016**	**2015**	**2016**	**2017**	**2018**	**2019**
Conductivity	EC	µS/cm	2	-	1	1	1	1	1
pH	pH	pH	-	-	-	-	-	-	-
Total Hardness ($CaCO_3$)	T-H	mg/L	0.5	-	0.5	0.5	0.5	0.5	0.5
Dissolved Hardness ($CaCO_3$)	D-H	mg/L	-	-	0.5	0.5	0.5	0.5	0.5
Total Suspended Solids	TSS	mg/L	3	-	1	1	1	1	1
Total Dissolved Solids	TDS	mg/L	20	-	10	10	10	10	10
Turbidity	-	NTU	0.1	-	0.1	0.1	0.1	0.1	0.1
Inorganics									
Alkalinity (Total as $CaCO_3$)	-	mg/L	1	-	0.5	0.5	0.5	0.5	0.5
Alkalinity (PP as $CaCO_3$)	-	mg/L	-	-	0.5	0.5	0.5	0.5	0.5
Bicarbonate	HCO_3	mg/L	-	-	0.5	0.5	0.5	0.5	0.5
Carbonate	CO_3	mg/L	-	-	0.5	0.5	0.5	0.5	0.5
Hydroxide	OH	mg/L	-	-	0.5	0.5	0.5	0.5	0.5
Bromide	Br	mg/L	-	-	-	0.01	0.01	0.01	0.01
Fluoride	F	mg/L	0.02	-	0.01	0.01	0.01	0.01	0.01
Dissolved Chloride	Cl	mg/L	0.5	-	0.5	0.5	0.5	0.5	0.5
Organic/Inorganic Carbon									
Dissolved Organic Carbon	DOC	mg/L	0.5	-	0.5	0.5	0.5	0.5	0.5
Total Organic Carbon	TOC	mg/L	0.5	-	0.5	0.5	0.5	0.5	0.5
Anions and Nutrients									
Total Phosphorus	T-P	mg/L	0.002	-	0.005	0.002	0.005	0.003	0.003
Dissolved Phosphorus	D-P	mg/L	0.002	-	0.002	0.002	0.005	0.003	0.003
Orthophosphate	-	mg/L	-	-	-	-	-	0.005	0.003
Ammonia, Total (as N)	NH_3	mg/L	0.005	-	0.005	0.005	0.005	0.005	0.005
Total Total Kjeldahl Nitrogen	TKN	mg/L	0.05	-	0.02	0.02	0.02	0.02	0.02
Nitrate plus Nitrite	-	mg/L	-	-	0.002	0.002	0.002	0.002	0.002
Nitrate	NO_3	mg/L	0.005	-	0.002	0.002	0.002	0.002	0.002
Nitrite	NO_2	mg/L	0.001	-	0.002	0.002	0.002	0.002	0.002
Total Nitrogen	T-N	mg/L	0.05	-	0.02	0.02	0.02	0.02	0.02
Dissolved Nitrogen	D-N	mg/L	0.05	-	0.02	0.02	0.02	0.02	0.0028
Dissolved Sulphate	SO_4	mg/L	0.5	-	0.5	0.5	0.5	0.5	0.5
Total Sulphide	T-S	mg/L	0.002	-	0.005	0.005	0.005	0.005	-
Total Sulphide (as H_2S)	-	mg/L	-	-	-	0.005	0.005	0.005	-
Dissolved Sulphide	D-S	mg/L	-	-	-	-	-	0.005	0.0018
Dissolved Sulphide (as H_2S)	-	mg/L	-	-	-	-	-	0.005	0.0018
Cyanides									
Cyanide (WAD)	CN-WAD	mg/L	-	0.001	-	-	-	-	-
Total Cyanide	T-CN	mg/L	-	0.001	-	-	-	-	-
Cyanate	OCN	mg/L	-	0.2	-	-	-	-	-
Thiocyanate	SCN	mg/L	-	0.5	-	-	-	-	-
Total and Dissolved Metals									
Aluminum	Al	µg/L	3 [1] / 1 [2]	-	0.5	0.5	0.5	0.5	0.5
Antimony	Sb	µg/L	0.1	-	0.02	0.02	0.02	0.02	0.02
Arsenic	As	µg/L	0.1	-	0.02	0.02	0.02	0.02	0.02
Barium	Ba	µg/L	0.05	-	0.02	0.02	0.02	0.02	0.02
Beryllium	Be	µg/L	0.1	-	0.01	0.01	0.01	0.01	0.01
Bismuth	Bi	µg/L	0.5	-	0.005	0.005	0.005	0.005	0.005
Boron	B	µg/L	10	-	10	10	10	10	10
Cadmium	Cd	µg/L	0.01	-	0.005	0.005	0.005	0.005	0.005
Calcium	Ca	mg/L	0.05	-	0.05	0.05	0.05	0.05	0.05
Chromium	Cr	µg/L	0.1	-	0.1	0.1	0.1	0.1	0.1

Parameter	Symbol	Unit	Reportable Detection Limit						
			ALS		Maxxam				
Cobalt	Co	µg/L	0.1	-	0.005	0.005	0.005	0.005	0.005
Copper	Cu	µg/L	0.5 [1] / 0.2 [2]	-	0.05	0.05	0.05	0.05	0.05
Iron	Fe	µg/L	10	-	1	1	1	1	1
Lead	Pb	µg/L	0.05	-	0.005	0.005	0.005	0.005	0.005
Lithium	Li	µg/L	0.5	-	0.5	0.5	0.5	0.5	0.5
Magnesium	Mg	mg/L	0.1	-	0.05	0.05	0.05	0.05	0.05
Manganese	Mn	µg/L	0.05	-	0.05	0.05	0.05	0.05	0.05
Mercury	Hg	µg/L	0.01	-	0.002	0.002	0.002	0.002	0.002
Molybdenum	Mo	µg/L	0.05	-	0.05	0.05	0.05	0.05	0.05
Nickel	Ni	µg/L	0.5	-	0.02	0.02	0.02	0.02	0.02
Phosphorus	P	µg/L	50	-	2	2	2	2	2
Potassium	K	mg/L	0.1	-	0.05	0.05	0.05	0.05	0.05
Selenium	Se	µg/L	0.1	-	0.04	0.04	0.04	0.04	0.04
Silicon	Si	µg/L	50	-	50	50	50	50	50
Silver	Ag	µg/L	0.01	-	0.005	0.005	0.005	0.005	0.005
Sodium	Na	mg/L	0.05	-	0.05	0.05	0.05	0.05	0.05
Strontium	Sr	µg/L	0.2	-	0.05	0.05	0.05	0.05	0.05
Sulphur	S	mg/L	0.5	-	3	3	3	3	3
Thallium	Tl	µg/L	0.01	-	0.002	0.002	0.002	0.002	0.002
Tin	Sn	µg/L	0.1	-	0.2	0.2	0.2	0.2	0.2
Titanium	Ti	µg/L	10	-	0.5	0.5	0.5	0.5	0.5
Uranium	U	µg/L	0.01	-	0.002	0.002	0.002	0.002	0.002
Vanadium	V	µg/L	1	-	0.2	0.2	0.2	0.2	0.2
Zinc	Zn	µg/L	3 [1] / 1 [2]	-	0.1	0.1	0.1	0.1	0.1
Zirconium	Zr	µg/L	-	-	0.1	0.1	0.1	0.1	0.1

Notes:
1. Detection Limit for Total Metal
2. Detection Limit for Dissolved Metal

Groundwater samples were collected for the analysis of stable isotopes of hydrogen (^{2}H) and oxygen (^{18}O), and the radioisotopes tritium (^{3}H) and carbon-14 (^{14}C). The stable isotope of carbon (^{13}C) in dissolved bicarbonate was also analyzed as part of the ^{14}C analyses to facilitate the calculation of groundwater radiocarbon ages. In addition, aufeis and surface water samples were collected to support the interpretation of groundwater stable isotope results. Groundwater stable isotope samples were typically collected from all monitoring wells, with radioisotope samples collected at select wells. Aufeis and surface water samples were collected from select locations in Latte, Halfway and YT-24 Creeks. Table 3-9 presents a summary of the groundwater stable isotope and radioisotope samples collected from each monitoring well between 2014 and 2019, as well as aufeis and surface water isotope samples collected between 2014 and 2017.

Table 3-9:
Summary of Isotope Sampling Programs (2014-2019)

Station	Sample Matrix	2014			2015			2016	2017		2019		
		δ^2H, $\delta^{18}O$	^3H	^{14}C	δ^2H, $\delta^{18}O$	^3H	^{14}C	δ^2H, $\delta^{18}O$	δ^2H, $\delta^{18}O$	^3H	δ^2H, $\delta^{18}O$	^3H	^{14}C
CC-1.0_aufeis	A				1		1						
HC-2.5_aufeis	A				1		1						
HC-5.0_aufeis	A				1								
CC-1.0	SW	1	1	1	2	2		1	2	2			
CC-1.5	SW				2	1		1	2	2			
CC-5.5	SW				2	1			1	1			
CC-6.0	SW	1	1										
HC-2.5	SW	1	1	1	2	1		1	2	2	1		
HC-5.0	SW				2	1		1	2	2			
HC@MW15-03	SW										1		
ML-1.0	SW								2	2			
SW14-01	SW	1	1										
YT-24	SW	1	1		2								
MW14-02A	GW	1	1	1	4			3	4	2	4	1	1
MW14-02B	GW	2	2	2	3	1	1	3	4	2	4	1	1
MW14-03A	GW	1			3	2	2	2	4	2	4	2	1
MW14-03B	GW	1			4			2	4	2	3	1	1
MW14-05A	GW	1			3			3	4	2	4	1	1
MW14-05B	GW	1						3	4	2	3	1	1
MW15-01WB	GW				3			3	4	2	3	1	1
MW15-02AZ	GW				4	2		3	1	1			
MW15-02WB	GW				3	2	1	3	4	2	5	2	2
MW15-03AZ	GW				4	2		3	1	1	1	1	
MW15-03WB	GW				3	2	2	3	4	2	3	1	1
MW15-04WB	GW				4	2	1	2	4	2	3	1	1
MW15-05WB	GW				3			2	4	2	3	1	1
MW15-06WB	GW							3	4	2	3	1	1
MW16-01WB	GW							1	4	2	3	1	1

Notes:
A = aufeis, SW = surface water, GW = groundwater
1. Sample counts shown in the table include duplicate samples.
2. Isotope samples were not collected in 2018.

Stable isotope and tritium samples were typically collected in 1 L high-density polyethylene (HDPE) bottles between 2014 and 2019. Radiocarbon samples were collected in 1 L HDPE bottles in 2014 and 2015, and subsequently in 0.25 L amber glass bottles with a septum in August 2019. Radiocarbon samples collected in August 2019 were field filtered (0.45-micron), preserved with $ZnCl_2$ (1.25 grams per 250 mL sample), and kept cool until delivery to the laboratory.

Groundwater, surface water and aufeis samples were submitted to the Brigham Young University Laboratory of Isotope Geochemistry (BYU-LIG) in Provo, Utah for isotope analyses (δ^2H, $\delta^{18}O$, ^3H, $\delta^{13}C$, ^{14}C) in 2014 and 2105. Groundwater and surface water samples collected between 2016 and 2019 were submitted to the University of Waterloo - Environmental Isotope Laboratory (UW-EIL) in Waterloo, Ontario for isotope analyses. Stable isotope and radioisotope analyses and the corresponding precisions are presented in Table 3-10.

Table 3-10:
Stable isotope and radioisotope parameters and precisions (2014-2019)

Parameter	Units	BYU-LIG	UW-EIL
		2014-2015	2016-2019
δ^2H	‰ VSMOW	1.0	0.8
$\delta^{13}C$	‰ VPDB	0.04 or 0.1 [1]	0.2
$\delta^{18}O$	‰ VSMOW	0.20 or 0.40 [2]	0.2
^3H	TU	0.3	0.8
^{14}C	pMC	0.07 - 0.20 [3]	0.040 - 0.26 [3]

Notes:
BYU-LIG = Brigham Young University Laboratory of Isotope Geochemistry, pMC = percent modern carbon, TU = tritium units, UW-EIL = University of Waterloo-Environmental Isotope Laboratory, VPDB = Vienna Pee Dee Belemnite, VSMOW = Vienna Standard Mean Ocean Water
1. Precision of $\delta^{13}C$ analyzed at BYU-LIG was 0.04 ‰ for samples collected between June and September 2015 and 0.1 ‰ for samples collected between September 2014 and April 2015.
2. Precision of $\delta^{18}O$ analyzed at BYU-LIG was 0.2 ‰ for samples collected between May and October 2015 and 0.4 ‰ for samples collected between September 2014 and April 2015.
3. Precision of radiocarbon counts vary by sample; consequently, a range is presented.

4. Physical Hydrogeology Results

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4. Physical Hydrogeology Results

This section discusses physical groundwater data collected during the field programs outlined in Section 3. The discussion covers permafrost characterization, hydraulic testing results, water level time series and hydraulic gradients. Overall, the physical hydrogeological data reveal a complex groundwater system influenced by both discontinuous permafrost and a well-developed fracture system.

4.1 Permafrost

The permafrost data presented in this section is based on ground temperatures measured by thermistors installed by Lorax, SRK, Tetra Tech (or EBA TT), and KP, and other anecdotal observations of bedrock ice occurrence from the Lorax field programs. Key findings are summarized Table 4-1.

4.1.1 Observations of Visible Ice

Observations of ice in bedrock include visible ice shards in RC chips from shallow, fractured bedrock in Halfway Creek (MW15-03) and small lenses of ice at depth in core holes in Latte (MW14-03B) and Kona North (exploration hole CFD0376) (Figure 4-1). Not included in Table 4-1 are observations of ice in bedrock from drill holes advanced in the 2016 and 2017 geotechnical programs (Tetra Tech and SRK, 2016; Tetra Tech, 2017). These programs used chilled drilling fluids to preserve ice in core. Ice infilling of fractures and joints in bedrock was observed in some boreholes, typically within several metres of ground surface.

Detailed observations of ice in overburden are described in Tetra Tech and SRK (2016) and Tetra Tech (2018). Occasionally, ice was returned in RC cuttings in drillholes advanced by Lorax. Most notably, three large lobes of ice were intercepted between 8 and 13 metres below ground surface at MW15-01T (Figure 4-2). This drill pad is located on a slope classified as poorly drained colluvial veneer modified by solifluction (xszCv-S:p-i) (AECOM, 2012).

4.1.2 Permafrost Occurrence and Thickness

Ground temperature profiles for select multibead thermistor locations are provided in Appendix 4-A. Readings from VWP temperature sensors are included in the plots noting that the thermistors contained within VWPs are less accurate than those used in thermistor strings. A typical ground thermal profile, as measured at thermistor MW14-07T, is shown in Figure 4-3.

Table 4-1:
Observations of permafrost depth from thermistor installations, exploration drilling and monitoring well sampling.

Hole ID	Ground Surface (m asl)	Inferred Base of Permafrost (m bgs)	Temperature at 20 m bgs (°C)	Comments
Halfway Creek				
MW14-05B	1270.3	<134	NR	Water level in well remains unfrozen to 134 m.
MW16-01T	1203.7	70	-0.3 to -0.1	North (downslope) of Heap Leach Facility
GT17-10T	1260.1	>20	-0.5	Based on October 2017 data (TetraTech, 2017)
CFD0318	1213.2	na	NR	Single point VWP at 118 m, unfrozen (EBA 2013)
MW14-04T	1185.8	168	-1.2 to -0.5	Borehole located in road cut, vegetation stripped.
MW14-03B	1095.2	61.8 ≤ x ≤ 133	NR	Small ice lens observed in core at 61.8 m, water in well is unfrozen at ~133 m bgs.
GT-63	~1020	>20	-1.4	Based on data between October 2016 and January 2017 (TetraTech, 2016)
SRK-15D-10T	1008.2	40 to 50	-1.85	Inferred base of permafrost estimated by projecting temperature trend beyond the end of the thermistor string at 25 m bgs.
GT17-28T	970	>20	-1.6	Based on October 2017 data (TetraTech, 2017)
SRK-15D-08AT	925.1	60 to 80	-0.9 to -0.7	
GT17-26T	875.2	>20	-0.1	Based on October 2017 data (TetraTech, 2017)
GT17-39T	837.2	5	0.9	Based on October 2017 data (TetraTech, 2017)
GT17-36T	804.4	>20	-1.9 to -1.2	Based on October 2017 data (TetraTech, 2017)
GT17-34T	801.3	>20	-0.5	Based on October 2017 data (TetraTech, 2017)
GT17-37T	765.4	>20	-0.2	Based on October 2017 data (TetraTech, 2017)
MW15-04T	670.9	29 to 31	-0.4 to -0.2	
MW15-03T	557.7	10.4 ≤ x ≤16.9	0.02	Ice shards observed in rock chips 8.8-10.4 m, near zero temperatures observed at 16.9 m.
MW15-03WB	557.9	10.4 ≤ x ≤16.9	NR	Ice shards observed in rock chips 7.7, 8.2 and 8.5-10.4 m.
Kona Creek				
MW17-01T	1245.8	95	-0.5	200 m NW of MW14-05B
CFD0376	1052.1	x ≥ 85	na	Exploration hole in Kona North; ice lens observed around 85 m.
YT-24				
MW15-01T	803.9	75 to 80	-1.5 to -1.3	
MW15-07T	1183.1	140 to 150	-1.3 to -1.1	Borehole located in road cut, vegetation stripped.
SRK-15D-07T	948.9	82 to 85	-1.9 to -1.7	
GT-14	NA	>20	-1	Based on data between August 2016 and January 2017 (TetraTech, 2016)
Latte Creek				
CFD0332	1221.8	na	NR	Single point VWP at 117 m, unfrozen (EBA 2013)
MW14-07T	1156.3	60 to 64	-1.1 to -0.8	
SRK-15D-13T	1136.9	41 to 50	-0.2	Inferred base of permafrost estimated by projecting temperature trend beyond the end of the thermistor string at 25 m bgs.
CFD0351	1123.6	na	NR	Single point VWP at 184 m, unfrozen (EBA 2013)
KPBH-01	1122.7	>50 (80)	-0.9	Inferred base of permafrost (value in brackets) estimated by projecting temperature trend beyond end of thermistor string (50m bgs).
KPBH-04	1121.3	>50 (120)	-1	Inferred base of permafrost (value in brackets) estimated by projecting temperature trend beyond end of thermistor string (50m bgs).
MW15-05T	1067.1	45 to 47	-0.6 to-0.4	
MW14-02B	1030.9	>34	NR	Inferred base of permafrost estimated from ice surface in conventional MW after several months of inactivity.
CFD0324	992.9	na	NR	Single point VWP at 178 m, unfrozen (EBA 2013)
MW15-02T	737.1	na	0.5 to 0.6	Permafrost absent.
SRK-15D-09T	784.3	na	0.8	Permafrost absent.

Notes:
m asl = metres above sea level; m bgs = metres below ground surface; °C = degrees Celsius.
NR = no reading; na = not applicable



Figure 4-1: Ice lens observed in exploration hole CFD0376 (Kona North). Depth is ~85 m vertical.



Figure 4-2: Ice "cuttings" intercepted at MW15-01T while advancing casing through colluvium.

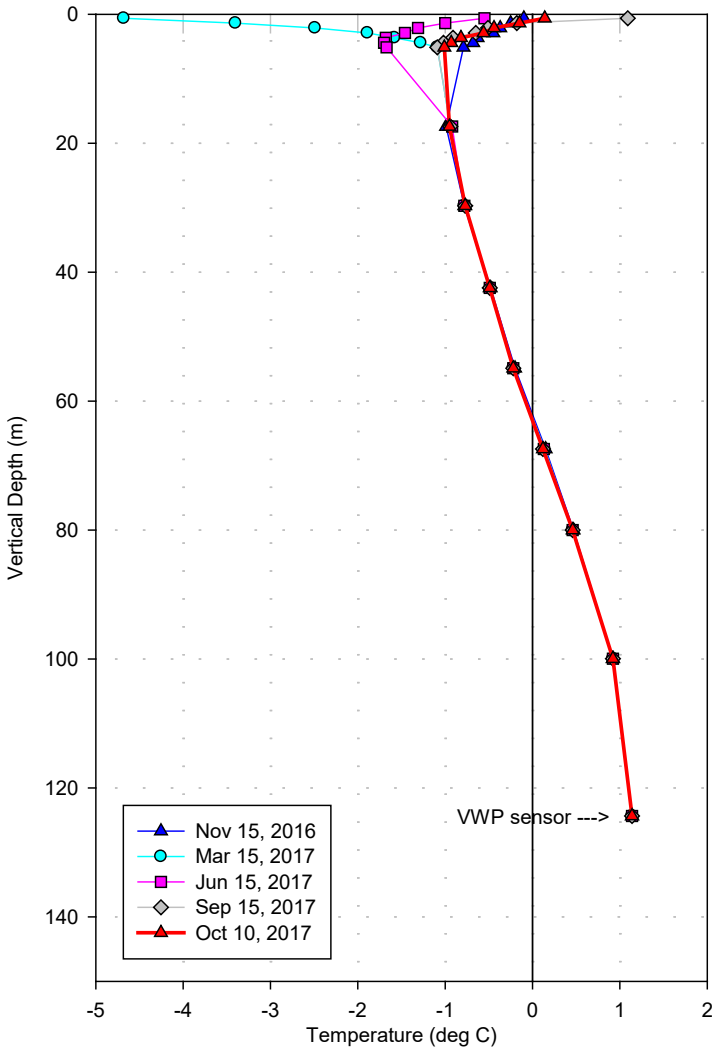


Figure 4-3: Thermal profile at MW14-07T, downgradient of the proposed heap leach facility.

Table 4-1 summarizes the thickness of permafrost measured or inferred from site thermistors. This depth is based on where the thermal profile crosses the 0°C line, or where it is extrapolated to cross the 0ºC line as illustrated in Figure 4-3. The generally low levels of total dissolved solids (TDS) in the sub-permafrost groundwater (<1000 mg/L) suggest that freezing point is not depressed below 0ºC. Permafrost in the project area is relatively warm (between 0 and -2°C) and at 20 metres depth (*i.e.* beyond the depth of zero annual fluctuation), is coolest (-1.4°C to -1.9°C) on north facing slopes.

Figure 4-4 plots permafrost thickness versus instrument elevation at locations where permafrost thickness could be constrained. The data reveal a general trend of permafrost thickness decreasing towards areas of lower elevation. North-facing slopes tend to have thicker permafrost than south-facing slopes. The thickest permafrost (~168 metres) encountered is near the north end of the proposed Supremo pit at MW14-04T.

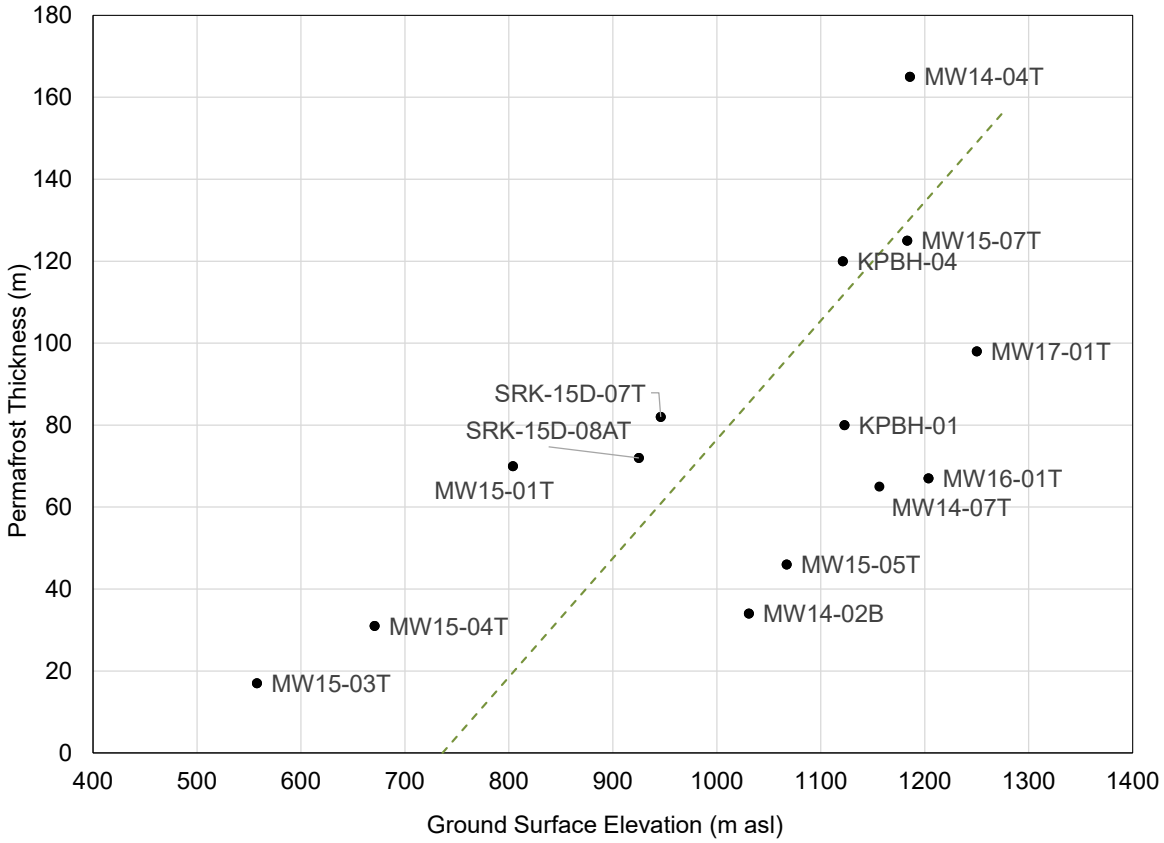
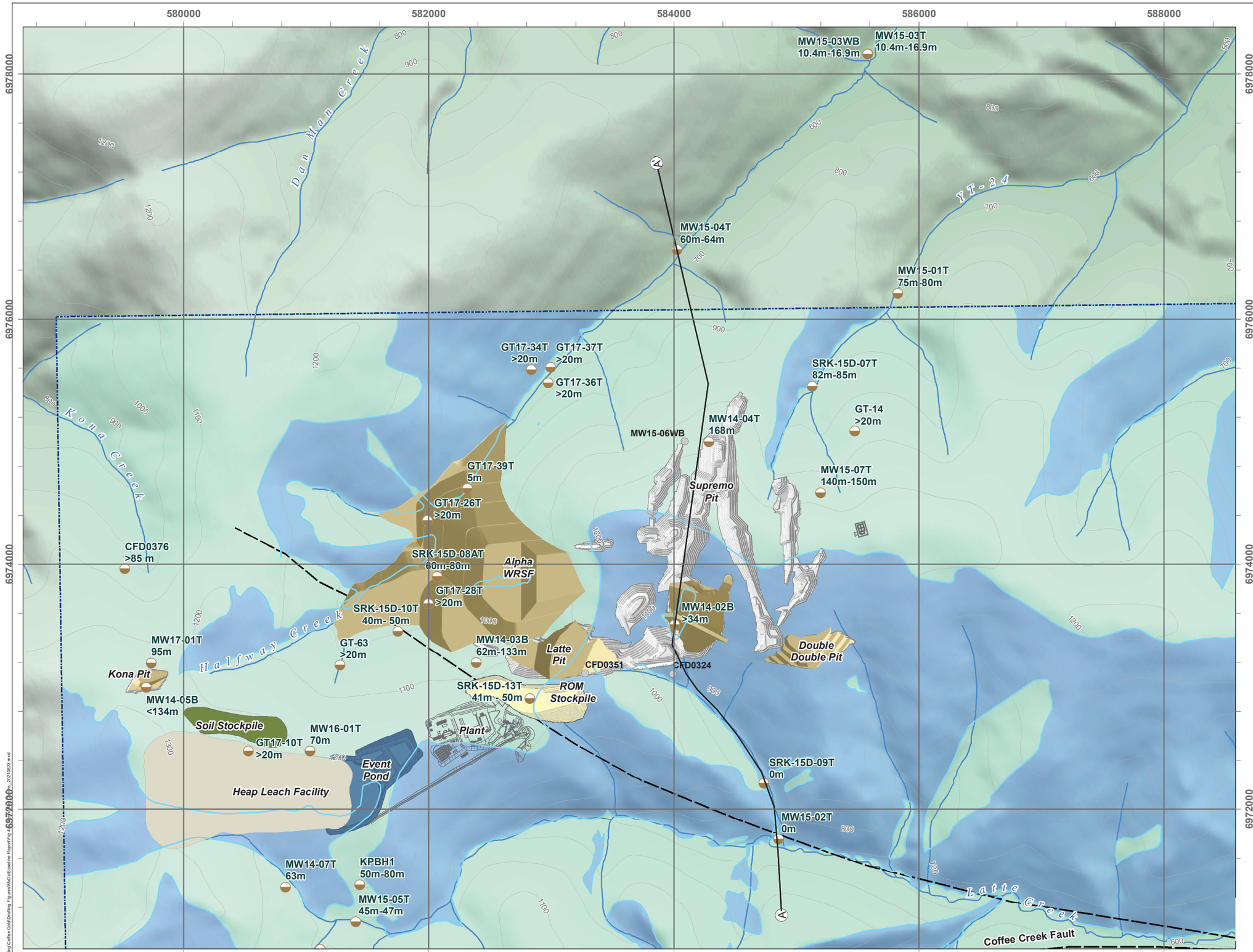


Figure 4-4: Depth of permafrost versus ground surface elevation at the Coffee Gold Project.

The point measurements provided in Table 4-1 are plotted on the permafrost distribution map in Figure 4-5. The map is based on the 2017 permafrost distribution map compiled by Tetra Tech (2017). Versions of this map and the permafrost thickness versus elevation trend (Figure 4-4) have been used to inform the groundwater model constructed for the Project (Lorax, 2016).

4.1.3 Active Zone

The active zone is defined as the top layer of ground that overlies permafrost and seasonally freezes and thaws. Table 4-2 summarizes time periods for which shallow temperature sensors record above zero readings in 2016, 2017 and 2018 and hence provides insight as to when the active zone is "active". Time series plots of the shallow temperature data are found in Appendix 4-B. Only thermistors where continuous data loggers are deployed are considered in Table 4-2 and Appendix 4-B.



LEGEND

- Cross-Section Trace
- Permafrost Depth
- WL Station (no permafrost data)
- Permafrost Present
- No Permafrost Present
- Extent of Recent Permafrost Mapping (TetraTech, 2017)
- Fault (Approximate) (Grodzicki et. al, 2015).

Proposed Infrastructure

- WRSF/Backfill
- Pit
- Heap Leach Pad
- Soil Stockpile
- Stockpile Pad
- Event Pond

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:30,000

0 400 800 Meters

DATE SAVED:	Aug 23, 2021
DRAWN BY:	GM/AL
REVIEWED:	LF
VERSION:	1

CLIENT:

Newmont COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE: Measured and Estimated Base of Permafrost at the Coffee Gold Site

PROJECT #: A362-4 *FIGURE:* 4-5

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Table 4-2:
2016-2018 Period of record with above 0°C temperatures at shallow thermistor sensors

Instrument	Ground Surface Elevation (m asl)	Sensor Depth (m bgs)	2016			2017			2018		
			Date Temperature >0˚C	Date Temperature <0˚C	# of Days >0°C	Date Temperature >0˚C	Date Temperature <0˚C	# of Days >0°C	Date Temperature >0˚C	Date Temperature <0˚C	# of Days >0°C
Halfway Creek											
MW14-04T	1186	3.1	All readings >0°C			29-Jul-17	07-Jan-18	162	01-Jul-18	>31-Dec-18	>183
SRK-15D-10T	1008	0.5	28-Mar-16	02-Oct-16	188	08-Apr-17	11-Oct-17	186	06-Apr-18	08-Oct-18	185
		3	All readings <0°C			All readings <0°C			All readings <0°C		
SRK-15D-08T	925	1	08-Jun-16	27-Sep-16	111	29-Jul-17	01-Oct-17	64	10-Jul-18	12-Nov-18	125
		4	All readings <0°C			All readings <0°C			All readings <0°C		
MW15-04T	671	1.7	26-Mar-16	29-Sep-16	187	05-Apr-17	10-Oct-17	188	22-Aug-18	09-Oct-18	>
MW15-03T	558	0.5	13-May-16	23-Oct-16	163	24-May-17	07-Nov-17	167	13-Apr-18	4-Nov-18	205
		1.2	02-May-16	06-Dec-16	218	12-Jun-17	04-Dec-17	175	n/a	n/a	
		1.9	All readings >0°C			All readings >0°C			All readings >0°C		
		2.6	All readings >0°C			All readings >0°C			All readings >0°C		
		3.4	All readings >0°C			All readings >0°C			All readings >0°C		
		4.1	11-May-16	>31-Dec-16	>234	All readings >0°C			All readings >0°C		
		4.9	All readings >0°C			All readings >0°C			All readings >0°C		
YT-24 Drainage											
MW15-07T	1183	7	17-Jul-16	07-Nov-16	113	All readings <0°C			20-Sep-18	9-Oct-18[b]	19
SRK-15D-07T	949	0.7	All readings <0°C			All readings <0°C			All readings <0°C		
		2.2	All readings <0°C			All readings <0°C			All readings <0°C		
		3.7	All readings <0°C			All readings <0°C			All readings <0°C		
		5.2	All readings <0°C			All readings <0°C			All readings <0°C		
MW15-01T	804	0.5	12-May-16	05-Oct-16	146	09-May-17	12-Oct-17	157	10-May-18	01-Oct-18	144
		1.3	08-Aug-16	27-Sep-16	51	19-Sep-17	31-Dec-17	103	12-Aug-18	17-Sep-18	36
Upper Latte Creek											
MW14-07T	1156	0.6	30-Jul-16	30-Sep-16	62	05-Jul-17	13-Oct-17	100	21-Jun-18	8-Nov-18	140
		1.4	All readings <0°C			All readings <0°C			04-Aug-18	02-Oct-18	59
KPBH01	1123	0.8	11-May-16	11-Oct-16	153	12-May-17	15-Oct-17	157	09-May-18	10-Oct-18	154
		1.5	17-Jun-16	04-Nov-16	140	16-Jun-17	21-Nov-17	158	12-May-18	16-Nov-18	188
KPBH04	1121	0.8	09-Jun-16	12-Oct-16	125	10-Jun-17	22-Oct-17	135	14-Jun-18	9-Oct-18	117
		1.5	03-Jul-16	16-Oct-16	105	17-Jul-17	23-Oct-17	98	13-Jul-18	12-Oct-18	91
MW15-05T	1067	0.8	20-May-16	07-Oct-16	139	09-Jun-17	17-Oct-17	130	01-Jun-18	28-Oct-18	107
		1.5	15-Jun-16	07-Oct-16	114	06-Jul-17	17-Oct-17	103	22-Jun-18	8-Oct-18	129
SRK-15D-13T	1137	0.5	01-Apr-16	30-Sep-16	182	24-Apr-17	08-Oct-17	167	18-Apr-18	7-Oct-18[b]	172
		3	16-Jul-16	08-Nov-16	116	12-Jul-17	12-Dec-17	153	18-Jul-18	17-Dec-18[b]	152
		5.5	All readings <0°C			All readings <0°C			All readings <0°C		
Latte Creek Tributary Drainage											
SRK-15D-09T	784	1.1	10-Jun-16	23-Oct-16	135	21-Jun-17	17-Oct-17	118	21-Jun-18	07-Oct-18	108
		2.6	All readings >0°C			All readings >0°C			All readings >0°C		
		4.1	All readings >0°C			All readings >0°C			All readings >0°C		
MW15-02T	737	1.2	17-Jun-16	13-Oct-16	118	18-Jun-17	25-Oct-17	129	03-Jul-18	27-Oct-18[b]	116
		3.2	All readings <0°C			All readings <0°C			All readings <0°C		
		5.2	All readings >0°C			All readings >0°C			All readings >0°C		

The active zone is conceptualized as a highly heterogeneous zone that is variable in timing and duration between location and between years at the same location. In the Halfway Creek catchment, the thickest active zone (3.1 m) is measured at the highest elevation thermistor, MW14-04T, within the footprint of the Supremo pit (Figure 1-2) and along a road cut. MW15-03T, the lowest elevation thermistor in Halfway Creek, appears to be on the fringe of permafrost coverage. The upper 1.2 m appears seasonally active, but the thermistors between 1.9 m and 4.9 m register above zero temperatures essentially all year. While the presence of permafrost at this station is not identified in the temperature record, drilling observations of ice in the rock cuttings suggest that it does intercept permafrost. In this drainage, the active layer becomes active any time between March and August and stays unfrozen between September and December. The timing and duration of the active zone is highly variable between 2016 and 2018.

In YT-24, both the highest elevation (MW15-07T) and lowest elevation (MW15-01T) instruments intercept the active zone which becomes active between May and July and remains active through October to December. SRK-15D-07T, at an intermediate elevation, remained perennially frozen.

The active zone in Latte Creek becomes active between April and July and remains active through October to December. The period of active flow is relatively consistent between 2016 and 2018. Thermistors completed in lower portions of the Latte Creek tributary (MW15-02T, SRK15D-09T) indicate this area is permafrost free.

4.2 Hydraulic Testing

Sixty successful measurements of bedrock hydraulic conductivity (K) have been collected during field programs executed between 2013 and 2017. Testing results from unfrozen bedrock are shown in Table 4-3. Most measurements were acquired through packer testing, but airlift yield recovery tests and slug tests were also performed. Slug tests were performed on two overburden wells (MW15-03AZ and MW15-02AZ), however, the tests recovered so quickly (*i.e.,* within seconds) that they could not be interpreted.

Bedrock K values are plotted versus vertical depth below ground surface in Figure 4-6 and are color coded according to lithology. Ranges in bedrock K values for different depth intervals are also shown in a box and whisker plot in Figure 4-7 with median values summarized in Table 4-4. The hydraulic conductivity data range over several orders of magnitude with values exceeding 1E-06 m/s and others below the resolution of the testing method (red italicized numbers in Table 4-3). A broad range in K values is typical of a fractured bedrock system (Golder, 2010). A regression line though the data points (Figure 4-6) indicates a broad trend of decreasing hydraulic conductivity with depth.

Median K values decrease by an order of magnitude or more below 150 m depth and again below 250 m depth (Figure 4-7, Table 4-4).

Rock type does not appear to play a large control on hydraulic properties (Figure 4-6). Rather, structural features, which crosscut all lithologies, impart the dominant control on hydraulic conductivity. Hydraulic tests performed on pit structures (SRK, 2015), along valley traces and in the currently proposed HLF footprint (MW16-01T/WB) have been grouped together as 'structures' in Table 4-4 and Figure 4-6 and Figure 4-7. Some of these test results comprise the cluster of the higher hydraulic conductivity values between 150 m and 300 m depth (Figure 4-6). While not mapped as such, the YT-24 and Halfway Creek drainages are inferred to coincide with fault structures. Reverse circulation drillholes advanced below permafrost in these drainages returned airlift yields on the order of 30 US GPM (~1.9 L/s). Latte Creek coincides with the mapped Coffee Creek Fault.

The two boreholes advanced near the proposed HLF (MW16-01T and MW16-01WB) happened to intercept a previously identified NNW-SSE trending magnetic anomaly. Ground conditions and the hydraulic response of this feature (K values exceeding 5E-7 m/s) suggest that this is a fault structure. The median K of structures is 2E-07 m/s with tests ranging up to 275 m depth. This K value is one to two orders of magnitude higher than other bedrock tests over the same depth interval (Figure 4-7, Table 4-4).

Tetra Tech (2017) conducted packer tests on shallow, frozen bedrock in the Halfway Creek to determine foundation conditions in a proposed sediment pond location (Table 4-5). Nine out of thirteen tests had no discernible flow and were assigned maximum values based on the resolution of the test. The median K value estimated for shallow, frozen bedrock is 2E-08 m/s (Figure 4-7, Table 4-4).

Table 4-3:
Hydraulic testing results for the Coffee Gold project (unfrozen bedrock).

Hole ID	Consultant	Azimuth	Dip	Test Interval[1] (v m bgs)		Test Interval Length (m)	Test Method	Test Type[2]	Analysis Type[3]	K[4] (m/s)	Geologic Unit[5]
				From	To						
Supremo											
MW14-01A	Lorax (2017c)	0	-90	155	166	11	Packer	CHI	Thiem	4E-08	GN
MW14-01A	Lorax (2017c)	0	-90	179	202	23	Packer	CHI	Thiem	3E-08	GN/SCH/GN
MW14-04T	Lorax (2017c)	0	-90	182	202	20	Packer	CHI	Thiem	2E-10	SCH
MW14-04T	Lorax (2017c)	0	-90	164	202	38	Packer	Lugeon	Thiem	6E-10	GN/SCH
MW14-04T	Lorax (2017c)	0	-90	203	232	29	Packer	Lugeon	Thiem	1E-09	SCH/GN
MW14-04T	Lorax (2017c)	0	-90	233	256	23	Packer	Lugeon	Thiem	4E-09	GN
MW14-04T	Lorax (2017c)	0	-90	251	280	29	Packer	CHI	Thiem	3E-10	GN
MW14-04T	Lorax (2017c)	0	-90	281	301	20	Packer	CHI	Thiem	*4E-11*	GN
MW14-06A	Lorax (2017c)	0	-90	197	216	19	Slug Test	RH	Hvorslev	1E-07	GN
MW15-06WB	Lorax (2017c)	0	-90	281	286	5	Westbay	Pulse Test	Hvorslev	1E-09	GN
MW15-06WB	Lorax (2017c)	0	-90	238	243	5	Westbay	Pulse Test	Hvorslev	2E-07	GN
MW15-06WB	Lorax (2017c)	0	-90	227	237	10	Westbay	Pulse Test	Hvorslev	1E-08	GN
VWP CFD-0318	EBA TT (2014)	175	-45	89	91	3	Packer	Lugeon	Thiem	5E-07	Dyke/GN
VWP CFD-0318	EBA TT (2014)	175	-45	105	108	4	Packer	Lugeon	Thiem	1E-06	Amph
VWP CFD-0318	EBA TT (2014)	175	-45	118	122	4	Packer	Lugeon	Thiem	5E-08	GN
CFD-0319	EBA TT (2014)	0	-45	76	83	7	Packer	Lugeon	Thiem	7E-08	GN/Dykes
CFD-0323	EBA TT (2014)	280	-70	93	118	25	Packer	Lugeon	Thiem	4E-08	GN/SCH
IFSPD124	SRK (2015)	270	-50	36	125	89	Slug Test	FH	Hvorslev	2E-07	GN
IFSPD110a	SRK (2015)	270	-50	220	239	19	Slug Test	FH	Hvorslev	2E-07	GN
VWP CFD-0324	EBA TT (2014)	280	-45	54	60	6	Packer	Lugeon	Thiem	4E-08	SCH
VWP CFD-0324	EBA TT (2014)	280	-45	72	105	32	Packer	Lugeon	Thiem	1E-07	SCH
CFD-0327	EBA TT (2014)	275	-60	73	86	13	Packer	Lugeon	Thiem	5E-08	GN
MW14-02B	Lorax (2017c)	0	-90	85	104	20	Packer	CHI	Thiem	5E-09	GN
MW14-02B	Lorax (2017c)	0	-90	103	125	23	Packer	CHI	Thiem	8E-08	GN
MW14-02B	Lorax (2017c)	0	-90	130	137	8	Packer	CHI	Thiem	3E-08	SZ/SCH
MW14-02B	Lorax (2017c)	0	-90	139	152	14	Packer	CHI	Thiem	1E-07	SCH/BRC
MW14-02B	Lorax (2017c)	0	-90	157	173	17	Packer	CHI	Thiem	1E-08	BRC/HAR/BRC
MW14-02B	Lorax (2017c)	0	-90	181	200	20	Packer	CHI	Thiem	1E-08	SCH
Latte											
MW14-03A	Lorax (2017c)	0	-90	157	199	42	Packer	CHI	Thiem	5E-09	SCH/SZ
SRK-15D-15P	SRK (2015)	0	-90	200	274	74	Airlift	Recovery	Theis Recovery	3E-07	GN/SCH/BRC
Kona and HLF											
MW14-05A	Lorax (2017c)	0	-90	156	179	23	Packer	CHI	Thiem	*4E-11*	GR
MW14-05A	Lorax (2017c)	0	-90	183	200	17	Packer	CHI	Thiem	3E-09	GR
MW14-05A	Lorax (2017c)	0	-90	201	221	19	Packer	CHI	Thiem	1E-09	GR
MW14-05A	Lorax (2017c)	0	-90	156	221	64	Packer	CHI	Thiem	1E-09	GR
MW14-05B	Lorax (2017c)	0	-90	139	118	-21	Slug Test	RH	Hvorslev	5E-10	GR
SRK-15D-14P	SRK (2015)	345	-70	173	212	38	Packer	CHI/FH Slug	Hvorslev	1E-07	GR
MW16-01T	Lorax (2017b)	0	-90	148	189	42	Packer	CHI	Thiem	6E-07	GR
MW16-01WB	Lorax (2017b)	0	-90	76	120	44	Airlift	Recovery	Cooper-Jacob	5E-06	GR
MW17-01T	Lorax (2017a)	0	-90	175	202	27	Packer	CHI	Thiem	4E-08	GR
MW17-01T	Lorax (2017a)	0	-90	152	202	50	Packer	CHI	Thiem	1E-08	GR
Double Double											
SRK-15D-16P	SRK (2015)	165	-70	137	150	13	Packer	CHI & FH	Cooper-Jacob/Theis	2E-07	BRC/dyke
SRK-15D-16P	SRK (2015)	165	-70	167	214	47	Packer	Recovery	Theis Recovery	1E-07	dyke/GN
Valley											
MW14-07T	Lorax (2017c)	0	-90	64	89	25	Packer	Lugeon	Thiem	3E-08	GR
MW14-07T	Lorax (2017c)	0	-90	83	125	42	Packer	Lugeon	Thiem	1E-08	GR
MW15-05T	Lorax (2017c)	125	80	51	83	32	Airlift	Recovery	Cooper-Jacob	3E-06	GR
MW15-03T	Lorax (2017c)	39	80	32	97	64	Airlift	Recovery	Cooper-Jacob	3E-07	BN/SCH
MW15-04T	Lorax (2017c)	40	80	40	53	12	Packer	Shut-In/CHI	Thiem	4E-06	GN
GT17-35	TT (2017)	0	-90	8	11	3	Packer	Lugeon	Thiem	7E-06	SCH
GT17-35	TT (2017)	0	-90	13	21	8	Packer	Lugeon	Thiem	*1E-08*	SCH
GT17-35	TT (2017)	0	-90	24	30	6	Packer	Lugeon	Thiem	4E-06	SCH/GN

Notes:
v mbgs = vertical metres below ground surface, K = hydraulic conductivity
1. Depth below ground surface for inclined tests has been calculated by Lorax to take surface topography into account.
2. CHI = constant head injection, FH = falling head test
3. Thiem (1906); Cooper-Jacob (1946), Hvorslev (1951), Theis (1935)
4. *Italicized red* values are an inferred upper value computed based on injection pressures and resolution of the flow gauge
5. Tests straddling two or more geologic units denoted by a '/' (*e.g.* SCH/GN). Amph = amphibole rich rock, SCH = schist, BRC = breccia, GN = gneiss, GR = granite, HAR = hydrothermally altered rock, SZ = shear zone

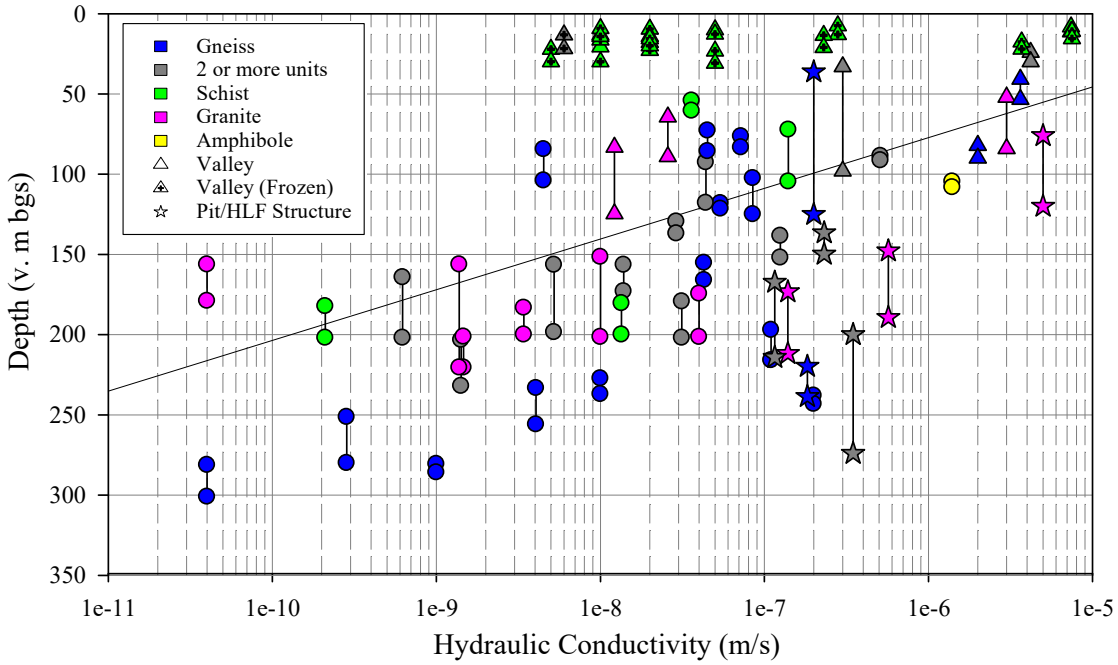

Figure 4-6: Bedrock hydraulic conductivity versus vertical depth below ground surface at the Coffee Gold Project (organized by lithology).

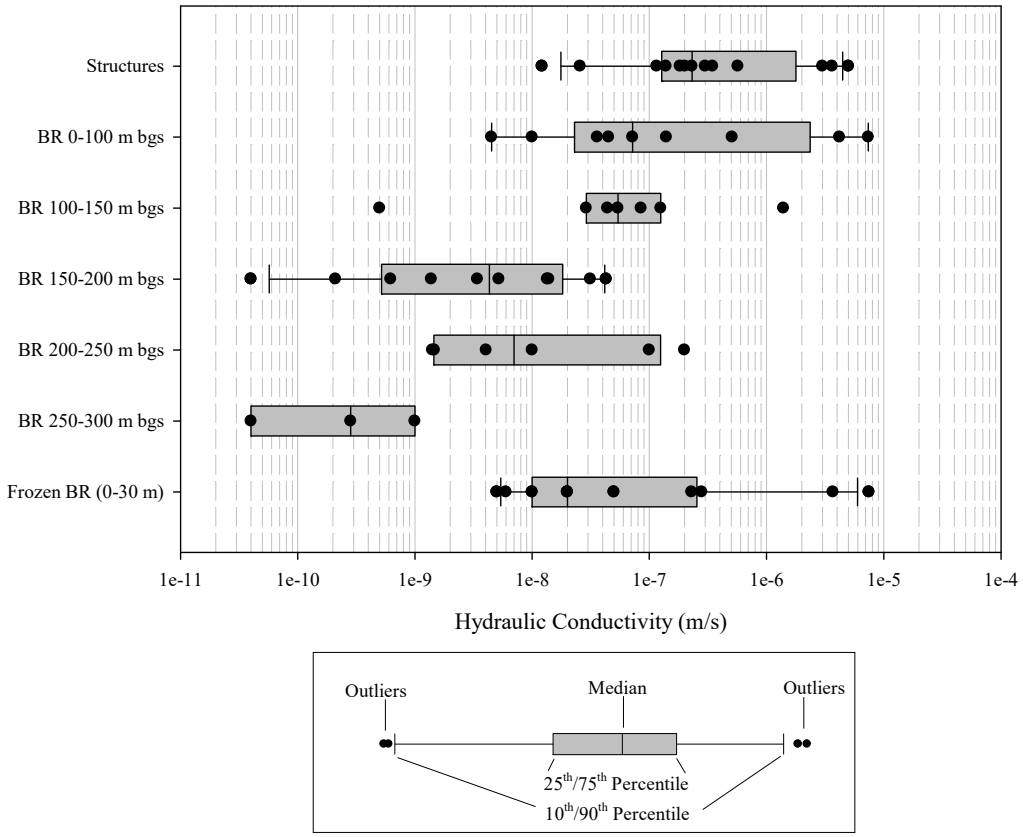

Figure 4-7: Box and whisker plot of hydraulic testing results with legend in bottom pane.

Table 4-4:
Median bedrock hydraulic conductivity

Bedrock Unit	Median K (m/s)
Structures & Valley Traces	2E-07
0-100 m deep	7E-08
100-150 m deep	5E-08
150-200 m deep	4E-09
200-250 m deep	7E-09
250-300 m deep	3E-10
Frozen (0-30 m deep)	2E-08

Table 4-5:
Packer testing results on frozen bedrock (Tetra Tech, 2017).

Alternate ID	Azimuth	Dip	Test Interval (v m bgs)		Test Interval Length (m)	Test Type	Analysis Type	K[1] (m/s)	Geologic Unit[2]
			From	To					
GT17-33	0	-90	10	13	3	Lugeon	Thiem (1906)	*5E-08*	SCH
GT17-33	0	-90	18	23	5	Lugeon	Thiem (1906)	*2E-08*	SCH
GT17-33	0	-90	16	30	14	Lugeon	Thiem (1906)	*1E-08*	SCH
GT17-34T	0	-90	11	16	5	Lugeon	Thiem (1906)	8E-06	SCH
GT17-34T	0	-90	18	22	5	Lugeon	Thiem (1906)	4E-06	SCH
GT17-34T	0	-90	23	31	8	Lugeon	Thiem (1906)	*5E-08*	SCH
GT17-36T	0	-90	8	13	5	Lugeon	Thiem (1906)	3E-07	SCH
GT17-36T	0	-90	14	21	8	Lugeon	Thiem (1906)	2E-07	SCH
GT17-36T	0	-90	22	30	8	Lugeon	Thiem (1906)	*5E-09*	SCH
GT17-37T	0	-90	9	14	5	Lugeon	Thiem (1906)	*1E-08*	SCH
GT17-37T	0	-90	13	22	9	Lugeon	Thiem (1906)	*6E-09*	SCH/GN
GT17-38	0	-90	10	14	5	Lugeon	Thiem (1906)	*2E-08*	SCH
GT17-38	0	-90	16	20	5	Lugeon	Thiem (1906)	*2E-08*	SCH

Notes:
v mbgs = vertical metres below ground surface, K = hydraulic conductivity
1. *Italicized red* values are an inferred upper value computed based on injection pressures and resolution of the flow gauge
2. Tests straddling two or more geologic units denoted by a '/' (*e.g.* SCH/GN). SCH = schist, GN = Gneiss

4.3 Water Levels and Gradients

4.3.1 Overview

A summary of groundwater level monitoring at the Coffee Gold site is provided in Table 4-6. Groundwater level monitoring started in the fall of 2013 with the inception of the VWPs installed by EBA TT. Readings from these installations were collected sporadically until dedicated, continuously recording dataloggers were connected in the fall of 2014. Conventional monitoring wells installed by Lorax in the summer/fall of 2014 were equipped with Solinst Leveloggers. Any instrument nest equipped with a VWP from 2014 onwards has also been hardwired to a datalogger. A continuous water level record is available from most instruments on site from June 2015 onwards.

Bedrock water levels measured in June 2018 are presented in Figure 4-8. Table 4-6 summarizes magnitude of seasonal water level fluctuations between 2015 and 2019. Vertical hydraulic gradients measured at conventional wells pairs and nested VWP sensors are summarized in Table 4-7 and plotted in Figure 4-9. Horizontal hydraulic gradients measured between installations are summarized in Table 4-8. Groundwater level time series from 2015 through August 2019 are presented in Figure 4-10 to Figure 4-15 for instruments with continuously recording dataloggers. Point water level measurements collected at Westbay instruments are presented in Appendix 4-D.

Water levels are highly variable across the site with the deepest water levels (from 130 to over 220 metres below ground surface) measured in ridge areas and flowing artesian conditions often measured in the drainages. However, the presence of permafrost and faults/structures can create unexpected hydrogeological conditions. For instance, artesian water levels are measured near the height of land in the Halfway Creek drainage while downward hydraulic gradients are observed near Latte Creek.

The transient water level data show distinct responses to seasonal recharge. The first type is a broad sinusoidal response to seasonal recharge with a single water level maximum per annum. The maxima appear as smooth to slightly sharp peaks in the hydrograph record. Seasonal maxima and minima may vary annually in both magnitude and timing on account of the variable climate. As discussed in Section 2.1, it is inferred that more precipitation was available to recharge the groundwater system in 2013, 2015 and 2018 while 2014 and 2017 are considered drier years. As expected, higher seasonal maxima are experienced in wetter years. This type of response is more frequently observed in the Coffee groundwater record as compared to the second type of transient water level response.

580000 582000 584000 586000 588000

6978000 6976000 6974000 6972000

Dan Man Creek
Kona Creek
Halfway Creek
Latte Creek
Coffee Creek Fault

MW15-03 WB/AZ/T (BH12) (557)
HC-6.8
MW15-04WB/AZ/T (BH4) (673)
YT-24
YT24-4.9
MW15-01T/WB (BH8) (777)
MW15-01 AZ (BH8)
SRK-15D-07T (890)
MW15-06WB (BH5) (966)
Supremo Pit
MW15-07T (BH7) (1052)
IFSPD062 (1166)
IFSPD110a (1082)
IFSPD124
CFD0318 (<1092)
CFD0332 (<1105)
SRK-15D-08AT (933)
Alpha WRSF
MW14-02A/B (BH9) (1017)
SRK-15D-16H (1035)
Double Double Pit
MW17-01T (1134)
Kona Pit
SRK-15D-14H
MW14-05A/B (BH11) (1140)
MW14-03A/B (BH3) (963)
SRK-15D-15H
Latte Pit
CFD0351 (983)
CFD0324 (936)
MW16-01T/WB (WB002) (1199)
Heap Leach Facility
SRK-15D-09T (784)
LCT20-0.14
MW15-02WB/AZ/T (BH10) (728)
LC-11.4
LCT20-0.1
MW14-07T (BH1) (1167)
MW15-05 WB/AZ/T (BH2) (1043)
LC-15.5

LEGEND

(1082) Static water level elevation (m asl) June, 2018 except the water level elevations for packer test locations by SRK (2015) are from June/July 2015.

- Surface WQ Monitoring Stations
- Surface and Hydrology Monitoring Stations
- Monitoring Well — *AZ = active zone, WB = Westbay, A = deep conventional (200+m), B = shallow coventional (150+m), T = thermistor/VWP, BH = original drill pad name*
- Thermistor/VWP (Lorax 2014-2017)
- Thermistor/VWP (SRK 2015)
- Vibrating Wire Piezometer (VWP) (EBA 2013)
- Packer Tests (SRK 2015)
- Cross-Section Trace
- Inferred Groundwater Equipotentials
- Linament (Huscroft, 2002)
- Fault (Approximate) (Grodzicki et. al, 2015).
- Drilled Structure
- Inferred Structure

Proposed Infrastructure

- WRSF/Backfill
- Open Pit
- Heap Leach Pad Base

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:30,000

0 500 1,000 Meters

DATE SAVED:	Aug 26, 2021
DRAWN BY:	GM/AL
REVIEWED:	LF
VERSION:	1

CLIENT: Newmont COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE: Hydrogeological Monitoring Network and June 2018 Bedrock Groundwater Head Contours

PROJECT #: A362-4 *FIGURE:* 4-8

Path: P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Baseline Report\Fig 4-8_GW Contours_June2018_20210823.mxd

P:\@Drafting\Coffee Gold\Drafting Figures\MxDs\Baseline Report\Fig 4-8_GW Contours_June2018_20210823.mxd

Table 4-6:
Selected water level information for the Coffee Gold Project.

Installation Type[1]	Monitoring ID	Westbay Port[2]	Period of Record[3]		Ground Surface Elevation	Monitoring Depth[4]	Base of Permafrost	Minimum Groundwater Level[5]		Typical Timing of Minimum	Maximum Groundwater Level[5]		Typical Timing of Maximum	Annual Water Level Fluctuation[6]				Water Level Record Description/Comments[7]
														2015	2016	2017	2018	
					(m asl)	(m bgs)	(m bgs)	(m bgs)	(m asl)		(m bgs)	(m asl)		(m)	(m)	(m)	(m)	
MW	MW14-02A	na	Sept. 2014[a]	Aug. 2019	1029.54	188.20	34	12.0	1017.5	Spring	-4.8	1034.3	Fall	13.3	5.8	4.0	9.5	Sinusoidal, artesian
	MW14-02B	na	Sept. 2014[a]	Aug. 2019	1030.93	146.60	34	21.4	1009.5	Spring	-1.0	1031.9	Fall	18.8	8.4	5.0	18.2	Sinusoidal, periodically artesian
	MW14-03A	na	Oct. 2014[b]	Jun 2019	1097.59	191.30	61.8≤ x ≤133	137.9	959.7	Summer	128.1	969.5	Fall	6.3	5.3	1.2	7.0	Sinusoidal
	MW14-03B	na	Oct. 2014	Jun 2019	1095.16	145.70	61.8≤ x ≤133	135.5	959.7	Summer	125.7	969.5	Fall	6.1	5.4	1.3	6.8	Sinusoidal
	MW14-05A	na	Sept. 2014[a]	Aug. 2019	1268.50	206.40	<134	132.4	1136.1	Variable	125.6	1142.9	Fall	1.3	1.1	1.8	3.0	Sinusoidal, continuously increasing
	MW14-05B	na	Sept. 2014[a]	Aug. 2019	1270.30	171.00	<134	134.1	1136.2	Winter	127.6	1142.7	Fall	1.1	0.7	1.6	1.9	Sinusoidal, continuously increasing
OW	MW15-02 AZ	na	May 2015	Aug. 2018	737.25	5.50	na	7.0	730.3	Spring	4.8	732.5	Summer	1.0	1.1	1.8	1.6	Flat but slightly flashy
	MW15-03 AZ	na	June 2015	Aug. 2019	557.94	3.40	10 ≤ x ≤ 20	2.0	555.9	Spring	-13.1	571.0	Variable	0.6	1.3	1.7	1.8	Sinusoidal, maximum opposite timing of upgradient well
WB	MW15-01WB	P1	June 2015[c]	Aug. 2019	803.58	90.50	70.0	36.2	767.4	Spring/Summer	12.8	790.8	Summer/Fall	1.6	0.2	1.7	6.4	Spot measurements only
		P6	June 2015[c]	Aug. 2019	803.58	77.80	70.0	36.2	767.4	Spring	20.0	783.6	Fall	1.6	2.2	1.7	6.4	Spot measurements only
	MW15-02WB	P1	June 2015[c]	Aug. 2019	737.11	63.30	na	10.2	726.9	Spring	8.3	728.8	Summer	0.3	0.4	1.4	1.8	Spot measurements only
		P4	June 2015[c]	Aug. 2019	737.11	19.20	na	4.8	732.4	Spring/Summer	3.2	733.9	Spring/Summer	0.4	0.1	0.8	1.3	Spot measurements only
	MW15-03WB	P1	June 2015[c]	Aug. 2019	557.92	98.70	10 ≤ x ≤ 20	-1.5	559.4	Summer/Fall	-4.2	562.1	Spring	0.8	0.6	1.2	2.3	Spot measurements only
		P7	June 2015[c]	Aug. 2019	557.92	40.90	10 ≤ x ≤ 20	0.5	557.4	Summer/Fall	-1.3	559.2	Spring/Summer	0.1	0.1	1.6	0.8	Spot measurements only
	MW15-04WB	P1	June 2015[c]	Aug. 2019	671.46	61.70	31.0	0.1	671.4	Spring/Summer	-2.9	674.4	Spring/Fall	2.1	0.5	0.5	1.4	Spot measurements only
		P5	June 2015[c]	Aug. 2019	671.46	35.10	31.0	-0.1	671.6	Spring/Summer	-3.2	674.7	Variable	1.8	0.6	0.3	1.6	Spot measurements only
	MW15-05WB	P1	June 2015[c]	Aug. 2019	1067.69	80.30	47.0	25.6	1042.1	Spring	18.9	1048.8	Spring	0.7	0.8	3.0	1.6	Spot measurements only
		P4	June 2015[c]	Aug. 2019	1067.69	62.70	47.0	25.7	1042.0	Spring	18.9	1048.8	Variable	0.7	0.5	3.0	1.6	Spot measurements only
	MW15-06WB	P3	June 2015[c]	Aug. 2019	1184.95	265.80	168.0	228.6	956.3	Variable	218.9	966.1	Variable	0.7	0.4	4.4	0.4	Spot measurements only
		P7	June 2015[c]	Aug. 2019	1184.95	232.20	168.0	222.4	962.6	Spring/Summer	218.5	966.5	Variable	0.1	0.6	3.0	0.6	Spot measurements only
	MW16-01WB	P1	Sept. 2016[c]	Aug. 2019	1203.91	114.90	70.0	1.9	1202.0	Summer	-1.5	1205.4	Fall	-	na	1.3	3.1	Spot measurements only
		P6	Sept. 2016[c]	Aug. 2019	1203.91	71.60	70.0	1.7	1202.2	Spring/Summer	-1.6	1205.5	Fall	-	na	1.3	3.0	Spot measurements only
T/VWP	MW14-07T	na	Oct. 2014	Aug. 2019	1156.25	124.40	64.0	-7.8	1164.1	Winter	-12.7	1168.9	Fall	1.7	1.9	na	3.3**	Sinusoidal
	MW15-01T	na	May 2015	Aug. 2019	803.93	75.98	75 to 80	37.6	766.3	Spring	22.2	781.7	Fall	5.7	3.4	2.3	6.4	Sinusoidal, continuously increasing
		na	May 2015	Aug. 2019	803.93	89.09	75 to 80	38.1	765.8	Spring	22.5	781.4	Fall	5.8	3.3	2.1	6.6	Sinusoidal, continuously increasing
	MW15-02T	na	March 2015	Aug. 2019	737.10	33.90	na	11.1	726.0	Spring	9.6	727.5	Variable	1.3	1.0	1.0**	0.8**	Flat
	MW15-03T	na	June 2015	Aug. 2019	557.75	49.50	~20	1.4	556.4	Fall	-1.0	558.8	Spring/Fall	1.3	1.5	2.2	2.1	Sinusoidal, maximum opposite timing of upgradient well
		na	June 2015	Aug. 2019	557.75	96.20	~20	-2.3	560.0	Variable	-5.5	563.2	Spring/Fall	1.8	1.1	1.7	1.1	Sinusoidal, maximum opposite timing of upgradient well
	MW15-04T	na	May 2015	Aug. 2019	670.91	51.60	29 to 31	1.4	669.5	Winter	-2.0	672.9	Spring/Fall	1.9	1.3	1.2	2.3	Flashy
		na	May 2015	Aug. 2019	670.91	38.80	29 to 31	1.0	669.9	Winter	-2.3	673.2	Spring/Fall	2.5	1.3	1.2	2.3	Flashy
	MW15-05T	na	May 2015	Aug. 2019	1067.15	55.40	45 to 47	28.3	1038.9	Winter	20.5	1046.7	Spring/Summer	3.4	3.6	3.7	4.1	Flashy
		na	May 2015	Aug. 2019	1067.15	81.40	45 to 47	38.6	1028.6	Winter	31.8	1035.4	Summer	3.6	5.9	5.0	5.6	Flashy
	MW15-07T	na	Jul 2015	Aug. 2019	1183.14	267.80	140 to 150	136.9	1046.2	Spring/Summer	121.9	1061.2	Fall/Winter	13.7	5.0	6.4	10.9	Sinusoidal
		na	Jul 2015	Aug. 2019	1183.14	239.00	140 to 150	138.1	1045.0	Spring/Summer	120.2	1062.9	Fall/Winter	13.9	5.1	5.5	10.9	Sinusoidal
	MW16-01T	na	Sept. 2016	Aug. 2019	1203.67	97.50	70	4.9	1198.8	Variable	-2.5	1206.2	Fall/Winter	-	2.5	4.1	7.4	Sinusoidal
		na	Sept. 2016	Aug. 2019	1203.67	131.50	70	5.2	1198.5	Variable	-0.7	1204.4	Fall/Winter	-	1.0	4.2	4.0	Sinusoidal
	MW17-01T	na	Sept. 2017	Aug. 2019	1245.75	170.90	95	112.0	1133.8	Variable	109.6	1136.2	Fall	-	-	1.1	1.4	Sinusoidal
		na	Sept. 2017	Aug. 2019	1245.75	200.90	95	112.6	1133.1	Variable	109.4	1136.3	Fall	-	-	1.5	2.2	Sinusoidal
	SRK-15D-07T	na	Sept. 2015	Aug. 2019	948.85	149.20	82 to 85	55.5	893.3	Winter	55.0	893.9	Variable	0.3	0.4	0.3	0.2	Flat, potentially erroneous
		na	Sept. 2015	Aug. 2019	948.85	103.60	82 to 85	57.5	891.3	Winter	55.3	893.6	Variable	0.2	0.3	0.3	0.3	Flat, potentially erroneous
	SRK-15D-08AT	na	Jul 2015	Jun. 2019	925.11	149.20	60 to 80	3.9	921.2	Spring	-2.7	927.8	Fall	5.0	3.4	2.4	6.6	Sinusoidal
		na	Jul 2015	Jun. 2019	925.11	103.60	60 to 80	-7.5	932.6	Spring	-13.0	938.1	Fall	3.9	2.7	1.8	5.4	Sinusoidal
	SRK-15D-09T	na	Jul 2015	Aug. 2019	784.25	99.70	na	1.3	783.0	Spring	-2.5	786.8	Summer	3.3	2.3	1.2	3.5	Sinusoidal
	CFD318	na	Aug. 2013[f]	Oct. 2017	1233.04	118.00	na	141.0	1092.0	na	135.4	1097.6	na	na	na	na	NR	Dry since 2015, potential sensor malfunction
	CFD324	na	Aug. 2013[f]	Aug 2019	955.99	178.30	na	24.7	931.3	Spring	15.8	940.2	Fall	5.2	4.4	2.5	6.0	Sinusoidal
	CFD332	na	Oct. 2013[g]	Nov. 2014	1246.61	116.60	na	na	na	na	na	na	na	na	na	na	na	Dry since inception
	CFD351	na	Oct. 2013[g]	Aug 2019	1120.50	184.40	na	153.5	967.0	Spring	111.0	1009.5	Summer/Fall	33.0	32.5	15.0	34.5	Sinusoidal, largest WL fluctuation on site

Notes:
m asl = metres above sea level, m bgs = metres below ground surface, m = metres; NR = no reading; na = not applicable; '-' = instrument not installed
1. MW = monitoring well; OW = overburden well; WB = Westbay system; T/VWP = thermistor/vibrating wire piezometer
2. Westbay system port number, not all ports are presented.
3. Period of record as indicated with the following additional notes: (a) Sporadic measurements beginning in September 2014, semi-continuous readings beginning June 2015; (b) Between Feb 2015 and June 2015 semi-continuous readings were not recorded; (c) Manual measurements collected 4-times annually; (d) After April 2017 semi-continuous readings are sporadic; (e) Between mid-Nov 2017 and early-May 2018 semi-continuous readings were not recorded; (f) Manual measurements beginning August 2013; semi-continuous readings beginning September 2014; (g) Manual measurements beginning October 2013; semi-continuous readings beginning October 2014.
4. Monitoring depth represents sand pack midpoint for conventional monitoring wells, zone midpoint for Westbay system installation, vertical depth below ground surface for VWP sensor.
5. Negative (-ve) water level readings indicate pressure reading above ground surface elevation (artesian conditions).
6. Calculated annual water level fluctuation. Values denoted with ** may not capture full magnitude of changes.
7. Sinusoidal – one maximum per year, generally smooth hydrograph, flashy – responsive to short term rainfall events.

Table 4-7:
Maximum and minumum vertical hydraulic gradients measured at selected installations across the Coffee Gold Project.

Monitoring Location	Catchment	Ground Surface Elevation	Shallow Monitoring Point Depth[1]	Deep Monitoring Point Depth[a]	Vertical Distance	Vertical Gradient[2,3]			
						Min	Date	Max	Date
		(m asl)	(m bgs)	(m bgs)	(m)	(m/m)		(m/m)	
MW14-05A/B[4]	Halfway Creek	1268.5/1270.3	171	206.4	35.4	sampling	n/a	0.008	May-19
MW17-01T	Halfway/Independence	1250	170.9	200.9	30	-0.006	Aug-17	0.041	Aug-17
MW16-01T	Halfway Creek	1203.7	97.5	131.5	34	-0.023	May-17	0.114	Sep-18
MW15-06WB	Halfway Creek	1184.9	241.3	251.9	10.6	0.198	May-19	0.723	Sep-15
MW15-06WB	Halfway Creek	1184.9	251.9	287	35.1	-0.582	Jun-15	0.127	May-19
MW14-03A/B	Halfway Creek	1097.6/1095.2	145.7	191.3	45.6	-0.031	May-19	0.013	Apr-19
SRK-15D-08AT	Halfway Creek	925.1	103.6	149.2	45.6	0.222	Aug-16	0.253	Jun-19
MW15-04T	Halfway Creek	670.9	38.8	51.6	12.8	-0.019	May-15	0.038	Dec-16
MW15-03T	Halfway Creek	557.7	49.6	96.2	46.6	-0.115	May-16	-0.084	Mar-19
MW15-07T	YT-24	1183.1	239	267.8	28.8	-0.034	Jan-16	0.085	Jul-19
SRK-15D-07T	YT-24	948.9	103.6	149.24	45.6	0.042	Mar-18	0.048	Sep-15
MW15-01T	YT-24	803.9	76	89.1	13.1	0.014	Aug-19	0.047	Oct-17
MW15-05T	Latte Creek	1067.1	55.4	81.4	26	0.288	Jul-17	0.562	Jun-15
MW14-02A/B[5]	Latte Tributary	1029.5/1030.9	146.6	188.2	41.6	-0.266	Aug-15	not constrained	n/a
MW15-02WB	Latte Tributary/Latte Creek	737.1	9.2	13.7	4.5	-0.392	Sep-15	-0.193	Apr-19
MW15-02WB		737.1	32	61	29	0.205	Oct-18	0.266	May-16

Notes:
m asl = metres above sea level; m bgs = metres below ground surface; m = metres
1. Monitoring point depth indicates the VWP sensor depth in vertical metres below ground surface, the Westbay port depth, or conventional monitoring well screen midpoint, as applicable.
2. Positive values indicate downward gradient, negative values indicate upward gradient.
3. The minimum and maximum vertical gradient is calculated from the data record following water level stabilization after MW or datalogger installation through August 2019.
4. Slow recovery after sampling at MW14-05B precludes calculation of minimum vertical gradients.
5. MW14-02A typically demonstrates artesian conditions between late summer (Aug/Sept) and early winter (Dec). Gradient calculation during this period is not representative.

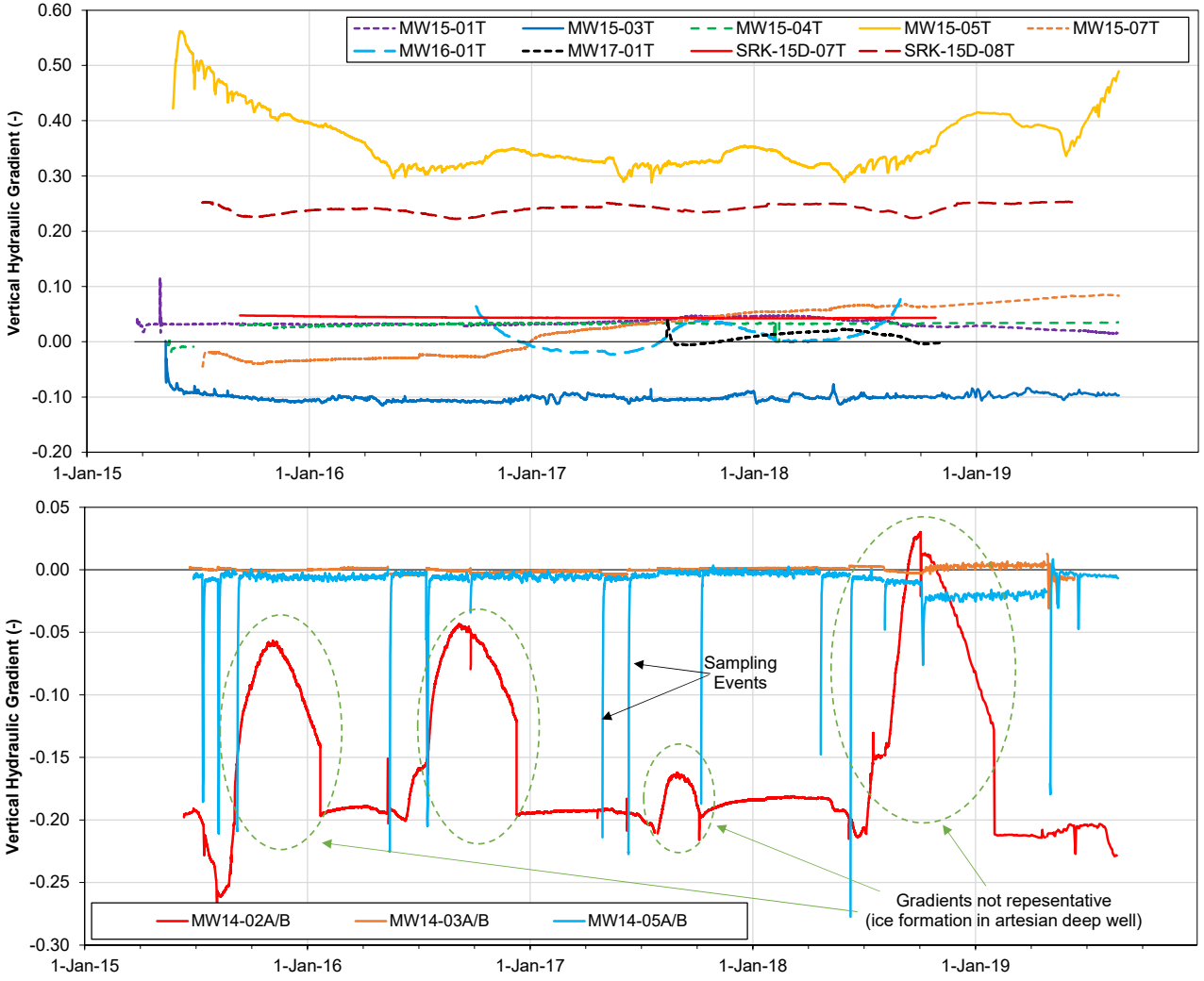

Figure 4-9: Vertical gradient time series for VWPs (upper pane) and conventional monitoring wells (bottom pane). Downward gradients are positive.

Table 4-8:
Minimum and maximum horizontal hydraulic gradients measured between 2015 and 2019 at the Coffee Gold Mine

Well Pair[1]	Horizontal Distance (m)	Topographic Gradient (%)	Hydraulic Gradient[2] (%)	Date	Comments
YT-24 Drainage					
MW15-07T, MW15-01T	1744.2	22%	16.5%	05-Dec-2018	Max
			15.8%	14-Sep-2015	Min
Halfway Creek					
MW16-01T, SRK-15D-08AT	1756.2	16%	15.3%	15-Oct-2016	Max
			15.1%	18-Jul-2018	Min
MW14-05B, SRK-15D-08AT	2524.9	14%	8.4%	16-Jun-2019	Max
			7.7%	09-Sep-2015	Min
MW15-06WB, Halfway Ck	1256.0	38%	20.4%	25-Aug-2019	Max
			20.1%	05-Aug-2015	Min
SRK-15D-08AT, MW15-04T	3324.0	8%	8.0%	07-Oct-2018	Max
			7.8%	16-May-2018	Min
MW15-04T, MW15-03T	2232.5	5%	5.2%	26-Sep-2015	Max
			5.1%	13-Jan-2016	Min
Latte Creek Tributary					
CFD0351, CFD0324	718.2	23%	9.6%	27-Sep-2018	Max
			4.8%	09-Jul-2015	Min
MW14-02B, CFD0324	407.6	18%	22.7%	12-Nov-2015	Max
			18.9%	05-Jul-2015	Min
CFD324, SRK-15D-09T	1154.2	15%	13.3%	17-Jul-2018	Max
			12.8%	01-Aug-2015	Min
SRK-15D-09T, MW15-02T	474.9	10%	12.5%	22-Sep-2016	Max
			11.8%	10-Jul-2015	Min
Latte Creek					
MW14-07T, MW15-05T	639.3	14%	20.0%	29-Nov-2018	Max
			18.9%	28-Jun-2015	Min
MW15-05T, MW15-02T	3514.1	9%	9.1%	21-Aug-2019	Max
			8.9%	13-Dec-2016	Min

Notes:
1. Where two or more monitoring depth intervals are available at an installation, the measurement from the shallower installation is used to calculate the gradient.
2. The minimum and maximum gradient for each well pair is selected from the calculated hydraulic gradient between the locations using a daily average water level value from all days in the data record when both locations had at least one recorded water level reading.

The second type of transient water level response observed is flashier and tracks more closely with the surface water signature. Hydrograph maxima may occur more that once annually, coinciding with a freshet peak with late summer rainfall feeding a second maximum. This type groundwater level response is registered at selected wells completed near creek channels.

Some transient water level responses do not fit either type described above – they may remain flat, continuously climb or represent a hybrid of the two response types. These are discussed on a case by case basis in the discussion of the individual catchments below.

4.3.2 Halfway Creek

There are several installations located within the Halfway Creek catchment (Figure 4-8). Water level time series for higher elevations stations (MW14-05A/B, MW17-01T, MW16-01T and MW14-03A/B) are shown in Figure 4-10 while lower elevation installations (SRK15D-08AT, MW15-04T, MW15-03T) are shown in Figure 4-11. Measured discharge at hydrometric station HC-6.8 (HC-2.5) is shown for comparison. Note that hydrometric and surface water quality monitoring stations underwent a name change in 2019. Current station names are referenced, followed by the former station name in parentheses.

A combination of water level responses is displayed at stations near the proposed Kona pit (MW14-05A/B, MW17-01T) and HLF footprint (MW16-01T) (Figure 4-10). Water levels at MW14-05A/B track closely together and have continuously climbed between 2015 and 2019, gaining several meters over this period. A very subdued seasonal fluctuation is observed in the trend, but annual minima and maxima are difficult to extract given the overwhelming increasing trend. Vertical gradients are minimal.

MW17-01T is ~200 m north of MW14-05A/B and was established to confirm depth of permafrost in this area. The early part of the data record appears influenced by drilling, but a seasonal pattern emerges whereby minima occur in the late spring and maxima occur in the fall. Vertical gradients at MW17-01T are also small, ranging between slightly upward (<1%) to downward (~4%). Maximum water levels are 125 m bgs and 110 m bgs at MW14-05A/B and MW17-01T, respectively. The water level at MW17-01T is several meters below the base of permafrost.

MW16-01T is about 1.5 km southeast of MW17-0T and is located essentially along contour. Surprisingly, artesian water levels were encountered at this instrument. The installation crosses a suspected fault in the area and groundwater pressures are confined by 60 m of permafrost. The resulting water level data trend falls into the first type discussed previously (*i.e.,* broadly sinusoidal). The shallow sensor (97.5 m bgs) registers a larger seasonal fluctuation than the deeper sensor (131 m bgs) (Table 4-6). Despite artesian conditions, vertical gradients are frequently downwards between the two sensors (Figure 4-9).

Conventional monitoring wells MW14-03A/B also screen groundwater confined by permafrost. An ice lens observed in core while drilling MW14-03A/B suggests permafrost is present to at least 62 metres depth; however, it does not appear to extend to the saturated zone as the wells remain unfrozen (water levels are ~130 metres below ground surface). The shallow and deep monitoring wells report minimal vertical hydraulic gradients. The hydrographs are of the broad sinusoidal type, with annual maxima occurring in November/ December, while minima occur in the summer. Variations in annual recharge are reflected by the hydrographs, with the smallest annual fluctuation (<1.5 m) occurring in 2017 and the largest (>6 m) occurring in 2018 (Table 4-6).

SRK-15D-08AT is located at high elevation near the trace of the Halfway Creek channel (Figure 4-8). Strong artesian pressures of several meters above ground surface have registered at the shallow sensor (104 m bgs) while the deeper sensor (149 m bgs) is seasonally artesian. The hydraulic gradient is strongly and consistently downward (~22% to 25%) throughout the year. This may suggest that a permeable feature is under-draining the area. This area is confined by 60 to 80 meters of permafrost. The groundwater level hydrographs are of the broad sinusoidal type, with annual minima and maxima occurring consistently in the spring and fall, respectively.

MW15-04T, located near surface water station HC-6.8 (HC-2.5), has a flashy groundwater level hydrograph that more rapidly responds to recharge events (Figure 4-11). Annual minima occur in the winter while one to two annual maxima occur in conjunction with freshet and/or summer rainfall. This location is confined by ~ 30 m of permafrost and groundwater levels are largely artesian throughout the data record. Resting flow rates measured at the Westbay hole advanced from the same drill pad were on the order of 30 to 40 US GPM (1.9 L/s to 2.5 L/s). Groundwater levels measured by the shallow (38.8 m bgs) and deep (51.6 m bgs) sensors track closely together. Hydraulic gradients measured between the two sensors are consistent and slightly downward (<5%).

MW15-03T is the lowest elevation groundwater station in Halfway Creek (Figure 4-8) and is inferred to be on the fringe of permafrost coverage. A lineament, inferred to be a fault, cross-sects Halfway Creek in this area. Groundwater level and groundwater quality data (Section 5) indicate that MW15-03T intersects a hydrogeologically distinct area. Unlike the two instruments further upstream (MW15-04T, SRK15D-08AT), there is a strong upward hydraulic gradient (10%) between the VWP sensors at 94.7 m bgs and 48.8 m bgs. The deeper sensor measures artesian pressures, while the shallow sensor is seasonally artesian. The water level measured in the shallow overburden well (MW15-03AZ) is lower than that measured in bedrock. The water levels at MW15-03T/AZ track differently than MW15-04T, annual maxima occur during the winter with a short and muted response to freshet and summer rainfall.

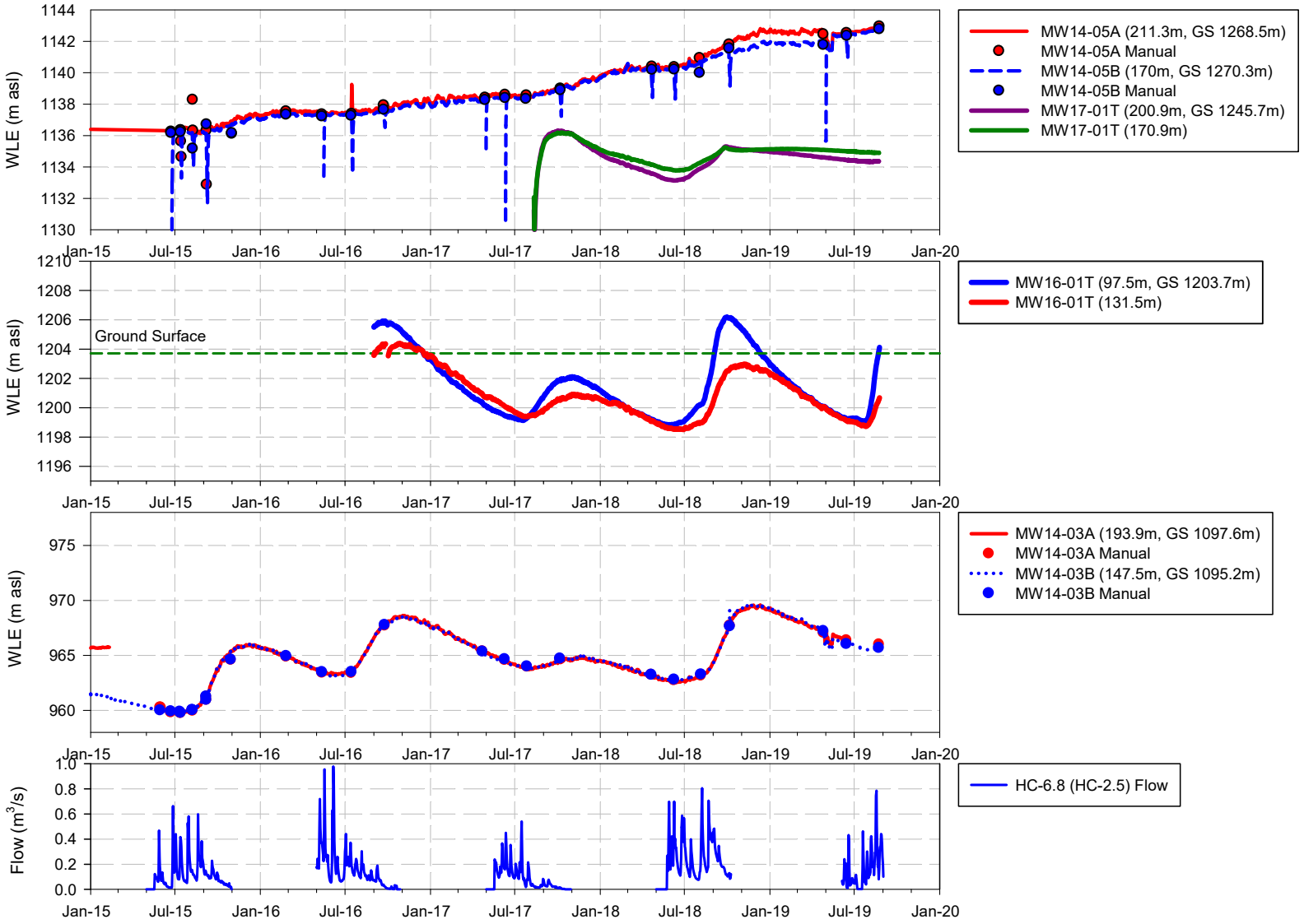

Figure 4-10: Groundwater level hydrographs measured in Halfway Creek catchment at MW14-05A/B, MW17-01T, MW16-01T and MW14-03A/B.

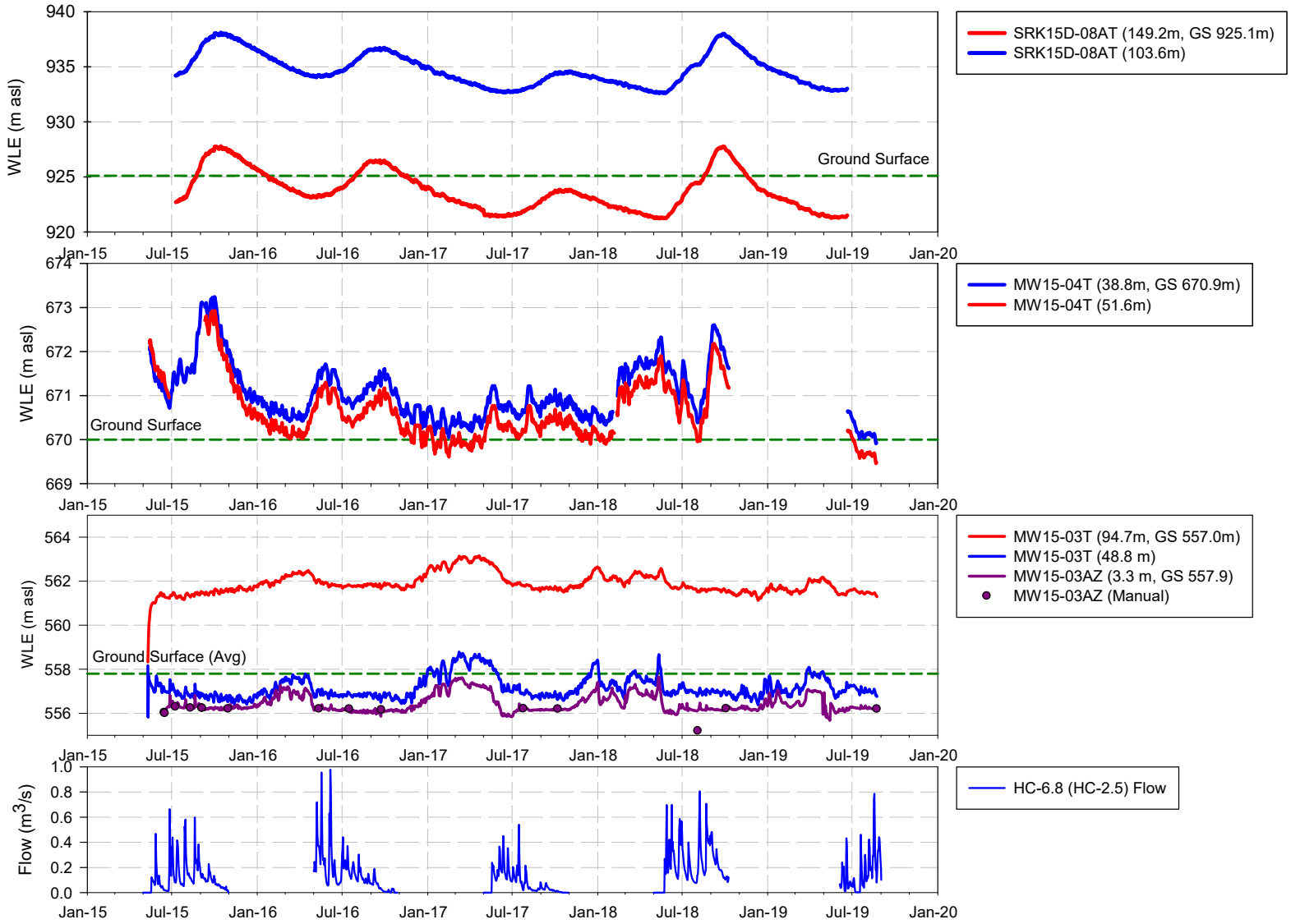

Figure 4-11: Groundwater level hydrographs measured in Halfway Creek catchment at SRK-15D-08AT, MW15-04T, MW15-03T/AZ.

MW15-06WB is a standalone, high elevation installation at the north end of the proposed Supremo pit complex that characterizes groundwater draining north and northwest towards Halfway Creek. Time series of water level point measurements from this installation are shown in Figure 4-12. This area has the deepest water levels (>215 m bgs) on site. Bedrock ~252 metres below ground surface appears to be draining more readily, as vertical hydraulic gradients are towards this zone (65% downward from an upper port at 241 m, and 15% upward from a lower port at 287 m). The shallowest water level measured at this location is nearly 50 m below the base of permafrost which is inferred to be ~170 m thick based on the thermal profile measured at MW14-04T.

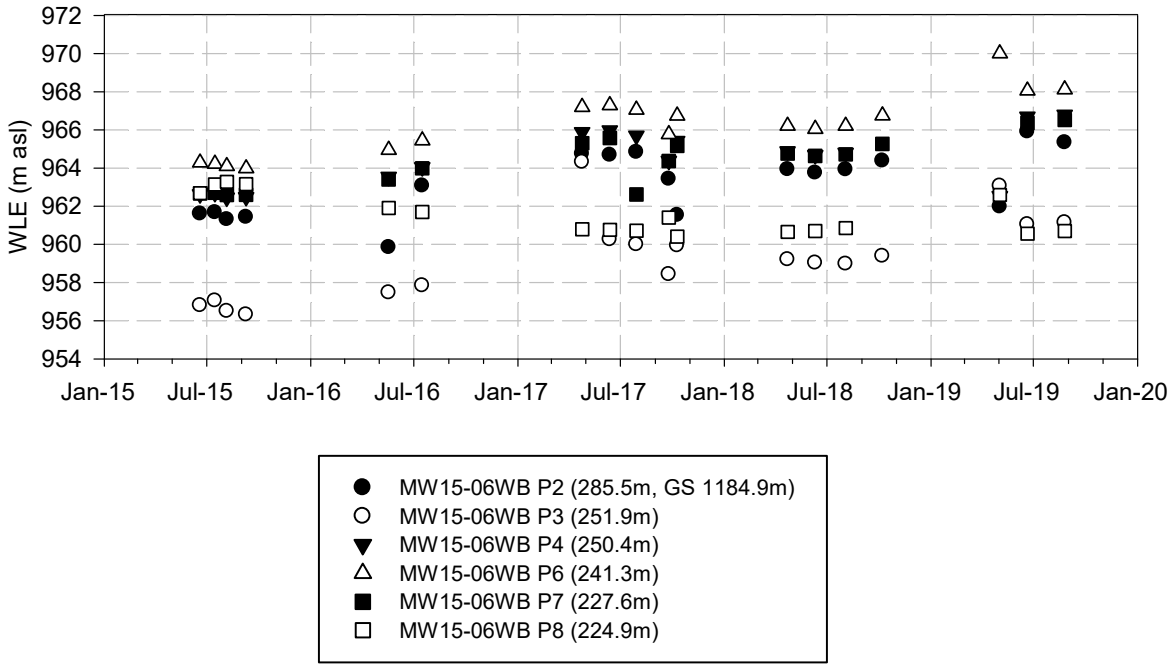

Figure 4-12: Point measurements of water levels measured at MW15-06WB.

4.3.3 YT-24

Groundwater level data from three VWP installations along the YT-24 drainage is presented in Figure 4-13. Measured discharge at hydrometric station YT24-0.1 (formerly YT-24) is shown for comparison. Thermal data collected from these instruments indicates that groundwater is confined by permafrost in this drainage, with higher confining pressures experienced farther downstream. The groundwater level hydrographs are distinct at each of the installations.

The installation at MW15-07T, at the headwaters of YT-24, has two deep water level sensors at 239 m bgs and 267.8 m bgs. Permafrost depth is between 140 to 150 m and

confines water levels that range between 120 m bgs and 138 m bgs. The water level hydrographs are broadly sinusoidal, with annual maxima occurring in November or December and annual minima occurring in June or July. Upward hydraulic gradients (<5%) were measured at this station prior to 2017 but have remained consistently downward since then. The hydrograph clearly demonstrates the below average recharge in 2017.

SRK-15D-07T is located less than one kilometre downstream from MW15-07T. The data from this installation are suspicious as no seasonal fluctuation is reported; however, the magnitude of computed water levels is reasonable. Water levels are 50 to 60 m bgs and are confined by permafrost, which extends to ~85 m bgs.

MW15-01T is located about one kilometre downstream from SRK-15D-07T. Similar to the other installations in this drainage, water levels are confined by permafrost. Permafrost extends to 70 m depth while water levels at their deepest were 36 m bgs. Since inception of the instrument, water levels have steadily increased whilst showing a seasonal variation. Annual maxima occur in the fall while minima occur in the spring. Recharge in 2018 caused the most pronounce fluctuation in water levels (>5 m). Vertical hydraulic gradients are consistently and modestly downwards (~1%). The active zone well completed near this installation, MW15-01AZ, intercepted water at some point in June/July 2015, which froze the logger in place. Unfrozen water was not observed in the well during subsequent visits.

4.3.4 Latte Creek Tributary

The Latte Creek Tributary drainage is instrumented in its upper reaches with a conventional monitoring well pair (MW14-02A/B) on the north fork and VWP CFD0351 on the west fork. Both locations demonstrate a strong response to seasonal recharge (Figure 4-14). Seasonal water level fluctuations measured at CFD0351 have exceeded 30 metres and are the largest recorded across the site (Figure 4-13, Table 4-6). The water level hydrograph is broadly sinusoidal with seasonal maxima occurring in September or October. CFD0351 is not equipped with a thermistor string and permafrost conditions are not constrained. The current permafrost map has it located on the margin, but outside of permafrost coverage (Figure 4-5). Water levels at the single VWP sensor range from 111 m bgs to 153.5 m bgs.

Groundwater is confined by a lens of permafrost at conventional well pair MW14-02A/B (Figure 4-5). While no thermistor data is available for this location, a plug of ice typically forms in the wells over winter which has estimated thickness of >30 metres. Groundwater levels in the deeper “A” well (190 m bgs) are flowing artesian in the summer/fall until the well freezes in over the winter. Hydrograph minima occur in the spring. Groundwater levels in the shallower “B” well (148 m bgs) approach ground surface but are not flowing artesian (with exception to the fall of 2018). The full magnitude of seasonal water level fluctuations is captured for the shallow well and ranges between 5 m and 19 m over the

last few years, with the smallest annual fluctuation occurring in 2017. Vertical hydraulic gradients are strongly upward (>20%) for representative portions of the hydrograph record.

CFD0324 is located downgradient of CFD0351 and MW14-02A/B. The water level hydrograph at this VWP is broadly sinusoidal and subdued compared to water level records of the upgradient stations. Seasonal fluctuations at this VWP are on the order of five metres with annual maxima occurring in September or October. A similar water level record is observed at SRK-15D-09T, located about 1.1 km south of CFD0324 along the trace of the Latte Creek Tributary.

4.3.5 Latte Creek

There are three hydrogeological installations along Latte Creek (Figure 4-8). The highest elevation station, MW14-07T, was established in September 2014. The thermistor string installed in this hole indicates a permafrost depth of approximately 60 metres. The water level recorded at the single VWP is flowing artesian and consistently several metres above ground (Figure 4-15). While there have been interruptions in data collection at this station, the record indicates that annual maxima occur in the early fall.

MW15-05T is located ~600 metres downgradient of MW14-07T. Groundwater at MW15-05T is confined by ~47 m of permafrost, with water levels at the two sensors ranging from 20 m to 40 m bgs. The hydrographs are similar between the shallow (55 m) and deep (81 m) sensors, but the deeper sensor has a slightly noisier *(i.e.,* more responsive) signal. Water levels at both sensors climb in unison in late spring and remain high through early/mid fall. Some minor flashiness arises from summer rainfall. Annual minima occur in the winter. The vertical hydraulic gradient is consistently and strongly downward (~30%) which suggests that a fault is under-draining groundwater. This 'under-draining' also produces a horizontal hydraulic gradient between MW14-07T and MW15-05T that exceeds the topographic gradient (~19% versus 14%) (Table 4-8).

MW15-02T is located at the confluence of Latte Creek Tributary with Latte Creek and is the lowest elevation groundwater installation in Latte Creek catchment. The area is devoid of permafrost. The groundwater hydrograph recorded by the single VWP sensor at MW15-02T shows little if any seasonal fluctuations. Groundwater pressure measured at the adjacent Westbay installation (MW15-02WB, Appendix 4D) indicate an upward gradient in very shallow bedrock (between 9 and 14 m bgs), while a strong downward gradient (~24%) is measured across deeper bedrock (32 and 61 m bgs). The downward gradient in deeper bedrock may suggest a hydraulically significant feature at depth under-draining the area, consistent with observations at MW15-05T. The horizontal hydraulic gradient between SRK-15D-09T and MW15-02T slightly exceeds the average topographic gradient (10%) along the Latte Tributary, while the gradient between MW15-05T and MW15-02T is consistent with topography along Latte Creek (Table 4-8).

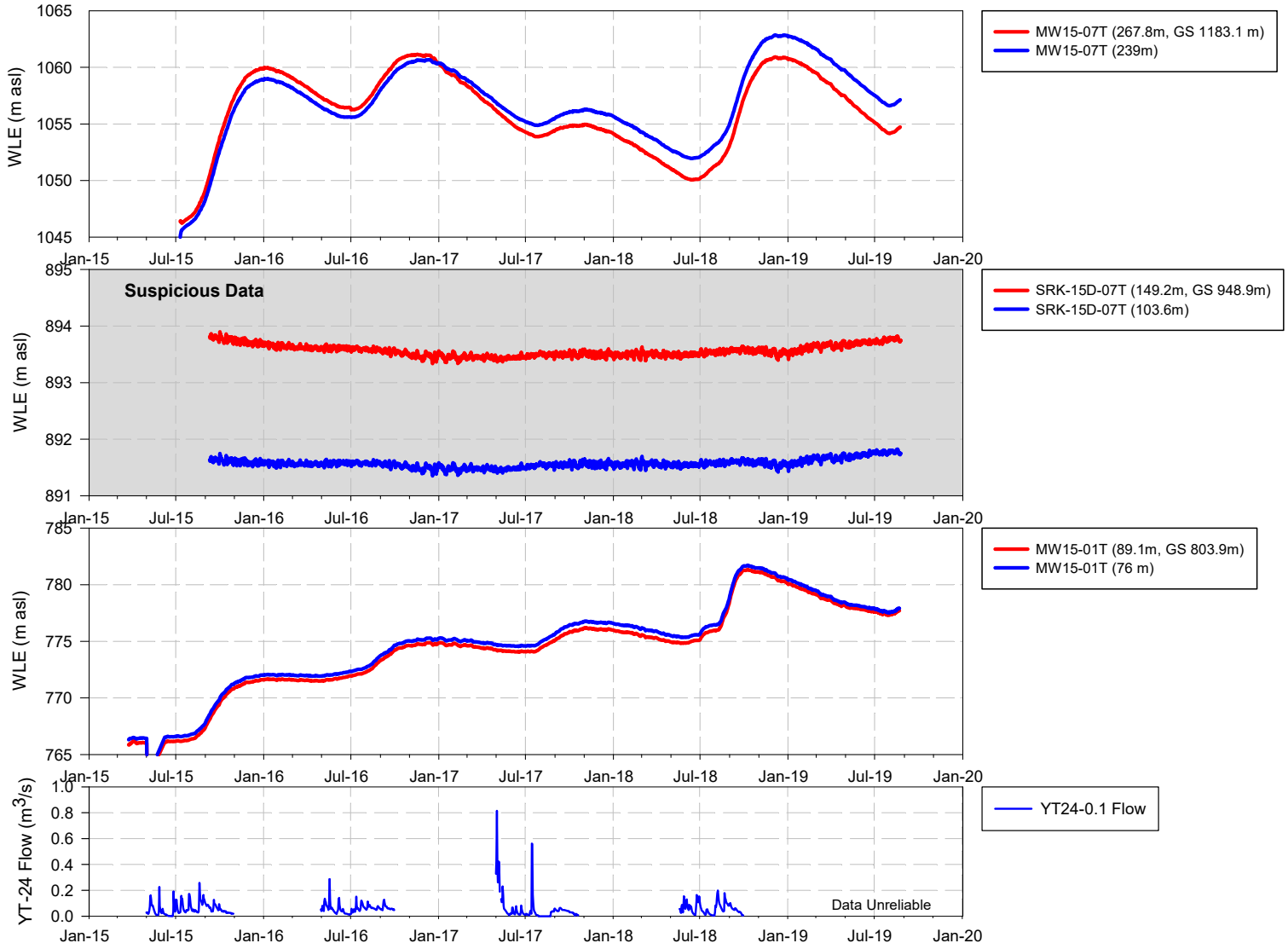

Figure 4-13: Groundwater level hydrographs measured in YT-24 catchment at MW15-07T, SRK-15D-07T and MW15-01T.

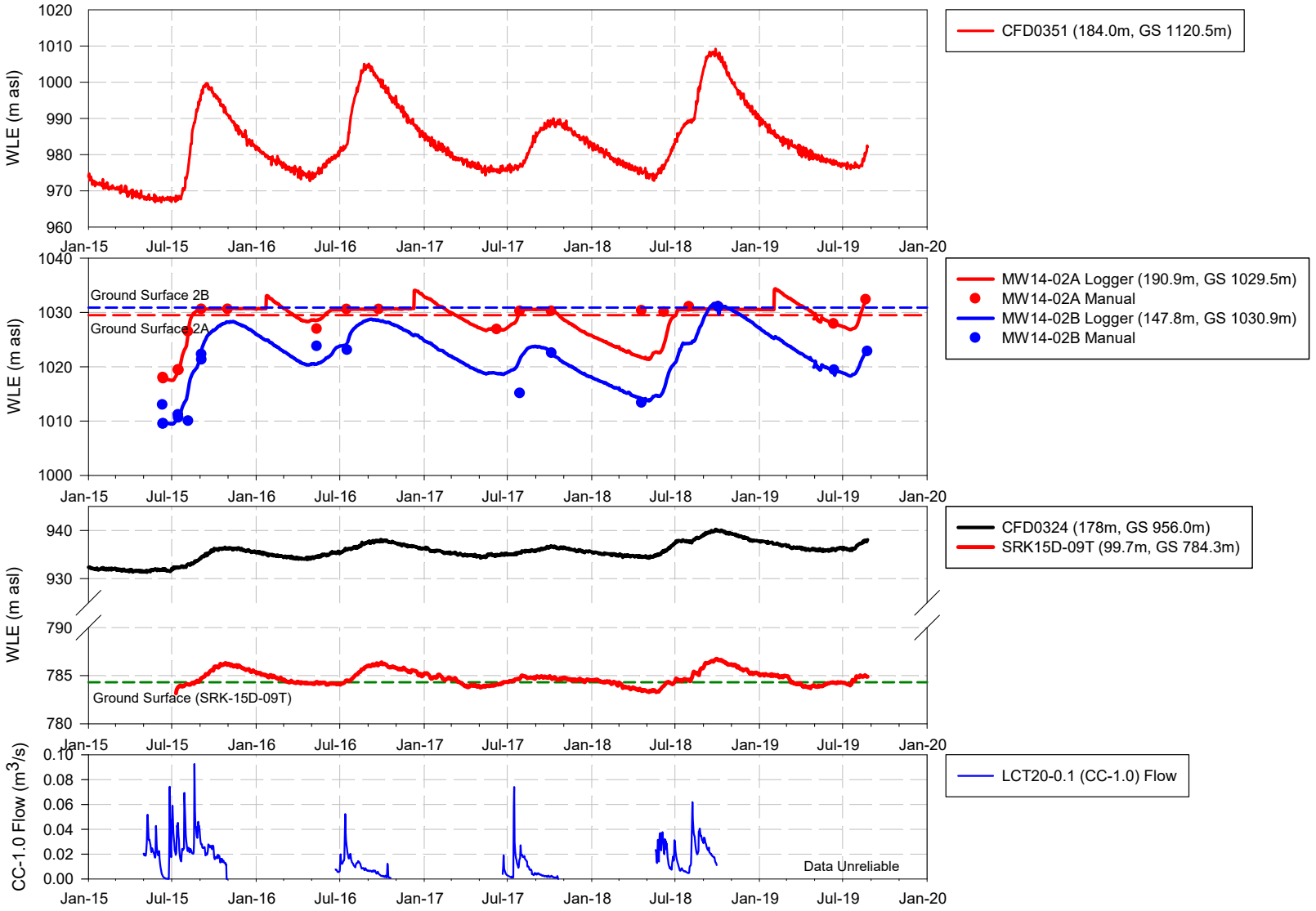

Figure 4-14: Groundwater level hydrographs measured in Latte Creek tributary drainage at CFD0351, MW14-02A/B, CFD0324 and SRK15D-09T.

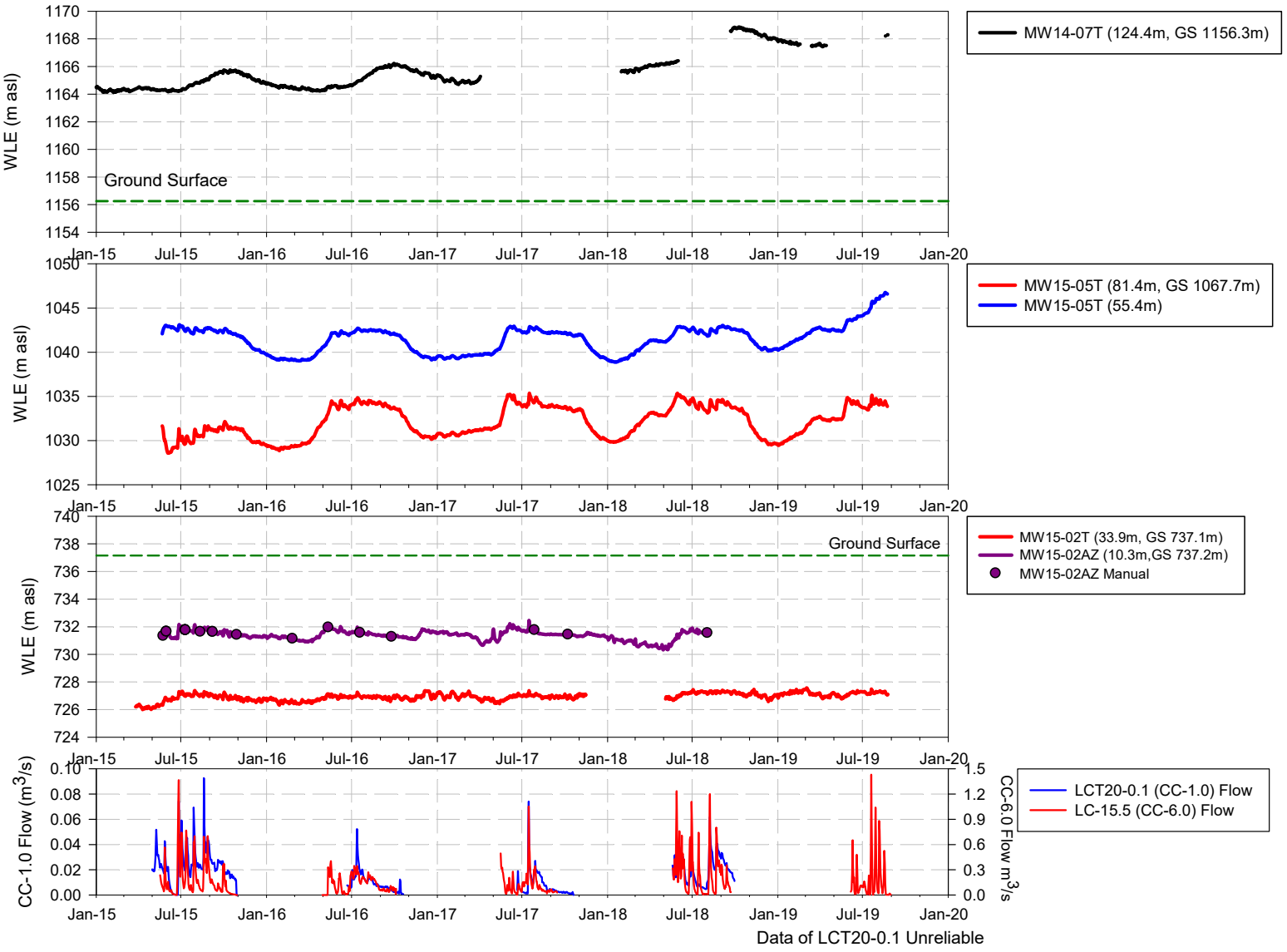

Figure 4-15: Groundwater level hydrographs measured in Latte Creek catchment at MW14-07T, MW15-05T and MW15-02T/AZ.

The shallow well installed adjacent to MW15-02T, MW15-02AZ, screens several metres of a cobbly/bouldery package of colluvial sediments classified by AECOM (2012) as a poorly drained apron of colluvial complex (xzsC1a:p). The water level at this monitoring well is within a few meters of ground surface and experiences annual maxima in the summer and minima in the spring.

4.4 Baseflow

Baseflow represents the portion of streamflow that is derived from groundwater discharge. While baseflow occurs throughout the year, it is typically most easily characterized during the winter low flow period, when runoff and interflow (shallow subsurface flow) are at their minimum. In the case of the groundwater system at the Coffee Gold Project, interflow also encompasses active zone flow.

Characterization of the baseflow regime at the Project presents numerous challenges. Accurate measurement of winter streamflow is challenging in drainages at the site on account of extensive icing that forms in local channels over the winter months. This icing, sometimes termed aufeis, is the result of shallow groundwater discharge and/or baseflow in the stream channel freezing. This ice impedes subsequent flow, which is forced on top of the existing ice cover, where it freezes. This process repeats continuously throughout the winter, and results in laminated ice layers that have been measured close to 1.5 m in thickness and greater than 50 m in width in channels at the Project. Liquid flow is thus either not present, or occurs between these laminae, and at the edges of the stream channel. It is these flows that are measured during the winter. Aufeis also acts as a storage reservoir for winter baseflows and can store up to a third of the cumulative annual baseflow in sub-Arctic watersheds (Yoshikawa et al., 2007). This stored baseflow is released during the freshet and early summer period.

Based on site data alone, winter low flows are expected to range from 0 to 0.7 L/s/km^2 (Lorax, 2019). Low flow conditions can occur intermittently during the summer and early autumn across the Project site, with unit yields during early summer often approaching those measured during the winter months. Low flows measured in June 2015 at valley bottom stations (~1 L/s/km^2) formed a critical input to the site-wide groundwater model calibration (Lorax, 2016).

5. Groundwater Quality Results

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5. Groundwater Quality Results

Groundwater quality in the Project area is discussed in terms of major ion chemistry with reference to physical parameters (field pH, field SC) followed by oxidation-reduction (redox) conditions and trace element geochemistry. In addition, groundwater characterization by use of isotopic analyses of hydrogen, oxygen and carbon is presented. Where analytical results are reported as non-detectable, the reportable detection limit (RDL) values are conservatively used for graphing purposes. The groundwater quality is discussed in relation to the principal lithology at the screened interval of each monitoring well: overburden, gneiss, granite, breccia and schist (Figure 2-2, Table 3-2, Table 3-3). Borehole and well completion logs can be referenced in Appendix 3-A. Groundwater quality data is tabulated in Appendix 5-A, with a statistical summary of the data (count, minimum, mean, median, maximum and the number of analyses below the RDL) provided in Appendix 5-B. The laboratory certificates of analysis for samples collected by Lorax between 2016 and 2019 are included in Appendix 5-C. The laboratory certificates of analysis for groundwater samples collected by Lorax between 2014 and 2015 are included in Lorax (2017c).

A quality assurance/quality control (QA/QC) assessment was performed on the 2016 to 2019 groundwater quality data set and is provided in Appendix 5-D. As described in Lorax (2017c), several samples were deemed to have been influenced by artifacts of drilling and monitoring well installation: MW14-03A, MW14-03B, MW14-05A, and MW14-05B in October 2014, and MW15-06WB in June 2015. All four samples collected at MW14-05B in 2015 (June, July, August, September) were deemed to have been influenced by artifacts of drilling and well installation based on the examination of 2016 to 2019 groundwater quality data (Appendix 5-D). As a result, water quality data for these samples is not considered to be representative of formation groundwater and has been omitted from the discussion below. Outside of the issues listed above, the QA/QC analysis indicates a robust groundwater quality dataset has been collected and is suitable for interpretation.

Time series plots of field-measured physical parameters, and concentrations of major cations and anions, redox-sensitive parameters, and trace elements are presented in Appendix 5-E. When plotted, the lowest RDL is shown for reference.

The results of groundwater, surface water, and aufeis stable isotope and radioisotope analyses in the Project area are summarized and discussed in this report. The isotope data is tabulated, and a detailed analysis and discussion of the groundwater isotopic data is provided in Appendix 5-F.

5.1 Major Ions

The relationship of major ion charge equivalents in the Project groundwater is presented in a tri-linear Piper plot (Figure 5-1) which identifies wells of similar screened lithology by colour. Time

series plots of field-measured physical parameters grouped by lithology are presented in separate figures in Appendix 5-E (Figure 5-E-1 to Figure 5-E-4). Absolute concentrations of major cations (Ca, Mg, Na, K) and major anions (HCO_3, SO_4, Cl) are similarly plotted in Appendix 5-E (Figure 5-E-5 to Figure 5-E-8 and Figure 5-E-9 to Figure 5-E-12, respectively). Field-measured pH and SC are referenced and discussed with major ion chemistry. Field-measured DO and ORP, as well as sulphide (S^{2-}), included on the time-series plots with major anions, are discussed with redox geochemistry in Section 5.2.

Major ion concentrations, in addition to field-pH and field-SC measurements from the most recent groundwater sampling events are tabulated in Table 5-1, with the highest concentration for each parameter across the Project area highlighted yellow. Parameters that display trends (*i.e.*, increasing or decreasing concentrations) are flagged in Table 5-1.

Groundwater at the Project is predominantly circum-neutral (pH 6 to 8), with most samples characterized by pH 6.5 to 8 (Appendix 5-E). Groundwater wells show variable influence from weathering of sulphide minerals and/or dissolution of sulphate minerals, either from the deposits or other disseminated mineralization across the Project area. This is evidenced by low to substantial sulphate (SO_4) concentrations which range from 7 to 1120 mg/L and variable salinity with field-SC ranging from 28 to 2390 µS/cm (Appendix 5-E).

5.1.1 Overburden

Groundwater in overburden wells (orange symbols in Figure 5-1) is calcium-bicarbonate-type (Ca-HCO_3), irrespective of the type of deposit screened (colluvium, colluvium/bedrock interface). MW15-02AZ and MW15-03AZ have similar proportions of dissolved calcium (Ca), magnesium (Mg) and sodium (Na), with the spread in the data points largely reflecting variable sulphate (SO_4) content. As a result, the groundwater at MW15-02AZ is classified as Ca-HCO_3-type with significant SO_4 influence, while that at MW15-03AZ is Ca-HCO_3-type. Calcium is the dominant cation in the overburden groundwater, which, along with significantly lower major ion concentrations and specific conductance at MW15-03AZ (128 to 322 µS/cm) relative to MW15-02AZ (437 to 874 µS/cm) suggests that groundwater in the shallow overburden at MW15-03AZ is fresher. Groundwater pH is predominantly circum-neutral at MW15-02AZ (field pH 7.3 to 8.0) and MW15-03AZ (field pH 6.6 to 7.8, except 8.9 on Oct. 7, 2017).

A single groundwater sample was collected at MW15-05AZ (Sept. 2015), which is also classified as Ca-HCO_3-type. However, in contrast to groundwater at MW15-02AZ which has significant SO_4 influence (~41 to 49%) and MW15-03AZ with moderate SO_4 influence (~21 to 34%), the groundwater at MW15-05AZ is characterized by very low SO_4 content (~5%). In addition, the chloride (Cl) content in MW15-05AZ groundwater is elevated (~ 7%) in relation to other Project area groundwater which typically has Cl contents <1%. The field pH at MW15-05AZ is slightly acidic (pH 5.8) and the lowest measured in the Project area. Field measured specific conductance is also low (28 µS/cm) indicating very fresh water.

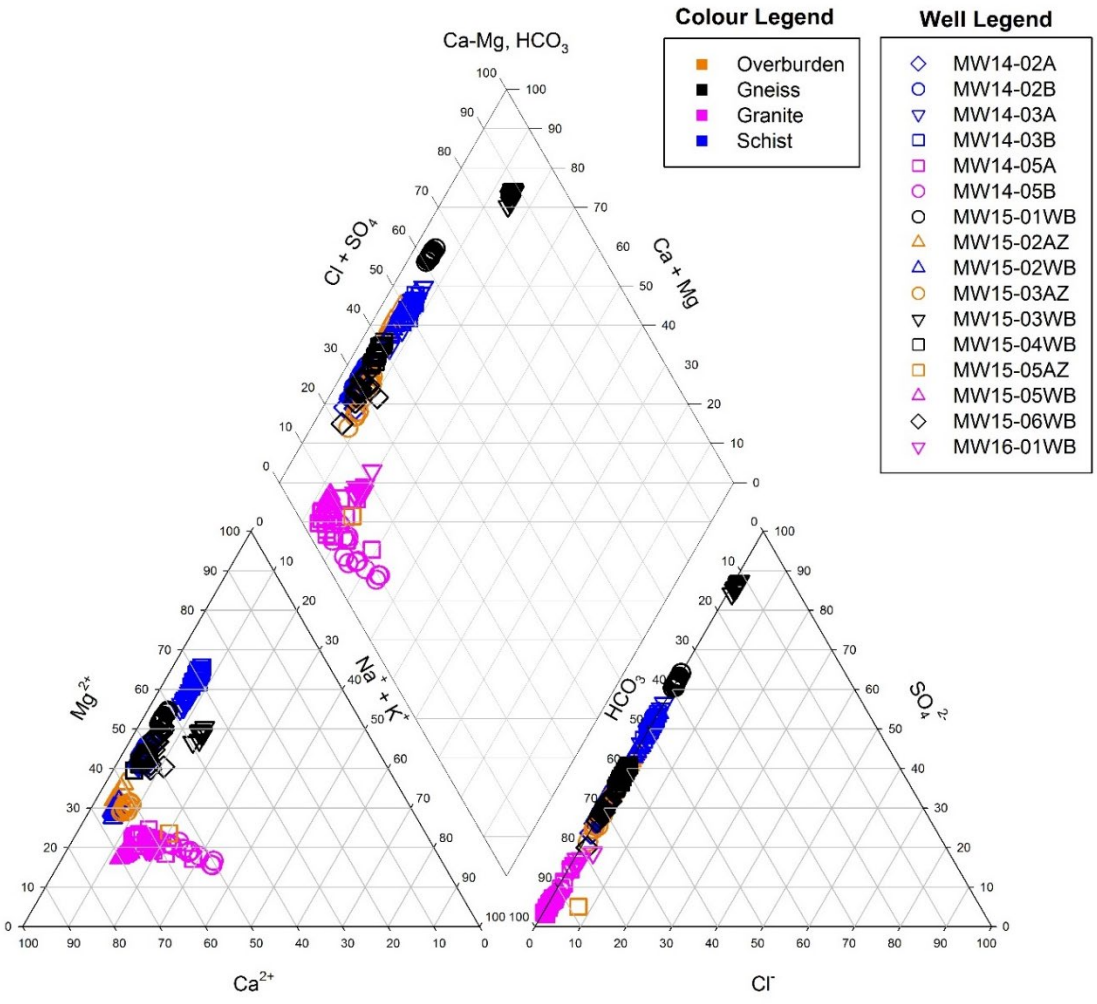

Figure 5-1: Piper Plot of Project Groundwater Quality Data (2014 - 2019).

5.1.2 Gneiss

Monitoring wells screened in gneiss are located on the north side of the Project area (black symbols in Figure 5-1). Groundwater sampled from these wells presents a wide range of hydrogeochemical compositions that range from Ca-HCO_3-type to mixed-magnesium-calcium-sodium-sulphate-type (Mg-Ca-Na-SO_4).

The groundwater compositions downstream from the proposed Supremo Pit at MW15-06WB and along Halfway Creek at MW15-04WB cluster on the Piper plot. Groundwater at MW15-06WB is predominantly mixed-magnesium-calcium-bicarbonate type (Mg-Ca-HCO_3), but ranges from Ca-HCO_3-type with significant Mg influence to magnesium-bicarbonate-type (Mg-HCO_3-type) with significant Ca influence, while groundwater at MW15-04WB is predominantly Ca-HCO_3-type with significant Mg. The groundwater at both wells has similar major ion proportions and concentrations, in addition to specific conductance which ranges from 474 to

762 µS/cm at MW15-06WB and 418 to 745 µS/cm at MW15-04WB. Field pH at these wells is typically circum-neutral, ranging from pH 7.2 to 8.2 at MW15-06WB and pH 5.5 to 8.3 at MW15-04WB.

The groundwater downstream from the proposed Supremo Pit at MW15-01WB along YT-24 and at MW15-03WB along Halfway Creek (downstream from MW15-04WB) is characterized by elevated SO_4, suggesting the oxidation of sulphide minerals. Groundwater at MW15-01WB is classified as magnesium-sulphate-type (Mg-SO_4) with significant Ca influence, while groundwater at MW15-03WB is predominantly Mg-Ca-Na-SO_4-type and represents an end-member composition in the Project area (Figure 5-1). Groundwater SO_4 concentrations and proportions at both wells are the greatest in the Project area, with higher values observed at MW15-03WB. In addition, Cl concentrations and proportions were consistently greatest at MW15-03WB. The groundwater at MW15-03WB and MW15-01WB is the most saline in the Project area, with elevated specific conductance values ranging from 1437 to 2080 µS/cm and 1156 to 2390 µS/cm, respectively. Field pH is predominantly circum-neutral at MW15-03WB (pH 7.0 to 8.3) and MW15-01WB (pH 6.1 to 7.9).

5.1.3 Granite

Monitoring wells screened in granite (pink symbols in Figure 5-1) are located in the proposed Kona Pit footprint (MW14-05A and MW14-05B), adjacent to the proposed HLF in the upper Halfway Creek catchment (MW16-01WB), and adjacent to Latte Creek downstream from the proposed HLF (MW15-05WB). Groundwater sampled from these wells is Ca-HCO_3-type.

The groundwater at MW15-05WB and MW16-01WB is Ca-HCO_3-type and is characterized by uniform compositions at each well. Both wells have similar major ion proportions, with comparable to slightly higher concentrations observed at MW15-05WB. Groundwater at both wells is fresh, with slightly higher field-measured specific conductance at MW15-05WB (162 to 402 µS/cm) compared to MW16-01WB (140 to 247 µS/cm). Field pH is predominantly circum-neutral at MW16-01WB (pH 5.9 to 7.4) and MW15-05WB (pH 5.5 to 8.1).

Monitoring wells MW14-05A and MW14-05B present among the most variable hydrogeochemical compositions in the Project area. Groundwater is Ca-HCO_3-type at both wells, with that at MW14-05B showing greater Na proportions and concentrations than at MW14-05A. Both wells present a shift to lower Na proportions and concentrations throughout the data record, with a greater decrease observed at MW14-05B. Groundwater at MW14-05B and MW14-05A has comparable salinity with specific conductance values of 359 to 519 µS/cm and 329 to 475 µS/cm, respectively; however, the data record shows opposing trends with field-SC increasing slightly at MW14-05A and decreasing slightly at MW14-05B. The field pH at both wells is typically circum-neutral with similar values at MW14-05A (pH 6.5 to 8.3) and MW14-05B (pH 6.7 to 7.5).

Table 5-1:
Select Groundwater Quality Parameters Measured in Project Monitoring Wells (August 2019, except where noted).

Well ID	Units	MW15-02AZ	MW15-03AZ	MW15-05AZ	MW15-01WB	MW15-03WB	MW15-04WB	MW15-06WB	MW14-05A	MW14-05B	MW15-05WB	MW16-01WB	MW14-02A	MW14-02B	MW14-03A	MW14-03B	MW15-02WB
Sample Date	**Units**	03-Aug-18	23-Aug-19	06-Sep-15	22-Aug-19	23-Aug-19	22-Aug-19	25-Aug-19	24-Aug-19	25-Aug-19	23-Aug-19	21-Aug-19	22-Aug-19	22-Aug-19	23-Aug-19	23-Aug-19	24-Aug-19
Catchment Area		LC	HC	LC	YT-24	HC	HC	HC	HC	HC	LC	HC	LCT	LCT	HC	HC	LCT/LC
Lithology		OVB	OVB	OVB	GN	GN	GN	GN	GR	GR	GR	GR	SCH	SCH	SCH	SCH	SCH
Physical Parameters and Major Ions																	
field SC	µS/cm	862	259	28	1720	1969	n/a	598	424 ↑	361 ↓	260	n/a	366	n/a	1560	1806	894
field pH	pH	8.02	6.96	5.76	7.41	7.02	n/a	7.69	6.97	6.89	8.10	n/a	6.85	n/a	7.29	7.02	7.36
TSS	mg/L	<1.0	<1.0	1.5	3.3	3.6	1.5	3.2	28 ↑	16	<1.0	10	3.4	<1.0	4.8↓	3.6	1.6
Turbidity	NTU	0.39	0.11	11.3	12	4.1	<0.10	3.1	140 ↑	69	0.41	70	0.74	0.56	7.6 ↓	9.4	1.7
Bicarbonate	mg/L as HCO_3	305	115	11.1	708	187	279	286	261	218 ↓	181	96	174	218	604	699	314
Chloride	mg/L	<0.50 ↓	0.86	0.52	0.95	11	0.79	0.67	0.84	1.1 ↓	0.93	0.71	0.54	0.62	1.5	0.88↓	1.5
Nitrate-N	mg/L	0.322	0.327 ↑	0.01	0.0209	<0.0020	0.48 ↑	<0.0020	<0.0020	<0.0020	<0.0020	0.0026	0.176	0.152	<0.0020	<0.0020	<0.0020
Sulphate	mg/L	203	36	<0.50	850	1000	120	100	12	14	14	14	50	75	490	590	240
Calcium	mg/L	116	32.6	2.93	249	177	72	58.9	56.8	43.8	42.1	21.6	39.2	48.7	137	136	129
Magnesium	mg/L	35.9	9.5	0.747	175	143	35.5	35.6	11.9	9.53	6.66	4.24	19.7	25.7	136	184	35.7
Potassium	mg/L	7.95	1.67	0.12	4.74	8.49	4.03	3.69	4.14 ↓	4.11 ↓	0.679	1.41	2.8	3.26	9.01	8.73	8.95
Sodium	mg/L	5.64	3.47	1.14	24.6	72.9	5.92	4.64	10.5 ↓	13.1 ↓	8.74	7.01	2.71	2.95	27.5	26.5	7.69
Dissolved Metals																	
Aluminum	µg/L	5.05	13.6	189	3.5	8.2	0.91	2.78	20.4	1.73	0.84	0.52	2.4	1.06	7.3	5.9	2.81
Antimony	µg/L	0.119	0.176	0.084	0.057	0.047	1.48 ↓	0.287	0.57	0.102	0.167	0.065 ↓	0.658	4.65 ↓	0.13	0.054	0.084
Arsenic	µg/L	0.848	0.62	2.28	10.9 ↓	0.282	1.38	123 ↑	2080 ↑	209	0.893	4.37	56.4	37.2	30.7 ↓	15.4	2.03
Cadmium	µg/L	<0.0050	0.0063	0.022	<0.010	<0.010	0.0226	<0.0050	<0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	<0.010	0.0094
Chromium	µg/L	<0.10	0.22	0.7	<0.20	<0.20	0.19	<0.10	<0.50	0.16	<0.10	<0.10	0.54	0.52	0.34	0.2	0.18
Cobalt	µg/L	0.081	0.0323	2.49	0.256	0.013	0.187	0.129	0.24	0.331 ↓	0.0419	0.0161	0.0118	0.0648	1.28	4.46 ↓	0.147
Copper	µg/L	0.713	1.48	1.86	<0.10	0.12	1.17	0.052	<0.25	0.075	0.071	0.925	<0.050	<0.050	<0.10	1.45	0.254
Iron	µg/L	5.9	6.6	931	943	357	15.2	952	12000 ↑	6150 ↑	4.1	1900	<1.0	<1.0	3750 ↓	1310	301
Lead	µg/L	<0.0050	<0.0050	0.033	<0.010	0.023	0.282	0.0145	<0.025	<0.0050	0.0094	0.0201	<0.0050	<0.0050	0.026	0.087	0.0442
Manganese	µg/L	50.1	49.8	617	353	82.9	79.1	4460	1890	2220	7.1	1280	0.179	23.3 ↓	420 ↓	2250 ↓	86.7
Mercury	µg/L	<0.0020	0.0054	0.0054	<0.0020	0.0024	<0.0020	0.0081	0.0051	<0.0020	0.0055	<0.0020	0.006	0.0022	0.003	0.0108	0.005
Molybdenum	µg/L	0.409	0.517	0.248	0.46	0.61	2.15	77.5 ↓	4.18	1.14 ↓	0.5	0.669	3.0	3.1 ↓	0.86	3.58 ↓	0.708
Nickel	µg/L	0.593	0.802	1.23	0.794	0.971	0.514 ↓	0.295	0.39	0.264	0.187	0.301	0.035	1.19↓	1.34	10.8 ↓	0.972
Selenium	µg/L	0.198	0.075	0.069	<0.080	<0.080	0.369	0.046	<0.20	<0.040	<0.040	0.068	0.256	0.35	<0.080	0.101	<0.040
Silver	µg/L	<0.0050	<0.0050	<0.0050	<0.010	<0.010	<0.0050	<0.0050	<0.025	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.010	0.025	<0.0050
Uranium	µg/L	31.4 ↑	25.3	0.899	532	5.82	128	33.4	4.04 ↓	1.46	79.7	2.36	42.3	66.7	88.3	58.2 ↑	33

Notes:
OVB = overburden; GN = gneiss; GR = granite; SCH = schist
HC = Halfway Creek; LT = Latte Creek; LCT = Latte Creek Tributary; YT-24 = YT-24 Drainage
µg/L = micrograms per litre; SC = specific conductance; TSS = total suspended solids
↑ = parameter concentration shows an increasing trend; â = parameter concentration shows a decreasing trend
=Highlighted values are the maximum concentration measured across the site.

5.1.4 Schist

Monitoring wells screened in schist are distributed on the north and south sides of the Project in the vicinity and downstream from the proposed Latte Pit and southern Supremo pit area (dark blue symbols in Figure 5-1). MW14-03A and MW14-03B are upgradient and adjacent to the proposed Latte Pit on the north side of the Project. MW14-02A and MW14-02B are situated upgradient and within the proposed southern Supremo Pit area, while MW15-02WB is downgradient of the proposed Latte Pit and southern Supremo Pit area. Although MW14-02A is screened across hydrothermally altered rock (crackle breccia), it is mainly biotite schist and therefore has been grouped with wells screened in schist. Groundwater at these monitoring wells ranges from Ca-HCO_3 to Mg-SO_4-type.

Groundwater at both MW14-03A and MW14-03B is predominantly Mg-SO_4-type with significant HCO_3 influence, with three to four samples collected at each well classified as magnesium-bicarbonate-type (Mg-HCO_3) with significant SO_4 influence. The groundwater compositions at both wells are similar and cluster on the Piper plot, with a slightly greater range observed at MW14-03A due to more variable SO_4 proportions. Major ion concentrations at both wells are generally uniform and comparable. The groundwater at MW14-03B (1604 to 1884 µS/cm) is slightly more saline than at MW14-03A (1376 to 1700 µS/cm). Field pH is circum-neutral at both wells with values of pH 6.7 to 8.1 at MW14-03A and pH 6.9 to 7.5 at MW14-03B.

Monitoring well pair MW14-02B and MW14-02A is characterized by similar groundwater composition, with uniform major ion proportions and concentrations at each well. Groundwater composition at MW14-02B ranges from Ca-HCO_3-type with significant Mg influence to mixed-calcium-magnesium-bicarbonate-type (Ca-Mg-HCO_3), while that at MW14-02A is Ca-HCO_3-type with significant Mg influence. Field-measured specific conductance is relatively low at both wells, with more saline groundwater at MW14-02B (317 to 521 µS/cm) than at MW14-02A (204 to 400 µS/cm). Groundwater at both wells is circum-neutral, with wider range of field pH values observed at MW14-02A (pH 6.1 to 8.3) compared to MW14-02B (pH 7.2 to 8.0).

The hydrogeochemical composition of groundwater at MW15-02WB clusters with MW14-03A and MW14-03B on the Piper plot (Figure 5-1). MW15-02WB ranges from Ca-HCO_3-type water with significant SO_4 influence to calcium-sulphate-type (Ca-SO_4) water with significant HCO_3 influence. The spread in the groundwater composition reflects the variable SO_4 content. Groundwater at MW15-02WB has circum-neutral field pH (7.1 to 7.7) and is moderately saline with specific conductance values between 480 and 941 µS/cm.

5.2 Oxidation-Reduction Geochemistry

Redox conditions within a groundwater system can be assessed based on the presence and concentration of oxidized and reduced inorganic compounds in groundwater samples. Bacteria utilize oxidants (electron acceptors) in order of their energy yield as follows: dissolved oxygen (DO, O_2), nitrate (NO_3^{2-}), manganese (Mn^{4+})-oxides, ferric iron (Fe^{3+})-oxides, sulfate (SO_4^{2-}) and carbon dioxide (CO_2). Therefore, in the order of increasing reduced conditions, key indicators of suboxia can include:

- absence of O_2;
- removal of NO_3 and/or nitrite (NO_2) (associated with NO_3 reduction);
- elevated (>0.5 mg/L) concentrations of ammonia (NH_3); NH_3 is unstable in the presence of O_2;
- elevated (>1 mg/L) concentrations of dissolved Mn^{2+} and/or Fe^{2+} at circum-neutral pH, which implies the reductive dissolution of Mn^{4+}-oxide and Fe^{3+}-oxide phases, respectively; and,
- presence of dissolved sulphide species (S^{2-}, HS^- and H_2S; hereafter referred to as S^{2-}) reflecting SO_4 reduction.

Of these, the presence of elevated dissolved Fe^{2+} and/or the presence of detectable dissolved S^{2-} provide the most robust indicators of suboxia, given that the presence of these parameters is incompatible with that of O_2. Where groundwater was characterized by low concentrations of redox indicator parameters, the relative concentrations of parameters and/or presence or absence of specific parameters was used to assess redox conditions.

Oxidation-reduction potential (ORP), in units of millivolts (mV), is a field-measured parameter and provides a qualitative assessment of the general redox conditions only. Strongly negative ORP values are associated with suboxic conditions whereas positive values are associated with oxic conditions. Field measurements of ORP and DO are considered informative, but less reliable than analytical results for NO_3, NO_2, NH_3, dissolved Mn and Fe, and S^{2-}. Field readings of DO and ORP are tabulated in Appendix 5-A and presented in time series plots in Appendix 5-E (Figure 5-E-1 to Figure 5-E-4). Analytical results for NO_3, NH_3, dissolved Mn, dissolved Fe, and S^{2-} are presented in Appendix 5-A, with time series plots in Appendix 5-E (Figure 5-E-9 to Figure 5-E-16). Note that total sulphide was initially reported, with a switch to dissolved sulphide in 2018 (Table 3-8). As a result, the time series plots for S^{2-} show total concentrations (Sept. 2014 to Jun. 2018) and dissolved concentrations (Aug. 2018 to Aug. 2019), except for April 2018 when total or dissolved concentrations are graphed depending on available analyses at each location. The general presence/absence of redox sensitive parameters is summarized in Table 5-2, along with classification of the groundwater by location.

Table 5-2:
Summary of Groundwater Redox Classification[1]

Lithology	Well ID	NO_3	NO_2	NH_3	Mn	Fe	S^{2-}	DO [2]	ORP [2]	Classification
Overburden	MW15-02AZ	✓	ND	✓ (low)	✓ (low)	✓ (low)	Mostly ND	✓	Mostly +ve	Oxic
	MW15-03AZ	✓	ND	✓ (low)	✓ (low)	✓ (low)	Mostly ND	✓	Mostly +ve	Oxic
	MW15-05AZ	✓ (low)	ND	✓	✓	✓	ND	✓	+ve	Mildly to moderately reducing
Gneiss	MW15-01WB	Mostly ND	ND	✓	✓	✓	Mix of ND and ✓	-	-	Moderately reducing
	MW15-03WB	ND (except 2 rounds)	ND (except 1 round)	✓	✓	✓	Mix of ND and ✓	-	-	Moderately to strongly reducing
	MW15-04WB	✓	✓	✓	✓	✓ (low)	Mostly ND	-	-	Oxic to mildly reducing
	MW15-06WB	Mostly ND	ND	✓	✓	✓	✓	-	-	Mildly to moderately reducing
Granite	MW14-05A	Mostly ND	Mostly ND	✓	✓	✓	✓	✓ (low)	Mostly -ve	Moderately to strongly reducing
	MW14-05B	Mostly ND	Mostly ND	✓	✓	✓	✓	✓ (low)	-ve	Moderately to strongly reducing
	MW15-05WB	ND	ND	Mix of ND and ✓	✓ (low)	✓ (low)	ND	-	-	Mildly reducing
	MW16-01WB	Mostly ND	Mix of ND and ✓	Mix of ND and ✓	✓	✓	Mix of ND and ✓	-	-	Moderately reducing
Schist	MW14-02A	✓	ND	Mix of ND and ✓	✓ (low)	Mix of ND and ✓	Mostly ND	✓	Mostly +ve	Oxic
	MW14-02B	✓	ND	Mix of ND and ✓	✓	Mix of ND and ✓	Mostly ND	✓	Mostly +ve	Oxic to mildly reducing
	MW14-03A	ND (except 2 rounds)	ND	✓	✓	✓	✓	✓ (low)	-ve	Moderately to strongly reducing
	MW14-03B	ND (except 2 rounds)	ND (except 1 round)	✓ (low)	✓	✓	Mostly ✓ (low)	✓ (low)	Mostly -ve	Mildly to moderately reducing
	MW15-02WB	Mix of ND and ✓	ND	Mix of ND and ✓	✓	✓	Mostly ND	-	-	Varies betwen oxic and midly to moderately reducing

Notes:
✓ = detect; -ve = negative; +ve = positive; ND = non-detect; " – " = not used for interpretation purposes
1. Redox parameter concentrations ≤ 2 times the reportable detection limit (RPD) are considered to be non-detect for the purpose of assessing groundwater redox conditions.
2. Field DO and ORP readings are not used to assess redox conditions at the Westbay installations, as these parameters were measured in a calibration cup or graduated cylinder and are consequently not considered to be representative.

Field DO and ORP measurements collected from Westbay installations are not considered to be necessarily representative of formation conditions since measurements were collected in a graduated cylinder or calibration cup (*i.e.*, not isolated from atmospheric conditions). Consequently, the field DO and ORP readings are not used for interpretation purposes and the assessment of redox conditions at MW15-01WB to MW15-06WB and MW16-01WB relies solely on groundwater analytical data (Table 5-2).

5.2.1 Overburden

Groundwater sampled from overburden wells ranged from oxic to moderately suboxic.

Shallow groundwater at MW15-02AZ was oxic. NO_3 was consistently measured at concentrations between 0.23 and 0.63 mg/L, along with low concentrations of dissolved Mn and Fe (<94 and <16 µg/L, respectively). NH_3 was measurable at low levels (<0.005 to 0.025 mg/L) in most samples. The consistent presence of NO_3, along with moderate DO (4.4 to 8.8 mg/L) readings and predominantly positive ORP measurements indicate oxygenated groundwater.

The groundwater at MW15-03AZ was predominantly oxic. NO_3 was consistently measurable in groundwater, with concentrations typically ranging between 0.1 and 0.45 mg/L. DO readings were low (0.3 to 2.9 mg/L), while ORP measurements were typically positive (6 to 136 mV). Low levels of NH_3 and dissolved Mn, and very low dissolved Fe were measured in most samples. The presence of NO_3, DO and positive ORP indicate predominantly oxic conditions.

The single groundwater sample collected at MW15-05AZ in September 2015 is classified as mildly to moderately reducing based on the analytical results. Substantial levels of DO (7.9 mg/L) and positive ORP (98 mV) suggest oxygenated water, with NO_3 (0.01 mg/L) only measured slightly above its detection limit. Measurable NH_3 (0.6 mg/L), dissolved Mn (0.6 mg/L) and Fe (0.9 mg/L) concentrations are indicative of mildly to moderately reducing groundwater.

5.2.2 Gneiss

Monitoring wells screened in gneiss are situated on the north side of the Project in the Halfway Creek (MW15-06WB, MW15-04WB and MW15-03WB) and YT-24 (MW15-01WB) drainages. Redox conditions at these wells range from oxic to strongly suboxic.

Groundwater at MW15-06WB is suboxic. Dissolved Fe concentrations were low in July and August 2015 (0.057 and 0.074 mg/L, respectively), and increased about one order of magnitude in September 2015 (0.85 mg/L), typically ranging between 0.6 and 1.1 mg/L thereafter. The consistent presence of dissolved Mn (2.4 to 6.4 mg/L) and Fe, along with negligible to low NO_3 (<0.002 to 0.025 mg/L) levels, low concentrations of NH_3 (<0.005 to 0.23 mg/L), and variable S^{2-} (0.002 to 0.05 mg/L) concentrations indicate the predominance of suboxic conditions. The elevated dissolved Mn concentrations relative to dissolved Fe in the groundwater at MW15-06WB suggest mildly to moderately reducing conditions.

MW15-04WB is oxic to mildly suboxic. NO_3 and dissolved Mn were consistently measured at MW15-04WB, with NO_2 and NH_3 measured in most samples. NO_3 concentrations were highest, ranging from 0.07 to 0.5 mg/L, while NO_2, NH_3 and dissolved Mn levels were generally lower. Sulphide was typically absent (<2.3 times RDL) in the groundwater, while dissolved Fe concentrations were very low (<44 µg/L). The consistent presence of NO_3 indicates oxic conditions, while low levels of NO_2, NH_3 and dissolved Mn indicate mildly reducing conditions.

Monitoring well MW15-03WB is classified as suboxic and moderately to strongly reducing. NO_3 was typically absent (<2 times RDL), while low levels of NH_3 (<0.005 to 0.08 mg/L, except 0.9 mg/L in July 2015) and dissolved Mn (74 to 104 µg/L) were consistently measured. Dissolved Fe concentrations were very low between June and August 2015 (6 to 11 µg/L) and increased significantly from September 2015 (569 µg/L) to April 2017 (1420 µg/L), decreasing thereafter until August 2019 (357 µg/L). Sulphide concentrations were negligible (<2.8 times RDL) from June 2015 to April 2017, increasing more than one order of magnitude between June 2017 and 2019 (0.05 to 0.19 mg/L). Elevated Fe concentrations in relation to the other redox parameters suggest moderately reducing conditions, while the apparent decrease in Fe concentrations in conjunction with measurable and increasing S^{2-} levels between June 2017 and August 2019 suggest a shift to more strongly reducing conditions.

The groundwater at MW15-01WB is anoxic and moderately reducing. Dissolved Mn was consistently measurable in groundwater at concentrations ranging from 0.3 to 0.5 mg/L, along with low levels of NH_3 (<0.005 to 0.06 mg/L). NO_3 was measured sporadically at concentrations close to its RDL (<0.002 to 0.02 mg/L), while S^{2-} was absent (<2 times RDL) in almost half of the groundwater samples collected at MW15-01WB. Dissolved Fe concentrations were very low between June and August 2015 (0.003 to 0.025 mg/L), and increased significantly in September 2015, typically ranging between 0.6 and 2.0 mg/L thereafter. The elevated Fe concentrations in relation to Mn levels, along with low levels of NH_3 and absence of S^{2-} in almost half of the samples suggest that groundwater at MW15-01WB is moderately reducing.

The first two to three groundwater samples collected at MW15-01WB, MW15-03WB, and MW15-06WB were characterized by low dissolved Fe concentrations which increased significantly by up to 1 to 2 orders of magnitude in the next sample collected at each location. The initially depressed Fe levels are suspected of being artifacts of reverse circulation drilling which likely injected air into the formation thereby affecting the groundwater redox conditions.

5.2.3 Granite

Groundwater redox conditions at monitoring wells screened in granite were mildly to strongly anoxic.

Monitoring well pair MW14-05A and MW14-05B had elevated dissolved Mn, Fe and S^{2-}concentrations indicating moderately to strongly reducing conditions. NH_3 levels in both wells were generally close to the RDL (0.005 mg/L). Field DO was low at MW14-05A (typically <2 mg/L) and MW14-05B (typically <3 mg/L), while ORP readings were negative in both wells. Groundwater was slightly more reducing at MW14-05A which was characterized by greater dissolved Fe and S^{2-} concentrations compared to MW14-05B. In addition, field ORP readings generally were slightly more negative at MW14-05A than MW14-05B. Dissolved Fe concentrations increased throughout the data record at MW14-05B (2.6 to 6.2 mg/L) and at MW15-04A (1.9 to 12 mg/L) (Appendix 5-E).

The groundwater at MW15-05WB is classified as anoxic and mildly reducing. Very low levels of dissolved Mn (5 to 13 µg/L) and Fe (<1 to 11 µg/L) were consistently measured, along with absence of NO_3 (<2 times RDL) and S^{2-} (<2 times RDL). NH_3 was measurable (>2 times RDL) in half of the groundwater samples collected at MW15-05WB. The occasional presence of NH_3, in addition to dissolved Mn concentrations that were typically greater than Fe concentrations suggest mildly reducing conditions at MW15-05WB.

Westbay installation MW16-01WB is characterized by moderately reducing conditions. Dissolved Mn (1.3 to 1.4 mg/L) and Fe (1.9 to 6.5 mg/L) were consistently measured, along with negligible NO_3 concentrations (≤ 2.5 times RDL) and sporadic measurable NH_3 concentrations (> 2 times RDL). Groundwater sampled between October 2015 and August 2018 had negligible sulphide levels (<2.5 times RDL of 0.0050 mg/L), while samples collected thereafter were characterized by increasing sulphide concentrations (0.03 to 0.09 mg/L). The elevated Fe levels indicates moderately reducing conditions, while the increasing sulphide concentrations in late 2018 and 2019 suggests a possible shift towards more strongly reducing conditions.

5.2.4 Schist

Monitoring wells screened in schist spans the entire range of redox conditions from oxic to strongly reducing.

Groundwater at monitoring well MW14-02A screened in hydrothermal breccia was oxic. NO_3 was consistently measured in groundwater between 0.14 and 0.18 mg/L, with high field DO (7.0 to 12 mg/L) and predominantly positive ORP (29 to 247 mV, except once at -61 mV), indicating oxygenated water. NH_3 was measurable (>2 times RDL) in about half the samples. Dissolved Mn (<0.08 mg/L) and Fe (<0.03 mg/L) were consistently measured at very low levels, along with absence of S^{2-} (<2.7 times RDL).

Groundwater at MW14-02B consistently had measurable levels of NO_3 (0.01 to 0.16 mg/L) and dissolved Mn (0.02 to 0.91 mg/L) which along with moderate to high DO (4.7 to 9.0 mg/L) and generally positive ORP readings (15 to 209 mV) suggest oxic to mildly reducing conditions.

Measurable NH_3 (>2 times RDL) was present in less than half of the samples, while dissolved Fe (<0.01 mg/L) concentrations were generally very low. Dissolved S^{2-} was absent in all sampling events (<2.4 times RDL).

Groundwater at monitoring well pair MW14-03A and MW14-03B was anoxic. The consistent presence of NH_3, dissolved Mn, and Fe along with negligible NO_3 during all sampling rounds indicate that suboxic conditions predominated at MW14-03A and MW14-03B. The groundwater at MW14-03B is classified as mildly to moderately reducing due to higher dissolved Mn concentrations and lower concentrations of dissolved Fe and S^{2-} relative to MW14-03A which is classified as moderately to strongly reducing. At MW14-03A, observed Fe, Mn and S^{2-} trends between 2015 and 2019 suggest a shift towards more strongly reducing conditions. The average Fe concentration at MW14-03A decreased from 8.3 mg/L (2015) to 3.8 mg/L (2019), in conjunction with a slight decrease in average Mn concentrations during this period (0.8 to 0.4 mg/L) and measurable sulphide levels that remained stable until April 2019 (~0.1 mg/L) and increased slightly in June and August 2019 (0.2 and 0.5 mg/L, respectively).

MW15-02WB is characterized by variable groundwater redox conditions. Eight samples were characterized by negligible NO_3 concentrations (≤2.1 times RDL), while the remaining 10 samples had measurable NO_3 (0.08 to 0.33 mg/L). Low levels of NH_3 were present in most samples, while S^{2-} was absent (<2.3x RDL). Dissolved Mn and Fe were consistently measurable in the groundwater at MW15-02WB; however, concentrations ranged up to one to two orders of magnitude. Samples with NO_3, typically had lower Mn (2 to 71 µg/L) and Fe (3 to 162 µg/L) concentrations compared to Mn (87 to 111 µg/L) and Fe (4 to 377 µg/L) levels in samples with negligible NO_3. The groundwater redox condition at MW15-02WB varies between oxic groundwater with NO_3 and low levels of dissolved Mn and Fe, and mildly to moderately reducing groundwater with negligible NO_3 and higher Mn and Fe concentrations.

5.3 Trace Elements

This section presents a review of trace element concentrations across the Project area. Groundwater data for all analysed parameters are tabulated and presented in Appendix 5-A. Selected dissolved parameters of concern (aluminum (Al), arsenic (As), antimony (Sb), cadmium (Cd), chromium (Cr), copper (Cu), cobalt (Co), mercury (Hg), molybdenum (Mo), nickel (Ni), lead (Pb), selenium (Se), silver (Ag), uranium (U) and zinc (Zn)) are presented as time series plots in Appendix 5-E (Figure 5-E-17 to Figure 5-E-32). These parameters were selected based on consideration of geochemical test results and potential for complexation with cyanide, in addition to surface water quality results across the Project area.

Selected trace element concentrations from the most recent groundwater sampling events are tabulated in Table 5-1, with the highest concentration for each parameter across the Project area

highlighted yellow. Parameters that display trends (*i.e.*, increasing or decreasing concentrations) are flagged in Table 5-1.

Dissolved Al was measured in virtually all groundwater samples. Concentrations were typically below 10 µg/L in bedrock groundwater. The highest concentrations were in overburden groundwater at MW15-03AZ (14 to 38 µg/L) and MW15-05AZ (189 µg/L). In contrast, concentrations at MW15-02AZ (1.9 to 15 µg/L) were predominantly within the range observed in bedrock wells. Dissolved Al values at MW15-04WB decreased one order of magnitude in 2015 (from 44 to 3.5 µg/L) and remained below 4 µg/L thereafter, with a similar decrease observed at MW14-03B in 2015 (Appendix 5-E).

Dissolved As was measured in all groundwater samples. Concentrations were generally low in overburden groundwater (0.43 to 2.3 µg/L) and highest in bedrock groundwater (0.12 to 2650 µg/L). Concentrations of dissolved As were below 6 µg/L in bedrock Westbay installations MW15-02WB, MW15-03WB, MW15-04WB, and MW15-05WB. The highest concentrations were measured in granite at MW14-05B (150 to 212 µg/L) and MW14-05A (1480 to 2650 µg/L), with a slight increase observed at MW14-05A between 2018 and 2019. A significant increase in As concentrations was observed at MW15-06WB between 2015 and 2019 (10 to 123 µg/L) (Appendix 5-E).

Concentrations of dissolved Sb were generally below 1 µg/L in overburden and bedrock groundwater, except at MW14-02B, MW15-04WB, and MW15-06WB. Dissolved Sb was highest at MW14-02B (3.3 to 12 µg/L), MW15-04WB (1.1 to 3.0 µg/L), and MW15-06WB (0.3 to 3.8 µg/L.

Dissolved Cd concentrations measured in overburden and bedrock groundwater were predominantly between <0.0050 and 0.06 µg/L, except at MW15-02AZ and MW15-04WB. Concentrations at MW15-02AZ were generally close to or below the RDL (range of <0.005 to 0.125 µg/L), while concentrations at MW15-04WB were consistently measurable (0.01 to 0.1 µg/L). MW14-05A, MW15-01WB and MW15-03WB had multiple samples with results below RDLs that were raised (0.010, 0.025 µg/L), and consequently may appear elevated in relation to other samples or wells in the plots in Appendix E (Figure 5-E-18, Figure 5-E-19).

Dissolved Cr was low in overburden and bedrock groundwater, with concentrations ranging from below RDL (0.1µg/L) to 2.7 µg/L. Concentrations were generally close to or below the RDL at most wells, with the highest concentrations consistently observed at MW14-02A (0.45 to 0.65 µg/L), MW14-02B (<0.1 to 2.7 µg/L) and MW14-05B (<0.1 to 0.7 µg/L).

Concentrations of dissolved Cu were generally highest in overburden groundwater (0.57 to 2.0 µg/L). Bedrock groundwater concentrations ranged from below RDL (0.05 µg/L) to 2.8 µg/L. Concentrations in bedrock groundwater were highest in schist at MW14-03B (0.2 to 2.8 µg/L) and MW15-02WB (0.1 to 2.6 µg/L), and in gneiss at MW15-04WB (0.5 to 2.3 µg/L).

Dissolved Co concentrations were generally higher in bedrock groundwater than in overburden groundwater. Concentrations of dissolved Co in overburden groundwater were generally below 0.25 µg/L, except at MW15-05AZ (2.5 µg/L). Dissolved Co levels were highest in schist at MW14-03A (1.3 to 2.5 µg/L) and MW14-03B (3.4 to 7.6 µg/L), with a slow decreasing trend observed at MW14-03B between 2015 and 2019. A slight decrease in concentrations was also observed at MW14-05A (1.2 to 0.2 µg/L) between 2015 and 2017.

Dissolved Hg concentrations were close to or below the RDL (0.002 µg/L) in most overburden and bedrock groundwater samples. Monitoring wells with measurable dissolved Hg were typically characterized by concentrations <0.01 µg/L, except MW14-03B (<0.002 to 0.033 µg/L) and MW15-06WB (0.0041 to 0.095 µg/L) where the highest concentrations were detected; however, concentrations at MW15-06WB appear to have stabilized below 0.01 µg/L between 2017 and 2019.

Dissolved Mo was consistently measured in overburden and bedrock groundwater. Groundwater concentrations were lowest in the overburden (0.25 to 0.53 µg/L). In contrast, concentrations in bedrock groundwater ranged from 0.83 to 29 µg/L in the conventional monitoring wells and 0.31 to 199 µg/L in the Westbay installations. The highest concentrations were observed at MW15-06WB (28 to 199 µg/L), with a significant increase in 2015, followed by slowly decreasing concentrations thereafter. Concentration decreases were also observed at MW14-03A (2015 to 2017), and MW14-02B, MW14-03B and MW14-05B (2015 to 2019) (Appendix 5-E).

Concentrations of dissolved Ni in groundwater were generally below 5 µg/L, except at MW14-02B and MW14-03B. Dissolved Ni concentrations were highest and most variable at MW14-02B (1.2 to 15 µg/L) and MW14-03B (9.9 to 22 µg/L); however, concentrations decreased at both wells between 2015 and 2019.

Dissolved Pb concentrations were low in the overburden and bedrock groundwater. Concentrations were lowest in the overburden (<0.005 to 0.033 µg/L) and more variable in bedrock, ranging from <0.005 µg/L to 1.6 µg/L.

Dissolved Se was generally low in overburden and bedrock groundwater, with concentrations ranging from below RDL (0.04 µg/L) to 1.1 µg/L. The May 2015 sample collected at MW15-02AZ and the April 2018 sample collected at MW15-03WB had the highest Se concentrations of any overburden and bedrock wells at 1.1 µg/L. All other overburden and bedrock groundwater samples were consistently below 0.6 µg/L.

Concentrations of dissolved Ag were generally below the RDL (0.0050 µg/L) in overburden and bedrock groundwater. Dissolved Ag levels were highest at specific wells in schist (MW14-03A, MW14-03B) and gneiss (MW15-03WB, MW15-06WB). All wells with measurable dissolved Ag were typically characterized by concentrations below 0.015 µg/L. MW14-05A, MW15-01WB and MW15-03WB had multiple samples with results below RDLs that were raised (0.010, 0.025 µg/L),

and consequently appear elevated in relation to other samples or wells in the plots in Appendix E (Figure 5-E-30, Figure 5-E-31).

Concentrations of dissolved U were consistently elevated (>15 µg/L) at most wells, except for MW14-05A, MW14-05B, MW15-03WB, MW15-05AZ, and MW16-01WB. Dissolved U levels were highest in gneiss at MW15-01WB (526 to 589 µg/L), MW15-04WB (107 to 176 µg/L) and MW15-06WB (5.7 to 103 µg/L). Concentrations at MW15-03WB, the only other well screened in gneiss, were significantly lower (5.7 to 9.1 µg/L). Dissolved U levels were lowest in the overburden groundwater (0.90 to 35 µg/L) and in granite (1.2 to 33 µg/L) at MW14-05A, MW14-05B and MW16-01WB. A decreasing concentration trend is apparent throughout the data record at MW14-05A (33 to 4 µg/L) and to a lesser extent at MW14-05B (~7 to <2 µg/L), while a slight but steady increase was observed at MW14-03B (~40 to 58 µg/L) between 2015 and 2019 (Appendix 5-E).

Dissolved Zn was typically measured across the Project area with higher and more variable concentrations at Westbay installations screened in the bedrock. Dissolved Zn levels were lowest in the overburden (<0.1 to 8.6 µg/L), followed by bedrock groundwater in conventional wells (<0.1 to 34 µg/L). Groundwater concentrations in the Westbay installations ranged from 4.9 to 253 µg/L in 2015 and from <0.5 to 64 µg/L between 2016 and 2019.

5.4 Isotopes

Groundwater, surface water and aufeis samples were collected from the Project area between 2014 and 2019 for the analysis of stable isotopes (^{2}H, ^{18}O, ^{13}C) and radioisotopes (^{3}H, ^{14}C) (Table 3-9). Water stable isotopes of hydrogen (^{2}H) and oxygen (^{18}O) are used to assess groundwater sources and recharge history, while the radioisotopes tritium (^{3}H) and radiocarbon (^{14}C) are used to estimate groundwater age (*i.e.*, mean residence time), which is an indication of how long water is circulating within a groundwater system. A summary of the key findings is presented herein, with a detailed discussion of the isotopic data and results provided in Appendix 5-F. The 2014 to 2019 stable isotope and radioisotope data are tabulated in Appendix 5-F.

Tritium (^{3}H) and radiocarbon (^{14}C) measurements in samples were used to estimate the fractions of young and paleo groundwaters (F_{young} and F_{paleo}, respectively) in a given groundwater sample based on the method proposed by Jasechko (2016a). In this method, young groundwater is defined as any groundwater that recharged since 1953 (*i.e.*, before the onset of large-scale thermonuclear bomb testing). Paleo groundwater refers to any groundwater that recharged prior to the end of the last major Earth glaciation, approximately 11,700 years ago. A summary of this method, as well as details of the calculations involved are presented in Appendix 5-F.

5.4.1 Stable Isotopes

The stable isotope compositions of groundwater, surface water, and aufeis samples collected in the Project area generally plot along an array of similar slopes to the local meteoric water line (LMWL) (Figure 5-2). The data plot slightly above the LMWL, which may reflect a slight difference in the source of water vapour that generates precipitation in the Project area in comparison to precipitation in Dawson City and Mayo (Lapp, 2015; IAEA, 2020) which was used to develop the LMWL. The range of estimated isotopic compositions for annual precipitation, rain-dominated precipitation (May-Oct.), and snow-dominated precipitation (Nov.-Apr.) in the Project area are defined by purple, red, and blue shading in Figure 5-2, respectively. These ranges were calculated using isotope and precipitation data from Mayo (IAEA, 2020) and correcting for elevations encountered at the Project site (see Appendix 5-F).

Overall, groundwaters collected from the Project site are isotopically heavier than the estimated value for mean annual precipitation and plot closer to the isotopic composition of rain-dominated precipitation (May to October) than that of snow-dominated precipitation falling between November and April (Figure 5-2). This observation suggests that groundwater recharge at the Project site is more heavily driven by infiltration of rain than by snowmelt, and is consistent with a greater proportion of annual precipitation falling as rain (~70 %) and a smaller contribution from snow (~30 %) at an elevation of 975 m asl (Lorax, 2019). Similar results have been obtained in a groundwater stable isotope study in the nearby Ogilvie River Watershed, north of Dawson City, Yukon (Baranova, 2017). Surface waters are shifted towards an isotopically heavier range of values in comparison to groundwater. This may simply reflect surface water samples that were predominantly collected between late April and October, when their water budget included greater input from summer precipitation, which is expected to be isotopically heavier than the mean annual precipitation and groundwater discharge (Figure 5-2).

There is considerable overlap in the stable isotope composition of groundwater at most monitoring wells, except for MW15-03WB (Figure 5-3). The water sampled at this location consistently has lower $\delta^{18}O$ and $\delta^{2}H$ values in comparison to other monitoring wells. This isotopically lighter signature at MW15-03WB is indicative of a colder recharge environment, which could be due to higher elevation precipitation or precipitation that fell during colder geological periods. For example, during the late-Pleistocene (50,000 to 20,000 years ago), $\delta^{18}O$ in precipitation was likely ~1 to 2 ‰ lower than during the Holocene (11,700 years ago to present time) due to a colder climate in extratropical areas (Jasechko, 2016b). In contrast, MW15-03AZ, which is screened in the active zone in the Halfway Creek valley, is characterized by isotopically heavier water, which indicates greater contribution of summer precipitation in the active zone flow system.

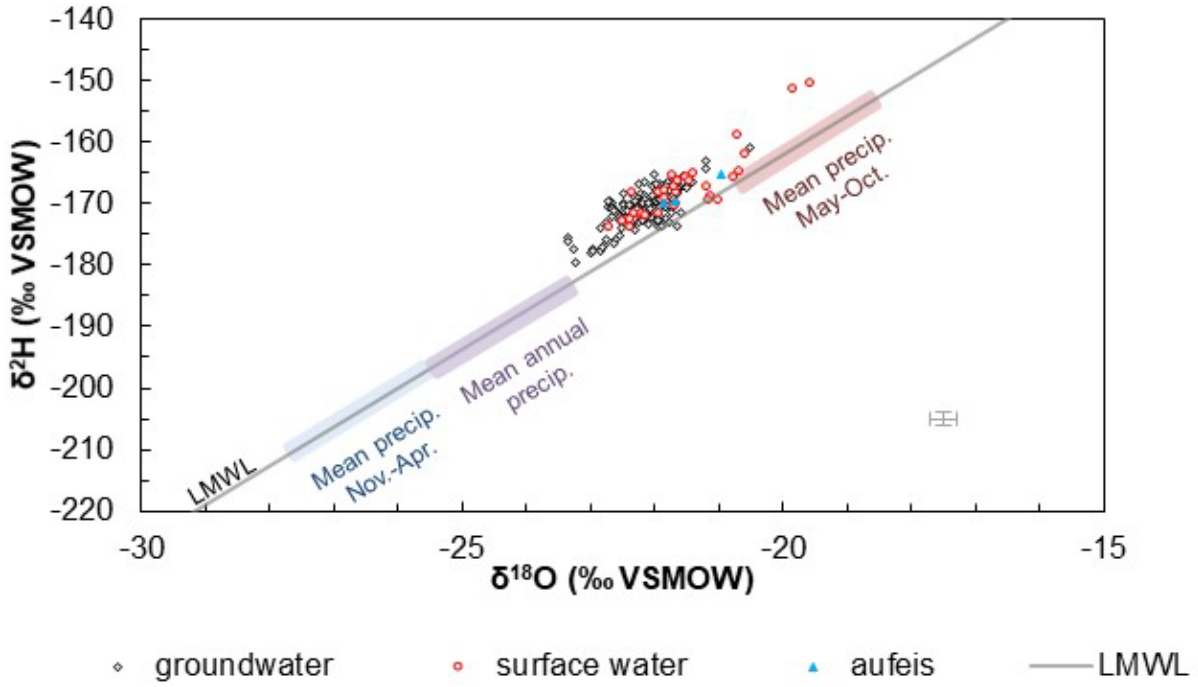

Figure 5-2: Isotopic composition of groundwater, surface water and aufeis at the Project site.

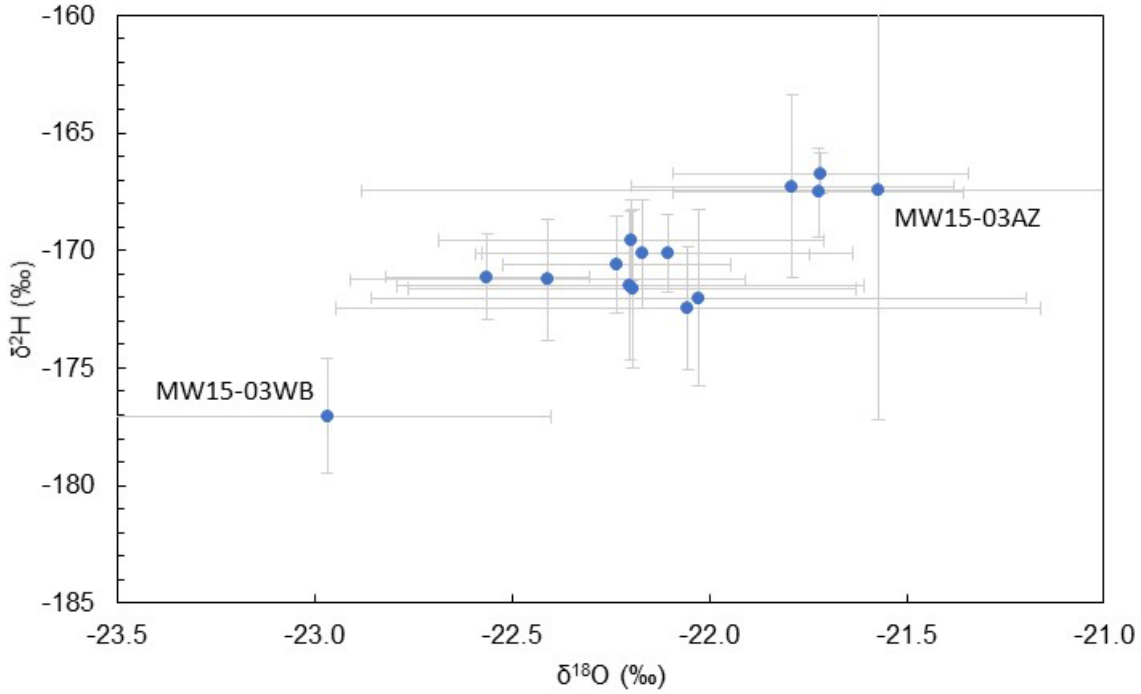

Figure 5-3: Mean stable isotope composition of groundwater at each monitoring well in the Project area (2014-2019). Error bars are ± 2 standard deviations.

5.4.2 Tritium and Radicarbon

The Pearson and Hanshaw (1970) method for correcting radiocarbon age relies on assumptions of $\delta^{13}C$ of the recharge environment, which depends on factors including soil vegetation type and soil porewater pH (at the time of recharge). These factors cannot truly be known, and as a result $\delta^{13}C$ is commonly estimated (Clark and Fritz, 1997). For the interpretation of radiocarbon ages presented in this memorandum, a groundwater recharge pH of 7.0 and a soil $\delta^{13}C$ value of -23 ‰ (typical of C3-plant based ecosystems; Clark and Fritz, 1997) are assumed, which correspond to a $\delta^{13}C_{recharge}$ value of -17.3 ‰ (Table 5-3). It is worth mentioning that under a slightly lower soil pH (*e.g.*, pH 6.0), $\delta^{13}C$ of recharge under these conditions would change to -21.5 ‰, and the reported radiocarbon ages would be offset by approximately 1,000 to 2,000 years. The uncertainty inherent in this method should be considered when interpreting the calculated ^{14}C ages (Table 5-3).

Calculations of F_{young} and F_{paleo} are prone to large uncertainties given the large range in possible ^{3}H and ^{14}C concentrations since 1953 and over the last 60,000 years, respectively, as well as assumptions that must be made regarding $\delta^{13}C$ of recharge and DIC concentrations. Therefore, the results are interpreted using mean fractions of young and paleo waters in a qualitative manner.

Tritium and radioisotope data indicate that the majority of groundwater in high-elevation and sub-permafrost monitoring wells is at least 70 years old and may be thousands of years in age (Table 5-3). This includes groundwater from high-elevation monitoring wells in granite (MW14-05A, MW14-05B, MW16-01WB, MW15-05WB) and sub-permafrost north-facing terrain in gneiss (MW15-06WB, MW15-01WB). All these wells have little to no tritium and F_{young} values ≤0.1, indicating that they are predominantly composed of water older than ~70 years (Figure 5-4, Figure 5-5). Calculated radiocarbon ages for these wells range from 6,500 to 22,400 years and F_{paleo} values range from 0.5 to 1, suggesting much longer residence times for sub-permafrost groundwater at high elevations at the Project site (Figure 5-6, Figure 5-7). The long groundwater residence times beneath permafrost in granite are supported by observations of low bedrock hydraulic conductivity at MW14-05A and MW14-05B which is ≤ $1x10^{-9}$ m/s and very slow well recharge rates observed during groundwater sampling.

In contrast, a large component of young groundwater with ages on the order of a few decades predominates along south-facing slopes above Latte Creek where permafrost is sparse (*i.e.*, MW14-02A, MW14-02B). Groundwater at MW14-02B and MW14-02A is tritiated (*i.e.,* contains tritium, with 5.4 and 7.2 tritium units (TU), respectively) and has F_{young} values greater than 0.6 (Table 5-3). A more active groundwater circulation pattern at these locations is consistent with higher hydraulic conductivity in the vicinity of MW14-02B, which ranges from $1x10^{-7}$ to $5x10^{-9}$ m/s. There is nevertheless a component of older groundwater that also appears to contribute to the water sampled at these locations, given calculated radiocarbon ages greater than 8,000 years and F_{paleo} values of 0.7 (Table 5-3). Groundwater mixing can account for this combination of young and old groundwater at MW14-02A and MW14-02B. The younger groundwater system in this area also appears in valley wells in Latte Creek at MW15-02AZ and MW15-02WB, which are

tritiated (9.4 and 6.6 TU, respectively) and have F_{young} values of 1.0 and 0.7, respectively. These results indicate that permafrost-free and more rapid groundwater circulation on the south-facing slope above Latte Creek may be a major input to groundwater contributions in the Latte Creek valley.

Along the Halfway Creek valley, groundwater in overburden at MW15-03AZ is likely on the order of a few decades old, based on an elevated tritium content (7.9 TU) which is indicative of more rapid groundwater circulation. However, a large range in groundwater ages is apparent in bedrock groundwater along Halfway Creek. MW15-04WB contains elevated tritium (6 TU) indicating it is mostly comprised of water several decades in age. In contrast, groundwater at MW15-03WB is tritium-free (< 0.8 TU), has a calculated radiocarbon age of 13,500 years, and an F_{paleo} value of 1.0, suggesting that it is likely several thousand years old (Table 5-3). Groundwater at MW15-03WB also has the lowest $\delta^{18}O$ value (Figure 5-3), which could be consistent with paleo-groundwater that recharged during the Pleistocene when meteoric $\delta^{18}O$ values were approximately 1 to 2 ‰ lower than present-day (Jasechko, 2016b). MW15-03WB is artesian and is installed in a valley bottom, and its location is along an inferred lineament (Huscroft, 2002) which may act as a conduit for long-residence time flow with upwelling groundwater (based on strong upward hydraulic gradients measured by MW15-03T). The unique $\delta^{18}O$ value is consistent with distinct groundwater quality at MW15-03WB, given its end-member major ion composition for the Project site, as well as elevated salinity and SO_4 concentrations in relation to other bedrock wells, and low dissolved uranium concentrations compared to other wells screened in gneiss and located upstream along Halfway Creek.

Table 5-3:
Isotopic composition of 2019 groundwater samples.

Station	Sample Date	$\delta^{18}O$	$\delta^{2}H$	$\delta^{13}C$	^{14}C	*q* [1]	^{14}C age [2]	^{3}H [3]	F_{young} [4]			F_{paleo} [5]		
		‰ VSMOW	‰ VSMOW	‰ VPBD	pMC	-	Years	TU	Mean	Min	Max	Mean	Min	Max
MW14-02A	22-Aug-19	-22.12	-172.7	-7.2	15.5	0.43	8,400	7.2	0.8	0.1	1.0	0.7	0.0	0.9
MW14-02B	22-Aug-19	-22.11	-173.4	-5.5	11.3	0.33	8,800	5.4	0.6	0.0	1.0	0.7	0.0	1.0
MW14-03A	23-Aug-19	-21.69	-165.8	-3.1	7.1	0.19	8,400	1.1	0.1	0.0	1.0	0.7	0.0	0.9
MW14-03B	23-Aug-19	-21.70	-166.8	-2.2	3.7	0.14	10,800	1.2	0.1	0.0	1.0	0.8	0.0	1.0
MW14-05A	24-Aug-19	-22.11	-170.2	-12.1	32.2	0.70	6,500	< 0.8	0.0	0.0	0.0	0.5	0.0	0.9
MW14-05B	25-Aug-19	-22.14	-170.8	-11.8	19.4	0.69	10,500	< 0.8	0.0	0.0	0.0	0.8	0.0	1.0
MW15-01WB	22-Aug-19	-21.65	-168.2	-3.7	1.5	0.23	22,400	< 0.8	0.0	0.0	0.0	1.0	0.8	1.0
MW15-02AZ [6]	07-Sep-15	-22.17	-169.4	-	-	-	-	9.4	1.0	0.1	1.0	-	-	-
MW15-02WB	24-Aug-19	-21.83	-170.4	-8.1	35.2	0.48	2,500	6.6	0.7	0.1	1.0	0.0	0.0	0.7
MW15-03AZ	23-Aug-19	-20.51	-161.0	-	-	-	-	7.9	0.9	0.1	1.0	-	-	-
MW15-03WB	23-Aug-19	-22.65	-176.6	-7.0	8.0	0.41	13,500	< 0.8	0.0	0.0	0.0	1.0	0.3	1.0
MW15-04WB	22-Aug-19	-21.91	-170.7	-7.5	19.5	0.45	6,800	6	0.7	0.0	1.0	0.5	0.0	0.9
MW15-05WB	23-Aug-19	-22.27	-171.4	-7.0	10.6	0.41	11,300	< 0.8	0.0	0.0	0.0	0.9	0.1	1.0
MW15-06WB	25-Aug-19	-22.08	-170.8	-8.9	17.0	0.52	9,300	1	0.1	0.0	1.0	0.7	0.0	1.0
MW16-01WB	21-Aug-19	-22.42	-171.3	-5.3	9.3	0.32	10,200	< 0.8	0.0	0.0	0.0	0.8	0.0	1.0

Notes:
Max = maximum, Min = minimum, pMC = percent modern carbon, TU = tritium units, VPBD = Vienna Pee Dee Belemnite, VSMOW = Vienna Standard Mean Ocean Water
1. Radiocarbon dilution factor (q) used to correct ^{14}C ages, based on Pearson and Hanshaw (1970); assumes $\delta^{13}C_{recharge}$ = -17.3 ‰ and $\delta^{13}C_{carbonates}$ = 0.28 ‰ (see Section 2.2 in Appendix 5-F).
2. ^{14}C age determined using the Pearson and Hanshaw (1970) correction for carbonate mineral dissolution (see Section 2.2 in Appendix 5-F).
3. ^{3}H results reported below the detection limit of 0.8 TU were assumed to be equal to 0 TU for F_{young} calculations.
4. F_{young} input parameters: 1) $^{3}H_{post\text{-}1953}$ (TU) calculated using 10-year moving average of combined Anchorage and Ottawa ^{3}H precipitation records from International Atomic Energy Agency Global Network of Isotopes in Precipitation (mean 9.25 TU, minimum 2.56 TU, maximum 87.6 TU); and 2) $^{3}H_{pre\text{-}1953,}$ assumed to be 0 (all ^{3}H older than 1953 has decayed to below detection limit). Based on Jasechko (2016a) and Jasechko et al., (2017) (see Appendix B of Appendix 5-F).
5. F_{paleo} input parameters: ^{14}C of atmosphere taken using 30-point moving average of ^{14}C compilations of Reimer et al. (2020) and Hua et al. (2013), decay-corrected to 2019, and corrected for carbonate mineral dissolution using *q* for each well. Based on Jasechko (2016a) (see Appendix B of Appendix 5-F).
6. MW15-02AZ was frozen in 2019; 2015 data used instead.

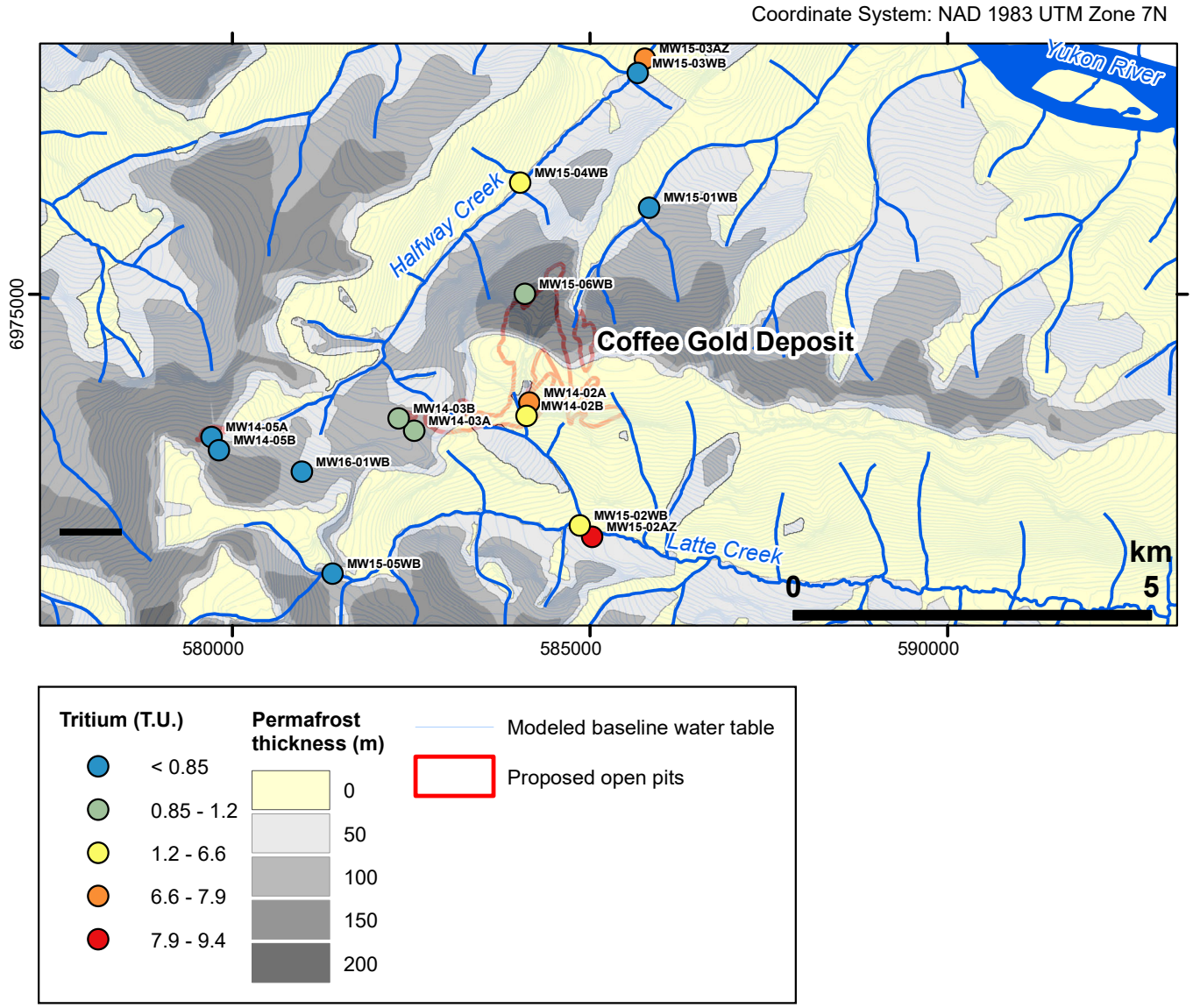

Figure 5-4: Tritium concentrations in groundwater across the Project site. Based on ^{3}H values in Table 5-3. Higher tritium concentrations indicate a greater component of young groundwater.

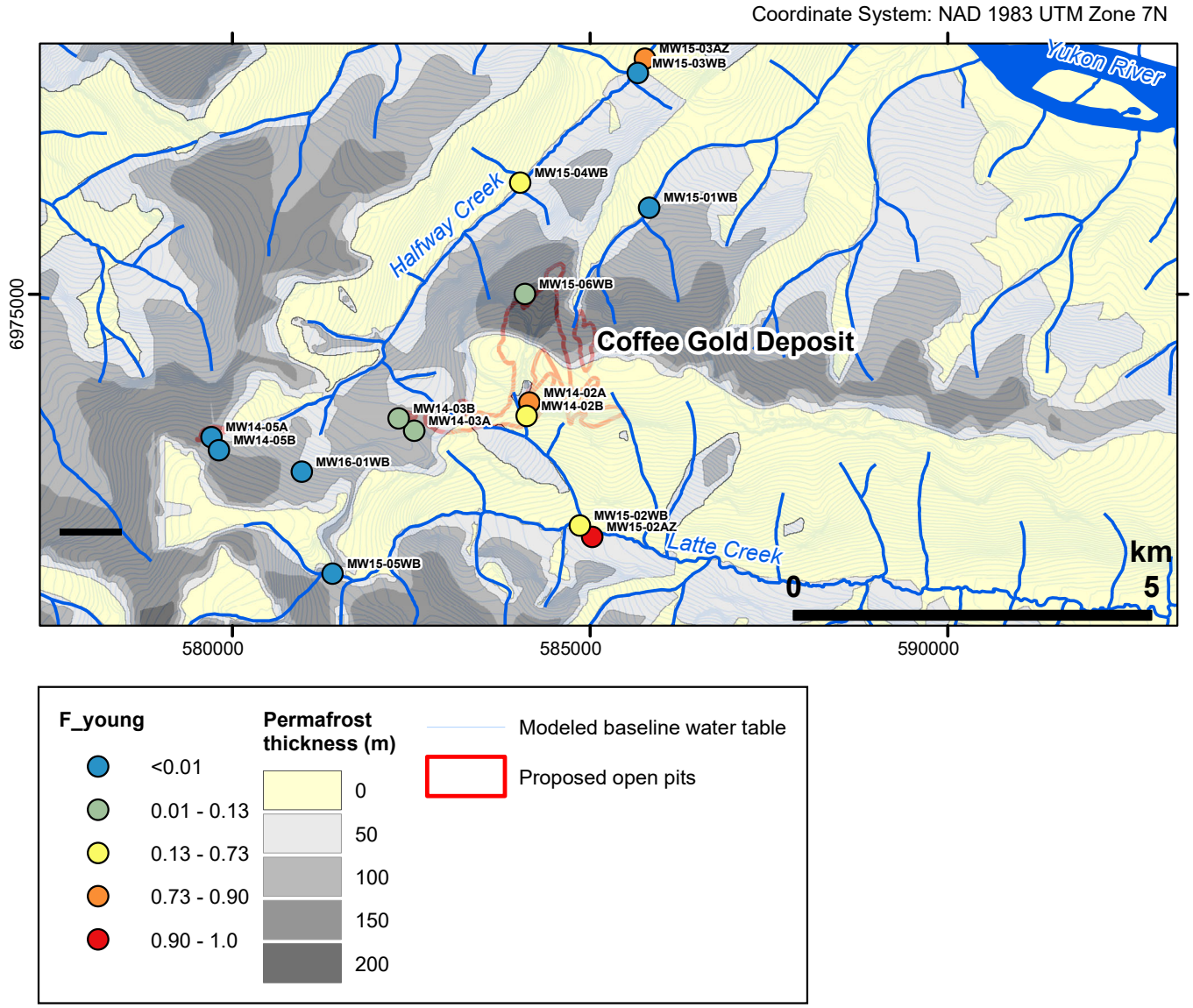

Figure 5-5: Fraction of groundwater recharged between 1953 and 2019 across the Project site. Based on F_{young} mean values calculated from tritium in Table 5-3.

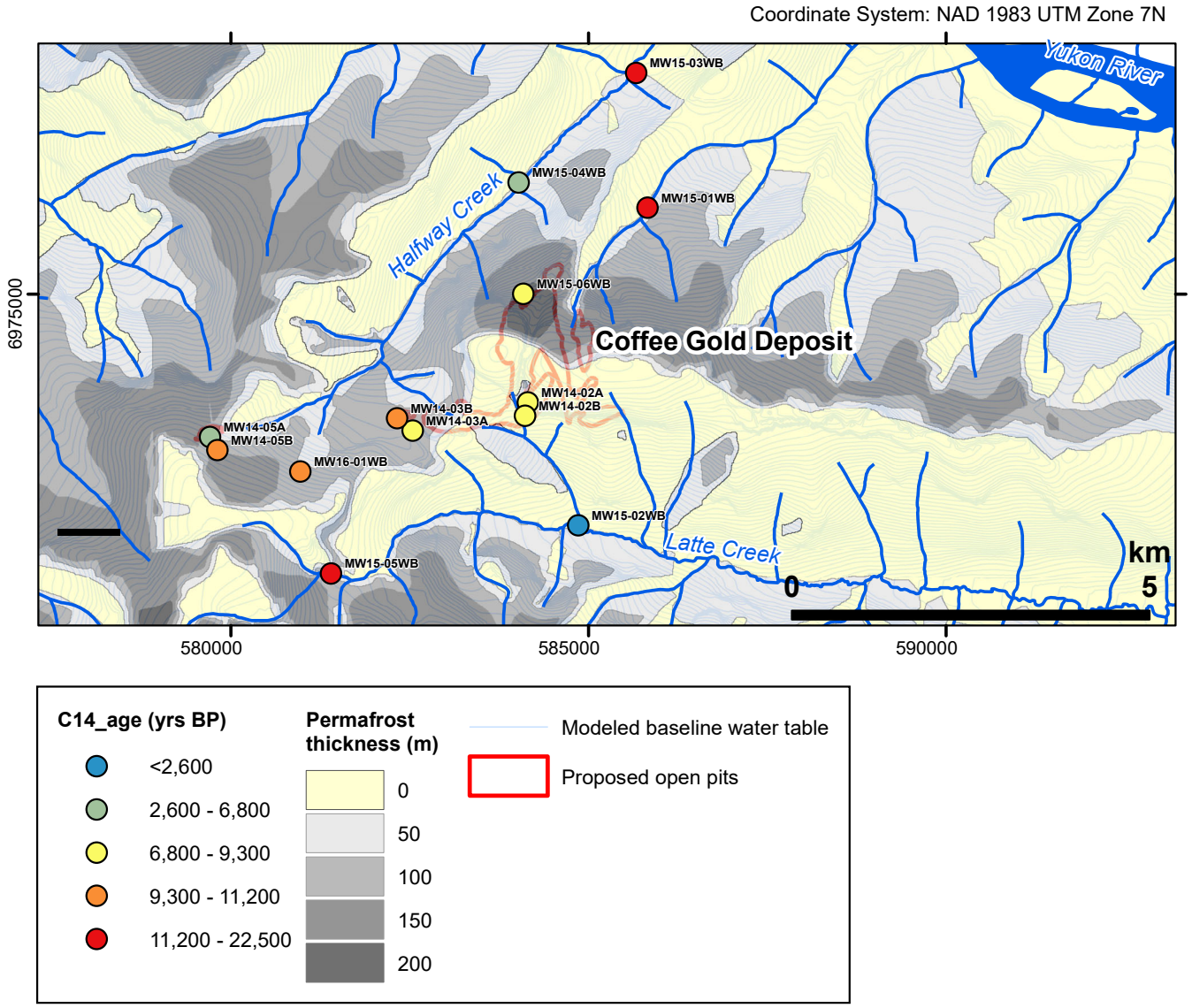

Figure 5-6: Groundwater ages determined from ^{14}C analyses across the Project site. Based on ^{14}C ages in Table 5-3.

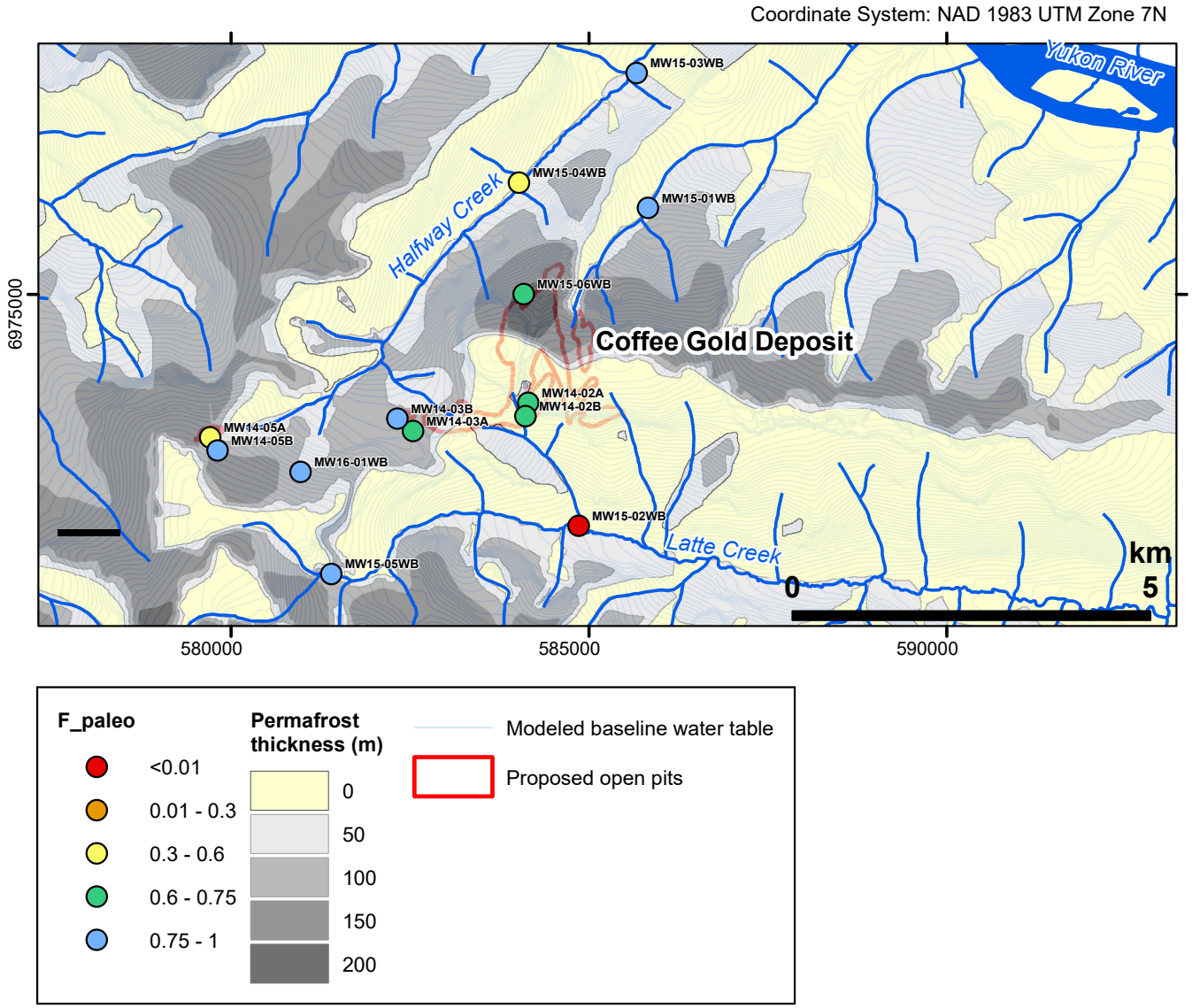

Figure 5-7: Fraction of groundwater recharged prior to 11,700 years before present across the Project site. Based on F_{paleo} mean values calculated from ^{14}C in Table 5-3. Note that there are no wells with F_{paleo} values from 0.01 to 0.3.

6. Groundwater System Conceptual Model

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6. Groundwater System Conceptual Model

Figure 6-1 illustrates a conceptual hydrogeological cross-section along section line A-A' which transects Latte Creek, the Supremo Pit complex, and Halfway Creek (Figure 4-5, Figure 4-8). The cross-section shows baseline water levels, hydraulic conductivity measurements, borehole airlift yields (where applicable), permafrost distribution, as well as water quality and isotope results. The lateral extents of permafrost are derived from Tetra Tech (2017), with permafrost thickness inferred from field measurements and the elevation trend shown in Figure 4-4.

Ground temperature data from thermistors, as well as observations from drilling and groundwater monitoring indicate that permafrost is discontinuous but extensive across the project area (Figure 4-5). Permafrost is inferred to be of very low hydraulic conductivity (Woo, 2012; Kane *et al.* 2013; Walrood *et al.*, 2012). Permafrost is of hydrogeological significance as it is considered to behave like an aquiclude or an aquitard and can confine sub-permafrost groundwater such that it exhibits artesian conditions (Woo, 2012).

Overall, permafrost extends to greatest depths in ridge areas and appears to reduce in thickness towards areas of lower elevation (Figure 4-4). The north-facing slopes tend to have thicker and more prevalent permafrost than south-facing slopes. The thickest permafrost at site (~168 m) is encountered near the north end of the proposed Supremo pit at MW14-04T (Figure 4-5). South facing slopes are largely permafrost-free. Supra-permafrost groundwater flow occurs in the active zone. At the Coffee mine, the active zone is conceptualized as a highly heterogeneous zone that is variable in timing and duration, both spatially and temporally (Table 4-2).

Hydraulic testing at the project site has been completed on multiple lithologies located within pit footprint areas and farther afield (Table 4-3). The hydraulic conductivity (K) data are typical of a fractured bedrock system with values ranging over several orders of magnitude (Figure 4-6). Structural features that crosscut all lithologies impart the dominant control on hydraulic conductivity with lesser influence from lithology. Most of the elevated K values at depth are attributed to hydraulic tests that targeted geologic structures intersecting the proposed pits (SRK, 2015). Major creek traces (*i.e.*, Latte Creek, Latte Tributary, Halfway Creek, YT-24) are conceptualized to represent permeable fault structures as indicated by high airlift yields encountered during drilling and other hydraulic tests yielding elevated K values (Figure 6-1).

Groundwater levels across the Coffee project are highly variable with respect to depth to water level, vertical and horizontal hydraulic gradients, and the timing and magnitude of hydrograph fluctuations. This variability speaks to the complexity of a groundwater system in an area of topographic relief influenced by faulting and discontinuous permafrost.

Groundwater levels are relatively deep in ridge areas (~130 to 220 m bgs; Figure 6-1), although flowing artesian conditions are also encountered at moderate to high elevations in the southwestern project area (MW16-01T, MW14-07T) and the south facing slopes of the Latte Creek Tributary (MW14-02A). At monitoring locations where permafrost depth is accurately known, groundwater pressures generally exceed the base of permafrost, demonstrating confined conditions. Notable exceptions are at MW15-06WB and MW17-01T (Figure 6-1), where the water table is inferred to be at least 50 m and 20 m below the base of permafrost, respectively. Artesian groundwater pressures are reported at many lower elevation installations in both permafrost and permafrost-free areas, including the Halfway Creek drainage (MW15-04WB/MW15-04T) and Latte Creek Tributary (SRK-15D-09T) (Figure 6-1).

Water level hydrographs indicate variable response to seasonal recharge patterns, with fluctuations ranging from <1 m to over 30 m (Table 4-6). The magnitude of seasonal fluctuations is not clearly correlated to well collar elevation, nor the presence of permafrost. Continuous water level records indicate that most wells are relatively insensitive to individual rainfall events and show gradual seasonal increases in water levels that peak between late summer and winter. The timing of peak groundwater levels is highly variable across the site.

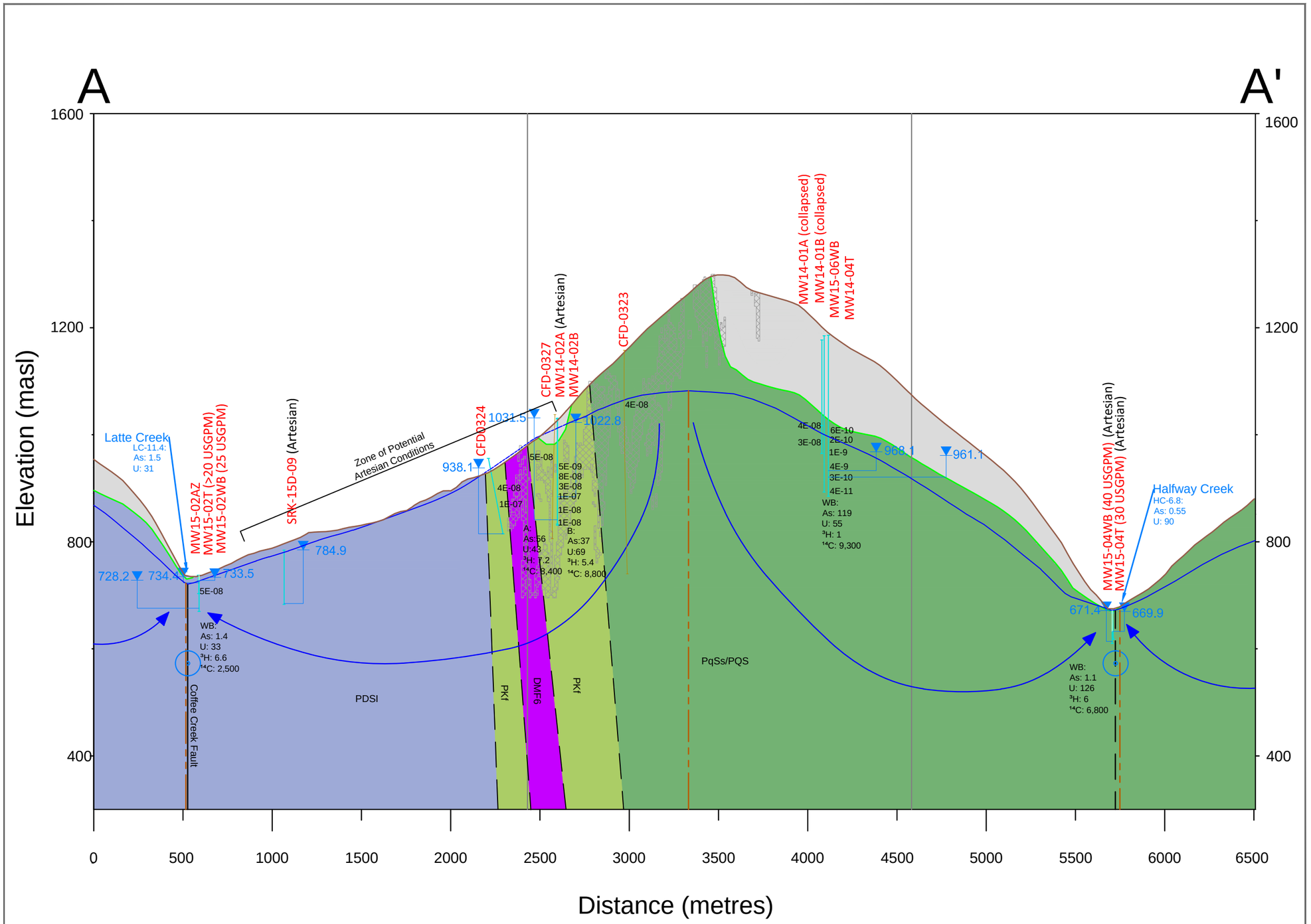
Arsenic and uranium are consistently measured in the overburden and bedrock groundwater in the Project area. Bedrock groundwater is characterized by elevated concentrations of dissolved As and U (0.12 to 2,650 µg/L and 1.2 to 589 µg/L, respectively). Arsenic levels are highest in the deeper groundwater near mineralized areas at upgradient locations in the Halfway Creek (MW14-05A, MW14-03A, MW15-06WB) and Latte Creek Tributary (MW14-02A, MW14-02B) drainages. Groundwater As concentrations are significantly lower in downgradient areas of these two drainages (MW15-04WB, MW15-02WB; Figure 6-1), indicating the attenuation of As along groundwater flow paths. This is also reflected in low concentrations of As measured in surface water at Halfway Creek (HC-6.8) and Latte Creek (LC-11.4) during winter low flow periods (Figure 6-1). In contrast, elevated U concentrations measured at these stations during the winter low flow period suggests little to no attenuation with U behaving conservatively (Figure 6-1). Uranium concentrations in Halfway Creek (HC-6.8) and Latte Creek (LC-11.4) during low flow periods are typically similar to groundwater concentrations in the nearby wells (*i.e.*, MW15-04WB, MW15-02WB; Figure 6-1).

Groundwater stable isotope compositions across the site suggest that groundwater recharge is more heavily driven by infiltration of rain than by snowmelt, while tritium and radiocarbon data suggest that permafrost exerts a strong control on groundwater residence times. At high elevations and beneath permafrost, ^{3}H and ^{14}C data suggest that groundwater is predominantly greater than 70 years in age and could be thousands of years old. In contrast, ^{3}H data suggest a more active groundwater circulation pattern along south-facing

slopes where permafrost coverage is limited such as Latte Creek, with a large component of young groundwater with residence times on the order of decades (MW14-02A, MW14-02B; Figure 6-1).

Radioisotope data (^{3}H, ^{14}C) indicate that valley bottoms include a mixture of young and old groundwaters that converge in discharge areas. Shallow overburden wells (MW15-02AZ, MW15-03AZ) are characterized by young groundwater (decades-old or less) based on elevated tritium contents. Deeper groundwater screened in valley bottoms contains components of young (decades old or less) and old (thousands of years) groundwater as evidenced by the presence of ^{3}H and long mean groundwater ages (^{14}C) (MW15-02WB, MW15-04WB; Figure 6-1). The isotopic data indicate bedrock groundwater at MW15-03WB, the farthest downgradient groundwater station on Halfway Creek, is on the order of thousands of years old and is distinct in both isotopic and geochemical composition from other groundwater sampled in Halfway Creek and across the Project.

There is very little literature on sub-permafrost groundwater ages in Yukon. However, during the early Holocene, the climate was several degrees Celsius warmer with more precipitation than present day (Grinter et al., 2019; Lecavalier et al., 2017; Kaufman et al., 2016; Clark et al., 2004). During this period, permafrost would have likely been sparse/absent in this part of Canada, thereby allowing a pulse of groundwater recharge. Later, in the mid to late-Holocene, the climate cooled and permafrost likely grew back creating confining conditions. The estimated radiocarbon ages generally agree with the timing of this permafrost regression several thousand years ago. Wells with reliable radiocarbon ages (*i.e.*, with lower TDS and DIC levels) consistently indicate a component of recharge that occurred between approximately 6,000 and 11,000 years ago.



LEGEND

- Pre-mine topography
- Piezeometric Surface (obs)
- Groundwater Divide
- Water Table (obs)
- Permafrost
- Mineralized Zone
- Inflection Point
- Inferred Fault
- Drillholes (instrumented)
- Drillholes (not instrumented)
- 5E-08 — Bedrock hydraulic conductivity (m/s)
- 30 USGPM — Borehole airlift yield (open hole)
- As: 0.55 U: 90 — 2019 Baseflow SW Concentraion (µg/L)
- As: 1 U: 163 — Average 2019 GW Concentration (µg/L)
- ³H: 6 — 2019 GW Concentration (TU)
- ¹⁴C:6,800 — 2019 Estimated GW age (years)
- Water Level Elevation (Aug. 2019; m asl)
- GW flow direction
- GW flow into page

Geology

- PQSs, PqS - Sulphur Creek Suite - gneiss/schist
- PKf - Klondike Schist
- DMF6 - Finlayson: metagabbro
- PDSI: Snowcap Assemblage (biotite schist)

Vertical Exaggeration = 3X

DATE SAVED:	Dec 13, 2021
DRAWN BY:	GM
REVIEWED:	JH
VERSION:	1

CLIENT: Newmont COFFEE

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Mine

TITLE:

Conceptual Hydrogeological Cross-Section A-A'

PROJECT #:	*FIGURE:*
A362-4	6-1

P:\@Drafting\Coffee Gold\Drafting Figures\Auto Cad Figures\Cross Sections\GW_sections_2017\long_sections\Profiles_C-C'\Section_C-C'_updated_wr_VE3_20221212.dwg

7. Conclusions

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7. Conclusions

Multiple hydrogeological and geotechnical field investigations have been advanced at the Project between 2013 and 2019. This report constitutes the synthesis of all baseline hydrogeological data up to August 2019. The investigations have revealed a complex groundwater system influenced by permafrost and fractures. The main findings of this baseline study are as follows:

- Overall, permafrost is widespread across the Project. It extends to greatest depths in ridge areas and appears to thin towards areas of lower elevation; north facing slopes tend to have thicker permafrost than south-facing slopes. The thickest permafrost (~168 metres) is encountered near the north end of the proposed Supremo pit. Permafrost in the project area is relatively warm (between 0 and -2˚C) and is coolest (-1.4°C to -1.9˚C) on north facing slopes.
- Hydraulic conductivity data range over several orders of magnitude and generally decreased with depth which is typical of a fractured bedrock system. Median K values decrease markedly at 150 m bgs and again below 250 m bgs. The median K of structures is 2E-07 m/s with tests ranging up to 275 m depth. This K value is one to two orders of magnitude higher than other bedrock tests over the same depth interval. There does not appear to be a correlation between hydraulic conductivity and lithology.
- Groundwater draining the Halfway Creek catchment is largely confined by permafrost. At high elevations in the area of the proposed Kona and Supremo pits, groundwater occurs at significant depth (130 to over 220 m bgs) and is below the base of permafrost. This is contrasted by artesian groundwater presssures confined by permafrost in the high elevation heap leach facility footprint. At lower elevations of the Halfway Creek catchment, groundwater is typically confined by permafrost and artesian conditions are frequently encountered. The lowest elevation monitoring installation in Halfway Creek, MW15-03T, is situated on the fringe of permafrost along a fault that crosscuts both Halfway Creek and YT-24. This station registers strong upward hydraulic gradients in bedrock and hydrograph maxima in the early spring, both of which are in contrast to other stations located along the creek trace.
- Groundwater is well-confined along the upper reaches of the YT-24 drainage. The piezometric surface is several to tens of metres above the base of permafrost and vertical hydraulic gradients vary in both magnitude and direction along the drainage, indicative of the complex hydrogeologic regime at the Project. Groundwater level hydrographs vary distinctly between the three stations along this

drainage with some trending upward since station initiation, others remaining flat with and without seasonal variation.

- The Latte Creek Tributary catchment has partial permafrost coverage. At the highest elevation installation in this catchment, CFD0351, groundwater is more than 100 m deep and varies seasonally by up to 35 m. Elsewhere, groundwater pressures are artesian or close to ground surface with seasonal hydrograph fluctutaions between 2 m and 20 m. Strong upward hydraulic gradients are measured in upper reaches of the drainage, while both upward and downward hydraulic gradients are measured in bedrock at the confluence with Latte Creek.
- Strong artesian groundwater pressures are measured at the headwaters of Latte Creek. Immediately downstream, the piezometric surface is above the base of permafrost, but groundwater pressures are not flowing artesian. Seasonal trends in water pressure are subdued compared to other areas, with water levels rising on the order of a few metres at some locations. Strong downward vertical gradients are observed in both upper and lower reaches of the drainage. Horizontal hydraulic gradients along the intrumented length of the drainage exceed topographic gradients, suggesting groundwater is underdrained by a broader regional fault (*i.e.,* a splay of the Coffee Creek Fault).
- Groundwater is predominantly circum-neutral (pH 6 to 8), with most groundwater between pH 6.5 and 8. Groundwater quality shows variable influence from weathering of sulphide minerals and dissolution of sulphate minerals, either from the deposits or other disseminated mineralization across the Project area. Sulphate concentrations range from low to substantial (7 to 1120 mg/L) and salinity is variable (field specific conductance readings between 28 and 2390 µS/cm).
- Major ion chemistry of overburden groundwater is calcium-bicarbonate-type. The bedrock groundwater has a wide range of major ion signatures from calcium-bicarbonate to mixed magnesium-calcium-sodium-sulphate-type water, reflecting variable influence of sulphide weathering. The groundwater in granite calcium-bicarbonate-type, but is generally more sodic (*i.e.*, contains a higher sodium proportion) than other groundwater on site.
- Groundwater redox conditions predominantly range from oxic in the overburden to anoxic and mildly to strongly reducing in bedrock wells. Exceptions include bedrock wells MW14-02A and MW14-02B which are oxic and oxic to mildly reducing, respectively, while MW15-02WB appears to vary between oxic and mildly to moderately reducing conditions.
- Dissolved arsenic and uranium were consistently measured in the overburden and bedrock groundwater during baseline monitoring. Groundwater quality in the Project area is characterized by elevated dissolved arsenic and uranium

concentrations which generally were highest in the bedrock, ranging from 0.12 to 2650 µg/L and 1.2 to 589 µg/L, respectively.

- Water quality trends observed in several bedrock monitoring wells and Westbay installations suggest that groundwater chemistry is slowly stabilizing after drilling and well installation. Groundwater major ion composition has progressively shifted towards lower sodium proportions and concentrations at MW14-05A and MW14-05B, while redox parameters show a shift to more strongly reducing conditions throughout the data record at MW14-03A, MW15-03WB and MW16-01WB. In addition, several parameters including major ion, redox and/or trace elements are characterized by concentrations that appear to be trending slowly at a few wells (*e.g.*, MW14-03A/B, MW14-05A/B, MW15-06WB).
- Groundwater stable isotope compositions across the Project are isotopically heavier than the estimated composition for mean annual precipitation, and closer to the isotopic composition of rain-dominated precipitation (May-October) than that of snow-dominated precipitation (November-April). This suggests that groundwater recharge is more heavily driven by infiltration of rain than by snowmelt, which is consistent with a greater proportion of annual precipitation occurring as rain (~70 % at an elevation of 975 m asl) in the Project area (Lorax, 2019).
- Isotopic analyses of carbon and hydrogen suggest that permafrost exerts a strong control on groundwater residence times. At high elevations and beneath permafrost, ^{3}H and ^{14}C data suggest that groundwater is predominantly greater than 70 years in age and could be thousands of years old. In contrast, along south-facing slopes where permafrost coverage is limited, such as Latte Creek around MW14-02A and MW14-02B, ^{3}H data suggest a more active groundwater circulation pattern with a large component of young groundwater with residence times on the order of decades.
- Valley bottoms include a mixture of young and old groundwaters that converge in discharge areas. Shallow wells completed in overburden (MW15-02AZ, MW15-03AZ) are characterized by young (decades-old or less) groundwater based on elevated tritium contents. Deeper Westbay installations MW15-02WB and MW15-04WB contain tritium, indicating decades-old or less groundwater ages; however, MW15-04WB also includes a component of groundwater thousands of years in age based on its radiocarbon age. Valley bedrock installation MW15-03WB screens groundwater that is likely thousands of years in age based on its ^{3}H, ^{14}C, and $\delta^{18}O$ signatures, and is distinct in both isotopic and geochemical composition from other groundwater sampled in Halfway Creek and across the Project.

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Appendices

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Appendix 3-A: Lorax Borehole Logs

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LORAX ENVIRONMENTAL

MW14-01A / BH5 / CFD-0402

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: Aug 11, 2014	Northing Coord.	: ~6,975,003
Install Completed	: Aug 13, 2014	Easting Coord.	: ~583,990
Drilling Method	: Diamond / HQ	Ground Surface	: ~1175 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: LF/MS	Checked By	: LF

Well: Abandoned
Elev.: N/A

Depth (m)	Elev. (m amsl)1175	DESCRIPTION	RQD (%) 0 50100	Fracture = Fr Fault = Flt	Packer Test Interval (m amsl)	K (m/s)	Depth (m)
0	1175	**GNEISS** Weakly oxidised gneiss, biotite schist zones are weakly carbonaceous					0
20	1155	Biotite schist zones are weakly carbonaceous and stongly chloritic 21.7 to 91.6 m					20
40	1135	Dark mafic / schistose bands are strongly chloritic with moderate carbonate alteration parallel to schistosity 91.6 to 196.17 m *40 m - loss of half of return					40
60	1115			N/A			60
80	1095	*72 m - some loss of return *80 m - lost circulation (G-Stop used)					80
100	1075	*109 m - lost circulation (G-Stop used)					100
120	1055	*118 m - 121 m inferred fault zone, highly fractured with possible 10" core loss around 121 m, circulation lost @ 118 m					120
140	1035						140
160	1015				155.3 - 166.0	4E-08	160
180	995	**BIOTITE FELDSPAR SCHIST** Strongly chlorite altered biotite schist					180
200	975	**GNEISS** Dark mafic / schistose bands are strongly chloritic with moderate carbonate alteration parallel to schistosity			179.3 - 202.0	3E-08	200
220		EOH @ 202 m Hole position not surveyed. Co-ordinates estimated from CFD-0419 N/A: Borhole not logged for structure *Comment from supervising hydrogeologist, all other descriptons provided by Kaminak					220

MW14-01A / BH5 / CFD-0419

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

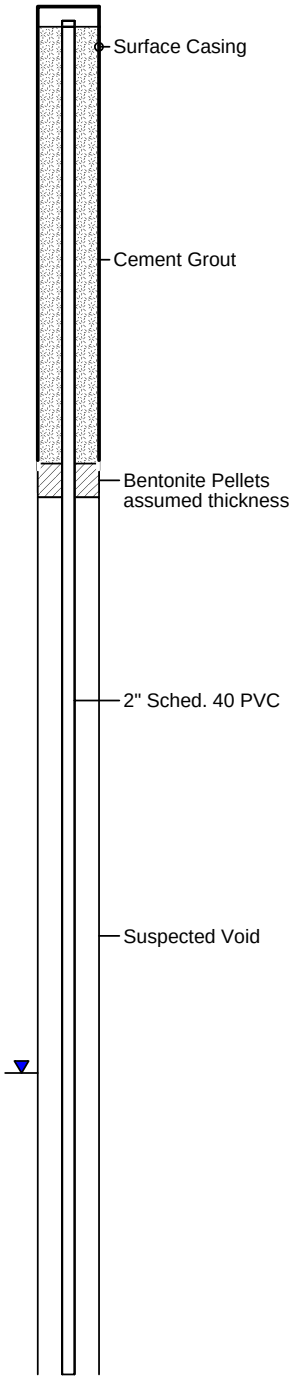
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Aug 20, 2014	Northing Coord.	: 6,975,002.66
Install Completed	: Aug 27, 2014	Easting Coord.	: 583,995.31
Drilling Method	: Diamond / HQ	Ground Surface	: 1177.01 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: SK/LF/JY	Checked By	: LF

Water Level:

1083.30 m amsl 03-Sep-14 @ 23:15 (still falling)

Depth (m)	Elev. (m amsl)1177.01	DESCRIPTION	RQD (%) 0 50100	Fracture = Fr Fault = Flt	Packer Interval (mbgs)	K (m/s)
0	1175	**OVERBURDEN**				
		ANDESITE Dark blackish green,feldspar phyric dyke, moderate hematite and limonite after mafic groundmass		Fr		
		GNEISS Zone: Bleached cream-organge felsic augen gneiss with local ones of biotite schist, limonite and hematite in groundmass and fractures		Fr Fr Fr		
20	1155	**LIMONITE MATRIX BRECCIA** Zone: Bleached orange limonite and clay filled breccia, moderate clay overprint on sericitized and strongly oxized rock		Fr		
		FELSIC GNEISS Zone: pale pink to orange augen gneiss, limonitic fractures		Fr Fr		
40	1135	**DIORITE** Dark green phyric dyke		Fr Fr		
		GNEISS Pink augen gneiss with narrow 30-60 cm bands of chloritic biotite schist, weakly disseminated hematite, minor limonite on fractures		Fr Fr	N/A	N/A
60	1115	Bleached orange white augen gneiss with minor 30 cm bands of biotite schist, moderate limonite and hematite in fractures and in groundmass, narrow crackle or fault at 46.4 to 46.5 m		Fr Fr		
		Pale pink to grey augen gneiss, weak to moderate hematite dusting throughout, minor limonite on fracture faces 54.1 to 82.8 m		Fr		
80	1095	Pale bleached orange augen gneiss 82.8 to 84.5 m		Fr		
		Pink to grey felsic gneiss with local 60 cm intervals of chloritic biotite schist 84.5 to 118.9 m		Fr Fr Fr		
100	1075			Fr		
120		Pink massive with little to no augen, gneiss, minor intervals of banded biotite schist, minor oxidation at 131 to132 m.				



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LORAX ENVIRONMENTAL

MW14-01A / BH5 / CFD-0419

KAMINAK GOLD CORPORATION

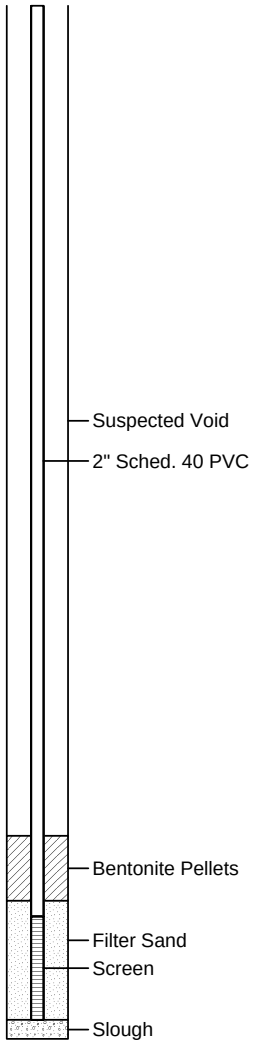
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Aug 20, 2014	Northing Coord.	: 6,975,002.66
Install Completed	: Aug 27, 2014	Easting Coord.	: 583,995.31
Drilling Method	: Diamond / HQ	Ground Surface	: 1177.01 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: SK/LF/JY	Checked By	: LF

Water Level:

1083.30 m amsl 03-Sep-14 @ 23:15 (still falling)

Depth (m)	Elev. (m amsl)\1177.01	DESCRIPTION	RQD (%) 0 50 100	Fracture = Fr Fault = Flt	Packer Interval (mbgs)	K (m/s)
120	1055					
140	1035	Grey green banded biotite schist with minor felsic gneiss, gradational contacts, weak hematite dusting in groundmass 136.0 to 143.5 m		Fr Fr Fr Flt	N/A	N/A
160	1015			Fr Fr Fr Fr		
180	995	Pale pink glassy augen rich gneiss, minor hematite dusting throughout, minor weak oxidation zone at 174.5 to 176.4 m and 192.8 to 195.7 m		Fr Fr Fr		
200	975					
220	955	EOH @ 212 m N/A: Hole was not packer tested				
240						



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MW14-01B / BH5 / CFD-0434

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

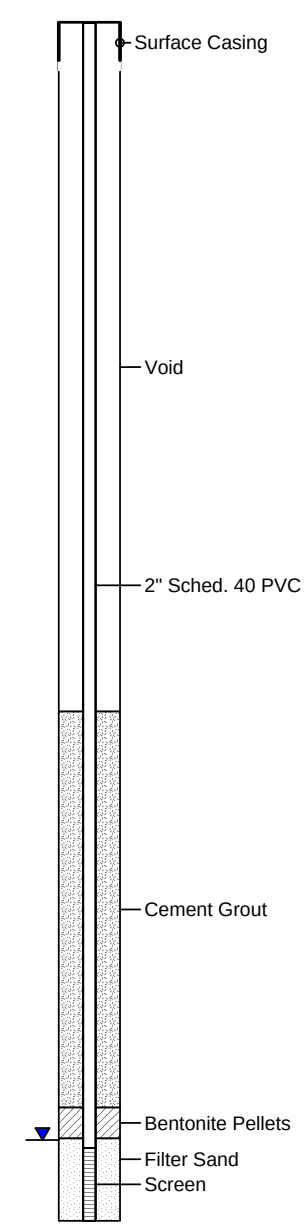
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 1, 2014	Northing Coord.	: 6,975,002.66
Install Completed	: Sep 4, 2014	Easting Coord.	: 583,995.31
Drilling Method	: Diamond / HQ	Ground Surface	: 1177.01 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: SK/JY/LF	Checked By	: LF

Water Level:

1027.75 m amsl 08-Sep-14 @ 12:55

Depth (m)	Elev. (m amsl) 1177.01	DESCRIPTION	RQD (%) 0 50 100	Fracture = Fr Fault = Flt	Packer Interval (mbgs)	K (m/s)
0	1175	**OVERBURDEN**				
		GNEISS Mix felsic gneiss & biotite schist, dark green, fine-coarse, moderate-strong chlorite alteration, variable weak - no oxide				
20	1155					
		See MW14-01A for more details				
40	1135					
60	1115			N/A	N/A	N/A
80	1095					
100	1075					
120	1055					
140	1035					
160	1015	EOH @ 160 m N/A: Hole not logged for structure or packer tested				
180						



03-04-2016 P:\A362-4 (Coffee Gold Project - Hydrogeology)\Data\BH Logs\Quicklog\2014\MW14-01B.bor

MW14-02A / BH9 / CFD-0428

LORAX ENVIRONMENTAL

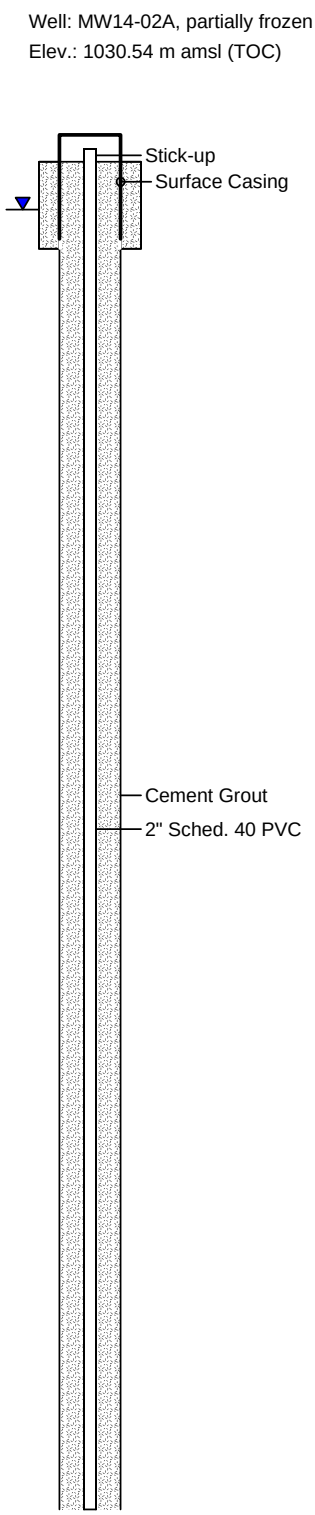
KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 25, 2014	Northing Coord.	: 6,973,507.99
Install Completed	: Sep 28, 2014	Easting Coord.	: 583,993.73
Drilling Method	: Diamond / HQ	Ground Surface	: 1029.54 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: MS/RC/CB	Checked By	: LF

Water Level:
1025.81 m amsl 11-Oct-14 @ 13:30

Depth (m)	Elev. (m amsl)1029.54	DESCRIPTION	RQD (%) 0 50100	Fracture = Fr Fault = Flt ; Joint = J	Packer Test Interval (mbgs)	K (m/s)
0	1025	**OVERBURDEN**		J(73)		
10	1015	**BIOTITE-FELDSPAR SCHIST** Biotite schist, 10% pervasive-fractured oxide (surface weathering?), 0.5% fractured limotite		Fr Fr Fr Fr Fr J(11)		
30	995	**FELSIC GNEISS** Massive pink hard felsic gneiss				
40	985			J(21)	N/A	N/A
50	975	**GNEISS** Biotite schist, moderate fracturing, weak fractured clay, 10% pervasive-fractured oxide (surface weathering?), 0.5% fractured limonite		Fr		
60	965			J((6)		
70	955			Fr		
80	945	*85.3 to 85.5 m some circulation loss		J(18) Fr		
90	935	**BIOTITE-FELDSPAR SCHIST** Biotite schist				
100		**ANDESITE** Mafic dykes intruding biotite schist, weak fractured clay, dark orange fracture staining		J(22)		



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MW14-02A / BH9 / CFD-0428

LORAX ENVIRONMENTAL

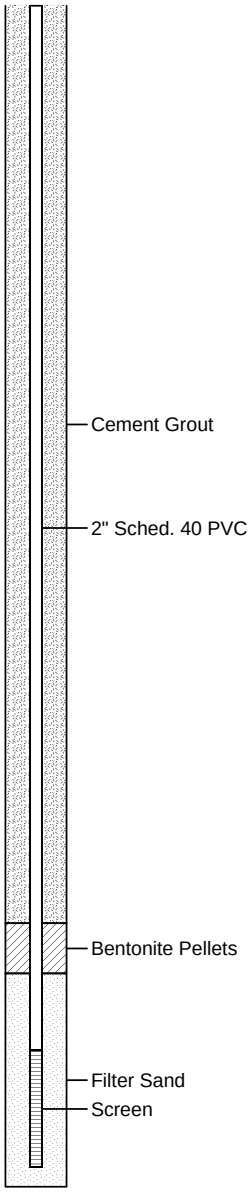
KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 25, 2014	Northing Coord.	: 6,973,507.99
Install Completed	: Sep 28, 2014	Easting Coord.	: 583,993.73
Drilling Method	: Diamond / HQ	Ground Surface	: 1029.54 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: MS/RC/CB	Checked By	: LF

Water Level:
1025.81 m amsl 11-Oct-14 @ 13:30

Depth (m)	Elev. (m amsl)1029.54	DESCRIPTION	RQD (%) 0 50100	Fracture = Fr Fault = Flt ; Joint = J	Packer Test Interval (mbgs)	K (m/s)
105	920			J(22)		
115	910			Fr		
125	900			Fr		
135	890	**GABBRO** Gabbro, coarse, varying orange oxide bands		J(28)	N/A	N/A
145	880			Fr		
155	870	**HYDROTHERMALLY ALTERED ROCK** Breccia zone overlaps gabbro-biotite schist contact around 180.3m. At 184 m, increased brecciation with stronger pervasive oxide		J(3)		
165	860	**CARBONATE +/- LIMONITE MTX BX** Clasts in orange & white carbonate matrix (dolomite, ankerite)				
175	850					
185	840	**HYDROTHERMALLY ALTERED ROCK** Crackle breccia. At 189.9 m, less intensely yet strong fracturing with carbonate infill *193 m some circulation loss				
195	830	EOH @ 197 m N/A: Hole not packer tested *Comment from supervising hydrogeologist, all other descriptons provided by Kaminak Number of joints reported for every 20 m interval				
205						



LORAX ENVIRONMENTAL

MW14-02B / BH9 / CFD-0418

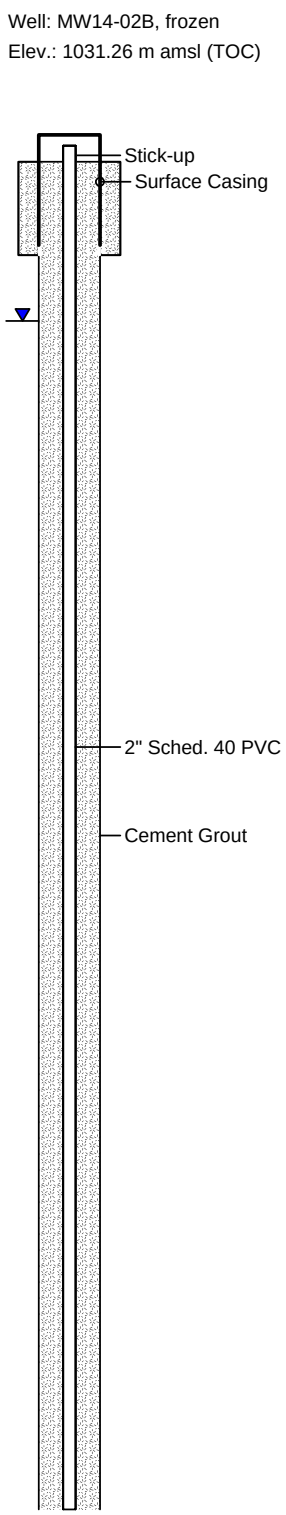
KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 19, 2014	Northing Coord.	: 6,973,507.27
Install Completed	: Sep 24, 2014	Easting Coord.	: 584,008.13
Drilling Method	: Diamond / HQ	Ground Surface	: 1030.93 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: MS/RC	Checked By	: LF

Water Level:
1018.80 m amsl 17-Sep-14 @ 18:08

Depth (m)	Elev. (m amsl)	DESCRIPTION	RQD (%)	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
0	1030.93	**OVERBURDEN** Pebbles and boulders of mixed mafic gneiss	0 50 100			
		GNEISS Grey with orange strongly banded chlorite and feldspar rich gneiss		Fr		
10	1020			Fr		
				Fr		
				Fr		
20	1010	Augen rich chlorite and feldspar rich gneiss 22.1 to 46.9 m		Fr		
				Fr		
30	1000			Fr		
				Fr		
				Fr		
40	990			Fr		
		Weakly oxidized mixed mafic, augen rich gneiss, weak patchy oxidation 46.9 to 56.4 m		Fr		
50	980			Fr		
		Mixed biotite schist and augen rich gneiss, weak patchy oxidation 56.4 to 76.5 m		Fr		
				Fr		
60	970			Fr		
				Fr		
70	960			Fr		
		Weak Zone: Pale buff and orange strongly foliated chlorite rich an augen gneiss, pervasive limonite and foliation controlled hematite 76.5 to 83.8 m		Fr		
80	950			Fr		
		Fresh biotite and augen rich gneiss, moderate hematite dusting 83.8 to 87.5 m		Fr		
		Weak Zone: Bleached buff orange well foliated mixed gneiss, limonite in groundmass hematite in fractures and foliation parallel 87.5 to 96.1 m		Fr	84.5 - 104.0	5E-9
90	940			Fr		
		Pink and green fresh looking biotite schist and augen gneiss 96.1 to 108.0 m		Fr		
100						



MW14-02B / BH9 / CFD-0418

LORAX ENVIRONMENTAL

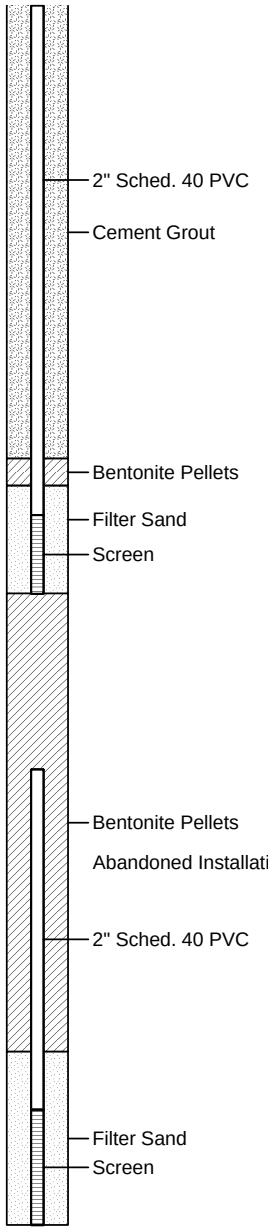
KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 19, 2014	Northing Coord.	: 6,973,507.27
Install Completed	: Sep 24, 2014	Easting Coord.	: 584,008.13
Drilling Method	: Diamond / HQ	Ground Surface	: 1030.93 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: MS/RC	Checked By	: LF

Water Level:
1018.80 m amsl 17-Sep-14 @ 18:08

Depth (m)	Elev. (m amsl) 1030.93	DESCRIPTION	RQD (%) 0 50 100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
105	925	Strong Zone: Patchy orange and grey mixed gneiss, patchy strong to weak oxidation 108.0 to 126.6 m		Fr Fr	102.5 - 125.0	8E-8
115	915			Fr Fr		
				Fr		
125	905	**BIOTITE-FELDSPAR SCHIST** Green well foliated biotite schist, common limonite fractures		Fr Fr		
		SHEAR ZONE Pale green highly deformed and folded chloritic +- talc schist. Moderate carbonate overprint as stringers		Fr	129.5 - 137	3E-8
135	895	**BIOTITE FELDSPAR SCHIST** Zone: Orange strongly oidized biotite schist, strong pervasive limonite and hematite		Fr Fr		
145	885	Green-orange feldspar rich biotite schist, moderate limonite on fractures and in groundmass with hematite 139.3 to 144.2 m		Fr Fr Fr	138.5 - 152.0	bypass
155	875	**CRACKLE BRECCIA** Zone: Bright orange crackle breccia to biotite schist? Strong pervasive hematite and limonite		Fr Fr Fr		
165	865	**HYDROTHERMALLY ALTERED ROCK** Bleached cream-orange qtz-sericite-pyrite altered zone, moderate limonite oxidation throughout.			156.5 - 173.0	1E-8
175	855	**CRACKLE BRECCIA** Bleached cream-orange qtz-sericite-pyrite altered zone, moderate limonite oxidation throughout		Fr		
185	845	**BIOTITE-FELDSPAR SCHIST** Green feldspar rich biotite schist, Pale orange and bleached white biotite schist? Weak patchy oxidation 183.9 to 200.0 m		Fr	180.5 - 200.0	1E-8
195	835			Fr Fr Fr		
205		EOH @ 200 m				



MW14-03A / BH3 / CFD-0432

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

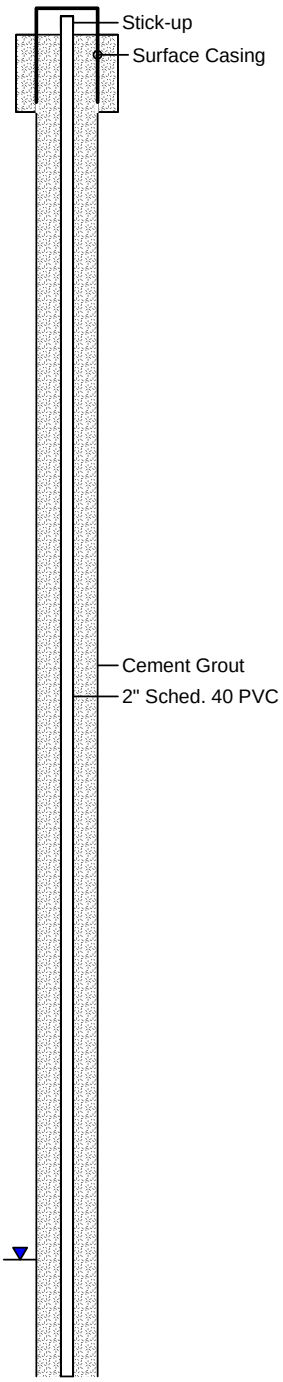
Drilling Started	: Aug 29, 2014	Northing Coord.	: 6,973,191.08
Install Completed	: Sep 07, 2014	Easting Coord.	: 582,401.16
Drilling Method	: Diamond / HQ	Ground Surface	: 1097.59 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: RC/CB	Checked By	: LF

Water Level:

997.10 m amsl 04-Oct-14 @ 10:00 (not stable)

Depth (m)	Elev. (m amsl)	DESCRIPTION	RQD (%)	Fracture = Fr Fault = Flt ; Joint = J	Packer Test Interval (mbgs)	K (m/s)
0	1097.59		0 50 100			
	1095	**OVERBURDEN** *Ice crystals observed in silty sand 7.6 m to 8.3 m				
		METACARBONATE Massive to weakly foliated carbonate unit with minor intervals of biotite schist		Fr		
		*Ice lens (<1cm) observed at 10.9 m		Fr		
20	1075	*23 m loss of circulation (poly added)		Fr		
		*33m loss of circulation				
		CRACKLE BRECCIA Orange polymictic clast supported breccia, carbonate and qtz fragments, moderate to strong oxidation				
40	1055	**METACARBONATE** Massive to weakly foliated carbonate unit as above				
		*51.5 m cave-in observed with loss of recovery (rods greased)		Fr		
60	1035	**CARBONATE +/- LIMONITE** Orange polymictic cement and clast supported breccia				
		METACARBONATE Massive to weakly foliated carbonate unit as above				
80	1015	**CRACKLE BRECCIA** Orange crackled breccia of marble, minor biotite schist, and minor dacitic dyke, moderate to strong pervasive oxidation, weak patchy clay alteration in fractures		Fr		
		DACITE Patchy blackish green to light orangy grey massive to weakly foliated dyke, common fractures with weakly oxidized halos		Fr Fr Fr	81.5 - 110.0	1
100		**BIOTITE FELDSPAR SCHIST** Dark green well foliated biotite schist with minor intervals of marble		Fr		

Well: MW14-03A
Elev.: 1098.59 m amsl (TOC)



LORAX ENVIRONMENTAL

MW14-03A / BH3 / CFD-0432

KAMINAK GOLD CORPORATION

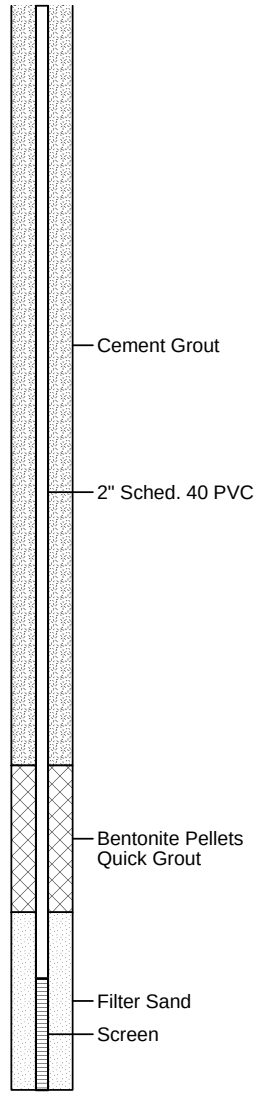
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Aug 29, 2014	Northing Coord.	: 6,973,191.08
Install Completed	: Sep 07, 2014	Easting Coord.	: 582,401.16
Drilling Method	: Diamond / HQ	Ground Surface	: 1097.59 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: RC/CB	Checked By	: LF

Water Level:

997.10 m amsl 04-Oct-14 @ 10:00 (not stable)

Depth (m)	Elev. (m amsl) 1097.59	DESCRIPTION	RQD (%) 0 50 100	Fracture = Fr Fault = Flt ; Joint = J	Packer Test Interval (mbgs)	K (m/s)
110	985	**METACARBONATE** White marble unit with light grey banding and minor intervals of biotite schist, limonite on fractures		Fr	111.5 - 140.0	1
		BIOTITE FELDSPAR SCHIST Dark green well foliated biotite schist with minor marble intervals as above, limonite along fractures and minor oxidation as halos to carbonate stringers				
130	965	**CRACKLE BRECCIA** Dark green weak crackle breccia in biotite schist and minor marble, moderate fracture controlled clay		Fr Fr		
				Fr Fr	132.5 - 155.0	2
		BIOTITE FELDSPAR SCHIST Dark green well foliated biotite schist with minor marble intervals as above, limonite along fractures and minor oxidation as halos to carbonate stringers.		Fr		
150	945			Fr	156.5 - 198.5	5E-09
				J(7)		
170	925					
		SHEAR ZONE Pale green sheared biotite schist				
190	905	**BIOTITE FELDSPAR SCHIST** Pale cream grey biotite schist partially obscured by alteration				
		EOH @ 198.5 m *Comment from supervising hydrogeologist, all other descriptons provided by Kaminak Number of joints reported for every 20 m interval 1. Packer test performed in unsaturated zone; test analysis is not valid 2. Packer test performed in unsaturated zone; test analysis is not valid. Interval did not hold water (i.e. bedrock highly permeable)				
210						



LORAX ENVIRONMENTAL

MW14-03B / BH3 / CFD-0442

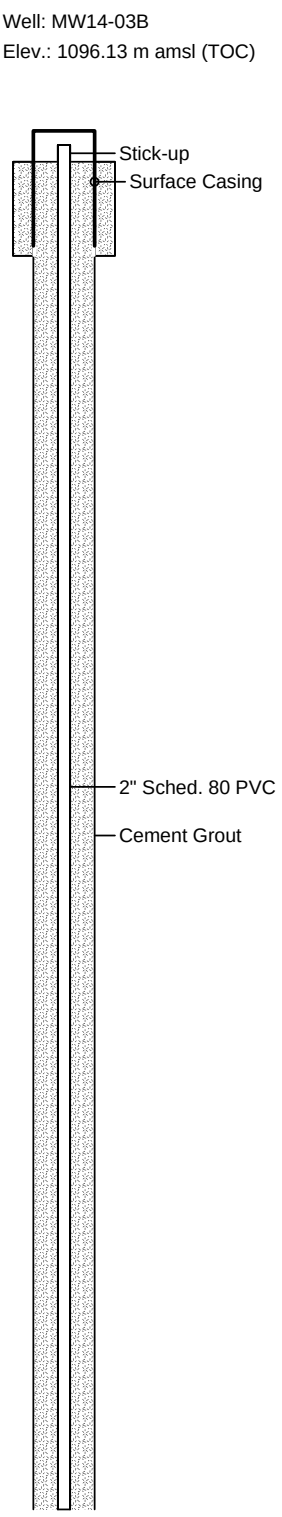
KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 08, 2014	Northing Coord.	: 6,973,196.66
Install Completed	: Sep 12 , 2014	Easting Coord.	: 582,388.30
Drilling Method	: Diamond / HQ	Ground Surface	: 1095.16 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: RC / CB	Checked By	: LF

Water Level:
962.39 m amsl 13-Oct-14 @ 15:41

Depth (m)	Elev. (m amsl)1095.16	DESCRIPTION	RQD (%) 0 50100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
0	1095	**OVERBURDEN** *Silty sand, ice lenses observed near base				
		HYDROTHERMALLY ALTERED ROCK Strongly oxidised, massive to local weak fracture breccia, clay rich with fault pug from 11.9 to 13.1 m.				
		METACARBONATE Alternating white-grey marble with weak foliation				
		FAULT Crumbly, broken up, clay rich fault pug *Loss of circulation at 17 m				
20	1075	**METACARBONATE** Alternating white-grey marble with weak remnant patches of fracture controlled, weak limonite				
		GNEISS Foliated mafic gneiss, facture controlled limonite		N/A	N/A	N/A
		METACARBONATE White-grey marble with fracture controlled limonite				
40	1055	*Loss of circulation at 41 m				
		HYDROTHERMALLY ALTERED ROCK Hydrothermally altered. Monomictic, sub-angular to sub-rounded, fine to medium grained quartz clasts supported in a limonite matrix breccia				
		MEATACARBONATE Banded white-grey marble with strongly altered limonite bands *Minor cave-in at bit change at 54 m				
60	1035	**HYDROTHERMALLY ALTERED ROCK** Strongly limonite altered, fine grained monomictic, round marble clasts in a limonite supported matrix				
		METACARBONATE Alternating grey-white and brown limonite altered marble				
		HYDROTHERMALLY ALTERED ROCK Fine-grained, rounded carbonate clasts supported in a limonite altered matrix				
		METACARBONATE Banded white-grey marble with strongly limonite altered bands				
80						



LORAX ENVIRONMENTAL

MW14-03B / BH3 / CFD-0442

KAMINAK GOLD CORPORATION

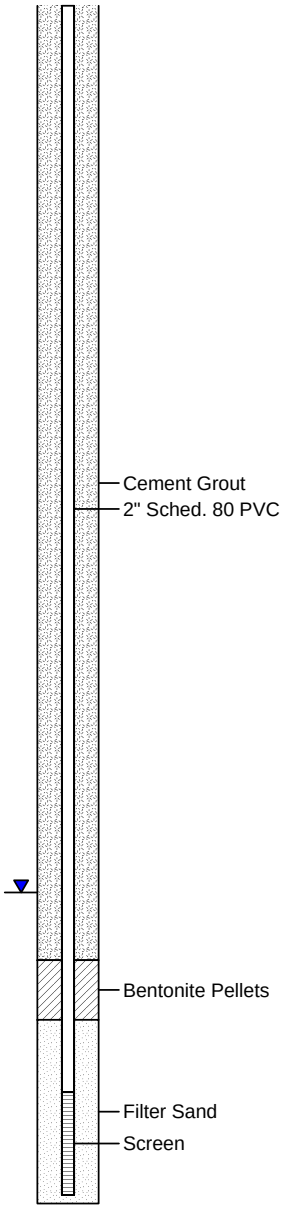
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 08, 2014	Northing Coord.	: 6,973,196.66
Install Completed	: Sep 12 , 2014	Easting Coord.	: 582,388.30
Drilling Method	: Diamond / HQ	Ground Surface	: 1095.16 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: RC / CB	Checked By	: LF

Water Level:

962.39 m amsl 13-Oct-14 @ 15:41

Depth (m)	Elev. (m amsl) 1095.16	DESCRIPTION	RQD (%) 0 50 100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
80	1015	**GNEISS** Mafic gneiss with weak patchy carbonate alteration, fracture controlled limonite and interstitial limonite alteration parallel to foliation				
		ANDESITE Fine grained, dark mafic dyke, fractures and carbonate veinlets with +- limonite and alteration halo				
100	995	**GNEISS** Mafic gneiss with minor thin bands of white marble, fracture controlled limonite alteration and selective interstitial limonite replacement		N/A	N/A	N/A
		MEATACARBONATE Alternating bands of mafic gneiss and marble, fracture controlled limonite and selective interstitial limonite replacement of marble / gneiss				
120	975	**BIOTITE FELDSPAR SCHIST** Fine grained, with weak patchy carbonate alteration, white marble bands also present, weak frature controlled limonite Zone strongly oxidised with weak, patchy carbonate alteration, fracture controlled limonite, local stockwork of limonite fractures 126.1 to130.5 m Patchy, weak fracture controlled oxdation / limonite alteration, weak fracture controlled clay alteration 130.5 to 137.5 m Weak zone. Moderate oxidation / limonite alteration and patchy hematite alteration 137.5 to 152.0 m				
140	955					
		EOH @ 152 m *Comment from supervising hydrogeologist, all other descriptons provided by Kaminak N/A: Hole not logged for structure or packer tested				
160						



MW14-04T / BH6 / CFD-0439

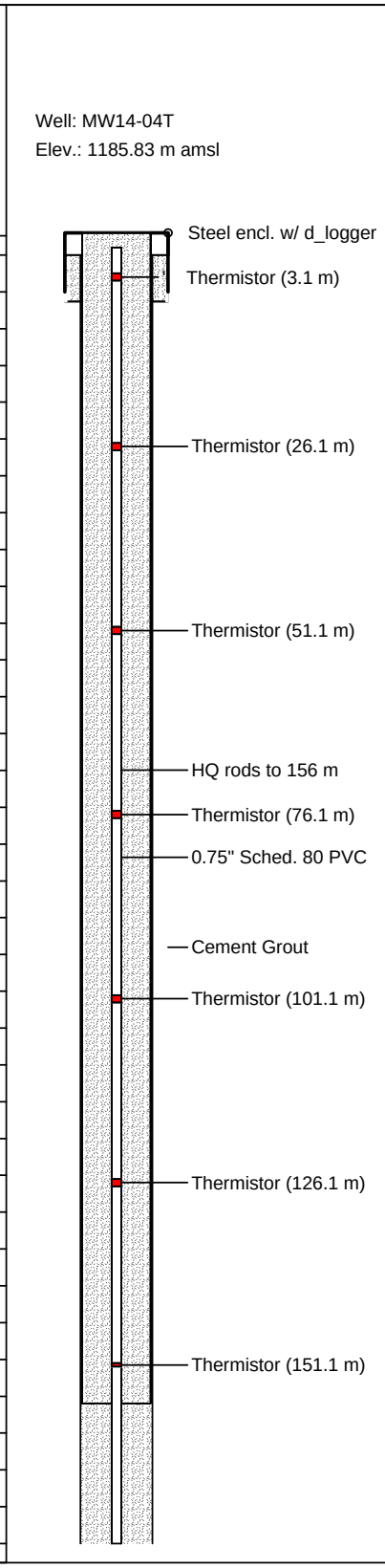
LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 07, 2014	Northing Coord.	: 6,975,001.35
Install Completed	: Sep 12 , 2014	Easting Coord.	: 584,286.64
Drilling Method	: Diamond / HQ	Ground Surface	: 1185.83 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: JY/LF/MS	Checked By	: LF

Depth (m)	Elev. (m amsl)\1185.83	DESCRIPTION	RQD (%) 0 50100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
0	1185	**OVERBURDEN**				
		GNEISS Mix of felsic gneiss dominant over biotite schist, occasional zone of stronger clay fractures alternating				
25	1160					
		OTHER BRECCIA Low angle brecciation of host with stronger oxide				
50	1135	**GNEISS** Mix of felsic gneiss dominant over biotite schist, occasional zone of stronger clay fractures alternating, various vuggy elongate voids subparallel foliation		N/A		
75	1110					
100	1085					
		OTHER BRECCIA Brecciated closed fractures *lost circulation at 107.5 m, regained on next run				
		GNEISS Mix of felsic gneiss dominant over biotite schist, occasional zone of stronger clay fractures alternating, various vuggy elongate voids subparallel foliation Mix of mafic rich zones and felsic pink gneiss 136.0 to 165.8 m				
125	1060					
150	1035					
		BIOTITE FELDSPAR SCHIST Dark grey-black biotite-amphibole schist			164.3 - 202.0	3E-10
175						



MW14-04T / BH6 / CFD-0439

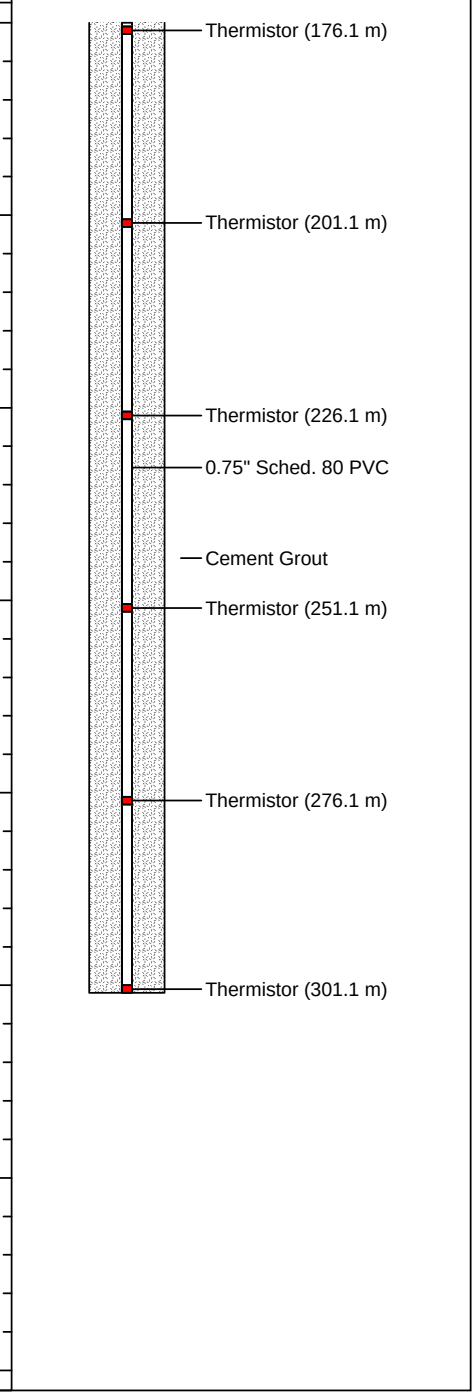
LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 07, 2014	Northing Coord.	: 6,975,001.35
Install Completed	: Sep 12 , 2014	Easting Coord.	: 584,286.64
Drilling Method	: Diamond / HQ	Ground Surface	: 1185.83 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: JY/LF/MS	Checked By	: LF

Depth (m)	Elev. (m amsl)1185.83	DESCRIPTION	RQD (%) 0 50100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
175	1010				182.3 - 202.0	2E-10
200	985	**GNEISS** Mixed felsic gneiss with mafic rich bands			203.3 - 232.0	1E-09
225	960				233.3 - 256.0	4E-09
250	935				251.3 - 280.0	3E-10
275	910				281.3 - 301.0	No Flow
300	885	EOH @ 301 m Notes: - Steel enclosure with data logger not to scale - RST Model 2040 Multichannel Data logger S/N: 0215 - Thermistor string (3 m to 301 m) S/N: TS3795 - Solinst Barologger S/N:12036812 *Comment from supervising hydrogeologist, all other descriptons provided by Kaminak N/A: Hole not logged for structure				
325	860					
350						



MW14-05A / BH11 / CFD-0444

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

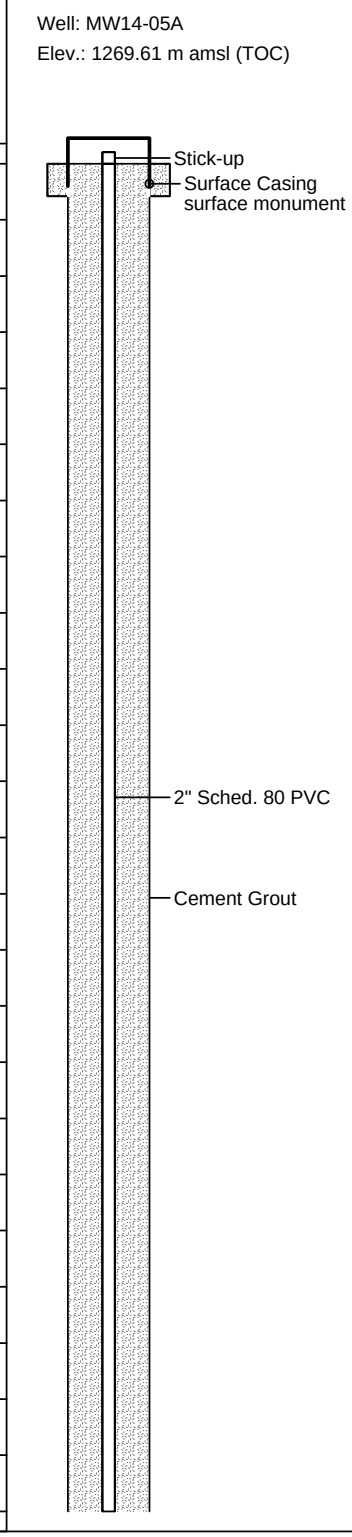
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 12, 2014	Northing Coord.	: 6,972,997.94
Install Completed	: Sep 17 , 2014	Easting Coord.	: 579,708.14
Drilling Method	: Diamond / HQ	Ground Surface	: 1268.50 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: CB/RC	Checked By	: LF

Water Level:

1136.42 m amsl 11-Oct-14 @ 15:45

Depth (m)	Elev. (m amsl)1268.50	DESCRIPTION	RQD (%) 0 50100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
0						
	1265	**OVERBURDEN**				
		GRANITE Coarse grained, pink-grey granite, local, patchy, weak limonite staining				
20	1245					
40	1225			N/A		
60	1205					
80	1185					
100	1165	**ANDESITE** Fresh andesite intrusion				
		GRANITE Coarse grained, grey-pink granite, predominantly fresh and unaltered with patchy fracture controlled limonite alteration limited to small haloes around fractures				
120						



MW14-05A / BH11 / CFD-0444

LORAX ENVIRONMENTAL

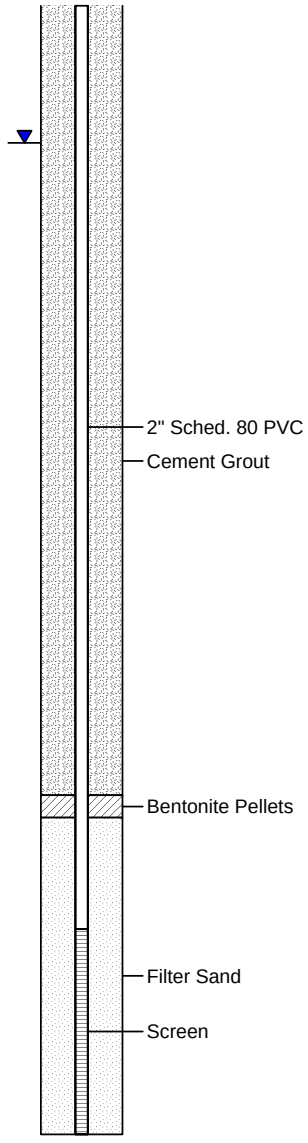
KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 12, 2014	Northing Coord.	: 6,972,997.94
Install Completed	: Sep 17 , 2014	Easting Coord.	: 579,708.14
Drilling Method	: Diamond / HQ	Ground Surface	: 1268.50 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: CB/RC	Checked By	: LF

Water Level:
1136.42 m amsl 11-Oct-14 @ 15:45

Depth (m)	Elev. (m amsl)1268.50	DESCRIPTION	RQD (%) 0 50100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
120	1145				111.3 - 140.0	1
140	1125			N/A		
160	1105	Weak zone; weakly oxidised and limonite altered granite 166.6 to 170.7 m Leucocratic granite with weak patchy limonite and clay alteration 170.7 to 178.1 m			156.3 - 179.0	No Flow
180	1085	Zone, moderately oxidised and limonite altered, fracture controlled limonite and clay alteration 178.1 to 182.7 m └Coarse grained grey-pink granite 182.7 to 183.7 m └Weak zone, fracture controlled limonite with weak to moderate oxidation 183.7 to 185.5 m └Coarse grained granite with patchy replacement of feldspars by clay and chlorite 185.5 to 221 m .			156.3 - 220.5	1E-09
200	1065				183.3 - 200.0	3E-09
220	1045	EOH @ 220.5 m N/A: Borehole not logged for structure 1. Packer test performed in unsaturated zone; test analysis is not valid.			201.3- 220.5	1e-09
240						



MW14-05B / BH11 / CFD-0455

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

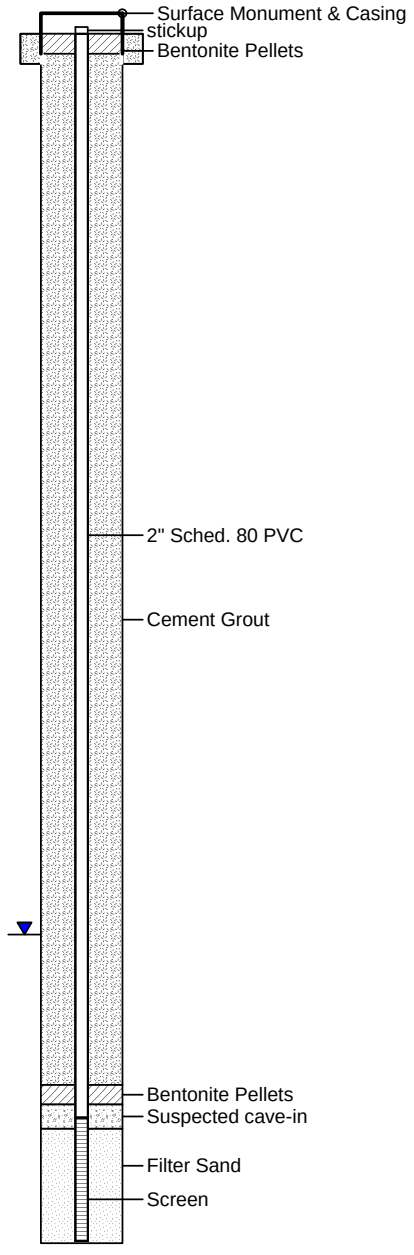
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 17, 2014	Northing Coord.	: 6,972,998.51
Install Completed	: Sep 20 , 2014	Easting Coord.	: 579,694.92
Drilling Method	: Diamond / HQ	Ground Surface	: 1270.3 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: JH/JB/MS	Checked By	: LF

Water Level:

1136.32 m amsl 11-Oct-14 @ 15:53

Depth (m)	Elev. (m amsl) 1270.3	DESCRIPTION	RQD (%) 0 50 100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
0	1270	**GRANITE** Fresh coarse grained granite, patchy clay alteration of feldspar, typically associated with fractures, weak to moderate fracture controlled limonite. See MW14-05A for details		N/A	N/A	N/A
20	1250					
40	1230					
60	1210					
80	1190					
100	1170					
120	1150					
140	1130					
160	1110					
180	1090	EOH @ 179.5 m N/A: Borehole not packer tested or logged for structure				
200						



MW14-06A / BH7 / CFD-0453

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

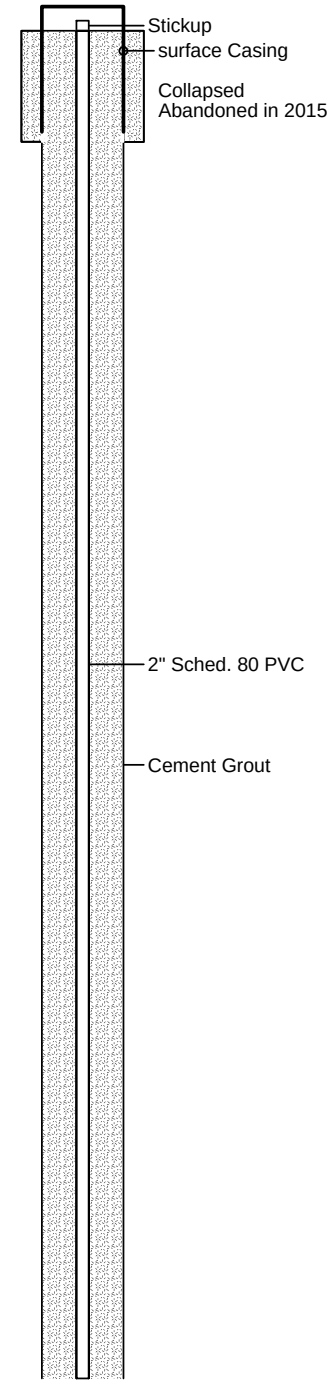
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 16, 2014	Northing Coord.	: 6,974,582.81
Install Completed	: Sep 22 , 2014	Easting Coord.	: 585,202.21
Drilling Method	: Diamond / PQ	Ground Surface	: 1183.0 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: LF/RW/MS	Checked By	: LF

Water Level:

1053.18 m amsl 07-Oct-14 @ 9:46

Depth (m)	Elev. (m amsl) 1183.0	DESCRIPTION	RQD (%) 0 50 100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
0	1180	**OVERBURDEN**				
		FELSIC GNEISS Felsic gneiss with muscovite rich mafic bands, fractures with limonite alteration and interstitial limonite *Drilling additive (Pure Vis) used at 10 m onwards Weak zone, weakly oxidised with fracture controlled limonite, strong fracture controlled clay alteration 21.9 to 25.3 m				
20	1160	**HYDROTHERMALLY ATERED ROCK** Zone, Oxidized and brecciated hydro-thermally altered rock				
		FELSIC GNEISS Felsic geiss with weak fracture controlled limonite and clay alteration				
40	1140					
		GNEISS Felsic gneiss mixed with minor mafic, amphibole rich, bands		N/A	N/A	N/A
60	1120					
80	1100					
		ANDESITE Fine grained mafic dyke				
100	1080					
		GNEISS Felsic gneiss				
		ANDESITE Fine grained, massive, mafic dyke				
		GNEISS Mixed felsic gneiss with mafic, amphibole rich mafic bands				
120						



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MW14-06A / BH7 / CFD-0453

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

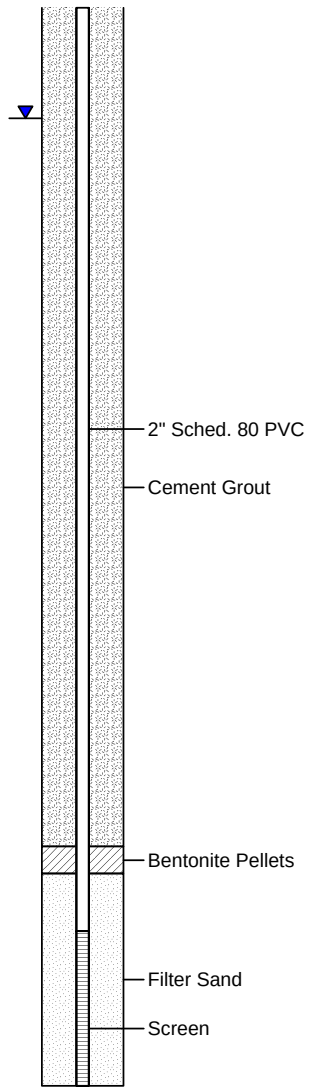
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 16, 2014	Northing Coord.	: 6,974,582.81
Install Completed	: Sep 22 , 2014	Easting Coord.	: 585,202.21
Drilling Method	: Diamond / PQ	Ground Surface	: 1183.0 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: LF/RW/MS	Checked By	: LF

Water Level:

1053.18 m amsl 07-Oct-14 @ 9:46

Depth (m)	Elev. (m amsl) 1183.0	DESCRIPTION	RQD (%) 0 50 100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
120	1060	*Minor circulation loss noted at 127.5 m, possibly enteriing formation at ~25 m *Stronger iron staining at 129.5 to 130.5 m suggests presence of water				
140	1040			N/A	N/A	N/A
160	1020	*Minor iron stained fracture zones suggesting presence of water at ~165, 175, 181, and 187 m Strongly foliated mixed felsic gneiss, bleached, weak carbonate alteration, white clay alteration to feldspars, weak fracture controlled limonite alteration 171.6 to 177.42 m └Zone, mixed gneiss, possible early mafic dyke with weak alteration 177.4 to 179.17 m └Strongly foliated mixed felsic gneiss, weak carbonate alteration 179.2 to 183.2 m				
180	1000					
200	980	└Mixed felsic gneiss, 187.3 to 187.8 m, and EOH fracture zone with limonite alteration				
220	960	EOH @ 216 m *Comment from supervising hydrogeologist, all other descriptons provided by Kaminak N/A: Borehole not packer tested or logged for structure				
240						



MW14-06B / BH7 / CFD-0463

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

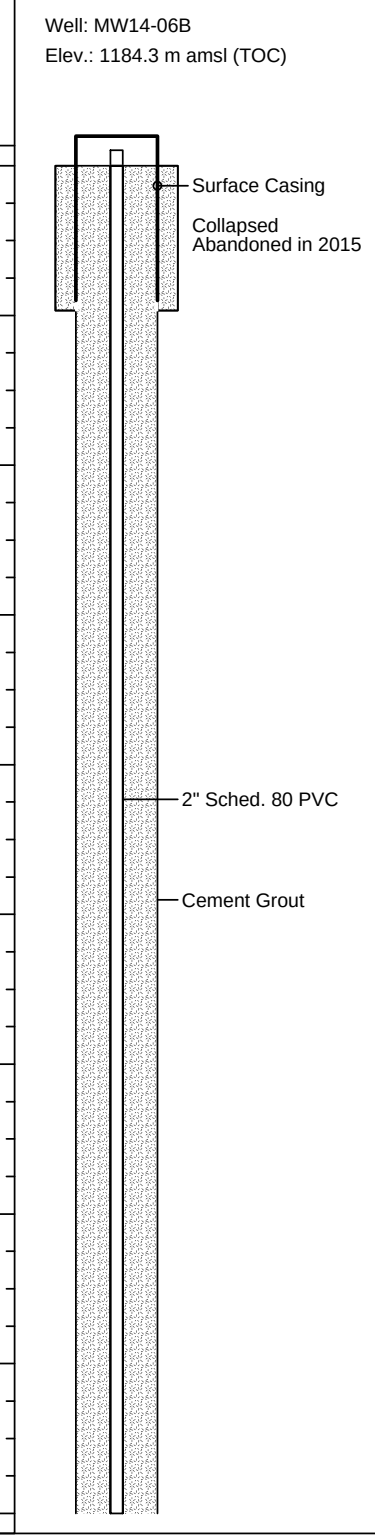
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 22, 2014	Northing Coord.	: 6,974,583.17
Install Completed	: Sep 24 , 2014	Easting Coord.	: 585,195.39
Drilling Method	: Diamond / PQ	Ground Surface	: 1183.3 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: LF/RW/GB	Checked By	: LF

Water Level:

1053.32 m amsl 07-Oct-14 @ 11:15 (approximate)

Depth (m)	Elev. (m amsl) 1183.3	DESCRIPTION	RQD (%) 0 50 100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
0	1183.3	**OVERBURDEN**				
	1180	**GNEISS** Weak to modedrate fracture controlled and interstitial limonite alteration and clay alteration to feldspars				
10		**HYDROTHERMALLY ALTERED ROCK** Zone				
	1170	**GNEISS** Weak to moderate fracture controlled and interstitial limonite alteration				
20		**HYDROTHERMALLLY ALTERED ROCK** Zone. Bleached and silicified medium grained, monomictic clasts supported in a pale yellow clay 12.8 to 17.5 m				
	1160					
30		**ANDESITE** Zone. Strongly oxidised and limonite altered mafic dyke			N/A	N/A
	1150	**GNEISS** Weak fracture controlled limonite alteration				
40				Fr		
	1140					
50						
	1130					
60						
	1120					
70						
	1110					
80						
	1100					
90						



MW14-06B / BH7 / CFD-0463

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

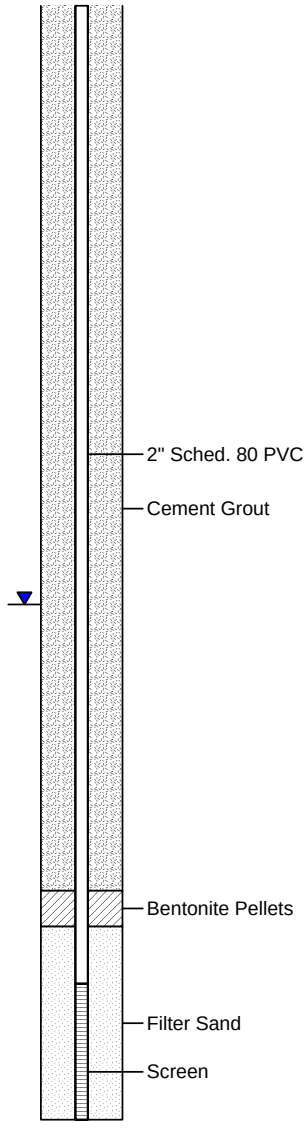
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 22, 2014	Northing Coord.	: 6,974,583.17
Install Completed	: Sep 24 , 2014	Easting Coord.	: 585,195.39
Drilling Method	: Diamond / PQ	Ground Surface	: 1183.3 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: LF/RW/GB	Checked By	: LF

Water Level:

1053.32 m amsl 07-Oct-14 @ 11:15 (approximate)

Depth (m)	Elev. (m amsl) 1183.3	DESCRIPTION	RQD (%) 0 50 100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
90	1090					
		ANDESITE Sharp fg dark-grey black dykes				
100	1080	**GNEISS** Felsic bands common augens occ bt schist +/- amph, occ band pervasive pink = hematite? <1m				
110	1070					
120	1060					
130	1050	*Iron stained fractures 133.3 to 136.0 m suggesting presence of water			N/A	N/A
140	1040	**HYDROTHERMALLY ALTERED ROCK** Minimal zone mix ox & sulph *Iron stained fractures at ~144 and 148 m suggesting presence of water				
150	1030	**GNEISS** Felsic bands common augens occ bt schist +/- amph, occ band perv pink = hematite? <1m				
160	1020					
		EOH @ 164.4 m N/A: Borehole not packer tested				
170	1010					
180						



MW14-07T / BH1 / CFD-0462

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

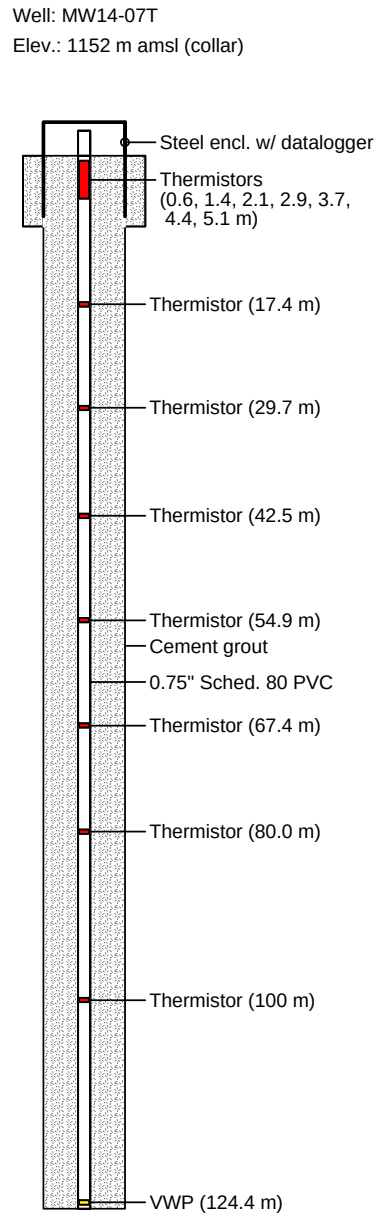
Coffee Creek Gold
Project #: A362-4

Drilling Started	: Sep 21, 2014	Northing Coord.	: 6,971,364.89
Install Completed	: Sep 24, 2014	Easting Coord.	: 580,832.07
Drilling Method	: Diamond / HQ	Ground Surface	: 1156.25 m amsl
Drilling Company	: CYR Drilling Ltd.	Logged By	: Kaminak
Supervised By	: JH/MS	Checked By	: LF

VWP Water Level:

1160.7 m amsl Oct 13, 2014 @ 16:00 (artesian)

Depth (m)	Elev. (m amsl)1156.25	DESCRIPTION	RQD (%) 0 50100	Fracture = Fr Fault = Flt	Packer Test Interval (mbgs)	K (m/s)
0	1155	**OVERBURDEN** *Cored with rods and shoe to 4.8 m. Ice observed from 0.6 to 1.3 m				
20	1135	**GRANITE** Coarse grained, massive, variable orange oxide fracture controlled-pervasive, variable weak- moderate limonite +/- hematite fracture coating				
40	1115					
60	1095			N/A		
80	1075				64.4 - 89.0	3E-08
100	1055				83.2 - 124.7	1E-08
120	1035	*Drilling additive (Pure Vis) used at 115 m onwards *Hole observed making water at 113 m *Hole observed making water at EOH (<1L/min)				
140	1015	EOH @ 125 m Notes: *Comment from supervising hydrogeologist, all other descriptons provided by Kaminak N/A: Borehole not logged for structure Steel enclosure with data logger not to scale RST Model 2040 Multichannel Data logger S/N: 2018 Thermistor string #1 (0.6 to 80.0 m) S/N: TS3796 Thermistor string #2 (100.0 m) S/N: TS3830 VWP S/N: VW30262				
160						



MW15-01AZ / BH08-AZ / CFR-0982

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

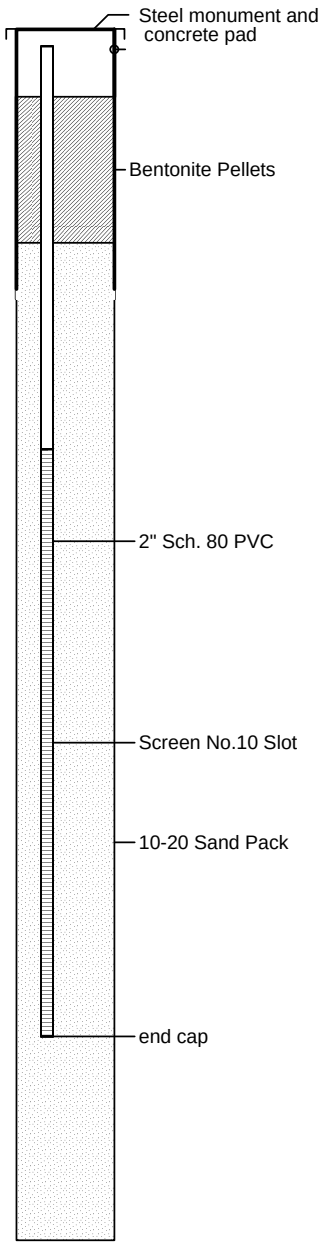
Drilling Started	: May 5,2015	Drilling Method	: Casing Advance ODEX
Install Completed	: May 5,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 4.5 "	Supervised By	: JH (Lorax)
Total Depth	: 5.94 mbgs	Logged By	: Kaminak
Completion Depth	: 5.90 mbgs	Checked By	: LF

ODEX Casing: pulled
PVC Stickup: 0.55 m ags
Top of PVC: 810.30 m asl

Easting: 585,683.0 m
Northing: 6,976,037.9 m
Elevation: 809.75 m asl
Survey Type: RTK GPS

Water Level: frozen @ 3.79 m (8-Jul-15)
No free water in well

Depth (m)	Elev. (masl)	LITHOLOGY
0		OVERBURDEN-Colluvium *Organic material.
		OVERBURDEN *Gravel, boulders.
	809	
1		
	808	
2		
		OVERBURDEN *Sand, silt and gravel. Moisture observed on fines at 2.3 m.
	807	
3		
	806	OVERBURDEN *Brown silt, sand, gravel.
4		
	805	SCHIST *Harder drilling, dusty.
5		
	804	
6		End of hole at 5.94 m (19.5 ft) *Comment from supervising hydrogeologist. Datum: UTM NAD83 Zone 7
	803	
7		



MW15-01T / BH-08T / CFR-0941 (North Dump D/S)

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: March 21, 2015	Drilling Method	: Casing Advance & Convent.
Install Completed	: March 24,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: LF/AS (Lorax)
Total Depth	: 90.5 mbgs	Logged By	: Kaminak
Completion Depth	: 89.3 mbgs	Checked By	: LF

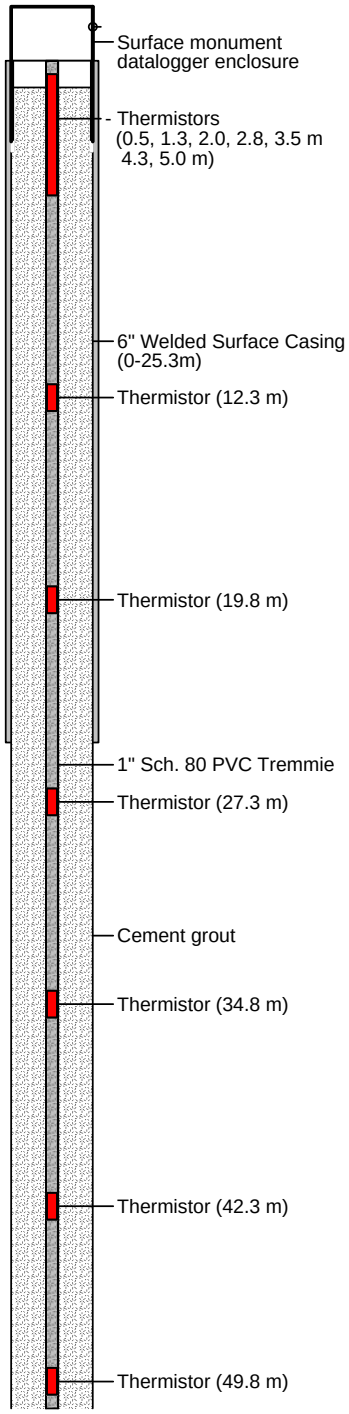
Depth to Bedrock: 17.1 mbgs
Casing Depth: 25.3 mbgs

Easting: 585,826
Northing: 6,976,210.3
Elevation: 803.93
Survey Type: RTK GPS

Depth (m)	Elev. (masl)	LITHOLOGY	Fracture = Fr Fault = Flt	Airlift Yield** (USGPM)
0		Muddy brown organics & Colluvium		
	800	Colluvium. Ranges from silty fine sand to coarse sand with gravel. Clasts of schist and gneiss. *Ice rich. Massive ice lenses observed (8.8-9.4, 10.0-11.3, 11.9-12.5 m).		
10				
	790			
		Overburden *bouldery		
		SCHIST/GNEISS *Surface casing breaks at 21.6 m. Casing is cemented in.		
20				
	780			
		NO SAMPLES		
		Green-grey mafic schist with pink-grey felsic gneiss. Pale orange-grey from 107-112 ft (32.6-34.1 m).		
30				
	770			
40				
	760			
50		Schist & gneiss w/ orange texture observed unit with minor milky quartz fragments.		

Well: MW15-01T

Installation depths along hole (m)



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MW15-01T / BH-08T / CFR-0941 (North Dump D/S)

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

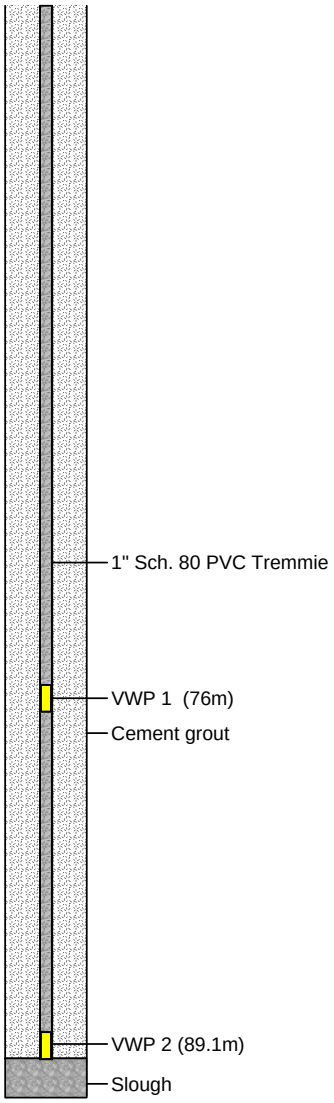
Drilling Started	: March 21, 2015	Drilling Method	: Casing Advance & Convent.
Install Completed	: March 24,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: LF/AS (Lorax)
Total Depth	: 90.5 mbgs	Logged By	: Kaminak
Completion Depth	: 89.3 mbgs	Checked By	: LF

Depth to Bedrock: 17.1 mbgs
Casing Depth: 25.3 mbgs

Easting: 585,826
Northing: 6,976,210.3
Elevation: 803.93
Survey Type: RTK GPS

Well: MW15-01T
Installation depths along hole (m)

Depth (m)	Elev. (masl)	LITHOLOGY	Fracture = Fr Fault = Flt	Airlift Yield** (USGPM)
50		Grey-pink felsic gneiss with light grey-green mafic schist. Both are slightly bleached, increasing with depth. Minor limonite from 197-202 ft (60-61.6m).		
	750			
60				
	740			
70		Black, *Much less dust at 235 ft (70.7 m). Water discharge at cyclone at 235 ft (71.6 m).		2-3
	730	Orange texture observed with moderate limonite and serricite alteration. *Rod feels fractured. Pick up water.		
		Dark green to green grey mafic schist with moderately disseminate hematite. Well foliated.		4-5
80				
	720	Grey felsic gneiss with trace pink. Dark grey mafic schist. Trace to moderate quartz vein fragments. *Pick up minor water 86.0-87.5m.		6-7
90		Dark grey-green mafic schist with minor grey felsic gneis. Minor disseminated hematite.		
	710	EOH 90.5 m Datum: UTM NAD83 Zone 7 RST Model 2040 Multichannel Data Logger S/N: 2017 Thermistor String (0-50 m) S/N: TS3797 VWP 1 (76 m) S/N: 30462; VWP 2 (89.1 m) S/N: 30463 *Comment from Hydrogeologist, others by Kaminak Geologist ** Visual estimation of flow		
100				



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MW15-01WB / BH8-WB / CFR-0977

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

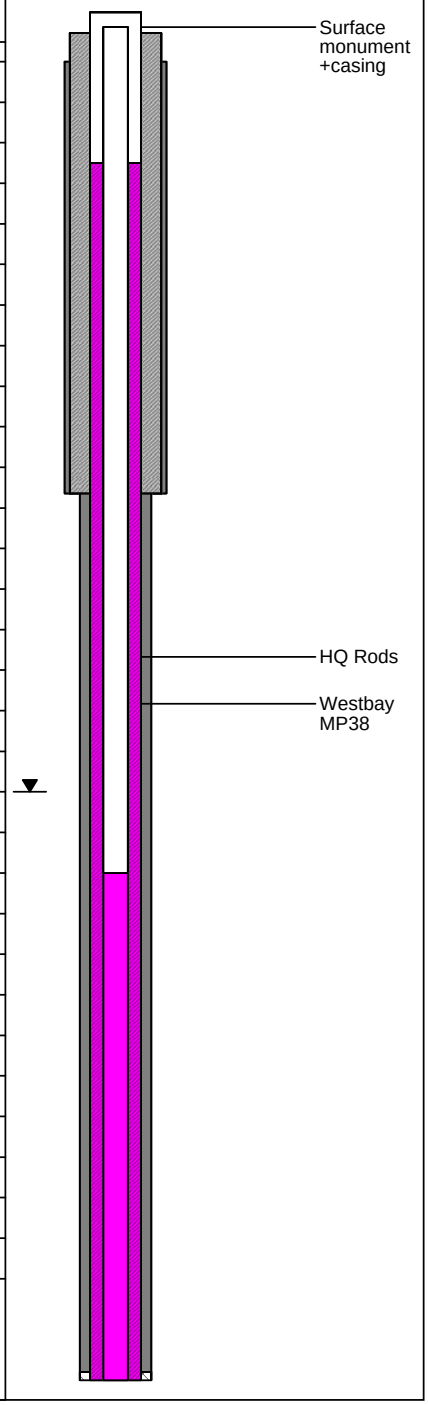
Drilling Started	: April 30,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 05,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: JH/AS/CS (Lorax)
Drilled Depth	: 118.56 m	Logged By	: Kaminak
Completion Depth	: 116.72m	Checked By	: LF

Casing Depth: 21.3 mbgs
HQ Depth: 76.12 mbgs
Westbay Depth: 117.0 m bgs

Easting: 585,828.6 m
Northing: 6,976,211.9 m
Elevation: 803.58 m asl
Survey Type: RTK GPS

Surface Casing Stickup: 1.4 m ags
HQ Stickup: 1.56 m ags
Westbay Stickup: 1.67 m ags
Water Level: 36.0 m bgs
(8-Jul-15; Port 4)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC (µS/cm)	Airlift Yield (USGPM)
0	803	Not logged to 17.1 m See MW15-01T for details			
10	793				
20	783	FELSIC GNEISS Fresh			
30	773	Not Logged			
40	763				
50	753	FELSIC GNEISS clay-sericite alteration Not Logged			
60					



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MW15-01WB / BH8-WB / CFR-0977

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

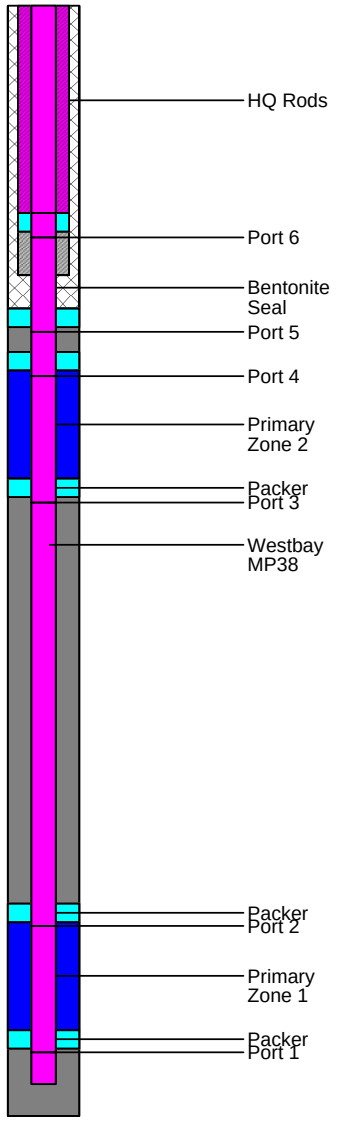
Drilling Started	: April 30,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 05,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: JH/AS/CS (Lorax)
Drilled Depth	: 118.56 m	Logged By	: Kaminak
Completion Depth	: 116.72m	Checked By	: LF

Casing Depth: 21.3 mbgs
HQ Depth: 76.12 mbgs
Westbay Depth: 117.0 m bgs

Easting: 585,828.6 m
Northing: 6,976,211.9 m
Elevation: 803.58 m asl
Survey Type: RTK GPS

Surface Casing Stickup: 1.4 m ags
HQ Stickup: 1.56 m ags
Westbay Stickup: 1.67 m ags
Water Level: 36.0 m bgs
(8-Jul-15; Port 4)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC (µS/cm)	Airlift Yield (USGPM)
65	738				
		FELSIC GNEISS bleached, clay-sericite altered			
		FELSIC GNEISS fresh			
75	728	FELSIC GNEISS Weakly serricite altered			
		FELSIC GNEISS fresh *77.7 m less dusty drilling			
		FELSIC GNEISS oxidized, silicified, 0.5% dissemianted limonite	n/a	n/a	4.9
85	718	*82.1 m hit water *82.6 m cuttings show signs of reddish brown staining	n/a	n/a	5.4
		FELSIC GNEISS fresh	n/a	n/a	2
95	708				
		FELSIC GNEISS fresh	n/a	n/a	4
			n/a	n/a	5
105	698	MIXED MAFIC GNEISS fresh, biotite rich	n/a	n/a	6
115	688	MIXED MAFIC GNEISS bleached			
		MIXED MAFIC GNEISS bleached			
		End of hole 118.6 m (389 ft). *Comment from supervising hydrogeologist; lithology logged by Kaminak Primary Zone 2 was sampled Datum: UTM NAD83 Zone 7			
125					



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MW15-02AZ / BH10-AZ / CFR-0995

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

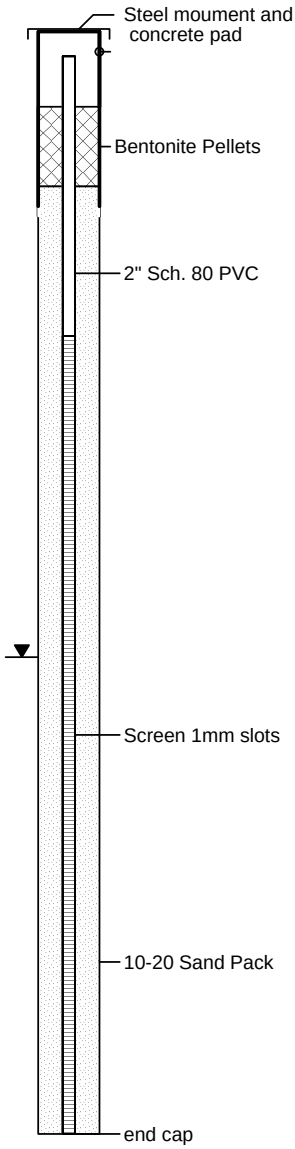
Drilling Started	: May 24,2015	Drilling Method	: Casing Advance ODEX
Install Completed	: May 24,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 4.5 "	Supervised By	: JY/LF (Lorax)
Drilled Depth	: 10.3 mbgs	Logged By	: LF
		Checked By	: LF

ODEX Casing: pulled
PVC Stickup: 0.68 m
Top of PVC: 737.93 m asl

Easting: 584,857.8 m
Northing: 6971754.5 m
Elevation: 737.25 m asl
Survey Type: RTK GPS

Water level: 5.5 m bgs (11-Jul-15)

Depth (m)	Elev. (masl)	LITHOLOGY
0	737	*OVERBURDEN *Not logged.
1	736	
2	735	
3	734	
4	733	*Damp ~4.0 m.
5	732	
6	731	
7	730	*Some drizzle at 7.3 m bgs.
8	729	
9	728	*SCHIST *Not logged
10	727	End of hole at 10.3 m (34 ft).
11	726	*Comment from supervising hydrogeologist. Datum: UTM NAD83 Zone 7
12		



MW15-02T / BH10-T / CFR-0948 (South Dump D/S)

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

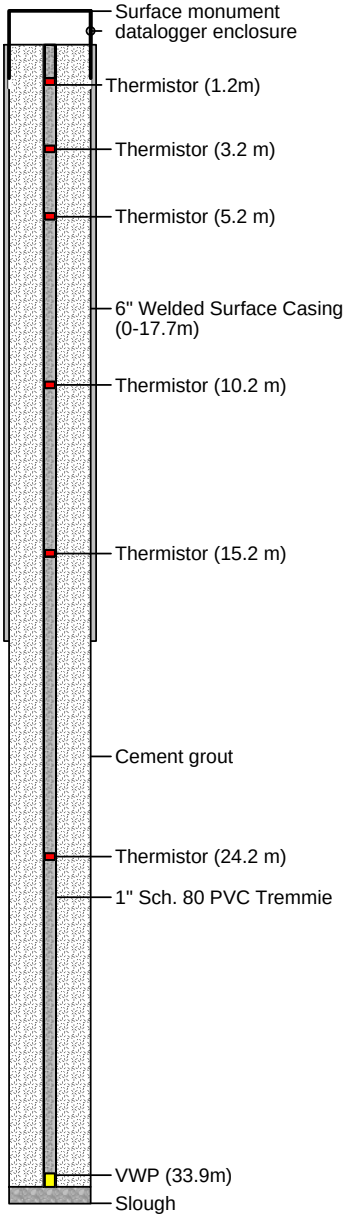
Coffee Creek Gold
Project #: A362-4

Drilling Started	: March 25,2015	Drilling Method	: Casing Advance & Convent.
Install Completed	: March 26,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: LF/AS/CS (Lorax)
Total Depth	: 34.4 mbgs	Logged By	: Kaminak
Completion Depth	: 33.7 mbgs	Checked By	: LF

Depth to Bedrock: 10.7 mbgs
Casing Depth: 17.7 mbgs
Stick up: 0.38 m

Easting: 584,854.9
Northing: 6,971,756.0
Elevation 737.1
Survey Type: Handheld +/-8m

Depth (m)	Elev. (masl)	LITHOLOGY	Fracture = Fr Fault = Flt	Airlift Yield (GPM)**
0				
	735	OVERBURDEN Brown to light dirty orange felsic gneiss, granite and schist. *Colluvium ranging from sitly sand to bouldery sections. Visibly frozen 0-2.4 m. *Water present at casing weld at 7 m, may have orginated between 5.5-7m (flow not sustained).		Present
5				
	730			
10				
	725	SCHIST Light grey to green, well foliated schist. Moderately chlorite altered. *Small fracture at 45 ft (13.8 m), 50 ft (15.2 m)		
15				
	720			0.25
20		SCHIST Light grey to green, well foliated schist. Common strained feldspr and pyrite blebs. Moderately chlorite altered. *Broken area with iron stained surfaces 68-72 ft (20.7-21.9m). Interval grabs onto rods (cave).		3
	715			15-20
25				
	710	SILTY SAND, *Fractured area ~26 m, water increases but not measurable at cyclone.		15-20+
30		SCHIST Dark grey to greenish biotite schist. Increased pervasive chlorite alteration. Common pyrite. Decrease in feldspar/quartz content.		
	705			
35		RST Model DT2055-B Multichannel Data logger S/N: 3686 Logging Frequency: 4 hrs Thermistor string (0-24 m) S/N: TS3798 VWP (33.9 m) 1MPa, S/N: 30460 *Comment from supervising hydrogeologist; all other descriptions provided by Kaminak **Visual estimations of flow only.		
	700			
40				



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LORAX ENVIRONMENTAL

MW15-02WB / BH10-WB / CFR-0997

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

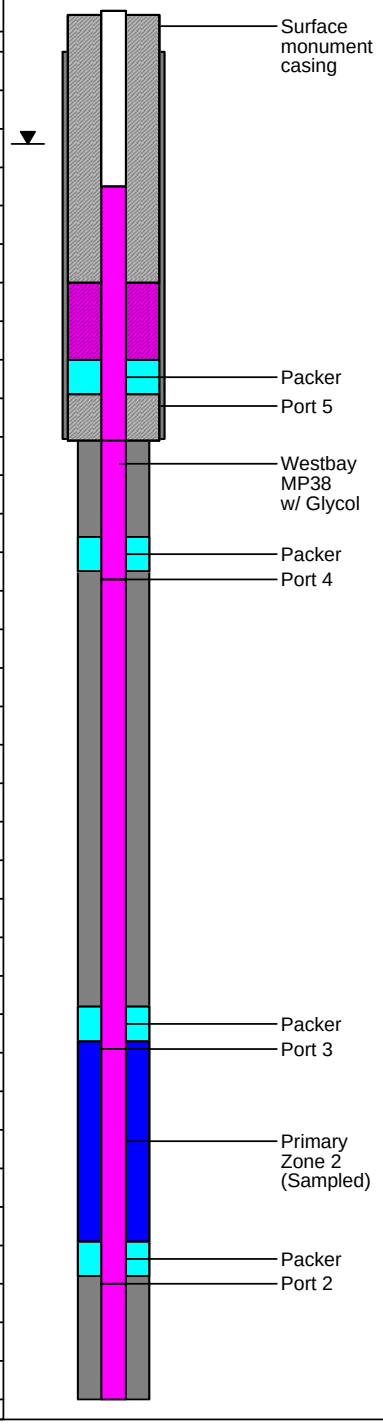
Drilling Started	: May 22,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 24,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: VS/JY/LF (Lorax)
Drilled Depth	: 66.4m	Logged By	: Kaminak
		Checked By	: LF

Casing Depth: 10.1 m bgs
HQ: not deployed
Westbay Depth: 65.5 m bgs

Easting: 584,857.7
Northing: 6,971,757.8
Elevation: 737.11
Survey Type: RTK GPS

Surface Casing Stickup: 0.93 m ags
Westbay Stickup: 1.06 m ags
Water Level: 2.4 m bgs
(10-Jul-15; Port 3)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC (µS/cm)	Airlift Yield (USGPM)
0	737	*OVERBURDEN *Loose sand and gravel with variable silt content, occasional cobble/boulders. Moist to dry 0-0.9m, possibly frozen. *Moist 0.9-7.3 m.			
5	732				moist
		*Moist to wet 7.3-8.5 m. Small amount of water returned at cyclone after casing weld at 8.5 m.			
10	727	BIOTITE SCHIST Weakly oxidized, weak sericite. *Variably fractured throughout hole. *Not sampled.			
		BIOTITE SCHIST Weak clay and sericite alteration. *Not sampled.			
15	722	BIOTITE SCHIST Patchy blebs of brassy pyrite (0.1%), weak patchy chlorite.			
			9.4	923	5
20	717	BIOTITE SCHIST Weak clay alteration, moderate chlorite alteration.			0
					0
		*Intermittent wet and dry patches encountered 23.8-28.3 m.			Spotty
25	712				
		BIOTITE SCHIST Generally fresh, weak patchy chlorite. *Two separate fractures noted at 29, 29.7 m. *Zero water during spot airlift measurement at 29.9 m, water appears to be lost to fractures.	8.4	1007	0
30	707		8.4	1006	35
		*Formation grabby at 32.3 m.			
35			8.4	992	8



LORAX ENVIRONMENTAL

MW15-02WB / BH10-WB / CFR-0997

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: May 22,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 24,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: VS/JY/LF (Lorax)
Drilled Depth	: 66.4m	Logged By	: Kaminak
		Checked By	: LF

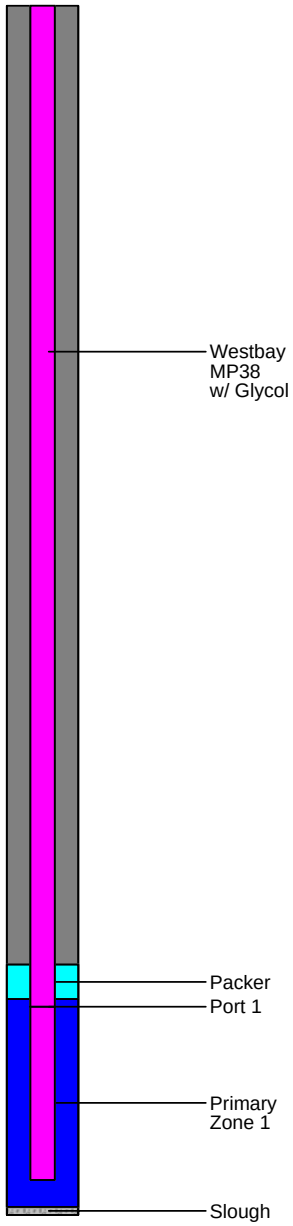
Casing Depth: 10.1 m bgs
HQ: not deployed
Westbay Depth: 65.5 m bgs

Easting: 584,857.7
Northing: 6,971,757.8
Elevation: 737.11
Survey Type: RTK GPS

Surface Casing Stickup: 0.93 m ags
Westbay Stickup: 1.06 m ags
Water Level: 2.4 m bgs
(10-Jul-15; Port 3)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC (µS/cm)	Airlift Yield (USGPM)
35	702	*Not sampled.			
		VEIN Pure milky quartz.	8.5	997	8
		*Not sampled.			
40	697	BIOTITE SCHIST Weak patchy chlorite, rare brassy pyrite blebs (0.1%)	8.5	963	4
45	692		8.5	873	17
			8.5	955	17
50	687		8.5	960	12
		BIOTITE SCHIST Patchy quartz veining.	8.0	960	12
			8.3	960	10**
55	682		8.3	995	9**
			8.4	955	8**
			8.3	950	
60	677		8.6	960	25**
			8.2	960	20**
			8.5	960	11**
65	672		8.3	960	20**
			8.3	965	14**
70		End of hole at 66.4 m (218 ft).			

*Comment from supervising hydrogeologist; lithology logged by Kaminak geologist.
**Trapped air visible during airflow measurements, values may be inaccurate.



MW15-03AZ / BH12-AZ / CFR-0986

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

Drilling Started	: May 9,2015	Drilling Method	: Casing Advance ODEX
Install Completed	: May 9,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 4.5 "	Supervised By	: AS (Lorax)
Total Depth	: 5.62 mbgs	Logged By	: Kaminak
Completion Depth	: 5.55 mbgs	Checked By	: LF

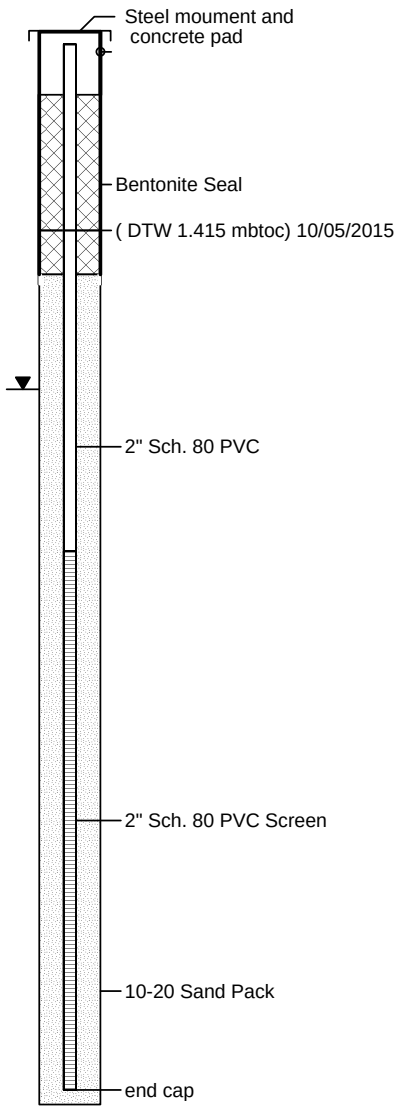
ODEX Casing: pulled
Stickup: 0.66 m
Top of PVC: 558.60 m asl

Easting: 585,582.5 m
Northing: 6,978,157.3 m
Elevation: 557.94 m asl
Survey Type: RTK GPS

Water level: 1.65 m bgs (9-Jul-15)

Depth (m)	Elev. (masl)	LITHOLOGY
0		*OVERBURDEN (Not logged)
1	557	
2	556	
3	555	
4	554	
5	553	
6	552	
7	551	

Datum: UTM NAD83 Zone 7



MW15-03T / BH12-T / CFR-0983

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

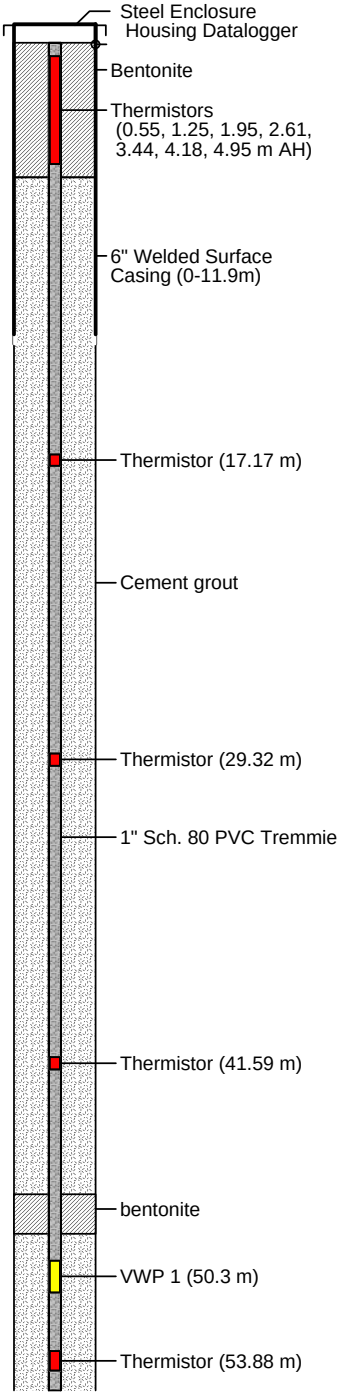
Drilling Started	: May 05,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 10,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: JH/AS (Lorax)
Drilled Depth	: 98.14 m along hole (AH)	Logged By	: Kaminak
		Checked By	: LF

Casing Depth: 11.9m along hole
Hole Dip: 80°

Easting: 585,584.5. m
Northing: 6,978,167.8 m
Elevation: 557.75 m asl
Survey Type: RTK GPS

Depth Along Hole (m)	Elev. (masl)	LITHOLOGY	pH	EC (uS/cm)	Airlift Yield (USGPM)
0	557	OVERBURDEN *Fine to coarse colluvium. Saturated.			
5	552	MIXED MAFIC GNEISS Weak pervasive epidote and silica.			
10	547	MIXED MAFIC GNEISS Weak pervasive silica. *Flat, thin shards of ice observed in cuttings - possibly frozen fractures (8.8-10.4 m)			
		BIOTITE SCHIST Weak chlorite and sericite.			
15	542	MIXED MAFIC GNEISS Moderate pervasive silica. *Chip samples collected every 10 ft.			
20	537				
25	532	*Moisture observed (26.5 m).			
30	527				
		*Water encountered (36.5 m).			2.4
35	522				3
					10
					9.8
40	517				
					11.5
					10
45	512				10
		*Chip size suggests fractured ground (48.2m).			15
50	507	MIXED MAFIC GNEISS Mixed with massive quartz vein.			30
		QUARTZ VEIN			
55		MIXED MAFIC GNEISS Mixed with massive quartz vein.			30

Installation depths along hole (m AH)



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MW15-03T / BH12-T / CFR-0983

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

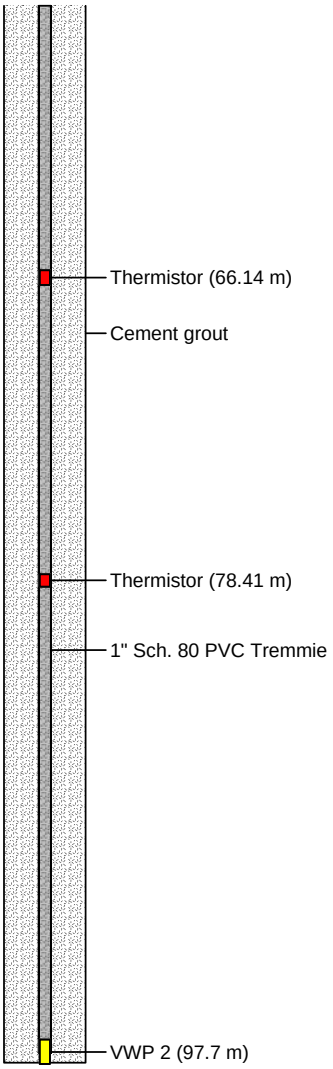
Drilling Started	: May 05,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 10,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: JH/AS (Lorax)
Drilled Depth	: 98.14 m along hole (AH)	Logged By	: Kaminak
		Checked By	: LF

Casing Depth: 11.9m along hole
Hole Dip: 80°

Easting: 585,584.5. m
Northing: 6,978,167.8 m
Elevation: 557.75 m asl
Survey Type: RTK GPS

Installation depths along hole (m AH)

Depth Along Hole (m)	Elev. (masl)	LITHOLOGY	pH	EC (uS/cm)	Airlift Yield (USGPM)
55	502				
		QUARTZ VEIN			30
		AMPHIBOLE BEARING SCHIST Moderate sericite and weak epidote alteration.			
60	497				30
		AMPHIBOLE BEARING SCHIST Weak patchy sericite and epidote. Missing chips; samples collect every 10 ft.			30
65	492				30
70	487				30
					30
75	482				28
					30
80	477				33
85	472				
					30
90	467				
					25.3
95	462				26.9
		End of Hole 98.2 m Datum: UTM NAD83 Zone 7 Geology & Construction based on drill length along hole *Comments from supervising hydrogeologist, litholgy logged by Kaminak RST Model DT2040 Multichannel Data logger S/N: DT2037 Thermistor string S/N: TS3969 VWP 1, 1MPa S/N: 30461; VWP 2, 1MPa S/N: 32594			
100	457				
105	452				
110					



MW15-03WB / BH12-WB / CFR-0987

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

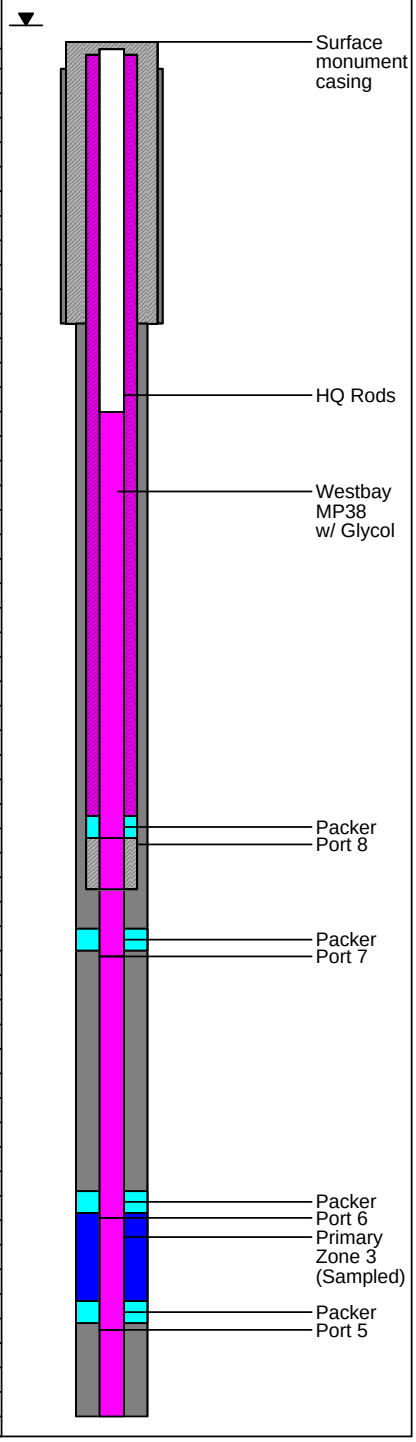
Drilling Started	: May 10,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 12,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: JH/AS (Lorax)
Drilled Depth	: 99.52m	Logged By	: Kaminak
		Checked By	: LF

Casing Depth: 10.4 mbgs
HQ Depth: 33.5 mbgs
Westbay Depth: 99.3 mbgs

Easting: 585,581.4 m
Northing: 6,978,164.6 m
Elevation: 557.92 m asl
Survey Type: RTK GPS

Surface Casing Stickup: 0.42 m ags
HQ Rods Stickup: 0.57 m abs
Westbay Stickup: 0.78 m ags
Water Level: 1.8 m above ground (9-Jul-15; Port 6)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC (uS/cm)	Airlift (USGPM)
0	557	OVERBURDEN *Water return at 1.2 m			
5	552	FELSIC GNEISS Weathered.			
10	547	MAFIC MIXED GNEISS Very small black mafic chips with muscovite mixed with mod silicified felsic chips. Fresh. *Flat, platey ice fragments observed in cuttings representing possible frozen fractures 7.7 m, 8.2 m, 8.5-10.4 m. No samples.			
15	542				
20	537	MAFIC MIXED GNEISS Moderately silicified. No samples.			
25	532	MAFIC MIXED GNEISS Moderately silicified. No samples.			
30	527	BIOTITE SCHIST Fresh with weak muscovite. Not sampled.	9.6		2.1
35	522	MAIFC MIXED GNEISS Weak chlorite after mafics, 0.1% diss brassy pyrite. Not sampled.	9.9		5.3
40	517	FELSIC MIXED GNEISS bleached from moderate sil-ser, 5% vein qtz. MIXED MAFIC GNEISS Weak patchy chlorite after mafics and weak patchy sil ser. 0.1% diss cubic pyrite. Interval switches: 58.8-60.4 m, 60.4-61 m, 61-62.5 m, 62.5-63 m.	9.9 9.5 9.2		5.1 5.1 5.5
45	512		9.3		4.5
50	507		8.8		6 6.5
55					6



LORAX ENVIRONMENTAL

MW15-03WB / BH12-WB / CFR-0987

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

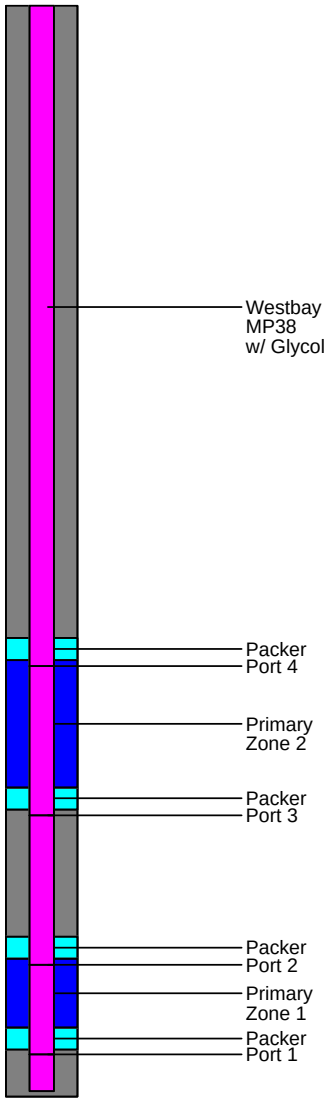
Drilling Started	: May 10,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 12,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: JH/AS (Lorax)
Drilled Depth	: 99.52m	Logged By	: Kaminak
		Checked By	: LF

Casing Depth: 10.4 mbgs
HQ Depth: 33.5 mbgs
Westbay Depth: 99.3 mbgs

Easting: 585,581.4 m
Northing: 6,978,164.6 m
Elevation: 557.92 m asl
Survey Type: RTK GPS

Surface Casing Stickup: 0.42 m ags
HQ Rods Stickup: 0.57 m abs
Westbay Stickup: 0.78 m ags
Water Level: 1.8 m above ground (9-Jul-15; Port 6)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC (uS/cm)	Airlift (USGPM)
55	502		8.8		7
60	497		8.4		7.5
65	492	MIXED FELSIC GNEISS Moderate patchy sil bleaching, weak patchy chlorite 0.1% diss cubic pyrite. Interval switches every 3 ft.	8.1		7.75
70	487		8.1		8
75	482		8.7		8
80	477				
85	472	Not sampled.			
90	467				
95	462		8.8		12
100	457	End of hole 100 m (328 ft). Datum: UTM NAD83 Zone 7 *Comment from supervising hydrogeologist; lithology logged by Kaminak			
105	452				
110					



MW15-04AZ / BH04-AZ / CFR-0992

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

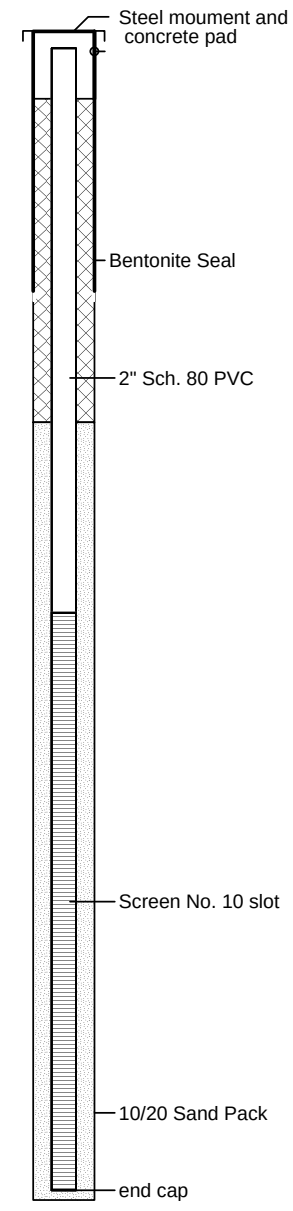
Drilling Started	: May 14,2015	Drilling Method	: Casing Advance ODEX
Install Completed	: May 14,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 4.5 "	Supervised By	: JY (Lorax)
Total Depth	: 5.72 mbgs	Logged By	: Kaminak
Completion Depth	: 5.72 mbgs	Checked By	: LF

ODEX Casing: pulled
PVC Stickup: 0.47 m
Top of PVC: 672.97 masl

Easting: 584,016.4 m
Northing: 6,976,566.0 m
Elevation: 672.50 m asl
Survey Type: RTK GPS

Water Level: Dry (9-Jul-2015)

Depth (m)	Elev. (masl)	LITHOLOGY
0	672	*OVERBURDEN - Colluvium (Not Logged) *Trace moisture observed in upper half of hole, dry thereafter.
1	671	
2	670	
3	669	
4	668	
5	667	*BEDROCK (not logged)
6	666	End of hole at 5.7 m. *Comment from supervising hydrogeologist. Datum: UTM NAD83 Zone 7
7		



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MW15-04T / BH04-T / CFR-0990

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

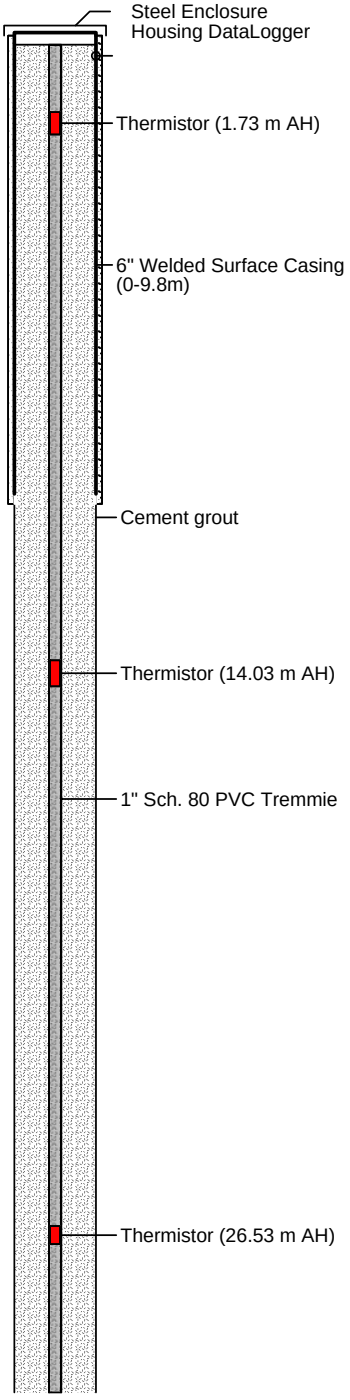
Coffee Creek Gold
Project #: A362-4

Drilling Started	: May 12,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 14,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: JH/AS/CS/LF/JY (Lorax)
Drilled Depth	: 53.4 m along hole	Logged By	: Kaminak
		Checked By	: LF

Casing Depth: 9.8 m AH
Hole Dip: 80°

Easting: 584,027 m
Northing: 6,976,568 m
Elevation: 670.91
Survey Type: RTK GPS

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC (uS/cm)	Airlift Yield (USGPM)	Packer Test
0	670	OVERBURDEN				
5	665	MIXED FELSIC GNEISS Fresh, minor mafic component. Weak patchy sil, weak muscovite along chip fabric. 0.1% fc lim, 0.1% diss brassy cubic pyrite.				
10	660					
15	655					
20	650					
25	645					
30						



MW15-04T / BH04-T / CFR-0990

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

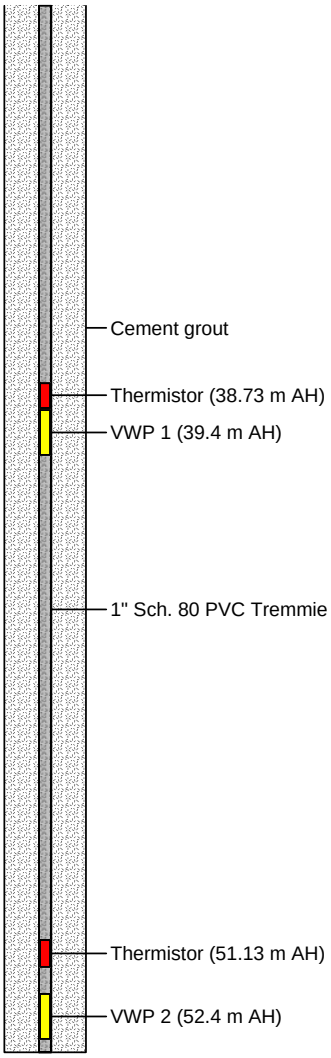
Coffee Creek Gold
Project #: A362-4

Drilling Started	: May 12,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 14,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: JH/AS/CS/LF/JY (Lorax)
Drilled Depth	: 53.4 m along hole	Logged By	: Kaminak
		Checked By	: LF

Casing Depth: 9.8 m AH
Hole Dip: 80°

Easting: 584,027 m
Northing: 6,976,568 m
Elevation: 670.91
Survey Type: RTK GPS

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC (uS/cm)	Airlift Yield (USGPM)	Packer Test
30	640	*Damp patch at 32 m., damp again at 34.3m, wet at 35.1 m.				
35	635	MIXED FELSIC GNEISS Fresh, with stronger muscovite along chip fabric, weak fc clay,0.1% fc lim.	n/a	n/a	1-2	130-175' (failed)
		*Soft patch at 39.2 m, 40.8 m.				
40	630		n/a	n/a	9	
		FELSIC GNEISS Weak zone in felsic gneiss. Strong patchy sil and weak fc clay. 1% fc lim.	n/a	n/a	10	
45	625	*Cuttings size suggests fracturing (43.5 m), very soft drilling 45.1-45.7 m.	n/a	n/a		140-175' (failed)
		*Formation grabby on rods at 47.2 m (fractured). Softer drilling 47.35-48.2 m, becoming hard although still fractured. Driller reports layers of more fractured rock (49.8m).	n/a	n/a	21	
50	620	*Return water is very dark orange 50.1 m and alternates between dark orange and very light until end of hole.	n/a	n/a	27	110-175 shut-in
			n/a	n/a		
		*Hole stability issues (caving and redrilling) at 52.7 m.	n/a	n/a	30	
55	615	End of hole at 53.3 m (175 ft) along hole.				
60		RST Model DT2040 Multichannel Datalogger S/N: 2030 Thermistor string S/N: TS3970 VWP 1, 1MPa (39.4m) S/N: 32593; VWP 2, 2MPa (52.4m) S/N: 32596				
		*Comment from supervising hydrogeologist; geology logged by Kaminak geologists				
		Datum: UTM NAD83 Zone 7 n/a: not available				



MW15-04WB / BH04-WB / CFR-0993

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

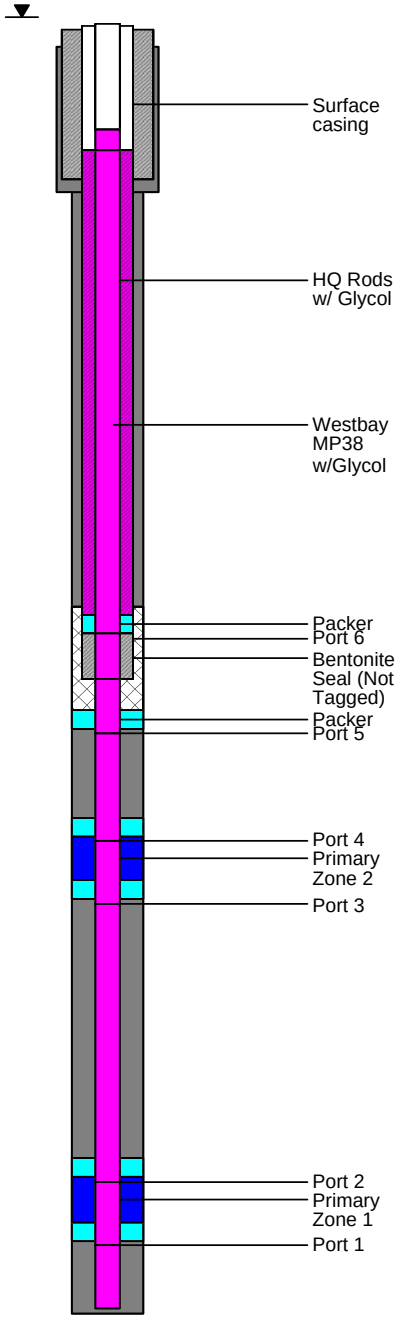
Drilling Started	: May 15,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 19,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: JY/LF (Lorax)
Drilled Depth	: 61.1 m	Logged By	: Kaminak
		Checked By	: LF

Casing Depth: 6.4 mbgs
HQ Depth: 30.4 mbgs
Westbay Depth: 60.85 mbgs

Easting: 584,024.0 m
Northing: 6,976,565.8 m
Elevation: 671.46 m asl
Survey Type: RTK GPS

Surface Casing Stickup: 0.383 m ags
HQ Rods Stickup: 0.99 m
Westbay Stickup: 1.06 m ags
Water Level: 1.42 m above ground (9-Jul-15, Port 4)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC µS/cm	Airlift Yield (USGPM)
0	671	*OVERBURDEN *Mix of organics and gravel.			
5	666	*OVERBURDEN *Ranging from silty sand with gravel to silty fine sand. *Damp at 1.5 m, 1.8-2.4 m (appears frozen). Not logged (no sample collected).			
10	661	MIXED FELSIC GNEISS Fresh, minor mafic component. Weak patchy sil, weak muscovite along chip fabric. 0.1% fc lim, 0.1% diss brassy cubic pyrite.			
15	656				
20	651				
25	646				
30	641				<1
35	636		10.8	801	1
			9.2	770	2
			8.3	717	1
			8.9	696	1-2
40	631		8.6	705	5
					trickle
			8.5	705	trickle
45	626		8.2	710	8
			8.2	782	12
			8.2	742	12
			8.4	744	40
50	621		8	760	24
		FELSIC GNEISS Strong red hematite staining 47.2-48.8 m, moderate patchy sil. 0.1% fc lim.	8.2	767	11.5
55	616		8	775	12
60	611		8.2	774	5
65		*Comments from supervising hydrogeologist; lithology by Kaminak. Primary Zone 2 was sampled. Datum: UTM NAD83 Zone 7			



LORAX ENVIRONMENTAL

MW15-05AZ / BH02-AZ / CFR-0995

KAMINAK GOLD CORPORATION

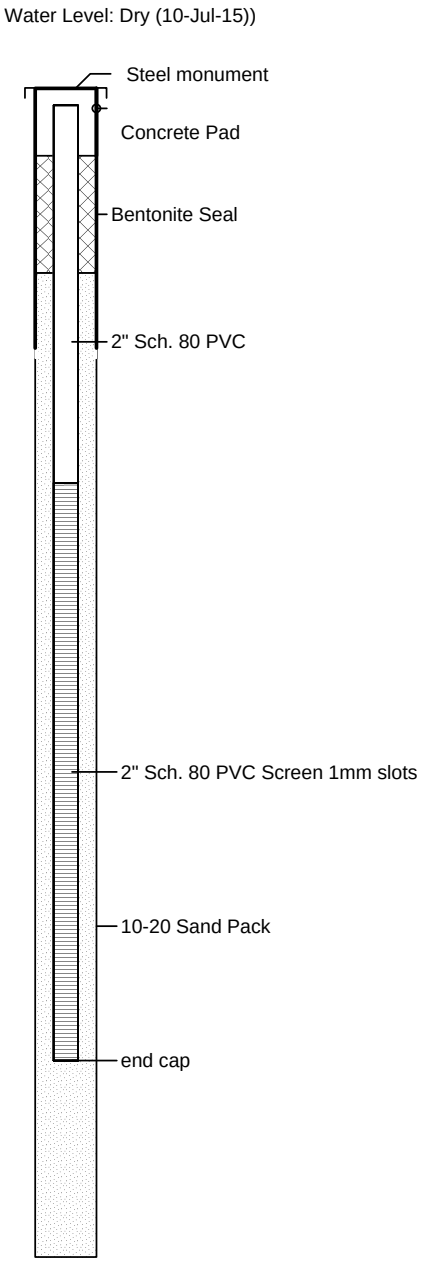
Coffee Creek Gold
Project #: A362-4

Drilling Started	: May 20,2015	Drilling Method	: Casing Advance ODEX
Install Completed	: May 20,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 4.5 "	Supervised By	: JY (Lorax)
Drilled Depth	: 5.72 mbgs	Logged By	: N/A
		Checked By	: LF

ODEX surface casing: pulled
PVC Stickup: 0.55 m ags
Top of PVC: 1069.4 m asl

Eastiing: 581,387.5 m
Northing: 6,971,079.2 m
Elevation: 1068.86 m asl
Survey Type: RTK GPS

Depth (m)	Elev. (masl)	LITHOLOGY
0		
		*OVERBURDEN - Colluvium *Not logged.
1	1068	
2	1067	
3	1066	
4	1065	
5	1064	*BEDROCK *Not logged
6	1063	End of hole at 5.7 m. Datum: UTM NAD83 Zone 7
7	1062	



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MW15-05T / BH02-T / CFR-0994

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

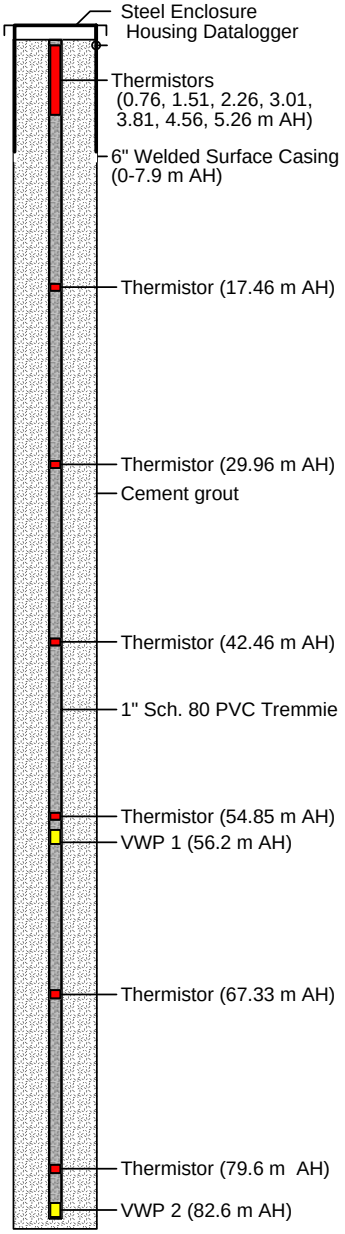
Drilling Started	: May 18,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 20,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: LF/JY (Lorax)
Drilled Depth	: 83.8 m AH	Logged By	: Kaminak
		Checked By	: LF

Casing Depth: 7.9 m AH
Hole Dip: 80°

Easting: 581,405.8 m
Northing: 6,971,082.9 m
Elevation: 1067.15 m asl
Survey Type: RTK GPS

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC (uS/cm)	Airlift Yield (USGPM)	Packer Test
0	1067	*OVERBURDEN *Colluvium. Silty sand to bouldery sections. No visible ice.				
5	1062	GRANITE Weak to moderate oxidation throughout, weak fracture controlled clay.				
10	1057	Not sampled.				
15	1052	GRANITE Weak fracture controlled oxidation, weak fracture controlled clay and silica.				
20	1047					
25	1042					
30	1037					
35	1032					
40	1027					
45	1022	*Less dust at cyclone (45.7 m)				
50	1017	*Cuttings damp (48.7 m).			damp	
		*Water at cyclone (51.8 m).	8.8	296	3.2	
55	1012	GRANITE Moderate silica, sooty sulphides up to 2%.	8.8	307	9.9	
60	1007	GRANITE Pervasive clay bleaching, weak fracture controlled oxidation. Moderate pervasive silica.	8.8	315	16.7	
					30	
65	1002		9.2	323	25-30	
			8.8	312	30	
70	997		8.7	320	30	
75	992		8.8	327	30	
			8.8	327	33	
80	987		8.8	331	33	
85	982	End of hole at 83.8 m (274 ft) along hole (AH). *Comments from supervising hydrogeologist; lithology logged by Kaminak geologist. RST Model DT2040 Multichannel Datalogger S/N: 2038 Thermistor string S/N: TS3971 VWP 2, 2MPa S/N:30464; VWP 1, 2MPa S/N: 32595 Datum: UTM NAD83 Zone 7				
90	977					
95						

Installation depths along drill hole:



MW15-05WB / BH02-WB / CFR-0996

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

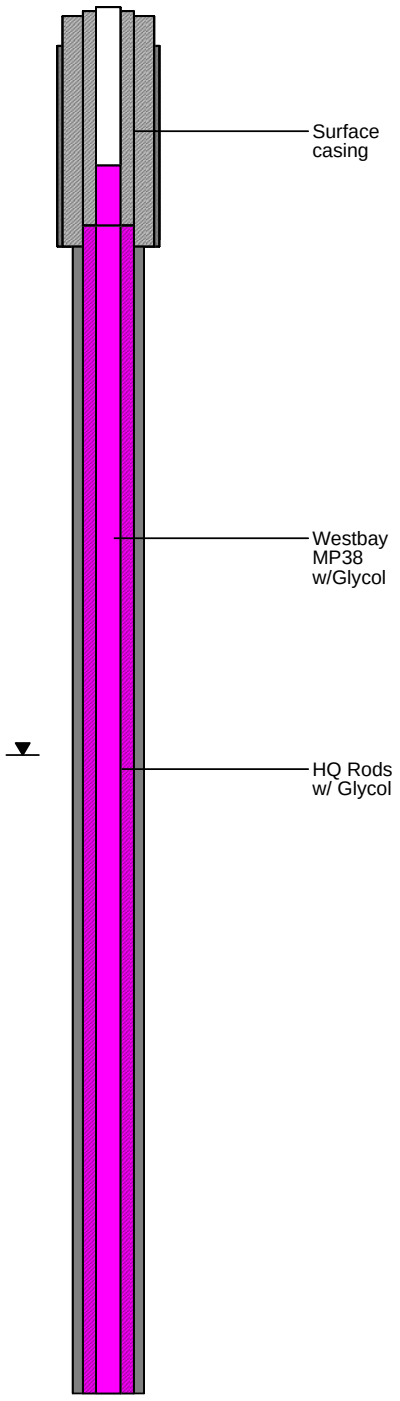
Drilling Started	: May 20,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 22,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: JY/VS/LF (Lorax)
Drilled Depth	: 82.9 mbgs	Logged By	: Kaminak
		Checked By	: LF

Casing Depth: 6.7 mbgs
HQ Depth: 56.38 mbgs
Westbay Depth: 82.7 mbgs

Easting: 581,402.2
Northing: 6,971,084.0
Elevation: 1067.69 m asl
Survey Type: RTK GPS

HWT Stickup: 0.99 m ags
HQ Stickup: 1.15 m ags
Westbay Stickup: 1.29 m ags
Water Level: 23.7 m bgs
(20-Jul-15; Port 3)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC EC= µS/cm	Airlift Yield (USGPM)
0	1067	*OVERBURDEN *No recovery 0-0.6 m (top soil/muskeg). Silty sand to sand, bouldery in sections. *Moist patch 3.7-5.2 m.			
5	1062	*GRANITE *Weathered bedrock.			
		GRANITE Weak patchy oxidation, and weak patchy clay.			
10	1057				
15	1052				
20	1047				
25	1042				
30	1037				
35	1032				
40	1027	GRANITE Moderate patchy oxidation, weak fracture controlled clay, fracture controlled limonite 0.1%, hematite 0.1%.			
45					



MW15-05WB / BH02-WB / CFR-0996

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

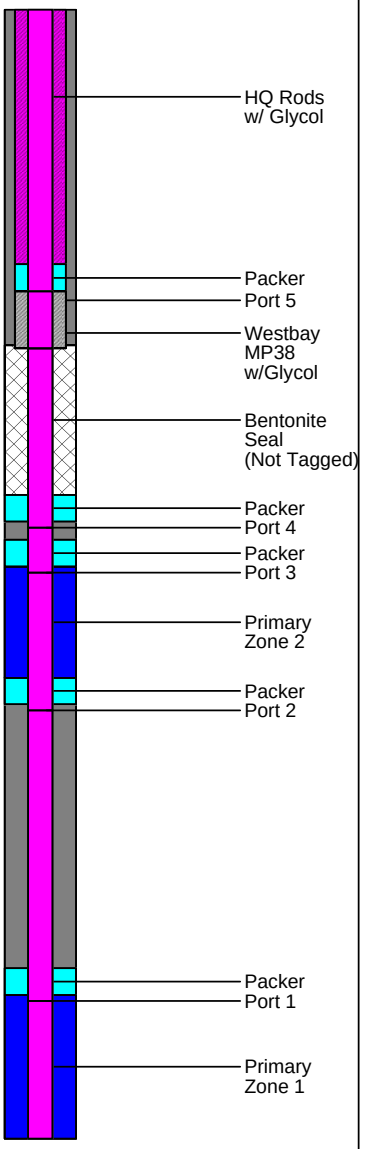
Drilling Started	: May 20,2015	Drilling Method	: Casing Advance & RC
Install Completed	: May 22,2015	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: JY/VS/LF (Lorax)
Drilled Depth	: 82.9 mbgs	Logged By	: Kaminak
		Checked By	: LF

Casing Depth: 6.7 mbgs
HQ Depth: 56.38 mbgs
Westbay Depth: 82.7 mbgs

Easting: 581,402.2
Northing: 6,971,084.0
Elevation: 1067.69 m asl
Survey Type: RTK GPS

HWT Stickup: 0.99 m ags
HQ Stickup: 1.15 m ags
Westbay Stickup: 1.29 m ags
Water Level: 23.7 m bgs
(20-Jul-15; Port 3)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC EC= µS/cm	Airlift Yield (USGPM)
45	1022	GRANITE Fresh.			
50	1017	GRANITE Moderate oxidation, moderate clay alteration, disseminated hematite up to 0.25%. *Slightly damp patch 48.8-49.3 m.			
		GRANITE Fresh.			
55	1012	GRANITE Weak oxidation, fracture controlled hematite up to 0.1%. *Not sampled. *Water encountered at 54.9 m.			
		GRANITE Strong clay alteration, moderate oxidation, dissmeminated limonite/ hematite up to 1%.	12.3 12.2	1045 1630	5
60	1007	GRANITE Strong clay, bleached.	10.3	358	10
		GRANITE Moderate oxidation, weak fracture controlled clay alteration, patchy disseminated hematite up to 0.25%.	9.9	338	3
65	1002	GRANITE Generally fresh, weak fracture controlled oxidation. *Driller indicates that water is likely being blown into formation; hence lower airlift yields.	10.1 10.5	296 321	2
		GRANITE Weak-moderate oxidation, patchy weak fracture controlled clay. Fracture controlled hematite up to 0.1%.	9.3 9.1 9.3 9	293 302 321 301	5 4
75	992		8.8 8.3	310 308	30 35
		GRANITE Generally fresh, patchy clay bleaching.	8.8 8.4 8.5	315 303 310	35
80	987		8.5	320	35
85	982	End of hole 82.9 m (272 ft). Primary Zone 2 was sampled *Comment from supervising hydrogeologist; all other descriptions provided by Kaminak Datum: UTM NAD83 Zone 7			
90					



MW15-06WB / BH05-WB / CFR-0999

LORAX ENVIRONMENTAL

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

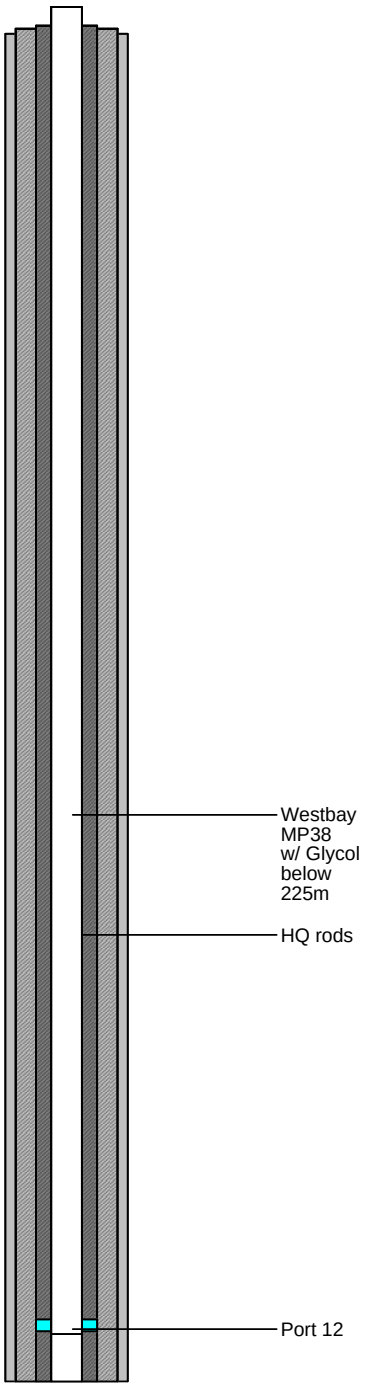
Drilling Started	: May 24,2015	Drilling Method	: RC & DDH
Install Completed	: June 06,2015	Drilling Company	: Northspan, CYR
Drilling Diameter(s)	: 6.0", 4.5", 3.78"	Supervised By	: JY/VS/LF (Lorax)
Drilled Depth	: 293 mbgs	Logged By	: Kaminak
		Checked By	: LF

HWT Depth: 162 mbgs
HQ Depth: 203.6 mbgs
Westbay Depth: #293# m bgs

Easting: 584,089.5
Northing: 6,975,003.3
Elevation: 1184.95 m asl
Survey Type: RTK GPS

HWT Stickup: 0.37 m ags
HQ Stickup: 0.62 m ags
Westbay Stickup: 0.62 m ags
RC 6" 0-8.8m, 4.5" 8.8-200.3 m; DDH HQ 200.3-293 m
WL: 220.73 m bgs (15-Jul-15; Port 6)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC EC= µS/cm	Airlift Yield (USGPM)	Depth (m)
0						0
5	1180	FELSIC GNEISS Weak zone. Moderate pervasive clay alteration, fracture controlled hematite and limonite up ot 0.5%.				5
10	1175					10
15	1170	FELSIC GNEISS Weak zone. Red hematite stain, weak silica, clay, and sericite alteration. Disseminated hematite and limonite up to 0.25%.				15
20	1165					20
25	1160	FELSIC GNEISS Weak zone. Moderate clay alteration, weak silica. Dissminated hematite and limonite up to 0.5%.				25
30	1155	*Dark brown, slight damp with some visible ice				30
35	1150	FELSIC GNEISS Weak patchy sericite and silica.				35
40	1145	FELSIC GNEISS Moderate clay alteration, weak sericite. Disseminated limonite up to 0.25%.				40
45	1140	MIXED FELSIC GNEISS Patchy weak sericite and silica, weak fracture controlled clay, trace fracture controlled limonite up to 0.1%.				45
50	1135					50
55	1130					55
60	1125					60
65	1120	MIXED FELSIC Moderate sericite, weak fracture controlled clay. Disseminated limonite up to 0.1%.				65
70	1115					70
75	1110	FELSIC GNEISS Weak sericite. Pink-Purple hematite stain. Weak silica.				75
80	1105	HOST UNIT Zone. Strong clay alteration, disseminated hematite up to 3%, limonite up to 1.5%.				80
85	1100	MIXED FELSIC GNEISS Weak clay and sericite alteration. Fracture controlled limonite up to 0.1%.				85
90	1095	BIOTITE SCHIST Coarse biotite. Frcture controlled hematite up to 0.1%.				90
95	1090					95
100	1085	FELSIC GNEISS Weak sericite and silica. Patchy pink hematite stain.				100



LORAX ENVIRONMENTAL

MW15-06WB / BH05-WB / CFR-0999

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

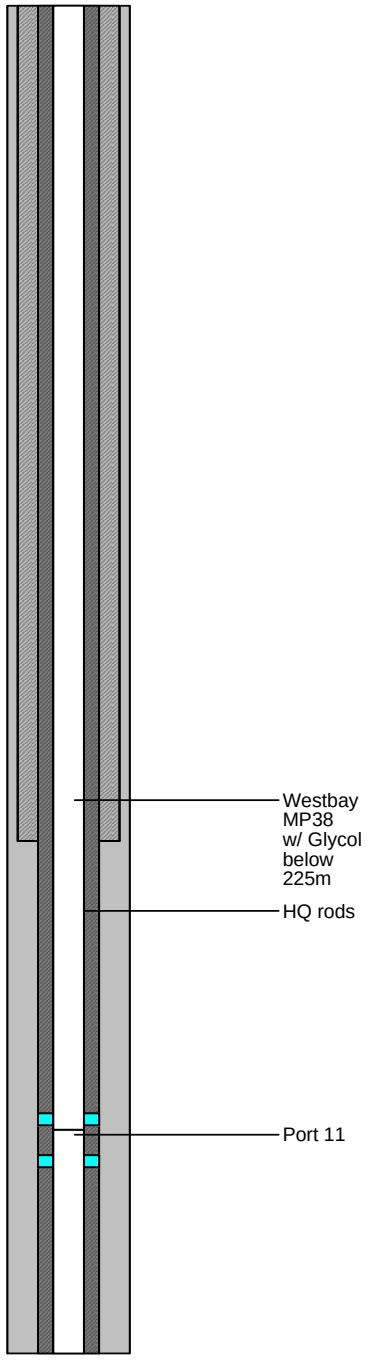
Drilling Started	: May 24,2015	Drilling Method	: RC & DDH
Install Completed	: June 06,2015	Drilling Company	: Northspan, CYR
Drilling Diameter(s)	: 6.0", 4.5", 3.78"	Supervised By	: JY/VS/LF (Lorax)
Drilled Depth	: 293 mbgs	Logged By	: Kaminak
		Checked By	: LF

HWT Depth: 162 mbgs
HQ Depth: 203.6 mbgs
Westbay Depth: #293# m bgs

Easting: 584,089.5
Northing: 6,975,003.3
Elevation: 1184.95 m asl
Survey Type: RTK GPS

HWT Stickup: 0.37 m ags
HQ Stickup: 0.62 m ags
Westbay Stickup: 0.62 m ags
RC 6" 0-8.8m, 4.5" 8.8-200.3 m; DDH HQ 200.3-293 m
WL: 220.73 m bgs (15-Jul-15; Port 6)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC EC= µS/cm	Airlift Yield (USGPM)	Depth (m)
100		MIXED MAFIC GNEISS Fresh Rock. Weak silica altertion.				100
105	1080	MIXED FELSIC GNEISS Weak patchy zone. Weak patchy sericite alteration, patchy fracture controlled weak clay. Patchy fracture controlled hematite and limonite up to 0.5%. Patchy clay bealching.				105
110	1075					110
115	1070					115
120	1065					120
125	1060					125
130	1055					130
135	1050					135
140	1045	MIXED FELSIC GNEISS Patchy moderate sercitite, weak fracture controlled clay, pathy pink hematite stain. *No dust at 139.9 m, brown rock. Dust returns at 140.2m. Trace moisture after rod connected 142.3 m, 145.3 m.				140
145	1040					145
150	1035					150
155	1030					155
160	1025					160
165	1020					165
170	1015					170
175	1010	*Trace moisture 174.3 m.				175
180	1005					180
185	1000	MIXED FELSIC GNEISS Interbedded gneiss and schist. Silicified throughout. Patchy bleaching due to albite altn. Patchy chlorite and epidote altn in mafic bands. Primary pink hematite staining.				185
190	995					190
195	990					195
200	985					200



LORAX ENVIRONMENTAL

MW15-06WB / BH05-WB / CFR-0999

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

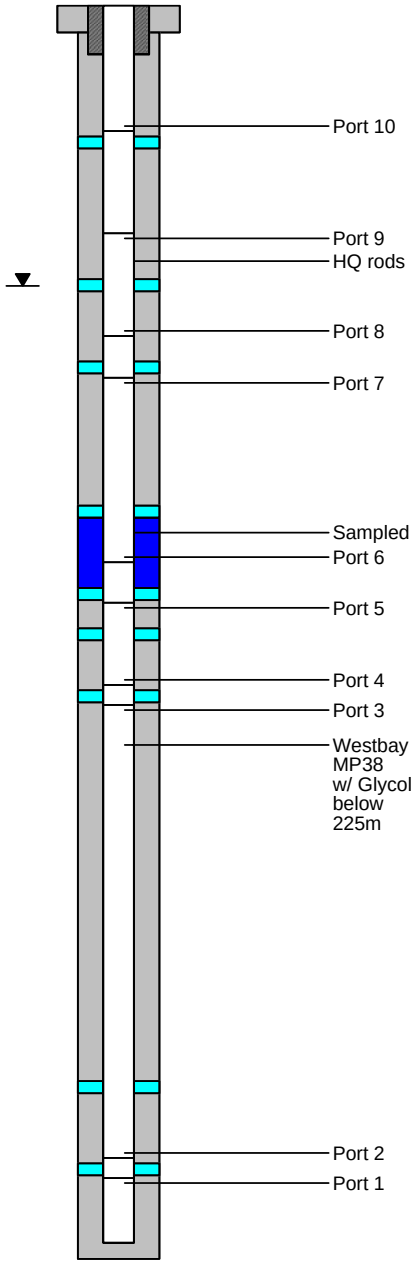
Drilling Started	: May 24,2015	Drilling Method	: RC & DDH
Install Completed	: June 06,2015	Drilling Company	: Northspan, CYR
Drilling Diameter(s)	: 6.0", 4.5", 3.78"	Supervised By	: JY/VS/LF (Lorax)
Drilled Depth	: 293 mbgs	Logged By	: Kaminak
		Checked By	: LF

HWT Depth: 162 mbgs
HQ Depth: 203.6 mbgs
Westbay Depth: #293# m bgs

Easting: 584,089.5
Northing: 6,975,003.3
Elevation: 1184.95 m asl
Survey Type: RTK GPS

HWT Stickup: 0.37 m ags
HQ Stickup: 0.62 m ags
Westbay Stickup: 0.62 m ags
RC 6" 0-8.8m, 4.5" 8.8-200.3 m;
DDH HQ 200.3-293 m
WL: 220.73 m bgs (15-Jul-15; Port 6)

Depth (m)	Elev. (masl)	LITHOLOGY	pH	EC EC= µS/cm	Airlift Yield (USGPM)
200		*Hole drilled RC to 200.3 m by May 26, 2015 2:45 am. Hole dry to depth. Resumed drilling May 30, 2015 04:00am using diamond rig advancing HWT casing followed by HQ drilling.			
205	980				
210	975				
215	970	*Formation grabby on rods at ~213 m, circulation is redulced by half. Fracture at ~215 m results in full circulation loss. Partial return after 215 m, lost again at 218 m, and then parital return thereafter (unchanged to end of hole).			
220	965				
225	960				
230	955	*Rusty fractures ~230-234.5 m. Friable in places from 233.6-234 m.			
235	950				
240	945	*Rusty fractures ~238-242 m.			
245	940				
250	935				
255	930				
260	925	MIXED MAFIC GNEISS Schistose band with minor felsic component. Silicified, interstitial carbonate and weak epidote altn.			
265	920				
270	915	*Three clayey seams 270.15-270.25m.			
275	910	*Rusty fractures ~272-277 m.			
280	905	*Rusty fractures ~278-287 m.			
285	900	MIXED MAFIC GNEISS Fresh schist. Foliated and strongly silicifed. Minor cross cutting carb veinlets.			
290	895				
295	890	End of hole 292.9 m. *Comments from supervising hydrogeologist; lithology logged by Kaminak geologist. Datum: UTM NAD83 Zone 7			
300	885				



LORAX ENVIRONMENTAL

MW15-07T / BH-07T / CFD-0596

KAMINAK GOLD CORPORATION

Coffee Creek Gold
Project #: A362-4

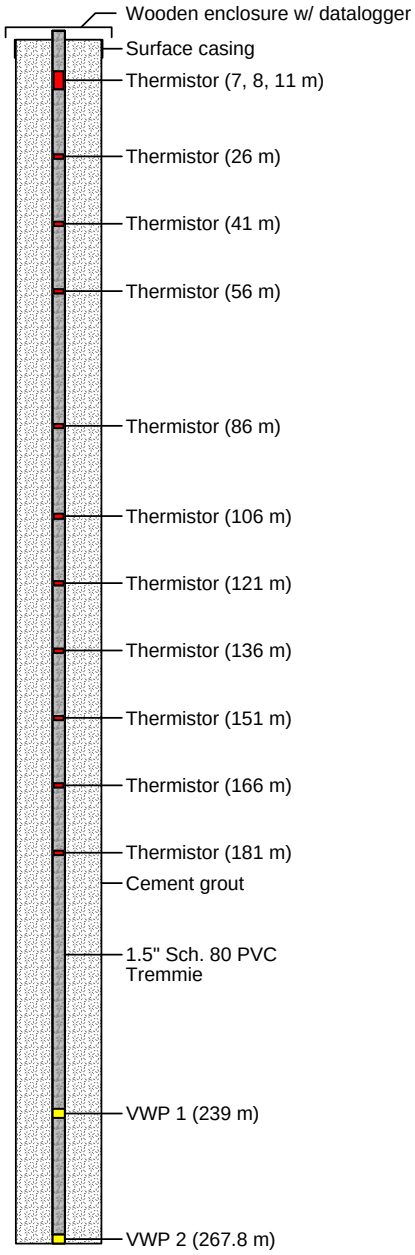
Drilling Started	: August 10, 2015	Drilling Method	: Diamond
Install Completed	: August 12,2015	Drilling Company	: Cyr Drilling
Drilling Diameter(s)	: HQ (96 mm)	Supervised By	: C.Bearor (SRK)
Drilled depth	: 268 mbgs	Logged By	: Kaminak
		Checked By	: LF

Depth to Bedrock: <1.0 mbgs
Casing Depth: n/a mbgs

Easting: 585,198.4 m
Northing: 6,974,582.9 m
Elevation: 1183.14 m asl
Survey Type: RTK GPS

Depth (m)	Elev. (masl)	LITHOLOGY	Fracture = Fr Fault = Flt	Airlift Yield (USGPM)
0	1180	OVERBURDEN		
		MIXED FELSIC GNEISS Grey moderately altered felsic gneiss with minor green mafic schist. Minor patches of bleaching and clay alteration, weakk pathes of oxidation.		
20	1160	YC Orange limonite+-clay altered cemented coarse grained angular monomictic breccia. More of a crackle breccia in to and bottom 20-30cm.		
40	1140	MIXED FELSIC GNEISS 75% grey to dark grey felsic gneiss with immature augens. 25% green mafic schist, biotite-feldspar, moderate chlorite alteration.		
60	1120			
80	1100			
100	1080			
120	1060			
140	1040	MIXED MAFIC GNEISS Same rocks as above, but 40% felsic gneiss and 60% mafic schist. A bit more alteration, a couple blebs of cpy+pyo at 166m, mod oxide zone from 158.6-160.7m		
160	1020			
180	1000	MIXED FELSIC GNEISS 70% drk grey to green-grey felsic gneiss, 30% schist. Trace disseminated pyrite.		
200	980			
220	960			
240	940			
260	920			
280	900	EOH 268 m RST Model 2040 Multichannel Data Logger S/N: Thermistor String (0-200 m) S/N: TS3837 VWP 1 (239 m) 3MPa, S/N: 33363; VWP 2 (267.8m) 3MPa, S/N: 33364 Lithology logged by Kaminak geologist		
300				

Installation depths along hole (m)



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MW16-01T / BH-14 / CFR-1137

GOLDCORP

Coffee Creek Gold
Project #: A362-4

Drilling Started	: August 18, 2016	Drilling Method	: Casing Advance / RC
Install Completed	: August 27,2016	Drilling Company	: Northspan
Drilling Diameter(s)	: 6" / 4.5" / 3.5"	Supervised By	: A. Solod
Drilled depth	: 189.28 mbgs	Logged By	: Goldcorp
		Checked By	: A. Solod

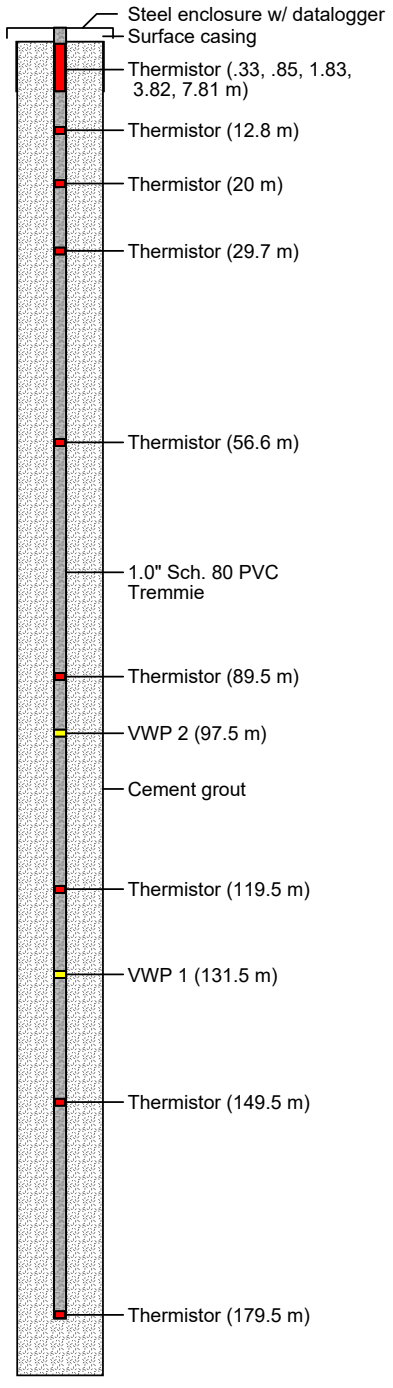
Depth to Bedrock: 5 mbgs
Casing Depth: 7 mbgs

Easting: 580,978.69 m
Northing: 6,972,502.92 m
Elevation: 1203.67 m asl
Survey Type: RTK GPS

LITHOLOGY

Depth (m)	Elev. (masl)	LITHOLOGY	Fracture = Fr Fault = Flt	Airlift Yield 8/22/2016 (USGPM)	Airlift Yield 8/23/2016 (USGPM)
0	1203	OVERBURDEN			
		6.1-25.9 Oxidized granite grading to weakly bleached down-hole. Patchy fracture controlled weak clay alteration. Blebs of silver-brassy pyrite up to 0.25%. Weak patchy sericite (generally along fracture surfaces).	6-25		
20	1183				
		25.9 -32 Weak zone. Weak to moderate fracture controlled clay alteration with weak patchy sericite. Disseminated hematite up to 1%, with fracture controlled limonite up to 0.5%.	25-32		
			32-39		
40	1163	32-39.6 Weak zone. Moderate pervasive clay alteration with weak pervasive sericite. Disseminated sooty sulphides up to 2.5%, patchy disseminated hematite up to 1.5%. (distinct sulphur smell)	39-54		
		39.6-54.9 Weak zone. Moderate pervasive clay with weak patchy sericite. Strongly oxidized throughout. Disseminated hematite up to 1.5%, with disseminated limonite up to 1%. (No significant As-by-XRF results)			
60	1143	54.9-73.2 Fresh granite, weak patchy fracture controlled oxidation.			
		73.2-83.8 Moderate pervasive clay alteration with weak pervasive sericite alteration. Disseminated hematite up to 1.5%, with patchy limonite up to 0.75%.	73-86		
80	1123	83.8-86.9 Moderate pervasive clay alteration, weak pervasive sericite.			
		86.9-114.3 Weak zone. Moderate pervasive clay alteration, with weak patchy sericite alteration. Disseminated hematite up to 1%, fracture controlled limonite up to 0.75%.			
100	1103		86-114	7.75	15
		114.3-125.0 Fresh granite with weak clay alteration/trace bleaching.		7.75	
120	1083				
		125.0-135.6 Weak zone. Weak to moderate pervasive clay alteration, fracture controlled hematite up to 0.75%, with patchy limonite up to 0.25%.	124-135		
140	1063	135.6-189.0 Fresh Granite			
160	1043				
180				7.75	15

Installation depths along hole (m)



MW16-01WB / BH14-WB / CFR-1206

GOLDCORP

Coffee Creek Gold
Project #: A362-4

Drilling Started	: September 28,2016	Drilling Method	: Casing Advance & RC
Install Completed	: October 03,2016	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: AS (Lorax)
Drilled Depth	: 120.09m	Logged By	: AS
		Checked By	: LF

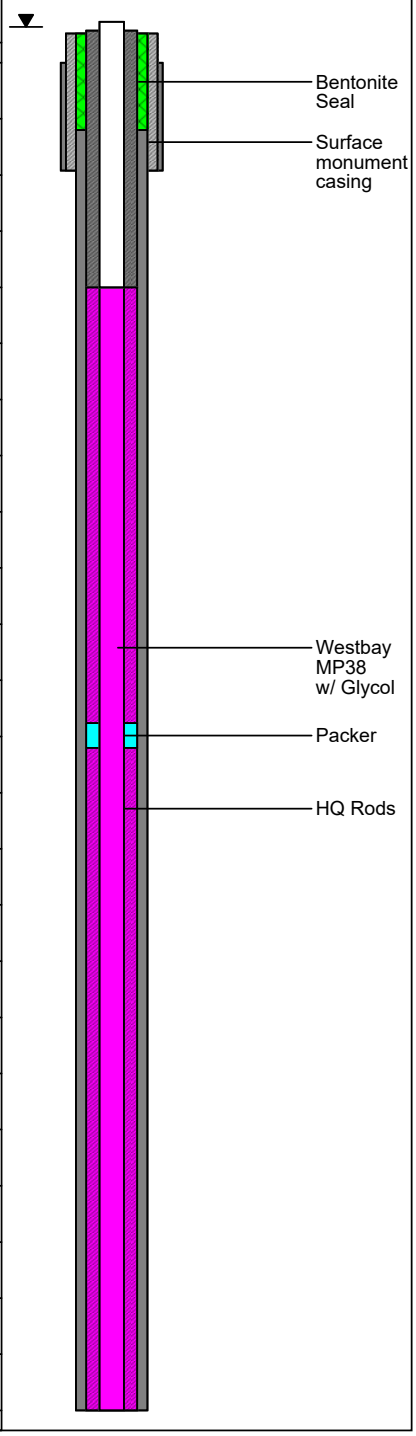
Casing Depth: 4.8 mbgs
HQ Depth: 68.4 mbgs
Westbay Depth: 117.97 mbgs

Easting: 580,971.33 m
Northing: 6,972,510.54 m
Elevation: 1203.91 m asl
Survey Type: RTK GPS

Surface Casing Stickup: 1.30 m ags
HQ Rods Stickup: 1.44 m abs
Westbay Stickup: 1.82 m ags
Water Level: 1.6 m above ground (3-Oct-16; Port 6)

Depth (m)	Elev. (masl)	LITHOLOGY
0	1203	OVERBURDEN Oxidized granite in overburden with mixed biological material.
		Oxidized granite grading to weakly bleached down-hole. Patchy fracture controlled weak clay alteration.
10	1193	
20	1183	
30	1173	
		Moderate pervasive clay alteration, weak pervasive sericite.
40	1163	Fresh granite with weak clay alteration/trace bleaching.
50	1153	
60		

pH | Airlift 9/29/2016 (USGPM) | Airlift 9/30/2016 (USGPM)



MW16-01WB / BH14-WB / CFR-1206

GOLDCORP

Coffee Creek Gold
Project #: A362-4

Drilling Started	: September 28,2016	Drilling Method	: Casing Advance & RC
Install Completed	: October 03,2016	Drilling Company	: Northspan
Drilling Diameter(s)	: 6.0" & 4.5"	Supervised By	: AS (Lorax)
Drilled Depth	: 120.09m	Logged By	: AS
		Checked By	: LF

Casing Depth: 4.8 mbgs
HQ Depth: 68.4 mbgs
Westbay Depth: 117.97 mbgs

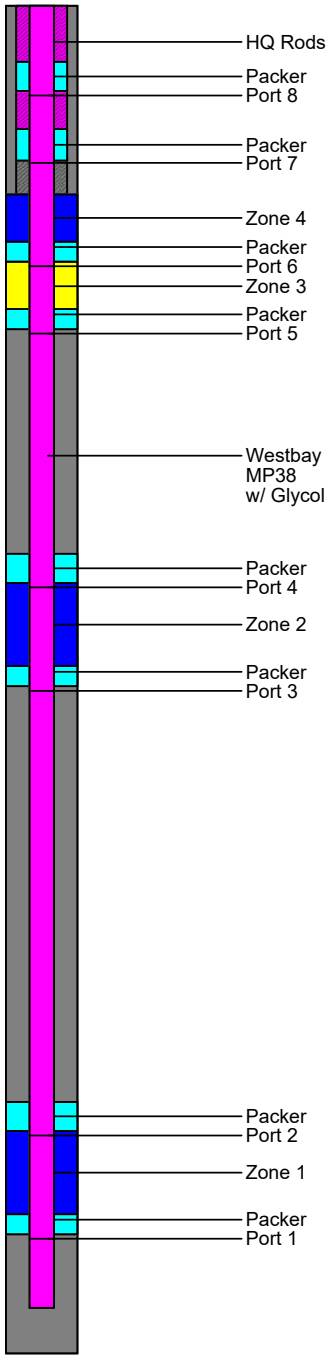
Easting: 580,971.33 m
Northing: 6,972,510.54 m
Elevation: 1203.91 m asl
Survey Type: RTK GPS

Surface Casing Stickup: 1.30 m ags
HQ Rods Stickup: 1.44 m abs
Westbay Stickup: 1.82 m ags
Water Level: 1.6 m above ground (3-Oct-16; Port 6)

LITHOLOGY

Fresh granite

Depth (m)	Elev. (masl)	pH	Airlift 9/29/2016 (USGPM)	Airlift 9/30/2016 (USGPM)
60	1143			
70	1133		18	24
80	1123		15.5	16
90	1113		14.5	
100	1103			
110	1093			23
120				31



LORAX ENVIRONMENTAL

MW17-01 T/VWP (site GT17-01)

GOLDCORP

Coffee Creek Gold
Project #: A447-1

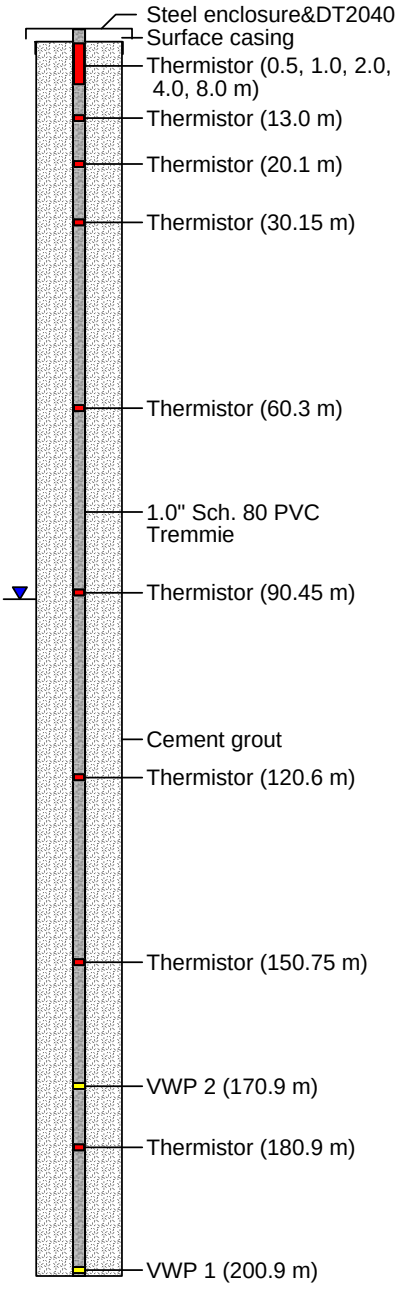
Drilling Started	: August 3, 2017	Drilling Method	: Casing Advance / RC
Install Completed	: August 10, 2017	Drilling Company	: Northspan Exploration Ltd.
Drilling Diameter(s)	: 150 mm / 114 mm	Supervised By	: V. Stastny
Drilled depth	: 201.5m bgs	Logged By	: Goldcorp Inc.
		Checked By	: V. Stastny

Depth to Bedrock: 0.7 m bgs
Casing Depth: 2.0 m bgs
Stickup: 1.2 m

Easting: 579,735.93 m
Northing: 6,973,194.65 m
Elevation: 1245.75 m asl
Survey Type: RTK GPS

Depth (m)	Elev. (masl)	LITHOLOGY	Test Interval	Packer Tests	K m/day
	1246.5				
0	1246.5	OVERBURDEN			
		GRANITE - week clay bleaching of feldspars. Localized trace fracture controlled limonite and hematite. Minor biotite present.			
20	1226.5	pinkish to light grey, dry			
40	1206.5	GRANITE - fresh with intact biotite			
		pinkish to light greenish grey, dry			
60	1186.5				
80	1166.5	open hole reading on Aug 8, 2017 -->			
100	1146.5	GRANITE - patchy weak bleaching from weak clay replacing feldspars, pathcy weak sericite alteration. Minor biotite present.			
		pinkish to light grey-green, dry			
120	1126.5				
140	1106.5				
160	1086.5				
180	1066.5	GRANITE - fresh with intact biotite, localized slight greenish hue. Biotote present throughout interval.		#2	0.005
		light greenish grey, dry		#1	0.003
200	1046.5	EOH at 201.5 m			
		VWP #1 sn. 44543, VWP #2 sn. 44544 Thermistor sn. TS4545, DT2040 sn. 2236			
220					

Installation depths along hole (m)



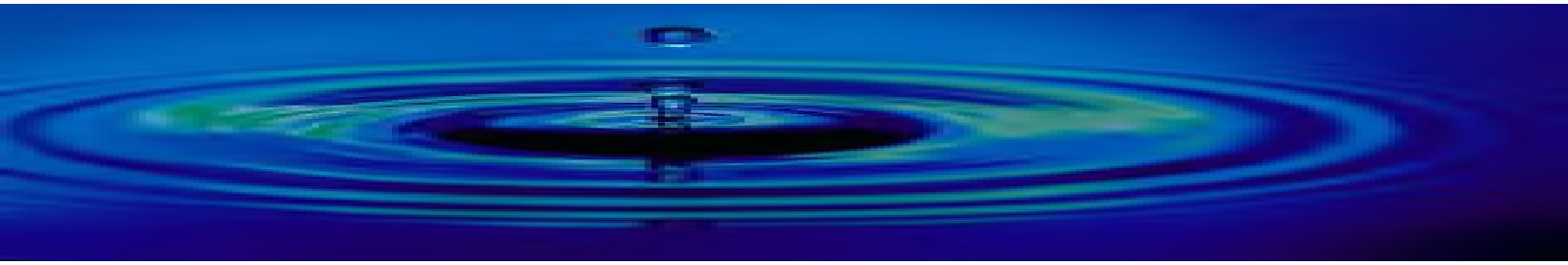
Appendix 3-B: Westbay Completion Reports

Newmont™
COFFEE

September 21, 2015

Completion Report WB950

Kaminak Gold Coffee Creek Project



Westbay Instruments

September 21, 2015

Completion Report WB950

Kaminak Gold Coffee Creek Project

Project Number: WB950

Prepared for:

Lorax Environmental Services Ltd.

Prepared by:

Westbay Instruments

3480 Gilmore Way
Suite110
Burnaby, BC
V5G 4Y1

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- 3.2 Layout of Westbay System Components 3
- 3.3 Lowering of Westbay System Components 3
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APPENDIX B: Monitoring Well: BH4-WB
APPENDIX C: Monitoring Well: BH5-WB
APPENDIX D: Monitoring Well: BH8-WB
APPENDIX E: Monitoring Well: BH10-WB
APPENDIX F: Monitoring Well: BH12-WB

1 INTRODUCTION

This report and the attached Appendices document the technical services carried out by Westbay Instruments (Westbay) under Lorax Environmental Services Ltd. P.O. No. A362-4. Westbay System completions were installed in boreholes BH2-WB, BH4-WB, BH5-WB, BH8-WB, BH10-WB and BH12-WB on a site near Coffee Creek, Yukon Territory.

This report documents the installation tasks and related QA checks.

2 PRE-INSTALLATION ACTIVITIES

All boreholes were drilled using air rotatory methods at a nominal 4.5-inch diameter (HQ-size). Permanent surface casings were installed to bedrock in each borehole. The surface casing depths are not included in this report. An exception to the above drilling method used is discussed in section 4.2, where addition drilling was conducted using a coring rig.

3 INSTALLATION

Westbay technical services representatives were on site for installation of the Westbay System completions as follows: Mr. Mark Lessard, April 29 – May 20, 2015. Mr. Andrew Bessant, May 20 – June 7, 2015, and Mr. Dave Larssen was on site June 7th-June 10th. Lorax representatives Ms. Laura Findlater, Mr. Jordi Helsen, Mr. Andrew Solod, and BGC representative Ms. Catherine Schmid were on-site to assist and supervise the work.

(Note: all depths are with respect to ground surface. Monitoring well reference elevations were not available at the time of writing).

Table 1, Summary of Westbay System Completions

Monitoring Well No.	Installation Dates 2015	Borehole Depth (m)	Depth of HQ rods (m)	MP38 Tubing Length (m)	No. Monitoring Zones
BH2-WB	May 22	82.9	56.5	82.9	2
BH4-WB	May 17-19	61.1	30	60.9	2
BH5-WB	June 6-9	293	200	294	4
BH8-WB	May 4-5	116.7	78	116.7	2
BH10-WB	May 25	65.7	10*	65.6	2
BH12-WB	May 11-14	99.7	34	99.6	3

* HQ rods removed, surface casing only.

The Westbay Systems were installed according to the procedure described below.

3.1 Preparation of Westbay System Design

Packer and zone depths and the projected depth of permafrost for each borehole were provided to Westbay by Mr. Jordi Helsen or Ms. Laura Findlater of Lorax. Well designs were created based on these depths. Each well design was used to prepare a Westbay Completion Log, which specifies the location of components in the well. These logs were reviewed and approved in the field by Mr. Helsen or Ms. Findlater prior to installation of the wells. The Westbay Completion Log as approved was used as an installation guide in the field. Field copies of the logs are in the Appendices.

A measurement port coupling was included in each primary zone to provide the capability to measure fluid pressures and collect fluid samples. Measurement port couplings were also included in QA zones to provide QA testing capabilities. A pumping port was placed above the top packer located directly above the expected base of permafrost in each completion. This pumping port was placed as part of a plan to introduce a 3:1 propylene glycol/water mixture into the steel casing adjacent to the permafrost zone.

Ms. Laura Findlater of Lorax requested that optional synthetic (PET) filters were not to be installed over the measurement port couplings.

3.2 Layout of Westbay System Components

Prior to Westbay System installation, the Westbay System components were set out on a rack near the borehole according to the sequence indicated on the Westbay Completion Log. Each component was numbered beginning with the lowermost as an aid to confirming the proper sequence of components. The appropriate Westbay System couplings were attached to the tubing sections. Magnetic location collars were attached 0.6 meters below the top of the measurement port in each primary zone.

Each component was visually inspected. Serial numbers for each packer, pumping port and measurement port coupling were recorded on the Westbay Completion Log. The well component layout was confirmed with the log before the components were lowered into each borehole.

3.3 Lowering of Westbay System Components

The Westbay System components were lowered into the boreholes by hand or rig assisted as required, through HQ drill rods (nominal 76mm ID) which were used as a temporary guide tube. Each tubing joint was tested with a minimum internal hydraulic pressure of 150 psi for one minute to confirm hydraulic seals. A record of each successful joint test and the placement of each component are noted on the Westbay Completion Log by check marks.

A 3:1 water/propylene glycol mixture supplied by Lorax was added to the Westbay completion when necessary to counter buoyancy effects while components were lowered into each borehole and for testing of joint seals during lowering.

3.4 Hydraulic Integrity Testing

After the Westbay System components were lowered into each borehole, the water inside the tubing was monitored at a depth different from the open borehole water level for a minimum period of thirty minutes to confirm hydraulic integrity of the tubing. The data from the hydraulic integrity tests are shown in Table 2 below.

Table 2, Borehole and Westbay Tubing Water Level

Well number	Borehole water level Per-Installation (ground surface)	Westbay tubing water level (below top of Westbay)
BH2-WB	24.8 m	65.14 m
BH4-WB	artesian	34.304 m
BH5-WB	215.2 m	282.9 m
BH8-WB	38.41 m	41.32 m
BH10-WB	8.2 m	20.72 m
BH12-WB	~ 1 m	34.304 m

3.5 Positioning of Westbay System Completion

After the components were lowered into the borehole, and the guide tube was removed (BH10-WB) or the guide tube was lifted into position just below the, permafrost interface and was hung permanently from the surface casing. (BH2-WB, BH4-WB, BH8-WB, BH5-WB and BH12-WB). The final position of the guide tube is illustrated on each wells Summary Completion Log in the Appendices. The Westbay System tubing was positioned as indicated on the cover page of the Summary Completion Log. Ground surface was used as zero reference for all installations. The Westbay System components were supported in this position while packer inflations were carried out.

The positioning of the Westbay System is based on the "nominal" lengths of Westbay System components. The positioning calculations do not include allowances for borehole temperature or deviation effects.

The attached figure titled “MOSDAX Transducer Position” provides information to correlate the position of MOSDAX Transducer sensors to the reference position at the top of the Measurement Port. The attached figure titled “Dimensions of Packer Seals and Monitoring Zones” outlines the calculations used to determine the packer centerline depths and zone length.

The Summary Completion Log and Table 4, shows the final “as-built” locations of key components in the well, and Table 5 shows the final “as-built” locations of all components in the well, are included in the Appendices.

3.6 Pre-inflation Profile

Prior to inflating the packers, a pre-inflation pressure profile was carried out in the Westbay Systems to confirm the proper operation and position of measurement ports and magnetic collars. The data confirmed proper operation and position of all measurment ports (Figure 3). The data for the pre-inflation profile for each well is located in the Appendices.

3.7 Inflation of Westbay System Packers and Placement of Antifreeze Solution

The Westbay packers were inflated using a 3:1 proplyene glycol/water mixture provided by Lorax. The Westbay Model No. 6055 vented inflation tool was used for packer inflation. All the packers appear to have inflated normally. The data for inflation of each packer are provided on the Westbay Packer Inflation Records included in the Appendices.

The packers were inflated in a specific sequence as part of a plan to introduce and control an antifreeze solution in the well annulus through the permafrost zone, with the exception of BH5-WB where no glycol/water mixture was introducted as there is no fluid in the annulus between the HQ and the Westbay to flush out of the permafrost zone.

The sequence of tasks for introducing 3:1 proplyene glycol/water mixture is illustrated below:

- A set of two packers positioned inside the HQ rods immediately below the expected base of permafrost are inflated.
- The pumping port above the upper inflated packer was opened.
- A 3:1 mixture of water and propylene glycol supplied by Lorax was pumped inside the Westbay tubing, out the pumping port and into the well annulus (HQ rods). Pumping continued until a return flow of the mixture was observed from the well annulus at ground level, thus indicating that the well annulus (HQ rods) was full of the antifreeze mixture.
- The pumping port above the upper inflated packer was closed.
- The remaining Westbay packers were inflated sequentially beginning at the bottom.
- The squeeze relief venting function of the packer inflation tool was disabled to prevent accidental release of tubing fluid to the formations.

4 EXCEPTIONS TO STANDARD INSTALLATION PROCEDURES

4.1 BH8-WB Release of Antifreeze Solution

There was an unintentional release of 3:1 propylene glycol/water mixture into the annulus of the borehole during the installation process.

1. Packer inflation was completed on May 5th. It was noted by the field crew on May 6th that about 42 liters of the water-glycol mixture had been released from inside the Westbay tubing during the squeeze relief venting by the packer inflation tool.
2. The release was reported on May 6th. After discussions it was decided by Lorax to conduct purging of the individual zones to determine the effect on the native fluid chemistry. This purging was done by the Westbay representative on May 8th to May 10th.
3. We understand that chemical analysis of retrieved samples yielded no detectable glycol mixture after field analysis.
   Lorax sent other samples for more detailed analysis offsite, and these results are not known.
4. The squeeze relief venting capability of the packer inflation tool was mechanically disabled to prevent a similar release in future wells onsite.
5. As a preventive measure against future occurrences, Westbay implemented changes to the field crew mobilization procedures to more clearly document any exceptions to the standard procedures.

After preventive measures were implemented, no further occurrences of propylene glycol/water mixture release occurred during the remaining installations.

4.2 BH5-WB Installation

BH5-WB was first drilled using air rotary to a depth of 200m. On completion it was determined that no water was present in the borehole. It was decided by Lorax to continue drilling to a depth 295m using a diamond coring drill rig. HWT casing was installed to 170m. The remaining 95m to TD was cored with HQ-size wireline equipment. On completion of the coring the water level in the borehole was at surface. The water level was monitored by Lorax, and it dropped to below 200m. It was determined at this point that the plan to introduce and control an antifreeze solution in the well annulus through the permafrost zone would not be followed as there was no drilling fluids that needed to be flushed out above the permafrost packers.

The sequence of events below describes the installation process and the unintentional positioning of the Westbay System.

1. The HQ rods used as a guide tube in BH5-WB were lifted into position, 200m below ground surface and hung permanently from the HWT surface casing using a casing clamp.
2. The borehole was sounded using a tag line supplied and operated by Lorax personnel to confirm total depth (TD) of the borehole (293m). Multiple attempts at sounding where conducted by Lorax and a few different depths were recorded, (291.8m, and 287m) it was uncertain whether the hole was at depth or some material had sluffed in. The unclear readings of TD led to the adjustment of the Westbay System design, removing some tubing components from the bottom to prevent unexpected landing too high in the borehole. The standard installation procedure for landing the Westbay System on bottom were changed to an alternative standard procedure which included suspending the Westbay tubing at ground surface.
3. Lorax approved the changes and signed the installation documentation.
4. Once all Westbay System components were lowered into the borehole, two packers in the HQ guide tube were inflated to hold the Westbay System in its final designed position. These packers would provide support to Westbay System while mobilization of the drill rig off site took place. The Westbay System top section was below the top of HQ rods at the end of shift, safely protected from possible damage.
5. The following morning the Westbay System was found to have had slid down the well 7.55m from top of the HQ rods and was resting on bottom of hole (293m).
6. It was speculated onsite that ice may have formed inside the HQ rods, decreasing the capability of the two inflated packers to support the weight of the Westbay completion string.
7. An additional 7.5m of Westbay tubing were attached to the downhole tubing and the “as-is” position of the packer seals were reviewed and accepted by Lorax.
8. A pre-inflation profile and hydraulic integrity test were carried out, as a QA check to show the Westbay System to be hydraulically sealed and functioning properly.
9. Based on the successful outcome of the QA checks, Lorax approved the inflation of the Westbay System packers as positioned in the borehole.
10. All packers seemed to have inflated normally and the well is operating to designed specifications.

5 FLUID PRESSURE MEASUREMENTS

After packer inflation was completed, fluid pressures were measured at each measurement port. At that time, the in-situ formation pressures may not have recovered from the pre-installation activities and potential groundwater pressure increases in monitoring zones that may result from packer inflation. This latter effect may be more likely to occur in monitoring zones located in low-permeability geological formations. Longer term monitoring may be required to establish representative fluid pressures.

A plot of the piezometric levels in all zones in each well is shown on Figure 4 in the Appendices. The data were examined to confirm proper operation of the measurement ports and as a check on the presence of annulus seals between monitoring zones. The calculation sheets for the pressure profiles of the Westbay System are also enclosed in the Appendices.

6 OPERATOR TRAINING

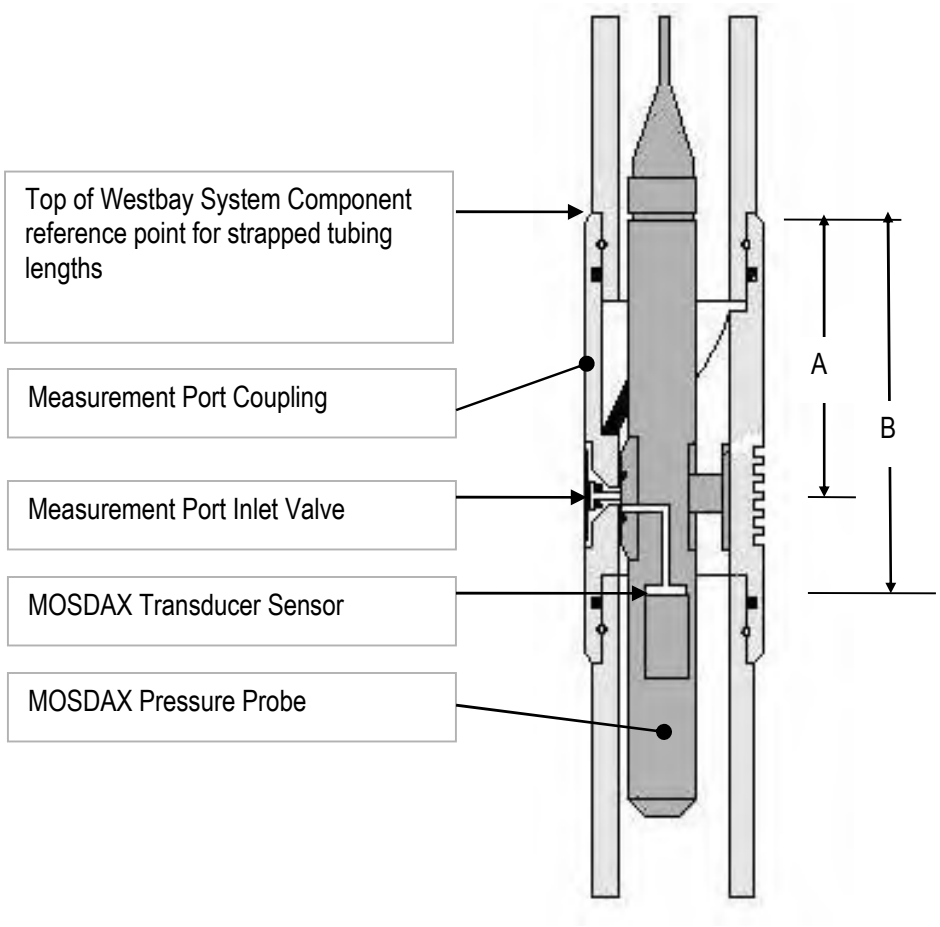
Training was provided to Mr. Jordi Helson, Mr. Chris Bourque, and Ms. Laura Findlater of Lorax. The training covered the following areas:

- Operation and maintenance of Model 2531 Sampler Probe and MAGI controller in pressure profiling, sample collection.
- Cable reheading and troubleshooting.

Mr. Jordi Helson, Mr. Chris Bourque, and Ms. Laura Findlater are certified for un-supervised operation and field maintenance of this Westbay equipment.

MOSDAX Transducer Position

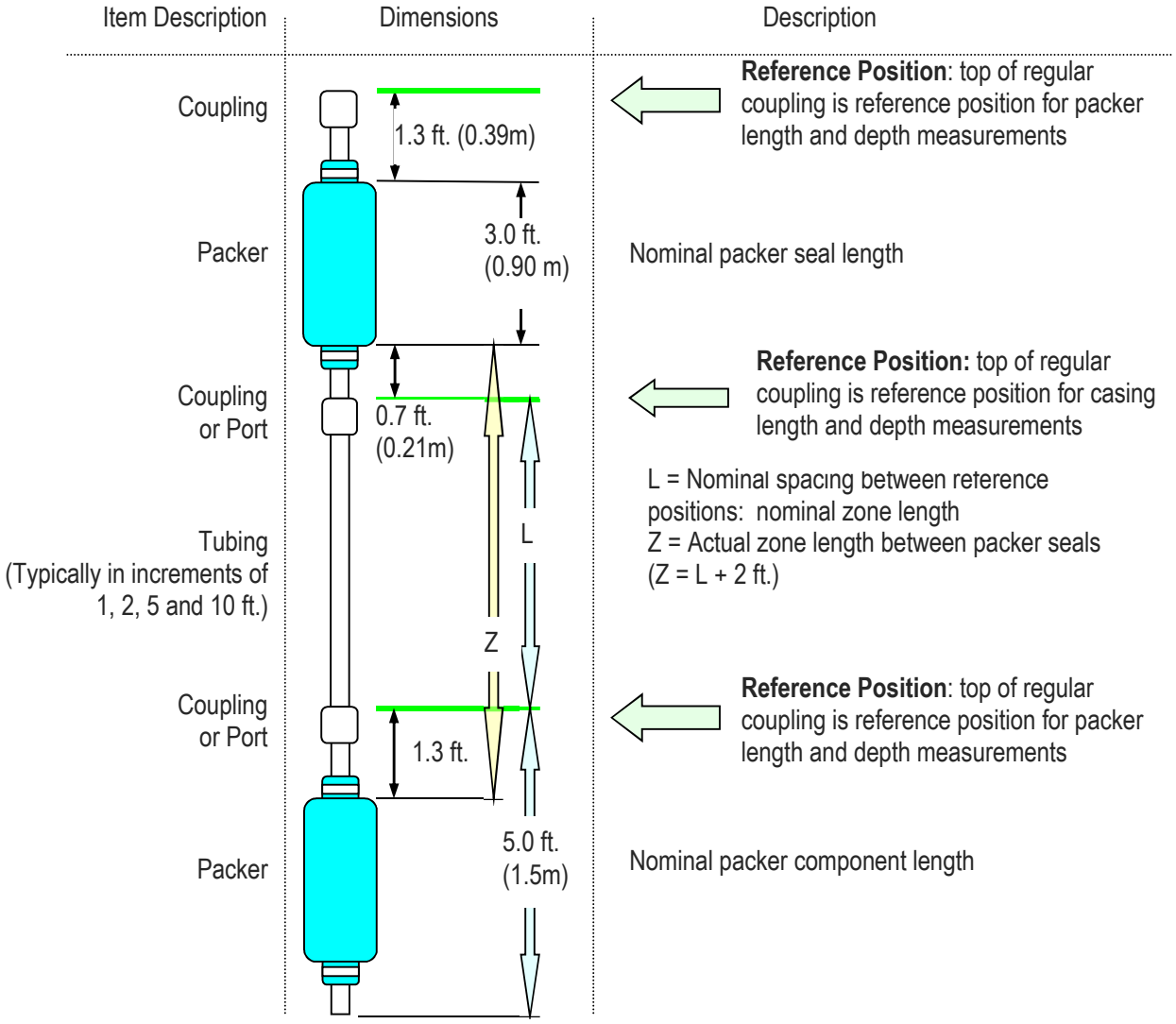
In an Westbay System Measurement Port Coupling



System	Measurement Port	A	B
Plastic MP38	0205	4.5" (114.3 mm)	6.5" (165.1 mm)

Figure 1: MOSDAX Transducer Position

Dimensions of Packer Seals and Monitoring Zones. 0238 Packers



Discussion Points:

- The top of a coupling (Regular Coupling, Measurement Port or Pumping Port) is the reference point for describing nominal depths and nominal lengths. Actual positions of packer seals and zone lengths are determined with respect to the appropriate reference positions.
- Packer Position Example: A packer with a nominal depth of 50 ft. (15.2m), will have a nominal packer seal position of 51.3 to 54.3 ft. (15.59 to 16.49m)
- Zone Length Example: A zone whose upper packer is at 50 ft. (15.2m) and bottom packer is at 70 ft. (21.3m) will have a nominal zone length of 15 ft. (4.6m) and an actual zone length (between packer seals) of 15.0+1.3+0.7 = 17.0ft. (4.6 + 0.39 + 0.2 = 5.19m)
- Information on the position of Measurement Port Valve and MOSDAX Transducer sensor, used for detailed calculation of piezometric level measurements, are described separately.

Figure 2: Zone Dimensions

APPENDIX A: MONITORING WELL: BH2-WB

As-Built Key Components Summary (Table 4)	- 1 page
As-Built Tubing Summary (Table 5)	- 1 page
Summary Completion Log	- 2 pages
Pre-Inflation Piezometric Pressure/ Levels	
Field Data and Calculation Sheet (May 22)	- 1 page
Figure 3, Pre-Inflation Profile	- 1 page
Post- Inflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (May 22)	- 1 page
Figure 4, Post-Inflation Profile	- 1 page
Westbay Completion Log (field copy)	- 5 pages
Westbay System Packer Inflation Records	- 5 pages

Table 4: BH2-WB As-Built Packer and Port Summary

AB ,01/06/2015

Port No.	Zone	Measurement Port Depth, (m)	Pumping Port Depth, (m)	Depth to top of Packer, (m)	Top of Zone (m)	Bottom of Zone (m)	Comments
1	1	78.1		76.6	77.9	82.7	
2	QA 1	68.4		66.9	68.2	77.0	
3	2	63.8		62.3	63.6	67.3	
4	QA 2	62.3		60.8	62.1	62.7	
5	QA 3	54.7	53.1	53.1	54.4	61.2	
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Note 1: All depth measurements in meters below datum (GS).
Note 2: All depth measurements use 'Nominal' tubing lengths.
Note 3: Not corrected for borehole deviation or borehole temperature effects.
Note 4: All depth measurements to upper edge of Westbay System coupling item.

Table 5: BH2-WB As-Built Summary

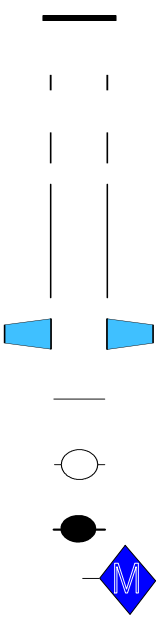
AB ,01/06/2015

Item No.	Component P/N	Component Description	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Accessory Depth (m)	Final Position (m)
34	20102			203				-1.2896
33	20102			202				-0.81
32	20105			202				-0.20043
31	20110			202		216	1.9	1.3235
30	20110			202				4.3713
29	20110			202				7.4192
28	20110			202				10.467
27	20110			202				13.515
26	20110			202				16.563
25	20110			202				19.611
24	20110			202				22.658
23	20110			202				25.706
22	20110			202				28.754
21	20110			202				31.802
20	20110			202				34.85
19	20110			202				37.898
18	20110			202				40.946
17	20110			202				43.993
16	20110			202				47.041
15	20110			202				50.089
14	238	Packer	19249	224	8716			53.137
13	20110	Measurement Port		205	8463			54.661
12	20110			202				57.709
11	238	Packer	19210	202				60.757
10	238	Packer	19206	205	8461			62.281
9	20110	Measurement Port		205	8460	216	64.4	63.804
8	238	Packer	19207	202				66.852
7	20110	Measurement Port		205	8462			68.376
6	20105			202				71.424
5	20102			202				72.948
4	20110			202				73.558
3	238	Packer	19202	202				76.605
2	20105	Measurement Port		205	8476	216	78.7	78.129
1	20110			202				79.653
0	203							82.701

Legend

(Qty) MP Components

(Library - WD Library 04/29/15)



(2) 0203 - MP38 End Cap

(3) 020102 - MP38 Casing 3 (2F/0.6M)

(3) 020105 - MP38 Casing 2 (5F/1.5M)

(23) 020110 - MP38 Casing 1 (10F/3M)

(5) 0238 - MP38 Packer - 74mm (5F/1.5M)

(28) 0202 - MP38 Regular Coupling

(1) 0224 - MP38 Pumping Port

(5) 0205 - MP38 Measurement Port

(4) 0216 - Magnetic Location Collar

Geology

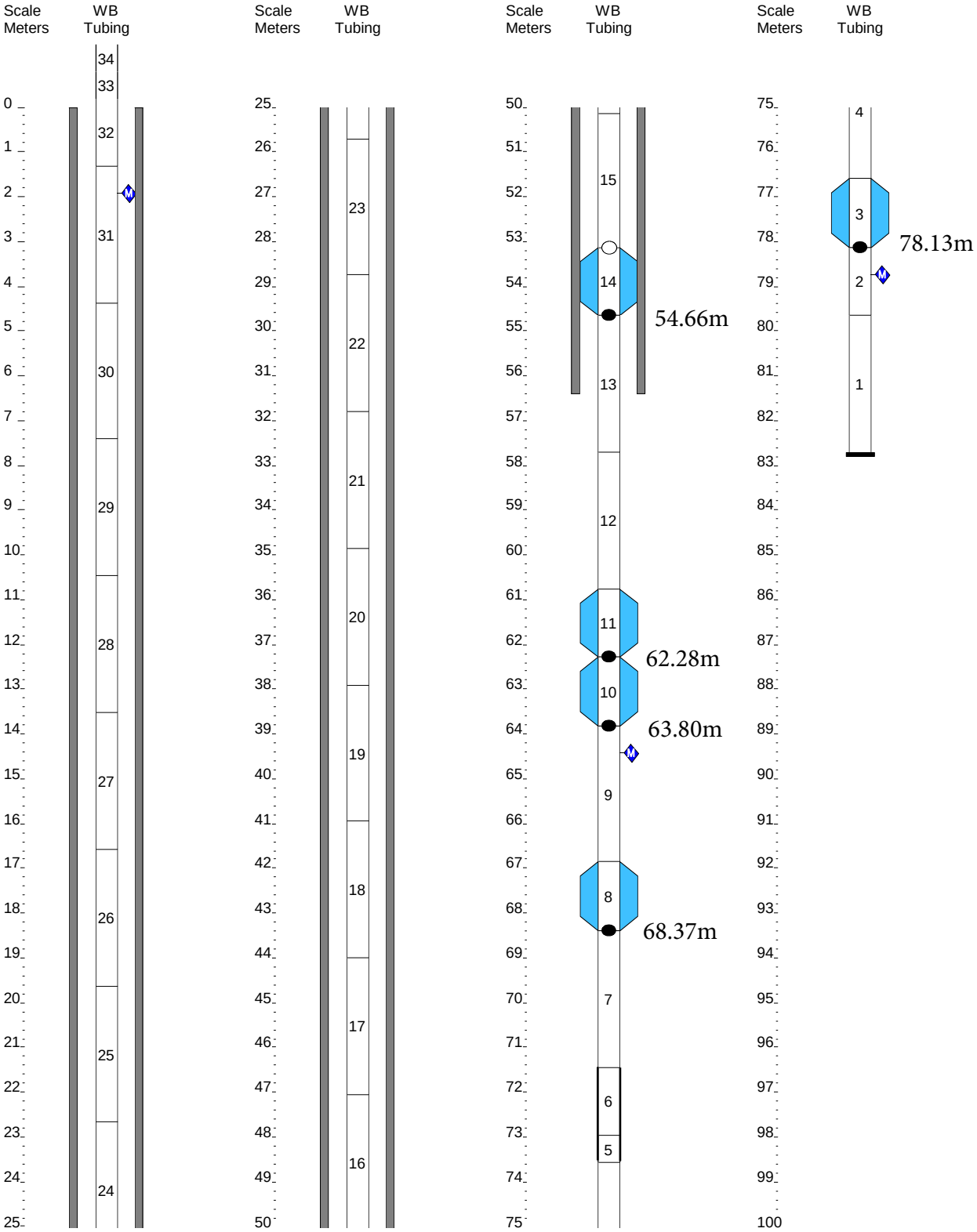
Backfill/Casing



Mild Steel

Summary Completion Log
LORAX

Job No: WB950
Well: BH2-WB



Westbay Instruments

Westbay Piezometric Pressures/Levels

Pre-dynamite

Field Data and Calculation Sheet

Well No.: BH-2
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: MP45
Serial No.: 2455
Probe Range: 250
Westbay Casing Type: MP38
Sampler Valve Position: C

Date: Apr 22/2015
Client: Golder
Job No.: 950
Location: Cable Creek
Weather: Sun
Operator: AB LF

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure 12.97 Finish: 13.03
Temp — —
Time — —

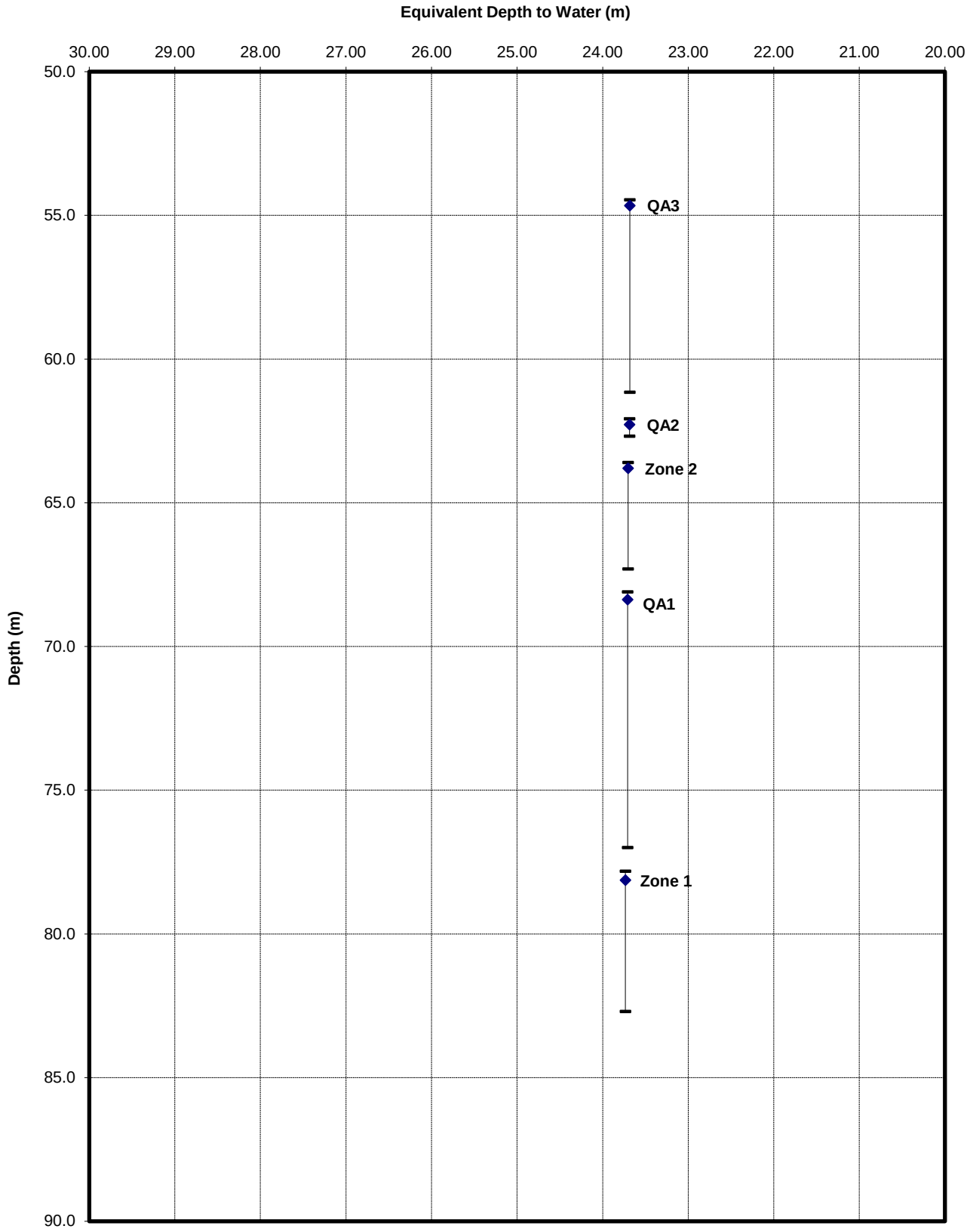
P_{atm} 12.97 psi

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings					Pressure Head Outside Port (m)	Piez. Level Outside Port (m)	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	H = (P2-Patm)/w	Dz = Dp - H	
1	78.1	78.3	—	34.39	90.32	9:26	6.40	34.39	54.39	23.7	
2	68.37	68.6	—	20.21	76.48	9:28	4.32	20.21	44.66	23.7	
3	63.8	63.0	—	13.59	69.99	9:29	3.61	13.59	40.10	23.7	
4	62.28	62.5	—	13.11	67.85	9:32	2.55	13.11	38.59	23.7	
5	54.6	54.8	—	13.11	57.07	9:35	2.18	13.11	30.97	23.7	

Notes: w = 1.422psi / m of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: BH2-WB

Profile Date: May 22, 2015
Comments: Pre-Inflation Profile



Client:LORAX Environmental Ltd
Site: Coffee Creek
Datum: Ground Surface

Figure 3

Plot By:____Date:____
Checked By:____Date:____
Westbay Project: WB950

Westbay Instruments

Westbay Piezometric Pressures/Levels

Post-inflation Field Data and Calculation Sheet

Well No.: BH-2
Datum: GS
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: EMS
Serial No.: 2499
Probe Range: 250
Westbay Casing Type: MP38
Sampler Valve Position: C

Date: 22/05/2015
Client: LORAK
Job No.: 950
Location: Coffee Creek
Weather: Sun 24
Operator: AB LF

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 13.03 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)

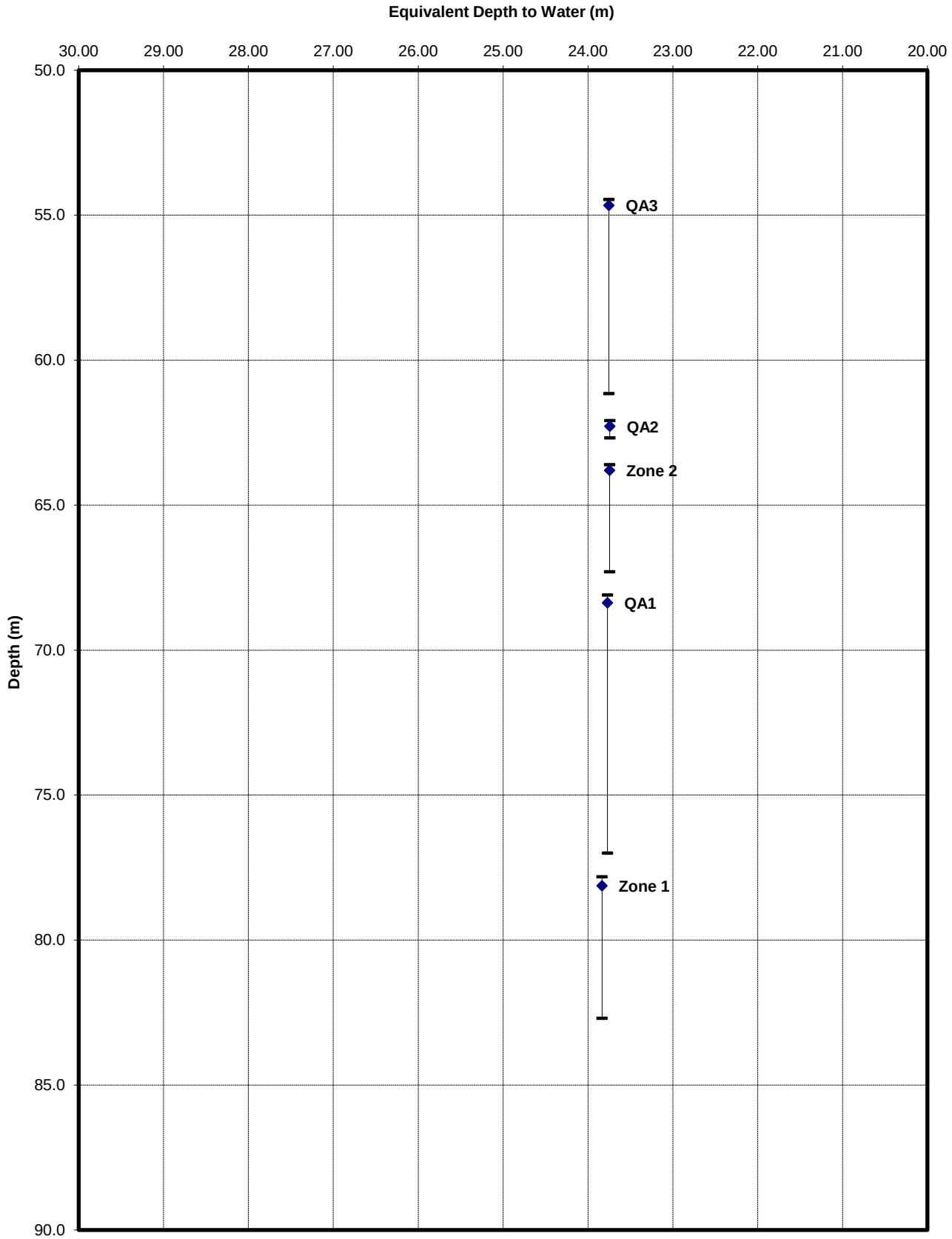
Start: Pressure 13.03 Finish: 13.05
Temp — —
Time — —

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
1	78.1	78.6		127.22	90.24	13:31	7.51	127.27	54.28	23.8	
2	68.4	68.9		113.13	76.45	13:35	3.43	~~76.45~~ 113.14	44.58	23.8	
3	63.8	~~62~~ 63.6		106.58	69.99	13:42	1.28	106.58	40.04	23.7	
4	62.3	62.1		104.37	67.83	13:45	1.05	104.38	38.52	23.8	
5	54.6	54.3		93.36	56.98	13:48	1.47	93.37	30.89	23.7	

Notes: w = 1.422psi / m of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: BH2-WB

Profile Date: May 22, 2015
Comments: Post-Inflation Profile



Client: LORAX Envivromental Ltd
Site: Coffee Creek
Datum: Ground Surface

Figure 4

Plot By:____Date:_____
Checked By:____Date:_____
Westbay Project:WB950

Westbay System Completion Log

Company: Loax
Well: BH-2
Site: Coffee Creek
Project: 11

WB #: 950
Author: AB

Well Information

Reference Datum: 0 ft. GS
Elevation of Datum: — ft.
WB Tubing Top: 1.4 ft. m
WB Tubing Length: 83.05 ft.

Borehole Depth: 83.5 ft. m
Borehole Inclination:
Borehole Diameter: 4.5 in.

Well Description:

Other References:

File Information

File Name: _____
Report Date: _____

File Date: _____

Comments

Installation sign-off Information

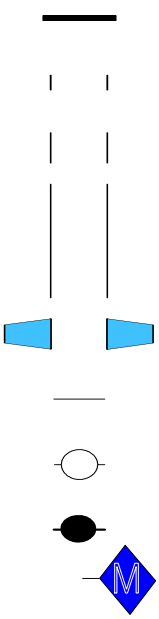
Borehole condition confirmed.(Client)	(method) Sounded	Date: 22/05/15
WB System design & preparation.(Client / WB)	By: AB	Date: 22/05/15
WB System design checked. (Client / WB)	By: AB VS	Date: 22/05/15
WB System and borehole approved to install. (Client)	By: VS	Date: 22/05/15

VSR

Legend

(Qty) MP Components

(Library - WD Library 04/29/15)



(2) 0203 - MP38 End Cap

(3) 020102 - MP38 Casing 3 (2F/0.6M)

(3) 020105 - MP38 Casing 2 (5F/1.5M)

(23) 020110 - MP38 Casing 1 (10F/3M)

(5) 0238 - MP38 Packer - 74mm (5F/1.5M)

(28) 0202 - MP38 Regular Coupling

(1) 0224 - MP38 Pumping Port

(5) 0205 - MP38 Measurement Port

(4) 0216 - Magnetic Location Collar

Geology

Backfill/Casing

Mild Steel

Westbay Instruments

Westbay System Completion Log

Sheet 1 of 3

Project: Coffee Creek / LORAX WB#.: 950

Location: Hole No.: BH-2 Installed by: AB

Hole Depth: 83.5m WB Depth: 83.05m Hole Diameter: 4.5" Date Installed: 22/05/15

Measurement Datum: GS Datum Elevation: — Date Drawn: 22/05/15

Scale, (m)(ft)	Component Description	Depth Log	WB Tubing Log	Serial No.	Final Packer Pressure/Volume	Comments	Joint Install	Joint Test
0		-1.40	39			2	✓	✓
		-.80	38			2	✓	✓
			32			5		
							✓	✓
			31			10		
							✓	✓
			30			10		
							✓	✓
			29			10		
							✓	✓
			28			10		
							✓	✓
			27			10		
							✓	✓
			26			10		
							✓	✓
			25			10		
							✓	✓
			24			10		
							✓	✓
			23			10		
							✓	✓

WB Tubing | WB Packer | Magnetic Collar | Filter Sleeve | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Westbay Instruments

Westbay System Completion Log

Sheet 2 of 3

Project: — WB#.: 950

Location: — Hole No.: BH2 Installed by: AB

Hole Depth: — WB Depth: — Hole Diameter: — Date Installed: —

Measurement Datum: — Datum Elevation: — Date Drawn: —

Scale, (m/ft)	Component Description	Depth Log	WB Tubing Log	Serial No.	Final Packer Pressure/Volume	Comments	Joint Install	Joint Test
			22			10		
							✓	✓
			21			10		
							✓	✓
			20			10		
							✓	✓
			19			10		
							✓	✓
			18			10		
							✓	✓
			17			10		
							✓	✓
			16			10		
							✓	✓
			15			10	✓	✓
		53.14		8716				
			14	19249		238	✓	✓
		54.67		8463				
			13			10	✓	✓
			12			10	✓	✓

WB Tubing | WB Packer | Magnetic Collar / Filter Sleeve | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Westbay Instruments

Westbay System Completion Log

Sheet 3 of 3

Project: — WB#.: 950

Location: — Hole No.: BH-2 Installed by: AB

Hole Depth: — WB Depth: — Hole Diameter: — Date Installed: —

Measurement Datum: — Datum Elevation: — Date Drawn: —

Scale, (m/ft)	Component Description	Depth Log	WB Tubing Log	Serial No.	Final Packer Pressure/Volume	Comments	Joint Install	Joint Test
			11	19210		238	—	—
		62.28		8461				
			10	19206		238	—	—
		63.80		8460				
			9			10		
							—	—
			8	19207		238	—	—
		68.37		8462				
			7			10		
							—	—
			6			5	—	—
			5			2	—	—
			4			10		
			3	19202		238	—	—
		78.13		8476				
			2			5	—	—
			1			10		
		82.70					—	—

WB Tubing WB Packer Magnetic Collar Filter Sleeve Measurement Port Coupling Pumping Port Coupling Regular Coupling

Sheet ___ of ___

Westbay Packer Inflation Record

Project: Cokker Creek Project No.: WB950 Well No.: BH-2

Location: " Completed by: AB Date Inflated: 22/05/2015

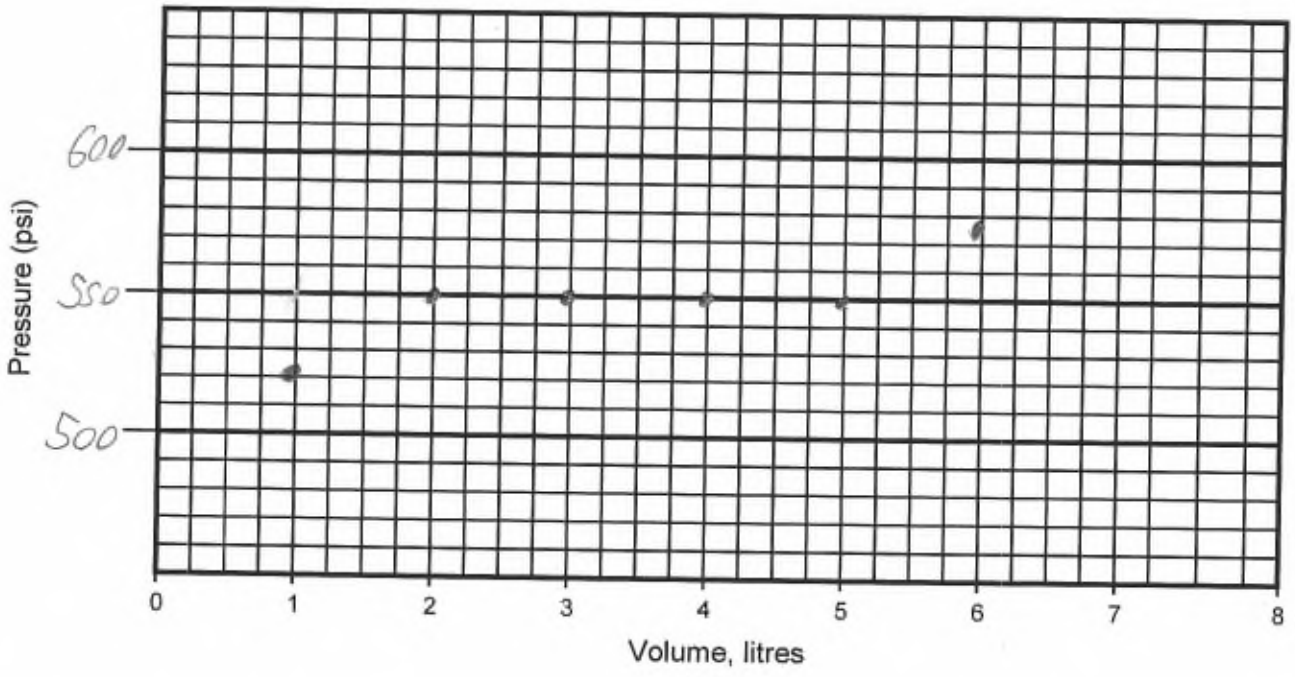
Packer No. 19202 #1 Depth (ft / m): — Inflation Tool No.: —

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 575 psi Tool Pressure, P_T: 300 psi

Borehole Water Level: 24 (ft / m) = 10 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 135 psi

Volume, litres	1	2	3	4	5	6	/	5.6		
Pressure, psi	525	550	550	550	550	575	/	0		
Volume, litres										
Pressure, psi										



Comments: Time - 10:22 Start

10:34 Finish

Sheet___of___

Westbay Packer Inflation Record

Project: Coffee Creek Project No.: WB-950 Well No.: BH-2

Location: 11 Completed by: AB Date Inflated: 22/05/2015

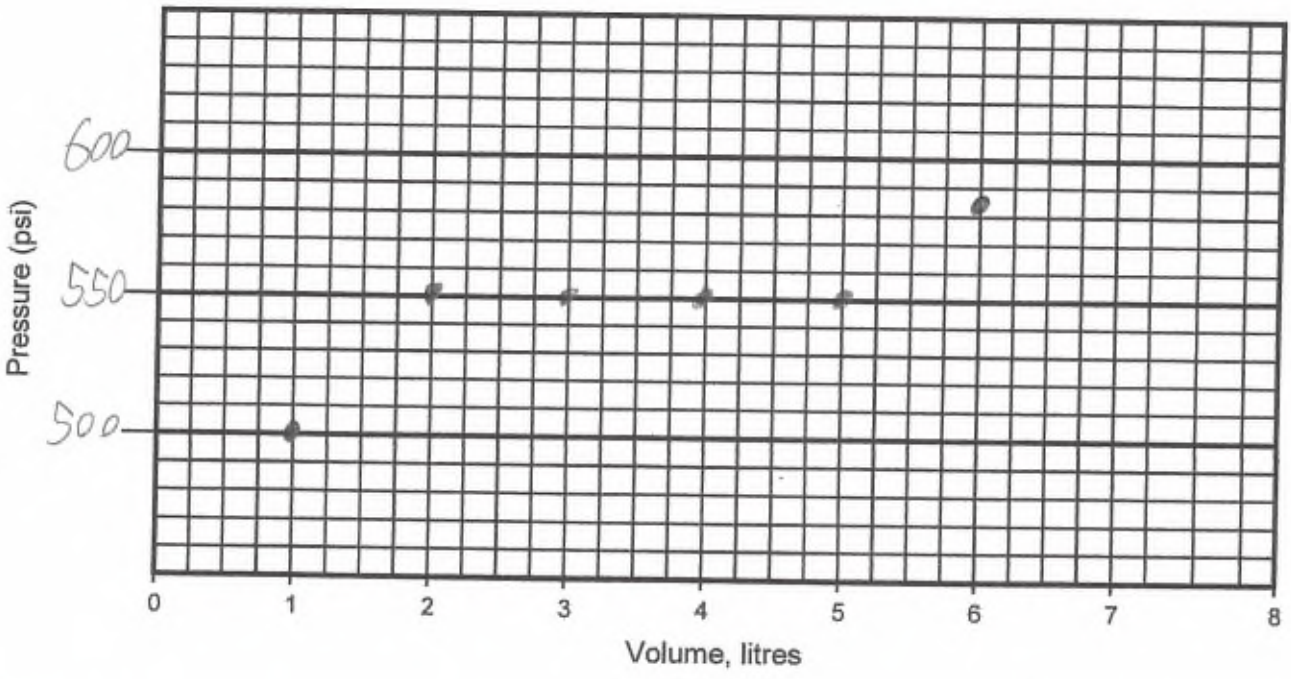
Packer No. 2 19207 Depth (ft / m): — Inflation Tool No.: —

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 575 psi Tool Pressure, P_T: 300 psi

Borehole Water Level: 24 (ft / m) = 10 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 130 psi

Volume, litres	1	2	3	4	5	6	/	5.6		
Pressure, psi	500	550	550	550	550	575	/	0		
Volume, litres										
Pressure, psi										



Comments: Time - 10:40 START

Sheet ___ of ___

Westbay Packer Inflation Record

Project: Coffee Creek Project No.: WB950 Well No.: BH-2

Location: 11 Completed by: AB Date Inflated: 22/05/2015

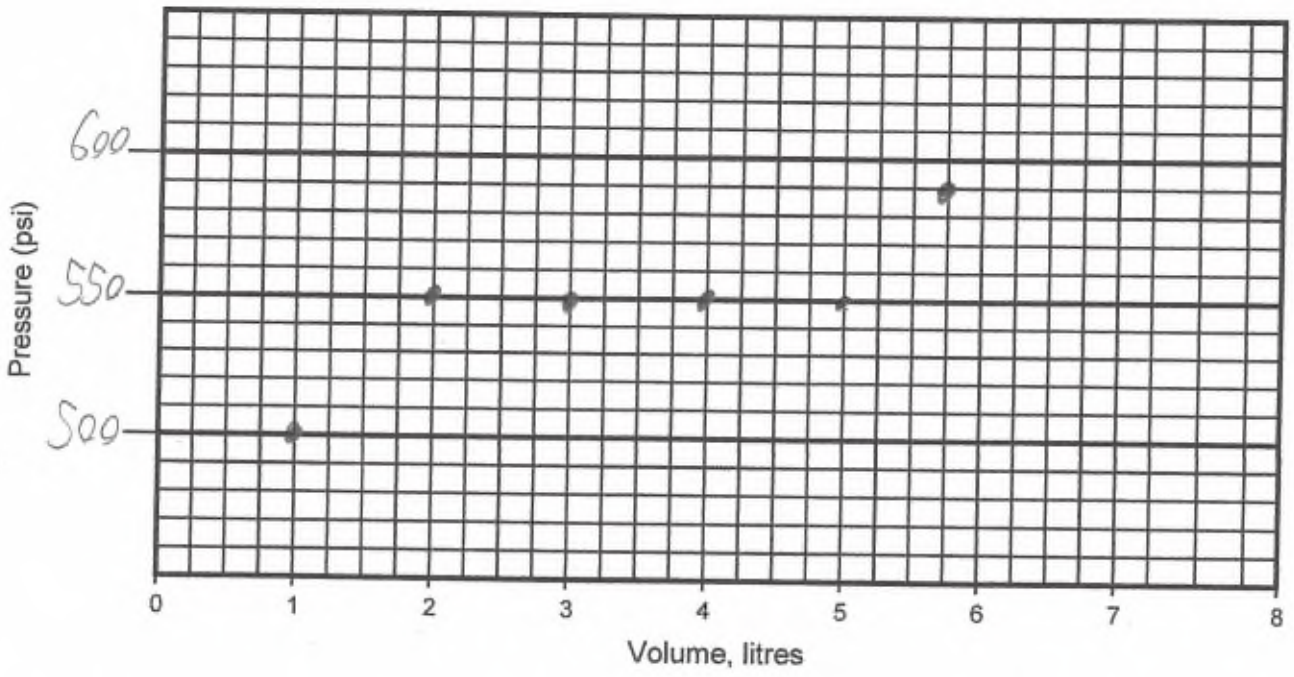
Packer No. 3 19206 Depth (ft / m): — Inflation Tool No.: —

Packer Valve Pressure, P_V: 155 psi Final Line Pressure, P_L: 575 psi Tool Pressure, P_T: 300 psi

Borehole Water Level: 24 (ft / (m)) = 10 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 135 psi

Volume, litres	1	2	3	4	5	5.75	/	5.25		
Pressure, psi	500	550	550	550	550	575	/	0		
Volume, litres										
Pressure, psi										



Comments: Time - 10:59

11:12

Sheet___of___

Westbay Packer Inflation Record

Project: Coffee Creek Project No.: WB950 Well No.: BH-2

Location: _____ Completed by: AB Date Inflated: 22/05/2015

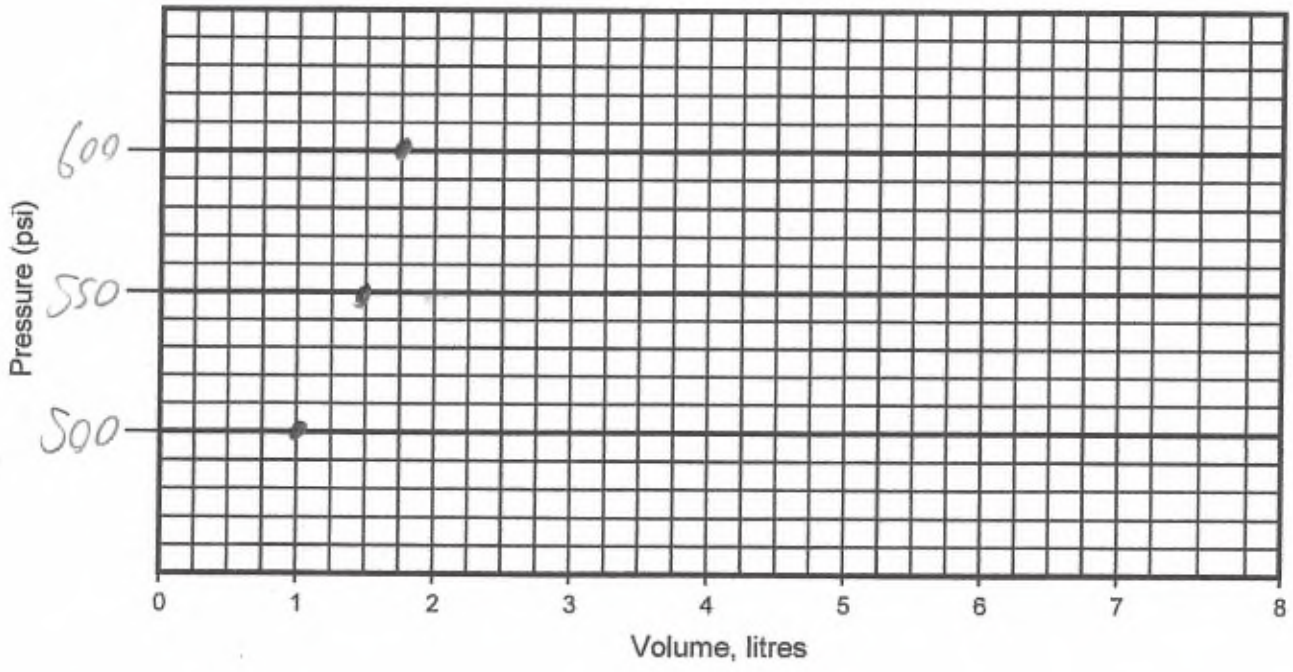
Packer No. 19249 #5 Depth (ft / m): — Inflation Tool No.: —

Packer Valve Pressure, P_V: 155 psi Final Line Pressure, P_L: 600 psi Tool Pressure, P_T: 300 psi

Borehole Water Level: 24 (ft / (m)) = 10 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 155 psi

Volume, litres	1	1.5	1.75							
Pressure, psi	500	550	600							
Volume, litres										
Pressure, psi										



Comments: HQ Packer Time - 11:37

Sheet ___ of ___

Westbay Packer Inflation Record

Westbay Instruments

Project: Coffee Creek Project No.: WB950 Well No.: BH-2

Location: 11 Completed by: AB Date Inflated: 22/05/2015

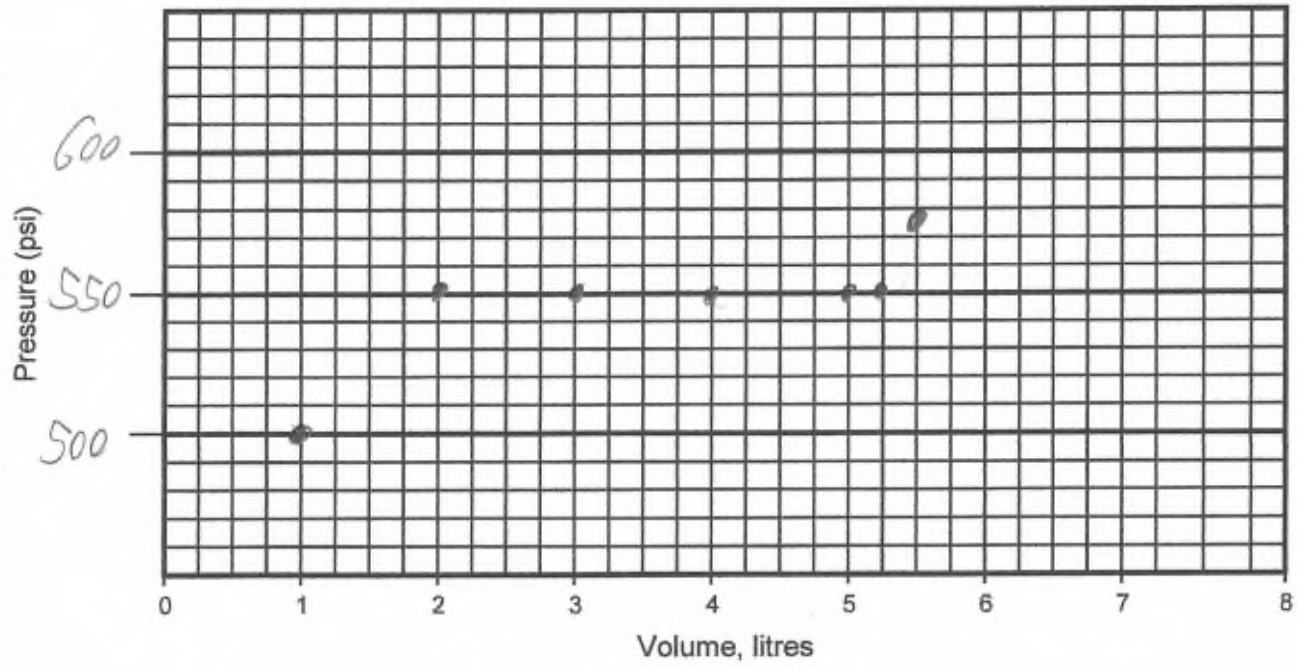
Packer No. 4 / 9210 Depth (ft / m): — Inflation Tool No.: ____

Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 575 psi Tool Pressure, P_T: 300 psi

Borehole Water Level: 24 (ft / m) = 10 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 145 psi

Volume, litres	1	2	3	4	5	5.25	5.5	/	5.1	
Pressure, psi	500	550	550	550	550	550	575	/	0	
Volume, litres										
Pressure, psi										



Comments: Back to Back Packers Time - 11:16

APPENDIX B: MONITORING WELL: BH4-WB

As-Built Key Components Summary (Table 4)	- 1 page
As-Built Tubing Summary (Table 5)	- 1 page
Summary Completion Log	- 2 pages
Pre-Inflation Piezometric Pressure/ Levels	
Field Data and Calculation Sheet (May 19)	- 1 page
Figure 3, Pre-Inflation Profile	- 1 page
Post- Inflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (May 19)	- 1 page
Figure 4, Post-Inflation Profile	- 1 page
Westbay Completion Log (field copy)	- 4 pages
Westbay System Packer Inflation Records	- 6 pages

Table 5: BH4-WB As-Built Summary



AB, 01/06/2015

Port No.	Zone	Measurement Port Depth, (m)	Pumping Port Depth, (m)	Depth to top of Packer, (m)	Top of Zone (m)	Bottom of Zone (m)	Comments
1		57.809		56.285	57.6	65.7	
2		54.762		53.238	54.5	56.7	
3		41.351		39.827	41.1	53.6	
4		38.303		36.779	38.1	40.2	
5		33.122		31.598	32.9	37.2	
6		28.55	27.026	27.026	28.3	32.0	
7							
8							
9							
10							
11							
12							
13							
14							
15							

Note 1: All depth measurements in meters below datum (GS).
Note 2: All depth measurements use 'Nominal' tubing lengths.
Note 3: Not corrected for borehole deviation or borehole temperature effects.
Note 4: All depth measurements to upper edge of Westbay System coupling item.

Table 5: BH4-WB As-Built Summary



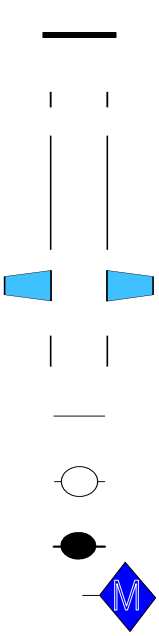
AB ,01/06/2015

Item No.	Component P/N	Component Description	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Accessory Depth (m)	Final Position (m)
29	203							-1.062
28	20102			202				-1.0142
27	20110			202				-0.40459
26	20110			202		216	3.2	2.6433
25	20110			202				5.6911
24	20110			202				8.739
23	20110			202				11.787
22	20110			202				14.835
21	20110			202				17.883
20	20110			202				20.93
19	20110			202				23.978
18	238	Packer	19204	224	8715			27.026
17	20110	Measurement Port		205	8448			28.55
16	238	Packer	19219	202				31.598
15	20110	Measurement Port		205	8477			33.122
14	20102			202				36.17
13	238	Packer	19217	202				36.779
12	20105	Measurement Port		205	8472	216	38.9	38.303
11	238	Packer	19218	202				39.827
10	20110	Measurement Port		205	8475			41.351
9	20110			202				44.399
8	20105			202				47.447
7	20102			202				48.971
6	20102			202				49.58
5	20110			202				50.19
4	238	Packer	19203	202				53.238
3	20105	Measurement Port		205	8474	216	55.4	54.762
2	238	Packer	19220	202				56.285
1	20110	Measurement Port		205	8473			57.809
0	203							60.857

Legend

(Qty) MP Components

(Library - WD Library 04/29/15)



(2) 0203 - MP38 End Cap

(5) 020102 - MP38 Casing 3 (2F/0.6M)

(15) 020110 - MP38 Casing 1 (10F/3M)

(6) 0238 - MP38 Packer - 74mm (5F/1.5M)

(3) 020105 - MP38 Casing 2 (5F/1.5M)

(22) 0202 - MP38 Regular Coupling

(1) 0224 - MP38 Pumping Port

(6) 0205 - MP38 Measurement Port

(3) 0216 - Magnetic Location Collar

Geology

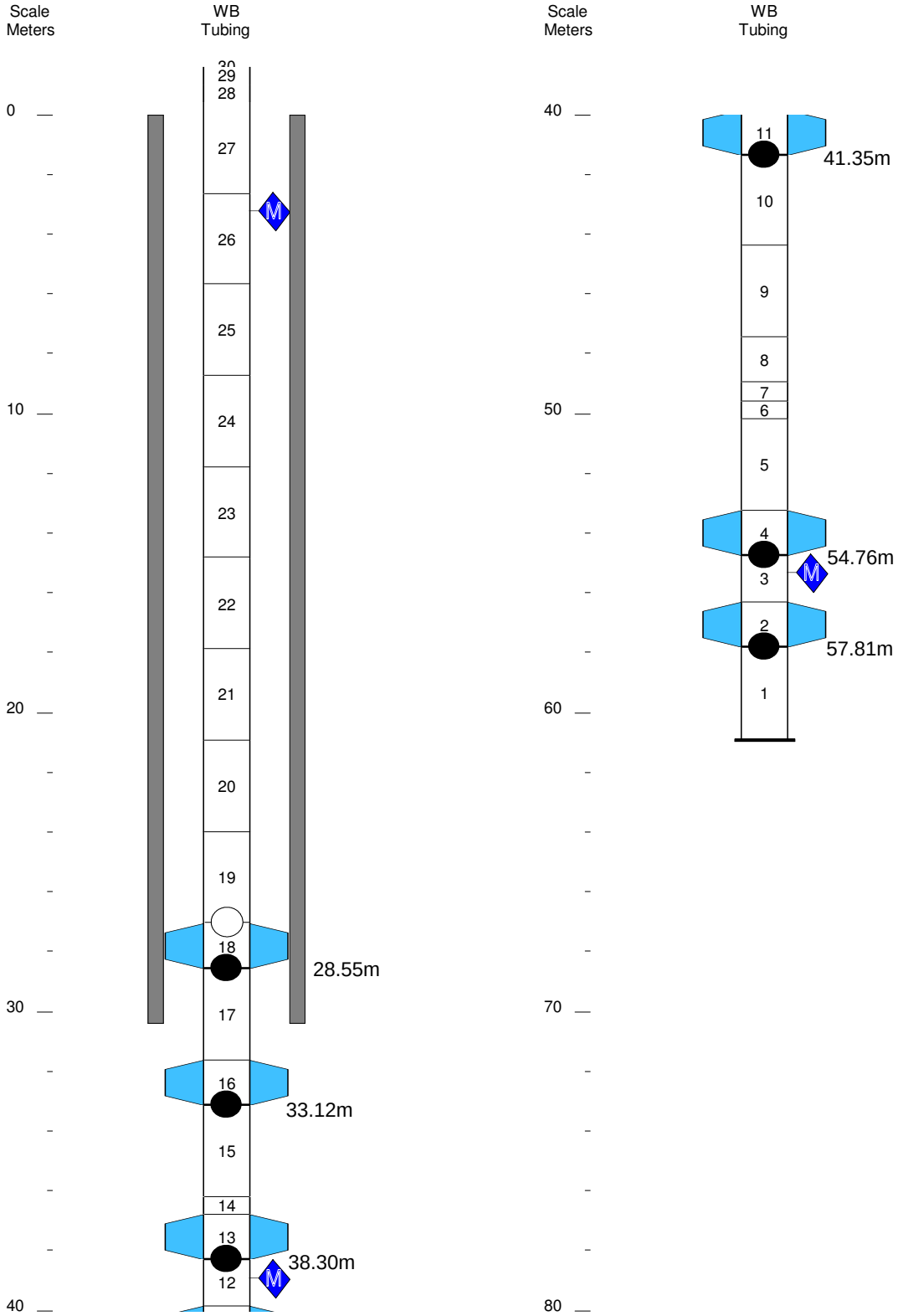
Backfill/Casing



Mild Steel

Summary Completion Log
LORAX

Job No: WB950
Well: BH4-WB



PRE-INFLATION OF 4 BOTTOM PACKERS

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Well No.: BH4-WB
Datum: GS
Elev. G.S.: Ø
Height of Westbay above G.S.: 1.44m (recoupling)
Elev. top of Westbay Casing: Ø
Reference Elevation: Ø
Borehole angle: Vertical

Probe Type: Sampler
Serial No.: EM52499
Probe Range: 250 psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Date: May 19/15
Client: CDRAX
Job No.: WB950
Location: Coffee
Weather: Overcast/Warm
Operator: M. Lessard

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 13.59 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure 13.59 psi
Temp 10.35 °C
Time 8:51 am

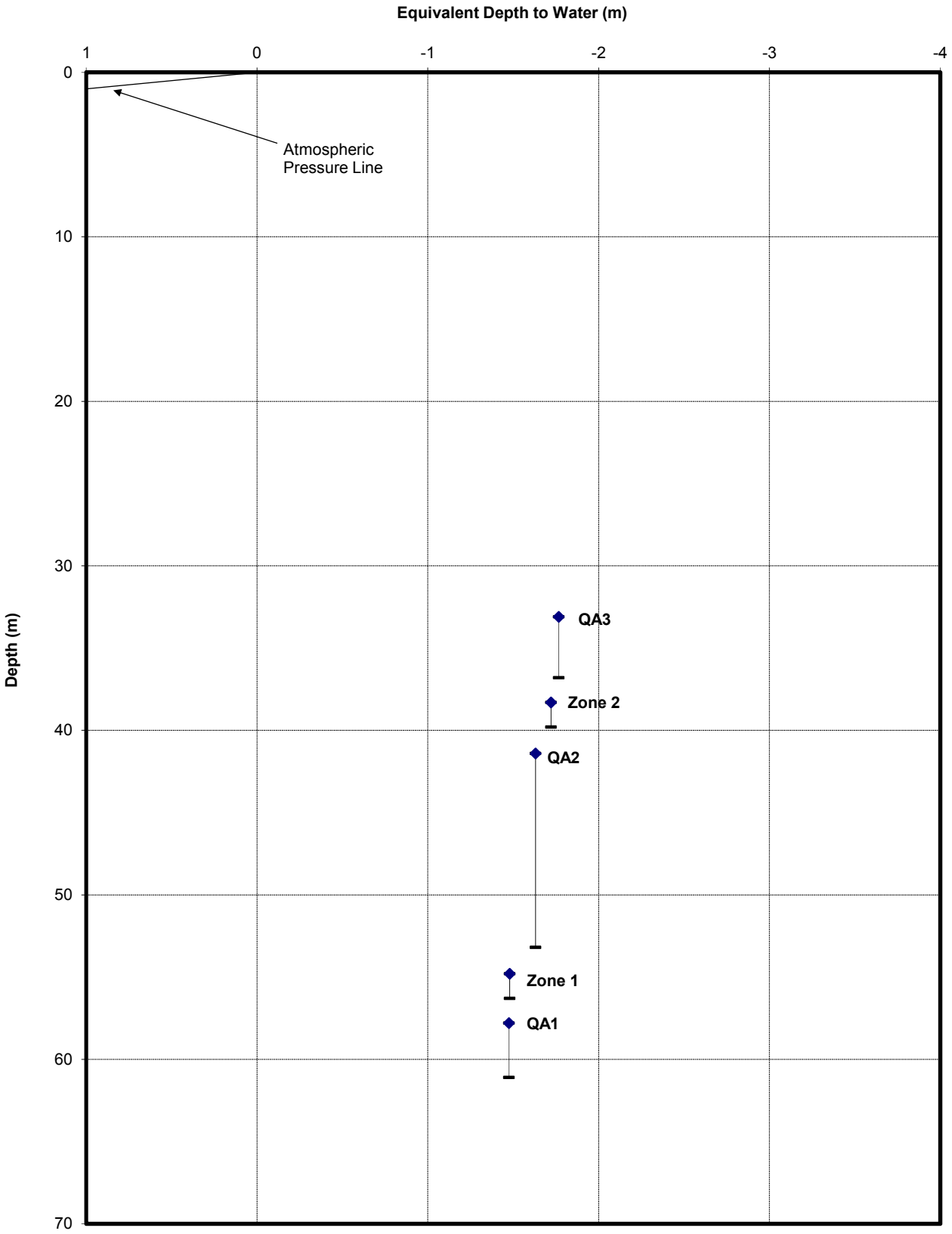
Finish: 13.59 psi
0.61 °C
9:42 am

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	ZONES	Comments
1	57.8	58.0	-	98.57	97.88	9:31	1.02	98.57	59.3	-1.5	QA1	
2	54.8	54.9	-	94.20	93.62	9:33	1.02	94.20	56.3	-1.5	Zone1	
3	41.4	41.5	-	79.84	74.78	9:35	0.86	74.84	43.0	-1.6	QA2	
4	38.3	38.4	-	70.45	70.50	9:36	0.75	70.45	40.0	-1.7	Zone2	
5	33.1	33.2	-	62.93	63.17	9:38	0.63	62.94	34.9	-1.8	QA3	
6	28.6	28.7	-	56.28	56.66	9:39	0.54	56.28	30.3	-1.7	QA4	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: BH4-WB

Profile Date: May 19, 2015
Comments: Pre-Inflation Profile



Client: LORAX
Site: Coffee Creek
Datum: GS

Figure 3

Plot By:____Date:____
Checked By:____Date:____
Westbay Project: WB950

POST INFLATION

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Well No.: BH4-WB
Datum: GS
Elev. G.S.: Ø
Height of Westbay above G.S.:
Elev. top of Westbay Casing: Ø
Reference Elevation: Ø
Borehole angle: Vertical

Probe Type: Sampler
Serial No.: EMS 2499
Probe Range: 250psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Date: May 19/15
Client: LoraX
Job No.: WB 958
Location: Coffee
Weather: Hot, Clear
Operator: M. Leggard

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

		Finish:
Start: Pressure	13.59 psi	13.59 psi
Temp	22.92 °C	2.48 °C
Time	12:37pm	12:54 pm

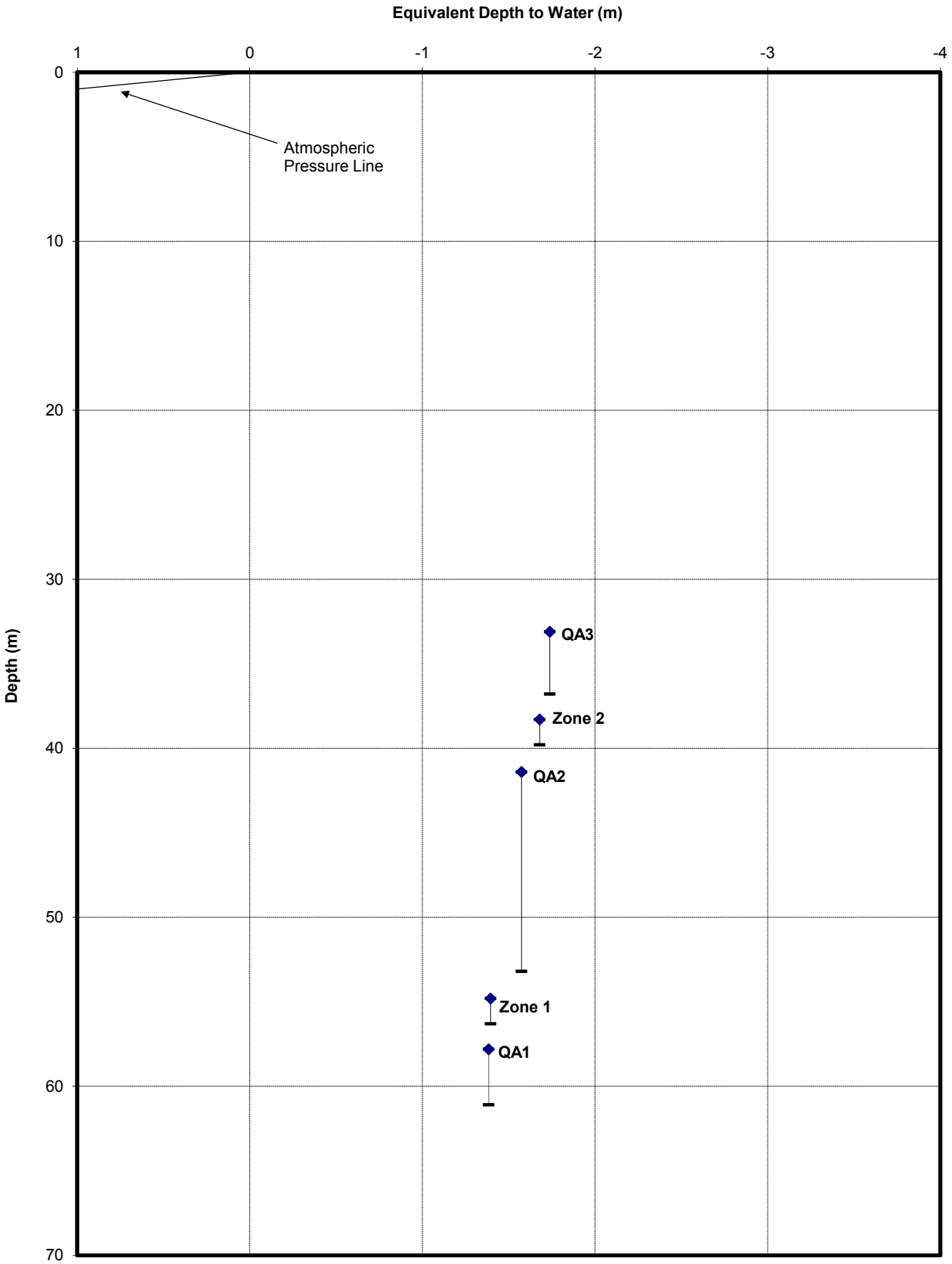
P_{atm} 13.59 psi

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
											Zones
1	57.8	58.0	-	90.22	97.75	12:42	11.55	90.23	59.2	-1.4	QA1
2	54.8	55.0	-	85.84	93.50	12:44	7.53	85.85	56.2	-1.4	Zone 1
3	41.4	41.5	-	66.54	74.70	12:46	4.74	66.56	43.0	-1.6	QA2
4	38.3	38.4	-	62.16	70.44	12:48	3.47	62.18	40.0	-1.7	Zone 2
5	33.1	33.2	-	54.67	63.13	12:50	2.93	54.68	34.8	-1.7	QA3
6	28.6	28.7	-	48.04	56.63	12:51	2.41	48.05	30.3	-1.7	QA4

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: BH4-WB

Profile Date: May 19, 2015
Comments: Post-Inflation Profile



Client: LORAX
Site: Coffee
Datum: GS

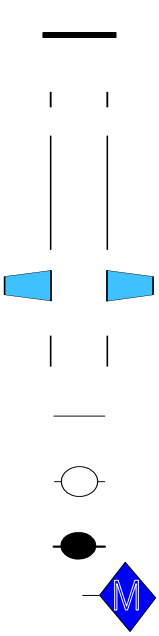
Figure 4

Plot By:____Date:_____
Checked By:____Date:_____
Westbay Project: WB950

Legend

(Qty) MP Components

(Library - WD Library 04/29/15)



(2) 0203 - MP38 End Cap

(5) 020102 - MP38 Casing 3 (2F/0.6M)

(15) 020110 - MP38 Casing 1 (10F/3M)

(6) 0238 - MP38 Packer - 74mm (5F/1.5M)

(3) 020105 - MP38 Casing 2 (5F/1.5M)

(22) 0202 - MP38 Regular Coupling

(1) 0224 - MP38 Pumping Port

(6) 0205 - MP38 Measurement Port

(3) 0216 - Magnetic Location Collar

Geology

Backfill/Casing



Mild Steel

Westbay Completion Log

Company: LORAX
Well: BH4-WB
Site: Coffee
Project: Coffee

Job No: WB950
Author: ML

Well Information

Reference Datum:
Elevation of Datum: 0.00 m.
MP Casing Top: 0.00 m.
MP Casing Length: 60.91 m.

Borehole Depth: 61.10 m.
Borehole Inclination: Vertical
Borehole Diameter: 114.00 mm

Well Description:
Permafrost
Other References:

File Information

File Name: BH4_WB.WWD
Report Date: Sun May 17 17:18:06 2015

File Date: May 17 11:45:14 2015

Comments

Zero reference is ground surface - LF
Filter socks not to be used - LF

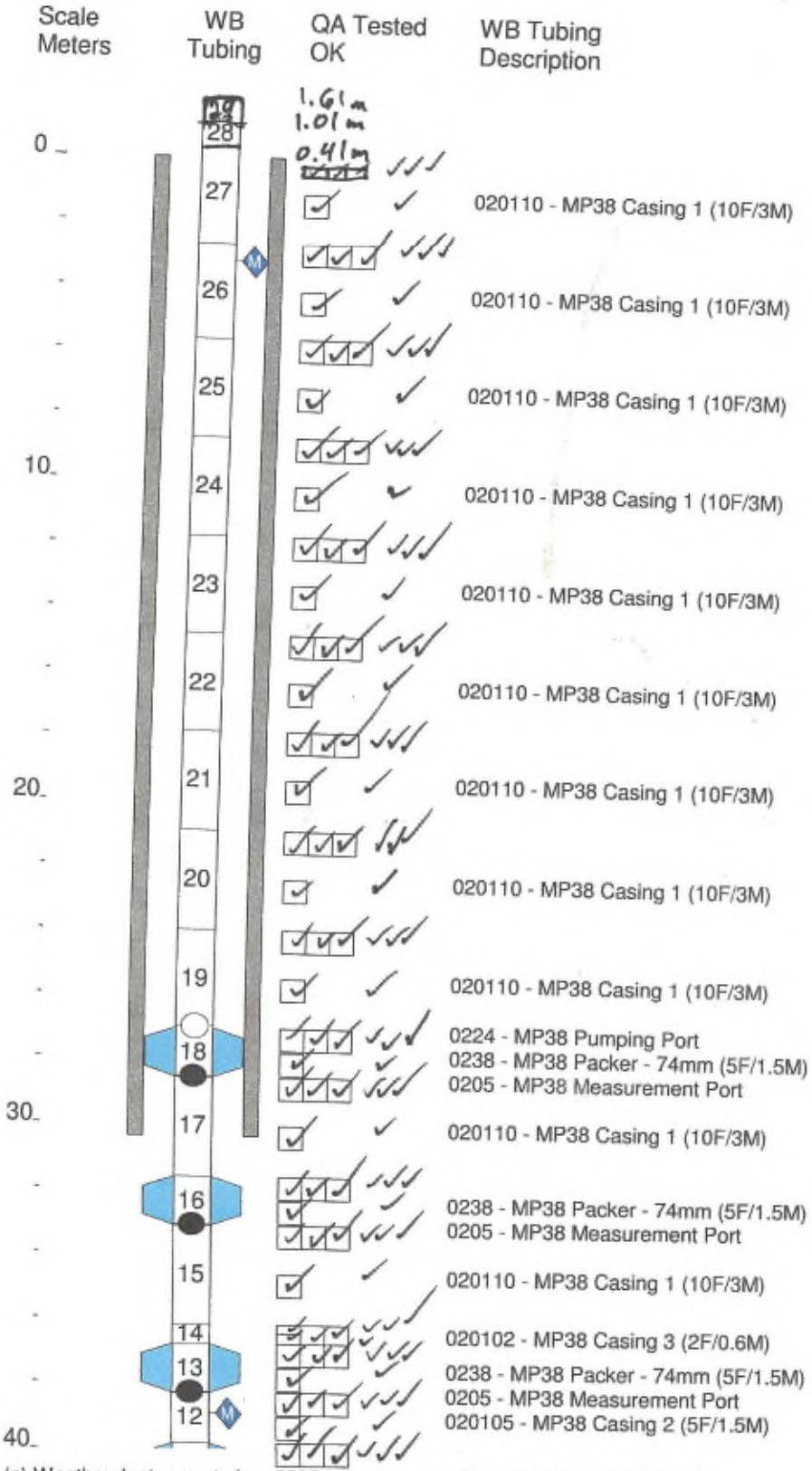
Log Information

Borehole condition confirmed.
MP well design & preparation.
MP well design checked.
MP well and borehole approved to install.

(method) _____ Date: _____
By: _____ Date: 5/17/15
By: _____ Date: 5/17/15
By: _____ Date: 5/17/15

Westbay Completion Log
LORAX

Job No: WB950
Well: BH4-WB



Finish lowering at 9.57pm May 17/15

Finish re-lowering at 3:20am on May 17/15

8715
19204-155psi
8448

19219-150psi
8477

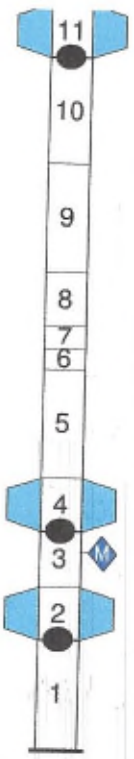
19217-145psi
8472

(c) Westbay Instruments Inc. 2000

Sun May 17 17:18:32 2015

Westbay Completion Log
LORAX

Job No: WB950
Well: BH4-WB



Scale Meters	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
40	11	✓	0238 - MP38 Packer - 74mm (5F/1.5M)	19218 - 145 psi: 8475
		✓	0205 - MP38 Measurement Port	
	10	✓	020110 - MP38 Casing 1 (10F/3M)	
		✓		9:00 pm
	9	✓	020110 - MP38 Casing 1 (10F/3M)	
	8	✓	020105 - MP38 Casing 2 (5F/1.5M)	
50	7	✓	020102 - MP38 Casing 3 (2F/0.6M)	
	6	✓	020102 - MP38 Casing 3 (2F/0.6M)	
	5	✓	020110 - MP38 Casing 1 (10F/3M)	
	4	✓	0238 - MP38 Packer - 74mm (5F/1.5M)	19203 - 150 psi: 8474
		✓	0205 - MP38 Measurement Port	
	3	✓	020105 - MP38 Casing 2 (5F/1.5M)	
	2	✓	0238 - MP38 Packer - 74mm (5F/1.5M)	19220 - 140 psi: 8473
		✓	0205 - MP38 Measurement Port	
60	1	✓	020110 - MP38 Casing 1 (10F/3M)	
		✓	0203 - MP38 End Cap	

Joint test tool 200 psi.

Borehole is artesian

Start lowering at 08:25 pm May 17/15

Start re-lowering casing at 2:10 am May 17/15

70

80

(c) Westbay Instruments Inc. 2000

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH4-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Lessard Date Inflated: May 19/15

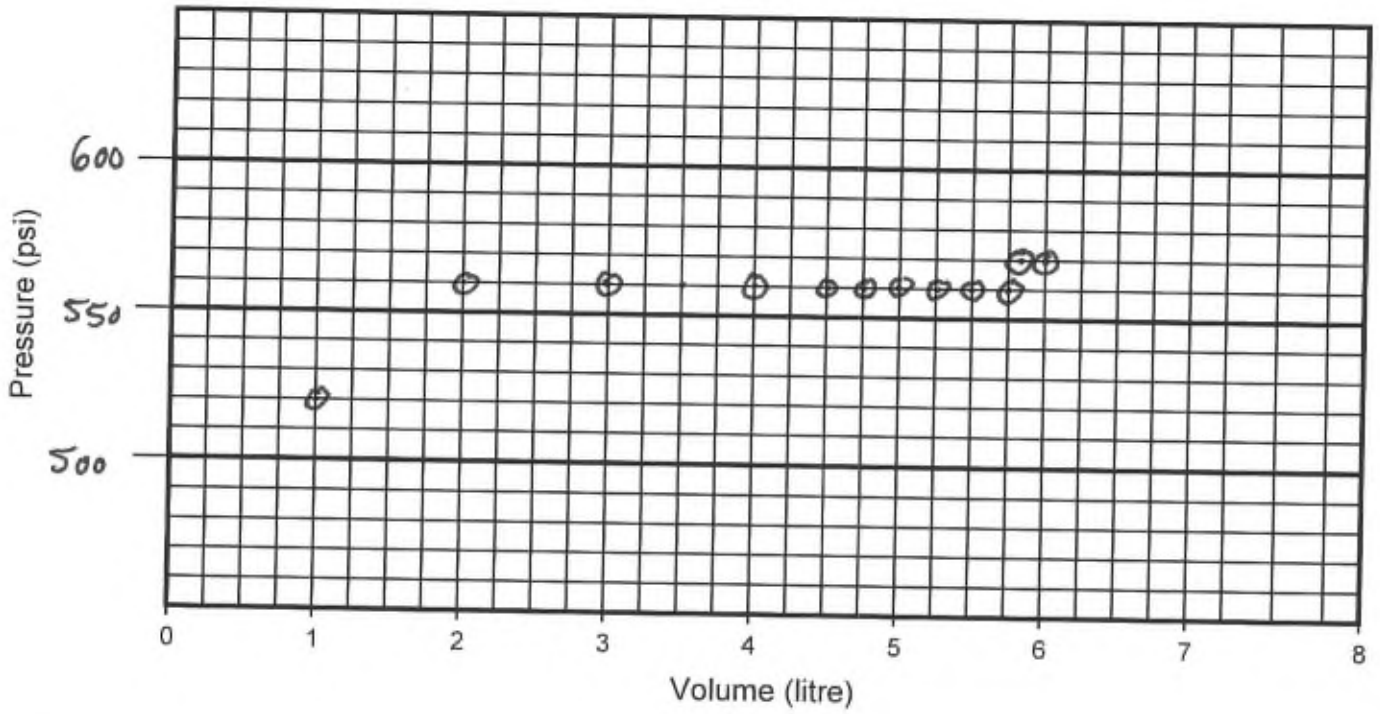
Packer No. 1, comp 2 SN# 19280 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 140 psi Final Line Pressure, P_L: 570 psi Tool Pressure, P_T: 350 psi

Borehole Water Level: 0 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 80 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	4.75	5.0	5.25	5.5	5.75
Pressure, psi	520	560	560	560	560	560	560	560	560	560
Volume, litres	5.85	6.0	/	5.6						
Pressure, psi	570	570	/	0						



Comments: _____ Time - 10:54 am

_____

_____

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH4-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Legaard Date Inflated: May 19/15

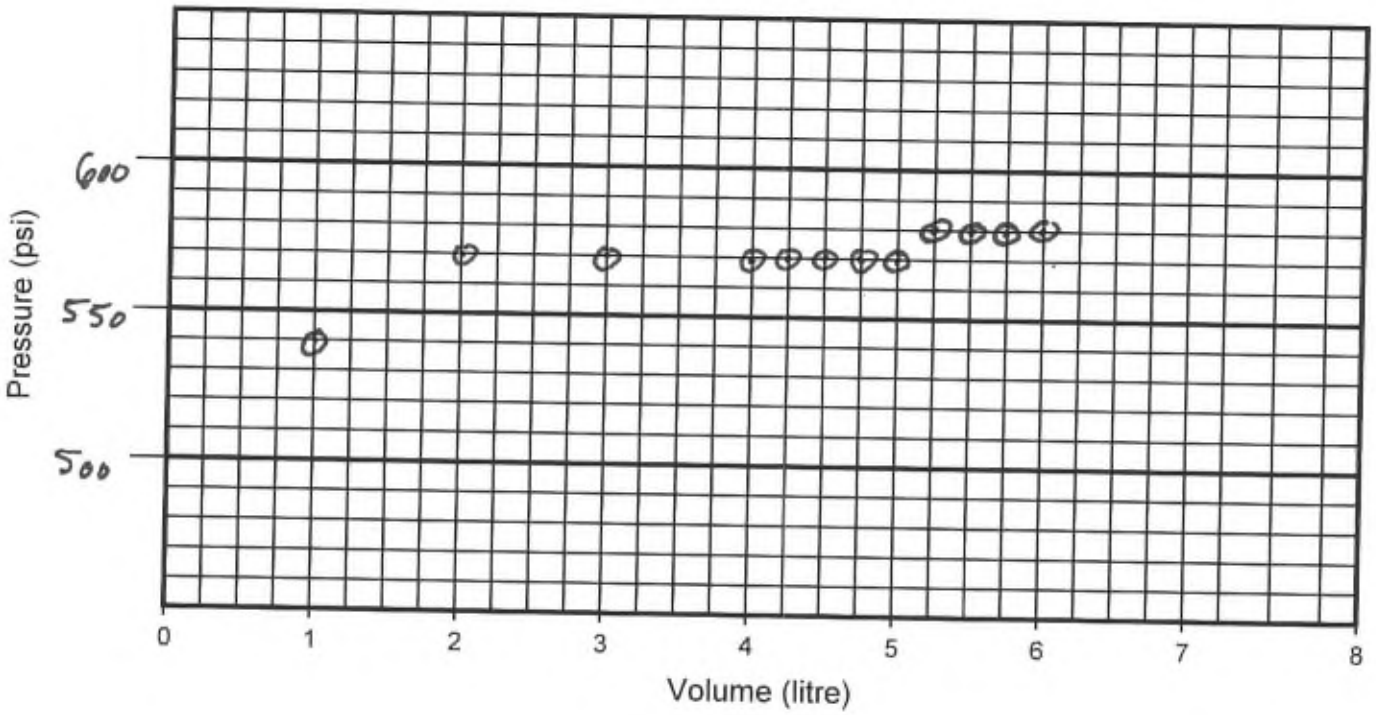
Packer No. 2, comp 4 SN# 19203 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 580 psi Tool Pressure, P_T: 350 psi

Borehole Water Level: 0 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 80 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	4.75	5.0	5.25	5.5	5.75
Pressure, psi	540	570	570	570	570	570	570	580	580	580
Volume, litres	6.0	/	5.6							
Pressure, psi	580	/	0							



Comments: _____ Time - 11:18 am

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH4-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M.Lessard Date Inflated: May 19/15

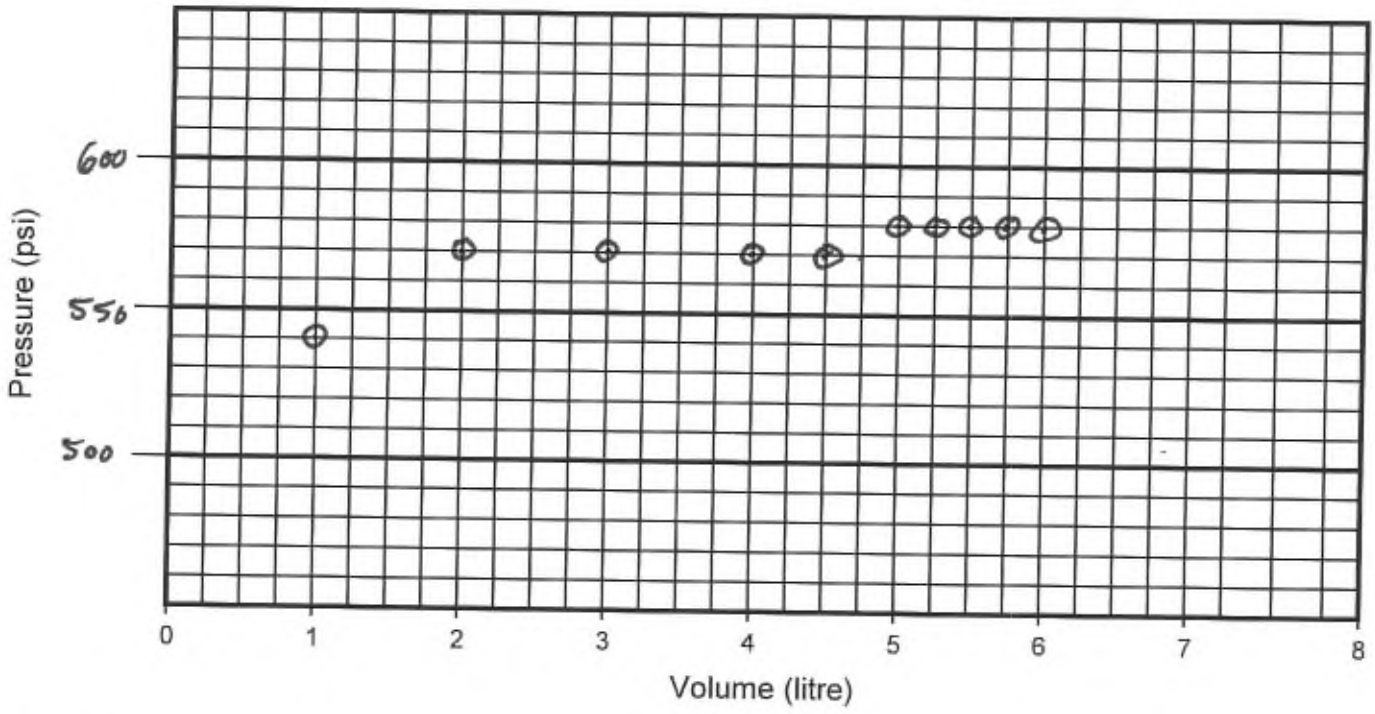
Packer No. 3, comp II SN#19218 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 580 psi Tool Pressure, P_T: 350 psi

Borehole Water Level: 0 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 85 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	4.75	5.0	5.25	5.5	5.75
Pressure, psi	540	570	570	570	570	580	580	580	580	580
Volume, litres	6.0	/	5.6							
Pressure, psi	580	/	ø							



Comments: _____ Time - 11:43 am

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH4-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: MLessard Date Inflated: May 19/15

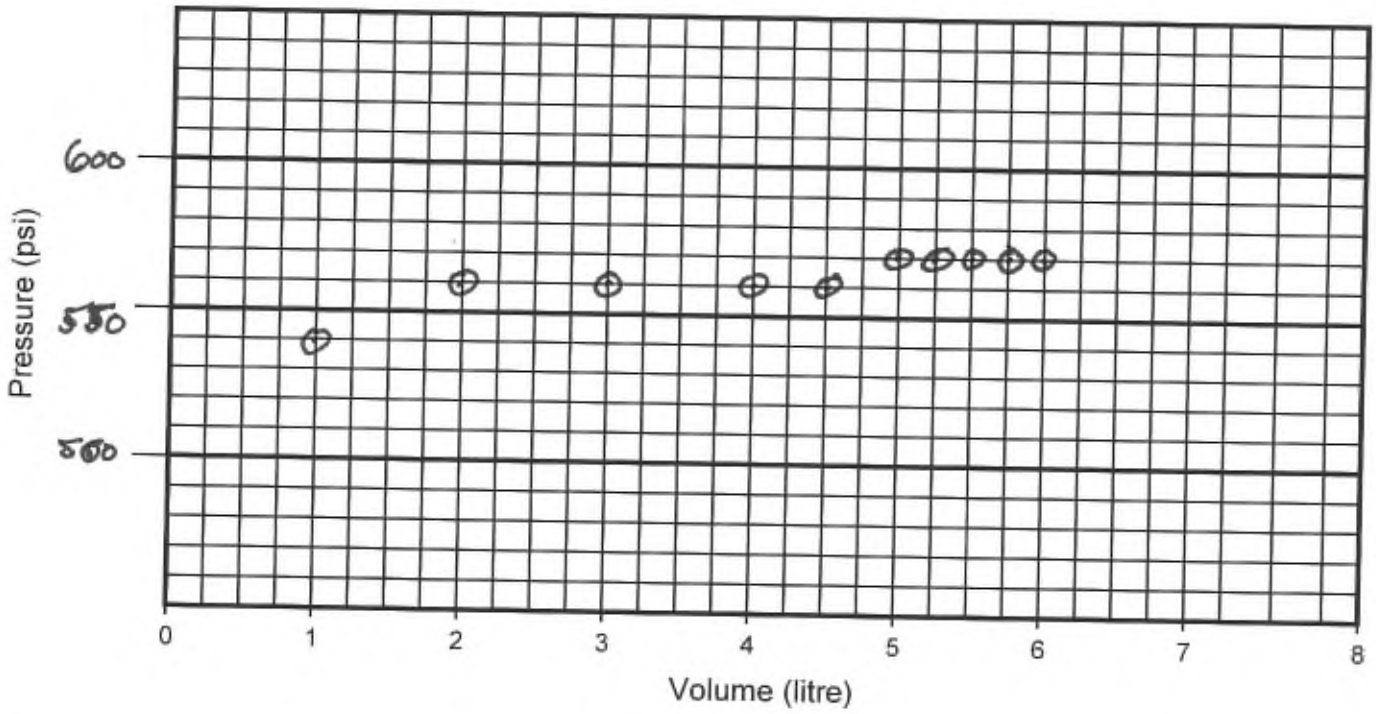
Packer No. 4" comp 13 SN# 19217 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 570 psi Tool Pressure, P_T: 350 psi

Borehole Water Level: 0 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 75 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	5.0	5.25	5.5	5.75	6.0
Pressure, psi	540	560	560	560	560	570	570	570	570	570
Volume, litres	/	5.6								
Pressure, psi	/	0								



Comments: _____ Time - 12:06 pm

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: May 18/15

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Lessard Date Inflated: May 18/15

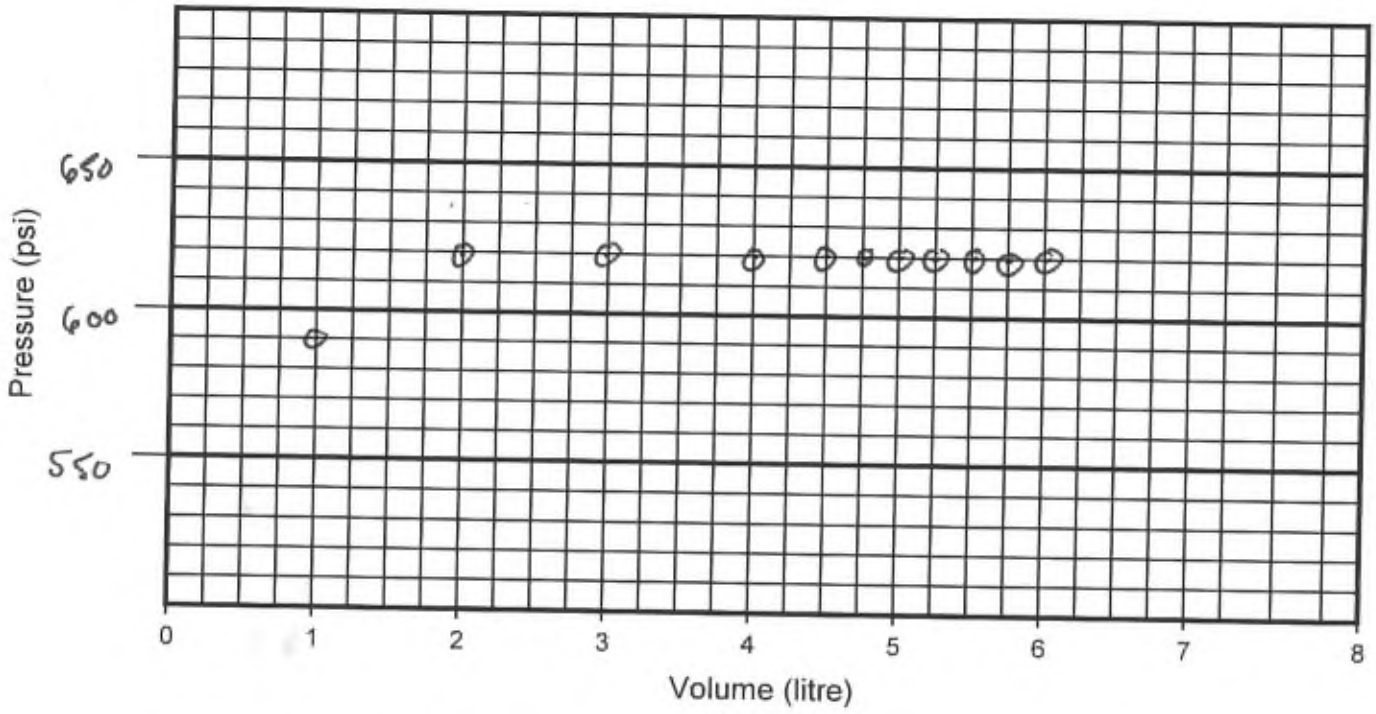
Packer No. 5, comp 16 SN# 19219 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 620 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 0 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 700 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	4.75	5.0	5.25	5.5	5.75
Pressure, psi	590	620	620	620	620	620	620	620	620	620
Volume, litres	6.0	/	5.6							
Pressure, psi	620	/	Ø							



Comments: 3.5 L flow stopped Time - 6:04 am

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH4-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M.Lessard Date Inflated: May 18/15

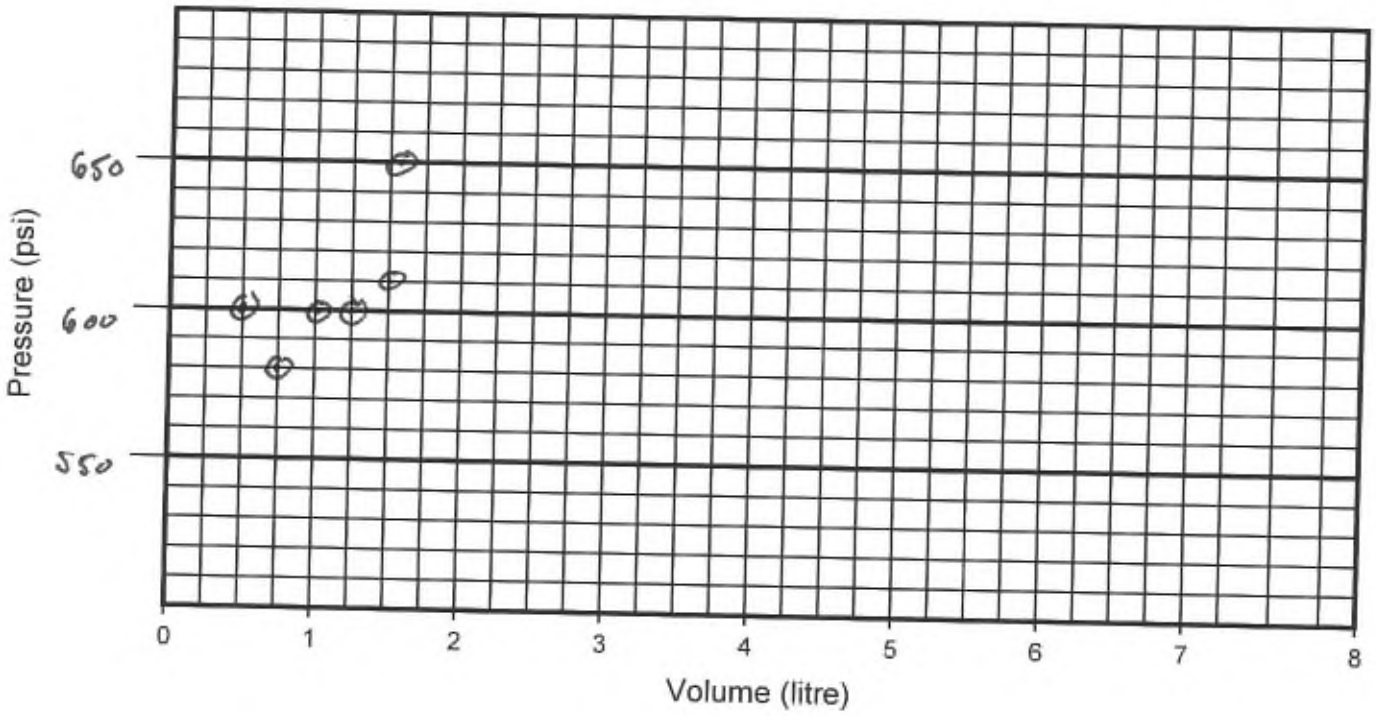
Packer No. 6, comp 18 SN# 19204 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 155 psi Final Line Pressure, P_L: 650 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 0 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 95 psi

Volume, litres	0.25	0.5	0.75	1.0	1.25	1.5	1.6	/	1.25	
Pressure, psi	350	600	580	600	600	610	650	/	Ø	
Volume, litres										
Pressure, psi										



Comments: In HQ Time - 6:17pm

APPENDIX C: MONITORING WELL: BH5-WB

As-Built Key Components Summary (Table 4)	- 1 page
As-Built Tubing Summary (Table 5)	- 3 pages
Summary Completion Log	- 2 pages
Pre-Inflation Piezometric Pressure/ Levels	
Field Data and Calculation Sheet (June 8)	- 1 page
Figure 3, Pre-Inflation Profile	- 1 page
Post- Inflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (June 9)	- 2 pages
Figure 4, Post-Inflation Profile	- 1 page
Westbay Completion Log (field copy)	- 5 pages
Westbay System Packer Inflation Records	- 12 pages

Table 4: BH5-WB As-Built Packer and Port Summary



AB, 01/06/2015

Port No.	Zone	Measurement Port Depth, (m)	Pumping Port Depth, (m)	Depth to top of Packer, (m)	Top of Zone (m)	Bottom of Zone (m)	Comments
1		286.99		285.46	286.8	293.0	
2		285.46		279.37	280.7	285.9	
3		251.94		250.41	251.7	279.8	
4		250.41		245.84	247.1	250.8	
5		244.32		242.79	244.1	246.2	
6		241.27		236.7	238.0	243.2	
7		227.55		226.03	227.3	237.1	
8		224.51		219.94	221.2	226.4	
9		216.89		209.27	210.6	220.3	
10		209.27		184.88	186.2	209.7	
11		183.36		181.84	183.1	185.3	
12		96.497	94.973	94.973	96.3	182.2	
13							
14							
15							

Note 1: All depth measurements in meters below datum (GS).
Note 2: All depth measurements use 'Nominal' tubing lengths.
Note 3: Not corrected for borehole deviation or borehole temperature effects.
Note 4: All depth measurements to upper edge of Westbay System coupling item.

Table 5: BH5-WB As-Built Summary



AB ,01/06/2015

Item No.	Component P/N	Component Description	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Accessory Depth (m)	Final Position (m)
112	203							-0.77705
111	20102			202				-0.7292
110	20105			202				-0.11963
109	20105			202				1.4043
108	20105			202				2.9282
107	20105			202				4.4521
106	20105			202				5.9761
105	20102			202				7.5
104	20105			202				8.1096
103	20110			202				9.6335
102	20110			202				12.681
101	20110			202				15.729
100	20110			202				18.777
99	20110			202				21.825
98	20110			202				24.873
97	20110			202				27.921
96	20110			202				30.968
95	20110			202				34.016
94	20110			202				37.064
93	20110			202				40.112
92	20110			202				43.16
91	20110			202				46.208
90	20110			202				49.256
89	20110			202				52.303
88	20110			202				55.351
87	20110			202				58.399
86	20110			202				61.447
85	20110			202				64.495
84	20110			202				67.543
83	20110			202				70.591
82	20110			202				73.638
81	20110			202				76.686
80	20110			202				79.734
79	20110			202				82.782
78	20110			202				85.83
77	20110			202				88.878
76	20110			202				91.925
75	238	Packer	19228	202				94.973
74	20110	Measurement Port		205	8482			96.497
73	20110			202				99.545
72	20110			202				102.59
71	20110			202				105.64
70	20110			202				108.69
69	20110			202				111.74

Table 5: BH5-WB As-Built Summary



AB ,01/06/2015

Item No.	Component P/N	Component Description	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Accessory Depth (m)	Final Position (m)
68	20110			202				114.78
67	20110			202				117.83
66	20110			202				120.88
65	20110			202				123.93
64	20110			202				126.98
63	20110			202				130.02
62	20110			202				133.07
61	20110			202				136.12
60	20110			202				139.17
59	20110			202				142.22
58	20110			202				145.26
57	20110			202				148.31
56	20110			202				151.36
55	20110			202				154.41
54	20110			202				157.45
53	20110			202				160.5
52	20110			202				163.55
51	20110			202				166.6
50	20110			202				169.65
49	20110			202				172.69
48	20110			202				175.74
47	20110			202				178.79
46	238	Packer/Pumping Port	19230	224	8713			181.84
45	20105	Measurement Port		205	8467			183.36
44	238	Packer	19221	202				184.88
43	20110			202				186.41
42	20110			202				189.46
41	20110			202				192.5
40	20110			202				195.55
39	20110			202				198.6
38	20110			202				201.65
37	20110			202				204.7
36	20105			202				207.74
35	238	Packer/Measurement Port	19227	205	8469			209.27
34	20110			202				210.79
33	20110			202				213.84
32	20110	Measurement Port		205	8481			216.89
31	238	Packer	19222	202				219.94
30	20110			202				221.46
29	20105	Measurement Port		205	8465	216	225.1	224.51
28	238	Packer	19223	202				226.03
27	20110	Measurement Port		205	8480			227.55
26	20110			202				230.6
25	20110			202				233.65
24	238	Packer	19229	202				236.7

Table 5: BH5-WB As-Built Summary

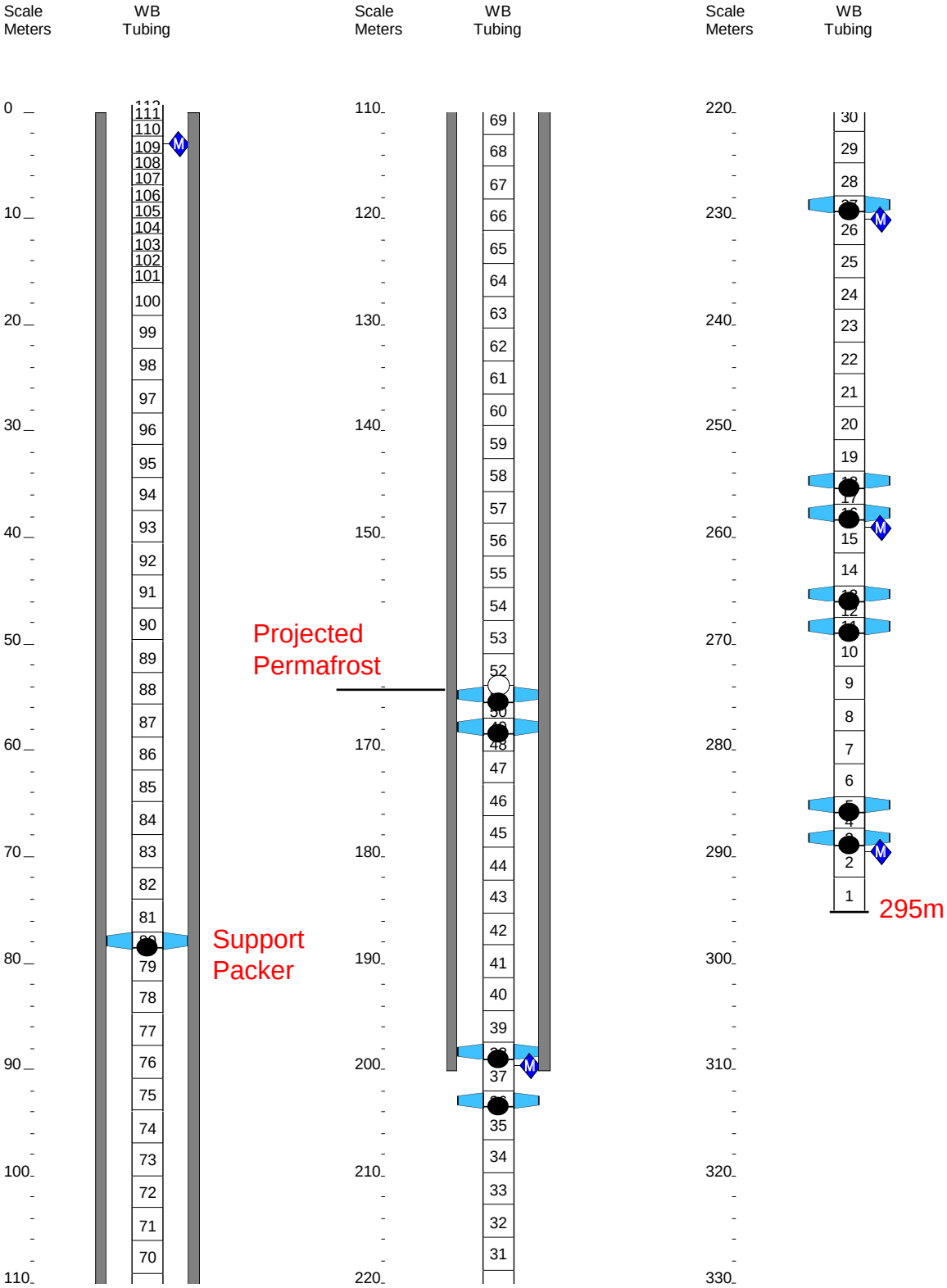


AB ,01/06/2015

Item No.	Component P/N	Component Description	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Accessory Depth (m)	Final Position (m)
23	20110			202				238.22
22	20105	Measurement Port		205	8479	216	241.9	241.27
21	238	Packer	19241	202				242.79
20	20105	Measurement Port		205	8468			244.32
19	238	Packer	19242	202				245.84
18	20110			202		216	248.0	247.37
17	238	Packer/Measurement Port	19226	205	8464			250.41
16	20110	Measurement Port		205	8470			251.94
15	20110			202				254.99
14	20110			202				258.03
13	20110			202				261.08
12	20110			202				264.13
11	20110			202				267.18
10	20110			202				270.22
9	20110			202				273.27
8	20110			202				276.32
7	238	Packer	19239	202				279.37
6	20110			202				280.89
5	20105			202				283.94
4	238	Packer/Measurement Port	19240	205	8466			285.46
3	20105	Measurement Port		205	8471	216	287.6	286.99
2	20105			202				288.51
1	20110			202				290.04
0	203							293.08

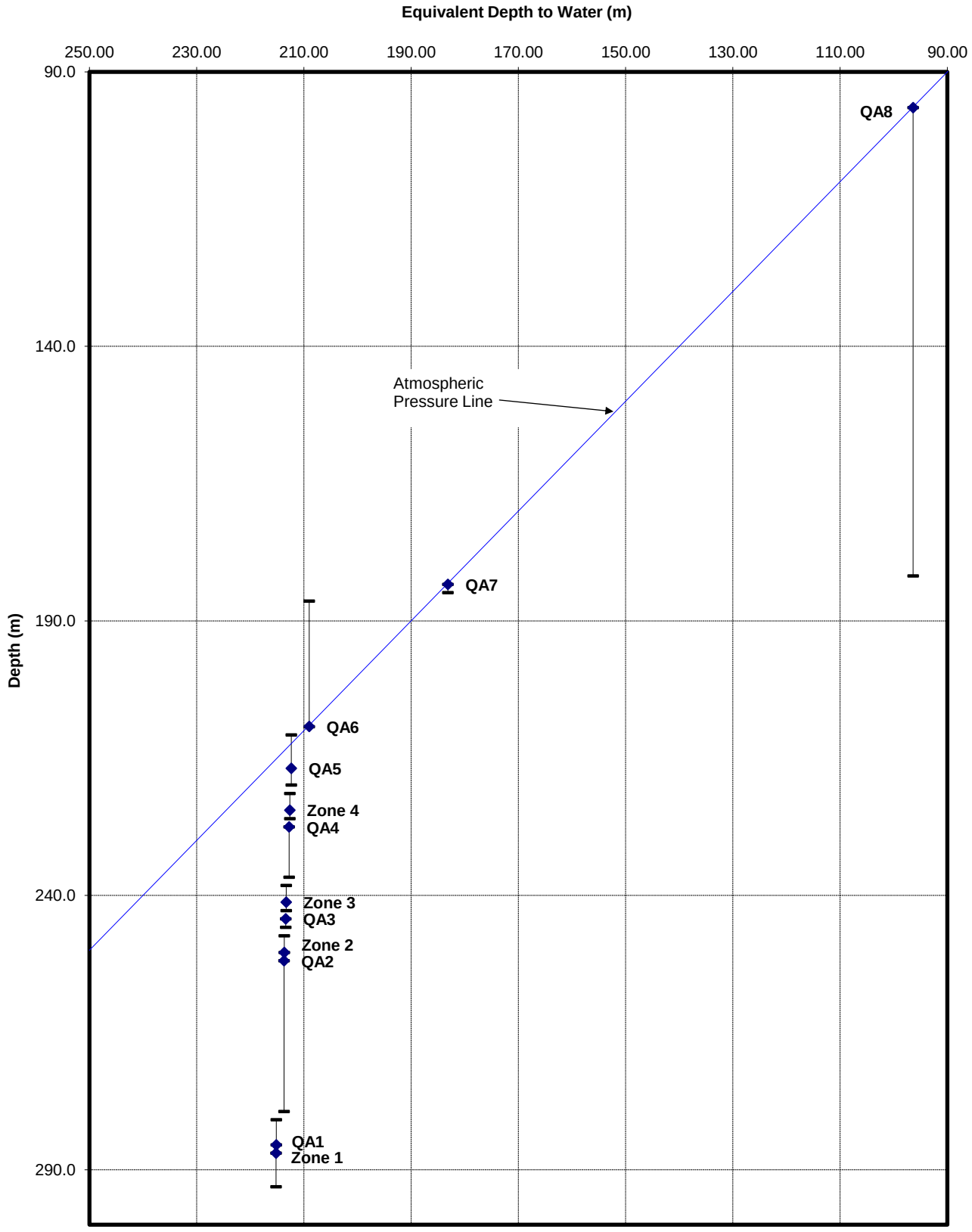
Summary Completion Log

Job No: WB950
Well: BH5



Piezometric Profile
Monitoring Well: BH5-WB

Profile Date: June 8/2015
Comments: Pre-Inflation Profile



Client: Lorax
Site: Coffee Creek
Datum: Ground Surface

Figure 3

Plot By:____Date:____
Checked By:____Date:____
Westbay Project: WB950

Westbay Instruments

Westbay Piezometric Pressures/Levels

PRE-INFLATION

Field Data and Calculation Sheet

Well No.: BH5-WB
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: GS
Borehole angle: 90

Probe Type: EMS
Serial No.: 2495
Probe Range: 250
Westbay Casing Type: 38
Sampler Valve Position: C

Date: June 8th / 2015
Client: LORAX
Job No.: 950
Location: Cullen Creek
Weather:
Operator: DL

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure ____ Finish: ____
Temp ____ ____
Time ____ ____

P_{atm} 12.71 psi

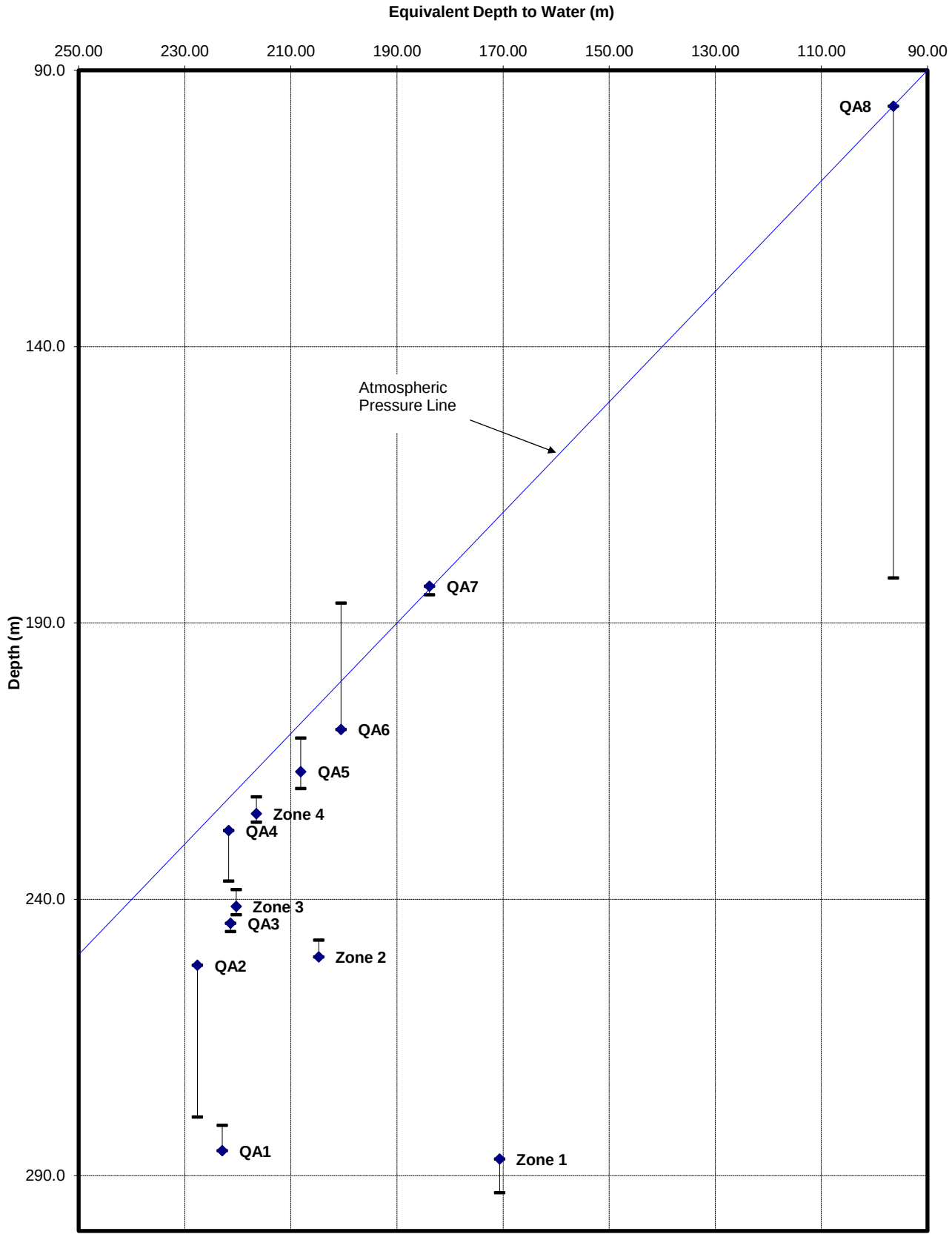
DATA TRANSPOSED FROM FIELD NOTES BOOK #3 JUNE 8

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
1	286.88	—	—	99.59	114.78	0938	—	99.60	72.1	215.2	
2	285.46	—	—	97.47	112.71	940	—	97.47	71.42	215.1	
3	251.93	—	—	50.33	67.05	944	—	50.33	38.8	213.9	
4	250.41	—	—	48.21	64.97	946	—	48.21	37.3	213.7	
5	244.31	—	—	39.68	56.66	950	—	39.69	31.4	213.4	
6	241.27	—	—	35.41	52.47	952	—	35.41	28.4	213.3	
7	227.55	—	—	16.20	33.75	955	—	16.20	15.0	212.8	
8	224.50	—	—	13.07	29.58	957	—	13.08	12.0	212.6	
9	216.88	—	—	13.06	19.15	959	—	13.06	4.6	212.4	
10	209.26	—	—	13.05	13.05	1001	—	12.99	Air	Air	
11	182.36	—	—	13.00	13.01	1004	—	12.87	Air	Air	
12	96.50	—	—	12.88	12.87	1009	—	12.88	Air	Air	

Notes: w = 1.422psi / m of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: BH5-WB

Profile Date: June 09 /2015
Comments: Post-Inflation Profile



Client: Lorax
Site: Coffee Creek
Datum: Ground Surface

Figure 4

Plot By:____Date:_____
Checked By:____Date:_____
Westbay Project:WB950

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

POST INFLATION

Well No.: BH5
Datum: @ TOP OF HQ
Elev. G.S.:
Height of Westbay above G.S.:
Elev. top of Westbay Casing:
Reference Elevation:
Borehole angle: VERTICAL

Probe Type: GMS
Serial No.: 2499
Probe Range: 0-250
Westbay Casing Type: MP38
Sampler Valve Position: C

Date: 9
Client: _ O
Job No.: 95
Location: K AK
Weather:
Operator: V /



Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

DTW ~ 222 m

P_{atm} 12,69 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)

		Start:	Finish:
Pressure		9	1,9
Temp		1,6	0,8
Time		1	16 5

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
1	287.0	286.8		103.10	178.32	1532	5.4				
					178.33	1533	4.8	103.13	116.48	170.5	
1	287.0	286.8		103.15	178.11	1538	3.0				Beep 287.4 counter
					178.10	1539	2.8	103.16		170.7	
2	285.5	285.3		101.02	101.62	1541	2.6				POSSIBLE SQUEEZE IP?
					101.60	1542	2.4	101.02	62.52	223.0	
3	251.9	251.7		53.90	47.27	1548	1.9				
					47.27	1549	1.6	53.90	24.32	229.6	
4	250.4	250.4		52.45		1551	1.5				TIGHT.
					77.61	55	1.4				
					77.60	1553	1.4	52.46	45.65	204.7	
5	244.3	244.1		4	45.36	1558	—				Beep 249.6
					45.33	1600	1.2	43.23	22.95	221.3	
6	241.3	241.1		38.98	42.50	1602	1.2				Beep 241.6
					42.49	1603	1.2	38.98	21.0	220.3	

Notes: w = 1.422psi / m of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Westbay Instruments

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

POST INFLATION

Well No.: BH5
Datum:
Elev. G.S.:
Height of Westbay above G.S.:
Elev. top of Westbay Casing:
Reference Elevation:
Borehole angle:

Probe Type: EMS
Serial No.: 2221
Probe Range:
Westbay Casing Type:
Sampler Valve Position:

Date: 09 June 2015
Client:
Job No.:
Location:
Weather:
Operator:

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure Finish:
Temp
Time

P_{atm} psi

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings					Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)			
7	227.6	227.3		19.78	20.95	1607	1.2				
					20.94	1608	1.1	19.78	5.80	221.8	
8	224.5	224.3		15.49	24.09	1611	1.0				Beep 225.0
					24.09	1612	1.0	15.49	8.02	216.5	
9	216.9	216.7		13.04	25.14	1616	1.0				
					25.14	1617	1.0	13.03	8.76	208.1	
10	209.3	209.1		13.01	25.06	1621	1.0				
					25.05	1622	1.0	13.01	8.69	200.6	
11	183.4	183.2		12.97	11.97	1625	1.0				
					11.98	1626	1.0	12.97			IN AIR
12	96.5	96.4		12.84	12.79	1630	0.9				
					12.79	1631	0.8	12.82			IN AIR
PA =		12.69	psig								
		T = 0.8									
		@ 1625									

Notes: w = 1.422psi / m of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Westbay System Completion Log

Company: LORAX
Well: BH5-WB
Site: Collins Creek
Project: 950

WB #: 950
Author: AB

Well Information

Reference Datum: _____ ~~ft.~~ m
Elevation of Datum: ~ ~~ft.~~
WB Tubing Top: _____ ~~ft.~~ m
WB Tubing Length: _____ ~~ft.~~ m

Borehole Depth: 293 ~~ft.~~ m
Borehole Inclination:
Borehole Diameter: 4.5 in.

Well Description:

Other References:

File Information

File Name: _____
Report Date: _____

File Date: _____

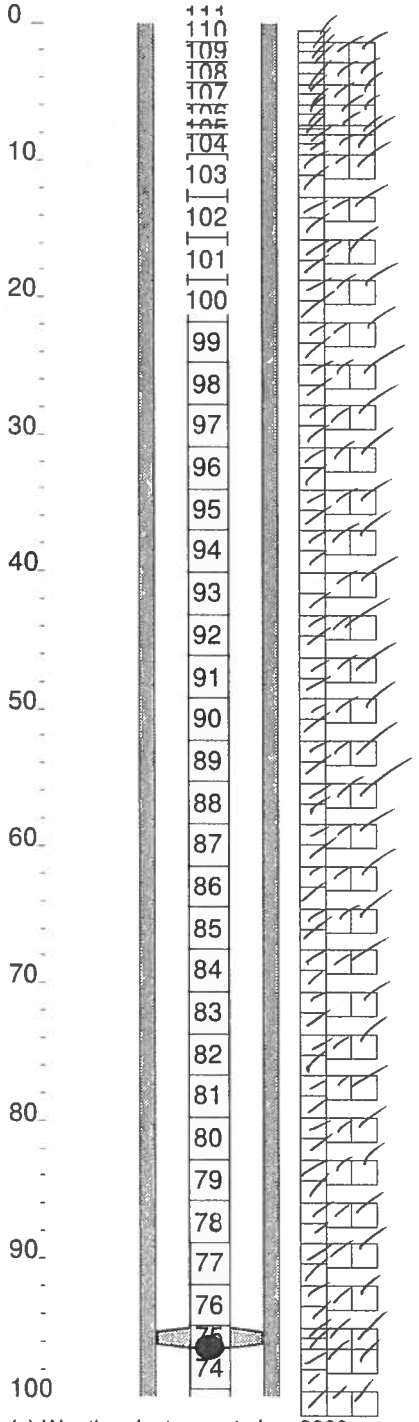
Comments

Installation sign-off Information

Borehole condition confirmed.(Client) (method) Sound Date: 05/06/15
WB System design & preparation.(Client / WB) By: AB LF Date: 05/06/15
WB System design checked. (Client / WB) By: AB LF Date: [redacted]/06/15
WB System and borehole approved to install. (Client) By: [signature] Date: 05/06/15

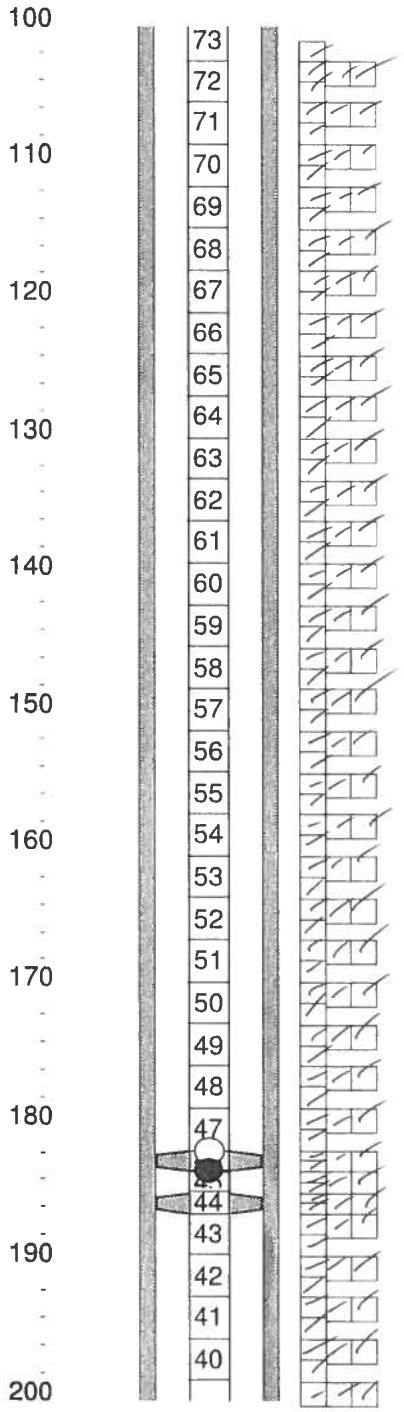
Westbay Completion Log
Lorax

Job No: WB950
Well: BH5-WB


Scale Meters
WB Tubing
QA Tested OK
WB Tubing Description
Serial Numbers
0
10
20
30
40
50
60
70
80
90
100
111
110
109
108
107
106
105
104
103
102
101
100
99
98
97
96
95
94
93
92
91
90
89
88
87
86
85
84
83
82
81
80
79
78
77
76
75
74
W020105 - MP38 Tubing 2 (5F/1.5M)
W020105 - MP38 Tubing 2 (5F/1.5M)
W020105 - MP38 Tubing 2 (5F/1.5M)
W020105 - MP38 Tubing 2 (5F/1.5M)
W020105 - MP38 Tubing 2 (5F/1.5M)
W020102 - MP38Tubing 3 (2F/0.6M)
W020105 - MP38 Tubing 2 (5F/1.5M)
W020110 - MP38 Tubing 1 (10F/3M)
W020110 - MP38 Tubing 1 (10F/3M)
W020110 - MP38 Tubing 1 (10F/3

Westbay Completion Log
Lorax

Job No: WB950
Well: BH5-WB



WB Tubing Description	Serial Numbers
W020110 - MP38 Tubing 1 (10F/3M)	
W020110 - MP38 Tubing 1 (10F/3M)	
W020110 - MP38 Tubing 1 (10F/3M)	

Westbay Completion Log
Lorax

Job No: WB950
Well: BH5-WB

Scale Meters	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
200	39		W020110 - MP38 Tubing 1 (10F/3M)	
	38		W020110 - MP38 Tubing 1 (10F/3M)	
	37		W020110 - MP38 Tubing 1 (10F/3M)	
210	36		W020105 - MP38 Tubing 2 (5F/1.5M)	
	35		W0238 - MP38 Packer - 74mm (5F/1.5M)	
	34		W020110 - MP38 Tubing 1 (10F/3M)	
	33		W020110 - MP38 Tubing 1 (10F/3M)	
	32		W0205 - MP38 Measurement Port	
220	31		W020110 - MP38 Tubing 1 (10F/3M)	
	30		W0238 - MP38 Packer - 74mm (5F/1.5M)	
	29		W020110 - MP38 Tubing 1 (10F/3M)	
	28		W020105 - MP38 Tubing 2 (5F/1.5M)	
	27		W0205 - MP38 Measurement Port	
230	26		W020110 - MP38 Tubing 1 (10F/3M)	
	25		W020110 - MP38 Tubing 1 (10F/3M)	
	24		W020110 - MP38 Tubing 1 (10F/3M)	
	23		W0238 - MP38 Packer - 74mm (5F/1.5M)	
240	22		W020110 - MP38 Tubing 1 (10F/3M)	
	21		W020105 - MP38 Tubing 2 (5F/1.5M)	
	20		W0238 - MP38 Packer - 74mm (5F/1.5M)	
	19		W020105 - MP38 Tubing 2 (5F/1.5M)	
	18		W0238 - MP38 Packer - 74mm (5F/1.5M)	
250	17		W020110 - MP38 Tubing 1 (10F/3M)	
	16		W0205 - MP38 Measurement Port	
	15		W020110 - MP38 Tubing 1 (10F/3M)	
	14		W020110 - MP38 Tubing 1 (10F/3M)	
260	13		W020110 - MP38 Tubing 1 (10F/3M)	
	12		W020110 - MP38 Tubing 1 (10F/3M)	
	11		W020110 - MP38 Tubing 1 (10F/3M)	
	10		W020110 - MP38 Tubing 1 (10F/3M)	
270	9		W020110 - MP38 Tubing 1 (10F/3M)	
	8		W020110 - MP38 Tubing 1 (10F/3M)	
	7		W0238 - MP38 Packer - 74mm (5F/1.5M)	
	6		W020110 - MP38 Tubing 1 (10F/3M)	
280	5		W020105 - MP38 Tubing 2 (5F/1.5M)	
	4		W020105 - MP38 Tubing 2 (5F/1.5M)	
	3		W020105 - MP38 Tubing 2 (5F/1.5M)	
	2		W020110 - MP38 Tubing 1 (10F/3M)	
290	1		W0203 - MP38 End Cap	
300				

(c) Westbay Instruments Inc. 2000

Sheet____of____

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH-5

Location: Coffee Creek, Kaminak Gold Project Completed by: DC Date Inflated: June 8/2015

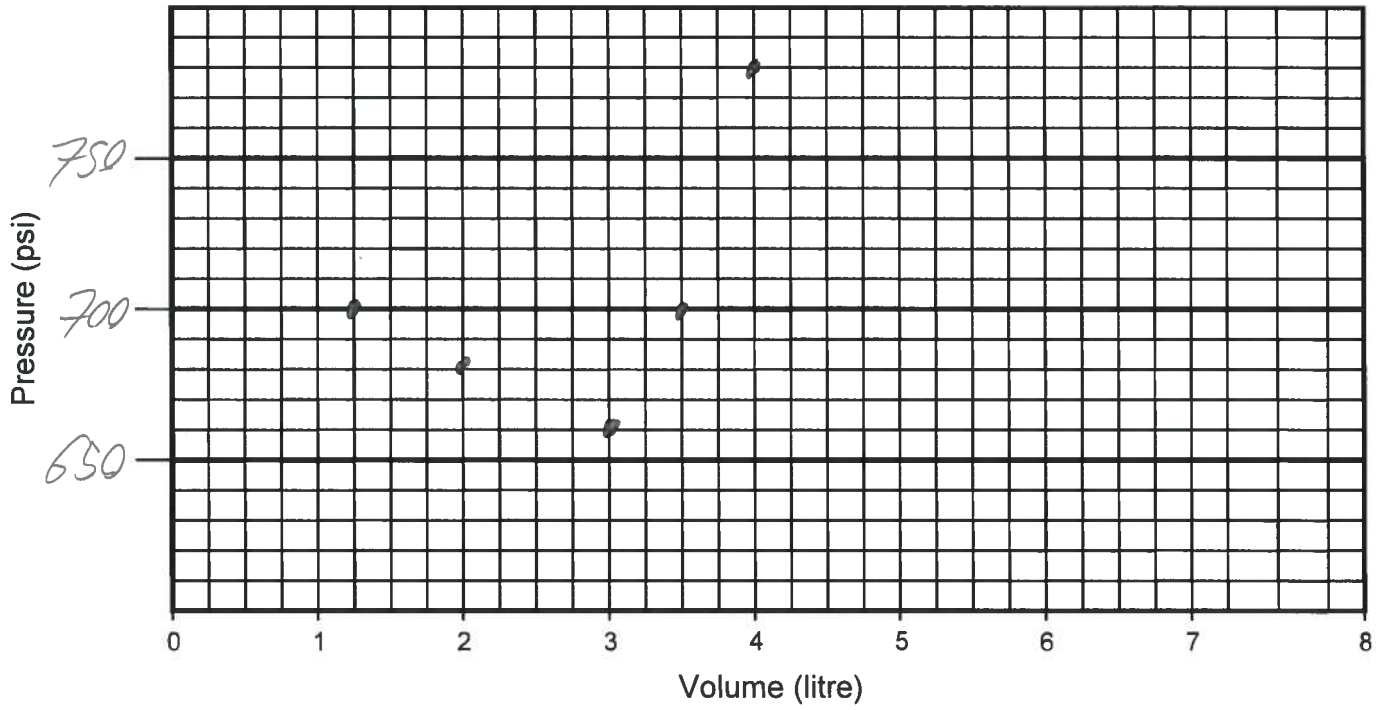
Packer No. P1 Depth (m): _____ Inflation Tool No.: 3198

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 780 psi Tool Pressure, P_T: 650 psi

Borehole Water Level: 213 (m) = 303 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 183 psi

Volume, litres	1	2	3	3.5	4	↓	3.5			
Pressure, psi	700	680	660	700	780	/	0			
Volume, litres										
Pressure, psi										



Comments: Transcribed from Field Note Book #3 Time - 1300

Sheet ____ of ____

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH5-W13

Location: Coffee Creek, Kaminak Gold Project Completed by: DL Date Inflated: JUNE 8

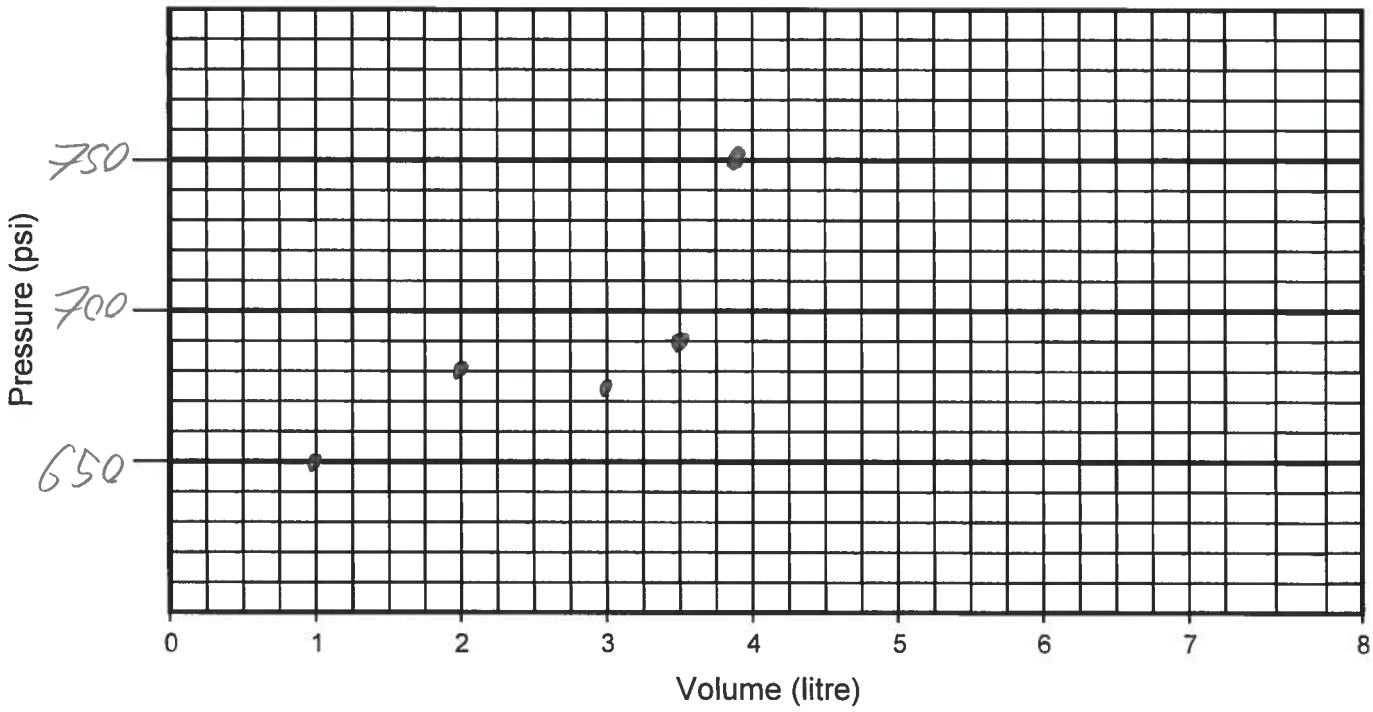
Packer No. P2 Depth (m): — Inflation Tool No.: 3198

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 750 psi Tool Pressure, P_T: ~~8~~50 psi

Borehole Water Level: 213 (m) = 303 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 153 psi

Volume, litres	1	2	3	3.5	3.8	—	3.3			
Pressure, psi	650	680	670	690	750	—	0			
Volume, litres										
Pressure, psi										



Comments: Transcribed from Field Note Book #3 Time - 1330

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH-5-W13

Location: Coffee Creek, Kaminak Gold Project Completed by: DL Date Inflated: June 8/15

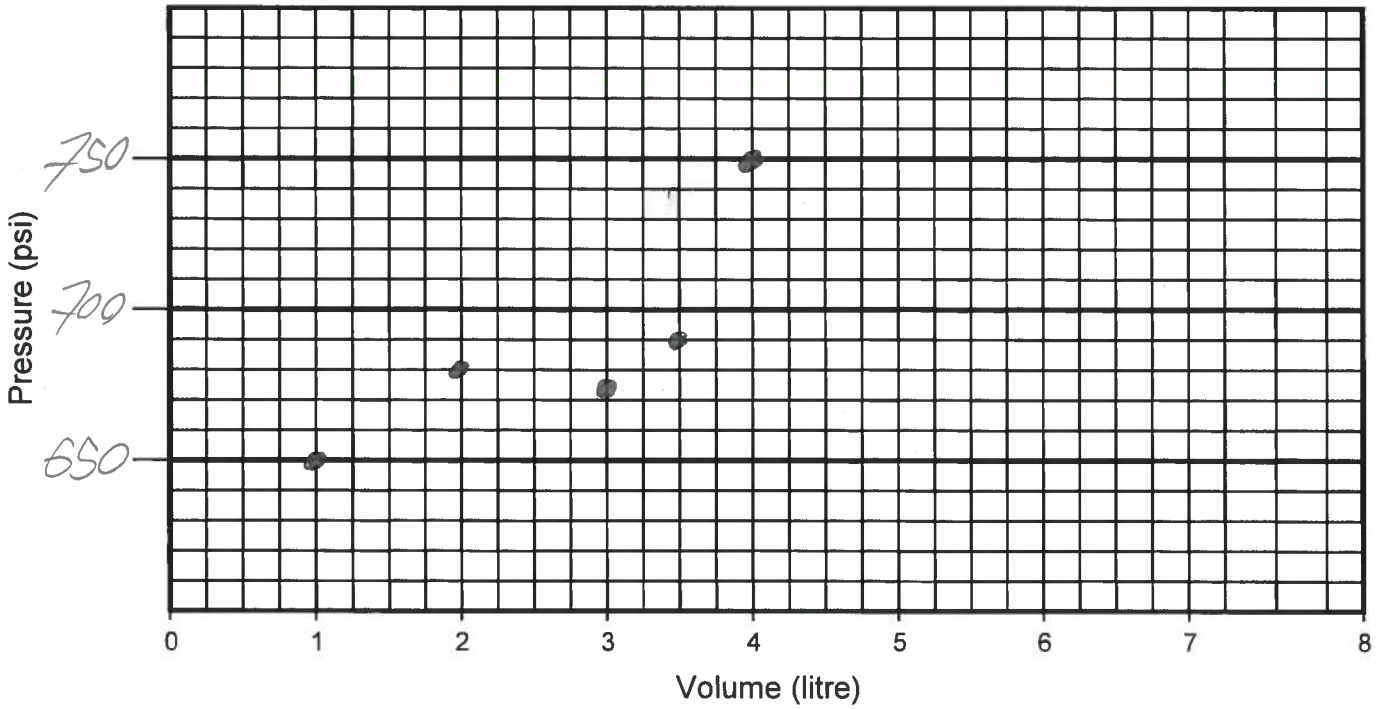
Packer No. P3 Depth (m): — Inflation Tool No.: 3198

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 750 psi Tool Pressure, P_T: 750 psi

Borehole Water Level: 213 (m) = 303 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 153 psi

Volume, litres	1	2	3	3.5	3.8	/	3.3			
Pressure, psi	650	680	670	690	750	/	0			
Volume, litres										
Pressure, psi										



Comments: Transcribed from Field Notebook #3 Time - 1405

Sheet____of____

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH-5

Location: Coffee Creek, Kaminak Gold Project Completed by: DL Date Inflated: JUNE 8

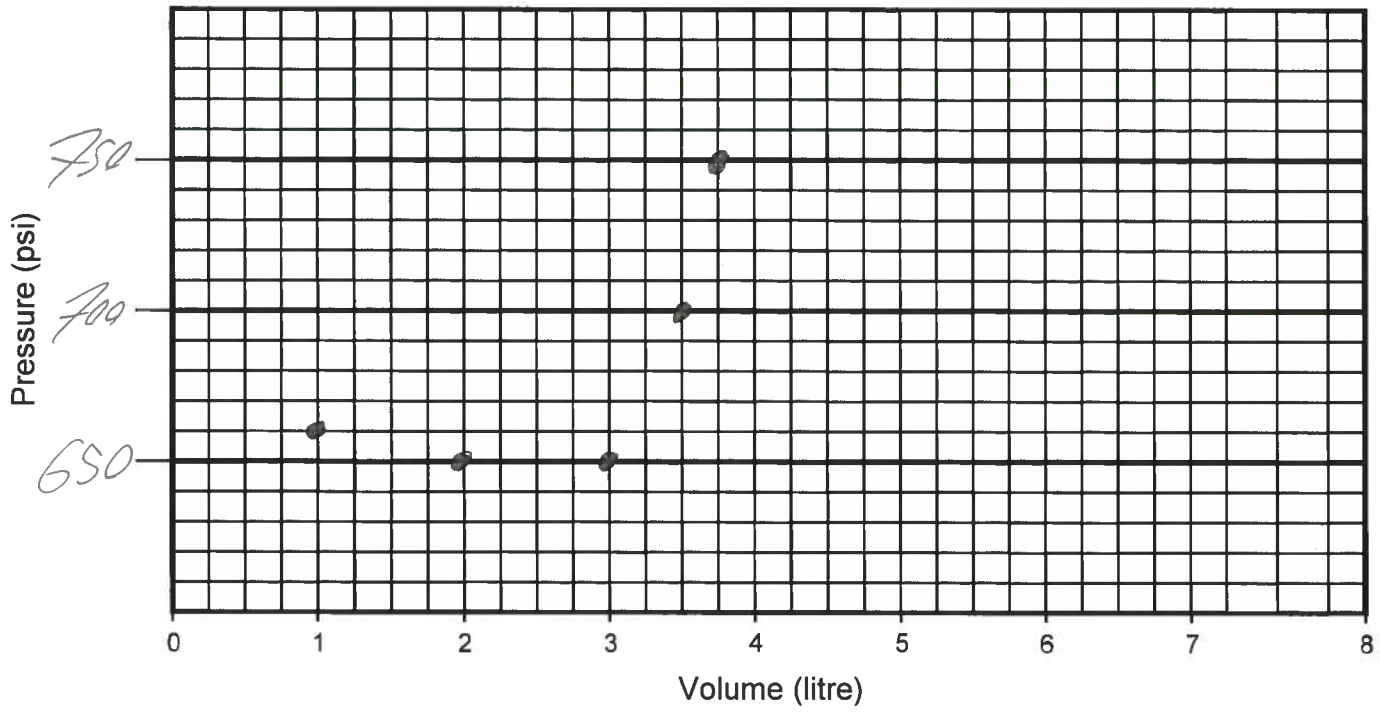
Packer No. P4 Depth (m): — Inflation Tool No.: 3198

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 750 psi Tool Pressure, P_T: 750 psi

Borehole Water Level: 213 (m) = 303 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 153 psi

Volume, litres	1	2	3	3.5	3.7	—	3.2			
Pressure, psi	660	650	650	700	750	—	0			
Volume, litres										
Pressure, psi										



Comments: Transcribed from Field Notebook #3 Time - 1430

Sheet ____ of ____

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BHS_WB

Location: Coffee Creek, Kaminak Gold Project Completed by: DL Date Inflated: JUNE 8/15

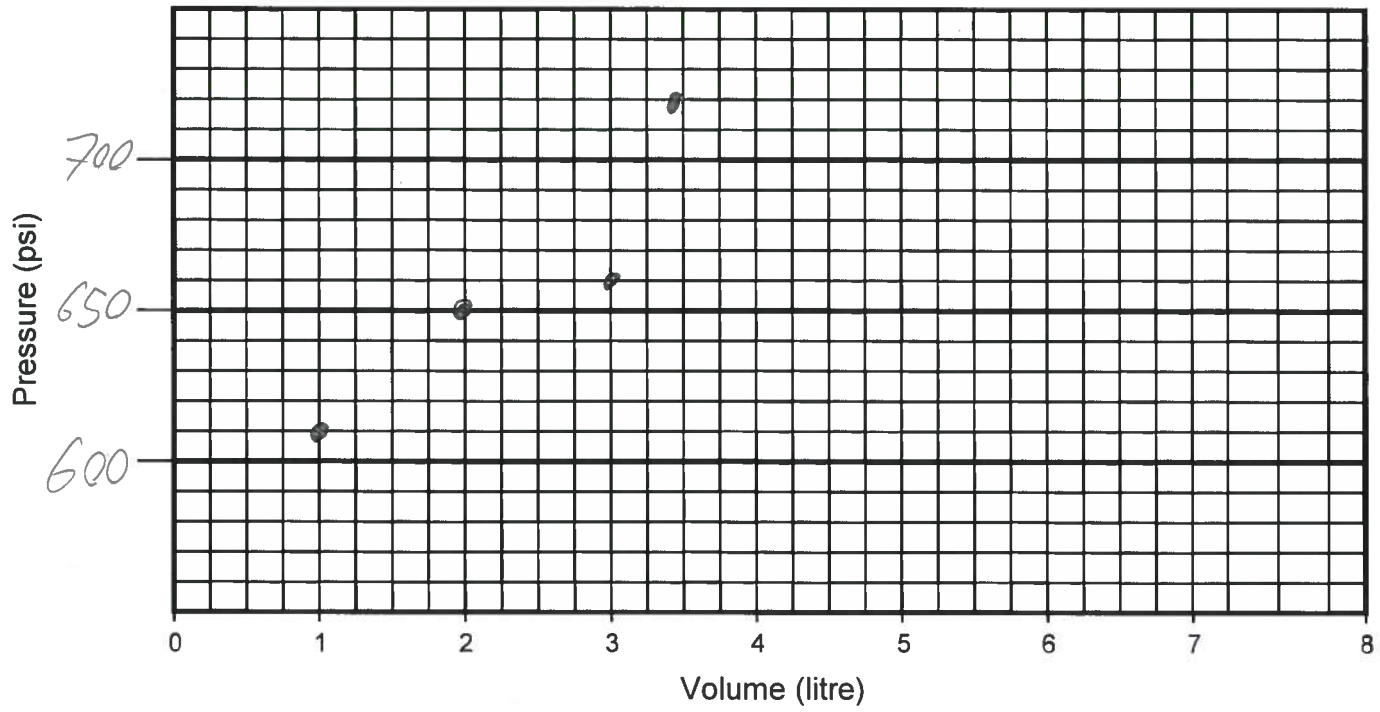
Packer No. P5 Depth (m): _____ Inflation Tool No.: 3198

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 720 psi Tool Pressure, P_T: 750 psi

Borehole Water Level: 213 (m) = 303 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 123 psi

Volume, litres	1	2	3	3.4	/	3.0				
Pressure, psi	610	650	660	720	/	0				
Volume, litres										
Pressure, psi										



Comments: Transcribed from field Work Book #3 Time - 1500

Sheet ____ of ____

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH-5 WB

Location: Coffee Creek, Kaminak Gold Project Completed by: DL Date Inflated: June 8/15

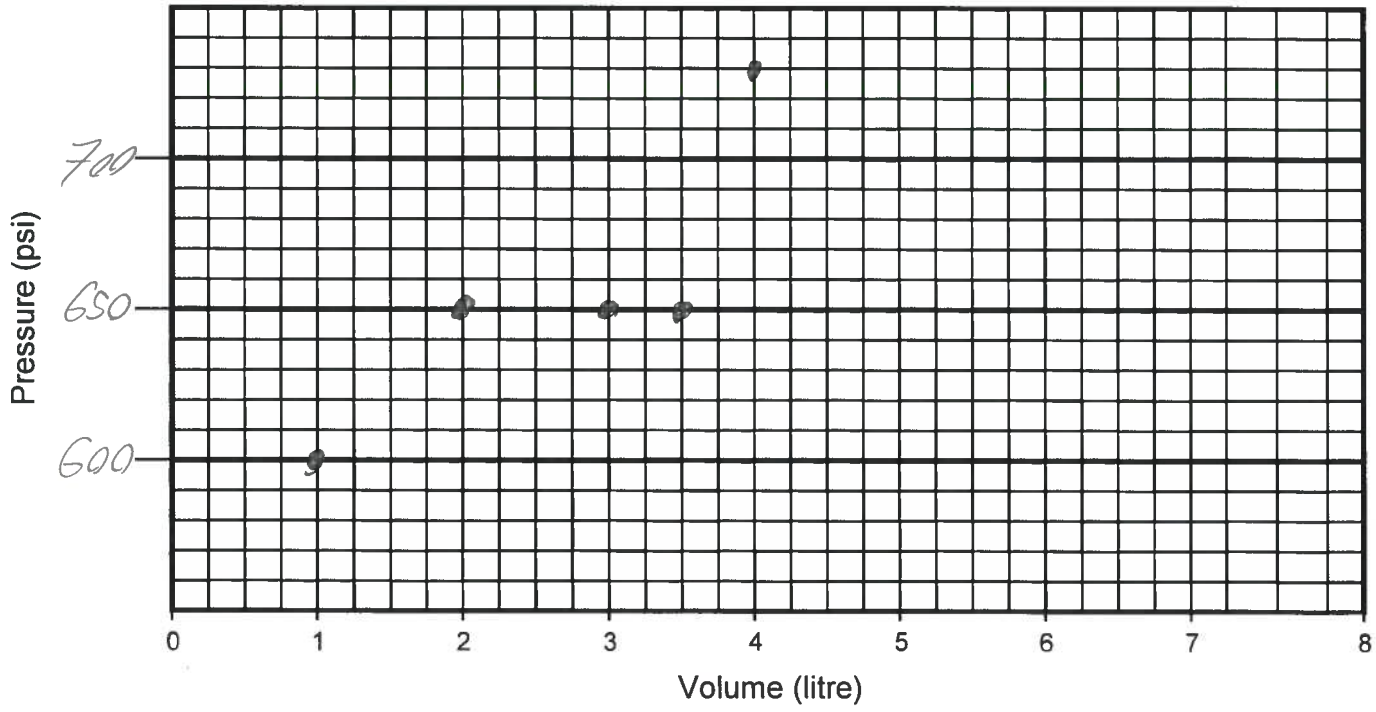
Packer No. P6 Depth (m): _____ Inflation Tool No.: 3/99

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 730 psi Tool Pressure, P_T: 750 psi

Borehole Water Level: 213 (m) = 303 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 133 psi

Volume, litres	1	2	3	3.5	4	/	3.5			
Pressure, psi	600	650	650	650	730	/	Ø			
Volume, litres										
Pressure, psi										



Comments: Transcribed from field Notebook #3 Time - 1515

Sheet ____ of ____

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BHS_W13

Location: Coffee Creek, Kaminak Gold Project Completed by: DL Date Inflated: June 8/15

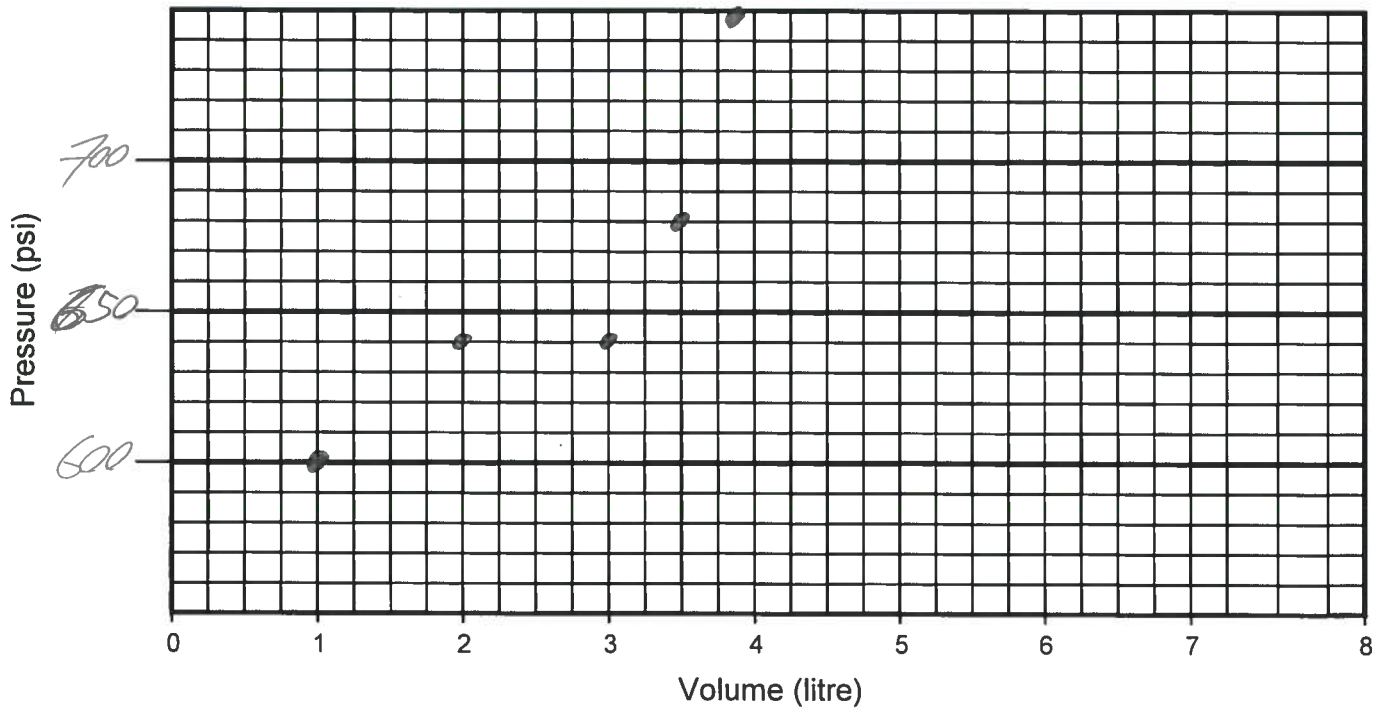
Packer No. P7 Depth (m): — Inflation Tool No.: 3198

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 750 psi Tool Pressure, P_T: ~~750~~ psi

Borehole Water Level: 213 (m) = 303 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 153 psi

Volume, litres	1	2	3	3.5	3.8	/	3.3			
Pressure, psi	600	640	640	680	~~750~~	/	0			
Volume, litres										
Pressure, psi										



Comments: Transcribed from field notebook #3 Time - 1540

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH5_WB

Location: Coffee Creek, Kaminak Gold Project Completed by: DL Date Inflated: JUNE 8 15

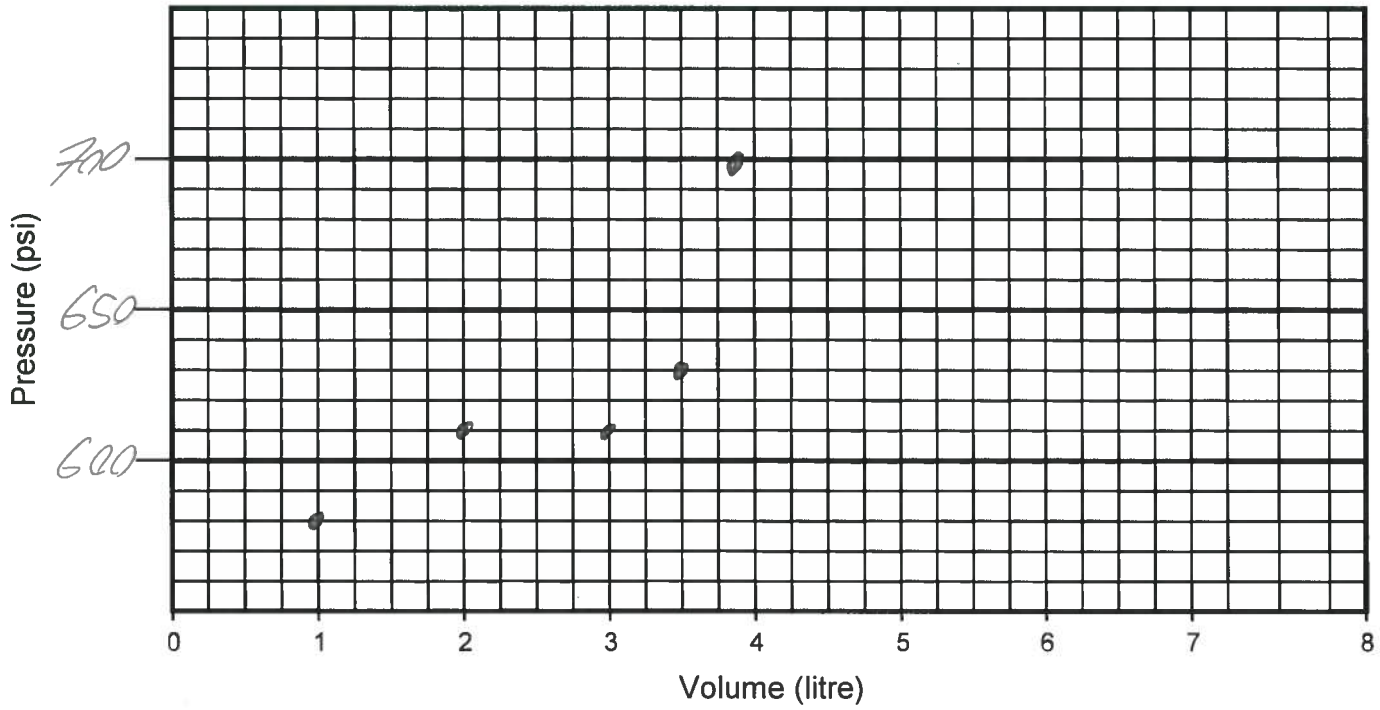
Packer No. P8 Depth (m): _____ Inflation Tool No.: 3198

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 700 psi Tool Pressure, P_T: 700 psi

Borehole Water Level: 213 (m) = 303 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 153 psi

Volume, litres	1	2	3	3.5	3.8	/	3.4			
Pressure, psi	570	610	610	630	700	/	0			
Volume, litres										
Pressure, psi										



Comments: Transcribed from Field Work Book #3 Time - 1600

Sheet___of___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH5_WB

Location: Coffee Creek, Kaminak Gold Project Completed by: DL Date Inflated: JUNE 9/15

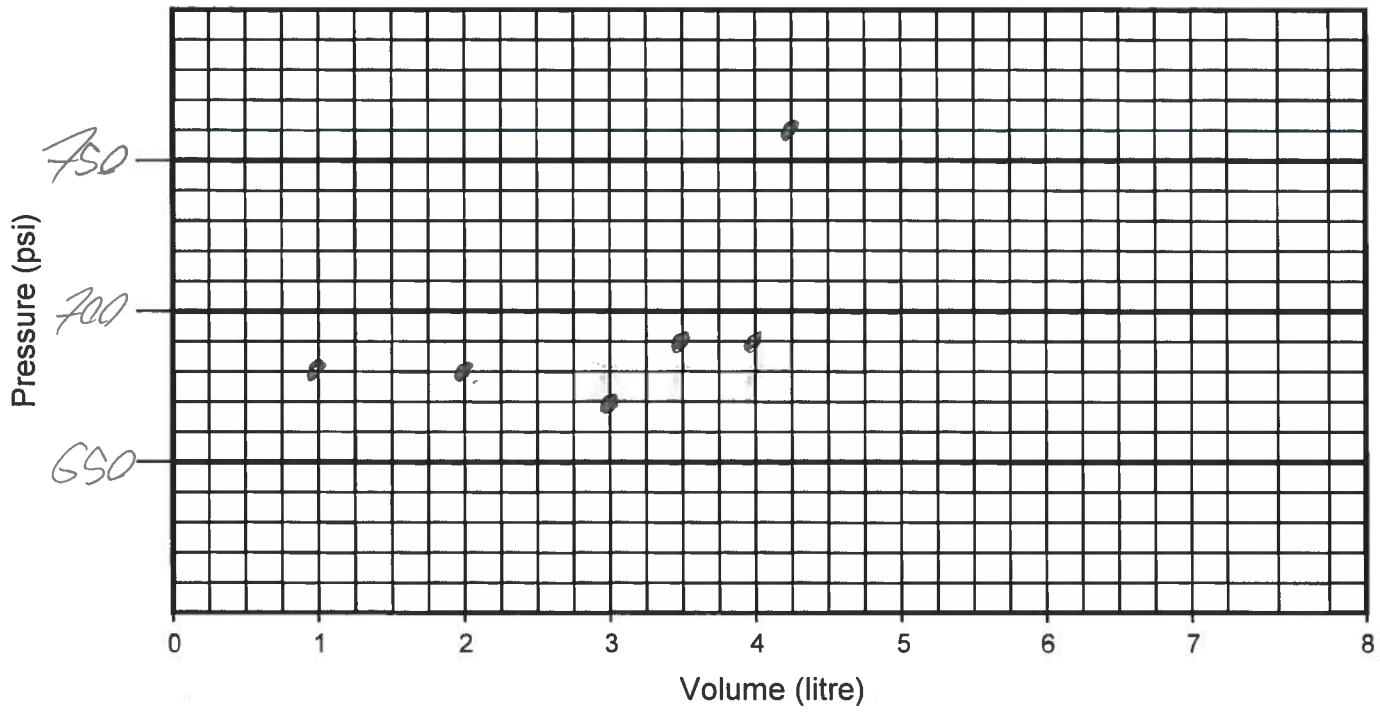
Packer No. P9 Depth (m): _____ Inflation Tool No.: 3198

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 760 psi Tool Pressure, P_T: 700 psi

Borehole Water Level: 209 (m) = 292 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 202 psi

Volume, litres	1	2	3	3.5	4	4.25	/	3.8		
Pressure, psi	680	680	670	690	690	760	/	Ø		
Volume, litres										
Pressure, psi										



Comments: Transcribed from field Note Book #3 Time -

Sheet___of___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH5_WB

Location: Coffee Creek, Kaminak Gold Project Completed by: DL Date Inflated: JUNE 9/15

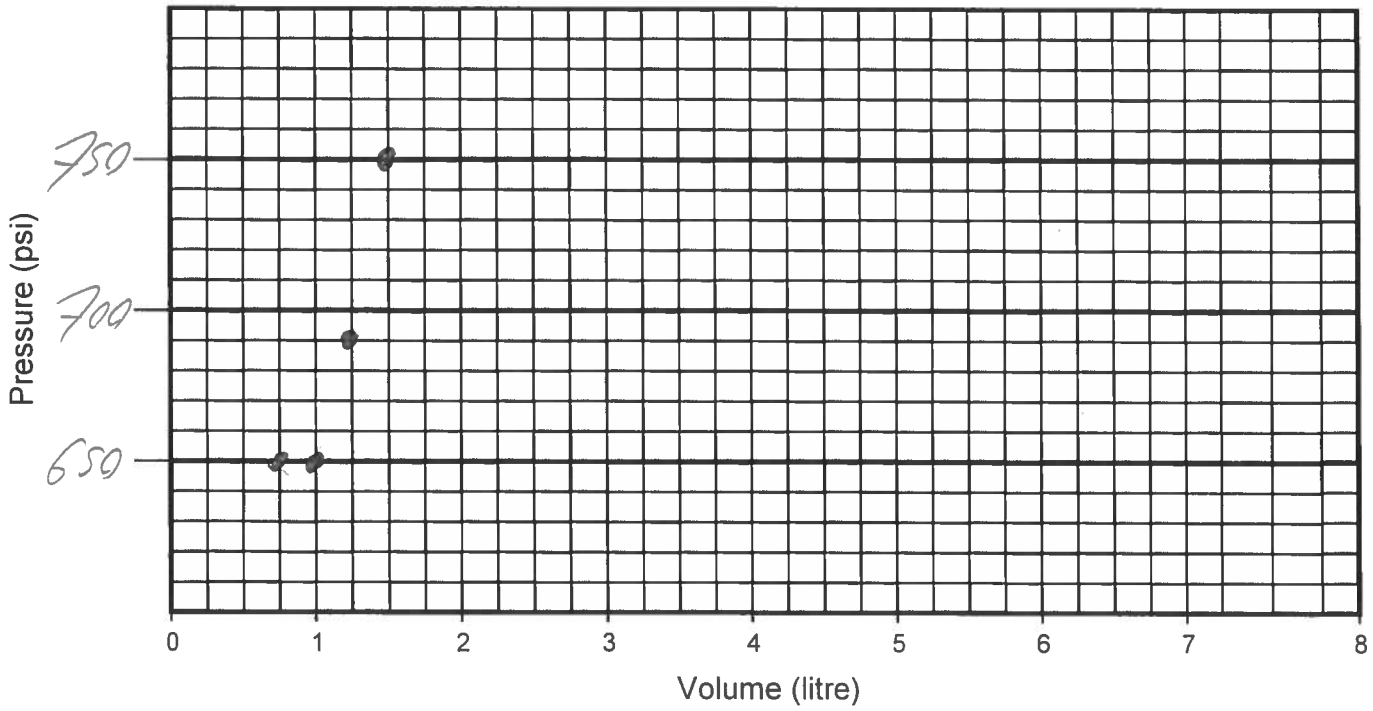
Packer No. P10 Depth (m): _____ Inflation Tool No.: 3198

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 750 psi Tool Pressure, P_T: 700 psi

Borehole Water Level: 185 (m) = 263 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 163 psi

Volume, litres	.75	1	1.25	1.5	/	1.0				
Pressure, psi	650	650	690	750	/	Ø				
Volume, litres										
Pressure, psi										



Comments: Transcribed from field notes Book #3 Time -

Sheet____of____

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH5 WB

Location: Coffee Creek, Kaminak Gold Project Completed by: DL Date Inflated: June 9/15

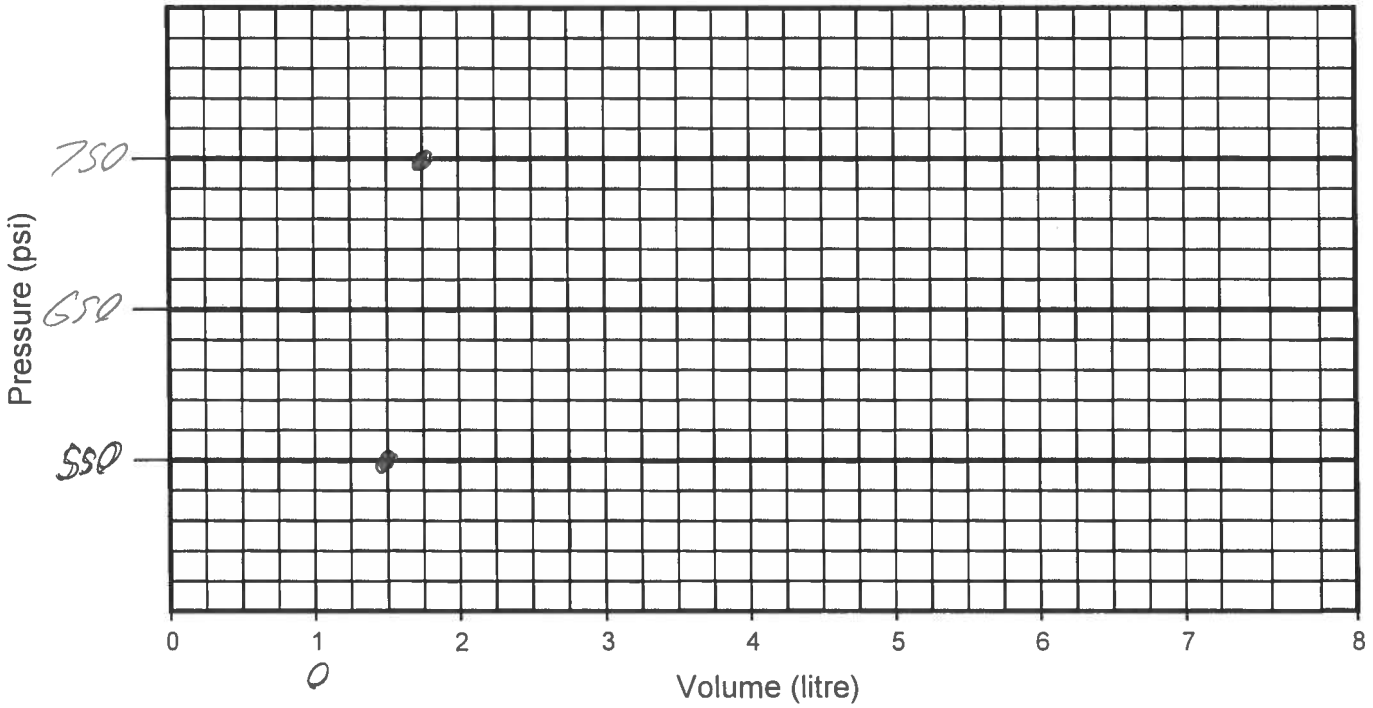
Packer No. P11 Depth (m): _____ Inflation Tool No.: 3198

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 750 psi Tool Pressure, P_T: 700 psi

Borehole Water Level: 181 (m) = 257 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T =$ 157 psi

Volume, litres	1.0	1.5	1.75	/	1.25					
Pressure, psi	0	550	750	/	0					
Volume, litres										
Pressure, psi										



Comments: Transferred from Fuel Note Book #3 Time - 0940

Packer/Rev Inflated Add 250ml

Sheet____of____

Westbay Packer Inflation Record

Westbay Instruments

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH5_WB

Location: Coffee Creek, Kaminak Gold Project Completed by: DL Date Inflated: June 9/15

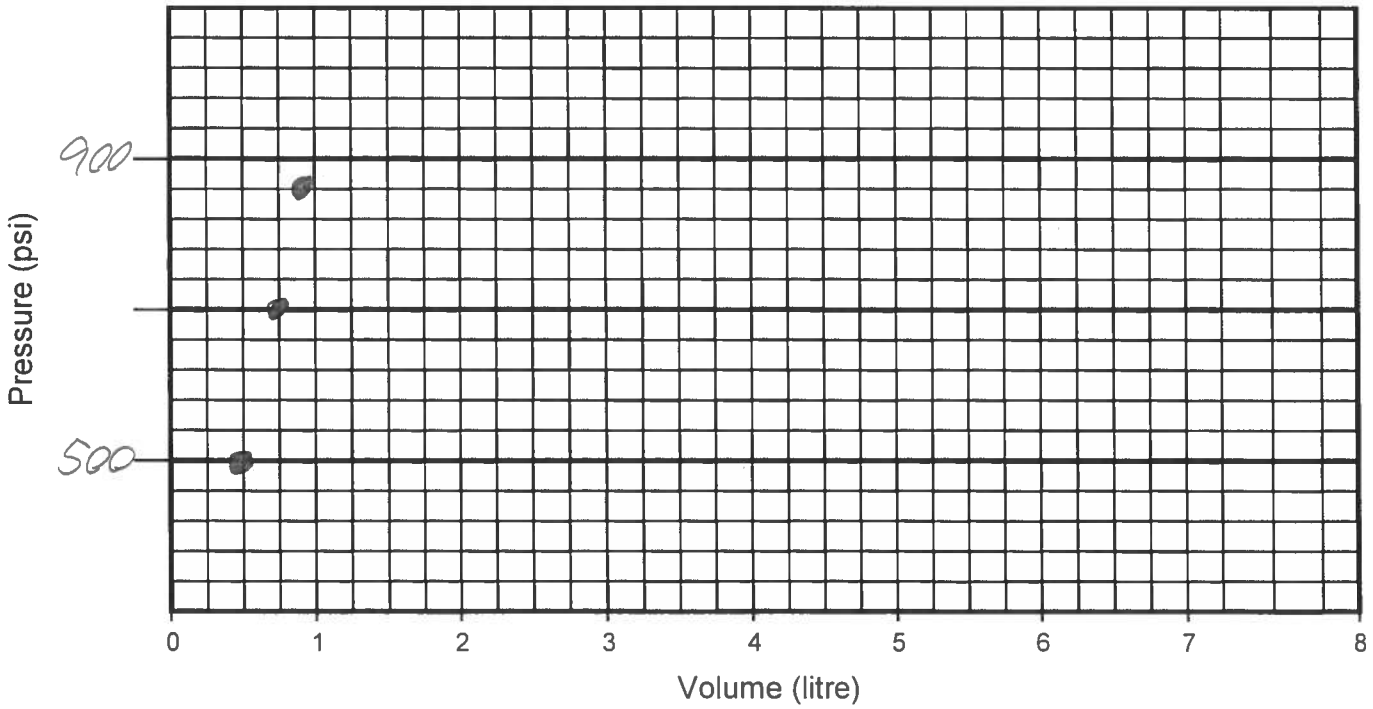
Packer No. P12 Depth (m): 94.9 Inflation Tool No.: 3198

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 875 psi Tool Pressure, P_T: 700 psi

Borehole Water Level: 94 (m) = 133 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T =$ 158 psi

Volume, litres	0	0.5	0.75	0.9	/	0.25				
Pressure, psi	0	550	760	875	/	0				
Volume, litres										
Pressure, psi										



Comments: Transcribed from field Note Book #3 Time -

Pokin there inflated

APPENDIX D: MONITORING WELL: BH8-WB

As-Built Key Components Summary (Table 4)	- 1 page
As-Built Tubing Summary (Table 5)	- 2 pages
Summary Completion Log	- 2 pages
Pre-Inflation Piezometric Pressure/ Levels	
Field Data and Calculation Sheet (May 5)	- 1 page
Figure 3, Pre-Inflation Profile	- 1 page
Post- Inflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (May 5)	- 1 page
Figure 4, Post-Inflation Profile	- 1 page
Westbay Completion Log (field copy)	- 5 pages
Westbay System Packer Inflation Records	- 6 pages

Table 4: BH8-WB As-Built Packer and Port Summary



AB, 01/06/2015

Port No.	Zone	Measurement Port Depth, (m)	Pumping Port Depth, (m)	Depth to top of Packer, (m)	Top of Zone (m)	Bottom of Zone (m)	Comments
1		115.48		113.96	115.3	65.7	
2		109.39		107.86	109.2	114.4	
3		88.97		87.44	88.7	108.3	
4		82.87		81.35	82.6	87.8	
5		80.74		79.21	80.5	81.7	
6		76.17	74.64	74.64	75.9	79.6	
7							
8							
9							
10							
11							
12							
13							
14							
15							

Note 1: All depth measurements in meters below datum (GS).
Note 2: All depth measurements use 'Nominal' tubing lengths.
Note 3: Not corrected for borehole deviation or borehole temperature effects.
Note 4: All depth measurements to upper edge of Westbay System coupling item.

Table 5: BH8-WB As-Built Summary



AB ,01/06/2015

Item No.	Component P/N	Component Description	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Accessory Depth (m)	Final Position (m)
50	203							-1.91
48	20102			202				-1.86
47	20102			202				-1.25
46	20102			202				-0.64
45	20110			202				-0.03
44	20110			202		216	3.6	3.02
43	20110			202				6.06
42	20110			202				9.11
41	20110			202				12.16
40	20110			202				15.21
39	20110			202				18.26
38	20110			202				21.30
37	20110			202				24.35
36	20110			202				27.40
35	20110			202				30.45
34	20110			202				33.50
33	20110			202				36.54
32	20110			202				39.59
31	20110			202				42.64
30	20110			202				45.69
29	20110			202				48.73
28	20110			202				51.78
27	20110			202				54.83
26	20110			202				57.88
25	20110			202				60.93
24	20110			202				63.97
23	20110			202				67.02
22	20110			202				70.07
21	20105			202				73.12
20	238	Packer	19216	224				74.64
19	20110	Measurement Port		205	8451			76.17
18	238	Packer	19212	202				79.21
17	20102	Measurement Port		205	8452			80.74
16	238	Packer	19214	202				81.35
15	20105	Measurement Port		205	8441	216	83.5	82.87
14	20110			202				84.39
13	238	Packer	19213	202				87.44
12	20110	Measurement Port		205	8449			88.97
11	20102			202				92.01
10	20110			202				92.62
9	20110			202				95.67
8	20110			202				98.72
7	20110			202				101.77

Table 5: BH8-WB As-Built Summary



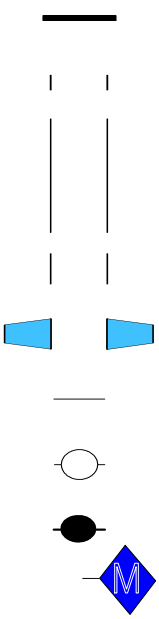
AB ,01/06/2015

Item No.	Component P/N	Component Description	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Accessory Depth (m)	Final Position (m)
6	20110			202				104.81
5	238	Packer	19215	202				107.86
4	20105	Measurement Port		205	8443	216	110.0	109.39
3	20110			202				110.91
2	238	Packer	19211	202				113.96
1	20105	Measurement Port		205	8442			115.48
0	203							117.01

Legend

(Qty) MP Components

(Library - WD Library 04/29/15)



(2) 0203 - MP38 End Cap

(5) 020102 - MP38 Casing 3 (2F/0.6M)

(33) 020110 - MP38 Casing 1 (10F/3M)

(4) 020105 - MP38 Casing 2 (5F/1.5M)

(6) 0238 - MP38 Packer - 74mm (5F/1.5M)

(41) 0202 - MP38 Regular Coupling

(1) 0224 - MP38 Pumping Port

(6) 0205 - MP38 Measurement Port

(3) 0216 - Magnetic Location Collar

Geology

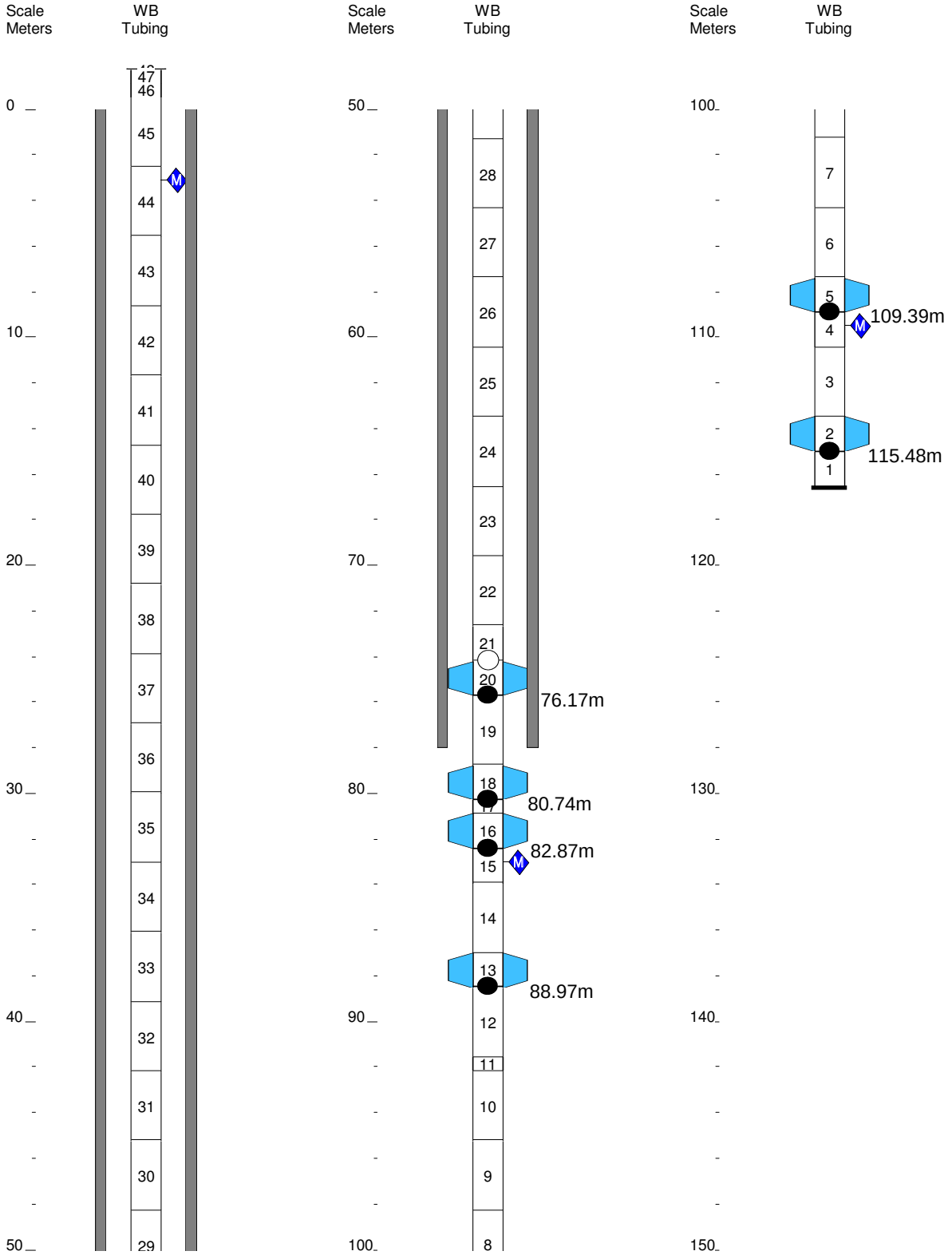
Backfill/Casing



Mild Steel

Summary Completion Log
LORAX

Job No: WB950
Well: BH8-WB



PRE-INFLATION OF 4 BOTTOM PACKERS

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Well No.: BH8-WB
Datum: GS
Elev. G.S.: ~~[illegible]~~
Height of Westbay above G.S.: ~~[illegible]~~ 1.67m
Elev. top of Westbay Casing: ~~[illegible]~~
Reference Elevation: ~~[illegible]~~
Borehole angle: Vertical

Probe Type: Sampler
Serial No.: EMS 2499
Probe Range: 250 psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Date: May 5/15
Client: LoRAx
Job No.: WB950
Location: Coffee
Weather: cool - clear
Operator: M. Lessard

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

		Finish:
Start: Pressure	13.30 psi	13.37 psi
Temp	7.57 °C	0.11 °C
Time	10:31 am	10:58 am

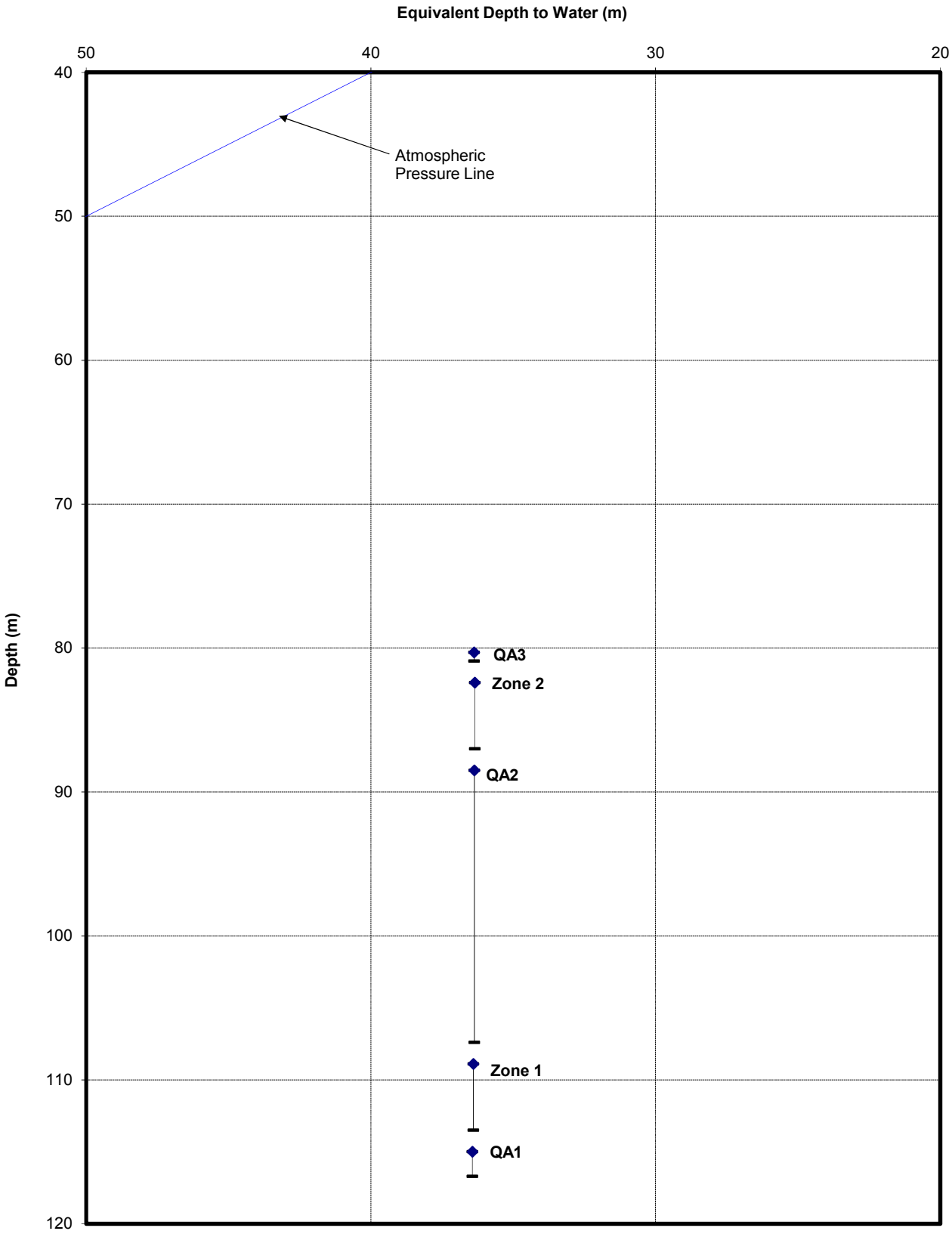
P_{atm} 13.30 psi

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
1	115.0	115.6	-	181.47	125.02	10:41	1.96	181.48	78.6	36.4	Zones
2	108.9	109.5	-	172.63	116.40	10:45	1.68	172.60	72.5	36.4	QA1
3	88.5	89.1	-	142.95	87.44	10:48	1.43	142.95	52.1	36.4	Zone1
4	82.4	83.0	-	134.10	78.79	10:49	1.17	134.09	46.1	36.3	QA2
5	80.3	80.8	-	131.01	75.76	10:52	0.84	131.01	43.9	36.4	Zone2
6	75.7	76.3	-	124.36	69.25	10:54	0.69	124.36	39.7	36.4	QA3
											QA4

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: BH8-WB

Profile Date: May 5, 2015
Comments: Pre-Inflation Profile



Client: LORAX
Site: Coffee Creek
Datum: GS

Figure 3

Plot By:____Date:____
Checked By:____Date:____
Westbay Project: WB950

Post INFLATION

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Well No.: BH8-WB
Datum: GS
Elev. G.S.: ø
Height of Westbay above G.S.: ~~2.44m~~ 1.67m
Elev. top of Westbay Casing: ø
Reference Elevation: ø
Borehole angle: Vertical

Probe Type: Sampler
Serial No.: EMS 2499
Probe Range: 250psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Date: May 5/15
Client: LORAX
Job No.: WB 950
Location: Coffee
Weather: Cool - Clear
Operator: M. Lessard

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 13.34 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)

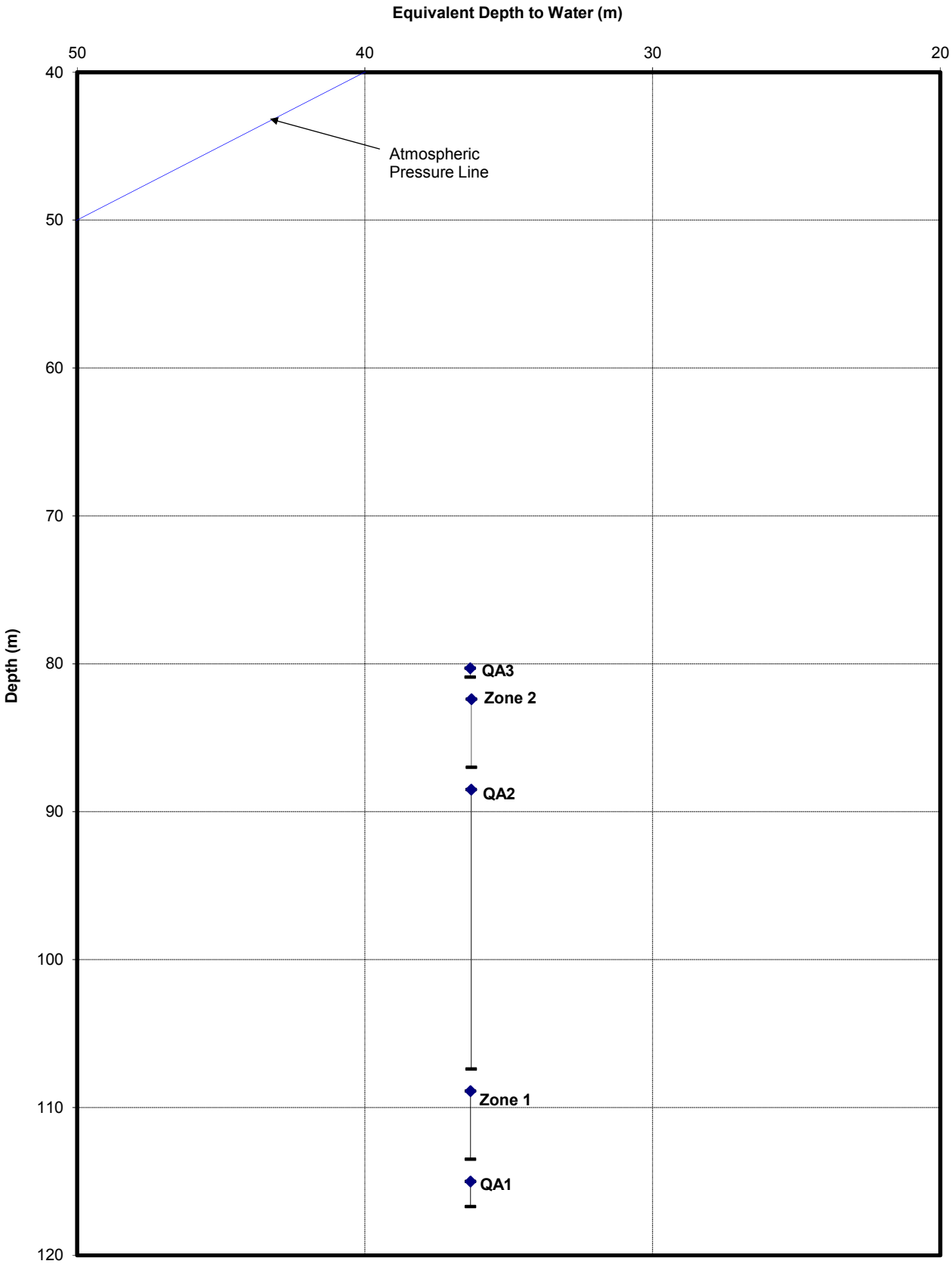
Start: Pressure 13.34 psi Finish: 13.32 psi
Temp 13.80 °C 0.89 °C
Time 2:48 pm 3:18 pm

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings					Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)			Zones
1	115.0	115.5	–	120.60	125.21	3:02	4.17	120.62	78.7	36.3	QA1
2	108.9	109.4	–	111.78	116.54	~~2.98~~ 3:05	2.98	111.80	72.6	36.3	Zone 1
3	88.5	89.0	–	82.15	87.57	3:07	2.11	82.16	52.2	36.3	QA2
4	82.4	82.9	–	73.31	78.90	3:10	1.47	73.31	46.1	36.3	Zone 2
5	80.3	80.8	–	70.22	75.86	3:12	1:22	70.22	44.0	36.3	QA3
6	75.7	76.2	–	63.55	69.36	3:13	1.00	63.55	39.9	36.3	QA4

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: BH8-WB

Profile Date: May 5, 2015
Comments: Post-Inflation Profile



Client: LORAX
Site: Coffee
Datum: GS

Plot By:____Date:_____
Checked By:____Date:_____
Westbay Project: WB950

Figure 4

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Well No.: BH8-WB
Datum: GS
Elev. G.S.: 0
Height of Westbay above G.S.: 1.67 m
Elev. top of Westbay Casing: 0
Reference Elevation: 0
Borehole angle: Vertical

Probe Type: Sampler
Serial No.: EMS2499
Probe Range: 250 psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Date: May 9/15
Client: CoRAF
Job No.: WB950
Location: Coffee
Weather: warm-clear
Operator: M. Lessard

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure 13.29 psi — Finish: 13.28 psi
Temp 18.40 °C — 23.7 °C
Time 4:42 pm — 5:05 pm

P_{atm} 13.29 psi

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
1	115.0	114.7	-	121.56	125.06	4:51	8.29	121.56			QA1
2	108.9	108.6	-	112.72	116.40	4:53	5.62	112.75			Zone 1
3	88.5	88.2	-	83.10	87.47	4:55	3.47	83.11			QA2
4	82.4	82.1	-	74.25	78.82	4:57	2.70	74.25			Zone 2
5	80.3	80.0	-	71.16	75.79	4:58	2.09	71.16			QA3
6	75.7	75.3	-	64.52	69.30	5:00	1.57	64.52			QA4

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O — Dz = piezometric level in zone — Patm = atmospheric pressure — H = pressure head of water in zone — Dp = true depth of measurement port

Westbay Completion Log

Company: LORAX
Well: BH8-WB
Site: Coffee
Project: Coffee

Job No: WB950
Author: ML

Well Information

Reference Datum: Ground Surface
Elevation of Datum: 0.00 m.
MP Casing Top: 0.00 m.
MP Casing Length: 116.59 m.

Borehole Depth: ~~120.00~~ 116.7 mL m.
Borehole Inclination: Vertical
Borehole Diameter: 114.00 mm

Well Description:
Permafrost
Other References:

File Information

File Name: BH8-WB2.WWD
Report Date: Sun May 03 21:22:20 2015

File Date: May 02 20:58:29 2015

Comments

Zero reference is ground surface - ML
Filter socks not to be used - ML

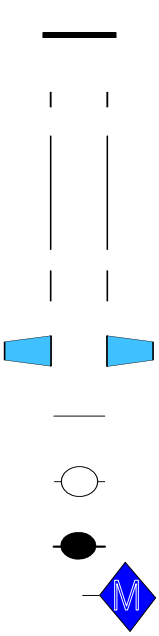
Log Information

Borehole condition confirmed. (method) TAG Date: May 4/15
MP well design & preparation. By: [signature] Date: May 4/15
MP well design checked. By: [signature] Date: May 4/15
MP well and borehole approved to install. By: [signature] Date: May 4, 15

Legend

(Qty) MP Components

(Library - WD Library 04/29/15)



(2) 0203 - MP38 End Cap

(5) 020102 - MP38 Casing 3 (2F/0.6M)

(33) 020110 - MP38 Casing 1 (10F/3M)

(4) 020105 - MP38 Casing 2 (5F/1.5M)

(6) 0238 - MP38 Packer - 74mm (5F/1.5M)

(41) 0202 - MP38 Regular Coupling

(1) 0224 - MP38 Pumping Port

(6) 0205 - MP38 Measurement Port

(3) 0216 - Magnetic Location Collar

Geology

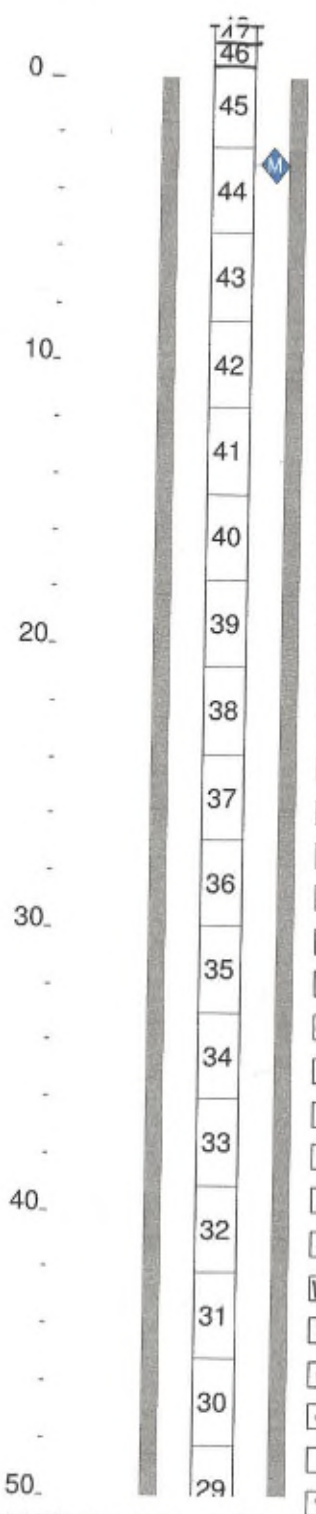
Backfill/Casing



Mild Steel

Westbay Completion Log
LORAX

Job No: WB950
Well: BH8-WB



Stickup is 1.67m above zero (GS) - without WB coupling.

Finish lowering at 13:50 May 4/15. well set at depth on bottom of bore hole.

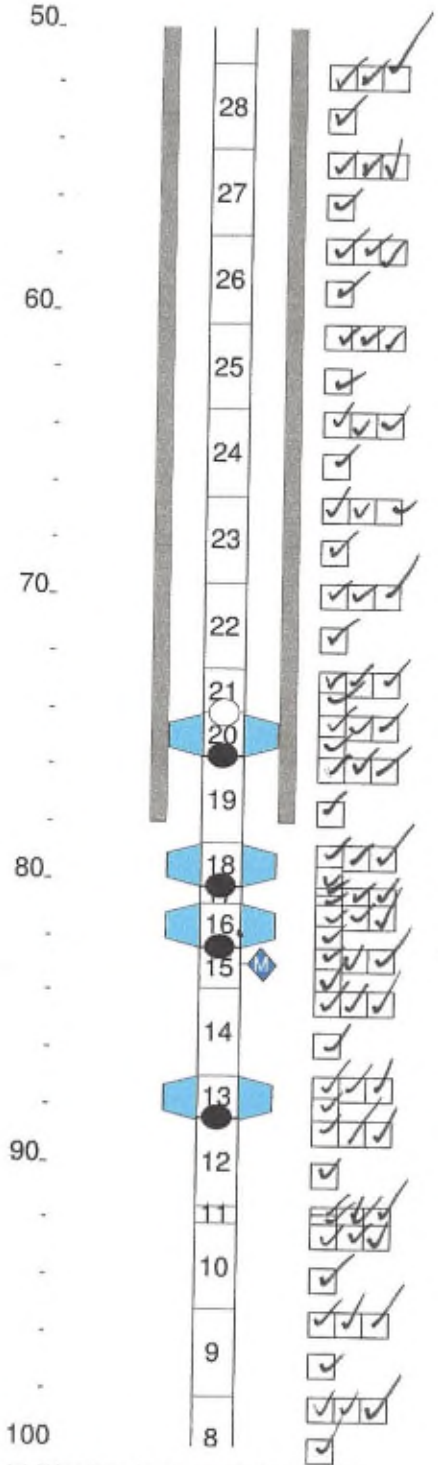
12:50

(c) Westbay Instruments Inc. 2000

Sun May 03 21:22:00 2015

Westbay Completion Log
LORAX

Job No: WB950
Well: BH8-WB



WB Tubing Description	Serial Numbers
	12:00
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	11:37
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	
020105 - MP38 Casing 2 (5F/1.5M) 0224 - MP38 Pumping Port 0238 - MP38 Packer - 74mm (5F/1.5M) 0205 - MP38 Measurement Port	19216 - 140 ps: 8451
020110 - MP38 Casing 1 (10F/3M)	
0238 - MP38 Packer - 74mm (5F/1.5M) 020102 - MP38 Casing 3 (2F/0.6M)	19212 - 150 ps: 8452
0238 - MP38 Packer - 74mm (5F/1.5M) 0205 - MP38 Measurement Port 020105 - MP38 Casing 2 (5F/1.5M)	19214 - 150 ps: 8441
020110 - MP38 Casing 1 (10F/3M)	
0238 - MP38 Packer - 74mm (5F/1.5M) 0205 - MP38 Measurement Port	19213 - 140 ps: 8449
020110 - MP38 Casing 1 (10F/3M)	
020102 - MP38 Casing 3 (2F/0.6M)	
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	
020110 - MP38 Casing 1 (10F/3M)	10:21

(c) Westbay Instruments Inc. 2000

Sun May 03 21:22:00 2015

Westbay Completion Log
LORAX

Job No: WB950
Well: BH8-WB

Scale Meters	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
100				
	7		020110 - MP38 Casing 1 (10F/3M)	
	6		020110 - MP38 Casing 1 (10F/3M)	
	5		0238 - MP38 Packer - 74mm (5F/1.5M)	19215 - 150 ps: 8443
110	4 (M)		0205 - MP38 Measurement Port 020105 - MP38 Casing 2 (5F/1.5M)	
	3		020110 - MP38 Casing 1 (10F/3M)	
	2		0238 - MP38 Packer - 74mm (5F/1.5M)	19211 - 145 ps: 8442
	1		0205 - MP38 Measurement Port 020105 - MP38 Casing 2 (5F/1.5M) 0203 - MP38 End Cap	
120				0945 start lowering May 4, 2015.

Borehole water level ~126 ft. TOC

Joint test tool: 200 ps:

Inflation tool: 400 ps: May 4+5, 2015

130

Hydraulic Integrity Test

135.60 ft at 4:10 pm May 5/15
135.55 ft at 4:15 pm
135.53 ft at 4:25 pm
140 135.53 ft at 4:30 pm
135.53 ft at 4:40 pm
135.53 ft at 4:45 pm
135.53 ft at 5:00 pm

Westbay Casing is water tight.
Mark Fasel

150

(c) Westbay Instruments Inc. 2000

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH8-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Lessard Date Inflated: May 5/15

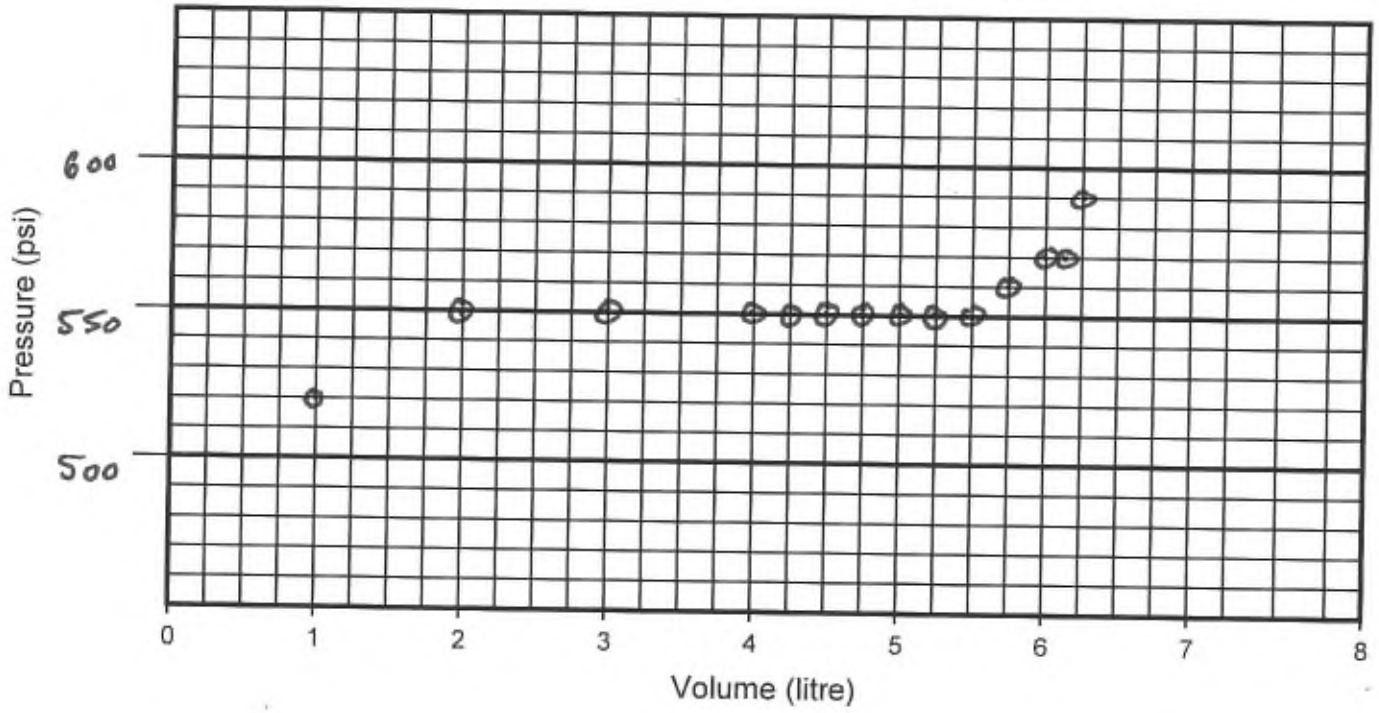
Packer No. 1, comp 2 SN# 19211 Depth (m): 115.0 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 590 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 38.4 (m) = 55 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 100 psi

Volume, litres	1.0	2.0	3.0	4.0	4.25	4.5	4.75	5.0	5.25	5.5
Pressure, psi	520	550	550	550	550	550	550	550	550	550
Volume, litres	5.75	6.0	6.1	/	6.25	/	5.8			
Pressure, psi	560	570	570	/	590	/	ø			



Comments: Time - 12:23 pm

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH8-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M.Lossard Date Inflated: May 5/15

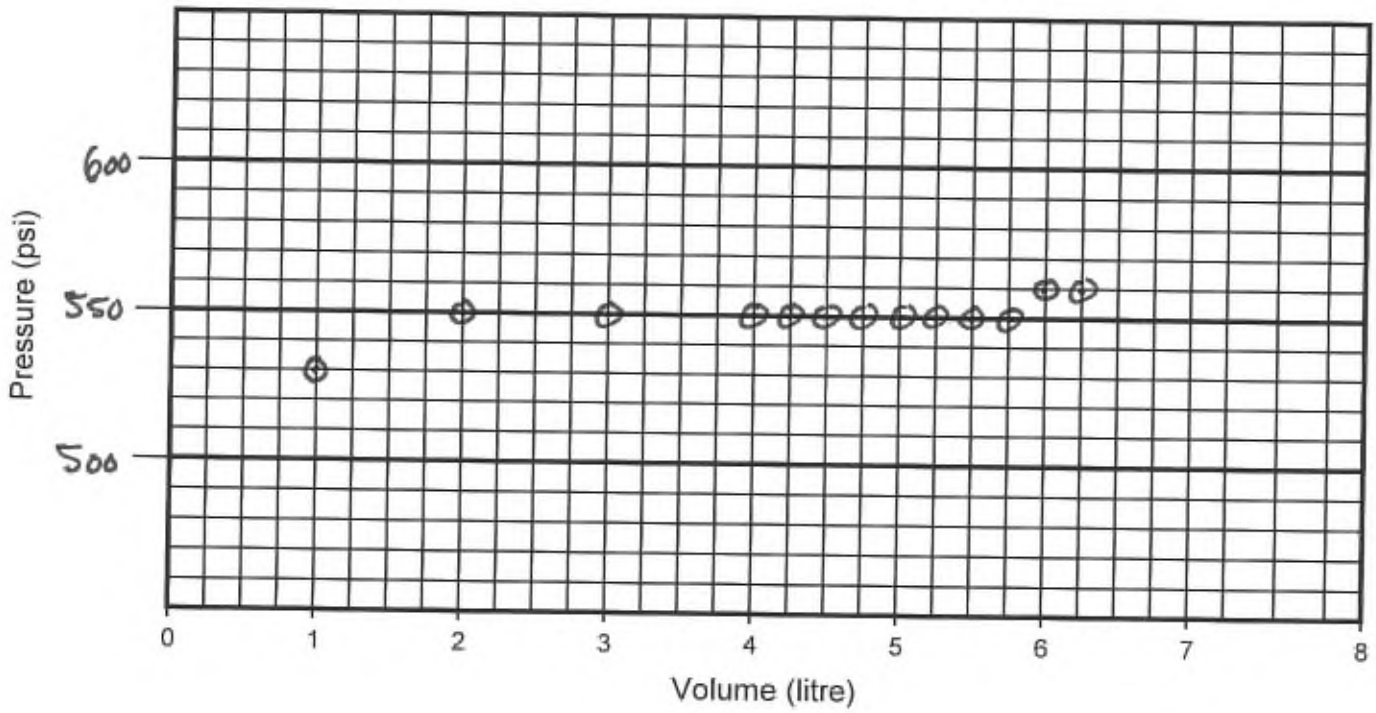
Packer No. 2, comp 5 SN# 19215 Depth (m): 108.9 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 560 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 38.4 (m) = 55 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 65 psi

Volume, litres	1.0	2.0	3.0	4.0	4.25	4.5	4.75	5.0	5.25	5.5
Pressure, psi	530	550	550	550	550	550	550	550	550	550
Volume, litres	5.75	6.0	6.25	/	5.9					
Pressure, psi	550	560	560	/	∅					



Comments: Time - 12:51 pm

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH8-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Lessard Date Inflated: May 5/15

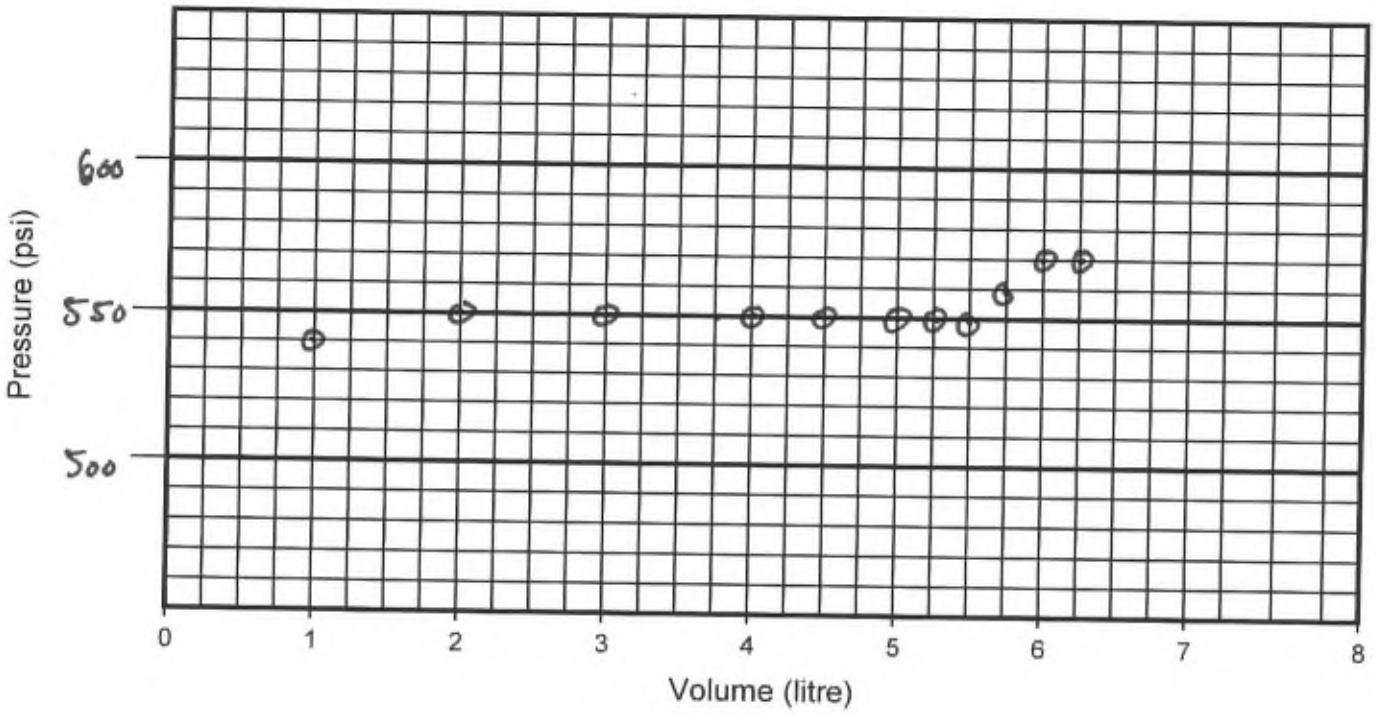
Packer No. 3 comp 13 SN# 19213 Depth (m): 88.5 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 140 psi Final Line Pressure, P_L: 570 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 38.4 (m) = 55 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 85 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	5.0	5.25	5.5	5.75	6.0
Pressure, psi	540	550	550	550	550	550	550	550	560	570
Volume, litres	6.25	/	5.9							
Pressure, psi	570	/	0							



Comments: Time - 1:21 pm

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH8-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Lessard Date Inflated: May 5/15

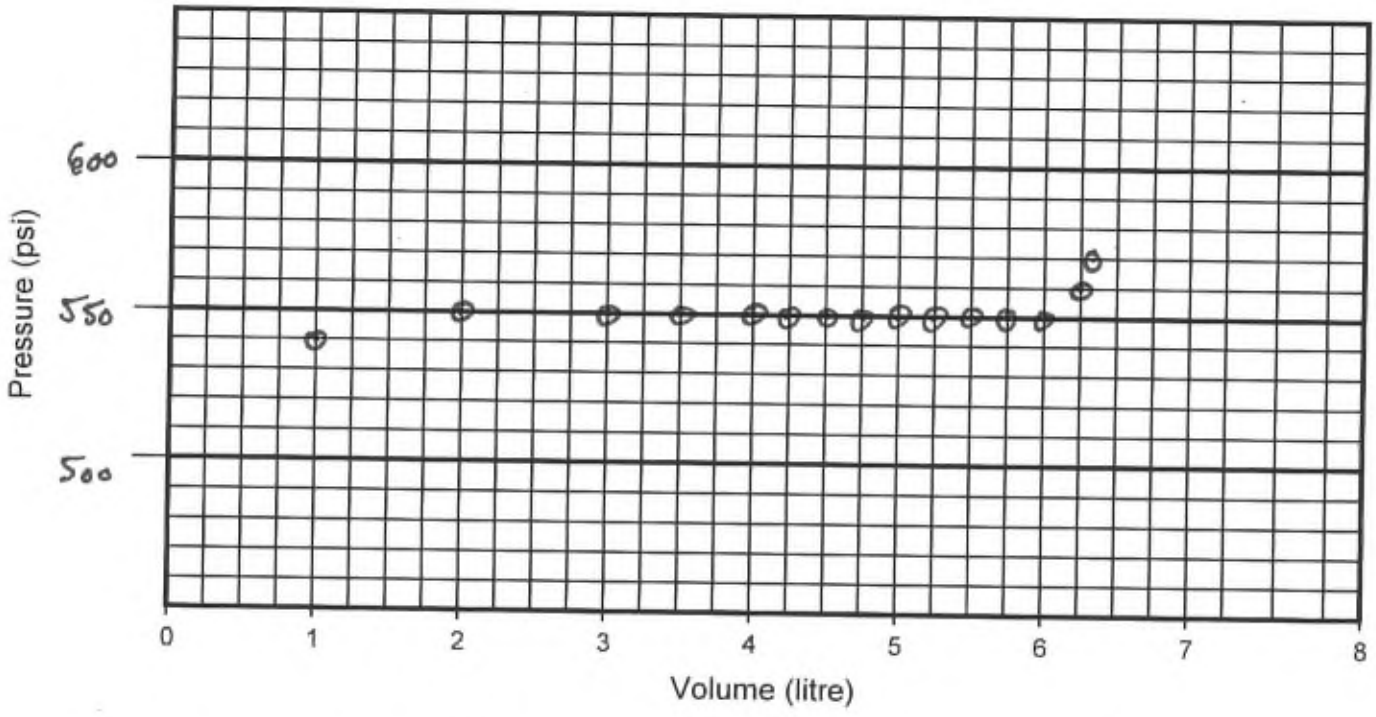
Packer No. 4" comp 16 SN# 19214 Depth (m): 82.4 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 570 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 38.4 (m) = 55 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 75 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.25	4.5	4.75	5.0	5.25
Pressure, psi	540	550	550	550	550	550	550	550	550	550
Volume, litres	5.5	5.75	6.0	6.25	6.35	/	6.0			
Pressure, psi	550	550	550	560	570	/	ϕ			



Comments: Squeeze relief? Time - 1:56 pm

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH8-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Lessard Date Inflated: May 4/15

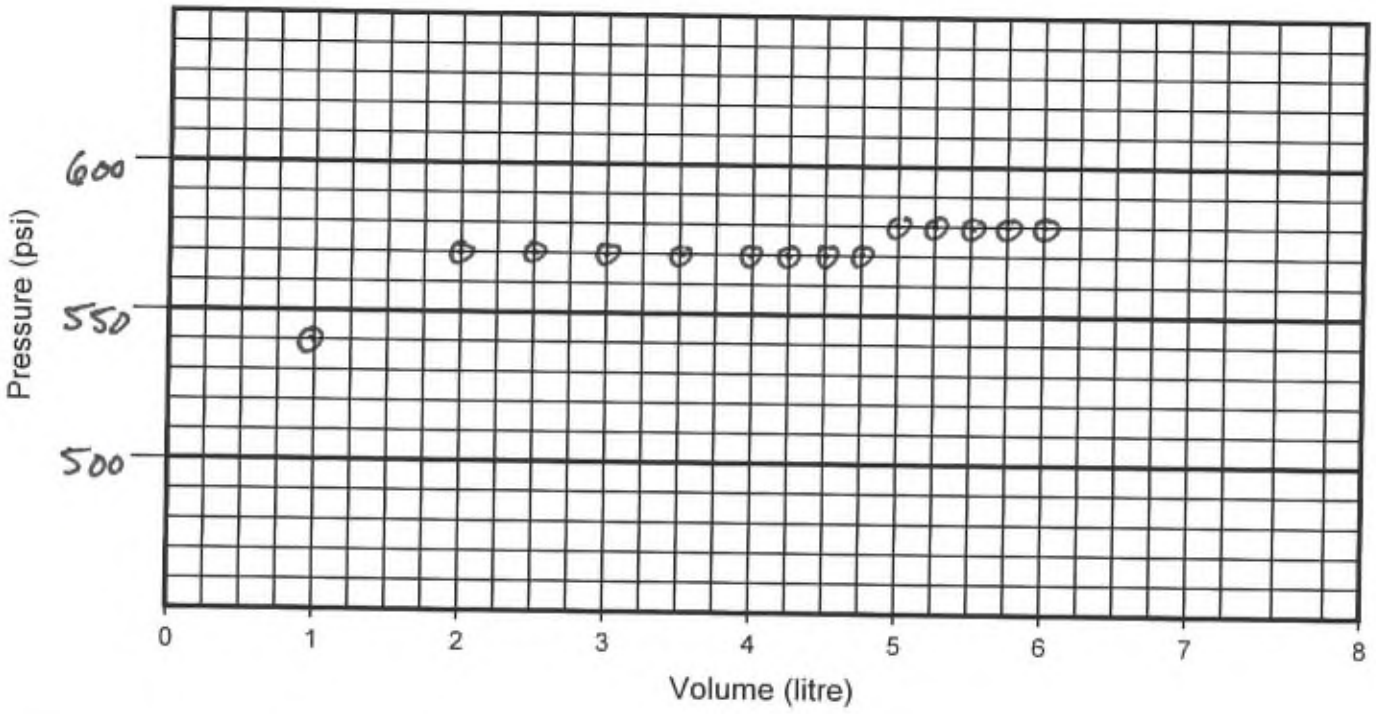
Packer No. 5, comp 18 SN# 19212 Depth (m): 80.3 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 580 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 38.4 (m) = 55 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 85 psi

Volume, litres	1.0	2.0	2.5	3.0	3.5	4.0	4.25	4.5	4.75	5.0
Pressure, psi	540	570	570	570	570	570	570	570	570	580
Volume, litres	5.25	5.5	5.75	6.0	/	5.7				
Pressure, psi	580	580	580	580	/	Ø				



Comments: 4.5 in BH Time - 6:02 pm

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH8-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Lessard Date Inflated: May 4/15

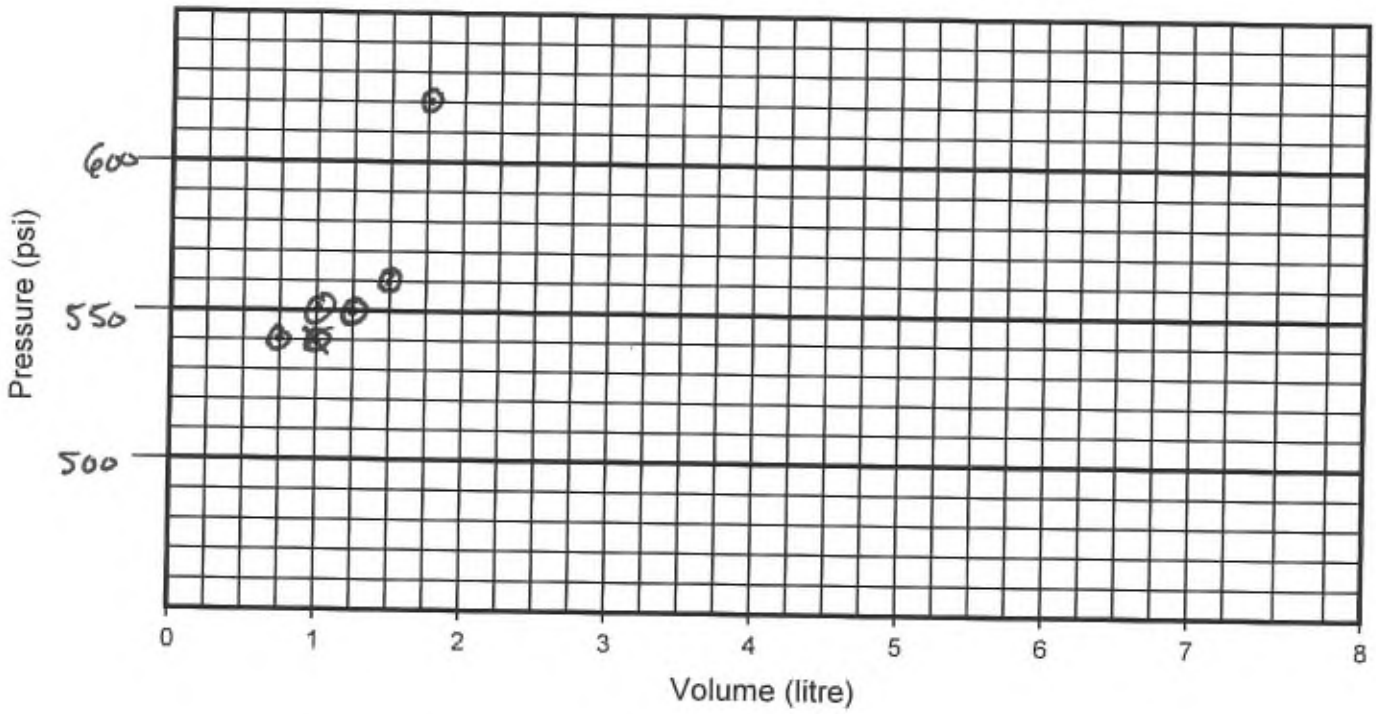
Packer No. 6, comp 20 SN# 19216 Depth (m): 75.7 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 140 psi Final Line Pressure, P_L: 620 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 38.4 (m) = 55 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 135 psi

Volume, litres	0.75	1.0	1.25	1.5	1.75	/	1.4			
Pressure, psi	540	550	550	560	620	/	ø			
Volume, litres										
Pressure, psi										



Comments: In HQ surface casing Time - 6:16 pm

APPENDIX E: MONITORING WELL: BH10-WB

As-Built Key Components Summary (Table 4)	- 1 page
As-Built Tubing Summary (Table 5)	- 1 page
Summary Completion Log	- 2 pages
Pre-Inflation Piezometric Pressure/ Levels	
Field Data and Calculation Sheet (May 24)	- 1 page
Figure 3, Pre-Inflation Profile	- 1 page
Post- Inflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (May 24)	- 1 page
Figure 4, Post-Inflation Profile	- 1 page
Westbay Completion Log (field copy)	- 5 pages
Westbay System Packer Inflation Records	- 5 pages

Table 4: BH10-WB As-Built Packer and Port Summary

AB, 01/06/2015

Port No.	Zone	Measurement Port Depth, (m)	Pumping Port Depth, (m)	Depth to top of Packer, (m)	Top of Zone (m)	Bottom of Zone (m)	Comments
1	1	61.0		59.5	60.8	65.7	
2	QA 1	32.0		30.5	31.8	59.9	
3	2	25.9		24.4	25.7	30.9	
4	QA 2	13.7		12.2	13.5	24.8	
5	QA 3	9.2	7.6	7.6	8.9	12.6	
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

Note 1: All depth measurements in meters below datum (GS).
Note 2: All depth measurements use 'Nominal' tubing lengths.
Note 3: Not corrected for borehole deviation or borehole temperature effects.
Note 4: All depth measurements to upper edge of Westbay System coupling item.

Table 5: BH10-WB As-Built Summary

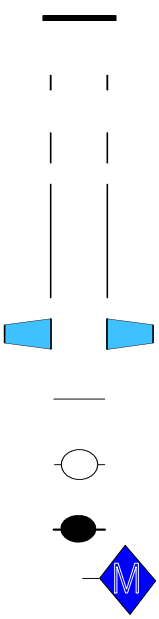
AB ,01/06/2015

Item No.	Component P/N	Component Description	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Accessory Depth (m)	Final Position (m)
28	20102			203				-1.07
27	20102			202				-0.59043
26	20105			202				0.019141
25	20110			202		216	2.1	1.5431
24	20110			202				4.5909
23	238	Packer	19225	224	8712			7.6388
22	20110	Measurement Port		205	8456			9.1627
21	238	Packer	19224	202				12.211
20	20105	Measurement Port		205	8458			13.734
19	20110			202				15.258
18	20110			202				18.306
17	20110			202				21.354
16	238	Packer	19201	202				24.402
15	20110	Measurement Port		205	8457	216	26.5	25.926
14	20105			202				28.974
13	238	Packer	19208	202				30.498
12	20110	Measurement Port		205	8459			32.022
11	20110			202				35.069
10	20110			202				38.117
9	20110			202				41.165
8	20110			202				44.213
7	20110			202				47.261
6	20110			202				50.309
5	20110			202				53.357
4	20110			202				56.404
3	238	Packer	19205	202				59.452
2	20105	Measurement Port		205	8478	216	61.6	60.976
1	20110			202				62.5
0	203			202				65.548

Legend

(Qty) MP Components

(Library - WD Library 04/29/15)



(2) 0203 - MP38 End Cap

(3) 020102 - MP38 Casing 3 (2F/0.6M)

(4) 020105 - MP38 Casing 2 (5F/1.5M)

(17) 020110 - MP38 Casing 1 (10F/3M)

(5) 0238 - MP38 Packer - 74mm (5F/1.5M)

(22) 0202 - MP38 Regular Coupling

(1) 0224 - MP38 Pumping Port

(5) 0205 - MP38 Measurement Port

(3) 0216 - Magnetic Location Collar

Geology

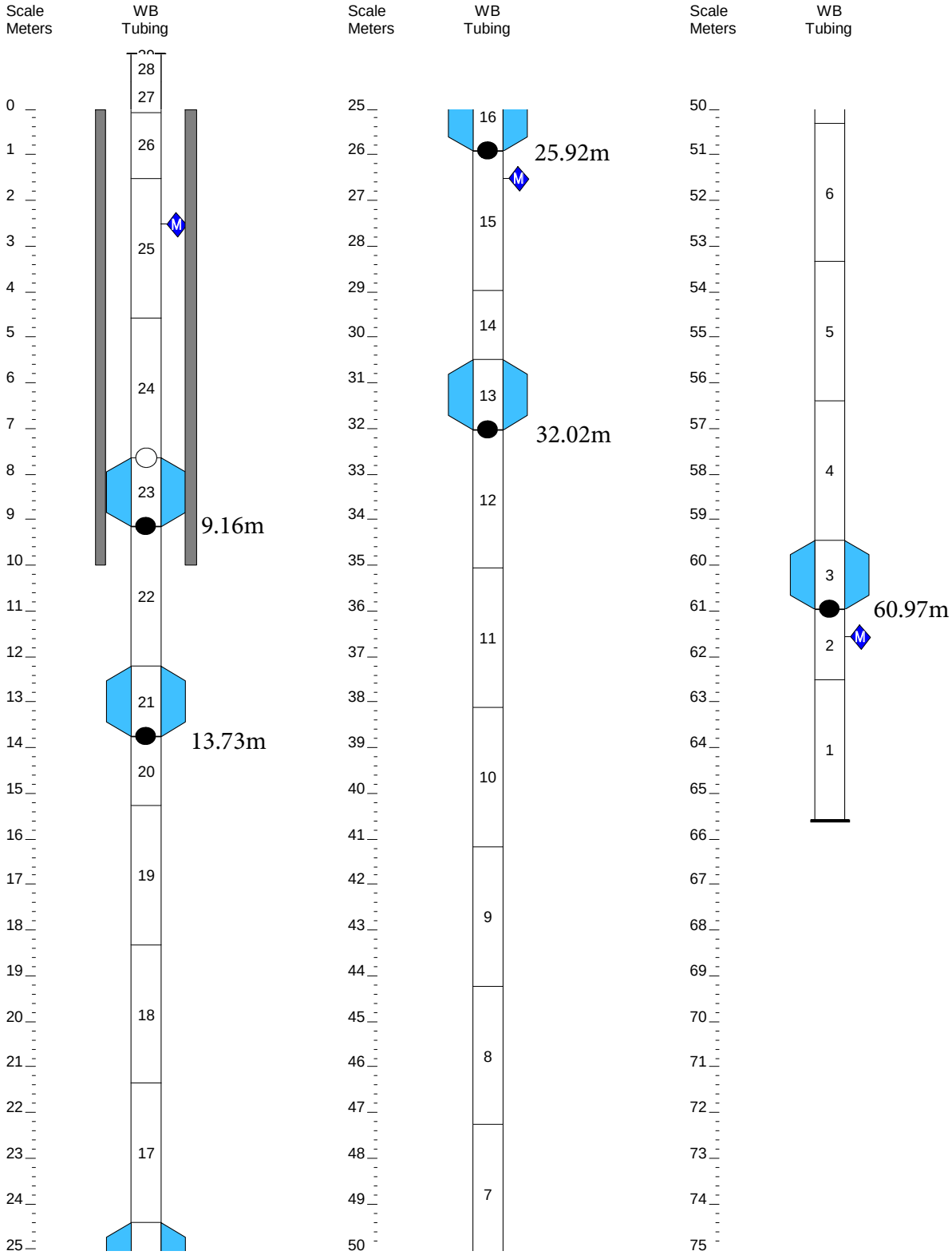
Backfill/Casing



Mild Steel

Summary Completion Log
LORAX

Job No: WB950
Well: BH10-WB



Westbay Instruments

Westbay Piezometric Pressures/Levels

Pre-Irrigation Field Data and Calculation Sheet

Well No.: BH-10
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: EMS
Serial No.: 2499
Probe Range: 250
Westbay Casing Type: MP38
Sampler Valve Position: C

Date: May 24, 2015
Client: LORAX
Job No.: 950
Location: Cathedral Creek
Weather: Sunny + Warm
Operator: KB

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure —
Temp —
Time —

Finish: —

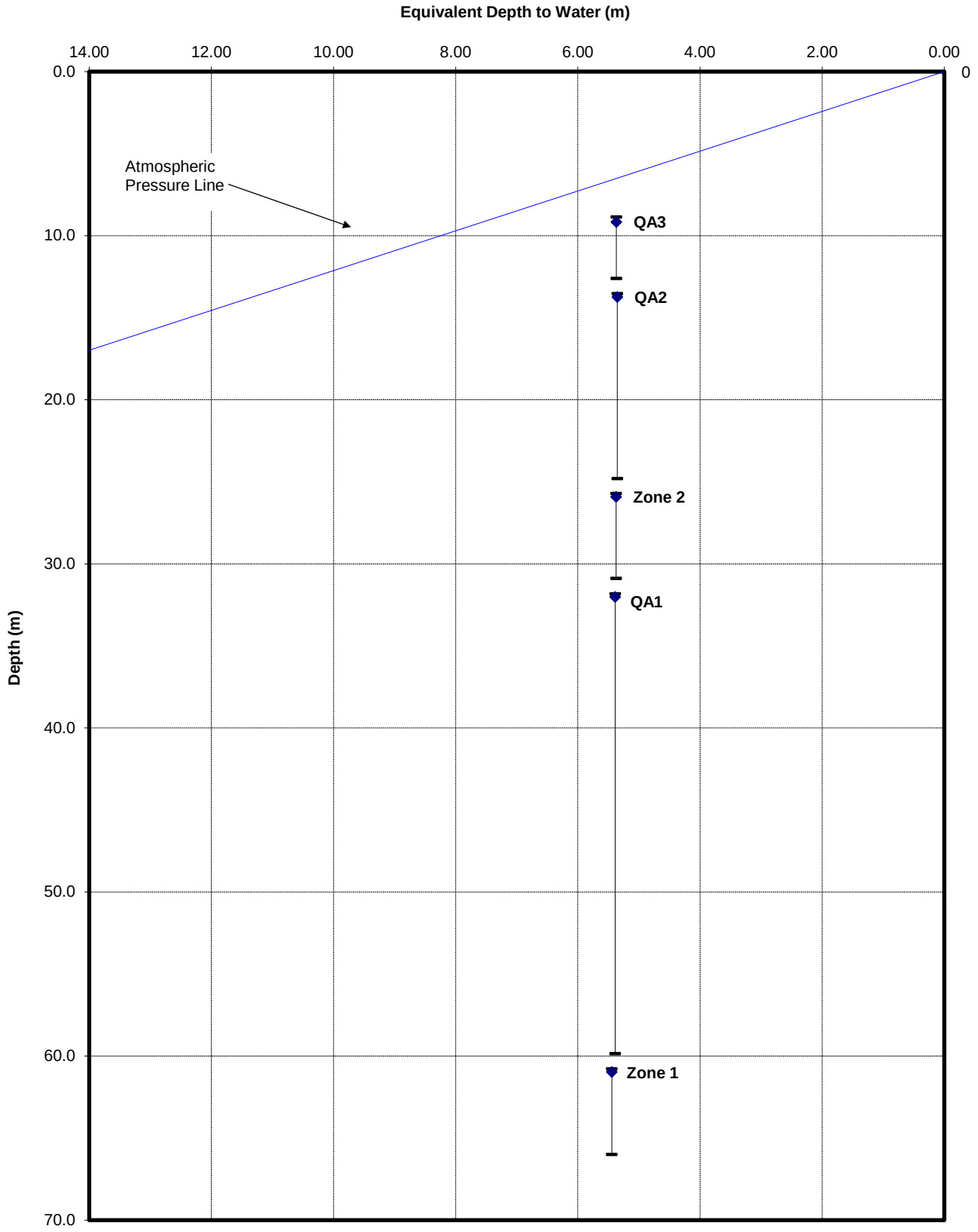
P_{atm} 13.46 psi

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings					Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)			
1	61	61.2		74.53	92.42	11:38	4.24	74.54	55.51	5.4	
2	32.5	32.3		32.41	51.33	11:42	2.24	32.42	26.63	5.8	
3	26.5	26.2		23.54	42.68	11:45	1.62	23.54	20.54	5.9	
4	18.5	13.7		13.48	25.37	11:50	1.33	13.48	8.37	6.12	
5	10.0	9.1		13.47	18.85	11:53	1.26	13.48	3.79	6.20	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: BH10-WB

Profile Date: May 24, 2015
Comments: Pre-Inflation Profile



Client: LORAX Environmental Ltd.
Site: Coffee Creek
Datum: Ground Surface

Figure 3

Plot By:____Date:____
Checked By:____Date:____
Westbay Project: WB950

Westbay Piezometric Pressures/Levels

post-inflation

Field Data and Calculation Sheet

Well No.: BH-10
Datum: —
Elev. G.S.: —
Height of Westbay above G.S.: —
Elev. top of Westbay Casing: —
Reference Elevation: —
Borehole angle: —

Probe Type: EMS
Serial No.: 2499
Probe Range: 250
Westbay Casing Type: MP38
Sampler Valve Position: C

Date:
Client: LORAX
Job No.: 950
Location: Coffin Creek
Weather:
Operator: AB

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure
Temp
Time

Finish: 13:46

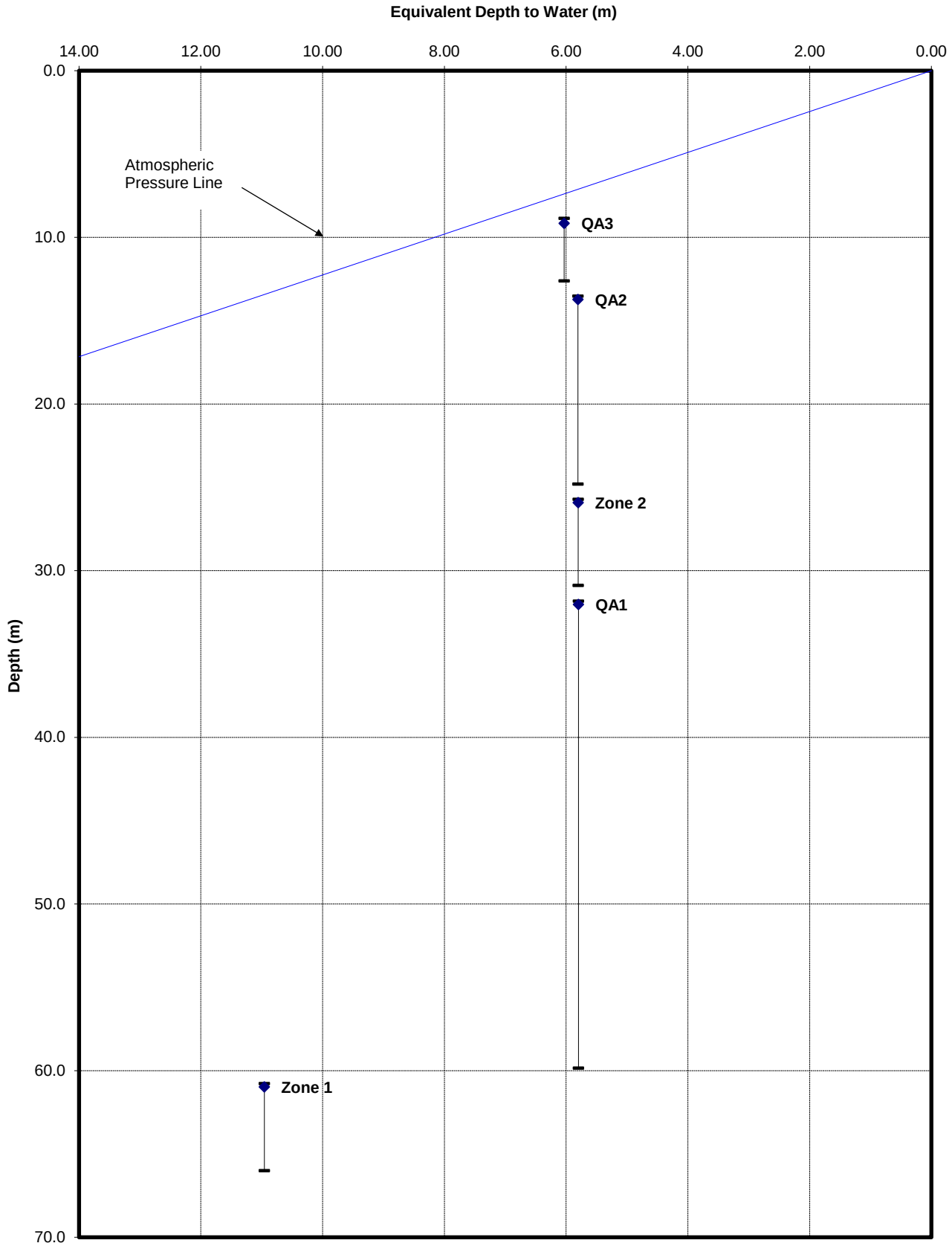
P_{atm} 13.46 psi

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings					Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments
				Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)			
1	60.97	61.1		75.19	85.74	13:50	5.60	75.20	50.82	10.14	
2	32.0	32.1		33.08	51.91	13:54	2.77	33.09	27.03	4.96	
3	25.92	26.1		24.20	43.23	13:56	2.37	24.20	20.93	4.99	
4	13.73	13.8		13.46	25.89	15:59	2.26	13.48	8.74	4.98	
5	9.16	9.2		13.44	17.07	14'01	2.17	13.49	3.94	5.21	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: BH10-WB

Profile Date: May 24, 2015
Comments: Post-Inflation Profile



Client: LORAX Environmental Ltd.
Site: Coffee Creek
Datum: Ground Surface

Figure 4

Plot By:____Date:_____
Checked By:____Date:_____
Westbay Project:WB950

Westbay System Completion Log

Company: LORAX
Well: BH-10
Site: Coffee Creek
Project: —

WB #: 950
Author: AB

Well Information

Reference Datum: GS ft.
Elevation of Datum: — ft.
WB Tubing Top: _____ ft.
WB Tubing Length: 655 ft./m

Borehole Depth: 702 ft.
Borehole Inclination:
Borehole Diameter: 4.5 in.

Well Description:

Other References:

File Information

File Name: _____
Report Date: _____

File Date: _____

Comments

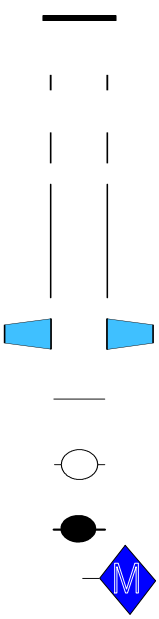
Installation sign-off Information

Borehole condition confirmed.(Client) (method) Sand Date: 24/05/2015
WB System design & preparation.(Client / WB) By: AB Date: 24/05/2015
WB System design checked. (Client / WB) By: AB Date: 24/05/2015
WB System and borehole approved to install. (Client) By: J Sundeen Date: 24/05/2015

Legend

(Qty) MP Components

(Library - WD Library 04/29/15)



(2) 0203 - MP38 End Cap

(3) 020102 - MP38 Casing 3 (2F/0.6M)

(4) 020105 - MP38 Casing 2 (5F/1.5M)

(17) 020110 - MP38 Casing 1 (10F/3M)

(5) 0238 - MP38 Packer - 74mm (5F/1.5M)

(22) 0202 - MP38 Regular Coupling

(1) 0224 - MP38 Pumping Port

(5) 0205 - MP38 Measurement Port

(3) 0216 - Magnetic Location Collar

Geology

Backfill/Casing



Mild Steel

Westbay Instruments

Westbay System Completion Log

Sheet 1 of 3

Project: LARAY WB#.: 950

Location: Coffee Creek Hole No.: BH-10 Installed by: AB

Hole Depth: 65.8m WB Depth: 65.6m Hole Diameter: 4.5" Date Installed: 24/5/2015

Measurement Datum: GS Datum Elevation: — Date Drawn: —

Scale, (m/ft)	Component Description	Depth Log	WB Tubing Log	Serial No.	Final Packer Pressure/Volume	Comments	Joint Install	Joint Test
0	2		28					
	2		27					
	5		26					
10	10		25					
			24					
20	10							
	224							
	238		23	8712 19225 8456				
30	205							
	10		22					
40								
	238		21	19224 8458				
	205							
50	5		20					
	10		19					
60								
	10		18					
70								
	10		17					
80								
	238		16	19201 8457				
	205							
90								

WB Tubing | WB Packer | Magnetic Collar | Filter Sleeve | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Westbay Instruments

Westbay System Completion Log

Sheet 2 of 3

Project: LORAX WB#.: 950

Location: Coffee Creek Hole No.: BH-10 Installed by: AB

Hole Depth: 65.8m WB Depth: 65.6m Hole Diameter: 4.5" Date Installed: 24/05/2015

Measurement Datum: GS Datum Elevation: — Date Drawn:

Scale, (m/ft)	Component Description	Depth Log	WB Tubing Log	Serial No.	Final Packer Pressure/Volume	Comments	Joint Install	Joint Test
90	10		15				✓	✓
	5		14				✓	✓
100	238 205		13	19208 8459			✓	✓
110	10		12				✓	✓
120	10		11				✓	✓
130	10		10				✓	✓
140	10		9				✓	✓
150	10		8				✓	✓
160	10		7				✓	✓
170	10		6				✓	✓
180	10		5				✓	✓
190			4					

WB Tubing | WB Packer | Magnetic Collar | Filter Sleeve | Measurement Port Coupling | Pumping Port Coupling | Regular Coupling

Westbay Instruments

Westbay System Completion Log

Sheet 3 of 3

Project: LORAX — WB#.: 950

Location: Coffee Creek — Hole No.: BH-10 — Installed by: AB

Hole Depth: 65.8m — WB Depth: 65.6m — Hole Diameter: 4.5" — Date Installed: 24/5/2015

Measurement Datum: GS — Datum Elevation: — — Date Drawn: —

Scale (m/ft)	Component Description	Depth Log	WB Tubing Log	Serial No.	Final Packer Pressure/Volume	Comments	Joint Install	Joint Test
200	5		4	19205			✓	✓
	238 205		3	8478			✓	✓
	5		2				✓	✓
210	10		1				✓	✓
220								
230								
240								
250								

WB Tubing — WB Packer — Magnetic Collar — Filter Sleeve — Measurement Port Coupling — Pumping Port Coupling — Regular Coupling

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH-19

Location: Coffee Creek, Kaminak Gold Project Completed by: AB Date Inflated: 24/05/2015

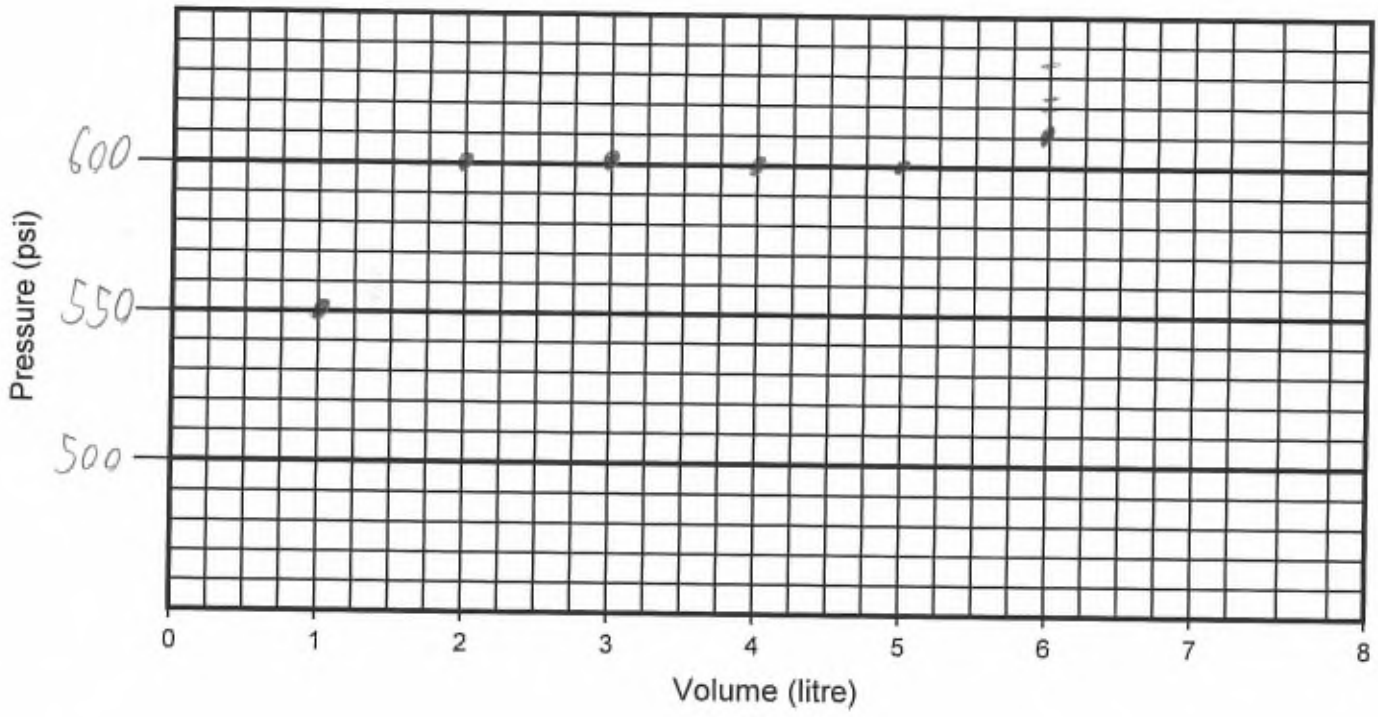
Packer No. 19205 Depth (m): — Inflation Tool No.: ____

Packer Valve Pressure, P_V: 155 psi Final Line Pressure, P_L: 625 psi Tool Pressure, P_T: 350 psi

Borehole Water Level: 8 (m) = 11.4 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 131 psi

Volume, litres	1	2	3	4	5	6	/	5.6		
Pressure, psi	550	600	600	600	600	625	/	Ø		
Volume, litres										
Pressure, psi										



Comments: Time - 12:15

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH-10

Location: Coffee Creek, Kaminak Gold Project Completed by: AB Date Inflated: 24/05/2015

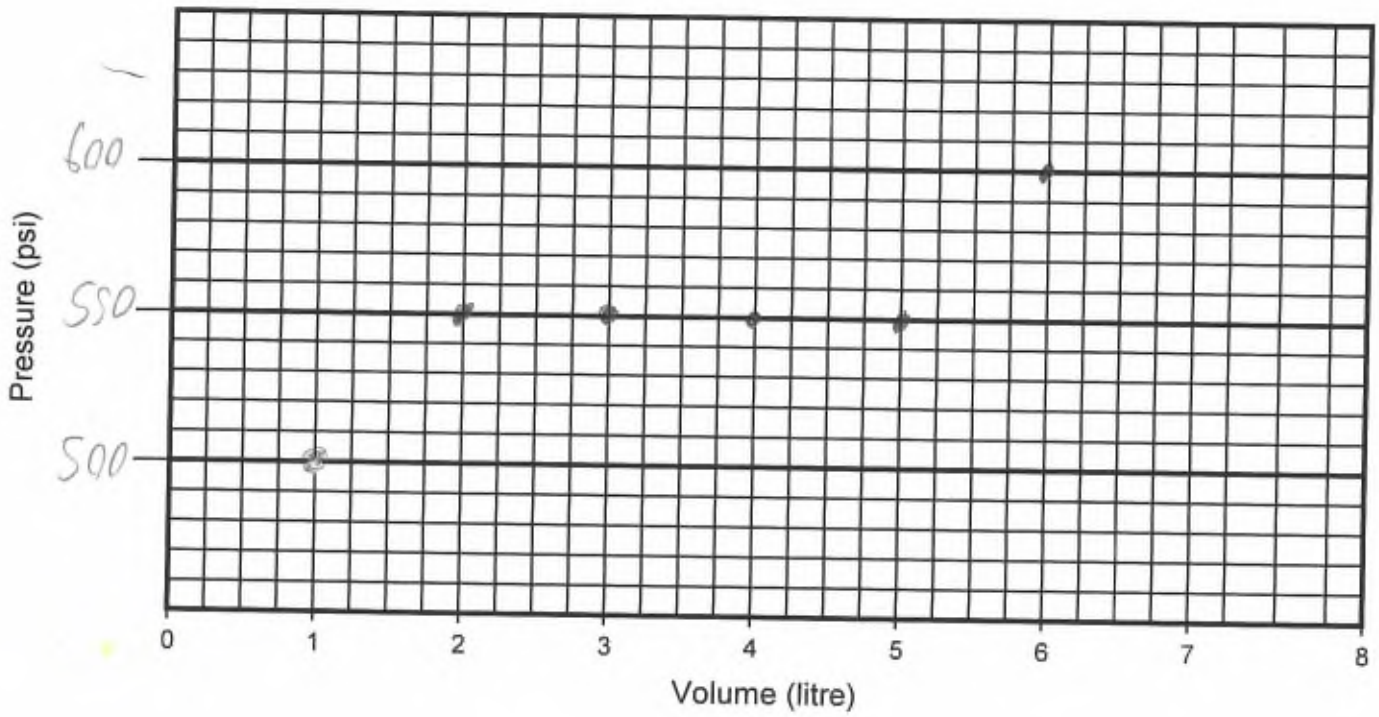
Packer No. 2 19208 Depth (m): — Inflation Tool No.: —

Packer Valve Pressure, P_V: 140 psi Final Line Pressure, P_L: 600 psi Tool Pressure, P_T: 350 psi

Borehole Water Level: 8 (m) = 11.4 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 121 psi

Volume, litres	1	2	3	4	5	6	/	5.6		
Pressure, psi	500	550	550	550	550	600	/	0		
Volume, litres										
Pressure, psi										



Comments: Time - 12:35

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH-10

Location: Coffee Creek, Kaminak Gold Project Completed by: AB Date Inflated: 24/05/2015

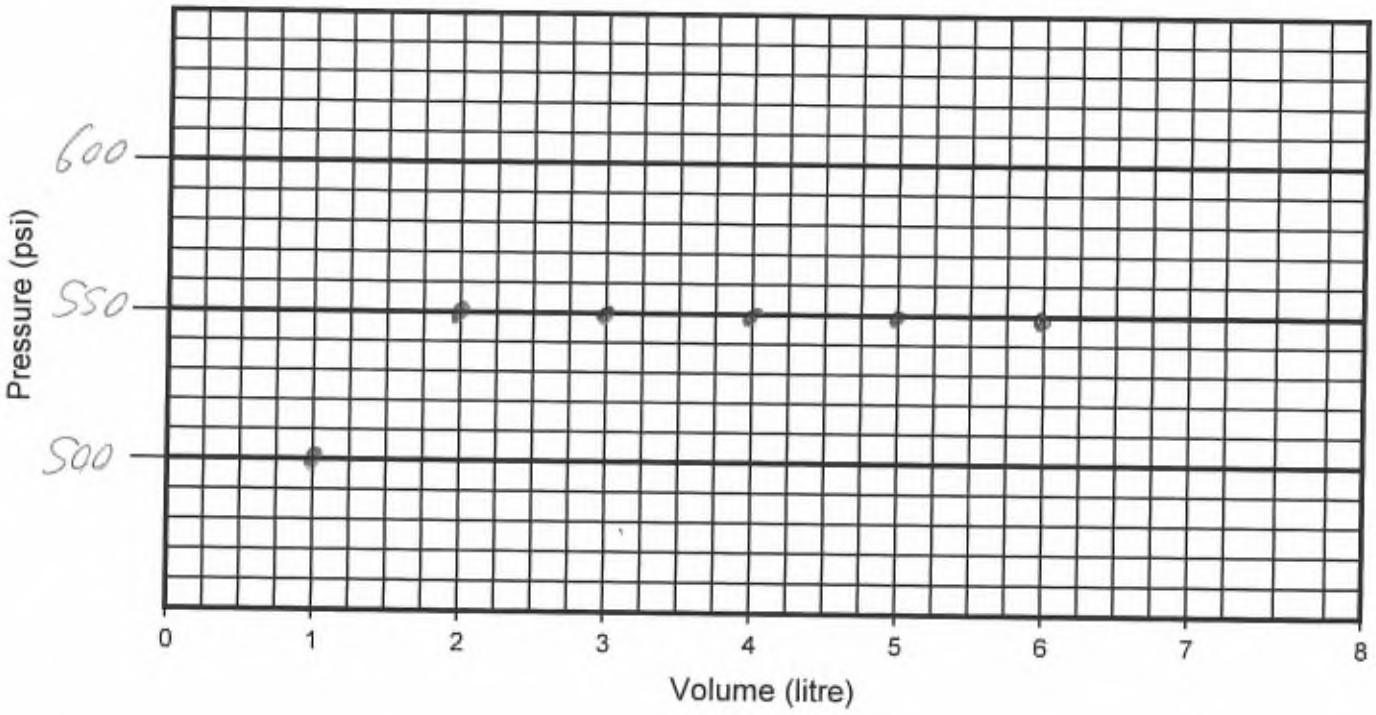
Packer No. 3 19201 Depth (m): — Inflation Tool No.: —

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 575 psi Tool Pressure, P_T: 350 psi

Borehole Water Level: 8 (m) = 11 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 86 psi

Volume, litres	1	2	3	4	5	6	6.25	/	5.8	
Pressure, psi	500	550	550	550	550	550	575	/	0	
Volume, litres										
Pressure, psi										



Comments: Time - 12:51

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH-10

Location: Coffee Creek, Kaminak Gold Project Completed by: AB Date Inflated: 24/05/2015

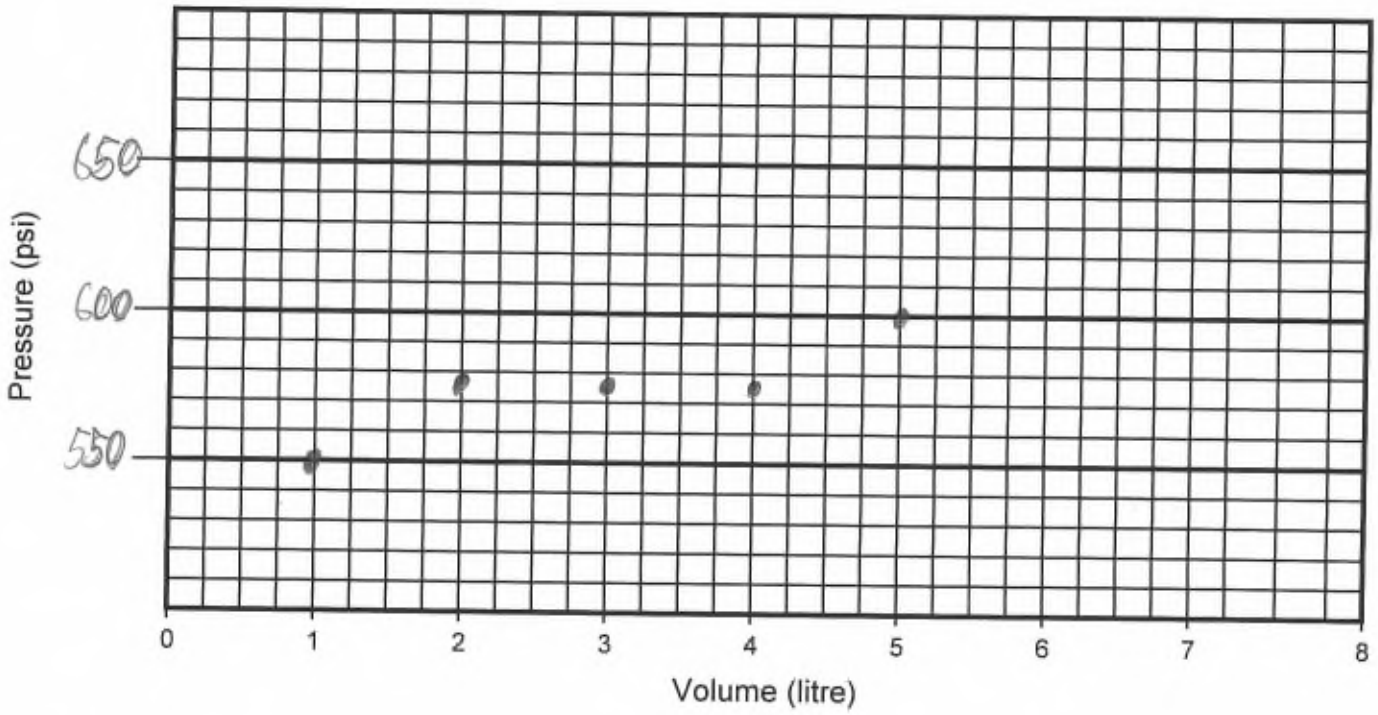
Packer No. 4 19224 Depth (m): — Inflation Tool No.: 1

Packer Valve Pressure, P_V: 155 psi Final Line Pressure, P_L: 610 psi Tool Pressure, P_T: 350 psi

Borehole Water Level: 8 (m) = 11.4 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 116 psi

Volume, litres	1	2	3	4	5	5.25	/	4.8		
Pressure, psi	550	575	575	575	600	610	/	Ø		
Volume, litres										
Pressure, psi										



Comments: Time - 13:08

Sheet ____ of ____

Westbay Packer Inflation Record

Project: Coffee Creek Project No.: WB950 Well No.: BH-10

Location: Coffee Creek Completed by: AB Date Inflated: 24/05/2025

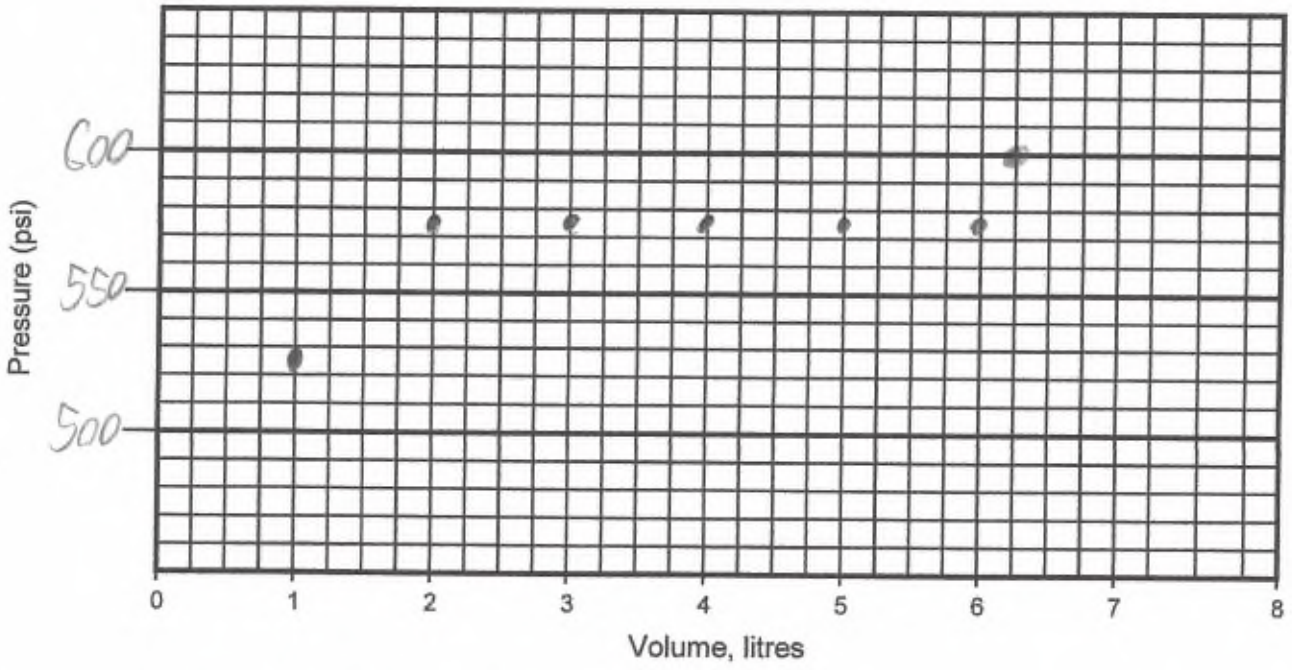
Packer No.: 19225 Depth (ft / m): — Inflation Tool No.: —

Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 600 psi Tool Pressure, P_T: 350 psi

Borehole Water Level: 8 (ft / m) = 11.4 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 116 psi

Volume, litres	1	2	3	4	5	6	6.25	/	5.8	
Pressure, psi	525	575	575	575	575	575	600	/	Ø	
Volume, litres										
Pressure, psi										



Comments: 5" Surface Casing Time - 13:22

APPENDIX F: MONITORING WELL: BH12-WB

As-Built Key Components Summary (Table 4)	- 1 page
As-Built Tubing Summary (Table 5)	- 1 page
Summary Completion Log	- 2 pages
Pre-Inflation Piezometric Pressure/ Levels	
Field Data and Calculation Sheet (May 12)	- 1 page
Figure 3, Pre-Inflation Profile	- 1 page
Post- Inflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (May 14)	- 1 page
Figure 4, Post-Inflation Profile	- 1 page
Westbay Completion Log (field copy)	- 4 pages
Westbay System Packer Inflation Records	- 8 pages

Table 4: BH12-WB As-Built Packer and Port Summary

AB, 01/06/2015

Port No.	Zone	Measurement Port Depth, (m)	Pumping Port Depth, (m)	Depth to top of Packer, (m)	Top of Zone (m)	Bottom of Zone (m)	Comments
1		97.799		96.275	97.6	99.7	
2		94.142		92.618	93.9	96.7	
3		88.046		86.522	87.8	93.0	
4		81.95		80.426	81.7	86.9	
5		51.472		49.948	51.2	80.8	
6		46.9		45.376	46.7	50.3	
7		36.233		34.709	36.0	45.8	
8		31.661	30.137	30.137	31.4	35.1	
9							
10							
11							
12							
13							
14							
15							

Note 1: All depth measurements in meters below datum (GS).
Note 2: All depth measurements use 'Nominal' tubing lengths.
Note 3: Not corrected for borehole deviation or borehole temperature effects.
Note 4: All depth measurements to upper edge of Westbay System coupling item.

Table 5: BH12-WB As-Built Summary

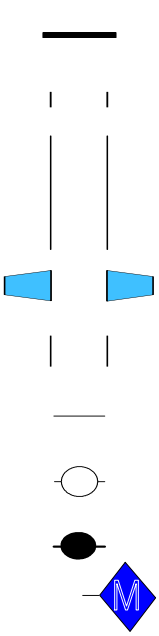
AB ,01/06/2015

Item No.	Component P/N	Component Description	Component S/N	Coupling P/N	Coupling S/N	Accessory P/N	Accessory Depth (m)	Final Position (m)
42	203							-0.99912
41	20102			202				-0.95126
40	20110			202				-0.34169
39	20110			202		216	3.3	2.7062
38	20110			202				5.754
37	20110			202				8.8019
36	20110			202				11.85
35	20110			202				14.898
34	20110			202				17.945
33	20110			202				20.993
32	20110			202				24.041
31	20110			202				27.089
30	238	Packer	19237	224	8714			30.137
29	20110	Measurement Port		205	8450			31.661
28	238	Packer	19234	202				34.709
27	20110	Measurement Port		205	8454			36.233
26	20110			202				39.28
25	20110			202				42.328
24	238	Packer	19236	202				45.376
23	20110	Measurement Port		205	8455	216	47.5	46.9
22	238	Packer	19233	202				49.948
21	20110	Measurement Port		205	8453			51.472
20	20105			202				54.52
19	20110			202				56.044
18	20110			202				59.091
17	20110			202				62.139
16	20110			202				65.187
15	20110			202				68.235
14	20110			202				71.283
13	20110			202				74.331
12	20110			202				77.379
11	238	Packer	19231	202				80.426
10	20105	Measurement Port		205	8445	216	82.6	81.95
9	20110			202				83.474
8	238	Packer	19232	202				86.522
7	20110	Measurement Port		205	8444			88.046
6	20105			202				91.094
5	238	Packer	19238	202				92.618
4	20105	Measurement Port		205	8447	216	94.7	94.142
3	20102			202				95.666
2	238	Packer	19235	202				96.275
1	20105	Measurement Port		205	8446			97.799
0	203							99.323

Legend

(Qty) MP Components

(Library - WD Library 04/29/15)



(2) 0203 - MP38 End Cap

(2) 020102 - MP38 Casing 3 (2F/0.6M)

(26) 020110 - MP38 Casing 1 (10F/3M)

(8) 0238 - MP38 Packer - 74mm (5F/1.5M)

(5) 020105 - MP38 Casing 2 (5F/1.5M)

(32) 0202 - MP38 Regular Coupling

(1) 0224 - MP38 Pumping Port

(8) 0205 - MP38 Measurement Port

(4) 0216 - Magnetic Location Collar

Geology

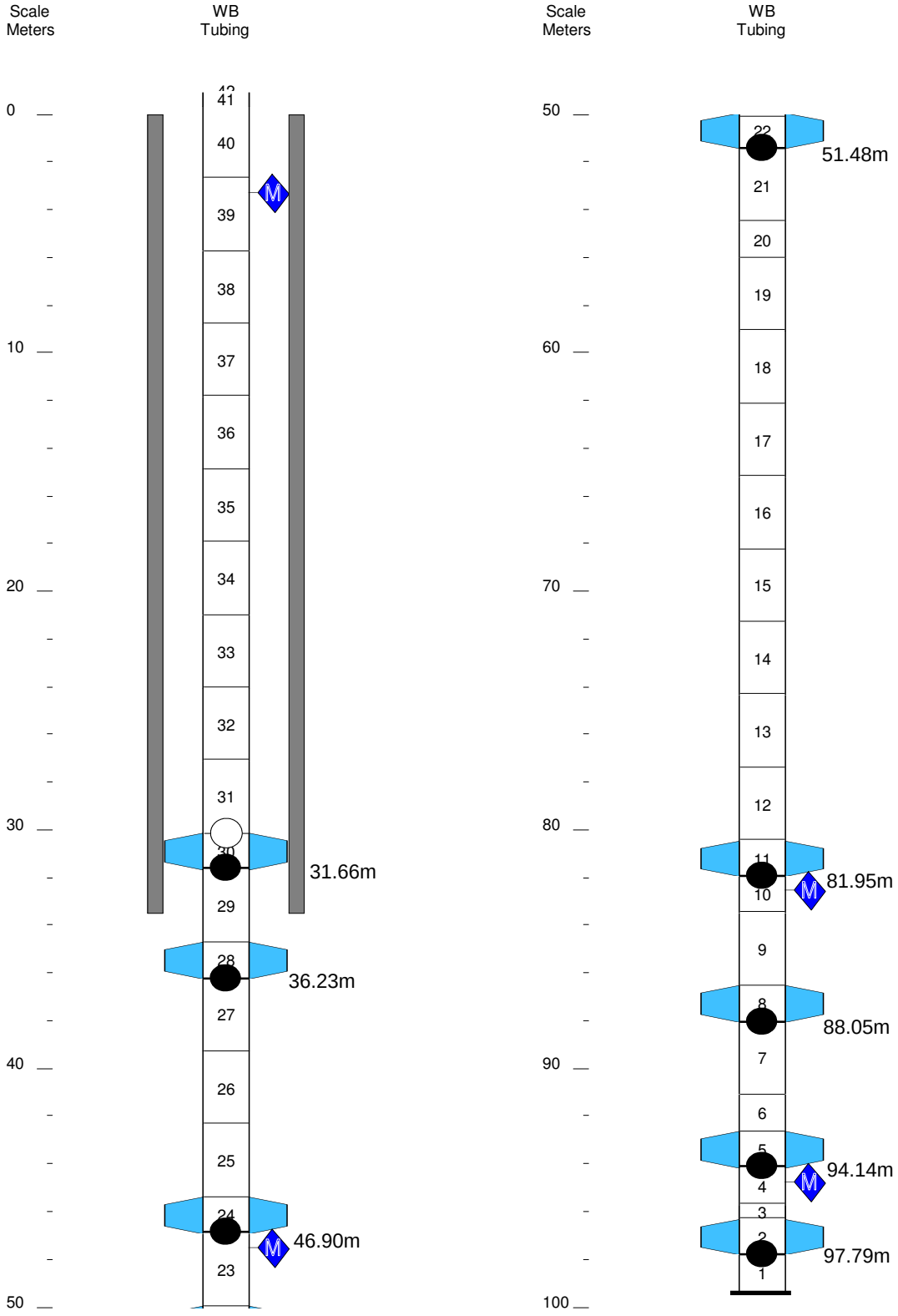
Backfill/Casing



Mild Steel

Summary Completion Log
LORAX

Job No: WB950
Well: BH12-WB



PRE-INFLATION

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Westbay Instruments

Well No.: BH12-WB
Datum: GS
Elev. G.S.: Ø
Height of Westbay above G.S.: 0.95m
Elev. top of Westbay Casing: Ø
Reference Elevation: Ø
Borehole angle: Vertical

Probe Type: Sampler
Serial No.: EMS2499
Probe Range: 250 psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Date: May 12/15
Client: LORAX
Job No.: WB950
Location: Coffee
Weather: Night - cold - clear
Operator: M.L.

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

WB water level ~ 33m

P_{atm} 13.73 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)

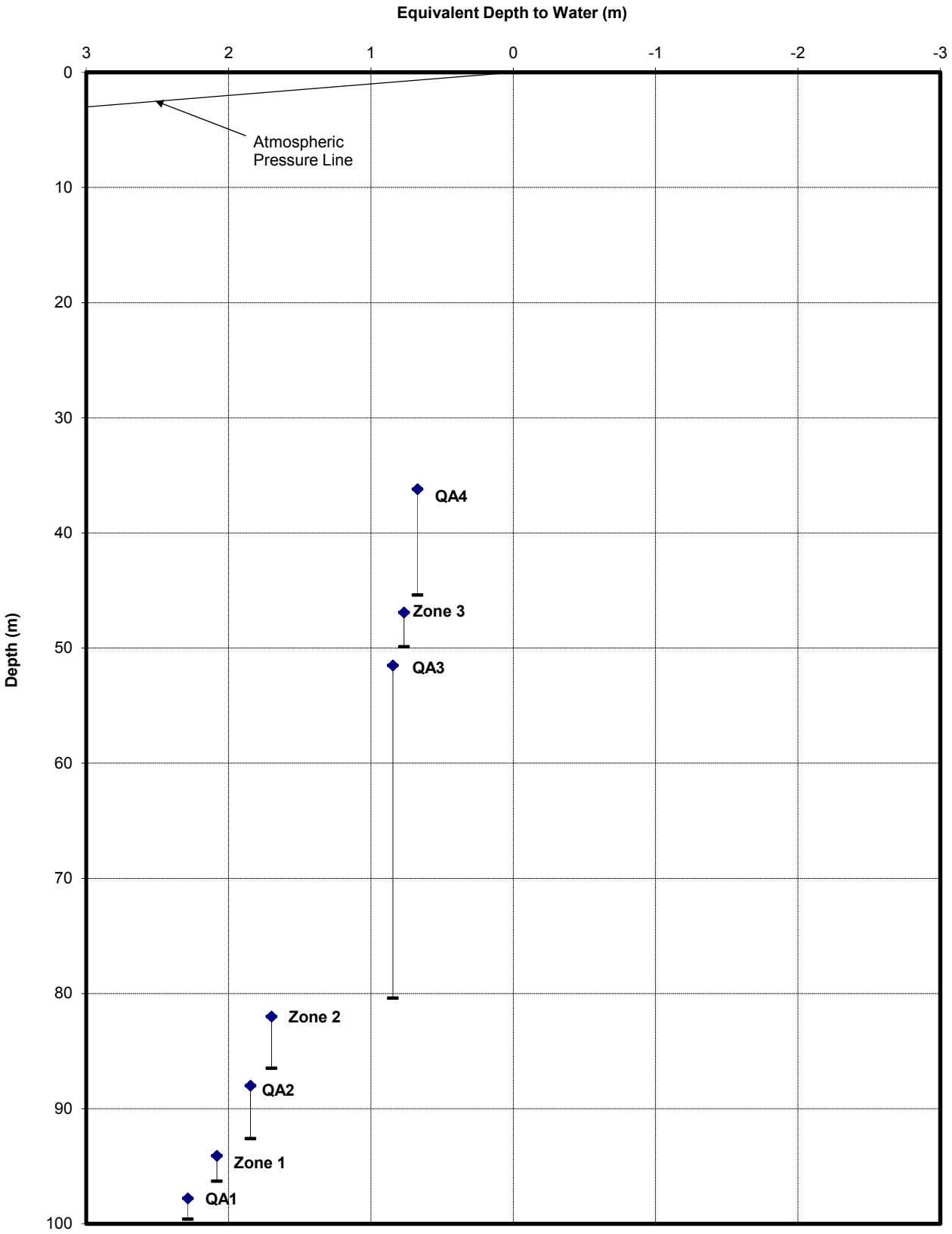
Start: Pressure	13.73 psi	Finish:	13.74
Temp	~~2:47 am~~ 13.14 C		0.95
Time	2:47 am		3:12 am

Port No.	Port Position From Log (m)	Port Position From Cable (m)	True Port Depth "Dp" (m)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (m) H = (P2-Patm)/w	Piez. Level Outside Port (m) Dz = Dp - H	Comments: Zones
1	97.8	98.0	—	105.95	149.55	2:59	2.89	105.95	95.5	2.3	QA1
2	94.1	94.3	—	100.87	144.58	3:00	2.62	100.88	92.0	2.1	Zone1
3	88.0	88.2	—	92.37	136.24	3:02	2.25	92.37	86.2	1.8	QA2
4	82.0	82.2	—	83.85	127.92	3:03	2.03	83.85	80.3	1.7	Zone 2
5	51.5	51.6	—	40.67	85.76	3:05	1.69	40.68	50.6	0.8	QA3
6	46.9	47.0	—	34.10	79.33	3:06	1.46	34.10	46.1	0.8	Zone 3
7	36.2	36.3	—	18.66	64.25	3:07	1.25	18.66	35.5	0.7	QA4
8	31.7	31.8	—	13.85	57.80	3:09	1.17	13.82	31.0	0.7	QA5

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: BH12-WB

Profile Date: May 12, 2015
Comments: Pre-Inflation Profile



Client: LORAX
Site: Coffee Creek
Datum: GS

Figure 3

Plot By:____Date:____
Checked By:____Date:____
Westbay Project: WB950

POST INFLATION

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Well No.: BH12-WB
Datum: GS
Elev. G.S.: 0
Height of Westbay above G.S.: 0.
Elev. top of Westbay Casing: 0
Reference Elevation: 0
Borehole angle: Vertical

Probe Type: Sampler
Serial No.: EMS2499
Probe Range: 250 psi
Westbay Casing Type: MP38
Sampler Valve Position: Closed

Date: May 14/15
Client: LORAX
Job No.: WB 950
Location: Coffee
Weather: Warm - Clear
Operator: M.L.

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure 13.66 psi Finish: 13.65 psi
Temp 22.36 °C 1.43 °C
Time 1:36 pm 1:58 pm

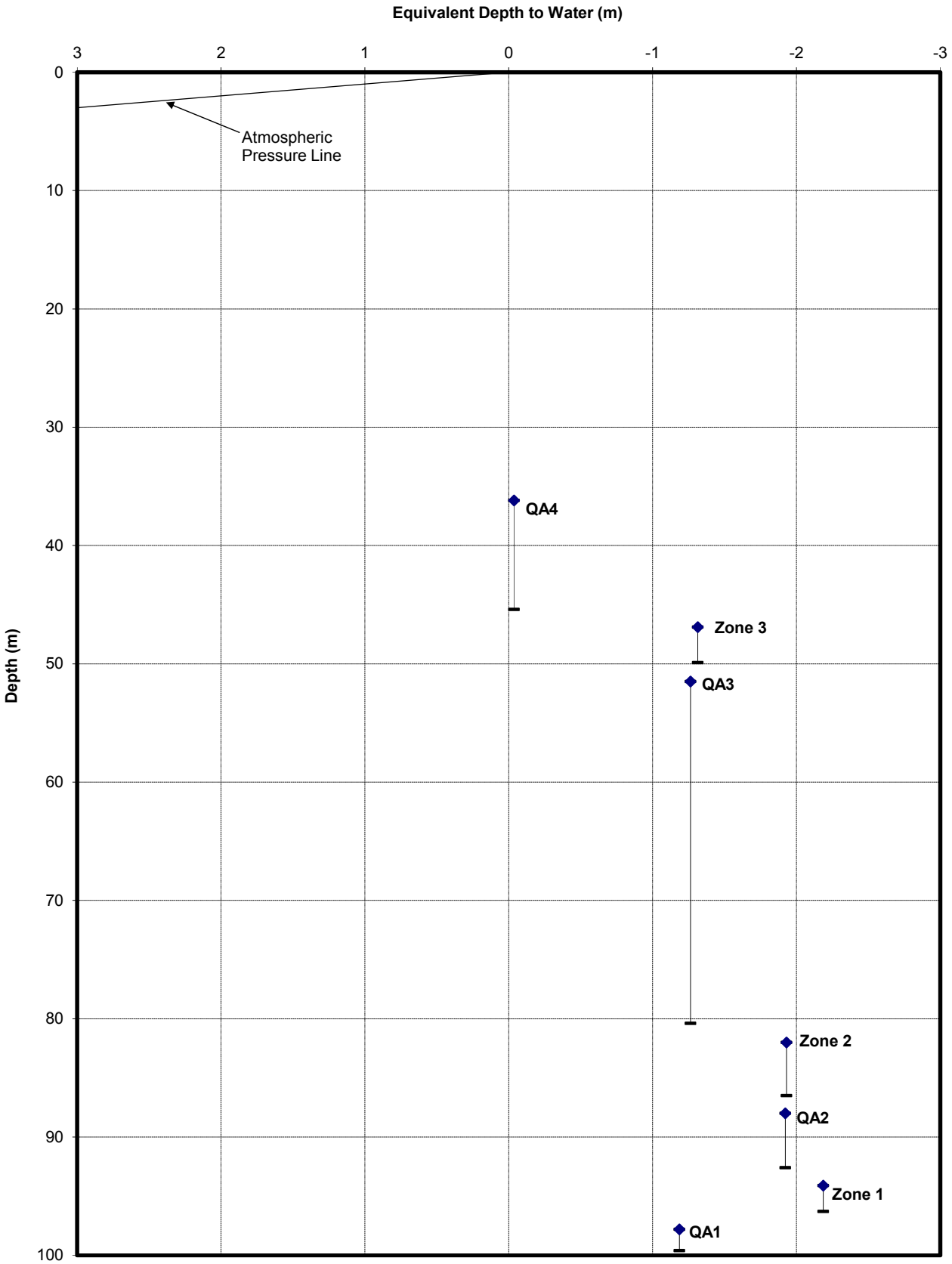
P_{atm} 13.66 psi

Port No.	Port Position From Log (ft) m	Port Position From Cable (ft) m	True Port Depth "Dp" (ft)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (ft) m H = (P2-Patm)/w	Piez. Level Outside Port (ft) m Dz = Dp - H	Comments
											Zones
1	97.8	98.0	-	135.19	154.42	1:40	10.51	135.21	99.0	-1.2	QA1
2	94.1	94.3	-	130.13	150.58	1:44	5.30	130.14	96.3	-2.2	Zone1
3	88.0	88.2	-	121.60	141.53	1:46	9.13	121.61	89.9	-1.9	QA2
4	82.0	82.1	-	113.05	133.01	1:48	3.23	113.06	83.9	-1.9	Zone2
5	51.5	51.6	-	69.74	88.69	1:50	2.62	69.76	52.8	-1.3	QA3
6	46.9	47.0	-	63.16	82.22	1:51	2.03	63.16	48.2	-1.3	Zone3
7	36.2	36.3	-	47.66	65.19	1:53	1.63	47.66	36.2	0.0	QA4
8	31.7	31.8	-	41.01	57.09	1:55	1.27	41.02	30.5	1.2	QA5

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: BH12-WB

Profile Date: May 14, 2015
Comments: Post-Inflation Profile



Client: LORAX
Site: Coffee
Datum: GS

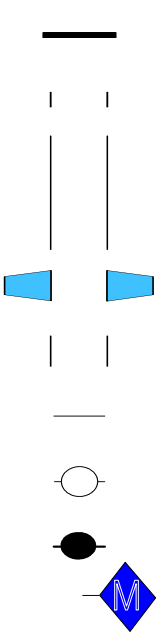
Figure 4

Plot By:____Date:_____
Checked By:____Date:_____
Westbay Project: WB950

Legend

(Qty) MP Components

(Library - WD Library 04/29/15)



(2) 0203 - MP38 End Cap

(2) 020102 - MP38 Casing 3 (2F/0.6M)

(26) 020110 - MP38 Casing 1 (10F/3M)

(8) 0238 - MP38 Packer - 74mm (5F/1.5M)

(5) 020105 - MP38 Casing 2 (5F/1.5M)

(32) 0202 - MP38 Regular Coupling

(1) 0224 - MP38 Pumping Port

(8) 0205 - MP38 Measurement Port

(4) 0216 - Magnetic Location Collar

Geology

Backfill/Casing

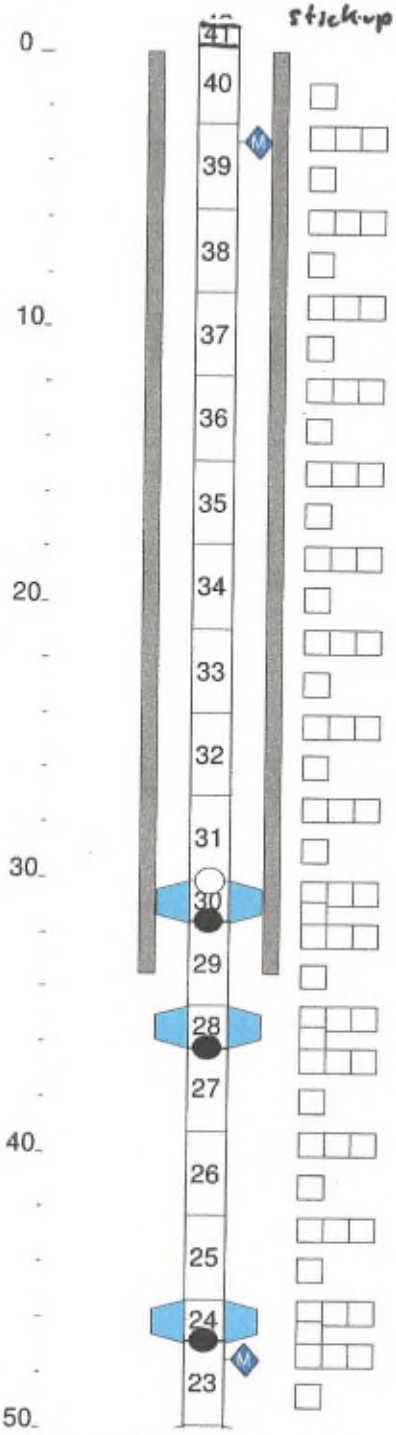


Mild Steel

Westbay Completion Log
LORAX

Job No: WB950
Well: BH12-WB

stick-up 0.95m from zero (GS)



QA Tested OK	WB Tubing Description	Serial Numbers
	020110 - MP38 Casing 1 (10F/3M)	
	020110 - MP38 Casing 1 (10F/3M)	
	020110 - MP38 Casing 1 (10F/3M)	
	020110 - MP38 Casing 1 (10F/3M)	
	020110 - MP38 Casing 1 (10F/3M)	
	020110 - MP38 Casing 1 (10F/3M)	
	020110 - MP38 Casing 1 (10F/3M)	
	020110 - MP38 Casing 1 (10F/3M)	
	020110 - MP38 Casing 1 (10F/3M)	
	0224 - MP38 Pumping Port 0238 - MP38 Packer - 74mm (5F/1.5M) 0205 - MP38 Measurement Port	8714 19237-140 psi 8450
	020110 - MP38 Casing 1 (10F/3M)	
	0238 - MP38 Packer - 74mm (5F/1.5M) 0205 - MP38 Measurement Port	19234-140 psi 8454
	020110 - MP38 Casing 1 (10F/3M)	
	020110 - MP38 Casing 1 (10F/3M)	
	020110 - MP38 Casing 1 (10F/3M)	
	0238 - MP38 Packer - 74mm (5F/1.5M) 0205 - MP38 Measurement Port	19236-145 psi 8455
	020110 - MP38 Casing 1 (10F/3M)	

Finish lowering at 2:15 am on May 12, 2015.

Hydraulic Integrity Test

34.306 m at 3:22 am
34.304 m at 3:30 am
34.304 m at 3:40 am
34.304 m at 3:55 am
34.304 m at 4:00 am

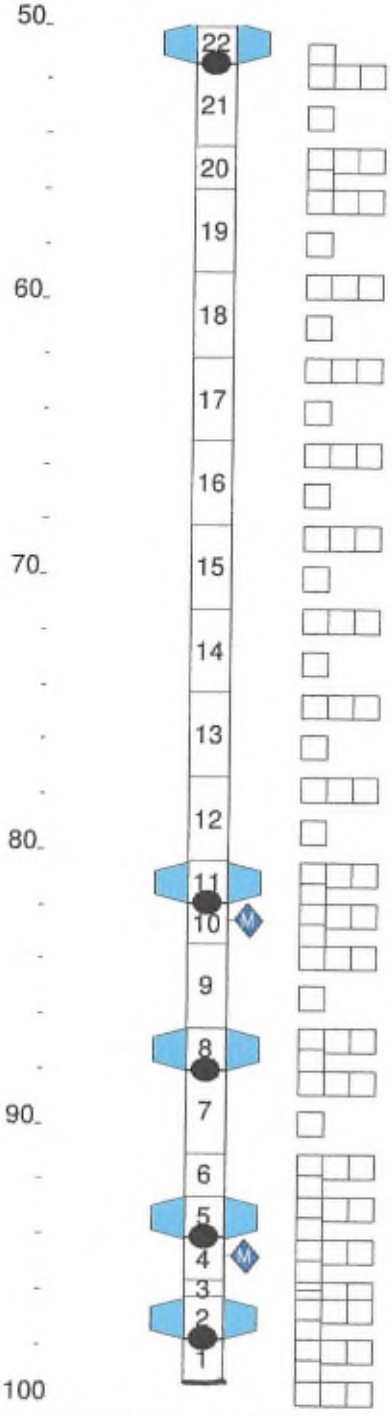
Westbay Casing is water tight.
Mark Lessard

(c) Westbay Instruments Inc. 2000

Tue May 12 21:52:27 2015

Westbay Completion Log
LORAX

Job No: WB950
Well: BH12-WB



Scale Meters	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
50	22		0238 - MP38 Packer - 74mm (5F/1.5M) 0205 - MP38 Measurement Port	19233 - 145 psi 8453
	21		020110 - MP38 Casing 1 (10F/3M)	
	20		020105 - MP38 Casing 2 (5F/1.5M)	
	19		020110 - MP38 Casing 1 (10F/3M)	
60	18		020110 - MP38 Casing 1 (10F/3M)	
	17		020110 - MP38 Casing 1 (10F/3M)	
	16		020110 - MP38 Casing 1 (10F/3M)	
70	15		020110 - MP38 Casing 1 (10F/3M)	12:35 am
	14		020110 - MP38 Casing 1 (10F/3M)	
	13		020110 - MP38 Casing 1 (10F/3M)	
	12		020110 - MP38 Casing 1 (10F/3M)	
80	11		0238 - MP38 Packer - 74mm (5F/1.5M) 0205 - MP38 Measurement Port 020105 - MP38 Casing 2 (5F/1.5M)	19231 - 150 psi 8445
	10			
	9		020110 - MP38 Casing 1 (10F/3M)	
	8		0238 - MP38 Packer - 74mm (5F/1.5M) 0205 - MP38 Measurement Port	19232 - 140 psi 8444
90	7		020110 - MP38 Casing 1 (10F/3M)	
	6		020105 - MP38 Casing 2 (5F/1.5M)	
	5		0238 - MP38 Packer - 74mm (5F/1.5M) 0205 - MP38 Measurement Port 020105 - MP38 Casing 2 (5F/1.5M)	19238 - 145 psi 8447
	4			
	3		020102 - MP38 Casing 3 (2F/0.6M)	
	2		0238 - MP38 Packer - 74mm (5F/1.5M) 0205 - MP38 Measurement Port 020105 - MP38 Casing 2 (5F/1.5M)	19235 - 150 psi 8446
	1		0203 - MP38 End Cap	
100				

Pre-Inflation Profile May 12/15
- measurements recorded, calculations completed
- confirm m-port position and function [illegible]

(c) Westbay Instruments Inc. 2000

Tue May 12 21:52:28 2015

Start lowering at 11:50pm on May 11, 2015.

Borehole water level: 1.61 m below surface casing.

Joint test tool: 200 psi

Inflation tool on May 12/15: 400 psi

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH12-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Lessard Date Inflated: May 14/15

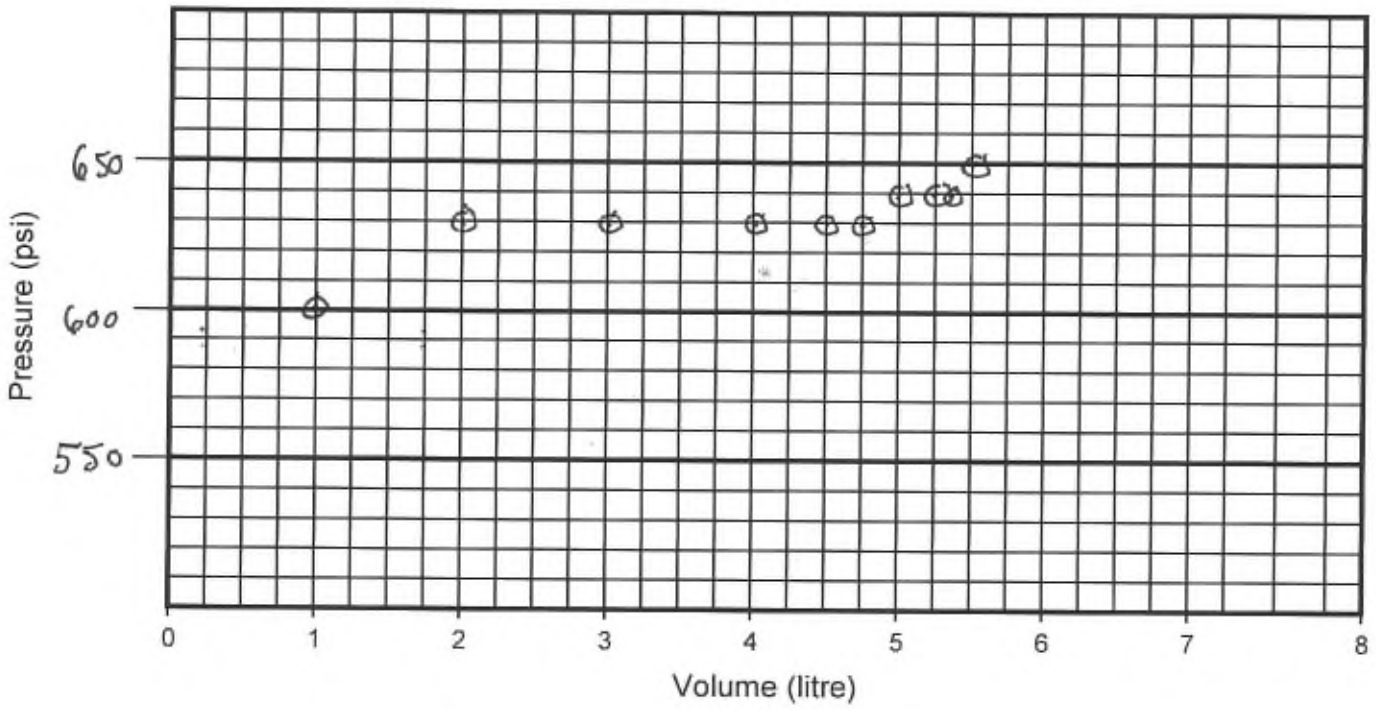
Packer No. 1 comp 2 SN# 19235 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 650 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 1 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 100 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	4.75	5.0	5.25	5.35	5.5
Pressure, psi	600	630	630	630	630	630	640	640	640	650
Volume, litres	/	5.0								
Pressure, psi	/	0								



Comments: _____ Time - 10:35 am

_____

_____

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH12-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M.Lessard Date Inflated: May 14/15

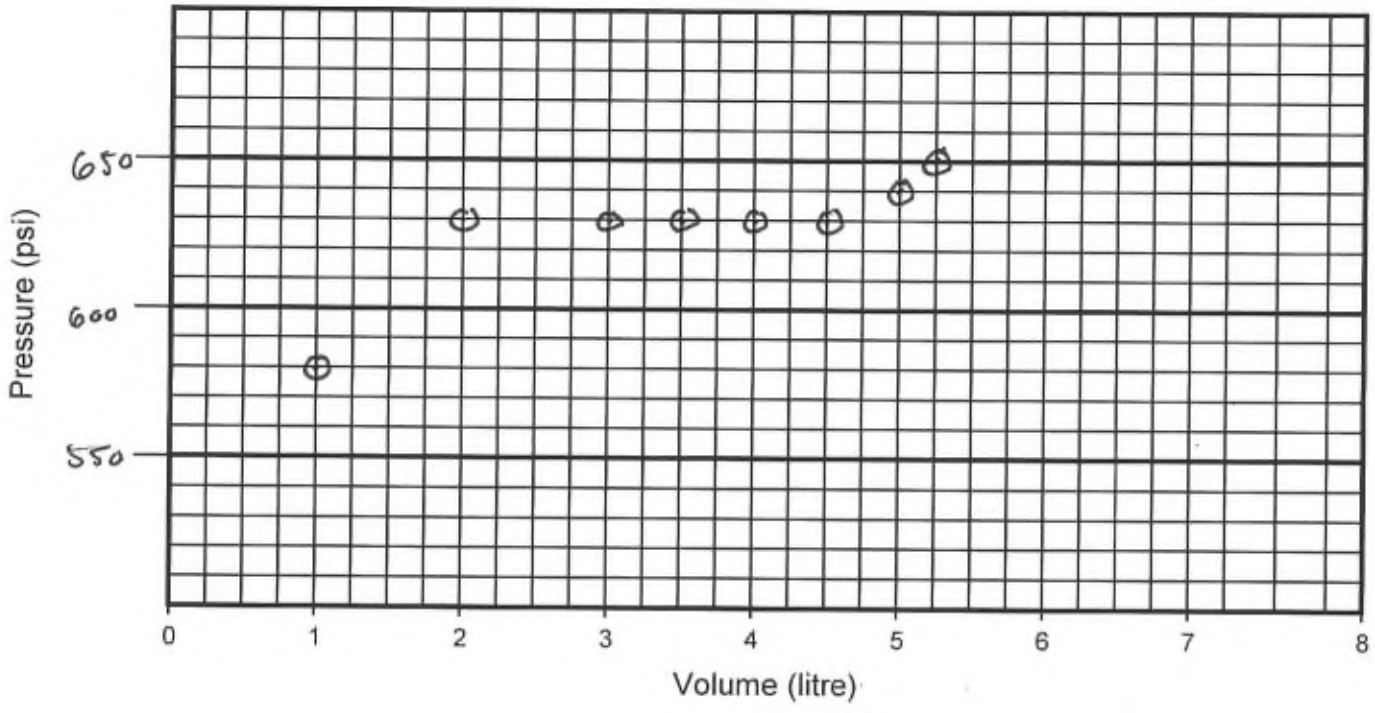
Packer No. 2, comp 5 SN# 19238 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 650 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 1 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 105 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.5	5.0	5.25	/	4.75
Pressure, psi	580	630	630	630	630	630	640	650	/	Ø
Volume, litres										
Pressure, psi										



Comments: _____ Time - 10:55 am

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Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH12-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M.Lessard Date Inflated: May/14/15

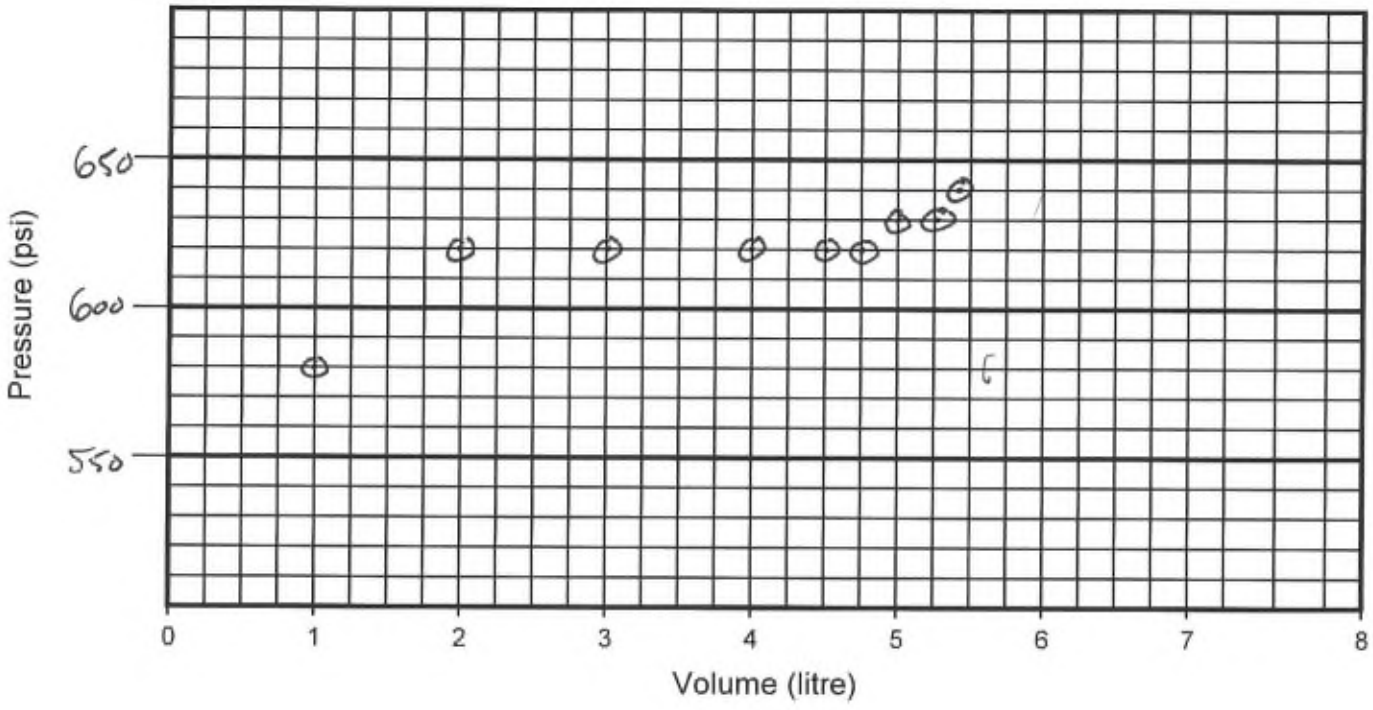
Packer No. 3, comp 8 SN# 19232 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 140 psi Final Line Pressure, P_L: 640 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 1 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 100 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	4.75	5.0	5.25	5.4	✓
Pressure, psi	580	620	620	620	620	620	630	630	640	✓
Volume, litres	5.0									
Pressure, psi	Ø									



Comments: _____ Time - 11:27 am

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH12-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Lessard Date Inflated: May 14/15

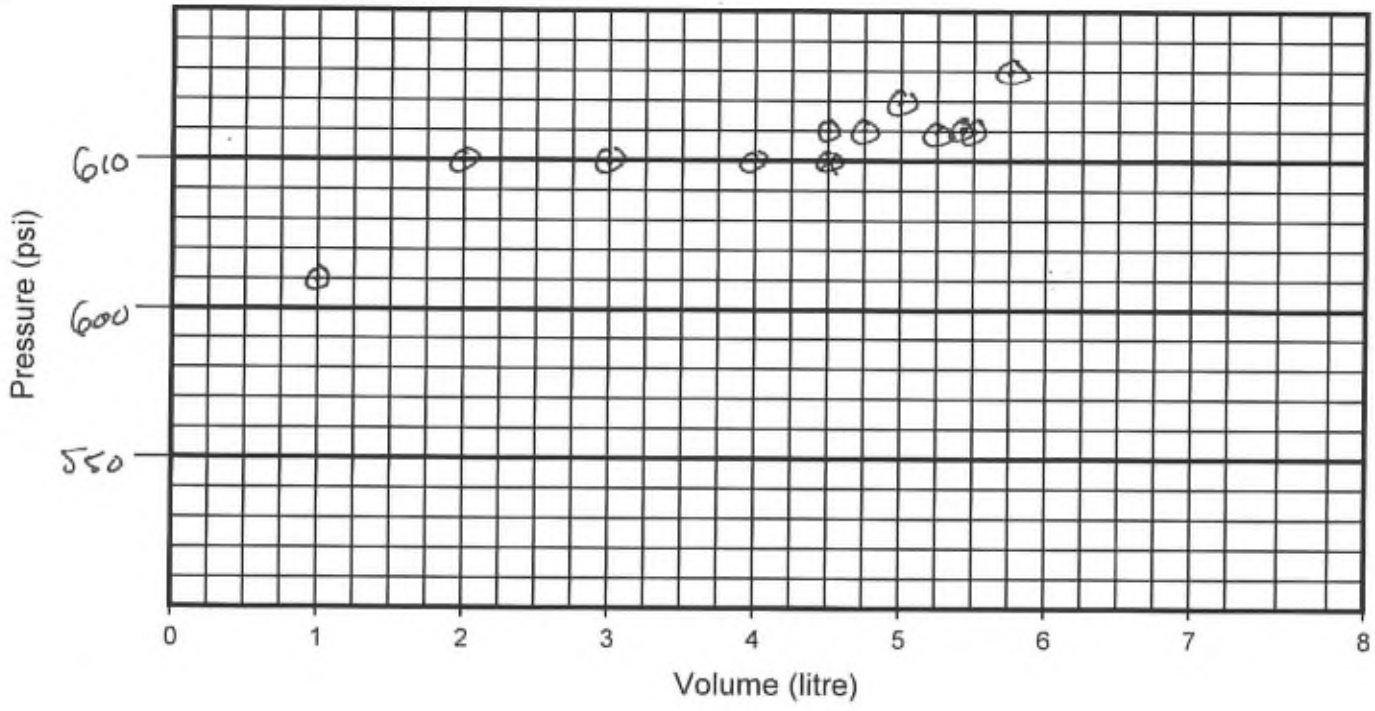
Packer No. 4" comp II SN# 19231 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: _____ psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 1 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 130 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	4.75	5.0	5.25	5.4	5.5
Pressure, psi	610	650	650	650	660	660	670	660	660	660
Volume, litres	5.75	—	5.25							
Pressure, psi	680	/	0							



Comments: _____ Time - 12:00 pm

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH12-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Lessard Date Inflated: May 14/15

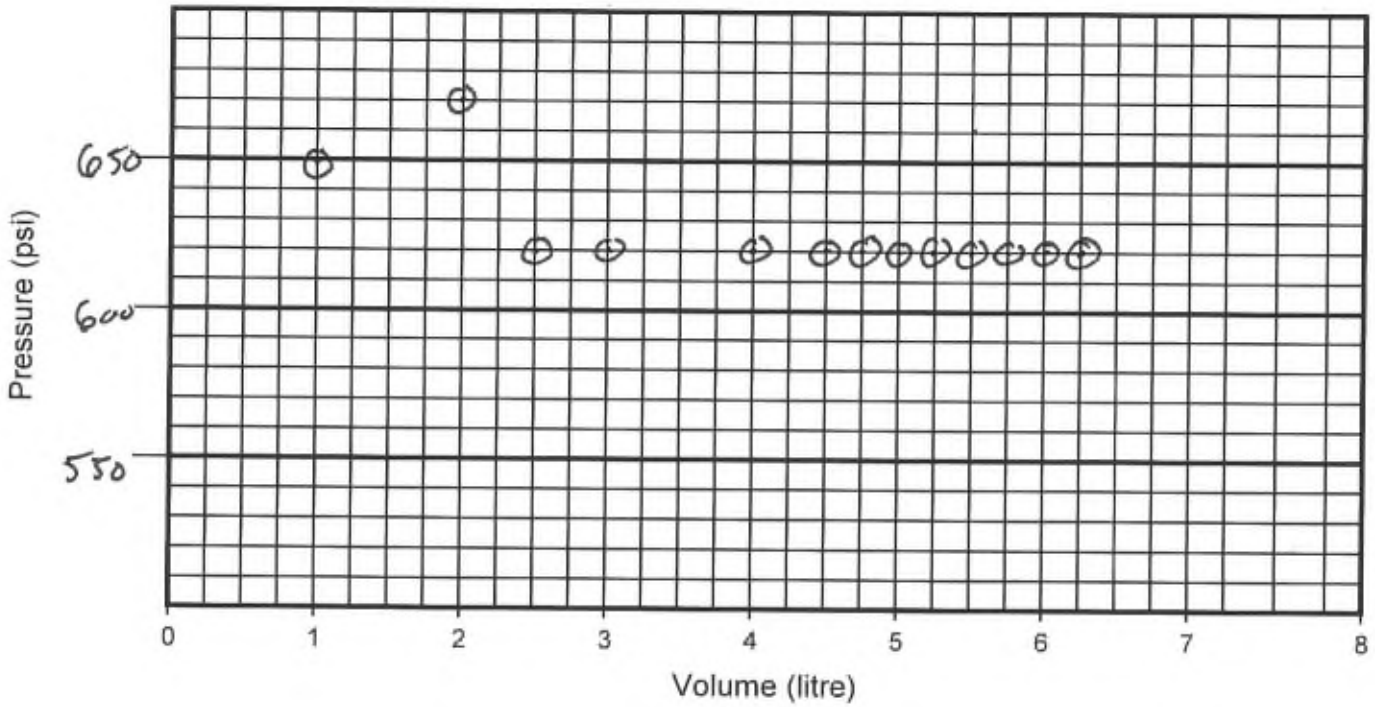
Packer No. 5, comp#22 Sn# 19233 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 620 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 1 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 75 psi

Volume, litres	1.0	2.0	/	1.5	/	2.5	3.0	4.0	4.5	4.75
Pressure, psi	650	670	/	ϕ	/	620	620	620	620	620
Volume, litres	5.0	5.25	5.5	5.75	6.0	6.25	/	5.75		
Pressure, psi	620	620	620	620	620	620	/	ϕ		



Comments: After 2L bring tool up and change 90 micron filter. Time - 12:45 pm

Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH12-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M.Lessard Date Inflated: May 14/15

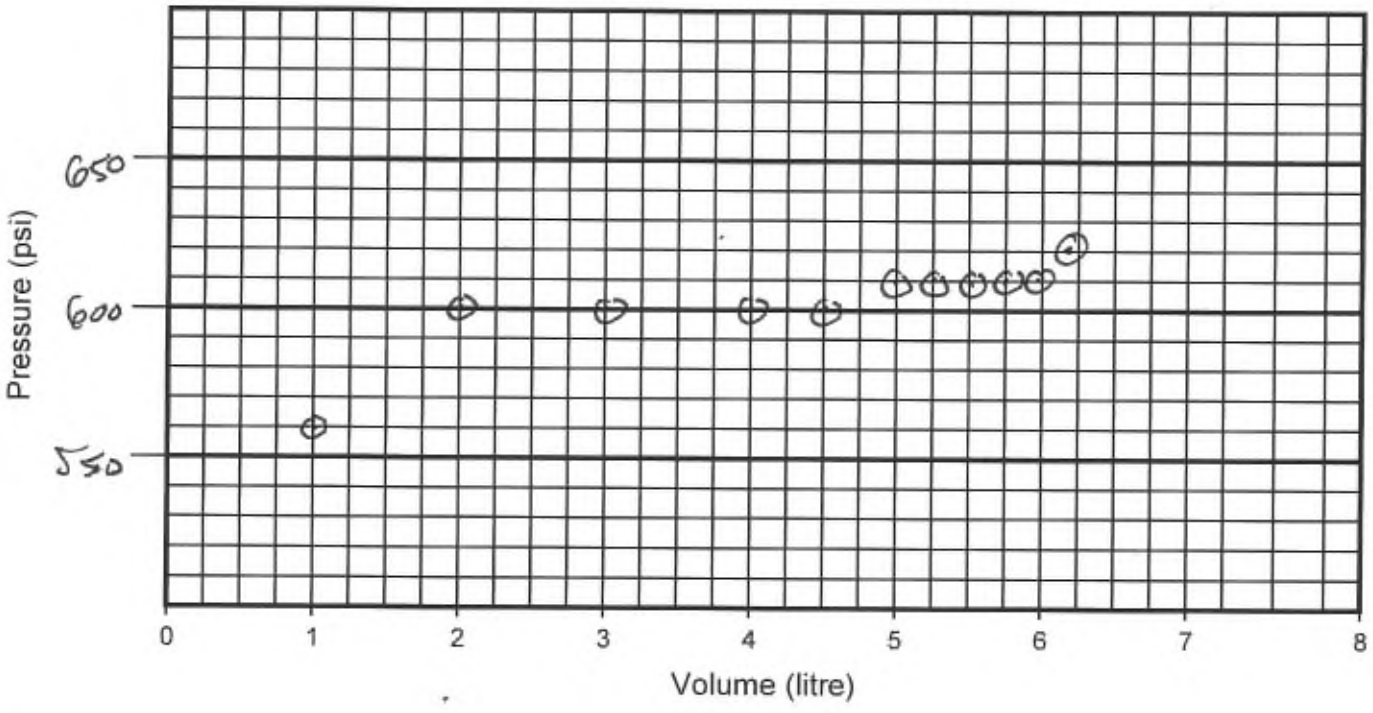
Packer No. 6 comp # 24 SN# 19236 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 620 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 1 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 75 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	4.75	5.0	5.25	5.5	5.75
Pressure, psi	560	600	600	600	600	600	610	610	610	610
Volume, litres	6.0	6.2	/	5.75						
Pressure, psi	610	620	/	Ø						



Comments: _____ Time - 1:10 pm

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Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH12-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M.Lessard Date Inflated: May 12/15

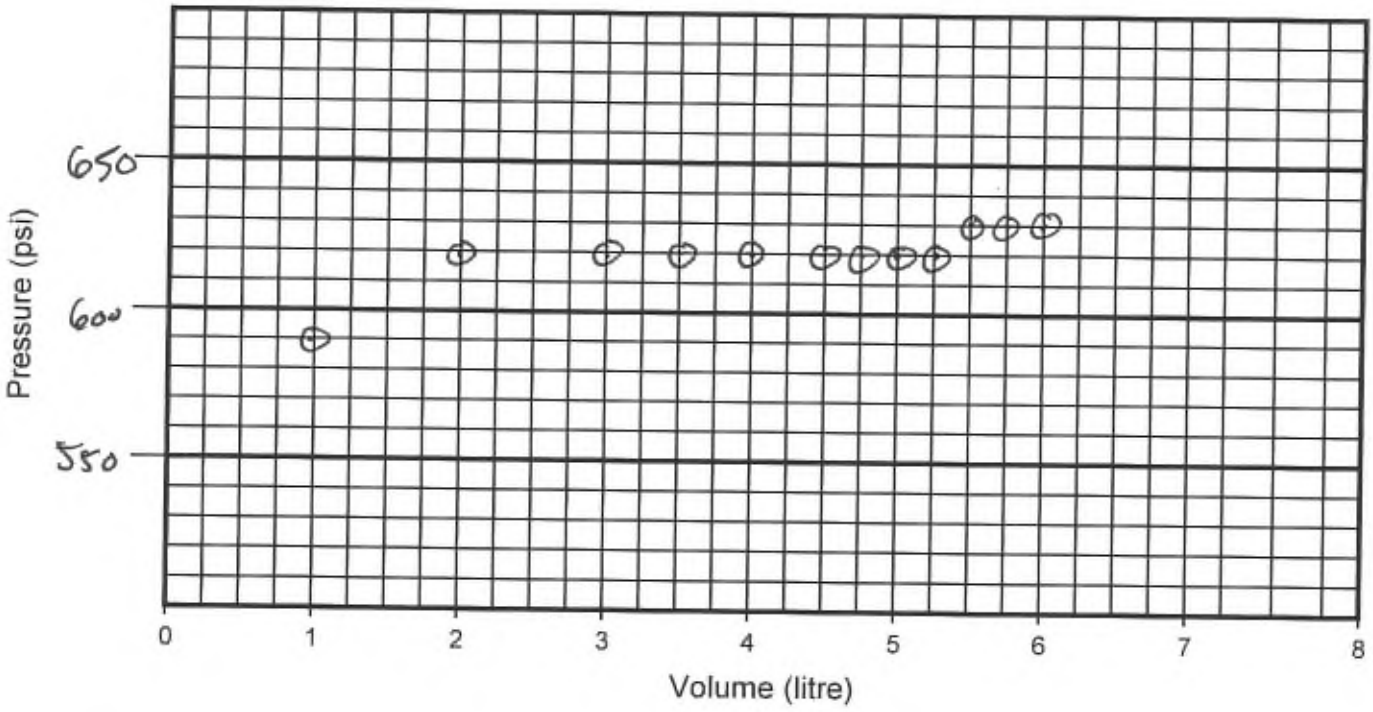
Packer No. 7, comp #28 SN# 19234 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 140 psi Final Line Pressure, P_L: 640 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 1 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 100 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.5	4.75	5.0	5.25	5.5
Pressure, psi	590	620	620	620	620	620	620	620	630	640
Volume, litres	5.75	6.0	/	5.5						
Pressure, psi	640	640	/	ø						



Comments: _____ Time - 5:19 am

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Sheet ___ of ___

Westbay Packer Inflation Record

Project: LORAX Environmental Services Ltd. Project No.: WB950 Well No.: BH12-WB

Location: Coffee Creek, Kaminak Gold Project Completed by: M. Lessard Date Inflated: May 12/15

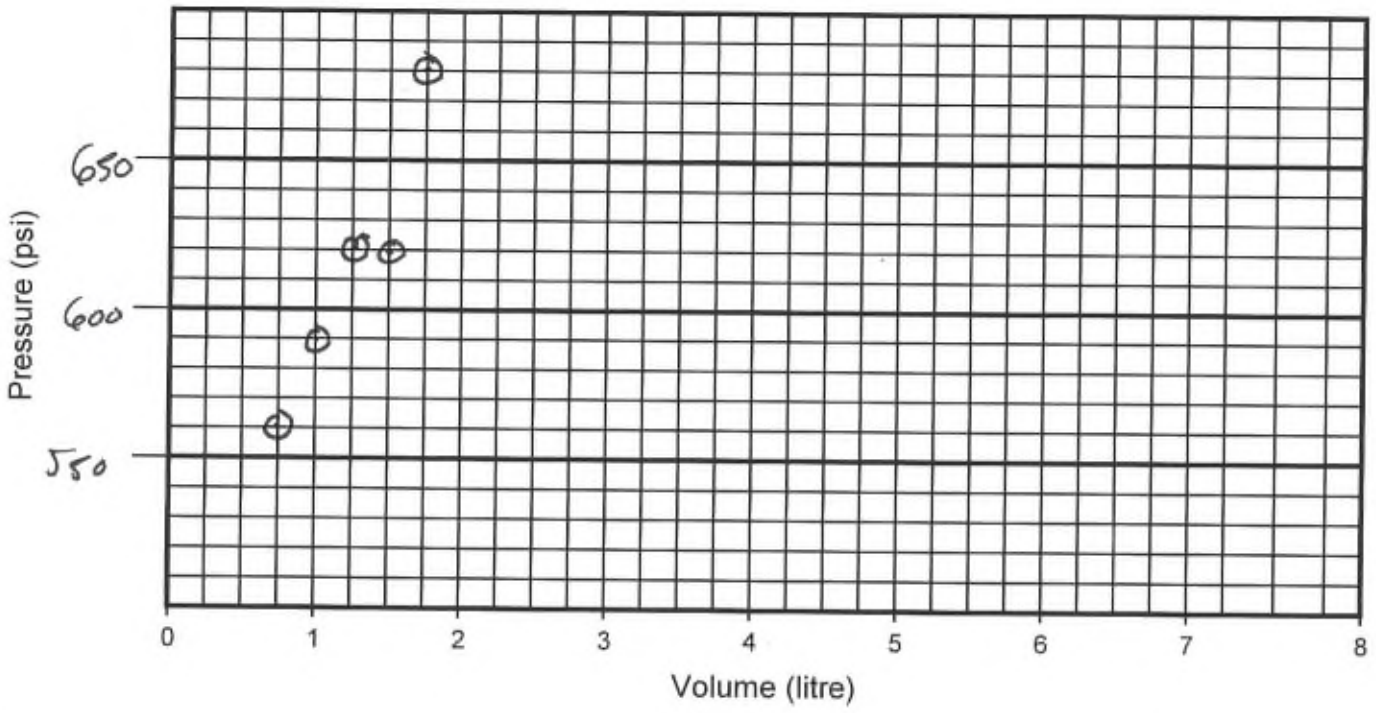
Packer No. 8, comp#30 SN#19237 Depth (m): _____ Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 140 psi Final Line Pressure, P_L: 680 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 1 (m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 140 psi

Volume, litres	0.75	1.0	1.25	1.5	1.75	/	1.3			
Pressure, psi	560	590	620	620	680	/	Ø			
Volume, litres										
Pressure, psi										



Comments: In HQ Time - 5:32 am

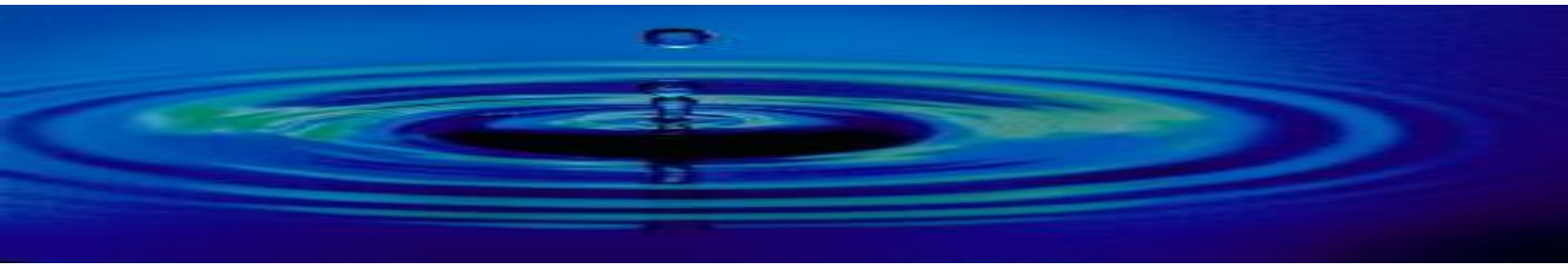

Westbay
Instruments

November 2, 2016

Completion Report WB950

Kaminak Gold Coffee Creek Project

MW-16-01WB



Westbay Instruments

November 2, 2016

Completion Report WB950

Kaminak Gold Coffee Creek Project
MW-16-01WB

Project Number: WB950

Prepared for:

Lorax Environmental Services Ltd.

Prepared by:

Westbay Instruments

8610 Glenlyon Parkway
Suite134
Burnaby, BC
V5J 0B6

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2 PRE-INSTALLATION ACTIVITIES 1

3 INSTALLATION 1

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3.2 Layout of Westbay System Components 2
3.3 Lowering of Westbay System Components 2
3.4 Hydraulic Integrity Testing 2
3.5 Positioning of Westbay System Completion 2
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Figure 2: Zone Dimensions 6

APPENDICES

APPENDIX: Monitoring Well: MW-16-01WB

1 INTRODUCTION

This report and the attached Appendix document the technical services carried out by Westbay Instruments (Westbay) under Lorax Environmental Services Ltd. P.O. No. A362-4. A Westbay System completion was installed in borehole MW-16-01WB at the Kaminak Gold site near Coffee Creek, Yukon Territory.

This report documents the installation tasks and related QA checks.

2 PRE-INSTALLATION ACTIVITIES

Borehole MW-16-01WB was drilled using an air rotatory method at a nominal 4.5-inch diameter to a depth of 120.1m. Permanent surface casing was installed to bedrock in the borehole. A string of HQ-size drill rods (nominal 76mm ID) was permanently installed to 68 meters depth before installation of the Westbay System.

3 INSTALLATION

Westbay technical services representative Mr. Mark Lessard was on site for the installation from September 30 to October 5, 2016. Lorax representatives Mr. Andrew Solod and Mr. Chris Bourque were on-site to assist and supervise the work.

Table 1, Summary of Westbay System Completion

Monitoring Well No.	Installation Dates 2016	Borehole Depth (m)	Depth of HQ rods (m)	MP38 Tubing Length (m)	No. Monitoring Zones
MW-16-01WB	Oct 1 - 3	120.1	68	118.0	4

(Note: all depths are with respect to ground surface. Monitoring well reference elevations were not available at the time of writing).

The Westbay System was installed according to the procedure described below.

3.1 Preparation of Westbay System Design

Packer locations and the projected depth of permafrost (about 60m) for the borehole were provided to Westbay by Mr. Andrew Solod of Lorax. A well design was created based on these depths. The well design was used to prepare a Westbay Completion Log, which specifies the location of components in the well. The log was reviewed and approved in the field by Mr. Solod prior to installation of the well. The Westbay Completion Log as approved was used as an installation guide in the field. A field copy of the log is in the Appendix.

A measurement port coupling was included in each primary zone to provide the capability to measure fluid pressures and to collect fluid samples. Measurement port couplings were also included in QA zones to provide QA testing capabilities. A pumping port was placed above the top packer located directly above the expected base of permafrost in the completion. This pumping port was placed as part

of a plan to introduce a 3:1 propylene glycol/water mixture into the steel casing adjacent to the permafrost zone.

Mr. Andrew Solod of Lorax requested that optional synthetic (PET) filters were not to be installed over the measurement port couplings.

3.2 Layout of Westbay System Components

Prior to Westbay System installation, the Westbay System components were set out on a rack near the borehole according to the sequence indicated on the Westbay Completion Log. Each component was numbered beginning with the lowermost as an aid to confirming the proper sequence of components. The appropriate Westbay System couplings were attached to the tubing sections. Magnetic location collars were attached 0.6 meters below the top of the measurement port in each primary zone.

Each component was visually inspected. Serial numbers for each packer, pumping port and measurement port coupling were recorded on the Westbay Completion Log. The well component layout was confirmed with the log before the components were lowered into the borehole.

3.3 Lowering of Westbay System Components

The Westbay System components were lowered into the borehole by hand, through permanent HQ drill rods (nominal 76mm ID) to 68 meters and open borehole to total depth. Each tubing joint was tested with a minimum internal hydraulic pressure of 150 psi for one minute to confirm hydraulic seals. A record of each successful joint test and the placement of each component are noted on the Westbay Completion Log by check marks.

A 3:1 water/propylene glycol mixture supplied by Lorax was added to the Westbay completion when necessary to counter buoyancy effects while components were lowered into the borehole and for testing of joint seals during lowering.

3.4 Hydraulic Integrity Testing

After the Westbay System components were lowered into the borehole, the water inside the tubing was monitored at a depth different from the open borehole water level for a minimum period of thirty minutes to confirm hydraulic integrity of the tubing. The data from the hydraulic integrity test is shown in Table 2 below.

Table 2, Borehole and Westbay Tubing Water Level

Well number	Borehole water level (ground surface)	Westbay tubing water level (below top of Westbay)
MW-16-01WB	ground level (artesian)	37.310 m

3.5 Positioning of Westbay System Completion

The final position of the guide tube is illustrated on the Summary Completion Log in the Appendix. The Westbay System tubing was positioned as indicated on the cover page of the Summary Completion

Log. Ground surface was used as zero reference for the installation. The Westbay System components were supported in this position while packer inflations were carried out.

The positioning of the Westbay System is based on the "nominal" lengths of Westbay System components. The positioning calculations do not include allowances for borehole temperature or deviation effects.

The attached figure titled “MOSDAX Transducer Position” provides information to correlate the position of MOSDAX Transducer sensors to the reference position at the top of the Measurement Port. The attached figure titled “Dimensions of Packer Seals and Monitoring Zones” outlines the calculations used to determine the packer centerline depths and zone length.

The Summary Completion Log and Table 4, shows the final “as-built” locations of key components in the well, and Table 5 shows the final “as-built” locations of all components in the well, are included in the Appendix.

3.6 Pre-inflation Profile

Prior to inflating the packers, a pre-inflation pressure profile was carried out in the Westbay System to confirm the proper operation and position of measurement ports and magnetic collars. The data confirmed proper operation and position of all measurment ports (Figure 3). The data for the pre-inflation profile for the well is located in the Appendix.

3.7 Inflation of Westbay System Packers and Placement of Antifreeze Solution

The Westbay packers were inflated using a 3:1 proplyene glycol/water mixture provided by Lorax. The Westbay Model No. 6055 vented inflation tool was used for packer inflation. All the packers appear to have inflated normally. The data for inflation of each packer are provided on the Westbay Packer Inflation Records included in the Appendix.

The packers were inflated in a specific sequence as part of a plan to introduce and control an antifreeze solution in the well annulus through the permafrost zone.

The sequence of tasks for introducing 3:1 proplyene glycol/water mixture is illustrated below:

- A set of two packers positioned inside the HQ rods immediately below the expected base of permafrost are inflated.
- The pumping port above the upper inflated packer was opened.
- A 3:1 mixture of water and propylene glycol supplied by Lorax was pumped inside the Westbay tubing, out the pumping port and into the well annulus (HQ rods). Pumping continued until a return flow of the mixture was observed from the well annulus at ground level, thus indicating that the well annulus (HQ rods) was full of the antifreeze mixture.
- The pumping port above the upper inflated packer was closed.
- The remaining Westbay packers were inflated sequentially beginning at the bottom.
- The squeeze relief venting function of the packer inflation tool was disabled to prevent accidental release of tubing fluid to the formations.

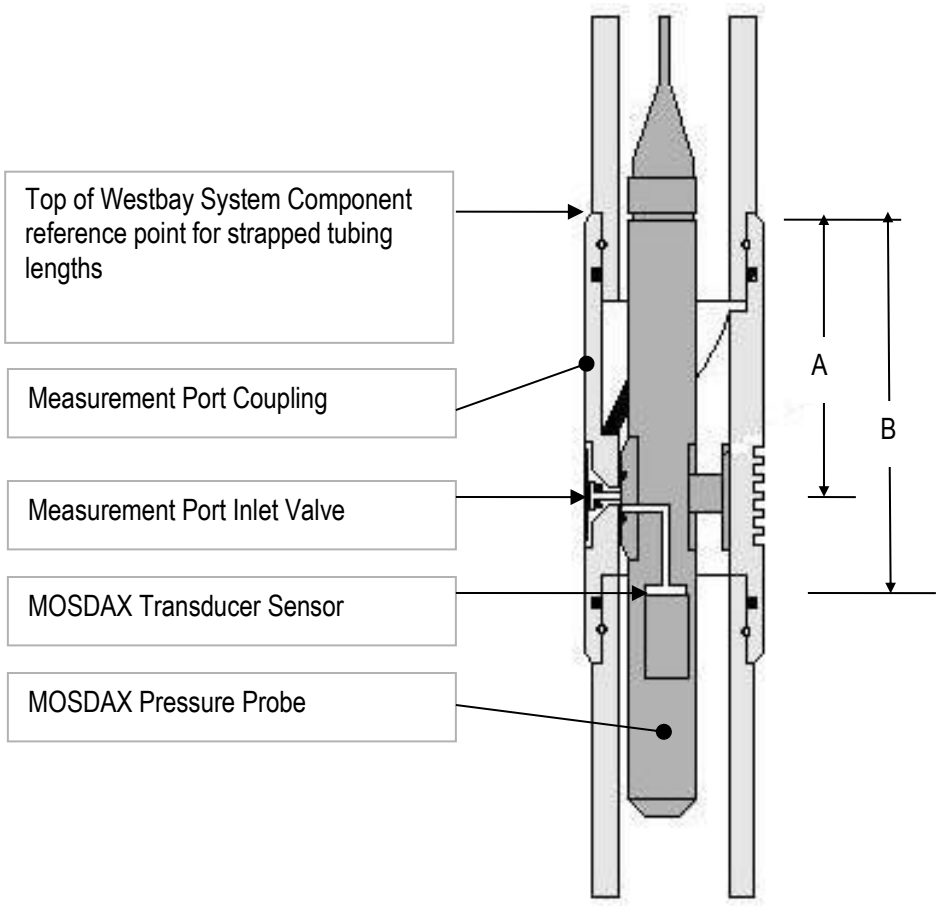
4 FLUID PRESSURE MEASUREMENTS

After packer inflation was completed, fluid pressures were measured at each measurement port. At that time, the in-situ formation pressures may not have recovered from the pre-installation activities and potential groundwater pressure increases in monitoring zones that may result from packer inflation. This latter effect may be more likely to occur in monitoring zones located in low-permeability geological formations. Longer term monitoring may be required to establish representative fluid pressures.

A plot of the piezometric levels in all zones in the well is shown on Figure 4 in the Appendix. The data were examined to confirm proper operation of the measurement ports and as a check on the presence of annulus seals between monitoring zones. The calculation sheet for the pressure profile is also enclosed in the Appendix.

MOSDAX Transducer Position

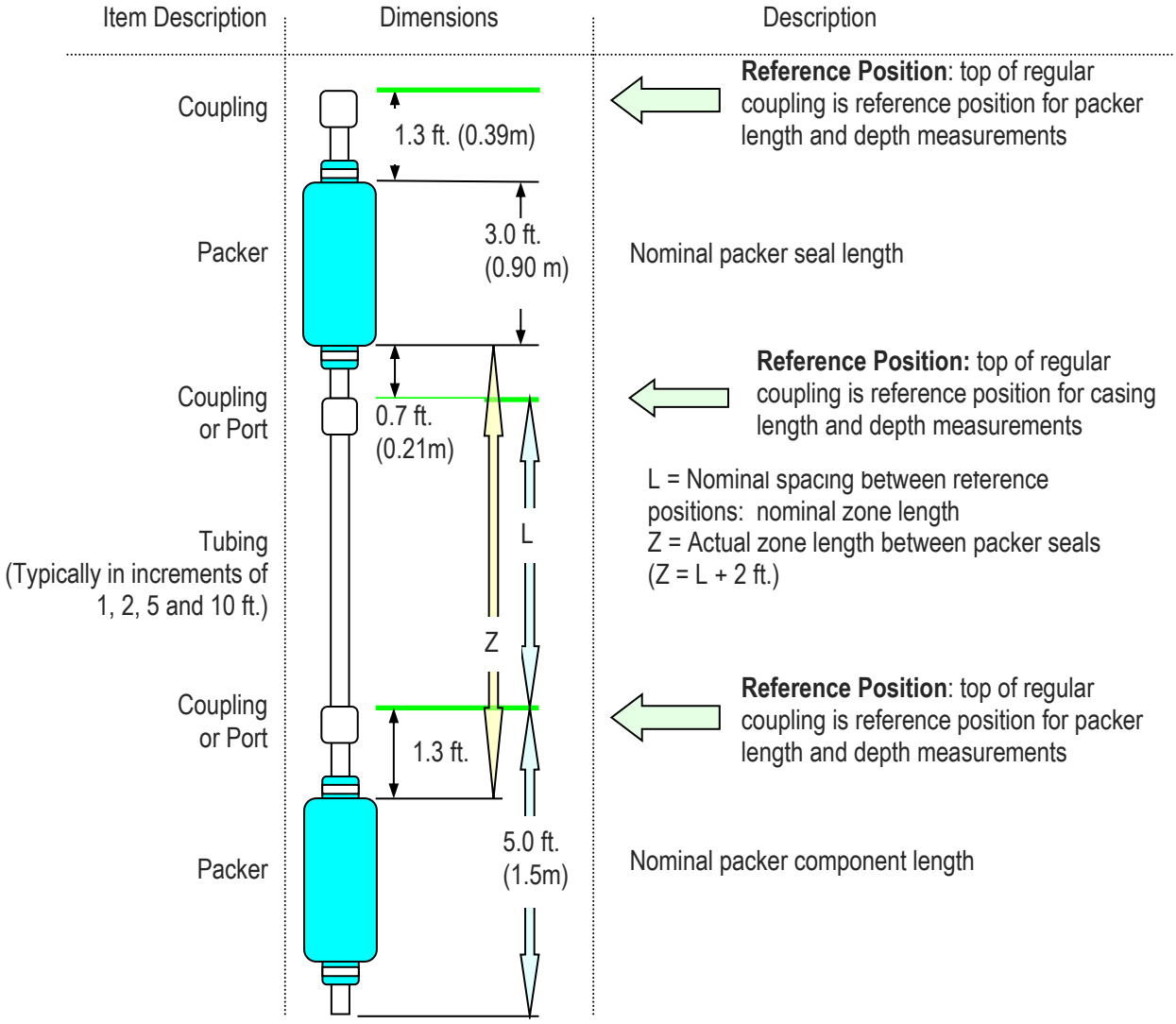
In an Westbay System Measurement Port Coupling



System	Measurement Port	A	B
Plastic MP38	0205	4.5" (114.3 mm)	6.5" (165.1 mm)

Figure 1: MOSDAX Transducer Position

Dimensions of Packer Seals and Monitoring Zones. 0238 Packers



Discussion Points:

- The top of a coupling (Regular Coupling, Measurement Port or Pumping Port) is the reference point for describing nominal depths and nominal lengths. Actual positions of packer seals and zone lengths are determined with respect to the appropriate reference positions.
- Packer Position Example: A packer with a nominal depth of 50 ft. (15.2m), will have a nominal packer seal position of 51.3 to 54.3 ft. (15.59 to 16.49m)
- Zone Length Example: A zone whose upper packer is at 50 ft. (15.2m) and bottom packer is at 70 ft. (21.3m) will have a nominal zone length of 15 ft. (4.6m) and an actual zone length (between packer seals) of 15.0+1.3+0.7 = 17.0ft. (4.6 + 0.39 + 0.2 = 5.19m)
- Information on the position of Measurement Port Valve and MOSDAX Transducer sensor, used for detailed calculation of piezometric level measurements, are described separately.

APPENDIX: MONITORING WELL: MW-16-01WB

As-Built Key Components Summary (Table 4)	- 1 page
As-Built Tubing Summary (Table 5)	- 2 pages
Summary Completion Log	- 3 pages
Pre-Inflation Piezometric Pressure/ Levels	
Field Data and Calculation Sheet (Oct 1)	- 1 page
Figure 3, Pre-Inflation Profile	- 1 page
Post- Inflation Piezometric Pressure/Levels	
Field Data and Calculation Sheet (Oct 3)	- 1 page
Figure 4, Post-Inflation Profile	- 1 page
Westbay Completion Log (field copy)	- 5 pages
Westbay System Packer Inflation Records	- 9 pages

TABLE 4
MW-16-01WB As-Built Packer and Port Summary

Port No.	Zone No.	Measurement Port Depth (m)	Pumping Port Depth (m)	Magnetic Collar Depth (m)	Depth to top of Packer (m)	Top of Zone (m)	Bottom of Zone (m)
1	QA1	114.9			113.4	114.7	120.1
2	Zone 1	110.3		110.9	108.8	110.1	113.8
3	QA2	90.5			89.0	90.3	109.2
4	Zone 2	85.9		86.5	84.4	85.7	89.4
5	QA3	74.6			73.1	74.4	84.8
6	Zone 3	71.6		72.2	70.1	71.4	73.5
7	Zone 4	67.0		67.6	65.5	66.8	70.5
8	QA4	64.0			62.5	63.8	65.9
	Riser		62.5	61.3	30.5	31.8	62.9

Note 1: All depth measurements in meters below ground surface.
Note 2: All depth measurements use 'Nominal' casing lengths.
Note 3: Not corrected for borehole angle, deviation or borehole temperature effects.
Note 4: All Westbay Port depth measurements to upper edge of coupling item.
Note 5: Depths for top and bottom of zone based on packer seal position.



Item No.	Component Part Number	Component Description	Component S/N	Coupling P/N	Coupling Description	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
49	W0203								-1.91
48	W020105			W0202					-1.86
47	W020101			W0202					-0.33
46	W020105			W0202					-0.03
45	W020110			W0202			W0216	2.1	1.50
44	W020105			W0202					4.54
43	W020110			W0202					6.07
42	W020110			W0202					9.11
41	W020110			W0202					12.16
40	W020110			W0202					15.21
39	W020110			W0202					18.26
38	W020110			W0202					21.31
37	W020110			W0202					24.35
36	W020110			W0202					27.40
35	W0238	Packer	19330	W0202					30.45
34	W020110			W0202					31.97
33	W020110			W0202					35.02
32	W020110			W0202					38.07
31	W020110			W0202					41.12
30	W020110			W0202					44.17
29	W020110			W0202					47.21
28	W020110			W0202					50.26
27	W020110			W0202					53.31
26	W020110			W0202					56.36
25	W020110			W0202			W0216	60.0	59.40
24	W0238	Packer	19325	W0224	Pumping Port	8821			62.45
23	W020105			W0205	Measurement Port	8908			63.98
22	W0238	Packer	19388	W0202					65.50
21	W020110			W0205	Measurement Port	8906	W0216	67.6	67.02
20	W0238	Packer	19387	W0202					70.07
19	W020105			W0205	Measurement Port	8907	W0216	72.2	71.60
18	W0238	Packer	19404	W0202					73.12
17	W020110			W0205	Measurement Port	8914			74.64
16	W020110			W0202					77.69
15	W020102			W0202					80.74
14	W020110			W0202					81.35
13	W0238	Packer	19403	W0202					84.40
12	W020110			W0205	Measurement Port	8912	W0216	86.5	85.92
11	W0238	Packer	19402	W0202					88.97
10	W020110			W0205	Measurement Port	8915			90.49
9	W020110			W0202					93.54
8	W020110			W0202					96.59
7	W020110			W0202					99.64
6	W020110			W0202					102.68

Item No.	Component Part Number	Component Description	Component S/N	Coupling P/N	Coupling Description	Coupling S/N	Accessory P/N	Accessory Depth (m)	Depth (m) *
5	W020110			W0202					105.73
4	W0238	Packer	19401	W0202					108.78
3	W020110			W0205	Measurement Port	8916	W0216	110.9	110.30
2	W0238	Packer	19334	W0202	Packer				113.35
1	W020110			W0205	Measurement Port	8911			114.88
0	W0203								117.92

Depths are with respect to ground surface.

* Component positions are referenced to the top of the subject Westbay System coupling.

* Packer positions are referenced to the top Westbay System coupling on the packer.

Monitoring zone dimensions are determined as described on the attached "Dimensions of Packer Seals and Monitoring Zones".

The position of a MOSDAX Transducer in a Measurement Port is illustrated in the attached "MOSDAX Transducer Position".

This information may be used in calculating piezometric levels.

Summary Completion Log

Company: LORAX
Well: MW-16-01WB
Site: Coffee Creek
Project: Kaminak

Job No: WB950
Author: ML

Well Information

Reference Datum: Ground Surface
Elevation of Datum: 0.00 m.
MP Casing Top: 0.00 m.
MP Casing Length: 117.97 m.

Borehole Depth: 120.09 m.
Borehole Inclination: Vertical
Borehole Diameter: 114.00 mm

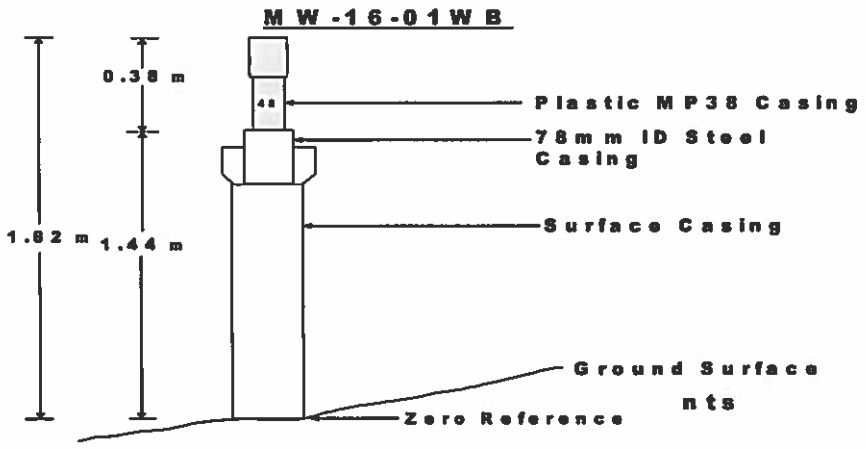
Well Description:
Permafrost
Other References:

File Information

File Name: MW-16-~1.WWD
Report Date: Tue Oct 11 10:38:09 2016

File Date: Oct 01 17:57:08 2016

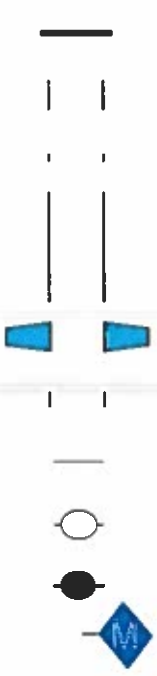
Sketch of Wellhead Completion



Legend

(Qty) MP Components

(Library - WD Library 01/23/14)



(2) W0203 - MP38 End Cap

(5) W020105 - MP38 Tubing 2 (5F/1.5M)

(1) W020101 - MP38 Tubing 4 (1F/0.3M)

(32) W020110 - MP38 Tubing 1 (10F/3M)

(9) W0238 - MP38 Packer - 74mm (5F/1.5M)

(1) W020102 - MP38Tubing 3 (2F/0.6M)

(39) W0202 - MP38 Regular Coupling

(1) W0224 - MP38 Pumping Port

(8) W0205 - MP38 Measurement Port

(6) W0216 - Magnetic Location Collar

Geology

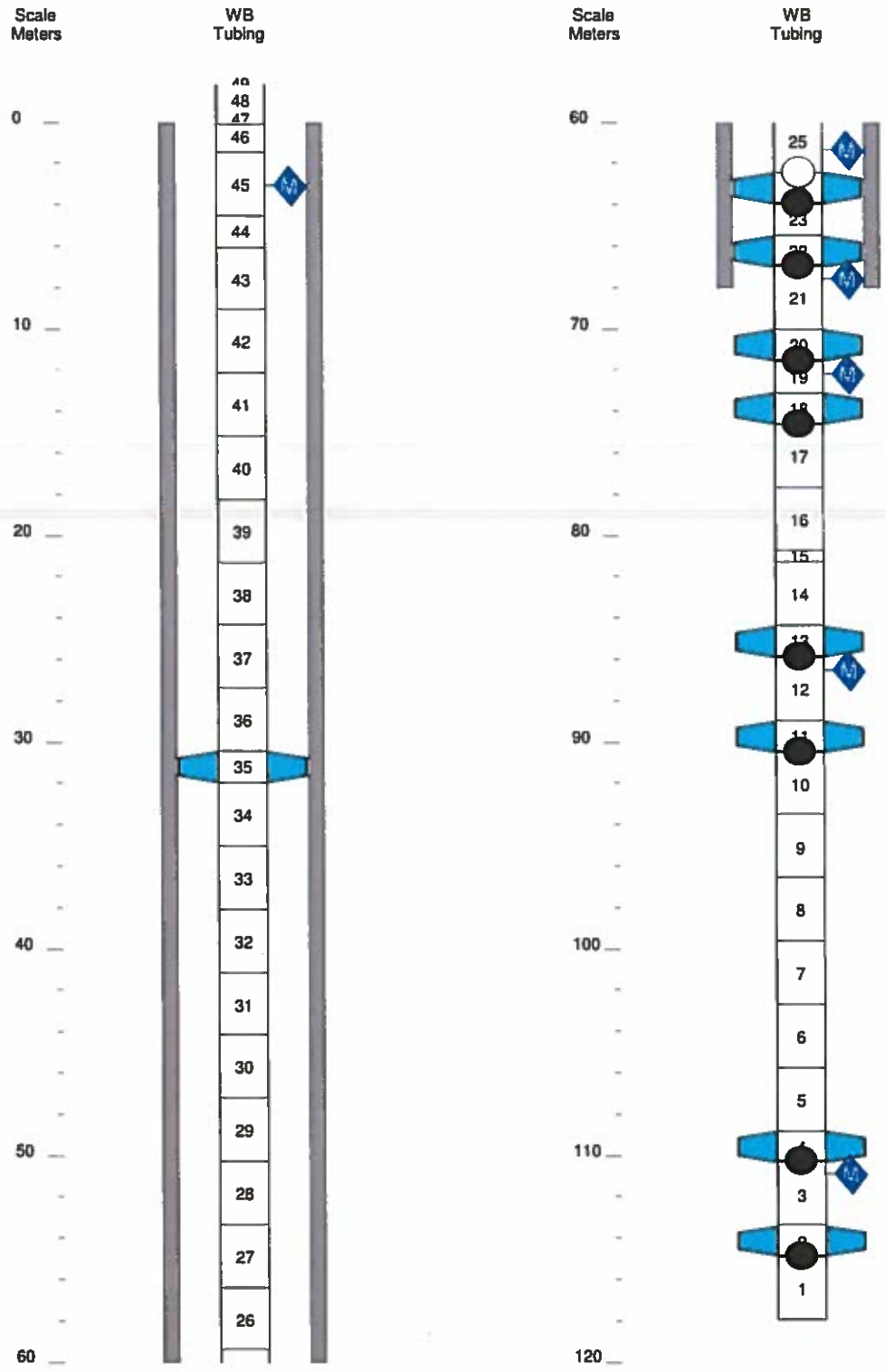
Backfill/Casing



Mild Steel

Summary Completion Log
LORAX

Job No: WB950
Well: MW-16-01WB



(c) Westbay Instruments Inc. 2000

Tue Oct 11 10:17:25 2016

PRE-INFLATION

Westbay Instruments

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Well No.: MW16-01WB
Datum: GS
Elev. G.S.: Ø
Height of Westbay above G.S.: 1.85 m
Elev. top of Westbay Casing: Ø
Reference Elevation: Ø
Borehole angle: 90°

Probe Type: Sampler
Serial No.: EMS 2221
Probe Range: 250 psi
Westbay Casing Type: MP38
Sampler Valve Position: CLOSED

Date: 10/1/16
Client: Goldcorp
Job No.: WB 950
Location: Coffee Creek
Weather: Sunny ~ 2°C
Operator: A. SOLOD

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

P_{atm} 12.64 psi

Ambient Reading (P_{atm}) (pressure, temperature, time)

Start: Pressure 12.64
Temp -
Time 17:56

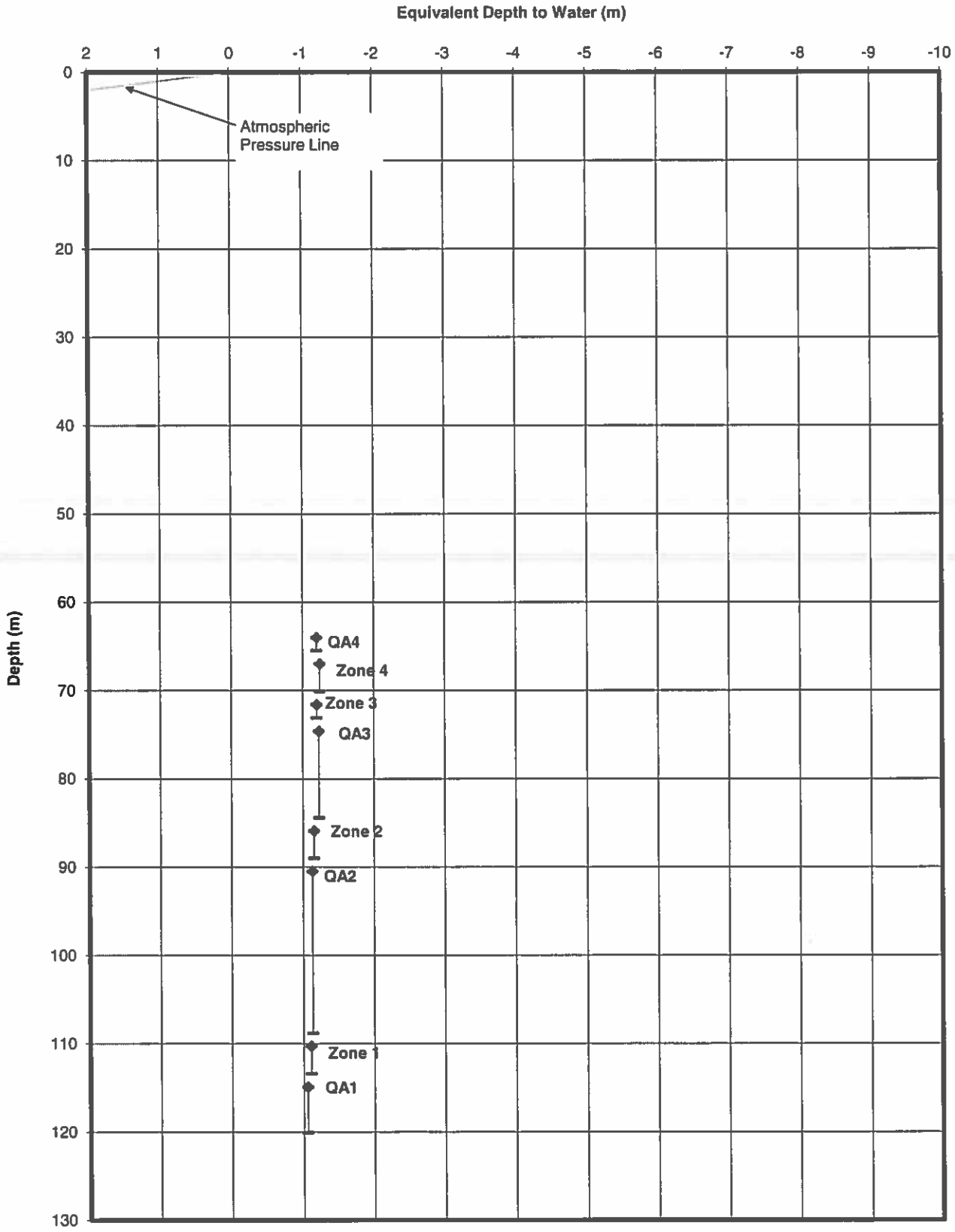
Finish:

Port No.	Port Position From Log M (ft)	Port Position From Cable (ft)	True Port Depth "Dp" (ft)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (ft) H = (P2-Patm)/w	Piez. Level Outside Port (ft) Dz = Dp - H	ZONE	Comments
1	114.9	114.3	—	129.65	177.53	18:09:12	4.14	129.65	116.0	-1.1	QA1	
2	110.3	109.6	—	122.97	171.06	18:19:08	1.01	122.96	111.4	-1.1	ZONE 1	
3	90.5	90.0	—	93.99	142.94	18:22:00	0.61	94.01	91.63	-1.1	QA2	
4	85.9	85.4	—	87.32	136.45	18:24:19	0.43	87.32	87.0	-1.1	ZONE 2	
5	74.6	74.2	—	70.83	120.47	18:27:28	0.29	70.84	75.83	-1.2	QA3	
6	71.6	71.2	—	66.37	116.16	18:30:51	0.14	66.37	72.80	-1.2	ZONE 3	
7	67.0	66.6	—	59.69	109.68	18:33:18	0.07	59.69	68.24	-1.2	ZONE 4	
8	64.0	63.6	—	55.23	105.35	18:35:48	0.01	55.23	65.2	-1.2	QA4	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: MW-16-01-WB

Profile Date: Oct 1, 2016
Comments: Pre-Inflation Profile



Client: LORAX
Site: Coffee Creek
Datum: GS

Figure 3

Plot By: MF Date: Oct 11/16
Checked By: DL Date: Nov 2/16
Westbay Project: WB950

POST INFLATION

Westbay Piezometric Pressures/Levels

Field Data and Calculation Sheet

Westbay Instruments

Well No.: MW16-01WB
Datum: GS
Elev. G.S.: 0
Height of Westbay above G.S.: 1.82 m
Elev. top of Westbay Casing: 0
Reference Elevation: Ground level
Borehole angle: 90°

Probe Type: WB Sampling
Serial No.: 222.1
Probe Range: 250 psi
Westbay Casing Type: MP38
Sampler Valve Position: CLOSED

Date: 10/03/16
Client: Enbridge
Job No.: WB950
Location: Cobden, Ontario
Weather: Overcast
Operator: A. Solod

Note: "Port position" in angled boreholes refer to position along drillhole. True depth (Dp) needs to be calculated using borehole angle and deviation data to calculate zone piezometric level (Dz).

Ambient Reading (P_{atm}) (pressure, temperature, time)

		Finish:
Start: Pressure	12.66	12.67
Temp	5.51	-0.19
Time	16:10	16:51

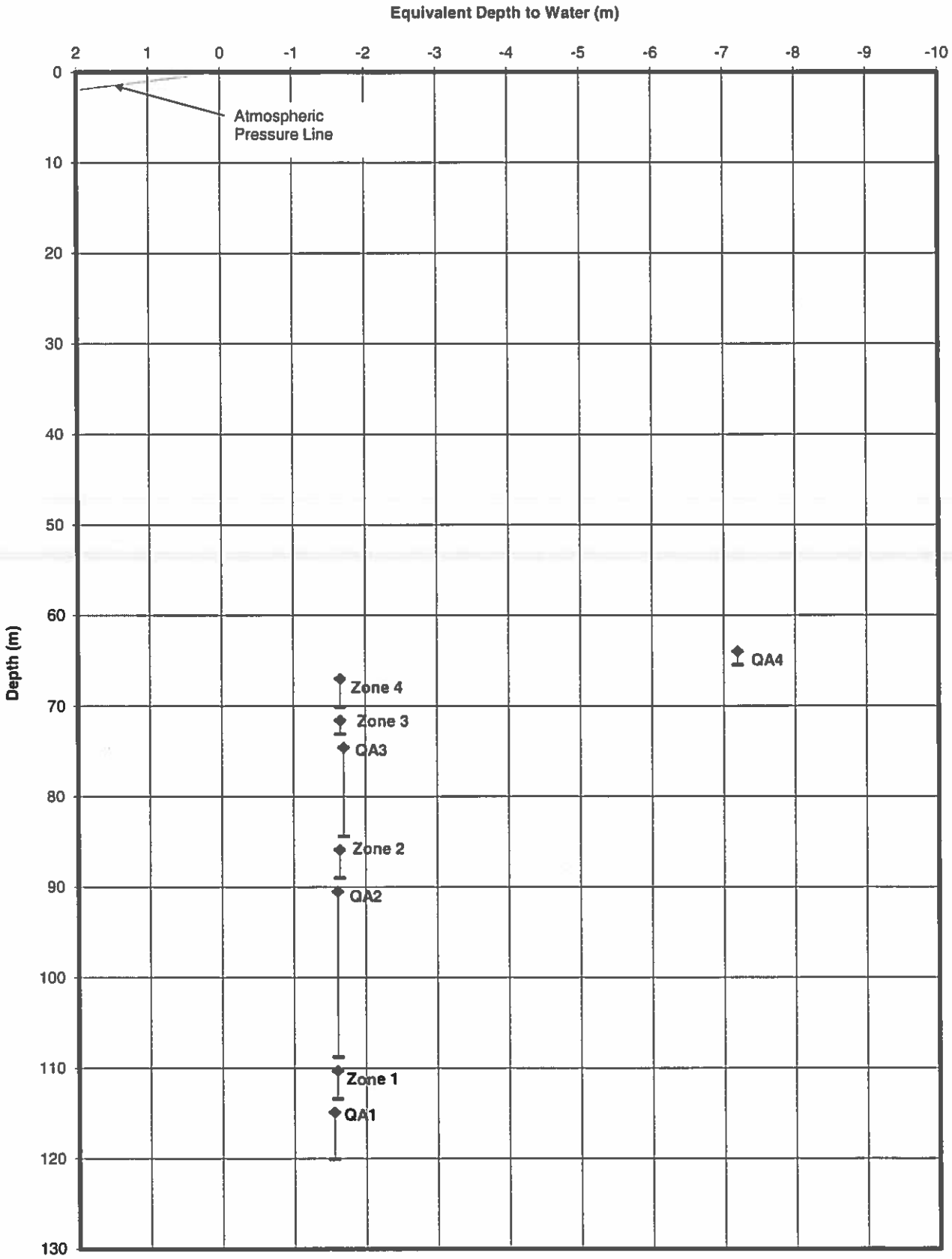
P_{atm} 12.66 psi

Port No.	Port Position From Log (ft)	Port Position From Cable (ft)	True Port Depth "Dp" (ft)	Fluid Pressure Readings: Inside Casing (P1)	Outside Casing (P2)	Time H:M:S	Probe Temp. (°C)	Inside Casing (P1)	Pressure Head Outside Port (ft) H = (P2-Patm)/w	Piez. Level Outside Port (ft) Dz = Dp - H	ZONE	Comments
1	114.9	114.2	–	169.14	178.26	16:26	2.25	169.14	116.46	-1.56	QA1	
2	110.3	109.7	–	162.45	171.78	16:30	1.31	162.45	111.90	-1.60	ZONE 1	
3	90.5	90.0	–	133.40	143.64	16:34	0.79	133.40	92.11	-1.61	QA2	
4	85.9	85.4	–	126.70	137.14	16:36	0.52	126.70	87.54	-1.64	ZONE 2	
5	74.6	74.2	–	110.16	121.15	16:38	0.36	110.18	76.29	-1.69	QA3	
6	71.6	71.2	–	105.71	116.87	16:41	0.16	105.71	73.25	-1.65	ZONE 3	
7	67.0	66.6	–	99.01	110.28	16:43	0.05	99.01	68.65	-1.65	ZONE 4	
8	64.0	63.6	–	94.56	113.90	16:46	-0.03	94.55	71.20	-7.20	QA4	

Notes: w = 0.4335 psi/ft (1.422psi/m) of H_2O Dz = piezometric level in zone Patm = atmospheric pressure H = pressure head of water in zone Dp = true depth of measurement port

Piezometric Profile
Monitoring Well: MW-16-01WB

Profile Date: Oct 3, 2016
Comments: Post-Inflation Profile



Client: LORAX
Site: Coffee Creek
Datum: GS

Plot By: ML Date: Oct 11/16
Checked By: DC Date: Nov 2/16
Westbay Project: WB950

Figure 4

Westbay Completion Log

Company: LORAX
Well: MW-16-01WB
Site: Coffee Creek
Project: Coffee Creek

Job No: WB950
Author: ML

Well Information

Reference Datum: Ground Surface
Elevation of Datum: 0.00 m.
MP Casing Top: 0.00 m.
MP Casing Length: 117.97 m.

Borehole Depth: 120.09 m.
Borehole Inclination: Vertical
Borehole Diameter: 114.00 mm

Well Description:
Permafrost
Other References:

File Information

File Name: MW-16V2.WWD
Report Date: Sat Oct 01 09:07:42 2016

File Date: Oct 01 09:04:01 2016

Comments

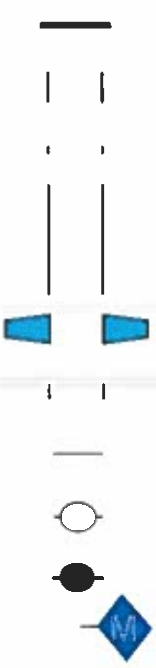
Zero reference is ground surface
Filter socks not to be used -

Log Information

Borehole condition confirmed.	(method) Tagline	Date:	Oct 1/16
MP well design & preparation.	By:	Date:	Oct 1/16
MP well design checked.	By:	Date:	10/1/16
MP well and borehole approved to install.	By:	Date:	10/1/16

Legend

(Qty) MP Components
(Library - WD Library 01/23/14)



(2) W0203 - MP38 End Cap

(5) W020105 - MP38 Tubing 2 (5F/1.5M)

(1) W020101 - MP38 Tubing 4 (1F/0.3M)

(32) W020110 - MP38 Tubing 1 (10F/3M)

(9) W0238 - MP38 Packer - 74mm (5F/1.5M)

(1) W020102 - MP38Tubing 3 (2F/0.6M)

(39) W0202 - MP38 Regular Coupling

(1) W0224 - MP38 Pumping Port

(8) W0205 - MP38 Measurement Port

(6) W0216 - Magnetic Location Collar

Geology

Backfill/Casing

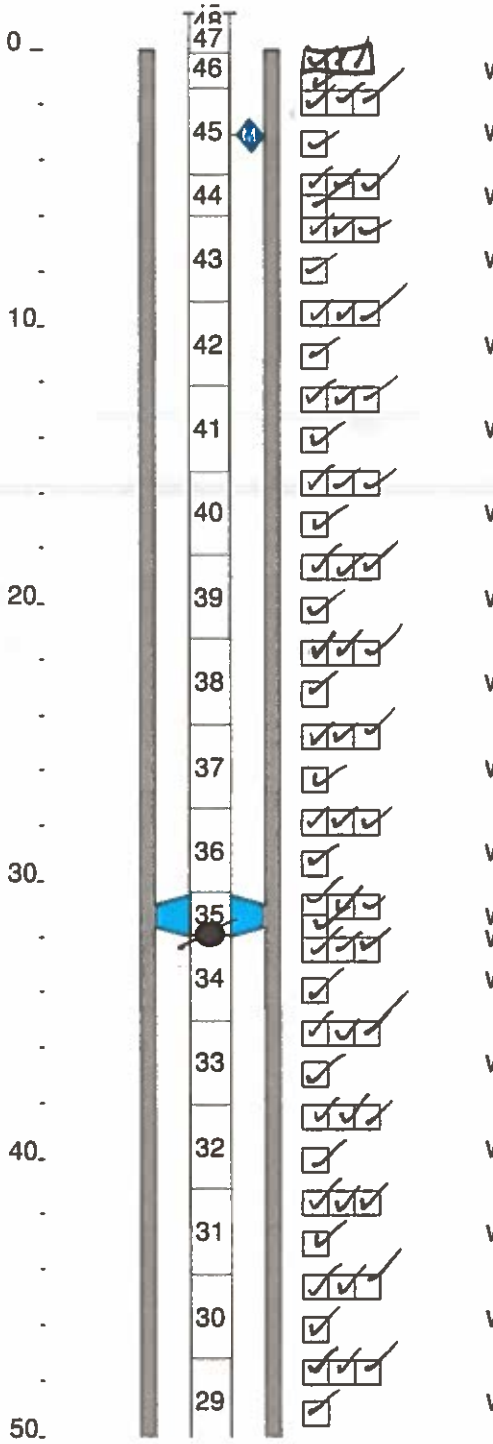


Mild Steel

Westbay Completion Log
LORAX

Job No: WB950
Well: MW-16-01WB

Finish lowering + westbay set
4:55 pm on Oct 1, 2016



QA Tested OK	WB Tubing Description	Serial Numbers
☑☑☑	W020105 - MP38 Tubing 2 (5F/1.5M)	
☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑☑☑	W020105 - MP38 Tubing 2 (5F/1.5M)	
☑☑☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑☑☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑☑☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑☑☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑☑☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑☑☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑☑☑	W0238 - MP38 Packer - 74mm (5F/1.5M) W0205 - MP38 Measurement Port	19730-155
☑☑☑	W020110 - MP38 Tubing 1 (10F/3M)	~~8910~~ Replaced with regular coupling
☑☑☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑☑☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑☑☑	W020110 - MP38 Tubing 1 (10F/3M)	
☑	W020110 - MP38 Tubing 1 (10F/3M)	

4:10

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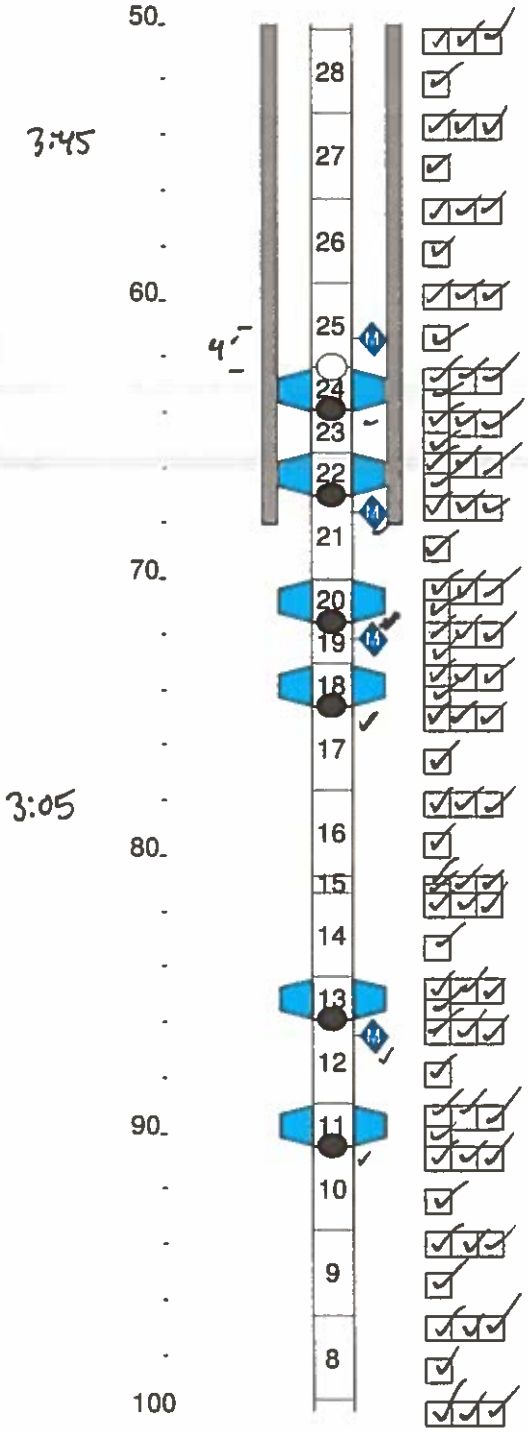
Sat Oct 01 09:08:20 2016

Westbay Completion Log
LORAX

Job No: WB950
Well: MW-16-01WB



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Sat Oct 01 09:08:20 2016

Westbay Completion Log
LORAX

Job No: WB950
Well: MW-16-01WB

Scale Meters	WB Tubing	QA Tested OK	WB Tubing Description	Serial Numbers
100	7	☑	W020110 - MP38 Tubing 1 (10F/3M)	
	6	☑	W020110 - MP38 Tubing 1 (10F/3M)	
2:31	5	☑	W020110 - MP38 Tubing 1 (10F/3M)	
110	4	☑	W0238 - MP38 Packer - 74mm (5F/1.5M)	19401 - 160
		☑	W0205 - MP38 Measurement Port	8916
	3	☑	W020110 - MP38 Tubing 1 (10F/3M)	
	2	☑	W0238 - MP38 Packer - 74mm (5F/1.5M)	19334 - 145
		☑	W0205 - MP38 Measurement Port	8911
	1	☑	W020110 - MP38 Tubing 1 (10F/3M)	
		☑	W0203 - MP38 End Cap	
120				

Start lowering at 2:21 pm on Oct 1, 2016.

Joint test tool - 300 psi.
Borehole water depth - artesian.
Inflation tool - 400-410 psi.

Hydraulic Integrity Test

37.310 m at 1850 on Oct 1/16
37.310 m at 1905 on Oct 1/16
37.310 m at 1915 on Oct 1/16
37.310 m at 1930 on Oct 1/16
37.310 m at 1415 on Oct 2/16

Pre-Inflation Profile

- measurements recorded, calculations completed.
- confirm m-port position and function.

Mark Leonard

Westbay tubing is water tight.

Mark Leonard

130
140
150

Sheet 1 of 9

Westbay Packer Inflation Record

Project: LORAX Project No.: WB 950 Well No.: MW.16-01WB

Location: Coffee Creek Completed by: M. Lorsard Date Inflated: Oct 3/16

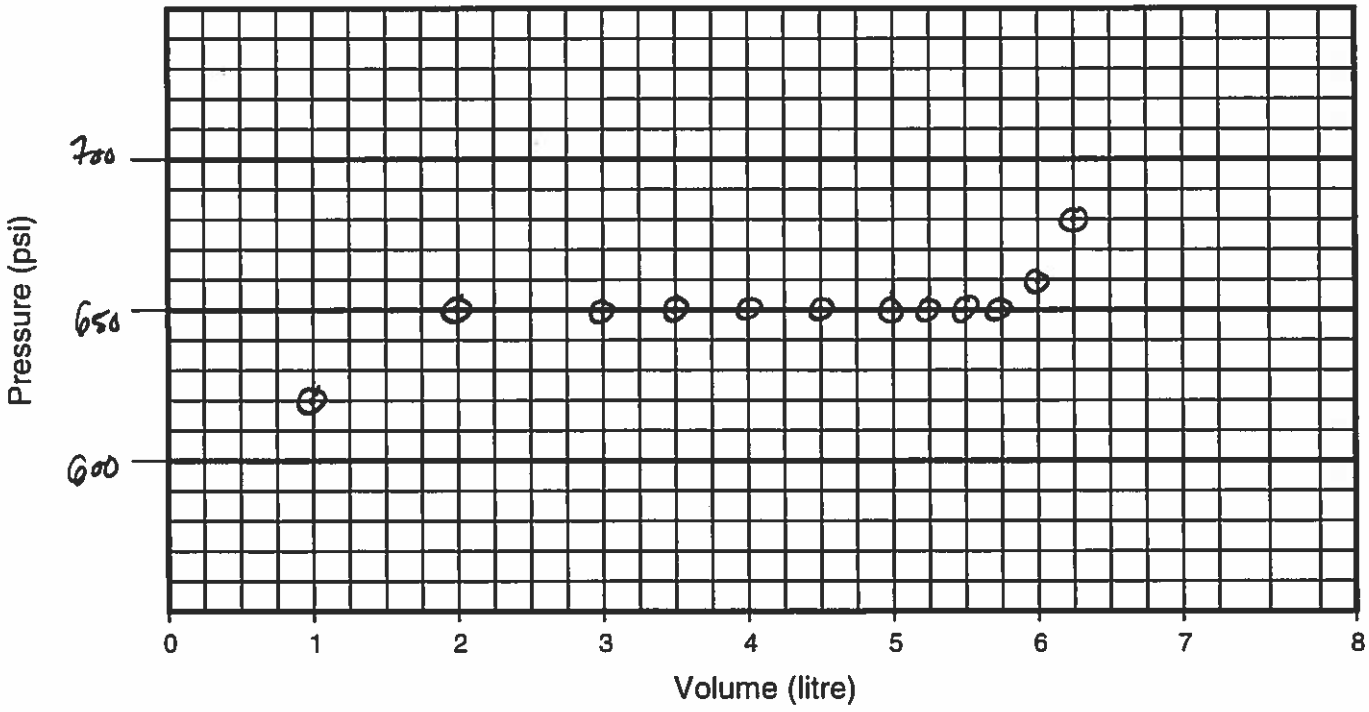
Packer No. 1, comp2 SN# 19334 Depth (ft / m): 113.4 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 145 psi Final Line Pressure, P_L: 680 psi Tool Pressure, P_T: 410 psi

Borehole Water Level: 0 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 125 psi

Volume, litres	1.0	2.0	3.0	3.5	4.0	4.5	5.0	5.25	5.5	5.75
Pressure, psi	620	650	650	650	650	650	650	650	650	650
Volume, litres	6.0	6.25	/	6.0						
Pressure, psi	660	680	/	Ø						



Comments: Packer #1 Time - 10:40 am

700PL = 145 PE

Sheet 2 of 9

Westbay Packer Inflation Record

Project: LORAX Project No.: WB950 Well No.: MW-16-01 WB

Location: Coffee Creek Completed by: M. Lessard Date Inflated: Oct 3/16

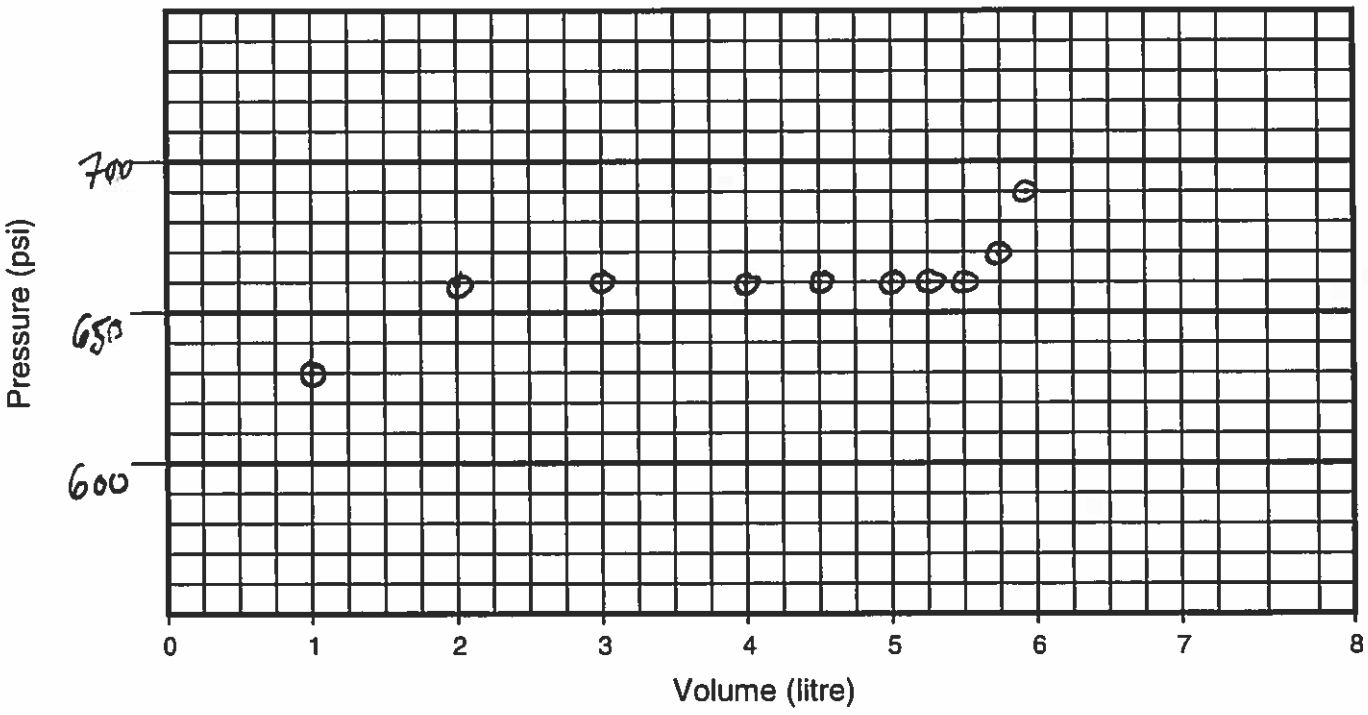
Packer No. 2, comp 4 SN# 19401 Depth (ft / m): 108.8 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 160 psi Final Line Pressure, P_L: 690 psi Tool Pressure, P_T: 910 psi

Borehole Water Level: 0 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 120 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	5.0	5.25	5.5	5.75	5.9
Pressure, psi	630	660	660	660	660	660	660	660	670	690
Volume, litres	/	5.6								
Pressure, psi	/	Ø								



Comments: Packer #2 Time - 11:00 am

Sheet 3 of 9

Westbay Packer Inflation Record

Project: LORAX | Project No.: WB950 | Well No.: MW-16-01 WB

Location: Coffee Creek | Completed by: M. Lessard | Date Inflated: Oct 3/16

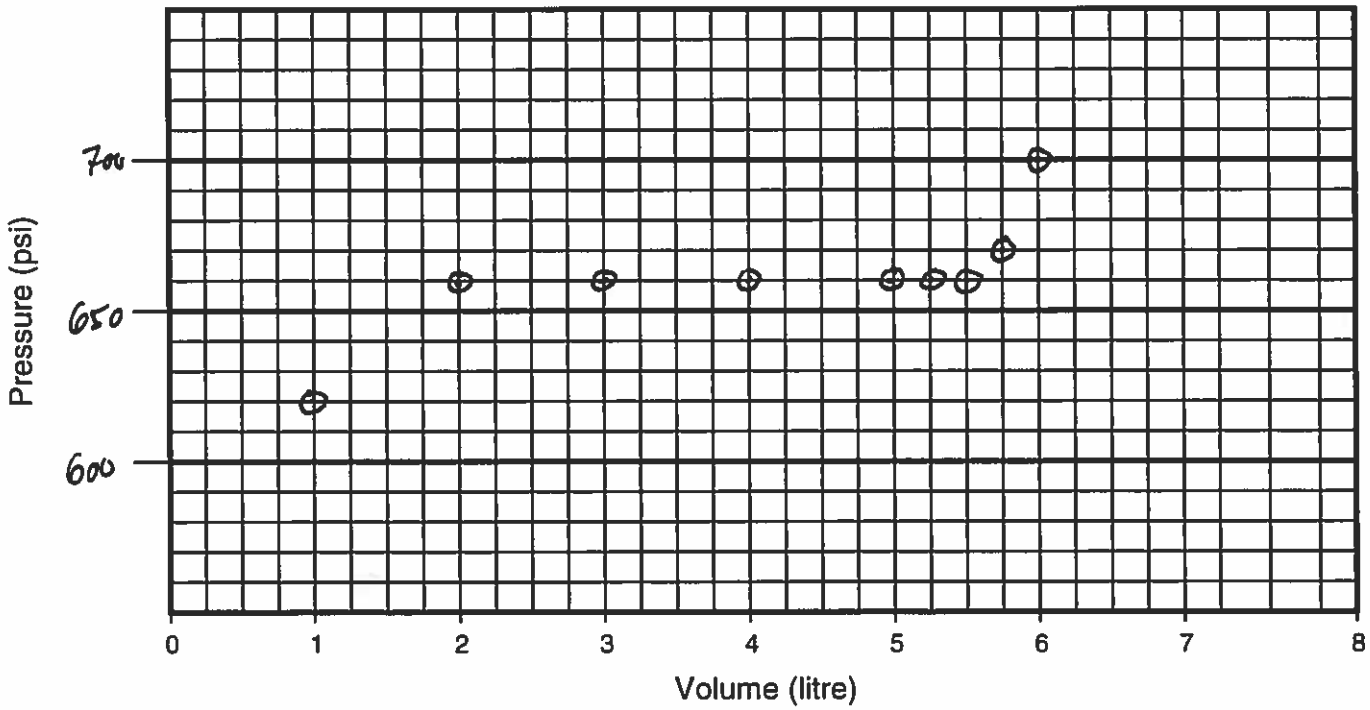
Packer No. 3, comp II SN# 19402 | Depth (ft / m): 89.0 | Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 1600 psi | Final Line Pressure, P_L: 700 psi | Tool Pressure, P_T: 410 psi

Borehole Water Level: 0 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 130 psi

Volume, litres	1.0	2.0	3.0	4.0	5.0	5.25	5.5	5.75	6.0	✓
Pressure, psi	620	660	660	660	660	660	660	670	700	✓
Volume, litres	5.75									
Pressure, psi	Ø									



Comments: Packer #3 | Time - 11:26 am

Sheet 4 of 9

Westbay Packer Inflation Record

Project: LoRAX Project No.: WB950 Well No.: MW-16-01WB

Location: Coffee Creek Completed by: M.Lessard Date Inflated: Oct 3/16

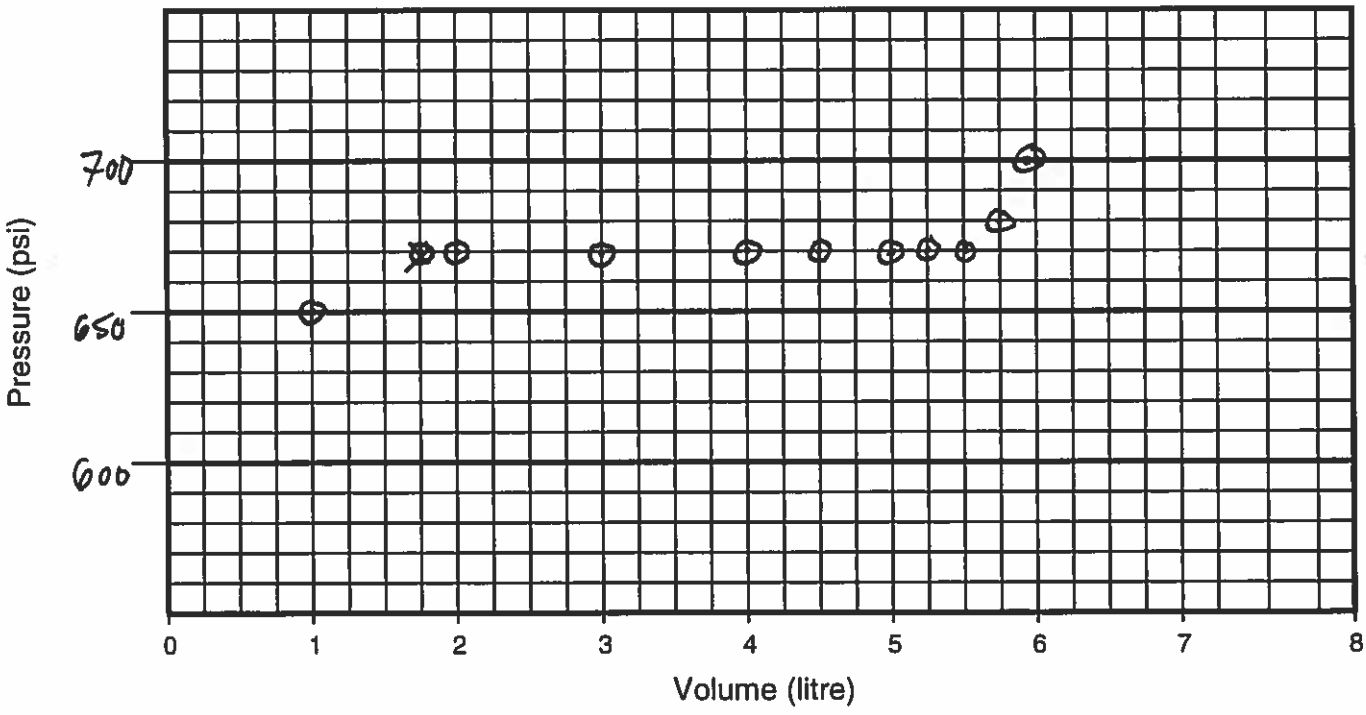
Packer No. 4, Comp 13 SN# 19403 Depth (ft / m): 84.4 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 700 psi Tool Pressure, P_T: 410 psi

Borehole Water Level: 0 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 140 psi

Volume, litres	1.0	2.0	3.0	4.0	4.5	5.0	5.25	5.5	5.75	5.9
Pressure, psi	650	670	670	670	670	670	670	670	680	700
Volume, litres	/	5.7								
Pressure, psi	/	ø								



Comments: Packer #4 Time - 11:56 am

Filter getting dirty

Sheet 5 of 9

Westbay Packer Inflation Record

Project: LORAX Project No.: WB950 Well No.: MW-16-01 WB

Location: Coffee Creek Completed by: M. Lessard Date Inflated: Oct 3/16

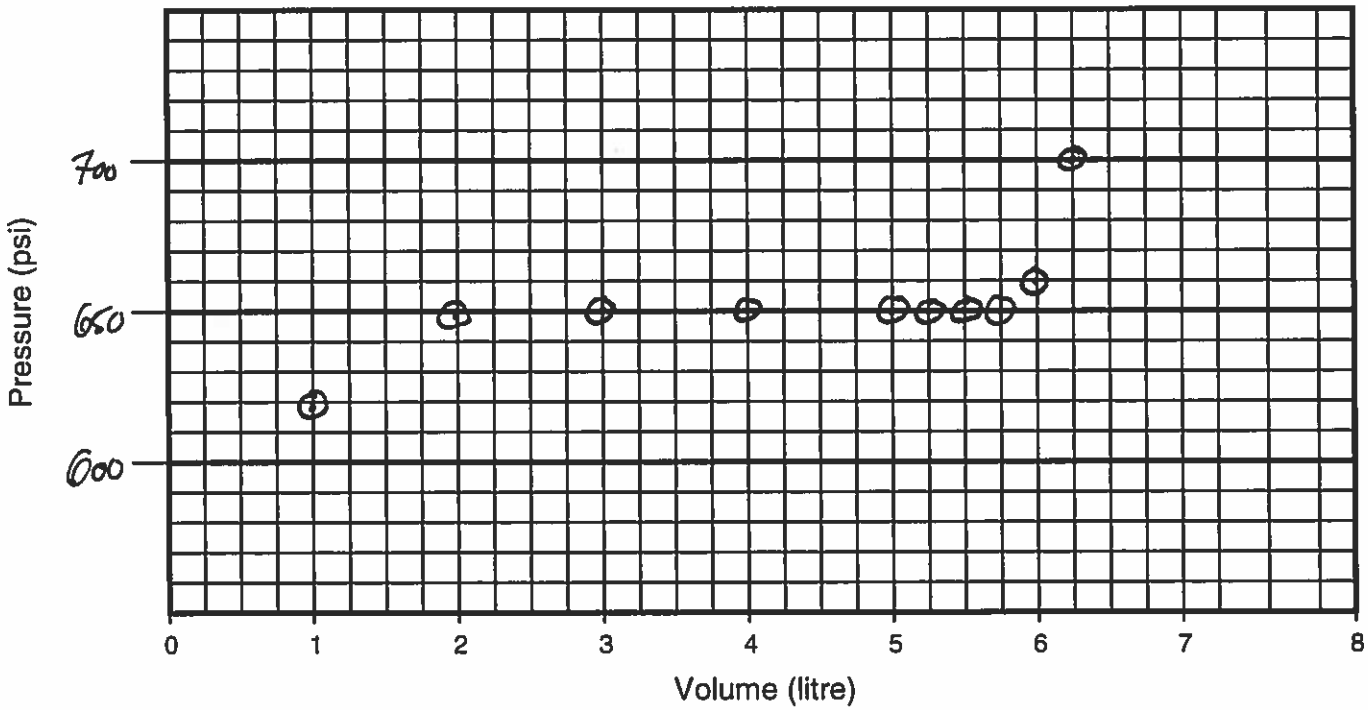
Packer No. 5, comp 19 SN#19404 Depth (ft / m): 73.1 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 700 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 0 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = ~~150~~ 0 psi

Volume, litres	1.0	2.0	3.0	4.0	5.0	5.25	5.5	5.75	6.0	6.25
Pressure, psi	620	650	650	650	650	650	650	650	660	700
Volume, litres	/	6.0								
Pressure, psi	/	0								



Comments: Packer # 5 Time - 12:30pm

Sheet 6 of 9

Westbay Packer Inflation Record

Project: LORAX Project No.: WB 950 Well No.: MW-16-01 WB

Location: Coffee Creek Completed by: M. Lessard Date Inflated: Oct 3/16

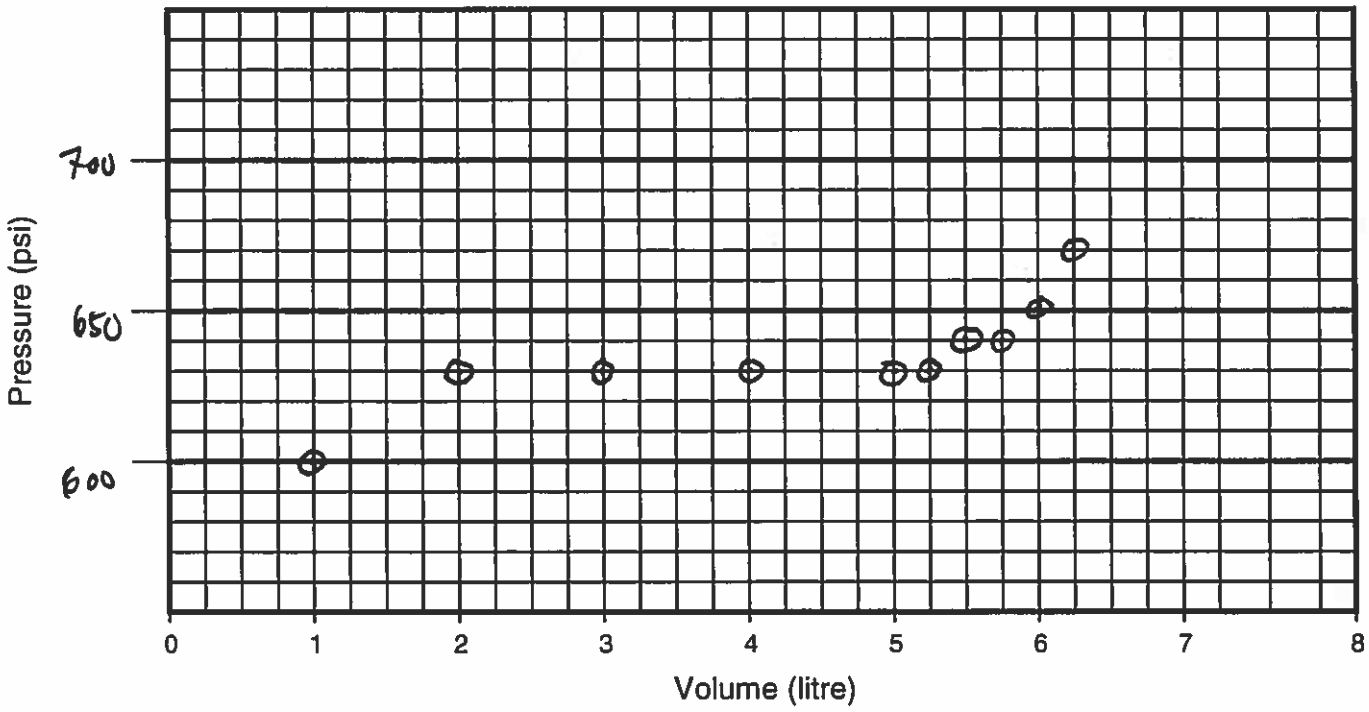
Packer No. 6, comp 20 SN# 19387 Depth (ft/ m): 70.1 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 155 psi Final Line Pressure, P_L: 670 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 0 (ft/ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 115 psi

Volume, litres	1.0	2.0	3.0	4.0	5.0	5.25	5.5	5.75	6.0	6.25
Pressure, psi	600	630	630	630	630	630	640	640	650	670
Volume, litres	/	6.0								
Pressure, psi	/	0								



Comments: Packer # 6 Time - 12:51 pm

Sheet 7 of 9

Westbay Packer Inflation Record

Project: LORAX Project No.: WB950 Well No.: MW-16-01 WB

Location: Coffee Creek Completed by: M. Lessard Date Inflated: Oct 21/16

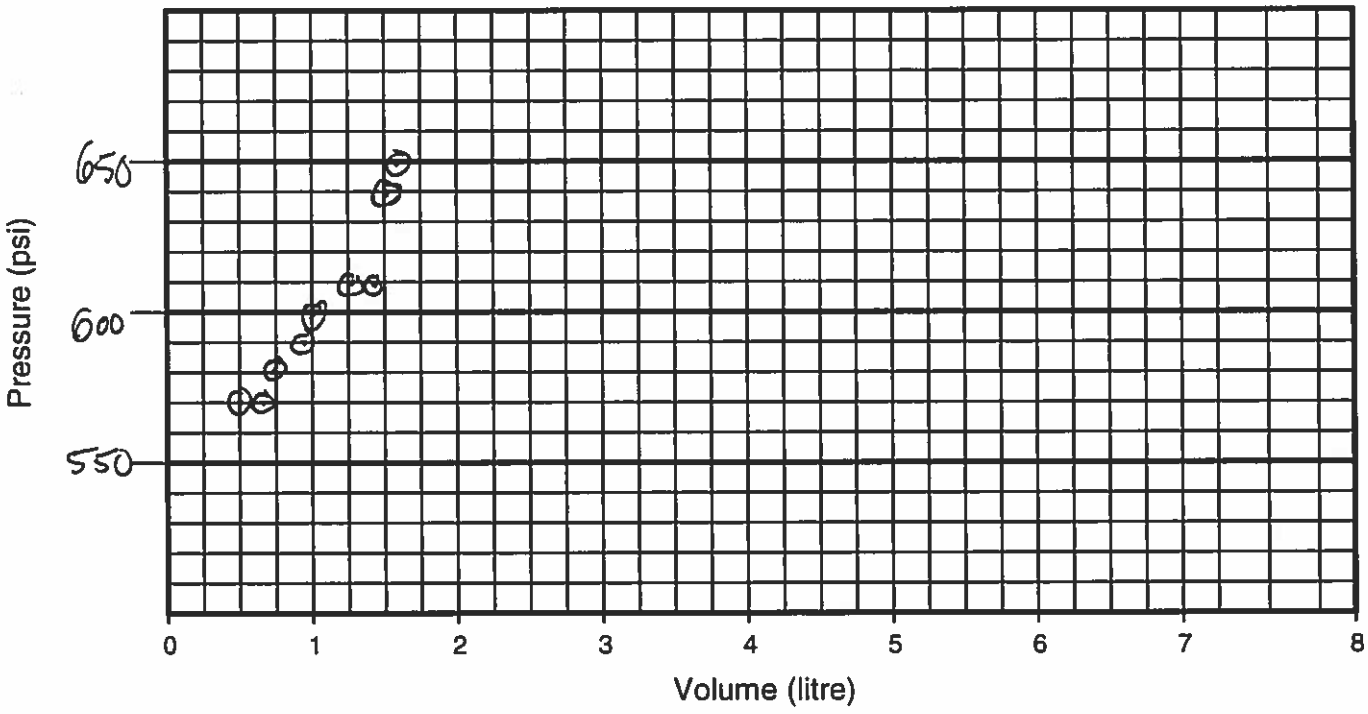
Packer No. 7, comp 22 Depth (~~MP~~ m): 65.5 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 650 psi Tool Pressure, P_T: 460 psi

Borehole Water Level: 0 (~~MP~~ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 90 psi

Volume, litres	0.25	0.5	0.7	0.75	0.9	1.0	1.25	1.3	1.4	1.5
Pressure, psi	280	570	570	580	590	600	610	620	620	640
Volume, litres	1.6	/	1.3							
Pressure, psi	650	/	∅							



Comments: Packer #7
Target 700 psi

Time - 4:34 pm

Sheet 8 of 9

Westbay Packer Inflation Record

Project: LORAX Project No.: WB950 Well No.: MW-16-01WB

Location: Coffee Creek Completed by: M. Lessard Date Inflated: Oct 2/16

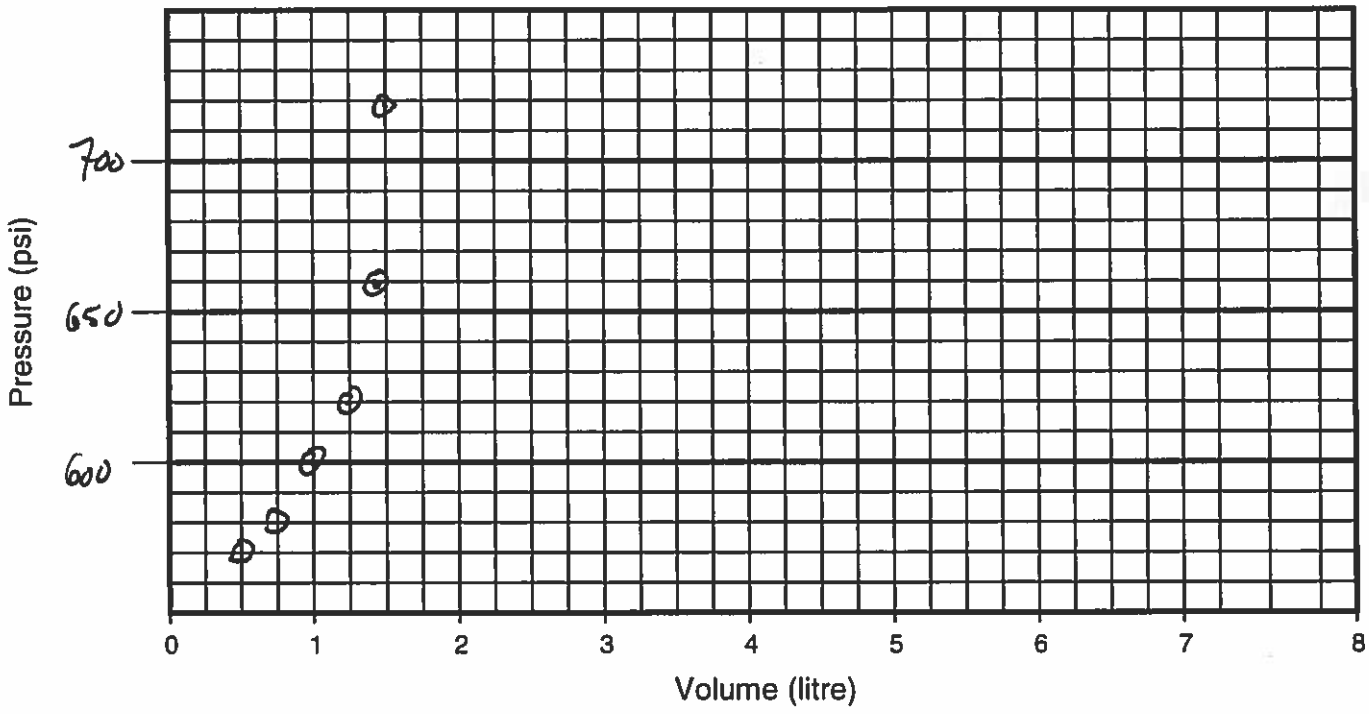
Packer No. 8, comp 24 SN# 19325 Depth (ft / m): 62.5 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 150 psi Final Line Pressure, P_L: 720 psi Tool Pressure, P_T: 410 psi

Borehole Water Level: 0 (ft/ m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 160 psi

Volume, litres	0.25	5.0	7.5	1.0	1.25	1.4	1.5	✓	1.25	
Pressure, psi	340	570	580	600	620	660	720	✓	Ø	
Volume, litres										
Pressure, psi										



Comments: Packer #8 Time - 4:52 pm

Sheet 9 of 9

Westbay Packer Inflation Record

Project: LORAX Project No.: WB950 Well No.: MW-16-01 WB

Location: Coffee Creek Completed by: M. Lessard Date Inflated: Oct 3/16

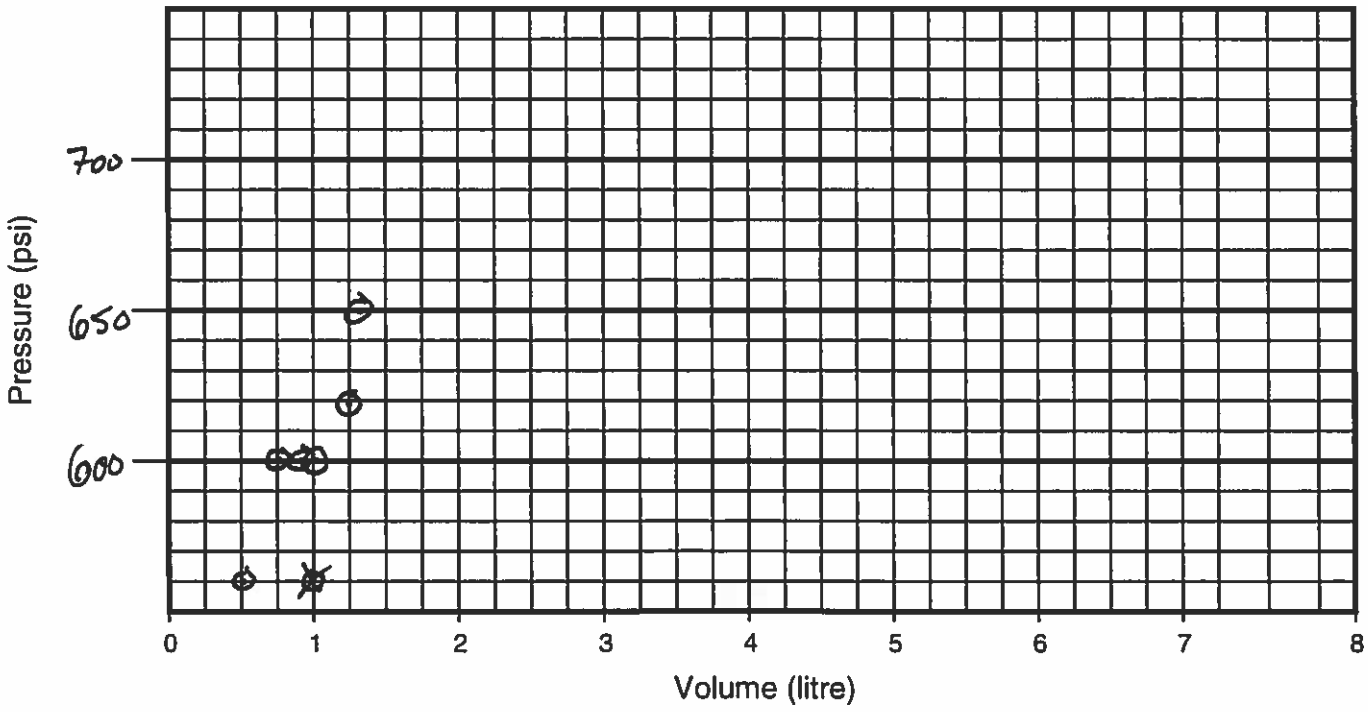
Packer No. 9, comp 35 SN# 19330 Depth (ft / m): 30.5 Inflation Tool No.: 3197

Packer Valve Pressure, P_V: 155 psi Final Line Pressure, P_L: 650 psi Tool Pressure, P_T: 400 psi

Borehole Water Level: 0 (ft / m) = 0 psi (P_W)

Calculated Packer Element Pressure, $P_E = P_L + P_W - P_V - P_T$ = 95 psi

Volume, litres	0.5	0.75	0.9	1.0	1.25	1.35	✓	1.1		
Pressure, psi	560	600	600	600	620	650	✓	✓		
Volume, litres										
Pressure, psi										



Comments: Packer #9 In HQ casing. Time - 1:03 pm

Appendix 3-C: RST VWP and Thermistor Documentation

APPENDIX 3-C1: RST VWP CALIBRATION SHEETS

APPENDIX 3-C2: RST THERMISTOR WIRING DIAGRAMS

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APPENDIX 3-C1: RST VWP CALIBRATION SHEETS

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Calibration Record

Vibrating Wire Piezometer

CFD0318-P1

Customer:		EBA Eng. Consultants-Yukon	
Model:		VW2100-5.0-HD	
Serial Number:		**VW25899**	
Mfg Number:		1313002	
Range:		5.0	MPa
Temperature:		24.8	°C
Barometric Pressure:		988.9	millibars
Work Order Number:		201464	
Cable Length:		230	meters
Cable Markings:		181880 m - 182108 m	
Cable Colour Code:	Red / Black (Coil)	Green / White	(Thermistor)
Cable Type:		EL380004	
Thermistor Type:		3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8765	8765	8765	0.010	0.20	-0.02
1.0	7990	7990	7990	1.000	-0.01	0.04
2.0	7213	7214	7214	1.991	-0.17	0.00
3.0	6431	6432	6432	2.990	-0.19	-0.02
4.0	5644	5643	5644	3.997	-0.06	-0.02
5.0	4848	4850	4849	5.012	0.23	0.01
			Max. Error (%):		0.23	0.04

Linear Calibration Factor:	**C.F.=**	**0.0012773**	**MPa/B unit**
Regression Zero:	**At Calibration =**	**8772.7**	**B unit**
Temperature Correction Factor:	**Tk =**	**0.0009906**	**MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -5.3394E-09 **B:** -0.0012046 **C:** 10.967

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	17-Jul-13	8772	22.4	1020.1

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = $Hz^2 / 1000$ ie: 1700Hz = 2890 B units

Technician: Benson Yu Date: 17-Jul-13

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

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Calibration Record

CFD0324-P2

Vibrating Wire Piezometer

Customer:		EBA Eng. Consultants-Yukon	
Model:		VW2100-5.0-HD	
Serial Number:		**VW25900**	
Mfg Number:		1313003	
Range:		5.0	MPa
Temperature:		24.8	°C
Barometric Pressure:		988.9	millibars
Work Order Number:		201464	
Cable Length:		230	meters
Cable Markings:		182109 m - 182338 m	
Cable Colour Code:	Red / Black (Coil)	Green / White	(Thermistor)
Cable Type:		EL380004	
Thermistor Type:		3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8696	8697	8697	0.010	0.21	-0.02
1.0	7936	7935	7936	1.000	0.01	0.06
2.0	7175	7176	7176	1.989	-0.21	-0.03
3.0	6407	6406	6407	2.990	-0.20	-0.02
4.0	5632	5631	5632	3.998	-0.04	0.01
5.0	4852	4853	4853	5.012	0.23	0.00
			Max. Error (%):		0.23	0.06

Linear Calibration Factor:	**C.F.=**	**0.0013010 MPa/B unit**
Regression Zero:	**At Calibration =**	**8704.5 B unit**
Temperature Correction Factor:	**Tk =**	**0.0009280 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -5.8977E-09 **B:** -0.0012211 **C:** 11.064

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	17-Jul-13	8694	22.5	1020.1

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = $Hz^2 / 1000$ ie: 1700Hz = 2890 B units

Technician: Benson Yu Date: 17-Jul-13

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Calibration Record

Vibrating Wire Piezometer

CFD0332-P3

Customer:		EBA Eng. Consultants-Yukon	
Model:		VW2100-5.0-HD	
Serial Number:		**VW25901**	
Mfg Number:		1316118	
Range:		5.0	MPa
Temperature:		23.3	°C
Barometric Pressure:		996.2	millibars
Work Order Number:		201464	
Cable Length:		230	meters
Cable Markings:		181650 m - 181878 m	
Cable Colour Code:	Red / Black (Coil)	Green / White	(Thermistor)
Cable Type:		EL380004	
Thermistor Type:		3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8981	8982	8982	0.014	0.27	-0.02
1.0	8204	8203	8204	0.999	-0.02	0.03
2.0	7422	7422	7422	1.988	-0.23	0.00
3.0	6634	6633	6634	2.987	-0.26	-0.02
4.0	5837	5836	5837	3.996	-0.07	-0.01
5.0	5032	5032	5032	5.015	0.30	0.01
			Max. Error (%):		0.30	0.03

Linear Calibration Factor:	**C.F.=**	**0.0012664 MPa/B unit**
Regression Zero:	**At Calibration =**	**8992.2 B unit**
Temperature Correction Factor:	**Tk =**	**0.0009979 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -7.0535E-09 **B:** -0.0011675 **C:** 11.054

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	17-Jul-13	8991	22.3	1020.1

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: Benson Yu Date: 17-Jul-13

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Calibration Record

CFD0351-P4

Vibrating Wire Piezometer

Customer:		EBA Eng. Consultants-Yukon	
Model:		VW2100-5.0-HD	
Serial Number:		**VW25902**	
Mfg Number:		1316119	
Range:		5.0	MPa
Temperature:		23.3	°C
Barometric Pressure:		996.2	millibars
Work Order Number:		201464	
Cable Length:		230	meters
Cable Markings:		181420 m - 181649 m	
Cable Colour Code:	Red / Black (Coil)	Green / White	(Thermistor)
Cable Type:		EL380004	
Thermistor Type:		3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8899	8900	8900	0.011	0.23	-0.03
1.0	8113	8113	8113	1.000	0.00	0.05
2.0	7325	7325	7325	1.991	-0.19	0.02
3.0	6532	6531	6532	2.988	-0.24	-0.03
4.0	5731	5729	5730	3.995	-0.09	-0.03
5.0	4919	4920	4920	5.014	0.29	0.03
			Max. Error (%):		0.29	0.05

Linear Calibration Factor:	**C.F.=**	**0.0012570**	**MPa/B unit**
Regression Zero:	**At Calibration =**	**8908.5**	**B unit**
Temperature Correction Factor:	**Tk =**	**0.001014**	**MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -6.1713E-09 **B:** -0.0011717 **C:** 10.915

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	17-Jul-13	8922	22.3	1020.1

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: Benson Yu Date: 17-Jul-13

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

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Vibrating Wire Piezometer

MW14-07T (124m)

Customer:		Lorax Environmental
Model:		VW2100-2.0
Serial Number:		VW30262
Mfg Number:		1425034
Range:		2.0 MPa
Temperature:		22.6 °C
Barometric Pressure:		985.7 millibars
Work Order Number:		205069
Cable Length:		130 meters
Cable Markings:		584320 m - 584449 m
Cable Colour Code:	Red / Black (Coil)	Green / White (Thermistor)
Cable Type:		EL380004
Thermistor Type:		3 kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	9004	9004	9004	0.004	0.21	-0.01
0.4	8294	8294	8294	0.399	-0.03	0.01
0.8	7580	7581	7581	0.796	-0.18	0.00
1.2	6862	6862	6862	1.196	-0.18	0.00
1.6	6138	6139	6139	1.599	-0.05	0.00
2.0	5410	5410	5410	2.004	0.22	0.00
			Max. Error (%):		0.22	0.01

Linear Calibration Factor:	C.F.=	**0.00055654 MPa/B unit**
Regression Zero:	At Calibration =	**9011.6 B unit**
Temperature Correction Factor:	Tk =	**0.0005086 MPa/°C rise**

Polynomial Gage Factors (MPa) A: -2.5492E-09 B: -0.00051979 C: 4.8867

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	19-Sep-14	9004	21.6	1017.1

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: H. Chang Date: 19-Sep-14

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

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MW15-01T (76m)

Vibrating Wire Piezometer

Customer:		Lorax Environmental	
Model:		VW2100-2.0	
Serial Number:		VW30262	
Mfg Number:		1425034	
Range:		2.0 MPa	
Temperature:		22.6 °C	
Barometric Pressure:		985.7 millibars	
Work Order Number:		205069	
Cable Length:		130 meters	
Cable Markings:		584320 m - 584449 m	
Cable Colour Code:	Red / Black (Coil)	Green / White	(Thermistor)
Cable Type:		EL380004	
Thermistor Type:		3 kΩ	

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	9004	9004	9004	0.004	0.21	-0.01
0.4	8294	8294	8294	0.399	-0.03	0.01
0.8	7580	7581	7581	0.796	-0.18	0.00
1.2	6862	6862	6862	1.196	-0.18	0.00
1.6	6138	6139	6139	1.599	-0.05	0.00
2.0	5410	5410	5410	2.004	0.22	0.00
			Max. Error (%):		0.22	0.01

Linear Calibration Factor:	C.F.=	**0.00055654 MPa/B unit**
Regression Zero:	At Calibration =	**9011.6 B unit**
Temperature Correction Factor:	Tk =	**0.0005086 MPa/°C rise**

Polynomial Gage Factors (MPa) A: -2.5492E-09 B: -0.00051979 C: 4.8867

Pressure is calculated with the following equations:
Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$
Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	19-Sep-14	9004	21.6	1017.1

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: H. Chang Date: 19-Sep-14

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Calibration Record

MW15-01T (89.1m)

Vibrating Wire Piezometer

Customer:		Kaminak Gold Corporation	
Model:		VW2100-2.0	
Serial Number:		**VW30463**	
Mfg Number:		1425036	
Range:		2.0	MPa
Temperature:		22.6	°C
Barometric Pressure:		985.7	millibars
Work Order Number:		205089	
Cable Length:		155	meters
Cable Markings:		592942 m - 593099 m	
Cable Colour Code:	Red / Black (Coil)	Green / White	(Thermistor)
Cable Type:		EL380004	
Thermistor Type:		3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8908	8909	8909	0.004	0.18	-0.01
0.4	8196	8196	8196	0.400	-0.01	0.03
0.8	7482	7482	7482	0.797	-0.17	-0.01
1.2	6762	6763	6763	1.197	-0.17	-0.01
1.6	6038	6039	6039	1.599	-0.04	0.00
2.0	5310	5311	5311	2.004	0.20	0.00
			Max. Error (%):		0.20	0.03

Linear Calibration Factor:	**C.F.=**	**0.00055594 MPa/B unit**
Regression Zero:	**At Calibration =**	**8915.0 B unit**
Temperature Correction Factor:	**Tk =**	**0.0004177 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -2.2532E-09 **B:** -0.00052390 **C:** 4.8458

Pressure is calculated with the following equations:
Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$
Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	26-Sep-14	8910	21.0	1015.5

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: S. Kim S.K Date: 26-Sep-14

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

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Calibration Record

MW15-02T (33.9m)

Vibrating Wire Piezometer

Customer:		Kaminak Gold Corporation
Model:		VW2100-1.0
Serial Number:		**VW30460**
Mfg Number:		1427122
Range:		1.0 MPa
Temperature:		22.6 °C
Barometric Pressure:		993.2 millibars
Work Order Number:		205089
Cable Length:		80 meters
Cable Markings:		586052 m - 586131 m
Cable Colour Code:	Red / Black (Coil)	Green / White (Thermistor)
Cable Type:		EL380004
Thermistor Type:		3 kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8982	8982	8982	0.002	0.17	0.00
0.2	8228	8228	8228	0.200	-0.04	0.00
0.4	7470	7470	7470	0.399	-0.13	0.00
0.6	6708	6708	6708	0.599	-0.13	0.01
0.8	5943	5943	5943	0.800	-0.04	-0.01
1.0	5173	5173	5173	1.002	0.17	0.00
			Max. Error (%):		0.17	0.01

Linear Calibration Factor:	**C.F.=**	**0.00026254 MPa/B unit**
Regression Zero:	**At Calibration =**	**8988.4 B unit**
Temperature Correction Factor:	**Tk =**	**0.00002498 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -8.7254E-10 **B:** -0.00025019 **C:** 2.3176

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	26-Sep-14	8978	20.9	1015.5

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = $Hz^2 / 1000$ ie: 1700Hz = 2890 B units

Technician: S. Kim S K Date: 26-Sep-14

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

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Calibration Record

MW15-03T (48.8m)

Vibrating Wire Piezometer

Customer:		Kaminak Gold Corporation
Model:		VW2100-1.0
Serial Number:		**VW30461**
Mfg Number:		1427123
Range:		1.0 MPa
Temperature:		22.6 °C
Barometric Pressure:		993.2 millibars
Work Order Number:		205089
Cable Length:		105 meters
Cable Markings:		585741 m - 585845 m
Cable Colour Code:	Red / Black (Coil)	Green / White (Thermistor)
Cable Type:		EL380004
Thermistor Type:		3 kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8788	8788	8788	0.001	0.14	0.01
0.2	8081	8081	8081	0.199	-0.05	-0.02
0.4	7368	7368	7368	0.399	-0.07	0.03
0.6	6656	6656	6656	0.599	-0.12	-0.01
0.8	5939	5939	5939	0.800	-0.03	-0.01
1.0	5219	5219	5219	1.001	0.14	0.00
				Max. Error (%):	0.14	0.03

Linear Calibration Factor:	**C.F.=**	**0.00028019 MPa/B unit**
Regression Zero:	**At Calibration =**	**8793.0 B unit**
Temperature Correction Factor:	**Tk =**	**0.0001214 MPa/°C rise**

Polynomial Gage Factors (MPa) A: -7.9534E-10 B: -0.00026905 C: 2.4259

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	26-Sep-14	8786	21.1	1015.5

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: S. Kim S IC Date: 26-Sep-14

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This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

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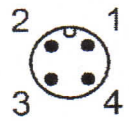
Calibration Record

MW15-03T (94.7m)

Vibrating Wire Piezometer

Customer:	Kaminak Gold Corporation	
Model:	VW2100-1.0	
Serial Number:	**VW32594**	
Mfg Number:	1504836	
Range:	1.0	MPa
Temperature:	22.4	°C
Barometric Pressure:	1000.4	millibars
Work Order Number:	206796	
Cable Length:	105	meters
Cable Markings:	814838 m - 814942 m	
Cable Colour Code:	Coil: Red 1, Blk 2	Thermistor: Grn 3, Wht 4
Cable Type:	EL380004	
Thermistor Type:	3 kΩ	

Male M12 Connector Wiring Diagram



Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8901	8901	8901	0.002	0.19	0.00
0.2	8176	8176	8176	0.200	-0.04	0.00
0.4	7447	7447	7447	0.398	-0.16	-0.01
0.6	6713	6713	6713	0.599	-0.14	0.01
0.8	5976	5976	5976	0.800	-0.05	0.00
1.0	5234	5234	5234	1.002	0.19	0.00
				Max. Error (%):	0.19	0.01

Linear Calibration Factor: **C.F.=** **0.00027270 MPa/B unit**
Regression Zero: **At Calibration =** **8908.0 B unit**
Temperature Correction Factor: **Tk =** **0.0001547 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** **-1.0592E-09** **B:** **-0.00025772** **C:** **2.3779**

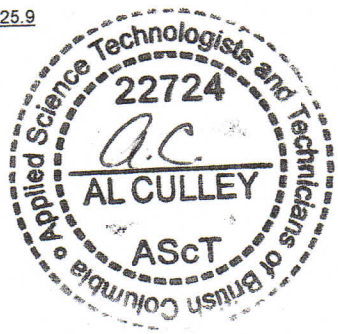
Pressure is calculated with the following equations:
Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$
Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	30-Apr-15	8902	21.4	1025.9

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = $Hz^2 / 1000$ ie: 1700Hz = 2890 B units

Technician: S. Kim SK Date: 30-Apr-15

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1



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Calibration Record

MW15-04T (38.8m)

Vibrating Wire Piezometer

Customer:		Kaminak Gold Corporation
Model:		VW2100-1.0
Serial Number:		**VW32593**
Mfg Number:		1504835
Range:		1.0 MPa
Temperature:		22.4 °C
Barometric Pressure:		1000.4 millibars
Work Order Number:		206796
Cable Length:		105 meters
Cable Markings:		814733 m - 814837 m
Cable Colour Code:	Coil: Red 1, Blk 2	Thermistor: Grn 3, Wht 4
Cable Type:		EL380004
Thermistor Type:		3 kΩ

Male M12 Connector Wiring Diagram



Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8883	8883	8883	0.002	0.18	0.01
0.2	8175	8176	8176	0.199	-0.05	-0.02
0.4	7463	7463	7463	0.399	-0.15	-0.01
0.6	6746	6747	6747	0.599	-0.13	0.01
0.8	6026	6027	6027	0.800	-0.01	0.02
1.0	5305	5304	5305	1.002	0.16	-0.01
			Max. Error (%):		0.18	0.02

Linear Calibration Factor:	**C.F.=**	**0.00027937 MPa/B unit**
Regression Zero:	**At Calibration =**	**8889.5 B unit**
Temperature Correction Factor:	**Tk =**	**0.0001763 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -9.9777E-10 **B:** -0.00026521 **C:** 2.4348

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	30-Apr-15	8881	21.5	1025.9

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: S. Kim S K Date: 30-Apr-15

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Calibration Record

MW15-04T (51.6m)

Vibrating Wire Piezometer

Customer:	Kaminak Gold Corporation	
Model:	VW2100-2.0	
Serial Number:	**VW32596**	
Mfg Number:	1504858	
Range:	2.0	MPa
Temperature:	22.5	°C
Barometric Pressure:	1003.1	millibars
Work Order Number:	206796	
Cable Length:	105	meters
Cable Markings:	814522 m - 814626 m	
Cable Colour Code:	Coil: Red 1, Blk 2	Thermistor: Grn 3, Wht 4
Cable Type:	EL380004	
Thermistor Type:	3	kΩ

Male M12 Connector Wiring Diagram



Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	9047	9048	9048	0.005	0.23	-0.01
0.4	8311	8311	8311	0.399	-0.04	0.01
0.8	7570	7570	7570	0.796	-0.18	0.00
1.2	6824	6824	6824	1.196	-0.19	0.00
1.6	6072	6073	6073	1.599	-0.06	-0.01
2.0	5315	5315	5315	2.005	0.24	0.01
			Max. Error (%):		0.24	0.01

Linear Calibration Factor:	**C.F.=**	**0.00053589 MPa/B unit**
Regression Zero:	**At Calibration =**	**9056.0 B unit**
Temperature Correction Factor:	**Tk =**	**0.0004083 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -2.5250E-09 **B:** -0.00049963 **C:** 4.7269

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	30-Apr-15	9048	21.4	1025.9

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: S. Kim SK Date: 30-Apr-15

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

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Calibration Record

MW15-05T (55.4m)

Vibrating Wire Piezometer

Customer:		Kaminak Gold Corporation
Model:		VW2100-2.0
Serial Number:		**VW30464**
Mfg Number:		1425037
Range:		2.0 MPa
Temperature:		22.6 °C
Barometric Pressure:		985.7 millibars
Work Order Number:		205089
Cable Length:		205 meters
Cable Markings:		585846 m - 586051 m
Cable Colour Code:	Red / Black (Coil)	Green / White (Thermistor)
Cable Type:		EL380004
Thermistor Type:		3 kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8911	8911	8911	0.004	0.22	-0.01
0.4	8173	8173	8173	0.399	-0.03	0.01
0.8	7431	7432	7432	0.796	-0.18	0.00
1.2	6685	6685	6685	1.196	-0.20	-0.01
1.6	5932	5932	5932	1.599	-0.04	0.01
2.0	5175	5175	5175	2.004	0.22	0.00
				Max. Error (%):	0.22	0.01

Linear Calibration Factor:	**C.F.=**	**0.00053537 MPa/B unit**
Regression Zero:	**At Calibration =**	**8919.1 B unit**
Temperature Correction Factor:	**Tk =**	**0.0003744 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -2.4148E-09 **B:** -0.00050135 **C:** 4.6592

Pressure is calculated with the following equations:
Linear: P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]
Polynomial: P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	26-Sep-14	8911	20.7	1015.5

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: S. Kim SK Date: 26-Sep-14

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

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Calibration Record

MW15-05T (81.4m)

Vibrating Wire Piezometer

Customer:		Kaminak Gold Corporation
Model:		VW2100-2.0
Serial Number:		**VW32595**
Mfg Number:		1504857
Range:		2.0 MPa
Temperature:		22.5 °C
Barometric Pressure:		1003.1 millibars
Work Order Number:		206796
Cable Length:		105 meters
Cable Markings:		814627 m - 814732 m
Cable Colour Code:	Coil: Red 1, Blk 2	Thermistor: Grn 3, Wht 4
Cable Type:		EL380004
Thermistor Type:		3 kΩ

Male M12 Connector Wiring Diagram



Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	9003	9003	9003	0.005	0.23	0.00
0.4	8295	8295	8295	0.399	-0.04	0.01
0.8	7583	7583	7583	0.796	-0.20	-0.01
1.2	6865	6865	6865	1.196	-0.19	0.00
1.6	6142	6142	6142	1.599	-0.05	0.00
2.0	5414	5414	5414	2.005	0.24	0.00
				Max. Error (%):	0.24	0.01

Linear Calibration Factor:	**C.F.=**	**0.00055727 MPa/B unit**
Regression Zero:	**At Calibration =**	**9011.4 B unit**
Temperature Correction Factor:	**Tk =**	**0.0004612 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -2.7813E-09 **B:** -0.00051717 **C:** 4.8814

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	30-Apr-15	9009	21.2	1025.9

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: S. Kim SK Date: 30-Apr-15

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Calibration Record

MW15-07T (239m)

Vibrating Wire Piezometer

Customer:		Kaminak Gold Corporation	
Model:		VW2100-3.0	
Serial Number:		**VW33363**	
Mfg Number:		1515537	
Range:		3.0	MPa
Temperature:		23.3	°C
Barometric Pressure:		990.0	millibars
Work Order Number:		207453	
Cable Length:		280	meters
Cable Markings:		886588 m - 886868 m	
Cable Colour Code:	Red / Black (Coil)	Green / White	(Thermistor)
Cable Type:		EL380004	
Thermistor Type:		3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8767	8768	8768	0.006	0.21	0.00
0.6	8066	8067	8067	0.599	-0.04	0.00
1.2	7361	7361	7361	1.195	-0.16	0.00
1.8	6651	6652	6652	1.795	-0.17	0.00
2.4	5937	5937	5937	2.399	-0.04	0.00
3.0	5218	5219	5219	3.006	0.20	0.00
			Max. Error (%):		0.21	0.00

Linear Calibration Factor:	**C.F.=**	**0.00084529 MPa/B unit**
Regression Zero:	**At Calibration =**	**8774.8 B unit**
Temperature Correction Factor:	**Tk =**	**0.0006609 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -3.7001E-09 **B:** -0.00079354 **C:** 7.2418

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	30-Jun-15	8775	22.9	1019.1

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: I. Barua

Date: 30-Jun-15

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Calibration Record

Vibrating Wire Piezometer

MW15-07T (267.8m)

Customer:		Kaminak Gold Corporation	
Model:		VW2100-3.0	
Serial Number:		**VW33364**	
Mfg Number:		1515556	
Range:		3.0	MPa
Temperature:		23.3	°C
Barometric Pressure:		990.0	millibars
Work Order Number:		207453	
Cable Length:		300	meters
Cable Markings:		886871 m - 887172 m	
Cable Colour Code:	Red / Black (Coil)	Green / White	(Thermistor)
Cable Type:		EL380004	
Thermistor Type:		3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8761	8761	8761	0.007	0.22	0.00
0.6	8081	8081	8081	0.599	-0.03	0.01
1.2	7398	7398	7398	1.194	-0.19	-0.01
1.8	6709	6709	6709	1.795	-0.18	0.00
2.4	6016	6016	6016	2.399	-0.05	0.00
3.0	5318	5318	5318	3.007	0.22	0.00
				Max. Error (%):	0.22	0.01

Linear Calibration Factor:	**C.F.=**	**0.00087138 MPa/B unit**
Regression Zero:	**At Calibration =**	**8768.5 B unit**
Temperature Correction Factor:	**Tk =**	**0.001181 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -4.2667E-09 **B:** -0.00081131 **C:** 7.4352

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	30-Jun-15	8766	22.7	1019.1

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = $Hz^2 / 1000$ ie: 1700Hz = 2890 B units

Technician: I. Barua

Date: 30-Jun-15

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Calibration Record

SRK-15D-07 (103.6m)

Vibrating Wire Piezometer

Customer:		Kaminak Gold Corporation
Model:		VW2100-1.0
Serial Number:		**VW32653**
Mfg Number:		1504837
Range:		1.0 MPa
Temperature:		22.4 °C
Barometric Pressure:		1000.4 millibars
Work Order Number:		206893
Cable Length:		110 meters
Cable Markings:		828121 m - 828230 m
Cable Colour Code:	Red / Black (Coil)	Green / White (Thermistor)
Cable Type:		EL380004
Thermistor Type:		3 kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8893	8893	8893	0.002	0.21	0.00
0.2	8189	8189	8189	0.200	-0.05	-0.01
0.4	7480	7480	7480	0.398	-0.16	0.00
0.6	6767	6767	6767	0.598	-0.16	0.00
0.8	6049	6050	6050	0.800	-0.04	0.01
1.0	5328	5328	5328	1.002	0.20	0.00
			Max. Error (%):		0.21	0.01

Linear Calibration Factor:	**C.F.=**	**0.00028048 MPa/B unit**
Regression Zero:	**At Calibration =**	**8900.4 B unit**
Temperature Correction Factor:	**Tk =**	**0.0001733 MPa/°C rise**

Polynomial Gage Factors (MPa) A: -1.1969E-09 B: -0.00026346 C: 2.4377

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	6-May-15	8897	22.1	1018.6

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = $Hz^2 / 1000$ ie: 1700Hz = 2890 B units

Technician: J. Somphanthabansouk Date: 6-May-15

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Calibration Record

Vibrating Wire Piezometer

SRK-15D-07 (149.2m)

Customer:		Kaminak Gold Corporation
Model:		VW2100-2.0
Serial Number:		**VW32655**
Mfg Number:		1505025
Range:		2.0 MPa
Temperature:		21.6 °C
Barometric Pressure:		1004.0 millibars
Work Order Number:		206893
Cable Length:		160 meters
Cable Markings:		828393 m - 828552 m
Cable Colour Code:	Red / Black (Coil)	Green / White (Thermistor)
Cable Type:		EL380004
Thermistor Type:		3 kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8987	8988	8988	0.004	0.20	-0.01
0.4	8284	8284	8284	0.400	-0.02	0.02
0.8	7578	7578	7578	0.797	-0.17	0.00
1.2	6867	6867	6867	1.196	-0.18	-0.01
1.6	6151	6151	6151	1.599	-0.05	-0.01
2.0	5430	5430	5430	2.004	0.22	0.01
			Max. Error (%):		0.22	0.02

Linear Calibration Factor: **C.F.= 0.00056229 MPa/B unit**
Regression Zero: **At Calibration = 8994.6 B unit**
Temperature Correction Factor: **Tk = 0.0005237 MPa/°C rise**

Polynomial Gage Factors (MPa) A: -2.5298E-09 B: -0.00052582 C: 4.9299

Pressure is calculated with the following equations:
Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$
Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	6-May-15	8996	21.7	1018.6

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: J. Somphanthabansouk JS Date: 6-May-15

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Calibration Record

Vibrating Wire Piezometer

SRK-15D-08 (103.6m)

Customer:		Kaminak Gold Corporation
Model:		VW2100-1.0
Serial Number:		**VW33361**
Mfg Number:		1514089
Range:		1.0 MPa
Temperature:		23.0 °C
Barometric Pressure:		1002.5 millibars
Work Order Number:		207453
Cable Length:		105 meters
Cable Markings:		887173 m - 887278 m
Cable Colour Code:	Red / Black (Coil)	Green / White (Thermistor)
Cable Type:		EL380004
Thermistor Type:		3 kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8957	8958	8958	0.002	0.22	0.01
0.2	8227	8228	8228	0.199	-0.05	-0.01
0.4	7491	7492	7492	0.398	-0.17	0.01
0.6	6751	6752	6752	0.598	-0.17	0.01
0.8	6007	6007	6007	0.799	-0.05	0.00
1.0	5257	5257	5257	1.002	0.22	0.00
				Max. Error (%):	0.22	0.01

Linear Calibration Factor: **C.F.=** **0.00027022 MPa/B unit**
Regression Zero: **At Calibration =** **8965.6 B unit**
Temperature Correction Factor: **Tk =** **0.0001134 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -1.1804E-09 **B:** -0.00025344 **C:** 2.3650

Pressure is calculated with the following equations:
Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$
Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	30-Jun-15	8958	22.9	1019.1

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = $Hz^2 / 1000$ ie: 1700Hz = 2890 B units

Technician: I. Barua Date: 30-Jun-15

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Calibration Record

Vibrating Wire Piezometer

SRK-15-08 (149.2m)

Customer:	Kaminak Gold Corporation	
Model:	VW2100-2.0	
Serial Number:	**VW32654**	
Mfg Number:	1505023	
Range:	2.0	MPa
Temperature:	21.6	°C
Barometric Pressure:	1004.0	millibars
Work Order Number:	206893	
Cable Length:	160	meters
Cable Markings:	828232 m - 828391 m	
Cable Colour Code:	Red / Black (Coil)	Green / White (Thermistor)
Cable Type:	EL380004	
Thermistor Type:	3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	9038	9039	9039	0.004	0.22	0.00
0.4	8309	8310	8310	0.399	-0.04	0.00
0.8	7576	7576	7576	0.796	-0.18	0.00
1.2	6838	6838	6838	1.196	-0.19	-0.01
1.6	6094	6094	6094	1.599	-0.04	0.00
2.0	5345	5346	5346	2.004	0.22	0.00
				Max. Error (%):	0.22	0.01

Linear Calibration Factor:	**C.F.=**	**0.00054158 MPa/B unit**
Regression Zero:	**At Calibration =**	**9046.6 B unit**
Temperature Correction Factor:	**Tk =**	**0.0003615 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -2.4733E-09 **B:** -0.00050601 **C:** 4.7755

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	6-May-15	9046	21.7	1018.6

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: J. Somphanthabansouk Date: 6-May-15

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Calibration Record

SRK-15D-09 (99.7m)

Vibrating Wire Piezometer

Customer:		Kaminak Gold Corporation
Model:		VW2100-1.0
Serial Number:		**VW33362**
Mfg Number:		1514140
Range:		1.0 MPa
Temperature:		22.2 °C
Barometric Pressure:		998.5 millibars
Work Order Number:		207453
Cable Length:		105 meters
Cable Markings:		887279 m - 887384 m
Cable Colour Code:	Red / Black (Coil)	Green / White (Thermistor)
Cable Type:		EL380004
Thermistor Type:		3 kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8709	8710	8710	0.002	0.21	-0.01
0.2	7975	7976	7976	0.200	-0.03	0.02
0.4	7238	7238	7238	0.398	-0.17	0.01
0.6	6496	6496	6496	0.598	-0.19	-0.01
0.8	5748	5749	5749	0.799	-0.06	-0.01
1.0	4995	4995	4995	1.002	0.23	0.01
				Max. Error (%):	0.23	0.02

Linear Calibration Factor:	**C.F.=**	**0.00026927 MPa/B unit**
Regression Zero:	**At Calibration =**	**8717.2 B unit**
Temperature Correction Factor:	**Tk =**	**0.0001677 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -1.1985E-09 **B:** -0.00025285 **C:** 2.2930

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	30-Jun-15	8707	23.0	1019.1

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = $Hz^2 / 1000$ ie: 1700Hz = 2890 B units

Technician: I. Barua Date: 30-Jun-15

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Calibration Record

MW16-01T (97.5 m)

Vibrating Wire Piezometer

Customer:		LORAX ENVIRONMENTAL	
Model:		VW2100-3.0	
Serial Number:		**VW37992**	
Mfg Number:		1616312	
Range:		3.0	MPa
Temperature:		23.1	°C
Barometric Pressure:		997.0	millibars
Work Order Number:		210583	
Cable Length:		205	meters
Cable Markings:		74073 m - 74277 m	
Cable Colour Code:	Red / Black (Coil)	Green / White	(Thermistor)
Cable Type:		EL380004	
Thermistor Type:		3	kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8898	8899	8899	0.007	0.25	-0.02
0.6	8172	8172	8172	0.599	-0.03	0.02
1.2	7441	7442	7442	1.194	-0.20	0.01
1.8	6706	6706	6706	1.793	-0.23	-0.01
2.4	5964	5964	5964	2.398	-0.08	-0.02
3.0	5214	5214	5214	3.008	0.28	0.02
			Max. Error (%):		0.28	0.02

Linear Calibration Factor:	**C.F.=**	**0.00081449 MPa/B unit**
Regression Zero:	**At Calibration =**	**8907.6 B unit**
Temperature Correction Factor:	**Tk =**	**0.0006591 MPa/°C rise**

Polynomial Gage Factors (MPa) A: -4.3824E-09 B: -0.00075264 C: 7.0439

Pressure is calculated with the following equations:
Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$
Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	29-Jul-16	8904	22.2	1016.2

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: I. Kurchavov Date: 29-Jul-16

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Calibration Record

Vibrating Wire Piezometer

MW16-01T (131.5 m)

Customer:		LORAX ENVIRONMENTAL
Model:		VW2100-3.0
Serial Number:		**VW37991**
Mfg Number:		1616311
Range:		3.0 MPa
Temperature:		23.1 °C
Barometric Pressure:		997.0 millibars
Work Order Number:		210583
Cable Length:		205 meters
Cable Markings:		74278 m - 74484 m
Cable Colour Code:	Red / Black (Coil)	Green / White (Thermistor)
Cable Type:		EL380004
Thermistor Type:		3 kΩ

Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8716	8717	8717	0.006	0.20	-0.01
0.6	7985	7985	7985	0.599	-0.02	0.02
1.2	7251	7251	7251	1.195	-0.17	0.00
1.8	6512	6512	6512	1.794	-0.19	-0.02
2.4	5767	5767	5767	2.398	-0.05	0.00
3.0	5017	5017	5017	3.007	0.23	0.01
				Max. Error (%):	0.23	0.02

Linear Calibration Factor:	**C.F.=**	**0.00081109 MPa/B unit**
Regression Zero:	**At Calibration =**	**8724.1 B unit**
Temperature Correction Factor:	**Tk =**	**0.0007624 MPa/°C rise**

Polynomial Gage Factors (MPa) A: -3.6128E-09 B: -0.00076147 C: 6.9114

Pressure is calculated with the following equations:
Linear: P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]
Polynomial: P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	29-Jul-16	8726	22.8	1016.2

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: I. Kurchavov IK Date: 29-Jul-16

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Calibration Record

MW17-01T (170.9 m)

Vibrating Wire Piezometer

Customer:	TETRA TECH CANADA, INC.
Model:	VW2100-3.0
Serial Number:	**VW44544**
Mfg Number:	1718181
Range:	3.0 MPa
Temperature:	23.5 °C
Barometric Pressure:	989.8 millibars
Work Order Number:	214027
Cable Length:	205 meters
Cable Markings:	967660 m - 967865 m
Cable Colour Code:	Coil: Red 1, Black 2 Thermistor: Green 3, White 4
Cable Type:	EL380004
Thermistor Type:	3 kΩ

Male M12 Connector Wiring Diagram



Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8714	8714	8714	0.005	0.17	0.00
0.6	7994	7994	7994	0.599	-0.03	0.00
1.2	7271	7271	7271	1.196	-0.14	0.00
1.8	6544	6544	6544	1.796	-0.14	0.00
2.4	5813	5813	5813	2.399	-0.03	0.01
3.0	5079	5079	5079	3.005	0.16	0.00
				Max. Error (%):	0.17	0.01

Linear Calibration Factor: **C.F.=** **0.00082530 MPa/B unit**
Regression Zero: **At Calibration =** **8720.0 B unit**
Temperature Correction Factor: **Tk =** **0.0006693 MPa/°C rise**

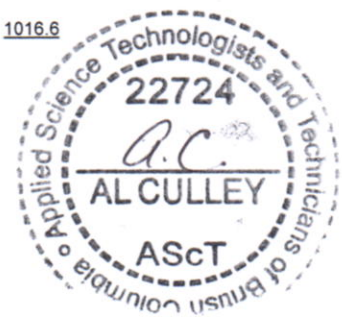
Polynomial Gage Factors (MPa) **A:** -2.8441E-09 **B:** -0.00078607 **C:** 7.0657

Pressure is calculated with the following equations:
Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$
Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	5-Jul-17	8714	22.3	1016.6

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: M. Miftode MM Date: 5-Jul-17



This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

Document Number: ELL0143H

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RST Instruments Ltd., 11545 Kingston St., Maple Ridge, British Columbia, Canada V2X 0Z5
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e-mail: info@rstinstruments.com • Website: www.rstinstruments.com

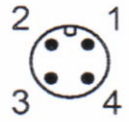
Calibration Record

MW17-01T (200.9 m)

Vibrating Wire Piezometer

Customer:	TETRA TECH CANADA, INC.
Model:	VW2100-3.0
Serial Number:	**VW44543**
Mfg Number:	1718180
Range:	3.0 MPa
Temperature:	23.5 °C
Barometric Pressure:	989.8 millibars
Work Order Number:	214027
Cable Length:	205 meters
Cable Markings:	967453 m - 967659 m
Cable Colour Code:	Coil: Red 1, Black 2 Thermistor: Green 3, White 4
Cable Type:	EL380004
Thermistor Type:	3 kΩ

Male M12 Connector Wiring Diagram



Applied Pressure (MPa)	First Reading (B units)	Second Reading (B units)	Average Reading (B units)	Calculated Linear (MPa)	Linearity Error (% FS)	Polynomial Error (% FS)
0.0	8808	8808	8808	0.005	0.17	-0.01
0.6	8094	8095	8095	0.599	-0.02	0.01
1.2	7378	7378	7378	1.196	-0.13	0.01
1.8	6659	6659	6659	1.795	-0.17	-0.03
2.4	5933	5934	5934	2.399	-0.04	0.00
3.0	5205	5205	5205	3.006	0.19	0.00
				Max. Error (%):	0.19	0.03

Linear Calibration Factor:	**C.F.=**	**0.00083276 MPa/B unit**
Regression Zero:	**At Calibration =**	**8814.2 B unit**
Temperature Correction Factor:	**Tk =**	**0.0007598 MPa/°C rise**

Polynomial Gage Factors (MPa) **A:** -3.1797E-09 **B:** -0.00078820 **C:** 7.1888

Pressure is calculated with the following equations:

Linear: $P(MPa) = C.F.(Li-Lc) - [Tk(Ti-Tc)] + [0.00010(Bi-Bc)]$

Polynomial: $P(MPa) = A(Lc)^2 + BLc + C + Tk(Tc-Ti) - [0.00010(Bc-Bi)]$

	Date (dd/mm/yy)	VW Readout Pos. B (Li)	Temp °C (Ti)	Baro (Bi)
Shipped Zero Readings:	5-Jul-17	8808	21.7	1016.6

Li, Lc = initial (at installation) and current readings
Ti, Tc = initial (at installation) and current temperature, in °C
Bi, Bc = initial (at installation) and current barometric pressure readings, in millibars
B units = B scale output of VW 2102, VW 2104, VW 2106 and DT 2011 readouts
B units = Hz^2 / 1000 ie: 1700Hz = 2890 B units

Technician: M. Miftode Date: 5-Jul-17

This instrument has been calibrated using standards traceable to the NIST in compliance with ANSI Z540-1

Applied Science Technologists and Technicians of British Columbia
22724
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ASCT

Document Number: ELL0143H

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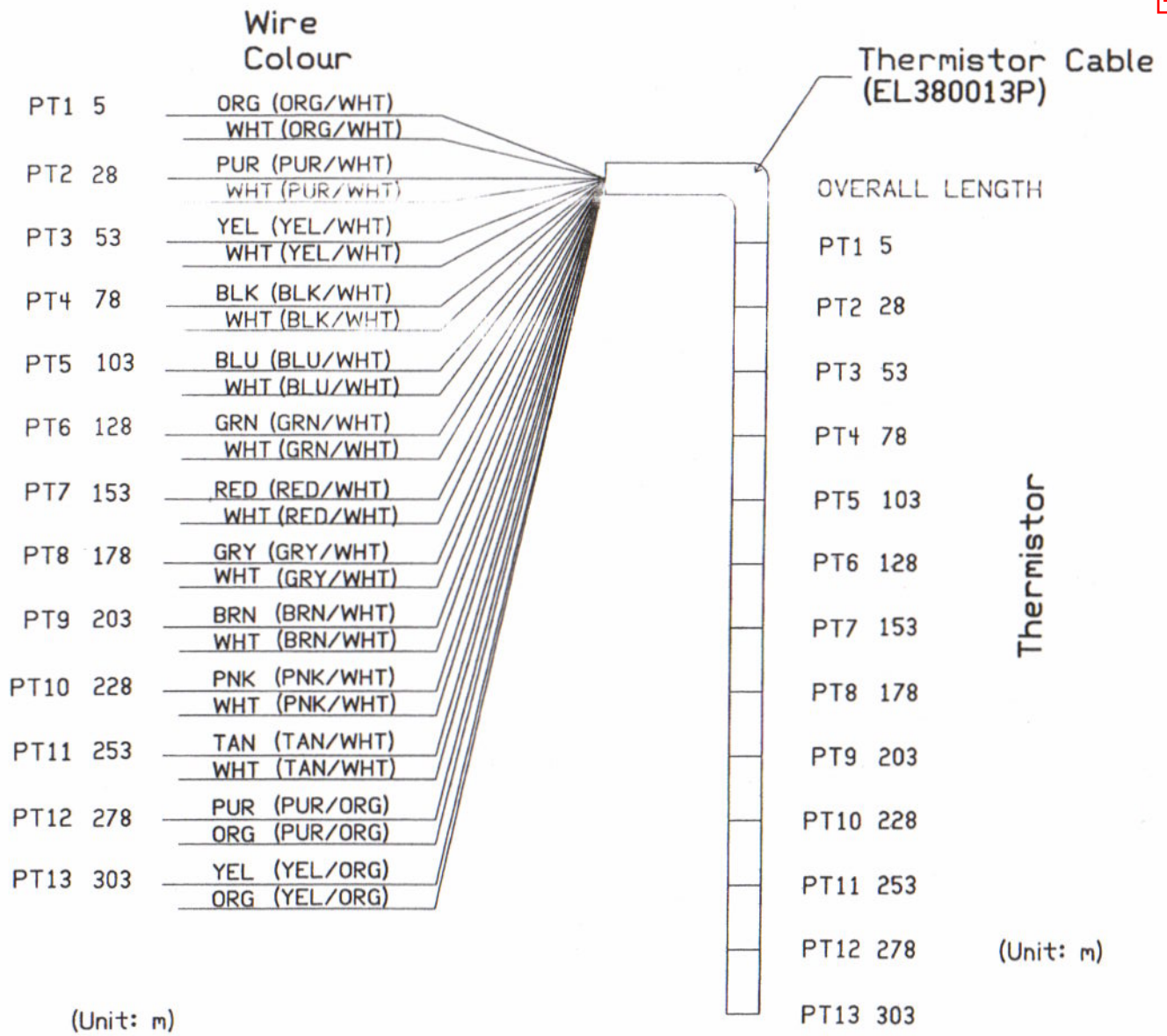
APPENDIX 3-C2: RST THERMISTOR WIRING DIAGRAMS

MW14-04T

Installed at BH6

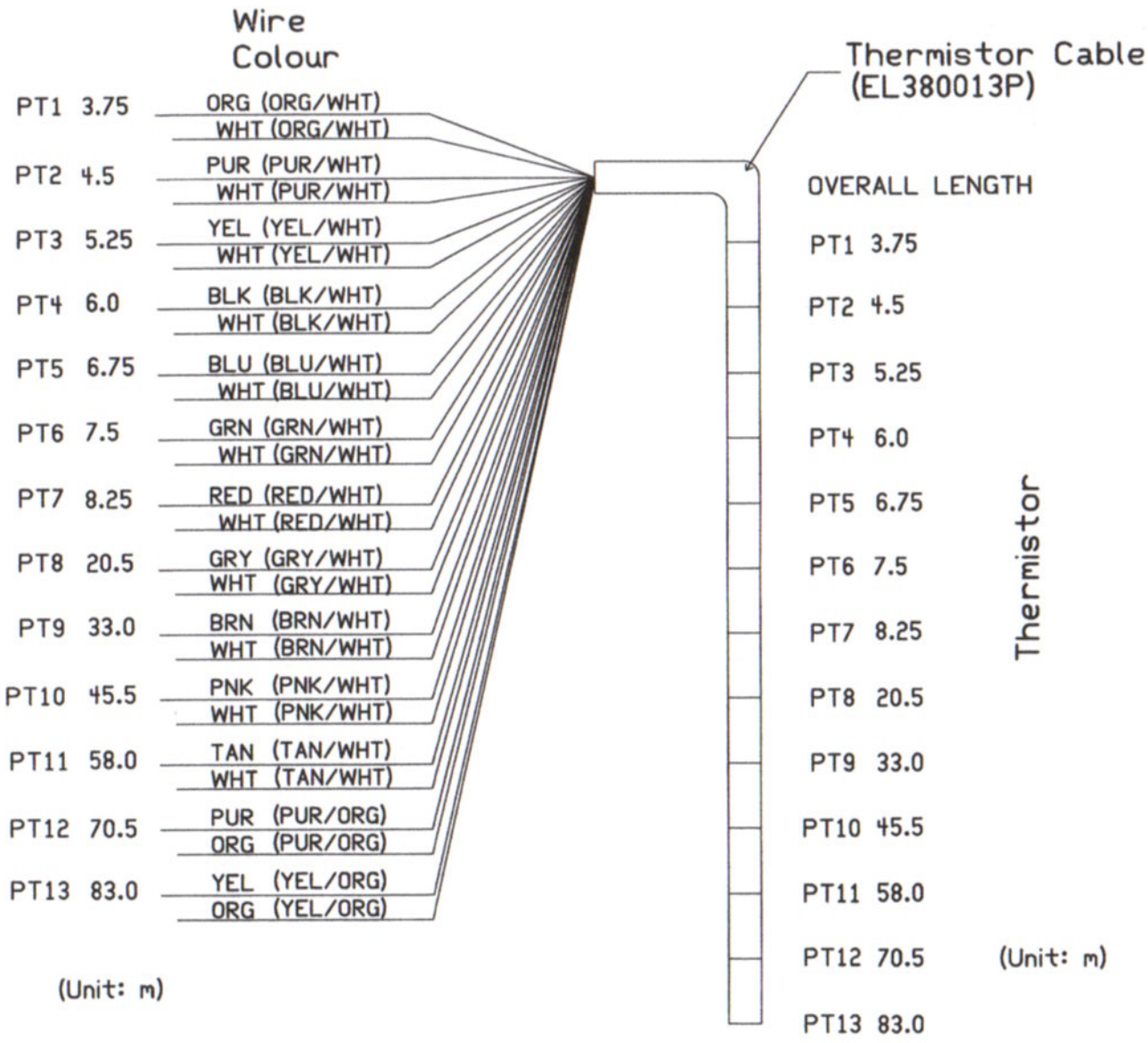


Co:	RST INSTRUMENTS LTD
Title:	THERMISTOR CABLE
J/N:	THW0190/WO204548 Revision: A
Author:	CB Size: A
Date:	2014/07/29 Sheet 1 of 1

TAG: BH-6T

S/N: TS3795

MW14-07T



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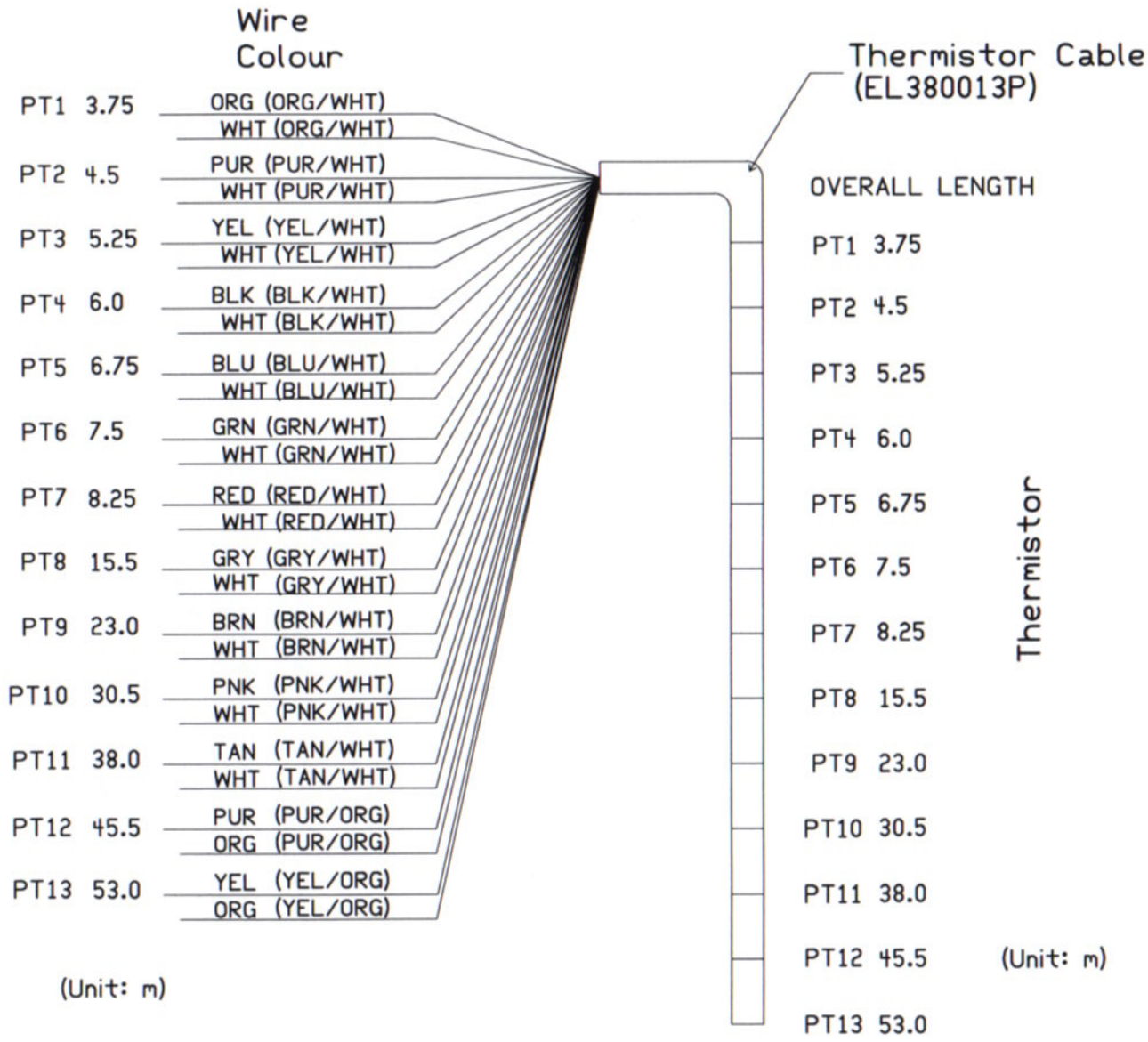
Title:	THERMISTOR CABLE		
J/N:	THW0191/WO204549	Revision:	A
Author:	CB	Size:	A
Date:	2014/07/29	Sheet	1 of 1

TAG: BH-1T

S/N: TS3796

MW15-01T

Installed at BH8



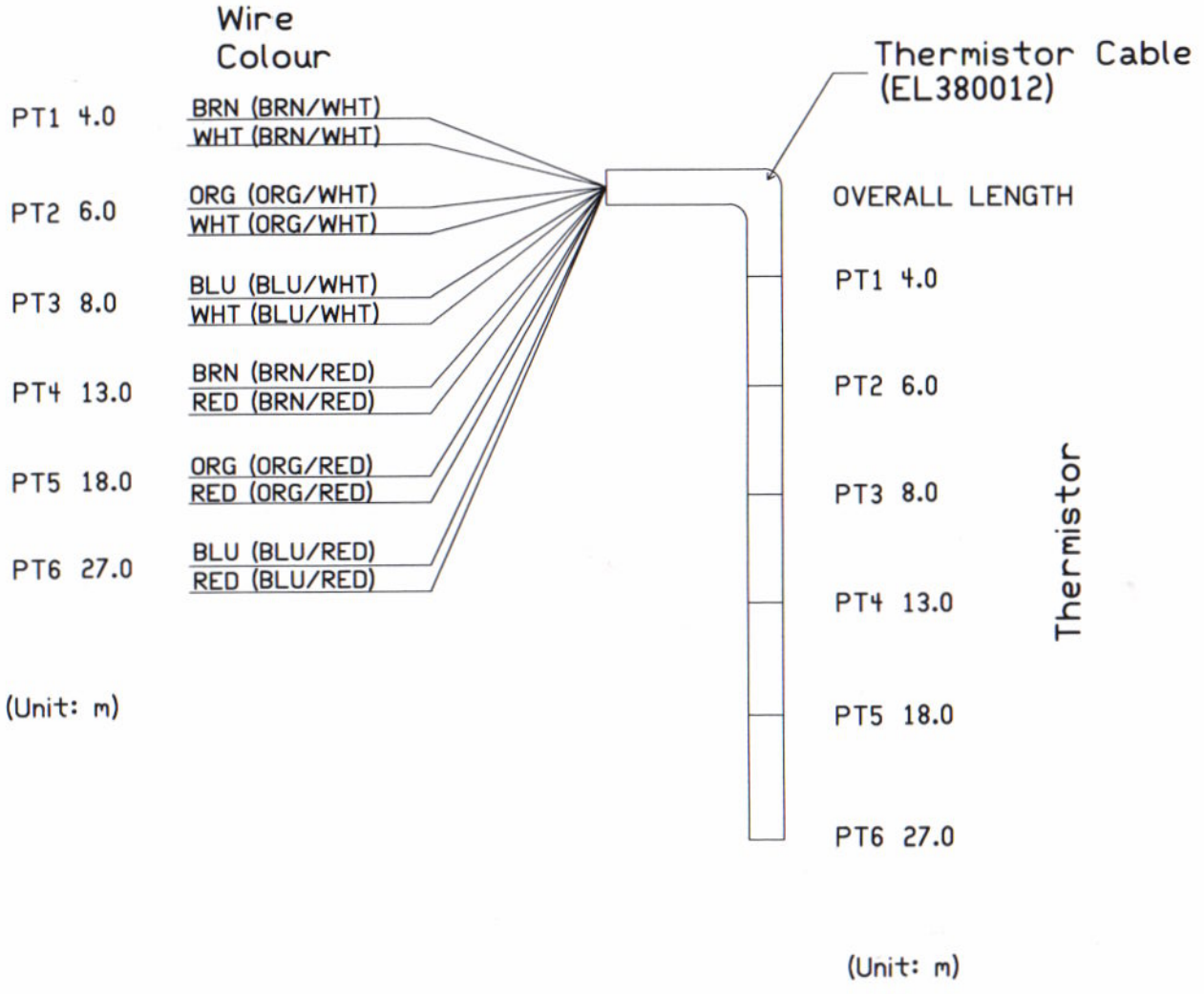
Co:	RST INSTRUMENTS LTD		
Title:	THERMISTOR CABLE		
J/N:	THW0191/WO204549	Revision:	A
Author:	CB	Size:	A
Date:	2014/07/29	Sheet	1 of 1

TAG: BH-8T

S/N: TS3797

MW15-02T

Installed at BH10



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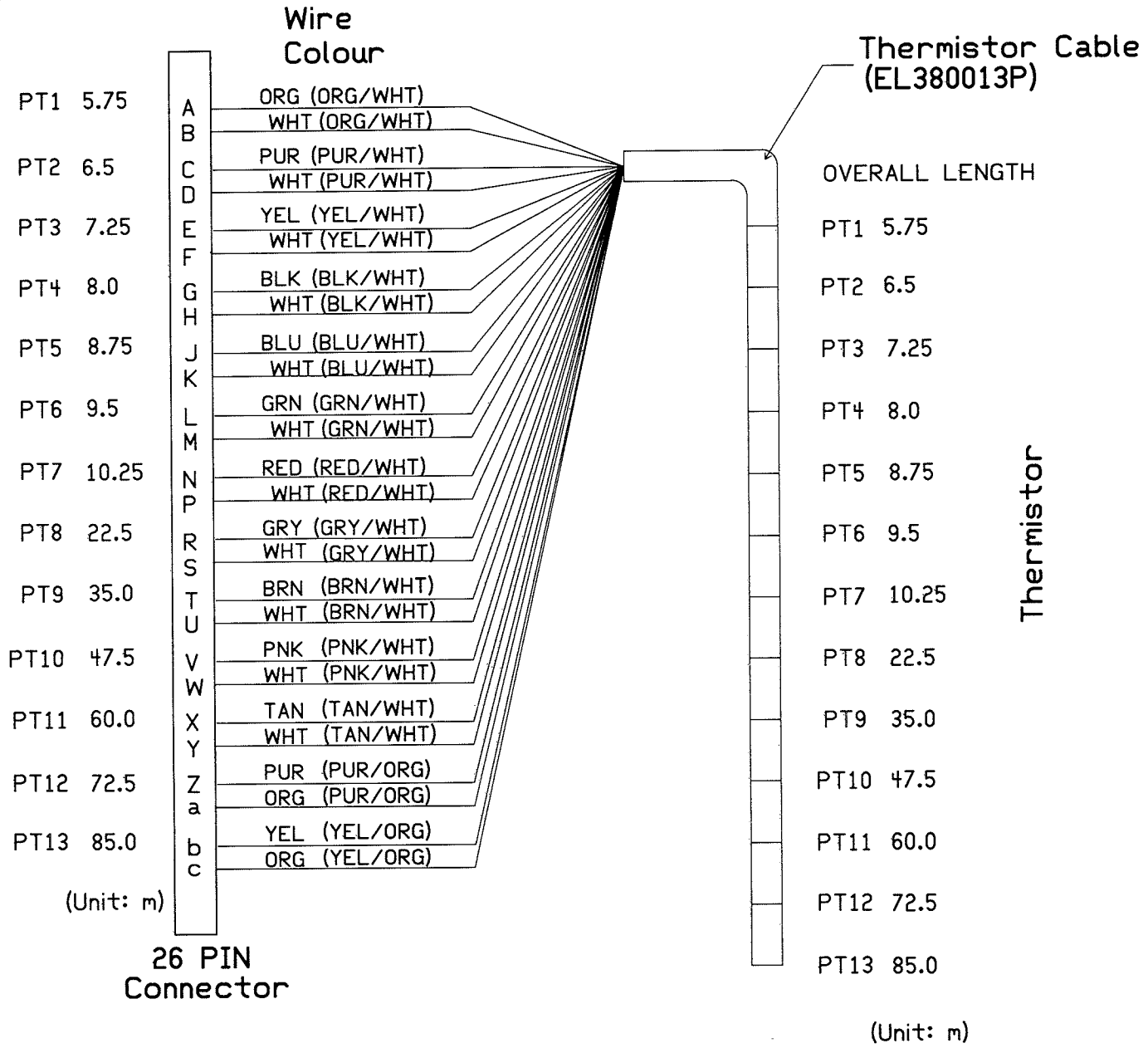
Title:	THERMISTOR CABLE
J/N:	THW0191/WO204549 Revision: A
Author:	CB Size: A
Date:	2014/07/29 Sheet 1 of 1

TAG: BH-10T

S/N: TS3798

MW15-03T,
MW15-04T,
MW15-05T



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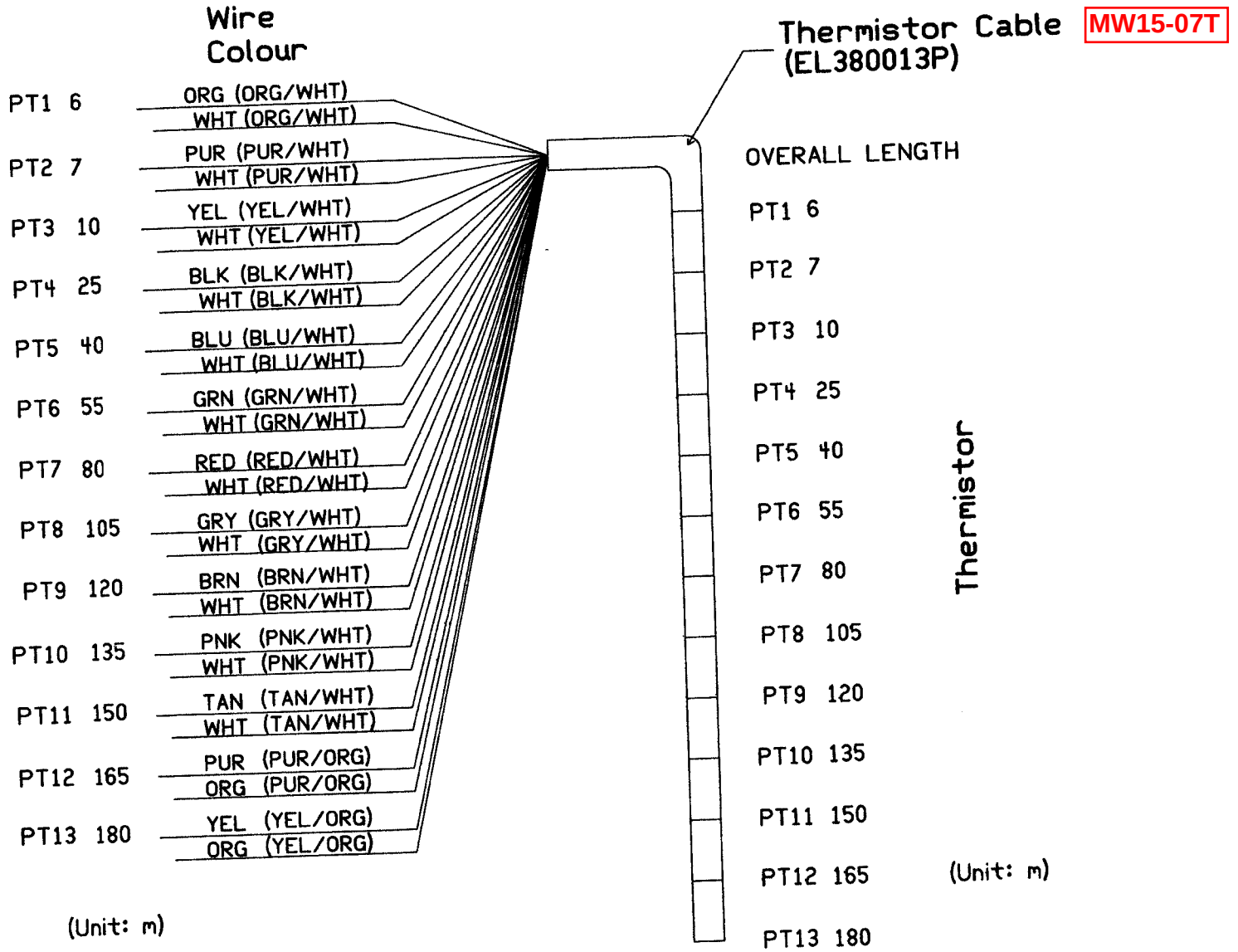
Author:	CB	Size:	A
Date:	2015/04/16	Sheet	1 of 1

S/N: TS3969-TS3971



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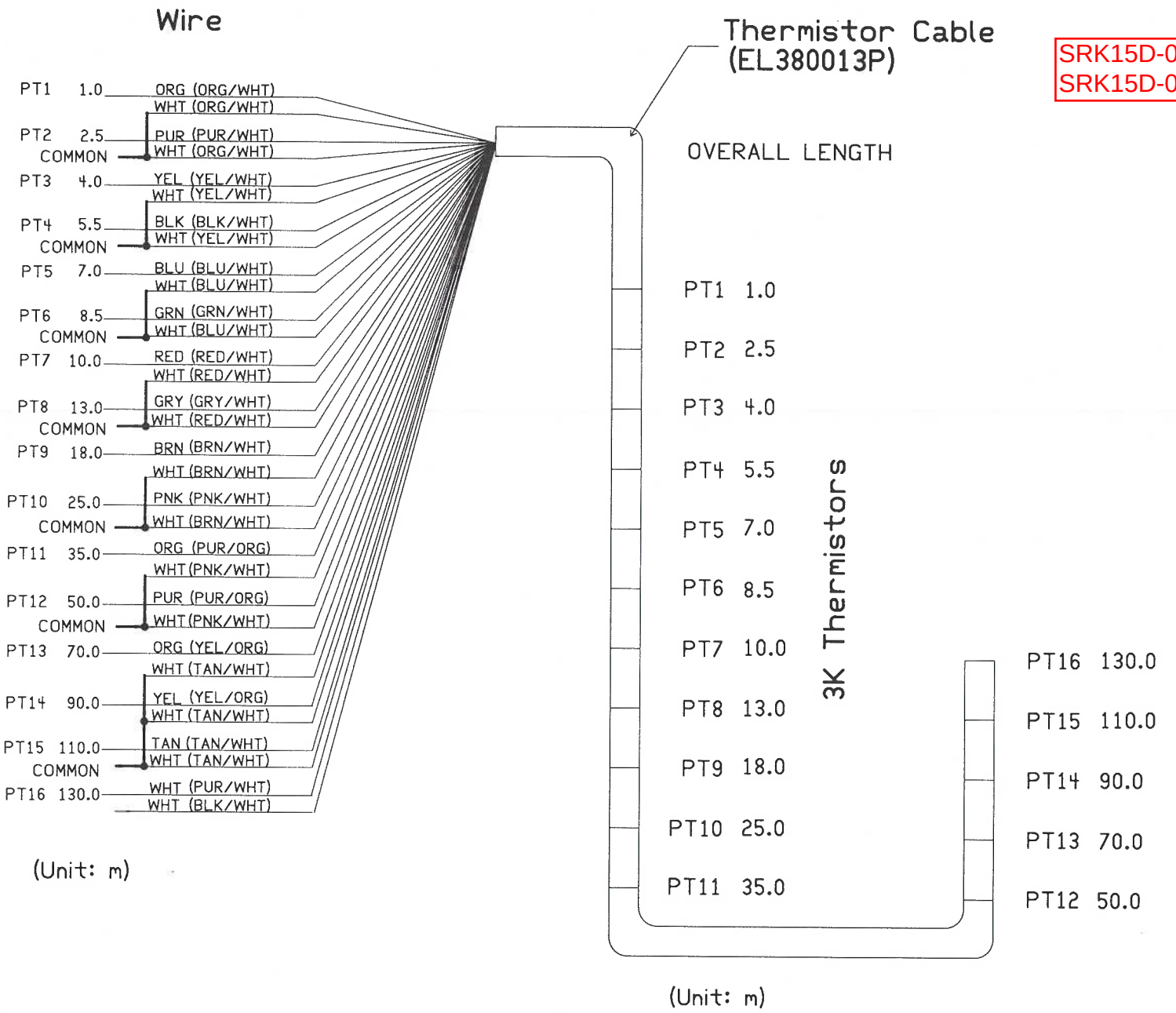
Title:	THERMISTOR CABLE
J/N:	THW0197/WO205090
Revision:	A
Author:	WY
Size:	A
Date:	2014/09/22
Sheet	1 of 1

S/N: TS3837



S/N: TS3977-TS3978

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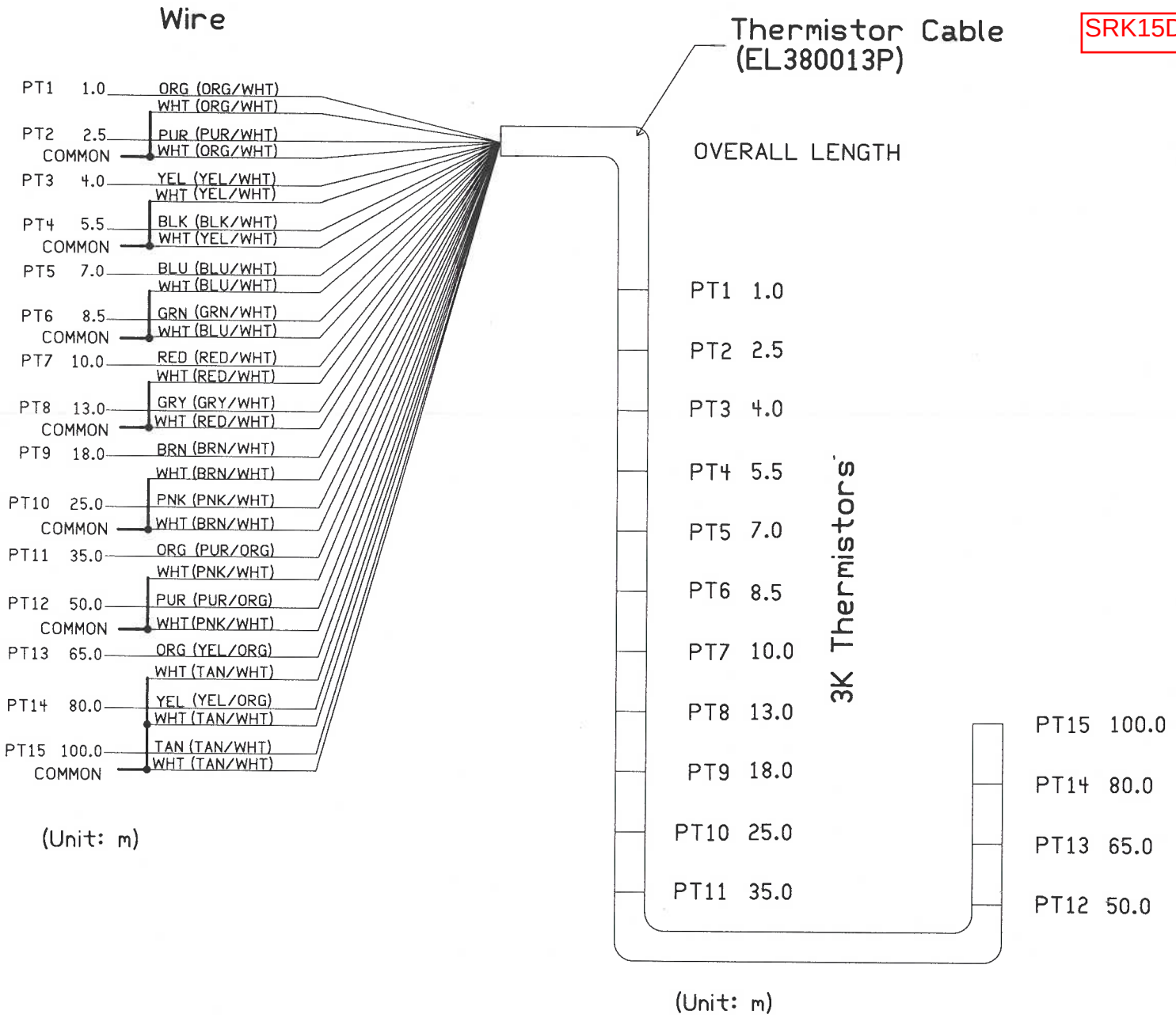
Title:	THERMISTOR CABLE
J/N:	THW0219/WO206893-1 Revision: A
Author:	CB Size: A
Date:	2015/05/01 Sheet 1 of 2

SRK15D-09



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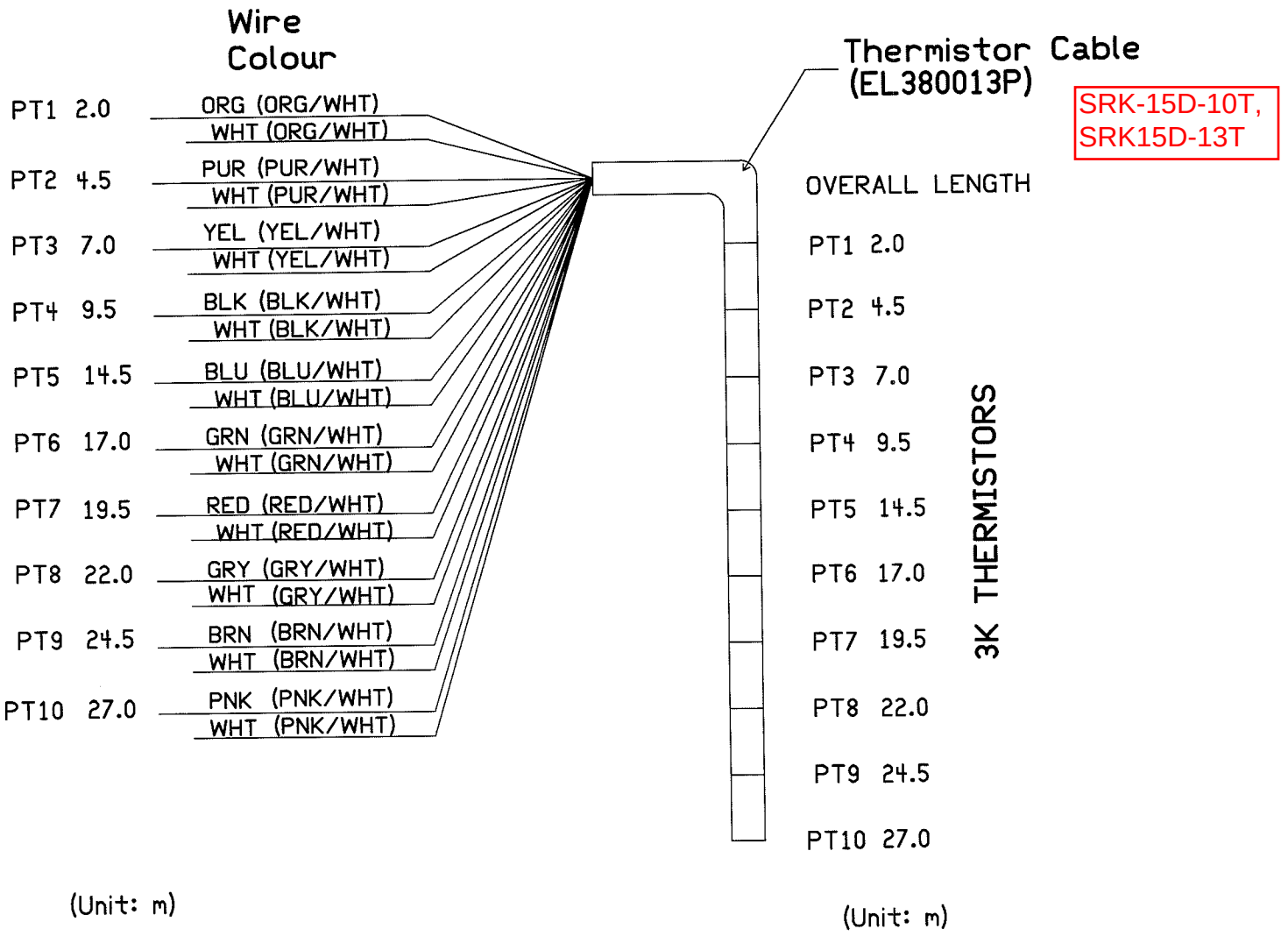
J/N:	THW0219/WO206893-2 Revision: A
Author:	CB Size: A
Date:	2015/05/01 Sheet 2 of 2



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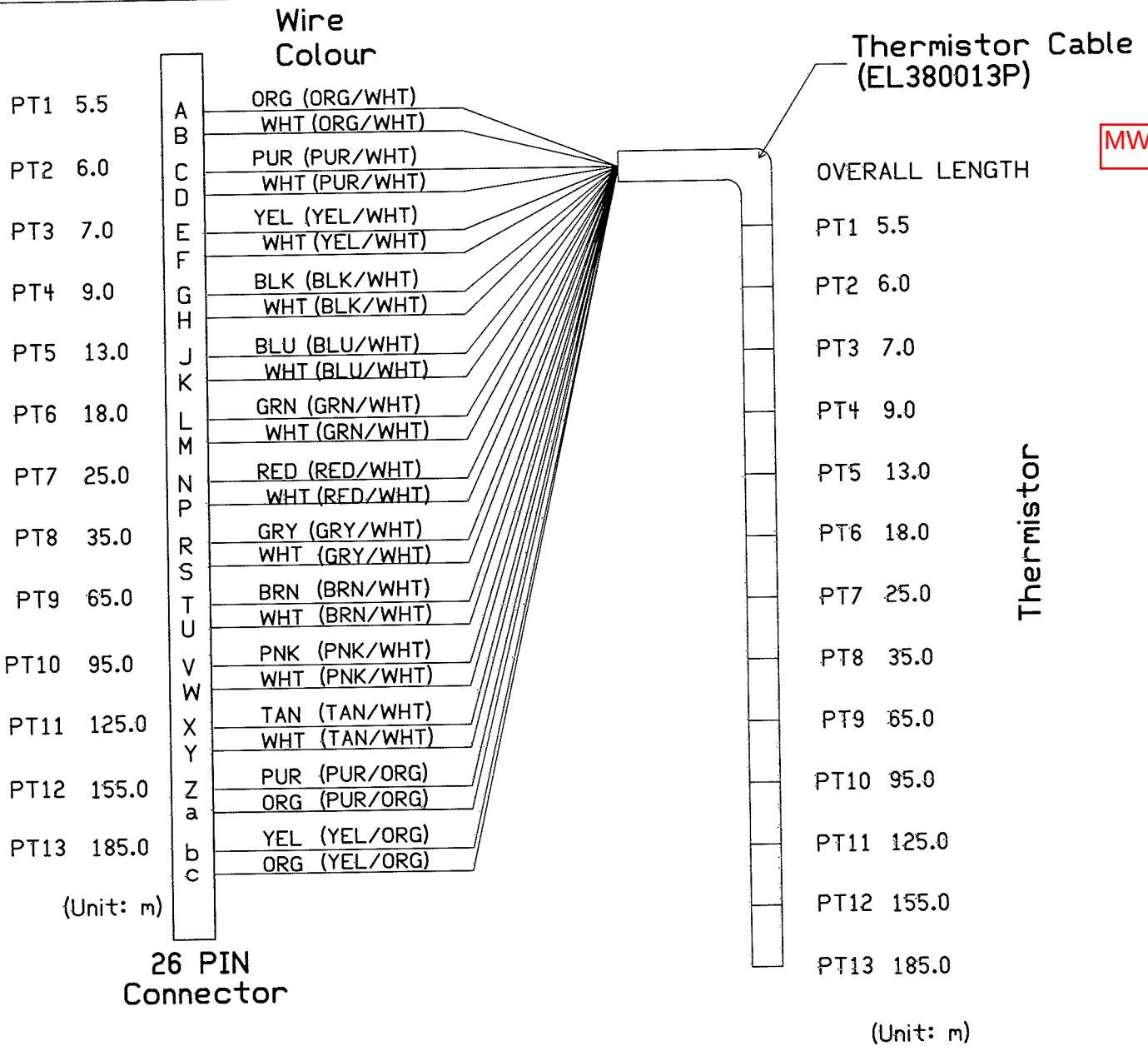
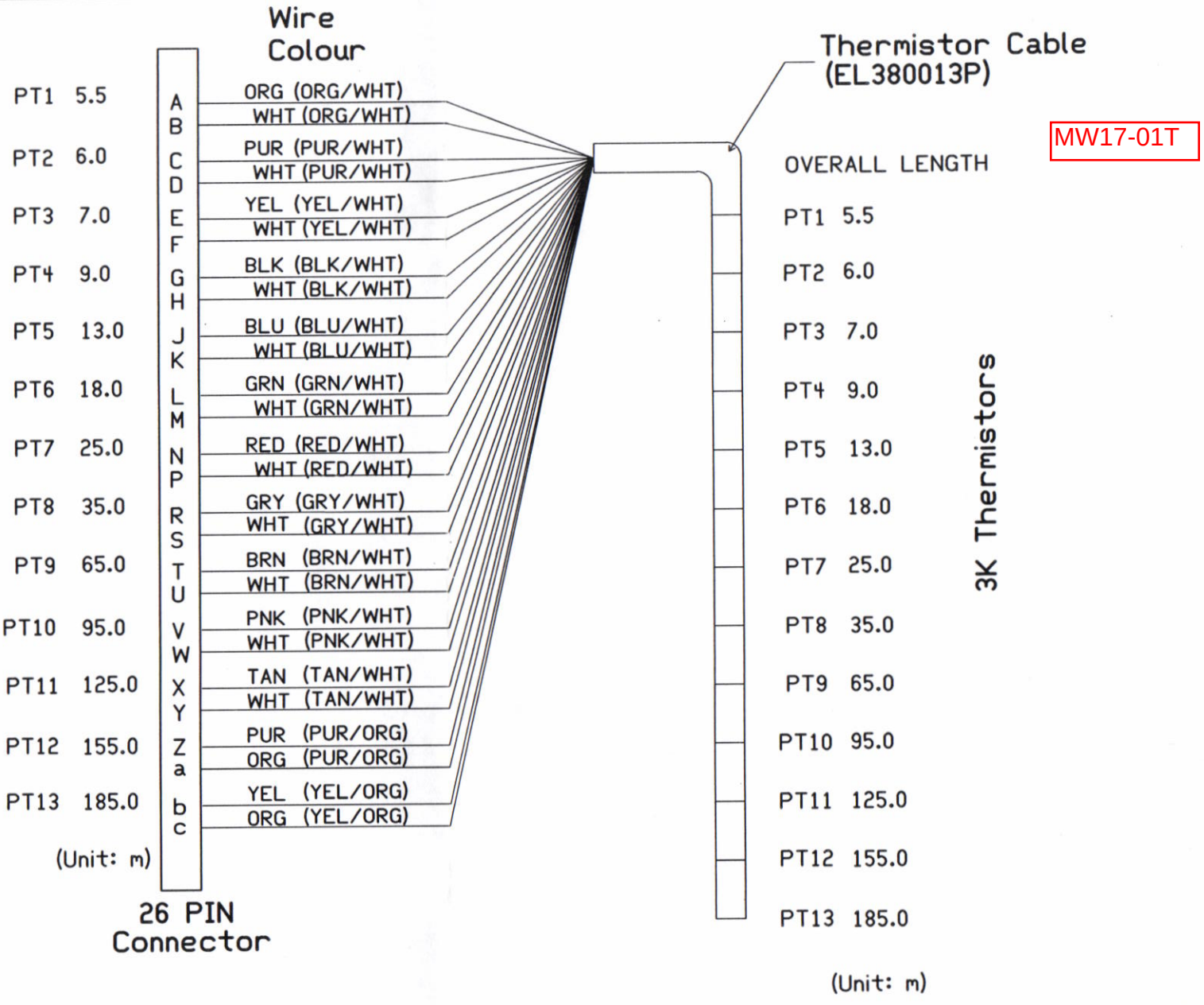
J/N:	THW0211/WO206585 Revision: A
Author:	CB Size: A
Date:	2015/03/17 Sheet 2 of 2

S/N: TS3950-TS3951



Co:	RST INSTRUMENTS LTD
Title:	THERMISTOR CABLE - 185M
J/N:	THW0247/WO210583 Revision: A
Author:	CB Size: A
Date:	2016/07/08 Sheet 1 of 1

S/N: TS4132



Co:	RST INSTRUMENTS LTD
Title:	THERMISTOR CABLE - 185M/13PT
J/N:	THW0290/WO214027 Revision: A
Author:	EG Size: A
Date:	2017/JUL/04 Sheet 1 of 2

S/N: TS4545

Appendix 4-A: Thermistor Profiles

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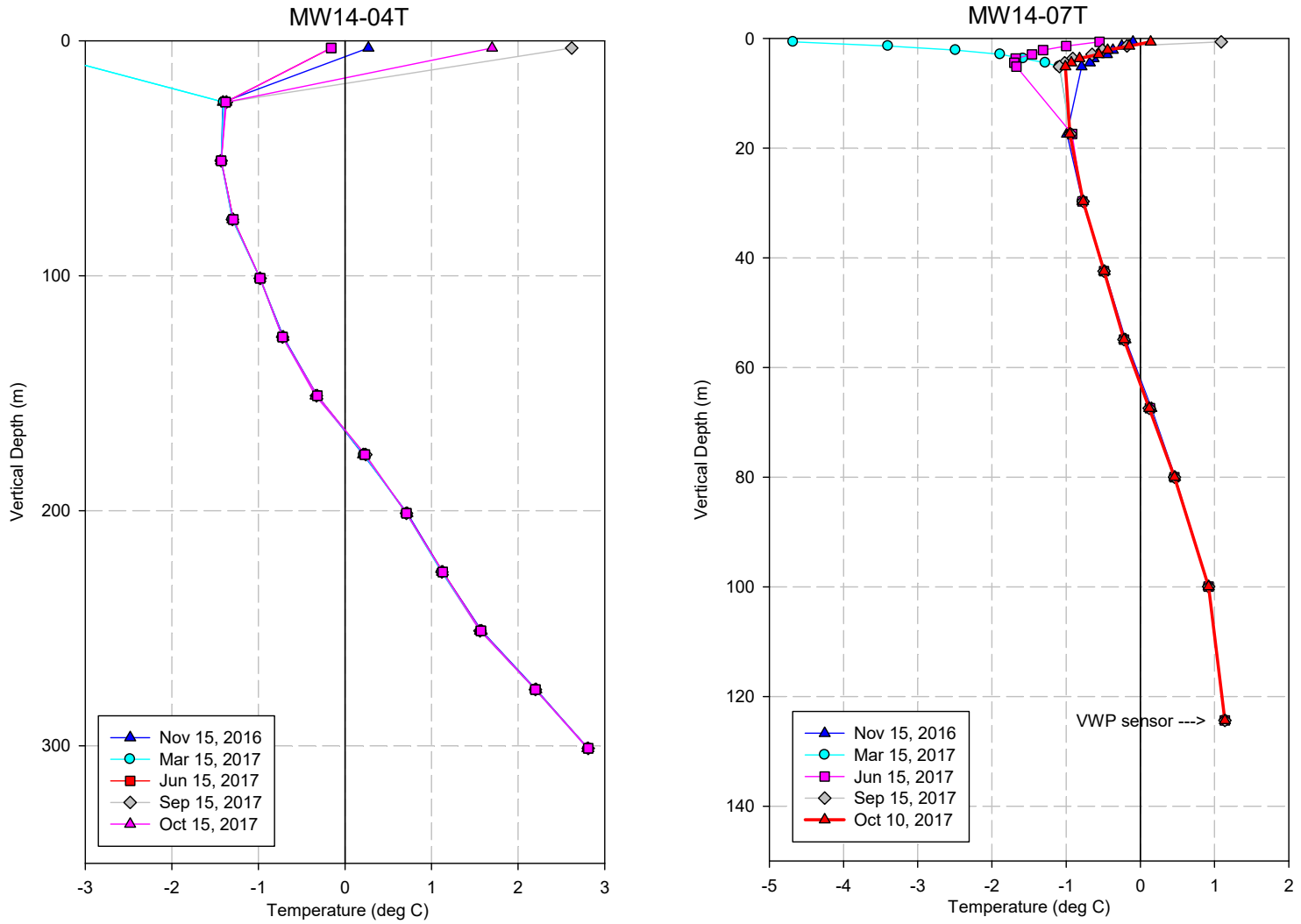

Figure 4-A-1: Thermistor profile data from MW14-04T and MW14-07T.

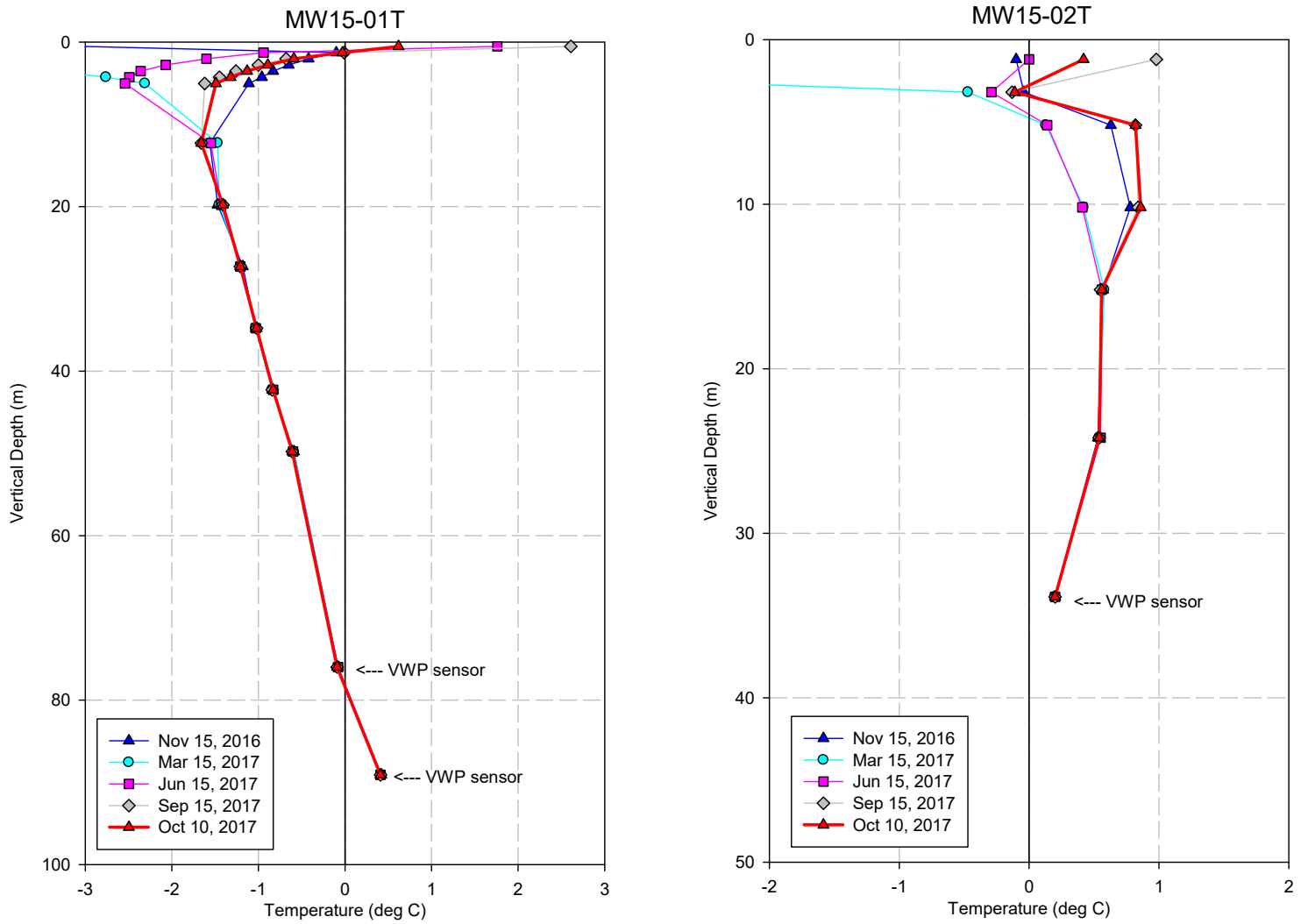

Figure 4-A-2: Thermistor profile data from MW15-01T and MW15-02T.

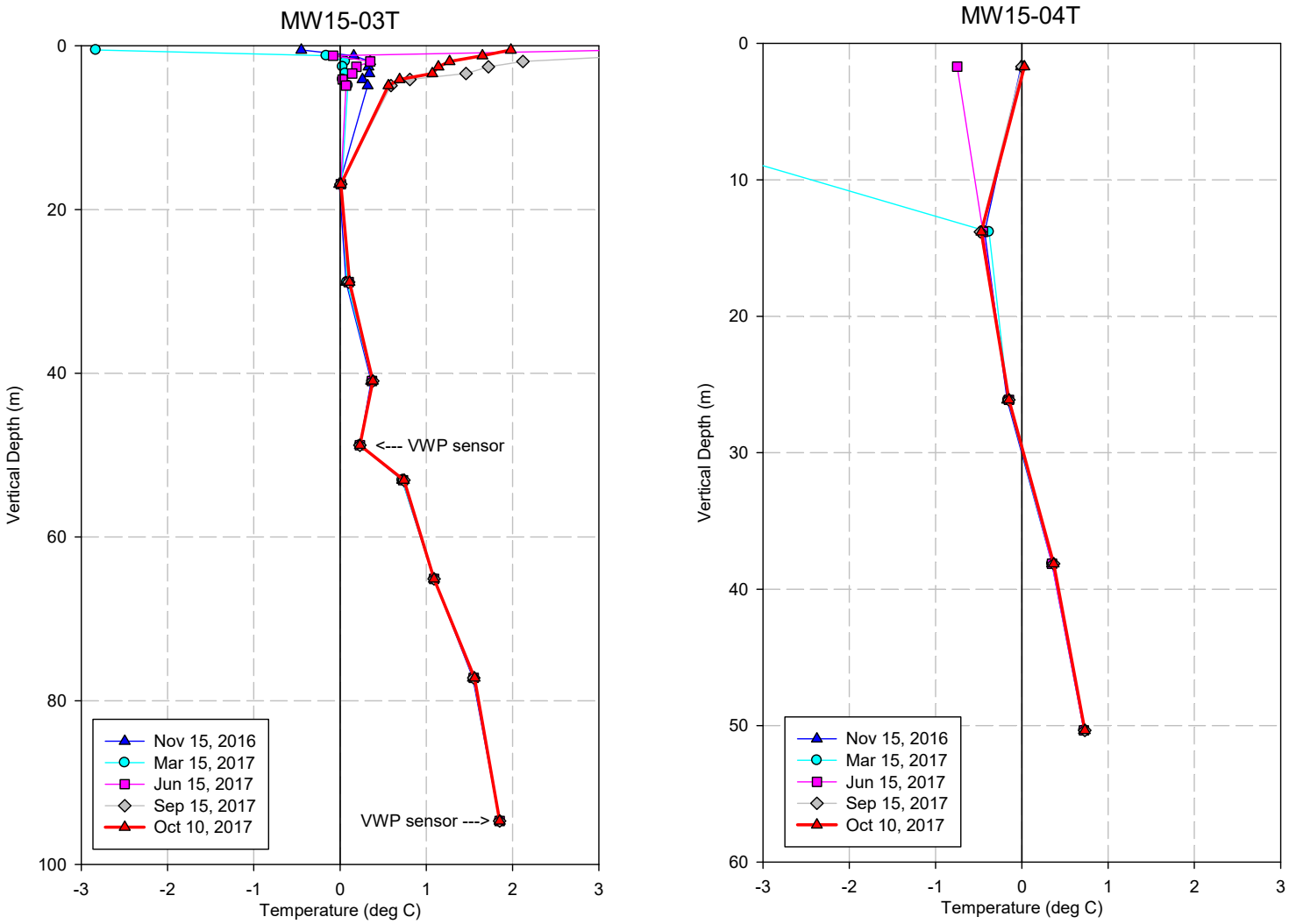

Figure 4-A-3: Thermistor profile data from MW15-03T and MW15-04T.

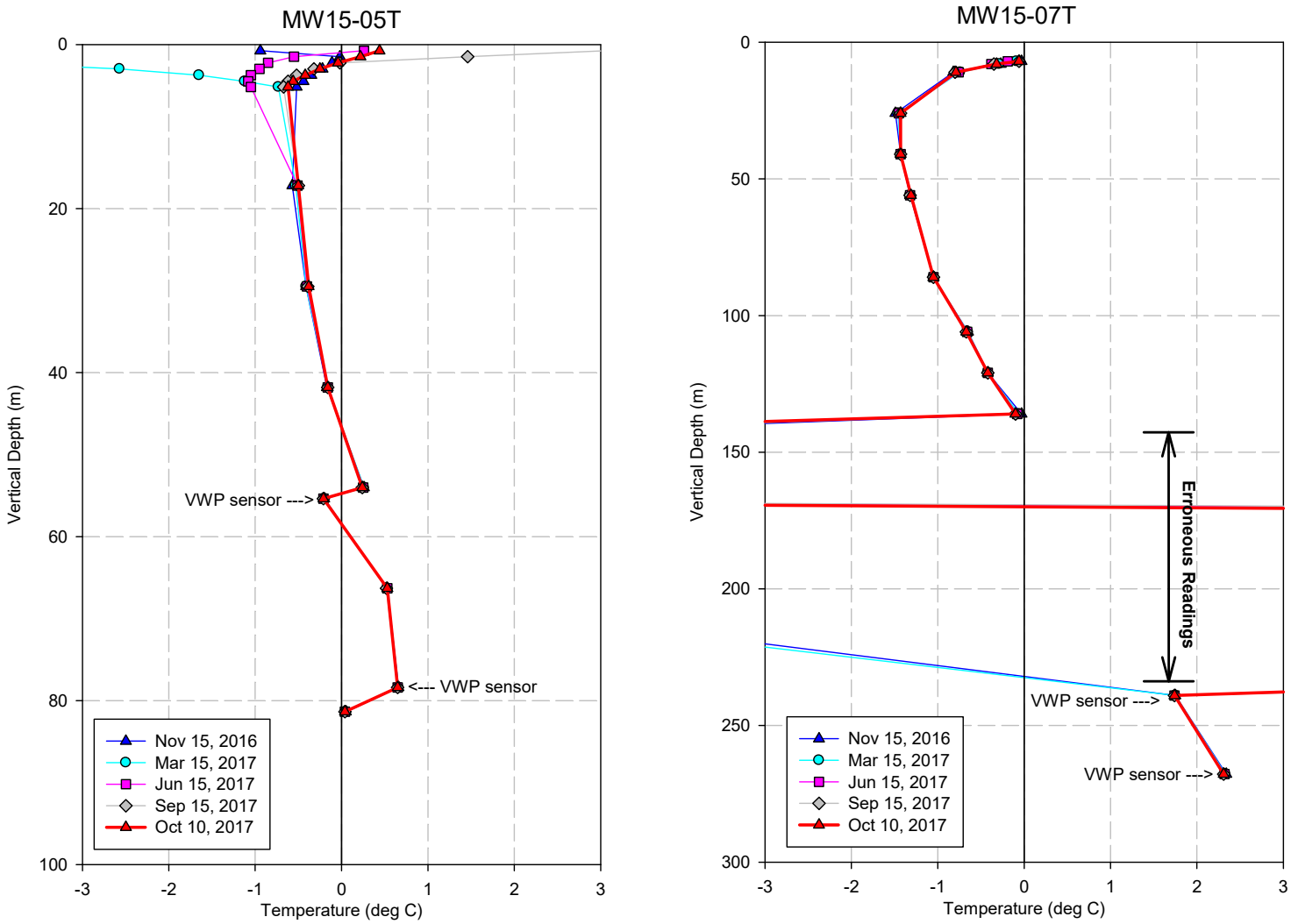

Figure 4A-4: Thermistor profile data from MW15-05T and MW15-07T.

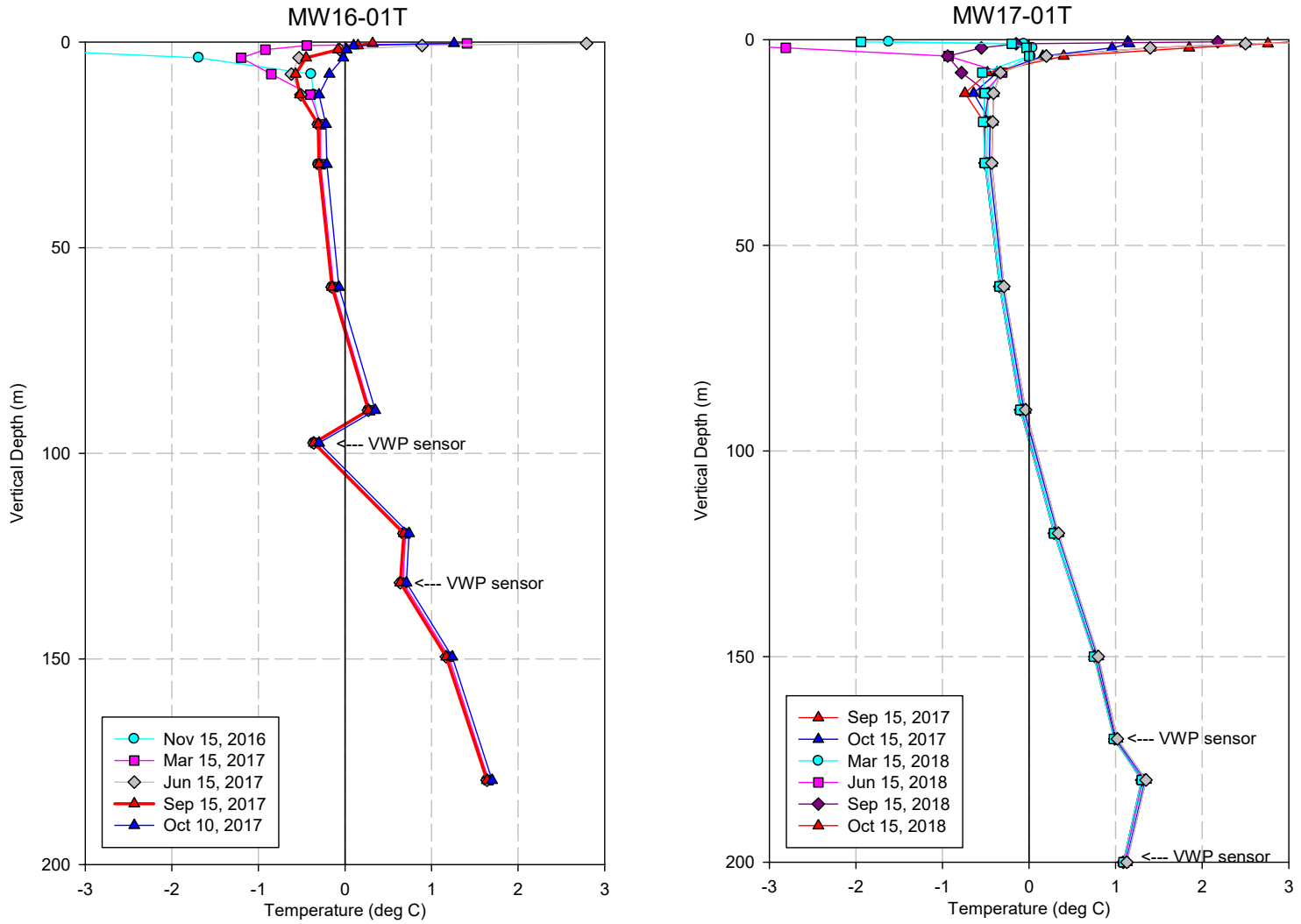

Figure 4A-5: Thermistor profile data from MW16-01T and MW17-01T.

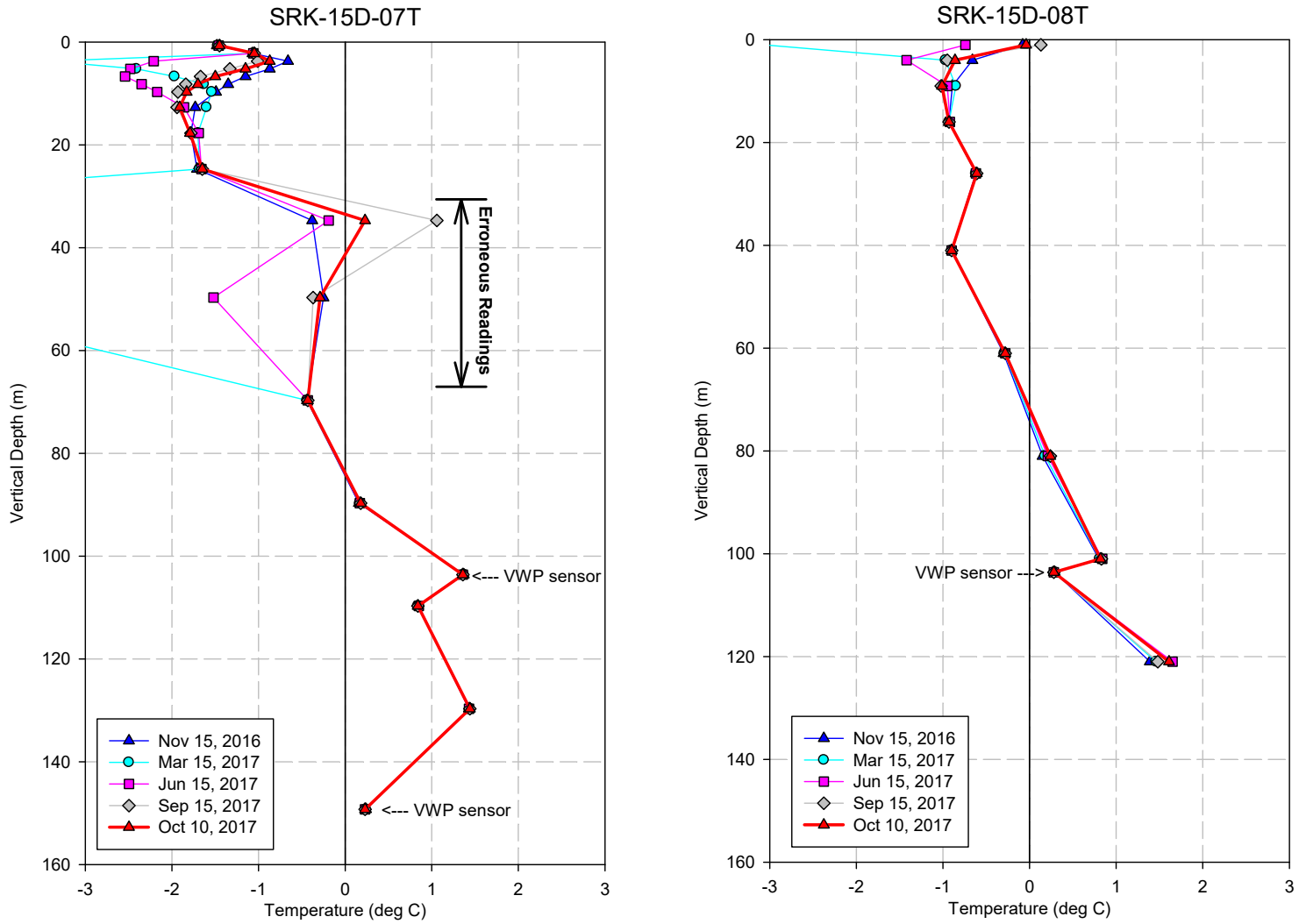

Figure 4A-6: Thermistor profile data from SRK-15D-07T and SRK-15D-08AT.

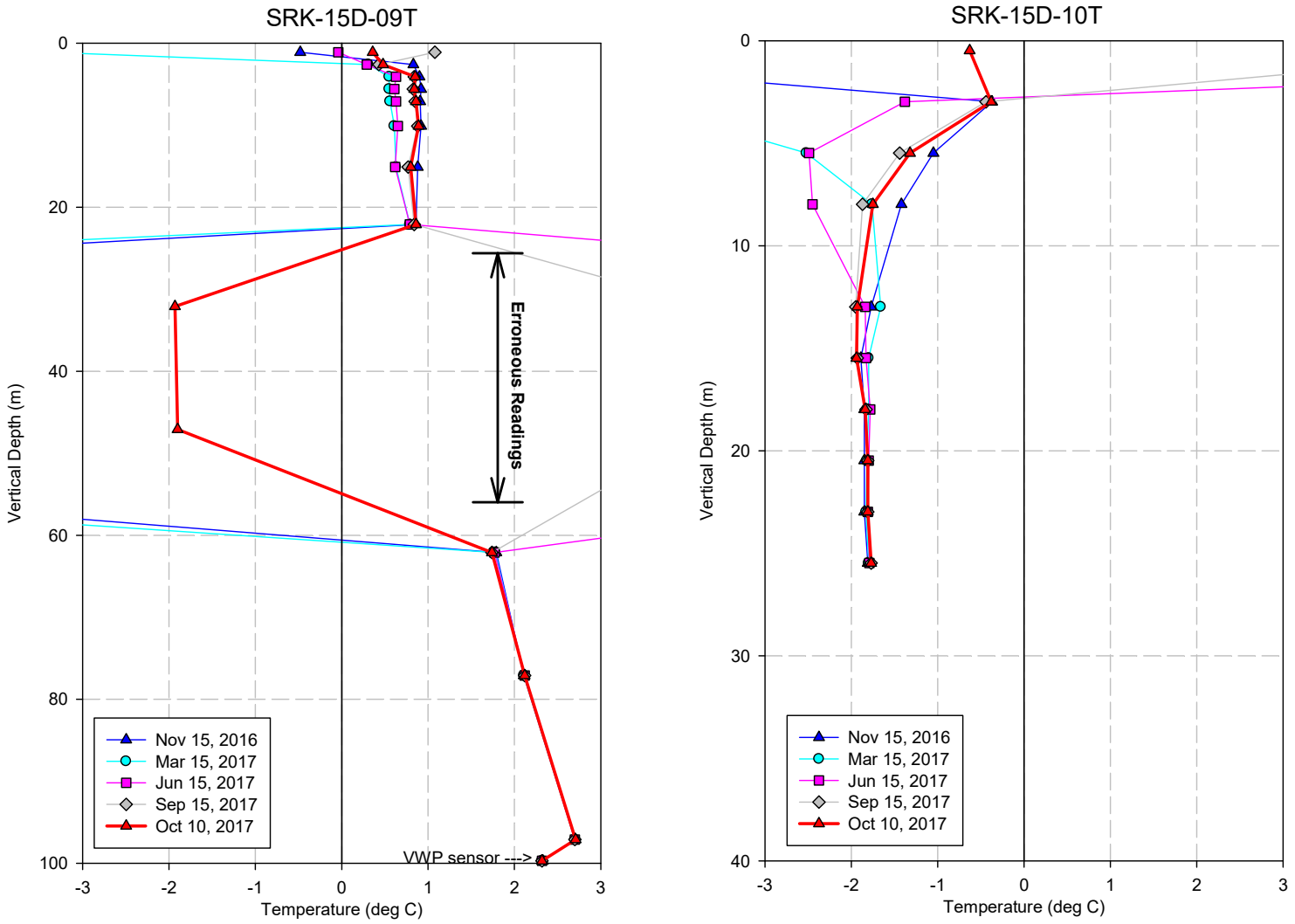

Figure 4-A-7: Thermistor profile data from SRK-15D-09T and SRK-15D-10T.

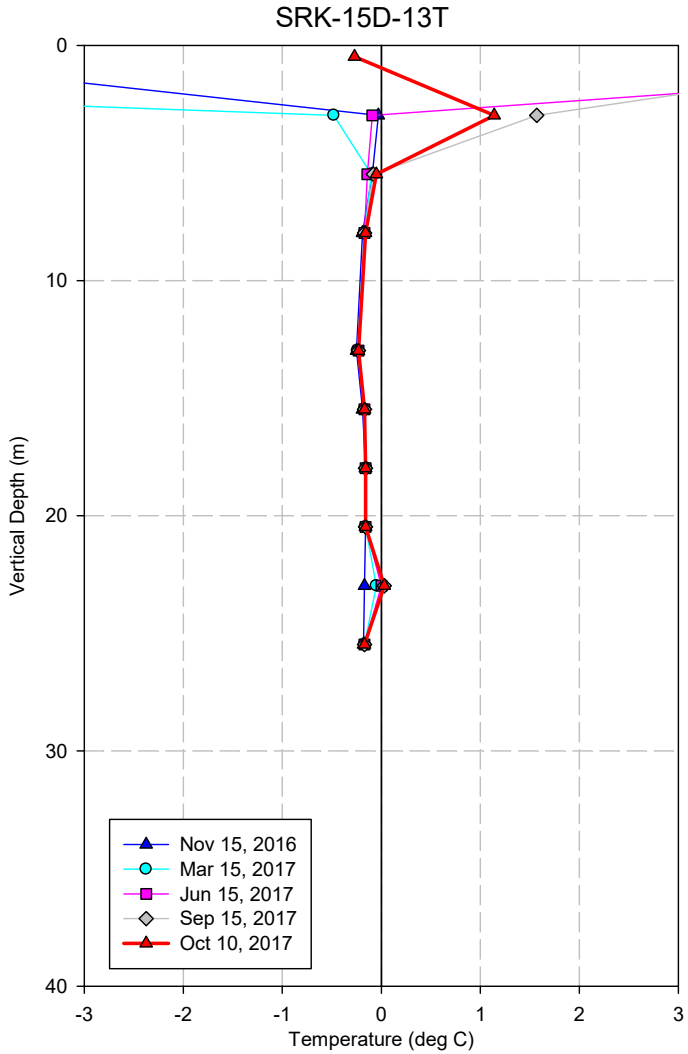

Figure 4-A-8: Thermistor profile data from SRK-15D-13T.

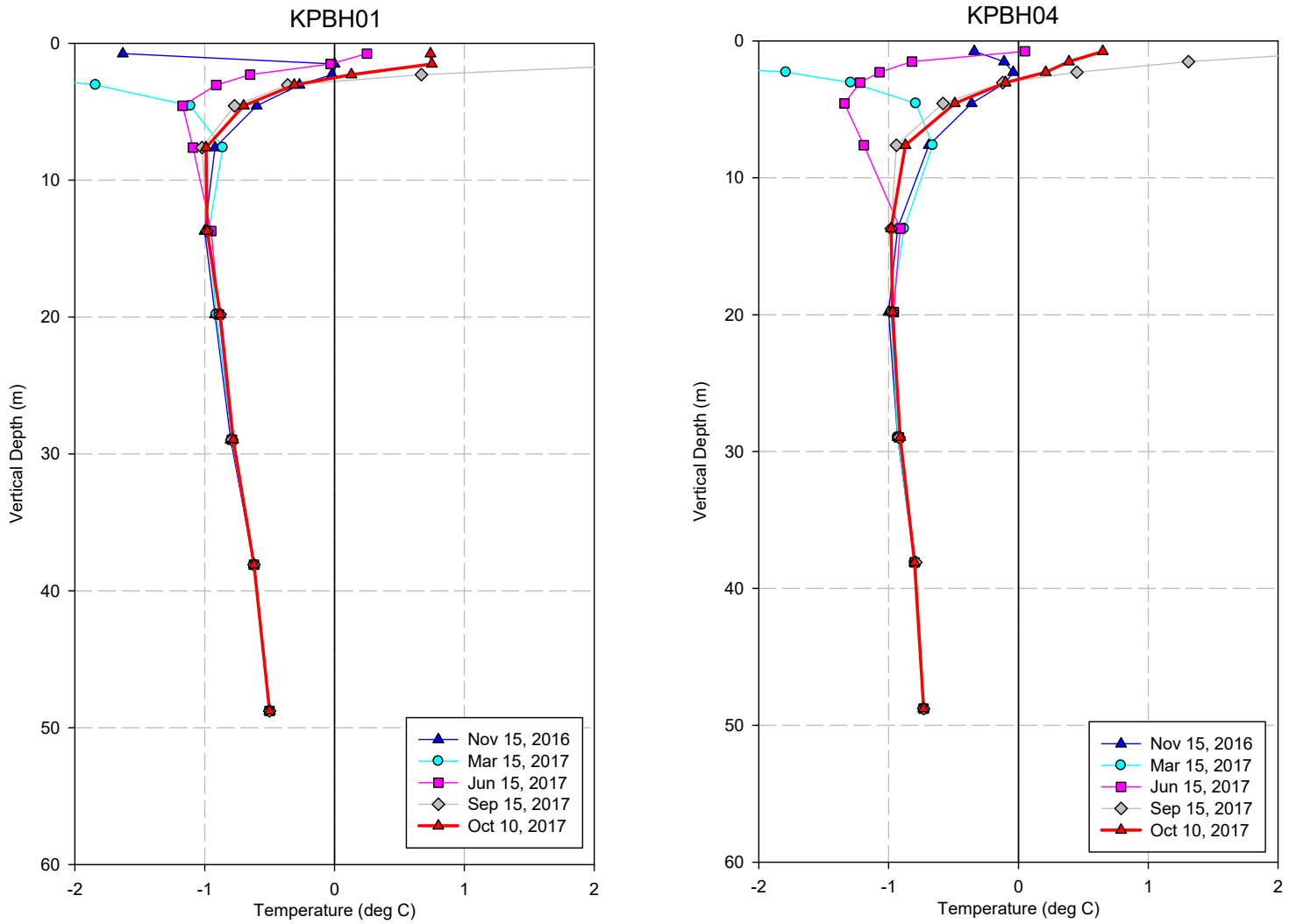

Figure 4-A-9: Thermistor profile data from KBPH01 and KPBH04.

Appendix 4-B: Shallow Thermistor Sensor Time Series Data

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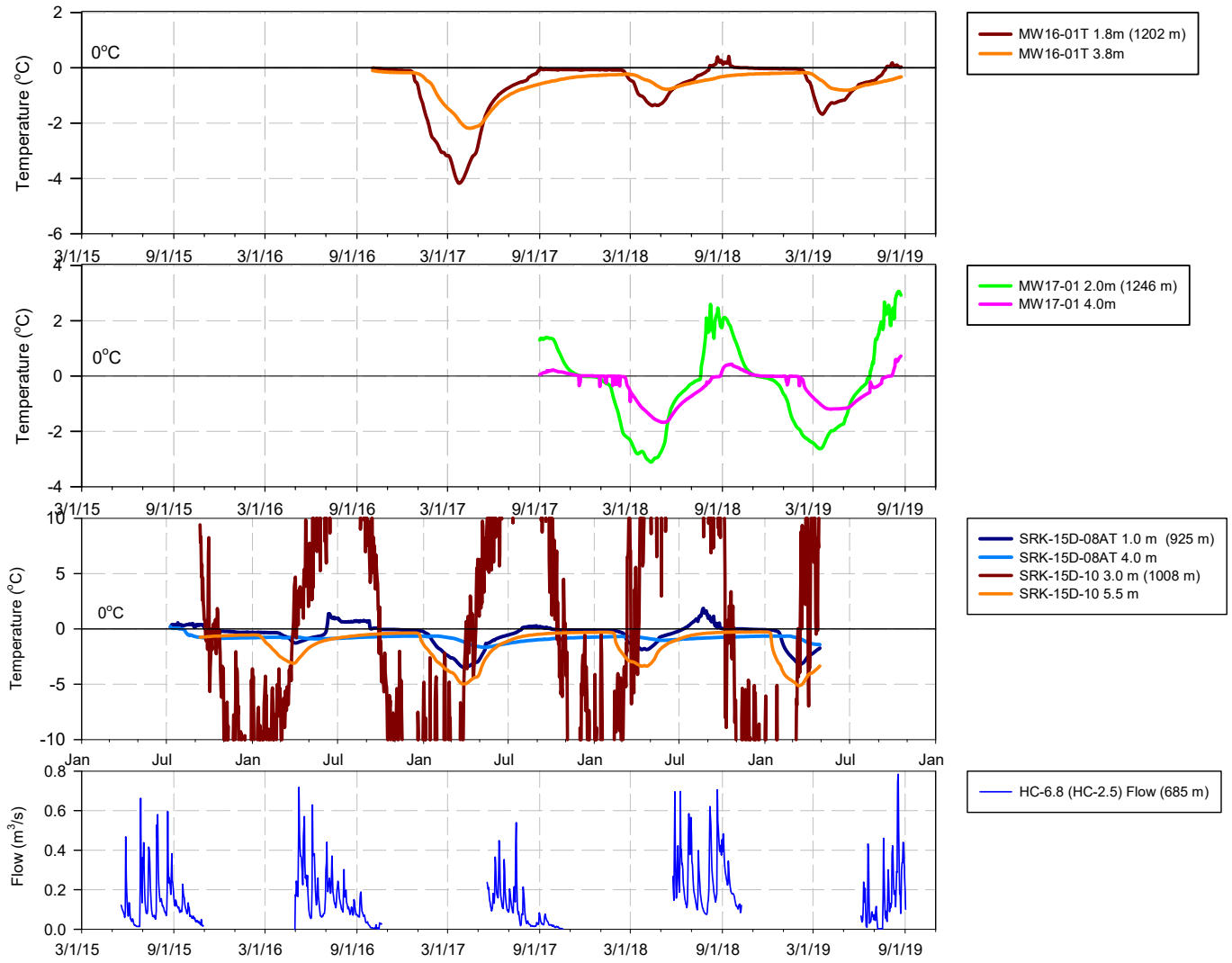

Figure 4B-1: Temperature time series data for shallow thermistor beads in Halfway Creek catchment (1).

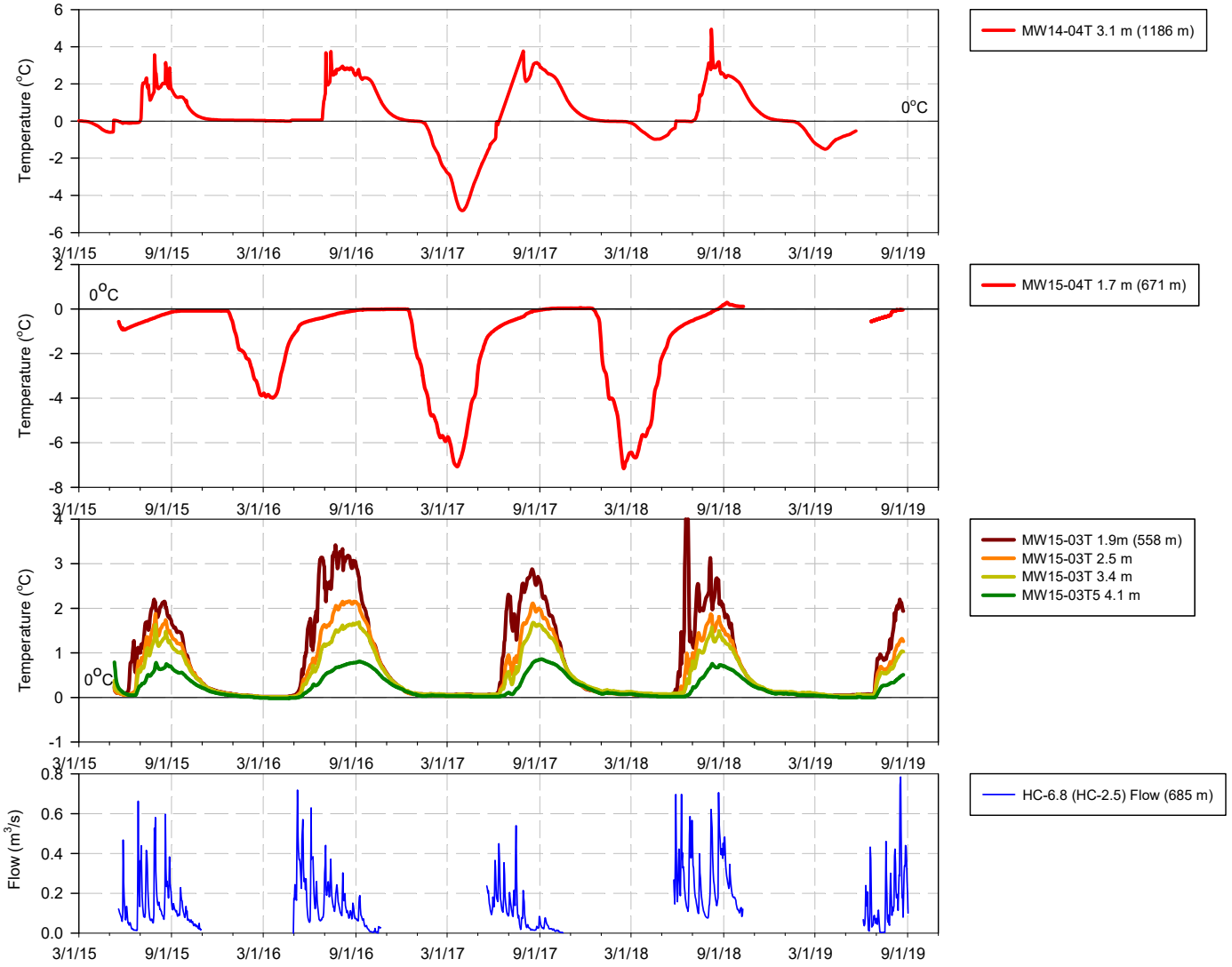

Figure 4B-2: Temperature time series data for shallow thermistor beads in Halfway Creek catchment (2).

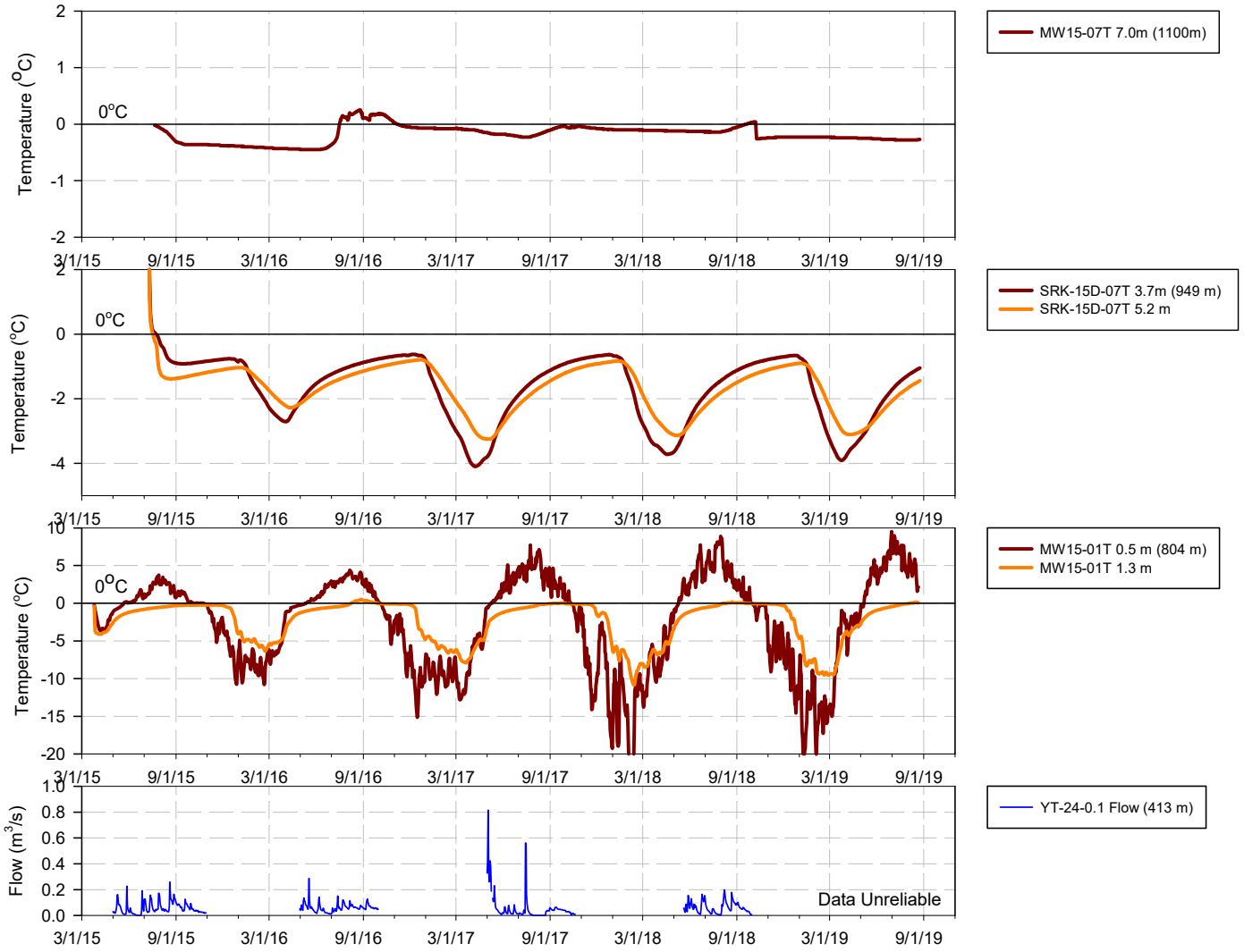

Figure 4B -3: Temperature time series data for shallow thermistor beads in YT-24 catchment.

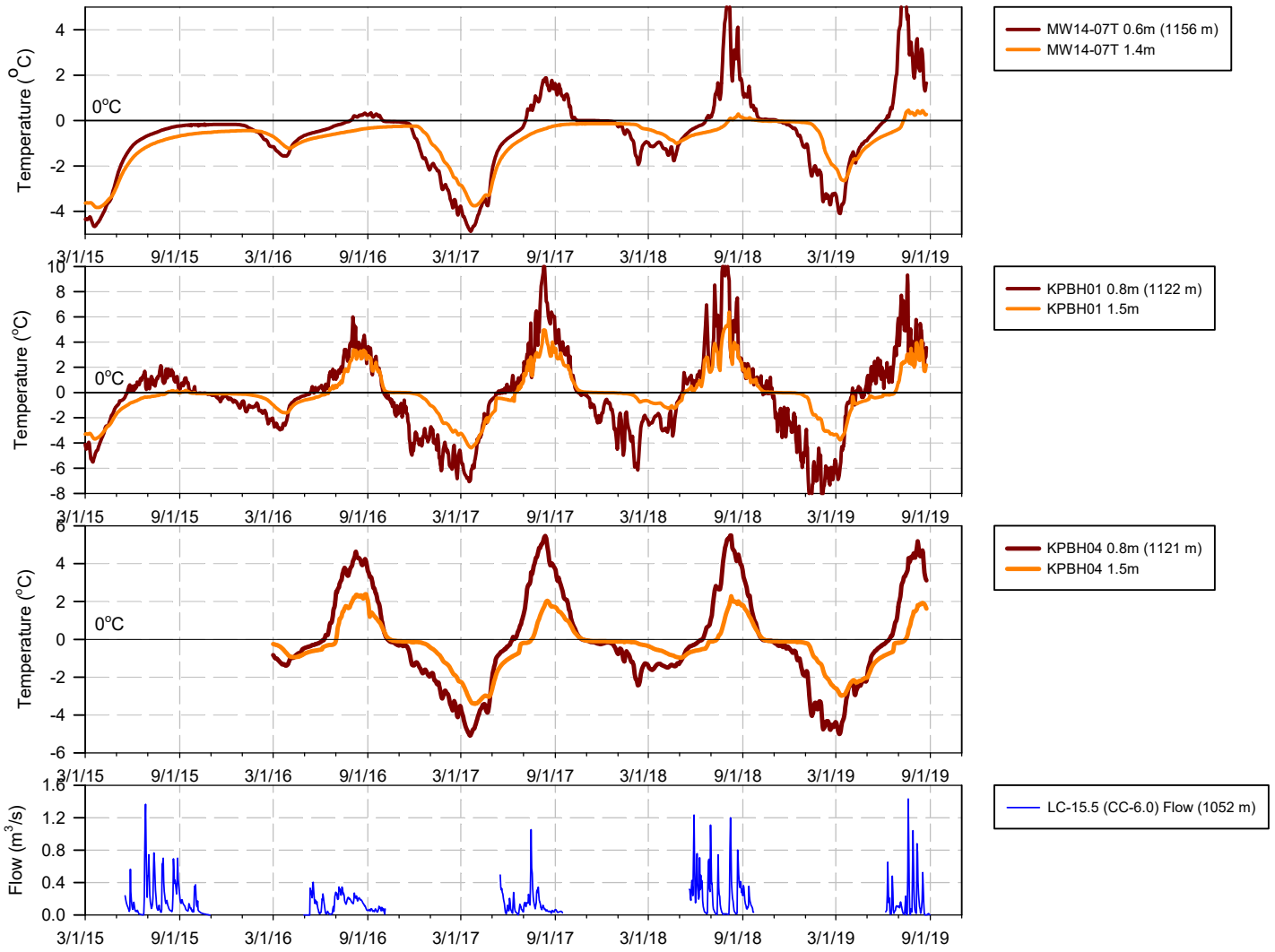

Figure 4B -4: Temperature time series data for shallow thermistor beads in Latte Creek catchment (1).

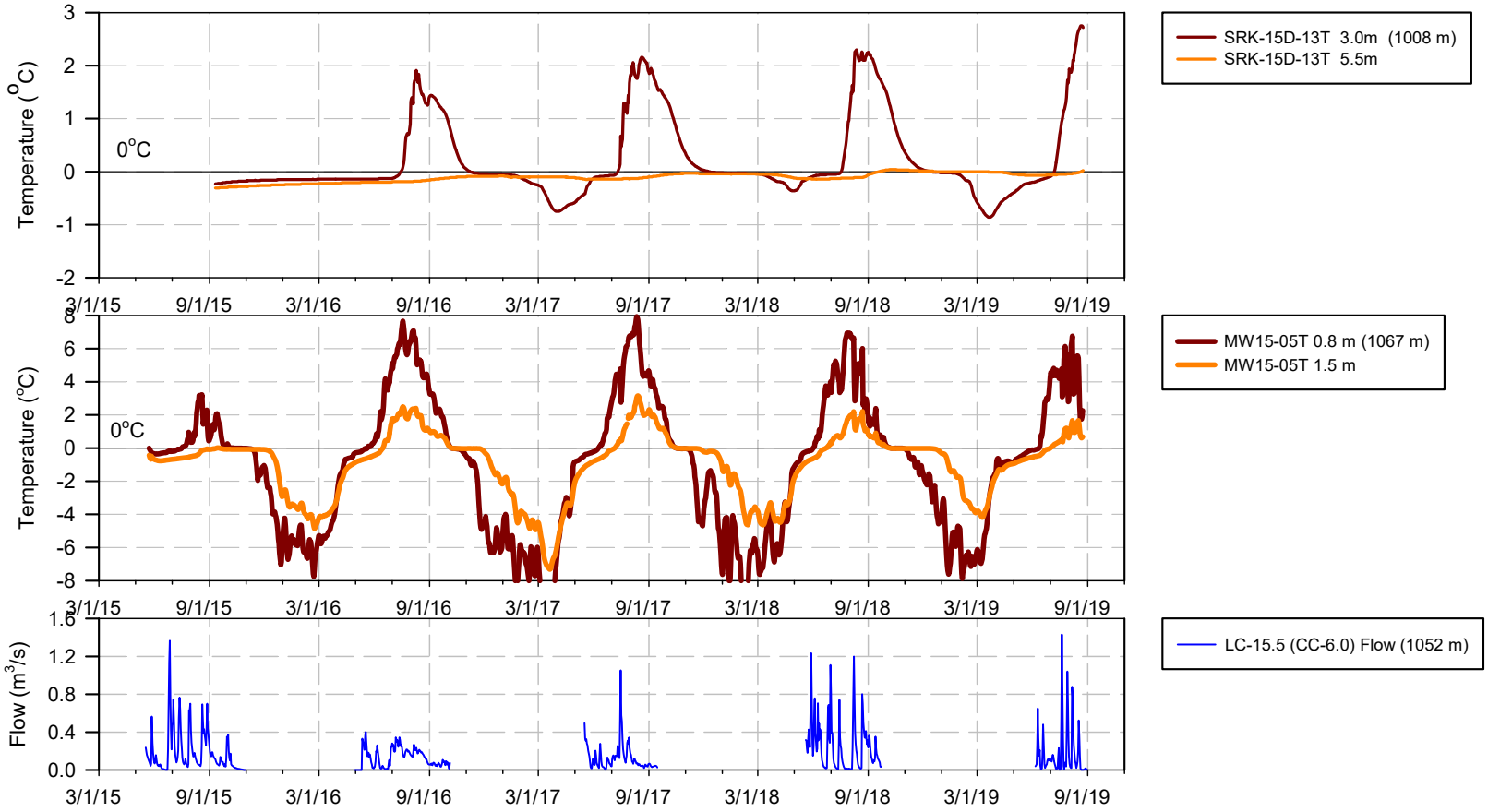

Figure 4B -5: Temperature time series data for shallow thermistor beads in Latte Creek catchment (2).

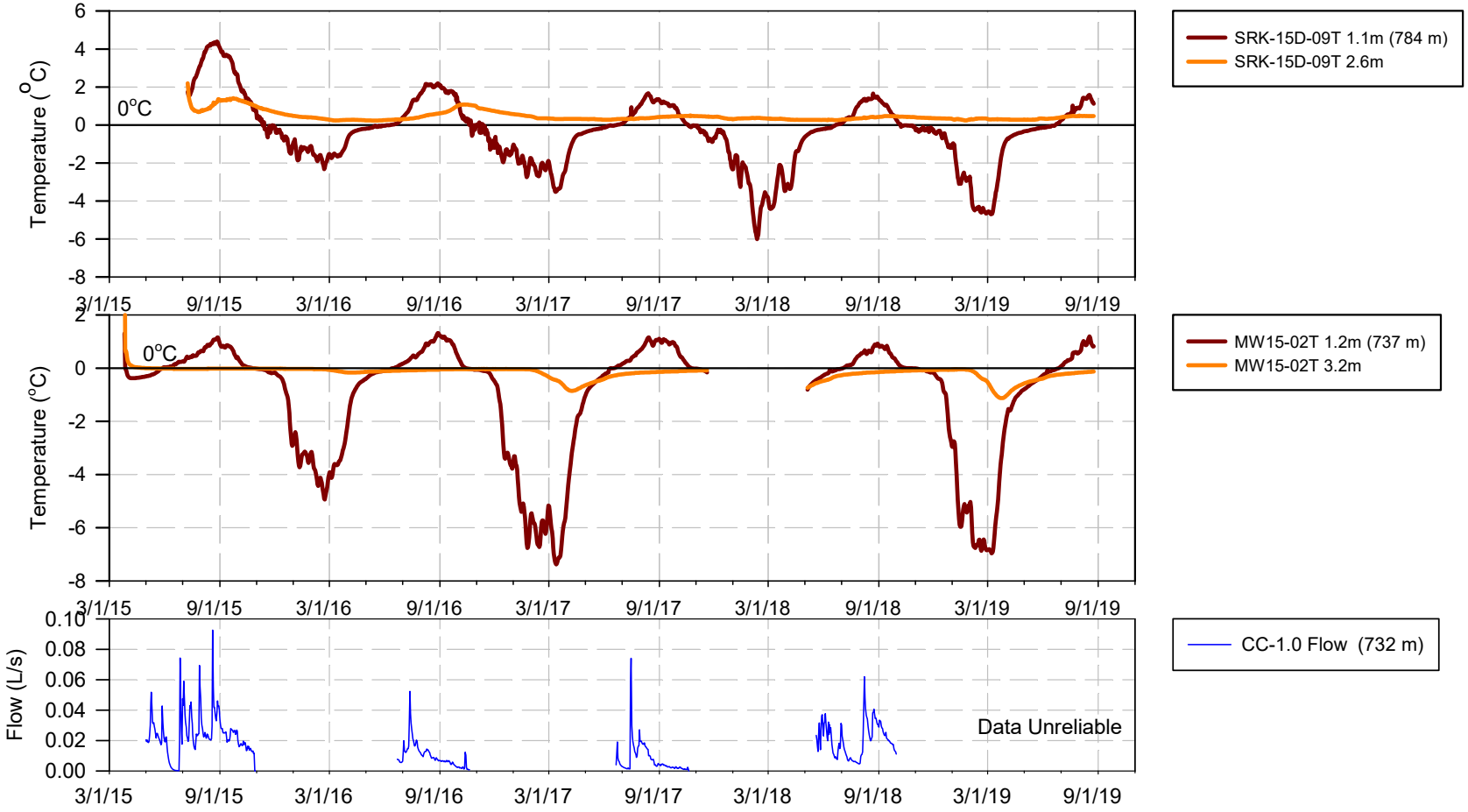

Figure 4B -6: Temperature time series data for shallow thermistor beads in Latte Creek Tributary catchment.

Appendix 4-C: Hydraulic Testing Results

APPENDIX 4-C1: Lorax 2014-2017 Hydraulic Tests

APPENDIX 4-C2: Tetra Tech EBA 2013 Hydraulic Tests

APPENDIX 4-C3: SRK 2015 Hydraulic Tests

APPENDIX 4-C4: Tetra Tech 2017 Hydraulic Tests

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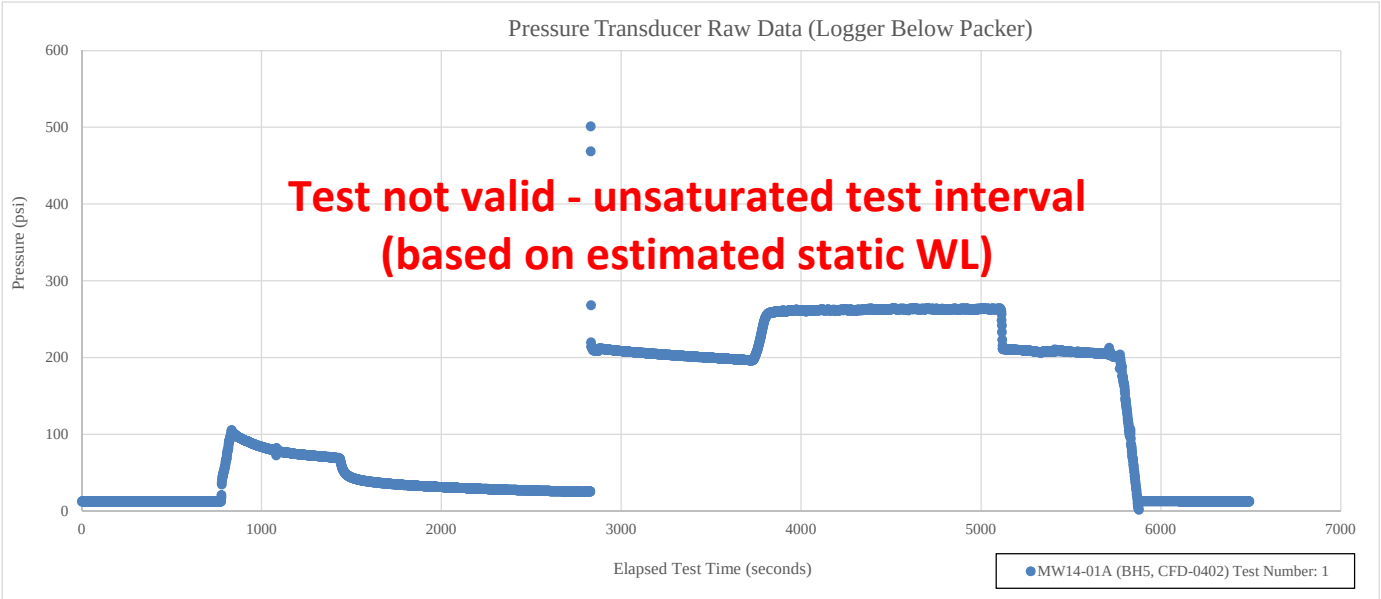
APPENDIX 4-C1: LORAX 2014-2017 HYDRAULIC TESTS

Borehole:	MW14-01A (BH5, CFD-0402)	**Test Number:**	1	**Tester:**	LF/MS
Date:	12-Aug-14	**Start Time:**	8:10 PM	**Stop Time:**	10:15 PM
Test Number:	1	**Geology:**		**Height of P gauge (mags):**	1.8
Depth to bit (m AH):	136	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	3
Interval (Top) (m AH):	137.25	**Interval Bottom (m AH):**	148	**Target Interval description:**	
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**	G-Stop in unsat. Zone		
Hole Diamter (mm):	96				
transducer SN:	301401 (Troll 700)	**packer inflation pressure (psi):**	650	**open hole static WL (mbgs):**	>113
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	536.4			
1	541.8	5.4	50	Pressure oscillatory (30-70 psi)
2	546.4	4.6	50	
4	555.14	4.4	50	
5	559.34	4.2	50	
6	563.44	4.1	50	
7	567.48	4.0	50	
8	571.54	4.1	50	
9	575.58	4.0	50	
10	579.42	3.8	50	
12	587.2	3.9	50	
14	594.86	3.8	50	
16	602.48	3.8	50	
18	610.2	3.9	50	
20	617.6	3.7	50	
	AVERAGE:	**3.82**	**50**	

Notes:
highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-01A (BH5, CFD-0402)
Borehole Angle: 90 [degrees]
Test Number: 1
Start of Test Interval: 137.25 [mbgs]
End of Test Interval: 148 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 12-Aug-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	3.82	[L/min]	collected in field
injection flow rate (Q)	6.4E-05	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	138.3	[mbgs]	in pressure transducer holder below single packer
pipe stickup	3.00	[mags]	collected in field
pressure head	196.74	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	12.81	[psi]	assumed
pressure head	129.32	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	9.02	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	0.33	[mags]	collected in field
depth to water	149.26	[mbtp]	Estimated from the closest static WL at MW14-01B on 8-Sept-2014 at 12:55 PM.
Water Level 2 (manual)	148.93	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.03	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.27	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.80	[vertical mags]	collected in field
analog pressure gauge reading	50.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	185.6	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	263.52	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	67	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	46.9	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	10.8	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	10.8	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	5.4	[-]	calculated
Is packer test interval in the unsaturated zone	TRUE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0088	[m/s]	flow rate divided by cross-sectional area
Reynold's number	528.0	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	3.0E-07	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	2.7E-08	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

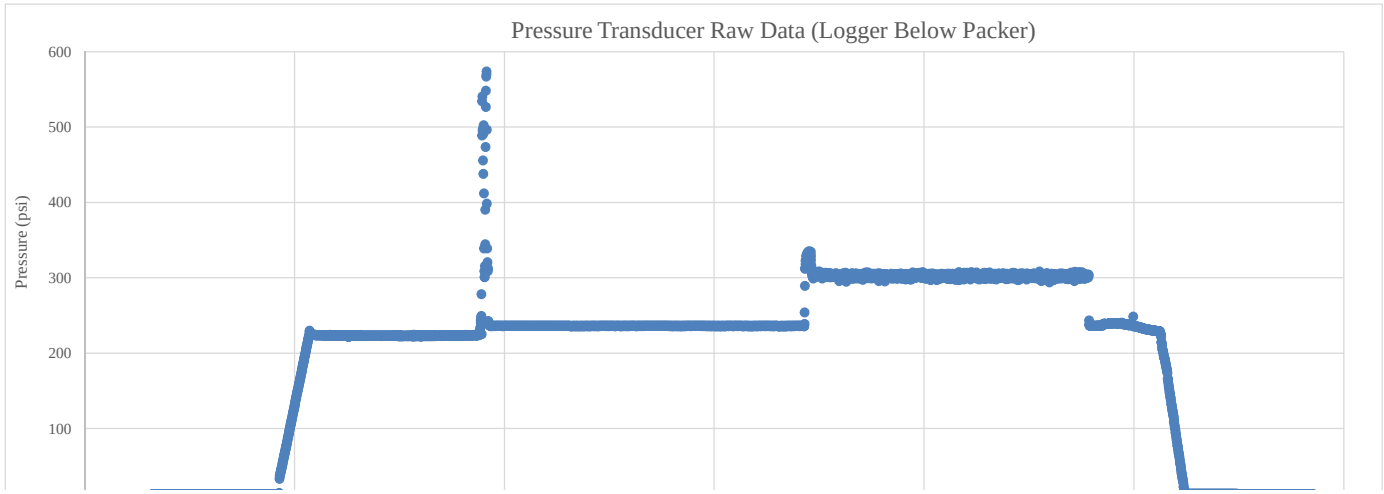
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-01A (BH5, CFD-0402)	**Test Number:**	2	**Tester:**	MS
Date:	13-Aug-14	**Start Time:**	12:21 AM	**Stop Time:**	13:57 AM
Test Number:	2	**Geology:**		**Height of P gauge (mags):**	1.8
Depth to bit (m AH):	154	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	3
Interval (Top) (m AH):	155.25	**Interval Bottom (m AH):**	166	**Target Interval description:**	
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**	G-Stop in unsat. Zone		
Hole Diamter (mm):	96				
transducer SN:	301401 (Troll 700)	**packer inflation pressure (psi):**		**open hole static WL (mbgs):**	
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	838.00		50	
1	844.40	6.4	50	
2	850.00	5.6	50	
3	856.10	6.1	50	
4	861.90	5.8	50	
5	867.70	5.8	50	
6	873.50	5.8	50	
7	879.40	5.9	50	
8	885.60	6.2	50	
9	891.20	5.6	50	
10	897.20	6.0	50	
11	903.20	6.0	50	
12	909.40	6.2	50	
13	915.30	5.9	50	
14	921.00	5.7	50	
15	927.10	6.1	50	
16	933.10	6.0	50	
17	939.20	6.1	50	
18	945.30	6.1	50	
19	951.00	5.7	50	
20	957.20	6.2	50	
	AVERAGE:	**5.96**	**50.0**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-01A (BH5, CFD-0402)
Borehole Angle: 90 [degrees]
Test Number: 2
Start of Test Interval: 155.25 [mbgs]
End of Test Interval: 166 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 13-Aug-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	5.96	[L/min]	collected in field
injection flow rate (Q)	9.9E-05	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	156.3	[mbgs]	in pressure transducer holder below single packer
pipe stickup	3.00	[mags]	collected in field
pressure head	236.44	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	12.81	[psi]	assumed
pressure head	157.24	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	-0.90	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	0.33	[mags]	collected in field
depth to water	149.26	[mbtp]	Estimated from the closest static WL at MW14-01B on 8-Sept-2014 at 12:55 PM.
Water Level 2 (manual)	148.93	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.07	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.42	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.80	[vertical mags]	collected in field
analog pressure gauge reading	50.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	185.4	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	302.59	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	66	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	46.5	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	10.8	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	10.8	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	5.4	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0137	[m/s]	flow rate divided by cross-sectional area
Reynold's number	822.8	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	4.6E-07	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	4.3E-08	[m/s]	equivalent to T divided by test interval

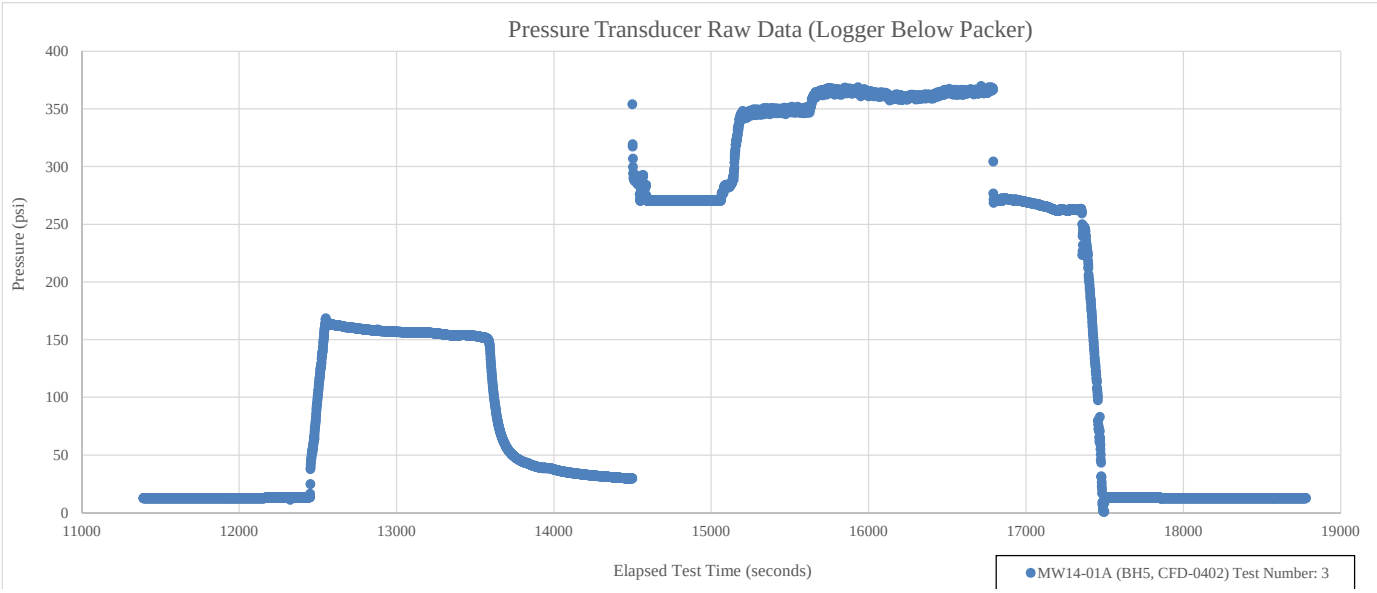
mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-01A (BH5, CFD-0402)	**Test Number:**	3	**Tester:**	LF
Date:	13-Aug-14	**Start Time:**	12:00 PM	**Stop Time:**	4:00 PM
Test Number:	3	**Geology:**		**Height of P gauge (mags):**	1.8
Depth to bit (m AH):	178	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	3
Interval (Top) (m AH):	179.25	**Interval Bottom (m AH):**	202	**Target Interval description:**	
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**	G-Stop in unsat. Zone		
Hole Diamter (mm):	96				
transducer SN:	301401 (Troll 700)	**packer inflation pressure (psi):**	550	**open hole static WL (mbgs):**	
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	459.0		80	
1	467.0	8.0	80	Pump knocking (large P gauge oscillating between 70 and 120; small P gauge oscillating between 30 and 140)
2	474.0	7.0	80	
3	481.1	7.1	80	
4	488.0	6.9	80	
5	494.9	6.9	80	
6	501.8	6.9	80	
8	516.7	7.5	80	
10	533.6	8.4	80	
12	550.6	8.5	80	
14	567.3	8.3	80	
16	584.4	8.6	80	
18	602.2	8.9	80	
20	619.8	8.8	80	
22	637.8	9.0	80	
24	655.7	9.0	80	
26	673.9	9.1	80	
	AVERAGE:	**9.0**	**80**	

Notes:
highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-01A (BH5, CFD-0402)
Borehole Angle: 90 [degrees]
Test Number: 3
Start of Test Interval: 179.25 [mbgs]
End of Test Interval: 202 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 13-Aug-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	9.02	[L/min]	collected in field
injection flow rate (Q)	1.5E-04	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	180.3	[mbgs]	in pressure transducer holder below single packer
pipe stickup	3.00	[mags]	collected in field
pressure head	29.96	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	12.78	[psi]	assumed
pressure head	12.08	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	168.26	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	0.33	[mags]	collected in field
depth to water	149.26	[mbtp]	Estimated from the closest static WL at MW14-01B on 8-Sept-2014 at 12:55 PM.
Water Level 2 (manual)	148.93	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.16	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.63	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.80	[vertical mags]	collected in field
analog pressure gauge reading	80.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	206.2	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	365.63	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	336	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	236.0	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	22.8	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	22.8	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.2	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0208	[m/s]	flow rate divided by cross-sectional area
Reynold's number	1245.7	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	7.1E-07	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	3.1E-08	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

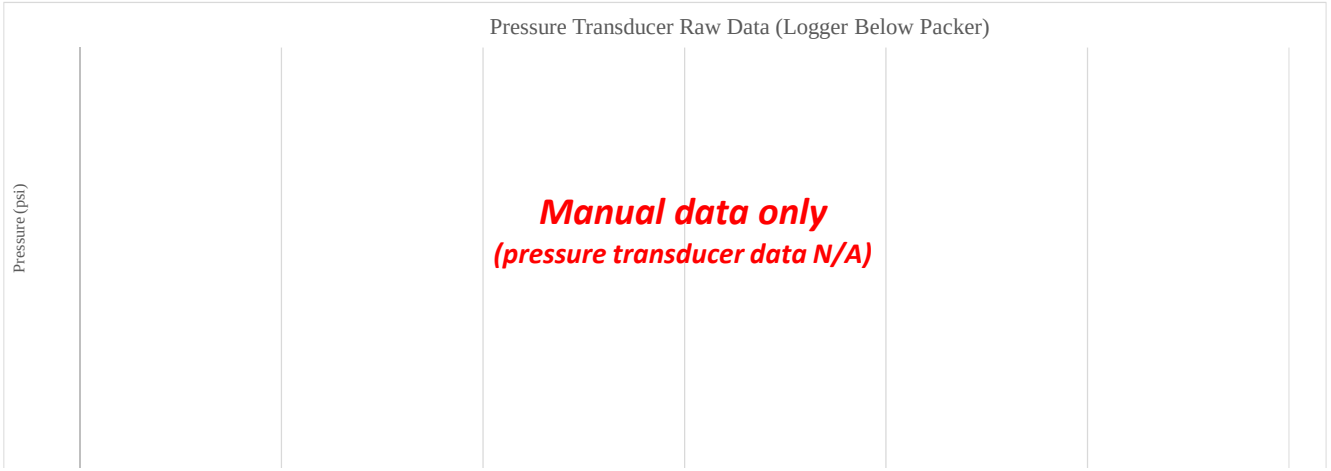
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-02B (BH-09, CFD-0418)	**Test Number:**	1	**Tester:**	MS
Date:	20-Aug-14	**Start Time:**		**Stop Time:**	
Test Number:	1	**Geology:**	gneiss	**Height of P gauge (mags):**	1.83
Depth to bit (m AH):	83	**Length of Packer (m):**	1.50	**Pipe Stickup (mags):**	2.93
Interval (Top) (m AH):	84.50	**Interval Bottom (m AH):**	104	**Target Interval description:**	
Packer type (pneumatic/hydraulic):	pneumatic	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**	G-Stop in unsat. Zone		
Hole Diamter (mm):	96				
transducer SN:	n/a	**packer inflation pressure (psi):**	375	**open hole static WL (mbgs):**	n/a
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	14.0			
				approx. 30 mL/min leakage from
1	14.5	0.50	30	stuffing assembly
2	14.5	0.00	30	
3	15.0	0.50	30	
4	15.0	0.00	30	
5	15.0	0.00	30	
6	15.5	0.50	30	
7	15.5	0.00	30	
8	15.5	0.00	30	
9	15.5	0.00	30	
10	16.0	0.50	30	
11	16.0	0.00	30	
12	16.0	0.00	30	
13	16.5	0.50	30	
14	16.5	0.00	30	
15	17.0	0.50	30	
16	17.0	0.00	30	
17	17.0	0.00	30	
18	17.5	0.50	30	
19	17.5	0.00	30	
20	17.5	0.00	30	
	AVERAGE:	**0.19**	**30**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-02B (BH-09, CFD-0418)
Borehole Angle: 90 [degrees]
Test Number: 1
Start of Test Interval: 84.50 [mbgs]
End of Test Interval: 104 [mbgs]
Test Type: constant rate injection
Packer System: pneumatic
Date: 20-Aug-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.19	[L/min]	collected in field
injection flow rate (Q)	3.2E-06	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.93	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.27	[mags]	collected in field
depth to water	13.60	[mbtp]	Static WL in MW14-02B on 26-Aug-2014 at 20:00
Water Level 2 (manual)	12.33	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.00	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.83	[vertical mags]	collected in field
analog pressure gauge reading	30.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	35.3	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	19.5	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	19.5	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.0	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0004	[m/s]	flow rate divided by cross-sectional area
Reynold's number	26.9	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	8.8E-08	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	4.5E-09	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

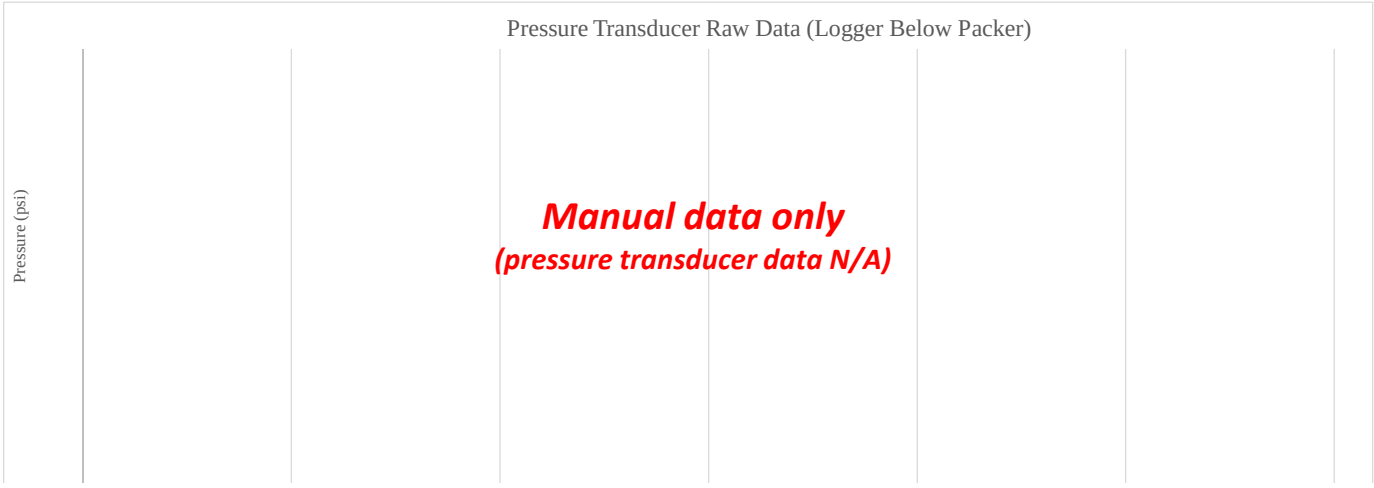
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-02B (BH-09, CFD-0418)	**Test Number:**	2	**Tester:**	MS/CB
Date:	21-Aug-14	**Start Time:**	9:40 PM	**Stop Time:**	10:00 PM
Test Number:	2	**Geology:**	gneiss	**Height of P gauge (mags):**	1.83
Depth to bit (m AH):	101	**Length of Packer (m):**	1.50	**Pipe Stickup (mags):**	2.93
Interval (Top) (m AH):	102.50	**Interval Bottom (m AH):**	125	**Target Interval description:**	broken rock / rock fragment
Packer type (pneumatic/hydraulic):	pneumatic	**Hole dip:**	90		
Rod Type:	HQ	**Type of water used:**	Fresh	**Hydraulic packer sink time:**	n/a
Rod ID (mm):	77.8	**Additives used (type):**	G-Stop in unsat. Zone		
Hole Diamter (mm):	96				
transducer SN:	n/a	**packer inflation pressure (psi):**	425	**open hole static WL (mbgs):**	n/a
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	3095			
1	3099	4.00	30	
2	3105	6.00	30	
3	3108	3.00	30	
4	3112	4.00	30	
5	3116	4.00	30	
6	3120	4.00	30	
7	3124	4.00	30	
8	3129	5.00	30	
9	3133	4.00	30	
10	3137	4.00	30	
11	3141	4.00	30	
12	3145	4.00	30	
13	3149	4.00	30	
14	3153	4.00	30	
15	3157	4.00	30	
16	3162	5.00	30	
17	-	-	30	
18	3170	4.00	30	
19	3174	4.00	30	
20	3178	4.00	30	
	AVERAGE:	**4.13**	**30**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-02B (BH-09, CFD-0418)
Borehole Angle: 90 [degrees]
Test Number: 2
Start of Test Interval: 102.50 [mbgs]
End of Test Interval: 125 [mbgs]
Test Type: constant rate injection
Packer System: pneumatic
Date: 21-Aug-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	4.13	[L/min]	collected in field
injection flow rate (Q)	6.9E-05	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.93	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.27	[mags]	collected in field
depth to water	13.60	[mbtp]	Static WL in MW14-02B on 26-Aug-2014 at 20:00
Water Level 2 (manual)	12.33	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.04	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.01	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.83	[vertical mags]	collected in field
analog pressure gauge reading	30.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	35.2	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	22.5	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	22.5	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.2	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0095	[m/s]	flow rate divided by cross-sectional area
Reynold's number	569.9	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	1.9E-06	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	8.5E-08	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

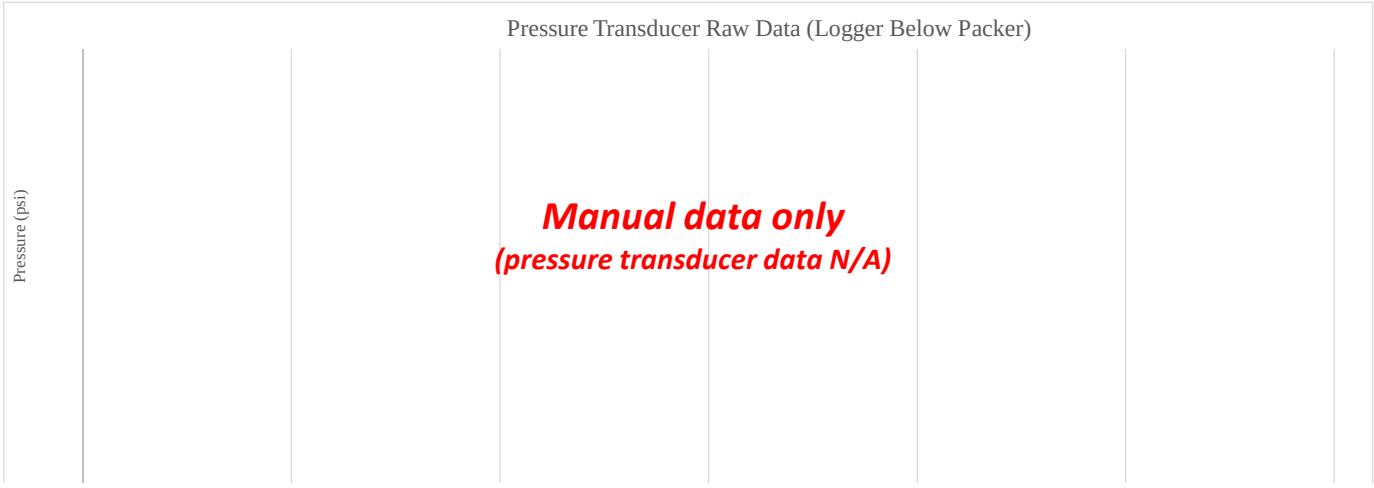
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-02B (BH-09, CFD-0418)	**Test Number:**	3	**Tester:**	MS/CB
Date:	22-Aug-14	**Start Time:**	2:20 AM	**Stop Time:**	2:45 AM
Test Number:	3	**Geology:**	shear zone/biotite-feldspar schist	**Height of P gauge (mags):**	1.83
Depth to bit (m AH):	128			**Pipe Stickup (mags):**	2.93
Interval (Top) (m AH):	129.50	**Length of Packer (m):**	1.50	**Target Interval description:**	broken rock 132 - 134 m
Packer type (pneumatic/hydraulic):	pneumatic	**Interval Bottom (m AH):**	137		
Rod Type:	HQ	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod ID (mm):	77.8	**Type of water used:**	Fresh		
Hole Diamter (mm):	96	**Additives used (type):**	G-Stop in unsat. Zone		
transducer SN:	n/a	**packer inflation pressure (psi):**	-	**open hole static WL (mbgs):**	near top of rods
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	3089.0			
1	3090.0	1.00	40	
2	-	-	40	
3	3092.0	1.00	40	
4	3093.0	1.00	40	
5	3094.0	1.00	40	
6	3095.0	1.00	40	
7	3096.0	1.00	40	
8	3097.0	1.00	40	
9	3098.0	1.00	40	
10	3099.0	1.00	40	
11	3100.0	1.00	40	
12	3101.0	1.00	40	
13	3102.0	1.00	40	
14	3102.5	0.50	40	
15	3103.0	0.50	40	
16	3104.0	1.00	40	
17	3104.5	0.50	40	
18	3105.0	0.50	40	
19	3106.0	1.00	40	
20	3106.5	0.50	40	
	AVERAGE:	**0.69**	**40**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-02B (BH-09, CFD-0418)
Borehole Angle: 90 [degrees]
Test Number: 3
Start of Test Interval: 129.50 [mbgs]
End of Test Interval: 137 [mbgs]
Test Type: constant rate injection
Packer System: pneumatic
Date: 22-Aug-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.69	[L/min]	collected in field
injection flow rate (Q)	1.1E-05	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.93	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.27	[mags]	collected in field
depth to water	13.60	[mbtp]	Static WL in MW14-02B on 26-Aug-2014 at 20:00
Water Level 2 (manual)	12.33	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.00	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.83	[vertical mags]	collected in field
analog pressure gauge reading	40.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	42.3	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	7.5	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	7.5	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	5.1	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0016	[m/s]	flow rate divided by cross-sectional area
Reynold's number	94.98	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	2.2E-07	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	2.9E-08	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

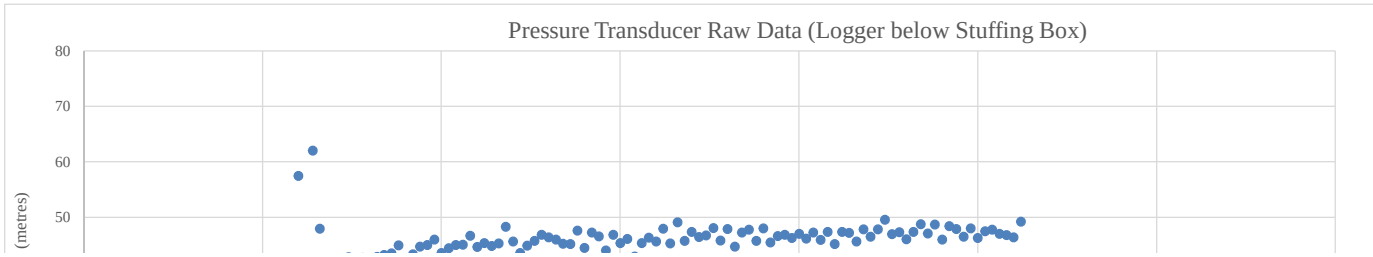
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-02B (BH-09, CFD-0418)	**Test Number:**	4	**Tester:**	RC
Date:	22-Aug-14	**Start Time:**	10:20 AM	**Stop Time:**	10:52 AM
Test Number:	4	**Geology:**	biotite-feldspar schist/crackle breccia	**Height of P gauge (mags):**	1.83
Depth to bit (m AH):	137			**Pipe Stickup (mags):**	3.12
Interval (Top) (m AH):	138.50	**Length of Packer (m):**	1.50	**Target Interval description:**	Low RQD, altered
Packer type (pneumatic/hydraulic):	pneumatic	**Interval Bottom (m AH):**	152		
Rod Type:	HQ	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod ID (mm):	77.8	**Type of water used:**	Fresh		
Hole Diamter (mm):	96	**Additives used (type):**	G-Stop in unsat. Zone		
transducer SN:	2031684	**packer inflation pressure (psi):**	525	**open hole static WL (mbgs):**	0.38
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	3190.00		42	
1	3196.50	6.50	43	Small leak at top of casing. Constant pressure for intervals.
2	3203.00	6.50	45	
3	3209.50	6.50	45	
4	3216.00	6.50	45	
5	3222.50	6.50	45	
6	3229.00	6.50	46	
7	3235.25	6.25	45	
8	3241.50	6.25	45	
9	3247.25	5.75	45	
10	3253.00	5.75	45	
11	3259.00	6.00	46	
12	3265.00	6.00	45	
13	3270.50	5.50	46	
14	3276.00	5.50	46	
15	3281.50	5.50	47	
16	3287.00	5.50	47	
17	3292.50	5.50	46	
18	3298.00	5.50	47	
19	3303.50	5.50	47	
20	3309.00	5.50	47	
21	3314.50	5.50	46	
22	3320.00	5.50	47	
23	3325.25	5.25	46	
24	3330.50	5.25	47	
25	3335.75	5.25	47	
26	3341.00	5.25	47	
27	3346.50	5.50	47	
28	3352.00	5.50	47	
29	3357.25	5.25	47	
30	3362.50	5.25	47	
	AVERAGE:	**5.31**	**46.9**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-02B (BH-09, CFD-0418)
Borehole Angle: 90 [degrees]
Test Number: 4
Start of Test Interval: 138.50 [mbgs]
End of Test Interval: 152 [mbgs]
Test Type: constant rate injection
Packer System: pneumatic
Date: 22-Aug-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	5.31	[L/min]	collected in field
injection flow rate (Q)	8.9E-05	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	3.12	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.27	[mags]	collected in field
depth to water	13.60	[mbtp]	Static WL in MW14-02B on 26-Aug-2014 at 20:00
Water Level 2 (manual)	12.33	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.06	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.02	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.83	[vertical mags]	collected in field
analog pressure gauge reading	46.9	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	47.0	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	13.5	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	13.5	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	5.6	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0122	[m/s]	flow rate divided by cross-sectional area
Reynold's number	734.0	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	1.7E-06	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	1.3E-07	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

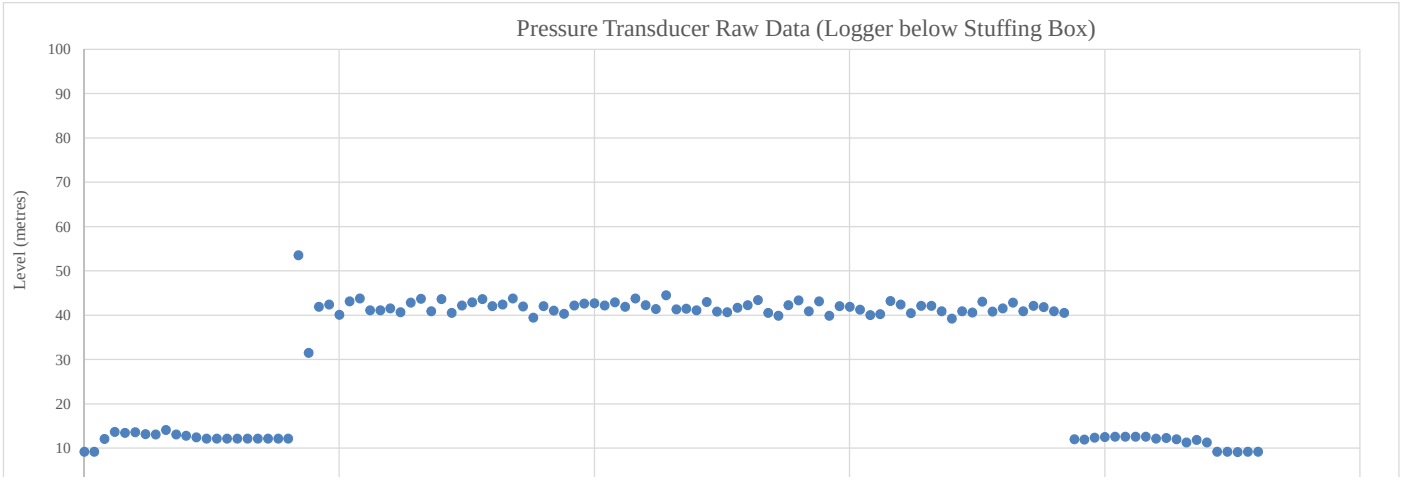
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-02B (BH-09, CFD-0418)	**Test Number:**	5	**Tester:**	RC
Date:	22-Aug-14	**Start Time:**	5:52 PM	**Stop Time:**	6:14 PM
Test Number:	5	**Geology:**	crackle breccia/hydrothermally altered/crackle breccia	**Height of P gauge (mags):**	1.83
Depth to bit (m AH):	155			**Pipe Stickup (mags):**	2.74
Interval (Top) (m AH):	156.50	**Length of Packer (m):**	1.50	**Target Interval description:**	Competent Gneiss
Packer type (pneumatic/hydraulic):	pneumatic	**Interval Bottom (m AH):**	173		
Rod Type:	HQ	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod ID (mm):	77.8	**Type of water used:**	Fresh		
Hole Diamter (mm):	96	**Additives used (type):**	G-Stop in unsat. Zone		
transducer SN:	2031684	**packer inflation pressure (psi):**	575	**open hole static WL (mbgs):**	1.36
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	3427.00		40	
1	3427.50	0.50	42	Constant pressure for intervals.
2	3428.00	0.50	41	
3	3428.75	0.75	42	
4	3429.50	0.75	42	
5	3430.00	0.50	41	
6	3430.50	0.50	42	
7	3431.25	0.75	41	
8	3432.00	0.75	41	
9	3432.50	0.50	42	
10	3433.00	0.50	40	
11	3433.75	0.75	40	
12	3434.50	0.75	42	
13	3435.00	0.50	40	
14	3435.50	0.50	41	
15	3436.25	0.75	40	
16	3437.00	0.75	41	
17	3437.50	0.50	40	
18	3438.00	0.50	40	
19	3438.75	0.75	40	
20	3439.50	0.75	40	
	AVERAGE:	**0.63**	**40.0**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-02B (BH-09, CFD-0418)
Borehole Angle: 90 [degrees]
Test Number: 5
Start of Test Interval: 156.50 [mbgs]
End of Test Interval: 173 [mbgs]
Test Type: constant rate injection
Packer System: pneumatic
Date: 22-Aug-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.63	[L/min]	collected in field
injection flow rate (Q)	1.0E-05	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.74	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.27	[mags]	collected in field
depth to water	13.60	[mbtp]	Static WL in MW14-02B on 26-Aug-2014 at 20:00
Water Level 2 (manual)	12.33	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.00	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.83	[vertical mags]	collected in field
analog pressure gauge reading	40.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	42.3	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	16.5	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	16.5	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	5.8	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0014	[m/s]	flow rate divided by cross-sectional area
Reynold's number	86.3	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	2.3E-07	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	1.4E-08	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

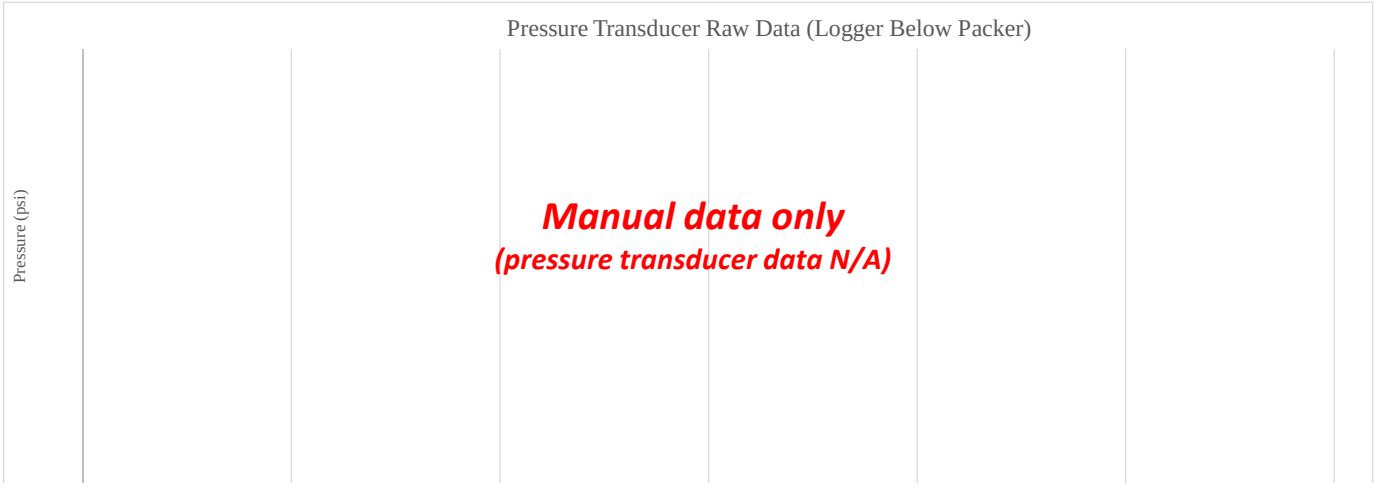
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-02B (BH-09, CFD-0418)	**Test Number:**	6	**Tester:**	MS/CB
Date:	23-Aug-14	**Start Time:**	4:40 AM	**Stop Time:**	5:03 AM
Test Number:	6	**Geology:**	biotite-feldspar schist	**Height of P gauge (mags):**	1.83
Depth to bit (m AH):	179	**Length of Packer (m):**	1.50	**Pipe Stickup (mags):**	2.93
Interval (Top) (m AH):	180.50	**Interval Bottom (m AH):**	200	**Target Interval description:**	
Packer type (pneumatic/hydraulic):	pneumatic	**Hole dip:**	90		
Rod Type:	HQ	**Type of water used:**	Fresh	**Hydraulic packer sink time:**	n/a
Rod ID (mm):	77.8	**Additives used (type):**	G-Stop in unsat. Zone		
Hole Diamter (mm):	96				
transducer SN:	n/a	**packer inflation pressure (psi):**	-	**open hole static WL (mbgs):**	n/a
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	3485.0		35	
1	3486.0	1.00	35	
2	3487.0	1.00	35	
3	3488.0	1.00	35	
4	3489.0	1.00	35	
5	3490.0	1.00	35	
6	3491.0	1.00	35	
7	3492.0	1.00	35	
8	3492.5	0.50	35	
9	3493.0	0.50	35	
10	3493.5	0.50	35	
11	3494.0	0.50	35	
12	3494.5	0.50	35	
13	3495.0	0.50	35	
14	3495.5	0.50	35	
15	3496.0	0.50	35	
16	3496.5	0.50	35	
17	3497.0	0.50	35	
18	3497.5	0.50	35	
19	3498.0	0.50	35	
20	3498.5	0.50	35	
	AVERAGE:	**0.50**	**35**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-02B (BH-09, CFD-0418)
Borehole Angle: 90 [degrees]
Test Number: 6
Start of Test Interval: 180.50 [mbgs]
End of Test Interval: 200 [mbgs]
Test Type: constant rate injection
Packer System: pneumatic
Date: 23-Aug-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.50	[L/min]	collected in field
injection flow rate (Q)	8.3E-06	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.93	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.00	[mags]	collected in field
depth to water	4.89	[mbtp]	Static WL in MW14-02A on 1-Sept-14 at 15:00
Water Level 2 (manual)	3.90	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.00	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.83	[vertical mags]	collected in field
analog pressure gauge reading	35.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	30.3	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	19.5	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	19.5	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.0	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0012	[m/s]	flow rate divided by cross-sectional area
Reynold's number	69.1	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	2.6E-07	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	1.3E-08	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

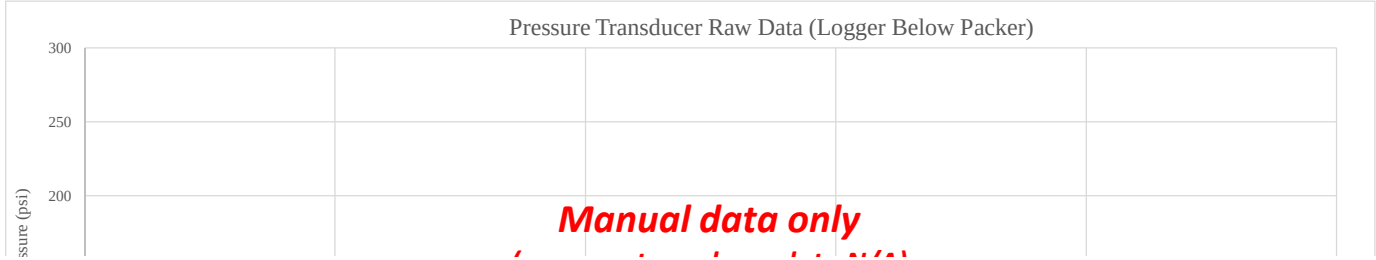
Borehole:	MW14-03A (BH-03, CFD-0432)	**Test Number:**	1	**Tester:**	CB
Date:	31-Aug-14	**Start Time:**	5:25 PM	**Stop Time:**	6:15 PM
Test Number:	1	**Geology:**	crackle breccia/dacite/biotite-feldspar schist	**Height of P gauge (mags):**	1.52
Depth to bit (m AH):	80			**Pipe Stickup (mags):**	2.41
Interval (Top) (m AH):	81.50	**Length of Packer (m):**	1.50	**Target Interval description:**	
Packer type (pneumatic/hydraulic):	pneumatic	**Interval Bottom (m AH):**	110	**Hydraulic packer sink time:**	n/a
Rod Type:	HQ	**Hole dip:**	90		
Rod ID (mm):	77.8	**Type of water used:**	Fresh		
Hole Diamter (mm):	96	**Additives used (type):**			
transducer SN:	n/a	**packer inflation pressure (psi):**		**open hole static WL (mbgs):**	n/a
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	3520			Test started at approx. 17:25
1	3531	11.0		
2	3541	10.0		
3	3558	17.0		
4	3573	15.0		
5	3582	9.0		
6	3595	13.0		
7	3605	10.0		
8		-		Test stopped at approx. 17:33
-		-		
30	3700	-	30	Test started at approx. 17:45
31	3709	9.0	30	
32	3719	10.0	30	Pressure fluctuating 25-35 psi
33	3727	8.0	30	
34	3738	11.0	30	
35	3747	9.0	30	
36	3757	10.0	30	
37	3767	10.0	30	
38	3776	9.0	30	
39	3786	10.0	30	
40	3795	9.0	30	
41	3805	10.0	30	
42	3815	10.0	30	
43	3824	9.0	30	
44	3834	10.0	30	
45	3844	10.0	30	
46	3854	10.0	30	
47	3863	9.0	30	
48	3873	10.0	30	
49	3883	10.0	30	
50	3893	10.0	30	
	AVERAGE:	**9.75**	**30**	

Test not valid - unsaturated test interval (based on estimated static WL)

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-03A (BH-03, CFD-0432)
Borehole Angle: 90 [degrees]
Test Number: 1
Start of Test Interval: 81.50 [mbgs]
End of Test Interval: 110 [mbgs]
Test Type: constant rate injection
Packer System: pneumatic
Date: 31-Aug-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	9.75	[L/min]	collected in field
injection flow rate (Q)	1.6E-04	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.41	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	0.97	[mags]	collected in field
depth to water	133.64	[mbtp]	Static WL in MW14-03B on 13-Oct-2014 at 15:41
Water Level 2 (manual)	132.67	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.18	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.06	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.52	[vertical mags]	collected in field
analog pressure gauge reading	30.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	155.0	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	28.5	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	28.5	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.4	[-]	calculated
Is packer test interval in the unsaturated zone?	TRUE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0225	[m/s]	flow rate divided by cross-sectional area
Reynold's number	1347.0	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	1.1E-06	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	3.7E-08	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

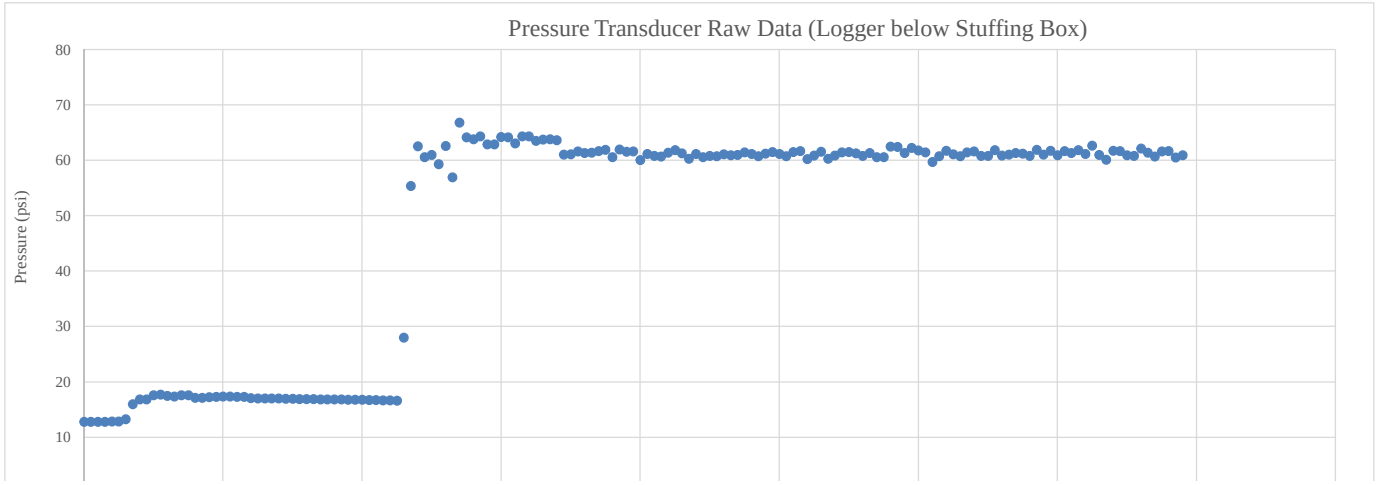
Borehole:	MW14-03A (BH-03, CFD-0432)	**Test Number:**	2	**Tester:**	RC
Date:	31-Aug-14	**Start Time:**	4:55 PM	**Stop Time:**	6:00 PM
Test Number:	2	**Geology:**	metacarbonate/biotite-feldspar schist	**Height of P gauge (mags):**	1.52
Depth to bit (m AH):	110			**Pipe Stickup (mags):**	2.44
Interval (Top) (m AH):	111.50	**Length of Packer (m):**	1.50	**Target Interval description:**	Low RQD, altered
Packer type (pneumatic/hydraulic):	pneumatic	**Interval Bottom (m AH):**	140		
Rod Type:	HQ	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod ID (mm):	77.8	**Type of water used:**	Fresh		
Hole Diamter (mm):	96	**Additives used (type):**	G-Stop		
transducer SN:	2031684	**packer inflation pressure (psi):**	525	**open hole static WL (mbgs):**	45.83
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	3909.0		42	Water level taken after a minute of filling the rods. Depth to water table likely greater than 48.27 mbtop.
1	3910.5	1.50	41	
2	3912.0	1.50	42	
3	3913.5	1.50	41	
4	3915.0	1.50	42	Constant pressure for intervals.
5	3916.5	1.50	42	
6	3918.0	1.50	42	
7	3919.5	1.50	42	
8	3921.0	1.50	42	
9	3922.3	1.25	42	
10	3923.5	1.25	41	
11	3925.0	1.50	42	
12	3926.5	1.50	42	
13	3927.8	1.25	42	
14	3929.0	1.25	43	
15	3930.3	1.25	44	
16	3931.5	1.25	43	
17	3933.0	1.50	43	
18	3934.5	1.50	44	
19	3935.8	1.25	44	
20	3937.0	1.25	44	
	AVERAGE:	**1.31**	**43.6**	

Test not valid - partially unsaturated test interval (based on estimated static WL)

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-03A (BH-03, CFD-0432)
Borehole Angle: 90 [degrees]
Test Number: 2
Start of Test Interval: 111.50 [mbgs]
End of Test Interval: 140 [mbgs]
Test Type: constant rate injection
Packer System: pneumatic
Date: 31-Aug-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	1.31	[L/min]	collected in field
injection flow rate (Q)	2.2E-05	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.44	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	0.97	[mags]	collected in field
depth to water	133.64	[mbtp]	Static WL in MW14-02B on 26-Aug-2014 at 20:00
Water Level 2 (manual)	132.67	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.00	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.52	[vertical mags]	collected in field
analog pressure gauge reading	43.6	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	164.8	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	28.5	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	28.5	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.4	[-]	calculated
Is packer test interval in the unsaturated zone?	TRUE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0030	[m/s]	flow rate divided by cross-sectional area
Reynold's number	181.3	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	1.3E-07	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	4.7E-09	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

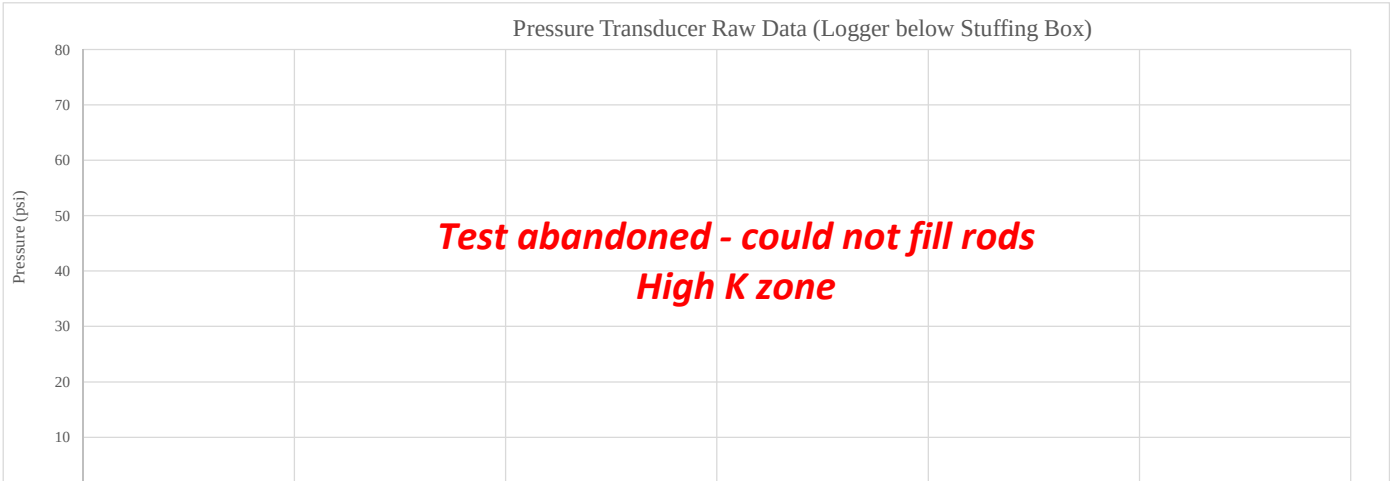
Borehole:	MW14-03A (BH-03, CFD-0432)	**Test Number:**	3	**Tester:**	RC
Date:	1-Sep-14	**Start Time:**	n/a	**Stop Time:**	n/a
Test Number:	3	**Geology:**	biotite-feldspar schist /crackle breccia/biotite-feldspar schist	**Height of P gauge (mags):**	1.52
Depth to bit (m AH):	131			**Pipe Stickup (mags):**	2.38
Interval (Top) (m AH):	132.50	**Length of Packer (m):**	1.50	**Target Interval description:**	crackle breccia 143 - 145.1 m
Packer type (pneumatic/hydraulic):	pneumatic	**Interval Bottom (m AH):**	155		
Rod Type:	HQ	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod ID (mm):	77.8	**Type of water used:**	Fresh		
Hole Diamter (mm):	96	**Additives used (type):**	G-Stop		
transducer SN:	n/a	**packer inflation pressure (psi):**	550	**open hole static WL (mbgs):**	131.98
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
1	30.0	30.00	1	estimated
2	60.0	30.00	1	estimated
3	90.0	30.00	1	estimated
4	120.0	30.00	1	estimated
	AVERAGE:	**30.00**	**1.0**	

Test abandoned - could not fill rods
High K zone

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-03A (BH-03, CFD-0432)
Borehole Angle: 90 [degrees]
Test Number: 3
Start of Test Interval: 132.50 [mbgs]
End of Test Interval: 155 [mbgs]
Test Type: constant rate injection
Packer System: pneumatic
Date: 1-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	30.00	[L/min]	collected in field
injection flow rate (Q)	5.0E-04	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.38	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	0.97	[mags]	collected in field
depth to water	133.64	[mbtp]	Static WL in MW14-03B on 13-Oct-2014 at 15:41
Water Level 2 (manual)	132.67	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	1.47	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.44	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.52	[vertical mags]	collected in field
analog pressure gauge reading	1.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	133.0	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	22.5	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	22.5	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.2	[-]	calculated
Is packer test interval in the unsaturated zone?	TRUE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0691	[m/s]	flow rate divided by cross-sectional area
Reynold's number	4144.7	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Turbulent	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	3.7E-06	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	1.6E-07	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

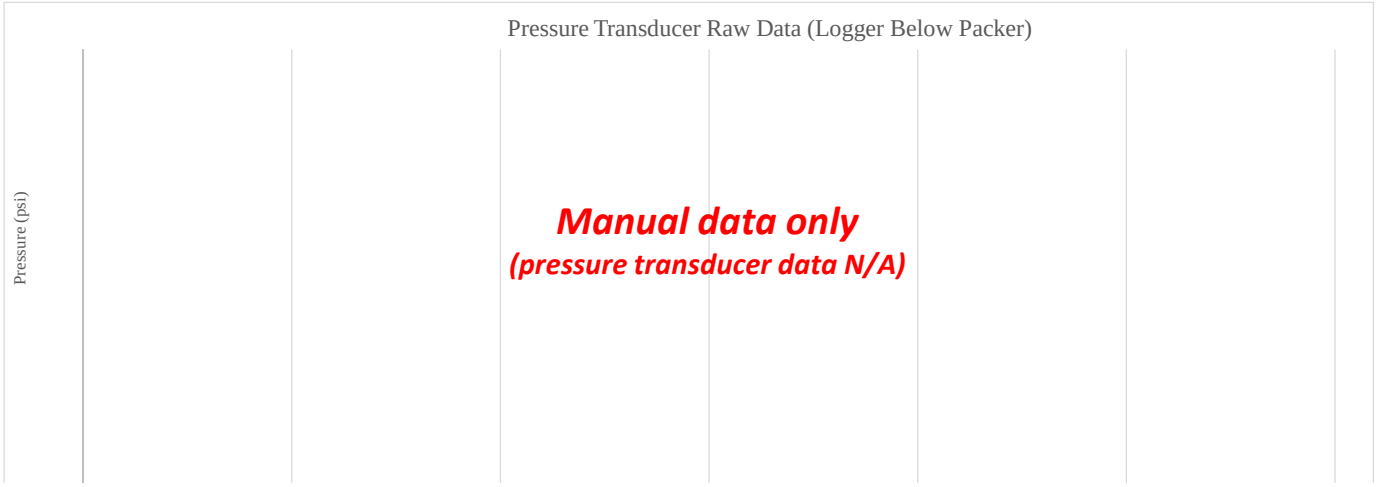
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-03A (BH-03, CFD-0432)	**Test Number:**	4	**Tester:**	CB
Date:	5-Sep-14	**Start Time:**	10:23 PM	**Stop Time:**	10:44 PM
Test Number:	4	**Geology:**	biotite-feldspar schist/shear zone/biotite-feldspar schist	**Height of P gauge (mags):**	1.52
Depth to bit (m AH):	155			**Pipe Stickup (mags):**	2.41
Interval (Top) (m AH):	156.50	**Length of Packer (m):**	1.50	**Target Interval description:**	shear zone 188.3 - 194.7
Packer type (pneumatic/hydraulic):	pneumatic	**Interval Bottom (m AH):**	198.5		
Rod Type:	HQ	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod ID (mm):	77.8	**Type of water used:**	Fresh		
Hole Diamter (mm):	96	**Additives used (type):**			
transducer SN:	n/a	**packer inflation pressure (psi):**	600	**open hole static WL (mbgs):**	n/a
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	7675		60	
1	7677.5	2.5	60	
2	7680	2.5	60	
3	7682	2.0	60	
4	7684.5	2.5	60	
5	7687	2.5	60	
6	7689.5	2.5	60	
7	7692	2.5	60	Decreased pressure as was a
8	7694	2.0	60	little above 60
9	7696	2.0	60	
10	7697.5	1.5	60	
11	7699.5	2.0	60	
12	7702	2.5	60	
13	7704	2.0	60	
14	7706	2.0	60	
15	7708.5	2.5	60	
16	7710.5	2.0	60	
17	7713	2.5	60	
18	7715	2.0	60	
19	7717	2.0	60	
20	7719	2.0	60	
	AVERAGE:	**2.15**	**60.0**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-03A (BH-03, CFD-0432)
Borehole Angle: 90 [degrees]
Test Number: 4
Start of Test Interval: 156.50 [mbgs]
End of Test Interval: 199 [mbgs]
Test Type: constant rate injection
Packer System: pneumatic
Date: 5-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	2.15	[L/min]	collected in field
injection flow rate (Q)	3.6E-05	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.41	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	0.97	[mags]	collected in field
depth to water	133.64	[mbtp]	Static WL in MW14-03B on 13-Oct-2014 at 15:41
Water Level 2 (manual)	132.67	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.01	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.00	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	1.52	[vertical mags]	collected in field
analog pressure gauge reading	60.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	176.4	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	42.0	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	42.0	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.8	[-]	calculated
Is packer test interval in the unsaturated zone?	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.005	[m/s]	flow rate divided by cross-sectional area
Reynold's number	297.0	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	2.2E-07	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	5.2E-09	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

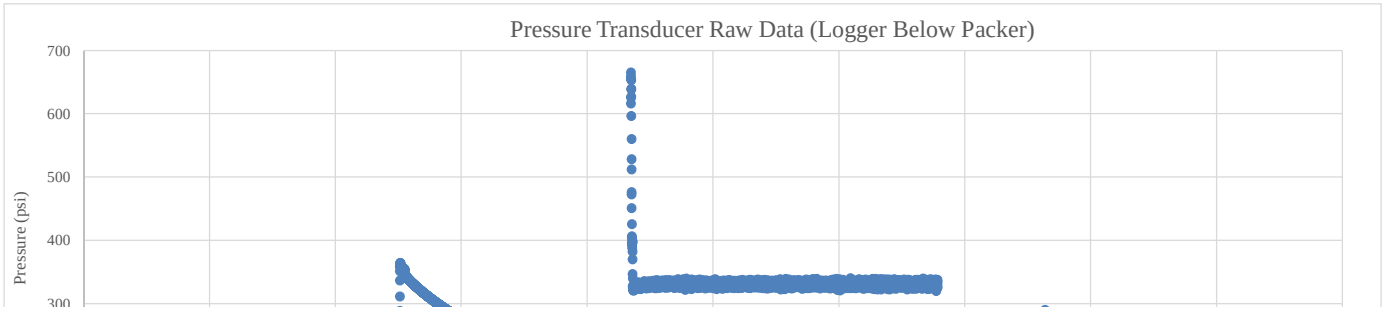
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-04T (BH-06, CFD-0439)	**Test Number:**	1	**Tester:**	JY
Date:	9-Sep-14	**Start Time:**	5:20 PM	**Stop Time:**	6:49 PM
Test Number:	1	**Geology:**		**Height of P gauge (mags):**	2.0
Depth to bit (m AH):	181	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	2.5
Interval (Top) (m AH):	182.25	**Interval Bottom (m AH):**	202	**Target Interval description:**	
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**	G-Stop in unsat. Zone		
Hole Diamter (mm):	96				
transducer SN:	301401 (Troll 700)	**packer inflation pressure (psi):**	500	**open hole static WL (mbgs):**	n/a
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	929		0	Started test at 17:20
0.5	929	0	0	
2.5	934.6	2.80	50	
3.5	934.775	0.17	50	
5	935.05	0.18		
6	935.175	0.13	50	
7	935.18	0.005		
10	935.55	0.12	50	
15	935.95	0.08	50	
20	936.25	0.06	50	
25	936.57	0.06	50	
30	936.88	0.06	50	17:50 - test stopped (shear pin did not
0				17:54 - shear pin blew
0.5	942.55		50	
1	943.35	1.60	50	
1.5	943.87	1.04	60	
2	944.32	0.90	60	
3	944.66	0.34	60	
4	944.77	0.11	60	
5	944.88	0.11		
7	945.08	0.10	55	
10	945.39	0.10	60	
16	945.9	0.08	55	
20	946.17	0.07	60	
26	946.71	0.09	60	
30	946.92	0.05	60	
36	947.24	0.05	55	
40	947.44	0.05	55	18:34 - test end
	AVERAGE:	**0.05**	**56.7**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-04T (BH-06, CFD-0439)
Borehole Angle: 90 [degrees]
Test Number: 1
Start of Test Interval: 182.25 [mbgs]
End of Test Interval: 202 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 9-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.05	[L/min]	collected in field
injection flow rate (Q)	8.7E-07	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	183.3	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.50	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	0.33	[mags]	collected in field
depth to water	158.08	[mbtp]	Estimated from the closest static WL at MW14-01B (accounts for elevation difference).
Water Level 2 (manual)	157.75	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.00	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	2.00	[vertical mags]	collected in field
analog pressure gauge reading	56.7	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	199.6	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	19.8	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	19.8	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.0	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0001	[m/s]	flow rate divided by cross-sectional area
Reynold's number	7.2	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	4.2E-09	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	2.1E-10	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

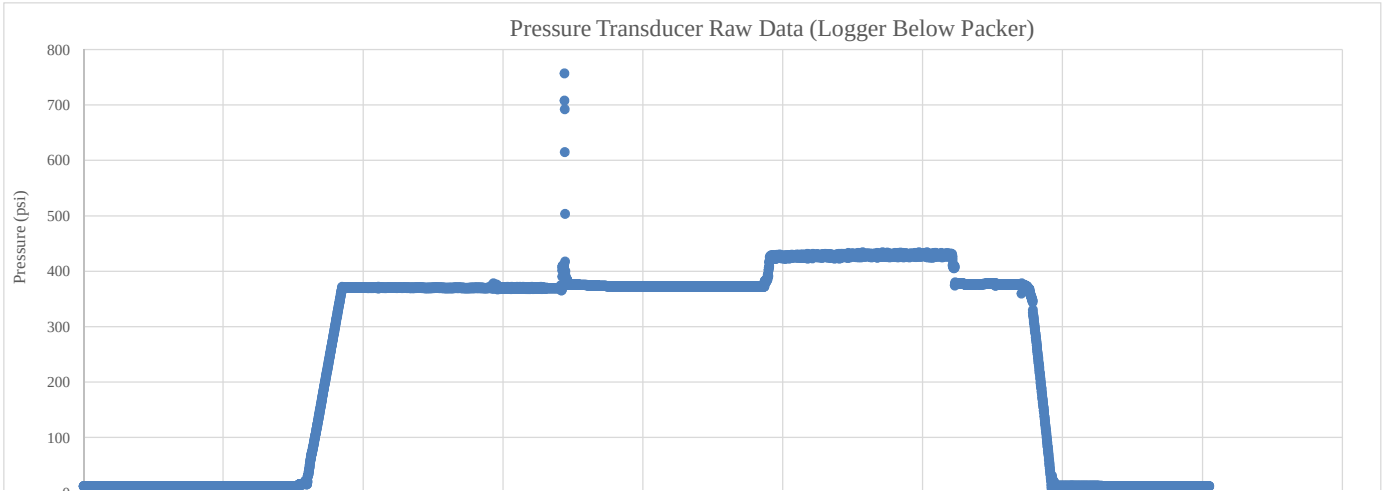
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-04T (BH-06, CFD-0439)	**Test Number:**	5	**Tester:**	MS
Date:	10-Sep-14	**Start Time:**	11:06 PM	**Stop Time:**	12:00 AM
Test Number:	5	**Geology:**		**Height of P gauge (mags):**	2.0
Depth to bit (m AH):	250	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	2.5
Interval (Top) (m AH):	251.25	**Interval Bottom (m AH):**	280	**Target Interval description:**	
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**	G-Stop in unsat. Zone		
Hole Diamter (mm):	96				
transducer SN:	301401 (Troll 700)	**packer inflation pressure (psi):**	500	**open hole static WL (mbgs):**	n/a
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	519.50		50	11:29
1	519.72	0.22	50	
2	519.90	0.18	50	
3	519.98	0.08	50	
4	520.10	0.12	50	
5	520.20	0.10	50	
6	520.30	0.10	50	
7	520.40	0.10	50	
8	520.50	0.10	50	
9	520.60	0.10	50	
10	520.70	0.10	50	
11	520.80	0.10	50	
12	520.90	0.10	50	
13	520.98	0.08	50	
14	521.06	0.08	50	
15	521.13	0.07	50	
16	521.22	0.09	50	
17	521.30	0.08	50	
18	521.40	0.10	50	
19	521.50	0.10	50	
20	521.60	0.10	50	
	AVERAGE:	**0.094**	**50**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-04T (BH-06, CFD-0439)
Borehole Angle: 90 [degrees]
Test Number: 5
Start of Test Interval: 251.25 [mbgs]
End of Test Interval: 280 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 10-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.09	[L/min]	collected in field
injection flow rate (Q)	1.6E-06	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.50	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	0.33	[mags]	collected in field
depth to water	158.08	[mbtp]	Estimated from the closest static WL at MW14-01B (accounts for elevation difference).
Water Level 2 (manual)	157.75	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.01	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	2.00	[vertical mags]	collected in field
analog pressure gauge reading	50.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	194.9	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	28.8	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	28.8	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.4	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0002	[m/s]	flow rate divided by cross-sectional area
Reynold's number	13.0	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	8.2E-09	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	2.8E-10	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

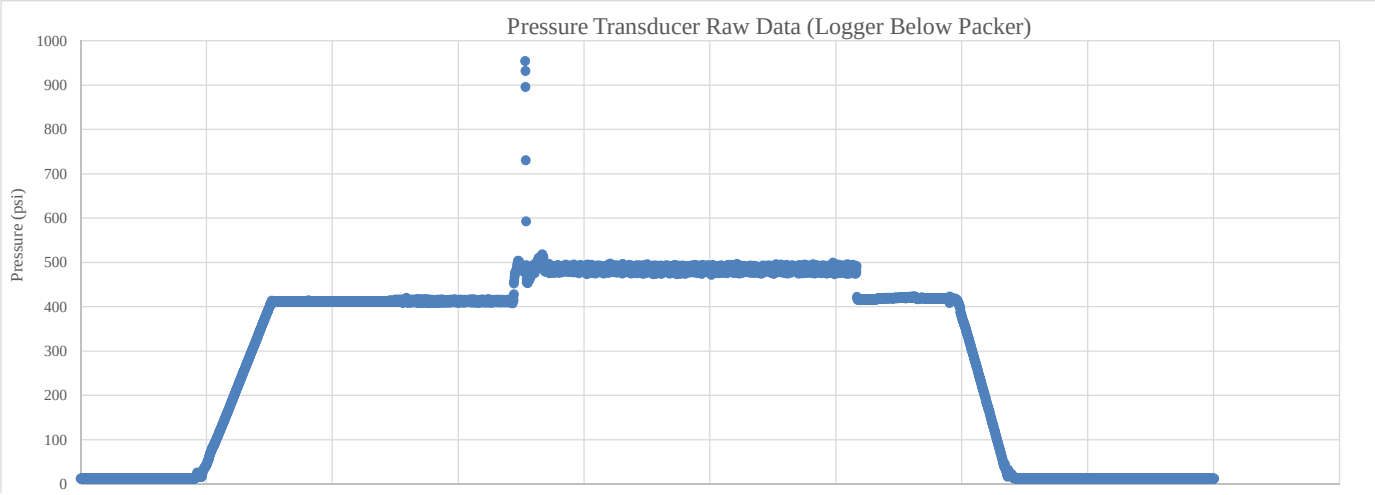
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-04T (BH-06, CFD-0439)	**Test Number:**	6	**Tester:**	MS
Date:	11-Sep-14	**Start Time:**	5:30 AM	**Stop Time:**	6:28 AM
Test Number:	6	**Geology:**		**Height of P gauge (mags):**	2.0
Depth to bit (m AH):	280	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	2.5
Interval (Top) (m AH):	281.25	**Interval Bottom (m AH):**	301	**Target Interval description:**	
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**	G-Stop in unsat. Zone		
Hole Diamter (mm):	96				
transducer SN:	301401 (Troll 700)	**packer inflation pressure (psi):**	500	**open hole static WL (mbgs):**	n/a
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	607.30		70	
1	607.51	0.21	70	
2	607.78	0.27	70	
3	607.98	0.20	70	
4	608.16	0.18	70	
5	608.38	0.22	70	
6	608.55	0.17	70	
7	608.71	0.16	70	
8	608.85	0.14	70	
9	609.04	0.19	70	
10	609.20	0.16	70	
11	609.32	0.12	70	
12	609.50	0.18	70	
13	609.61	0.11	70	
14	609.83	0.22	70	
15	609.90	0.07	70	**Flow rates during the constant rate injection test are within the range measured during leak testing. Therefore test not analyzed.**
16	610.10	0.20	70	
17	610.15	0.05	70	
18	610.20	0.05	70	
19	610.31	0.11	70	
20	610.44	0.13	70	
	AVERAGE:	**0.12**	**70**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-04T (BH-06, CFD-0439)
Borehole Angle: 90 [degrees]
Test Number: 6
Start of Test Interval: 281.25 [mbgs]
End of Test Interval: 301 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 11-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.12	[L/min]	collected in field
injection flow rate (Q)	2.1E-06	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.50	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	-	[mags]	collected in field
depth to water	-	[mbtp]	Static WL in MW14-02B on 26-Aug-2014 at 20:00
Water Level 2 (manual)	#VALUE!	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.01	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	2.00	[vertical mags]	collected in field
analog pressure gauge reading	70.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	#VALUE!	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	19.8	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	19.8	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.0	[-]	calculated
Is packer test interval in the unsaturated zone	#VALUE!	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0003	[m/s]	flow rate divided by cross-sectional area
Reynold's number	17.1	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	#VALUE!	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	#VALUE!	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

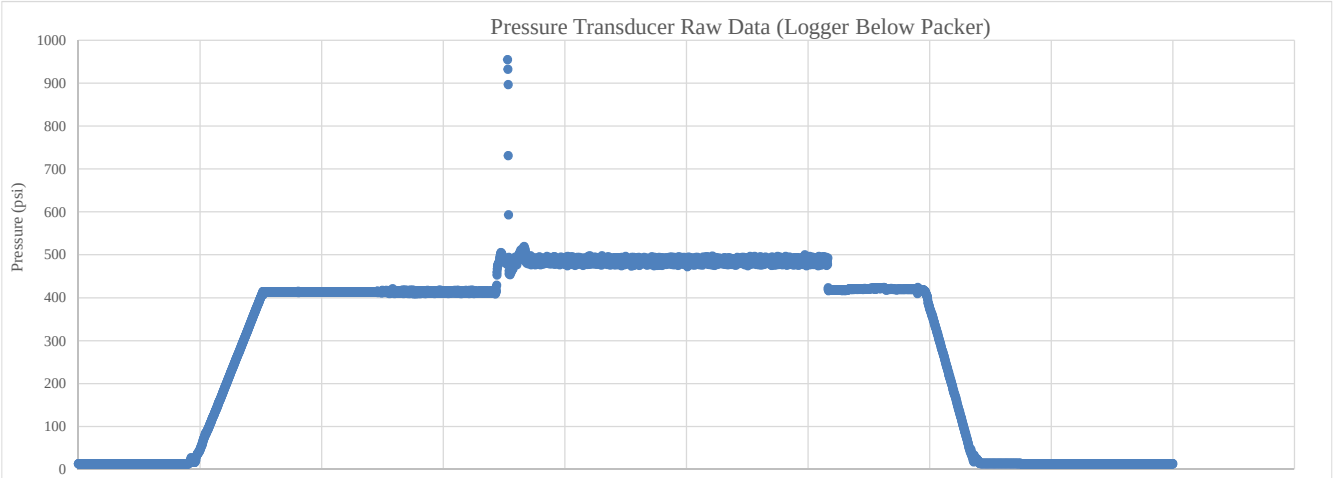
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-04T (BH-06, CFD-0439)	**Test Number:**	6	**Tester:**	MS
Date:	11-Sep-14	**Start Time:**	5:30 AM	**Stop Time:**	6:28 AM
Test Number:	6	**Geology:**		**Height of P gauge (mags):**	2.0
Depth to bit (m AH):	280	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	2.5
Interval (Top) (m AH):	281.25	**Interval Bottom (m AH):**	301	**Target Interval description:**	
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90	**Hydraulic packer sink time:**	n/a
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**	G-Stop in unsat. Zone		
Hole Diamter (mm):	96				
transducer SN:	301401 (Troll 700)	**packer inflation pressure (psi):**	500	**open hole static WL (mbgs):**	n/a
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	607.30		70	
1	607.51	0.21	70	
2	607.78	0.27	70	
3	607.98	0.20	70	
4	608.16	0.18	70	
5	608.38	0.22	70	
6	608.55	0.17	70	
7	608.71	0.16	70	
8	608.85	0.14	70	
9	609.04	0.19	70	
10	609.20	0.16	70	
11	609.32	0.12	70	
12	609.50	0.18	70	
13	609.61	0.11	70	
14	609.83	0.22	70	
15	609.90	0.07	70	**Flow rates during the constant rate injection test are within the range measured during leak testing. Therefore test not analyzed.**
16	610.10	0.20	70	
17	610.15	0.05	70	
18	610.20	0.05	70	
19	610.31	0.11	70	
20	610.44	0.13	70	
	AVERAGE:	**0.12**	**70**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-04T (BH-06, CFD-0439)
Borehole Angle: 90 [degrees]
Test Number: 6
Start of Test Interval: 281.25 [mbgs]
End of Test Interval: 301 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 11-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.01	[L/min]	collected in field
injection flow rate (Q)	1.7E-07	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.50	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	0.33	[mags]	collected in field
depth to water	158.08	[mbtp]	Estimated from the closest static WL at MW14-01B (accounts for elevation difference).
Water Level 2 (manual)	157.75	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.00	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	2.00	[vertical mags]	collected in field
analog pressure gauge reading	70.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	209.0	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	19.8	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	19.8	[m]	assumed (equivalent to length of test interval)
ln(R_i/R_{ew})	6.0	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0000	[m/s]	flow rate divided by cross-sectional area
Reynold's number	1.4	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	7.6E-10	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	3.9E-11	[m/s]	equivalent to T divided by test interval

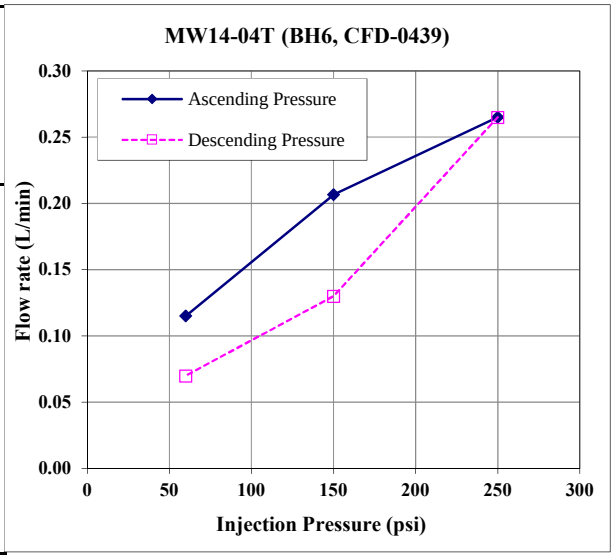
mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Location: **MW14-04T (BH6, CFD-0439)** **Lugeon Test**

Test Interval: **164.3-202** **(m bgs)**

Injection Pressure (Pi) (psi)	Net Injection Pressure (H) (m)	Stabilized Flow Rate (Q) (m^3/min)	Stabilized Flow Rate (Q) (L/min)
60	201.9	0.00012	0.12
150	265.3	0.00021	0.21
250	335.6	0.00027	0.27
150	265.3	0.00013	0.13
60	202.0	0.00007	0.07
-	-	-	-
-	-	-	-



$T=Q\ln(R/r_b)/2\Pi H$

T = transmissivity [L^2/t]
Q = flow rate [L^3/t]
R = radius of influence (assumed to equal packer interval length, b) [L]
r_b = radius of borehole [L]
H= net injection pressure [L]

K=T/b

K = hydraulic conductivity [L/t]
b = packer interval length [L]

Pressure Interval	T (m^2/s)	K (m/s)	Flow Descriptor
60 psi	1.0E-08	2.7E-10	Laminar
150 psi	1.4E-08	3.7E-10	Laminar
250 psi	1.4E-08	3.7E-10	Laminar
150 psi	8.7E-09	2.3E-10	Laminar
60 psi	6.1E-09	1.6E-10	Laminar
-	-	-	-
-	-	-	-

Test Geometry	
0.0778	inside diameter of HQ rod
2	height of pressure gauge above ground
202	depth to bottom of packer
157.75	depth to pre-test water level
0.048	radius of drillhole (HQ)

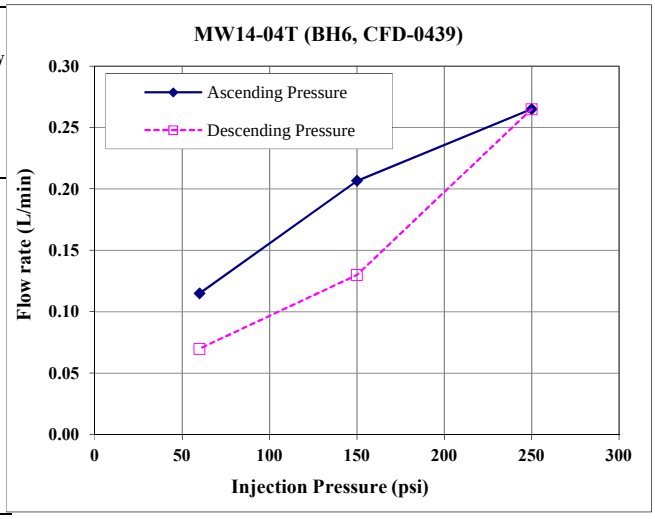
Packer Test Results

Pressure Interval	T (m^2/s)	K (m/s)
Avg(ascending)	1.3E-08	3.3E-10
Avg(descending)	9.6E-09	2.5E-10
Average	1.1E-08	2.8E-10

Location: **MW14-04T (BH6, CFD-0439)** **Lugeon Test**

Test Interval: **164.3-182.3 (m bgs)**

Injection Pressure (Pi) (psi)	Net Injection Pressure (H) (m)	Stabilized Flow Rate (Q) (m^3/min)	Stabilized Flow Rate (Q) (L/min)
60	201.9	0.00012	0.12
150	265.3	0.00021	0.21
250	335.6	0.00027	0.27
150	265.3	0.00013	0.13
60	202.0	0.00007	0.07
-	-	-	-
-	-	-	-



$T=Q\ln(R/r_b)/2\Pi H$

T = transmissivity [L^2/t]
Q = flow rate [L^3/t]
R = radius of influence (assumed to equal packer interval length, b) [L]
r_b = radius of borehole [L]
H= net injection pressure [L]

K=T/b

K = hydraulic conductivity [L/t]
b = packer interval length [L]

Pressure Interval	T (m^2/s)	K (m/s)	Flow Descriptor
60 psi	9.0E-09	5.0E-10	Laminar
150 psi	1.2E-08	6.8E-10	Laminar
250 psi	1.2E-08	6.9E-10	Laminar
150 psi	7.7E-09	4.3E-10	Laminar
60 psi	5.4E-09	3.0E-10	Laminar
-	-	-	-
-	-	-	-

Test Geometry	
0.0778	inside diameter of HQ rod
2	height of pressure gauge above ground
182.3	depth to bottom of packer
157.75	depth to pre-test water level
0.048	radius of drillhole (HQ)

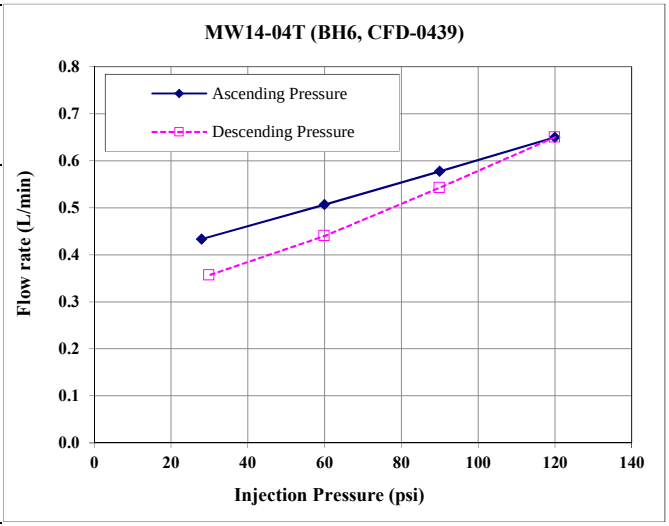
Packer Test Results

Pressure Interval	T (m^2/s)	K (m/s)
Avg(ascending)	1.1E-08	6.2E-10
Avg(descending)	8.5E-09	4.7E-10
Average	9.4E-09	5.2E-10

Location: **MW14-04T (BH6, CFD-0439)** **Lugeon Test**

Test Interval: **203.3-232 (m bgs)**

Injection Pressure (Pi) (psi)	Net Injection Pressure (H) (m)	Stabilized Flow Rate (Q) (m^3/min)	Stabilized Flow Rate (Q) (L/min)
28	179.4	0.00043	0.43
60	201.9	0.00051	0.51
90	223.0	0.00058	0.58
120	244.1	0.00065	0.65
90	223.0	0.00054	0.54
60	201.9	0.00044	0.44
30	180.8	0.00036	0.36



$T=Q\ln(R/r_b)/2\Pi H$

T = transmissivity [L^2/t]
Q = flow rate [L^3/t]
R = radius of influence (assumed to equal packer interval length, b) [L]
r_b = radius of borehole [L]
H= net injection pressure [L]

K=T/b

K = hydraulic conductivity [L/t]
b = packer interval length [L]

Pressure Interval	T (m^2/s)	K (m/s)	Flow Descriptor
28 psi	4.1E-08	1.4E-09	Laminar
60 psi	4.3E-08	1.5E-09	Laminar
90 psi	4.4E-08	1.5E-09	Laminar
120 psi	4.5E-08	1.6E-09	Laminar
90 psi	4.1E-08	1.4E-09	Laminar
60 psi	3.7E-08	1.3E-09	Laminar
30 psi	3.3E-08	1.2E-09	Laminar

Test Geometry	
0.0778	inside diameter of HQ rod
2	height of pressure gauge above ground
232	depth to bottom of packer
157.75	depth to pre-test water level
0.048	radius of drillhole (HQ)

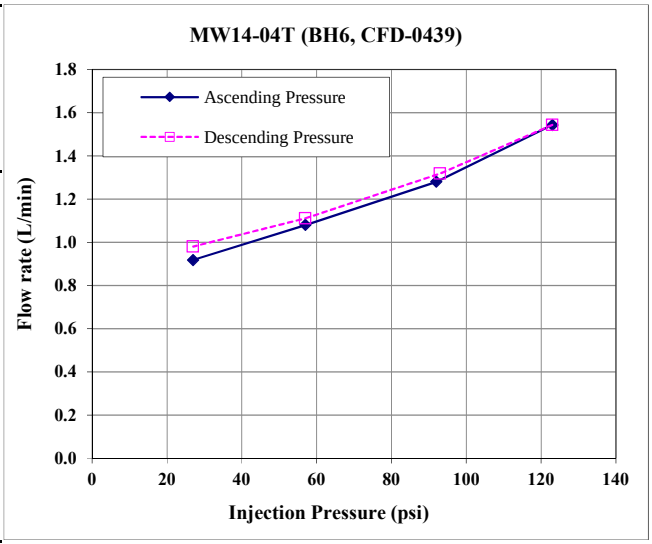
Packer Test Results

Pressure Interval	T (m^2/s)	K (m/s)
Avg(ascending)	4.3E-08	1.5E-09
Avg(descending)	3.9E-08	1.4E-09
Average	4.1E-08	1.4E-09

Location: **MW14-04T (BH6, CFD-0439)** **Lugeon Test**

Test Interval: **233.3-256 (m bgs)**

Injection Pressure (Pi) (psi)	Net Injection Pressure (H) (m)	Stabilized Flow Rate (Q) (m^3/min)	Stabilized Flow Rate (Q) (L/min)
27	178.7	0.00092	0.92
57	199.8	0.00108	1.08
92	224.4	0.00128	1.28
123	246.2	0.00154	1.54
93	225.1	0.00132	1.32
57	199.8	0.00111	1.11
27	178.7	0.00098	0.98



$T=Q\ln(R/r_b)/2\Pi H$

T = transmissivity [L^2/t]
Q = flow rate [L^3/t]
R = radius of influence (assumed to equal packer interval length, b) [L]
r_b = radius of borehole [L]
H= net injection pressure [L]

K=T/b

K = hydraulic conductivity [L/t]
b = packer interval length [L]

Pressure Interval	T (m^2/s)	K (m/s)	Flow Descriptor
27 psi	8.4E-08	3.7E-09	Laminar
57 psi	8.8E-08	3.9E-09	Laminar
92 psi	9.3E-08	4.1E-09	Laminar
123 psi	1.0E-07	4.5E-09	Laminar
93 psi	9.6E-08	4.2E-09	Laminar
57 psi	9.1E-08	4.0E-09	Laminar
27 psi	9.0E-08	3.9E-09	Laminar

Test Geometry	
0.0778	inside diameter of HQ rod
2	height of pressure gauge above ground
256	depth to bottom of packer
157.75	depth to pre-test water level
0.048	radius of drillhole (HQ)

Packer Test Results

Pressure Interval	T (m^2/s)	K (m/s)
Avg(ascending)	9.2E-08	4.1E-09
Avg(descending)	9.5E-08	4.2E-09
Average	9.2E-08	4.1E-09

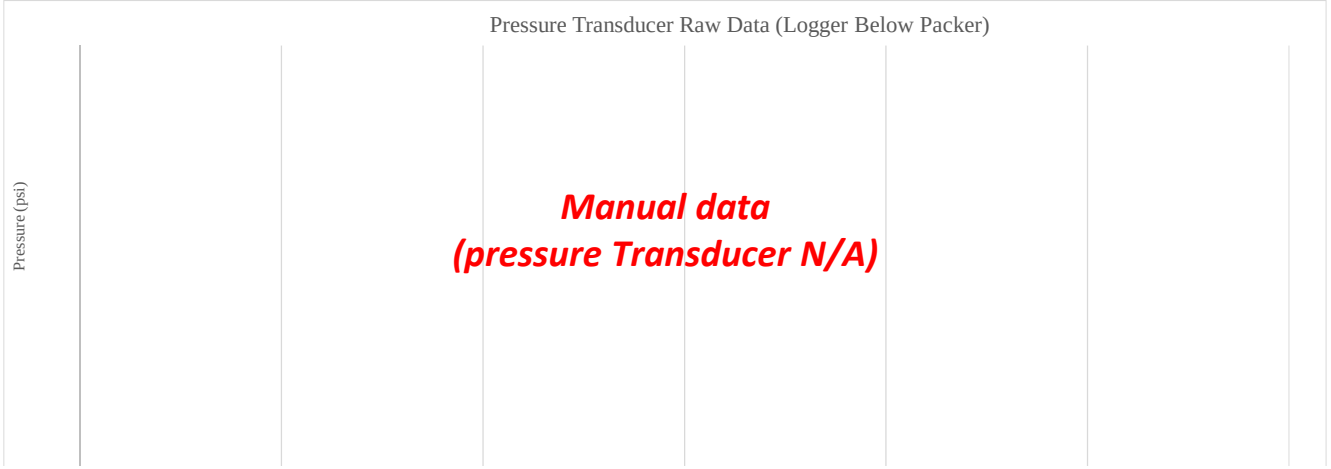
Borehole:	MW14-05A (BH-11A, CFD-0444)	**Test Number:**	1	**Tester:**	RC/LF
Date:	14-Sep-14	**Start Time:**	5:10 PM	**Stop Time:**	5:43 PM
Test Number:	1	**Geology:**	competent granite	**Height of P gauge (mags):**	2.07
Depth to bit (m AH):	110.05	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	2.38
Interval (Top) (m AH):	111.30	**Interval Bottom (m AH):**	140	**Target Interval description:**	
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90	**Hydraulic packer sink time:**	1 min 40 sec
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**			
Hole Diamter (mm):	96				
transducer SN:	n/a	**packer inflation pressure (psi):**	500	**open hole static WL (mbgs):**	2.69 (likely not static)
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	615.95		50	
1	616.15	0.20	51	
2	616.37	0.22	52	
3	616.55	0.18	55	
4	616.74	0.19	53	
5	616.96	0.19	53	
6	617.15	0.19	53	
7	617.35	0.20	54	
8	617.52	0.17	53	
9	617.66	0.14	53	
10	617.78	0.12	52	
11	618.06	0.28	53	
12	618.38	0.32	52	
13	618.69	0.31	51	
14	619.00	0.31	52	
15	619.28	0.28	52	
16	619.54	0.26	53	
17	619.82	0.28	52	
18	620.09	0.27	54	
19	620.36	0.27	53	
20	620.61	0.25	53	
	AVERAGE:	**0.28**	**52.5**	

Test not valid - partially unsaturated test interval (based on estimated static WL)

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-05A (BH-11A, CFD-0444)
Borehole Angle: 90 [degrees]
Test Number: 1
Start of Test Interval: 111.30 [mbgs]
End of Test Interval: 140.0 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 14-Sep-14

Steady State Equation: $T = \frac{Q * \ln (R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.28	[L/min]	collected in field
injection flow rate (Q)	4.7E-06	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.38	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.11	[mags]	collected in field
depth to water	133.20	[mbtp]	Static WL in MW14-05A on 11-Oct-14 at 15:45
Water Level 2 (manual)	132.09	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.02	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	2.07	[vertical mags]	collected in field
analog pressure gauge reading	52.5	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	171.0	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	28.7	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	28.7	[m]	assumed (equivalent to length of test interval)
ln(R_i/R_{ew})	6.4	[-]	calculated
Is packer test interval in the unsaturated zone	TRUE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0007	[m/s]	flow rate divided by cross-sectional area
Reynold's number	39.10	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	2.8E-08	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	9.8E-10	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

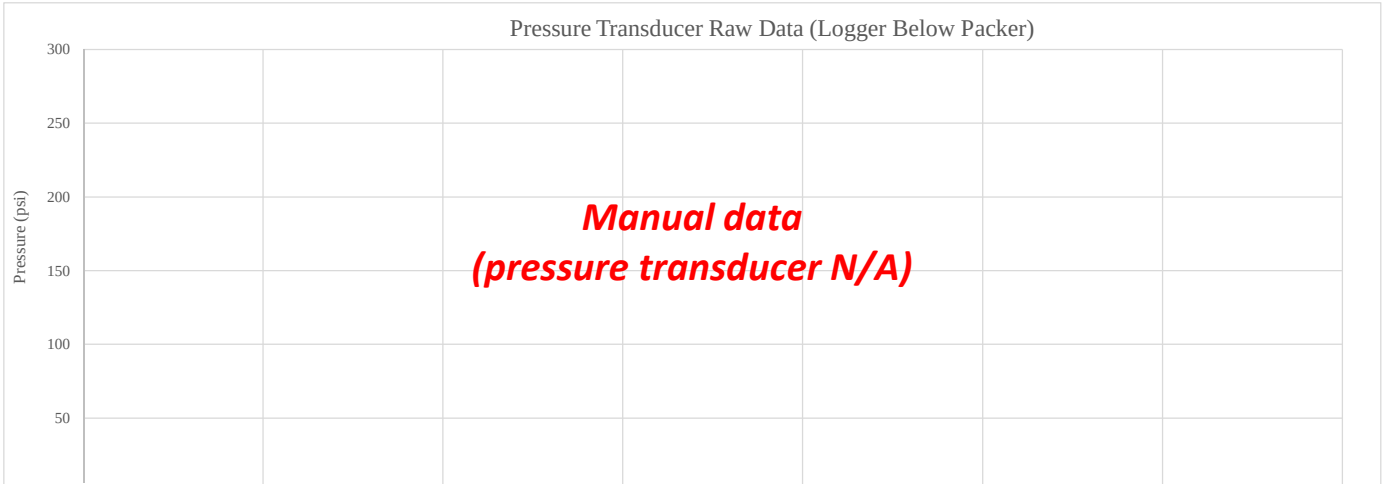
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-05A (BH-11A, CFD-0444)	**Test Number:**	2	**Tester:**	CB/MS
Date:	15-Sep-14	**Start Time:**	6:33 AM	**Stop Time:**	6:40 AM
Test Number:	2	**Geology:**	granite	**Height of P gauge (mags):**	2.07
Depth to bit (m AH):	155	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	
Interval (Top) (m AH):	156.25	**Interval Bottom (m AH):**	179	**Target Interval description:**	altered/broken granite 166.6-174 and 176-179 m
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90		
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**		**Hydraulic packer sink time:**	
Hole Diamter (mm):	96				
transducer SN:	n/a	**packer inflation pressure (psi):**	750	**open hole static WL (mbgs):**	
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	644.925		50	
1	644.925	0.00	50	
2	644.925	0.00	50	
3	644.925	0.00	50	
4	644.925	0.00	50	
5	644.925	0.00	50	
6	644.925	0.00	50	
7	644.925	0.00	50	
				Test terminated - no flow.
	AVERAGE:	**0.00**	**50.0**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-05A (BH-11A, CFD-0444)
Borehole Angle: 90 [degrees]
Test Number: 2
Start of Test Interval: 156.25 [mbgs]
End of Test Interval: 179.0 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 15-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.00	[L/min]	collected in field
injection flow rate (Q)	0.0E+00	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	0.00	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	-	[mags]	collected in field
depth to water	-	[mbtp]	
Water Level 2 (manual)	#VALUE!	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.00	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	2.07	[vertical mags]	collected in field
analog pressure gauge reading	50.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	#VALUE!	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	22.8	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	22.8	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.2	[-]	calculated
Is packer test interval in the unsaturated zone	#VALUE!	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0000	[m/s]	flow rate divided by cross-sectional area
Reynold's number	0.00	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	#VALUE!	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	#VALUE!	[m/s]	equivalent to T divided by test interval

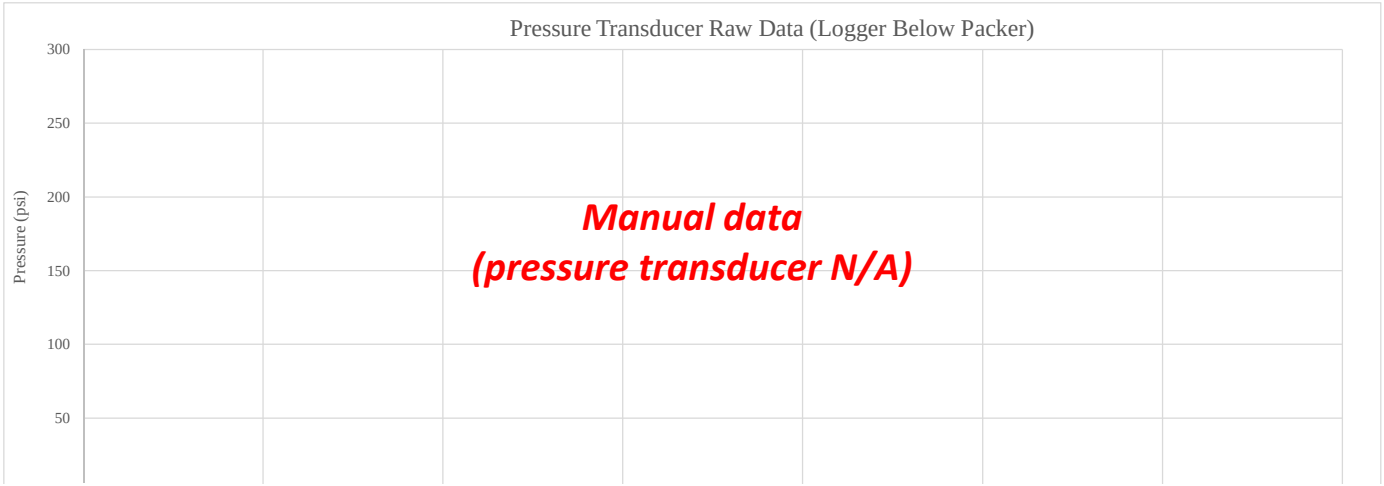
mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-05A (BH-11A, CFD-0444)	**Test Number:**	2	**Tester:**	CB/MS
Date:	15-Sep-14	**Start Time:**	6:33 AM	**Stop Time:**	6:40 AM
Test Number:	2	**Geology:**	granite	**Height of P gauge (mags):**	2.07
Depth to bit (m AH):	155	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	
Interval (Top) (m AH):	156.25	**Interval Bottom (m AH):**	179	**Target Interval description:**	altered/broken granite 166.6-174 and 176-179 m
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90		
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**		**Hydraulic packer sink time:**	
Hole Diamter (mm):	96				
transducer SN:	n/a	**packer inflation pressure (psi):**	750	**open hole static WL (mbgs):**	
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	644.925		50	
1	644.925	0.00	50	
2	644.925	0.00	50	
3	644.925	0.00	50	
4	644.925	0.00	50	
5	644.925	0.00	50	
6	644.925	0.00	50	
7	644.925	0.00	50	
				Test terminated - no flow.
	AVERAGE:	**0.00**	**50.0**	

Notes:
highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-05A (BH-11A, CFD-0444)
Borehole Angle: 90 [degrees]
Test Number: 2
Start of Test Interval: 156.25 [mbgs]
End of Test Interval: 179.0 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 15-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.01	[L/min]	collected in field
injection flow rate (Q)	1.7E-07	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	0.00	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.11	[mags]	collected in field
depth to water	133.20	[mbtp]	
Water Level 2 (manual)	132.09	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.00	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	2.07	[vertical mags]	collected in field
analog pressure gauge reading	50.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	169.3	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	22.8	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	22.8	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.2	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0000	[m/s]	flow rate divided by cross-sectional area
Reynold's number	1.38	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	9.7E-10	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	4.2E-11	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

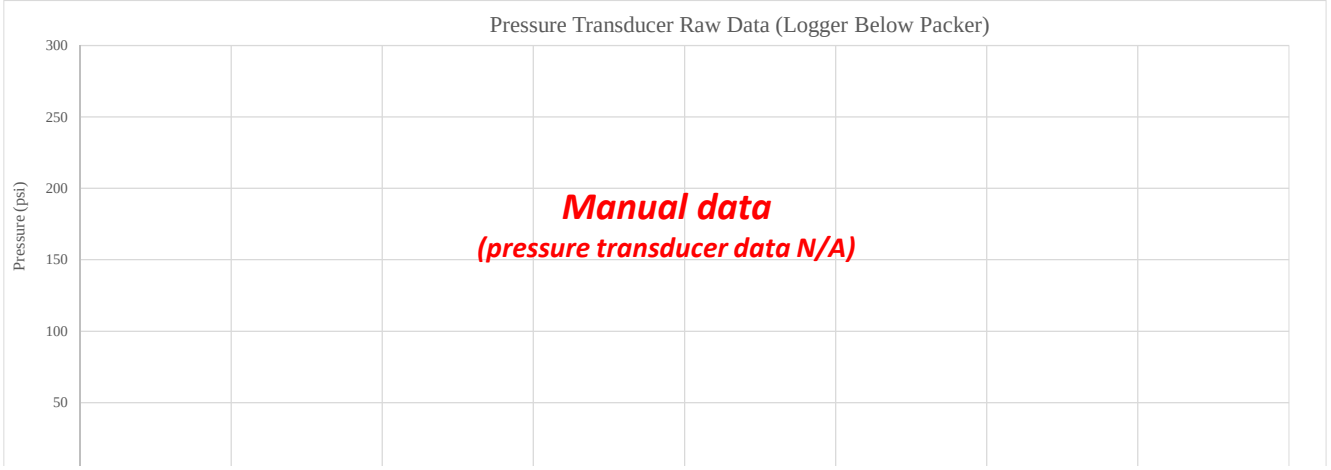
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-05A (BH-11A, CFD-0444)	**Test Number:**	3	**Tester:**	RC
Date:	15-Sep-14	**Start Time:**	3:05 PM	**Stop Time:**	3:33 PM
Test Number:	3	**Geology:**	granite	**Height of P gauge (mags):**	2.07
Depth to bit (m AH):	182	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	2.41
Interval (Top) (m AH):	183.25	**Interval Bottom (m AH):**	200	**Target Interval description:**	low RQD from 183.3 to
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90		
Rod Type:	HQ	**Type of water used:**	Fresh	**Hydraulic packer sink time:**	2 min 50 sec
Rod ID (mm):	77.8	**Additives used (type):**			
Hole Diamter (mm):	96				
transducer SN:	n/a	**packer inflation pressure (psi):**	500	**open hole static WL (mbgs):**	3.38 (likely not static)
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	651.50		50	
1	652.31	0.81	48	
2	653.06	0.75	48	
3	653.75	0.69	49	
4	654.43	0.68	47	
5	655.10	0.67	46	
6	655.75	0.65	45	
7	656.45	0.70	46	
8	657.03	0.58	46	
9	657.67	0.64	45	
10	658.24	0.57	47	
11	658.93	0.69	45	
12	659.55	0.62	45	
13	660.18	0.63	46	
14	660.79	0.61	45	
15	661.42	0.63	47	
16	662.03	0.61	48	
17	662.65	0.62	50	
18	663.26	0.61	50	
19	663.87	0.61	50	
20	664.49	0.62	50	
	AVERAGE:	**0.62**	**47.9**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-05A (BH-11A, CFD-0444)
Borehole Angle: 90 [degrees]
Test Number: 3
Start of Test Interval: 183.25 [mbgs]
End of Test Interval: 200.0 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 15-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.62	[L/min]	collected in field
injection flow rate (Q)	1.0E-05	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.41	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.11	[mags]	collected in field
depth to water	133.20	[mbtp]	Static WL in MW14-05A on 11-Oct-14 at 15:45
Water Level 2 (manual)	132.09	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.04	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	2.07	[vertical mags]	collected in field
analog pressure gauge reading	47.9	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	167.8	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	16.8	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	16.8	[m]	assumed (equivalent to length of test interval)
ln(R_i/R_{ew})	5.9	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0014	[m/s]	flow rate divided by cross-sectional area
Reynold's number	85.35	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	5.7E-08	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	3.4E-09	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

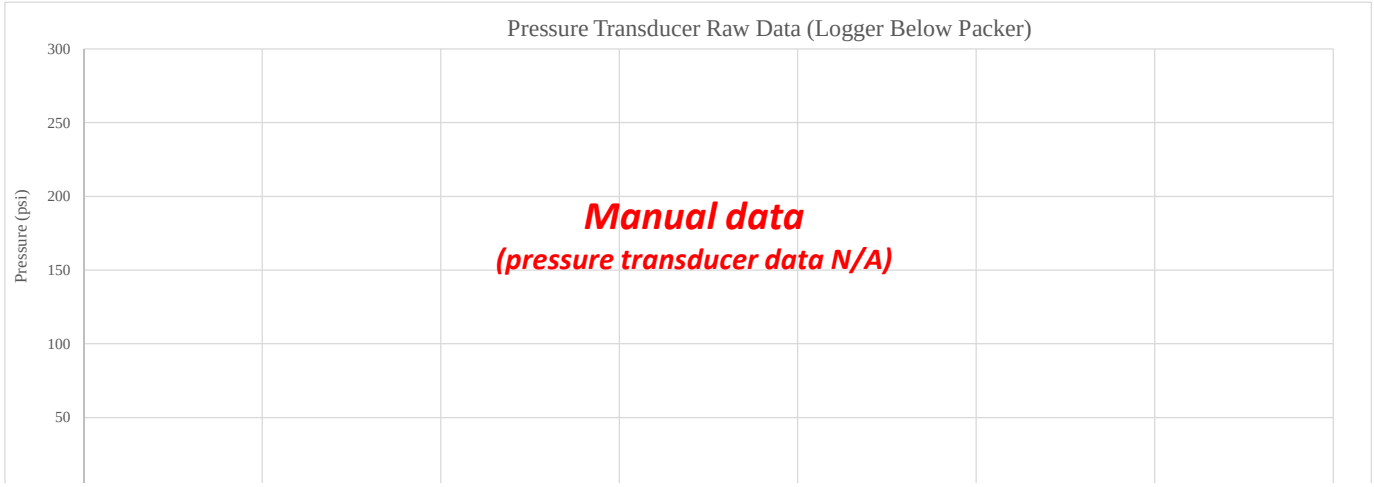
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-05A (BH-11A, CFD-0444)	**Test Number:**	4	**Tester:**	CB/MS
Date:	16-Sep-14	**Start Time:**	1:20 AM	**Stop Time:**	1:40 AM
Test Number:	4	**Geology:**		**Height of P gauge (mags):**	2.07
Depth to bit (m AH):	200	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	2.39
Interval (Top) (m AH):	201.25	**Interval Bottom (m AH):**	220.5	**Target Interval description:**	altered/broken granite from ~209-212 and218-220m
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90		
Rod Type:	HQ	**Type of water used:**	Fresh		
Rod ID (mm):	77.8	**Additives used (type):**			
Hole Diamter (mm):	96			**Hydraulic packer sink time:**	
transducer SN:	n/a	**packer inflation pressure (psi):**	500	**open hole static WL (mbgs):**	
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	672.50		50	
1	672.87	0.37	50	
2	673.21	0.34	50	
3	673.55	0.34	50	
4	673.89	0.34	50	
5	674.20	0.31	50	
6	674.53	0.33	50	
7	674.85	0.32	50	
8	675.16	0.31	50	
9	675.48	0.32	50	
10	675.78	0.30	50	
11	676.09	0.31	50	
12	676.40	0.31	50	
13	676.70	0.30	50	
14	677.00	0.30	50	
15	677.30	0.30	50	
16	677.60	0.30	50	
17	677.90	0.30	50	
18	678.20	0.30	50	
19	678.50	0.30	50	
20	678.80	0.30	50	
	AVERAGE:	**0.30**	**50.0**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-05A (BH-11A, CFD-0444)
Borehole Angle: 90 [degrees]
Test Number: 4
Start of Test Interval: 201.25 [mbgs]
End of Test Interval: 220.5 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 16-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.30	[L/min]	collected in field
injection flow rate (Q)	5.0E-06	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.39	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.11	[mags]	collected in field
depth to water	133.20	[mbtp]	Static WL in MW14-05A on 11-Oct-14 at 15:45
Water Level 2 (manual)	132.09	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.02	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	2.07	[vertical mags]	collected in field
analog pressure gauge reading	50.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	169.3	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	19.3	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	19.3	[m]	assumed (equivalent to length of test interval)
$\ln(R_i/R_{ew})$	6.0	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0007	[m/s]	flow rate divided by cross-sectional area
Reynold's number	41.45	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	2.8E-08	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	1.5E-09	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

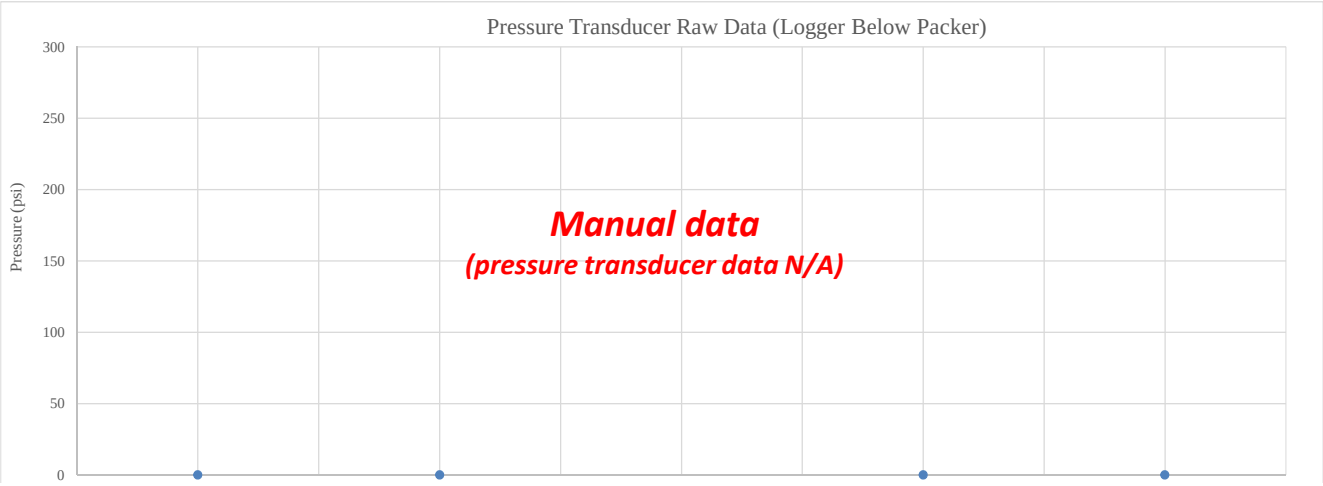
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-05A (BH-11A, CFD-0444)	**Test Number:**	5	**Tester:**	CB/MS
Date:	16-Sep-14	**Start Time:**	2:35 AM	**Stop Time:**	2:56 AM
Test Number:	5	**Geology:**		**Height of P gauge (mags):**	2.07
Depth to bit (m AH):	155	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	2.39
Interval (Top) (m AH):	156.25	**Interval Bottom (m AH):**	220.5	**Target Interval description:**	see Tests 2, 3 & 4
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90		
Rod Type:	HQ	**Type of water used:**	Fresh	**Hydraulic packer sink time:**	
Rod ID (mm):	77.8	**Additives used (type):**			
Hole Diamter (mm):	96				
transducer SN:	n/a	**packer inflation pressure (psi):**	500	**open hole static WL (mbgs):**	
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	687.00		50	
1	687.65	0.65	50	
2	688.28	0.63	50	
3	688.95	0.67	50	
4	689.64	0.69	50	
5	690.25	0.61	50	
6	690.89	0.64	50	
7	691.50	0.61	50	
8	692.14	0.64	50	
9	692.74	0.60	50	
10	693.31	0.57	50	Decreased press. a little as it had risen a little above 50
11	693.75	0.44	50	
12	694.32	0.57	50	
13	694.90	0.58	50	
14	695.49	0.59	50	
15	696.07	0.58	50	
16	696.65	0.58	50	
17	697.22	0.57	50	
18	697.81	0.59	50	
19	698.37	0.56	50	
20	698.96	0.59	50	
	AVERAGE:	**0.58**	**50.0**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-05A (BH-11A, CFD-0444)
Borehole Angle: 90 [degrees]
Test Number: 5
Start of Test Interval: 156.25 [mbgs]
End of Test Interval: 220.5 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 16-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.58	[L/min]	collected in field
injection flow rate (Q)	9.6E-06	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.39	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.11	[mags]	collected in field
depth to water	133.20	[mbtp]	Static WL in MW14-05A on 11-Oct-14 at 15:45
Water Level 2 (manual)	132.09	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.04	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	2.07	[vertical mags]	collected in field
analog pressure gauge reading	50.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	169.3	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	64.3	[m]	collected in field
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w exp(Skin)$
radius of influence (R_i)	64.3	[m]	assumed (equivalent to length of test interval)
$ln(R_i/R_{ew})$	7.2	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0013	[m/s]	flow rate divided by cross-sectional area
Reynold's number	79.98	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	6.5E-08	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	1.0E-09	[m/s]	equivalent to T divided by test interval

mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

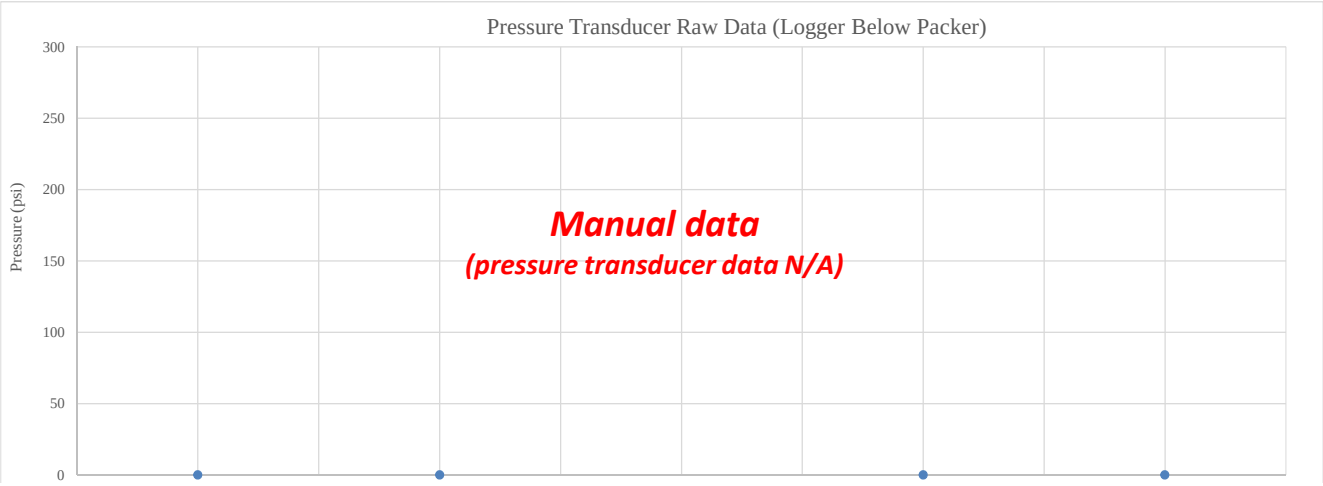
1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Borehole:	MW14-05A (BH-11A, CFD-0444)	**Test Number:**	5	**Tester:**	CB/MS
Date:	16-Sep-14	**Start Time:**	2:35 AM	**Stop Time:**	2:56 AM
Test Number:	5	**Geology:**		**Height of P gauge (mags):**	2.07
Depth to bit (m AH):	155	**Length of Packer (m):**	1.25	**Pipe Stickup (mags):**	2.39
Interval (Top) (m AH):	156.25	**Interval Bottom (m AH):**	220.5	**Target Interval description:**	see Tests 2, 3 & 4
Packer type (pneumatic/hydraulic):	hydraulic	**Hole dip:**	90		
Rod Type:	HQ	**Type of water used:**	Fresh	**Hydraulic packer sink time:**	
Rod ID (mm):	77.8	**Additives used (type):**			
Hole Diamter (mm):	96				
transducer SN:	n/a	**packer inflation pressure (psi):**	500	**open hole static WL (mbgs):**	
seal test successful:	yes	**test type:**	constant rate injection		

Time Elapsed (min)	Flowmeter Reading (L)	Flow Rate (L/min)	Pressure (psi)	Comments
0	687.00		50	
1	687.65	0.65	50	
2	688.28	0.63	50	
3	688.95	0.67	50	
4	689.64	0.69	50	
5	690.25	0.61	50	
6	690.89	0.64	50	
7	691.50	0.61	50	
8	692.14	0.64	50	
9	692.74	0.60	50	
10	693.31	0.57	50	Decreased press. a little as it had risen a little above 50
11	693.75	0.44	50	
12	694.32	0.57	50	
13	694.90	0.58	50	
14	695.49	0.59	50	
15	696.07	0.58	50	
16	696.65	0.58	50	
17	697.22	0.57	50	
18	697.81	0.59	50	
19	698.37	0.56	50	
20	698.96	0.59	50	
	AVERAGE:	**0.58**	**50.0**	

Notes:

highlighted cells indicate period of test used for stabilized P and Q readings.



Borehole: MW14-05A (BH-11A, CFD-0444)
Borehole Angle: 90 [degrees]
Test Number: 5
Start of Test Interval: 156.25 [mbgs]
End of Test Interval: 220.5 [mbgs]
Test Type: constant rate injection
Packer System: hydraulic
Date: 16-Sep-14

Steady State Equation: $T = \frac{Q * \ln(R_i/R_{ew})}{2*(pi)*H}$ (Thiem, 1906)[1]

Flow Rate			
injection flow rate (Q)	0.58	[L/min]	collected in field
injection flow rate (Q)	9.6E-06	[m^3/s]	calculated
Water Level			
[pressure transducer data used to estimate static WL]			
pressure transducer depth[2]	-	[mbgs]	in pressure transducer holder below single packer
pipe stickup	2.39	[mags]	collected in field
pressure head	-	[psi]	pressure transducer reading, psi absolute
atmospheric pressure	-	[psi]	assumed
pressure head	#VALUE!	[vertical m H2O]	corrected for atmospheric pressure
Water Level 1 (pressure transducer)	#VALUE!	[vertical mbgs]	calculated
[if pressure transducer data not available]			
pipe stickup	1.11	[mags]	collected in field
depth to water	133.20	[mbtp]	Static WL in MW14-05A on 11-Oct-14 at 15:45
Water Level 2 (manual)	132.09	[vertical mbgs]	calculated
Excess Pressure Head (based on surface readings)[3]			
friction losses (hose to swivel)[4]	0.00	[m]	computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm
friction losses (packer mandrel)[5]	0.04	[m]	IPI hydraulic packer manual or from Darcy-Weisbach equation (pneumatic packer)
most reliable static water level measurement	manual	transducer/manual	transducer (water level 1) or manual (water level 2)
analog pressure gauge height above ground	2.07	[vertical mags]	collected in field
analog pressure gauge reading	50.0	[psi]	collected in field
Exess Pressure Head (most reliable static WL)	169.3	[m]	H, calculated: static WL plus injection pressure, relative to ground surface
Excess Pressure Head Check (based on pressure transducer readings only)			
stabilized pressure[6]	-	[psi]	pressure transducer reading, psi absolute
differential pressure[7]	#VALUE!	[psi]	difference between injection pressure and static WL pressure
Excess Pressure Head (transducer readings)	#VALUE!	[m]	H, calculated - convert differential pressure to m H2O
Other Data			
radius of wellbore (R_w)	0.048	[m]	1/2 of the ID of open HQ borehole
length of test interval	45.0	[m]	adjusted for overlap with Test 4 (ie. subtracted interval portion that overlaps)
skin	0	[-]	assumed
effective wellbore radius (R_{ew})	0.048	[m]	$R_w$exp(Skin)
radius of influence (R_i)	45.0	[m]	assumed (equivalent to length of test interval)
ln(R_i/R_{ew})	6.8	[-]	calculated
Is packer test interval in the unsaturated zone	FALSE	[TRUE/FALSE]	tests in the unsaturated zone are not considered reliable
Flow velocity in open borehole	0.0013	[m/s]	flow rate divided by cross-sectional area
Reynold's number	79.98	[-]	flow velocity x borehole diameter / kinematic viscosity of H2O (at approx. 4°C)
Is flow laminar (Reynold's No. <2040) or turbulent (>2040)	Laminar	[TRUE/FALSE]	results based on turbulent flow should be considered very approximate
Calculated Result			
Transmissivity -- T	6.2E-08	[m^2/s]	Thiem equation; uses excess pressure head based on most reliable of surface (manual) or transducer readings
Hydraulic Conductivity -- K	1.4E-09	[m/s]	equivalent to T divided by test interval

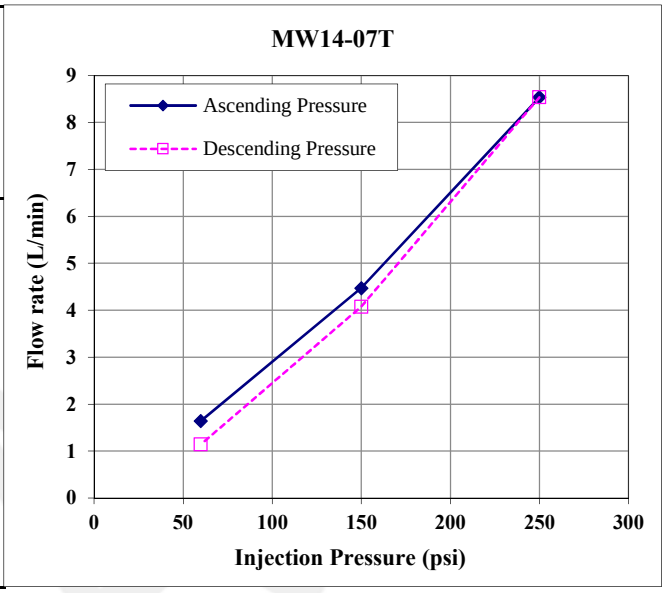
mbtp = metres below top of pipe, mags = metres above ground surface, mbgs = metres below ground surface

1. Thiem, G., 1906. Hydrologische Methoden; Gebhardt, Leipzig.
2. For hydraulic packer, transducer positioned 43" below bottom of packer in gauge holder; for pneumatic packer it is located just below stuffing box.
3. Data from analog pressure gauge read at surface used to guide test during injection and to confirm pressure transducer data
4. Computed from http://www.tasonline.co.za/toolbox/pipe/velfirc.htm assuming rubber lined pipe, 5 m length, ID 19 mm
5. IPI hydraulic packer manual or Darcy-Weisbach equation as provided in http://www.pipeflow.com/pipe-pressure-drop-calculations/pipe-friction-loss for the pneumatic packer.
6. Estimated stabilized pressure at end of injection period
7. Differential pressure eliminates absolute gauge effect, does not need to be corrected for atmospheric

Location: **MW14-07T / BH1 / CFD-0462** **LUGEON TEST**

Test Interval: **64.4-89** **(m bgs)**

Injection Pressure (Pi) (psi)	Net Injection Pressure (H) (m)	Stabilized Flow Rate (Q) (m^3/min)	Stabilized Flow Rate (Q) (L/min)
60	43.8	0.0016	1.6
150	106.9	0.0045	4.5
250	176.8	0.0085	8.5
150	106.9	0.0041	4.1
60	43.8	0.0011	1.1
-	-	-	-
-	-	-	-



$T=Q\ln(R/r_b)/2\pi H$

T = transmissivity [L^2/t]
Q = flow rate [L^3/t]
R = radius of influence (assumed to equal packer interval length, b) [L]
r_b = radius of borehole [L]
H= net injection pressure [L]

K=T/b

K = hydraulic conductivity [L/t]
b = packer interval length [L]

Pressure Interval	T (m^2/s)	K (m/s)	Flow Descriptor
60 psi	6.2E-07	2.5E-08	Laminar
150 psi	6.9E-07	2.8E-08	Laminar
250 psi	8.0E-07	3.2E-08	Laminar
150 psi	6.3E-07	2.6E-08	Laminar
60 psi	4.3E-07	1.8E-08	Laminar
-	-	-	-
-	-	-	-

Test Geometry (m)	
0.0778	inside diameter of HQ rod
1.7000	height of pressure gauge above ground
60 psi	depth to bottom of packer
0.0000	depth to pre-test water level
0.0480	radius of drillhole (HQ)

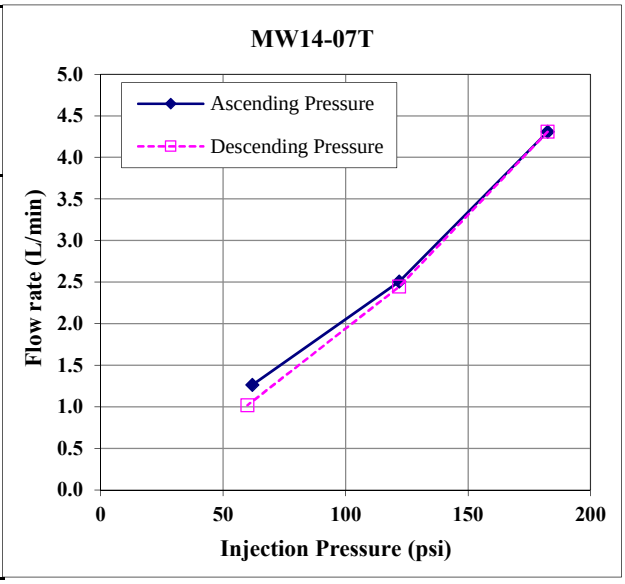
Packer Test Results

Pressure Interval	T (m^2/s)	K (m/s)
Avg. (ascending)	7.0E-07	2.9E-08
Avg. (descending)	6.2E-07	2.5E-08
Avg. (overall)	6.4E-07	2.6E-08

Location: **MW14-07T / BH1 / CFD-0462** **Lugeon Test**

Test Interval: **83.2-124.7 (m bgs)**

Injection Pressure (Pi) (psi)	Net Injection Pressure (H) (m)	Stabilized Flow Rate (Q) (m^3/min)	Stabilized Flow Rate (Q) (L/min)
62	45.2	0.0013	1.3
122	87.3	0.0025	2.5
182.5	129.7	0.0043	4.3
122	87.3	0.0024	2.4
60	43.8	0.0010	1.0
-	-	-	-
-	-	-	-



$T=Q\ln(R/r_b)/2\Pi H$

T = transmissivity [L^2/t]
Q = flow rate [L^3/t]
R = radius of influence (assumed to equal packer interval length, b) [L]
r_b = radius of borehole [L]
H= net injection pressure [L]

K=T/b

K = hydraulic conductivity [L/t]
b = packer interval length [L]

Pressure Interval	T (m^2/s)	K (m/s)	Flow Descriptor
62 psi	5.0E-07	1.2E-08	Laminar
122 psi	5.2E-07	1.2E-08	Laminar
182.5 psi	6.0E-07	1.4E-08	Laminar
122 psi	5.0E-07	1.2E-08	Laminar
60 psi	4.2E-07	1.0E-08	Laminar
-	-	-	-
-	-	-	-

Test Geometry (m)	
0.0778	inside diameter of HQ rod
1.7000	height of pressure gauge above ground
124.6600	depth to bottom of packer
0.0000	depth to pre-test water level
0.0480	radius of drillhole (HQ)

Packer Test Results

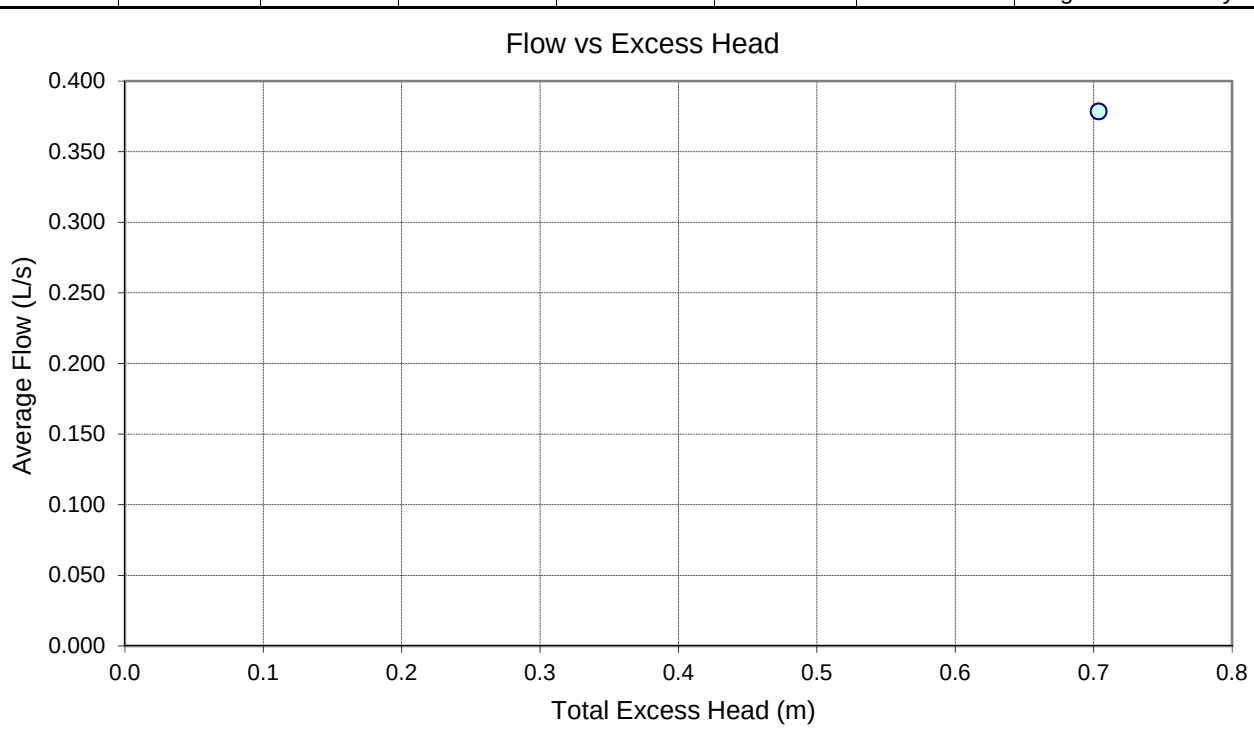
Pressure Interval	T(m^2/s)	K(m/s)
Avg. (ascending)	5.4E-07	1.3E-08
Avg. (descending)	5.1E-07	1.2E-08
Avg. (overall)	5.1E-07	1.2E-08

PACKER TESTING - CONSTANT HEAD TEST

Date of Test:	13-May-15	Apparent Current Depth of Drill Hole (m):			53.34
Drill Hole No:	**MW15-04T**	Test Section from (m):	34.75	to:	53.34
Test No:	#1	Length of Test Section (m):			18.59
Packer Type:	single	Static Groundwater Level (vertical m below datum):			0.00
Inflation Pressure (kPa):	350 psi	Height of Gauge (m above datum):			0.00
Casing Details:	n/a	Drill Hole Dip (deg from horizontal):			80
Diameter of Drill Hole (mm):	114.3	Vertical Depth of Drill Hole (m):			52.53
ID of Drilling Rods (mm):		Vertical Depth of Test Section Centre (m):			43.37

If groundwater level is unknown during the test use depth of test center section

Injection			Cummulative	Friction Head Loss		Total Excess Head	Injection Rate	Note
Stage	Duration	Pressure	Consumption	Packer	Hose			
no.	min	kPa	liters	m	m	m	L/s	
zero		0	0.0	0	0	0	0.00	
#1	10	6.90	227.1	0.00	0.00	0.70	0.38	
#2								
#3								poor
#2								seal
#1							rough estimate only	

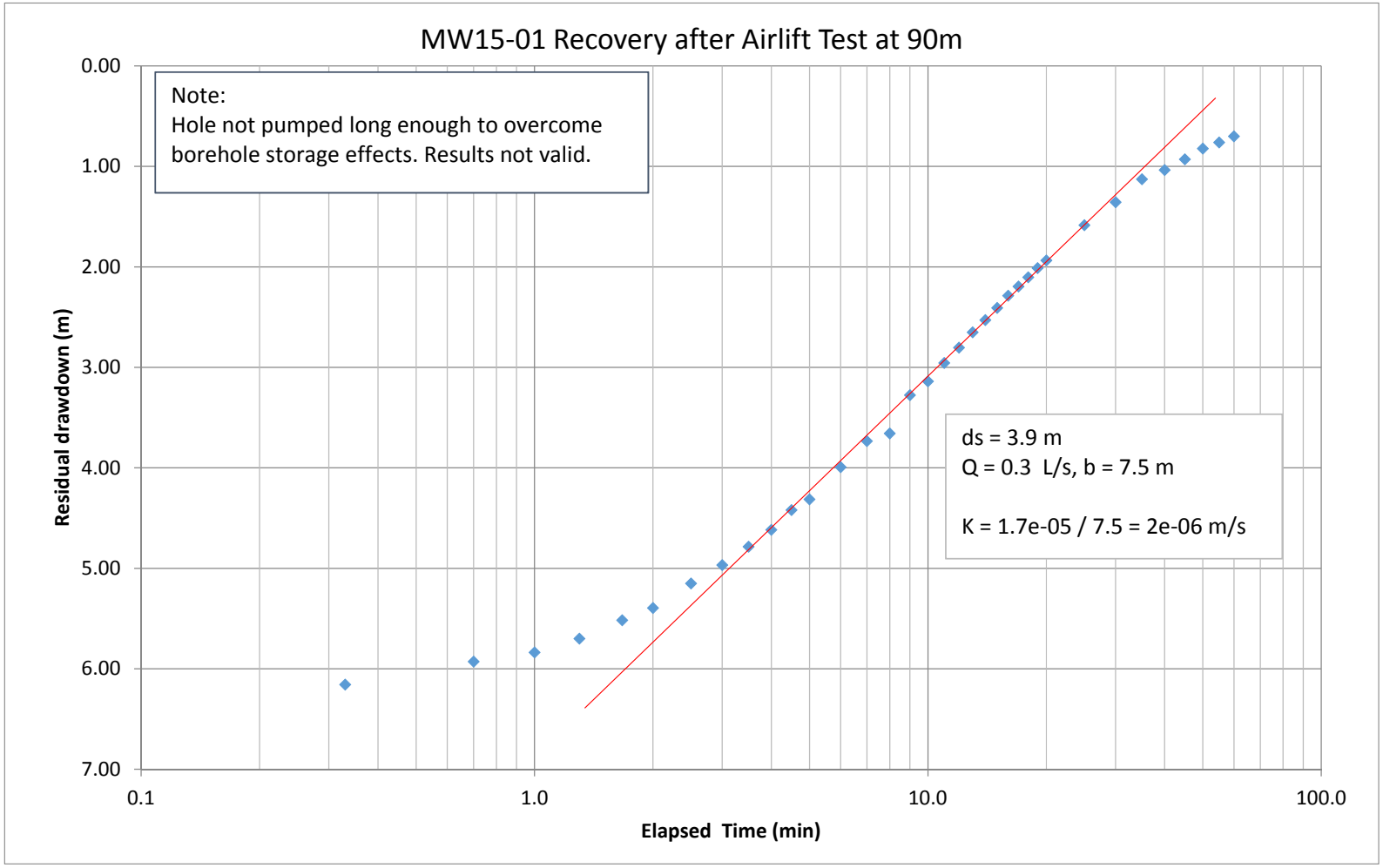


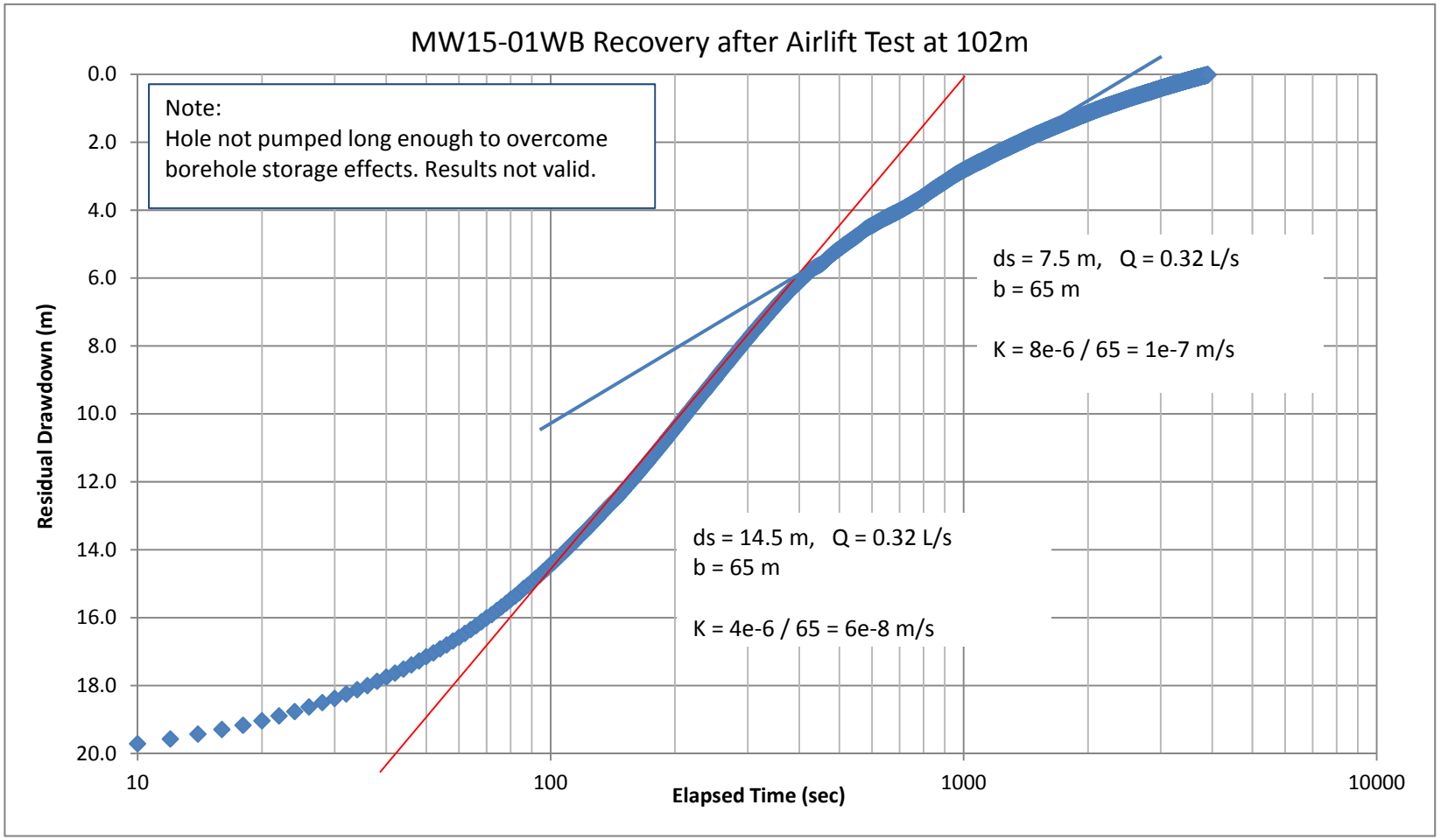
Bulk K (m/s)	Stage no.					**Average K**	Lugeon
	#1	#2	#3	#2 back	#1 back		
	2.7E-05					**2.7E-05**	

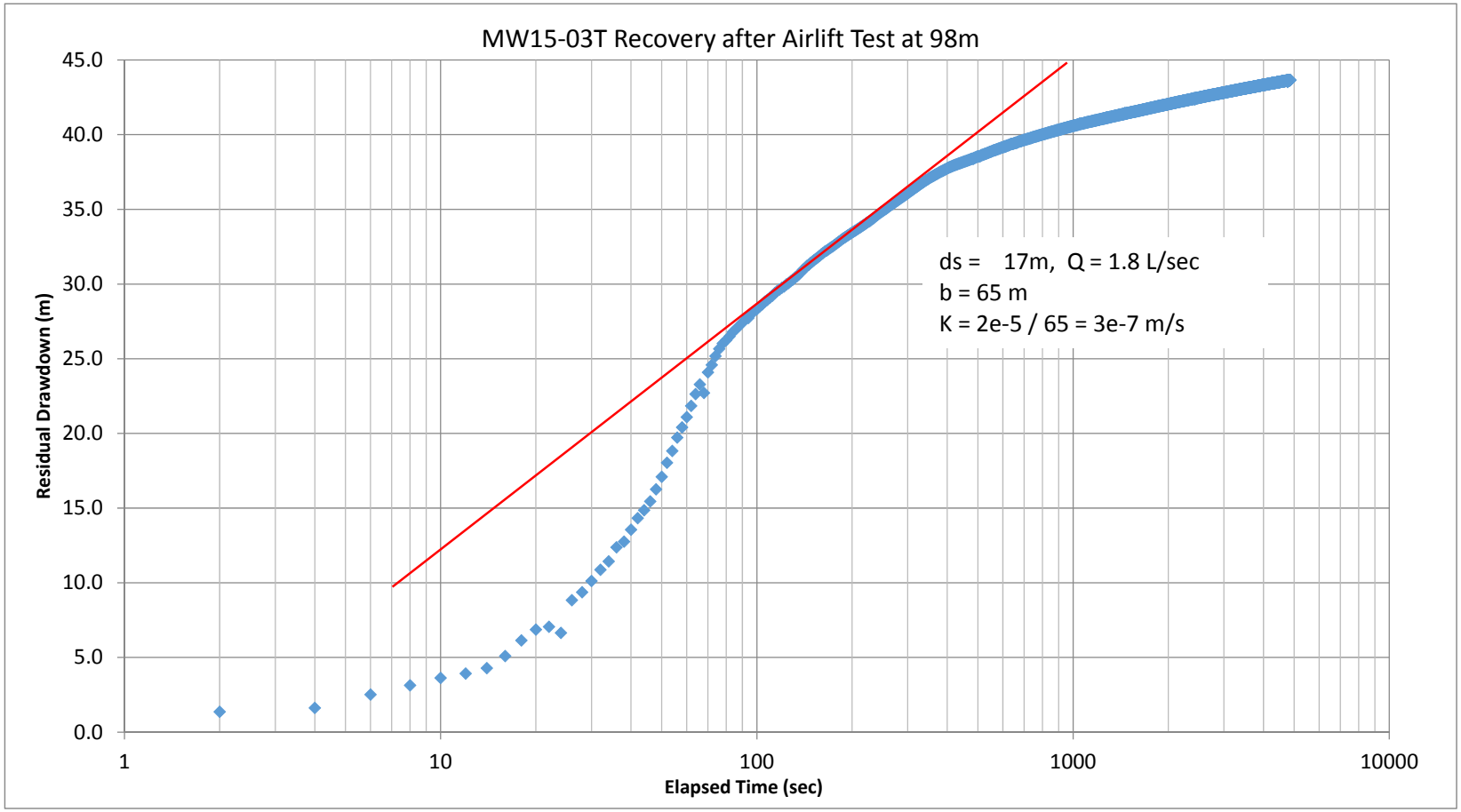
LORAX ENVIRONMENTAL

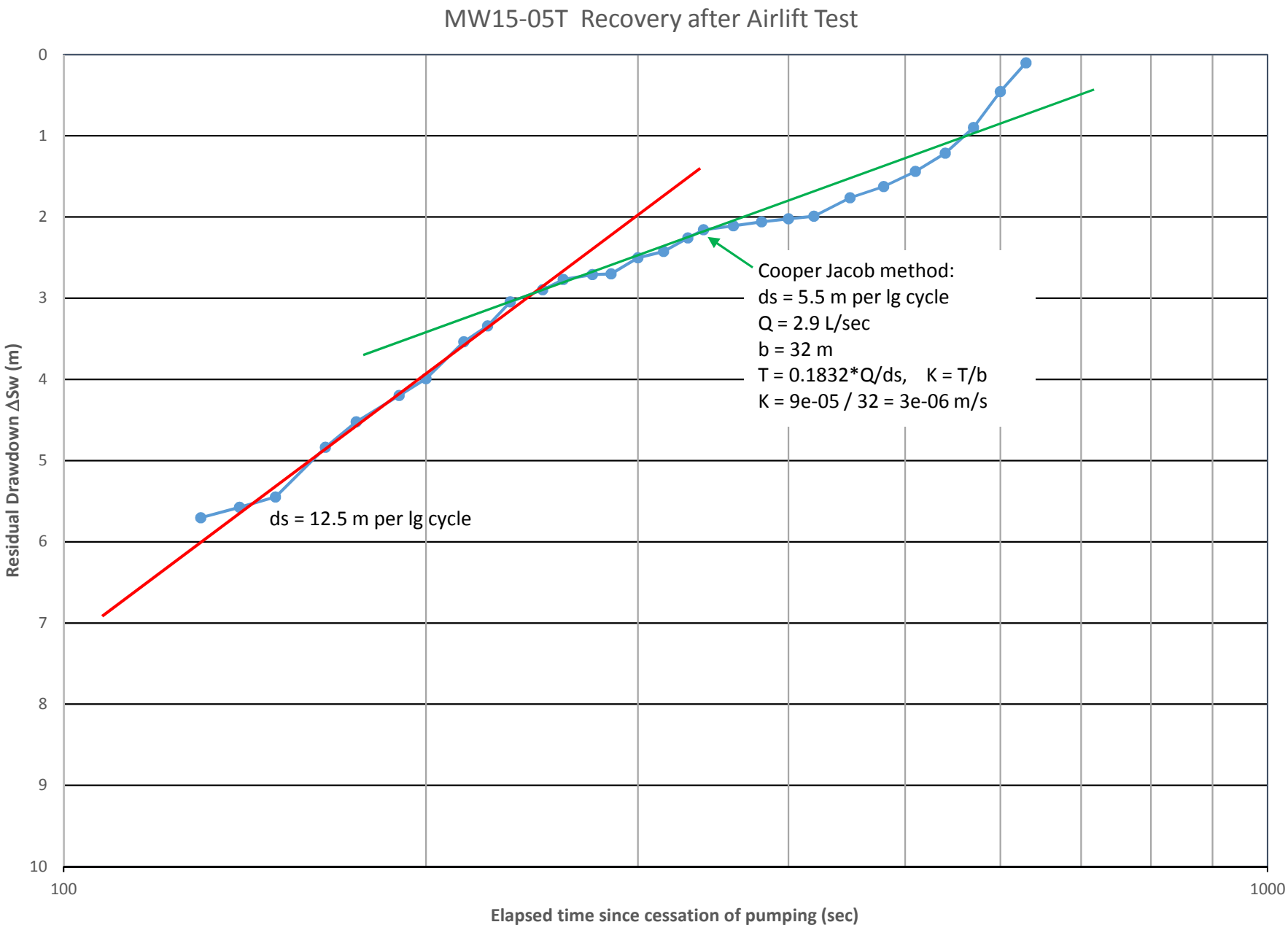
2289 Burrard St., Vancouver, B.C.

PROJ. NO.:	A362-4		
PROJECT:	Coffee Creek Gold Project		
DETAILS:	Shut-in Test in MW15-04T (BH-04)		
ENG.	LF	Checked:	
DATE	18-Feb-16	Figure:	


MW15-01 Recovery after Airlift Test at 90m
Note:
Hole not pumped long enough to overcome borehole storage effects. Results not valid.
ds = 3.9 m
Q = 0.3 L/s, b = 7.5 m
K = 1.7e-05 / 7.5 = 2e-06 m/s
Residual drawdown (m)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
0.1
1.0
10.0
100.0
Elapsed Time (min)


MW15-01WB Recovery after Airlift Test at 102m
Note:
Hole not pumped long enough to overcome borehole storage effects. Results not valid.
ds = 7.5 m, Q = 0.32 L/s
b = 65 m
K = 8e-6 / 65 = 1e-7 m/s
ds = 14.5 m, Q = 0.32 L/s
b = 65 m
K = 4e-6 / 65 = 6e-8 m/s
Residual Drawdown (m)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
10
100
1000
10000
Elapsed Time (sec)


MW15-03T Recovery after Airlift Test at 98m
Residual Drawdown (m)
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
1
10
100
1000
10000
Elapsed Time (sec)
ds = 17m, Q = 1.8 L/sec
b = 65 m
K = 2e-5 / 65 = 3e-7 m/s


MW15-05T Recovery after Airlift Test
Residual Drawdown ΔSw (m)
0
1
2
3
4
5
6
7
8
9
10
100
1000
Elapsed time since cessation of pumping (sec)
Cooper Jacob method:
ds = 5.5 m per lg cycle
Q = 2.9 L/sec
b = 32 m
T = 0.1832*Q/ds, K = T/b
K = 9e-05 / 32 = 3e-06 m/s
ds = 12.5 m per lg cycle

Falling Head Test - Hvorslev Solution

Date:	August 9, 2015		Time Initiated:	11:00	**Well:**	**MW14-05B**
Borehole Diameter (mm):		96	Riser ID (mm):	50	Screen Length (m):	20.50
Static Level H (mbrp) :		135.00	Initial Level H_0 (mbrp):	145.00	**T_o (sec) =**	**55000**
Screen at impervious boundary: Yes = 1, No=0		0			**K (m/s) =**	**4.7E-10**
Clock Time	Elapsed Time (sec)	Elapsed Time (min)	Depth to Water (h) (mbrp)	Drawdown H - h (m)	Normalized Level $(H-h)/(H-H_0)$	Comments
11:00	0	0.0	145.000	10.000	1.00	Recovery after purging and sampling
	25200	420.0	141.481	6.481	0.65	
	39600	660.0	139.938	4.938	0.49	DTW recorded with data logger
	61200	1020.0	138.269	3.269	0.33	
	82800	1380.0	137.185	2.185	0.22	
	118800	1980.0	136.164	1.164	0.12	
	176400	2940.0	135.440	0.440	0.04	
	262800	4380.0	135.117	0.117	0.01	

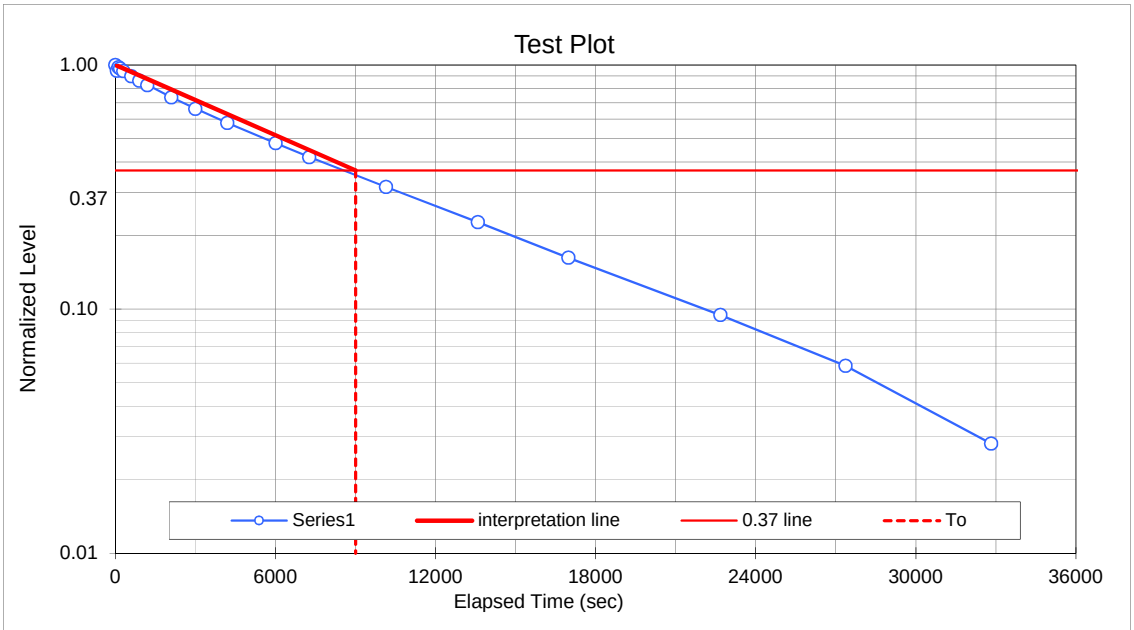


LORAX ENVIRONMENTAL 2289 Burrard St., Vancouver, B.C.	Project No.:	A362-4	
	Project:	Coffee Creek Gold Project	
	Details:	Recovery after GW Sampling in MW14-05B	
	Eng.:	VS	Checked:
	Date:	18-Feb-16	Figure No:

Hvorslev Method - Falling Head Test

Date:	September 1, 2014	Time Initiated:	12:00	Well:	**MW14-06A**
Effective Screen Radius (mm)	61	Riser Radius (mm):	25	Screen Length (m):	18.00
Static Level H (mbrp) :	0.00	Initial Level H_0 (mbrp):	1.00	**T_o (sec) =**	**9000**
Aquifer Thickness (m):	20.0			**K (m/s) =**	**1.1E-08**

Clock Time	Elapsed Time (sec)	Elapsed Time (min)	Depth to Water (h) (mbrp)	Drawdown H - h (m)	Normalized Level $(H-h)/(H-H_0)$	Comments
	0	0.0	1.000	1.00	1.00	
	60	1.00	0.95	0.946	0.946	
	120	2.00	0.98	0.978	0.978	Solid slug
	180	3.00	0.97	0.966	0.966	data logger was
	300	5.00	0.94	0.943	0.943	used to record
	600	10.00	0.90	0.899	0.899	the response
	900	15.00	0.86	0.861	0.861	
	1200	20.00	0.83	0.827	0.827	Actual static level
	2100	35.00	0.74	0.737	0.737	below 150 mTOC
	3000	50.00	0.66	0.661	0.661	
	4200	70.00	0.58	0.579	0.579	
	6000	100.00	0.48	0.478	0.478	
	7260	121.00	0.42	0.419	0.419	
	10140	169.00	0.32	0.316	0.316	
	13590	226.50	0.23	0.227	0.227	
	16980	283.00	0.16	0.162	0.162	
	22680	378.00	0.09	0.094	0.094	
	27360	456.00	0.06	0.059	0.059	
	32820	547.00	0.03	0.028	0.028	

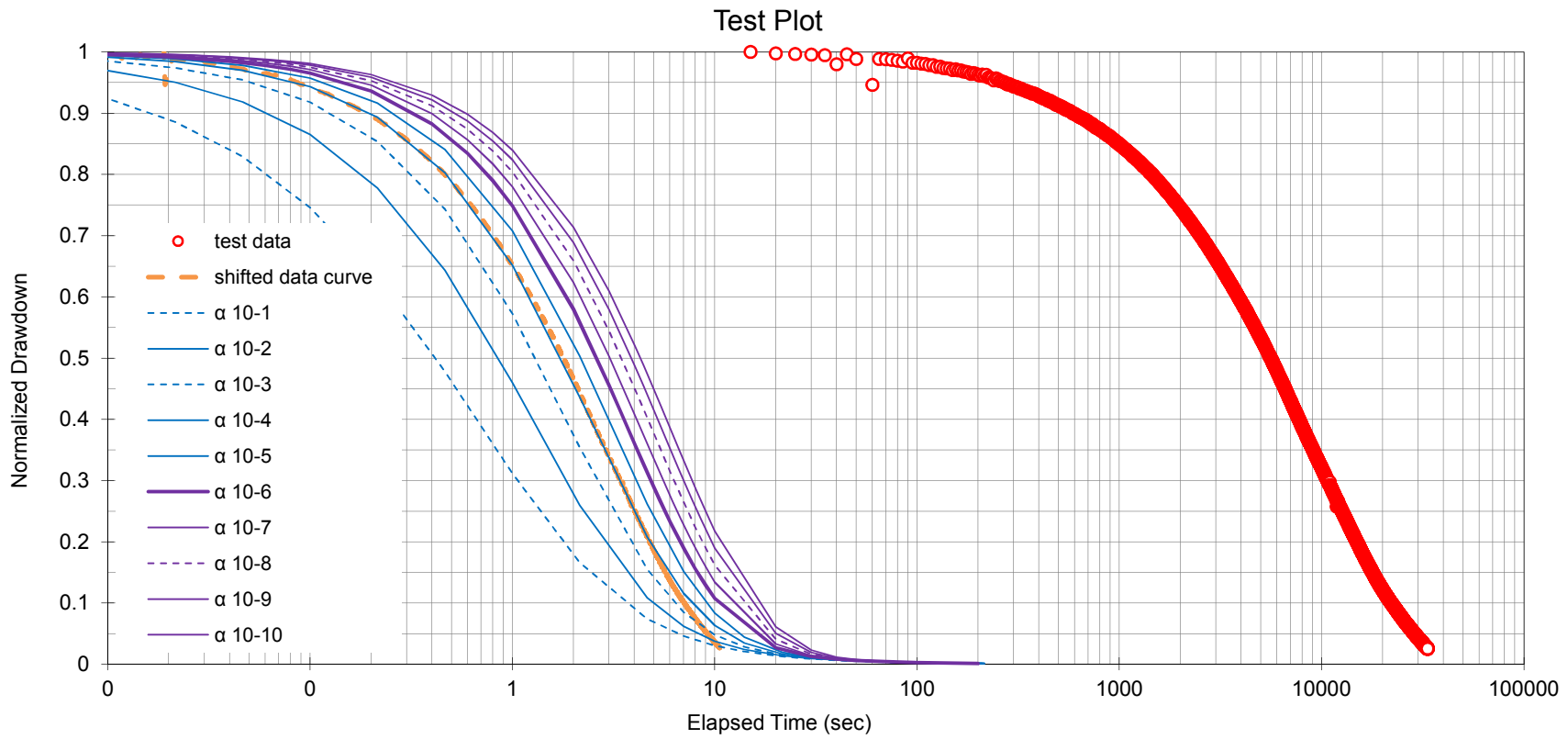


LORAX ENVIRONMENTAL
2289 Burrard St., Vancouver, B.C.

Project No.:	A362-4		
Project:	Coffee Creek Gold Project		
Details:	Falling head test in MW14-06A		
Eng.:	VS	Checked:	
Date:	18-Feb-16	Figure No:	

Papadopulos-Cooper Type Curve Method - Slug Test Evaluation

Date :	September 1, 2014	Time Initiated :	12:00			Well :	**MW14-06A**
Screen Radius rs (mm) :	61.0	Riser Radius rc (mm) :	25.0	Time correction :	0.00032	type curve α :	1.E-04
Static Level Ho (m TOC) :	0.00	Initial Test Level H (m TOC) :	1.00	t_o (sec) =	3125.00	**T (m^2/s) =**	**2.00E-07**
Aquifer Thickness b (m) :	20.0	Screen Length (m) :	18.00	**S (-) =**	**1.68E-05**	**K (m/s) =**	**1.1E-08**



Note:
Actual static level @ 160 m TOC
Data logger readings not converted to DTW

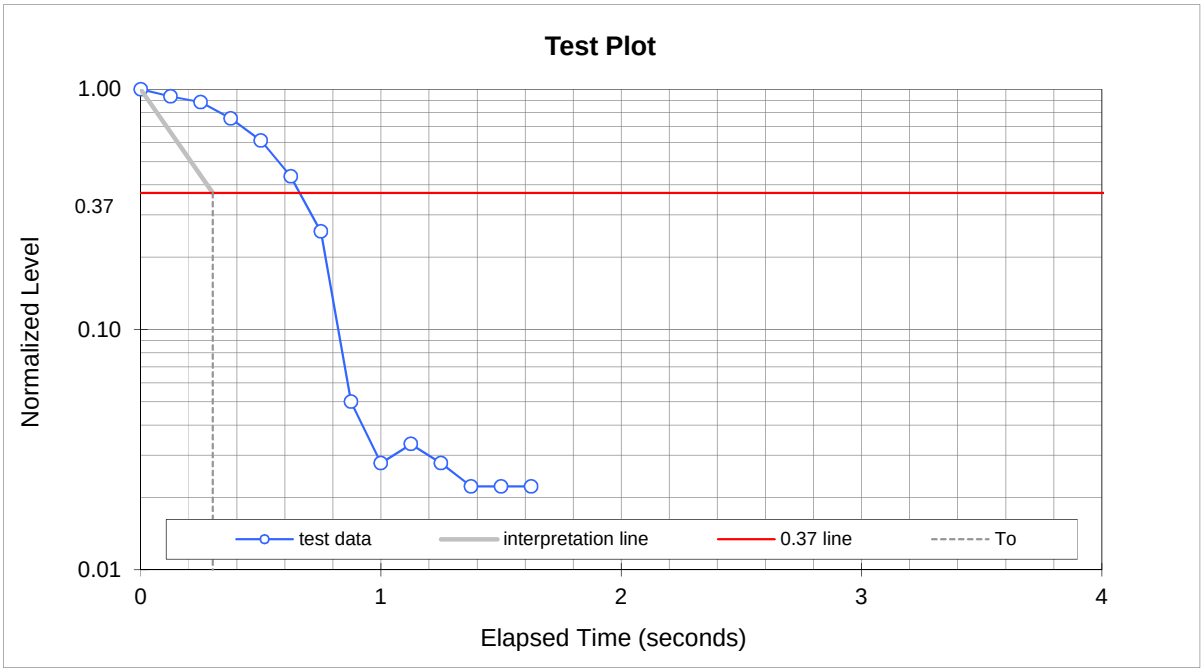
LORAX ENVIRONMENTAL
2289 Burrard St., Vancouver, B.C.

Project No.:	A362-4		
Project:	Coffee Creek Gold Project		
Details:	Falling head test in MW14-06A		
Eng.:	VS	Checked:	
Date:	2/18/2016	Figure No:	

Falling Head Test - Hvorslev Solution

Date:	September 7, 2015		Time Initiated:	10:30	**Well:**	**MW15-2 AZ**
Borehole Diameter (mm):		114	Riser ID (mm):	50	Screen Length (m):	13.00
Static Level H (mbrp) :		0.00	Initial Level H_0 (mbrp):	0.90	**T_o (sec) =**	**0.3**
Screen at impervious boundary: Yes = 1, No=0		0			**K (m/s) =**	**1.2E-04**

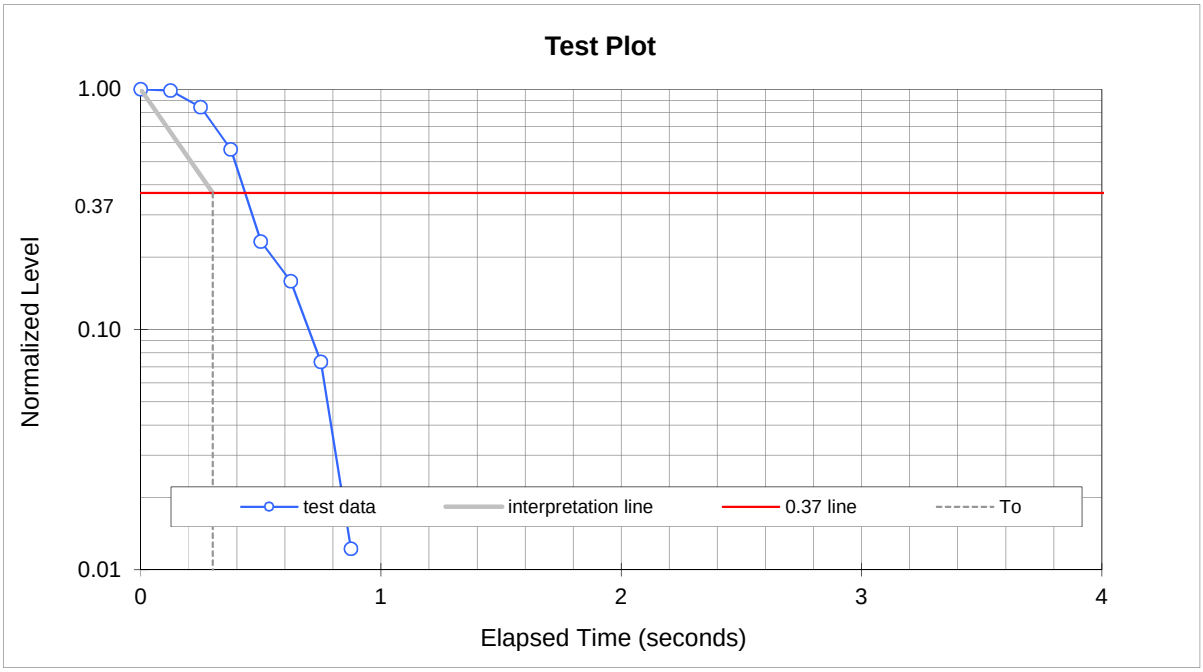
Clock Time	Elapsed Time (sec)	Elapsed Time (min)	Depth to Water (h) (mbrp)	Drawdown H - h (m)	Normalized Level $(H-h)/(H-H_0)$	Comments
10:30	0	0.0	0.900	0.900	1.00	
	0.125	0.0	0.840	0.840	0.93	
	0.25	0.0	0.795	0.795	0.88	screened across
	0.375	0.0	0.680	0.680	0.76	sandpack
	0.5	0.0	0.550	0.550	0.61	
	0.625	0.0	0.390	0.390	0.43	**very fast response**
	0.75	0.0	0.230	0.230	0.26	**due to sandpack**
	0.875	0.0	0.045	0.045	0.05	**high K and storage**
	1	0.0	0.025	0.025	0.03	
	1.125	0.0	0.030	0.030	0.03	
	1.25	0.0	0.025	0.025	0.03	
	1.375	0.0	0.020	0.020	0.02	
	1.5	0.0	0.020	0.020	0.02	**K value is not**
	1.625	0.0	0.020	0.020	0.02	**valid for the tested formation**



LORAX ENVIRONMENTAL 2289 Burrard St., Vancouver, B.C.	Project No.:	A362-4	
	Project:	Coffee Creek Gold	
	Details:	Stug Test in MW15-2 AZ	
	Eng.:	VS	Checked:
	Date:	18-Feb-16	Figure No:

Falling Head Test - Hvorslev Solution

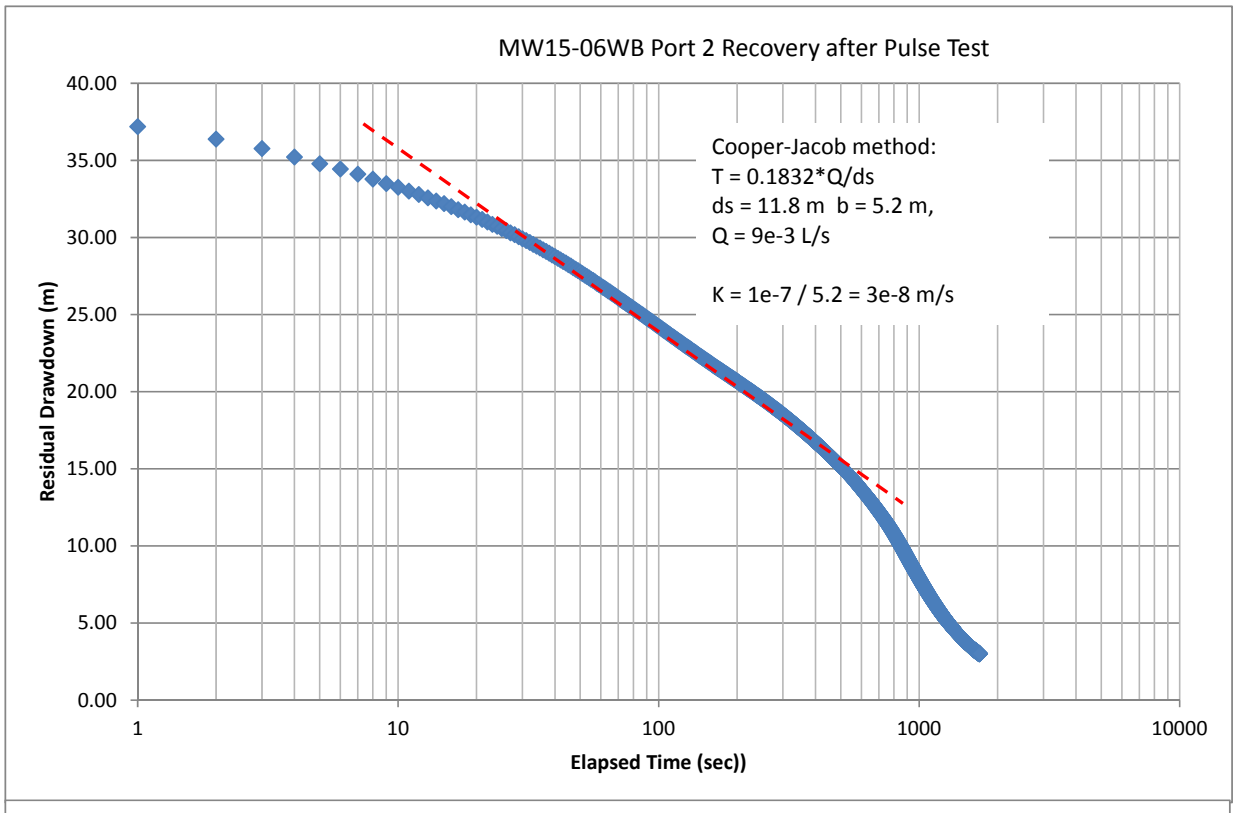
Date:	September 4, 2015		Time Initiated:	10:30	**Well:**	**MW15-3 AZ**
Borehole Diameter (mm):		114	Riser ID (mm):	50	Screen Length (m):	13.00
Static Level H (mbrp) :		0.00	Initial Level H_0 (mbrp):	0.82	**T_o (sec) =**	**0.3**
Screen at impervious boundary: Yes = 1, No=0		0			**K (m/s) =**	**1.2E-04**
Clock Time	Elapsed Time (sec)	Elapsed Time (min)	Depth to Water (h) (mbrp)	Drawdown H - h (m)	Normalized Level $(H-h)/(H-H_0)$	Comments
10:30	0	0.0	0.820	0.820	1.00	
	0.125	0.002	0.810	0.810	0.99	
	0.25	0.004	0.690	0.690	0.84	screened across sandpack
	0.375	0.006	0.460	0.460	0.56	
	0.5	0.008	0.190	0.190	0.23	
	0.625	0.010	0.130	0.130	0.16	
	0.75	0.013	0.060	0.060	0.07	**very fast response due to K and storage of sandpack**
	0.875	0.015	0.010	0.010	0.01	
						screened across water level
						Not valid for the tested aquifer

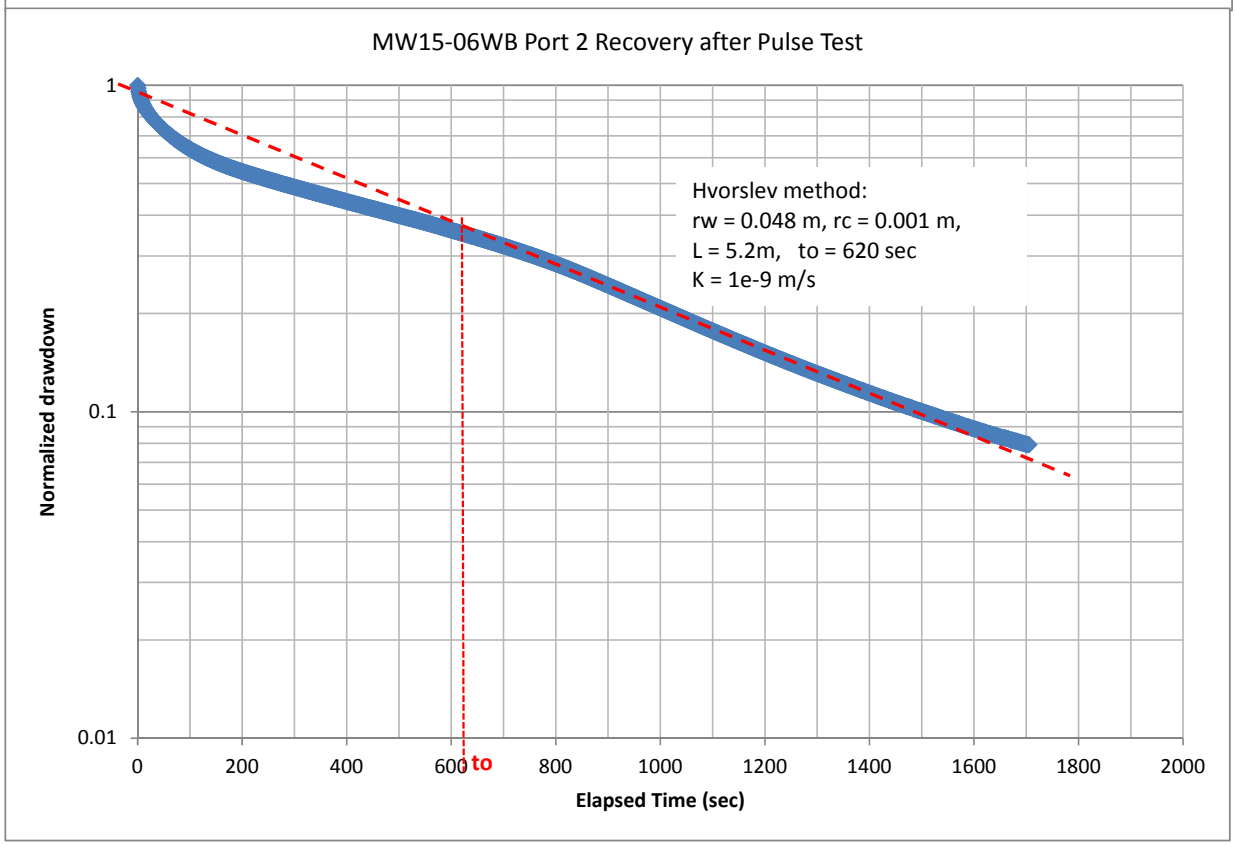


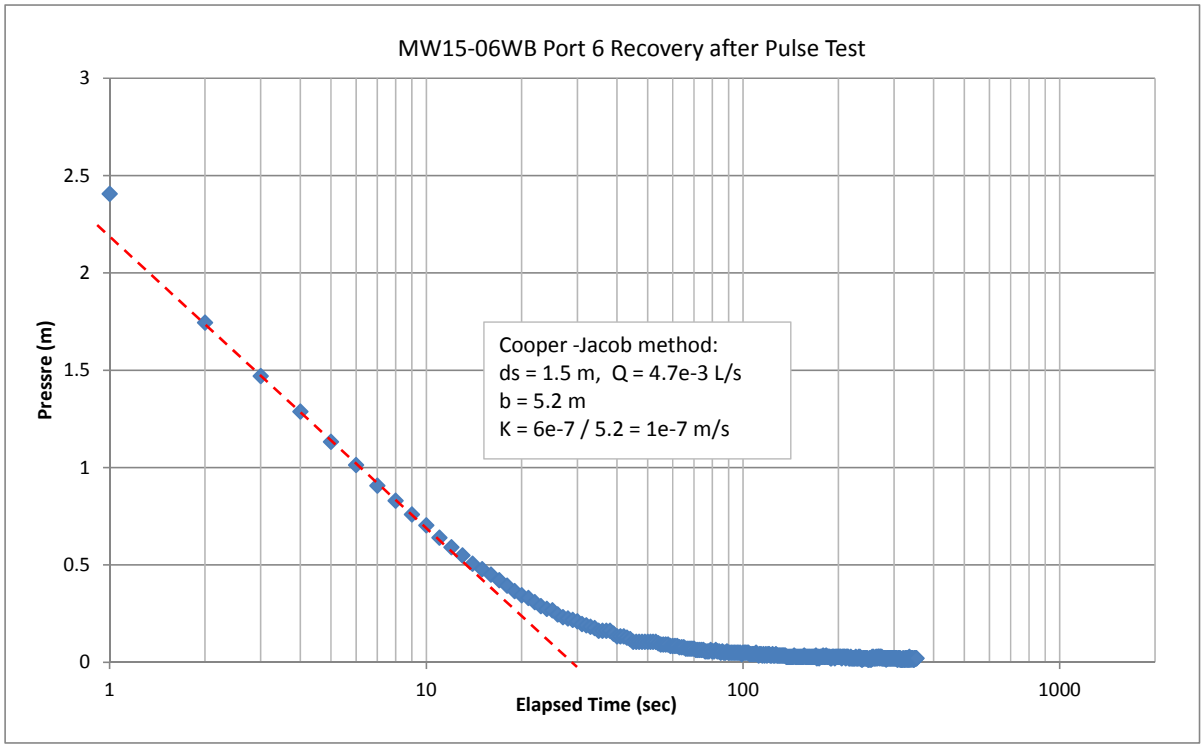
LORAX ENVIRONMENTAL

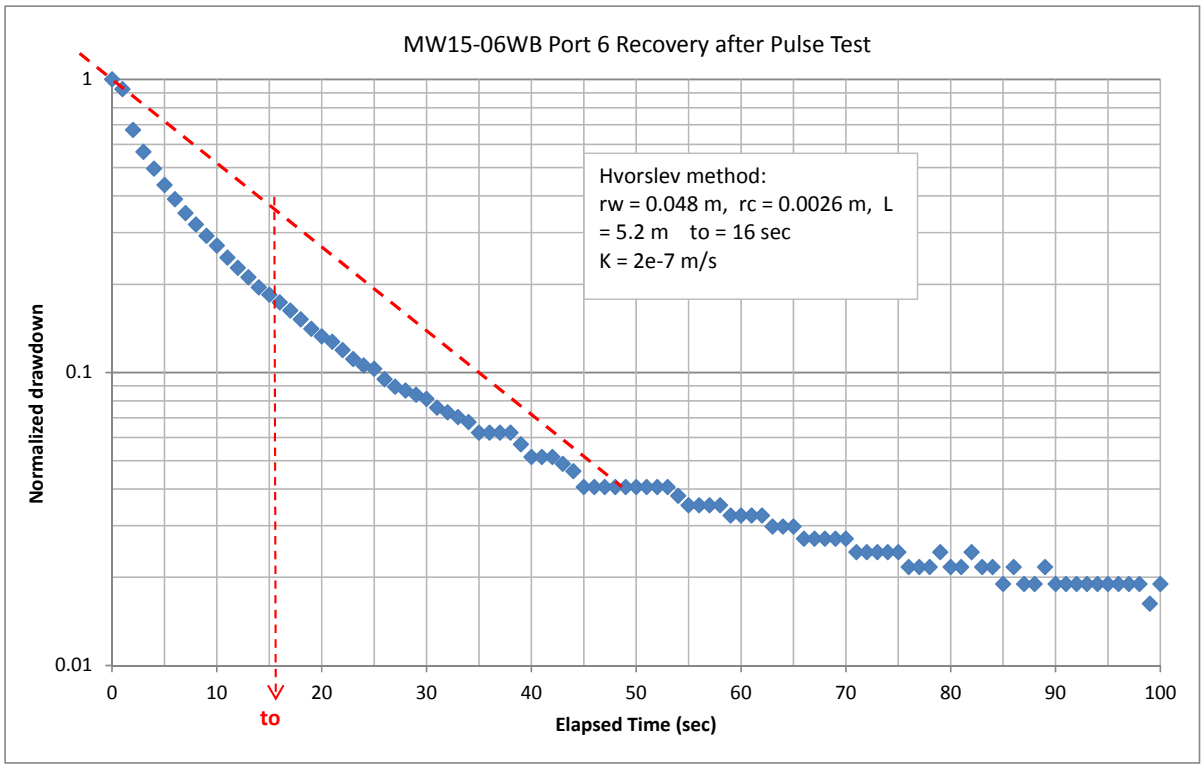
2289 Burrard St., Vancouver, B.C.

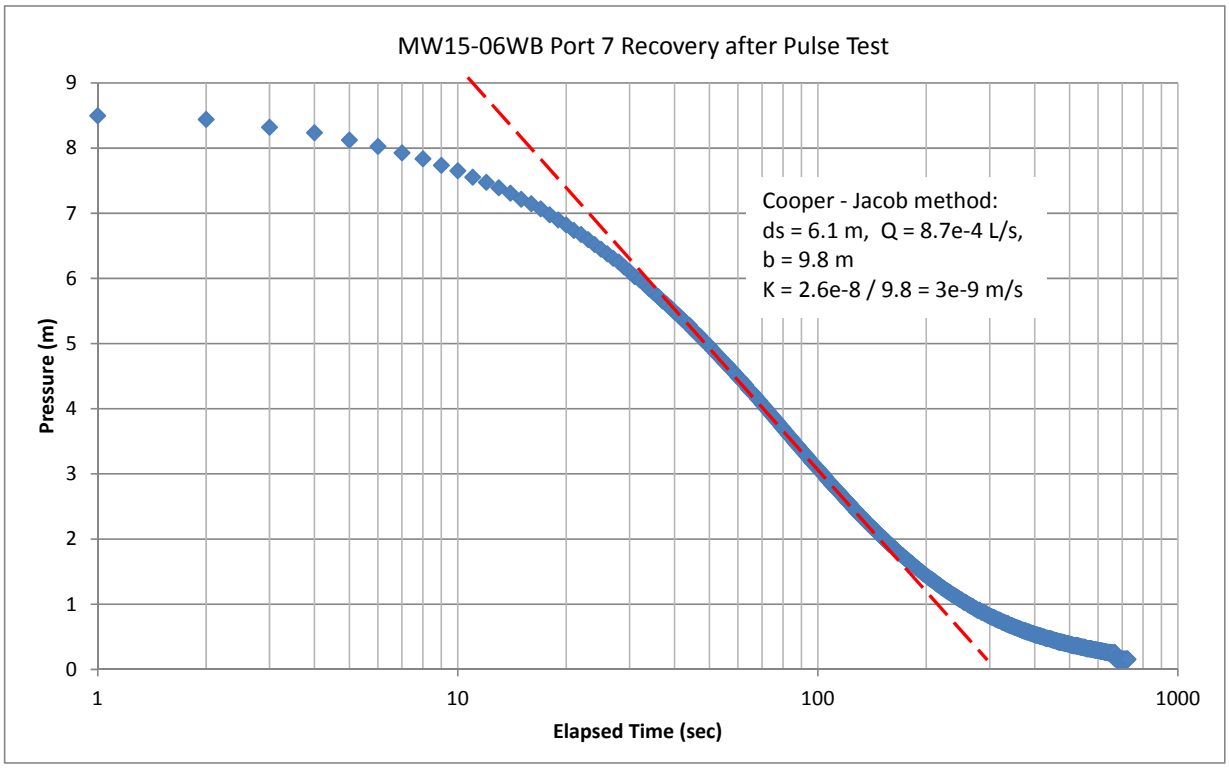
Project No.:	A362-4		
Project:	Coffee Creek Gold Project		
Details:	Stug Test in MW15-3 AZ		
Eng.:	VS	Checked:	
Date:	18-Feb-16	Figure No:	


MW15-06WB Port 2 Recovery after Pulse Test
Residual Drawdown (m)
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
1
10
100
1000
10000
Elapsed Time (sec))
Cooper-Jacob method:
T = 0.1832*Q/ds
ds = 11.8 m b = 5.2 m,
Q = 9e-3 L/s
K = 1e-7 / 5.2 = 3e-8 m/s


MW15-06WB Port 2 Recovery after Pulse Test
Normalized drawdown
1
0.1
0.01
0
200
400
600
800
1000
1200
1400
1600
1800
2000
to
Elapsed Time (sec)
Hvorslev method:
rw = 0.048 m, rc = 0.001 m,
L = 5.2m, to = 620 sec
K = 1e-9 m/s


MW15-06WB Port 6 Recovery after Pulse Test
Pressre (m)
Elapsed Time (sec)
Cooper -Jacob method:
ds = 1.5 m, Q = 4.7e-3 L/s
b = 5.2 m
K = 6e-7 / 5.2 = 1e-7 m/s


MW15-06WB Port 6 Recovery after Pulse Test
Normalized drawdown
Elapsed Time (sec)
to
Hvorslev method:
rw = 0.048 m, rc = 0.0026 m, L = 5.2 m to = 16 sec
K = 2e-7 m/s


MW15-06WB Port 7 Recovery after Pulse Test
Cooper - Jacob method:
ds = 6.1 m, Q = 8.7e-4 L/s,
b = 9.8 m
K = 2.6e-8 / 9.8 = 3e-9 m/s
Pressure (m)
Elapsed Time (sec)
0
1
2
3
4
5
6
7
8
9
1
10
100
1000

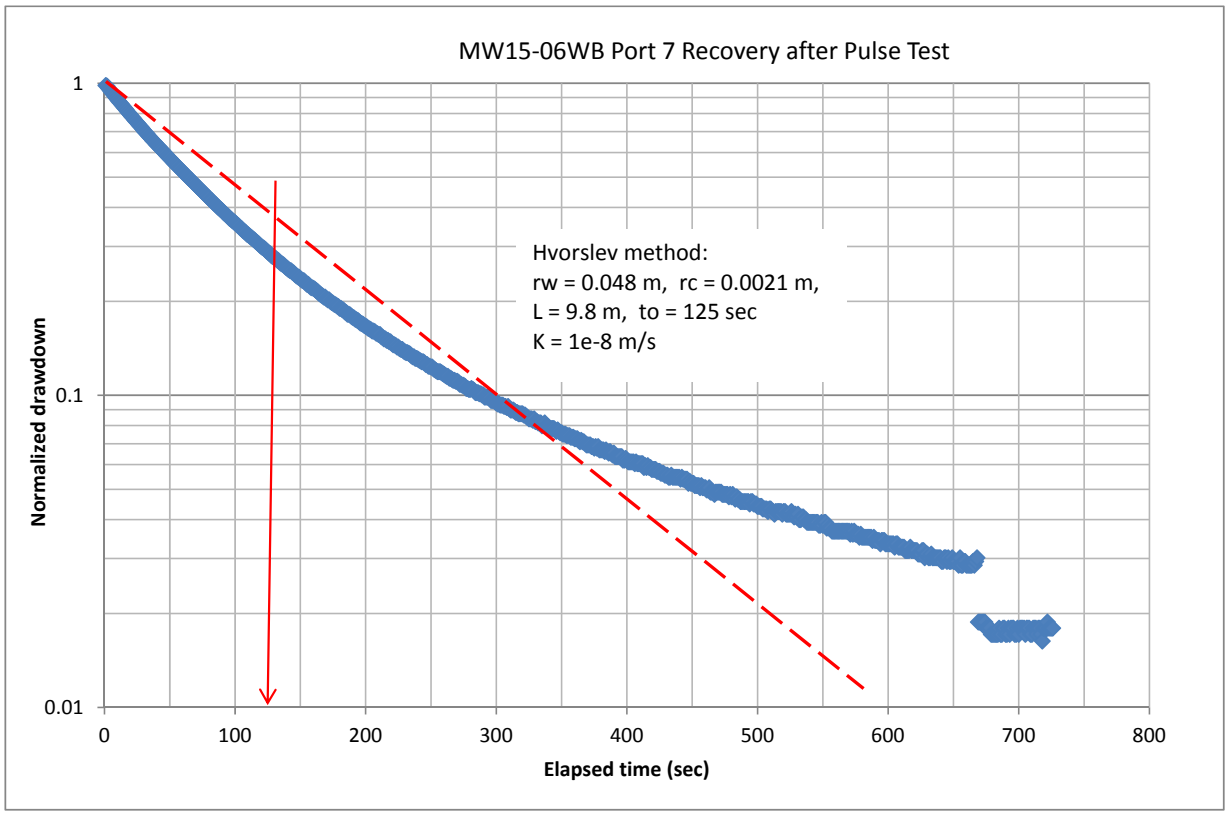

MW15-06WB Port 7 Recovery after Pulse Test
Hvorslev method:
rw = 0.048 m, rc = 0.0021 m,
L = 9.8 m, to = 125 sec
K = 1e-8 m/s
Normalized drawdown
Elapsed time (sec)
1
0.1
0.01
0
100
200
300
400
500
600
700
800

Table 6:
Summary of hydraulic testing results at MW16-01T/WB

Hole ID	Test Type	Analytical Method	Interval (m)	Transmissivity (m^2/s)	Hydraulic Conductivity (m/s)
MW16-01T	Packer Constant Head Test	Hvorslev (1951)	147.8-189		6E-07
MW16-01T	Pumping Test Recovery	Cooper and Jacob (1946)	0-189	1E-05	6E-07[2]
MW16-01WB	Airlift Test Recovery	Cooper and Jacob (1946)	0-120[1]	1E-04	

Notes
[1]Airlifting conducted in MW16-01WB, measurements recorded at 97 and 131.5 m bgs in MW16-01T
[2] Bulk measurement based on 20m fracture zone

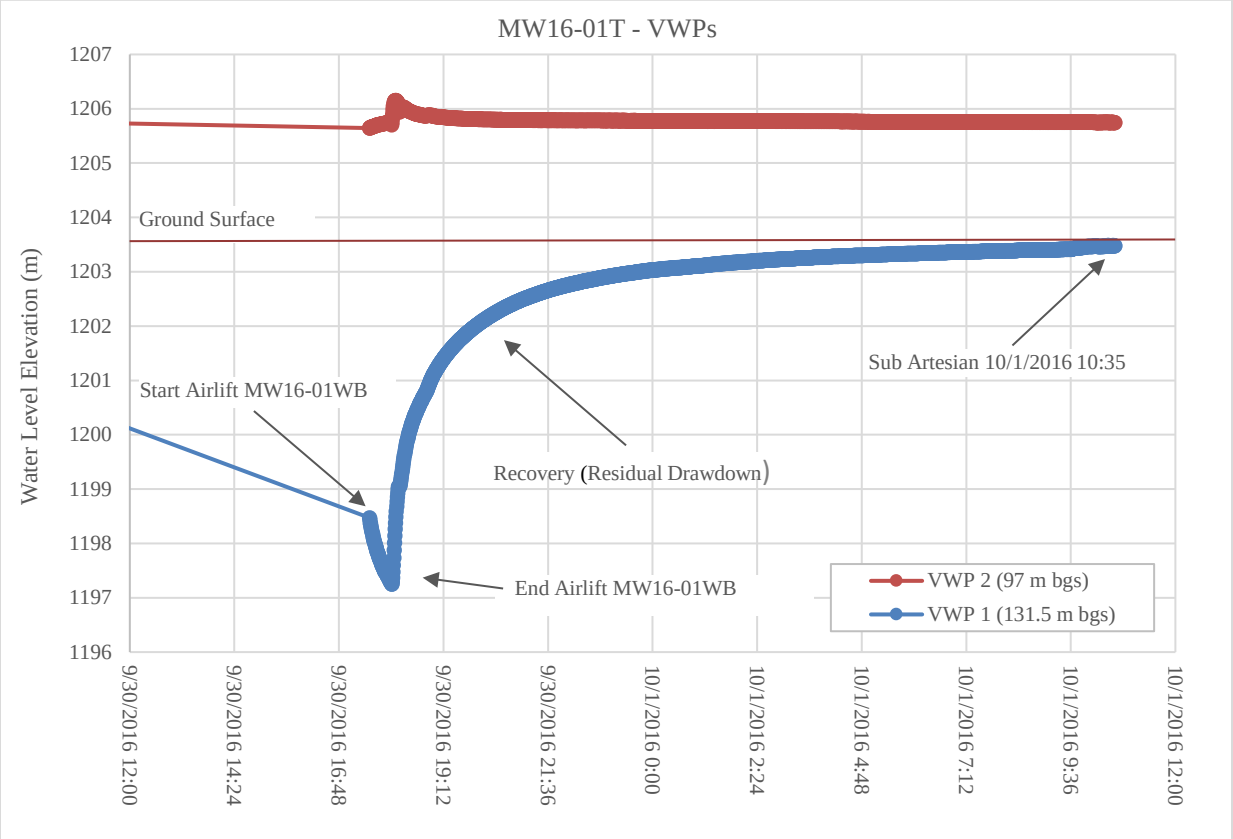


Figure 8: Water level changes at MW16-01T in respone to airlift testing in MW16-01WB

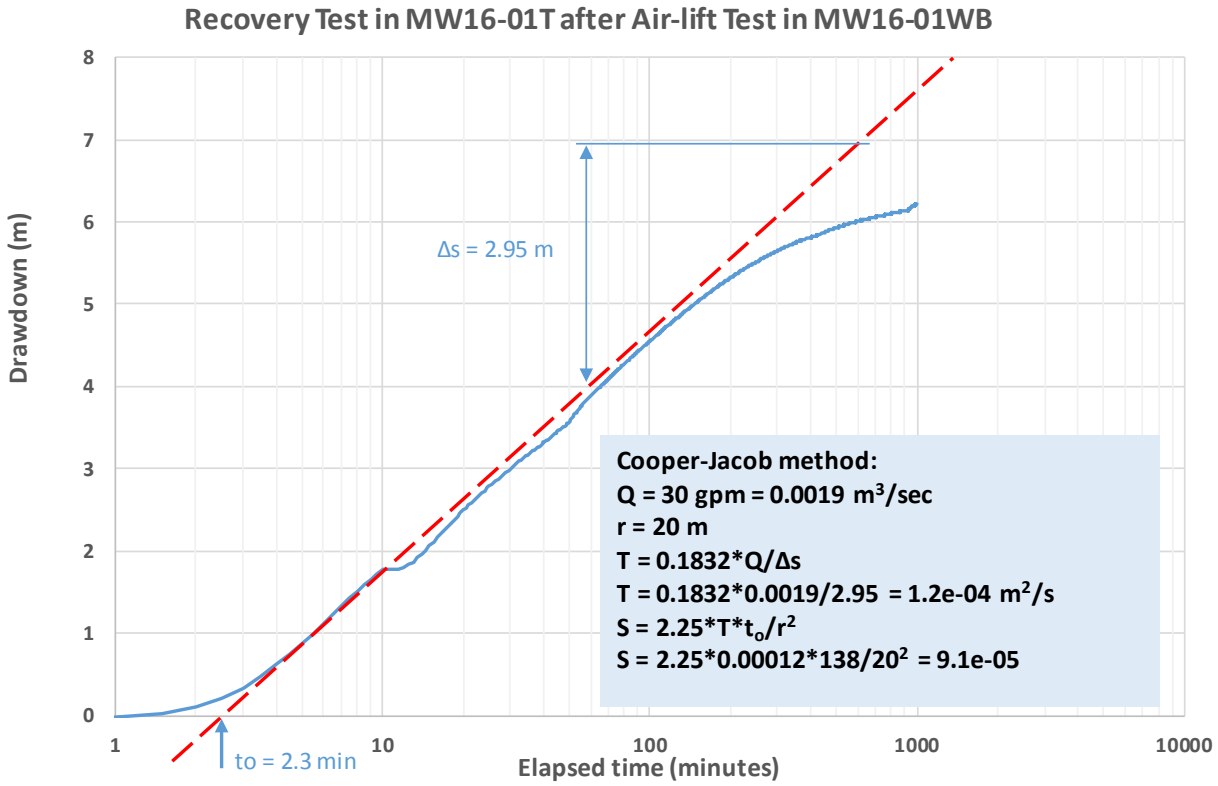


Figure 9: Recovery test in MW16-01T in response to airlift testing in MW16-01WB

4.4 Ground Temperature

The thermistor string was downloaded approximately five (5) weeks after installation which provided sufficient time for the cement to set and cool, and the sensors to equilibrate to ground conditions. The thermistor data displayed temperature stabilization useful for determining permafrost thickness for the final planning of the MW16-01WB installation. Permafrost thickness is on the order of 67 metres, with temperatures below 0°C between 0.5 and 67 metres below ground surface. Figure 10 demonstrates sensor temperature stabilization over the course of several weeks after installation.

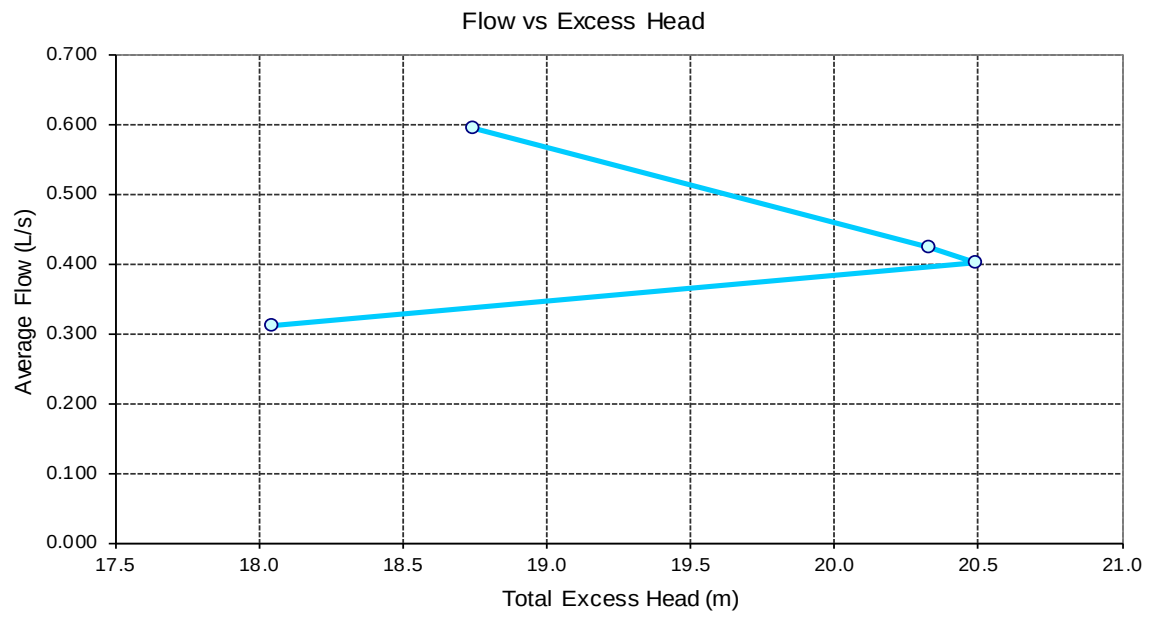
Packer Test Analysis MW16-01T

PACKER TESTING - CONSTANT HEAD TEST (Hvorslev, 1951)

Date of Test:	21-Aug-16	Apparent Current Depth of Drill Hole (m):			189.00
Drill Hole No:	**MW16-01T**	Test Section from (m):	147.83	to:	189.00
Test No:	#1	Length of Test Section (m):			41.17
Packer Type:	Single	Static Groundwater Level (vertical m below datum):			0.47
Inflation Pressure (kPa):	4143.8	Height of Gauge (m above datum):			1.40
Casing Details:	8 m	Drill Hole Dip (deg from horizontal):			90
Diameter of Drill Hole (mm):	114.3	Vertical Depth of Drill Hole (m):			189.00
ID of Drilling Rods (mm):	n/a	Vertical Depth of Test Section (m):			168.41

If groundwater level is unknown during the test use depth of test center section

Injection			Cummulative	Friction Head Loss		Total Excess Head	Injection Rate	Note
Stage	Duration	Pressure	Consumption	Drop pipe	Hose			
no.	min	kPa	m3	m	m	m	L/s	
zero		0	7.920	0	0	0	0.00	
#1	5	200	8.098	3.55	0.00	18.74	0.593	
#2	5	200	8.225	1.97	0.00	20.33	0.423	
#3	7	200	8.394	1.80	0.00	20.49	0.402	
#2	3	170	8.450	1.15	0.00	18.05	0.311	
#1								



Bulk K (m/s)	Stage no.					**Average K**	Lugeon
	#1	#2	#3	#2 back	#1 back		
	8.1E-07	5.3E-07	5.0E-07	4.4E-07		**5.7E-07**	3.32

LORAX ENVIRONMENTAL

2289 Burrard St., Vancouver, B.C.

PROJ. NO.:	A362-4		
PROJECT:	Coffee Creek Gold		
DETAILS:	MW16-01 Packer Testing 148-189m		
ENG.	VS	Checked:	
DATE	30-Aug-16	Figure:	1

Pumping Test MW16-01T

RECOVERY TEST EVALUATION

Cooper - Jacob Graphical Method

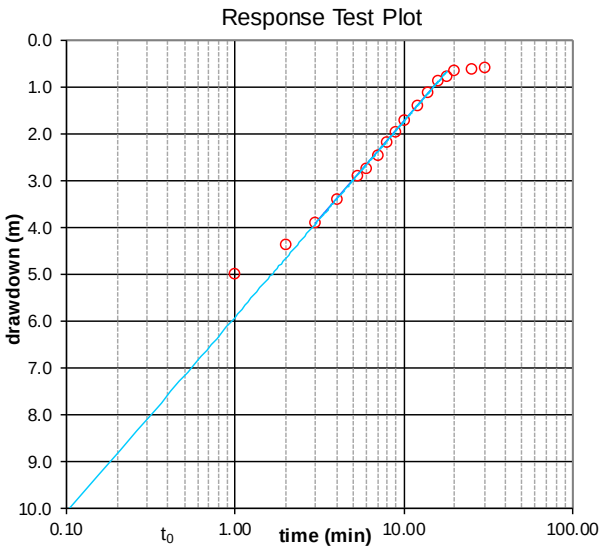
Well:	**MW16-01T**	Date:	**August 24, 2016**		
Location:	**Coffee Ck, HLF**	Discharge Q:	**0.323**	(l/s)	
Type of Test:	Recovery after 16.5min of drawdown from pumpin				
Radial Distance r (m):	**0.063**	Static level:	**0**	(m)	
Well Diameter (mm):	**125**	Max. level:	**6.79**	(m)	

Interpretation section :
point 1: **3**
point 2: **13**

T = 0.1832.Q/s
S = 2.246.T.t_o/ r^2
s (m) = 4.20
t_o (min) = 26.28

T (m^2/s) = **1.41E-05** **S' =** **1.26E+01**

clock time	elapsed time t (min)	point	water level h (m)	d_down s (m)	normalized drawdown
8:05	0	*0*	0	0	0.00
8:06	1.00	*1*	5.00	5.00	0.74
8:07	2.00	*2*	4.39	4.39	0.65
8:08	3.00	*3*	3.92	3.92	0.58
8:09	4.00	*4*	3.42	3.42	0.50
8:10	5.30	*5*	2.92	2.92	0.43
8:11	6.00	*6*	2.74	2.74	0.40
8:12	7.00	*7*	2.48	2.48	0.37
8:13	8.00	*8*	2.19	2.19	0.32
8:14	9.00	*9*	1.99	1.99	0.29
8:15	10.00	*10*	1.73	1.73	0.25
8:17	12.00	*11*	1.41	1.41	0.21
8:19	14.00	*12*	1.13	1.13	0.17
8:21	16.00	*13*	0.89	0.89	0.13
8:23	18.00	*14*	0.78	0.78	0.11
8:25	20.00	*15*	0.67	0.67	0.10
8:27	25.00	*16*	0.62	0.62	0.09
8:32	30.00	*17*	0.59	0.59	0.09



LORAX ENVIRONMENTAL
2289 Burrard St., Vancouver, B.C.

Project no:	A362-4		
Project:	Coffee Ck Gold		
Details:	Recovery test in MW16-01T		
Eng.: VS	Checked:	**AS**	
Date:	Fig. no.:	**1**	

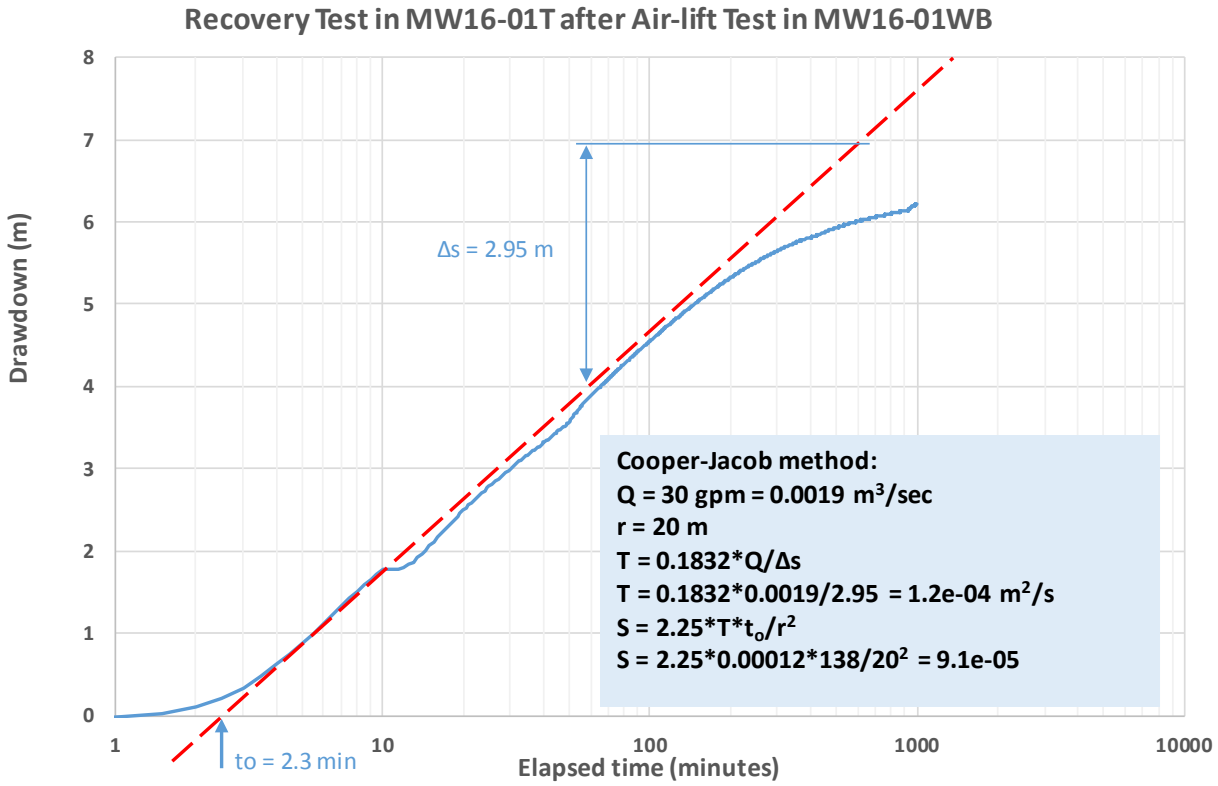


Figure 9: Recovery test in MW16-01T in response to airlift testing in MW16-01WB

4.4 Ground Temperature

The thermistor string was downloaded approximately five (5) weeks after installation which provided sufficient time for the cement to set and cool, and the sensors to equilibrate to ground conditions. The thermistor data displayed temperature stabilization useful for determining permafrost thickness for the final planning of the MW16-01WB installation. Permafrost thickness is on the order of 67 metres, with temperatures below 0°C between 0.5 and 67 metres below ground surface. Figure 10 demonstrates sensor temperature stabilization over the course of several weeks after installation.

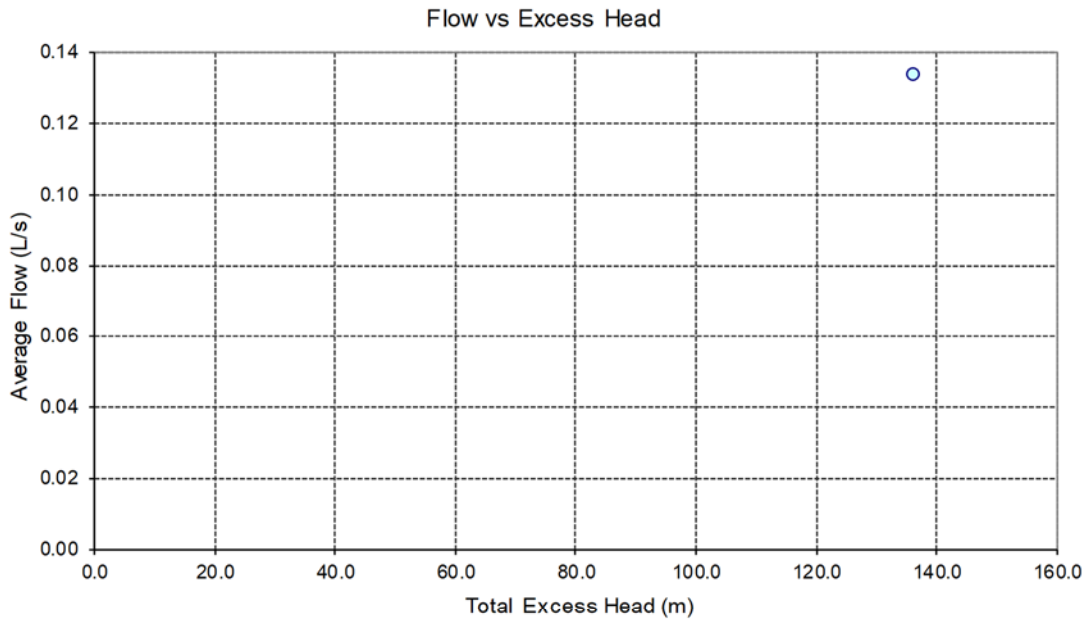
Injection Test #1

PACKER TESTING - CONSTANT HEAD TEST (Hvorslev, 1951)

Date of Test:	6-Aug-17	Apparent Current Depth of Drill Hole (m):			201.50
Drill Hole No:	MW17-01 T	Test Section from (m):	176.00	to:	201.50
Test No:	#1	Length of Test Section (m):			25.50
Packer Type:	Single	Static Groundwater Level (vertical m below datum):			160.00
Inflation Pressure (psi):	650.0	Height of Gauge (m above datum):			1.20
Casing Details:	3 m	Drill Hole Dip (deg from horizontal):			90
Diameter of Drill Hole (mm):	114.3	Vertical Depth of Drill Hole (m):			201.50
ID of Drilling Rods (mm):	57.2	Vertical Depth of Test Section (m):			188.75

If groundwater level is unknown during the test use depth of test center section

Injection			Cummulative	Friction Head Loss		Total Excess Head	Injection Rate	Note
Stage	Duration	Pressure	Consumption	Packer	Hose			
no.	min	kPa	liters	m	m	m	L/s	
zero		0	0.0	0	0	0	0.00	
#1	10	0.00	800.0	0.00	25.00	136.20	0.13	open rods
#2								
#3								
#2								
#1								



Bulk K (m/s)	Stage no.					Average K	Lugeon
	#1	#2	#3	#2 back	#1 back		
	3.7E-08					**3.7E-08**	

LORAX ENVIRONMENTAL
2289 Burrard St., Vancouver, B.C.

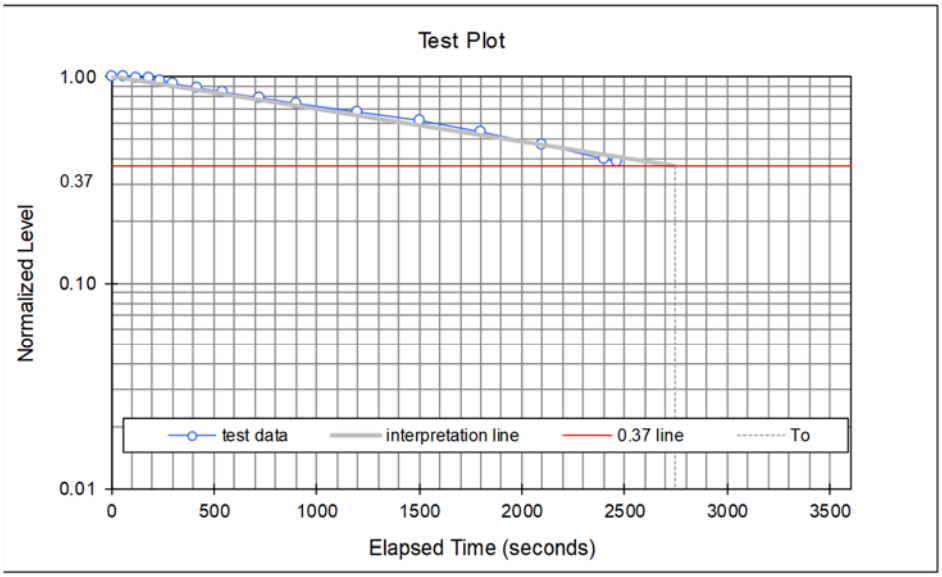
PROJ. NO.:	A447-1		
PROJECT:	Coffee Creek Gold		
DETAILS:	MW17-01 T/VWP Packer Testing		
ENG.	VS	Checked:	
DATE	15-Aug-17	Figure:	1

Recovery Test #1

Falling Head Test - Hvorslev Solution

Date:	August 6, 2017	Time Initiated:	15:30	**Well:**	**MW17-01 T/VWP**
Borehole Diameter (mm):	114	Well Diameter (mm):	57.0	Screen Length (m):	25
Static Level H (mbrp) :	100.00	Initial Level H_0 (mbrp):	0.00	**T_o (sec) =**	**2750**
Water level within screen during test?	yes	Test details:	after Q=const	**K (m/s) =**	**1.1E-08**

Clock Time	Elapsed Time (sec)	Elapsed Time (min)	Depth to Water (h) (m)	Drawdown H - h (m)	Normalized Level (H-h)/(H-H_0)	Comments
15:00	0	0.000	0.00	100.00	1.00	
	60	1.000	0.15	99.85	1.00	
	120	2.000	0.28	99.72	1.00	
	180	3.000	1.53	98.47	0.98	Recovery rest after #1
	240	4.000	4.11	95.89	0.96	packer test
	300	5.000	6.46	93.54	0.94	zone 176 to 201.5m
	420	7.000	10.90	89.10	0.89	
	540	9.000	15.02	84.98	0.85	
	720	12.000	20.60	79.40	0.79	Static level estimated
	900	15.000	25.43	74.57	0.75	
	1200	20.000	32.249	67.75	0.68	
	1500	25.000	38.635	61.365	0.61	
	1800	30.000	45.599	54.401	0.54	
	2100	35.000	52.859	47.141	0.47	
	2400	40.000	59.819	40.181	0.40	
	2460	41.000	61.054	38.946	0.39	



LORAX ENVIRONMENTAL 2289 Burrard St., Vancouver, B.C.	Project No.:	**A447-1**		
	Project:	Coffee Creek Gold Project		
	Details:	Recovery Test after #1 Packer Test		
	Eng.:	**VS**	Checked:	
	Date:	**8/15/17**	Figure No:	**3**

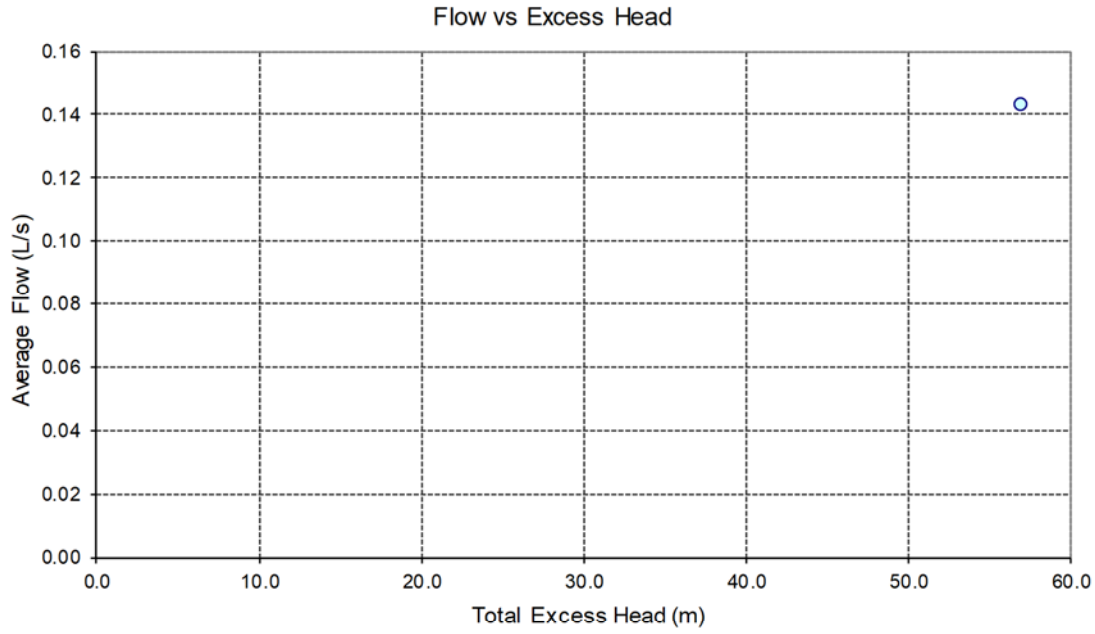
Injection Test #2

PACKER TESTING - CONSTANT HEAD TEST (Hvorslev, 1951)

Date of Test:	7-Aug-17	Apparent Current Depth of Drill Hole (m):			201.50
Drill Hole No:	**MW17-01 T**	Test Section from (m):	153.50	to:	201.50
Test No:	#2	Length of Test Section (m):			48.00
Packer Type:	Single	Static Groundwater Level (vertical m below datum):			88.00
Inflation Pressure (psi):	750.0	Height of Gauge (m above datum):			1.20
Casing Details:	3 m	Drill Hole Dip (deg from horizontal):			90
Diameter of Drill Hole (mm):	114.3	Vertical Depth of Drill Hole (m):			201.50
ID of Drilling Rods (mm):	57.2	Vertical Depth of Test Section (m):			177.50

If groundwater level is unknown during the test use depth of test center section

Injection			Cummulative	Friction Head Loss		Total Excess Head	Injection Rate	Note
Stage	Duration	Pressure	Consumption	Packer	Hose			
no.	min	kPa	liters	m	m	m	L/s	
zero		0	0.0	0	0	0	0.00	
#1	10	-100.00	750.0	0.00	22.00	57.00	0.14	open rods
#2								
#3								
#2								
#1								



Bulk K (m/s)	Stage no.					**Average K**	Lugeon
	#1	#2	#3	#2 back	#1 back		
	5.6E-08					**5.6E-08**	

LORAX ENVIRONMENTAL
2289 Burrard St., Vancouver, B.C.

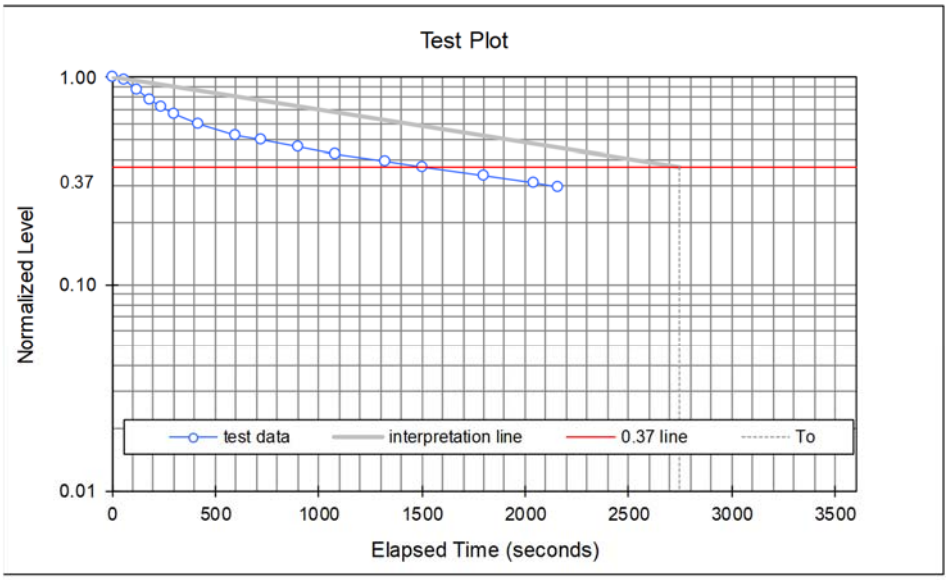
PROJ. NO.:	A447-1		
PROJECT:	Coffee Creek Gold		
DETAILS:	MW17-01 T/VWP Packer Testing		
ENG.	VS	Checked:	
DATE	15-Aug-17	Figure:	2

Recovery Test #2

Falling Head Test - Hvorslev Solution

Date:	August 7, 2017	Time Initiated:	10:00	**Well:**	**MW17-01 T/VWP**
Borehole Diameter (mm):	114	Well Diameter (mm):	57.0	Screen Length (m):	47
Static Level H (mbrp) :	97.00	Initial Level H_0 (mbrp):	10.00	**T_o (sec) =**	**2750**
Water level within screen during test?	yes	Test details:	after Q=const	**K (m/s) =**	**6.4E-09**

Clock Time	Elapsed Time (sec)	Elapsed Time (min)	Depth to Water (h) (m)	Drawdown H - h (m)	Normalized Level (H-h)/(H-H_0)	Comments
15:00	0	0	10.00	87.00	1.00	
	60	1	12.36	84.64	0.97	
	120	2	21.45	75.55	0.87	
	180	3	29.07	67.93	0.78	Recovery rest after #2
	240	4	34.59	62.41	0.72	packer test
	300	5	38.78	58.22	0.67	zone 153.5 to 201.5 m
	420	7	44.76	52.24	0.60	
	600	10	51.02	45.98	0.53	
	720	12	53.79	43.21	0.50	Initial portion of the test
	900	15	56.94	40.06	0.46	was affected by bubbles
	1080	18	59.62	37.38	0.43	of air escaping from the
	1320	22	62.75	34.247	0.39	rods
	1500	25	64.83	32.167	0.37	
	1800	30	67.90	29.097	0.33	
	2040	34	70.10	26.896	0.31	
	2160	36	71.05	25.946	0.30	



LORAX ENVIRONMENTAL 2289 Burrard St., Vancouver, B.C.	Project No.:	**A447-1**		
	Project:	Coffee Creek Gold Project		
	Details:	Recovery Test after #2 Packer Test		
	Eng.:	**VS**	Checked:	
	Date:	**8/15/17**	Figure No:	**4**

APPENDIX 4-C2: TETRA TECH EBA 2013 HYDRAULIC TESTS

Table E-1.1: Packer Test Results for CFD0318

Test	Dip		45	Pressure	Pressure	Time	Aquifer thickness tested	SWL	H	Drill hole radius	Cumulative Volume	Injection Rate	Hydraulic Conductivity (K)	Log(K)
	From	To	Midpoint											
	m	m	m bgs	psi	KPa	min	m	m bgs	m H20	m	m^3	m^3/min	m/s	
Test 1						0.0					78.5650			
	146.4	151.0	148.7	32	221	1.0	3.25	60	84.0	0.038	78.5730	0.0080	3E-07	-6.46
	146.4	151.0	148.7	32	221	2.0	3.25	60	84.0	0.038	78.5825	0.0095	4E-07	-6.39
	146.4	151.0	148.7	32	221	3.0	3.25	60	84.0	0.038	78.5915	0.0090	4E-07	-6.41
	146.4	151.0	148.7	32	221	4.0	3.25	60	84.0	0.038	78.6005	0.0090	4E-07	-6.41
	146.4	151.0	148.7	32	221	5.0	3.25	60	84.0	0.038	78.6095	0.0090	4E-07	-6.41
						0.0					78.6600			
	146.4	151.0	148.7	66	455	1.0	3.25	60	107.9	0.038	78.6800	0.0200	7E-07	-6.17
	146.4	151.0	148.7	66	455	2.0	3.25	60	107.9	0.038	78.6960	0.0160	5E-07	-6.27
	146.4	151.0	148.7	66	455	3.0	3.25	60	107.9	0.038	78.7140	0.0180	6E-07	-6.22
	146.4	151.0	148.7	66	455	4.0	3.25	60	107.9	0.038	78.7310	0.0170	6E-07	-6.24
	146.4	151.0	148.7	66	455	5.0	3.25	60	107.9	0.038	78.7470	0.0160	5E-07	-6.27
						0.0					78.7750			
	146.4	151.0	148.7	100	690	1.0	3.25	60	131.8	0.038	78.7950	0.0200	6E-07	-6.26
	146.4	151.0	148.7	100	690	2.0	3.25	60	131.8	0.038	78.8150	0.0200	6E-07	-6.26
	146.4	151.0	148.7	100	690	3.0	3.25	60	131.8	0.038	78.8360	0.0210	6E-07	-6.24
	146.4	151.0	148.7	100	690	4.0	3.25	60	131.8	0.038	78.8560	0.0200	6E-07	-6.26
	146.4	151.0	148.7	100	690	5.0	3.25	60	131.8	0.038	78.8760	0.0200	6E-07	-6.26
						0.0					78.8900			
	146.4	151.0	148.7	66	455	1.0	3.25	60	107.9	0.038	78.9070	0.0170	6E-07	-6.24
	146.4	151.0	148.7	66	455	2.0	3.25	60	107.9	0.038	78.9250	0.0180	6E-07	-6.22
	146.4	151.0	148.7	66	455	3.0	3.25	60	107.9	0.038	78.9420	0.0170	6E-07	-6.24
	146.4	151.0	148.7	66	455	4.0	3.25	60	107.9	0.038	-	-	-	
	146.4	151.0	148.7	66	455	5.0	3.25	60	107.9	0.038	-	-	-	

Table E-1.2: Packer Test Results for CFD0318

Test	Dip		45	Pressure	Pressure	Time	Aquifer thickness tested	SWL	H	Drill hole radius	Cumulative Volume	Injection Rate	Hydraulic Conductivity (K)	Log(K)
	From	To	Midpoint											
	m	m	m bgs	psi	KPa	min	m	m bgs	m H20	m	m^3	m^3/min	m/s	
Test 2						0.0					79.5640			
	173.9	180.0	177.0	30	207	1.0	4.31	60	82.6	0.038	79.6040	0.0400	1E-06	-5.85
	173.9	180.0	177.0	30	207	2.0	4.31	60	82.6	0.038	79.6460	0.0420	1E-06	-5.83
	173.9	180.0	177.0	30	207	3.0	4.31	60	82.6	0.038	79.6880	0.0420	1E-06	-5.83
	173.9	180.0	177.0	30	207	4.0	4.31	60	82.6	0.038	79.7290	0.0410	1E-06	-5.84
	173.9	180.0	177.0	30	207	5.0	4.31	60	82.6	0.038	79.7690	0.0400	1E-06	-5.85
						0.0					79.8870			
	173.9	180.0	177.0	65	448	1.0	4.31	60	107.2	0.038	79.9360	0.0840	2E-06	-5.64
	173.9	180.0	177.0	65	448	2.0	4.31	60	107.2	0.038	79.9850	0.0490	1E-06	-5.88
	173.9	180.0	177.0	65	448	3.0	4.31	60	107.2	0.038	80.0350	0.0500	1E-06	-5.87
	173.9	180.0	177.0	65	448	4.0	4.31	60	107.2	0.038	80.0840	0.0490	1E-06	-5.88
	173.9	180.0	177.0	65	448	5.0	4.31	60	107.2	0.038	80.1340	0.0500	1E-06	-5.87
						0.0					80.3070			
	173.9	180.0	177.0	95	655	1.0	4.31	60	128.3	0.038	80.3670	0.0600	1E-06	-5.87
	173.9	180.0	177.0	95	655	2.0	4.31	60	128.3	0.038	80.4240	0.0570	1E-06	-5.89
	173.9	180.0	177.0	95	655	3.0	4.31	60	128.3	0.038	80.4830	0.0590	1E-06	-5.87
	173.9	180.0	177.0	95	655	4.0	4.31	60	128.3	0.038	80.5420	0.0590	1E-06	-5.87
	173.9	180.0	177.0	95	655	5.0	4.31	60	128.3	0.038	80.5990	0.0570	1E-06	-5.89
						0.0					80.6500			
	173.9	180.0	177.0	70	483	1.0	4.31	60	110.7	0.038	80.7010	0.0510	1E-06	-5.87
	173.9	180.0	177.0	70	483	2.0	4.31	60	110.7	0.038	80.7540	0.0530	1E-06	-5.86
	173.9	180.0	177.0	65	448	3.0	4.31	60	107.2	0.038	80.8040	0.0500	1E-06	-5.87
	173.9	180.0	177.0	65	448	4.0	4.31	60	107.2	0.038	80.8560	0.0520	1E-06	-5.85
	173.9	180.0	177.0	65	448	5.0	4.31	60	107.2	0.038	80.9070	0.0510	1E-06	-5.86
						0.0					80.9910			
	173.9	180.0	177.0	33	228	1.0	4.31	60	84.7	0.038	81.0350	0.0440	2E-06	-5.82
	173.9	180.0	177.0	33	228	2.0	4.31	60	84.7	0.038	81.0800	0.0450	2E-06	-5.81
	173.9	180.0	177.0	33	228	3.0	4.31	60	84.7	0.038	81.1240	0.0440	2E-06	-5.82
	173.9	180.0	177.0	33	228	4.0	4.31	60	84.7	0.038	81.1680	0.0440	2E-06	-5.82
	173.9	180.0	177.0	33	228	5.0	4.31	60	84.7	0.038	81.2120	0.0440	2E-06	-5.82

Table E-1.3: Packer Test Results for CFD0318

Test	Dip		45	Pressure	Pressure	Time	Aquifer thickness tested	SWL	H	Drill hole radius	Cumulative Volume	Injection Rate	Hydraulic Conductivity (K)	Log(K)
	From	To	Midpoint											
	m	m	m bgs	psi	KPa	min	m	m bgs	m H20	m	m^3	m^3/min	m/s	
Test 3						0.0					82.2070			
	195.4	200.0	197.7	32	221	1.0	3.25	60	84.0	0.038	82.2085	0.0015	6E-08	-7.19
	195.4	200.0	197.7	32	221	2.0	3.25	60	84.0	0.038	82.2100	0.0015	6E-08	-7.19
	195.4	200.0	197.7	33	228	3.0	3.25	60	84.7	0.038	82.2110	0.0010	4E-08	-7.37
	195.4	200.0	197.7	33	228	4.0	3.25	60	84.7	0.038	82.2130	0.0020	9E-08	-7.07
	195.4	200.0	197.7	33	228	5.0	3.25	60	84.7	0.038	82.2140	0.0010	4E-08	-7.37
						0.0					82.2170			
	195.4	200.0	197.7	70	483	1.0	3.25	60	110.7	0.038	82.2190	0.0020	7E-08	-7.18
	195.4	200.0	197.7	70	483	2.0	3.25	60	110.7	0.038	82.2200	0.0010	3E-08	-7.48
	195.4	200.0	197.7	70	483	3.0	3.25	60	110.7	0.038	82.2220	0.0020	7E-08	-7.18
	195.4	200.0	197.7	70	483	4.0	3.25	60	110.7	0.038	82.2240	0.0020	7E-08	-7.18
	195.4	200.0	197.7	70	483	5.0	3.25	60	110.7	0.038	82.2250	0.0010	3E-08	-7.48
						0.0					82.2320			
	195.4	200.0	197.7	104	717	1.0	3.25	60	134.7	0.038	82.2335	0.0015	4E-08	-7.39
	195.4	200.0	197.7	104	717	2.0	3.25	60	134.7	0.038	82.2360	0.0025	7E-08	-7.17
	195.4	200.0	197.7	104	717	3.0	3.25	60	134.7	0.038	82.2380	0.0020	5E-08	-7.27
	195.4	200.0	197.7	104	717	4.0	3.25	60	134.7	0.038	82.2400	0.0020	5E-08	-7.27
	195.4	200.0	197.7	104	717	5.0	3.25	60	134.7	0.038	82.2420	0.0020	5E-08	-7.27
						0.0					82.2430			
	195.4	200.0	197.7	72	497	1.0	3.25	60	112.1	0.038	82.2450	0.0020	6E-08	-7.19
	195.4	200.0	197.7	72	497	2.0	3.25	60	112.1	0.038	82.2470	0.0020	6E-08	-7.19
	195.4	200.0	197.7	72	497	3.0	3.25	60	112.1	0.038	82.2485	0.0015	5E-08	-7.31
	195.4	200.0	197.7	72	497	4.0	3.25	60	112.1	0.038	82.2500	0.0015	5E-08	-7.31
	195.4	200.0	197.7	72	497	5.0	3.25	60	112.1	0.038	82.2515	0.0015	5E-08	-7.31
						0.0					82.2530			
	195.4	200.0	197.7	31	214	1.0	4.60	60	83.3	0.038	82.2545	0.0015	5E-08	-7.30
	195.4	200.0	197.7	31	214	2.0	4.60	60	83.3	0.038	82.2560	0.0015	5E-08	-7.30
	195.4	200.0	197.7	31	214	3.0	4.60	60	83.3	0.038	82.2580	0.0020	7E-08	-7.18
	195.4	200.0	197.7	31	214	4.0	4.60	60	83.3	0.038	82.2595	0.0015	5E-08	-7.30
	195.4	200.0	197.7	31	214	5.0	4.60	60	83.3	0.038	82.2610	0.0015	5E-08	-7.30

Table E-2.1: Packer Test Results for CFD0319

Test	Dip		45	Pressure	Pressure	Time	Aquifer thickness tested	SWL	H	Drill hole radius	Cumulative Volume	Injection Rate	Hydraulic Conductivity (K)	Log(K)
	From	To	Midpoint											
	m	m	m bgs	psi	KPa	min	m	m bgs	m H20	m	m^3	m^3/min	m/s	
Test 1						0.0					82.4070			
	66.5	74.0	70.3	20	138	2.0	5.30	50	65.6	0.038	82.4075	0.0003	9E-09	-8.03
	66.5	74.0	70.3	20	138	4.0	5.30	50	65.6	0.038	82.4080	0.0003	9E-09	-8.03
	66.5	74.0	70.3	20	138	6.0	5.30	50	65.6	0.038	82.4090	0.0005	2E-08	-7.73
	66.5	74.0	70.3	20	138	8.0	5.30	50	65.6	0.038	82.4095	0.0002	9E-09	-8.03
	66.5	74.0	70.3	20	138	10.0	5.30	50	65.6	0.038	82.4105	0.0005	2E-08	-7.73
						0.0					82.4120			
	66.5	74.0	70.3	40	276	1.0	5.30	50	79.6	0.038	82.4125	0.0005	2E-08	-7.81
	66.5	74.0	70.3	40	276	2.0	5.30	50	79.6	0.038	82.4135	0.0010	3E-08	-7.51
	66.5	74.0	70.3	40	276	3.0	5.30	50	79.6	0.038	82.4140	0.0005	2E-08	-7.81
	66.5	74.0	70.3	40	276	4.0	5.30	50	79.6	0.038	82.4150	0.0010	3E-08	-7.51
	66.5	74.0	70.3	40	276	5.0	5.30	50	79.6	0.038	82.4155	0.0005	2E-08	-7.81
						0.0					82.4180			
	66.5	74.0	70.3	60	414	1.0	5.30	50	93.7	0.038	82.4190	0.0010	3E-08	-7.58
	66.5	74.0	70.3	60	414	2.0	5.30	50	93.7	0.038	82.4200	0.0010	3E-08	-7.58
	66.5	74.0	70.3	60	414	3.0	5.30	50	93.7	0.038	82.4213	0.0012	3E-08	-7.48
	66.5	74.0	70.3	60	414	4.0	5.30	50	93.7	0.038	82.4223	0.0010	3E-08	-7.58
	66.5	74.0	70.3	60	414	5.0	5.30	50	93.7	0.038	82.4235	0.0012	3E-08	-7.48
						0.0					82.4250			
	66.5	74.0	70.3	40	276	1.0	5.30	50	79.6	0.038	82.4260	0.0010	3E-08	-7.51
	66.5	74.0	70.3	40	276	2.0	5.30	50	79.6	0.038	82.4268	0.0007	2E-08	-7.63
	66.5	74.0	70.3	40	276	3.0	5.30	50	79.6	0.038	82.4278	0.0010	3E-08	-7.51
	66.5	74.0	70.3	40	276	4.0	5.30	50	79.6	0.038	82.4283	0.0005	2E-08	-7.81
	66.5	74.0	70.3	40	276	5.0	5.30	50	79.6	0.038	82.4293	0.0010	3E-08	-7.51
						0.0					82.4310			
	66.5	74.0	70.3	20	138	2.0	5.30	50	65.6	0.038	82.4320	0.0005	2E-08	-7.73
	66.5	74.0	70.3	20	138	4.0	5.30	50	65.6	0.038	82.4330	0.0005	2E-08	-7.73
	66.5	74.0	70.3	20	138	6.0	5.30	50	65.6	0.038	82.4340	0.0005	2E-08	-7.73
	66.5	74.0	70.3	20	138	8.0	5.30	50	65.6	0.038	82.4350	0.0005	2E-08	-7.73
	66.5	74.0	70.3	20	138	10.0	5.30	50	65.6	0.038	82.4360	0.0005	2E-08	-7.73

Table E-2.2: Packer Test Results for CFD0319

Test	Dip		45	Pressure	Pressure	Time	Aquifer thickness tested	SWL	H	Drill hole radius	Cumulative Volume	Injection Rate	Hydraulic Conductivity (K)	Log(K)
	From	To	Midpoint											
	m	m	m bgs	psi	KPa	min	m	m bgs	m H20	m	m^3	m^3/min	m/s	
Test 2						0.0					82.5940			
	111.5	125.0	118.3	30	207	1.0	9.55	50	72.6	0.038	82.5970	0.0030	6E-08	-7.20
	111.5	125.0	118.3	30	207	2.0	9.55	50	72.6	0.038	82.6000	0.0030	6E-08	-7.20
	111.5	125.0	118.3	30	207	3.0	9.55	50	72.6	0.038	82.6035	0.0035	7E-08	-7.13
	111.5	125.0	118.3	30	207	4.0	9.55	50	72.6	0.038	82.6065	0.0030	6E-08	-7.20
	111.5	125.0	118.3	30	207	5.0	9.55	50	72.6	0.038	82.6090	0.0025	5E-08	-7.28
						0.0					82.6150			
	111.5	125.0	118.3	60	414	1.0	9.55	50	93.7	0.038	82.6195	0.0045	7E-08	-7.13
	111.5	125.0	118.3	60	414	2.0	9.55	50	93.7	0.038	82.6240	0.0045	7E-08	-7.13
	111.5	125.0	118.3	60	414	3.0	9.55	50	93.7	0.038	82.6280	0.0040	7E-08	-7.18
	111.5	125.0	118.3	60	414	4.0	9.55	50	93.7	0.038	82.6325	0.0045	7E-08	-7.13
	111.5	125.0	118.3	60	414	5.0	9.55	50	93.7	0.038	82.6365	0.0040	7E-08	-7.18
						0.0					82.6430			
	111.5	125.0	118.3	100	690	1.0	9.55	50	121.8	0.038	82.6505	0.0075	9E-08	-7.02
	111.5	125.0	118.3	100	690	2.0	9.55	50	121.8	0.038	82.6550	0.0045	6E-08	-7.25
	111.5	125.0	118.3	100	690	3.0	9.55	50	121.8	0.038	82.6605	0.0055	7E-08	-7.16
	111.5	125.0	118.3	100	690	4.0	9.55	50	121.8	0.038	82.6665	0.0060	8E-08	-7.12
	111.5	125.0	118.3	100	690	5.0	9.55	50	121.8	0.038	82.6725	0.0060	8E-08	-7.12
						0.0					82.6800			
	111.5	125.0	118.3	62	428	1.0	9.55	50	95.1	0.038	82.6845	0.0045	7E-08	-7.14
	111.5	125.0	118.3	62	428	2.0	9.55	50	95.1	0.038	82.6890	0.0045	7E-08	-7.14
	111.5	125.0	118.3	62	428	3.0	9.55	50	95.1	0.038	82.6940	0.0050	8E-08	-7.09
	111.5	125.0	118.3	62	428	4.0	9.55	50	95.1	0.038	82.6990	0.0050	8E-08	-7.09
	111.5	125.0	118.3	62	428	5.0	9.55	50	95.1	0.038	82.7035	0.0045	7E-08	-7.14
						0.0					82.7070			
	111.5	125.0	118.3	30	207	1.0	9.55	50	72.6	0.038	82.7105	0.0035	7E-08	-7.13
	111.5	125.0	118.3	30	207	2.0	9.55	50	72.6	0.038	82.7145	0.0040	8E-08	-7.07
	111.5	125.0	118.3	30	207	3.0	9.55	50	72.6	0.038	82.7180	0.0035	7E-08	-7.13
	111.5	125.0	118.3	30	207	4.0	9.55	50	72.6	0.038	82.7220	0.0040	8E-08	-7.07
	111.5	125.0	118.3	30	207	5.0	9.55	50	72.6	0.038	82.7255	0.0035	7E-08	-7.13

Table E-3: Packer Test Results for CFD0323

Test	Dip		70	Pressure	Pressure	Time	Aquifer thickness tested	SWL	H	Drill hole radius	Cumulative Volume	Injection Rate	Hydraulic Conductivity (K)	Log(K)
	From	To	Midpoint											
	m	m	m bgs	psi	KPa	min	m	m bgs	m H20	m	m^3	m^3/min	m/s	
Test 1						0.0					83.7560			
	102.9	139.3	121.1	30	207	1.0	34.22	100	122.6	0.038	83.7660	0.0100	4E-08	-7.37
	102.9	139.3	121.1	30	207	2.0	34.22	100	122.6	0.038	83.7760	0.0100	4E-08	-7.37
	102.9	139.3	121.1	30	207	3.0	34.22	100	122.6	0.038	83.7860	0.0100	4E-08	-7.37
	102.9	139.3	121.1	30	207	4.0	34.22	100	122.6	0.038	83.7960	0.0100	4E-08	-7.37
	102.9	139.3	121.1	30	207	5.0	34.22	100	122.6	0.038	83.8060	0.0100	4E-08	-7.37
						0.0					83.8190			
	102.9	139.3	121.1	66	455	1.0	34.22	100	147.9	0.038	83.8310	0.0120	4E-08	-7.37
	102.9	139.3	121.1	66	455	2.0	34.22	100	147.9	0.038	83.8440	0.0130	5E-08	-7.33
	102.9	139.3	121.1	66	455	3.0	34.22	100	147.9	0.038	83.8560	0.0120	4E-08	-7.37
	102.9	139.3	121.1	66	455	4.0	34.22	100	147.9	0.038	83.8700	0.0140	5E-08	-7.30
	102.9	139.3	121.1		0	5.0	34.22	100	101.5	0.038	-	-	-	-

Table E-4.1: Packer Test Results for CFD0324

Test	Dip		45	Pressure	Pressure	Time	Aquifer thickness tested	SWL	H	Drill hole radius	Cumulative Volume	Injection Rate	Hydraulic Conductivity (K)	Log(K)
	From	To	Midpoint											
	m	m	m bgs	psi	KPa	min	m	m bgs	m H20	m	m^3	m^3/min	m/s	
Test 1						0.0					82.8170			
	68.2	81.0	74.6	33	228	1.0	9.05	40	64.7	0.038	82.8200	0.0030	7E-08	-7.13
	68.2	81.0	74.6	33	228	2.0	9.05	40	64.7	0.038	82.8220	0.0020	5E-08	-7.30
	68.2	81.0	74.6	33	228	3.0	9.05	40	64.7	0.038	82.8230	0.0010	2E-08	-7.61
	68.2	81.0	74.6	33	228	4.0	9.05	40	64.7	0.038	82.8240	0.0010	2E-08	-7.61
	68.2	81.0	74.6	33	228	5.0	9.05	40	64.7	0.038	82.8255	0.0015	4E-08	-7.43
						0.0					82.8255			
	68.2	81.0	74.6	66	455	1.0	9.05	40	87.9	0.038	82.8290	0.0035	6E-08	-7.19
	68.2	81.0	74.6	66	455	2.0	9.05	40	87.9	0.038	82.8310	0.0020	4E-08	-7.44
	68.2	81.0	74.6	66	455	3.0	9.05	40	87.9	0.038	82.8340	0.0030	5E-08	-7.26
	68.2	81.0	74.6	66	455	4.0	9.05	40	87.9	0.038	82.8370	0.0030	5E-08	-7.26
	68.2	81.0	74.6	66	455	5.0	9.05	40	87.9	0.038	82.8390	0.0020	4E-08	-7.44
						0.0					82.8390			
	68.2	81.0	74.6	105	724	1.0	9.05	40	115.4	0.038	82.8420	0.0030	4E-08	-7.38
	68.2	81.0	74.6	105	724	2.0	9.05	40	115.4	0.038	82.8450	0.0030	4E-08	-7.38
	68.2	81.0	74.6	105	724	3.0	9.05	40	115.4	0.038	82.8470	0.0020	3E-08	-7.56
	68.2	81.0	74.6	105	724	4.0	9.05	40	115.4	0.038	82.8500	0.0030	4E-08	-7.38
	68.2	81.0	74.6	105	724	5.0	9.05	40	115.4	0.038	82.8540	0.0040	6E-08	-7.25
						0.0					82.8590			
	68.2	81.0	74.6	66	455	1.0	9.05	40	87.9	0.038	82.8610	0.0020	4E-08	-7.44
	68.2	81.0	74.6	66	455	2.0	9.05	40	87.9	0.038	82.8620	0.0010	2E-08	-7.74
	68.2	81.0	74.6	66	455	3.0	9.05	40	87.9	0.038	82.8640	0.0020	4E-08	-7.44
	68.2	81.0	74.6	66	455	4.0	9.05	40	87.9	0.038	82.8660	0.0020	4E-08	-7.44
	68.2	81.0	74.6	66	455	5.0	9.05	40	87.9	0.038	82.8670	0.0010	2E-08	-7.74
						0.0					82.8680			
	68.2	81.0	74.6	33	228	1.0	9.05	40	64.7	0.038	82.8700	0.0020	5E-08	-7.30
	68.2	81.0	74.6	33	228	2.0	9.05	40	64.7	0.038	82.8710	0.0010	2E-08	-7.61
	68.2	81.0	74.6	33	228	3.0	9.05	40	64.7	0.038	82.8720	0.0010	2E-08	-7.61
	68.2	81.0	74.6	33	228	4.0	9.05	40	64.7	0.038	82.8730	0.0010	2E-08	-7.61
	68.2	81.0	74.6	33	228	5.0	9.05	40	64.7	0.038	82.8740	0.0010	2E-08	-7.61

Table E-4.2: Packer Test Results for CFD0324

Test	Dip		45	Pressure	Pressure	Time	Aquifer thickness tested	SWL	H	Drill hole radius	Cumulative Volume	Injection Rate	Hydraulic Conductivity (K)	Log(K)
	From	To	Midpoint											
	m	m	m bgs	psi	KPa	min	m	m bgs	m H20	m	m^3	m^3/min	m/s	
Test 2						0.0					83.3840			
	117.0	141.4	129.2	33	228	1.0	17.25	40	64.7	0.038	83.3950	0.0110	2E-07	-6.80
	117.0	141.4	129.2	33	228	2.0	17.25	40	64.7	0.038	83.4060	0.0110	2E-07	-6.80
	117.0	141.4	129.2	33	228	3.0	17.25	40	64.7	0.038	83.4150	0.0090	1E-07	-6.88
	117.0	141.4	129.2	33	228	4.0	17.25	40	64.7	0.038	83.4250	0.0100	1E-07	-6.84
	117.0	141.4	129.2	33	228	5.0	17.25	40	64.7	0.038	83.4340	0.0090	1E-07	-6.88
						0.0					83.4340			
	117.0	141.4	129.2	66	455	1.0	17.25	40	87.9	0.038	83.4480	0.0140	1E-07	-6.82
	117.0	141.4	129.2	66	455	2.0	17.25	40	87.9	0.038	83.4620	0.0140	1E-07	-6.82
	117.0	141.4	129.2	66	455	3.0	17.25	40	87.9	0.038	83.4770	0.0150	2E-07	-6.79
	117.0	141.4	129.2	66	455	4.0	17.25	40	87.9	0.038	83.4910	0.0140	1E-07	-6.82
	117.0	141.4	129.2	66	455	5.0	17.25	40	87.9	0.038	83.5050	0.0140	1E-07	-6.82
						0.0					83.5050			
	117.0	141.4	129.2	105	724	1.0	17.25	40	115.4	0.038	83.5240	0.0190	2E-07	-6.81
	117.0	141.4	129.2	105	724	2.0	17.25	40	115.4	0.038	83.5420	0.0180	1E-07	-6.83
	117.0	141.4	129.2	105	724	3.0	17.25	40	115.4	0.038	83.5610	0.0190	2E-07	-6.81
	117.0	141.4	129.2	105	724	4.0	17.25	40	115.4	0.038	83.5800	0.0190	2E-07	-6.81
	117.0	141.4	129.2	105	724	5.0	17.25	40	115.4	0.038	83.5990	0.0190	2E-07	-6.81
						0.0					83.6130			
	117.0	141.4	129.2	62	428	1.0	17.25	40	85.1	0.038	83.6210	0.0080	9E-08	-7.05
	117.0	141.4	129.2	62	428	2.0	17.25	40	85.1	0.038	83.6390	0.0180	2E-07	-6.70
	117.0	141.4	129.2	62	428	3.0	17.25	40	85.1	0.038	83.6520	0.0130	1E-07	-6.84
	117.0	141.4	129.2	62	428	4.0	17.25	40	85.1	0.038	83.6650	0.0130	1E-07	-6.84
	117.0	141.4	129.2	62	428	5.0	17.25	40	85.1	0.038	83.6780	0.0130	1E-07	-6.84
						0.0					83.6880			
	117.0	141.4	129.2	33	228	1.0	17.25	40	64.7	0.038	83.6960	0.0080	1E-07	-6.93
	117.0	141.4	129.2	33	228	2.0	17.25	40	64.7	0.038	83.7050	0.0090	1E-07	-6.88
	117.0	141.4	129.2	33	228	3.0	17.25	40	64.7	0.038	83.7140	0.0090	1E-07	-6.88
	117.0	141.4	129.2	33	228	4.0	17.25	40	64.7	0.038	83.7230	0.0090	1E-07	-6.88
	117.0	141.4	129.2	33	228	5.0	17.25	40	64.7	0.038	83.7310	0.0080	1E-07	-6.93

Table E-5: Packer Test Results for CFD0327

Test	Dip		60	Pressure	Pressure	Time	Aquifer thickness tested	SWL	H	Drill hole radius	Cumulative Volume	Injection Rate	Hydraulic Conductivity (K)	Log(K)
	From	To	Midpoint											
	m	m	m bgs	psi	KPa	min	m	m bgs	m H20	m	m^3	m^3/min	m/s	
Test 1						0.0					84.1550			
	94.0	118.7	106.3	33	228	1.0	21.38	100	124.7	0.038	84.1610	0.0060	4E-08	-7.42
	94.0	118.7	106.3	33	228	2.0	21.38	100	124.7	0.038	84.1670	0.0060	4E-08	-7.42
	94.0	118.7	106.3	33	228	3.0	21.38	100	124.7	0.038	84.1740	0.0070	4E-08	-7.36
	94.0	118.7	106.3	33	228	4.0	21.38	100	124.7	0.038	84.1810	0.0070	4E-08	-7.36
	94.0	118.7	106.3	33	228	5.0	21.38	100	124.7	0.038	84.1870	0.0060	4E-08	-7.42
						0.0					84.1870			
	94.0	118.7	106.3	66	455	1.0	21.38	100	147.9	0.038	84.1950	0.0080	4E-08	-7.37
	94.0	118.7	106.3	66	455	2.0	21.38	100	147.9	0.038	84.2040	0.0090	5E-08	-7.32
	94.0	118.7	106.3	66	455	3.0	21.38	100	147.9	0.038	84.2130	0.0090	5E-08	-7.32
	94.0	118.7	106.3	66	455	4.0	21.38	100	147.9	0.038	84.2220	0.0090	5E-08	-7.32
	94.0	118.7	106.3	66	455	5.0	21.38	100	147.9	0.038	84.2300	0.0080	4E-08	-7.37
						0.0					84.2400			
	94.0	118.7	106.3	100	690	1.0	21.38	100	171.8	0.038	84.2510	0.0110	5E-08	-7.30
	94.0	118.7	106.3	100	690	2.0	21.38	100	171.8	0.038	84.2620	0.0110	5E-08	-7.30
	94.0	118.7	106.3	100	690	3.0	21.38	100	171.8	0.038	84.2730	0.0110	5E-08	-7.30
	94.0	118.7	106.3	100	690	4.0	21.38	100	171.8	0.038	84.2860	0.0130	6E-08	-7.23
	94.0	118.7	106.3	100	690	5.0	21.38	100	171.8	0.038	84.2970	0.0110	5E-08	-7.30
						0.0					84.4070			
	94.0	118.7	106.3	66	455	1.0	21.38	100	147.9	0.038	84.4160	0.0090	5E-08	-7.32
	94.0	118.7	106.3	66	455	2.0	21.38	100	147.9	0.038	84.4250	0.0090	5E-08	-7.32
	94.0	118.7	106.3	66	455	3.0	21.38	100	147.9	0.038	84.4330	0.0080	4E-08	-7.37
	94.0	118.7	106.3	66	455	4.0	21.38	100	147.9	0.038	84.4410	0.0080	4E-08	-7.37
	94.0	118.7	106.3	66	455	5.0	21.38	100	147.9	0.038	84.4490	0.0080	4E-08	-7.37
						0.0					84.4490			
	94.0	118.7	106.3	35	241	1.0	21.38	100	126.1	0.038	84.4560	0.0070	4E-08	-7.36
	94.0	118.7	106.3	35	241	2.0	21.38	100	126.1	0.038	84.4630	0.0070	4E-08	-7.36
	94.0	118.7	106.3	35	241	3.0	21.38	100	126.1	0.038	84.4700	0.0070	4E-08	-7.36
	94.0	118.7	106.3	35	241	4.0	21.38	100	126.1	0.038	84.4770	0.0070	4E-08	-7.36
	94.0	118.7	106.3	35	241	5.0	21.38	100	126.1	0.038	84.4840	0.0070	4E-08	-7.36

Table E-6: Packer Test Results for CFD0336

Test	Dip		50	Pressure	Pressure	Time	Aquifer thickness tested	SWL	H	Drill hole radius	Cumulative Volume	Injection Rate	Hydraulic Conductivity (K)	Log(K)
	From	To	Midpoint											
	m	m	m bgs	psi	KPa	min	m	m bgs	m H20	m	m^3	m^3/min	m/s	
Test 1						0.0					85.3200			
	67.0	84.3	75.6	33	228	1.0	13.20	100	124.7	0.038	85.3230	0.0030	3E-08	-7.55
	67.0	84.3	75.6	33	228	2.0	13.20	100	124.7	0.038	85.3240	0.0010	9E-09	-8.03
	67.0	84.3	75.6	33	228	3.0	13.20	100	124.7	0.038	85.3255	0.0015	1E-08	-7.85
	67.0	84.3	75.6	33	228	4.0	13.20	100	124.7	0.038	85.3270	0.0015	1E-08	-7.85
	67.0	84.3	75.6	33	228	5.0	13.20	100	124.7	0.038	85.3285	0.0015	1E-08	-7.85
						0.0					85.3300			
	67.0	84.3	75.6	66	455	1.0	13.20	100	147.9	0.038	85.3340	0.0040	3E-08	-7.50
	67.0	84.3	75.6	66	455	2.0	13.20	100	147.9	0.038	85.3360	0.0020	2E-08	-7.80
	67.0	84.3	75.6	66	455	3.0	13.20	100	147.9	0.038	85.3380	0.0020	2E-08	-7.80
	67.0	84.3	75.6	66	455	4.0	13.20	100	147.9	0.038	-	-	-	-
	67.0	84.3	75.6	66	455	5.0	13.20	100	147.9	0.038	-	-	-	-
						0.0					85.3400			
	67.0	84.3	75.6	105	724	1.0	13.20	100	175.4	0.038	85.3430	0.0030	2E-08	-7.70
	67.0	84.3	75.6	105	724	2.0	13.20	100	175.4	0.038	85.3460	0.0030	2E-08	-7.70
	67.0	84.3	75.6	105	724	3.0	13.20	100	175.4	0.038	85.3480	0.0020	1E-08	-7.87
	67.0	84.3	75.6	105	724	4.0	13.20	100	175.4	0.038	85.3500	0.0020	1E-08	-7.87
			0.0	105	724	5.0	0.00	100	175.4	0.038	-	-	-	-

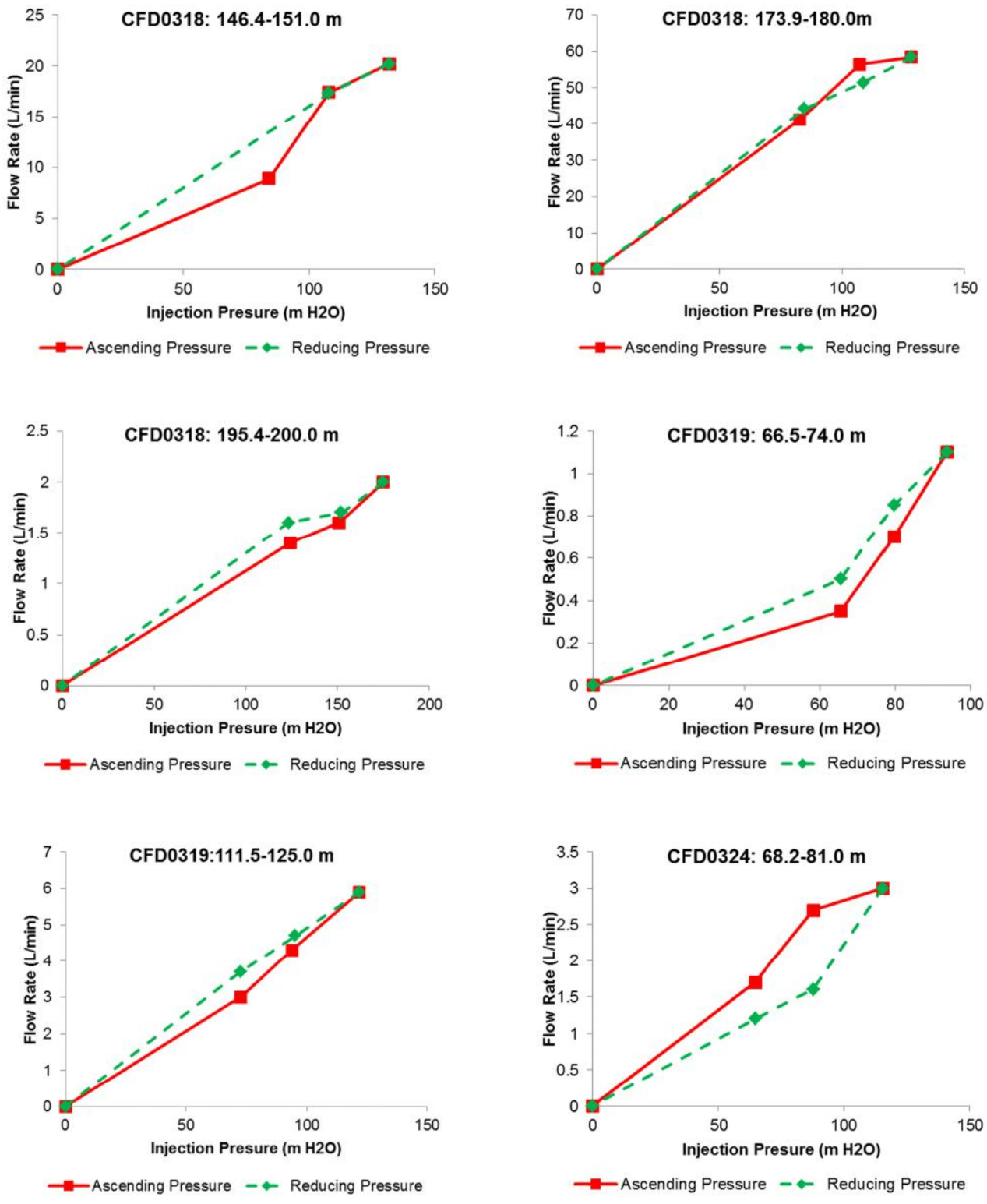


Figure 5-1: Diagnostic Plots of Packer Test Data

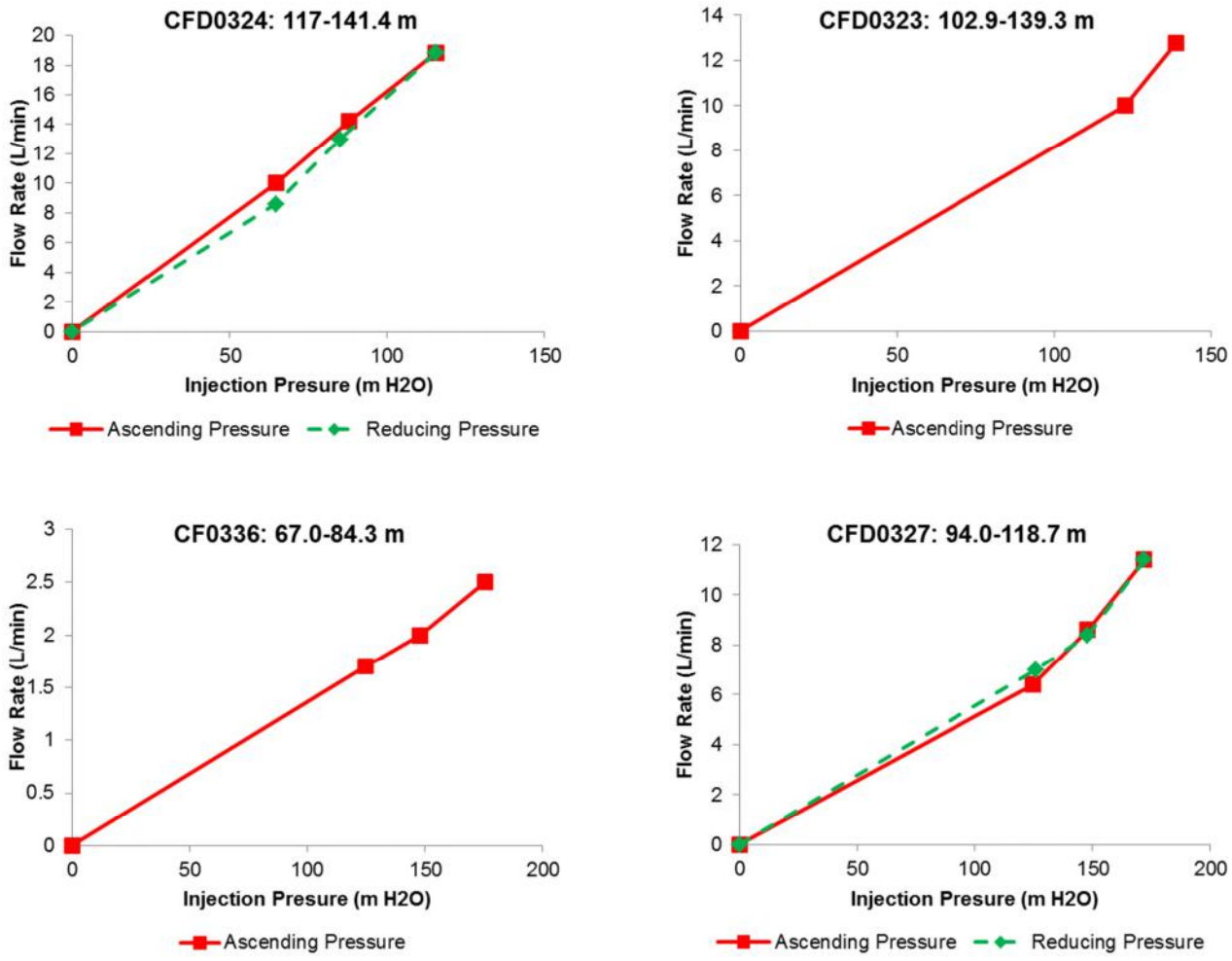
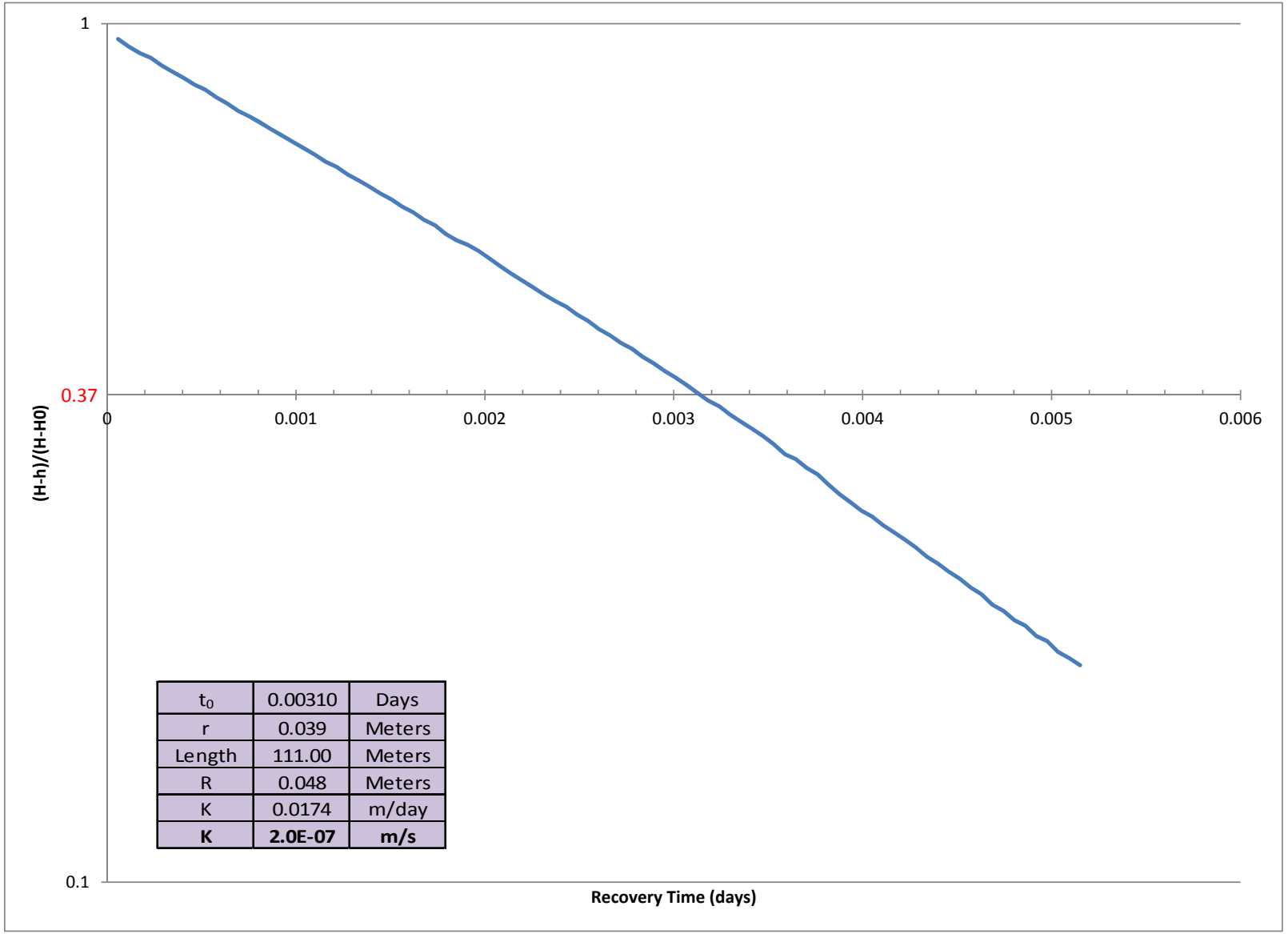


Figure 5-2: Diagnostic Plots of Packer Test Data

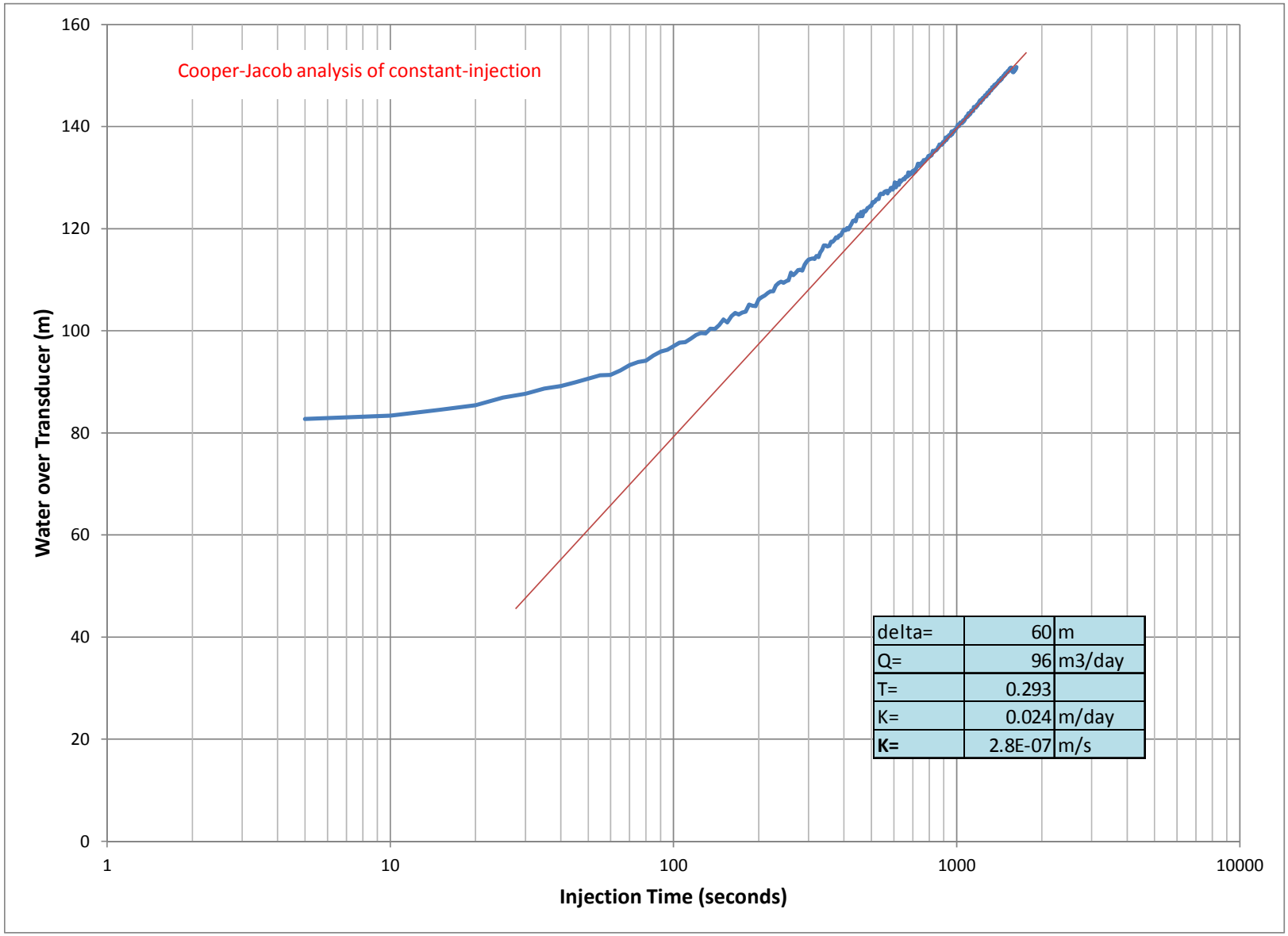
APPENDIX 4-C3: SRK 2015 HYDRAULIC TESTS

IFSPD-124 (45 – 152 m)
Falling-head slug: Hvorslev analysis

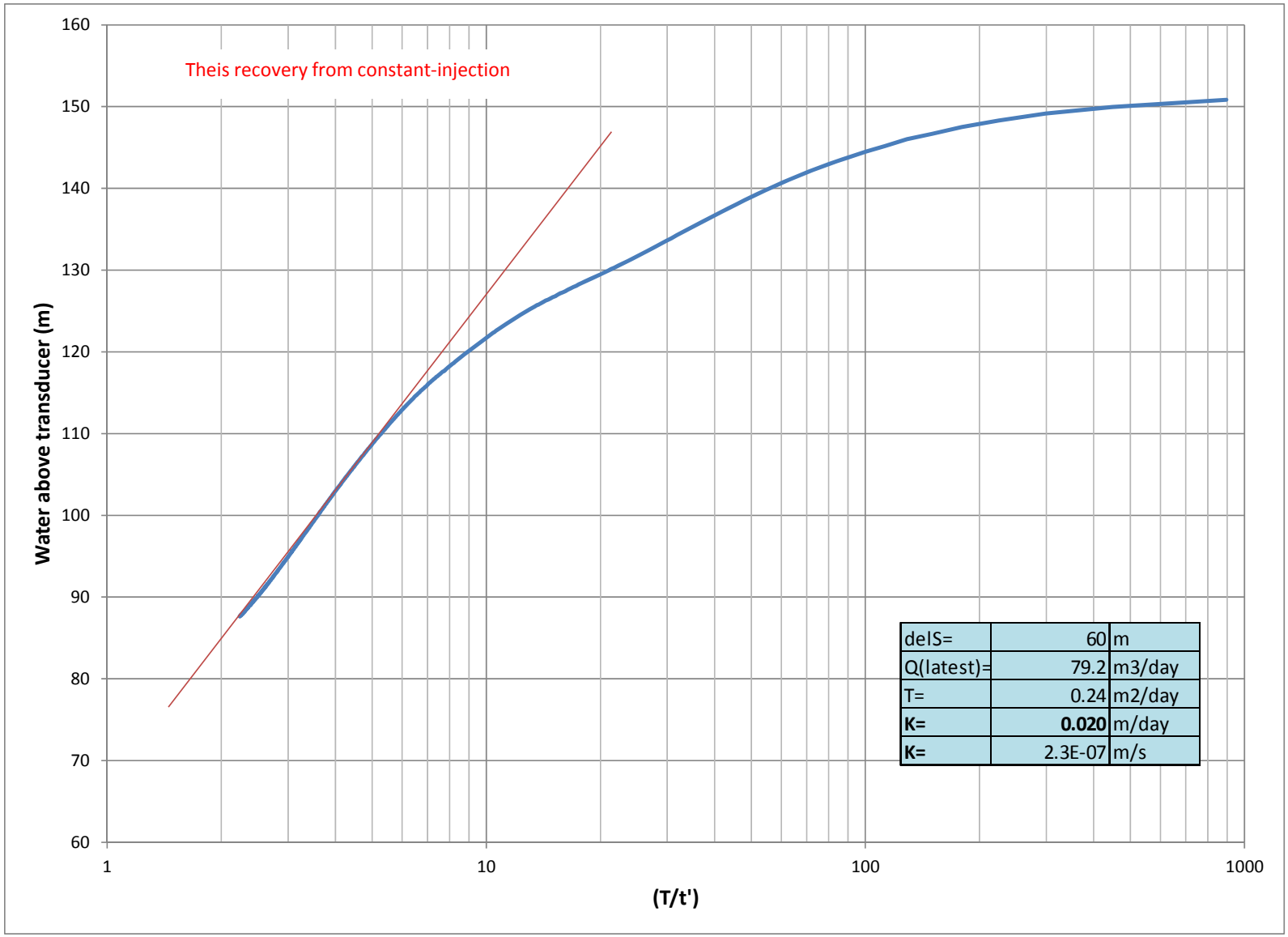


t_0	0.00310	Days
r	0.039	Meters
Length	111.00	Meters
R	0.048	Meters
K	0.0174	m/day
K	**2.0E-07**	**m/s**

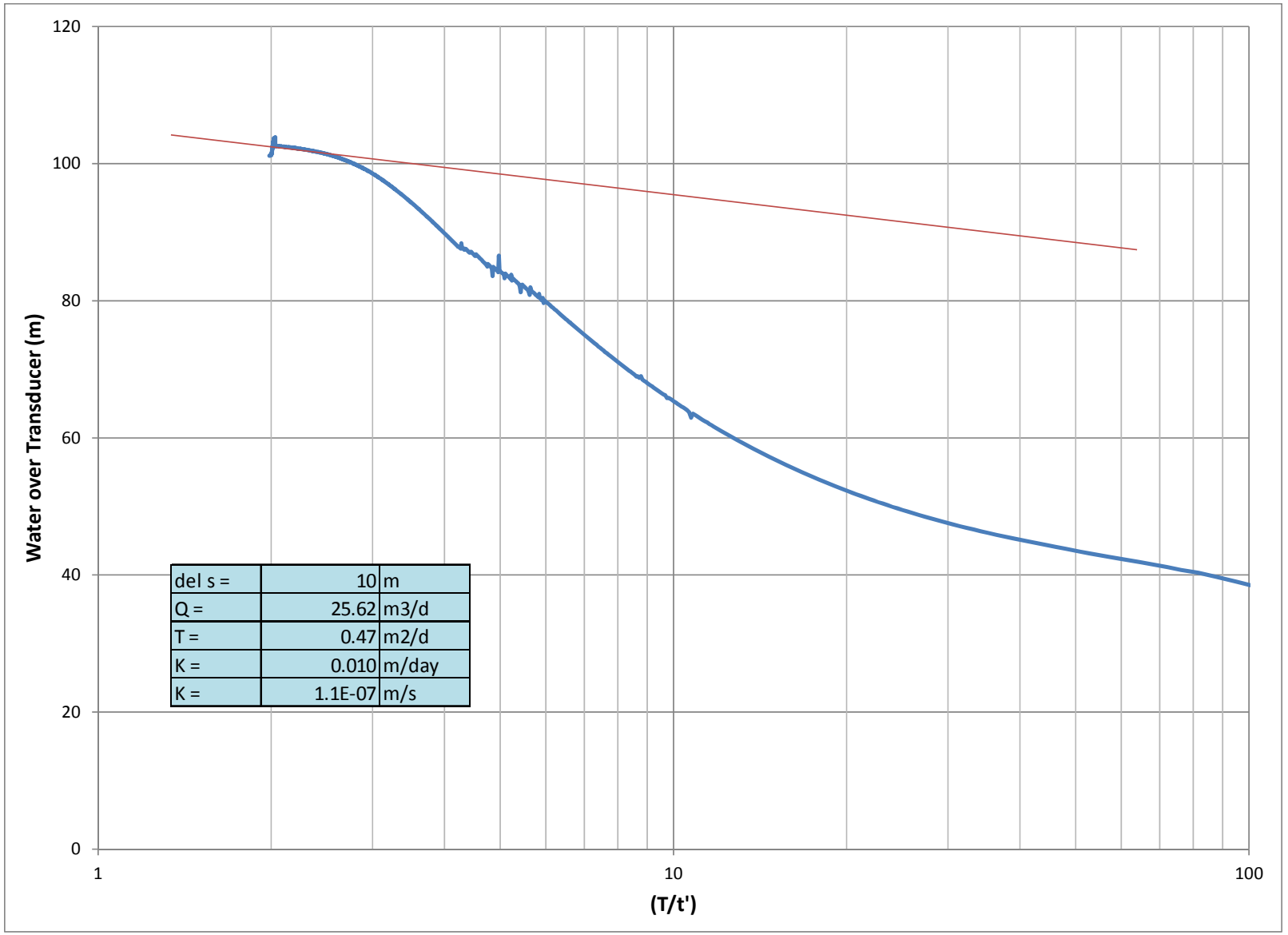
SRK15D-16P (136 – 148 m)
Constant Injection: Cooper Jacob analysis



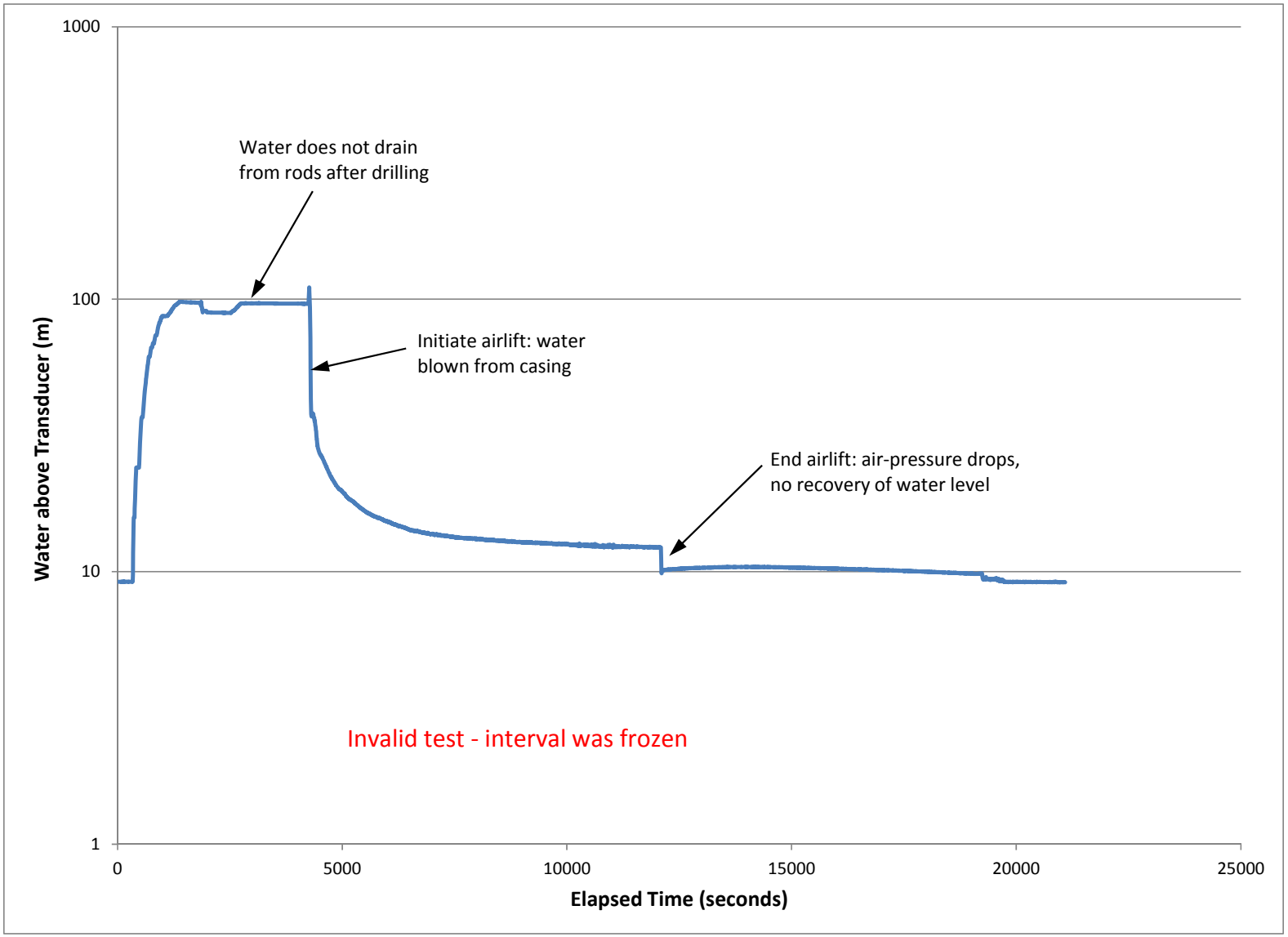
SRK15D-16P (136 – 148 m)
Constant Injection: Theis recovery analysis



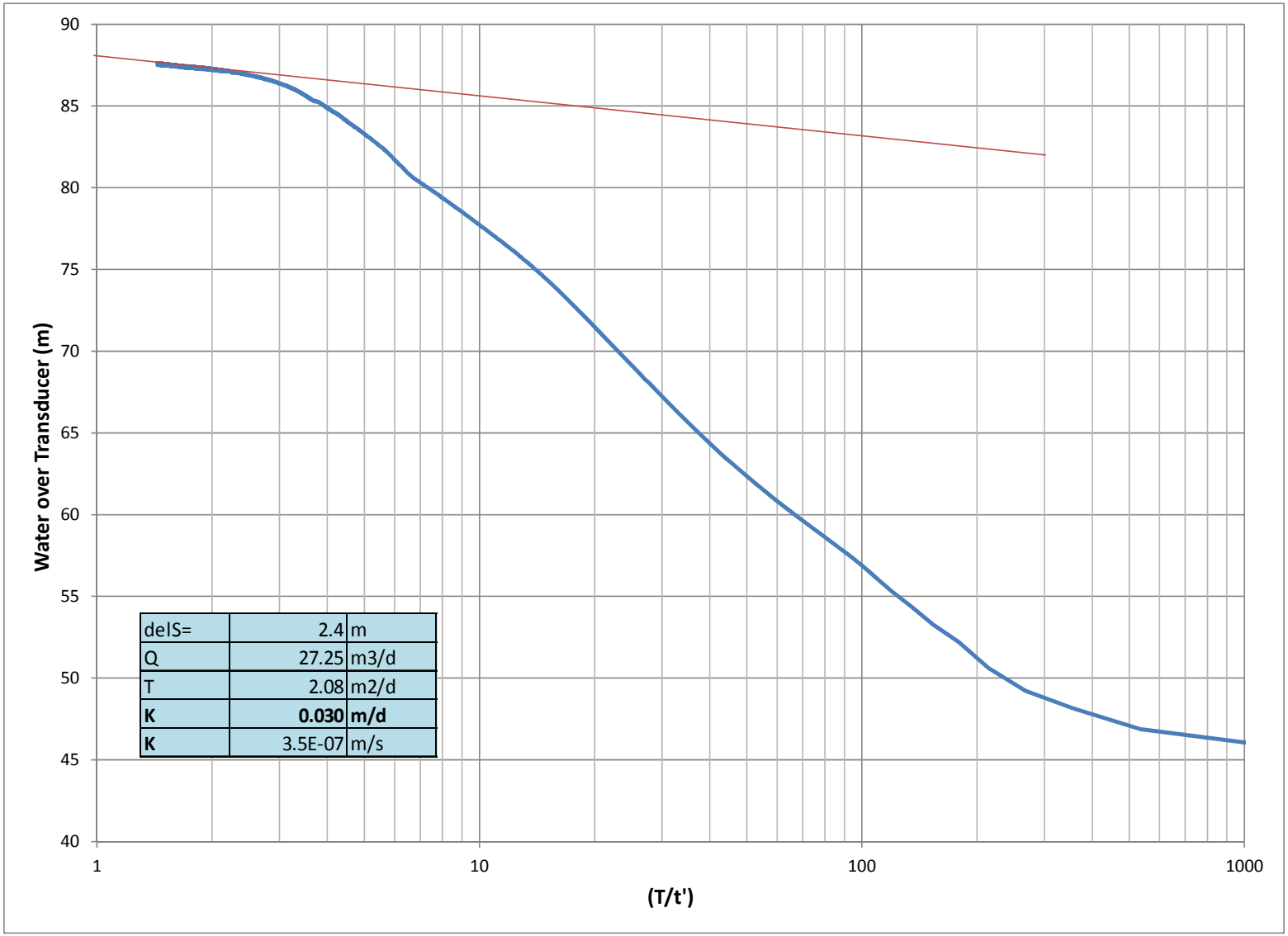
SRK15D-16P (164 – 212 m)
Constant-drawdown Airlift: Theis recovery analysis



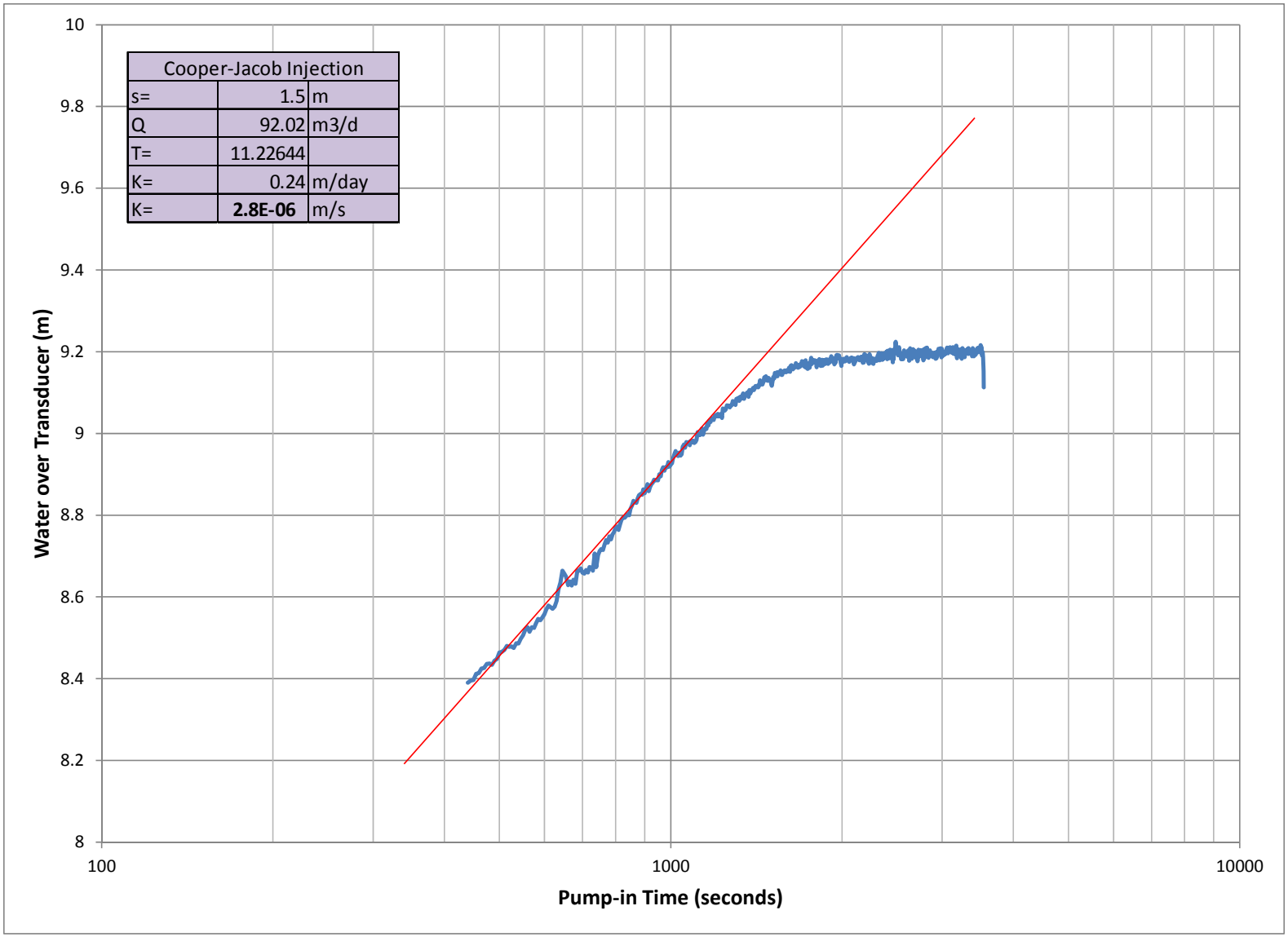
SRK15D-15P (115 – 205 m)
Constant-drawdown Airlift: Invalid Test



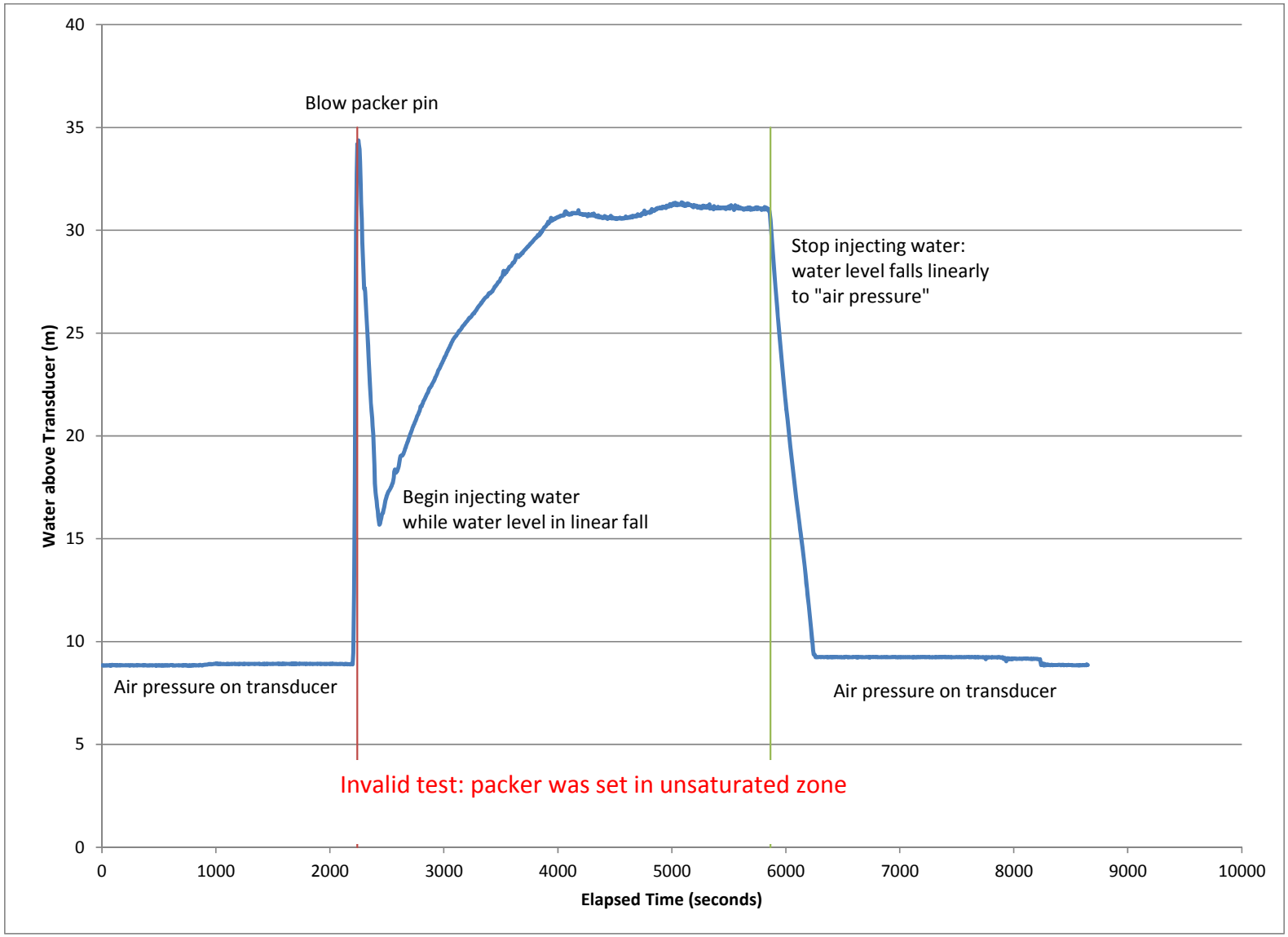
SRK15D-15P (200 – 274 m)
Constant-drawdown Airlift: Theis recovery analysis



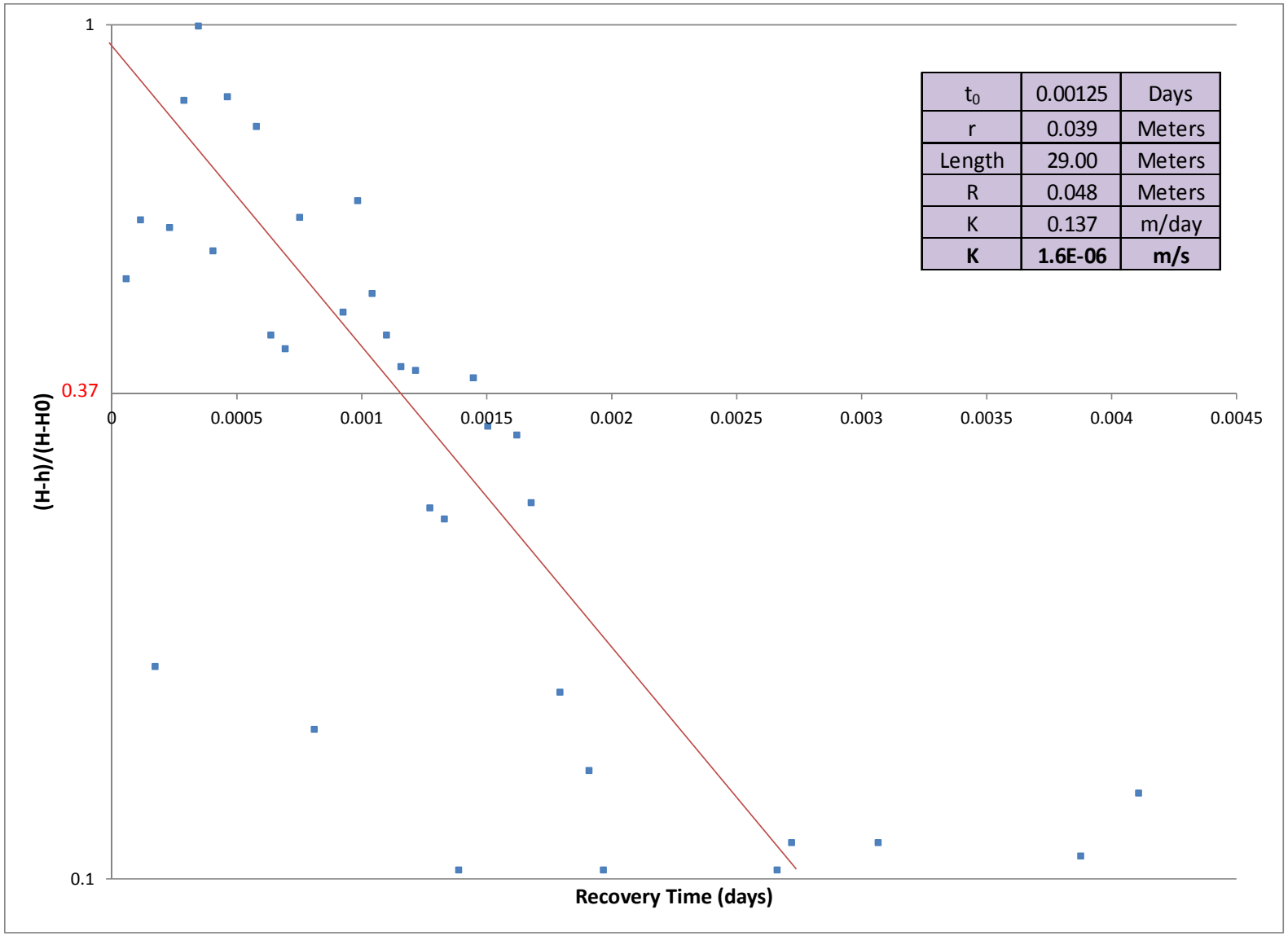
IFSPD-062 (175 – 221 m)
Constant- injection: Cooper-Jacob analysis



IFSPD-110a (80 – 119 m)
Constant-injection: Invalid Test

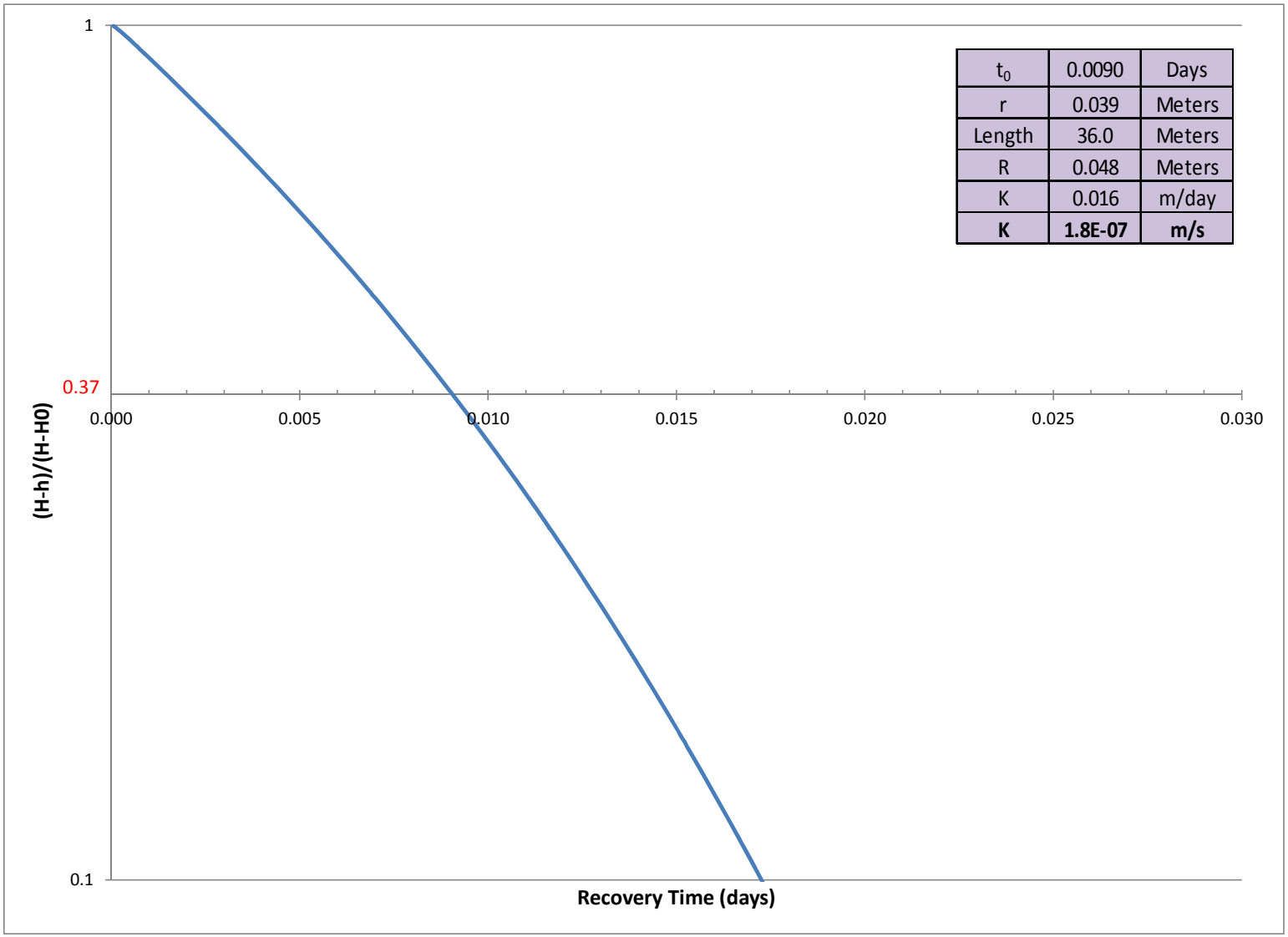


IFSPD-110a (237 – 266 m)
Falling-head slug: Hvorslev analysis



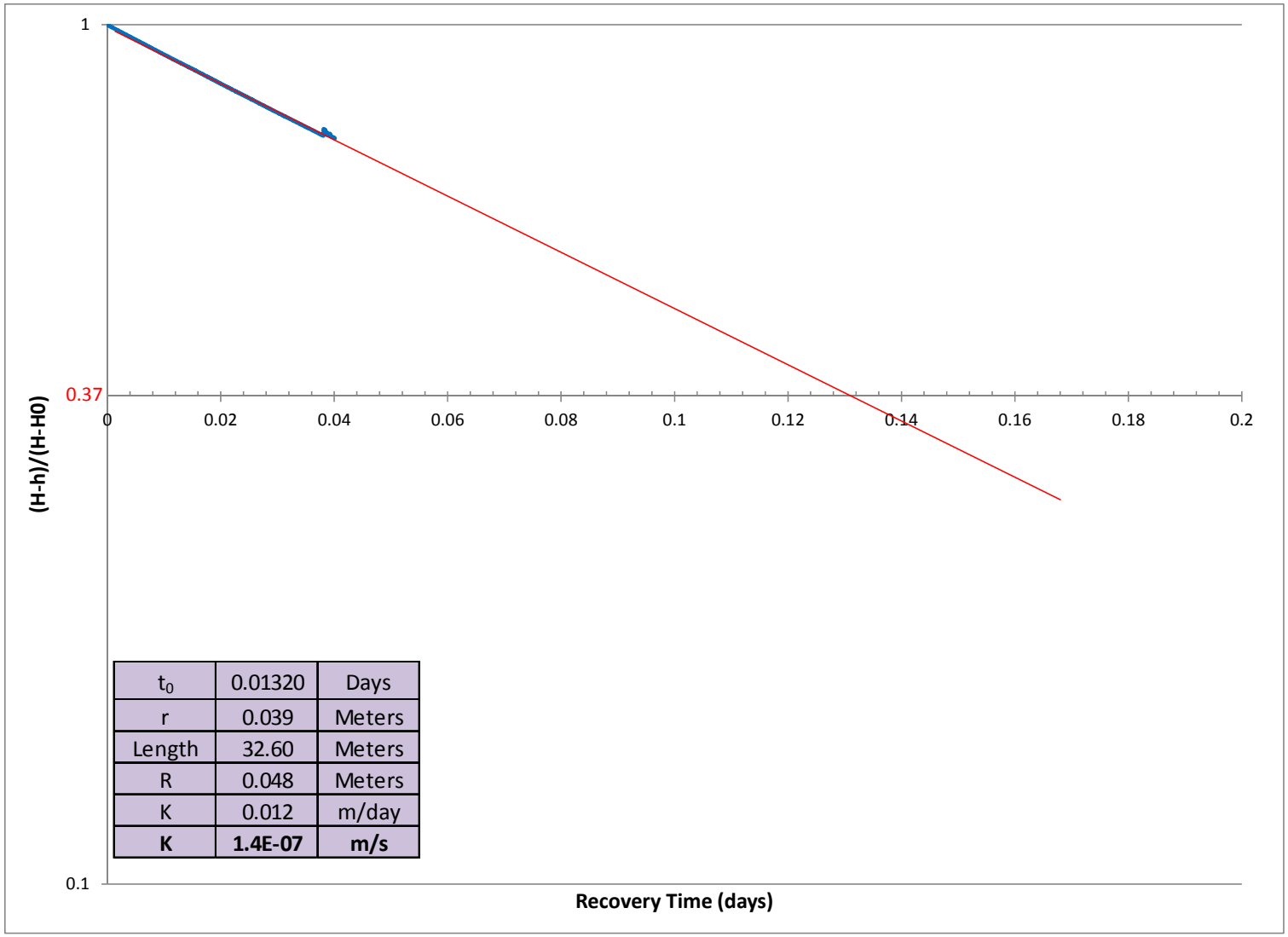
t_0	0.00125	Days
r	0.039	Meters
Length	29.00	Meters
R	0.048	Meters
K	0.137	m/day
K	**1.6E-06**	**m/s**

IFSPD-110a (266 – 302 m)
Falling-head slug: Hvorslev analysis



t_0	0.0090	Days
r	0.039	Meters
Length	36.0	Meters
R	0.048	Meters
K	0.016	m/day
K	**1.8E-07**	**m/s**

SRK15D-14P (175.5 – 216 m)
Falling-head slug: Hvorslev analysis



t_0	0.01320	Days
r	0.039	Meters
Length	32.60	Meters
R	0.048	Meters
K	0.012	m/day
K	**1.4E-07**	**m/s**

APPENDIX 4-C4: TETRA TECH 2017 HYDRAULIC TESTS

Hole #: **GT17-34T**
Test #: **1**

TETRA TECH

Calculation Input Parameters

Top of Packer Test Interval (mah):	11.0
Bottom of Packer Test Interval (mah):	15.5
L: Length of Test Interval (mah)	4.5
Test Interval Midpoint (mah):	13.3
s: Casing Stickup Height (mah):	3.00
a: Pressure Gauge Height (m above ground	2.00
DTW: Depth to Water Table (mah):	4.00
Borehole Diameter (mm):	75.7
r: Borehole Radius (m):	0.03785
A: Angle From Horizontal (deg):	-90
λ: Specific Weight of Water	1

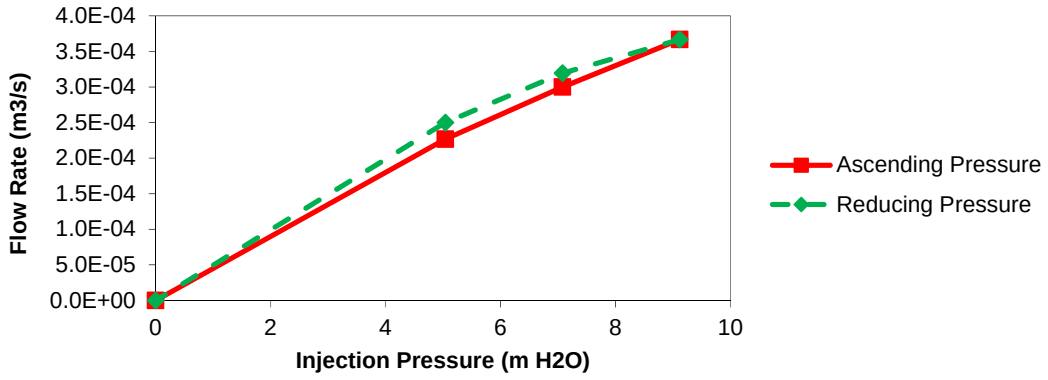
* mah indicates "meters along hole"

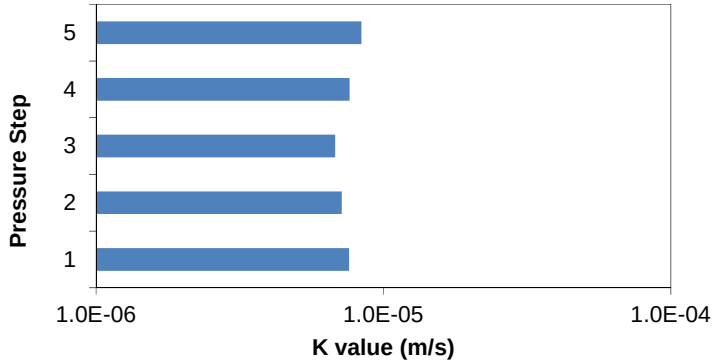
$$K = \frac{Q\ ln\left(\frac{L}{r}\right)}{2\ \pi\ L\ dH}$$

$$dH = (DTW - s + a)\sin(A) + \frac{p}{\lambda}$$

Pressure Step	Pressure (psi)	Pressure (kPa)	Pressure (m of water)	Head Differential dH (m)	Flowrate Q (m^3/s):	Hydraulic Conductivity K (m/s)
1	2.9	20.0	2.0	5.0	2.3E-04	7.6E-06
2	5.8	40.0	4.1	7.1	3.0E-04	7.2E-06
3	8.7	60.0	6.1	9.1	3.7E-04	6.8E-06
4	5.8	40.0	4.1	7.1	3.2E-04	7.6E-06
5	2.9	20.0	2.0	5.0	2.5E-04	8.4E-06
					Geo Mean	**7.5E-06**

Diagnostic Plots





Hole #: **GT17-34T**
Test #: **2**

TETRA TECH

Calculation Input Parameters

Top of Packer Test Interval (mah):	17.5
Bottom of Packer Test Interval (mah):	22.0
L: Length of Test Interval (mah)	4.5
Test Interval Midpoint (mah):	19.8
s: Casing Stickup Height (mah):	3.00
a: Pressure Gauge Height (m above ground	2.00
DTW: Depth to Water Table (mah):	4.00
Borehole Diameter (mm):	75.7
r: Borehole Radius (m):	0.03785
A: Angle From Horizontal (deg):	-90
λ: Specific Weight of Water	1

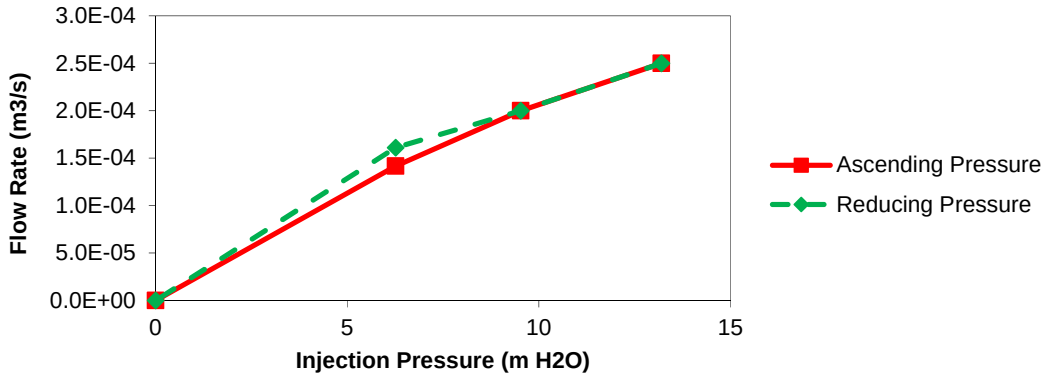
* mah indicates "meters along hole"

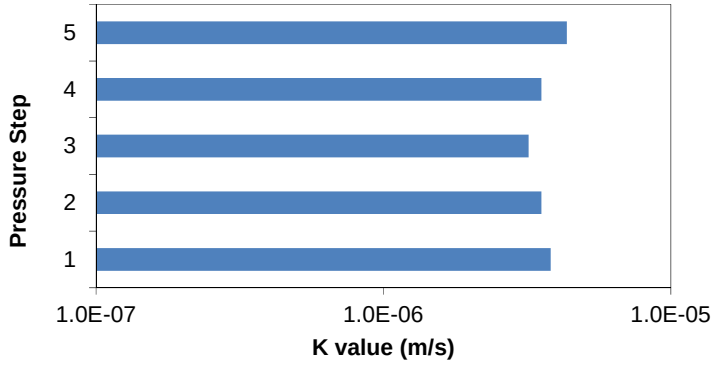
$$K = \frac{Q\ ln\left(\frac{L}{r}\right)}{2\ \pi\ L\ dH}$$

$$dH = (DTW - s + a)\sin(A) + \frac{p}{\lambda}$$

Pressure Step	Pressure (psi)	Pressure (kPa)	Pressure (m of water)	Head Differential dH (m)	Flowrate Q (m^3/s):	Hydraulic Conductivity K (m/s)
1	4.6	32.0	3.3	6.3	1.4E-04	3.8E-06
2	9.3	64.0	6.5	9.5	2.0E-04	3.5E-06
3	14.5	100.0	10.2	13.2	2.5E-04	3.2E-06
4	9.3	64.0	6.5	9.5	2.0E-04	3.5E-06
5	4.6	32.0	3.3	6.3	1.6E-04	4.3E-06
					Geo Mean	**3.7E-06**

Diagnostic Plots





Hole #: **GT17-34T**
Test #: **3**

TETRA TECH

Calculation Input Parameters

Top of Packer Test Interval (mah):	23.3
Bottom of Packer Test Interval (mah):	30.9
L: Length of Test Interval (mah)	7.6
Test Interval Midpoint (mah):	27.1
s: Casing Stickup Height (mah):	3.00
a: Pressure Gauge Height (m above ground):	2.00
DTW: Depth to Water Table (mah):	4.00
Borehole Diameter (mm):	75.7
r: Borehole Radius (m):	0.03785
A: Angle From Horizontal (deg):	-90
λ: Specific Weight of Water	1

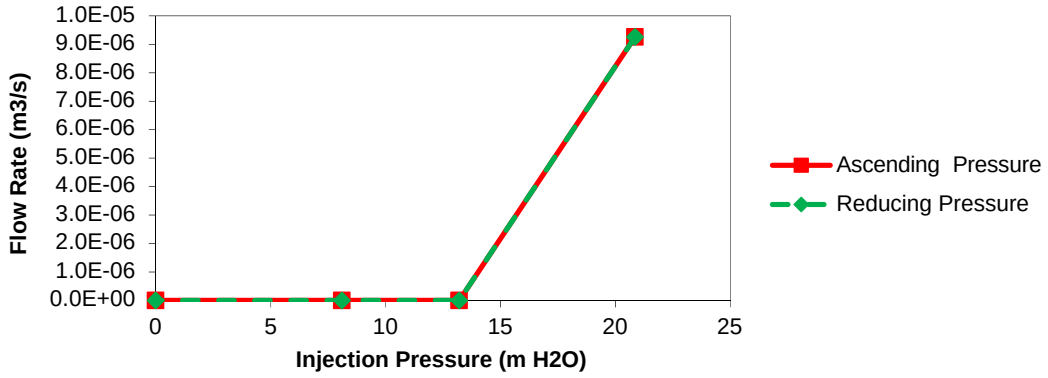
* mah indicates "meters along hole"

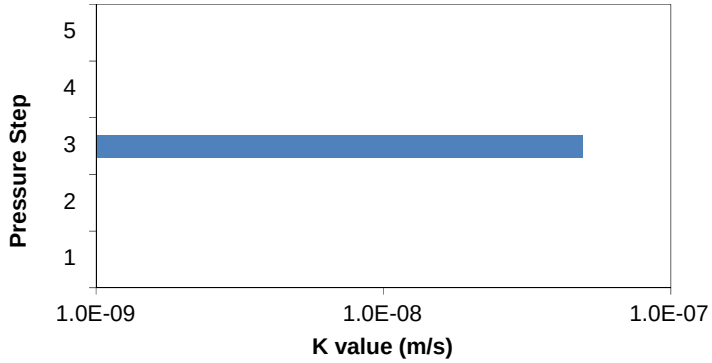
$$K = \frac{Q\ ln\left(\frac{L}{r}\right)}{2\ \pi\ L\ dH}$$

$$dH = (DTW - s + a)\sin(A) + \frac{p}{\lambda}$$

Pressure Step	Pressure (psi)	Pressure (kPa)	Pressure (m of water)	Head Differential dH (m)	Flowrate Q (m^3/s):	Hydraulic Conductivity K (m/s)
1	7.3	50.0	5.1	8.1	0.0E+00	0.0E+00
2	14.5	100.0	10.2	13.2	0.0E+00	0.0E+00
3	25.4	175.0	17.8	20.8	9.3E-06	4.9E-08
4	14.5	100.0	10.2	13.2	0.0E+00	0.0E+00
5	7.3	50.0	5.1	8.1	0.0E+00	0.0E+00
					Geo Mean	**<5E-08**

Diagnostic Plots





Hole #: **GT17-35**
Test #: **1**

TETRA TECH

Calculation Input Parameters

Top of Packer Test Interval (mah):	8.2
Bottom of Packer Test Interval (mah):	11.2
L: Length of Test Interval (mah)	3.0
Test Interval Midpoint (mah):	9.7
s: Casing Stickup Height (mah):	2.50
a: Pressure Gauge Height (m above ground	1.00
DTW: Depth to Water Table (mah):	5.15
Borehole Diameter (mm):	75.7
r: Borehole Radius (m):	0.03785
A: Angle From Horizontal (deg):	-90
λ: Specific Weight of Water	1

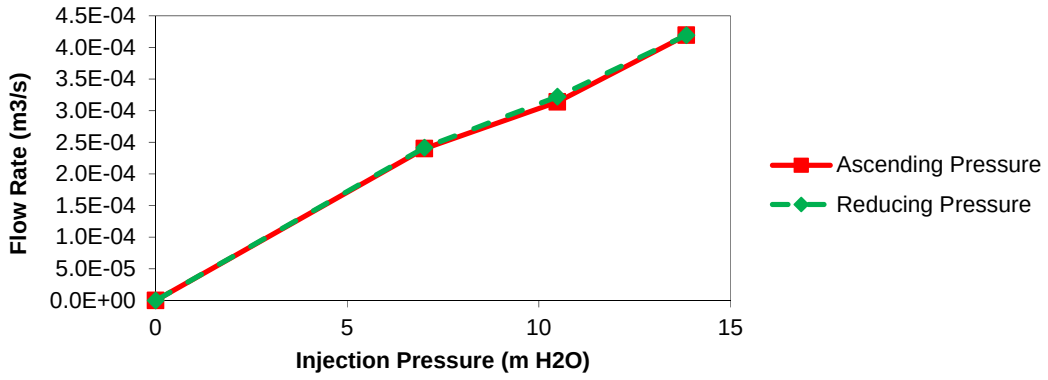
* mah indicates "meters along hole"

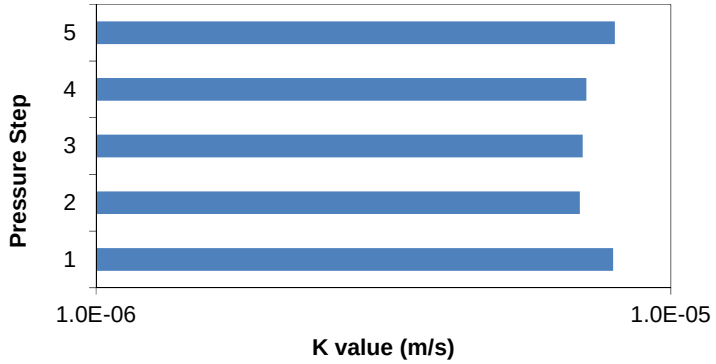
$$K = \frac{Q\ ln\left(\frac{L}{r}\right)}{2\ \pi\ L\ dH}$$

$$dH = (DTW - s + a)\sin(A) + \frac{p}{\lambda}$$

Pressure Step	Pressure (psi)	Pressure (kPa)	Pressure (m of water)	Head Differential dH (m)	Flowrate Q (m^3/s):	Hydraulic Conductivity K (m/s)
1	4.8	33.0	3.4	7.0	2.4E-04	7.9E-06
2	9.7	67.0	6.8	10.5	3.1E-04	6.9E-06
3	14.5	100.0	10.2	13.8	4.2E-04	7.0E-06
4	9.7	67.0	6.8	10.5	3.2E-04	7.1E-06
5	4.8	33.0	3.4	7.0	2.4E-04	8.0E-06
					Geo Mean	**7.4E-06**

Diagnostic Plots





Hole #: **GT17-35**
Test #: **3**

TETRA TECH

Calculation Input Parameters

Top of Packer Test Interval (mah):	24.0
Bottom of Packer Test Interval (mah):	29.9
L: Length of Test Interval (mah)	5.9
Test Interval Midpoint (mah):	27.0
s: Casing Stickup Height (mah):	2.50
a: Pressure Gauge Height (m above ground	1.00
DTW: Depth to Water Table (mah):	5.15
Borehole Diameter (mm):	75.7
r: Borehole Radius (m):	0.03785
A: Angle From Horizontal (deg):	-90
λ: Specific Weight of Water	1

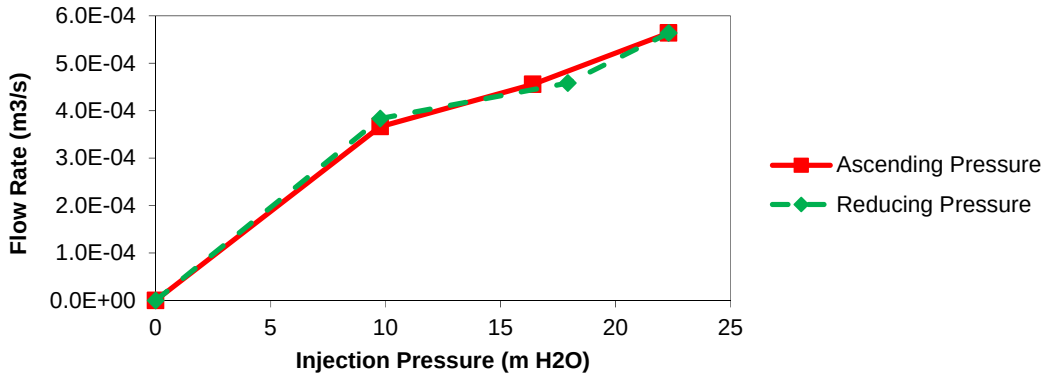
* mah indicates "meters along hole"

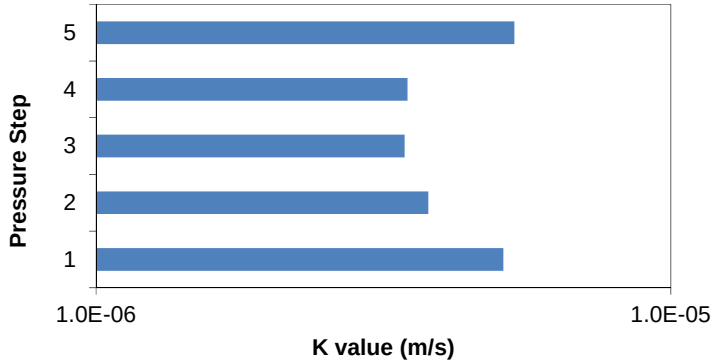
$$K = \frac{Q\ ln\left(\frac{L}{r}\right)}{2\ \pi\ L\ dH}$$

$$dH = (DTW - s + a)\sin(A) + \frac{p}{\lambda}$$

Pressure Step	Pressure (psi)	Pressure (kPa)	Pressure (m of water)	Head Differential dH (m)	Flowrate Q (m^3/s):	Hydraulic Conductivity K (m/s)
1	8.7	60.0	6.1	9.8	3.7E-04	5.1E-06
2	18.1	125.0	12.7	16.4	4.6E-04	3.8E-06
3	26.5	183.0	18.7	22.3	5.6E-04	3.4E-06
4	20.3	140.0	14.3	17.9	4.6E-04	3.5E-06
5	8.7	60.0	6.1	9.8	3.8E-04	5.3E-06
					Geo Mean	**4.2E-06**

Diagnostic Plots





Hole #: **GT17-36T**
Test #: **1**

TETRA TECH

Calculation Input Parameters

Top of Packer Test Interval (mah):	7.5
Bottom of Packer Test Interval (mah):	13.0
L: Length of Test Interval (mah)	5.5
Test Interval Midpoint (mah):	10.2
s: Casing Stickup Height (mah):	2.90
a: Pressure Gauge Height (m above ground	1.50
DTW: Depth to Water Table (mah):	11.60
Borehole Diameter (mm):	75.7
r: Borehole Radius (m):	0.03785
A: Angle From Horizontal (deg):	-90
λ: Specific Weight of Water	1

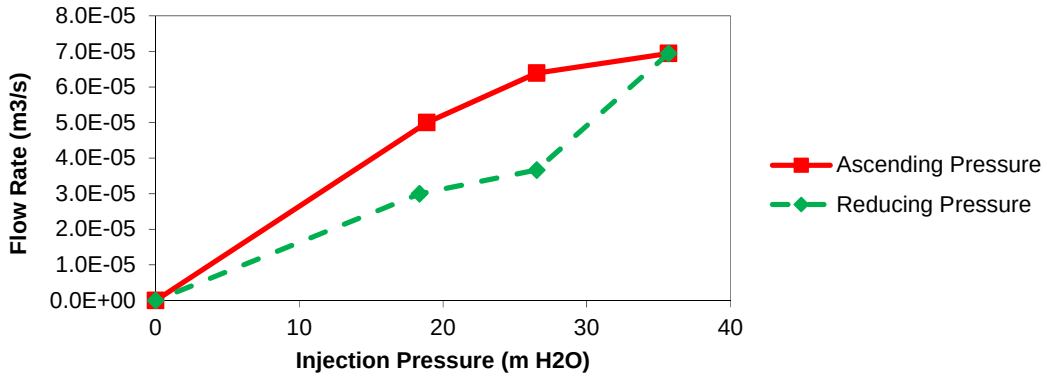
* mah indicates "meters along hole"

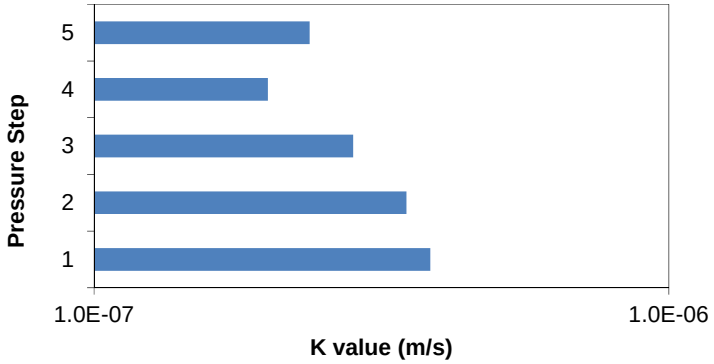
$$K = \frac{Q\ ln\left(\frac{L}{r}\right)}{2\ \pi\ L\ dH}$$

$$dH = (DTW - s + a)\sin(A) + \frac{p}{\lambda}$$

Pressure Step	Pressure (psi)	Pressure (kPa)	Pressure (m of water)	Head Differential dH (m)	Flowrate Q (m^3/s):	Hydraulic Conductivity K (m/s)
1	12.3	85.0	8.7	18.9	5.0E-05	3.8E-07
2	23.2	160.0	16.3	26.5	6.4E-05	3.5E-07
3	36.3	250.0	25.5	35.7	6.9E-05	2.8E-07
4	23.2	160.0	16.3	26.5	3.7E-05	2.0E-07
5	11.6	80.0	8.2	18.4	3.0E-05	2.4E-07
					Geo Mean	**2.8E-07**

Diagnostic Plots





Hole #: **GT17-36T**
Test #: **2**

TETRA TECH

Calculation Input Parameters

Top of Packer Test Interval (mah):	13.5
Bottom of Packer Test Interval (mah):	21.0
L: Length of Test Interval (mah)	7.5
Test Interval Midpoint (mah):	17.3
s: Casing Stickup Height (mah):	2.90
a: Pressure Gauge Height (m above ground	1.50
DTW: Depth to Water Table (mah):	7.50
Borehole Diameter (mm):	75.7
r: Borehole Radius (m):	0.03785
A: Angle From Horizontal (deg):	-90
λ: Specific Weight of Water	1

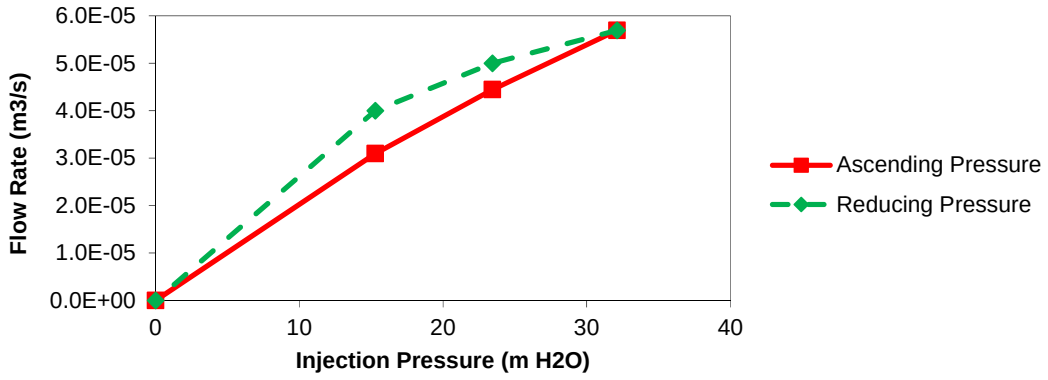
* mah indicates "meters along hole"

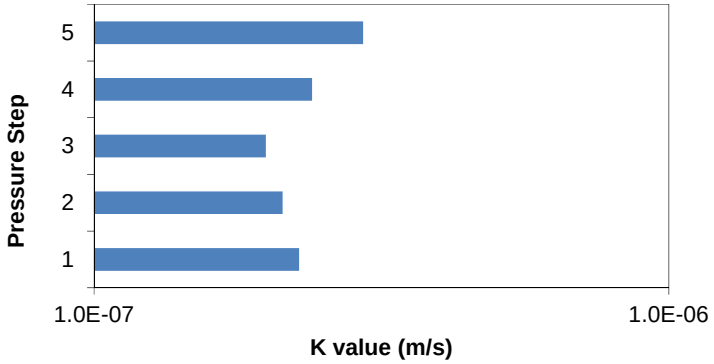
$$K = \frac{Q\ ln\left(\frac{L}{r}\right)}{2\ \pi\ L\ dH}$$

$$dH = (DTW - s + a)\sin(A) + \frac{p}{\lambda}$$

Pressure Step	Pressure (psi)	Pressure (kPa)	Pressure (m of water)	Head Differential dH (m)	Flowrate Q (m^3/s):	Hydraulic Conductivity K (m/s)
1	13.1	90.0	9.2	15.3	3.1E-05	2.3E-07
2	24.7	170.0	17.3	23.4	4.4E-05	2.1E-07
3	37.0	255.0	26.0	32.1	5.7E-05	2.0E-07
4	24.7	170.0	17.3	23.4	5.0E-05	2.4E-07
5	13.1	90.0	9.2	15.3	4.0E-05	2.9E-07
					Geo Mean	**2.3E-07**

Diagnostic Plots





Appendix 4-D: Westbay Water Level Time Series Data

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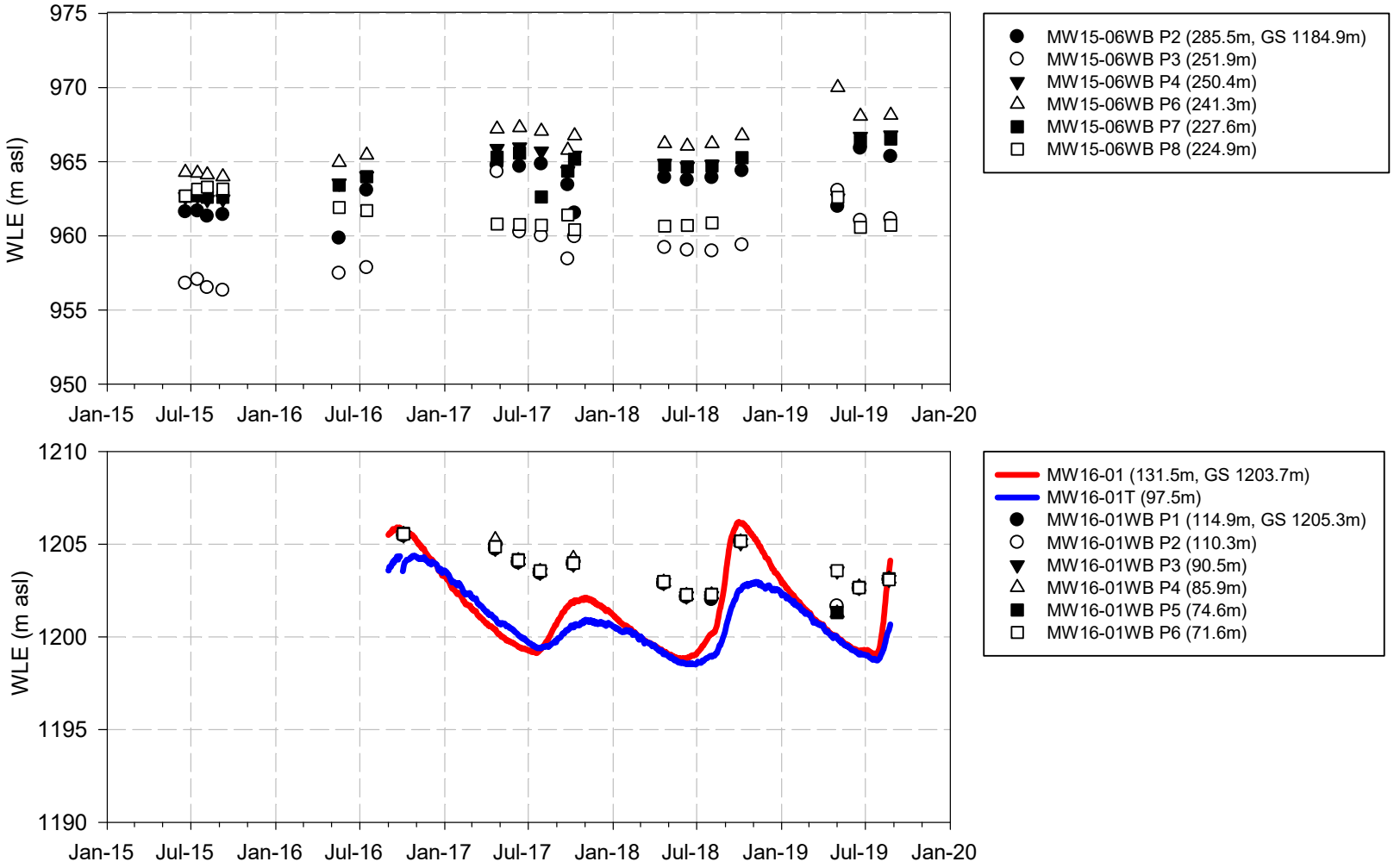

Figure 4D-1: Westbay water level time series at high elevation installations in Halfway Creek catchment.

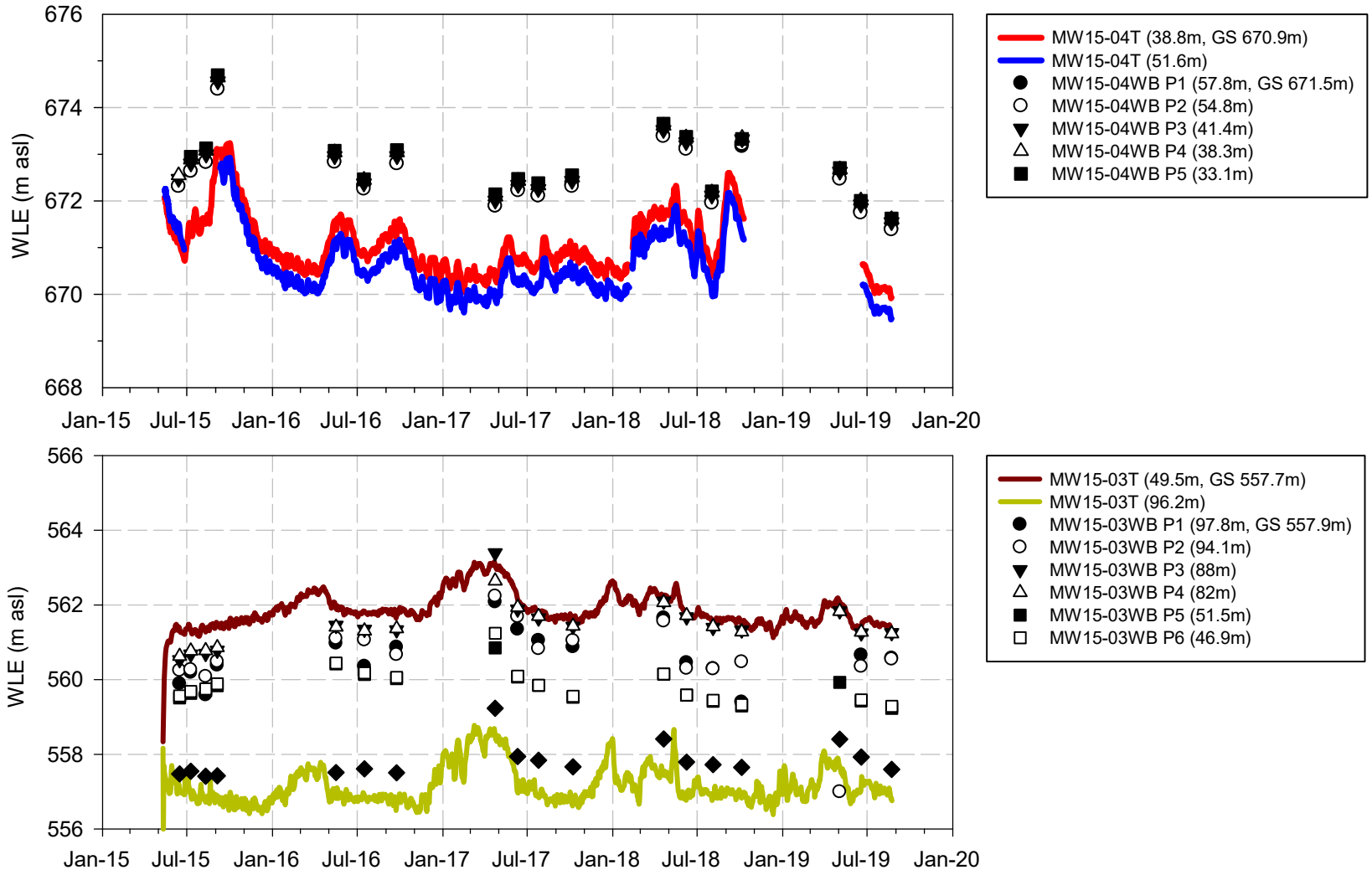

Figure 4D-2: Westbay water level time series in low elevation installatins in Halfway Creek catchment.

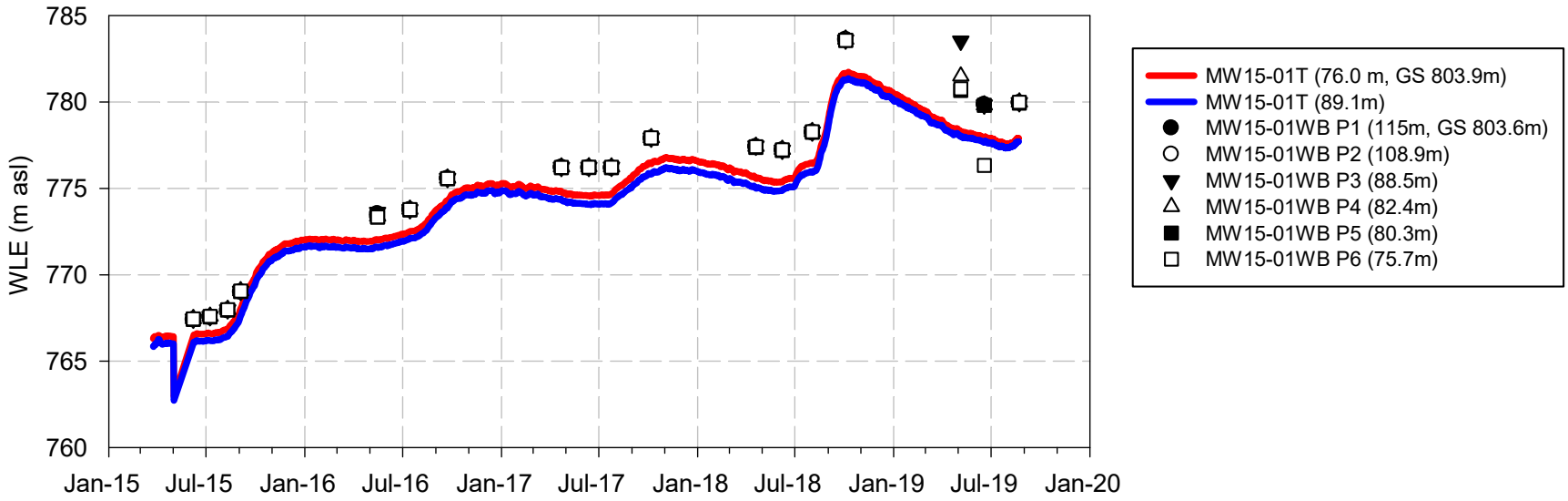

Figure 4D-3: Westbay water level time series in YT-24 catchment.

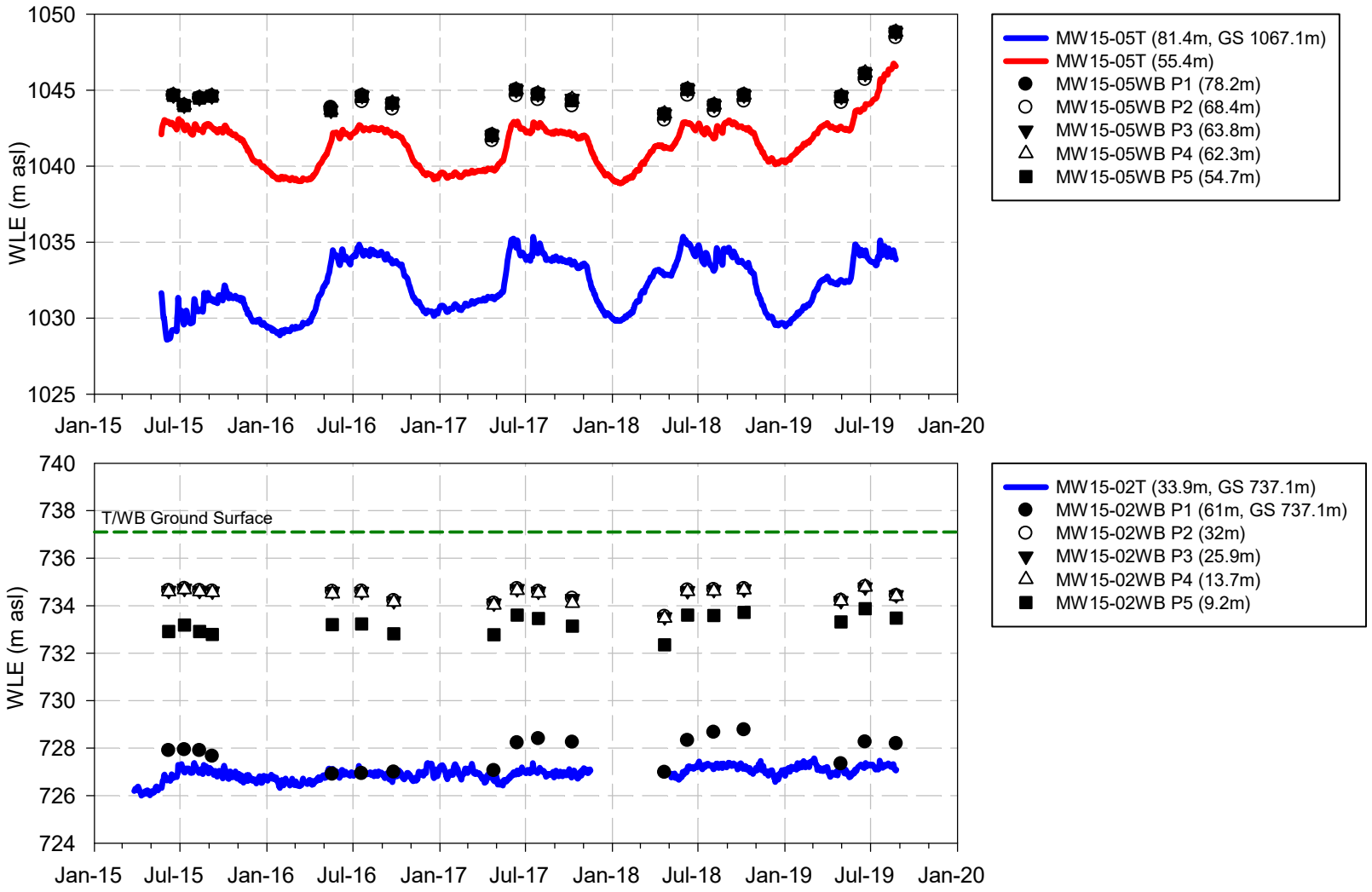

Figure D4-4: Westbay water level time series in Latte Creek and Latte Creek Tributary catchments.

Appendix 5-A: Groundwater Quality Data

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Station	Sample ID	Sample Class	Sample Date	Analytical Laboratory	Lab Job ID	Lab Sample ID	Field Paramaters	pH (field)	Specific Conductance (field)	DO (field)	ORP (field)	Temperature (field)	Physical Properties	Conductivity (lab)	pH (lab)	Total Hardness (CaCO3)	Dissolved Hardness (CaCO3)	Total Suspended Solids	Total Dissolved Solids	Turbidity	Inorganics	Alkalinity (Total as CaCO3)
								pH	uS/cm	mg/L	ORP mV	°C		uS/cm	pH	mg/L	mg/L	mg/L	mg/L	NTU		mg/L
Maxxam RDL[1]:														1	-	0.5	0.5	1	10	0.1		0.5
ALS RDL[1]:														2	-	0.5	-	3	20	-		1
MW14-02A	MW14-02A	primary	28-Sep-2014	ALS	L1525019	L1525019-1		8.23	349	9.19	163	0.5		390	7.95	203		<3	264	0.3		163
MW14-02A	MW14-02A	primary	12-Jun-2015	Maxxam	B550137	ML4991		7.34	400	12.07	99	1.41		392	8.14	255	200	<1.0	222	0.27		150
MW14-02A	MW14-02A	primary	16-Jul-2015	Maxxam	B562572	MS4331		7.84	389	9.94	47	1.8		390	8.16	180	188	<1.0	182	0.28		150
MW14-02A	MW14-02A	primary	06-Aug-2015	Maxxam	B569424	MW5112		7.58	361	10.05	152	1.33		380	8.17	211	205	<1.0	257	0.26		147
MW14-02A	MW14-02A	primary	04-Sep-2015	Maxxam	B578440	NC0866		7.74	380	9.75	213	1.38		385	8.14	188	185	<1.0	224	<0.10		145
MW14-02A	MW14-100	duplicate	04-Sep-2015	Maxxam	B578440	NC0868								389	8.21	194	189	<1.0	240	0.49		145
MW14-02A	MW14-02A	primary	13-May-2016	Maxxam / ALS	B637982 / L1769281	OQ4922 / L1769281-6		7.71	259	10.07	83	7.65		403	8.11	194	210	7.0	238	2.63		166
MW14-02A	MW14-02A	primary	17-Jul-2016	Maxxam / ALS	B659949 / L1802108	PB7358 / L1802108-1		7.55	369	10.79	30	3.07		371	8.10	187	202	<1.0	222	0.2		144
MW14-02A	JH40-05	duplicate	25-Sep-2016	Maxxam / ALS	B685473 / L1836619	PQ2530 / L1836619-2								368	8.03	183	186	<1.0	220	0.13		143
MW14-02A	MW14-02A	primary	25-Sep-2016	Maxxam / ALS	B685473 / L1836619	PQ2531 / L1836619-3		7.59	343	8.95	69	2.19		367	8.02	181	183	<1.0	220	0.26		143
MW14-02A	MW14-02A	primary	21-Apr-2017	Maxxam	B730366	QX9657		7.21	350	9.92	145	1.74		381	8.25	198	187	1.6	218	0.53		153
MW14-02A	JH41-03	duplicate	08-Jun-2017	Maxxam	B746144	RG4987								371	8.31	186	191	<1.0	212	<0.10		146
MW14-02A	MW14-02A	primary	08-Jun-2017	Maxxam	B746144	RG4988		6.06	372	7.04	225	3.46		374	8.3	183	189	<1.0	218	<0.10		146
MW14-02A	MW14-02A	primary	28-Jul-2017	Maxxam	B763678	RQ0450		8.28	368	9.59	56	2.78		360	8.31	185	183	1.9	212	1.2		146
MW14-02A	MW14-02A	primary	05-Oct-2017	Maxxam	B788595	SE1624		7.80	334	8.71	-61	0.66		371	8.03	200	188	<1.0	220	0.16		144
MW14-02A	MW14-02A	primary	19-Apr-2018	Maxxam	B830002	TH7277		7.56	341	9.51	114	1		1420	4.55	199	203	<1.0	178	0.42		140
MW14-02A	MW14-02A	primary	07-Jun-2018	Maxxam	B845895	TP7509		7.55	368	7.13	147	4.1		375	8.1	182	191	<1.0	222	0.26		147
MW14-02A	MW14-02A	primary	02-Aug-2018	Maxxam	B865713	UA2951		7.86	354	8.01	150	2.4		374	8.18	181	183	<1.0	194	<0.10		142
MW14-02A	JH42-06	duplicate	02-Aug-2018	Maxxam	B865713	UA2953								386	7.96	180	181	<1.0	202	<0.10		141
MW14-02A	MW14-02A	primary	04-Oct-2018	Maxxam	B888292	UN0550		7.72	369	8.11	29	3.1		366	8.03	187	190	<1.0	218	<0.10		143
MW14-02A	MW14-02A	primary	28-Apr-2019	Maxxam	B931684	VP1758		7.62	204	11.3	43	2.32		374	7.9	184	180	<1.0	216	0.31		150
MW14-02A	BD1-Q1	duplicate	28-Apr-2019	Maxxam	B931684	VP1760								362	7.81	187	186	<1.0	204	0.33		144
MW14-02A	MW14-02A	primary	13-Jun-2019	Maxxam	B946942	VX0055		7.21	362	9.3	247	2.49		373	8.01	184	181	<1.0	202	0.27		141
MW14-02A	MW14-02A	primary	22-Aug-2019	Maxxam	B970851	WJ1605		6.85	366	10.17	85	2.07		361	7.95	178	179	3.4	216	0.74		143
MW14-02A	BD2-Q3	duplicate	22-Aug-2019	Maxxam	B970851	WJ1607								369	7.98	175	176	5.2	234	0.62		144
MW14-02B	MW14-02B	primary	28-Sep-2014	ALS	L1525019	L1525019-2		7.63	496	5.18	-185	0.6		508	8.02	283		<3	348	0.34		209
MW14-02B	F-DUP-1	duplicate	28-Sep-2014	ALS	L1525019	L1525019-4								514	7.92	282		<3	347	0.43		209
MW14-02B	MW14-02B	primary	12-Jun-2015	Maxxam	B550137	ML4992		7.57	497	6.73	16	1.3		503	8.15	191	242	6.3	282	2.78		189
MW14-02B	MW14-02B	primary	16-Jul-2015	Maxxam	B562572	MS4332		7.62	508	4.73	32	3.15		507	8.19	254	256	<1.0	254	0.26		190
MW14-02B	MW14-02B	primary	06-Aug-2015	Maxxam	B569424	MW5113		7.56	481	4.9	137	2		504	8.12	280	275	1.8	374	0.43		191
MW14-02B	MW14-02B	primary	04-Sep-2015	Maxxam	B578440	NC0867		7.51	509	6.2	137	1.6		492	8.19	257	249	7.1	328	2.32		184
MW14-02B	JH40-01	duplicate	13-May-2016	Maxxam / ALS	B637982 / L1769281	OQ4929 /L1769281-7		7.8	317	9.02	15	4.58		502	8.08	280	273	10.9	306	4.71		191
MW14-02B	MW14-02B	primary	13-May-2016	Maxxam / ALS	B637982 / L1769281	OQ4923 / L1769281-5		7.8	317	9.02	15	4.58		499	8.11	252	277	7.7	298	2.43		210
MW14-02B	MW14-02B	primary	17-Jul-2016	Maxxam / ALS	B659949 / L1802108	PB7359 / L1802108-2		7.60	435	7.61	97	2.26		491	8.11	252	267	5.7	282	26.2		182
MW14-02B	MW14-02B	primary	25-Sep-2016	Maxxam / ALS	B684472 / L1835140	PP7172 / L1835140-2		7.37	459	6.52	89	1.69		498	8.15	247	255	2.2	288	2.08		181
MW14-02B	JH41-01	duplicate	21-Apr-2017	Maxxam	B730366	QX9656								488	8.3	271	261	4.8	288	2.49		184
MW14-02B	MW14-02B	primary	21-Apr-2017	Maxxam	B730366	QX9658		7.52	496	7.1	157	1.42		490	8.27	261	264	4.8	292	2.67		187
MW14-02B	MW14-02B	primary	08-Jun-2017	Maxxam	B746144	RG4989		7.55	463	6.22	131	7.82		487	8.4	246	259	<1.0	276	0.73		184
MW14-02B	JH41-06	duplicate	28-Jul-2017	Maxxam	B763678	RQ0449								474	8.36	247	240	3.1	290	2.31		182
MW14-02B	MW14-02B	primary	28-Jul-2017	Maxxam	B763678	RQ0451		7.68	469	6.43	130	3.48		472	8.34	241	235	2.9	266	2.14		182
MW14-02B	MW14-02B	primary	05-Oct-2017	Maxxam	B788595	SE1625		7.23	521	9.43	-67	1.31		482	8.08	258	246	2.3	264	1.88		181
MW14-02B	JH42-02	duplicate	19-Apr-2018	Maxxam	B830002	TH7276								1430	4.78	271	265	1.8	254	2.07		176
MW14-02B	MW14-02B	primary	19-Apr-2018	Maxxam	B830002	TH7278		8.03	467	7.37	102	1.3		488	8.18	267	271	2.2	310	1.71		177
MW14-02B	MW14-02B	primary	07-Jun-2018	Maxxam	B845895	TP7510		7.69	476	7.41	105	3.2		481	8.1	249	247	79.3	292	44.1		183
MW14-02B	MW14-02B	primary	02-Aug-2018	Maxxam	B865713	UA2952		7.42	446	8.13	209	3.4		481	8.22	237	237	10.7	262	3.83		176
MW14-02B	MW14-02B	primary	04-Oct-2018	Maxxam	B888292	UN0551		7.6	477	5.97	38	1.4		473	8.06	235	243	5.1	294	1.37		180
MW14-02B	JH42-08	duplicate	05-Oct-2018	Maxxam	B888292	UN0655								481	8.26	239	259	5.0	280	1.27		182
MW14-02B	MW14-02B	primary	28-Apr-2019	Maxxam	B931684	VP1759		7.72	473	6.98	90	1.3		476	7.87	236	235	2.5	260	1.11		181
MW14-02B	MW14-02B	primary	13-Jun-2019	Maxxam	B946942	VX0056		7.8	469	6.53	95	2.7		479	8.04	237	234	<1.0	264	0.41		176
MW14-02B	BD1-Q2	duplicate	13-Jun-2019	Maxxam	B946942	VX0057								476	8.1	237	229	<1.0	274	0.32		176
MW14-02B	MW14-02B	primary	22-Aug-2019	Maxxam	B970851	WJ1606								470	7.95	230	227	<1.0	282	0.56		179
MW14-03A	MW14-03A	primary	12-Oct-2014	ALS	L1533094	L1533094-2		9.27	950	0.21	46	0.7		887	7.84	351		100	1060	76.2		243
MW14-03A	MW14-03A	primary	22-Jun-2015	Maxxam	B553846	MN4268			1620	0.21		1.89		1570	8.05	897	928	25.0	1110	21.8		477
MW14-03A	MW14-03A	primary	12-Jul-2015	Maxxam	B559978	MR0624		7.44	1562	0.31	-106	1.1		1580	7.65	863	860	31.2	1120	20.3		467
MW14-03A	MW14-03A	primary	07-Aug-2015	Maxxam	B569424	MW5114		7.41	1376	2.6	-152	1.1		1570	8.03	893	924	23.2	1180	35.9		486
MW14-03A	MW14-50	duplicate	07-Aug-2015	Maxxam	B569424	MW5119								1550	8.04	890	916	22.7	1170	44.7		483
MW14-03A	MW14-03A	primary	06-Sep-2015	Maxxam	B578440	NC0876		7.36	1583	2.08	-138	0.9		1540	8	875	826	22.5	1140	0.35		495
MW14-03A	MW14-03A	primary	16-May-2016	Maxxam / ALS	B638880 / L1770639	OQ9462 / L1770639-8		7.44	1625	0.12	-118	1.67		1620	8.08	914	1010	12.4	1090	17.9		513
MW14-03A	MW14-03A	primary	14-Jul-2016	Maxxam / ALS	B659949 / L1799815	PB1620 / L1799815-2		7.41	1599	0.37	-107	1.90		1640	7.82	908	961	12.0	1200	23.5		501

Station	Sample ID	Sample Class	Sample Date	Analytical Laboratory	Lab Job ID	Lab Sample ID	Field Paramaters	pH (field)	Specific Conductance (field)	DO (field)	ORP (field)	Temperature (field)	Physical Properties	Conductivity (lab)	pH (lab)	Total Hardness (CaCO3)	Dissolved Hardness (CaCO3)	Total Suspended Solids	Total Dissolved Solids	Turbidity	Inorganics	Alkalinity (Total as CaCO3)
								pH	uS/cm	mg/L	ORP mV	°C		uS/cm	pH	mg/L	mg/L	mg/L	mg/L	NTU		mg/L
Maxxam RDL[1]:														1	-	0.5	0.5	1	10	0.1		0.5
ALS RDL[1]:														2	-	0.5	-	3	20	-		1
MW14-03A	MW14-03A	primary	24-Sep-2016	Maxxam / ALS	B684472 / L1835140	PP7173 / L1835140-3		6.98	1646	0.08	-114	0.83		1650	8.09	897	925	13.4	1190	74.3		474
MW14-03A	MW14-03A	primary	27-Apr-2017	Maxxam	B732222	QY9087		7.24	1571	0.44	-67	0.56		1590	7.88	897	894	8.8	1180	31.7		480
MW14-03A	MW14-03A	primary	09-Jun-2017	Maxxam	B746341	RG5996		7.45	1650		-157	1.53		1610	8.3	976	988	9.8	1180	28.4		465
MW14-03A	MW14-03A	primary	26-Jul-2017	Maxxam	B763122	RP7230		7.41	1567	0.46	-105	0.97		1630	8.29	963	993	8.8	1210	26.4		481
MW14-03A	JH41-08	duplicate	06-Oct-2017	Maxxam	B788595	SE1623								1650	7.83	1020	924	10.4	1160	40.1		482
MW14-03A	MW14-03A	primary	06-Oct-2017	Maxxam	B788595	SE1626		7.42	1681	0.19	-232	0.19		1660	7.76	991	935	11.2	1170	41.1		483
MW14-03A	MW14-03A	primary	20-Apr-2018	Maxxam	B830002	TH7279		8.09	1594	0.5	-82	0		7600	7	1020	1020	9.8	1180	29.1		469
MW14-03A	MW14-03A	primary	08-Jun-2018	Maxxam	B845895	TP7513		7.29	1672	0.1	-99	0.3		1650	8.02	917	902	10.4	1210	29.7		483
MW14-03A	MW14-03A	primary	05-Aug-2018	Maxxam	B866687	UA8350		6.73	1623	0.13	-56	0.9		1640	8.13	927	925	8.6	1230	33.4		485
MW14-03A	MW14-03A	primary	07-Oct-2018	Maxxam	B888703	UN2793		7.17	1700	0.08	-113	0.2		1650	7.83	949	920	10.3	1210	24		474
MW14-03A	MW14-03A	primary	27-Apr-2019	Maxxam	B931684	VP1756		6.82	1644	0.13	-178	0.1		1670	7.7	922	833	11	1170	12.1		493
MW14-03A	MW14-03A	primary	14-Jun-2019	Maxxam	B947584	VX3865		7.2	1636	0.56	-114	1.07		1640	7.82	884	891	10	1210	13.4		479
MW14-03A	MW14-03A	primary	23-Aug-2019	Maxxam	B971044	WJ2831		7.29	1560	0.68	-92	0.79		1630	8.03	949	902	4.8	1230	7.6		495
MW14-03B	MW14-03B	primary	06-Oct-2014	ALS	L1530127	L1530127-1		7.35	1582	0.07	89	0.5		1490	7.83	801		24	1240	28.3		476
MW14-03B	MW14-03B	primary	22-Jun-2015	Maxxam	B553846	MN4269		7.36	1717	0.14	48	1.2		1800	8.12	951	1070	5.2	1330	5.03		579
MW14-03B	MW14-03B	primary	12-Jul-2015	Maxxam	B559978	MR0625		7.45	1711	0.19	-109	0.99		1700	7.71	900	907	5.4	1160	6.87		516
MW14-03B	MW14-03B	primary	07-Aug-2015	Maxxam	B569424	MW5115		7.37	1604	0.14	-52	1.42		1710	8.09	1030	1090	3.8	1370	4.6		533
MW14-03B	MW14-03B	primary	06-Sep-2015	Maxxam	B578440	NC0877		7.16	1707	0.23	-54	1.06		1700	7.95	987	998	3.5	1330	3.06		529
MW14-03B	MW14-200	duplicate	06-Sep-2015	Maxxam	B578440	NC0878								1730	7.98	990	1000	2.8	1330	3.32		538
MW14-03B	MW14-03B	primary	16-May-2016	Maxxam / ALS	B638880 / L1770639	OQ9461 / L1770639-7		7.16	1707	0.23	-54	1.06		1740	8.11	1030	972	2.6	1260	1.95		554
MW14-03B	MW14-03B	primary	14-Jul-2016	Maxxam / ALS	B659949 / L1799815	PB1628 / L1799815-3		7.41	1717	0.31	-40	1.29		1750	7.92	1050	1060	2.9	1310	1.93		548
MW14-03B	MW14-03B	primary	24-Sep-2016	Maxxam / ALS	B684472 / L1835140	PP7174 / L1835140-4		6.88	1640	0.45	-62	0.52		1730	8.03	952	1020	2.3	1260	2.71		514
MW14-03B	MW14-03B	primary	27-Apr-2017	Maxxam	B732222	QY9088		7.37	1762	0.96	-26	0.42		1720	8.19	963	964	3	1290	5.04		531
MW14-03B	MW14-03B	primary	09-Jun-2017	Maxxam	B746341	RG5997		7.00	1746	0.53	-28	1.63		1720	8.34	1090	1100	3.4	1270	6.16		525
MW14-03B	MW14-03B	primary	26-Jul-2017	Maxxam	B763122	RP7231		7.36	1742	0.51	-54	0.96		1760	8.34	1050	1080	4.5	1320	3.76		540
MW14-03B	MW14-03B	primary	06-Oct-2017	Maxxam	B788595	SE1627		7.48	1884	0.41	-220	0.21		1770	8.06	1100	1030	3.3	1310	3.53		554
MW14-03B	MW14-03B	primary	20-Apr-2018	Maxxam	B830002	TH7280		7.22	1647	2.06	-85	0.1		1850	8.11	1150	1150	3.4	1260	3.24		538
MW14-03B	MW14-03B	primary	08-Jun-2018	Maxxam	B845895	TP7514		7.46	1834	0.06	-70	0.1		1830	7.98	1040	1030	4.8	1340	5.59		566
MW14-03B	MW14-03B	primary	05-Aug-2018	Maxxam	B866687	UA8351		7.28	1813	0.1	-69	0.7		1800	8.16	1040	1040	3.3	1380	5.39		562
MW14-03B	MW14-03B	primary	07-Oct-2018	Maxxam	B888703	UN2792		7.28	1789	0.07	-43	0.2		1740	7.78	1050	1010	3.3	1260	5.5		524
MW14-03B	MW14-03B	primary	27-Apr-2019	Maxxam	B931684	VP1757		7.50	1763	2.35	19	0.47		1840	7.72	996	1020	2.7	1310	2.56		575
MW14-03B	MW14-03B	primary	14-Jun-2019	Maxxam	B947584	VX3866		7.11	1842	6.38	46.9	1.05		1850	7.87	1030	1050	3.3	1370	6.88		561
MW14-03B	MW14-03B	primary	23-Aug-2019	Maxxam	B971044	WJ2832		7.02	1806	3.5	-27	0.77		1880	8.01	1090	1100	3.6	1390	9.4		573
MW14-05A	MW14-05A	primary	02-Oct-2014	ALS	L1529013	L1529013-1		7.2	287	1.82	125	-0.1		316	7.93	116		58	249	64.7		127
MW14-05A	MW14-05A	primary	23-Jun-2015	Maxxam	B553846	MN4272		6.94	350	0.88	3.8	1.6		343	7.85	142	154	5.2	204	5.2		155
MW14-05A	MW14-05A	primary	13-Jul-2015	Maxxam	B559978	MR0626		6.49	365	0.11	-117	1.56		358	7.43	146	144	7.7	186	13.1		164
MW14-05A	MW14-05A	primary	08-Aug-2015	Maxxam	B569424	MW5116		7.29	329	1.22	-150	1.9		367	8	162	154	9.8	264	15.3		182
MW14-05A	MW14-05A	primary	07-Sep-2015	Maxxam	B578440	NC0908		7.00	379	2.08	-122	0.9		357	7.72	153	144	9.6	230	9.7		167
MW14-05A	MW14-05A	primary	14-May-2016	Maxxam / ALS	B637982 / L1769281	OQ4924 / L1769281-2		7.41	436	0.65	-118	3.27		423	7.7	197	187	14.0	252	15.6		214
MW14-05A	JH40-04	duplicate	16-Jul-2016	Maxxam / ALS	B658689 / L1799815	PB1633 / L1799815-11								363	7.52	169	172	15.7	236	12.1		175
MW14-05A	MW14-05A	primary	16-Jul-2016	Maxxam / ALS	B658689 / L1799815	PB1621 / L1799815-7			356	0.35	-194	1.57		371	7.54	160	162	12.9	240	12.8		178
MW14-05A	MW14-05A	primary	23-Sep-2016	Maxxam / ALS	B684472 / L1835140	PP7175 / L1835140-5		7.74	430	0.38	-82	1.35		421	8.03	177	181	18.3	246	30.6		205
MW14-05A	MW14-05A	primary	28-Apr-2017	Maxxam	B732222	QY9085		7.58	475	0.47	-183	0.72		425	8.05	186	184	20	298	52.3		216
MW14-05A	MW14-05A	primary	10-Jun-2017	Maxxam	B747325	RH1794		6.95	406	0.57	-102	1.65		376	8.06	167	164	15	224	38.1		181
MW14-05A	MW14-05A	primary	25-Jul-2017	Maxxam	B762525	RP3649		7.19	399	0.85	-100	1.24		383	8.06	166	174	20.9	238	50.3		193
MW14-05A	MW14-05A	primary	08-Oct-2017	Maxxam	B789159	SE4582		7.63	370	0.4	-213	0.08		398	7.63	196	192	20.3	232	43.3		256
MW14-05A	MW14-05A	primary	21-Apr-2018	Maxxam	B830272	TH8280		8.25	417	0.51	-103	0.6		411	8.11	192	204	13.5	208	112		210
MW14-05A	JH42-04	duplicate	09-Jun-2018	Maxxam	B846878	TQ2238								263	7.88	177	179	21.9	144	46.9		194
MW14-05A	MW14-05A	primary	09-Jun-2018	Maxxam	B846878	TQ2236		7.17	439	1.13	-87	0.9		401	7.91	179	174	23.1	240	118		192
MW14-05A	MW14-05A	primary	04-Aug-2018	Maxxam	B866687	UA8352		7.22	415	0.1	-96	0.8		397	7.93	174	178	23.4	252	130		207
MW14-05A	MW14-05A	primary	06-Oct-2018	Maxxam	B888703	UN2796		7.31	430	3.49	-124	0.2		400	7.54	183	193	28.1	228	92		206
MW14-05A	MW14-05A	primary	29-Apr-2019	Maxxam	B932398	VP4748		7.18	474	0.18	-108	0.3		417	7.86	187	182	27	236	114		213
MW14-05A	BD2-Q1	duplicate	29-Apr-2019	Maxxam	B932398	VP4749								417	7.4	187	183	26	236	92.1		219
MW14-05A	MW14-05A	primary	15-Jun-2019	Maxxam	B947584	VX3867		7.07	452	1.34	-96	1.45		410	7.59	189	192	24	234	117		205
MW14-05A	MW14-05A	primary	24-Aug-2019	Maxxam	B971044	WJ2833		6.97	424	2.58	-88	0.98		416	7.8	212	191	28	250	140		214
MW14-05B	MW14-05B	primary	03-Oct-2014	ALS	L1529013	L1529013-2		9.45	489	0.73	91	0.1		520	8.09	152		120	342	139		151
MW14-05B	MW14-05B	primary	24-Jun-2015	Maxxam	B554336	MN7151		7.67	569	4.47	102	4.6		589	7.92	140	140	64.3	420	38		182
MW14-05B	MW14-05B	primary	14-Jul-2015	Maxxam	B560161	MR1584		7.72	709	0.45	-91	1.4		736	8.04	147	134	14.7	484	14		192
MW14-05B	MW14-05B	primary	09-Aug-2015	Maxxam	B569424	MW5117		7.43	696	0.44	-51	1.48		756	8.03	154	148	7	579	7.85		196

Station	Sample ID	Sample Class	Sample Date	Analytical Laboratory	Lab Job ID	Lab Sample ID	Field Paramaters	pH (field)	Specific Conductance (field)	DO (field)	ORP (field)	Temperature (field)	Physical Properties	Conductivity (lab)	pH (lab)	Total Hardness (CaCO3)	Dissolved Hardness (CaCO3)	Total Suspended Solids	Total Dissolved Solids	Turbidity	Inorganics	Alkalinity (Total as CaCO3)
								pH	uS/cm	mg/L	ORP mV	°C		uS/cm	pH	mg/L	mg/L	mg/L	mg/L	NTU		mg/L
Maxxam RDL[1]:														1	-	0.5	0.5	1	10	0.1		0.5
ALS RDL[1]:														2	-	0.5	-	3	20	-		1
MW14-05B	MW14-05B	primary	08-Sep-2015	Maxxam	B579224	NC4789		7.24	607	0.96	-65	4.37		583	7.9	148	150	11	402	9.03		197
MW14-05B	MW14-05B	primary	15-May-2016	Maxxam / ALS	B637982 / L1769281	OQ4925 / L1769281-1		7.37	519	0.85	-104	2.36		503	7.76	184	185	5.8	312	11		241
MW14-05B	MW14-05B	primary	16-Jul-2016	Maxxam / ALS	B659949 / L1799815	PB1622 / L1799815-8		7.33	416	0.45	-78	1.39		472	7.79	165	169	9.9	290	19.6		228
MW14-05B	MW14-05B	primary	23-Sep-2016	Maxxam / ALS	B684472 / L1835140	PP7176 / L1835140-6		7.15	406	0.31	-90	1.49		446	7.76	152	156	9.9	288	25.9		206
MW14-05B	MW14-05B	primary	29-Apr-2017	Maxxam	B732222	QY9086		6.66	436	1.37	-67	0.17		411	8.05	153	155	13.5	272	51.4		203
MW14-05B	MW14-05B	primary	11-Jun-2017	Maxxam	B747325	RH1795		7.43	422	0.68	-77	2.18		426	8.13	157	157	15.8	256	65.1		211
MW14-05B	MW14-05B	primary	26-Jul-2017	Maxxam	B763122	RP7233		7.33	409	0.92	-80	0.7		410	8.27	150	165	17.6	250	57.3		207
MW14-05B	MW14-05B	primary	08-Oct-2017	Maxxam	B789159	SE4583		7.50	359	1.78	-200	-0.1		397	7.78	174	166	14.1	232	54.2		206
MW14-05B	MW14-05B	primary	22-Apr-2018	Maxxam	B830272	TH8281		7.4	388	2.64	-40	0.1		388	7.99	159	166	15.5	224	62		199
MW14-05B	MW14-05B	primary	10-Jun-2018	Maxxam	B846878	TQ2237		7.19	383	0.41	-80	0.6		374	7.96	155	148	13.7	236	56.1		182
MW14-05B	MW14-05B	primary	04-Aug-2018	Maxxam	B866687	UA8353		7.17	382	0.23	-85	1.3		366	7.95	152	147	11.3	234	62.9		187
MW14-05B	MW14-05B	primary	06-Oct-2018	Maxxam	B888703	UN2799		7.18	383	0.21	-91	0		363	7.64	141	146	13.3	212	45		179
MW14-05B	MW14-05B	primary	30-Apr-2019	Maxxam	B932398	VP4747		6.96	367	8.38	-80	0.71		359	7.54	152	149	14	204	60.1		194
MW14-05B	MW14-05B	primary	16-Jun-2019	Maxxam	B947584	VX3868		6.97	376	3.61	-66	0.81		361	7.66	150	149	11	234	56.9		180
MW14-05B	MW14-05B	primary	25-Aug-2019	Maxxam	B971044	WJ2834		6.89	361	1.31	-72	0.78		357	7.78	146	149	16	210	69		179
MW15-01WB	MW15-01WB	primary	07-Jun-2015	Maxxam	B549739	ML2152		6.95	2229	6.83	33	3.4		2130	7.9	1460	1470	2.5	1800	3.52		556
MW15-01WB	MW15-01WB	primary	08-Jul-2015	Maxxam	B558595	MQ2530		7.85	2269	8.96	23	4.7		2200	7.95	1400	1410	2.5	1690	4.31		554
MW15-01WB	MW15-01WB	primary	10-Aug-2015	Maxxam	B569424	MW5120		7.01	2160	7.96	38	9.2		2180	7.75	1450	1330	3.0	1890	5.93		565
MW15-01WB	MW15-01WB	primary	03-Sep-2015	Maxxam	B578440	NC0865		6.78	2215			6.86		2190	7.85	1360	1390	2.7	1940	5.11		547
MW15-01WB	MW15-01WB	primary	15-May-2016	Maxxam / ALS	B637982 / L1769281	OQ4926 / L1769281-3		7.08	2355	10.99	6	11.3		2240	7.81	1410	1400	2.6	1700	5.95		590
MW15-01WB	MW15-01WB	primary	14-Jul-2016	Maxxam / ALS	B659949 / L1799815	PB1623 / L1799815-1		6.71	2293	12.41	-0.9	5.20		2200	7.86	1420	1390	5.3	1870	12.7		584
MW15-01WB	MW15-01WB	primary	22-Sep-2016	Maxxam / ALS	B684472 / L1835140	PP7177 / L1835140-7		6.84	2278	17.29	-15	3		2190	7.95	1350	1360	5.6	1850	24.7		542
MW15-01WB	MW15-01WB	primary	22-Apr-2017	Maxxam	B730366	QX9659		6.60	2078	2.15	63	2.5		2210	7.82	1430	1460	4.7	1790	16.8		576
MW15-01WB	MW15-01WB	primary	08-Jun-2017	Maxxam	B746144	RG4990		7.04	1925	7.28	102	16.8		2180	7.98	1390	1410	1.6	1850	0.74		550
MW15-01WB	MW15-01WB	primary	24-Jul-2017	Maxxam	B762525	RP3650		6.60	2078	2.15	63	2.5		2170	7.78	1390	1360	5.5	1820	26.1		551
MW15-01WB	MW15-01WB	primary	06-Oct-2017	Maxxam	B788595	SE1628		6.07	2041			8.03		2210	8.02	1480	1430	3.9	1820	15.2		589
MW15-01WB	MW15-01WB	primary	19-Apr-2018	Maxxam	B830002	TH7281		6.99	2390	6.3	36	2.9		2220	8.03	1530	1510	4.5	1820	10		550
MW15-01WB	MW15-01WB	primary	07-Jun-2018	Maxxam	B845895	TP7507		7.25	2160	11.5	2.6	3.9		2210	7.85	1370	1340	2.2	1840	9.2		585
MW15-01WB	MW15-01WB	primary	02-Aug-2018	Maxxam	B865713	UA2954		7.40	1156	10.88	-25	0.9		2190	7.78	1340	1320	2.4	1800	12		541
MW15-01WB	MW15-01WB	primary	03-Oct-2018	Maxxam	B888292	UN0552		7.40	1156	10.88	-25	0.9		2180	7.8	1350	1390	2.5	1800	6.32		566
MW15-01WB	MW15-01WB	primary	05-May-2019	Maxxam	B934027	VQ2549		6.78	2252	4.56	58	1.57		2220	8.04	1270	1340	2.8	1830	5.41		585
MW15-01WB	MW15-01WB	primary	18-Jun-2019	Maxxam	B948843	VY0459		7.36	1518	7.42	37	10.23		2200	7.7	1350	1340	1.8	1840	9.31		595
MW15-01WB	MW15-01WB	primary	22-Aug-2019	Maxxam	B970851	WJ1608		7.41	1720	8.6	198	3.8		2190	7.76	1340	1340	3.3	1910	12		580
MW15-02AZ	MW15-02AZ	primary	31-May-2015	Maxxam	B546672	MJ5444		7.32	874	6.43	21	1.2		926	8.08	493	513	<1.0	640	0.19		264
MW15-02AZ	MW15-02AZ	primary	11-Jul-2015	Maxxam	B559978	MR0622		7.54	800	8.2	41	1.95		792	8.04	410	417	<1.0	484	0.11		239
MW15-02AZ	MW15-40AZ	duplicate	11-Jul-2015	Maxxam	B559978	MR0623								792	7.83	411	412	<1.0	500	0.15		242
MW15-02AZ	MW15-02AZ	primary	12-Aug-2015	Maxxam	B569424	MW5162		7.41	767	6.8	48	1.08		738	8.06	408	405	<1.0	500	<0.10		234
MW15-02AZ	MW15-02AZ	primary	07-Sep-2015	Maxxam	B578440	NC0910		7.49	728	7.37	143	1.76		747	8.16	394	383	<1.0	514	0.24		231
MW15-02AZ	MW15-02AZ	primary	17-May-2016	Maxxam / ALS	B638880 / L1770639	OQ9455 / L1770639-1		7.36	769	4.41	46	1.22		802	8.17	420	424	<1.0	486	<0.10		246
MW15-02AZ	MW15-02AZ	primary	19-Jul-2016	Maxxam / ALS	B659949 / L1802108	PB7361 / L1802108-4		7.37	752	5.05	65	2.40		754	8.00	435	420	<1.0	484	0.13		227
MW15-02AZ	JH40-06	duplicate	25-Sep-2016	Maxxam / ALS	B684472 / L1835140	PP7159 / L1835140-1								798	7.94	412	420	4.4	536	0.47		243
MW15-02AZ	MW15-02AZ	primary	25-Sep-2016	Maxxam / ALS	B684472 / L1835140	PP7181 / L1835140-11		7.33	770	3.98	58	2		804	8.11	410	420	6.5	540	0.34		237
MW15-02AZ	MW15-02AZ	primary	28-Jul-2017	Maxxam	B763678	RQ0453		7.38	565	6.7	-333	1.98		795	8.36	422	467	<1.0	524	<0.10		248
MW15-02AZ	MW15-02AZ	primary	08-Oct-2017	Maxxam	B789159	SE4581		7.57	437	8.8	103	1.29		826	8.19	445	469	<1.0	552	<0.10		260
MW15-02AZ	JH42-05	duplicate	03-Aug-2018	Maxxam	B865713	UA2959								849	8.28	450	434	<1.0	560	0.1		249
MW15-02AZ	MW15-02AZ	primary	03-Aug-2018	Maxxam	B865713	UA2958		8.02	862		32	2.1		849	8.29	443	438	<1.0	554	0.39		250
MW15-02WB	MW15-02WB	primary	01-Jun-2015	Maxxam	B546672	MJ5445		7.27	889		75	3.2		889	7.99	464	514	<1.0	634	1.33		245
MW15-02WB	MW15-02WB	primary	11-Jul-2015	Maxxam	B559978	MR0621		7.44	884	9.22	-17	6.7		816	7.66	462	458	<1.0	602	1.97		206
MW15-02WB	MW15-02WB	primary	12-Aug-2015	Maxxam	B569424	MW5161		7.3	898	7.45	9	3.18		866	7.95	486	466	1.1	636	2.24		224
MW15-02WB	MW15-02WB	primary	07-Sep-2015	Maxxam	B578440	NC0909		7.47	863	5.26	117	4.52		865	8.16	465	456	<1.0	610	0.21		247
MW15-02WB	MW15-02WB	primary	18-May-2016	Maxxam / ALS	B639291 / L1771766	OR1434 / L1771766-2		7.32	880	11.92	95	3.2		869	8.28	437	488	<1.0	586	1.63		255
MW15-02WB	MW15-02WB	primary	19-Jul-2016	Maxxam / ALS	B659949 / L1802108	PB7360 / L1802108-5		7.58	827	8.04	111	11.50		828	8.05	428	469	<1.0	550	0.37		240
MW15-02WB	MW15-02WB	primary	25-Sep-2016	Maxxam / ALS	B684472 / L1835140	PP7178 / L1835140-8		7.46	806	7.62	105	7		813	8.15	435	432	<1.0	540	0.43		233
MW15-02WB	JH41-02	duplicate	25-Apr-2017	Maxxam	B731280	QY4060								900	8.39	480	481	<1.0	644	0.33		257
MW15-02WB	MW15-02WB	primary	25-Apr-2017	Maxxam	B731280	QY4061		7.34	941	4.04	224	3.1		911	8.23	484	505	<1.0	636	0.31		257
MW15-02WB	JH41-04	duplicate	13-Jun-2017	Maxxam	B747738	RH3691								863	8.31	460	451	<1.0	614	1.15		248
MW15-02WB	MW15-02WB	primary	13-Jun-2017	Maxxam	B747738	RH3690		7.4	895	6.73	-30	2.2		857	8.31	465	447	<1.0	602	1.38		249
MW15-02WB	MW15-02WB	primary	28-Jul-2017	Maxxam	B763678	RQ0452		7.07	691	7.45	-32	5.2		861	8.33	456	452	<1.0	598	0.21		254
MW15-02WB	MW15-02WB	primary	08-Oct-2017	Maxxam	B789159	SE4580			480	6.23	114	3.5		841	8.08	454	472	<1.0	566	0.24		252

Station	Sample ID	Sample Class	Sample Date	Analytical Laboratory	Lab Job ID	Lab Sample ID	Field Paramaters	pH (field)	Specific Conductance (field)	DO (field)	ORP (field)	Temperature (field)	Physical Properties	Conductivity (lab)	pH (lab)	Total Hardness (CaCO3)	Dissolved Hardness (CaCO3)	Total Suspended Solids	Total Dissolved Solids	Turbidity	Inorganics	Alkalinity (Total as CaCO3)
								pH	uS/cm	mg/L	ORP mV	°C		uS/cm	pH	mg/L	mg/L	mg/L	mg/L	NTU		mg/L
Maxxam RDL[1]:														1	-	0.5	0.5	1	10	0.1		0.5
ALS RDL[1]:														2	-	0.5	-	3	20	-		1
MW15-02WB	MW15-02WB	primary	21-Apr-2018	Maxxam	B830272	TH8282		7.28	520	7.6	32	0.1		937	8.2	532	532	<1.0	574	0.48		270
MW15-02WB	JH42-03	duplicate	09-Jun-2018	Maxxam	B846878	TQ2235								887	8.06	465	459	<1.0	600	1.78		243
MW15-02WB	MW15-02WB	primary	09-Jun-2018	Maxxam	B846878	TQ2232		7.47	900	10.5	27	5.8		887	8.1	468	481	<1.0	606	1.54		245
MW15-02WB	MW15-02WB	primary	04-Aug-2018	Maxxam	B866687	UA8355		7.66	880		-28	8.9		890	7.98	470	463	1.0	628	1.71		252
MW15-02WB	JH42-07	duplicate	06-Oct-2018	Maxxam	B888703	UN2798								848	7.89	448	449	<1.0	586	0.27		252
MW15-02WB	MW15-02WB	primary	06-Oct-2018	Maxxam	B888703	UN2797		7.23	853	8.9	91	1.2		863	7.88	448	441	<1.0	574	0.13		257
MW15-02WB	MW15-02WB	primary	29-Apr-2019	Maxxam	B932398	VP4745		7.34	860	8.54	55	9.6		917	7.74	479	488	3.1	612	0.28		266
MW15-02WB	MW15-02WB	primary	19-Jun-2019	Maxxam	B950398	VY8201		7.55	900	10.73	43	8.28		909	7.93	468	468	<1.0	638	1.35		292
MW15-02WB	BD2-Q2	duplicate	19-Jun-2019	Maxxam	B950398	VY8200								876	7.88	460	456	<1.0	628	1.38		255
MW15-02WB	MW15-02WB	primary	24-Aug-2019	Maxxam	B971044	WJ2826		7.36	894	9.95	54	7.2		906	8.09	462	470	1.6	634	1.7		257
MW15-03AZ	MW15-03AZ	primary	16-Jun-2015	Maxxam	B551383	MM1021		6.64	322	0.34	108	2.79		323	7.97	151	151	<1.0	216	0.24		108
MW15-03AZ	MW15-21	duplicate	16-Jun-2015	Maxxam	B551383	MM1022								319	7.96	148	158	<1.0	202	0.27		107
MW15-03AZ	MW15-03AZ	primary	09-Jul-2015	Maxxam	B558921	MQ4540		6.99	308	0.57	80	2.2		308	7.82	139	141	<1.0	184	<0.10		110
MW15-03AZ	MW15-03AZ	primary	10-Aug-2015	Maxxam	B569424	MW5157		7.02	217	1.42	73	2.54		212	7.71	108	107	<1.0	150	0.51		80.3
MW15-03AZ	MW15-03AZ	primary	04-Sep-2015	Maxxam	B578440	NC0874		7.07	213	1.17	92	1.65		212	7.86	99	96.6	<1.0	140	0.29		82.3
MW15-03AZ	JH40-02	duplicate	16-May-2016	Maxxam / ALS	B638880 / L1770639	OQ9460 / L1770639-6		7.12	260	0.43	87	1.5		246	7.88	90.4	133	1.3	142	0.17		85.1
MW15-03AZ	MW15-03AZ	primary	16-May-2016	Maxxam / ALS	B638880 / L1770639	OQ9459 / L1770639-5		7.12	260	0.43	87	1.5		245	7.9	93.8	135	2.6	158	0.14		85.3
MW15-03AZ	MW15-03AZ	primary	16-Jul-2016	Maxxam / ALS	B658689 / L1799815	PB1624 / L1799815-10		7.11	204	0.27	81	3.10		207	7.72	101	105	<1.0	124	<0.10		80.8
MW15-03AZ	MW15-03AZ	primary	23-Sep-2016	Maxxam / ALS	B684472 / L1835140-	PP7182 / L1835140-12		7.2	205	0.31	72	2.1		207	7.85	94.6	99.9	<1.0	144	0.26		78.1
MW15-03AZ	MW15-03AZ	primary	25-Jul-2017	Maxxam	B762525	RP3706		6.97	153	1.67	-233	2.12		245	8.04	115	114	<1.0	162	<0.10		87
MW15-03AZ	MW15-03AZ	primary	07-Oct-2017	Maxxam	B789159	SE4578		8.88	128	2.93	133	1.38		243	8.01	116	119	<1.0	152	<0.10		81.5
MW15-03AZ	MW15-03AZ	primary	04-Aug-2018	Maxxam	B866687	UA8354		7.76	256		40	1.7		266	7.79	127	129	<1.0	172	0.22		94.1
MW15-03AZ	MW15-03AZ	primary	05-Oct-2018	Maxxam	B888292	UN0556		6.94	221	2.4	6.1	0.8		225	8.02	105	107	<1.0	120	<0.10		85
MW15-03AZ	MW15-03AZ	primary	23-Aug-2019	Maxxam	B971044	WJ2830		6.96	259	1.22	136	1.2		252	7.73	117	121	<1.0	168	0.11		94.4
MW15-03WB	MW15-03WB	primary	16-Jun-2015	Maxxam	B551383	MM1020		7.65	1907			7.55		1900	8.02	1030	1010	3.6	1520	3.81		150
MW15-03WB	MW15-03WB	primary	09-Jul-2015	Maxxam	B558921	MQ4541		7.42	1914	8.69	-27	4.2		1870	7.98	929	935	2.9	1400	4.48		152
MW15-03WB	MW15-03WB	primary	10-Aug-2015	Maxxam	B569424	MW5121		7.49	1978	9.28	7.1	4.84		1840	7.98	937	911	1.8	1550	4.55		151
MW15-03WB	MW15-03WB	primary	04-Sep-2015	Maxxam	B578440	NC0873		7.37	1883	6.05	16	4.47		1840	8.03	921	937	1.7	1670	4.91		146
MW15-03WB	MW15-03WB	primary	16-May-2016	Maxxam / ALS	B638880 / L1770639	OQ9457 / L1770639-3		7.69	1833	11.92	-28	6.8		1820	8.15	910	910	2.1	1370	4.49		159
MW15-03WB	MW15-03WB	primary	16-Jul-2016	Maxxam / ALS	B658689 / L1799815	PB1632 / L1799815-9		7.57	2080	7.12	-48	9.60		2000	7.97	1100	1080	29	1710	20.2		150
MW15-03WB	MW15-03WB	primary	23-Sep-2016	Maxxam / ALS	B684472 / L1835140	PP7179 / L1835140-9		7.31	2002	8.3	-28	2.2		2030	7.99	1000	1110	3.5	1680	10.1		141
MW15-03WB	MW15-03WB	primary	23-Apr-2017	Maxxam	B730366	QX9670		7.69	1917	9.58	-56			2010	8.11	1080	1120	8.4	1660	12.1		146
MW15-03WB	MW15-03WB	primary	10-Jun-2017	Maxxam	B747325	RH1789		7.18	1485	7.82	24	11.3		2010	8.21	1070	1030	5.1	1680	7.7		146
MW15-03WB	MW15-03WB	primary	25-Jul-2017	Maxxam	B762525	RP3705		7.57	1437	9.03	-172	11.4		2010	8.27	1040	1020	1.5	1640	8.61		150
MW15-03WB	MW15-03WB	primary	07-Oct-2017	Maxxam	B789159	SE4577								2060	8.04	1190	1110	2.8	1620	8.03		154
MW15-03WB	JH42-01	duplicate	20-Apr-2018	Maxxam	B830002	TH7246								2030	8.08	1120	1130	2.7	1670	6.35		147
MW15-03WB	MW15-03WB	primary	20-Apr-2018	Maxxam	B830002	TH7282		7.54	1950	3.3	-66	8.1		2030	8.08	1140	1120	4.7	1630	4.92		144
MW15-03WB	MW15-03WB	primary	08-Jun-2018	Maxxam	B845895	TP7511		7.89	1940	9.8	-61	9.4		2010	7.98	1040	1050	2.5	1670	4.66		152
MW15-03WB	MW15-03WB	primary	05-Aug-2018	Maxxam	B866687	UA8356		8.33	1960		-104	13.1		2000	7.95	1050	1010	2.6	1690	3.45		151
MW15-03WB	MW15-03WB	primary	04/10/2018 and 05/10/2018	Maxxam	B888292	UN0554 / UN0555		7.61	1995	8.2	-90	2.7		2010	7.93	856	1110	2.8	1640	4.49		149
MW15-03WB	MW15-03WB	primary	03-May-2019	Maxxam	B934035	VQ2634		7.48	1980	7.3	-53	4.18		2030	7.91	1030	1050	1.5	1630	4.94		151
MW15-03WB	MW15-03WB	primary	18-Jun-2019	Maxxam	B948843	VY0460		7.66	1947	8.64	-49	13.65		1990	7.88	1050	1010	2.5	1730	4.95		152
MW15-03WB	MW15-03WB	primary	23-Aug-2019	Maxxam	B971044	WJ2827		7.02	1969	5.75	-61	9.7		2010	8.02	1010	1030	3.6	1750	4.1		153
MW15-04WB	MW15-04WB	primary	14-Jun-2015	Maxxam	B551383	MM1018		8.32	648	12.74	73			667	8.26	335	338	<1.0	446	0.2		233
MW15-04WB	MW15-20	duplicate	14-Jun-2015	Maxxam	B551383	MM1019								670	8.22	339	346	<1.0	480	0.14		234
MW15-04WB	MW15-04WB	primary	10-Jul-2015	Maxxam	B558916	MQ4530		7.28	665	7.75	170	7.35		661	8.1	329	326	<1.0	396	0.12		234
MW15-04WB	MW15-30WB	duplicate	10-Jul-2015	Maxxam	B558916	MQ4532								656	8.15	327	330	<1.0	402	<0.10		234
MW15-04WB	MW15-04WB	primary	11-Aug-2015	Maxxam	B569424	MW5158		7.23	688	11.19	98	3.15		639	8.07	351	355	<1.0	452	0.24		227
MW15-04WB	MW15-04WB	primary	05-Sep-2015	Maxxam	B578440	NC0875		6.32	665	4.76	187	5.84		657	8.06	330	339	<1.0	444	0.14		232
MW15-04WB	MW15-04WB	primary	13-May-2016	Maxxam / ALS	B637982 / L1769281	OQ4927 / L1769281-8		7.20	626	8.2	84	13.8		607	8.02	350	332	<1.0	366	0.38		214
MW15-04WB	JH40-03	duplicate	15-Jul-2016	Maxxam / ALS	B658689 / L1799815	PB1630 / L1799815-5								610	7.95	326	316	<1.0	392	0.23		216
MW15-04WB	MW15-04WB	primary	15-Jul-2016	Maxxam / ALS	B658689 / L1799815	PB1629 / L1799815-4		7.39	635	19.21	186	5.20		608	7.98	323	319	<1.0	394	0.25		214
MW15-04WB	MW15-04WB	primary	24-Sep-2016	Maxxam / ALS	B684472 / L1835140-	PP7180 / L1835140-10		8.26	609	12.69	9.5	2.7		615	8.08	310	314	<1.0	390	0.27		205
MW15-04WB	MW15-04WB	primary	23-Apr-2017	Maxxam	B730366	QX9671		7.40	603	10.55	62	8.2		642	8.14	336	334	<1.0	394	0.3		224
MW15-04WB	MW15-04WB	primary	11-Jun-2017	Maxxam	B747325	RH1790		5.5	418	12.3	110	5.3		654	8.33	358	348	<1.0	418	0.21		228
MW15-04WB	MW15-04WB	primary	26-Jul-2017	Maxxam	B763122	RP7232		6.87	550	5.69	281	8.1		668	8.4	341	353	<1.0	464	0.2		238
MW15-04WB	JH41-07	duplicate	05-Oct-2017	Maxxam	B788595	SE1622								664	8.16	371	351	<1.1	394	0.2		236
MW15-04WB	MW15-04WB	primary	05-Oct-2017	Maxxam	B788595	SE1629		7.54	660	10.15	59	5.38		662	8.15	381	349	<1.1	404	0.41		237
MW15-04WB	MW15-04WB	primary	19-Apr-2018	Maxxam	B830002	TH7283		7.19	745	6.1	68	0.4		685	8.17	390	391	<1.0	404	0.6		226

Station	Sample ID	Sample Class	Sample Date	Analytical Laboratory	Lab Job ID	Lab Sample ID	Field Paramaters	pH (field)	Specific Conductance (field)	DO (field)	ORP (field)	Temperature (field)	Physical Properties	Conductivity (lab)	pH (lab)	Total Hardness (CaCO3)	Dissolved Hardness (CaCO3)	Total Suspended Solids	Total Dissolved Solids	Turbidity	Inorganics	Alkalinity (Total as CaCO3)
								pH	uS/cm	mg/L	ORP mV	°C		uS/cm	pH	mg/L	mg/L	mg/L	mg/L	NTU		mg/L
Maxxam RDL[1]:														1	-	0.5	0.5	1	10	0.1		0.5
ALS RDL[1]:														2	-	0.5	-	3	20	-		1
MW15-04WB	MW15-04WB	primary	07-Jun-2018	Maxxam	B845895	TP7508		7.87	691	15.9	39	5.6		667	8.03	339	346	<1.0	418	0.16		237
MW15-04WB	MW15-04WB	primary	02-Aug-2018	Maxxam	B865713	UA2955		7.43	652	5.6	45	6.7		638	8.22	314	329	<1.0	386	0.3		220
MW15-04WB	MW15-04WB	primary	05-Oct-2018	Maxxam	B888292	UN0557		7.40	575	12.9	53	1.4		577	8.27	292	305	<1.0	364	0.17		203
MW15-04WB	MW15-04WB	primary	03-May-2019	Maxxam	B934035	VQ2635		7.36	623	7.58	166	3.67		641	7.94	325	320	<1.0	388	0.28		222
MW15-04WB	MW15-04WB	primary	17-Jun-2019	Maxxam	B948843	VY0458		7.30	650	7.1	170	6.3		615	7.84	320	328	<1.0	428	0.18		225
MW15-04WB	MW15-04WB	primary	22-Aug-2019	Maxxam	B970851	WJ1609								644	7.87	321	326	1.5	438	<0.10		229
MW15-04WB	BD1-Q3	duplicate	22-Aug-2019	Maxxam	B970851	WJ1610								644	7.87	326	320	<1.0	412	0.19		227
MW15-05AZ	MW15-05AZ	primary	06-Sep-2015	Maxxam	B578440	NC0907		5.76	28	7.89	98	1.07		28.2	6.76	9.97	10.4	1.5	22	11.3		9.09
MW15-05WB	MW15-05WB	primary	18-Jun-2015	Maxxam	B553846	MN4270		7.35	306	13.07	193	7.95		298	8.15	140	151	<1.0	170	1.01		146
MW15-05WB	MW15-05WB	primary	10-Jul-2015	Maxxam	B558916	MQ4531		7.62	304	11.61	0.2	4.63		296	7.98	132	134	<1.0	162	0.27		145
MW15-05WB	MW15-05WB	primary	11-Aug-2015	Maxxam	B569424	MW5159		7.63	300	11.92	39	3.98		287	7.98	136	139	<1.0	189	<0.10		140
MW15-05WB	MW15-60	duplicate	11-Aug-2015	Maxxam	B569424	MW5160		7.63	300	11.92	39	3.98		290	8	141	140	1.6	184	0.13		144
MW15-05WB	MW15-05WB	primary	06-Sep-2015	Maxxam	B578440	NC0906		6.55	291	9.95	75	5.3		291	7.98	133	146	<1.0	186	0.17		138
MW15-05WB	MW15-05WB	primary	15-May-2016	Maxxam / ALS	B637982 / L1769281	OQ4928 / L1769281-4		7.88	326	9.73	152	3.9		299	7.97	145	139	<1.0	164	0.15		148
MW15-05WB	MW15-05WB	primary	20-Jul-2016	Maxxam / ALS	B660160 / L1802110	PB8492 / L1802110-1		7.90	324	4.72	155	3.80		295	8.08	134	145	<1.0	176	0.19		144
MW15-05WB	MW15-05WB	primary	27-Sep-2016	Maxxam / ALS	B685473 / L1836619	PQ2532 / L1836619-4		7.70	335	5.3	160	2.2		294	7.86	133	137	<1.1	182	0.22		143
MW15-05WB	MW15-05WB	primary	21-Apr-2017	Maxxam	B730366	QX9672		6.90	402	4.37	142			290	8.25	137	144	<1.0	166	0.28		146
MW15-05WB	MW15-05WB	primary	11-Jun-2017	Maxxam	B747325	RH1791		5.5	179	12.62	-36	3.24		294	8.25	137	132	<1.0	170	0.2		144
MW15-05WB	MW15-05WB	primary	27-Jul-2017	Maxxam	B763678	RQ0446		6.99	248	10.37	-285	8.4		292	8.28	136	135	<1.0	184	0.13		145
MW15-05WB	MW15-05WB	primary	07-Oct-2017	Maxxam	B789159	SE4579		7.56	162	7.60	128	2.32		297	8.14	138	152	<1.0	142	1.44		147
MW15-05WB	MW15-05WB	primary	21-Apr-2018	Maxxam	B830272	TH8283		7.39	309	4.2	34	3.7		298	8.16	137	139	1.3	160	0.29		146
MW15-05WB	MW15-05WB	primary	09-Jun-2018	Maxxam	B846878	TQ2233		7.76	295	13	51	6.5		296	8.09	140	140	<1.0	186	0.14		246
MW15-05WB	MW15-05WB	primary	04-Aug-2018	Maxxam	B866687	UA8357		7.60	287		27	4.8		294	8.02	136	132	<1.0	182	0.31		147
MW15-05WB	MW15-05WB	primary	06-Oct-2018	Maxxam	B888703	UN2795		7.52	291	11.03	56	2.1		293	7.77	133	135	<1.1	168	0.12		143
MW15-05WB	MW15-05WB	primary	30-Apr-2019	Maxxam	B932398	VP4746								294	7.78	132	133	<1.0	162	0.24		149
MW15-05WB	MW15-05WB	primary	19-Jun-2019	Maxxam	B950398	VY8202		7.62	296	8.14	59	11.75		284	7.86	129	130	<1.0	170	0.22		148
MW15-05WB	MW15-05WB	primary	23-Aug-2019	Maxxam	B971044	WJ2828		8.10	260	6.09	196	8.1		296	7.97	129	132	<1.0	194	0.41		149
MW15-06WB	MW15-06WB	primary	21-Jun-2015	Maxxam	B553846	MN4271		7.21	456	5.69	18	6.56		425	8.03	175	195	15.8	306	25.1		164
MW15-06WB	MW15-06WB	primary	21-Jul-2015	Maxxam	B562572	MS4335		8.00	607	9.16	-50	4.6		608	7.97	288	299	4.6	330	6.95		224
MW15-06WB	MW15-06WB	primary	09-Aug-2015	Maxxam	B569424	MW5118		7.71	601	6.67	-26	7.66		636	8.01	335	317	3.7	416	3.21		241
MW15-06WB	MW15-06WB	primary	08-Sep-2015	Maxxam	B579224	NC4790		7.68	671	6.09	-8.7	4.85		662	8.15	329	370	2.3	382	3.15		258
MW15-06WB	MW15-06WB	primary	17-May-2016	Maxxam / ALS	B638880 / L1770639	OQ9458 / L1770639-4		8.04	514	8.06	163	5.1		534	8.4	270	270	1	296	1.1		222
MW15-06WB	MW15-06WB	primary	18-Jul-2016	Maxxam / ALS	B659949 / L1802108	PB7362 / L1802108-3		8.05	524	6.83	69	12.80		540	8.34	276	275	1.5	308	0.93		209
MW15-06WB	MW15-06WB	primary	26-Sep-2016	Maxxam / ALS	B685473 / L1836619	PQ2533 / L1836619-5		8.16	485	2.74	-46	2.6		502	8.29	245	247	1.2	312	1.78		201
MW15-06WB	MW15-06WB	primary	24-Apr-2017	Maxxam	B731280	QY4062		7.94	474	3.93	-97	3.6		510	8.45	255	259	3.6	274	1.07		209
MW15-06WB	MW15-06WB	primary	12-Jun-2017	Maxxam	B747325	RH1792		8.15	543	10.34	-53	3.99		531	8.45	271	266	1.4	326	1.46		213
MW15-06WB	MW15-06WB	primary	29-Jul-2017	Maxxam	B764119	RQ2608		7.72	561	9.23		3.94		546	8.36	286	273	1.5	346	1.45		218
MW15-06WB	MW15-06WB	primary	09-Oct-2017	Maxxam	B789159	SE4584		7.80	523		81	2.65		563	8.31	310	301	5.4	322	2.34		225
MW15-06WB	MW15-06WB	primary	22-Apr-2018	Maxxam	B830272	TH8284		7.95	579	4.4	-144			564	8.31	295	306	4.8	280	2.76		223
MW15-06WB	MW15-06WB	primary	10-Jun-2018	Maxxam	B846878	TQ2234		7.72	552	10.6	-29	4.9		561	8.22	284	288	3	348	1.39		214
MW15-06WB	MW15-06WB	primary	03-Aug-2018	Maxxam	B865713	UA2957		8.08	531	2.2	-122	15		565	8.31	285	274	5.6	332	2.85		214
MW15-06WB	MW15-06WB	primary	07-Oct-2018	Maxxam	B888703	UN2794		8.00	541	4.91	-115	3		565	7.99	294	282	4.9	326	2.2		219
MW15-06WB	MW15-06WB	primary	02-May-2019	Maxxam	B934035	VQ2632		7.20	762	5.45	246	1.48		591	8.07	286	301	9.6	356	6.57		257
MW15-06WB	MW15-06WB	primary	20-Jun-2019	Maxxam	B950398	VY8199		7.49	605	8.68	-8.5	10.91		559	7.96	294	288	2.8	372	2.32		225
MW15-06WB	MW15-06WB	primary	25-Aug-2019	Maxxam	B971044	WJ2829		7.69	598	9.08	-64	3.8		584	8.18	290	294	3.2	368	3.1		235
MW16-01WB	MW16-01WB	primary	04-Oct-2016	Maxxam / ALS	B688097 / L1840208	PS0716 / L1840208-1		7.38	187	4.93	9	1.2		185	7.57	69.9	72.4	6	130	19.9		78.6
MW16-01WB	MW16-01WB	primary	20-Apr-2017	Maxxam	B730366	QX9673								188	7.57	77	76.5	9.7	114	42.7		81.4
MW16-01WB	MW16-01WB	primary	09-Jun-2017	Maxxam	B746341	RG5998		5.94	147	9.5	24	7.6		190	8.06	75.7	79.9	11.3	118	77.8		82.6
MW16-01WB	MW16-01WB	primary	26-Jul-2017	Maxxam	B763678	RQ0447		6.57	159	12.12	-29	6.26		183	7.93	74.7	75.8	12.4	120	74.1		82.1
MW16-01WB	JH41-05	duplicate	27-Jul-2017	Maxxam	B763678	RQ0448								182	7.97	75.9	75.1	12.2	116	92.9		82.5
MW16-01WB	MW16-01WB	primary	06-Oct-2017	Maxxam	B788595	SE1630		7.02	190	12.54	-46	2.0		183	7.78	81.8	73	8.3	126	55.5		81.6
MW16-01WB	MW16-01WB	primary	20-Apr-2018	Maxxam	B830002	TH7284		6.58	247	4.9	1.4			185	7.64	78.2	77.4	9.8	114	25.7		74.3
MW16-01WB	MW16-01WB	primary	08-Jun-2018	Maxxam	B845895	TP7512		6.97	205	17.3	23	11.7		186	7.41	73.4	71.1	11.8	132	38.8		80.8
MW16-01WB	MW16-01WB	primary	02-Aug-2018	Maxxam	B865713	UA2956		6.38	197	6.2	-18	4.3		181	7.74	73	71.3	12.4	108	87.8		77
MW16-01WB	MW16-01WB	primary	04-Oct-2018	Maxxam	B888292	UN0553		7.33	196	11.9	-38	1.6		179	7.35	70.8	70.8	7.9	106	41.6		77.5
MW16-01WB	MW16-01WB	primary	01-May-2019	Maxxam	B934027	VQ2551		6.42	196	11.75	59	5.54		177	7.51	68.5	67	9.7	112	56.3		76.5
MW16-01WB	MW16-01WB	primary	17-Jun-2019	Maxxam	B948843	VY0457		6.95	140	11.6	-91	9.3		180	7.35	73	68	13	132	64.9		75.8
MW16-01WB	MW16-01WB	primary	21-Aug-2019	Maxxam	B970851	WJ1604								178	7.09	68	71.4	10	96	70		78.7
	F-BLANK-1	field blank	28-Sep-2014	ALS	L1525019	L1525019-3								<2	5.57	<0.5		<3	<20	<0.1		<1

Station	Sample ID	Sample Class	Sample Date	Analytical Laboratory	Lab Job ID	Lab Sample ID	Field Paramaters	pH (field)	Specific Conductance (field)	DO (field)	ORP (field)	Temperature (field)	Physical Properties	Conductivity (lab)	pH (lab)	Total Hardness (CaCO3)	Dissolved Hardness (CaCO3)	Total Suspended Solids	Total Dissolved Solids	Turbidity	Inorganics	Alkalinity (Total as CaCO3)
								pH	uS/cm	mg/L	ORP mV	°C		uS/cm	pH	mg/L	mg/L	mg/L	mg/L	NTU		mg/L
Maxxam RDL[1]:														1	-	0.5	0.5	1	10	0.1		0.5
ALS RDL[1]:														2	-	0.5	-	3	20	-		1
	FB-23/06/15	field blank	23-Jun-2015	Maxxam	B553846	MN4273								1.2	6.15	<0.50	<0.50	<1.0	<10	<0.10		0.71
	FB-2	field blank	18-Jul-2015	Maxxam	B562572	MS4334								1.2	5.75	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	FB-3	field blank	12-Aug-2015	Maxxam	B569424	MW5163								1	5.44	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	FB-4	field blank	08-Sep-2015	Maxxam	B579224	NC4791								1.1	5.08	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	FB-007	field blank	16-May-2016	Maxxam / ALS	B638880 / L1770639	OQ9456 / L1770639-2								1.3	6.04	<0.50	<0.50	<1.0	<10	<0.10		0.53
	FB-008	field blank	15-Jul-2016	Maxxam / ALS	B658689 / L1799815	PB1631 / L1799815-6								1	5.94	<0.50	<0.50	<1.0	<10	<0.10		0.63
	FB-009	field blank	26-Sep-2016	Maxxam / ALS	B685473 / L1836619	PQ2410 / L1836619-1								1	5.63	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	FB-010	field blank	25-Apr-2017	Maxxam	B731280	QY4048								<1.0	5.3	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	FB-020	field blank	11-Jun-2017	Maxxam	B747325	RH1796								<1.0	5.42	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	FB-030	field blank	29-Jul-2017	Maxxam	B764119	RQ2609								1.2	5.48	<0.50	<0.50	<1.0	<10	<0.10		0.57
	FB-040	field blank	09-Oct-2017	Maxxam	B789159	SE4585								1.4	5.5	<0.50	<0.50	<1.0	10	<0.10		0.65
	FB-Q1	field blank	22-Apr-2018	Maxxam	B830272	TH8279								<1.0	5.49	<0.50	<0.50	<1.0	<10	<0.10		0.59
	FB-Q2	field blank	10-Jun-2018	Maxxam	B846878	TQ2239								1	4.58	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	FB-Q3	field blank	05-Aug-2018	Maxxam	B866687	UA8358								<1.0	5.2	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	FB-Q4	field blank	07-Oct-2018	Maxxam	B888703	UN2800								<1.0	5.55	<0.50	<0.50	<1.0	<10	<0.10		0.52
	FB-Q1	field blank	01-May-2019	Maxxam	B934027	VQ2550								<1.0	5.02	<0.50	<0.50	<1.1	<10	0.11		<0.50
	FB-Q2	field blank	13-Jun-2019	Maxxam	B946942	VX0058								<1.0	5.39	<0.50	<0.50	<1.0	<10	0.12		0.69
	FB-Q3	field blank	23-Aug-2019	Maxxam	B971044	WJ2837								<1.0	5	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	TRIP BLANK	trip blank	11-Sep-2015	Maxxam	B579224	NC4792								<1.0	5.43	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	TRIP BLANK	trip blank	16-May-2016	Maxxam / ALS	B639291 / L1771766	OR1433 / L1771766-1								1	5.61	<0.50	<0.50	<1.0	<10	<0.10		0.55
	TRIP BLANK	trip blank	20-Jul-2016	Maxxam / ALS	B660160 / L1802110	PB8493 / L1802110-2								1	5.93	<0.50	<0.50	<1.0	<10	<0.10		0.65
	TRIP BLANK	trip blank	29-Sep-2016	Maxxam / ALS	B685473 / L1836619	PQ2534 / L1836619-6								1.1	6.08	<0.50	<0.50	<1.0	<10	<0.10		0.6
	TRIP BLANK	trip blank	26-Apr-2017	Maxxam	B731280	QY4063								1.1	6	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	TRIP BLANK	trip blank	14-Jun-2017	Maxxam	B747325	RH1793								<1.0	5.44	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	TRIP BLANK	trip blank	26-Jul-2017	Maxxam	B762525	RP3707								1	5.91	<0.50	<0.50	<1.0	<10	<0.10		0.78
	TRIP BLANK	trip blank	11-Oct-2017	Maxxam	B789159	SE4586								<1.0	5.56	<0.50	<0.50	<1.0	<10	<0.10		0.61
	TRIP BLANK	trip blank	23-Apr-2018	Maxxam	B830002	TH7285								1.1	4.51	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	TRIP BLANK	trip blank	10-Jun-2018	Maxxam	B846878	TQ2240								1.1	4.63	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	TRIP BLANK	trip blank	09-Aug-2018	Maxxam	B866687	UA8359								1	5.23	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	TRIP BLANK	trip blank	11-Oct-2018	Maxxam	B888703	UN2779								1.4	5.32	<0.50	<0.50	<1.0	<10	<0.10		<0.50
	TB-Q1	trip blank	02-May-2019	Maxxam	B934035	VQ2633								<1.0	5.68	<0.50	<0.50	<1.0	<10	0.15		0.81
	TRIP BLANK	trip blank	13-Jun-2019	Maxxam	B946942	VX0059								1.2	5.73	<0.50	<0.50	<1.0	<10	<0.10		0.92
	TRIP BLANK	trip blank	23-Aug-2019	Maxxam	B971044	WJ2838								<1.0	5.03	<0.50	<0.50	<1.0	<10	<0.10		<0.50

Notes:
Samples and sample data with RED text are not considered to be representative of formation water (See Appendix 5-D for further discussion).

1. Reportable detection limits (RDL) presented are the lowest detection limit for a given parameter. Note that the detection limit may have been raised by the analytical laboratory for some analytical results (e.g., due to matrix interference). See Table 3-8 in the main report for further details regarding reportable detection limits between 2014 and 2019.

2. Duplicate sample JH42-08 (Lab ID: UN0655) was collected on 04-Oct-2018 and not 05-Oct-2018 (dummy date for blind duplicate sampling) as indicated in the laboratory Certificate of Analysis.

Station	Sample ID	Sample Class	Sample Date	Alkalinity (PP as CaCO3)	Bicarbonate (HCO3)	Carbonate (CO3)	Hydroxide (OH)	Bromide (Br)	Fluoride (F)	Dissolved Chloride (Cl)	Organic / Inorganic Carbon	Dissolved Organic Carbon (C)	Total Organic Carbon (C)	Anions and Nutrients	Total Phosphorus (P)	Dissolved Phosphorus (P)	Orthophosphate	Total Ammonia (N)	Total Total Kjeldahl Nitrogen (Calc)	Nitrate plus Nitrite (N)	Nitrate (N)	Nitrite (N)	Total Nitrogen (N)	Dissolved Nitrogen (N)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Maxxam RDL[1]:				0.5	0.5	0.5	0.5	0.01	0.01	0.5		0.5	0.5		0.002	0.002	0.003	0.005	0.02	0.002	0.002	0.002	0.02	0.0028
ALS RDL[1]:				-	-	-	-	-	0.02	0.5		0.5	0.5		0.002	0.002		0.005	0.05	-	0.005	0.001	0.05	0.05
MW14-02A	MW14-02A	primary	28-Sep-2014						0.093	<0.5		0.55	0.55		0.005	0.0075		0.0673	0.213		0.155	<0.001	0.379	0.346
MW14-02A	MW14-02A	primary	12-Jun-2015	<0.50	183	<0.50	<0.50		0.088	0.7		0.83	1.48		0.0183	0.0138		0.0052	0.06	0.138	0.138	<0.0020	0.198	
MW14-02A	MW14-02A	primary	16-Jul-2015	<0.50	183	<0.50	<0.50		0.091	<0.50		1.28	1.64		0.0184	0.0175		0.011	<0.050	0.166	0.166	<0.0020	0.166	
MW14-02A	MW14-02A	primary	06-Aug-2015	<0.50	180	<0.50	<0.50		0.089	<0.50		<0.50	<0.50		0.0197	0.0187		<0.0050	<0.020	0.16	0.16	<0.0020	0.152	
MW14-02A	MW14-02A	primary	04-Sep-2015	<0.50	177	<0.50	<0.50		0.09	0.56		0.63	0.64		0.0192	0.0159		0.015	<0.020	0.16	0.16	<0.0020	0.159	
MW14-02A	MW14-100	duplicate	04-Sep-2015	<0.50	177	<0.50	<0.50		0.091	<0.50		0.59	0.51		0.0157	0.0192		0.021	0.18	0.113	0.161	<0.0020	0.293	
MW14-02A	MW14-02A	primary	13-May-2016	<0.50	203	<0.50	<0.50	<0.010	0.088	0.82		2.48	1.56		0.0282	0.0194		0.014	0.376	0.146	0.146	<0.0020	0.522	0.289
MW14-02A	MW14-02A	primary	17-Jul-2016	<0.50	176	<0.50	<0.50	<0.010	0.099	<0.50		<0.50	0.59		0.0173	0.0198		0.01	<0.020	0.171	0.171	<0.0020	0.166	0.173
MW14-02A	JH40-05	duplicate	25-Sep-2016	<0.50	175	<0.50	<0.50	<0.010	0.088	0.65		<0.50	0.76		0.0192	0.0192		<0.0050	<0.020	0.167	0.167	<0.0020	0.161	0.168
MW14-02A	MW14-02A	primary	25-Sep-2016	<0.50	175	<0.50	<0.50	<0.010	0.085	0.59		<0.50	<0.50		0.0184	0.0195		0.0098	0.043	0.162	0.162	<0.0020	0.206	0.169
MW14-02A	MW14-02A	primary	21-Apr-2017	<0.50	186	<0.50	<0.50	<0.010	0.095	0.53		0.86	<0.50		0.0231	0.0217		0.014	0.057	0.156	0.156	<0.0020	0.213	0.205
MW14-02A	JH41-03	duplicate	08-Jun-2017	1.58	174	1.9	<0.50	<0.010	0.091	<0.50		<0.50	0.53		0.0284	0.0234		0.017	0.034	0.159	0.159	<0.0020	0.192	0.22
MW14-02A	MW14-02A	primary	08-Jun-2017	0.94	176	1.13	<0.50	<0.010	0.091	<0.50		<0.50	<0.50		0.0268	0.0214		<0.0050	0.055	0.152	0.152	<0.0020	0.207	0.212
MW14-02A	MW14-02A	primary	28-Jul-2017	1.55	174	1.86	<0.50	<0.010	0.088	0.93		26	18		0.0241	0.0198		<0.0050	0.048	0.169	0.169	<0.0020	0.216	0.204
MW14-02A	MW14-02A	primary	05-Oct-2017	<0.50	175	<0.50	<0.50	<0.010	0.088	<0.50		<0.50	0.59		0.0166	0.0163		<0.0050	<0.020	0.169	0.169	<0.0020	0.185	0.187
MW14-02A	MW14-02A	primary	19-Apr-2018	<0.50	170	<0.50	<0.50	0.013	0.1	<0.50		<0.50	<0.50		0.0164	0.0193		0.027	<0.020	0.17	0.174	<0.0020	0.168	0.179
MW14-02A	MW14-02A	primary	07-Jun-2018	<0.50	180	<0.50	<0.50	<0.010	0.1	<0.50		<0.50	<0.50		0.0082	0.0071		0.013	0.369	0.17	0.169	<0.0020	0.538	0.24
MW14-02A	MW14-02A	primary	02-Aug-2018	<0.50	173	<0.50	<0.50	<0.010	0.099	<0.50		<0.50	<0.50		0.106	0.0189	0.02	0.016	0.02	0.18	0.176	<0.0020	0.196	0.234
MW14-02A	JH42-06	duplicate	02-Aug-2018	<0.50	172	<0.50	<0.50	<0.010	0.095	<0.50		0.79	<0.50		0.0186	0.0148	0.022	0.011	0.057	0.18	0.176	<0.0020	0.232	0.201
MW14-02A	MW14-02A	primary	04-Oct-2018	<0.50	174	<0.50	<0.50	<0.010	0.095	<0.50		<0.50	<0.50		0.0161	0.0179	0.0203	<0.0050	<0.020	0.17	0.165	<0.0020	0.179	0.16
MW14-02A	MW14-02A	primary	28-Apr-2019	<0.50	183	<0.50	<0.50	<0.010	0.098	<0.50		1.5	1.5		0.012	0.0081	0.012	<0.0050	<0.050	0.184	0.184	<0.0020	0.18	0.18
MW14-02A	BD1-Q1	duplicate	28-Apr-2019	<0.50	175	<0.50	<0.50	<0.010	0.097	<0.50		0.58	0.53		0.011	0.009	0.0094	0.013	<0.050	0.181	0.181	<0.0020	0.18	0.18
MW14-02A	MW14-02A	primary	13-Jun-2019	<0.50	171	<0.50	<0.50	<0.010	0.099	<0.50		<0.50	<0.50		0.012	0.013	0.006	0.012	0.04	0.166	0.166	<0.0020	0.206	0.233
MW14-02A	MW14-02A	primary	22-Aug-2019	<0.50	174	<0.50	<0.50	<0.010	0.097	0.54		0.61	<0.50		0.0087	0.0089		0.053	0.065	0.178	0.176	0.002	0.243	0.262
MW14-02A	BD2-Q3	duplicate	22-Aug-2019	<0.50	176	<0.50	<0.50	<0.010	0.096	0.65		<0.50	<0.50		0.0095	0.0083		0.049	0.086	0.175	0.175	<0.0020	0.261	0.232
MW14-02B	MW14-02B	primary	28-Sep-2014						0.102	<0.5		1.63	1.56		<0.002	0.0033		<0.005	0.142		0.0138	0.0015	0.155	0.163
MW14-02B	F-DUP-1	duplicate	28-Sep-2014						0.102	<0.5		1.37	1.48		0.0025	0.0028		<0.005	0.145		0.0164	0.002	0.156	0.155
MW14-02B	MW14-02B	primary	12-Jun-2015	<0.50	231	<0.50	<0.50		0.1	<0.50		0.87	0.77		0.0095	0.0092		0.0094	0.053	0.107	0.107	<0.0020	0.16	
MW14-02B	MW14-02B	primary	16-Jul-2015	<0.50	232	<0.50	<0.50		0.11	<0.50		0.99	1.76		0.0129	0.0066		0.0067	0.099	0.1	0.0981	0.0022	0.199	
MW14-02B	MW14-02B	primary	06-Aug-2015	<0.50	233	<0.50	<0.50		0.11	<0.50		<0.50	0.84		0.0147	0.0112		0.006	0.025	0.109	0.109	<0.0020	0.134	
MW14-02B	MW14-02B	primary	04-Sep-2015	<0.50	224	<0.50	<0.50		0.11	0.65		0.62	0.83		0.0136	0.0114		0.02	0.425	0.108	0.135	<0.0020	0.532	
MW14-02B	JH40-01	duplicate	13-May-2016	<0.50	234	<0.50	<0.50	<0.010	0.1	0.6		0.61	<0.50		0.0228	0.0234		0.019	0.03	0.14	0.14	<0.0020	0.17	0.18
MW14-02B	MW14-02B	primary	13-May-2016	<0.50	256	<0.50	<0.50	<0.010	0.1	<0.50		0.63	0.71		0.0196	0.02		0.013	0.074	0.139	0.139	<0.0020	0.213	0.203
MW14-02B	MW14-02B	primary	17-Jul-2016	<0.50	223	<0.50	<0.50	<0.010	0.11	0.71		<0.50	0.59		0.0191	0.0163		0.019	<0.020	0.152	0.15	0.0020	0.172	0.181
MW14-02B	MW14-02B	primary	25-Sep-2016	<0.50	221	<0.50	<0.50	<0.10	0.1	<1.0		<0.50	0.75		0.0137	0.0151		0.0074	0.05	0.153	0.153	<0.0020	0.165	0.219
MW14-02B	JH41-01	duplicate	21-Apr-2017	1.02	222	1.22	<0.50	<0.010	0.11	0.61		<0.50	<0.50		0.0248	0.0208		0.023	0.048	0.146	0.146	<0.0020	0.194	0.194
MW14-02B	MW14-02B	primary	21-Apr-2017	<0.50	228	<0.50	<0.50	<0.010	0.11	0.58		<0.50	<0.50		0.0219	0.0213		0.022	0.047	0.145	0.145	<0.0020	0.192	0.187
MW14-02B	MW14-02B	primary	08-Jun-2017	3.25	217	3.9	<0.50	<0.010	0.11	<0.50		0.77	<0.50		0.021	0.0247		<0.0050	0.059	0.138	0.138	<0.0020	0.197	0.195
MW14-02B	JH41-06	duplicate	28-Jul-2017	2.37	216	2.84	<0.50	<0.010	0.1	<0.50		2.3	1		0.0185	0.0161		<0.0050	0.055	0.154	0.154	<0.0020	0.209	0.205
MW14-02B	MW14-02B	primary	28-Jul-2017	1.89	218	2.27	<0.50	<0.010	0.1	<0.50		1	0.84		0.0221	0.0157		0.0099	0.059	0.153	0.153	<0.0020	0.211	0.197
MW14-02B	MW14-02B	primary	05-Oct-2017	<0.50	221	<0.50	<0.50	0.018	0.1	<0.50		<0.50	<0.50		0.012	0.0095		<0.0050	<0.020	0.155	0.153	0.0020	0.168	0.18
MW14-02B	JH42-02	duplicate	19-Apr-2018	<0.50	214	<0.50	<0.50	0.02	0.12	<0.50		0.89	0.58		0.0119	0.0133		0.021	0.032	0.15	0.149	<0.0020	0.18	0.175
MW14-02B	MW14-02B	primary	19-Apr-2018	<0.50	216	<0.50	<0.50	0.017	0.11	0.53		<0.50	<0.50		0.0121	0.014		0.015	<0.020	0.15	0.154	<0.0020	0.158	0.176
MW14-02B	MW14-02B	primary	07-Jun-2018	<0.50	223	<0.50	<0.50	0.014	0.11	0.56		<0.50	1.3		0.029	0.02		0.025	0.218	0.15	0.15	0.0029	0.371	0.245
MW14-02B	MW14-02B	primary	02-Aug-2018	<0.50	215	<0.50	<0.50	<0.010	0.11	<0.50		0.9	<0.50		0.0284	0.0108	0.013	0.021	0.042	0.15	0.153	<0.0020	0.195	0.192
MW14-02B	MW14-02B	primary	04-Oct-2018	<0.50	219	<0.50	<0.50	0.011	0.11	<0.50		<0.50	<0.50		0.0129	0.0114	0.0166	<0.0050	<0.020	0.14	0.143	<0.0020	0.16	0.149
MW14-02B	JH42-08	duplicate	05-Oct-2018	<0.50	222	<0.50	<0.50	0.015	0.11	2.7		<0.50	0.86		0.0142	0.0118	0.0126	<0.0050	<0.020	0.15	0.148	<0.0020	0.145	0.34
MW14-02B	MW14-02B	primary	28-Apr-2019	<0.50	221	<0.50	<0.50	<0.010	0.11	<0.50		0.79	1.2		0.0072	0.0037	0.008	0.011	<0.050	0.157	0.157	<0.0020	0.16	0.16
MW14-02B	MW14-02B	primary	13-Jun-2019	<0.50	215	<0.50	<0.50	<0.010	0.11	<0.50		<0.50	<0.50		0.0078	0.012	0.0126	<0.0050	0.034	0.141	0.141	<0.0020	0.175	0.204
MW14-02B	BD1-Q2	duplicate	13-Jun-2019	<0.50	214	<0.50	<0.50	0.014	0.11	1.5		<0.50	<0.50		0.0084	0.0094	0.0119	0.0057	0.066	0.14	0.14	<0.0020	0.206	0.22
MW14-02B	MW14-02B	primary	22-Aug-2019	<0.50	218	<0.50	<0.50	<0.010	0.11	0.62		0.59	<0.50		0.0063	0.0068		0.058	0.063	0.152	0.152	<0.0020	0.215	0.226
MW14-03A	MW14-03A	primary	12-Oct-2014						0.232	8.17		79.1	216		0.721	0.437		0.82	37.7		<0.005	0.0053	37.9	6.66
MW14-03A	MW14-03A	primary	22-Jun-2015	<0.50	582	<0.50	<0.50		0.2	1.6		4.8	6.08		0.0547	0.0404		0.02	0.75	0.0035	<0.0020	0.0022	0.753	
MW14-03A	MW14-03A	primary	12-Jul-2015	<0.50	570	<0.50	<0.50		0.19	1.3		7.48	9.01		0.0887	0.0697		0.021	0.46	0.0031	0.0031	<0.0020	0.46	
MW14-03A	MW14-03A	primary	07-Aug-2015	<0.50	592	<0.50	<0.50		0.2	1.2		3.7	4.3		0.0817	0.0714		0.012	0.282	<0.0020	<0.0020	<0.0020	0.282	
MW14-03A	MW14-50	duplicate	07-Aug-2015	<0.50	590	<0.50	<0.50		0.2	1		4.1	3.6		0.0808	0.0714		0.014	0.254	<0.0020	<0.0020	<0.0020	0.254	
MW14-03A	MW14-03A	primary	06-Sep-2015	<0.50	604	<0.50	<0.50		0.21	1.3		3.5	3.8		0.0884	0.0772		0.022	0.285	<0.0020	<0.0020	<0.0020	0.285	
MW14-03A	MW14-03A	primary	16-May-2016	<0.50	626	<0.50	<0.50	<0.10	0.18	1.2		<0.50	1.22		0.0759	0.066		0.083	0.2	<0.0020	<0.0020	<0.0020	0.2	0.212
MW14-03A	MW14-03A	primary	14-Jul-2016	<0.50	611	<0.50	<0.50	<0.10	0.18	0.95		1.06	0.63		0.0696	0.0648		0.069	0.169	<0.0020	<0.0020	<0.0020	0.169	0.148

Station	Sample ID	Sample Class	Sample Date	Alkalinity (PP as CaCO3)	Bicarbonate (HCO3)	Carbonate (CO3)	Hydroxide (OH)	Bromide (Br)	Fluoride (F)	Dissolved Chloride (Cl)	Organic / Inorganic Carbon	Dissolved Organic Carbon (C)	Total Organic Carbon (C)	Anions and Nutrients	Total Phosphorus (P)	Dissolved Phosphorus (P)	Orthophosphate	Total Ammonia (N)	Total Total Kjeldahl Nitrogen (Calc)	Nitrate plus Nitrite (N)	Nitrate (N)	Nitrite (N)	Total Nitrogen (N)	Dissolved Nitrogen (N)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Maxxam RDL[1]:				0.5	0.5	0.5	0.5	0.01	0.01	0.5		0.5	0.5		0.002	0.002	0.003	0.005	0.02	0.002	0.002	0.002	0.02	0.0028
ALS RDL[1]:				-	-	-	-	-	0.02	0.5		0.5	0.5		0.002	0.002		0.005	0.05	-	0.005	0.001	0.05	0.05
MW14-03A	MW14-03A	primary	24-Sep-2016	<0.50	578	<0.50	<0.50	<0.10	0.17	<1.0		0.62	0.77		0.059	0.0553		0.067	0.151	<0.0020	<0.0020	<0.0020	0.129	0.187
MW14-03A	MW14-03A	primary	27-Apr-2017	<0.50	585	<0.50	<0.50	<0.050	0.18	1.7		<0.50	<0.50		0.0537	0.0488		0.1	0.191	0.0056	0.0056	<0.0020	0.196	0.145
MW14-03A	MW14-03A	primary	09-Jun-2017	2.25	561	2.7	<0.50	<0.10	0.17	0.55		0.58	<0.50		0.0523	0.0527		0.076	0.125	<0.0020	<0.0020	<0.0020	0.125	0.131
MW14-03A	MW14-03A	primary	26-Jul-2017	<0.50	587	<0.50	<0.50	<0.050	0.17	0.66		0.58	0.96		0.0528	0.0501		0.085	0.15	<0.0020	<0.0020	<0.0020	0.15	0.112
MW14-03A	JH41-08	duplicate	06-Oct-2017	<0.50	588	<0.50	<0.50	<0.10	0.16	0.87		<0.50	<0.50		0.0502	0.0269		0.044	0.106	<0.0020	<0.0020	<0.0020	0.106	0.098
MW14-03A	MW14-03A	primary	06-Oct-2017	<0.50	589	<0.50	<0.50	<0.10	0.16	0.91		0.99	0.94		0.0492	0.0451		0.043	0.121	<0.0020	<0.0020	<0.0020	0.121	0.13
MW14-03A	MW14-03A	primary	20-Apr-2018	<0.50	573	<0.50	<0.50	0.14	0.18	1		<0.50	1.22		0.0381	0.0465		0.1	0.164	<0.0020	<0.0020	0.0020	0.164	0.122
MW14-03A	MW14-03A	primary	08-Jun-2018	<0.50	590	<0.50	<0.50	0.12	0.18	0.86		<0.50	4.03		0.03	0.02		0.12	0.088	0.01	0.0104	<0.0020	0.098	0.113
MW14-03A	MW14-03A	primary	05-Aug-2018	<0.50	591	<0.50	<0.50	0.1	0.18	0.7		0.6	0.82				<0.0050	0.43		<0.0020	<0.0020	<0.0020		
MW14-03A	MW14-03A	primary	07-Oct-2018	<0.50	578	<0.50	<0.50	0.093	0.18	1.1		<0.50	<0.50		0.0513	0.0397	<0.0050	0.071	0.141	<0.0020	<0.0020	<0.0020	0.141	0.062
MW14-03A	MW14-03A	primary	27-Apr-2019	<0.50	601	<0.50	<0.50	0.12	0.18	0.72		1.6	1.7		0.035	0.019	0.0036	0.098	0.35	<0.0020	<0.0020	<0.0020	0.35	0.3
MW14-03A	MW14-03A	primary	14-Jun-2019	<0.50	585	<0.50	<0.50	0.11	0.17	0.52		0.57	0.9		0.025	0.025	<0.0050	0.074	0.222	0.0038	0.0038	<0.0020	0.226	0.079
MW14-03A	MW14-03A	primary	23-Aug-2019	<0.50	604	<0.50	<0.50	0.099	0.18	1.5		2.5	2.8		0.028	0.032	0.021	0.16	0.988	<0.0020	<0.0020	<0.0020	0.988	0.617
MW14-03B	MW14-03B	primary	06-Oct-2014						<0.2	<5		18.8	32.6		0.0119	0.0124		0.255	4.1		<0.05	<0.01	4.46	1.7
MW14-03B	MW14-03B	primary	22-Jun-2015	<0.50	706	<0.50	<0.50		0.3	2.3		4.77	4.77		0.0368	0.0271		0.033	0.56	<0.0020	<0.0020	<0.0020	0.556	
MW14-03B	MW14-03B	primary	12-Jul-2015	<0.50	629	<0.50	<0.50		0.26	1.8		3.93	5.06		0.045	0.0336		0.043	0.3	0.0045	0.0045	<0.0020	0.303	
MW14-03B	MW14-03B	primary	07-Aug-2015	<0.50	650	<0.50	<0.50		0.27	1.8		2.4	1.8		0.0349	0.0297		0.024	0.343	0.0021	0.0021	<0.0020	0.345	
MW14-03B	MW14-03B	primary	06-Sep-2015	<0.50	646	<0.50	<0.50		0.26	1.6		2.5	1.9		0.031	0.0282		0.076	0.259	0.0048	0.0048	<0.0020	0.264	
MW14-03B	MW14-200	duplicate	06-Sep-2015	<0.50	657	<0.50	<0.50		0.26	2		2	1.9		0.0316	0.0277		0.051	0.159	0.0021	0.0035	<0.0020	0.161	
MW14-03B	MW14-03B	primary	16-May-2016	<0.50	676	<0.50	<0.50	<0.10	0.26	1.6		1.88	1.28		0.0273	<0.0050		0.031	0.136	<0.0020	<0.0020	<0.0020	0.136	0.149
MW14-03B	MW14-03B	primary	14-Jul-2016	<0.50	668	<0.50	<0.50	<0.10	0.27	1.8		1.5	1.5		0.0265	0.024		0.049	0.13	<0.0020	<0.0020	0.0047	0.130	0.288
MW14-03B	MW14-03B	primary	24-Sep-2016	<0.50	627	<0.50	<0.50	<0.10	0.25	<1.0		0.73	1.62		0.0217	0.0184		0.057	0.143	<0.0020	<0.0020	<0.0020	0.143	0.132
MW14-03B	MW14-03B	primary	27-Apr-2017	<0.50	648	<0.50	<0.50	<0.050	0.26	2		1.5	2.24		0.0263	0.0199		0.087	0.258	<0.0020	<0.0020	<0.0020	0.258	0.292
MW14-03B	MW14-03B	primary	09-Jun-2017	5.26	628	6.31	<0.50	<0.10	0.26	1		1.38	1.46		0.024	0.0292		0.086	0.25	<0.0020	<0.0020	0.0021	0.25	0.242
MW14-03B	MW14-03B	primary	26-Jul-2017	6	644	7.2	<0.50	<0.050	0.26	0.89		1.6	1.6		0.0283	0.0235		0.082	0.197	<0.0020	<0.0020	<0.0020	0.197	0.21
MW14-03B	MW14-03B	primary	06-Oct-2017	<0.50	676	<0.50	<0.50	<0.10	0.25	1.3		1.36	1.14		0.0226	0.0183		0.038	0.155	<0.0020	<0.0020	<0.0020	0.155	0.132
MW14-03B	MW14-03B	primary	20-Apr-2018	<0.50	657	<0.50	<0.50	0.15	0.25	1.1		1.21	0.76		0.0225	0.0223		0.15	0.172	<0.0020	<0.0020	<0.0020	0.172	0.15
MW14-03B	MW14-03B	primary	08-Jun-2018	<0.50	690	<0.50	<0.50	0.13	0.26	1.4		1.15	2.18		0.015	0.011		0.2	0.957	<0.0020	<0.0020	<0.0020	0.957	<0.20
MW14-03B	MW14-03B	primary	05-Aug-2018	<0.50	686	<0.50	<0.50	0.12	0.26	0.9		1.13	1.4				<0.0050	0.29		0.00	0.0038	<0.0020		
MW14-03B	MW14-03B	primary	07-Oct-2018	<0.50	639	<0.50	<0.50	0.099	0.25	0.97		<0.50	<0.50		0.0118	0.0132	0.0064	0.034	0.094	<0.0020	<0.0020	<0.0020	0.094	0.083
MW14-03B	MW14-03B	primary	27-Apr-2019	<0.50	702	<0.50	<0.50	0.12	0.26	0.75		<0.50	2		0.013	<0.0030	0.004	0.05	0.065	<0.0020	<0.0020	<0.0020	0.065	<0.0028
MW14-03B	MW14-03B	primary	14-Jun-2019	<0.50	684	<0.50	<0.50	0.14	0.26	0.61		0.75	0.76		0.015	0.011	<0.0050	0.059	0.096	0.0029	0.0029	<0.0020	0.099	0.153
MW14-03B	MW14-03B	primary	23-Aug-2019	<0.50	699	<0.50	<0.50	0.11	0.25	0.88		0.8	0.83		0.01	0.012	<0.0030	0.1	0.195	<0.0020	<0.0020	<0.0020	0.195	0.156
MW14-05A	MW14-05A	primary	02-Oct-2014						0.163	1.2		17	26.5		0.178	0.111		0.0194	2.06		<0.005	<0.001	2.17	0.63
MW14-05A	MW14-05A	primary	23-Jun-2015	<0.50	189	<0.50	<0.50		0.22	0.87		4.39	4.34		0.717	0.653		0.013	0.39	0.0025	<0.0020	0.0021	0.397	
MW14-05A	MW14-05A	primary	13-Jul-2015	<0.50	200	<0.50	<0.50		0.21	1.1		6.04	6.34		0.697	0.669		0.011	0.44	0.0047	0.0023	0.0024	0.446	
MW14-05A	MW14-05A	primary	08-Aug-2015	<0.50	222	<0.50	<0.50		0.23	1.3		5.6	4.9		0.64	0.622		0.0078	0.538	<0.0020	<0.0020	0.0021	0.538	
MW14-05A	MW14-05A	primary	07-Sep-2015	<0.50	204	<0.50	<0.50		0.21	1.2		4.5	4.3		0.754	0.738		0.1	0.321	0.0059	<0.0020	0.004	0.327	
MW14-05A	MW14-05A	primary	14-May-2016	<0.50	261	<0.50	<0.50	<0.010	0.24	1.3		7.75	7.52		0.807	0.738		0.012	0.369	<0.0020	<0.0020	<0.0020	0.369	0.247
MW14-05A	JH40-04	duplicate	16-Jul-2016	<0.50	214	<0.50	<0.50	<0.010	0.22	1.3		3.26	3.19		0.857	0.0505		0.022	0.201	<0.0020	<0.0020	0.0050	0.201	0.157
MW14-05A	MW14-05A	primary	16-Jul-2016	<0.50	217	<0.50	<0.50	<0.010	0.23	1.5		3	3.51		0.841	0.838		0.013	0.201	<0.0020	<0.0020	0.0089	0.201	0.164
MW14-05A	MW14-05A	primary	23-Sep-2016	<0.50	250	<0.50	<0.50	<0.010	0.24	<1.0		9	7.85		0.601	0.584		0.05	0.177	<0.0020	<0.0020	0.0027	0.155	0.59
MW14-05A	MW14-05A	primary	28-Apr-2017	<0.50	263	<0.50	<0.50	<0.010	0.26	1.6		10.3	11.4		0.634	0.618		0.039	0.246	0.0069	0.0069	<0.0020	0.253	0.152
MW14-05A	MW14-05A	primary	10-Jun-2017	<0.50	221	<0.50	<0.50	<0.010	0.25	0.87		5.78	4.99		0.775	0.766		0.0058	0.2	0.0035	<0.0020	0.0052	0.203	0.153
MW14-05A	MW14-05A	primary	25-Jul-2017	<0.50	236	<0.50	<0.50	<0.010	0.25	0.77		6.2	6.3		0.744	0.754		0.016	0.193	<0.0020	<0.0020	<0.0020	0.193	0.193
MW14-05A	MW14-05A	primary	08-Oct-2017	<0.50	312	<0.50	<0.50	<0.10	0.23	1		9.02	8.76		0.790	0.713		<0.0050	0.212	0.0038	<0.0020	0.0059	0.215	0.139
MW14-05A	MW14-05A	primary	21-Apr-2018	<0.50	256	<0.50	<0.50		0.27	0.56		6.71	6.29		0.735	0.732		0.013	0.144	0.00	0.0041	<0.0020	0.148	0.145
MW14-05A	JH42-04	duplicate	09-Jun-2018	<0.50	237	<0.50	<0.50	<0.010	0.24	0.63		5.36	6.25		0.33	0.33		<0.0050	0.111	0.00	0.0027	<0.0020	0.114	<0.020
MW14-05A	MW14-05A	primary	09-Jun-2018	<0.50	235	<0.50	<0.50	<0.010	0.24	0.69		5.51	7.5		0.34	0.28		0.038	0.112	0.00	0.0026	<0.0020	0.114	0.069
MW14-05A	MW14-05A	primary	04-Aug-2018	<0.50	252	<0.50	<0.50	<0.010	0.24	0.61		4.18	4.27				<0.0050	0.043		0.00	0.0037	<0.0020		
MW14-05A	MW14-05A	primary	06-Oct-2018	<0.50	252	<0.50	<0.50	<0.010	0.25	<0.50		4.9	4.5		1.1	0.9	<0.0050	0.01	0.137	<0.0020	<0.0020	<0.0020	0.137	0.115
MW14-05A	MW14-05A	primary	29-Apr-2019	<0.50	260	<0.50	<0.50	<0.010	0.25	0.54		6.1	6.2		0.61	0.74	0.0034	0.033	0.096	0.0039	0.0039	<0.0020	0.1	0.073
MW14-05A	BD2-Q1	duplicate	29-Apr-2019	<0.50	267	<0.50	<0.50	<0.010	0.24	0.72		5.5	5.2		0.60	0.76	0.0042	0.022	0.094	0.0081	0.0081	<0.0020	0.1	0.09
MW14-05A	MW14-05A	primary	15-Jun-2019	<0.50	251	<0.50	<0.50	<0.010	0.25	1		5.8	5.4		0.54	0.50	<0.0050	0.023	0.08	0.0036	0.0036	<0.0020	0.084	0.076
MW14-05A	MW14-05A	primary	24-Aug-2019	<0.50	261	<0.50	<0.50	<0.010	0.24	0.84		5.6	5.2		0.36	0.12	0.01	0.058	0.127	<0.0020	<0.0020	<0.0020	0.127	0.176
MW14-05B	MW14-05B	primary	03-Oct-2014						0.157	3.35		21.8	34.8		0.125	0.0594		0.0227	2.55		<0.005	<0.001	2.73	0.76
MW14-05B	MW14-05B	primary	24-Jun-2015	<0.50	222	<0.50	<0.50		0.41	4.9		23.7	23.2		0.224	0.144		0.017	0.95	0.003	<0.0020	0.003	0.95	
MW14-05B	MW14-05B	primary	14-Jul-2015	<0.50	234	<0.50	<0.50		0.38	5.9		21.7	24.6		0.208	0.179		0.024	0.44	0.0046	<0.0020	0.0037	0.448	
MW14-05B	MW14-05B	primary	09-Aug-2015	<0.50	239	<0.50	<0.50		0.36	5.9		28	30		0.213	0.197		<0.0050	0.316	0.0024	<0.0020	0.0024	0.318	

Station	Sample ID	Sample Class	Sample Date	Alkalinity (PP as CaCO3)	Bicarbonate (HCO3)	Carbonate (CO3)	Hydroxide (OH)	Bromide (Br)	Fluoride (F)	Dissolved Chloride (Cl)	Organic / Inorganic Carbon	Dissolved Organic Carbon (C)	Total Organic Carbon (C)	Anions and Nutrients	Total Phosphorus (P)	Dissolved Phosphorus (P)	Orthophosphate	Total Ammonia (N)	Total Total Kjeldahl Nitrogen (Calc)	Nitrate plus Nitrite (N)	Nitrate (N)	Nitrite (N)	Total Nitrogen (N)	Dissolved Nitrogen (N)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Maxxam RDL[1]:				0.5	0.5	0.5	0.5	0.01	0.01	0.5		0.5	0.5		0.002	0.002	0.003	0.005	0.02	0.002	0.002	0.002	0.02	0.0028
ALS RDL[1]:				-	-	-	-	-	0.02	0.5		0.5	0.5		0.002	0.002		0.005	0.05	-	0.005	0.001	0.05	0.05
MW14-05B	MW14-05B	primary	08-Sep-2015	<0.50	240	<0.50	<0.50		0.28	3.1		14	15		0.246	0.227		0.016	0.289	<0.0020	<0.0020	<0.0020	0.289	
MW14-05B	MW14-05B	primary	15-May-2016	<0.50	295	<0.50	<0.50	0.013	0.24	2.5		8	7.18		0.242	0.251		0.016	0.178	<0.0020	<0.0020	<0.0020	0.178	0.155
MW14-05B	MW14-05B	primary	16-Jul-2016	<0.50	278	<0.50	<0.50	<0.010	0.25	2.3		7.59	7.42		0.222	0.224		0.015	0.186	<0.0020	<0.0020	0.0046	0.186	0.184
MW14-05B	MW14-05B	primary	23-Sep-2016	<0.50	252	<0.50	<0.50	<0.010	0.23	1.6		7.75	6.89		0.233	0.218		0.022	0.128	<0.0020	<0.0020	<0.0020	0.128	0.138
MW14-05B	MW14-05B	primary	29-Apr-2017	<0.50	248	<0.50	<0.50	<0.010	0.24	2		4.01	5.35		0.194	0.168		0.067	0.249	0.007	0.007	<0.0020	0.256	0.157
MW14-05B	MW14-05B	primary	11-Jun-2017	<0.50	257	<0.50	<0.50	<0.010	0.28	1.6		6.12	6.34		0.166	0.145		0.066	0.219	0.002	0.002	<0.0020	0.221	0.165
MW14-05B	MW14-05B	primary	26-Jul-2017	<0.50	253	<0.50	<0.50	<0.010	0.25	1.3		4.4	4.2		0.146	0.171		0.057	0.225	0.0035	<0.0020	0.0022	0.229	0.205
MW14-05B	MW14-05B	primary	08-Oct-2017	<0.50	252	<0.50	<0.50	<0.10	0.24	1.1		5.82	8.44		0.176	0.152		0.014	0.155	<0.0020	<0.0020	<0.0020	0.155	0.145
MW14-05B	MW14-05B	primary	22-Apr-2018	<0.50	243	<0.50	<0.50		0.26	0.79		2.53	2.66		0.165	0.174		0.024	0.124	0.01	<0.0020	0.0105	0.136	0.1
MW14-05B	MW14-05B	primary	10-Jun-2018	<0.50	222	<0.50	<0.50	0.011	0.22	0.78		3.19	5.12		0.1	0.065		0.012	0.105	<0.0020	<0.0020	<0.0020	0.105	0.062
MW14-05B	MW14-05B	primary	04-Aug-2018	<0.50	228	<0.50	<0.50	<0.010	0.21	0.83		2.29	3.14				<0.0050	0.24		0.00	0.003	<0.0020		
MW14-05B	MW14-05B	primary	06-Oct-2018	<0.50	218	<0.50	<0.50	<0.010	0.21	<0.50		1.7	2.3		0.167	0.143	<0.0050	0.007	0.076	<0.0020	<0.0020	<0.0020	0.076	0.107
MW14-05B	MW14-05B	primary	30-Apr-2019	<0.50	237	<0.50	<0.50	0.015	0.21	0.59		2.4	2.5		0.068	0.098	0.0053	0.025	0.059	<0.0020	<0.0020	<0.0020	0.059	0.061
MW14-05B	MW14-05B	primary	16-Jun-2019	<0.50	219	<0.50	<0.50	<0.010	0.2	0.86		2.1	2		0.066	0.057	<0.0050	0.0099	0.031	0.0033	0.0033	<0.0020	0.034	0.07
MW14-05B	MW14-05B	primary	25-Aug-2019	<0.50	218	<0.50	<0.50	<0.010	0.19	1.1		1.8	2.1		0.048	0.0075	0.0049	0.039	0.12	<0.0020	<0.0020	<0.0020	0.12	0.116
MW15-01WB	MW15-01WB	primary	07-Jun-2015	<0.50	678	<0.50	<0.50		0.057	0.69		32.7	36.5		0.0139	0.01		0.015	0.043	<0.0020	<0.0020	<0.0020	0.043	
MW15-01WB	MW15-01WB	primary	08-Jul-2015	<0.50	676	<0.50	<0.50		0.044	0.81		38.4	284		0.0517	0.0041		0.016	0.069	<0.0020	<0.0020	<0.0020	0.069	
MW15-01WB	MW15-01WB	primary	10-Aug-2015	<0.50	689	<0.50	<0.50		0.058	0.75		120	490		0.111	0.0178		0.0052	0.35	<0.0020	<0.0020	<0.0020	0.35	
MW15-01WB	MW15-01WB	primary	03-Sep-2015	<0.50	668	<0.50	<0.50		0.06	1.7		35	32		0.0138	0.0159		0.015	0.035	0.0048	0.0048	<0.0020	0.04	
MW15-01WB	MW15-01WB	primary	15-May-2016	<0.50	720	<0.50	<0.50	<0.10	0.06	1.1		223	34.7		0.0195	0.0238		0.038	<0.020	<0.0020	<0.0020	<0.0020	<0.020	<0.020
MW15-01WB	MW15-01WB	primary	14-Jul-2016	<0.50	712	<0.50	<0.50	<0.10	0.06	1.4		304	38.4		0.0177	0.0174		0.014	0.034	<0.0020	<0.0020	<0.0020	0.034	<0.020
MW15-01WB	MW15-01WB	primary	22-Sep-2016	<0.50	661	<0.50	<0.50	<0.10	0.059	<1.0		378	9.82		0.0221	0.0542		0.029	0.022	<0.0020	<0.0020	<0.0020	0.022	<0.020
MW15-01WB	MW15-01WB	primary	22-Apr-2017	<0.50	703	<0.50	<0.50	<0.10	0.068	1.2		358	64.6		0.0194	0.0674		0.025	0.074	0.0079	0.0079	<0.0020	0.081	0.051
MW15-01WB	MW15-01WB	primary	08-Jun-2017	<0.50	671	<0.50	<0.50	<0.10	0.044	<0.50		222	258		0.0473	0.0557		0.01	<0.020	<0.0020	<0.0020	<0.0020	<0.020	0.43
MW15-01WB	MW15-01WB	primary	24-Jul-2017	<0.50	672	<0.50	<0.50	<0.050	0.06	<0.50		51	26		0.0196	0.0191		0.02	0.042	<0.0020	<0.0020	<0.0020	0.042	0.077
MW15-01WB	MW15-01WB	primary	06-Oct-2017	<0.50	718	<0.50	<0.50	<0.10	0.053	0.89		183	45.2		0.0146	0.0116		<0.0050	0.06	<0.0020	<0.0020	<0.0020	0.06	<0.20
MW15-01WB	MW15-01WB	primary	19-Apr-2018	<0.50	671	<0.50	<0.50	0.37	0.059	0.73		73.6	24.7		0.019	0.0152		0.045	0.054	0.00	0.0037	<0.0020	0.058	0.056
MW15-01WB	MW15-01WB	primary	07-Jun-2018	<0.50	714	<0.50	<0.50	0.22	0.058	0.69		308	68.2		<0.0030	0.0074		0.013	0.249	0.00	0.0025	<0.0020	0.252	0.7
MW15-01WB	MW15-01WB	primary	02-Aug-2018	<0.50	660	<0.50	<0.50	0.17	0.061	<0.50		55.8	188		0.0151	0.0103	<0.0050	0.049	0.23	0.00	0.002	<0.0020	0.23	0.077
MW15-01WB	MW15-01WB	primary	03-Oct-2018	<0.50	691	<0.50	<0.50	0.16	0.057	<0.50		170	120		0.0104	0.0163	<0.0050	0.02	0.022	<0.0020	<0.0020	<0.0020	0.022	0.28
MW15-01WB	MW15-01WB	primary	05-May-2019	<0.50	714	<0.50	<0.50	0.2	0.062	0.67		190	100		<0.050	0.0169	0.0038	0.013	0.04	0.0065	0.0065	<0.0020	0.046	0.21
MW15-01WB	MW15-01WB	primary	18-Jun-2019	<0.50	726	<0.50	<0.50	0.17	0.058	5.3		140	130		0.0032	0.004	<0.0050	0.017	0.3	<0.0020	<0.0020	<0.0020	0.3	0.27
MW15-01WB	MW15-01WB	primary	22-Aug-2019	<0.50	708	<0.50	<0.50	0.17	0.058	0.95		440	33		<0.0030	0.0058		0.061	0.052	0.0209	0.0209	<0.0020	0.079	0.79
MW15-02AZ	MW15-02AZ	primary	31-May-2015	<0.50	322	<0.50	<0.50		0.1	0.84		3.86	3.77		<0.0050	<0.0050		0.01	0.147	0.232	0.232	<0.0020	0.379	
MW15-02AZ	MW15-02AZ	primary	11-Jul-2015	<0.50	291	<0.50	<0.50		0.088	0.5		5.62	6.29		<0.0050	<0.0050		0.016	0.22	0.436	0.436	<0.0020	0.654	
MW15-02AZ	MW15-40AZ	duplicate	11-Jul-2015	<0.50	295	<0.50	<0.50		0.087	0.58		5.28	6.24		<0.0050	<0.0050		0.01	0.19	0.437	0.437	<0.0020	0.626	
MW15-02AZ	MW15-02AZ	primary	12-Aug-2015	<0.50	286	<0.50	<0.50		0.097	0.87		4.5	4.7		<0.0050	<0.0050		<0.0050	0.109	0.531	0.531	<0.0020	0.641	
MW15-02AZ	MW15-02AZ	primary	07-Sep-2015	<0.50	281	<0.50	<0.50		0.11	1.1		5.5	5.4		<0.0050	<0.0050		0.025	0.153	0.495	0.544	<0.0020	0.694	
MW15-02AZ	MW15-02AZ	primary	17-May-2016	<0.50	300	<0.50	<0.50	<0.10	0.11	0.72		4.51	3.98		<0.0050	<0.0050		0.022	0.121	0.232	0.232	<0.0020	0.353	0.367
MW15-02AZ	MW15-02AZ	primary	19-Jul-2016	<0.50	277	<0.50	<0.50	<0.010	0.13	0.64		3.68	4.74		<0.0050	<0.0050		0.01	0.111	0.32	0.32	<0.0020	0.432	0.462
MW15-02AZ	JH40-06	duplicate	25-Sep-2016	<0.50	297	<0.50	<0.50	<0.10	0.11	<1.0		4.3	4.83		<0.0050	<0.0050		0.021	0.39	0.272	0.272	<0.0020	0.662	0.421
MW15-02AZ	MW15-02AZ	primary	25-Sep-2016	<0.50	290	<0.50	<0.50	<0.10	0.12	<1.0		4.86	4.59		<0.0050	<0.0050		0.016	0.129	0.277	0.277	<0.0020	0.406	0.409
MW15-02AZ	MW15-02AZ	primary	28-Jul-2017	3.76	293	4.51	<0.50	<0.010	0.11	<0.50		4.6	5.1		<0.0050	<0.0050		0.006	0.152	0.331	0.331	<0.0020	0.482	0.277
MW15-02AZ	MW15-02AZ	primary	08-Oct-2017	<0.50	317	<0.50	<0.50	<0.10	0.099	0.74		4.01	4.65		<0.0050	<0.0050		<0.0050	0.088	0.629	0.629	<0.0020	0.717	0.735
MW15-02AZ	JH42-05	duplicate	03-Aug-2018	<0.50	304	<0.50	<0.50	0.025	0.11	<0.50		4.39	3.91		<0.0050	<0.0050	<0.0050	0.015	0.157	0.33	0.327	<0.0020	0.484	0.45
MW15-02AZ	MW15-02AZ	primary	03-Aug-2018	<0.50	305	<0.50	<0.50	0.027	0.12	<0.50		3.83	4.35		<0.0050	<0.0050	<0.0050	0.011	0.144	0.32	0.322	<0.0020	0.466	0.471
MW15-02WB	MW15-02WB	primary	01-Jun-2015	<0.50	299	<0.50	<0.50		0.17	0.93		29.9	42.4		0.0847	0.0042		0.011	0.129	<0.0020	<0.0020	<0.0020	0.129	
MW15-02WB	MW15-02WB	primary	11-Jul-2015	<0.50	251	<0.50	<0.50		0.2	0.58		14.7	74.2		<0.0050	0.0024		0.018	0.17	<0.0020	<0.0020	<0.0020	0.165	
MW15-02WB	MW15-02WB	primary	12-Aug-2015	<0.50	274	<0.50	<0.50		0.21	<0.50		190	230		0.0085	0.0062		0.012	0.37	0.003	0.003	<0.0020	0.37	
MW15-02WB	MW15-02WB	primary	07-Sep-2015	<0.50	301	<0.50	<0.50		0.12	1.2		9.4	14		<0.0050	0.0034		0.018	0.103	0.14	0.138	0.0026	0.243	
MW15-02WB	MW15-02WB	primary	18-May-2016	<0.50	311	<0.50	<0.50	<0.10	<0.010	0.79		57.7	13.5		<0.0050	<0.0050		0.01	0.167	0.0753	0.0753	<0.0020	0.242	0.192
MW15-02WB	MW15-02WB	primary	19-Jul-2016	<0.50	293	<0.50	<0.50	<0.010	0.12	0.88		18.9	104		<0.0050	<0.0050		0.018	0.095	0.206	0.206	<0.0020	0.301	0.342
MW15-02WB	MW15-02WB	primary	25-Sep-2016	<0.50	285	<0.50	<0.50	<0.10	0.1	<1.0		67.1	10.5		<0.0050	<0.0050		0.012	0.116	0.266	0.266	<0.0020	0.382	0.427
MW15-02WB	JH41-02	duplicate	25-Apr-2017	4.24	303	5.09	<0.50	<0.050	0.096	0.82		44.9	10.4		<0.0050	<0.0050		0.024	0.147	0.242	0.242	<0.0020	0.389	0.396
MW15-02WB	MW15-02WB	primary	25-Apr-2017	<0.50	314	<0.50	<0.50	<0.010	0.1	0.95		43.2	27.5		<0.0050	<0.0050		0.025	0.104	0.245	0.245	<0.0020	0.358	0.483
MW15-02WB	JH41-04	duplicate	13-Jun-2017	2.32	297	2.78	<0.50	<0.010	0.16	0.83		20	42.4		0.0979	0.0307		0.027	0.171	<0.0020	<0.0020	<0.0020	0.171	0.163
MW15-02WB	MW15-02WB	primary	13-Jun-2017	1.28	301	1.54	<0.50	<0.010	0.15	0.86		44.6	23.6		0.107	0.0063		0.022	0.164	<0.0020	<0.0020	<0.0020	0.164	0.181
MW15-02WB	MW15-02WB	primary	28-Jul-2017	2.34	305	2.81	<0.50	<0.010	0.1	0.65		180	80		0.0053	<0.0050		0.0082	0.029	0.162	0.162	<0.0020	0.191	0.22
MW15-02WB	MW15-02WB	primary	08-Oct-2017	<0.50	307	<0.50	<0.50	<0.10	0.1	0.81		62.2	25.5		<0.0050	<0.0050		<0.0050	0.116	0.221	0.221	<0.0020	0.337	0.367

Station	Sample ID	Sample Class	Sample Date	Alkalinity (PP as CaCO3)	Bicarbonate (HCO3)	Carbonate (CO3)	Hydroxide (OH)	Bromide (Br)	Fluoride (F)	Dissolved Chloride (Cl)	Organic / Inorganic Carbon	Dissolved Organic Carbon (C)	Total Organic Carbon (C)	Anions and Nutrients	Total Phosphorus (P)	Dissolved Phosphorus (P)	Orthophosphate	Total Ammonia (N)	Total Total Kjeldahl Nitrogen (Calc)	Nitrate plus Nitrite (N)	Nitrate (N)	Nitrite (N)	Total Nitrogen (N)	Dissolved Nitrogen (N)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Maxxam RDL[1]:				0.5	0.5	0.5	0.5	0.01	0.01	0.5		0.5	0.5		0.002	0.002	0.003	0.005	0.02	0.002	0.002	0.002	0.02	0.0028
ALS RDL[1]:				-	-	-	-	-	0.02	0.5		0.5	0.5		0.002	0.002		0.005	0.05	-	0.005	0.001	0.05	0.05
MW15-02WB	MW15-02WB	primary	21-Apr-2018	<0.50	330	<0.50	<0.50		0.12	0.61		63.4	13.6		<0.0050	<0.0050		<0.0050	0.133	0.21	0.205	<0.0020	0.339	0.344
MW15-02WB	JH42-03	duplicate	09-Jun-2018	<0.50	297	<0.50	<0.50	0.05	0.17	0.62		5.95	22.1		<0.0030	0.0043		0.008	0.108	<0.0020	<0.0020	<0.0020	0.108	0.104
MW15-02WB	MW15-02WB	primary	09-Jun-2018	<0.50	298	<0.50	<0.50	0.054	0.18	0.69		172	38.5		0.0031	0.0031		0.008	0.107	0.004	0.004	<0.0020	0.111	0.34
MW15-02WB	MW15-02WB	primary	04-Aug-2018	<0.50	307	<0.50	<0.50	0.06	0.17	0.62		35.1	103				<0.0050	0.021		0.00	0.0041	<0.0020		
MW15-02WB	JH42-07	duplicate	06-Oct-2018	<0.50	307	<0.50	<0.50	<0.050	0.11	<0.50		230	300		0.15	0.0155	<0.0050	0.005	0.26	0.31	0.313	<0.0020	0.57	0.64
MW15-02WB	MW15-02WB	primary	06-Oct-2018	<0.50	313	<0.50	<0.50	<0.050	0.11	0.51		270	310		0.0491	0.0201	<0.0050	0.033	0.31	0.31	0.311	<0.0020	0.62	0.81
MW15-02WB	MW15-02WB	primary	29-Apr-2019	<0.50	325	<0.50	<0.50	0.047	0.11	0.64		12	110		<0.0030	<0.0030	<0.0030	0.012	0.18	0.331	0.331	<0.0020	0.51	0.56
MW15-02WB	MW15-02WB	primary	19-Jun-2019	<0.50	357	<0.50	<0.50	0.049	0.16	0.77		14	11		<0.0030	<0.0030	<0.0050	<0.015	0.118	0.0027	<0.0020	0.0025	0.12	0.106
MW15-02WB	BD2-Q2	duplicate	19-Jun-2019	<0.50	311	<0.50	<0.50	0.048	0.16	0.77		13	17		<0.0030	<0.0030	<0.0050	0.031	0.18	<0.0020	<0.0020	<0.0020	0.18	0.124
MW15-02WB	MW15-02WB	primary	24-Aug-2019	<0.50	314	<0.50	<0.50	0.033	0.16	1.5		120	29		0.0033	0.0047	<0.0030	0.06	0.176	<0.0020	<0.0020	<0.0020	0.197	0.369
MW15-03AZ	MW15-03AZ	primary	16-Jun-2015	<0.50	132	<0.50	<0.50		0.048	0.78		7.87	8.32		<0.0050	<0.0050		0.0087	0.227	0.0255	0.0255	<0.0020	0.253	
MW15-03AZ	MW15-21	duplicate	16-Jun-2015	<0.50	130	<0.50	<0.50		0.047	0.52		7.81	7.39		<0.0050	<0.0050		0.025	0.209	0.0263	0.0263	<0.0020	0.235	
MW15-03AZ	MW15-03AZ	primary	09-Jul-2015	<0.50	134	<0.50	<0.50		0.057	0.72		7.11	7.12		<0.0050	0.0057		0.02	0.18	0.0294	0.0294	<0.0020	0.207	0.236
MW15-03AZ	MW15-03AZ	primary	10-Aug-2015	<0.50	97.9	<0.50	<0.50		0.059	<0.50		8.8	10		<0.0050	<0.0050		0.0065	0.231	0.15	0.15	<0.0020	0.381	
MW15-03AZ	MW15-03AZ	primary	04-Sep-2015	<0.50	100	<0.50	<0.50		0.063	0.76		10	11		<0.0050	<0.0050		0.025	0.309	0.146	0.166	<0.0020	0.455	
MW15-03AZ	JH40-02	duplicate	16-May-2016	<0.50	104	<0.50	<0.50	<0.010	0.06	<0.50		9.29	10.1		<0.0050	<0.0050		0.038	0.273	0.112	0.112	<0.0020	0.385	0.342
MW15-03AZ	MW15-03AZ	primary	16-May-2016	<0.50	104	<0.50	<0.50	<0.010	0.059	0.52		9.37	10.6		<0.0050	<0.0050		0.022	0.279	0.0987	0.0987	<0.0020	0.377	0.397
MW15-03AZ	MW15-03AZ	primary	16-Jul-2016	<0.50	98.6	<0.50	<0.50	<0.010	0.066	0.58		9.63	9.46		0.0053	<0.0050		0.019	0.241	0.112	0.112	<0.0020	0.353	0.384
MW15-03AZ	MW15-03AZ	primary	23-Sep-2016	<0.50	95.3	<0.50	<0.50	<0.010	0.064	<1.0		7.61	9.33		<0.0050	<0.0050		0.021	0.275	0.241	0.241	<0.0020	0.516	0.537
MW15-03AZ	MW15-03AZ	primary	25-Jul-2017	<0.50	106	<0.50	<0.50	<0.010	0.059	<0.50		9.8	9.3		<0.0050	<0.0050		0.019	0.269	0.19	0.19	<0.0020	0.459	0.52
MW15-03AZ	MW15-03AZ	primary	07-Oct-2017	<0.50	99.4	<0.50	<0.50	0.026	0.057	0.57		7.98	8.89		<0.0050	<0.0050		<0.0050	0.189	0.445	0.445	<0.0020	0.635	0.687
MW15-03AZ	MW15-03AZ	primary	04-Aug-2018	<0.50	115	<0.50	<0.50	<0.010	0.061	0.63		8.67	8.26				<0.0050	0.006		0.21	0.208	<0.0020		
MW15-03AZ	MW15-03AZ	primary	05-Oct-2018	<0.50	104	<0.50	<0.50	<0.010	0.063	<0.50		9.4	8.8		<0.0050	<0.0050	<0.0050	<0.0050	0.236	0.35	0.354	<0.0020	0.59	0.71
MW15-03AZ	MW15-03AZ	primary	23-Aug-2019	<0.50	115	<0.50	<0.50	<0.010	0.067	0.86		8.3	8.2		0.0056	0.0044	<0.0030	0.04	0.336	0.327	0.327	<0.0020	0.663	0.645
MW15-03WB	MW15-03WB	primary	16-Jun-2015	<0.50	183	<0.50	<0.50		0.13	9.1		220	12.1		<0.0050	0.0048		0.012	0.036	0.0076	0.0076	<0.0020	0.044	
MW15-03WB	MW15-03WB	primary	09-Jul-2015	<0.50	185	<0.50	<0.50		0.14	8.9		362	311		0.0897	0.0361		0.92	0.098	<0.0020	<0.0020	<0.0020	0.098	0.23
MW15-03WB	MW15-03WB	primary	10-Aug-2015	<0.50	184	<0.50	<0.50		0.15	9.1		340	280		0.0323	0.0385		0.0093	0.45	<0.0020	<0.0020	<0.0020	0.45	
MW15-03WB	MW15-03WB	primary	04-Sep-2015	<0.50	178	<0.50	<0.50		0.14	8.7		8.5	8.3		<0.0050	0.0032		0.039	0.047	0.003	0.003	<0.0020	0.05	
MW15-03WB	MW15-03WB	primary	16-May-2016	<0.50	194	<0.50	<0.50	<0.10	0.14	8.5		119	27		<0.0050	<0.0050		0.036	0.071	0.0024	0.0024	<0.0020	0.073	0.081
MW15-03WB	MW15-03WB	primary	16-Jul-2016	<0.50	182	<0.50	<0.50	<0.10	0.23	10		149	14.4		0.0115	0.0062		0.018	0.041	<0.0020	<0.0020	0.0096	0.041	0.04
MW15-03WB	MW15-03WB	primary	23-Sep-2016	<0.50	171	<0.50	<0.50	<0.10	0.24	11		368	28.3		<0.0050	0.0633		0.015	0.044	<0.0020	<0.0020	<0.0020	0.044	0.51
MW15-03WB	MW15-03WB	primary	23-Apr-2017	<0.50	178	<0.50	<0.50	<0.10	0.27	11		133	71.5		0.0075	0.0061		0.023	0.08	0.004	0.004	<0.0020	0.084	0.072
MW15-03WB	MW15-03WB	primary	10-Jun-2017	<0.50	178	<0.50	<0.50	0.054	0.25	11		184	78.2		<0.0050	<0.0050		0.016	0.171	<0.0020	<0.0020	<0.0020	0.171	<0.20
MW15-03WB	MW15-03WB	primary	25-Jul-2017	<0.50	183	<0.50	<0.50	<0.050	0.22	11		<13	280		0.036	<0.0050		0.0094	0.233	<0.0020	<0.0020	<0.0020	0.233	0.222
MW15-03WB	MW15-03WB	primary	07-Oct-2017	<0.50	188	<0.50	<0.50	<0.10	0.21	11		109	27.2		<0.0050	<0.0050		0.021	0.04	<0.0020	<0.0020	<0.0020	0.04	0.063
MW15-03WB	JH42-01	duplicate	20-Apr-2018	<0.50	179	<0.50	<0.50	1	0.24	11		99.3	56.3		<0.0050	<0.0050		0.063	0.07	0.00	0.0044	<0.0020	0.075	0.0310
MW15-03WB	MW15-03WB	primary	20-Apr-2018	<0.50	175	<0.50	<0.50	0.3	0.24	11		152	38		<0.0050	0.0077		0.076	<0.20	0.00	0.0034	<0.0020	<0.20	<0.020
MW15-03WB	MW15-03WB	primary	08-Jun-2018	<0.50	186	<0.50	<0.50	0.28	0.22	11		249	94.2		0.0039	0.0037		0.082	0.178	0.01	0.0028	0.0025	0.183	0.24
MW15-03WB	MW15-03WB	primary	05-Aug-2018	<0.50	185	<0.50	<0.50	0.19	0.2	11		112	103				<0.0050	0.038		0.00	0.0038	<0.0020		
MW15-03WB	MW15-03WB	primary	04/10/2018 and 05/10/2018	<0.50	182	<0.50	<0.50	0.19	0.2	12		170	83		<0.0050		<0.0050	<0.0050	0.061	<0.0020	<0.0020	<0.0020	0.061	
MW15-03WB	MW15-03WB	primary	03-May-2019	<0.50	185	<0.50	<0.50	0.24	0.2	12		24	94		<0.0030	<0.0030	0.0032	0.017	0.052	<0.0020	<0.0020	<0.0020	0.052	0.11
MW15-03WB	MW15-03WB	primary	18-Jun-2019	<0.50	186	<0.50	<0.50	0.24	0.2	11		44	25		<0.0030	<0.0030	<0.0050	0.021	<0.20	0.0097	0.0097	<0.0020	<0.20	<0.20
MW15-03WB	MW15-03WB	primary	23-Aug-2019	<0.50	187	<0.50	<0.50	0.11	0.2	11		<25	400		0.0067	0.012	<0.0030	0.062	0.109	<0.0020	<0.0020	<0.0020	0.1	0.281
MW15-04WB	MW15-04WB	primary	14-Jun-2015	<0.50	284	<0.50	<0.50		0.096	<0.50		268	1080		0.105	0.0951		0.022	<0.20	0.156	0.139	0.0167	<0.20	
MW15-04WB	MW15-20	duplicate	14-Jun-2015	<0.50	285	<0.50	<0.50		0.094	<0.50		219	1310		0.401	0.022		0.012	<0.20	0.158	0.141	0.017	<0.20	
MW15-04WB	MW15-04WB	primary	10-Jul-2015	<0.50	285	<0.50	<0.50		0.1	0.68		93.6	8.99		<0.0050	0.0069		0.019	0.15	0.0809	0.0702	0.0107	0.227	
MW15-04WB	MW15-30WB	duplicate	10-Jul-2015	<0.50	285	<0.50	<0.50		0.11	0.67		10.3	63.8		<0.0050	0.0043		0.02	0.088	0.0874	0.0777	0.0097	0.175	
MW15-04WB	MW15-04WB	primary	11-Aug-2015	<0.50	277	<0.50	<0.50		0.11	<0.50		150	120		0.0056	0.0074		0.015	0.061	0.24	0.228	0.0116	0.301	
MW15-04WB	MW15-04WB	primary	05-Sep-2015	<0.50	283	<0.50	<0.50		0.11	0.84		7	130		<0.0050	0.0043		0.019	0.044	0.222	0.215	0.0065	0.266	
MW15-04WB	MW15-04WB	primary	13-May-2016	<0.50	261	<0.50	<0.50	0.011	0.1	0.77		134	45.3		0.0073	<0.0050		0.015	0.1	0.113	0.0991	0.0134	0.213	0.179
MW15-04WB	JH40-03	duplicate	15-Jul-2016	<0.50	263	<0.50	<0.50	<0.010	0.11	0.87		226	15.3		<0.0050	<0.0050		0.029	0.106	0.0776	0.0633	0.0143	0.184	0.071
MW15-04WB	MW15-04WB	primary	15-Jul-2016	<0.50	261	<0.50	<0.50	<0.010	0.11	0.82		237	14.2		<0.0050	0.0097		0.017	0.188	0.0787	0.0661	0.0126	0.267	0.065
MW15-04WB	MW15-04WB	primary	24-Sep-2016	<0.50	250	<0.50	<0.50	<0.10	0.11	<1.0		275	21.9		<0.0050	0.0553		0.015	0.131	0.149	0.136	0.0128	0.280	0.133
MW15-04WB	MW15-04WB	primary	23-Apr-2017	<0.50	273	<0.50	<0.50	<0.010	0.11	0.75		166	262		0.0603	0.0082		0.018	0.52	0.284	0.267	0.0172	0.8	0.78
MW15-04WB	MW15-04WB	primary	11-Jun-2017	2.18	273	2.62	<0.50	0.011	0.12	0.63		95.6	54.7		0.0056	0.0054		0.016	0.238	0.298	0.28	0.0173	0.535	0.426
MW15-04WB	MW15-04WB	primary	26-Jul-2017	4.82	279	5.78	<0.50	<0.010	0.11	0.58		34	30		0.0051	<0.0050		0.022	0.084	0.3	0.28	0.0204	0.384	0.468
MW15-04WB	JH41-07	duplicate	05-Oct-2017	<0.50	287	<0.50	<0.50	<0.10	0.1	0.84		261	57.0		<0.0050	0.024		<0.0050	0.075	0.358	0.345	0.0135	0.433	0.86
MW15-04WB	MW15-04WB	primary	05-Oct-2017	<0.50	289	<0.50	<0.50	<0.10	0.1	0.83		140	17.4		<0.0050	0.0067		<0.0050	0.054	0.359	0.346	0.0129	0.413	0.36
MW15-04WB	MW15-04WB	primary	19-Apr-2018	<0.50	276	<0.50	<0.50	0.032	0.11	0.56		91.4	22.3		<0.0050	<0.0050		0.018	0.092	0.26	0.247	0.0109	0.35	0.291

Station	Sample ID	Sample Class	Sample Date	Alkalinity (PP as CaCO3)	Bicarbonate (HCO3)	Carbonate (CO3)	Hydroxide (OH)	Bromide (Br)	Fluoride (F)	Dissolved Chloride (Cl)	Organic / Inorganic Carbon	Dissolved Organic Carbon (C)	Total Organic Carbon (C)	Anions and Nutrients	Total Phosphorus (P)	Dissolved Phosphorus (P)	Orthophosphate	Total Ammonia (N)	Total Total Kjeldahl Nitrogen (Calc)	Nitrate plus Nitrite (N)	Nitrate (N)	Nitrite (N)	Total Nitrogen (N)	Dissolved Nitrogen (N)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Maxxam RDL[1]:				0.5	0.5	0.5	0.5	0.01	0.01	0.5		0.5	0.5		0.002	0.002	0.003	0.005	0.02	0.002	0.002	0.002	0.02	0.0028
ALS RDL[1]:				-	-	-	-	-	0.02	0.5		0.5	0.5		0.002	0.002		0.005	0.05	-	0.005	0.001	0.05	0.05
MW15-04WB	MW15-04WB	primary	07-Jun-2018	<0.50	290	<0.50	<0.50	0.026	0.12	0.88		290	132		<0.0030	0.006		0.032	0.62	0.29	0.29	0.0041	0.91	0.69
MW15-04WB	MW15-04WB	primary	02-Aug-2018	<0.50	269	<0.50	<0.50	0.027	0.12	<0.50		61.5	104		<0.0050	<0.0050	<0.0050	0.019	0.116	0.25	0.248	0.0027	0.366	0.366
MW15-04WB	MW15-04WB	primary	05-Oct-2018	<0.50	248	<0.50	<0.50	0.02	0.11	<0.50		120	67		<0.0050	<0.0050	<0.0050	<0.0050	0.115	0.27	0.269	<0.0020	0.383	0.51
MW15-04WB	MW15-04WB	primary	03-May-2019	<0.50	270	<0.50	<0.50	0.027	0.11	<0.50		19	150		<0.0030	<0.0030	0.0036	0.017	0.25	0.507	0.507	<0.0020	0.76	0.77
MW15-04WB	MW15-04WB	primary	17-Jun-2019	<0.50	274	<0.50	<0.50	0.019	0.11	1.8		58	160		<0.0030	<0.0030	<0.0050	0.19	0.37	0.519	0.519	<0.0020	0.89	0.75
MW15-04WB	MW15-04WB	primary	22-Aug-2019	<0.50	279	<0.50	<0.50	0.023	0.11	0.79		190	170		0.0042	0.0036		0.053	0.184	0.48	0.48	<0.0020	0.664	0.92
MW15-04WB	BD1-Q3	duplicate	22-Aug-2019	<0.50	277	<0.50	<0.50	0.018	0.11	0.78		14	7.9		<0.0030	0.0035		0.047	0.157	0.474	0.474	<0.0020	0.631	0.668
MW15-05AZ	MW15-05AZ	primary	06-Sep-2015	<0.50	11.1	<0.50	<0.50		0.036	0.52		13	13		0.0245	0.0134		0.61	0.77	0.012	0.01	0.002	0.782	
MW15-05WB	MW15-05WB	primary	18-Jun-2015	<0.50	179	<0.50	<0.50		0.26	0.64		371	771		0.0761	0.0358		0.0067	0.082	<0.0020	<0.0020	<0.0020	0.082	
MW15-05WB	MW15-05WB	primary	10-Jul-2015	<0.50	177	<0.50	<0.50		0.28	<0.50		138	335		0.0744	0.0143		0.016	0.085	<0.0020	<0.0020	<0.0020	0.085	
MW15-05WB	MW15-05WB	primary	11-Aug-2015	<0.50	171	<0.50	<0.50		0.3	<0.50		9.5	330		0.0654	0.0125		<0.0050	0.32	<0.0020	<0.0020	<0.0020	0.32	
MW15-05WB	MW15-60	duplicate	11-Aug-2015	<0.50	175	<0.50	<0.50		0.3	<0.50		11	410		0.121	0.0112		<0.0050	0.37	<0.0020	<0.0020	<0.0020	0.37	
MW15-05WB	MW15-05WB	primary	06-Sep-2015	<0.50	168	<0.50	<0.50		0.3	0.75		270	24		0.0124	0.0297		0.14	0.027	0.0022	0.0031	<0.0020	0.229	
MW15-05WB	MW15-05WB	primary	15-May-2016	<0.50	181	<0.50	<0.50	<0.010	0.29	<0.50		252	49.6		0.0162	0.0209		0.011	0.032	<0.0020	<0.0020	<0.0020	0.032	<0.020
MW15-05WB	MW15-05WB	primary	20-Jul-2016	<0.50	175	<0.50	<0.50	<0.010	0.32	0.6		26.8	95.7		0.0113	0.013		0.015	0.042	<0.0020	<0.0020	<0.0020	0.042	0.35
MW15-05WB	MW15-05WB	primary	27-Sep-2016	<0.50	175	<0.50	<0.50	<0.010	0.29	0.6		391	36.5		0.012	0.0312		0.011	0.058	<0.0020	<0.0020	<0.0020	0.058	<0.020
MW15-05WB	MW15-05WB	primary	21-Apr-2017	<0.50	178	<0.50	<0.50	<0.010	0.31	<0.50		121	30		0.0146	0.0164		0.02	0.053	<0.0020	<0.0020	<0.0020	0.053	0.099
MW15-05WB	MW15-05WB	primary	11-Jun-2017	<0.50	175	<0.50	<0.50	<0.010	0.32	<0.50		178	35.4		0.0132	<0.0050		0.022	0.048	<0.0020	<0.0020	<0.0020	0.048	<0.20
MW15-05WB	MW15-05WB	primary	27-Jul-2017	<0.50	176	<0.50	<0.50	<0.010	0.3	<0.50		340	95		0.0114	0.0209		0.0055	0.094	<0.0020	<0.0020	<0.0020	0.094	<0.20
MW15-05WB	MW15-05WB	primary	07-Oct-2017	<0.50	179	<0.50	<0.50	<0.010	0.29	<0.50		132	138		0.0121	<0.0050		<0.0050	0.048	<0.0020	<0.0020	<0.0020	0.048	0.042
MW15-05WB	MW15-05WB	primary	21-Apr-2018	<0.50	178	<0.50	<0.50		0.32	0.65		59.7	29.4		0.0125	0.012		<0.0050	0.078	0.00	0.0039	<0.0020	0.082	0.115
MW15-05WB	MW15-05WB	primary	09-Jun-2018	<0.50	300	<0.50	<0.50	<0.010	0.3	<0.50		369	208		0.0033	0.0079		<0.0050	<0.020	<0.0020	<0.0020	<0.0020	<0.020	0.24
MW15-05WB	MW15-05WB	primary	04-Aug-2018	<0.50	179	<0.50	<0.50	<0.010	0.3	<0.50		53.5	177				0.0061	<0.0050		<0.0020	<0.0020	<0.0020		
MW15-05WB	MW15-05WB	primary	06-Oct-2018	<0.50	174	<0.50	<0.50	<0.010	0.31	<0.50		280	270		0.0067	0.0686	0.0098	<0.0050	0.33	<0.0020	<0.0020	<0.0020	0.33	0.82
MW15-05WB	MW15-05WB	primary	30-Apr-2019	<0.50	182	<0.50	<0.50	<0.010	0.034	<0.50		130	200		<0.0030	0.004	0.008	0.007	0.063	0.0037	0.0037	<0.0020	0.067	0.1
MW15-05WB	MW15-05WB	primary	19-Jun-2019	<0.50	180	<0.50	<0.50	<0.010	0.31	<0.50		110	93		<0.0030	0.0086	0.0091	0.055	0.026	<0.0020	<0.0020	<0.0020	0.026	0.059
MW15-05WB	MW15-05WB	primary	23-Aug-2019	<0.50	181	<0.50	<0.50	<0.010	0.31	0.93		200	52		0.011	0.01	0.012	0.051	0.107	<0.0020	<0.0020	<0.0020	0.107	0.26
MW15-06WB	MW15-06WB	primary	21-Jun-2015	<0.50	200	<0.50	<0.50		0.063	8.8		34.4	48.6		0.0505	0.0317		0.59	6	0.0101	<0.0020	0.0101	6.01	
MW15-06WB	MW15-06WB	primary	21-Jul-2015	<0.50	273	<0.50	<0.50		0.073	2.1		69.2	15.8		0.0247	0.0308		0.23	2.4	0.0028	<0.0020	0.0024	2.36	
MW15-06WB	MW15-06WB	primary	09-Aug-2015	<0.50	294	<0.50	<0.50		0.082	1.7		17	33		0.0316	0.027		0.098	1.26	<0.0020	<0.0020	<0.0020	1.26	
MW15-06WB	MW15-06WB	primary	08-Sep-2015	<0.50	315	<0.50	<0.50		0.11	1.5		39	130		0.0519	0.0463		0.047	0.597	0.002	<0.0020	0.003	0.599	
MW15-06WB	MW15-06WB	primary	17-May-2016	3.62	262	4.34	<0.50	<0.010	0.13	0.95		209	17		0.0477	0.0256		0.013	0.379	0.0027	0.0027	<0.0020	0.382	0.391
MW15-06WB	MW15-06WB	primary	18-Jul-2016	2.37	250	2.84	<0.50	<0.010	0.14	0.66		50	172		0.0424	0.0333		0.017	0.036	0.0078	0.0078	<0.0020	0.044	0.7
MW15-06WB	MW15-06WB	primary	26-Sep-2016	<0.50	245	<0.50	<0.50	<0.010	0.12	1.6		241	77.1		0.0418	0.0444		0.022	0.396	0.0131	0.0131	<0.0020	0.409	0.031
MW15-06WB	MW15-06WB	primary	24-Apr-2017	4.34	244	5.21	<0.50	<0.010	0.11	0.79		114	19.7		0.0299	0.0251		0.12	0.261	<0.0020	<0.0020	<0.0020	0.125	0.122
MW15-06WB	MW15-06WB	primary	12-Jun-2017	5.05	248	6.06	<0.50	<0.010	0.11	1		260	93.6		0.0378	0.0298		0.0065	0.375	<0.0020	<0.0020	<0.0020	0.375	0.39
MW15-06WB	MW15-06WB	primary	29-Jul-2017	3.17	259	3.8	<0.50	<0.010	0.1	0.64		110	110		0.0374	0.0297		0.019	0.183	<0.0020	<0.0020	<0.0020	0.183	0.177
MW15-06WB	MW15-06WB	primary	09-Oct-2017	1.69	271	2.03	<0.50	<0.10	0.097	0.73		344	60.7		0.0339	0.0490		<0.0050	0.22	<0.0020	<0.0020	<0.0020	0.22	0.25
MW15-06WB	MW15-06WB	primary	22-Apr-2018	1.45	269	1.74	<0.50		0.1	1		59.5	16.5		0.0198	0.0164		0.015	0.264	0.00	0.0024	<0.0020	0.266	0.169
MW15-06WB	MW15-06WB	primary	10-Jun-2018	<0.50	262	<0.50	<0.50	0.016	0.099	0.73		213	226		<0.015	0.0084		0.018	0.206	0.00	0.004	<0.0020	0.21	0.25
MW15-06WB	MW15-06WB	primary	03-Aug-2018	1.9	256	2.28	<0.50	<0.010	0.1	<0.50		85.7	106		0.0282	0.0174	<0.0050	0.026	0.208	0.00	0.0037	<0.0020	0.211	0.155
MW15-06WB	MW15-06WB	primary	07-Oct-2018	<0.50	267	<0.50	<0.50	<0.010	0.095	1		360	270		0.0228	0.0252	<0.0050	0.027	0.53	<0.0020	<0.0020	<0.0020	0.53	0.51
MW15-06WB	MW15-06WB	primary	02-May-2019	<0.50	313	<0.50	<0.50	0.025	0.089	3.6		340	200		0.035	0.027	0.0073	0.019	2.7	0.0249	0.0249	<0.0020	2.8	2.6
MW15-06WB	MW15-06WB	primary	20-Jun-2019	<0.50	274	<0.50	<0.50	0.017	0.09	<0.50		58	13		0.031	0.038	<0.0050	0.049	<0.20	0.0041	0.0041	<0.0020	<0.20	0.113
MW15-06WB	MW15-06WB	primary	25-Aug-2019	<0.50	286	<0.50	<0.50	<0.010	0.092	0.67		15	15		0.0041	<0.0030	0.004	0.079	0.167	<0.0020	<0.0020	<0.0020	0.167	0.224
MW16-01WB	MW16-01WB	primary	04-Oct-2016	<0.50	95.8	<0.50	<0.50	<0.010	0.2	1.1		328	21.7		<0.0050	0.0311		0.072	<0.020	0.0086	<0.0020	0.0072	<0.020	<0.020
MW16-01WB	MW16-01WB	primary	20-Apr-2017	<0.50	99.3	<0.50	<0.50	<0.010	0.21	0.72		59.6	92.8		0.0266	0.0252		0.012	0.063	<0.0020	<0.0020	<0.0020	0.063	0.058
MW16-01WB	MW16-01WB	primary	09-Jun-2017	<0.50	101	<0.50	<0.50	<0.010	0.22	0.52		199	239		0.0171	0.031		0.016	<0.020	0.0049	<0.0020	0.0059	<0.020	<0.20
MW16-01WB	MW16-01WB	primary	26-Jul-2017	<0.50	100	<0.50	<0.50	<0.010	0.22	0.6		490	55		0.0198	0.0774		0.0068	0.09	0.0053	<0.0020	0.0042	0.096	0.036
MW16-01WB	JH41-05	duplicate	27-Jul-2017	<0.50	101	<0.50	<0.50	<0.010	0.22	0.52		500	220		0.0213	0.0476		0.0051	0.23	0.0053	<0.0020	0.0068	0.23	<0.020
MW16-01WB	MW16-01WB	primary	06-Oct-2017	<0.50	99.5	<0.50	<0.50	<0.10	0.2	0.69		129	52.2		0.0111	0.0184		<0.0050	0.054	0.0092	0.0023	0.0069	0.063	0.064
MW16-01WB	MW16-01WB	primary	20-Apr-2018	<0.50	90.6	<0.50	<0.50	<0.010	0.21	<0.50		113	32.8		0.0079	0.0097		0.01	<0.020	0.01	0.0028	0.0067	<0.020	0.08
MW16-01WB	MW16-01WB	primary	08-Jun-2018	<0.50	98.6	<0.50	<0.50	<0.010	0.22	0.95		367	47.3		0.0063	0.0069		0.005	0.23	0.00	0.0042	<0.0020	0.235	0.24
MW16-01WB	MW16-01WB	primary	02-Aug-2018	<0.50	93.9	<0.50	<0.50	<0.010	0.22	1		245	86.4		0.01	0.0104	<0.0050	0.009	0.074	0.01	<0.0020	0.0071	0.081	0.25
MW16-01WB	MW16-01WB	primary	04-Oct-2018	<0.50	94.6	<0.50	<0.50	<0.010	0.22	<0.50		440	160		0.0156	0.0575	<0.0050	<0.0050	0.37	<0.0020	<0.0020	0.002	0.37	0.55
MW16-01WB	MW16-01WB	primary	01-May-2019	<0.50	93.3	<0.50	<0.50	<0.010	0.21	<0.50		200	240		<0.010	0.006	<0.0030	<0.0050	<0.20	0.0036	0.0036	<0.0020	<0.20	<0.20
MW16-01WB	MW16-01WB	primary	17-Jun-2019	<0.50	92.5	<0.50	<0.50	<0.010	0.21	2.4		17	210		0.005	0.0052	<0.0050	0.06	<0.20	0.0044	0.0044	<0.0020	<0.20	0.28
MW16-01WB	MW16-01WB	primary	21-Aug-2019	<0.50	96	<0.50	<0.50	<0.010	0.2	0.71		210	460		0.0096	0.0057		0.044	<0.20	0.0026	0.0026	<0.0020	<0.20	0.2
	F-BLANK-1	field blank	28-Sep-2014						<0.02	<0.5		<0.5	<0.5		<0.002	<0.002		<0.005	<0.05		<0.005	<0.001	<0.05	<0.05

Station	Sample ID	Sample Class	Sample Date	Alkalinity (PP as CaCO3)	Bicarbonate (HCO3)	Carbonate (CO3)	Hydroxide (OH)	Bromide (Br)	Fluoride (F)	Dissolved Chloride (Cl)	Organic / Inorganic Carbon	Dissolved Organic Carbon (C)	Total Organic Carbon (C)	Anions and Nutrients	Total Phosphorus (P)	Dissolved Phosphorus (P)	Orthophosphate	Total Ammonia (N)	Total Total Kjeldahl Nitrogen (Calc)	Nitrate plus Nitrite (N)	Nitrate (N)	Nitrite (N)	Total Nitrogen (N)	Dissolved Nitrogen (N)
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Maxxam RDL[1]:				0.5	0.5	0.5	0.5	0.01	0.01	0.5		0.5	0.5		0.002	0.002	0.003	0.005	0.02	0.002	0.002	0.002	0.02	0.0028
ALS RDL[1]:				-	-	-	-	-	0.02	0.5		0.5	0.5		0.002	0.002		0.005	0.05	-	0.005	0.001	0.05	0.05
	FB-23/06/15	field blank	23-Jun-2015	<0.50	0.87	<0.50	<0.50		<0.010	<0.50		<0.50	<0.50		<0.0050	0.0036		0.0092	<0.050	<0.0020	<0.0020	<0.0020	<0.050	
	FB-2	field blank	18-Jul-2015	<0.50	<0.50	<0.50	<0.50		<0.010	<0.50		<0.50	<0.50		<0.0050	<0.0020		0.01	<0.050	<0.0020	<0.0020	<0.0020	<0.050	
	FB-3	field blank	12-Aug-2015	<0.50	<0.50	<0.50	<0.50		<0.010	<0.50		<0.50	<0.50		<0.0050	<0.0050		<0.0050	<0.020	<0.0020	<0.0020	<0.0020	<0.020	
	FB-4	field blank	08-Sep-2015	<0.50	<0.50	<0.50	<0.50		<0.010	<0.50		<0.50	<0.50		<0.0050	<0.0020		0.0085	0.041	<0.0020	<0.0020	<0.0020	0.041	
	FB-007	field blank	16-May-2016	<0.50	0.65	<0.50	<0.50	<0.010	0.012	<0.50		0.76	<0.50		<0.0050	<0.0050		<0.0050	0.032	<0.0020	<0.0020	<0.0020	0.032	<0.020
	FB-008	field blank	15-Jul-2016	<0.50	0.77	<0.50	<0.50	<0.010	<0.010	0.6		<0.50	<0.50		<0.0050	<0.0050		<0.0050	<0.020	<0.0020	<0.0020	0.0079	<0.020	0.029
	FB-009	field blank	26-Sep-2016	<0.50	<0.50	<0.50	<0.50	<0.010	0.011	<0.50		<0.50	<0.50		<0.0050	<0.0050		0.024	0.031	<0.0020	<0.0020	<0.0020	0.031	0.026
	FB-010	field blank	25-Apr-2017	<0.50	<0.50	<0.50	<0.50	<0.050	0.013	<0.50		<0.50	<0.50		<0.0050	<0.0050		0.025	0.06	<0.0020	<0.0020	<0.0020	0.06	0.034
	FB-020	field blank	11-Jun-2017	<0.50	<0.50	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	0.52		<0.0050	<0.0050		0.01	<0.020	<0.0020	<0.0020	<0.0020	<0.020	<0.020
	FB-030	field blank	29-Jul-2017	<0.50	0.7	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		<0.0050	<0.0050		<0.020	<0.020	<0.0020	<0.0020	<0.0020	<0.020	0.037
	FB-040	field blank	09-Oct-2017	<0.50	0.79	<0.50	<0.50	<0.010	0.011	<0.50		<0.50	0.57		<0.0050	<0.0050		<0.0050	0.032	<0.0020	<0.0020	<0.0020	0.032	<0.020
	FB-Q1	field blank	22-Apr-2018	<0.50	0.72	<0.50	<0.50		<0.010	<0.50		5.94	8.99		<0.0050	<0.0050		<0.0050	0.057	<0.0020	<0.0020	<0.0020	0.057	0.026
	FB-Q2	field blank	10-Jun-2018	<0.50	<0.50	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		<0.0030	<0.0030		0.006	<0.020	<0.0020	<0.0020	<0.0020	<0.020	<0.020
	FB-Q3	field blank	05-Aug-2018	<0.50	<0.50	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50				<0.0050	<0.0050		<0.0020	<0.0020	<0.0020		
	FB-Q4	field blank	07-Oct-2018	<0.50	0.63	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		0.005	<0.0050	<0.0050	<0.0050	0.023	<0.0020	<0.0020	<0.0020	0.023	<0.020
	FB-Q1	field blank	01-May-2019	<0.50	<0.50	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		<0.0050	<0.0050	<0.0030	<0.0050	0.022	0.0025	0.0025	<0.0020	0.024	<0.20
	FB-Q2	field blank	13-Jun-2019	<0.50	0.84	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		<0.0030	<0.0030	<0.0050	<0.0050	0.045	0.0034	0.0034	<0.0020	0.049	0.053
	FB-Q3	field blank	23-Aug-2019	<0.50	<0.50	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		<0.0030	0.0031	<0.0030	0.05	0.068	<0.0020	<0.0020	<0.0020	0.068	0.078
	TRIP BLANK	trip blank	11-Sep-2015	<0.50	<0.50	<0.50	<0.50		<0.010	<0.50		<0.50	<0.50		<0.0020	<0.0020		0.0094	0.033	<0.0020	<0.0020	<0.0020	0.033	
	TRIP BLANK	trip blank	16-May-2016	<0.50	0.67	<0.50	<0.50	<0.010	0.011	<0.50		<0.50	<0.50		<0.0020	<0.0020		0.005	<0.020	<0.0020	<0.0020	<0.0020	<0.020	<0.020
	TRIP BLANK	trip blank	20-Jul-2016	<0.50	0.79	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		<0.0050	<0.0050		<0.0050	<0.020	<0.0020	<0.0020	<0.0020	<0.020	0.021
	TRIP BLANK	trip blank	29-Sep-2016	<0.50	0.73	<0.50	<0.50	<0.010	0.012	<0.50		<0.50	<0.50		<0.0050	<0.0050		<0.0050	0.032	<0.0020	<0.0020	<0.0020	0.032	<0.020
	TRIP BLANK	trip blank	26-Apr-2017	<0.50	<0.50	<0.50	<0.50	<0.010	0.013	<0.50		<0.50	<0.50		<0.0050	<0.0050		<0.0050	0.035	<0.0020	<0.0020	<0.0020	0.026	0.033
	TRIP BLANK	trip blank	14-Jun-2017	<0.50	<0.50	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		<0.0050	<0.0050		<0.0050	<0.020	<0.0020	<0.0020	<0.0020	<0.020	<0.020
	TRIP BLANK	trip blank	26-Jul-2017	<0.50	0.95	<0.50	<0.50	<0.010	0.01	<0.50		<0.50	0.61		<0.0050	<0.0050		<0.0050	<0.020	<0.0020	<0.0020	<0.0020	<0.020	<0.020
	TRIP BLANK	trip blank	11-Oct-2017	<0.50	0.74	<0.50	<0.50	<0.010	<0.010	<0.50		0.63	<0.50		<0.0050	<0.0050		<0.0050	0.029	<0.0020	<0.0020	<0.0020	0.029	0.04
	TRIP BLANK	trip blank	23-Apr-2018	<0.50	<0.50	<0.50	<0.50	<0.010	0.012	<0.50		<0.50	<0.50		<0.0050	<0.0050		<0.0050	0.021	<0.0020	<0.0020	<0.0020	0.021	<0.020
	TRIP BLANK	trip blank	10-Jun-2018	<0.50	<0.50	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		<0.0030	<0.0030		<0.0050	<0.020	0.00	0.002	<0.0020	<0.020	<0.020
	TRIP BLANK	trip blank	09-Aug-2018	<0.50	<0.50	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50				<0.0050	0.005		<0.0020	<0.0020	<0.0020		
	TRIP BLANK	trip blank	11-Oct-2018	<0.50	<0.50	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		<0.0050	<0.0050	<0.0050	<0.0050	<0.020	<0.0020	<0.0020	<0.0020	<0.020	<0.020
	TB-Q1	trip blank	02-May-2019	<0.50	0.99	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		<0.0030	<0.0030	<0.0030	<0.0050	<0.050	<0.0020	<0.0020	<0.0020	<0.020	<0.0028
	TRIP BLANK	trip blank	13-Jun-2019	<0.50	1.12	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		<0.0030	<0.0030	<0.0050	<0.0050	<0.020	<0.0020	<0.0020	<0.0020	<0.020	<0.020
	TRIP BLANK	trip blank	23-Aug-2019	<0.50	<0.50	<0.50	<0.50	<0.010	<0.010	<0.50		<0.50	<0.50		0.0033	<0.0030	<0.0030	0.0087	0.033	<0.0020	<0.0020	<0.0020	0.033	0.034

Notes:
Samples and sample data with RED text are not considered to be representative of formation water (See Appendix 5-D for further discussion).

1. Reportable detection limits (RDL) presented are the lowest detection limit for a given parameter. Note that the detection limit may have been raised by the analytical laboratory for some analytical results (e.g., due to matrix interference). See Table 3-8 in the main report for further details regarding reportable detection limits between 2014 and 2019.

2. Duplicate sample JH42-08 (Lab ID: UN0655) was collected on 04-Oct-2018 and not 05-Oct-2018 (dummy date for blind duplicate sampling) as indicated in the laboratory Certificate of Analysis.

Station	Sample ID	Sample Class	Sample Date	Dissolved Sulphate (SO4)	Total Sulphide	Total Sulphide (as H2S)	Dissolved Sulphide	Dissolved Sulphide (as H2S)	Cyanides	Cyanide, Weak Acid Diss	Cyanide, Total	Cyanate	Thiocyanate (SCN)	Total Metals	Total Aluminum (Al)	Total Antimony (Sb)	Total Arsenic (As)	Total Barium (Ba)	Total Beryllium (Be)	Total Bismuth (Bi)	Total Boron (B)	Total Cadmium (Cd)	Total Calcium (Ca)	Total Chromium (Cr)	Total Cobalt (Co)	Total Copper (Cu)
				mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.5	0.005	0.005	0.0018	0.0018							0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05
ALS RDL[1]:				0.5	0.002	-				0.001	0.001	0.20	0.50		3	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.5
MW14-02A	MW14-02A	primary	28-Sep-2014	55.4	<0.002										7.5	0.85	68.4	13.4	<0.1	<0.5	<10	<0.01	44.6	0.65	0.13	<0.5
MW14-02A	MW14-02A	primary	12-Jun-2015	56.5	0.0056										59.9	7.07	38	51.3	0.02	0.0106	<10	<0.0050	49.5	0.22	2.81	0.368
MW14-02A	MW14-02A	primary	16-Jul-2015	54.5	0.0068										12.9	0.748	47.4	13.1	<0.010	<0.0050	<10	<0.0050	39.6	0.4	0.0233	<0.050
MW14-02A	MW14-02A	primary	06-Aug-2015	57.6	0.0063										16.1	0.734	55.2	13.9	<0.010	<0.0050	<10	<0.0050	46.1	0.58	0.0332	0.183
MW14-02A	MW14-02A	primary	04-Sep-2015	52.8	0.0113										3.72	0.745	59	10.3	<0.010	<0.0050	<10	<0.0050	39.4	0.51	0.019	0.075
MW14-02A	MW14-100	duplicate	04-Sep-2015	55.9	<0.0050										3.79	0.797	59.1	10.5	<0.010	<0.0050	<10	<0.0050	40.7	0.52	0.017	0.091
MW14-02A	MW14-02A	primary	13-May-2016	49.9	0.013	0.014				<0.0010	<0.0010	<0.20	<0.50		78.7	1.23	51	33.1	<0.010	<0.0050	<10	0.027	43.8	0.88	1.39	2.64
MW14-02A	MW14-02A	primary	17-Jul-2016	50.3	0.0057	0.006				<0.0010	<0.0010	<0.20	<0.50		2.82	0.708	57	10	<0.010	<0.0050	<10	<0.0050	39.7	0.54	0.005	0.057
MW14-02A	JH40-05	duplicate	25-Sep-2016	56.2	<0.0050	<0.0050				<0.0010	<0.0010	<0.20	<0.50		2.94	0.714	56.7	9.77	<0.010	<0.0050	<10	<0.0050	40.4	0.53	<0.0050	<0.050
MW14-02A	MW14-02A	primary	25-Sep-2016	54.6	<0.0050	<0.0050				<0.0010	<0.0010	<0.20	<0.50		2.49	0.735	56.4	9.84	<0.010	<0.0050	<10	<0.0050	40.2	0.56	0.005	<0.050
MW14-02A	MW14-02A	primary	21-Apr-2017	51.9	<0.0050	<0.0050									16.3	1.64	56.9	19.4	<0.010	<0.0050	<10	0.012	43.6	0.56	0.079	0.279
MW14-02A	JH41-03	duplicate	08-Jun-2017	55.8	<0.0050	<0.0050									2.73	0.732	56.6	10.3	<0.010	<0.0050	<10	<0.0050	41	0.54	<0.0050	<0.050
MW14-02A	MW14-02A	primary	08-Jun-2017	55	<0.0050	<0.0050									3.46	0.73	56.1	10.3	<0.010	<0.0050	<10	<0.0050	39.5	0.53	0.005	<0.050
MW14-02A	MW14-02A	primary	28-Jul-2017	54.1	0.0055	0.006									21.3	0.699	58.2	10.5	<0.010	<0.0050	<10	<0.0050	40.4	0.56	0.0162	0.068
MW14-02A	MW14-02A	primary	05-Oct-2017	50.3	0.0121	0.013									3.33	0.752	54.8	10.4	<0.010	<0.0050	<10	<0.0050	44.2	0.55	0.0072	<0.050
MW14-02A	MW14-02A	primary	19-Apr-2018	55.3	<0.0050	<0.0050									4.52	0.716	55.6	10.9	<0.010	<0.0050	<10	<0.0050	42.7	0.54	0.0077	0.058
MW14-02A	MW14-02A	primary	07-Jun-2018	59.7	0.0094	0.01									6.48	0.718	59.6	10.9	<0.010	<0.0050	<10	<0.0050	40.8	0.51	0.0093	<0.050
MW14-02A	MW14-02A	primary	02-Aug-2018	52.5			<0.0050	<0.0050							4.42	0.717	55.1	10.1	<0.010	<0.0050	<10	<0.0050	39.1	0.56	0.0059	<0.050
MW14-02A	JH42-06	duplicate	02-Aug-2018	53.5			<0.0050	<0.0050							3.54	0.699	54.9	10	<0.010	<0.0050	<10	<0.0050	38.8	0.95	0.0064	<0.050
MW14-02A	MW14-02A	primary	04-Oct-2018	50.4			0.0064	0.007							2.04	0.686	56.1	9.46	0.011	<0.0050	<10	<0.0050	41.6	0.53	0.0057	0.05
MW14-02A	MW14-02A	primary	28-Apr-2019	53.4			<0.0019	<0.0019							5.17	0.716	55.3	9.97	<0.010	<0.0050	<10	<0.0050	42.4	0.49	0.029	0.126
MW14-02A	BD1-Q1	duplicate	28-Apr-2019	49.7			<0.0019	<0.0019							4.4	0.716	54.5	10.1	<0.010	<0.0050	<10	<0.0050	42.1	0.52	0.032	0.108
MW14-02A	MW14-02A	primary	13-Jun-2019	53.9			<0.0019	<0.0020							5.72	0.706	55.9	9.29	<0.010	<0.0050	<10	<0.0050	40	0.49	0.0128	<0.050
MW14-02A	MW14-02A	primary	22-Aug-2019	50			<0.0018	<0.0018							23.3	0.678	57.9	10	<0.010	<0.0050	<10	<0.0050	39.3	0.61	0.0624	0.066
MW14-02A	BD2-Q3	duplicate	22-Aug-2019	50			<0.0018	<0.0018							20.1	0.67	57.2	9.84	<0.010	<0.0050	<10	<0.0050	38.8	0.61	0.0558	<0.050
MW14-02B	MW14-02B	primary	28-Sep-2014	85.5	<0.002										6.3	3.25	19.4	54	<0.1	<0.5	<10	<0.01	61.4	0.51	0.62	<0.5
MW14-02B	F-DUP-1	duplicate	28-Sep-2014	85.5	<0.002										4.5	2.87	20	53	<0.1	<0.5	<10	<0.01	60.8	0.5	0.63	<0.5
MW14-02B	MW14-02B	primary	12-Jun-2015	84.3	0.0061										13	0.86	54.4	14.6	<0.010	<0.0050	<10	<0.0050	41.9	0.58	0.0385	0.538
MW14-02B	MW14-02B	primary	16-Jul-2015	82.3	0.0069										12.5	6.39	37.2	57.9	<0.010	<0.0050	<10	<0.0050	52.3	<0.10	1.57	0.143
MW14-02B	MW14-02B	primary	06-Aug-2015	87.3	0.0053										15.3	5.96	39.2	55.3	<0.010	<0.0050	<10	<0.0050	59.7	0.17	1.45	0.264
MW14-02B	MW14-02B	primary	04-Sep-2015	83.7	0.0076										21.8	6.37	42	44.6	0.013	<0.0050	<10	0.013	52.3	0.37	1.75	0.981
MW14-02B	JH40-01	duplicate	13-May-2016	81	0.0119	0.013				<0.0010	<0.0010	<0.20	<0.50		41	9.37	56.8	42	0.019	<0.0050	<10	0.008	59.3	0.55	1.12	0.248
MW14-02B	MW14-02B	primary	13-May-2016	80.8	0.0107	0.011				<0.0010	<0.0010	<0.20	<0.50		41.5	9.28	57.7	44.7	0.015	0.006	<10	0.009	54.8	0.51	1.2	0.343
MW14-02B	MW14-02B	primary	17-Jul-2016	78.1	0.007	0.007				<0.0010	<0.0010	<0.20	<0.50		26.2	9.35	57.9	44.4	0.014	<0.0050	<10	0.009	51.2	0.36	0.865	0.148
MW14-02B	MW14-02B	primary	25-Sep-2016	81	0.0101	0.011				<0.0010	<0.0010	<0.20	<0.50		15.6	7.74	52.7	41.1	<0.010	<0.0050	<10	0.008	53.8	0.37	0.605	0.11
MW14-02B	JH41-01	duplicate	21-Apr-2017	82.7	0.0057	0.006									27.4	6.92	54.3	39.4	<0.010	<0.0050	<10	0.007	58.2	0.42	0.242	0.114
MW14-02B	MW14-02B	primary	21-Apr-2017	83.7	0.0051	0.005									28	6.88	53.5	39.9	0.01	<0.0050	<10	0.006	55.7	0.43	0.238	0.12
MW14-02B	MW14-02B	primary	08-Jun-2017	79.2	<0.0050	<0.0050									7.56	6.66	41.4	36.6	<0.010	<0.0050	<10	<0.0050	52.5	0.41	0.262	0.058
MW14-02B	JH41-06	duplicate	28-Jul-2017	76.5	0.0057	0.006									27.5	7.28	43.7	40.6	<0.010	<0.0050	<10	0.0061	51.3	0.48	0.458	0.125
MW14-02B	MW14-02B	primary	28-Jul-2017	77.4	<0.0050	<0.0050									26.4	7.22	43.2	40.7	<0.010	<0.0050	<10	<0.0050	50.3	0.46	0.385	0.11
MW14-02B	MW14-02B	primary	05-Oct-2017	86	0.0112	0.012									27.3	7.07	42.1	39.1	<0.010	<0.0050	<10	<0.0050	54.6	0.88	0.306	0.182
MW14-02B	JH42-02	duplicate	19-Apr-2018	82.3	0.0196	0.021									16.9	5.79	37.8	34.8	<0.010	<0.0050	<10	0.007	57.4	0.44	0.114	0.113
MW14-02B	MW14-02B	primary	19-Apr-2018	81	0.0089	0.009									18.7	5.73	36.6	33.9	<0.010	<0.0050	<10	0.0073	55.2	0.48	0.115	0.107
MW14-02B	MW14-02B	primary	07-Jun-2018	89.9	0.0068	0.007									611	11.9	93.1	65.8	0.156	0.0625	<10	0.0335	53.9	2.65	3.06	1.85
MW14-02B	MW14-02B	primary	02-Aug-2018	82.3			<0.0050	<0.0050							101	6.62	44.3	37.7	0.027	0.0087	<10	0.0085	49.7	0.78	0.478	0.299
MW14-02B	MW14-02B	primary	04-Oct-2018	89.1			<0.0050	<0.0053							34.3	5.73	40.1	32.1	<0.010	<0.010	<10	<0.0050	50.5	0.56	0.205	0.23
MW14-02B	JH42-08	duplicate	05-Oct-2018	81.2			<0.0050	<0.0053							34.3	5.8	40.6	33.9	<0.010	<0.010	<10	<0.0050	50.9	0.55	0.222	0.2
MW14-02B	MW14-02B	primary	28-Apr-2019	81.1			<0.0019	<0.0019							17.6	5.44	37.1	29.5	<0.010	<0.0050	<10	0.005	51.5	0.55	0.185	0.066
MW14-02B	MW14-02B	primary	13-Jun-2019	70.4			<0.0019	<0.0020							3.11	4.67	36.2	28.4	<0.010	<0.0050	<10	<0.0050	50.1	0.49	0.0863	<0.050
MW14-02B	BD1-Q2	duplicate	13-Jun-2019	70.9			<0.0019	<0.0020							4.71	4.74	36.5	28.1	<0.010	<0.0050	<10	<0.0050	50.1	0.47	0.0857	<0.050
MW14-02B	MW14-02B	primary	22-Aug-2019	75			<0.0018	<0.0018							0.92	4.68	37.1	28.4	<0.010	<0.0050	<10	<0.0050	49.5	0.5	0.0636	<0.050
MW14-03A	MW14-03A	primary	12-Oct-2014	269	<0.02										337	0.99	59.8	381	<0.1	<0.5	<10	0.072	72.5	8.36	0.81	8.91
MW14-03A	MW14-03A	primary	22-Jun-2015	482	0.0999										6.05	0.979	46	141	0.013	0.008	<10	0.007	133	<0.10	2.42	0.63
MW14-03A	MW14-03A	primary	12-Jul-2015	450	0.116										24.5	0.754	65	132	0.013	<0.0050	<10	0.0065	140	0.27	2.05	0.887
MW14-03A	MW14-03A	primary	07-Aug-2015	455	0.12										9.08	0.591	68	99.5	0.012	0.0076	<10	<0.0050	130	<0.10	1.73	0.44
MW14-03A	MW14-50	duplicate	07-Aug-2015	458	0.12										27	0.592	68.7	96.8	0.015	<0.0050	<10	0.0109	131	0.13	1.66	1.06
MW14-03A	MW14-03A	primary	06-Sep-2015	411	0.147										5.29	0.356	75.3	118	0.018	<0.0050	10	<0.0050	126	<0.10	1.51	0.726
MW14-03A	MW14-03A	primary	16-May-2016	483	0.167	0.18				<0.0010	<0.0010	<0.20	<0.50		2.73	0.119	73.4	98.3	0.014	<0.0050	<10	<0.0050	153	<0.10	1.44	0.221
MW14-03A	MW14-03A	primary	14-Jul-2016	504	0.148	0.16				<0.0010	<0.0010	<0.20	<0.50		3.76	0.127	74.6	87.2	0.016	<0.0050	10	<0.0050	142	<0.10	1.53	0.476

Station	Sample ID	Sample Class	Sample Date	Dissolved Sulphate (SO4)	Total Sulphide	Total Sulphide (as H2S)	Dissolved Sulphide	Dissolved Sulphide (as H2S)	Cyanides	Cyanide, Weak Acid Diss	Cyanide, Total	Cyanate	Thiocyanate (SCN)	Total Metals	Total Aluminum (Al)	Total Antimony (Sb)	Total Arsenic (As)	Total Barium (Ba)	Total Beryllium (Be)	Total Bismuth (Bi)	Total Boron (B)	Total Cadmium (Cd)	Total Calcium (Ca)	Total Chromium (Cr)	Total Cobalt (Co)	Total Copper (Cu)
				mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.5	0.005	0.005	0.0018	0.0018							0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05
ALS RDL[1]:				0.5	0.002	-				0.001	0.001	0.20	0.50		3	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.5
MW14-03A	MW14-03A	primary	24-Sep-2016	520	0.116	0.12				<0.0010	<0.0010	<0.20	<0.50		3.95	0.105	65.8	80.6	0.016	<0.0050	<10	<0.0050	144	<0.10	1.6	0.46
MW14-03A	MW14-03A	primary	27-Apr-2017	539	0.113	0.12									8.27	0.148	61.7	75.3	0.013	<0.0050	<10	<0.0050	137	0.13	1.4	0.887
MW14-03A	MW14-03A	primary	09-Jun-2017	501	0.0524	0.056									6.89	0.122	58.9	66.1	<0.010	<0.0050	<10	<0.0050	145	<0.10	1.45	1.07
MW14-03A	MW14-03A	primary	26-Jul-2017	604	0.086	0.091									7.7	0.1	46.3	54.6	<0.050	<0.025	<50	0.049	139	<0.50	1.43	1.16
MW14-03A	JH41-08	duplicate	06-Oct-2017	514	0.102	0.11									11.8	0.163	57.8	63.5	0.018	<0.0050	<10	<0.0050	157	0.14	1.5	3.46
MW14-03A	MW14-03A	primary	06-Oct-2017	513	0.0979	0.1									26.2	0.524	56.5	62.5	0.015	<0.0050	11	<0.0050	151	0.24	1.48	1.72
MW14-03A	MW14-03A	primary	20-Apr-2018	556	0.0848	0.09									9.96	0.153	53.4	52.8	0.016	<0.0050	<10	<0.0050	149	0.1	1.47	1.08
MW14-03A	MW14-03A	primary	08-Jun-2018	526	0.133	0.14									12	0.19	53.5	52.5	0.019	<0.0050	<10	<0.0050	144	0.14	1.43	2.53
MW14-03A	MW14-03A	primary	05-Aug-2018	530			0.0549	0.058							10.3	0.12	57.4	46.1	0.015	<0.010	<10	<0.0050	139	0.14	1.49	0.75
MW14-03A	MW14-03A	primary	07-Oct-2018	512			0.0805	0.086							12.4	0.131	58.4	60.1	0.012	<0.010	10	<0.0050	141	0.16	1.64	0.96
MW14-03A	MW14-03A	primary	27-Apr-2019	334			0.12	0.13							4.69	0.14	42	51.6	0.012	<0.0050	<10	0.005	146	0.13	1.43	0.504
MW14-03A	MW14-03A	primary	14-Jun-2019	528			0.19								14.9	0.181	52.7	47.1	<0.020	<0.010	<20	<0.010	138	<0.20	1.35	0.946
MW14-03A	MW14-03A	primary	23-Aug-2019	490			0.50	0.54							10.8	0.364	41.8	59.2	<0.020	<0.020	<20	<0.010	145	0.34	1.39	1.47
MW14-03B	MW14-03B	primary	06-Oct-2014	476	0.0064										665	0.21	3.57	90.5	<0.1	<0.5	16	0.021	118	2.5	2.14	1.93
MW14-03B	MW14-03B	primary	22-Jun-2015	502	0.0252										18.4	0.136	7.68	91.7	<0.010	0.006	<10	0.067	120	0.3	6.9	5.38
MW14-03B	MW14-03B	primary	12-Jul-2015	511	0.0239										26.4	0.129	9.72	87.6	<0.010	<0.0050	<10	0.106	133	0.55	6.78	4.39
MW14-03B	MW14-03B	primary	07-Aug-2015	515	0.0229										15.9	0.111	8.23	70	<0.010	0.0139	<10	0.056	130	0.14	6.94	3.47
MW14-03B	MW14-03B	primary	06-Sep-2015	490	0.0253										4.38	0.1	8.13	68.2	<0.010	<0.0050	<10	0.051	118	<0.10	6.94	2.36
MW14-03B	MW14-200	duplicate	06-Sep-2015	535	0.0249										4.08	0.101	7.94	69.4	<0.010	<0.0050	<10	0.049	119	<0.10	6.93	2.62
MW14-03B	MW14-03B	primary	16-May-2016	539	0.01	0.011				<0.0010	<0.0010	<0.20	<0.50		4.39	0.089	13	51.4	<0.010	0.005	<10	0.051	138	<0.10	5.74	3.05
MW14-03B	MW14-03B	primary	14-Jul-2016	559	0.0112	0.012				<0.0010	<0.0010	<0.20	<0.50		4.36	0.089	12.4	49.3	<0.010	<0.0050	<10	0.041	135	<0.10	5.24	2.45
MW14-03B	MW14-03B	primary	24-Sep-2016	530	0.0168	0.018				<0.0010	<0.0010	<0.20	<0.50		5.78	0.122	8.27	45.2	<0.010	0.005	<10	0.038	134	0.13	4.62	1.79
MW14-03B	MW14-03B	primary	27-Apr-2017	568	0.0105	0.011									9.11	0.249	10.3	47.7	<0.010	<0.0050	<10	0.03	120	0.34	4.26	2.76
MW14-03B	MW14-03B	primary	09-Jun-2017	538	0.0102	0.011									14	0.265	11.2	48.4	<0.010	0.007	<10	0.033	132	0.37	4.53	3.02
MW14-03B	MW14-03B	primary	26-Jul-2017	566	0.009	0.01									10.2	0.14	10.7	41.9	<0.050	<0.025	<50	<0.025	125	<0.50	4.52	2.35
MW14-03B	MW14-03B	primary	06-Oct-2017	568	0.0221	0.024									12.8	0.324	14.3	44.2	<0.010	<0.0050	<10	0.0181	139	0.19	4.16	2.28
MW14-03B	MW14-03B	primary	20-Apr-2018	579	0.0201	0.021									8.19	0.259	12.7	42.4	<0.010	<0.0050	<10	0.0184	139	0.26	4.13	2.08
MW14-03B	MW14-03B	primary	08-Jun-2018	592	0.0277	0.029									1.85	0.091	14.4	50.9	<0.010	0.0067	<10	<0.0050	131	<0.10	4.6	0.269
MW14-03B	MW14-03B	primary	05-Aug-2018	593			0.0072	0.008							9.8	0.26	15.4	43.3	<0.010	<0.010	<10	0.0108	128	0.16	4.07	1.87
MW14-03B	MW14-03B	primary	07-Oct-2018	548			0.0072	0.008							10.8	0.225	7.46	41.8	<0.010	<0.010	<10	0.0127	133	0.19	4.13	1.4
MW14-03B	MW14-03B	primary	27-Apr-2019	559			<0.0019	<0.0019							5	0.158	10.4	31.9	<0.020	<0.010	<20	0.011	127	<0.20	3.35	1.38
MW14-03B	MW14-03B	primary	14-Jun-2019	630			<0.0019								11.4	0.133	17.6	37.5	0.191	0.0215	10	0.199	132	0.24	4.16	1.23
MW14-03B	MW14-03B	primary	23-Aug-2019	590			<0.0018	<0.0019							<6.0	0.128	18.1	39.1	<0.020	<0.020	<20	<0.010	135	<0.20	4.3	1.14
MW14-05A	MW14-05A	primary	02-Oct-2014	31.9	<0.002										1250	0.39	571	95.9	0.14	<0.5	12	0.039	35.8	10.3	0.83	7.85
MW14-05A	MW14-05A	primary	23-Jun-2015	25.5	0.031										89.5	0.789	1910	99.7	0.03	0.008	<10	0.015	42.6	0.22	1.13	1.77
MW14-05A	MW14-05A	primary	13-Jul-2015	20.2	0.0642										116	0.748	1670	95.8	0.027	0.0095	<10	0.0499	46.7	0.43	0.89	3.19
MW14-05A	MW14-05A	primary	08-Aug-2015	13.1	0.171										69.7	0.746	1710	108	0.024	0.0105	<10	0.0705	47.8	0.35	0.948	1.86
MW14-05A	MW14-05A	primary	07-Sep-2015	17.3	0.12										22.8	0.561	1810	123	0.023	<0.0050	<10	0.024	46.6	0.2	1.04	0.467
MW14-05A	MW14-05A	primary	14-May-2016	10.4	0.143	0.15				<0.0010	<0.0010	<0.20	<0.50		31.2	0.58	1870	206	0.017	<0.0050	<10	0.035	59	0.23	0.566	0.493
MW14-05A	JH40-04	duplicate	16-Jul-2016	17.8	0.132	0.14				<0.0010	<0.0010	<0.20	<0.50		12.4	0.543	2060	201	0.018	<0.0050	<10	0.026	49.9	0.16	0.573	0.266
MW14-05A	MW14-05A	primary	16-Jul-2016	21	0.12	0.13				<0.0010	<0.0010	<0.20	<0.50		12.6	0.574	2250	204	0.022	0.005	<10	0.023	47.9	0.18	0.56	0.347
MW14-05A	MW14-05A	primary	23-Sep-2016	9.9	0.212	0.23				<0.0010	<0.0010	<0.20	<0.50		15.7	0.795	1540	228	0.015	0.006	<10	0.13	54	0.29	0.465	0.768
MW14-05A	MW14-05A	primary	28-Apr-2017	6.73	0.153	0.16									14.5	0.712	1520	231	0.011	<0.0050	<10	0.045	54.4	0.27	0.333	0.568
MW14-05A	MW14-05A	primary	10-Jun-2017	13.4	0.0914	0.097									8.2	0.61	2040	253	<0.050	<0.025	<50	<0.025	49.4	<0.50	0.325	0.26
MW14-05A	MW14-05A	primary	25-Jul-2017	12.7	0.161	0.17									<15	0.51	1910	240	<0.050	<0.050	<50	<0.025	49.2	<0.50	0.36	<0.50
MW14-05A	MW14-05A	primary	08-Oct-2017	10.8	0.115	0.12									18.7	0.65	2100	259	<0.050	<0.025	60	0.035	57.3	<0.50	0.348	0.42
MW14-05A	MW14-05A	primary	21-Apr-2018	10.3			0.055	0.058							25.1	0.76	1960	273	<0.050	<0.025	<50	0.057	55.1	<0.50	0.279	0.9
MW14-05A	JH42-04	duplicate	09-Jun-2018	14.3	0.117	0.12									7.7	0.67	2290	256	<0.050	<0.025	<50	<0.025	51.8	<0.50	0.254	<0.25
MW14-05A	MW14-05A	primary	09-Jun-2018	14.3	0.128	0.14									9.6	0.66	2210	252	<0.050	<0.025	<50	<0.025	52.5	<0.50	0.283	0.27
MW14-05A	MW14-05A	primary	04-Aug-2018	12.5			0.0504	0.054							20	0.72	2230	264	<0.050	<0.050	<50	<0.025	51.2	<0.50	0.269	0.51
MW14-05A	MW14-05A	primary	06-Oct-2018	7.28			0.061	0.065							21	0.68	2090	286	<0.050	<0.050	<50	<0.025	53.6	<0.50	0.326	0.89
MW14-05A	MW14-05A	primary	29-Apr-2019	10			0.032								<15	0.64	2330	262	<0.050	<0.050	<50	<0.025	55.2	<0.50	0.262	<0.50
MW14-05A	BD2-Q1	duplicate	29-Apr-2019	12.1			0.04								<15	0.64	2510	265	<0.050	<0.050	<50	<0.025	55.8	<0.50	0.249	<0.50
MW14-05A	MW14-05A	primary	15-Jun-2019	10.6			0.084								10.9	0.58	2570	269	<0.050	<0.025	<50	0.037	56	<0.50	0.261	0.54
MW14-05A	MW14-05A	primary	24-Aug-2019	12			0.039	0.042							<15	0.84	2800	304	<0.050	<0.050	<50	<0.025	62.9	<0.50	0.26	<0.50
MW14-05B	MW14-05B	primary	03-Oct-2014	109	<0.002										3840	0.34	145	186	0.15	<0.5	15	0.049	48.1	12.8	1.53	12.9
MW14-05B	MW14-05B	primary	24-Jun-2015	107	<0.0050										945	1.16	148	111	0.067	0.019	11	0.14	43.1	1.85	2.15	13.4
MW14-05B	MW14-05B	primary	14-Jul-2015	158	0.0443										334	0.912	129	93.4	0.016	0.0057	18	0.0815	47.4	1.2	1.59	5.86
MW14-05B	MW14-05B	primary	09-Aug-2015	170	0.12										108	0.642	141	83	0.015	<0.0050	26	0.0356	49	0.58	1.4	2.07

Station	Sample ID	Sample Class	Sample Date	Dissolved Sulphate (SO4)	Total Sulphide	Total Sulphide (as H2S)	Dissolved Sulphide	Dissolved Sulphide (as H2S)	Cyanides	Cyanide, Weak Acid Diss	Cyanide, Total	Cyanate	Thiocyanate (SCN)	Total Metals	Total Aluminum (Al)	Total Antimony (Sb)	Total Arsenic (As)	Total Barium (Ba)	Total Beryllium (Be)	Total Bismuth (Bi)	Total Boron (B)	Total Cadmium (Cd)	Total Calcium (Ca)	Total Chromium (Cr)	Total Cobalt (Co)	Total Copper (Cu)
				mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.5	0.005	0.005	0.0018	0.0018							0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05
ALS RDL[1]:				0.5	0.002	-				0.001	0.001	0.20	0.50		3	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.5
MW14-05B	MW14-05B	primary	08-Sep-2015	99.6	0.0887										68.9	0.635	176	81.5	<0.010	0.007	12	0.046	45.5	1.73	1.51	2.56
MW14-05B	MW14-05B	primary	15-May-2016	24.1	0.14	0.15				<0.0010	<0.0010	<0.20	<0.50		13.2	0.225	137	85.2	<0.010	<0.0050	<10	<0.0050	55.6	0.69	0.688	<0.050
MW14-05B	MW14-05B	primary	16-Jul-2016	22.2	0.116	0.12				<0.0010	<0.0010	<0.20	<0.50		20.4	0.332	160	93.9	<0.010	<0.0050	11	0.011	49.1	2.05	0.812	0.821
MW14-05B	MW14-05B	primary	23-Sep-2016	18	0.0512	0.054				<0.0010	<0.0010	<0.20	<0.50		10.4	0.245	191	80.4	<0.010	<0.0050	11	0.009	45.8	0.67	0.734	0.442
MW14-05B	MW14-05B	primary	29-Apr-2017	13.5	0.0637	0.068									94.8	0.22	190	93.8	<0.010	<0.0050	<10	0.027	44.7	0.98	0.79	1.65
MW14-05B	MW14-05B	primary	11-Jun-2017	15.8	0.0293	0.031									12.5	0.144	163	91.8	<0.010	<0.0050	11	0.006	46.4	0.19	0.761	0.232
MW14-05B	MW14-05B	primary	26-Jul-2017	13.6	0.0247	0.026									40.1	0.165	130	88.5	<0.010	<0.010	<10	0.033	44.2	0.55	0.666	0.86
MW14-05B	MW14-05B	primary	08-Oct-2017	9.5	0.0302	0.032									11.1	0.121	153	92.5	<0.010	<0.0050	11	0.0108	51.3	0.6	0.446	0.311
MW14-05B	MW14-05B	primary	22-Apr-2018	9.33			0.025	0.027							40.9	0.212	158	92.6	<0.010	<0.0050	<10	0.0318	46.1	0.51	0.463	2.51
MW14-05B	MW14-05B	primary	10-Jun-2018	15.3	0.0316	0.034									9.3	0.114	199	83.5	<0.010	<0.0050	<10	<0.0050	45.4	0.12	0.419	0.167
MW14-05B	MW14-05B	primary	04-Aug-2018	14.9			0.0164	0.017							10.1	0.1	210	85.3	<0.010	<0.010	<10	<0.0050	44.7	0.14	0.436	0.2
MW14-05B	MW14-05B	primary	06-Oct-2018	13.1			0.0213	0.023							9.6	0.087	210	83.2	<0.010	<0.010	<10	0.007	41	0.12	0.397	0.18
MW14-05B	MW14-05B	primary	30-Apr-2019	8.31			0.0097								4.2	0.079	184	86	<0.010	<0.010	<10	<0.0050	44.8	<0.10	0.306	0.15
MW14-05B	MW14-05B	primary	16-Jun-2019	14.6			0.027								5.31	0.091	225	80	<0.010	<0.0050	<10	<0.0050	44.2	<0.10	0.268	0.091
MW14-05B	MW14-05B	primary	25-Aug-2019	14			0.0056	0.006							21.1	0.122	217	79.5	<0.010	<0.010	<10	0.0077	43.2	0.2	0.321	0.93
MW15-01WB	MW15-01WB	primary	07-Jun-2015	906	<0.0050										4.17	0.742	34.5	10.1	0.041	<0.0050	<10	0.0211	283	0.21	0.88	0.459
MW15-01WB	MW15-01WB	primary	08-Jul-2015	954	0.0074										11.9	0.585	31	10.7	0.038	<0.0050	<10	0.0476	246	0.23	0.765	0.862
MW15-01WB	MW15-01WB	primary	10-Aug-2015	880	0.0057										49	0.376	34.7	11.4	0.04	<0.0050	<10	0.108	251	1.48	0.77	0.605
MW15-01WB	MW15-01WB	primary	03-Sep-2015	841	0.0094										5.1	0.321	39.8	8.96	0.045	<0.0050	<10	0.026	222	0.46	0.701	0.301
MW15-01WB	MW15-01WB	primary	15-May-2016	886	0.0109	0.012				<0.0010	<0.0010	<0.20	<0.50		4.95	0.18	37.7	8.55	0.037	<0.0050	<10	0.009	253	<0.10	0.613	<0.050
MW15-01WB	MW15-01WB	primary	14-Jul-2016	912	0.027	0.029				<0.0010	<0.0010	<0.20	<0.50		5.62	0.185	45.3	7.51	0.044	<0.0050	<10	0.006	259	0.38	0.438	0.107
MW15-01WB	MW15-01WB	primary	22-Sep-2016	860	0.056	0.06				<0.0010	<0.0010	<0.20	<0.50		3.94	0.2	39.4	8.3	0.057	<0.0050	<10	0.007	257	<0.10	0.367	0.235
MW15-01WB	MW15-01WB	primary	22-Apr-2017	907	0.0447	0.048									11.8	0.21	24.7	8.27	<0.050	<0.025	<50	0.046	262	<0.50	0.338	<0.25
MW15-01WB	MW15-01WB	primary	08-Jun-2017	881	<0.0050	<0.0050									<2.5	0.27	4.63	7.95	<0.050	<0.025	<50	<0.025	250	<0.50	0.283	<0.25
MW15-01WB	MW15-01WB	primary	24-Jul-2017	911	0.0468	0.05									6.4	0.22	25.9	8.19	0.079	<0.025	<50	<0.025	255	<0.50	0.176	<0.25
MW15-01WB	MW15-01WB	primary	06-Oct-2017	887	0.0255	0.027									23.9	0.144	24.7	9.95	0.064	0.0053	<10	0.043	278	3.56	0.305	0.908
MW15-01WB	MW15-01WB	primary	19-Apr-2018	848	0.0071	0.008									<2.5	<0.10	32.1	7.69	0.082	<0.025	<50	<0.025	262	<0.50	0.408	<0.25
MW15-01WB	MW15-01WB	primary	07-Jun-2018	891	0.0218	0.023									5.5	0.12	18.8	8.88	0.056	<0.025	<50	<0.025	252	<0.50	0.35	<0.25
MW15-01WB	MW15-01WB	primary	02-Aug-2018	895			0.033	0.035							6.61	0.152	19.3	8.15	0.053	0.0057	<10	0.0844	245	0.12	0.263	0.145
MW15-01WB	MW15-01WB	primary	03-Oct-2018	906			0.0095	0.01							<6.0	0.117	28.9	7.19	0.031	<0.020	<20	0.012	246	<0.20	0.419	0.75
MW15-01WB	MW15-01WB	primary	05-May-2019	899			<0.0019	<0.0020							7.8	0.387	17.3	7.16	0.034	<0.020	<20	0.074	230	<0.20	0.425	2.42
MW15-01WB	MW15-01WB	primary	18-Jun-2019	888			0.076								6.4	0.207	12	8.53	0.051	<0.010	<20	<0.010	248	<0.20	0.261	<0.10
MW15-01WB	MW15-01WB	primary	22-Aug-2019	850			0.052	0.055							3.1	<0.040	12.1	7.41	0.041	<0.010	<20	<0.010	249	<0.20	0.267	<0.10
MW15-02AZ	MW15-02AZ	primary	31-May-2015	245	0.0054										8.38	0.434	1.1	95.8	<0.010	<0.0050	<10	0.0089	130	0.11	0.186	1.19
MW15-02AZ	MW15-02AZ	primary	11-Jul-2015	190	<0.0050										10.3	0.14	0.948	87.6	<0.010	<0.0050	<10	0.0146	109	0.17	0.0261	1.03
MW15-02AZ	MW15-40AZ	duplicate	11-Jul-2015	185	0.006										8.17	0.143	0.831	94.4	<0.010	<0.0050	<10	0.0209	114	0.13	0.0244	1.01
MW15-02AZ	MW15-02AZ	primary	12-Aug-2015	163	0.0077										8.95	0.153	1.03	82.8	<0.010	<0.0050	<10	0.0056	106	0.15	0.049	1.12
MW15-02AZ	MW15-02AZ	primary	07-Sep-2015	154	<0.0050										6.95	0.152	1.04	74.9	<0.010	<0.0050	<10	<0.0050	104	0.12	0.1	0.994
MW15-02AZ	MW15-02AZ	primary	17-May-2016	196	0.0139	0.015				<0.0010	<0.0010	<0.20	<0.50		3.82	0.132	0.804	65.5	<0.010	<0.0050	<10	<0.0050	115	<0.10	0.114	0.775
MW15-02AZ	MW15-02AZ	primary	19-Jul-2016	163	<0.0050	<0.0050				<0.0010	<0.0010	<0.20	<0.50		4.16	0.144	0.789	63.4	<0.010	<0.0050	<10	<0.0050	120	<0.10	0.116	0.87
MW15-02AZ	JH40-06	duplicate	25-Sep-2016	180	0.0169	0.018				<0.0010	<0.0010	<0.20	<0.50		64.5	0.134	0.873	66.3	<0.010	<0.0050	<10	0.005	114	0.36	0.168	0.77
MW15-02AZ	MW15-02AZ	primary	25-Sep-2016	190	0.0158	0.017				<0.0010	<0.0010	<0.20	<0.50		62.2	0.141	1.01	66.2	<0.010	<0.0050	<10	0.007	114	0.25	0.211	0.788
MW15-02AZ	MW15-02AZ	primary	28-Jul-2017	175	0.0054	0.006									3.49	0.14	0.827	77.6	<0.010	<0.0050	<10	0.0051	111	0.11	0.0758	0.826
MW15-02AZ	MW15-02AZ	primary	08-Oct-2017	196	0.0082	0.009									4.43	0.154	1.04	93.1	<0.010	<0.0050	<10	0.006	113	0.15	0.0249	0.915
MW15-02AZ	JH42-05	duplicate	03-Aug-2018	212			<0.0050	<0.0050							5.08	0.13	0.808	77.7	<0.010	0.0057	<10	0.005	119	0.11	0.0842	0.746
MW15-02AZ	MW15-02AZ	primary	03-Aug-2018	203			<0.0050	<0.0050							3.99	0.119	0.759	76.5	<0.010	<0.0050	<10	0.0056	117	0.11	0.0829	0.739
MW15-02WB	MW15-02WB	primary	01-Jun-2015	242	0.006										6.19	0.343	2.44	26.3	<0.010	<0.0050	<10	0.0478	129	2.1	0.154	1.44
MW15-02WB	MW15-02WB	primary	11-Jul-2015	234	0.0051										22.9	0.128	2.68	23	0.013	<0.0050	<10	0.0348	128	0.37	0.106	0.293
MW15-02WB	MW15-02WB	primary	12-Aug-2015	236	0.0095										8.86	0.128	2.99	24	0.015	<0.0050	<10	0.0342	134	0.62	0.13	0.248
MW15-02WB	MW15-02WB	primary	07-Sep-2015	202	0.0054										1.84	0.082	0.581	38.9	<0.010	<0.0050	<10	0.011	128	0.15	0.074	1.81
MW15-02WB	MW15-02WB	primary	18-May-2016	209	0.0094	0.01				<0.0010	<0.0010	<0.20	<0.50		2.47	0.073	2.67	30.6	0.01	<0.0050	<10	0.006	120	<0.10	0.111	0.768
MW15-02WB	MW15-02WB	primary	19-Jul-2016	184	0.011	0.012				<0.0010	<0.0010	<0.20	<0.50		3.13	0.08	0.664	40.9	<0.010	<0.0050	<10	0.005	117	0.21	0.032	1.81
MW15-02WB	MW15-02WB	primary	25-Sep-2016	190	0.0094	0.01				<0.0010	<0.0010	<0.20	<0.50		3.11	0.127	0.396	41.5	<0.010	<0.0050	<10	0.033	124	<0.10	0.061	2.57
MW15-02WB	JH41-02	duplicate	25-Apr-2017	229	<0.0050	<0.0050									1.51	0.086	0.46	47.9	<0.010	<0.0050	<10	0.019	132	0.14	0.044	1.85
MW15-02WB	MW15-02WB	primary	25-Apr-2017	227	0.0061	0.006									1.61	0.097	0.464	47.4	<0.010	<0.0050	<10	0.016	135	0.12	0.042	1.87
MW15-02WB	JH41-04	duplicate	13-Jun-2017	222	0.0119	0.013									5.78	0.099	2.53	22.5	0.014	<0.0050	<10	0.025	128	0.32	0.084	0.321
MW15-02WB	MW15-02WB	primary	13-Jun-2017	224	0.0107	0.011									2.34	0.076	2.48	22.9	0.012	<0.0050	<10	0.015	128	<0.10	0.08	0.217
MW15-02WB	MW15-02WB	primary	28-Jul-2017	193	<0.0050	<0.0050									2.7	0.083	0.367	43.1	<0.010	<0.0050	<10	0.0192	125	0.32	0.0278	1.69
MW15-02WB	MW15-02WB	primary	08-Oct-2017	201	0.0067	0.007									13.3	0.081	0.408	44.2	<0.010	<0.0050	<10	0.081	124	1.22	0.0458	1.97

Station	Sample ID	Sample Class	Sample Date	Dissolved Sulphate (SO4)	Total Sulphide	Total Sulphide (as H2S)	Dissolved Sulphide	Dissolved Sulphide (as H2S)	Cyanides	Cyanide, Weak Acid Diss	Cyanide, Total	Cyanate	Thiocyanate (SCN)	Total Metals	Total Aluminum (Al)	Total Antimony (Sb)	Total Arsenic (As)	Total Barium (Ba)	Total Beryllium (Be)	Total Bismuth (Bi)	Total Boron (B)	Total Cadmium (Cd)	Total Calcium (Ca)	Total Chromium (Cr)	Total Cobalt (Co)	Total Copper (Cu)
				mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.5	0.005	0.005	0.0018	0.0018							0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05
ALS RDL[1]:				0.5	0.002	-				0.001	0.001	0.20	0.50		3	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.5
MW15-02WB	MW15-02WB	primary	21-Apr-2018	260			<0.0050	<0.0050							9.13	0.079	0.809	47.6	<0.010	<0.0050	<10	0.0071	143	<0.10	0.0605	1.6
MW15-02WB	JH42-03	duplicate	09-Jun-2018	246	0.0081	0.009									4.62	0.055	3.42	20.9	0.018	<0.0050	<10	0.0194	126	0.12	0.0604	0.109
MW15-02WB	MW15-02WB	primary	09-Jun-2018	248	0.0053	0.006									4.47	0.048	2.37	20.8	0.016	<0.0050	<10	0.0282	128	0.16	0.0665	0.132
MW15-02WB	MW15-02WB	primary	04-Aug-2018	207			<0.0050	<0.0050							4.2	0.044	2.5	22.9	0.017	<0.010	<10	0.0095	129	0.12	0.072	0.12
MW15-02WB	JH42-07	duplicate	06-Oct-2018	227			<0.0050	<0.0053							<3.0	0.073	0.342	46	<0.010	<0.010	<10	0.007	123	0.15	0.026	1.77
MW15-02WB	MW15-02WB	primary	06-Oct-2018	191			<0.0050	<0.0053							<3.0	0.072	0.358	46.3	<0.010	<0.010	<10	<0.0050	123	<0.10	0.03	1.84
MW15-02WB	MW15-02WB	primary	29-Apr-2019	238			<0.0019								3.1	0.073	0.39	49.8	<0.010	<0.010	<10	0.008	131	0.41	0.062	1.94
MW15-02WB	MW15-02WB	primary	19-Jun-2019	213			<0.0019	<0.0019							2.41	0.079	1.96	22.3	0.016	<0.0050	<10	0.0175	129	0.17	0.0782	0.156
MW15-02WB	BD2-Q2	duplicate	19-Jun-2019	213			<0.0019	<0.0019							2.95	0.077	1.89	22.3	0.016	<0.0050	<10	0.0305	127	1.29	0.0702	0.202
MW15-02WB	MW15-02WB	primary	24-Aug-2019	240			<0.0018	<0.0019							7.1	0.059	1.95	22.4	0.017	<0.010	<10	0.0129	128	3.81	0.134	0.29
MW15-03AZ	MW15-03AZ	primary	16-Jun-2015	53	<0.0050										47.2	0.15	0.45	38	<0.010	<0.0050	<10	0.0118	41	0.19	0.0612	1.39
MW15-03AZ	MW15-21	duplicate	16-Jun-2015	57.7	0.0065										34.4	0.141	0.445	38.1	0.011	<0.0050	<10	0.0104	40	0.14	0.0589	1.28
MW15-03AZ	MW15-03AZ	primary	09-Jul-2015	51	0.0065										25.5	0.128	0.409	29.5	<0.010	<0.0050	<10	0.0185	37.7	0.2	0.0709	1.44
MW15-03AZ	MW15-03AZ	primary	10-Aug-2015	25.4	0.0061										32.8	0.203	0.525	30	0.013	<0.0050	<10	0.016	29.3	0.3	0.0583	1.94
MW15-03AZ	MW15-03AZ	primary	04-Sep-2015	21.7	0.0073										19.4	0.188	0.515	25.8	0.016	<0.0050	<10	0.011	26	0.22	0.058	1.99
MW15-03AZ	JH40-02	duplicate	16-May-2016	39.4	0.0073	0.008				<0.0010	<0.0010	<0.20	<0.50		683	0.208	1.4	30.4	0.043	<0.020	<50	0.011	24	1.68	0.535	1.8
MW15-03AZ	MW15-03AZ	primary	16-May-2016	38.9	0.0107	0.011				<0.0010	<0.0010	<0.20	<0.50		935	0.222	1.52	34.7	0.05	<0.020	<50	0.012	24.5	2.05	0.649	1.76
MW15-03AZ	MW15-03AZ	primary	16-Jul-2016	25.6	0.0076	0.008				<0.0010	<0.0010	<0.20	<0.50		20	0.234	0.468	26.7	0.011	<0.0050	<10	<0.0050	27	0.19	0.039	1.74
MW15-03AZ	MW15-03AZ	primary	23-Sep-2016	26	0.0097	0.01				<0.0010	<0.0010	<0.20	<0.50		17.5	0.236	0.564	30.8	0.012	<0.0050	<10	0.005	25.3	0.18	0.035	1.69
MW15-03AZ	MW15-03AZ	primary	25-Jul-2017	36.9	<0.0050	<0.0050									18.2	0.176	0.47	29.8	0.011	<0.0050	<10	0.0063	29.9	0.2	0.0343	1.53
MW15-03AZ	MW15-03AZ	primary	07-Oct-2017	37.9	0.008	0.009									13.2	0.207	0.487	35.2	<0.010	<0.0050	<10	0.0056	30.7	0.19	0.0313	1.5
MW15-03AZ	MW15-03AZ	primary	04-Aug-2018	44.6			<0.0050	<0.0050							17.8	0.203	0.522	38	0.011	<0.010	<10	0.0119	34.3	0.21	0.036	1.54
MW15-03AZ	MW15-03AZ	primary	05-Oct-2018	28.1			<0.0050	<0.0053							14.7	0.197	0.513	30.5	<0.010	<0.010	<10	<0.0050	28.5	0.21	0.037	1.7
MW15-03AZ	MW15-03AZ	primary	23-Aug-2019	36			<0.0018	<0.0018							28	0.191	0.481	31	0.013	<0.010	<10	0.0076	31.7	0.17	0.036	1.51
MW15-03WB	MW15-03WB	primary	16-Jun-2015	951	0.0128										54.5	0.076	0.525	17	0.017	<0.0050	18	0.0096	182	1.37	0.187	0.232
MW15-03WB	MW15-03WB	primary	09-Jul-2015	938	<0.0050										30	0.091	0.611	13.9	0.01	<0.0050	31	0.0258	155	0.74	0.102	0.362
MW15-03WB	MW15-03WB	primary	10-Aug-2015	939	<0.0050										9.55	0.046	0.719	11.4	<0.010	<0.0050	25	0.0186	156	0.48	0.068	0.325
MW15-03WB	MW15-03WB	primary	04-Sep-2015	873	0.0052										6.88	0.059	0.447	10.4	0.011	<0.0050	31	0.022	151	0.3	0.064	0.238
MW15-03WB	MW15-03WB	primary	16-May-2016	879	0.0063	0.007				<0.0010	<0.0010	<0.20	<0.50		1.95	<0.020	0.396	8.41	0.01	<0.0050	31	<0.0050	162	<0.10	0.018	0.061
MW15-03WB	MW15-03WB	primary	16-Jul-2016	1070	<0.0050	<0.0050				<0.0010	<0.0010	<0.20	<0.50		338	0.022	0.662	16.5	0.074	0.009	26	<0.0050	192	1.53	0.165	0.201
MW15-03WB	MW15-03WB	primary	23-Sep-2016	1000	0.0139	0.015				<0.0010	<0.0010	<0.20	<0.50		10.1	0.035	0.978	15.2	<0.010	<0.0050	28	<0.0050	181	0.14	0.031	0.067
MW15-03WB	MW15-03WB	primary	23-Apr-2017	1080	<0.0050	<0.0050									50.3	<0.10	0.99	15.5	<0.050	<0.025	<50	<0.025	183	<0.50	<0.025	<0.25
MW15-03WB	MW15-03WB	primary	10-Jun-2017	1080	0.0493	0.052									41.9	<0.10	0.87	13	<0.050	<0.025	<50	<0.025	182	<0.50	<0.025	<0.25
MW15-03WB	MW15-03WB	primary	25-Jul-2017	1060	0.0502	0.053									26.1	<0.10	1.37	13.2	<0.050	<0.025	<50	<0.025	179	<0.50	<0.025	<0.25
MW15-03WB	MW15-03WB	primary	07-Oct-2017	1050	0.0445	0.047									22.5	<0.10	0.55	13	<0.050	<0.025	<50	<0.025	200	<0.50	<0.025	<0.25
MW15-03WB	JH42-01	duplicate	20-Apr-2018	1040	0.264	0.28									12.3	<0.10	0.31	12.4	<0.050	<0.025	<50	<0.025	185	<0.50	<0.025	<0.25
MW15-03WB	MW15-03WB	primary	20-Apr-2018	1060	0.163	0.17									9.2	<0.10	0.22	13	<0.050	<0.025	<50	<0.025	188	<0.50	<0.025	<0.25
MW15-03WB	MW15-03WB	primary	08-Jun-2018	1090	0.126	0.13									47.5	<0.10	0.17	13.1	<0.050	<0.025	<50	0.032	183	1.53	0.07	0.44
MW15-03WB	MW15-03WB	primary	05-Aug-2018	1070			0.114	0.12							20	<0.10	0.23	11.7	<0.050	<0.050	<50	<0.025	178	<0.50	<0.050	<0.50
MW15-03WB	MW15-03WB	primary	04/10/2018 and 05/10/2018	1080			0.123	0.13							9.6	<0.040	0.124	9.11	<0.020	<0.020	22	<0.010	149	<0.20	<0.020	0.32
MW15-03WB	MW15-03WB	primary	03-May-2019	1120			0.18	0.19							18	0.067	0.311	11.1	<0.020	<0.020	30	<0.010	179	<0.20	0.056	0.24
MW15-03WB	MW15-03WB	primary	18-Jun-2019	959			0.19								23.9	0.046	0.381	11.8	<0.020	<0.010	30	<0.010	182	<0.20	0.019	<0.10
MW15-03WB	MW15-03WB	primary	23-Aug-2019	1000			0.078	0.083							14.7	<0.040	<0.040	10.3	<0.020	<0.020	<20	<0.010	172	4.45	0.071	<0.20
MW15-04WB	MW15-04WB	primary	14-Jun-2015	125	<0.0050										8.95	2.86	1.65	35.4	<0.010	<0.0050	<10	0.0605	73.2	0.3	0.221	2.15
MW15-04WB	MW15-20	duplicate	14-Jun-2015	130	0.0074										11.8	2.91	1.69	34.8	<0.010	<0.0050	<10	0.0572	75.4	0.28	0.22	2.11
MW15-04WB	MW15-04WB	primary	10-Jul-2015	129	0.0072										7.77	2.88	1.39	34.5	<0.010	<0.0050	<10	0.0611	71.2	0.4	0.255	1.18
MW15-04WB	MW15-30WB	duplicate	10-Jul-2015	130	0.0086										7.62	3.37	1.25	38.2	<0.010	<0.0050	<10	0.0353	71.4	0.12	0.243	1.08
MW15-04WB	MW15-04WB	primary	11-Aug-2015	130	<0.0050										23.8	2.69	1.65	37.6	<0.010	<0.0050	<10	0.125	75.7	1.02	0.241	2.85
MW15-04WB	MW15-04WB	primary	05-Sep-2015	120	0.0088										5.75	2.69	1.2	33.3	0.012	<0.0050	<10	0.042	69.3	0.21	0.218	1.07
MW15-04WB	MW15-04WB	primary	13-May-2016	120	0.0095	0.01				<0.0010	<0.0010	<0.20	<0.50		3.35	1.97	2.01	29	<0.010	<0.0050	<10	0.021	77.2	<0.10	0.34	1.07
MW15-04WB	JH40-03	duplicate	15-Jul-2016	122	0.0059	0.006				<0.0010	<0.0010	<0.20	<0.50		1.47	1.63	1.92	27.2	<0.010	<0.0050	<10	0.027	71.8	<0.10	0.316	1.13
MW15-04WB	MW15-04WB	primary	15-Jul-2016	122	0.0074	0.008				<0.0010	<0.0010	<0.20	<0.50		1.43	1.53	1.86	25.9	<0.010	<0.0050	<10	0.027	69.9	<0.10	0.294	1.13
MW15-04WB	MW15-04WB	primary	24-Sep-2016	120	0.0092	0.01				<0.0010	<0.0010	<0.20	<0.50		6.15	1.43	1.98	27.6	<0.010	<0.0050	<10	0.042	70.4	<0.10	0.306	1.26
MW15-04WB	MW15-04WB	primary	23-Apr-2017	140	0.0061	0.006									8.96	2.16	1.14	32.1	<0.010	<0.0050	<10	0.081	74	2.3	0.289	1.67
MW15-04WB	MW15-04WB	primary	11-Jun-2017	139	0.0063	0.007									<2.5	2.05	1.03	30.5	<0.050	<0.025	<50	<0.025	78.8	<0.50	0.238	1.23
MW15-04WB	MW15-04WB	primary	26-Jul-2017	146	<0.0050	<0.0050									1.19	2.02	0.789	27.8	<0.010	<0.0050	<10	0.0269	74	<0.10	0.206	1.15
MW15-04WB	JH41-07	duplicate	05-Oct-2017	136	0.0131	0.014									3.76	2.06	1.05	33.3	<0.010	<0.0050	<10	0.0473	82.4	0.44	0.252	1.65
MW15-04WB	MW15-04WB	primary	05-Oct-2017	145	0.0113	0.012									3.52	2.09	1.2	33.7	<0.010	<0.0050	<10	0.0545	84.7	0.1	0.255	2.01
MW15-04WB	MW15-04WB	primary	19-Apr-2018	147	<0.0050	<0.0050									4.57	2.07	0.936	32.3	<0.010	<0.0050	<10	0.0501	83.8	1.04	0.239	1.47

Station	Sample ID	Sample Class	Sample Date	Dissolved Sulphate (SO4)	Total Sulphide	Total Sulphide (as H2S)	Dissolved Sulphide	Dissolved Sulphide (as H2S)	Cyanides	Cyanide, Weak Acid Diss	Cyanide, Total	Cyanate	Thiocyanate (SCN)	Total Metals	Total Aluminum (Al)	Total Antimony (Sb)	Total Arsenic (As)	Total Barium (Ba)	Total Beryllium (Be)	Total Bismuth (Bi)	Total Boron (B)	Total Cadmium (Cd)	Total Calcium (Ca)	Total Chromium (Cr)	Total Cobalt (Co)	Total Copper (Cu)
				mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.5	0.005	0.005	0.0018	0.0018							0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05
ALS RDL[1]:				0.5	0.002	-				0.001	0.001	0.20	0.50		3	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.5
MW15-04WB	MW15-04WB	primary	07-Jun-2018	158	0.0077	0.008									7.92	1.41	1.86	31.3	<0.010	<0.0050	<10	0.082	75.7	0.34	0.301	1.17
MW15-04WB	MW15-04WB	primary	02-Aug-2018	127			0.0085	0.009							2.86	1.17	1.27	28.3	<0.010	<0.0050	<10	0.0463	68.8	<0.10	0.282	1.56
MW15-04WB	MW15-04WB	primary	05-Oct-2018	115			<0.0050	<0.0053							<3.0	1.07	1.24	24.8	<0.010	<0.010	<10	0.0238	65.3	<0.10	0.212	1.2
MW15-04WB	MW15-04WB	primary	03-May-2019	132			<0.0019	<0.0020							1.58	1.37	1.12	28	<0.010	<0.0050	<10	0.02	70.8	<0.10	0.184	1.02
MW15-04WB	MW15-04WB	primary	17-Jun-2019	125			0.0024								8	1.44	1.03	28.2	<0.010	<0.0050	<10	0.0298	71	0.26	0.165	0.994
MW15-04WB	MW15-04WB	primary	22-Aug-2019	120			<0.0018	<0.0018							2.07	1.33	1.21	27.5	<0.010	<0.0050	<10	0.0152	71.2	1.44	0.199	0.962
MW15-04WB	BD1-Q3	duplicate	22-Aug-2019	130			<0.0018	<0.0018							3.53	1.45	1.28	28.3	<0.010	<0.0050	<10	0.0246	72.5	0.68	0.196	0.978
MW15-05AZ	MW15-05AZ	primary	06-Sep-2015	<0.50	<0.0050										201	0.088	3.03	18.5	0.03	<0.0050	<10	0.022	2.73	0.8	2.7	2.03
MW15-05WB	MW15-05WB	primary	18-Jun-2015	14	0.0091										7.11	0.371	1.25	3.97	<0.010	<0.0050	<10	0.041	44.3	0.5	0.072	0.607
MW15-05WB	MW15-05WB	primary	10-Jul-2015	12.1	0.0051										29.7	0.348	1.25	5.44	<0.010	<0.0050	<10	0.0683	41.1	2.67	0.125	0.551
MW15-05WB	MW15-05WB	primary	11-Aug-2015	12.2	<0.0050										2.56	0.202	0.927	1.65	<0.010	<0.0050	<10	0.0135	42.8	0.3	0.058	0.116
MW15-05WB	MW15-60	duplicate	11-Aug-2015	13.1	<0.0050										20.4	0.212	0.957	1.91	<0.010	<0.0050	<10	0.0158	44.5	0.4	0.0656	0.411
MW15-05WB	MW15-05WB	primary	06-Sep-2015	12	0.0076										1.43	0.186	0.891	1.01	<0.010	<0.0050	<10	<0.0050	42	0.13	0.055	0.118
MW15-05WB	MW15-05WB	primary	15-May-2016	12.6	0.0058	0.006				<0.0010	<0.0010	<0.20	<0.50		5.29	0.263	1.08	1.04	<0.010	<0.0050	<10	<0.0050	45.8	<0.10	0.066	0.529
MW15-05WB	MW15-05WB	primary	20-Jul-2016	11.2	0.0094	0.01				<0.0010	<0.0010	<0.20	<0.50		3.02	0.181	1.1	1.34	<0.010	<0.0050	<10	0.013	41.8	0.17	0.033	0.157
MW15-05WB	MW15-05WB	primary	27-Sep-2016	14.6	<0.0050	<0.0050				<0.0010	<0.0010	<0.20	<0.50		3.42	0.211	0.971	1.33	<0.010	<0.0050	<10	0.006	42.1	0.12	0.048	0.098
MW15-05WB	MW15-05WB	primary	21-Apr-2017	12.3	0.0063	0.007									1.26	0.197	0.789	0.878	<0.010	<0.0050	<10	0.149	43.4	<0.10	0.022	0.191
MW15-05WB	MW15-05WB	primary	11-Jun-2017	12.1	0.0076	0.008									1.33	0.195	0.804	0.765	<0.010	<0.0050	<10	<0.0050	43.6	<0.10	0.02	<0.050
MW15-05WB	MW15-05WB	primary	27-Jul-2017	12.8	0.0059	0.006									3.62	0.297	0.877	1.59	<0.010	<0.0050	<10	0.0223	42.5	0.32	0.051	0.164
MW15-05WB	MW15-05WB	primary	07-Oct-2017	13.2	0.0057	0.006									18.9	0.21	0.891	2.46	<0.010	<0.0050	<10	0.0368	43.6	1.5	0.0566	0.508
MW15-05WB	MW15-05WB	primary	21-Apr-2018	12.3			<0.0050	<0.0050							0.93	0.169	0.944	0.803	<0.010	<0.0050	<10	0.0054	42.8	<0.10	0.0206	<0.050
MW15-05WB	MW15-05WB	primary	09-Jun-2018	14.9	0.0062	0.007									3.92	0.189	0.96	1.31	<0.010	<0.0050	<10	0.0191	44.3	0.16	0.0249	0.095
MW15-05WB	MW15-05WB	primary	04-Aug-2018	13.2			<0.0050	<0.0050							4.6	0.218	0.997	1.82	<0.010	<0.010	<10	0.0249	42.9	0.43	0.046	0.21
MW15-05WB	MW15-05WB	primary	06-Oct-2018	12.3			<0.0050	<0.0053							2.97	0.173	0.925	0.906	<0.010	<0.0050	<10	0.007	42.1	<0.10	0.0235	0.064
MW15-05WB	MW15-05WB	primary	30-Apr-2019	12.7			<0.0019								<3.0	0.152	0.84	1.25	<0.010	<0.010	<10	0.008	42.2	0.13	0.027	<0.10
MW15-05WB	MW15-05WB	primary	19-Jun-2019	13.4			<0.0019	<0.0019							1.82	0.175	0.827	1.01	<0.010	<0.0050	<10	0.0056	40.7	0.11	0.0187	0.05
MW15-05WB	MW15-05WB	primary	23-Aug-2019	14			<0.0018	<0.0019							<3.0	0.156	0.828	0.903	<0.010	<0.010	<10	<0.0050	40.7	0.69	0.029	0.35
MW15-06WB	MW15-06WB	primary	21-Jun-2015	44.4	0.0054										814	1.25	11.7	44.3	0.031	0.005	<10	0.053	42.6	2.49	1.35	2.94
MW15-06WB	MW15-06WB	primary	21-Jul-2015	101	0.0134										275	2.3	12.5	39.2	<0.010	<0.0050	<10	0.0635	65.1	1.86	2.13	1.38
MW15-06WB	MW15-06WB	primary	09-Aug-2015	106	0.0114										151	2.63	21.2	41.8	<0.010	<0.0050		0.0407	74.5	1.13	2.58	0.952
MW15-06WB	MW15-06WB	primary	08-Sep-2015	116	0.0069										58.7	0.673	22.8	52.5	<0.010	<0.0050	<10	0.026	73.4	0.59	2.95	1.09
MW15-06WB	MW15-06WB	primary	17-May-2016	75.5	0.0458	0.049				<0.0010	<0.0010	<0.20	<0.50		21.1	0.454	79	68.9	<0.010	<0.0050	<10	0.019	55.9	0.18	0.092	1.32
MW15-06WB	MW15-06WB	primary	18-Jul-2016	80.3	0.0404	0.043				<0.0010	<0.0010	<0.20	<0.50		22.9	0.43	73.6	86.9	<0.050	<0.025	<50	<0.025	52.8	<0.50	0.082	1.18
MW15-06WB	MW15-06WB	primary	26-Sep-2016	79.1	0.0374	0.04				<0.0010	<0.0010	<0.20	<0.50		19.8	0.549	78.7	94.3	<0.010	0.005	<10	0.026	49.2	0.28	0.09	1.36
MW15-06WB	MW15-06WB	primary	24-Apr-2017	73.9	0.0172	0.018									28.7	0.426	56.3	82	<0.010	0.006	<10	0.017	49.8	<0.10	0.069	0.967
MW15-06WB	MW15-06WB	primary	12-Jun-2017	82.6	0.0215	0.023									12.6	0.463	90.5	95.3	<0.010	0.005	<10	0.022	51.1	0.75	0.08	0.986
MW15-06WB	MW15-06WB	primary	29-Jul-2017	84.8	0.011	0.012									13.2	0.403	86.3	108	<0.010	0.0058	<10	0.0632	54.1	0.42	0.0943	0.996
MW15-06WB	MW15-06WB	primary	09-Oct-2017	85.4	0.0175	0.019									15.6	0.367	70.1	120	<0.010	0.0124	<10	0.0647	59.6	2.34	0.101	1.24
MW15-06WB	MW15-06WB	primary	22-Apr-2018	94.7			0.015	0.016							9.46	0.336	65	137	<0.010	0.005	<10	0.0174	55.7	<0.10	0.0431	0.723
MW15-06WB	MW15-06WB	primary	10-Jun-2018	101	0.026	0.028									9.19	0.334	76.8	131	<0.010	<0.0050	<10	0.0196	54.8	<0.10	0.0338	0.585
MW15-06WB	MW15-06WB	primary	03-Aug-2018	91.1			0.0109	0.012							8.82	0.354	91.7	154	<0.010	0.006	<10	0.0066	55.7	0.1	0.0666	0.578
MW15-06WB	MW15-06WB	primary	07-Oct-2018	84.6			0.0067	0.007							8.9	0.343	124	178	<0.010	<0.010	<10	<0.0050	57.4	0.17	0.087	0.79
MW15-06WB	MW15-06WB	primary	02-May-2019	62.9			0.042	0.045							62.9	5.45	157	35.7	<0.010	<0.010	<10	0.019	64.3	0.62	1.31	2.74
MW15-06WB	MW15-06WB	primary	20-Jun-2019	97.7			0.046	0.049							4.7	0.344	124	160	<0.010	<0.010	<10	0.0134	56.3	0.12	0.121	0.32
MW15-06WB	MW15-06WB	primary	25-Aug-2019	100			0.0024	0.003							5.8	0.308	133	161	<0.010	<0.010	<10	<0.0050	57.9	0.38	0.101	0.29
MW16-01WB	MW16-01WB	primary	04-Oct-2016	16	0.0081	0.009				<0.0010	<0.0010	<0.40	<0.50		4.07	0.657	8.75	18.1	0.073	<0.0050	<10	0.005	21	0.12	0.048	0.071
MW16-01WB	MW16-01WB	primary	20-Apr-2017	14.7	0.0062	0.007									4.32	0.565	11.3	19.8	0.071	<0.0050	<10	0.069	23.3	0.35	0.025	1.8
MW16-01WB	MW16-01WB	primary	09-Jun-2017	13.9	<0.0050	<0.0050									2.14	0.436	11.6	19	0.065	<0.0050	<10	0.006	22.8	<0.10	0.009	0.095
MW16-01WB	MW16-01WB	primary	26-Jul-2017	13.5	0.0064	0.007									4.72	0.419	11.3	18.9	0.079	<0.0050	<10	0.0113	22.5	0.12	0.0134	0.054
MW16-01WB	JH41-05	duplicate	27-Jul-2017	13.4	0.0057	0.006									1.33	0.357	11.9	19.3	0.076	<0.0050	<10	0.0075	22.8	<0.10	0.0065	<0.050
MW16-01WB	MW16-01WB	primary	06-Oct-2017	13.3	0.0125	0.013									5.79	0.335	12	20	0.095	<0.0050	<10	0.0229	24.9	2.15	0.0434	0.354
MW16-01WB	MW16-01WB	primary	20-Apr-2018	13.6	0.006	0.006									22.5	0.268	12.4	19.5	0.1	<0.0050	<10	0.096	23.2	5.34	0.126	1.33
MW16-01WB	MW16-01WB	primary	08-Jun-2018	15.1	0.0094	0.01									2.05	0.21	11.7	19.5	0.087	<0.0050	<10	0.0116	22.5	<0.10	0.006	0.074
MW16-01WB	MW16-01WB	primary	02-Aug-2018	14.1			<0.0050	<0.0050							2.75	0.185	11.5	19	0.092	<0.0050	<10	<0.0050	21.8	<0.10	<0.0050	0.077
MW16-01WB	MW16-01WB	primary	04-Oct-2018	14.3			0.0281	0.03							3	0.107	10.4	17.7	0.088	<0.010	<10	<0.0050	21.7	0.14	<0.010	<0.10
MW16-01WB	MW16-01WB	primary	01-May-2019	15.2			0.035	0.037							0.56	0.086	11.4	18	0.097	<0.0050	<10	<0.0050	20.6	<0.10	0.009	<0.050
MW16-01WB	MW16-01WB	primary	17-Jun-2019	17.5			0.04								11.6	0.226	11.6	19.6	0.119	<0.010	<20	<0.010	22.1	<0.20	0.013	<0.10
MW16-01WB	MW16-01WB	primary	21-Aug-2019	14			0.085	0.09							24.1	0.057	10.7	18.9	0.098	<0.0050	<10	0.0058	20.8	1.45	0.0581	1.28
	F-BLANK-1	field blank	28-Sep-2014	<0.5	<0.002										<3	<0.1	<0.1	<0.05	<0.1	<0.5	<10	<0.01	<0.05	<0.1	<0.1	<0.5

Station	Sample ID	Sample Class	Sample Date	Dissolved Sulphate (SO4)	Total Sulphide	Total Sulphide (as H2S)	Dissolved Sulphide	Dissolved Sulphide (as H2S)	Cyanides	Cyanide, Weak Acid Diss	Cyanide, Total	Cyanate	Thiocyanate (SCN)	Total Metals	Total Aluminum (Al)	Total Antimony (Sb)	Total Arsenic (As)	Total Barium (Ba)	Total Beryllium (Be)	Total Bismuth (Bi)	Total Boron (B)	Total Cadmium (Cd)	Total Calcium (Ca)	Total Chromium (Cr)	Total Cobalt (Co)	Total Copper (Cu)
				mg/L	mg/L	mg/L	mg/L	mg/L		mg/L	mg/L	mg/L	mg/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.5	0.005	0.005	0.0018	0.0018							0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05
ALS RDL[1]:				0.5	0.002	-				0.001	0.001	0.20	0.50		3	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.5
	FB-23/06/15	field blank	23-Jun-2015	<0.50	<0.0050										0.55	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-2	field blank	18-Jul-2015	<0.50	0.0069										8.12	<0.020	0.024	0.033	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-3	field blank	12-Aug-2015	<0.50	0.0089										<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-4	field blank	08-Sep-2015	<0.50	0.0061										1.29	<0.020	0.022	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-007	field blank	16-May-2016	0.99	<0.0050	<0.0050				<0.0010	<0.0010	<0.20	<0.50		0.59	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	0.066
	FB-008	field blank	15-Jul-2016	<0.50	0.0056	0.006				<0.0010	<0.0010	<0.20	<0.50		0.63	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-009	field blank	26-Sep-2016	0.71	<0.0050	<0.0050				<0.0010	<0.0010	<0.20	<0.50		0.97	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	0.06
	FB-010	field blank	25-Apr-2017	0.83	<0.0050	<0.0050									0.54	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-020	field blank	11-Jun-2017	<0.50	<0.0050	<0.0050									<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-030	field blank	29-Jul-2017	<0.50	0.0051	0.005									<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-040	field blank	09-Oct-2017	0.5	0.0092	0.01									<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-Q1	field blank	22-Apr-2018	<0.50			<0.0050	<0.0050							<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-Q2	field blank	10-Jun-2018	<0.50	<0.0050	<0.0050									2.51	<0.020	0.022	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-Q3	field blank	05-Aug-2018	<0.50			<0.0050	<0.0050							2.41	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-Q4	field blank	07-Oct-2018	<0.50			<0.0050	<0.0053							<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-Q1	field blank	01-May-2019	<0.50			<0.0019	<0.0020							<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-Q2	field blank	13-Jun-2019	<0.50			<0.0019	<0.0020							<0.50	<0.020	<0.020	0.026	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	FB-Q3	field blank	23-Aug-2019	0.79			<0.0018	<0.0018							<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TRIP BLANK	trip blank	11-Sep-2015	0.78	0.006										<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	0.069
	TRIP BLANK	trip blank	16-May-2016	<0.50	0.0068	0.007				<0.0010	<0.0010		<0.50		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TRIP BLANK	trip blank	20-Jul-2016	<0.50	<0.0050	<0.0050				<0.0010	<0.0010	<0.20	<0.50		2.17	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TRIP BLANK	trip blank	29-Sep-2016	<0.50	0.0077	0.008				<0.0010	<0.0010	<0.20	<0.50		0.63	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TRIP BLANK	trip blank	26-Apr-2017	<0.50	<0.0050	<0.0050									0.59	<0.020	<0.020	0.022	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	0.071
	TRIP BLANK	trip blank	14-Jun-2017	<0.50	<0.0050	<0.0050									<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TRIP BLANK	trip blank	26-Jul-2017	<0.50	<0.0050	<0.0050									<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TRIP BLANK	trip blank	11-Oct-2017	0.6	0.0092	0.01									<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TRIP BLANK	trip blank	23-Apr-2018	<0.50	<0.0050	<0.0050									<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TRIP BLANK	trip blank	10-Jun-2018	<0.50	<0.0050	<0.0050									<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TRIP BLANK	trip blank	09-Aug-2018	<0.50			<0.0050	<0.0050							1.23	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	0.148
	TRIP BLANK	trip blank	11-Oct-2018	<0.50			<0.0050	<0.0053							0.87	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TB-Q1	trip blank	02-May-2019	<0.50			<0.0019	<0.0020							<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TRIP BLANK	trip blank	13-Jun-2019	<0.50			<0.0019	<0.0019							<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050
	TRIP BLANK	trip blank	23-Aug-2019	0.84			<0.0018	<0.0018							<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050

Notes:

Samples and sample data with RED text are not considered to be representative of formation water (See Appendix 5-D for further discussion).

1. Reportable detection limits (RDL) presented are the lowest detection limit for a given parameter. Note that the detection limit may have been raised by the analytical laboratory for some analytical results (e.g., due to matrix interference). See Table 3-8 in the main report for further details regarding reportable detection limits between 2014 and 2019.

2. Duplicate sample JH42-08 (Lab ID: UN0655) was collected on 04-Oct-2018 and not 05-Oct-2018 (dummy date for blind duplicate sampling) as indicated in the laboratory Certificate of Analysis.

Station	Sample ID	Sample Class	Sample Date	Total Iron (Fe)	Total Lead (Pb)	Total Lithium (Li)	Total Magnesium (Mg)	Total Manganese (Mn)	Total Mercury (Hg)	Total Molybdenum (Mo)	Total Nickel (Ni)	Total Phosphorus (P)	Total Potassium (K)	Total Selenium (Se)	Total Silicon (Si)	Total Silver (Ag)	Total Sodium (Na)	Total Strontium (Sr)	Total Sulphur (S)	Total Thallium (Tl)	Total Tin (Sn)	Total Titanium (Ti)	Total Uranium (U)	Total Vanadium (V)	Total Zinc (Zn)
				ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				1	0.005	0.5	0.05	0.05	0.002	0.05	0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1
ALS RDL[1]:				10	0.05	0.5	0.1	0.05	0.01	0.05	0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	3
MW14-02A	MW14-02A	primary	28-Sep-2014	<10	<0.05	7.01	21.4	17.5	<0.01	4.56	<0.5	<50	3.61	0.28	6350	<0.01	5.28	341	18.7	0.041	<0.1	<10	62.7	<1	<3
MW14-02A	MW14-02A	primary	12-Jun-2015	42.4	0.159	7.53	31.9	687	0.0038	7.53	16.7	8.1	3.77	0.267	6050	0.0093	3.68	509	26.6	0.0883	<0.20	1.76	85.8	0.49	2.05
MW14-02A	MW14-02A	primary	16-Jul-2015	14.1	<0.0050	7.73	19.7	7.69	0.0043	3.09	0.278	28	2.67	0.235	6400	<0.0050	2.77	325	14.5	0.0223	<0.20	<0.50	47.7	<0.20	2.62
MW14-02A	MW14-02A	primary	06-Aug-2015	20.7	0.0148	8.79	23.4	7.59	0.0032	3.57	0.354	7.3	3.34	0.251	6760	0.0096	5.01	402	17.9	0.0454	<0.20	0.84	50.6	0.29	1.23
MW14-02A	MW14-02A	primary	04-Sep-2015	1.1	<0.0050	7.72	21.7	2.63	0.0041	3.28	0.075	10.6	2.75	0.274	5610	<0.0050	3.09	381	19.6	0.028	<0.20	<0.50	49.6	0.23	0.33
MW14-02A	MW14-100	duplicate	04-Sep-2015	1.2	<0.0050	7.96	22.5	2.8	0.0041	3.2	0.067	9.1	2.8	0.298	5720	<0.0050	3.14	391	19.7	0.04	<0.20	<0.50	50.3	<0.20	0.31
MW14-02A	MW14-02A	primary	13-May-2016	334	2.18	6.73	20.5	76	0.0035	3.16	0.52	15	2.87	0.273	6320	0.035	3.05	371	16.8	0.021	0.53	4.31	41.8	0.33	40.9
MW14-02A	MW14-02A	primary	17-Jul-2016	<1.0	<0.0050	7.14	21.3	0.251	0.0061	3.01	0.038	8.8	2.72	0.255	6130	<0.0050	2.86	372	17.8	0.009	<0.20	<0.50	46.1	<0.20	0.16
MW14-02A	JH40-05	duplicate	25-Sep-2016	<1.0	<0.0050	7.23	19.9	0.119	0.0067	3.02	0.035	6.5	2.66	0.255	5980	<0.0050	2.63	349	16.5	0.004	<0.20	<0.50	42.2	<0.20	0.4
MW14-02A	MW14-02A	primary	25-Sep-2016	<1.0	<0.0050	7.29	19.6	0.152	0.0059	2.96	0.034	6.3	2.67	0.235	5930	<0.0050	2.67	342	16.8	0.004	<0.20	<0.50	42.7	<0.20	0.16
MW14-02A	MW14-02A	primary	21-Apr-2017	77.6	0.254	7.49	21.7	31.8	0.0097	3.16	0.15	9.5	2.92	0.238	6460	0.03	2.99	400	17	0.013	<0.20	<0.50	46	<0.20	3.27
MW14-02A	JH41-03	duplicate	08-Jun-2017	1.9	<0.0050	6.85	20.3	0.51	0.0063	2.97	0.032	8.3	2.7	0.25	5980	<0.0050	2.75	351	17.3	0.011	<0.20	<0.50	44	<0.20	0.45
MW14-02A	MW14-02A	primary	08-Jun-2017	2.4	<0.0050	6.93	20.4	0.466	0.006	2.94	0.054	11.5	2.71	0.248	5740	<0.0050	2.73	347	17.8	0.012	<0.20	<0.50	44.3	<0.20	0.88
MW14-02A	MW14-02A	primary	28-Jul-2017	14	0.0447	7.44	20.6	0.914	0.0074	2.94	0.051	7.8	2.75	0.239	6290	0.0438	2.78	347	18.3	0.011	<0.20	<0.50	44.5	0.2	0.16
MW14-02A	MW14-02A	primary	05-Oct-2017	3.2	0.0107	7.54	21.8	0.263	0.0071	2.77	0.026	9.1	3.03	0.237	6240	<0.0050	3	337	17.3	0.0078	<0.20	<0.50	45	0.27	0.11
MW14-02A	MW14-02A	primary	19-Apr-2018	7.4	0.009	7.16	22.5	3.49	0.0079	2.93	0.055	11.9	2.8	0.225	6430	<0.0050	3.06	365	17.8	0.0114	<0.20	<0.50	44.8	0.22	0.33
MW14-02A	MW14-02A	primary	07-Jun-2018	3.8	0.0067	6.1	19.5	0.588	0.0087	3.1	0.057	9.7	2.75	0.238	5890	<0.0050	2.7	384	16.6	0.01	<0.20	<0.50	43.8	<0.20	0.31
MW14-02A	MW14-02A	primary	02-Aug-2018	1.1	<0.0050	7.15	20.4	0.087	0.0066	2.89	0.052	7	2.8	0.242	5780	<0.0050	2.87	372	15.9	0.0059	<0.20	<0.50	43	<0.20	0.2
MW14-02A	JH42-06	duplicate	02-Aug-2018	2.2	<0.0050	7.12	20.2	0.084	0.0062	2.91	0.207	6.7	2.75	0.244	5620	<0.0050	2.85	371	15.4	0.0057	<0.20	<0.50	41.8	<0.20	0.19
MW14-02A	MW14-02A	primary	04-Oct-2018	<1.0	<0.0050	6.81	20.2	0.174	0.0091	3.11	0.047	9.4	2.71	0.242	6160	<0.0050	2.8	372	16.8	0.0059	<0.20	<0.50	42.8	<0.20	<0.10
MW14-02A	MW14-02A	primary	28-Apr-2019	11.1	0.053	5.89	18.8	1.37	0.0078	3.03	0.047	7	2.65	0.232	5630	0.023	2.64	340	16	0.006	<0.20	<0.50	41.8	<0.20	0.29
MW14-02A	BD1-Q1	duplicate	28-Apr-2019	9.8	0.028	5.6	19.9	2.39	0.0092	3.07	0.077	5.9	2.71	0.234	5580	0.022	2.71	337	16.7	0.007	<0.20	<0.50	42.3	<0.20	0.38
MW14-02A	MW14-02A	primary	13-Jun-2019	6.8	0.0129	6.37	20.5	0.613	0.0088	3	0.046	7.6	2.74	0.239	5680	0.012	2.78	333	16.7	0.0066	<0.20	<0.50	42.5	<0.20	0.79
MW14-02A	MW14-02A	primary	22-Aug-2019	33.5	0.0743	6.86	19.3	3.87	0.0098	3.05	0.187	8.8	2.76	0.246	5720	0.104	2.6	355	16.2	0.0155	<0.20	<0.50	41.8	0.52	0.22
MW14-02A	BD2-Q3	duplicate	22-Aug-2019	28.2	0.0521	6.8	18.9	2.55	0.0109	3.03	0.189	7.7	2.72	0.259	5810	0.0745	2.58	352	16.3	0.0108	<0.20	<0.50	42.2	0.44	<0.10
MW14-02B	MW14-02B	primary	28-Sep-2014	<10	<0.05	7.65	30.5	161	0.017	5.43	2.49	<50	3.73	0.34	6230	0.011	4.42	514	28.7	0.026	<0.1	<10	91.9	<1	11.9
MW14-02B	F-DUP-1	duplicate	28-Sep-2014	<10	<0.05	6.87	30.7	156	0.017	4.89	2.47	<50	3.66	0.33	6240	<0.01	4.37	467	29	0.021	<0.1	<10	81.6	<1	11
MW14-02B	MW14-02B	primary	12-Jun-2015	38	0.0472	7.06	21	10.6	0.0054	3.5	0.24	9.6	3	0.232	5920	0.0092	3.23	380	17.8	0.0445	<0.20	<0.50	52.7	0.24	4.15
MW14-02B	MW14-02B	primary	16-Jul-2015	20	0.0142	7.72	29.9	714	0.008	6.9	8.77	69	3.63	0.248	6440	<0.0050	3.72	463	26	0.0507	<0.20	<0.50	73.3	<0.20	5.49
MW14-02B	MW14-02B	primary	06-Aug-2015	24.2	0.0434	8.55	31.7	667	0.0035	6.61	9.22	6.5	3.71	0.271	6270	0.0054	3.68	474	25.5	0.27	<0.20	1	75.9	0.32	3.4
MW14-02B	MW14-02B	primary	04-Sep-2015	101	0.113	8.23	30.7	560	0.0036	6.06	12	7.1	3.35	0.296	5790	<0.0050	3.55	483	28.7	0.288	<0.20	0.62	78.2	0.23	4.06
MW14-02B	JH40-01	duplicate	13-May-2016	68.4	0.133	8.55	32	424	0.0038	5.04	9.98	15	3.51	0.309	7120	<0.0050	3.63	480	27.7	0.147	<0.20	1.38	79.2	<0.20	3.19
MW14-02B	MW14-02B	primary	13-May-2016	73.6	0.137	7.61	27.9	428	0.0038	4.92	10.2	10.5	3.63	0.37	6790	<0.0050	3.42	478	26.6	0.195	<0.20	1.68	75.3	<0.20	2.9
MW14-02B	MW14-02B	primary	17-Jul-2016	26	0.084	7.3	30.2	397	0.0038	4.6	8.42	5.1	3.42	0.363	6480	0.005	3.22	486	27.2	0.2	<0.20	0.6	78.2	<0.20	2.51
MW14-02B	MW14-02B	primary	25-Sep-2016	17	0.037	7.83	27.4	310	0.0037	4.1	6.54	10.5	3.32	0.309	6430	<0.0050	3.11	475	25.6	0.143	<0.20	<0.50	76.3	0.21	1.8
MW14-02B	JH41-01	duplicate	21-Apr-2017	19.9	0.062	8.05	30.5	219	0.0062	4.05	3.87	7.6	3.64	0.349	7110	0.006	3.37	503	27.8	0.237	<0.20	<0.50	80.7	<0.20	1.7
MW14-02B	MW14-02B	primary	21-Apr-2017	19.7	0.066	7.89	29.7	213	0.0045	4.07	3.77	6.6	3.47	0.357	6730	0.006	3.3	497	27.1	0.236	<0.20	<0.50	79.9	0.22	1.71
MW14-02B	MW14-02B	primary	08-Jun-2017	8.3	0.016	7.02	28	155	0.0034	3.4	4.01	7.3	3.32	0.354	6140	<0.0050	3.15	436	27.1	0.237	<0.20	<0.50	72.3	<0.20	0.99
MW14-02B	JH41-06	duplicate	28-Jul-2017	30.5	0.0509	7.67	28.8	169	0.0038	3.44	4.77	7.7	3.3	0.356	6520	0.0092	3.17	431	26.8	0.24	<0.20	0.88	71.6	0.23	1.52
MW14-02B	MW14-02B	primary	28-Jul-2017	29.7	0.0487	7.43	28	169	0.004	3.44	4.57	7.6	3.32	0.346	6370	0.0103	3.1	427	26.6	0.252	<0.20	<0.50	70.4	0.2	0.97
MW14-02B	MW14-02B	primary	05-Oct-2017	67.4	0.0505	7.32	29.5	125	0.0047	3.42	3.54	7.7	3.58	0.36	6310	0.0167	3.3	434	26.5	0.254	<0.20	0.66	72.1	0.31	1.8
MW14-02B	JH42-02	duplicate	19-Apr-2018	25.8	0.0318	7.5	31.1	49	0.0045	3.3	1.29	12.3	3.55	0.333	6900	<0.0050	3.49	477	27.5	0.137	<0.20	<0.50	73.6	0.23	1.12
MW14-02B	MW14-02B	primary	19-Apr-2018	30.5	0.0351	7.15	31.4	48.9	0.0043	3.02	1.28	8	3.58	0.352	6510	<0.0050	3.51	466	26.5	0.134	<0.20	0.53	70.9	0.22	0.97
MW14-02B	MW14-02B	primary	07-Jun-2018	1230	1.46	6.9	27.7	943	0.0203	4.09	11.1	29.4	3.72	0.321	7350	0.946	3.13	502	24.7	0.818	0.52	16.6	71.8	1.81	8.17
MW14-02B	MW14-02B	primary	02-Aug-2018	168	0.184	7.03	27.5	156	0.0052	3.63	2.99	8.9	3.5	0.318	5920	0.115	3.14	459	22.9	0.341	<0.20	3.17	68	0.4	1.8
MW14-02B	MW14-02B	primary	04-Oct-2018	52.3	0.061	6.31	26.4	82.7	0.0051	3.11	2.13	14.4	3.26	0.304	5760	<0.010	2.99	453	24.5	0.199	<0.20	<2.0	70.6	0.21	<1.0
MW14-02B	JH42-08	duplicate	05-Oct-2018	55.5	0.067	6.48	27.3	85.6	<0.0020	3.24	2.1	14.7	3.32	0.321	5870	<0.010	3.03	455	25.4	0.198	<0.20	<2.0	70.9	0.25	1.1
MW14-02B	MW14-02B	primary	28-Apr-2019	24	0.042	5.74	26	53	0.0027	3.12	2.49	4.2	3.24	0.328	5750	0.006	2.95	428	24.2	0.193	<0.20	<0.50	66	<0.20	0.68
MW14-02B	MW14-02B	primary	13-Jun-2019	5.3	0.0069	6.44	27.3	32.9	0.0026	3.05	1.44	5.7	3.26	0.308	5820	<0.0050	3	417	23.5	0.208	<0.20	<0.50	67.9	<0.20	0.31
MW14-02B	BD1-Q2	duplicate	13-Jun-2019	11.4	0.0067	6.44	27.1	33.9	0.0028	3.05	1.47	5.9	3.26	0.324	5950	<0.0050	3.08	418	23.6	0.213	<0.20	<0.50	67.8	<0.20	0.3
MW14-02B	MW14-02B	primary	22-Aug-2019	<1.0	<0.0050	6.92	25.9	23.1	0.0045	3.11	1.2	6.4	3.26	0.338	5790	<0.0050	2.85	445	23.2	0.172	<0.20	<0.50	68.5	0.33	0.14
MW14-03A	MW14-03A	primary	12-Oct-2014	371	0.184	10.2	46.9	15.5	8.68	12.8	3.41	644	10.4	2.61	6870	0.632	66.9	762	85.6	0.151	0.76	13	13.6	2.1	8
MW14-03A	MW14-03A	primary	22-Jun-2015	7680	0.076	27.4	137	794	0.0254	4.56	2.56	53.9	8.99	0.065	6090	<0.0050	28.2	4490	169	0.033	<0.20	0.68	58.2	0.25	1.69
MW14-03A	MW14-03A	primary	12-Jul-2015	9580	0.128	26.9	125	963	0.0284	5.22	1.5	123	8.58	0.118	6840	0.0115	27.1	4490	145	0.0163	<0.20	1.98	50.9	0.51	2.51
MW14-03A	MW14-03A	primary	07-Aug-2015	8400	0.0491	24.9	138	748	0.0118	2.92	0.616	65.3	8.4	<0.040	7300	0.0058	27.6	4240	166	0.0377	<0.20	0.62	49.4	0.29	2.46
MW14-03A	MW14-50	duplicate	07-Aug-2015	8610	0.124	29.7	137	742	0.0116	3.1	0.804	157	8.47	<0.040	7310	0.0063	28.5	4240	167	0.0088	<0.20	<0.50	48.9	0.33	8.34
MW14-03A	MW14-03A	primary	06-Sep-2015	8370	0.564	29.9	136	795	0.0112	4.11	0.772	74.8	8.82	<0.040	6660	0.008	28.3	4760	164	0.011	<0.20	<0.50	47	0.42	1.11
MW14-03A	MW14-03A	primary	16-May-2016	5870	0.085	30.1	129	534	<0.0020	1.56	0.531	53.2	8.62	<0.040	6750	0.008	25.1	4690	166	0.016	<0.20	<0.50	71.4	<0.20	0.68
MW14-03A	MW14-03A	primary	14-Jul-2016	5670	0.309	30.1	134	543	0.0054	1.52	0.516	51	9.23	<0.040	6300	0.019	26.2	5330	167	0.005	<0.20	<0.50	80.7	0.22	0.84

Station	Sample ID	Sample Class	Sample Date	Total Iron (Fe)	Total Lead (Pb)	Total Lithium (Li)	Total Magnesium (Mg)	Total Manganese (Mn)	Total Mercury (Hg)	Total Molybdenum (Mo)	Total Nickel (Ni)	Total Phosphorus (P)	Total Potassium (K)	Total Selenium (Se)	Total Silicon (Si)	Total Silver (Ag)	Total Sodium (Na)	Total Strontium (Sr)	Total Sulphur (S)	Total Thallium (Tl)	Total Tin (Sn)	Total Titanium (Ti)	Total Uranium (U)	Total Vanadium (V)	Total Zinc (Zn)
				ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				1	0.005	0.5	0.05	0.05	0.002	0.05	0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1
ALS RDL[1]:				10	0.05	0.5	0.1	0.05	0.01	0.05	0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	3
MW14-03A	MW14-03A	primary	24-Sep-2016	5720	0.166	31	130	448	0.0028	1.27	0.451	38.2	8.58	<0.040	6470	0.007	25	5290	178	0.044	<0.20	<0.50	87.6	<0.20	0.43
MW14-03A	MW14-03A	primary	27-Apr-2017	4270	0.412	28.6	135	483	0.0059	1.37	0.742	38.9	8.43	<0.040	6290	0.007	26.1	4730	163	0.005	<0.20	0.66	96.8	<0.20	1.11
MW14-03A	MW14-03A	primary	09-Jun-2017	4540	0.348	29.2	149	457	0.0058	1.15	0.888	36.2	9.21	<0.040	6050	0.006	28.4	4700	173	0.004	<0.20	0.51	96.7	<0.20	0.82
MW14-03A	MW14-03A	primary	26-Jul-2017	4450	0.58	29.3	149	398	0.0143	1.11	1.08	35	8.64	<0.20	6480	<0.025	27.8	4360	180	<0.010	<1.0	<2.5	88.4	<1.0	1.49
MW14-03A	JH41-08	duplicate	06-Oct-2017	4610	1.15	30.8	154	440	0.0056	1.39	1.09	36.8	9.37	<0.040	6560	0.0085	29	4960	182	0.0063	<0.20	0.78	103	0.25	1.61
MW14-03A	MW14-03A	primary	06-Oct-2017	4570	0.996	30.3	149	436	0.0048	1.38	1	36.8	9.21	<0.040	6400	0.0096	28.2	4870	178	0.0066	<0.20	<0.50	103	0.25	1.21
MW14-03A	MW14-03A	primary	20-Apr-2018	4560	1.01	29.2	157	446	0.0066	1.37	1.17	40.6	9.12	0.078	6700	0.0059	29.1	5230	192	0.0085	<0.20	0.8	95.9	0.23	1.38
MW14-03A	MW14-03A	primary	08-Jun-2018	4260	0.966	25.3	136	413	0.0093	1.56	1.3	30.1	9.25	0.109	6040	<0.0050	25.4	5440	172	0.0049	<0.20	0.75	93.8	<0.20	1.59
MW14-03A	MW14-03A	primary	05-Aug-2018	4230	0.557	30.6	141	413	0.0041	1.19	1.06	32.7	8.56	<0.040	6030	0.011	26.5	5200	184	0.0044	<0.20	<2.0	95.6	<0.20	1.3
MW14-03A	MW14-03A	primary	07-Oct-2018	4390	0.852	30.7	145	497	0.0034	1.36	1.14	35.8	8.94	<0.040	6320	<0.010	26.4	5850	192	0.0097	<0.20	<2.0	101	<0.20	1.6
MW14-03A	MW14-03A	primary	27-Apr-2019	4310	0.329	31.3	136	403	0.0107	1.61	2	30.8	8.56	0.178	6270	0.008	26.4	4870	182	0.01	0.22	<0.50	90.9	<0.20	2.25
MW14-03A	MW14-03A	primary	14-Jun-2019	4030	0.671	29.3	131	385	<0.040	1.42	1.87	40.2	8.66	<0.080	5840	<0.010	25.7	5190	181	0.0069	<0.40	<1.0	92.4	<0.40	4.52
MW14-03A	MW14-03A	primary	23-Aug-2019	4400	1.06	29.3	143	445	0.0168	2.52	3.69	44	9.34	<0.080	6710	<0.020	29.6	4900	185	0.0175	0.56	<4.0	91.1	<0.40	5.7
MW14-03B	MW14-03B	primary	06-Oct-2014	646	0.175	20.9	139	242	0.879	2.76	5.55	<50	7.78	1.07	6650	0.652	25.3	2530	156	0.058	0.2	23	59.9	1.4	8.4
MW14-03B	MW14-03B	primary	22-Jun-2015	1670	0.201	22.9	158	3090	0.0309	8.75	20.6	42.9	8.25	0.28	5350	0.063	27.2	2990	170	0.276	<0.20	0.72	35	0.29	2.21
MW14-03B	MW14-03B	primary	12-Jul-2015	2280	0.297	20.8	138	3240	0.017	8.71	18.3	70.8	7.5	0.2	6460	0.0348	23.9	2850	155	0.148	<0.20	0.95	35.2	0.23	10.2
MW14-03B	MW14-03B	primary	07-Aug-2015	1320	0.172	22.8	171	3030	0.0304	6.95	19.5	53.5	8.07	0.146	6350	0.0325	27.1	2960	198	0.143	<0.20	<0.50	39	<0.20	11.8
MW14-03B	MW14-03B	primary	06-Sep-2015	1070	0.164	27	168	3180	0.0201	7.65	18.3	34.6	8.46	0.15	5380	0.034	26.8	3490	193	0.193	<0.20	<0.50	41.3	<0.20	1.07
MW14-03B	MW14-200	duplicate	06-Sep-2015	1100	0.178	26.4	168	3140	0.0211	7.86	18.7	35.1	8.7	0.153	5470	0.033	27.3	3490	194	0.206	<0.20	<0.50	41.7	<0.20	1.01
MW14-03B	MW14-03B	primary	16-May-2016	931	1.33	24	166	3050	<0.0020	5.64	16.2	30.6	8.87	0.17	5990	0.032	27.1	3600	188	0.193	<0.20	<0.50	40.8	<0.20	1.2
MW14-03B	MW14-03B	primary	14-Jul-2016	1020	0.73	23.3	173	3190	0.0098	5.57	15.5	22.4	8.73	0.24	5520	0.041	28	3710	172	0.235	<0.20	<0.50	41.8	<0.20	1.05
MW14-03B	MW14-03B	primary	24-Sep-2016	838	1.54	26.6	150	2420	0.0109	4.94	13.5	22.1	8.23	0.17	6030	0.006	24.9	3820	184	0.168	<0.20	<0.50	45.2	<0.20	1.36
MW14-03B	MW14-03B	primary	27-Apr-2017	983	2.89	22.6	161	2390	0.0141	5.35	12.9	24	8.38	0.229	5490	0.055	28	3460	177	0.231	0.39	0.54	46.3	<0.20	2.7
MW14-03B	MW14-03B	primary	09-Jun-2017	1210	4.03	25.3	185	2730	0.014	5.1	14.4	27.4	9	0.304	5660	0.069	30.9	3340	188	0.21	0.37	0.78	46.6	<0.20	3.38
MW14-03B	MW14-03B	primary	26-Jul-2017	1420	2.87	23.5	180	2530	0.0086	4.19	12.7	24	8.2	0.22	5970	0.046	27.9	2970	191	0.18	<1.0	<2.5	41.2	<1.0	2.59
MW14-03B	MW14-03B	primary	06-Oct-2017	1260	1.98	26.3	183	2730	0.0108	4.63	12.4	22.2	9.06	0.235	5960	0.0548	30.1	3570	197	0.213	<0.20	0.66	49.2	<0.20	1.62
MW14-03B	MW14-03B	primary	20-Apr-2018	1220	2.57	25.7	195	2500	0.0064	4.43	12	24.4	9.11	0.225	6190	0.0248	31	3640	209	0.142	0.23	0.57	51.2	<0.20	1.98
MW14-03B	MW14-03B	primary	08-Jun-2018	1500	0.123	22.6	173	2780	0.0066	4.62	11.2	28.6	8.94	0.158	5810	<0.0050	26.2	3760	191	0.0943	<0.20	<0.50	49	<0.20	0.48
MW14-03B	MW14-03B	primary	05-Aug-2018	1460	3.05	26	174	2530	0.0043	4.38	11	20.6	8.47	0.156	5850	0.032	27.6	3670	202	0.173	<0.20	<2.0	51.2	<0.20	1.6
MW14-03B	MW14-03B	primary	07-Oct-2018	1190	3.58	25.8	174	1890	0.0057	3.84	12.8	17.1	8.62	0.152	6050	0.03	28.2	4200	202	0.363	<0.20	<2.0	57.7	<0.20	2
MW14-03B	MW14-03B	primary	27-Apr-2019	897	2.22	28.4	165	1860	0.0081	3.36	10.2	14.7	7.92	0.135	5590	0.026	24.9	3270	190	0.23	<0.40	<1.0	52.4	<0.40	2.04
MW14-03B	MW14-03B	primary	14-Jun-2019	1290	1.97	27.5	171	2170	<0.040	3.61	9.42	46.5	8.6	0.293	5630	0.0341	25.6	3750	207	0.159	<0.20	<0.50	55.9	<0.20	2.59
MW14-03B	MW14-03B	primary	23-Aug-2019	1440	1.28	26.9	183	2280	0.006	3.54	10.2	16	8.56	0.113	6290	<0.020	26.2	3600	215	0.205	<0.40	<4.0	59.4	<0.40	<2.0
MW14-05A	MW14-05A	primary	02-Oct-2014	1360	1.27	28.5	6.12	338	0.01	8.88	2.41	113	12.6	0.6	14500	0.609	15.4	342	10.7	0.045	1.1	33	4.99	<1	99.1
MW14-05A	MW14-05A	primary	23-Jun-2015	2080	0.317	25.9	8.72	1320	0.003	3.65	1.31	84.5	5.14	0.149	13700	0.04	12.4	336	8.6	0.01	<0.20	2.76	26.4	0.31	14.8
MW14-05A	MW14-05A	primary	13-Jul-2015	2660	0.742	27.4	7.12	1080	0.0024	4.05	1.6	128	5.22	0.147	13700	0.0397	11.7	323	5.6	0.0211	0.2	3.88	26.8	0.33	16.7
MW14-05A	MW14-05A	primary	08-Aug-2015	3080	0.372	35.3	10.3	1160	<0.0020	4.89	1.92	247	8.03	0.108	13900	0.016	18.4	498	7.5	0.0197	0.47	2.03	24.3	0.25	19.1
MW14-05A	MW14-05A	primary	07-Sep-2015	3790	0.154	28.1	8.95	1620	<0.0020	4.27	0.659	92.1	5.62	0.102	13400	0.006	12.4	356	6.5	0.002	0.2	1.09	36.5	<0.20	4.56
MW14-05A	MW14-05A	primary	14-May-2016	5730	0.151	34.6	12	1910	<0.0020	5.98	1.45	96	6.77	0.07	14200	<0.0050	17.2	438	<3.0	<0.0020	0.37	2.07	22.5	<0.20	7.81
MW14-05A	JH40-04	duplicate	16-Jul-2016	6780	0.171	24.1	10.7	2230	<0.0020	4.14	0.308	77.4	4.89	0.121	14400	0.008	11.5	314	6.1	<0.0020	<0.20	0.74	19.4	<0.20	3.07
MW14-05A	MW14-05A	primary	16-Jul-2016	6490	0.18	26.4	9.82	2060	<0.0020	4.3	0.34	84.8	4.99	0.14	14300	0.012	11	323	6.8	0.003	0.27	0.65	18.5	<0.20	2.83
MW14-05A	MW14-05A	primary	23-Sep-2016	6710	0.641	31.9	10.2	2050	0.0028	5.99	0.424	79.4	6.29	0.081	12700	<0.0050	13	441	3.2	0.024	0.42	1.59	12.9	<0.20	5.77
MW14-05A	MW14-05A	primary	28-Apr-2017	8110	0.301	29	12.2	2060	0.0021	6.45	0.419	76.7	6.46	0.096	11500	0.021	14.5	428	<3.0	0.002	0.49	1.56	7.37	<0.20	4.78
MW14-05A	MW14-05A	primary	10-Jun-2017	8110	0.099	25.2	10.6	1910	0.002	4.99	0.23	75	4.44	<0.20	13300	<0.025	11.1	305	<15	<0.010	<1.0	<2.5	9.44	<1.0	2.69
MW14-05A	MW14-05A	primary	25-Jul-2017	8080	0.16	25.7	10.5	1940	<0.0020	4.62	<0.50	96	4.9	<0.20	13400	<0.050	11.7	347	<15	<0.010	<1.0	<10	8.11	<1.0	<5.0
MW14-05A	MW14-05A	primary	08-Oct-2017	10600	0.398	29.6	12.8	2110	<0.0020	4.77	0.92	80	5.67	<0.20	14900	<0.025	13.9	393	<15	<0.010	<1.0	<2.5	6.23	<1.0	5.87
MW14-05A	MW14-05A	primary	21-Apr-2018	10700	0.374	22.8	13.1	2210	<0.0020	6.33	0.29	62	4.94	<0.20	12100	<0.025	12.9	345	<15	<0.010	<1.0	3.8	5.61	<1.0	4.49
MW14-05A	JH42-04	duplicate	09-Jun-2018	10100	0.128	24.3	11.6	1970	<0.0020	4.73	0.21	59	4.18	<0.20	12700	<0.025	11.2	322	<15	<0.010	<1.0	3.8	6.16	<1.0	2.92
MW14-05A	MW14-05A	primary	09-Jun-2018	10100	0.127	25	11.6	1940	<0.0020	4.53	0.25	55	4.13	<0.20	13100	<0.025	11.2	318	<15	0.021	<1.0	5.3	6.25	<1.0	3.45
MW14-05A	MW14-05A	primary	04-Aug-2018	10700	0.24	27.2	11.2	2010	<0.0020	4.48	<0.50	70	4.2	<0.20	13400	<0.050	10.8	322	<15	<0.010	<1.0	<10	5.45	<1.0	<5.0
MW14-05A	MW14-05A	primary	06-Oct-2018	10500	0.28	25.3	12	2320	<0.0020	4.7	<0.50	65	4.9	<0.20	12500	<0.050	11.7	374	<15	<0.010	<1.0	<10	4.51	<1.0	<5.0
MW14-05A	MW14-05A	primary	29-Apr-2019	11700	0.14	21.4	11.9	1990	<0.0020	4.33	<0.50	57	4.3	<0.20	11600	<0.050	10.9	306	<15	<0.010	<1.0	<10	3.84	<1.0	<5.0
MW14-05A	BD2-Q1	duplicate	29-Apr-2019	11900	0.17	21.8	11.6	1930	<0.0020	4.22	<0.50	63	4.1	<0.20	12100	<0.050	10.4	297	<15	<0.010	<1.0	<10	3.99	<1.0	<5.0
MW14-05A	MW14-05A	primary	15-Jun-2019	11900	0.131	24	12.1	1990	<0.040	4.09	0.38	60	4.19	<0.20	13400	<0.025	10.7	312	<15	<0.010	<1.0	<2.5	4.14	<1.0	4.57
MW14-05A	MW14-05A	primary	24-Aug-2019	13200	0.15	25.6	13.4	2120	<0.0020	4.17	<0.50	65	4.4	<0.20	15300	<0.050	11.4	337	<15	<0.010	<1.0	<10	4.28	<1.0	<5.0
MW14-05B	MW14-05B	primary	03-Oct-2014	2610	2.36	32.6	8.01	341	0.019	18.2	9.4	112	15.8	0.5	19900	5.55	43.7	621	35.8	0.133	1.65	133	6.91	2.1	40.1
MW14-05B	MW14-05B	primary	24-Jun-2015	1370	1.94	35.7	7.79	612	0.0054	27.3	10.1	176	14.3	0.403	12300	0.302	72.8	701	40.5	0.119	0.92	50.1	16.6	2.56	34.3
MW14-05B	MW14-05B	primary	14-Jul-2015	969	1.23	34.1	6.83	734	0.0062	22	7.87	187	12.3	0.408	11800	0.111	91.5	722	50.9	0.0486	0.83	13	18.4	1.55	34.5
MW14-05B	MW14-05B	primary	09-Aug-2015	1290	0.525	37.9	7.72	935	0.0056	16.1	5.33	161	10.8	0.356	12800	0.0406	112	693	59.9	0.0201	0.64	3.88	14.8	1.23	6.49

Station	Sample ID	Sample Class	Sample Date	Total Iron (Fe)	Total Lead (Pb)	Total Lithium (Li)	Total Magnesium (Mg)	Total Manganese (Mn)	Total Mercury (Hg)	Total Molybdenum (Mo)	Total Nickel (Ni)	Total Phosphorus (P)	Total Potassium (K)	Total Selenium (Se)	Total Silicon (Si)	Total Silver (Ag)	Total Sodium (Na)	Total Strontium (Sr)	Total Sulphur (S)	Total Thallium (Tl)	Total Tin (Sn)	Total Titanium (Ti)	Total Uranium (U)	Total Vanadium (V)	Total Zinc (Zn)
				ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				1	0.005	0.5	0.05	0.05	0.002	0.05	0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1
ALS RDL[1]:				10	0.05	0.5	0.1	0.05	0.01	0.05	0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	3
MW14-05B	MW14-05B	primary	08-Sep-2015	1900	0.427	34.9	8.47	1240	0.0039	9.09	4.23	173	9.95	0.17	14200	0.128	62.3	600	30.7	0.008	0.94	3.96	9.67	0.96	7.84
MW14-05B	MW14-05B	primary	15-May-2016	2690	0.174	33.3	10.9	2530	<0.0020	2.05	0.822	222	8.89	0.094	16800	<0.0050	41.6	589	10	<0.0020	0.24	0.69	6.97	<0.20	2.32
MW14-05B	MW14-05B	primary	16-Jul-2016	2920	0.302	31.1	10.2	2730	<0.0020	2.69	1.76	162	7.62	0.068	14600	0.028	35	493	8.4	<0.0020	0.53	1.62	5.23	0.78	3.72
MW14-05B	MW14-05B	primary	23-Sep-2016	3400	0.198	27.3	9.2	2600	<0.0020	1.67	0.853	148	6.32	0.054	16000	<0.0050	29.4	475	7.3	0.01	0.24	0.85	3.1	0.61	1.58
MW14-05B	MW14-05B	primary	29-Apr-2017	4660	1.57	23.4	10	2980	<0.0020	2.23	1.22	112	6.31	0.065	14400	0.01	24.5	453	6.1	0.005	0.92	7.49	2.61	0.62	5.45
MW14-05B	MW14-05B	primary	11-Jun-2017	5640	0.287	24.4	9.87	3180	<0.0020	2.37	0.593	104	5.91	0.042	14300	0.021	26.5	413	5.7	<0.0020	<0.20	1.4	2.08	0.49	1.23
MW14-05B	MW14-05B	primary	26-Jul-2017	5530	2.26	23	9.52	3060	<0.0020	1.86	0.94	121	5.69	<0.040	14000	0.065	21.6	390	4.6	0.0027	0.39	2.6	1.66	0.41	5.5
MW14-05B	MW14-05B	primary	08-Oct-2017	5790	1.87	25.3	11.2	3310	<0.0020	1.36	4.27	124	5.96	<0.040	15900	0.0109	23.8	420	3.7	<0.0020	0.77	0.79	1.44	0.48	1.65
MW14-05B	MW14-05B	primary	22-Apr-2018	5790	3.66	20.4	10.7	3200	<0.0020	1.98	0.666	115	5.39	<0.040	14300	0.0634	19.1	391	<3.0	<0.0020	0.47	4.78	2.04	0.41	3.76
MW14-05B	MW14-05B	primary	10-Jun-2018	5710	0.213	23.6	10.2	2690	<0.0020	1.66	0.378	92.3	4.76	<0.040	15600	<0.0050	17.2	383	4.9	<0.0020	<0.20	2.42	1.71	0.24	1.38
MW14-05B	MW14-05B	primary	04-Aug-2018	6080	0.379	23.5	9.91	2700	<0.0020	1.23	0.36	95	4.79	<0.040	15200	<0.010	16.9	377	4.4	<0.0020	<0.20	<2.0	1.47	0.27	1.2
MW14-05B	MW14-05B	primary	06-Oct-2018	5370	0.203	20.5	9.3	2560	<0.0020	1.08	0.28	84.3	4.15	<0.040	14600	<0.010	14.9	364	4.5	<0.0020	<0.20	<2.0	1.34	0.24	<1.0
MW14-05B	MW14-05B	primary	30-Apr-2019	6400	0.112	21	9.83	2750	<0.0020	1.24	0.24	99.3	4.28	<0.040	13900	<0.010	13.9	343	<3.0	<0.0020	<0.20	<2.0	2.01	<0.20	1.6
MW14-05B	MW14-05B	primary	16-Jun-2019	5780	0.0495	21.7	9.71	2310	<0.040	1.08	0.299	74.8	4.17	<0.040	16100	0.0078	13.8	347	4.6	0.0041	<0.20	2.22	1.2	0.59	0.89
MW14-05B	MW14-05B	primary	25-Aug-2019	6160	0.591	20.3	9.28	2220	0.004	1.14	0.33	80.2	3.9	<0.040	15100	<0.010	12.5	314	4.8	<0.0020	0.35	<2.0	1.39	<0.20	2.3
MW15-01WB	MW15-01WB	primary	07-Jun-2015	384	0.123	22	184	377	<0.0020	0.788	1.91	4.4	4.96	0.106	8960	0.01	26.2	3000	294	0.0347	<0.20	<0.50	490	<0.20	58
MW15-01WB	MW15-01WB	primary	08-Jul-2015	510	4.83	23.4	192	373	<0.0020	0.864	2.03	14.9	5.09	1.65	8170	<0.0050	26.8	2700	296	0.0172	<0.20	<0.50	542	<0.20	84.2
MW15-01WB	MW15-01WB	primary	10-Aug-2015	620	0.211	26.5	200	382	<0.0020	0.776	2.39	209	5.13	0.07	8530	<0.0050	28.8	2700	304	0.0297	<0.20	3.26	548	<0.20	138
MW15-01WB	MW15-01WB	primary	03-Sep-2015	520	0.167	25.7	197	368	<0.0020	0.788	1.73	18.1	5.26	0.135	6760	<0.0050	27.2	3020	316	0.045	<0.20	<0.50	598	<0.20	110
MW15-01WB	MW15-01WB	primary	15-May-2016	786	0.092	25.8	190	356	<0.0020	0.479	1.51	<2.0	4.87	<0.040	8910	<0.0050	27.4	2900	310	0.016	<0.20	<0.50	564	<0.20	17.6
MW15-01WB	MW15-01WB	primary	14-Jul-2016	1710	0.111	22.2	188	353	<0.0020	0.482	1.18	10.1	4.75	0.05	7830	<0.0050	26.8	3110	273	0.017	<0.20	<0.50	501	<0.20	31.2
MW15-01WB	MW15-01WB	primary	22-Sep-2016	1900	0.129	27	171	365	<0.0020	0.512	0.949	17.5	4.57	<0.040	8620	0.005	24.1	3200	297	0.01	<0.20	<0.50	533	<0.20	25
MW15-01WB	MW15-01WB	primary	22-Apr-2017	1480	0.252	26.6	188	404	<0.0020	0.46	0.79	<10	4.3	<0.20	8630	<0.025	26.9	3230	303	0.015	<1.0	<2.5	558	<1.0	18.2
MW15-01WB	MW15-01WB	primary	08-Jun-2017	86.4	0.246	25	187	531	<0.0020	0.55	0.72	<10	4.8	<0.20	7550	<0.025	25.9	2550	308	0.109	<1.0	<2.5	537	<1.0	22.6
MW15-01WB	MW15-01WB	primary	24-Jul-2017	2070	0.19	25.6	182	407	<0.0020	0.52	0.63	18	4.57	<0.20	8640	<0.025	26	2840	308	<0.010	<1.0	<2.5	541	<1.0	7.33
MW15-01WB	MW15-01WB	primary	06-Oct-2017	1460	0.268	26.5	192	420	<0.0020	1.01	3.03	14.8	4.89	0.058	8220	<0.0050	27.8	3020	288	0.009	<0.20	1.3	580	0.23	23.9
MW15-01WB	MW15-01WB	primary	19-Apr-2018	811	0.044	24.8	213	360	<0.0020	0.43	1.22	<10	5	<0.20	8810	<0.025	29.6	2860	312	<0.010	<1.0	<2.5	564	<1.0	11.7
MW15-01WB	MW15-01WB	primary	07-Jun-2018	858	0.043	21.4	180	383	<0.0020	0.48	1.24	<10	4.76	0.64	7830	<0.025	25.4	3010	286	0.02	<1.0	<2.5	539	<1.0	13.7
MW15-01WB	MW15-01WB	primary	02-Aug-2018	981	0.0641	23.7	176	368	<0.0020	0.446	0.675	11.6	4.7	<0.040	7610	<0.0050	25.1	2920	268	0.0077	<0.20	<0.50	522	<0.20	15
MW15-01WB	MW15-01WB	primary	03-Oct-2018	693	0.772	22.5	178	333	<0.0020	0.46	1.12	<10	4.57	<0.080	7710	<0.020	25	2780	289	0.0167	<0.40	<4.0	539	<0.40	13
MW15-01WB	MW15-01WB	primary	05-May-2019	608	0.336	20.7	170	351	<0.0020	0.46	1.27	17	4.47	0.092	7480	<0.020	24.3	2590	280	0.018	<0.40	<4.0	525	<0.40	18.9
MW15-01WB	MW15-01WB	primary	18-Jun-2019	1050	0.08	24	177	409	<0.0020	0.5	0.988	17.3	4.85	<0.080	8300	<0.010	24.8	2880	287	0.0076	<0.40	<1.0	552	<0.40	50.6
MW15-01WB	MW15-01WB	primary	22-Aug-2019	967	0.045	23.8	174	353	<0.0020	0.44	0.616	6.2	4.61	<0.080	7640	<0.010	24.4	2890	289	0.0059	<0.40	<1.0	529	<0.40	4.11
MW15-02AZ	MW15-02AZ	primary	31-May-2015	6.4	0.0094	4.09	41	19.8	<0.0020	0.436	1.09	39.7	7.14	1.26	5200	<0.0050	5.87	1260	83.1	0.0059	<0.20	<0.50	29.3	<0.20	1.01
MW15-02AZ	MW15-02AZ	primary	11-Jul-2015	8.4	0.0135	3.85	33.2	0.31	0.0028	0.348	0.479	8.2	5.43	0.182	5040	<0.0050	4.64	1060	55.9	0.0072	<0.20	<0.50	23.5	0.29	1.72
MW15-02AZ	MW15-40AZ	duplicate	11-Jul-2015	7.1	0.0145	3.73	30.5	0.244	0.0029	0.352	0.539	26.8	5.16	0.185	5530	<0.0050	4.38	981	50.7	0.0057	<0.20	<0.50	25.2	0.21	1.39
MW15-02AZ	MW15-02AZ	primary	12-Aug-2015	6.8	0.01	4.03	34.8	8.32	0.0023	0.367	0.674	32.1	6.11	0.193	5380	<0.0050	5.05	959	56.1	0.0026	<0.20	<0.50	24.7	0.43	1.24
MW15-02AZ	MW15-02AZ	primary	07-Sep-2015	12.6	<0.0050	3.77	32.4	28.7	<0.0020	0.418	0.69	5.2	6.87	0.162	5560	<0.0050	4.77	996	58	0.003	<0.20	<0.50	27.7	<0.20	0.2
MW15-02AZ	MW15-02AZ	primary	17-May-2016	15.9	0.005	4.07	32.5	61.1	<0.0020	0.416	0.683	7.1	7.71	0.205	5220	<0.0050	5.09	1000	68.4	0.006	<0.20	<0.50	26.8	<0.20	0.15
MW15-02AZ	MW15-02AZ	primary	19-Jul-2016	15.9	<0.0050	4.15	32.9	63.3	<0.0020	0.424	0.752	2.6	7.7	0.177	5350	<0.0050	5.65	994	65.2	0.005	<0.20	<0.50	26.3	0.22	0.12
MW15-02AZ	JH40-06	duplicate	25-Sep-2016	116	0.035	4.61	31.3	68.4	<0.0020	0.423	1	8.8	8.44	0.207	5090	<0.0050	5.11	1050	62.5	0.012	<0.20	5.44	26.1	0.33	0.71
MW15-02AZ	MW15-02AZ	primary	25-Sep-2016	127	0.077	4.23	30.6	68.7	<0.0020	0.434	0.882	10.1	8.29	0.186	5230	<0.0050	5.24	1050	64.3	0.009	<0.20	4.73	26.9	0.37	0.99
MW15-02AZ	MW15-02AZ	primary	28-Jul-2017	8.3	<0.0050	4.3	35	40.9	<0.0020	0.383	0.561	4.7	7.8	0.193	5190	<0.0050	5.24	1010	70.3	0.0047	<0.20	<0.50	28.9	0.26	0.2
MW15-02AZ	MW15-02AZ	primary	08-Oct-2017	16	0.0066	3.76	39.5	0.087	0.0021	0.397	0.494	5.1	6.14	0.347	4840	<0.0050	5.17	1110	63.5	<0.0020	<0.20	<0.50	29.7	0.31	0.22
MW15-02AZ	JH42-05	duplicate	03-Aug-2018	7.9	<0.0050	4.33	36.8	51.3	<0.0020	0.401	0.59	<2.0	8.21	0.175	5100	<0.0050	5.69	1150	67.5	0.0042	<0.20	<0.50	30.7	<0.20	0.13
MW15-02AZ	MW15-02AZ	primary	03-Aug-2018	6.5	<0.0050	4.24	36.3	51.2	<0.0020	0.415	0.633	<2.0	8.24	0.186	4980	<0.0050	5.68	1120	69.5	0.0047	<0.20	<0.50	30.4	<0.20	<0.10
MW15-02WB	MW15-02WB	primary	01-Jun-2015	324	0.311	3.73	34.6	94.1	<0.0020	1.17	2.54	8.1	8.43	0.344	5090	<0.0050	8.32	954	81.5	0.0071	<0.20	<0.50	36.4	<0.20	35.6
MW15-02WB	MW15-02WB	primary	11-Jul-2015	397	0.24	3.91	34.5	105	<0.0020	0.69	1.04	46.7	8.5	0.113	4910	<0.0050	9.12	949	82.6	0.0164	<0.20	1.16	31.8	0.22	18.2
MW15-02WB	MW15-02WB	primary	12-Aug-2015	412	0.362	4.57	36.9	110	<0.0020	0.708	1.24	27.9	9.07	0.139	5560	<0.0050	10.1	917	83.7	0.0057	<0.20	0.56	31	0.23	28.1
MW15-02WB	MW15-02WB	primary	07-Sep-2015	16.7	0.023	3.85	35.2	37.9	<0.0020	0.56	1.56	6.9	11	0.12	5200	<0.0050	6.22	916	80.2	0.017	<0.20	<0.50	31.4	<0.20	10.2
MW15-02WB	MW15-02WB	primary	18-May-2016	169	0.139	4.06	33.3	60.6	<0.0020	0.573	0.922	4.1	9.2	0.081	4840	<0.0050	6.87	927	78.9	0.01	<0.20	<0.50	31.3	<0.20	11.5
MW15-02WB	MW15-02WB	primary	19-Jul-2016	8.2	0.01	4.09	32.7	7.63	<0.0020	0.48	2.17	4.6	9.81	0.177	4900	<0.0050	5.58	909	73.2	0.031	<0.20	<0.50	28.4	<0.20	16.1
MW15-02WB	MW15-02WB	primary	25-Sep-2016	5.2	0.024	3.61	30.7	3.95	0.0021	0.538	1.26	13	9.99	0.193	4630	<0.0050	5.47	899	67.8	0.014	<0.20	<0.50	26.8	<0.20	42.8
MW15-02WB	JH41-02	duplicate	25-Apr-2017	9.2	0.02	3.86	36.4	6.38	<0.0020	0.449	1.07	3.8	10.2	0.269	4460	<0.0050	5.73	964	83.6	0.023	<0.20	<0.50	33.5	<0.20	4.06
MW15-02WB	MW15-02WB	primary	25-Apr-2017	12.9	0.028	4.19	35.8	6.32	<0.0020	0.437	0.99	3.9	10.3	0.266	4480	<0.0050	5.74	961	82.6	0.023	<0.20	<0.50	32.8	<0.20	5.86
MW15-02WB	JH41-04	duplicate	13-Jun-2017	367	0.222	3.56	34.4	94.5	<0.0020	0.696	0.911	11.2	8.53	0.12	4540	<0.0050	7.69	903	73.2	0.006	<0.20	<0.50	32.8	0.21	60.6
MW15-02WB	MW15-02WB	primary	13-Jun-2017	343	0.173	3.29	35.1	93.1	<0.0020	0.623	0.659	5.7	8.46	0.043	4540	<0.0050	7.84	931	77.4	0.005	<0.20	<0.50	33.3	<0.20	25.4
MW15-02WB	MW15-02WB	primary	28-Jul-2017	7.6	0.0126	3.96	34.7	3.56	<0.0020	0.44	0.969	4.5	11	0.17	4930	<0.0050	5.68	906	82.2	0.024	<0.20	<0.50	30.1	<0.20	8.73
MW15-02WB	MW15-02WB	primary	08-Oct-2017	35.2	0.0728	3.57	34.8	2.66	<0.0020	0.631	1.92	8.4	10.8	0.205	4500	<0.0050	5.91	857	67.9	0.0266	<0.20	<0.50	28.1	<0.20	39

Station	Sample ID	Sample Class	Sample Date	Total Iron (Fe)	Total Lead (Pb)	Total Lithium (Li)	Total Magnesium (Mg)	Total Manganese (Mn)	Total Mercury (Hg)	Total Molybdenum (Mo)	Total Nickel (Ni)	Total Phosphorus (P)	Total Potassium (K)	Total Selenium (Se)	Total Silicon (Si)	Total Silver (Ag)	Total Sodium (Na)	Total Strontium (Sr)	Total Sulphur (S)	Total Thallium (Tl)	Total Tin (Sn)	Total Titanium (Ti)	Total Uranium (U)	Total Vanadium (V)	Total Zinc (Zn)
				ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				1	0.005	0.5	0.05	0.05	0.002	0.05	0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1
ALS RDL[1]:				10	0.05	0.5	0.1	0.05	0.01	0.05	0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	3
MW15-02WB	MW15-02WB	primary	21-Apr-2018	27.4	0.0576	3.68	42.9	18.2	<0.0020	0.568	1.02	4.9	11.5	0.232	5010	<0.0050	7.01	1050	90.5	0.0203	<0.20	<0.50	35.5	<0.20	5.61
MW15-02WB	JH42-03	duplicate	09-Jun-2018	370	0.109	4.07	36.3	90.4	<0.0020	0.709	0.474	6	8.73	0.093	5160	<0.0050	8.52	1000	83.1	<0.0020	<0.20	<0.50	33.1	<0.20	34.5
MW15-02WB	MW15-02WB	primary	09-Jun-2018	386	0.128	4	36.1	91.6	<0.0020	0.642	0.552	9.2	8.79	0.217	5230	<0.0050	8.54	1020	83.3	0.0038	<0.20	<0.50	32.7	<0.20	38.5
MW15-02WB	MW15-02WB	primary	04-Aug-2018	386	0.145	4.03	35.7	101	<0.0020	0.646	0.62	<5.0	8.84	<0.040	5210	<0.010	8.54	1010	83.7	0.005	<0.20	<2.0	33.9	<0.20	9.4
MW15-02WB	JH42-07	duplicate	06-Oct-2018	5.4	<0.020	3.83	34.5	2.09	<0.0020	0.498	0.98	5	9.88	0.166	4770	<0.010	5.62	1030	74.3	0.0221	<0.20	<2.0	29.6	<0.20	8.6
MW15-02WB	MW15-02WB	primary	06-Oct-2018	6	0.03	3.81	34.4	2.04	<0.0020	0.496	0.85	6.1	10	0.168	4820	<0.010	5.68	1040	74.5	0.0217	<0.20	<2.0	29.5	<0.20	7.2
MW15-02WB	MW15-02WB	primary	29-Apr-2019	8.3	0.022	3.69	37	2.33	<0.0020	0.509	1.18	5.1	10.1	0.346	4320	<0.010	5.77	983	83.2	0.016	<0.20	<2.0	32.2	<0.20	22.3
MW15-02WB	MW15-02WB	primary	19-Jun-2019	312	0.148	3.51	35.6	87.7	<0.0020	0.677	0.699	9	8.78	0.061	4790	<0.0050	7.63	978	78.8	0.0045	<0.20	<0.50	33.1	<0.20	57
MW15-02WB	BD2-Q2	duplicate	19-Jun-2019	305	0.151	3.58	34.8	87.7	<0.0020	0.679	0.804	11.3	8.75	0.069	4820	<0.0050	7.46	940	81.4	0.0046	<0.20	<0.50	33	<0.20	78.8
MW15-02WB	MW15-02WB	primary	24-Aug-2019	368	0.114	3.55	34.8	86.2	<0.0020	1.3	3.51	6	8.59	<0.040	4940	<0.010	7.67	954	81	0.0038	<0.20	<2.0	33.5	<0.20	45.2
MW15-03AZ	MW15-03AZ	primary	16-Jun-2015	30.1	0.0311	0.7	11.9	55.5	0.0067	0.442	1.05	22	1.82	0.045	5030	<0.0050	4	307	17.4	0.0028	<0.20	0.74	35.4	0.2	7.96
MW15-03AZ	MW15-21	duplicate	16-Jun-2015	23.5	0.0216	<0.50	11.8	56.1	<0.0020	0.444	1.06	4.4	1.84	0.052	5010	<0.0050	3.92	301	17.1	0.0029	<0.20	0.57	37	<0.20	0.71
MW15-03AZ	MW15-03AZ	primary	09-Jul-2015	17.4	0.0129	0.56	11	214	<0.0020	0.465	1.25	7.9	1.82	<0.040	4670	<0.0050	3.72	280	14.7	0.0023	<0.20	1.69	36.3	0.2	0.57
MW15-03AZ	MW15-03AZ	primary	10-Aug-2015	23.3	0.0136	0.85	8.44	66.4	0.0028	0.497	1.1	40.9	1.59	0.055	4970	0.0056	3.38	210	8	0.0052	<0.20	0.72	17.9	0.27	6.03
MW15-03AZ	MW15-03AZ	primary	04-Sep-2015	14	<0.0050	0.8	8.27	105	0.0026	0.528	1.15	7	1.5	0.058	4690	<0.0050	3.29	212	7.6	0.003	<0.20	0.7	18.6	<0.20	0.37
MW15-03AZ	JH40-02	duplicate	16-May-2016	1230	0.568	1.03	7.4	62.3	<0.0020	0.312	1.43	24	1.39	0.046	4660	<0.0050	2.62	188	<15	0.025	<0.20	49.1	15.2	1.59	3.2
MW15-03AZ	MW15-03AZ	primary	16-May-2016	1530	0.472	1.32	7.91	71.8	<0.0020	0.308	1.79	26	1.51	<0.040	5150	<0.0050	2.69	198	<15	0.024	<0.20	62.4	15.7	2.08	3.6
MW15-03AZ	MW15-03AZ	primary	16-Jul-2016	10.2	<0.0050	0.61	8.15	24.8	0.0038	0.494	0.602	5	1.51	0.05	4860	<0.0050	3.46	201	7.2	0.002	<0.20	<0.50	14.3	<0.20	0.18
MW15-03AZ	MW15-03AZ	primary	23-Sep-2016	7.8	<0.0050	0.82	7.63	15	<0.0020	0.487	0.64	7.6	1.49	0.057	5320	<0.0050	2.99	220	7.2	0.003	<0.20	<0.50	13.7	<0.20	0.38
MW15-03AZ	MW15-03AZ	primary	25-Jul-2017	8.2	<0.0050	0.67	9.67	33.3	0.0023	0.381	0.703	6.6	1.5	0.054	4920	<0.0050	3.54	226	12.7	0.0021	<0.20	<0.50	19.8	0.2	0.14
MW15-03AZ	MW15-03AZ	primary	07-Oct-2017	5.7	<0.0050	0.65	9.6	22.2	0.0022	0.478	0.695	5.5	1.68	0.072	4920	<0.0050	3.47	235	12.5	<0.0020	<0.20	<0.50	15	0.2	0.14
MW15-03AZ	MW15-03AZ	primary	04-Aug-2018	7.9	<0.020	0.82	10.1	39.9	<0.0020	0.534	0.73	8.1	1.67	0.054	5070	<0.010	3.65	296	13.7	0.0025	<0.20	<2.0	26.3	0.22	<1.0
MW15-03AZ	MW15-03AZ	primary	05-Oct-2018	7	0.021	0.6	8.29	37.6	0.0021	0.527	0.76	8.1	1.47	0.058	4860	<0.010	3.14	225	9.4	<0.0020	<0.20	<2.0	16.5	<0.20	<1.0
MW15-03AZ	MW15-03AZ	primary	23-Aug-2019	6.8	<0.020	0.61	9.12	47.7	0.0026	0.471	0.67	<5.0	1.59	0.056	4950	<0.010	3.37	245	11.2	<0.0020	<0.20	<2.0	24.8	<0.20	<1.0
MW15-03WB	MW15-03WB	primary	16-Jun-2015	533	0.0361	12.1	140	89.6	<0.0020	0.848	2.96	83	9.03	<0.040	8600	<0.0050	76.5	9260	341	0.0172	<0.20	1.03	8.56	<0.20	16.5
MW15-03WB	MW15-03WB	primary	09-Jul-2015	586	0.0656	10	132	76.1	<0.0020	0.916	1.64	47.8	8.14	0.108	7530	0.0074	71	8840	310	0.006	<0.20	0.85	7.39	<0.20	27
MW15-03WB	MW15-03WB	primary	10-Aug-2015	553	0.0308	12.1	133	76.5	<0.0020	0.817	1.6	37.3	8.14	0.073	8010	<0.0050	71.9	8040	329	0.0061	<0.20	<0.50	8.51	<0.20	51.2
MW15-03WB	MW15-03WB	primary	04-Sep-2015	557	0.036	12	132	75.5	<0.0020	0.962	1.24	12.9	8.59	0.109	7010	<0.0050	73.9	9280	328	0.008	<0.20	<0.50	8.02	<0.20	46.3
MW15-03WB	MW15-03WB	primary	16-May-2016	803	<0.0050	12	123	72.6	<0.0020	0.773	0.25	8.9	8.1	<0.040	8200	<0.0050	69.7	8840	302	0.003	<0.20	<0.50	7.28	<0.20	4.7
MW15-03WB	MW15-03WB	primary	16-Jul-2016	1420	0.35	11.7	150	104	<0.0020	1.04	1.64	7	9.05	<0.040	7870	0.01	76.9	11200	359	0.005	<0.20	6.62	8.07	0.52	3.8
MW15-03WB	MW15-03WB	primary	23-Sep-2016	1020	0.014	12	133	95.2	<0.0020	1.19	0.38	6.6	8.86	<0.040	7810	0.009	68.6	11100	358	0.007	<0.20	<0.50	7.69	<0.20	7.72
MW15-03WB	MW15-03WB	primary	23-Apr-2017	1400	0.071	12.9	150	100	<0.0020	1.27	0.44	<10	8.82	<0.20	8120	<0.025	77.3	10700	379	<0.010	<1.0	<2.5	8.15	<1.0	42.1
MW15-03WB	MW15-03WB	primary	10-Jun-2017	1160	0.05	12.4	151	98.8	<0.0020	1.07	0.15	<10	8.92	<0.20	7840	<0.025	77.5	9750	372	<0.010	<1.0	<2.5	7.9	<1.0	3.81
MW15-03WB	MW15-03WB	primary	25-Jul-2017	1020	0.03	11.8	143	96.9	<0.0020	0.97	0.16	<10	8.86	<0.20	8250	<0.025	75.9	9640	372	<0.010	<1.0	<2.5	7.5	<1.0	16.2
MW15-03WB	MW15-03WB	primary	07-Oct-2017	926	<0.025	12.7	167	98.8	<0.0020	0.87	<0.10	<10	9.67	<0.20	8420	<0.025	84.9	10600	393	<0.010	<1.0	<2.5	7.9	<1.0	2.97
MW15-03WB	JH42-01	duplicate	20-Apr-2018	610	0.033	12.2	160	93	<0.0020	0.44	0.21	17	8.99	2.59	8920	<0.025	82.6	10400	384	0.011	<1.0	<2.5	6.61	<1.0	9.09
MW15-03WB	MW15-03WB	primary	20-Apr-2018	618	0.031	11.9	162	90.9	<0.0020	0.57	0.23	43	8.89	2.32	8550	<0.025	83.2	10200	379	<0.010	<1.0	<2.5	6.33	<1.0	13.7
MW15-03WB	MW15-03WB	primary	08-Jun-2018	700	0.051	10	141	91.8	<0.0020	0.75	1.41	10	8.73	<0.20	7910	<0.025	72.9	10900	348	<0.010	<1.0	<2.5	6.36	<1.0	24.5
MW15-03WB	MW15-03WB	primary	05-Aug-2018	669	<0.10	13.5	147	90.8	<0.0020	0.49	<0.50	<25	8.6	<0.20	8130	<0.050	77.3	10300	360	<0.010	<1.0	<10	6.58	<1.0	6.3
MW15-03WB	MW15-03WB	primary	04/10/2018 and 05/10/2018	504	0.047	9	118	72.4	<0.0020	0.37	<0.20	<10	7.13	<0.080	6290	<0.020	60.7	8580	293	<0.0040	<0.40	<4.0	4.96	<0.40	4.5
MW15-03WB	MW15-03WB	primary	03-May-2019	585	<0.040	11.6	142	86.1	<0.0020	2.42	0.33	13	8.33	<0.080	7710	<0.020	73.4	10200	359	0.007	<0.40	<4.0	5.43	0.79	10.2
MW15-03WB	MW15-03WB	primary	18-Jun-2019	697	0.045	11.9	144	102	<0.0020	0.42	0.244	13.3	8.83	1.28	8000	<0.010	73.4	10400	353	<0.0040	<0.40	<1.0	12.7	<0.40	56
MW15-03WB	MW15-03WB	primary	23-Aug-2019	573	<0.040	11.2	140	82.6	0.0038	0.96	2.86	<10	8.4	<0.080	7830	<0.020	73.9	10200	364	<0.0040	<0.40	<4.0	5.42	<0.40	12.8
MW15-04WB	MW15-04WB	primary	14-Jun-2015	23.1	0.491	6.88	36.9	118	<0.0020	2.58	0.934	49.6	4.65	0.43	5680	<0.0050	5.95	783	40.6	0.0116	<0.20	<0.50	176	0.25	44.6
MW15-04WB	MW15-20	duplicate	14-Jun-2015	20.1	0.48	6.47	36.6	119	<0.0020	2.47	0.875	59.9	4.57	0.349	5790	<0.0050	5.98	789	40.9	0.0099	<0.20	0.57	176	0.26	42.5
MW15-04WB	MW15-04WB	primary	10-Jul-2015	21.1	0.293	6.04	36.7	121	<0.0020	2.41	1.17	39.6	4.3	0.153	5490	0.0051	5.98	792	38.2	0.0093	<0.20	<0.50	170	0.29	17.9
MW15-04WB	MW15-30WB	duplicate	10-Jul-2015	12.6	0.513	7.19	36.1	119	<0.0020	2.66	0.798	29.5	3.96	0.06	5560	0.0076	5.92	764	39.1	0.0105	<0.20	<0.50	192	0.29	3.3
MW15-04WB	MW15-04WB	primary	11-Aug-2015	43.1	0.293	7.01	39.4	110	<0.0020	2.57	1.58	119	4.9	0.477	5930	<0.0050	6.4	788	41.7	0.0109	<0.20	0.82	157	0.33	122
MW15-04WB	MW15-04WB	primary	05-Sep-2015	17	0.367	7.33	38.2	106	<0.0020	2.59	0.688	16.9	3.98	0.403	5440	<0.0050	6.05	846	43.2	0.01	<0.20	<0.50	167	0.21	23
MW15-04WB	MW15-04WB	primary	13-May-2016	52.7	0.625	6.71	38.3	161	<0.0020	2.08	0.836	4.7	3.85	<0.040	7090	<0.0050	6.57	812	44.9	<0.0020	<0.20	<0.50	132	<0.20	9.13
MW15-04WB	JH40-03	duplicate	15-Jul-2016	36.1	0.533	6.85	35.6	144	<0.0020	2.05	0.739	3	3.67	0.061	6380	<0.0050	5.95	800	39.4	0.008	<0.20	<0.50	124	<0.20	6.63
MW15-04WB	MW15-04WB	primary	15-Jul-2016	37.8	0.51	6.43	36.1	142	<0.0020	1.92	0.73	6.1	3.65	0.092	5870	<0.0050	6.02	747	37.4	0.008	<0.20	<0.50	115	<0.20	6.97
MW15-04WB	MW15-04WB	primary	24-Sep-2016	46	0.363	7.08	32.6	144	<0.0020	2.1	0.758	6.3	3.54	0.056	6420	<0.0050	5.42	829	39.8	0.007	<0.20	<0.50	123	<0.20	11
MW15-04WB	MW15-04WB	primary	23-Apr-2017	35.8	0.314	6.62	36.6	128	<0.0020	2.62	2.71	8.2	4.03	0.121	5990	<0.0050	5.79	859	40.6	0.013	<0.20	<0.50	146	<0.20	25.1
MW15-04WB	MW15-04WB	primary	11-Jun-2017	11.6	0.321	7	39.1	132	<0.0020	2.18	0.67	<10	3.93	<0.20	6280	<0.025	6.2	797	47	0.012	<1.0	<2.5	152	<1.0	11.5
MW15-04WB	MW15-04WB	primary	26-Jul-2017	4.8	0.127	6.08	37.9	102	<0.0020	2.04	0.588	6	3.81	0.128	5850	<0.0050	5.94	735	43.7	0.011	<0.20	<0.50	148	<0.20	3.49
MW15-04WB	JH41-07	duplicate	05-Oct-2017	15.4	0.384	6.93	40.2	130	<0.0020	2.29	0.921	6	4.1	0.164	6180	<0.0050	6.41	831	45.6	0.0122	<0.20	<0.50	160	0.3	9.37
MW15-04WB	MW15-04WB	primary	05-Oct-2017	16.9	0.46	6.87	41.2	130	<0.0020	2.19	0.653	16.4	4.35	0.377	6310	<0.0050	6.55	814	46.8	0.011	<0.20	<0.50	161	0.27	29.6
MW15-04WB	MW15-04WB	primary	19-Apr-2018	19.5	0.232	7.66	43.9	119	<0.0020	2.43	0.928	14	4.15	0.225	6780	0.114	7.44	872	48.2	0.009	<0.20	<0.50	153	0.23	16.6

Station	Sample ID	Sample Class	Sample Date	Total Iron (Fe)	Total Lead (Pb)	Total Lithium (Li)	Total Magnesium (Mg)	Total Manganese (Mn)	Total Mercury (Hg)	Total Molybdenum (Mo)	Total Nickel (Ni)	Total Phosphorus (P)	Total Potassium (K)	Total Selenium (Se)	Total Silicon (Si)	Total Silver (Ag)	Total Sodium (Na)	Total Strontium (Sr)	Total Sulphur (S)	Total Thallium (Tl)	Total Tin (Sn)	Total Titanium (Ti)	Total Uranium (U)	Total Vanadium (V)	Total Zinc (Zn)
				ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				1	0.005	0.5	0.05	0.05	0.002	0.05	0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1
ALS RDL[1]:				10	0.05	0.5	0.1	0.05	0.01	0.05	0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	3
MW15-04WB	MW15-04WB	primary	07-Jun-2018	59.2	0.771	6.13	36.5	136	<0.0020	2.28	0.895	32.5	4.55	1.64	5930	0.0155	6.13	908	41.7	0.0149	<0.20	<0.50	137	<0.20	85.8
MW15-04WB	MW15-04WB	primary	02-Aug-2018	23.2	0.494	6.81	34.6	127	<0.0020	2.11	0.512	5.1	3.71	0.134	5910	<0.0050	5.93	841	37	0.0096	<0.20	<0.50	126	<0.20	7.67
MW15-04WB	MW15-04WB	primary	05-Oct-2018	22.8	0.599	5.95	31.2	106	<0.0020	2.07	0.49	9.4	3.53	0.174	5690	<0.010	5.26	750	35.5	0.0054	<0.20	<2.0	104	<0.20	11.3
MW15-04WB	MW15-04WB	primary	03-May-2019	11.8	0.394	5.98	36	82.5	<0.0020	2.1	0.472	5	3.66	0.283	5670	<0.0050	5.74	765	40.3	0.003	<0.20	<0.50	123	<0.20	7.73
MW15-04WB	MW15-04WB	primary	17-Jun-2019	12.3	0.342	6.14	34.7	76.6	<0.0020	2.2	0.485	9.1	3.89	0.219	6110	<0.0050	5.62	794	40.6	0.0076	<0.20	<0.50	128	<0.20	21.3
MW15-04WB	MW15-04WB	primary	22-Aug-2019	24.6	0.358	6.28	34.7	73.8	0.0031	2.31	1.53	4.1	3.72	0.286	5700	<0.0050	5.65	797	38.2	0.0074	<0.20	0.5	127	0.35	6.98
MW15-04WB	BD1-Q3	duplicate	22-Aug-2019	27.4	0.422	6.51	35.3	81.4	0.0021	2.27	1.08	14.6	3.95	1.01	6010	<0.0050	5.92	808	41.2	0.0073	<0.20	<0.50	127	<0.20	51.3
MW15-05AZ	MW15-05AZ	primary	06-Sep-2015	1360	0.06	<0.50	0.766	620	0.0057	0.276	1.33	21.1	0.123	0.052	6010	0.005	1.16	16.2	<3.0	0.008	<0.20	2.94	0.811	2.97	0.99
MW15-05WB	MW15-05WB	primary	18-Jun-2015	13.7	0.15	12.9	7.06	14.5	<0.0020	0.646	0.235	66.2	1.66	0.374	9670	<0.0050	8.88	138	4	0.007	<0.20	<0.50	71.7	<0.20	64.7
MW15-05WB	MW15-05WB	primary	10-Jul-2015	47.5	0.104	11.7	7.08	7.43	<0.0020	0.969	2.26	91.6	1.45	0.444	8580	0.0078	9.11	140	3.9	0.0031	<0.20	1.24	69.5	0.21	102
MW15-05WB	MW15-05WB	primary	11-Aug-2015	7.3	0.019	12.5	7.01	4.45	<0.0020	0.564	0.448	21.2	0.792	0.104	8980	<0.0050	9.36	138	3.8	<0.0020	<0.20	<0.50	72.9	<0.20	20.3
MW15-05WB	MW15-60	duplicate	11-Aug-2015	14.3	0.0281	12	7.3	4.9	<0.0020	0.631	0.489	59.8	0.857	0.111	9780	<0.0050	9.65	137	3.9	<0.0020	<0.20	0.69	73.3	<0.20	26.3
MW15-05WB	MW15-05WB	primary	06-Sep-2015	3.2	0.009	12.2	6.97	6.25	<0.0020	0.682	0.247	18.2	0.693	<0.040	9410	<0.0050	9.16	145	4.2	<0.0020	<0.20	<0.50	76.9	<0.20	12.5
MW15-05WB	MW15-05WB	primary	15-May-2016	56.6	0.037	11.4	7.46	10.4	<0.0020	0.534	0.686	9.3	0.631	<0.040	10600	<0.0050	10.1	140	3.3	<0.0020	<0.20	<0.50	80	<0.20	9.71
MW15-05WB	MW15-05WB	primary	20-Jul-2016	5.5	0.029	11.7	7.14	7.03	<0.0020	0.531	0.254	23.6	0.75	0.088	9130	<0.0050	9.32	136	4.4	0.003	<0.20	<0.50	82.1	<0.20	39.2
MW15-05WB	MW15-05WB	primary	27-Sep-2016	5.3	0.019	12	6.89	9.11	<0.0020	0.518	0.196	13.2	0.601	<0.040	8860	<0.0050	9.12	130	4.2	<0.0020	<0.20	<0.50	78.8	<0.20	22.4
MW15-05WB	MW15-05WB	primary	21-Apr-2017	1.6	0.026	12.2	6.93	6.97	<0.0020	0.514	0.183	15.8	0.565	<0.040	9000	<0.0050	9.23	132	3.4	0.003	<0.20	<0.50	81.3	<0.20	8.62
MW15-05WB	MW15-05WB	primary	11-Jun-2017	1.8	0.022	12.3	6.94	5.73	<0.0020	0.514	0.175	14.9	0.576	<0.040	9090	<0.0050	9.29	133	4.7	0.002	<0.20	<0.50	79.3	<0.20	5.92
MW15-05WB	MW15-05WB	primary	27-Jul-2017	7.6	0.0712	12.9	7.3	11.4	<0.0020	0.603	1.18	29.4	0.893	0.279	9290	<0.0050	9.3	131	4.5	0.0025	<0.20	<0.50	73.5	<0.20	61.2
MW15-05WB	MW15-05WB	primary	07-Oct-2017	37.6	0.0701	11.8	7.02	7.21	<0.0020	0.724	1.56	18	0.663	0.083	8490	<0.0050	9.37	129	4.1	0.0024	<0.20	1.46	77	<0.20	30.7
MW15-05WB	MW15-05WB	primary	21-Apr-2018	3.1	0.0332	10.9	7.28	6.59	<0.0020	0.565	0.353	15.3	0.604	0.062	8750	<0.0050	9.71	132	3.8	<0.0020	<0.20	<0.50	77.2	<0.20	7.07
MW15-05WB	MW15-05WB	primary	09-Jun-2018	8.3	0.0558	13.2	7.19	7.73	<0.0020	0.606	0.531	31.4	0.917	0.168	9390	<0.0050	9.52	139	4.6	<0.0020	<0.20	<0.50	78.6	<0.20	61.5
MW15-05WB	MW15-05WB	primary	04-Aug-2018	10.6	0.056	13.5	7.02	12.2	<0.0020	0.827	1.37	24.2	0.92	<0.040	9220	<0.010	9.2	141	3.7	<0.0020	<0.20	<2.0	74.3	<0.20	64.7
MW15-05WB	MW15-05WB	primary	06-Oct-2018	5	0.0464	12.5	6.69	7.29	0.0039	0.54	0.311	19.9	0.658	0.225	8920	<0.0050	8.91	143	4.9	<0.0020	<0.20	0.65	80.7	<0.20	19.9
MW15-05WB	MW15-05WB	primary	30-Apr-2019	<5.0	0.03	11.7	6.53	8.49	<0.0020	0.547	0.22	16.3	0.62	0.052	8280	<0.010	8.86	131	3.7	0.002	<0.20	<2.0	77.8	<0.20	24.4
MW15-05WB	MW15-05WB	primary	19-Jun-2019	7.1	0.0309	11	6.54	6.98	<0.0020	0.544	0.263	17.9	0.66	0.06	8460	<0.0050	9.16	135	4.1	<0.0020	<0.20	<0.50	78.5	<0.20	89.3
MW15-05WB	MW15-05WB	primary	23-Aug-2019	10.6	0.028	11	6.54	7.33	0.0038	0.572	0.91	12.7	0.57	<0.040	8390	<0.010	8.69	127	3.9	<0.0020	<0.20	<2.0	75.4	<0.20	17
MW15-06WB	MW15-06WB	primary	21-Jun-2015	1610	0.663	7.09	16.7	850	1.54	16	6.06	83.9	10.4	0.47	5870	0.228	21.9	246	15.4	0.061	0.2	41.9	46.1	1.98	269
MW15-06WB	MW15-06WB	primary	21-Jul-2015	507	0.263	11.1	30.5	2300	0.091	34.5	4.18	99.8	7.22	0.475	7040	0.0748	10.9	413	30.7	0.024	<0.20	16.1	96.5	0.5	604
MW15-06WB	MW15-06WB	primary	09-Aug-2015	269	0.124	11.4	36.3	3410	0.281	42.6	3.34	54.1	6.51	0.414	6520	0.0524	9.74	442	32.5	0.053	<0.20	7.78	103	0.49	172
MW15-06WB	MW15-06WB	primary	08-Sep-2015	780	0.063	11.9	35.4	5430	0.0942	80.4	2.7	46.8	6.42	0.147	5550	0.036	8.43	444	33.6	0.033	<0.20	3.17	95	<0.20	85.1
MW15-06WB	MW15-06WB	primary	17-May-2016	807	0.347	14.5	31.8	5560	0.0049	196	0.349	22	4.07	<0.040	4870	0.012	6.5	394	24.7	0.009	<0.20	1.13	26.2	<0.20	31.6
MW15-06WB	MW15-06WB	primary	18-Jul-2016	697	0.435	14.3	35	6310	0.0473	181	0.39	13	3.64	<0.20	5140	<0.025	5.93	380	27	<0.010	<1.0	<2.5	23.4	<1.0	13.1
MW15-06WB	MW15-06WB	primary	26-Sep-2016	783	0.555	13.7	29.6	5720	0.0367	190	0.486	18.9	3.47	<0.040	4520	0.015	5.48	386	22.4	0.008	<0.20	0.86	18.8	<0.20	113
MW15-06WB	MW15-06WB	primary	24-Apr-2017	780	0.555	13.5	31.7	4750	0.0339	157	0.256	18.4	3.49	<0.040	4470	0.017	5.42	384	23.2	0.009	<0.20	0.77	13.4	<0.20	18.7
MW15-06WB	MW15-06WB	primary	12-Jun-2017	895	0.577	13.6	34.8	5670	0.0369	142	0.501	17.6	3.63	0.095	5080	0.013	5.55	432	29.7	0.01	<0.20	0.59	16.7	<0.20	144
MW15-06WB	MW15-06WB	primary	29-Jul-2017	990	0.518	13.1	36.6	5480	0.0297	130	0.937	16.9	3.52	<0.040	5600	<0.0050	5.62	422	29.8	0.0082	<0.20	<0.50	14.3	<0.20	336
MW15-06WB	MW15-06WB	primary	09-Oct-2017	1320	0.608	13.4	39.2	5910	0.0344	128	2.14	21.4	3.99	0.098	5900	0.0116	5.72	471	30.7	0.0074	<0.20	0.68	7.42	<0.20	248
MW15-06WB	MW15-06WB	primary	22-Apr-2018	1460	0.463	10.9	37.7	5480	0.0323	103	0.322	11.3	3.68	0.079	5930	0.0077	5.46	461	28.8	0.004	<0.20	0.64	4.27	<0.20	12
MW15-06WB	MW15-06WB	primary	10-Jun-2018	1280	0.416	12.7	35.6	5090	0.0177	103	0.245	10.8	3.46	<0.040	6070	<0.0050	5.22	482	29.3	0.0031	<0.20	1.4	4.9	<0.20	5.45
MW15-06WB	MW15-06WB	primary	03-Aug-2018	1410	0.372	12.1	35.5	5240	0.0316	101	0.245	8.2	3.67	0.053	6060	0.0159	5.18	505	28.2	0.0046	<0.20	0.6	15	<0.20	12.2
MW15-06WB	MW15-06WB	primary	07-Oct-2018	1420	0.499	12.3	36.6	5740	0.0314	107	0.34	14	3.69	0.097	6120	<0.010	5.16	559	32.5	0.0048	<0.20	<2.0	20	<0.20	32.8
MW15-06WB	MW15-06WB	primary	02-May-2019	925	0.244	4.91	30.6	4450	0.0616	43.5	1.83	24.5	3.31	0.258	5560	0.036	7.83	370	18.3	0.021	<0.20	4.9	87.2	1.4	39
MW15-06WB	MW15-06WB	primary	20-Jun-2019	1210	0.215	10.9	37.4	4660	0.026	83.2	0.2	8	3.52	0.066	5560	0.012	5.05	449	30.6	0.0028	<0.20	<2.0	34.8	0.45	8.9
MW15-06WB	MW15-06WB	primary	25-Aug-2019	1320	0.185	10.5	35.4	4640	0.0189	76.2	0.51	7.2	3.51	0.066	6030	<0.010	4.68	465	31	0.0021	<0.20	<2.0	37	<0.20	49.1
MW16-01WB	MW16-01WB	primary	04-Oct-2016	4350	0.014	13.9	4.23	1380	<0.0020	0.52	0.258	8.7	1.05	<0.040	11200	<0.0050	6.96	86	4.5	0.005	<0.20	<0.50	4.93	<0.20	15.9
MW16-01WB	MW16-01WB	primary	20-Apr-2017	6140	0.049	16.3	4.57	1490	<0.0020	0.896	0.775	47.6	1.39	<0.040	12900	<0.0050	7.24	90.6	4.4	0.007	<0.20	<0.50	4.19	<0.20	88.3
MW16-01WB	MW16-01WB	primary	09-Jun-2017	6150	0.021	14.7	4.53	1420	<0.0020	0.728	0.227	29.9	1.21	0.088	10900	<0.0050	7.32	87.1	4.8	0.003	<0.20	<0.50	4.32	<0.20	42.5
MW16-01WB	MW16-01WB	primary	26-Jul-2017	6050	0.0143	16.6	4.5	1390	<0.0020	0.649	0.354	15.5	0.958	0.058	12300	<0.0050	7.1	86.6	5.1	0.0027	<0.20	<0.50	4.41	<0.20	27.8
MW16-01WB	JH41-05	duplicate	27-Jul-2017	6180	0.0094	16.8	4.59	1430	<0.0020	0.621	0.103	17.5	1.02	0.04	12200	<0.0050	7.22	86.4	5.1	0.003	<0.20	<0.50	4.41	<0.20	25.3
MW16-01WB	MW16-01WB	primary	06-Oct-2017	6400	0.0484	15.8	4.76	1310	<0.0020	0.891	1.75	18.3	1.11	0.077	12100	<0.0050	7.62	85.5	4.9	0.0029	<0.20	0.68	4.02	<0.20	36.3
MW16-01WB	MW16-01WB	primary	20-Apr-2018	6310	0.12	14.6	4.91	1470	<0.0020	1.35	4.44	17.8	1.13	0.154	12600	<0.0050	7.95	87.2	4.7	0.0023	<0.20	1.09	3.11	<0.20	28.6
MW16-01WB	MW16-01WB	primary	08-Jun-2018	6380	0.0204	13.3	4.21	1360	<0.0020	0.573	0.153	17.9	1.27	0.73	12000	<0.0050	6.75	90.3	3.7	<0.0020	<0.20	<0.50	2.89	<0.20	32.9
MW16-01WB	MW16-01WB	primary	02-Aug-2018	6120	0.0107	15.1	4.48	1340	<0.0020	0.613	0.109	6.6	1.02	<0.040	12100	<0.0050	7.1	86	4.1	<0.0020	<0.20	<0.50	3.1	<0.20	7.46
MW16-01WB	MW16-01WB	primary	04-Oct-2018	6080	0.036	13.4	4.05	1300	<0.0020	0.84	0.13	19	1.03	0.074	11500	<0.010	6.66	79.8	4.8	<0.0020	<0.20	<2.0	2.81	<0.20	8.7
MW16-01WB	MW16-01WB	primary	01-May-2019	6090	0.007	13.9	4.12	1280	<0.0020	0.512	0.079	10.3	1.06	<0.040	11400	<0.0050	6.7	77.2	4.7	<0.0020	<0.20	<0.50	2.61	<0.20	14.9
MW16-01WB	MW16-01WB	primary	17-Jun-2019	6240	0.016	14.1	4.36	1280	<0.0020	0.5	0.118	13.9	1.03	<0.080	12400	<0.010	6.88	86.4	<6.0	<0.0040	<0.40	<1.0	2.54	<0.40	14.8
MW16-01WB	MW16-01WB	primary	21-Aug-2019	6190	0.0738	14.6	3.88	1230	<0.0020	0.822	1.61	14.1	1.03	0.222	11800	<0.0050	6.47	80.1	4.5	<0.0020	<0.20	1.12	2.44	0.85	150
	F-BLANK-1	field blank	28-Sep-2014	<10	<0.05	<0.5	<0.1	<0.05	<0.01	<0.05	<0.5	<50	<0.1	<0.1	<50	<0.01	<0.05	<0.2	<0.5	<0.01	<0.1	<10	<0.01	<1	<3

Station	Sample ID	Sample Class	Sample Date	Total Iron (Fe)	Total Lead (Pb)	Total Lithium (Li)	Total Magnesium (Mg)	Total Manganese (Mn)	Total Mercury (Hg)	Total Molybdenum (Mo)	Total Nickel (Ni)	Total Phosphorus (P)	Total Potassium (K)	Total Selenium (Se)	Total Silicon (Si)	Total Silver (Ag)	Total Sodium (Na)	Total Strontium (Sr)	Total Sulphur (S)	Total Thallium (Tl)	Total Tin (Sn)	Total Titanium (Ti)	Total Uranium (U)	Total Vanadium (V)	Total Zinc (Zn)
				ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				1	0.005	0.5	0.05	0.05	0.002	0.05	0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1
ALS RDL[1]:				10	0.05	0.5	0.1	0.05	0.01	0.05	0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	3
	FB-23/06/15	field blank	23-Jun-2015	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	0.131	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	FB-2	field blank	18-Jul-2015	4.6	<0.0050	<0.50	<0.050	0.057	<0.0020	<0.050	0.11	90.6	<0.050	<0.040	<50	<0.0050	0.146	<0.050	<3.0	<0.0020	<0.20	<0.50	0.0037	<0.20	0.65
	FB-3	field blank	12-Aug-2015	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	FB-4	field blank	08-Sep-2015	<1.0	<0.0050	<0.50	<0.050	0.152	<0.0020	<0.050	<0.020	4.3	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	0.23	0.14
	FB-007	field blank	16-May-2016	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.13
	FB-008	field blank	15-Jul-2016	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.22
	FB-009	field blank	26-Sep-2016	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	0.027	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.56
	FB-010	field blank	25-Apr-2017	<1.0	0.005	<0.50	<0.050	<0.050	<0.0020	<0.050	0.032	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.1
	FB-020	field blank	11-Jun-2017	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	2.7	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	FB-030	field blank	29-Jul-2017	<1.0	0.006	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	2.1	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	FB-040	field blank	09-Oct-2017	1.2	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	FB-Q1	field blank	22-Apr-2018	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	FB-Q2	field blank	10-Jun-2018	1.6	<0.0050	<0.50	<0.050	0.097	<0.0020	<0.050	<0.020	2.8	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.4
	FB-Q3	field blank	05-Aug-2018	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	2.2	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	FB-Q4	field blank	07-Oct-2018	<1.0	<0.0050	<0.50	<0.050	0.067	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	FB-Q1	field blank	01-May-2019	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	FB-Q2	field blank	13-Jun-2019	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	FB-Q3	field blank	23-Aug-2019	<1.0	<0.0050	<0.50	<0.050	<0.050	0.003	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	11-Sep-2015	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	16-May-2016	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.12
	TRIP BLANK	trip blank	20-Jul-2016	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	29-Sep-2016	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	0.021	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	26-Apr-2017	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.19
	TRIP BLANK	trip blank	14-Jun-2017	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	26-Jul-2017	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	2	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	11-Oct-2017	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	23-Apr-2018	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	10-Jun-2018	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	09-Aug-2018	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	0.077	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	11-Oct-2018	<1.0	<0.0050	<0.50	<0.050	0.052	<0.0020	<0.050	<0.020	2	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TB-Q1	trip blank	02-May-2019	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	13-Jun-2019	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10
	TRIP BLANK	trip blank	23-Aug-2019	<1.0	<0.0050	<0.50	<0.050	<0.050	0.0022	<0.050	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10

Notes:

Samples and sample data with RED text are not considered to be representative of formation water (See Appendix 5-D for further discussion).

1. Reportable detection limits (RDL) presented are the lowest detection limit for a given parameter. Note that the detection limit may have been raised by the analytical laboratory for some analytical results (e.g., due to matrix interference). See Table 3-8 in the main report for further details regarding reportable detection limits between 2014 and 2019.

2. Duplicate sample JH42-08 (Lab ID: UN0655) was collected on 04-Oct-2018 and not 05-Oct-2018 (dummy date for blind duplicate sampling) as indicated in the laboratory Certificate of Analysis.

Station	Sample ID	Sample Class	Sample Date	Total Zirconium (Zr)	Dissolved Metals	Dissolved Aluminum (Al)	Dissolved Antimony (Sb)	Dissolved Arsenic (As)	Dissolved Barium (Ba)	Dissolved Beryllium (Be)	Dissolved Bismuth (Bi)	Dissolved Boron (B)	Dissolved Cadmium (Cd)	Dissolved Calcium (Ca)	Dissolved Chromium (Cr)	Dissolved Cobalt (Co)	Dissolved Copper (Cu)	Dissolved Iron (Fe)	Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Magnesium (Mg)	Dissolved Manganese (Mn)	Dissolved Mercury (Hg)	Dissolved Molybdenum (Mo)
				ug/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.1		0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05	1	0.005	0.5	0.05	0.05	0.002	0.05
ALS RDL[1]:				-		1	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.2	10	0.05	0.5	0.1	0.05	0.01	0.05
MW14-02A	MW14-02A	primary	28-Sep-2014			5.7	0.92	71.1	14.2	<0.1	<0.5	<10	<0.01	45.7	0.49	0.11	<0.2	<10	<0.05	7.79	21.6	17	<0.01	4.88
MW14-02A	MW14-02A	primary	12-Jun-2015	<0.10		14.5	0.784	53.8	13.4	<0.010	<0.0050	<10	<0.0050	45.8	0.51	0.0356	0.232	14	0.0206	6.45	20.8	10.7	0.0035	3.19
MW14-02A	MW14-02A	primary	16-Jul-2015	<0.10		8.65	0.719	52.4	12.9	<0.010	<0.0050	<10	<0.0050	40.7	0.45	0.0194	<0.050	2.9	<0.0050	7.74	20.9	7.88	0.0042	3.04
MW14-02A	MW14-02A	primary	06-Aug-2015	<0.10		17.4	0.7	51.9	13.8	<0.010	<0.0050	<10	0.006	46.1	0.6	0.0419	0.305	26.6	0.0291	8.06	21.8	6.82	0.0025	3.14
MW14-02A	MW14-02A	primary	04-Sep-2015	<0.10		3.96	0.697	53.8	9.88	<0.010	<0.0050	<10	<0.0050	40.3	0.47	0.014	0.065	<1.0	<0.0050	7.42	20.5	2.42	0.004	2.78
MW14-02A	MW14-100	duplicate	04-Sep-2015	<0.10		4.44	0.708	54.7	10.1	<0.010	<0.0050	<10	<0.0050	40.5	0.49	0.013	0.056	<1.0	<0.0050	7.66	21.4	2.46	0.0038	2.84
MW14-02A	MW14-02A	primary	13-May-2016	<0.10		4.38	0.842	43.5	32.8	<0.010	<0.0050	<10	0.024	46.7	0.46	1.26	1.58	4.7	0.075	6.66	22.6	79.2	0.0043	2.95
MW14-02A	MW14-02A	primary	17-Jul-2016	<0.10		3.63	0.711	54.6	9.97	<0.010	<0.0050	<10	<0.0050	44.2	0.65	0.006	<0.050	1.6	0.005	7.31	22.2	0.275	0.0052	2.93
MW14-02A	JH40-05	duplicate	25-Sep-2016	<0.10		3.08	0.739	55.8	10.3	<0.010	<0.0050	<10	<0.0050	41.6	0.54	0.006	0.051	<1.0	<0.0050	7.35	19.9	0.182	0.0055	2.98
MW14-02A	MW14-02A	primary	25-Sep-2016	<0.10		2.61	0.835	55.7	10.2	<0.010	<0.0050	<10	<0.0050	41.3	0.51	<0.0050	<0.050	<1.0	<0.0050	7.06	19.4	0.138	0.0054	2.97
MW14-02A	MW14-02A	primary	21-Apr-2017	<0.10		2.69	0.806	55	17.1	<0.010	<0.0050	<10	0.007	40.7	0.46	0.025	0.083	<1.0	0.013	7.34	20.8	26.7	0.006	2.97
MW14-02A	JH41-03	duplicate	08-Jun-2017	<0.10		2.98	0.728	55.4	10.4	<0.010	<0.0050	<10	<0.0050	41.8	0.52	<0.0050	<0.050	<1.0	<0.0050	7.17	21.1	0.071	0.0061	2.95
MW14-02A	MW14-02A	primary	08-Jun-2017	<0.10		2.58	0.725	55.5	10.3	<0.010	<0.0050	<10	<0.0050	41.5	0.5	0.005	<0.050	<1.0	<0.0050	7.22	20.7	0.069	0.0064	2.89
MW14-02A	MW14-02A	primary	28-Jul-2017	<0.10		4.55	0.739	56.6	9.76	<0.010	<0.0050	<10	<0.0050	39.8	0.52	0.0052	<0.050	<1.0	<0.0050	6.86	20.2	0.18	0.0054	2.84
MW14-02A	MW14-02A	primary	05-Oct-2017	<0.10		1.99	0.728	59.2	11.2	<0.010	<0.0050	<10	<0.0050	42.8	0.5	<0.0050	<0.050	3.9	<0.0050	7.46	19.7	0.122	0.0067	2.96
MW14-02A	MW14-02A	primary	19-Apr-2018	<0.10		3.16	0.748	55.7	11.4	<0.010	<0.0050	<10	<0.0050	44	0.5	0.0084	<0.050	1	<0.0050	7.26	22.7	3.94	0.0062	3.1
MW14-02A	MW14-02A	primary	07-Jun-2018	<0.10		6.2	0.757	60.2	11.1	<0.010	<0.0050	<10	<0.0050	42.7	0.56	0.0074	<0.050	2.9	<0.0050	6.44	20.4	0.483	0.0094	3.23
MW14-02A	MW14-02A	primary	02-Aug-2018	<0.10		4	0.71	60.2	10.2	<0.010	<0.0050	<10	<0.0050	39.5	0.53	<0.0050	<0.050	<1.0	<0.0050	7.33	20.4	0.06	0.006	3.04
MW14-02A	JH42-06	duplicate	02-Aug-2018	<0.10		3.68	0.714	61.1	10.3	<0.010	<0.0050	<10	<0.0050	39.2	0.54	0.0064	<0.050	<1.0	<0.0050	7.38	20.2	<0.050	0.0066	3.01
MW14-02A	MW14-02A	primary	04-Oct-2018	<0.10		2.25	0.761	56.7	9.55	<0.010	<0.0050	<10	<0.0050	42.2	0.57	0.0065	0.078	<1.0	0.0066	7.36	20.7	0.127	0.009	3.13
MW14-02A	MW14-02A	primary	28-Apr-2019	<0.10		1.56	0.674	55.3	10.1	<0.010	<0.0050	<10	<0.0050	39.6	0.51	0.008	<0.050	<1.0	<0.0050	6.9	19.8	0.12	0.0055	3.09
MW14-02A	BD1-Q1	duplicate	28-Apr-2019	<0.10		1.49	0.669	56	10.3	<0.010	<0.0050	<10	<0.0050	41.4	0.5	0.005	0.056	<1.0	<0.0050	6.95	20.1	0.094	0.0056	3.1
MW14-02A	MW14-02A	primary	13-Jun-2019	<0.10		1.73	0.695	56.2	9.8	<0.010	<0.0050	<10	<0.0050	39.8	0.56	0.0207	<0.050	<1.0	<0.0050	5.88	19.7	<0.050	0.0069	3.08
MW14-02A	MW14-02A	primary	22-Aug-2019	<0.10		2.4	0.658	56.4	9.84	<0.010	<0.0050	<10	<0.0050	39.2	0.54	0.0118	<0.050	<1.0	<0.0050	6.8	19.7	0.179	0.006	3
MW14-02A	BD2-Q3	duplicate	22-Aug-2019	<0.10		1.89	0.687	57	9.7	<0.010	<0.0050	<10	<0.0050	38.8	0.55	0.0098	<0.050	<1.0	<0.0050	6.73	19.1	0.172	0.0064	2.98
MW14-02B	MW14-02B	primary	28-Sep-2014			1	3.27	20.4	54.7	<0.1	<0.5	<10	<0.01	61.8	0.41	0.62	<0.2	<10	<0.05	7.59	31.2	162	<0.01	4.96
MW14-02B	F-DUP-1	duplicate	28-Sep-2014			<1	2.89	20.5	54.2	<0.1	<0.5	<10	<0.01	61.4	0.42	0.62	<0.2	<10	<0.05	7.19	31.1	159	<0.01	4.55
MW14-02B	MW14-02B	primary	12-Jun-2015	<0.10		3.19	6.56	34	45	<0.010	<0.0050	<10	<0.0050	52.4	0.12	2.47	0.081	7.3	0.0114	6.75	27.1	621	0.0021	7.45
MW14-02B	MW14-02B	primary	16-Jul-2015	<0.10		15.1	6.6	37.4	57.7	<0.010	<0.0050	<10	<0.0050	52.3	<0.10	1.57	<0.050	9.8	<0.0050	7.08	30.3	710	0.0042	6.84
MW14-02B	MW14-02B	primary	06-Aug-2015	<0.10		2.16	5.89	39.3	52.2	<0.010	<0.0050	<10	<0.0050	57.5	0.17	1.46	0.082	4.8	0.0098	7.63	31.9	645	<0.0020	6.42
MW14-02B	MW14-02B	primary	04-Sep-2015	<0.10		1.57	5.97	38.8	40.5	<0.010	<0.0050	<10	0.008	52.2	0.24	1.53	0.074	1.5	0.009	7.52	28.8	511	0.0027	5.72
MW14-02B	JH40-01	duplicate	13-May-2016	<0.10		0.85	9.01	55.6	42.8	<0.010	<0.0050	<10	0.009	59.1	0.29	1.1	<0.050	2.7	<0.0050	8.17	30.4	421	0.0021	5.07
MW14-02B	MW14-02B	primary	13-May-2016	<0.10		1.43	9.08	55.7	41.9	<0.010	<0.0050	<10	0.009	61.2	0.3	1.09	<0.050	3	<0.0050	7.76	30.1	413	0.0021	5.22
MW14-02B	MW14-02B	primary	17-Jul-2016	<0.10		1.68	8.95	52.7	42.4	<0.010	<0.0050	<10	0.007	56.4	0.33	0.795	<0.050	1.8	0.011	7.18	30.5	388	0.0024	4.39
MW14-02B	MW14-02B	primary	25-Sep-2016	<0.10		1.58	7.59	52.6	40.8	<0.010	<0.0050	<10	0.007	53.9	0.36	0.617	0.106	2	0.006	8.37	29.3	310	0.0022	4.23
MW14-02B	JH41-01	duplicate	21-Apr-2017	<0.10		1.03	6.18	48.8	36.5	<0.010	<0.0050	<10	0.005	56	0.35	0.158	<0.050	1.1	0.005	7.52	29.4	179	0.0026	3.84
MW14-02B	MW14-02B	primary	21-Apr-2017	<0.10		1.32	6.01	50.1	35.6	<0.010	<0.0050	<10	0.007	56.2	0.37	0.158	<0.050	<1.0	<0.0050	7.17	30.1	183	0.0027	3.72
MW14-02B	MW14-02B	primary	08-Jun-2017	<0.10		1.93	6.79	41.4	39	<0.010	<0.0050	<10	0.005	54.6	0.41	0.241	0.054	7.2	<0.0050	7.45	29.8	156	0.0025	3.38
MW14-02B	JH41-06	duplicate	28-Jul-2017	<0.10		4.8	7.36	43.5	39.1	<0.010	<0.0050	<10	<0.0050	50.8	0.4	0.33	<0.050	1.8	<0.0050	6.97	27.5	153	0.0023	3.44
MW14-02B	MW14-02B	primary	28-Jul-2017	<0.10		2.76	7.14	41.6	38.7	<0.010	<0.0050	<10	0.0053	49.4	0.4	0.323	0.055	1.7	<0.0050	6.82	27.1	149	0.0021	3.37
MW14-02B	MW14-02B	primary	05-Oct-2017	<0.10		0.82	6.47	43.2	37.7	<0.010	<0.0050	<10	<0.0050	51.1	0.4	0.227	<0.050	<1.0	<0.0050	7.29	28.6	107	0.0024	3.35
MW14-02B	JH42-02	duplicate	19-Apr-2018	<0.10		2.04	5.87	36.8	34.5	<0.010	<0.0050	<10	0.007	54.1	0.43	0.067	0.056	3	<0.0050	7.46	31.4	36	0.003	3.15
MW14-02B	MW14-02B	primary	19-Apr-2018	<0.10		2.67	5.73	36.3	34.2	<0.010	<0.0050	<10	0.0073	56.4	0.43	0.0664	0.056	2.9	<0.0050	7.51	31.5	35.3	0.0031	3.26
MW14-02B	MW14-02B	primary	07-Jun-2018	0.28		568	11.9	90.1	72.5	0.144	<0.025	<10	0.0344	53.7	2.7	2.79	1.74	1210	1.58	6.95	27.3	911	0.0206	3.55
MW14-02B	MW14-02B	primary	02-Aug-2018	<0.10		2.32	5.89	41.5	35.3	<0.010	<0.0050	<10	<0.0050	50	0.49	0.0712	<0.050	<1.0	<0.0050	7.34	27.3	38.8	<0.0020	3.39
MW14-02B	MW14-02B	primary	04-Oct-2018	<0.10		2.26	5.48	37.4	31.7	<0.010	<0.0050	<10	<0.0050	52.1	0.52	0.108	0.059	3.9	<0.0050	6.93	27.4	50.5	0.0037	3.19
MW14-02B	JH42-08	duplicate	05-Oct-2018	<0.10		1.98	5.93	40.7	33	<0.010	<0.0050	<10	<0.0050	54.7	0.53	0.107	0.056	1.4	<0.0050	7.65	29.8	54.2	0.0023	3.43
MW14-02B	MW14-02B	primary	28-Apr-2019	<0.10		1.28	5.39	35.9	30.6	<0.010	<0.0050	<10	<0.0050	50	0.43	0.123	<0.050	<1.0	<0.0050	7.09	26.7	37.2	<0.0020	3.19
MW14-02B	MW14-02B	primary	13-Jun-2019	<0.10		1.05	4.8	36.6	30.5	<0.010	<0.0050	<10	<0.0050	49.6	0.48	0.0895	<0.050	1.2	<0.0050	6.02	26.8	31.2	0.0022	3.14
MW14-02B	BD1-Q2	duplicate	13-Jun-2019	<0.10		0.92	4.69	35.7	29.9	<0.010	<0.0050	<10	<0.0050	48.8	0.53	0.0924	<0.050	<1.0	<0.0050	5.76	26	30.7	0.0021	3.07
MW14-02B	MW14-02B	primary	22-Aug-2019	<0.10		1.06	4.65	37.2	28.5	<0.010	<0.0050	<10	<0.0050	48.7	0.52	0.0648	<0.050	<1.0	<0.0050	6.8	25.7	23.3	0.0022	3.1
MW14-03A	MW14-03A	primary	12-Oct-2014			14	0.99	60	364	<0.1	<0.5	15	0.067	69.3	5.46	0.75	2.82	18	0.09	10.8	43.2	9.52	0.554	12.9
MW14-03A	MW14-03A	primary	22-Jun-2015	1.49		5.35	1.02	49.4	143	0.012	<0.0050	12	<0.0050	135	<0.10	2.46	0.175	7330	0.162	31.3	143	815	0.0068	4.82
MW14-03A	MW14-03A	primary	12-Jul-2015	2.7		20.2	0.698	58.6	128	<0.010	<0.0050	<10	0.0121	138	0.3	2.03	0.417	9370	0.0778	27.2	125	954	0.0098	5.14
MW14-03A	MW14-03A	primary	07-Aug-2015	2.58		52.8	0.586	68.9	98	0.016	<0.0050	<10	0.0545	135	0.21	1.75	1.65	8760	0.14	32.3	142	754	0.0021	2.95
MW14-03A	MW14-50	duplicate	07-Aug-2015	2.88		43.5	0.595	71.9	103	0.017	0.0111	18	0.014	137	0.22	1.88	1.53	8880	0.205	31.4	139	797	0.0039	3.41
MW14-03A	MW14-03A	primary	06-Sep-2015	3.15		3.44	0.313	75.7	103	0.013	<0.0050	<10	<0.0050	124	<0.10	1.32	0.068	7560	0.006	26.6	125	653	0.003	3.19
MW14-03A	MW14-03A	primary	16-May-2016	2.45		1.98	0.099	95	96.6	0.013	<0.0050	<10	<0.0050	134	<0.10	1.79	0.056	5160	<0.0050	29.5	164	676	<0.0020	1.35
MW14-03A	MW14-03A	primary	14-Jul-2016	2.46		2.97	0.098	72.4	90	0.012	0.006	<10	<0.0050	157	<0.10	1.49	<0.050	6230	0.006	28.7	138	572	<0.0020	1.3

Station	Sample ID	Sample Class	Sample Date	Total Zirconium (Zr)	Dissolved Metals	Dissolved Aluminum (Al)	Dissolved Antimony (Sb)	Dissolved Arsenic (As)	Dissolved Barium (Ba)	Dissolved Beryllium (Be)	Dissolved Bismuth (Bi)	Dissolved Boron (B)	Dissolved Cadmium (Cd)	Dissolved Calcium (Ca)	Dissolved Chromium (Cr)	Dissolved Cobalt (Co)	Dissolved Copper (Cu)	Dissolved Iron (Fe)	Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Magnesium (Mg)	Dissolved Manganese (Mn)	Dissolved Mercury (Hg)	Dissolved Molybdenum (Mo)
				ug/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.1		0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05	1	0.005	0.5	0.05	0.05	0.002	0.05
ALS RDL[1]:				-		1	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.2	10	0.05	0.5	0.1	0.05	0.01	0.05
MW14-03A	MW14-03A	primary	24-Sep-2016	2.04		2.03	0.078	67.5	75.8	0.017	<0.0050	<10	<0.0050	142	<0.10	1.67	0.058	5670	0.006	33.5	139	443	<0.0020	1.16
MW14-03A	MW14-03A	primary	27-Apr-2017	1.57		3.37	0.049	60.3	76.6	0.011	<0.0050	<10	<0.0050	138	<0.10	1.37	0.145	4380	0.022	28.6	133	474	0.0039	1.01
MW14-03A	MW14-03A	primary	09-Jun-2017	1.38		1.36	0.07	57.7	65	<0.010	<0.0050	<10	<0.0050	147	<0.10	1.4	<0.050	4460	<0.0050	30.7	151	448	0.0053	0.867
MW14-03A	MW14-03A	primary	26-Jul-2017	1.24		<2.5	<0.10	42.6	53.1	<0.050	<0.025	<50	<0.025	143	<0.50	1.4	<0.25	4410	<0.025	29	155	427	0.005	0.83
MW14-03A	JH41-08	duplicate	06-Oct-2017	1.42		1.13	0.057	57.4	61	<0.010	<0.0050	<10	<0.0050	142	<0.10	1.37	<0.050	4390	0.005	31.1	138	434	0.0025	0.993
MW14-03A	MW14-03A	primary	06-Oct-2017	1.35		1.16	0.067	57.6	56.5	0.01	<0.0050	<10	<0.0050	149	<0.10	1.38	0.055	4420	0.023	28.3	137	434	0.0023	0.947
MW14-03A	MW14-03A	primary	20-Apr-2018	1.27		1.31	0.065	47.7	52.2	0.012	<0.0050	12	<0.0050	149	<0.10	1.39	0.05	4330	<0.0050	29.9	158	459	<0.0020	0.995
MW14-03A	MW14-03A	primary	08-Jun-2018	1.37		11.4	0.223	54.2	53.2	<0.010	<0.0050	<10	<0.0050	139	0.13	1.44	2.54	4220	1.24	25.3	135	409	0.0073	1.82
MW14-03A	MW14-03A	primary	05-Aug-2018	1.23		3.17	0.068	55.5	43.9	<0.010	0.0081	<10	<0.0050	142	<0.10	1.5	<0.050	4220	0.0077	28.9	138	400	0.0025	0.946
MW14-03A	MW14-03A	primary	07-Oct-2018	1.16		1.51	0.066	49.5	51.8	<0.010	<0.0050	<10	<0.0050	140	<0.10	1.47	0.117	4180	<0.0050	28.3	139	454	0.0026	0.984
MW14-03A	MW14-03A	primary	27-Apr-2019	1.22		1.28	0.063	40.4	46.6	<0.010	<0.0050	<10	<0.0050	126	0.14	1.34	0.07	3680	0.013	21.9	126	389	<0.0020	0.894
MW14-03A	MW14-03A	primary	14-Jun-2019	1.33		3	<0.040	52.4	44.1	<0.020	<0.010	48	<0.010	139	0.22	1.34	0.16	4010	0.186	28.8	132	398	<0.0020	0.99
MW14-03A	MW14-03A	primary	23-Aug-2019	1.18		7.3	0.13	30.7	55.3	<0.020	<0.010	<20	<0.010	137	0.34	1.28	<0.10	3750	0.026	27.6	136	420	0.003	0.86
MW14-03B	MW14-03B	primary	06-Oct-2014			4.9	0.15	1.68	84	<0.1	<0.5	<10	0.012	114	0.12	1.92	0.6	22	<0.05	21	125	233	0.041	2.54
MW14-03B	MW14-03B	primary	22-Jun-2015	0.35		18.9	0.134	8.7	99	<0.010	<0.0050	12	0.0223	138	0.14	7.55	1.58	1770	0.0798	24.6	176	3490	0.0049	9.53
MW14-03B	MW14-03B	primary	12-Jul-2015	0.41		14.1	0.103	9.2	87.8	<0.010	<0.0050	<10	0.0628	127	0.16	7	0.941	2140	0.0615	21.1	143	3300	0.0066	8.76
MW14-03B	MW14-03B	primary	07-Aug-2015	0.33		7.11	0.091	8.21	74.7	<0.010	0.0129	<10	0.0184	133	<0.10	7.2	1.11	1340	0.0338	26.6	184	3210	0.0028	7.38
MW14-03B	MW14-03B	primary	06-Sep-2015	0.33		2.81	0.087	7.63	61.8	<0.010	<0.0050	<10	0.008	129	<0.10	6.14	0.489	1010	0.022	23	164	2920	0.0047	6.77
MW14-03B	MW14-200	duplicate	06-Sep-2015	0.27		2.88	0.085	7.76	64.1	<0.010	<0.0050	<10	<0.0050	131	<0.10	6.11	0.434	1020	0.015	24.9	163	2890	0.0033	6.86
MW14-03B	MW14-03B	primary	16-May-2016	0.23		2.76	0.068	12.1	52	<0.010	<0.0050	<10	0.01	131	<0.10	5.45	0.724	913	0.043	25.5	157	2940	0.0022	5.86
MW14-03B	MW14-03B	primary	14-Jul-2016	0.16		1.88	0.066	13.2	51	<0.010	0.007	<10	0.005	139	<0.10	5.22	0.777	994	0.046	24.1	173	3300	0.0035	5.79
MW14-03B	MW14-03B	primary	24-Sep-2016	0.13		2.12	0.064	8.43	42	<0.010	<0.0050	<10	0.005	136	<0.10	4.92	0.563	807	0.123	28.8	164	2490	0.0043	4.79
MW14-03B	MW14-03B	primary	27-Apr-2017	0.17		2.46	0.178	10.2	47.5	<0.010	0.01	<10	0.015	120	0.17	4.24	2.79	974	1.18	23.5	161	2370	0.0327	5.28
MW14-03B	MW14-03B	primary	09-Jun-2017	0.14		2.32	0.103	11	47.5	<0.010	<0.0050	<10	<0.0050	135	<0.10	4.29	0.589	1170	0.275	25.4	184	2690	0.0129	5.02
MW14-03B	MW14-03B	primary	26-Jul-2017	<0.50		<2.5	<0.10	12.6	42.7	<0.050	<0.025	<50	<0.025	129	<0.50	4.58	1.14	1390	0.163	24.6	183	2820	0.0147	4.48
MW14-03B	MW14-03B	primary	06-Oct-2017	0.16		1.15	0.049	13.3	41	<0.010	<0.0050	<10	<0.0050	140	<0.10	3.91	0.355	1280	0.034	24	166	2490	0.0140	4.25
MW14-03B	MW14-03B	primary	20-Apr-2018	0.14		1.66	0.079	11.8	43.1	<0.010	<0.0050	11	<0.0050	138	<0.10	4.13	0.278	1250	0.135	26.7	197	2540	<0.0020	4.41
MW14-03B	MW14-03B	primary	08-Jun-2018	0.23		1.92	0.099	14.6	50.3	<0.010	0.0078	<10	<0.0050	129	<0.10	4.62	0.939	1580	0.201	22.2	172	2760	0.0073	4.64
MW14-03B	MW14-03B	primary	05-Aug-2018	0.18		3.75	0.111	14.8	43.2	<0.010	<0.0050	<10	<0.0050	128	0.25	4.21	0.549	1470	0.466	25.2	174	2600	0.0024	4.32
MW14-03B	MW14-03B	primary	07-Oct-2018	0.12		1.46	0.109	6.29	37.8	<0.010	<0.0050	<10	<0.0050	131	<0.10	3.77	0.631	1100	0.0301	24	166	1760	0.0077	3.6
MW14-03B	MW14-03B	primary	27-Apr-2019	<0.20		2.4	0.052	10.4	33.2	<0.020	<0.010	<20	<0.010	130	<0.20	3.44	0.2	907	0.225	25.4	168	1910	0.0029	3.43
MW14-03B	MW14-03B	primary	14-Jun-2019	0.24		1.5	<0.040	19.3	37.7	0.027	<0.010	27	0.023	130	<0.20	4.14	0.24	1380	0.097	26.4	175	2330	<0.0020	3.67
MW14-03B	MW14-03B	primary	23-Aug-2019	0.27		5.9	0.054	15.4	38.4	<0.020	<0.010	<20	<0.010	136	0.2	4.46	1.45	1310	0.087	26.2	184	2250	0.0108	3.58
MW14-05A	MW14-05A	primary	02-Oct-2014			38.8	0.29	578	63.5	<0.1	<0.5	<10	0.018	36.6	6.25	0.57	3.83	266	0.114	27.6	5.97	302	<0.01	8.6
MW14-05A	MW14-05A	primary	23-Jun-2015	0.11		7.95	0.688	1860	98.4	0.026	<0.0050	<10	<0.0050	47.1	<0.10	1.17	0.152	1920	0.0483	30	8.9	1390	<0.0020	3.8
MW14-05A	MW14-05A	primary	13-Jul-2015	0.17		24.2	0.664	1680	93.4	0.016	<0.0050	<10	0.0115	43.8	0.2	0.933	1.16	2380	0.257	27.9	8.42	1170	<0.0020	4.14
MW14-05A	MW14-05A	primary	08-Aug-2015	0.18		8.88	0.476	1480	109	0.015	0.0089	<10	<0.0050	47.2	0.17	0.742	0.18	2940	0.0112	34.3	8.87	1100	<0.0020	4.83
MW14-05A	MW14-05A	primary	07-Sep-2015	0.12		4	0.407	1700	118	0.02	<0.0050	<10	<0.0050	43.2	0.12	0.85	0.053	3590	0.007	28.4	8.86	1600	<0.0020	3.71
MW14-05A	MW14-05A	primary	14-May-2016	<0.10		2.93	0.39	1810	192	0.016	<0.0050	<10	<0.0050	55.6	0.12	0.414	<0.050	5220	0.016	34	11.6	1840	<0.0020	5.44
MW14-05A	JH40-04	duplicate	16-Jul-2016	<0.10		3.19	0.439	2260	215	0.015	<0.0050	<10	<0.0050	52.2	<0.10	0.474	<0.050	6890	0.018	26.2	10	2130	<0.0020	3.92
MW14-05A	MW14-05A	primary	16-Jul-2016	0.1		3.26	0.426	2190	208	0.016	<0.0050	<10	<0.0050	49.1	0.15	0.456	0.079	6520	0.015	27	9.64	2120	<0.0020	3.94
MW14-05A	MW14-05A	primary	23-Sep-2016	0.12		12	0.44	1540	237	<0.050	<0.025	<50	0.026	53.5	<0.50	0.328	0.6	7010	0.115	36.7	11.5	2130	<0.0020	5.19
MW14-05A	MW14-05A	primary	28-Apr-2017	0.15		4.2	0.51	1530	221	<0.050	<0.025	<50	<0.025	54.5	<0.50	0.26	<0.25	8160	0.029	30.6	11.6	1910	<0.0020	5.16
MW14-05A	MW14-05A	primary	10-Jun-2017	<0.50		1.78	0.449	2030	246	0.015	<0.0050	<10	<0.0050	47.9	0.11	0.266	<0.050	7760	0.006	27	10.7	1920	<0.0020	4.95
MW14-05A	MW14-05A	primary	25-Jul-2017	<0.50		8.6	0.52	1680	254	<0.050	<0.025	<50	<0.025	52	<0.50	0.29	0.31	8200	0.12	26.6	10.8	1920	<0.0020	4.37
MW14-05A	MW14-05A	primary	08-Oct-2017	<0.50		2.6	0.45	2000	257	<0.050	<0.025	<50	<0.025	56.7	<0.50	0.196	<0.25	10200	0.031	28.7	12.3	2040	<0.0020	4.18
MW14-05A	MW14-05A	primary	21-Apr-2018	<0.50		<2.5	0.56	1950	280	<0.050	<0.025	<50	<0.025	58	<0.50	0.234	<0.25	10700	0.025	26.7	14.4	2320	<0.0020	5.81
MW14-05A	JH42-04	duplicate	09-Jun-2018	<0.50		<2.5	0.56	2100	257	<0.050	<0.025	<50	<0.025	52.8	<0.50	0.222	<0.25	10400	<0.025	24.5	11.4	1970	<0.0020	4.59
MW14-05A	MW14-05A	primary	09-Jun-2018	<0.50		3.1	0.56	2070	254	<0.050	<0.025	<50	<0.025	51.4	<0.50	0.23	<0.25	9960	<0.025	23.7	11.2	1960	<0.0020	4.4
MW14-05A	MW14-05A	primary	04-Aug-2018	<0.50		7.1	0.61	2080	269	<0.050	<0.025	<50	<0.025	52	<0.50	0.235	<0.25	10800	<0.025	25.6	11.6	2030	<0.0020	4.32
MW14-05A	MW14-05A	primary	06-Oct-2018	<0.50		7.3	0.54	2000	276	<0.050	<0.025	<50	<0.025	57	<0.50	0.199	0.26	10700	0.032	24.6	12.2	2160	0.0024	4.3
MW14-05A	MW14-05A	primary	29-Apr-2019	<0.50		3.3	0.6	2430	265	<0.050	<0.025	<50	<0.025	53.1	<0.50	0.206	<0.25	11100	0.032	24.2	12	2020	<0.0020	4.35
MW14-05A	BD2-Q1	duplicate	29-Apr-2019	<0.50		3.8	0.61	2480	270	<0.050	<0.025	<50	<0.025	53.6	<0.50	0.203	<0.25	11200	0.035	24.6	12	1970	<0.0020	4.26
MW14-05A	MW14-05A	primary	15-Jun-2019	<0.50		54.5	1.09	2650	262	<0.050	<0.025	<50	<0.025	56.5	<0.50	0.22	<0.25	12100	<0.025	23.8	12.3	2070	<0.0020	3.96
MW14-05A	MW14-05A	primary	24-Aug-2019	<0.50		20.4	0.57	2080	279	<0.050	<0.025	<50	<0.025	56.8	<0.50	0.24	<0.25	12000	<0.025	23.1	11.9	1890	0.0051	4.18
MW14-05B	MW14-05B	primary	03-Oct-2014			52	0.22	143	97.2	<0.1	<0.5	10	0.027	48.6	3.19	0.76	5.27	96	0.073	32.7	7.48	187	<0.01	18.5
MW14-05B	MW14-05B	primary	24-Jun-2015	0.59		18.5	1.17	135	83.6	<0.010	<0.0050	13	0.0423	45.8	0.17	0.955	2.48	69.2	0.0788	36	6.28	414	<0.0020	28.9
MW14-05B	MW14-05B	primary	14-Jul-2015	0.42		28.5	0.86	117	78	<0.10	<1.0	<50	0.031	42.7	<1.0	1.14	1.02	638	<0.20	32.8	6.6	685	<0.010	20
MW14-05B	MW14-05B	primary	09-Aug-2015	0.3		12.4	0.672	145	84.1	<0.010	<0.0050	25	0.017	46.6	0.31	1.25	0.293	1180	0.0283	34.3	7.71	933	0.0029	16.1

Station	Sample ID	Sample Class	Sample Date	Total Zirconium (Zr)	Dissolved Metals	Dissolved Aluminum (Al)	Dissolved Antimony (Sb)	Dissolved Arsenic (As)	Dissolved Barium (Ba)	Dissolved Beryllium (Be)	Dissolved Bismuth (Bi)	Dissolved Boron (B)	Dissolved Cadmium (Cd)	Dissolved Calcium (Ca)	Dissolved Chromium (Cr)	Dissolved Cobalt (Co)	Dissolved Copper (Cu)	Dissolved Iron (Fe)	Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Magnesium (Mg)	Dissolved Manganese (Mn)	Dissolved Mercury (Hg)	Dissolved Molybdenum (Mo)
				ug/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.1		0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05	1	0.005	0.5	0.05	0.05	0.002	0.05
ALS RDL[1]:				-		1	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.2	10	0.05	0.5	0.1	0.05	0.01	0.05
MW14-05B	MW14-05B	primary	08-Sep-2015	0.34		6.82	0.572	161	77.2	<0.010	<0.0050	11	<0.0050	46	0.47	1.25	0.122	1610	0.01	34.2	8.4	1260	<0.0020	8.31
MW14-05B	MW14-05B	primary	15-May-2016	0.51		5.13	0.165	168	81.3	<0.010	<0.0050	<10	<0.0050	56.6	0.49	0.609	<0.050	2620	<0.0050	35.1	10.5	2460	<0.0020	2.01
MW14-05B	MW14-05B	primary	16-Jul-2016	0.46		5.04	0.304	183	91.1	<0.010	<0.0050	11	<0.0050	51.8	0.7	0.719	0.184	2860	0.018	32.2	9.61	2790	<0.0020	2.35
MW14-05B	MW14-05B	primary	23-Sep-2016	0.4		5.01	0.224	198	77.6	<0.010	<0.0050	13	<0.0050	46.7	0.64	0.692	0.131	3420	0.007	29.9	9.46	2580	<0.0020	1.52
MW14-05B	MW14-05B	primary	29-Apr-2017	0.32		2.97	0.123	205	87.8	<0.010	<0.0050	<10	<0.0050	45.8	0.18	0.464	<0.050	4210	0.005	24.6	9.87	2810	<0.0020	1.7
MW14-05B	MW14-05B	primary	11-Jun-2017	0.33		2.3	0.132	150	87	<0.010	<0.0050	11	<0.0050	46.8	0.14	0.685	<0.050	5360	<0.0050	25.8	9.69	3150	<0.0020	2.29
MW14-05B	MW14-05B	primary	26-Jul-2017	0.28		3.11	0.148	157	97.1	<0.010	<0.0050	13	<0.0050	49.3	0.17	0.606	<0.050	5870	0.0069	26.2	10.3	3430	<0.0020	1.56
MW14-05B	MW14-05B	primary	08-Oct-2017	0.31		2.7	0.11	150	89.7	<0.010	<0.0050	<10	<0.0050	49	0.14	0.332	0.207	5430	<0.0050	23.6	10.6	3220	<0.0020	1.09
MW14-05B	MW14-05B	primary	22-Apr-2018	0.3		3.09	0.137	156	88.1	<0.010	<0.0050	<10	<0.0050	47.9	<0.10	0.342	<0.050	5180	<0.0050	22.3	11.3	3270	<0.0020	1.58
MW14-05B	MW14-05B	primary	10-Jun-2018	0.28		3.58	0.102	193	81.5	<0.010	<0.0050	<10	<0.0050	43.5	<0.10	0.388	<0.050	5420	<0.0050	21.1	9.58	2630	<0.0020	1.51
MW14-05B	MW14-05B	primary	04-Aug-2018	0.26		2.84	0.085	196	82.6	<0.010	<0.0050	<10	<0.0050	43.2	<0.10	0.418	<0.050	5650	<0.0050	21.5	9.52	2660	<0.0020	1.14
MW14-05B	MW14-05B	primary	06-Oct-2018	0.21		3.4	0.079	193	80	<0.010	<0.0050	<10	<0.0050	43.1	<0.10	0.374	<0.050	5680	<0.0050	20	9.45	2530	<0.0020	0.987
MW14-05B	MW14-05B	primary	30-Apr-2019	0.21		1.55	0.077	175	85.9	<0.010	<0.0050	<10	<0.0050	43.6	0.11	0.285	<0.050	6060	<0.0050	21.4	9.77	2830	<0.0020	1.15
MW14-05B	MW14-05B	primary	16-Jun-2019	0.17		1.41	0.073	212	78.6	<0.010	<0.0050	<10	<0.0050	44.1	<0.10	0.253	<0.050	5540	0.0092	21.2	9.48	2370	<0.0020	0.988
MW14-05B	MW14-05B	primary	25-Aug-2019	0.18		1.73	0.102	209	80.3	<0.010	<0.0050	<10	<0.0050	43.8	0.16	0.331	0.075	6150	<0.0050	21.3	9.53	2220	<0.0020	1.14
MW15-01WB	MW15-01WB	primary	07-Jun-2015	0.72		<0.50	0.808	23.9	11.1	0.033	<0.0050	<10	0.0141	266	<0.10	0.888	0.098	2.8	<0.0050	25.9	195	382	<0.0020	0.843
MW15-01WB	MW15-01WB	primary	08-Jul-2015	0.38		3.92	0.626	22.2	11.2	<0.010	<0.0050	<10	0.0485	244	<0.10	0.794	0.348	2.6	0.0235	25.8	194	375	<0.0020	1.04
MW15-01WB	MW15-01WB	primary	10-Aug-2015	0.59		5.67	0.395	29	9.93	0.022	0.0114	12	0.0607	228	<0.10	0.704	0.191	24.9	<0.0050	25.7	185	372	<0.0020	0.936
MW15-01WB	MW15-01WB	primary	03-Sep-2015	0.42		14.3	0.347	42.2	9.23	0.038	<0.0050	<10	0.046	250	0.94	0.664	0.413	558	0.225	22.8	186	357	<0.0020	1.01
MW15-01WB	MW15-01WB	primary	15-May-2016	0.41		0.89	0.173	39.7	7.83	0.042	<0.0050	<10	0.008	258	<0.10	0.555	0.066	695	0.024	25.1	183	349	<0.0020	0.467
MW15-01WB	MW15-01WB	primary	14-Jul-2016	0.86		0.93	0.208	48.6	8.23	0.046	0.006	<10	<0.0050	259	<0.10	0.437	<0.050	1680	0.012	25.3	181	384	<0.0020	0.524
MW15-01WB	MW15-01WB	primary	22-Sep-2016	1.12		1.56	0.172	39.6	8.42	0.058	<0.0050	<10	<0.0050	252	<0.10	0.377	0.106	1720	0.014	29.2	178	358	<0.0020	0.534
MW15-01WB	MW15-01WB	primary	22-Apr-2017	1.1		6.4	0.15	20.9	7.6	0.05	<0.025	<50	<0.025	261	<0.50	0.348	<0.25	1480	<0.025	26	195	398	<0.0020	0.41
MW15-01WB	MW15-01WB	primary	08-Jun-2017	<0.50		<2.5	0.25	6.79	8.15	<0.050	<0.025	<50	<0.025	251	<0.50	0.3	<0.25	112	0.074	24.7	191	541	<0.0020	0.31
MW15-01WB	MW15-01WB	primary	24-Jul-2017	1.17		<2.5	0.18	23.7	8.31	0.058	<0.025	<50	<0.025	248	<0.50	0.191	<0.25	1980	<0.025	24.7	180	405	<0.0020	0.53
MW15-01WB	MW15-01WB	primary	06-Oct-2017	1.17		0.98	0.116	25.1	8.97	0.043	<0.0050	<10	0.019	265	<0.10	0.271	0.821	1230	0.027	23.2	187	398	<0.0020	0.897
MW15-01WB	MW15-01WB	primary	19-Apr-2018	0.86		<2.5	0.11	28.2	7.61	<0.050	<0.025	<50	<0.025	262	<0.50	0.449	<0.25	787	0.026	24.9	208	357	<0.0020	0.48
MW15-01WB	MW15-01WB	primary	07-Jun-2018	0.94		<2.5	0.1	17	8.07	<0.050	<0.025	<50	<0.025	247	<0.50	0.343	<0.25	799	<0.025	21.1	177	368	<0.0020	0.36
MW15-01WB	MW15-01WB	primary	02-Aug-2018	1.15		4.4	0.114	18.5	7.98	0.057	<0.010	<20	<0.010	239	<0.20	0.249	<0.10	1030	0.016	24.8	175	364	<0.0020	0.49
MW15-01WB	MW15-01WB	primary	03-Oct-2018	0.5		2.5	0.11	28.4	7.3	0.028	<0.010	<20	<0.010	248	<0.20	0.421	<0.10	696	0.023	24.1	186	340	<0.0020	0.45
MW15-01WB	MW15-01WB	primary	05-May-2019	0.82		8.7	0.144	17.3	7.4	0.035	<0.010	<20	0.014	241	<0.20	0.417	1.07	611	0.102	17.3	179	358	<0.0020	0.47
MW15-01WB	MW15-01WB	primary	18-Jun-2019	0.91		16.2	0.183	11.5	7.4	0.051	<0.010	<20	<0.010	243	<0.20	0.251	<0.10	852	0.011	22.6	177	385	<0.0020	0.42
MW15-01WB	MW15-01WB	primary	22-Aug-2019	1.1		3.5	0.057	10.9	7.53	0.042	<0.010	<20	<0.010	249	<0.20	0.256	<0.10	943	<0.010	23.9	175	353	<0.0020	0.46
MW15-02AZ	MW15-02AZ	primary	31-May-2015	0.16		3.65	0.435	1.1	91.7	<0.010	<0.0050	<10	0.009	135	0.14	0.207	1.28	4.9	<0.0050	4.35	42.5	21	<0.0020	0.436
MW15-02AZ	MW15-02AZ	primary	11-Jul-2015	0.17		14.8	0.147	0.917	89.9	<0.010	<0.0050	<10	0.125	111	0.2	0.0388	1.34	10.7	0.021	3.71	33.8	1	0.0028	0.354
MW15-02AZ	MW15-40AZ	duplicate	11-Jul-2015	0.16		12.2	0.14	0.905	85.5	<0.010	<0.0050	<10	0.0283	110	0.15	0.0294	1.09	11.2	0.0085	3.91	33.3	0.269	0.0029	0.343
MW15-02AZ	MW15-02AZ	primary	12-Aug-2015	0.16		8.74	0.14	1.12	81.3	<0.010	<0.0050	<10	0.007	125	0.2	0.0699	1.33	9	0.0069	4.27	43.1	12.9	<0.0020	0.362
MW15-02AZ	MW15-02AZ	primary	07-Sep-2015	0.15		3.62	0.145	0.978	71.5	<0.010	<0.0050	<10	<0.0050	101	<0.10	0.088	0.947	5.2	<0.0050	4.22	31.8	28.5	<0.0020	0.38
MW15-02AZ	MW15-02AZ	primary	17-May-2016	0.11		3.4	0.134	0.821	67.1	<0.010	<0.0050	<10	<0.0050	117	<0.10	0.121	0.745	14.7	<0.0050	4.17	32	61.4	0.002	0.377
MW15-02AZ	MW15-02AZ	primary	19-Jul-2016	0.13		3.42	0.15	0.816	63.9	<0.010	<0.0050	<10	<0.0050	114	<0.10	0.114	0.875	14.2	<0.0050	4.07	32.8	63.4	<0.0020	0.411
MW15-02AZ	JH40-06	duplicate	25-Sep-2016	0.11		2.54	0.128	0.727	59.7	<0.010	<0.0050	<10	<0.0050	116	<0.10	0.134	0.809	14.1	0.006	5.17	31.9	67	0.0037	0.401
MW15-02AZ	MW15-02AZ	primary	25-Sep-2016	0.11		2.44	0.134	0.777	63.2	<0.010	<0.0050	<10	<0.0050	116	<0.10	0.118	0.728	13.9	0.005	4.56	31.9	69.1	<0.0020	0.411
MW15-02AZ	MW15-02AZ	primary	28-Jul-2017	0.12		1.9	0.116	0.643	58.6	<0.010	<0.0050	<10	<0.0050	130	0.11	0.149	0.567	15.8	<0.0050	4.31	34.6	93.7	<0.0020	0.414
MW15-02AZ	MW15-02AZ	primary	08-Oct-2017	0.15		3.42	0.156	1.17	96.6	<0.010	<0.0050	<10	0.0058	117	0.17	0.0217	0.858	2.8	<0.0050	4.09	42.9	<0.050	0.0021	0.429
MW15-02AZ	JH42-05	duplicate	03-Aug-2018	0.13		3.7	0.125	0.862	73.8	<0.010	<0.0050	<10	<0.0050	116	0.12	0.0766	0.712	6	<0.0050	4.28	35	49.1	<0.0020	0.42
MW15-02AZ	MW15-02AZ	primary	03-Aug-2018	0.13		5.05	0.119	0.848	74	<0.010	<0.0050	<10	<0.0050	116	<0.10	0.081	0.713	5.9	<0.0050	4.29	35.9	50.1	<0.0020	0.409
MW15-02WB	MW15-02WB	primary	01-Jun-2015	0.91		6.92	0.375	2.5	26.6	0.019	<0.0050	<10	0.042	144	1.92	0.184	0.692	362	0.312	4.42	37.5	98.2	<0.0020	1.31
MW15-02WB	MW15-02WB	primary	11-Jul-2015	0.84		4.2	0.123	1.92	22.7	<0.010	<0.0050	<10	0.0345	130	<0.10	0.0957	0.199	13.7	0.0078	3.64	32.7	101	<0.0020	0.68
MW15-02WB	MW15-02WB	primary	12-Aug-2015	0.67		4.8	0.143	2.48	23.5	<0.010	<0.0050	<10	0.0267	129	<0.10	0.135	0.249	3.9	0.0052	4.12	35.2	111	<0.0020	0.851
MW15-02WB	MW15-02WB	primary	07-Sep-2015	0.13		1.92	0.076	0.498	39.5	<0.010	<0.0050	<10	0.011	125	0.18	0.068	1.66	13.8	0.021	4.45	35.2	36.4	<0.0020	0.525
MW15-02WB	MW15-02WB	primary	18-May-2016	0.61		2.16	0.098	2.71	32	<0.010	<0.0050	<10	0.013	136	<0.10	0.122	0.908	162	0.137	4.01	36	71.1	<0.0020	0.573
MW15-02WB	MW15-02WB	primary	19-Jul-2016	0.12		2.26	0.073	0.412	41	<0.010	<0.0050	<10	<0.0050	130	<0.10	0.028	1.82	2.7	<0.0050	3.74	35	4.09	<0.0020	0.424
MW15-02WB	MW15-02WB	primary	25-Sep-2016	<0.10		2.54	0.124	0.399	40.6	<0.010	<0.0050	<10	0.032	120	0.11	0.061	2.64	4.7	0.025	4.23	31.9	3.89	<0.0020	0.524
MW15-02WB	JH41-02	duplicate	25-Apr-2017	0.13		2.11	0.088	0.598	48.8	<0.010	<0.0050	<10	0.026	134	<0.10	0.094	2.16	9.2	0.02	4.04	35.9	17.7	<0.0020	0.713
MW15-02WB	MW15-02WB	primary	25-Apr-2017	0.13		1.44	0.088	0.523	48.5	<0.010	<0.0050	<10	0.021	140	<0.10	0.06	1.85	8.7	0.022	3.94	37.7	16.4	<0.0020	0.566
MW15-02WB	JH41-04	duplicate	13-Jun-2017	0.77		2.77	0.084	2.57	22.2	0.01	<0.0050	<10	0.024	124	0.14	0.092	0.795	340	0.1	3.44	34.4	96.9	<0.0020	0.954
MW15-02WB	MW15-02WB	primary	13-Jun-2017	0.77		1.04	0.059	2.47	22.6	0.011	<0.0050	<10	0.009	124	<0.10	0.08	0.113	348	0.087	3.38	33.6	91	<0.0020	0.663
MW15-02WB	MW15-02WB	primary	28-Jul-2017	0.12		1.19	0.08	0.407	41.5	<0.010	<0.0050	<10	0.0091	126	<0.10	0.0246	1.64	2.9	0.006	3.66	33.6	3.44	<0.0020	0.447
MW15-02WB	MW15-02WB	primary	08-Oct-2017	0.11		1.33	0.078	0.43	44.2	<0.010	<0.0050	<10	0.0184	129	<0.10	0.0293	1.77	4.5	0.0088	3.81	36.2	2.31	<0.0020	0.506

Station	Sample ID	Sample Class	Sample Date	Total Zirconium (Zr)	Dissolved Metals	Dissolved Aluminum (Al)	Dissolved Antimony (Sb)	Dissolved Arsenic (As)	Dissolved Barium (Ba)	Dissolved Beryllium (Be)	Dissolved Bismuth (Bi)	Dissolved Boron (B)	Dissolved Cadmium (Cd)	Dissolved Calcium (Ca)	Dissolved Chromium (Cr)	Dissolved Cobalt (Co)	Dissolved Copper (Cu)	Dissolved Iron (Fe)	Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Magnesium (Mg)	Dissolved Manganese (Mn)	Dissolved Mercury (Hg)	Dissolved Molybdenum (Mo)
				ug/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.1		0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05	1	0.005	0.5	0.05	0.05	0.002	0.05
ALS RDL[1]:				-		1	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.2	10	0.05	0.5	0.1	0.05	0.01	0.05
MW15-02WB	MW15-02WB	primary	21-Apr-2018	0.26		1.56	0.089	1.11	45.1	<0.010	<0.0050	<10	0.0105	142	0.12	0.0599	1.49	27.4	0.0496	3.84	43.3	20.6	<0.0020	0.579
MW15-02WB	JH42-03	duplicate	09-Jun-2018	1.05		2.56	0.036	2.47	21	0.019	<0.0050	<10	0.0117	126	<0.10	0.0574	0.112	294	0.0176	3.74	35.2	90.8	<0.0020	0.67
MW15-02WB	MW15-02WB	primary	09-Jun-2018	1.03		2.5	0.038	1.89	21.9	0.012	<0.0050	<10	0.0132	132	<0.10	0.0612	0.222	96.5	0.0065	3.79	36.6	94.5	<0.0020	0.664
MW15-02WB	MW15-02WB	primary	04-Aug-2018	0.77		2.74	0.041	2.29	22.4	0.015	<0.0050	<10	0.008	127	<0.10	0.0737	0.095	377	0.107	3.84	35.5	99.8	<0.0020	0.614
MW15-02WB	JH42-07	duplicate	06-Oct-2018	<0.10		0.84	0.074	0.403	42.7	<0.010	<0.0050	<10	0.0074	124	<0.10	0.0239	1.73	3.2	<0.0050	3.49	33.6	1.81	<0.0020	0.5
MW15-02WB	MW15-02WB	primary	06-Oct-2018	0.11		1.26	0.078	0.405	42.8	<0.010	<0.0050	<10	<0.0050	122	<0.10	0.0249	1.76	3.9	0.0066	3.46	32.9	1.73	<0.0020	0.458
MW15-02WB	MW15-02WB	primary	29-Apr-2019	<0.10		0.89	0.076	0.385	52	<0.010	<0.0050	<10	0.006	134	0.11	0.05	1.85	3.4	0.012	3.78	37.6	1.6	<0.0020	0.486
MW15-02WB	MW15-02WB	primary	19-Jun-2019	0.89		1.42	0.068	1.83	22.2	0.014	<0.0050	<10	0.0097	129	<0.10	0.075	0.132	263	0.0417	3.54	35.3	87.3	<0.0020	0.673
MW15-02WB	BD2-Q2	duplicate	19-Jun-2019	0.86		1.49	0.053	1.84	22.2	0.014	<0.0050	<10	<0.0050	125	<0.10	0.0669	0.071	285	0.041	3.54	34.7	85.6	<0.0020	0.602
MW15-02WB	MW15-02WB	primary	24-Aug-2019	0.53		2.81	0.084	2.03	23.1	0.016	<0.0050	<10	0.0094	129	0.18	0.147	0.254	301	0.0442	3.63	35.7	86.7	0.005	0.708
MW15-03AZ	MW15-03AZ	primary	16-Jun-2015	0.3		38.1	0.153	0.431	37.9	<0.010	<0.0050	<10	0.012	40.6	0.16	0.0611	1.37	12.3	0.0196	1.33	12.1	55.2	<0.0020	0.451
MW15-03AZ	MW15-21	duplicate	16-Jun-2015	0.28		30.5	0.158	0.411	39.7	<0.010	<0.0050	<10	0.0122	41.4	0.1	0.0597	1.54	11.1	<0.0050	2.45	13.2	57.6	<0.0020	0.42
MW15-03AZ	MW15-03AZ	primary	09-Jul-2015	0.27		24.6	0.137	0.446	30.1	<0.010	<0.0050	<10	0.0258	38.7	0.21	0.0861	1.74	21.3	0.0257	<0.50	10.9	225	<0.0020	0.47
MW15-03AZ	MW15-03AZ	primary	10-Aug-2015	0.41		26.3	0.197	0.552	29.4	0.013	<0.0050	<10	0.0108	28.4	0.28	0.0601	1.98	19.5	0.0113	0.77	8.75	67.7	0.0028	0.502
MW15-03AZ	MW15-03AZ	primary	04-Sep-2015	0.4		18.6	0.178	0.477	24.5	0.011	<0.0050	<10	0.01	25.9	0.17	0.05	1.73	9.3	0.005	1.13	7.73	102	0.0026	0.467
MW15-03AZ	JH40-02	duplicate	16-May-2016	0.36		13.5	0.259	0.575	31.5	0.012	<0.0050	<10	<0.0050	36.5	0.12	0.07	1.37	18.2	<0.0050	0.92	10.2	71.1	0.0041	0.413
MW15-03AZ	MW15-03AZ	primary	16-May-2016	0.39		13.8	0.277	0.535	32.9	0.01	<0.0050	<10	<0.0050	37.1	0.12	0.071	1.36	18.8	<0.0050	0.91	10.2	72.3	0.0042	0.447
MW15-03AZ	MW15-03AZ	primary	16-Jul-2016	0.35		22.1	0.253	0.551	29	0.011	0.006	<10	0.006	28.6	0.22	0.045	1.89	11.1	<0.0050	0.75	8.12	30.2	0.0029	0.523
MW15-03AZ	MW15-03AZ	primary	23-Sep-2016	0.31		17.2	0.226	0.548	30.2	0.013	<0.0050	<10	<0.0050	26.5	0.2	0.037	1.8	7.4	0.005	0.8	8.18	15.2	0.0023	0.471
MW15-03AZ	MW15-03AZ	primary	25-Jul-2017	0.33		23	0.24	0.512	35.2	0.015	<0.0050	<10	0.007	30.7	0.23	0.0401	1.67	8.7	<0.0050	0.66	9.16	39.2	0.0026	0.522
MW15-03AZ	MW15-03AZ	primary	07-Oct-2017	0.31		13.6	0.209	0.51	34.3	0.012	<0.0050	<10	<0.0050	31.3	0.18	0.0315	1.5	5.8	<0.0050	0.71	9.8	27.1	0.0025	0.468
MW15-03AZ	MW15-03AZ	primary	04-Aug-2018	0.3		14.4	0.186	0.5	36.4	0.01	<0.0050	<10	0.0076	34.8	0.19	0.0384	1.51	6.7	<0.0050	0.71	10.2	42.1	<0.0020	0.527
MW15-03AZ	MW15-03AZ	primary	05-Oct-2018	0.33		13.9	0.187	0.49	29.4	0.011	<0.0050	<10	0.0052	29	0.25	0.0388	1.64	6.9	<0.0050	0.72	8.49	35.7	0.0024	0.494
MW15-03AZ	MW15-03AZ	primary	23-Aug-2019	0.29		13.6	0.176	0.62	32.7	<0.010	<0.0050	<10	0.0063	32.6	0.22	0.0323	1.48	6.6	<0.0050	0.7	9.5	49.8	0.0054	0.517
MW15-03WB	MW15-03WB	primary	16-Jun-2015	0.11		35.6	0.096	0.268	17.6	<0.010	<0.0050	42	<0.0050	172	<0.10	0.123	0.074	11.4	<0.0050	12.2	141	84.2	<0.0020	0.981
MW15-03WB	MW15-03WB	primary	09-Jul-2015	0.1		7.69	0.099	0.474	14.4	<0.010	<0.0050	33	0.0481	160	<0.10	0.0867	0.238	5.6	<0.0050	10	130	78.9	<0.0020	1.04
MW15-03WB	MW15-03WB	primary	10-Aug-2015	<0.10		3.72	0.058	0.485	11.8	<0.010	0.0148	38	0.014	156	<0.10	0.0656	0.145	5.6	<0.0050	12.5	126	78.1	<0.0020	0.976
MW15-03WB	MW15-03WB	primary	04-Sep-2015	<0.10		3.53	0.042	0.413	10.4	<0.010	<0.0050	29	0.01	160	0.22	0.055	0.087	569	0.02	11.2	131	73.5	<0.0020	0.851
MW15-03WB	MW15-03WB	primary	16-May-2016	<0.10		1.42	0.033	0.484	8.83	<0.010	<0.0050	29	0.007	162	<0.10	0.017	0.065	693	<0.0050	11.8	123	74.7	<0.0020	0.826
MW15-03WB	MW15-03WB	primary	16-Jul-2016	3.48		72.7	0.061	0.825	15.9	<0.010	0.005	28	<0.0050	199	0.43	0.071	0.09	680	0.033	12.2	143	99.7	<0.0020	1.17
MW15-03WB	MW15-03WB	primary	23-Sep-2016	0.13		6.8	<0.10	0.921	15.7	<0.050	<0.025	<50	<0.025	189	<0.50	0.032	<0.25	1090	<0.025	15.2	155	104	<0.0020	1.24
MW15-03WB	MW15-03WB	primary	23-Apr-2017	0.51		6.9	<0.10	0.8	13.8	<0.050	<0.025	<50	<0.025	191	<0.50	<0.025	<0.25	1420	<0.025	12.3	155	96.1	<0.0020	1.22
MW15-03WB	MW15-03WB	primary	10-Jun-2017	0.64		6	<0.10	0.78	13.3	<0.050	<0.025	<50	<0.025	175	<0.50	<0.025	0.26	1040	<0.025	11.9	143	94.2	<0.0020	1.14
MW15-03WB	MW15-03WB	primary	25-Jul-2017	<0.50		2.6	<0.10	0.59	12.4	<0.050	<0.025	<50	<0.025	173	<0.50	<0.025	<0.25	720	<0.025	11.5	143	92.7	<0.0020	1.07
MW15-03WB	MW15-03WB	primary	07-Oct-2017	<0.50		3.2	<0.10	0.62	13.5	<0.050	<0.025	<50	<0.025	189	<0.50	<0.025	<0.25	740	<0.025	11.9	155	92.6	<0.0020	0.86
MW15-03WB	JH42-01	duplicate	20-Apr-2018	<0.50		3.2	<0.10	0.12	12.5	<0.050	<0.025	75	<0.025	188	<0.50	<0.025	<0.25	520	<0.025	12.4	161	93.3	<0.0020	0.74
MW15-03WB	MW15-03WB	primary	20-Apr-2018	<0.50		3.4	<0.10	0.16	12.8	<0.050	<0.025	62	<0.025	183	<0.50	<0.025	0.26	503	0.046	11.7	160	91.6	<0.0020	0.63
MW15-03WB	MW15-03WB	primary	08-Jun-2018	<0.50		4.3	<0.10	0.25	13.7	<0.050	<0.025	<50	<0.025	180	<0.50	<0.025	<0.25	383	<0.025	10.4	146	94	<0.0020	0.62
MW15-03WB	MW15-03WB	primary	05-Aug-2018	<0.50		8.3	<0.10	0.12	11.3	<0.050	<0.025	<50	<0.025	171	<0.50	<0.025	<0.25	548	<0.025	11.7	143	87	<0.0020	0.47
MW15-03WB	MW15-03WB	primary	04/10/2018 and 05/10/2018	<0.20		3.4	<0.10	5.32	12	<0.050	<0.025	<50	<0.025	188	<0.50	<0.025	<0.25	620	<0.025	11.9	156	93.4	0.0025	0.53
MW15-03WB	MW15-03WB	primary	03-May-2019	0.26		2.27	<0.020	0.193	11.1	<0.010	<0.0050	25	<0.0050	177	<0.10	0.039	0.052	521	0.011	10.2	146	88.1	<0.0020	0.345
MW15-03WB	MW15-03WB	primary	18-Jun-2019	0.33		17.9	0.069	0.145	10.2	<0.020	<0.010	27	<0.010	171	<0.20	<0.010	<0.10	474	<0.010	10.9	142	89	<0.0020	0.37
MW15-03WB	MW15-03WB	primary	23-Aug-2019	<0.20		8.2	0.047	0.282	11.5	<0.020	<0.010	31	<0.010	177	<0.20	0.013	0.12	357	0.023	11.6	143	82.9	0.0024	0.61
MW15-04WB	MW15-04WB	primary	14-Jun-2015	0.26		44.1	3.02	1.54	33.3	<0.010	<0.0050	<10	0.0487	73.1	<0.10	0.221	2.26	6.4	0.337	7.37	37.7	115	<0.0020	2.55
MW15-04WB	MW15-20	duplicate	14-Jun-2015	0.27		44.1	2.87	1.51	32.4	<0.010	<0.0050	<10	0.0539	76.4	<0.10	0.227	2.12	8.9	0.32	6.91	37.7	116	<0.0020	2.4
MW15-04WB	MW15-04WB	primary	10-Jul-2015	0.27		21	2.97	1.37	31.9	<0.10	<1.0	<50	0.081	70	<1.0	<0.50	1.31	12.4	<0.20	6.7	36.7	123	<0.010	2.6
MW15-04WB	MW15-30WB	duplicate	10-Jul-2015	0.24		3.2	3.05	1.32	32.3	<0.10	<1.0	<50	0.037	71.7	<1.0	<0.50	0.96	5.4	0.31	7	36.6	119	<0.010	2.3
MW15-04WB	MW15-04WB	primary	11-Aug-2015	0.24		11.3	2.79	1.32	33.8	<0.010	<0.0050	<10	0.0999	78.8	<0.10	0.225	1.22	6.7	0.149	6.73	38.4	109	<0.0020	2.56
MW15-04WB	MW15-04WB	primary	05-Sep-2015	0.24		3.47	2.56	1.32	32.7	<0.010	<0.0050	<10	0.042	74.1	0.37	0.202	1.09	13	0.366	6.98	37.4	105	<0.0020	2.6
MW15-04WB	MW15-04WB	primary	13-May-2016	0.25		1.66	1.83	1.86	29	<0.010	<0.0050	<10	0.0310	75.6	<0.10	0.31	1.11	27.9	0.222	6.84	34.9	152	<0.0020	2.16
MW15-04WB	JH40-03	duplicate	15-Jul-2016	0.17		0.84	1.55	2	28.4	<0.010	0.007	<10	0.021	70.6	<0.10	0.298	0.574	36.4	0.167	6.97	33.9	149	<0.0020	1.99
MW15-04WB	MW15-04WB	primary	15-Jul-2016	0.17		0.96	1.58	1.93	28	<0.010	0.007	<10	0.02	71.3	<0.10	0.291	0.633	32	0.164	6.77	34.1	150	<0.0020	2.05
MW15-04WB	MW15-04WB	primary	24-Sep-2016	0.17		1.65	1.42	1.87	27.5	<0.010	<0.0050	<10	0.027	69.8	<0.10	0.301	0.868	35.7	0.173	7.31	34	146	<0.0020	2.07
MW15-04WB	MW15-04WB	primary	23-Apr-2017	0.2		0.72	2.07	1.09	29.6	0.01	<0.0050	<10	0.032	71.9	<0.10	0.241	1.08	7.2	0.13	6.15	37.5	123	<0.0020	2.18
MW15-04WB	MW15-04WB	primary	11-Jun-2017	<0.50		0.64	2.02	0.988	31.1	<0.010	<0.0050	<10	0.027	81.5	<0.10	0.222	0.987	7.1	0.196	6.45	35	120	<0.0020	2.24
MW15-04WB	MW15-04WB	primary	26-Jul-2017	0.16		0.65	2.16	0.914	28.5	<0.010	<0.0050	<10	0.0266	75.5	<0.10	0.215	1.04	3.1	0.153	6.53	39.9	107	<0.0020	2.12
MW15-04WB	JH41-07	duplicate	05-Oct-2017	0.18		0.98	1.9	0.997	31.2	<0.010	<0.0050	<10	0.035	77.7	<0.10	0.24	1.14	11.7	0.338	6.63	38.1	127	<0.0020	2.15
MW15-04WB	MW15-04WB	primary	05-Oct-2017	0.21		0.71	1.84	0.995	30.6	<0.010	<0.0050	<10	0.043	78.4	<0.10	0.237	1.11	11.4	0.328	6.46	37.3	121	<0.0020	2.08
MW15-04WB	MW15-04WB	primary	19-Apr-2018	0.22		1.18	2.18	1.14	32.9	<0.010	<0.0050	<10	0.0444	84.4	<0.10	0.242	1.11	12.6	0.367	7.69	43.7	127	<0.0020	2.51

Station	Sample ID	Sample Class	Sample Date	Total Zirconium (Zr)	Dissolved Metals	Dissolved Aluminum (Al)	Dissolved Antimony (Sb)	Dissolved Arsenic (As)	Dissolved Barium (Ba)	Dissolved Beryllium (Be)	Dissolved Bismuth (Bi)	Dissolved Boron (B)	Dissolved Cadmium (Cd)	Dissolved Calcium (Ca)	Dissolved Chromium (Cr)	Dissolved Cobalt (Co)	Dissolved Copper (Cu)	Dissolved Iron (Fe)	Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Magnesium (Mg)	Dissolved Manganese (Mn)	Dissolved Mercury (Hg)	Dissolved Molybdenum (Mo)
				ug/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.1		0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05	1	0.005	0.5	0.05	0.05	0.002	0.05
ALS RDL[1]:				-		1	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.2	10	0.05	0.5	0.1	0.05	0.01	0.05
MW15-04WB	MW15-04WB	primary	07-Jun-2018	0.2		3.06	1.34	2.27	31.2	<0.010	<0.0050	<10	0.037	77.5	<0.10	0.314	0.514	43.7	0.376	6.38	36.9	139	<0.0020	2.31
MW15-04WB	MW15-04WB	primary	02-Aug-2018	0.14		2.45	1.24	1.55	29.4	<0.010	<0.0050	<10	0.0321	71.1	<0.10	0.279	1.06	25.3	0.425	7.38	36.7	133	<0.0020	2.28
MW15-04WB	MW15-04WB	primary	05-Oct-2018	0.11		1.4	1.09	1.15	24.9	<0.010	<0.0050	<10	0.0198	66.8	<0.10	0.231	0.912	19.6	0.439	6.63	33.5	113	0.0027	2.18
MW15-04WB	MW15-04WB	primary	03-May-2019	0.19		<0.50	1.32	1.06	28.1	<0.010	<0.0050	<10	0.012	69.3	<0.10	0.183	0.859	9.5	0.248	6.61	35.6	80.4	<0.0020	2.08
MW15-04WB	MW15-04WB	primary	17-Jun-2019	0.19		0.77	1.35	0.997	28.3	<0.010	<0.0050	<10	0.0196	72.5	<0.10	0.163	0.978	9.2	0.296	5.98	35.8	80.9	<0.0020	2.03
MW15-04WB	MW15-04WB	primary	22-Aug-2019	0.21		0.91	1.48	1.38	28.9	<0.010	<0.0050	<10	0.0226	72	0.19	0.187	1.17	15.2	0.282	6.44	35.5	79.1	<0.0020	2.15
MW15-04WB	BD1-Q3	duplicate	22-Aug-2019	0.23		0.55	1.42	1.14	28.4	<0.010	<0.0050	<10	0.0095	70.3	<0.10	0.174	0.766	11.6	0.245	6.37	35	73.3	0.0026	2.15
MW15-05AZ	MW15-05AZ	primary	06-Sep-2015	1.2		189	0.084	2.28	18.8	0.026	0.005	<10	0.022	2.93	0.7	2.49	1.86	931	0.033	0.69	0.747	617	0.0054	0.248
MW15-05WB	MW15-05WB	primary	18-Jun-2015	<0.10		4.1	0.403	1.27	4	<0.010	<0.0050	<10	0.029	47.4	<0.10	0.037	0.363	2.3	0.013	14.2	8.02	13.4	<0.0020	0.698
MW15-05WB	MW15-05WB	primary	10-Jul-2015	<0.10		3.1	<0.50	0.88	2.1	<0.10	<1.0	<50	0.019	42	<1.0	<0.50	<0.20	<5.0	<0.20	11.9	6.99	4.6	<0.010	<1.0
MW15-05WB	MW15-05WB	primary	11-Aug-2015	<0.10		1.7	0.217	0.971	1.97	<0.010	<0.0050	<10	0.0159	44.5	<0.10	0.0571	0.083	2.7	0.0104	13	7	5.36	<0.0020	0.635
MW15-05WB	MW15-60	duplicate	11-Aug-2015	<0.10		23.1	0.222	0.958	1.91	<0.010	<0.0050	<10	0.0159	44.7	<0.10	0.0451	0.102	3.3	0.0122	13	6.97	4.02	<0.0020	0.721
MW15-05WB	MW15-05WB	primary	06-Sep-2015	<0.10		4.49	0.252	1.19	2.47	<0.010	<0.0050	<10	0.023	45.5	0.41	0.057	0.243	11.1	0.044	12.1	7.9	7.09	<0.0020	1.85
MW15-05WB	MW15-05WB	primary	15-May-2016	<0.10		1.12	0.223	1.31	2.06	<0.010	<0.0050	<10	0.013	45.9	<0.10	0.052	0.494	1.5	0.02	11.9	7.33	10.3	<0.0020	0.556
MW15-05WB	MW15-05WB	primary	20-Jul-2016	<0.10		1.75	0.195	0.845	1	<0.010	<0.0050	<10	<0.0050	45.7	<0.10	0.027	0.067	<1.0	0.018	12.8	7.48	5.22	<0.0020	0.518
MW15-05WB	MW15-05WB	primary	27-Sep-2016	<0.10		1.39	0.215	0.87	1.42	<0.010	<0.0050	<10	0.005	43.8	<0.10	0.043	0.065	1.1	0.016	11.6	6.69	9.62	<0.0020	0.507
MW15-05WB	MW15-05WB	primary	21-Apr-2017	<0.10		<0.50	0.166	0.734	0.83	<0.010	<0.0050	<10	0.053	46.3	<0.10	0.019	0.141	<1.0	0.019	12.9	6.93	6.47	<0.0020	0.519
MW15-05WB	MW15-05WB	primary	11-Jun-2017	<0.10		<0.50	0.192	0.79	0.827	<0.010	<0.0050	<10	<0.0050	41.3	<0.10	0.022	0.053	<1.0	0.018	12.9	6.88	5.98	<0.0020	0.532
MW15-05WB	MW15-05WB	primary	27-Jul-2017	<0.10		14	0.498	0.837	1.48	<0.010	<0.0050	<10	0.0051	42.8	<0.10	0.0376	<0.050	2.5	0.0389	11.9	6.82	9.12	<0.0020	0.499
MW15-05WB	MW15-05WB	primary	07-Oct-2017	<0.10		2.53	0.241	0.968	1.94	<0.010	<0.0050	<10	0.0133	48	<0.10	0.0276	0.772	5.3	0.0376	12.2	7.7	7.81	<0.0020	0.621
MW15-05WB	MW15-05WB	primary	21-Apr-2018	<0.10		0.84	0.181	0.902	0.84	<0.010	<0.0050	<10	0.0083	42.8	<0.10	0.0218	<0.050	2.4	0.0245	11.5	7.75	7.02	<0.0020	0.593
MW15-05WB	MW15-05WB	primary	09-Jun-2018	<0.10		2.03	0.186	0.875	1.27	<0.010	<0.0050	<10	0.0168	44.6	<0.10	0.0189	0.087	5.3	0.0249	12.6	7	7.93	<0.0020	0.587
MW15-05WB	MW15-05WB	primary	04-Aug-2018	<0.10		1.8	0.179	0.821	1.07	<0.010	<0.0050	<10	0.0053	41.6	<0.10	0.0165	0.073	2.3	0.0148	11.8	6.86	7.73	<0.0020	0.536
MW15-05WB	MW15-05WB	primary	06-Oct-2018	<0.10		0.77	0.177	1.03	0.867	<0.010	<0.0050	<10	0.0058	43	<0.10	0.0162	0.061	1.7	0.0276	11.1	6.72	7.46	0.0021	0.512
MW15-05WB	MW15-05WB	primary	30-Apr-2019	<0.10		0.6	0.171	0.907	1.46	<0.010	<0.0050	<10	0.014	41.9	0.13	0.028	0.380	3.9	0.039	11.6	6.8	9.07	<0.0020	0.576
MW15-05WB	MW15-05WB	primary	19-Jun-2019	<0.10		1.83	0.152	0.823	0.888	<0.010	<0.0050	<10	<0.0050	41.3	<0.10	0.0143	0.098	3.6	0.023	11.5	6.62	7.85	<0.0020	0.504
MW15-05WB	MW15-05WB	primary	23-Aug-2019	<0.10		0.84	0.167	0.893	0.944	<0.010	<0.0050	<10	<0.0050	42.1	<0.10	0.0419	0.071	4.1	0.0094	11.7	6.66	7.1	0.0055	0.5
MW15-06WB	MW15-06WB	primary	21-Jun-2015	0.67		888	1.29	12.9	48	0.037	0.006	<10	0.046	49.1	1.99	1.43	2.89	1640	0.527	5.28	17.6	913	0.368	17.7
MW15-06WB	MW15-06WB	primary	21-Jul-2015	0.65		8.4	2.45	10.3	39.1	<0.010	<0.0050	<10	0.0131	65.6	<0.10	2.14	0.193	56.9	0.023	8.36	32.9	2390	0.022	37.6
MW15-06WB	MW15-06WB	primary	09-Aug-2015	0.81		7.18	2.84	20.2	41.5	<0.010	<0.0050	<10	0.0217	71.8	<0.10	2.49	0.629	73.5	0.0172	10.7	33.4	3400	0.0544	45.6
MW15-06WB	MW15-06WB	primary	08-Sep-2015	0.62		67.5	0.764	25.8	56.1	<0.010	<0.0050	<10	0.037	82.5	0.66	3.22	1.23	849	0.098	12.4	39.9	5810	0.0952	87.4
MW15-06WB	MW15-06WB	primary	17-May-2016	3.68		8.1	0.266	69.3	62.3	<0.010	<0.0050	<10	0.005	56.3	<0.10	0.061	0.241	648	0.06	13.7	31.3	5690	0.0147	199
MW15-06WB	MW15-06WB	primary	18-Jul-2016	3.52		12.9	0.33	77.2	89	<0.050	<0.025	<50	<0.025	51.9	<0.50	0.073	<0.25	597	0.522	14.3	35.3	6390	0.0147	183
MW15-06WB	MW15-06WB	primary	26-Sep-2016	2.92		8.51	0.43	72	99.9	<0.010	<0.0050	<10	<0.0050	49.6	<0.10	0.056	0.218	634	0.089	13.3	29.9	5670	0.0114	187
MW15-06WB	MW15-06WB	primary	24-Apr-2017	1.62		5.39	0.291	50.6	85	<0.010	<0.0050	<10	<0.0050	52	<0.10	0.051	0.059	672	0.038	13.1	31.4	4700	0.006	158
MW15-06WB	MW15-06WB	primary	12-Jun-2017	1.87		4.62	0.323	74.6	95	<0.010	<0.0050	<10	<0.0050	51	<0.10	0.052	0.14	650	0.049	13.1	33.6	5440	0.0058	143
MW15-06WB	MW15-06WB	primary	29-Jul-2017	1.91		5.16	0.317	79.8	105	<0.010	<0.0050	<10	<0.0050	52.8	<0.10	0.05	0.117	733	0.08	13.5	34.4	5160	0.0097	128
MW15-06WB	MW15-06WB	primary	09-Oct-2017	2.04		6.55	0.287	72.9	120	<0.010	<0.0050	<10	0.0079	57.6	<0.10	0.0496	0.277	1070	0.148	13.2	38.1	5800	0.0081	121
MW15-06WB	MW15-06WB	primary	22-Apr-2018	2.39		3.86	0.256	64.4	139	<0.010	<0.0050	<10	<0.0050	56.9	<0.10	0.0487	<0.050	932	0.0152	11.8	39.8	5620	0.0053	105
MW15-06WB	MW15-06WB	primary	10-Jun-2018	2.52		7.76	0.282	78.5	132	<0.010	<0.0050	<10	0.012	57.3	<0.10	0.0361	0.315	985	0.212	12.3	35.3	5110	0.0101	104
MW15-06WB	MW15-06WB	primary	03-Aug-2018	2.78		4.06	0.307	91	158	<0.010	<0.0050	<10	<0.0050	53.2	<0.10	0.0932	<0.050	875	0.0263	12.1	34.2	5170	0.0041	105
MW15-06WB	MW15-06WB	primary	07-Oct-2018	2.71		4.11	0.266	102	159	<0.010	<0.0050	<10	<0.0050	56.3	<0.10	0.0541	0.117	1070	0.0373	11.1	34.4	5270	0.0091	100
MW15-06WB	MW15-06WB	primary	02-May-2019	3.02		7.14	3.79	122	36.7	<0.010	<0.0050	<10	<0.0050	66.1	0.18	0.761	0.225	322	0.015	5.44	32.9	4000	0.006	27.6
MW15-06WB	MW15-06WB	primary	20-Jun-2019	2.1		2.83	0.305	112	150	<0.010	<0.0050	<10	<0.0050	57.5	<0.10	0.11	0.05	832	0.0166	10.9	35	4800	0.005	82.9
MW15-06WB	MW15-06WB	primary	25-Aug-2019	2.37		2.78	0.287	123	159	<0.010	<0.0050	<10	<0.0050	58.9	<0.10	0.129	0.052	952	0.0145	10.8	35.6	4460	0.0081	77.5
MW16-01WB	MW16-01WB	primary	04-Oct-2016	<0.10		1.49	0.687	9	18.8	0.075	<0.0050	<10	<0.0050	21.8	<0.10	0.046	<0.050	4430	<0.0050	14.8	4.35	1390	<0.0020	0.508
MW16-01WB	MW16-01WB	primary	20-Apr-2017	<0.10		0.69	0.477	10.6	18.8	0.078	<0.0050	<10	0.031	23.4	<0.10	0.008	<0.050	6470	<0.0050	14.5	4.37	1400	<0.0020	0.773
MW16-01WB	MW16-01WB	primary	09-Jun-2017	<0.10		0.59	0.412	11.2	19.2	0.064	<0.0050	<10	<0.0050	24.3	<0.10	0.008	<0.050	6160	<0.0050	15.3	4.66	1400	<0.0020	0.706
MW16-01WB	MW16-01WB	primary	26-Jul-2017	<0.10		41.3	1.12	11.7	18.5	0.079	<0.0050	<10	0.0051	23	<0.10	0.0075	<0.050	6100	0.0222	14.9	4.46	1390	<0.0020	0.719
MW16-01WB	JH41-05	duplicate	27-Jul-2017	<0.10		16.4	0.598	12	18.3	0.09	<0.0050	<10	0.0061	22.8	<0.10	0.0068	0.369	6180	0.0095	14.8	4.43	1390	<0.0020	0.631
MW16-01WB	MW16-01WB	primary	06-Oct-2017	<0.10		0.83	0.322	13.4	19	0.084	<0.0050	<10	0.0410	22.1	<0.10	0.019	0.783	5810	0.027	15.2	4.31	1310	<0.0020	0.875
MW16-01WB	MW16-01WB	primary	20-Apr-2018	<0.10		1.08	0.202	10.7	17.7	0.111	<0.0050	<10	0.0113	23.2	<0.10	0.0096	<0.050	6250	0.0052	15.1	4.75	1380	<0.0020	0.626
MW16-01WB	MW16-01WB	primary	08-Jun-2018	<0.10		2.63	0.193	11.4	18.8	0.076	<0.0050	<10	<0.0050	21.7	<0.10	0.005	<0.050	6130	<0.0050	12.9	4.08	1310	<0.0020	0.588
MW16-01WB	MW16-01WB	primary	02-Aug-2018	<0.10		2.02	0.201	11.8	18.6	0.097	<0.0050	<10	<0.0050	21.3	<0.10	<0.0050	<0.050	6130	<0.0050	15.1	4.37	1350	<0.0020	0.578
MW16-01WB	MW16-01WB	primary	04-Oct-2018	<0.10		1	0.097	10	18.1	0.101	<0.0050	<10	<0.0050	21.7	<0.10	<0.0050	<0.050	6150	<0.0050	14	4.06	1330	0.002	0.842
MW16-01WB	MW16-01WB	primary	01-May-2019	<0.10		2.04	0.116	11	17.8	0.078	<0.0050	<10	<0.0050	20.2	<0.10	0.009	<0.050	5650	<0.0050	10.5	4	1280	<0.0020	0.505
MW16-01WB	MW16-01WB	primary	17-Jun-2019	<0.20		<0.50	0.143	10.9	17.3	0.109	<0.010	<20	<0.010	20.5	<0.20	<0.010	<0.10	5870	<0.010	13.3	4.07	1290	<0.0020	0.44
MW16-01WB	MW16-01WB	primary	21-Aug-2019	<0.10		0.52	0.065	4.37	18.6	0.045	<0.0050	<10	<0.0050	21.6	<0.10	0.0161	0.925	1900	0.0201	14.7	4.24	1280	<0.0020	0.669
	F-BLANK-1	field blank	28-Sep-2014			<1	<0.1	<0.1	<0.05	<0.1	<0.5	<10	<0.01	<0.05	<0.1	<0.1	<0.2	<10	<0.05	<0.5	<0.1	<0.05	<0.01	<0.05

Station	Sample ID	Sample Class	Sample Date	Total Zirconium (Zr)	Dissolved Metals	Dissolved Aluminum (Al)	Dissolved Antimony (Sb)	Dissolved Arsenic (As)	Dissolved Barium (Ba)	Dissolved Beryllium (Be)	Dissolved Bismuth (Bi)	Dissolved Boron (B)	Dissolved Cadmium (Cd)	Dissolved Calcium (Ca)	Dissolved Chromium (Cr)	Dissolved Cobalt (Co)	Dissolved Copper (Cu)	Dissolved Iron (Fe)	Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Magnesium (Mg)	Dissolved Manganese (Mn)	Dissolved Mercury (Hg)	Dissolved Molybdenum (Mo)
				ug/L		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	mg/L	ug/L	ug/L	ug/L
Maxxam RDL[1]:				0.1		0.5	0.02	0.02	0.02	0.01	0.005	10	0.005	0.05	0.1	0.005	0.05	1	0.005	0.5	0.05	0.05	0.002	0.05
ALS RDL[1]:				-		1	0.1	0.1	0.05	0.1	0.5	10	0.01	0.05	0.1	0.1	0.2	10	0.05	0.5	0.1	0.05	0.01	0.05
	FB-23/06/15	field blank	23-Jun-2015	<0.10		0.56	<0.020	0.047	0.127	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	0.62	<0.050	<0.050	<0.0020	<0.050
	FB-2	field blank	18-Jul-2015	<0.10		23.4	<0.020	0.024	0.068	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	0.0062	1.85	19.9	0.0069	<0.50	<0.050	0.301	<0.0020	<0.050
	FB-3	field blank	12-Aug-2015	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-4	field blank	08-Sep-2015	<0.10		0.67	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	0.169	<0.0020	0.052
	FB-007	field blank	16-May-2016	<0.10		1.03	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-008	field blank	15-Jul-2016	<0.10		1.09	<0.020	<0.020	<0.020	<0.010	0.007	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	2.2	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-009	field blank	26-Sep-2016	<0.10		0.94	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-010	field blank	25-Apr-2017	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-020	field blank	11-Jun-2017	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-030	field blank	29-Jul-2017	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	0.006	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-040	field blank	09-Oct-2017	<0.10		0.51	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	1.7	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-Q1	field blank	22-Apr-2018	<0.10		0.68	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-Q2	field blank	10-Jun-2018	<0.10		2.26	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-Q3	field blank	05-Aug-2018	<0.10		2.65	<0.020	<0.020	0.041	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	0.0051	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-Q4	field blank	07-Oct-2018	<0.10		2.09	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-Q1	field blank	01-May-2019	<0.10		3.36	<0.020	<0.020	0.024	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	0.127	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-Q2	field blank	13-Jun-2019	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	FB-Q3	field blank	23-Aug-2019	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	0.0023	<0.050
	TRIP BLANK	trip blank	11-Sep-2015	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	16-May-2016	<0.10		0.85	<0.020	<0.020	0.03	<0.010	<0.0050	<10	<0.0050	<0.25	<0.10	<0.0050	<0.050	<1.0	0.007	<0.50	<0.25	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	20-Jul-2016	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	29-Sep-2016	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	26-Apr-2017	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	14-Jun-2017	<0.10		<0.50	<0.020	<0.020	0.045	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	26-Jul-2017	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	11-Oct-2017	<0.10		<0.50	<0.020	<0.020	0.147	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	23-Apr-2018	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	10-Jun-2018	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	09-Aug-2018	<0.10		0.8	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	0.395	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	11-Oct-2018	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	0.0028	<0.050
	TB-Q1	trip blank	02-May-2019	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	13-Jun-2019	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	<0.0020	<0.050
	TRIP BLANK	trip blank	23-Aug-2019	<0.10		<0.50	<0.020	<0.020	<0.020	<0.010	<0.0050	<10	<0.0050	<0.050	<0.10	<0.0050	<0.050	<1.0	<0.0050	<0.50	<0.050	<0.050	0.0021	<0.050

Notes:

Samples and sample data with RED text are not considered to be representative of formation water (See Appendix 5-D for further discussion).

1. Reportable detection limits (RDL) presented are the lowest detection limit for a given parameter. Note that the detection limit may have been raised by the analytical laboratory for some analytical results (e.g., due to matrix interference). See Table 3-8 in the main report for further details regarding reportable detection limits between 2014 and 2019.

2. Duplicate sample JH42-08 (Lab ID: UN0655) was collected on 04-Oct-2018 and not 05-Oct-2018 (dummy date for blind duplicate sampling) as indicated in the laboratory Certificate of Analysis.

Station	Sample ID	Sample Class	Sample Date	Dissolved Nickel (Ni)	Dissolved Phosphorus (P)	Dissolved Potassium (K)	Dissolved Selenium (Se)	Dissolved Silicon (Si)	Dissolved Silver (Ag)	Dissolved Sodium (Na)	Dissolved Strontium (Sr)	Dissolved Sulphur (S)	Dissolved Thallium (Tl)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)	Dissolved Uranium (U)	Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Filter and HNO3 Preservation (Metals)
				ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Maxxam RDL[1]:				0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1	
ALS RDL[1]:				0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	1	-	-
MW14-02A	MW14-02A	primary	28-Sep-2014	<0.5	<50	3.63	0.25	6410	<0.01	5.18	378	18.7	0.041	<0.1	<10	70.4	<1	1.6		FIELD
MW14-02A	MW14-02A	primary	12-Jun-2015	0.348	53	2.94	0.255	6070	0.0053	3.17	361	17.7	0.0555	<0.20	<0.50	46.4	0.25	3.37	<0.10	FIELD
MW14-02A	MW14-02A	primary	16-Jul-2015	0.327	12.8	2.98	0.241	6580	<0.0050	3.03	372	17.4	0.0217	<0.20	<0.50	48	<0.20	2.26	<0.10	FIELD
MW14-02A	MW14-02A	primary	06-Aug-2015	0.419	11.1	2.94	0.218	6050	0.0135	4.69	353	17.6	0.0486	<0.20	0.65	48.1	0.3	3.83	<0.10	FIELD
MW14-02A	MW14-02A	primary	04-Sep-2015	0.086	7.4	2.86	0.229	6160	<0.0050	2.87	362	18.2	0.024	<0.20	<0.50	44.6	<0.20	0.27	<0.10	FIELD
MW14-02A	MW14-100	duplicate	04-Sep-2015	0.082	6.9	2.83	0.237	6350	<0.0050	2.89	352	18.6	0.035	<0.20	<0.50	45.4	<0.20	0.54	<0.10	FIELD
MW14-02A	MW14-02A	primary	13-May-2016	0.394	7.6	2.9	0.224	6590	<0.0050	3.16	388	16.2	0.015	0.32	<0.50	42	<0.20	34	<0.10	FIELD
MW14-02A	MW14-02A	primary	17-Jul-2016	0.035	7.2	2.74	0.227	6440	<0.0050	3.12	347	16.7	0.011	<0.20	<0.50	43	<0.20	0.28	<0.10	FIELD
MW14-02A	JH40-05	duplicate	25-Sep-2016	0.037	7.6	2.85	0.233	6140	<0.0050	2.59	375	15.2	0.006	<0.20	<0.50	45.7	<0.20	0.38	<0.10	FIELD
MW14-02A	MW14-02A	primary	25-Sep-2016	0.03	9.8	2.79	0.249	6130	<0.0050	2.57	369	14.6	0.007	<0.20	<0.50	44.8	<0.20	0.3	<0.10	FIELD
MW14-02A	MW14-02A	primary	21-Apr-2017	0.107	7.3	2.8	0.242	6300	<0.0050	2.79	386	17	0.011	<0.20	<0.50	42.7	<0.20	1.47	<0.10	FIELD
MW14-02A	JH41-03	duplicate	08-Jun-2017	0.036	9.5	2.86	0.227	6200	<0.0050	2.87	355	18	0.01	<0.20	<0.50	45.7	<0.20	0.24	<0.10	FIELD
MW14-02A	MW14-02A	primary	08-Jun-2017	0.036	9.5	2.8	0.242	6180	<0.0050	2.86	345	18	0.01	<0.20	<0.50	44.3	<0.20	0.23	<0.10	FIELD
MW14-02A	MW14-02A	primary	28-Jul-2017	0.022	8.6	2.71	0.229	6220	<0.0050	2.78	337	17.5	0.0107	<0.20	<0.50	43.5	<0.20	<0.10	<0.10	FIELD
MW14-02A	MW14-02A	primary	05-Oct-2017	0.026	7.4	2.71	0.249	7000	<0.0050	2.67	369	17.2	0.006	<0.20	<0.50	43.8	<0.20	<0.10	<0.10	FIELD
MW14-02A	MW14-02A	primary	19-Apr-2018	0.067	9.4	2.85	0.244	6740	<0.0050	3.15	374	18.3	0.0098	<0.20	<0.50	44.5	0.23	0.4	<0.10	FIELD
MW14-02A	MW14-02A	primary	07-Jun-2018	0.034	7.3	2.85	0.205	6180	<0.0050	2.77	395	17.3	0.0071	<0.20	<0.50	46.7	<0.20	0.46	<0.10	FIELD
MW14-02A	MW14-02A	primary	02-Aug-2018	0.049	8.6	2.76	0.247	6300	<0.0050	2.91	374	17.2	0.0046	<0.20	<0.50	45.9	<0.20	<0.10	<0.10	FIELD
MW14-02A	JH42-06	duplicate	02-Aug-2018	0.045	8.4	2.73	0.244	6350	<0.0050	2.91	380	17.1	0.0058	<0.20	<0.50	46.6	<0.20	<0.10	<0.10	FIELD
MW14-02A	MW14-02A	primary	04-Oct-2018	0.051	5.4	2.86	0.239	6160	<0.0050	2.83	377	17.6	0.008	<0.20	<0.50	42.6	<0.20	0.18	<0.10	FIELD
MW14-02A	MW14-02A	primary	28-Apr-2019	0.045	7.6	2.74	0.237	5570	<0.0050	2.71	352	16	0.005	<0.20	<0.50	43.6	<0.20	0.15	<0.10	FIELD
MW14-02A	BD1-Q1	duplicate	28-Apr-2019	0.035	7.2	2.82	0.227	5620	<0.0050	2.77	362	16.3	0.004	<0.20	<0.50	42.5	<0.20	0.23	<0.10	FIELD
MW14-02A	MW14-02A	primary	13-Jun-2019	0.038	8.1	2.78	0.24	5320	<0.0050	2.72	328	16.3	0.0051	<0.20	<0.50	44	<0.20	<0.10	<0.10	FIELD
MW14-02A	MW14-02A	primary	22-Aug-2019	0.035	8.1	2.8	0.256	5570	<0.0050	2.71	353	16.1	0.0053	<0.20	<0.50	42.3	0.38	<0.10	<0.10	FIELD
MW14-02A	BD2-Q3	duplicate	22-Aug-2019	0.027	7.6	2.75	0.252	5720	<0.0050	2.67	347	15.9	0.0082	<0.20	<0.50	41.1	0.39	<0.10	<0.10	FIELD
MW14-02B	MW14-02B	primary	28-Sep-2014	2.5	<50	3.74	0.31	6270	<0.01	4.53	494	29	0.025	<0.1	<10	92.5	<1	10.3		FIELD
MW14-02B	F-DUP-1	duplicate	28-Sep-2014	2.4	<50	3.69	0.33	6270	<0.01	4.56	459	29	0.022	<0.1	<10	83.3	<1	10.3		FIELD
MW14-02B	MW14-02B	primary	12-Jun-2015	14.7	6.6	3.25	0.277	6090	<0.0050	3.21	441	24.6	0.0784	<0.20	<0.50	72.2	0.36	1.92	<0.10	FIELD
MW14-02B	MW14-02B	primary	16-Jul-2015	8.85	117	3.67	0.264	6420	<0.0050	3.73	469	26.1	0.0536	<0.20	<0.50	76.8	<0.20	3.78	<0.10	FIELD
MW14-02B	MW14-02B	primary	06-Aug-2015	9.29	7.5	3.61	0.274	6130	<0.0050	3.73	462	26.8	0.267	<0.20	<0.50	79.9	0.31	3.86	<0.10	FIELD
MW14-02B	MW14-02B	primary	04-Sep-2015	10.6	5.2	3.47	0.278	6430	<0.0050	3.28	454	26.7	0.249	<0.20	<0.50	72.2	<0.20	2.19	<0.10	FIELD
MW14-02B	JH40-01	duplicate	13-May-2016	9.59	6.3	3.72	0.322	7030	<0.0050	3.4	511	26.4	0.176	<0.20	<0.50	78.4	<0.20	1.55	<0.10	FIELD
MW14-02B	MW14-02B	primary	13-May-2016	9.55	5.1	3.61	0.348	7190	<0.0050	3.48	495	26.6	0.185	<0.20	<0.50	77.5	<0.20	1.77	<0.10	FIELD
MW14-02B	MW14-02B	primary	17-Jul-2016	8.39	5.4	3.4	0.317	6780	<0.0050	3.48	446	25.3	0.223	<0.20	<0.50	73	<0.20	2.03	<0.10	FIELD
MW14-02B	MW14-02B	primary	25-Sep-2016	7.01	8.7	3.42	0.327	5310	<0.0050	3.5	438	24.4	0.155	<0.20	<0.50	79	0.21	1.64	<0.10	FIELD
MW14-02B	JH41-01	duplicate	21-Apr-2017	3.41	6.2	3.49	0.333	6600	<0.0050	3.21	474	27.1	0.217	<0.20	<0.50	74.8	<0.20	1.32	<0.10	FIELD
MW14-02B	MW14-02B	primary	21-Apr-2017	3.48	7.3	3.66	0.367	6070	<0.0050	3.29	494	27.1	0.212	<0.20	<0.50	74.4	<0.20	1.54	<0.10	FIELD
MW14-02B	MW14-02B	primary	08-Jun-2017	4.11	6.6	3.54	0.35	6210	<0.0050	3.37	449	27	0.253	<0.20	<0.50	74.1	0.2	0.96	<0.10	FIELD
MW14-02B	JH41-06	duplicate	28-Jul-2017	4.62	6.7	3.33	0.403	6310	<0.0050	3.14	429	26.9	0.248	<0.20	<0.50	72	<0.20	0.77	<0.10	FIELD
MW14-02B	MW14-02B	primary	28-Jul-2017	4.44	7.1	3.21	0.335	6230	<0.0050	3.05	421	26.4	0.233	<0.20	<0.50	70.1	<0.20	0.77	<0.10	FIELD
MW14-02B	MW14-02B	primary	05-Oct-2017	3.3	5.5	3.49	0.327	6470	<0.0050	3.2	470	25.4	0.221	<0.20	<0.50	70.7	<0.20	0.53	<0.10	FIELD
MW14-02B	JH42-02	duplicate	19-Apr-2018	1.2	10.7	3.56	0.326	6720	<0.0050	3.53	481	28.5	0.136	<0.20	<0.50	74.2	0.22	0.78	<0.10	FIELD
MW14-02B	MW14-02B	primary	19-Apr-2018	1.26	11.9	3.49	0.33	6880	<0.0050	3.55	481	28.1	0.138	<0.20	<0.50	72.4	0.22	0.81	<0.10	FIELD
MW14-02B	MW14-02B	primary	07-Jun-2018	10.3	26.8	3.58	0.342	7250	1.01	2.98	488	24.3	<0.010	0.48	14.8	70.3	1.77	8.28	0.25	FIELD
MW14-02B	MW14-02B	primary	02-Aug-2018	1.8	6.2	3.3	0.341	6560	<0.0050	3.2	495	25.5	0.193	<0.20	<0.50	73.3	<0.20	0.91	<0.10	FIELD
MW14-02B	MW14-02B	primary	04-Oct-2018	1.79	9.6	3.41	0.331	5900	<0.0050	3.07	457	24.5	0.188	<0.20	0.51	70.2	0.23	0.6	<0.10	FIELD
MW14-02B	JH42-08	duplicate	05-Oct-2018	1.92	9.8	3.6	0.362	6460	<0.0050	3.36	490	27.5	0.19	<0.20	<0.50	74.4	<0.20	0.68	<0.10	FIELD
MW14-02B	MW14-02B	primary	28-Apr-2019	2.22	5.8	3.36	0.338	5730	<0.0050	3.03	437	23.5	0.175	<0.20	<0.50	69.4	<0.20	0.34	<0.10	FIELD
MW14-02B	MW14-02B	primary	13-Jun-2019	1.54	7.3	3.35	0.311	5460	<0.0050	3.07	421	23.9	0.154	<0.20	<0.50	70.1	<0.20	0.21	<0.10	FIELD
MW14-02B	BD1-Q2	duplicate	13-Jun-2019	1.48	6.1	3.31	0.288	5220	<0.0050	2.99	407	23	0.17	<0.20	<0.50	68.7	0.26	0.17	<0.10	FIELD
MW14-02B	MW14-02B	primary	22-Aug-2019	1.19	6.6	3.26	0.35	5740	<0.0050	2.95	433	23.6	0.167	<0.20	<0.50	66.7	0.32	0.17	<0.10	FIELD
MW14-03A	MW14-03A	primary	12-Oct-2014	2.79	440	9.19	2.61	5910	<0.01	69.7	742	83.3	0.136	0.59	<10	12.8	1.4	7.9		FIELD
MW14-03A	MW14-03A	primary	22-Jun-2015	2.36	42.7	9.39	0.097	8050	0.0079	28.3	5130	182	0.0176	<0.20	<0.50	69.3	0.23	1.68	2.39	FIELD
MW14-03A	MW14-03A	primary	12-Jul-2015	1.35	118	8.31	0.043	7100	0.0082	26.8	4570	156	0.0037	<0.20	0.6	49.3	0.48	4.35	3.07	FIELD
MW14-03A	MW14-03A	primary	07-Aug-2015	0.846	144	8.25	<0.040	7320	0.0135	29	4380	166	0.0263	<0.20	0.69	50.1	0.41	16.2	2.96	FIELD
MW14-03A	MW14-50	duplicate	07-Aug-2015	0.935	195	8.91	<0.040	7270	0.0077	28	4550	162	0.01	<0.20	0.86	53.7	0.34	16.2	3.1	FIELD
MW14-03A	MW14-03A	primary	06-Sep-2015	0.343	57.2	8.38	<0.040	7080	0.01	26.1	4440	153	0.003	<0.20	<0.50	43.6	<0.20	0.29	3.39	FIELD
MW14-03A	MW14-03A	primary	16-May-2016	0.344	65.2	11	<0.040	6950	0.007	31.8	6300	213	0.011	<0.20	<0.50	69.3	0.24	0.42	3.23	FIELD
MW14-03A	MW14-03A	primary	14-Jul-2016	0.258	46.2	9.38	<0.040	6940	0.013	27.2	5570	162	<0.0020	<0.20	<0.50	79.2	0.25	0.39	2.34	FIELD

Station	Sample ID	Sample Class	Sample Date	Dissolved Nickel (Ni)	Dissolved Phosphorus (P)	Dissolved Potassium (K)	Dissolved Selenium (Se)	Dissolved Silicon (Si)	Dissolved Silver (Ag)	Dissolved Sodium (Na)	Dissolved Strontium (Sr)	Dissolved Sulphur (S)	Dissolved Thallium (Tl)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)	Dissolved Uranium (U)	Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Filter and HNO3 Preservation (Metals)
				ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Maxxam RDL[1]:				0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1	
ALS RDL[1]:				0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	1	-	-
MW14-03A	MW14-03A	primary	24-Sep-2016	0.336	37.6	9.02	<0.040	5170	0.005	27.5	4910	168	0.036	<0.20	<0.50	89.1	<0.20	0.29	2.01	FIELD
MW14-03A	MW14-03A	primary	27-Apr-2017	0.518	38.3	8.57	<0.040	6650	0.005	25.8	4970	177	<0.0020	<0.20	<0.50	95.8	<0.20	0.36	1.1	FIELD
MW14-03A	MW14-03A	primary	09-Jun-2017	0.51	35.9	9.11	<0.040	6400	<0.0050	28.7	4640	187	<0.0020	<0.20	<0.50	97.3	<0.20	0.12	1.43	FIELD
MW14-03A	MW14-03A	primary	26-Jul-2017	0.56	28	8.83	<0.20	6430	<0.025	28.3	4590	184	<0.010	<1.0	<2.5	92.5	<1.0	<0.50	1.17	FIELD
MW14-03A	JH41-08	duplicate	06-Oct-2017	0.542	33.7	8.89	<0.040	6210	<0.0050	25.4	5490	184	<0.0020	<0.20	<0.50	101	<0.20	<0.10	1.63	FIELD
MW14-03A	MW14-03A	primary	06-Oct-2017	0.625	32.8	8.82	<0.040	6130	0.005	25.4	5290	169	<0.0020	<0.20	<0.50	97.9	<0.20	<0.10	1.59	FIELD
MW14-03A	MW14-03A	primary	20-Apr-2018	0.615	37.6	9.15	0.053	6880	<0.0050	29.4	5320	199	0.0035	<0.20	<0.50	96.8	<0.20	0.21	1.32	FIELD
MW14-03A	MW14-03A	primary	08-Jun-2018	1.31	33.4	8.83	0.053	6030	0.0139	25	5410	176	0.0119	<0.20	0.85	92.3	<0.20	1.85	1.31	FIELD
MW14-03A	MW14-03A	primary	05-Aug-2018	0.794	28.4	8.83	<0.040	5930	0.0061	26.1	4960	177	<0.0020	<0.20	0.51	97	<0.20	0.24	1.39	FIELD
MW14-03A	MW14-03A	primary	07-Oct-2018	0.726	23.1	8.89	<0.040	5950	<0.0050	25.5	5050	184	0.0034	<0.20	<0.50	94.4	<0.20	0.15	1.24	FIELD
MW14-03A	MW14-03A	primary	27-Apr-2019	1.08	25.4	8.11	<0.040	5050	0.01	24.3	4290	162	<0.0020	<0.20	<0.50	81.6	0.28	0.42	1.16	FIELD
MW14-03A	MW14-03A	primary	14-Jun-2019	1.38	42.4	8.49	<0.080	5540	<0.010	25.9	4870	180	0.0058	<0.40	<1.0	89.6	<0.40	1.87	1.05	FIELD
MW14-03A	MW14-03A	primary	23-Aug-2019	1.34	40.9	9.01	<0.080	6330	<0.010	27.5	4660	173	<0.0040	<0.40	<1.0	88.3	<0.40	0.71	1.29	FIELD
MW14-03B	MW14-03B	primary	06-Oct-2014	4.46	<50	6.9	1.13	4950	<0.01	25.9	2540	139	0.044	<0.1	<10	57.5	<1	5.4		FIELD
MW14-03B	MW14-03B	primary	22-Jun-2015	22	69.9	9.18	0.249	7250	0.0121	30	3620	198	0.132	<0.20	<0.50	43.3	0.26	10.1	0.44	FIELD
MW14-03B	MW14-03B	primary	12-Jul-2015	18.5	50.2	7.7	0.169	5980	0.0056	24.5	2950	164	0.0793	<0.20	<0.50	37.9	0.21	9.45	0.44	FIELD
MW14-03B	MW14-03B	primary	07-Aug-2015	20.4	38.2	8.46	0.143	6290	0.0138	29.8	3010	200	0.11	<0.20	<0.50	40.5	<0.20	6.03	0.33	FIELD
MW14-03B	MW14-03B	primary	06-Sep-2015	16.6	29.4	8.42	0.123	6070	0.007	26.8	3380	193	0.135	<0.20	<0.50	37.5	<0.20	0.75	0.34	FIELD
MW14-03B	MW14-200	duplicate	06-Sep-2015	16.6	27.4	8.51	0.131	6300	0.006	25.6	3400	191	0.14	<0.20	<0.50	38.2	<0.20	0.85	0.3	FIELD
MW14-03B	MW14-03B	primary	16-May-2016	15.1	22.1	8.43	0.189	6180	<0.0050	25.6	3470	182	0.147	<0.20	<0.50	41.7	<0.20	0.76	0.17	FIELD
MW14-03B	MW14-03B	primary	14-Jul-2016	15.4	22.1	9.46	0.234	6120	0.013	28.4	4070	184	0.17	<0.20	<0.50	42.1	<0.20	0.72	0.25	FIELD
MW14-03B	MW14-03B	primary	24-Sep-2016	14.3	14.3	8.91	0.161	4880	<0.0050	27.8	3630	171	0.147	<0.20	<0.50	44.1	<0.20	0.83	0.23	FIELD
MW14-03B	MW14-03B	primary	27-Apr-2017	13.2	20.7	8.46	0.161	5630	0.041	28.6	3420	174	0.233	0.52	<0.50	45.3	<0.20	1.73	0.42	FIELD
MW14-03B	MW14-03B	primary	09-Jun-2017	13.3	22.3	8.9	0.228	6200	0.014	30.2	3260	198	0.172	<0.20	<0.50	46.5	<0.20	0.87	0.19	FIELD
MW14-03B	MW14-03B	primary	26-Jul-2017	12.8	18	8.55	<0.20	6160	<0.025	28.3	3250	204	0.147	<1.0	<2.5	41.7	<1.0	0.6	<0.50	FIELD
MW14-03B	MW14-03B	primary	06-Oct-2017	11.7	17.5	8.53	0.174	6130	0.012	27.3	3720	182	0.163	<0.20	<0.50	46.2	<0.20	0.31	0.2	FIELD
MW14-03B	MW14-03B	primary	20-Apr-2018	11.3	24.9	9.2	0.153	6470	<0.0050	31.6	3770	224	0.0353	<0.20	<0.50	52	<0.20	1.17	0.2	FIELD
MW14-03B	MW14-03B	primary	08-Jun-2018	11.3	15.9	8.99	0.103	5840	0.005	26	3750	197	0.0953	<0.20	<0.50	49.6	<0.20	9.75	0.22	FIELD
MW14-03B	MW14-03B	primary	05-Aug-2018	11.2	18.4	8.85	0.146	6070	0.0132	27.7	3430	196	0.119	<0.20	0.51	50	<0.20	0.62	0.19	FIELD
MW14-03B	MW14-03B	primary	07-Oct-2018	12.3	11	8.54	0.083	5690	0.0118	26.9	3660	194	0.311	<0.20	<0.50	54.1	<0.20	0.74	0.15	FIELD
MW14-03B	MW14-03B	primary	27-Apr-2019	10.1	14.9	7.95	0.089	5610	<0.010	26	3420	199	0.178	<0.40	<1.0	53.6	<0.40	1.38	<0.20	FIELD
MW14-03B	MW14-03B	primary	14-Jun-2019	9.92	26.7	8.5	0.179	5330	<0.010	25.6	3540	209	0.113	<0.40	1	54.6	<0.40	1.84	0.23	FIELD
MW14-03B	MW14-03B	primary	23-Aug-2019	10.8	18.3	8.73	0.101	6160	0.025	26.5	3480	211	0.203	<0.40	<1.0	58.2	<0.40	1.6	0.27	FIELD
MW14-05A	MW14-05A	primary	02-Oct-2014	1.39	87	12.3	0.59	12500	<0.01	15	330	10.7	0.01	0.57	<10	4.04	<1	42.5		FIELD
MW14-05A	MW14-05A	primary	23-Jun-2015	1.25	89.7	5.34	0.103	14800	0.0054	13.5	375	9.4	0.0048	<0.20	<0.50	32.5	<0.20	11.2	<0.10	FIELD
MW14-05A	MW14-05A	primary	13-Jul-2015	1.39	124	5.92	0.1	13400	<0.0050	23.2	353	6.8	0.0085	<0.20	0.88	28.6	0.24	7.63	0.14	FIELD
MW14-05A	MW14-05A	primary	08-Aug-2015	1.38	112	7.12	0.071	13700	<0.0050	15.9	437	5.1	0.0114	<0.20	<0.50	25.4	<0.20	0.92	0.14	FIELD
MW14-05A	MW14-05A	primary	07-Sep-2015	0.544	84.2	5.45	0.068	14100	<0.0050	12.2	334	6.6	<0.0020	<0.20	<0.50	32.4	<0.20	0.71	0.12	FIELD
MW14-05A	MW14-05A	primary	14-May-2016	0.339	76.3	7.02	0.099	13400	<0.0050	15.8	459	3.5	0.006	<0.20	<0.50	22.2	<0.20	0.37	0.15	FIELD
MW14-05A	JH40-04	duplicate	16-Jul-2016	0.213	75.7	5.3	0.103	15500	<0.0050	11.1	354	6.4	<0.0020	<0.20	<0.50	18.1	<0.20	0.53	0.1	FIELD
MW14-05A	MW14-05A	primary	16-Jul-2016	0.216	74.3	4.92	0.091	15500	<0.0050	10.8	345	6.5	<0.0020	<0.20	<0.50	18.3	<0.20	0.64	0.13	FIELD
MW14-05A	MW14-05A	primary	23-Sep-2016	0.33	73	6.53	<0.20	12200	<0.025	15.2	430	<15	0.026	<1.0	<2.5	12.3	<1.0	<0.50	<0.50	FIELD
MW14-05A	MW14-05A	primary	28-Apr-2017	0.33	57	6.05	<0.20	11800	<0.025	13.6	412	<15	<0.010	<1.0	<2.5	6.85	<1.0	0.64	<0.50	FIELD
MW14-05A	MW14-05A	primary	10-Jun-2017	0.157	70.9	4.69	0.076	13300	<0.0050	11.7	322	5.2	<0.0020	<0.20	<0.50	9.82	<0.20	0.22	<0.10	FIELD
MW14-05A	MW14-05A	primary	25-Jul-2017	0.31	73	5.16	<0.20	13200	<0.025	12.5	341	<15	<0.010	<1.0	<2.5	8.46	<1.0	2.7	<0.50	FIELD
MW14-05A	MW14-05A	primary	08-Oct-2017	0.14	67	5.59	<0.20	14400	<0.025	13.8	376	<15	<0.010	<1.0	<2.5	5.76	<1.0	0.69	<0.50	FIELD
MW14-05A	MW14-05A	primary	21-Apr-2018	0.13	54	5.03	<0.20	13100	<0.025	14	356	<15	<0.010	<1.0	<2.5	5.83	<1.0	0.69	<0.50	FIELD
MW14-05A	JH42-04	duplicate	09-Jun-2018	0.14	65	4.1	<0.20	13400	<0.025	11	315	<15	<0.010	<1.0	5.2	6.24	<1.0	<0.50	<0.50	FIELD
MW14-05A	MW14-05A	primary	09-Jun-2018	0.17	51	4.03	<0.20	13000	<0.025	10.9	307	<15	<0.010	<1.0	4.4	6.16	<1.0	<0.50	<0.50	FIELD
MW14-05A	MW14-05A	primary	04-Aug-2018	0.64	62	4.38	<0.20	14400	<0.025	11.5	317	<15	<0.010	<1.0	<2.5	5.41	<1.0	2.53	<0.50	FIELD
MW14-05A	MW14-05A	primary	06-Oct-2018	0.14	45	4.57	<0.20	12900	<0.025	11.4	356	<15	<0.010	<1.0	<2.5	4.39	<1.0	1.4	<0.50	FIELD
MW14-05A	MW14-05A	primary	29-Apr-2019	0.19	52	4.26	<0.20	13400	<0.025	10.8	319	<15	<0.010	<1.0	<2.5	3.9	<1.0	1.41	<0.50	FIELD
MW14-05A	BD2-Q1	duplicate	29-Apr-2019	<0.10	56	4.1	<0.20	13700	<0.025	10.4	313	<15	<0.010	<1.0	<2.5	4	<1.0	1.03	<0.50	FIELD
MW14-05A	MW14-05A	primary	15-Jun-2019	0.43	43	4.23	<0.20	12200	<0.025	10.7	301	<15	0.011	<1.0	<2.5	3.95	<1.0	2.81	<0.50	FIELD
MW14-05A	MW14-05A	primary	24-Aug-2019	0.39	65	4.14	<0.20	13800	<0.025	10.5	309	<15	<0.010	<1.0	3.2	4.04	<1.0	1.9	<0.50	FIELD
MW14-05B	MW14-05B	primary	03-Oct-2014	4.5	71	14.2	0.57	12000	0.084	44.5	632	36.1	0.02	0.7	<10	5.95	<1	3.8		FIELD
MW14-05B	MW14-05B	primary	24-Jun-2015	7.23	112	14	0.421	10600	0.0067	76.4	719	39.8	0.0456	0.4	0.87	16.2	1.25	4.31	0.25	FIELD
MW14-05B	MW14-05B	primary	14-Jul-2015	6.3		12.2	0.42	10200	<0.020	92.5	665	51.7	<0.050	<5.0	<5.0	16.2	<5.0	16.5	<0.50	FIELD
MW14-05B	MW14-05B	primary	09-Aug-2015	4.79	161	11.3	0.318	12700	<0.0050	116	701	59.1	0.0124	0.34	<0.50	15.1	1.12	1.53	0.32	FIELD

Station	Sample ID	Sample Class	Sample Date	Dissolved Nickel (Ni)	Dissolved Phosphorus (P)	Dissolved Potassium (K)	Dissolved Selenium (Se)	Dissolved Silicon (Si)	Dissolved Silver (Ag)	Dissolved Sodium (Na)	Dissolved Strontium (Sr)	Dissolved Sulphur (S)	Dissolved Thallium (Tl)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)	Dissolved Uranium (U)	Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Filter and HNO3 Preservation (Metals)
				ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Maxxam RDL[1]:				0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1	
ALS RDL[1]:				0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	1	-	-
MW14-05B	MW14-05B	primary	08-Sep-2015	2.93	160	10	0.157	14400	<0.0050	62.1	596	31.7	<0.0020	0.3	<0.50	9.43	0.85	0.89	0.33	FIELD
MW14-05B	MW14-05B	primary	15-May-2016	0.755	201	9.02	0.088	16300	<0.0050	37.9	608	10.4	0.007	<0.20	<0.50	6.78	0.76	0.57	0.49	FIELD
MW14-05B	MW14-05B	primary	16-Jul-2016	1.49	141	8.37	0.06	15300	<0.0050	34.1	551	8.2	<0.0020	0.25	<0.50	5.21	0.8	1.34	0.5	FIELD
MW14-05B	MW14-05B	primary	23-Sep-2016	0.807	156	6.32	0.041	14000	<0.0050	32.2	440	7.4	0.002	<0.20	<0.50	3.03	0.6	1.76	0.42	FIELD
MW14-05B	MW14-05B	primary	29-Apr-2017	0.38	101	5.83	<0.040	16100	<0.0050	23.1	434	5.4	<0.0020	0.27	<0.50	2.04	0.3	0.72	0.36	FIELD
MW14-05B	MW14-05B	primary	11-Jun-2017	0.419	74.6	5.8	<0.040	14200	<0.0050	27	417	5	<0.0020	<0.20	<0.50	1.96	0.43	0.36	0.3	FIELD
MW14-05B	MW14-05B	primary	26-Jul-2017	0.597	109	6.58	0.051	16400	<0.0050	24.1	426	5.5	<0.0020	<0.20	<0.50	1.83	0.45	1.71	0.34	FIELD
MW14-05B	MW14-05B	primary	08-Oct-2017	0.352	107	5.73	0.111	16000	<0.0050	22.5	400	4	<0.0020	<0.20	<0.50	1.34	0.38	2.97	0.31	FIELD
MW14-05B	MW14-05B	primary	22-Apr-2018	0.258	75	5.48	<0.040	14700	<0.0050	20.3	397	3.2	<0.0020	<0.20	<0.50	1.92	0.31	0.64	0.31	FIELD
MW14-05B	MW14-05B	primary	10-Jun-2018	0.322	73.9	4.63	<0.040	14700	<0.0050	16.3	368	4.4	<0.0020	<0.20	1.25	1.65	0.22	0.59	0.25	FIELD
MW14-05B	MW14-05B	primary	04-Aug-2018	0.272	77.5	4.8	<0.040	14700	<0.0050	16.6	347	4.3	<0.0020	<0.20	<0.50	1.47	0.29	0.66	0.19	FIELD
MW14-05B	MW14-05B	primary	06-Oct-2018	0.219	78.8	4.3	<0.040	14500	<0.0050	15.4	342	4.3	<0.0020	<0.20	<0.50	1.35	0.22	0.55	0.21	FIELD
MW14-05B	MW14-05B	primary	30-Apr-2019	0.18	71	4.33	<0.040	14800	<0.0050	13.5	356	<3.0	<0.0020	<0.20	0.76	2.08	0.32	0.59	0.23	FIELD
MW14-05B	MW14-05B	primary	16-Jun-2019	0.261	64.8	4.04	<0.040	14900	<0.0050	13.4	326	4.3	0.0033	<0.20	1.25	1.16	<0.20	0.65	0.16	FIELD
MW14-05B	MW14-05B	primary	25-Aug-2019	0.264	70.5	4.11	<0.040	16400	<0.0050	13.1	314	4.6	<0.0020	<0.20	2.08	1.46	<0.20	1.02	0.21	FIELD
MW15-01WB	MW15-01WB	primary	07-Jun-2015	1.78	<2.0	5.27	0.091	7820	<0.0050	27.6	2990	287	0.038	<0.20	<0.50	589	<0.20	53.9	0.69	LAB
MW15-01WB	MW15-01WB	primary	08-Jul-2015	2.31	6.4	5.53	0.126	7870	<0.0050	27.6	2690	294	0.0201	<0.20	<0.50	530	<0.20	128	0.49	LAB
MW15-01WB	MW15-01WB	primary	10-Aug-2015	2.24	68.3	5.19	0.075	7950	<0.0050	25.9	2660	295	0.0273	<0.20	<0.50	542	<0.20	167	0.53	LAB
MW15-01WB	MW15-01WB	primary	03-Sep-2015	2.38	20	5.43	0.11	8250	0.006	26.1	2770	310	0.036	<0.20	0.58	535	0.28	181	0.41	LAB
MW15-01WB	MW15-01WB	primary	15-May-2016	1.16	10.6	4.99	<0.040	8640	<0.0050	25.6	2960	291	0.0370	<0.20	<0.50	562	<0.20	21.8	0.56	FIELD
MW15-01WB	MW15-01WB	primary	14-Jul-2016	1.19	9	5.16	<0.040	8200	<0.0050	25.7	3350	281	0.012	<0.20	<0.50	531	<0.20	25.7	0.85	FIELD
MW15-01WB	MW15-01WB	primary	22-Sep-2016	1.09	14.2	4.63	<0.040	6920	<0.0050	25.9	3050	275	0.009	<0.20	<0.50	532	<0.20	55.7	0.88	FIELD
MW15-01WB	MW15-01WB	primary	22-Apr-2017	0.89	<10	4.57	<0.20	8170	<0.025	27.1	3130	309	0.011	<1.0	<2.5	571	<1.0	20	1.15	FIELD
MW15-01WB	MW15-01WB	primary	08-Jun-2017	0.77	<10	4.72	<0.20	7460	<0.025	26.5	2610	301	0.101	<1.0	<2.5	540	<1.0	15.6	<0.50	FIELD
MW15-01WB	MW15-01WB	primary	24-Jul-2017	0.57	13	4.44	<0.20	7800	<0.025	25.5	2800	287	<0.010	<1.0	<2.5	543	<1.0	7.3	1.2	FIELD
MW15-01WB	MW15-01WB	primary	06-Oct-2017	1.01	23	5.09	0.171	6520	<0.0050	26.4	3180	292	0.006	1.74	<0.50	545	<0.20	51.2	1.05	FIELD
MW15-01WB	MW15-01WB	primary	19-Apr-2018	1.13	24	4.97	<0.20	8710	<0.025	29.6	2910	324	0.012	<1.0	<2.5	558	<1.0	21.5	0.71	FIELD
MW15-01WB	MW15-01WB	primary	07-Jun-2018	0.82	<10	4.48	<0.20	7840	<0.025	24.9	2900	286	0.011	<1.0	<2.5	526	<1.0	22.2	0.95	FIELD
MW15-01WB	MW15-01WB	primary	02-Aug-2018	0.672	11.5	4.54	<0.080	7970	<0.010	25.8	3050	297	<0.0040	<0.40	<1.0	559	<0.40	13.5	1.14	FIELD
MW15-01WB	MW15-01WB	primary	03-Oct-2018	1.04	13	4.82	<0.080	7950	<0.010	26.2	2890	303	0.0171	<0.40	<1.0	553	<0.40	8.59	0.76	FIELD
MW15-01WB	MW15-01WB	primary	05-May-2019	1.21	18.7	4.85	0.154	6750	<0.010	25.6	2570	287	0.018	<0.40	<1.0	531	<0.40	63.8	0.7	FIELD
MW15-01WB	MW15-01WB	primary	18-Jun-2019	0.758	9.8	4.7	<0.080	7400	<0.010	25	2680	274	<0.0040	<0.40	<1.0	535	<0.40	18.1	0.85	FIELD
MW15-01WB	MW15-01WB	primary	22-Aug-2019	0.794	8	4.74	<0.080	7580	<0.010	24.6	2800	287	<0.0040	<0.40	<1.0	532	<0.40	11.1	1.01	FIELD
MW15-02AZ	MW15-02AZ	primary	31-May-2015	1.26	7.1	7.41	1.1	5740	<0.0050	6.04	1150	81.7	0.007	<0.20	<0.50	26.4	0.26	0.55	0.19	FIELD
MW15-02AZ	MW15-02AZ	primary	11-Jul-2015	0.682	36.3	5.36	0.169	5180	<0.0050	4.75	1070	59.8	0.0059	<0.20	<0.50	23.9	0.29	8.64	0.19	FIELD
MW15-02AZ	MW15-40AZ	duplicate	11-Jul-2015	0.552	11.2	5.39	0.177	5130	<0.0050	4.66	1070	59	0.0049	<0.20	<0.50	23.6	0.27	1.75	0.17	FIELD
MW15-02AZ	MW15-02AZ	primary	12-Aug-2015	0.722	50.7	7.51	0.199	5020	<0.0050	6.09	1170	67.6	0.0044	<0.20	0.55	24.4	0.39	1.55	0.2	FIELD
MW15-02AZ	MW15-02AZ	primary	07-Sep-2015	0.649	4.1	6.65	0.161	5890	<0.0050	4.67	943	58.4	0.004	<0.20	<0.50	23.9	<0.20	0.8	0.13	FIELD
MW15-02AZ	MW15-02AZ	primary	17-May-2016	0.705	3.9	7.82	0.212	5270	<0.0050	5.29	1010	66.9	0.005	<0.20	<0.50	25.3	<0.20	0.37	0.12	FIELD
MW15-02AZ	MW15-02AZ	primary	19-Jul-2016	0.756	3.7	7.85	0.192	5200	<0.0050	5.54	977	59.2	0.005	<0.20	<0.50	26.4	0.21	0.35	0.1	FIELD
MW15-02AZ	JH40-06	duplicate	25-Sep-2016	0.816	5.8	8.07	0.213	4160	<0.0050	5.58	907	61.5	0.006	<0.20	<0.50	27.1	0.25	0.31	0.1	FIELD
MW15-02AZ	MW15-02AZ	primary	25-Sep-2016	0.779	4.9	8.57	0.214	4710	<0.0050	5.5	1020	61.4	0.006	<0.20	<0.50	26.6	0.23	0.35	0.12	FIELD
MW15-02AZ	MW15-02AZ	primary	28-Jul-2017	0.793	3.6	10.2	0.121	4970	<0.0050	5.91	965	82.5	0.0064	<0.20	<0.50	30	<0.20	0.19	<0.10	FIELD
MW15-02AZ	MW15-02AZ	primary	08-Oct-2017	0.481	6	6.31	0.314	5590	<0.0050	5.48	1200	75.8	<0.0020	<0.20	<0.50	31.3	0.39	0.19	0.16	FIELD
MW15-02AZ	JH42-05	duplicate	03-Aug-2018	0.618	3.9	7.7	0.18	5110	<0.0050	5.58	1160	70.5	0.0034	<0.20	<0.50	31.4	0.21	<0.10	0.12	FIELD
MW15-02AZ	MW15-02AZ	primary	03-Aug-2018	0.593	5	7.95	0.198	5160	<0.0050	5.64	1160	71.5	0.0029	<0.20	<0.50	31.4	0.22	<0.10	0.13	FIELD
MW15-02WB	MW15-02WB	primary	01-Jun-2015	2.16	15.6	9.28	0.373	5880	<0.0050	9.45	932	76	0.008	<0.20	0.91	37.4	0.31	36.8	0.76	LAB
MW15-02WB	MW15-02WB	primary	11-Jul-2015	0.885	17.3	7.96	0.102	5430	<0.0050	8.69	943	82.3	0.0112	0.73	<0.50	31.9	<0.20	16.9	0.67	LAB
MW15-02WB	MW15-02WB	primary	12-Aug-2015	1.37	30.5	8.8	0.169	5140	<0.0050	9.4	952	78.8	0.0057	<0.20	<0.50	33.2	<0.20	44.5	0.58	LAB
MW15-02WB	MW15-02WB	primary	07-Sep-2015	1.46	5	10.8	0.126	5250	<0.0050	6.09	963	80.9	0.015	<0.20	<0.50	28.2	<0.20	10.1	0.13	LAB
MW15-02WB	MW15-02WB	primary	18-May-2016	1.05	7.8	10.1	0.115	4840	<0.0050	7.57	925	93	0.009	<0.20	<0.50	32.9	<0.20	25.5	0.57	FIELD
MW15-02WB	MW15-02WB	primary	19-Jul-2016	0.947	2.6	10.1	0.186	4950	<0.0050	6.06	947	70.3	0.021	<0.20	<0.50	27.6	<0.20	6.9	<0.10	FIELD
MW15-02WB	MW15-02WB	primary	25-Sep-2016	1.22	13.1	10.4	0.197	4140	<0.0050	5.78	893	63.4	0.02	<0.20	<0.50	25.3	<0.20	43.1	0.11	FIELD
MW15-02WB	JH41-02	duplicate	25-Apr-2017	1.37	12.8	10.6	0.268	4590	<0.0050	5.73	994	84.8	0.021	<0.20	<0.50	31.7	<0.20	49.4	0.19	FIELD
MW15-02WB	MW15-02WB	primary	25-Apr-2017	1.21	9.6	10.5	0.277	4520	<0.0050	6.05	974	86.5	0.022	<0.20	<0.50	31.7	<0.20	40.6	0.16	FIELD
MW15-02WB	JH41-04	duplicate	13-Jun-2017	1.31	13.2	8.83	0.06	4980	<0.0050	7.99	922	73.9	0.005	1.9	<0.50	31.2	<0.20	47.7	0.75	FIELD
MW15-02WB	MW15-02WB	primary	13-Jun-2017	0.744	6.9	8.38	0.04	4740	<0.0050	7.77	945	73.8	0.005	<0.20	<0.50	32.2	<0.20	22.9	0.81	FIELD
MW15-02WB	MW15-02WB	primary	28-Jul-2017	0.888	5.1	10.8	0.206	4850	<0.0050	5.64	884	80.3	0.0238	<0.20	<0.50	29	<0.20	12.2	0.11	FIELD
MW15-02WB	MW15-02WB	primary	08-Oct-2017	1.01	8.4	10.9	0.243	5230	<0.0050	6.09	891	80.4	0.0251	<0.20	<0.50	29	<0.20	25	0.11	FIELD

Station	Sample ID	Sample Class	Sample Date	Dissolved Nickel (Ni)	Dissolved Phosphorus (P)	Dissolved Potassium (K)	Dissolved Selenium (Se)	Dissolved Silicon (Si)	Dissolved Silver (Ag)	Dissolved Sodium (Na)	Dissolved Strontium (Sr)	Dissolved Sulphur (S)	Dissolved Thallium (Tl)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)	Dissolved Uranium (U)	Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Filter and HNO3 Preservation (Metals)
				ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Maxxam RDL[1]:				0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1	
ALS RDL[1]:				0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	1	-	-
MW15-02WB	MW15-02WB	primary	21-Apr-2018	1.09	5.7	11	0.268	5030	<0.0050	7.1	1040	93.9	0.0218	<0.20	<0.50	34.6	<0.20	13.3	0.25	FIELD
MW15-02WB	JH42-03	duplicate	09-Jun-2018	0.475	3.3	8.71	0.04	5110	<0.0050	8.3	1000	81.2	0.0041	<0.20	<0.50	32.5	<0.20	15.7	1.05	FIELD
MW15-02WB	MW15-02WB	primary	09-Jun-2018	0.529	<2.0	9.35	0.087	5210	<0.0050	8.67	1060	83.5	0.0048	<0.20	<0.50	34	0.23	19.1	1	FIELD
MW15-02WB	MW15-02WB	primary	04-Aug-2018	0.553	<2.0	8.86	<0.040	5030	<0.0050	8.47	943	81.2	0.004	<0.20	<0.50	33	<0.20	5.91	0.89	FIELD
MW15-02WB	JH42-07	duplicate	06-Oct-2018	0.864	7.5	10.1	0.173	4650	<0.0050	5.64	922	73.5	0.0208	<0.20	<0.50	29.4	<0.20	11.6	0.1	FIELD
MW15-02WB	MW15-02WB	primary	06-Oct-2018	0.843	3.1	9.86	0.178	4540	<0.0050	5.5	936	70.5	0.0215	<0.20	<0.50	29.5	<0.20	8.5	0.11	FIELD
MW15-02WB	MW15-02WB	primary	29-Apr-2019	0.924	2.1	10.3	0.34	4640	<0.0050	5.74	1030	82.5	0.021	<0.20	<0.50	33	<0.20	8.62	0.13	FIELD
MW15-02WB	MW15-02WB	primary	19-Jun-2019	0.604	7.3	8.82	0.07	4710	<0.0050	7.64	958	76.4	0.0061	<0.20	<0.50	33.7	<0.20	24.9	0.85	FIELD
MW15-02WB	BD2-Q2	duplicate	19-Jun-2019	0.533	4.2	8.57	0.051	4740	<0.0050	7.43	964	76.2	0.0061	<0.20	<0.50	33.6	<0.20	10.9	0.93	FIELD
MW15-02WB	MW15-02WB	primary	24-Aug-2019	0.972	8	8.95	<0.040	5170	<0.0050	7.69	944	84	0.0038	<0.20	<0.50	33	<0.20	34.9	0.97	FIELD
MW15-03AZ	MW15-03AZ	primary	16-Jun-2015	1.08	26.8	1.78	0.052	5300	<0.0050	4.16	303	18	0.0024	<0.20	<0.50	35.4	<0.20	7.61	0.32	FIELD
MW15-03AZ	MW15-21	duplicate	16-Jun-2015	1.12	7.2	1.89	0.064	5810	<0.0050	4.37	319	18.2	<0.0020	<0.20	<0.50	37.4	<0.20	3.15	0.26	FIELD
MW15-03AZ	MW15-03AZ	primary	09-Jul-2015	1.4	78.8	1.86	0.041	4810	<0.0050	3.89	290	15	0.0021	<0.20	0.56	34.3	0.23	3.75	0.31	FIELD
MW15-03AZ	MW15-03AZ	primary	10-Aug-2015	1.07	26.3	1.65	0.055	5050	<0.0050	3.39	220	8.4	0.0045	<0.20	0.53	18.2	0.24	3.28	0.44	FIELD
MW15-03AZ	MW15-03AZ	primary	04-Sep-2015	1.02	5.5	1.53	0.044	5250	<0.0050	3.07	198	7.6	0.002	<0.20	<0.50	17.2	0.27	0.41	0.34	FIELD
MW15-03AZ	JH40-02	duplicate	16-May-2016	0.651	3.4	1.65	0.05	5410	<0.0050	3.73	281	16.1	<0.0020	<0.20	<0.50	21.5	<0.20	0.35	0.27	FIELD
MW15-03AZ	MW15-03AZ	primary	16-May-2016	0.654	7.3	1.68	0.049	5490	<0.0050	3.71	284	16.4	0.002	<0.20	<0.50	21.7	<0.20	0.37	0.3	FIELD
MW15-03AZ	MW15-03AZ	primary	16-Jul-2016	0.683	9.3	1.58	0.047	5280	<0.0050	3.46	225	7.9	0.002	<0.20	<0.50	14.7	0.32	2.93	0.4	FIELD
MW15-03AZ	MW15-03AZ	primary	23-Sep-2016	0.665	4.2	1.56	0.056	4820	<0.0050	3.3	213	6.8	0.002	<0.20	<0.50	14.2	0.22	0.28	0.35	FIELD
MW15-03AZ	MW15-03AZ	primary	25-Jul-2017	0.792	5.2	1.58	0.062	4950	<0.0050	3.36	245	12.4	<0.0020	<0.20	<0.50	19.8	<0.20	0.23	0.36	FIELD
MW15-03AZ	MW15-03AZ	primary	07-Oct-2017	0.761	6.1	1.71	0.063	5570	<0.0050	3.6	240	14.2	<0.0020	<0.20	<0.50	15.9	0.26	0.23	0.31	FIELD
MW15-03AZ	MW15-03AZ	primary	04-Aug-2018	0.73	3.4	1.71	0.051	4920	<0.0050	3.74	273	13.2	0.0021	<0.20	0.56	28	<0.20	<0.10	0.28	FIELD
MW15-03AZ	MW15-03AZ	primary	05-Oct-2018	0.773	3	1.51	0.051	5010	<0.0050	3.34	230	8.7	<0.0020	<0.20	<0.50	16.9	0.21	<0.10	0.33	FIELD
MW15-03AZ	MW15-03AZ	primary	23-Aug-2019	0.802	5.7	1.67	0.075	5350	<0.0050	3.47	252	12.2	<0.0020	<0.20	<0.50	25.3	<0.20	0.18	0.44	FIELD
MW15-03WB	MW15-03WB	primary	16-Jun-2015	2.01	10.1	8.87	<0.040	10300	<0.0050	75.7	9250	348	<0.0020	<0.20	<0.50	8.4	<0.20	4.92	<0.10	LAB
MW15-03WB	MW15-03WB	primary	09-Jul-2015	1.56	52.8	8.97	0.432	6990	0.0069	71.1	9090	294	0.0062	<0.20	<0.50	7.86	<0.20	47.5	<0.10	LAB
MW15-03WB	MW15-03WB	primary	10-Aug-2015	1.58	13.7	8.04	0.09	8060	0.006	68.4	8190	320	0.0061	<0.20	<0.50	9.09	<0.20	107	<0.10	LAB
MW15-03WB	MW15-03WB	primary	04-Sep-2015	1.1	9.6	8.62	<0.040	8230	0.006	71.9	9210	309	0.007	<0.20	<0.50	7.57	<0.20	39.9	<0.10	LAB
MW15-03WB	MW15-03WB	primary	16-May-2016	0.226	5.1	8.32	0.119	8190	0.005	69.3	9400	309	0.002	<0.20	<0.50	7.2	<0.20	11.6	<0.10	FIELD
MW15-03WB	MW15-03WB	primary	16-Jul-2016	0.97	8.8	10	<0.040	7820	0.01	74.5	12100	335	0.002	<0.20	1.59	7.4	<0.20	4.68	0.52	FIELD
MW15-03WB	MW15-03WB	primary	23-Sep-2016	0.4	<10	9.4	<0.20	7600	<0.025	77.3	10900	384	<0.010	<1.0	<2.5	8.61	<1.0	13.3	<0.50	FIELD
MW15-03WB	MW15-03WB	primary	23-Apr-2017	0.16	<10	9.61	<0.20	7930	<0.025	78.2	10400	373	<0.010	<1.0	<2.5	7.37	<1.0	4.25	<0.50	FIELD
MW15-03WB	MW15-03WB	primary	10-Jun-2017	0.14	<10	8.53	<0.20	7260	<0.025	75.8	9860	361	<0.010	<1.0	<2.5	7.12	<1.0	2.6	<0.50	FIELD
MW15-03WB	MW15-03WB	primary	25-Jul-2017	<0.10	<10	8.67	<0.20	7220	<0.025	74	9510	349	<0.010	<1.0	<2.5	7.35	<1.0	2.31	<0.50	FIELD
MW15-03WB	MW15-03WB	primary	07-Oct-2017	<0.10	<10	9.36	0.26	8610	<0.025	79	9900	384	<0.010	<1.0	<2.5	7.47	<1.0	1.07	<0.50	FIELD
MW15-03WB	JH42-01	duplicate	20-Apr-2018	0.14	15	8.92	0.25	8580	<0.025	83.8	10500	392	<0.010	<1.0	<2.5	6.61	<1.0	<0.50	<0.50	FIELD
MW15-03WB	MW15-03WB	primary	20-Apr-2018	0.192	28	8.96	1.08	8100	<0.025	82.6	10500	387	<0.010	<1.0	<2.5	6.56	<1.0	<0.50	<0.50	FIELD
MW15-03WB	MW15-03WB	primary	08-Jun-2018	0.14	<10	8.93	0.208	7890	<0.025	74.8	10900	368	<0.010	<1.0	<2.5	6.46	<1.0	0.62	<0.50	FIELD
MW15-03WB	MW15-03WB	primary	05-Aug-2018	0.52	<10	8.52	<0.20	8120	<0.025	75.1	10100	356	<0.010	<1.0	<2.5	6.56	<1.0	2.03	<0.50	FIELD
MW15-03WB	MW15-03WB	primary	04/10/2018 and 05/10/2018	<0.10	<10	8.8	<0.20	8070	<0.025	78.8	11100	378	<0.010	<1.0	<2.5	6.37	<1.0	0.65	<0.50	FIELD
MW15-03WB	MW15-03WB	primary	03-May-2019	0.135	4.8	8.6	<0.040	7360	0.008	74.5	10100	351	0.004	<0.20	<0.50	5.66	0.22	1	0.21	FIELD
MW15-03WB	MW15-03WB	primary	18-Jun-2019	0.262	5.6	8.43	<0.080	7420	<0.010	72.2	9610	344	<0.0040	<0.40	<1.0	8.31	<0.40	0.82	<0.20	FIELD
MW15-03WB	MW15-03WB	primary	23-Aug-2019	0.971	7.1	8.49	<0.080	7910	<0.010	72.9	9830	361	<0.0040	<0.40	<1.0	5.82	<0.40	6.05	0.23	FIELD
MW15-04WB	MW15-04WB	primary	14-Jun-2015	0.804	23.8	4.16	0.246	6370	<0.0050	6.05	782	45.9	0.0068	<0.20	<0.50	176	0.25	24	0.26	LAB
MW15-04WB	MW15-20	duplicate	14-Jun-2015	0.795	30.4	4.55	0.265	6270	<0.0050	5.96	794	42.3	0.0078	<0.20	<0.50	176	0.25	29.4	0.26	LAB
MW15-04WB	MW15-04WB	primary	10-Jul-2015	1.2		4.47	0.2	5550	<0.020	6.61	777	44.9	<0.050	<5.0	<5.0	161	<5.0	35.9	<0.50	LAB
MW15-04WB	MW15-30WB	duplicate	10-Jul-2015	<1.0		4.05	0.13	5680	<0.020	5.92	776	41.6	<0.050	<5.0	<5.0	169	<5.0	9.6	<0.50	LAB
MW15-04WB	MW15-04WB	primary	11-Aug-2015	0.99	102	4.38	0.251	5890	<0.0050	6.15	783	41.3	0.0114	<0.20	<0.50	161	0.28	57.6	0.23	LAB
MW15-04WB	MW15-04WB	primary	05-Sep-2015	0.986	21.8	4.43	0.335	6320	<0.0050	5.94	804	44.4	0.008	<0.20	<0.50	154	<0.20	42.7	0.21	LAB
MW15-04WB	MW15-04WB	primary	13-May-2016	0.862	14.9	3.99	0.119	6550	<0.0050	5.71	822	40.5	0.009	<0.20	<0.50	124	<0.20	16.8	0.19	FIELD
MW15-04WB	JH40-03	duplicate	15-Jul-2016	0.771	7.5	3.89	0.055	6200	<0.0050	5.64	935	37.7	0.009	<0.20	<0.50	122	<0.20	6.44	0.16	FIELD
MW15-04WB	MW15-04WB	primary	15-Jul-2016	0.75	6.1	4	0.064	6260	<0.0050	5.71	818	37.6	0.008	<0.20	<0.50	122	<0.20	6.97	0.16	FIELD
MW15-04WB	MW15-04WB	primary	24-Sep-2016	0.716	7.1	3.68	0.063	5640	<0.0050	5.69	848	36.8	0.006	<0.20	<0.50	123	<0.20	10.3	0.18	FIELD
MW15-04WB	MW15-04WB	primary	23-Apr-2017	0.693	4.3	3.93	0.127	5740	<0.0050	5.81	832	43.7	0.011	<0.20	<0.50	136	<0.20	4.51	0.19	FIELD
MW15-04WB	MW15-04WB	primary	11-Jun-2017	0.591	4	3.76	0.116	6310	<0.0050	5.52	799	39.9	0.011	<0.20	<0.50	149	<0.20	6.42	0.16	FIELD
MW15-04WB	MW15-04WB	primary	26-Jul-2017	0.523	6.3	3.91	0.17	6060	<0.0050	6.32	776	46.8	0.0103	<0.20	<0.50	152	<0.20	5.88	0.18	FIELD
MW15-04WB	JH41-07	duplicate	05-Oct-2017	0.654	10.1	4.02	0.162	6250	<0.0050	6.08	891	44.1	0.01	<0.20	<0.50	149	<0.20	12.0	0.22	FIELD
MW15-04WB	MW15-04WB	primary	05-Oct-2017	0.588	9	3.79	0.15	6340	<0.0050	5.92	846	41.3	0.011	<0.20	<0.50	157	<0.20	9.57	0.16	FIELD
MW15-04WB	MW15-04WB	primary	19-Apr-2018	0.647	9.1	4.36	0.278	6850	<0.0050	7.51	894	51.7	0.0079	<0.20	<0.50	157	0.21	13.6	0.22	FIELD

Station	Sample ID	Sample Class	Sample Date	Dissolved Nickel (Ni)	Dissolved Phosphorus (P)	Dissolved Potassium (K)	Dissolved Selenium (Se)	Dissolved Silicon (Si)	Dissolved Silver (Ag)	Dissolved Sodium (Na)	Dissolved Strontium (Sr)	Dissolved Sulphur (S)	Dissolved Thallium (Tl)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)	Dissolved Uranium (U)	Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Filter and HNO3 Preservation (Metals)
				ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Maxxam RDL[1]:				0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1	
ALS RDL[1]:				0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	1	-	-
MW15-04WB	MW15-04WB	primary	07-Jun-2018	0.502	2.7	3.92	0.233	6200	<0.0050	6.15	940	43.6	0.0118	<0.20	<0.50	142	<0.20	10.7	0.18	FIELD
MW15-04WB	MW15-04WB	primary	02-Aug-2018	0.517	8.5	3.73	0.14	6510	<0.0050	6.32	914	43.3	0.0058	<0.20	<0.50	135	<0.20	7.86	0.17	FIELD
MW15-04WB	MW15-04WB	primary	05-Oct-2018	0.476	3.6	3.61	0.144	6060	<0.0050	5.68	772	36.4	0.0074	<0.20	<0.50	107	<0.20	5.07	0.16	FIELD
MW15-04WB	MW15-04WB	primary	03-May-2019	0.53	3.7	3.66	0.308	5950	<0.0050	5.67	744	37.7	0.006	<0.20	<0.50	124	0.25	4.66	0.16	FIELD
MW15-04WB	MW15-04WB	primary	17-Jun-2019	0.43	3.8	3.83	0.227	5860	<0.0050	5.82	781	38.2	0.0059	<0.20	<0.50	126	<0.20	7.03	0.17	FIELD
MW15-04WB	MW15-04WB	primary	22-Aug-2019	0.514	13.3	4.03	0.369	5750	<0.0050	5.92	797	39	0.0074	<0.20	<0.50	128	0.34	30.9	0.21	FIELD
MW15-04WB	BD1-Q3	duplicate	22-Aug-2019	0.498	4.3	3.68	0.303	5830	<0.0050	5.7	788	40	0.0084	<0.20	<0.50	129	<0.20	6.03	0.18	FIELD
MW15-05AZ	MW15-05AZ	primary	06-Sep-2015	1.23	13.3	0.12	0.069	6040	<0.0050	1.14	15.4	<3.0	0.008	<0.20	1.96	0.899	1.51	1.1	1.18	FIELD
MW15-05WB	MW15-05WB	primary	18-Jun-2015	0.217	66.7	1.8	0.372	10200	<0.0050	10.4	147	4.6	0.009	<0.20	<0.50	70.9	<0.20	60.7	<0.10	LAB
MW15-05WB	MW15-05WB	primary	10-Jul-2015	<1.0		0.964	0.12	8720	<0.020	9.06	138	4.5	<0.050	<5.0	<5.0	66.3	<5.0	37.8	<0.50	LAB
MW15-05WB	MW15-05WB	primary	11-Aug-2015	0.345	42.4	1.07	0.138	8860	<0.0050	9.22	140	3.5	0.0027	<0.20	<0.50	70	<0.20	45.8	<0.10	LAB
MW15-05WB	MW15-60	duplicate	11-Aug-2015	0.365	105	1.03	0.128	8910	<0.0050	9.16	140	3.6	<0.0020	<0.20	<0.50	71.6	<0.20	40.1	<0.10	LAB
MW15-05WB	MW15-05WB	primary	06-Sep-2015	0.607	44.4	1.33	0.102	9880	<0.0050	9.88	150	4.4	<0.0020	<0.20	<0.50	74.8	<0.20	97	<0.10	LAB
MW15-05WB	MW15-05WB	primary	15-May-2016	0.189	34.7	1.16	0.102	10200	<0.0050	9.22	146	3.8	0.004	<0.20	<0.50	72.8	<0.20	27.8	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	20-Jul-2016	0.077	14	0.613	0.063	9590	<0.0050	9.52	129	4	0.002	<0.20	<0.50	84.3	<0.20	8.32	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	27-Sep-2016	0.115	14.7	0.655	0.049	8850	<0.0050	8.73	140	3.7	0.002	<0.20	<0.50	81.5	<0.20	20.7	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	21-Apr-2017	0.206	11.9	0.586	<0.040	10400	<0.0050	9.17	135	4	0.002	<0.20	<0.50	78.4	<0.20	8.68	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	11-Jun-2017	0.163	15.8	0.606	<0.040	8960	<0.0050	9	125	4	0.002	<0.20	<0.50	78.4	<0.20	9.65	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	27-Jul-2017	0.2	14.7	0.619	0.109	9180	<0.0050	9.13	131	4.4	<0.0020	<0.20	<0.50	77	<0.20	6.69	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	07-Oct-2017	1.09	37.1	1.09	0.300	9760	<0.0050	10	133	4.8	<0.0020	<0.20	<0.50	79	<0.20	50.4	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	21-Apr-2018	0.544	18.8	0.679	0.306	8730	<0.0050	10.3	129	4	<0.0020	<0.20	<0.50	77.4	<0.20	12.6	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	09-Jun-2018	0.49	26	0.914	0.172	9210	<0.0050	9.31	142	4.7	<0.0020	<0.20	<0.50	77.9	<0.20	30.7	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	04-Aug-2018	0.268	13	0.637	<0.040	8810	<0.0050	9.19	129	3.8	<0.0020	<0.20	<0.50	77.1	<0.20	11	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	06-Oct-2018	0.126	17.8	0.644	0.072	8640	<0.0050	8.84	134	4.2	<0.0020	<0.20	<0.50	77	<0.20	12.9	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	30-Apr-2019	0.313	26.4	0.954	0.12	8730	<0.0050	9.03	138	3.9	0.002	<0.20	0.54	74.7	<0.20	60.2	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	19-Jun-2019	0.15	17.6	0.674	<0.040	8610	<0.0050	8.75	136	4.1	<0.0020	<0.20	<0.50	76.8	<0.20	19.2	<0.10	FIELD
MW15-05WB	MW15-05WB	primary	23-Aug-2019	0.187	15.7	0.679	<0.040	9270	<0.0050	8.74	134	4.2	<0.0020	<0.20	<0.50	79.7	<0.20	16.1	<0.10	FIELD
MW15-06WB	MW15-06WB	primary	21-Jun-2015	5.99	50.3	11.2	0.319	6380	0.22	23.3	301	16.7	0.0567	<0.20	43.5	54.8	2.07	162	0.69	LAB
MW15-06WB	MW15-06WB	primary	21-Jul-2015	3.1	24.6	7.57	0.502	6540	<0.0050	11.9	417	33.2	0.0261	<0.20	<0.50	100	<0.20	253	0.46	LAB
MW15-06WB	MW15-06WB	primary	09-Aug-2015	2.72	7.1	6.27	0.349	6090	0.0113	9.08	434	31.1	0.0487	<0.20	<0.50	103	<0.20	20.9	0.62	LAB
MW15-06WB	MW15-06WB	primary	08-Sep-2015	3.44	46.4	7.18	0.172	6030	0.027	9.55	487	36.9	0.034	0.24	3.7	100	<0.20	159	0.63	LAB
MW15-06WB	MW15-06WB	primary	17-May-2016	0.206	21.6	4.08	<0.040	4940	0.009	6.12	408	25.4	0.002	<0.20	0.69	25.5	<0.20	7.68	3.87	FIELD
MW15-06WB	MW15-06WB	primary	18-Jul-2016	0.3	14	3.5	<0.20	5190	<0.025	5.81	366	30	<0.010	<1.0	<2.5	27.2	<1.0	4.24	3.98	FIELD
MW15-06WB	MW15-06WB	primary	26-Sep-2016	0.291	19	3.69	<0.040	4600	0.006	5.31	415	19.7	<0.0020	<0.20	<0.50	13.9	<0.20	5.22	3.18	FIELD
MW15-06WB	MW15-06WB	primary	24-Apr-2017	0.226	11.8	3.58	<0.040	4860	0.005	5.38	417	24.2	<0.0020	<0.20	<0.50	13.1	<0.20	7.06	1.77	FIELD
MW15-06WB	MW15-06WB	primary	12-Jun-2017	0.225	11.6	3.57	<0.040	4870	0.007	5.48	427	25.8	<0.0020	<0.20	<0.50	16.4	<0.20	2.49	2.08	FIELD
MW15-06WB	MW15-06WB	primary	29-Jul-2017	0.212	9.9	3.61	<0.040	5050	0.008	5.19	453	26	<0.0020	<0.20	<0.50	15	<0.20	4.84	2.12	FIELD
MW15-06WB	MW15-06WB	primary	09-Oct-2017	0.498	11.8	4.14	0.125	6060	<0.0050	5.53	453	31.3	0.002	<0.20	<0.50	7.43	<0.20	14.8	2.22	FIELD
MW15-06WB	MW15-06WB	primary	22-Apr-2018	0.431	6.1	3.81	0.309	5980	<0.0050	5.75	467	31.4	<0.0020	<0.20	0.67	9.26	<0.20	3.08	2.21	FIELD
MW15-06WB	MW15-06WB	primary	10-Jun-2018	0.202	8.4	3.61	0.064	6030	<0.0050	5.18	486	28.5	0.0032	<0.20	1.47	5.74	<0.20	17.2	2.33	FIELD
MW15-06WB	MW15-06WB	primary	03-Aug-2018	0.239	7.5	3.46	<0.040	5950	<0.0050	5.11	508	29.5	<0.0020	<0.20	<0.50	26.6	<0.20	1.18	2.73	FIELD
MW15-06WB	MW15-06WB	primary	07-Oct-2018	0.25	9.3	3.62	0.144	5720	<0.0050	4.93	485	30.6	<0.0020	<0.20	<0.50	12.2	<0.20	3.24	2.31	FIELD
MW15-06WB	MW15-06WB	primary	02-May-2019	1.62	12.7	3.52	0.373	5870	0.006	7.27	390	22.3	0.002	<0.20	<0.50	100	0.58	35.7	2.28	FIELD
MW15-06WB	MW15-06WB	primary	20-Jun-2019	0.202	6	3.58	0.067	5910	<0.0050	4.73	475	29.9	<0.0020	<0.20	<0.50	32.8	<0.20	3.28	2.03	FIELD
MW15-06WB	MW15-06WB	primary	25-Aug-2019	0.295	6.3	3.69	0.046	6460	<0.0050	4.64	457	32	<0.0020	<0.20	<0.50	33.4	<0.20	27.9	2.23	FIELD
MW16-01WB	MW16-01WB	primary	04-Oct-2016	0.184	8.4	1.06	<0.040	11100	<0.0050	7.17	81.3	4.6	0.004	<0.20	<0.50	5.16	<0.20	15.3	<0.10	FIELD
MW16-01WB	MW16-01WB	primary	20-Apr-2017	0.15	21.9	0.982	<0.040	12500	<0.0050	6.82	80.3	4.2	0.005	<0.20	<0.50	3.96	<0.20	35.6	<0.10	FIELD
MW16-01WB	MW16-01WB	primary	09-Jun-2017	0.171	11.7	1.17	<0.040	12800	<0.0050	7.21	86.9	5.4	0.003	<0.20	<0.50	4.36	<0.20	25.5	<0.10	FIELD
MW16-01WB	MW16-01WB	primary	26-Jul-2017	0.115	14.3	1.09	0.202	12100	<0.0050	7.05	86.1	5.1	0.0025	<0.20	<0.50	4.34	<0.20	21.8	<0.10	FIELD
MW16-01WB	JH41-05	duplicate	27-Jul-2017	0.1	17.4	1.08	0.129	11900	<0.0050	7.13	86.7	4.9	0.0024	<0.20	<0.50	4.28	<0.20	26.8	<0.10	FIELD
MW16-01WB	MW16-01WB	primary	06-Oct-2017	0.509	50.1	1.51	0.109	12200	<0.0050	6.72	87.1	4.5	0.002	1.33	<0.50	3.89	<0.20	43.4	<0.10	FIELD
MW16-01WB	MW16-01WB	primary	20-Apr-2018	0.261	7.2	1.05	<0.040	13300	<0.0050	7.61	83.7	4.7	0.0021	<0.20	<0.50	2.96	<0.20	11.5	<0.10	FIELD
MW16-01WB	MW16-01WB	primary	08-Jun-2018	0.129	5.7	1.05	0.223	11700	0.0147	6.61	87.6	4.9	0.0097	<0.20	<0.50	2.78	<0.20	11.5	<0.10	FIELD
MW16-01WB	MW16-01WB	primary	02-Aug-2018	0.069	7.4	1.05	<0.040	12200	<0.0050	7.15	87.5	4.5	<0.0020	<0.20	<0.50	3.37	<0.20	6.57	<0.10	FIELD
MW16-01WB	MW16-01WB	primary	04-Oct-2018	0.041	9	0.978	0.045	11400	<0.0050	6.67	81.4	4.6	<0.0020	<0.20	<0.50	2.81	<0.20	2.8	<0.10	FIELD
MW16-01WB	MW16-01WB	primary	01-May-2019	0.106	7.5	1.14	0.122	9900	<0.0050	6.79	74.9	4.3	<0.0020	<0.20	<0.50	2.58	<0.20	9.01	<0.10	FIELD
MW16-01WB	MW16-01WB	primary	17-Jun-2019	0.034	5.8	0.92	<0.080	11500	<0.010	6.7	73.1	<6.0	<0.0040	<0.40	<1.0	2.59	<0.40	3.5	<0.20	FIELD
MW16-01WB	MW16-01WB	primary	21-Aug-2019	0.301	5.8	1.41	0.068	11300	<0.0050	7.01	80.6	4.6	<0.0020	<0.20	<0.50	2.36	0.56	11.3	<0.10	FIELD
	F-BLANK-1	field blank	28-Sep-2014	<0.5	<50	<0.1	<0.1	<50	<0.01	<0.05	<0.2	<0.5	<0.01	<0.1	<10	<0.01	<1	<1		

Station	Sample ID	Sample Class	Sample Date	Dissolved Nickel (Ni)	Dissolved Phosphorus (P)	Dissolved Potassium (K)	Dissolved Selenium (Se)	Dissolved Silicon (Si)	Dissolved Silver (Ag)	Dissolved Sodium (Na)	Dissolved Strontium (Sr)	Dissolved Sulphur (S)	Dissolved Thallium (Tl)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)	Dissolved Uranium (U)	Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Filter and HNO3 Preservation (Metals)
				ug/L	ug/L	mg/L	ug/L	ug/L	ug/L	mg/L	ug/L	mg/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	
Maxxam RDL[1]:				0.02	2	0.05	0.04	50	0.005	0.05	0.05	3	0.002	0.2	0.5	0.002	0.2	0.1	0.1	
ALS RDL[1]:				0.5	50	0.1	0.1	50	0.01	0.05	0.2	0.5	0.01	0.1	10	0.01	1	1	-	-
	FB-23/06/15	field blank	23-Jun-2015	0.068	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.16	<0.10	LAB
	FB-2	field blank	18-Jul-2015	1.17	179	<0.050	<0.040	<50	<0.0050	0.382	0.061	<3.0	<0.0020	<0.20	0.64	0.0066	<0.20	1.26	<0.10	LAB
	FB-3	field blank	12-Aug-2015	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	FB-4	field blank	08-Sep-2015	<0.020	3.2	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	0.6	0.019	<0.20	0.1	<0.10	LAB
	FB-007	field blank	16-May-2016	<0.020	3.1	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.19	<0.10	FIELD
	FB-008	field blank	15-Jul-2016	<0.020	4	<0.050	<0.040	<50	<0.0050	<0.25	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.29	<0.10	FIELD
	FB-009	field blank	26-Sep-2016	<0.020	3.4	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.34	<0.10	FIELD
	FB-010	field blank	25-Apr-2017	<0.020	5.9	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	FIELD
	FB-020	field blank	11-Jun-2017	<0.020	2.1	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	FIELD
	FB-030	field blank	29-Jul-2017	<0.020	3.3	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	FIELD
	FB-040	field blank	09-Oct-2017	<0.020	2.8	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	FIELD
	FB-Q1	field blank	22-Apr-2018	<0.020	2.4	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.1	<0.10	FIELD
	FB-Q2	field blank	10-Jun-2018	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	0.0024	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	FIELD
	FB-Q3	field blank	05-Aug-2018	<0.020	2.2	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	FIELD
	FB-Q4	field blank	07-Oct-2018	<0.020	3.3	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	0.17	<0.10	FIELD
	FB-Q1	field blank	01-May-2019	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	0.114	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	FIELD
	FB-Q2	field blank	13-Jun-2019	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	FIELD
	FB-Q3	field blank	23-Aug-2019	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	FIELD
	TRIP BLANK	trip blank	11-Sep-2015	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	16-May-2016	<0.020	<2.0	<0.25	<0.040	<50	<0.0050	<0.25	<0.050	<15	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	20-Jul-2016	<0.020	2.8	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	29-Sep-2016	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	26-Apr-2017	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	14-Jun-2017	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	26-Jul-2017	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	11-Oct-2017	<0.020	2.6	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	23-Apr-2018	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	0.0037	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	10-Jun-2018	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	0.0038	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	09-Aug-2018	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	11-Oct-2018	<0.020	2.7	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TB-Q1	trip blank	02-May-2019	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	13-Jun-2019	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB
	TRIP BLANK	trip blank	23-Aug-2019	<0.020	<2.0	<0.050	<0.040	<50	<0.0050	<0.050	<0.050	<3.0	<0.0020	<0.20	<0.50	<0.0020	<0.20	<0.10	<0.10	LAB

Notes:

Samples and sample data with RED text are not considered to be representative of formation water (See Appendix 5-D for further discussion).

1. Reportable detection limits (RDL) presented are the lowest detection limit for a given parameter. Note that the detection limit may have been raised by the analytical laboratory for some analytical results (e.g., due to matrix interference). See Table 3-8 in the main report for further details regarding reportable detection limits between 2014 and 2019.

2. Duplicate sample JH42-08 (Lab ID: UN0655) was collected on 04-Oct-2018 and not 05-Oct-2018 (dummy date for blind duplicate sampling) as indicated in the laboratory Certificate of Analysis.

Appendix 5-B: Groundwater Quality Summary Statistics

Newmont™
COFFEE

Monitoring Well		MW14-02A					MW14-02B					MW14-03A					MW14-03B				
Screen Lithology		Schist					Schist					Schist					Schist				
Sample Count		19					19					18					18				
Statistics		Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD
Field Paramaters	Units																				
pH (field)	pH	6.06	7.54	7.59	8.28	0.477	7.23	7.61	7.60	8.03	0.173	6.73	7.30	7.36	8.09	0.290	6.88	7.27	7.32	7.50	0.177
Specific Conductance (field)	uS/cm	204	349	362	400	44.3	317	470	475	521	43.0	1380	1610	1620	1700	69.1	1600	1750	1740	1880	72.1
DO (field)	mg/L	7.04	9.45	9.59	12.1	1.25	4.73	6.80	6.63	9.43	1.23	0.0800	0.532	0.310	2.60	0.690	0.0600	1.03	0.360	6.38	1.59
ORP (field)	ORP mV	-61.0	107	98.5	247	75.4	-185	73.9	96.3	209	88.2	-232	-119	-113	-56.0	41.3	-220	-48.9	-53.0	48.1	57.7
Temperature (field)	°C	0.500	2.39	2.19	7.65	1.55	0.600	2.47	1.85	7.82	1.65	0.00	0.889	0.900	1.90	0.578	0.100	0.786	0.865	1.63	0.457
Physical Properties																					
Conductivity (lab)	uS/cm	360	432	374	1420	233	470	488	488	508	11.8	1540	1950	1640	7600	1370	1700	1770	1760	1880	56.5
pH (lab)	pH	4.55	7.92	8.10	8.31	0.801	7.87	8.13	8.12	8.40	0.122	7.00	7.92	8.01	8.30	0.285	7.71	8.03	8.05	8.34	0.178
Total Hardness (CaCO3)	mg/L	178	193	187	255	17.2	191	248	249	283	19.5	863	925	916	1020	41.1	900	1030	1040	1150	59.9
Dissolved Hardness (CaCO3)	mg/L	179	190	188	210	9.21	227	251	248	277	14.8	826	924	925	1020	53.7	907	1040	1040	1150	56.0
Total Suspended Solids	mg/L	1.00	1.63	1.00	7.00	1.44	1.00	7.77	2.90	79.3	17.1	4.80	13.5	10.7	31.2	6.83	2.30	3.57	3.35	5.40	0.846
Total Dissolved Solids	mg/L	178	218	218	264	20.4	254	290	282	374	30.5	1090	1180	1180	1230	39.1	1160	1310	1310	1390	55.1
Turbidity	NTU	0.100	0.447	0.270	2.63	0.575	0.260	5.12	1.88	44.1	10.7	0.350	26.2	25.2	74.3	15.4	1.93	4.62	4.82	9.40	1.92
Inorganics																					
Alkalinity (Total as CaCO3)	mg/L	140	148	146	166	6.72	176	185	182	210	9.29	465	483	482	513	12.1	514	546	544	579	20.1
Alkalinity (PP as CaCO3)	mg/L	0.500	0.583	0.500	1.55	0.255	0.500	0.730	0.500	3.25	0.689	0.500	0.597	0.500	2.25	0.401	0.500	1.07	0.500	6.00	1.62
Bicarbonate (HCO3)	mg/L	170	179	176	203	7.38	215	224	221	256	9.53	561	589	588	626	15.3	627	664	663	706	25.9
Carbonate (CO3)	mg/L	0.500	0.611	0.500	1.86	0.336	0.500	0.787	0.500	3.90	0.857	0.500	0.622	0.500	2.70	0.504	0.500	1.20	0.500	7.20	1.97
Hydroxide (OH)	mg/L	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0
Bromide (Br)	mg/L	0.0100	0.0102	0.0100	0.0130	0.000773	0.0100	0.0179	0.0100	0.100	0.0229	0.0500	0.0987	0.100	0.140	0.0232	0.0500	0.105	0.100	0.150	0.0275
Fluoride (F)	mg/L	0.0850	0.0933	0.0930	0.100	0.00487	0.100	0.107	0.110	0.110	0.00451	0.160	0.181	0.180	0.210	0.0120	0.250	0.261	0.260	0.300	0.0113
Dissolved Chloride (Cl)	mg/L	0.500	0.562	0.500	0.930	0.119	0.500	0.561	0.500	1.00	0.120	0.520	1.04	1.00	1.70	0.340	0.610	1.32	1.20	2.30	0.474
Organic / Inorganic Carbon																					
Dissolved Organic Carbon (C)	mg/L	0.500	2.09	0.500	26.0	5.66	0.500	0.699	0.590	1.63	0.281	0.500	1.73	0.610	7.48	1.90	0.500	1.64	1.37	4.77	1.11
Total Organic Carbon (C)	mg/L	0.500	1.66	0.500	18.0	3.87	0.500	0.797	0.710	1.76	0.376	0.500	2.26	1.09	9.01	2.29	0.500	1.82	1.55	5.06	1.20
Anions and Nutrients																					
Total Phosphorus (P)	mg/L	0.00500	0.0218	0.0183	0.106	0.0207	0.00200	0.0150	0.0136	0.0290	0.00713	0.0250	0.0549	0.0528	0.0887	0.0197	0.0100	0.0242	0.0240	0.0450	0.00924
Dissolved Phosphorus (P)	mg/L	0.00710	0.0160	0.0179	0.0217	0.00473	0.00330	0.0128	0.0114	0.0247	0.00575	0.0190	0.0485	0.0488	0.0772	0.0173	0.00300	0.0194	0.0199	0.0336	0.00874
Orthophosphate	mg/L	0.00600	0.0146	0.0160	0.0203	0.00597	0.00800	0.0126	0.0128	0.0166	0.00305	0.00360	0.00792	0.00500	0.0210	0.00656	0.00300	0.00468	0.00500	0.00640	0.00114
Total Ammonia (N)	mg/L	0.00500	0.0156	0.0110	0.0673	0.0164	0.00500	0.0141	0.00990	0.0580	0.0122	0.0120	0.0917	0.0750	0.430	0.0901	0.0240	0.0827	0.0580	0.290	0.0665
Total Total Kjeldahl Nitrogen (Calc)	mg/L	0.0200	0.0824	0.0480	0.376	0.108	0.0200	0.0800	0.0500	0.425	0.0941	0.0880	0.285	0.191	0.988	0.235	0.0650	0.254	0.195	0.957	0.210
Nitrate plus Nitrite (N)	mg/L	0.138	0.165	0.166	0.184	0.0111	0.100	0.140	0.149	0.157	0.0188	0.00200	0.00291	0.00200	0.0104	0.00205	0.00200	0.00245	0.00200	0.00480	0.000898
Nitrate (N)	mg/L	0.138	0.164	0.166	0.184	0.0109	0.0138	0.134	0.145	0.157	0.0329	0.00200	0.00283	0.00200	0.0104	0.00205	0.00200	0.00245	0.00200	0.00480	0.000898
Nitrite (N)	mg/L	0.00100	0.00195	0.00200	0.00200	0.000223	0.00150	0.00203	0.00200	0.00290	0.000239	0.00200	0.00201	0.00200	0.00220	0.0000458	0.00200	0.00216	0.00200	0.00470	0.000618
Total Nitrogen (N)	mg/L	0.152	0.236	0.198	0.538	0.112	0.134	0.207	0.175	0.532	0.0905	0.0980	0.285	0.196	0.988	0.236	0.0650	0.254	0.195	0.957	0.210
Dissolved Nitrogen (N)	mg/L	0.160	0.218	0.205	0.346	0.0493	0.149	0.192	0.192	0.245	0.0248	0.0620	0.181	0.131	0.617	0.139	0.00280	0.168	0.153	0.292	0.0766
Dissolved Sulphate (SO4)	mg/L	49.9	53.6	53.9	59.7	2.67	70.4	82.0	82.3	89.9	4.66	334	497	508	604	57.3	490	554	559	630	35.4
Total Sulphide	mg/L	0.00200	0.00698	0.00565	0.0130	0.00309	0.00200	0.00698	0.00685	0.0112	0.00247	0.0524	0.114	0.116	0.167	0.0295	0.00900	0.0181	0.0201	0.0277	0.00673
Total Sulphide (as H2S)	mg/L	0.00500	0.00767	0.00600	0.0140	0.00346	0.00500	0.00800	0.00700	0.0120	0.00267	0.0560	0.117	0.120	0.180	0.0362	0.0100	0.0163	0.0120	0.0290	0.00657
Dissolved Sulphide	mg/L	0.00180	0.00340	0.00190	0.00640	0.00193	0.00180	0.00312	0.00190	0.00500	0.00154	0.0549	0.189	0.120	0.500	0.162	0.00180	0.00400	0.00190	0.00720	0.00261
Dissolved Sulphide (as H2S)	mg/L	0.00180	0.00354	0.00200	0.00700	0.00211	0.00180	0.00320	0.00200	0.00530	0.00160	0.0580	0.204	0.108	0.540	0.196	0.00190	0.00495	0.00495	0.00800	0.00305
Cyanides																					
Cyanide, Weak Acid Diss	mg/L	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0
Cyanide, Total	mg/L	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0
Cyanate	mg/L	0.200	0.200	0.200	0.200	0	0.200	0.200	0.200	0.200	0	0.200	0.200	0.200	0.200	0	0.200	0.200	0.200	0.200	0
Thiocyanate (SCN)	mg/L	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0
Total Metals																					
Total Aluminum (Al)	ug/L	2.04	14.7	5.72	78.7	20.0	0.920	54.1	18.7	611	133	2.73	9.97	8.68	26.2	6.33	1.85	9.93	9.46	26.4	5.89
Total Antimony (Sb)	ug/L	0.678	1.14	0.730	7.07	1.42	0.860	6.41	6.39	11.9	2.28	0.100	0.289	0.151	0.979	0.251	0.0890	0.167	0.135	0.324	0.0726
Total Arsenic (As)	ug/L	38.0	55.5	56.1	68.4	5.65	19.4	45.5	42.0	93.1	14.4	41.8	58.4	57.9	75.3	10.3	7.46	11.7	11.0	18.1	3.22
Total Barium (Ba)	ug/L	9.29	14.5	10.4	51.3	10.2	14.6	40.5	39.9	65.8	11.7	46.1	76.9	64.3	141	28.9	31.9	51.8	46.5	91.7	16.2
Total Beryllium (Be)	ug/L	0.0100	0.0153	0.0100	0.100	0.0201	0.0100	0.0239	0.0100	0.156	0.0370	0.0100	0.0169	0.0150	0.0500	0.00851	0.0100	0.0234	0.0100	0.191	0.0417
Total Bismuth (Bi)	ug/L	0.00500	0.0313	0.00500	0.500	0.110	0.00500	0.0346	0.00500	0.500	0.110	0.00500	0.00809	0.00500	0.0250	0.00550	0.00500	0.00945	0.00635	0.0250	0.00625
Total Boron (B)	ug/L	10.0	10.0	10.0	10.0	0	10.0	10.0	10.0	10.0	0	10.0	13.4	10.0	50.0	9.41	10.0	13.3	10.0	50.0	9.43
Total Cadmium (Cd)	ug/L	0.00500	0.00679	0.00500	0.0270	0.00512	0.00500	0.00812	0.00500	0.0335	0.00639	0.00500	0.00819	0.00500	0.0490	0.0100	0.00500	0.0435	0.0315	0.199	0.0451
Total Calcium (Ca)	mg/L	39.1	41.9	40.8	49.5	2.74	41.9	52.7	52.3	61.4	4.03	126	141	142	153	6.78	118	131	132	139	6.22
Total Chromium (Cr)	ug/L	0.220	0.541	0.540	0.880	0.118	0.100	0.587	0.490	2.65	0.516	0.100	0.169	0.130	0.500	0.105	0.100	0.232	0.195	0.550	0.131
Total Cobalt (Co)	ug/L	0.00500	0.245	0.0162	2.81	0.677	0.0385	0.710	0.385	3.06	0.763	1.35	1.57	1.48	2.42	0.260	3.35	4.97	4.53	6.94	1.14
Total Copper (Cu)	ug/L	0.0500	0.254	0.0580	2.64	0.576	0.0500	0.324	0.148	1.85	0.423	0.221	0.940	0.887	2.53	0.532	0.269	2.37	2.32	5.38	1.18
Total Iron (Fe)	ug/L	1.00	30.9	7.40	334	73.8	1.00	102	26.0	1230	269	4030	5520	4550	9580	1710	838	1280	1240	2280	330

Monitoring Well		MW14-02A					MW14-02B					MW14-03A					MW14-03B				
Screen Lithology		Schist					Schist					Schist					Schist				
Sample Count		19					19					18					18				
	Statistics	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD
Total Lead (Pb)	ug/L	0.00500	0.153	0.0107	2.18	0.482	0.00500	0.132	0.0487	1.46	0.316	0.0491	0.509	0.485	1.06	0.342	0.123	1.72	1.76	4.03	1.23
Total Lithium (Li)	ug/L	5.89	7.14	7.15	8.79	0.633	5.74	7.27	7.30	8.55	0.654	24.9	29.1	29.3	31.3	1.79	20.8	24.9	25.5	28.4	2.06
Total Magnesium (Mg)	mg/L	18.8	21.3	20.5	31.9	2.74	21.0	28.2	28.0	31.7	2.43	125	139	137	157	8.14	138	170	172	195	13.0
Total Manganese (Mn)	ug/L	0.0870	44.3	1.37	687	152	10.6	276	161	943	264	385	533	453	963	166	1860	2640	2630	3240	421
Total Mercury (Hg)	ug/L	0.00320	0.00683	0.00710	0.0100	0.00220	0.00260	0.00579	0.00430	0.0203	0.00459	0.00200	0.0116	0.00795	0.0400	0.00997	0.00200	0.0137	0.0103	0.0400	0.0102
Total Molybdenum (Mo)	ug/L	2.77	3.37	3.05	7.53	1.05	3.02	4.19	3.63	6.90	1.21	1.11	2.07	1.47	5.22	1.24	3.36	5.29	4.79	8.75	1.63
Total Nickel (Ni)	ug/L	0.0260	1.01	0.0550	16.7	3.70	0.240	5.07	3.77	12.0	3.65	0.451	1.27	1.07	3.69	0.800	9.42	14.0	12.9	20.6	3.30
Total Phosphorus (P)	ug/L	6.30	12.3	9.10	50.0	10.0	4.20	14.4	7.70	69.0	16.6	30.1	47.8	39.6	123	21.7	14.7	30.1	24.2	70.8	14.2
Total Potassium (K)	mg/L	2.65	2.90	2.75	3.77	0.314	3.00	3.44	3.42	3.73	0.196	8.40	8.84	8.74	9.34	0.310	7.50	8.50	8.52	9.11	0.416
Total Selenium (Se)	ug/L	0.225	0.247	0.242	0.280	0.0152	0.232	0.322	0.328	0.370	0.0379	0.0400	0.0727	0.0400	0.200	0.0480	0.113	0.199	0.185	0.304	0.0555
Total Silicon (Si)	ug/L	5610	6080	6130	6760	326	5750	6250	6270	7350	415	5840	6420	6360	7300	352	5350	5870	5910	6460	326
Total Silver (Ag)	ug/L	0.00500	0.0172	0.00500	0.104	0.0234	0.00500	0.0621	0.00540	0.946	0.210	0.00500	0.0101	0.00800	0.0250	0.00548	0.00500	0.0356	0.0333	0.0690	0.0168
Total Sodium (Na)	mg/L	2.60	3.12	2.86	5.28	0.733	2.85	3.30	3.22	4.42	0.353	25.0	27.1	26.8	29.6	1.35	23.9	27.3	27.2	31.0	1.91
Total Strontium (Sr)	ug/L	325	368	365	509	39.6	380	459	463	514	32.4	4240	4920	4870	5850	408	2850	3480	3590	4200	347
Total Sulphur (S)	mg/L	14.5	17.6	17.0	26.6	2.39	17.8	25.4	26.0	28.7	2.42	145	174	176	192	11.3	155	191	191	215	14.6
Total Thallium (Tl)	ug/L	0.00400	0.0192	0.0114	0.0883	0.0199	0.0260	0.224	0.200	0.818	0.162	0.00400	0.0139	0.00985	0.0440	0.0117	0.0943	0.198	0.193	0.363	0.0578
Total Tin (Sn)	ug/L	0.100	0.212	0.200	0.530	0.0782	0.100	0.212	0.200	0.520	0.0760	0.200	0.277	0.200	1.00	0.198	0.200	0.288	0.200	1.00	0.189
Total Titanium (Ti)	ug/L	0.500	1.28	0.500	10.0	2.23	0.500	2.18	0.530	16.6	4.02	0.500	1.14	0.670	4.00	0.945	0.500	1.07	0.615	4.00	0.930
Total Uranium (U)	ug/L	41.8	47.8	44.5	85.8	10.1	52.7	72.6	72.1	91.9	7.37	47.0	82.8	91.0	103	18.3	35.0	46.6	46.5	59.4	7.07
Total Vanadium (V)	ug/L	0.200	0.292	0.200	1.00	0.191	0.200	0.363	0.220	1.81	0.385	0.200	0.309	0.225	1.00	0.192	0.200	0.273	0.200	1.00	0.187
Total Zinc (Zn)	ug/L	0.100	3.01	0.330	40.9	8.99	0.140	2.88	1.80	11.9	2.88	0.430	1.82	1.44	5.70	1.31	0.480	2.88	2.00	11.8	2.96
Total Zirconium (Zr)	ug/L	0.100	0.100	0.100	0.100	0	0.100	0.110	0.100	0.280	0.0412	1.16	1.73	1.38	3.15	0.626	0.120	0.238	0.215	0.500	0.104
Dissolved Metals																					
Dissolved Aluminum (Al)	ug/L	1.56	4.94	3.63	17.4	4.17	0.820	32.3	1.68	568	126	1.16	7.01	2.99	52.8	12.0	1.15	4.26	2.43	18.9	4.64
Dissolved Antimony (Sb)	ug/L	0.658	0.748	0.728	0.920	0.0636	3.27	6.53	6.01	11.9	1.84	0.0400	0.213	0.0880	1.02	0.267	0.0400	0.0882	0.0890	0.178	0.0331
Dissolved Arsenic (As)	ug/L	43.5	56.0	55.7	71.1	5.00	20.4	43.3	39.3	90.1	13.5	30.7	57.6	56.6	95.0	14.3	6.29	11.5	11.4	19.3	3.19
Dissolved Barium (Ba)	ug/L	9.55	12.5	10.3	32.8	5.17	28.5	41.6	39.0	72.5	10.7	43.9	74.0	60.8	143	28.9	33.2	51.7	45.4	99.0	17.6
Dissolved Beryllium (Be)	ug/L	0.0100	0.0147	0.0100	0.100	0.0201	0.0100	0.0218	0.0100	0.144	0.0351	0.0100	0.0148	0.0120	0.0500	0.00914	0.0100	0.0143	0.0100	0.0500	0.00989
Dissolved Bismuth (Bi)	ug/L	0.00500	0.0311	0.00500	0.500	0.111	0.00500	0.0321	0.00500	0.500	0.110	0.00500	0.00689	0.00500	0.0250	0.00469	0.00500	0.00793	0.00500	0.0250	0.00483
Dissolved Boron (B)	ug/L	10.0	10.0	10.0	10.0	0	10.0	10.0	10.0	10.0	0	10.0	15.1	10.0	50.0	12.2	10.0	14.4	10.0	50.0	9.83
Dissolved Cadmium (Cd)	ug/L	0.00500	0.00642	0.00500	0.0240	0.00431	0.00500	0.00763	0.00500	0.0344	0.00649	0.00500	0.00981	0.00500	0.0545	0.0119	0.00500	0.0136	0.00900	0.0628	0.0137
Dissolved Calcium (Ca)	mg/L	39.2	42.2	41.5	46.7	2.43	48.7	53.7	52.4	61.8	3.71	124	140	139	157	7.72	120	132	131	140	4.99
Dissolved Chromium (Cr)	ug/L	0.450	0.521	0.510	0.650	0.0495	0.100	0.483	0.400	2.70	0.536	0.100	0.163	0.100	0.500	0.109	0.100	0.157	0.100	0.500	0.0957
Dissolved Cobalt (Co)	ug/L	0.00500	0.0842	0.00840	1.26	0.278	0.0648	0.759	0.323	2.79	0.820	1.28	1.55	1.42	2.46	0.293	3.44	4.96	4.52	7.55	1.20
Dissolved Copper (Cu)	ug/L	0.0500	0.165	0.0500	1.58	0.341	0.0500	0.156	0.0540	1.74	0.375	0.0500	0.337	0.0850	2.54	0.645	0.200	0.853	0.678	2.79	0.607
Dissolved Iron (Fe)	ug/L	1.00	4.08	1.00	26.6	6.30	1.00	67.0	2.00	1210	269	3680	5340	4420	9370	1720	807	1270	1270	2140	327
Dissolved Lead (Pb)	ug/L	0.00500	0.0136	0.00500	0.0750	0.0183	0.00500	0.0914	0.00500	1.58	0.351	0.00500	0.109	0.0175	1.24	0.280	0.0220	0.183	0.0920	1.18	0.265
Dissolved Lithium (Li)	ug/L	5.88	7.12	7.26	8.06	0.514	6.02	7.22	7.18	8.37	0.479	21.9	28.7	28.8	33.5	2.53	21.1	24.9	24.9	28.8	1.76
Dissolved Magnesium (Mg)	mg/L	19.4	20.8	20.7	22.7	0.968	25.7	28.8	28.8	31.9	1.82	125	140	138	164	10.7	143	172	173	197	12.0
Dissolved Manganese (Mn)	ug/L	0.0500	8.23	0.275	79.2	18.1	23.3	289	162	911	267	389	532	451	954	163	1760	2680	2650	3490	459
Dissolved Mercury (Hg)	ug/L	0.00250	0.00593	0.00600	0.0100	0.00189	0.00200	0.00385	0.00240	0.0206	0.00432	0.00200	0.00364	0.00255	0.00980	0.00223	0.00200	0.00769	0.00480	0.0327	0.00733
Dissolved Molybdenum (Mo)	ug/L	2.78	3.12	3.04	4.88	0.431	3.10	4.31	3.55	7.45	1.35	0.830	1.73	1.00	5.14	1.33	3.43	5.31	4.72	9.53	1.72
Dissolved Nickel (Ni)	ug/L	0.0220	0.139	0.0490	0.500	0.159	1.19	5.60	4.11	14.7	3.96	0.258	0.850	0.676	2.36	0.521	9.92	13.9	13.0	22.0	3.42
Dissolved Phosphorus (P)	ug/L	5.40	13.0	8.10	53.0	13.3	5.10	16.1	7.10	117	26.0	23.1	48.7	38.0	144	31.1	11.0	25.3	21.4	69.9	14.1
Dissolved Potassium (K)	mg/L	2.71	2.87	2.80	3.63	0.196	3.21	3.46	3.47	3.74	0.151	8.11	8.91	8.83	11.0	0.623	7.70	8.65	8.55	9.46	0.419
Dissolved Selenium (Se)	ug/L	0.205	0.238	0.241	0.256	0.0128	0.264	0.322	0.330	0.367	0.0286	0.0400	0.0581	0.0400	0.200	0.0384	0.0830	0.160	0.161	0.249	0.0476
Dissolved Silicon (Si)	ug/L	5320	6210	6180	7000	395	5310	6270	6230	7250	513	5050	6440	6420	8050	749	4880	6000	6100	7250	480
Dissolved Silver (Ag)	ug/L	0.00500	0.00573	0.00500	0.0135	0.00214	0.00500	0.0582	0.00500	1.01	0.224	0.00500	0.00914	0.00805	0.0250	0.00489	0.00500	0.0130	0.0119	0.0410	0.00895
Dissolved Sodium (Na)	mg/L	2.57	3.09	2.86	5.18	0.661	2.95	3.35	3.28	4.53	0.363	24.3	27.1	27.0	31.8	1.82	24.5	27.6	27.5	31.6	1.84
Dissolved Strontium (Sr)	ug/L	328	364	369	395	17.4	421	460	457	495	24.8	4290	4960	4940	6300	483	2950	3490	3480	4070	265
Dissolved Sulphur (S)	mg/L	14.6	17.1	17.3	18.7	0.953	23.5	25.7	25.5	29.0	1.51	153	176	177	213	14.4	164	193	197	224	14.6
Dissolved Thallium (Tl)	ug/L	0.00460	0.0161	0.0100	0.0555	0.0151	0.0100	0.167	0.185	0.267	0.0742	0.00200	0.00823	0.00360	0.0360	0.00931	0.0353	0.149	0.147	0.311	0.0592
Dissolved Tin (Sn)	ug/L	0.100	0.201	0.200	0.320	0.0358	0.100	0.209	0.200	0.480	0.0675	0.200	0.267	0.200	1.00	0.189	0.200	0.296	0.200	1.00	0.197
Dissolved Titanium (Ti)	ug/L	0.500	1.01	0.500	10.0	2.12	0.500	1.75	0.500	14.8	3.73	0.500	0.703	0.500	2.50	0.467	0.500	0.695	0.500	2.50	0.475
Dissolved Uranium (U)	ug/L	42.0	45.9	44.3	70.4	6.05	66.7	73.9	72.4	92.5	5.51	43.6	81.9	89.4	97.9	17.5	37.5	46.6	45.8	58.2	5.95
Dissolved Vanadium (V)	ug/L	0.200	0.261	0.200	1.00	0.180	0.200	0.348	0.200	1.77	0.380	0.200	0.305	0.215	1.00	0.191	0.200	0.282	0.200	1.00	0.189
Dissolved Zinc (Zn)	ug/L	0.100	2.59	0.280	34.0	7.49	0.170	2.24	1.54	10.3	2.64	0.100	1.68	0.405	16.2	3.67	0.310	2.74	1.02	10.1	3.37
Dissolved Zirconium (Zr)	ug/L	0.100	0.100	0.100	0.100	0	0.100	0.108	0.100	0.250	0.0344	1.05	1.86	1.41	3.39	0.796	0.150	0.276	0.230	0.500	0.105

Notes:

1. Where analytical results are below the reportable detection limit (<RDL), the RDL values are used in the statistical calculations.
2. Analytical results for the following samples have been excluded from the statistical calculations: MW14-03A (12-Oct-2014), MW14-03B (06-Oct-2014), MW14-05A (02-Oct-2014), MW14-05B (03-Oct-2014, 24-Jun-2015, 14-Jul-2015, 09-Aug-2015, 08-Sep-2015), and MW15-06WB (21-Jun-2015). See Appendix 5-D for further discussion.
3. Analytical results for dissolved organic carbon and total organic carbon for all samples collected at Westbay monitoring wells (MW15-01WB to MW15-06WB, and MW16-01WB) have been excluded from the statistical calculations. See Appendix 5-D for further discussion.
4. SD = Standard Deviation

Monitoring Well		MW14-05A					MW14-05B					MW15-01WB					MW15-02AZ				
Screen Lithology		Granite					Granite					Gneiss					-				
Sample Count		18					14					18					10				
Statistics		Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD
Field Paramaters	Units																				
pH (field)	pH	6.49	7.26	7.19	8.25	0.382	6.66	7.18	7.19	7.50	0.230	6.07	7.01	7.00	7.85	0.395	7.32	7.48	7.40	8.02	0.198
Specific Conductance (field)	uS/cm	329	408	416	475	41.1	359	400	386	519	39.8	1160	2020	2160	2390	371	437	732	768	874	127
DO (field)	mg/L	0.100	0.961	0.610	3.49	0.892	0.210	1.65	0.885	8.38	2.09	2.15	8.51	8.28	17.3	3.76	3.98	6.42	6.70	8.80	1.56
ORP (field)	ORP mV	-213	-115	-105	3.80	47.0	-200	-86.5	-80.0	-40.3	34.5	-25.1	36.9	34.2	198	53.7	-333	22.5	47.0	143	123
Temperature (field)	°C	0.0800	1.17	1.11	3.27	0.727	-0.100	0.892	0.745	2.36	0.741	0.900	5.43	3.85	16.8	4.12	1.08	1.70	1.86	2.40	0.438
Physical Properties																					
Conductivity (lab)	uS/cm	343	393	399	425	24.9	357	402	393	503	44.0	2130	2200	2200	2240	23.2	738	803	799	926	52.7
pH (lab)	pH	7.43	7.82	7.86	8.11	0.207	7.54	7.86	7.79	8.27	0.196	7.70	7.87	7.85	8.04	0.102	8.00	8.15	8.14	8.36	0.107
Total Hardness (CaCO3)	mg/L	142	176	178	212	18.4	141	156	153	184	10.9	1270	1390	1390	1530	59.8	394	428	421	493	26.6
Dissolved Hardness (CaCO3)	mg/L	144	175	180	204	17.3	146	158	156	185	10.8	1320	1390	1390	1510	51.9	383	436	422	513	35.7
Total Suspended Solids	mg/L	5.20	17.8	19.2	28.1	6.95	5.80	13.0	13.6	17.6	2.99	1.60	3.30	2.75	5.60	1.25	1.00	1.55	1.00	6.50	1.65
Total Dissolved Solids	mg/L	186	237	237	298	23.6	204	247	235	312	31.8	1690	1830	1830	1940	60.3	484	528	519	640	45.4
Turbidity	NTU	5.20	61.6	46.8	140	47.3	11.0	49.8	56.5	69.0	17.3	0.740	10.3	9.26	26.1	6.73	0.100	0.180	0.120	0.390	0.103
Inorganics																					
Alkalinity (Total as CaCO3)	mg/L	155	198	205	256	23.3	179	200	201	241	18.0	541	567	566	595	18.0	227	244	243	264	11.6
Alkalinity (PP as CaCO3)	mg/L	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.826	0.500	3.76	0.978
Bicarbonate (HCO3)	mg/L	189	241	251	312	28.4	218	244	246	295	22.2	660	692	690	726	21.9	277	296	292	322	14.0
Carbonate (CO3)	mg/L	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.901	0.500	4.51	1.20
Hydroxide (OH)	mg/L	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0
Bromide (Br)	mg/L	0.0100	0.0169	0.0100	0.100	0.0240	0.0100	0.0176	0.0100	0.100	0.0238	0.0500	0.151	0.130	0.370	0.0766	0.0100	0.0578	0.0635	0.100	0.0425
Fluoride (F)	mg/L	0.210	0.239	0.240	0.270	0.0154	0.190	0.231	0.235	0.280	0.0243	0.0440	0.0576	0.0585	0.0680	0.00557	0.0880	0.108	0.110	0.130	0.0120
Dissolved Chloride (Cl)	mg/L	0.500	0.958	0.935	1.60	0.318	0.500	1.28	1.10	2.50	0.614	0.500	1.10	0.780	5.30	1.07	0.500	0.741	0.730	1.10	0.202
Organic / Inorganic Carbon																					
Dissolved Organic Carbon (C)	mg/L	3.00	6.13	5.79	10.3	1.81	1.70	4.26	3.60	8.00	2.27	-	-	-	-	-	3.68	4.50	4.51	5.62	0.645
Total Organic Carbon (C)	mg/L	3.51	6.09	5.80	11.4	1.90	2.00	4.69	4.66	8.44	2.19	-	-	-	-	-	3.77	4.76	4.68	6.29	0.683
Anions and Nutrients																					
Total Phosphorus (P)	mg/L	0.340	0.687	0.717	1.10	0.172	0.0480	0.153	0.166	0.242	0.0623	0.00300	0.0252	0.0184	0.111	0.0253	0.00500	0.00500	0.00500	0.00500	0
Dissolved Phosphorus (P)	mg/L	0.120	0.645	0.713	0.900	0.188	0.00750	0.144	0.152	0.251	0.0680	0.00400	0.0207	0.0161	0.0674	0.0181	0.00500	0.00500	0.00500	0.00500	0
Orthophosphate	mg/L	0.00340	0.00568	0.00500	0.0100	0.00225	0.00490	0.00504	0.00500	0.00530	0.000136	0.00380	0.00470	0.00500	0.00500	0.000520	0.00500	0.00500	0.00500	0.00500	0
Total Ammonia (N)	mg/L	0.00500	0.0273	0.0145	0.100	0.0238	0.00700	0.0439	0.0230	0.240	0.0579	0.00500	0.0228	0.0165	0.0610	0.0153	0.00500	0.0126	0.0105	0.0250	0.00664
Total Total Kjeldahl Nitrogen (Calc)	mg/L	0.0800	0.234	0.200	0.538	0.128	0.0310	0.143	0.128	0.249	0.0642	0.0200	0.0953	0.0475	0.350	0.103	0.0880	0.137	0.137	0.220	0.0342
Nitrate plus Nitrite (N)	mg/L	0.00200	0.00329	0.00305	0.00690	0.00142	0.00200	0.00334	0.00200	0.0120	0.00273	0.00200	0.00391	0.00200	0.0209	0.00446	0.232	0.381	0.327	0.629	0.128
Nitrate (N)	mg/L	0.00200	0.00273	0.00200	0.00690	0.00126	0.00200	0.00252	0.00200	0.00700	0.00131	0.00200	0.00391	0.00200	0.0209	0.00446	0.232	0.385	0.327	0.629	0.134
Nitrite (N)	mg/L	0.00200	0.00296	0.00200	0.00890	0.00184	0.00200	0.00281	0.00200	0.0105	0.00223	0.00200	0.00200	0.00200	0.00200	0	0.00200	0.00200	0.00200	0.00200	0
Total Nitrogen (N)	mg/L	0.0840	0.236	0.201	0.538	0.129	0.0340	0.145	0.136	0.256	0.0651	0.0200	0.0982	0.0520	0.350	0.103	0.353	0.522	0.474	0.717	0.132
Dissolved Nitrogen (N)	mg/L	0.0690	0.176	0.152	0.590	0.129	0.0610	0.128	0.138	0.205	0.0447	0.0200	0.229	0.139	0.790	0.242	0.277	0.454	0.436	0.735	0.142
Dissolved Sulphate (SO4)	mg/L	6.73	13.2	12.3	25.5	4.76	8.31	14.7	14.3	24.1	4.31	841	889	890	954	26.7	154	188	190	245	24.9
Total Sulphide	mg/L	0.0310	0.126	0.124	0.212	0.0465	0.0247	0.0608	0.0414	0.140	0.0411	0.00500	0.0209	0.0109	0.0560	0.0173	0.00500	0.00793	0.00540	0.0158	0.00389
Total Sulphide (as H2S)	mg/L	0.0970	0.150	0.145	0.230	0.0373	0.0260	0.0644	0.0440	0.150	0.0435	0.00500	0.0291	0.0270	0.0600	0.0186	0.00500	0.0104	0.00900	0.0170	0.00480
Dissolved Sulphide	mg/L	0.0320	0.0536	0.0527	0.0840	0.0167	0.00560	0.0175	0.0189	0.0270	0.00780	0.00190	0.0345	0.0330	0.0760	0.0273	0.00500	0.00500	0.00500	0.00500	0
Dissolved Sulphide (as H2S)	mg/L	0.0420	0.0548	0.0560	0.0650	0.00835	0.00600	0.0183	0.0200	0.0270	0.00792	0.00200	0.0255	0.0225	0.0550	0.0209	0.00500	0.00500	0.00500	0.00500	0
Cyanides																					
Cyanide, Weak Acid Diss	mg/L	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0
Cyanide, Total	mg/L	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0
Cyanate	mg/L	0.200	0.200	0.200	0.200	0	0.200	0.200	0.200	0.200	0	0.200	0.200	0.200	0.200	0	0.200	0.200	0.200	0.200	0
Thiocyanate (SCN)	mg/L	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0
Total Metals																					
Total Aluminum (Al)	ug/L	8.20	29.5	17.2	116	29.4	4.20	21.6	11.8	94.8	23.1	2.50	9.29	5.81	49.0	10.8	3.49	11.7	5.69	62.2	17.0
Total Antimony (Sb)	ug/L	0.510	0.675	0.670	0.840	0.0914	0.0790	0.161	0.133	0.332	0.0722	0.0400	0.253	0.204	0.742	0.172	0.119	0.171	0.143	0.434	0.0883
Total Arsenic (As)	ug/L	1520	2030	2000	2800	329	130	181	187	225	29.3	4.63	26.8	27.4	45.3	10.8	0.759	0.935	0.979	1.10	0.121
Total Barium (Ba)	ug/L	95.8	220	246	304	65.3	79.5	86.9	85.7	93.9	5.09	7.16	8.61	8.29	11.4	1.18	63.4	78.3	77.1	95.8	10.9
Total Beryllium (Be)	ug/L	0.0110	0.0372	0.0500	0.0500	0.0149	0.0100	0.0100	0.0100	0.0100	0	0.0310	0.0496	0.0475	0.0820	0.0138	0.0100	0.0100	0.0100	0.0100	0
Total Bismuth (Bi)	ug/L	0.00500	0.0238	0.0250	0.0500	0.0180	0.00500	0.00679	0.00500	0.0100	0.00240	0.00500	0.0128	0.00785	0.0250	0.00881	0.00500	0.00500	0.00500	0.00500	0
Total Boron (B)	ug/L	10.0	32.8	50.0	60.0	20.5	10.0	10.3	10.0	11.0	0.452	10.0	23.3	15.0	50.0	17.0	10.0	10.0	10.0	10.0	0
Total Cadmium (Cd)	ug/L	0.0150	0.0387	0.0250	0.130	0.0261	0.00500	0.0120	0.00735	0.0330	0.00998	0.00600	0.0336	0.0250	0.108	0.0282	0.00500	0.00678	0.00560	0.0146	0.00285
Total Calcium (Ca)	mg/L	42.6	52.3	53.1	62.9	4.93	41.0	46.2	45.1	55.6	3.53	222	253	252	283	13.8	104	114	114	130	7.08
Total Chromium (Cr)	ug/L	0.180	0.398	0.500	0.500	0.125	0.100	0.501	0.355	2.05	0.510	0.100	0.552	0.305	3.56	0.791	0.100	0.137	0.115	0.250	0.0441
Total Cobalt (Co)	ug/L	0.260	0.495	0.341	1.13	0.289	0.268	0.536	0.455	0.812	0.189	0.176	0.446	0.388	0.880	0.202	0.0249	0.0986	0.0915	0.211	0.0589
Total Copper (Cu)	ug/L	0.260	0.820	0.505	3.19	0.722	0.0500	0.614	0.272	2.51	0.682	0.0500	0.461	0.250	2.42	0.540	0.739	0.925	0.893	1.19	0.146
Total Iron (Fe)	ug/L	2080	8010	8110	13200	3350	2690	5140	5680	6400	1190	86.4	972	835	2070	531	6.40	22.4	10.5	127	35.1

Monitoring Well		MW14-05A					MW14-05B					MW15-01WB					MW15-02AZ				
Screen Lithology		Granite					Granite					Gneiss					-				
Sample Count		18					14					18					10				
	Statistics	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD
Total Lead (Pb)	ug/L	0.0990	0.275	0.210	0.742	0.175	0.0495	0.848	0.295	3.66	1.04	0.0430	0.445	0.148	4.83	1.08	0.00500	0.0142	0.00580	0.0770	0.0211
Total Lithium (Li)	ug/L	21.4	27.2	26.2	35.3	3.61	20.3	24.2	23.5	33.3	3.82	20.7	24.3	24.4	27.0	1.90	3.76	4.05	4.08	4.30	0.186
Total Magnesium (Mg)	mg/L	7.12	11.0	11.4	13.4	1.61	9.20	9.99	9.89	11.2	0.588	170	186	186	213	10.7	30.6	34.8	34.0	41.0	3.13
Total Manganese (Mn)	ug/L	1080	1880	1990	2320	341	2220	2770	2720	3310	320	333	383	371	531	42.5	0.0870	34.2	34.8	68.7	25.1
Total Mercury (Hg)	ug/L	0.00200	0.00424	0.00200	0.0400	0.00868	0.00200	0.00486	0.00200	0.0400	0.00976	0.00200	0.00200	0.00200	0.00200	0	0.00200	0.00212	0.00200	0.00280	0.000244
Total Molybdenum (Mo)	ug/L	3.65	4.81	4.58	6.45	0.805	1.08	1.69	1.67	2.69	0.505	0.430	0.580	0.491	1.01	0.173	0.348	0.404	0.416	0.436	0.0279
Total Nickel (Ni)	ug/L	0.230	0.705	0.500	1.92	0.498	0.240	0.929	0.630	4.27	1.01	0.616	1.33	1.20	3.03	0.645	0.479	0.694	0.679	1.09	0.174
Total Phosphorus (P)	ug/L	55.0	87.4	78.1	247	42.4	74.8	117	108	222	37.7	2.00	22.8	10.9	209	45.4	2.00	11.7	6.15	39.7	12.4
Total Potassium (K)	mg/L	4.13	5.26	4.97	8.03	1.03	3.90	5.58	5.54	8.89	1.37	4.30	4.79	4.78	5.26	0.242	5.43	7.14	7.42	8.29	0.931
Total Selenium (Se)	ug/L	0.0700	0.161	0.200	0.200	0.0478	0.0400	0.0488	0.0400	0.0940	0.0157	0.0400	0.220	0.0860	1.65	0.372	0.162	0.309	0.190	1.26	0.321
Total Silicon (Si)	ug/L	11500	13400	13400	15300	990	13900	15100	14900	16800	866	6760	8120	8200	8960	587	4840	5200	5210	5560	197
Total Silver (Ag)	ug/L	0.00500	0.0289	0.0250	0.0500	0.0162	0.00500	0.0187	0.0100	0.0650	0.0196	0.00500	0.0131	0.0100	0.0250	0.00868	0.00500	0.00500	0.00500	0.00500	0
Total Sodium (Na)	mg/L	10.7	12.6	11.7	18.4	2.12	12.5	22.2	20.4	41.6	8.32	24.1	26.3	26.1	29.6	1.51	4.64	5.24	5.21	5.87	0.375
Total Strontium (Sr)	ug/L	305	361	341	498	54.4	314	411	391	589	69.4	2550	2900	2900	3230	185	959	1060	1030	1260	84.1
Total Sulphur (S)	mg/L	3.00	10.8	15.0	15.0	4.91	3.00	5.36	4.70	10.0	1.94	268	295	295	316	13.2	55.9	65.4	64.8	83.1	7.74
Total Thallium (Tl)	ug/L	0.00200	0.0108	0.0100	0.0240	0.00651	0.00200	0.00299	0.00200	0.0100	0.00214	0.00590	0.0221	0.0164	0.109	0.0233	0.00200	0.00501	0.00485	0.00900	0.00204
Total Tin (Sn)	ug/L	0.200	0.701	1.00	1.00	0.343	0.200	0.365	0.240	0.920	0.225	0.200	0.467	0.300	1.00	0.340	0.200	0.200	0.200	0.200	0
Total Titanium (Ti)	ug/L	0.650	4.57	2.63	10.0	3.52	0.690	2.35	2.00	7.49	1.73	0.500	1.70	1.15	4.00	1.23	0.500	0.923	0.500	4.73	1.27
Total Uranium (U)	ug/L	3.84	13.0	7.74	36.5	9.87	1.20	2.45	1.86	6.97	1.61	490	542	540	598	25.1	23.5	27.4	27.3	30.4	2.11
Total Vanadium (V)	ug/L	0.200	0.661	1.00	1.00	0.381	0.200	0.410	0.410	0.780	0.184	0.200	0.468	0.315	1.00	0.339	0.200	0.268	0.240	0.430	0.0773
Total Zinc (Zn)	ug/L	2.69	6.80	5.00	19.1	4.69	0.890	2.40	1.63	5.50	1.52	4.11	36.8	20.8	138	36.7	0.100	0.595	0.210	1.72	0.560
Total Zirconium (Zr)	ug/L	0.100	0.336	0.500	0.500	0.184	0.170	0.301	0.290	0.510	0.0967	0.380	0.818	0.860	1.17	0.280	0.110	0.139	0.140	0.170	0.0207
Dissolved Metals																					
Dissolved Aluminum (Al)	ug/L	1.78	9.92	5.65	54.5	12.4	1.41	3.13	3.03	5.13	1.19	0.500	4.47	2.50	16.2	4.34	1.90	5.04	3.52	14.8	3.71
Dissolved Antimony (Sb)	ug/L	0.390	0.553	0.530	1.09	0.155	0.0730	0.133	0.117	0.304	0.0617	0.0570	0.236	0.173	0.808	0.191	0.116	0.168	0.143	0.435	0.0900
Dissolved Arsenic (As)	ug/L	1480	1930	1980	2650	301	150	182	188	212	21.5	6.79	25.2	23.8	48.6	11.1	0.643	0.919	0.883	1.17	0.162
Dissolved Barium (Ba)	ug/L	93.4	218	250	280	64.7	77.6	84.9	84.3	97.1	5.36	7.30	8.46	8.11	11.2	1.16	58.6	75.8	72.8	96.6	12.7
Dissolved Beryllium (Be)	ug/L	0.0150	0.0374	0.0500	0.0500	0.0159	0.0100	0.0100	0.0100	0.0100	0	0.0100	0.0424	0.0445	0.0580	0.0126	0.0100	0.0100	0.0100	0.0100	0
Dissolved Bismuth (Bi)	ug/L	0.00500	0.0174	0.0250	0.0250	0.00952	0.00500	0.00500	0.00500	0.00500	0	0.00500	0.0124	0.0100	0.0250	0.00814	0.00500	0.00500	0.00500	0.00500	0
Dissolved Boron (B)	ug/L	10.0	34.4	50.0	50.0	19.5	10.0	10.6	10.0	13.0	1.05	10.0	24.0	20.0	50.0	16.6	10.0	10.0	10.0	10.0	0
Dissolved Cadmium (Cd)	ug/L	0.00500	0.0176	0.0250	0.0260	0.00945	0.00500	0.00500	0.00500	0.00500	0	0.00500	0.0214	0.0166	0.0607	0.0155	0.00500	0.0177	0.00500	0.125	0.0358
Dissolved Calcium (Ca)	mg/L	43.2	52.0	52.6	58.0	4.51	43.1	46.8	46.3	56.6	3.76	228	251	250	266	9.66	101	118	117	135	9.20
Dissolved Chromium (Cr)	ug/L	0.100	0.359	0.500	0.500	0.177	0.100	0.231	0.140	0.700	0.204	0.100	0.286	0.200	0.940	0.228	0.100	0.132	0.105	0.200	0.0404
Dissolved Cobalt (Co)	ug/L	0.196	0.415	0.263	1.17	0.290	0.253	0.464	0.403	0.719	0.158	0.191	0.440	0.397	0.888	0.197	0.0217	0.101	0.101	0.207	0.0511
Dissolved Copper (Cu)	ug/L	0.0500	0.272	0.250	1.16	0.248	0.0500	0.0784	0.0500	0.207	0.0525	0.0500	0.267	0.221	1.07	0.263	0.567	0.938	0.867	1.34	0.267
Dissolved Iron (Fe)	ug/L	1920	7850	8180	12100	3310	2620	4960	5430	6150	1140	2.60	845	793	1980	585	2.80	9.71	9.85	15.8	4.55
Dissolved Lead (Pb)	ug/L	0.00600	0.0469	0.0250	0.257	0.0597	0.00500	0.00651	0.00500	0.0180	0.00341	0.00500	0.0374	0.0238	0.225	0.0512	0.00500	0.00679	0.00500	0.0210	0.00477
Dissolved Lithium (Li)	ug/L	23.1	27.9	27.0	36.7	3.80	20.0	24.7	23.0	35.1	4.49	17.3	24.3	24.8	29.2	2.38	3.71	4.20	4.25	4.56	0.212
Dissolved Magnesium (Mg)	mg/L	8.42	11.0	11.6	14.4	1.52	9.45	9.90	9.65	11.3	0.539	175	185	184	208	8.53	31.8	36.1	34.2	43.1	4.56
Dissolved Manganese (Mn)	ug/L	1100	1870	1940	2320	328	2220	2780	2730	3430	351	340	380	370	541	42.8	0.0500	40.1	39.3	93.7	30.3
Dissolved Mercury (Hg)	ug/L	0.00200	0.00219	0.00200	0.00510	0.000711	0.00200	0.00200	0.00200	0.00200	0	0.00200	0.00200	0.00200	0.00200	0	0.00200	0.00209	0.00200	0.00280	0.000239
Dissolved Molybdenum (Mo)	ug/L	3.71	4.50	4.34	5.81	0.577	0.987	1.50	1.52	2.35	0.442	0.310	0.591	0.485	1.04	0.230	0.354	0.398	0.410	0.436	0.0267
Dissolved Nickel (Ni)	ug/L	0.130	0.471	0.330	1.39	0.413	0.180	0.470	0.337	1.49	0.340	0.570	1.21	1.07	2.38	0.557	0.481	0.742	0.714	1.26	0.194
Dissolved Phosphorus (P)	ug/L	43.0	70.7	69.0	124	20.9	64.8	100	78.2	201	38.7	2.00	15.6	11.1	68.3	13.9	3.60	12.5	4.95	50.7	15.9
Dissolved Potassium (K)	mg/L	4.03	5.25	5.10	7.12	0.942	4.04	5.67	5.61	9.02	1.47	4.44	4.90	4.84	5.53	0.318	5.36	7.56	7.67	10.2	1.25
Dissolved Selenium (Se)	ug/L	0.0680	0.156	0.200	0.200	0.0558	0.0400	0.0508	0.0400	0.111	0.0211	0.0400	0.120	0.101	0.200	0.0598	0.121	0.288	0.199	1.10	0.275
Dissolved Silicon (Si)	ug/L	11800	13500	13400	15500	913	14000	15200	14900	16400	823	6520	7770	7860	8710	574	4710	5270	5190	5890	346
Dissolved Silver (Ag)	ug/L	0.00500	0.0172	0.0250	0.0250	0.00972	0.00500	0.00500	0.00500	0.00500	0	0.00500	0.0120	0.0100	0.0250	0.00831	0.00500	0.00500	0.00500	0.00500	0
Dissolved Sodium (Na)	mg/L	10.5	13.2	12.4	23.2	2.98	13.1	22.1	21.4	37.9	7.87	24.6	26.2	25.9	29.6	1.15	4.67	5.49	5.52	6.09	0.461
Dissolved Strontium (Sr)	ug/L	301	358	349	459	46.5	314	409	399	608	80.5	2570	2890	2900	3350	207	943	1070	1050	1200	91.2
Dissolved Sulphur (S)	mg/L	3.50	11.6	15.0	15.0	4.44	3.00	5.29	4.50	10.4	1.98	274	293	292	324	12.3	58.4	68.5	67.3	82.5	8.66
Dissolved Thallium (Tl)	ug/L	0.00200	0.00909	0.0100	0.0260	0.00517	0.00200	0.00245	0.00200	0.00700	0.00131	0.00400	0.0210	0.0120	0.101	0.0223	0.00200	0.00486	0.00500	0.00700	0.00149
Dissolved Tin (Sn)	ug/L	0.200	0.689	1.00	1.00	0.390	0.200	0.209	0.200	0.270	0.0213	0.200	0.563	0.400	1.74	0.434	0.200	0.200	0.200	0.200	0
Dissolved Titanium (Ti)	ug/L	0.500	1.89	2.50	4.40	1.15	0.500	0.739	0.500	2.08	0.455	0.500	1.20	1.00	2.50	0.832	0.500	0.505	0.500	0.550	0.0150
Dissolved Uranium (U)	ug/L	3.90	13.1	7.66	32.5	10.2	1.16	2.38	1.88	6.78	1.57	526	545	541	589	16.5	23.9	27.0	26.4	31.4	2.77
Dissolved Vanadium (V)	ug/L	0.200	0.691	1.00	1.00	0.387	0.200	0.391	0.315	0.800	0.192	0.200	0.482	0.400	1.00	0.331	0.200	0.259	0.225	0.390	0.0711
Dissolved Zinc (Zn)	ug/L	0.220	2.08	0.815	11.2	2.78	0.360	1.01	0.655	2.97	0.690	7.30	49.2	22.0	181	52.5	0.100	1.31	0.360	8.64	2.48
Dissolved Zirconium (Zr)	ug/L	0.100	0.354	0.500	0.500	0.183	0.160	0.306	0.305	0.500	0.104	0.410	0.802	0.805	1.20	0.240	0.100	0.144	0.130	0.200	0.0361

Notes:

1. Where analytical results are below the reportable detection limit (<RDL), the RDL values are used in the statistical calculations.
2. Analytical results for the following samples have been excluded from the statistical calculations: MW14-03A (12-Oct-2014), MW14-03B (06-Oct-2014), MW14-05A (02-Oct-2014), MW14-05B (03-Oct-2014, 24-Jun-2015, 14-Jul-2015, 09-Aug-2015, 08-Sep-2015), and MW15-06WB (21-Jun-2015). See Appendix 5-D for further discussion.
3. Analytical results for dissolved organic carbon and total organic carbon for all samples collected at Westbay monitoring wells (MW15-01WB to MW15-06WB, and MW16-01WB) have been excluded from the statistical calculations. See Appendix 5-D for further discussion.
4. SD = Standard Deviati

Monitoring Well		MW15-02WB					MW15-03AZ					MW15-03WB					MW15-04WB				
Screen Lithology		Schist					-					Gniess					Gniess				
Sample Count		18					12					18					18				
Statistics		Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD
Field Paramaters	Units																				
pH (field)	pH	7.07	7.38	7.36	7.66	0.139	6.64	7.22	7.05	8.88	0.558	7.02	7.56	7.57	8.33	0.279	5.50	7.29	7.36	8.32	0.633
Specific Conductance (field)	uS/cm	480	826	880	941	126	128	229	219	322	54.0	1440	1890	1950	2080	166	418	630	648	745	68.8
DO (field)	mg/L	4.04	8.14	7.83	11.9	2.00	0.270	1.16	1.17	2.93	0.857	3.30	8.05	8.30	11.9	1.95	4.76	10.0	10.2	19.2	3.86
ORP (field)	ORP mV	-31.8	58.0	54.3	224	64.6	-233	56.1	80.5	136	93.7	-172	-49.6	-50.8	24.0	46.4	9.50	109	83.7	281	69.8
Temperature (field)	°C	0.100	5.24	4.86	11.5	3.01	0.800	1.92	1.90	3.10	0.648	2.20	7.70	7.83	13.7	3.55	0.400	5.57	5.49	13.8	3.04
Physical Properties																					
Conductivity (lab)	uS/cm	813	874	868	937	34.3	207	245	244	323	36.5	1820	1970	2010	2060	75.2	577	642	643	685	26.9
pH (lab)	pH	7.66	8.06	8.09	8.33	0.181	7.71	7.87	7.86	8.04	0.115	7.88	8.03	8.01	8.27	0.0999	7.84	8.11	8.09	8.40	0.148
Total Hardness (CaCO3)	mg/L	428	465	465	532	22.5	93.8	114	112	151	17.0	856	1020	1040	1190	82.7	292	336	333	390	23.4
Dissolved Hardness (CaCO3)	mg/L	432	472	469	532	25.0	96.6	119	117	151	16.4	910	1030	1030	1120	69.2	305	336	333	391	18.9
Total Suspended Solids	mg/L	1.00	1.16	1.00	3.10	0.491	1.00	1.13	1.00	2.60	0.442	1.50	4.59	2.80	29.0	6.13	1.00	1.03	1.00	1.50	0.115
Total Dissolved Solids	mg/L	540	601	604	638	30.0	120	158	155	216	25.1	1370	1620	1650	1750	101	364	411	404	464	28.5
Turbidity	NTU	0.130	0.973	0.905	2.24	0.711	0.100	0.189	0.125	0.510	0.119	3.45	6.69	4.92	20.2	4.02	0.100	0.251	0.225	0.600	0.118
Inorganics																					
Alkalinity (Total as CaCO3)	mg/L	206	250	252	292	17.8	78.1	88.9	85.2	110	10.2	141	150	151	159	3.99	203	225	227	238	10.1
Alkalinity (PP as CaCO3)	mg/L	0.500	0.646	0.500	2.34	0.448	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.833	0.500	4.82	1.04
Bicarbonate (HCO3)	mg/L	251	305	306	357	21.8	95.3	108	104	134	12.5	171	183	184	194	5.15	248	273	275	290	11.7
Carbonate (CO3)	mg/L	0.500	0.686	0.500	2.81	0.567	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.911	0.500	5.78	1.28
Hydroxide (OH)	mg/L	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0
Bromide (Br)	mg/L	0.0100	0.0487	0.0490	0.100	0.0332	0.0100	0.0120	0.0100	0.0260	0.00529	0.0500	0.154	0.105	0.300	0.0810	0.0100	0.0304	0.0215	0.100	0.0293
Fluoride (F)	mg/L	0.0100	0.133	0.120	0.210	0.0460	0.0480	0.0603	0.0600	0.0670	0.00487	0.130	0.199	0.200	0.270	0.0412	0.0960	0.109	0.110	0.120	0.00660
Dissolved Chloride (Cl)	mg/L	0.500	0.805	0.780	1.50	0.246	0.500	0.660	0.605	1.00	0.157	8.50	10.5	11.0	12.0	1.08	0.500	0.746	0.715	1.80	0.298
Organic / Inorganic Carbon																					
Dissolved Organic Carbon (C)	mg/L	-	-	-	-	-	7.11	8.71	8.74	10.0	0.904	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon (C)	mg/L	-	-	-	-	-	7.12	9.11	9.10	11.0	1.04	-	-	-	-	-	-	-	-	-	-
Anions and Nutrients																					
Total Phosphorus (P)	mg/L	0.00300	0.0181	0.00500	0.107	0.0305	0.00500	0.00508	0.00500	0.00560	0.000185	0.00300	0.0137	0.00500	0.0897	0.0212	0.00300	0.0135	0.00500	0.105	0.0256
Dissolved Phosphorus (P)	mg/L	0.00240	0.00538	0.00500	0.0201	0.00384	0.00440	0.00501	0.00500	0.00570	0.000278	0.00300	0.0130	0.00500	0.0633	0.0168	0.00300	0.0133	0.00520	0.0951	0.0229
Orthophosphate	mg/L	0.00300	0.00420	0.00500	0.00500	0.000980	0.00300	0.00433	0.00500	0.00500	0.000943	0.00300	0.00424	0.00500	0.00500	0.000933	0.00360	0.00465	0.00500	0.00500	0.000606
Total Ammonia (N)	mg/L	0.00500	0.0174	0.0135	0.0600	0.0125	0.00500	0.0164	0.0190	0.0400	0.0101	0.00500	0.0789	0.0210	0.920	0.205	0.00500	0.0287	0.0180	0.190	0.0404
Total Total Kjeldahl Nitrogen (Calc)	mg/L	0.0290	0.152	0.129	0.370	0.0783	0.180	0.252	0.241	0.336	0.0452	0.0360	0.124	0.0800	0.450	0.104	0.0440	0.195	0.141	0.620	0.155
Nitrate plus Nitrite (N)	mg/L	0.00200	0.121	0.108	0.331	0.119	0.0255	0.194	0.170	0.445	0.124	0.00200	0.00329	0.00200	0.00970	0.00213	0.0787	0.270	0.264	0.519	0.129
Nitrate (N)	mg/L	0.00200	0.121	0.107	0.331	0.119	0.0255	0.196	0.178	0.445	0.123	0.00200	0.00315	0.00200	0.00970	0.00208	0.0661	0.260	0.258	0.519	0.133
Nitrite (N)	mg/L	0.00200	0.00206	0.00200	0.00260	0.000174	0.00200	0.00200	0.00200	0.00200	0	0.00200	0.00245	0.00200	0.00960	0.00174	0.00200	0.00988	0.0113	0.0204	0.00602
Total Nitrogen (N)	mg/L	0.111	0.281	0.243	0.620	0.138	0.207	0.444	0.455	0.663	0.142	0.0400	0.125	0.0840	0.450	0.104	0.200	0.456	0.375	0.910	0.235
Dissolved Nitrogen (N)	mg/L	0.106	0.365	0.344	0.810	0.177	0.236	0.515	0.529	0.710	0.156	0.0200	0.174	0.200	0.510	0.128	0.0650	0.479	0.447	0.920	0.258
Dissolved Sulphate (SO4)	mg/L	184	219	219	260	22.2	21.7	35.4	36.5	53.0	9.93	873	1020	1060	1120	74.0	115	131	128	158	11.7
Total Sulphide	mg/L	0.00500	0.00747	0.00640	0.0110	0.00223	0.00500	0.00732	0.00730	0.0107	0.00184	0.00500	0.0378	0.0128	0.163	0.0491	0.00500	0.00719	0.00720	0.0113	0.00197
Total Sulphide (as H2S)	mg/L	0.00500	0.00838	0.00850	0.0120	0.00250	0.00500	0.00860	0.00900	0.0110	0.00206	0.00500	0.0538	0.0470	0.170	0.0556	0.00500	0.00789	0.00800	0.0120	0.00228
Dissolved Sulphide	mg/L	0.00180	0.00343	0.00345	0.00500	0.00157	0.00180	0.00393	0.00500	0.00500	0.00151	0.0780	0.137	0.123	0.190	0.0421	0.00180	0.00392	0.00240	0.00850	0.00257
Dissolved Sulphide (as H2S)	mg/L	0.00190	0.00382	0.00500	0.00530	0.00157	0.00180	0.00403	0.00500	0.00530	0.00158	0.0830	0.131	0.125	0.190	0.0384	0.00180	0.00453	0.00365	0.00900	0.00293
Cyanides																					
Cyanide, Weak Acid Diss	mg/L	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0
Cyanide, Total	mg/L	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0
Cyanate	mg/L	0.200	0.200	0.200	0.200	0	0.200	0.200	0.200	0.200	0	0.200	0.200	0.200	0.200	0	0.200	0.200	0.200	0.200	0
Thiocyanate (SCN)	mg/L	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0
Total Metals																					
Total Aluminum (Al)	ug/L	1.61	5.66	3.12	22.9	5.17	13.2	99.1	19.7	935	252	1.95	40.8	21.3	338	73.7	1.19	5.74	4.05	23.8	5.11
Total Antimony (Sb)	ug/L	0.0440	0.0973	0.0795	0.343	0.0640	0.128	0.195	0.200	0.236	0.0305	0.0200	0.0690	0.0715	0.100	0.0297	1.07	1.90	2.00	2.88	0.575
Total Arsenic (As)	ug/L	0.358	1.47	1.38	2.99	1.01	0.409	0.577	0.500	1.52	0.287	0.0400	0.533	0.486	1.37	0.342	0.789	1.36	1.23	2.01	0.365
Total Barium (Ba)	ug/L	20.8	34.2	34.8	49.8	10.7	25.8	31.7	30.7	38.0	3.81	8.41	12.6	13.0	17.0	2.33	24.8	30.4	29.8	37.6	3.43
Total Beryllium (Be)	ug/L	0.0100	0.0120	0.0100	0.0170	0.00275	0.0100	0.0148	0.0110	0.0500	0.0108	0.0100	0.0318	0.0200	0.0740	0.0200	0.0100	0.0123	0.0100	0.0500	0.00915
Total Bismuth (Bi)	ug/L	0.00500	0.00611	0.00500	0.0100	0.00208	0.00500	0.00750	0.00500	0.0200	0.00433	0.00500	0.0172	0.0200	0.0500	0.0117	0.00500	0.00639	0.00500	0.0250	0.00466
Total Boron (B)	ug/L	10.0	10.0	10.0	10.0	0	10.0	13.3	10.0	50.0	11.1	18.0	35.7	31.0	50.0	12.0	10.0	12.2	10.0	50.0	9.16
Total Cadmium (Cd)	ug/L	0.00500	0.0217	0.0155	0.0810	0.0188	0.00500	0.00964	0.00930	0.0185	0.00440	0.00500	0.0174	0.0203	0.0320	0.00880	0.0152	0.0463	0.0420	0.125	0.0274
Total Calcium (Ca)	mg/L	117	128	128	143	5.64	24.5	30.5	29.6	41.0	4.82	149	175	180	200	14.2	65.3	73.6	72.2	84.7	4.93
Total Chromium (Cr)	ug/L	0.100	0.571	0.165	3.81	0.929	0.170	0.359	0.200	2.05	0.511	0.100	0.791	0.500	4.45	0.989	0.100	0.478	0.235	2.30	0.586
Total Cobalt (Co)	ug/L	0.0278	0.0759	0.0693	0.154	0.0363	0.0313	0.0955	0.0380	0.649	0.167	0.0180	0.0581	0.0405	0.187	0.0479	0.165	0.247	0.240	0.340	0.0459
Total Copper (Cu)	ug/L	0.120	1.15	1.52	2.57	0.821	1.39	1.64	1.62	1.99	0.183	0.0610	0.252	0.250	0.500	0.110	0.962	1.40	1.19	2.85	0.482
Total Iron (Fe)	ug/L	5.20	179	102	412	172	5.70	139	9.20	1530	419	504	796	683	1420	287	4.80	26.9	23.0	59.2	15.0

Monitoring Well		MW15-02WB					MW15-03AZ					MW15-03WB					MW15-04WB				
Screen Lithology		Schist					-					Gniess					Gniess				
Sample Count		18					12					18					18				
	Statistics	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD
Total Lead (Pb)	ug/L	0.0100	0.113	0.0934	0.362	0.102	0.00500	0.0513	0.0133	0.472	0.127	0.00500	0.0593	0.0400	0.350	0.0735	0.127	0.409	0.365	0.771	0.150
Total Lithium (Li)	ug/L	3.29	3.84	3.83	4.57	0.292	0.560	0.751	0.685	1.32	0.197	9.00	11.7	12.0	13.5	1.06	5.95	6.61	6.67	7.66	0.493
Total Magnesium (Mg)	mg/L	30.7	35.3	35.0	42.9	2.35	7.63	9.17	8.78	11.9	1.27	118	142	142	167	11.9	31.2	36.9	36.7	43.9	2.90
Total Manganese (Mn)	ug/L	2.04	50.8	49.3	110	43.2	15.0	61.1	43.8	214	52.0	72.4	88.9	90.9	104	10.3	73.8	117	120	161	23.0
Total Mercury (Hg)	ug/L	0.00200	0.00201	0.00200	0.00210	0.0000229	0.00200	0.00276	0.00225	0.00670	0.00129	0.00200	0.00210	0.00200	0.00380	0.000412	0.00200	0.00206	0.00200	0.00310	0.000252
Total Molybdenum (Mo)	ug/L	0.437	0.649	0.598	1.30	0.223	0.308	0.468	0.483	0.534	0.0628	0.370	0.928	0.893	2.42	0.436	1.92	2.27	2.20	2.62	0.212
Total Nickel (Ni)	ug/L	0.552	1.32	1.03	3.51	0.750	0.602	0.928	0.745	1.79	0.338	0.100	0.907	0.410	2.96	0.899	0.472	0.924	0.744	2.71	0.537
Total Phosphorus (P)	ug/L	3.90	9.95	6.05	46.7	10.4	5.00	12.5	7.75	40.9	10.8	6.60	20.4	10.0	83.0	19.6	4.10	20.1	9.25	119	27.1
Total Potassium (K)	mg/L	8.43	9.62	9.51	11.5	0.980	1.47	1.60	1.55	1.82	0.120	7.13	8.62	8.78	9.67	0.523	3.53	4.01	3.91	4.90	0.386
Total Selenium (Se)	ug/L	0.0400	0.164	0.169	0.346	0.0925	0.0400	0.0533	0.0545	0.0720	0.00843	0.0400	0.305	0.109	2.32	0.560	0.0400	0.302	0.210	1.64	0.348
Total Silicon (Si)	ug/L	4320	4880	4910	5560	305	4670	4950	4940	5320	174	6290	7890	7960	8600	532	5440	6010	5920	7090	421
Total Silver (Ag)	ug/L	0.00500	0.00611	0.00500	0.0100	0.00208	0.00500	0.00630	0.00500	0.0100	0.00214	0.00500	0.0176	0.0200	0.0500	0.0114	0.00500	0.0130	0.00500	0.114	0.0250
Total Sodium (Na)	mg/L	5.47	7.09	6.94	10.1	1.39	2.69	3.39	3.42	4.00	0.330	60.7	74.4	73.9	84.9	5.23	5.26	6.04	5.97	7.44	0.481
Total Strontium (Sr)	ug/L	857	953	952	1050	50.8	198	238	226	307	35.4	8040	9890	10200	11200	890	735	807	797	908	44.5
Total Sulphur (S)	mg/L	67.8	79.6	81.3	90.5	5.57	7.20	11.4	11.9	17.4	3.33	293	350	359	393	27.1	35.5	41.4	40.6	48.2	3.53
Total Thallium (Tl)	ug/L	0.00380	0.0142	0.0150	0.0310	0.00862	0.00200	0.00441	0.00240	0.0240	0.00597	0.00300	0.00785	0.00750	0.0172	0.00337	0.00200	0.00904	0.00945	0.0149	0.00322
Total Tin (Sn)	ug/L	0.200	0.200	0.200	0.200	0	0.200	0.200	0.200	0.200	0	0.200	0.556	0.400	1.00	0.362	0.200	0.244	0.200	1.00	0.183
Total Titanium (Ti)	ug/L	0.500	0.873	0.500	2.00	0.621	0.500	6.19	0.730	62.4	17.0	0.500	2.69	2.50	10.0	2.39	0.500	0.712	0.500	2.50	0.555
Total Uranium (U)	ug/L	26.8	31.8	32.0	36.4	2.44	13.7	21.2	18.3	36.3	7.54	4.96	7.49	7.60	12.7	1.65	104	141	142	176	19.9
Total Vanadium (V)	ug/L	0.200	0.203	0.200	0.230	0.00803	0.200	0.364	0.200	2.08	0.518	0.200	0.595	0.460	1.00	0.353	0.200	0.274	0.200	1.00	0.182
Total Zinc (Zn)	ug/L	5.61	23.7	20.3	57.0	15.5	0.140	1.86	0.785	7.96	2.49	2.97	19.5	13.3	56.0	17.2	3.49	25.6	14.1	122	30.0
Total Zirconium (Zr)	ug/L	0.100	0.456	0.395	1.03	0.343	0.270	0.333	0.320	0.410	0.0438	0.100	0.487	0.295	3.48	0.749	0.110	0.218	0.205	0.500	0.0796
Dissolved Metals																					
Dissolved Aluminum (Al)	ug/L	0.890	2.39	2.04	6.92	1.50	13.6	19.9	17.9	38.1	7.07	1.42	11.0	5.15	72.7	16.9	0.500	5.40	1.29	44.1	10.6
Dissolved Antimony (Sb)	ug/L	0.0380	0.0995	0.0790	0.375	0.0716	0.137	0.202	0.192	0.277	0.0395	0.0200	0.0792	0.0995	0.100	0.0274	1.09	1.90	1.84	3.02	0.595
Dissolved Arsenic (As)	ug/L	0.385	1.37	1.47	2.71	0.904	0.431	0.514	0.511	0.620	0.0494	0.120	0.729	0.479	5.32	1.14	0.914	1.37	1.32	2.27	0.379
Dissolved Barium (Ba)	ug/L	21.9	34.0	35.8	52.0	10.5	24.5	31.8	31.5	37.9	3.61	8.83	12.8	12.6	17.6	2.15	24.9	30.0	29.5	33.8	2.30
Dissolved Beryllium (Be)	ug/L	0.0100	0.0115	0.0100	0.0190	0.00261	0.0100	0.0113	0.0110	0.0150	0.00155	0.0100	0.0311	0.0350	0.0500	0.0191	0.0100	0.0150	0.0100	0.100	0.0206
Dissolved Bismuth (Bi)	ug/L	0.00500	0.00500	0.00500	0.00500	0	0.00500	0.00508	0.00500	0.00600	0.000276	0.00500	0.0161	0.0199	0.0250	0.00921	0.00500	0.0604	0.00500	1.00	0.228
Dissolved Boron (B)	ug/L	10.0	10.0	10.0	10.0	0	10.0	10.0	10.0	10.0	0	25.0	41.3	46.0	62.0	11.0	10.0	12.2	10.0	50.0	9.16
Dissolved Cadmium (Cd)	ug/L	0.00500	0.0158	0.0108	0.0420	0.0107	0.00500	0.00881	0.00665	0.0258	0.00563	0.00500	0.0188	0.0250	0.0481	0.0110	0.0120	0.0370	0.0315	0.0999	0.0214
Dissolved Calcium (Ca)	mg/L	120	130	129	144	6.44	25.9	32.0	31.0	40.6	4.62	156	176	176	199	11.8	66.8	74.1	72.8	84.4	4.46
Dissolved Chromium (Cr)	ug/L	0.100	0.212	0.100	1.92	0.415	0.120	0.203	0.205	0.280	0.0409	0.100	0.336	0.465	0.500	0.179	0.100	0.170	0.100	1.00	0.211
Dissolved Cobalt (Co)	ug/L	0.0246	0.0766	0.0646	0.184	0.0436	0.0315	0.0493	0.0426	0.0861	0.0163	0.0100	0.0396	0.0250	0.123	0.0288	0.163	0.254	0.234	0.500	0.0736
Dissolved Copper (Cu)	ug/L	0.0950	1.07	1.20	2.64	0.809	1.36	1.64	1.66	1.98	0.191	0.0520	0.180	0.244	0.260	0.0814	0.514	1.07	1.07	2.26	0.345
Dissolved Iron (Fe)	ug/L	2.70	111	13.8	377	143	5.80	11.2	9.00	21.3	5.35	5.60	577	559	1420	361	3.10	16.6	12.5	43.7	11.3
Dissolved Lead (Pb)	ug/L	0.00500	0.0502	0.0215	0.312	0.0737	0.00500	0.00847	0.00500	0.0257	0.00669	0.00500	0.0202	0.0250	0.0460	0.0109	0.130	0.270	0.265	0.439	0.0980
Dissolved Lithium (Li)	ug/L	3.38	3.85	3.80	4.45	0.294	0.500	0.808	0.735	1.33	0.213	10.0	11.7	11.8	15.2	1.10	5.98	6.74	6.67	7.69	0.440
Dissolved Magnesium (Mg)	mg/L	31.9	35.6	35.4	43.3	2.48	7.73	9.43	9.33	12.1	1.23	123	143	143	160	10.3	33.5	36.7	36.7	43.7	2.34
Dissolved Manganese (Mn)	ug/L	1.60	51.7	53.8	111	43.1	15.2	63.5	46.0	225	53.6	73.5	88.6	90.3	104	8.24	79.1	118	121	152	21.7
Dissolved Mercury (Hg)	ug/L	0.00200	0.00217	0.00200	0.00500	0.000687	0.00200	0.00281	0.00255	0.00540	0.000967	0.00200	0.00205	0.00200	0.00250	0.000142	0.00200	0.00248	0.00200	0.0100	0.00183
Dissolved Molybdenum (Mo)	ug/L	0.424	0.625	0.576	1.31	0.197	0.447	0.488	0.483	0.527	0.0281	0.345	0.831	0.856	1.24	0.287	2.03	2.26	2.18	2.60	0.200
Dissolved Nickel (Ni)	ug/L	0.529	1.03	0.960	2.16	0.372	0.654	0.869	0.783	1.40	0.217	0.100	0.593	0.244	2.01	0.598	0.430	0.684	0.619	1.20	0.207
Dissolved Phosphorus (P)	ug/L	2.00	8.45	7.10	30.5	6.91	3.00	15.1	5.90	78.8	20.8	4.80	12.5	10.0	52.8	10.9	2.70	14.4	7.10	102	22.7
Dissolved Potassium (K)	mg/L	7.96	9.73	9.98	11.0	0.922	1.51	1.65	1.66	1.86	0.101	8.04	8.84	8.74	10.0	0.477	3.61	3.98	3.93	4.47	0.268
Dissolved Selenium (Se)	ug/L	0.0400	0.170	0.174	0.373	0.0989	0.0410	0.0538	0.0515	0.0750	0.00892	0.0400	0.206	0.200	1.08	0.233	0.0630	0.197	0.185	0.369	0.0873
Dissolved Silicon (Si)	ug/L	4140	4960	4990	5880	384	4810	5150	5150	5570	246	6990	7950	7920	10300	702	5550	6120	6130	6850	340
Dissolved Silver (Ag)	ug/L	0.00500	0.00500	0.00500	0.00500	0	0.00500	0.00500	0.00500	0.00500	0	0.00500	0.0162	0.0175	0.0250	0.00890	0.00500	0.00583	0.00500	0.0200	0.00344
Dissolved Sodium (Na)	mg/L	5.50	7.19	7.34	9.45	1.32	3.07	3.54	3.47	4.16	0.283	68.4	74.8	74.7	82.6	3.49	5.52	6.03	5.92	7.51	0.452
Dissolved Strontium (Sr)	ug/L	884	953	945	1060	46.9	198	248	243	303	31.8	8190	10000	9880	12100	875	744	818	802	940	51.5
Dissolved Sulphur (S)	mg/L	63.4	79.9	80.7	93.9	7.36	6.80	11.7	12.3	18.0	3.62	294	351	354	387	27.1	36.4	41.8	41.3	51.7	3.95
Dissolved Thallium (Tl)	ug/L	0.00380	0.0138	0.0131	0.0251	0.00783	0.00200	0.00226	0.00200	0.00450	0.000685	0.00200	0.00707	0.00850	0.0100	0.00320	0.00580	0.0108	0.00800	0.0500	0.00972
Dissolved Tin (Sn)	ug/L	0.200	0.229	0.200	0.730	0.121	0.200	0.200	0.200	0.200	0	0.200	0.622	0.700	1.00	0.382	0.200	0.467	0.200	5.00	1.10
Dissolved Titanium (Ti)	ug/L	0.500	0.523	0.500	0.910	0.0939	0.500	0.513	0.500	0.560	0.0228	0.500	1.62	2.05	2.50	0.921	0.500	0.750	0.500	5.00	1.03
Dissolved Uranium (U)	ug/L	25.3	31.6	32.6	37.4	2.87	14.2	21.8	19.0	35.4	7.05	5.66	7.29	7.36	9.09	0.918	107	141	139	176	17.9
Dissolved Vanadium (V)	ug/L	0.200	0.208	0.200	0.310	0.0257	0.200	0.229	0.215	0.320	0.0362	0.200	0.623	0.700	1.00	0.381	0.200	0.485	0.200	5.00	1.10
Dissolved Zinc (Zn)	ug/L	5.91	22.2	21.0	44.5	12.7	0.100	1.62	0.325	7.61	2.24	0.500	13.9	3.43	107	26.1	4.51	16.7	9.94	57.6	15.0
Dissolved Zirconium (Zr)	ug/L	0.100	0.462	0.410	1.00	0.345	0.280	0.348	0.335	0.440	0.0506	0.100	0.342	0.500	0.520	0.182	0.160	0.205	0.180	0.500	0.0767

Notes:

1. Where analytical results are below the reportable detection limit (<RDL), the RDL values are used in the statistical calculations.
2. Analytical results for the following samples have been excluded from the statistical calculations: MW14-03A (12-Oct-2014), MW14-03B (06-Oct-2014), MW14-05A (02-Oct-2014), MW14-05B (03-Oct-2014, 24-Jun-2015, 14-Jul-2015, 09-Aug-2015, 08-Sep-2015), and MW15-06WB (21-Jun-2015). See Appendix 5-D for further discussion.
3. Analytical results for dissolved organic carbon and total organic carbon for all samples collected at Westbay monitoring wells (MW15-01WB to MW15-06WB, and MW16-01WB) have been excluded from the statistical calculations. See Appendix 5-D for further discussion.
4. SD = Standard Deviati

Monitoring Well		MW15-05AZ					MW15-05WB					MW15-06WB					MW16-01WB				
Screen Lithology		-					Granite					Gniess					Granite				
Sample Count		1					18					17					12				
Statistics		Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD
Field Paramaters	Units																				
pH (field)	pH	5.76	5.76	5.76	5.76	-	5.50	7.39	7.60	8.10	0.602	7.20	7.85	7.94	8.16	0.247	5.94	6.75	6.77	7.38	0.431
Specific Conductance (field)	uS/cm	28.0	28.0	28.0	28.0	-	162	289	296	402	53.9	474	569	552	762	68.1	140	186	193	247	29.6
DO (field)	mg/L	7.89	7.89	7.89	7.89	-	4.20	8.98	9.84	13.1	3.12	2.20	6.77	6.75	10.6	2.58	4.90	10.3	11.7	17.3	3.73
ORP (field)	ORP mV	97.6	97.6	97.6	97.6	-	-285	67.4	58.5	196	111	-144	-12.7	-37.3	246	102	-91.0	-10.6	-8.20	58.7	40.7
Temperature (field)	°C	1.07	1.07	1.07	1.07	-	2.10	5.17	4.31	11.8	2.62	1.48	5.68	4.30	15.0	3.78	1.20	5.50	5.54	11.7	3.42
Physical Properties																					
Conductivity (lab)	uS/cm	28.2	28.2	28.2	28.2	-	284	294	294	299	3.78	502	566	563	662	40.2	177	183	183	190	3.88
pH (lab)	pH	6.76	6.76	6.76	6.76	-	7.77	8.03	8.00	8.28	0.151	7.96	8.22	8.29	8.45	0.164	7.09	7.58	7.57	8.06	0.258
Total Hardness (CaCO3)	mg/L	9.97	9.97	9.97	9.97	-	129	135	136	145	3.90	245	288	286	335	22.0	68.0	73.7	73.2	81.8	3.93
Dissolved Hardness (CaCO3)	mg/L	10.4	10.4	10.4	10.4	-	130	139	138	152	6.44	247	289	288	370	26.9	67.0	72.9	71.9	79.9	3.68
Total Suspended Solids	mg/L	1.50	1.50	1.50	1.50	-	1.00	1.03	1.00	1.30	0.0731	1.00	3.54	3.20	9.60	2.12	6.00	10.2	9.90	13.0	2.01
Total Dissolved Solids	mg/L	22.0	22.0	22.0	22.0	-	142	173	170	194	12.7	274	335	330	416	35.9	96.0	117	116	132	10.8
Turbidity	NTU	11.3	11.3	11.3	11.3	-	0.100	0.327	0.220	1.44	0.334	0.930	2.63	2.32	6.95	1.68	19.9	54.6	55.9	87.8	20.3
Inorganics																					
Alkalinity (Total as CaCO3)	mg/L	9.09	9.09	9.09	9.09	-	138	151	146	246	23.3	201	224	222	258	15.4	74.3	78.9	78.7	82.6	2.63
Alkalinity (PP as CaCO3)	mg/L	0.500	0.500	0.500	0.500	-	0.500	0.500	0.500	0.500	0	0.500	1.65	0.500	5.05	1.49	0.500	0.500	0.500	0.500	0
Bicarbonate (HCO3)	mg/L	11.1	11.1	11.1	11.1	-	168	184	178	300	28.4	244	270	267	315	20.8	90.6	96.3	95.9	101	3.23
Carbonate (CO3)	mg/L	0.500	0.500	0.500	0.500	-	0.500	0.500	0.500	0.500	0	0.500	1.93	0.500	6.06	1.82	0.500	0.500	0.500	0.500	0
Hydroxide (OH)	mg/L	0.500	0.500	0.500	0.500	-	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0
Bromide (Br)	mg/L	-	-	-	-	-	0.0100	0.0100	0.0100	0.0100	0	0.0100	0.0191	0.0100	0.100	0.0238	0.0100	0.0175	0.0100	0.100	0.0249
Fluoride (F)	mg/L	0.0360	0.0360	0.0360	0.0360	-	0.0340	0.286	0.300	0.320	0.0628	0.0730	0.102	0.100	0.140	0.0163	0.200	0.212	0.210	0.220	0.00799
Dissolved Chloride (Cl)	mg/L	0.520	0.520	0.520	0.520	-	0.500	0.565	0.500	0.930	0.114	0.500	1.16	0.950	3.60	0.755	0.500	0.849	0.700	2.40	0.508
Organic / Inorganic Carbon																					
Dissolved Organic Carbon (C)	mg/L	13.0	13.0	13.0	13.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon (C)	mg/L	13.0	13.0	13.0	13.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Anions and Nutrients																					
Total Phosphorus (P)	mg/L	0.0245	0.0245	0.0245	0.0245	-	0.00300	0.0211	0.0121	0.0761	0.0239	0.00410	0.0315	0.0316	0.0519	0.0116	0.00500	0.0120	0.0100	0.0266	0.00629
Dissolved Phosphorus (P)	mg/L	0.0134	0.0134	0.0134	0.0134	-	0.00400	0.0186	0.0130	0.0686	0.0155	0.00300	0.0280	0.0270	0.0490	0.0120	0.00520	0.0237	0.0144	0.0774	0.0220
Orthophosphate	mg/L	-	-	-	-	-	0.00610	0.00900	0.00910	0.0120	0.00195	0.00400	0.00526	0.00500	0.00730	0.00109	0.00300	0.00450	0.00500	0.00500	0.000866
Total Ammonia (N)	mg/L	0.610	0.610	0.610	0.610	-	0.00500	0.0217	0.00900	0.140	0.0322	0.00500	0.0477	0.0220	0.230	0.0557	0.00500	0.0208	0.00950	0.0720	0.0228
Total Total Kjeldahl Nitrogen (Calc)	mg/L	0.770	0.770	0.770	0.770	-	0.0200	0.0890	0.0580	0.330	0.0895	0.0360	0.611	0.264	2.70	0.757	0.0200	0.128	0.0820	0.370	0.106
Nitrate plus Nitrite (N)	mg/L	0.0120	0.0120	0.0120	0.0120	-	0.00200	0.00221	0.00200	0.00390	0.000565	0.00200	0.00479	0.00240	0.0249	0.00575	0.00200	0.00526	0.00465	0.00950	0.00258
Nitrate (N)	mg/L	0.0100	0.0100	0.0100	0.0100	-	0.00200	0.00226	0.00200	0.00390	0.000600	0.00200	0.00475	0.00200	0.0249	0.00576	0.00200	0.00266	0.00215	0.00440	0.000868
Nitrite (N)	mg/L	0.00200	0.00200	0.00200	0.00200	-	0.00200	0.00200	0.00200	0.00200	0	0.00200	0.00208	0.00200	0.00300	0.000248	0.00200	0.00417	0.00310	0.00720	0.00229
Total Nitrogen (N)	mg/L	0.782	0.782	0.782	0.782	-	0.0200	0.101	0.0670	0.330	0.0937	0.0440	0.608	0.266	2.80	0.772	0.0200	0.131	0.0885	0.370	0.105
Dissolved Nitrogen (N)	mg/L	-	-	-	-	-	0.0200	0.194	0.115	0.820	0.205	0.0310	0.434	0.237	2.60	0.625	0.0200	0.182	0.200	0.550	0.142
Dissolved Sulphate (SO4)	mg/L	0.500	0.500	0.500	0.500	-	11.2	12.9	12.7	14.9	0.955	62.9	89.2	85.4	116	13.0	13.3	14.6	14.2	17.5	1.16
Total Sulphide	mg/L	0.00500	0.00500	0.00500	0.00500	-	0.00500	0.00656	0.00605	0.00940	0.00146	0.00690	0.0226	0.0175	0.0458	0.0126	0.00500	0.00766	0.00640	0.0125	0.00240
Total Sulphide (as H2S)	mg/L	-	-	-	-	-	0.00500	0.00688	0.00650	0.0100	0.00145	0.0120	0.0290	0.0255	0.0490	0.0126	0.00500	0.00814	0.00700	0.0130	0.00253
Dissolved Sulphide	mg/L	-	-	-	-	-	0.00180	0.00343	0.00345	0.00500	0.00157	0.00240	0.0205	0.0130	0.0460	0.0171	0.00500	0.0386	0.0350	0.0850	0.0261
Dissolved Sulphide (as H2S)	mg/L	-	-	-	-	-	0.00190	0.00382	0.00500	0.00530	0.00157	0.00300	0.0220	0.0140	0.0490	0.0182	0.00500	0.0405	0.0335	0.0900	0.0310
Cyanides																					
Cyanide, Weak Acid Diss	mg/L	-	-	-	-	-	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0
Cyanide, Total	mg/L	-	-	-	-	-	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0	0.00100	0.00100	0.00100	0.00100	0
Cyanate	mg/L	-	-	-	-	-	0.200	0.200	0.200	0.200	0	0.200	0.200	0.200	0.200	0	0.400	0.400	0.400	0.400	0
Thiocyanate (SCN)	mg/L	-	-	-	-	-	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0	0.500	0.500	0.500	0.500	0
Total Metals																					
Total Aluminum (Al)	ug/L	201	201	201	201	-	0.930	5.44	3.01	29.7	7.07	4.70	42.8	15.6	275	67.6	0.560	7.30	4.20	24.1	7.63
Total Antimony (Sb)	ug/L	0.0880	0.0880	0.0880	0.0880	-	0.152	0.216	0.196	0.371	0.0613	0.308	0.951	0.426	5.45	1.31	0.0570	0.296	0.247	0.657	0.183
Total Arsenic (As)	ug/L	3.03	3.03	3.03	3.03	-	0.789	0.953	0.926	1.25	0.134	12.5	80.1	78.7	157	38.4	8.75	11.2	11.5	12.4	0.898
Total Barium (Ba)	ug/L	18.5	18.5	18.5	18.5	-	0.765	1.64	1.28	5.44	1.19	35.7	103	95.3	178	44.7	17.7	19.0	19.0	20.0	0.708
Total Beryllium (Be)	ug/L	0.0300	0.0300	0.0300	0.0300	-	0.0100	0.0100	0.0100	0.0100	0	0.0100	0.0124	0.0100	0.0500	0.00941	0.0650	0.0887	0.0900	0.119	0.0143
Total Bismuth (Bi)	ug/L	0.00500	0.00500	0.00500	0.00500	-	0.00500	0.00583	0.00500	0.0100	0.00186	0.00500	0.00795	0.00580	0.0250	0.00491	0.00500	0.00583	0.00500	0.0100	0.00186
Total Boron (B)	ug/L	10.0	10.0	10.0	10.0	-	10.0	10.0	10.0	10.0	0	10.0	12.5	10.0	50.0	9.68	10.0	10.8	10.0	20.0	2.76
Total Cadmium (Cd)	ug/L	0.0220	0.0220	0.0220	0.0220	-	0.00500	0.0244	0.0105	0.149	0.0344	0.00500	0.0267	0.0196	0.0647	0.0191	0.00500	0.0211	0.00800	0.0960	0.0285
Total Calcium (Ca)	mg/L	2.73	2.73	2.73	2.73	-	40.7	42.7	42.7	45.8	1.29	49.2	58.1	55.9	74.5	7.13	20.6	22.3	22.3	24.9	1.17
Total Chromium (Cr)	ug/L	0.800	0.800	0.800	0.800	-	0.100	0.429	0.145	2.67	0.638	0.100	0.573	0.380	2.34	0.627	0.100	0.856	0.130	5.34	1.49
Total Cobalt (Co)	ug/L	2.70	2.70	2.70	2.70	-	0.0187	0.0442	0.0395	0.125	0.0259	0.0338	0.590	0.0920	2.95	0.964	0.00500	0.0305	0.0132	0.126	0.0336
Total Copper (Cu)	ug/L	2.03	2.03	2.03	2.03	-	0.0500	0.223	0.138	0.607	0.189	0.290	1.03	0.986	2.74	0.538	0.0500	0.449	0.0975	1.80	0.606
Total Iron (Fe)	ug/L	1360	1360	1360	1360	-	1.60	13.2	7.20	56.6	15.8	269	991	925	1460	339	4350	6040	6150	6400	522

Monitoring Well		MW15-05AZ					MW15-05WB					MW15-06WB					MW16-01WB				
Screen Lithology		-					Granite					Gniess					Granite				
Sample Count		1					18					17					12				
	Statistics	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD	Min	Mean	Median	Max	SD
Total Lead (Pb)	ug/L	0.0600	0.0600	0.0600	0.0600	-	0.00900	0.0465	0.0321	0.150	0.0339	0.0630	0.379	0.416	0.608	0.165	0.00700	0.0359	0.0207	0.120	0.0318
Total Lithium (Li)	ug/L	0.500	0.500	0.500	0.500	-	10.9	12.1	12.1	13.5	0.736	4.91	12.0	12.3	14.5	2.16	13.3	14.7	14.6	16.6	1.03
Total Magnesium (Mg)	mg/L	0.766	0.766	0.766	0.766	-	6.53	6.98	7.02	7.46	0.258	29.6	34.7	35.4	39.2	2.73	3.88	4.38	4.42	4.91	0.287
Total Manganese (Mn)	ug/L	620	620	620	620	-	4.45	8.17	7.31	14.5	2.43	2300	5050	5430	6310	954	1230	1350	1350	1490	76.2
Total Mercury (Hg)	ug/L	0.00570	0.00570	0.00570	0.00570	-	0.00200	0.00221	0.00200	0.00390	0.000582	0.00490	0.0535	0.0339	0.281	0.0613	0.00200	0.00200	0.00200	0.00200	0
Total Molybdenum (Mo)	ug/L	0.276	0.276	0.276	0.276	-	0.514	0.611	0.565	0.969	0.119	34.5	112	103	196	48.7	0.500	0.741	0.689	1.35	0.232
Total Nickel (Ni)	ug/L	1.33	1.33	1.33	1.33	-	0.175	0.632	0.332	2.26	0.578	0.200	1.12	0.486	4.18	1.21	0.0790	0.834	0.243	4.44	1.22
Total Phosphorus (P)	ug/L	21.1	21.1	21.1	21.1	-	9.30	25.5	18.1	91.6	20.1	7.20	24.3	17.6	99.8	22.6	6.60	18.3	16.7	47.6	10.5
Total Potassium (K)	mg/L	0.123	0.123	0.123	0.123	-	0.565	0.790	0.662	1.66	0.295	3.31	4.16	3.64	7.22	1.20	0.958	1.11	1.06	1.39	0.119
Total Selenium (Se)	ug/L	0.0520	0.0520	0.0520	0.0520	-	0.0400	0.123	0.0610	0.444	0.122	0.0400	0.132	0.0790	0.475	0.129	0.0400	0.137	0.0755	0.730	0.186
Total Silicon (Si)	ug/L	6010	6010	6010	6010	-	8280	9030	8990	10600	536	4470	5650	5600	7040	661	10900	11900	12100	12900	569
Total Silver (Ag)	ug/L	0.00500	0.00500	0.00500	0.00500	-	0.00500	0.00599	0.00500	0.0100	0.00190	0.00500	0.0211	0.0130	0.0748	0.0183	0.00500	0.00583	0.00500	0.0100	0.00186
Total Sodium (Na)	mg/L	1.16	1.16	1.16	1.16	-	8.69	9.24	9.22	10.1	0.317	4.68	6.35	5.55	10.9	1.74	6.47	7.06	7.03	7.95	0.407
Total Strontium (Sr)	ug/L	16.2	16.2	16.2	16.2	-	127	136	136	145	5.05	370	439	442	559	48.5	77.2	85.2	86.2	90.6	3.94
Total Sulphur (S)	mg/L	3.00	3.00	3.00	3.00	-	3.30	4.07	4.05	4.90	0.423	18.3	28.4	29.7	33.6	3.97	3.70	4.68	4.70	6.00	0.535
Total Thallium (Tl)	ug/L	0.00800	0.00800	0.00800	0.00800	-	0.00200	0.00250	0.00200	0.00700	0.00116	0.00210	0.0126	0.00820	0.0530	0.0130	0.00200	0.00308	0.00250	0.00700	0.00149
Total Tin (Sn)	ug/L	0.200	0.200	0.200	0.200	-	0.200	0.200	0.200	0.200	0	0.200	0.247	0.200	1.00	0.188	0.200	0.217	0.200	0.400	0.0553
Total Titanium (Ti)	ug/L	2.94	2.94	2.94	2.94	-	0.500	0.853	0.500	2.00	0.577	0.500	2.80	1.40	16.1	3.80	0.500	0.783	0.500	2.00	0.438
Total Uranium (U)	ug/L	0.811	0.811	0.811	0.811	-	69.5	77.0	77.5	82.1	3.37	4.27	36.3	20.0	103	34.0	2.44	3.45	3.11	4.93	0.829
Total Vanadium (V)	ug/L	2.97	2.97	2.97	2.97	-	0.200	0.201	0.200	0.210	0.00229	0.200	0.367	0.200	1.40	0.329	0.200	0.271	0.200	0.850	0.183
Total Zinc (Zn)	ug/L	0.990	0.990	0.990	0.990	-	5.92	36.7	23.4	102	28.9	5.45	113	39.0	604	153	7.46	39.0	28.2	150	39.4
Total Zirconium (Zr)	ug/L	1.20	1.20	1.20	1.20	-	0.100	0.100	0.100	0.100	0	0.620	2.21	2.37	3.68	0.884	0.100	0.108	0.100	0.200	0.0276
Dissolved Metals																					
Dissolved Aluminum (Al)	ug/L	189	189	189	189	-	0.500	2.44	1.73	14.0	3.02	2.78	9.81	6.55	67.5	14.6	0.500	4.56	1.04	41.3	11.1
Dissolved Antimony (Sb)	ug/L	0.0840	0.0840	0.0840	0.0840	-	0.152	0.240	0.194	0.500	0.106	0.256	0.811	0.307	3.79	1.06	0.0650	0.336	0.202	1.12	0.294
Dissolved Arsenic (As)	ug/L	2.28	2.28	2.28	2.28	-	0.734	0.940	0.887	1.31	0.158	10.3	73.3	74.6	123	31.8	4.37	10.5	11.0	13.4	2.11
Dissolved Barium (Ba)	ug/L	18.8	18.8	18.8	18.8	-	0.827	1.52	1.35	4.00	0.788	36.7	102	99.9	159	42.4	17.3	18.4	18.6	19.2	0.556
Dissolved Beryllium (Be)	ug/L	0.0260	0.0260	0.0260	0.0260	-	0.0100	0.0150	0.0100	0.100	0.0206	0.0100	0.0124	0.0100	0.0500	0.00941	0.0450	0.0831	0.0785	0.111	0.0182
Dissolved Bismuth (Bi)	ug/L	0.00500	0.00500	0.00500	0.00500	-	0.00500	0.0603	0.00500	1.00	0.228	0.00500	0.00618	0.00500	0.0250	0.00471	0.00500	0.00542	0.00500	0.0100	0.00138
Dissolved Boron (B)	ug/L	10.0	10.0	10.0	10.0	-	10.0	12.2	10.0	50.0	9.16	10.0	12.4	10.0	50.0	9.41	10.0	10.8	10.0	20.0	2.76
Dissolved Cadmium (Cd)	ug/L	0.0220	0.0220	0.0220	0.0220	-	0.00500	0.0137	0.0107	0.0530	0.0118	0.00500	0.0101	0.00500	0.0370	0.00902	0.00500	0.0111	0.00500	0.0410	0.0115
Dissolved Calcium (Ca)	mg/L	2.93	2.93	2.93	2.93	-	41.3	43.9	43.4	48.0	2.09	49.6	58.7	56.9	82.5	8.25	20.2	22.1	21.8	24.3	1.15
Dissolved Chromium (Cr)	ug/L	0.700	0.700	0.700	0.700	-	0.100	0.169	0.100	1.00	0.214	0.100	0.161	0.100	0.660	0.157	0.100	0.108	0.100	0.200	0.0276
Dissolved Cobalt (Co)	ug/L	2.49	2.49	2.49	2.49	-	0.0143	0.0576	0.0278	0.500	0.108	0.0361	0.557	0.0610	3.22	0.986	0.00500	0.0124	0.00850	0.0460	0.0109
Dissolved Copper (Cu)	ug/L	1.86	1.86	1.86	1.86	-	0.0500	0.186	0.0850	0.772	0.192	0.0500	0.248	0.193	1.23	0.283	0.0500	0.188	0.0500	0.925	0.299
Dissolved Iron (Fe)	ug/L	931	931	931	931	-	1.00	3.21	2.45	11.1	2.39	56.9	703	733	1070	298	1900	5590	6120	6470	1220
Dissolved Lead (Pb)	ug/L	0.0330	0.0330	0.0330	0.0330	-	0.00940	0.0332	0.0215	0.200	0.0417	0.0145	0.0859	0.0380	0.522	0.121	0.00500	0.00996	0.00500	0.0270	0.00784
Dissolved Lithium (Li)	ug/L	0.690	0.690	0.690	0.690	-	11.1	12.2	11.9	14.2	0.735	5.44	11.8	12.3	14.3	2.13	10.5	14.2	14.8	15.3	1.33
Dissolved Magnesium (Mg)	mg/L	0.747	0.747	0.747	0.747	-	6.62	7.12	6.96	8.02	0.443	29.9	34.6	34.4	39.9	2.67	4.00	4.31	4.33	4.75	0.228
Dissolved Manganese (Mn)	ug/L	617	617	617	617	-	4.60	7.73	7.60	13.4	2.03	2390	4990	5170	6390	960	1280	1340	1340	1400	46.0
Dissolved Mercury (Hg)	ug/L	0.00540	0.00540	0.00540	0.00540	-	0.00200	0.00264	0.00200	0.0100	0.00195	0.00410	0.0170	0.00910	0.0952	0.0226	0.00200	0.00200	0.00200	0.00200	0
Dissolved Molybdenum (Mo)	ug/L	0.248	0.248	0.248	0.248	-	0.499	0.652	0.546	1.85	0.312	27.6	111	105	199	49.5	0.440	0.652	0.648	0.875	0.131
Dissolved Nickel (Ni)	ug/L	1.23	1.23	1.23	1.23	-	0.0770	0.349	0.212	1.09	0.286	0.202	0.850	0.291	3.44	1.09	0.0340	0.173	0.140	0.509	0.127
Dissolved Phosphorus (P)	ug/L	13.3	13.3	13.3	13.3	-	11.9	25.4	17.8	66.7	14.6	6.00	13.8	11.6	46.4	9.72	5.70	12.9	7.95	50.1	12.1
Dissolved Potassium (K)	mg/L	0.120	0.120	0.120	0.120	-	0.586	0.871	0.679	1.80	0.317	3.46	4.26	3.62	7.57	1.30	0.920	1.12	1.06	1.51	0.168
Dissolved Selenium (Se)	ug/L	0.0690	0.0690	0.0690	0.0690	-	0.0400	0.124	0.102	0.372	0.0991	0.0400	0.152	0.0670	0.502	0.141	0.0400	0.0874	0.0565	0.223	0.0623
Dissolved Silicon (Si)	ug/L	6040	6040	6040	6040	-	8610	9260	9070	10400	582	4600	5660	5910	6540	586	9900	11800	11900	13300	854
Dissolved Silver (Ag)	ug/L	0.00500	0.00500	0.00500	0.00500	-	0.00500	0.00583	0.00500	0.0200	0.00344	0.00500	0.00849	0.00500	0.0270	0.00663	0.00500	0.00623	0.00500	0.0147	0.00290
Dissolved Sodium (Na)	mg/L	1.14	1.14	1.14	1.14	-	8.73	9.31	9.18	10.4	0.502	4.64	6.29	5.48	11.9	1.96	6.61	6.96	6.92	7.61	0.282
Dissolved Strontium (Sr)	ug/L	15.4	15.4	15.4	15.4	-	125	136	136	150	6.67	366	444	453	508	37.7	73.1	82.5	82.6	87.6	4.68
Dissolved Sulphur (S)	mg/L	3.00	3.00	3.00	3.00	-	3.50	4.14	4.05	4.80	0.350	19.7	28.7	29.9	36.9	4.16	4.20	4.78	4.60	6.00	0.484
Dissolved Thallium (Tl)	ug/L	0.00800	0.00800	0.00800	0.00800	-	0.00200	0.00521	0.00200	0.0500	0.0110	0.00200	0.00859	0.00200	0.0487	0.0135	0.00200	0.00336	0.00230	0.00970	0.00215
Dissolved Tin (Sn)	ug/L	0.200	0.200	0.200	0.200	-	0.200	0.467	0.200	5.00	1.10	0.200	0.249	0.200	1.00	0.188	0.200	0.311	0.200	1.33	0.312
Dissolved Titanium (Ti)	ug/L	1.96	1.96	1.96	1.96	-	0.500	0.752	0.500	5.00	1.03	0.500	0.884	0.500	3.70	0.866	0.500	0.542	0.500	1.00	0.138
Dissolved Uranium (U)	ug/L	0.899	0.899	0.899	0.899	-	66.3	76.3	77.1	84.3	4.15	5.74	37.7	25.5	103	35.9	2.36	3.43	3.17	5.16	0.856
Dissolved Vanadium (V)	ug/L	1.51	1.51	1.51	1.51	-	0.200	0.467	0.200	5.00	1.10	0.200	0.269	0.200	1.00	0.203	0.200	0.247	0.200	0.560	0.109
Dissolved Zinc (Zn)	ug/L	1.10	1.10	1.10	1.10	-	6.69	29.8	20.0	97.0	23.9	1.18	33.6	7.06	253	65.7	2.80	16.5	11.5	43.4	12.2
Dissolved Zirconium (Zr)	ug/L	1.18	1.18	1.18	1.18	-	0.100	0.122	0.100	0.500	0.0916	0.460	2.18	2.22	3.98	0.953	0.100	0.108	0.100	0.200	0.0276

Notes:
1. Where analytical results are below the reportable detection limit (<RDL), the RDL values are used in the statistical calculations.
2. Analytical results for the following samples have been excluded from the statistical calculations: MW14-03A (12-Oct-2014), MW14-03B (06-Oct-2014), MW14-05A (02-Oct-2014), MW14-05B (03-Oct-2014, 24-Jun-2015, 14-Jul-2015, 09-Aug-2015, 08-Sep-2015), and MW15-06WB (21-Jun-2015). See Appendix 5-D for further discussion.
3. Analytical results for dissolved organic carbon and total organic carbon for all samples collected at Westbay monitoring wells (MW15-01WB to MW15-06WB, and MW16-01WB) have been excluded from the statistical calculations. See Appendix 5-D for further discussion.
4. SD = Standard Deviati

Appendix 5-C: Laboratory Certificates of Analysis (Electronic Only)

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Appendix 5-D: Groundwater Quality Assurance/Quality Control

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Appendix 5-E: Time Series Plots of Groundwater Quality

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COFFEE

Appendix 5-E: Time Series Plots of Groundwater Quality

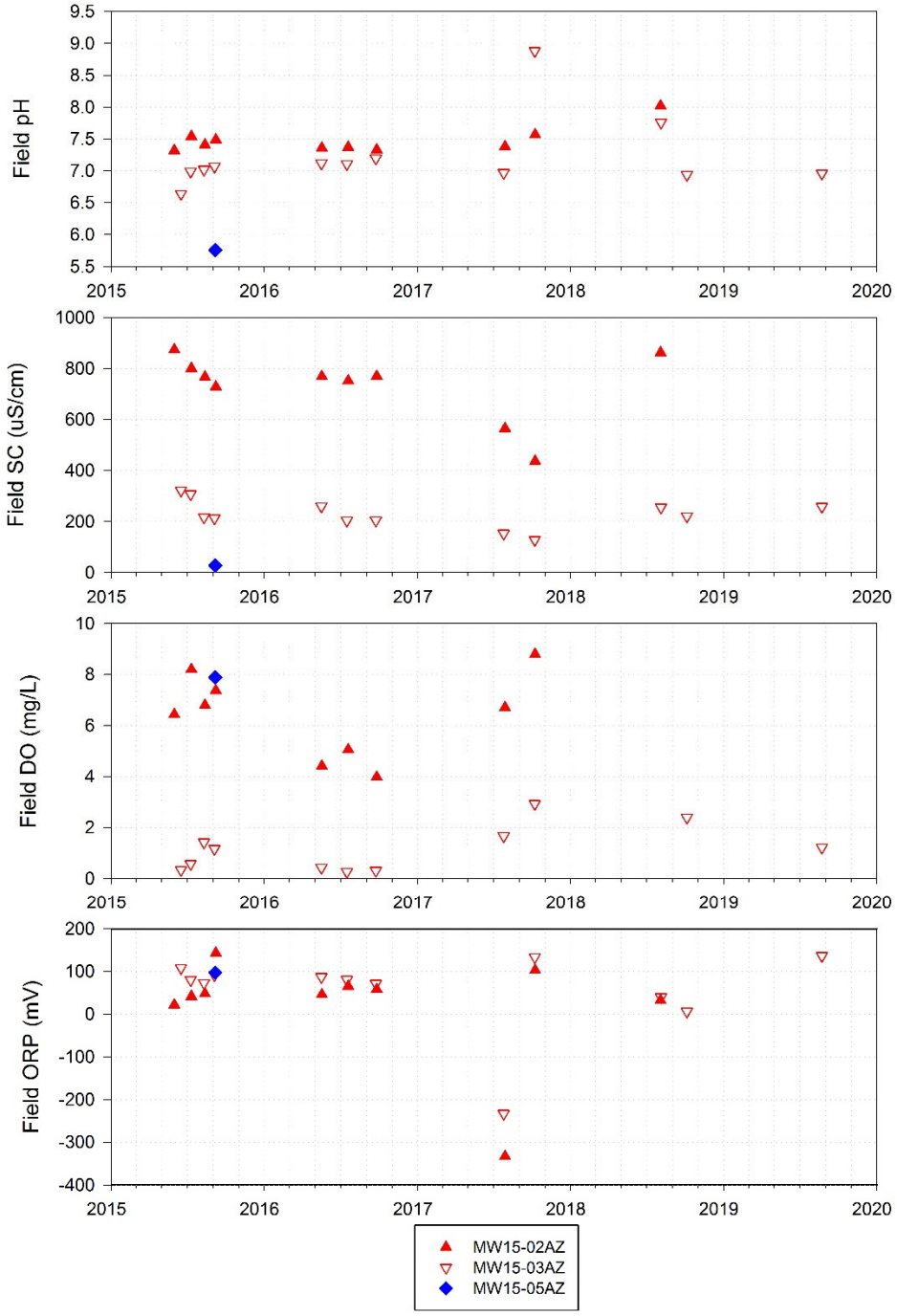

Figure 5-E-1: Field-measured physical parameters in overburden at MW15-02AZ, MW15-03AZ, and MW15-05AZ.

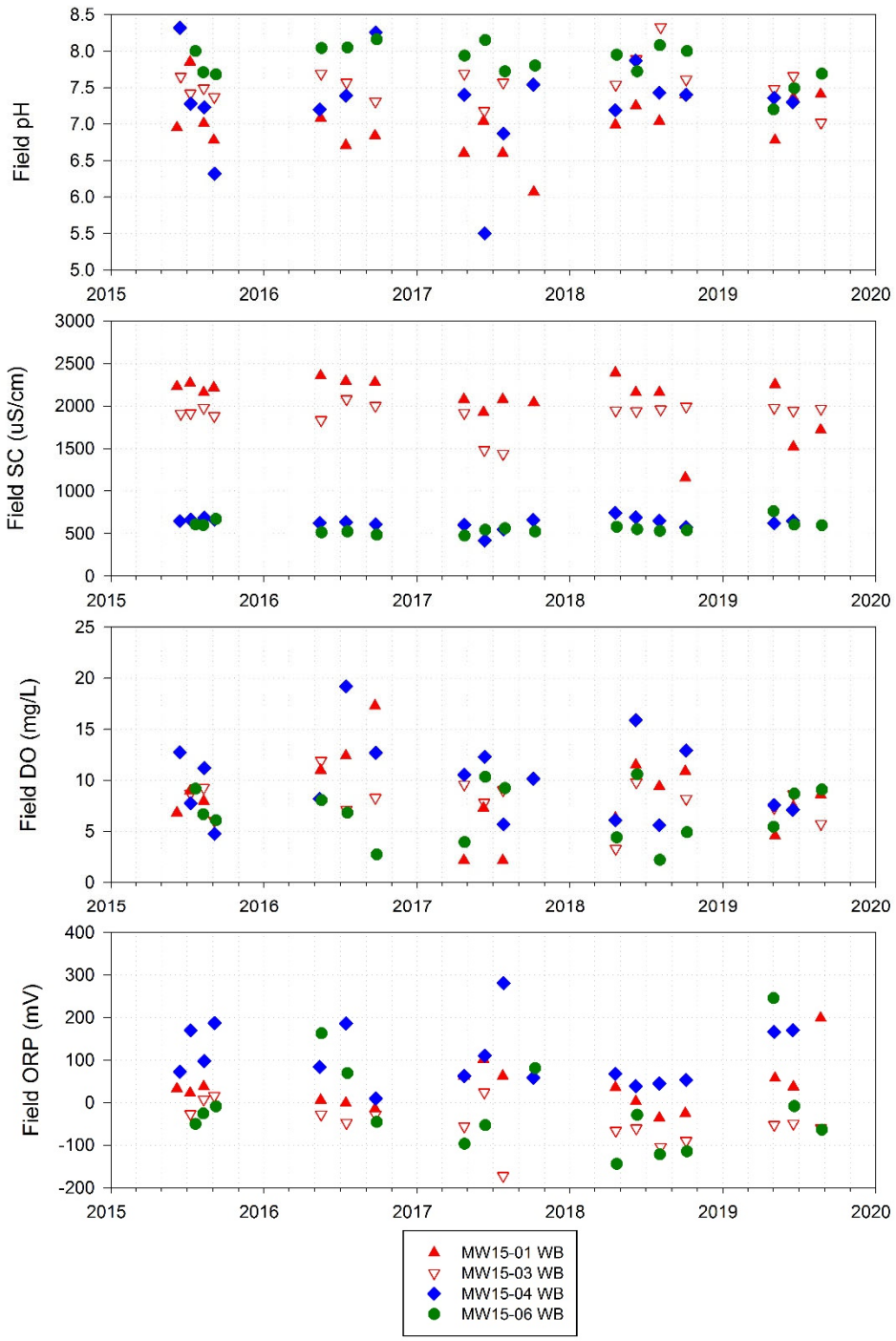

Figure 5-E-2: Field-measured physical parameters in gneiss at MW15-01WB, MW15-03WB, MW15-04WB, and MW15-06WB.

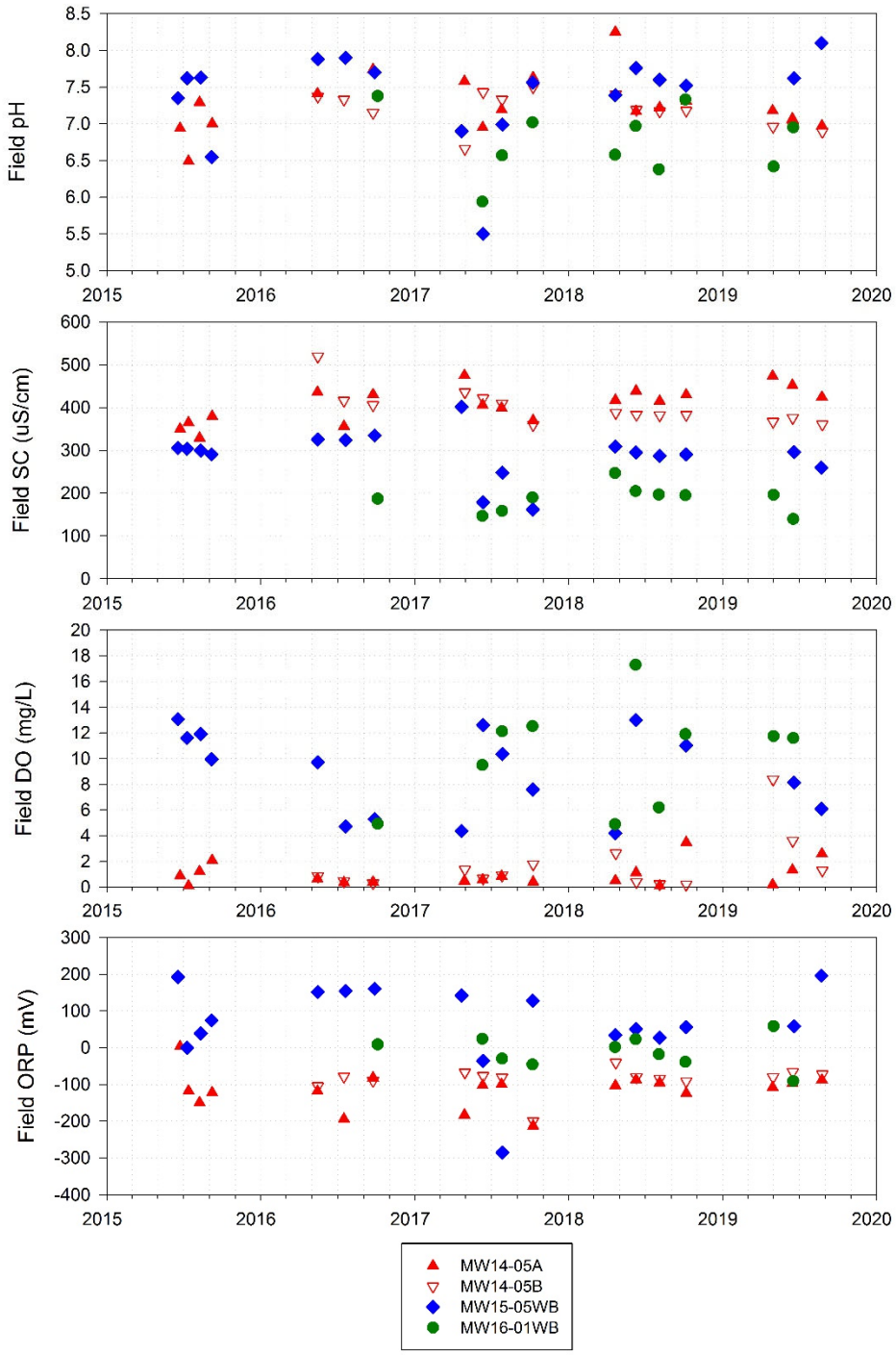

Figure 5-E-3: Field-measured physical parameters in granite at MW14-05A, MW14-05B, MW15-05WB, and MW16-01WB.

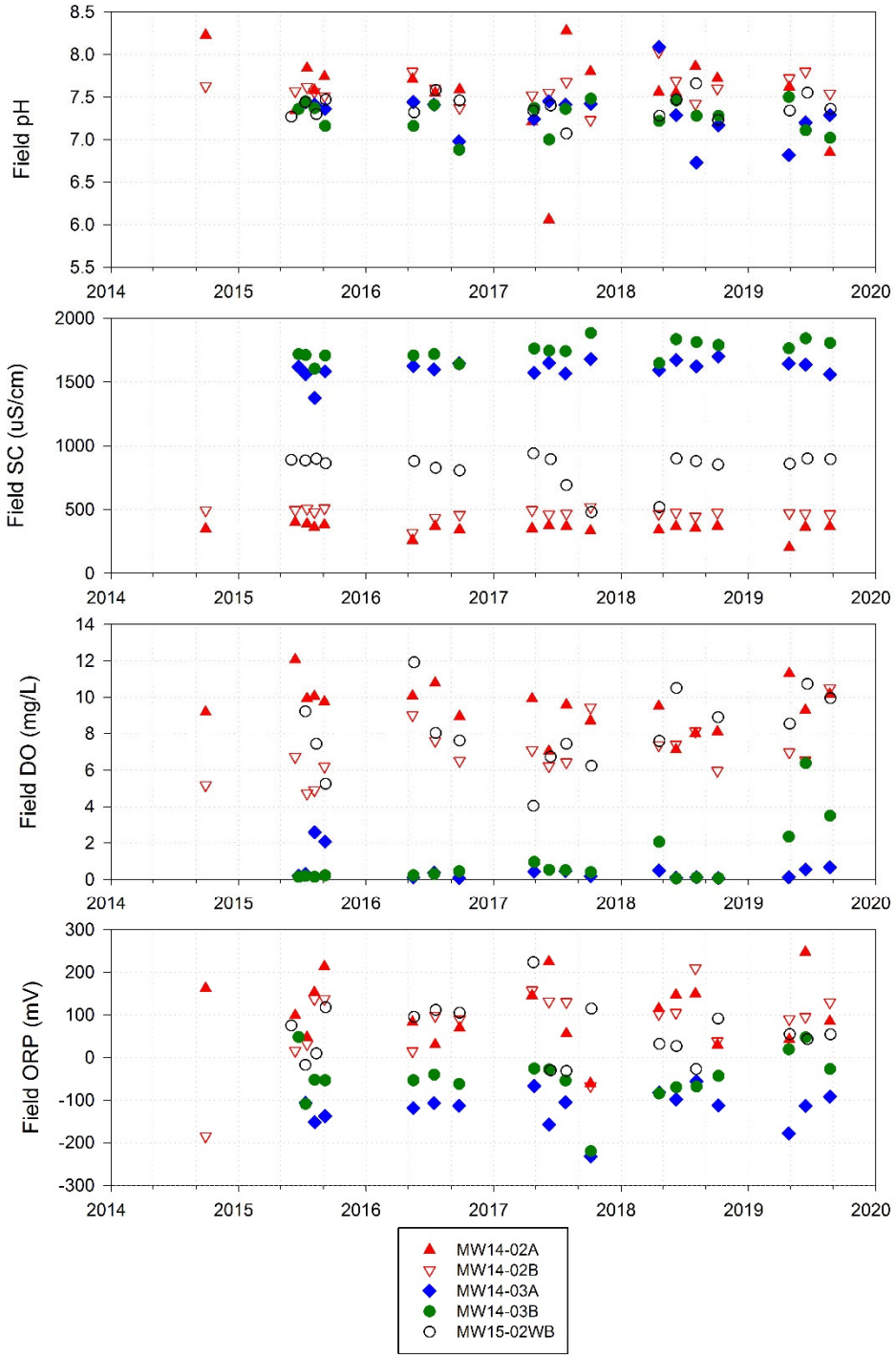

Figure 5-E-4: Field-measured physical parameters in schist at MW14-02A, MW14-02B, MW14-03A, MW14-03B, and MW15-02WB.

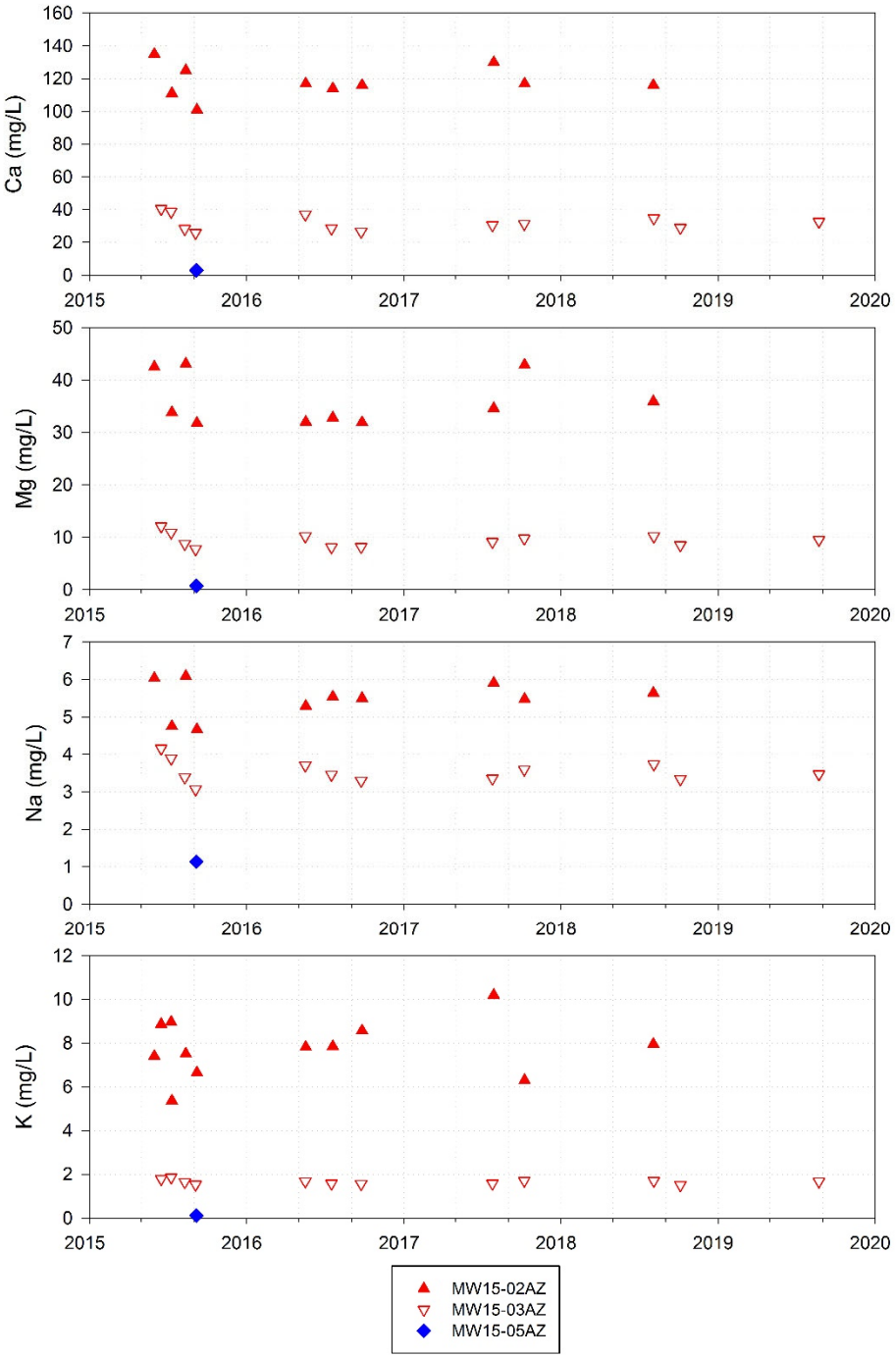

Figure 5-E-5: Major cations concentrations in overburden at MW15-02AZ, MW15-03AZ, and MW15-05AZ.

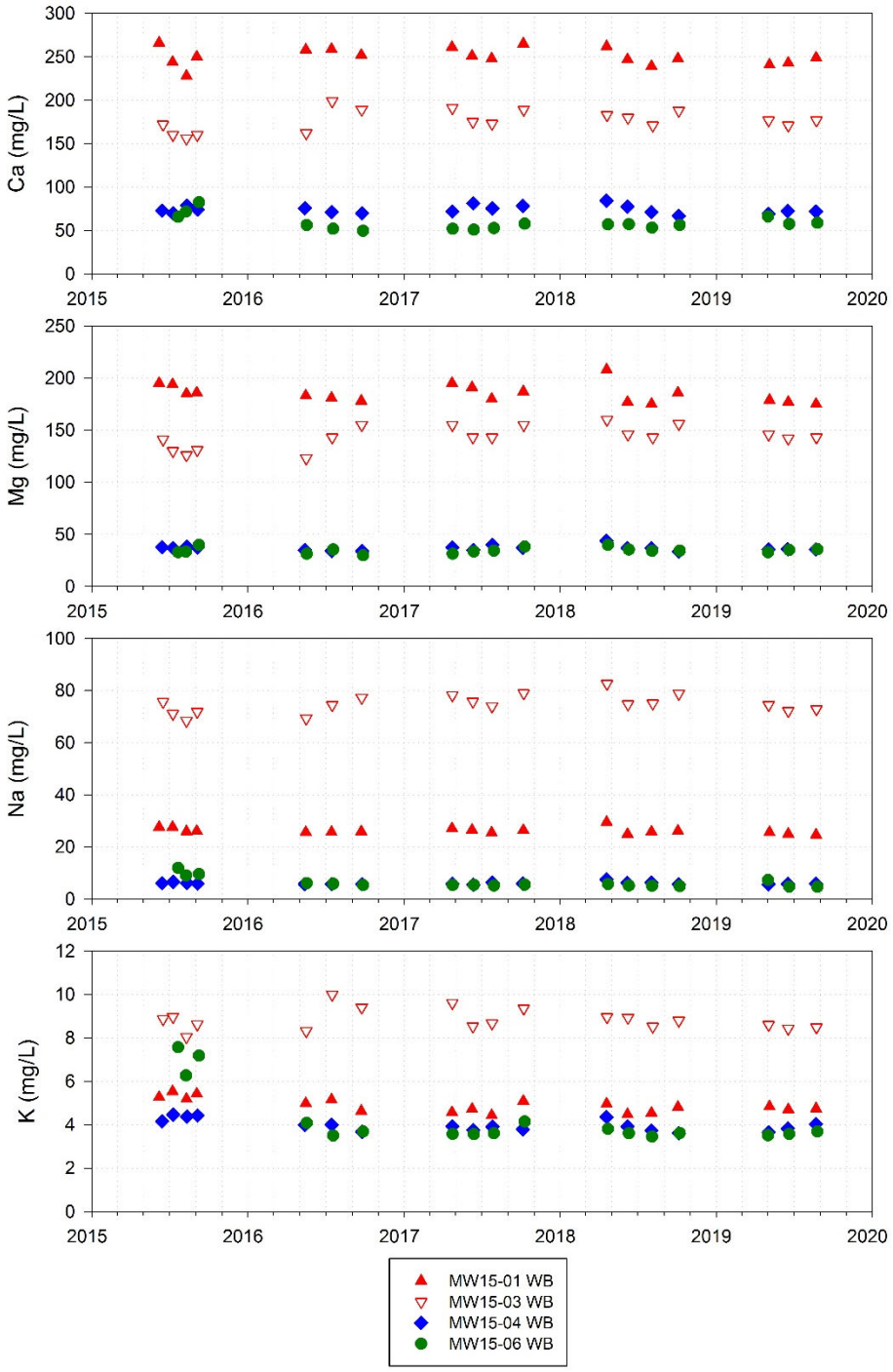

Figure 5-E-6: Major cations concentrations in gneiss at MW15-01WB, MW15-03WB, MW15-04WB, and MW15-06WB.

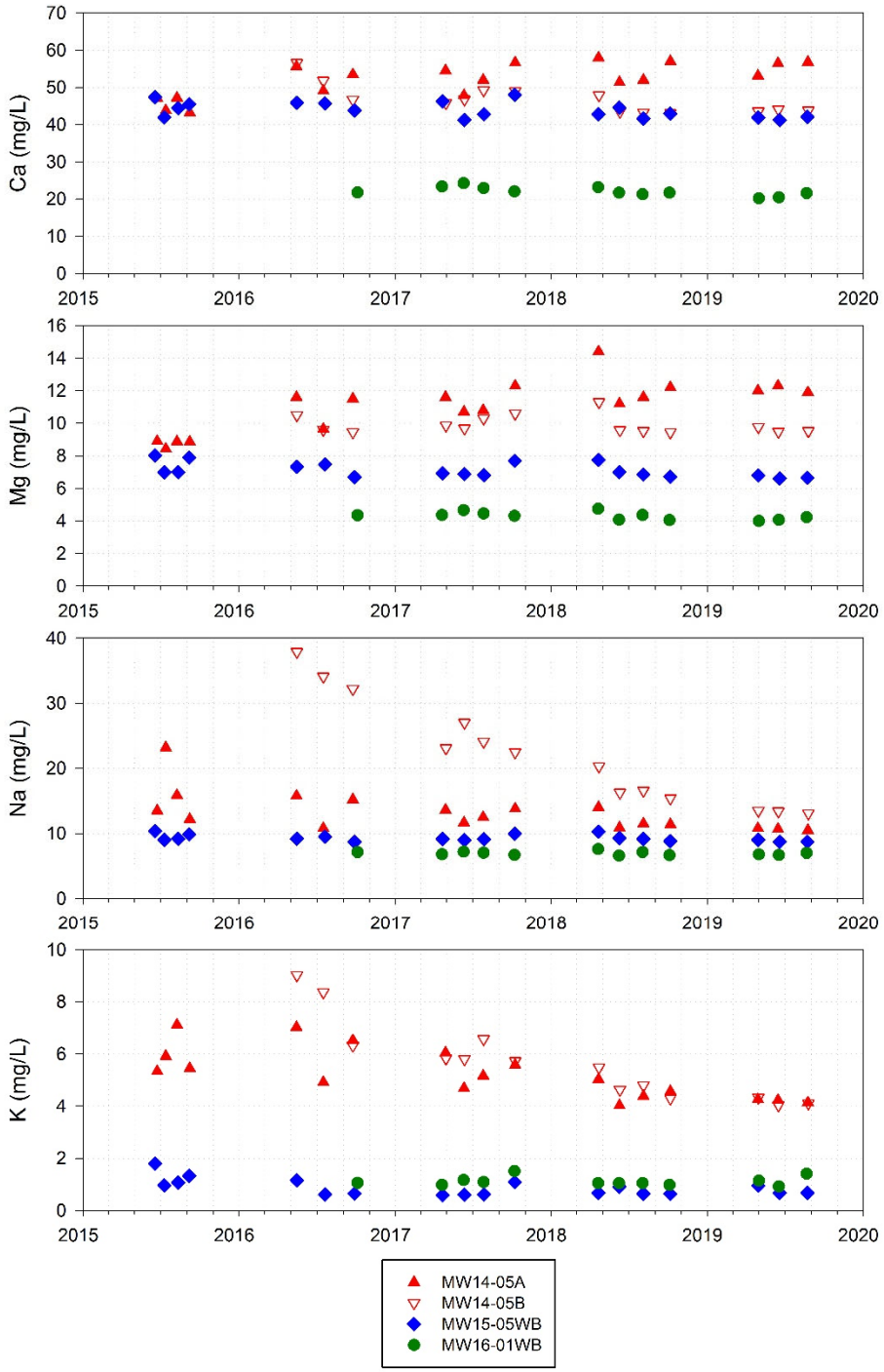

Figure 5-E-7: Major cations concentrations in granite at MW14-05A, MW14-05B, MW15-05WB, and MW16-01WB.

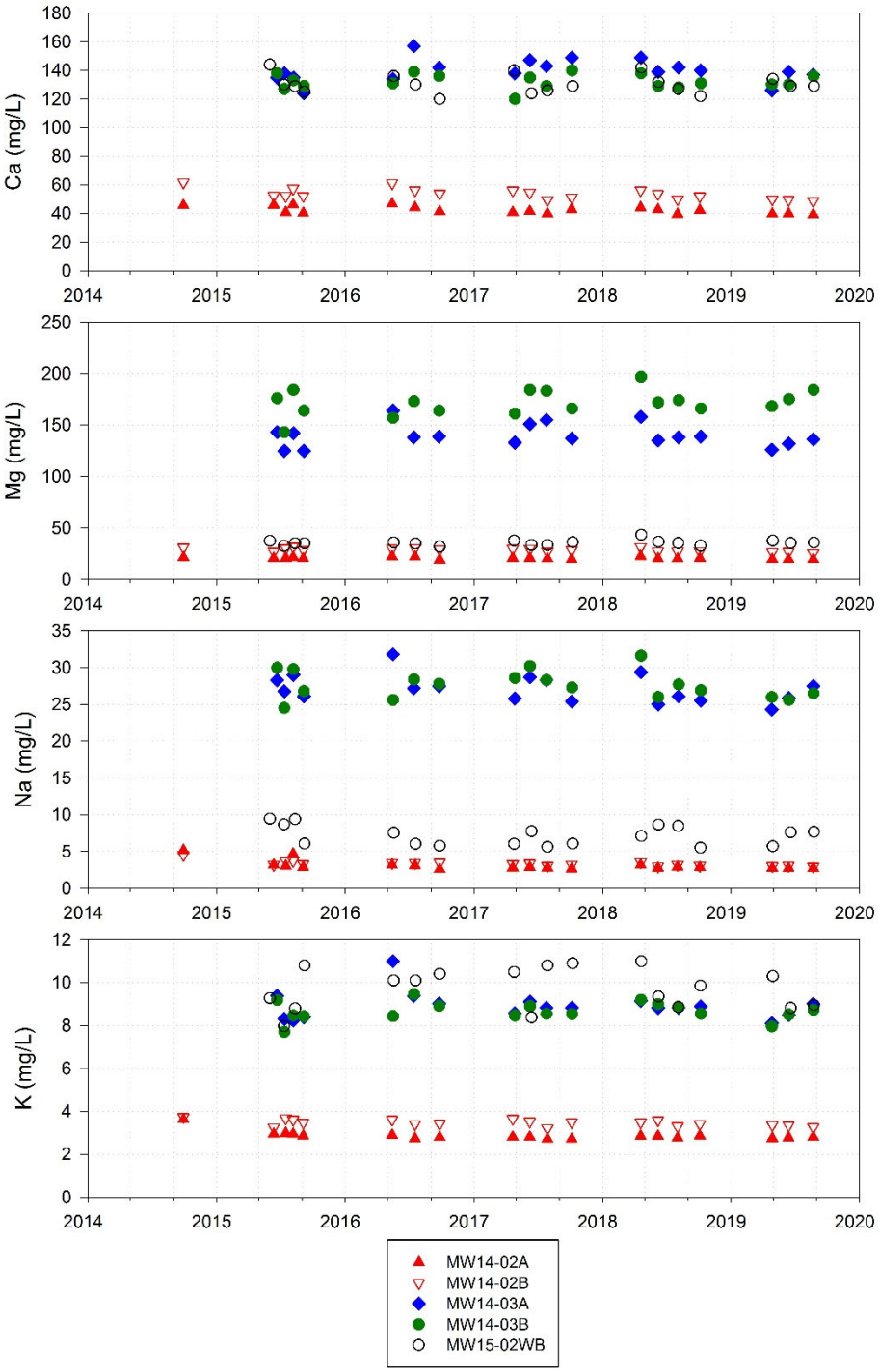

Figure 5-E-8: Major cations concentrations in schist at MW14-02A, MW14-02B, MW14-03A, MW14-03B, and MW15-02WB.

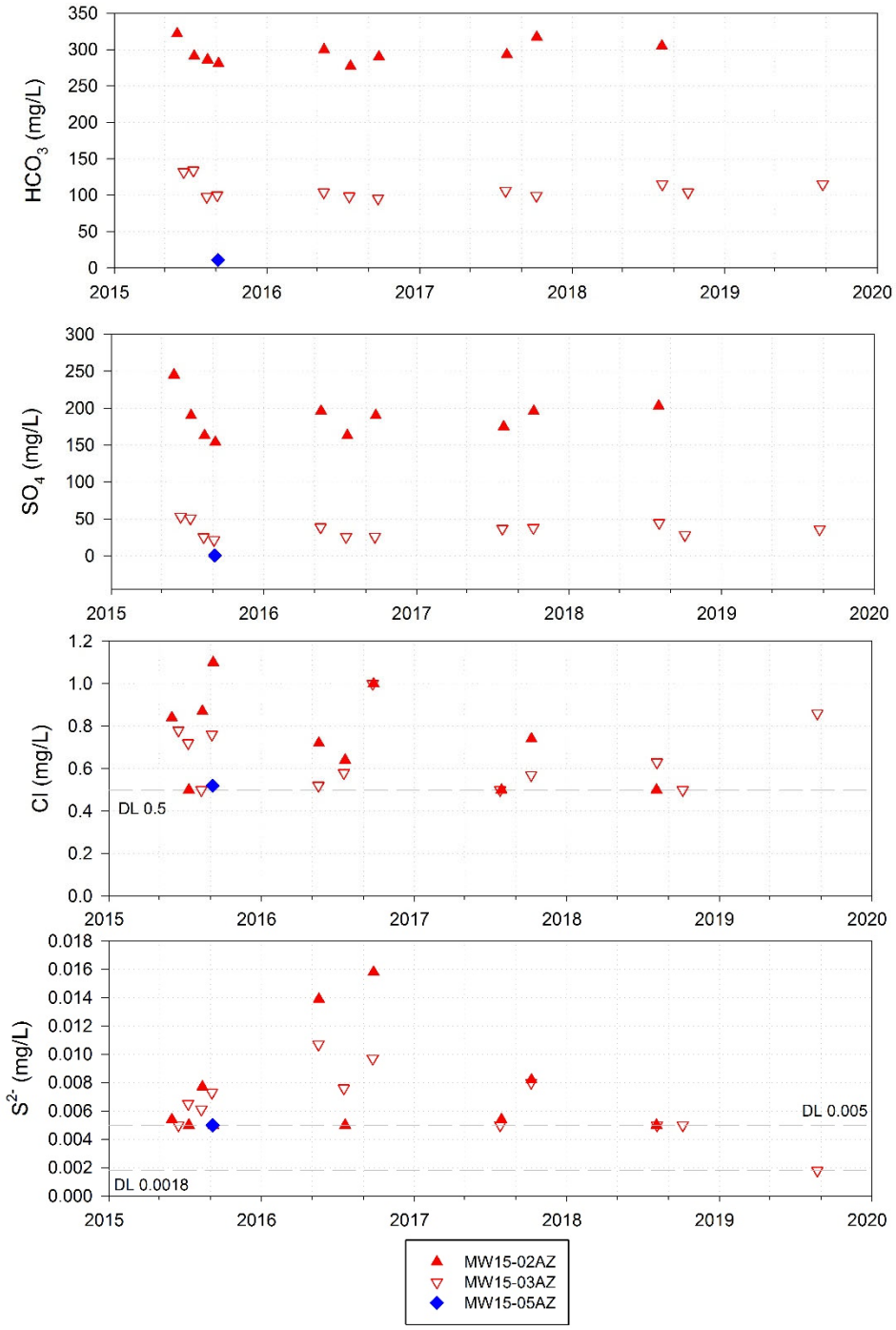

Figure 5-E-9: Major anions and sulphide concentrations in overburden at MW15-02AZ, MW15-03AZ, and MW15-05AZ.

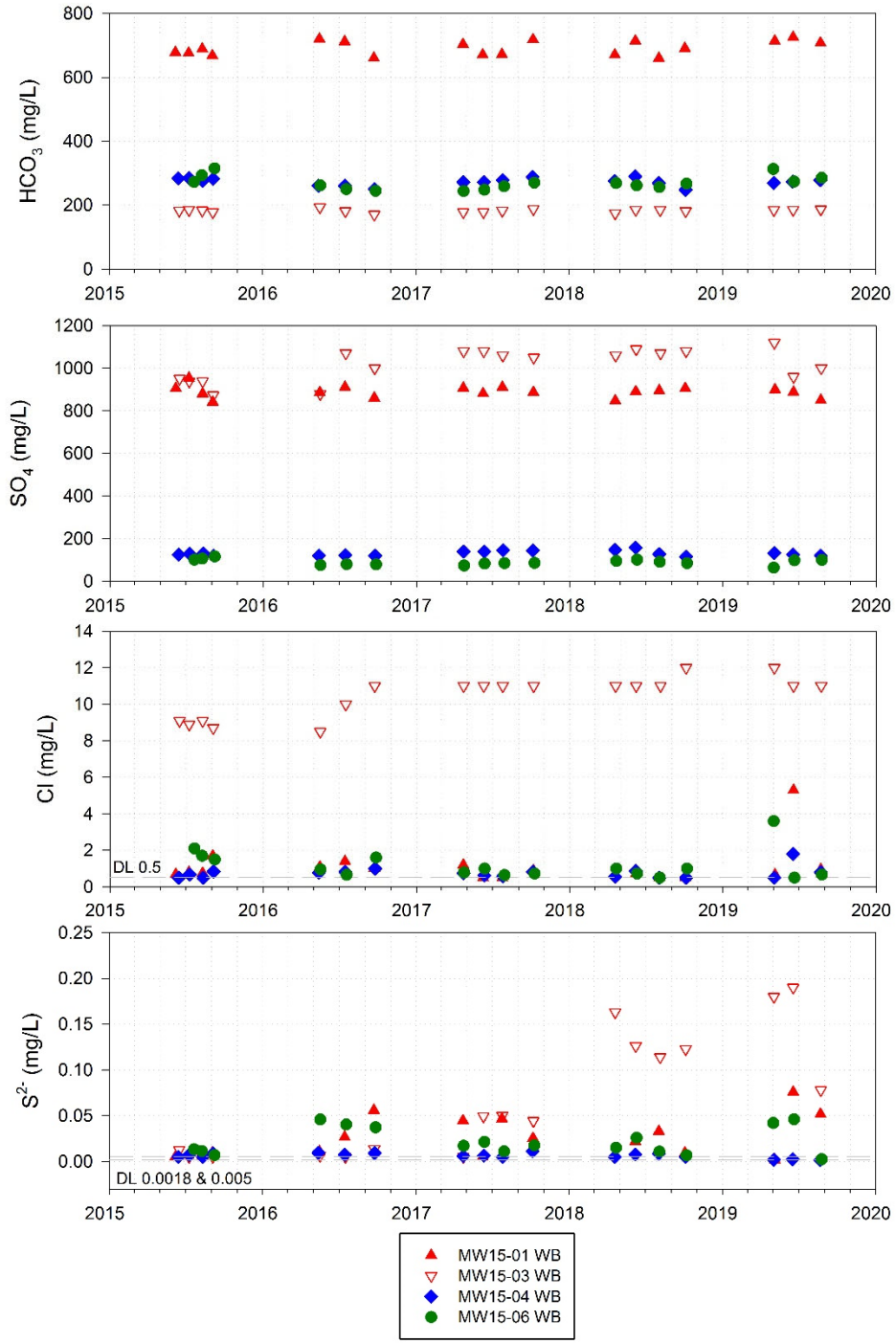

Figure 5-E-10: Major anions and sulphide concentrations in gneiss at MW15-01WB, MW15-03WB, MW15-04WB, and MW15-06WB.

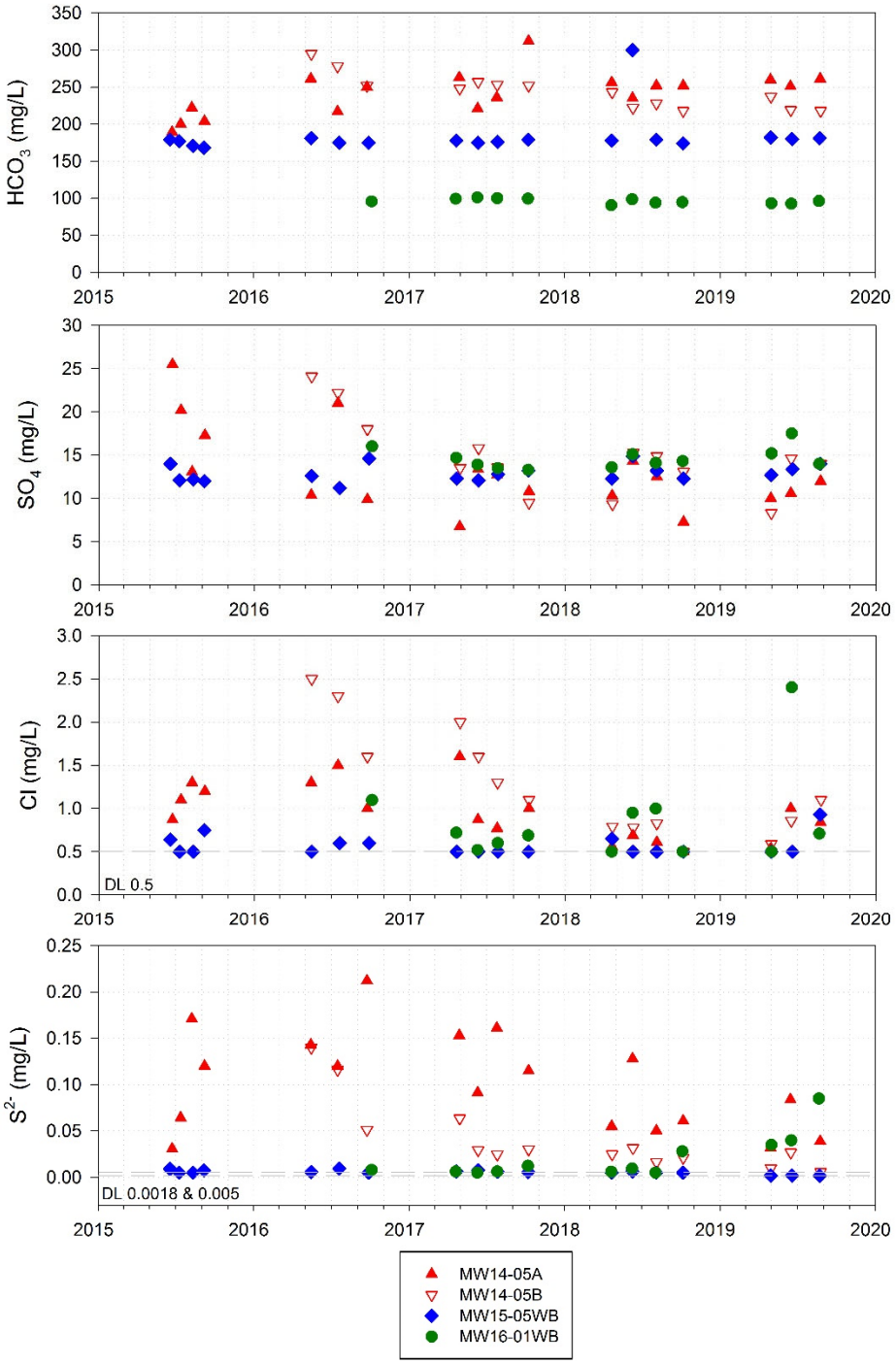

Figure 5-E-11: Major anions and sulphide concentrations in granite at MW14-05A, MW14-05B, MW15-05WB, and MW16-01WB.

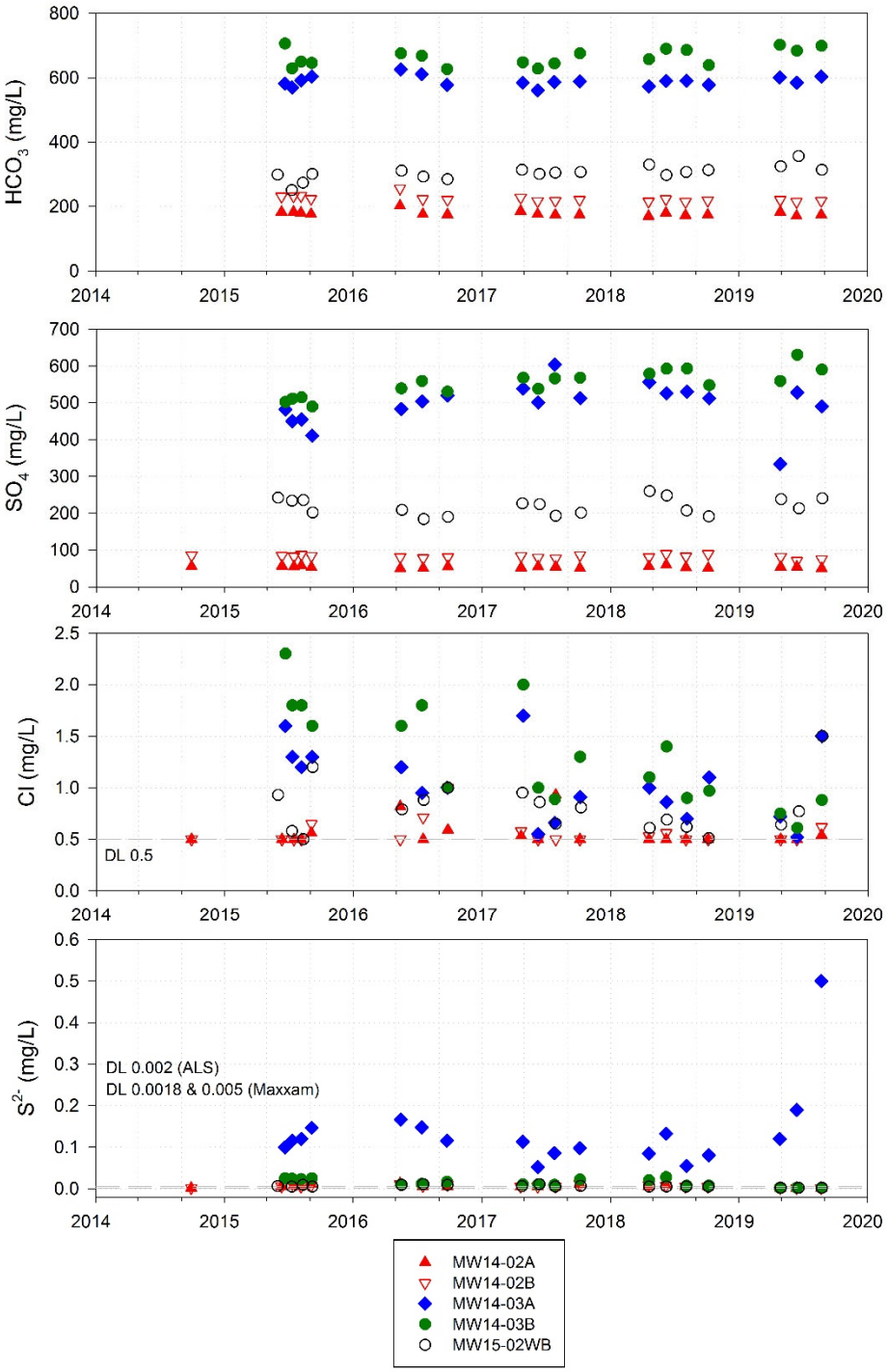

Figure 5-E-12: Major anions and sulphide concentrations in schist at MW14-02A, MW14-02B, MW14-03A, MW14-03B, and MW15-02WB.

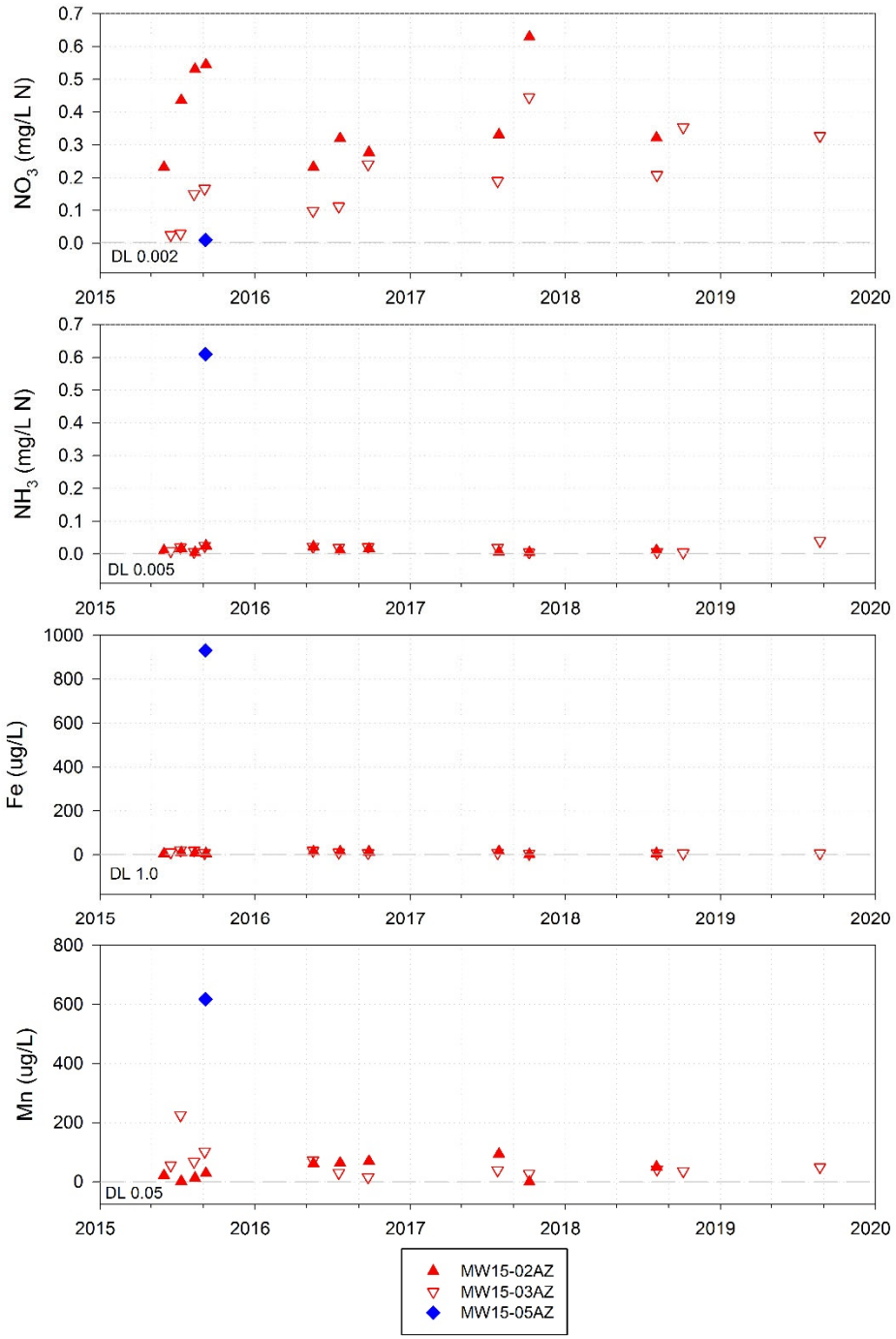

Figure 5-E-13: Redox-sensitive parameter concentrations in overburden at MW15-02AZ, MW15-03AZ, and MW15-05AZ.

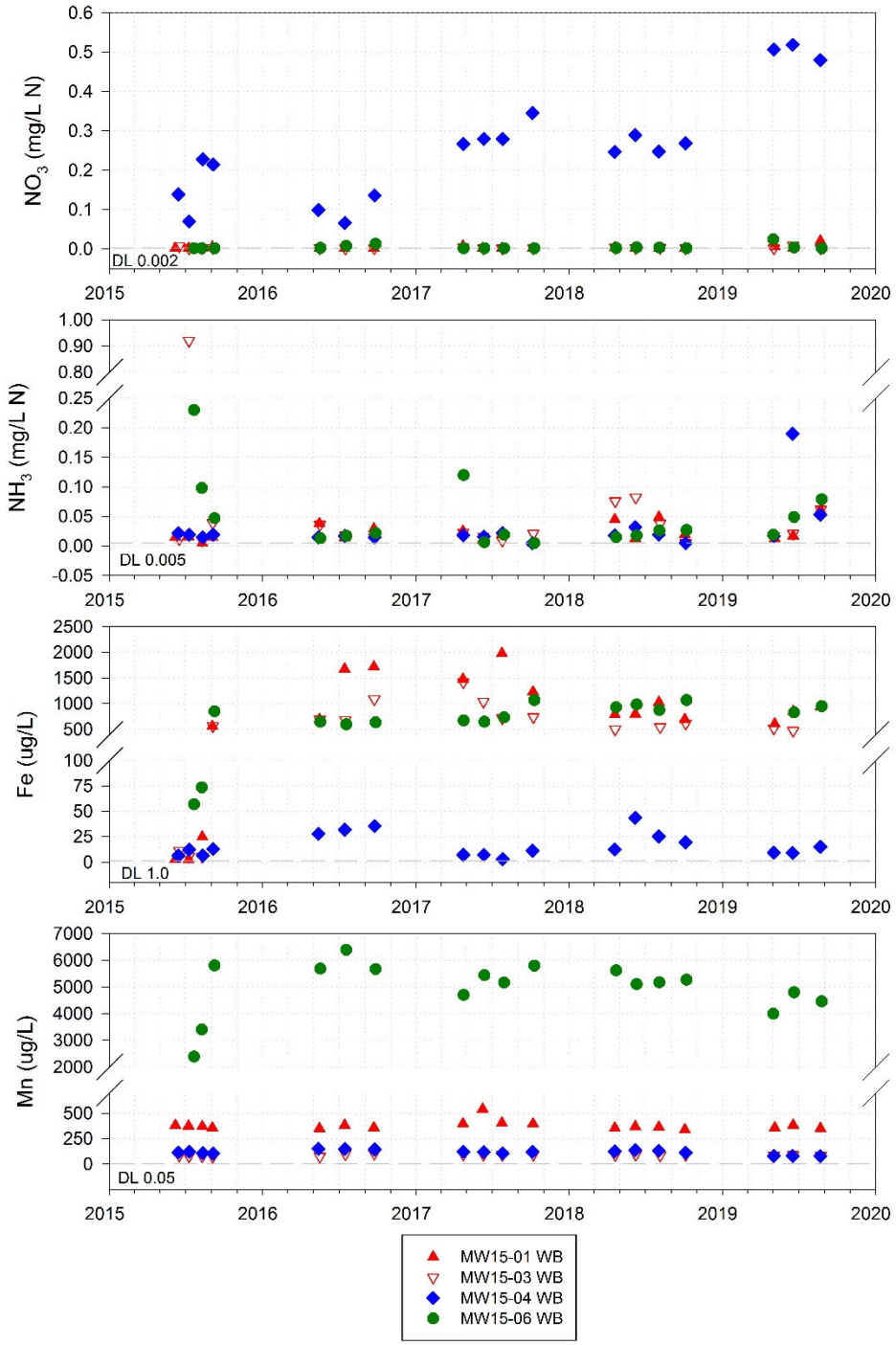

Figure 5-E-14: Redox-sensitive parameter concentrations in gneiss at MW15-01WB, MW15-03WB, MW15-04WB, and MW15-06WB.

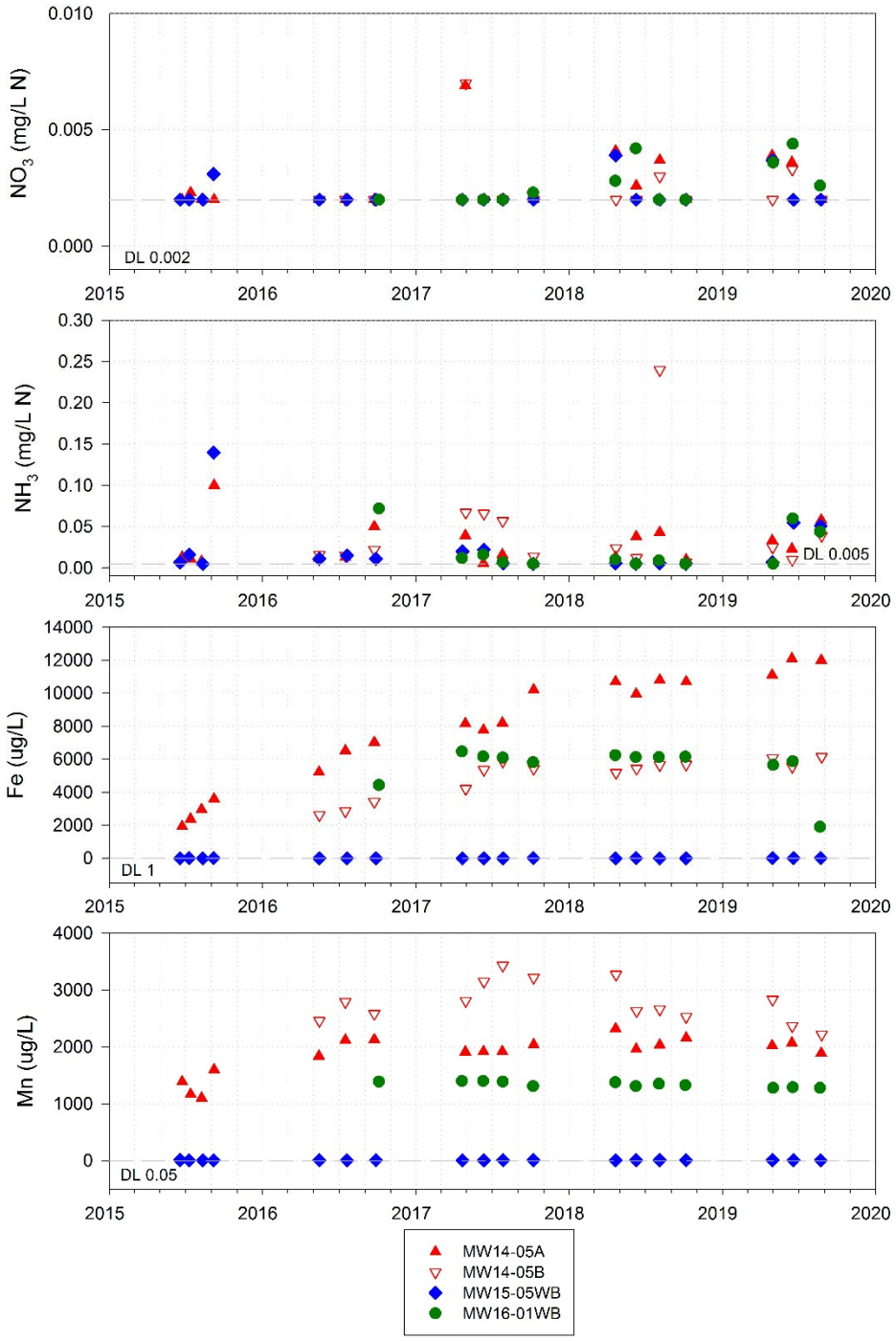

Figure 5-E-15: Redox-sensitive parameter concentrations in granite at MW14-05A, MW14-05B, MW15-05WB, and MW16-01WB.

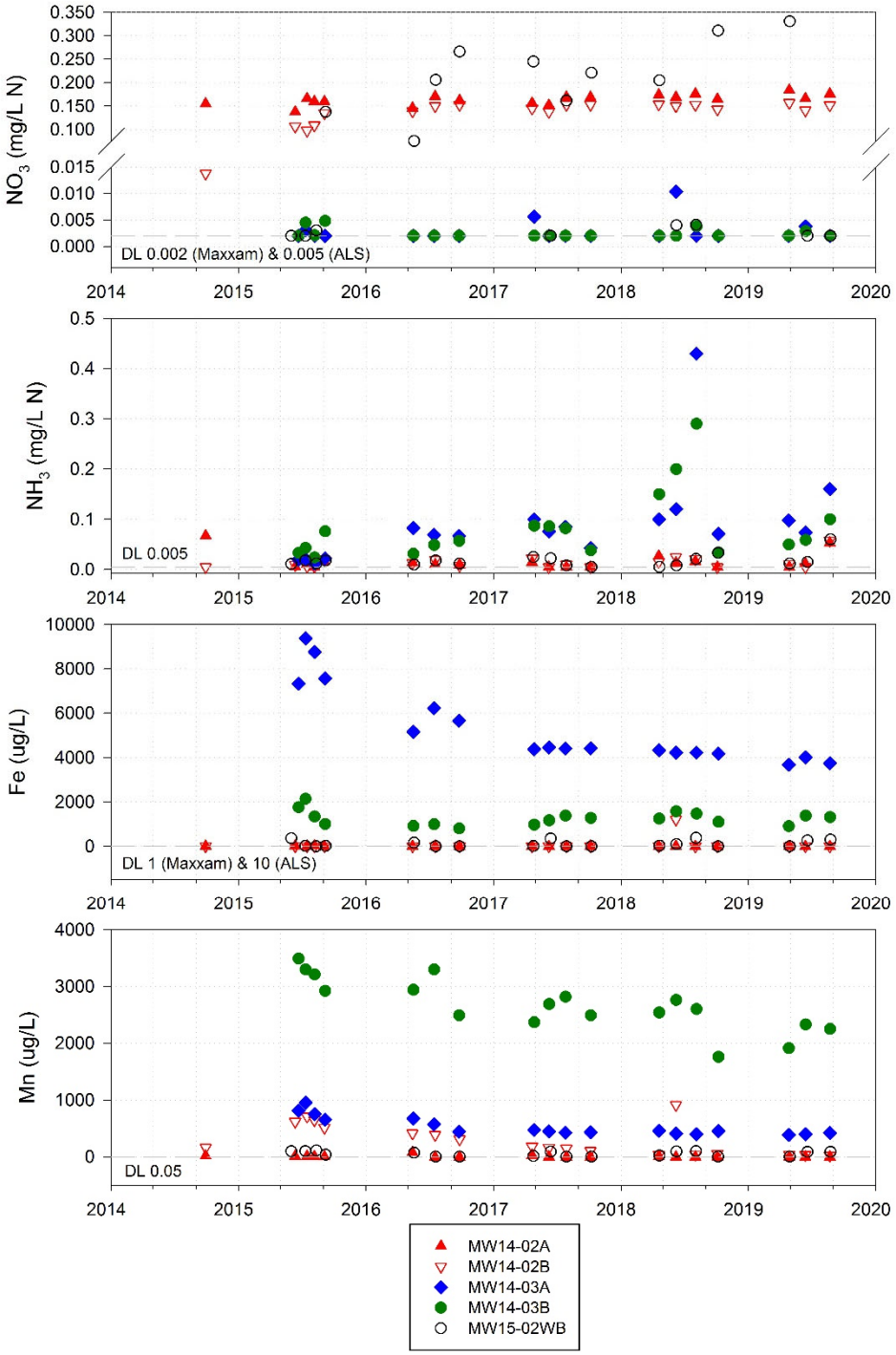

Figure 5-E-16: Redox-sensitive parameter concentrations in schist at MW14-02A, MW14-02B, MW14-03A, MW14-03B, and MW15-02WB.

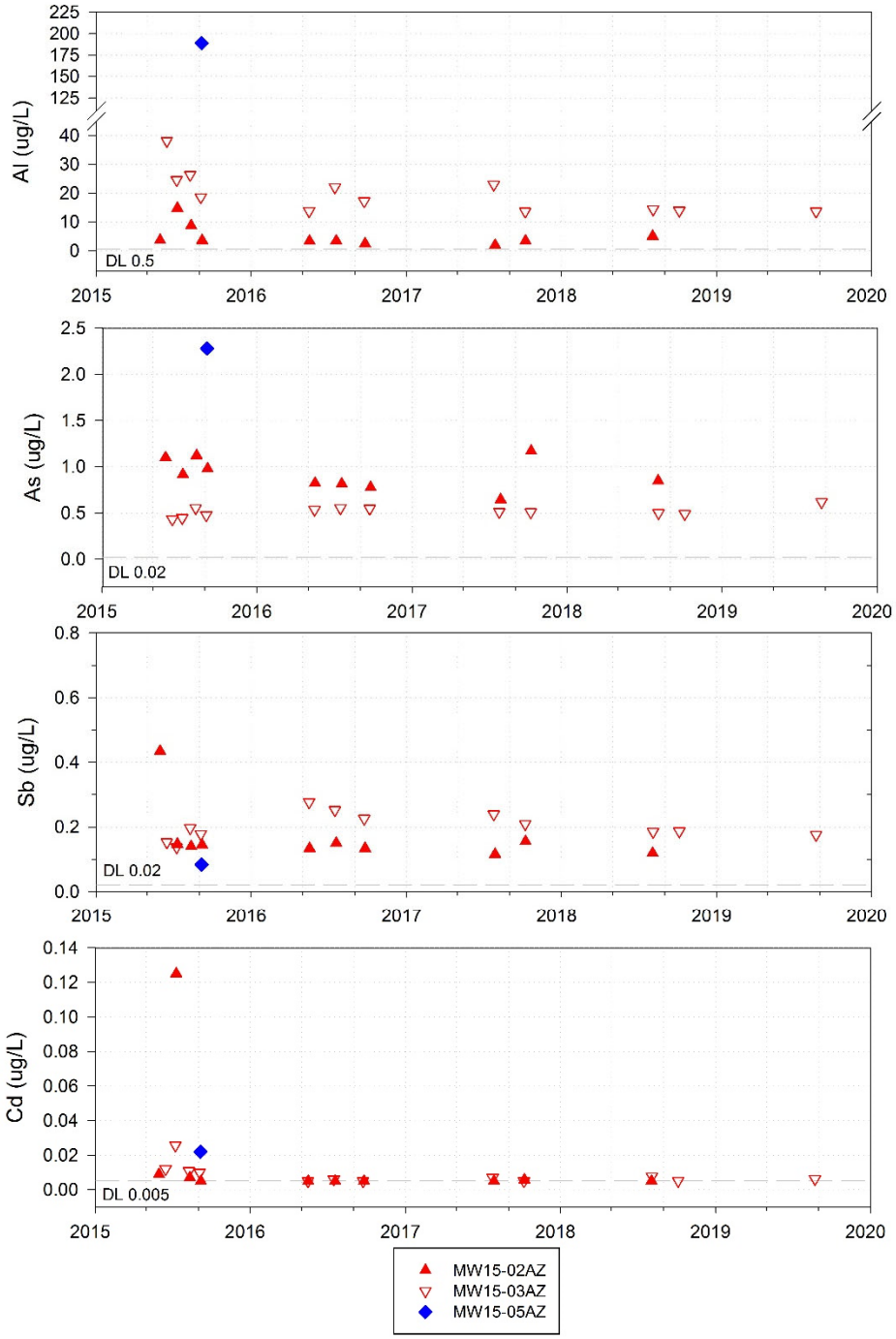

Figure 5-E-17: Dissolved aluminum, arsenic, antimony, and cadmium concentrations in overburden at MW15-02AZ, MW15-03AZ, and MW15-05AZ.

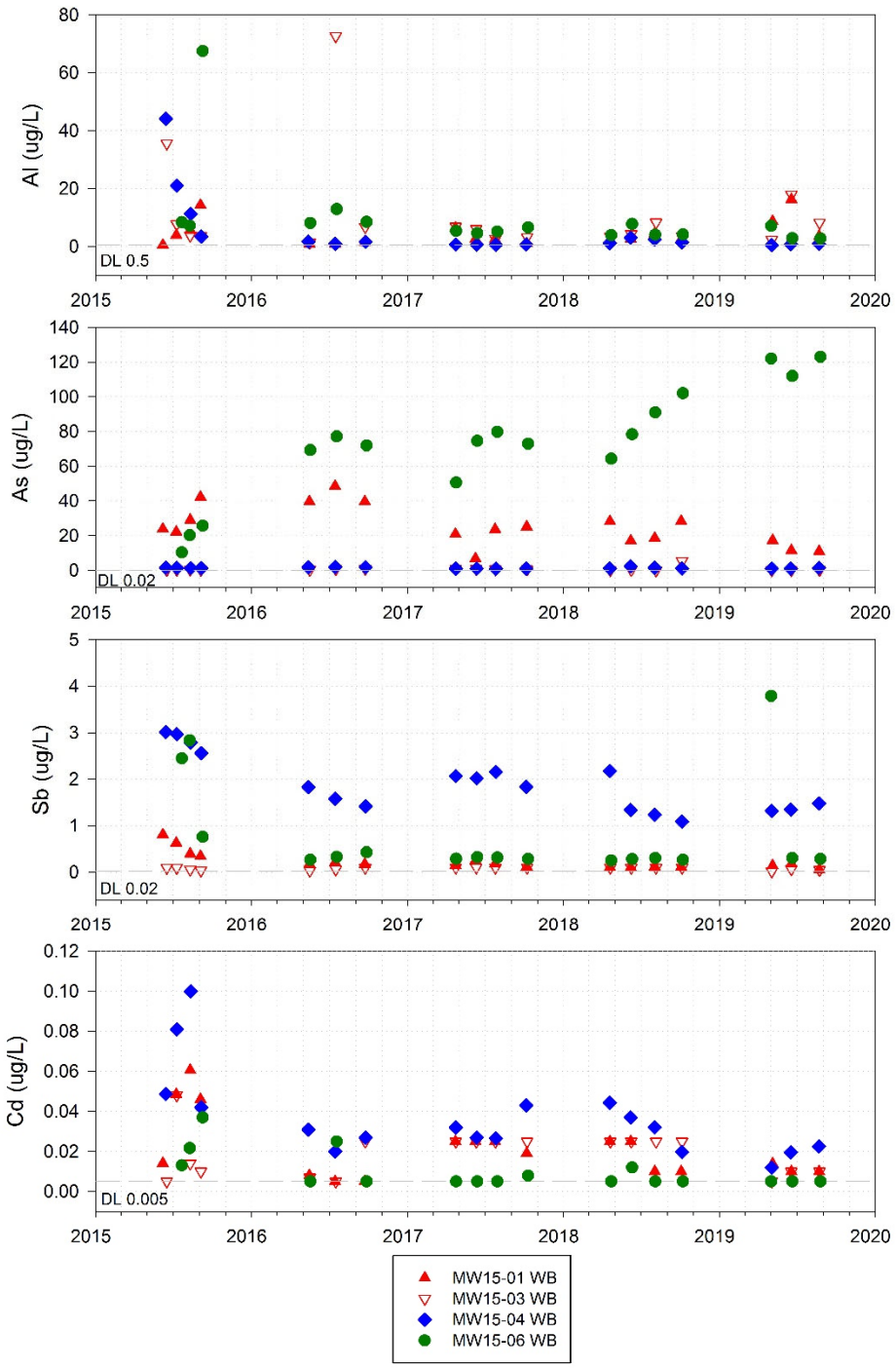

Figure 5-E-18: Dissolved aluminum, arsenic, antimony, and cadmium concentrations in gneiss at MW15-01WB, MW15-03WB, MW15-04WB, and MW15-06WB.

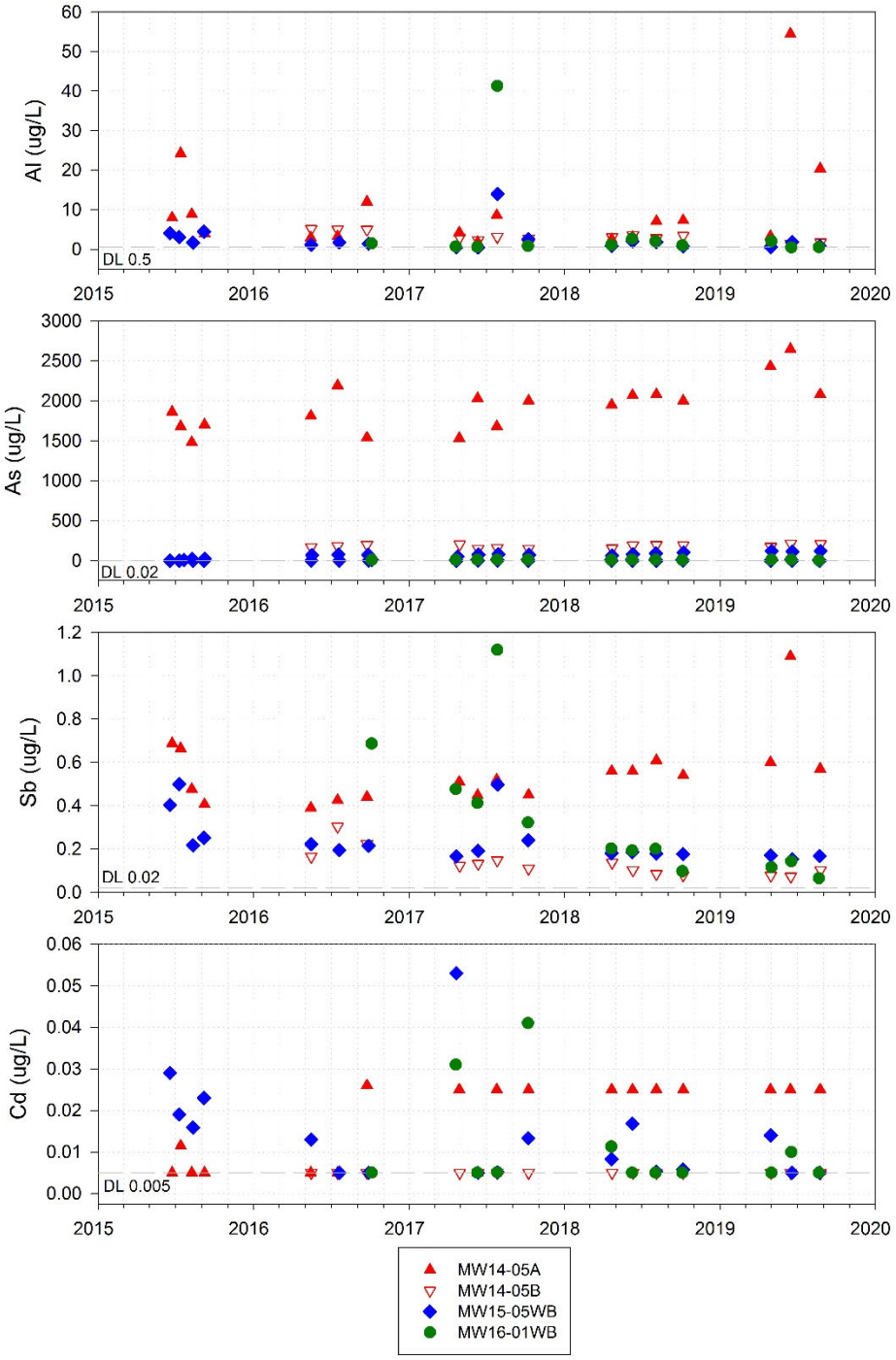

Figure 5-E-19: Dissolved aluminum, arsenic, antimony, and cadmium concentrations in granite at MW14-05A, MW14-05B, MW15-05WB, and MW16-01WB.

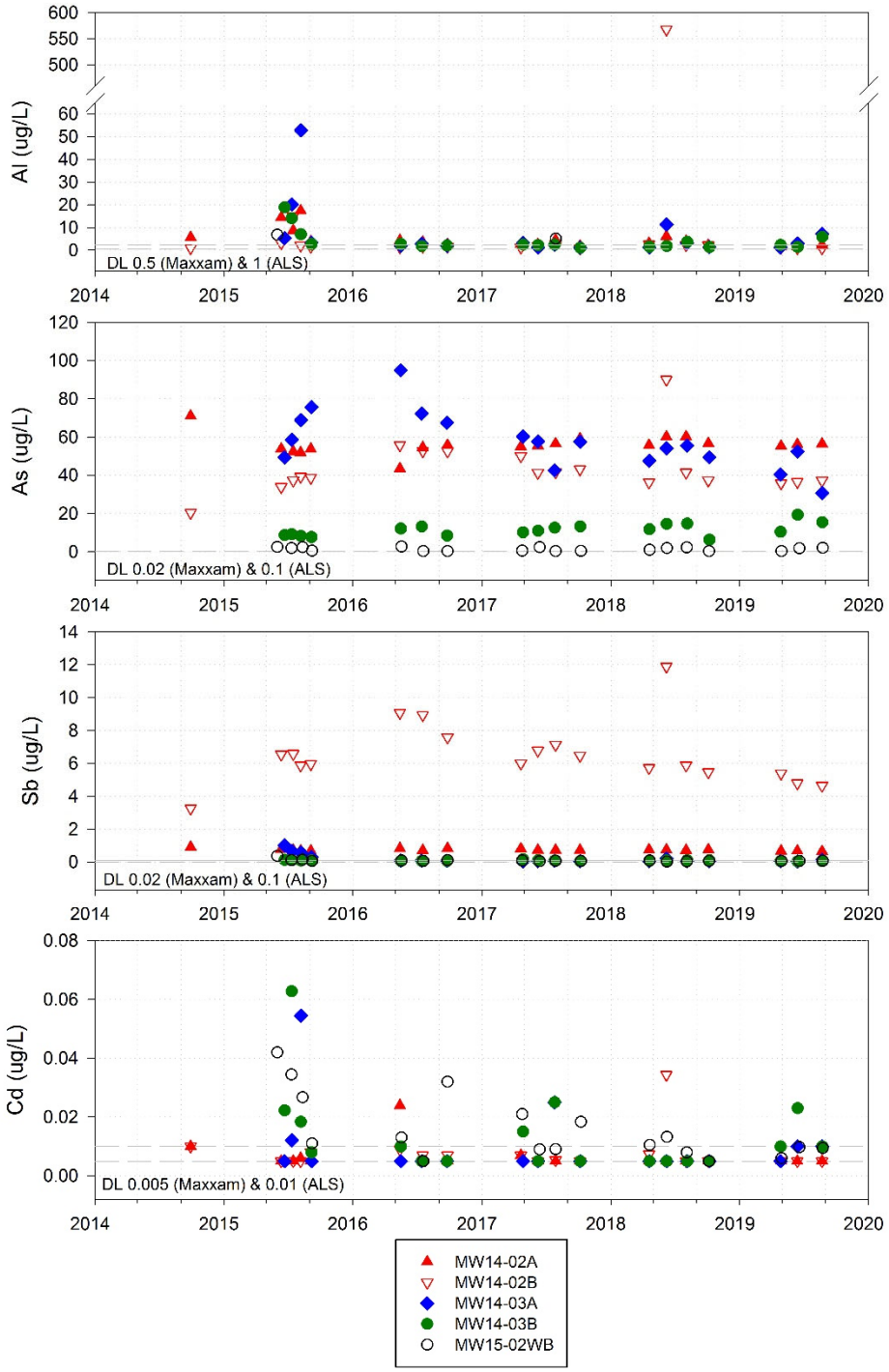

Figure 5-E-20: Dissolved aluminum, arsenic, antimony, and cadmium concentrations in schist at MW14-02A, MW14-02B, MW14-03A, MW14-03B, and MW15-02WB.

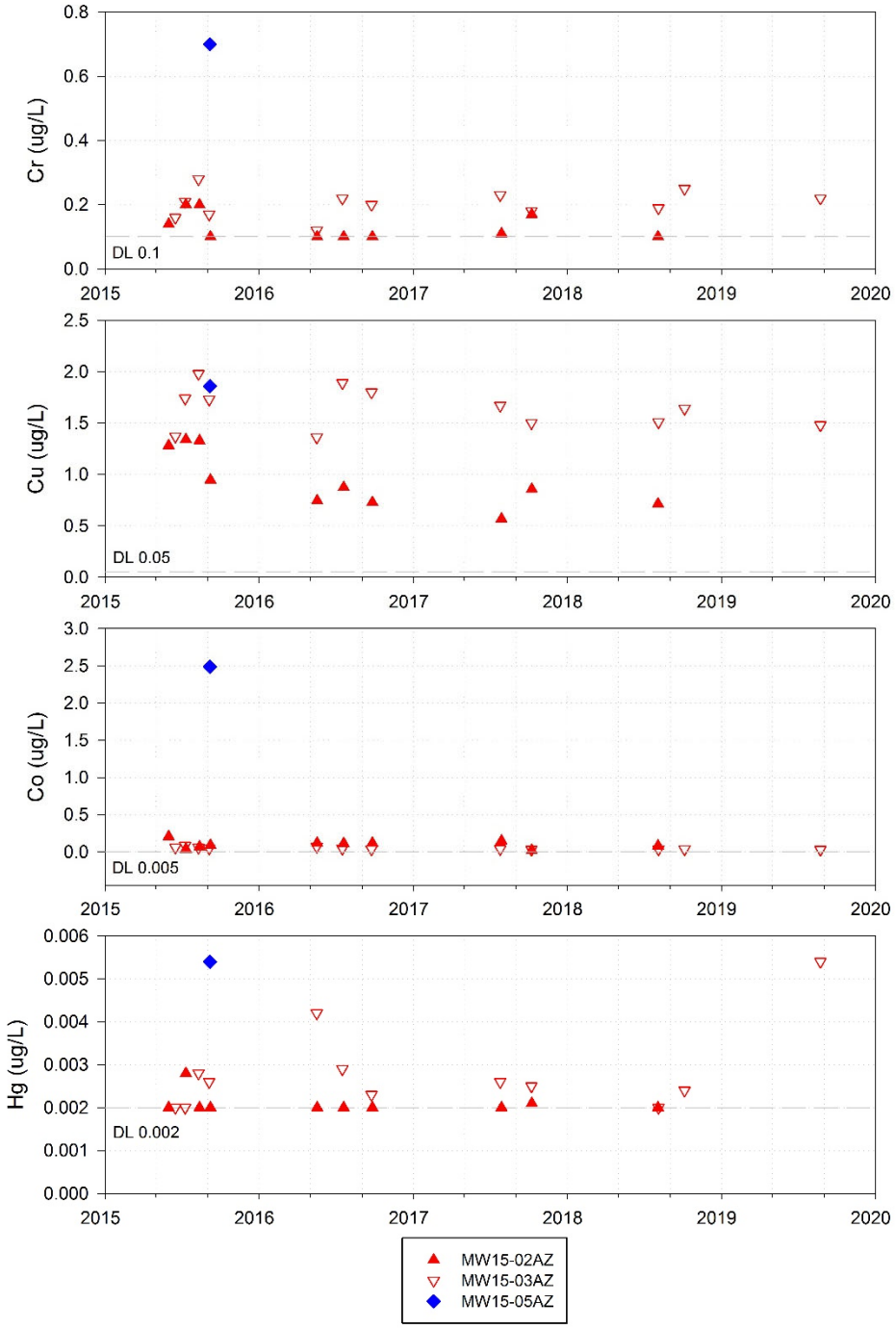

Figure 5-E-21: Dissolved chromium, copper, cobalt, and mercury concentrations in overburden at MW15-02AZ, MW15-03AZ, and MW15-05AZ.

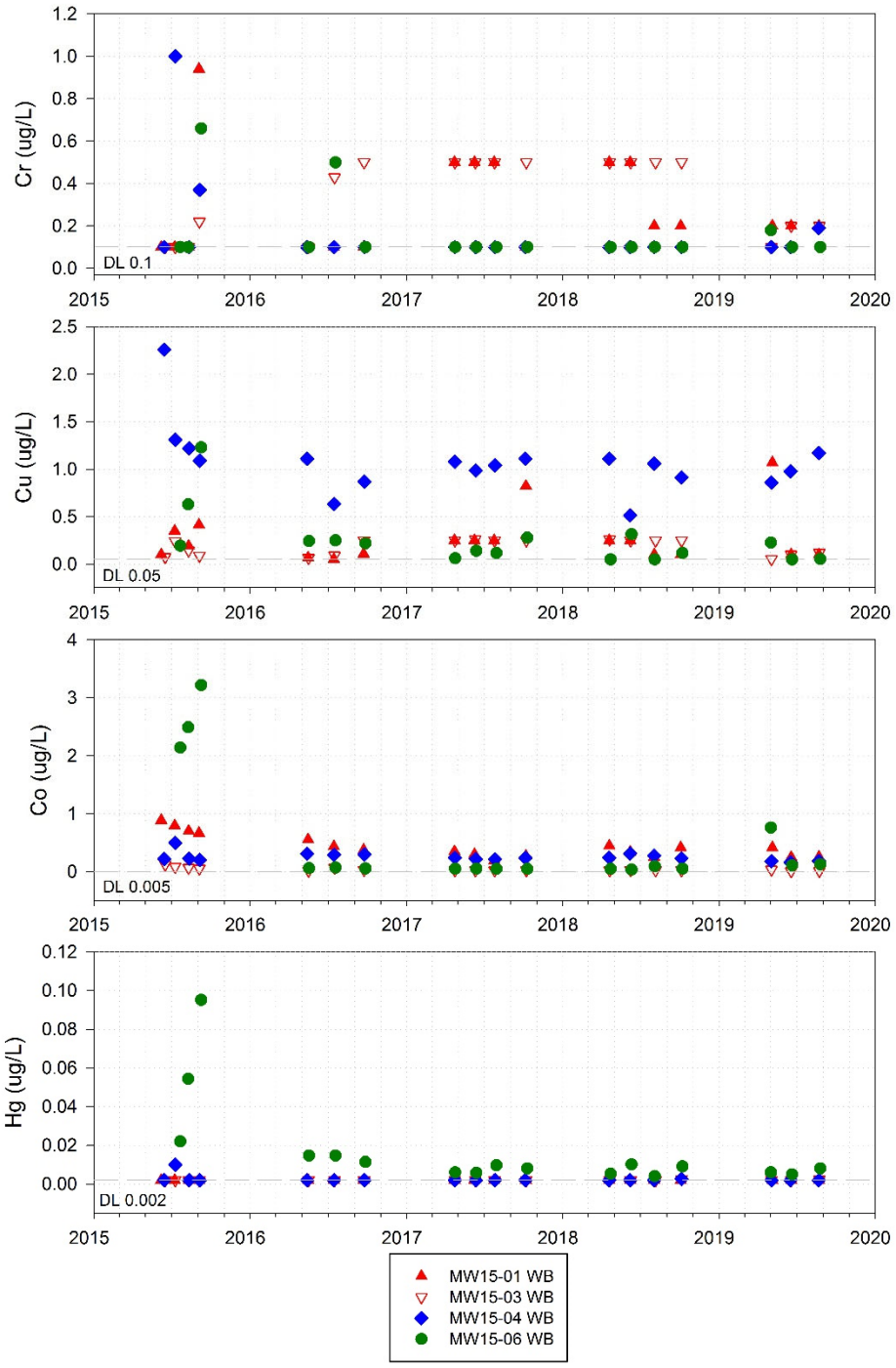

Figure 5-E-22: Dissolved chromium, copper, cobalt, and mercury concentrations in gneiss at MW15-01WB, MW15-03WB, MW15-04WB, and MW15-06WB.

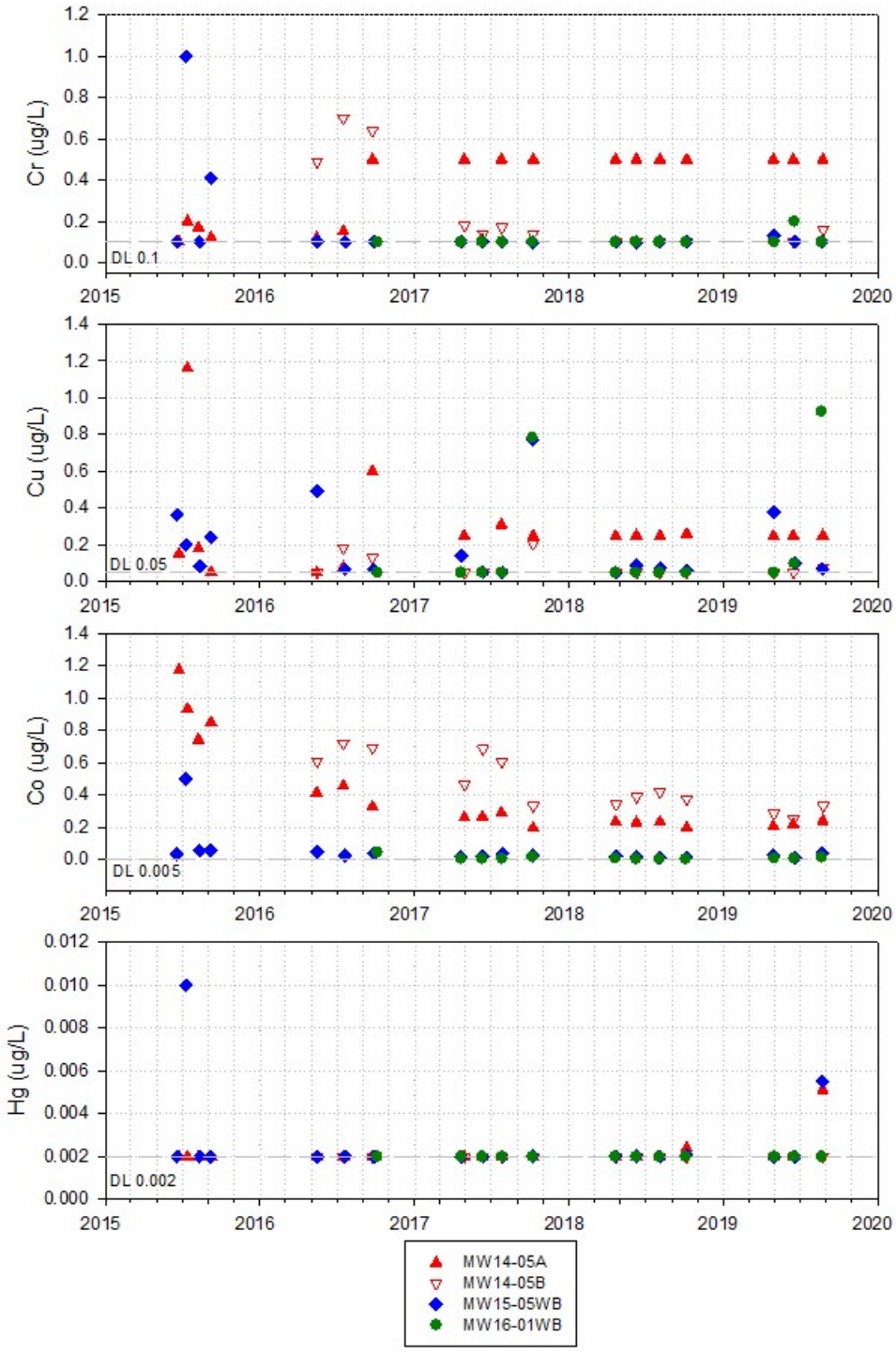

Figure 5-E-23: Dissolved chromium, copper, cobalt, and mercury concentrations in granite at MW14-05A, MW14-05B, MW15-05WB, and MW16-01WB.

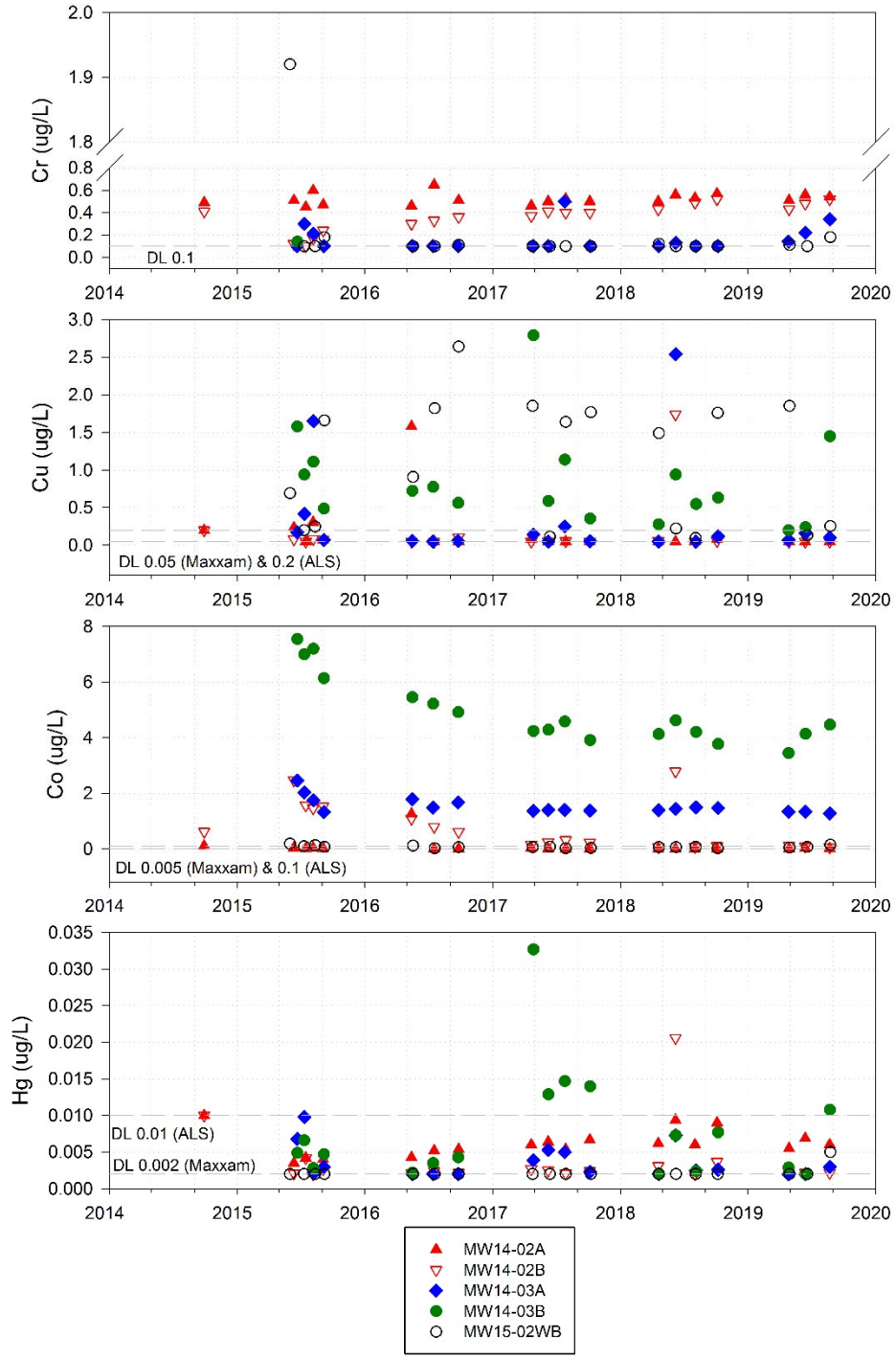

Figure 5-E-24: Dissolved chromium, copper, cobalt, and mercury concentrations in schist at MW14-02A, MW14-02B, MW14-03A, MW14-03B, and MW15-02WB.

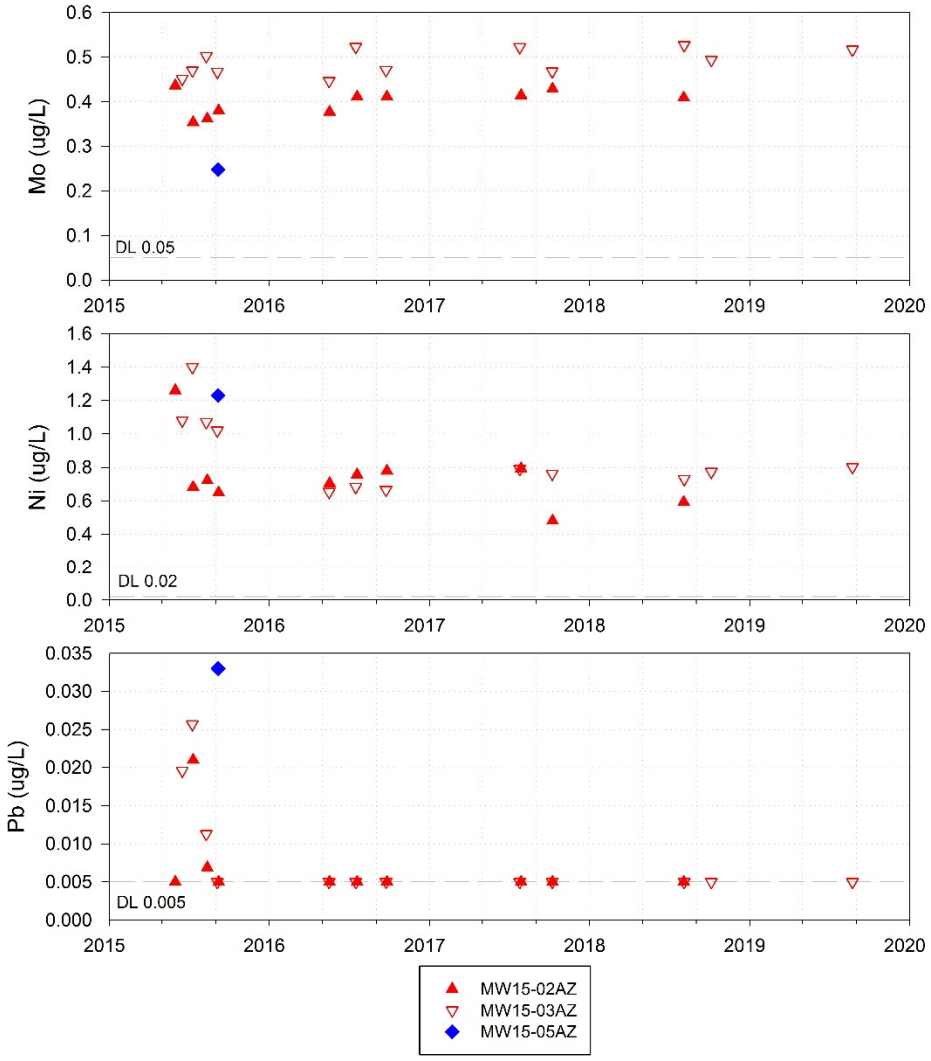

Figure 5-E-25: Dissolved molybdenum, nickel, and lead concentrations in overburden at MW15-02AZ, MW15-03AZ, and MW15-05AZ.

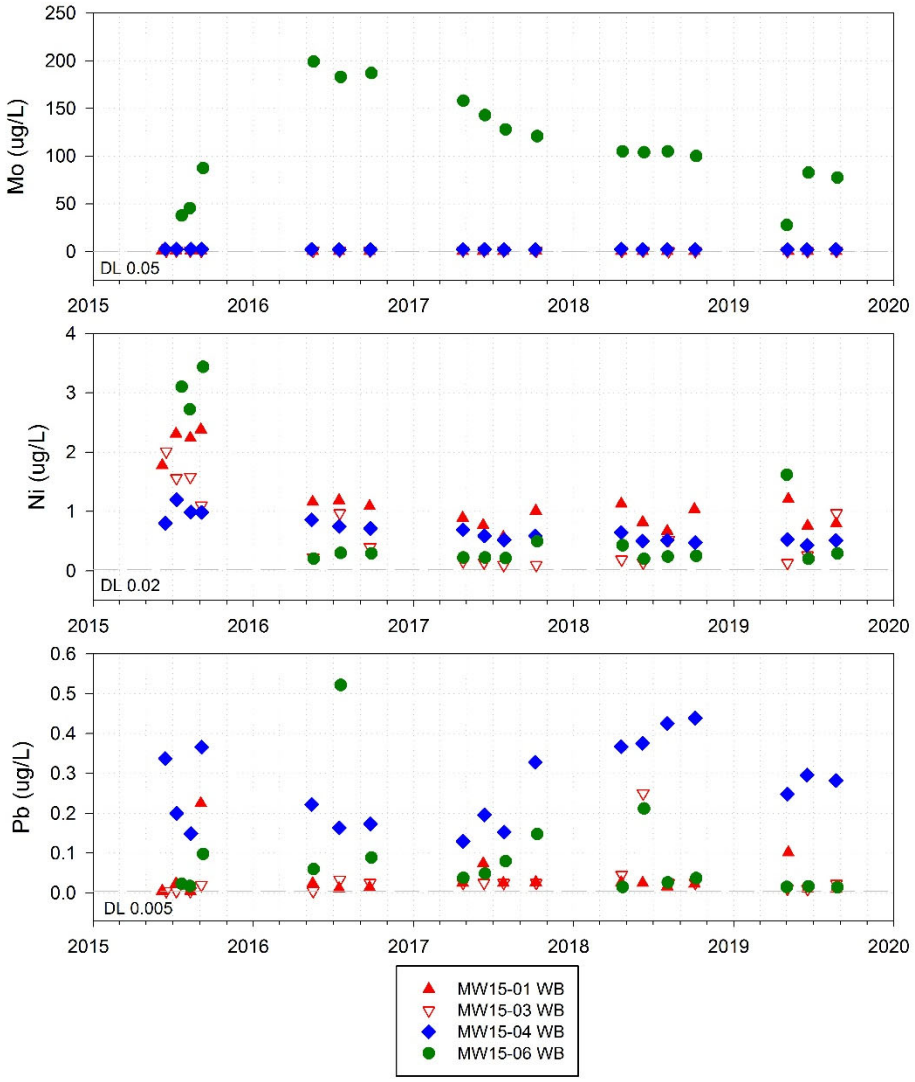

Figure 5-E-26: Dissolved molybdenum, nickel, and lead concentrations in gneiss at MW15-01WB, MW15-03WB, MW15-04WB, and MW15-06WB.

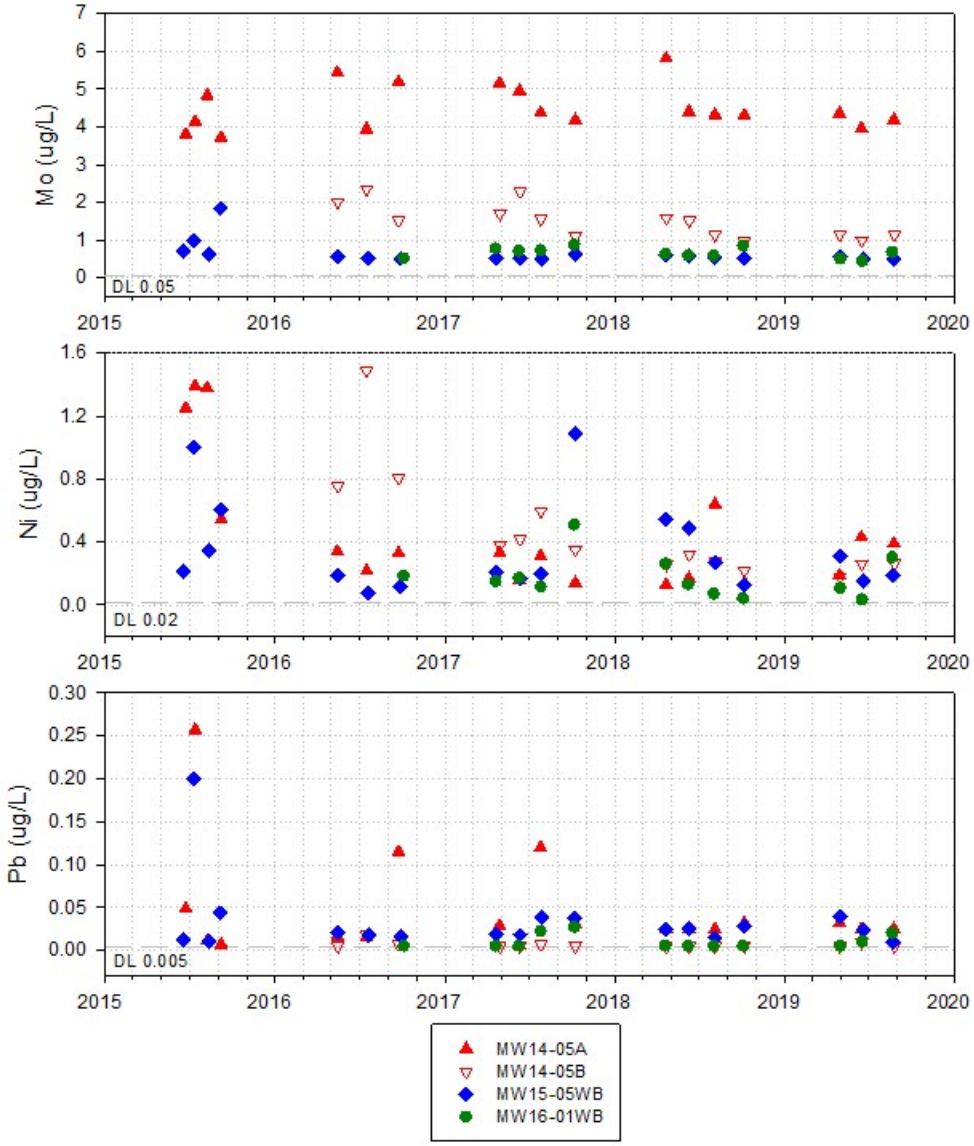

Figure 5-E-27: Dissolved molybdenum, nickel, and lead concentrations in granite at MW14-05A, MW14-05B, MW15-05WB, and MW16-01WB.

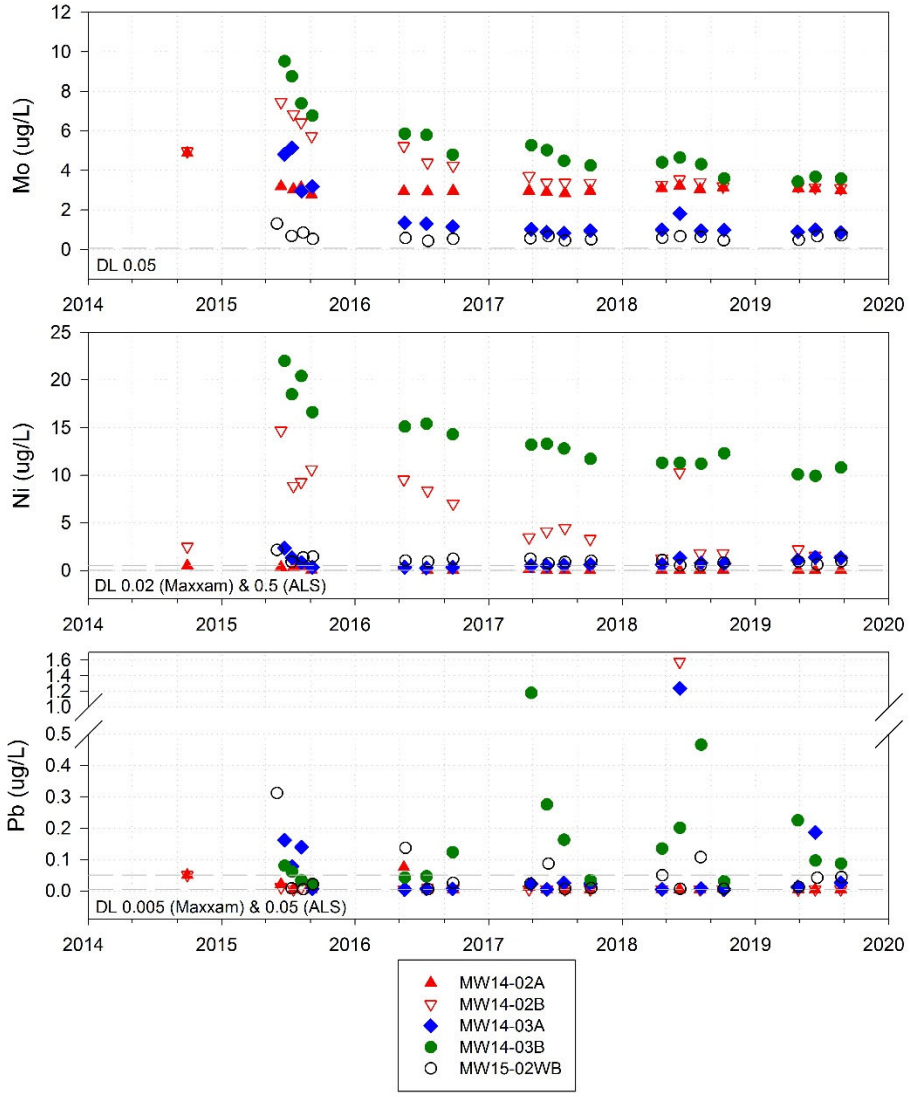

Figure 5-E-28: Dissolved molybdenum, nickel, and lead concentrations in schist at MW14-02A, MW14-02B, MW14-03A, MW14-03B, and MW15-02WB.

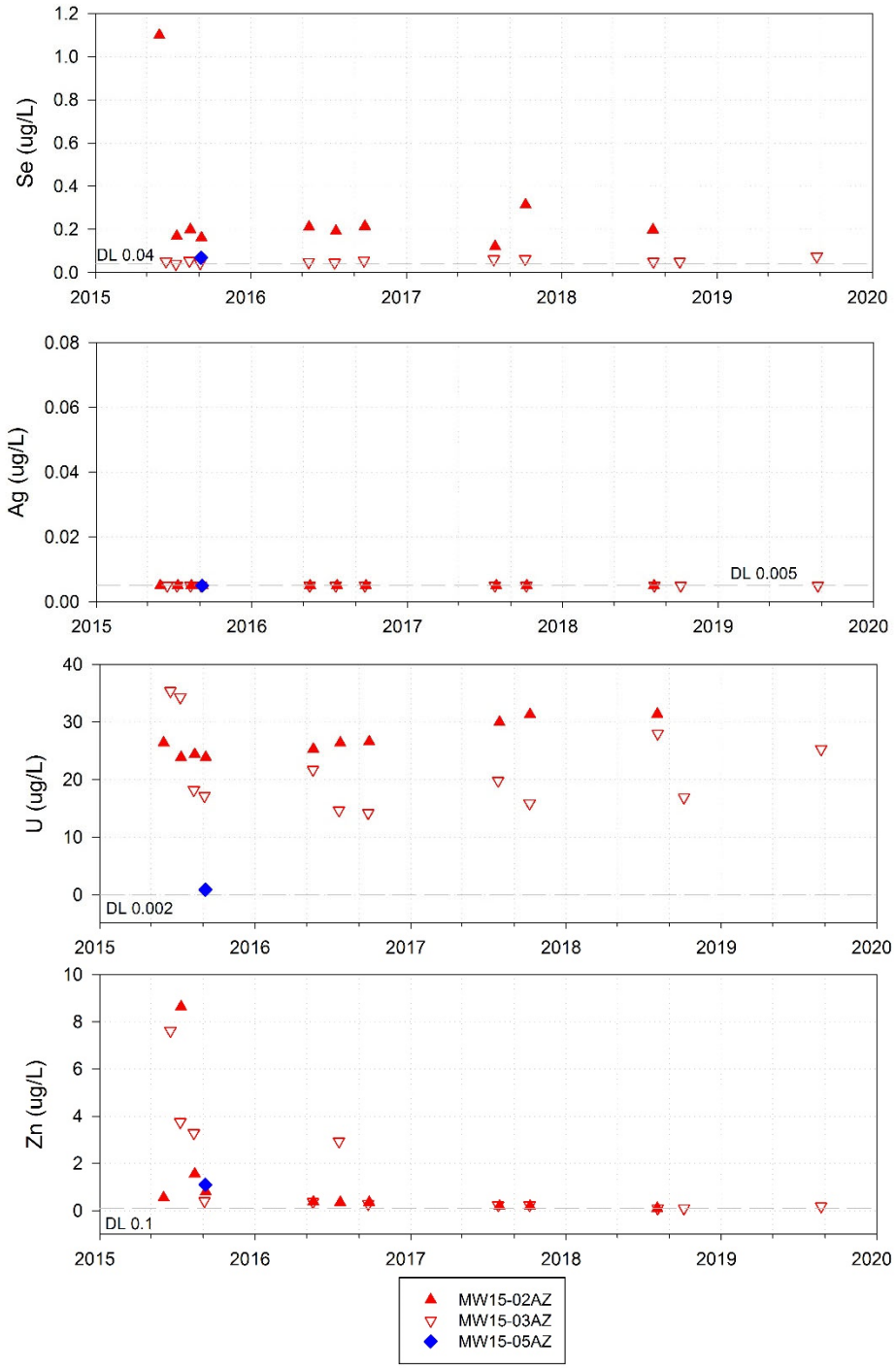

Figure 5-E-29: Dissolved selenium, silver, uranium, and zinc concentrations in overburden at MW15-02AZ, MW15-03AZ, and MW15-05AZ.

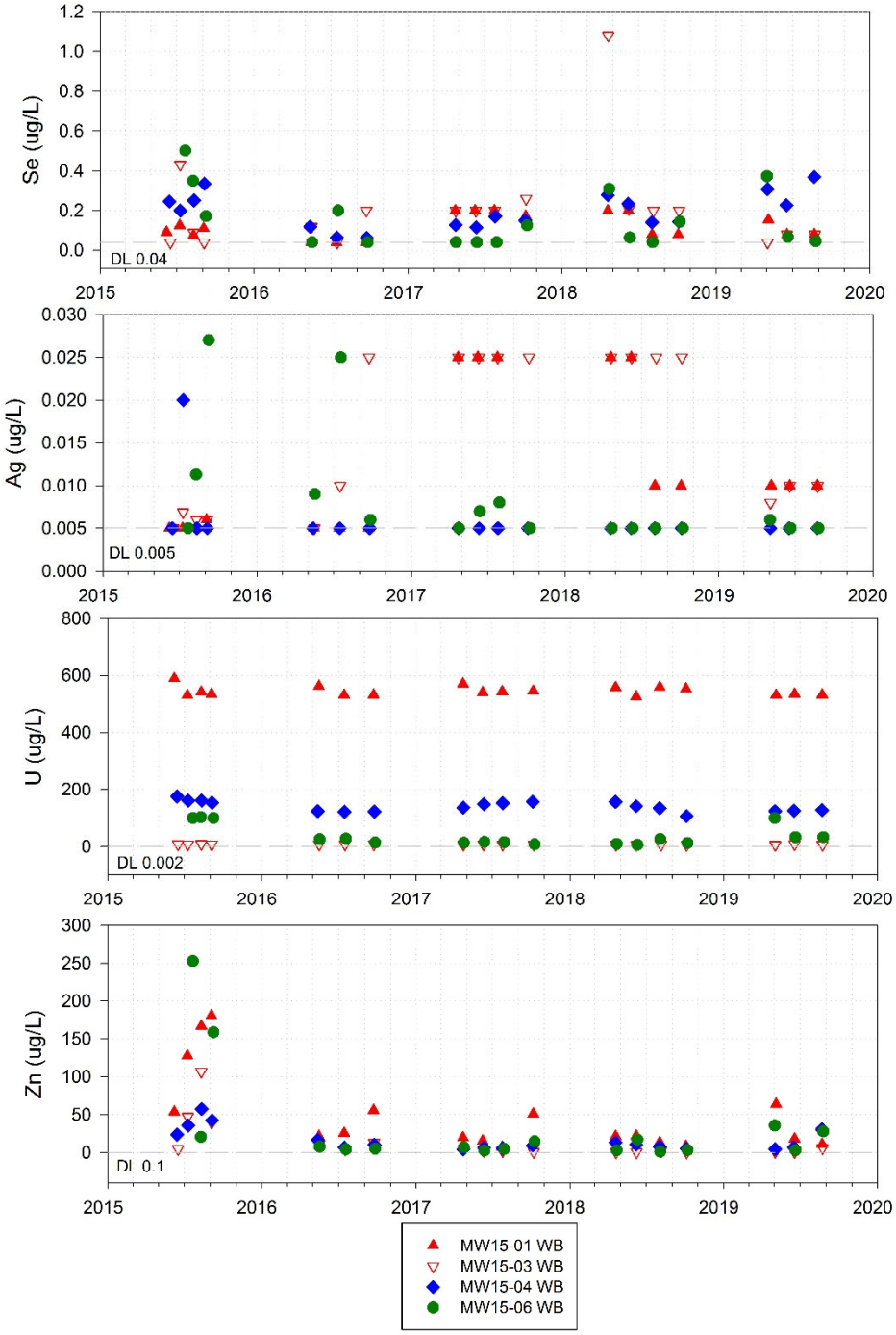

Figure 5-E-30: Dissolved selenium, silver, uranium, and zinc concentrations in gneiss at MW15-01WB, MW15-03WB, MW15-04WB, and MW15-06WB.

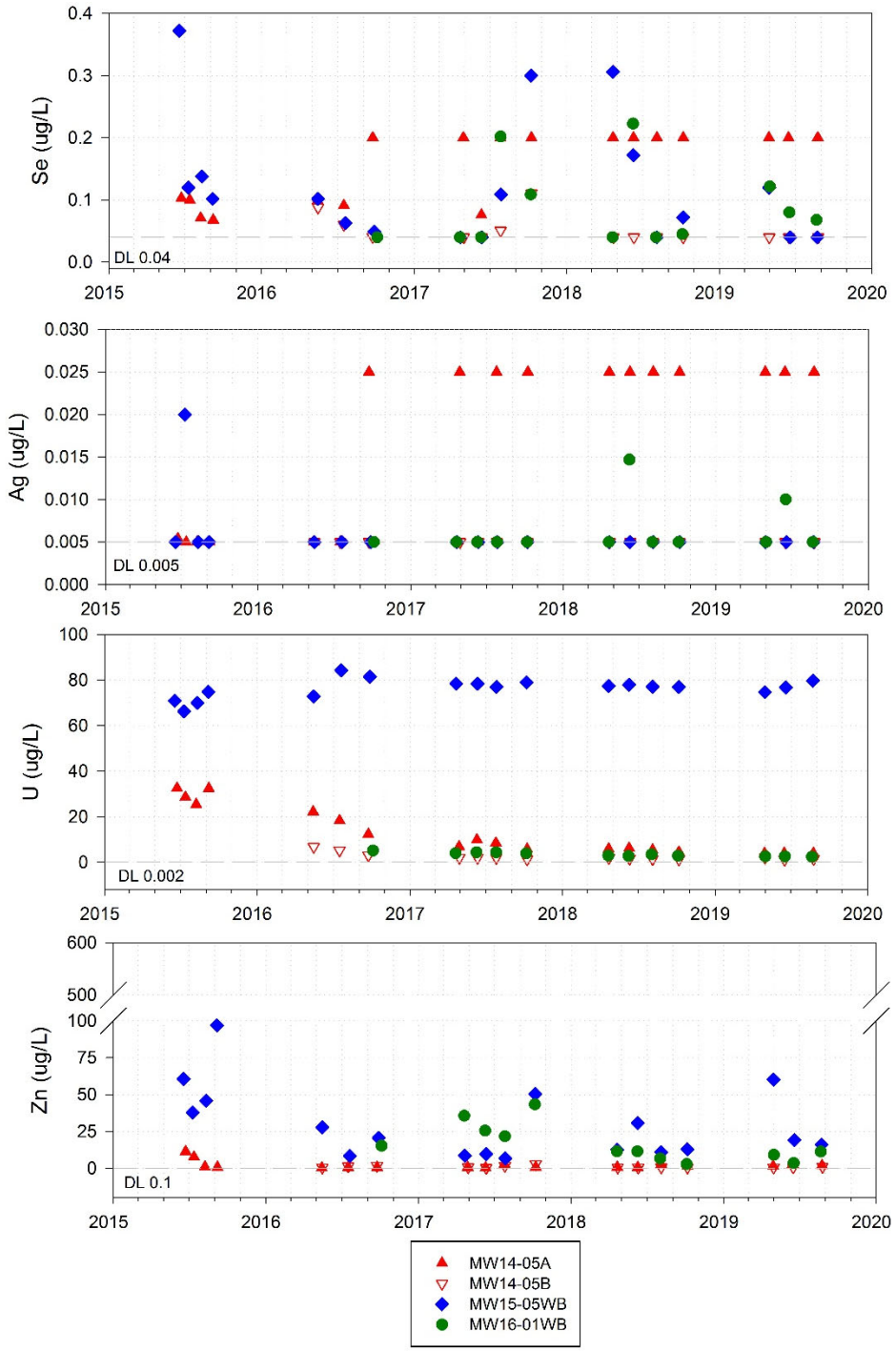

Figure 5-E-31: Dissolved selenium, silver, uranium, and zinc concentrations in granite at MW14-05A, MW14-05B, MW15-05WB, and MW16-01WB.

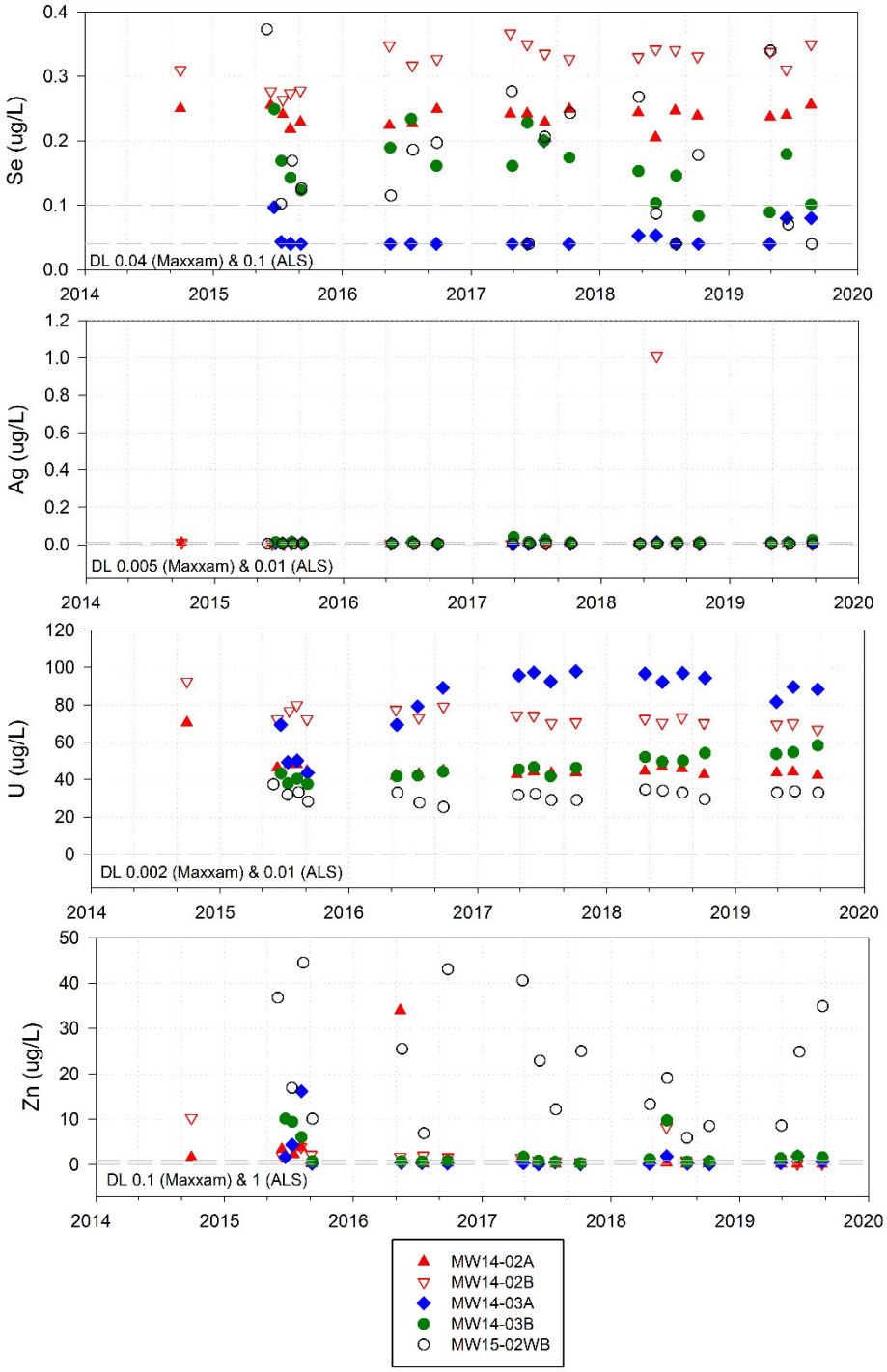

Figure 5-E-32: Dissolved selenium, silver, uranium, and zinc concentrations in schist at MW14-02A, MW14-02B, MW14-03A, MW14-03B, and MW15-02WB.

Appendix 5-F: Isotope Analyses

Appendix A: Methodology for Estimation of $\delta^{18}O$ and $\delta^{2}H$ of Local Precipitation

Appendix B: Groundwater Ages Methodology

Appendix C: Laboratory Certificates of Analysis

Appendix D: Isotope Data and Quality Assurance/ Quality Control

Newmont™
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TECHNICAL MEMORANDUM

To:	**Jennie Gjertsen (Newmont Goldcorp)**	**Date:**	**December 15, 2021**
From:	**Elliott Skierszkan (UBC), Jordi Helsen (Lorax)**	**Project #:**	**A362-4**
Subject:	**Coffee Gold – Isotopic Analyses in Support of Baseline Hydrogeological Assessment 2019 Update**		

1. Introduction and Objective

The following memorandum, prepared by Lorax Environmental Services Ltd. (Lorax), presents results of groundwater and surface water characterization within the Coffee Gold Project (the Project) by use of isotopic analyses of hydrogen, oxygen, and carbon. The Project is located within the Whitehorse Mining District, Canada, 130 kilometers (km) south of Dawson City, Yukon. The objective is to provide a better understanding of groundwater flow and ages across the Project area. This memorandum complements the Coffee Gold Baseline Hydrogeological Assessment (Lorax, 2017) and the Coffee Baseline Hydrogeological Assessment 2019 Update (Lorax, 2021).

2. Background - Isotopes of Hydrogen, Oxygen, and Carbon as Hydrological Tracers

2.1 Stable Isotopes for Tracing Groundwater Provenance

There are multiple stable isotopes of oxygen (^{18}O, ^{17}O, ^{16}O) and hydrogen (^{2}H and ^{1}H). The ratios of these isotopes in water are altered during phase transfer such as evaporation, condensation, and freezing. Preferential partitioning of isotopes between phases (*e.g.*, water and vapour) is defined as isotope fractionation.

The delta notation (δ) is used to describe the stable isotope composition of water samples by normalizing the ratio (R) of heavy to light isotopes in samples relative to that of an international standard:

$$\delta = \frac{R_{sample} - R_{standard}}{R_{standard}} \times 1000 \qquad (1)$$

The $^{18}O/^{16}O$ ratio is typically used for oxygen, and $^{2}H/^{1}H$ for hydrogen. Delta values are expressed in per-mil (‰) units relative to the VSMOW standard (Vienna Standard Mean Ocean Water).

Water stable isotope ratios vary in precipitation and can therefore be used to trace groundwater sources and recharge history. In a general sense, $\delta^{18}O$ and $\delta^{2}H$ values decrease for precipitation occurring under colder conditions. For example, precipitation falling at higher altitude (colder temperatures) in a given region tends to have lower $\delta^{18}O$ and $\delta^{2}H$ values. Similarly, precipitation occurring during the colder winter months and falling as snow tends to have lower $^{18}O/^{16}O$ and $^{2}H/^{1}H$ ratios than precipitation occurring during the warmer summer months. These seasonal

pulses are most evident in surface water and shallow groundwater systems because mixing of recharge through advection-dispersion mutes this signal in deeper groundwater.

In deeper groundwater systems with residence times of thousands to tens of thousands of years, variations in $\delta^{18}O$ and $\delta^{2}H$ values can be used to indicate water that recharged during periods of colder climatic conditions, such as the Pleistocene glacial period.

The slope of $\delta^{2}H$ versus $\delta^{18}O$ in precipitation is also useful as a hydrological tracer. The slope can vary depending on the air humidity during the primary evaporation of a vapour mass in a source region (*e.g.*, the oceans), as well as any evaporation that occurs between the formation of rain or snow in a cloud and the transfer of that water into aquifers (*i.e.*, groundwater recharge). At the local scale, a local meteoric water line (LMWL) can be defined for a given region, which describes the slope of $\delta^{2}H$ against $\delta^{18}O$ data in local precipitation. Deviations of the slope in groundwater data relative to the LMWL can indicate evaporation that occurred between precipitation and recharge.

To aid in the interpretation of $\delta^{18}O$ and $\delta^{2}H$ values in groundwater samples from the Project site, a LMWL was developed by combining rain and snow isotope data available in the literature from the nearby cities of Dawson City and Mayo, Yukon (Lapp, 2015; IAEA, 2020). These cities are located 130 km north and 180 km east of the Project area, respectively, and the isotopic compositions of their precipitation follow very similar meteoric water line trends, supporting the use of pooled precipitation isotope data (n = 85 samples) from these cities to generate a LMWL applicable to the Project site (Figure 1). In addition, average $\delta^{18}O$ and $\delta^{2}H$ values for precipitation at the Project site were estimated using rain and snow isotope compositions at Mayo and accounting for the change in elevation between Mayo (504 metres above sea level (m asl) and the Project area (430 to ~1,300 masl). For these calculations, an elevation gradient of 0.28 ‰ for $\delta^{18}O$ per 100 m elevation gain was assumed, which has been deemed appropriate for the Yukon climate (Poage and Chamberlain, 2001). Further details describing the development of a LMWL and estimation of the isotopic composition of precipitation at the Project site are provided in Appendix A.

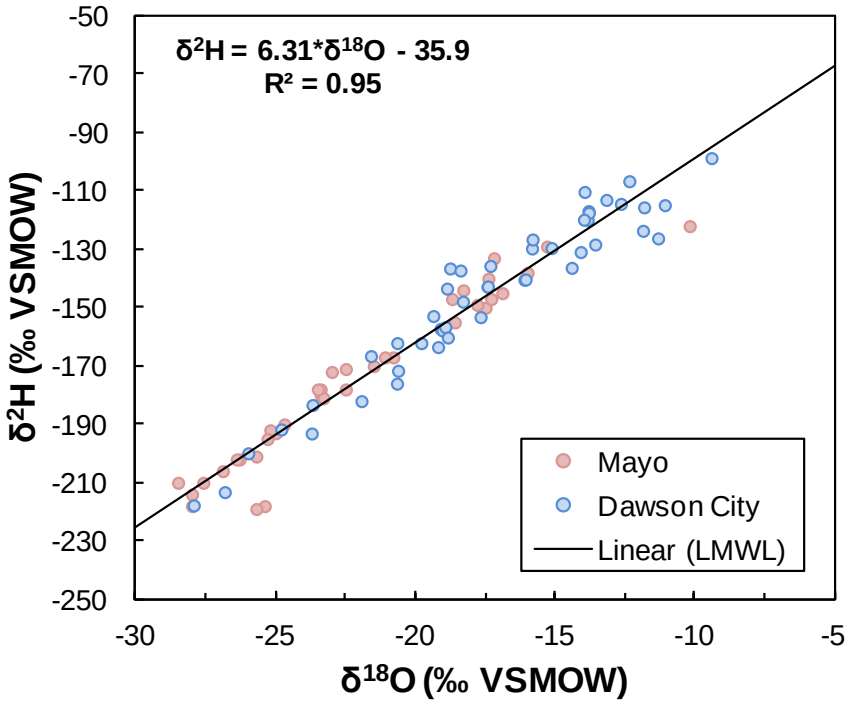

Figure 1: A local meteoric water line (LMWL) was developed for the Project site by pooling previously published isotope data for precipitation in the nearby cities of Dawson (Lapp, 2015) and Mayo, Yukon (IAEA, 2020).

2.2 Radioisotopes as Tracers of Groundwater Age

2.2.1 Overview

Tritium (^{3}H) and radiocarbon (^{14}C) are radioactive isotopes that decay at known rates through time and can therefore be used to estimate groundwater age (*i.e.*, mean residence time) assuming their concentrations at the time of recharge are known (Clark and Fritz, 1997). Both radioisotopes are naturally produced in the upper atmosphere and enter groundwater during precipitation and recharge events. These radioisotopes were also emitted by anthropogenic activity in massive quantities (*i.e.*, exceeding natural production) during Cold-War era nuclear weapons testing. Atmospheric ^{14}C concentrations were further impacted by humans since the industrial revolution because of combustion of fossil fuels that has released ^{14}C-free CO_2 into the atmosphere.

Tritium enters the hydrological cycle because it is incorporated into water molecules. Tritium data are expressed in tritium units (TU), where one TU corresponds to one ^{3}H atom per 10^{18} H atoms. The half-life of 12.32 years makes tritium a good qualitative tracer of relatively young (<70 years old) groundwater ages.

The half-life of radiocarbon is 5,730 years and it is therefore useful to determine the age of groundwater that is thousands of years old. Radiocarbon enters the hydrological cycle by uptake

of atmospheric $^{14}CO_2$ by biomass which enters the soil as organic matter. ^{14}C then enters groundwater through biodegradation of organic matter and release of this ^{14}C-bearing biomass into soil porewater as dissolved inorganic carbon (DIC). Raw radiocarbon data are expressed in units of percent modern carbon (pMC). A radiocarbon content of 100 pMC corresponds to the amount of radioactivity of ^{14}C equivalent to that of atmospheric CO_2 in 1890 (since that time, the ^{14}C content of atmospheric CO_2 has been altered by thermonuclear bomb testing and global anthropogenic combustion of fossil fuels). Older waters have lower pMC values due to radioactive decay.

Estimating groundwater age based on ^{14}C measurements requires corrections for dissolution of carbonate minerals from aquifer rocks and mineralization of ancient organic matter, which can generate ^{14}C-free DIC because many of these materials were formed hundreds of thousands to millions of years ago and thus all the radiocarbon has decayed in the time since their formation. Uncorrected radiocarbon dating of groundwater would therefore bias groundwater ages towards older values if ^{14}C dilution were not accounted for. In this memorandum, radiocarbon age corrections are based on the method of Pearson and Hanshaw (1970). Further details describing the method and radiocarbon age corrections employed in this memorandum are provided in Appendix B.

Hydrodynamic mixing creates uncertainty as to a water sample's absolute age for ages determined with both ^{3}H and ^{14}C radioisotopes. For example, groundwater mixing can contribute water to a well from different flow paths with a wide range of ages, meaning that the overall radioisotope age represents an average value of all the water sources contributing to that sample.

2.2.2 Mass Fractions of Young and Paleo Groundwater

Jasechko (2016a) proposes a method to estimate the fractions of young and paleo groundwaters (F_{young} and F_{paleo}, respectively) in a given groundwater sample on the basis of ^{3}H and ^{14}C measurements in samples. In this method, young groundwater is defined as groundwater that recharged between 1953 (*i.e.*, before the onset of large-scale thermonuclear bomb testing) and the time of sampling (*i.e.*, 2019). Paleo groundwater refers to groundwater that recharged prior to the end of the last major glaciation on Earth, approximately 11,700 years before present (BP; where present is defined as the year AD 1950). Further details describing the calculations involved in this method are presented in Appendix B.

It is important to note that there is substantial inherent uncertainty with calculated F_{young} and F_{paleo} values, therefore the results are interpreted as a qualitative assessment of the fraction of young and paleo groundwaters in a given sample, respectively (Jasechko, 2016a; Jasechko et al., 2017).

3. Isotope Samples and Data Collection

3.1 Surface Water, Aufeis and Groundwater Sampling

Isotope sampling was conducted between September 2014 and August 2019, and included samples of aufeis, surface water, and groundwater. Aufeis (*i.e.*, frozen groundwater seepage that accumulates within and adjacent to local creeks and streams at the Project site) is pervasive throughout the winter and melts during the freshet but can persist into the early summer. Surface water samples were collected at a total of eight locations in Latte, Halfway and YT-24 Creeks, while aufeis was sampled at three stations along Latte and Halfway Creeks. Groundwater was sampled from 15 monitoring wells in the Project area.

Stable isotope and tritium samples were typically collected in 1 L high-density polyethylene (HDPE) bottles between 2014 and 2019. Radiocarbon samples were collected in 1 L HDPE bottles in 2014 and 2015, and in 0.25 L amber glass bottles with a septum in August 2019. Radiocarbon samples collected in August 2019 were field filtered (0.45-micron), preserved with $ZnCl_2$ (1.25 grams per 250 mL sample), and kept cool until delivery to the UW-EIL.

3.2 Laboratory Analyses

Isotope samples collected in 2014 and 2015 were submitted to the Brigham Young University Laboratory of Isotope Geochemistry (BYU-LIG) in Provo, Utah, while samples collected in 2016, 2017 and 2019 were submitted to the University of Waterloo - Environmental Isotope Laboratory (UW-EIL) in Waterloo, Ontario. Stable isotope and radioisotope analyses and the corresponding precisions are presented in Table 1. Certificates of analysis for stable isotope and radioisotope samples provided by BYU-LIG and UW-EIL are presented in Appendix C.

Isotope samples sent to the BYU-LIG were analyzed for δ^2H, $\delta^{18}O$, and $\delta^{13}C$ using mass spectrometry, while ^3H samples were analyzed by electrolytic tritium enrichment followed by ultra-low level liquid scintillation spectrometry. The ^{14}C samples were precipitated as $BaCO_3$ at the BYU-LIG and splits of extracted CO_2 were analyzed using accelerator mass spectrometry (AMS) at the University of Georgia.

Samples sent to the UW-EIL were analyzed for δ^2H and $\delta^{18}O$ using a liquid water isotope analyzer, while the ^3H samples were enriched by electrolysis and then analyzed by liquid scintillation counting. For radiocarbon analysis, the sample was extracted under vacuum using H_3PO_4 to convert dissolved inorganic carbon (DIC) to CO_2, which was reduced to graphite and analyzed for ^{14}C by AMS. A subsample was analyzed for $\delta^{13}C$-DIC via dual inlet isotope ratio mass spectrometry (DI-IRMS). The AMS analysis was conducted at DirectAMS in Bothell, Washington.

Table 1:
Stable isotope and radioisotope parameters and precision (2014-2019)

Parameter	Units	BYU-LIG	UW-EIL
		2014-2015	2016-2019
$\delta^{2}H$	‰ VSMOW	1.0	0.8
$\delta^{13}C$	‰ VPDB	0.04 or 0.1 [1]	0.2
$\delta^{18}O$	‰ VSMOW	0.20 or 0.40 [2]	0.2
^{3}H	TU	0.3	0.8
^{14}C	pMC	0.07 - 0.20 [3]	0.040 - 0.26 [3]

Notes:
BYU-LIG = Brigham Young University Laboratory of Isotope Geochemistry, pMC = percent modern carbon, TU = tritium units, UW-EIL = University of Waterloo-Environmental Isotope Laboratory, VPDB = Vienna Pee Dee Belemnite, VSMOW = Vienna Standard Mean Ocean Water
1. Precision of $\delta^{13}C$ analyzed at BYU-LIG was 0.04 ‰ for samples collected between June and September 2015 and 0.1 ‰ for samples collected between September 2014 and April 2015.
2. Precision of $\delta^{18}O$ analyzed at BYU-LIG was 0.2 ‰ for samples collected between May and October 2015 and 0.4 ‰ for samples collected between September 2014 and April 2015.
3. Precision of radiocarbon counts vary by sample; consequently, a range is presented.

3.3 Sample Quality Assurance and Quality Control

A quality assurance/quality control (QA/QC) program was implemented to evaluate the quality of the isotope analyses. Six field duplicate samples collected in 2014 and 2015 were submitted for isotope analyses to the BYU-LIG, while six field duplicate samples collected in 2019 were submitted to the UW-EIL. In addition, internal reproducibility checks (*i.e.*, re-analysis) were completed at the UW-EIL on 26 samples collected in 2016 and 2017, and 14 samples collected in 2019. Isotope analytical results for field duplicate samples are presented in Appendix D (Table 1), while the results of the internal laboratory re-analysis of isotope samples are provided in Appendix D (Table 2).

Overall, the QA/QC analysis of isotope samples indicates reliable stable isotope ($\delta^{2}H$, $\delta^{18}O$) and radioisotope (^{3}H, ^{14}C) results for the interpretation of groundwater provenance and groundwater age tracing. The relatively large number of sampling locations, synoptic sampling at many locations, in addition to the general consistency of the data between sampling events, has yielded a robust isotopic data set. Some early inconsistencies with 2014 and 2015 $\delta^{13}C$ and ^{14}C data existed which were addressed with improved sampling protocols in 2019 that yielded satisfactory QA/QC results. Further details are provided in Appendix D.

4. Results and Discussion

This section discusses groundwater, surface water and aufeis isotope data collected as outlined in Section 3. The discussion covers stable isotope and radioisotope data. Stable isotope and radioisotope data for aufeis, surface water and groundwater samples are presented in Appendix D (Table 3).

4.1 Water Stable Isotopes

The stable isotope compositions of groundwater, surface water, and aufeis samples collected in the Project area generally plot along an array of similar slopes to the LMWL (Figure 2). The data plot slightly above the LMWL, which may reflect a slight difference in the source of water vapour that generates precipitation in the Project area in comparison to precipitation in Dawson City and Mayo.

Overall, groundwaters collected from the Project site are isotopically heavier than the estimated value for mean annual precipitation and plot closer to the isotopic composition of rain-dominated precipitation (May to October) than that of snow-dominated precipitation falling between November and April (Figure 2). This observation suggests that groundwater recharge at the Project site is more heavily driven by infiltration of rain than by snowmelt, and is consistent with a greater proportion of annual precipitation falling as rain (~70 %) and a smaller contribution from snow (~30 %) at an elevation of 975 m asl (Lorax, 2019). Similar results have been obtained in a groundwater stable isotope study in the nearby Ogilvie River Watershed, north of Dawson City, Yukon (Baranova, 2017). Surface waters are shifted towards an isotopically heavier range of values in comparison to groundwater. This may simply reflect surface water samples that were predominantly collected between late April and October, when their water budget included greater input from summer precipitation, which is expected to be isotopically heavier than the mean annual precipitation and groundwater discharge (Figure 2).

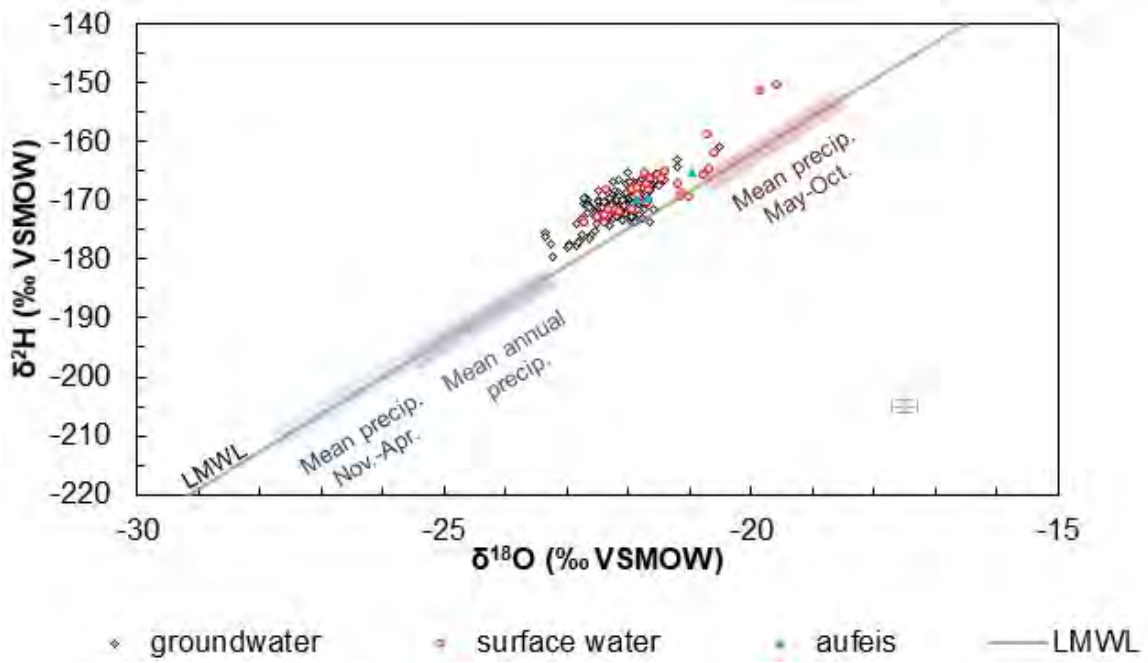

Figure 2: Isotopic composition of groundwater, surface water, and aufeis at the Project site. The LMWL was developed by combining precipitation isotope data from in Dawson City and Mayo (Lapp, 2015; IAEA, 2020). The range of estimated isotopic compositions for annual precipitation, rain-dominated precipitation (May-Oct.), and snow-dominated precipitation (Nov.-Apr.) are defined by purple, red, and blue shading, respectively. These ranges were calculated using isotope and precipitation data from Mayo (IAEA, 2020) and correcting for elevations encountered at the Project site (details in Appendix A).

There is considerable overlap in the stable isotope composition of groundwater at most monitoring wells, except for MW15-03WB (Figure 3). The water sampled at this location consistently has lower $\delta^{18}O$ and $\delta^{2}H$ values in comparison to other monitoring wells. This isotopically lighter signature at MW15-03WB is indicative of a colder recharge environment, which could be due to higher elevation precipitation or precipitation that fell during colder geological periods. For example, during the late-Pleistocene (50,000 to 20,000 years ago), $\delta^{18}O$ in precipitation was likely ~1 to 2 ‰ lower than during the Holocene (11,700 years ago to present time) due to a colder climate in extratropical areas (Jasechko, 2016b). In contrast, MW15-03AZ, which is screened in the active zone in the Halfway Creek valley, is characterized by isotopically heavier water, which indicates greater contribution of summer precipitation in the active zone flow system.

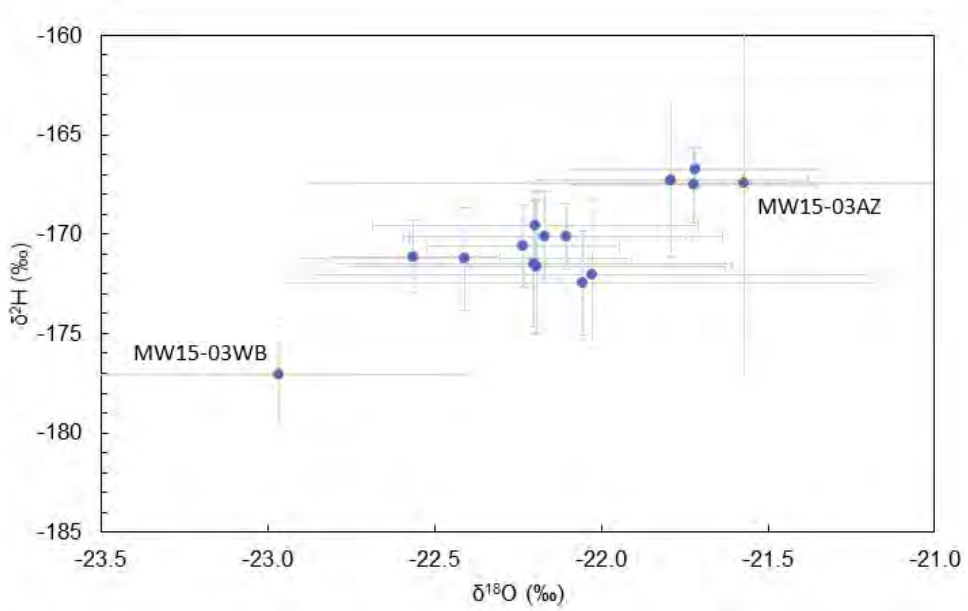

Figure 3: Mean stable isotope composition of groundwater at each monitoring well in the Project area (2014-2019). Error bars are ± 2 standard deviations.

4.2 Tritium and Radiocarbon

The Pearson and Hanshaw (1970) method for correcting radiocarbon age relies on assumptions of $\delta^{13}C$ of the recharge environment, which depends on factors including soil vegetation type and soil porewater pH (at the time of recharge). These factors cannot truly be known, and as a result $\delta^{13}C$ is commonly estimated (Clark and Fritz, 1997). For the interpretation of radiocarbon ages presented in this memorandum, a groundwater recharge pH of 7.0 and a soil $\delta^{13}C$ value of -23 ‰ (typical of C3-plant based ecosystems; Clark and Fritz, 1997) are assumed, which correspond to a $\delta^{13}C_{recharge}$ value of -17.3 ‰ (Table 2). It is worth mentioning that under a slightly lower soil pH (*e.g.*, pH 6.0), $\delta^{13}C$ of recharge under these conditions would change to -21.5 ‰, and the reported radiocarbon ages would be offset by approximately 1,000 to 2,000 years. The uncertainty inherent in this method should be considered when interpreting the calculated ^{14}C ages (Table 2).

Calculations of F_{young} and F_{paleo} are prone to large uncertainties given the large range in possible ^{3}H and ^{14}C concentrations since 1953 and over the last 60,000 years, respectively, as well as assumptions that must be made regarding $\delta^{13}C$ of recharge and DIC concentrations. Therefore, the results are interpreted using mean fractions of young and paleo waters in a qualitative manner.

Tritium and radioisotope data indicate that the majority of groundwater in high-elevation and sub-permafrost monitoring wells is at least 70 years old and may be thousands of years in age (Table 2). This includes groundwater from high-elevation monitoring wells in granite (MW14-05A, MW14-05B, MW16-01WB, MW15-05WB) and sub-permafrost north-facing terrain in gneiss (MW15-06WB, MW15-01WB). All these wells have little to no tritium and F_{young} values $\leq$0.1,

indicating that they are predominantly composed of water older than ~70 years (Figure 4, Figure 5). Calculated radiocarbon ages for these wells range from 6,500 to 22,400 years and F_{paleo} values range from 0.5 to 1, suggesting much longer residence times for sub-permafrost groundwater at high elevations at the Project site (Figure 6, Figure 7). The long groundwater residence times beneath permafrost in granite are supported by observations of low bedrock hydraulic conductivity at MW14-05A and MW14-05B which is $\leq 1x10^{-9}$ m/s and very slow well recharge rates observed during groundwater sampling.

In contrast, a large component of young groundwater with ages on the order of a few decades predominates along south-facing slopes above Latte Creek where permafrost is sparse (*i.e.*, MW14-02A, MW14-02B). Groundwater at MW14-02B and MW14-02A is tritiated (*i.e.*, contains tritium, with 5.4 and 7.2 TU, respectively) and has F_{young} values greater than 0.6 (Table 2:). A more active groundwater circulation pattern at these locations is consistent with higher hydraulic conductivity in the vicinity of MW14-02B, which ranges from $1x10^{-7}$ to $5x10^{-9}$ m/s. There is nevertheless a component of older groundwater that also appears to contribute to the water sampled at these locations, given calculated radiocarbon ages greater than 8,000 years and F_{paleo} values of 0.7 (Table 2). Groundwater mixing can account for this combination of young and old groundwater at MW14-02A and MW14-02B. The younger groundwater system in this area also appears in valley wells in Latte Creek at MW15-02AZ and MW15-02WB, which are tritiated (9.4 and 6.6 TU, respectively) and have F_{young} values of 1.0 and 0.7, respectively. These results indicate that permafrost-free and more rapid groundwater circulation on the south-facing slope above Latte Creek may be a major input to groundwater contributions in the Latte Creek valley.

Along the Halfway Creek valley, groundwater in overburden at MW15-03AZ is likely on the order of a few decades old, based on an elevated tritium content (7.9 TU) which is indicative of more rapid groundwater circulation. However, a large range in groundwater ages is apparent in bedrock groundwater along Halfway Creek. MW15-04WB contains elevated tritium (6 TU) indicating it is mostly comprised of water several decades in age. In contrast, groundwater at MW15-03WB is tritium-free (< 0.8 TU), has a calculated radiocarbon age of 13,500 years, and an F_{paleo} value of 1.0, suggesting that it is likely several thousand years old (Table 2). Groundwater at MW15-03WB also has the lowest $\delta^{18}O$ value (Figure 3), which could be consistent with paleo-groundwater that recharged during the Pleistocene when meteoric $\delta^{18}O$ values were approximately 1 to 2 ‰ lower than present-day (Jasechko, 2016b). MW15-03WB is artesian and is installed in a valley bottom, and its location is along an inferred lineament (Huscroft, 2002) which may act as a conduit for long-residence time flow with upwelling groundwater (based on strong upward hydraulic gradients measured by MW15-03T). The unique $\delta^{18}O$ value is consistent with distinct groundwater quality at MW15-03WB, given its end-member major ion composition for the Project site, as well as elevated salinity and SO_4 concentrations in relation to other bedrock wells, and low dissolved uranium concentrations compared to other wells screened in gneiss and located upstream along Halfway Creek.

Table 2:
Isotopic composition of 2019 groundwater samples.

Station	Sample Date	$\delta^{18}O$	$\delta^{2}H$	$\delta^{13}C$	^{14}C	*q* [1]	^{14}C age [2]	^{3}H [3]	F_{young} [4]			F_{paleo} [5]		
		‰ VSMOW	‰ VSMOW	‰ VPBD	pMC	-	Years	TU	Mean	Min	Max	Mean	Min	Max
MW14-02A	22-Aug-19	-22.12	-172.7	-7.2	15.5	0.43	8,400	7.2	0.8	0.1	1.0	0.7	0.0	0.9
MW14-02B	22-Aug-19	-22.11	-173.4	-5.5	11.3	0.33	8,800	5.4	0.6	0.0	1.0	0.7	0.0	1.0
MW14-03A	23-Aug-19	-21.69	-165.8	-3.1	7.1	0.19	8,400	1.1	0.1	0.0	1.0	0.7	0.0	0.9
MW14-03B	23-Aug-19	-21.70	-166.8	-2.2	3.7	0.14	10,800	1.2	0.1	0.0	1.0	0.8	0.0	1.0
MW14-05A	24-Aug-19	-22.11	-170.2	-12.1	32.2	0.70	6,500	< 0.8	0.0	0.0	0.0	0.5	0.0	0.9
MW14-05B	25-Aug-19	-22.14	-170.8	-11.8	19.4	0.69	10,500	< 0.8	0.0	0.0	0.0	0.8	0.0	1.0
MW15-01WB	22-Aug-19	-21.65	-168.2	-3.7	1.5	0.23	22,400	< 0.8	0.0	0.0	0.0	1.0	0.8	1.0
MW15-02AZ [6]	07-Sep-15	-22.17	-169.4	-	-	-	-	9.4	1.0	0.1	1.0	-	-	-
MW15-02WB	24-Aug-19	-21.83	-170.4	-8.1	35.2	0.48	2,500	6.6	0.7	0.1	1.0	0.0	0.0	0.7
MW15-03AZ	23-Aug-19	-20.51	-161.0	-	-	-	-	7.9	0.9	0.1	1.0	-	-	-
MW15-03WB	23-Aug-19	-22.65	-176.6	-7.0	8.0	0.41	13,500	< 0.8	0.0	0.0	0.0	1.0	0.3	1.0
MW15-04WB	22-Aug-19	-21.91	-170.7	-7.5	19.5	0.45	6,800	6	0.7	0.0	1.0	0.5	0.0	0.9
MW15-05WB	23-Aug-19	-22.27	-171.4	-7.0	10.6	0.41	11,300	< 0.8	0.0	0.0	0.0	0.9	0.1	1.0
MW15-06WB	25-Aug-19	-22.08	-170.8	-8.9	17.0	0.52	9,300	1	0.1	0.0	1.0	0.7	0.0	1.0
MW16-01WB	21-Aug-19	-22.42	-171.3	-5.3	9.3	0.32	10,200	< 0.8	0.0	0.0	0.0	0.8	0.0	1.0

Notes:
Max = maximum, Min = minimum, pMC = percent modern carbon, TU = tritium units, VPBD = Vienna Pee Dee Belemnite, VSMOW = Vienna Standard Mean Ocean Water
1. Radiocarbon dilution factor (q) used to correct ^{14}C ages, based on Pearson and Hanshaw (1970); assumes $\delta^{13}C_{recharge}$ = -17.3 ‰ and $\delta^{13}C_{carbonates}$ = 0.28 ‰ (see Section 2.2).
2. ^{14}C age determined using the Pearson and Hanshaw (1970) correction for carbonate mineral dissolution (see Section 2.2).
3. ^{3}H results reported below the detection limit of 0.8 TU were assumed to be equal to 0 TU for F_{young} calculations.
4. F_{young} input parameters: 1) $^{3}H_{post\text{-}1953}$ (TU) calculated using 10-year moving average of combined Anchorage and Ottawa ^{3}H precipitation records from International Atomic Energy Agency Global Network of Isotopes in Precipitation (mean 9.25 TU, minimum 2.56 TU, maximum 87.6 TU); and 2) $^{3}H_{pre\text{-}1953,}$ assumed to be 0 (all ^{3}H older than 1953 has decayed to below detection limit). Based on Jasechko (2016a) and Jasechko et al., (2017) (See Appendix B).
5. F_{paleo} input parameters: ^{14}C of atmosphere taken using 30-point moving average of ^{14}C compilations of Reimer et al. (2020) and Hua et al. (2013), decay-corrected to 2019, and corrected for carbonate mineral dissolution using *q* for each well. Based on Jasechko (2016a) (See Appendix B).
6. MW15-02AZ was frozen in 2019; 2015 data used instead.

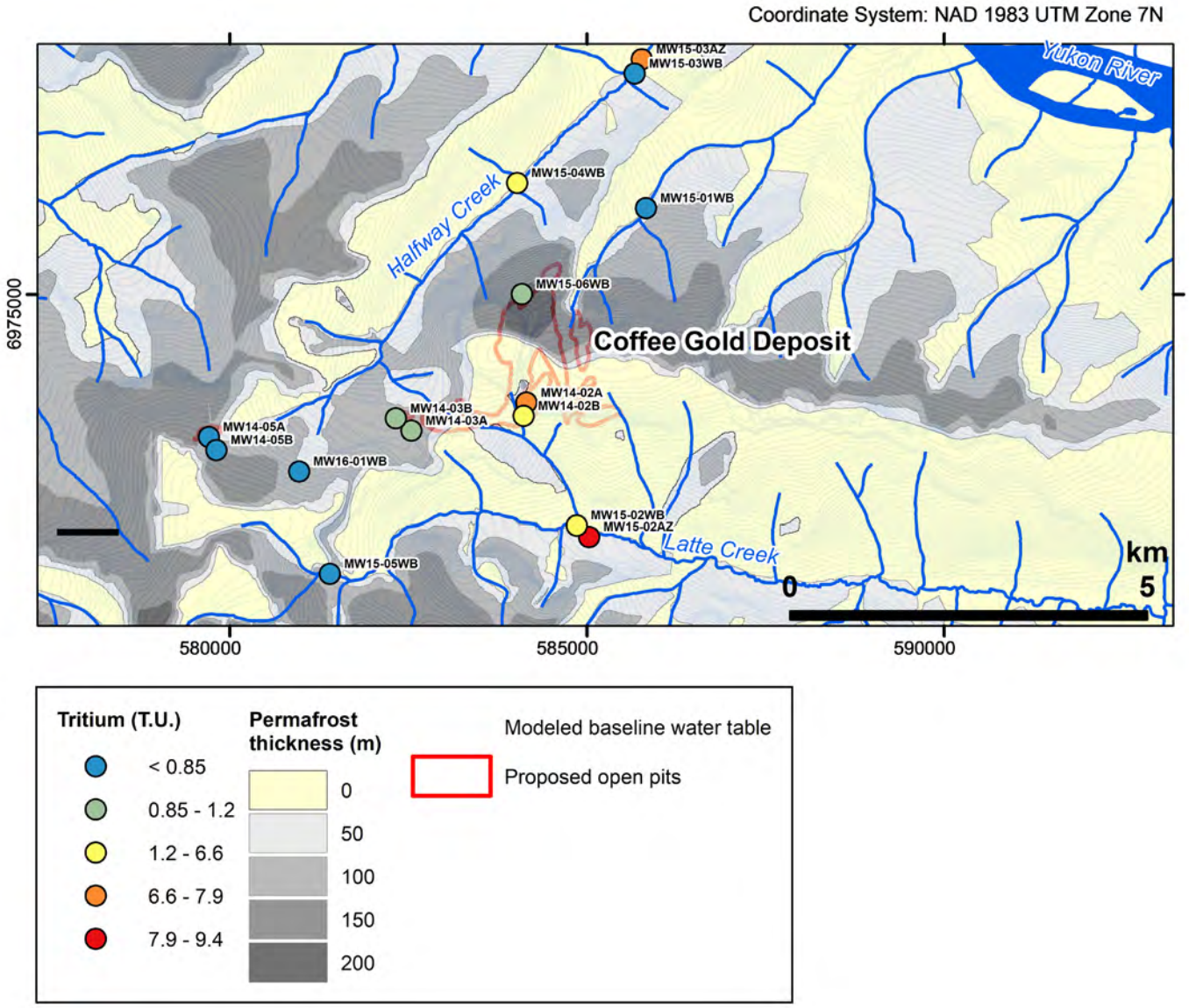

Figure 4: Tritium concentrations in groundwater across the Project site. Based on ^{3}H values in Table 2. Higher tritium concentrations indicate a greater component of young groundwater.

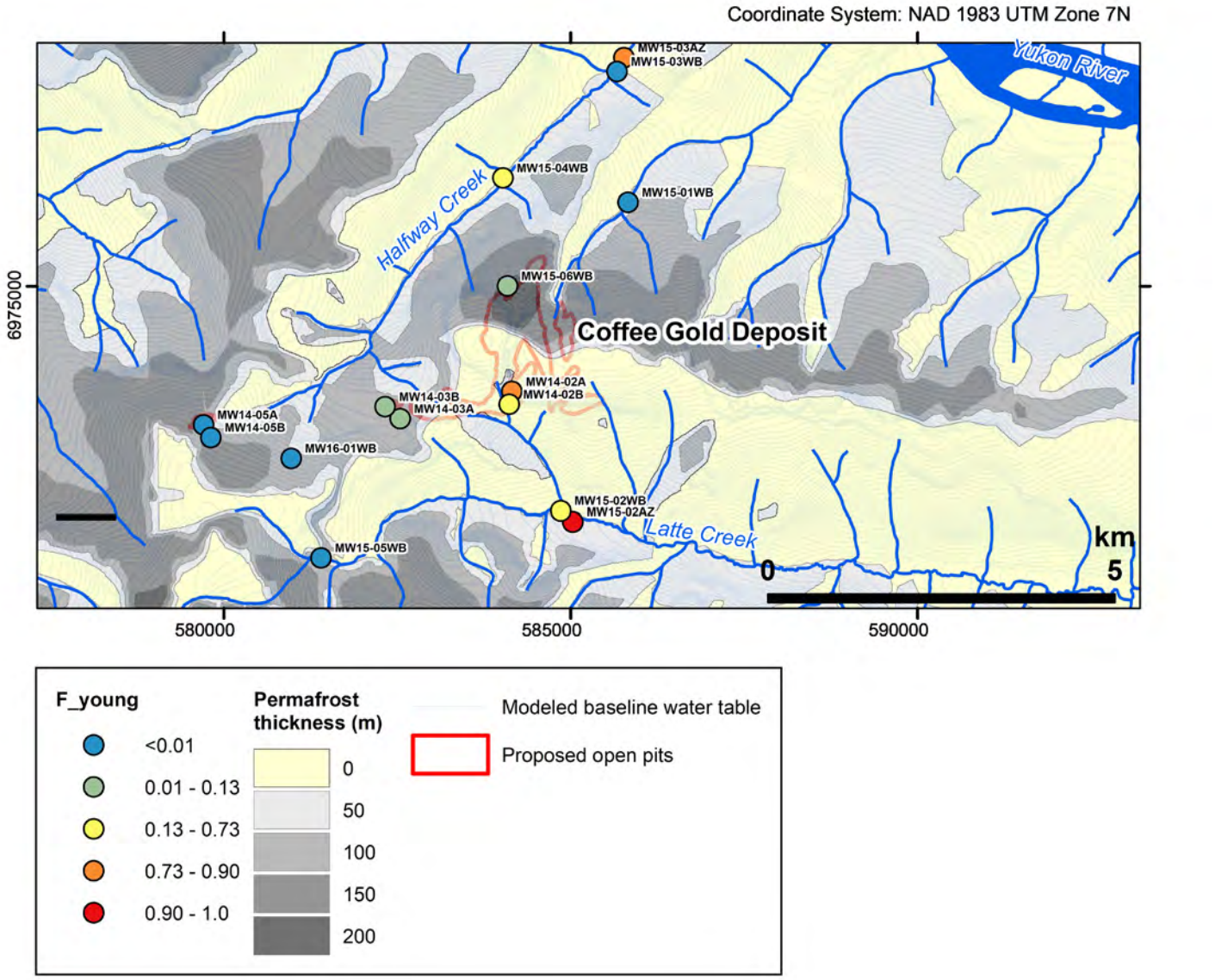

Figure 5: Fraction of groundwater recharged between 1953 and 2019 across the Project site. Based on F_{young} mean values calculated from tritium in Table 2.

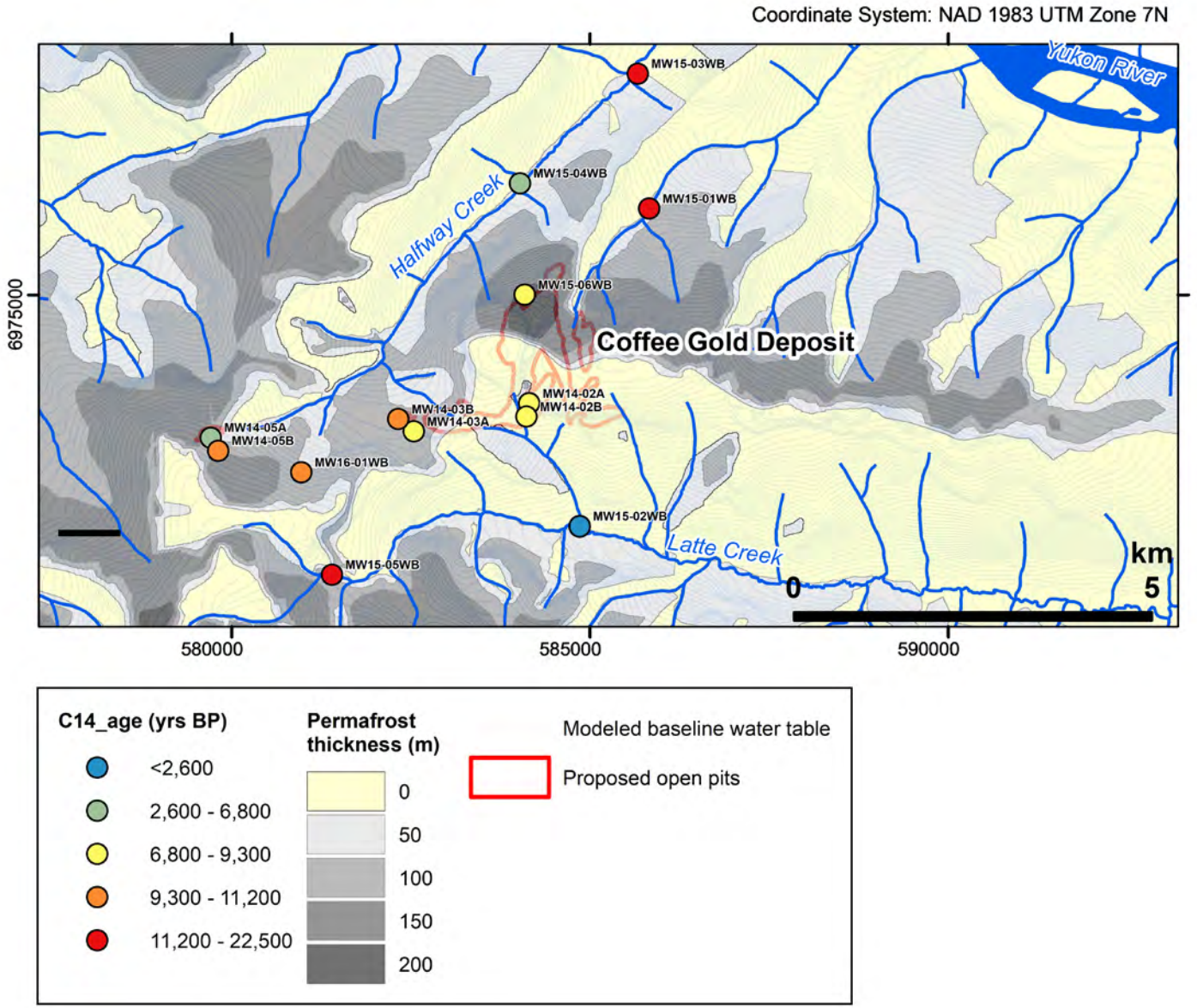

Figure 6: Groundwater ages determined from ^{14}C analyses across the Project site. Based on ^{14}C ages in Table 2.

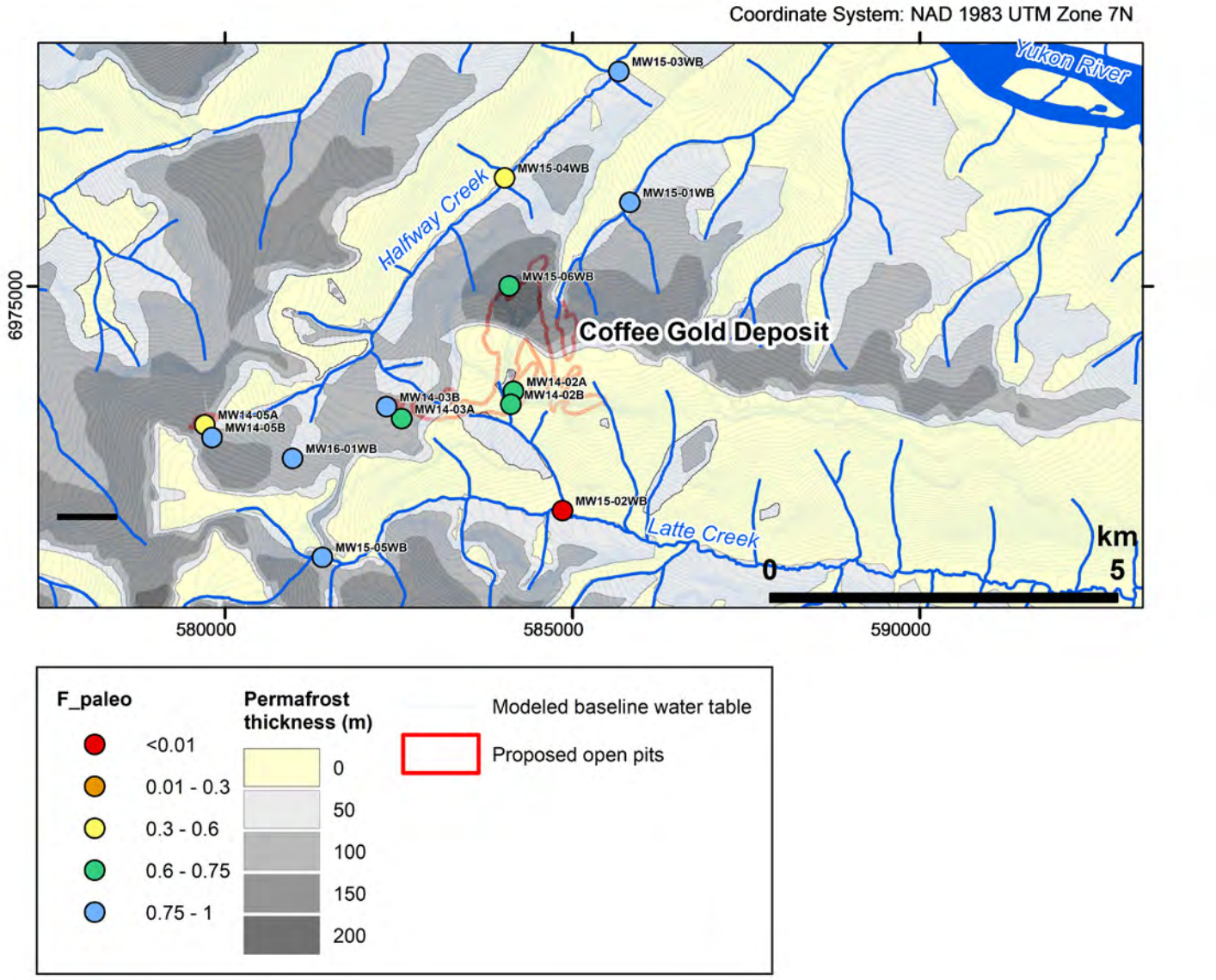

Figure 7: Fraction of groundwater recharged prior to 11,700 years before present across the Project site. Based on F_{paleo} mean values calculated from ^{14}C in Table 2. Note that there are no wells with F_{paleo} values between 0.01 and 0.3.

5. Conclusions

Stable isotope compositions of groundwaters collected at the Project site are isotopically heavier than the estimated composition for mean annual precipitation, and closer to the isotopic composition of rain-dominated precipitation (May-October) than that of snow-dominated precipitation (November-April). This suggests that groundwater recharge is more heavily driven by infiltration of rain than by snowmelt, which is consistent with a greater proportion of annual precipitation occurring as rain (~70 % at an elevation of 975 m asl) in the Project area (Lorax, 2019).

Isotopic analyses of carbon and hydrogen suggest that permafrost exerts a strong control on groundwater residence times. At high elevations and beneath permafrost, ^{3}H and ^{14}C data suggest that groundwater is predominantly greater than 70 years in age and could be thousands of years old. In contrast, along south-facing slopes where permafrost coverage is limited, such as Latte Creek around MW14-02A and MW14-02B, ^{3}H data suggest a more active groundwater circulation pattern with a large component of young groundwater with residence times on the order of decades.

Valley bottoms include a mixture of old and young groundwaters that converge in discharge areas. Shallow monitoring well installations completed in overburden (MW15-02AZ and MW15-03AZ) are characterized by young (decades-old or less) groundwater based on elevated tritium contents. Deeper Westbay installations MW15-02WB and MW15-04WB are also tritiated, indicating decades-old or less groundwater ages; however, MW15-04WB also includes a component of groundwater thousands of years in age based on its radiocarbon age. Valley bedrock installation MW15-03WB screens groundwater that is likely thousands of years in age based on its ^{3}H, ^{14}C, and $\delta^{18}O$ signatures, and is distinct in both isotopic and geochemical composition from other groundwater sampled in Halfway Creek and across the Project.

6. Closure

We trust that this memorandum meets your requirements at this time. Please contact us should you have any questions or concerns, or require additional information in support of this work.

Prepared by:



Elliott Skierszkan, Ph.D.
Post-doctoral Fellow
Department of Earth, Ocean and Atmospheric Sciences
University of British Columbia

Jordi Helsen, M.Sc., P.Geo.
Environmental Hydrogeologist
Lorax Environmental Services Ltd.

Reviewed by:

Laura Findlater, B.Sc., P.Geo.
Senior Hydrogeologist
Lorax Environmental Services Ltd.

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APPENDIX A: METHODOLOGY FOR ESTIMATION OF $\delta^{18}O$ AND $\delta^{2}H$ OF LOCAL PRECIPITATION

Appendix A: Methodology for Estimation of $\delta^{18}O$ and $\delta^{2}H$ of Local Precipitation

1. Development of the Local Meteoric Water Line

A local meteoric water line (LMWL) for the Project site was estimated from previously published precipitation isotope data at Dawson City and Mayo, Yukon (Lapp, 2015; IAEA 2020). These cities are located at 130 km north and 180 km east of the Project site, respectively, and the isotopic compositions of their precipitation follow very similar meteoric water line (MWL) trends, supporting the use of the pooled precipitation isotope data (n = 85 samples) from these cities to generate a LMWL applicable to the Project site (Figure 1). Because there is no effect due to a change in altitude on the slope of the LMWL (Baranova, 2017), precipitation in the Project area should fall along a slope of ~6.3.

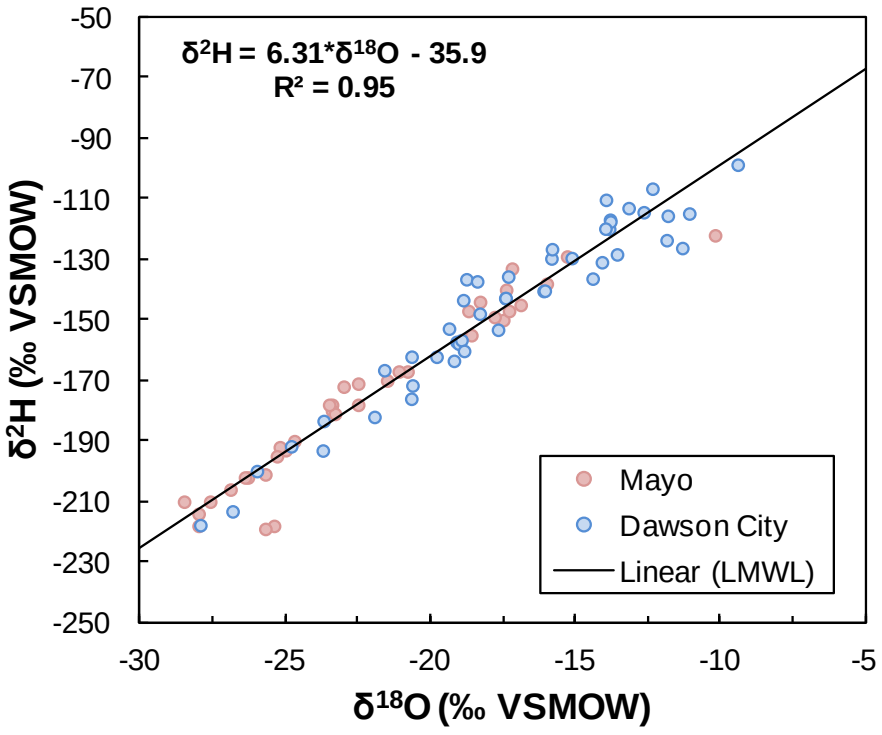


Figure 1: **A local meteoric water line (LMWL) was developed for the Project site by pooling previously published isotope data for precipitation in the nearby cities of Dawson (Lapp, 2015) and Mayo, Yukon (IAEA, 2020).**

1.1 Estimation of the Isotopic Composition of Groundwater Recharge

Precipitation isotope data from Mayo (IAEA, 2020) were used to extrapolate the isotopic composition of precipitation that occurs primarily as rain and snow at the Project site by applying corrections to account for the difference in elevation between the two sites.

The seasonal variability in the isotopic composition of precipitation at Mayo ranges from –10 to –30 ‰ for $\delta^{18}O$, and –122 to –229 ‰ for $\delta^{2}H$ (IAEA, 2020). The mean isotopic composition of precipitation at Mayo, weighted by precipitation depth, was calculated for each month, and is shown in Figure 2. The mean monthly isotopic composition in Mayoprecipitation ranges from –17 to –26 ‰ for $\delta^{18}O$, and –143 to –213 ‰ for $\delta^{2}H$ (Figure 2).

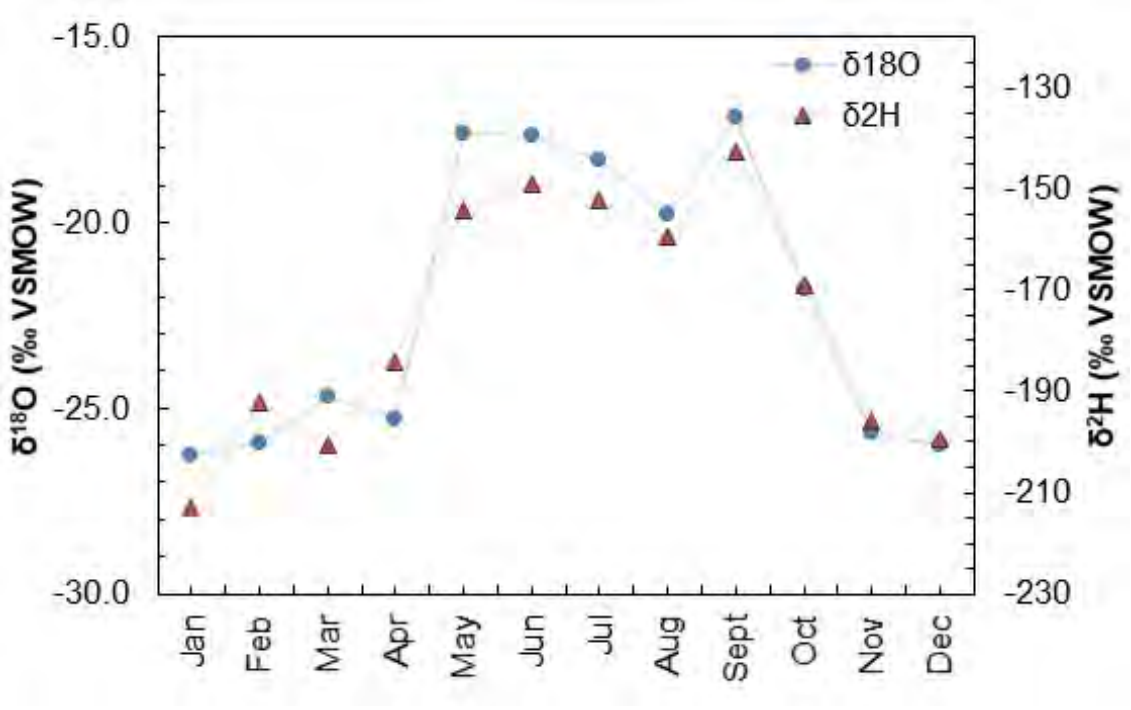


Figure 2: Depth-weighted mean isotopic composition of precipitation at Mayo, Yukon by month. Data from IAEA (2020).

The mean annual $\delta^{18}O$ and $\delta^{2}H$ values of precipitation in Mayo, weighted by precipitation depth, were calculated and are –24 ‰ and –186 ‰, respectively (Table 1). Since precipitation occurs primarily as snow between November and April, and rain for the balance of the year (*i.e.*, May to October), the depth-weighted mean monthly precipitation data from Mayo were used to estimate end-member isotopic compositions for snowmelt and rainfall, using the average of the monthly mean values for each time period (Table 1). These values were then used to calculate corresponding mean isotopic compositions for annual precipitation, snow-dominated and rain-dominated precipitation for the Project area using an elevation gradient of -0.28 ‰ for $\delta^{18}O$ per 100 m of elevation gain (Poage and Chamberlain, 2001) and a corresponding value of –1.76 ‰

per 100 m for $\delta^{2}H$ (calculated from the $\delta^{18}O$ elevation gradient and using the slope of 6.3 from the Mayo MWL, since the slope does not change with altitude (Baranova, 2017)). The isotopic composition of precipitation at the Project site was calculated based on the range of elevations present at the site (*i.e.,* 430 to 1,300 m asl). The estimated mean isotopic compositions of snow-dominated and rain-dominated precipitation, as well as the annual precipitation for the Project site are shown in Table 1.

Table 1:
Mean isotopic composition of annual precipitation, snow-dominated precipitation, and rain-dominated precipitation in the Project area estimated using precipitation depth-weighted monitoring data from Mayo (IAEA, 2020).

Location	Elevation	Mean Annual Precipitation		Mean Precipitation (Nov.-Apr.)		Mean Precipitation (May-Oct.)	
	m asl	$\delta^{18}O$	$\delta^{2}H$	$\delta^{18}O$	$\delta^{2}H$	$\delta^{18}O$	$\delta^{2}H$
Mayo	504	-24	-186	-26	-198	-19	-155
Project Site (Coffee Camp)	430	-23	-185	-25	-196	-19	-153
Project Site (ridgetop)	1,300	-26	-200	-28	-212	-21	-169

Notes:
m asl = metres above sea level
1. All $\delta^{18}O$ and $\delta^{2}H$ values expressed in ‰ VSMOW.
2. The estimated mean isotopic composition of precipitation, snow and rain for the Project site are based on Mayo precipitation data (IAEA, 2020) which have been corrected for elevation using an assumed elevation gradient of -0.28 ‰ for $\delta^{18}O$ per 100 metres of elevation gain (Poage and Chamberlain, 2001) and a calculated gradient for $\delta^{2}H$ of -1.76 ‰ per 100 metres of elevation gain (calculated from the $\delta^{18}O$ elevation gradient and the slope of the Mayo meteoric water line (6.3), since the slope does not change with altitude (Baranova, 2017)).

The estimated mean isotopic compositions for annual precipitation, snow-dominated precipitation (November to April), and rain-dominated precipitation (May to October) shown in Table 1 were used to define corresponding ranges of compositions across the Project site from the lowest to the highest elevation (*i.e.*, 430 to 1300 m asl). The range of compositions corresponding to each precipitation class (annual, May-Oct., Nov.-Apr.) is defined by an isotopically heavy end-member (*i.e.*, mean composition at 430 m asl) and an isotopically light end-member (*i.e.*, mean composition at 1300 m asl). These estimated ranges of isotopic compositions for mean annual precipitation, rain-dominated precipitation (May to October), and snow-dominated precipitation were then plotted on the LMWL that was developed for the Project site, along with the isotopic compositions of groundwater, surface water and aufeis as shown in Figure 3. This was done to facilitate interpretation of the isotopic data.

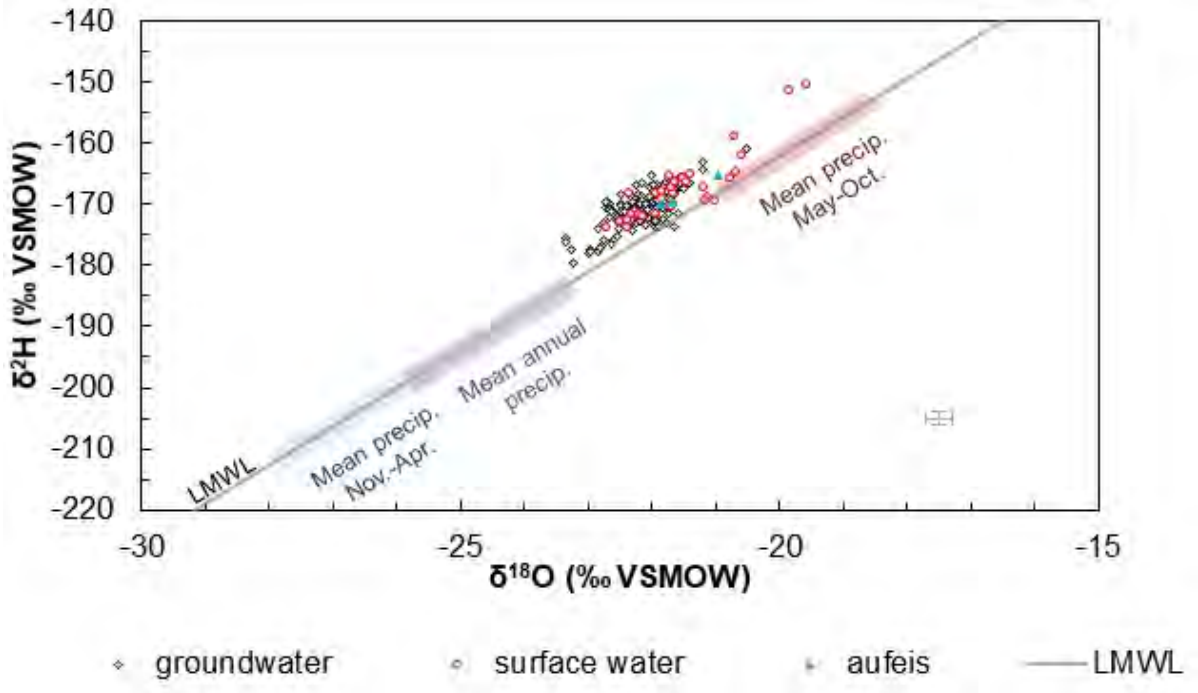


Figure 3: Isotopic composition of groundwater, surface water, and aufeis at the Project site. The LMWL was developed by combining precipitation isotope data from Dawson City and Mayo (Lapp, 2015; IAEA, 2020). The range of estimated mean isotopic compositions for annual precipitation, rain-dominated precipitation (May-Oct.), and snow-dominated precipitation (Nov.-Apr.) are defined by purple, red, and blue shading, respectively. These ranges were calculated using isotope and precipitation data from Mayo (IAEA, 2020) and correcting for elevations encountered at the Project site.

APPENDIX B: GROUNDWATER AGES METHODOLOGY

Appendix B: Groundwater Ages Methodology

1. Methodology for Radiocarbon Age Corrections

Estimating groundwater age based on ^{14}C measurements requires corrections for dissolution of carbonate minerals from aquifer rocks and mineralization of ancient organic matter, which can generate ^{14}C-free DIC because many of these materials were formed hundreds of thousands to millions of years ago and thus all the radiocarbon has decayed in the time since their formation. Uncorrected radiocarbon dating of groundwater would therefore bias groundwater ages towards older values if ^{14}C dilution were not accounted for.

In this memorandum, radiocarbon age corrections are based on the method of Pearson and Hanshaw (1970):

$$Apparent\ ^{14}C\ age = -8267 * \ln\left(\frac{a_C^{14}{}_t}{q \times a_C^{14}{}_{initial}}\right) \quad (1)$$

where, $a_C^{14}{}_t$ is the ^{14}C activity (pMC) at the time of sampling, $a_C^{14}{}_{initial}$ is 100 pMC, and q is a radiocarbon dilution factor.

The radiocarbon dilution factor (q) accounts for input of ^{14}C-free DIC from carbonate mineral dissolution and ancient organic matter degradation and is calculated using the carbon stable isotopes ^{13}C and ^{12}C, which provide a means to estimate the quantity of carbonate-mineral dissolution in groundwater. Biodegradation of ancient organic matter can be assumed negligible in the Project area where fossil fuels (*e.g.*, coal, oil) are not present in the rock. Thus, q is determined using the equation:

$$q = \frac{\delta^{13}C_{DIC} - \delta^{13}C_{carbonates}}{\delta^{13}C_{recharge} - \delta^{13}C_{carbonates}} \quad (2)$$

In this equation, the subscripts DIC, carbonates, and recharge relate to the measured $\delta^{13}C$ in the DIC component of a sample, of carbonate minerals, and of recharging groundwater, respectively. $\delta^{13}C_{DIC}$ was measured directly, while $\delta^{13}C_{carbonates}$ was computed as the average of a database of 51 carbonate-mineral $^{13}C/^{12}C$ analyses from the Project site (MacWilliam, 2018), which corresponds to +0.28 ‰ (relative to the Pee Dee Belemnite standard). The $\delta^{13}C$ value of groundwater recharge is unknown but is commonly estimated based on assumptions of soil pH and soil $\delta^{13}C$ values (Clark and Fritz, 1997). In this memorandum, a groundwater recharge pH of 7.0 (typical of the Project area) and a soil organic carbon $\delta^{13}C$ value of -23 ‰ (typical of plant

ecosystems using the C_3 carbon dioxide metabolic pathway; Clark and Fritz, 1997) are assumed, which correspond to a $\delta^{13}C_{recharge}$ value of -17.3 ‰.

2. Methodology for Groundwater Age Determination

The age of groundwater was determined using a method based on Jasechko (2016a). In this method, the fractions of young and paleo water in a sample are calculated from ^{3}H and ^{14}C data, respectively. Where F_{young} and F_{paleo} are defined as follows:

- F_{young} is the fraction of a groundwater sample that was recharged between 1953 and the time of sampling (*i.e.*, 2019). The year 1953 is selected to distinguish young water because it predates widespread Cold War-era thermonuclear bomb testing, which released orders of magnitude higher ^{3}H into the atmosphere.
- F_{paleo} is the fraction of a groundwater sample that was recharged prior to 11,700 years before present (BP). Present is defined as the year AD 1950 to follow conventions established by the radiocarbon isotope community: AD 1950 was the year that ^{14}C emerged as a tracer of artefact ages and it also predates large-scale thermonuclear bomb testing, which at its peak doubled the ^{14}C concentrations in the atmosphere. 11,700 years BP is used to separate paleo-groundwaters from younger (*i.e.*, Holocene) groundwaters because it marks the Pleistocene-Holocene transition and the end of the last major glaciation on Earth, which was a major driver of groundwater recharge.

2.1 Determination of F_{young} Using ^{3}H Data

F_{young} is calculated using the equation:

$$F_{young} = (^{3}H_{sample} - {}^{3}H_{pre\text{-}1953}) / (^{3}H_{post\text{-}1953} - {}^{3}H_{pre\text{-}1953}) \quad (3)$$

Where $^{3}H_{sample}$ is the measured ^{3}H concentration in a sample, $^{3}H_{pre\text{-}1953}$ is the tritium concentration in precipitation prior to 1953, decay-corrected to the year of sampling (2019), and $^{3}H_{post\text{-}1953}$ is the tritium concentration in precipitation between 1953 and the year of sampling. $^{3}H_{pre\text{-}1953}$ was estimated using the global relationship between latitude and ^{3}H of Jasechko et al. (2017):

$$^{3}H_{pre\text{-}1953,uncorr} = 0.0014*10^{-3}(latitude)^2 + 0.0236*10^{-2} + 2.4 \quad (4)$$

which yields 9.4 tritium units (TU) at the Coffee site latitude of 62.9°N. Accounting for radioactive decay of ^{3}H (using the ^{3}H half-life of 12.32 years), this value in 2019 is 0.23 TU, which is below the laboratory detection limit of 0.8 TU. Therefore, it can be assumed that for a sample collected in 2019, $^{3}H_{pre\text{-}1953} \approx 0$, such that F_{young} can be approximated as:

$$F_{young} = (^{3}H_{sample}) / (^{3}H_{post\text{-}1953}) \quad (5)$$

$^{3}H_{post\text{-}1953}$ must be estimated based on long-term ^{3}H records of precipitation, available from the International Atomic Energy Agency's Global Network of Isotopes in Precipitation (IAEA, 2020).

The nearest stations for which continuous data are available are Anchorage, Alaska and Ottawa, Ontario, for which records are available for the periods 1966-2019 and 1953-2019, respectively (Figure 1). As shown in Figure 1, there are differences in ^{3}H concentrations between these locations. Assuming that precipitation at the Coffee site consist of a mixture of storm events driven by Pacific and continental weather patterns, the average ^{3}H data from Anchorage and Ottawa were combined to create a ^{3}H record for use at the Project site. $^{3}H_{post\text{-}1953}$ was calculated using a 10-year moving average over this dataset, to account for hydrodynamic dispersion that occurs in groundwater systems (Jasechko et al., 2017). Decay-correcting this 10-year moving average ^{3}H concentration in precipitation to 2019 gives a $^{3}H_{post\text{-}1953}$ value of 9.25 TU. Thus, F_{young} can be approximated by:

$$F_{young} \approx (^{3}H_{sample}) / 9.25 \qquad (6)$$

The uncertainty with respects to F_{young} can be bracketed by assuming maximum and minimum 10-year moving average values of $^{3}H_{post\text{-}1953}$, and decay-correcting these values to 2019, which yields maximum and minimum $^{3}H_{post\text{-}1953}$ values of 2.56 and 87.6 TU, respectively. Due to the very large variations in ^{3}H since 1953, F_{young} uncertainties tend to be large (Jasechko *et al.*, 2017).

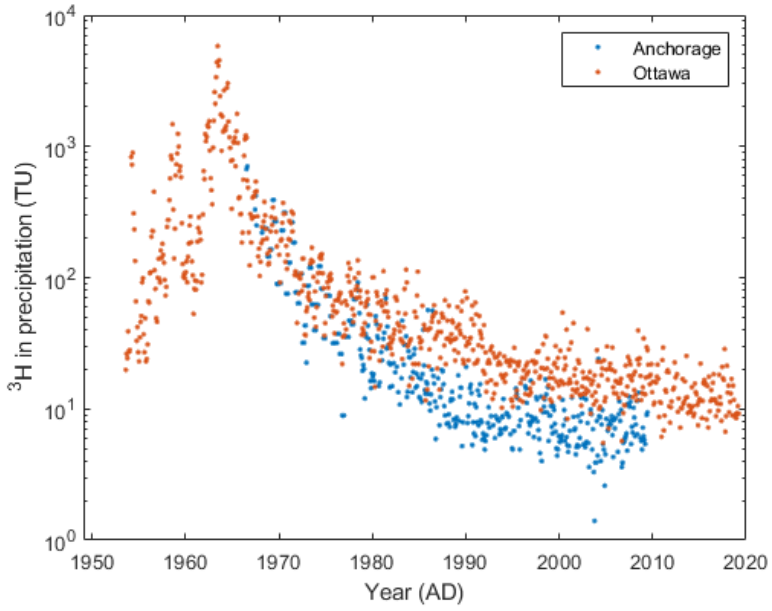


Figure 1: Tritium concentrations in rain and snow in Ottawa, Ontario and Anchorage, Alaska since 1953 (data from the International Atomic Energy Agency's Global Network of Isotopes in Precipitation). The peak in 1962 corresponds to maximum ^{3}H released during Cold-War era thermonuclear bomb testing. As of 2020, ^{3}H concentrations in rain and snow have returned to pre-nuclear bomb values as ^{3}H released into the atmosphere from nuclear bomb testing has undergone radioactive decay.

2.2 Determination of F_{paleo} Using ^{14}C Data

2.2.1 Overview

F_{paleo} is computed from ^{14}C data in a sample and requires several additional inputs that include re-constructed and decay-corrected ^{14}C data in the atmosphere from records spanning the last ~60,000 years, and $\delta^{13}C$ data to account for dissolution of radiocarbon-free carbonate minerals that contribute ^{14}C-free dissolved inorganic carbon (DIC) into groundwater, in addition to the ^{14}C-bearing groundwater that originates from recharge containing DIC sourced from the dissolution of atmospheric CO_2. The mass fraction, F_{paleo}, of a groundwater that recharged prior to 11,700 years BP corresponds to:

$$F_{paleo} = 1 - F_{Holocene} \quad (7)$$

where $F_{Holocene}$ is the mass fraction of a groundwater that recharged after 11,700 years BP (*i.e.*, during the Holocene). $F_{Holocene}$ is given by the equation (Jasechko, 2016a):

$$F_{Holocene} = ([DIC]_{sample}{}^{14}C_{sample} - [DIC]_{paleo}{}^{14}C_{paleo}) / ([DIC]_{Holocene}{}^{14}C_{Holocene} - [DIC]_{paleo}{}^{14}C_{paleo}) \quad (8)$$

where [DIC] is the concentration of dissolved inorganic carbon, ^{14}C is the radiocarbon concentration (in units of percent Modern Carbon, pMC), and the subscripts sample, paleo, Holocene pertain to the respective DIC and radiocarbon concentrations in the sample, in the atmosphere prior to the Holocene, and in the atmosphere during the Holocene, respectively. Paleo and Holocene ^{14}C values must also be decay-corrected to the year of sample analysis using the ^{14}C half-life of 5,730 years.

Groundwater ^{14}C concentrations also require correction for dissolution of carbonate minerals that formed millions of years ago, which contribute DIC without ^{14}C (because all ^{14}C from carbonate minerals has decayed in the time since their formation). The correction applied herein uses a radiocarbon dilution factor, *q*, that accounts for the amount of DIC sourced from carbonate mineral dissolution rather than from atmospheric CO_2, as per the method of Pearson and Hanshaw (1970) outlined in Section 1 of this appendix.

As per recommendations by Jasechko (2016a), equation (8) can be simplified by assuming that $[DIC]_{sample} \approx [DIC]_{Holocene} \approx [DIC]_{paleo}$ and that $q_{sample} \approx q_{Holocene} \approx q_{paleo}$. Thus equation (6) reduces to:

$$F_{Holocene} = (^{14}C_{sample} - {}^{14}C_{paleo}) / (^{14}C_{Holocene} - {}^{14}C_{paleo}) \quad (9)$$

$^{14}C_{paleo}$ and $^{14}C_{Holocene}$ must be estimated from ^{14}C records for the last ~60,000 years, decay-corrected to the year of sampling (*i.e.*, 2019) and accounting for dissolution of ^{14}C-free carbonate minerals using the equation:

$$^{14}C_{decay\text{-}corrected} = q_t\,^{14}C_{precip(t)}\, e^{[\lambda \times \Delta t]} \quad (10)$$

where $^{14}C_{precip(t)}$ is the ^{14}C activity in precipitation at a time t, λ is the ^{14}C decay constant (1.209×10^{-4} years), and Δt is the time (in years) elapsed between the recharge event and the year the sample ^{14}C analysis was completed. q is the dilution factor and is assumed to be time-invariant (Jasechko, 2016a).

2.2.2 Estimating the ^{14}C activity of DIC during the Holocene and Pleistocene

The ^{14}C activity of precipitation during the Holocene and Pleistocene was estimated from a database of ^{14}C determinations in the atmosphere from ~60,000 years BP to AD 1950 (Reimer et al., 2020) and from AD 1950 to 2010 (Hua et al., 2013). These databases were combined and ^{14}C activities were re-expressed in units of pMC (Figure 2). A 30-sample moving average was calculated as shown in Figure 2. Decay-corrections and corrections for carbonate-mineral dissolution were computed individually for each monitoring well, as each well sample had its own value of q from measurements of $\delta^{13}C$. Thus, decay-corrected and carbonate-mineral-dissolution-corrected ^{14}C activities were computed at each well for the entire Holocene and Pleistocene periods using a 30-point moving average over the Hua et al. (2013) and Reimer et al (2020) datasets. The average of the 30-point moving average over the Holocene and Pleistocene were taken as $^{14}C_{Holocene}$ and $^{14}C_{Pleistocene}$, respectively. There is a large range in minimum and maximum ^{14}C activities during these periods (range of <100 pMC to >160 pMC) as shown in Figure 2. Therefore, calculations of F_{paleo} also have substantial inherent uncertainty, as with F_{young}.

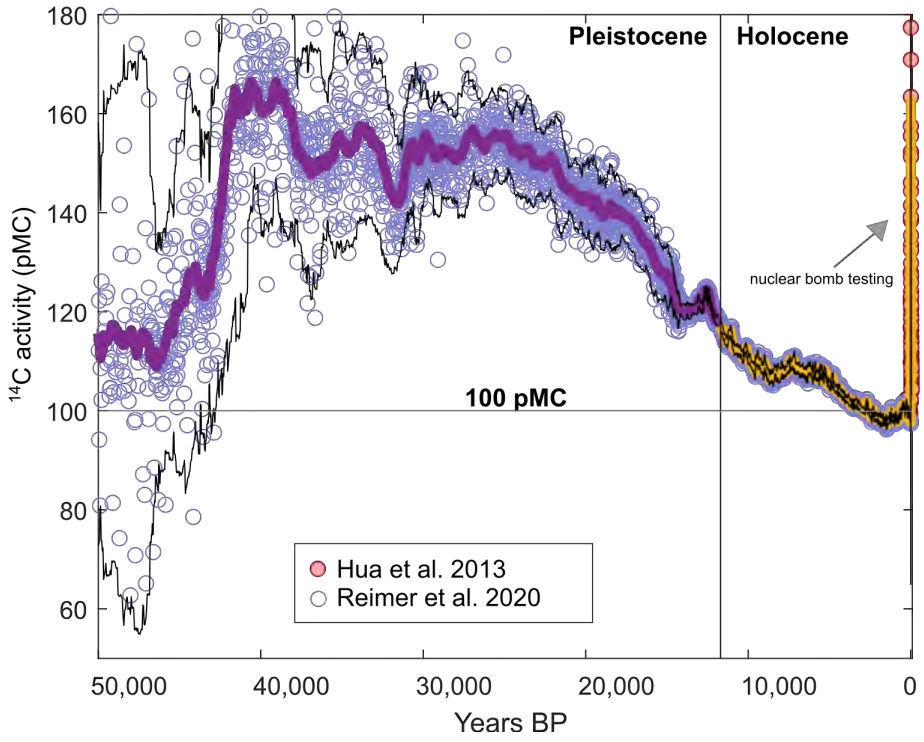


Figure 2: **Reconstructed ^{14}C activity of the atmosphere over the last 50,000 years, based on data from Reimer et al. (2020) (purple circles with white fill) and Hua *et al.* (2013) (red-filled circles). The thick line represents a moving average of ^{14}C (averaged over each 30 measurements available) over the Pleistocene (purple) and Holocene (yellow). One standard deviation around the moving averages is shown by the thin black line. The large increase in ^{14}C due to thermonuclear weapon detonations since the mid-20th Century is visible at the extreme right-hand side of the graph.**

APPENDIX C: LABORATORY CERTIFICATES OF ANALYSIS

BYU *Laboratory of Isotope Geochemistry*
Department of Geological Sciences
BYU campus, Provo, Utah 84602
phone: (801) 422-3918

Client: Mayo and Associates
710 East 100 North
Lindon, UT 84042

Reporting Date: 16 July 2015

Project: Lorax Coffee Creek

Stable Isotopic Data

Sample ID	BYU lab#	Collection date	d18O	+/-	dD	+/-
HC-5.0	11945	03-Apr-15	-21.85	0.40	-169.8	1.0
HC-2.5	11944	03-Apr-15	-21.68	0.40	-169.7	1.0
CC-1.0	11943	03-Apr-15	-20.96	0.40	-165.4	1.0
ML-1.0	11638	24-Oct-14	-21.12	0.40	-168.9	1.0
HC-2.5	11637	24-Oct-14	-21.01	0.40	-167.2	1.0
CC-1.0	11636	23-Oct-14	-21.15	0.40	-169.5	1.0
CC-6.0	11635	24-Oct-14	-20.76	0.40	-166.0	1.0
SW14-01	11634	10-Oct-14	-20.66	0.40	-165.1	1.0
F-Dup-1	11633	28-Sep-14	-20.91	0.40	-168.9	1.0
MW14-05B	11632	03-Oct-14	-22.09	0.40	-169.0	1.0
MW14-05A	11631	02-Oct-14	-22.03	0.40	-168.9	1.0
MW14-03B	11630	06-Oct-14	-21.74	0.40	-167.9	1.0
MW14-03A	11629	12-Oct-14	-21.60	0.40	-166.1	1.0
MW14-02B	11628	28-Sep-14	-21.00	0.40	-169.9	1.0
MW14-02A	11627	28-Sep-14	-21.05	0.40	-168.2	1.0

NOTES:

$\delta^{18}O_{VSMOW\ (sample)} = [(^{18}O/^{16}O)_{sample} - (^{18}O/^{16}O)_{VSMOW} / (^{18}O/^{16}O)_{VSMOW}] * 1000$

$\delta D_{VSMOW(sample)} = [(^{2}H/^{1}H)_{sample} - (^{12}H/^{1}H)_{VSMOW} / (^{2}H/^{1}H)_{VSMOW}] * 1000$

$\delta^{13}C_{VPDB\ (sample)} = [(^{13}C/^{12}C)_{sample} - (^{13}C/^{12}C)_{VPDB} / (^{13}C/^{12}C)_{VPDB}] * 1000$

$\delta^{18}O_{VSMOW\ (sample)}$, $\delta D_{VSMOW\ (sample)}$ and $\delta^{13}C_{VPDB\ (sample)}$ are the measured "delta" values for the given sample. $(^{18}O/^{16}O)_{sample}$, $(^{2}H/^{1}H)_{sample}$ and $(^{13}C/^{12}C)_{sample}$ are raw isotope ratios, and $(^{18}O/^{16}O)_{VSMOW}$ $(^{2}H/^{1}H)_{VSMOW}$ are the defined isotope ratios for hydrogen and oxygen of the VSMOW international standard. VPDB values for carbon are produced by analysis with reference gases calibrated to NBS-19.

Values are normalized to the VSMOW/SLAP scale (Coplen, 1988; Nelson, 2000; Nelson and Detlman, 2001); however, uncertainties in normalization are not included in error estimates.

David G. Tingey
Research Professor

BYU *Laboratory of Isotope Geochemistry*
Department of Geological Sciences
BYU campus, Provo, Utah 84602
phone: (801) 422-3918

Client: Mayo and Associates
710 East 100 North
Lindon, UT 84042

Reporting Date: 10 March 2016

Project: Lorax Coffee Creek

Stable Isotopic Data

Sample ID	BYU lab#	Collection date	d18O	+/-	dD	+/-
MW14-02A	12342	12-Jun-15	-22.35	0.20	-170.7	1.0
MW14-02B	12343	12-Jun-15	-22.74	0.20	-170.5	1.0
MW14-03A	12344	22-Jun-15	-22.00	0.20	-165.3	1.0
MW14-03B	12345	22-Jun-15	-21.54	0.20	-165.7	1.0
MW14-05A	12346	23-Jun-16	-22.22	0.20	-170.1	1.0
MW15-01WB/BH8-WB	12347	07-Jun-15	-21.98	0.20	-166.9	1.0
MW15-02AZ/BH10-AZ	12348	31-May-15	-22.67	0.20	-170.0	1.0
MW15-02WB/BH10-WB	12349	01-Jun-15	-22.67	0.20	-170.5	1.0
MW15-03AZ	12350	16-Jun-15	-21.81	0.20	-169.0	1.0
MW15-03WB	12351	16-Jun-15	-23.35	0.20	-175.6	1.0
MW15-04WB	12352	14-Jun-15	-22.38	0.20	-173.7	1.0
MW15-05WB	12353	18-Jun-15	-21.93	0.20	-169.3	1.0
MW15-21	12354	21-Jun-15	-22.25	0.20	-169.4	1.0
MW14-02A	12355	16-Jul-15	-22.07	0.20	-169.8	1.0
MW14-02B	12356	16-Jul-15	-22.22	0.20	-170.7	1.0
MW14-03A	12357	12-Jul-15	-21.96	0.20	-172.6	1.0
MW14-03B	12358	12-Jul-15	-21.91	0.20	-166.8	1.0
MW14-05A	12359	13-Jul-15	-22.45	0.20	-171.4	1.0
MW15-01WB	12360	08-Jul-15	-21.90	0.20	-169.9	1.0
MW15-02AZ	12361	11-Jul-15	-22.17	0.20	-169.8	1.0
MW15-02WB	12362	11-Jul-15	-22.74	0.20	-175.9	1.0
MW15-03AZ	12363	09-Jul-15	-21.65	0.20	-168.3	1.0
MW15-03WB	12364	09-Jul-15	-23.25	0.20	-177.4	1.0
MW15-04WB	12365	10-Jul-15	-22.71	0.20	-169.5	1.0
MW15-05WB	12366	10-Jul-15	-22.38	0.20	-170.6	1.0
MW15-40-AZ	12367	11-Jul-15	-22.03	0.20	-169.5	1.0

Sample ID	BYU lab#	Collection date	d18O	+/-	dD	+/-
MW15-30WB	12368	10-Jul-15	-22.38	0.20	-172.3	1.0
MW14-02A	12369	04-Sep-15	-22.30	0.20	-174.2	1.0
MW14-02B	12370	04-Sep-15	-22.48	0.20	-172.9	1.0
MW14-03A	12371	06-Sep-15	-21.97	0.20	-169.0	1.0
MW14-03B	12372	06-Sep-15	-21.71	0.20	-165.0	1.0
MW14-05A	12373	07-Sep-15	-22.35	0.20	-168.7	1.0
MW15-01WB	12374	03-Sep-15	-21.97	0.20	-166.8	1.0
MW15-02AZ	12375	07-Sep-15	-22.17	0.20	-169.4	1.0
MW15-02WB	12376	07-Sep-15	-22.38	0.20	-172.0	1.0
MW15-03AZ	12377	04-Sep-15	-21.22	0.20	-163.0	1.0
MW15-03WB	12378	04-Sep-15	-23.36	0.20	-176.2	1.0
MW15-04WB	12379	05-Sep-15	-21.92	0.20	-168.6	1.0
MW15-05WB	12380	06-Sep-15	-22.62	0.20	-171.6	1.0
MW14-100	12381	04-Sep-15	-22.77	0.20	-176.3	1.0
MW14-200	12382	06-Sep-15	-22.05	0.20	-167.1	1.0
CC-1.0	12383	27-Jun-15	-20.59	0.20	-162.0	1.0
CC-1.5	12384	25-Jun-15	-19.83	0.20	-151.7	1.0
CC-5.5	12385	25-Jun-15	-19.56	0.20	-150.6	1.0
HC-2.5	12386	26-Jun-15	-21.70	0.20	-165.5	1.0
HC-5.0	12387	26-Jun-15	-21.67	0.20	-167.6	1.0
YT-24	12388	26-Jun-15	-22.33	0.20	-168.5	1.0
CC-1.0	12389	28-Oct-15	-21.91	0.20	-168.3	1.0
CC-1.5	12390	28-Oct-15	-21.92	0.20	-171.7	1.0
CC-5.5	12391	28-Oct-15	-21.66	0.20	-168.5	1.0
HC-2.5	12392	30-Oct-15	-21.65	0.20	-170.3	1.0
HC-5.0	12393	30-Oct-15	-21.62	0.20	-166.6	1.0
YT-24	12394	30-Oct-15	-21.17	0.20	-167.4	1.0

NOTES:

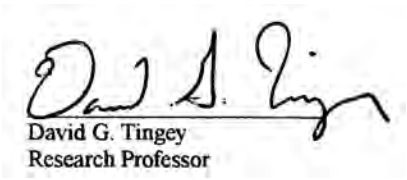
$\delta^{18}O_{VSMOW\ (sample)} = [(^{18}O/^{16}O)_{sample} - (^{18}O/^{16}O)_{VSMOW} / (^{18}O/^{16}O)_{VSMOW}] * 1000$

$\delta D_{VSMOW(sample)} = [(^{2}H/^{1}H)_{sample} - (^{12}H/^{1}H)_{VSMOW} / (^{2}H/^{1}H)_{VSMOW}] * 1000$

$\delta^{13}C_{VPDB\ (sample)} = [(^{13}C/^{12}C)_{sample} - (^{13}C/^{12}C)_{VPDB} / (^{13}C/^{12}C)_{VPDB}] * 1000$

$\delta^{18}O_{VSMOW\ (sample)}$, $\delta D_{VSMOW\ (sample)}$ and $\delta^{13}C_{VPDB\ (sample)}$ are the measured "delta" values for the given sample. $(^{18}O/^{16}O)_{sample}$, $(^{2}H/^{1}H)_{sample}$ and $(^{13}C/^{12}C)_{sample}$ are raw isotope ratios, and $(^{18}O/^{16}O)_{VSMOW}$ $(^{2}H/^{1}H)_{VSMOW}$ are the defined isotope ratios for hydrogen and oxygen of the VSMOW international standard. VPDB values for carbon are produced by analysis with reference gases calibrated to NBS-19.

Values are normalized to the VSMOW/SLAP scale (Coplen, 1988; Nelson, 2000; Nelson and Detlman, 2001); however, uncertainties in normalization are not included in error estimates.



David G. Tingey
Research Professor

BYU *Laboratory of Isotope Geochemistry*

Department of Geological Sciences

BYU campus, Provo, Utah 84602

Phone: (801) 422-3918

Client: Mayo and Associates
710 East 100 North
Lindon, UT 84042

Reporting Date: 16 July 2015

Project: Lorax Coffee Creek

Carbon 13 Analysis

Sample ID	BYU ID	Sample Date	$\delta^{13}C$ (‰)	+/- 1 σ
HC-5.0	11945	03-Apr-15	-10.8	0.1
MW14-05B	11632	03-Oct-14	-12.4	0.1
MW14-05A	11631	02-Oct-14	-10.9	0.1
MW14-03B	11630	06-Oct-14	-2.4	0.1
MW14-03A	11629	12-Oct-14	-12.1	0.1

NOTES:

Insufficient sample size for Carbon 14 Analyses on these samples

Pretreatment: Carbon was extracted from the water sample as barium carbonate precipitate. Carbon dioxide was recovered from the carbonate in a high-vacuum system for processing into benzene and isotopic analysis.

Comments: Percent modern carbon was calculated according to Stuvier, M. and Polach, HA, 1997, Discussion of ^{14}C data: Radiocarbon 19:355-63 by comparison against the activities of 4990C NBS oxalic acid and a total process blank. Based upon a Libby half life of 5568 years for ^{14}C.

David G. Tingey
Research Professor

BYU *Laboratory of Isotope Geochemistry*

Department of Geological Sciences

BYU campus, Provo, Utah 84602

Client: Mayo and Associates
710 East 100 North
Lindon, UT 84042

Reporting Date: 16 July 2015

Project: Lorax Coffee Creek

Tritium Analysis

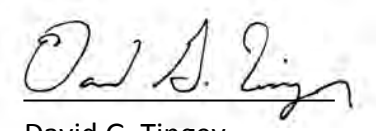
Sample ID	BYU ID	Sample Date	^{3}H (TU)	MDA*	Sample Preparation
ML-1.0	11638	24-Oct-14	8.4	0.3	Enriched
HC-2.5	11637	24-Oct-14	6.7	0.3	Enriched
CC-1.0	11636	23-Oct-14	6.0	0.3	Enriched
CC-6.0	11635	24-Oct-14	7.5	0.3	Enriched
SW14-01	11634	10-Oct-14	8.0	0.3	Enriched
F-Dup-1	11633	28-Sep-14	5.3	0.3	Enriched
MW14-02B	11628	28-Sep-14	5.8	0.3	Enriched
MW14-02A	11627	28-Sep-14	7.4	0.3	Enriched

NOTES:

* Minimum Detectable Activity

Standardization was done using NIST Radioactivity Standard Reference Material SRM 436 1C Hydrogen-3.

Samples analyzed using a PerkinElmer 1220 Quantulus Ultra Low Level Liquid Scintillation Spectrometer after electrolytic Tritium enrichment. Average counting statistic for each sample is +/- 0.2 TU. Minimum detectable activity is a combination of the counting statistics, cosmic contributions, instrument noise and effects from LSC vials.



David G. Tingey
Research Professor

BYU *Laboratory of Isotope Geochemistry*

Department of Geological Sciences

BYU campus, Provo, Utah 84602

Client: Mayo and Associates
710 East 100 North
Lindon, UT 84042

Reporting Date: 8 April 2016

Project: Lorax Coffee Creek

Tritium Analysis

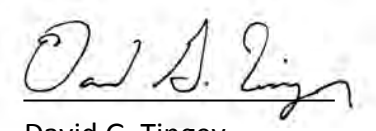
Sample ID	BYU ID	Sample Date	^{3}H (TU)	MDA*	Sample Preparation
CC-1.5	12390	10/25/15	8.0	0.3	Enriched
MW14-02B	12370	9/4/15	7.1	0.3	Enriched
MW14-03A	12357	7/12/15	1.3	0.3	Enriched
MW14-03A	12371	9/6/15	1.1	0.3	Enriched
MW15-02AZ	12375	9/7/15	9.4	0.3	Enriched
MW15-02WB	12376	9/7/15	6.7	0.3	Enriched
MW15-03AZ	12377	9/4/15	8.3	0.3	Enriched
MW15-03WB	12378	9/4/15	0.9	0.3	Enriched
MW15-04WB	12379	9/5/15	6.6	0.3	Enriched

NOTES:

* Minimum Detectable Activity

Standardization was done using NIST Radioactivity Standard Reference Material SRM 436 1C Hydrogen-3.

Samples analyzed using a PerkinElmer 1220 Quantulus Ultra Low Level Liquid Scintillation Spectrometer after electrolytic Tritium enrichment. Average counting statistic for each sample is +/- 0.2 TU. Minimum detectable activity is a combination of the counting statistics, cosmic contributions, instrument noise and effects from LSC vials.



David G. Tingey
Research Professor

BYU *Laboratory of Isotope Geochemistry*

Department of Geological Sciences

BYU campus, Provo, Utah 84602

Client: Mayo and Associates
710 East 100 North
Lindon, UT 84042

Reporting Date: 17 March 2016

Project: Lorax Coffee Creek

Tritium Analysis

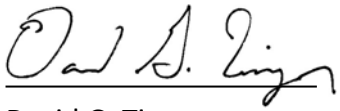
Sample ID	BYU ID	Sample Date	^{3}H (TU)	MDA*	Sample Preparation
CC-1.0	12383	27-Jun-15	9.2	0.3	Enriched
CC-1.0	12389	28-Oct-15	6.4	0.3	Enriched
CC-5.5	12391	28-Oct-15	9.4	0.3	Enriched
HC-2.5	12386	26-Jun-15	6.5	0.3	Enriched
HC-5.0	12387	26-Jun-15	6.6	0.3	Enriched
MW15-02AZ	12361	11-Jul-15	7.4	0.3	Enriched
MW15-02WB	12362	11-Jul-15	7.1	0.3	Enriched
MW15-03AZ	12350	16-Jun-15	7.1	0.3	Enriched
MW15-03WB	12351	16-Jun-15	0.6	0.3	Enriched
MW15-04WB	12352	14-Jun-15	7.1	0.3	Enriched

NOTES:

* Minimum Detectable Activity

Standardization was done using NIST Radioactivity Standard Reference Material SRM 436 1C Hydrogen-3.

Samples analyzed using a PerkinElmer 1220 Quantulus Ultra Low Level Liquid Scintillation Spectrometer after electrolytic Tritium enrichment. Average counting statistic for each sample is +/- 0.2 TU. Minimum detectable activity is a combination of the counting statistics, cosmic contributions, instrument noise and effects from LSC vials.



David G. Tingey
Research Professor

BYU *Laboratory of Isotope Geochemistry*
Department of Geological Sciences
BYU campus, Provo, Utah 84602
phone: (801) 422-3918

Client: Mayo and Associates
710 East 100 North
Lindon, UT 84042

Reporting Date: 16 July 2015

Project: Lorax Coffee Creek

Radiocarbon Age Analysis

Sample ID	BYU ID	Sample Date	^{14}C (pmc)	+/- 1 σ	$\delta^{13}C$ (‰)	+/- 1 σ
HC-2.5	11944	03-Apr-15	53.81	0.16	-9.1	0.1
CC-1.0	11943	03-Apr-15	45.87	0.14	-9.5	0.1
HC-2.5	11637	24-Oct-14	71.34	0.20	-7.0	0.1
CC-1.0	11636	23-Oct-14	38.46	0.12	-6.5	0.1
F-Dup-1	11633	28-Sep-14	18.28	0.07	-5.8	0.1
MW14-02B	11628	28-Sep-14	28.68	0.10	-4.6	0.1
MW14-02A	11627	28-Sep-14	33.10	0.11	-5.9	0.1

NOTES:

Pretreatment: Carbon was extracted from the water sample as barium carbonate precipitate. Carbon dioxide was recovered from the carbonate in a high-vacuum system for processing into benzene and isotopic analysis.

Comments: Percent modern carbon was calculated according to Stuvier, M. and Polach, HA, 1997, Discussion of ^{14}C data: Radiocarbon 19:355-63 by comparison against the activities of 4990C NBS oxalic acid and a total process blank. Based upon a Libby half life of 5568 years for ^{14}C.

David G. Tingey
Research Professor

BYU *Laboratory of Isotope Geochemistry*
Department of Geological Sciences
BYU campus, Provo, Utah 84602
phone: (801) 422-3918

Client: Mayo and Associates
710 East 100 North
Lindon, UT 84042

Reporting Date: 25 March 2016

Project: Lorax Coffee Creek

Radiocarbon Age Analysis

Sample ID	BYU ID	Sample Date	^{14}C (pmc)	+/- 1 σ	$\delta^{13}C$ (‰)	+/- 1 σ
MW14-02B	12370	04-Sep-15	16.24	0.07	-5.93	0.04
MW14-03A	12357	12-Jul-15	15.82	0.07	-3.79	0.04
MW14-03A	12371	06-Sep-15	17.89	0.08	-4.96	0.04
MW15-02WB	12362	11-Jul-15	34.19	0.12	-6.66	0.04
MW15-03WB	12378	04-Sep-15	11.11	0.07	-8.20	0.04
MW15-03WB	12351	16-Jun-15	16.77	0.07	-10.93	0.04
MW15-04WB	12379	05-Sep-15	23.91	0.10	-7.14	0.04

NOTES:

Pretreatment: Carbon was extracted from the water sample as barium carbonate precipitate. Carbon dioxide was recovered from the carbonate in a high-vacuum system for processing into benzene and isotopic analysis.

Comments: Percent modern carbon was calculated according to Stuvier, M. and Polach, HA, 1997, Discussion of ^{14}C data: Radiocarbon 19:355-63 by comparison against the activities of 4990C NBS oxalic acid and a total process blank. Based upon a Libby half life of 5568 years for ^{14}C.

David G. Tingey
Research Professor

#	Sample	Date	Lab#	$\delta^{18}O$	Result	Repeat	$\delta^{2}H$	Result	Repeat	E3H	Result	± 1σ	Repeat	± 1σ	pH	EC	AZD
				H_2O	VSMOW	± 0.2‰	H_2O	VSMOW	± 0.8‰		± 0.8 T.U.		± 0.8 T.U.			µS/cm	
1	MW14-02A	13-May-16	408399	X	-21.75	-21.76	X	-171.41	-172.28						7.71	259	
2	MW14-02A	17-Jul-16	408400	X	-21.98		X	-172.60							7.55	369	
3	MW14-02A	25-Sep-16	408401	X	-21.83		X	-172.46							7.59	343	
4	MW14-02A	21-Apr-17	408402	X	-21.59		X	-171.58		X	6.5	0.6			7.21	350	
5	MW14-02A	8-Jun-17	408403	X	-21.94	-21.63	X	-172.08	-171.70						6.06	372	
6	MW14-02A	5-Oct-17	408404	X	-14.43	-14.43	X	-103.49	-103.57	X	1.9	0.4			7.80	334	
7	MW14-02B	13-May-16	408405	X	-21.91		X	-172.67							7.80	317	
8	MW14-02B	17-Jul-16	408406	X	-21.95		X	-173.55							7.60	435	
9	MW14-02B	25-Sep-16	408407	X	-21.65		X	-173.71							7.37	459	
10	MW14-02B	21-Apr-17	408408	X	-21.77	-21.87	X	-173.15	-173.44	X	6.9	0.7			7.52	496	
11	MW14-02B	8-Jun-17	408409	X	-21.90		X	-173.83							7.55	463	
12	MW14-02B	5-Oct-17	408410	X	-13.76	-14.13	X	-102.26	-102.24	X	3.6	0.5			7.23	521	
13	MW14-03A	16-May-16	408411	X	-21.60		X	-167.07							7.44	1625	
14	MW14-03A	14-Jul-16	408412	X	-21.64		X	-167.52							7.41	1599	
15	MW14-03A	27-Apr-17	408413	X	-21.67	-21.80	X	-166.62	-167.63	X	<0.8	0.3			7.24	1571	
16	MW14-03A	9-Jun-17	408414	X	-21.67		X	-167.07							7.45	1650	
17	MW14-03A	6-Oct-17	408415	X	-21.72		X	-167.45		X	<0.8	0.3			7.42	1681	
18	MW14-03B	16-May-16	408416	X	-21.58		X	-167.02							7.16	1707	
19	MW14-03B	14-Jul-16	408417	X	-21.63		X	-167.15							7.41	1717	
20	MW14-03B	24-Sep-16	408418	DNR			DNR								6.88	1640	
21	MW14-03B	27-Apr-17	408419	X	-21.69	-21.60	X	-166.81	-166.24	X	<0.8	0.4			7.37	1762	
22	MW14-03B	9-Jun-17	408420	X	-21.54		X	-166.69							7.00	1746	
23	MW14-03B	6-Oct-17	408421	X	-21.68		X	-167.39		X	0.9	0.3			7.48	1884	
24	MW14-05A	14-May-16	408422	X	-22.04		X	-170.56							7.41	436	
25	MW14-05A	16-Jul-16	408423	X	-22.05		X	-170.34							7.54	356	
26	MW14-05A	23-Sep-16	408424	X	-21.92	-22.01	X	-170.35	-170.36						7.74	430	
27	MW14-05A	28-Apr-17	408425	X	-21.91		X	-170.61		X	<0.8	0.4			7.58	475	
28	MW14-05A	10-Jun-17	408426	X	-21.83		X	-170.70							6.95	406	
29	MW14-05A	8-Oct-17	408427	X	-21.72		X	-170.49		X	<0.8	0.4			7.63	370	
30	MW14-05B	15-May-16	408428	X	-22.23	-22.12	X	-168.36	-169.72						7.37	519	
31	MW14-05B	16-Jul-16	408429	X	-22.16		X	-168.80							7.33	416	
32	MW14-05B	23-Sep-16	408430	X	-22.21		X	-169.65							7.15	406	
33	MW14-05B	29-Apr-17	408431	X	-22.25		X	-169.96		X	<0.8	0.3			6.66	436	
34	MW14-05B	11-Jun-17	408432	X	-21.69		X	-168.26							7.43	422	
35	MW14-05B	8-Oct-17	408433	X	-22.13	-22.17	X	-170.06	-169.28	X	<0.8	0.4			7.50	359	
36	MW15-01WB	15-May-16	408434	X	-21.50		X	-167.06							7.08	2355	
37	MW15-01WB	14-Jul-16	408435	X	-21.57		X	-167.08							6.71	2293	
38	MW15-01WB	22-Sep-16	408436	X	-21.56		X	-166.67							6.84	2278	
39	MW15-01WB	22-Apr-17	408437	X	-21.42		X	-166.42		X	<0.8	0.3			6.60	2078	
40	MW15-01WB	8-Jun-17	408438	X	-21.86	-22.00	X	-167.90	-167.90						7.04	1925	

To Contact uwEILAB:
519 888 4732

Rick Heemskerk
uwEILAB Manager
rkhmskrk@uwaterloo.ca
519 888 4567 ext 35838

#	Sample	Date	Lab#	$\delta^{18}O$	Result	Repeat	$\delta^{2}H$	Result	Repeat	E3H	Result	± 1σ	Repeat	± 1σ	pH	EC	AZD
				H_2O	VSMOW	± 0.2‰	H_2O	VSMOW	± 0.8‰		± 0.8 T.U.		± 0.8 T.U.			µS/cm	
41	MW15-01WB	6-Oct-17	408439	X	-21.84		X	-167.22		X	<0.8	0.3			6.07	2041	
42	MW15-02AZ	17-May-16	408440	X	-22.10		X	-171.50							7.36	769	
43	MW15-02AZ	19-Jul-16	408441	X	-22.14		X	-171.49							7.37	752.1	
44	MW15-02AZ	25-Sep-16	408442	X	-22.10		X	-171.20							7.33	769.8	
45	MW15-02AZ	8-Oct-17	408443	X	-21.99	-21.72	X	-168.35	-167.95	X	8.3	0.8			7.57	437	
46	MW15-02WB	18-May-16	408444	X	-22.24		X	-171.29							7.32	880	
47	MW15-02WB	19-Jul-16	408445	X	-22.31		X	-170.93							7.58	827	
48	MW15-02WB	25-Sep-16	408446	X	-22.21		X	-171.24							7.46	806	
49	MW15-02WB	25-Apr-17	408447	X	-22.08		X	-171.34		X	5.3	0.6			7.34	941	
50	MW15-02WB	13-Jun-17	408448	X	-22.01	-22.01	X	-171.41	-171.40						7.40	895	
51	MW15-02WB	8-Oct-17	408449	X	-21.84		X	-170.48		X	5.9	0.6			8.08	480	
52	MW15-03AZ	16-May-16	408450	X	-22.78		X	-176.77							7.12	260	
53	MW15-03AZ	16-Jul-16	408451	X	-21.88		X	-169.81							7.11	204	
54	MW15-03AZ	23-Sep-16	408452	X	-21.51		X	-167.31							7.20	205.1	
55	MW15-03AZ	7-Oct-17	408453	X	-21.20	-21.27	X	-164.44	-164.71	X	8.0	0.7			8.88	128	
56	MW15-03WB	16-May-16	408454	X	-22.55		X	-175.38							7.69	1833	
57	MW15-03WB	16-Jul-16	408455	X	-22.86		X	-177.63							7.57	2080	
58	MW15-03WB	23-Sep-16	408456	X	-12.52	-12.38	X	-88.94	-88.19						7.31	2002	
59	MW15-03WB	23-Apr-17	408457	X	-22.83		X	-177.21		X	<0.8	0.3			7.69	1917	
60	MW15-03WB	10-Jun-17	408458	X	-22.95	-22.90	X	-177.30	-176.87						7.18	1485	
61	MW15-03WB	7-Oct-17	408459	X	-22.99		X	-177.93		X	<0.8	0.4			8.04	2060	
62	MW15-04WB	15-Jul-16	408460	X	-22.16		X	-172.47							7.39	634.6	
63	MW15-04WB	24-Sep-16	408461	X	-22.19		X	-172.70							8.26	608.8	
64	MW15-04WB	23-Apr-17	408462	X	-22.12		X	-171.98		X	5.9	0.6	6.5	0.6	7.40	602.6	
65	MW15-04WB	11-Jun-17	408463	X	-22.35	-22.28	X	-172.85	-172.40						5.50	418	
66	MW15-04WB	5-Oct-17	408464	X	-22.32		X	-172.44		X	5.1	0.6			7.54	660	
67	MW15-05WB	15-May-16	408465	X	-22.50		X	-172.11							7.88	326	
68	MW15-05WB	27-Sep-16	408466	X	-22.22		X	-170.10							7.70	335.1	
69	MW15-05WB	21-Apr-17	408467	X	-22.56		X	-172.15		X	<0.8	0.3			6.90	401.9	
70	MW15-05WB	11-Jun-17	408468	X	-22.66	-22.54	X	-172.10	-171.30						5.50	179	
71	MW15-05WB	7-Oct-17	408469	X	-22.48		X	-169.88		X	<0.8	0.3			7.56	162	
72	MW15-06WB	17-May-16	408470	X	-22.20		X	-170.00							8.04	514.4	
73	MW15-06WB	18-Jul-16	408471	X	-22.29		X	-170.72							8.05	523.6	
74	MW15-06WB	26-Sep-16	408472	X	-22.09		X	-170.01							8.16	485.4	
75	MW15-06WB	24-Apr-17	408473	X	-22.25	-22.24	X	-170.49	-170.12	X	<0.8	0.4			7.94	473.9	
76	MW15-06WB	12-Jun-17	408474	X	-22.27		X	-170.62							8.15	543	
77	MW15-06WB	9-Oct-17	408475	X	-22.31		X	-170.84		X	<0.8	0.4			7.80	523	
78	MW16-01WB	4-Oct-16	408476	X	-22.49		X	-170.32							7.38	187.4	
79	MW16-01WB	20-Apr-17	408477	X	-22.64		X	-170.82		X	<0.8	0.3			7.57	188	
80	MW16-01WB	9-Jun-17	408478	X	-22.67	-22.77	X	-170.90	-170.84						5.94	147	

Rick Heemskerk
uwEILAB Manager
rkhmskrk@uwaterloo.ca
519 888 4567 ext 35838

To Contact uwEILAB:
519 888 4732

#	Sample	Date	Lab#	$\delta^{18}O$	Result	Repeat	$\delta^{2}H$	Result	Repeat	E3H	Result	± 1σ	Repeat	± 1σ	pH	EC	AZD
				H_2O	VSMOW	± 0.2‰	H_2O	VSMOW	± 0.8‰		± 0.8 T.U.		± 0.8 T.U.			µS/cm	
81	MW16-01WB	6-Oct-17	408479	X	-22.63		X	-171.06		X	<0.8	0.3			7.02	190	
82	MW14-02A	28-Jul-17	408480	X	-22.47		X	-171.76							8.31	360	
83	MW14-02B	28-Jul-17	408481	X	-22.54		X	-171.96							8.34	472	
84	MW14-03A	26-Jul-17	408482	X	-22.24		X	-166.80							8.29	1630	
85	MW14-03B	26-Jul-17	408483	X	-22.17	-22.34	X	-166.56	-166.73						8.34	1760	
86	MW14-05A	25-Jul-17	408484	X	-22.48		X	-168.24							8.06	383	
87	MW14-05B	26-Jul-17	408485	X	-22.70		X	-169.63							8.27	410	
88	MW15-01WB	24-Jul-17	408486	X	-21.82		X	-168.39							7.78	2170	
89	MW15-02WB	28-Jul-17	408487	X	-22.37		X	-173.24							8.33	861	
90	MW15-03WB	25-Jul-17	408488	X	-23.25	-23.33	X	-179.74	-179.85						8.27	2010	
91	MW15-04WB	26-Jul-17	408489	X	-22.51		X	-173.93							8.40	668	
92	MW15-05WB	27-Jul-17	408490	X	-22.85		X	-173.97							8.28	292	
93	MW15-06WB	29-Jul-17	408491	X	-22.53		X	-172.83							8.36	546	
94	MW16-01WB	27-Jul-17	408492	X	-22.76		X	-173.16							7.93	183	
95	CC-1.0	02-Apr-16	408493	X	-22.69	-22.69	X	-173.94	-174.76						8.16	922.2	
96	CC-1.0	26-Apr-17	408494	X	-22.22		X	-172.22		X	5.4	0.6			8.45	777	
97	CC-1.0	19-Oct-17	408495	X	-22.30		X	-171.69		X	6.7	0.6			8.14	833	
98	CC-1.5	02-Apr-16	408496	X	-22.49		X	-172.92							7.58	826.6	
99	CC-1.5	26-Apr-17	408497	X	-22.37		X	-172.75		X	6.5	0.6			7.80	834	
100	CC-1.5	19-Oct-17	408498	X	-21.82	-21.89	X	-168.14	-168.04	X	7.7	0.7			7.82	393	
101	CC-5.5	20-Oct-17	408499	X	-20.71		X	-159.05		X	10.9	0.9			7.24	286	
102	HC-2.5	3-Apr-16	408500	X	-22.19		X	-172.04							7.56	438.7	
103	HC-2.5	27-Apr-17	408501	X	-22.19		X	-171.90		X	5.6	0.6			8.23	375	
104	HC-2.5	19-Oct-17	408502	X	-21.52		X	-165.85		X	7.5	0.7			7.52	334	
105	HC-5.0	3-Apr-16	408503	X	-22.36	-22.08	X	-174.11	-172.84						7.74	422	
106	HC-5.0	27-Apr-17	408504	X	-22.14		X	-172.11		X	4.9	0.5			8.38	473	
107	HC-5.0	20-Oct-17	408505	X	-21.44		X	-166.59		X	6.6	0.6			7.61	381	
108	ML-1.0	27-Apr-17	408506	X	-21.39	-21.29	X	-165.22	-165.94	X	1.2	0.4			8.80	1522	
109	ML-1.0	21-Oct-17	408507	X	-21.83		X	-169.27		X	6.3	0.6	7.7	0.7	7.68	349	

Tritium is reported in Tritium Units.
1TU = 3.221 Picocurries/L per IAEA, 2000 Report.
1TU = 0.11919 Becquerels/L per IAEA, 2000 Report.

1 Sample did not arrive (Lab #408418)

18O/2H Results from LGR Laser

Rick Heemskerk
uwEILAB Manager
rkhmskrk@uwaterloo.ca
519 888 4567 ext 35838

To Contact uwEILAB:
519 888 4732

Client: Helsen/Skierszkan
Lorax Environmental Services Ltd.
Project: A362-4 Coffee Creek GWQ

ISO# 2019510
Location: Fridge 3,
48 for 18O+2H,
15 for E3H, 14C-DIC AMS

Environmental Isotope Lab
1/14/2020

#	Sample	Date	Lab#	$\delta^{18}O$	Result	Repeat	$\delta^{2}H$	Result	Repeat	E3H	Result	± 1σ	Repeat	± 1σ	δ13C/14C	Result	Repeat
				H_2O	VSMOW	± 0.2‰	H_2O	VSMOW	± 0.8‰		± 0.8 T.U.		± 0.8 T.U.		DIC/AMS	PDB	± 0.2‰
1	BD1-Q1	28-Apr-2019	428782	X	-21.94	-21.89	X	-171.97	-172.64								
2	BD2-Q1	29-Apr-2019	428783	X	-21.98		X	-170.78									
3	HC@MW15-03	03-May-2019	428784	X	-21.59		X	-170.51									
4	HC-2.5	03-May-2019	428785	X	-21.68		X	-170.54									
5	MW14-02A	28-Apr-2019	428786	X	-21.98	-22.09	X	-172.67	-172.72								
6	MW14-02B	28-Apr-2019	428787	X	-22.25		X	-173.11									
7	MW14-03A	27-Apr-2019	428788	X	-21.75		X	-166.44									
8	MW14-03B	27-Apr-2019	428789	X	-21.65		X	-166.60									
9	MW14-05A	29-Apr-2019	428790	X	-22.06		X	-170.21									
10	MW14-05B	30-Apr-2019	428791	X	-22.15	-22.09	X	-170.51	-170.25								
11	MW15-01WB	04-May-2019	428792	X	-21.69		X	-167.91									
12	MW15-02WB	29-Apr-2019	428793	X	-22.02		X	-170.75									
13	MW15-03WB	03-May-2019	428794	X	-22.62		X	-175.90									
14	MW15-04WB	03-May-2019	428795	X	-21.81		X	-169.61									
15	MW15-05WB	30-Apr-2019	428796	X	-22.21	-22.22	X	-170.24	-170.10								
16	MW15-06WB	02-May-2019	428797	X	-22.04		X	-168.72									
17	MW16-01WB	01-May-2019	428798	X	-22.40		X	-170.21									
18	BD1-Q2	13-Jun-2019	428799	X	-22.35		X	-172.21									
19	BD2-Q2	19-Jun-2019	428800	X	-21.99		X	-170.00									
20	MW14-02A	13-Jun-2019	428801	X	-22.18	-21.95	X	-172.00	-170.91								
21	MW14-02B	13-Jun-2019	428802	X	-22.19		X	-172.59									
22	MW14-03A	14-Jun-2019	428803	X	-21.57		X	-165.50									
23	MW14-03B	14-Jun-2019	428804	X	-21.80		X	-166.50									
24	MW14-05A	15-Jun-2019	428805	X	-22.24		X	-169.91									
25	MW14-05B	16-Jun-2019	428806	X	-22.30	-22.01	X	-169.63	-169.04								
26	MW15-01WB	18-Jun-2019	428807	X	-21.65		X	-167.39									
27	MW15-02WB	19-Jun-2019	428808	X	-21.89		X	-169.91									
28	MW15-03WB	18-Jun-2019	428809	X	-22.95		X	-177.85									
29	MW15-04WB	17-Jun-2019	428810	X	-21.77		X	-170.39									
30	MW15-05WB	19-Jun-2019	428811	X	-22.24	-22.28	X	-171.53	-170.92								
31	MW15-06WB	20-Jun-2019	428812	X	-22.29		X	-170.85									
32	MW16-01WB	17-Jun-2019	428813	X	-22.48		X	-171.26									
33	MW15-02WB-Dup	24-Aug-2019	428814	X	-22.01		X	-170.80		X	5.3	0.8			X	-7.54	
34	D-1	23-Aug-2019	428815	X	-21.83		X	-166.52		X	< 0.8	0.8			X	-2.60	
35	MW14-02A	22-Aug-2019	428816	X	-22.12	-22.20	X	-172.70	-172.77	X	7.2	0.8			X	-7.24	
36	MW14-02B	22-Aug-2019	428817	X	-22.11		X	-173.42		X	5.4	0.8			X	-5.48	
37	MW14-03A	23-Aug-2019	428818	X	-21.69	-21.69	X	-165.85	-166.56	X	1.1	0.8			X	-3.12	
38	MW14-03B	23-Aug-2019	428819	X	-21.70		X	-166.75		X	1.2	0.8			X	-2.16	
39	MW14-05A	24-Aug-2019	428820	X	-22.11		X	-170.19		X	< 0.8	0.8	< 0.8	0.8	X	-12.10	
40	MW14-05B	25-Aug-2019	428821	X	-22.14		X	-170.77		X	< 0.8	0.8			X	-11.80	
41	MW15-01WB	22-Aug-2019	428822	X	-21.65	-21.59	X	-168.21	-167.92	X	< 0.8	0.8			X	-3.71	
42	MW15-02WB	24-Aug-2019	428823	X	-21.83		X	-170.42		X	6.6	0.8			X	-8.08	
43	MW15-03WB	23-Aug-2019	428824	X	-22.65		X	-176.61		X	< 0.8	0.8			X	-6.97	
44	MW15-04WB	22-Aug-2019	428825	X	-21.91		X	-170.66		X	6	0.8			X	-7.55	-7.16
45	MW15-05WB	23-Aug-2019	428826	X	-22.27		X	-171.37		X	< 0.8	0.8			X	-7.01	
46	MW15-06WB	25-Aug-2019	428827	X	-22.08	-22.19	X	-170.79	-170.79	X	1.0	0.8			X	-8.95	
47	MW16-01WB	21-Aug-2019	428828	X	-22.42		X	-171.29		X	< 0.8	0.8			X	-5.33	
48	MW15-03AZ	23-Aug-2019	428829	X	-20.51	-20.57	X	-161.02	-161.03	X	7.9	0.8					

DirectAMS Code	14C		RCAge		14C		RCAge		pH	EC	HCO3		AZD
	pmC	1σ error	BP	1σ error	pmC	1σ error	BP	1σ error		µS/cm	mg/L		
									7.81	362			
									7.40	417			
									8.00	414			
									7.89	414			
									7.90	374			
									7.87	476			
									7.70	1670			
									7.72	1840			
									7.86	417			
									7.54	359			
									8.04	2220			
									7.74	917			
									7.91	2030			
									7.94	641			
									7.78	294			
									8.07	591			
									7.51	177			
									8.10	476			
									7.88	876			
									8.01	373			
									8.04	479			
									7.82	1640			
									7.87	1850			
									7.59	410			
									7.66	361			
									7.70	2200			
									7.93	909			
									7.88	1990			
									7.84	615			
									7.86	284			
									7.96	559			
									7.35	180			
D-AMS 035858	35.05	0.18	8421	40	34.44	0.17	8564	40	8.09	906	314		
D-AMS 035859	insufficient carbon for analysis				insufficient carbon for analysis				8.03	1630	604		
D-AMS 035860	15.54	0.12	14955	64	15.26	0.12	15100	64	7.95	361	174		
D-AMS 035861	11.30	0.10	17514	71	11.080	0.098	17673	71	7.95	470	218		
D-AMS 035862	7.070	0.070	21282	80	6.914	0.068	21461	80	8.03	1630	604		
D-AMS 035863	3.746	0.049	26385	106	3.660	0.048	26571	106	8.01	1880	699		
D-AMS 035864	32.25	0.15	9092	38	31.82	0.15	9197	38	7.80	416	261		
D-AMS 035865	19.37	0.11	13184	47	19.12	0.11	13292	47	7.78	357	218		
D-AMS 035866	1.503	0.040	33718	214	1.471	0.039	33891	214	7.76	2190	708		
D-AMS 035867	35.20	0.26	8387	59	34.60	0.26	8526	59	8.09	906	314		
D-AMS 035868	8.012	0.087	20277	87	7.866	0.085	20425	87	8.02	2010	187		
D-AMS 035869	19.55	0.14	13113	59	19.20	0.14	13257	59	7.87	644	279		
D-AMS 035870	10.61	0.10	18023	79	10.42	0.10	18170	79	7.87	296	181		
D-AMS 035871	16.99	0.12	14239	58	16.71	0.12	14371	58	8.18	584	286		
D-AMS 035872	9.26	0.11	19113	100	9.08	0.11	19273	100	7.09	178	96		
									7.73	252	115		

uncorrected values	renormalized to -25 permil using provided d13C values

Tritium is reported in Tritium Units.
1TU = 3.221 Picocurries/L per IAEA, 2000 Report.
1TU = 0.11919 Becquerels/L per IAEA, 2000 Report.

14C+δ13C-DIC sample preserved with 1.25 g ZnCl2

To Contact uwEILAB:
519 888 4732

Rick Heemskerk
uwEILAB Manager
rkhmskrk@uwaterloo.ca
519 888 4567 ext 35838

APPENDIX D: ISOTOPE DATA AND QUALITY ASSURANCE/ QUALITY CONTROL

Appendix D: Isotope Data and Quality Assurance/ Quality Control

Six field duplicate samples collected in 2014 and 2015 were submitted for isotope analyses to the Brigham Young University Laboratory of Isotope Geochemistry (BYU-LIG), while six duplicate samples collected in 2019 were submitted to the University of Waterloo - Environmental Isotope Laboratory (UW-EIL). In addition, internal reproducibility checks on 2016 and 2017 samples were completed at the UW-EIL which included re-analysis of 26 stable isotope samples. In 2019, the UW-EIL re-analyzed 12 samples submitted for stable isotope analyses, as well as one sample for tritium and $\delta^{13}C$ analyses. Isotope analytical results for field duplicate samples are presented and compared in Table 1. The results of the internal re-analysis (*i.e.*, reproducibility checks) of samples submitted to the UW-EIL for stable isotope, tritium, and $\delta^{13}C$ analyses are provided in Table 2. The stable isotope and radioisotope data for groundwater, surface water and aufeis samples are tabulated in Table 3.

Field duplicate sample results were within 2.8 ‰ for $\delta^{2}H$ and 0.5 ‰ for $\delta^{18}O$ for samples submitted to BYU-LIG. Three duplicate pairs were characterized by a difference in $\delta^{2}H$ values (2.1 to 2.8 ‰) that slightly exceeded two times the precision (*i.e.*, 2.0 ‰), while two sample pairs had a difference in $\delta^{18}O$ values (0.44 and 0.48 ‰) slightly exceeding two times the precision (*i.e.*, 0.4 ‰).

In contrast, field duplicate results were within 0.71 ‰ for $\delta^{2}H$ and 0.18 ‰ for $\delta^{18}O$ (*i.e.*, within the precision of 0.8 ‰ for $\delta^{2}H$ and 0.2 ‰ for $\delta^{18}O$) for samples submitted to the UW-EIL. The internal replicate analyses conducted at the UW-EIL were within 1.36 ‰ for $\delta^{2}H$ and 0.37 ‰ for $\delta^{18}O$ (*i.e.*, within two times precisions of 0.8 and 0.2 ‰, respectively).

For tritium, $\delta^{13}C$, and radiocarbon analyses, duplicates samples were analyzed at the BYU-LIG and UW-EIL. The duplicate sample pair analyzed at BYU-LIG was characterized by results that were within 0.5 TU for ^{3}H (*i.e.*, less than two times the precision of 0.3 ‰); however, there were discrepancies of 1.2 ‰ for $\delta^{13}C$ values and 10.4 pMC for ^{14}C values, which are anomalously high relative to the precisions of 0.1 ‰ and 0.1 pMC, respectively. The cause of this difference is not known but it may involve CO_2 degassing following sampling (CO_2 degassing induces isotope fractionation) or post-sampling microbial oxidation of dissolved organic carbon. Following the initial sample analyses at BYU, improved sampling methods in 2019 included minimizing sample headspace and hold time, and addition of $ZnCl_2$ as an anti-microbial agent, which appear to have improved sample reproducibility for the latest analyses conducted at UW as $\delta^{13}C$ values were within 0.54 ‰ and ^{14}C data were within 0.15 pMC. Therefore, the 2019 radiocarbon analyses are given greater consideration when interpreting groundwater ages in this report.

Field duplicate sample results were within 1.3 TU for ^{3}H, 0.54 ‰ for $\delta^{13}C$, and 0.15 pMC for ^{14}C for the two duplicate pairs analyzed at the UW-EIL. Duplicate results for tritium were less than two times precision (*i.e.*, 1.6 TU), while ^{14}C results were within the precision of both sample results; only $\delta^{13}C$ values were slightly above two times precision (*i.e.*, 0.4 ‰). Internal replicate analyses conducted at the UW-EIL were within 0.39 ‰ for $\delta^{13}C$ (*i.e.*, within two times precision of 0.2 ‰), while the result and repeat analysis for tritium were both below the detection limit (< 0.8 TU).

Three samples analyzed for O and H stable isotopes and tritium at MW15-03WB (23-Sep-16), MW14-02A (5-Oct-17), and MW14-02B (5-Oct-17) showed results inconsistent with the larger dataset. The $\delta^{2}H$ and $\delta^{18}O$ values in these samples were substantially higher than those of all other samples collected at these locations, and outside the range of isotopic composition of precipitation measured at Dawson and Mayo (IAEA, 2020, Lapp, 2015). These analyses have been flagged as suspect. The source of error in these samples is uncertain but the internal laboratory replicate of the MW15-03WB (23-Sep-16) sample gave reproducible results. Regardless of the cause for these anomalous values, these samples were not considered in data interpretations made in this report.

Overall, the quality assurance and quality control (QA/QC) analysis of isotope samples indicates reliable stable isotope ($\delta^{2}H$, $\delta^{18}O$) and radioisotope (^{3}H, ^{14}C) results for the interpretation of groundwater provenance and groundwater age tracing. The relatively large number of sampling locations, synoptic sampling at many locations, in addition to the general consistency of the data between sampling events, has yielded a robust isotopic data set. Some early inconsistencies with 2014 and 2015 $\delta^{13}C$ and ^{14}C data existed which were addressed with improved sampling protocols in 2019 that yielded satisfactory QA/QC results.

Table 1:
Comparison of field duplicate sample isotope analyses

Primary Sample ID (#1)	Duplicate Sample ID (#2)	Sample Date	Lab	δ^2H (‰ VSMOW)			δ^{18}O (‰ VSMOW)			^{3}H (TU)			δ^{13}C (‰ VPDB)			^{14}C (pMC)		
				#1	#2	Difference	#1	#2	Difference	#1	#2	Difference	#1	#2	Difference	#1	#2	Difference
MW14-02B	F-DUP-1	28-Sep-2014	BYU-LIG	-169.9	-168.9	1.0	-21.00	-20.91	0.09	5.8	5.3	0.5	-4.6	-5.8	1.2	28.68	18.28	10.40
MW15-03AZ	MW15-21	16-Jun-2015	BYU-LIG	-169.0	-169.4	0.4	-21.81	-22.25	0.44	-	-	-	-	-	-	-	-	-
MW15-04WB	MW15-30WB	10-Jul-2015	BYU-LIG	-169.5	-172.3	2.8	-22.71	-22.38	0.34	-	-	-	-	-	-	-	-	-
MW15-02AZ	MW15-40AZ	11-Jul-2015	BYU-LIG	-169.8	-169.5	0.3	-22.17	-22.03	0.14	-	-	-	-	-	-	-	-	-
MW14-02A	MW14-100	04-Sep-2015	BYU-LIG	-174.2	-176.3	2.1	-22.30	-22.77	0.48	-	-	-	-	-	-	-	-	-
MW14-03B	MW14-200	06-Sep-2015	BYU-LIG	-165.0	-167.1	2.1	-21.71	-22.05	0.34	-	-	-	-	-	-	-	-	-
MW14-02A	BD1-Q1	28-Apr-2019	UW-EIL	-171.97	-172.67	0.71	-21.94	-21.98	0.04	-	-	-	-	-	-	-	-	-
MW14-05A	BD2-Q1	29-Apr-2019	UW-EIL	-170.21	-170.78	0.58	-22.06	-21.98	0.08	-	-	-	-	-	-	-	-	-
MW14-02B	BD1-Q2	13-Jun-2019	UW-EIL	-172.59	-172.21	0.38	-22.19	-22.35	0.16	-	-	-	-	-	-	-	-	-
MW15-02WB	BD2-Q2	19-Jun-2019	UW-EIL	-169.91	-170.00	0.09	-21.89	-21.99	0.09	-	-	-	-	-	-	-	-	-
MW14-03A	D-1	23-Aug-2019	UW-EIL	-165.85	-166.52	0.67	-21.69	-21.83	0.14	1.1	< 0.8	0.3 - 1.1	-3.12	-2.60	0.52	7.07	*insuf*	-
MW15-02WB	MW15-02WB-Dup	24-Aug-2019	UW-EIL	-170.42	-170.80	0.38	-21.83	-22.01	0.18	6.6	5.3	1.3	-8.08	-7.54	0.54	35.20	35.05	0.15

Notes:
BYU-LIG = Brigham Young University Laboratory of Isotope Geochemistry, UW-EIL = University of Waterloo-Environmental Isotope Laboratory
pMC = percent modern carbon, TU = tritium units, VPDB = Vienna Pee Dee Belemnite, VSMOW = Vienna Standard Mean Ocean Water
insuf = insufficient carbon for analysis in duplicate sample D-1 (23-Aug-2019)

2.1 red shading and text indicates that the difference between the primary sample and duplicate sample results is greater than 2 times the precision as referenced in Table 1 in the memorandum.

Table 2:
Comparison of internal laboratory re-analyses of isotope samples

Sample ID	Date	Lab#	$\delta^{18}O$ (‰ VSMOW)			$\delta^{2}H$ (‰ VSMOW)			^{3}H (TU)			$\delta^{13}C$ (‰ PDB)		
			Result	Repeat	Difference	Result	Repeat	Difference	Result	Repeat	Difference	Result	Repeat	Difference
MW14-02A	13-May-16	408399	-21.75	-21.76	0.00	-171.41	-172.28	0.87	-	-	-	-	-	-
MW14-02A	8-Jun-17	408403	-21.94	-21.63	0.31	-172.08	-171.70	0.38	-	-	-	-	-	-
MW14-02A	5-Oct-17	408404	-14.43	-14.43	0.00	-103.49	-103.57	0.08	-	-	-	-	-	-
MW14-02B	21-Apr-17	408408	-21.77	-21.87	0.11	-173.15	-173.44	0.29	-	-	-	-	-	-
MW14-02B	5-Oct-17	408410	-13.76	-14.13	0.37	-102.26	-102.24	0.02	-	-	-	-	-	-
MW14-03A	27-Apr-17	408413	-21.67	-21.80	0.13	-166.62	-167.63	1.01	-	-	-	-	-	-
MW14-03B	27-Apr-17	408419	-21.69	-21.60	0.10	-166.81	-166.24	0.56	-	-	-	-	-	-
MW14-05A	23-Sep-16	408424	-21.92	-22.01	0.08	-170.35	-170.36	0.01	-	-	-	-	-	-
MW14-05B	15-May-16	408428	-22.23	-22.12	0.11	-168.36	-169.72	1.36	-	-	-	-	-	-
MW14-05B	8-Oct-17	408433	-22.13	-22.17	0.04	-170.06	-169.28	0.78	-	-	-	-	-	-
MW15-01WB	8-Jun-17	408438	-21.86	-22.00	0.14	-167.90	-167.90	0.00	-	-	-	-	-	-
MW15-02AZ	8-Oct-17	408443	-21.99	-21.72	0.27	-168.35	-167.95	0.39	-	-	-	-	-	-
MW15-02WB	13-Jun-17	408448	-22.01	-22.01	0.00	-171.41	-171.40	0.00	-	-	-	-	-	-
MW15-03AZ	7-Oct-17	408453	-21.20	-21.27	0.07	-164.44	-164.71	0.27	-	-	-	-	-	-
MW15-03WB	23-Sep-16	408456	-12.52	-12.38	0.14	-88.94	-88.19	0.75	-	-	-	-	-	-
MW15-03WB	10-Jun-17	408458	-22.95	-22.90	0.05	-177.30	-176.87	0.42	-	-	-	-	-	-
MW15-04WB	11-Jun-17	408463	-22.35	-22.28	0.07	-172.85	-172.40	0.44	-	-	-	-	-	-
MW15-05WB	11-Jun-17	408468	-22.66	-22.54	0.12	-172.10	-171.30	0.80	-	-	-	-	-	-
MW15-06WB	24-Apr-17	408473	-22.25	-22.24	0.01	-170.49	-170.12	0.37	-	-	-	-	-	-
MW16-01WB	9-Jun-17	408478	-22.67	-22.77	0.10	-170.90	-170.84	0.06	-	-	-	-	-	-
MW14-03B	26-Jul-17	408483	-22.17	-22.34	0.16	-166.56	-166.73	0.17	-	-	-	-	-	-
MW15-03WB	25-Jul-17	408488	-23.25	-23.33	0.08	-179.74	-179.85	0.11	-	-	-	-	-	-
CC-1.0	02-Apr-16	408493	-22.69	-22.69	0.00	-173.94	-174.76	0.82	-	-	-	-	-	-
CC-1.5	19-Oct-17	408498	-21.82	-21.89	0.07	-168.14	-168.04	0.10	-	-	-	-	-	-
HC-5.0	3-Apr-16	408503	-22.36	-22.08	0.28	-174.11	-172.84	1.27	-	-	-	-	-	-
ML-1.0	27-Apr-17	408506	-21.39	-21.29	0.10	-165.22	-165.94	0.72	-	-	-	-	-	-
BD1-Q1	28-Apr-2019	428782	-21.94	-21.89	0.05	-171.97	-172.64	0.67	-	-	-	-	-	-
MW14-02A	28-Apr-2019	428786	-21.98	-22.09	0.11	-172.67	-172.72	0.05	-	-	-	-	-	-
MW14-05B	30-Apr-2019	428791	-22.15	-22.09	0.06	-170.51	-170.25	0.25	-	-	-	-	-	-
MW15-05WB	30-Apr-2019	428796	-22.21	-22.22	0.02	-170.24	-170.10	0.15	-	-	-	-	-	-
MW14-02A	13-Jun-2019	428801	-22.18	-21.95	0.23	-172.00	-170.91	1.09	-	-	-	-	-	-
MW14-05B	16-Jun-2019	428806	-22.30	-22.01	0.29	-169.63	-169.04	0.59	-	-	-	-	-	-
MW15-05WB	19-Jun-2019	428811	-22.24	-22.28	0.04	-171.53	-170.92	0.61	-	-	-	-	-	-
MW14-02A	22-Aug-2019	428816	-22.12	-22.20	0.08	-172.70	-172.77	0.07	7.2	-	-	-7.24	-	-
MW14-03A	23-Aug-2019	428818	-21.69	-21.69	0.00	-165.85	-166.56	0.71	1.1	-	-	-3.12	-	-
MW14-05A	24-Aug-2019	428820	-22.11	-	-	-170.19	-	-	< 0.8	< 0.8	-	-12.10	-	-
MW15-01WB	22-Aug-2019	428822	-21.65	-21.59	0.06	-168.21	-167.92	0.29	< 0.8	-	-	-3.71	-	-
MW15-04WB	22-Aug-2019	428825	-21.91	-	-	-170.66	-	-	6	-	-	-7.55	-7.16	0.39
MW15-06WB	25-Aug-2019	428827	-22.08	-22.19	0.11	-170.79	-170.79	0.00	1.0	-	-	-8.95	-	-
MW15-03AZ	23-Aug-2019	428829	-20.51	-20.57	0.06	-161.02	-161.03	0.00	7.9	-	-		-	-

Notes:
TU = tritium units, PDB = Pee Dee Belemnite, VSMOW = Vienna Standard Mean Ocean Water

Table 3:
Summary of Stable Isotope and Radioisotope Data

Station ID	Sample ID	Sample Date	Matrix	Sample Class	Lab	Lab ID	δ^2H	$\delta^{18}O$	$\delta^{13}C$	^3H	^{14}C	^{14}C error	^{14}C age [1]
Units	-	-	-	-	-	-	(‰ VSMOW)	(‰ VSMOW)	(‰ VPDB)	(TU)	(pMC)	(±1 σ)	Years
CC-1.0	CC-1.0	03-Apr-2015	Aufeis	PS	BYU-LIG	11943	-165.4	-20.96	-9.5	-	45.87	0.14	1,595
HC-2.5	HC-2.5	03-Apr-2015	Aufeis	PS	BYU-LIG	11944	-169.7	-21.68	-9.1	-	53.81	0.16	-70
HC-5.0	HC-5.0	03-Apr-2015	Aufeis	PS	BYU-LIG	11945	-169.8	-21.85	-10.8	-	-	-	-
CC-1.0	CC-1.0	23-Oct-2014	SW	PS	BYU-LIG	11636	-169.5	-21.15	-6.5	6.0	38.46	0.12	23
CC-1.0	CC-1.0	27-Jun-2015	SW	PS	BYU-LIG	12383	-162.0	-20.59	-	9.2	-	-	-
CC-1.0	CC-1.0	28-Oct-2015	SW	PS	BYU-LIG	12389	-168.3	-21.91	-	6.4	-	-	-
CC-1.0	CC-1.0	02-Apr-2016	SW	PS	UW-EIL	408493	-173.94	-22.69	-	-	-	-	-
CC-1.0	CC-1.0	26-Apr-2017	SW	PS	UW-EIL	408494	-172.22	-22.22	-	5.4	-	-	-
CC-1.0	CC-1.0	19-Oct-2017	SW	PS	UW-EIL	408495	-171.69	-22.30	-	6.7	-	-	-
CC-1.5	CC-1.5	25-Jun-2015	SW	PS	BYU-LIG	12384	-151.7	-19.83	-	-	-	-	-
CC-1.5	CC-1.5	28-Oct-2015	SW	PS	BYU-LIG	12390	-171.7	-21.92	-	8.0	-	-	-
CC-1.5	CC-1.5	02-Apr-2016	SW	PS	UW-EIL	408496	-172.92	-22.49	-	-	-	-	-
CC-1.5	CC-1.5	26-Apr-2017	SW	PS	UW-EIL	408497	-172.75	-22.37	-	6.5	-	-	-
CC-1.5	CC-1.5	19-Oct-2017	SW	PS	UW-EIL	408498	-168.14	-21.82	-	7.7	-	-	-
CC-5.5	CC-5.5	25-Jun-2015	SW	PS	BYU-LIG	12385	-150.6	-19.56	-	-	-	-	-
CC-5.5	CC-5.5	28-Oct-2015	SW	PS	BYU-LIG	12391	-168.5	-21.66	-	9.4	-	-	-
CC-5.5	CC-5.5	20-Oct-2017	SW	PS	UW-EIL	408499	-159.05	-20.71	-	10.9	-	-	-
CC-6.0	CC-6.0	24-Oct-2014	SW	PS	BYU-LIG	11635	-166.0	-20.76	-	7.5	-	-	-
HC-2.5	HC-2.5	24-Oct-2014	SW	PS	BYU-LIG	11637	-169.5	-21.01	-7.0	6.7	71.34	0.20	-4,497
HC-2.5	HC-2.5	26-Jun-2015	SW	PS	BYU-LIG	12386	-165.5	-21.70	-	6.5	-	-	-
HC-2.5	HC-2.5	30-Oct-2015	SW	PS	BYU-LIG	12392	-170.3	-21.65	-	-	-	-	-
HC-2.5	HC-2.5	03-Apr-2016	SW	PS	UW-EIL	408500	-172.04	-22.19	-	-	-	-	-
HC-2.5	HC-2.5	27-Apr-2017	SW	PS	UW-EIL	408501	-171.90	-22.19	-	5.6	-	-	-
HC-2.5	HC-2.5	19-Oct-2017	SW	PS	UW-EIL	408502	-165.85	-21.52	-	7.5	-	-	-
HC-2.5	HC-2.5	03-May-2019	GW	PS	UW-EIL	428785	-170.54	-21.68	-	-	-	-	-
HC@MW15-03	HC@MW15-03	03-May-2019	GW	PS	UW-EIL	428784	-170.51	-21.59	-	-	-	-	-
HC-5.0	HC-5.0	26-Jun-2015	SW	PS	BYU-LIG	12387	-167.6	-21.67	-	6.6	-	-	-
HC-5.0	HC-5.0	30-Oct-2015	SW	PS	BYU-LIG	12393	-166.6	-21.62	-	-	-	-	-
HC-5.0	HC-5.0	03-Apr-2016	SW	PS	UW-EIL	408503	-174.11	-22.36	-	-	-	-	-
HC-5.0	HC-5.0	27-Apr-2017	SW	PS	UW-EIL	408504	-172.11	-22.14	-	4.9	-	-	-
HC-5.0	HC-5.0	20-Oct-2017	SW	PS	UW-EIL	408505	-166.59	-21.44	-	6.6	-	-	-
SW14-01	SW14-01	10-Oct-2014	SW	PS	BYU-LIG	11634	-165.1	-20.66	-	8.0	-	-	-
YT24-0.1	ML-1.0	24-Oct-2014	SW	PS	BYU-LIG	11638	-168.9	-21.12	-	8.4	-	-	-
YT24-0.1	YT-24	26-Jun-2015	SW	PS	BYU-LIG	12388	-168.5	-22.33	-	-	-	-	-
YT24-0.1	YT-24	30-Oct-2015	SW	PS	BYU-LIG	12394	-167.4	-21.17	-	-	-	-	-
YT24-0.1	ML-1.0	27-Apr-2017	SW	PS	UW-EIL	408506	-165.22	-21.39	-	1.2	-	-	-
YT24-0.1	ML-1.0	21-Oct-2017	SW	PS	UW-EIL	408507	-169.27	-21.83	-	6.3	-	-	-
MW14-02A	MW14-02A	28-Sep-2014	GW	PS	BYU-LIG	11627	-168.2	-21.05	-5.9	7.4	33.10	0.11	498
MW14-02A	MW14-02A	12-Jun-2015	GW	PS	BYU-LIG	12342	-170.7	-22.35	-	-	-	-	-
MW14-02A	MW14-02A	16-Jul-2015	GW	PS	BYU-LIG	12355	-169.8	-22.07	-	-	-	-	-
MW14-02A	MW14-02A	04-Sep-2015	GW	PS	BYU-LIG	12369	-174.2	-22.30	-	-	-	-	-
MW14-02A	MW14-100	04-Sep-2015	GW	DUP	BYU-LIG	12381	-176.3	-22.77	-	-	-	-	-
MW14-02A	MW14-02A	13-May-2016	GW	PS	UW-EIL	408399	-171.41	-21.75	-	-	-	-	-
MW14-02A	MW14-02A	17-Jul-2016	GW	PS	UW-EIL	408400	-172.60	-21.98	-	-	-	-	-
MW14-02A	MW14-02A	25-Sep-2016	GW	PS	UW-EIL	408401	-172.46	-21.83	-	-	-	-	-
MW14-02A	MW14-02A	21-Apr-2017	GW	PS	UW-EIL	408402	-171.58	-21.59	-	6.5	-	-	-
MW14-02A	MW14-02A	08-Jun-2017	GW	PS	UW-EIL	408403	-172.08	-21.94	-	-	-	-	-
MW14-02A	MW14-02A	05-Oct-2017	GW	PS	UW-EIL	408404	-103.49	-14.43	-	1.9	-	-	-
MW14-02A	BD1-Q1	28-Apr-2019	GW	DUP	UW-EIL	428782	-171.97	-21.94	-	-	-	-	-
MW14-02A	MW14-02A	28-Apr-2019	GW	PS	UW-EIL	428786	-172.67	-21.98	-	-	-	-	-
MW14-02A	MW14-02A	13-Jun-2019	GW	PS	UW-EIL	428801	-172.00	-22.18	-	-	-	-	-
MW14-02A	MW14-02A	22-Aug-2019	GW	PS	UW-EIL	428816	-172.70	-22.12	-7.20	7.2	15.54	0.12	8,367
MW14-02A	MW14-02A	28-Jul-2017	GW	PS	UW-EIL	408480	-171.76	-22.47	-	-	-	-	-
MW14-02B	MW14-02B	28-Sep-2014	GW	PS	BYU-LIG	11628	-169.9	-21.00	-4.6	5.8	28.68	0.10	-270
MW14-02B	F-DUP-1	28-Sep-2014	GW	DUP	BYU-LIG	11633	-168.9	-20.91	-5.8	5.3	18.28	0.07	5,271
MW14-02B	MW14-02B	12-Jun-2015	GW	PS	BYU-LIG	12343	-170.5	-22.74	-	-	-	-	-
MW14-02B	MW14-02B	16-Jul-2015	GW	PS	BYU-LIG	12356	-170.7	-22.22	-	-	-	-	-
MW14-02B	MW14-02B	04-Sep-2015	GW	PS	BYU-LIG	12370	-172.9	-22.48	-5.9	7.1	16.24	0.07	6,424
MW14-02B	MW14-02B	13-May-2016	GW	PS	UW-EIL	408405	-172.67	-21.91	-	-	-	-	-
MW14-02B	MW14-02B	17-Jul-2016	GW	PS	UW-EIL	408406	-173.55	-21.95	-	-	-	-	-
MW14-02B	MW14-02B	25-Sep-2016	GW	PS	UW-EIL	408407	-173.71	-21.65	-	-	-	-	-
MW14-02B	MW14-02B	21-Apr-2017	GW	PS	UW-EIL	408408	-173.15	-21.77	-	6.9	-	-	-
MW14-02B	MW14-02B	08-Jun-2017	GW	PS	UW-EIL	408409	-173.83	-21.90	-	-	-	-	-
MW14-02B	MW14-02B	28-Jul-2017	GW	PS	UW-EIL	408481	-171.96	-22.54	-	-	-	-	-
MW14-02B	MW14-02B	05-Oct-2017	GW	PS	UW-EIL	408410	-102.26	-13.76	-	3.6	-	-	-
MW14-02B	MW14-02B	28-Apr-2019	GW	PS	UW-EIL	428787	-173.11	-22.25	-	-	-	-	-
MW14-02B	BD1-Q2	13-Jun-2019	GW	DUP	UW-EIL	428799	-172.21	-22.35	-	-	-	-	-
MW14-02B	MW14-02B	13-Jun-2019	GW	PS	UW-EIL	428802	-172.59	-22.19	-	-	-	-	-
MW14-02B	MW14-02B	22-Aug-2019	GW	PS	UW-EIL	428817	-173.42	-22.11	-5.48	5.4	11.30	0.10	8,801
MW14-03A	MW14-03A	12-Oct-2014	GW	PS	BYU-LIG	11629	-166.1	-21.60	-12.1	-	-	-	-
MW14-03A	MW14-03A	22-Jun-2015	GW	PS	BYU-LIG	12344	-165.3	-22.00	-	-	-	-	-
MW14-03A	MW14-03A	12-Jul-2015	GW	PS	BYU-LIG	12357	-172.6	-21.96	-3.8	1.3	15.82	0.07	3,148
MW14-03A	MW14-03A	06-Sep-2015	GW	PS	BYU-LIG	12371	-169.0	-21.97	-5.0	1.1	17.89	0.08	4,220
MW14-03A	MW14-03A	16-May-2016	GW	PS	UW-EIL	408411	-167.07	-21.60	-	-	-	-	-
MW14-03A	MW14-03A	14-Jul-2016	GW	PS	UW-EIL	408412	-167.52	-21.64	-	-	-	-	-
MW14-03A	MW14-03A	27-Apr-2017	GW	PS	UW-EIL	408413	-166.62	-21.67	-	<0.8	-	-	-
MW14-03A	MW14-03A	09-Jun-2017	GW	PS	UW-EIL	408414	-167.07	-21.67	-	-	-	-	-
MW14-03A	MW14-03A	26-Jul-2017	GW	PS	UW-EIL	408482	-166.80	-22.24	-	-	-	-	-
MW14-03A	MW14-03A	06-Oct-2017	GW	PS	UW-EIL	408415	-167.45	-21.72	-	<0.8	-	-	-

Station ID	Sample ID	Sample Date	Matrix	Sample Class	Lab	Lab ID	δ^2H	$\delta^{18}O$	$\delta^{13}C$	^3H	^{14}C	^{14}C error	^{14}C age [1]
Units	-	-	-	-	-	-	(‰ VSMOW)	(‰ VSMOW)	(‰ VPDB)	(TU)	(pMC)	(±1 σ)	Years
MW14-03A	MW14-03A	27-Apr-2019	GW	PS	UW-EIL	428788	-166.44	-21.75	-	-	-	-	-
MW14-03A	MW14-03A	14-Jun-2019	GW	PS	UW-EIL	428803	-165.50	-21.57	-	-	-	-	-
MW14-03A	D-1	23-Aug-2019	GW	DUP	UW-EIL	428815	-166.52	-21.83	-2.60	< 0.8	-	-	-
MW14-03A	MW14-03A	23-Aug-2019	GW	PS	UW-EIL	428818	-165.85	-21.69	-3.12	1.1	7.070	0.070	8,402
MW14-03B	MW14-03B	06-Oct-2014	GW	PS	BYU-LIG	11630	-167.9	-21.74	-2.4	-	-	-	-
MW14-03B	MW14-03B	22-Jun-2015	GW	PS	BYU-LIG	12345	-165.7	-21.54	-	-	-	-	-
MW14-03B	MW14-03B	12-Jul-2015	GW	PS	BYU-LIG	12358	-166.8	-21.91	-	-	-	-	-
MW14-03B	MW14-200	06-Sep-2015	GW	DUP	BYU-LIG	12382	-167.1	-22.05	-	-	-	-	-
MW14-03B	MW14-03B	06-Sep-2015	GW	PS	BYU-LIG	12372	-165.0	-21.71	-	-	-	-	-
MW14-03B	MW14-03B	16-May-2016	GW	PS	UW-EIL	408416	-167.02	-21.58	-	-	-	-	-
MW14-03B	MW14-03B	14-Jul-2016	GW	PS	UW-EIL	408417	-167.15	-21.63	-	-	-	-	-
MW14-03B	MW14-03B	27-Apr-2017	GW	PS	UW-EIL	408419	-166.81	-21.69	-	<0.8	-	-	-
MW14-03B	MW14-03B	09-Jun-2017	GW	PS	UW-EIL	408420	-166.69	-21.54	-	-	-	-	-
MW14-03B	MW14-03B	26-Jul-2017	GW	PS	UW-EIL	408483	-166.56	-22.17	-	-	-	-	-
MW14-03B	MW14-03B	06-Oct-2017	GW	PS	UW-EIL	408421	-167.39	-21.68	-	0.9	-	-	-
MW14-03B	MW14-03B	27-Apr-2019	GW	PS	UW-EIL	428789	-166.60	-21.65	-	-	-	-	-
MW14-03B	MW14-03B	14-Jun-2019	GW	PS	UW-EIL	428804	-166.50	-21.80	-	-	-	-	-
MW14-03B	MW14-03B	23-Aug-2019	GW	PS	UW-EIL	428819	-166.75	-21.70	-2.16	1.2	3.746	0.049	10,822
MW14-05A	MW14-05A	02-Oct-2014	GW	PS	BYU-LIG	11631	-168.9	-22.03	-10.9	-	-	-	-
MW14-05A	MW14-05A	23-Jun-2015	GW	PS	BYU-LIG	12346	-170.1	-22.22	-	-	-	-	-
MW14-05A	MW14-05A	13-Jul-2015	GW	PS	BYU-LIG	12359	-171.4	-22.45	-	-	-	-	-
MW14-05A	MW14-05A	07-Sep-2015	GW	PS	BYU-LIG	12373	-168.7	-22.35	-	-	-	-	-
MW14-05A	MW14-05A	14-May-2016	GW	PS	UW-EIL	408422	-170.56	-22.04	-	-	-	-	-
MW14-05A	MW14-05A	16-Jul-2016	GW	PS	UW-EIL	408423	-170.34	-22.05	-	-	-	-	-
MW14-05A	MW14-05A	23-Sep-2016	GW	PS	UW-EIL	408424	-170.35	-21.92	-	-	-	-	-
MW14-05A	MW14-05A	28-Apr-2017	GW	PS	UW-EIL	408425	-170.61	-21.91	-	<0.8	-	-	-
MW14-05A	MW14-05A	10-Jun-2017	GW	PS	UW-EIL	408426	-170.70	-21.83	-	-	-	-	-
MW14-05A	MW14-05A	25-Jul-2017	GW	PS	UW-EIL	408484	-168.24	-22.48	-	-	-	-	-
MW14-05A	MW14-05A	08-Oct-2017	GW	PS	UW-EIL	408427	-170.49	-21.72	-	<0.8	-	-	-
MW14-05A	BD2-Q1	29-Apr-2019	GW	DUP	UW-EIL	428783	-170.78	-21.98	-	-	-	-	-
MW14-05A	MW14-05A	29-Apr-2019	GW	PS	UW-EIL	428790	-170.21	-22.06	-	-	-	-	-
MW14-05A	MW14-05A	15-Jun-2019	GW	PS	UW-EIL	428805	-169.91	-22.24	-	-	-	-	-
MW14-05A	MW14-05A	24-Aug-2019	GW	PS	UW-EIL	428820	-170.19	-22.11	-12.10	< 0.8	32.25	0.15	6,457
MW14-05B	MW14-05B	03-Oct-2014	GW	PS	BYU-LIG	11632	-169.0	-22.09	-12.4	-	-	-	-
MW14-05B	MW14-05B	15-May-2016	GW	PS	UW-EIL	408428	-168.36	-22.23	-	-	-	-	-
MW14-05B	MW14-05B	16-Jul-2016	GW	PS	UW-EIL	408429	-168.80	-22.16	-	-	-	-	-
MW14-05B	MW14-05B	23-Sep-2016	GW	PS	UW-EIL	408430	-169.65	-22.21	-	-	-	-	-
MW14-05B	MW14-05B	29-Apr-2017	GW	PS	UW-EIL	408431	-169.96	-22.25	-	<0.8	-	-	-
MW14-05B	MW14-05B	11-Jun-2017	GW	PS	UW-EIL	408432	-168.26	-21.69	-	-	-	-	-
MW14-05B	MW14-05B	26-Jul-2017	GW	PS	UW-EIL	408485	-169.63	-22.70	-	-	-	-	-
MW14-05B	MW14-05B	08-Oct-2017	GW	PS	UW-EIL	408433	-170.06	-22.13	-	<0.8	-	-	-
MW14-05B	MW14-05B	30-Apr-2019	GW	PS	UW-EIL	428791	-170.51	-22.15	-	-	-	-	-
MW14-05B	MW14-05B	16-Jun-2019	GW	PS	UW-EIL	428806	-169.63	-22.30	-	-	-	-	-
MW14-05B	MW14-05B	25-Aug-2019	GW	PS	UW-EIL	428821	-170.77	-22.14	-11.80	< 0.8	19.37	0.11	10,467
MW15-01WB	MW15-01WB /BH8-WB	07-Jun-2015	GW	PS	BYU-LIG	12347	-166.9	-21.98	-	-	-	-	-
MW15-01WB	MW15-01WB	08-Jul-2015	GW	PS	BYU-LIG	12360	-169.9	-21.90	-	-	-	-	-
MW15-01WB	MW15-01WB	03-Sep-2015	GW	PS	BYU-LIG	12374	-166.8	-21.97	-	-	-	-	-
MW15-01WB	MW15-01WB	15-May-2016	GW	PS	UW-EIL	408434	-167.06	-21.50	-	-	-	-	-
MW15-01WB	MW15-01WB	14-Jul-2016	GW	PS	UW-EIL	408435	-167.08	-21.57	-	-	-	-	-
MW15-01WB	MW15-01WB	22-Sep-2016	GW	PS	UW-EIL	408436	-166.67	-21.56	-	-	-	-	-
MW15-01WB	MW15-01WB	22-Apr-2017	GW	PS	UW-EIL	408437	-166.42	-21.42	-	<0.8	-	-	-
MW15-01WB	MW15-01WB	08-Jun-2017	GW	PS	UW-EIL	408438	-167.90	-21.86	-	-	-	-	-
MW15-01WB	MW15-01WB	06-Oct-2017	GW	PS	UW-EIL	408439	-167.22	-21.84	-	<0.8	-	-	-
MW15-01WB	MW15-01WB	04-May-2019	GW	PS	UW-EIL	428792	-167.91	-21.69	-	-	-	-	-
MW15-01WB	MW15-01WB	18-Jun-2019	GW	PS	UW-EIL	428807	-167.39	-21.65	-	-	-	-	-
MW15-01WB	MW15-01WB	22-Aug-2019	GW	PS	UW-EIL	428822	-168.21	-21.65	-3.71	< 0.8	1.503	0.040	22,444
MW15-01WB	MW15-01WB	24-Jul-2017	GW	PS	UW-EIL	408486	-168.39	-21.82	-	-	-	-	-
MW15-02AZ	MW15-02AZ /BH10-AZ	31-May-2015	GW	PS	BYU-LIG	12348	-170.0	-22.67	-	-	-	-	-
MW15-02AZ	MW15-02AZ	11-Jul-2015	GW	PS	BYU-LIG	12361	-169.8	-22.17	-	7.4	-	-	-
MW15-02AZ	MW15-40AZ	11-Jul-2015	GW	DUP	BYU-LIG	12367	-169.5	-22.03	-	-	-	-	-
MW15-02AZ	MW15-02AZ	07-Sep-2015	GW	PS	BYU-LIG	12375	-169.4	-22.17	-	9.4	-	-	-
MW15-02AZ	MW15-02AZ	17-May-2016	GW	PS	UW-EIL	408440	-171.50	-22.10	-	-	-	-	-
MW15-02AZ	MW15-02AZ	19-Jul-2016	GW	PS	UW-EIL	408441	-171.49	-22.14	-	-	-	-	-
MW15-02AZ	MW15-02AZ	25-Sep-2016	GW	PS	UW-EIL	408442	-171.20	-22.10	-	-	-	-	-
MW15-02AZ	MW15-02AZ	08-Oct-2017	GW	PS	UW-EIL	408443	-168.35	-21.99	-	8.3	-	-	-
MW15-02WB	MW15-02WB /BH10-WB	01-Jun-2015	GW	PS	BYU-LIG	12349	-170.5	-22.67	-	-	-	-	-
MW15-02WB	MW15-02WB	11-Jul-2015	GW	PS	BYU-LIG	12362	-175.9	-22.74	-6.7	7.1	34.19	0.12	1,189
MW15-02WB	MW15-02WB	07-Sep-2015	GW	PS	BYU-LIG	12376	-172.0	-22.38	-	6.7	-	-	-
MW15-02WB	MW15-02WB	18-May-2016	GW	PS	UW-EIL	408444	-171.29	-22.24	-	-	-	-	-
MW15-02WB	MW15-02WB	19-Jul-2016	GW	PS	UW-EIL	408445	-170.93	-22.31	-	-	-	-	-
MW15-02WB	MW15-02WB	25-Sep-2016	GW	PS	UW-EIL	408446	-171.24	-22.21	-	-	-	-	-
MW15-02WB	MW15-02WB	25-Apr-2017	GW	PS	UW-EIL	408447	-171.34	-22.08	-	5.3	-	-	-
MW15-02WB	MW15-02WB	13-Jun-2017	GW	PS	UW-EIL	408448	-171.41	-22.01	-	-	-	-	-
MW15-02WB	MW15-02WB	28-Jul-2017	GW	PS	UW-EIL	408487	-173.24	-22.37	-	-	-	-	-
MW15-02WB	MW15-02WB	08-Oct-2017	GW	PS	UW-EIL	408449	-170.48	-21.84	-	5.9	-	-	-
MW15-02WB	MW15-02WB	29-Apr-2019	GW	PS	UW-EIL	428793	-170.75	-22.02	-	-	-	-	-
MW15-02WB	BD2-Q2	19-Jun-2019	GW	DUP	UW-EIL	428800	-170.00	-21.99	-	-	-	-	-
MW15-02WB	MW15-02WB	19-Jun-2019	GW	PS	UW-EIL	428808	-169.91	-21.89	-	-	-	-	-
MW15-02WB	MW15-02WB-Dup	24-Aug-2019	GW	DUP	UW-EIL	428814	-170.80	-22.01	-7.54	5.3	35.05	0.18	

Station ID	Sample ID	Sample Date	Matrix	Sample Class	Lab	Lab ID	$\delta^{2}H$	$\delta^{18}O$	$\delta^{13}C$	^{3}H	^{14}C	^{14}C error	^{14}C age [1]
Units	-	-	-	-	-	-	(‰ VSMOW)	(‰ VSMOW)	(‰ VPDB)	(TU)	(pMC)	(±1 σ)	Years
MW15-02WB	MW15-02WB	24-Aug-2019	GW	PS	UW-EIL	428823	-170.42	-21.83	-8.08	6.6	35.20	0.26	2,489
MW15-03AZ	MW15-03AZ	16-Jun-2015	GW	PS	BYU-LIG	12350	-169.0	-21.81	-	7.1	-	-	-
MW15-03AZ	MW15-21	16-Jun-2015	GW	DUP	BYU-LIG	12354	-169.4	-22.25	-	-	-	-	-
MW15-03AZ	MW15-03AZ	09-Jul-2015	GW	PS	BYU-LIG	12363	-168.3	-21.65	-	-	-	-	-
MW15-03AZ	MW15-03AZ	04-Sep-2015	GW	PS	BYU-LIG	12377	-163.0	-21.22	-	8.3	-	-	-
MW15-03AZ	MW15-03AZ	16-May-2016	GW	PS	UW-EIL	408450	-176.77	-22.78	-	-	-	-	-
MW15-03AZ	MW15-03AZ	16-Jul-2016	GW	PS	UW-EIL	408451	-169.81	-21.88	-	-	-	-	-
MW15-03AZ	MW15-03AZ	23-Sep-2016	GW	PS	UW-EIL	408452	-167.31	-21.51	-	-	-	-	-
MW15-03AZ	MW15-03AZ	07-Oct-2017	GW	PS	UW-EIL	408453	-164.44	-21.20	-	8.0	-	-	-
MW15-03AZ	MW15-03AZ	23-Aug-2019	GW	PS	UW-EIL	428829	-161.02	-20.51	-	7.9	-	-	-
MW15-03WB	MW15-03WB	16-Jun-2015	GW	PS	BYU-LIG	12351	-175.6	-23.35	-10.9	0.6	16.77	0.07	11,042
MW15-03WB	MW15-03WB	09-Jul-2015	GW	PS	BYU-LIG	12364	-177.4	-23.25	-	-	-	-	-
MW15-03WB	MW15-03WB	04-Sep-2015	GW	PS	BYU-LIG	12378	-176.2	-23.36	-8.2	0.9	11.11	0.07	12,138
MW15-03WB	MW15-03WB	16-May-2016	GW	PS	UW-EIL	408454	-175.38	-22.55	-	-	-	-	-
MW15-03WB	MW15-03WB	16-Jul-2016	GW	PS	UW-EIL	408455	-177.63	-22.86	-	-	-	-	-
MW15-03WB	MW15-03WB	23-Sep-2016	GW	PS	UW-EIL	408456	-88.94	-12.52	-	-	-	-	-
MW15-03WB	MW15-03WB	23-Apr-2017	GW	PS	UW-EIL	408457	-177.21	-22.83	-	<0.8	-	-	-
MW15-03WB	MW15-03WB	10-Jun-2017	GW	PS	UW-EIL	408458	-177.30	-22.95	-	-	-	-	-
MW15-03WB	MW15-03WB	25-Jul-2017	GW	PS	UW-EIL	408488	-179.74	-23.25	-	-	-	-	-
MW15-03WB	MW15-03WB	07-Oct-2017	GW	PS	UW-EIL	408459	-177.93	-22.99	-	<0.8	-	-	-
MW15-03WB	MW15-03WB	03-May-2019	GW	PS	UW-EIL	428794	-175.90	-22.62	-	-	-	-	-
MW15-03WB	MW15-03WB	18-Jun-2019	GW	PS	UW-EIL	428809	-177.85	-22.95	-	-	-	-	-
MW15-03WB	MW15-03WB	23-Aug-2019	GW	PS	UW-EIL	428824	-176.61	-22.65	-6.97	< 0.8	8.012	0.087	13,541
MW15-04WB	MW15-04WB	14-Jun-2015	GW	PS	BYU-LIG	12352	-173.7	-22.38	-	7.1	-	-	-
MW15-04WB	MW15-04WB	10-Jul-2015	GW	PS	BYU-LIG	12365	-169.5	-22.71	-	-	-	-	-
MW15-04WB	MW15-30WB	10-Jul-2015	GW	DUP	BYU-LIG	12368	-172.3	-22.38	-	-	-	-	-
MW15-04WB	MW15-04WB	05-Sep-2015	GW	PS	BYU-LIG	12379	-168.6	-21.92	-7.1	6.6	23.91	0.10	4,698
MW15-04WB	MW15-04WB	15-Jul-2016	GW	PS	UW-EIL	408460	-172.47	-22.16	-	-	-	-	-
MW15-04WB	MW15-04WB	24-Sep-2016	GW	PS	UW-EIL	408461	-172.70	-22.19	-	-	-	-	-
MW15-04WB	MW15-04WB	23-Apr-2017	GW	PS	UW-EIL	408462	-171.98	-22.12	-	5.9	-	-	-
MW15-04WB	MW15-04WB	11-Jun-2017	GW	PS	UW-EIL	408463	-172.85	-22.35	-	-	-	-	-
MW15-04WB	MW15-04WB	26-Jul-2017	GW	PS	UW-EIL	408489	-173.93	-22.51	-	-	-	-	-
MW15-04WB	MW15-04WB	05-Oct-2017	GW	PS	UW-EIL	408464	-172.44	-22.32	-	5.1	-	-	-
MW15-04WB	MW15-04WB	03-May-2019	GW	PS	UW-EIL	428795	-169.61	-21.81	-	-	-	-	-
MW15-04WB	MW15-04WB	17-Jun-2019	GW	PS	UW-EIL	428810	-170.39	-21.77	-	-	-	-	-
MW15-04WB	MW15-04WB	22-Aug-2019	GW	PS	UW-EIL	428825	-170.66	-21.91	-7.55	6	19.55	0.14	6,806
MW15-05WB	MW15-05WB	18-Jun-2015	GW	PS	BYU-LIG	12353	-169.3	-21.93	-	-	-	-	-
MW15-05WB	MW15-05WB	10-Jul-2015	GW	PS	BYU-LIG	12366	-170.6	-22.38	-	-	-	-	-
MW15-05WB	MW15-05WB	06-Sep-2015	GW	PS	BYU-LIG	12380	-171.6	-22.62	-	-	-	-	-
MW15-05WB	MW15-05WB	15-May-2016	GW	PS	UW-EIL	408465	-172.11	-22.50	-	-	-	-	-
MW15-05WB	MW15-05WB	27-Sep-2016	GW	PS	UW-EIL	408466	-170.10	-22.22	-	-	-	-	-
MW15-05WB	MW15-05WB	21-Apr-2017	GW	PS	UW-EIL	408467	-172.15	-22.56	-	<0.8	-	-	-
MW15-05WB	MW15-05WB	11-Jun-2017	GW	PS	UW-EIL	408468	-172.10	-22.66	-	-	-	-	-
MW15-05WB	MW15-05WB	27-Jul-2017	GW	PS	UW-EIL	408490	-173.97	-22.85	-	-	-	-	-
MW15-05WB	MW15-05WB	07-Oct-2017	GW	PS	UW-EIL	408469	-169.88	-22.48	-	<0.8	-	-	-
MW15-05WB	MW15-05WB	30-Apr-2019	GW	PS	UW-EIL	428796	-170.24	-22.21	-	-	-	-	-
MW15-05WB	MW15-05WB	19-Jun-2019	GW	PS	UW-EIL	428811	-171.53	-22.24	-	-	-	-	-
MW15-05WB	MW15-05WB	23-Aug-2019	GW	PS	UW-EIL	428826	-171.37	-22.27	-7.01	< 0.8	10.61	0.10	11,265
MW15-06WB	MW15-06WB	17-May-2016	GW	PS	UW-EIL	408470	-170.00	-22.20	-	-	-	-	-
MW15-06WB	MW15-06WB	18-Jul-2016	GW	PS	UW-EIL	408471	-170.72	-22.29	-	-	-	-	-
MW15-06WB	MW15-06WB	26-Sep-2016	GW	PS	UW-EIL	408472	-170.01	-22.09	-	-	-	-	-
MW15-06WB	MW15-06WB	24-Apr-2017	GW	PS	UW-EIL	408473	-170.49	-22.25	-	<0.8	-	-	-
MW15-06WB	MW15-06WB	12-Jun-2017	GW	PS	UW-EIL	408474	-170.62	-22.27	-	-	-	-	-
MW15-06WB	MW15-06WB	29-Jul-2017	GW	PS	UW-EIL	408491	-172.83	-22.53	-	-	-	-	-
MW15-06WB	MW15-06WB	09-Oct-2017	GW	PS	UW-EIL	408475	-170.84	-22.31	-	<0.8	-	-	-
MW15-06WB	MW15-06WB	02-May-2019	GW	PS	UW-EIL	428797	-168.72	-22.04	-	-	-	-	-
MW15-06WB	MW15-06WB	20-Jun-2019	GW	PS	UW-EIL	428812	-170.85	-22.29	-	-	-	-	-
MW15-06WB	MW15-06WB	25-Aug-2019	GW	PS	UW-EIL	428827	-170.79	-22.08	-8.95	1.0	16.99	0.12	9,326
MW16-01WB	MW16-01WB	04-Oct-2016	GW	PS	UW-EIL	408476	-170.32	-22.49	-	-	-	-	-
MW16-01WB	MW16-01WB	20-Apr-2017	GW	PS	UW-EIL	408477	-170.82	-22.64	-	<0.8	-	-	-
MW16-01WB	MW16-01WB	09-Jun-2017	GW	PS	UW-EIL	408478	-170.90	-22.67	-	-	-	-	-
MW16-01WB	MW16-01WB	27-Jul-2017	GW	PS	UW-EIL	408492	-173.16	-22.76	-	-	-	-	-
MW16-01WB	MW16-01WB	06-Oct-2017	GW	PS	UW-EIL	408479	-171.06	-22.63	-	<0.8	-	-	-
MW16-01WB	MW16-01WB	01-May-2019	GW	PS	UW-EIL	428798	-170.21	-22.40	-	-	-	-	-
MW16-01WB	MW16-01WB	17-Jun-2019	GW	PS	UW-EIL	428813	-171.26	-22.48	-	-	-	-	-
MW16-01WB	MW16-01WB	21-Aug-2019	GW	PS	UW-EIL	428828	-171.29	-22.42	-5.33	< 0.8	9.26	0.11	10,227

Notes
BYU-LIG = Brigham Young University Laboratory of Isotope Geochemistry, DUP = duplicate sample, GW = groundwater, PS = primary sample, SW = surface water, UW-EIL = University of Waterloo-Environmental Isotope Laboratory
pMC = percent modern carbon, TU = tritium units, VPDB = Vienna Pee Dee Belemnite, VSMOW = Vienna Standard Mean Ocean Water
1. ^{14}C age determined using the Pearson and Hanshaw (1970) correction for carbonate mineral dissolution; assumes groundwater recharge pH of 7.0 and a soil $\delta^{13}C$ value of -23 ‰, which corresponds to a $\delta^{13}C_{recharge}$ value of of -17.3 ‰, as well as a $\delta^{13}C_{carbonates}$ value 0.28 ‰ (see Section 2.2 of this memorandum). Negative ^{14}C ages for HC-2.5 (24-Oct-2014, 3-Apr-2015) and MW14-02B (28-Sept-2014) are a result of the radiocarbon dilution factor correction and could be due to uncertain quality of $\delta^{13}C$ or ^{14}C values associated with these samples; these results are not considered in the data interpetation.
2. Samples and sample data with **RED** text and numbers are not considered to be representative of formation water (See Appendix 5-D of Lorax (2017).
3. Samples and sample data with **BLUE** text and numbers showed results that were inconsistent with the larger data set. These analyses have been flagged as suspect and were not considered in data interpretations made in the report (see Section 3.3 of this memorandum).
4. The sample date for MW14-05A (Lab ID 12346) is 23-Jun-2015, as shown above. Note that it is incorrectly referenced as 23-Jun-16 in the BYU-LIG certificate of analysis (Appendix C).

APPENDIX E

Fish and Aquatic Resources Baseline Reports (2013-2016)

Coffee Gold Mine: Fisheries & Aquatic Resource Baseline Update - 2016



Prepared For
Kaminak Gold Corporation
Suite 3400-666 Burrard Street
Vancouver, BC V6C 2X8

Prepared By
EDI Environmental Dynamics Inc.
2195-2nd Avenue
Whitehorse, YT Y1A 3T8

EDI Contact
Anne MacLeod, R.P.Bio.
867.393.4882

EDI Project
17Y0032
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EDI
ENVIRONMENTAL DYNAMICS INC.
Down to Earth Biology

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REVISION SUMMARY

Version No.	Date	Revision Notes	Revision Authors
1.0	24 March 2016	Original Version	
1.1	30 May 2016 / 22 June 2016	Updated with 2016 Metals Analyses Data, eDNA and addressing of comments from Hemmera. Reviewed for consistency	Ben Snow Pat Tobler
1.2	October 31, 2016	Updated with 2016 field results	Pat Tobler Ben Schonewille Lyndsay Doetzel Ben Snow
1.3	March 12, 2017	Updated to address First Nation reviewer comments and include additional lab data.	Pat Tobler Lyndsay Doetzel

EXECUTIVE SUMMARY

Fisheries and aquatic baseline studies for the proposed Coffee Gold Project were conducted from 2013 to 2016; some additional data was collected for other projects prior to 2013. Baseline studies undertaken to date have included the compilation of existing information, fish habitat assessments, sampling for fish (summer, fall and winter), environmental DNA (eDNA), benthic invertebrates, periphyton and stream sediments.

The study area includes a 332 km^2 area around the Mine (Mine study area; including portions of the Yukon River, Coffee, Latte, Halfway, Independence and YT-24 creeks) and a 125 km long corridor along the Northern Access Route (NAR study area; which crosses the Yukon and Stewart rivers as well as several smaller watersheds).

A total of 14 species of fish can be found within the streams adjacent to or downstream of the Project infrastructure including two species of salmon and 12 species of resident freshwater fish species. The majority of these species are found only in the Yukon and Stewart rivers with three of these species documented in the small/medium sized streams downstream of proposed mine. These species include slimy sculpin (*Cottus cognatus*), Arctic grayling (*Thymallus arcticus*), and juvenile Chinook salmon *(Oncorhynchus tshawytscha*). These three species were also the most common species encountered along the NAR. Baseline studies have not found Chinook spawning within the study areas; however, chum salmon (*Oncorhynchus keta*) spawning has been confirmed in groundwater fed side channels of the Yukon River in the study area, and in similar habitats in the Stewart River downstream of the NAR study area. Among the tributary creeks, the highest species diversity and abundance of fish have been documented in Coffee and Independence creeks, which are the two largest creeks in the Mine study area.

Coffee, Independence (and occasionally Halfway) creeks are used by juvenile Chinook as non-natal rearing habitat, and Coffee Creek provides confirmed overwintering habitat for this species. Arctic grayling use the creeks in the Mine study area primarily for summer rearing; eDNA data from March 2016 confirmed Arctic grayling overwintering in Coffee Creek and the Yukon River but not in any other streams within the Mine study area. It is common for Arctic grayling to use different streams for important life history periods such as spawning, summer rearing and overwintering. Moderate densities of Arctic grayling have been documented in the lower reaches of Latte Creek during the summer months; however, overwintering habitat for fish within this stream appears poor and eDNA samples collected in this creek in March 2016 tested negative for both Arctic grayling and juvenile Chinook salmon. Slimy sculpin are year round residents in Coffee Creek, the lower portion of Independence Creeks and the Yukon River.

The headwater streams within the Mine footprint are small, steep, have poor habitat and with are located significant distances from documented fish bearing locations. Lower down in the watersheds, these streams eventually provide fish habitat or flow into areas that are used by fish. Along the NAR, fish presence is typically associated with the larger streams that are crossed with likelihood of fish presence decreasing with distance from mainstem habitat.

Benthic invertebrate sampling indicated that mean total abundance was variable throughout the Mine study area, with the highest abundance in Independence Creek, followed by YT-24, Coffee, Latte and Halfway creeks. Primary production (as indicated through periphyton sampling) was very low for all sampling stations, which is typical of northern, nutrient poor aquatic habitats. Chlorophyll-a concentrations were lowest in samples collected farthest upstream in each of the watersheds, and increased in downstream locations, as stream flows and nutrient inputs increased.

Baseline tissue metal concentrations within the Mine study area were analyzed in fish (Arctic grayling, slimy sculpin and juvenile Chinook salmon) and benthic invertebrate tissues, as well as in sediment samples collected from the creeks in the Mine study area. Concentrations of estimated methylmercury in all slimy sculpin, Arctic grayling and juvenile Chinook salmon tissues exceeded the CCME residue guidelines for the protection of wildlife consumers of aquatic biota (CCME 2000a). Baseline concentrations of selenium in slimy sculpin exceeded the United States Environmental Protection Agency guideline for whole-body selenium (EPA 2015) at a small number of samples from Coffee and Independence creeks, and samples from Arctic grayling and slimy sculpin from all areas exceeded the BC guideline for selenium.

Analysis of baseline benthic invertebrate tissue metals concentrations conducted in March and August 2016 indicated that estimated methylmercury concentrations in all benthic invertebrate tissue samples (54% of total mercury) did not exceeded the CCME guideline set for the protection of piscivorous wildlife (0.033 µg/g ww; CCME 2000a) at any sample stations in the Project area; the highest concentration was found in the sample collected from Coffee Creek (CF2.7) in March 2016 (0.0226 µg/g ww). Uranium concentrations in benthic invertebrate tissues were higher in samples collected in March when compared with August data; this correlated to when uranium concentrations in water are at their annual peak during late winter low flows, resulting in increased proportions of groundwater contributions to surface water.

Analyses of sediment baseline metals concentrations collected throughout the Mine study area indicate that arsenic and chromium are consistently present at concentrations that exceed the CCME interim Freshwater Sediment Quality Guidelines (CCME 2000b). Concentrations of copper, cadmium and mercury were found to exceed the applicable guidelines in only a small number of samples, all of which were located in the Coffee Creek watershed.

ACKNOWLEDGEMENTS

Jennie Gjertsen managed this project on behalf of the Goldcorp Inc. and Allison Rippin-Armstrong managed the earlier portion of the project on behalf of Kaminak. Tom Bokenfohr (Goldcorp) provided GIS data used in this report. Ryan Fetterley and Jasmin Dobson from Goldcorp provided exceptional logistical support to ensure our field crews could complete the work in an efficient and effective matter. Ken Nordin of Laberge Environmental Services provided value insight and knowledge of streams within the Local study area.

EDI would like to highlight the exceptional assistance provided by Goldcorp's Environmental Monitors. Robert Farr and Kim Joseph provided navigation, local insight and field assistance for the road accessible portions of fieldwork. Evan Warren, Andrew Taylor and Derek Scheffen provided local insight and assistance for components that were based from the mine.

AUTHORSHIP

This report was prepared by EDI Environmental Dynamics Inc. Staff who contributed to this project include:

Pat Tobler B.Sc., R.P.Bio.....Author, Senior Review

Ben Schonewille, B.Sc., R.P.Bio .....Section Author

Ben Snow, B.Sc., R.P.Bio .....Section Author

Lyndsay Doetzel, M.Sc., R.P.Bio.....Section Author

Matt Power, A.Sc.T. .....GIS Mapping and Database Management

Jared Hobbs (M.Sc., R.P.Bio.) of Hemmera Envirochem Inc. produced the eDNA report included in Appendix A and led the eDNA sampling component of the field program.

Members of the EDI field crew for the 2016 fieldwork included the following EDI personnel: Ben Schonewille, Ben Snow, Josh Taylor, Dawn Hansen, Joel MacFabe, Jake Duncan and Pat Tobler.

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1 INTRODUCTION

1.1 PROJECT DETAILS

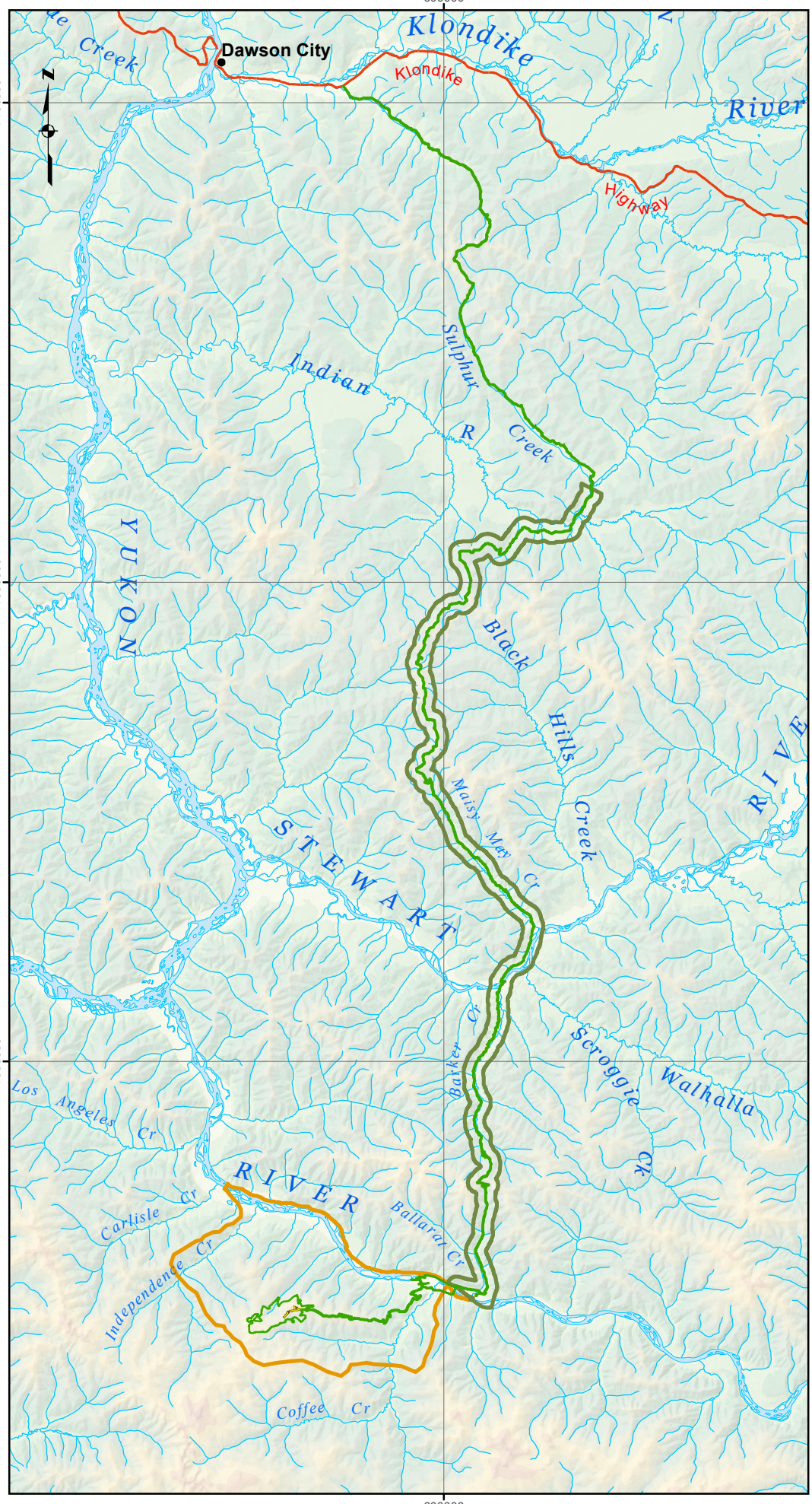
The Coffee Gold Project (Coffee Project; the Project) is a proposed gold mine in west-central Yukon, located 130 km south of Dawson City. Gold was initially discovered at Coffee Creek in 2010, and exploration activities have been ongoing since then. Baseline environmental studies began in 2010 and were expanded in the following years in anticipation of future regulatory requirements.

The proposed Project will consist of an open pit gold mine and heap leach facility. The projected mine life is ten years with an 18 month construction period. The feasibility study proposes four open pits mined by conventional shovel and truck methods. The mine and associated activities will generally be located on a relatively high elevation ridge top, and will not extend into the lower elevations where the larger streams are located. The mine footprint does include the upper part of some headwater watershed (including Halfway Creek, YT-24 and unnamed tributaries to Latte Creek). Most prominently, the main proposed Waste Rock Storage Facility (WRSF) will be positioned in the upper Halfway Creek watershed.

The Project will be accessed by road from Dawson City via a 214 km single-lane, gravel road with pull outs. The initial part of this route, from the highway to Sulphur Creek utilizes a government-maintained gravel road. Beyond Sulphur Creek, the Northern Access Route (NAR) mainly follows existing placer mine roads which will be upgraded to provide all season access to supply vehicles. Approximately 30 km of new road will be constructed (Figure 1). Electricity will be generated onsite by diesel-powered generators. The majority of mine staff will access the site by air.

The Coffee Project is located on Crown land within the Traditional Territory of the Tr'ondëk Hwëch'in and the asserted traditional territory of the White River First Nation. A portion of Goldcorp's claim block is located in the Traditional Territory of the Selkirk First Nation and the proposed road also overlaps with the Traditional Territory of the First Nation of the Na-cho Nyak Dun.

The proposed Project will require an Executive Committee Screening from the Yukon Environmental and Socio-economic Assessment Board (YESAB), a Type A Water Licence issued by the Yukon Water Board and a Quartz Mining License issued by the Yukon Government, among other permits and licences.





Legend

- Settlement/Community
- Highway
- Government-Maintained Gravel Road Along Proposed Route
- Proposed Route
- Project Footprint (as of March 10, 2017)

Aquatic Local Study Areas

- Mine Study
- NAR Study

FIGURE: 1

Overview of the Coffee Project study area

Data Sources
1:250,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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1.2 PURPOSE AND SCOPE OF REPORT

This report provides an update to the Coffee Project fish and aquatic resource baseline for the mine. Palmer Environmental Consulting Group collected baseline data around the mine in 2014 and 2015 (PECG 2017) and along the access road in 2015 (PECG 2016). EDI collected additional baseline data in 2016 around the mine and NAR. This report synthesizes the 2016 results with all previous fish and aquatic resource data collected in the study areas from 2000 to 2015 and includes the Mine study area (Figure 2) and the Northern Access Road (NAR) study area (Figure 3). This report is intended to support the effects assessment for the Project and the preparation of the YESAB Project Proposal. This report includes:

- A summary of data collection methods and existing knowledge (prior to 2016) for fish and aquatic resources within the study areas including fish and fish habitat, benthic invertebrates, periphyton and stream sediments;
- Methods and results for 2016 Mine study area field studies include:
    - winter fish and fish habitat sampling including environmental DNA;
    - benthic invertebrate tissue sampling, March and August for metals;
    - whole-body fish tissue sampling for metals, March, July and August;
    - chlorophyll-a sampling in August;
    - fish and fish habitat investigations (July and August);
    - stream gradient modelling and analysis for small streams within the Project footprint, and;
    - spawning surveys for Chinook salmon.
- Methods and results for 2016 NAR study area field studies include:
    - fish and fish habitat investigations at stream crossings along the NAR;
    - fish sampling and fish habitat characterization at proposed barge landings;
    - fish and fish habitat investigations at back channel of Stewart River;
    - spawning surveys for chum salmon in the Yukon and Stewart rivers.
- A synthesis of the results from all fish and aquatic resources studies to date, and an updated discussion on fish use of streams within the study areas with an emphasis on the stream in the Mine study area.

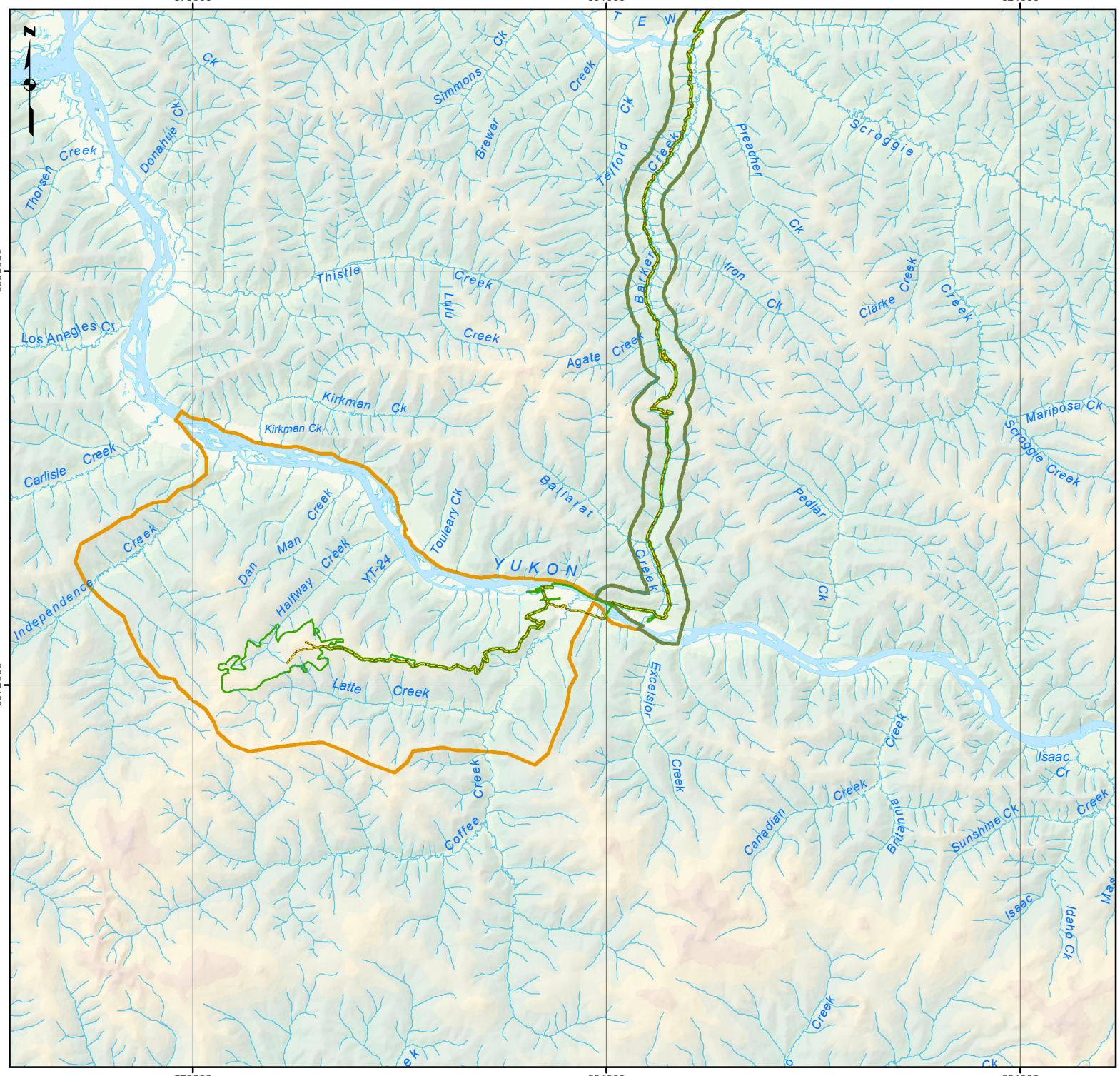
1.3 INFORMATION SOURCES

Available information sources for fish and aquatic resources within the study areas include scientific studies conducted between 2000 and 2016 (Table 1), as well as Traditional Knowledge. Preliminary fisheries and aquatic assessments associated with the Coffee Project were conducted in 2013 (ACG 2014), and were followed by two years of fish and aquatic baseline data collection for the Project in 2014 and 2015 by Palmer Environmental Consulting Group (PECG 2017) and data collection by EDI Environmental Dynamics in 2016 (this report).

Additional data that is not associated with either Project was collected on Coffee Creek in 2010, 2001 and 2000 (Laberge and White Mountain 2010; Laberge and White Mountain 2002; White Mountain 2001). Traditional Knowledge was also incorporated and was sourced from a database of such information compiled by the Kaminak Gold Corporation.

Table 1. Summary of available information sources for aquatic resources in the study areas.

Year	Data Summary	Agency	Report References
2016	Winter: fish and fish habitat assessments, environmental DNA (eDNA) sampling for Arctic grayling and Chinook salmon and benthic invertebrate sampling for analysis of baseline metal levels. Summer/fall: salmon spawning surveys, stream assessments along NAR, fish sampling/habitat assessments around mine, chlorophyll-a sampling, metals analysis of invertebrates and fish tissue.	EDI Environmental Dynamics (EDI)	This report
2014, 2015	Fish and aquatic resources baseline report for the Coffee Project, including data on fish and fish habitat, benthic invertebrates, periphyton and stream sediments. Includes fish tissue sampling data and salmon spawning surveys.	Palmer Environmental Consulting Group (PECG)	PECG 2017
2015	Fish and aquatic resources baseline report for the mine access route (NAR) focusing on collection of fish and habitat data at proposed stream crossings.	Palmer Environmental Consulting Group (PECG)	PECG 2016
2013	Preliminary fish and fish habitat assessment for the Coffee Project baseline, including surveys of fish abundance, distribution and size/weight data. Salmon spawning surveys were conducted on lower Independence Creek, and the Yukon River.	Access Consulting Group (ACG)	ACG 2014
2010	Fish and fish habitat assessments and benthic invertebrate sampling in lower Coffee Creek.	Laberge Environmental Services and White Mountain Consulting	Laberge and White Mountain 2012
2001	Fish and fish habitat assessments and benthic invertebrate sampling in lower Coffee Creek; a salmon spawning survey was conducted on lower Coffee Creek and the Yukon River.	Laberge Environmental Services and White Mountain Consulting	Laberge and White Mountain 2002
2000	Fish and fish habitat assessments in lower Coffee Creek; a salmon spawning survey was conducted on lower Coffee Creek and the Yukon River.	White Mountain Environmental Consulting	White Mountain Environmental Consulting 2001



Legend

- Settlement/Community
- Proposed Route
- Project Footprint (as of March 10, 2017)

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 2

Overview of the Coffee Project - Mine study area

Data Sources
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Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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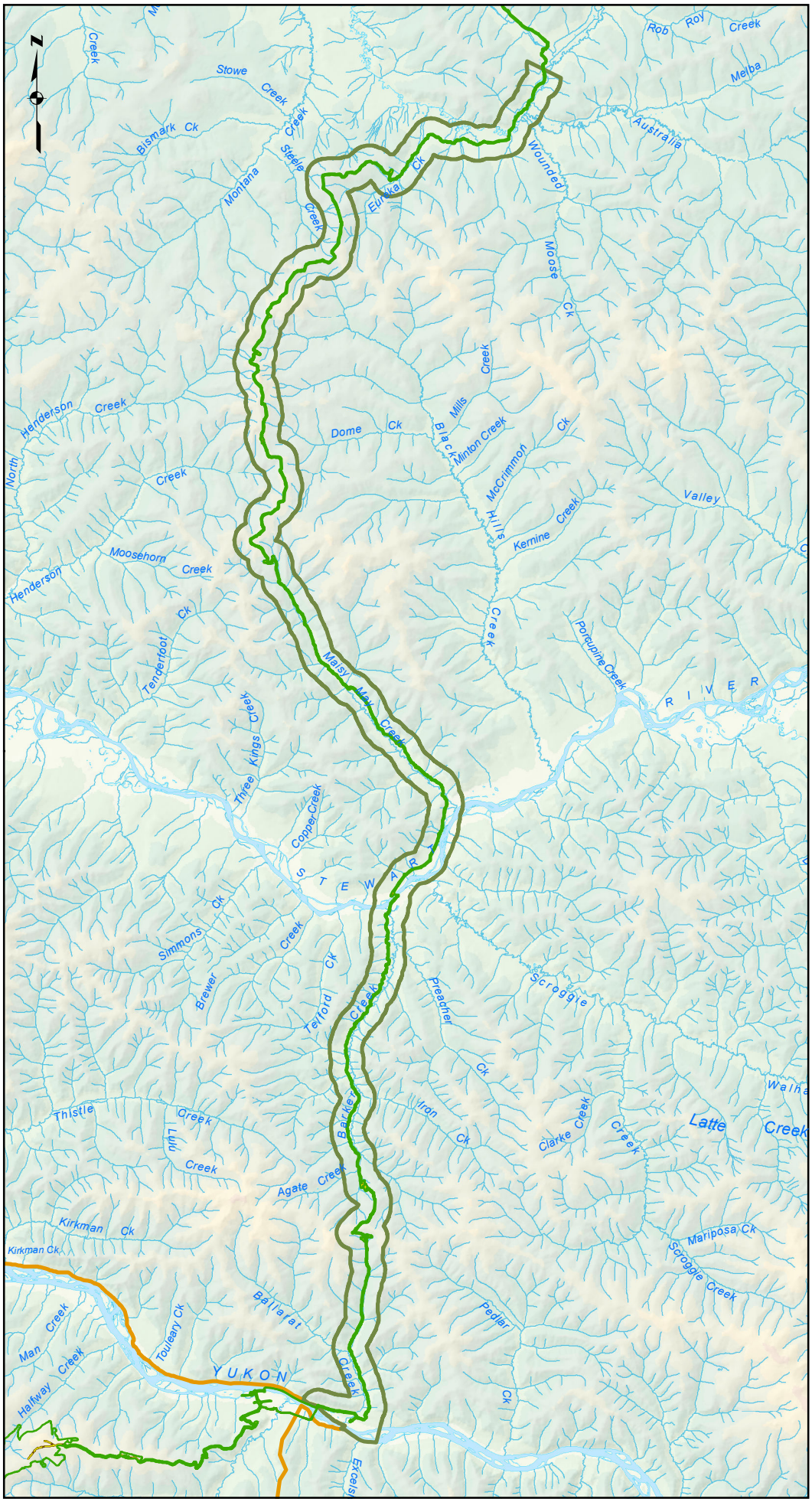

Legend

- Settlement/Community
- Government-Maintained Gravel Road Along Proposed Route
- Proposed Route
- Project Footprint (as of March 10, 2017)

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 3

Overview of the Coffee Project - Northern Access Road (NAR) study area

Data Sources
1:250,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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1.4 WATERSHED SUMMARY AND FISH SPECIES OVERVIEW

The Mine study area includes 32 km of the Yukon River as well as five smaller watersheds, all of which are tributaries of the Yukon River and generally flow in a northerly direction (Figure 2). These include:

- Coffee Creek watershed to the east;
- Latte Creek watershed to the south, which flows into Coffee Creek;
- Independence Creek watershed to the west, including the Kona Tributary; and,
- Halfway Creek and YT-24 watersheds to the north.

The NAR study area includes portions of the Yukon and Stewart Rivers and several smaller watersheds including (Figure 3):

- Indian River;
- Maisy May Creek;
- Barker Creek; and
- Ballarat Creek.

There are headwater tributaries of Latte Creek, Halfway Creek and YT-24 Creek which lie in close proximity to, or overlap with, with the planned Mine footprint (Figure 2). One tributary to Independence Creek, the 'Kona Tributary', is also near the planned Project footprint. In addition to these watersheds, two watersheds outside of the study area were sampled during 2014 to 2016 studies (Los Angeles and Isaac creeks; reference streams). Within the study areas, the Yukon and Stewart rivers provide overwintering, migration and rearing habitat for many fish species. Chum salmon spawning activity has been previously documented in the Yukon River in the study area (ACG 2014; PECG 2017) and in the Stewart River downstream of the NAR study area (Rivest Pers. Comm. 2016). In contrast, the smaller watersheds within the study areas support simpler fish communities, which include Chinook salmon (*Oncorhynchus tshawytscha*), Arctic grayling (*Thymallus arcticus*), and slimy sculpin (*Cottus cognatus*). Further information on relevant life history of key species found in the study areas (slimy sculpin, Chinook salmon, chum salmon [*Oncorhynchus keta*], and Arctic grayling) is described in the following sections.

Slimy sculpin are a small fish species commonly found in streams and lakes throughout the Yukon. This species is widespread and common in a variety of habitats although it is most common in streams with moderate to swift currents and coarse gravel/cobble substrate (McPhail 2007, McPhail and Lindsey 1970). Slimy sculpin diets include a wide variety of invertebrate prey items with chironomid larvae being a primary item taken; larger individuals may also feed upon the eggs of other fish species (McPhail 2007). They are bottom-oriented species and are known to have relatively small home ranges; they do not conduct any substantial migrations for any part of their life history (i.e. spawning, rearing, and feeding) and exhibit a high

degree of site fidelity (Gray et al. 2004). For this reason, the presence of slimy sculpin in Yukon watersheds is a good indicator of suitable overwintering habitat for other fish species. This species can also be a useful indicator species for bioaccumulation of metals at intermediate trophic levels in aquatic ecosystems, as they consume various benthic invertebrate species and are themselves prey items for larger fish species.

Chinook salmon are an anadromous fish species and the largest salmon species in the Yukon. This species is known to be an important fish for First Nations and recreational fishers in the Yukon River. As indicated by Traditional Knowledge (TH 2012), the Yukon River in the vicinity of Coffee Creek has long been an important salmon fishing location for First Nations. There is general acknowledgement that the Chinook salmon returns in the Yukon River are not as strong as historical.

In the Yukon River watershed, Chinook spawn from late July to late August in clear, fast flowing streams and rivers, where large and clean cobble substrates are present. Eggs are deposited in stream gravels and hatch in late fall or early winter as alevins. Chinook alevins remain in the gravels through the duration of the winter, and live off stored energy reserves during this time before emerging as fry in late spring (May/June). Juvenile Chinook salmon rear in freshwater streams for up to one year after emerging from the stream gravels. Juvenile Chinook salmon are known to migrate many kilometers as juveniles in order to find high quality rearing habitat; this can include use of both natal and non-natal streams. Juvenile Chinook salmon generally leave rearing habitats in the early spring in the year after emergence, spend 3 to 5 years in the ocean, and return to spawn in the Yukon River watershed as 4 to 6 year olds.

Chum salmon spawning has been documented in the Yukon River mainstem slough and side channel habitats from the White River to Tatchun Creek (near Carmacks) and appear to use similar habitats in the Stewart River. Chum salmon also migrate through the study areas of the Yukon and Stewart rivers to reach spawning areas further upstream. In the Yukon River watershed, chum spawning occurs from September to November and is almost exclusively associated with areas of upwelling groundwater discharge. As with Chinook salmon, the eggs hatch as alevins during the winter and remain in the gravel until emergence during the spring (May/June). However, unlike Chinook, chum fry head directly downstream to the ocean and do not reside in freshwater for any considerable period of time. Chum salmon from the Yukon River watershed typically spend 3 to 4 years in the ocean before returning as adults to spawn.

Arctic grayling are an important recreational fish species in the Yukon River watershed, and are also a traditional food source for local First Nations. This species can be found in a wide variety of habitats ranging from large lakes to small headwater streams. A common life history strategy involves seasonal migrations between overwintering, spawning and summer rearing habitats with the largest individuals often being found the furthest upstream during the summer months (McPhail 2007). As such, this species is typically the most widespread in terms of distribution in Yukon watersheds. Spawning occurs during the spring shortly after ice-out and takes place in flowing water over substrates dominated by gravels. Small juveniles are typically found along the margins of the spawning streams although sub-adults and adults are often found in streams which do not provide spawning habitat. Food items taken by grayling include a wide variety of aquatic and terrestrial insects and they may also feed upon small fish and/or eggs (McPhail 2007, McPhail and Lindsey 1970).

1.5 BASELINE SAMPLING STATION CONCORDANCE

Aquatic sampling stations established during the 2014/2015 baseline studies (within the Mine study area) were given the form "AQ##", where the hashtags represented a numerical station designation. An alternate set of sample station codes were developed as a component of the Coffee Project water quality baseline data collection program; these were used during recent aquatics sampling programs as sampling was conducted in areas not visited as part of the 2014/2015 program. Going forward, EDI has developed the following station designation codes that allow for easy determination of station location, and allow for the addition of new stations, if and where needed:

1. Each station ID designation begins with a two or three letter code for each stream in the Mine study area. Three letter codes are used for unnamed tributaries to named streams; LCC therefore corresponds to Latte Creek Tributary C.

2. Following the stream letter code is a numeric designation that represents the straight line distance (kilometres) of a sampling station from its major confluence.

3. For stations in the Yukon River, the same naming convention was used although distances were measured in a straight line from the Coffee Creek confluence. A 'U' was used to indicate a station upstream of Coffee Creek and a 'D' for stations downstream. To assist in rectifying previous sampling stations with the new system, a table of concordance is shown below (Table 2).

4. Discrete sampling locations within the same station are designated as sites (e.g. station CF2.3 sediment sampling sites 1, 2 and 3).

Table 2. Concordance table of Coffee Project fisheries and aquatic field sampling station identifiers.

Stream	2014/2015 Aquatic Baseline Station Name (PECG 2017)	Water Quality and Hydrology Station (Lorax 2016)	2016 Station Name (this report)
Coffee Creek		CC4.5	CF2.7
Coffee Creek	AQ00		CF3.9
Coffee Creek	AQ01		CF5.7
Coffee Creek	AQ02		CF8.0
Coffee Creek		CC0.5	CF8.3
Latte Creek	AQ03	CC3.5	LC0.5[1]
Latte Creek	AQ04		LC2.7
Latte Creek		CC1.5	LC9.7
Latte Creek	AQ04.5		LC9.9
Latte Creek	AQ05		LC10.4
Latte Creek	AQ06		LC11.8
Latte Creek		CC6.0	LC13.5
Latte Creek, Tributary C		CC1.0	LCC0.1
Halfway Creek	AQ20		HF0.0
Halfway Creek		HC5.0	HF0.2
Halfway Creek		HC2.5	HF6.3
Halfway Creek	AQ21		HF9.3
YT-24	AQ30		YT0.0
YT-24		ML1.0	YT0.2
YT-24	AQ31		YT5.0
Independence Creek	AQ10	IC4.5	ID1.9
Independence Creek	AQ11		ID6.7
Kona Tributary	AQ12		KT0.1
Kona Tributary	AQ13		KT5.2
Yukon River		YUK2.0	YRU2.2
Yukon River		YUK5.0	YRD21.7
Isaac Creek	AQREF1		IS0.1
Los Angeles Creek	AQREF2		LaC4.8

[1] While this site was labeled LC0.5, the actual distance of this site from the mouth of Latte Creek is ~50 m.

2 METHODS

2.1 TRADITIONAL KNOWLEDGE AND EXISTING INFORMATION SOURCES

Traditional Knowledge (TK) and current land use data provide information on fish species that are known to use the study areas and speak to fish species of interest to First Nations and local Yukon residents. This includes TK information shared by the Tr'ondëk Hwëch'in and White River First Nations, as well as a local trapping concession holder (Bates et. al. 2014, TH 2012, DRPC 2013; Interview 14, Pers. Comm. 2016). Prior to the initiation of the aquatic baseline studies for the Coffee Project, aquatic assessments in/near the Mine study area were conducted in Coffee Creek and the Yukon River in 2000 (White Mountain 2001), 2001 (Laberge and White Mountain 2002) and 2010 (Laberge and White Mountain 2012). The Fisheries and Oceans Canada Fisheries Information Summary System (FISS; DFO 2016) contains general data on fish presence in the Yukon River, including data records prior to the Coffee Project baseline studies.

Fish and fish habitat data were also collected just upstream of the mouth of Coffee Creek in July 2000 and 2001 and August 2010. Data collection included in-situ water quality parameters, stream discharge and velocity measurements, and general habitat attributes (e.g., channel width, substrate composition, cover, and stream morphology). Surface water quality samples were collected and analysed for metals concentrations, total dissolved solids (TDS) and total suspended solids (TSS). Benthic invertebrate sampling was conducted at the site at the mouth of Coffee Creek in 2001 and 2010 and fish sampling was conducted in all three sampling years (2000, 2001 and 2010). Sampling methods included minnow trapping in all years and, backpack electrofishing (2010 and 2001), gill netting (2001) and beach seining (2000 and 2001). Aerial surveys to attempt to locate Chinook salmon spawning were conducted in Coffee Creek 2000 and 2001.

2.2 SAMPLING AREAS AND RATIONALE

Aquatic resources sampling included fish sampling, habitat assessment (summer and overwintering), sediment and periphyton sampling, benthic invertebrate community composition via CABIN methods, and fish and benthic invertebrate tissue analysis for total metals. These activities were carried out in a number of streams in the Mine study area:

- Latte, Halfway and YT-24 creeks directly drain the Mine Site, and are those that are predicted to be most affected by project activities. These streams are considered 'near' to project activities.
- Latte Creek flows into Coffee Creek. Therefore, while Coffee Creek is downstream of the Project area, the reaches that are downstream of the Latte confluence are considered 'far' from Project activities.
- Independence, Los Angeles, and Coffee Creek upstream of the Latte Creek confluence were studies as part of the baseline program to act as 'reference' sites.

2.3 2013 TO 2015 BASELINE STUDIES

2.3.1 MINE AREA

The preliminary baseline studies for the Coffee Project began in 2013. Fish and fish habitat assessments were conducted at 10 stations (Figure 4), including Independence, Halfway and Coffee creeks. Fish habitat data collection included in-situ water quality measurements, stream discharge measurements and general observations of fish habitat suitability. Fish sampling was conducted using minnow traps. Aerial surveys to attempt to document spawning salmon were conducted in July, August, September and October 2013, and included the south bank of the Yukon River and the lower portions of Independence Creek (in July only; ACG 2014). Surveys focused on likely chum salmon spawning habitats in the Yukon River (i.e. side channel areas and sloughs), and included the portion of the river extending from approximately 500 m downstream of the confluence of Ballarat Creek to approximately 1 km downstream of the confluence of Independence Creek (ACG 2014).

More in depth aquatic baseline studies for the Coffee Project were completed in 2014 and 2015. The 2014 and 2015 baseline field sampling program included sampling at 18 fish community sampling stations, 17 fish habitat stations, and 12 benthic invertebrate, periphyton and sediment stations (PECG 2017; Figure 4). Sampling was conducted by Palmer Environmental Consulting Group (PECG) in August and October, 2014, and in March, June, July, and September, 2015. Winter sampling in March 2015 focused on documenting under-ice water flow in Latte and Coffee Creeks; however, no fish sampling was conducted.

Fish habitat was characterized by PECG at each fish sampling station in the study area. Data collected included in situ water quality parameters and an assessment of habitat quality and quantity based on general habitat attributes (e.g., channel width, gradient, substrate composition, cover, and stream morphology). Various station-specific fish sampling methods included backpack electrofishing, minnow trapping, fyke net trapping, and angling. In addition to summer fish habitat surveys, winter fish habitat surveys as well as salmon and Arctic grayling spawning surveys were completed. Fish samples were obtained from watersheds in the Mine study area and reference areas to analyze fish age, diet, and tissue metal concentrations[2].

Sediment samples were collected by PECG at stations throughout the Mine study area and were analyzed for nutrients, pH and metal concentrations. Periphyton sampling included analysis for chlorophyll-a and periphyton cell density. Benthic invertebrate field sampling was completed using the Canadian Aquatic Biomonitoring Network (CABIN) protocols (NWRI 2008), and were analyzed using the Reference Condition Approach (RCA).

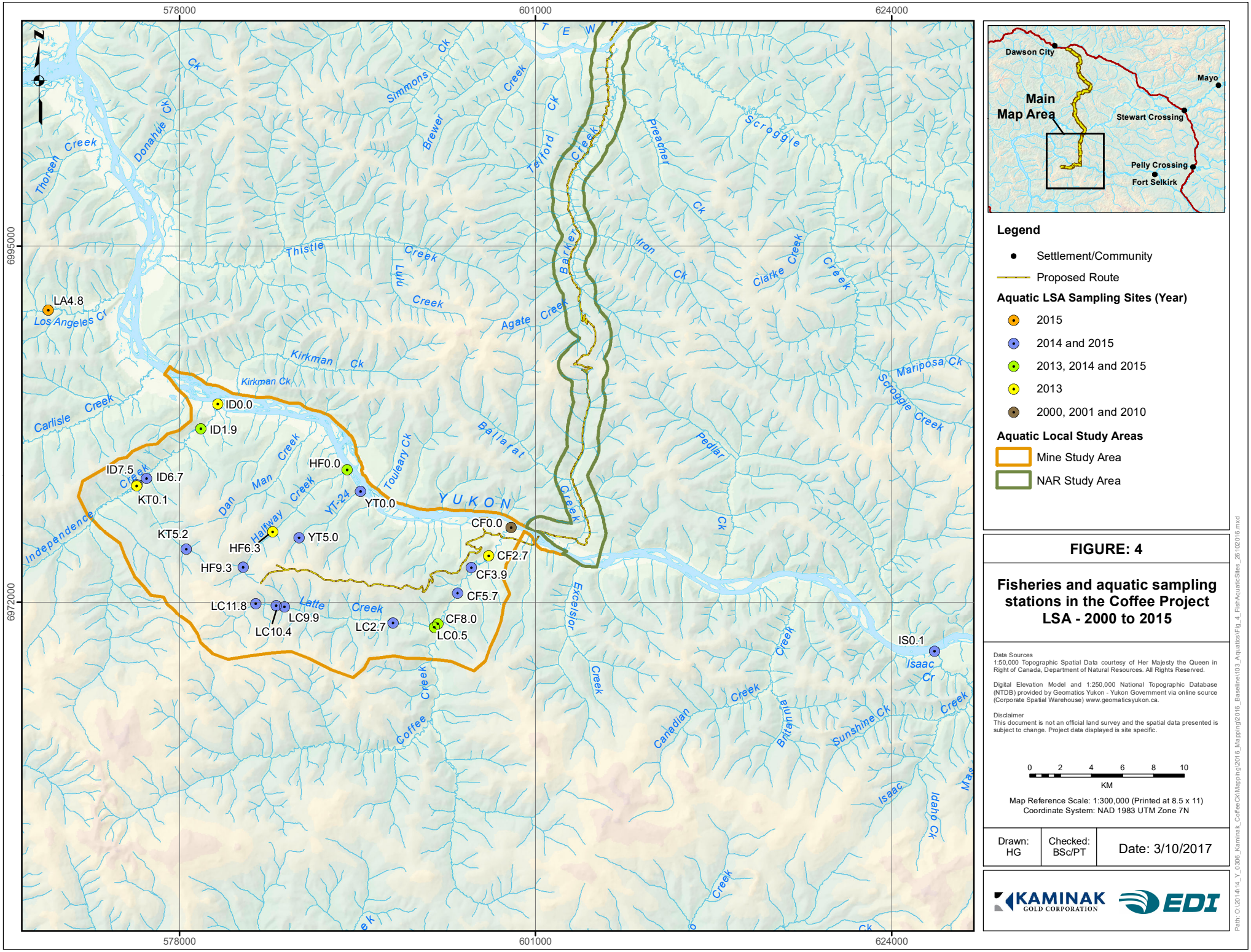
[2] Metal analysis for fish was performed on whole slimy sculpin (except for head) and pieces of muscle tissue from the dorso-lateral area from Arctic grayling.

2.3.2 NORTHERN ACCESS ROUTE

In 2015, PECG completed stream assessments at 66 potential watercourse crossings along the Northern Access Route (PECG 2016). Streams were assessed for fish habitat, existence of downstream barriers to fish passage, and in some cases were sampled for fish. Since the completion of the work, a portion of the NAR has been realigned to avoid the Black Hills Creek watershed.

Included in the 66 watercourse crossings were the proposed barge crossings of Yukon and Stewart rivers. In these locations Chinook spawning surveys were completed and a general characterization of habitat was completed at the proposed barge landings.

Additional investigation was completed at a side/back channel of the Stewart River where the proposed road footprint will encroach on the high water mark. A description of the habitat, minnow trapping and water quality data was collected.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601000
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Dawson City
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Main Map Area
Stewart Crossing
Pelly Crossing
Fort Selkirk
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Settlement/Community
Proposed Route
Aquatic LSA Sampling Sites (Year)
2015
2014 and 2015
2013, 2014 and 2015
2013
2000, 2001 and 2010
Aquatic Local Study Areas
Mine Study Area
NAR Study Area
LA4.8
ID0.0
ID1.9
ID7.5
ID6.7
KT0.1
KT5.2
HF0.0
YT0.0
YT5.0
HF6.3
HF9.3
CF0.0
CF2.7
CF3.9
CF5.7
CF8.0
LC0.5
LC11.8
LC9.9
LC10.4
LC2.7
IS0.1
YUKON
Thistle Creek
Agate Creek
Kirkman Ck
Carlisle Creek
Ballarat Creek
Toulaey Ck
Dan Man Creek
Halfway Creek
YT-24
Independence Creek
Latte Creek
Coffee Creek
Barker Creek
Iron Ck
Clarke Creek
Mariposa Ck
Scroggie Creek
Pedlar Ck
Excelsior Creek
Canadian Creek
Britannia Creek
Sunshine Ck
Isaac Cr
Idaho Ck
Telford Creek
Preacher Ck
Donahue Ck
Simmons Ck
Brewer Creek
Thorsen Creek
Los Angeles Cr
FIGURE: 4
Fisheries and aquatic sampling stations in the Coffee Project LSA - 2000 to 2015
Data Sources
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2.4 2016 BASELINE STUDIES

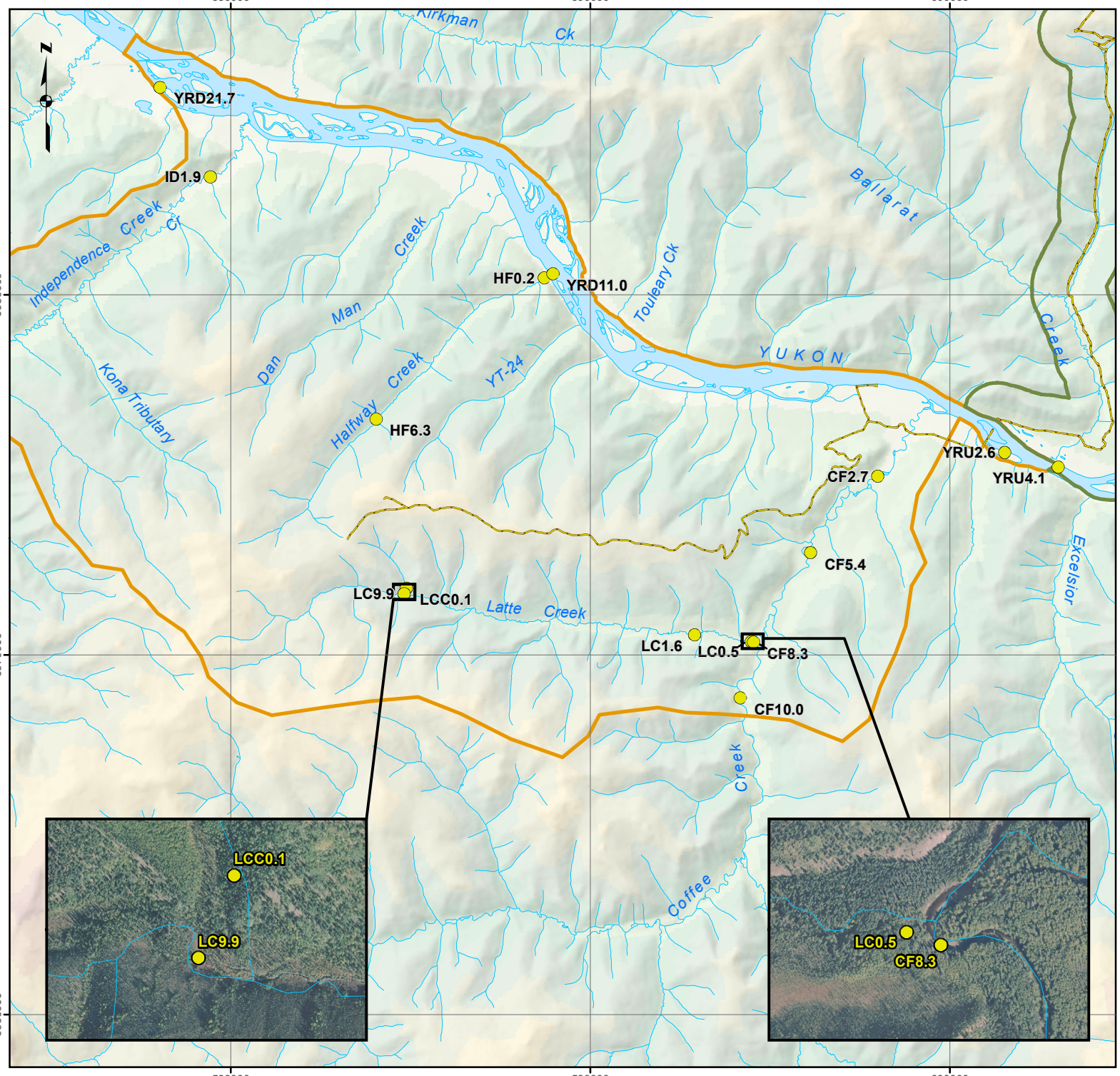
Baseline fish and aquatic resource studies conducted 2016 included fish and fish habitat assessments, sampling for environmental DNA (eDNA), winter fish habitat assessments, chlorophyll-a sampling, and fish and benthic invertebrate tissue sampling to assess baseline metal concentrations. A stream gradient modelling exercise was conducted to assess stream gradients in headwater tributaries of creeks in the vicinity of the Mine footprint. The methods for each of these components are summarized in the following subsections.

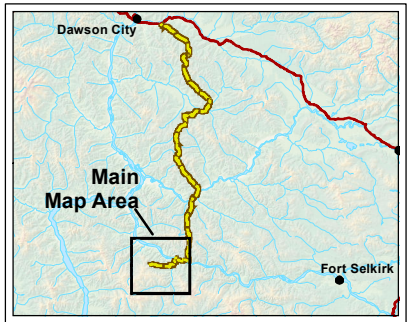
2.4.1 ENVIRONMENTAL DNA SAMPLING

The eDNA sampling conducted during March 2016 involved the collection of both water and sediment samples with the goal of supplementing conventional fish sampling results for Coffee, Latte, Halfway and Independence creek watersheds. Water-based eDNA samples provide an indication of winter habitat utilization whereas the sediment samples can potentially provide a longer term indication of habitat use. This is particularly important given that portions of the watersheds that were sampled may only contain the target species for some portions of the year. The eDNA field sampling effort was conducted for the Coffee Gold Project on March 1 and 2, 2016 and included 14 stations sampled for water and 12 stations sampled for sediment (Table 3; Figure 5). Detailed methods of the eDNA component of this project are described in APPENDIX A.

Table 3. Summary of eDNA sampling stations at the Coffee Gold Project, March 2016.

Station Name	Stream	UTM Co-ordinates (Zone 7)		Samples Collected	
		Easting	Northing	Water	Sediment
CF2.7	Coffee Creek	597998	6974963	✓	✓
CF5.4	Coffee Creek	596129	6972840	✓	✓
CF8.3	Coffee Creek	594533	6910347	✓	✓
CF10.0	Coffee Creek	594174	6968807	✓	✓
LC0.5	Latte Creek	594470	6970371	✓	✓
LC1.6	Latte Creek	592896	6970557	✓	✓
LC9.9	Latte Creek	584815	6971704	✓	✓
LCC1.0	Latte Creek Tributary	584835	6971857	✓	✓
ID1.9	Independence Creek	579439	6982199	✓	✓
HF0.2	Halfway Creek	588716	6980472	✓	
HF6.3	Halfway Creek	584040	6976554	✓	✓
YRD11.0	Yukon River	588957	6980596	✓	
YRD23.0	Yukon River	578042	6985775	✓	✓
YRU4.1	Yukon River	603003	6995219	✓	
YRU2.6	Yukon River	601522	6975623		✓
CF990	NA – distilled water control			✓	





Legend

- Settlement/Community
- eDNA Sampling Site
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 5

eDNA sampling stations in the Mine study area

Data Sources
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2.4.2 WINTER FISH HABITAT ASSESSMENT/SAMPLING

Winter fish habitat assessments and fish sampling were conducted from March 3 to 5, 2016 at seven stations (Table 4; Figure 6). Aerial video was also collected for Halfway, Coffee and Latte creeks on March 5, to provide additional data on winter fish habitat conditions in these streams. At stations where the stream channel was ice covered, an ice chisel (spud) was used to penetrate through the ice to allow for the assessment of under ice fish habitat conditions and fish sampling.

Table 4. Summary fish habitat assessment and fish sampling stations in the Coffee Project Mine study area, March 2016.

Station Name	Stream	UTM Co-ordinates (Zone 7)		Fish Sampling	
		Easting	Northing	Minnow Trapping	Underwater Camera
CF2.7	Coffee Creek	597994	6975001	✓	✓
CF8.3	Coffee Creek	594500	6970382	✓	✓
CF0.5	Coffee Creek	599243	6976704	✓	✓
CF10.0	Coffee Creek	594171	6968811	✓	✓
LC1.6	Latte Creek	592896	6970560	✓	
ID1.9	Independence Creek	579414	6983296	✓	✓
HF6.3	Halfway Creek	584040	6976554	✓	

Qualitative fish habitat data collection included station photos, descriptions of stream channel morphology and notes on observed under ice water flow and the presence of observed woody debris. Quantitative fish habitat data collection included measurements of ice thickness, water depth and the collection of in-situ water quality parameters (temperature, pH, dissolved oxygen and specific conductivity). In-situ water quality data was collected in the near vicinity of fish sampling sites, to provide context to fish capture and observation data.

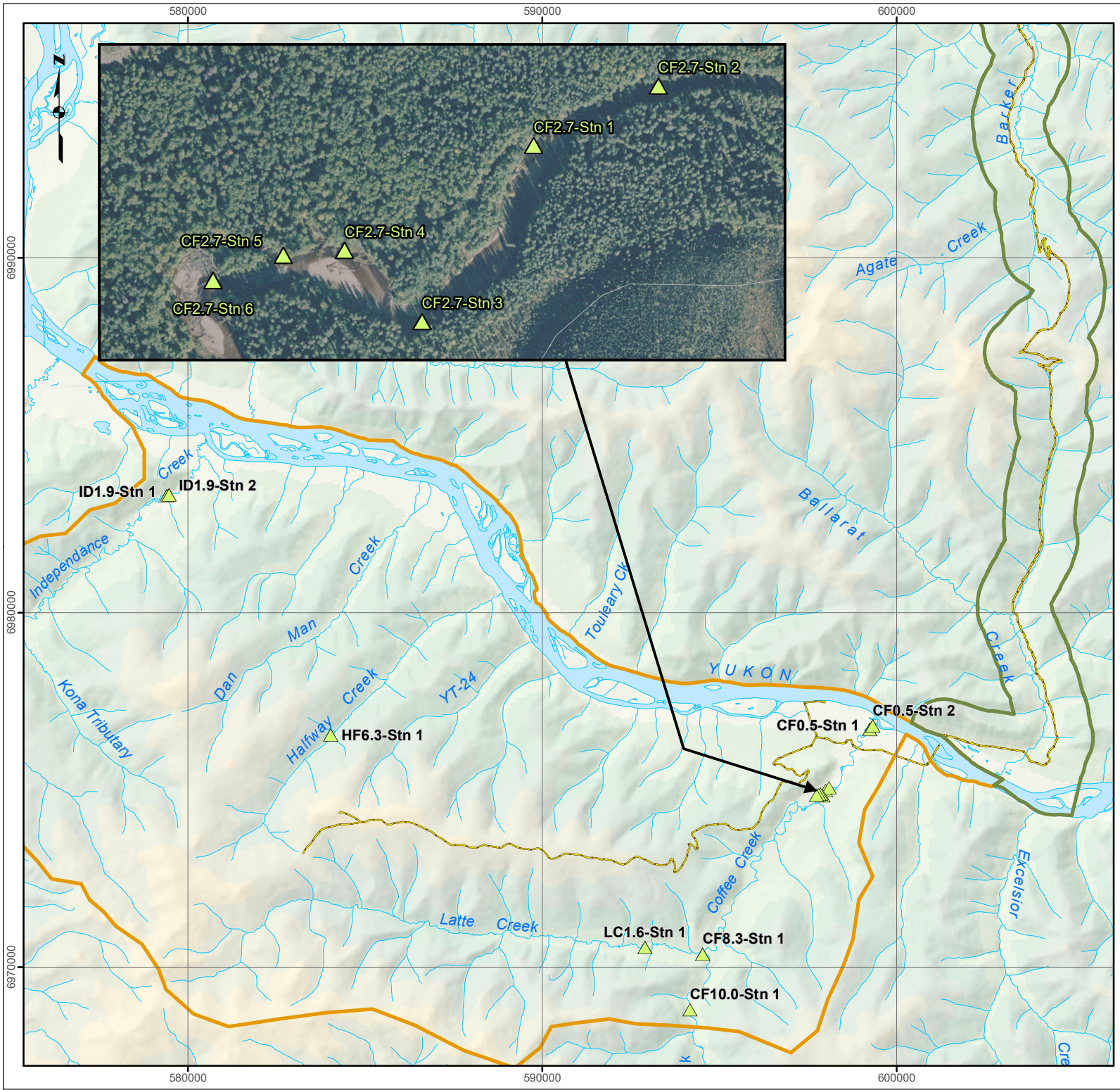
Fish sampling included under ice minnow trapping and the use of an underwater video camera to attempt to visually document the presence of fish at sampling stations. At stations with numerous suitable locations to sample for fish, multiple minnow traps were set at various sites within the station in order to increase sampling effort at accessible micro-habitats (e.g. ice covered pools). At each station, 0.25 inch mesh (0.6 cm), gee-type minnow traps were baited with Yukon River salmon roe and were deployed in stream margin, slow water habitats. Traps were set to soak overnight, with soak times ranging from 17 to 25 hours. Under ice video was collected in pools at all minnow trapping stations except for LC1.6 and HF6.3, where a lack of suitable pool habitat prevented investigation with the camera. Observations were completed using one of two Aqua-Vu high definition underwater cameras (models AV 760c and AV Micro Plus with DVR). Both cameras were suspended below the ice to allow for easy rotation and movement in the water column. The duration of viewing ranged from 10 to 30 minutes, depending on the observed conditions at each station. The AV Micro Plus camera was used to record video data, while the AV 760c camera was used to

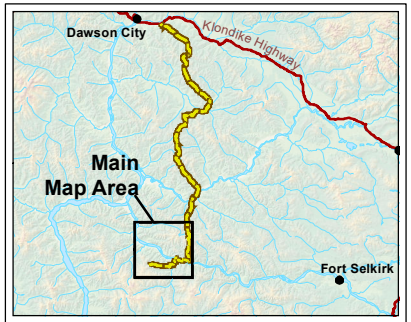
view the video data in real-time via a small attached display screen. Field staff watched the video data in real-time for the presence of fish, and recorded data was reviewed again in the office to ensure that all objects of interest were identified.

All captured fish were identified to species and measured. Fork lengths were measured for species with forked tails; total lengths were measured for fish with non-forked tails (i.e. sculpin). Incidental mortalities and those fish that were retained were also weighed.

High definition aerial video of Halfway, Coffee and Latte creeks was collected from a helicopter, which was flown at a low and slow speed over the creeks. Video data was collected with the goal of documenting any indications of winter groundwater flow (open water, ice free leads), as well as aufeis formation and general ice coverage extent. The surveyed portions of the creeks included:

- The entire channel of Halfway Creek from the confluence of the Yukon River upstream to its headwaters, including Tributary B;
- YT-24 Creek from to confluence with the Yukon River upstream to its headwaters;
- Coffee Creek from the confluence with the Yukon River, upstream to station CF10.0; and,
- Latte Creek Tributary C.





Legend

- Settlement/Community
- Fish Sampling Site
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 6

Winter 2016 fish sampling stations in the Mine study area

Data Sources
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2.4.3 SUMMER FISH AND FISH HABITAT ASSESSMENTS (MINE)

Fish and fish habitat investigations were conducted in streams within the Coffee Project Mine study area in July and August 2016 to provide additional insight into fish presence and distribution. Sampled streams included Halfway and YT-24 as well as two small tributaries to the Latte Creek (Tributaries B and C; Table 5). Fish sampling was also completed in Latte, Coffee and Independence Creek to gain more information on fish use of the area and obtain additional tissue samples. Most sampling stations that were established and sampled during 2014 to 2015 summer baseline studies were revisited and sampled for fish, new sites were also established (Figure 7).

Fish habitat was characterized at representative locations in each stream using the methods described in the Resources Inventory Standards Committee (RISC) the Fish and Fish Habitat Inventory: Site Card Field Guide for the British Columbia government (BC MOE 2008). At each location where site cards were used to assess fish habitat (Table 5), a minimum of 100 m linear metres of stream channel was surveyed. At additional locations where fish sampling was conducted, fish habitat was characterized with detailed field including information on water depths, relative instream cover and channel morphology and bed material.

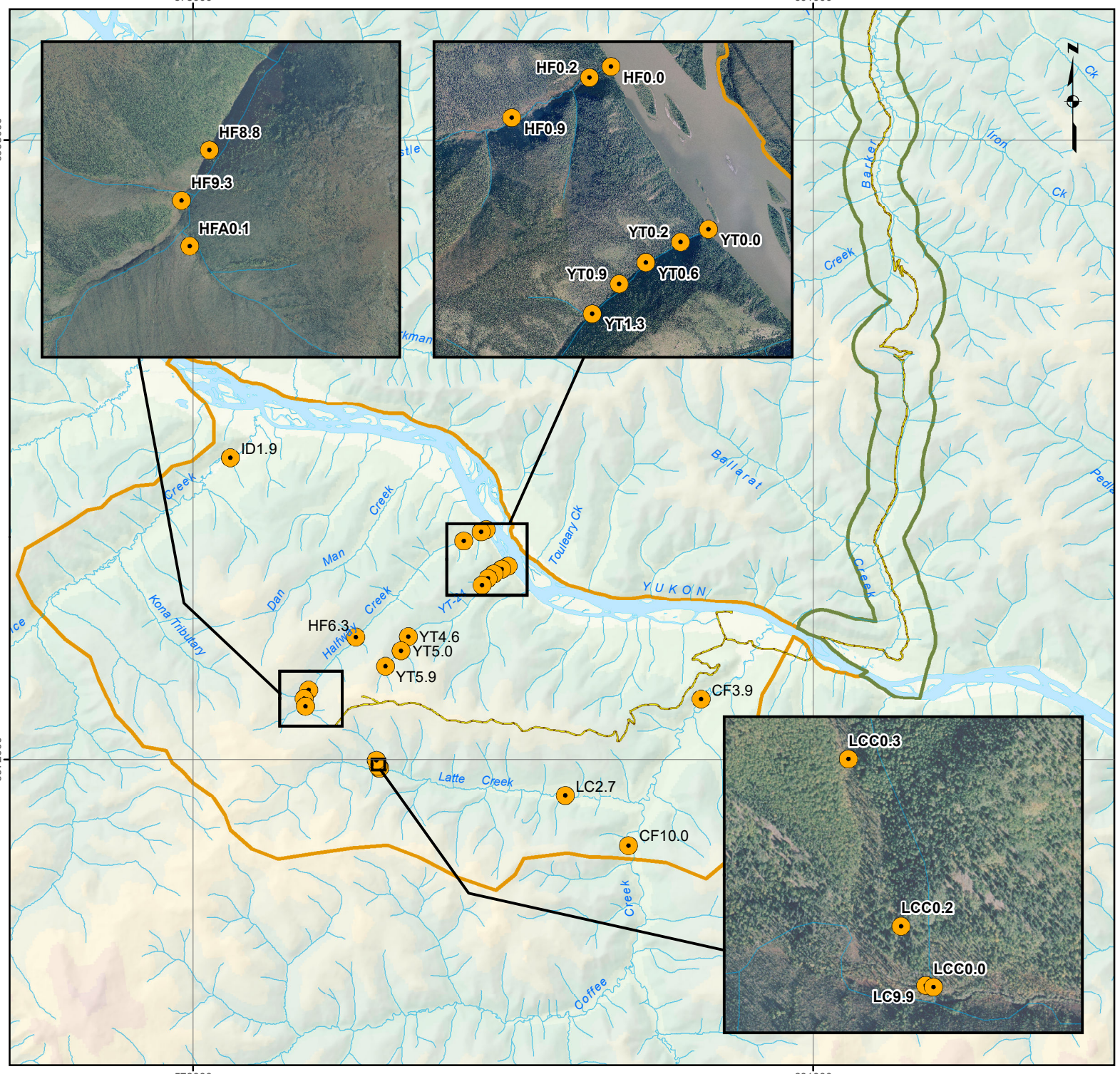
Electrofishing was the primary fish sampling method used to assess the presence of fish in Halfway and YT-24 Creek and Latte Creek Tributary C (Table 5). Latte Creek Tributary B was dry and was not sampled. Electrofishing was conducted using a Smith Root LR-24 electrofisher set at 60 or 70 Hz with a voltage setting ranging from 350 to 600 volts, depending on the in-situ specific conductivity at each site (i.e. higher volts were used at stations with lower conductivity). Electrofishing sampling effort ranged from 105 to 2,084 seconds with the goal of sampling at least 100 m of linear stream channel.

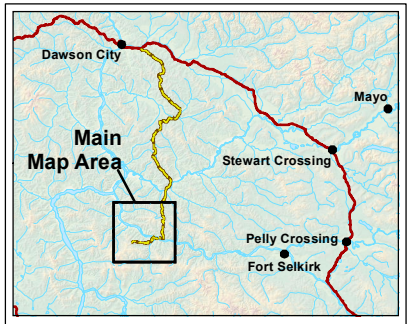
Minnow traps were deployed to increase fish sampling efforts at stations where water depths were sufficiently deep and stream velocities were not excessive. At each station, 0.25 inch mesh (0.6 cm), gee-type minnow traps were baited with Yukon River salmon roe and were deployed along stream margin, slow water habitats. Trap set depths were recorded and traps were set to soak overnight, with soak times ranging from 13.8 to 29.8 hours. At stations with numerous suitable locations to sample for fish, multiple minnow traps were set at various sites within the station in order to increase sampling effort. At all fish sampling stations, in-situ water quality parameters (temperature, dissolved oxygen, specific conductivity and pH) and photos were collected.

Table 5. Fish and fish habitat assessment stations in the Mine study area, July and August 2016.

Watercourse Name	Station Name	Fish Habitat Assessment Type	Fish Sampling Type
Coffee Creek	CF3.9	-	EF, AG
Coffee Creek	CF10.0	-	EF, AG
Independence Creek	ID1.9	-	EF, AG
Latte Creek	LC2.7	-	EF
Latte Creek	LC9.9	-	MT
Latte Creek Tributary C	LCC0.0	Site Card	EF, MT
Latte Creek Tributary C	LCC0.2	Site Card	EF, MT
Latte Creek Tributary C	LCC0.3	Field Notes	EF
Latte Creek Tributary B	LCB0.0	Field Notes	Site dry, not sampled
Halfway Creek	HF0.0	Field Notes	EF
Halfway Creek	HF0.2	Site Card	EF, MT
Halfway Creek	HF0.9	Field Notes	EF
Halfway Creek	HF6.3	Field Notes	EF
Halfway Creek	HF8.8	Site Card	EF
Halfway Creek	HF9.3	Field Notes	EF
YT-24 Creek	YT0.0	Field Notes	EF
YT-24 Creek	YT0.2	Site Card	EF, MT
YT-24 Creek	YT0.6	Field Notes	EF
YT-24 Creek	YT0.9	Field Notes	EF
YT-24 Creek	YT1.3	Field Notes	EF
YT-24 Creek	YT4.6	Site Card	EF
YT-24 Creek	YT5.0	Field Notes	EF
YT-24 Creek	YT5.9	Field Notes	EF

EF = Electrofishing, MT = Minnow Trapping, AG = Angling





Legend

- Settlement/Community
- 2016 Fish Sampling Sites
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 7

Summer 2016 fish and fish habitat assessment locations in the Mine study area

Data Sources
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Aerial imagery courtesy of Kaminak Gold Corporation.

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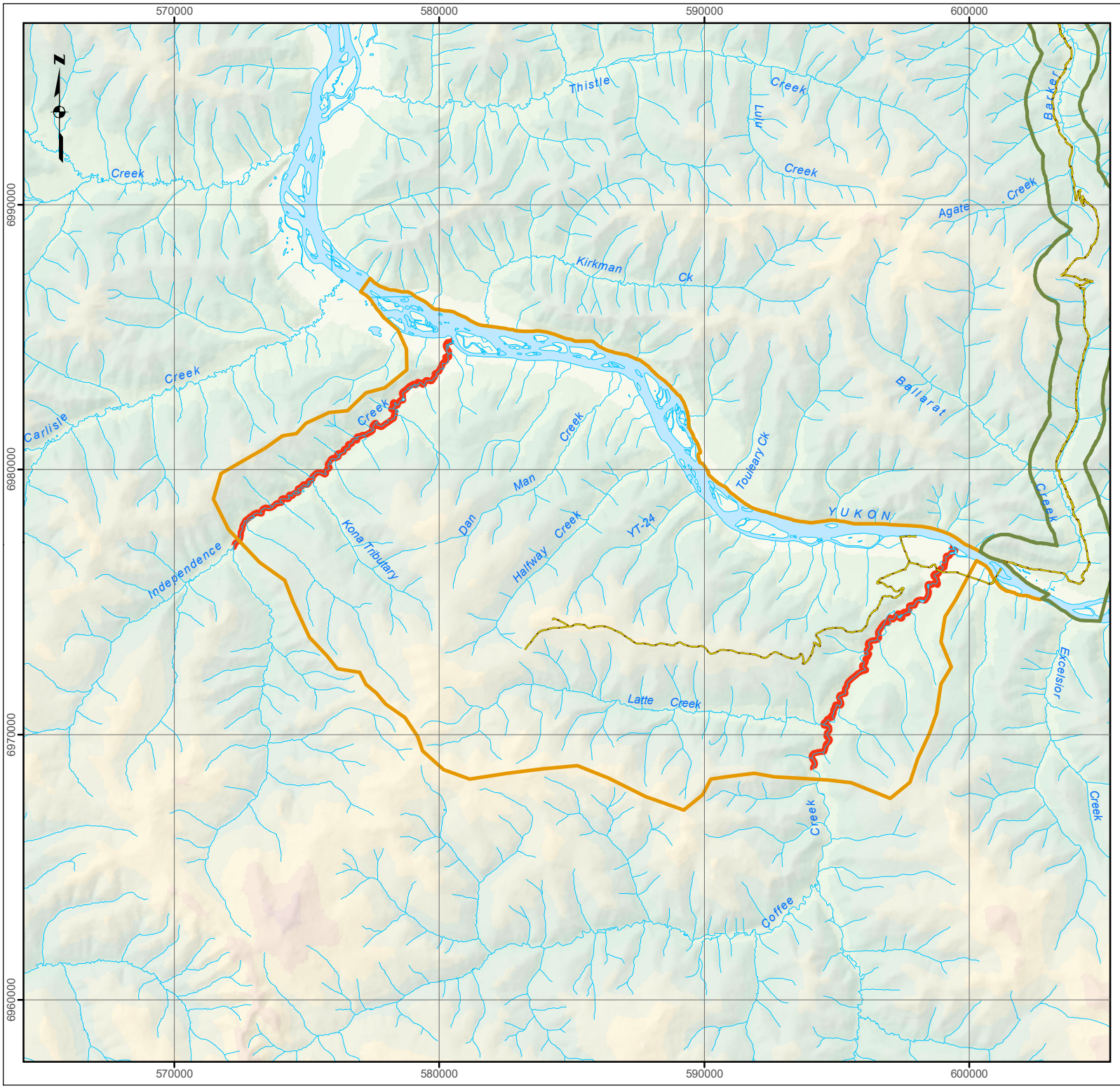
2.4.4 CHINOOK SALMON SPAWNING SURVEYS

Chinook spawning surveys were completed in areas where Traditional Knowledge indicated past presence and where habitat appeared to be suitable for Chinook spawning (Coffee and Independence Creek). Aerial surveys were completed by helicopter on Coffee Creek on August 18th, 2016 between 11:05 and 11:35 hrs and on Independence Creek on August 20th, 2016 between 13:27 and 14:11 hrs. Both streams were surveyed from the Yukon River upstream to a point where the stream was thought to be too small for adult Chinook (Independence was surveyed for 16 km and Coffee for 13 km; Figure 8). Observers were located in the front and backseats and the pilot positioned them over the river, flying sideways with the best possible vantage point at approximately 40-45 m above ground level. Surveys were completed in an upstream manner, from the mouth towards its headwaters. Observers wore polarized glasses to reduce glare. Weather was sunny and light conditions were considered very good. Tannins in both streams reduced the visibility in very deep pools, but the river could be seen to a depth of ~1m.



Legend

- Settlement/Community
- Proposed Route
- Chinook Salmon Spawning Survey Extent

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 8

August 2016 Chinook salmon spawning survey extent in the Mine study area

Data Sources
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Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Survey flight tracks (Chinook salmon spawning survey extent) were recorded by EDI Environmental Dynamics Inc. on August 18 and 20, 2016.

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2.4.5 FISH TISSUE METALS ANALYSIS

Fish tissues for metals analysis were collected and analyzed by PECG in 2014 and 2015 and by EDI in 2016 (Table 6). Before the 2016 sampling it was determined that uranium is a contaminant of concern in the Project area; concentrations of uranium in water are predicted to increase and in some cases exceed the CCME guideline for the protection of freshwater aquatic life. Uranium is stored preferentially in mineralized tissues, including bone. Therefore, previous years sampling which focussed on muscle tissues are believed to have underestimated the uranium concentration in tissues. Fish tissue sampling in 2016 was conducted using whole body samples (Table 6). Aging structures could not be collected from samples collected for analysis of the whole body samples to avoid sample contamination. However age/length relationships were developed by PECG (2017) and these relationships can be used together with length data collected in 2016 to estimate age.

Fish were collected for tissue sampling during winter and summer fish and fish habitat assessments, from March 3 and 4, and August 20-23, 2016. Sampling attempted to capture 10 of each slimy sculpin and Arctic grayling from each sampling location; juvenile Chinook salmon were only retained when incidental mortalities of individuals occurred during sampling. All captured fish were identified to species and measured. Fork lengths were measured for species with forked tails; total lengths were measured for fish with non-forked tails (i.e. sculpin). Incidental mortalities and those fish that were retained were also weighed. Retained individuals from both species were rinsed with creek water from each station to remove any sediment or organics debris, and were preserved on-site via freezing. The target tissue size for total metals and percent moisture analyses was 5.0 g, however the lab indicated they would be able to work with as little as 2.0 grams if necessary. Individual retained fish of the same species from the same sample site with weights of less than one gram were pooled together to achieve a minimum target sample mass of one gram. Whole body samples were sent for analysis to Maxxam Analytics in Burnaby, B.C.

Maxxam conducted analyzed tissue samples for both percent moisture and metals concentrations. For percent moisture the lab collected a subsample from the homogenized tissue samples. The subsamples were placed on a tared pan and weighed on a two decimal point balance. The samples were then placed in a forced-air oven at 105 ± 5°C to dry, generally overnight. The samples were dried to a constant weight (removed and allow to cool, weigh sample, return to oven for 30 minutes, remove and cool, reweigh, repeat as needed), and the final weight recorded. The percent moisture was then calculated.

Maxxam analytics analyzed metal concentrations in fish tissue samples by first weighing and then digesting samples using a mixture of hydrogen peroxide and hydrochloric acid at 95°C for two hours. Samples were then filtered and analyzed using inductively coupled plasma mass spectrometry (ICP/MS). There were 31 total metals analyzed with detection limits as presented in Table 7.

Table 6. Fish collected for baseline tissue metal analysis in the Coffee Project area.

Watershed	SSID - old	SSID new	Sample Date	Species	Sample Type	Samples Collected
Coffee	CCM	CF0.5	Winter 2016	CH	whole body	3 juvenile Chinook salmon
Coffee	CC4.5	CF2.7	Winter 2016	CCG	whole body	5 slimy sculpin
Coffee	CC4.5	CF2.7	Winter 2016	CH	whole body	3 juvenile Chinook salmon
Coffee	--	CF3.9	Summer 2016	CCG	whole body	10 slimy sculpin
Coffee	AQ00	CF3.9	Summer 2015	GR	muscle	2 Arctic grayling
Coffee	AQ02	CF8.0	Summer 2014	CCG	whole body minus head	9 slimy sculpin
Coffee	AQ02	CF8.0	Summer 2015	CCG	whole body minus head	3 slimy sculpin
Coffee	AQ02	CF8.0	Summer 2015	GR	muscle	6 Arctic grayling
Coffee	CC0.5	CF8.0	Winter 2016	CCG	whole body	1 slimy sculpin
Coffee	CC997	CF10.0	Winter 2016	CCG	whole body	1 slimy sculpin
Coffee	--	CF10.0	Summer 2016	CCG	whole body	10 slimy sculpin
Coffee	--	CF10.0	Summer 2016	GR	whole body	7 Arctic grayling
Halfway	--	HF0.2	Summer 2016	CH	whole body	12 juvenile Chinook salmon
Halfway	--	HF0.2	Summer 2016	GR	whole body	1 Arctic grayling
Independence	AQ10	ID1.9	Summer 2014	CCG	whole body minus head	8 slimy sculpin
Independence	AQ10	ID1.9	Summer 2015	CCG	whole body minus head	1 slimy sculpin
Independence	--	ID1.9	Summer 2016	CCG	whole body	10 slimy sculpin
Independence	AQ11	ID6.7	Summer 2014	GR	muscle	1 Arctic grayling
Independence	AQ11	ID6.7	Summer 2015	GR	muscle	7 Arctic grayling
Isaac	AQREF1	IS0.1	Summer 2014	CCG	whole body minus head	9 slimy sculpin
Isaac	AQREF1	IS0.1	Summer 2015	CCG	whole body minus head	3 slimy sculpin
Los Angeles	AQREF2	LaC4.8	Summer 2015	CCG	whole body minus head	1 slimy sculpin
Los Angeles	AQREF2	LaC4.8	Summer 2015	GR	muscle	1 Arctic grayling
Los Angeles	AQREF2	LaC4.8	Summer 2015	GR	muscle	1 Arctic grayling
Los Angeles	--	LaC4.8	Summer 2016	GR	whole body	3 Arctic grayling
Latte	AQ03	LC0.5	Summer 2014	CCG	whole body minus head	1 slimy sculpin
Latte	AQ03	LC0.5	Summer 2015	CCG	whole body minus head	2 slimy sculpin
Latte	AQ04	LC2.7	Summer 2015	GR	muscle	2 Arctic grayling
Latte	--	LC2.7	Winter 2016	GR	whole body	5 Arctic grayling
Latte	AQ04	LC2.7	Summer 2016	GR	muscle	6 Arctic grayling

Table 7. Tissue metals and detection limits (Maxxam Analytics) for tissue analysis.

Metal	Detection Limit
Total Aluminum (Al)	0.2
Total Antimony (Sb)	0.001
Total Arsenic (As)	0.005
Total Barium (Ba)	0.01
Total Beryllium (Be)	0.002
Total Bismuth (Bi)	0.02
Total Boron (B)	0.4
Total Cadmium (Cd)	0.002
Total Calcium (Ca)	2
Total Chromium (Cr)	0.01
Total Cobalt (Co)	0.004
Total Copper (Cu)	0.01
Total Iron (Fe)	1
Total Lead (Pb)	0.002
Total Magnesium (Mg)	2
Total Manganese (Mn)	0.02
Total Mercury (Hg)	0.002
Total Molybdenum (Mo)	0.01
Total Nickel (Ni)	0.01
Total Phosphorus (P)	2
Total Potassium (K)	2
Total Selenium (Se)	0.01
Total Silver (Ag)	0.004
Total Sodium (Na)	2
Total Strontium (Sr)	0.01
Total Thallium (Tl)	0.0004
Total Tin (Sn)	0.02
Total Titanium (Ti)	0.05
Total Uranium (U)	0.0004
Total Vanadium (V)	0.02
Total Zinc (Zn)	0.04

2.4.6 BENTHIC INVERTEBRATE SAMPLING FOR TISSUE METALS ANALYSIS

Benthic invertebrate sampling for tissue metals analysis in the Mine study area and reference sites was conducted on March 3 and 4, and August 20 to 23, 2016 (Figure 9). The goal of this sampling was to collect benthic invertebrate samples of sufficient mass to allow for analysis of metals concentrations in benthic invertebrate tissues; sampling was not intended to assess benthic invertebrate abundance or distribution. Prior to March 2016, no metals analysis had been conducted on benthic invertebrate tissues; however, benthic invertebrate samples had been collected and submitted for taxonomic analysis to assess community composition and overall benthic invertebrate abundance/diversity (PECG 2017).

Tissue metals concentrations assist with the comprehensive understanding of station-specific metal bioaccumulation between sediments, benthic invertebrates and fish populations. Benthic invertebrate sampling was conducted via kick netting, and focused on riffle habitats (Table 8) which had the following characteristics:

- For winter sampling: sufficient area of riffle habitat that could be cleared of ice, or was ice free, at the time of sampling;
- Sufficient amount of stream flow to allow for dislodged benthic invertebrates to be washed into the kick net; and,
- Sufficient stream bed material to be easily agitated by kicking.

At each of the stations sampled, kick netting was conducted using a 250 micron mesh with a detachable collection cup. The final samples were all composites made of three or more net kicks. The opening of the net faced upstream and the bottom of the net was rested on the stream bed; the field sampler walked backward while moving in a zig-zag motion upstream through the sampling area. Benthic invertebrates were dislodged from the stream bed by vigorous kicking for a period of 20 to 40 minutes; the amount of sampling effort at each site was proportional to the available area of suitable habitat. In-situ water quality parameters including water temperature, pH, specific conductivity and dissolved oxygen concentration were collected at each sample site. More than one replicate was collected when benthic invertebrate abundance allowed (Table 8).

All collected sample material from each site was washed from the collection cup using stream water from each site. Samples were placed in large, clean Ziploc bags and all washings were retained. At the completion of each day's sampling, collected sample material was sorted and invertebrates were separated from stream sediments and organic debris. All observed macroscopic invertebrates were removed from each sample and were then preserved by freezing. All samples were weighed, and individually packaged in sterile, labelled WhirlPak containers, and were kept frozen until they were delivered under chain of custody (COC) documentation to Maxxam Analytical for analyses including percent moisture and total metals concentrations in benthic invertebrate tissues. The target tissue size for total metals and percent moisture analyses was 5.0 g, however the lab indicated they would be able to work with as little as 2.0 grams if necessary.

Maxxam conducted analyzed tissue samples for both percent moisture and metals concentrations. For percent moisture the lab collected a subsample from the homogenized tissue samples. The subsamples were placed on a tared pan and weighed on a two decimal point balance. The samples were then placed in a forced-air oven at 105 ± 5°C to dry, generally overnight. The samples were dried to a constant weight (removed and allow to cool, weigh sample, return to oven for 30 minutes, remove and cool, reweigh, repeat as needed), and the final weight recorded. The percent moisture was then calculated.

Maxxam analytics analyzed metal concentrations in fish tissue samples by first weighing and then digesting samples using a mixture of hydrogen peroxide and hydrochloric acid at 95°C for two hours. Samples were then filtered and analyzed using inductively coupled plasma mass spectrometry (ICP/MS). There were 31 total metals analyzed with detection limits as presented in Table 7.

Table 8. Summary of 2016 benthic invertebrate sampling in the Mine study area.

Station Name/Site Name	Stream	Sampling Date	Number of replicates collected	Sample weight (g) [1]
CF2.7	Coffee Creek	4/5 March 2016	6	1.3, 3.4, 2.5, 2.2, 1.3, 2.0
ID4.5	Independence Creek	04-Mar-16	1	0.6
LC2.7	Latte Creek	21-Aug-16	1	2.6
LC9.9	Latte Creek	21-Aug-16	1	2.4
CF3.9	Coffee Creek	21-Aug-16	1	3.5
CF10.0	Coffee Creek	21-Aug-16	1	3.5
HF0.2	Halfway Creek	23-Aug-16	2	2.5, 2.7
HF6.3	Halfway Creek	20-Aug-16	1	2.6
YT0.2	YT-24 Creek	23-Aug-16	1	2.8
YT5.0	YT-24 Creek	21-Aug-16	1	2.1
ID1.9	Independence Creek	20-Aug-16	1	2.5
LaC4.8	Los Angeles Creek	20-Aug-16	2	2.2, 2.9

[1] Sample weights less than 2.0 g were analysed by the lab, but detection limits were raised, as necessary, see Maxxam COA, Appendix E, for detailed detection limits.

2.4.7 CHLOROPHYLL–A

Chlorophyll-a sampling was conducted in late summer when communities were expected to have reached maximum density and diversity. Sampling sites were selected with an attempt to standardize, where possible, water depth, velocity, gradient, substrate, and sunlight exposure (Figure 9; Table 9).

Six rocks were randomly selected and sampled at each chlorophyll-a sample site using a 10 cm (4") diameter template and scrub brush. Each rock represented one replicate, resulting in a total of six replicates collected

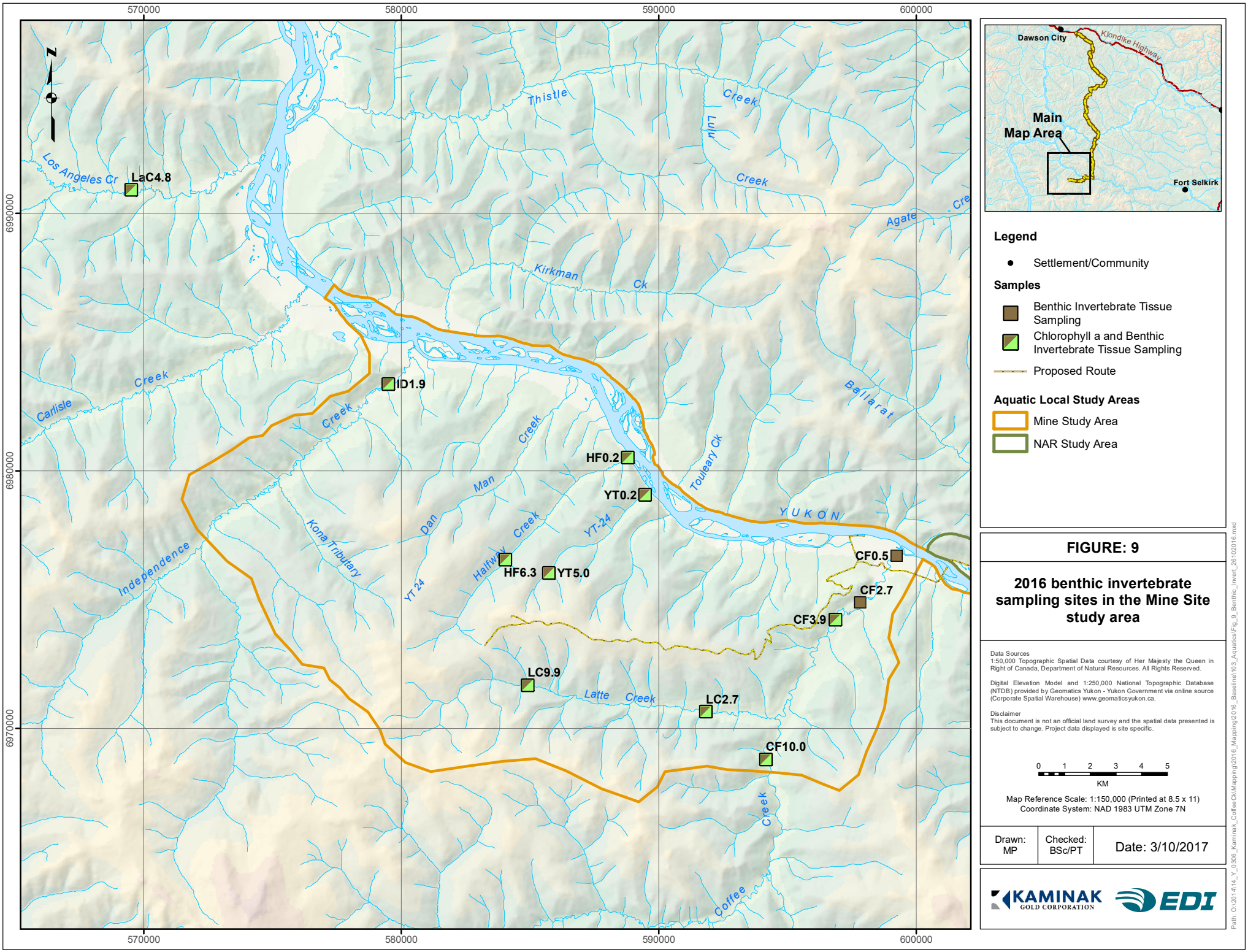
per site. Algae scrubbed from within the template area were washed into a 500 mL laboratory-supplied bottle; sample volume from each rock was approximately 50 mL. Each replicate was then filtered through a 0.45 µm filter within 12 hours of sample collection. The sample filters were separately preserved, as recommended by the analytical laboratory performing the analysis, and labelled with the site name, date, and area sampled. Sample filters were kept frozen and dark until they were transferred to the laboratory under chain of custody documentation.

Samples were sent to Maxxam Analytics in Burnaby, BC where they were filtered, ground, and extracted using 90% acetone and analyzed on a spectrophotometer. Results were presented as mass/area (µg/cm² or mg/cm²) as the lab was provided with the known volume sampled per area of substrate sampled at each site.

Upon receipt of data results from the laboratory, summary statistics for each site including minimum, maximum and mean values were calculated from the six replicates collected at each site. Mean values from each site were used to perform a between site comparison.

Table 9. Summary of 2016 chlorophyll-a sampling in the Mine study area.

Station Name/Site Name	Stream	Sampling Date
LC9.9	Latte Creek	21-Aug-16
LC2.7	Latte Creek	21-Aug-16
CF3.9	Coffee Creek	21-Aug-16
CF10.0	Coffee Creek	21-Aug-16
HF0.2	Halfway Creek	23-Aug-16
HF6.3	Halfway Creek	20-Aug-16
YT0.2	YT-24 Creek	23-Aug-16
YT5.0	YT-24 Creek	21-Aug-16
ID1.9	Independence Creek	20-Aug-16
LaC4.8	Los Angeles Creek	20-Aug-16



Legend

- Settlement/Community

Samples

- Benthic Invertebrate Tissue Sampling
- Chlorophyll a and Benthic Invertebrate Tissue Sampling
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 9

2016 benthic invertebrate sampling sites in the Mine Site study area

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change. Project data displayed is site specific.

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KM

Map Reference Scale: 1:150,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn:	Checked:	Date:
MP	BSc/PT	3/10/2017

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2.4.8 STREAM GRADIENT MODELLING

Modelling of stream gradients was completed to provide additional context to the fish bearing potential of focal streams in the vicinity of the Project infrastructure, particularly those streams that intersect the proposed mine infrastructure. Although stream gradient alone cannot be used to indicate whether streams are fish bearing, analysis of stream gradient properties can be a useful tool in determining the likelihood of fish presence (BC MOF 1998).

The stream gradient modelling involved the use of LIDAR imagery (2 m resolution digital elevation model) with stream gradients measured at 100 m intervals along the streams of interest. A watercourse layer was produced digitally using the LIDAR imagery and provided to EDI for the purposes of this modelling. Stream gradient measurement data points where then color coded according to the stream gradient ranges, with hotter colors (reds) indicating steep gradients and cooler colors (greens) indicating shallow gradients (stream gradients found in Table 10).

2.4.9 NORTHERN ACCESS ROUTE

Fish and fish habitat assessments were completed along the NAR in 2016. Many crossings that were assessed in 2015 were revisited in order to collect additional information and where applicable, update the fish bearing status of each crossing. At each crossing, an assessment of channel characteristics was made to determine if the drainage should be considered a stream. A stream was defined as having flow on a perennial or seasonal basis having a continuous channel bed that was scoured by water and contains deposits of alluvium[3]. If it was determined to be a stream, a Fish Habitat Site Card (BC MOE 2008) was completed and investigations were made to determine if the stream was fish bearing, potentially fish bearing or non-fish bearing. Investigations included fish sampling (electrofishing and/or minnow trapping), assessment of habitat quality and evaluation of downstream barriers to fish passage and closely followed methods outlined in BC MOF (1998).

2.4.9.1 Barge Landing Investigations

Proposed barge landings on the Stewart and Yukon rivers were visited and sampled for fish during 2016. Visual observations were made to describe the fish habitat present in these areas. Fish sampling was conducted primarily using beach seining with minnow trapping also conducted at the proposed north Yukon River barge landing site. In some cases, the beach seining sites were located upstream or downstream of the proposed landing sites due to the presence of vertical banks which were not conducive to fish sampling. A total of six beach seining hauls were completed at proposed barge landing sites (three hauls on

[3] This definition is consistent with Forest Practices Code of British Columbia (1998); no such definition of stream in the Yukon could be found. A key consideration is that fish species found in Yukon would not use habitats that do not meet this definition of stream (unless it is a lake or open water wetland).

the Yukon River and three on the Stewart River) and minnow traps were set at two stations on the Yukon River (Figure 10).

The beach seine used was 10 m in length, 2 m deep and constructed of 5 mm mesh. Information collected for each beach seine haul included in-situ water quality, water clarity and seine haul dimensions (length, width, depth). Minnow traps were baited with Yukon River origin salmon roe and left to sit for approximately 24 hours. All fish captured were identified to species and subsample of 10 individuals per species measured to fork length.

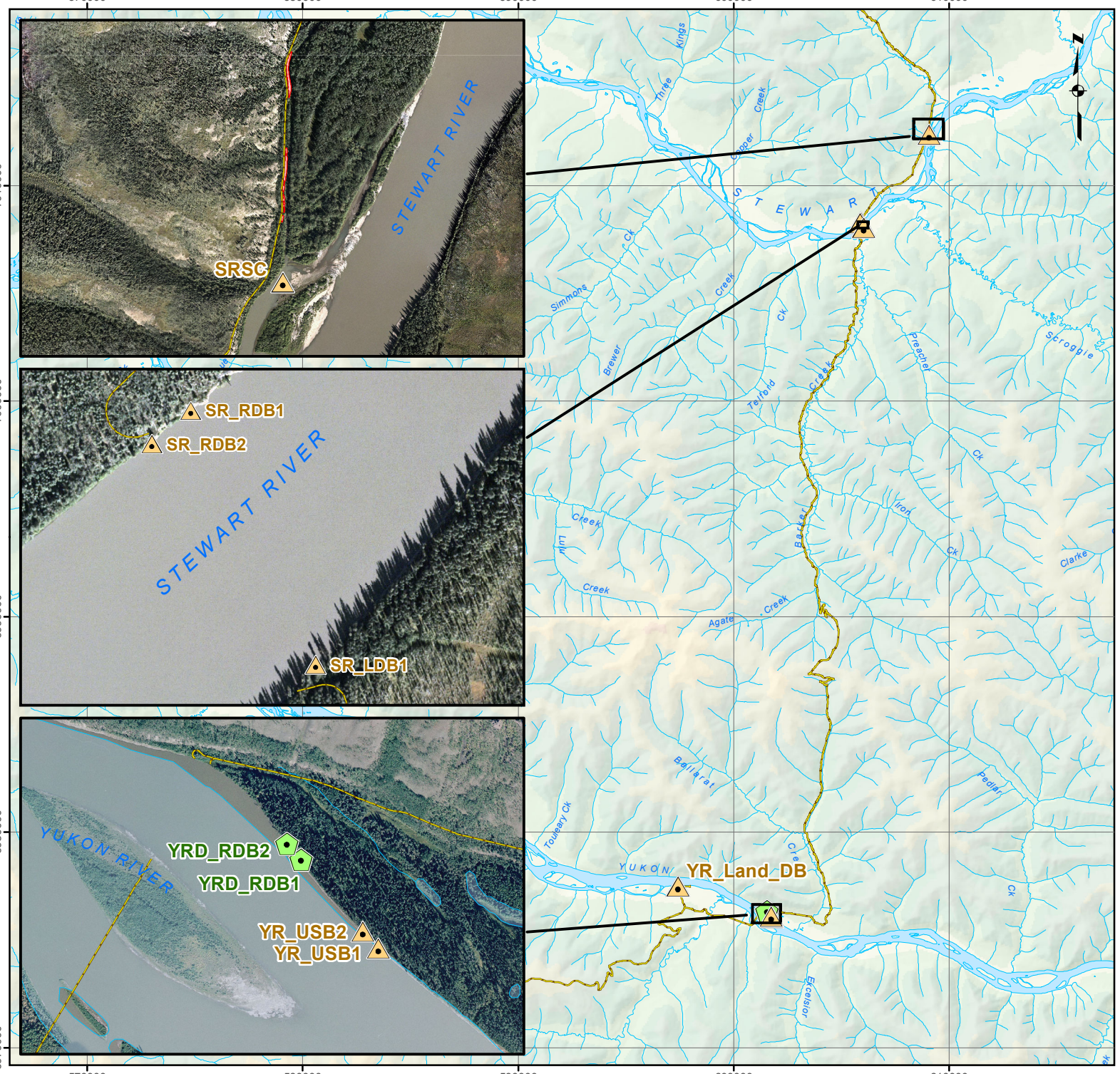
2.4.9.2 Stewart River Back Channel Investigations

A back channel on the Stewart River which will be encroached upon by the Northern Access Route was visited on two occasions during 2016: July 14 and October 25. During the July visit, the area downstream of the back channel (Figure 10) was sampled for fish using a beach seine and in-situ water quality parameters were collected. During the October visit, the back channel was visited to collect water quality parameters and determine the potential for fish overwintering.

2.4.9.3 Chum Salmon Spawning Surveys

Aerial surveys were completed by helicopter on the Yukon and Stewart rivers on October 24 and 25, 2016. The Yukon River was surveyed from Britannia Creek (21 km upstream of Coffee Creek) downstream to Dan Man Creek, a river distance of approximately 35 km (Figure 11). The Stewart River was surveyed from 6 km upstream of Maisy May Creek, downstream below the proposed barge landings near Barker Creek to a point 8 kilometers downstream of Brewer Creek for a total river distance of approximately 26 km (Figure 11).

Observers were located in the front and backseats and the pilot positioned them over the river, flying sideways with the best possible vantage point at approximately 40-45 m above ground level. Surveys were completed in an upstream manner with both observers wearing polarized glasses to reduce glare. Air temperatures during the survey were relatively cold (-20°C) which resulted in freezing conditions on both rivers, particularly the Stewart River where the ice conditions limited the ability to see spawning chum. All open water areas within river channel were surveyed, although an emphasis was placed on side channel habitats where groundwater discharge areas were present (known preferred spawning areas for chum salmon on large Yukon rivers).



Legend

- Settlement/Community
- Highway
- Proposed Route
- Encroachment Areas - Stewart River Back Channel

Fish Sampling Type

- Beach Seine
- Minnow Trap

FIGURE: 10

Fish sampling sites for proposed barge landings

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:50,000 National Topographic Database (NTDB) provided by Geomatics Yukon - www.geomaticsyukon.ca.

Aerial imagery courtesy of Kaminak gold Corporation.

Survey data collected by Environmental Dynamics Inc. (EDI). 2016. Locations obtained using Garmin GPS technology.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change. Project data displayed is site specific.

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KM

Map Reference Scale: 1:250,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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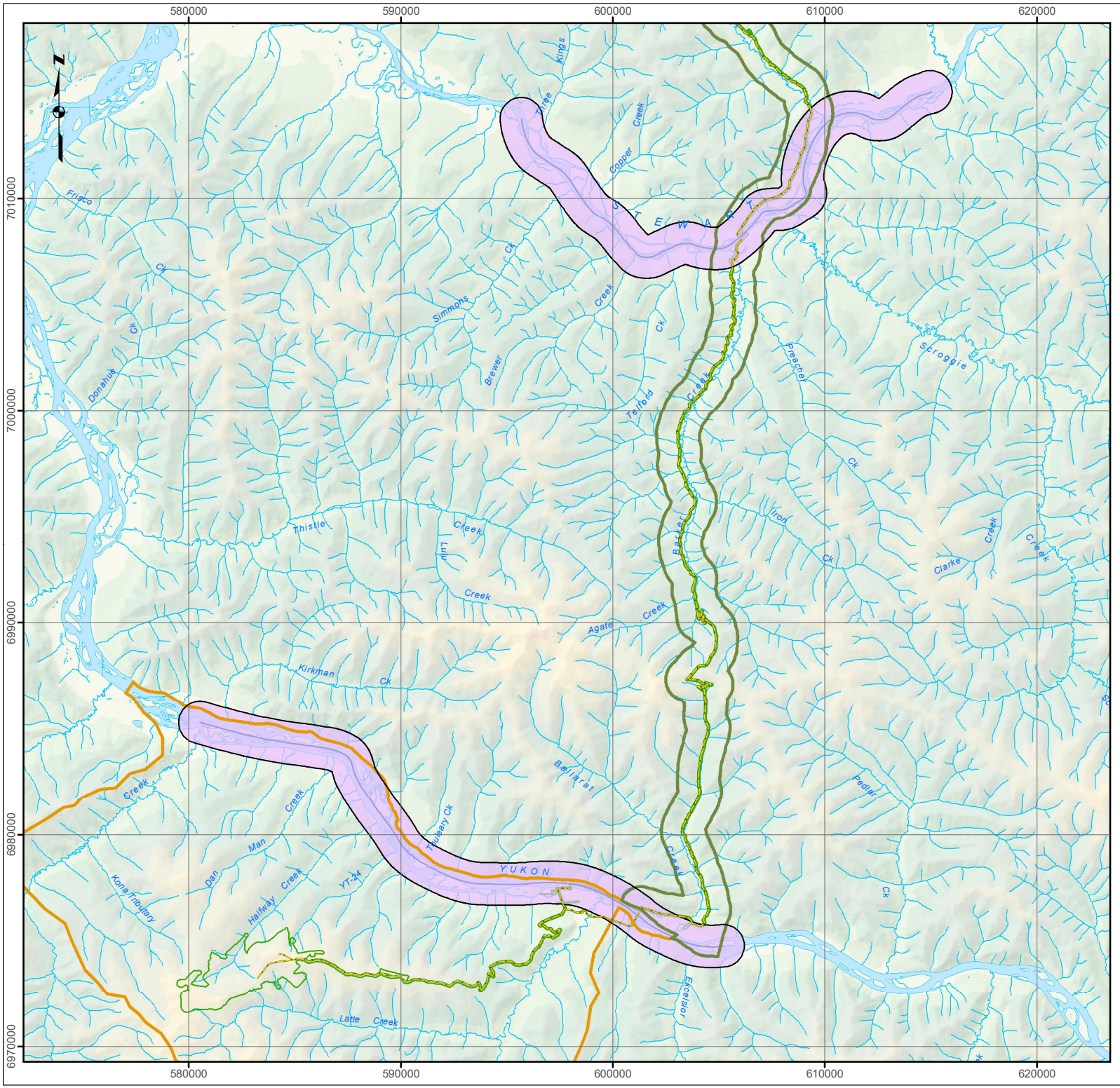

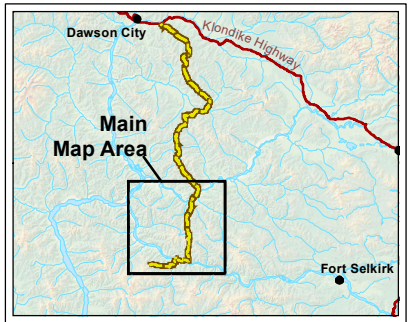

Legend

- Settlement/Community
- Proposed Route
- Chum Spawning Survey Extent (Stewart and Yukon Rivers)
- Project Footprint

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 11

October 2016 chum slamon spawning survey extent in the NAR study area

Data Sources
1:250,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Survey flight tracks (Chinook salmon spawning survey extent) were recorded by EDI Environmental Dynamics Inc. on August 18 and 20, 2016.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change. Project data displayed is site specific.

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3 RESULTS – MINE STUDY AREA

The results from all fish and aquatic resource data collected in the Mine study area are synthesized in the following sections. Where results are detailed by date and are not otherwise referenced, the following reference sources apply:

- This report (2016 data);
- PECG 2017 (2014 and 2015 data);
- PECG 2016 (2015 NAR specific data);
- ACG 2014 (2013 data);
- Laberge and White Mountain 2010 and 2002 (2012 and 2001 data, respectively);
- White Mountain (2000 data); and,
- Traditional Knowledge.

3.1 BIOPHYSICAL CHARACTERISTICS OF STREAMS (OVERVIEW)

The biophysical characteristics of the creeks in the Mine study area that were measured from 2014 and 2016 are summarized in Table 10. Other than recent mining exploration for the Project, the watersheds associated with the Mine study area have not been subject to development and as such the streams/watersheds are in an unaltered state. Fish habitat quality varies between and within watersheds, with the most complex and high quality habitat being located in Coffee and Independence creeks. These low gradient streams have moderate size (mean channel widths range of 12 to 25 m; Table 10) with riffle-pool morphologies and primarily a gravel dominated bed. Deep pools (>1 m) are also found in Coffee and Independence creeks. Latte, Halfway and YT-24 creeks have substantially smaller channel widths, no deep pools (>1 m) and higher gradients, especially at sampling stations further upstream in the watersheds. Additional information on biophysical characteristics on streams around the Mine can be found in PECG (2017), APPENDIX B and in sections 3.4 and 5 of this report.

Table 10. Summary of biophysical characteristics of small watersheds associated with Coffee Project, data from PECG 2017 and from 2016 field studies.

Stream Name (Sampling Station)	Mean Channel Width (m)	Mean Channel Gradient (%)	Deep Pools (>1m)	Substrate Type		Total Stream Cover
				Dominant	Subdominant	
Yukon River	~500	0	Y	-	-	-
Coffee Creek (CF3.9)	14.90	1	Y	gravels	cobbles / fines	Moderate
Coffee Creek (CF5.9)	22.08	2	Y	gravel	cobble	Moderate
Coffee Creek (CF8.0)	18.43	2	Y	gravel	cobble	Abundant
Coffee Creek (CF10.0)	24.55	2.5	Y	cobble	gravel	Moderate
Latte Creek (LC2.7)	5.86	2	N	cobble	gravel	Moderate
Latte Creek (LC9.9)	2.83	3	N	boulder	cobble	Moderate
Latte Creek (LC10.4)	3.81	7	N	cobble	boulder	Moderate
Latte Creek (LC11.8)	4.00	11	N	boulder	cobble	Abundant
Latte Creek, Tributary C (LCC0.2)	1.01	13.5	N	fines	gravel	Moderate
Independence Creek (ID1.9)	12.21	2	Y	gravel	cobble	Abundant
Independence Creek (ID6.7)	23.23	2	Y	gravel	cobble	Moderate
Kona Creek Tributary (KT0.1)	3.05	1	N	gravel	fines	Abundant
Kona Tributary (KT5.2)	2.23	8	N	boulder	cobble	Abundant
Halfway Creek (HF0.0)	4.03	2	N	cobble	gravel	Moderate
Halfway Creek (HF0.2)	4.80	2.3	N	cobble	gravel	Moderate
Halfway Creek (HF8.8)	2.60	10.5	N	boulder	cobble	Trace
Halfway Creek (HF9.3)	2.47	10	N	boulder	cobble	Moderate
YT-24 Creek (YT0.0)	4.20	8	N	cobble	boulder	Moderate
YT-24 Creek (YT0.2)	4.08	4	N	cobble	gravel	Moderate
YT-24 Creek (YT4.6)	2.83	9	N	cobble	boulder	Trace
YT-24 Creek (YT5.0)	1.87	11	N	boulder	cobble	Moderate

3.2 WINTER ICE COVERAGE EXTENT

Aerial video of Coffee, Latte, YT-24, Halfway and Latte Tributary C creeks that was collected in March 2016 showed that that majority of these watercourses were generally completely ice covered at the time of the overflights. Coffee Creek was the only creek where open water was observed. Varying amounts of aufeis formation (evidenced by snow free ice cover, and blue or brown tinged ice cover) were observed in all

creeks, particularly in the lower reaches of YT-24 and Halfway creeks. Ice coverage extent is detailed for each stream in the following sections.

3.2.1 COFFEE CREEK

The aerial video collected on Coffee Creek included the full length of the creek within the Mine study area; this included filming the creek from the confluence with the Yukon River to a linear distance of approximately 11 km upstream. Small, discontinuous areas of open water were observed in several areas in the lower 5 km of the creek (linear distance). This included a number of open water areas in the vicinity of the confluence with the Yukon River, as well as station CF2.7 (Photo 1), where several minnow traps were set in these areas of open water. A narrow area of open water was observed approximately 5 km upstream of the confluence with the Yukon River (Photo 2). Several small and discontinuous areas of 'overflow' or aufeis were observed in Coffee Creek, most notably in two straight and partially confined sections of the creek located approximately 4 km and 6.5 km (Photo 3) upstream of the Yukon River confluence. A small area of open water was also observed in the vicinity of sampling station CF10.0. The remainder of the surface of Coffee Creek was fully ice covered, including all areas upstream of the Latte Creek confluence.



Photo 1. Aerial view of site Coffee Creek sampling station CF2.7, showing winter open water leads; March 15, 2016. Photo blur due to motion of helicopter.



Photo 2. Aerial view of winter open water lead on Coffee Creek approximately 5 km upstream from the Yukon River confluence; March 15, 2016. Photo blur due to motion of helicopter.

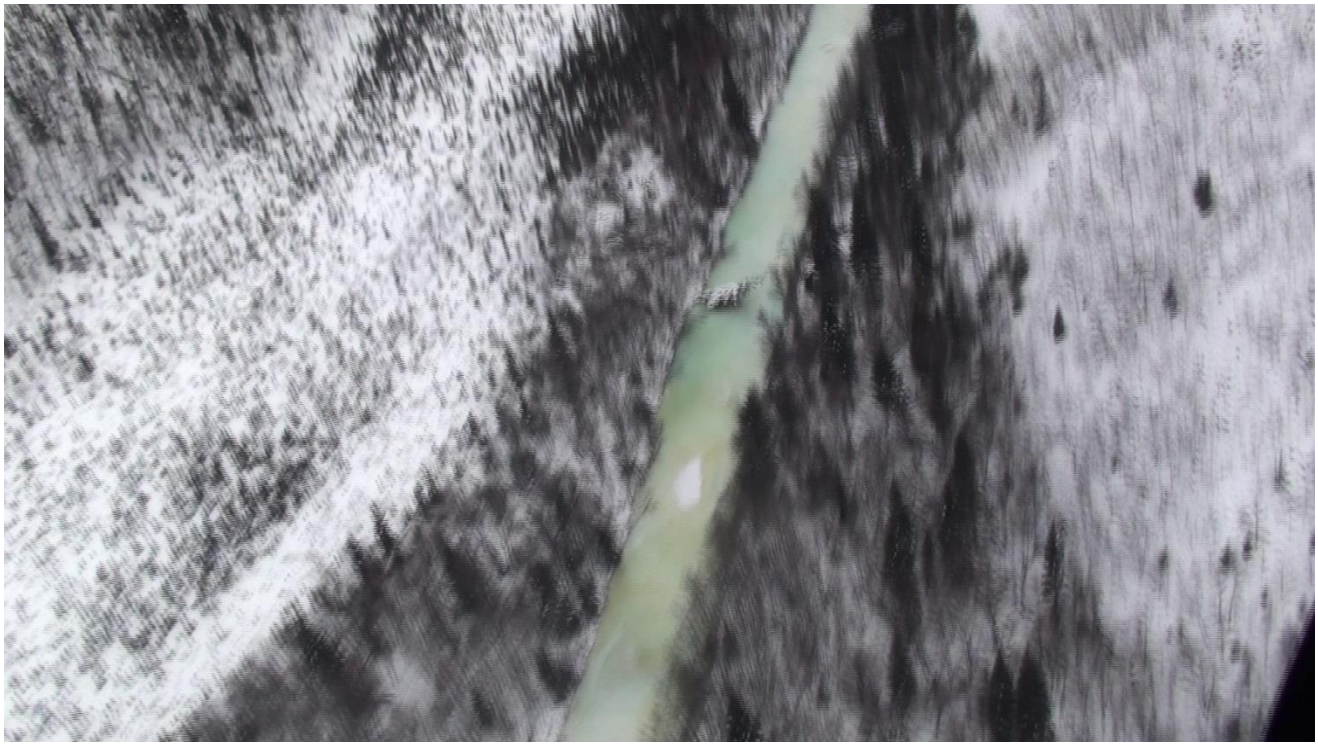


Photo 3. Aerial view of aufeis on Coffee Creek, approximately 5 km upstream of the confluence with the Yukon River.

3.2.2 LATTE CREEK

The aerial video collected on Latte Creek included filming from the confluence with the Coffee Creek to the confluence with Latte Creek Tributary C. No open water areas were observed, and the channel was fully ice covered. Discontinuous aufeis was observed throughout the creek (Photo 4).



Photo 4. Aerial view of aufeis on Latte Creek.

3.2.3 LATTE CREEK TRIBUTARY C

The aerial video collected on Latte Creek Tributary C included filming from the confluence with the Latte Creek to the headwaters of the tributary. No open water areas were observed, and the small channel width was fully ice covered. A small area of 'overflow' or aufeis was observed approximately 600 m upstream of the confluence with Latte Creek (Photo 5).



Photo 5. Aerial view of aufeis area on Latte Creek Tributary C, approximately 600 m upstream of the Latte Creek confluence; March 15, 2016.

3.2.4 YT-24 CREEK

The aerial video collected on YT-24 Creek included filming from the confluence with the Yukon River to the headwaters of the creek. Much of the lower 3 km of the creek channel is heavily forested along the stream banks, and the creek channel was difficult to observe from the air in this portion of the creek. No open water areas were observed, and the small channel width was fully ice covered. A substantial area of aufeis was observed approximately 3 km upstream of the confluence with the Yukon River (Photo 6), and it appeared that the area of aufeis extended beyond the banks of the creek channel.



Photo 6. Aerial view of aufeis formation on YT-24 Creek, approximately 3 km upstream of the Yukon River confluence; March 15, 2016.

3.2.5 HALFWAY CREEK

The aerial video collected on Halfway Creek included filming from the confluence with the Yukon River to the headwaters of the creek. No open water areas were observed, and the channel was fully ice covered. Discontinuous aufeis was observed throughout the Halfway Creek mainstem (Photo 7), but was not observed in smaller first order tributaries.



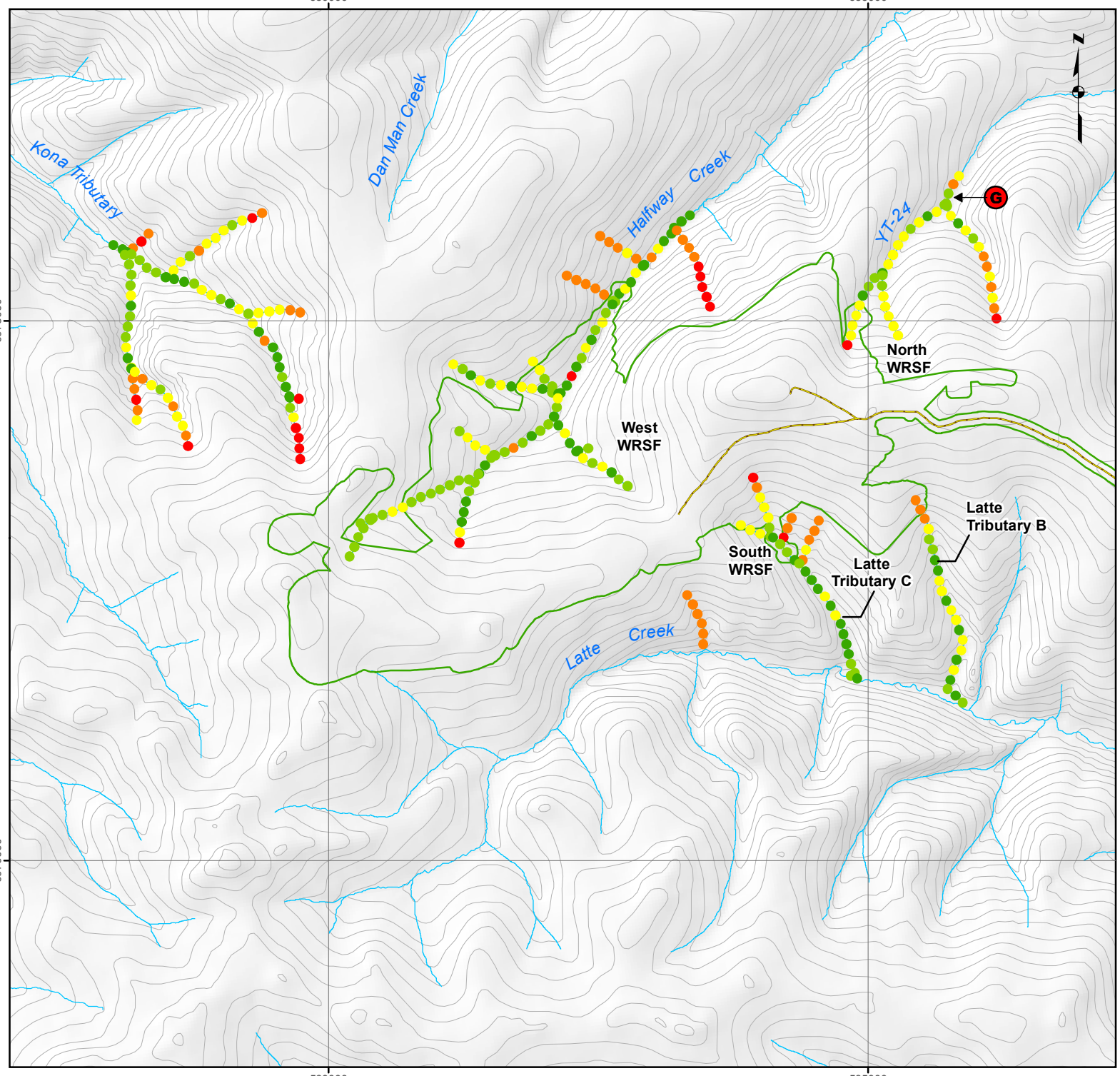
Photo 7. **Aerial view of aufeis formation on Halfway Creek, approximately 2 km upstream of the confluence with the Yukon River; March 15, 2016.**

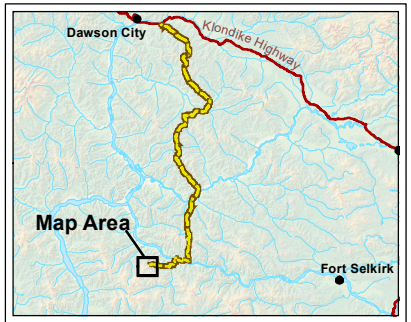
3.3 STREAM GRADIENT MODELLING

The 2016 modelling of gradients in the small streams in the vicinity of the Project infrastructure indicates that portions of these streams have gradients that can be prohibitive to fish migration and use. Considering stream gradients independently of other variables, the British Columbia Fish Stream Identification Guidebook (BC MOF 1998) indicates that stream gradients greater than 20% for 100 m or greater can be considered barriers to all fish species.

Due to identified interactions with the Mine footprint, the primary focal streams for the gradient modelling included Latte Creek tributaries B and C and the upper portion of the YT-24 and Halfway Creek watersheds (Figure 12). On Latte Creek Tributary C, modelled stream gradients are commonly within the range of 8 to 16% and higher in the watershed there are sections with gradients in excess of 17% and some gradients over 20%.

The stream gradient modelling indicates that upper Halfway Creek has a number of high gradient sections which likely preclude fish presence in this portion of the watershed. The upper portion of YT-24 Creek has a relatively steep gradient, almost exclusively in excess of 12%. A field verified gradient barrier of 30% has also been documented by PECG (2017) near an area where the modelled gradient data shows an area of greater than 20%.





Legend

- Field Documented Fish Passage Barrier (Gradient)
- Proposed Route
- Project Footprint (as of March 10, 2017)

Stream Gradients in the Coffee Property (100 m intervals)

- up to 8% Stream Gradient
- 8% – 12% Stream Gradient
- 12% – 16% Stream Gradient
- 16% – 19% Stream Gradient
- 20%+ Stream Gradient

FIGURE: 12

Gradients of focal streams within the Coffee Property as derived by LiDAR imagery

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Stream gradients were developed by EDI using a watercourse layer that was produced digitally by Kaminak using LiDAR imagery. EDI does not gaurantee any accuracy of the data.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change. Project data displayed is site specific.

0 0.5 1 1.5 2
KM

Map Reference Scale: 1:50,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MP	Checked: BSc/PT	Date: 3/10/2017

KAMINAK GOLD CORPORATION EDI

Path: O:\2014\14_Y_0306_Kaminak_CoffeeCk\Mapping\2016_Mapping\2016_Baseline\103_Aquatics\Fig_12_StreamGradients_26102016.mxd

3.4 FISH DISTRIBUTION

Chinook salmon (juvenile), Arctic grayling, slimy sculpin and chum salmon have been captured or documented in Mine study area sampling stations during sampling conducted in 2000, 2001, 2010, 2013, 2014, 2015 and 2016 (Table 11; APPENDIX C). More detailed information is described for each stream in the following subsections.

Table 11. Summary of fish species documented in the Mine study area during baseline studies.

Station	Location	Years Sampled	Documented Fish Species	Season of Fish Capture or Observation
-	Yukon River	2016	Refer to Table 12	n/a
CF0.5	Coffee Creek near Yukon River	2000, 2001, 2010, 2016 –winter only	CH, CCG, GR	Summer and Winter
CF2.7	Coffee Creek below Latte Creek	2013, 2016 – winter only	CH, CCG	Summer and Winter
CF3.9	Coffee Creek below Latte Creek	2014, 2015, 2016	CH, CCG, GR	Summer
CF5.7	Coffee Creek below Latte Creek	2014, 2015	CH, GR	Summer
CF8.0	Coffee Creek below Latte Creek	2016	CCG	Winter
CF8.3	Coffee Creek near Latte Creek	2013, 2014, 2015	CH, CCG, GR	Summer
CF10.0	Coffee Creek above Latte Creek	2016	CCG, GR	Summer and Winter
LaC4.8	Los Angeles Creek	2015, 2016	CH, GR, RW[1]	Summer
LC0.5	Latte Creek near Coffee Creek	2013, 2014, 2015, 2016 – winter only	CCG, GR[2]	Summer
LC1.6	Lower Latte Creek	2016 – winter only	No fish captured	-
LC2.7	Lower Latte Creek	2014, 2015, 2016	GR	Summer
LC9.9	Upper Latte Creek	2015, 2016	GR[1]	Summer
LC10.4	Upper Latte Creek	2014	No fish captured	-
LC11.8	Upper Latte Creek	2014, 2015	No fish captured	-
LCC0.0	Latte Creek tributary C	2016	No fish captured	-
LCC0.2	Latte Creek tributary C	2016	No fish captured	-
LCC0.3	Latte Creek tributary C	2016	No fish captured	-
HF0.0	Lower Halfway Creek	2014, 2015	GR	Summer
HF0.2	Lower Halfway Creek	2013, 2016	CH, GR	Summer
HF0.9	Lower Halfway Creek	2016	No fish captured	-
HF6.3	Upper Halfway Creek	2013, 2016	No fish captured	-
HF8.8	Upper Halfway Creek	2016	No fish captured	-
HF9.3	Upper Halfway Creek	2014, 2015	No fish captured	-
HFA0.1	Trib to Halfway	2016	No fish captured	-

Station	Location	Years Sampled	Documented Fish Species	Season of Fish Capture or Observation
YT0.0	Lower YT-24 Creek at mouth	2014, 2015, 2016	CCG[3]	Summer
YT0.2	Lower YT-24 Creek	2016	No fish captured	-
YT0.6	Lower YT-24 Creek	2016	No fish captured	-
YT0.9	Lower YT-24 Creek	2016	No fish captured	-
YT1.3	Lower YT-24 Creek	2016	No fish captured	-
YT4.6	Upper YT-24 Creek	2016	No fish captured	-
YT5.0	Upper YT-24 Creek	2014, 2015	No fish captured	-
ID0.0	Independence Creek at Yukon R.	2013	CCG	Summer
ID1.9	Lower Independence Creek	2013, 2014, 2015, 2016	CH, CCG, GR	Summer
ID6.7	Upper Independence Creek	2014, 2015	CH, CCG	Summer
IC7.5	Upper Independence Creek	2013	CH	Summer
KT0.1	Lower Kona Tributary	2014, 2015	GR	Summer
KT5.2	Upper Kona Tributary	2014, 2015	No fish captured	-
IS0.1	Isaac Creek	2014, 2015	GR, CH, CCG, BB, LSU, AL	Summer

Fish species codes: CM =Adult chum salmon, CH = Chinook salmon (juvenile), CCG = slimy sculpin, GR = Arctic grayling, AL = Arctic Lamprey, LSU = longnose sucker, BB = burbot, RW = round whitefish.

[1] Round whitefish were added to the fish species at this site during fish tissue sampling during 2016.

[2]Arctic grayling were observed but not captured at this site.

[3]Slimy sculpin were captured in the lower 50 m of the creek, which was back flooded by the Yukon River at the time of sampling.

3.4.1 YUKON RIVER

Traditional Knowledge (TK) and Current Land Use information provides information on fish species that can be found in the Yukon River and speaks to fish species of interest to First Nations and local Yukon residents. TK identifies whitefish (various species), burbot (*Lota lota*), northern pike (*Esox Lucius*), Arctic grayling and Chinook and chum salmon in the Yukon River within the study areas (Bates et. al. 2014, TH 2012, DRPC 2013; Interview 14, Pers. Comm. 2016). This species assemblage is supported by fish sampling during 2016 and is supplemented by the information in the Yukon FISS database of fish species that have been documented in the Yukon River and could potentially be present in the study areas (Table 12).

Table 12. Documented Yukon River fish species that may potentially occur in the study areas (data from DFO 2016).

Category	Common Name[1]	Scientific Name
Salmon species	Chinook salmon *	*Oncorhynchus tshawytscha*
	chum salmon *	*Oncorhynchus keta*
Freshwater fish species	Arctic grayling *	*Thymallus arcticus*
	broad whitefish	*Coregonus nasus*
	lake whitefish	*Coregonus clupeaformis*
	burbot *	*Lota lota*
	inconnu	*Stenodus leucichthys*
	northern pike *	*Esox lucius*
	least cisco	*Coregonus sardinella*
	longnose sucker *	*Catostomus catostomus*
	lake chub *	*Couesius plumbeus*
	slimy sculpin *	*Cottus cognatus*
	round whitefish	*Prosopium cylindraceum*
	Arctic lamprey	*Lethenteron camtschaticum*

[1] Species denoted with an '*' were documented in the Yukon River during 2016 sampling associated with barge landing assessments or spawning assessments. Refer to Section 4.2 for additional information.

Aerial surveys to attempt to document Chinook salmon spawning in the Yukon River within the study areas in July and August 2013 (ACG 2014) and July 2015 (PECG 2017) did not document any spawning activity. Aerial surveys to attempt to document chum spawning salmon in the Yukon River were conducted in September and October 2013 (ACG 2014), 2014 (PECG 2017) and 2016 (this report). Spawning was documented in groundwater fed side channels in both 2013 and 2016. Additional details are provided in Section 4.2.1.

3.4.2 COFFEE CREEK

Juvenile Chinook salmon, Arctic grayling, and slimy sculpin have been documented in Coffee Creek throughout the Mine study area. Juvenile Chinook salmon were captured downstream of the confluence with Latte Creek via minnow trapping (in 2000, 2001, 2010, 2014, 2015 and winter 2016) and electrofishing (2001 and 2010; Table 13). Arctic grayling were captured via angling, electrofishing, beach seining and to a lesser extent, via fyke netting. Upstream of the Latte Creek confluence, sampling during 2016 documented both slimy sculpin and Arctic grayling. Slimy sculpin were captured throughout Coffee Creek via electrofishing, minnow trapping and beach seining. Tr'ondëk Hwëch'in TK indicates that Chinook salmon used to spawn up Coffee Creek (TH 2012); however, recent aerial surveys to attempt to locate Chinook salmon spawning in Coffee Creek in 2000 (sampling month not specified), July 2001, August 2014, July 2015, August 2015 and August 2016 did not report any evidence of spawning. An aerial for chum salmon spawning in October 2014 also did not report any observed spawning activity for this species in Coffee Creek.

Table 13. Baseline fish sampling and capture data in Coffee Creek from 2014 to 2016, ordered by sampling site from downstream to upstream-most site (open water season only).

Sampling Site	Sample Date	Sampling Methods	Total Sampling Effort	Fish Captured
CF3.9	Aug 2014	Minnow Trapping	243.3 trap hours	Chinook salmon (122 juveniles), Slimy sculpin (3)
CF3.9	Aug 2014	Electrofishing	1,457 seconds	Slimy sculpin (24), Chinook salmon (10 juveniles)
CF3.9	Aug 2014	Angling	2 hours	Arctic grayling (1)
CF3.9	Aug 2014	Fyke Net	53.8 trap hours	Arctic grayling (6), Chinook salmon (3 juveniles)
CF3.9	Oct 2014	Minnow Trapping	126.3 trap hours	Chinook salmon (25 juveniles), Slimy sculpin (1)
CF3.9	June 2015	Angling	3.8 hours	Arctic grayling (6)
CF3.9	June 2015	Minnow Trapping	121.25 trap hours	Slimy sculpin (3)
CF3.9	July 2015	Angling	2.5 hours	Arctic grayling (12)
CF3.9	July 2015	Minnow Trapping	132.9 trap hours	Chinook salmon (8 juveniles)
CF3.9	July 2015	Fyke Net	23.1 trap hours	Chinook salmon (1 juvenile)
CF3.9	July 2016	Electrofishing	5,324 seconds	Chinook salmon (3 juveniles), Slimy sculpin (144)
CF3.9	July 2016	Angling	1.3 hours	None
CF5.7	Aug 2014	Minnow Trapping	237.5 trap hours	Chinook salmon (72 juveniles) Slimy sculpin (1)
CF5.7	Oct 2014	Minnow Trapping	125 trap hours	Chinook salmon (30 juveniles) Slimy sculpin (2)
CF5.7	June 2015	Angling	3 hours	Arctic grayling (2)
CF5.7	June 2015	Minnow Trapping	112.5 trap hours	Slimy sculpin (2)
CF5.7	July 2015	Angling	1.5 hours	Arctic grayling (7)
CF5.7	July 2015	Minnow Trapping	99.6 trap hours	Chinook salmon (2 juveniles), Slimy sculpin (1)
CF5.7	July 2015	Fyke Net	26 trap hours	None
CF8.0	Aug, 2014	Minnow Trapping	271.7 trap hours	Chinook salmon (62 juveniles), Slimy sculpin (4)
CF8.0	Oct 2014	Minnow Trapping	125 trap hours	Chinook salmon (16 juveniles), Slimy sculpin (3)
CF8.0	July 2015	Minnow Trapping	123.8 trap hours	Arctic grayling (1), Chinook salmon (14 juveniles), Slimy sculpin (4)
CF8.0	July 2015	Fyke Net	23.92 trap hours	None
CF8.0	Aug 2014	Fyke Net	46.6 trap hours	Arctic grayling (3) Slimy sculpin (3)
CF8.0	Aug, 2014	Electrofishing	1,118 seconds	Slimy sculpin (31)
CF8.0	July 2015	Electrofishing	942 seconds	Slimy sculpin (6)
CF8.0	July 2015	Fyke Net	23.9 trap hours	None
CF8.0	July 2015	Angling	3.8 hours	Arctic grayling (20)
CF10.0	July 2016	Electrofishing	4,616	Arctic grayling (9), Slimy sculpin (34)
CF10.0	July 2016	Angling	0.5 hours	Arctic grayling (3)

3.4.3 LATTE CREEK

In Latte Creek, Arctic grayling and slimy sculpin were documented in 2014, 2015 and 2016 (grayling only; Table 14). Slimy sculpin were captured only at the most downstream station (LC0.5), near the confluence with Coffee Creek (within 50 m). Further upstream, Arctic grayling were captured in moderate numbers at station LC2.7, with an approximate population estimate of 6 Arctic grayling/100 m² in 2014, and 10 Arctic grayling/100 m² in 2015 (±2 grayling, 90% confidence intervals for both years; PECG 2017). No fish were captured upstream of station LC2.7 (including at stations LC9.9, LC10.4 and LC11.8); however, one adult Arctic grayling was observed at station LC9.9 during the summer of 2015. None were captured or observed during 2016.

Table 14. Baseline fish sampling and capture data in Latte Creek from 2013 to 2016, ordered by sampling site from downstream to upstream-most site (open water period only).

Sampling Site	Sample Date	Sampling Methods	Total Sampling Effort	Fish Captured
LC0.5	July 2015	Minnow Trapping	240 trap hours	Slimy sculpin (1)
LC0.5	June 2015	Electrofishing	1,839 seconds	Arctic grayling (5) Slimy sculpin (3)
LC0.5	July 2015	Electrofishing	1,309 seconds	Arctic grayling (1) Slimy sculpin (1)
LC0.5	Sept 2015	Electrofishing	1,100 seconds	Arctic grayling (1) Slimy sculpin (1)
LC0.5	Oct 2014	Fyke Netting	25.8 trap hours	Slimy sculpin (7) Arctic grayling (1)
LC0.5	Sept 2015	Minnow Trapping	110.4 trap hours	None
LC2.7	Aug 2014	Minnow Trapping	118.4 trap hours	None
LC2.7	Aug 2014	Electrofishing	2,898 seconds	Arctic grayling (20)
LC2.7	June 2015	Electrofishing	1,278 seconds	Arctic grayling (11)
LC2.7	July 2015	Electrofishing	3,151 seconds	Arctic grayling (39)
LC2.7	July 2016	Electrofishing	3,108 seconds	Arctic grayling (7)
LC9.9	June 2015	Electrofishing	870 seconds	None
LC9.9	July 2015	Electrofishing	854 seconds	None
LC9.9	July 2016	Minnow Trapping	216 trap hours	None
LC10.4	Aug 2014	Minnow Trapping	58 trap hours	No fish captured
LC11.8	Aug 2014	Minnow Trapping	55 trap hours	No fish captured
LC11.8	June 2015	Electrofishing	768 seconds	No fish captured
LC11.8	July 2015	Electrofishing	835 seconds	No fish captured

3.4.4 LATTE CREEK TRIBUTARY B

Latte Creek Tributary B was visited in July 2016. This tributary was dewatered at its confluence with Latte Creek at the time of the field visit and had no potential to support fish of any kind. Small areas of

discontinuous pooled water were present in the lower 100 m of the watercourse, potentially from recent precipitation. Considerable amounts of terrestrial vegetation were present in this seasonal drainage and alluvial bed material was discontinuous (Photo 8). Further upstream the dry drainage narrowed and two hard barriers were documented with drops of 0.5 and 0.6 m, respectively. Gradients of 16 and 21% were measured in this portion of the watercourse. This is not a stream, rather a seasonal seepage area.



Photo 8. Latte Creek Tributary B lacking continuous channel and alluvial material.

3.4.5 LATTE CREEK TRIBUTARY C

This small tributary was not sampled for fish previous to 2016. Minnow trapping and electrofishing was completed in the lower 300 m of the stream in July 2016, no fish were captured (Table 15).

The lower 15 m of this stream is influenced by back flooding from Latte Creek (Photo 9). A 1 m high cascade over organics is present 15 m upstream of the mouth (Photo 10). Between this drop and 100 m from the mouth the channel is often poorly defined with a discontinuous alluvial bed (Photo 11). Upstream of the first 100 m, channel banks and alluvial bed material re-establish; however, the channel is narrow (~0.6 m channel width) with maximum residual pool depths of 0.13 m and numerous (non-permanent) drops over organic material up to 0.65 m (Photo 12). The average stream gradient of Tributary C between 100 m and

200 m from the confluence with Latte Creek was 13.5%. Moving upstream in the watershed gradients increase and the channel becomes narrower.

Table 15. Baseline fish sampling and capture data in Latte Creek Tributary C, ordered by sampling site from downstream to upstream-most site.

Sampling Site	Sample Date	Sampling Methods	Total Sampling Effort	Fish Captured
LCC0.0	July 2016	Minnow Trapping	69.5 trap hours	None
LCC0.0	July 2016	Electrofishing	105 seconds	None
LCC0.2	July 2016	Minnow Trapping	57.1 trap hours	None
LCC0.2	July 2016	Electrofishing	509 seconds	None
LCC0.3	July 2016	Electrofishing	114 seconds	None



Photo 9. Downstream view of lower 15 m of Latte Tributary C. Note Latte Creek in the background and cascade at the lower portion of the photo.



Photo 10. One metre high cascade located 15 m upstream from the mouth of the stream.



Photo 11. Poorly defined channel in the lower 100 m of the Latte Creek Tributary C.



Photo 12. Upstream view of Latte Creek Tributary C in in the section 100-300 m upstream of the mouth.

3.4.6 HALFWAY CREEK

Halfway Creek has been sampled from 2013 to 2016 via a combination of minnow trapping and electrofishing (Table 16). Sampling near the confluence with the Yukon (HF0.0) resulted in the capture of one Arctic grayling in 2014 and 2015 and twenty slimy sculpin in 2016 (sculpin were captured in an area backwatered by the Yukon River). In the lower part of Halfway Creek, upstream of the mouth (HF0.2), no fish were captured in July 2016 or four sampling events in 2013, but twenty juvenile Chinook salmon and one Arctic grayling were captured in August 2016 in the lower 350 m of the stream. No fish were captured from 350-800 m of the mouth during the same sampling event.

Upstream of station HF0.2, the stream gradient of Halfway Creek begins to increase, the stream channel narrows and a number of small drops are present, including a 1.05 m drop over a large log jam at station HF0.9 (Photo 13). The water drops onto a log before dropping to the streambed, the plunge pool at the bottom of the drop has a depth of 0.4 m. This obstruction exceeds the jumping ability of adult Arctic grayling and juvenile Chinook salmon (Parker 2000). Electrofishing conducted in July 2016 immediately downstream and upstream of this drop did not capture any fish.

In the middle reaches of Halfway Creek (HF6.3) the stream channel gradient increases to an average of 10%, the channel narrows to approximately 2 m and residual pool depths are 0.17 m or less. Fish habitat is limited by fast flow and lack of deep pool habitat. Similar gradients and habitat extend up to stations HF8.8 and HF9.3. A field verified channel gradient of 21.3% over a distance of 100 m was documented in July

2016 in the headwaters of Halfway Creek at station HFA0.1. Fish sampling at station HF6.3, HF8.8, HF9.3 and HFA0.1 has included 3,205 seconds of electrofishing and 228 minnow trap hours (Table 16, not including winter sampling) and no fish have been captured at any of these sites.

Table 16. Baseline fish sampling and capture data in Halfway Creek from 2013 to 2016, ordered by sampling site from downstream to upstream-most site (open water season only).

Sampling Site	Sample Date	Sampling Methods	Total Sampling Effort	Fish Captured
HF0.0	August 2014	Electrofishing	653 seconds	1 Arctic grayling
HF0.0	June and July 2015	Electrofishing	1,421 seconds	1 Arctic grayling
HF0.0	August 2016	Electrofishing	97 seconds	20 slimy sculpin (in area backwatered by Yukon River)
HF0.2	July, August, September, October 2013	Minnow Trapping	185.2 trap hours	None
HF0.2	July 2016	Electrofishing	829 seconds	None
HF0.2	July 2016	Minnow Trapping	128.3 trap hours	None
HF0.2	August 2016	Electrofishing	2,084 seconds (600 m lineal length)	20 juvenile Chinook salmon, 1 Arctic grayling (all fish captured in the lower 350 m of stream)
HF0.9	July 2016	Electrofishing	287 seconds (210 of which upstream of falls)	None
HF6.3	July, August, September, October 2013	Minnow Trapping	175.9 trap hours	None
HF6.3	July 2016	Electrofishing	211 seconds	None
HF6.3	August 2016	Electrofishing	1,107 seconds	None
HF8.8	July 2016	Electrofishing	201 seconds	None
HF9.3	August 2014	Minnow Trapping	52.2 trap hours	None
HF9.3	June and July 2015	Electrofishing	1,741 seconds	None
HFA0.1	July 2016	Electrofishing	156 seconds	None



Photo 13. Field crew member standing downstream of a 1.05 m drop on Halfway Creek at station HF0.9, July 2016.

3.4.7 YT-24

Slimy sculpin are the only fish species that have been captured in YT-24 Creek. Five slimy sculpin were captured within 50 m of the Yukon River in 2015, which was back-flooded into the creek at the time of sampling (at station YT0.0; Table 17). In August 2016, twenty slimy sculpin were captured at this same sampling station; back-flooding by the Yukon River was also occurring during this sampling event. No fish were captured at the mouth of YT-24 in August 2014 or July 2016.

Upstream of the stream mouth, no fish have been captured by electrofishing and minnow trapping conducted in the lower reaches of the YT-24 (YT0.2, YT0.6, YT0.9 and YT1.3). Similarly, no fish were captured in the upper portion of YT-24 (YT4.6 and YT5.0) in any of the sampling conducted in 2014, 2015 or 2016 (Table 17).

A number of small drops in the stream channel are present a short distance upstream of the confluence with the Yukon River, including a 0.75 drop over a log jam approximately 100 m upstream of the mouth of the creek (Photo 14), a 0.7 m drop approximately 600 m upstream of the creek mouth as well as additional smaller drops. These drops are not permanent features, but likely limit the extent of fish use in the watershed.

In the upper reaches of YT-24 Creek (YT4.6), the average stream gradient increases to 9%, there is minimal instream cover and residual pool depths are 0.18 m on average. Fish habitat quality is poor. Electrofishing at this location in July 2016, and at stations YT5.0 in 2014, 2015 and August 2016 did not capture any fish. A barrier to fish passage (30% gradient over 7.4 m) was documented upstream of station YT5.0 by PECG

(2017; Figure 12). This barrier prevents access for all fish to the portion of YT-24 near the mine infrastructure.

Table 17. Baseline fish sampling and capture data in YT-24 from 2014 to 2016, ordered by sampling site from downstream to upstream-most site.

Sampling Site	Sample Date	Sampling Methods	Total Sampling Effort	Fish Captured
YT0.0	August 2014, June and July 2015, July 2016	Electrofishing	1,918 seconds	25 slimy sculpin
YT0.2	July and August 2016	Electrofishing	2,172 seconds	None
YT0.2	July 2016	Minnow Trapping	125.8 trap hours	None
YT0.6	July 2016	Electrofishing	259 seconds	None
YT0.9	July 2016	Electrofishing	276 seconds	None
YT1.3	July 2016	Electrofishing	209 seconds	None
YT4.6	July 2016	Electrofishing	331 seconds	None
YT5.0	August 2014	Minnow Trapping	48.8 trap hours	None
YT5.0	June and July 2015, August 2016	Electrofishing	2,306 seconds	None
YT5.9	July 2016	Electrofishing	171 seconds	None



Photo 14. View of a 0.75 m drop in YT-24 Creek approximately 100 m upstream of the Yukon River, July 2016.

3.4.8 INDEPENDENCE CREEK, INCLUDING THE KONA TRIBUTARY

Arctic grayling, juvenile Chinook salmon, and slimy sculpin were captured in the mainstem of Independence Creek in 2014 and 2015. Juvenile Chinook salmon were present in low numbers throughout Independence Creek, with the highest numbers closer to the confluence with the Yukon River (Table 18). Slimy sculpin were captured in the downstream sampling station (ID1.9), but not upstream at the ID6.7 sampling station. Arctic grayling were found throughout Independence Creek. In 2014, an Arctic grayling population estimate of 3 Arctic grayling/100 m^2 (±2, 90% CI) was documented at station ID6.7 using multiple-pass electrofishing depletion sampling (PECG 2017).

Two stations were sampled in the Kona Tributary of Independence Creek in 2014 and 2015; one near its confluence with the mainstem of Independence Creek (KT0.1) and one in the upper headwaters of the Kona Tributary (KT5.2). Fish sampling results have documented Arctic grayling at the lower sampling site in the Kona Tributary; however, they were present in low numbers.

Chinook salmon aerial spawning surveys in Independence Creek (July 2013, August 2014, July 2015, August 2015 and August 2016) did not document any spawning activity. Similarly, an aerial spawning survey of Independence Creek in October 2014 did report any chum salmon spawning activity.

Table 18. Baseline fish sampling and capture data in Independence Creek and Kona Tributary 2014 to 2016, ordered by sampling site from downstream to upstream-most site (open water season only).

Sampling Site	Sample Date	Sampling Methods	Total Sampling Effort	Fish Captured
ID1.9	Aug-14	Minnow Trapping	249.2 trap hours	10 Chinook salmon
ID1.9	Aug-14	Electrofishing	1,939 seconds	3 Arctic grayling, 9 slimy sculpin, and 1 Chinook salmon
ID1.9	Oct-14	Minnow Trapping	125 trap hours	6 Chinook salmon
ID1.9	Jun-15	Minnow Trapping	127.9 trap hours	1 Chinook salmon
ID1.9	Jul-15	Minnow Trapping	311.6 trap hours	10 Chinook salmon
ID1.9	Sep-15	Minnow Trapping	382.5 trap hours	1 slimy sculpin and 4 Chinook salmon
ID1.9	May-15	Electrofishing	4,034 seconds	7 slimy sculpin
ID1.9	July 2016	Electrofishing	5,325 seconds	31 slimy sculpin
ID1.9	July 2016	Angling	58 minutes	None
ID6.7	Aug-14	Minnow Trapping	247.5 trap hours	1 Chinook salmon
ID6.7	Aug-14	Electrofishing	1,295 seconds	5 Arctic grayling
ID6.7	Oct-14	Minnow Trapping	103.4 trap hours	None
ID6.7	Jul-15	Minnow Trapping	118.8 trap hours	None
ID6.7	Jul-15	Angling	5.5 hours	8 Arctic grayling
KT0.1	Aug-14	Minnow Trapping	45 trap hours	None
KT0.1	Aug-14	Electrofishing	591 seconds	None
KT0.1	Jun-15	Electrofishing	690 seconds	3 Arctic grayling
KT0.1	Jul-15	Electrofishing	627 seconds	None
KT5.2	Aug-14	Minnow Trapping	47 trap hours	None
KT5.2	Jun-15	Electrofishing	773 seconds	None
KT5.2	Jul-15	Electrofishing	559 seconds	None

3.5 FISH OVERWINTERING

The March 2015 winter fish habitat assessments was completed at six stations in Latte and Coffee creeks and included collection of under-ice video. The March 2016 winter fish habitat and overwintering assessment was completed at 13 stations including Coffee, Latte, Independence, Halfway and YT-24 creeks and included under ice video and fish sampling.

In 2015, ice covered all stations with ice thickness ranging from of 15 to 57 cm. Flowing water was only found at Coffee Creek in 2015 with depths ranging from 37 to 82 cm. In March 2016, all stations on Coffee Creek were covered by 5 to 10 cm of ice (Table 19), with the exception of an ice free glide at station CF2.3 (station 5). Flowing water was present at most samplings stations in 2016, and water depths at sampling stations varied from 22 to 135 cm. Water was deepest at sampling stations in the mainstem of Coffee Creek and was shallower at sampling stations in Latte and Halfway creeks.

Fish sampling in March 2016 was generally conducted in glide or pool habitats, where there was sufficient water depth to set minnow traps. Water temperature was near freezing (range of 0.5 of -0.1 °C) at all sampling stations; in-situ pH ranged from slightly acidic to slightly basic (6.21 to 7.65) and specific conductivity ranged from 242.8 to 402.1 µS/cm.

Dissolved oxygen concentrations differed considerably between sampling stations. In March 2015, dissolved oxygen in Coffee Creek was 10.3 to 13.95 mg/L, at stations CF8.0 and CF5.7, respectively. At sampling stations in Latte Creek, Halfway Creek and the upstream portions of Coffee Creek (CF2.7, CF8.3 and CF10.0) dissolved oxygen concentrations were relatively high, and ranged from 8.84 mg/L to 12.59 mg/L (March 2016; Table 19). In contrast, dissolved oxygen concentrations ranged from 5.85 mg/L to 7.82 mg/L in the downstream most sites in Coffee Creek and Independence creeks (station CF0.5 and ID1.9; March 2016).

In the vicinity of sampling station CF2.7 on Coffee Creek, two small side channels were observed to be free of ice during the March 2016 field investigations. Based upon the lack of ice cover in these channels and the slightly warmer water (up to 0.5°C; Photo 15), these areas are probable groundwater discharge areas. Such areas are often important for overwintering fish and this was confirmed by the capture of juvenile Chinook either within the channels or in the mainstem of Coffee Creek near the outlet of the channels.

Table 19. Summary of winter fish habitat information collected at the Coffee Project, March 2016.

Stream Name	Station Name	Sampling Site Number	Habitat Type	Water Depth (cm)	Ice Thickness (cm)[1]	In-Situ Water Quality			
						Temperature (°C)	Dissolved Oxygen (mg/L)	pH	Specific Conductivity (µS/cm)
Coffee Creek	CF0.5	1	Pool	35	5-10	0.3	5.85	6.81	271.2
Coffee Creek	CF0.5	2	Pool	54	10	0.2	7.35	6.92	269.2
Coffee Creek	CF2.7	1	Glide	25	5	0.1	8.96	6.44	294.7
Coffee Creek	CF2.7	2	Glide	26	5	0	12.29	6.75	291.7
Coffee Creek	CF2.7	3	Not observable due to ice cover	135	5-10	0	11.54	6.88	283.2
Coffee Creek	CF2.7	4	Glide/Pool	45	<5	0.2	9.12	6.21	292.4
Coffee Creek	CF2.7	5	Glide	22	0	0.5	9.16	6.57	285.4
Coffee Creek	CF2.7	6	Pool	126	<5	0.1	8.84	6.79	306.9
Coffee Creek	CF8.3	1	Glide/Pool	80	<5	0	10.84	7.11	401.2
Coffee Creek	CF10.0	1	Pool	41	<5	0	12.59	7.37	374.1
Latte Creek	LC1.6	1	Not observable due to ice cover	26	10	-0.1	8.74	7.24	259.5
Latte Creek	LC 9.9	1	Not observable due to ice cover	-	-	0.0	9.88	6.99	482.1
Latte Creek Trib C	LCC0.1	1	Not observable due to ice cover	-	-	0.0	9.45	8.03	929.0
YT-24	YT0.2	1	Not observable due to ice cover	Frozen to bed, no water found.					
Kona Trib	KT0.1	1	Not observable due to ice cover	Frozen to bed, no water found.					
Halfway Creek	HF6.3	1	Pool	34	5-10	0	11.36	7.65	336.9
Independence Creek	ID1.9	1	Pool	67	5	0	6.55	6.83	242.8
Independence Creek	ID1.9	2	Pool	35	5-10	0.1	7.82	6.77	245.6

[1] Ice thickness varied throughout the areas sampled; however, minnow traps were placed in areas where the ice was thin and easy to clear.



Photo 15. View of probable groundwater fed side channel in Coffee Creek (station CF2.7).

3.5.1 MINNOW TRAPPING AND UNDERWATER VIDEO COLLECTION

Minnow trapping effort and fish capture data from the March 2016 field sampling is shown in Table 20; detailed station specific fish sampling data is included in APPENDIX B. A total of 39 minnow traps were set for a cumulative total of 838.15 hours of minnow trapping effort. A total of 53 fish were captured including 47 juvenile Chinook and 6 slimy sculpin (Table 20; Photo 16). All fish were captured at sampling stations in Coffee Creek with the highest number of fish captured at stations CF0.5 and CF2.7. Slimy sculpin were captured at all four sampling stations in Coffee Creek, although the catch per unit effort (CPUE) was relatively low across all stations (average = 0.22 fish/24 minnow trapping hours by sampling station). Juvenile Chinook were only captured at stations CF0.5 and CF2.7, with CPUE which ranged from a low of 4.80 fish/24 minnow trapping hours to a high of 17.06 fish/24 minnow trapping hours at station CF0.5.



Photo 16. Juvenile Chinook salmon captured in Coffee Creek (station CF2.7) during early March 2016.

Lengths and weights of captured fish are summarized in Table 21; due to the relatively small samples size of captured fish, length and weight data from all stations were grouped together. Only fish that were retained for metals tissue analysis were weighed; this included incidental mortalities of juvenile Chinook and all slimy sculpin. Captured slimy sculpin had fork lengths ranging from 66 to 85 mm, while juvenile Chinook salmon had fork lengths ranging from 60 to 90 mm (Table 21). The mean fork length of both species was 75 mm. Juvenile Chinook weighed between 3.2 and 5.1 grams; the range of slimy sculpin weights was greater (2.3 to 7.1 grams). Mean weights were 4.7 grams for slimy sculpin and 3.9 grams for juvenile Chinook salmon.

Fish observations from underwater video data collected in 2016 are summarized in Table 22. Underwater visibility was very good (5 to 10 m or greater) at all stations where investigations were conducted in 2016; information on the condition of under ice visibility was not recorded in 2015. A total of 150 minutes of underwater video were recorded in 2016 and only a single fish was observed on the collected video data (at station CF0.5, site 1). This species of this fish could not be discerned from the collected video data. A total of 30 minutes of underwater video were recorded in March 2015; no fish were observed in any of the video data collected in 2015.

Table 20. Summary of minnow trapping effort and fish capture data from the Mine study area in March 2016.

Stream Name	Station Name	Sampling Site Number	Number of Minnow Traps Set	Total Set Time (Hours)	Number of Fish Captured		Catch-per-unit-effort (Number of fish per 24 minnow trap hrs)	
					Slimy Sculpin	Juvenile Chinook	Slimy Sculpin	Juvenile Chinook
Coffee Creek	CF0.5	1	3	59.75	0	17	0.00	6.83
		2	3	61.00	0	1	0.00	0.39
	CF2.7	1	4	99.32	2	5	0.48	1.21
		2	2	49.00	1	0	0.49	0.00
		3	2	48.33	1	15	0.50	7.45
		4	4	91.67	0	2	0.00	0.52
		5	3	68.00	0	7	0.00	2.47
		6	2	44.83	0	0	0.00	0.00
	CF8.3	1	3	66.50	1	0	0.36	0.00
	CF10.0	1	3	64.00	1	0	0.38	0.00
Latte Creek	LC1.6	1	2	40.67	0	0	0.00	0.00
Halfway Creek	HF6.3	1	2	38.83	0	0	0.00	0.00
Independence Creek	ID1.9	1	3	53.25	0	0	0.00	0.00
		2	3	53.00	0	0	0.00	0.00
TOTALS			**39**	**838.15**	**6**	**47**	-	-

Table 21. Summary of lengths and weights of fish captured via minnow trapping in the Mine study area in March 2016.

Species	Number Measured	Number Weighed[1]	Fork Lengths (mm)			Weights (grams)		
			Minimum	Maximum	Mean	Minimum	Maximum	Mean
Slimy Sculpin	5	5	66	85	75	2.3	7.1	4.7
Juvenile Chinook	41	6	60	90	75	3.2	5.1	3.9

[1]Only captured fish that were retained for metals analyses were weighed.

Table 22. Summary of underwater video data collected in the Mine study area in March 2016.

Stream Name	Station Name	Sampling Site Number	Duration of Video (minutes)	Number and Species of Observed Fish
Coffee Creek	CF0.5	1	15	1 fish observed, species unidentified
Coffee Creek	CF0.5	2	10	None
Coffee Creek	CF2.7	1	15	None
Coffee Creek	CF2.7	3	30	None; habitat appears to be of high quality
Coffee Creek	CF2.7	4	15	None
Coffee Creek	CF2.7	6	20	None
Coffee Creek	CF3.3	1	10	None
Coffee Creek	CF10.0	1	10	None
Independence Creek	ID1.9	1	10	None

3.6 PERIPHYTON

Mean chlorophyll-a and ash-free dry mass (AFDM) measured in 2014 and 2015 were very low for all stations[4], which is typical of northern, nutrient poor aquatic habitats (PECG 2017). There was little variation among the stations and there was no relationship between chlorophyll-a and ash-free periphyton mass; differences in chlorophyll-a content may have been due to varying light conditions, nutrient availability, and periphyton taxonomy, which results in different proportions of photosynthetic:non-photosynthetic organisms that comprise periphyton (Barbour et al. 1999). Given that the 2014 and 2015 samples missed laboratory holding times, combined with the low nutrient status of these streams, the results may have underestimated the chlorophyll-a concentrations. Therefore, all streams within the Project area as well as reference sites were re-sampled for chlorophyll-a concentration in August 2016. The 2016 data indicated higher concentrations of chlorophyll-a throughout the sampling locations when compared with 2014 and 2015 data. Chlorophyll-a was lowest in samples collected farthest upstream in each of the watersheds, and increased in downstream locations. This trend existed in Latte Creek, with values of 0.13 mg/cm^2 at the upstream sampling location (LC9.9), and 0.26 mg/cm^2 closer to the confluence (LC2.7), in Coffee Creek (0.57 and 0.88 mg/cm^2) at the upstream and downstream sites, respectively, and in YT-24 (0.61 and 0.76 mg/cm^2) and Halfway creeks (0.30 and 0.69 mg/cm^2) as well (APPENDIX D).

Community composition included blue-green algae (cyanophyta), which comprised approximately 80% of the overall community composition and was the most dominant algal group in the study area; diatoms were the second most dominant group, followed by small percentages of green algae (chlorophyte; PECG 2017). Blue-green algae tended to dominate at higher elevation stations within the Mine study area, whereas higher proportions of diatoms were present further downstream, at lower elevations. The large diatom *Didymosphenia geminata* was confirmed at station ID1.9 in Independence Creek in 2014; this species has become increasingly prolific in British Columbia and Yukon in recent years, and is commonly referred to as 'rock snot' (YISC 2014).

3.7 BENTHIC INVERTEBRATE COMMUNITIES

Benthic invertebrate sampling in 2001 was conducted using a 300 µm mesh surber sampler and did not follow the standardized Canadian Aquatic Biomonitoring Network (CABIN) protocols used in later sampling in 2010, 2014 and 2015. The CABIN protocols provide a standardized method to sample benthic invertebrate communities (NWRI 2008), and allows for robust data analysis by leveraging a large, nation-wide database of invertebrate community data. As such, the data described in this section are from the 2010, 2014 and 2015 studies only. The benthic invertebrate sampling conducted in March and August 2016 focused on collecting samples for metals analysis only, and was not analyzed for benthic invertebrate abundance and diversity (APPENDIX E).

[4] Hold times for chlorophyll-a sample analysis were exceeded for a number of stations during the 2014/2015 baselines studies (PECG 2016).

Sampling in 2010 at the mouth of Coffee Creek showed the highest abundance of benthic invertebrate in all three sampling years (2010, 2014 and 2015) with a total abundance of 9,500 individuals per kick-net. In 2014 and 2015, mean total abundance of benthic invertebrates ranged from 247 to 3,885 individuals per kick-net in the watersheds in the Mine study area. Independence Creek had the highest total abundance followed by YT-24, Coffee Creek, Latte Creek and then Halfway Creek. Total abundance generally increased in an upstream direction within watersheds.

Ephemeroptera-Plecoptera-Trichoptera (EPT) abundances within the study area demonstrated similar patterns to overall abundance. Some stations had high between-year variability, such as at ID1.9 in lower Independence Creek (PECG 2017).

Dipterans were the most dominant benthic invertebrate group in the Mine study area, making up approximately 50% of the overall community composition. The second and third most dominant groups were the mayflies (*Ephemeroptera*) and stoneflies (*Plecoptera*), which contributed approximately 26% and 21% to the overall community composition, respectively. Small percentages of ringed worms (Annelids), and caddisflies (*Trichoptera*) were also present at the majority of stations. In Coffee and Independence creeks, EPT organisms typically dominated stations higher in the watershed; dipteran species dominated further downstream (PECG 2017).

3.8 METAL CONCENTRATIONS IN THE AQUATIC ECOSYSTEM

3.8.1 METAL CONCENTRATIONS IN FISH TISSUE

Fish tissue metal concentrations were analyzed from a total of twenty-four Arctic grayling and seventeen slimy sculpin captured in Coffee, Latte and Independence creeks in 2014 and 2015 (PECG 2017); muscle tissues were collected from Arctic grayling, and full body samples were collected from sculpin. In March 2016, additional tissue samples were collected and analyzed for metal concentrations from seven slimy sculpin and six juvenile Chinook salmon that were captured in Coffee Creek. All fish collected in 2016 were analysed as whole body samples in order to fully investigate uranium concentrations in fish tissues; uranium is stored preferentially in mineralized tissues such as bones. In July additional samples were collected from Coffee, Latte, Independent and Los Angeles creeks, and finally in August 2016 there were 12 juvenile Chinook salmon and one Arctic grayling from Halfway Creek were collected for analysis (Table 6; APPENDIX E). Currently, established tissue concentration guidelines exist for total mercury (CFIA 2011) and methylmercury (CCME 2000a). There are no federal guidelines for tissue concentrations of selenium, however, the EPA has developed guidelines for both tissue and whole body samples (8.5 µg/g dw for whole body and 11.3 µg/g dw for fish tissue, EPA 2015), and British Columbia has developed a muscle tissue and whole body guideline (both set at 4 µg/g dw, BC MOE 2014). Additionally, uranium concentrations in fish tissues were reviewed as uranium can be naturally elevated in some streams in the Mine study area (especially during low flows).

3.8.1.1 Arctic Grayling

Mercury is stored in muscle tissue, generally in the form of methylmercury, and therefore the muscle tissue samples generally had a slightly higher mercury and methylmercury concentrations that the whole body samples; however, the difference was small (Table 23). Baseline total mercury concentrations in all sampled Arctic grayling, including tissue and whole body samples, did not exceed the Canadian Food and Inspection Agency (CFIA) guideline (0.5 µg/g ww; CFIA 2011; Figure 13). In contrast, estimated methylmercury concentrations (95% of total mercury concentrations, Jewett et. al. 2003) in nearly all Arctic grayling sampled in Coffee, Latte, Independence and Los Angeles Creek exceeded the Canadian Council for the Ministers of the Environment (CCME) guideline for the protection of piscivorous wildlife (0.033 µg/g ww; CCME 2000a). Mean concentrations were lowest in Halfway (the only grayling captured in Halfway Creek had a methylmercury concentration below the guideline), Los Angeles, and Independence creeks, while higher methylmercury concentrations were noted in Coffee and Latte creeks (Table 23; Figure 14).

Selenium concentrations in Arctic grayling muscle tissue did not exceed the EPA's interim guideline for fish muscle tissue (11.3 µg/g dw; EPA 2015). The lowest selenium concentrations were found in Arctic grayling muscle tissues collected in Latte Creek, just upstream of the confluence with Coffee Creek. In 2016 whole body selenium concentrations were collected in Coffee Creek at CF10.0, in Latte Creek at LC2.7, in Halfway Creek at HF0.2 (only one grayling) and in Los Angeles Creek at LaC4.8. Mean dry weight concentrations were similar across all sampling sites, ranging from 5.1 µg/g dw at Latte Creek (LC2.7) to a high of 6.5 µg/g dw at Coffee Creek (CF10.0) (Table 23; Figure 15). Nearly all samples from all sites, with the exception of five Arctic grayling from Latte Creek exceeded the BC tissue and whole body guidelines for selenium (which are both set at 4 µg/g dw, BC MOE 2014).

Uranium concentrations in Arctic grayling muscle tissues collected in 2014 and 2015 from all watersheds ranged from less than 0.001 µg/g ww in Latte, Los Angeles, Coffee and Independence creeks to a high of 0.014 µg/g ww in Halfway Creek (Table 23; Figure 16). Whole body uranium concentrations were collected in 2016 from Coffee Creek at CF10.0, in Latte Creek at LC2.7, in Halfway Creek at HF0.2 (only one grayling) and in Los Angeles Creek at LaC4.8. All whole body grayling samples had higher uranium concentrations than muscle tissue samples collected in 2014 and 2015. However, there was no discernable trend was observed in uranium concentrations in Arctic grayling tissues among different sites. The highest mean whole body uranium concentration was at LC2.7, 0.034 µg/g ww, and the lowest at LaC4.8, with a concentration of 0.034 µg/g ww; only one whole body Arctic grayling sample was collected from Halfway Creek, and the concentration was 0.011 µg/g ww. With the exception of Coffee Creek, Arctic grayling generally only populate streams in the LSA during the summer months, when uranium concentrations in the water are lowest; this use of the habitat likely allows the grayling to maintain low tissue concentrations of uranium.

Table 23. Descriptive statistics for Arctic grayling tissue metals concentrations (whole body and muscle tissue samples presented separately).

Creek	Sampling Site	N	Statistic	Mercury (µg/g ww)	MeHg Estimate [1] (µg/g ww)	Selenium (µg/g ww)	Selenium [2] (µg/g dw)	Uranium (µg/g ww)
Muscle Tissue Only Samples								
Coffee	CF3.9	2	Minimum	0.050	0.047	1.180	5.540	0.003
			Mean	0.070	0.066	1.235	5.841	0.003
			Maximum	0.090	0.085	1.290	6.143	0.003
	CF8.0	6	Minimum	0.039	0.037	1.310	5.771	0.001
			Mean	0.062	0.059	1.587	7.329	0.001
			Maximum	0.092	0.086	1.790	8.443	0.002
Latte	LC2.7	8	Minimum	0.071	0.067	0.480	2.172	0.001
			Mean	0.110	0.103	0.836	4.041	0.002
			Maximum	0.132	0.124	1.080	5.320	0.002
Independence	IC6.7	8	Minimum	0.036	0.034	1.230	5.168	0.001
			Mean	0.052	0.049	1.569	7.427	0.001
			Maximum	0.086	0.081	2.070	10.098	0.003
Los Angeles	LaC4.8	2	Minimum	0.065	0.061	0.900	4.230	<0.001
			Mean	0.067	0.063	1.295	5.887	<0.001
			Maximum	0.068	0.064	1.690	7.545	<0.001
Whole Body Samples								
Coffee	CF10.0	7	Minimum	0.022	0.021	1.130	4.346	0.014
			Mean	0.044	0.041	1.554	6.511	0.028
			Maximum	0.069	0.065	3.000	13.043	0.051
Latte	LC2.7	5	Minimum	0.043	0.040	0.929	3.871	0.017
			Mean	0.074	0.070	1.246	5.093	0.034
			Maximum	0.109	0.102	1.730	6.920	0.046
Halfway	HF0.2	1	Minimum	0.033	0.031	1.320	6.000	0.011
			Mean	-	-	-	-	-
			Maximum	-	-	-	-	-
Los Angeles	LaC4.8	3	Minimum	0.033	0.031	1.300	5.909	0.008
			Mean	0.044	0.041	1.438	6.307	0.019
			Maximum	0.062	0.058	1.610	6.708	0.046

1. For Arctic grayling, methylmercury was estimated as 94% of total mercury, as per Jewett et al 2003.
2. Selenium is presented as dry weight (dw) in addition to wet weight (ww) to compare with the EPA guidelines, which were calculated as dry weight.

3.8.1.2 Slimy Sculpin

Slimy sculpin samples for metals analysis were collected only from Coffee Creek, the mouth of Latte Creek (LC0.5), Independence Creek, and Los Angeles Creek (only one sample). Mean total mercury concentrations were lowest in upstream Coffee Creek at CF10.0, with a concentration of 0.055 µg/g ww, and highest in fish sampled at the mouth of Latte Creek, where the mean concentration was 0.154 µg/g ww (Table 24). The CFIA guideline for total mercury does not apply to slimy sculpin because they are not a human food source; however, mercury concentrations from all sculpin samples were below the guideline (Figure 13). The estimated concentrations of methylmercury (81% of total mercury, Jewett et al 2003) exceeded the CCME

guideline set for the protection of piscivorous wildlife (0.033 µg/g ww; CCME 2000a) in all creeks where sculpin were sampled including Coffee, Latte (at the mouth), Independence and Los Angeles creeks (Table 24; Figure 14). The lowest concentrations were found in slimy sculpin collected from Independence Creek, while the highest concentrations were found in sculpin collected in the Coffee Creek watershed, including from the mouth of Latte Creek.

Selenium concentrations in slimy sculpin tissue samples varied widely across the LSA, and even within Coffee Creek. Mean selenium concentration in samples collected from Coffee Creek at CF3.9 and CF10.0 and the single sample from Los Angeles Creek exceeded the EPA whole body fish tissue concentration guideline (8.5 µg/g dw; EPA 2015; Table 24). Concentrations were lower (and less variable) in sculpin collected from Coffee Creek at CF2.3 and CF8.0, as well as Latte and Independence creeks (Figure 15).

Uranium concentrations were higher in slimy sculpin tissues, compared with Arctic grayling and juvenile Chinook salmon, due to their high site fidelity and overwintering habits (water quality data indicates that the highest water uranium concentrations are seen in later winter (Lorax 2016). Concentrations of uranium were considerably higher in the Coffee Creek watershed when compared with other stations in the study area. The lowest concentrations were noted in slimy sculpin tissues collected from Isaac and Los Angeles creeks (mean concentrations of 0.015 and 0.011 µg/g ww, respectively) (Table 24; Figure 16).

Table 24. Descriptive statistics for slimy sculpin tissue metals concentrations.

Creek	Sampling Site	N	Statistic	Mercury (µg/g ww)	MeHg Estimate [1] (µg/g ww)	Selenium (µg/g ww)	Selenium [2] (µg/g dw)	Uranium (µg/g ww)
Coffee	CF2.3	5	Minimum	0.077	0.062	1.070	4.374	0.052
			Mean	0.117	0.095	1.418	6.507	0.091
			Maximum	0.168	0.136	1.950	10.263	0.124
	CF3.9	10	Minimum	0.059	0.047	1.620	7.043	0.032
			Mean	0.087	0.071	2.645	15.165	0.069
			Maximum	0.130	0.105	3.460	38.444	0.131
	CF8.0	13	Minimum	0.058	0.047	0.950	3.378	0.021
			Mean	0.125	0.102	1.508	5.881	0.057
			Maximum	0.248	0.201	2.740	10.111	0.146
	CF10.0	11	Minimum	0.038	0.031	2.130	8.680	0.062
			Mean	0.055	0.045	2.675	15.533	0.088
			Maximum	0.097	0.079	3.740	21.429	0.167
Latte	LC0.5	3	Minimum	0.047	0.038	1.150	4.123	0.029
			Mean	0.154	0.125	1.417	5.080	0.101
			Maximum	0.213	0.173	1.880	6.741	0.175
Independence	IC1.9	19	Minimum	0.041	0.033	0.900	2.866	0.008
			Mean	0.071	0.058	1.734	7.309	0.029
			Maximum	0.110	0.089	2.760	12.545	0.052
Los Angeles [3]	LaC4.8	1	Minimum	0.084	0.068	2.740	9.514	0.011
			Mean	-	-	-	-	-
			Maximum	0.084	0.068	2.740	9.514	0.011

1. For slimy sculpin, methylmercury was estimated as 81% of total mercury, as per Jewett et al 2003.
2. Selenium is presented as dry weight (dw) in addition to wet weight (ww) to compare with the EPA guidelines, which were calculated as dry weight.
3. Only one sample was collected from Los Angeles Creek

3.8.1.3 Juvenile Chinook Salmon

Juvenile Chinook salmon samples for total metal analysis were collected from Coffee Creek at CF0.5 and CF2.3, and from Halfway Creek at HF0.2. Mean total mercury concentrations in juvenile Chinook salmon were lowest in Halfway Creek at HF0.2, and slightly higher in Coffee Creek at CF0.5 and at CF2.3, with mean concentrations of 0.025, 0.050 and 0.076 µg/g ww, respectively (Table 25). The CFIA guideline for total mercury does not apply to juvenile Chinook salmon because they are not a human food source at the juvenile life stage; however mercury concentrations form all Chinook samples were below the guideline (Figure 13). There are no currently available studies that estimate the percentage of methylmercury relative to total mercury for juvenile Chinook salmon tissue; for the purpose of this report a conservative estimate of 94% of total mercury concentration was used. This percentage is based on the estimated methylmercury concentration for Arctic grayling tissue (Jewett et al 2003), as well as the fact that juvenile Chinook salmon are at a similar or lower trophic level than Arctic grayling and thus could be expected to bio-accumulate methylmercury at comparable rates. Estimated methylmercury concentrations in all juvenile Chinook salmon tissue samples (94% of total mercury) from Coffee Creek exceeded the CCME guideline set for the protection of piscivorous wildlife (0.033 µg/g ww; CCME 2000a). All samples from Halfway Creek had estimate methylmercury concentrations below the CCME guideline (Table 25; Figure 14).

Selenium concentrations in juvenile Chinook salmon muscle tissue in Coffee Creek did not exceed the EPA guideline for muscle tissue (11.3 µg/g dw; EPA 2015) at any sampled stations (Table 25; Figure 15). Only one same from Halfway Creek exceeded the BC selenium tissue guideline (4.0 µg/g dw, BC MOE 2012).

Uranium concentrations in juvenile Chinook salmon tissues ranged from 0.005 µg/g ww in a sample collected from Halfway Creek to 0.0604 µg/g ww, in a sample from Coffee Creek. Concentrations in Coffee Creek were highest at stations further upstream in the watershed (Table 25; Figure 16).

Table 25. Descriptive statistics for Chinook salmon tissue metals concentrations.

Creek	Sampling Site	N	Statistic	Mercury (µg/g ww)	MeHg Estimate [1] (µg/g ww)	Selenium (µg/g ww)	Selenium [2] (µg/g dw)	Uranium (µg/g ww)
Coffee	CF0.5	3	Minimum	0.039	0.037	0.502	2.191	0.012
			Mean	0.050	0.047	0.533	2.391	0.014
			Maximum	0.071	0.067	0.594	2.700	0.017
	CF2.3	3	Minimum	0.058	0.055	0.498	1.302	0.013
			Mean	0.076	0.071	0.534	2.182	0.033
			Maximum	0.100	0.094	0.570	2.767	0.060
Halfway	HF0.2	12	Minimum	0.021	0.020	0.403	2.096	0.005
			Mean	0.025	0.024	0.592	2.997	0.018
			Maximum	0.029	0.028	0.676	4.714	0.037

1. For slimy sculpin, methylmercury was estimated as 81% of total mercury, as per Jewett et al 2003.
2. Selenium is presented as dry weight (dw) in addition to wet weight (ww) to compare with the EPA guidelines, which were calculated as dry weight.

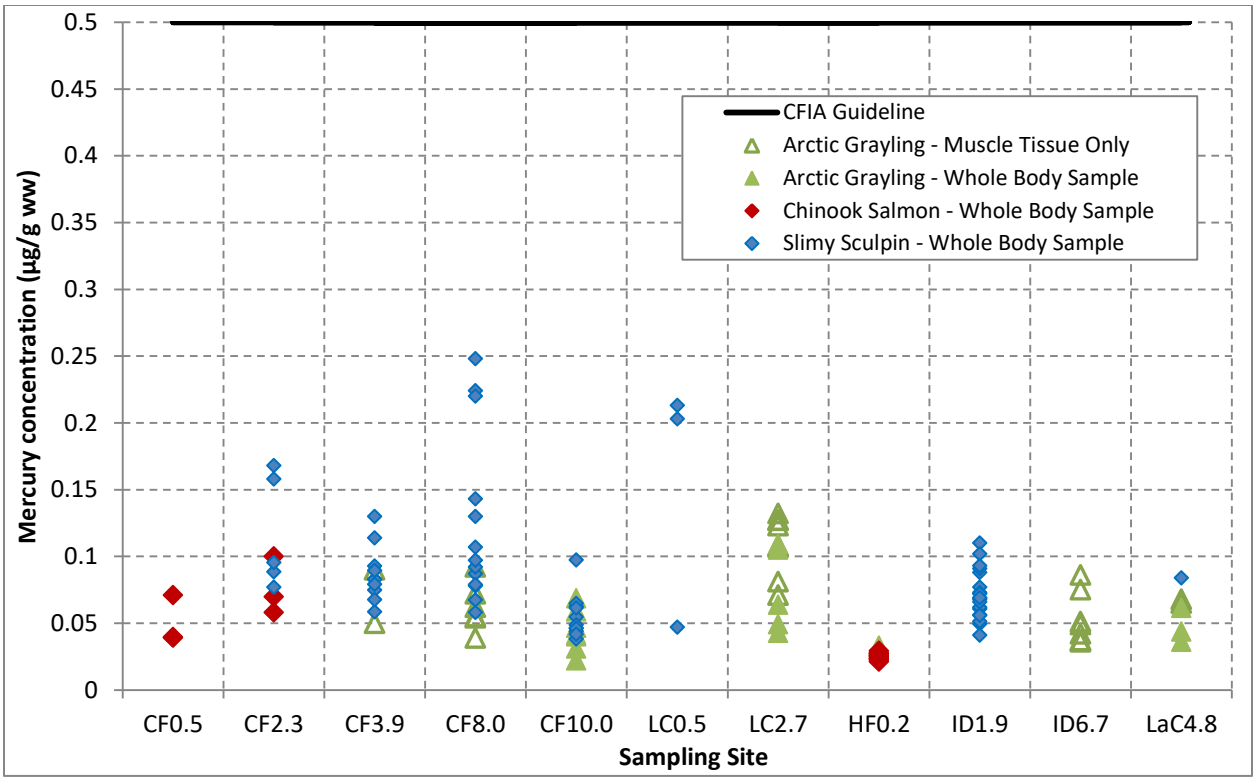


Figure 13. Total mercury concentrations in fish sampled throughout the Coffee Project area.

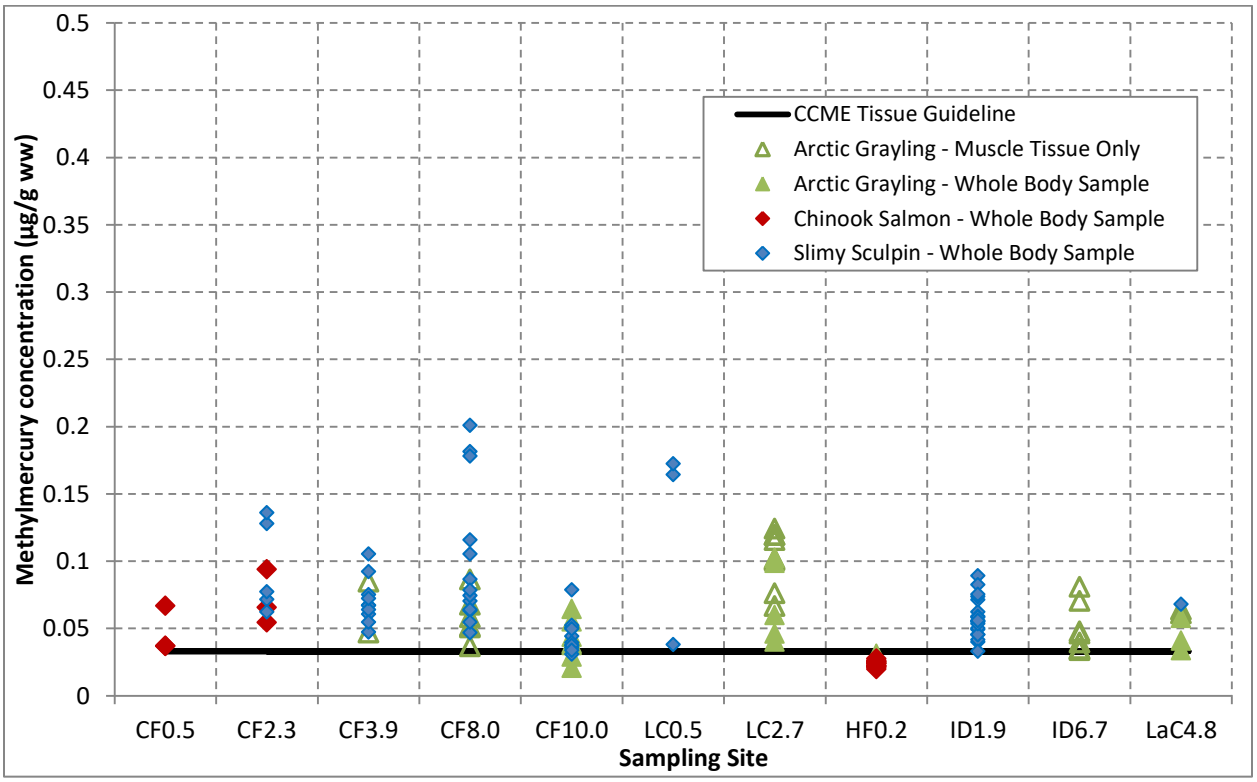


Figure 14. Estimated methylmercury concentrations in fish sampled throughout the Coffee Project area.

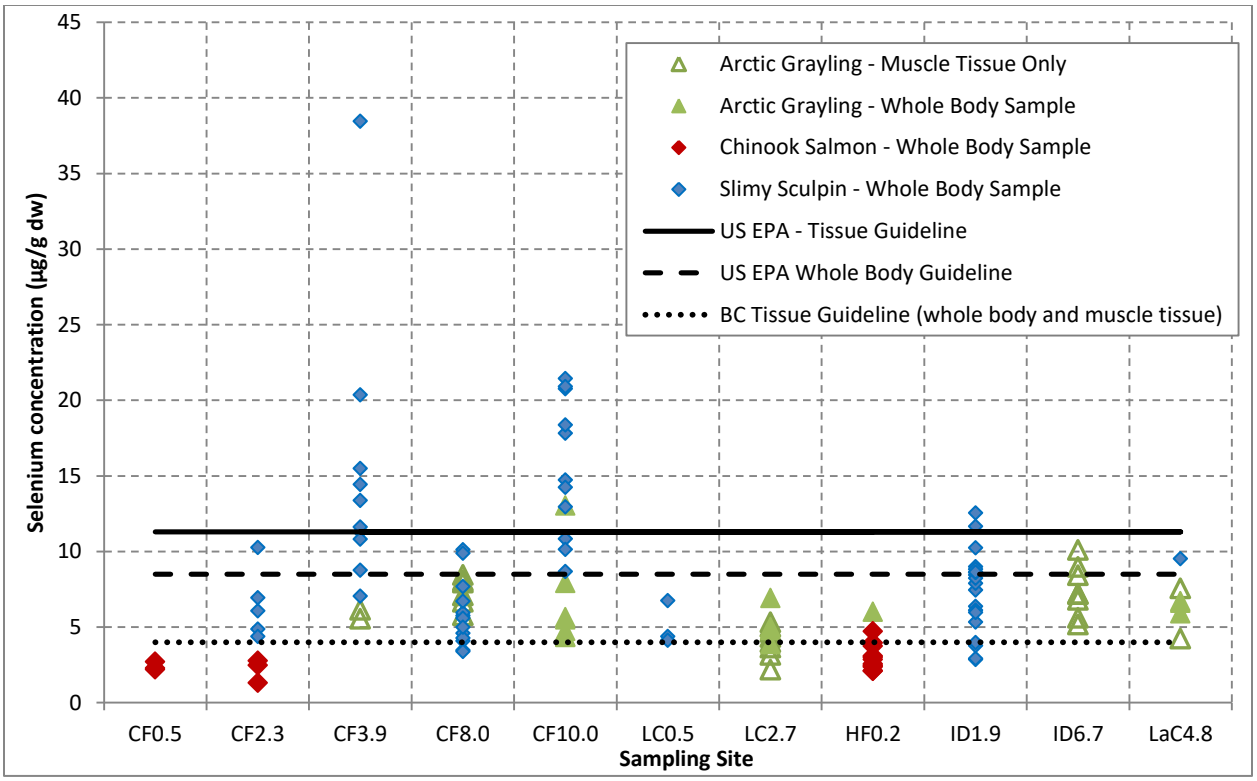


Figure 15. Selenium concentrations in fish sampled throughout the Coffee Project area.

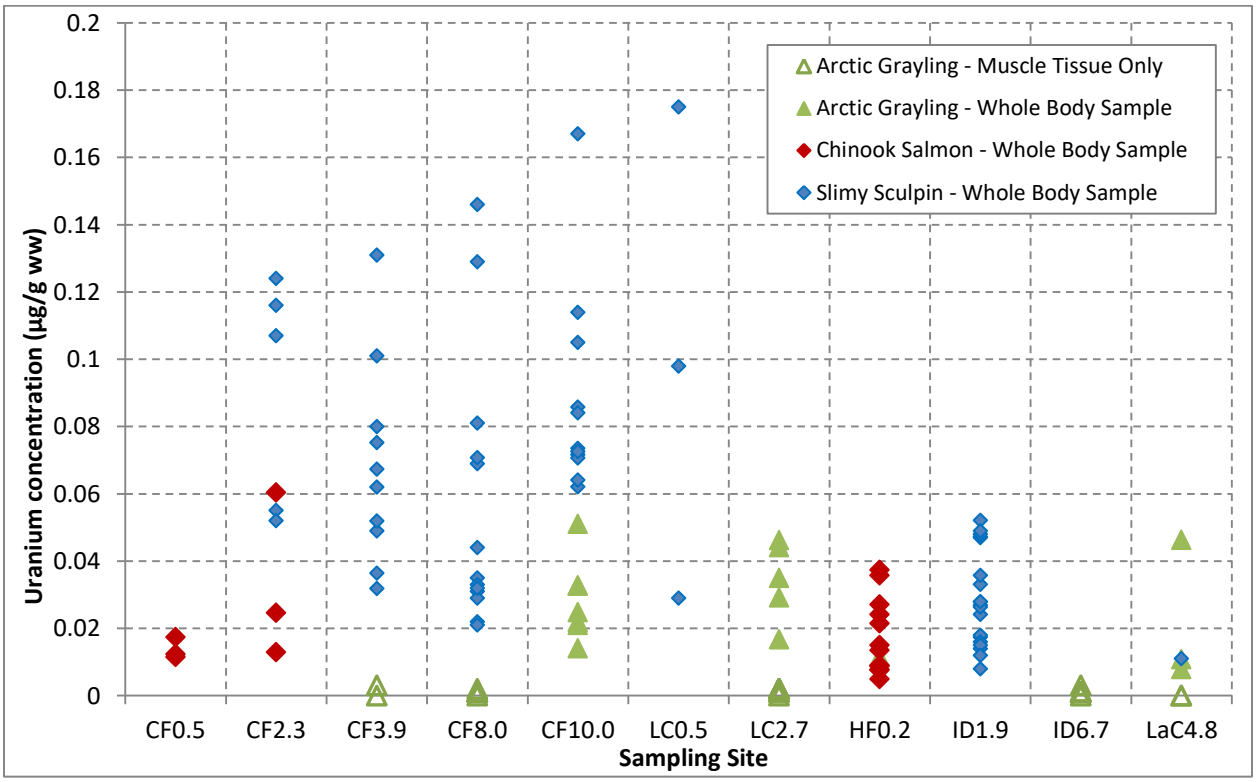


Figure 16. Uranium concentrations in fish sampled throughout the Coffee Project area.

3.8.2 METAL CONCENTRATIONS IN BENTHIC INVERTEBRATES

Benthic invertebrate samples were collected in March and August 2016. March samples were collected at two stations in Coffee Creek and one station in Independence Creek, and August samples were collected from Coffee, Latte, Halfway, YT-24, Independence and Los Angeles creeks. All samples were analyzed for tissue metal concentrations; detailed analysis results are included in APPENDIX E. Benthic invertebrate tissue metal concentration guidelines exist for methylmercury (CCME 2000a). Additionally, uranium concentrations were reviewed as uranium can be naturally elevated in some streams in the LSA. The CFIA total metal tissue guideline does not apply to benthic invertebrates as they are not consumed by humans.

There are no currently available studies that estimate the percentage of methylmercury relative to total mercury for benthic invertebrate tissues; for the purpose of this report a conservative estimate of 54% of total mercury concentration was used. This percentage is based on the fact that different species of invertebrates occupy different trophic levels and accumulate methylmercury at different rates (e.g. range of 22% to 85% of total mercury concentration; Tremblay and Lucotte 1997) as well as the fact that methylmercury concentrations were not collected for all sampled benthic invertebrate taxa described in Tremblay and Lucotte (1997).

Estimated methylmercury concentrations in all benthic invertebrate tissue samples (54% of total mercury) did not exceeded the CCME guideline set for the protection of piscivorous wildlife (0.033 µg/g ww; CCME 2000a) at any sample stations in the Project area; the highest concentration was found in the sample collected from Coffee Creek (CF2.7) in March (0.0226 µg/g ww).

Uranium concentrations in benthic invertebrate tissues were highest in samples collected in March; uranium concentrations in water are at their annual peak during late winter low flows, resulting in increased proportions of groundwater contributions to surface water (Lorax 201.) Uranium concentrations in benthic invertebrate tissues collected from Coffee Creek in March 2016 ranged from 6.97 to 18.1 µg/g ww, and in Independence Creek was 1.26 µg/g ww. The lowest concentrations from August 2016 samples were found in benthic invertebrate tissues collected from YT-24 and Los Angeles creeks, and the highest concentrations were in benthic invertebrate concentrations from Halfway Creek, at HF0.2 (5.76 µg/g ww; Figure 17).

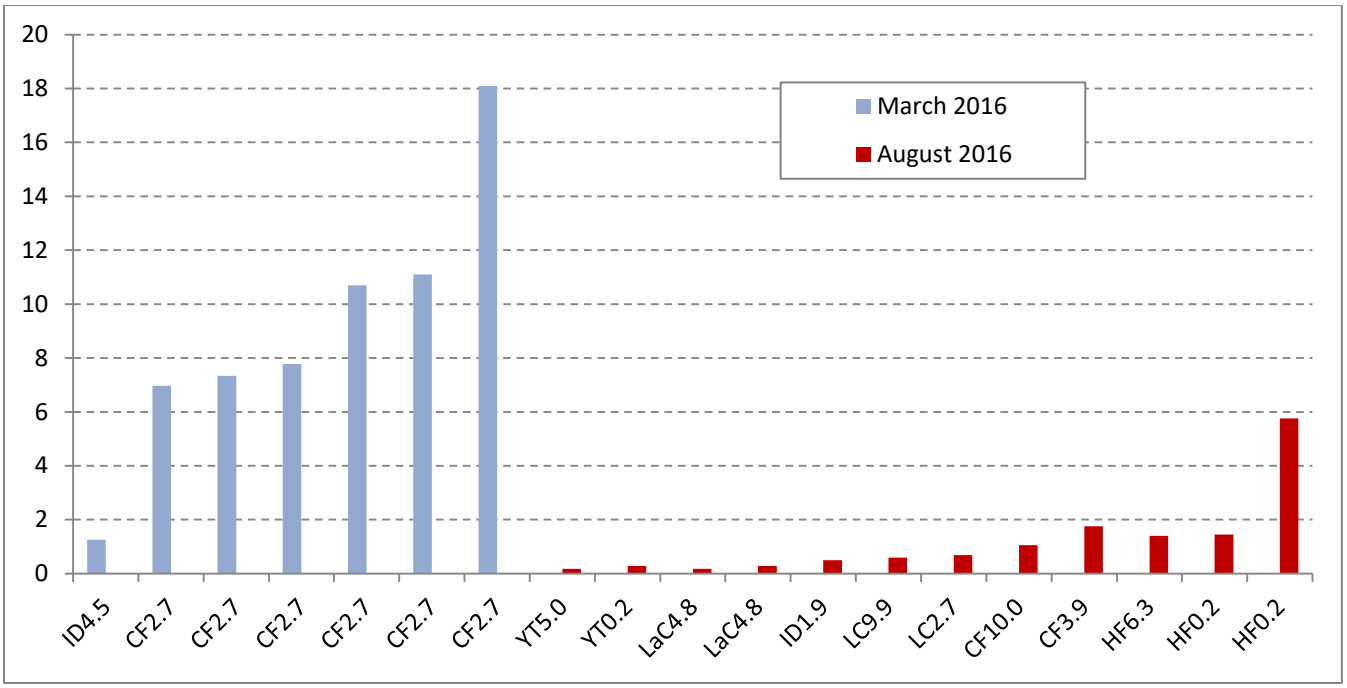


Figure 17. Uranium concentrations in benthic invertebrate tissues collected in March and August 2016.

3.8.3 METAL CONCENTRATIONS IN SEDIMENT

Analyses of baseline metals concentrations in stream sediments collected in the study area in 2014 and 2015 (PECG 2017) indicate that arsenic and chromium are consistently present at concentrations that exceed the CCME interim Freshwater Sediment Quality Guidelines (CCME 2000b). Concentrations of copper, cadmium and mercury were found to exceed the applicable guidelines in only a small number of samples, all located in the Coffee Creek watershed.

Baseline sediment samples collected by PECG in 2014 and 2015 from Coffee Creek and Latte Creek were found to have the highest concentrations of a number of metals. Concentrations from samples collected in 2014 and 2015 exceeded the CCME interim Freshwater Sediment Quality Guidelines for chromium (Coffee Creek CF3.9 and Latte Creek LC2.7), copper (Coffee Creek CF8.0), cadmium (Coffee and Latte creeks, CF8.0 and LC9.9), and mercury (Latte Creek LC2.7).

Analysis of metals concentrations in sediment samples from, Halfway Creek, YT-24 and Independence Creek and the Kona Tributary all indicate that the arsenic concentrations were elevated over the CCME interim Freshwater Sediment Quality Guideline in all samples collected in 2014 and 2015 (CCME 2000b). Additionally, chromium concentrations exceeded the CCME interim Freshwater Sediment Quality Guideline in samples collected from the Kona Tributary, upstream Independence Creek (ID6.7).

3.9 ENVIRONMENTAL DNA SAMPLING

Environmental DNA samples filtered from water collected in March 2016 tested positive for both Arctic grayling and Chinook salmon DNA markers at several sample sites (Table 26). In contrast, all stream sediment eDNA samples tested negative for except for a single replicate at site CF2.3. However, some thawing of stream sediment samples had occurred during transit to the lab and lab staff indicated that the relatively coarse sediment particle sizes present at sample sites may reduce eDNA residence time (as compared to finer sediment; Carim pers. comm. 2016). As such, eDNA results from sediment samples may be considered inconclusive, and are not discussed further in this section. All results discussed in the following paragraphs pertain to eDNA detected in filtered water samples; detailed eDNA collection data and analytical results from both sediment and water samples are included in APPENDIX A. The eDNA persistence time in the aquatic environment is estimated to range from 7 to 25 days (Hobbs et. al. 2015). The station and species specific eDNA persistence may vary for Chinook salmon in the study area; however, none of the DNA collected in March 2016 could have come from adult salmon (which migrate through the Yukon River to spawn in July and August). As such, all positive Chinook salmon eDNA detections from March 2016 are representative of DNA from juvenile Chinook salmon.

Arctic grayling eDNA was detected at three stations in Coffee Creek (CF2.7, CF8.3 and CF10.0; Table 26). Samples collected in the Yukon River also tested positive for Arctic grayling eDNA, with positive detections at all Yukon River sample collection stations (YRD23.0, YRD11.0 and YRD4.1). No Arctic grayling eDNA was detected in Latte Creek Tributary C, or in Latte, Halfway or Independence creeks.

Juvenile Chinook salmon eDNA was detected at all sampled stations in Coffee Creek (CF2.7, CF5.4, CF8.3 and CF10.0; Table 26). No juvenile Chinook salmon eDNA was detected at any other sampled locations in the study area, including the Yukon River.

Table 26. Summary of eDNA detection results in the Mine study area, March 2016.

Station Name[1]	Sample Replicate	Arctic Grayling eDNA Detected (Yes/No)	Chinook Salmon eDNA Detected (Yes/No)
CF2.7	A	No	**Yes**
CF2.7	B	**Yes**	**Yes**
CF2.7	C	No	**Yes**
CF5.4	A	No	**Yes**
CF5.4	B	No	**Yes**
CF5.4	C	No	**Yes**
LC0.5	A	No	No
LC0.5	B	No	No
LC0.5	C	No	No
CF8.3	A	**Yes**	**Yes**
CF8.3	B	No	**Yes**
CF8.3	C	**Yes**	**Yes**
CF10.0	A	**Yes**	**Yes**
CF10.0	B	**Yes**	**Yes**
CF10.0	C	**Yes**	**Yes**

Station Name[1]	Sample Replicate	Arctic Grayling eDNA Detected (Yes/No)	Chinook Salmon eDNA Detected (Yes/No)
LC1.6	A	No	No
LC1.6	B	No	No
LC1.6	C	No	No
LCC0.1	A	No	No
LCC0.1	B	No	No
LCC0.1	C	No	No
LC9.9	A	No	No
LC9.9	B	No	No
LC9.9	C	No	No
ID1.9	A	No	No
ID1.9	B	No	No
ID1.9	C	No	No
HF0.2	A	No	No
HF0.2	B	No	No
HF0.2	C	No	No
YRD11.0	A	No	No
YRD11.0	B	**Yes**	No
YRD11.0	C	**Yes**	No
HF6.3	A	No	No
HF6.3	B	No	No
HF6.3	C	No	No
YRD23.0	A	**Yes**	No
YRD23.0	B	**Yes**	No
YRD23.0	C	**Yes**	No
YRU4.1	A	**Yes**	No
YRU4.1	B	**Yes**	No
YRU4.1	C	**Yes**	No
Control (Deionized Water)	Control	No	No

[1] Station names converted to system outlined in Section 1.5

4 RESULTS – NORTHERN ACCESS ROUTE

A total of 14 species of fish can be found within the streams that are intersected by the NAR including two species of salmon and 12 species of resident freshwater fish species (Table 12). The majority of these species are found only in the Yukon and Stewart rivers. The NAR intersects the upper portion of the Indian River watershed, in a location that is a considerable distance upstream from documented Chinook presence; however, a number of freshwater species are expected to be present (PECG 2017). The other primary watersheds intersected by the NAR (Maisy May, Barker, Ballarat) are smaller in size with the most diverse habitat (e.g. overwintering potential) near the mouths of these watersheds. Placer mining activity is prominent along the NAR (north of the Yukon River) and many stream channels and associated fish habitat has been changed by past activity.

4.1 STREAM CROSSINGS

Fish had been previously documented in the larger streams which the NAR intersects. PECG (2016) captured Arctic grayling at two sites in Maisy May Creek and burbot, slimy sculpin and juvenile Chinook salmon near the mouth of Maisy May (Crossing 91). Fish had been also previously documented in some of the larger streams along the route including the Stewart, Yukon and Indian rivers as well as Ballarat and Coffee creeks.

In 2016, 53 proposed crossings were visited; fish sampling was completed where stream channels were present with an emphasis on streams that did not have previously documented fish presence. Fish were captured in the Indian River (slimy sculpin) and in the upper Barker watershed (Arctic grayling at Crossing 208). Many of the smaller streams had poor habitat quality and/or downstream obstructions (e.g. high gradients[5]) to fish habitat (APPENDIX B and APPENDIX F).

Several of the smaller drainages assessed did not have stream characteristics such as a continuous channel bed where water has scoured a channel or deposited mineral alluvium within the channel. Any drainage that did not meet the criteria of a stream and did not have any fish habitat was referred to a Non-Classified Drainage (NCD).

Of the 56 drainages along the NAR (not including the Yukon and Stewart rivers), 16 were determined to be fish bearing or assumed fish bearing, 19 were determined to be non-fish bearing due to poor habitat and/or the presence of downstream barriers and 21 were determined to be NCD's (Figure 18 to Figure 20). Table 27 outlines all the streams assessed and provides rationale for each designation.

[5] Based on information from BC MOF (1998) stream grades of >20% were used to identify gradient barriers; this would be considered a very conservative for the fish species found in the study area (i.e. species that are known to navigate steep gradients in small streams in BC, e.g. bull trout and rainbow trout are not present).

Table 27. Summary of fish and fish habitat assessment work for road crossing associated with the NAR.

Crossing Number	Stream Name[1]	Avg. Channel Width (m)	Avg. Stream Gradient (%)	Fish Bearing Status[2]	Rationale for Fish Bearing Status
47	Sulphur Creek	n/a	n/a	FB	Not assessed in 2016 due to access restrictions. Considered fish bearing by PECG (2016). Round whitefish and Arctic grayling documented by DFO (2016). Large enough to provide overwintering habitat.
50	Indian River	~15 m	1	FB	Slimy sculpin captured at this site. Arctic grayling also documented in Indian River (PECG 2016).
51	unnamed (Indian River Trib 1)	-	5.0	NCD	Flow through moss, bog. No defined channel banks or alluvial substrate.
52	unnamed (Indian River Trib 2)	0.52	5.0	NFB	Poor habitat near road, spread out and underground flow downstream of road prevents access. No fish captured via electrofishing and minnow trapping.
53	unnamed (Indian River Trib 3)	-	-	NCD	Flow spread out through vegetation, lacks continuous defined channel banks or alluvial substrate.
54	unnamed (Indian River Trib 4)	-	-	NCD	Drainage dry, alluvial substrate only present immediately downstream of culvert.
54.5	unnamed (Eureka Trib)	0.55	23.0	NFB	Drainage is dry upstream of culvert and has an average gradient of 23% downstream, which precludes fish usage.
55	Eureka Creek	~30[a]	2[a]	PFB	Not assessed in 2016 due to active placer mining in area. Sampled by PECG (2016), no fish captured but potential exists given stream size and proximity to the Indian River.
57	unnamed tributary to Maisy May	-	-	NCD	Ditch water collects and flows across the road, no channel or defined banks.
58	unnamed tributary to Maisy May	-	-	NCD	No visible channel, as assessed by PECG (2016).
59	unnamed tributary to Maisy May	-	-	NCD	No visible channel, as assessed by PECG (2016).
60	unnamed tributary of Maisy May	n/a	30	NFB	Channel results from road/ditching drainage, no water at time of survey. Likely only flows during rain/melt events. Steep gradient and poor habitat would preclude fish use. Road planned to be moved away (upslope) from this area.
61	unnamed tributary of Maisy May	-	-	NCD	No stream bed/alluvial bed material downstream of the road. Road planned to be moved away from this area.

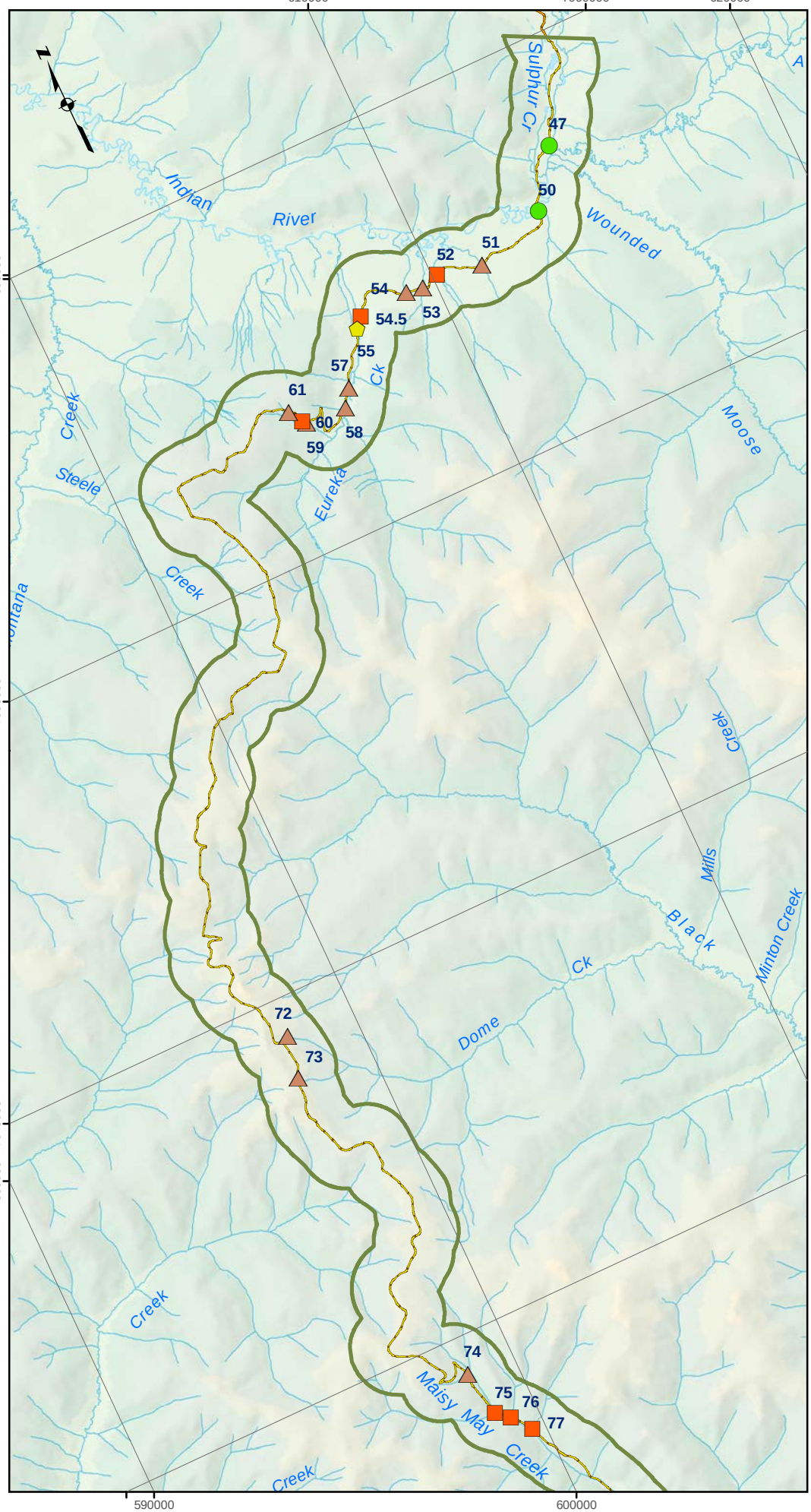
Crossing Number	Stream Name[1]	Avg. Channel Width (m)	Avg. Stream Gradient (%)	Fish Bearing Status[2]	Rationale for Fish Bearing Status
72	unnamed tributary of Maisy May Creek	-	-	NCD	Flow over moss and organics, no alluvial bed material or defined streambanks.
73	unnamed tributary of Maisy May	-	-	NCD	No stream channel evident on either side of road, just seepage from ditch.
74	unnamed (Upper Maisy May Trib)	-	-	NCD	Flow only near road, no defined stream channel upstream or downstream of road, and no alluvial bed materials.
75	unnamed (Maisy May Trib 1)	1.73	6.0	NFB	High gradient downstream of road prevents fish access. Electrofished, no fish captured.
76	unnamed (Maisy May Trib 2)	2.35	5.5	NFB	High gradient downstream of road prevents fish access. Electrofished, no fish captured.
77	unnamed (Maisy May Trib 3)	1.73	4.0	NFB	Some fish potential downstream of road; however, channel on approach to culvert is steep and would not pass fish. NFC during electrofishing.
MMTT-1	Maisy May Tailings Trib 1	-	-	NCD	Spread out flow through vegetation for 40 m upstream of the road. Shallow ponded water upstream. Minnow trapped, no fish captured.
MMTT-2	Maisy May Tailings Trib 2	3.94	1.8	PFB	Shallow flow in wide stream channel, possibly an old channel of Maisy May. Habitat could be used seasonally during high flows.
MMTT-3	Maisy May Tailings Trib 3	-	-	NCD	No flow, no signs of scouring or defined channel. Appears to be only wetted during super high flows in Maisy May, where the stream flows over road into this area. Suggestion to block off flow permanently to prevent fish from entering and possibly getting stranded during flood events.
MMTT-4	Maisy May Tailings Trib 4	-	-	NCD	No stream scouring or channel on Maisy May side of road, small groundwater channel starts 80 m east of crossing and flows south (away from road) into MMTT-5. It also appears that during times of flood in Maisy May, water flows over road at this location. Suggest building up the road to block off flow permanently to prevent flow through old placer mined area.
MMTT-5	Maisy May Tailings Trib 5	1.71	0.5	NFB	Shallow stream, poor fish habitat, flows through vegetation immediately upstream of road. Electrofished, no fish captured.
81	unnamed (Maisy May	3.6[a]	1[a]	FB	Arctic grayling captured by PECG (2016). Minnow traps set in 2016, no fish captured.

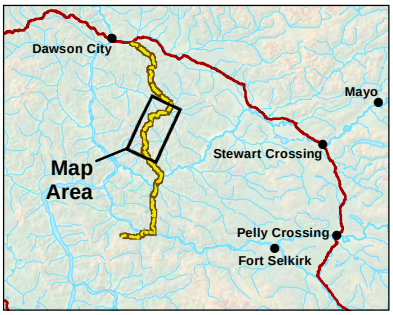
Crossing Number	Stream Name[1]	Avg. Channel Width (m)	Avg. Stream Gradient (%)	Fish Bearing Status[2]	Rationale for Fish Bearing Status
	Trib 4)				
83	unnamed (Lower Maisy May Trib 1)	0.67	8.5	NFB	Poor habitat quality, small channel with many obstructions. Electrofished, no fish captured.
84	unnamed (Lower Maisy May Trib 2)	-	-	NCD	No alluvial substrate or defined, continuous channel banks. Seepage flow only.
85	Unnamed Tributary of Maisy May Creek	-	-	NCD	No alluvial substrate or defined, continuous channel banks.
91	Maisy May Creek	4.00	2.5	FB	Burbot, Arctic grayling, Chinook salmon (juveniles) and slimy sculpin captured in Maisy May Creek by PECG (2016) and others.
97	unnamed (North Stewart Trib)	0.49	9.3	NFB	Too steep/shallow, lack of nearby spawning habitat, no fish captured by electrofishing or minnow trapping, multiple obstructions to fish passage.
100	Barker Creek	~10 [a]	2 [a]	FB	Good quality fish habitat, Arctic grayling captured upstream (Crossing 208).
101	unnamed (Lower Barker Trib 1)	3.38	12.0	NCD	Channel bed and banks are not continuous, no fish captured during electrofishing
102	unnamed (Lower Barker Trib 2)	2.12	13.0	NCD	Channel bed/banks not continuous for >100m, poorly defined.
103	unnamed (Lower Barker Trib 3)	2.43	9.5	NFB	Poor habitat and obstructions downstream, no fish captured via electrofishing.
104	unnamed (Lower Barker Trib 4)	3.74	8.0	NFB	Poor habitat and obstructions downstream, no fish captured via electrofishing.
110	unnamed tributary of Barker Creek	0.81[a]	3[a]	NFB	3 m falls 55 m downstream crossing, no overwintering habitat upstream of falls. No fish captured by electrofishing.
111	unnamed (Mid Barker Camp)	4.40	6.0	PFB	No fish captured during electrofishing; however, habitat exists and Arctic grayling have been captured upstream (Agate Creek).
112	unnamed (Mid Barker Tailings 1)	1.30		NFB	Small, poorly defined and shallow stream with downstream obstructions to fish passage.

Crossing Number	Stream Name[1]	Avg. Channel Width (m)	Avg. Stream Gradient (%)	Fish Bearing Status[2]	Rationale for Fish Bearing Status
113	unnamed (Mid Barker Tailings 2)	5.00	2.3	PFB	No fish captured during electrofishing; however, habitat exists.
114	unnamed tributary of Barker Creek	n/a	n/a	NFB	Discontinuous and poorly defined upstream of road, more defined downstream, but goes subsurface occasionally. Gradient barrier downstream of the crossing (24% for over 100 m), no fish captured via electrofishing.
115	unnamed tributary of Barker Creek	n/a	n/a	NFB	Small, poorly defined and shallow stream. Not enough water to sample.
210	unnamed (Upper Barker Trib 1)	2.23	3.0	PFB	Moderate rearing habitat, no fish captured during electrofishing but usage for summer rearing (i.e. Arctic grayling) cannot be ruled out.
209	unnamed (Upper Barker Trib 3)	3.80	4.5	PFB	Moderate rearing habitat, no fish captured during electrofishing but usage for summer rearing (i.e. Arctic grayling) cannot be ruled out.
208	Agate Creek (Upper Barker)	2.35	4.0	FB	Arctic grayling captured.
207	unnamed (Upper Barker Trib 4)	1.23	17.0	NFB	Too steep/shallow, cascades to 0.9 m, no spawning/overwintering nearby. No fish captured during electrofishing.
206	unnamed (Ballarat Headwaters)	-	-	NCD	Water flow through willow and moss, no defined stream channel. No fish captured during electrofishing
205	unnamed (Upper Ballarat)	0.97	11.5	NFB	Barrier located downstream of this site on Ballarat Creek, also habitat poor overall. No fish captured during electrofishing
204	unnamed tributary to Ballarat Creek	-	-	NCD	No drainage found in this location.
203	unnamed (Upper Ballarat Trib)	0.44	10.7	NFB	Low habitat quality, very small channel, poor habitat, very cold water temps. No fish captured during electrofishing.
202	unnamed tributary to Ballarat Creek	-	-	NCD	Small backwatered area at confluence of Ballarat Creek only, otherwise flow through organics with no defined channel.
201	Ballarat Creek (Mid Ballarat)	3.60	2.8	PFB	Moderate overwintering and rearing habitat quality, no hard barriers identified/confirmed downstream. No fish captured via electrofishing.
118	unnamed	11[a]	5[a]	PFB	Substantial stream, no barriers to fish passage.

Crossing Number	Stream Name[1]	Avg. Channel Width (m)	Avg. Stream Gradient (%)	Fish Bearing Status[2]	Rationale for Fish Bearing Status
	(Lower Ballarat Trib 1)				
119	unnamed (Lower Ballarat Trib 2)	n/a	n/a	NFB	No water, steep boulder dominated channel with gradient barrier downstream of road.
200	Ballarat Creek (Ballarat Proper)			FB	Juvenile Chinook salmon documented nearby by WMEC (2001).
WRC-1	unnamed (Winter Road Creek)	0.76	2.8	PFB	Moderate rearing habitat quality, no hard barriers identified and relatively few obstructions downstream.
WRC-2	unnamed tributary to Yukon River	-	-	NCD	Trickle of water through vegetation, no defined stream channel or alluvial bed material.
125	Coffee Creek	21.83	1.5	FB	Fish captured during previous sampling by PECG (2017) and this report (mine sampling). Chinook salmon (juveniles), slimy sculpin and Arctic grayling documented.

[1] Names in brackets are consistent with OnSite Crossing ID (project engineers). 2 Where FB = Fish Bearing, NFB = Non-Fish Bearing, PFB = Potentially Fish Bearing and NCD = Non-Classified Drainage. [a] data from PECG (2016)





Legend

- Settlement/Community
- Fish Bearing Stream
- Potentially Fish Bearing Stream
- Non Fish Bearing Stream
- Non-classified Drainage (not a stream)
- Proposed Route
- Government-Maintained Gravel Road Along Proposed Route
- NAR Study Area

FIGURE: 18

Stream crossing assessment sites on the Northern Access Road during 2016 (Map 1 of 3)

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change. Project data displayed is site specific.

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KM

Map Reference Scale: 1:150,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MP	Checked: BSc/PT	Date: 10/31/2016

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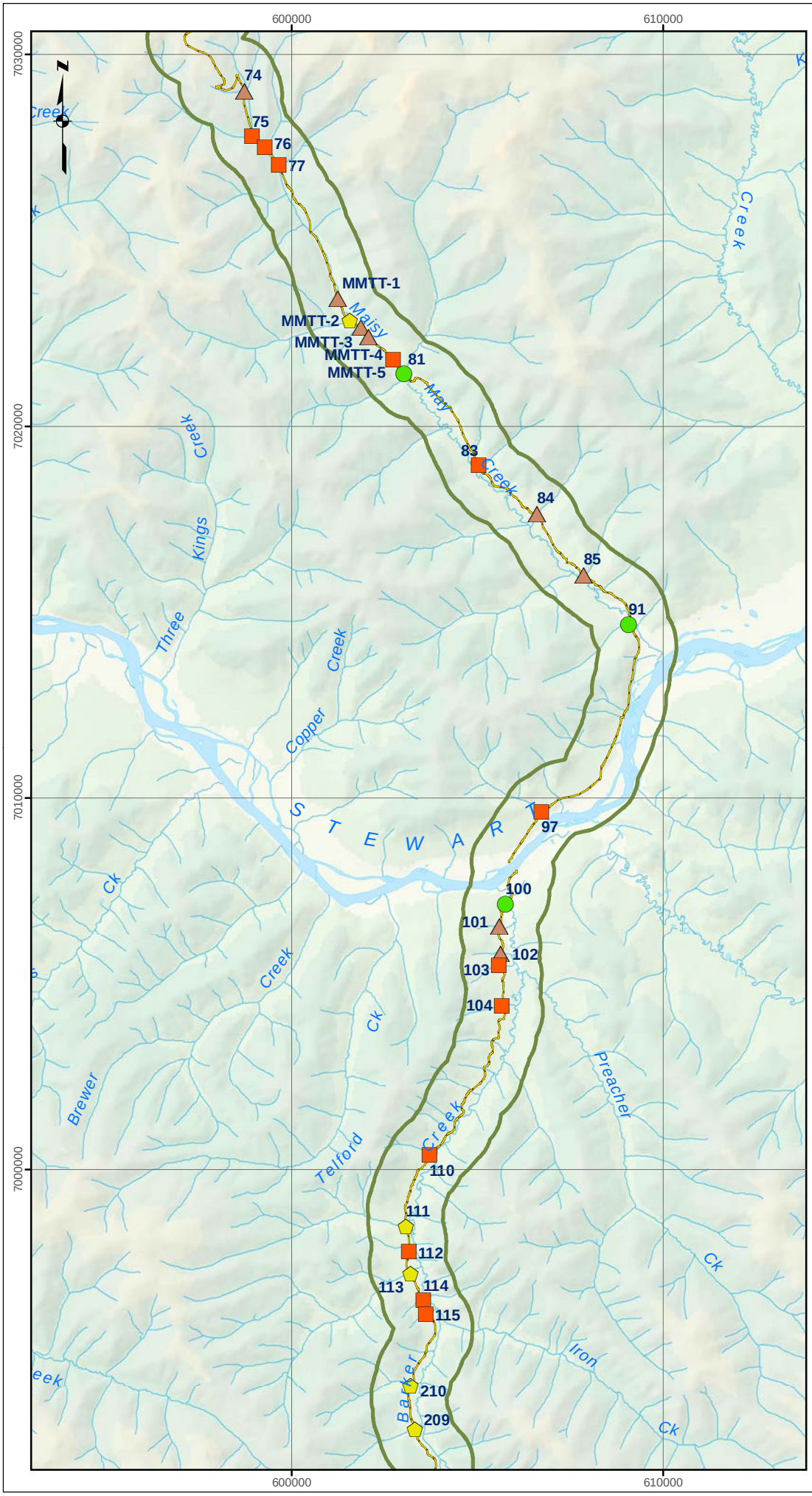

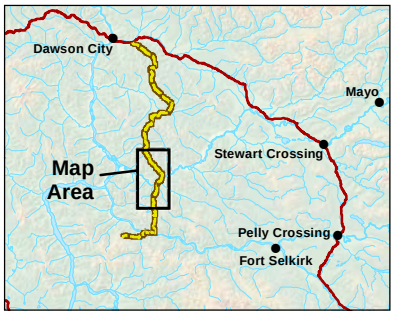

Legend

- Settlement/Community
- Fish Bearing Stream
- Potentially Fish Bearing Stream
- Non Fish Bearing Stream
- Non-classified Drainage (not a stream)
- Proposed Route
- NAR Study Area

FIGURE: 19

Stream crossing assessment sites on the Northern Access Road during 2016 (Map 2 of 3)

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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Map Reference Scale: 1:150,000 (Printed at 8.5 x 11)
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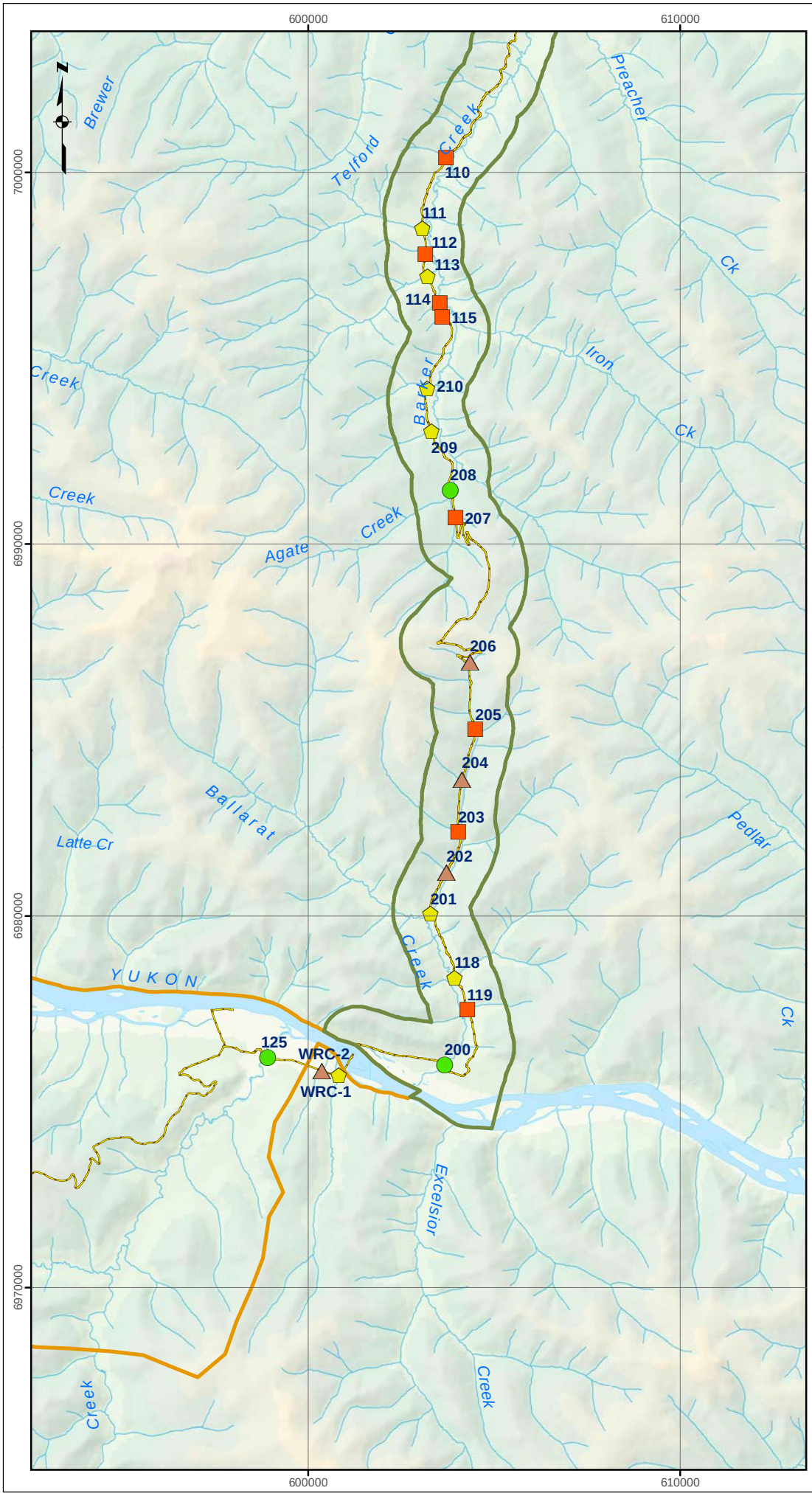

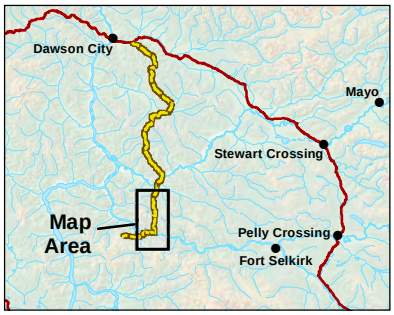

Legend

- Settlement/Community
- Fish Bearing Stream
- Potentially Fish Bearing Stream
- Non Fish Bearing Stream
- Non-classified Drainage (not a stream)
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 20

Stream crossing assessment sites on the Northern Access Road during 2016 (Map 3 of 3)

Data Sources
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Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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KM

Map Reference Scale: 1:150,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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4.2 BARGE LANDINGS – YUKON AND STEWART RIVERS

Past work at the barge landings on the Yukon and Stewart rivers indicates that the sites are located in areas that have typical streambank habitat associated with these large rivers. No sampling was completed in 2015; however, it was speculated that these areas would provide migration and rearing habitat for the various species of fish in these rivers. Sampling was conducted in both the Yukon and Stewart rivers in 2016 to provide information on fish species presence within the vicinity of the proposed barge landings.

A total of eight species were captured during 2016 sampling (Table 28) with similar fish species being captured in both the Yukon and Stewart rivers. Northern pike and round whitefish were captured in the Yukon and Stewart rivers only, respectively.

Juvenile Chinook salmon were the most frequently captured species and were captured in three beach seine hauls on the Yukon River where they accounted for nearly 80% of the fish captured (Figure 21). Slimy sculpin and longnose sucker were also captured in all three seine hauls although the number of individuals captured was relatively low. In the Stewart River, juvenile Chinook and longnose sucker were the most common species captured with only the latter captured in all three seine hauls.

Table 28. Summary of fish species captured in the Yukon and Stewart rivers during 2016 as associated with the proposed barge landing locations.

Species	Fish Captured	
	Yukon River	Stewart River
Chinook salmon	✓	✓
Arctic grayling	✓	✓
burbot	✓	✓
northern pike	✓	
longnose sucker	✓	✓
lake chub	✓	✓
slimy sculpin	✓	✓
round whitefish		✓
lake/round whitefish[6]		✓

[6] These species are not discernable at the juvenile life stage without genetic testing.

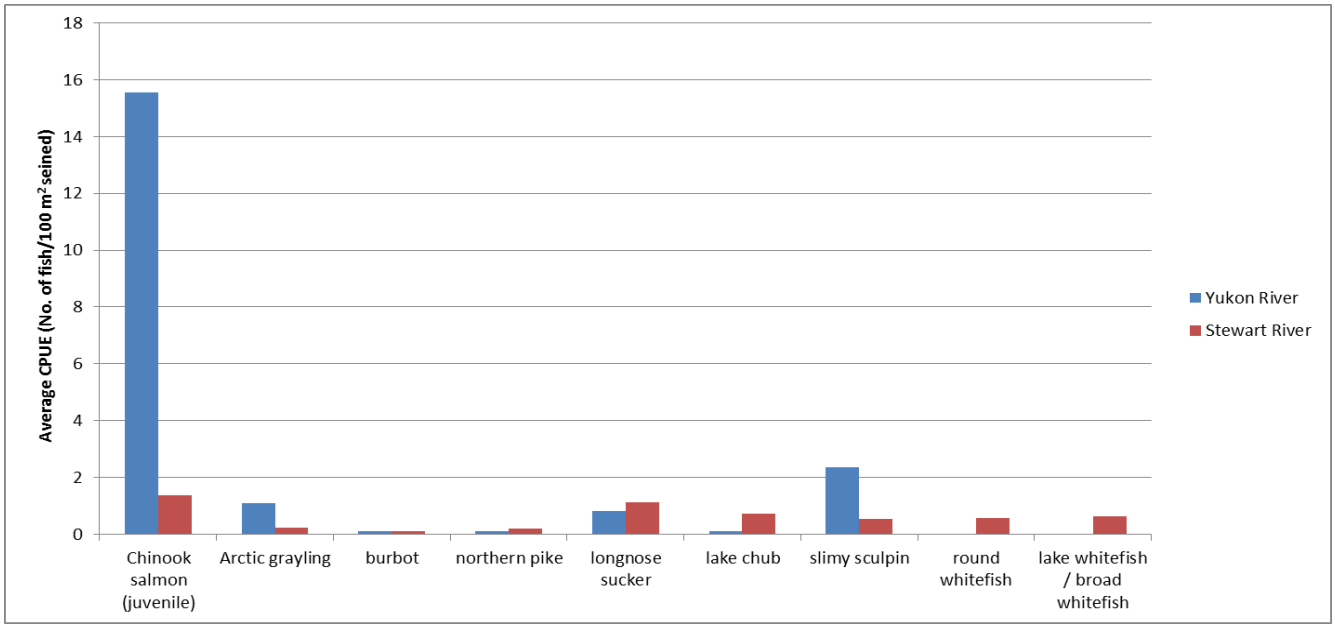


Figure 21. Catch-per-unit-effort (CPUE) of fish captured by beach seining in the vicinity of the proposed barge landings on the Yukon and Stewart rivers.

4.2.1 CHUM SPAWNING SURVEYS

Spawning chum salmon were observed in the Yukon River in September and October 2013 (Figure 22). An unverified salmon species was documented spawning within the study area in October 2014; the timing of the observation indicates that the observed spawning salmon were chum (PECG 2016). During the October 2016 spawning survey, spawning chum were found in six locations within the Yukon River with a total of 263 chum observed (Table 29, Figure 22). The Stewart River was mostly frozen over at the time of the survey; however, three spawning chum were observed in one location near the downstream end of the survey extent (Table 29, Figure 22). All areas were shallow and gravel and cobble bed material. On both rivers, the ice conditions and unseasonably cold temperatures likely reduced the number of spawning sites observed. On the Yukon River a number of the spawning areas located during 2013 were frozen over during the October 2016 survey and thus could not be surveyed.

All documented chum salmon spawning areas in the LSA occur in small, clear water side channels of the Yukon River (Photo 17, Photo 18) and the Stewart River (Photo 19). This suggests that chum salmon spawn preferentially in these clear water locations, rather than the more turbid mainstem or larger secondary side channels of the these large rivers. In addition, the upstream inlet of the spawning channels appears to be disconnected from the flow of the mainstem Yukon River during the fall chum salmon spawning period (i.e. fall months; Photo 10). As such, the naturally turbid river water would be prevented from flowing into this channel during the fall, while chum salmon are spawning/incubating in these areas.

Table 29. Summary of spawning chum salmon observed on the Yukon and Stewart rivers during October 2016.

Stream	Site	Number of Chum Salmon Observed
Yukon River	YR1	50
	YR2	63
	YR3	39
	YR4	42
	YR5	37
	YR6	32
Stewart River	SR1	3

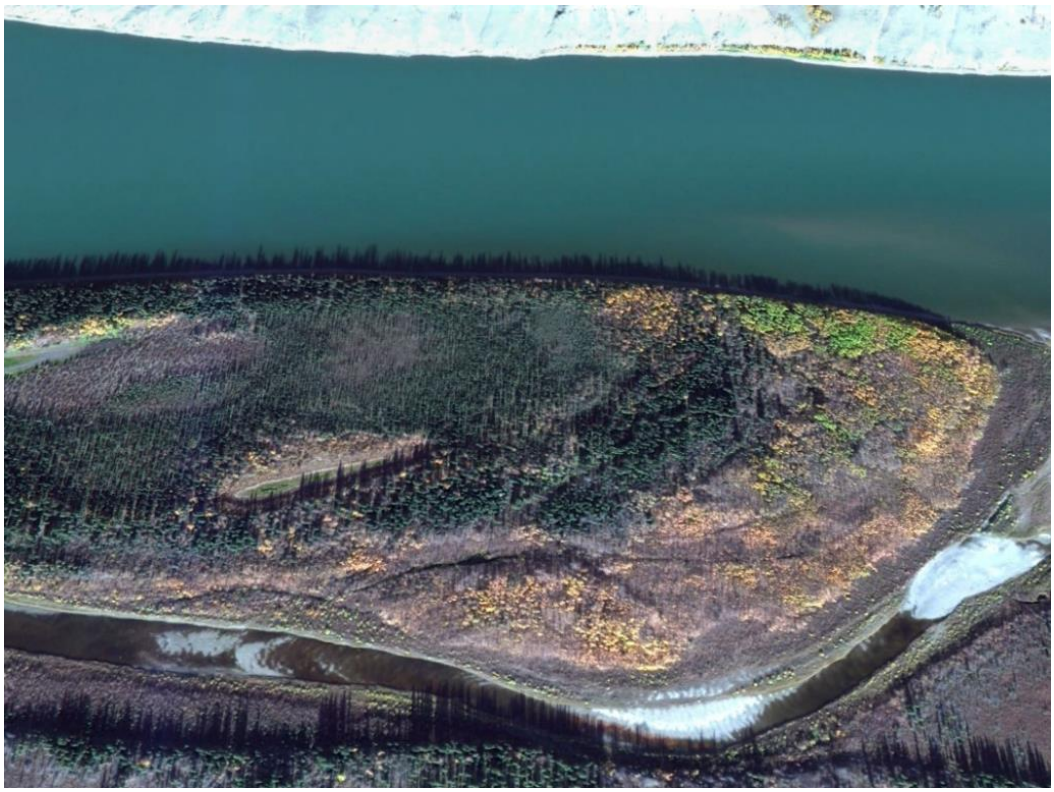


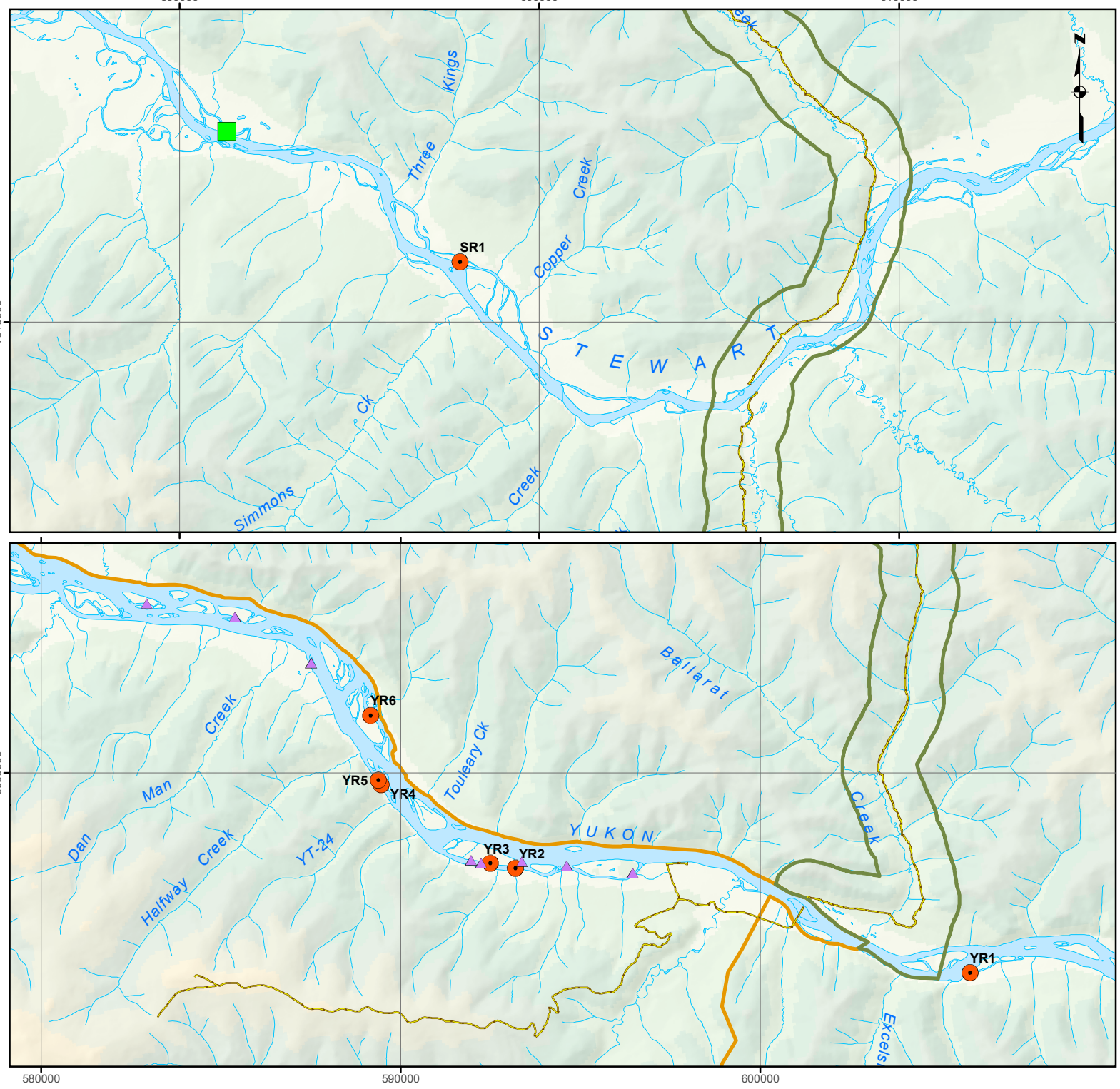
Photo 17. Aerial image showing a clear water side channel where chum salmon spawning has been observed in the study area, the more turbid water above is the mainstem of the Yukon River (from Google Earth image date September 19, 2010).

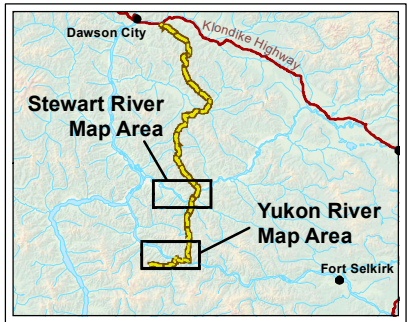


Photo 18. Ground photo of spawning chum salmon in a clear water side channel of the Yukon River during the October 2016 survey (site YR5 shown).



Photo 19. Aerial image showing a clear water side channel on where chum salmon spawning was observed (red circle) in clear water side channel of the Stewart River (from Google Earth image date: September 19, 2010).





Legend

- Settlement/Community
- 2016 Chum Spawning Sites
- 2014 Chum Spawning (Rivest; Pers. Comm. 2016)
- 2013 Chum Spawning Sites
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 22

Results of chum spawning surveys on the Yukon and Stewart rivers

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change. Project data displayed is site specific.

0 1 2 3 4 5
KM

Map Reference Scales: 1:150,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MP	Checked: PT	Date: 3/10/2017

KAMINAK GOLD CORPORATION EDI

Path: O:\2014\14_Y_0306_Kaminak_CoffeeCk\Mapping\2016_Mapping\2016_Baseline\03_Aquatics\Fig_18_Oct_SpawnResults_26102016.mxd

4.3 STEWART RIVER BACK CHANNEL

Previous investigations indicated this channel had limited fish habitat during low flows in the Stewart River (PECG 2016). No fish were captured via minnow trapping (September 2015) in the vicinity of the area that will be encroached upon and dissolved oxygen levels were relatively low (5.19 mg/L; PECG 2016). Given its connection with the Stewart River, it is considered fish bearing and is likely most valuable as refuge habitat when water levels in the Stewart River are high.

During July 2016, fish sampling downstream of the area that will be encroached by the NAR (where the channel is deeper and wider), resulted in the capture of lake chub, northern pike, round whitefish and lake whitefish. During the late October visit, the back channel in the vicinity of the encroachment areas was found to be frozen to bed with no water under the ice (Photo 20, Photo 21). The crew investigated the upstream extent of this channel to determine if it receives flow from the upstream end and found that there was more terrestrial vegetation (i.e. willows) towards the upper end of the channel; however, it appears likely that flow does occasionally enter the channel during high flows in the Stewart River.

In the vicinity of the encroachment areas, this channel appears to be only wetted during high flows in the Stewart River and is most likely used as refuge habitat by species utilize the area downstream (i.e. lake chub, northern pike and perhaps whitefish). The channel bottom is made of fines and organics. No critical habitats will be affected by the encroachment on the edge of this channel.



Photo 20. Downstream view of Stewart River back channel in the vicinity of an encroachment area (right side of photo).



Photo 21. Upstream view of Stewart River back channel in the vicinity of an encroachment area (left side of photo).

5 DISCUSSION

The fish habitat in the study area comprises large river and smaller stream habitat. The Yukon and Stewart rivers provide important overwintering habitat and migration corridors within the region, while tributary streams, depending on their size, provide a variety of rearing habitat and overwintering capabilities. Tributaries that provide overwintering habitat (i.e. Coffee, lower Independence and Maisy May creeks) have more diverse fish assemblages, while smaller tributaries with no overwintering habitat provide some summer rearing habitat for migratory fish (e.g. grayling). Most tributary streams in the area are nutrient-poor and have cool water temperatures, which limit their overall productivity. Many smaller streams in headwater areas have moderate gradients and poor habitats (i.e. limited pool depth) that are not typically used by the species present in the region. Many of the streams along the NAR have been subject to placer mining activities which have resulted in change of stream and riparian morphology. The following sections use all available information to discuss the fish and fish habitat values in each stream with an emphasis on the Mine study area.

5.1 YUKON RIVER

The Yukon River flows within the Mine and NAR study areas and all of the streams near the Mine infrastructure are tributaries of this stream. The river has a relatively diverse assemblage of fish species with numerous species likely to occur within the vicinity of Coffee Creek including both Chinook and chum salmon. Near the study area, adult Chinook use the river as a migration route to spawning areas further upstream. Juvenile Chinook use the main channel of the river during the downstream migration from rearing areas to the ocean. Juveniles may also rear in the main channel during the summer; however, this is not considered ideal rearing habitat for these fish which prefer clear water smaller streams with woody debris and other forms of in-stream cover. The lack of detected Chinook salmon eDNA in river Yukon River water collected in March 2016 provides an indication that Chinook do not overwinter in the Yukon River.

Adult chum have been observed spawning in side channel areas of the Yukon River within the study area in 2013, 2014 and 2016 (Figure 22). These spawners belong to the 'mainstem Yukon River' stock, which spawn in side channels/sloughs of the Yukon River between the White River and the Tatchun Creek area near Carmacks. During 2014, this stock constituted 49% of the Canadian border passage of fall chum salmon (JTC 2015); however, only a small portion of these individuals likely spawn in the portion of the Yukon River within the study area. These chum that spawn within the study area use clear water side channel habitat that appear disconnected from the flow of the mainstem of the Yukon River during fall and winter months. Based on known chum salmon habitat preferences, these channels are likely fed by groundwater throughout the incubation period.

No chum spawning has been documented in close proximity to the barge and winter road landings (Photo 22); the closest location is in a side channel 1.8 km downstream of south barge landing. While the southern winter road landing is located in a side channel, this side channel appears to be frequently fed by river flow

rather than groundwater (Photo 22, all documented spawning locations were in clear water locations on this imagery), no spawning has been observed in this side channel.



Photo 22. Google earth imagery (Sept 19, 2010) of the Stewart River near the locations of barge and winter road landings.

In addition to salmon, the mainstem Yukon River also provides habitat for a wide range of species including Arctic grayling, a valued recreational fish species in the Yukon and species of interest for the Coffee Project due to their presence in the small streams directly downstream of the Project infrastructure. The river likely does not provide spawning habitat for this species; however, it does provides suitable overwintering conditions. The detection of Arctic grayling eDNA in river water samples collected at several locations in the Yukon River provides evidence of Arctic grayling overwintering in the portion of the river within the study area. Arctic grayling often make considerable migrations between spawning, rearing and overwintering locations with smaller streams (such as Coffee, Latte and Independence creeks) used primarily for summer rearing.

Northern pike, burbot and whitefish are also present in the Yukon River. Low numbers of burbot (one fish) and pike (one fish) were captured associated with the barge landing sampling; whitefish were not captured. Northern pike are likely more common in back channel areas where flow velocities and turbidity is low (based on habitat preference and knowledge of them being visual feeders as outlined by McPhail, 2007). Burbot are associated with deep main channels of northern rivers and are found in areas where clear streams enter turbid rivers (McPhail, 2007). Whitefish likely seek out clearer water habitat (moderate size rivers) during the spring/summer when the Yukon River is turbid. All of these species likely use the Yukon River for overwintering purposes when turbidity is low and other overwintering locations are limited.

5.2 STEWART RIVER

The Stewart River provides very similar habitat to the Yukon River; it is also a migration corridor for Chinook and chum salmon that are known to spawn upstream of the NAR. Chum spawning has been documented in clear groundwater fed side channels downstream (~10 km [in 2016] and ~18 km [Rivest Pers. Comm. 2016]) of the barge landings. While spawning survey conditions were not ideal in 2016, there is no similar side channel habitat in the vicinity of the barge crossings (as viewed from the 2016 survey and Project Lidar (Photo 23).

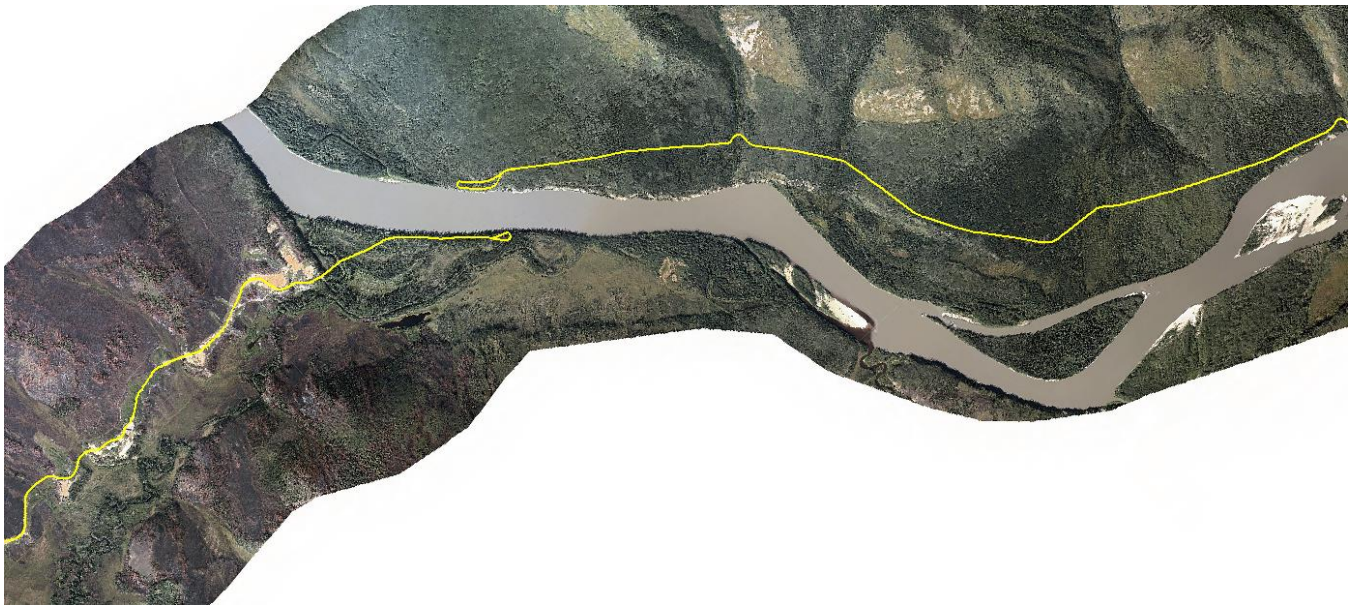


Photo 23. Lidar imagery of the Stewart River near the locations of barge landings (yellow line = NAR).

The Stewart River back channel that will be encroached upon during road construction provides marginal fish habitat that is most likely to be used as refuge habitat during high water events in the Stewart River.

Northern pike, burbot and whitefish are also likely to occur in the Stewart River and utilize similar habitats as the Yukon River (refer to Section 5.1).

5.3 COFFEE CREEK

Aside from the Yukon River, Coffee Creek has the largest catchment in the Mine study area with a total area of approximately 49,000 ha. Three fish species have been documented in the portion of Coffee Creek within the study area, including Chinook salmon (juveniles), Arctic grayling and slimy sculpin.

During the open water season, juvenile Chinook salmon have been captured at sites from the confluence of Coffee Creek and the Yukon River upstream to the Latte Creek confluence, a linear distance of

approximately 8.3 km. These juveniles are presumed to be non-natal and likely originated from spawning areas in the Yukon River watershed upstream of Coffee Creek. This hypothesis is supported by recent spawning surveys and the lack of capture of juvenile Chinook during late June (2015) sampling efforts. The use of small streams for non-natal rearing by juvenile Chinook has been well documented in the Yukon by other researchers including Beacham et al. (1989) and Moodie et al. (2000). This life history strategy allows for juvenile Chinook to access areas which provide productive rearing habitats and may also be associated with predation avoidance (Moodie et al. 2000).

Overwintering habitat was confirmed in the lower 10.0 km of Coffee Creek in early March 2016, as indicated by the capture of slimy sculpin (at stations CF2.7, CF8.3 and CF10.0) and juvenile Chinook (stations CF0.5 and CF2.7) and the detection of juvenile Chinook salmon eDNA water samples collected from all sampling sites. Open water was observed in several side channels in this portion of Coffee Creek, which is often indicative of groundwater discharge in winter. Groundwater discharge influences the presence of juvenile Chinook during the winter months as these areas typically have slightly warmer water temperatures and provide security in terms of sufficient water flows during the winter months. Traditional Knowledge (TH 2012) indicates that Chinook salmon used to spawn up Coffee Creek; however, spawning Chinook were not documented in Coffee Creek during surveys in 2000, 2001, 2014, 2015 or 2016.

Arctic grayling use Coffee Creek for summer rearing and feeding habitat and there is evidence of use for overwintering. PECG (2017) documented Arctic grayling in Coffee Creek from the Yukon River upstream to the Latte Creek confluence in the summer months (a linear distance of approximately 8.3 km). Despite favourable underwater viewing conditions and presence of pool habitat in the lower portions of Coffee Creek no Arctic grayling have been observed or captured during the winter in Coffee Creek. However, positive detection of eDNA of this species in winter at sites in lower (CF2.7) and upper Coffee Creek (CF8.3 and CF10.0) indicate that grayling do overwinter in the stream.

It appears unlikely that Coffee Creek is used by Arctic grayling for spawning. Juvenile grayling (including young-of-the-year) are typically associated with stream margins and would be effectively captured by electrofishing if they were present in the stream. A total of 15 Arctic grayling were captured in Coffee Creek during 2014 and 2015 (PECG 2017) and ranged in size from 134 to 357 mm; YOY were not captured and the majority of individuals captured were over 200 mm in length. The Arctic grayling captured in upper Coffee Creek by PECG (2013) were also consistent with the sampling lower in the watershed; the 12 individuals captured in this area ranged in length from 173 to 238 mm.

Slimy sculpin have been documented in Coffee Creek upstream to the CF10.0 sampling station and likely occur further upstream in the watershed. Given that this species is non-migratory; their presence supports the conclusion that Coffee Creek provides suitable overwintering conditions for fish. In March 2016, slimy sculpin were captured at sampling stations where open water leads were present (CF2.7 and CF10.0) as well as stations where the channel had full ice coverage (CF8.3), indicating that this species overwinters in both habitat types.

Baseline benthic invertebrate tissue metal concentrations in samples collected from Coffee Creek indicates that concentrations of total mercury and methylmercury (calculated) are below the relevant guidelines. In

contrast, calculated baseline Arctic grayling, slimy sculpin and juvenile Chinook salmon tissue methylmercury concentrations exceeded the CCME tissue residue guidelines for the protection of wildlife consumers of aquatic biota (CCME 2000a). Baseline tissue concentrations of selenium in benthic invertebrates, Arctic grayling and juvenile Chinook tissue samples were below the EPA aquatic life ambient water quality criterion for selenium. A small number of sampled slimy sculpin had selenium tissue concentrations above the draft EPA guideline. Selenium concentrations in some Arctic grayling and many slimy sculpin exceeded the BC selenium standard. Uranium concentrations in both invertebrates and slimy sculpin tissue were higher in samples collected from Coffee Creek in March when compared to those collected in August, which is reflective of the baseline uranium concentrations in the creek water, which were highest during low flow conditions experience in late winter (Lorax Environmental 2016).

5.3.1 LATTE CREEK

Latte Creek flows into Coffee Creek approximately 8.3 km upstream from the Yukon River. Latte Creek has a catchment area of approximately 7,000 ha (Lorax Pers. Comm. 2016) and a portion of the headwaters of the drainage are located within the footprint of the Project infrastructure. Two species of fish have been documented in Latte Creek to date including slimy sculpin and Arctic grayling. Slimy sculpin were captured only in the very lower portion of the Latte Creek watershed (LC0.5), in close proximity to Coffee Creek.

Arctic grayling have been captured or observed in Latte Creek from the mouth of the creek upstream to station LC9.9, a linear distance of nearly 10 km. A total of 57 Arctic grayling were captured in the stream during 2014 and 2015 (PECG 2017) and ranged in length from 128 to 355 mm with a mean length of 260 mm. Multiple pass electrofishing was used to estimate the density of Arctic grayling at station LC2.7 and documented a moderate density of individuals (6/100 m^2 during 2014 and 10/100 m^2 in 2015; ± 2, 90% confidence interval in both years; PECG 2017). The lack of YOY captured in the stream indicates that the stream is not used for spawning. PECG (2017) conducted spawning surveys in Latte Creek during mid-June 2015 and did not observe any spawning behaviour nor did they capture any fish that were actively spawning.

Fish overwintering in Latte Creek appears to be unlikely, as determined by observations of the stream during early March 2016. The stream was completely ice covered with no open water leads and had minimal water flow under the ice. Water quality parameters (temperature and dissolved oxygen) were suitable for fish overwintering; however, the limited water depth and lack of deeper pools likely do not provide suitable conditions for overwintering. All eDNA samples collected from water in Latte Creek in March 2016 tested negative for both Arctic grayling and juvenile Chinook salmon DNA. The absence of slimy sculpin in all but the very lower portion of the watershed (adjacent to documented overwintering habitat in Coffee Creek) also supports this conclusion that fish overwintering in Latte Creek is unlikely. Due to the non-migratory nature of this species, their absence is often a good indicator that overwintering habitat is lacking.

Baseline fish tissue concentrations of methylmercury in Latte Creek exceeded the CCME tissue guideline in Arctic grayling and slimy sculpin samples. Uranium concentrations in all fish tissues were among the lowest in the Mine LSA. Baseline benthic invertebrate tissue metal concentrations in samples collected from Latte Creek indicate that concentrations of total mercury and methylmercury (calculated) were below the relevant

guidelines; however, it was noted that concentrations of total and methylmercury were higher at LC9.9 when compared to LC2.7, located closer to the confluence with Coffee Creek.

5.3.1.1 Latte Creek Tributary C

The Latte Creek Tributary C is a small stream (2nd order, 1:50,000) that flows into Latte Creek approximately 10 km upstream from Coffee Creek. The catchment area of this stream is relatively small (344 ha; Lorax Pers. Comm. 2016) and the upper portion of this watershed overlaps with mine infrastructure (e.g. proposed pits).

The stream has a moderate to high gradients, has a poorly defined channel near the mouth and has numerous obstructions to fish passage (described in Section 3.4.5). The only species/life stage that use Latte Creek near the confluence of this stream is sub-adult and adult Arctic grayling. With the exception of the lower 15 m that is influenced by flows in Latte Creek, the poor habitat (small and poorly defined channel, lack of deep pools, high gradient, and numerous obstructions) in this stream is not suitable to this species/life stage.

5.4 HALFWAY CREEK

Halfway Creek is a tributary of the Yukon River and has a catchment area of 2,704 ha (Lorax Pers. Comm. 2016). The total length of the mainstem of this stream is approximately 11 km and a portion of its headwaters are located within the footprint of the proposed WRSF.

The capture of a single Arctic grayling in 2014, 2015 and 2016 and a small number of slimy sculpin in August 2016 at station HF0.0 indicates that the area at/near the confluence with the Yukon River is used by low densities of fish. Previous sampling in July, August, September and October 2013 and in July 2016 ~200 m upstream of the mouth (HF0.2) did not result in the capture any fish; however, one Arctic grayling and 20 juvenile Chinook salmon were captured at this station in August 2016.

Winter fish sampling was conducted during March 2016 at station HF6.3 and no fish were captured. Due to the extensive ice coverage of the stream and minimal water flow/depths under the ice, winter fish sampling could not be completed in the lower portion of the stream; however, the overwintering potential appears to be low. A sufficient amount of water was present in the stream to allow for the collection of eDNA samples from two sites on Halfway Creek (HF6.3 and HF0.2); both sites tested negative for both Arctic grayling and juvenile Chinook salmon.

Based on the fish sampling results from 2013 to 2016 and the fish habitat data collected in the lower, middle and upper reaches of Halfway Creek, fish presence in low numbers is confirmed in the lower 350 m of Halfway Creek. Fish presence is also possible in the lower 900 m that are accessible to fish from the Yukon River. While the barrier 900 m upstream of the mouth is not permanent, there are other obstructions to fish accessing the middle reaches of Halfway Creek (HF6.3), and fish habitat in this area is generally poor due to moderate gradients (~10%) and lack of pools.

In Yukon, headwater streams with moderate gradients (in the range of 10% or higher) are often absent of fish. A study in the Peel River watershed indicated that Arctic Grayling were predicted to be found in only the larger, lower reaches of 3rd order streams, with probabilities in upstream sections declining rapidly to nil (Barker et al. 2011). Barker et al. (2011) indicated that their predictive model reflected observed patterns of grayling presence; with most grayling found in larger, lower-elevation streams with large amounts of surrounding vegetation, often overhanging the stream. They also indicated "Predicted probability of Arctic Grayling presence was near nil in 1st and 2nd order streams and very low in most 3rd order streams, but approached one in most 4th order streams". While this study was in a different area of the Yukon, the results are consistent with the observations of fish distribution in streams adjacent to the Coffee Mine site (e.g. Halfway is a 3rd order, Lower Latte is a 4th order stream and YT-24 is a 2nd order stream). This is also consistent with the habitat modelling completed with the Yukon Placer Secretariat (2010) which indicated low suitability habitat in Halfway Creek above HF6.3.

Baseline fish tissue concentrations of methylmercury in Halfway Creek were below the CCME tissue guideline in Arctic grayling and juvenile Chinook salmon tissue samples; methylmercury concentrations in samples from Halfway Creek were among the lowest in the Mine LSA. Uranium concentrations in all fish tissues ranged from 0.005 to 0.037 µg/g ww, which was average for the Mine LSA. Baseline benthic invertebrate tissue metal concentrations in samples collected from Halfway Creek indicate that concentrations of total mercury and methylmercury (calculated) were below relevant guidelines and uranium concentrations in benthic invertebrate tissues collect both at upstream and downstream sampling locations in Halfway Creek were among the highest of all sites in the Mine LSA sampled in August 2016.

5.5 YT-24

YT-24 Creek is a tributary of the Yukon River and has a catchment area of 1,183 ha (Lorax Pers. Comm. 2016). The total length of the mainstem of YT-24 Creek is approximately 7 km and a portion of its catchment will overlap with the proposed mine footprint. Open water season fish sampling in the stream includes sampling at the confluence of the Yukon River (YT0.0), as well as several stations in the lower reaches of the creek (YT0.2, YT0.6, YT0.9 and YT1.3) and three stations in the upper reaches of the creek (YT4.6, YT5.0 and YT5.9).

Slimy sculpin are the only fish species to have been captured in YT-24; they were found in the lower 50 m of the stream in 2015 and at the confluence with the Yukon River in August 2016 (station YT0.0); however, the Yukon River had back flooded this portion of the stream at the time of sampling in 2015 (PECG 2017) and 2016.

Winter fish sampling and eDNA sampling collection was attempted near the mouth during March 2016; however, no flowing water was located. These findings suggest that overwintering habitat in the stream is absent.

Based on the fish sampling results from 2014 to 2016 and the fish habitat data collected in the lower and upper reaches of YT-24 Creek, fish use occurs at the confluence of YT-24 with the Yukon River and

appears limited in any areas further upstream. Multiple drops in the stream channel of 0.7 m or more impede fish access in the first few hundred meters of the creek and appear to cumulatively present a barrier to fish passage. An additional barrier to fish passage (30% gradient over 7.4 m) further precludes fish presence in the area of YT-24 Creek that is in the vicinity of mine infrastructure.

No fish tissue samples were collected from YT-24, however benthic invertebrate tissue samples that were analyzed to metals concentrations indicate that concentrations of total and methylmercury and uranium were all among the lowest of the benthic invertebrate tissue concentrations analyzed throughout the Mine LSA.

5.6 INDEPENDENCE CREEK

With a catchment area of approximately 22,000 ha (Lorax Pers. Comm. 2016), Independence Creek has the second largest catchment area in the Mine study area. The fish community composition in this stream is very similar to that of Coffee Creek with three species documented including: juvenile Chinook salmon, Arctic grayling and slimy sculpin.

All three fish species have been documented to a linear distance of 6.7 km upstream from the Yukon River confluence with Independence Creek. The CPUE of juvenile Chinook in Independence Creek was generally lower than that of Coffee Creek, particularly during 2014 when capture rates were less than 1 fish per trap day as compared to 5 to 12 fish per trap day in Coffee Creek (PECG 2017). Chinook salmon spawning has not been documented in Independence Creek and, similar to Coffee Creek, it is likely that juvenile Chinook use the stream as non-natal rearing and potentially overwintering habitat.

Arctic grayling in Independence Creek were found in low densities and multiple pass electrofishing at station ID6.7 during 2014 resulted in an estimate of 3 individuals per 100 m^2 with a 90% confidence interval of ±2 fish (PECG 2017). The catch of Arctic grayling in the stream was dominated by sub-adult and adult individuals, although a single YOY was captured at station ID1.9 which indicates that some spawning occurred in the stream. Environmental DNA samples from water collected at a site near the confluence of Independence Creek with the Yukon River (ID1.9) tested negative for both Arctic grayling and juvenile Chinook salmon DNA.

The capture of slimy sculpin in Independence Creek provides an indication that overwintering habitat may be present in the stream. Winter fish sampling during March 2016 did not capture any fish in six minnow traps set at station ID1.9; however, conditions appeared to be suitable for fish overwintering at the time of sampling as indicated by areas of open water and considerable under ice water flow. The winter fish sampling data, combined with the eDNA results, suggest that while overwintering is probable in the creek, it does not appear be as extensive as in Coffee Creek.

Baseline benthic invertebrate tissue metal concentrations in samples collected from Independence Creek indicate that tissue concentrations of total mercury, methylmercury and selenium were all below the relevant guideline levels. In contrast, baseline fish tissue metal concentrations of methylmercury exceeded the CCME

guideline for Arctic grayling and slimy sculpin. Baseline tissue concentrations of selenium exceeded the BC and EPA whole-body guideline in two sampled slimy sculpin. Tissue uranium concentrations in benthic invertebrates and fish were low, compared with benthic invertebrate tissues analyzed from other streams in the Mine site LSA.

5.6.1 KONA TRIBUTARY

The Kona Tributary flows into Independence Creek 7.5 km upstream from the Yukon River and has a catchment area of 1,833 ha (Lorax Pers. Comm. 2016). The upper portion of the watershed is located in proximity to the Project footprint, but is not impacted by it as it is separate by a ridge. Fish sampling occurred at two stations including: KT0.1 in the lower portion of the watershed near Independence Creek and KT5.2 in the upper portion of the watershed. No fish were captured at the upper station and low numbers of adult Arctic grayling were captured and observed at the lower station.

Stream gradient modelling of the upper portion of the watershed near the Project footprint indicates the presence of numerous sections of the stream with moderate to high gradients and therefore fish potential is low in this portion. Winter fish sampling was not attempted in this stream as a suitable location for sampling could not be located and the stream appeared to be frozen to bed.

6 SUMMARY

The fisheries and aquatic resource data collected in the Coffee Gold Project study area provide a comprehensive understanding of the aquatic environment. The following conclusions can be made from the results of this data collection.

- The presence of fish has been confirmed in the larger creeks downstream/near the Mine footprint including Coffee, Latte and Independence creeks. Latte and Coffee Creeks are used by Arctic grayling for summer rearing/feeding purposes. Coffee Creek provides year round rearing habitat for juvenile Chinook salmon and Arctic grayling

- Smaller streams including Halfway Creek, YT-24 Creek and the Kona Tributary have confirmed fish presence only in the very lower reaches (at the mouth only for YT-24). The headwater portions of YT-24 and Halfway Creek and, including the location of the proposed mine facilities, are characterized by moderate stream gradients and poor habitat and are a considerable distance from documented fish habitat (i.e. fish presence).

- Overwintering of fish in the creeks with the Mine study area appears to be unlikely outside of the Yukon River, Coffee and Independence creeks.

- Periphyton sampling indicates that streams have very low primary productivity, which is common of low nutrient, northern watercourses.

- Baseline metals analysis of Arctic grayling, slimy sculpin and juvenile Chinook salmon tissues indicate that the estimated concentrations of methylmercury exceeded CCME tissue guidelines for the protection of aquatic like for all three fish species (Jewett et al. 2003; inferred for juvenile Chinook salmon). Baseline tissue concentrations of selenium were generally below the interim guideline values (EPA 2015), but often exceeded the BC guideline for selenium in sampled fish.

- Baseline uranium concentrations in Coffee Creek invertebrates were higher in the winter compared with the summer which is consistent with the uranium concentrations in the water quality data from the Mine study area.

- Baseline metals analysis of sediment samples throughout the Mine study area indicate that arsenic and chromium are consistently present at concentrations that exceed the CCME interim Freshwater Sediment Quality Guidelines.

- Chum spawning has been documented in groundwater fed side channels of the Yukon and Stewart Rivers. No such areas have been documented in close proximity (i.e. within one kilometre) of the proposed barge or winter road landings.

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APPENDIX A. ENVIRONMENTAL DNA

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Hemmera Envirochem Inc.
230 – 2237 2nd Avenue
Whitehorse, YT Y1A 0K7
T: 867.456.4865
F: 604.669.0430
hemmera.com

May 9, 2016
File: 1930-001.01

Environmental Dynamics Inc.
2195 2nd Avenue
Whitehorse, YT Y1A 3T8

Attn: Ben Schonewille, Fish & Wildlife Biologist

Dear Ben,

Re: Kaminak Coffee Gold Environmental DNA Assessment of Winter Use by Arctic Grayling and Chinook Salmon

Environmental Dynamics Inc. (EDI), on behalf of Kaminak, is interested in characterizing baseline environmental conditions for Arctic grayling (*Thymallus Arcticus)* and Chinook Salmon (*Oncorhynchus tshawytscha*) at the Kaminak Coffee Gold Project site (the "Project") near Dawson City, Yukon.

The information presented in this report summarizes results of field-based inventory and assessment (completed in March 2016) to characterize winter use of selected lotic systems by these target taxa. Data collected by EDI field staff during these studies is submitted separately.

We are pleased to provide EDI and Kaminak with this final report and hope the information compiled and described is of benefit to both EDI and Kaminak as the Project advances.

Regards,



Jared Hobbs, M.Sc., R.P.Bio.
Senior Biologist
250.889.2071
jhobbs@hemmera.com

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1.0 INTRODUCTION

As living organisms complete their life processes their genetic material, or DNA, is shed exogenously into the surrounding environment. For aquatic and semi-aquatic species environmental DNA (eDNA) can be collected in water samples, filtered to capture eDNA, and effectively assayed to detect the presence of aquatic and semi-aquatic species without direct observation (Farrington and Lance 2014). This method is referred to as eDNA (analysis) and provides a promising and emerging method for more cost-effective, less invasive and more efficient survey of aquatic species living in natural lotic and lentic systems (Biggs et al. 2014; Herder et al. 2015). The reliable detection of aquatic vertebrate species using eDNA, from a variety of freshwater systems, has been confirmed as an effective survey method for tested species (Waits and Paetkau 2005, Ficetola et al. 2008, Goldberg et al. 2011, Thomsen et al. 2012). Analysis of eDNA is currently being applied to a diverse suite of species in a variety of freshwater habitats including both lotic and lentic systems (Goldberg et al. 2011).

Water and/or sediment samples from habitats potentially inhabited by the species in question, are collected for subsequent analysis of the environmental sample(s) to detect the presence of DNA from the target taxa. Testing for the presence of a species' DNA is completed *ex situ* (in a laboratory) using quantitative polymerase chain reaction (qPCR) methods. qPCR methods enzymatically increase the abundance of a specific sequence of DNA from target taxa in a solution. Next, the DNA sequence for the target taxa is targeted using 'primers' (short fragments of DNA that bind to the target sequence). The PCR process repeatedly subjects the sample to alternating heat (to denature, or separate, the double helix) followed by cooling to copy the original DNA in the sample. This process is repeated many times (e.g. 30-40 cycles) resulting in an exponential increase in copy number of the DNA from the target taxa. Each process, including all cycles, is referred to as a run; samples are typically run between three to eight times, for each sample collected, to arrive at a binary conclusion regarding presence or absence of DNA from the target taxa (Hobbs et al 2015). Samples from each site are then considered collectively to derive a determination of positive or negative at the site level (**see Methods**). The use of a qPCR assay requires development of a set of species-specific primers that target a small section of the genome; primer specificity is key to this process (Farrington and Lance 2014). The primer for Arctic grayling was developed independently, prior to this study, at the National Genomics Center for Wildlife and Fish Conservation in Missoula Montana (by Carim et al 2016); the assay used in this study, for Chinook salmon, was developed by Dr. C. Goldberg, Dr. M.B. Laramie and Dr. D.S Pilliod (Laramie et al. 2015).

The objective of this study was to assess winter season presence of Arctic grayling (*Thymallus Arcticus*) and Chinook salmon (*Oncorhynchus tshawytscha*) (hereafter referred to as Chinook) within lotic reaches associated with the Kaminak Coffee proposed mine site (the Project).The eDNA methods used in this assessment have been confirmed to be effective for both Arctic grayling (Veldhoen et al 2013) and Chinook (Hobbs and Kanary 2016 *in press*) in Yukon. In this study eDNA methods were used to supplement existing information derived from conventional fish survey methods previously applied within Coffee Creek, Latte Creek, Independence Creek, Halfway Creek and the Yukon River. In total, 14 sites were assessed in these five systems, using eDNA methods, to better determine winter use of these reaches by both Arctic grayling and Chinook in February 2016.

2.0 METHODS

2.1 FIELD SAMPLE COLLECTION

2.1.1 Water Sample Collection

Water sample collection followed protocols developed through direct collaboration with Dr. Caren Goldberg and summarized by Hobbs et al (2015). These methods have been successfully applied by Hemmera Envirochem Inc. (Hemmera), in 24 eDNA field studies (at the time of writing of this report), for fourteen species in BC and Yukon. These methods have also been accepted by the BC Ministry of Environment as an approved Resource Inventory Standards Committee (RISC) guidance document (Hobbs et al. 2015). The same methods have been applied and accepted by the Yukon Conservation Center and the Yukon Department of Environment in a previous study (Hobbs and Goldberg 2016). These accepted standards provide detailed guidance regarding appropriate collection and interpretation of qPCR results, for eDNA practitioners engaged in surface water sampling and eDNA qPCR analysis methods. These standards are intended for (and applicable to) use for all freshwater eDNA studies utilizing surface water collection.

Sample collection methods involved the collection of triplicate 1 litre (L) water samples at each sampling location (replication determined on a site-by-site basis as required by study and site-specific limitations). During sample collection, bottles were labelled using a permanent marker with the site and sample ID, (gazetted) location name, Universal Transverse Mercator (UTM) coordinates, collection time and the initials of the field personnel responsible for sample collection. Biologists avoided entering the water during sampling, particularly upstream of the sample collection site, to prevent contamination of the sample water from boots, clothing or other equipment.

For all sites where ice >30 cm thick covered the sample location (e.g., on the Yukon River) an ice auger (Stihl BT 130 with a 10-inch diameter blade) was used to penetrate the ice. For sites where ice cover was relatively less thick an ice spud (chisel) was used as decontamination of the ice spud was more practical. At each site, biologists augured (n=3) or chiseled (n=11) two holes. The downstream hole was used as a rinse hole for sample bottles and other equipment; the upstream hole was used for sample collection. The biologists observed a five-minute wait time before sampling at sites where the ice auger was used to minimize risk of cross-site contamination as the auger could not be thoroughly cleaned between each use.

During sample collection biologists wore clean nitrile gloves and triple rinsed the sample bottles with site water before collection of samples at each site. Each sample bottle was filled with water from the surface immediately beneath the ice layer of the water feature (at smaller features) or in the upwelling water (at all three Yukon River collection locations). Immediately following sample collection, a YSI® brand water quality meter was used to measure water chemistry data at each location. Field biologists recorded

location UTM coordinates, water quality data and site photographs at each sample site location. Water chemistry parameters collected in the field were as follows:

- Temperature (°C)
- pH
- Conductivity (µS/cm)
- Dissolved oxygen (mg/L)

During sample collection biologists placed sample bottles in the cabin of the helicopter to prevent sample freezing as ambient conditions encountered during collection were sub-zero. Genetic material in the water sample was not permitted to freeze prior to off-site filtration and preservation.

2.1.2 Sediment Sample Collection

Sediment sample collection methods involved the collection of triplicate sediment samples at 12 of 14 selected water sample sites (as feasible according to site conditions). The biologists used an ice-spud to move rocks and expose the sediment at the bottom of each sample site. Sediment was then scooped from the bottom of the waterbody using a 4-inch ladle sieve which allowed water to drain out. Approximately 25 – 35 mL of sediment was placed into separately labelled 50 mL falcon tubes for laboratory analysis. All sediment sampling instruments were sterilized and rinsed between sites and water sampling was always completed prior to sediment sampling to avoid introducing disturbed sediment into water samples. In the field sediment was stored in the cargo area of the helicopter to permit freezing before being placed in a cooler, packed with dry ice, for transport (in a frozen state) to the laboratory.

2.2 POST-COLLECTION SAMPLE PROCESSING

2.2.1 Water Sample Processing

Water was collected at each site and processed following standard eDNA surface water sample collection protocols (Hobbs et al 2015). Samples were processed within 12 hours of collection[1] in the same order as collected. Samples were poured into a 250 mL sterile polypropylene filter funnel with a 0.45 µm pore-diameter cellulose nitrate membrane. The sample was filtered through the membrane using a Gast High-Capacity Vacuum Pump (Gauge/Reg; 1.1 cfm/25.5"Hg-60psi/115V) to create a vacuum. Upon completion of filtration, the filter was removed using clean nitrile gloves and sterilized forceps[2]. The membrane was placed in a 2.5”x3.5” coin envelope with two approximately 15 ml of self-indicating silica beads as a desiccant. Envelopes were labelled and placed inside labelled whirl-pak storage bags for shipping.

---

1 Processing is recommended within 24 hours of collection to limit degradation of DNA (Caren Goldberg, *pers. comm.*)

2 Forceps were sterilized by immersing, for 30 seconds, in a 50% bleach/water solution and rinsing in a 100% distilled water solution for >1 minute.

One control sample, using distilled water, was processed using the same filtration procedure. This served as a contamination test of both the filtration and laboratory analysis processes as required by provincial protocol (Hobbs *et al.* 2015). Preserved membranes were shipped to the National Genomics Center for Wildlife and Fish Conservation for subsequent DNA extraction and analysis; distilled water samples were not identified to the lab prior to analysis.

2.2.2 Sediment Sample Processing

Sediment samples were stored in Falcon tubes and shipped in a cooler with ~4 kg of dry ice during transport to the lab. Falcon tubes were shipped to the National Genomics Center for Wildlife and Fish Conservation for subsequent extraction and analysis.

2.3 LABORATORY ANALYSIS

All laboratory testing, including sediment and water samples, were tested at the National Genomics Center for Wildlife and Fish Conservation (a part of the U.S. Forest Service Rocky Mountain Research Station) in Missoula, MT, USA.

2.3.1 Primer Details

Tissue samples from ten Arctic grayling were collected from the study area, as well as ten tissue samples from two conspecific fish species; slimy sculpin (*Cottus cognatus*) and round whitefish (*Prosopium cylindraceum*). The primer used (in this study) for Arctic grayling had not been previously tested on Yukon populations of Arctic grayling. Efficacy of the Arctic grayling primer was confirmed through laboratory testing of the primer, in Montana, using the pure grayling DNA tissue samples collected in Yukon and provided to the lab (by Yukon Government and EDI) for this purpose. The grayling primer was also tested to ensure exclusion of both sculpin and whitefish as these conspecifics have been confirmed to occur sympatrically within the Project study area.

The primer used to test for Chinook is published (Laramie et al 2015) and has been tested and confirmed effective with a 94% detection rate in Yukon (Hobbs and Kanary 2016 *in prep*). For further confirmation Chinook tissue was collected from the study area (Coffee Creek) and sequenced at the National Genomics Center for Wildlife and Fish Conservation laboratory and proved to be an exact match to the eDNA marker (primer) developed by Laramie et al (2015) (C. Kellie *pers. comm*. 2016).

2.3.2 Water Samples

Preserved sample filters were processed in a laboratory dedicated to the analysis of low-quantity DNA sources using a Qiashredder/DNeasy protocol (Goldberg *et al.* 2011). Each filter was extracted and subsequently run in triplicate using a species-specific qPCR assay that included positive and negative controls in each plate, as well as an internal exogenous internal positive control reagents to screen for PCR inhibition. When PCR inhibition was detected, samples were run through a One-Step PCR Inhibitor Removal kit column (Zymo Research) and reanalyzed. When triplicate wells did not test consistently (i.e., one or two tested positive), the sample was reanalyzed to confirm the result.

2.3.3 Sediment Samples

Environmental DNA from sediment samples was extracted using a Mobio PowerSoil® DNA isolation kit to isolate microbial genomic DNA. Cell lysis is achieved by mechanical and chemical methods and total genomic DNA is captured on a silica membrane in a centrifuge. DNA is washed and extracted from the membrane and then used for PCR analysis as described for water samples (**Section 2.3.2**).

3.0 RESULTS

Forty-two surface water samples were collected from 14 sample locations, at 14 spatially distinct aquatic features (sites) between March 1 and March 3, 2016. Concomitant collection of sediment was also completed for 11 of the water collection sites (as feasible); sediment was also collected at a single additional site in the Yukon River at which water was not collected (Site ID: YR998A1). Sampling conditions at all sites were excellent with cold water temperatures and no precipitation or meltwater in the stream for several months preceding or during sample collection

All collected surface water and sediment samples were analyzed, using qPCR methods (as described in Section 2.3) for the presence of eDNA from both Arctic grayling and Chinook. Results are described below.

3.1 WATER SAMPLES

The distilled water control sample yielded a negative result, evidence that appropriate rigour was observed during processing. This result confirms the efficacy of controls used to prevent contamination during all phases of surface water sample-collection, filtration, transport, and qPCR laboratory analysis.

Arctic grayling: The presence of Arctic grayling had previously been confirmed, using traditional methods, at three of the 14 sample sites (21%). The targeted DNA sequence for the species was recovered at six (43%) of the sites sampled including all three of the previously confirmed sites (i.e., a 100% detection rate when compared to known sites). The remaining three sites that tested positive for the presence of eDNA for Arctic grayling suggest winter use, by Arctic grayling, of stream reaches where winter use was previously unknown.

Six of the remaining eight sites that tested negative for winter use by Arctic grayling had been previously surveyed and no evidence of winter use by Arctic grayling had been documented. Negative eDNA results at these six sites serve to further corroborate this conclusion. The final two sites had not been previously surveyed to assess winter use by Arctic grayling; eDNA results from this study suggest these sites are not currently being used by Arctic grayling as winter habitat (**Table 1 and Figure 1**).

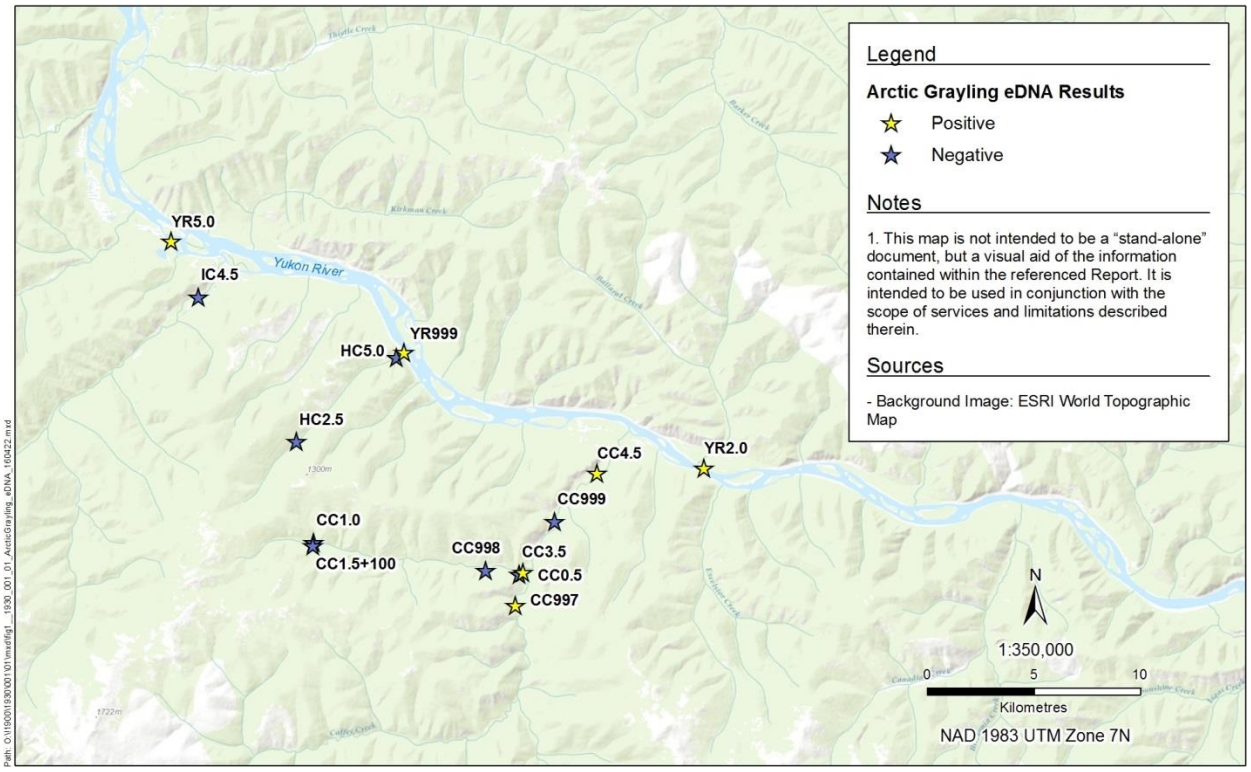

Figure 1 qPCR results for Arctic grayling

Table 1 Results of qPCR Analysis summarized by site and denoting previous confirmation of either Chinook or Arctic grayling.

Site	Grayling winter use previosly confirmed	Grayling detected - filter	Grayling detected - sediment	Chinook winter use previously confirmed	Chinook detected - filter	Chinook detected - sediment
CC0.5	Unknown	Yes	No	Yes	Yes	No
CC1.0	No	No	No	No	No	No
CC1.5+100	No	No	No	No	No	No
CC3.5	No	No	No	No	No	No
CC4.5	Unknown	No	No	Yes	Yes	Yes
CC997	Unknown	Yes	No	Unknown	Yes	No
CC998	No	No	No	No	No	No
CC999	Unknown	No	No	Yes	Yes	No
HC2.5	No	No	No	No	No	No
HC5.0	No	No	N/A	No	No	N/A
IC4.5	Unknown	No	No	Unknown	No	No
YR2.0	Yes	Yes	N/A	Yes	No	N/A
YR5.0	Yes	Yes	No	Yes	No	No
YR998A3	N/A	N/A	No	Yes	N/A	No
YR999	Yes	No	N/A	Yes	No	N/A

Chinook: The presence of juvenile Chinook had been previously confirmed at six of the 14 sample sites, however, the targeted DNA sequence for the species was recovered at only three (50%) of the six known extant (based on data collected in the summer) Chinook sites sampled in February 2016; Chinook DNA was not recovered from any of the three sites in the Yukon River. These three Yukon River sites are known to be used by adult or juvenile Chinook in summer however no data exists for winter use. eDNA results suggest juvenile Chinook are not using these sites (including habitat immediately upstream) during the winter of 2016.

Overwinter use, by juvenile Chinook was unknown at the remaining eight sites; one of these sites tested positive for Chinook salmon DNA during qPCR analysis suggesting this site is also being used as overwintering or year round rearing habitat by Chinook. The remaining seven sites, including Latte Creek, Halfway Creek and Independence Creek each tested negative for Chinook during qPCR analysis (**Table 1** and **Figure 2**).

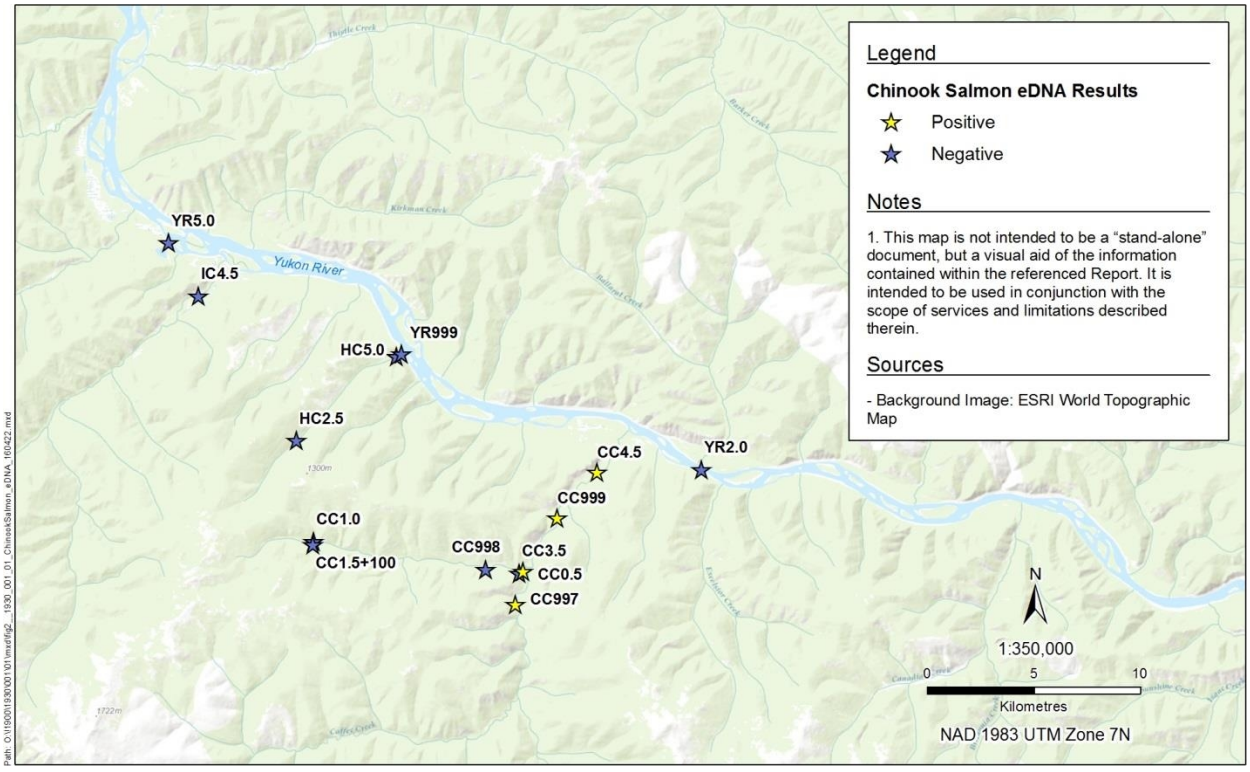

Figure 2 qPCR results for Chinook.

3.2 SEDIMENT SAMPLES

Sediment was collected at 12 sites during surface water sample collection. Only one sediment sample tested positive for the presence of Chinook eDNA during qPCR analysis and no samples tested positive for Arctic grayling eDNA.

4.0 DISCUSSION

Results from the study confirm earlier findings by Veldhoen et al (2014) and by Hobbs and Kanary (2016); eDNA provides a useful, powerful and cost-effective means to establish presence of use of aquatic habitats by both Chinook and Arctic grayling in the Yukon. This study represents the first Canadian, and perhaps global, application of eDNA in near Arctic aquatic ecosystems in winter conditions. There are no published studies to inform degradation rates of eDNA in the stream temperatures (0.5°C) encountered during field collection in this study. There are also no published studies regarding degradation rates in ice-bound lotic systems. As temperature and incidental ambient ultra-violet (UV) exposure are both positively correlated with degradation of eDNA this study provides valuable insight regarding eDNA degradation rates, flushing time and transport distances encountered during these relatively extreme environmental sampling conditions.

Detection of Arctic grayling DNA at 100% of known extant winter areas (n=3) provides further confirmation of methodological efficacy. Detection of Arctic grayling DNA at an additional three sites where previous studies, using conventional techniques, have failed to detect Arctic grayling in winter conditions also demonstrates the applicability and usefulness of eDNA methods. Despite the inherent sensitivity of qPCR methods Arctic grayling eDNA was not detected at eight sites; this suggests that the species was not using these habitats during or in the weeks or months preceding sample collection in February 2016.

Detection of Chinook DNA at three of six sites (50%) where juvenile Chinook have been documented in the spring/summer/fall seasons is corroborative with detection rates from an independent previous eDNA assessment conducted on Chinook in Yukon in 2015 (Hobbs and Kanary 2016). In addition, tests conducted by the lab in Montana confirms the efficacy of the primer used, for Chinook, in this study ("*Chinook tissues that we sequenced from Coffee Creek were an exact match for the eDNA marker developed by Laramie et al."* email from K. Carim, April 7, 2016). eDNA from Chinook was detected at all four sites in Coffee Creek; this indicates that this creek provides winter habitat for juvenile Chinook. Despite the inherent sensitivity of qPCR methods Chinook eDNA was not detected at any of the water samples collected from three sites in the Yukon River in the winter. This observation is more challenging to explain and suggests that juvenile Chinook are absent from proximal reaches in Yukon River during winter. This conclusion merits further investigation.

Finally, sediment sampling was conducted in this study to obviate the need for summer sampling, as eDNA persistence times are known to exceed eDNA persistence times in water. If successful, sediment sampling would have allowed inference of summer use of aquatic systems, by target taxa, at any time of year. By comparison, water sampling only allows inference of use, by target taxa, within a short period (7-21 days) preceding sampling. The negative results from sediment sampling at 11 of 12 sites, including sites that appear to be used during winter by either or both juvenile Chinook or Arctic grayling, demonstrate that further research is required regarding appropriate field sampling, sample storage, sample shipping and eDNA extraction.

The most plausible explanation for the low detection rate associated with sediment samples may be best attributed to sample preservation methods (i.e., samples were subjected to repeated thawing and refreezing during shipment likely causing DNA to denature). A second plausible explanation may be attributed to insufficient sample volume and / or availability of sediment with higher organic content during sampling. During sample collection, at most sites, the streambed was frozen; access to deeper, more organic sediment layers was challenging. As a result, sediment samples collected in this study were largely comprised of course sedimentary material collected from the upper surface layer of the streambed. Flushing would likely have removed DNA from this surface layer (K. Carim pers com: email dated April 7, 2016). Unfortunately, there are few published papers that have attempted and / or described sediment sampling techniques (Turner et al 2015) so this aspect of the project was considered experimental. Concomitant sampling of sediment and water in the winter, if successful, would have theoretically provided information regarding year round habitat use by Chinook and Arctic grayling within the study area. Recognizing the inconclusive comparative utility of results derived from collection of sediment sample and water samples at the same sites future water sampling is recommended, at the 14 sites in this study, during the 2016 summer field season to better understand year-round use of these habitats by both focal fish taxa.

5.0 CLOSURE

This Work was performed in accordance with the contract between Hemmera Envirochem Inc. ("Hemmera") and EDI. ("Client"). This Report has been prepared by Hemmera, based on fieldwork conducted by Hemmera, for sole benefit and use by Kaminak and EDI. In performing this Work, Hemmera has relied in good faith on information provided by others, and has assumed that the information provided by those individuals is both complete and accurate. This Work was performed to current industry standard practice for similar environmental work, within the relevant jurisdiction and same locale. The findings presented herein should be considered within the context of the scope of work and project terms of reference; further, the findings are time sensitive and are considered valid only at the time the Report was produced. The conclusions and recommendations contained in this Report are based upon the applicable guidelines, regulations, and legislation existing at the time the Report was produced; any changes in the regulatory regime may alter the conclusions and/or recommendations.

We have appreciated the opportunity of working with you on this project and trust that this report is satisfactory to your requirements. Please feel free to contact the undersigned regarding any questions or further information that you may require.

Report prepared by:
Hemmera Envirochem Inc.



Jared Hobbs, M.Sc., R.P.Bio.
Technical Expert – Terrestrial Ecology
250.889.2071 (cell)
jhobbs@hemmera.com



Kristina Beckmann, B.Sc., Ept.
Environmental Coordinator
867.456.4865 (711)
kbeckmann@hemmera.com

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APPENDIX B. 2016 PHYSICAL STREAM ATTRIBUTES AND FISH SAMPLING DATA

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Table B1. 2016 physical stream attribute and fish sampling data.

Crossing	Station/Pass	Data Row	Stream Name	Sample Date	Avg Channel Width (m)	Avg Wet Width (m)	Avg. Residual Pool Depth (m)	Avg. Bankfull Depth (m)	Avg Stream Gradient (%)	Cover - Total	Cover - Dominant	Cover - Subdominant				Substrate		Water Temp (°C)	pH	SPC (µg/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% sat)	Turbidity
		1	Coffee Creek	4-Mar-16														0.3	6.81	271.2	5.85		
		2	Coffee Creek	4-Mar-16														0.3	6.81	271.2	5.85		
		3	Coffee Creek	4-Mar-16														0.3	6.81	271.2	5.85		
		4	Coffee Creek	4-Mar-16														0.2	7.35	269.2	7.35		
		5	Coffee Creek	4-Mar-16														0.2	7.35	269.2	7.35		
		6	Coffee Creek	4-Mar-16														0.2	7.35	269.2	7.35		
		7	Coffee Creek	3-Mar-16														0	7.37	374.1	12.59		
		8	Coffee Creek	3-Mar-16														0.1	7.37	374.1	12.35		
		9	Coffee Creek	3-Mar-16														0.1	7.37	374.1	11.93		
	1	10	Coffee Creek	10-Jul-16														8	7.62	90.3		101.6	T - Turbid
	2	11	Coffee Creek	10-Jul-16														8	7.62	90.3		101.6	T - Turbid
		12	Coffee Creek	10-Jul-16	24.55	16.39	0.50	1.45	2.5	moderate		B - Boulder	U - Undercut Banks	OV - Overhanging Veg		C - Cobble	G - Gravel	8	7.62				M - Moderate
	1	13	Coffee Creek	10-Jul-16														4.9	7.32	88.2		94.4	T - Turbid
	2	14	Coffee Creek	10-Jul-16														4.9	7.32	88.2		94.4	T - Turbid
	3	15	Coffee Creek	10-Jul-16														4.9	7.32	88.2		94.4	T - Turbid
	1	16	Coffee Creek	10-Jul-16														4.9	7.32	88.2		94.4	T - Turbid
	2	17	Coffee Creek	10-Jul-16														4.9	7.32	88.2		94.4	T - Turbid
	3	18	Coffee Creek	10-Jul-16														4.9	7.32	88.2		94.4	T - Turbid
	1	19	Coffee Creek	10-Jul-16														4.9	7.32	88.2		94.4	T - Turbid
	2	20	Coffee Creek	10-Jul-16														4.9	7.32	88.2		94.4	T - Turbid
	3	21	Coffee Creek	10-Jul-16														4.9	7.32	88.2		94.4	T - Turbid
		22	Coffee Creek	3-Mar-16														0.1	6.44	294.7	8.96		
		23	Coffee Creek	3-Mar-16														0.1	6.44	294.7	8.91		
		24	Coffee Creek	3-Mar-16														0.1	6.44	294.7	8.8		
		25	Coffee Creek	3-Mar-16														0.2	6.44	294.7	9.56		
		26	Coffee Creek	3-Mar-16														0	6.75	291.7	12.29		
		27	Coffee Creek	3-Mar-16														0	6.75	291.7	10.74		
		28	Coffee Creek	3-Mar-16														0	6.88	283.2	11.54		
		29	Coffee Creek	3-Mar-16														0	6.88	283.2	12.42		
		30	Coffee Creek	4-Mar-16														0.2	6.21	292.4	9.12		
		31	Coffee Creek	4-Mar-16														0.2	6.21	292.4	9.12		
		32	Coffee Creek	4-Mar-16														0.2	6.21	292.4	9.12		
		33	Coffee Creek	4-Mar-16														0.2	6.21	292.4	9.12		
		34	Coffee Creek	4-Mar-16														0.5	6.57	285.4	9.16		
		35	Coffee Creek	4-Mar-16														0.5	6.57	285.4	9.16		
		36	Coffee Creek	4-Mar-16														0.5	6.57	285.4	9.16		
		37	Coffee Creek	4-Mar-16														0.1	6.79	306.9	8.84		
		38	Coffee Creek	4-Mar-16														0.1	6.79	306.9	8.84		
		39	Coffee Creek	11-Jul-16																			
		40	Coffee Creek	11-Jul-16																			
	1	41	Coffee Creek	11-Jul-16														5.8	7.36	91.3	12.23		M - Moderate
	2	42	Coffee Creek	11-Jul-16														5.8	7.36	91.3	12.23		M - Moderate

Crossing	Station/Pass	Data Row	Stream Name	Sample Date	Avg Channel Width (m)	Avg Wet Width (m)	Avg. Residual Pool Depth (m)	Avg. Bankfull Depth (m)	Avg Stream Gradient (%)	Cover - Total	Cover - Dominant	Cover - Subdominant				Substrate		Water Temp (°C)	pH	SPC (µg/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% sat)	Turbidity
	3	43	Coffee Creek	11-Jul-16														5.8	7.36	91.3	12.23		M - Moderate
	1	44	Coffee Creek	11-Jul-16														5.8	7.36	91.3	12.23		M - Moderate
	2	45	Coffee Creek	11-Jul-16														5.8	7.36	91.3	12.23		M - Moderate
	3	46	Coffee Creek	11-Jul-16														5.8	7.36	91.3	12.23		M - Moderate
	4	47	Coffee Creek	11-Jul-16																			
	1	48	Coffee Creek	11-Jul-16														5.8	7.36	91.3	12.23		M - Moderate
	2	49	Coffee Creek	11-Jul-16														5.8	7.36	91.3	12.23		M - Moderate
	3	50	Coffee Creek	11-Jul-16														5.8	7.36	91.3	12.23		M - Moderate
		51	Coffee Creek	3-Mar-16														0	7.11	401.2	11.17		
		52	Coffee Creek	3-Mar-16														0	7.11	401.2	10.84		
		53	Coffee Creek	3-Mar-16														0	7.11	401.2	11.32		
		54	Halfway Creek	8-Jul-16	4.80	4.27	0.14	0.70	2.3	moderate	U - Undercut Banks	LWD - Large Woody Debris				C - Cobble	G - Gravel	7.2	4.97	138	9.76		C - Clear
		55	Halfway Creek	23-Aug-16														4	8.28	174			L - Light
		56	Halfway Creek	9-Jul-16														4.4	5.55	142	11.02		C - Clear
		57	Halfway Creek	3-Mar-16														0	7.65	336.9	11.36		
		58	Halfway Creek	3-Mar-16														0	7.65	336.9	11.36		
		59	Halfway Creek	9-Jul-16														5.8	6.23	98	10.05		
		60	Halfway Creek	20-Aug-16														2.5	8.58	131			L - Light
		61	Halfway Creek	9-Jul-16	2.60	2.12	No pools	0.43	10.5	trace	U - Undercut Banks	SWD - Small Woody Debris				B - Boulder	C - Cobble	2.9	4.84	55	10.63		C - Clear
		62	Unnamed Tributary to Halfway Creek	9-Jul-16					21.3	moderate								4.1	5.71	79	10.67		C - Clear
		63	Independence Creek	4-Mar-16														0	6.83	242.8	6.55		
		64	Independence Creek	4-Mar-16														0	6.83	242.8	6.55		
		65	Independence Creek	4-Mar-16														0	6.83	242.8	6.55		
		66	Independence Creek	4-Mar-16														0.1	6.77	245.6	7.82		
		67	Independence Creek	4-Mar-16														0.1	6.77	245.6	7.82		
		68	Independence Creek	4-Mar-16														0.1	6.77	245.6	7.82		
		69	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
		70	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
		71	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
	1	72	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
	2	73	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
	3	74	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
	1	75	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
	2	76	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
	3	77	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
	1	78	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
	2	79	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
	3	80	Independence Creek	12-Jul-16														6.5	7.49	83.4	11.26		L - Light
50		81	Indian River	20-Aug-16																			T - Turbid

Crossing	Station/Pass	Data Row	Stream Name	Sample Date	Avg Channel Width (m)	Avg Wet Width (m)	Avg. Residual Pool Depth (m)	Avg. Bankfull Depth (m)	Avg Stream Gradient (%)	Cover - Total	Cover - Dominant	Cover - Subdominant				Substrate		Water Temp (°C)	pH	SPC (µg/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% sat)	Turbidity
		82	Los Angeles Creek	13-Jul-16												G - Gravel	F - Fines	7.1				84.2	T - Turbid
		83	Los Angeles Creek	13-Jul-16												G - Gravel	F - Fines	7.1				84.2	T - Turbid
		84	Los Angeles Creek	13-Jul-16												G - Gravel	F - Fines	7.1				84.2	T - Turbid
		85	Los Angeles Creek	13-Jul-16												G - Gravel	F - Fines	7.1				84.2	T - Turbid
		86	Los Angeles Creek	13-Jul-16												G - Gravel	F - Fines	7.1				84.2	T - Turbid
	1	87	Los Angeles Creek	13-Jul-16														7.1	7.82	223		84.2	T - Turbid
	2	88	Los Angeles Creek	13-Jul-16														7.1	7.82	223		84.2	T - Turbid
	3	89	Los Angeles Creek	13-Jul-16														7.1	7.82	223		84.2	T - Turbid
	4	90	Los Angeles Creek	13-Jul-16														7.1	7.82	223		84.2	T - Turbid
	5	91	Los Angeles Creek	13-Jul-16														7.1	7.82	223		84.2	T - Turbid
	6	92	Los Angeles Creek	13-Jul-16														7.1	7.82	223		84.2	T - Turbid
		93	Los Angeles Creek	13-Jul-16														7.1	7.82	223		84.2	T - Turbid
		94	Los Angeles Creek	13-Jul-16														7.1	7.82	223		84.2	T - Turbid
		95	Latte Creek	3-Mar-16														-0.1	7.24	259.5	8.74		
		96	Latte Creek	3-Mar-16														-0.1	7.24	259.5	8.74		
	1	97	Latte Creek	9-Jul-16														4.5	7.66	128.1	11.23		M - Moderate
	2	98	Latte Creek	9-Jul-16														4.5	7.66	128.1	11.23		M - Moderate
	3	99	Latte Creek	9-Jul-16														4.5	7.66	128.1	11.23		M - Moderate
	1	100	Latte Creek	9-Jul-16														4.5	7.66	128.1	11.23		M - Moderate
	2	101	Latte Creek	9-Jul-16														4.5	7.66	128.1	11.23		M - Moderate
	3	102	Latte Creek	9-Jul-16														4.5	7.66	128.1	11.23		M - Moderate
	1	103	Latte Creek	9-Jul-16														4.5	7.66	128.1	11.23		M - Moderate
	2	104	Latte Creek	9-Jul-16														4.5	7.66	128.1	11.23		M - Moderate
	3	105	Latte Creek	9-Jul-16														4.5	7.66	128.1	11.23		M - Moderate
	1	106	Latte Creek	8-Jul-16														5.2	6.81	95.2	11.37		C - Clear
	2	107	Latte Creek	8-Jul-16														5.2	6.81	95.2	11.37		C - Clear
	3	108	Latte Creek	8-Jul-16														5.2	6.81	95.2	11.37		C - Clear
		109	Latte Creek Tributary C	10-Jul-16														2.6	5.93	695	11.41		C - Clear
		110	Latte Creek Tributary C	10-Jul-16														3.3	7.41	704	11.03		C - Clear
		111	Latte Creek Tributary C	10-Jul-16														2.6	5.93	695	11.41		C - Clear
		112	Latte Creek Tributary C	10-Jul-16														2.1	6.7	695	11.49		C - Clear
		113	Latte Creek Tributary C	10-Jul-16														2.1	6.92	695	11.5		C - Clear
		114	Latte Creek Tributary C	10-Jul-16														2	6.85	695	11.54		C - Clear
		115	Latte Creek Tributary C	10-Jul-16														2.7	7.42	694	11.33		C - Clear
		116	Latte Creek Tributary C	10-Jul-16														2	7.26	696	11.49		C - Clear
		117	Latte Creek Tributary C	10-Jul-16					15.0									1.9	7.19	696	11.51		C - Clear
		118	Latte Creek Tributary C	10-Jul-16					15.0														
		119	Latte Creek Tributary C	11-Jul-16	1.01	0.88	0.11	0.35	13.5	moderate	U - Undercut Banks	SWD - Small Woody Debris				F - Fines	C - Cobble	1.9	6.93	696	11.54		C - Clear
		120	Latte Creek Tributary C	11-Jul-16														1.47	7.19	696	11.34		C - Clear
		121	Latte Creek Tributary C	11-Jul-16																			

Crossing	Station/Pass	Data Row	Stream Name	Sample Date	Avg Channel Width (m)	Avg Wet Width (m)	Avg. Residual Pool Depth (m)	Avg. Bankfull Depth (m)	Avg Stream Gradient (%)	Cover - Total	Cover - Dominant	Cover - Subdominant				Substrate		Water Temp (°C)	pH	SPC (µg/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% sat)	Turbidity
91		122	Unnamed Tributary of Maisy May Creek	22-Aug-16	4.00				2.5	trace	B - Boulder												T - Turbid
MMTT-1		123	Unnamed Tributary of Maisy May Creek	21-Aug-16														11	7.99	654	15.16		
MMTT-2		124	Unnamed Tributary of Maisy May Creek	21-Aug-16	3.94	2.60	0.06	0.47	1.8	trace	IV - Instream Veg					G - Gravel	C - Cobble	10.4	7.69	518	11.13		C - Clear
MMTT-3		125	Unnamed Tributary of Maisy May Creek	21-Aug-16																			
MMTT-4		126	Unnamed Tributary of Maisy May Creek	21-Aug-16																			
MMTT-5		127	Unnamed Tributary of Maisy May Creek	21-Aug-16	1.71	1.52	0.10	0.43	0.5	trace	B - Boulder	SWD - Small Woody Debris	OV - Overhanging Veg			G - Gravel	C - Cobble	8.3	8.12	682.4	12.97		
		128	Stewart River	14-Jul-16																			
		129	Stewart River	14-Jul-16												C - Cobble	F - Fines	18.3			8.53		T - Turbid
		130	Stewart River	14-Jul-16												C - Cobble	G - gravel	18.3			8.52		T - Turbid
		131	Stewart River	14-Jul-16												F - fines		17.2			7.98		T - Turbid
	1	132	Stewart River Side Channel	14-Jul-16												F - Fines		17.2	7.9	351.4	7.98		T - Turbid
	1	133	Stewart River Side Channel	14-Jul-16												F - Fines		17.2	7.9	351.4	7.98		T - Turbid
	1	134	Stewart River Side Channel	14-Jul-16												F - Fines		17.2	7.9	351.4	7.98		T - Turbid
	2	135	Stewart River Side Channel	14-Jul-16												F - Fines		17.9	8.09	345.8	8.04		T - Turbid
	2	136	Stewart River Side Channel	14-Jul-16												F - Fines		17.9	8.09	345.8	8.04		T - Turbid
	2	137	Stewart River Side Channel	14-Jul-16												F - Fines		17.9	8.09	345.8	8.04		T - Turbid
		138	Yukon River	8-Jul-16												G - Gravel	C - Cobble						T - Turbid
		139	Yukon River	8-Jul-16												G - Gravel		18.3	8.2	217	8.14		T - Turbid
		140	Yukon River	8-Jul-16												C - Cobble		18.3	8.2	217	8.14		T - Turbid
	1	141	Yukon River	8-Jul-16														18.3	8.21	216.5	7.97		T - Turbid
	1	142	Yukon River	8-Jul-16														18.3	8.22	216.1	8.11		T - Turbid
WRC-2		143	Unnamed Tributary to Yukon River	13-Jul-16																			
WRC-1		144	Unnamed Tributary to Yukon River	13-Jul-16	0.76	1.09	0.38	0.51	2.8	moderate	U - Undercut Banks	SWD - Small Woody Debris	LWD - Large Woody Debris			G - Gravel	C - Cobble	4.4	5.89	333	11.07		C - Clear
		145	Unnamed Tributary to Yukon River	13-Jul-16														4.3	4.74	333	11.17		C - Clear
		146	YT24	23-Aug-16																			
		147	YT24 Creek	10-Jul-16	4.08	2.77	0.26	0.73	4.0	moderate	U - Undercut Banks	SWD - Small Woody Debris	LWD - Large Woody Debris			C - Cobble	G - Gravel	4	5.86	121	11.23		C - Clear
		148	YT24	23-Aug-16														4.2	8.08	124			L - Light
		149	YT24 Creek	10-Jul-16					6.0	moderate								4	5.39	115	11.24		C - Clear
		150	YT24 Creek	10-Jul-16														4.4	6.28	101	11.15		C - Clear
		151	YT24 Creek	10-Jul-16														6.1	6.64	96	10.5		C - Clear
		152	YT24 Creek	10-Jul-16	2.83	2.43	0.18	0.71	9.0	trace	U - Undercut Banks	B - Boulder				C - Cobble	B - Boulder	4.8	6.27	108	10.45		C - Clear
		153	YT24	21-Aug-16														2	8.49	60			L - Light
		154	YT24 Creek	11-Jul-16														2.4	4.13	22	10.78		C - Clear
51		155	Unnamed Tributary to	20-Aug-16					5.0														

Crossing	Station/Pass	Data Row	Stream Name	Sample Date	Avg Channel Width (m)	Avg Wet Width (m)	Avg. Residual Pool Depth (m)	Avg. Bankfull Depth (m)	Avg Stream Gradient (%)	Cover - Total	Cover - Dominant	Cover - Subdominant				Substrate		Water Temp (°C)	pH	SPC (µg/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% sat)	Turbidity
			Indian River																				
52		156	Unnamed Tributary to Indian River	20-Aug-16	0.52	0.75	0.18	0.33	5.0	moderate	OV - Overhanging Veg	U - Undercut Banks						3.2	7.87	226	13.2		M - Moderate
53		157	Unnamed Tributary to Indian River	20-Aug-16														5.8	7.92	1006	11.9		
54		158	Unnamed Tributary to Indian River	20-Aug-16																			
54.5		159	Unnamed Tributary to Eureka Creek	20-Aug-16	0.55	0.55		0.07	23.0									6.5	7.19	86.5	11.14		M - Moderate
55		160	Eureka Creek	20-Aug-16														7.9	71	487.1	6.67		T - Turbid
57		161	Unnamed Tributary to Maisy May	20-Aug-16																			
58		162	Unnamed Tributary to Maisy May	Not visited in 2016																			
59		163	Unnamed Tributary to Maisy May	Not visited in 2016																			
60		164	Unnamed Tributary of Maisy May Creek	20-Aug-16					30.0														
61		165	Unnamed Tributary of Maisy May Creek	20-Aug-16																			
72		166	Unnamed Tributary of Maisy May Creek	22-Aug-16																			
73		167	Unnamed Tributary of Maisy May Creek	22-Aug-16																			
74		168	Unnamed Tributary of Maisy May Creek	22-Aug-16																			
75		169	Unnamed Tributary of Maisy May Creek	22-Aug-16	1.73	1.28	0.21	0.38	6.0	moderate	OV - Overhanging Veg	SWD - Small Woody Debris				G - Gravel	F - Fines	4.9	7.84	356.7	12.49		L - Light
76		170	Unnamed Tributary of Maisy May Creek	22-Aug-16	2.35	1.43	0.16	0.67	5.5	trace		SWD - Small Woody Debris	B - Boulder	U - Undercut Banks	DP - Deep Pools	G - Gravel	C - Cobble	5.9	7.89	287	12.14		M - Moderate
77		171	Unnamed Tributary of Maisy May Creek	22-Aug-16	1.73	1.74	0.25	0.38	4.0	moderate	U - Undercut Banks	DP - Deep Pools				G - Gravel	F - Fines	4.3	7.68	138	12.87		C - Clear
80		172	Unnamed Tributary of Maisy May Creek	22-Aug-16																			
80.5		173	Unnamed Tributary of Maisy May Creek	22-Aug-16																			
81		174	Unnamed Tributary of Maisy May Creek	21-Aug-16														2.7	7.92	287.2	15.88		
83		175	Unnamed Tributary of Maisy May Creek	21-Aug-16	0.67	0.41	0.13	0.50	8.5	moderate	U - Undercut Banks					F - Fines	G - Gravel	6.1	8.23	505			
84		176	Unnamed Tributary of Maisy May Creek	21-Aug-16														6.4	7.06	662	1.2		
85		177	Unnamed Tributary of Maisy May Creek	21-Aug-16																			
97	1	178	Unnamed Tributary of Stewart River	14-Jul-16												G - Gravel	F - Fines	6.4	7.84	420.2	9.16		C - Clear
97	1	179	Unnamed Tributary of Stewart River	14-Jul-16												G - Gravel	F - Fines	6.4	7.84	420.2	9.16		C - Clear
97	1	180	Unnamed Tributary of Stewart River	14-Jul-16												G - Gravel	F - Fines	6.4	7.84	420.2	9.16		C - Clear
97	2	181	Unnamed Tributary of Stewart River	14-Jul-16												G - Gravel	F - Fines	6.8	7.85	409.8	10.27		C - Clear
97	2	182	Unnamed Tributary of Stewart River	14-Jul-16												G - Gravel	F - Fines	6.8	7.85	409.8	10.27		C - Clear
97	2	183	Unnamed Tributary of	14-Jul-16												G - Gravel	F - Fines	6.8	7.85	409.8	10.27		C - Clear

Crossing	Station/Pass	Data Row	Stream Name	Sample Date	Avg Channel Width (m)	Avg Wet Width (m)	Avg. Residual Pool Depth (m)	Avg. Bankfull Depth (m)	Avg Stream Gradient (%)	Cover - Total	Cover - Dominant	Cover - Subdominant				Substrate		Water Temp (°C)	pH	SPC (µg/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% sat)	Turbidity
			Stewart River																				
97	3	184	Unnamed Tributary of Stewart River	14-Jul-16												F - Fines		6.9	7.97	402.4	10.23		C - Clear
97	3	185	Unnamed Tributary of Stewart River	14-Jul-16												F - Fines		6.9	7.97	402.4	10.23		C - Clear
97	3	186	Unnamed Tributary of Stewart River	14-Jul-16												F - Fines		6.9	7.97	402.4	10.23		C - Clear
97		187	Unnamed Tributary of Stewart River	14-Jul-16														6.9	7.97	402.4	10.23		C - Clear
97		188	Unnamed Tributary of Stewart River	14-Jul-16	0.49	0.46	0.17	0.24	9.3	abundant	DP - Deep Pools	SWD - Small Woody Debris	U - Undercut Banks	OV - Overhanging Veg		F - Fines	G - Gravel	6.8	7.85	409.8	10.23		C - Clear
101		189	Unnamed trib of Barker Creek	22-Aug-16	3.38	0.90	0.08	0.10	12.0	abundant	OV - Overhanging Veg	SWD - Small Woody Debris	U - Undercut Banks	IV - Instream Veg		F - Fines	G - Gravel	8.4	8.25	130			M - Moderate
102		190	Unnamed trib of Barker Creek	22-Aug-16	2.12	1.02	0.13	0.20	13.0	abundant	OV - Overhanging Veg	SWD - Small Woody Debris	LWD - Large Woody Debris	U - Undercut Banks	IV - Instream Veg	F - Fines	G - Gravel	7.1	8.01	177			M - Moderate
103		191	Unnamed trib of Barker Creek	22-Aug-16	2.43	0.58	0.20	0.20	9.5	abundant	OV - Overhanging Veg	SWD - Small Woody Debris	LWD - Large Woody Debris	IV - Instream Veg		F - Fines	G - Gravel	5	8.29	203			M - Moderate
104		192	Unnamed trib of Barker Creek	22-Aug-16	3.74	0.62	0.18	0.37	8.0	moderate	OV - Overhanging Veg	LWD - Large Woody Debris	U - Undercut Banks	IV - Instream Veg		F - Fines	G - Gravel	4.2	8.42	550			L - Light
110		193	Unnamed trib of Barker Creek	22-Aug-16																			
111		194	Unnamed trib of Barker Creek	22-Aug-16	4.40	3.10	0.17	0.20	6.0	trace						C - Cobble	F - Fines	3.8	8.32	271			L - Light
112		195	Unnamed Tributary to Barker Creek	11-Jul-16	1.30	1.00		0.07		trace	IV - Instream Veg					G - Gravel	F - Fines	16.1	7.41	644	8.08		C - Clear
113		196	Unnamed trib of Barker Creek	22-Aug-16	5.00	2.94	0.14	0.30	2.3	trace						G - Gravel	F - Fines	5.3	8.24	460			L - Light
114		197	Unnamed trib of Barker Creek	22-Aug-16																			
115		198	Unnamed trib of Barker Creek	22-Aug-16																			
118		199	Unnamed Tributary to Ballarat Creek	13-Jul-16																			T - Turbid
119		200	Unnamed Tributary to Ballarat Creek	13-Jul-16																			
125		201	Coffee Creek	13-Jul-16	21.83	19.83	Flooding, unsafe to access	Flooding, unsafe to access	1.5	trace	LWD - Large Woody Debris	SWD - Small Woody Debris				Flooding, unsafe to access	Flooding, unsafe to access	5.2	5.08	65	10.82		T - Turbid
200		202	Ballarat Creek	Not visited in 2016																			
201		203	Ballarat Creek	13-Jul-16	3.60	3.12	0.38	0.69	2.8	abundant	SWD - Small Woody Debris	LWD - Large Woody Debris	U - Undercut Banks	DP - Deep Pools		G - Gravel	F - Fines	4.3	6.51	332	10.7		C - Clear
202		204	Unnamed Tributary to Ballarat Creek	13-Jul-16																			
203		205	Unnamed Tributary of Ballarat Creek	12-Jul-16	0.44	0.48	0.23	0.34	10.7	abundant	U - Undercut Banks	SWD - Small Woody Debris	OV - Overhanging Veg			F - Fines	G - Gravel	1.48	5.89	482	11.54		C - Clear
204		206	Unnamed Tributary to Ballarat Creek	13-Jul-16																			
205		207	Unnamed Tributary of Ballarat Creek	12-Jul-16	0.97	0.58	0.15	0.44	11.5	abundant	U - Undercut Banks	SWD - Small Woody Debris	OV - Overhanging Veg			F - Fines	C - Cobble	2.2	4.6	345	11.14		C - Clear
206		208	Unnamed Tributary to Ballarat Creek	12-Jul-16																			

Crossing	Station/Pass	Data Row	Stream Name	Sample Date	Avg Channel Width (m)	Avg Wet Width (m)	Avg. Residual Pool Depth (m)	Avg. Bankfull Depth (m)	Avg Stream Gradient (%)	Cover - Total	Cover - Dominant	Cover - Subdominant				Substrate		Water Temp (°C)	pH	SPC (µg/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% sat)	Turbidity
207		209	Unnamed trib of Barker Creek	19-Aug-16	1.23	0.50	0.12	0.10	17.0	moderate	OV - Overhanging Veg	SWD - Small Woody Debris	IV - Instream Veg			F - Fines	G - Gravel	4.2	8.4	124			L - Light
208		210	Unnamed branch of Barker Creek	19-Aug-16	2.35	2.28	0.28	0.40	4.0	moderate	U - Undercut Banks	SWD - Small Woody Debris	OV - Overhanging Veg			C - Cobble	G - Gravel	4.5	8.32	225			L - Light
209		211	Unnamed trib of Barker Creek	19-Aug-16	3.80	0.80	0.55	0.50	4.5	abundant	U - Undercut Banks	SWD - Small Woody Debris	DP - Deep Pools	OV - Overhanging Veg		C - Cobble	F - Fines	4.1	8.3	228			L - Light
210		212	Unnamed trib of Barker Creek	19-Aug-16	2.23	0.80	0.42	0.40	3.0	abundant	U - Undercut Banks	SWD - Small Woody Debris	LWD - Large Woody Debris	DP - Deep Pools	OV - Overhanging Veg	F - Fines	G - Gravel	4	8.52	459			L - Light
Maisy May at Airstrip		213	Maisy May Creek	21-Aug-16																			

[1] Cover: B- boulder, DP – deep pool, IV –instream vegetation, LWD – large woody debris, OV – overhanging vegetation, SWD – small woody debris, U – undercut bank.

[2] Substrate: B – boulder, C- cobble, F – fines, G – gravel.

Table B2. 2016 physical stream attribute and fish sampling data (continued).

Site Name	Crossing	Station	Pass	Data Row	Overwinter Habitat Description[1]	Spawning Habitat Description[1]	Rearing Habitat Description[1]	Fish Bearing Status[1]	Sampling Method	Angling Effort (mins)	EF Effort (seconds)	EF Section Length (m)	EF Section Width (m)	BS - Haul Length (m)	BS - Haul Width (m)	BS - Haul Depth (m)	MT depth (m)	MT total time (hours)	No Fish Captured [2]	GR	CH (juv)	CCG	LSU	BB	LKC	NP	RW	LW/ BW
CF0.5				1					MT - Minnow Trapping								35	19.9			7							
CF0.5				2					MT - Minnow Trapping								65	19.9			7							
CF0.5				3					MT - Minnow Trapping								67	19.9			3							
CF0.5				4					MT - Minnow Trapping								54	20.3			1							
CF0.5				5					MT - Minnow Trapping								50	20.3	NFC									
CF0.5				6					MT - Minnow Trapping								110	20.3	NFC									
CF10.0		1		7					AG - Angling	75										8								
CF10.0		2		8					AG - Angling	30										3								
CF10.0				9					MT - Minnow Trapping								41	45.3	NFC									
CF10.0				10					MT - Minnow Trapping								42	45.3	NFC									
CF10.0				11					MT - Minnow Trapping								26	45.3				1						
CF10.0-1			1	12					EF - Electrofishing		732	20	5.0									10						
CF10.0-1			2	13					EF - Electrofishing		559	20	5.0									7						
CF10.0-1			3	14					EF - Electrofishing		707	20	5.0									2						
CF10.0-2			1	15					EF - Electrofishing		468	20	5.0							7		3						
CF10.0-2			2	16					EF - Electrofishing		574	20	5.0									2						
CF10.0-2			3	17					EF - Electrofishing		415	20	5.0									1						
CF10.0-3			1	18					EF - Electrofishing		427	20	5.0							1		2						
CF10.0-3			2	19					EF - Electrofishing		344	20	5.0							1		6						
CF10.0-3			3	20					EF - Electrofishing		390	20	5.0									1						
CF2.7				21					MT - Minnow Trapping								25	25			2	1						
CF2.7				22					MT - Minnow Trapping								35	25				1						
CF2.7				23					MT - Minnow Trapping								55	25	NFC		2							
CF2.7				24					MT - Minnow Trapping								25	25	NFC		1							
CF2.7				25					MT - Minnow Trapping								26	24.6	NFC									
CF2.7				26					MT - Minnow Trapping								21	24.6				1						
CF2.7				27					MT - Minnow Trapping								135	24.2	NFC									
CF2.7				28					MT - Minnow Trapping								108	24.2			15	1						
CF2.7				29					MT - Minnow Trapping								45	22.9	NFC									
CF2.7				30					MT - Minnow Trapping								80	22.9			2							
CF2.7				31					MT - Minnow Trapping								55	22.9	NFC									
CF2.7				32					MT - Minnow Trapping								35	22.9	NFC									
CF2.7				33					MT - Minnow Trapping								22	22.7			6							
CF2.7				34					MT - Minnow Trapping								20	22.7	NFC									
CF2.7				35					MT - Minnow Trapping								20	22.7			1							
CF2.7				36					MT - Minnow Trapping								126	22.4	NFC									
CF2.7				37					MT - Minnow Trapping								41	22.4	NFC									
CF3.9		1		38					AG - Angling	55									NFC									
CF3.9		2		39					AG - Angling	20									NFC									
CF3.9-1			1	40					EF - Electrofishing		476	20.75	5.8									15						
CF3.9-1			2	41					EF - Electrofishing		293	20.75	5.8									7						
CF3.9-1			3	42					EF - Electrofishing		313	20.75	5.8									6						
CF3.9-2			1	43					EF - Electrofishing		853	28	8.9								1	19						
CF3.9-2			2	44					EF - Electrofishing		443	28	8.9								2	13						
CF3.9-2			3	45					EF - Electrofishing		476	28	8.9									6						
CF3.9-2			4	46					EF - Electrofishing		355	28	8.9									6						
CF3.9-3			1	47					EF - Electrofishing		1125	33.75	6.9									41						
CF3.9-3			2	48					EF - Electrofishing		762	33.75	6.9									21						
CF3.9-3			3	49					EF - Electrofishing		570	33.75	6.9									10						
CF8.3				50					MT - Minnow Trapping								21	22.2	NFC									

Site Name	Crossing	Station	Pass	Data Row	Overwinter Habitat Description[1]	Spawning Habitat Description[1]	Rearing Habitat Description[1]	Fish Bearing Status[1]	Sampling Method	Angling Effort (mins)	EF Effort (seconds)	EF Section Length (m)	EF Section Width (m)	BS - Haul Length (m)	BS - Haul Width (m)	BS - Haul Depth (m)	MT depth (m)	MT total time (hours)	No Fish Captured [2]	GR	CH (juv)	CCG	LSU	BB	LKC	NP	RW	LW/ BW
CF8.3				51					MT - Minnow Trapping								80	22.2	NFC									
CF8.3				52					MT - Minnow Trapping								39	22.1				1						
HF0.2				53	Low	Low	Low		EF - Electrofishing		829								NFC									
HF0.2		1		54	Low	Low	Low		MT - Minnow Trapping									14.3	NFC									
HF0.2		1		55	Low	Low	Low		MT - Minnow Trapping									14.3	NFC									
HF0.2		1		56	Low	Low	Low		MT - Minnow Trapping									14.3	NFC									
HF0.2		2		57	Low	Low	Low		MT - Minnow Trapping									14.3	NFC									
HF0.2		2		58	Low	Low	Low		MT - Minnow Trapping									14.3	NFC									
HF0.2		2		59	Low	Low	Low		MT - Minnow Trapping									14.3	NFC									
HF0.2		3		60	Low	Low	Low		MT - Minnow Trapping									14.3	NFC									
HF0.2		3		61	Low	Low	Low		MT - Minnow Trapping									14.3	NFC									
HF0.2		3		62	Low	Low	Low		MT - Minnow Trapping									14.3	NFC									
HF0.2				63	Low	Low	Low		EF - Electrofishing		84								NFC									
HF0.2				64	Low	Low	Low		EF - Electrofishing		2084									1	20							
HF0.9				65					EF - Electrofishing		287								NFC									
HF6.3				66					EF - Electrofishing		211								NFC									
HF6.3				67					EF - Electrofishing		1107								NFC									
HF6.3				68					MT - Minnow Trapping								34	19.5	NFC									
HF6.3				69					MT - Minnow Trapping								26	19.5	NFC									
HF8.8				70	Low	None	Low		EF - Electrofishing		201								NFC									
HFA0.1				71					EF - Electrofishing		156								NFC									
ID1.9				72					EF - Electrofishing		256											7						
ID1.9				73					EF - Electrofishing		3778								NFC									
ID1.9				74					AG - Angling	58									NFC									
ID1.9				75					MT - Minnow Trapping								67	17.8	NFC									
ID1.9				76					MT - Minnow Trapping								42	17.8	NFC									
ID1.9				77					MT - Minnow Trapping								56	17.8	NFC									
ID1.9				78					MT - Minnow Trapping								35	17.7	NFC									
ID1.9				79					MT - Minnow Trapping								35	17.7	NFC									
ID1.9				80					MT - Minnow Trapping								40	17.7	NFC									
ID1.9-1			1	81					EF - Electrofishing		694	25.9	8.5									11						
ID1.9-1			2	82					EF - Electrofishing		705	25.9	8.5									4						
ID1.9-1			3	83					EF - Electrofishing		638	25.9	8.5									3						
ID1.9-2			1	84					EF - Electrofishing		448	20	7.2									3						
ID1.9-2			2	85					EF - Electrofishing		435	20	7.2						NFC									
ID1.9-2			3	86					EF - Electrofishing		440	20	7.2									1						
ID1.9-3			1	87					EF - Electrofishing		627	20.5	5.7									1						
ID1.9-3			2	88					EF - Electrofishing		641	20.5	5.7									1						
ID1.9-3			3	89					EF - Electrofishing		441	20.5	5.7						NFC									
LA-1				90					BS - Beach Seining					20	2	0.2			NFC									
LA-2				91					BS - Beach Seining					30	5	1.2			NFC									
LA-3				92					BS - Beach Seining					50	3.5	0.8				2								
LA-4				93					BS - Beach Seining					30	4	0.7				1							1	
LA-5				94					BS - Beach Seining					40	6	1.3			NFC									
LaC4.8		1		95					EF - Electrofishing		279	15	4.0						NFC									
LaC4.8		1		96					EF - Electrofishing		279	15	4.0						NFC									
LaC4.8		1		97					EF - Electrofishing		310	25	3.0						NFC									
LaC4.8		1		98					EF - Electrofishing		57								NFC									
LaC4.8		1		99					EF - Electrofishing		224	15	3.0						NFC									
LaC4.8		1		100					EF - Electrofishing		160	4	5.0						NFC									
LaC4.8				101					BS - Beach Seining											2								
LaC4.8				102					AG - Angling	60										1								

Site Name	Crossing	Station	Pass	Data Row	Overwinter Habitat Description[1]	Spawning Habitat Description[1]	Rearing Habitat Description[1]	Fish Bearing Status[1]	Sampling Method	Angling Effort (mins)	EF Effort (seconds)	EF Section Length (m)	EF Section Width (m)	BS - Haul Length (m)	BS - Haul Width (m)	BS - Haul Depth (m)	MT depth (m)	MT total time (hours)	No Fish Captured [2]	GR	CH (juv)	CCG	LSU	BB	LKC	NP	RW	LW/ BW
LC1.6				103					MT - Minnow Trapping								26	20.4	NFC									
LC1.6				104					MT - Minnow Trapping								36	20.4	NFC									
LC2.7-1			1	105					EF - Electrofishing		489	35	4.1						NFC									
LC2.7-1			2	106					EF - Electrofishing		661	35	4.1						NFC									
LC2.7-1			3	107					EF - Electrofishing		442	35	4.1						NFC									
LC2.7-2			1	108					EF - Electrofishing		214	13	5.5							1								
LC2.7-2			2	109					EF - Electrofishing		328	13	5.5						NFC									
LC2.7-2			3	110					EF - Electrofishing		216	13	5.5							1								
LC2.7-3			1	111					EF - Electrofishing		199	30	5.7							2								
LC2.7-3			2	112					EF - Electrofishing		304	30	5.7						NFC									
LC2.7-3			3	113					EF - Electrofishing		255	30	5.7							3								
LC9.9		1		114					MT - Minnow Trapping								0.35	24	NFC									
LC9.9		1		115					MT - Minnow Trapping								0.4	24	NFC									
LC9.9		1		116					MT - Minnow Trapping								0.4	24	NFC									
LC9.9		2		117					MT - Minnow Trapping								0.3	24	NFC									
LC9.9		2		118					MT - Minnow Trapping								0.35	24	NFC									
LC9.9		2		119					MT - Minnow Trapping								0.35	24	NFC									
LC9.9		3		120					MT - Minnow Trapping								0.5	24	NFC									
LC9.9		3		121					MT - Minnow Trapping								0.45	24	NFC									
LC9.9		3		122					MT - Minnow Trapping								0.55	24	NFC									
LCC0.0				123					MT - Minnow Trapping									14	NFC									
LCC0.0				124					MT - Minnow Trapping									13.8	NFC									
LCC0.0				125					MT - Minnow Trapping									13.9	NFC									
LCC0.0				126					MT - Minnow Trapping									13.8	NFC									
LCC0.0				127					MT - Minnow Trapping									14	NFC									
LCC0.2				128					MT - Minnow Trapping									14.1	NFC									
LCC0.2				129					MT - Minnow Trapping									14.1	NFC									
LCC0.2				130					MT - Minnow Trapping									14.2	NFC									
LCC0.2				131					MT - Minnow Trapping									14.8	NFC									
LCC0.2				132	Nil	None	Low		EF - Electrofishing		509								NFC									
LCC0.3				133					EF - Electrofishing		1145								NFC									
LLC0.0				134					EF - Electrofishing		105								NFC									
SR_LDB_1				135					BS - Beach Seining					85	7	1.5				6	18	12	4		10		1	
SR_RDB_1				136					BS - Beach Seining					38	8	1.2							2					
SR_RDB_2				137					BS - Beach Seining					55	8	1.1					11	1	14	2				
SRSC				138					BS - Beach Seining					30	8	0.5									3	2	5	6
SRSC		1		139					MT - Minnow Trapping									5.4	NFC									
SRSC		1		140					MT - Minnow Trapping									5.4	NFC									
SRSC		1		141					MT - Minnow Trapping									5.4	NFC									
SRSC		2		142					MT - Minnow Trapping									5.4	NFC									
SRSC		2		143					MT - Minnow Trapping									5.4	NFC									
SRSC		2		144					MT - Minnow Trapping									5.4				1						
YR Land LDB				145					BS - Beach Seining					71	4	1.2				3	62	6	1	1	1	1		
YR US Barge1				146					BS - Beach Seining					45	2	1.2				2	20	4	1					
YR US Barge2				147					BS - Beach Seining					65	3	1.2					5	1	2					
YRD_RDB1		1		148					MT - Minnow Trapping								0.5	23.08333333	NFC									
YRD_RDB1		1		149					MT - Minnow Trapping								0.2	23.08333333	NFC									
YRD_RDB1		1		150					MT - Minnow Trapping								0.5	23.08333333	NFC									
YRD_RDB2		1		151					MT - Minnow Trapping								0.5	22.83333333	NFC									
YRD_RDB2		1		152					MT - Minnow Trapping								0.25	22.83333333					1					

Site Name	Crossing	Station	Pass	Data Row	Overwinter Habitat Description[1]	Spawning Habitat Description[1]	Rearing Habitat Description[1]	Fish Bearing Status[1]	Sampling Method	Angling Effort (mins)	EF Effort (seconds)	EF Section Length (m)	EF Section Width (m)	BS - Haul Length (m)	BS - Haul Width (m)	BS - Haul Depth (m)	MT depth (m)	MT total time (hours)	No Fish Captured [2]	GR	CH (juv)	CCG	LSU	BB	LKC	NP	RW	LW/ BW
YRD_RDB2		1		153					MT - Minnow Trapping								0.6	22.83333333	NFC									
YT0.0				154					EF - Electrofishing		97											20						
YT0.2				155	Nil	Nil	Low		EF - Electrofishing		835								NFC									
YT0.2		1		156	Nil	Nil	Low		MT - Minnow Trapping									14	NFC									
YT0.2		1		157	Nil	Nil	Low		MT - Minnow Trapping									14	NFC									
YT0.2		2		158	Nil	Nil	Low		MT - Minnow Trapping									13.9	NFC									
YT0.2		2		159	Nil	Nil	Low		MT - Minnow Trapping									13.9	NFC									
YT0.2		3		160	Nil	Nil	Low		MT - Minnow Trapping									13.9	NFC									
YT0.2		3		161	Nil	Nil	Low		MT - Minnow Trapping									13.9	NFC									
YT0.2		3		162	Nil	Nil	Low		MT - Minnow Trapping		735							13.9	NFC									
YT0.2		4		163	Nil	Nil	Low		MT - Minnow Trapping									14.1	NFC									
YT0.2		4		164	Nil	Nil	Low		MT - Minnow Trapping									14.1	NFC									
YT0.2				165	Nil	Nil	Low		EF - Electrofishing		1337								NFC									
YT0.6				166					EF - Electrofishing		259								NFC									
YT0.9				167					EF - Electrofishing		276								NFC									
YT1.3				168					EF - Electrofishing		209								NFC									
YT4.6				169	Nil	Nil	Low		EF - Electrofishing		331								NFC									
YT5.0				170					EF - Electrofishing		803								NFC									
YT5.9				171					EF - Electrofishing		171								NFC									
	52			172	None	Non	Poor to fair	NFB - Non-fish bearing	MT - Minnow Trapping									8.2	NFC									
	52			173	None	Non	Poor to fair	NFB - Non-fish bearing	MT - Minnow Trapping									8.2	NFC									
	52			174	None	Non	Poor to fair	NFB - Non-fish bearing	EF - Electrofishing		495								NFC									
	75			175	Poor	Poor	Fair	NFB - Non-fish bearing	EF - Electrofishing		295								NFC									
	76			176	Poor	Poor	Poor	NFB - Non-fish bearing	EF - Electrofishing		124								NFC									
	77			177	Poor	Poor	Moderate	NFB - Non-fish bearing	EF - Electrofishing		265								NFC									
	81			178					MT - Minnow Trapping									22.3	NFC									
	81			179			Moderate	FB - Fish Bearing	MT - Minnow Trapping									22.3	NFC									
	84			180			Moderate	FB - Fish Bearing	EF - Electrofishing		231								NFC									
	97	1		181				NFB - Non-fish bearing	MT - Minnow Trapping									5.7	NFC									
	97	1		182				NFB - Non-fish bearing	MT - Minnow Trapping									5.7	NFC									
	97	1		183				NFB - Non-fish bearing	MT - Minnow Trapping									5.7	NFC									
	97	2		184				NFB - Non-fish bearing	MT - Minnow Trapping									5.4	NFC									
	97	2		185				NFB - Non-fish bearing	MT - Minnow Trapping									5.4	NFC									
	97	2		186				NFB - Non-fish bearing	MT - Minnow Trapping									5.4	NFC									
	97	3		187				NFB - Non-fish bearing	MT - Minnow Trapping									5.4	NFC									
	97	3		188				NFB - Non-fish bearing	MT - Minnow Trapping									5.4	NFC									
	97	3		189				NFB - Non-fish bearing	MT - Minnow Trapping									5.4	NFC									
	97			190				NFB - Non-fish bearing	EF - Electrofishing		420								NFC									
	101			191	None	None	None	NCD - Non-classified drainage	EF - Electrofishing		164																	
	102			192	NA	NA	NA	NCD - Non-classified drainage	EF - Electrofishing		146								NFC									
	103			193	None	Low	Low	NFB - Non-fish bearing	EF - Electrofishing		283								NFC									
	104			194	None	None	Low	NFB - Non-fish bearing	EF - Electrofishing		288								NFC									
	110			195				NFB - Non-fish bearing	EF - Electrofishing		133								NFC									
	111			196	None	Low	Moderate	PFB - Potentially fish bearing	EF - Electrofishing		303								NFC									
	112			197	None	None	None	NFB - Non-fish bearing	EF - Electrofishing		304								NFC									
	113			198	None	Low	Low	PFB - Potentially fish bearing	EF - Electrofishing		330								NFC									
	114			199				NFB - Non-fish bearing	EF - Electrofishing		203								NFC									
	201			200	Moderate	Low	Moderate	PFB - Potentially fish bearing	EF - Electrofishing		338								NFC									

Site Name	Crossing	Station	Pass	Data Row	Overwinter Habitat Description[1]	Spawning Habitat Description[1]	Rearing Habitat Description[1]	Fish Bearing Status[1]	Sampling Method	Angling Effort (mins)	EF Effort (seconds)	EF Section Length (m)	EF Section Width (m)	BS - Haul Length (m)	BS - Haul Width (m)	BS - Haul Depth (m)	MT depth (m)	MT total time (hours)	No Fish Captured [2]	GR	CH (juv)	CCG	LSU	BB	LKC	NP	RW	LW/ BW
	203			201	None	None	None	NFB - Non-fish bearing	EF - Electrofishing		160								NFC									
	205			202	None	Low	Moderate	NFB - Non-fish bearing	EF - Electrofishing		231								NFC									
	207			203	None	None	Low	NFB - Non-fish bearing	EF - Electrofishing		316								NFC									
	208			204	None	Low	Moderate	FB - Fish Bearing	EF - Electrofishing		573									1								
	209			205	None	None	Moderate	PFB - Potentially fish bearing	EF - Electrofishing		571								NFC									
	210			206	None	None	Moderate	PFB - Potentially fish bearing	EF - Electrofishing		601								NFC									
	Indian River Mainstem			207				FB - Fish Bearing	MT - Minnow Trapping									8.7	NFC									
	Indian River Mainstem			208				FB - Fish Bearing	MT - Minnow Trapping									8.7	NFC									
	Indian River Mainstem			209				FB - Fish Bearing	MT - Minnow Trapping									8.7				1						
	Tailings Trib 1			210				NCD - Non-classified drainage	MT - Minnow Trapping									22.2	NFC									
	Tailings Trib 1			211				NCD - Non-classified drainage	MT - Minnow Trapping									22.2	NFC									
	Tailings Trib 1			212				NCD - Non-classified drainage	MT - Minnow Trapping									22.2	NFC									
	Tailings Trib 2			213	Poor	Poor	Poor	PFB - Potentially fish bearing	EF - Electrofishing		382								NFC									
	Tailings Trib 2			214	Poor	Poor	Poor	PFB - Potentially fish bearing	MT - Minnow Trapping									22.2	NFC									
	Tailings Trib 2			215	Poor	Poor	Poor	PFB - Potentially fish bearing	MT - Minnow Trapping									22.2	NFC									
	Tailings Trib 5			216	None	None	Poor to fair	NFB - Non-fish bearing	EF - Electrofishing		516								NFC									
	YRUB_Winter Road Crossing			217	Moderate	Low	Moderate	PFB - Potentially fish bearing	EF - Electrofishing		276								NFC									
	YRUB_Winter Road Crossing			218					EF - Electrofishing		838								NFC									
		Maisy May at Airstrip		219					MT - Minnow Trapping									22.3	NFC									
		Maisy May at Airstrip		220					MT - Minnow Trapping									22.3	NFC									

[1] Summary information only, for additional information refer to Section 3.4 (fish distribution and abundance) and Section 4.1 (stream crossings) for additional information and rationale.
[2] Fish species codes: GR – Arctic grayling, CH – Chinook salmon (juvenile), CCG – slimy sculpin, LSU – longnose sucker, BB – burbot, LKC – lake chub, NP – northern pike, RW – round whitefish, LW/BW – lake whitefish/broad whitefish.

APPENDIX C. 2016 FISH CAPTURE DATA

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Table C1. 2016 fish capture data.

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
IC1.9-1-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	81	6.5	retained
IC1.9-1-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	68	3.4	retained
IC1.9-1-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	75	4.6	retained
IC1.9-1-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	65	3.5	retained
IC1.9-1-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	54	1.6	released
IC1.9-1-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	56	2.2	released
IC1.9-1-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	59	2.5	released
IC1.9-1-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	56	2.4	released
IC1.9-1-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	57	2.1	released
IC1.9-1-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	60	2.9	released
IC1.9-1-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	57	1.8	released
IC1.9-1-2	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin			released
IC1.9-1-2	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin			released
IC1.9-1-2	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin			released
IC1.9-1-2	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin			released
IC1.9-1-3	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin			released
IC1.9-1-3	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin			released
IC1.9-1-3	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin			released
IC1.9-2-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	52	1.7	retained
IC1.9-2-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	57	2.4	retained
IC1.9-2-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	60	2.2	retained
IC1.9-2-3	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	52	1.4	retained
IC1.9-3-1	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	45	1	retained
IC1.9-3-2	Independence Creek	12-Jul-16	EF - electrofishing	slimy sculpin	64	2.6	retained
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	84	5.1	retained
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	75	3.9	retained
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	72	3.2	retained
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	60		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	65		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	77		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	73		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	71		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	72		released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	70		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	71		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	64		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	72		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	70		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	76		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	72		released
CF0.5	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	78		released
CF10.0	Coffee Creek	4-Mar-16	MT - minnow trapping	slimy sculpin	69	2.6	retained
CF10.0	Coffee Creek	10-Jul-16	AG - angling	Arctic grayling			escape
CF10.0	Coffee Creek	10-Jul-16	AG - angling	Arctic grayling			escape
CF10.0	Coffee Creek	10-Jul-16	AG - angling	Arctic grayling			escape
CF10.0	Coffee Creek	10-Jul-16	AG - angling	Arctic grayling			escape
CF10.0	Coffee Creek	10-Jul-16	AG - angling	Arctic grayling			escape
CF10.0	Coffee Creek	10-Jul-16	AG - angling	Arctic grayling			escape
CF10.0	Coffee Creek	10-Jul-16	AG - angling	Arctic grayling			escape
CF10.0	Coffee Creek	10-Jul-16	AG - angling	Arctic grayling	190	67.6	retained
CF10.0	Coffee Creek	10-Jul-16	AG - angling	Arctic grayling	280	197.6	retained
CF10.0	Coffee Creek	10-Jul-16	AG - angling	Arctic grayling	245	148.7	retained
CF10.0	Coffee Creek	10-Jul-16	AG - angling	Arctic grayling	330	378.5	retained
CF10.0-1-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	76	4	retained
CF10.0-1-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	79	4.6	retained
CF10.0-1-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	50	1.3	retained
CF10.0-1-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	71	3.2	retained
CF10.0-1-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	74	3.6	retained
CF10.0-1-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	54	1.5	retained
CF10.0-1-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	53	1.2	retained
CF10.0-1-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	54	1.6	retained
CF10.0-1-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	55	1.5	retained
CF10.0-1-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	55	1.6	retained
CF10.0-1-2	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	56	1.7	released
CF10.0-1-2	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	71	3.4	released
CF10.0-1-2	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	50	1.1	released
CF10.0-1-2	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	57	1.5	released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
CF10.0-1-2	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	57	1.4	released
CF10.0-1-2	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	50	1.1	released
CF10.0-1-2	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	52	1.4	released
CF10.0-1-3	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	75	3.6	released
CF10.0-1-3	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	32	0.4	released
CF10.0-2-1	Coffee Creek	10-Jul-16	EF - electrofishing	Arctic grayling	225	122.9	retained
CF10.0-2-1	Coffee Creek	10-Jul-16	EF - electrofishing	Arctic grayling	50	1	released
CF10.0-2-1	Coffee Creek	10-Jul-16	EF - electrofishing	Arctic grayling	55	1.2	released
CF10.0-2-1	Coffee Creek	10-Jul-16	EF - electrofishing	Arctic grayling	59	1.6	released
CF10.0-2-1	Coffee Creek	10-Jul-16	EF - electrofishing	Arctic grayling	60	1.9	released
CF10.0-2-1	Coffee Creek	10-Jul-16	EF - electrofishing	Arctic grayling	46	1	released
CF10.0-2-1	Coffee Creek	10-Jul-16	EF - electrofishing	Arctic grayling	51	1.3	released
CF10.0-2-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	53	1.3	released
CF10.0-2-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	31	0.4	released
CF10.0-2-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	32	0.4	released
CF10.0-2-2	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	30	0.4	released
CF10.0-2-2	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	29	0.2	released
CF10.0-2-3	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	32	0.4	released
CF10.0-3-1	Coffee Creek	10-Jul-16	EF - electrofishing	Arctic grayling	245	174.3	retained
CF10.0-3-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	55	1.8	released
CF10.0-3-1	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	54	1.4	released
CF10.0-3-2	Coffee Creek	10-Jul-16	EF - electrofishing	Arctic grayling	164	53	retained
CF10.0-3-2	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	55	1.5	released
CF10.0-3-2	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	56	1.7	released
CF10.0-3-3	Coffee Creek	10-Jul-16	EF - electrofishing	slimy sculpin	51	1.2	released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	slimy sculpin	85	7.1	retained
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	slimy sculpin	70	4.2	retained
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	slimy sculpin	84	7.1	retained
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	slimy sculpin		6.5	retained
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	75	3.8	retained
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	81	3.8	retained
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	70	3.5	retained
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	80		released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	84		released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	80		released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	80		released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	78		released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	85		released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	75		released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	75		released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	73		released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	80		released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	70		released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon	76		released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon			released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon			released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon			released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon			released
CF2.7	Coffee Creek	4-Mar-16	MT - minnow trapping	Chinook salmon			released
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	slimy sculpin		0.4	retained
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	slimy sculpin		0.3	retained
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	slimy sculpin		0.9	retained
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	slimy sculpin		<0.1	retained
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	90		released
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	76		released
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	76		released
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	78		released
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	76		released
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	79		released
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	83		released
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon	76		released
CF2.7	Coffee Creek	5-Mar-16	MT - minnow trapping	Chinook salmon			released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	78	4.4	released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	64	2.8	released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	56	2.3	released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	54	1.5	released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	32	0.7	released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	45	1.2	released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	53	1.8	released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	55	1.8	released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	55	1.7	released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	50	1.3	released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-1-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	Chinook salmon	58	2.2	released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	48	0.8	released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	44	0.8	released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	25	0.2	released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	46	0.8	released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	41	0.5	released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	45	1	released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	43	0.7	released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	41	0.7	released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	40	0.6	released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	25	0.3	released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	Arctic grayling	160		released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	Chinook salmon	62	3.1	released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	Chinook salmon	56	2.3	released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-4	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-4	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-4	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-4	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
CF3.9-2-4	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-2-4	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	66	3	retained
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	67	3.6	retained
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	84	5.8	retained
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	67	2.9	retained
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	67	2.7	retained
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	50	1.1	retained
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	50	1.2	retained
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	58	1.9	retained
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	55	1.5	retained
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	46	0.8	retained
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	50	1.2	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	51	1.4	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	55	1.6	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	52	1.2	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	50	1.1	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	51	1.4	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	51	1.3	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	43	0.8	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	50	1.2	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	51	1.4	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	50	1.6	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	50	1.1	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	50	1.1	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	50	1.3	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	45	1.1	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin	42	1	released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-1	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-2	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
CF3.9-3-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF3.9-3-3	Coffee Creek	11-Jul-16	EF - electrofishing	slimy sculpin			released
CF8.3	Coffee Creek	4-Mar-16	MT - minnow trapping	slimy sculpin	66	2.3	retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	69		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	77		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	70		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	82		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	73		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	69		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	70		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	72		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	71		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	77		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	76		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Arctic grayling	123		retained
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	78		released
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	78		released
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	75		released
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	74		released
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	70		released
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	68		released
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	73		released
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	75		released
HF0.2	Halfway Creek	23-Aug-16	EF - electrofishing	Chinook salmon	76		released
Indian River Mainstem	Indian River Crossing	20-Aug-16	MT - minnow trapping	slimy sculpin	50		released
LC2.7-2-1	Latte Creek	9-Jul-16	EF - electrofishing	Arctic grayling			escape
LC2.7-2-3	Latte Creek	9-Jul-16	EF - electrofishing	Arctic grayling			escape
LC2.7-3-1	Latte Creek	9-Jul-16	EF - electrofishing	Arctic grayling	267	199.6	retained
LC2.7-3-1	Latte Creek	9-Jul-16	EF - electrofishing	Arctic grayling	284	276.9	retained

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
LC2.7-3-3	Latte Creek	9-Jul-16	EF - electrofishing	Arctic grayling	247	180.2	retained
LC2.7-3-3	Latte Creek	9-Jul-16	EF - electrofishing	Arctic grayling	235	157.9	retained
LC2.7-3-3	Latte Creek	9-Jul-16	EF - electrofishing	Arctic grayling	168		retained
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	55		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	59		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	52		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	46		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	44		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	50		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	57		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	51		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	38		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	24		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	33		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	41		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	70		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	75		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	64		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	74		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	76		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	63		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	69		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	73		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	65		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	62		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	70		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	72		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	68		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	67		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	74		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	63		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	66		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	59		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Arctic grayling	135		released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Arctic grayling	145		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Arctic grayling	125		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Arctic grayling	110		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Arctic grayling	105		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	Arctic grayling	58		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	lake chub	95		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	lake chub	85		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	lake chub	85		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	lake chub	85		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	lake chub	83		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	lake chub	87		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	lake chub	90		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	lake chub	80		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	lake chub	22		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	lake chub	75		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	140		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	150		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	150		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	105		released
SR_LDB_1	Stewart River	14-Jul-16	BS - beach seining	round whitefish	45		released
SR_RDB_1	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	280		released
SR_RDB_1	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	175		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	burbot	320		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	burbot	180		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	70		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	55		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	50		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	55		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	53		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	50		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	54		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	45		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	45		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	50		released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	slimy sculpin	51		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	Chinook salmon	75		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	275		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	220		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	200		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	190		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	180		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	90		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	130		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	130		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	120		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	110		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	80		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	110		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	100		released
SR_RDB_2	Stewart River	14-Jul-16	BS - beach seining	longnose sucker	160		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake chub	23		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake chub	22		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	northern pike	62		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	northern pike	110		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish	45		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish	45		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish	45		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish	46		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish	130		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish	85		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish	70		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish	45		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish	58		released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake chub			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake chub			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake chub			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	round whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River	14-Jul-16	BS - beach seining	lake/broad whitefish			released
SRSC	Stewart River Side Channel	14-Jul-16	MT - minnow trapping	slimy sculpin	57		released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	burbot			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	slimy sculpin			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	slimy sculpin			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	slimy sculpin			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	slimy sculpin			released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	slimy sculpin			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	slimy sculpin			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Arctic grayling			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Arctic grayling			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	Arctic grayling			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	lake chub			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	longnose sucker			released
YR Land LDB	Yukon River	8-Jul-16	BS - beach seining	northern pike			released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	slimy sculpin	52		released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	slimy sculpin	56		released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	slimy sculpin	55		released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	slimy sculpin			released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	68	3.8	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	67	3.5	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	64	3.2	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	68	3.6	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	75	5.2	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	68	4	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	70	4.1	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	68	3.7	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	64	3.3	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	65	3.8	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	66	3.8	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released

Site Name	Stream Name	Sample Date	Capture Method	Species	Length (mm)	Weight (g)	Release Condition
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon			released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	Arctic grayling	119	15.6	released
YR US Barge1	Yukon River	8-Jul-16	BS - beach seining	longnose sucker	108	12.5	released
YR US Barge2	Yukon River	8-Jul-16	BS - beach seining	slimy sculpin	70		released
YR US Barge2	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	69	3.8	released
YR US Barge2	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	65	2.9	released
YR US Barge2	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	69	3.9	released
YR US Barge2	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	58	2.2	released
YR US Barge2	Yukon River	8-Jul-16	BS - beach seining	Chinook salmon	64	2	released
YR US Barge2	Yukon River	8-Jul-16	BS - beach seining	longnose sucker	100	10	released
YR US Barge2	Yukon River	8-Jul-16	BS - beach seining	longnose sucker	62	2.3	released
YRD_RDB2	Yukon River	8-Jul-16	MT - minnow trapping	longnose sucker	83		released

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APPENDIX D. 2016 PERIPHYTON DATA

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Table D1. 2016 periphyton data.

Site	Rep Number	Watercourse	Sample Date	Area Sampled (cm^2)	chl a ($\mu g/cm^2$)
YT0.2	YT0.2-CHLA-1	YT-24 Creek	23-Aug-16	81	0.67
YT0.2	YT0.2-CHLA-2	YT-24 Creek	23-Aug-16	81	0.23
YT0.2	YT0.2-CHLA-3	YT-24 Creek	23-Aug-16	81	0.61
YT0.2	YT0.2-CHLA-4	YT-24 Creek	23-Aug-16	81	1.04
YT0.2	YT0.2-CHLA-5	YT-24 Creek	23-Aug-16	81	0.84
YT0.2	YT0.2-CHLA-6	YT-24 Creek	23-Aug-16	81	1.17
YT0.2	YT0.2 - Mean	YT-24 Creek	23-Aug-16	81	0.76
HF0.2	HF0.2-CHLA-1	Halfway Creek	23-Aug-16	81	0.44
HF0.2	HF0.2-CHLA-2	Halfway Creek	23-Aug-16	81	0.61
HF0.2	HF0.2-CHLA-3	Halfway Creek	23-Aug-16	81	0.75
HF0.2	HF0.2-CHLA-4	Halfway Creek	23-Aug-16	81	0.39
HF0.2	HF0.2-CHLA-5	Halfway Creek	23-Aug-16	81	0.58
HF0.2	HF0.2-CHLA-6	Halfway Creek	23-Aug-16	81	1.40
HF0.2	HF0.2-Mean	Halfway Creek	23-Aug-16	81	0.69
ID1.9	ICD1.9-CHLA-1	Independence Creek	20-Aug-16	81	0.48
ID1.9	ID1.9-CHLA-2	Independence Creek	20-Aug-16	81	0.36
ID1.9	ID1.9-CHLA-3	Independence Creek	20-Aug-16	81	0.11
ID1.9	ID1.9-CHLA-4	Independence Creek	20-Aug-16	81	0.29
ID1.9	ID1.9-CHLA-5	Independence Creek	20-Aug-16	81	0.93
ID1.9	ID1.9-CHLA-6	Independence Creek	20-Aug-16	81	0.38
ID1.9	ID1.9-Mean	Independence Creek	20-Aug-16	81	0.43
YT5.0	YT5.0-CHLA-1	YT-24 Creek	21-Aug-16	81	0.19
YT5.0	YT5.0-CHLA-2	YT-24 Creek	21-Aug-16	81	0.50
YT5.0	YT5.0-CHLA-3	YT-24 Creek	21-Aug-16	81	0.42
YT5.0	YT5.0-CHLA-4	YT-24 Creek	21-Aug-16	81	1.81
YT5.0	YT5.0-CHLA-5	YT-24 Creek	21-Aug-16	81	0.33
YT5.0	YT5.0-CHLA-6	YT-24 Creek	21-Aug-16	81	0.42
YT5.0	YT5.0-Mean	YT-24 Creek	21-Aug-16	81	0.61

Site	Rep Number	Watercourse	Sample Date	Area Sampled (cm^2)	chl a ($\mu g/cm^2$)
LC9.9	LC9.9-CHLA-1	Latte Creek	21-Aug-16	81	0.14
LC9.9	LC9.9-CHLA-2	Latte Creek	21-Aug-16	81	0.20
LC9.9	LC9.9-CHLA-3	Latte Creek	21-Aug-16	81	0.14
LC9.9	LC9.9-CHLA-4	Latte Creek	21-Aug-16	81	0.14
LC9.9	LC9.9-CHLA-5	Latte Creek	21-Aug-16	81	0.10
LC9.9	LC9.9-CHLA-6	Latte Creek	21-Aug-16	81	0.10
LC9.9	LC9.9-Mean	Latte Creek	21-Aug-16	81	0.13
LaC4.8	LaC4.8-CHLA-1	Los Angeles Creek	20-Aug-16	81	1.06
LaC4.8	LaC4.8-CHLA-2	Los Angeles Creek	20-Aug-16	81	0.73
LaC4.8	LaC4.8-CHLA-3	Los Angeles Creek	20-Aug-16	81	0.81
LaC4.8	LaC4.8-CHLA-4	Los Angeles Creek	20-Aug-16	81	1.08
LaC4.8	LaC4.8-CHLA-5	Los Angeles Creek	20-Aug-16	81	0.27
LaC4.8	LaC4.8-CHLA-6	Los Angeles Creek	20-Aug-16	81	0.47
LaC4.8	LaC4.8-Mean	Los Angeles Creek	20-Aug-16	81	0.74
HF6.3	HF6.3-CHLA-1	Halfway Creek	20-Aug-16	81	0.19
HF6.3	HF6.3-CHLA-2	Halfway Creek	20-Aug-16	81	0.12
HF6.3	HF6.3-CHLA-3	Halfway Creek	20-Aug-16	81	0.13
HF6.3	HF6.3-CHLA-4	Halfway Creek	20-Aug-16	81	0.64
HF6.3	HF6.3-CHLA-5	Halfway Creek	20-Aug-16	81	0.52
HF6.3	HF6.3-CHLA-6	Halfway Creek	20-Aug-16	81	0.18
HF6.3	HC6.3 - Mean	Halfway Creek	20-Aug-16	81	0.30
CF10.0	CF10.0-CHLA-1	Coffee Creek	21-Aug-16	81	0.07
CF10.0	CF10.0-CHLA-2	Coffee Creek	21-Aug-16	81	0.21
CF10.0	CF10.0-CHLA-3	Coffee Creek	21-Aug-16	81	0.48
CF10.0	CF10.0-CHLA-4	Coffee Creek	21-Aug-16	81	0.64
CF10.0	CF10.0-CHLA-5	Coffee Creek	21-Aug-16	81	0.66
CF10.0	CF10.0-CHLA-6	Coffee Creek	21-Aug-16	81	1.35
CF10.0	CF10.0 - Mean	Coffee Creek	21-Aug-16	81	0.57
LC2.7	LC2.7-CHLA-1	Latte Creek	21-Aug-16	81	0.21

Site	Rep Number	Watercourse	Sample Date	Area Sampled (cm^2)	chl a ($\mu g/cm^2$)
LC2.7	LC2.7-CHLA-2	Latte Creek	21-Aug-16	81	0.11
LC2.7	LC2.7-CHLA-3	Latte Creek	21-Aug-16	81	0.19
LC2.7	LC2.7-CHLA-4	Latte Creek	21-Aug-16	81	0.45
LC2.7	LC2.7-CHLA-5	Latte Creek	21-Aug-16	81	0.24
LC2.7	LC2.7-CHLA-6	Latte Creek	21-Aug-16	81	0.39
LC2.7	LC2.7 - Mean	Latte Creek	21-Aug-16	81	0.26
CF3.9	CF3.9-CHLA-1	Coffee Creek	21-Aug-16	81	1.07
CF3.9	CF3.9-CHLA-2	Coffee Creek	21-Aug-16	81	1.30
CF3.9	CF3.9-CHLA-3	Coffee Creek	21-Aug-16	81	0.77
CF3.9	CF3.9-CHLA-4	Coffee Creek	21-Aug-16	81	0.65
CF3.9	CF3.9-CHLA-5	Coffee Creek	21-Aug-16	81	0.68
CF3.9	CF3.9-CHLA-6	Coffee Creek	21-Aug-16	81	0.79
CF3.9	CC3.9 - Mean	Coffee Creek	21-Aug-16	81	0.88

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Success Through Science®

Your Project #: 14Y0306:102
Site Location: COFFEE CREEK

Attention:LYNDSAY DOETZEL

EDI ENVIRONMENTAL DYNAMICS INC.
2195 2nd Avenue
WHITEHORSE, YT
CANADA Y1A 3T8

Your C.O.C. #: 08426768, 08426769, 08426771, 08426772, 08426773, 08426774

Report Date: 2016/09/02
Report #: R2252940
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B673220
Received: 2016/08/25, 14:15

Sample Matrix: Water
Samples Received: 60

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Chlorophyll A (surface)(sin)	30	N/A	2016/08/30	BBY6SOP-00002	SM 22 10200 H m
Chlorophyll A (surface)(sin)	30	N/A	2016/09/01	BBY6SOP-00002	SM 22 10200 H m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Maxxam
REPORT AUTOMATION ENGINE
02 Sep 2016 16:08:34 -07:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Graham Rudkin, Project Manager, Environmental
Email: GRudkin@maxxam.ca
Phone# (604)638-5926 Ext:5926

==========

This report has been generated and distributed using a secure automated process.
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B673220
Report Date: 2016/09/02

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: JT

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		PJ3292	PJ3293	PJ3294		PJ3295	PJ3296		
Sampling Date		2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00		2016/08/23 12:00	2016/08/23 12:00		
COC Number		08426768	08426768	08426768		08426768	08426768		
	UNITS	YT 0.2-CHLA-1	YT 0.2-CHLA-2	YT 0.2-CHLA-3	RDL	YT 0.2-CHLA-4	YT 0.2-CHLA-5	RDL	QC Batch
Parameter									
Chlorophyll a	ug/cm2	0.669	0.228	0.610	0.030	1.04 (1)	0.836 (1)	0.060	8381929

RDL = Reportable Detection Limit
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam ID		PJ3297		PJ3298	PJ3299		PJ3300		
Sampling Date		2016/08/23 12:00		2016/08/23 13:00	2016/08/23 13:00		2016/08/23 13:00		
COC Number		08426768		08426768	08426768		08426768		
	UNITS	YT 0.2-CHLA-6	RDL	HF 0.2-CHLA-1	HF 0.2-CHLA-2	RDL	HF 0.2-CHLA-3	RDL	QC Batch
Parameter									
Chlorophyll a	ug/cm2	1.17 (1)	0.060	0.437	0.606	0.030	0.752 (1)	0.060	8381929

RDL = Reportable Detection Limit
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam ID		PJ3301		PJ3313		PJ3314		PJ3315		
Sampling Date		2016/08/23 13:00		2016/08/23 13:00		2016/08/23 13:00		2016/08/20 12:00		
COC Number		08426768		08426769		08426769		08426769		
	UNITS	HF 0.2-CHLA-4	QC Batch	HF 0.2-CHLA-5	RDL	HF 0.2-CHLA-6	RDL	IC 1.9-CHLA-1	RDL	QC Batch
Parameter										
Chlorophyll a	ug/cm2	0.393	8381929	0.576	0.030	1.40 (1)	0.15	0.483	0.030	8381932

RDL = Reportable Detection Limit
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam ID		PJ3316	PJ3317	PJ3318		PJ3319		PJ3320		
Sampling Date		2016/08/20 12:00	2016/08/20 12:00	2016/08/20 12:00		2016/08/20 12:00		2016/08/20 12:00		
COC Number		08426769	08426769	08426769		08426769		08426769		
	UNITS	IC 1.9-CHLA-2	IC 1.9-CHLA-3	IC 1.9-CHLA-4	RDL	IC 1.9-CHLA-5	RDL	IC 1.9-CHLA-6	RDL	QC Batch
Parameter										
Chlorophyll a	ug/cm2	0.363	0.105	0.291	0.030	0.932 (1)	0.060	0.381	0.030	8381932

RDL = Reportable Detection Limit
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B673220
Report Date: 2016/09/02

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: JT

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		PJ3321	PJ3322	PJ3331		PJ3332		PJ3333		
Sampling Date		2016/08/21 12:00	2016/08/21 12:00	2016/08/21 12:00		2016/08/21 12:00		2016/08/21 12:00		
COC Number		08426769	08426769	08426771		08426771		08426771		
	UNITS	YT 5.0-CHLA-1	YT 5.0-CHLA-2	YT 5.0-CHLA-3	RDL	YT 5.0-CHLA-4	RDL	YT 5.0-CHLA-5	RDL	QC Batch
Parameter										
Chlorophyll a	ug/cm2	0.190	0.497	0.423	0.030	1.81 (1)	0.15	0.331	0.030	8381932

RDL = Reportable Detection Limit
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam ID		PJ3334	PJ3335	PJ3336	PJ3337	PJ3338	PJ3339		
Sampling Date		2016/08/21 12:00	2016/08/21 13:00	2016/08/21 13:00	2016/08/21 13:00	2016/08/21 13:00	2016/08/21 13:00		
COC Number		08426771	08426771	08426771	08426771	08426771	08426771		
	UNITS	YT 5.0-CHLA-6	LC 9.9-CHLA-1	LC 9.9-CHLA-2	LC 9.9-CHLA-3	LC 9.9-CHLA-4	LC 9.9-CHLA-5	RDL	QC Batch
Parameter									
Chlorophyll a	ug/cm2	0.417	0.136	0.202	0.139	0.140	0.097	0.030	8381932

RDL = Reportable Detection Limit

Maxxam ID		PJ3340			PJ3354	PJ3355	PJ3356	PJ3357		
Sampling Date		2016/08/21 13:00			2016/08/20 12:00	2016/08/20 12:00	2016/08/20 12:00	2016/08/20 12:00		
COC Number		08426771			08426772	08426772	08426772	08426772		
	UNITS	LC 9.9-CHLA-6	RDL	QC Batch	LA 4.8-CHLA-1	LA 4.8-CHLA-2	LA 4.8-CHLA-3	LA 4.8-CHLA-4	RDL	QC Batch
Parameter										
Chlorophyll a	ug/cm2	0.095	0.030	8381932	1.06 (1)	0.728 (1)	0.808 (1)	1.08 (1)	0.060	8384179

RDL = Reportable Detection Limit
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam ID		PJ3358	PJ3359	PJ3360	PJ3361	PJ3362	PJ3363		
Sampling Date		2016/08/20 12:00	2016/08/20 12:00	2016/08/20 13:00	2016/08/20 13:00	2016/08/20 13:00	2016/08/20 13:00		
COC Number		08426772	08426772	08426772	08426772	08426772	08426772		
	UNITS	LA 4.8-CHLA-5	LA 4.8-CHLA-6	HF 6.3-CHLA-1	HF 6.3-CHLA-2	HF 6.3-CHLA-3	HF 6.3-CHLA-4	RDL	QC Batch
Parameter									
Chlorophyll a	ug/cm2	0.267	0.474	0.192	0.118	0.133	0.638	0.030	8384179

RDL = Reportable Detection Limit

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Maxxam Job #: B673220
Report Date: 2016/09/02

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: JT

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		PJ3370	PJ3371	PJ3372	PJ3373	PJ3374		
Sampling Date		2016/08/20 13:00	2016/08/20 13:00	2016/08/21 14:00	2016/08/21 14:00	2016/08/21 14:00		
COC Number		08426773	08426773	08426773	08426773	08426773		
	UNITS	HF 6.3-CHLA-5	HF 6.3-CHLA-6	CF 10.0-CHLA-1	CF 10.0-CHLA-2	CF 10.0-CHLA-3	RDL	QC Batch
Parameter								
Chlorophyll a	ug/cm2	0.524	0.182	0.072	0.213	0.476	0.030	8384179

RDL = Reportable Detection Limit

Maxxam ID		PJ3375	PJ3376		PJ3377		PJ3378	PJ3379		
Sampling Date		2016/08/21 14:00	2016/08/21 14:00		2016/08/21 14:00		2016/08/21 15:00	2016/08/21 15:00		
COC Number		08426773	08426773		08426773		08426773	08426773		
	UNITS	CF 10.0-CHLA-4	CF 10.0-CHLA-5	RDL	CF 10.0-CHLA-6	RDL	LC 2.7-CHLA-1	LC 2.7-CHLA-2	RDL	QC Batch
Parameter										
Chlorophyll a	ug/cm2	0.637	0.663	0.030	1.35 (1)	0.060	0.205	0.107	0.030	8384179

RDL = Reportable Detection Limit
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam ID		PJ3381	PJ3382	PJ3383	PJ3384		PJ3385		
Sampling Date		2016/08/21 15:00	2016/08/21 15:00	2016/08/21 15:00	2016/08/21 15:00		2016/08/21 16:00		
COC Number		08426774	08426774	08426774	08426774		08426774		
	UNITS	LC 2.7-CHLA-3	LC 2.7-CHLA-4	LC 2.7-CHLA-5	LC 2.7-CHLA-6	RDL	CF 3.9-CHLA-1	RDL	QC Batch
Parameter									
Chlorophyll a	ug/cm2	0.191	0.452	0.240	0.390	0.030	1.07 (1)	0.060	8384182

RDL = Reportable Detection Limit
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam ID		PJ3386	PJ3387		PJ3388		PJ3389	PJ3390		
Sampling Date		2016/08/21 16:00	2016/08/21 16:00		2016/08/21 16:00		2016/08/21 16:00	2016/08/21 16:00		
COC Number		08426774	08426774		08426774		08426774	08426774		
	UNITS	CF 3.9-CHLA-2	CF 3.9-CHLA-3	RDL	CF 3.9-CHLA-4	RDL	CF 3.9-CHLA-5	CF 3.9-CHLA-6	RDL	QC Batch
Parameter										
Chlorophyll a	ug/cm2	1.30 (1)	0.772 (1)	0.060	0.647	0.030	0.678 (1)	0.785 (1)	0.060	8384182

RDL = Reportable Detection Limit
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

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Maxxam Job #: B673220
Report Date: 2016/09/02

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: JT

GENERAL COMMENTS

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B673220
Report Date: 2016/09/02

QUALITY ASSURANCE REPORT

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: JT

			Spiked Blank		Method Blank	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**Value**	**UNITS**
8381929	Chlorophyll a	2016/08/30	104	80 - 120	<0.030	ug/cm2
8381932	Chlorophyll a	2016/08/30	111	80 - 120	<0.030	ug/cm2
8384179	Chlorophyll a	2016/09/01	107	80 - 120	<0.030	ug/cm2
8384182	Chlorophyll a	2016/09/01	110	80 - 120	<0.030	ug/cm2

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

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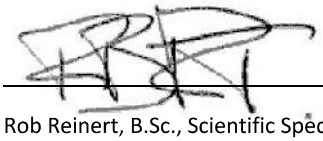
Maxxam Job #: B673220
Report Date: 2016/09/02

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: JT

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Rob Reinert, B.Sc., Scientific Specialist

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CHAIN OF CUSTODY RECORD

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

COC 08426768

BBY FCD-00077/05

Page 1 of 6

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)		Turnaround Time (TAT) Required
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053	[X] Regular TAT 5 days (Most analyses)
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102	Rush TAT (Surcharges will be applied)
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek	[ ] Same Day [ ] 2 Days [ ] 1 Day [ ] 3 Days
Phone:	867-393-4882	Phone:	867-393-4882	Site #:		
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com,	Sampled By:	J. Taylor / J. Duncan	Date Required:
						Rush Confirmation #:

Regulatory Criteria

[ ] BC CSR Soil [ ] BC CSR Water
[ ] CCME (Specify) [ ] Other (Specify)
[ ] Drinking Water [ ] BC Water Quality

Special Instructions

[ ] Return Cooler
[ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

BTEX/VPH [ ] VOC/VPH [ ] MTBE [ ] TEH [ ] EPH [ ] LEPH/HEPH [ ] PAH [ ] F2 - F4 [ ] BTEX/ F1 [ ] CCME-PHC [ ] Filtered? [ ] Preserved? [ ] Dissolved Metals [ ] Filtered? [ ] Preserved? [ ] Dissolved Mercury [ ] Field Preserved? [ ] Total Metals [ ] Field Preserved? [ ] Total Mercury [ ] Chloride [ ] Fluoride [ ] Sulphate [ ] TSS [ ] TDS [ ] BOD [ ] COD [ ] pH [ ] Conductivity [ ] Alkalinity [ ] Nitrite [ ] Nitrate [ ] Ammonia

chlorophyll a

OF CONTAINERS SUBMITTED

HOLD - DO NOT ANALYZE

LABORATORY USE ONLY

CUSTODY SEAL Y / N — Present / Intact

COOLER TEMPERATURES: 3.22

COOLING MEDIA PRESENT Y / N

COMMENTS

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	chlorophyll a	COMMENTS
1	YTO.2-chla-1		2016/08/23	12:00		✓	in same ziploch YTO.2
2	YTO.2-chla-2		2016/08/23			✓	
3	YTO.2-chla-3		2016/08/23			✓	
4	YT-0.2-chla-4		2016/08/23			✓	
5	YT-0.2-chla-5		2016/08/23			✓	
6	YT-0.2-chla-6		2016/08/23			✓	
7	HF0.2-chla-1		2016/08/23	13:00		✓	same ziplock HFO.2
8	HF0.2-chla-2		2016/08/23			✓	
9	HF0.2-chla-3		2016/08/23			✓	
10	HF 0.2-chla-4		2016/08/23			✓	

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
L. Doetzel	2016/08/25	14:00	Laurel Heather	2016/08/26	13:50

B673220_COC

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Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

CO[illegible] 08426769

BBY FCD-00077/05
Page 2 of 6

Invoice Information		Report Information (if differs from invoice)		Project Information (wh[illegible]		[illegible]round Time (TAT) Required
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053	[x] Regular TAT 5 days (Most analyses)
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102	Rush TAT (Surcharges will be applied)
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek	[ ] Same Day [ ] 2 Days
Phone:	867-393-4882	Phone:	867-393-4882	Site #:		[ ] 1 Day [ ] 3 Days
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com	Sampled By:	J. Taylor / J. Duncan	Date Required:
						Rush Confirmation #:

Regulatory Criteria

- [ ] BC CSR Soil
- [ ] BC CSR Water
- [ ] CCME (Specify)
- [ ] Other (Specify)
- [ ] Drinking Water
- [ ] BC Water Quality

Special Instructions

- [ ] Return Cooler
- [ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH ☐ MTBE ☐ VOC/VPH ☐	EPH ☐ TEH ☐	PAH ☐ LEPH/HEPH ☐	CCME-PHC BTEX/ F1 ☐ F2 - F4 ☐	Dissolved Metals Filtered? ☐ Preserved? ☐	Dissolved Mercury Filtered? ☐ Preserved? ☐	Total Metals Field Preserved? ☐	Total Mercury Field Preserved? ☐	Chloride ☐ Fluoride ☐ Sulphate ☐	TSS ☐ TDS ☐ BOD ☐ COD ☐	pH ☐ Conductivity ☐ Alkalinity ☐	Nitrite ☐ Nitrate ☐ Ammonia ☐	chlorophyll a				# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE	COMMENTS
1	HF-0.2-chla-5		2016/08/23	13:00														✓						ziplock labelled HF0.2
2	HF0.2-chla-6		2016/08/23	13:00														✓						
3	IC1.9-chla-1		2016/08/20	12:00														✓						Same ziplock IC1.9
4	IC1.9-chla-2		2016/08/20	↓														✓						
5	IC1.9-chla 3		2016/08/20															✓						
6	IC1.9-chla 4		2016/08/20															✓						
7	IC1.9-chla-5		2016/08/20															✓						
8	IC1.9-chla-6		2016/08/20	↓														✓						
9	YT5.0-chla-1		2016/08/21	12:00														✓						↓
10	YT5.0-chla-2		2016/08/21	12:00														✓						

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
1A		3.22

COOLING MEDIA PRESENT Y / N

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
L Doetzel / [signature]	2016/08/25	14:00	[signature] Laurel Berthier	2016/08/26	13:50

B673220_COC

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CHAIN OF CUSTODY RECORD

COC: 08426771

BBY FCD-00077/05
Page 3 of 6

Invoice Information		Report Information (if differs from invoice)		Project Information (when		und Time (TAT) Required
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053	[x] Regular TAT 5 days (Most analyses)
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102	Rush TAT (Surcharges will be applied)
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek	[ ] Same Day [ ] 2 Days
Phone:	867-393-4882	Phone:	867-393-4882	Site #:		[ ] 1 Day [ ] 3 Days
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com,	Sampled By:	J. Taylor / J. Duncan	Date Required:

Regulatory Criteria

- [ ] BC CSR Soil
- [ ] BC CSR Water
- [ ] CCME (Specify)
- [ ] Other (Specify)
- [ ] Drinking Water
- [ ] BC Water Quality

Special Instructions

- [ ] Return Cooler
- [ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

Rush Confirmation #:

LABORATORY USE ONLY

CUSTODY SEAL Y / N (Y circled) Present	Intact	COOLER TEMPERATURES
VA		3.22

COOLING MEDIA PRESENT Y / N (Y circled)

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH ☐ MTBE ☐ VOC/VPH ☐	EPH ☐ TEH ☐	PAH ☐ LEPH/HEPH ☐	CCME-PHC BTEX/ F1 ☐ F2 - F4 ☐	Dissolved Metals Filtered? ☐ Preserved? ☐	Dissolved Mercury Filtered? ☐ Preserved? ☐	Total Metals Field Preserved? ☐	Total Mercury Field Preserved? ☐	Chloride ☐ Fluoride ☐ Sulphate ☐	TSS ☐ TDS ☐ BOD ☐ COD ☐	pH ☐ Conductivity ☐ Alkalinity ☐	Nitrite ☐ Nitrate ☐ Ammonia ☐	chlorophyll a				# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE	COMMENTS
1	YT5.0-chla-3		2016/08/21	12:00														✓						same ziplock YT5.0
2	YT5.0-chla-4		2016/08/21	↓														✓						
3	YT5.0-chla-5		2016/08/21	↓														✓						
4	YT5.0-chla-6		2016/08/21	↓														✓						
5	LC9.9-chla-1		2016/08/21	13:00														✓						Same ziplock LC9.9
6	LC9.9-chla-2		2016/08/21	↓														✓						
7	LC9.9-chla-3		2016/08/21	↓														✓						
8	LC9.9-chla-4		2016/08/21	↓														✓						
9	LC9.9-chla-5		2016/08/21	↓														✓						
10	LC9.9-chla-6		2016/08/21	↓														✓						

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
L. Doetzel [signature]	2016/08/25	14:00	[signature]	2016/08/26	13:50

B673220_COC

Maxxam
A Bureau Veritas Group Company

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

COC #: 08426772

BBY FCD-00077/05
Page 4 of 6

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)		Turnaround Time (TAT) Required
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053	[x] Regular TAT 5 days (Most analyses)
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102	Rush TAT (Surcharges will be applied)
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek	[ ] Same Day [ ] 2 Days
Phone:	867-393-4882	Phone:	867-393-4882	Site #:		[ ] 1 Day [ ] 3 Days
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com,	Sampled By:	J. Taylor / J. Duncan	Date Required:
						Rush Confirmation #:

Regulatory Criteria

- [ ] BC CSR Soil
- [ ] BC CSR Water
- [ ] CCME (Specify)
- [ ] Other (Specify)
- [ ] Drinking Water
- [ ] BC Water Quality

Special Instructions

- [ ] Return Cooler
- [ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH ☐ MTBE ☐ VOC/VPH ☐	EPH ☐ TEH ☐	PAH ☐ LEPH/HEPH ☐	CCME-PHC BTEX/F1 ☐ F2 - F4 ☐	Dissolved Metals Filtered? ☐ Preserved? ☐	Dissolved Mercury Filtered? ☐ Preserved? ☐	Total Metals Field Preserved? ☐	Total Mercury Field Preserved? ☐	Chloride ☐ Fluoride ☐ Sulphate ☐	TSS ☐ TDS ☐ BOD ☐ COD ☐	pH ☐ Conductivity ☐ Alkalinity ☐	Nitrite ☐ Nitrate ☐ Ammonia ☐	chlorophyll a				# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE	COMMENTS
1	LA 4.8-chla-1		2016/08/20	12:00														✓						same ziplock LA4.8
2	LA4.8-chla-2		2016/08/20	↓														✓						
3	LA4.8-chla-3		2016/08/20															✓						
4	LA 4.8-chla-4		2016/08/20															✓						
5	LA4.8-chla-5		2016/08/20															✓						
6	LA4.8-chla-6		2016/08/20	↓														✓						
7	HF6.3-chla-1		2016/08/20	13:00														✓						same ziplock HF6.3
8	HF6.3-chla-2		2016/08/20	↓														✓						
9	HF6.3-chla-3		2016/08/20															✓						
10	HF6.3 chla-4		2016/08/20	↓														✓						

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
NA		3,2,2

COOLING MEDIA PRESENT Y / N

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
L. Doetzel / [signature]	2016/08/25	14:00	[signature] Laurel Berthier	2016/08/26	13:50

B673220_COC

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Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

COC # 08426773

BBY FCD-00077/05
Page 5 of 6

Invoice Information		Report Information (if differs from invoice)		Project Information (where ...		...nd Time (TAT) Required
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053	[x] Regular TAT 5 days (Most analyses)
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102	Rush TAT (Surcharges will be applied)
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek	[ ] Same Day [ ] 2 Days
Phone:	867-393-4882	Phone:	867-393-4882	Site #:		[ ] 1 Day [ ] 3 Days
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com,	Sampled By:	J. Taylor / J. Duncan	Date Required:
						Rush Confirmation #:

Regulatory Criteria

- [ ] BC CSR Soil
- [ ] BC CSR Water
- [ ] CCME (Specify)
- [ ] Other (Specify)
- [ ] Drinking Water
- [ ] BC Water Quality

Special Instructions

- [ ] Return Cooler
- [ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH ☐ MTBE ☐ VOC/VPH ☐	EPH ☐ TEH ☐	PAH ☐ LEPH/HEPH ☐	CCME-PHC BTEX/F1 ☐ F2 - F4 ☐	Dissolved Metals Filtered? ☐ Preserved? ☐	Dissolved Mercury Filtered? ☐ Preserved? ☐	Total Metals Field Preserved? ☐	Total Mercury Field Preserved? ☐	Chloride ☐ Fluoride ☐ Sulphate ☐	TSS ☐ TDS ☐ BOD ☐ COD ☐	pH ☐ Conductivity ☐ Alkalinity ☐	Nitrite ☐ Nitrate ☐ Ammonia ☐	chlorophyll a				# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE	COMMENTS
1	HF6.3-chla-5		2016/08/20	13:00														✓						same zoploch HF6.3
2	HF6.3-chla-6		2016/08/20	13:00														✓						
3	CF10.0-chla-1		2016/08/21	14:00														✓						same zoploch CF10.0
4	CF10.0-chla-2		2016/08/21	↓														✓						
5	CF10.0-chla-3		2016/08/21															✓						
6	CF10.0-chla-4		2016/08/21															✓						
7	CF10.0-chla-5		2016/08/21															✓						
8	CF10.0-chla-6		2016/08/21															✓						
9	LC2.7-chla-1		2016/08/21	15:00														✓						↓ see order
10	LC2.7-chla-2		2016/08/21	15:00														✓						

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
NA		3.22

COOLING MEDIA PRESENT Y / N

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
L. Doetzel / [signature]	2016/08/25	14:00	[signature] Laurel Berthier	2016/08/26	13:50

B673220_COC

Maxxam
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Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

CO 08426774

BBY FCD-00077/05
Page 6 of 6

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)		Round Time (TAT) Required
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053	[x] Regular TAT 5 days (Most analyses)
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102	Rush TAT (Surcharges will be applied)
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek	[ ] Same Day [ ] 2 Days
Phone:	867-393-4882	Phone:	867-393-4882	Site #:		[ ] 1 Day [ ] 3 Days
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com,	Sampled By:	J. Taylor / J. Duncan	Date Required:

Rush Confirmation #:

Regulatory Criteria

- [ ] BC CSR Soil
- [ ] BC CSR Water
- [ ] CCME (Specify)
- [ ] Other (Specify)
- [ ] Drinking Water
- [ ] BC Water Quality

Special Instructions

- [ ] Return Cooler
- [ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH ☐ MTBE ☐ VOC/VPH ☐	EPH ☐ TEH ☐	PAH ☐ LEPH/HEPH ☐	CCME-PHC BTEX/F1 ☐ F2 - F4 ☐	Dissolved Metals Filtered? ☐ Preserved? ☐	Dissolved Mercury Filtered? ☐ Preserved? ☐	Total Metals Field Preserved? ☐	Total Mercury Field Preserved? ☐	Chloride ☐ Fluoride ☐ Sulphate ☐	TSS ☐ TDS ☐ BOD ☐ COD ☐	pH ☐ Conductivity ☐ Alkalinity ☐	Nitrite ☐ Nitrate ☐ Ammonia ☐	chlorophyll a				# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	LC2.7-chla-3		2016/08/21	15:00														✓					
2	LC2.7-chla-4		2016/08/21	↓														✓					
3	LC2.7-chla-5		2016/08/21	↓														✓					
4	LC2.7-chla-6		2016/08/21	↓														✓					
5	CF3.9-chla-1		2016/08/21	16:00														✓					
6	CF3.9-chla-2		2016/08/21	↓														✓					
7	CF3.9-chla-3		2016/08/21	↓														✓					
8	CF3.9-chla-4		2016/08/21	↓														✓					
9	CF3.9-chla-5		2016/08/21	↓														✓					
10	CF3.9-chla-6		2016/08/21	↓														✓					

Sample 2 of 10 LC2.7

Sample 2 of 10 CF3.9

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
NA		3.22

COOLING MEDIA PRESENT Y / N

COMMENTS

RECEIVED IN WHITEHORSE
BY: Suyano @ 14:15
2016-08-25
TEMP: 0 / / / /

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
L. Doetzel / [signature]	2016/08/25	14:00	Laurel Berthier	2016/08/26	13:50

B673220_COC

APPENDIX E. 2016 FISH AND BENTHIC INVERTEBRATE TISSUE METALS DATA

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Table E1. Benthic invertebrate and fish tissue metals data; 2014 - 2016.

Sample ID	Watercourse	SSID - old	SSID new	Species[1]	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
CF 10.0-B1-1	Coffee	--	CF10.0	BI	20-Aug-16	-	3.5	-	whole body	83	mg/kg ww	687	0.0718	0.855	15.2	0.0197	<0.020	<0.40	0.425	821	0.92	0.749	4.11	1210	0.293	414	75.3
CF 3.9-B1-1	Coffee	--	CF3.9	BI	20-Aug-16	-	3.5	-	whole body	86	mg/kg ww	1880	0.0805	1.98	37.4	0.0497	<0.020	<0.40	0.259	1130	2.05	1.83	3.98	3980	0.692	1070	142
CC4.5-BI-1	Coffee	--	CF2.7	BI	4-Mar-16	-	1.3	-	whole body	71	µg/g ww	3820	0.14	5.54	112	0.116	<0.10	<2.0	0.135	1450	10.5	4.16	7.26	9420	5.29	2350	317
CC4.5-BI-2	Coffee	--	CF2.7	BI	4-Mar-16	-	3.4	-	whole body	70	µg/g ww	3840	0.0995	4.03	139	0.119	<0.040	<0.80	0.158	1710	6.78	3.67	7.44	9050	1.54	2380	285
CC4.5-BI-3	Coffee	--	CF2.7	BI	5-Mar-16	-	2.5	-	whole body	81	µg/g ww	3370	0.0696	3.84	100	0.101	<0.040	<0.80	0.142	1540	5.69	3.73	6.48	8510	1.17	2280	265
CC4.5-BI-4	Coffee	--	CF2.7	BI	5-Mar-16	-	2.2	-	whole body	73	µg/g ww	3420	0.0907	3.52	112	0.104	<0.060	<1.2	0.197	1900	6.56	3.57	6.78	8670	1.56	2370	290
CC4.5-BI-5	Coffee	--	CF2.7	BI	5-Mar-16	-	1.3	-	whole body	78	µg/g ww	2240	0.065	3.78	74.8	0.097	<0.20	<4.0	0.144	2110	2.88	2.11	5.97	5270	0.967	1240	171
CC4.5-BI-6	Coffee	--	CF2.7	BI	5-Mar-16	-	2.0	-	whole body	72	µg/g ww	3730	0.126	5.12	172	0.126	<0.060	<1.2	0.237	2320	5.32	4.15	8.05	10300	5.12	2510	473
CCM-BI-1	Coffee	--	CF0.5	BI	5-Mar-16	-	2.0	-	whole body	80	µg/g ww	2000	0.116	3.06	107	0.0868	<0.060	<1.2	0.23	2460	3.68	2.25	7.61	5550	4.13	1510	231
HF 0.2-B1-1	Halfway	--	HF0.2	BI	23-Aug-16	-	2.5	-	whole body	90	mg/kg ww	423	0.0918	0.902	6.58	0.019	<0.020	<0.40	0.0955	534	1.12	0.386	3.01	698	0.187	339	31.1
HF 0.2-B1-2	Halfway	--	HF0.2	BI	23-Aug-16	-	2.7	-	whole body	88	mg/kg ww	222	0.0887	0.596	9.15	0.02	<0.020	<0.40	0.104	855	0.495	0.336	3.4	457	0.151	254	44.7
HF 6.3-B1-1	Halfway	--	HF6.3	BI	20-Aug-16	-	2.6	-	whole body	88	mg/kg ww	384	0.0923	0.805	5.91	0.0163	<0.020	<0.40	0.131	380	0.653	0.273	2.03	523	0.161	242	29.8
IC 1.9-B1-1	Independence	--	ID1.9	BI	20-Aug-16	-	2.5	-	whole body	88	mg/kg ww	1270	0.0657	1.57	18.1	0.0431	<0.020	<0.40	0.187	573	2.47	1.14	3.2	2330	0.697	791	87.3
IC4.5-BI-1	Independence	--	ID4.5	BI	4-Mar-16	-	0.6	-	whole body	67	µg/g ww	1780	0.036	2.5	42.5	0.055	<0.24	<4.8	0.171	1890	3.62	1.99	6.32	4340	0.924	1340	159
LAC 4.8-B1-1	Los Angeles	--	LaC4.8	BI	20-Aug-16	-	2.2	-	whole body	89	mg/kg ww	223	0.0538	0.478	8.59	0.0153	<0.020	0.43	0.0836	414	2.2	0.478	3.07	675	0.181	392	67
LAC 4.8-B1-2	Los Angeles	--	LaC4.8	BI	20-Aug-16	-	2.9	-	whole body	92	mg/kg ww	535	0.0632	1.88	20.9	0.0441	<0.020	0.4	0.135	796	1.82	1.17	3.85	1920	0.505	444	126
LC 2.7-B1-1	Latte	--	LC2.7	BI	21-Aug-16	-	2.6	-	whole body	90	mg/kg ww	400	0.0302	0.563	5.56	0.0191	<0.020	<0.40	0.185	518	0.586	0.361	2.54	613	0.218	250	43.2
LC 9.9-B1-1	Latte	--	LC9.9	BI	21-Aug-16	-	2.4	-	whole body	87	mg/kg ww	447	0.0607	0.837	5.86	0.0209	<0.020	<0.40	0.067	435	0.655	0.291	2.14	921	0.286	246	40.2
YT 0.2-B1-1	YT-24	--	YT0.2	BI	23-Aug-16	-	2.8	-	whole body	88	mg/kg ww	359	0.0466	0.48	5.45	0.017	<0.020	<0.40	0.069	433	0.565	0.335	2.73	622	0.251	278	37.1
YT 5.0-B1-1	YT-24	--	YT5.0	BI	21-Aug-16	-	2.1	-	whole body	89	mg/kg ww	352	0.1	0.674	12.1	0.0159	<0.020	<0.40	0.088	471	0.539	0.462	1.78	564	0.229	215	41.1
CC997-CCG-1	Coffee	CC997	CF10.0	CCG	4-Mar-16	69	2.6	-	whole body	75	µg/g ww	1.17	0.0023	0.0854	3.36	<0.0020	<0.020	<0.40	0.0265	17500	0.02	0.0511	1.18	30.9	0.011	525	8.19
CC4.5-CCG-1	Coffee	CC4.5	CF2.3	CCG	4-Mar-16	85	7.1	-	whole body	78	µg/g ww	5.2	0.0011	0.0451	2.48	<0.0020	<0.020	<0.40	0.0121	11200	0.023	0.018	0.736	16.8	0.0077	343	4.15
CC4.5-CCG-2	Coffee	CC4.5	CF2.3	CCG	4-Mar-16	70	4.2	-	whole body	81	µg/g ww	1.63	<0.0010	0.0477	3.26	<0.0020	<0.020	<0.40	0.0789	14100	0.01	0.0232	1.14	16	0.0097	402	9.29
CC4.5-CCG-3	Coffee	CC4.5	CF2.3	CCG	4-Mar-16	84	7.1	-	whole body	80	µg/g ww	1.58	0.0011	0.0432	4.35	<0.0020	<0.020	<0.40	0.0221	21100	0.014	0.0235	0.789	20.1	0.0067	477	8.43
CC4.5-CCG-4	Coffee	CC4.5	CF2.3	CCG	4-Mar-16	-	6.5	-	whole body	76	µg/g ww	4.7	0.0014	0.0687	4.59	<0.0020	<0.020	<0.40	0.0909	17900	0.019	0.0273	1.01	19.8	0.0098	438	11.8
CC4.5BI-CCG-1	Coffee	CC4.5	CF2.3	CCG	4-Mar-16	-	0.4	-	whole body	72.1	µg/g ww	32.1	<0.0020	0.082	3.7	<0.0040	<0.040	<0.80	0.0244	12400	0.066	0.0561	1.27	87.2	0.021	369	6.67
0-219	Coffee	AQ02	CF8.0	CCG	27-Aug-2014	97	10.2	3	whole body, no head	67.6	µg/g ww	5.5	0.005	0.041	0.53	<0.002	<0.02	<0.1	0.011	2960	0.01	0.016	0.46	18	<0.004	282	1.28
0-220	Coffee	AQ02	CF8.0	CCG	27-Aug-2014	90	7	3	whole body, no head	76.0	µg/g ww	2	0.006	0.057	1.09	<0.002	<0.02	<0.1	0.005	7620	0.01	0.01	0.56	11	<0.004	337	2.66
0-221	Coffee	AQ02	CF8.0	CCG	27-Aug-2014	81	5.2	2	whole body, no head	74.9	µg/g ww	2.9	0.006	0.067	0.92	<0.002	<0.02	<0.1	0.006	6560	0.01	0.009	0.58	12	0.007	331	1.77
0-222	Coffee	AQ02	CF8.0	CCG	27-Aug-2014	68	3.2	1	whole body, no head	73.3	µg/g ww	8.5	0.005	0.082	0.91	<0.002	<0.02	<0.1	0.01	5190	0.02	0.012	0.5	21	0.009	312	3.35
0-255	Coffee	AQ02	CF8.0	CCG	28-Aug-2014	112	16.1	4	whole body, no head	73.8	µg/g ww	4.9	0.029	0.074	3.91	<0.002	<0.02	0.1	0.017	21900	0.02	0.019	0.68	23	0.008	469	8.82
0-256	Coffee	AQ02	CF8.0	CCG	28-Aug-2014	101	13.8	4	whole body, no head	72.7	µg/g ww	2.2	0.032	0.062	1.08	<0.002	<0.02	0.1	0.003	7420	0.01	0.01	0.47	12	0.008	299	2.99
0-257	Coffee	AQ02	CF8.0	CCG	28-Aug-2014	95	9.8	2	whole body, no head	76.3	µg/g ww	8.2	0.053	0.058	0.55	<0.002	<0.02	<0.1	0.039	2420	0.03	0.012	0.72	25	0.03	266	1.49
0-258	Coffee	AQ02	CF8.0	CCG	28-Aug-2014	96	9.7	5	whole body, no head	72.9	µg/g ww	20.4	0.025	0.096	2.93	<0.002	<0.02	<0.1	0.077	16100	0.05	0.03	1.21	56	0.022	350	7.17
0-259	Coffee	AQ02	CF8.0	CCG	28-Aug-2014	90	7.8	2	whole body, no head	70.1	µg/g ww	13.9	0.038	0.082	2.3	<0.002	<0.02	<0.1	0.015	10200	0.05	0.017	0.62	31	0.02	321	5.06
94	Coffee	AQ02	CF8.0	CCG	27-Jul-2015	90	8.2	4	whole body, no head	73.8	µg/g ww	112	0.017	0.164	3.54	0.002	<0.02	0.4	0.057	7410	0.3	0.105	1.26	154	0.036	412	14.6
96	Coffee	AQ02	CF8.0	CCG	27-Jul-2015	90	16.9	4	whole body, no head	72.1	µg/g ww	2.7	0.003	0.073	1.51	<0.002	<0.02	0.4	0.013	6320	<0.01	0.016	0.69	12	<0.004	362	2.89
102	Coffee	AQ02	CF8.0	CCG	27-Jul-2015	94	9	7	whole body, no head	72.1	µg/g ww	37.6	0.012	0.118	3.01	<0.002	<0.02	0.3	0.038	8670	0.1	0.054	0.97	58	0.014	409	7.99
CC0.5-CCG-2	Coffee	CC0.5	CF8.3	CCG	4-Mar-16	66	2.3	-	whole body	82	µg/g ww	3.79	<0.0020	0.058	3.06	<0.0040	<0.040	<0.80	0.0206	14600	<0.020	0.0264	1.44	21.9	0.0232	397	4.4

Sample ID	Watercourse	SSID - old	SSID new	Species[1]	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
CF10.0 1-1-A	Coffee	--	CF10.0	CCG	10-Jul-16	76	4	-	whole body	77	µg/g ww	32.6	0.0073	0.0906	3.26	<0.0020	<0.020	<0.40	0.054	11000	0.054	0.0563	1.13	63.6	0.0276	335	8.32
CF10.0 1-1-B	Coffee	--	CF10.0	CCG	10-Jul-16	79	4.6	-	whole body	79	µg/g ww	12.4	0.0074	0.0721	2.49	<0.0020	<0.020	<0.40	0.0279	11300	0.024	0.0318	0.884	31.5	0.0167	341	6.55
CF10.0 1-1-C	Coffee	--	CF10.0	CCG	10-Jul-16	50	1.3	-	whole body	79	µg/g ww	33.3	0.0349	0.122	4.36	<0.0020	<0.020	<0.40	0.073	15100	0.069	0.0705	1.17	68.2	0.172	405	9.14
CF10.0 1-1-D	Coffee	--	CF10.0	CCG	10-Jul-16	71	3.2	-	whole body	81	µg/g ww	12.8	0.011	0.0877	3.36	<0.0020	<0.020	<0.40	0.0395	13300	0.026	0.0478	0.836	34.5	0.0592	394	7.53
CF10.0 1-1-E	Coffee	--	CF10.0	CCG	10-Jul-16	74	3.6	-	whole body	81	µg/g ww	72	0.0083	0.115	3.54	<0.0020	<0.020	<0.40	0.0552	12000	0.104	0.0858	1.23	132	0.054	386	9.03
CF10.0-1-1-F	Coffee	--	CF10.0	CCG	10-Jul-16	54	1.5	-	whole body	86	µg/g ww	21.2	0.0124	0.0931	3.02	<0.0020	<0.020	<0.40	0.044	11300	0.046	0.0434	1.07	46.2	0.0777	371	7.68
CF10.0-1-1-G	Coffee	--	CF10.0	CCG	10-Jul-16	53	1.2	-	whole body	86	µg/g ww	36.8	0.0103	0.11	4.12	<0.0020	<0.020	<0.40	0.0534	11100	0.171	0.058	0.767	70.7	0.0546	334	7.56
CF10.0 1-1-H	Coffee	--	CF10.0	CCG	10-Jul-16	54	1.6	-	whole body	80	µg/g ww	82.6	0.0122	0.117	4.34	<0.0020	<0.020	<0.40	0.092	11200	0.133	0.0883	1.29	134	0.0927	337	11.9
CF10.0 1-1-J	Coffee	--	CF10.0	CCG	10-Jul-16	55	1.5	-	whole body	87	µg/g ww	35.1	0.0129	0.0962	3.72	<0.0020	<0.020	<0.40	0.0519	10500	0.085	0.0666	0.982	65.5	0.259	351	8.26
CF10.0 1-1-I	Coffee	--	CF10.0	CCG	10-Jul-16	55	1.6	-	whole body	88	µg/g ww	54.4	0.0195	0.121	3.9	<0.0020	<0.020	<0.40	0.0713	11200	0.111	0.0703	1.11	95.4	0.119	371	8.53
CF 3.9 3-1-A	Coffee	--	CF3.9	CCG	11-Jul-16	66	3	-	whole body	79	µg/g ww	14.8	0.0156	0.118	3.59	<0.0020	<0.020	<0.40	0.23	14800	0.029	0.045	1.15	31.1	0.202	401	13.3
CF-3.9 3-1-B	Coffee	--	CF3.9	CCG	11-Jul-16	67	3.6	-	whole body	74	µg/g ww	41	0.0095	0.134	4.62	<0.0020	<0.020	<0.40	0.439	17800	0.064	0.0824	1.28	76.3	0.161	407	14
CF3.9 3-1-C	Coffee	--	CF3.9	CCG	11-Jul-16	84	5.8	-	whole body	77	µg/g ww	48.3	0.017	0.0929	3.9	<0.0020	<0.020	<0.40	0.0373	15200	0.075	0.0469	1.02	78.7	0.109	405	6.1
CF3.9 3-1-D	Coffee	--	CF3.9	CCG	11-Jul-16	67	2.9	-	whole body	82	µg/g ww	9.64	0.048	0.0847	2.28	<0.0020	<0.020	<0.40	0.0259	9700	0.019	0.0286	0.943	24.9	0.0721	331	4.61
CF3.9 3-1-E	Coffee	--	CF3.9	CCG	11-Jul-16	67	2.7	-	whole body	79	µg/g ww	28.8	0.0231	0.0928	3.01	<0.0020	<0.020	<0.40	0.039	12100	0.043	0.0497	0.854	54.7	0.122	351	6.88
CF3.9 3-1-F	Coffee	--	CF3.9	CCG	11-Jul-16	50	1.1	-	whole body	79	µg/g ww	70.8	0.0222	0.122	2.23	<0.0020	<0.020	<0.40	0.0573	5500	0.124	0.0704	1.01	110	0.0902	328	4.95
CF3.9 3-1-G	Coffee	--	CF3.9	CCG	11-Jul-16	50	1.2	-	whole body	86	µg/g ww	31.9	0.016	0.114	2.71	<0.0020	<0.020	<0.40	0.0393	11100	0.055	0.0427	0.816	56.5	0.113	360	5.07
CF3.9 3-1-H	Coffee	--	CF3.9	CCG	11-Jul-16	58	1.9	-	whole body	76	µg/g ww	29.4	0.0344	0.092	1.95	<0.0020	<0.020	<0.40	0.0283	6310	0.041	0.0367	0.774	51.4	0.0841	300	3.83
CF3.9 3-1-I	Coffee	--	CF3.9	CCG	11-Jul-16	55	1.5	-	whole body	91	µg/g ww	40.2	0.0706	0.116	3.27	<0.0020	<0.020	<0.40	0.0467	12400	0.063	0.0758	0.95	79.7	0.144	368	7.36
CF3.9 3-1-J	Coffee	--	CF3.9	CCG	11-Jul-16	46	0.8	-	whole body	79	µg/g ww	15.3	0.0292	0.103	2.33	<0.0020	<0.020	<0.40	0.0246	8530	0.029	0.0266	0.808	30.3	0.0953	391	4.98
R1-1	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	82	6.8	4	whole body, no head	72.7	µg/g ww	2.1	0.013	0.066	1.65	<0.002	<0.02	<0.1	0.007	6070	0.01	0.008	0.4	10	0.005	341	4.38
R1-2	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	81	5.4	3	whole body, no head	73.0	µg/g ww	11.7	0.033	0.07	4.56	<0.002	<0.02	<0.1	0.133	22900	0.05	0.04	0.93	36	0.018	451	9.12
R1-3	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	76	4.6	2	whole body, no head	72.5	µg/g ww	7.8	0.023	0.069	4.47	<0.002	<0.02	<0.1	0.214	21400	0.05	0.027	0.83	27	0.015	485	12
R1-4	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	68	3.5	2	whole body, no head	71.7	µg/g ww	4.6	0.027	0.085	4.13	<0.002	<0.02	0.2	0.225	18300	0.02	0.024	0.58	18	0.021	462	19
R1-5	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	68	2.7	3	whole body, no head	72.1	µg/g ww	11.2	0.02	0.087	2.94	<0.002	<0.02	0.2	0.281	14500	0.03	0.016	0.63	28	0.013	407	7.78
R1-6	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	59	2.7	2	whole body, no head	72.1	µg/g ww	10.7	0.019	0.1	2.71	<0.002	<0.02	0.2	0.173	14000	0.03	0.039	0.73	30	0.017	412	11.3
R1-7	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	63	2.4	2	whole body, no head	75.2	µg/g ww	15.3	0.017	0.077	2.7	<0.002	<0.02	0.2	0.144	10900	0.06	0.022	0.57	40	0.015	359	9.03
R1-8	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	63	3.2	3	whole body, no head	69.7	µg/g ww	27.3	0.078	0.191	4.04	<0.002	<0.02	0.2	0.036	11900	0.06	0.033	0.62	70	0.027	349	7.48
R1-9	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	62	2.8	-	whole body, no head	74.3	µg/g ww	14.9	0.016	0.095	3.89	<0.002	<0.02	0.2	0.416	15600	0.04	0.05	0.52	41	0.028	439	15.5
205	Isaac	AQREF1	IS0.1	CCG	28-Jul-2015	65	2.5	2	whole body, no head	72.1	µg/g ww	32.5	0.023	0.157	3.7	<0.008	<0.08	0.5	0.087	9010	0.13	0.038	0.73	57	0.024	417	8.48
206	Isaac	AQREF1	IS0.1	CCG	28-Jul-2015	63	2.1	2	whole body, no head	72.1	µg/g ww	19.4	0.036	0.396	3.71	<0.011	<0.11	<0.5	0.151	12800	0.17	0.053	0.73	104	0.088	455	13
207	Isaac	AQREF1	IS0.1	CCG	28-Jul-2015	63	2.3	1	whole body, no head	72.1	µg/g ww	3.6	<0.009	0.097	2.64	<0.009	<0.09	<0.5	0.141	8080	<0.05	0.024	0.53	10	<0.018	385	7.15
IC-1.9 2-1-A	Independence	--	ID1.9	CCG	12-Jul-16	52	1.7	-	whole body	78	µg/g ww	30.2	0.0083	0.117	4.3	<0.0020	<0.020	<0.40	0.184	15900	0.196	0.0793	1.13	96	0.0626	434	10.3
IC-1.9 2-1-B	Independence	--	ID1.9	CCG	12-Jul-16	57	2.4	-	whole body	76	µg/g ww	29.2	0.0075	0.117	2.82	<0.0020	<0.020	0.4	0.138	9190	0.048	0.0583	0.868	49.9	0.0646	300	7.84
IC-1.9 2-1-C	Independence	--	ID1.9	CCG	12-Jul-16	60	2.2	-	whole body	77	µg/g ww	29.7	0.0168	0.102	2.16	<0.0020	<0.020	<0.40	0.0825	8650	0.041	0.0461	1.09	47.3	0.0663	331	5.5
IC-1.9 3-1-D	Independence	--	ID1.9	CCG	12-Jul-16	45	1	-	whole body	80	µg/g ww	55.1	0.0176	0.11	2	<0.0020	<0.020	<0.40	0.0849	6600	0.114	0.0697	1.09	80.6	0.0935	337	6.01
IC-1.9 3-2-E	Independence	--	ID1.9	CCG	12-Jul-16	64	2.6	-	whole body	80	µg/g ww	46.2	0.0103	0.121	4.39	<0.0020	<0.020	<0.40	0.183	17700	0.087	0.0541	0.974	75.5	0.0751	463	12.9
IC-1.9 2-3-F	Independence	--	ID1.9	CCG	12-Jul-16	52	1.4	-	whole body	82	µg/g ww	38.6	0.0447	0.159	1.69	<0.0020	<0.020	<0.40	0.0405	7270	0.055	0.0462	0.917	74.5	0.0872	329	5.92
IC-1.9 1-1-G	Independence	--	ID1.9	CCG	12-Jul-16	81	6.5	-	whole body	81	µg/g ww	43.5	0.0095	0.141	3.88	<0.0020	<0.020	<0.40	0.187	14800	0.086	0.0485	0.903	71.5	0.1	387	7.14
IC-1.9 1-1-H	Independence	--	ID1.9	CCG	12-Jul-16	68	3.4	-	whole body	81	µg/g ww	37.9	0.0304	0.125	3.9	<0.0020	<0.020	<0.40	0.187	13200	0.069	0.0457	0.888	65.2	0.103	365	10.6

Sample ID	Watercourse	SSID - old	SSID new	Species[1]	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
IC-1.9 1-1-I	Independence	--	ID1.9	CCG	12-Jul-16	75	4.6	-	whole body	79	µg/g ww	58.1	0.007	0.122	3.27	<0.0020	<0.020	<0.40	0.114	10900	0.106	0.0602	1.1	90.4	0.0788	351	9.37
IC-1.9 1-1-J	Independence	--	ID1.9	CCG	12-Jul-16	65	3.5	-	whole body	77	µg/g ww	38.5	0.0073	0.113	3.07	<0.0020	<0.020	<0.40	0.249	10000	0.082	0.0532	0.882	61.8	0.0728	363	9
I-301	Independence	AQ10	ID1.9	CCG	28-Aug-2014	80	5.2	3	whole body, no head	74.5	µg/g ww	106	0.011	0.173	1.48	<0.002	<0.02	0.2	0.245	4650	0.25	0.079	1.79	174	0.063	285	7.24
I-302	Independence	AQ10	ID1.9	CCG	28-Aug-2014	84	6.8	4	whole body, no head	68.6	µg/g ww	3	0.008	0.077	1.76	<0.002	<0.02	0.2	0.053	12700	0.01	0.014	0.62	11	0.019	355	6.07
I-303	Independence	AQ10	ID1.9	CCG	28-Aug-2014	90	10.7	3	whole body, no head	68.2	µg/g ww	4.7	0.006	0.069	0.59	<0.002	<0.02	0.1	0.041	3250	0.02	0.011	0.47	14	0.007	270	2.02
I-304	Independence	AQ10	ID1.9	CCG	28-Aug-2014	80	7.6	4	whole body, no head	70.9	µg/g ww	26.4	0.007	0.097	3.83	<0.002	<0.02	0.1	0.184	23400	0.07	0.04	1.03	59	0.029	480	12.4
I-305	Independence	AQ10	ID1.9	CCG	28-Aug-2014	80	8.5	3	whole body, no head	71.3	µg/g ww	103	0.011	0.178	3.43	0.002	<0.02	0.1	0.191	16600	0.22	0.087	1.9	167	0.059	404	12.6
I-306	Independence	AQ10	ID1.9	CCG	28-Aug-2014	80	7.4	4	whole body, no head	71.6	µg/g ww	13.2	0.005	0.094	1.8	<0.002	<0.02	0.1	0.096	10400	0.04	0.032	0.72	35	0.034	333	6.86
I-307	Independence	AQ10	ID1.9	CCG	28-Aug-2014	75	5.6	2	whole body, no head	71.0	µg/g ww	14.3	0.007	0.089	2.11	<0.002	<0.02	<0.1	0.117	13200	0.04	0.026	0.65	31	0.019	355	11.7
I-308	Independence	AQ10	ID1.9	CCG	28-Aug-2014	75	4.8	4	whole body, no head	67.1	µg/g ww	6.5	0.009	0.108	1.83	<0.002	<0.02	0.1	0.05	11100	0.02	0.015	0.54	19	0.035	345	5.8
004	Independence	AQ10	ID1.9	CCG	15-Sep-2015	85	9.5	1	whole body, no head	72.1	µg/g ww	17.8	0.965	0.107	0.66	<0.005	<0.05	<0.2	0.072	1720	0.05	0.049	0.92	45	0.016	292	3.83
042	Los Angeles	AQREF2	LaC4.8	CCG	25-Jul-2015	125	24.4	5	whole body, no head	71.2	µg/g ww	49.7	0.019	0.216	3.24	<0.002	<0.02	0.3	0.111	12300	0.22	0.089	1.55	85	0.02	525	16.2
208	Latte	AQ03	LC0.5	CCG	29-Jul-2015	108	9.2	6	whole body, no head	72.1	µg/g ww	28.3	0.005	0.126	4.58	<0.002	<0.02	0.3	0.047	16200	0.08	0.047	1.12	48	0.016	440	14.4
219	Latte	AQ03	LC0.5	CCG	01-Aug-2015	80	5	1	whole body, no head	72.1	µg/g ww	30.6	0.068	0.149	2.1	<0.004	<0.04	0.3	0.059	8010	0.08	0.055	1.21	45	0.022	415	7.08
003	Latte	AQ03	LC0.5	CCG	12-Sep-2015	126	15.5	7	whole body, no head	72.1	µg/g ww	31.8	0.182	0.119	4	<0.005	<0.05	<0.2	0.045	17700	0.07	0.05	1.01	69	0.022	546	9.51
CCM-CH-1	Coffee	CCM	CF0.5	CH	5-Mar-16	84	5.1	-	whole body	78	µg/g ww	1.46	<0.0020	0.022	1.08	<0.0040	<0.040	<0.80	0.0243	5920	0.048	0.0172	0.599	18.3	0.0048	299	1.49
CCM-CH-2	Coffee	CCM	CF0.5	CH	4-Mar-16	75	3.9	-	whole body	77	µg/g ww	1.61	<0.0020	0.031	1.92	<0.0040	<0.040	<0.80	0.0205	8080	<0.020	0.0383	0.675	19.7	0.0136	332	2.55
CCM-CH-3	Coffee	CCM	CF0.5	CH	5-Mar-16	72	3.2	-	whole body	78	µg/g ww	2.39	<0.0020	0.027	1.21	<0.0040	<0.040	<0.80	0.0645	5130	0.254	0.0253	0.713	17.9	0.0072	289	1.52
CC4.5-CH-1	Coffee	CC4.5	CF2.3	CH	4-Mar-16	75	3.8	-	whole body	77	µg/g ww	2.18	0.0023	0.033	2.55	<0.0040	<0.040	<0.80	0.0204	7990	0.044	0.0374	0.767	29.7	0.0274	360	2.57
CC4.5-CH-2	Coffee	CC4.5	CF2.3	CH	5-Mar-16	81	3.8	-	whole body	82	µg/g ww	1.54	<0.0020	0.03	1.72	<0.0040	<0.040	<0.80	0.016	7550	0.023	0.0302	0.666	23.8	0.0057	310	1.9
CC4.5-CH-3	Coffee	CC4.5	CF2.3	CH	4-Mar-16	70	3.5	-	whole body	59	µg/g ww	24.7	0.0024	0.054	1.86	<0.0040	<0.040	<0.80	0.0159	6630	0.071	0.058	0.851	60.6	0.0195	320	4.07
HF 0.2-CS-1	Halfway	--	HF0.2	CH	23-Aug-16	69	3.2	-	whole body	76	mg/kg ww	10	0.0085	0.036	1.16	<0.0020	<0.020	<0.40	0.0255	4230	0.023	0.0213	0.79	23.8	0.0083	302	1.54
HF 0.2-CS-2	Halfway	--	HF0.2	CH	23-Aug-16	77	4.0	-	whole body	78	mg/kg ww	25.6	0.0061	0.0561	0.873	<0.0020	<0.020	<0.40	0.0358	3650	0.256	0.048	0.676	47.6	0.01	317	2.58
HF 0.2-CS-3	Halfway	--	HF0.2	CH	23-Aug-16	70	3.3	-	whole body	79	mg/kg ww	1.24	0.0067	0.0365	0.776	<0.0020	<0.020	<0.40	0.0122	3960	<0.010	0.0183	0.599	10.8	0.0035	318	1.28
HF 0.2-CS-4	Halfway	--	HF0.2	CH	23-Aug-16	82	4.5	-	whole body	76	mg/kg ww	2.79	0.0102	0.039	0.911	<0.0040	<0.040	<0.80	0.0196	4550	<0.020	0.0476	0.66	11.8	0.0048	341	1.49
HF 0.2-CS-5	Halfway	--	HF0.2	CH	23-Aug-16	73	3.6	-	whole body	79	mg/kg ww	1.64	0.0094	0.0404	0.679	<0.0020	<0.020	<0.40	0.0594	2960	<0.010	0.0428	0.562	11.5	0.0067	285	2.7
HF 0.2-CS-6	Halfway	--	HF0.2	CH	23-Aug-16	69	3.2	-	whole body	74	mg/kg ww	7.97	0.009	0.0377	1.27	<0.0020	<0.020	<0.40	0.0987	5820	0.021	0.0449	1.06	36.2	0.0105	318	3.09
HF 0.2-CS-7	Halfway	--	HF0.2	CH	23-Aug-16	70	3.3	-	whole body	86	mg/kg ww	14.5	0.0078	0.0886	1.1	<0.0020	<0.020	<0.40	0.0367	4750	0.035	0.0366	0.835	33.3	0.008	308	2.53
HF 0.2-CS-8	Halfway	--	HF0.2	CH	23-Aug-16	72	3.5	-	whole body	83	mg/kg ww	11.7	0.0094	0.0526	1.08	<0.0020	<0.020	<0.40	0.0314	5460	0.023	0.0382	0.763	34.9	0.0074	321	2.02
HF 0.2-CS-9	Halfway	--	HF0.2	CH	23-Aug-16	71	3.4	-	whole body	<0.30	mg/kg ww	7.12	0.0078	0.0608	1.13	<0.0020	<0.020	<0.40	0.0306	5260	0.02	0.0449	0.596	26	0.0058	324	3.2
HF 0.2-CS-10	Halfway	--	HF0.2	CH	23-Aug-16	77	4.0	-	whole body	86	mg/kg ww	7.13	0.0084	0.0417	1.1	<0.0020	<0.020	<0.40	0.0333	6080	0.107	0.0202	0.587	28.7	0.0039	321	1.57
HF 0.2-CS-11	Halfway	--	HF0.2	CH	23-Aug-16	76	3.9	-	whole body	78	mg/kg ww	10.6	0.0081	0.0514	0.697	<0.0020	<0.020	<0.40	0.0289	5140	0.023	0.0198	0.637	27	0.0066	321	1.39
HF 0.2-CS-12	Halfway	--	HF0.2	CH	23-Aug-16	-	3.0	-	whole body	81	mg/kg ww	1.81	0.0067	0.0241	0.712	<0.0020	<0.020	<0.40	0.0154	4090	<0.010	0.0106	0.56	13.5	0.0026	347	1.02
052	Coffee	AQ00	CF3.9	GR	26-Jul-2015	268	205	6	muscle	78.7	µg/g ww	5.3	0.034	0.068	0.18	<0.002	<0.02	0.3	0.003	506	0.03	0.015	0.3	10	0.007	284	0.74
054	Coffee	AQ00	CF3.9	GR	26-Jul-2015	247	153	4	muscle	79.0	µg/g ww	1.2	0.012	0.02	0.07	<0.002	<0.02	0.3	0.003	287	<0.01	0.009	0.34	4	<0.004	296	0.25
69	Coffee	AQ02	CF8.0	GR	26-Jul-2015	254	163	6	muscle	78.2	µg/g ww	2.2	0.007	0.034	0.11	<0.002	<0.02	0.3	0.005	584	0.01	0.011	0.64	10	<0.004	304	0.33
70	Coffee	AQ02	CF8.0	GR	26-Jul-2015	278	211	6	muscle	78.0	µg/g ww	1.3	0.005	0.032	0.1	<0.002	<0.02	0.3	0.003	499	<0.01	0.009	0.42	10	<0.004	322	0.45
71	Coffee	AQ02	CF8.0	GR	26-Jul-2015	241	130	4	muscle	77.3	µg/g ww	3.1	0.06	0.029	0.05	<0.002	<0.02	0.3	0.005	162	0.01	0.014	0.43	10	<0.004	308	0.33
72	Coffee	AQ02	CF8.0	GR	26-Jul-2015	208	88	3	muscle	78.8	µg/g ww	2.1	0.006	0.028	0.1	<0.002	<0.02	0.3	0.007	508	0.04	0.016	0.4	8	<0.004	350	0.48
73	Coffee	AQ02	CF8.0	GR	26-Jul-2015	214	88	5	muscle	78.8	µg/g ww	2.1	0.053	0.029	0.12	<0.002	<0.02	0.4	0.006	406	0.01	0.011	0.71	10	<0.004	304	0.33

Sample ID	Watercourse	SSID - old	SSID new	Species[1]	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead	Magnesium	Manganese
74	Coffee	AQ02	CF8.0	GR	26-Jul-2015	284	248	5	muscle	78.7	µg/g ww	2.7	0.004	0.022	0.15	<0.002	<0.02	0.4	0.005	559	0.02	0.009	0.38	9	<0.004	312	0.41
CF10.0 AG-1	Coffee	--	CF10.0	GR	10-Jul-16	225	122.9	-	whole body	78	µg/g ww	22.4	0.0034	0.0395	1.97	<0.0020	<0.020	<0.40	0.0802	10100	0.139	0.0392	0.723	41.9	0.0226	358	4.23
CF10.0 AG-2	Coffee	--	CF10.0	GR	10-Jul-16	245	174.3	-	whole body	73	µg/g ww	23.2	0.0027	0.0487	1.77	<0.0020	<0.020	<0.40	0.0342	10900	0.075	0.0459	0.716	43.5	0.0163	394	6.71
CF10.0 AG-3	Coffee	--	CF10.0	GR	10-Jul-16	164	53	-	whole body	77	µg/g ww	19	0.0022	0.0398	3.66	<0.0020	<0.020	<0.40	0.0712	11200	0.128	0.0372	0.702	44	0.0204	362	4.73
CF10.0 AG-4	Coffee	--	CF10.0	GR	10-Jul-16	190	67.6	-	whole body	77	µg/g ww	25.8	0.0022	0.0445	1.37	<0.0020	<0.020	<0.40	0.0623	6600	0.24	0.0873	0.711	64.5	0.0118	299	3.54
CF10.0 2-1-K	Coffee	--	CF10.0	GR	10-Jul-16	280	197.6	-	whole body	74	µg/g ww	14.7	0.0028	0.0339	2.37	<0.0020	<0.020	<0.40	0.0708	10400	0.044	0.0338	0.618	33.3	0.0197	351	3.63
CF10.0 3-1-L	Coffee	--	CF10.0	GR	10-Jul-16	245	148.7	-	whole body	74	µg/g ww	9.78	0.0021	0.0344	3.02	<0.0020	<0.020	<0.40	0.0622	11800	0.079	0.0365	0.625	25.5	0.0084	385	5.03
CF10.0 3-2-M	Coffee	--	CF10.0	GR	10-Jul-16	330	378.5	-	whole body	77	µg/g ww	42.4	0.0039	0.0736	3.61	<0.0020	<0.020	<0.40	0.071	7430	0.065	0.0772	0.81	75.1	0.0286	355	6.04
HF 0.2-AG-1	Halfway	--	HF0.2	GR	23-Aug-16	123		-	whole body	78	mg/kg ww	4.63	0.0119	0.0636	1.68	<0.0020	<0.020	<0.40	0.0602	9190	0.011	0.0332	0.659	14	0.0079	375	2.8
104	Independence	AQ11	ID6.7	GR	24-Aug-2014	197	86	3	muscle	76.2	µg/g ww	1.4	0.227	0.041	0.45	<0.002	<0.02	<0.1	0.029	2390	0.02	0.02	0.44	7	0.064	332	0.76
107	Independence	AQ11	ID6.7	GR	28-Jul-2015	283	239.7	6	muscle	78.1	µg/g ww	0.7	0.005	0.043	0.18	<0.002	<0.02	0.3	0.003	705	<0.01	0.008	0.38	5	<0.004	300	0.39
108	Independence	AQ11	ID6.7	GR	28-Jul-2015	250	142.9	5	muscle	79.0	µg/g ww	1.2	<0.002	0.046	0.25	<0.002	<0.02	0.3	0.004	1550	<0.01	0.013	0.36	6	<0.004	318	0.7
109	Independence	AQ11	ID6.7	GR	28-Jul-2015	260	174.1	6	muscle	78.5	µg/g ww	1	<0.002	0.035	0.06	<0.002	<0.02	0.3	0.006	218	<0.01	0.013	0.32	5	<0.004	279	0.32
110	Independence	AQ11	ID6.7	GR	28-Jul-2015	175	56.4	3	muscle	79.7	µg/g ww	2	0.006	0.032	0.14	<0.002	<0.02	0.4	0.008	828	0.01	0.013	0.39	6	<0.004	330	0.43
111	Independence	AQ11	ID6.7	GR	28-Jul-2015	189	67.9	2	muscle	78.8	µg/g ww	1.2	<0.002	0.035	0.05	<0.002	<0.02	0.3	0.004	316	<0.01	0.012	0.3	4	<0.004	303	0.23
112	Independence	AQ11	ID6.7	GR	28-Jul-2015	177	60.3	2	muscle	79.7	µg/g ww	1.7	0.003	0.031	0.15	<0.002	<0.02	0.3	0.005	687	0.02	0.011	0.28	5	<0.004	330	0.5
113	Independence	AQ11	ID6.7	GR	28-Jul-2015	180	47.2	2	muscle	79.5	µg/g ww	7	0.007	0.038	0.18	<0.002	<0.02	0.3	0.008	725	0.03	0.031	0.34	14	0.006	331	0.78
041	Los Angeles	AQREF2	LaC4.8	GR	25-Jul-2015	251	177	4	muscle	77.6	µg/g ww	0.9	0.08	0.069	0.1	<0.002	<0.02	0.3	0.004	656	0.04	0.019	0.39	5	<0.004	319	0.53
002	Los Angeles	AQREF2	LaC4.8	GR	11-Sep-2015	270	199	3	muscle	78.7	µg/g ww	2	0.272	0.043	0.17	<0.005	<0.05	<0.2	<0.005	385	<0.02	0.021	0.39	7	<0.010	305	0.56
LAC-1-BS	Los Angeles	--	LAC4.8	GR	13-Jul-16	205	85.6	-	whole body	78	µg/g ww	25.8	0.003	0.0544	2.33	<0.0020	<0.020	<0.40	0.0578	10800	0.071	0.0698	0.912	57.8	0.0189	390	8.28
LAC-2-BS	Los Angeles	--	LAC4.8	GR	13-Jul-16	175	48.1	-	whole body	76	µg/g ww	62.4	0.0059	0.188	3.82	0.0039	<0.020	<0.40	0.105	11500	0.484	0.185	0.94	218	0.0572	417	15.1
LAC-3-AG	Los Angeles	--	LAC4.8	GR	13-Jul-16	230	162.3	-	whole body	77	µg/g ww	37.8	0.0037	0.063	1.87	<0.0020	<0.020	<0.40	0.0615	8180	0.085	0.0682	0.903	69.6	0.0216	371	5.53
0178	Latte	AQ04	LC2.7	GR	27-Aug-2014	233	148	3	muscle	79.1	µg/g ww	1.5	0.065	0.027	0.13	<0.002	<0.02	<0.1	0.003	880	<0.01	0.008	0.24	6	0.005	248	0.36
0179	Latte	AQ04	LC2.7	GR	27-Aug-2014	213	121	4	muscle	78.8	µg/g ww	0.8	0.099	0.027	0.05	<0.002	<0.02	<0.1	0.002	303	<0.01	0.006	0.27	4	0.004	286	0.25
0-9	Latte	AQ04	LC2.7	GR	21-Jun-2015	287	246	5	muscle	78.7	µg/g ww	2.4	0.703	0.027	0.11	<0.002	<0.02	<0.1	0.01	84	0.02	0.014	0.49	7	0.009	309	0.36
0-11	Latte	AQ04	LC2.7	GR	21-Jun-2015	316	337	4	muscle	77.9	µg/g ww	1.4	1.16	0.025	0.18	<0.002	<0.02	<0.1	0.006	400	0.01	0.006	0.36	5	0.006	299	0.45
0-22	Latte	AQ04	LC2.7	GR	23-Jun-2015	299	298.4	4	muscle	79.7	µg/g ww	0.7	0.383	0.059	0.26	<0.002	<0.02	<0.1	0.004	483	0.02	0.011	0.4	4	<0.004	293	0.37
0-23	Latte	AQ04	LC2.7	GR	23-Jun-2015	278	213	4	muscle	79.9	µg/g ww	0.7	0.505	0.042	0.15	<0.002	<0.02	<0.1	0.007	154	<0.01	0.011	0.33	4	0.01	288	0.3
0-25	Latte	AQ04	LC2.7	GR	23-Jun-2015	272	208	5	muscle	79.7	µg/g ww	1.7	0.201	0.03	0.07	<0.002	<0.02	<0.1	0.007	81	0.06	0.012	0.46	7	0.005	291	0.37
0-26	Latte	AQ04	LC2.7	GR	23-Jun-2015	273	224.4	5	muscle	79.7	µg/g ww	0.8	0.417	0.031	0.24	<0.002	<0.02	<0.1	0.007	131	0.01	0.011	0.54	4	0.006	282	0.28
LC2.7 3-1-A	Latte	--	LC2.7	GR	9-Jul-16	267	199.6	-	whole body	76	µg/g ww	16.5	0.0051	0.0349	1.54	<0.0020	<0.020	<0.40	0.0767	9400	0.066	0.0323	0.705	36.6	0.018	321	3.85
LC2.7 3-1-B	Latte	--	LC2.7	GR	9-Jul-16	284	276.9	-	whole body	76	µg/g ww	5.64	0.0031	0.0283	2.15	<0.0020	<0.020	<0.40	0.0699	11600	0.037	0.0247	0.685	23	0.0078	363	3.46
LC2.7 3-3-A	Latte	--	LC2.7	GR	9-Jul-16	247	180.2	-	whole body	75	µg/g ww	16.2	0.003	0.0471	2.16	<0.0020	<0.020	<0.40	0.0665	12300	0.266	0.0457	0.911	38.8	0.0296	380	4.74
LC2.7 3-3-B	Latte	--	LC2.7	GR	9-Jul-16	235	157.9	-	whole body	76	µg/g ww	31.9	0.0096	0.046	1.98	<0.0020	<0.020	<0.40	0.0559	12100	0.256	0.0455	0.877	55.1	0.0395	391	4.02
LC2.7 3-3-C	Latte	--	LC2.7	GR	9-Jul-16	168	-	-	whole body	75	µg/g ww	20.3	0.003	0.0442	1.87	<0.0020	<0.020	<0.40	0.109	7940	0.044	0.0453	0.756	39	0.016	324	4.44

[1] Species as follows: CCG – slimy sculpin, GR – Arctic grayling, CH – Chinook salmon (juvenile), BI – benthic invertebrates.

Table E1. Benthic invertebrate and fish tissue metals data; 2014 – 2016 (continued).

Sample ID	Watercourse	SSID - old	SSID new	Species [1]	Date	Sample Type	Moisture (%)	Units	Mercury	Me Hg (%)	MeHg Estimate	Molybdenum	Nickel	Phosphorus	Potassium	Selenium ww	Selenium dw	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
CF 10.0-B1-1	Coffee	--	CF10.0	BI	20-Aug-16	whole body	83	mg/kg ww	0.0208	0.5	0.0104	0.192	0.862	1310	1160	1.27	7.47	0.0159	445	4.42	0.0135	<0.020	36.6	1.06	2.42	25.1
CF 3.9-B1-1	Coffee	--	CF3.9	BI	20-Aug-16	whole body	86	mg/kg ww	0.0245	0.5	0.0123	0.308	1.76	950	1230	1.07	7.64	0.0122	359	7.66	0.0465	0.072	178	1.75	8.35	22.3
CC4.5-BI-1	Coffee	--	CF2.7	BI	4-Mar-16	whole body	71	µg/g ww	0.039	0.5	0.0195	0.63	4.94	1000	1930	0.393	1.36	<0.020	268	9.17	0.0935	0.7	369	10.7	17.3	34.3
CC4.5-BI-2	Coffee	--	CF2.7	BI	4-Mar-16	whole body	70	µg/g ww	0.0371	0.5	0.0186	0.511	3.92	1290	2330	0.628	2.09	<0.0080	374	11.5	0.0972	0.302	452	7.78	17.6	38.6
CC4.5-BI-3	Coffee	--	CF2.7	BI	5-Mar-16	whole body	81	µg/g ww	0.0397	0.5	0.0199	0.418	3.68	1200	2080	0.409	2.15	<0.0080	341	9.47	0.0875	0.249	428	6.97	17.2	34
CC4.5-BI-4	Coffee	--	CF2.7	BI	5-Mar-16	whole body	73	µg/g ww	0.0414	0.5	0.0207	0.449	4.27	1260	2070	0.458	1.70	<0.012	399	13.8	0.0865	0.142	395	11.1	16	43.8
CC4.5-BI-5	Coffee	--	CF2.7	BI	5-Mar-16	whole body	78	µg/g ww	0.038	0.5	0.0190	0.37	2.35	1190	1380	0.54	2.45	<0.040	384	12.2	0.041	0.52	237	7.34	9.05	27.6
CC4.5-BI-6	Coffee	--	CF2.7	BI	5-Mar-16	whole body	72	µg/g ww	0.0313	0.5	0.0157	0.603	4.26	1480	2590	0.405	1.45	<0.012	315	14.5	0.104	0.161	501	18.1	18.7	203
CCM-BI-1	Coffee	--	CF0.5	BI	5-Mar-16	whole body	80	µg/g ww	0.0452	0.5	0.0226	0.433	2.96	1900	1950	0.491	2.46	<0.012	347	13.6	0.0515	0.097	197	8.89	9.65	286
HF 0.2-B1-1	Halfway	--	HF0.2	BI	23-Aug-16	whole body	90	mg/kg ww	0.0114	0.5	0.0057	0.116	0.811	1250	1110	0.193	1.93	0.0041	436	4.37	0.00782	<0.020	17.5	1.45	1.17	19.2
HF 0.2-B1-2	Halfway	--	HF0.2	BI	23-Aug-16	whole body	88	mg/kg ww	0.0136	0.5	0.0068	0.288	0.753	1380	1180	0.232	1.93	0.0044	442	8.12	0.0054	<0.020	9.84	5.76	0.85	19.8
HF 6.3-B1-1	Halfway	--	HF6.3	BI	20-Aug-16	whole body	88	mg/kg ww	0.0163	0.5	0.0082	0.125	0.442	1310	1150	0.555	4.63	0.0069	387	3.84	0.00529	<0.020	17.3	1.4	0.846	18.5
IC 1.9-B1-1	Independence	--	ID1.9	BI	20-Aug-16	whole body	88	mg/kg ww	0.021	0.5	0.0105	0.217	1.72	1360	1480	0.76	6.33	0.0099	640	2.89	0.0286	0.049	89.6	0.498	3.92	23.4
IC4.5-BI-1	Independence	--	ID4.5	BI	4-Mar-16	whole body	67	µg/g ww	0.03	0.5	0.0150	0.22	4.63	1860	1430	0.54	1.64	<0.048	513	10.9	0.0551	0.25	214	1.26	6.69	47.8
LAC 4.8-B1-1	Los Angeles	--	LaC4.8	BI	20-Aug-16	whole body	89	mg/kg ww	0.0093	0.5	0.0047	0.218	1.47	1070	1550	0.469	4.26	0.0059	1260	2.98	0.00343	<0.020	11	0.178	1.45	14.3
LAC 4.8-B1-2	Los Angeles	--	LaC4.8	BI	20-Aug-16	whole body	92	mg/kg ww	0.0065	0.5	0.0033	0.2	2.79	634	718	0.542	6.78	0.0105	376	6.36	0.00768	<0.020	25	0.282	3.45	14.2
LC 2.7-B1-1	Latte	--	LC2.7	BI	21-Aug-16	whole body	90	mg/kg ww	0.0188	0.5	0.0094	0.112	0.534	1170	1090	0.727	7.27	0.0075	562	4.04	0.00561	<0.020	14.8	0.683	0.939	17.5
LC 9.9-B1-1	Latte	--	LC9.9	BI	21-Aug-16	whole body	87	mg/kg ww	0.0417	0.5	0.0209	0.094	0.433	1200	1010	0.221	1.70	0.0059	434	3.61	0.00513	<0.020	23.4	0.593	1.55	19.2
YT 0.2-B1-1	YT-24	--	YT0.2	BI	23-Aug-16	whole body	88	mg/kg ww	0.0115	0.5	0.0058	0.128	0.476	1400	1290	0.213	1.78	0.0054	513	2.49	0.00512	<0.020	19	0.28	1.12	20.3
YT 5.0-B1-1	YT-24	--	YT5.0	BI	21-Aug-16	whole body	89	mg/kg ww	0.0116	0.5	0.0058	0.099	0.406	1280	1080	0.099	0.90	0.0102	502	1.9	0.00454	<0.020	15.9	0.173	0.973	22.4
CC997-CCG-1	Coffee	CC997	CF10.0	CCG	4-Mar-16	whole body	75	µg/g ww	0.0973	0.81	0.0788	0.019	0.035	11000	3860	2.17	8.68	<0.0040	1500	22.5	0.0185	<0.020	0.477	0.167	0.154	29.8
CC4.5-CCG-1	Coffee	CC4.5	CF2.3	CCG	4-Mar-16	whole body	78	µg/g ww	0.0884	0.81	0.0716	0.013	0.017	7630	2480	1.07	4.86	<0.0040	990	14.7	0.00884	<0.020	0.594	0.0551	0.141	24.2
CC4.5-CCG-2	Coffee	CC4.5	CF2.3	CCG	4-Mar-16	whole body	81	µg/g ww	0.0769	0.81	0.0623	0.015	0.037	9240	2930	1.95	10.26	<0.0040	1230	18.9	0.0119	<0.020	0.365	0.052	0.123	23.1
CC4.5-CCG-3	Coffee	CC4.5	CF2.3	CCG	4-Mar-16	whole body	80	µg/g ww	0.158	0.81	0.1280	0.015	0.022	12200	3100	1.39	6.95	<0.0040	1470	24.9	0.0129	<0.020	0.412	0.124	0.209	36.7
CC4.5-CCG-4	Coffee	CC4.5	CF2.3	CCG	4-Mar-16	whole body	76	µg/g ww	0.168	0.81	0.1361	0.022	0.032	11600	3160	1.46	6.08	<0.0040	1470	24.1	0.0143	<0.020	0.696	0.116	0.249	25
CC4.5BI-CCG-1	Coffee	CC4.5	CF2.3	CCG	4-Mar-16	whole body	72.1	µg/g ww	0.0954	0.81	0.0773	0.023	0.071	7230	2360	1.22	4.37	<0.0080	733	16.8	0.0106	<0.040	2.67	0.107	0.207	23
0-219	Coffee	AQ02	CF8.0	CCG	27-Aug-2014	whole body, no head	67.6	µg/g ww	0.087	0.81	0.0705	<0.01	0.02	4320	3230	1.32	4.07	<0.01	744	3.63	0.004	<0.02	0.62	0.022	0.06	14.7
0-220	Coffee	AQ02	CF8.0	CCG	27-Aug-2014	whole body, no head	76.0	µg/g ww	0.078	0.81	0.0632	<0.01	0.02	6300	3410	1.38	5.75	<0.01	815	9.03	0.006	<0.02	0.46	0.035	0.06	19.2
0-221	Coffee	AQ02	CF8.0	CCG	27-Aug-2014	whole body, no head	74.9	µg/g ww	0.079	0.81	0.0640	<0.01	0.02	5500	3340	1.15	4.58	<0.01	747	8.29	0.004	<0.02	0.61	0.021	0.05	16
0-222	Coffee	AQ02	CF8.0	CCG	27-Aug-2014	whole body, no head	73.3	µg/g ww	0.058	0.81	0.0470	0.01	0.03	4900	3340	1.14	4.27	<0.01	707	6.3	0.005	<0.02	0.92	0.031	0.07	20.1
0-255	Coffee	AQ02	CF8.0	CCG	28-Aug-2014	whole body, no head	73.8	µg/g ww	0.107	0.81	0.0867	0.01	0.04	13700	3380	2.01	7.67	<0.01	1150	29.9	0.006	<0.02	1.26	0.044	0.18	38.8
0-256	Coffee	AQ02	CF8.0	CCG	28-Aug-2014	whole body, no head	72.7	µg/g ww	0.143	0.81	0.1158	<0.01	0.03	5680	3220	0.95	3.48	<0.01	739	8.93	0.005	<0.02	0.47	0.033	0.06	29.3
0-257	Coffee	AQ02	CF8.0	CCG	28-Aug-2014	whole body, no head	76.3	µg/g ww	0.224	0.81	0.1814	0.01	0.04	3240	3200	1.41	5.95	<0.01	732	2.82	0.008	<0.02	0.79	0.029	0.11	17.3
0-258	Coffee	AQ02	CF8.0	CCG	28-Aug-2014	whole body, no head	72.9	µg/g ww	0.092	0.81	0.0745	0.03	0.07	9460	2790	2.74	10.11	<0.01	1230	19	0.01	<0.02	1.94	0.146	0.28	22.6
0-259	Coffee	AQ02	CF8.0	CCG	28-Aug-2014	whole body, no head	70.1	µg/g ww	0.097	0.81	0.0786	<0.01	0.05	6580	3010	1.01	3.38	<0.01	731	11.9	0.009	<0.02	1.24	0.069	0.1	32.8
94	Coffee	AQ02	CF8.0	CCG	27-Jul-2015	whole body, no head	73.8	µg/g ww	0.248	0.81	0.2009	0.04	0.22	8450	4030	1.76	6.72	<0.01	1050	11.3	0.015	<0.02	7.97	0.129	0.43	51.6
96	Coffee	AQ02	CF8.0	CCG	27-Jul-2015	whole body, no head	72.1	µg/g ww	0.13	0.81	0.1053	0.01	0.08	7430	4010	1.56	5.59	<0.01	817	10	0.009	<0.02	0.71	0.032	0.05	21.1
102	Coffee	AQ02	CF8.0	CCG	27-Jul-2015	whole body, no head	72.1	µg/g ww	0.22	0.81	0.1782	0.02	0.13	8460	3930	1.39	4.98	<0.01	899	12.9	0.011	<0.02	2.94	0.081	0.21	36
CC0.5-CCG-2	Coffee	CC0.5	CF8.3	CCG	4-Mar-16	whole body	82	µg/g ww	0.0675	0.81	0.0547	<0.020	0.025	9030	3110	1.78	9.89	<0.0080	1250	16.8	0.0141	<0.040	0.48	0.0708	0.065	27.9

Sample ID	Watercourse	SSID - old	SSID new	Species [1]	Date	Sample Type	Moisture (%)	Units	Mercury	Me Hg (%)	MeHg Estimate	Molybdenum	Nickel	Phosphorus	Potassium	Selenium ww	Selenium dw	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
CF10.0 1-1-A	Coffee	--	CF10.0	CCG	10-Jul-16	whole body	77	µg/g ww	0.0547	0.81	0.0443	0.027	0.069	7660	3000	2.49	10.83	<0.0040	950	14.3	0.0113	0.021	2.4	0.0716	0.208	27.8
CF10.0 1-1-B	Coffee	--	CF10.0	CCG	10-Jul-16	whole body	79	µg/g ww	0.0627	0.81	0.0508	0.016	0.037	8550	2990	2.13	10.14	<0.0040	1010	14.8	0.0123	<0.020	1.03	0.0621	0.127	24.8
CF10.0 1-1-C	Coffee	--	CF10.0	CCG	10-Jul-16	whole body	79	µg/g ww	0.0647	0.81	0.0524	0.037	0.159	10700	3340	3.74	17.81	<0.0040	1030	18	0.0114	0.074	1.88	0.114	0.163	37.1
CF10.0 1-1-D	Coffee	--	CF10.0	CCG	10-Jul-16	whole body	81	µg/g ww	0.0463	0.81	0.0375	0.022	0.045	9810	3360	2.46	12.95	<0.0040	1150	17.1	0.0112	<0.020	1.38	0.0858	0.185	27.1
CF10.0 1-1-E	Coffee	--	CF10.0	CCG	10-Jul-16	whole body	81	µg/g ww	0.0615	0.81	0.0498	0.03	0.1	9040	3040	2.8	14.74	0.005	997	15.9	0.0154	<0.020	6.11	0.0707	0.36	29.3
CF10.0-1-1-F	Coffee	--	CF10.0	CCG	10-Jul-16	whole body	86	µg/g ww	0.0488	0.81	0.0395	0.018	0.063	8720	3260	3	21.43	<0.0040	1050	14.9	0.011	0.087	1.69	0.0735	0.174	30
CF10.0-1-1-G	Coffee	--	CF10.0	CCG	10-Jul-16	whole body	86	µg/g ww	0.044	0.81	0.0356	0.032	0.143	7730	3140	2.57	18.36	<0.0040	943	14	0.0106	0.104	2.47	0.0726	0.21	27.7
CF10.0 1-1-H	Coffee	--	CF10.0	CCG	10-Jul-16	whole body	80	µg/g ww	0.0462	0.81	0.0374	0.047	0.107	8670	3200	2.85	14.25	<0.0040	1080	15	0.0115	0.121	6.51	0.105	0.454	29.1
CF10.0 1-1-J	Coffee	--	CF10.0	CCG	10-Jul-16	whole body	87	µg/g ww	0.0382	0.81	0.0309	0.034	0.073	8380	3090	2.7	20.77	<0.0040	1050	15.3	0.0111	0.078	2.27	0.0641	0.23	26.5
CF10.0 1-1-I	Coffee	--	CF10.0	CCG	10-Jul-16	whole body	88	µg/g ww	0.0418	0.81	0.0339	0.045	0.093	8190	3100	2.51	20.92	0.0046	1020	14.1	0.00915	0.078	3.67	0.0841	0.312	27
CF 3.9 3-1-A	Coffee	--	CF3.9	CCG	11-Jul-16	whole body	79	µg/g ww	0.0927	0.81	0.0751	0.018	0.076	10100	2650	3.03	14.43	<0.0040	1140	18.4	0.0125	<0.020	1.11	0.0364	0.192	32.3
CF-3.9 3-1-B	Coffee	--	CF3.9	CCG	11-Jul-16	whole body	74	µg/g ww	0.0586	0.81	0.0475	0.036	0.183	11900	3180	2.94	11.31	<0.0040	1340	21.3	0.00797	0.037	2.67	0.049	0.289	49.7
CF3.9 3-1-C	Coffee	--	CF3.9	CCG	11-Jul-16	whole body	77	µg/g ww	0.13	0.81	0.1053	0.029	0.071	10400	3090	1.62	7.04	<0.0040	1090	18.6	0.0124	<0.020	3.43	0.131	0.278	31.8
CF3.9 3-1-D	Coffee	--	CF3.9	CCG	11-Jul-16	whole body	82	µg/g ww	0.083	0.81	0.0672	0.016	0.033	7570	3130	2.79	15.50	0.005	1040	13.3	0.00915	<0.020	0.94	0.062	0.118	24.6
CF3.9 3-1-E	Coffee	--	CF3.9	CCG	11-Jul-16	whole body	79	µg/g ww	0.0828	0.81	0.0671	0.026	0.049	8930	3090	2.27	10.81	<0.0040	1070	15.6	0.0106	<0.020	2.01	0.08	0.149	30.5
CF3.9 3-1-F	Coffee	--	CF3.9	CCG	11-Jul-16	whole body	79	µg/g ww	0.0748	0.81	0.0606	0.03	0.117	5310	3320	2.44	11.62	<0.0040	974	7.42	0.00858	0.074	5.28	0.0752	0.259	22.6
CF3.9 3-1-G	Coffee	--	CF3.9	CCG	11-Jul-16	whole body	86	µg/g ww	0.0791	0.81	0.0641	0.019	0.051	8440	3390	2.85	20.36	<0.0040	1090	15	0.00816	0.052	2.1	0.0519	0.169	30.8
CF3.9 3-1-H	Coffee	--	CF3.9	CCG	11-Jul-16	whole body	76	µg/g ww	0.0677	0.81	0.0548	0.022	0.047	5470	3110	3.21	13.38	<0.0040	1020	8.75	0.00816	0.041	1.94	0.0319	0.159	25.4
CF3.9 3-1-I	Coffee	--	CF3.9	CCG	11-Jul-16	whole body	91	µg/g ww	0.0894	0.81	0.0724	0.022	0.086	8810	3300	3.46	38.44	<0.0040	1050	16.4	0.013	0.037	2.52	0.0673	0.243	32.5
CF3.9 3-1-J	Coffee	--	CF3.9	CCG	11-Jul-16	whole body	79	µg/g ww	0.114	0.81	0.0923	0.025	0.062	7280	3400	1.84	8.76	<0.0040	1010	11.8	0.00898	0.183	0.814	0.101	0.055	24.3
R1-1	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	whole body, no head	72.7	µg/g ww	0.039	0.81	0.0316	<0.01	0.02	5350	3420	0.98	3.59	<0.01	614	9.73	0.003	<0.02	0.41	0.006	0.06	20
R1-2	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	whole body, no head	73.0	µg/g ww	0.049	0.81	0.0397	0.03	0.07	12500	3090	1.26	4.67	<0.01	1350	26.4	0.004	<0.02	1.57	0.03	0.24	30.5
R1-3	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	whole body, no head	72.5	µg/g ww	0.038	0.81	0.0308	0.02	0.08	13400	3210	2.19	7.96	<0.01	1290	26.9	0.004	<0.02	1.24	0.017	0.22	31.4
R1-4	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	whole body, no head	71.7	µg/g ww	0.061	0.81	0.0494	0.02	0.09	12100	3590	1.79	6.33	<0.01	1180	22.5	0.004	<0.02	0.98	0.008	0.35	48.9
R1-5	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	whole body, no head	72.1	µg/g ww	0.045	0.81	0.0365	0.02	0.06	9730	3510	1.56	5.59	<0.01	1150	20.4	0.004	<0.02	1.13	0.022	0.16	25.7
R1-6	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	whole body, no head	72.1	µg/g ww	0.032	0.81	0.0259	0.01	0.1	9530	3500	2.63	9.43	<0.01	1060	17.5	0.005	<0.02	1.32	0.007	0.14	28.4
R1-7	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	whole body, no head	75.2	µg/g ww	0.057	0.81	0.0462	0.02	0.07	7670	3260	1.22	4.92	<0.01	1090	14.4	0.004	<0.02	1.32	0.01	0.19	28.5
R1-8	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	whole body, no head	69.7	µg/g ww	0.031	0.81	0.0251	0.02	0.08	8330	3290	1.45	4.79	<0.01	973	17.7	0.002	<0.02	2.36	0.029	0.24	23.3
R1-9	Isaac	AQREF1	IS0.1	CCG	28-Aug-2014	whole body, no head	74.3	µg/g ww	0.04	0.81	0.0324	0.02	0.11	9920	3490	1.78	6.93	<0.01	1020	19.5	0.005	<0.02	1.7	0.01	0.27	40
205	Isaac	AQREF1	IS0.1	CCG	28-Jul-2015	whole body, no head	72.1	µg/g ww	0.065	0.81	0.0527	<0.04	0.25	7670	3750	1.4	5.02	<0.04	754	13.4	0.007	<0.08	2.26	0.016	0.27	38.2
206	Isaac	AQREF1	IS0.1	CCG	28-Jul-2015	whole body, no head	72.1	µg/g ww	0.051	0.81	0.0413	<0.05	0.35	9340	3740	2.36	8.46	<0.05	738	17	0.009	<0.1	1.24	0.021	0.42	61.3
207	Isaac	AQREF1	IS0.1	CCG	28-Jul-2015	whole body, no head	72.1	µg/g ww	0.031	0.81	0.0251	<0.05	0.25	6610	3770	1.61	5.77	<0.05	686	10.4	0.006	<0.09	0.55	0.006	0.15	33.5
IC-1.9 2-1-A	Independence	--	ID1.9	CCG	12-Jul-16	whole body	78	µg/g ww	0.0608	0.81	0.0492	0.037	0.265	11200	3150	2.76	12.55	0.0053	1150	20.4	0.00947	0.04	2.47	0.0269	0.347	36.5
IC-1.9 2-1-B	Independence	--	ID1.9	CCG	12-Jul-16	whole body	76	µg/g ww	0.0495	0.81	0.0401	0.025	0.124	6840	2990	2.16	9.00	<0.0040	1010	11.2	0.00808	0.034	1.98	0.0174	0.261	30
IC-1.9 2-1-C	Independence	--	ID1.9	CCG	12-Jul-16	whole body	77	µg/g ww	0.11	0.81	0.0891	0.022	0.069	7120	3210	1.94	8.43	<0.0040	1070	11.1	0.0111	0.04	1.98	0.0242	0.11	31.9
IC-1.9 3-1-D	Independence	--	ID1.9	CCG	12-Jul-16	whole body	80	µg/g ww	0.0771	0.81	0.0625	0.034	0.106	6290	3140	2.05	10.25	<0.0040	1110	8.05	0.00867	0.169	4.37	0.0331	0.163	28.9
IC-1.9 3-2-E	Independence	--	ID1.9	CCG	12-Jul-16	whole body	80	µg/g ww	0.068	0.81	0.0551	0.032	0.127	11600	2990	1.49	7.45	<0.0040	1090	21.3	0.0121	0.032	3.74	0.047	0.302	36
IC-1.9 2-3-F	Independence	--	ID1.9	CCG	12-Jul-16	whole body	82	µg/g ww	0.062	0.81	0.0502	0.027	0.086	6210	3220	2.1	11.67	<0.0040	1050	8.4	0.00824	0.047	2.64	0.0279	0.128	29.8
IC-1.9 1-1-G	Independence	--	ID1.9	CCG	12-Jul-16	whole body	81	µg/g ww	0.102	0.81	0.0826	0.028	0.095	9970	2670	1.21	6.37	<0.0040	1170	18.9	0.0114	<0.020	3.29	0.0521	0.317	31.9
IC-1.9 1-1-H	Independence	--	ID1.9	CCG	12-Jul-16	whole body	81	µg/g ww	0.0685	0.81	0.0555	0.027	0.097	9010	2850	1.5	7.89	<0.0040	1000	16.2	0.0101	<0.020	2.77	0.0473	0.366	48.9

Sample ID	Watercourse	SSID - old	SSID new	Species [1]	Date	Sample Type	Moisture (%)	Units	Mercury	Me Hg (%)	MeHg Estimate	Molybdenum	Nickel	Phosphorus	Potassium	Selenium ww	Selenium dw	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
IC-1.9 1-1-I	Independence	--	ID1.9	CCG	12-Jul-16	whole body	79	µg/g ww	0.0513	0.81	0.0416	0.031	0.118	8180	2930	1.73	8.24	0.0054	1070	13.4	0.00747	<0.020	4.39	0.0358	0.256	26.7
IC-1.9 1-1-J	Independence	--	ID1.9	CCG	12-Jul-16	whole body	77	µg/g ww	0.0562	0.81	0.0455	0.025	0.166	8630	3120	1.98	8.61	<0.0040	1180	13.2	0.00845	0.025	3.32	0.0263	0.294	36.2
I-301	Independence	AQ10	ID1.9	CCG	28-Aug-2014	whole body, no head	74.5	µg/g ww	0.088	0.81	0.0713	0.06	0.19	4550	2910	1.36	5.33	<0.01	954	5.06	0.008	0.02	7.08	0.048	0.37	21.5
I-302	Independence	AQ10	ID1.9	CCG	28-Aug-2014	whole body, no head	68.6	µg/g ww	0.056	0.81	0.0454	0.01	0.04	8510	3000	0.9	2.87	<0.01	895	14.7	0.007	<0.02	0.68	0.014	0.13	27.1
I-303	Independence	AQ10	ID1.9	CCG	28-Aug-2014	whole body, no head	68.2	µg/g ww	0.091	0.81	0.0737	<0.01	0.04	3960	3120	0.93	2.92	<0.01	656	3.88	0.008	<0.02	0.64	0.008	0.07	21.3
I-304	Independence	AQ10	ID1.9	CCG	28-Aug-2014	whole body, no head	70.9	µg/g ww	0.066	0.81	0.0535	0.03	0.11	14200	3060	1.78	6.12	<0.01	1360	28.9	0.008	<0.02	2.75	0.028	0.28	26.4
I-305	Independence	AQ10	ID1.9	CCG	28-Aug-2014	whole body, no head	71.3	µg/g ww	0.073	0.81	0.0591	0.07	0.19	10500	2990	2.53	8.82	<0.01	1210	18.7	0.01	<0.02	6.93	0.049	0.39	24.2
I-306	Independence	AQ10	ID1.9	CCG	28-Aug-2014	whole body, no head	71.6	µg/g ww	0.093	0.81	0.0753	0.02	0.08	7340	3090	1.07	3.77	<0.01	992	11.6	0.008	<0.02	1.32	0.018	0.1	22.1
I-307	Independence	AQ10	ID1.9	CCG	28-Aug-2014	whole body, no head	71.0	µg/g ww	0.041	0.81	0.0332	0.02	0.09	8960	3310	1.73	5.97	<0.01	930	15.2	0.007	<0.02	1.47	0.016	0.14	26.7
I-308	Independence	AQ10	ID1.9	CCG	28-Aug-2014	whole body, no head	67.1	µg/g ww	0.072	0.81	0.0583	0.01	0.04	7690	3080	1.31	3.98	<0.01	855	12.4	0.008	<0.02	0.9	0.015	0.09	27.8
004	Independence	AQ10	ID1.9	CCG	15-Sep-2015	whole body, no head	72.1	µg/g ww	0.069	0.81	0.0559	0.04	0.07	3830	4050	2.41	8.64	<0.02	867	1.95	0.007	<0.05	1.45	0.012	0.08	23.1
042	Los Angeles	AQREF2	LaC4.8	CCG	25-Jul-2015	whole body, no head	71.2	µg/g ww	0.084	0.81	0.0680	0.03	0.24	13700	4500	2.74	9.51	<0.01	1070	26	0.01	<0.02	4.41	0.011	0.47	61.4
208	Latte	AQ03	LC0.5	CCG	29-Jul-2015	whole body, no head	72.1	µg/g ww	0.203	0.81	0.1644	0.02	0.15	13000	3780	1.22	4.37	<0.01	1300	24.6	0.013	<0.02	2.51	0.175	0.27	71.7
219	Latte	AQ03	LC0.5	CCG	01-Aug-2015	whole body, no head	72.1	µg/g ww	0.047	0.81	0.0381	<0.02	0.1	7690	3960	1.88	6.74	<0.02	785	11	0.01	<0.04	2.56	0.029	0.22	29.8
003	Latte	AQ03	LC0.5	CCG	12-Sep-2015	whole body, no head	72.1	µg/g ww	0.213	0.81	0.1725	0.03	0.08	13400	4350	1.15	4.12	<0.02	1450	21.4	0.011	<0.05	2.46	0.098	0.42	52.4
CCM-CH-1	Coffee	CCM	CF0.5	CH	5-Mar-16	whole body	78	µg/g ww	0.0392	0.94	0.0368	<0.020	<0.020	5030	3290	0.502	2.28	<0.0080	1030	5.83	0.00316	<0.040	0.16	0.0124	<0.040	29.9
CCM-CH-2	Coffee	CCM	CF0.5	CH	4-Mar-16	whole body	77	µg/g ww	0.0711	0.94	0.0668	<0.020	<0.020	5910	3270	0.504	2.19	<0.0080	1190	9.23	0.00552	<0.040	0.46	0.0174	<0.040	35.3
CCM-CH-3	Coffee	CCM	CF0.5	CH	5-Mar-16	whole body	78	µg/g ww	0.0396	0.94	0.0372	<0.020	0.023	4390	3140	0.594	2.70	<0.0080	949	5.19	0.00422	<0.040	0.24	0.0115	<0.040	24.1
CC4.5-CH-1	Coffee	CC4.5	CF2.3	CH	4-Mar-16	whole body	77	µg/g ww	0.1	0.94	0.0940	<0.020	<0.020	6540	4200	0.57	2.48	<0.0080	1000	7.98	0.01	<0.040	0.65	0.0246	<0.040	42.1
CC4.5-CH-2	Coffee	CC4.5	CF2.3	CH	5-Mar-16	whole body	82	µg/g ww	0.0581	0.94	0.0546	<0.020	<0.020	5560	3150	0.498	2.77	<0.0080	1000	7.27	0.00601	<0.040	0.23	0.0129	<0.040	31.4
CC4.5-CH-3	Coffee	CC4.5	CF2.3	CH	4-Mar-16	whole body	59	µg/g ww	0.0699	0.94	0.0657	<0.020	0.049	5070	3630	0.534	1.30	<0.0080	1020	6.24	0.00773	<0.040	1.83	0.0604	0.102	31.5
HF 0.2-CS-1	Halfway	--	HF0.2	CH	23-Aug-16	whole body	76	mg/kg ww	0.0211	0.94	0.0198	0.023	0.025	4660	3380	0.59	2.46	<0.0040	870	4.63	0.00195	<0.020	0.578	0.0215	<0.020	25.2
HF 0.2-CS-2	Halfway	--	HF0.2	CH	23-Aug-16	whole body	78	mg/kg ww	0.0271	0.94	0.0255	0.021	0.108	4410	3610	0.66	3.00	<0.0040	963	4.11	0.00348	<0.020	1.56	0.0358	0.046	24.8
HF 0.2-CS-3	Halfway	--	HF0.2	CH	23-Aug-16	whole body	79	mg/kg ww	0.0268	0.94	0.0252	0.011	0.017	4850	3800	0.602	2.87	<0.0040	745	3.7	0.00318	<0.020	0.243	0.00776	<0.020	25.5
HF 0.2-CS-4	Halfway	--	HF0.2	CH	23-Aug-16	whole body	76	mg/kg ww	0.0258	0.94	0.0243	<0.020	0.026	5000	3520	0.613	2.55	<0.0080	883	3.8	0.00283	0.048	0.37	0.00881	<0.040	26.5
HF 0.2-CS-5	Halfway	--	HF0.2	CH	23-Aug-16	whole body	79	mg/kg ww	0.0255	0.94	0.0240	0.013	0.018	4090	3480	0.649	3.09	<0.0040	883	3.69	0.00302	<0.020	0.199	0.00903	<0.020	20.4
HF 0.2-CS-6	Halfway	--	HF0.2	CH	23-Aug-16	whole body	74	mg/kg ww	0.0237	0.94	0.0223	0.042	0.019	5720	3290	0.545	2.10	<0.0040	927	6.08	0.00328	<0.020	0.739	0.0135	0.025	29.8
HF 0.2-CS-7	Halfway	--	HF0.2	CH	23-Aug-16	whole body	86	mg/kg ww	0.0278	0.94	0.0261	0.023	0.043	5040	3480	0.553	3.95	<0.0040	999	5.9	0.00402	<0.020	1	0.0374	0.04	23.1
HF 0.2-CS-8	Halfway	--	HF0.2	CH	23-Aug-16	whole body	83	mg/kg ww	0.0223	0.94	0.0210	0.017	0.034	5210	3220	0.635	3.74	<0.0040	989	5.33	0.00255	<0.020	0.856	0.0271	0.039	29.4
HF 0.2-CS-9	Halfway	--	HF0.2	CH	23-Aug-16	whole body	<0.30	mg/kg ww	0.0235	0.94	0.0221	0.013	0.04	5210	3280	0.676		<0.0040	961	5.6	0.00326	<0.020	0.843	0.015	0.034	28.1
HF 0.2-CS-10	Halfway	--	HF0.2	CH	23-Aug-16	whole body	86	mg/kg ww	0.025	0.94	0.0235	0.016	0.017	5720	3480	0.66	4.71	<0.0040	957	5.46	0.00281	<0.020	0.528	0.00758	<0.020	36
HF 0.2-CS-11	Halfway	--	HF0.2	CH	23-Aug-16	whole body	78	mg/kg ww	0.0293	0.94	0.0275	0.016	0.028	5180	3530	0.523	2.38	<0.0040	911	5.65	0.00304	<0.020	0.684	0.0242	0.03	27.9
HF 0.2-CS-12	Halfway	--	HF0.2	CH	23-Aug-16	whole body	81	mg/kg ww	0.0232	0.94	0.0218	0.011	0.022	4440	3160	0.403	2.12	<0.0040	956	4.32	0.00276	<0.020	0.223	0.00498	<0.020	23
052	Coffee	AQ00	CF3.9	GR	26-Jul-2015	muscle	78.7	µg/g ww	0.09	0.94	0.0846	<0.01	0.06	3330	5110	1.18	5.54	<0.01	300	0.63	0.006	<0.02	0.41	0.003	0.03	4
054	Coffee	AQ00	CF3.9	GR	26-Jul-2015	muscle	79.0	µg/g ww	0.05	0.94	0.0470	<0.01	0.05	3300	5310	1.29	6.14	<0.01	293	0.34	0.005	<0.02	0.23	<0.001	<0.02	5.8
69	Coffee	AQ02	CF8.0	GR	26-Jul-2015	muscle	78.2	µg/g ww	0.072	0.94	0.0677	<0.01	0.05	3890	5750	1.73	7.94	<0.01	353	0.64	0.008	<0.02	0.34	0.001	<0.02	5.2
70	Coffee	AQ02	CF8.0	GR	26-Jul-2015	muscle	78.0	µg/g ww	0.062	0.94	0.0583	<0.01	0.05	3840	5790	1.56	7.09	<0.01	384	0.7	0.004	<0.02	0.27	<0.001	<0.02	4.6
71	Coffee	AQ02	CF8.0	GR	26-Jul-2015	muscle	77.3	µg/g ww	0.054	0.94	0.0508	<0.01	0.05	3650	5880	1.31	5.77	<0.01	381	0.18	0.006	<0.02	0.46	0.001	<0.02	7.3
72	Coffee	AQ02	CF8.0	GR	26-Jul-2015	muscle	78.8	µg/g ww	0.039	0.94	0.0367	<0.01	0.06	3980	5920	1.79	8.44	<0.01	446	0.6	0.005	<0.02	0.35	0.002	<0.02	5.5
73	Coffee	AQ02	CF8.0	GR	26-Jul-2015	muscle	78.8	µg/g ww	0.055	0.94	0.0517	<0.01	0.06	3830	5780	1.71	8.07	<0.01	364	0.47	0.006	<0.02	0.29	0.001	<0.02	6.5

Sample ID	Watercourse	SSID - old	SSID new	Species [1]	Date	Sample Type	Moisture (%)	Units	Mercury	Me Hg (%)	MeHg Estimate	Molybdenum	Nickel	Phosphorus	Potassium	Selenium ww	Selenium dw	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
74	Coffee	AQ02	CF8.0	GR	26-Jul-2015	muscle	78.7	µg/g ww	0.092	0.94	0.0865	<0.01	0.06	3830	5730	1.42	6.67	<0.01	372	0.76	0.004	<0.02	0.37	0.001	<0.02	5.3
CF10.0 AG-1	Coffee	--	CF10.0	GR	10-Jul-16	whole body	78	µg/g ww	0.0221	0.94	0.0208	0.019	0.099	7820	3480	1.21	5.50	<0.0040	942	13.1	0.00382	<0.020	1.81	0.021	0.084	18.8
CF10.0 AG-2	Coffee	--	CF10.0	GR	10-Jul-16	whole body	73	µg/g ww	0.0687	0.94	0.0646	0.018	0.052	8610	3680	1.28	4.74	<0.0040	937	22.9	0.0077	<0.020	2.07 (1)	0.0327	0.105 (2)	19.7
CF10.0 AG-3	Coffee	--	CF10.0	GR	10-Jul-16	whole body	77	µg/g ww	0.0412	0.94	0.0387	0.016	0.077	8210	3630	1.3	5.65	<0.0040	938	12.7	0.00623	<0.020	1.84	0.0219	0.08	23.5
CF10.0 AG-4	Coffee	--	CF10.0	GR	10-Jul-16	whole body	77	µg/g ww	0.0588	0.94	0.0553	0.015	0.11	5660	3380	3	13.04	<0.0040	926	7.76	0.00623	<0.020	2.55	0.0141	0.103	19.8
CF10.0 2-1-K	Coffee	--	CF10.0	GR	10-Jul-16	whole body	74	µg/g ww	0.04	0.94	0.0376	0.017	0.028	7930	3500	1.13	4.35	<0.0040	905	10.5	0.00601	<0.020	1.49	0.0248	0.066	21.2
CF10.0 3-1-L	Coffee	--	CF10.0	GR	10-Jul-16	whole body	74	µg/g ww	0.0465	0.94	0.0437	0.014	0.04	8970	3510	1.14	4.38	<0.0040	983	14.3	0.0078	0.022	1.2	0.0511	0.043	23.1
CF10.0 3-2-M	Coffee	--	CF10.0	GR	10-Jul-16	whole body	77	µg/g ww	0.0309	0.94	0.0290	0.033	0.059	6750	3680	1.82	7.91	<0.0040	875	9.39	0.00781	0.028	3.28	0.0327	0.168	25
HF 0.2-AG-1	Halfway	--	HF0.2	GR	23-Aug-16	whole body	78	mg/kg ww	0.0332	0.94	0.0312	0.011	0.015	8240	4110	1.32	6.00	<0.0040	993	12.9	0.00643	0.024	0.324	0.0114	<0.020	28.6
104	Independence	AQ11	ID6.7	GR	24-Aug-2014	muscle	76.2	µg/g ww	0.049	0.94	0.0461	<0.01	0.01	4010	4600	1.23	5.17	<0.01	481	2.65	0.006	<0.02	0.35	0.001	<0.02	11.9
107	Independence	AQ11	ID6.7	GR	28-Jul-2015	muscle	78.1	µg/g ww	0.075	0.94	0.0705	<0.01	0.06	3750	5550	1.23	5.62	<0.01	310	0.84	0.006	<0.02	0.25	0.001	<0.02	5.3
108	Independence	AQ11	ID6.7	GR	28-Jul-2015	muscle	79.0	µg/g ww	0.051	0.94	0.0479	<0.01	0.07	4280	5500	1.51	7.19	<0.01	326	1.9	0.006	<0.02	0.32	0.001	<0.02	6
109	Independence	AQ11	ID6.7	GR	28-Jul-2015	muscle	78.5	µg/g ww	0.086	0.94	0.0808	<0.01	0.06	3100	5040	1.54	7.16	0.01	295	0.27	0.006	<0.02	0.22	0.001	<0.02	6
110	Independence	AQ11	ID6.7	GR	28-Jul-2015	muscle	79.7	µg/g ww	0.037	0.94	0.0348	<0.01	0.07	4010	5660	1.82	8.97	<0.01	315	0.91	0.005	<0.02	0.34	0.001	<0.02	5.8
111	Independence	AQ11	ID6.7	GR	28-Jul-2015	muscle	78.8	µg/g ww	0.042	0.94	0.0395	<0.01	0.06	3430	5590	1.44	6.79	<0.01	301	0.32	0.005	<0.02	0.22	<0.001	<0.02	5.3
112	Independence	AQ11	ID6.7	GR	28-Jul-2015	muscle	79.7	µg/g ww	0.037	0.94	0.0348	<0.01	0.06	3720	5730	1.71	8.42	<0.01	328	0.74	0.004	<0.02	0.31	0.001	<0.02	6.3
113	Independence	AQ11	ID6.7	GR	28-Jul-2015	muscle	79.5	µg/g ww	0.036	0.94	0.0338	<0.01	0.06	3720	5470	2.07	10.10	<0.01	356	0.84	0.007	<0.02	0.6	0.003	0.02	6.3
041	Los Angeles	AQREF2	LaC4.8	GR	25-Jul-2015	muscle	77.6	µg/g ww	0.065	0.94	0.0611	<0.01	0.03	3840	5560	1.69	7.54	<0.01	305	0.95	0.006	<0.02	0.26	<0.001	<0.02	5.2
002	Los Angeles	AQREF2	LaC4.8	GR	11-Sep-2015	muscle	78.7	µg/g ww	0.068	0.94	0.0639	<0.02	0.03	3000	5200	0.9	4.23	<0.02	280	0.61	0.006	<0.05	0.26	<0.002	<0.05	5.7
LAC-1-BS	Los Angeles	--	LAC4.8	GR	13-Jul-16	whole body	78	µg/g ww	0.036	0.94	0.0338	0.02	0.102	8350	3650	1.3	5.91	<0.0040	1030	15.1	0.00501	<0.020	1.78	0.0108	0.112	20.2
LAC-2-BS	Los Angeles	--	LAC4.8	GR	13-Jul-16	whole body	76	µg/g ww	0.0615	0.94	0.0578	0.024	0.407	9060	3520	1.61	6.71	0.0041	1090	19	0.00914	<0.020	3.29	0.0463	0.322	24.5
LAC-3-AG	Los Angeles	--	LAC4.8	GR	13-Jul-16	whole body	77	µg/g ww	0.0436	0.94	0.0410	0.016	0.126	6890	3810	1.52	6.61	<0.0040	1120	11	0.0057	<0.020	2.1	0.00787	0.16	19.8
0178	Latte	AQ04	LC2.7	GR	27-Aug-2014	muscle	79.1	µg/g ww	0.081	0.94	0.0761	<0.01	<0.01	2530	3510	0.66	3.16	<0.01	293	0.95	0.003	<0.02	0.25	0.001	<0.02	5.1
0179	Latte	AQ04	LC2.7	GR	27-Aug-2014	muscle	78.8	µg/g ww	0.071	0.94	0.0667	<0.01	<0.01	2660	4250	0.92	4.34	<0.01	284	0.3	0.004	<0.02	0.23	<0.001	<0.02	3.9
0-9	Latte	AQ04	LC2.7	GR	21-Jun-2015	muscle	78.7	µg/g ww	0.108	0.94	0.1015	<0.01	0.01	2940	5060	0.85	4.00	<0.01	290	0.12	0.005	<0.02	0.26	0.002	<0.02	7.7
0-11	Latte	AQ04	LC2.7	GR	21-Jun-2015	muscle	77.9	µg/g ww	0.123	0.94	0.1156	<0.01	0.01	3040	4970	0.48	2.17	<0.01	350	0.56	0.004	<0.02	0.2	0.002	<0.02	4.5
0-22	Latte	AQ04	LC2.7	GR	23-Jun-2015	muscle	79.7	µg/g ww	0.127	0.94	0.1194	<0.01	<0.01	3010	4970	0.74	3.65	<0.01	369	0.68	0.004	<0.02	0.15	0.002	<0.02	5
0-23	Latte	AQ04	LC2.7	GR	23-Jun-2015	muscle	79.9	µg/g ww	0.107	0.94	0.1006	<0.01	0.01	2760	4850	0.94	4.68	<0.01	326	0.22	0.005	<0.02	0.14	0.002	<0.02	4.1
0-25	Latte	AQ04	LC2.7	GR	23-Jun-2015	muscle	79.7	µg/g ww	0.132	0.94	0.1241	<0.01	0.01	2800	4810	1.02	5.02	<0.01	314	0.11	0.007	<0.02	0.31	0.002	<0.02	6.6
0-26	Latte	AQ04	LC2.7	GR	23-Jun-2015	muscle	79.7	µg/g ww	0.127	0.94	0.1194	<0.01	0.01	2770	4680	1.08	5.32	<0.01	392	0.19	0.006	<0.02	0.15	0.001	<0.02	6.7
LC2.7 3-1-A	Latte	--	LC2.7	GR	9-Jul-16	whole body	76	µg/g ww	0.105	0.94	0.0987	0.014	0.037	7210	3230	1.2	5.00	<0.0040	999	13.1	0.00579	<0.020	1.14	0.035	0.071	22.6
LC2.7 3-1-B	Latte	--	LC2.7	GR	9-Jul-16	whole body	76	µg/g ww	0.109	0.94	0.1025	<0.010	0.018	8400	3420	0.929	3.87	<0.0040	1120	13.8	0.00745	<0.020	0.634	0.0292	0.025	22.2
LC2.7 3-3-A	Latte	--	LC2.7	GR	9-Jul-16	whole body	75	µg/g ww	0.0639	0.94	0.0601	0.016	0.153	8780	3540	1.2	4.80	<0.0040	1060	14.5	0.00647	<0.020	1.3	0.0441	0.07	29.1
LC2.7 3-3-B	Latte	--	LC2.7	GR	9-Jul-16	whole body	76	µg/g ww	0.0491	0.94	0.0462	0.021	0.121	8750	3550	1.17	4.88	<0.0040	1010	12.8	0.00551	<0.020	2.18	0.0462	0.094	23
LC2.7 3-3-C	Latte	--	LC2.7	GR	9-Jul-16	whole body	75	µg/g ww	0.0427	0.94	0.0401	0.015	0.057	6650	3220	1.73	6.92	<0.0040	890	10.3	0.00643	<0.020	1.7	0.0167	0.069	25.6

[1] Species as follows: CCG – slimy sculpin, GR – Arctic grayling, CH – Chinook salmon (juvenile), BI – benthic invertebrates.

Success Through Science®

Your Project #: 14Y0306:102
Site Location: COFFEE CREEK
Your C.O.C. #: 08418991, 08418990

Attention:LYNDSAY DOETZEL

EDI ENVIRONMENTAL DYNAMICS INC.
2195 2nd Avenue
WHITEHORSE, YT
CANADA Y1A 3T8

Report Date: 2016/04/07
Report #: R2153836
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B617947
Received: 2016/03/08, 11:45

Sample Matrix: TISSUE
Samples Received: 21

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by CRC ICPMS - Tissue Wet Wt	21	2016/03/22	2016/03/30	BBY7SOP-00002/21	EPA 6020a,200.3 R1 m
Moisture in Tissue	20	N/A	2016/03/30	BBY8SOP-00017	OMOE E3139 3.1 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key



Graham Rudkin
Project Manager, Environmental
07 Apr 2016 12:16:24 -07:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Graham Rudkin, Project Manager, Environmental
Email: GRudkin@maxxam.ca
Phone# (604)638-5926 Ext:5926

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B617947
Report Date: 2016/04/07

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: BS

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		OG2657		OG2658	OG2659		OG2660		OG2661		
Sampling Date		2016/03/04		2016/03/04	2016/03/05		2016/03/05		2016/03/05		
COC Number		08418991		08418991	08418991		08418991		08418991		
	UNITS	CC4.5-BI-1	RDL	CC4.5-BI-2	CC4.5-BI-3	RDL	CC4.5-BI-4	RDL	CC4.5-BI-5	RDL	QC Batch
Total Metals by ICPMS											
Total Aluminum (Al)	mg/kg	3820	1.0	3840	3370	0.40	3420	0.60	2240	2.0	8223417
Total Antimony (Sb)	mg/kg	0.140	0.0050	0.0995	0.0696	0.0020	0.0907	0.0030	0.065	0.010	8223417
Total Arsenic (As)	mg/kg	5.54	0.025	4.03	3.84	0.010	3.52	0.015	3.78	0.050	8223417
Total Barium (Ba)	mg/kg	112	0.050	139	100	0.020	112	0.030	74.8	0.10	8223417
Total Beryllium (Be)	mg/kg	0.116	0.010	0.119	0.101	0.0040	0.104	0.0060	0.097	0.020	8223417
Total Bismuth (Bi)	mg/kg	<0.10	0.10	<0.040	<0.040	0.040	<0.060	0.060	<0.20	0.20	8223417
Total Boron (B)	mg/kg	<2.0	2.0	<0.80	<0.80	0.80	<1.2	1.2	<4.0	4.0	8223417
Total Cadmium (Cd)	mg/kg	0.135	0.010	0.158	0.142	0.0040	0.197	0.0060	0.144	0.020	8223417
Total Calcium (Ca)	mg/kg	1450	10	1710	1540	4.0	1900	6.0	2110	20	8223417
Total Chromium (Cr)	mg/kg	10.5	0.050	6.78	5.69	0.020	6.56	0.030	2.88	0.10	8223417
Total Cobalt (Co)	mg/kg	4.16	0.020	3.67	3.73	0.0080	3.57	0.012	2.11	0.040	8223417
Total Copper (Cu)	mg/kg	7.26	0.050	7.44	6.48	0.020	6.78	0.030	5.97	0.10	8223417
Total Iron (Fe)	mg/kg	9420	5.0	9050	8510	2.0	8670	3.0	5270	10	8223417
Total Lead (Pb)	mg/kg	5.29	0.010	1.54	1.17	0.0040	1.56	0.0060	0.967	0.020	8223417
Total Magnesium (Mg)	mg/kg	2350	10	2380	2280	4.0	2370	6.0	1240	20	8223417
Total Manganese (Mn)	mg/kg	317	0.10	285	265	0.040	290	0.060	171	0.20	8223417
Total Mercury (Hg)	mg/kg	0.039	0.010	0.0371	0.0397	0.0040	0.0414	0.0060	0.038	0.020	8223417
Total Molybdenum (Mo)	mg/kg	0.630	0.050	0.511	0.418	0.020	0.449	0.030	0.37	0.10	8223417
Total Nickel (Ni)	mg/kg	4.94	0.050	3.92	3.68	0.020	4.27	0.030	2.35	0.10	8223417
Total Phosphorus (P)	mg/kg	1000	10	1290	1200	4.0	1260	6.0	1190	20	8223417
Total Potassium (K)	mg/kg	1930	10	2330	2080	4.0	2070	6.0	1380	20	8223417
Total Selenium (Se)	mg/kg	0.393	0.050	0.628	0.409	0.020	0.458	0.030	0.54	0.10	8223417
Total Silver (Ag)	mg/kg	<0.020	0.020	<0.0080	<0.0080	0.0080	<0.012	0.012	<0.040	0.040	8223417
Total Sodium (Na)	mg/kg	268	10	374	341	4.0	399	6.0	384	20	8223417
Total Strontium (Sr)	mg/kg	9.17	0.050	11.5	9.47	0.020	13.8	0.030	12.2	0.10	8223417
Total Thallium (Tl)	mg/kg	0.0935	0.0020	0.0972	0.0875	0.00080	0.0865	0.0012	0.0410	0.0040	8223417
Total Tin (Sn)	mg/kg	0.70	0.10	0.302	0.249	0.040	0.142	0.060	0.52	0.20	8223417
Total Titanium (Ti)	mg/kg	369	0.25	452	428	0.10	395	0.15	237	0.50	8223417
Total Uranium (U)	mg/kg	10.7	0.0020	7.78	6.97	0.00080	11.1	0.0012	7.34	0.0040	8223417
Total Vanadium (V)	mg/kg	17.3	0.10	17.6	17.2	0.040	16.0	0.060	9.05	0.20	8223417
Total Zinc (Zn)	mg/kg	34.3	0.20	38.6	34.0	0.080	43.8	0.12	27.6	0.40	8223417

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B617947
Report Date: 2016/04/07

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: BS

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		OG2662	OG2663		OG2664	OG2668	OG2666	OG2667		
Sampling Date		2016/03/05	2016/03/05		2016/03/04	2016/03/05	2016/03/04	2016/03/05		
COC Number		08418991	08418991		08418991	08418990	08418991	08418990		
	UNITS	CC4.5-BI-6	CCM-BI-1	RDL	CC4.5-CH-1	CC4.5-CH-2	CC4.5-CH-3	CCM-CH-1	RDL	QC Batch
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	3730	2000	0.60	2.18	1.54	24.7	1.46	0.40	8223417
Total Antimony (Sb)	mg/kg	0.126	0.116	0.0030	0.0023	<0.0020	0.0024	<0.0020	0.0020	8223417
Total Arsenic (As)	mg/kg	5.12	3.06	0.015	0.033	0.030	0.054	0.022	0.010	8223417
Total Barium (Ba)	mg/kg	172	107	0.030	2.55	1.72	1.86	1.08	0.020	8223417
Total Beryllium (Be)	mg/kg	0.126	0.0868	0.0060	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	8223417
Total Bismuth (Bi)	mg/kg	<0.060	<0.060	0.060	<0.040	<0.040	<0.040	<0.040	0.040	8223417
Total Boron (B)	mg/kg	<1.2	<1.2	1.2	<0.80	<0.80	<0.80	<0.80	0.80	8223417
Total Cadmium (Cd)	mg/kg	0.237	0.230	0.0060	0.0204	0.0160	0.0159	0.0243	0.0040	8223417
Total Calcium (Ca)	mg/kg	2320	2460	6.0	7990	7550	6630	5920	4.0	8223417
Total Chromium (Cr)	mg/kg	5.32	3.68	0.030	0.044	0.023	0.071	0.048	0.020	8223417
Total Cobalt (Co)	mg/kg	4.15	2.25	0.012	0.0374	0.0302	0.0580	0.0172	0.0080	8223417
Total Copper (Cu)	mg/kg	8.05	7.61	0.030	0.767	0.666	0.851	0.599	0.020	8223417
Total Iron (Fe)	mg/kg	10300	5550	3.0	29.7	23.8	60.6	18.3	2.0	8223417
Total Lead (Pb)	mg/kg	5.12	4.13	0.0060	0.0274	0.0057	0.0195	0.0048	0.0040	8223417
Total Magnesium (Mg)	mg/kg	2510	1510	6.0	360	310	320	299	4.0	8223417
Total Manganese (Mn)	mg/kg	473	231	0.060	2.57	1.90	4.07	1.49	0.040	8223417
Total Mercury (Hg)	mg/kg	0.0313	0.0452	0.0060	0.100	0.0581	0.0699	0.0392	0.0040	8223417
Total Molybdenum (Mo)	mg/kg	0.603	0.433	0.030	<0.020	<0.020	<0.020	<0.020	0.020	8223417
Total Nickel (Ni)	mg/kg	4.26	2.96	0.030	<0.020	<0.020	0.049	<0.020	0.020	8223417
Total Phosphorus (P)	mg/kg	1480	1900	6.0	6540	5560	5070	5030	4.0	8223417
Total Potassium (K)	mg/kg	2590	1950	6.0	4200	3150	3630	3290	4.0	8223417
Total Selenium (Se)	mg/kg	0.405	0.491	0.030	0.570	0.498	0.534	0.502	0.020	8223417
Total Silver (Ag)	mg/kg	<0.012	<0.012	0.012	<0.0080	<0.0080	<0.0080	<0.0080	0.0080	8223417
Total Sodium (Na)	mg/kg	315	347	6.0	1000	1000	1020	1030	4.0	8223417
Total Strontium (Sr)	mg/kg	14.5	13.6	0.030	7.98	7.27	6.24	5.83	0.020	8223417
Total Thallium (Tl)	mg/kg	0.104	0.0515	0.0012	0.0100	0.00601	0.00773	0.00316	0.00080	8223417
Total Tin (Sn)	mg/kg	0.161	0.097	0.060	<0.040	<0.040	<0.040	<0.040	0.040	8223417
Total Titanium (Ti)	mg/kg	501	197	0.15	0.65	0.23	1.83	0.16	0.10	8223417
Total Uranium (U)	mg/kg	18.1	8.89	0.0012	0.0246	0.0129	0.0604	0.0124	0.00080	8223417
Total Vanadium (V)	mg/kg	18.7	9.65	0.060	<0.040	<0.040	0.102	<0.040	0.040	8223417
Total Zinc (Zn)	mg/kg	203	286	0.12	42.1	31.4	31.5	29.9	0.080	8223417

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B617947
Report Date: 2016/04/07

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: BS

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		OG2665	OG2669		OG2676		OG2671		
Sampling Date		2016/03/04	2016/03/05		2016/03/04		2016/03/04		
COC Number		08418991	08418990		08418990		08418990		
	UNITS	CCM-CH-2	CCM-CH-3	RDL	CC997-CCG-1	RDL	CC0.5-CCG-2	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	1.61	2.39	0.40	1.17	0.20	3.79	0.40	8223417
Total Antimony (Sb)	mg/kg	<0.0020	<0.0020	0.0020	0.0023	0.0010	<0.0020	0.0020	8223417
Total Arsenic (As)	mg/kg	0.031	0.027	0.010	0.0854	0.0050	0.058	0.010	8223417
Total Barium (Ba)	mg/kg	1.92	1.21	0.020	3.36	0.010	3.06	0.020	8223417
Total Beryllium (Be)	mg/kg	<0.0040	<0.0040	0.0040	<0.0020	0.0020	<0.0040	0.0040	8223417
Total Bismuth (Bi)	mg/kg	<0.040	<0.040	0.040	<0.020	0.020	<0.040	0.040	8223417
Total Boron (B)	mg/kg	<0.80	<0.80	0.80	<0.40	0.40	<0.80	0.80	8223417
Total Cadmium (Cd)	mg/kg	0.0205	0.0645	0.0040	0.0265	0.0020	0.0206	0.0040	8223417
Total Calcium (Ca)	mg/kg	8080	5130	4.0	17500	2.0	14600	4.0	8223417
Total Chromium (Cr)	mg/kg	<0.020	0.254	0.020	0.020	0.010	<0.020	0.020	8223417
Total Cobalt (Co)	mg/kg	0.0383	0.0253	0.0080	0.0511	0.0040	0.0264	0.0080	8223417
Total Copper (Cu)	mg/kg	0.675	0.713	0.020	1.18	0.010	1.44	0.020	8223417
Total Iron (Fe)	mg/kg	19.7	17.9	2.0	30.9	1.0	21.9	2.0	8223417
Total Lead (Pb)	mg/kg	0.0136	0.0072	0.0040	0.0110	0.0020	0.0232	0.0040	8223417
Total Magnesium (Mg)	mg/kg	332	289	4.0	525	2.0	397	4.0	8223417
Total Manganese (Mn)	mg/kg	2.55	1.52	0.040	8.19	0.020	4.40	0.040	8223417
Total Mercury (Hg)	mg/kg	0.0711	0.0396	0.0040	0.0973	0.0020	0.0675	0.0040	8223417
Total Molybdenum (Mo)	mg/kg	<0.020	<0.020	0.020	0.019	0.010	<0.020	0.020	8223417
Total Nickel (Ni)	mg/kg	<0.020	0.023	0.020	0.035	0.010	0.025	0.020	8223417
Total Phosphorus (P)	mg/kg	5910	4390	4.0	11000	2.0	9030	4.0	8223417
Total Potassium (K)	mg/kg	3270	3140	4.0	3860	2.0	3110	4.0	8223417
Total Selenium (Se)	mg/kg	0.504	0.594	0.020	2.17	0.010	1.78	0.020	8223417
Total Silver (Ag)	mg/kg	<0.0080	<0.0080	0.0080	<0.0040	0.0040	<0.0080	0.0080	8223417
Total Sodium (Na)	mg/kg	1190	949	4.0	1500	2.0	1250	4.0	8223417
Total Strontium (Sr)	mg/kg	9.23	5.19	0.020	22.5	0.010	16.8	0.020	8223417
Total Thallium (Tl)	mg/kg	0.00552	0.00422	0.00080	0.0185	0.00040	0.0141	0.00080	8223417
Total Tin (Sn)	mg/kg	<0.040	<0.040	0.040	<0.020	0.020	<0.040	0.040	8223417
Total Titanium (Ti)	mg/kg	0.46	0.24	0.10	0.477	0.050	0.48	0.10	8223417
Total Uranium (U)	mg/kg	0.0174	0.0115	0.00080	0.167	0.00040	0.0708	0.00080	8223417
Total Vanadium (V)	mg/kg	<0.040	<0.040	0.040	0.154	0.020	0.065	0.040	8223417
Total Zinc (Zn)	mg/kg	35.3	24.1	0.080	29.8	0.040	27.9	0.080	8223417

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B617947
Report Date: 2016/04/07

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: BS

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		OG2670	OG2673	OG2674	OG2675		OG2672		
Sampling Date		2016/03/04	2016/03/04	2016/03/04	2016/03/04		2016/03/04		
COC Number		08418990	08418990	08418990	08418990		08418990		
	UNITS	CC4.5-CCG-1	CC4.5-CCG-2	CC4.5-CCG-3	CC4.5-CCG-4	RDL	CC4.5BI-CCG-1	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	5.20	1.63	1.58	4.70	0.20	32.1	0.40	8223417
Total Antimony (Sb)	mg/kg	0.0011	<0.0010	0.0011	0.0014	0.0010	<0.0020	0.0020	8223417
Total Arsenic (As)	mg/kg	0.0451	0.0477	0.0432	0.0687	0.0050	0.082	0.010	8223417
Total Barium (Ba)	mg/kg	2.48	3.26	4.35	4.59	0.010	3.70	0.020	8223417
Total Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	<0.0040	0.0040	8223417
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	<0.040	0.040	8223417
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	<0.40	0.40	<0.80	0.80	8223417
Total Cadmium (Cd)	mg/kg	0.0121	0.0789	0.0221	0.0909	0.0020	0.0244	0.0040	8223417
Total Calcium (Ca)	mg/kg	11200	14100	21100	17900	2.0	12400	4.0	8223417
Total Chromium (Cr)	mg/kg	0.023	0.010	0.014	0.019	0.010	0.066	0.020	8223417
Total Cobalt (Co)	mg/kg	0.0180	0.0232	0.0235	0.0273	0.0040	0.0561	0.0080	8223417
Total Copper (Cu)	mg/kg	0.736	1.14	0.789	1.01	0.010	1.27	0.020	8223417
Total Iron (Fe)	mg/kg	16.8	16.0	20.1	19.8	1.0	87.2	2.0	8223417
Total Lead (Pb)	mg/kg	0.0077	0.0097	0.0067	0.0098	0.0020	0.0210	0.0040	8223417
Total Magnesium (Mg)	mg/kg	343	402	477	438	2.0	369	4.0	8223417
Total Manganese (Mn)	mg/kg	4.15	9.29	8.43	11.8	0.020	6.67	0.040	8223417
Total Mercury (Hg)	mg/kg	0.0884	0.0769	0.158	0.168	0.0020	0.0954	0.0040	8223417
Total Molybdenum (Mo)	mg/kg	0.013	0.015	0.015	0.022	0.010	0.023	0.020	8223417
Total Nickel (Ni)	mg/kg	0.017	0.037	0.022	0.032	0.010	0.071	0.020	8223417
Total Phosphorus (P)	mg/kg	7630	9240	12200	11600	2.0	7230	4.0	8223417
Total Potassium (K)	mg/kg	2480	2930	3100	3160	2.0	2360	4.0	8223417
Total Selenium (Se)	mg/kg	1.07	1.95	1.39	1.46	0.010	1.22	0.020	8223417
Total Silver (Ag)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	<0.0080	0.0080	8223417
Total Sodium (Na)	mg/kg	990	1230	1470	1470	2.0	733	4.0	8223417
Total Strontium (Sr)	mg/kg	14.7	18.9	24.9	24.1	0.010	16.8	0.020	8223417
Total Thallium (Tl)	mg/kg	0.00884	0.0119	0.0129	0.0143	0.00040	0.0106	0.00080	8223417
Total Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	<0.040	0.040	8223417
Total Titanium (Ti)	mg/kg	0.594	0.365	0.412	0.696	0.050	2.67	0.10	8223417
Total Uranium (U)	mg/kg	0.0551	0.0520	0.124	0.116	0.00040	0.107	0.00080	8223417
Total Vanadium (V)	mg/kg	0.141	0.123	0.209	0.249	0.020	0.207	0.040	8223417
Total Zinc (Zn)	mg/kg	24.2	23.1	36.7	25.0	0.040	23.0	0.080	8223417
RDL = Reportable Detection Limit									

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B617947
Report Date: 2016/04/07

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: BS

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		OG2682		
Sampling Date		2016/03/04		
COC Number		08418991		
	UNITS	IC4.5-BI-1	RDL	QC Batch
Total Metals by ICPMS				
Total Aluminum (Al)	mg/kg	1780	2.4	8223417
Total Antimony (Sb)	mg/kg	0.036	0.012	8223417
Total Arsenic (As)	mg/kg	2.50	0.060	8223417
Total Barium (Ba)	mg/kg	42.5	0.12	8223417
Total Beryllium (Be)	mg/kg	0.055	0.024	8223417
Total Bismuth (Bi)	mg/kg	<0.24	0.24	8223417
Total Boron (B)	mg/kg	<4.8	4.8	8223417
Total Cadmium (Cd)	mg/kg	0.171	0.024	8223417
Total Calcium (Ca)	mg/kg	1890	24	8223417
Total Chromium (Cr)	mg/kg	3.62	0.12	8223417
Total Cobalt (Co)	mg/kg	1.99	0.048	8223417
Total Copper (Cu)	mg/kg	6.32	0.12	8223417
Total Iron (Fe)	mg/kg	4340	12	8223417
Total Lead (Pb)	mg/kg	0.924	0.024	8223417
Total Magnesium (Mg)	mg/kg	1340	24	8223417
Total Manganese (Mn)	mg/kg	159	0.24	8223417
Total Mercury (Hg)	mg/kg	0.030	0.024	8223417
Total Molybdenum (Mo)	mg/kg	0.22	0.12	8223417
Total Nickel (Ni)	mg/kg	4.63	0.12	8223417
Total Phosphorus (P)	mg/kg	1860	24	8223417
Total Potassium (K)	mg/kg	1430	24	8223417
Total Selenium (Se)	mg/kg	0.54	0.12	8223417
Total Silver (Ag)	mg/kg	<0.048	0.048	8223417
Total Sodium (Na)	mg/kg	513	24	8223417
Total Strontium (Sr)	mg/kg	10.9	0.12	8223417
Total Thallium (Tl)	mg/kg	0.0551	0.0048	8223417
Total Tin (Sn)	mg/kg	0.25	0.24	8223417
Total Titanium (Ti)	mg/kg	214	0.60	8223417
Total Uranium (U)	mg/kg	1.26	0.0048	8223417
Total Vanadium (V)	mg/kg	6.69	0.24	8223417
Total Zinc (Zn)	mg/kg	47.8	0.48	8223417
RDL = Reportable Detection Limit				

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Maxxam Job #: B617947
Report Date: 2016/04/07

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: BS

PHYSICAL TESTING (TISSUE)

Maxxam ID		OG2657	OG2658	OG2659	OG2660	OG2661	OG2662	OG2663		
Sampling Date		2016/03/04	2016/03/04	2016/03/05	2016/03/05	2016/03/05	2016/03/05	2016/03/05		
COC Number		08418991	08418991	08418991	08418991	08418991	08418991	08418991		
	UNITS	CC4.5-BI-1	CC4.5-BI-2	CC4.5-BI-3	CC4.5-BI-4	CC4.5-BI-5	CC4.5-BI-6	CCM-BI-1	RDL	QC Batch
Physical Properties										
Moisture	%	71	70	81	73	78	72	80	0.30	8227173
RDL = Reportable Detection Limit										

Maxxam ID		OG2664	OG2668	OG2666	OG2667	OG2665	OG2669	OG2676		
Sampling Date		2016/03/04	2016/03/05	2016/03/04	2016/03/05	2016/03/04	2016/03/05	2016/03/04		
COC Number		08418991	08418990	08418991	08418990	08418991	08418990	08418990		
	UNITS	CC4.5-CH-1	CC4.5-CH-2	CC4.5-CH-3	CCM-CH-1	CCM-CH-2	CCM-CH-3	CC997-CCG-1	RDL	QC Batch
Physical Properties										
Moisture	%	77	82	59	78	77	78	75	0.30	8227173
RDL = Reportable Detection Limit										

Maxxam ID		OG2671	OG2670	OG2673	OG2674	OG2675	OG2682		
Sampling Date		2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04	2016/03/04		
COC Number		08418990	08418990	08418990	08418990	08418990	08418991		
	UNITS	CC0.5-CCG-2	CC4.5-CCG-1	CC4.5-CCG-2	CC4.5-CCG-3	CC4.5-CCG-4	IC4.5-BI-1	RDL	QC Batch
Physical Properties									
Moisture	%	82	78	81	80	76	67	0.30	8227173
RDL = Reportable Detection Limit									

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Maxxam Job #: B617947
Report Date: 2016/04/07

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: BS

GENERAL COMMENTS

Revised Report (Version 2R): Client sample IDs for samples OG2665, OG2668, OG2670, and OG2672 have been corrected, and sample reporting order has also been corrected [GRR].

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE) Comments

Sample OG2657-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2658-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2659-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2660-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2661-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2662-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2663-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2664-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2668-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2666-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2667-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2665-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2669-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2671-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2672-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.
Sample OG2682-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.

Results relate only to the items tested.

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Maxxam Job #: B617947
Report Date: 2016/04/07

QUALITY ASSURANCE REPORT

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: BS

			Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8223417	Total Aluminum (Al)	2016/03/30			<0.20	mg/kg				
8223417	Total Antimony (Sb)	2016/03/30	102	75 - 125	<0.0010	mg/kg				
8223417	Total Arsenic (As)	2016/03/30	100	75 - 125	<0.0050	mg/kg			100	75 - 125
8223417	Total Barium (Ba)	2016/03/30	110	75 - 125	<0.010	mg/kg				
8223417	Total Beryllium (Be)	2016/03/30	96	75 - 125	<0.0020	mg/kg				
8223417	Total Bismuth (Bi)	2016/03/30			<0.020	mg/kg				
8223417	Total Boron (B)	2016/03/30			<0.40	mg/kg				
8223417	Total Cadmium (Cd)	2016/03/30	98	75 - 125	<0.0020	mg/kg			110	75 - 125
8223417	Total Calcium (Ca)	2016/03/30			<2.0	mg/kg				
8223417	Total Chromium (Cr)	2016/03/30	106	75 - 125	<0.010	mg/kg			89	75 - 125
8223417	Total Cobalt (Co)	2016/03/30	104	75 - 125	<0.0040	mg/kg				
8223417	Total Copper (Cu)	2016/03/30	105	75 - 125	<0.010	mg/kg			100	75 - 125
8223417	Total Iron (Fe)	2016/03/30			<1.0	mg/kg			113	75 - 125
8223417	Total Lead (Pb)	2016/03/30	88	75 - 125	<0.0020	mg/kg			75	75 - 125
8223417	Total Magnesium (Mg)	2016/03/30			<2.0	mg/kg				
8223417	Total Manganese (Mn)	2016/03/30	103	75 - 125	<0.020	mg/kg				
8223417	Total Mercury (Hg)	2016/03/30	106	75 - 125	<0.0020	mg/kg			104	75 - 125
8223417	Total Molybdenum (Mo)	2016/03/30	102	75 - 125	<0.010	mg/kg				
8223417	Total Nickel (Ni)	2016/03/30	104	75 - 125	<0.010	mg/kg			95	75 - 125
8223417	Total Phosphorus (P)	2016/03/30			<2.0	mg/kg				
8223417	Total Potassium (K)	2016/03/30			<2.0	mg/kg				
8223417	Total Selenium (Se)	2016/03/30	93	75 - 125	<0.010	mg/kg			98	75 - 125
8223417	Total Silver (Ag)	2016/03/30	95	75 - 125	<0.0040	mg/kg				
8223417	Total Sodium (Na)	2016/03/30			<2.0	mg/kg				
8223417	Total Strontium (Sr)	2016/03/30	93	75 - 125	<0.010	mg/kg				
8223417	Total Thallium (Tl)	2016/03/30	98	75 - 125	<0.00040	mg/kg				
8223417	Total Tin (Sn)	2016/03/30	101	75 - 125	<0.020	mg/kg				
8223417	Total Titanium (Ti)	2016/03/30	106	75 - 125	<0.050	mg/kg				
8223417	Total Uranium (U)	2016/03/30	85	75 - 125	<0.00040	mg/kg				
8223417	Total Vanadium (V)	2016/03/30	106	75 - 125	<0.020	mg/kg				
8223417	Total Zinc (Zn)	2016/03/30	101	75 - 125	<0.040	mg/kg			99	75 - 125

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Maxxam Job #: B617947
Report Date: 2016/04/07

QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: BS

			Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8227173	Moisture	2016/03/30			<0.30	%	1.6	20		

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

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Maxxam Job #: B617947
Report Date: 2016/04/07

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK
Sampler Initials: BS

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Rob Reinert, Data Validation Coordinator

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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RECEIVED IN WHITEHORSE
BY: [signature]

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

COC # 08418991

BBY FCD-00077/05

Page 1 of 2

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)		Turnaround Time (TAT) Required
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053	[X] Regular TAT 5 days (Most analyses)
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102	Rush TAT (Surcharges will be applied)
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek	[ ] Same Day [ ] 2 Days
Phone:	867-393-4882	Phone:	867-393-4882	Site #:		[ ] 1 Day [ ] 3 Days
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com,	Sampled By:	B. Schonewille	Date Required:

TEMP: 0.12 / 0.2

2016 -03 -08 Time

Rush Confirmation #:

Regulatory Criteria		Special Instructions
[ ] BC CSR Soil	[ ] BC CSR Water	[ ] Return Cooler
[ ] CCME (Specify)	[ ] Other (Specify)	[ ] Ship Sample Bottles (Please Specify)
[ ] Drinking Water	[ ] BC Water Quality	

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH [ ] MTBE [ ] VOC/VPH [ ]	EPH [ ] TEH [ ]	PAH [ ] LEPH/HEPH [ ]	CCME-PHC BTEX/F1 [ ] F2-F4 [ ]	Dissolved Metals Filtered? [ ] Preserved? [ ]	Dissolved Mercury Filtered? [ ] Preserved? [ ]	Total Metals Field Preserved? [ ]	Total Mercury Field Preserved? [ ]	Chloride [ ] Fluoride [ ] Sulphate [ ]	TSS [ ] TDS [ ] BOD [ ] COD [ ]	pH [ ] Conductivity [ ] Alkalinity [ ]	Nitrite [ ] Nitrate [ ] Ammonia [ ]	Total Metals in Tissue (wet weight)	% Moisture in Tissue			# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	CC4.5-BI-1		2016/03/04	NA	tissue													x	x			1	
2	CC4.5-BI-2		2016/03/04	NA	tissue													x	x			1	
3	CC4.5-BI-3		2016/03/05	NA	tissue													x	x			1	
4	CC4.5-BI-4		2016/03/05	NA	tissue													x	x			1	
5	CC4.5-BI-5		2016/03/05	NA	tissue													x	x			1	
6	CC4.5-BI-6		2016/03/05	NA	tissue													x	x			1	
7	CCM-BI-1		2016/03/05	NA	tissue													x	x			1	
8	CC4.5-CH-1		2016/03/04	NA	tissue													x	x			1	
9	CC4.5-CH-2		2016/03/04	NA	tissue													x	x			1	
10	CC4.5-CH-3		2016/03/04	NA	tissue													x	x			1	

LABORATORY USE ONLY

CUSTODY SEAL (Y) / N		COOLER TEMPERATURES
Present	Intact	
Y	Y	3.1

COOLING MEDIA PRESENT (Y) / N

COMMENTS

B617947_COC

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
[signature]	2016/03/08	11:30	[signature] M. Smith	2016/03/08	11:45.	B617947
Lyndsay Doetzel			[signature]	2016/03/09	13:30	

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BY: MSde
2016 -03- 08

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

COC 08418990

BBY FCD-00077/05
Page 2 of 2

Invoice Information		Report Information (if differs from invoice)		Project Information (whe		ound Time (TAT) Required
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053	[x] Regular TAT 5 days (Most analyses)
Contact Name:	Shannon Jenner TEMP:	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306: 102	Rush TAT (Surcharges will be applied)
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek	[ ] Same Day [ ] 2 Days
Phone:	867-393-4882	Phone:	867-393-4882	Site #:		[ ] 1 Day [ ] 3 Days
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com	Sampled By:	B. Schonewille	Date Required:

Regulatory Criteria		Special Instructions
[ ] BC CSR Soil	[ ] BC CSR Water	[ ] Return Cooler
[ ] CCME (Specify)	[ ] Other (Specify)	[ ] Ship Sample Bottles (Please Specify)
[ ] Drinking Water	[ ] BC Water Quality	

Rush Confirmation #:

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH [ ] MTBE [ ] VOC/VPH [ ]	EPH [ ] TEH [ ]	PAH [ ] LEPH/HEPH [ ]	CCME-PHC BTEX/F1 [ ] F2-F4 [ ]	Dissolved Metals Filtered? [ ] Preserved? [ ]	Dissolved Mercury Filtered? [ ] Preserved? [ ]	Total Metals Field Preserved? [ ]	Total Mercury Field Preserved? [ ]	Chloride [ ] Fluoride [ ] Sulphate [ ]	TSS [ ] TDS [ ] BOD [ ] COD [ ]	pH [ ] Conductivity [ ] Alkalinity [ ]	Nitrite [ ] Nitrate [ ] Ammonia [ ]	Total Metals in Tissue (wet weight)	% Moisture in Tissue			# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	CCM-CH-1		2016/03/05	NA	tissue													x	x			1	
2	CCM-CH-2		2016/03/05	NA	tissue													x	x			1	
3	CCM-CH-3		2016/03/05	NA	tissue													x	x			1	
4	CC997-CCG-1		2016/03/04	NA	tissue													x	x			1	
5	CC0.5-CCG-2		2016/03/04	NA	tissue													x	x			1	
6	CC4.5-CCG-1		2016/03/04	NA	tissue													x	x			1	
7	CC4.5-CCG-2		2016/03/04	NA	tissue													x	x			1	
8	CC4.5-CCG-3		2016/03/04	NA	tissue													x	x			1	
9	CC4.5-CCG-4		2016/03/04	NA	tissue													x	x			1	
10	CC4.5BI-CCG-1		2016/03/04	NA	tissue													x	x			1	

LABORATORY USE ONLY

CUSTODY SEAL (Y / N) Present	Intact	COOLER TEMPERATURES
Y	Y	3/1

COOLING MEDIA PRESENT (Y) / N

B617947_COC

pool of 3 very small scuplins

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
[signature] L. Doetzel	2016/03/08	11:30	[signature] M. Smith	2016/03/08	11:45	B617947
			[signature]	2016/03/09	13:30	

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Success Through Science®

Your Project #: 14Y0306:102
Site Location: COFFEE CREEK
Your C.O.C. #: 08426765, 08426766, 08426767

Attention:LYNDSAY DOETZEL

EDI ENVIRONMENTAL DYNAMICS INC.
2195 2nd Avenue
WHITEHORSE, YT
CANADA Y1A 3T8

Report Date: 2016/09/27
Report #: R2269922
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B673221
Received: 2016/08/25, 14:15

Sample Matrix: TISSUE
Samples Received: 25

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by CRC ICPMS - Tissue Wet Wt	17	2016/09/19	2016/09/22	BBY7SOP-00021,	BCLM2005,EPA6020bR2m
Elements by CRC ICPMS - Tissue Wet Wt	1	2016/09/19	2016/09/27	BBY7SOP-00021,	BCLM2005,EPA6020bR2m
Elements by CRC ICPMS - Tissue Wet Wt	7	2016/09/20	2016/09/24	BBY7SOP-00021,	BCLM2005,EPA6020bR2m
Moisture in Tissue	25	N/A	2016/09/22	BBY8SOP-00017	OMOE E3139 3.1 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Maxxam
REPORT AUTOMATION ENGINE
27 Sep 2016 16:25:39 -07:00

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Graham Rudkin, Project Manager, Environmental
Email: GRudkin@maxxam.ca
Phone# (604)638-5926 Ext:5926

==========

This report has been generated and distributed using a secure automated process.
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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Maxxam Job #: B673221
Report Date: 2016/09/27

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PJ3303	PJ3304	PJ3305	PJ3306	PJ3307	PJ3308		
Sampling Date		2016/08/23 12:00	2016/08/23 12:00	2016/08/23 13:00	2016/08/20 12:00	2016/08/20 12:30	2016/08/20 12:00		
COC Number		08426765	08426765	08426765	08426765	08426765	08426765		
	UNITS	HF 0.2-B1-1	HF 0.2-B1-2	YT 0.2-B1-1	LAC 4.8-B1-1	LAC 4.8-B1-2	CF 10.0-B1-1	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	423	222	359	223	535	687	0.20	8402808
Total Antimony (Sb)	mg/kg	0.0918	0.0887	0.0466	0.0538	0.0632	0.0718	0.0010	8402808
Total Arsenic (As)	mg/kg	0.902	0.596	0.480	0.478	1.88	0.855	0.0050	8402808
Total Barium (Ba)	mg/kg	6.58	9.15	5.45	8.59	20.9	15.2	0.010	8402808
Total Beryllium (Be)	mg/kg	0.0190	0.0200	0.0170	0.0153	0.0441	0.0197	0.0020	8402808
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8402808
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	0.43	0.40	<0.40	0.40	8402808
Total Cadmium (Cd)	mg/kg	0.0955	0.104	0.0690	0.0836	0.135	0.425	0.0020	8402808
Total Calcium (Ca)	mg/kg	534	855	433	414	796	821	2.0	8402808
Total Chromium (Cr)	mg/kg	1.12	0.495	0.565	2.20	1.82	0.920	0.010	8402808
Total Cobalt (Co)	mg/kg	0.386	0.336	0.335	0.478	1.17	0.749	0.0040	8402808
Total Copper (Cu)	mg/kg	3.01	3.40	2.73	3.07	3.85	4.11	0.010	8402808
Total Iron (Fe)	mg/kg	698	457	622	675	1920	1210	1.0	8402808
Total Lead (Pb)	mg/kg	0.187	0.151	0.251	0.181	0.505	0.293	0.0020	8402808
Total Magnesium (Mg)	mg/kg	339	254	278	392	444	414	2.0	8402808
Total Manganese (Mn)	mg/kg	31.1	44.7	37.1	67.0	126	75.3	0.020	8402808
Total Mercury (Hg)	mg/kg	0.0114	0.0136	0.0115	0.0093	0.0065	0.0208	0.0020	8402808
Total Molybdenum (Mo)	mg/kg	0.116	0.288	0.128	0.218	0.200	0.192	0.010	8402808
Total Nickel (Ni)	mg/kg	0.811	0.753	0.476	1.47	2.79	0.862	0.010	8402808
Total Phosphorus (P)	mg/kg	1250	1380	1400	1070	634	1310	2.0	8402808
Total Potassium (K)	mg/kg	1110	1180	1290	1550	718	1160	2.0	8402808
Total Selenium (Se)	mg/kg	0.193	0.232	0.213	0.469	0.542	1.27	0.010	8402808
Total Silver (Ag)	mg/kg	0.0041	0.0044	0.0054	0.0059	0.0105	0.0159	0.0040	8402808
Total Sodium (Na)	mg/kg	436	442	513	1260	376	445	2.0	8402808
Total Strontium (Sr)	mg/kg	4.37	8.12	2.49	2.98	6.36	4.42	0.010	8402808
Total Thallium (Tl)	mg/kg	0.00782	0.00540	0.00512	0.00343	0.00768	0.0135	0.00040	8402808
Total Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8402808
Total Titanium (Ti)	mg/kg	17.5	9.84	19.0	11.0	25.0	36.6	0.050	8402808
Total Uranium (U)	mg/kg	1.45	5.76	0.280	0.178	0.282	1.06	0.00040	8402808
Total Vanadium (V)	mg/kg	1.17	0.850	1.12	1.45	3.45	2.42	0.020	8402808
Total Zinc (Zn)	mg/kg	19.2	19.8	20.3	14.3	14.2	25.1	0.040	8402808

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B673221
Report Date: 2016/09/27

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PJ3309	PJ3310	PJ3311	PJ3312	PJ3343	PJ3344		
Sampling Date		2016/08/20 13:00	2016/08/20 13:00	2016/08/20 14:00	2016/08/21 12:00	2016/08/21 13:00	2016/08/21 14:00		
COC Number		08426765	08426765	08426765	08426765	08426766	08426766		
	UNITS	CF 3.9-B1-1	HF 6.3-B1-1	IC 1.9-B1-1	YT 5.0-B1-1	LC 2.7-B1-1	LC 9.9-B1-1	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	1880	384	1270	352	400	447	0.20	8402808
Total Antimony (Sb)	mg/kg	0.0805	0.0923	0.0657	0.100	0.0302	0.0607	0.0010	8402808
Total Arsenic (As)	mg/kg	1.98	0.805	1.57	0.674	0.563	0.837	0.0050	8402808
Total Barium (Ba)	mg/kg	37.4	5.91	18.1	12.1	5.56	5.86	0.010	8402808
Total Beryllium (Be)	mg/kg	0.0497	0.0163	0.0431	0.0159	0.0191	0.0209	0.0020	8402808
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8402808
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	8402808
Total Cadmium (Cd)	mg/kg	0.259	0.131	0.187	0.0880	0.185	0.0670	0.0020	8402808
Total Calcium (Ca)	mg/kg	1130	380	573	471	518	435	2.0	8402808
Total Chromium (Cr)	mg/kg	2.05	0.653	2.47	0.539	0.586	0.655	0.010	8402808
Total Cobalt (Co)	mg/kg	1.83	0.273	1.14	0.462	0.361	0.291	0.0040	8402808
Total Copper (Cu)	mg/kg	3.98	2.03	3.20	1.78	2.54	2.14	0.010	8402808
Total Iron (Fe)	mg/kg	3980	523	2330	564	613	921	1.0	8402808
Total Lead (Pb)	mg/kg	0.692	0.161	0.697	0.229	0.218	0.286	0.0020	8402808
Total Magnesium (Mg)	mg/kg	1070	242	791	215	250	246	2.0	8402808
Total Manganese (Mn)	mg/kg	142	29.8	87.3	41.1	43.2	40.2	0.020	8402808
Total Mercury (Hg)	mg/kg	0.0245	0.0163	0.0210	0.0116	0.0188	0.0417	0.0020	8402808
Total Molybdenum (Mo)	mg/kg	0.308	0.125	0.217	0.099	0.112	0.094	0.010	8402808
Total Nickel (Ni)	mg/kg	1.76	0.442	1.72	0.406	0.534	0.433	0.010	8402808
Total Phosphorus (P)	mg/kg	950	1310	1360	1280	1170	1200	2.0	8402808
Total Potassium (K)	mg/kg	1230	1150	1480	1080	1090	1010	2.0	8402808
Total Selenium (Se)	mg/kg	1.07	0.555	0.760	0.099	0.727	0.221	0.010	8402808
Total Silver (Ag)	mg/kg	0.0122	0.0069	0.0099	0.0102	0.0075	0.0059	0.0040	8402808
Total Sodium (Na)	mg/kg	359	387	640	502	562	434	2.0	8402808
Total Strontium (Sr)	mg/kg	7.66	3.84	2.89	1.90	4.04	3.61	0.010	8402808
Total Thallium (Tl)	mg/kg	0.0465	0.00529	0.0286	0.00454	0.00561	0.00513	0.00040	8402808
Total Tin (Sn)	mg/kg	0.072	<0.020	0.049	<0.020	<0.020	<0.020	0.020	8402808
Total Titanium (Ti)	mg/kg	178	17.3	89.6	15.9	14.8	23.4	0.050	8402808
Total Uranium (U)	mg/kg	1.75	1.40	0.498	0.173	0.683	0.593	0.00040	8402808
Total Vanadium (V)	mg/kg	8.35	0.846	3.92	0.973	0.939	1.55	0.020	8402808
Total Zinc (Zn)	mg/kg	22.3	18.5	23.4	22.4	17.5	19.2	0.040	8402808
RDL = Reportable Detection Limit									

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Maxxam Job #: B673221
Report Date: 2016/09/27

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PJ3345	PJ3346	PJ3347	PJ3348		PJ3349		
Sampling Date		2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00		2016/08/23 12:00		
COC Number		08426766	08426766	08426766	08426766		08426766		
	UNITS	HF 0.2-AG-1	HF 0.2-CS-1	HF 0.2-CS-2	HF 0.2-CS-3	RDL	HF 0.2-CS-4	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	4.63	10.0	25.6	1.24	0.20	2.79	0.40	8402808
Total Antimony (Sb)	mg/kg	0.0119	0.0085	0.0061	0.0067	0.0010	0.0102	0.0020	8402808
Total Arsenic (As)	mg/kg	0.0636 (1)	0.0360	0.0561	0.0365	0.0050	0.039	0.010	8402808
Total Barium (Ba)	mg/kg	1.68	1.16	0.873	0.776	0.010	0.911	0.020	8402808
Total Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	<0.0040	0.0040	8402808
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	<0.020	0.020	<0.040	0.040	8402808
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	<0.40	0.40	<0.80	0.80	8402808
Total Cadmium (Cd)	mg/kg	0.0602	0.0255	0.0358	0.0122	0.0020	0.0196	0.0040	8402808
Total Calcium (Ca)	mg/kg	9190	4230	3650	3960	2.0	4550	4.0	8402808
Total Chromium (Cr)	mg/kg	0.011	0.023	0.256	<0.010	0.010	<0.020	0.020	8402808
Total Cobalt (Co)	mg/kg	0.0332	0.0213	0.0480	0.0183	0.0040	0.0476	0.0080	8402808
Total Copper (Cu)	mg/kg	0.659	0.790	0.676	0.599	0.010	0.660	0.020	8402808
Total Iron (Fe)	mg/kg	14.0	23.8	47.6	10.8	1.0	11.8	2.0	8402808
Total Lead (Pb)	mg/kg	0.0079	0.0083	0.0100	0.0035	0.0020	0.0048	0.0040	8402808
Total Magnesium (Mg)	mg/kg	375	302	317	318	2.0	341	4.0	8402808
Total Manganese (Mn)	mg/kg	2.80	1.54	2.58	1.28	0.020	1.49	0.040	8402808
Total Mercury (Hg)	mg/kg	0.0332	0.0211	0.0271	0.0268	0.0020	0.0258	0.0040	8402808
Total Molybdenum (Mo)	mg/kg	0.011	0.023	0.021	0.011	0.010	<0.020	0.020	8402808
Total Nickel (Ni)	mg/kg	0.015	0.025	0.108	0.017	0.010	0.026	0.020	8402808
Total Phosphorus (P)	mg/kg	8240	4660	4410	4850	2.0	5000	4.0	8402808
Total Potassium (K)	mg/kg	4110	3380	3610	3800	2.0	3520	4.0	8402808
Total Selenium (Se)	mg/kg	1.32	0.590	0.660	0.602	0.010	0.613	0.020	8402808
Total Silver (Ag)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	<0.0080	0.0080	8402808
Total Sodium (Na)	mg/kg	993	870	963	745	2.0	883	4.0	8402808
Total Strontium (Sr)	mg/kg	12.9	4.63	4.11	3.70	0.010	3.80	0.020	8402808
Total Thallium (Tl)	mg/kg	0.00643	0.00195	0.00348	0.00318	0.00040	0.00283	0.00080	8402808
Total Tin (Sn)	mg/kg	0.024	<0.020	<0.020	<0.020	0.020	0.048	0.040	8402808
Total Titanium (Ti)	mg/kg	0.324	0.578	1.56	0.243	0.050	0.37	0.10	8402808
Total Uranium (U)	mg/kg	0.0114	0.0215	0.0358	0.00776	0.00040	0.00881	0.00080	8402808
Total Vanadium (V)	mg/kg	<0.020	<0.020	0.046	<0.020	0.020	<0.040	0.040	8402808
Total Zinc (Zn)	mg/kg	28.6	25.2	24.8	25.5	0.040	26.5	0.080	8402808

RDL = Reportable Detection Limit
(1) Duplicate RPD above control limit - (10% of analytes failure allowed).

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Maxxam Job #: B673221
Report Date: 2016/09/27

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PJ3350		PJ3351	PJ3352	PJ3364	PJ3365		
Sampling Date		2016/08/23 12:00		2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00		
COC Number		08426766		08426766	08426766	08426767	08426767		
	UNITS	HF 0.2-CS-5	QC Batch	HF 0.2-CS-6	HF 0.2-CS-7	HF 0.2-CS-8	HF 0.2-CS-9	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	1.64	8402808	7.97	14.5	11.7	7.12	0.20	8404270
Total Antimony (Sb)	mg/kg	0.0094	8402808	0.0090	0.0078	0.0094	0.0078	0.0010	8404270
Total Arsenic (As)	mg/kg	0.0404	8402808	0.0377	0.0886	0.0526	0.0608	0.0050	8404270
Total Barium (Ba)	mg/kg	0.679	8402808	1.27	1.10	1.08	1.13	0.010	8404270
Total Beryllium (Be)	mg/kg	<0.0020	8402808	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8404270
Total Bismuth (Bi)	mg/kg	<0.020	8402808	<0.020	<0.020	<0.020	<0.020	0.020	8404270
Total Boron (B)	mg/kg	<0.40	8402808	<0.40	<0.40	<0.40	<0.40	0.40	8404270
Total Cadmium (Cd)	mg/kg	0.0594	8402808	0.0987	0.0367	0.0314	0.0306	0.0020	8404270
Total Calcium (Ca)	mg/kg	2960	8402808	5820	4750	5460	5260	2.0	8404270
Total Chromium (Cr)	mg/kg	<0.010	8402808	0.021	0.035	0.023	0.020	0.010	8404270
Total Cobalt (Co)	mg/kg	0.0428	8402808	0.0449	0.0366	0.0382	0.0449	0.0040	8404270
Total Copper (Cu)	mg/kg	0.562	8402808	1.06	0.835	0.763	0.596	0.010	8404270
Total Iron (Fe)	mg/kg	11.5	8402808	36.2	33.3	34.9	26.0	1.0	8404270
Total Lead (Pb)	mg/kg	0.0067	8402808	0.0105	0.0080	0.0074	0.0058	0.0020	8404270
Total Magnesium (Mg)	mg/kg	285	8402808	318	308	321	324	2.0	8404270
Total Manganese (Mn)	mg/kg	2.70	8402808	3.09	2.53	2.02	3.20	0.020	8404270
Total Mercury (Hg)	mg/kg	0.0255	8402808	0.0237	0.0278	0.0223	0.0235	0.0020	8404270
Total Molybdenum (Mo)	mg/kg	0.013	8402808	0.042	0.023	0.017	0.013	0.010	8404270
Total Nickel (Ni)	mg/kg	0.018	8402808	0.019	0.043	0.034	0.040	0.010	8404270
Total Phosphorus (P)	mg/kg	4090	8402808	5720	5040	5210	5210	2.0	8404270
Total Potassium (K)	mg/kg	3480	8402808	3290	3480	3220	3280	2.0	8404270
Total Selenium (Se)	mg/kg	0.649	8402808	0.545	0.553	0.635	0.676	0.010	8404270
Total Silver (Ag)	mg/kg	<0.0040	8402808	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	8404270
Total Sodium (Na)	mg/kg	883	8402808	927	999	989	961	2.0	8404270
Total Strontium (Sr)	mg/kg	3.69	8402808	6.08	5.90	5.33	5.60	0.010	8404270
Total Thallium (Tl)	mg/kg	0.00302	8402808	0.00328	0.00402	0.00255	0.00326	0.00040	8404270
Total Tin (Sn)	mg/kg	<0.020	8402808	<0.020	<0.020	<0.020	<0.020	0.020	8404270
Total Titanium (Ti)	mg/kg	0.199	8402808	0.739	1.00	0.856	0.843	0.050	8404270
Total Uranium (U)	mg/kg	0.00903	8402808	0.0135	0.0374	0.0271	0.0150	0.00040	8404270
Total Vanadium (V)	mg/kg	<0.020	8402808	0.025	0.040	0.039	0.034	0.020	8404270
Total Zinc (Zn)	mg/kg	20.4	8402808	29.8	23.1	29.4	28.1	0.040	8404270

RDL = Reportable Detection Limit

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Maxxam Job #: B673221
Report Date: 2016/09/27

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Client Project #: 14Y0306:102
Site Location: COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PJ3366	PJ3367	PJ3368		
Sampling Date		2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00		
COC Number		08426767	08426767	08426767		
	UNITS	HF 0.2-CS-10	HF 0.2-CS-11	HF 0.2-CS-12	RDL	QC Batch
Total Metals by ICPMS						
Total Aluminum (Al)	mg/kg	7.13	10.6	1.81	0.20	8404270
Total Antimony (Sb)	mg/kg	0.0084	0.0081	0.0067	0.0010	8404270
Total Arsenic (As)	mg/kg	0.0417	0.0514	0.0241	0.0050	8404270
Total Barium (Ba)	mg/kg	1.10	0.697	0.712	0.010	8404270
Total Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	0.0020	8404270
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	0.020	8404270
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	0.40	8404270
Total Cadmium (Cd)	mg/kg	0.0333	0.0289	0.0154	0.0020	8404270
Total Calcium (Ca)	mg/kg	6080	5140	4090	2.0	8404270
Total Chromium (Cr)	mg/kg	0.107	0.023	<0.010	0.010	8404270
Total Cobalt (Co)	mg/kg	0.0202	0.0198	0.0106	0.0040	8404270
Total Copper (Cu)	mg/kg	0.587	0.637	0.560	0.010	8404270
Total Iron (Fe)	mg/kg	28.7	27.0	13.5	1.0	8404270
Total Lead (Pb)	mg/kg	0.0039	0.0066	0.0026	0.0020	8404270
Total Magnesium (Mg)	mg/kg	321	321	347	2.0	8404270
Total Manganese (Mn)	mg/kg	1.57	1.39	1.02	0.020	8404270
Total Mercury (Hg)	mg/kg	0.0250	0.0293	0.0232	0.0020	8404270
Total Molybdenum (Mo)	mg/kg	0.016	0.016	0.011	0.010	8404270
Total Nickel (Ni)	mg/kg	0.017	0.028	0.022	0.010	8404270
Total Phosphorus (P)	mg/kg	5720	5180	4440	2.0	8404270
Total Potassium (K)	mg/kg	3480	3530	3160	2.0	8404270
Total Selenium (Se)	mg/kg	0.660	0.523	0.403	0.010	8404270
Total Silver (Ag)	mg/kg	<0.0040	<0.0040	<0.0040	0.0040	8404270
Total Sodium (Na)	mg/kg	957	911	956	2.0	8404270
Total Strontium (Sr)	mg/kg	5.46	5.65	4.32	0.010	8404270
Total Thallium (Tl)	mg/kg	0.00281	0.00304	0.00276	0.00040	8404270
Total Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	0.020	8404270
Total Titanium (Ti)	mg/kg	0.528	0.684	0.223	0.050	8404270
Total Uranium (U)	mg/kg	0.00758	0.0242	0.00498	0.00040	8404270
Total Vanadium (V)	mg/kg	<0.020	0.030	<0.020	0.020	8404270
Total Zinc (Zn)	mg/kg	36.0	27.9	23.0	0.040	8404270
RDL = Reportable Detection Limit						

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PHYSICAL TESTING (TISSUE)

Maxxam ID		PJ3303	PJ3304	PJ3305	PJ3306	PJ3307	PJ3308	PJ3309		
Sampling Date		2016/08/23 12:00	2016/08/23 12:00	2016/08/23 13:00	2016/08/20 12:00	2016/08/20 12:30	2016/08/20 12:00	2016/08/20 13:00		
COC Number		08426765	08426765	08426765	08426765	08426765	08426765	08426765		
	UNITS	HF 0.2-B1-1	HF 0.2-B1-2	YT 0.2-B1-1	LAC 4.8-B1-1	LAC 4.8-B1-2	CF 10.0-B1-1	CF 3.9-B1-1	RDL	QC Batch
Physical Properties										
Moisture	%	90	88	88	89	92	83	86	0.30	8405552
RDL = Reportable Detection Limit										

Maxxam ID		PJ3310	PJ3311	PJ3312	PJ3343	PJ3344	PJ3345	PJ3346		
Sampling Date		2016/08/20 13:00	2016/08/20 14:00	2016/08/21 12:00	2016/08/21 13:00	2016/08/21 14:00	2016/08/23 12:00	2016/08/23 12:00		
COC Number		08426765	08426765	08426765	08426766	08426766	08426766	08426766		
	UNITS	HF 6.3-B1-1	IC 1.9-B1-1	YT 5.0-B1-1	LC 2.7-B1-1	LC 9.9-B1-1	HF 0.2-AG-1	HF 0.2-CS-1	RDL	QC Batch
Physical Properties										
Moisture	%	88	88	89	90	87	78	76	0.30	8405552
RDL = Reportable Detection Limit										

Maxxam ID		PJ3347	PJ3348	PJ3349	PJ3350	PJ3351	PJ3352		
Sampling Date		2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00		
COC Number		08426766	08426766	08426766	08426766	08426766	08426766		
	UNITS	HF 0.2-CS-2	HF 0.2-CS-3	HF 0.2-CS-4	HF 0.2-CS-5	HF 0.2-CS-6	HF 0.2-CS-7	RDL	QC Batch
Physical Properties									
Moisture	%	78	79	76	79	74	86	0.30	8405552
RDL = Reportable Detection Limit									

Maxxam ID		PJ3364	PJ3365	PJ3366	PJ3367	PJ3368		
Sampling Date		2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00	2016/08/23 12:00		
COC Number		08426767	08426767	08426767	08426767	08426767		
	UNITS	HF 0.2-CS-8	HF 0.2-CS-9	HF 0.2-CS-10	HF 0.2-CS-11	HF 0.2-CS-12	RDL	QC Batch
Physical Properties								
Moisture	%	83	<0.30	86	78	81	0.30	8405569
RDL = Reportable Detection Limit								

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Maxxam Job #: B673221
Report Date: 2016/09/27

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK

GENERAL COMMENTS

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE) Comments

Sample PJ3349-01 Elements by CRC ICPMS - Tissue Wet Wt: RDL raised due to limited initial sample amount.

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B673221
Report Date: 2016/09/27

QUALITY ASSURANCE REPORT

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8402808	Total Aluminum (Al)	2016/09/27					<0.20	mg/kg	23	35		
8402808	Total Antimony (Sb)	2016/09/27	125	75 - 125	109	75 - 125	<0.0010	mg/kg	24	35		
8402808	Total Arsenic (As)	2016/09/27	112	75 - 125	106	75 - 125	<0.0050	mg/kg	40 (2)	35	100	75 - 125
8402808	Total Barium (Ba)	2016/09/27	NC	75 - 125	119	75 - 125	<0.010	mg/kg	2.1	35		
8402808	Total Beryllium (Be)	2016/09/27	114	75 - 125	111	75 - 125	<0.0020	mg/kg	NC	35		
8402808	Total Bismuth (Bi)	2016/09/27					<0.020	mg/kg	NC	35		
8402808	Total Boron (B)	2016/09/27					<0.40	mg/kg	NC	35		
8402808	Total Cadmium (Cd)	2016/09/27	109	75 - 125	109	75 - 125	<0.0020	mg/kg	1.3	35	109	75 - 125
8402808	Total Calcium (Ca)	2016/09/27					<2.0	mg/kg	0.68	35		
8402808	Total Chromium (Cr)	2016/09/27	106	75 - 125	99	75 - 125	<0.010	mg/kg	NC	35	89	75 - 125
8402808	Total Cobalt (Co)	2016/09/27	105	75 - 125	100	75 - 125	<0.0040	mg/kg	23	35		
8402808	Total Copper (Cu)	2016/09/27	NC	75 - 125	100	75 - 125	<0.010	mg/kg	1.9	35	100	75 - 125
8402808	Total Iron (Fe)	2016/09/27					<1.0	mg/kg	2.9	35	110	75 - 125
8402808	Total Lead (Pb)	2016/09/27	109	75 - 125	105	75 - 125	<0.0020	mg/kg	NC	35	73 (1)	75 - 125
8402808	Total Magnesium (Mg)	2016/09/27					<2.0	mg/kg	2.1	35		
8402808	Total Manganese (Mn)	2016/09/27	NC	75 - 125	104	75 - 125	<0.020	mg/kg	13	35		
8402808	Total Mercury (Hg)	2016/09/27	NC	75 - 125	110	75 - 125	0.0021, RDL=0.0020	mg/kg	1.3	35	105	75 - 125
8402808	Total Molybdenum (Mo)	2016/09/27	120	75 - 125	106	75 - 125	<0.010	mg/kg	NC	35		
8402808	Total Nickel (Ni)	2016/09/27	104	75 - 125	102	75 - 125	<0.010	mg/kg	NC	35	102	75 - 125
8402808	Total Phosphorus (P)	2016/09/27					<2.0	mg/kg	5.5	35		
8402808	Total Potassium (K)	2016/09/27					<2.0	mg/kg	8.4	35		
8402808	Total Selenium (Se)	2016/09/27	NC	75 - 125	116	75 - 125	<0.010	mg/kg	0.74	35	113	75 - 125
8402808	Total Silver (Ag)	2016/09/27	84	75 - 125	88	75 - 125	<0.0040	mg/kg	NC	35		
8402808	Total Sodium (Na)	2016/09/27					<2.0	mg/kg	2.2	35		
8402808	Total Strontium (Sr)	2016/09/27	NC	75 - 125	106	75 - 125	<0.010	mg/kg	8.2	35		
8402808	Total Thallium (Tl)	2016/09/27	106	75 - 125	108	75 - 125	<0.00040	mg/kg	14	35		
8402808	Total Tin (Sn)	2016/09/27	114	75 - 125	105	75 - 125	<0.020	mg/kg	NC	35		
8402808	Total Titanium (Ti)	2016/09/27	110	75 - 125	99	75 - 125	<0.050	mg/kg	4.4	35		
8402808	Total Uranium (U)	2016/09/27	102	75 - 125	103	75 - 125	0.00052, RDL=0.00040	mg/kg	6.4	35		
8402808	Total Vanadium (V)	2016/09/27	108	75 - 125	102	75 - 125	<0.020	mg/kg	NC	35		

Maxxam Job #: B673221
Report Date: 2016/09/27

QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8402808	Total Zinc (Zn)	2016/09/27	NC	75 - 125	106	75 - 125	<0.040	mg/kg	23	35	106	75 - 125
8404270	Total Aluminum (Al)	2016/09/24					<0.20	mg/kg	8.9	35		
8404270	Total Antimony (Sb)	2016/09/24	110	75 - 125	108	75 - 125	<0.0010	mg/kg	NC	35		
8404270	Total Arsenic (As)	2016/09/24	107	75 - 125	104	75 - 125	<0.0050	mg/kg	NC	35	99	75 - 125
8404270	Total Barium (Ba)	2016/09/24	NC	75 - 125	115	75 - 125	<0.010	mg/kg	7.7	35		
8404270	Total Beryllium (Be)	2016/09/24	111	75 - 125	107	75 - 125	<0.0020	mg/kg	NC	35		
8404270	Total Bismuth (Bi)	2016/09/24					<0.020	mg/kg	NC	35		
8404270	Total Boron (B)	2016/09/24					<0.40	mg/kg	NC	35		
8404270	Total Cadmium (Cd)	2016/09/24	110	75 - 125	107	75 - 125	<0.0020	mg/kg	NC	35	107	75 - 125
8404270	Total Calcium (Ca)	2016/09/24					<2.0	mg/kg	1.3	35		
8404270	Total Chromium (Cr)	2016/09/24	106	75 - 125	101	75 - 125	<0.010	mg/kg	NC	35	91	75 - 125
8404270	Total Cobalt (Co)	2016/09/24	106	75 - 125	102	75 - 125	<0.0040	mg/kg	NC	35		
8404270	Total Copper (Cu)	2016/09/24	NC	75 - 125	104	75 - 125	<0.010	mg/kg	17	35	100	75 - 125
8404270	Total Iron (Fe)	2016/09/24					<1.0	mg/kg	NC	35	103	75 - 125
8404270	Total Lead (Pb)	2016/09/24	98	75 - 125	100	75 - 125	<0.0020	mg/kg	NC	35	69 (1)	75 - 125
8404270	Total Magnesium (Mg)	2016/09/24					<2.0	mg/kg	17	35		
8404270	Total Manganese (Mn)	2016/09/24	NC	75 - 125	101	75 - 125	<0.020	mg/kg	7.9	35		
8404270	Total Mercury (Hg)	2016/09/24	109	75 - 125	110	75 - 125	<0.0020	mg/kg	NC	35	102	75 - 125
8404270	Total Molybdenum (Mo)	2016/09/24	104	75 - 125	100	75 - 125	<0.010	mg/kg	NC	35		
8404270	Total Nickel (Ni)	2016/09/24	108	75 - 125	103	75 - 125	<0.010	mg/kg	12	35	158 (1)	75 - 125
8404270	Total Phosphorus (P)	2016/09/24					<2.0	mg/kg	16	35		
8404270	Total Potassium (K)	2016/09/24					<2.0	mg/kg	10	35		
8404270	Total Selenium (Se)	2016/09/24	115	75 - 125	110	75 - 125	<0.010	mg/kg	NC	35	106	75 - 125
8404270	Total Silver (Ag)	2016/09/24	90	75 - 125	94	75 - 125	<0.0040	mg/kg	NC	35		
8404270	Total Sodium (Na)	2016/09/24					<2.0	mg/kg	NC	35		
8404270	Total Strontium (Sr)	2016/09/24	104	75 - 125	100	75 - 125	<0.010	mg/kg	6.2	35		
8404270	Total Thallium (Tl)	2016/09/24	102	75 - 125	107	75 - 125	<0.00040	mg/kg	NC	35		
8404270	Total Tin (Sn)	2016/09/24	103	75 - 125	102	75 - 125	<0.020	mg/kg	NC	35		
8404270	Total Titanium (Ti)	2016/09/24	105	75 - 125	103	75 - 125	<0.050	mg/kg	NC	35		
8404270	Total Uranium (U)	2016/09/24	99	75 - 125	100	75 - 125	<0.00040	mg/kg	NC	35		
8404270	Total Vanadium (V)	2016/09/24	108	75 - 125	107	75 - 125	<0.020	mg/kg	NC	35		

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Maxxam Job #: B673221
Report Date: 2016/09/27

QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8404270	Total Zinc (Zn)	2016/09/24	NC	75 - 125	108	75 - 125	<0.040	mg/kg	18	35	104	75 - 125
8405552	Moisture	2016/09/22					<0.30	%	3.7	20		
8405569	Moisture	2016/09/22					<0.30	%	7.6	20		

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

(1) Reference outside acceptance criteria - re-analysis yields similar results.

(2) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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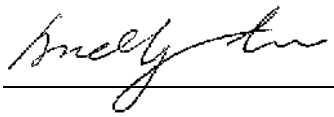
Maxxam Job #: B673221
Report Date: 2016/09/27

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306:102
Site Location: COFFEE CREEK

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Andy Lu, Ph.D., P.Chem., Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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CHAIN OF CUSTODY RECORD

COC 08426766

BBY FCD-00077/05

Invoice Information		Report Information (if differs from invoice)		Project Information (wher	
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:	
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek
Phone:	867-393-4882	Phone:	867-393-4882	Site #:	
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com,	Sampled By:	J. Taylor / J. Duncan

und Time (TAT) Required

[X] Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

[ ] Same Day [ ] 2 Days [ ] 1 Day [ ] 3 Days

Date Required:

Rush Confirmation #:

Regulatory Criteria

[ ] BC CSR Soil [ ] BC CSR Water [ ] CCME (Specify) [ ] Other (Specify) [ ] Drinking Water [ ] BC Water Quality

Special Instructions

[ ] Return Cooler [ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH [ ] MTBE [ ] VOC/VPH [ ]	EPH [ ] TEH [ ]	PAH [ ] LEPH/HEPH [ ]	CCME-PHC BTEX/ F1 [ ] F2 - F4 [ ]	Dissolved Metals Filtered? [ ] Preserved? [ ]	Dissolved Mercury Filtered? [ ] Preserved? [ ]	Total Metals Field Preserved? [ ]	Total Mercury Field Preserved? [ ]	Chloride [ ] Fluoride [ ] Sulphate [ ]	TSS [ ] TDS [ ] BOD [ ] COD [ ]	pH [ ] Conductivity [ ] Alkalinity [ ]	Nitrite [ ] Nitrate [ ] Ammonia [ ]	Total Metals in Tissue (wet weight)	% Moisture in Tissue			# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	LC2.7-B1-1		2016/08/21	13:00	tissue													x	x			1	
2	LC9.9-B1-1		2016/08/21	14:00	tissue													x	x			1	
3	HF0.2-AG-1		2016/08/23	12:00	tissue													x	x			1	
4	HF02-CS-1				tissue													x	x			1	
5	HF0.2-CS-2				tissue													x	x			1	
6	HF0.2-CS-3				tissue													x	x			1	
7	HF0.2-CS-4				tissue													x	x			1	
8	HF0.2-CS-5				tissue													x	x			1	
9	HF0.2-CS-6				tissue													x	x			1	
10	HF0.2-CS-7				tissue													x	x			1	

LABORATORY USE ONLY

CUSTODY SEAL Y / N — Present: NA — Intact:

COOLER TEMPERATURES: 3.2, 1.1

COOLING MEDIA PRESENT Y / N

COMMENTS:

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
L. Doetzel	2016/08/25	14:00	Laurel Berthier	2016/08/26	13:50

MAXXAM JOB # B673221

B673221_COC

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CHAIN OF CUSTODY RECORD

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

COC: 08426765

BBY FCD-00077/05

Page 1 of 3

Invoice Information		Report Information (if differs from invoice)		Project Information (where	
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:	
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek
Phone:	867-393-4882	Phone:	867-393-4882	Site #:	
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com,	Sampled By:	J. Taylor / J. Duncan

Turnaround Time (TAT) Required

[x] Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

[ ] Same Day [ ] 2 Days [ ] 1 Day [ ] 3 Days

Date Required:

Rush Confirmation #:

Regulatory Criteria

[ ] BC CSR Soil [ ] BC CSR Water [ ] CCME (Specify) [ ] Other (Specify) [ ] Drinking Water [ ] BC Water Quality

Special Instructions

[ ] Return Cooler [ ] Ship Sample Bottles (Please Specify)

Analysis Requested

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH	MTBE	VOC/VPH	EPH	TEH	PAH	LEPH/HEPH	CCME-PHC	BTEX/ F1	F2 - F4	Dissolved Metals	Filtered?	Preserved?	Dissolved Mercury	Filtered?	Preserved?	Total Metals	Field Preserved?	Total Mercury	Field Preserved?	Chloride	Fluoride	Sulphate	TSS	TDS	BOD	COD	pH	Conductivity	Alkalinity	Nitrite	Nitrate	Ammonia	Total Metals in Tissue (wet weight)	% Moisture in Tissue	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	HF02-B1-1		2016/08/23	12:00	tissue																																		x	x			1	
2	HF0.2-B1-2		2016/08/23	12:00	tissue																																		x	x			1	
3	YT0.2-B1-1		2016/08/23	13:00	tissue																																		x	x			1	
4	LAC4.8-B1-1		2016/08/20	12:00	tissue																																		x	x			1	
5	LAC4.8-B1-2		2016/08/20	12:50	tissue																																		x	x			1	
6	CF10.0-B1-1		2016/08/18	12:00	tissue																																		x	x			1	
7	CF3.9-B1-1		2016/08/18	13:00	tissue																																		x	x			1	
8	HF6.3-B1-1		2016/08/20	13:00	tissue																																		x	x			1	
9	IC1.9-B1-1		2016/08/20	14:00	tissue																																		x	x			1	
10	YT5.0-B1-1		2016/08/21	12:00	tissue																																		x	x			1	

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
NA		3.2.2 / 1.1

COOLING MEDIA PRESENT Y / N

COMMENTS

B673221_COC

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
L. Doetzel /	2016/08/25	14:00		2016/08/26	13:50	B673221

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CHAIN OF CUSTODY RECORD

COC 08426767

BBY FCD-00077/05
Page 3 of 3

Invoice Information		Report Information (if differs from invoice)		Project Information (where applicable)		Turnaround Time (TAT) Required
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053	[x] Regular TAT 5 days (Most analyses)
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102	Rush TAT (Surcharges will be applied)
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek	[ ] Same Day [ ] 2 Days
Phone:	867-393-4882	Phone:	867-393-4882	Site #:		[ ] 1 Day [ ] 3 Days
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com	Sampled By:	J. Taylor / J. Duncan	Date Required:
						Rush Confirmation #:

Regulatory Criteria

- [ ] BC CSR Soil
- [ ] BC CSR Water
- [ ] CCME (Specify)
- [ ] Other (Specify)
- [ ] Drinking Water
- [ ] BC Water Quality

Special Instructions

- [ ] Return Cooler
- [ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH ☐ MTBE ☐ VOC/VPH ☐	EPH ☐ TEH ☐	PAH ☐ LEPH/HEPH ☐	CCME-PHC BTEX/F1 ☐ F2 - F4 ☐	Dissolved Metals Filtered? ☐ Preserved? ☐	Dissolved Mercury Filtered? ☐ Preserved? ☐	Total Metals Field Preserved? ☐	Total Mercury Field Preserved? ☐	Chloride ☐ Fluoride ☐ Sulphate ☐	TSS ☐ TDS ☐ BOD ☐ COD ☐	pH ☐ Conductivity ☐ Alkalinity ☐	Nitrite ☐ Nitrate ☐ Ammonia ☐	Total Metals in Tissue (wet weight)	% Moisture in Tissue			# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	HFO.2-CS-8		2016/08/23	12:00	tissue													x	x			1	
2	HFO.2-CS-9		↓	↓	tissue													x	x			1	
3	HFO.2-CS-10				tissue													x	x			1	
4	HFO.2-CS-11				tissue													x	x			1	
5	HFO.2-CS-12				tissue													x	x			1	
6					tissue													x	x			1	
7					tissue													x	x			1	
8					tissue													x	x			1	
9					tissue													x	x			1	
10					tissue													x	x			1	

B673221_COC

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
NA		3.22

COOLING MEDIA PRESENT Y / N

COMMENTS

RECEIVED IN WHITEHORSE
BY: Slyons @ 1415
2016-08-25
TEMP: 1 / 1 / 10

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
L Doetzel [signature]	2016/08/25	14:00	Maurel Berthier	2016/08/26	13:50	B673221

Your Project #: 14Y0303:102
Site Location: COFFEE CREEK

Attention:LYNDSAY DOETZEL

EDI ENVIRONMENTAL DYNAMICS INC.
2195 2nd Avenue
WHITEHORSE, YT
CANADA Y1A 3T8

Your C.O.C. #: 08427766, 08427767, 08427768, 08427769, 08427770

Report Date: 2016/11/18
Report #: R2302800
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B684483
Received: 2016/09/26, 09:00

Sample Matrix: TISSUE
Samples Received: 45

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by CRC ICPMS - Tissue Wet Wt	45	2016/11/14	2016/11/17	BBY7SOP-00021,	BCLM2005,EPA6020bR2m
Moisture in Tissue	20	N/A	2016/11/15	BBY8SOP-00017	OMOE E3139 3.1 m
Moisture in Tissue	25	N/A	2016/11/16	BBY8SOP-00017	OMOE E3139 3.1 m

Remarks:

Maxxam Analytics' laboratories are accredited to ISO/IEC 17025:2005 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Maxxam are based upon recognized Provincial, Federal or US method compendia such as CCME, MDDELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Maxxam's profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Maxxam in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported: unless indicated otherwise, associated sample data are not blank corrected.

Maxxam Analytics' liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Maxxam has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Maxxam, unless otherwise agreed in writing.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods. Results relate to samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Your Project #: 14Y0303:102
Site Location: COFFEE CREEK

Attention:LYNDSAY DOETZEL

EDI ENVIRONMENTAL DYNAMICS INC.
2195 2nd Avenue
WHITEHORSE, YT
CANADA Y1A 3T8

Your C.O.C. #: 08427766, 08427767, 08427768, 08427769, 08427770

Report Date: 2016/11/18
Report #: R2302800
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B684483
Received: 2016/09/26, 09:00

Encryption Key

Maxxam
REPORT AUTOMATION ENGINE
18 Nov 2016 10:45:36

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Graham Rudkin, Project Manager, Environmental
Email: GRudkin@maxxam.ca
Phone# (604)638-5926 Ext:5926

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This report has been generated and distributed using a secure automated process.
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B684483
Report Date: 2016/11/18

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PP7258	PP7259	PP7260	PP7261	PP7262	PP7263		
Sampling Date		2016/07/09	2016/07/09	2016/07/09	2016/07/09	2016/07/09	2016/07/13		
COC Number		08427766	08427766	08427766	08427766	08427766	08427766		
	UNITS	LC2.7 3-1-A	LC2.7 3-1-B	LC2.7 3-3-A	LC2.7 3-3-B	LC2.7 3-3-C	LAC-1-BS	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	16.5	5.64	16.2	31.9	20.3	25.8	0.20	8469250
Total Antimony (Sb)	mg/kg	0.0051	0.0031	0.0030	0.0096	0.0030	0.0030	0.0010	8469250
Total Arsenic (As)	mg/kg	0.0349	0.0283	0.0471	0.0460	0.0442	0.0544	0.0050	8469250
Total Barium (Ba)	mg/kg	1.54	2.15	2.16	1.98	1.87	2.33	0.010	8469250
Total Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8469250
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8469250
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	8469250
Total Cadmium (Cd)	mg/kg	0.0767	0.0699	0.0665	0.0559	0.109	0.0578	0.0020	8469250
Total Calcium (Ca)	mg/kg	9400	11600	12300	12100	7940	10800	2.0	8469250
Total Chromium (Cr)	mg/kg	0.066	0.037	0.266	0.256	0.044	0.071	0.010	8469250
Total Cobalt (Co)	mg/kg	0.0323	0.0247	0.0457	0.0455	0.0453	0.0698	0.0040	8469250
Total Copper (Cu)	mg/kg	0.705	0.685	0.911	0.877	0.756	0.912	0.010	8469250
Total Iron (Fe)	mg/kg	36.6	23.0	38.8	55.1	39.0	57.8	1.0	8469250
Total Lead (Pb)	mg/kg	0.0180	0.0078	0.0296	0.0395	0.0160	0.0189	0.0020	8469250
Total Magnesium (Mg)	mg/kg	321	363	380	391	324	390	2.0	8469250
Total Manganese (Mn)	mg/kg	3.85	3.46	4.74	4.02	4.44	8.28	0.020	8469250
Total Mercury (Hg)	mg/kg	0.105	0.109	0.0639	0.0491	0.0427	0.0360	0.0020	8469250
Total Molybdenum (Mo)	mg/kg	0.014	<0.010	0.016	0.021	0.015	0.020	0.010	8469250
Total Nickel (Ni)	mg/kg	0.037	0.018	0.153	0.121	0.057	0.102	0.010	8469250
Total Phosphorus (P)	mg/kg	7210	8400	8780	8750	6650	8350	2.0	8469250
Total Potassium (K)	mg/kg	3230	3420	3540	3550	3220	3650	2.0	8469250
Total Selenium (Se)	mg/kg	1.20	0.929	1.20	1.17	1.73	1.30	0.010	8469250
Total Silver (Ag)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	8469250
Total Sodium (Na)	mg/kg	999	1120	1060	1010	890	1030	2.0	8469250
Total Strontium (Sr)	mg/kg	13.1	13.8	14.5	12.8	10.3	15.1	0.010	8469250
Total Thallium (Tl)	mg/kg	0.00579	0.00745	0.00647	0.00551	0.00643	0.00501	0.00040	8469250
Total Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8469250
Total Titanium (Ti)	mg/kg	1.14	0.634	1.30	2.18	1.70	1.78	0.050	8469250
Total Uranium (U)	mg/kg	0.0350	0.0292	0.0441	0.0462	0.0167	0.0108	0.00040	8469250
Total Vanadium (V)	mg/kg	0.071	0.025	0.070	0.094	0.069	0.112	0.020	8469250
Total Zinc (Zn)	mg/kg	22.6	22.2	29.1	23.0	25.6	20.2	0.040	8469250

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B684483
Report Date: 2016/11/18

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PP7264	PP7265	PP7266	PP7267	PP7268	PP7269		
Sampling Date		2016/07/13	2016/07/13	2016/07/12	2016/07/12	2016/07/12	2016/07/12		
COC Number		08427766	08427766	08427766	08427766	08427767	08427767		
	UNITS	LAC-2-BS	LAC-3-AG	IC-1.9 2-1-A	IC-1.9 2-1-B	IC-1.9 2-1-C	IC-1.9 3-1-D	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	62.4	37.8	30.2	29.2	29.7	55.1	0.20	8469250
Total Antimony (Sb)	mg/kg	0.0059	0.0037	0.0083	0.0075	0.0168	0.0176	0.0010	8469250
Total Arsenic (As)	mg/kg	0.188	0.0630	0.117	0.117	0.102	0.110	0.0050	8469250
Total Barium (Ba)	mg/kg	3.82	1.87	4.30	2.82	2.16	2.00	0.010	8469250
Total Beryllium (Be)	mg/kg	0.0039	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8469250
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8469250
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	0.40	<0.40	<0.40	0.40	8469250
Total Cadmium (Cd)	mg/kg	0.105	0.0615	0.184	0.138	0.0825	0.0849	0.0020	8469250
Total Calcium (Ca)	mg/kg	11500	8180	15900	9190	8650	6600	2.0	8469250
Total Chromium (Cr)	mg/kg	0.484	0.085	0.196	0.048	0.041	0.114	0.010	8469250
Total Cobalt (Co)	mg/kg	0.185	0.0682	0.0793	0.0583	0.0461	0.0697	0.0040	8469250
Total Copper (Cu)	mg/kg	0.940	0.903	1.13	0.868	1.09	1.09	0.010	8469250
Total Iron (Fe)	mg/kg	218	69.6	96.0	49.9	47.3	80.6	1.0	8469250
Total Lead (Pb)	mg/kg	0.0572	0.0216	0.0626	0.0646	0.0663	0.0935	0.0020	8469250
Total Magnesium (Mg)	mg/kg	417	371	434	300	331	337	2.0	8469250
Total Manganese (Mn)	mg/kg	15.1	5.53	10.3	7.84	5.50	6.01	0.020	8469250
Total Mercury (Hg)	mg/kg	0.0615	0.0436	0.0608	0.0495	0.110	0.0771	0.0020	8469250
Total Molybdenum (Mo)	mg/kg	0.024	0.016	0.037	0.025	0.022	0.034	0.010	8469250
Total Nickel (Ni)	mg/kg	0.407	0.126	0.265	0.124	0.069	0.106	0.010	8469250
Total Phosphorus (P)	mg/kg	9060	6890	11200	6840	7120	6290	2.0	8469250
Total Potassium (K)	mg/kg	3520	3810	3150	2990	3210	3140	2.0	8469250
Total Selenium (Se)	mg/kg	1.61	1.52	2.76	2.16	1.94	2.05	0.010	8469250
Total Silver (Ag)	mg/kg	0.0041	<0.0040	0.0053	<0.0040	<0.0040	<0.0040	0.0040	8469250
Total Sodium (Na)	mg/kg	1090	1120	1150	1010	1070	1110	2.0	8469250
Total Strontium (Sr)	mg/kg	19.0	11.0	20.4	11.2	11.1	8.05	0.010	8469250
Total Thallium (Tl)	mg/kg	0.00914	0.00570	0.00947	0.00808	0.0111	0.00867	0.00040	8469250
Total Tin (Sn)	mg/kg	<0.020	<0.020	0.040	0.034	0.040	0.169	0.020	8469250
Total Titanium (Ti)	mg/kg	3.29	2.10	2.47	1.98	1.98	4.37	0.050	8469250
Total Uranium (U)	mg/kg	0.0463	0.00787	0.0269	0.0174	0.0242	0.0331	0.00040	8469250
Total Vanadium (V)	mg/kg	0.322	0.160	0.347	0.261	0.110	0.163	0.020	8469250
Total Zinc (Zn)	mg/kg	24.5	19.8	36.5	30.0	31.9	28.9	0.040	8469250

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B684483
Report Date: 2016/11/18

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PP7270	PP7271	PP7272	PP7273	PP7274	PP7275		
Sampling Date		2016/07/12	2016/07/12	2016/07/12	2016/07/12	2016/07/12	2016/07/12		
COC Number		08427767	08427767	08427767	08427767	08427767	08427767		
	UNITS	IC-1.9 3-2-E	IC-1.9 2-3-F	IC-1.9 1-1-G	IC-1.9 1-1-H	IC-1.9 1-1-I	IC-1.9 1-1-J	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	46.2	38.6	43.5	37.9	58.1	38.5	0.20	8469250
Total Antimony (Sb)	mg/kg	0.0103	0.0447	0.0095	0.0304	0.0070	0.0073	0.0010	8469250
Total Arsenic (As)	mg/kg	0.121	0.159	0.141	0.125	0.122	0.113	0.0050	8469250
Total Barium (Ba)	mg/kg	4.39	1.69	3.88	3.90	3.27	3.07	0.010	8469250
Total Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8469250
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8469250
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	8469250
Total Cadmium (Cd)	mg/kg	0.183	0.0405	0.187	0.187	0.114	0.249	0.0020	8469250
Total Calcium (Ca)	mg/kg	17700	7270	14800	13200	10900	10000	2.0	8469250
Total Chromium (Cr)	mg/kg	0.087	0.055	0.086	0.069	0.106	0.082	0.010	8469250
Total Cobalt (Co)	mg/kg	0.0541	0.0462	0.0485	0.0457	0.0602	0.0532	0.0040	8469250
Total Copper (Cu)	mg/kg	0.974	0.917	0.903	0.888	1.10	0.882	0.010	8469250
Total Iron (Fe)	mg/kg	75.5	74.5	71.5	65.2	90.4	61.8	1.0	8469250
Total Lead (Pb)	mg/kg	0.0751	0.0872	0.100	0.103	0.0788	0.0728	0.0020	8469250
Total Magnesium (Mg)	mg/kg	463	329	387	365	351	363	2.0	8469250
Total Manganese (Mn)	mg/kg	12.9	5.92	7.14	10.6	9.37	9.00	0.020	8469250
Total Mercury (Hg)	mg/kg	0.0680	0.0620	0.102	0.0685	0.0513	0.0562	0.0020	8469250
Total Molybdenum (Mo)	mg/kg	0.032	0.027	0.028	0.027	0.031	0.025	0.010	8469250
Total Nickel (Ni)	mg/kg	0.127	0.086	0.095	0.097	0.118	0.166	0.010	8469250
Total Phosphorus (P)	mg/kg	11600	6210	9970	9010	8180	8630	2.0	8469250
Total Potassium (K)	mg/kg	2990	3220	2670	2850	2930	3120	2.0	8469250
Total Selenium (Se)	mg/kg	1.49	2.10	1.21	1.50	1.73	1.98	0.010	8469250
Total Silver (Ag)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	0.0054	<0.0040	0.0040	8469250
Total Sodium (Na)	mg/kg	1090	1050	1170	1000	1070	1180	2.0	8469250
Total Strontium (Sr)	mg/kg	21.3	8.40	18.9	16.2	13.4	13.2	0.010	8469250
Total Thallium (Tl)	mg/kg	0.0121	0.00824	0.0114	0.0101	0.00747	0.00845	0.00040	8469250
Total Tin (Sn)	mg/kg	0.032	0.047	<0.020	<0.020	<0.020	0.025	0.020	8469250
Total Titanium (Ti)	mg/kg	3.74	2.64	3.29	2.77	4.39	3.32	0.050	8469250
Total Uranium (U)	mg/kg	0.0470	0.0279	0.0521	0.0473	0.0358	0.0263	0.00040	8469250
Total Vanadium (V)	mg/kg	0.302	0.128	0.317	0.366	0.256	0.294	0.020	8469250
Total Zinc (Zn)	mg/kg	36.0	29.8	31.9	48.9	26.7	36.2	0.040	8469250

RDL = Reportable Detection Limit

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Maxxam Job #: B684483
Report Date: 2016/11/18

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PP7276	PP7277		PP7278	PP7279	PP7280		
Sampling Date		2016/07/11	2016/07/11		2016/07/11	2016/07/11	2016/07/11		
COC Number		08427767	08427767		08427768	08427768	08427768		
	UNITS	CF 3.9 3-1-A	CF-3.9 3-1-B	QC Batch	CF3.9 3-1-C	CF3.9 3-1-D	CF3.9 3-1-E	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	14.8	41.0	8469250	48.3	9.64	28.8	0.20	8469264
Total Antimony (Sb)	mg/kg	0.0156	0.0095	8469250	0.0170	0.0480	0.0231	0.0010	8469264
Total Arsenic (As)	mg/kg	0.118	0.134	8469250	0.0929	0.0847	0.0928	0.0050	8469264
Total Barium (Ba)	mg/kg	3.59	4.62	8469250	3.90	2.28	3.01	0.010	8469264
Total Beryllium (Be)	mg/kg	<0.0020	<0.0020	8469250	<0.0020	<0.0020	<0.0020	0.0020	8469264
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	8469250	<0.020	<0.020	<0.020	0.020	8469264
Total Boron (B)	mg/kg	<0.40	<0.40	8469250	<0.40	<0.40	<0.40	0.40	8469264
Total Cadmium (Cd)	mg/kg	0.230	0.439	8469250	0.0373	0.0259	0.0390	0.0020	8469264
Total Calcium (Ca)	mg/kg	14800	17800	8469250	15200	9700	12100	2.0	8469264
Total Chromium (Cr)	mg/kg	0.029	0.064	8469250	0.075	0.019	0.043	0.010	8469264
Total Cobalt (Co)	mg/kg	0.0450	0.0824	8469250	0.0469	0.0286	0.0497	0.0040	8469264
Total Copper (Cu)	mg/kg	1.15	1.28	8469250	1.02	0.943	0.854	0.010	8469264
Total Iron (Fe)	mg/kg	31.1	76.3	8469250	78.7	24.9	54.7	1.0	8469264
Total Lead (Pb)	mg/kg	0.202	0.161	8469250	0.109	0.0721	0.122	0.0020	8469264
Total Magnesium (Mg)	mg/kg	401	407	8469250	405	331	351	2.0	8469264
Total Manganese (Mn)	mg/kg	13.3	14.0	8469250	6.10	4.61	6.88	0.020	8469264
Total Mercury (Hg)	mg/kg	0.0927	0.0586	8469250	0.130	0.0830	0.0828	0.0020	8469264
Total Molybdenum (Mo)	mg/kg	0.018	0.036	8469250	0.029	0.016	0.026	0.010	8469264
Total Nickel (Ni)	mg/kg	0.076	0.183	8469250	0.071	0.033	0.049	0.010	8469264
Total Phosphorus (P)	mg/kg	10100	11900	8469250	10400	7570	8930	2.0	8469264
Total Potassium (K)	mg/kg	2650	3180	8469250	3090	3130	3090	2.0	8469264
Total Selenium (Se)	mg/kg	3.03	2.94	8469250	1.62	2.79	2.27	0.010	8469264
Total Silver (Ag)	mg/kg	<0.0040	<0.0040	8469250	<0.0040	0.0050	<0.0040	0.0040	8469264
Total Sodium (Na)	mg/kg	1140	1340	8469250	1090	1040	1070	2.0	8469264
Total Strontium (Sr)	mg/kg	18.4	21.3	8469250	18.6	13.3	15.6	0.010	8469264
Total Thallium (Tl)	mg/kg	0.0125	0.00797	8469250	0.0124	0.00915	0.0106	0.00040	8469264
Total Tin (Sn)	mg/kg	<0.020	0.037	8469250	<0.020	<0.020	<0.020	0.020	8469264
Total Titanium (Ti)	mg/kg	1.11	2.67	8469250	3.43	0.940	2.01	0.050	8469264
Total Uranium (U)	mg/kg	0.0364	0.0490	8469250	0.131	0.0620	0.0800	0.00040	8469264
Total Vanadium (V)	mg/kg	0.192	0.289	8469250	0.278	0.118	0.149	0.020	8469264
Total Zinc (Zn)	mg/kg	32.3	49.7	8469250	31.8	24.6	30.5	0.040	8469264
RDL = Reportable Detection Limit									

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Maxxam Job #: B684483
Report Date: 2016/11/18

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PP7281	PP7282	PP7283	PP7284	PP7285	PP7286		
Sampling Date		2016/07/11	2016/07/11	2016/07/11	2016/07/11	2016/07/11	2016/07/10		
COC Number		08427768	08427768	08427768	08427768	08427768	08427768		
	UNITS	CF3.9 3-1-F	CF3.9 3-1-G	CF3.9 3-1-H	CF3.9 3-1-I	CF3.9 3-1-J	CF10.0 AG-1	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	70.8	31.9	29.4	40.2	15.3	22.4	0.20	8469264
Total Antimony (Sb)	mg/kg	0.0222	0.0160	0.0344	0.0706	0.0292	0.0034	0.0010	8469264
Total Arsenic (As)	mg/kg	0.122	0.114	0.0920	0.116	0.103	0.0395	0.0050	8469264
Total Barium (Ba)	mg/kg	2.23	2.71	1.95	3.27	2.33	1.97	0.010	8469264
Total Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8469264
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8469264
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	8469264
Total Cadmium (Cd)	mg/kg	0.0573	0.0393	0.0283	0.0467	0.0246	0.0802	0.0020	8469264
Total Calcium (Ca)	mg/kg	5500	11100	6310	12400	8530	10100	2.0	8469264
Total Chromium (Cr)	mg/kg	0.124	0.055	0.041	0.063	0.029	0.139	0.010	8469264
Total Cobalt (Co)	mg/kg	0.0704	0.0427	0.0367	0.0758	0.0266	0.0392	0.0040	8469264
Total Copper (Cu)	mg/kg	1.01	0.816	0.774	0.950	0.808	0.723	0.010	8469264
Total Iron (Fe)	mg/kg	110	56.5	51.4	79.7	30.3	41.9	1.0	8469264
Total Lead (Pb)	mg/kg	0.0902	0.113	0.0841	0.144	0.0953	0.0226	0.0020	8469264
Total Magnesium (Mg)	mg/kg	328	360	300	368	391	358	2.0	8469264
Total Manganese (Mn)	mg/kg	4.95	5.07	3.83	7.36	4.98	4.23	0.020	8469264
Total Mercury (Hg)	mg/kg	0.0748	0.0791	0.0677	0.0894	0.114	0.0221	0.0020	8469264
Total Molybdenum (Mo)	mg/kg	0.030	0.019	0.022	0.022	0.025	0.019	0.010	8469264
Total Nickel (Ni)	mg/kg	0.117	0.051	0.047	0.086	0.062	0.099	0.010	8469264
Total Phosphorus (P)	mg/kg	5310	8440	5470	8810	7280	7820	2.0	8469264
Total Potassium (K)	mg/kg	3320	3390	3110	3300	3400	3480	2.0	8469264
Total Selenium (Se)	mg/kg	2.44	2.85	3.21	3.46	1.84	1.21	0.010	8469264
Total Silver (Ag)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.0040	8469264
Total Sodium (Na)	mg/kg	974	1090	1020	1050	1010	942	2.0	8469264
Total Strontium (Sr)	mg/kg	7.42	15.0	8.75	16.4	11.8	13.1	0.010	8469264
Total Thallium (Tl)	mg/kg	0.00858	0.00816	0.00816	0.0130	0.00898	0.00382	0.00040	8469264
Total Tin (Sn)	mg/kg	0.074	0.052	0.041	0.037	0.183	<0.020	0.020	8469264
Total Titanium (Ti)	mg/kg	5.28	2.10	1.94	2.52	0.814	1.81	0.050	8469264
Total Uranium (U)	mg/kg	0.0752	0.0519	0.0319	0.0673	0.101	0.0210	0.00040	8469264
Total Vanadium (V)	mg/kg	0.259	0.169	0.159	0.243	0.055	0.084	0.020	8469264
Total Zinc (Zn)	mg/kg	22.6	30.8	25.4	32.5	24.3	18.8	0.040	8469264

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B684483
Report Date: 2016/11/18

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PP7287	PP7288	PP7289	PP7290		PP7291		
Sampling Date		2016/07/10	2016/07/10	2016/07/10	2016/07/10		2016/07/10		
COC Number		08427768	08427769	08427769	08427769		08427769		
	UNITS	CF10.0 AG-2	CF10.0 AG-3	CF10.0 AG-4	CF10.0 2-1-K	QC Batch	CF10.0 3-1-L	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	23.2	19.0	25.8	14.7	8469264	9.78	0.20	8469326
Total Antimony (Sb)	mg/kg	0.0027	0.0022	0.0022	0.0028	8469264	0.0021	0.0010	8469326
Total Arsenic (As)	mg/kg	0.0487	0.0398	0.0445	0.0339	8469264	0.0344	0.0050	8469326
Total Barium (Ba)	mg/kg	1.77	3.66	1.37	2.37	8469264	3.02	0.010	8469326
Total Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	8469264	<0.0020	0.0020	8469326
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	<0.020	8469264	<0.020	0.020	8469326
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	<0.40	8469264	<0.40	0.40	8469326
Total Cadmium (Cd)	mg/kg	0.0342	0.0712	0.0623	0.0708	8469264	0.0622	0.0020	8469326
Total Calcium (Ca)	mg/kg	10900	11200	6600	10400	8469264	11800	2.0	8469326
Total Chromium (Cr)	mg/kg	0.075	0.128	0.240	0.044	8469264	0.079	0.010	8469326
Total Cobalt (Co)	mg/kg	0.0459	0.0372	0.0873	0.0338	8469264	0.0365	0.0040	8469326
Total Copper (Cu)	mg/kg	0.716	0.702	0.711	0.618	8469264	0.625	0.010	8469326
Total Iron (Fe)	mg/kg	43.5	44.0	64.5	33.3	8469264	25.5	1.0	8469326
Total Lead (Pb)	mg/kg	0.0163	0.0204	0.0118	0.0197	8469264	0.0084	0.0020	8469326
Total Magnesium (Mg)	mg/kg	394	362	299	351	8469264	385	2.0	8469326
Total Manganese (Mn)	mg/kg	6.71	4.73	3.54	3.63	8469264	5.03	0.020	8469326
Total Mercury (Hg)	mg/kg	0.0687	0.0412	0.0588	0.0400	8469264	0.0465	0.0020	8469326
Total Molybdenum (Mo)	mg/kg	0.018	0.016	0.015	0.017	8469264	0.014	0.010	8469326
Total Nickel (Ni)	mg/kg	0.052	0.077	0.110	0.028	8469264	0.040	0.010	8469326
Total Phosphorus (P)	mg/kg	8610	8210	5660	7930	8469264	8970	2.0	8469326
Total Potassium (K)	mg/kg	3680	3630	3380	3500	8469264	3510	2.0	8469326
Total Selenium (Se)	mg/kg	1.28	1.30	3.00	1.13	8469264	1.14	0.010	8469326
Total Silver (Ag)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	8469264	<0.0040	0.0040	8469326
Total Sodium (Na)	mg/kg	937	938	926	905	8469264	983	2.0	8469326
Total Strontium (Sr)	mg/kg	22.9	12.7	7.76	10.5	8469264	14.3	0.010	8469326
Total Thallium (Tl)	mg/kg	0.00770	0.00623	0.00623	0.00601	8469264	0.00780	0.00040	8469326
Total Tin (Sn)	mg/kg	<0.020	<0.020	<0.020	<0.020	8469264	0.022	0.020	8469326
Total Titanium (Ti)	mg/kg	2.07 (1)	1.84	2.55	1.49	8469264	1.20	0.050	8469326
Total Uranium (U)	mg/kg	0.0327	0.0219	0.0141	0.0248	8469264	0.0511	0.00040	8469326

RDL = Reportable Detection Limit
(1) Duplicate RPD above control limit - Reanalysis yields similar results.

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Maxxam Job #: B684483
Report Date: 2016/11/18

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PP7287	PP7288	PP7289	PP7290		PP7291		
Sampling Date		2016/07/10	2016/07/10	2016/07/10	2016/07/10		2016/07/10		
COC Number		08427768	08427769	08427769	08427769		08427769		
	UNITS	CF10.0 AG-2	CF10.0 AG-3	CF10.0 AG-4	CF10.0 2-1-K	QC Batch	CF10.0 3-1-L	RDL	QC Batch
Total Vanadium (V)	mg/kg	0.105 (1)	0.080	0.103	0.066	8469264	0.043	0.020	8469326
Total Zinc (Zn)	mg/kg	19.7	23.5	19.8	21.2	8469264	23.1	0.040	8469326

RDL = Reportable Detection Limit
(1) Duplicate RPD above control limit - (10% of analytes failure allowed).

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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PP7292	PP7293	PP7294	PP7295	PP7296	PP7297		
Sampling Date		2016/07/10	2016/07/10	2016/07/10	2016/07/10	2016/07/10	2016/07/10		
COC Number		08427769	08427769	08427769	08427769	08427769	08427769		
	UNITS	CF10.0 3-2-M	CF10.0 1-1-A	CF10.0 1-1-B	CF10.0 1-1-C	CF10.0 1-1-D	CF10.0 1-1-E	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	42.4	32.6	12.4	33.3	12.8	72.0	0.20	8469264
Total Antimony (Sb)	mg/kg	0.0039	0.0073	0.0074	0.0349	0.0110	0.0083	0.0010	8469264
Total Arsenic (As)	mg/kg	0.0736	0.0906	0.0721	0.122	0.0877	0.115	0.0050	8469264
Total Barium (Ba)	mg/kg	3.61	3.26	2.49	4.36	3.36	3.54	0.010	8469264
Total Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8469264
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8469264
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	8469264
Total Cadmium (Cd)	mg/kg	0.0710	0.0540	0.0279	0.0730	0.0395	0.0552	0.0020	8469264
Total Calcium (Ca)	mg/kg	7430	11000	11300	15100	13300	12000	2.0	8469264
Total Chromium (Cr)	mg/kg	0.065	0.054	0.024	0.069	0.026	0.104	0.010	8469264
Total Cobalt (Co)	mg/kg	0.0772	0.0563	0.0318	0.0705	0.0478	0.0858	0.0040	8469264
Total Copper (Cu)	mg/kg	0.810	1.13	0.884	1.17	0.836	1.23	0.010	8469264
Total Iron (Fe)	mg/kg	75.1	63.6	31.5	68.2	34.5	132	1.0	8469264
Total Lead (Pb)	mg/kg	0.0286	0.0276	0.0167	0.172	0.0592	0.0540	0.0020	8469264
Total Magnesium (Mg)	mg/kg	355	335	341	405	394	386	2.0	8469264
Total Manganese (Mn)	mg/kg	6.04	8.32	6.55	9.14	7.53	9.03	0.020	8469264
Total Mercury (Hg)	mg/kg	0.0309	0.0547	0.0627	0.0647	0.0463	0.0615	0.0020	8469264
Total Molybdenum (Mo)	mg/kg	0.033	0.027	0.016	0.037	0.022	0.030	0.010	8469264
Total Nickel (Ni)	mg/kg	0.059	0.069	0.037	0.159	0.045	0.100	0.010	8469264
Total Phosphorus (P)	mg/kg	6750	7660	8550	10700	9810	9040	2.0	8469264
Total Potassium (K)	mg/kg	3680	3000	2990	3340	3360	3040	2.0	8469264
Total Selenium (Se)	mg/kg	1.82	2.49	2.13	3.74	2.46	2.80	0.010	8469264
Total Silver (Ag)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	0.0050	0.0040	8469264
Total Sodium (Na)	mg/kg	875	950	1010	1030	1150	997	2.0	8469264
Total Strontium (Sr)	mg/kg	9.39	14.3	14.8	18.0	17.1	15.9	0.010	8469264
Total Thallium (Tl)	mg/kg	0.00781	0.0113	0.0123	0.0114	0.0112	0.0154	0.00040	8469264
Total Tin (Sn)	mg/kg	0.028	0.021	<0.020	0.074	<0.020	<0.020	0.020	8469264
Total Titanium (Ti)	mg/kg	3.28	2.40	1.03	1.88	1.38	6.11	0.050	8469264
Total Uranium (U)	mg/kg	0.0327	0.0716	0.0621	0.114	0.0858	0.0707	0.00040	8469264
Total Vanadium (V)	mg/kg	0.168	0.208	0.127	0.163	0.185	0.360	0.020	8469264
Total Zinc (Zn)	mg/kg	25.0	27.8	24.8	37.1	27.1	29.3	0.040	8469264

RDL = Reportable Detection Limit

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Maxxam Job #: B684483
Report Date: 2016/11/18

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

ELEMENTS BY ATOMIC SPECTROSCOPY - WET WT (TISSUE)

Maxxam ID		PP7298	PP7299	PP7300	PP7301	PP7302		
Sampling Date		2016/07/10	2016/07/10	2016/07/10	2016/07/10	2016/07/10		
COC Number		08427770	08427770	08427770	08427770	08427770		
	UNITS	CF10.0-1-1-F	CF10.0-1-1-G	CF10.0 1-1-H	CF10.0 1-1-J	CF10.0 1-1-I	RDL	QC Batch
Total Metals by ICPMS								
Total Aluminum (Al)	mg/kg	21.2	36.8	82.6	35.1	54.4	0.20	8469326
Total Antimony (Sb)	mg/kg	0.0124	0.0103	0.0122	0.0129	0.0195	0.0010	8469326
Total Arsenic (As)	mg/kg	0.0931	0.110	0.117	0.0962	0.121	0.0050	8469326
Total Barium (Ba)	mg/kg	3.02	4.12	4.34	3.72	3.90	0.010	8469326
Total Beryllium (Be)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8469326
Total Bismuth (Bi)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8469326
Total Boron (B)	mg/kg	<0.40	<0.40	<0.40	<0.40	<0.40	0.40	8469326
Total Cadmium (Cd)	mg/kg	0.0440	0.0534	0.0920	0.0519	0.0713	0.0020	8469326
Total Calcium (Ca)	mg/kg	11300	11100	11200	10500	11200	2.0	8469326
Total Chromium (Cr)	mg/kg	0.046	0.171	0.133	0.085	0.111	0.010	8469326
Total Cobalt (Co)	mg/kg	0.0434	0.0580	0.0883	0.0666	0.0703	0.0040	8469326
Total Copper (Cu)	mg/kg	1.07	0.767	1.29	0.982	1.11	0.010	8469326
Total Iron (Fe)	mg/kg	46.2	70.7	134	65.5	95.4	1.0	8469326
Total Lead (Pb)	mg/kg	0.0777	0.0546	0.0927	0.259	0.119	0.0020	8469326
Total Magnesium (Mg)	mg/kg	371	334	337	351	371	2.0	8469326
Total Manganese (Mn)	mg/kg	7.68	7.56	11.9	8.26	8.53	0.020	8469326
Total Mercury (Hg)	mg/kg	0.0488	0.0440	0.0462	0.0382	0.0418	0.0020	8469326
Total Molybdenum (Mo)	mg/kg	0.018	0.032	0.047	0.034	0.045	0.010	8469326
Total Nickel (Ni)	mg/kg	0.063	0.143	0.107	0.073	0.093	0.010	8469326
Total Phosphorus (P)	mg/kg	8720	7730	8670	8380	8190	2.0	8469326
Total Potassium (K)	mg/kg	3260	3140	3200	3090	3100	2.0	8469326
Total Selenium (Se)	mg/kg	3.00	2.57	2.85	2.70	2.51	0.010	8469326
Total Silver (Ag)	mg/kg	<0.0040	<0.0040	<0.0040	<0.0040	0.0046	0.0040	8469326
Total Sodium (Na)	mg/kg	1050	943	1080	1050	1020	2.0	8469326
Total Strontium (Sr)	mg/kg	14.9	14.0	15.0	15.3	14.1	0.010	8469326
Total Thallium (Tl)	mg/kg	0.0110	0.0106	0.0115	0.0111	0.00915	0.00040	8469326
Total Tin (Sn)	mg/kg	0.087	0.104	0.121	0.078	0.078	0.020	8469326
Total Titanium (Ti)	mg/kg	1.69	2.47	6.51	2.27	3.67	0.050	8469326
Total Uranium (U)	mg/kg	0.0735	0.0726	0.105	0.0641	0.0841	0.00040	8469326
Total Vanadium (V)	mg/kg	0.174	0.210	0.454	0.230	0.312	0.020	8469326
Total Zinc (Zn)	mg/kg	30.0	27.7	29.1	26.5	27.0	0.040	8469326
RDL = Reportable Detection Limit								

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Maxxam Job #: B684483
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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

PHYSICAL TESTING (TISSUE)

Maxxam ID		PP7258		PP7259	PP7260	PP7261	PP7262		
Sampling Date		2016/07/09		2016/07/09	2016/07/09	2016/07/09	2016/07/09		
COC Number		08427766		08427766	08427766	08427766	08427766		
	UNITS	LC2.7 3-1-A	QC Batch	LC2.7 3-1-B	LC2.7 3-3-A	LC2.7 3-3-B	LC2.7 3-3-C	RDL	QC Batch
Physical Properties									
Moisture	%	76	8470310	76	75	76	75	0.30	8470433
RDL = Reportable Detection Limit									

Maxxam ID		PP7263	PP7264		PP7265		PP7266	PP7267		
Sampling Date		2016/07/13	2016/07/13		2016/07/13		2016/07/12	2016/07/12		
COC Number		08427766	08427766		08427766		08427766	08427766		
	UNITS	LAC-1-BS	LAC-2-BS	QC Batch	LAC-3-AG	QC Batch	IC-1.9 2-1-A	IC-1.9 2-1-B	RDL	QC Batch
Physical Properties										
Moisture	%	78	76	8470310	77	8470433	78	76	0.30	8470307
RDL = Reportable Detection Limit										

Maxxam ID		PP7268	PP7269	PP7270	PP7271	PP7272	PP7273	PP7274		
Sampling Date		2016/07/12	2016/07/12	2016/07/12	2016/07/12	2016/07/12	2016/07/12	2016/07/12		
COC Number		08427767	08427767	08427767	08427767	08427767	08427767	08427767		
	UNITS	IC-1.9 2-1-C	IC-1.9 3-1-D	IC-1.9 3-2-E	IC-1.9 2-3-F	IC-1.9 1-1-G	IC-1.9 1-1-H	IC-1.9 1-1-I	RDL	QC Batch
Physical Properties										
Moisture	%	77	80	80	82	81	81	79	0.30	8470307
RDL = Reportable Detection Limit										

Maxxam ID		PP7275	PP7276	PP7277	PP7278	PP7279	PP7280	PP7281		
Sampling Date		2016/07/12	2016/07/11	2016/07/11	2016/07/11	2016/07/11	2016/07/11	2016/07/11		
COC Number		08427767	08427767	08427767	08427768	08427768	08427768	08427768		
	UNITS	IC-1.9 1-1-J	CF 3.9 3-1-A	CF-3.9 3-1-B	CF3.9 3-1-C	CF3.9 3-1-D	CF3.9 3-1-E	CF3.9 3-1-F	RDL	QC Batch
Physical Properties										
Moisture	%	77	79	74	77	82	79	79	0.30	8470307
RDL = Reportable Detection Limit										

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Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

PHYSICAL TESTING (TISSUE)

Maxxam ID		PP7282	PP7283	PP7284	PP7285		PP7286	PP7287		
Sampling Date		2016/07/11	2016/07/11	2016/07/11	2016/07/11		2016/07/10	2016/07/10		
COC Number		08427768	08427768	08427768	08427768		08427768	08427768		
	UNITS	CF3.9 3-1-G	CF3.9 3-1-H	CF3.9 3-1-I	CF3.9 3-1-J	QC Batch	CF10.0 AG-1	CF10.0 AG-2	RDL	QC Batch
Physical Properties										
Moisture	%	86	76	91	79	8470307	78	73	0.30	8470310
RDL = Reportable Detection Limit										

Maxxam ID		PP7288	PP7289	PP7290	PP7291	PP7292	PP7293	PP7294		
Sampling Date		2016/07/10	2016/07/10	2016/07/10	2016/07/10	2016/07/10	2016/07/10	2016/07/10		
COC Number		08427769	08427769	08427769	08427769	08427769	08427769	08427769		
	UNITS	CF10.0 AG-3	CF10.0 AG-4	CF10.0 2-1-K	CF10.0 3-1-L	CF10.0 3-2-M	CF10.0 1-1-A	CF10.0 1-1-B	RDL	QC Batch
Physical Properties										
Moisture	%	77	77	74	74	77	77	79	0.30	8470310
RDL = Reportable Detection Limit										

Maxxam ID		PP7295	PP7296	PP7297	PP7298	PP7299	PP7300	PP7301		
Sampling Date		2016/07/10	2016/07/10	2016/07/10	2016/07/10	2016/07/10	2016/07/10	2016/07/10		
COC Number		08427769	08427769	08427769	08427770	08427770	08427770	08427770		
	UNITS	CF10.0 1-1-C	CF10.0 1-1-D	CF10.0 1-1-E	CF10.0-1-1-F	CF10.0-1-1-G	CF10.0 1-1-H	CF10.0 1-1-J	RDL	QC Batch
Physical Properties										
Moisture	%	79	81	81	86	86	80	87	0.30	8470310
RDL = Reportable Detection Limit										

Maxxam ID		PP7302		
Sampling Date		2016/07/10		
COC Number		08427770		
	UNITS	CF10.0 1-1-I	RDL	QC Batch
Physical Properties				
Moisture	%	88	0.30	8470310
RDL = Reportable Detection Limit				

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Maxxam Job #: B684483
Report Date: 2016/11/18

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

GENERAL COMMENTS

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B684483
Report Date: 2016/11/18

QUALITY ASSURANCE REPORT

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8469250	Total Aluminum (Al)	2016/11/17					0.21, RDL=0.20	mg/kg	19	35		
8469250	Total Antimony (Sb)	2016/11/17	113	75 - 125	109	75 - 125	<0.0010	mg/kg	NC	35		
8469250	Total Arsenic (As)	2016/11/17	119	75 - 125	112	75 - 125	<0.0050	mg/kg	33	35	105	75 - 125
8469250	Total Barium (Ba)	2016/11/17	NC	75 - 125	121	75 - 125	<0.010	mg/kg	2.1	35		
8469250	Total Beryllium (Be)	2016/11/17	111	75 - 125	111	75 - 125	<0.0020	mg/kg	NC	35		
8469250	Total Bismuth (Bi)	2016/11/17					<0.020	mg/kg	NC	35		
8469250	Total Boron (B)	2016/11/17					<0.40	mg/kg	NC	35		
8469250	Total Cadmium (Cd)	2016/11/17	114	75 - 125	109	75 - 125	<0.0020	mg/kg	15	35	107	75 - 125
8469250	Total Calcium (Ca)	2016/11/17					<2.0	mg/kg	8.6	35		
8469250	Total Chromium (Cr)	2016/11/17	109	75 - 125	111	75 - 125	<0.010	mg/kg	23	35	85	75 - 125
8469250	Total Cobalt (Co)	2016/11/17	108	75 - 125	114	75 - 125	<0.0040	mg/kg	0.64	35		
8469250	Total Copper (Cu)	2016/11/17	NC	75 - 125	113	75 - 125	<0.010	mg/kg	6.3	35	99	75 - 125
8469250	Total Iron (Fe)	2016/11/17					<1.0	mg/kg	28	35	97	75 - 125
8469250	Total Lead (Pb)	2016/11/17	113	75 - 125	114	75 - 125	<0.0020	mg/kg	3.1	35	71 (1)	75 - 125
8469250	Total Magnesium (Mg)	2016/11/17					<2.0	mg/kg	1.2	35		
8469250	Total Manganese (Mn)	2016/11/17	NC	75 - 125	110	75 - 125	<0.020	mg/kg	9.1	35		
8469250	Total Mercury (Hg)	2016/11/17	NC	75 - 125	109	75 - 125	0.0034, RDL=0.0020	mg/kg	13	35	116	75 - 125
8469250	Total Molybdenum (Mo)	2016/11/17	115	75 - 125	101	75 - 125	<0.010	mg/kg	NC	35		
8469250	Total Nickel (Ni)	2016/11/17	105	75 - 125	114	75 - 125	<0.010	mg/kg	15	35	91	75 - 125
8469250	Total Phosphorus (P)	2016/11/17					<2.0	mg/kg	3.9	35		
8469250	Total Potassium (K)	2016/11/17					<2.0	mg/kg	7.3	35		
8469250	Total Selenium (Se)	2016/11/17	NC	75 - 125	116	75 - 125	<0.010	mg/kg	7.6	35	109	75 - 125
8469250	Total Silver (Ag)	2016/11/17	81	75 - 125	94	75 - 125	<0.0040	mg/kg	NC	35		
8469250	Total Sodium (Na)	2016/11/17					<2.0	mg/kg	0.058	35		
8469250	Total Strontium (Sr)	2016/11/17	NC	75 - 125	111	75 - 125	<0.010	mg/kg	2.4	35		
8469250	Total Thallium (Tl)	2016/11/17	109	75 - 125	109	75 - 125	<0.00040	mg/kg	3.3	35		
8469250	Total Tin (Sn)	2016/11/17	103	75 - 125	104	75 - 125	<0.020	mg/kg	NC	35		
8469250	Total Titanium (Ti)	2016/11/17	NC	75 - 125	102	75 - 125	<0.050	mg/kg	25	35		
8469250	Total Uranium (U)	2016/11/17	116	75 - 125	113	75 - 125	<0.00040	mg/kg	5.0	35		

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Maxxam Job #: B684483
Report Date: 2016/11/18

QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8469250	Total Vanadium (V)	2016/11/17	105	75 - 125	109	75 - 125	<0.020	mg/kg	9.1	35		
8469250	Total Zinc (Zn)	2016/11/17	NC	75 - 125	112	75 - 125	<0.040	mg/kg	3.5	35	108	75 - 125
8469264	Total Aluminum (Al)	2016/11/17					<0.20	mg/kg	27	35		
8469264	Total Antimony (Sb)	2016/11/17	110	75 - 125	109	75 - 125	<0.0010	mg/kg	NC	35		
8469264	Total Arsenic (As)	2016/11/17	122	75 - 125	115	75 - 125	<0.0050	mg/kg	11	35	107	75 - 125
8469264	Total Barium (Ba)	2016/11/17	NC	75 - 125	126 (3)	75 - 125	<0.010	mg/kg	28	35		
8469264	Total Beryllium (Be)	2016/11/17	106	75 - 125	111	75 - 125	<0.0020	mg/kg	NC	35		
8469264	Total Bismuth (Bi)	2016/11/17					<0.020	mg/kg	NC	35		
8469264	Total Boron (B)	2016/11/17					<0.40	mg/kg	NC	35		
8469264	Total Cadmium (Cd)	2016/11/17	109	75 - 125	110	75 - 125	<0.0020	mg/kg	8.0	35	109	75 - 125
8469264	Total Calcium (Ca)	2016/11/17					<2.0	mg/kg	24	35		
8469264	Total Chromium (Cr)	2016/11/17	113	75 - 125	107	75 - 125	<0.010	mg/kg	4.5	35	87	75 - 125
8469264	Total Cobalt (Co)	2016/11/17	108	75 - 125	111	75 - 125	<0.0040	mg/kg	5.8	35		
8469264	Total Copper (Cu)	2016/11/17	NC	75 - 125	112	75 - 125	<0.010	mg/kg	11	35	99	75 - 125
8469264	Total Iron (Fe)	2016/11/17					<1.0	mg/kg	35	35	100	75 - 125
8469264	Total Lead (Pb)	2016/11/17	111	75 - 125	118	75 - 125	<0.0020	mg/kg	6.5	35	71 (2)	75 - 125
8469264	Total Magnesium (Mg)	2016/11/17					<2.0	mg/kg	1.4	35		
8469264	Total Manganese (Mn)	2016/11/17	NC	75 - 125	108	75 - 125	<0.020	mg/kg	22	35		
8469264	Total Mercury (Hg)	2016/11/17	NC	75 - 125	112	75 - 125	0.0033, RDL=0.0020	mg/kg	9.2	35	113	75 - 125
8469264	Total Molybdenum (Mo)	2016/11/17	118	75 - 125	102	75 - 125	<0.010	mg/kg	NC	35		
8469264	Total Nickel (Ni)	2016/11/17	107	75 - 125	110	75 - 125	<0.010	mg/kg	NC	35	95	75 - 125
8469264	Total Phosphorus (P)	2016/11/17					<2.0	mg/kg	14	35		
8469264	Total Potassium (K)	2016/11/17					<2.0	mg/kg	4.9	35		
8469264	Total Selenium (Se)	2016/11/17	NC	75 - 125	112	75 - 125	<0.010	mg/kg	0.48	35	108	75 - 125
8469264	Total Silver (Ag)	2016/11/17	77	75 - 125	97	75 - 125	<0.0040	mg/kg	NC	35		
8469264	Total Sodium (Na)	2016/11/17					<2.0	mg/kg	2.0	35		
8469264	Total Strontium (Sr)	2016/11/17	NC	75 - 125	109	75 - 125	<0.010	mg/kg	12	35		
8469264	Total Thallium (Tl)	2016/11/17	117	75 - 125	112	75 - 125	<0.00040	mg/kg	1.2	35		
8469264	Total Tin (Sn)	2016/11/17	102	75 - 125	106	75 - 125	<0.020	mg/kg	NC	35		
8469264	Total Titanium (Ti)	2016/11/17	NC	75 - 125	104	75 - 125	<0.050	mg/kg	61 (4)	35		

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Maxxam Job #: B684483
Report Date: 2016/11/18

QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8469264	Total Uranium (U)	2016/11/17	117	75 - 125	115	75 - 125	<0.00040	mg/kg	3.6	35		
8469264	Total Vanadium (V)	2016/11/17	117	75 - 125	111	75 - 125	<0.020	mg/kg	36 (4)	35		
8469264	Total Zinc (Zn)	2016/11/17	NC	75 - 125	115	75 - 125	<0.040	mg/kg	5.4	35	108	75 - 125
8469326	Total Aluminum (Al)	2016/11/17					<0.20	mg/kg	14	35		
8469326	Total Antimony (Sb)	2016/11/17	109	75 - 125	111	75 - 125	<0.0010	mg/kg	NC	35		
8469326	Total Arsenic (As)	2016/11/17	120	75 - 125	115	75 - 125	<0.0050	mg/kg	7.4	35	107	75 - 125
8469326	Total Barium (Ba)	2016/11/17	NC	75 - 125	123	75 - 125	<0.010	mg/kg	4.2	35		
8469326	Total Beryllium (Be)	2016/11/17	107	75 - 125	114	75 - 125	<0.0020	mg/kg	NC	35		
8469326	Total Bismuth (Bi)	2016/11/17					<0.020	mg/kg	NC	35		
8469326	Total Boron (B)	2016/11/17					<0.40	mg/kg	NC	35		
8469326	Total Cadmium (Cd)	2016/11/17	111	75 - 125	111	75 - 125	<0.0020	mg/kg	3.3	35	108	75 - 125
8469326	Total Calcium (Ca)	2016/11/17					<2.0	mg/kg	3.8	35		
8469326	Total Chromium (Cr)	2016/11/17	106	75 - 125	113	75 - 125	<0.010	mg/kg	7.2	35	87	75 - 125
8469326	Total Cobalt (Co)	2016/11/17	105	75 - 125	116	75 - 125	<0.0040	mg/kg	2.9	35		
8469326	Total Copper (Cu)	2016/11/17	NC	75 - 125	116	75 - 125	<0.010	mg/kg	0.63	35	101	75 - 125
8469326	Total Iron (Fe)	2016/11/17					<1.0	mg/kg	2.2	35	99	75 - 125
8469326	Total Lead (Pb)	2016/11/17	111	75 - 125	118	75 - 125	<0.0020	mg/kg	NC	35	81	75 - 125
8469326	Total Magnesium (Mg)	2016/11/17					<2.0	mg/kg	2.6	35		
8469326	Total Manganese (Mn)	2016/11/17	NC	75 - 125	116	75 - 125	<0.020	mg/kg	2.5	35		
8469326	Total Mercury (Hg)	2016/11/17	NC	75 - 125	112	75 - 125	0.0039, RDL=0.0020	mg/kg	8.0	35	105	75 - 125
8469326	Total Molybdenum (Mo)	2016/11/17	112	75 - 125	108	75 - 125	<0.010	mg/kg	NC	35		
8469326	Total Nickel (Ni)	2016/11/17	103	75 - 125	117	75 - 125	<0.010	mg/kg	NC	35	91	75 - 125
8469326	Total Phosphorus (P)	2016/11/17					<2.0	mg/kg	1.1	35		
8469326	Total Potassium (K)	2016/11/17					<2.0	mg/kg	2.4	35		
8469326	Total Selenium (Se)	2016/11/17	NC	75 - 125	115	75 - 125	<0.010	mg/kg	4.0	35	110	75 - 125
8469326	Total Silver (Ag)	2016/11/17	79	75 - 125	89	75 - 125	<0.0040	mg/kg	NC	35		
8469326	Total Sodium (Na)	2016/11/17					<2.0	mg/kg	1.8	35		
8469326	Total Strontium (Sr)	2016/11/17	NC	75 - 125	112	75 - 125	<0.010	mg/kg	0.74	35		
8469326	Total Thallium (Tl)	2016/11/17	108	75 - 125	112	75 - 125	<0.00040	mg/kg	2.3	35		
8469326	Total Tin (Sn)	2016/11/17	104	75 - 125	105	75 - 125	<0.020	mg/kg	NC	35		

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Maxxam Job #: B684483
Report Date: 2016/11/18

QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8469326	Total Titanium (Ti)	2016/11/17	112	75 - 125	108	75 - 125	<0.050	mg/kg	32	35		
8469326	Total Uranium (U)	2016/11/17	116	75 - 125	116	75 - 125	<0.00040	mg/kg	3.0	35		
8469326	Total Vanadium (V)	2016/11/17	108	75 - 125	114	75 - 125	<0.020	mg/kg	NC	35		
8469326	Total Zinc (Zn)	2016/11/17	NC	75 - 125	116	75 - 125	<0.040	mg/kg	0.56	35	103	75 - 125
8470307	Moisture	2016/11/15					<0.30	%	11	20		
8470310	Moisture	2016/11/16					<0.30	%	2.6	20		
8470433	Moisture	2016/11/16					<0.30	%	2.4	20		

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

(1) Reference outside acceptance criteria - re-analysis yields similar results.

(2) Reference outside acceptance criteria (10% of analytes failure allowed).

(3) Blank Spike outside acceptance criteria (10% of analytes failure allowed).

(4) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

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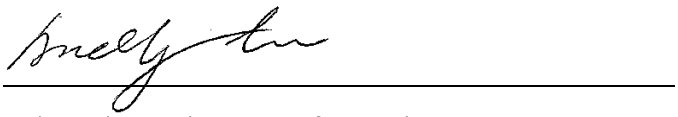
Maxxam Job #: B684483
Report Date: 2016/11/18

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0303:102
Site Location: COFFEE CREEK
Sampler Initials: DH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Andy Lu, Ph.D., P.Chem., Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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CHAIN OF CUSTODY RECORD

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

COC #: 08427766

BBY FCD-00077/05

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Invoice Information		Report Information (if differs from invoice)		Project Information (where a	
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:	
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek
Phone:	867-393-4882	Phone:	867-393-4882	Site #:	
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com.	Sampled By:	~~J. Taylor/J. Duncan~~ B.Snow

Turnaround Time (TAT) Required

[x] Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

[ ] Same Day [ ] 2 Days [ ] 1 Day [ ] 3 Days

Date Required:

Rush Confirmation #:

Regulatory Criteria

[ ] BC CSR Soil [ ] BC CSR Water [ ] CCME (Specify) [ ] Other (Specify) [ ] Drinking Water [ ] BC Water Quality

Special Instructions

[ ] Return Cooler [ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH	EPH	PAH	CCME-PHC	Dissolved Metals	Dissolved Mercury	Total Metals	Total Mercury	Chloride	TSS	pH	Nitrite	Total Metals in Tissue (wet weight)	% Moisture in Tissue	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	LC2.7 3-1-A		2016/07/09		tissue													x	x	1	
2	LC2.7 3-1-B		"		tissue													x	x	1	
3	LC2.7 3-3-A		"		tissue													x	x	1	
4	LC2.7 3-3-B		"		tissue													x	x	1	
5	LC2.7 3-3-C		"		tissue													x	x	1	
6	LaC-1-BS		2016/07/13		tissue													x	x	1	
7	LaC-2-BS		2016/07/13		tissue													x	x	1	
8	LaC-3-AG		2016/07/13		tissue													x	x	1	
9	IC-1.9 2-1-A		2016/07/12		tissue													x	x	1	
10	IC-1.9 2-1-B		2016/07/12		tissue													x	x	1	

LABORATORY USE ONLY

CUSTODY SEAL Y / (N) — Present / Intact

COOLER TEMPERATURES: 9.0 | 11.0

COOLING MEDIA PRESENT (Y) / N

COMMENTS: whole body tissue

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
L.Doetzel	2016/09/26	09:00	JWAHINNE NOV	2016/09/27	16:15

B684483_COC

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CHAIN OF CUSTODY RECORD

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

COC #: 08427767

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Invoice Information		Report Information (if differs from invoice)		Project Information (where a	
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:	
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek
Phone:	867-393-4882	Phone:	867-393-4882	Site #:	
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com.	Sampled By:	~~J. Taylor~~ / J. Duncan / D. Hansen

Required Time (TAT) Required

[x] Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

[ ] Same Day [ ] 2 Days [ ] 1 Day [ ] 3 Days

Date Required:

Rush Confirmation #:

Regulatory Criteria

[ ] BC CSR Soil [ ] BC CSR Water [ ] CCME (Specify) [ ] Other (Specify) [ ] Drinking Water [ ] BC Water Quality

Special Instructions

[ ] Return Cooler [ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

#	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH ☐ MTBE ☐ VOC/VPH ☐	EPH ☐ TEH ☐	PAH ☐ LEPH/HEPH ☐	CCME-PHC ☐ BTEX/ F1 ☐ F2 - F4 ☐	Dissolved Metals ☐ Filtered? ☐ Preserved? ☐	Dissolved Mercury ☐ Filtered? ☐ Preserved? ☐	Total Metals ☐ Field Preserved? ☐	Total Mercury ☐ Field Preserved? ☐	Chloride ☐ Fluoride ☐ Sulphate ☐	TSS ☐ TDS ☐ BOD ☐ COD ☐	pH ☐ Conductivity ☐ Alkalinity ☐	Nitrite ☐ Nitrate ☐ Ammonia ☐	Total Metals in Tissue (wet weight)	% Moisture in Tissue	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	IC-1.9 2-1-C		2016/07/12		tissue													x	x	1	
2	IC-1.9 3-1-D				tissue													x	x	1	
3	IC-1.9 3-2-E				tissue													x	x	1	
4	IC-1.9 2-3-F				tissue													x	x	1	
5	IC-1.9 1-1-G				tissue													x	x	1	
6	IC-1.9 1-1-H				tissue													x	x	1	
7	IC-1.9 1-1-I				tissue													x	x	1	
8	IC-1.9 1-1-J				tissue													x	x	1	
9	CF 3.9 3-1-A		2016/07/11		tissue													x	x	1	
10	CF-3.9 3-1-B		"		tissue													x	x	1	

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
		9/10.10

COOLING MEDIA PRESENT Y / N

COMMENTS: whole body tissue

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
L. Doetzel	2016/09/26	09:00	JWAHNE NOV	2016/09/27	16:15

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CHAIN OF CUSTODY RECORD

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

COC #: 08427768

BBY FCD-00077/05

Page 3 of 5

Invoice Information

Company Name: EDI Environmental Dynamics Inc.
Contact Name: Shannon Jenner
Address: 2195 2nd Avenue
Whitehorse, YT PC: Y1A 3T8
Phone: 867-393-4882
Email: sjenner@edynamics.com

Report Information (if differs from invoice)

Company Name: EDI
Contact Name: Lyndsay Doetzel
Address: same as invoice
PC:
Phone: 867-393-4882
Email: ldoetzel@edynamics.com,

Project Information (where a

Quotation #: B60053
P.O. #/ AFE#:
Project #: 14Y0306:102
Site Location: Coffee Creek
Site #:
Sampled By: ~~J. Taylor~~/ J. Duncan/ D. Hansen

d Time (TAT) Required

x Regular TAT 5 days (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

☐ Same Day ☐ 2 Days
☐ 1 Day ☐ 3 Days

Date Required:

Rush Confirmation #:

Regulatory Criteria

☐ BC CSR Soil ☐ BC CSR Water
☐ CCME (Specify) ☐ Other (Specify)
☐ Drinking Water ☐ BC Water Quality

Special Instructions

☐ Return Cooler
☐ Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

BTEX/VPH ☐ MTBE ☐ VOC/VPH ☐
EPH ☐ TEH ☐
PAH ☐ LEPH/HEPH ☐
CCME-PHC BTEX/ F1 ☐ F2 - F4 ☐
Dissolved Metals Filtered? ☐ Preserved? ☐
Dissolved Mercury Filtered? ☐ Preserved? ☐
Total Metals Field Preserved? ☐
Total Mercury Field Preserved? ☐
Chloride ☐ Fluoride ☐ Sulphate ☐
TSS ☐ TDS ☐ BOD ☐ COD ☐
pH ☐ Conductivity ☐ Alkalinity ☐
Nitrite ☐ Nitrate ☐ Ammonia ☐
Total Metals in Tissue (wet weight)
% Moisture in Tissue

LABORATORY USE ONLY

CUSTODY SEAL Y / N — Present / Intact
COOLER TEMPERATURES

COOLING MEDIA PRESENT Y / N

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE	COMMENTS
1	CF3.9 3-1-C		2016/07/11		tissue	1		whole body tissue
2	CF3.9 3-1-D				tissue	1		
3	CF3.9 3-1-E				tissue	1		
4	CF3.9 3-1-F				tissue	1		
5	CF3.9 3-1-G				tissue	1		
6	CF3.9 3-1-H				tissue	1		
7	CF3.9 3-1-I				tissue	1		
8	CF3.9 3-1-J				tissue	1		
9	CF10.0 AG-1		2016/07/10		tissue	1		
10	CF10.0 AG-2		2016/07/10		tissue	1		

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
L. Doetzel	2016/09/26	09:30	JWAHNNE MAY	2016/09/27	16:15

B684483_COC

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COC #: 08427769

BBY FCD-00077/05
Page 4 of 5

Invoice Information		Report Information (if differs from invoice)		Project Information (where a		Time (TAT) Required
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053	[x] Regular TAT 5 days (Most analyses)
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:		PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102	Rush TAT (Surcharges will be applied)
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek	[ ] Same Day [ ] 2 Days
Phone:	867-393-4882	Phone:	867-393-4882	Site #:		[ ] 1 Day [ ] 3 Days
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com,	Sampled By:	D. Hansen / J. Duncan	Date Required:
						Rush Confirmation #:

Regulatory Criteria

- [ ] BC CSR Soil
- [ ] BC CSR Water
- [ ] CCME (Specify)
- [ ] Other (Specify)
- [ ] Drinking Water
- [ ] BC Water Quality

Special Instructions

- [ ] Return Cooler
- [ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH ☐ MTBE ☐ VOC/VPH ☐	EPH ☐ TEH ☐	PAH ☐ LEPH/HEPH ☐	CCME-PHC BTEX/F1 ☐ F2 - F4 ☐	Dissolved Metals Filtered? ☐ Preserved? ☐	Dissolved Mercury Filtered? ☐ Preserved? ☐	Total Metals Field Preserved? ☐	Total Mercury Field Preserved? ☐	Chloride ☐ Fluoride ☐ Sulphate ☐	TSS ☐ TDS ☐ BOD ☐ COD ☐	pH ☐ Conductivity ☐ Alkalinity ☐	Nitrite ☐ Nitrate ☐ Ammonia ☐	Total Metals in Tissue (wet weight)	% Moisture in Tissue			# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE	COMMENTS
1	CF10.0 AG-3		2016/07/10		tissue													x	x			1		whole body
2	CF 10.0 AG-4		2016/07/10		tissue													x	x			1		
3	CF10.0 2-1-K		2016/07/10		tissue													x	x			1		
4	CF10.0 3-1-L		"		tissue													x	x			1		
5	CF 10.0 3-2-M		2016/07/10		tissue													x	x			1		
6	CF 10.0 1-1-A		2016/07/10		tissue													x	x			1		see comment on pg 5.
7	CF 10.0 1-1-B		"		tissue													x	x			1		
8	CF 10.0 1-1-C				tissue													x	x			1		
9	CF 10.0 1-1-D				tissue													x	x			1		
10	CF 10.0 1-1-E				tissue													x	x			1		

LABORATORY USE ONLY

CUSTODY SEAL Y / N (Y circled)		COOLER TEMPERATURES
Present	Intact	
		9, 10, 10

COOLING MEDIA PRESENT (Y) / N

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
[signature] L.Doetzel	2016/09/26	09:00	[signature] JUNAHNNE MOY	2016/09/27	16:15

B684483_COC

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COC #: 08427770

BBY FCD-00077/05

Page 5 of 5

Invoice Information		Report Information (if differs from invoice)		Project Information (where a...	
Company Name:	EDI Environmental Dynamics Inc.	Company Name:	EDI	Quotation #:	B60053
Contact Name:	Shannon Jenner	Contact Name:	Lyndsay Doetzel	P.O. #/ AFE#:	
Address:	2195 2nd Avenue	Address:	same as invoice	Project #:	14Y0306:102
	Whitehorse, YT PC: Y1A 3T8		PC:	Site Location:	Coffee Creek
Phone:	867-393-4882	Phone:	867-393-4882	Site #:	
Email:	sjenner@edynamics.com	Email:	ldoetzel@edynamics.com,	Sampled By:	D. Hansen / J. Duncan

d Time (TAT) Required

- [x] **Regular TAT 5 days** (Most analyses)

PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS

Rush TAT (Surcharges will be applied)

- [ ] Same Day
- [ ] 1 Day
- [ ] 2 Days
- [ ] 3 Days

Date Required:

Rush Confirmation #:

Regulatory Criteria

- [ ] BC CSR Soil
- [ ] BC CSR Water
- [ ] CCME (Specify)
- [ ] Other (Specify)
- [ ] Drinking Water
- [ ] BC Water Quality

Special Instructions

- [ ] Return Cooler
- [ ] Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

Analysis Requested

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	BTEX/VPH ☐ MTBE ☐ VOC/VPH ☐	EPH ☐ TEH ☐	PAH ☐ LEPH/HEPH ☐	CCME-PHC ☐ BTEX/F1 ☐ F2 - F4 ☐	Dissolved Metals ☐ Filtered? ☐ Preserved? ☐	Dissolved Mercury ☐ Filtered? ☐ Preserved? ☐	Total Metals ☐ Field Preserved? ☐	Total Mercury ☐ Field Preserved? ☐	Chloride ☐ Fluoride ☐ Sulphate ☐	TSS ☐ TDS ☐ BOD ☐ COD ☐	pH ☐ Conductivity ☐ Alkalinity ☐	Nitrite ☐ Nitrate ☐ Ammonia ☐	Total Metals in Tissue (wet weight)	% Moisture in Tissue	# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	CF10.0-1-1-F		2016/07/10		tissue													x	x	1	
2	CF10.0-1-1-G		"		tissue													x	x	1	
3	CF10.0 1-1-H				tissue													x	x	1	
4	CF10.0 1-1-J				tissue													x	x	1	
5	CF10.0 1-1-I				tissue													x	x	1	
6					tissue													x	x	1	
7					tissue													x	x	1	
8					tissue													x	x	1	
9					tissue													x	x	1	
10					tissue													x	x	1	

LABORATORY USE ONLY

CUSTODY SEAL Present	CUSTODY SEAL Intact	COOLER TEMPERATURES
		4.0, 1.0

COOLING MEDIA PRESENT Y / N

COMMENTS

If any samples from CF10.0 are too small for analysis please combine

RECEIVED IN WHITEHORSE

BY: [signature]

2016-09-26

TEMP: -12 / -12 / -12

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)
[signature] L.Doetzel	2016/09/26	09:00	JWATHNE	2016/09/27	16:15

B684483_COC

APPENDIX F. 2016 STREAM CROSSING PHOTOGRAPHS

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Photo 1. Crossing #51 (Indian River Trib 1) – upstream view.



Photo 2. Crossing #51 (Indian River Trib 1) – downstream view.



Photo 3. Crossing #52 (Indian River Trib 2) – upstream view downstream of road.



Photo 4. Crossing #52 (Indian River Trib 2) – downstream view downstream of road.



Photo 5. Crossing #52 (Indian River Trib 2) – upstream view from existing road.



Photo 6. Crossing #52 (Indian River Trib 2) – upstream view from existing road.



Photo 7. Crossing #53 (Indian River Trib 3) – upstream view.



Photo 8. Crossing #53 (Indian River Trib 3) – downstream view.



Photo 9. Crossing #53 (Indian River Trib 3) – upstream view from existing road.



Photo 10. Crossing #53 (Indian River Trib 3) – upstream view towards existing road.



Photo 11. Crossing #54 (Indian River Trib 4) – upstream view.



Photo 12. Crossing #54 (Indian River Trib 4) – downstream view.



Photo 13. Crossing #54.5 (Eureka Trib) – upstream view.



Photo 14. Crossing #54.5 (Eureka Trib) – downstream view.



Photo 15. Crossing #55 (Eureka Creek) – upstream view.



Photo 16. Crossing #55 (Eureka Creek) – downstream view.

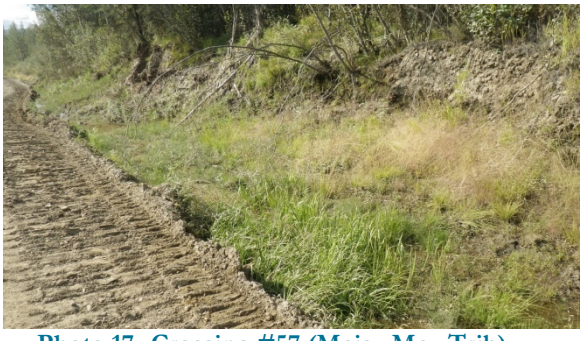


Photo 17. Crossing #57 (Maisy May Trib).



Photo 18. Crossing #57 (Maisy May Trib).



Photo 19. Crossing #60 (Maisy May Trib) – upstream view



Photo 20. Crossing #60 (Maisy May Trib) – downstream view.



Photo 21. Crossing #61 (Maisy May Trib).



Photo 22. Crossing #61 (Maisy May Trib).



Photo 23. Crossing #72 (Maisy May Trib) – upstream view.



Photo 24. Crossing #72 (Maisy May Trib) – downstream view.



Photo 25. Crossing #73 (Maisy May Trib).



Photo 26. Crossing #73 (Maisy May Trib).



Photo 27. Crossing #74 (Maisy May Trib) – upstream view.



Photo 28. Crossing #74 (Maisy May Trib) – downstream view.



Photo 29. Crossing #75 (Maisy May Trib 1) – upstream view.



Photo 30. Crossing #75 (Maisy May Trib 1) – downstream view of culvert inlet.



Photo 31. Crossing #75 (Maisy May Trib 1) – culvert outlet.



Photo 32. Crossing #75 (Maisy May Trib 1) – downstream view below road.



Photo 33. Crossing #76 (Maisy May Trib 2) – upstream view.



Photo 34. Crossing #76 (Maisy May Trib 2) – downstream view of existing crossing.



Photo 35. Crossing #76 (Maisy May Trib 2) – culvert inlet.



Photo 36. Crossing #76 (Maisy May Trib 2) – downstream view of culvert outlet.



Photo 37. Crossing #77 (Maisy May Trib 3) – upstream view.



Photo 38. Crossing #77 (Maisy May Trib 3) – upstream of existing crossing looking downstream to existing crossing.



Photo 39. Crossing #77 (Maisy May Trib 3) – existing crossing.



Photo 40. Crossing #77 (Maisy May Trib 3) – upstream view downstream of road.



Photo 41. Crossing MMTT-1 (Maisy May Tailings Trib 1) – upstream view above road crossing.



Photo 42. Crossing MMTT-1 (Maisy May Tailings Trib 1) – downstream view.



Photo 43. Crossing MMTT-2 (Maisy May Tailings Trib 2) – upstream view.



Photo 44. Crossing MMTT-2 (Maisy May Tailings Trib 2) – downstream view.



Photo 45. Crossing MMTT-3 (Maisy May Tailings Trib 3) – area between road and Maisy May Creek.



Photo 46. Crossing MMTT-3 (Maisy May Tailings Trib 3) – area between road and Maisy May Creek.

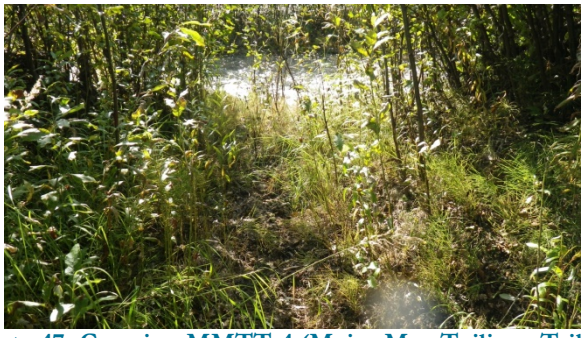


Photo 47. Crossing MMTT-4 (Maisy May Tailings Trib 4) – area between road and Maisy May Creek.



Photo 48. Crossing MMTT-4 (Maisy May Tailings Trib 4) – evidence of occasional flow on east side of road.



Photo 49. Crossing MMTT-5 (Maisy May Tailings Trib 5) – upstream view.



Photo 50. Crossing MMTT-5 (Maisy May Tailings Trib 5) – downstream view.



Photo 51. Crossing #81 (Maisy May Trib 4) – upstream view



Photo 52. Crossing #81 (Maisy May Trib 4) – downstream view



Photo 53. Crossing #83 (Lower Maisy May Trib) – upstream view.



Photo 54. Crossing #83 (Lower Maisy May Trib) – downstream view.



Photo 55. Crossing #84 (Lower Maisy May Trib 2) – upstream view.



Photo 56. Crossing #84 (Lower Maisy May Trib 2) – downstream view of ponded water.



Photo 57. Crossing #85 (Maisy May Trib) – upstream view.

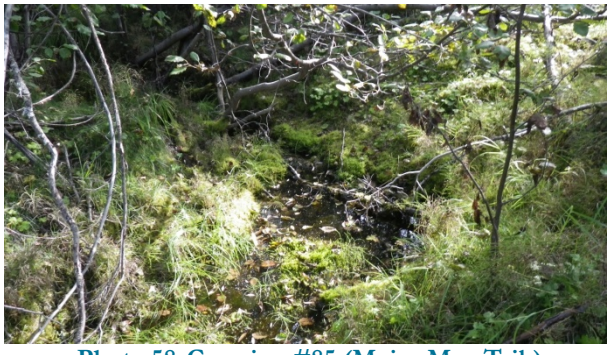


Photo 58. Crossing #85 (Maisy May Trib) – downstream view.



Photo 59. Crossing #97 (North Stewart Trib) – upstream view.



Photo 60. Crossing #97 (North Stewart Trib) – downstream view.



Photo 61. Crossing #101 (Lower Barker Trib 1) – upstream view.



Photo 62. Crossing #101 (Lower Barker Trib 1) – downstream view.



Photo 63. Crossing #102 (Lower Barker Trib 2) – upstream view.



Photo 64. Crossing #102 (Lower Barker Trib 2) – downstream view.



Photo 65. Crossing #103 (Lower Barker Trib 3) – upstream view.



Photo 66. Crossing #103 (Lower Barker Trib 3) – downstream view.



Photo 67. Crossing #104 (Lower Barker Trib 4) – upstream view.



Photo 68. Crossing #104 (Lower Barker Trib 4) – downstream view.



Photo 69. Crossing #110 (Barker Trib) – upstream view.



Photo 70. Crossing #110 (Barker Trib) – downstream view.



Photo 71. Crossing #111 (mid Barker camp) – upstream view.



Photo 72. Crossing #111 (mid Barker camp) – downstream view.



Photo 73. Crossing #112 (mid Barker tailings 1) – upstream view.



Photo 74. Crossing #112 (mid Barker tailings 1) – downstream view.



Photo 75. Crossing #113 (mid Barker tailings 2) – upstream view.



Photo 76. Crossing #113 (mid Barker tailings 2) – downstream view.



Photo 77. Crossing #114 (Barker trib) – upstream view.



Photo 78. Crossing #114 (Barker trib) – downstream view.



Photo 79. Crossing #115 (Barker trib) – upstream view.



Photo 80. Crossing #210 (Upper Barker Trib 1) – upstream view.



Photo 81. Crossing #210 (Upper Barker Trib 1) – downstream view.



Photo 82. Crossing #209 (Upper Barker Trib 3) – upstream view.



Photo 83. Crossing #209 (Upper Barker Trib 3) – downstream view.



Photo 84. Crossing #208 (Agate Creek) – upstream view.



Photo 85. Crossing #208 (Agate) – downstream view.



Photo 86. Crossing #207 (Upper Barker Trib 4) – upstream view.



Photo 87. Crossing #207 (Upper Barker Trib 4) – downstream view.



Photo 88. Crossing #206 (Ballarat headwaters) – upstream view.



Photo 89. Crossing #206 (Ballarat headwaters) – downstream view.



Photo 90. Crossing #205 (Upper Ballarat) – upstream view.



Photo 91. Crossing #205 (Upper Ballarat) – downstream view.



Photo 92. Crossing #204 (Ballarat Trib) – upstream view.



Photo 93. Crossing #203 (Upper Ballarat Trib) – upstream view.



Photo 94. Crossing #203 (Upper Ballarat Trib) – downstream view.



Photo 95. Crossing #202 (Ballarat Trib) – upstream view downstream of NAR crossing.



Photo 96. Crossing #202 (Ballarat Trib) – downstream view (below NAR crossing).



Photo 97. Crossing #201 (mid Ballarat) – upstream view.



Photo 98. Crossing #201 (mid Ballarat) – downstream view.



Photo 99. Crossing #118 (lower Ballarat Trib 1) – upstream view.



Photo 100. Crossing #118 (lower Ballarat Trib 1) – downstream view.



Photo 101. Crossing #119 (lower Ballarat Trib 2) – upstream view.



Photo 102. Winter road crossing 1 (Yukon River trib) – upstream view.



Photo 103. Winter road crossing 2 (Yukon River trib) – upstream view.



Photo 104. Winter road crossing 2 (Yukon River trib) – downstream view.

APPENDIX 14-C

Fish and Aquatic Resources Baseline

Memorandum

To:	YESAB Reviewers
From:	Pat Tobler
Date:	March 31, 2017
Project No:	17Y0032
Re:	Coffee Gold Project - Fish and Aquatic Resources Baseline Report

The above mentioned baseline report that follows this memo was completed for Kaminak Gold Corporation by Palmer Environmental Consulting Group (PECG) based on their fieldwork around the mine site in 2014 and 2015. Minor edits to this report were completed by PECG in 2017; therefore, the report is dated February 20, 2017.

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

Coffee Gold Project

Fish and Aquatic Resources Baseline Report

Prepared for

Kaminak Gold Corporation

February 20, 2017

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

*470 Granville Street, Suite 630, Vancouver, BC V6C 1V5 **t** 604-629-9075*

February 20, 2017

Allison Rippin Armstrong
Kaminak Gold Corporation
1020 – 800 West Pender Street
Vancouver, British Columbia
V6C 2V6 Canada

Dear Ms. Armstrong,

Re: Fish and Aquatic Resources Baseline Report, Coffee Gold Project

Palmer Environmental Consulting Group Inc. is pleased to submit the attached report describing results of the fish and aquatic resources baseline assessment conducted as part of the Coffee Gold Project's baseline collection program carried out in 2014 and 2015.

This report characterizes the pre-development conditions of the fish and aquatic resources in the study area of the proposed Coffee Gold Project and provides a basis for an effects assessment from mine development.

If there are any questions or comments on this report, please contact Rick Palmer at (604) 629-9075.

Thank you for the opportunity to work with you on this project.

Yours truly,

Palmer Environmental Consulting Group Inc.

[signature redacted]

Rick Palmer, M.Sc. R.P. Bio
President, Senior Fisheries Biologist

Distribution List

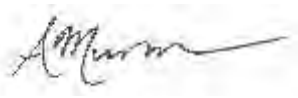
# of Hard Copies	PDF Required	Association / Company Name
1	Yes	Kaminak Gold Corporation
1	Yes	Palmer Environmental Consulting Group

Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	Nicola Lower	December 11, 2015	Senior Review
2	Rick Palmer	December 11, 2015	Senior Review
3	Rick Palmer	December 14, 2015	Senior Review
4	Nicola Lower	March 7, 2016	Senior Review
5	May Mason	February 20, 2017	Correction to Table 13

Signatures

Report Prepared By:



Alyssa Murdoch, M.Sc., R.P. Bio.
Aquatic Ecologist

Report Reviewed By:



Nicola Lower, M.Sc., Ph.D.
Senior Fisheries Biologist



Report Reviewed By:

Rick Palmer, M.Sc., R.P. Bio.
President, Senior Fisheries Biologist

Executive Summary

This report describes the studies conducted in 2014 and 2015 on the aquatic environments of the Coffee Gold Project, which specifically includes fish and fish habitat, benthic invertebrate and periphyton communities, and sediment quality. The Coffee Gold Project is a proposed open-pit, heap leach gold mine located in the White Gold district of west-central Yukon, approximately 130 km south of Dawson City. The objective of the 2014-2015 aquatic environmental baseline surveys was to characterize the pre-development aquatic environment of the Project area in support of the project proposal to the Yukon Environmental and Socio-economic Assessment Board (YESAB).

The fish and aquatic resources baseline program included sampling at 18 fish community sampling sites, 17 fish habitat sites, and 12 benthic invertebrate, periphyton and sediment sites throughout the project study area. Sampling was conducted in August and October, 2014, and in March, June, July, and September, 2015. Fish habitat was characterized at each fish sampling site including the collection of *in situ* water quality parameters, and an assessment of habitat quality and quantity based on general habitat attributes (e.g., channel width, gradient, substrate composition, cover, stream morphology). A winter fish habitat survey was completed at select sites on Latte and Coffee Creeks in late March, 2015. Various site-specific fish sampling methods were conducted and included backpack electrofishing, minnow trapping, fyke net trapping, and angling. Salmon spawning surveys were conducted in summer 2014, fall 2014, and summer 2015 in Coffee Creek, Independence Creek, and in adjacent sections of the Yukon River. An Arctic grayling spawning survey was conducted in spring 2015 in Latte Creek. Fish samples were obtained from watersheds in the project area for analyzing fish age, diet, and tissue metal concentrations. Sediment sampling was completed for analyzing nutrients, pH, and metal concentrations at sites in the project study area.

Results showed that sediment samples exceeded the arsenic Canadian Council of Ministers of the Environment (CCME) Interim Sediment Quality Guidelines (ISQG) at every station, and also exceeded the arsenic Probable Effects Level (PEL) at AQ05, AQ13, and AQREF1. The ISQG was exceeded for Chromium in the Kona tributary of Independence Creek (AQ13), as well as at the Los Angeles Creek reference site (AQREF2).

Chlorophyll *a* was very low for all sites, which is typical of northern aquatic habitats. Ash-free dry mass (AFDM) values ranged from 0.38 - 1.07 mg/cm^2, with the highest values observed in Halfway Creek (AQ20) and Los Angeles Creek (AQREF2). Dipterans were the most dominant benthic invertebrate group in the project study area (50%), followed by mayflies (26%), and then stoneflies (21%).

Fish habitat quality was greatest in the mainstems of Coffee and Independence Creeks due to their large sizes, ample in-stream cover, and the presence of a wide variety of habitat types available including potential overwintering habitat. The winter fish habitat survey confirmed that there were localized areas for overwintering on Coffee Creek mainstem, however no overwintering habitat was observed in Latte Creek. Good Arctic grayling summer feeding habitat was available in the lower reaches of Latte Creek due to the frequency of substantial pool habitat. Habitat quality decreased in the upper watersheds (Latte

Creek, Kona Tributary, Halfway Creek, Independence Creek) due to steeper, cascade-pool or step-pool segments. In Halfway Creek, there was marginal fish habitat for Arctic grayling (*Thymallus arcticus*) available in the lower watershed (AQ20). YR24 was even smaller and steeper than Halfway Creek, with little to no pool habitat observed for fish rearing at the downstream site (e.g. water depths were generally less than 20cm). A high gradient barrier to fish passage was identified on upper YR24, just upstream of the aquatic site AQ31. The Isaac Creek reference site was smaller and shallower than both Independence and Coffee Creeks, with a mean channel width of 10m, and fewer deep pools (>1m) noted. The Los Angeles Creek reference site was established as an additional reference site in 2015 and was comparable to a range of habitats present in the mine study area.

Arctic grayling, slimy sculpin (*Cottus Cognatus*), and juvenile Chinook salmon (*Oncorhynchus tshawytscha*) were the most dominant fish species captured in the project study area. Juvenile Chinook salmon were present in the mainstems of Coffee Creek and Independence Creek, but were not captured in Latte Creek, Kona Tributary of Independence Creek, Halfway Creek, or YR24. In August 2014, juvenile Chinook salmon (jcs) capture rates were highest in the mainstem of Coffee Creek (5-12 jcs/trap/day), and low to moderate in Independence Creek (0.1-1 jcs/trap/day). Catch per unit effort was slightly lower at all sites in October, however, the presence of juvenile Chinook late in the season suggested that overwintering occurred at most sites in mainstem Coffee and Independence Creeks. At sites in Coffee Creek, capture rates of juvenile Chinook salmon were 8-15 times lower in July 2015 in comparison to August 2014, suggesting that juvenile rearing may exhibit high variability year to year. Capture rates of juvenile Chinook salmon were similar across both years for Independence Creek sites. Slimy sculpin overlapped juvenile Chinook salmon in distribution, but were also present at the downstream end of Latte Creek, and at the mouth of YR24. Arctic grayling were captured at all sites, with the exception of YR24, upper Halfway Creek, upper Latte Creek, and upper Kona Tributary, where no fish were caught. Site AQ04 on lower Latte Creek had the highest number of Arctic grayling captured (n=70). Two years in a row, sampling in lower Halfway Creek produced a single adult Arctic grayling. Low numbers of Arctic grayling were captured in the lower Kona Tributary site, AQ12. In 2014, a reference site was established near the mouth of Isaac Creek, which contained high numbers of juvenile Chinook salmon, slimy sculpin, and low numbers of juveniles from four other fish species. In 2015, low numbers of juvenile Chinook salmon, Arctic grayling, and slimy sculpin were captured at a second reference site located on Los Angeles Creek.

Slimy sculpin and Arctic grayling samples were collected for analyzing baseline metal concentrations in tissues. Mean estimated methylmercury concentrations exceeded the guideline for the protection of fish-eating wildlife in all watersheds. Individual slimy scupin samples in Latte and Coffee Creeks also exceeded the human health guideline for subsistence consumers. No fish samples at any sites exceeded the maximum allowable level of mercury for sale guideline. Mean selenium concentrations in slimy sculpin and Arctic grayling tissues exceeded the selenium guidelines for the protection of freshwater aquatic life in all watersheds. Individual slimy sculpin and Arctic grayling samples throughout the study area exceeded the selenium human health guideline for high consumers of fish. The human health selenium guidelines based on moderate and low fish diets were not exceeded by any individual fish samples.

Similar to results from previous years (Sparling 2001; Laberge and White Mountain 2002), no Chinook salmon were observed spawning in Coffee and Independence Creeks in 2014 or 2015. Results from the

Arctic grayling spawning assessment on Latte Creek suggested that grayling likely spawned elsewhere prior to entering the creek for summer feeding.

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1 Introduction

1.1 Overview

This report describes the studies conducted in 2014 and 2015 by Palmer Environmental Consulting Group Inc. (PECG) on the aquatic environments of the Coffee Gold Project (the Project), which specifically includes sediment quality, periphyton, benthic invertebrate, fish habitat and fish community assessments. The purpose of these studies was to characterize the pre-development environment in support of the project proposal to the Yukon Environmental and Socio-economic Assessment Board (YESAB).

The Project is a proposed open-pit, heap leach gold mine located in the White Gold district of west-central Yukon, approximately 130 km south of Dawson City. The Project is wholly owned by the Kaminak Gold Corporation (KGC). The Project encloses several gold occurrences within an exploration concession covering an area of more than 600 square kilometres. The location of the Project is shown in Figure 1, as well as the fish and aquatic resources study area. All watercourses in the Project area eventually discharge into the Yukon River.

1.2 Study Objectives

The overall objectives of the Coffee Gold Fish and Aquatic Resources baseline study were to:

- Characterize fish and fish habitat in streams potentially affected by the Project to identify potential interactions and opportunities for mitigation, and to support an application to YESAB;
- Provide baseline data that will support future environmental effects monitoring programs; and
- To provide a basis for the assessment of any potential reduction of baseline fisheries productivity in order to support the future development of a Fisheries Mitigation and Offsetting Plan.

While some previous data has been collected in this region (see Appendix A: Review of Existing Fisheries and Aquatic Community Information, Coffee Gold Project, Yukon), the aim of the baseline program was to support a successful project submission to YESAB by establishing a thorough, repeatable, and multi-year baseline program. Several aquatic resources in the project area were studied in 2014-2015 including: periphyton, benthic invertebrates, fish and fish habitat, and sediment quality. These aquatic resources were chosen for study as they either directly or indirectly contribute to commercial, recreational or Aboriginal (CRA) fisheries, and/or they provide important indicators of aquatic ecosystem health that can be monitored over time. An overview of the importance of each program is briefly given below:

Sediment analysis is an important environmental monitoring component as sediments provide habitat for algae, plants, microorganisms, and invertebrates, which in turn support higher trophic communities such as fish. Sediment analysis may provide more insight into long-term contaminant levels in comparison to water quality testing, as contaminants are integrated into sediments over time, and are more likely to capture periodic or storm-based contamination events. Long-term accumulated contaminant levels may

be incorporated into the aquatic food web if sediments become re-suspended or are bioavailable. In 2014-2015, sediment samples were obtained and analyzed for nutrients, metals, and grain size.

Periphyton is the assemblage of algae, bacteria, fungi, microinvertebrates, bacteria, and detritus found attached to aquatic substrate such as rocks. The baseline program included the sampling of periphyton biomass, chlorophyll *a* concentrations, and community composition, which provides a mechanism for assessing water quality health and primary productivity in a watershed (BCMOE 2012).

The baseline program focused on determining benthic macroinvertebrate densities, species richness, biodiversity, and overall community composition, which provides insight into the aquatic health and resilience to disturbances. As benthic invertebrates are a common food source for fish, varying benthic invertebrate community health may have cascading trophic effects on fish communities. Benthic macroinvertebrates are also used as an indication of water quality due to varying species tolerance levels and the sentinel nature of the organisms. Biomonitoring of benthic invertebrates is therefore used as part of environmental effects monitoring to determine any potential effects, alongside water quality results and fish community surveys.

Fish contribute ecological, cultural, recreational and commercial value as they support fisheries, and constitute a fundamental role in aquatic ecosystem functioning. The Project study area is dominated by two CRA fish species: Chinook salmon and Arctic grayling. Yukon River Chinook salmon have historically supported valuable commercial, recreational and Aboriginal fisheries, however, the population has experienced significant declines and fishery closures in recent years (JTC 2013; Yukon Salmon Sub-Committee 2014). Arctic grayling is the most popular sport fish in the Yukon (Environment Yukon 2010), and may be targeted for fishing in accessible areas adjacent to the Yukon River. The protection of fish and fish habitat is built into the environmental legislation of the *Fisheries Act*, which aims to ensure that project activities do not impact fisheries productivity. Biomonitoring of fish species provides valuable information about the health of a watershed, as fish are long-lived and have specific habitat requirements that may be sensitive to environmental perturbations. In addition, fish are often positioned at the top of the aquatic food web, allowing them to integrate environmental variability experienced by species at the base of the food chain, and increasing the likelihood of detecting environmental impacts (BCMOE 2012). In the baseline program, sampling was undertaken to determine fish abundance, distribution, life history, and overall health via measurements of fish growth, population size, and metal concentrations of tissues. In addition, fish habitat characteristics were recorded, including physical parameters (e.g., channel size, stream substrate, habitat types) and *in situ* water quality parameters (e.g., temperature, pH, and dissolved oxygen).

Together, the study of sediment quality, periphyton, benthic invertebrates, and fish and fish habitat provides a thorough overview of the baseline conditions for aquatic resources in the project study area.

2 Methods

2.1 Study Area

The study area for the fish and aquatic resources survey of the Coffee Gold Project includes the four watersheds surrounding the project deposit: the mainstem of Coffee Creek to the east, Latte Creek to the south, the Independence Creek watershed to the west, including the Independence Creek Kona Tributary, and the Halfway Creek and YR24 Creek watersheds to the north (Figure 1). These watersheds have the potential to experience near-field project effects due to either overlap with the project footprint, or indirect effects resulting from activities in areas upstream. All of these watersheds eventually flow northward into the Yukon River.

The fish and aquatic resources study area also includes water bodies that may be indirectly affected (mid-to-far field effects), or are suitable for providing reference sites to the proposed Project activities. Mid-field effects include stream locations that may experience occasional effects of low magnitude due to project activities. Far-field effects are stream areas that are located at the most downstream end of the zone of potential influence, and thus would only experience rare and low-level influence from activities upstream. Reference sites are stream areas that are located outside of project effects, and thus are used as indicators of natural baseline variability in the regional area. In 2014, one reference site was established in the Isaac Creek watershed, which is located approximately 30km east from the mouth of Coffee Creek along the Yukon River, upstream of where Excelsior and Britannia Creeks enter the river. In 2015, an additional reference site was established in the Los Angeles Creek watershed, located approximately 10km west from the mouth of Independence Creek along the Yukon River.

2.2 Review of Existing Literature

A review of existing studies completed in the project area was completed in spring 2014, and is attached to this report as Appendix A. The review summarizes fish community data collected from the Coffee, Independence, and Halfway Creek watersheds in 2000-2001 (Sparling 2001; Laberge and White Mountain 2002), 2010 (Laberge and White Mountain 2012), and 2013 (PECG 2013a, b; Access 2014). Benthic invertebrate community data was available for one site in lower Coffee Creek (Laberge and White Mountain 2002, 2012), and no periphyton or sediment quality data had been collected at any sites.

2.3 Field Data Collection

The fish and aquatic resources study program was carried out at 18 fish sampling sites, 17 fish habitat sites, and 12 benthic invertebrate, periphyton and sediment sites throughout the project study area (Table 1, Figure 1). In 2014, field data were collected during August 19 – 30, on fish communities; fish habitat; benthic invertebrate; periphyton; and sediment data. Additional fish community data were collected from October 2 – 7. In 2015, a winter survey of fish habitat took place from March 27-28; spring fish and fish habitat data were collected from June 18 – 23; summer fish community, fish habitat, benthic invertebrate, periphyton, and sediment data were collected from July 24 – August 1; and additional fish and fish habitat

data were collected from September 10-13. A description of the field activities completed during each of the six seasonal assessments is provided in Table 2.

Table 1. Fish and Aquatic Resources Sampling Sites, Coffee Gold Project, 2014-2015

Watershed	Creek	Site	UTM Co-ordinates (Zone 7V)		Sampling Events						BI/P/S (Y/N)	Description
			Easting	Northing	2014		2015					
					Aug	Oct	Mar	Jun	Jul	Sep		
Coffee	Latte	AQ06	582934	6971891	MT, H	-	-	EF	EF	-	N	Upper watershed
	Latte	AQ05	584272	6971769	MT, H	-	H	-	-	-	Y (2014)	Upper watershed
	Latte	AQ04.5	584792	6971697	-	-	-	EF, H	EF	-	Y (2015)	New site in 2015 to replace AQ05
	Latte	AQ04	591817	6970662	MT, EF, H	-	H	EF	EF	-	Y	Lower Latte Creek
	Latte	AQ03	594487	6970386	-	FN	H	EF	MT, EF	MT, EF	N	Just upstream of mainstem Coffee Creek
	Coffee	AQ02	594695	6970599	MT, EF, FN, H	MT	H	-	MT, A, FN	-	Y	Mainstem Coffee Creek just downstream of Latte Creek
	Coffee	AQ01	595974	6972573	MT, H	MT	H	MT, A	MT, A, FN	-	N	Mainstem Coffee Creek
	Coffee	AQ00	596860	6974237	MT, EF, FN, A, H	MT	H	MT, A	MT, A, FN	-	Y	Mainstem Coffee Creek
Halfway	Halfway	AQ21	582125	6974262	MT, H	-	-	EF	EF	-	N	Upper watershed

	Halfway	AQ20	588842	6980559	EF, H	-	-	EF	EF	-	Y	Just upstream of Yukon River
YR24	YR24	AQ31	585748	6976166	MT, H	-	-	EF	EF	-	N	Upper watershed
	YR24	AQ30	589691	6979174	EF, H	-	-	EF	EF	-	Y	Just upstream of Yukon River
Independence	Kona tributary	AQ13	578443	6975427	MT, H	-	-	EF	EF	-	Y	Upper Kona tributary
	Kona tributary	AQ12	575282	6979605	MT, EF, H	-	-	EF	EF	-	N	Just upstream of the confluence with mainstem Independence Creek
	Independence	AQ11	575876	6980006	MT, EF, H	MT	-	-	MT, A	-	Y	Mainstem Independence Creek
	Independence	AQ10	579393	6983200	MT, EF, H	MT	-	MT	MT	MT	Y	Mainstem Independence Creek
Isaac	Isaac	AQREF1*	626796	6968817	MT, EF, H	MT	-	MT	MT	-	Y	Reference site
Los Angeles	Los Angeles	AQREF2*	569529	6990874	-	-	-	MT	MT, EF, A, H	MT, EF, A	Y (2015)	New Reference site 2015

*Notes: Dashes indicate no sampling was completed, "Y"=yes, "N"=no, BI/P/S=Benthic Invertebrate/Periphyton/Sediment Quality Sampling MT=Minnow trapping, EF=Electrofishing, FN=Fyke Net Trapping, A=Angling, H=Fish Habitat Assessment, *Reference site*

Table 2. Fish and Aquatic Resources Field Data Collection Summary, Coffee Gold Project, 2014-2015

Year	Sampling Events	Benthic Invertebrates, Periphyton, Sediment	Fish Habitat	Fish Community	Fish Samples			Spawning Survey
					Metals	Ageing	Diet	
2014	August 19-30	Y	Y	Y	CCG (n=26) GR (n=3)	CCG (n=26) GR (n=3)	GR (n=3)	• Aug 28: Coffee and Independence Creeks; • Oct 6-7: Coffee, Independence and Yukon River.
	October 5 - 7	N	Y	Y	N	N	N	N
2015	March 27-28	N	Y	N	N	N	N	N
	June 18 - 23	N	Y	Y	GR (n=6)	GR (n=6)	N	• Latte Creek Arctic grayling Spawning Survey
	July 24 - Aug 1	Y	Y	Y	CCG (n=9) GR (n=16)	CCG (n=9) GR (n=16, lethal; n=25 non-lethal)	GR (n=5)	• July 25 - August 1: Coffee and Independence Creeks; • July 30: Yukon River.
	September 10-13	N	Y	Y	CCG(n=2) GR (n=1)	CCG (n=2) GR (n=1)	N	N

Notes: CCG=slimy sculpin, GR=Arctic grayling, "Y"=Sampling was completed, "N"=Sampling was not completed.

580000

N

Independence Creek

AQ10

AQ12

AQ11

Kona Tributary

Dan Man Creek

AQ20

Yukon River

AQ30

Halfway Creek

YR 24

AQ31

AQ13

AQ21

Trib C

AQ06

AQ05

AQ04.5

Latte Creek

AQ04

AQ02

AQ03

Coffee Camp

Camp Airstrip

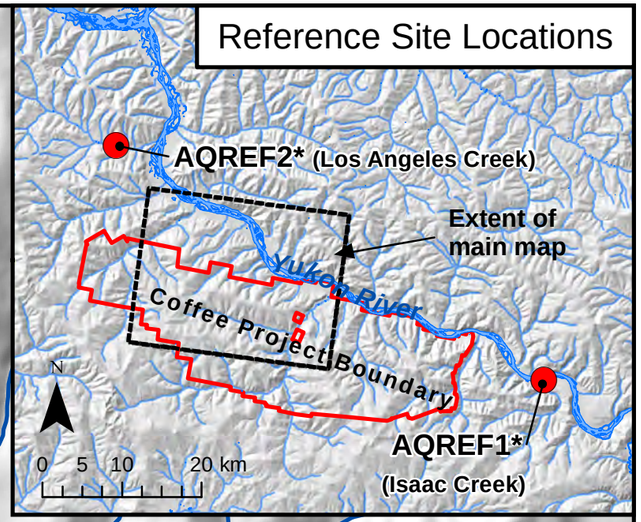
Coffee Creek

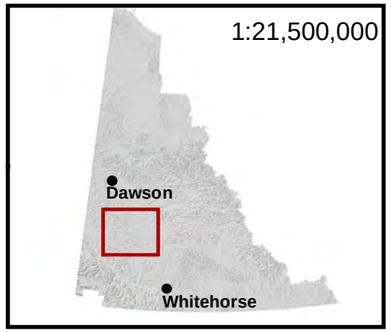
AQ00

AQ01

580000

Reference Site Locations





Legend

- Fish and fish habitat site
- Fish, fish habitat, benthic invertebrates, periphyton, and sediment site
- Reference site
- Access Road
- Watercourse
- Waterbody
- Coffee Project Boundary
- Proposed Heap Leach
- Proposed Waste Rock Dump
- Proposed Pit
- Fish barrier

0 0.75 1.5 3 km

Map scale 1:200,000

Figure 1 Coffee Gold Fish and Aquatic Resources Sampling Sites, 2014-2015

Drawn By: C. Brown
Checked By: A.Murdoch
Date: 14 December 2015
Projection: North American Datum 1983 UTM Zone 7N

Data notes

1:250,000 and 1:50,000 Topographic Spatial Data: National Topographic Database; courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

All other data provided by Kaminak Gold Corporation, 2014

This document is not an official land survey and the spatial data presented is subject to change without any notice.

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2.4 Field and Laboratory Methods

2.4.1 Sediment

At each site, three replicates per site were collected from three different erosional locations (e.g., undercut banks) using the finest sediment available at each site. Erosional locations were sampled based on Environment Canada recommendations for other mining baseline projects in the Yukon (e.g., Eagle Gold Project). Finer sediments are more useful for determining potential risks to aquatic life, as most chemical contaminants preferentially bind to silts and clays, and finer sediments are more likely to be consumed by benthic invertebrates (BC MOE 2012). Water depths and photos were taken at each sampling location (example photo shown in Figure 2). An additional sample was collected at one of the three replicate locations per site for analyzing particle size distribution. As recommended by the BC MOE (2012), a field split was completed for one replicate at every other site for Quality Assurance and Quality Control (QA/QC).



Figure 2. Example of sediment sampling location, Site AQ11, Coffee Gold Project, 2014

Sediment samples were analyzed for metals, total organic carbon, nutrients, and grain size by CARO Analytical Services. Samples were dried at 60°C, sieved using a 63 micron mesh (as recommended by BC MOE 2012), and digested using a nitric and hydrochloric acid mixture at 95°C for two hours. Inductively coupled plasma mass spectrometry (ICP/MS) was used to analyze samples. Laboratory detection limits for parameters are summarized in Table 3.

Table 3. Sediment Quality Parameters and Reported Detection Limits (RDL) (CARO Analytical) Coffee Gold Project, 2014-2015

Parameter	Units	RDL	Parameter	Units	RDL
Physical					
Carbon, Total Organic	% dry	0.05	Selenium	mg/kg	0.5
Percent moisture	% wet	0.1	Silicon	mg/kg	3000
pH	pH units	0.1	Silver	mg/kg	0.2
Ammonia	mg/kg	1	Sodium	mg/kg	40
Nitrate	mg/kg	1	Strontium	mg/kg	0.2
Phosphorus	mg/kg	2	Sulfur	mg/kg	1000
Calcium	mg/kg	5	Tellurium	mg/kg	0.1
Magnesium	mg/kg	5	Thallium	mg/kg	0.1
Potassium	mg/kg	5	Thorium	mg/kg	0.5
Sodium	mg/kg	5	Tin	mg/kg	0.2
Total Metals			Titanium	mg/kg	2
Aluminum	mg/kg	20	Uranium	mg/kg	0.1
Antimony	mg/kg	0.1	Vanadium	mg/kg	0.4
Arsenic	mg/kg	0.4	Zinc	mg/kg	2
Barium	mg/kg	1	Zirconium	mg/kg	2
Beryllium	mg/kg	0.1	**Particle Size Distribution**		
Bismuth	mg/kg	0.1	> 80 mm	%	0.1
Boron	mg/kg	2	> 56 mm	%	0.1
Cadmium	mg/kg	0.04	> 40 mm	%	0.1
Calcium	mg/kg	100	> 25 mm	%	0.1
Chromium	mg/kg	1	> 19 mm	%	0.1
Cobalt	mg/kg	0.1	> 12.5 mm	%	0.1
Copper	mg/kg	0.2	> 4.75 mm	%	0.1
Iron	mg/kg	20	> 2.36 mm	%	0.1
Lead	mg/kg	0.2	> 2.0 mm	%	0.1
Lithium	mg/kg	0.1	> 1.18 mm	%	0.1
Magnesium	mg/kg	10	> 600 µm	%	0.1
Manganese	mg/kg	0.4	> 425 µm	%	0.1
Mercury	mg/kg	0.05	> 300 µm	%	0.1
Molybdenum	mg/kg	0.1	> 150 µm	%	0.1
Nickel	mg/kg	0.4	> 75 µm	%	0.1
Phosphorus	mg/kg	10	< 75 µm	%	0.1
Potassium	mg/kg	10			

2.4.2 Periphyton

Periphyton sampling sites were selected in the project study area with the aim of standardizing depth, velocity, gradient, substrate, and sunlight exposure among sites (OMOE 2012). Sampling was completed in mid-late summer as periphyton communities were expected to have reached their maximum density and diversity during this time period.

At each site, five rocks were chosen randomly and sampled using a 1.7cm diameter syringe sampler. Approximately 50mL of sample was obtained per rock and emptied into a 1L bottle, for a combined 250mL volume per sample. The protocol differed slightly at site AQREF1 in 2014, where four rocks were sampled at a volume of 60mL/sample and a total of 240mL. The process was repeated two more times using un-sampled areas on the same rocks, for a total of 3 samples collected per site. Each of the three bottles was submitted for a separate analysis, which included chlorophyll *a*, biomass and species composition. Sample bottles submitted for chlorophyll *a* and biomass analyses were kept as cool as possible, covered in foil to prohibit entry of light, and delivered to an analytical laboratory within four days[1]. Sample bottles submitted for species composition were preserved using approximately 1mL of Lugol's iodine solution immediately following sampling. Samples were delivered to CARO Analytical Services (Burnaby, BC) for chlorophyll *a* and biomass analyses, and to Plankton R Us (Winnipeg, MB) for species composition enumeration. In 2015, one sample (AQ10), was broken upon arrival to Plankton R Us and thus periphyton community composition results are based only on 2014 analyses for this site.

To obtain chlorophyll *a* concentrations, samples were filtered, ground, extracted using 90% acetone and analyzed on a spectrophotometer. To measure algal ash-free dry mass (AFDM), samples were first dried at 105°C, weighed, and then oxidized at 550°C. AFDM quantifies the organic content of a sample, which is the difference in mass before and after incineration (mg/L).

Prior to species identification and enumeration, 1-2mL sub-samples were sonicated for 10-20s using a Sonifer Cell Disruptor w140, and then allowed to settle in an Ütermohl chamber for 24 hours (Findlay *et al.* 1999). Periphyton cells were then identified to the lowest taxonomic level possible and counted until 100 cells of the most numerous species were found.

2.4.3 Benthic Invertebrates

The Canadian Aquatic Biomonitoring Network (CABIN) protocol was applied at twelve sites in the project study area (Environment Canada 2012). A triangular CABIN protocol kick-net sampler with 400 micron mesh and detachable collection cup was employed. The net opening was faced into the stream current with the flat side of the net resting on the substrate of the stream. The sampler walked backward in the upstream direction, dragging the net along the bottom of the stream while disturbing the substrate with a kicking motion to a depth of ~5-10 cm. Sampling was zig-zagged over the stream bottom from bank to bank in an upstream direction for a timed period of three minutes. All samples were preserved using 85% ethanol and submitted to Cordillera Consulting (Summerland, BC) for species composition analysis.

Benthic invertebrates were identified to the lowest possible taxonomic group, which was to the family level for most aquatic insects, class for oligochaetes and phylum for nematodes. Benthic invertebrate density was reported relative to each kick net sampling event.

[1] Recommended holding times were surpassed for chlorophyll *a* analyses, but not for ash-free dry mass or periphyton taxonomy. Recommended sample temperatures (1-8°C) may have been exceeded during transport to the lab.

2.4.4 Fish Habitat

A total of 17 sites were assessed for fish habitat in the project study area (Table 1). Fish habitat was characterized following a modified version of the methods described in the Resources Inventory Standards Committee (RISC) Fish and Fish Habitat Inventory: Site Card Field Guide (Version 2.0, April 2008) and in the *Fish Habitat Assessment Procedures* guide for the British Columbia government (Johnston and Slaney, 1996), as there are no available watercourse sampling guides established for Yukon Territory. At each site, a minimum of 100m encompassing the fish sampling site was surveyed to assess habitat characteristics.

At each habitat site, stream length and stream width (*i.e*., wetted and bankfull width) was measured with surveyor's measuring tape. Gradient was measured with a Sunnto clinometer. Stream depth was measured with a meter stick, following methods outlined in Johnston and Slaney (1996). Stream stage (water level) was assessed as low, medium or high visually by comparison between stream surface height and bankfull height. Habitat was visually assessed into the following five types:

- ***Pools*** have zero gradient, slow-moving water and a concave bottom;
- ***Runs*** (also called glides) are sections of non-turbulent, fast-flowing water;
- ***Riffles*** are areas of turbulent, fast-flowing water with gravel or cobble substrates and with obvious surface turbulence;
- ***Cascades*** are steep, stepped "riffles" of bedrock or emergent cobble or boulders in channels with gradients greater than about 4%; and
- ***Other*** includes wetland complexes that lack an identifiable primary channel, sloughs, lakes, areas of sub-surface flow or areas where the channel cannot be observed (e.g., under large log jams).

Stream substrate was assessed visually into the following classes:

- fines (or silt);
- small gravel (2-16 mm particle diameter);
- large gravel (16-54 mm);
- small cobble (64-128 mm);
- large cobble (128-256 mm);
- boulder (>256 mm); or
- bedrock.

The percent of the stream surface that provided fish with cover was described using the following classes:

- deep pool (>1m depth);
- large woody debris (LWD);
- boulder;
- cutbank;
- instream vegetation; and
- overhanging vegetation.

The percentage of the overhead forest canopy that was closed was estimated visually.

The percentages of a stream section that belonged to each habitat type had to add to 100%, as did the percentages of the substrate of a stream section that belonged to each size class and the % of the canopy that was closed. However, the percentages of cover provided by the various classes did not have to add up to 100%.

Stream confinement was assessed as:

- unconfined (UC) – the stream bank is not touching the valley wall;
- occasionally confined (OC) – the stream bank is occasionally confined by the valley wall or terraces;
- frequently confined (FC) – the stream bank is frequently confined by the valley wall or terraces;
- confined (CO) – the stream bank is in continuous or repeated contact at the outside of meander bends;
- entrenched (EN) – the stream bank is in continuous contact with the valley walls or terraces due to downcutting; and
- not applicable (NA) – no valley walls exist (e.g., alluvial fans).

In addition, general *in situ* water quality parameters were measured as part of fish habitat assessments including pH, conductivity (µs/cm), temperature (°C), and dissolved oxygen concentration (mg/L and %).

Stream Temperature:

Temperature loggers (TidbiT v2 Temp Logger, Onset Hobo, 2013) were deployed in five creeks during the spring reconnaissance trip (June 1, 2014). The temperature loggers were anchored onto the streambed to reduce dislodging and were set to record stream temperatures every 15 minutes. On October 6-7, 2014, the loggers were downloaded and re-deployed, and the logging interval was changed in 60 minutes (Table 4). One temperature logger (T5) was originally set in a tributary south of the Kona Tributary, and was re-located to site AQ12 on the Kona Tributary in October, 2014. In spring 2015, some of the loggers had been re-located outside of the stream during freshet and were placed back into their original positions. Stream temperatures were again collected during the summer months and downloaded in September, 2015, with the exception of T1 which could not be located for retrieval. For a more thorough record of stream temperatures in the Coffee Gold study area, please refer to the Hydrology Baseline Report.

Table 4. Stream temperature logger locations, Coffee Gold Project, 2014-2015

Watershed	Creek	Logger ID	UTM Co-ordinates (Zone 7V)		Date Installed (2014)	Download Date (2014)	Removal Date (2015)	Description
			Easting	Northing				
Coffee	Coffee	T1	596,813	6,974,174	01-Jun-14	06-Oct-14	-	Lower Coffee Creek, downstream of AQ00
Coffee	Latte	T2	591,817	6,970,662	01-Jun-14	06-Oct-14	12-Sep-15	Lower Latte Creek, near AQ04
YR24	YR24	T3	585,708	6,976,068	01-Jun-14	06-Oct-14	12-Sep-15	Near the creek outlet and AQ30
Halfway	Halfway	T4	584,819	6,977,431	01-Jun-14	06-Oct-14	12-Sep-15	Near hydrology station and AQ20
Independence	Kona	T5	573,598	6,974,768	-	06-Oct-14*	12-Sep-15	Lower Kona tributary, near AQ12

Notes: T1 was not located for retrieval in 2015
**T5 was first installed on October 7, 2014*

2.4.4.1 Winter Fish Habitat Survey

The winter fish habitat survey was conducted on March 27-28, 2015. The objective of the survey was to determine if there was any potential overwintering habitat at sites in Latte and Coffee Creeks (Table 1). Late March was chosen for this survey as it was near the end of the winter season, and thus potentially provided the poorest water quality (e.g., low dissolved oxygen) and flow conditions under ice. An ice auger and chisel were used to conduct under ice assessments, and *in situ* water quality, ice thickness, and water depth measurements were collected where there was sufficient flow.

Prior to the field assessment, habitat mapping from the 2014 open water season was used to identify deep pool habitat sites that were candidates for overwintering habitat. Based on this assessment, the crew surveyed approximately 6 pools starting at the confluence with Coffee Creek to a location approximately 1 kilometer upstream. Further upstream, habitat near sites AQ04 and AQ04.5 were also surveyed. At AQ04, approximately 200 m of the creek was surveyed, upstream and downstream of the site (400 m total), including a location known to be a deep pool in summer. At AQ04.5, the survey covered areas of the creek in the immediate vicinity of the site, as well as the Latte Creek tributary that overlaps with the proposed south waste rock storage facility. On Coffee Creek, the crew surveyed the winter habitat at AQ02 (approximately 300 m downstream from Latte confluence), AQ01, and AQ00. An underwater camera (Aqua-Vu AV Micro II color camera, with an infrared light source) was deployed under the ice for 15 minutes at AQ02 and AQ01 to check for fish presence (no flow was detected at AQ00). The camera was attached to a rod and lowered slowly down to the stream bed, so that the substrate was visible. To maximize the view, the camera was slowly moved up and down (i.e. vertically) over the entire water column and also rotated 360 degrees at multiple depths. The two biologists watched the display for

any fish or movement. Visibility was limited by the extent of the light source and water turbidity, and occasionally by woody debris or sub surface layers of ice.

2.4.5 Fish Community

2.4.5.1 General Fish Community Field Methods:

Various site-specific fish sampling methods were conducted and included backpack electrofishing, minnow trapping, fyke net trapping, and angling. Specific sampling dates and methodologies are further detailed in Appendix F. Electrofishing at all sites was completed using a Smith-Root LR-20 Backpack Electrofisher and a two-person crew under two Scientific Fish Collection Permits (XR 249 2014 and XR 166 2015). Site lengths ranged from 60-275m and were selected to contain multiple mesohabitats (e.g., pool, riffle, run) representative of the reach being sampled. Electrofishing voltage ranged from 150-350V, and was adjusted at each site depending on water conductance, temperature, and expected fish size. Electrofishing effort varied from 430-2276s per electrofishing pass, with an average effort of 937s/pass. Multiple-pass electrofishing was carried out at three sites in 2014 (three-pass at AQ04, AQREF1, and two-pass at AQ10), and at two sites in 2015 (three-pass at AQ04, AQREF2) in order to obtain fish species presence/absence information and standardized density estimates.

Prior to electrofishing, stop nets were positioned at the upstream and downstream ends of the sample section to prohibit fish migration during sampling. Each pass completed had similar effort, and a minimum of 30 minutes was allowed to elapse between passes to allow recovery of un-captured fish. Fish were released into areas outside of the site boundaries after processing and recovery. Stop nets were also deployed at AQ10 in order to prevent escapement of fish from the sampling area. All other study sites did not require stop nets, as they were either too large for creek isolation (e.g., mainstem Coffee Creek), or were small enough with low enough flows that natural barriers to fish passage were present (e.g., lower Halfway Creek, YR24, and Kona Tributary). Headwater sites (Latte Creek: AQ05, AQ06; YR24: AQ31; Halfway Creek: AQ21; Independence Creek Kona Tributary: AQ13) had extremely low temperatures and flows at the time of sampling in late August 2014, and thus were not conducive to electrofishing, which is largely ineffective at low temperatures (<5°C). Similarly, electrofishing was not carried out in October, 2014 at any sites due to very cold water temperatures.

Extensive minnow trapping was conducted over both years and several seasons at the majority of sites (Table 10). In 2014, between eight to ten traps were deployed at all sites during August sampling on the mainstems of Coffee and Independence Creeks, and on Isaac Creek, whereas five traps were set per site in October. Smaller numbers of traps (two to five) were deployed in Latte Creek, Kona Tributary, Halfway Creek, and YR24 in August only. In 2015, five traps were set per site during spring and summer sampling in Coffee Creek, Independence Creek, and at both reference sites. Some additional trapping was carried out at select sites in the fall, with the aim of capturing more fish samples for metals analysis. Minnow traps were made of 0.6cm galvanized steel wire mesh with a conical entrance and were 42cm long with a 23cm diameter. Minnow traps were placed at each site in deep pools or among large woody debris or in slow-moving eddies. Each trap was baited with a perforated bag of Yukon River salmon roe and left to soak for approximately 24 hours.

In 2014, fyke nets were deployed overnight in August at sites AQ00 and AQ02, and in October at AQ03. Site AQ03 was a late addition to the 2014 program and was only sampled in October using a fyke net[2]. In 2015, fyke nets were again used at all three sites in mainstem Coffee Creek. The nets were set in slow-moving pool habitats, and the wings extended to direct fish towards the net entrance. Fyke nets were made of ½'' knotless nylon mesh, a funnel ring size of 2.5'', 24'' diameter aluminum hoops, a main net length of 12', and two wings each of 10' length (Fipec, Quebec, 2014). The nets were equipped with a leaded braid line on the lower net, and plastic floats on the wings.

In 2014, angling using spinning rods was conducted at AQ00 in August, 2014 using a two person crew for 1h. In 2015, angling was completed using both spinning and fly fishing rods at several sites including AQ00, AQ01, AQ02, AQ11, and AQREF2. The number of people fishing and duration varied at each site, with an average of 3.2 rod-hours per site (i.e. cumulative number of hours spent fishing per person per site).

All fish were identified to species and counted in the field. Fork length was measured to the nearest 1 mm with a measuring board (total length was measured for slimy sculpin), and wet weight was measured to the nearest 0.1 g or 1.0 g with a balance, depending on size of fish (Ohaus Scout Pro SP2001). Due to the large number of fish captured at some sites, up to 30 fish/species were measured per sampling event after which fish were counted but not individually measured for length or weight.

In 2014, an Arctic grayling tagging program was initiated to provide insight into annual site fidelity of feeding areas and migration patterns around project watercourses. Arctic grayling greater than 200m in length were tagged using an MK25 implant gun with 12mm Passive Integrated Transponder (PIT) tags (134.2 kHz ISO HDX, Biomark, ID, 2014). Tags were encapsulated in biocompatible glass and provide 100% unique identification. Fish were monitored for a minimum of 20 minutes following tagging to ensure successful re-entry into the stream. Due to time constraints, the tagging program was not continued in 2015, however a portable hand held reader (Biomark 601) was employed to scan captured Arctic grayling for tags. All implanted (n=31) and re-captured (n=4) tags are listed individually in Appendix F4.

In 2014, a small sub-set of slimy sculpin (n=26) from three sites (AQ02, AQ10, AQREF1) were sampled to obtain age (otoliths) and tissue metals analysis data. In 2015, more slimy sculpins were collected from sites that were added late in 2014, or in 2015 (AQ03, AQREF2). The aim was to collect eight samples from each of these sites, however low densities and poor sampling conditions (high and turbid flows) yielded small sample sizes (n=1 at AQREF2 and n=3 at AQ03). In addition, to verify sample quality from 2014[3], some additional samples were acquired from Coffee, Independence, and Isaac Creeks. Three samples were collected from AQ02 and AQREF1, but only one sample could be collected from AQ10 due to high flows. The selection of slimy sculpin for metals analysis provided relevant insight into site-specific metal contamination due to (1) the prevalence of the species in the study area, (2) its demonstrated high site fidelity (Gray *et al.* 2004), and (3) its sensitivity to stream sediment metal loading due to its benthic-dwelling nature.

[2] Due to the addition of AQ03 during the October sampling trip, sites further upstream were originally referred to as AQ03, AQ04 and AQ05 in field notes, August lab submissions, and in Appendix D2 unless otherwise noted. They were subsequently updated as AQ04, AQ05, and AQ06, respectively.

In 2014, three Arctic grayling samples were collected (two from AQ04 and one from AQ11) for analyzing diet, age (scales and otoliths), and metals analysis of tissues. In 2015, an additional 23 Arctic grayling from Latte, Coffee, Independence, and Los Angeles Creeks were lethally sampled for metals and ageing. A sub-set of the 2015 Coffee Creek Arctic grayling samples (n=5) were also sampled for diet analyses. An additional 25 grayling from both mine area and reference watercourses were non-lethally sampled for ageing using scales.

No fish samples were collected from Halfway Creek or YR24 due to very low sample sizes and captured fish being within the Yukon River influence. A total of n=1 Arctic grayling/year caught in lower Halfway Creek precluded any lethal sampling, as the DFO Scientific Collection permit prohibited sampling more than 10% of Arctic grayling captured at any site (XR 249 2014). No fish were captured at YR24 with the exception of five slimy sculpins that were captured in June 2015, all within 30m of the confluence with the Yukon River. Due to this close proximity to the Yukon River, absence of overwintering habitat in YR24, and high likelihood for migrations in and out of the creek outlet, these fish were not considered for providing representative baseline data for metals analyses.

Otoliths and scales were sent to North/South Consultants (Winnipeg, MB) for ageing, stomach contents were preserved using 85% ethanol and sent to Cordillera Consulting for species composition analysis, and dorsal muscle tissue was frozen upon sampling and delivered to CARO Analytical for metals analysis[3]. Slimy sculpin heads were submitted for ageing analyses, and the remaining whole-body was submitted for tissue metals analyses. Arctic grayling metals analyses was performed on a piece of muscle tissue from the dorso-lateral area, as recommended in BC MOE (2012).

Laboratory Methods:

To determine fish ages, a small sub-set (three or four) of intact representative scales were chosen by North/South Consultants from each individual fish sample. Scales were pressed between two glass slides and then viewed using a dissecting microscope under reflected light. Otoliths were set in Cold Cure™ epoxy for 48 hours until hardened, and then cut into thin sections using a Struers Minitom™ low speed-sectioning saw. The sectioned piece was then mounted on a microscope slide and viewed under a dissecting microscope with transmitted light for ageing.

Stomach sample contents (≥212 µm) were identified by Cordillera Consulting to the lowest possible taxonomic group, which was to family for most aquatic insects; Class for oligochaetes; and Phylum for nematodes.

CARO Analytical analyzed metals of fish tissue samples by first weighing and then digesting samples using a mixture of hydrogen peroxide and hydrochloric acid at 95°C for two hours. Samples were then filtered and analyzed using inductively coupled plasma mass spectrometry (ICP/MS). There were 31 total metals analyzed with detection limits reported in Table 5.

[3] In 2014, recommended fish sample temperatures may have been exceeded during transport to the lab.

Table 5. Fish Tissue Metals and Detection Limits (CARO Analytical), Coffee Gold Project, 2014-2015

Metal	Reported Detection Limit
Aluminum	0.4
Antimony	0.002
Arsenic	0.005
Barium	0.01
Beryllium	0.002
Bismuth	0.02
Boron	0.1
Cadmium	0.002
Calcium	2
Chromium	0.01
Cobalt	0.004
Copper	0.01
Iron	1
Lead	0.004
Magnesium	2
Manganese	0.02
Mercury	0.002
Molybdenum	0.01
Nickel	0.01
Phosphorus	5
Potassium	10
Selenium	0.02
Silver	0.01
Sodium	2
Strontium	0.01
Thallium	0.001
Tin	0.02
Titanium	0.05
Uranium	0.001
Vanadium	0.02
Zinc	0.5

Note: All units are mg/kg wet weight

2.4.5.2 Fish Spawning Surveys

2.4.5.2.1 Salmon Spawning Surveys

Both Chinook and chum salmon are known to migrate through or reside in the Yukon River near the Project area. Spawning salmon enter the Yukon River in Alaska from the Bering Sea and travel hundreds of kilometers upstream before entering Canadian waters. Yukon River Chinook salmon return to the mouth of the Yukon River from mid to late May through to early July, with the peak migration timing into Canadian waters occurring in mid to late July. Chinook salmon spawning typically occurs in Canadian waters from late July to mid-September (Yukon River Panel 2014). The peak migration timing of Yukon River chum salmon into Canadian waters occurs later in the fall in mid-September, with peak spawning occurring from October through to early November (Yukon River Panel 2014).

Salmon spawning surveys were conducted by two fisheries biologists in August 2014, October 2014, and in July-August 2015 (Table 6). A helicopter hovered just above the treeline and travelled at a slow enough speed to allow observations of any spawning activity, such as the presence of adult salmon or areas where salmon had created nests (redds). In Coffee and Independence Creeks, multiple spawning surveys occurred in summer 2015 over the course of a week of fish community sampling. The water clarity was moderate to good during each survey, although water clarity in the Yukon River ranged from turbid in the thalweg to clear in the river margins and side channels. Thus, surveying did not cover the entire Yukon River area from bank to bank.

Table 6. Salmon Spawning Surveys, Coffee Gold Project, 2014-2015

Date	Location	UTM Co-ordinates (Zone 7V, Easting, Northing)	
		Start	End
28-Aug-14	Independence Creek from Yukon River to Kona Tributary	580521, 6984765	575261, 6979622
28-Aug-14	Coffee Creek from Yukon River to Latte Creek	599397, 6977125	594507, 6970377
06-Oct-14	Coffee Creek from Yukon River to Latte Creek	599397, 6977125	594507, 6970377
07-Oct-14	Yukon River from Coffee Creek to Carlisle Creek	599397, 6977125	576016, 6987383
07-Oct-14	Independence Creek from Yukon River to Kona Tributary	580521, 6984765	575261, 6979622
30-Jul-15	Yukon River from Ballarat Creek to Independence Creek	603429, 6975051	581014, 6984576
July 25 - August 1, 2015	Coffee Creek from Yukon River to Latte Creek	599397, 6977125	594507, 6970377
July 24 - August 1, 2015	Independence Creek from Yukon River to Kona Tributary	580521, 6984765	575261, 6979622

2.4.5.2.2 Arctic Grayling Spawning Survey

In mid-late June 2015, Arctic grayling in Latte Creek were assessed for spawning behavior (territory guarding, spawning congregations, or any courtship displays), external features indicating spawning condition, and internal gonadal development (RIC 1996; Stewart *et al*., 2007a). Arctic grayling in northern ecosystems are known to spawn at or shortly after spring ice break-up which typically occurs from mid-May to mid-June, with some spawning continuing into early July (Stewart *et al*., 2007a). Spawning typically occurs annually after maturity, although some individuals may skip a year after their first spawning season (Stewart *et al.*, 2007a). Stream temperature is a major factor influencing Arctic grayling spawning, with spawning occurring at temperatures above 4°C and with daily means fluctuating between 6-10°C (Stewart *et al*., 2007a). Therefore, timing of the spawning assessment was made based on temperature data available from June-July 2014 which indicated that Latte Creek did not reach adequate temperatures for spawning until early summer.

The Arctic grayling spawning assessment consisted of several components and was carried out from June 18-23, 2015. Upon arrival to site, temperature data from the logger stationed at AQ03 on lower Latte Creek was downloaded and assessed relative to known preferred Arctic grayling spawning temperatures. Temperatures were also monitored using the YSI water quality metre at fish sampling sites AQ03 and AQ04 over the duration of the trip and cross-referenced with the temperature logger data. Sites AQ03 and AQ04 were selected for spawning assessments as they are representative of lower-mid Latte Creek habitat, and are known to support Arctic grayling during the summer months. Fish habitat quality for spawning was assessed over each fishing site concurrent with observations of any fish presence or spawning behavior. Arctic grayling prefer unembedded gravel sized substrate for spawning, at depths <1m, in clear, fast-flowing tributary streams (Stewart *et al*., 2007a). When no spawning behavior was confirmed, each site was electrofished twice over the one week period. Captured fish were assessed for any external signs of maturity state according to the RIC guidelines (1996):

- Immature (IM): Young individuals that have not yet reproduced; fish with underdeveloped gonads. Maturing (MT): Ovaries and testes begin to fill out and take up a large part of the body cavity; eggs distinguishable to the naked eye.
- Mature (M): Fish in full spawning colours; gonads at maximum size; body cavity feels full, especially females; roe or milt is not produced if the body cavity is lightly squeezed.
- Spawning (SP): Fish in full spawning colours; eggs and milt are expelled when body cavity is lightly squeezed (also referred to as gravid).
- Spent (ST): Still have spawning colours; eggs and sperm totally discharged; body cavity feels empty and genital opening is inflamed; gonads empty except for a few remaining eggs or residual sperm.
- Resting (R): Adult sized fish; spawning colours not as apparent; gonads are very small and eggs may not be visible to the naked eye.

At the end of the assessment period, six Arctic grayling were lethally sampled providing a more thorough assessment of sexual maturity state.

2.5 Data Analysis

The standard deviation (SD) was the index of dispersion for all arithmetic means shown in this report, and n was the sample size. All statistical analyses were completed using Statistica version 8 (StatSoft Inc.,Tulsa OK, 2008), with significance levels set to α=0.05.

2.5.1 Sediment

All sediment metrics were calculated as an average over the 2014-2015 period. Sediment data was compared to the Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the protection of aquatic life (1999) to identify any parameter exceedances. CCME established two types of guidelines: Interim Sediment Quality Guidelines (ISQG) and Probable Effects Level (PEL). ISQG are concentrations below which adverse biological effects are expected to occur rarely, and PEL are concentrations above which biological effects are expected to occur frequently.

Values below detection limits were replaced with one-half the detection limit. Mean, minimum, maximum and standard deviation were calculated for each parameter by site in Microsoft Excel. While most sites had sample sizes of three for each parameter/year, site AQ11 had only two in 2015 as the third sample was broken during transit to the lab. Thus, results reported for AQ11 are weighed slightly towards 2014 values.

2.5.2 Periphyton

All periphyton metrics were calculated as an average over the 2014-2015 period. Chlorophyll *a* concentrations (µg/L) and periphyton ash-free dry mass (mg/L) were converted to represent mass/area (µg/cm^2 or mg/cm^2) using the known volume sampled per area of substrate at each site. Similarly, periphyton cell density (cells/cm^2) was calculated relative to the sampled substrate area at each site. Periphyton community composition was determined by calculating the relative densities of four main algal groups by site including: Diatoms (*Bacillariophyceae*), green algae (*Chlorophyta*), blue-green algae (*Cyanophyta*), and red algae (*Rhodophyta*).

Taxa richness was calculated as the total number of species present at each site. Where species could not be discerned, the lowest possible taxonomic level identified was substituted. Biodiversity was measured for periphyton samples using the Shannon-Wiener index (H') as follows:

$$H' = -\sum_{i=1}^{R} p_i (\ln p_i) \quad (1)$$

Where R is taxa richness, and p_i is the total number of individuals in the ith species divided by the total number of organisms in the sample.

2.5.3 Benthic Invertebrates

Parameter selection for benthic invertebrates was based on the protocols recommended by the Canadian Aquatic Biomonitoring Network (CABIN), which is supported by the National Water Research Institute (NWRI) of Environment Canada (NWRI 2008).

Benthic invertebrate samples were analysed using the Reference Condition Approach (RCA) as adopted from Environment Canada's Canadian Aquatic Biomonitoring Network (CABIN) protocols. CABIN field sheets were used to collect all the data required for input into the CABIN database. This includes general site and location data, reach data (*i.e*. habitat types, canopy coverage, periphyton coverge, etc.), basic water chemistry, slope, widths, depth, velocity, and substrate data. Once uploaded to the CABIN database, data was compared to the Yukon 2013 reference model using the predictor variables: Channel depth, stream velocity, longitude, precipitation (June), rainfall (Feb, March, June, July), maximum April temperature, and landcover values (Natl-BroadLeafopen, Natl-Bryoids, Natl-MixedWoodOpen, Natl-WetlandHerb). With the exception of stream depth, velocity and longitude values, which were collected in the field, all parameters were generated from GIS layers by PECG.

CABIN analyses include Bray-Curtis, River Invertebrate Prediction and Classification System (RIVPACS) and Benthic Assessment of Sediment (BEAST) Site Assessment Graphs. The Bray-Curtis dissimilarity coefficient is a distance measure that analyses how similar the test sites are to the median of the reference sites; a value of 1 indicates the two sites are entirely different from one another and a value of 0 indicates the two sites are identical in community structure. RIVPACS predicts the probability of a taxonomic group occurring at a test site based on what is expected to occur. Finally, the BEAST analysis is a tool that evaluates whether or not a test site is in reference condition, and if not, then how divergent it is from reference condition. Ordination plots are generated in CABIN and provides an overall indicator of whether a site is in reference condition (unstressed), potentially stressed or stressed.

In addition to the CABIN model outputs described above, traditional community descriptors were also used on benthic invertebrate data. Metrics were calculated as an average over the 2014-2015 period. These include:

- Abundance, calculated as the total number of individuals per kick/net per site,
- Taxonomic richness, calculated as the total number of species present at each site. Where species could not be discerned, the lowest possible taxonomic level identified was substituted,
- EPT taxa richness, defined as the total number of mayflies (Ephemeroptera), stoneflies
- (Plecoptera) and caddisflies (Trichoptera) families per site. These three orders of aquatic insects are typically most sensitive to habitat disturbance,
- Percentage composition, calculated by dividing the density of dominant taxa groups by the total density, and,
- Simpson's diversity (D) and Evenness (E) indices, as defined in Equations (2) and (3) below:

$$D = 1 - \sum_{i=1}^{S} (p_i)^2 \quad (2)$$

$$E = 1/\sum_{i=1}^{S} (p_i)^2 / S \quad (3)$$

Where S is taxa richness, and p_i is the total number of individuals in the ith species divided by the total number of organisms in the sample.

2.5.4 Fish Habitat and Fish Community

Stream Temperature

The period of record for stream temperatures is from June 1, 2014 to mid-September 2015, with the exception of Coffee Creek which has a record from June 1 to October 6, 2014, and the Kona tributary which was first installed on October 7, 2014. Daily and monthly summary statistics (means, maxima, and minima) were calculated during the open water period (June – October) for each creek where a logger was deployed. Where multiple years of data were available, monthly averages were made based on both years. The temperature time series were examined to identify periods where data were suspect (e.g. elevated readings, when logger may have been dry), and any such data were excluded from the calculations. The mean temperatures were calculated as weighted averages based on the number of days of data available. Mean, minimum and maximum daily stream temperature data is included as Appendix E2.

Fish Abundance and Population Density

Relative fish abundance in the study area was determined using a catch per unit effort (CPUE) index, defined as the number of fish caught per 100s of electrofishing effort, or number of fish caught per trap per day. CPUE for minnow trapping was calculated by species and site, per sampling trip season (e.g., June, July, August or October). CPUE for electrofishing was calculated by species and site for the two years combined, as preliminary analyses revealed that data was similar for both years. Fish population estimates were calculated for sites where multiple passes were possible (AQ04, AQ10, AQREF1) using the Zippin two and three-pass exact methods approach as described in Seber & LeCren (1967), Seber & Whale (1970) and Seber (1982). Areas were calculated by multiplying site sampling length (m) with the mean wetted width (m), and then population estimates were divided by area to obtain density estimates (#/100m^2). For sites with multiple passes, CPUE was calculated only using data from the first pass.

Size, Age, Condition

The length-age relationships for Arctic grayling and slimy sculpin were estimated by fitting a von Bertalanffy growth model with non-linear regression. The model was as follows:

$$L_t = L_\infty\left(1 - e^{\left(-K(t-t_0)\right)}\right) \quad (4)$$

where L_t = length (mm) at time t, L_∞ = theoretical maximal length, K = growth coefficient measuring the rate at which the maximal size is attained, and t_0 = theoretical age at zero length. Weighted non-linear regression models with weights set equal to age-class sample sizes were implemented to increase model accuracy. The model for Arctic grayling length-at-age was created using combined data from mainstem Coffee, Latte, and Independence Creek watersheds in order to provide a robust relationship for the overall mine area. For slimy sculpin, only Coffee Creek sculpins (including Latte Creek data) produced a realistic model that was statistically significant. Sculpins from Latte and Coffee Creek were combined due to their close proximity, and low sample size for Latte Creek (n=3). For both species, mean length-at-age was calculated by watershed based on samples collected from five watercourses (mainstem Coffee Creek, Latte Creek, Independence Creek, Isaac Creek, and Los Angeles Creek). Mean age was tested

for statistical differences by watershed using one-way Analysis of Variance (ANOVA) and followed by post-hoc Tukey HSD tests to identify pairwise differences where appropriate. When data did not meet parametric test requirements (e.g., equal sample variances), a nonparametric Kruskal-Wallis H-test was performed.

Weight-length regressions for fish were calculated as:

$$ln\,(W) = a + b \times ln\,(L) \quad (5)$$

where W = weight (g) and L = length (mm), a = the intercept of the regression and b = the slope of the regression. Watershed-specific regressions were completed for each species with sufficient sample sizes (n>30), which included Arctic grayling, slimy sculpin and Chinook salmon. Watersheds were classified according to the following groupings: Coffee Creek mainstem (sites AQ00, AQ01, AQ02), Latte Creek (AQ03, AQ04), Independence Creek (sites AQ10, AQ11), YR24 (site AQ30), Isaac Creek (site AQREF1), and Los Angeles Creek (AQREF2). Only watersheds within a minimum of five fish/species were included in analyses. Combined regressions from fish in the Coffee Creek mainstem, Latte Creek, Independence Creek, YR24, and Halfway Creek are presented in the results to characterize the overall weight-length relationships of fish species in watersheds that may experience project effects. Five outliers were identified and subsequently removed from slimy sculpin weight data in Isaac Creek, and were likely due to the difficulties associated with weighing very small fish in the field.

One sample t-tests were performed on estimated weight-length slope coefficients to determine if slopes significantly differed from the isometric growth value of three. Slope coefficients used in t-tests were estimated using watershed-specific linear regressions. Isometric growth is a requirement for calculating fish condition using the Fulton condition factor (K), as it assumes that fish shape does not change with increasing length. The Fulton condition factor was calculated for slimy sculpin:

$$K = \frac{W}{L^3} \times 100{,}000 \quad (6)$$

Where K = Fulton condition factor, W= weight (g) and L= fork length (mm).

Arctic grayling and juvenile Chinook salmon condition could not be assessed using the Fulton condition factor, due to allometric growth in one or more watershed. Instead, the relative condition factor (K_n) was used to characterize fish condition:

$$K_n = \frac{W}{W'} \quad (7)$$

Where W = fish actual weight (g) and W'= predicted length-specific weight using the length-weight regression for all watersheds (data from reference sites included) outlined in equation 5.

Statistical comparisons of fish condition were made using one-way Analysis of Variance (ANOVA) and followed by post-hoc Tukey HSD tests to identify pairwise differences where appropriate. When data did not meet parametric test requirements (e.g., equal sample variances), a nonparametric Kruskal-Wallis H-test was performed. Only watersheds with n≥5 were included in statistical analyses.

Metals Analysis

Selected total metals were compared among watersheds and included: aluminum, arsenic, barium, cadmium, copper, iron, lead, mercury, manganese, molybdenum, nickel, selenium, strontium, thallium and zinc. Values below detection limits were replaced with one-half the detection limit for analyses.

The mean and standard deviation of each metal were reported by watershed and compared to various guidelines for the protection of aquatic and piscivorous wildlife, as well as to Health Canada standards for mercury levels in fish. Currently, information is lacking for developing safe metal concentration levels for fish, with guidelines available only for selenium and mercury. The selenium concentration guideline of 4mg/kg (dry weight) is a newly developed guideline prescribed by the British Columbia Ministry of Environment (2014) for the protection of freshwater aquatic life, with the aim of preventing selenium bioaccumulation up the food chain. With the 2014 updates, BC also provided Human Consumption Screening values for selenium that is based on Health Canada's recommended equation for ingestion of Se-contaminated fish and the dietary reference value's tolerable upper intake (BC MOE 2014). The screening values vary from 7.3 – 75 µg/g (dry weight) depending on the amount of fish regularly consumed. Selenium concentrations were converted to dry weight using percent moisture:

$$d \quad w \quad ht = \frac{w \quad w \quad ht}{1 \quad -(\%\, m \qquad)} \times 100 \qquad (8)$$

The CCME mercury guideline for the protection of piscivorous wildlife is based on methymercury concentrations (0.033mg/kg), which is the biologically relevant form of mercury due to its potent neurotoxicity to humans and wildlife (CCME, 2000). The proportion of mercury in fish tissue in its methylated form varies by species, and previous studies have demonstrated that in slimy sculpin tissue approximately 83% of total mercury levels are methylated (Raymond and Rossmann, 2009). Arctic grayling tissues have a higher proportion of methylated mercury at approximately 95% (Jewett *et al*. 2003). Thus, for comparing mercury levels with the CCME guideline, 83% and 95% of total mercury values were calculated as estimated methylmercury levels for slimy sculpin and Arctic grayling, respectively. In addition, total mercury was compared with Health Canada mercury guidelines, which range from 0.2mg/kg for subsistence consumers to 0.5mg/kg for the maximum allowable level for sale in Canada. Notably, as slimy sculpin are not consumed by humans the comparison to Health Canada guidelines are not directly relevant, but instead provide an estimation of non-piscivorous fish which may be in turn consumed by piscivorous fish. As mercury is known to both bioaccumulate in aquatic organisms and biomagnify up trophic levels, comparing forage fish mercury values to Health Canada guidelines still provides valuable insight into aquatic ecosystem health.

Diet

An analysis of diet focused on Arctic grayling from Latte and the mainstem of Coffee Creek only. Raw data for the single Independence Creek Arctic grayling is included in Appendix F6. Prey items were sorted by order, and then the mean and standard deviation of prey items per fish was calculated.

2.6 Quality Assurance and Quality Control

All field sampling was completed by two qualified aquatic biologists, with the same methods employed at each site for consistency. All field data was transcribed into excel spreadsheets and plotted to determine data outliers. Original field notes were consulted where necessary to identify transcription errors or potential field equipment errors. Outliers were corrected or excluded where appropriate.

2.6.1 Sediment

Sediment quality samples were collected by an aquatic biologist. Appropriate measures were taken to reduce potential for sample contamination. Field staff wore nitrile gloves when sampling and used pre-cleaned sample bottles supplied by CARO Analytical. Care was taken to ensure the inner portion of the sample container and caps did not touch anything other than the sample itself. Sample containers were kept in the laboratory supplied cooler before and after collection of the sample. All samples were kept cold at all times between sample collection and delivery to the laboratory. Chain of Custody forms accompanied all samples.

Field split samples were collected for one replicate sample at every other site, as recommended by the BC MOE (2012). Relative Percent Difference (RPD) was calculated for field split samples and is provided in Appendix B2. An RPD less than 25% is considered an acceptable difference, and an RPD greater than 25% warrants further examination to ensure that the result was not due to sampling error or analytical error. RPD is only relevant when both values are greater than the Practical Quantitation Limit (PQL), which was defined for this project as three times the detection limit. The PQL is considered the lowest concentration that can be accurately measured, as opposed to just detected. Between zero and four replicate values of the 47 parameters that were measured from each sample had RPDs greater than 25% and met PQL restrictions. This was equivalent to between 0-9% of all parameters (mean 4%), which is considered to be an acceptable level of variability. Most RPDs greater than 25% were for nutrient parameters, with the exception of arsenic, cadmium, and cobalt which had one sample higher than threshold criteria, and manganese and uranium which had 4 and 2 samples over the threshold criteria, respectively. All other metals were below 25% RPD for all sites.

2.6.2 Periphyton, Benthic Invertebrates, and Fish Community

Plankton R Us has over twenty five years of experience with periphyton and plankton taxonomy and enumeration. QA/QC methods included:

- Random sub-sampling to minimize counting bias.
- Analyzing all samples by the same technician to ensure consistency.
- Replicate counts performed on random samples.
- 10-15% of samples were re-analyzed by a secondary technician to ensure accuracy.
- The usage of best management methods supported by scientific literature.

CARO Analytical Services has over twenty years of experience with microbiological analysis, general chemical analysis, and contaminated site testing of water, vegetation, tissue, soil and sediments. They

are a quality management system based on ISO 17025:2005, 'General Requirements for the Competence of Calibration and Testing Laboratories.' As part of their quality assurance and control, CARO routinely employs method blanks, sample duplicates, and laboratory controls samples per every 10 test samples. Results from quality control samples are analyzed to ensure they are within regulation.

Cordillera Consulting has over ten years experience in taxonomic analysis of benthic invertebrates from streams, rivers and lakes of western Canada. The following QA/QC procedures are followed by Cordillera Consulting:

- sorting efficiency – 10% of the whole sample number was resorted with an expectation of >90% efficiency in the sorting process;
- taxonomic efficiency – 10% of the identified sample vials were sent to another taxonomist. The two results were compared with simple statistics and the taxonomists discussed how best to correct their differences and make appropriate changes to the results; and
- taxonomic precision – an externally verified reference collection is maintained by Cordillera Consulting. Any new specimens are sent away to experts of that taxon and the collection is reviewed every five years.

North/South Consultants specializes in the analysis of ageing structures including otoliths and scales. All structures were read by an experienced ageing technician using a confidence index with five denominations ranging from very good to very poor. Independent second readings were made for 10% of randomly selected structures.

3 Results and Discussion

3.1 Sediment Quality

Raw sediment quality data can be found in Appendix B1.

3.1.1 Comparisons to CCME Sediment Quality Guidelines

Sediment quality results compared to CCME guidelines are summarized in Table 7. Out of the seven metals with CCME sediment quality guidelines, exceedances were observed for two: arsenic (As), and chromium (Cr). There were no exceedances recorded for mercury. Arsenic exceedances occurred at every station for the ISQG. Arsenic also exceeded the PEL at AQ05, AQ13, and AQREF1, which are in headwater areas adjacent to the deposit (AQ05, AQ13), or proximate to the Yukon River (AQREF1). The ISQG was exceeded for Chromium in the Kona tributary of Independence Creek (AQ13), as well in the Los Angeles Creek reference location (AQREF2). However, the PEL was not exceeded for chromium at any sites in the study area.

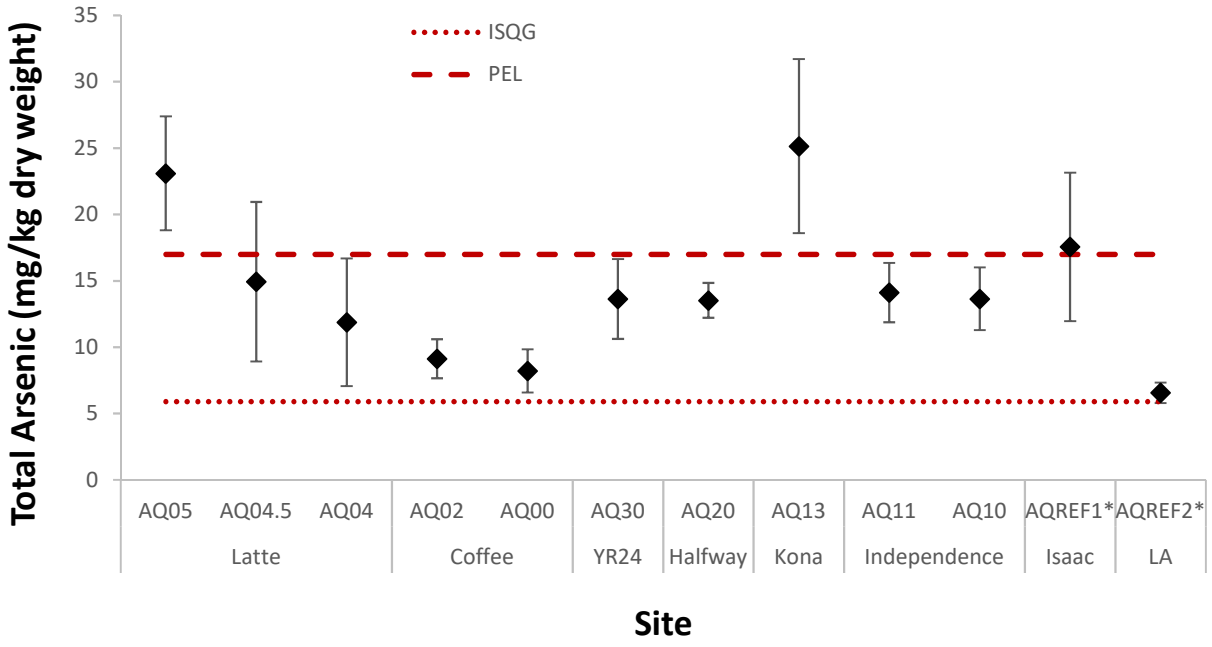
Table 7. Mean Sediment Quality Parameters Exceeding CCME Guidelines, Coffee Gold Project, 2014 - 2015

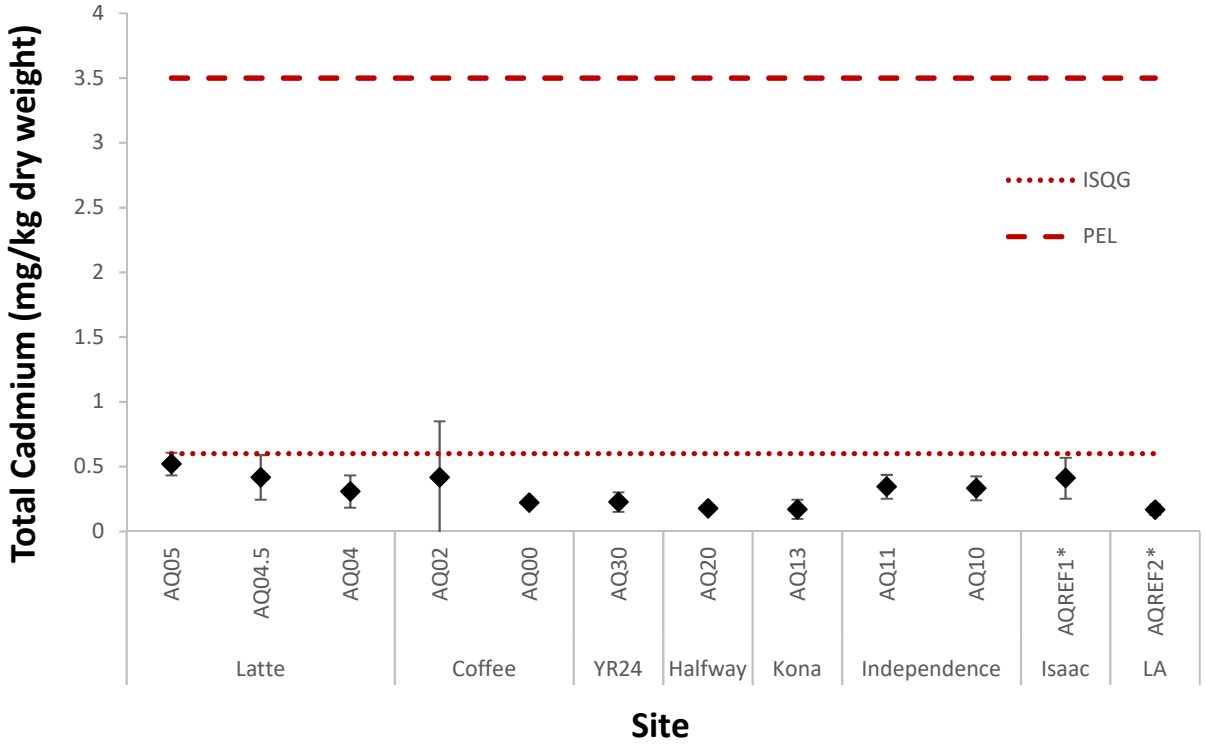
Watershed	Creek	Site	Interim Freshwater Sediment Quality Guideline (ISQG)	Probable Effects Level (PEL)
Coffee	Latte	AQ05	As	As
	Latte	AQ04.5	As	
	Latte	AQ04	As	-
	Coffee	AQ02	As	-
	Coffee	AQ00	As	-
Halfway	Halfway	AQ20	As	-
YR24	YR24	AQ30	As	-
Independence	Kona tributary	AQ13	As, Cr	As
	Independence	AQ11	As	-
	Independence	AQ10	As	-
Isaac	Isaac	AQREF1*	As	As
Los Angeles	Los Angeles	AQREF2*	As, Cr	-

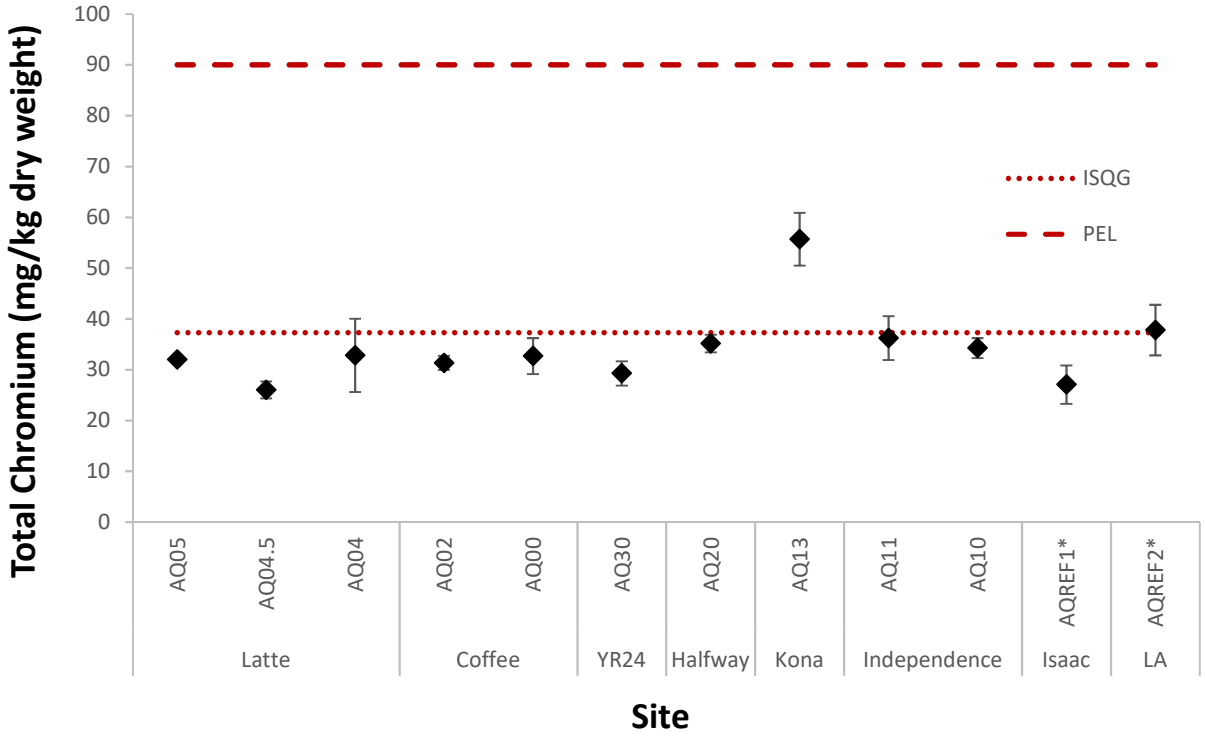
Dashes indicate sample mean did not exceed CCME guidelines

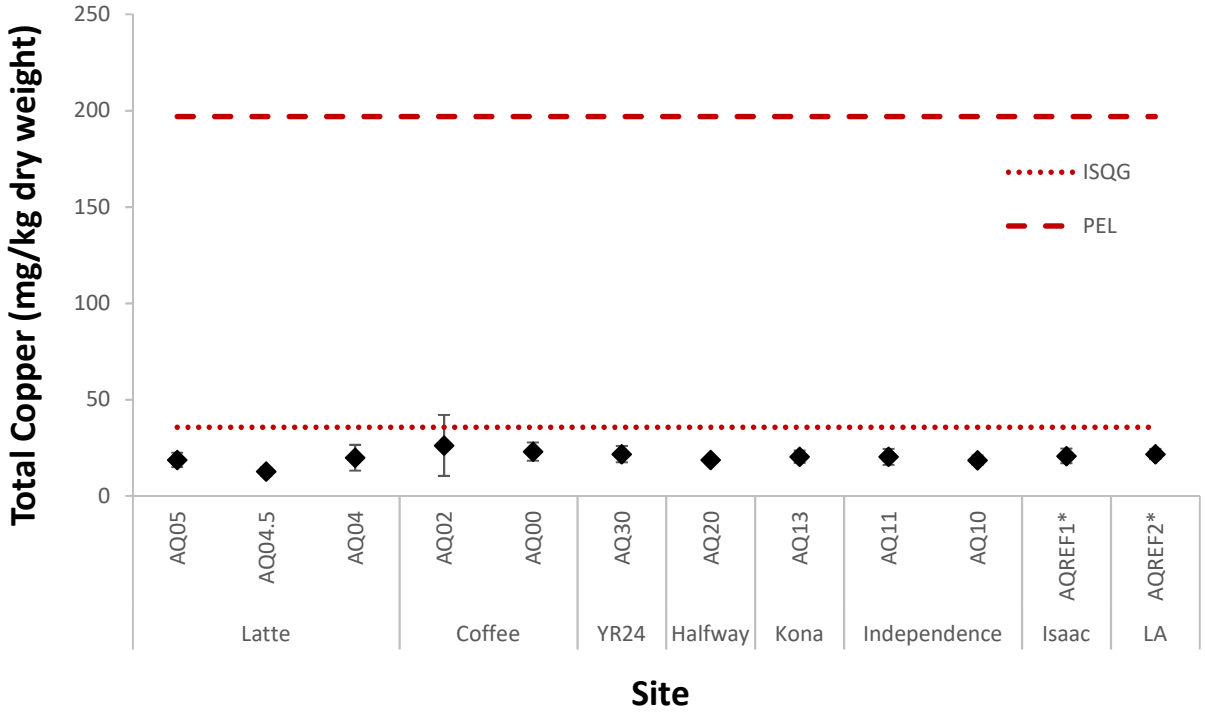
In addition to the mean exceedances outlined in Table 7, plots of mean sediment metal concentrations reveal that individual sediment samples exceeded CCME guidelines for cadmium, chromium, copper, and mercury at some aquatic sites (Figure 3). The majority of sample exceedances occurred in the Coffee Creek watershed, where exceedances of the CCME ISQG occurred at AQ00 (Cr), AQ02 (Cu, Cd), AQ04 (Cr, Hg), AQ04.5 (Cd), and two samples at AQ05 were equal to the mercury ISQG. In the Independence,

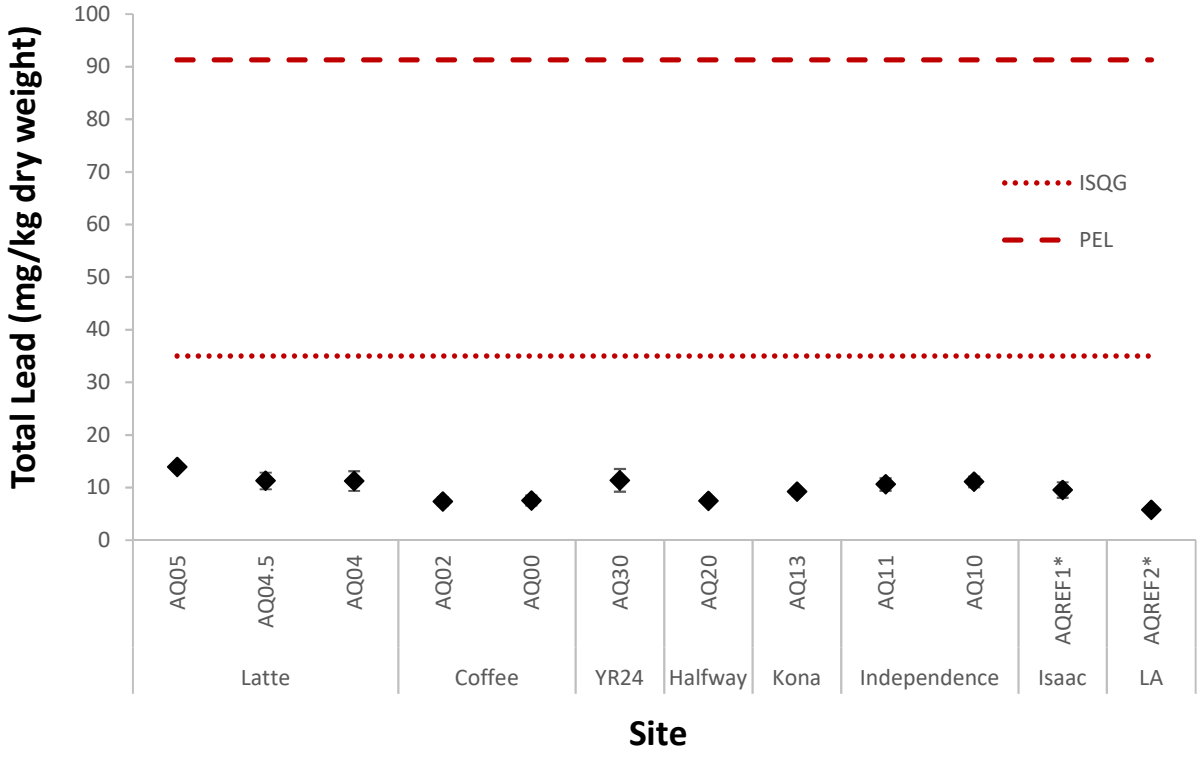
Halfway, YR24, and Los Angeles Creek watersheds, there were no individual exceedances for parameters other than the previously noted exceedances for chromium and arsenic. In the Isaac Creek reference site, there was an additional exceedance of the cadmium ISQG for one sample.

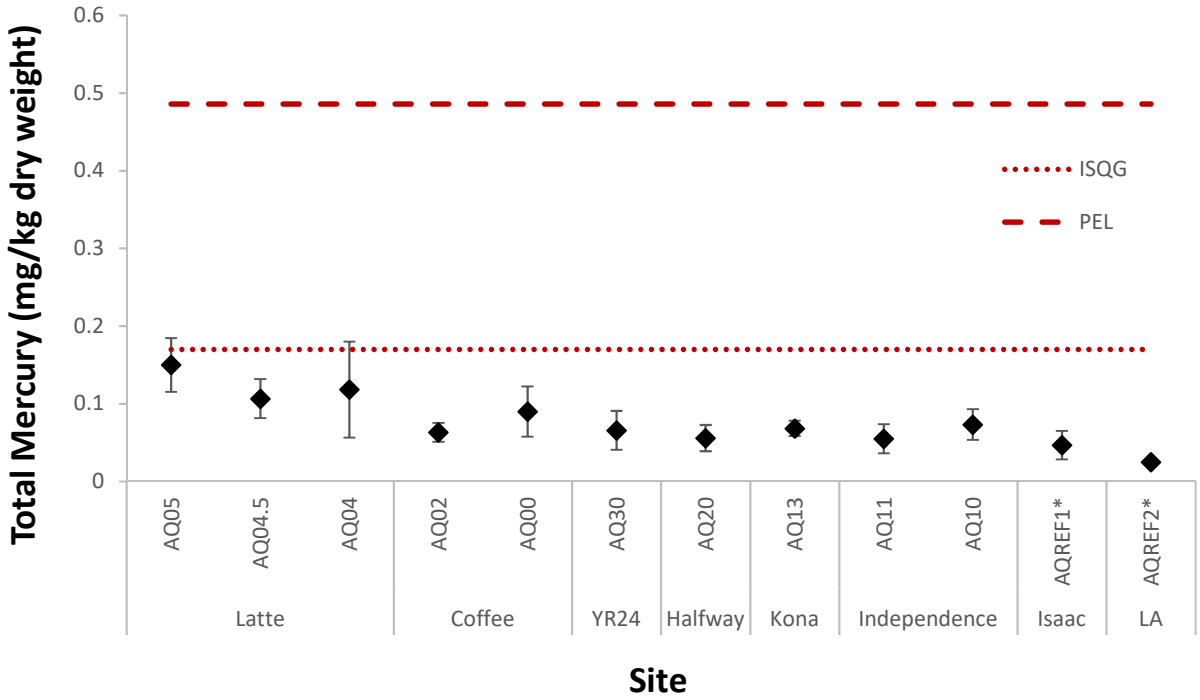





Total Chromium (mg/kg dry weight)
100
90
80
70
60
50
40
30
20
10
0
ISQG
PEL
AQ05
AQ04.5
AQ04
AQ02
AQ00
AQ30
AQ20
AQ13
AQ11
AQ10
AQREF1*
AQREF2*
Latte
Coffee
YR24
Halfway
Kona
Independence
Isaac
LA
Site


Total Copper (mg/kg dry weight)
250
200
150
100
50
0
ISQG
PEL
AQ05
AQ04.5
AQ04
AQ02
AQ00
AQ30
AQ20
AQ13
AQ11
AQ10
AQREF1*
AQREF2*
Latte
Coffee
YR24
Halfway
Kona
Independence
Isaac
LA
Site


Total Lead (mg/kg dry weight)
100
90
80
70
60
50
40
30
20
10
0
ISQG
PEL
AQ05
AQ04.5
AQ04
AQ02
AQ00
AQ30
AQ20
AQ13
AQ11
AQ10
AQREF1*
AQREF2*
Latte
Coffee
YR24
Halfway
Kona
Independence
Isaac
LA
Site


Total Mercury (mg/kg dry weight)
0.6
0.5
0.4
0.3
0.2
0.1
0
ISQG
PEL
AQ05
AQ04.5
AQ04
AQ02
AQ00
AQ30
AQ20
AQ13
AQ11
AQ10
AQREF1*
AQREF2*
Latte
Coffee
YR24
Halfway
Kona
Independence
Isaac
LA
Site

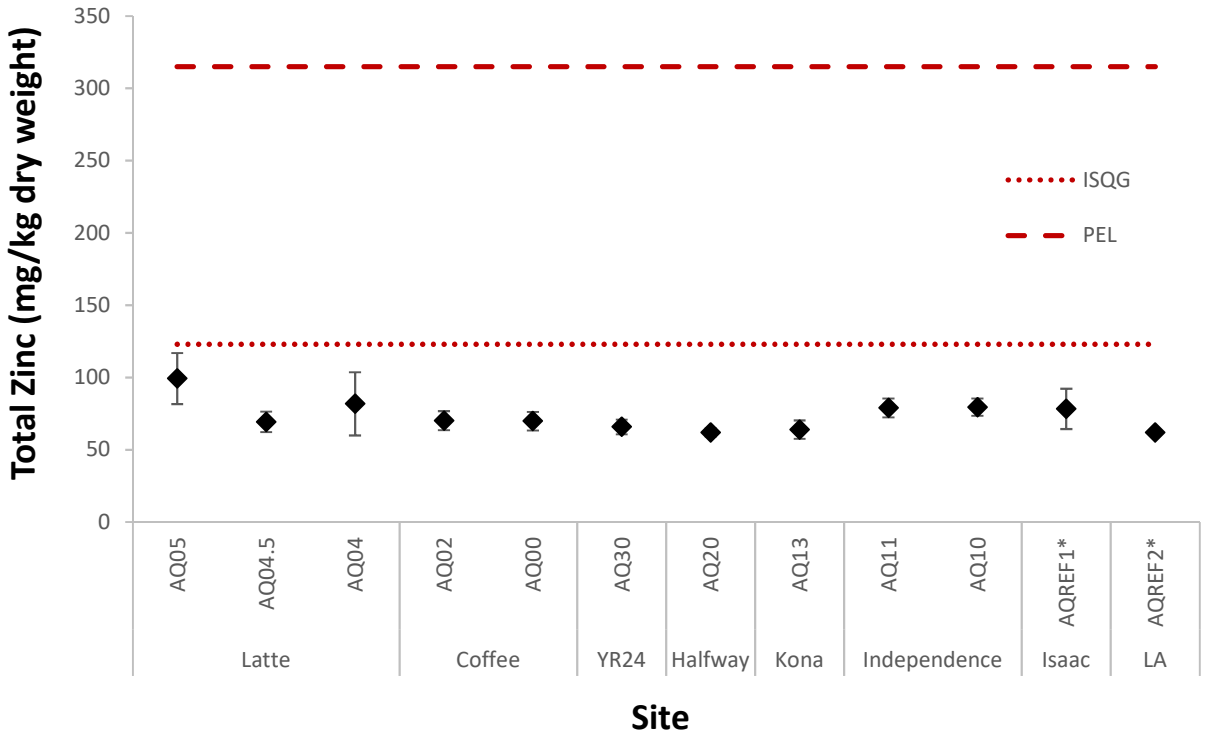


Figure 3. Range of Values (Mean and Standard Deviation) of Selected Total Metals Sediment Quality Parameters, Coffee Gold Project, 2014-2015. Dotted line is CCME Interim Sediment Quality Guideline (ISQG) and dashed line is CCME Probable Effects Level (PEL) guideline. Sites are grouped by watershed including: Latte= Latte Creek, Coffee= sites on mainstem Coffee Creek, YR24= Unnamed tributary between Coffee and Halfway Creeks, HW= Halfway Creek, Kona= Kona Tributary in the Independence Creek watershed, Independence= sites on mainstem Independence Creek, Isaac= Isaac Creek, LA= Los Angeles Creek, and (*) indicates study reference sites.

3.1.2 Sediment Particle Size Distribution

Over 60% of the sediment particle sizes in the study area were less than 300 µm in diameter (Figure 4). In the Coffee Creek watershed, particle size demonstrated a general decreasing trend in a downstream direction. However, a similar pattern for sites in the Independence Creek watershed was not observed. Overall, sites in mainstem Coffee Creek (AQ00, AQ02), Isaac Creek, (AQREF1) and Halfway Creek (AQ20) were comprised of the finest sediment particles in the study area. The Los Angeles Creek reference site (AQREF2) had the lowest amount of fine sediment collected.

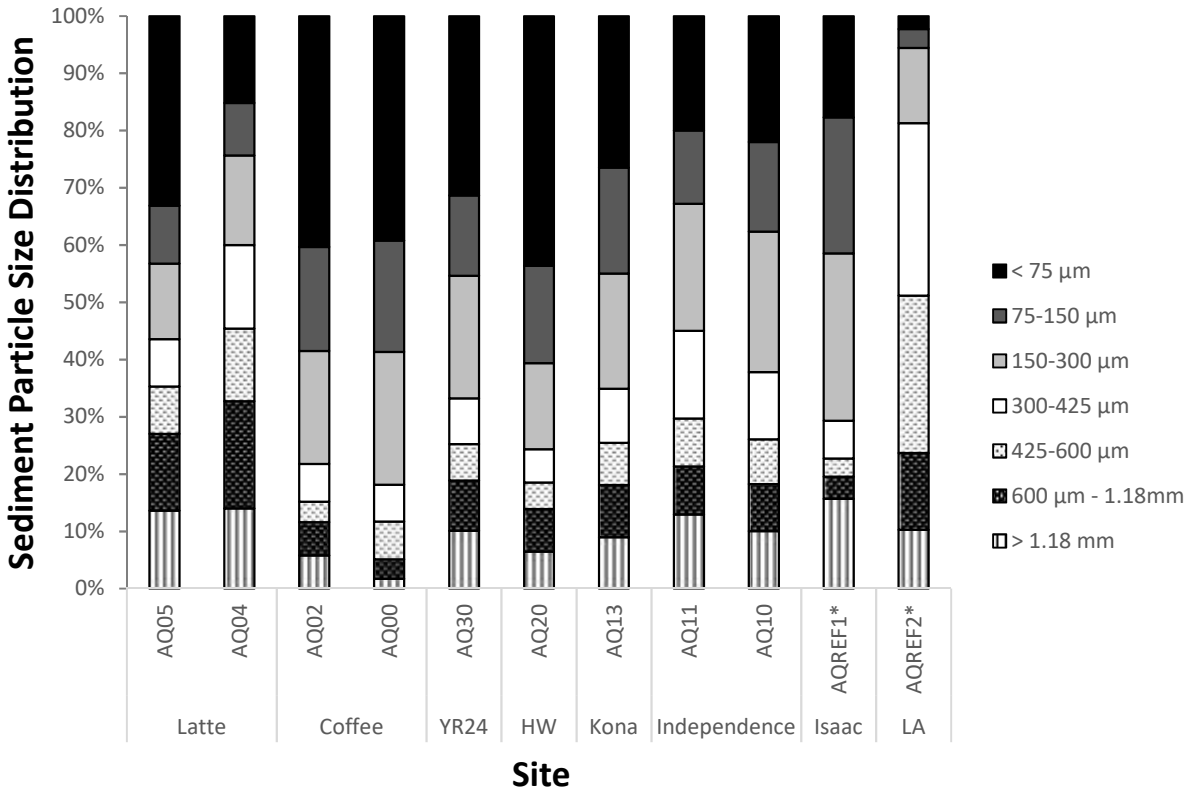


Figure 4. Sediment particle size distribution by site, Coffee Gold Project, 2014-2015. Sites are grouped by watershed including: Latte= Latte Creek, Coffee= sites on mainstem Coffee Creek, YR24= Unnamed tributary between Coffee and Halfway Creeks, HW= Halfway Creek, Kona= Kona Tributary in the Independence Creek watershed, Independence= sites on mainstem Independence Creek, Isaac= Isaac Creek, LA= Los Angeles Creek, and (*) indicates study reference sites.

3.2 Periphyton

3.2.1 Chlorophyll *a* and Periphyton Biomass

Mean chlorophyll *a* was very low for all sites, which is typical of northern aquatic habitats (Stantec 2011) (Figure 5). The lowest chlorophyll *a* value was observed in Independence Creek (mean=0.13 µg/cm^2), followed by Coffee Creek (mean=0.14 µg/cm^2), YR24 and Los Angeles Creeks (0.17 µg/cm^2), Halfway Creek (0.19 µg/cm^2), and then Isaac Creek (0.23 µg/cm^2).

Ash-free dry mass (AFDM) values ranged from 0.38 - 1.07 mg/cm^2, with the highest values observed in Halfway Creek (AQ20) and Los Angeles Creek (AQREF2). The remaining sites were in a similar range and did not display any strong longitudinal trends. The relationship between chlorophyll *a* and ash-free periphyton mass was not significant (Linear regression, R^2=0.17, P=0.18). Differences in chlorophyll *a* content may be due to varying light conditions, nutrient availability, and taxonomy, which result in different proportions of photosynthetic:non-photosynthetic organisms which comprise periphyton (Barbour *et al.*

1999). However, given the remote location of the project, surpassed holding times for chlorophyll *a* analyses may also have affected the accuracy of results.

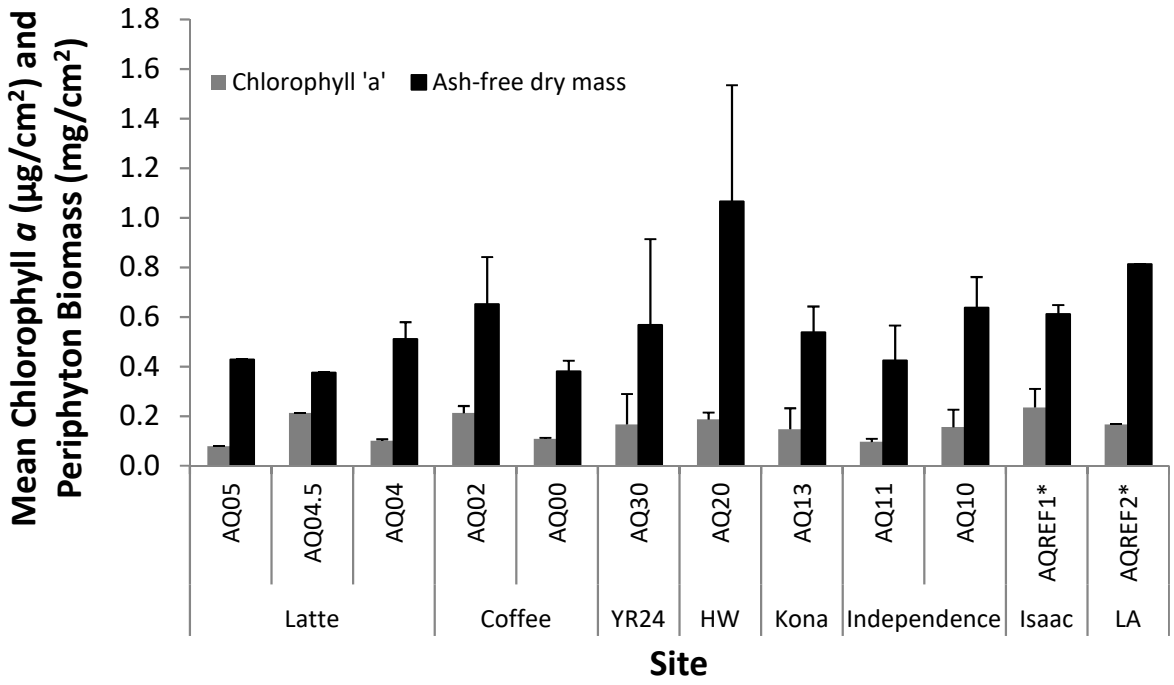


Figure 5. Mean Chlorophyll *a* and periphyton ash-free dry mass by site, Coffee Gold Project, 2014-2015. Sites are grouped by watershed including: Latte= Latte Creek, Coffee= sites on mainstem Coffee Creek, YR24= Unnamed tributary between Coffee and Halfway Creeks, HW= Halfway Creek, Kona= Kona Tributary in the Independence Creek watershed, Independence= sites on mainstem Independence Creek, Isaac= Isaac Creek, and LA= Los Angeles Creek. Bars represent standard deviation and (*) indicates study reference sites.

3.2.2 Periphyton Density

Mean periphyton density was highest in YR24 (497,737 cells/cm^2) and lowest in upper Latte Creek (68,802 cells/cm^2, Figure 6). Within the Coffee Creek watershed, the highest periphyton density was observed in lower Latte Creek (AQ04), with density decreasing longitudinally downstream. Within the Independence Creek watershed, periphyton density was relatively low and similar among all three sites. Periphyton density was intermediate at the Isaac Creek reference site in comparison to AQ30 and AQ20, which are both similarly located adjacent to the Yukon River. The Los Angeles Creek reference site displayed a low periphyton density value that was comparable to densities observed in both Independence and Coffee Creeks.

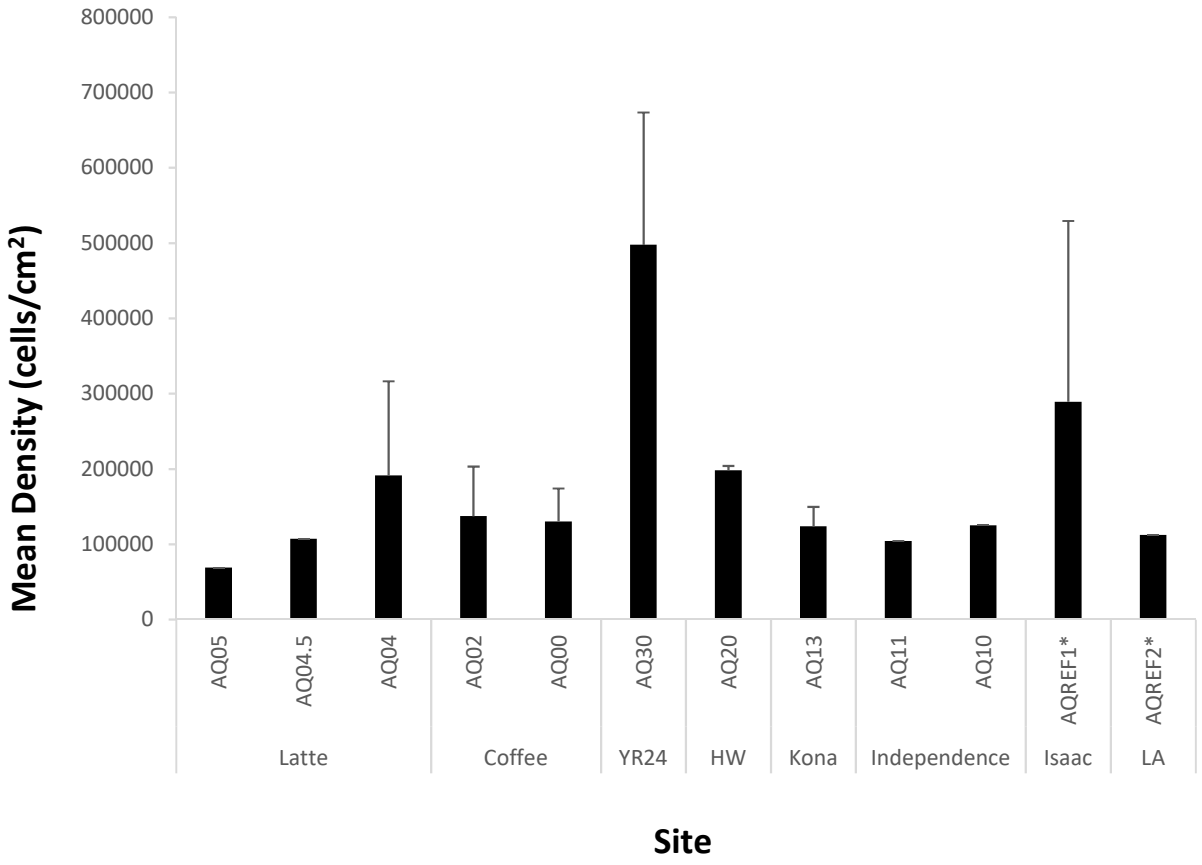


Figure 6. Mean periphyton density by site, Coffee Gold Project, 2014-2015. Sites are grouped by watershed including: Latte= Latte Creek, Coffee= sites on mainstem Coffee Creek, YR24= Unnamed tributary between Coffee and Halfway Creeks, HW= Halfway Creek, Kona= Kona Tributary in the Independence Creek watershed, Independence= sites on mainstem Independence Creek, Isaac= Isaac Creek, and LA= Los Angeles Creek. Bars represent standard deviation and (*) indicates study reference sites.

3.2.3 Periphyton Community Composition

Blue-green algae (Cyanophyta) was the most dominant algal group in the study area (Figure 7), making up approximately 80% of the overall community composition. After blue-green algae, diatoms were the second most dominant group (17%), followed by small percentages of green algae (chlorophyta, 3%). Red algae was not identified at sites within the local study area, but was present (2%) at the Isaac Creek reference site. Within watersheds, blue-green algae tended to dominate at higher elevation sites, whereas higher proportions of diatoms were present further downstream. Sites AQ20 and AQ30 were more similar to higher elevation sites, despite being adjacent to the Yukon River. Of note was the presence of *Didymosphenia geminata* confirmed in Isaac Creek and at AQ10 in Independence Creek in 2014, which is a large diatom that has become increasingly prolific in BC and Yukon in recent years, and is commonly referred to as ‘rock snot’ (YISC, 2014).

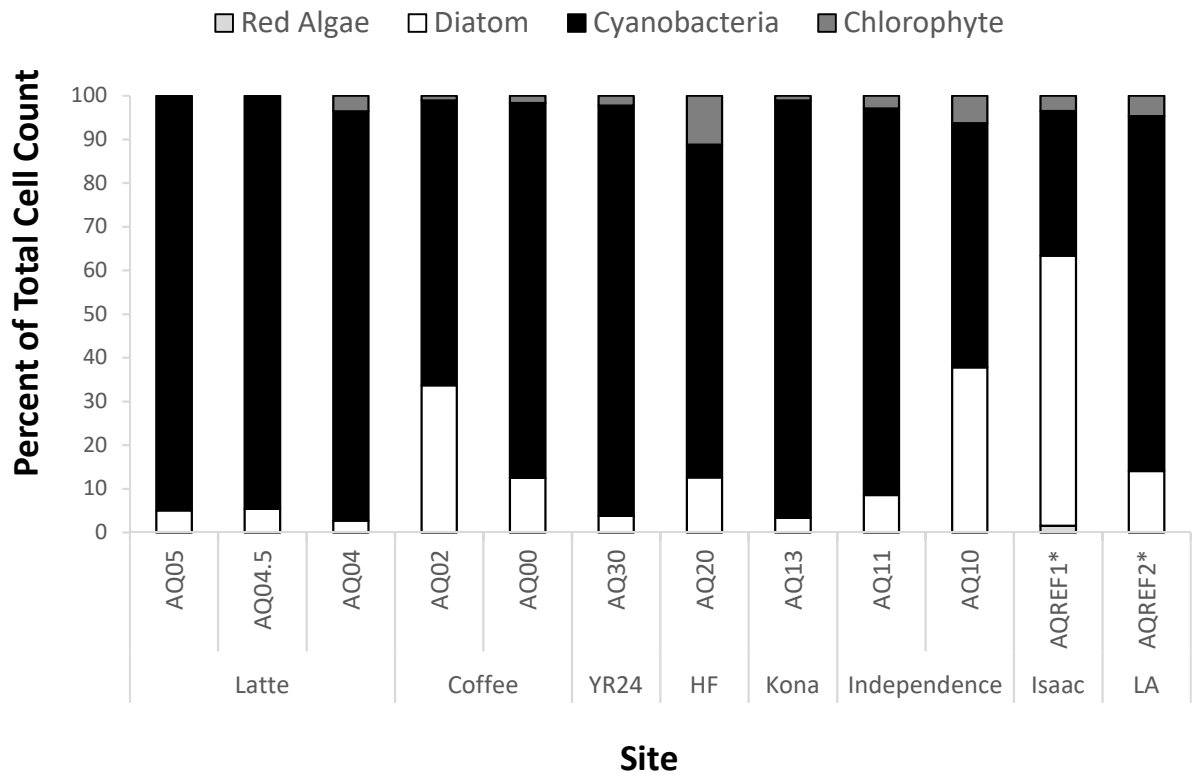


Figure 7. Mean relative cell densities of periphyton communities by site, Coffee Gold Project, 2014-2015. Sites are grouped by watershed including: Latte= Latte Creek, Coffee= sites on mainstem Coffee Creek, YR24= Unnamed tributary between Coffee and Halfway Creeks, HW= Halfway Creek, Kona= Kona Tributary in the Independence Creek watershed, Independence= sites on mainstem Independence Creek, Isaac= Isaac Creek, LA= Los Angeles Creek, and (*) indicates study reference sites.

3.2.4 Periphyton Taxonomic Richness and Biodiversity

Mean taxonomic richness in the Coffee Gold study area was overall low, ranging from 10-14 taxonomic groups (Figure 8). Richness was highest at sites in upper Latte Creek (AQ04.5), lower Coffee Creek (AQ00), lower Independence Creek (AQ10), and the two reference sites, with each site having 13-14 taxa present. Richness was lowest in YR24 and in the Kona tributary of Independence Creek. There was little indication of any trends in taxonomic richness in the study area, as mean richness values were fairly similar at all sites and substantial variability between years was observed.

Patterns of biodiversity were similar to what was noted for species richness, with a significant correlation between the two indices (Linear regression, R^2=0.45, P=0.02). Mean biodiversity ranged from 0.99 at AQ05 to 1.74 at AQ10. By watershed, Coffee Creek displayed the lowest overall mean biodiversity (1.31), followed by Independence Creek and YR24 (1.41), Los Angeles Creek (1.59), Halfway Creek (1.67), and then Isaac Creek (1.70).

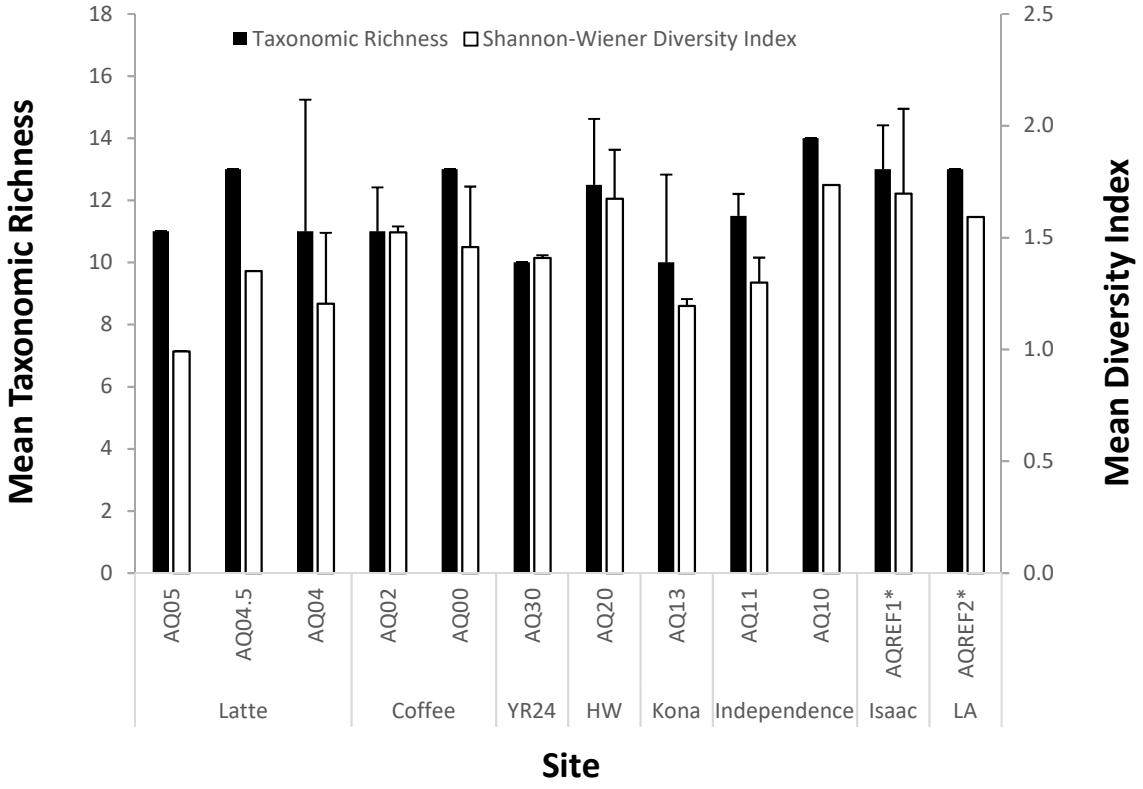


Figure 8. Mean Taxonomic Richness and Shannon-Wiener Diversity Index of periphyton communities by site, Coffee Gold Project, 2014-2015. Sites are grouped by watershed including: Latte= Latte Creek, Coffee= sites on mainstem Coffee Creek, YR24= Unnamed tributary between Coffee and Halfway Creeks, HW= Halfway Creek, Kona= Kona Tributary in the Independence Creek watershed, Independence= sites on mainstem Independence Creek, Isaac= Isaac Creek, and LA= Los Angeles Creek. Bars represent standard deviation and (*) indicates study reference sites.

3.3 Benthic Invertebrates

3.3.1 Benthic Invertebrate Abundance

Mean total abundance of benthic invertebrates ranged from 247 individuals per kick-net to 3885 individuals per kick-net in the project study area (Figure 9). Overall, Los Angeles Creek displayed the highest total abundance (3210), followed by Independence Creek (2092), YR24 (1291), Coffee Creek (762), Halfway Creek (466), and then Isaac Creek (306). Within watersheds with multiple sites, total abundance generally increased in an upstream direction. Site AQ10 in mainstem Independence Creek had a notably high mean abundance of benthic invertebrates (3885/kick-net).

Ephemeroptera Plecoptera Trichoptera (EPT) abundances within the study area demonstrated similar patterns to overall abundance, with a significant relationship observed between the two indices (Linear regression, R^2=0.62, P<0.01). EPT abundance was highest at AQREF2 (1880 EPT organisms/kick-net), lowest at the Isaac Creek reference site (90 EPT organisms/kick-net), and showed no strong longitudinal

patterns within watersheds. Some sites had high between-year variability, such as at AQ10 in lower Independence Creek (standard deviation=838).

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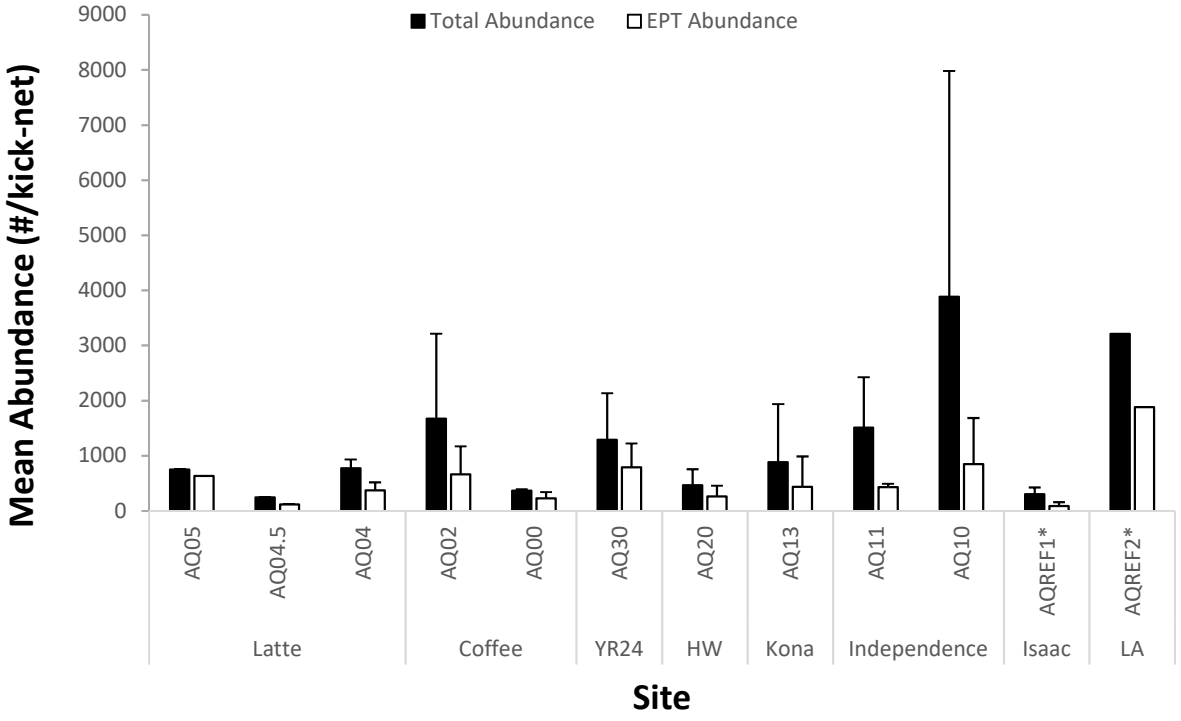

Figure 9. Benthic invertebrate total and Ephemeroptera Plecoptera Trichoptera (EPT) mean abundance by site, Coffee Gold Project, 2014-2015. Sites are grouped by watershed including: Latte= Latte Creek, Coffee= sites on mainstem Coffee Creek, YR24= Unnamed tributary between Coffee and Halfway Creeks, HW= Halfway Creek, Kona= Kona Tributary in the Independence Creek watershed, Independence= sites on mainstem Independence Creek, Isaac= Isaac Creek, and LA= Los Angeles Creek. Bars represent standard deviation and (*) indicates study reference sites.

3.3.2 Benthic Invertebrate Community Composition

Dipterans were the most dominant benthic invertebrate group in the project study area, making up approximately 50% of the overall community composition (Figure 10). The second and third most dominant groups were the mayflies (*Ephemeroptera*) and stoneflies (*Plecoptera*), which contributed approximately 26% and 21% to the overall community composition, respectively. Small percentages of ringed worms (Annelids), and caddisflies (*Trichoptera*) were also present at the majority of sites. The Isaac Creek reference site had the highest percentage of Dipterans and the lowest relative contribution from the “pollution sensitive” EPT organisms. Within the multi-site watersheds (Coffee and Independence Creeks), EPT organisms typically dominated sites higher in the watershed, whereas Dipteran species dominated at larger creek sites further downstream.

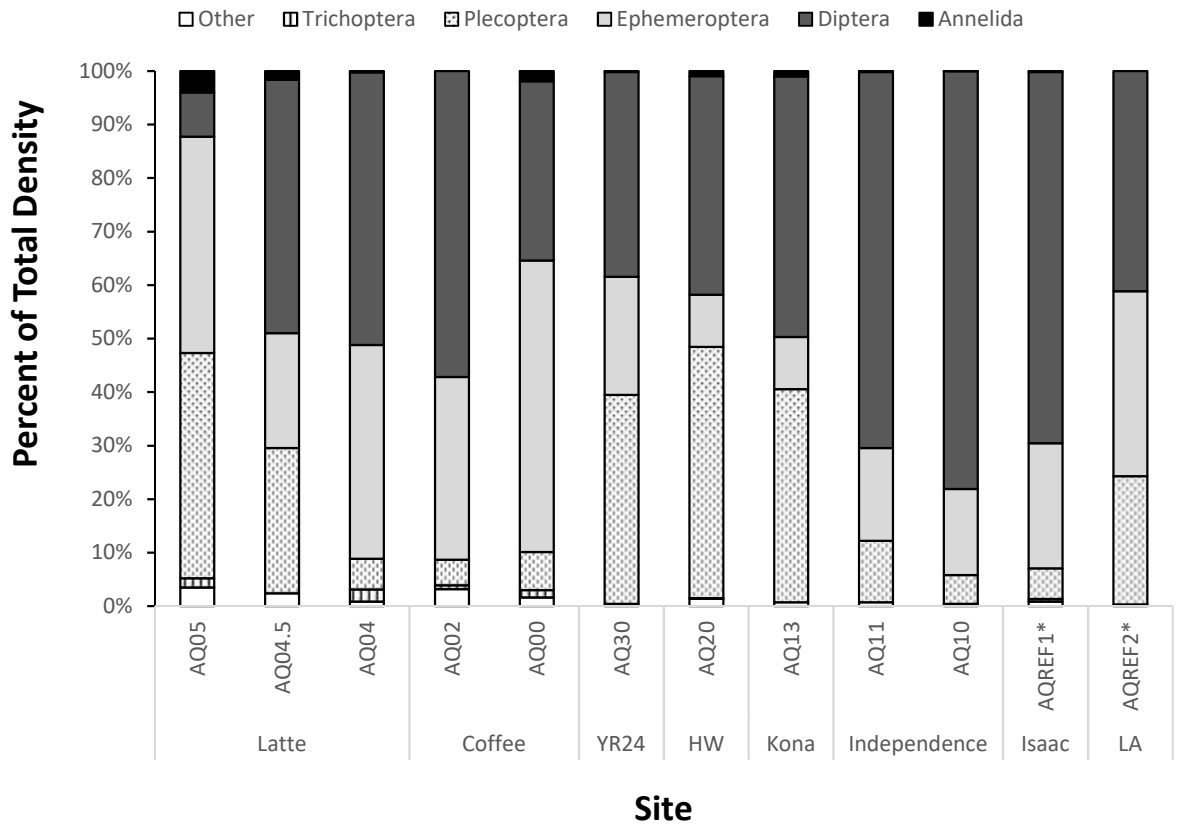

Figure 10. Relative densities of benthic invertebrate communities by site, Coffee Gold Project, 2014-2015. Sites are grouped by watershed including: Latte= Latte Creek, Coffee= sites on mainstem Coffee Creek, YR24= Unnamed tributary between Coffee and Halfway Creeks, HW= Halfway Creek, Kona= Kona Tributary in the Independence Creek watershed, Independence= sites on mainstem Independence Creek, Isaac= Isaac Creek, LA= Los Angeles Creek, and (*) indicates study reference sites.

3.3.3 Benthic Invertebrate Taxonomic Richness, Biodiversity, and Evenness:

Benthic invertebrate taxonomic richness was highest at AQ02 in the Coffee Creek watershed (34 taxa), and lowest at the Independence Creek Kona tributary (18 taxa, Figure 11). There were no apparent within-watershed patterns for taxonomic richness, although the mainstem sites on Independence Creek displayed higher richness values in comparison to AQ13 in the headwaters. Both reference sites displayed intermediate richness values (21-26).

Simpson's diversity values displayed similar patterns to those observed for taxonomic richness (Figure 12). Sites AQ04.5 and AQ11 demonstrated the highest and lowest values, respectively. At the watershed-level, Los Angeles Creek supported the highest diversity values (0.87), sites in YR24, Halfway Creek, and Coffee Creek supported intermediate values (0.78-0.86), and sites in Independence Creek contained the lowest diversity value (mean=0.75).

Simpson's evenness ranged from 0.15- 0.46, with the lowest and highest sites also being the two that were positioned closest together in upper Latte Creek (Figure 12). Generally, evenness decreased in a downstream direction within the Coffee and Independence watersheds.

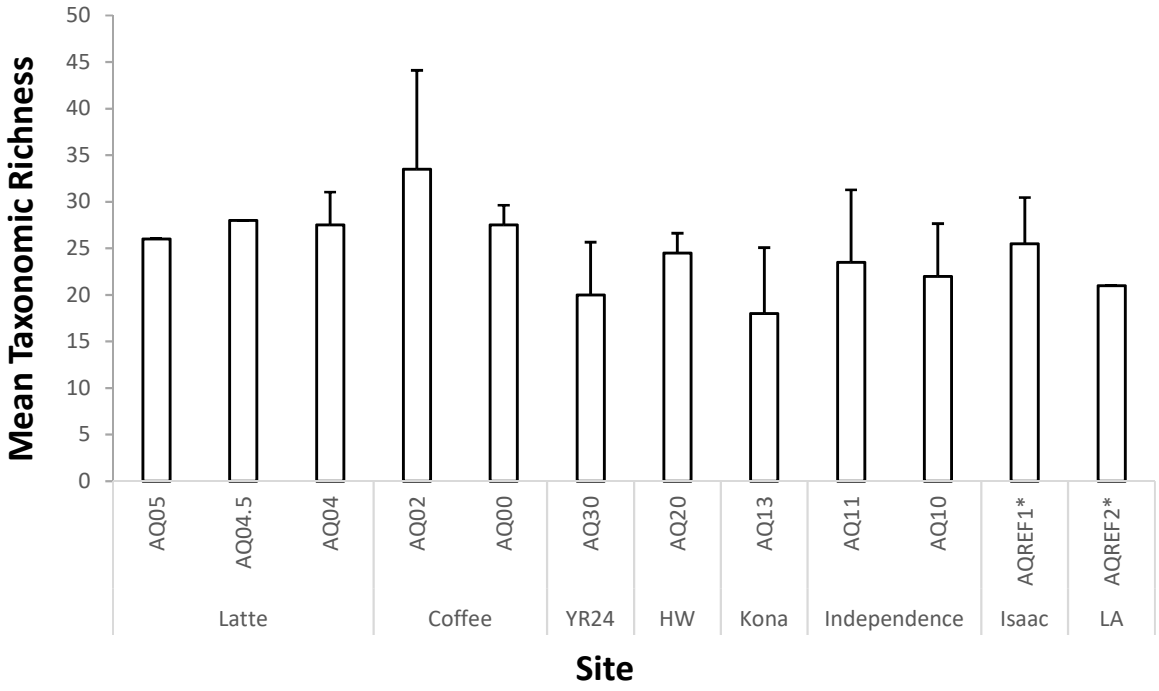

Figure 11. Mean Taxonomic Richness of benthic invertebrate communities by site, Coffee Gold Project, 2014-2015. Sites are grouped by watershed including: Latte= Latte Creek, Coffee= sites on mainstem Coffee Creek, YR24= Unnamed tributary between Coffee and Halfway Creeks, HW= Halfway Creek, Kona= Kona Tributary in the Independence Creek watershed, Independence= sites on mainstem Independence Creek, Isaac= Isaac Creek, LA= Los Angeles Creek, and (*) indicates study reference sites.

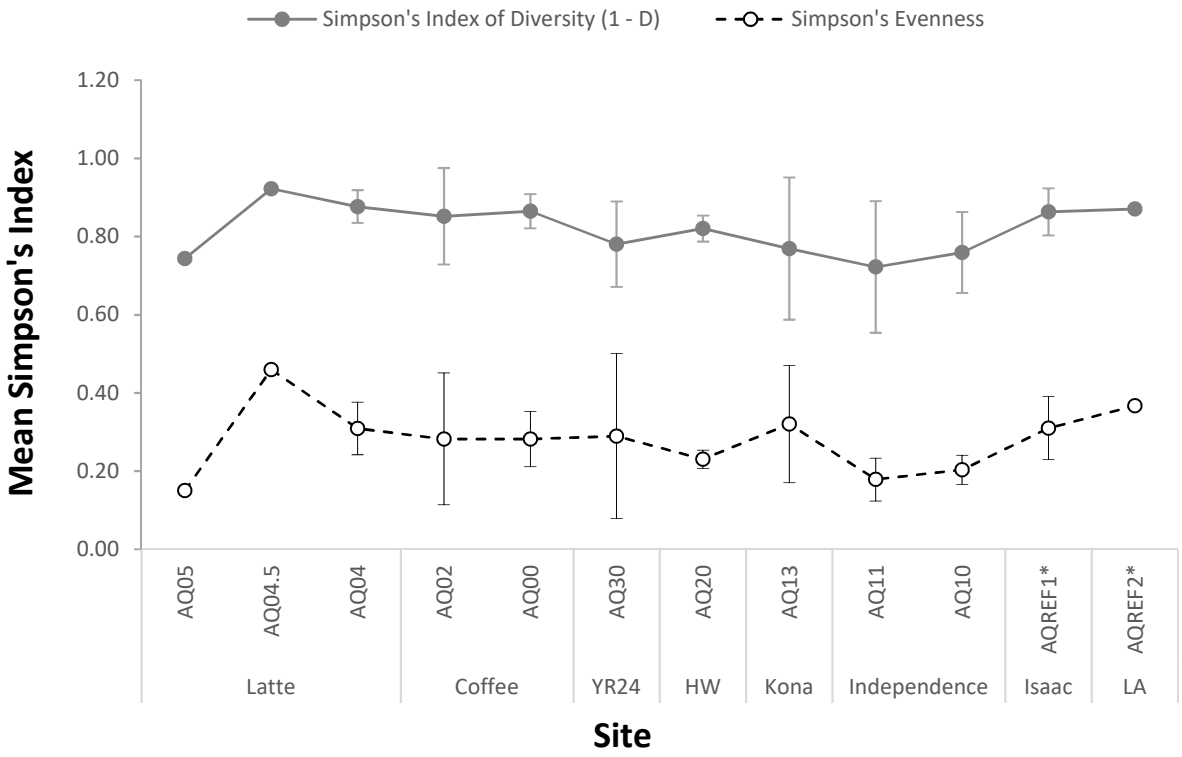

Figure 12. Mean Simpson's Diversity and Evenness Indices of benthic invertebrate communities by site, Coffee Gold Project, 2014-2015. Sites are grouped by watershed including: Latte= Latte Creek, Coffee= sites on mainstem Coffee Creek, YR24= Unnamed tributary between Coffee and Halfway Creeks, HW= Halfway Creek, Kona= Kona Tributary in the Independence Creek watershed, Independence= sites on mainstem Independence Creek, Isaac= Isaac Creek, LA= Los Angeles Creek, and (*) indicates study reference sites.

3.3.4 CABIN

CABIN analyses are summarized in site assessment reports (Appendix D2). The BEAST prediction results show that based on the benthic invertebrate communities, the majority of Coffee Gold study area sites belong to Group 1 (probabilities: 50 – 95%) with the exception of site AQ05 which belongs to Group 2 (probability: 48%). The Bray-Curtis analysis indicated that of the 12 sites assessed in CABIN, site AQ05 in upper Latte Creek and AQ13 in upper Kona were most similar in community structure to reference condition (0.81-0.84). However, all sites in the Coffee study area and reference areas were highly dissimilar from reference conditions (range 0.81-1). The RIVPACS tools assesses sites using the ratio of observed to expected (O:E) score, where sites with O:E ratios close to 1 are in good condition. All sites were close to the value of 1, with values ranging from 1.04-1.09 (Table 8).

Table 8. RIVPACS Observed/Expected Taxa Ratios

Site	Year	Description	Result
AQ00	2014	RIVPACS : Expected taxa P>0.70	0.94
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.06**
	2015	RIVPACS : Expected taxa P>0.70	0.96
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.05**
AQ02	2014	RIVPACS : Expected taxa P>0.70	0.95
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.05**
	2015	RIVPACS : Expected taxa P>0.70	0.96
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.05**
AQ04	2014	RIVPACS : Expected taxa P>0.70	0.95
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.06**
	2015	RIVPACS : Expected taxa P>0.70	0.94
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.07**
AQ05	2014	RIVPACS : Expected taxa P>0.70	0.96
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.04**
AQ04.5	2015	RIVPACS : Expected taxa P>0.70	0.95
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.05**
AQ10	2014	RIVPACS : Expected taxa P>0.70	0.94
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.06**
	2015	RIVPACS : Expected taxa P>0.70	0.94
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.06**
AQ11	2014	RIVPACS : Expected taxa P>0.70	0.95
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.05**

Site	Year	Description	Result
AQ11	2015	RIVPACS : Expected taxa P>0.70	0.95
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.06**
AQ13	**2014**	RIVPACS : Expected taxa P>0.70	0.94
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.06**
	2015	RIVPACS : Expected taxa P>0.70	0.94
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.07**
AQ20	2014	RIVPACS : Expected taxa P>0.70	0.92
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.08**
	2015	RIVPACS : Expected taxa P>0.70	0.92
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.09**
AQ30	2014	RIVPACS : Expected taxa P>0.70	0.92
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.08**
	2015	RIVPACS : Expected taxa P>0.70	0.92
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.08**
AQREF1	2014	RIVPACS : Expected taxa P>0.70	0.94
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.06**
	2015	RIVPACS : Expected taxa P>0.70	0.95
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.06**
AQREF2	**2015**	RIVPACS : Expected taxa P>0.70	0.92
		RIVPACS : Observed taxa P>0.70	1.00
		RIVPACS : O:E (p > 0.7)	**1.09**

The BEAST site assessment graphs display each test site in relation to the reference sites of the Yukon 2013 reference model. The degree of deviation from reference condition can indicate the severity of impairment. The different levels of deviation range in order from (1) reference condition, (2) mildly divergent, (3) divergent, and (4) highly divergent. Of the twelve sites tested, most sites were in the mildly divergent category, which indicates potential anthropogenic stress. Some of the stress ratings differed for each site by year, with 2015 results typically having a more stressed rating. One exception was site AQ13, which was considered unstressed (reference condition) in 2015 and divergent from reference

conditions in 2014. Highly divergent years were observed in 2015 at sites AQ10, AQ11, AQ30, and AQREF2.

3.4 Fish Habitat

A total of 17 sites were assessed for fish habitat quality around the study area (Figure 1, Table 9). Site-specific habitat information, site photos and *in situ* water quality data is included as Appendix E1. Fish habitat quality was highest in the mainstems of Coffee and Independence Creeks due to the presence of a wide variety of habitat types available (e.g., deep pools, side channels, slow moving riffles), and ample in-stream habitat cover (e.g., woody debris, undercut banks), that could potentially support a range of fish species throughout their various life history activities. Coffee Creek was the largest watercourse with the primary mainstem channel ranging from 15-22m wide, and numerous deep pools observed (>1.5m). Independence Creek was the second largest watercourse, with mean channel widths of 12m and 23m at Sites AQ10 and AQ11, respectively.

Tributaries of Coffee and Independence Creeks were relatively smaller than the creek mainstems (mean widths from 4-6m and 2-3m, respectively), and contained better quality habitat in the lowermost reaches (e.g., pool habitat, gravel substrates, lower stream gradients). Good Arctic grayling habitat was available in the lower reaches of Latte Creek due to the frequency of substantial pool habitat. Site AQ12 in the lower Kona tributary had much lower habitat quality than the mainstem of Independence Creek as water depths were low, and there were few pools noted for supporting fish feeding or rearing. Sites in the upper watersheds of both Latte Creek and Kona Tributary were of poorer habitat quality, as they contained higher gradient (means=7-11%), cascade-pool or step-pool segments dominated by larger cobble or boulder substrates, and little to no gravels. During the habitat mapping of Latte Creek, several hindrances to upstream fish passage were noted in the upper watershed due to steep natural drops. No permanent barriers to fish migration were noted.

Additional fish habitat surveying was completed in 2015 for a Latte Creek tributary (Tributary “C”) that overlaps with the south proposed waste rock storage facility. The watercourse was a small (mean channel width=0.82m), shallow (mean channel depth=0.26m), medium gradient (5-10%) channel dominated by gravel and fine substrates. Natural obstructions to fish passage were observed, such as sudden steep drops, but no permanent barriers to fish migration were noted. Supplementary hydrometric and water quality data for this tributary indicates that the streamflow is often groundwater dominated and may occasionally lose its surficial connection to mainstem Latte Creek (*pers. comm*., Lorax Environmental 2015). Thus, the noted habitat constraints suggest low suitability for Arctic grayling, especially at distances further from mainstem Latte Creek.

Halfway Creek and YR24 were relatively smaller watercourses, with mean widths of 4m at sites proximate to the Yukon River (AQ20, AQ30), decreasing to 2-2.5m widths in the headwaters (AQ21, AQ31). In Halfway Creek, there was marginal fish habitat for Arctic grayling available in the lower watershed (AQ20). YR24 was even smaller and steeper (8%) than Halfway Creek, with little to no pool habitat observed for fish rearing at the downstream site (e.g. water depths were generally less than 20cm). Habitat quality decreased in the upper watersheds due to steeper (means=10-11%), boulder-dominated cascade-pool segments. In September 2015, a high gradient (30%) barrier to fish passage was

documented immediately upstream of site AQ31, and downstream of the proposed waste rock storage facility (Figure 13).



Figure 13. High gradient (>30%) barrier to fish passage, upper YR24, September 2015

The Isaac Creek reference site was smaller and shallower than both Independence and Coffee Creeks, with a mean channel width of 10m, and fewer deep pools (>1m) noted. The site was low gradient, with moderate fish cover including small woody debris, undercut banks, overhanging vegetation and deep pools. The site was differentiated by its close proximity to the Yukon River and the potential for backwatering at the creek mouth. It had the highest percentage of fine substrate in the project study area, and also the most turbid water observed. Due to the shallow depths and sandy substrates, the site provided moderate habitat potential for juvenile Arctic grayling rearing, and low habitat potential for supporting adult Arctic grayling summer feeding.

The Los Angeles Creek reference site was established as an additional reference site in 2015 in order to document habitat more comparable with the range of habitats present at potential mine study sites. In addition, the site is well away from the influence of the Yukon River located 6km downstream. The site was low gradient and had moderate fish cover including large woody debris, undercut banks, and some deep pools providing excellent rearing/feeding habitat and potentially also overwintering. The site provided good potential for Arctic grayling spawning habitat with pockets of fine gravel present.

Table 9. Fish Habitat Characteristics, Coffee Gold Project, 2014 - 2015

Watershed	Creek	Site	Mean channel width (m)	Mean gradient (%)	Morphology	Substrate (%)		Cover			% Gravel	Deep pools >1m (Y/N)
						Dominant	Sub-dominant	Overall	Dominant	Sub-dominant		
Coffee	Latte	AQ06	4.00	11	SPb	65% B	30% C	A	B	OV	T	N
	Latte	AQ05	3.81	7	CPc-W	50 % C	40% B	M	B	OV	T	N
	Latte	AQ04.5	2.83	3	RPb	40% B	25% C	M	SWD,B	U, OV	5	N
	Latte	AQ04	5.86	2	RPc-W	45% C	45% G	M	LWD	OV, SWD	45	N
	Coffee	AQ02[1]	18.43	2	Rpg-W	45% G	35% C	A	SWD, LWD	U	45	Y
	Coffee	AQ01	22.08	2	RPg-W	45% G	40% C	M	SWD, LWD	U, OV	45	Y
	Coffee	AQ00[1]	14.90	1	PRg-W	60% G	20% F, 20% C	M	LWD, DP	SWD, OV	60	Y
Halfway	Halfway	AQ21	2.47	10	CPb	50% B	40% C	M	B	U	0	N
	Halfway	AQ20	4.03	2	RPc-W	45% C	35% G	M	LWD	SWD, B, U, OV	35	N
YR24	YR24	AQ30	4.20	8	CPc-W	50% C	35% B	M	B	SWD, LWD, U, OV	0	N
	YR24	AQ31	1.87	11	Cpb	40% B	40% C	M	B	OV	10	N
Independence	Kona tributary	AQ13	2.23	8	SPb	70% B	15% C	A	B	LWD, OV	T	N
	Kona tributary	AQ12	3.05	1	RPg-W	70% G	10% F	A	LWD, OV	SWD, U,DP	70	N
	Independence	AQ10	12.21	2	Rpg-W	50% G	30% C	A	LWD	SWD, U, OV	50	Y
	Independence	AQ11	23.23	2	RPg-W	40% G	30% C	M	LWD	SWD, B, U, DP, OV	40	Y
Isaac	Isaac	AQREF1*	9.75	1	RPg-W	40% G	40% F	M	SWD	LWD, U, OV	40	Y
Los Angeles	Los Angeles	AQREF2*	6.80	1	Rpg-W	70% C	20% F	M	LWD	SWD, U, DP	10	Y

*Notes: Morphology Codes: RP=Riffle Pool, CP=Cascade Pool, SP=Step Pool, sub-codes c=cobble, b=boulder, g=gravel, and "W"=functional large woody debris; Substrate Codes: B=Boulder, C=Cobble, G=Gravel, F=Fines; Cover Codes: Overall – A: Abundant >20%, M: Moderate 5-20%; Dominant/Sub-dominant -OV=Overhanging vegetation, SWD=small woody debris, LWD=large woody debris, B=boulder, U=undercut bank, DP=Deep pool; % Gravel T=Trace; *Reference Site; [1]Secondary side channel not included in total*

Stream temperatures:

Mean stream temperatures in the Coffee Gold study area did not rise above 5°C in any of the creeks, with the exception of mainstem Coffee Creek. The highest temperatures observed in mainstem Coffee Creek were during August, where mean and maximum daily temperatures approached 8°C and 11°C, respectively. However, based on other seasonal site trends it is likely that Coffee Creek temperatures peaked during July, when the logger was dislodged and not consistently recording water temperatures. Unreliable temperature data was removed during data screening and is not presented here (see methods section 2.5.4).

Latte Creek and Halfway Creek had similar temperature trends, with peak mean stream temperatures just below 5°C noted in July. YR24 was colder than Halfway and Latte Creeks during the period of record. The temperature record for the Kona Tributary had extended periods when the logger was likely out of water, and as a result the monthly average temperature is based on only six days of data near the end of June (June 22nd to 27th), and on fifteen days each for July and September. Reliable data were not available for August. The available record for the Kona tributary suggests that this site is generally colder than the other creeks.

Where the temperature record included the winter months, the onset of freezing temperatures generally occurred in mid to late October. In the Kona tributary freezing started in early October.

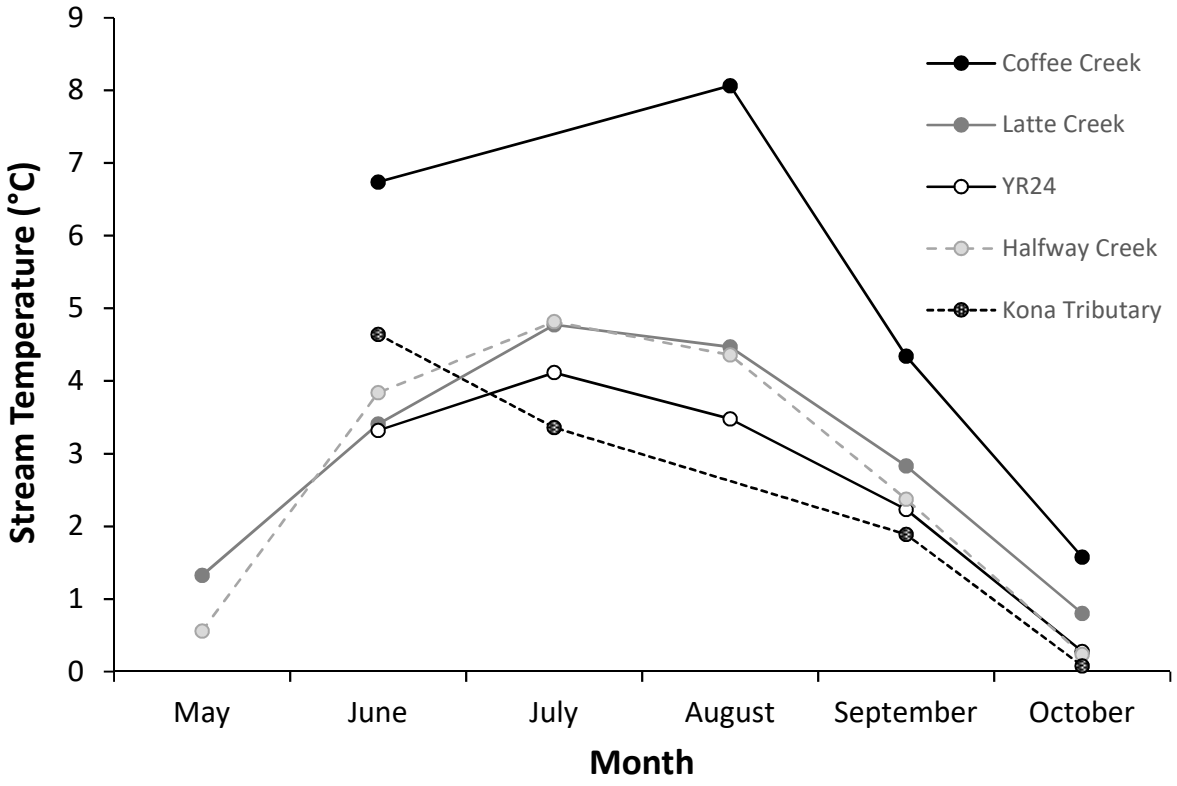

Figure 14. Mean monthly stream temperatures, Coffee Gold Project, 2014-2015

3.4.1 Winter Fish Habitat Survey

Results from the winter fish habitat survey on Latte Creek indicated a very low likelihood of fish utilization in winter, owing to lack of wetted habitat, and/or heavy ice cover. Lower Latte Creek was dry beneath the ice or frozen to the bottom in all surveyed areas with the exception of some localized over-ice flow. Upstream on Latte Creek, the creek was generally frozen to bottom, and any flow detected was over or through layers of ice. At AQ04, the creek was dry under ice at the location of a deep summer pool. Latte Creek Tributary C had some flow, but was heavily glaciated, and the water was running through or over layers of ice, as well as over land, with no defined channel or exposed substrate. The estimated flow in the tributary where it entered Latte Creek was 2 L/s. Dissolved oxygen measured *in situ* at the tributary input was 9.69 mg/L. Overall, suitable overwintering habitat (e.g. deep pools which were not frozen to bottom) was not detected on Latte Creek.

On Coffee Creek, under ice flow was detected at AQ02 and AQ01, however no fish were observed with the underwater camera. Water depths of 0.66 m and 0.37 m were measured at AQ02, beneath 0.44 m and 0.57 m of ice, respectively. At the deepest location (0.66 m depth) dissolved oxygen was 10.3 mg/L, temperature was 0.03°C, and pH was 6.70. At AQ01, water depth was 0.82 m at one drill hole, and ice thickness was 0.15 m. Water quality was measured *in situ* at this location; dissolved oxygen was 13.95 mg/L, temperature was 0.26°C, and pH was 7.27. The underwater camera showed layers of ice throughout the water column, and anchor ice on the stream bed. The creek was frozen to bottom or dry under ice at several other known summer pool locations within AQ01 and AQ02. At AQ00, two deep (>1 m) summer pools within the site were dry. No flow was observed at AQ00. Overall, Coffee Creek appeared to provide some potential overwintering habitat, but the nature and locations may vary year to year depending on temperatures and local climatic conditions.

3.5 Fish Community

Arctic grayling, slimy sculpin, and juvenile Chinook salmon were the most abundant fish species captured in the project study area (Table 10, Table 11, Table 12). Round whitefish (*Prosopium cylindraceum*) are also known to be present in the Coffee Creek watershed but were not captured in 2014 or 2015 (PECG 2013). No Chinook salmon were observed spawning in Coffee and Independence Creeks in 2014-2015 or in previous years (Sparling 2001; Laberge and White Mountain 2002). However, salmon were observed spawning in the Yukon River proximate to the project area during the October survey in 2014. Due to the timing of the survey, it is assumed that the observed spawners were chum salmon. Currently, there are no known fish species at risk in the regional area of the Project.

Table 10. Minnow Trapping Catch Per Unit Effort by Site, Coffee Gold Project, 2014

Date	Watershed	Creek	Site	# traps	mean soak time (h)	# fish caught/trap/day			
						GR	CCG	CH	Total
2014-08-24	Coffee	Coffee	AQ00	10	24.33	0	0.30	12.03	**12.33**
2014-08-27			AQ01	10	23.75	0	0.10	7.28	**7.38**
2014-08-26			AQ02	10	27.17	0	0.35	5.48	**5.83**
2014-08-25		Latte	AQ04	5	23.67	0	0	0	**0**
2014-08-23			AQ05	2	29.00	0	0	0	**0**
2014-08-23			AQ06	2	27.58	0	0	0	**0**
2014-08-23	YR24	YR24	AQ31	2	24.42	0	0	0	**0**
2014-08-23	Halfway	Halfway	AQ21	2	26.08	0	0	0	**0**
2014-08-24	Independence	Independence	AQ10	10	24.92	0	0	0.96	**0.96**
2014-08-25			AQ11	10	24.75	0	0	0.10	**0.10**
2014-08-23		Kona Tributary	AQ12	2	22.50	0	0	0	**0**
2014-08-23			AQ13	2	23.50	0	0	0	**0**
2014-08-21	Isaac	Isaac	AQREF1*	8	26.55	0.11	0.11	3.95	**4.18**
August Total				**75**	**25.15**	**0.01**	**0.11**	**3.84**	**3.97**
2014-10-05	Coffee	Coffee	AQ00	5	25.25	0	0.19	4.75	**4.94**
2014-10-05			AQ01	5	25.00	0	0.38	6.72	**7.10**
2014-10-05			AQ02	5	25.00	0	0.58	3.07	**3.65**
2014-10-05	Independence	Independence	AQ10	5	25.00	0	0	1.15	**1.15**
2014-10-06			AQ11	5	20.67	0	0	0	**0**
2014-10-05	Isaac	Isaac	AQREF1*	5	25.50	0	0	3.58	**3.58**
October Total				**30**	**24.40**	**0**	**0.20**	**3.31**	**3.51**

Notes: GR=Arctic grayling, CCG=slimy sculpin, CH=Chinook salmon (juveniles)
**Reference site*

Table 11. Minnow Trapping Catch Per Unit Effort by Site, Coffee Gold Project, 2015

Date	Watershed	Creek	Site	# traps	mean soak time (h)	# fish caught/trap/day			
						GR	CCG	CH	Total
2015-06-22	Coffee	Coffee	AQ00	5	24.25	0	0.59	0	**0.59**
2015-06-22			AQ01	5	22.50	0	0.43	0	**0.43**
2015-06-21	Independence	Independence	AQ10	5	25.58	0	0	0.19	**0.19**
2015-06-22	Isaac	Isaac	AQREF1*	5	22.75	0	1.27	0	**1.27**
2015-06-20	Los Angeles	Los Angeles	AQREF2*	5	22.50	0	0	0	**0**
			June Total	**75**	**23.52**	**0**	**0.14**	**0.01**	**0.15**
2015-07-26	Coffee	Coffee	AQ00	5	26.58	0	0	1.44	**1.44**
2015-07-26			AQ01	5	19.92	0	0.24	0.48	**0.72**
2015-07-26			AQ02	5	24.75	0.58	0.58	0	**1.16**
2015-07-31		Latte	AQ03	8	30.00	0	0.10	0	**0.10**
2015-07-27	Independence	Independence	AQ10	5	29.00	0	0	0.83	**0.83**
2015-07-31			AQ10	5	20.83	0	0	1.15	**1.15**
2015-07-27			AQ11	5	23.75	0	0	0.00	**0**
2015-07-27	Isaac	Isaac	AQREF1*	5	24.42	0	0.79	16.71	**17.50**
2015-07-30	Los Angeles	Los Angeles	AQREF2*	5	24.83	0	0	0	**0**
2015-07-31			AQREF2*	8	22.50	0	0	0.53	**0.53**
			July Total	**56**	**24.66**	**0.05**	**0.16**	**1.89**	**2.10**
2015-09-12	Coffee	Coffee	AQ03	5	22.08	0	0	0	**0**
2015-09-13	Independence	Independence	AQ10	10	38.25	0	0.06	0.25	**0.31**
2015-09-10	Los Angeles	Los Angeles	AQREF2*	6	32.00	0	0	0.13	**0.13**
			September Total	**21**	**30.78**	**0**	**0.04**	**0.19**	**0.22**

Notes: GR=Arctic grayling, CCG=slimy sculpin, CH=Chinook salmon (juveniles)
**Reference site*

Table 12. Electrofishing Catch Per Unit Effort by Site, Coffee Gold Project, 2014-2015

Watershed	Creek	Site	Section Length (m)	Effort (s)	Catch Per Unit Effort (#/100s)				
					GR	CCG	CH	AL	Total
Coffee	Coffee	AQ00	120	1457	0	1.65	0.69	0	2.33
		AQ02	150	2060	0	1.80	0	0	1.80
	Latte	AQ03	20 - 200	4248	0.16	0.12	0	0	0.28
		AQ04	120	3568	1.15	0	0	0	1.15
		AQ04.5	140	1724	0	0	0	0	0
		AQ06	100 - 150	1603	0	0	0	0	0
YR24	YR24	AQ30	100 - 120	1821	0	0.27	0	0	0.27
		AQ31	100 - 120	1503	0	0	0	0	0
Halfway	Halfway	AQ20	100	2074	0.10	0	0	0	0.10
		AQ21	100 - 120	1741	0	0	0	0	0
Independence	Independence	AQ10	100	957	0.21	0.73	0	0	0.94
		AQ11	150	1295	0.39	0	0	0	0.39
	Kona Tributary	AQ12	100 - 275	1908	0.16	0	0	0	0.16
		AQ13	100 - 120	1332	0	0	0	0	0
Isaac	Isaac	AQREF1*	60-100	2740	0.18	2.88	1.50	0.04	4.60
Los Angeles	Los Angeles	AQREF2*	250	2717	0.04	0	0	0	0.04
			Total	**33231**	0.20	0.50	0.15	0	0.86

Notes: GR=Arctic grayling, CCG=slimy sculpin, CH=Chinook salmon (juveniles), AL=Arctic lamprey
**Reference site*
Effort and catch per unit effort is based on Pass 1 only

3.5.1 Fish species Composition, Relative Abundance and Distribution

3.5.1.1 Coffee Creek

Minnow trapping was the most effective method for capturing juvenile Chinook salmon (jcs), with the highest mean catch/trap/day at site AQ00 in August 2014 (12.0 jcs/trap/day), at site AQ01 in October 2014 (6.7 jcs/trap/day), and at site AQ00 in July 2015 (1.4 jcs/trap/day) (Table 10 and Table 11). Capture rates of juvenile Chinook salmon were 8-15 times higher in August 2014 in comparison to July 2015, suggesting that juvenile rearing in Coffee Creek may exhibit variability year to year. Low numbers of juvenile Chinook salmon observed at the three Coffee Creek sites in fall 2014 indicated that overwintering likely occurred in the creek. However, it is noted that fish may not feed as actively during lower fall temperatures, and thus the lowered capture rate may not be indicative of any decline in abundance. Spring sampling in 2015 yielded almost no juvenile Chinook, suggesting that the fish had already left for their seasonal migration, or had not survived the winter.

Electrofishing was the most effective method for capturing slimy sculpin, with 1.8 and 1.7 sculpins/100s of electrofishing captured at sites AQ02 and AQ00, respectively (Table 12). Angling was the most effective method for capturing Arctic grayling in the study's larger systems such as mainstem Coffee Creek that are difficult to adequately isolate to prevent escapement during electrofishing. The highest catch per unit effort of angling (rod-hour) was at AQ02 (5.3 Arctic grayling per rod-hour), followed by AQ00 (2.3 Arctic grayling per rod-hour), and then AQ01 (2.0 Arctic grayling per rod-hour). Fyke trapping also produced small numbers of Arctic grayling, but was much less effective overall.

In Latte Creek, only Arctic grayling and slimy sculpin were present. Slimy sculpin were only captured at the most downstream site (AQ03), and near the mouth of Latte Creek. Further upstream, Arctic grayling were captured in relatively high densities at site AQ04, with an approximate population estimate of 6 Arctic grayling/100 m^2 in 2014, and 10 Arctic grayling/100 m^2 in 2015 (±2 grayling, 90% confidence intervals for both years). No slimy sculpin were captured at AQ04, suggesting that the species distribution may not extend far upstream. At the furthest upstream sites, AQ04.5, AQ05 and AQ06, no fish were caught using two sampling methods and over two seasons of sampling, however one adult Arctic grayling was observed at the furthest downstream site in summer 2015, at AQ04.5.

3.5.1.2 Independence Creek

Arctic grayling, juvenile Chinook salmon, and slimy sculpin were captured in mainstem Independence Creek. In 2014, juvenile Chinook were present in relatively low numbers at both sites (0.96 jcs/trap/day at AQ10 and 0.10 jcs/trap/day at AQ11) in August, and only at the most downstream site (1.15 jcs/trap/day at AQ10) in October. Capture rates were similar in summer 2015, with 0.83-1.15 jcs/trap/day at AQ10 and no juvenile Chinook captured at AQ11. In addition, a single juvenile Chinook was captured at AQ10 in spring 2015, and four juvenile Chinook remained during September 2015 sampling at this site. Slimy sculpin were captured at AQ10 at a rate of 1.18 sculpins/100s of electrofishing, but were not captured at AQ11 further upstream. Arctic grayling were present at both sites, with a higher CPUE observed at AQ11 (0.39 grayling/100s of electrofishing at AQ11, 0.21 grayling/100s of electrofishing at AQ10). In 2014, data was available for producing a population estimate at AQ11 using the two-pass sampling method (Seber

and Le Cren 1967), which estimated that there were approximately 3 Arctic grayling/100m^2 (±2, 90% CI). Flows were too high in 2015 to effectively isolate AQ11 for multiple pass electrofishing, and instead angling was used, with 1.45 Arctic grayling captured per rod-hour.

Two sites were sampled in the Kona tributary, one far downstream near its confluence with mainstem Independence Creek (AQ12), and one in the upper headwaters (AQ13). In 2014, no fish were captured at either site during August sampling, however, several Arctic grayling were observed at AQ12 while deploying minnow traps in the stream. In June 2015, three Arctic grayling were captured while electrofishing at a rate of 0.43 fish per 100s of effort. No fish were captured during summer sampling in July 2015 (627s of effort).

3.5.1.3 YR24

YR24, located between Coffee and Halfway Creeks, was sampled in late August 2014 using minnow traps and electrofishing. No fish were captured and the site was not re-visited in October of that year. In 2015, sites AQ30 and AQ31 were electrofished in both June and July. In June, five slimy sculpin were captured within 50m of the Yukon River, which was back-flooded into the creek at the time of sampling. No fish were caught at AQ30 during the subsequent July trip. Higher in the watershed, no fish were captured at AQ31 during either sampling period (effort ranged from 748-755s per sampling event).

3.5.1.4 Halfway Creek

Halfway Creek was sampled in late August 2014 using minnow traps and electrofishing. A single adult Arctic grayling was captured in a pool habitat at AQ20, producing a CPUE of 0.15 grayling/100s of electrofishing. The site was not re-visited in October. In 2015, sites AQ20 and AQ21 were electrofished in both June and July. Again, a single adult Arctic grayling was captured in a pool at AQ20. No fish were captured at AQ21 during either sampling period (effort ranged from 845-896s per sampling event).

3.5.1.5 Isaac Creek

Isaac Creek was comprised of the most diverse fish community in the study area, with a total of six fish species present: Arctic grayling, slimy sculpin, juvenile Chinook salmon, juvenile burbot (*Lota lota*), longnose sucker (*Catostomus catostomus*), and Arctic lamprey (*Lethenteron camtschaticum*). The most dominant species were slimy sculpin and juvenile Chinook salmon, which made up 39% and 56% of the catch, respectively. Juvenile Chinook salmon were caught at approximately 4.0 jcs/trap/day in August 2014, 3.6 jcs/trap/day in October 2014, and then rose markedly to 16.7 jcs/trap/day in July 2015. Electrofishing in 2014 yielded 4.6 fish/100s of electrofishing, with the majority of the catch being slimy sculpin. A three-pass population estimate of the site estimated that there were 11 juvenile Chinook salmon/100m^2 ±3 fish (90% CI). A population estimate for all fish species combined was not possible due to a violation of the assumption that probability of capture is the same for all passes.

3.5.1.6 Los Angeles Creek

Arctic grayling, slimy sculpin, and juvenile Chinook salmon were captured at AQREF2 in Los Angeles Creek in low abundances. All fish were caught during summer and fall sampling events; no fish were captured with minnow traps in June. Using minnow traps, the rate of catch was 0.53 jcs/trap/day in July and 0.13 jcs/trap/day in September 2015. Electrofishing efforts yielded a single slimy sculpin (in the

second electrofishing pass), and one adult Arctic grayling, however more grayling were observed in deep pools not accessible to backpack electrofishing. Angling efforts at this site yielded one additional adult Arctic grayling, but conditions were not suitable as heavy rains reduced visibility.

3.5.2 Size, Age and Condition

3.5.2.1 Arctic grayling

Arctic grayling length-at-age was characterized for the local study area using a von Bertalanffy growth curve (R^2=0.98, P<0.01 for all parameters; Figure 15). Ages from the Coffee (mainstem), Latte, Independence and Los Angeles Creek watersheds ranged from 2-9 years, with mean ages of 4-6. On average, Arctic grayling from Independence Creek exhibited the lowest length-at-age, whereas mainstem Coffee Creek Arctic grayling had the highest length-at-age (Table 13). However, among-watershed differences of mean age were not significant (ANOVA, $F_{3,47}$=2.63, P=0.06).

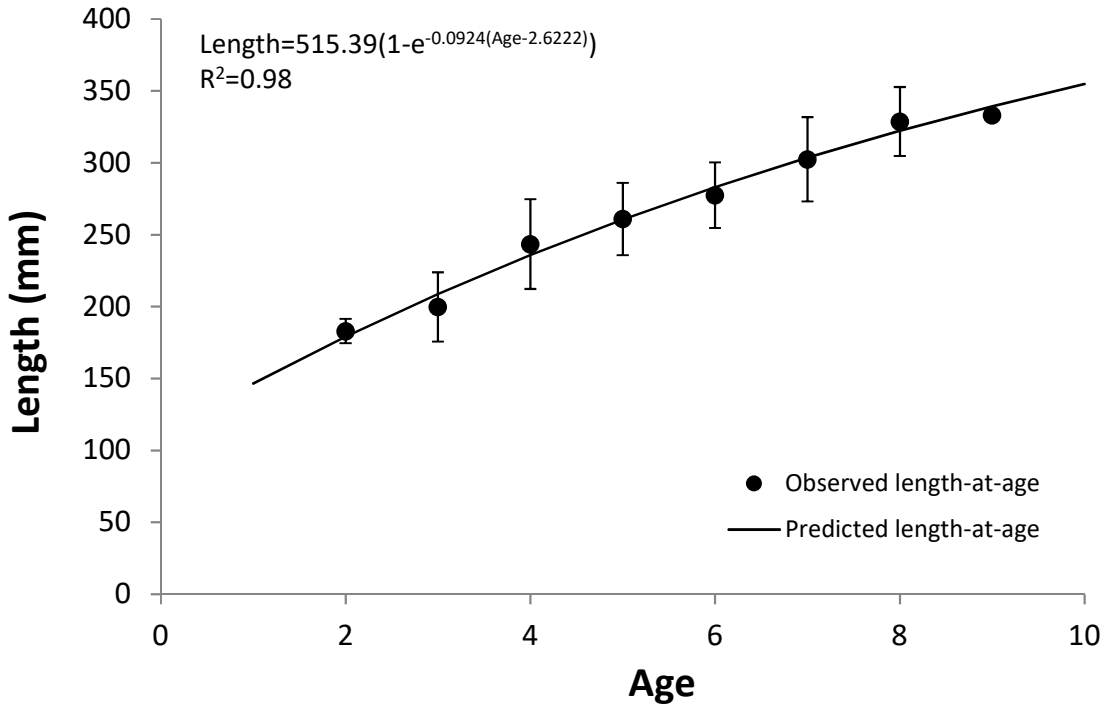

Figure 15. Length-at-age von Bertalanffy relationship for Arctic grayling in the local study area, Coffee Gold Project, 2014-2015. Bars represent standard deviation

Table 13. Arctic grayling length-at-age by Watershed, Coffee Gold Project, 2014-2015

Watershed	Age	n	Length (mm)	
			Mean	SD
Coffee	3	1	214	n/a
	4	4	231	17
	5	5	260	14
	6	3	291	32
	7	5	307	31
	8	1	320	n/a
	9	1	333	n/a
	Total	**20**	**275**	**41**
Latte	3	1	233	n/a
	4	4	256	39
	5	8	263	32
	6	2	272	20
	7	2	290	28
	8	3	332	28
	Total	**20**	**274**	**39**
Independence	2	2	183	8
	3	3	184	12
	5	1	250	n/a
	6	3	268	13
	Total	**9**	**219**	**43**
Los Angeles*	4	1	251	n/a
	6	1	270	n/a
	Total	**2**	**261**	**13**

Notes: n=sample size, SD=Standard deviation
**Reference site*

Arctic grayling lengths ranged from 48-357mm, with the majority of individuals between either 50-75mm or 175-350mm (Figure 16). In the Coffee Creek watershed, no young-of-the-year were captured as all Arctic grayling were greater than 113mm (Figure 15; PECG 2013a). The largest Arctic grayling captured in the study area were from Latte Creek, where two grayling exceeded 350mm in length. A single young-of-the-year was caught in the Independence Creek watershed at AQ10. In contrast, the majority of Arctic grayling caught at the Isaac Creek reference site were young-of-the-year (48-72mm), with only one fish large enough to likely represent an older age class (121mm; Figure 15; PECG 2013a).

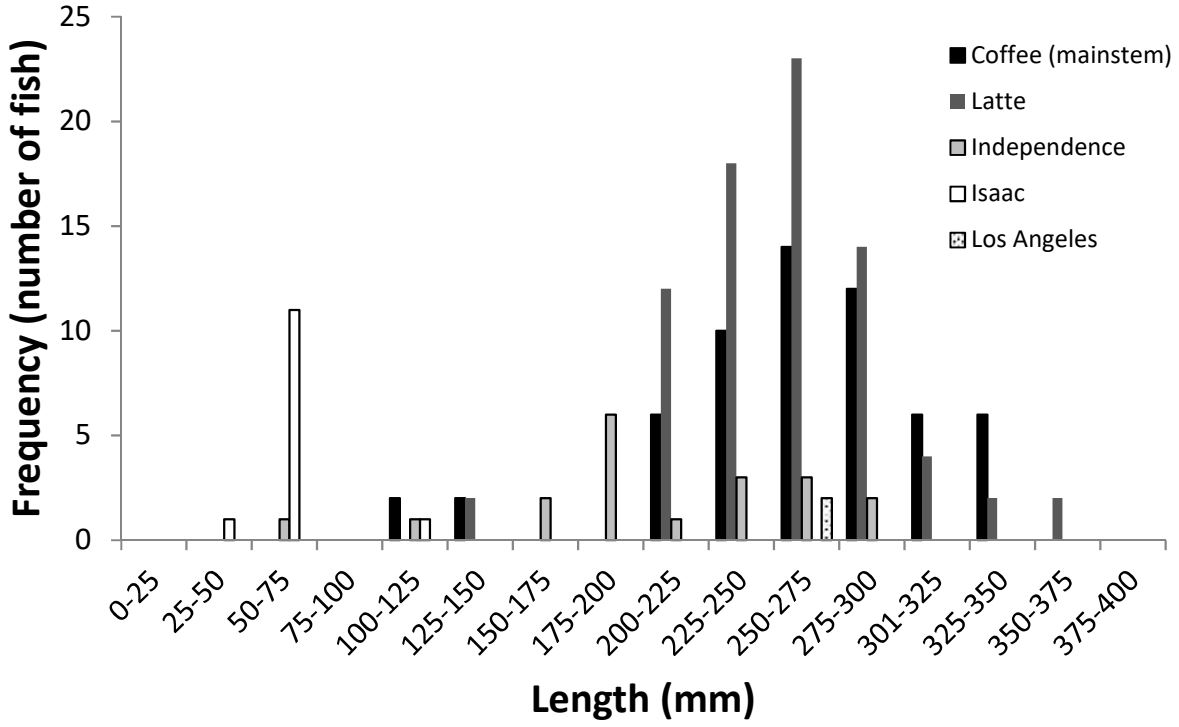

Figure 16. Arctic grayling lengths in the Coffee Gold study area, 2014-2015

Arctic grayling weight-length regressions for each watershed were significant (Figure 17, Linear regressions $R^2 \geq 0.96$, df≥1,11, P<0.01). Fish growth can either be allometric, meaning that the length:weight ratio changes over time, or isometric, meaning that the length:weight ratio remains consistent throughout growth. In the combined model for mine area sites (Latte, Coffee, Halfway, and Independence Creeks), fish growth was allometric (slope>3) with fish becoming heavier as length increased. In contrast, fish growth for Isaac Creek grayling was isometric (slope=3). Relative condition factors based on the combined length-weight regression were similar among watersheds, with the exception of mainstem Coffee Creek which was significantly lower than Latte and Independence Creeks (Figure 18, Kruskal Wallis, H_3=15.12, P=0.02; Post-hoc multiple comparison test, P<0.05).

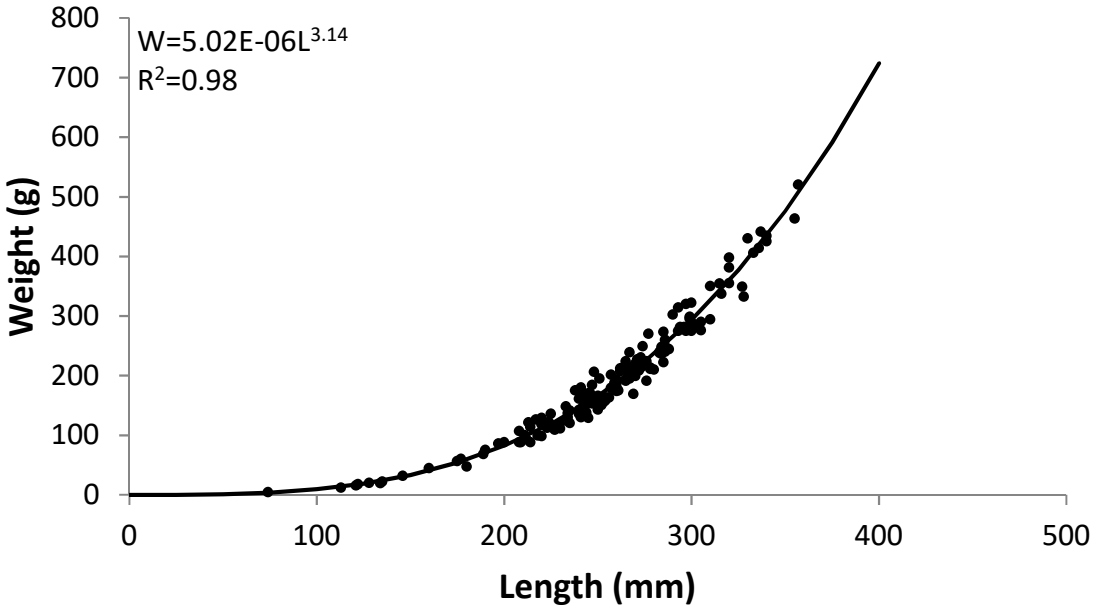

Figure 17. Arctic grayling weight-length relationship for Latte, Coffee, Independence, and Halfway Creeks, Coffee Gold Project, 2014-2015

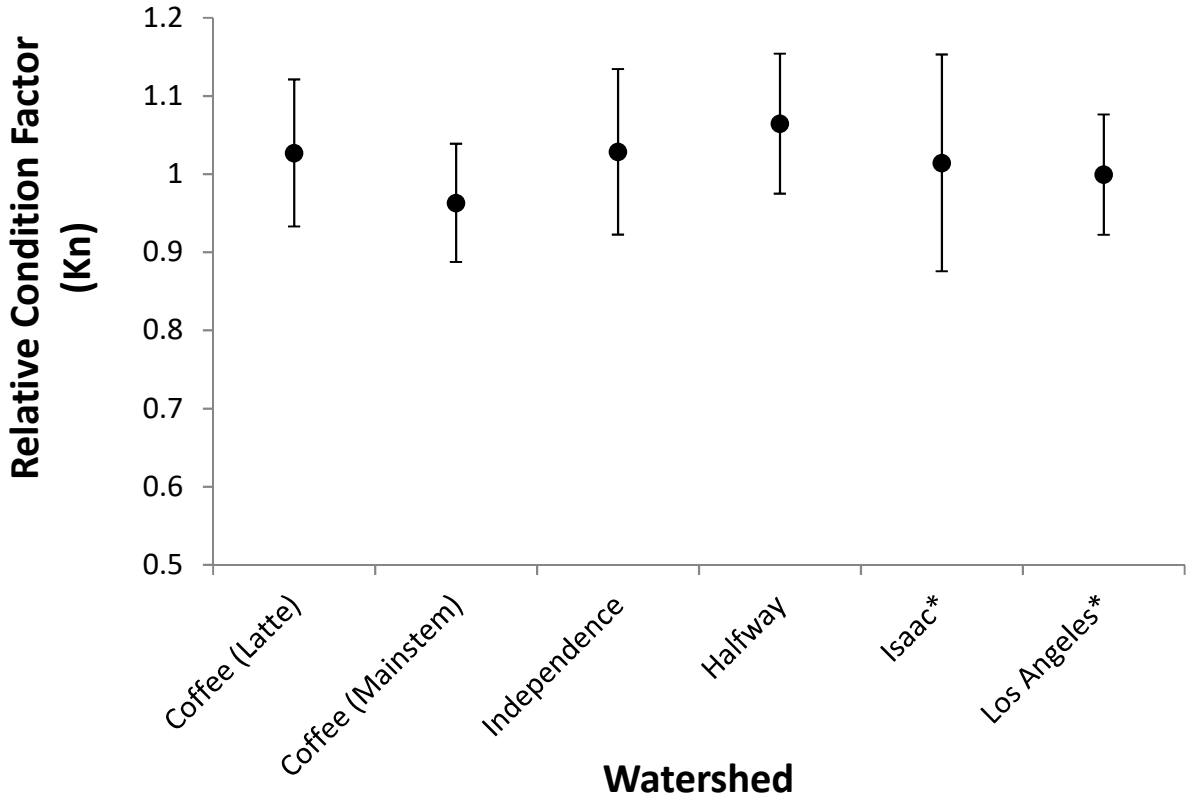

Figure 18. Arctic grayling relative condition factor (Kn) by watershed, Coffee Gold Project, 2014-2015. Bars represent standard deviation and (*) indicates a fisheries reference site

3.5.2.2 Slimy sculpin

Coffee Creek slimy sculpin length-at-age was characterized using a von Bertalanffy growth curve (R^2=0.95, P≤0.01 for all parameters; Length=115(1-$e^{-0.2965Age+2.6487}$)); (Table 14, Figure 19). Similar growth curves for the combined model or other separate watersheds are not presented here; parameter confidence intervals were too high and models were not statistically significant. Ages from the Coffee (mainstem), Independence, Isaac and Los Angeles Creek watersheds ranged from 1-7 years, with mean ages of 2-5. On average, Arctic grayling from Isaac Creek exhibited the lowest length-at-age, whereas mainstem Coffee Creek Arctic grayling had the highest length-at-age. However, among-watershed differences of mean age were not significant (Kruskal Wallis, H_2=4.28, P=0.12).

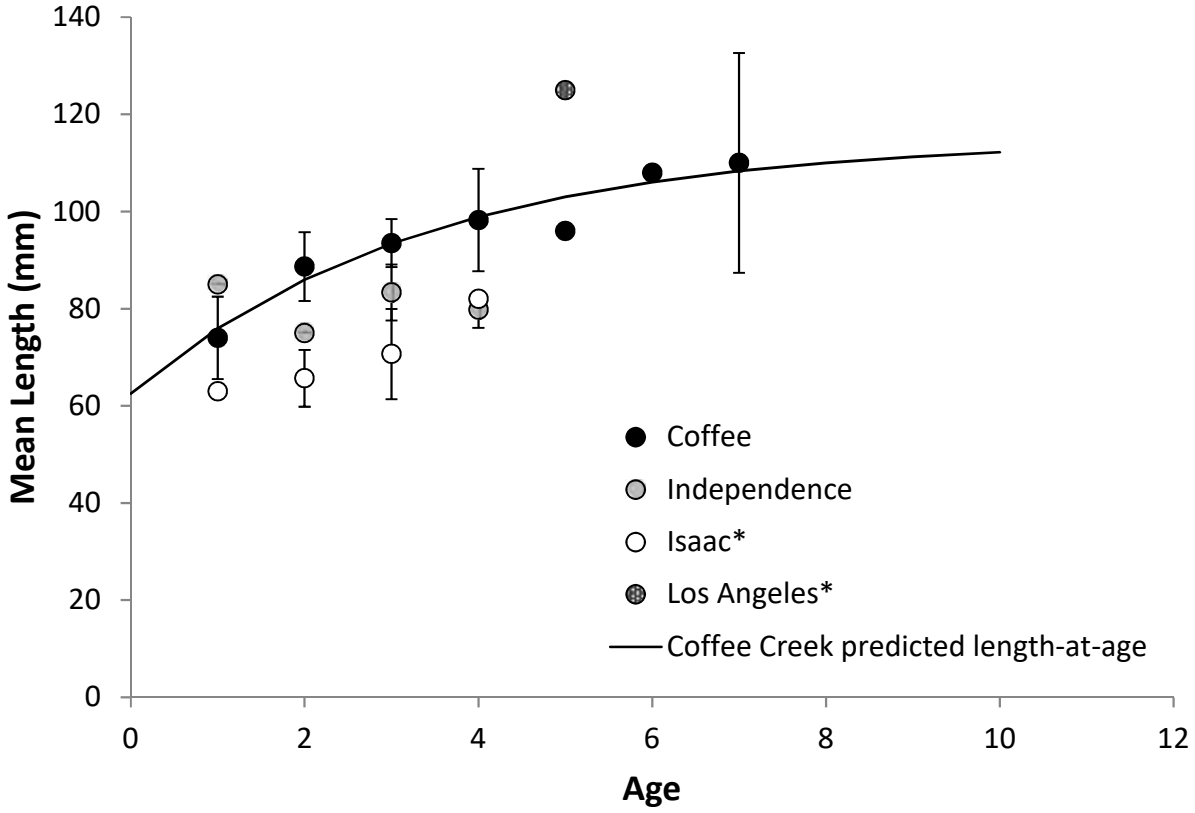

Figure 19. Length-at-age for slimy sculpin in the local study area, Coffee Gold Project, 2014-2015. Length-at-age von Bertalanffy relationship presented for Coffee Creek slimy sculpins. Bars represent standard deviation and (*) indicates a fisheries reference site

Table 14. Slimy sculpin length-at-age by Watershed, Coffee Gold Project, 2014-2015

Watershed	Age	n	Length (mm)	
			Mean	SD
Coffee	1	2	74	8
	2	3	89	7
	3	2	94	5
	4	4	98	11
	5	1	96	n/a
	6	1	108	n/a
	7	2	110	23
	Total	**15**	**95**	**14**
Independence	1	1	85	n/a
	2	1	75	n/a
	3	3	83	6
	4	4	80	4
	5	0	n/a	n/a
	Total	**9**	**81**	**5**
Isaac*	1	1	63	n/a
	2	6	66	6
	3	3	71	9
	4	1	82	n/a
	5	0	n/a	n/a
	Total	**11**	**68**	**8**
Los Angeles*	5	1	125	n/a

Notes: n=sample size, SD=Standard deviation
**Reference site*

Slimy sculpin lengths ranged from 19-126mm in the study area (Figure 20). The smallest slimy sculpins observed (<30mm) were noted in Isaac Creek. Length distributions were similar for all watersheds, being unimodal and converging around expected adult size. However, mean length was substantially higher for Latte Creek sculpins (99 mm, n=13), relative to the other watersheds which ranged from 67 – 77 mm.

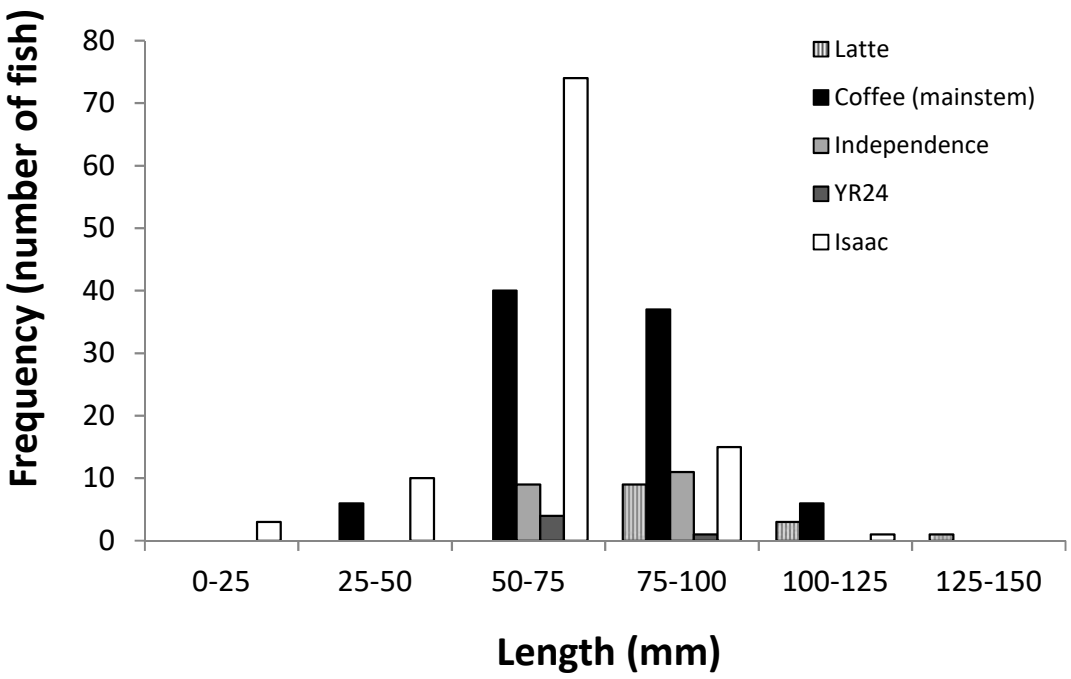

Figure 20. Slimy sculpin lengths in the Coffee Gold study area, 2014-2015

Slimy sculpin weight-length regressions for each watershed were significant (Figure 21, Linear regressions $R^2 \geq 0.53$, df≥1,3, P≤0.01). Fish growth was isometric for all watersheds, meaning that fish did not change shape as they increased in length (slope=3). Slimy sculpin condition was highest in Independence Creek (1.30), and lowest in YR24 (0.96), with Independence Creek having significantly higher condition than all four watersheds (Figure 22, ANOVA, $F_{4,219}=7.8$, P<0.01; Tukey post-hoc HSD Test, P≤0.01). In addition, slimy sculpins from Coffee Creek mainstem had significantly lower condition than sculpins from Isaac Creek (P=0.048).

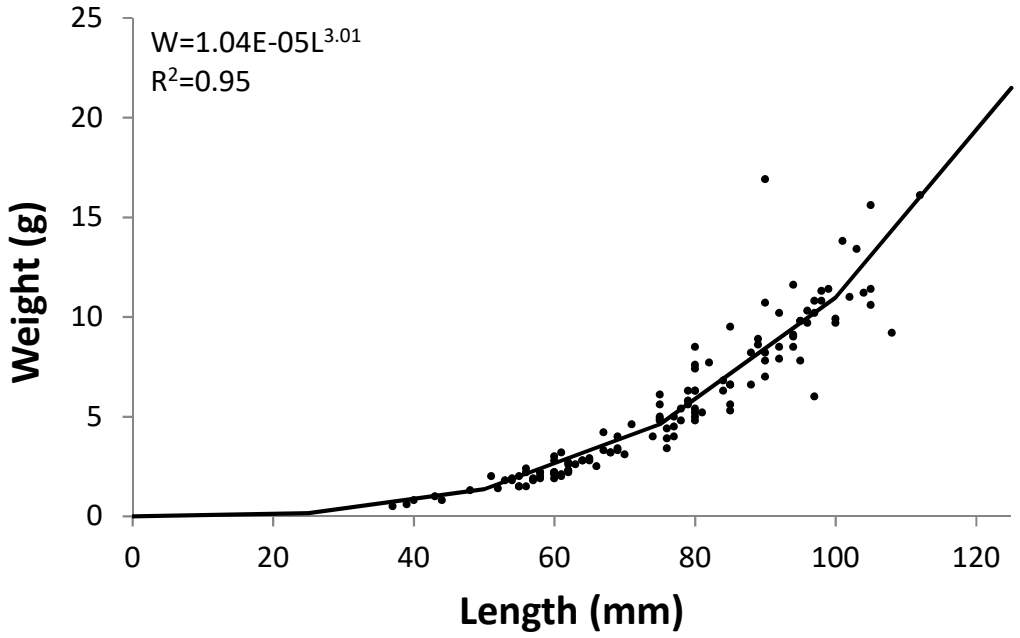

Figure 21. Slimy sculpin weight-length relationship for Latte, Coffee, YR24 and Independence Creeks, Coffee Gold Project, 2014-2015

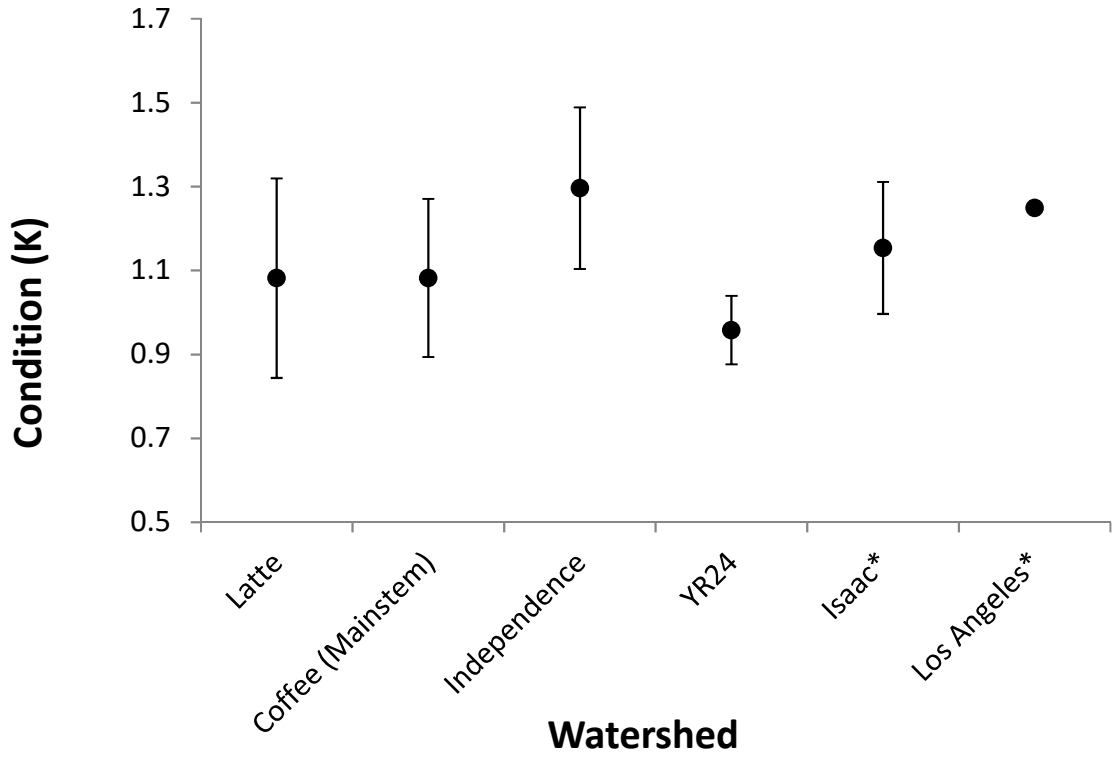

Figure 22. Slimy sculpin Fulton's condition factor (K) by watershed, Coffee Gold Project, 2014-2015. Bars represent standard deviation and (*) indicates a fisheries reference site

3.5.2.3 Chinook salmon

Juvenile Chinook salmon lengths ranged from 48-110mm in the project study area (Figure 23). Juvenile Chinook in Los Angeles Creek had the highest mean length (79mm), followed by Coffee and Independence Creeks (77m), and then Isaac Creek (68mm).

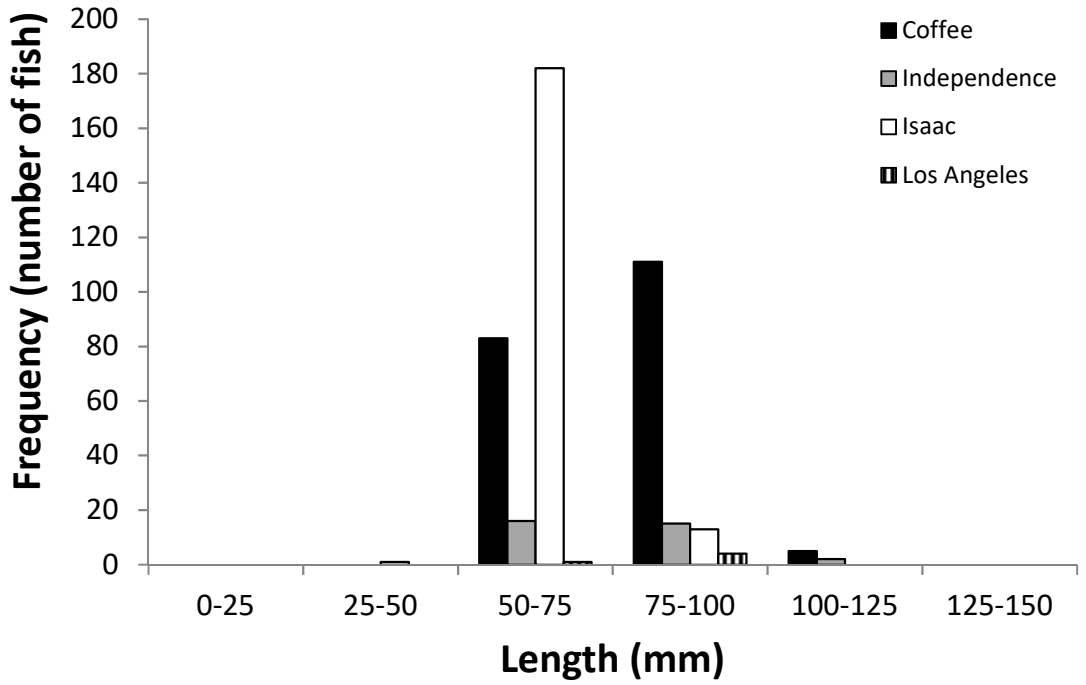

Figure 23. Juvenile Chinook salmon lengths in the Coffee Gold study area, June-October, 2014-2015

Juvenile Chinook salmon weight-length regressions for each watershed were significant (Figure 24, Linear regressions $R^2 \geq 0.81$, df≥1,3, P≤0.01). Fish growth was allometric for individuals in Coffee Creek (slope<3), with fish becoming proportionately lighter as length increased, and isometric for all other watersheds (slope = 3). Relative condition factors based on the combined length-weight regression were similar among all watersheds, with the exception of Coffee Creek which had significantly higher relative condition than Independence Creek (Figure 25, Kruskal Wallis, $H_3=10.44$, P=0.02; Post-hoc multiple comparison test, P=0.02).

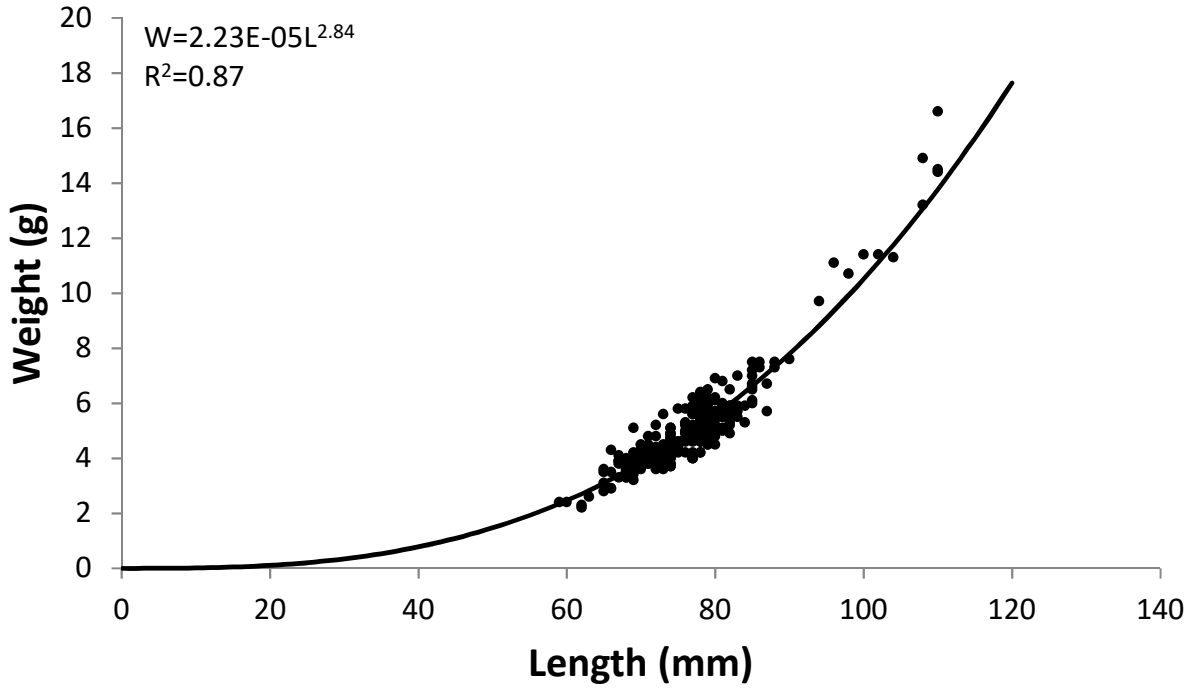

Figure 24. Juvenile Chinook salmon weight-length relationship for Coffee and Independence Creeks, Coffee Gold Project, 2014-2015

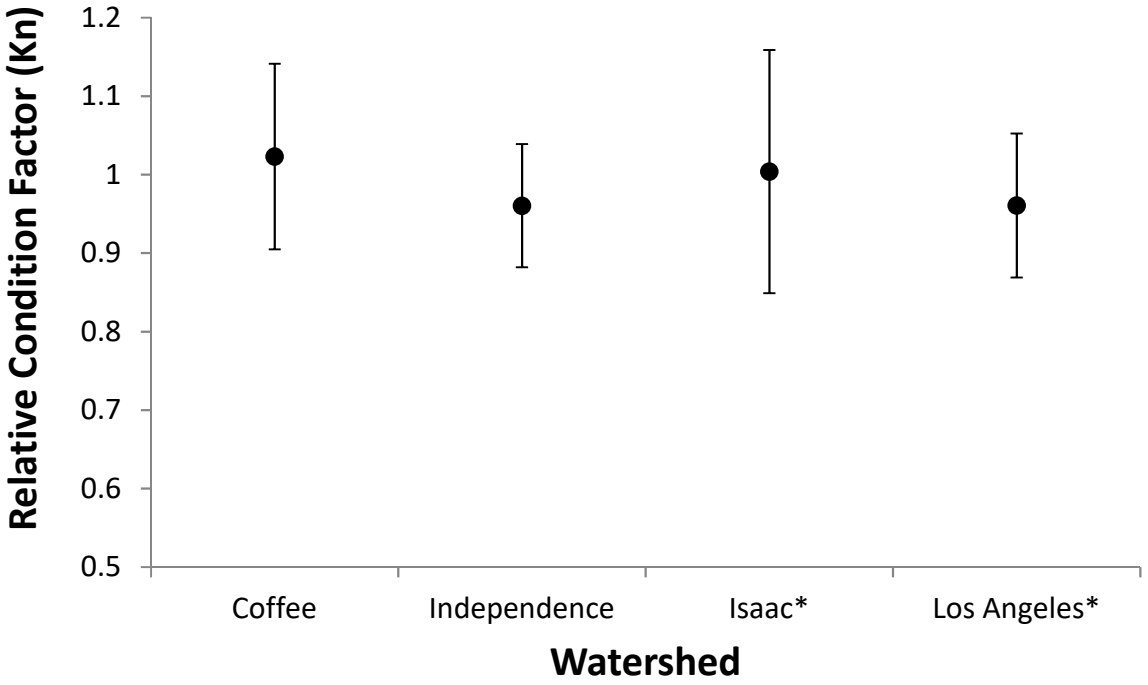

Figure 25. Juvenile Chinook salmon relative condition factor (Kn) by watershed, Coffee Gold Project, 2014-2015. Bars represent standard deviation and (*) indicates a fisheries reference site

3.5.3 Tissue Metal Concentrations

Selected metal concentrations in Arctic grayling and slimy sculpin tissues were compared among watersheds including Coffee Creek (mainstem), Latte Creek, Independence Creek, and the Isaac and Los Angeles Creek reference sites (raw data can be found in Appendix F5). Certain metals are required for fish physiological processes but may become toxic above certain thresholds (e.g., copper, selenium, zinc). In contrast, there are several non-essential metals that have no determined biological role and may be toxic even at low concentrations (*e.g.,* cadmium, lead, nickel). The only guidelines currently available to determine safe metal concentrations in slimy sculpin are for selenium and mercury. As there are no other guidelines developed, noted differences among watersheds may not provide insight into adverse metal effects. However, as guidelines may be developed in the future, it is important to characterize baseline metal concentrations within the project study area prior to development.

It should be noted that results from the metals analysis of fish tissues in 2014 may have been affected by potential thawing of samples during transit. However, results for slimy sculpins were within the range of values observed in nearby watersheds for the Casino Project and can therefore be considered as reliable baseline (PECG 2013a). Sub-sampling of sculpin tissues from some of the same watersheds in 2015 identified some potential differences between years, although guideline exceedances were overall similar for selenium and mercury. Based on these apparent differences between years, further sampling of these watersheds would be beneficial for characterizing more accurate baseline metal concentrations in the mine area.

3.5.3.1 Arctic grayling

Mean estimated methylmercury concentrations exceeded the guideline for the protection of piscivorous wildlife in all watersheds for Arctic grayling (CCME, 2000). In contrast, Health Canada total mercury guidelines were not exceeded by Arctic grayling tissues in any watershed (Health and Welfare Canada 1979; Canadian Food Inspection Agency, 2011). The guideline for the protection of piscivorous wildlife is conservatively based on one avian species (the storm petrel) that consumes almost its entire body weight each day, and thus is highly sensitive to methylmercury bioaccumulation (CCME, 2000).

Mean selenium concentrations in Arctic grayling tissues in all four watersheds exceeded the selenium guidelines for the protection of freshwater aquatic life, which were recently updated in spring 2014 (Table 15; BC MOE 2014). The mean selenium concentrations did not surpass the human health guidelines for selenium with the exception of Independence Creek samples, which exceeded the lowest guideline of 7.3 mg/kg, provided for high consumers of fish. In addition, approximately 33-38% of individual samples in all watersheds exceeded the lowest guideline provided for high consumers of fish, with the exception of Arctic grayling in Latte Creek which were all below the guideline. The human health selenium guidelines based on moderate and low fish diets were not exceeded by any individual Arctic grayling samples. Selenium toxicity can produce varying effects on fish and aquatic organisms including liver and ovary abnormalities (Sorensen 1998), impaired growth (Dobbs *et al.,* 1996), reduced reproduction (Lemly 2004), and teratogenesis during early development (Lemly and Smith 1987).

Overall, Independence Creek Arctic grayling tissues demonstrated the highest mean metal concentrations with greater barium, cadmium, selenium, strontium, and zinc concentrations in comparison to grayling from mainstem Coffee, Latte and Los Angeles Creeks (Table 15). The second overall highest tissue metal concentrations were observed in Los Angeles, where grayling demonstrated the highest mean concentrations of arsenic, manganese and thallium in comparison to grayling from other watersheds. Latte Creek grayling exhibited the lowest metal concentrations overall, except for mercury, selenium, and thallium where they had the highest (mercury) and second highest (barium, cadmium, copper) values relative to other watersheds. Uranium concentrations were low among all watersheds, with all values within 3x the laboratory detection limits (0.001-0.003 mg/kg wet weight).

Table 15. Selected total metal concentrations in Arctic grayling muscle tissue, Coffee Gold Project, 2014-2015

	Latte (n=8)		Coffee (n=8)		Independence (n=8)		Los Angeles* (n=2)		Guidelines	
Analyte	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Wildlife**	**Human Health**
Aluminum	1.25	0.61	2.50	1.30	2.03	2.05	1.45	0.78		
Arsenic	0.034	0.012	0.033	0.015	0.038	0.005	0.056	0.018		
Barium	0.15	0.08	0.11	0.04	0.18	0.13	0.14	0.05		
Cadmium	0.006	0.003	0.005	0.002	0.008	0.009	0.003	0.001		
Copper	0.39	0.11	0.45	0.14	0.35	0.05	0.39	n/a		
Iron	5.1	1.4	8.9	2.1	6.5	3.2	6.0	1.4		
Lead	0.006	0.003	0.003	0.002	0.010	0.022	<0.01	n/a		
Mercury	0.110	0.023	0.064	0.019	0.052	0.019	0.067	0.002		0.2-0.5[a]
Methylmercury[b]	**0.10**	0.02	**0.06**	0.02	**0.05**	0.02	**0.06**	0.00	0.033[c]	
Manganese	0.34	0.06	0.42	0.15	0.51	0.21	0.55	0.02		
Molybdenum	<0.01	n/a	<0.01	n/a	<0.01	n/a	<0.01	n/a		
Nickel	0.01	0.00	0.06	0.01	0.06	0.02	0.03	n/a		
Selenium[d]	**4.07**	1.04	**6.96**	1.11	**7.43**	1.66	**5.96**	2.25	4.0[e]	[f]High: 7.3; Medium: 14.5; Low: 75
Strontium	0.39	0.31	0.54	0.20	1.06	0.81	0.78	0.24		
Thallium	0.005	0.001	0.006	0.001	0.006	0.001	0.006	n/a		
Zinc	5.5	1.4	5.5	1.0	6.6	2.2	5.5	0.4		

*Notes: All units are mg/kg wet weight unless otherwise specified. SD=Standard deviation, n=sample size, *Reference site*

[a]Health Canada mercury guidelines range from 0.2-0.5 for subsistence consumers (Health and Welfare Canada 1979) and maximum allowable level for sale (Canadian Food Inspection Agency 2011), respectively

[b]Methylmercury is estimated based on 95% of total mercury for Arctic grayling (Jewett et al. 2003)

[c]Canadian Council of Ministers of the Environment tissue residue guideline (CCME 2000) to protect piscivorous wildlife from methylmercury toxicity

[d]Selenium is reported in mg/kg dry weight

[e]British Columbia Ministry of Environment aquatic life (whole-body) selenium guideline (BC MOE 2014) for the protection of freshwater aquatic life

[f]British Columbia Ministry of Environment human consumption selenium screening values for low (0.03 kg/day), medium (0.11 kg/day), and high (0.22 kg/day) fish intake (BC MOE 2014)

***Bolded** values exceed guidelines for the protection of aquatic and piscivorous wildlife; Grey Highlighted values exceed Human Health Guidelines*

3.5.3.2 Slimy Sculpin

2014 Data:

Mean estimated methylmercury concentrations exceeded the guideline for the protection of piscivorous wildlife in all watersheds for slimy sculpin. In contrast, Health Canada total mercury guidelines were not exceeded by mean mercury concentrations of sculpin tissues in any watershed. However, as people do not consume slimy sculpin, the comparison to Health Canada guidelines are not directly relevant.

Mean selenium concentrations in slimy sculpin tissues in all three watersheds exceeded the selenium guidelines for the protection of freshwater aquatic life (BC MOE, 2014). The mean selenium concentrations did not surpass the human health guidelines for selenium, although there were one to two sculpins in each watershed that individually exceeded the lowest guideline provided for high consumers of fish. The human health selenium guidelines based on moderate and low fish diets were not exceeded by any individual sculpin samples. Again, it should be noted that people do not consume slimy sculpin and thus the comparison to human health guidelines are not directly relevant.

Overall, Independence Creek slimy sculpin tissues demonstrated the highest mean metal concentrations with greater aluminum, arsenic, copper, iron, lead, molybdenum, nickel and thallium concentrations in comparison to sculpins from Coffee and Isaac Creeks (Table 16). The second overall highest tissue metal concentrations were observed in Isaac Creek, where sculpins demonstrated the highest mean concentrations of barium, cadmium, manganese, selenium, strontium, and zinc in comparison to sculpins from Independence and Coffee Creeks. Coffee Creek sculpins often exhibited the lowest metal concentrations overall, except for mercury, selenium, and thallium where they had the highest (mercury) and second highest (selenium, thallium) values relative to other watersheds.

Table 16. Selected total metal concentrations in slimy sculpin tissue, Coffee Gold Project, 2014

	Coffee (n=9)		Independence (n=8)		Isaac* (n=9)		Guidelines	
Analyte	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Wildlife**	**Human Health**
Aluminum	7.61	6.11	34.64	43.75	11.73	7.29		
Arsenic	0.069	0.017	0.111	0.042	0.093	0.038		
Barium	1.58	1.19	2.10	1.05	3.45	0.99		
Cadmium	0.020	0.024	0.122	0.076	0.181	0.124		
Copper	0.64	0.23	0.97	0.57	0.65	0.16		
Iron	23	14	64	68	33	17		
Lead	0.012	0.010	0.033	0.020	0.018	0.007		
Mercury	0.107	0.050	0.073	0.018	0.044	0.010		0.2-0.5[a]
Methylmercury[b]	**0.09**	0.04	**0.06**	0.02	**0.04**	0.01	0.033[c]	
Manganese	3.84	2.65	8.09	3.79	10.62	4.44		
Molybdenum	0.009	0.008	0.031	0.024	0.018	0.007		
Nickel	0.04	0.02	0.10	0.06	0.08	0.03		
Selenium[d]	**5.47**	2.21	**4.97**	2.01	**6.02**	1.84	4.0[e]	[f]High: 7.3; Medium: 14.5; Low: 75
Strontium	11.09	8.52	13.81	7.90	19.45	5.49		
Thallium	0.006	0.002	0.008	0.001	0.004	0.001		
Zinc	23.4	8.3	24.6	2.7	30.7	8.8		

*Notes: All units are mg/kg wet weight unless otherwise specified. Whole-body samples were analyzed without head tissues (Refer to Section 2.4.5.1 for more details). SD=Standard deviation, n=sample size, *Reference site. **Bolded** values exceed guidelines for the protection of aquatic and piscivorous wildlife.*

[a]Health Canada mercury guidelines range from 0.2-0.5 for subsistence consumers (Health and Welfare Canada 1979) and maximum allowable level for sale (Canadian Food Inspection Agency 2011), respectively

[b]Methylmercury is estimated based on 83% of total mercury for slimy sculpin (Raymond and Rossmann 2009)

[c]Canadian Council of Ministers of the Environment tissue residue guideline (CCME 2000) to protect piscivorous wildlife from methylmercury toxicity

[d]Selenium is reported in mg/kg dry weight

[e]British Columbia Ministry of Environment aquatic life (whole-body) selenium guideline (BC MOE 2014) for the protection of freshwater aquatic life

[f]British Columbia Ministry of Environment human consumption selenium screening values for low (0.03 kg/day), medium (0.11 kg/day), and high (0.22 kg/day) fish intake (BC MOE 2014)

2015 Data:
Poor sampling conditions (high flows, turbid waters) and low densities of fish lowered sample sizes in Latte and Los Angeles Creeks, where only 1-3 of 8 desired samples were collected in 2015. An additional three samples were obtained at AQ02 and AQREF1 in order to provide verification for sample quality in 2014. Results from these sites are summarized in Table 17.

Overall, guideline exceedances were generally similar to 2014 for both mercury and selenium. All watersheds had mean estimated methylmercury values that exceeded the guideline for the protection of piscivorous wildlife, which was also observed in 2014 (Table 17). One indication of potential between-year differences was for total mercury, as 2/3 slimy sculpin Coffee Creek samples exceeded the human health guideline for subsistence consumers, whereas in 2014 only 1/9 samples exceeded this level. The guideline was also exceeded at Latte Creek, where 2/3 sculpins had values greater than 0.2 mg/kg wet weight. No samples at any sites exceeded the maximum allowable level of mercury for sale guideline (Canadian Food Inspection Agency, 2011).

As was observed in 2014, mean selenium concentrations in slimy sculpin tissues in 2015 exceeded the selenium guidelines for the protection of freshwater aquatic life in all watersheds (BC MOE 2014). Individual samples in Independence, Isaac, and Los Angeles Creek exceeded the selenium human health guideline for high consumers of fish. However the rate of exceedances was comparable to results in 2014 (0-2 sample exceedances per site). The human health selenium guidelines based on moderate and low fish diets were not exceeded by any individual slimy sculpin samples.

Uranium:
Uranium concentrations for all watersheds over both years ranged from 0.006 – 0.175 mg/kg wet weight per slimy sculpin sample. The highest uranium concentrations were observed in Latte Creek (mean=0.10 mg/kg wet weight) and mainstem Coffee Creek (2014 mean=0.05 mg/kg wet weight, 2015 mean=0.08 mg/kg wet weight). The remaining watersheds had mean uranium concentrations ranging from 0.011 – 0.024 mg/kg wet weight. While there are no available guidelines for assessing healthy uranium levels, uranium results for Coffee Gold slimy sculpins were within the range of values observed in nearby watersheds for the Casino Project (PECG 2013a).

Table 17. Selected total metal concentrations in slimy sculpin tissue, Coffee Gold Project, 2015

	Latte (n=3)		Coffee (n=3)		Ind (n=1)	Isaac* (n=3)		LA* (n=1)	Guidelines	
Analyte	**Mean**	**SD**	**Mean**	**SD**	**Value**	**Value**	**SD**	**Value**	**Wildlife**	**Human Health**
Aluminum	30.23	1.78	50.77	55.83	17.80	18.50	14.47	49.70		
Arsenic	0.131	0.016	0.118	0.046	0.107	0.217	0.158	0.216		
Barium	3.56	1.30	2.69	1.05	0.66	3.35	0.61	3.24		
Cadmium	0.050	0.008	0.036	0.022	0.072	0.126	0.034	0.111		
Copper	1.11	0.10	0.97	0.29	0.92	0.66	0.12	1.55		
Iron	54.0	13.1	74.7	72.5	45.0	57.0	47.0	85.0		
Lead	0.020	0.003	0.017	0.017	0.016	0.040	0.042	0.020		
Mercury	0.154	0.093	0.199	0.062	0.069	0.049	0.017	0.084		0.2-0.5[a]
Methylmercury[b]	**0.13**	0.08	**0.17**	0.05	**0.06**	**0.04**	0.01	**0.07**	0.033[c]	
Manganese	10.33	3.73	8.49	5.87	3.83	9.54	3.07	16.20		
Molybdenum	0.020	0.010	0.023	0.015	0.040	<0.05	n/a	0.030		
Nickel	0.11	0.04	0.14	0.07	0.07	0.28	0.06	0.24		
Selenium[d]	**6.17**	1.74	**6.51**	0.41	**8.31**	**7.78**	2.19	**9.51**	4.0[e]	[f]High: 7.3; Medium: 14.5; Low: 75
Strontium	19.00	7.11	11.40	1.45	1.95	13.60	3.30	26.00		
Thallium	0.011	0.002	0.012	0.003	0.007	0.007	0.002	0.010		
Zinc	51.3	21.0	36.2	15.3	23.1	44.3	14.9	61.4		

Notes: All units are mg/kg wet weight unless otherwise specified. Whole-body samples were analyzed without head tissues (Refer to Section 2.4.5.1 for more details).
*SD=Standard deviation, n=sample size, *Reference site, Ind=Independence Creek, LA=Los Angeles Creek*
[a]Health Canada mercury guidelines range from 0.2-0.5 for subsistence consumers (Health and Welfare Canada 1979) and maximum allowable level for sale (Canadian Food Inspection Agency 2011), respectively
[b]Methylmercury is estimated based on 83% of total mercury for slimy sculpin (Raymond and Rossmann 2009)
[c]Canadian Council of Ministers of the Environment tissue residue guideline (CCME 2000) to protect piscivorous wildlife from methylmercury toxicity
[d]Selenium is reported in mg/kg dry weight
[e]British Columbia Ministry of Environment aquatic life (whole-body) selenium guideline (BC MOE 2014) for the protection of freshwater aquatic life
[f]British Columbia Ministry of Environment human consumption selenium screening values for low (0.03 kg/day), medium (0.11 kg/day), and high (0.22 kg/day) fish intake (BC MOE 2014)
***Bolded** values exceed guidelines for the protection of aquatic and piscivorous wildlife; Grey Highlighted values exceed Human Health Guidelines*

3.5.4 Arctic Grayling Diet

Coffee Creek Arctic grayling primarily fed on dipteran species (50%), followed by mayflies (*Ephemeroptera*=27%), caddisflies (*Trichoptera*=16%), and stoneflies (*Plecoptera*=3%) (Figure 26; Appendix F6). The remaining stomach contents consisted of low abundances of annelids, and species from the orders *Coeloptera, Hemiptera*, and *Chelicerata*. The number of prey items per fish was relatively high, with an average of 218 items per fish. During sampling, it was often noted that stomach fullness was high for Latte and Coffee Creek Arctic grayling. While this only provides a snapshop of diet, it is worth noting that none of the Arctic grayling sampled were piscivorous. Low frequencies of Arctic grayling piscivory have been documented elsewhere in Yukon and NWT streams (e.g., Bishop 1967; de Bruyn and McCart 1974; Mathers 1981; Jessop *et al.* 1993).

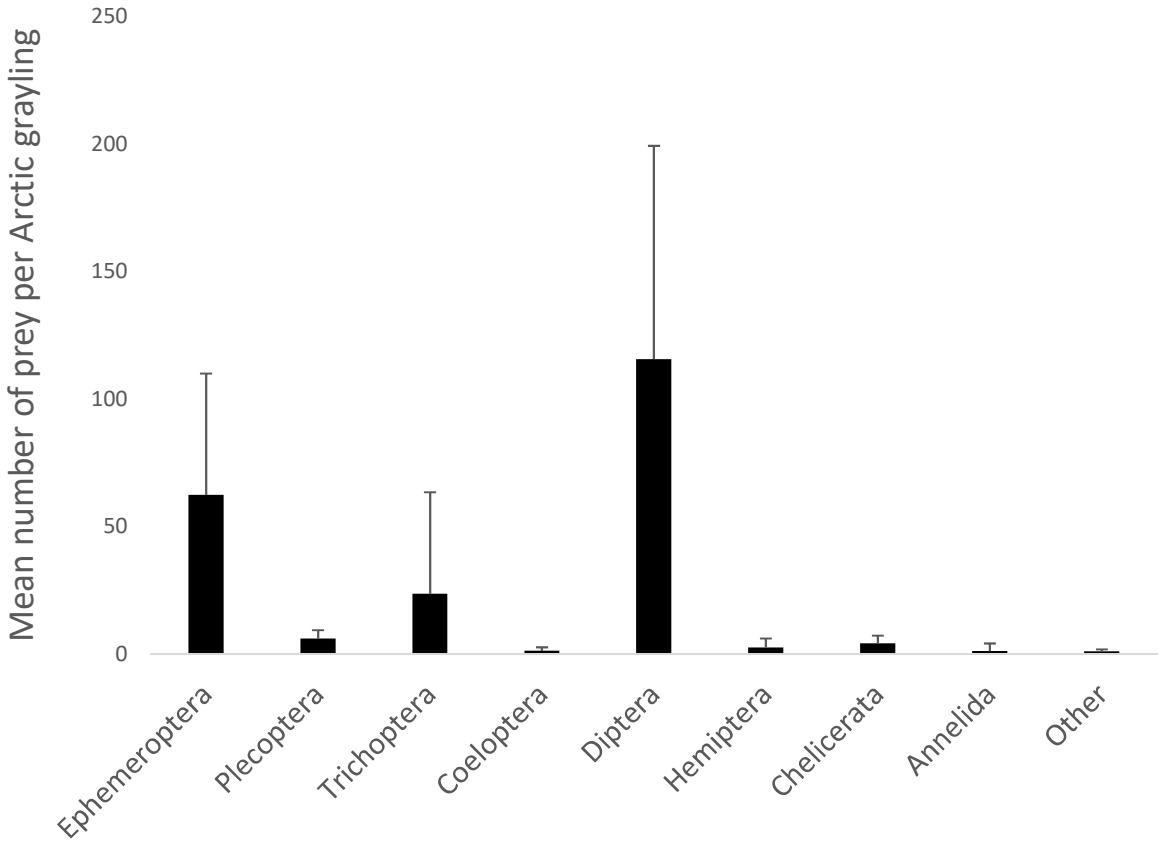

Figure 26. Mean number of prey per Arctic grayling, Coffee Gold Project, 2014-2015. Results are an average based on two grayling from Latte (AQ04) and five grayling from mainstem Coffee Creek (AQ02). Bars represent standard deviation

3.5.5 Arctic Grayling Tagging Program Results

Out of 31 Arctic grayling tagged in late August, 2014, four individuals were re-captured in late July, 2015. All four Arctic grayling were tagged and re-captured at the same site in mid Latte Creek, AQ04. Based on

external observations, all four grayling were likely male and varied from 244 – 357mm in length. Two grayling were determined to be in their eighth year based on scale ageing analysis. Growth between tagging and re-capture (change in length) was negligible and in all cases fish weight had decreased, with reductions of approximately 15-60g observed. Although there is room for measurement error with live fish, these findings suggest that the beginning of the 2015 growth season may have been poor, and/or that the bulk of growth was yet to occur.

3.5.6 Spawning Surveys

3.5.6.1 Salmon Spawning Surveys

In 2014, salmon spawning surveys were completed on Coffee and Independence Creeks in late August and early October, and also on the Yukon River proximate to the study area in October (Table 6). In 2015, salmon spawning surveys were completed on Coffee, Independence, and the Yukon River throughout a week of sampling in late July. No evidence of spawning was observed in either Coffee or Independence Creeks during any sampling period. However, in fall 2014 several salmon were spotted in a Yukon River side channel adjacent to the Coffee Creek camp (UTM: 7V 0596480 6977159), and are assumed to have been chum salmon due to the timing of the survey.

3.5.6.2 Arctic Grayling Spawning Survey

A total of 16 Arctic grayling were captured and visually assessed for spawning condition at two sites in Latte Creek from June 18 – 23, 2015. Approximately 200m of stream length was surveyed at AQ03, just upstream of the Latte Creek confluence with Coffee Creek, and an additional 120m of stream length was surveyed at AQ04 which is a high density summer feeding site. Fish habitat at AQ03 had low potential for supporting Arctic grayling spawning, with a small percentage (<5%) of unembedded gravel substrate noted (Stewart *et al*., 2007a). Habitat at AQ04 in the mid-section of Latte Creek had moderate to good potential for supporting Arctic grayling spawning based on suitable channel size, flow, and a high percentage of unembedded gravel substrate. Prior to electrofishing, the stream lengths were walked and fish were observed to determine any potential spawning behavior such as territory guarding, spawning congregations, or any courtship displays (*e.g.,* pairing up). No spawning behavior was noted, and electrofishing commenced. Lengths of captured Arctic grayling suggested a mature size (220-316mm). An external check of secondary sexual characteristics was made for each fish, and all fish appeared to be in the resting stage *i.e.,* spawning colours were not as apparent, the genital opening was not inflamed, the body cavity did not feel empty (as you would expect for a fish that had recently spawned), and no roe or milt was expelled when applying pressure to the body cavity (RIC 1996).

Dissection of six Arctic grayling samples (n=2 from AQ03, n=4 from AQ04; two females and four males total) provided a more in-depth assessment of gonad development and confirmed results based on external observations. The gonads only partly filled the body cavity, and showed no sign of recent expulsion. Female fish eggs were approximately 1mm diameter, which is less than 1/2 the size of grayling that are ready to spawn (2.5-2.7mm, Figure 27, Stewart *et al*., 2007a). The rate of gonad development suggests that Arctic grayling in Latte Creek had already spawned and begun re-development for 2016. As 2015 was an early spring, Arctic grayling spawning which typically coincides with the ice break-up may

have occurred as early as the beginning of May in nearby systems. Furthermore, gonadal development of Yukon Arctic grayling is typically accelerated due to the shortened northern growing season, and thus the state of maturity observed further supports the theory of early spawning and subsequent gonadal generation (*pers. comm*., von Finster, 2015). All six of the Arctic grayling stomachs were completely full, suggesting heavy active feeding in the stream. In contrast, spawning Arctic grayling are known to only passively feed before and during spawning activities (Stewart *et al*., 2007b).



Figure 27. Arctic grayling egg size, AQ04 in mid Latte Creek, Coffee Gold Project, June 23, 2015.

Stream temperatures from Latte Creek were recorded using an in-stream temperature logger located at AQ03 that ran from June 1, 2014 – September 2015 (Figure 28). Temperatures at this site were colder than preferred Arctic grayling spawning temperatures (above 4°C, with daily means between 6-10°C) throughout the expected spawning period of mid-May to mid-June (Stewart *et al*., 2007a). Further, mean daily temperatures were only reaching 5°C in early July, well past ice break-up and indicative of a permafrost-dominated system. While completing the Arctic grayling spawning assessment, spot temperatures measurements were obtained at several sites along Latte Creek and compared to the in-stream temperature logger record. Stream temperatures at AQ04 were warmer than those recorded at AQ03, with a maximum discrepancy of 1.8°C. Taking this potential difference into account, Latte Creek stream temperatures in the mid-watershed (AQ04) may have reached the bottom of the preferred spawning temperature range by early July.

Results from the Arctic grayling spawning assessment on Latte Creek suggested that spawning likely occurred elsewhere, either in Coffee Creek or even in other watersheds nearby. Stream temperatures were marginal at best for supporting spawning activities, and Arctic grayling behavior and gonadal development all indicated that the fish were in a “resting” maturity state. Furthermore, active feeding suggests that the Arctic grayling were beyond their spawning period and had entered their summer feeding stage.

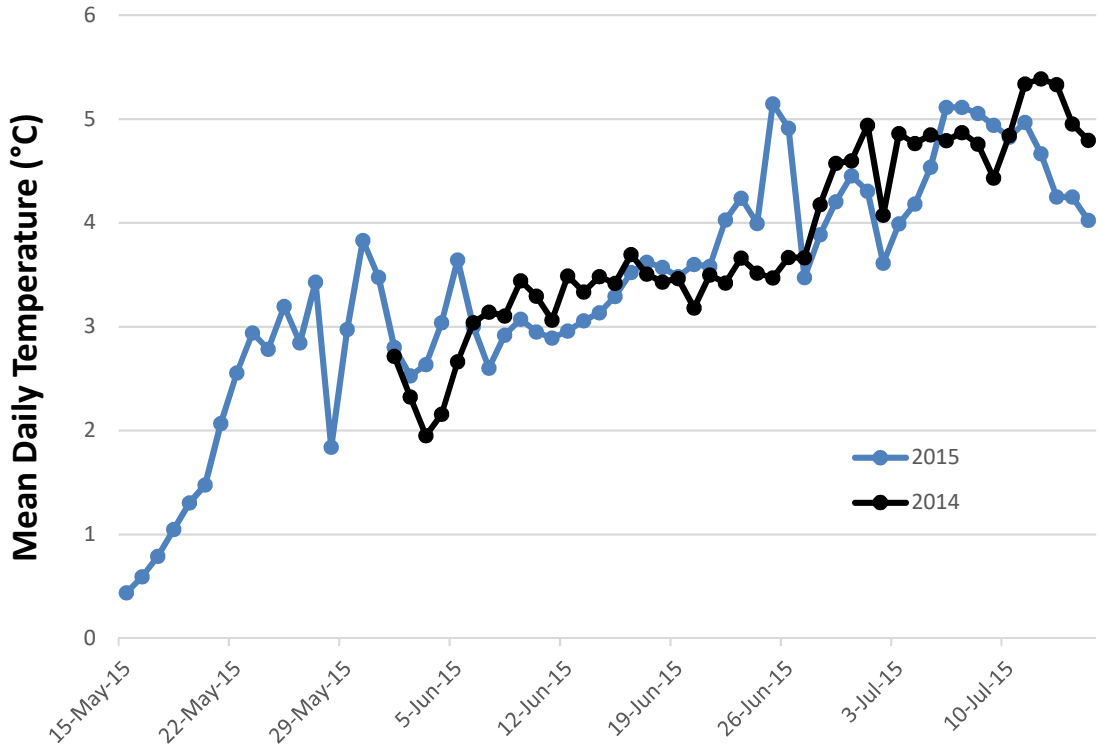

Figure 28. Mean Spring – Early Summer Daily Temperatures at AQ03 in lower Latte Creek, Coffee Gold Project, 2014-2015.

4 Summary

The fish and aquatic resources study program was conducted at 18 fish sampling sites, 17 fish habitat sites, and 12 benthic invertebrate, periphyton, and sediment sites throughout the project study area in August and October, 2014, and in March, June, July, and September, 2015. Watersheds within the local study area are Coffee Creek, Independence Creek, YR24 (between Coffee and Halfway Creeks), and Halfway Creek, with two reference sites located in Isaac and Los Angeles Creeks. Quality of fish habitat was assessed through investigations of aquatic communities (e.g., periphyton, benthic invertebrates), physical fish habitat parameters (e.g., stream size, gradient, habitat type), and physicochemical fish habitat parameters (e.g., sediment quality). The Coffee Gold study area provided non-natal rearing habitat for juvenile Chinook salmon, which is a highly valued CRA fish species in the Yukon. Adult and sub-adult Arctic grayling had the most widespread distribution in the Coffee Gold study area, with Latte Creek supporting high density summer feeding habitat. Currently, there are no known fish species at risk in the regional area of the Project.

4.1 Sediment Quality

Of the seven metals with CCME sediment quality guidelines, exceedances were observed for two: arsenic (As), and chromium (Cr). There were no exceedances recorded for mercury. Arsenic exceedances occurred at every station for the ISQG. Arsenic also exceeded the PEL at AQ05, AQ13, and AQREF1, which are in headwater areas adjacent to the deposit (AQ05, AQ13), or proximate to the Yukon River (AQREF1). The ISQG was exceeded for Chromium in the Kona tributary of Independence Creek (AQ13), as well as at the Los Angeles Creek reference site (AQREF2). Over 60% of the sediment particle sizes in the study area were less than 300 µm in diameter.

4.2 Periphyton and Benthic Invertebrates

Chlorophyll *a* was very low for all sites, which is typical of northern aquatic habitats. Ash-free dry mass (AFDM) values ranged from 0.38 - 1.07 mg/cm^2, with the highest values observed in Halfway Creek (AQ20) and Los Angeles Creek (AQREF2). Mean periphyton density was highest in YR24 (497,737 cells/cm^2) and lowest in upper Latte Creek (68,802 cells/cm^2). Blue-green algae (*Cyanophyta*) was the most dominant algal group in the study area, making up approximately 80% of the overall community composition. Mean taxonomic richness in the Coffee Gold study area was overall low, ranging from 10-14 taxonomic groups. Mean biodiversity ranged from 0.99 at AQ05 to 1.74 at AQ10.

Overall, Los Angeles Creek displayed the highest total abundance of benthic invertebrates (3210), followed by Independence Creek (2092), YR24 (1291), Coffee Creek (762), Halfway Creek (466), and then Isaac Creek (306). EPT abundances within the study area demonstrated similar patterns to overall abundance, with a significant relationship observed between the two indices. Dipterans were the most dominant benthic invertebrate group in the project study area, making up approximately 50% of the overall community composition. Benthic invertebrate taxonomic richness was highest at AQ02 in the Coffee Creek watershed (34 taxa), and lowest at the Independence Creek Kona tributary (18 taxa). Simpson's diversity values displayed similar patterns to those observed for taxonomic richness.

4.3 Fish and Fish Habitat:

Fish habitat quality was greatest in the mainstems of Coffee and Independence Creeks due to their large sizes, ample in-stream cover, and the presence of a wide variety of habitat types available including potential overwintering habitat. Good Arctic grayling summer feeding habitat was available in the lower reaches of Latte Creek. In Halfway Creek, there was marginal fish habitat for Arctic grayling available in the lower watershed (AQ20). YR24 was even smaller and steeper than Halfway Creek, with little to no pool habitat observed for fish rearing (*e.g*. water depths were generally less than 20cm). A high gradient barrier to fish passage was identified on upper YR24, just upstream of the aquatic site AQ31. Site AQ12 in the lower Kona tributary had much lower habitat quality than the mainstem of Independence Creek as water depths were low, and there were few pools noted for supporting fish feeding or rearing. Sites in the upper watersheds of Latte Creek (AQ04.5, AQ05, AQ06), Independence Kona tributary (AQ13), Halfway Creek (AQ21) and YR24 (AQ31) contained lower quality habitat for fish due to higher gradients, lack of deep pools, and many natural obstructions to fish passage. No fish were caught at these headwater sites using two sampling methods over two seasons (spring and summer), however one grayling was observed

at AQ04.5 in summer 2015. Latte Creek Tributary C, which intersects with the proposed south waste rock storage facility, was a small, shallow, medium gradient channel with low suitability for supporting Arctic grayling.

Slimy sculpin, juvenile Chinook salmon, and Arctic grayling were commonly found in fish-bearing project area streams. Currently, there are no known fish species at risk in the regional area of the Project. Juvenile Chinook salmon were present in the mainstems of Coffee Creek and Independence Creek, but were not captured in Latte Creek, Kona Tributary of Independence Creek, Halfway Creek, or YR24. Slimy sculpin overlapped juvenile Chinook salmon in distribution, but were also present at the downstream end of Latte Creek (AQ03), and at the mouth of YR24 (AQ30). Arctic grayling were captured at all sites, with the exception of YR24 (AQ30, AQ31), upper Halfway Creek (AQ21), upper Latte Creek (AQ05, AQ06), and upper Kona Tributary (AQ13). Site AQ04 on Latte Creek had the highest number of Arctic grayling captured, with a total catch of 70 sub-adult and adult grayling (>128mm). Two years in a row, sampling in lower Halfway Creek (AQ20) produced a single adult Arctic grayling. Low numbers of Arctic grayling were captured in the lower Kona Tributary site, AQ12. In 2014, a reference site was established near the mouth of Isaac Creek, which contained high numbers of juvenile Chinook salmon, slimy sculpin, and low numbers of juveniles from four other fish species. In 2015, low numbers of juvenile Chinook salmon, Arctic grayling, and slimy sculpin were captured at a second reference site located on Los Angeles Creek, approximately 6km upstream from the Yukon River.

Juvenile Chinook salmon were captured in high numbers along the mainstem of Coffee Creek upstream to its confluence with Latte Creek, however capture rates were much higher in summer 2014 (8-15x) than in summer 2015. For example, during the August 2014 sampling a total of 122 juvenile Chinook were caught using ten minnow traps set overnight at AQ00; 72 were caught at AQ01, and 62 were caught at AQ02. In the mainstem of Independence Creek lower numbers of juvenile Chinook salmon were captured in both 2014 and 2015. Catch per unit effort was slightly lower at all sites in October 2014, however, the presence of juvenile Chinook late in the season suggested that overwintering occurred at most sites in mainstem Coffee and Independence Creeks.

Slimy sculpin (n=37) samples were collected from AQ02, AQ03, AQ10, AQREF1, and AQREF2 for analyzing baseline metal concentrations in tissues. Mean estimated methylmercury concentrations exceeded the guideline for the protection of fish-eating (piscivorous) wildlife in all watersheds. Individual slimy scupin samples in Latte and Coffee Creeks also exceeded the human health guideline for subsistence consumers (0.2 mg/kg wet weight). No samples at any sites exceeded the maximum allowable level of mercury for sale guideline. Mean selenium concentrations in slimy sculpin tissues exceeded the selenium guidelines for the protection of freshwater aquatic life in all watersheds. Individual samples in Coffee, Independence, Isaac, and Los Angeles Creek exceeded the selenium human health guideline for high consumers of fish (1-2 samples per watershed/year). The human health selenium guidelines based on moderate and low fish diets were not exceeded by any individual slimy sculpin samples.

Arctic grayling (n=26) samples were collected from AQ00, AQ02, AQ03, AQ04, AQ11, and AQREF 2 for analyzing baseline metal concentrations in tissues. Mean estimated methylmercury concentrations exceeded the guideline for the protection of fish-eating (piscivorous) wildlife in all watersheds, but did not surpass Health Canada standards for mercury levels in fish. The mean selenium concentrations did not

surpass the human health guidelines for selenium with the exception of Independence Creek samples, which exceeded the lowest guideline, provided for high consumers of fish. In addition, approximately 33-38% of individual samples in all watersheds exceeded the lowest guideline provided for high consumers of fish, with the exception of Arctic grayling in Latte Creek, which were all below the guideline. The human health selenium guidelines based on moderate and low fish diets were not exceeded by any individual Arctic grayling samples.

Similar to results from previous years (Sparling 2001; Laberge and White Mountain 2002), no Chinook salmon were observed spawning in Coffee and Independence Creeks in 2014 or 2015. Results from the Arctic grayling spawning assessment on Latte Creek suggested that grayling likely spawned elsewhere prior to entering the creek for summer feeding. Stream temperatures were marginal at best for supporting spawning activities, and Arctic grayling behavior and gonadal development all indicated that the fish were in a "resting" maturity state.

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Appendix A

Review of Existing Fisheries and Aquatic Community Information, Coffee Gold Project, Yukon

PALMER ENVIRONMENTAL CONSULTING GROUP INC.

470 Granville Street, Suite 630, Vancouver, BC V6C 1V5 t 604-629-9075

June 5, 2014

Rory Kutluoglu
Kaminak Gold Corporation
1020 - 800 West Pender Street
Vancouver, British Columbia
V6C 2V6, Canada

Dear Mr. Kutluoglu,

Re: Review of Existing Fisheries and Aquatic Community Information, Coffee Gold Project, Yukon

Palmer Environmental Consulting Group (PECG) was retained by Kaminak Gold Corporation to identify and compile any existing fish and aquatic community (e.g., benthic invertebrate, periphyton) data within the Coffee Gold Project area. The purpose of the review was to determine if any existing data or noted data deficiencies could be incorporated into the baseline dataset and/or be used to guide the development of the baseline study design. A desktop review of pre-existing information was completed and consisted of environmental consultant aquatic study reports, government databases and reports, academic literature, salmon management advisory bodies (e.g., Yukon River Panel reports), and baseline data collected by PECG on upper Coffee Creek. Documents and databases which were found to include relevant information are listed below:

- Access Consulting Group. 2014. Memorandum: Kaminak Coffee 2013 Fisheries Summary Report. Prepared for Kaminak Gold Corporation, May 30, 2014.
- Fisheries and Oceans Canada. 2001. Yukon Fisheries Information Summary System (FISS) and Fish Sampling. Accessed April 2014 at http://cmnmaps.ca/fiss_yukon/.
- Laberge Environmental Services and White Mountain Environmental Consulting. 2002. Investigations into Fish Habitats of Selected Tributaries to the Yukon River between McGregor Creek and Coffee Creek 2000/2001. Prepared for Selkirk First Nation, August 2002.
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- PECG. 2013a. Casino Project Fish and Aquatic Resources Baseline Report, Prepared for Casino Mining Corporation, YT, November 12, 2013.
- PECG. 2013b. Casino Project: 2013 Aquatic Studies Technical Memo, Prepared for Casino Mining Corporation, YT, October 15, 2013. (Appendix F of PECG 2013a).

- Sparling, P., White Mountain Environmental Consulting, 2001. Fish Habitat and Utilization Assessment for 58 Tributaries to the Yukon River between McGregor and Coffee Creeks, July 2000. Prepared for Selkirk First Nation, February 2001.
- Yukon Placer Secretariat, 2010. Yukon Placer Fish Habitat Suitability Map – Yukon River South Watershed (Map 1 of 7) (Category A). Revised September 2010. Accessed April 2014 at http://www.yukonplacersecretariat.ca.

Furthermore, one additional report was referenced on the FISS database, but could not be accessed at this time:

- Duncan, J. 1997. Summary of Streams in the Tr'on dek Hwech'in Traditional Territory: A search for Candidate Streams to Support a Program based on a Klondike Area Central Incubation/Outplanting Facility. Prepared by Duncan Contracting.

Fish and Aquatic Resources Baseline Review Results:

1. Fish and Fish Habitat in Lower-Mid Coffee Creek

Fisheries sampling and aquatic habitat assessments were carried out in lower-mid Coffee Creek (Figures 1 and 2) during 2000 (Sparling 2001), 2001 (Laberge and White Mountain 2002), 2010 (Laberge and White Mountain 2012) and 2013 (Access 2014). A summary of the fish habitat assessment results, sampling effort, and fish catch are provided in Tables 1 and 2.

Just upstream of its confluence with the Yukon River, Coffee Creek had an average channel width of 25m (Figure 3, Table 1), and was noted to provide excellent fish habitat for a variety of fish species and life history stages (Sparling 2001). Habitat required for supporting overwintering and spawning activities were observed, such as deep pools and abundant gravel substrates. Fish sampling over multiple years demonstrated that lower Coffee Creek supported high abundances of juvenile Chinook salmon, as well as slimy sculpin, and Arctic grayling fry and juveniles (Table 2). Individual fish measurements were collected and reported for juvenile Chinook salmon and slimy sculpin in 2010 (Table 3).

During 2013, Coffee Creek was sampled with minnow traps at sites that ranged from 2-8 km upstream from the Yukon River (Figure 2, Table 2). High numbers of juvenile Chinook salmon were captured in late October at CC-0.5, with a CPUE of 13.7 fish/trap-day. Sampling in the adjacent western tributary (Site CC-3.5) yielded two juvenile Chinook salmon in August, with no fish caught in late July, September, or October. No fish were caught further downstream at site CC-4.5 in late July, August, or September, with only one juvenile Chinook salmon and one slimy sculpin captured in late October. The timing and size (mean length = 71 mm) of the captures from this study indicated that mid Coffee Creek was heavily used by 0+ juvenile Chinook salmon for overwintering.

Chinook salmon spawning surveys were conducted on Coffee Creek during field studies in 2000 and 2001 (Sparling 2001; Laberge and White Mountain 2002). The timing of both spawning surveys were decided in consultation with Fisheries and Oceans Canada (DFO). There was no evidence for Chinook salmon spawning in Coffee Creek during an aerial spawning survey completed on August 17, 2000 (Sparling 2001). Results from the 2001 study were not detailed in the report. Despite the lack of documented spawning observations, Selkirk First Nations elders reported that the river was a significant spawning location in the past (Laberge and White Mountain 2002).

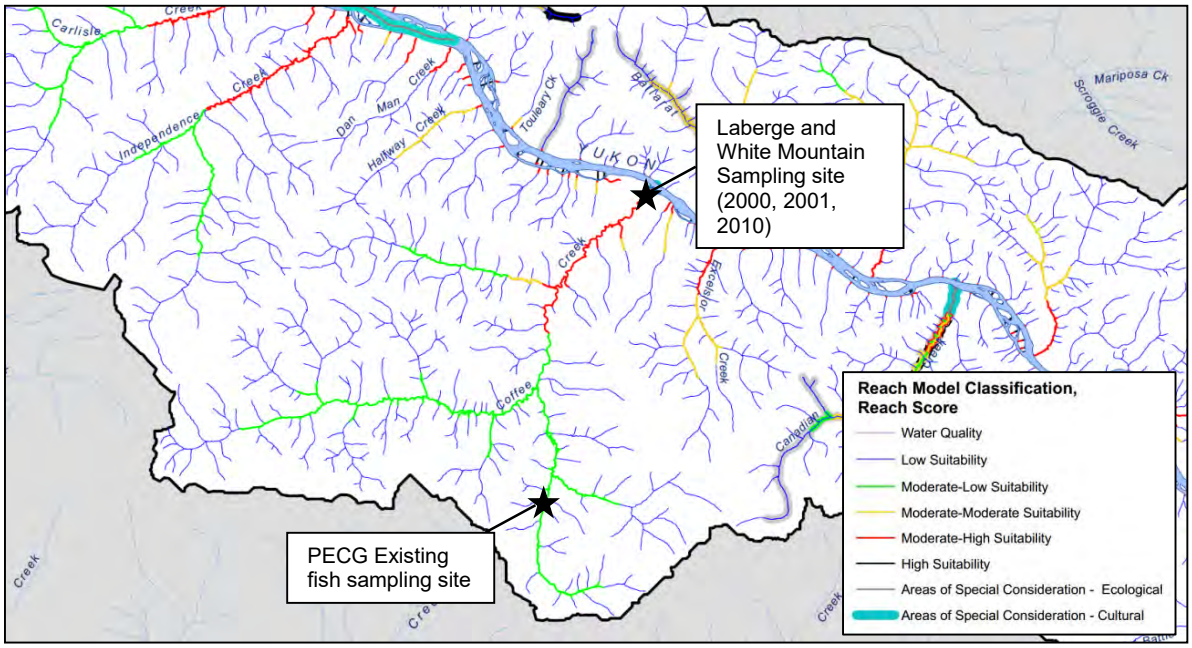

Figure 1. Excerpt of Coffee Project Study Area from Yukon Placer Fish Habitat Suitability Map – Yukon River South Watershed (Map 1 of 7). Black stars indicate fisheries sampling sites on Coffee Creek established by Laberge and White Mountain (2000, 2001, 2010) and PECG (2012-2013).

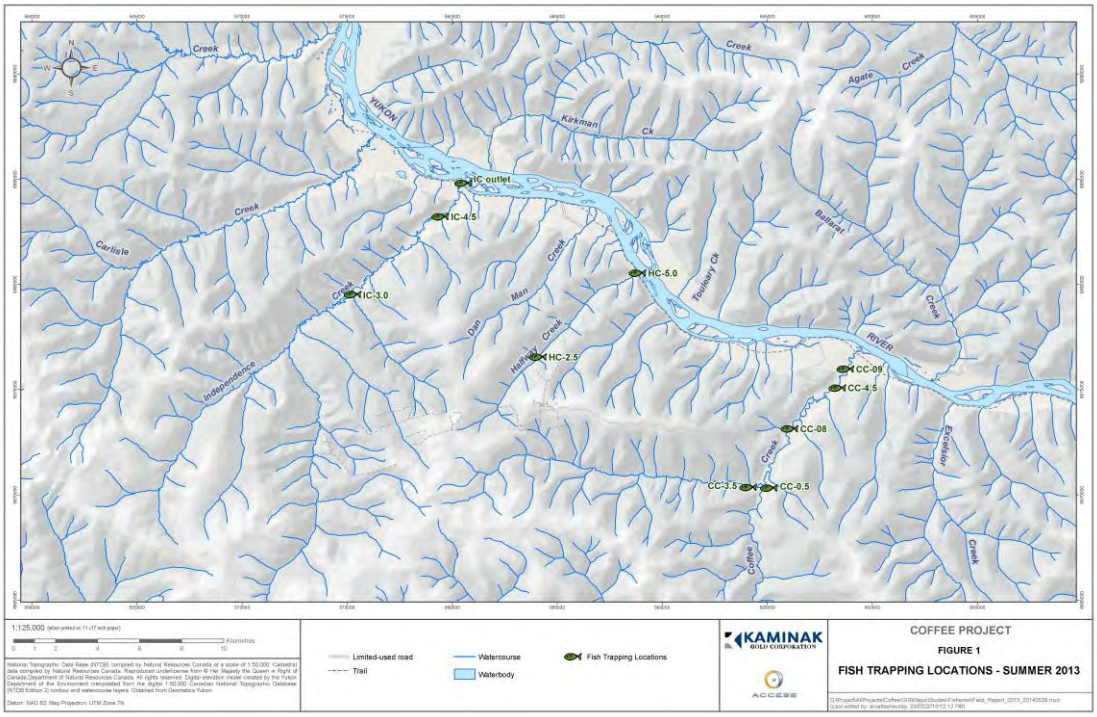

Figure 2. Fish Minnow Trapping Locations in the Coffee Project Study Area, Summer 2013 by Access Consulting



Figure 3. Lower Coffee Creek photo obtained from Laberge and White Mountain (2012)

Table 1. Fish Habitat Assessment Results from Sparling (2001) and Laberge and White Mountain (2012)

Date sampled	**July 27, 2000**	**July 28, 2001**	**August 3, 2010**
Average Channel Width	25m	-	24.7m
Wetted Width	-	-	11.4m
Average Depth	1m	-	-
Average Velocity	1 m/s	0.9 m/s	0.572 m/s
Discharge	36 m^3/s	15 m^3/s	-
Water temperature	5.6°C	7.6°C	10.8°C
Conductivity	-	76 µS/cm	126.8 µS/cm
Dissolved Oxygen	-	9.44 mg/L 78.2%	9.33 mg/L
Water quality CCME guideline exceedances	-	Extractable Copper[1]: July :0.0035 mg/L August: 0.0027 mg/L *Cu guideline: 0.002 mg/L*	Dissolved Copper: August: 0.00251 mg/L *Cu guideline: 0.002 mg/L*
Substrate	20% cobble, 60% gravel, 20% sand	20% cobble, 60% gravel, 20% sand	-
Morphology	50% run, 25% riffle, 25% pool	50% run, 25% riffle, 25% pool	Riffle, rapid, straight run and pool
Riparian vegetation	Willow, alder, poplar	-	Grasses, shrubs and deciduous, with deciduous dominant
Water clarity	"Coffee" coloured with some suspended solids	-	Total Suspended Solids: <4 mg/L Total Dissolved Solids: 110 mg/L Turbidity: 0.3 NTU

Notes: "-" =Not sampled, CCME=Canadian Council of Ministers of the Environment, [1]Methods for analyzing copper concentrations differed in 2001, see Laberge and White Mountain (2002)

Table 2: Summary of lower-mid Coffee Creek fish sampling effort and catch (Sparling 2001, Larberge and White Mountain 2002, 2012, Access 2014)

Date	Method	Effort	Catch	Comments
July 27, 2000	MT	14 traps for 24h	13 jcs/trap/24h, 8 CCG	Total catch of juvenile Chinook salmon not specified
July 27, 2000	Seine	7m x 1.5m, 1/8 inch oval weave mesh, pole seine in depths of <1.5m	CCG, GR	Catch numbers not reported
July 28, 2001	GN	2h	NFC	
July 28, 2001	EF	507s	8 jcs, 22 CCG	
July 28, 2001	Seine	4m x 6m x 3	3 CCG	
August 3, 2010	MT	8 traps overnight	32 jcs, 1 CCG	Soak time not specified
August 3, 2010	EF	633s	7 jcs, 24 CCG	
July 31 – Aug 1, 2013	MT	Trap-days: CC-0.5: 1.89 CC-3.5: 2.03 CC-4.5: 2.01	NFC	
Aug 21-22, 2013	MT	Trap-days: CC-0.5: 1.69 CC-3.5: 1.72 CC-4.5: 1.77	CC-0.5: 1 jcs CC-3.5: 2 jcs CC-4.5: NFC	
Sep 25-26, 2013	MT	Trap-days: CC-0.5: 2.00 CC-3.5: 2.11 CC-4.5: 2.24	CC-0.5: 8 jcs CC-3.5: 1 jcs CC-4.5: NFC	
Oct 28-29, 2013	MT	Trap-days: CC-0.5: 2.04 CC-3.5: 2.09 CC-4.5: 1.89	CC-0.5: 28 jcs CC-3.5: NFC CC-4.5: 1 jcs, 1 CCG	

Notes: MT=Minnow trap, GN=gill net, EF=electrofishing, jcs=juvenile Chinook salmon, CCG=slimy sculpin, GR=Arctic grayling, NFC=no fish caught

Table 3. Lower Coffee Creek individual length and weight measurements for juvenile Chinook salmon and slimy sculpin, August 2010 (Laberge and White Mountain 2012)

Species	Sample size	Mean Length (mm)	Length range (mm)	Mean Weight (g)	Weight range (g)
Chinook salmon	26	77.7	72-93	2.9	1.9-8
Slimy sculpin	18	62.2	40-82	1.97	0.4-3.4

2. Fish and Fish Habitat in Upper Coffee Creek

Baseline fisheries data on upper Coffee Creek is available from PECG (2013a), as a reference site was established there as part of the adjacent Casino Mine Project in 2012 (Figures 1 and 4). Two years of sampling at this site yielded a total of 12 Arctic grayling and one round whitefish at a rate of 0.8 fish per 100s of electrofishing effort. Arctic grayling lengths varied from 150-250mm, which suggested that the upper reach of Coffee Creek predominantly supported sub-adult and adult rearing. The single round whitefish captured was 265mm in length. A habitat assessment of the site was carried out in 2013, with detailed results reported in Appendix A4 of the 2013 Aquatic Studies Technical Memo (PECG 2013b). Briefly, the site was low gradient (2%) with a mean channel width of 3m, and followed a run-riffle sequence (Figure 4). Abundant overhanging vegetation and undercut banks provided good quality seasonal rearing habitat, however, a lack of deep pool habitat likely precluded fish overwintering. The bed substrate was dominated by large cobble and fines, suggesting a low potential for salmonid spawning activities.



Figure 4. Upstream view at PECG Reference Site on Upper Coffee Creek, July 2013

3. Yukon Placer Fish Habitat Suitability Maps

Based on the Yukon Placer Fish Habitat Suitability mapping, lower reaches of Coffee Creek were classified as **moderate-high** suitability and thus contain highly suitable habitat for juvenile Chinook salmon rearing, as well as high quality habitat for a broad range of adult and juvenile resident fish species (Figure 1). There was no Coffee Creek habitat designated as high suitability, which are defined as watercourses that provide spawning habitat for salmon or critical migratory corridors required to access salmon spawning areas. There is, however, a Cultural Area of Special Consideration located at the most downstream end of Coffee Creek. Cultural Areas of Special Consideration are watercourses that are identified by First Nations as containing culturally important fisheries or aquatic resources, and may also include anadromous (e.g., Chinook salmon) or non-anadromous fish production. Further upstream were areas of moderate-moderate suitability (yellow), moderate-low suitability (green), and low suitability (blue) (Figure 1). The Yukon Placer Secretariat defines these habitat types as:

- **Moderate-moderate** suitability habitats are defined as watercourses that are suitable for rearing juvenile Chinook salmon, although the habitat parameters and conditions are not as restricted as moderate-high suitability habitats within the watershed. These watercourses are also highly suitable for a broad range of adult and juvenile resident fish species.

- **Moderate-low** suitability habitats are defined as watercourses suitable for rearing juvenile Chinook salmon, although utilization may be limited at times due to environmental factors or conditions. These watercourses are typically highly suitable for non-anadromous resident fish species such as Arctic grayling.

- **Low** Habitat Suitability Watercourses (formally Freshwater Fisheries Production Zone) are areas within watercourses that are utilized by a variety of fish species and are typically relatively abundant within a watershed. As a function of gradient and distance from Chinook salmon production areas these streams are likely not utilized by rearing juvenile Chinook salmon, but may be highly suitable for and used by non-anadromous resident fish species.

4. Yukon Fisheries Information Summary System (FISS) Database

The Yukon FISS database was reviewed for determining previous fish studies or information relating to Coffee Creek. Notably, the database was last updated in 2001, and does not include any potential information gathered over the past 13 years. In addition to the work conducted by Laberge Environmental Services and White Mountain Environmental, the FISS database references the Yukon Placer Secretariat (Reference #800001), summarized above, and Duncan 1997 (Reference #DFO0016), which is not accessible for review at this time. Personal communications with Siegi Kriegl, a Fisheries Officer Fishery out of DFO Whitehorse were recorded in 1996 (Reference #11055), and indicated unconfirmed reports of chum salmon spawning in lower Coffee Creek, as well as an operational commercial fishery in the Yukon River off the mouth of Coffee Creek. Within the list of personal communications with Mr. Kriegl, there is also reference to Chinook salmon, and round whitefish, with no further details available (Reference

#11055). Also in 1996, personal communications with Nick De Graff from the Department of Renewable Resources, Yukon Territorial Government (Reference #11063), indicated that there was a First Nations fishery on Coffee Creek.

5. Benthic Invertebrates and Periphyton

Benthic invertebrate sampling on Coffee Creek was carried out in July 2001, and on August 3, 2010 (Laberge and White Mountain 2002, 2012). In 2001, sampling was conducted using a 300µm mesh surber sampler with an area of 0.0929 m^2. The benthic invertebrate community in Coffee Creek exhibited the lowest density (204 individuals/m^2) and diversity (14 taxon) of the eleven Yukon River tributaries sampled (Laberge and White Mountain 2002). In addition, the Coffee Creek benthic invertebrate community had the highest (61%) and lowest (19%) relative percentage of Ephemeroptera (mayflies) and Diptera (true flies), respectively.

The benthic invertebrate survey on Coffee Creek in 2010 employed a 363µm mesh kick-net and followed Canadian Aquatic Biomonitoring Network (CABIN) sampling protocols (Appendix D, Laberge and White Mountain 2012). In opposition to results from 2001, Lower Coffee Creek had the highest benthic invertebrate density of the 17 Yukon River tributaries sampled, with 9500 individuals/sample. The noted difference in benthic invertebrate density between 2001 and 2010 may be attributed to a change in community structure between the two time periods, or a difference in sampling methods (Page & Sylvestre 2006[1]). Taxa richness was moderate (18 taxa) and Simpson's diversity was high (0.85) relative to the other streams. Further, the number of sensitive EPT taxa present (15 taxa) was higher than 15 of the other tributaries sampled. Using the Yukon Reference Model which incorporates a database of 439 reference sites throughout the Yukon River drainage, Coffee Creek was determined to be a potentially stressed system and not in reference condition.

No existing information on primary producers (e.g., periphyton) in Coffee Creek was identified during this review.

6. Other watercourses:

Other watercourses within the potential project area include Halfway Creek, Dan Man Creek, and Independence Creek, which are located west of Coffee Creek and north (downslope) of the potential project activities (Figures 1 and 2). Minnow traps were deployed on Halfway and Independence Creeks during summer 2013 (Access 2014). Low numbers of juvenile Chinook salmon and slimy sculpin were captured at sites in Independence Creek, whereas a single Arctic grayling (length=125mm) was captured in Halfway Creek (Table 4). As only minnow traps were used, other fish sampling methods (e.g.,

[1] Page, N., and Sylvestre, S. 2006. Comparison of Two Benthic Invertebrate Sampling and Analysis Methods for Streams in Greater Vancouver. Available online at: http://www.raincoastappliedecology.ca/. (Accessed May 2014).

electrofishing, seining) are recommended for further characterizing the fish communities in these creeks. The presence of juvenile Chinook salmon in Independence Creek in late October suggested that some overwintering may occur in this system.

The Yukon Placer Fish Habitat classifications for the three creeks currently range from moderate-high to low suitability (Figure 1). In agreement with the minnow trapping results, Independence Creek contains the most moderate-high habitat which extends for several kilometers upstream of the Yukon River. Halfway Creek contains a short reach of moderate-high suitability habitat, followed by moderate-moderate suitability, and then low suitability. Based on the suitability mapping, Dan Man Creek appears to have the lowest quality habitat of the three watercourses.

Minimal information was available for these watercourses on the FISS database. Search results indicated that there was suspected Chinook salmon rearing in all three creeks, as well as suspected northern pike rearing in Independence Creek. No further information was identified or reviewed for these creeks.

Table 4: Summary of minnow trapping effort and catch on Independence and Halfway Creeks (Access 2014)

Date	Effort (trap-days)	Catch	Comments
June 12-13, 2013	IC-4.5: 2.10 IC Outlet: 1.97	IC-4.5: 1 CCG IC Outlet: 1 CCG	
July 31 – Aug 1, 2013	IC-4.5: 1.82 IC-3.0: 1.94 HC-5.0: 2.14 HC-2.5: 2.13	IC-4.5: NFC IC-3.0: NFC HC-5.0: 1 GR HC-2.5: NFC	At IC-3.0 traps were set in the main branch of Independence creek, near the helicopter landing pad, not on the tributary where the WQ stations is
Aug 21-22, 2013	IC-4.5: 1.64 IC-3.0: 2.41 HC-5.0: 1.68 HC-2.5: 1.75	IC-4.5: 4 jcs IC-3.0: NFC HC-5.0: NFC HC-2.5: NFC	
Sep 25-26, 2013	IC-4.5: 1.96 IC-3.0: 2.32 HC-5.0: 1.78 HC-2.5: 1.41	IC-4.5: 2 jcs IC-3.0: 1 jcs HC-5.0: NFC HC-2.5: NFC	
Oct 28-29, 2013	IC-4.5: 1.82 IC-3.0: 1.77 HC-5.0: 2.13 HC-2.5: 2.04	IC-4.5: 1 jcs IC-3.0: 1 jcs HC-5.0: NFC HC-2.5: NFC	

Notes: jcs=juvenile Chinook salmon, CCG=slimy sculpin, GR=Arctic grayling, NFC=no fish caught

June 5, 2014

Rory Kutluoglu
Kaminak Gold Corporation

If there are any questions or comments on this report, then please contact the undersigned. Thank you for the opportunity to work with you on this project.

Yours truly,

Palmer Environmental Consulting Group Inc.

[signature redacted]

Rick Palmer, M.Sc., R.P. Bio
President, Senior Fisheries Biologist

Appendix B

Sediment Quality

- **B1. Sediment Quality Data, Coffee Gold Project, 2014-2015**
- **B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015**

Appendix B1. Sediment quality data, Coffee Gold Project, 2014-2015

Method	Analyte	Units	RDL	CCME guideline		AQ11-1	AQ11-PSD	AQ11-2	AQ11-3	AQ11-3R	AQ20-1	AQ20-PSD	AQ20-2	AQ20-3	AQ04-1	AQ04-PSD	AQ04-2	AQ04-3	AQ04-3R	AQREF1-1
				ISQG	PEL	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	28-Aug-14
General Parameters	Carbon, Total Organic	% dry	0.05	n/a	n/a	4.22		2.39	2.83	3.34	6.01		4.67	4.92	3.63		4.41	5.1	4.01	1.93
General Parameters	Moisture	% wet	0.1	n/a	n/a	56.8		50.1	44.9	56.6	74.6		59.1	69.9	60.4		60.9	NS	NS	64.4
General Parameters	pH	pH units	0.1	n/a	n/a	7.1		7.1	7.2	5.8	7.6		7.4	7.5	7.6		7.2	7.6	7.8	5.9
Fertility / Nutrient Parameters	Nitrogen, Ammonia as N, Available	mg/kg dry	1	n/a	n/a	2.9		2	2	2	4		2.5	3.3	1.3		10	10	10	1.3
Fertility / Nutrient Parameters	Nitrogen, Nitrate as N, Available	mg/kg dry	1	n/a	n/a	4.6		2.3	2.1	3.9	4.3		1.4	1.1	1.6		8	1.4	3.4	1.1
Fertility / Nutrient Parameters	Phosphorus, Available	mg/kg dry	2	n/a	n/a	8		5	5	4	6		5	5	5		11	7	6	6
Particle Size Distribution	> 80 mm	%	0.1	n/a	n/a		<0.1					<0.1				<0.1				
Particle Size Distribution	> 56 mm	%	0.1	n/a	n/a		<0.1					<0.1				<0.1				
Particle Size Distribution	> 40 mm	%	0.1	n/a	n/a		<0.1					<0.1				<0.1				
Particle Size Distribution	> 25 mm	%	0.1	n/a	n/a		<0.1					<0.1				<0.1				
Particle Size Distribution	> 19 mm	%	0.1	n/a	n/a		<0.1					<0.1				<0.1				
Particle Size Distribution	> 12.5 mm	%	0.1	n/a	n/a		<0.1					<0.1				<0.1				
Particle Size Distribution	> 4.75 mm	%	0.1	n/a	n/a		<0.1					<0.1				<0.1				
Particle Size Distribution	> 2.36 mm	%	0.1	n/a	n/a		1.7					0.1				2.7				
Particle Size Distribution	> 2.0 mm	%	0.1	n/a	n/a		0.8					<0.1				1.3				
Particle Size Distribution	> 1.18 mm	%	0.1	n/a	n/a		4.1					1.9				9.4				
Particle Size Distribution	> 600 µm	%	0.1	n/a	n/a		6.2					4.3				17.7				
Particle Size Distribution	> 425 µm	%	0.1	n/a	n/a		5.5					2.7				6.8				
Particle Size Distribution	> 300 µm	%	0.1	n/a	n/a		9.8					4				6.4				
Particle Size Distribution	> 150 µm	%	0.1	n/a	n/a		20.7					12.7				13.9				
Particle Size Distribution	> 75 µm	%	0.1	n/a	n/a		16.2					16.7				13.5				
Particle Size Distribution	< 75 µm	%	0.1	n/a	n/a		34.9					57.5				28.4				
Exchangeable Ions	Calcium, Available	mg/kg dry	5	n/a	n/a	2700		2600	2500	2300	5500		4200	5500	1800		4750	2170	2670	1400
Exchangeable Ions	Magnesium, Available	mg/kg dry	5	n/a	n/a	360		315	310	275	630		525	580	200		500	300	333	220
Exchangeable Ions	Potassium, Available	mg/kg dry	5	n/a	n/a	77		73	76	61	118		69	113	56		133	102	102	39
Exchangeable Ions	Sodium, Available	mg/kg dry	5	n/a	n/a	27		26	49	24	36		34	39	17		93	43	25	17
Strong Acid Leachable Metals	Aluminum	mg/kg dry	20	n/a	n/a	21200		19200	19200	19100	17100		16000	17300	20100		27500	19200	20200	16600
Strong Acid Leachable Metals	Antimony	mg/kg dry	0.1	n/a	n/a	0.8		0.7	0.7	0.8	0.8		1	0.9	0.6		0.9	0.7	0.6	1.4
Strong Acid Leachable Metals	Arsenic	mg/kg dry	0.4	5.9	17	14.2		15.1	13.1	14.5	13		11.2	14.2	12.3		19.5	12.5	12.8	13.5
Strong Acid Leachable Metals	Barium	mg/kg dry	1	n/a	n/a	194		169	172	178	189		159	185	174		240	184	183	380
Strong Acid Leachable Metals	Beryllium	mg/kg dry	0.1	n/a	n/a	0.5		0.5	0.5	0.6	0.4		0.5	0.7	0.7		1.4	0.8	0.7	0.5
Strong Acid Leachable Metals	Bismuth	mg/kg dry	0.1	n/a	n/a	0.2		0.3	0.2	0.2	0.1		0.3	0.1	0.1		0.2	0.2	0.2	0.2
Strong Acid Leachable Metals	Boron	mg/kg dry	2	n/a	n/a	3		2	2	2	3		2	3	2		4	2	2	2
Strong Acid Leachable Metals	Cadmium	mg/kg dry	0.04	0.6	3.5	0.33		0.24	0.38	0.44	0.2		0.13	0.2	0.31		0.46	0.39	0.39	0.57
Strong Acid Leachable Metals	Calcium	mg/kg dry	100	n/a	n/a	7860		6510	7030	7220	8340		7430	8220	7060		11100	8380	8430	8190
Strong Acid Leachable Metals	Chromium	mg/kg dry	1	37.3	90	42.1		37.4	35.4	35.5	36.7		36.2	35.7	33.1		45.9	32.6	32.1	30.3
Strong Acid Leachable Metals	Cobalt	mg/kg dry	0.1	n/a	n/a	12.2		11.3	11.4	11.5	10.7		8.9	10.8	10.7		12.1	11.8	12.1	10.1
Strong Acid Leachable Metals	Copper	mg/kg dry	0.2	35.7	197	21.8		19.3	19.2	20.6	19.2		18.4	20.1	18.8		32.5	20.7	19.7	24.5
Strong Acid Leachable Metals	Iron	mg/kg dry	20	n/a	n/a	28100		28800	26900	27800	23900		22300	23500	26300		32400	25700	25400	26400
Strong Acid Leachable Metals	Lead	mg/kg dry	0.2	35	91.3	10.2		12.2	10.1	11.2	7.4		7.9	7.5	11.4		13.5	12.3	12.3	9.3
Strong Acid Leachable Metals	Lithium	mg/kg dry	0.1	n/a	n/a	14.9		14.6	14.8	15.9	12.4		11.7	13.3	15.5		23.4	19	19.8	11.5
Strong Acid Leachable Metals	Magnesium	mg/kg dry	10	n/a	n/a	8210		7620	7050	6870	6750		6650	6780	6520		7570	5970	5570	7830
Strong Acid Leachable Metals	Manganese	mg/kg dry	0.4	n/a	n/a	704		511	656	680	650		294	516	771		711	697	712	353
Strong Acid Leachable Metals	Mercury	mg/kg dry	0.05	0.17	0.486	0.07		<0.05	0.07	0.06	0.05		<0.05	0.07	0.1		0.23	0.14	0.15	0.07
Strong Acid Leachable Metals	Molybdenum	mg/kg dry	0.1	n/a	n/a	0.8		1.1	0.8	0.9	0.5		0.5	0.5	0.6		0.9	0.7	0.6	0.8
Strong Acid Leachable Metals	Nickel	mg/kg dry	0.4	n/a	n/a	26.6		23.1	24	24.7	24.3		22.5	24.2	23		35.9	24.6	23.9	23.8
Strong Acid Leachable Metals	Phosphorus	mg/kg dry	10	n/a	n/a	703		685	735	752	681		678	727	611		926	597	600	978
Strong Acid Leachable Metals	Potassium	mg/kg dry	10	n/a	n/a	1680		1530	1360	1330	1430		1310	1350	1280		1860	1270	1180	1340
Strong Acid Leachable Metals	Selenium	mg/kg dry	0.5	n/a	n/a	0.6		0.5	0.7	0.7	0.6		<0.5	0.7	0.9		2.4	1.5	1.3	0.8
Strong Acid Leachable Metals	Silicon	mg/kg dry	3000	n/a	n/a	<3000		<3000	<3000	<3000	<3000		<3000	<3000	<3000		<3000	<3000	<3000	<3000
Strong Acid Leachable Metals	Silver	mg/kg dry	0.2	n/a	n/a	<0.2		<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2
Strong Acid Leachable Metals	Sodium	mg/kg dry	40	n/a	n/a	396		385	367	342	314		287	317	303		308	246	279	328
Strong Acid Leachable Metals	Strontium	mg/kg dry	0.2	n/a	n/a	55.3		44.7	48.2	51.5	81.3		69.9	78.3	70.6		115	81.3	80.5	64.4
Strong Acid Leachable Metals	Sulfur	mg/kg dry	1000	n/a	n/a	<1000		<1000	<1000	<1000	<1000		<1000	<1000	<1000		1500	<1000	<1000	1100
Strong Acid Leachable Metals	Tellurium	mg/kg dry	0.1	n/a	n/a	<0.1		<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1
Strong Acid Leachable Metals	Thallium	mg/kg dry	0.1	n/a	n/a	0.2		0.2	0.2	0.2	0.2		0.1	0.2	0.2		0.2	0.2	0.2	0.2
Strong Acid Leachable Metals	Thorium	mg/kg dry	0.5	n/a	n/a	9.1		9.5	8.9	9.2	8.3		8.2	8.5	13		22.3	14.6	14.8	8.2
Strong Acid Leachable Metals	Tin	mg/kg dry	0.2	n/a	n/a	0.8		0.7	0.9	0.7	0.6		0.7	0.6	0.6		1.2	0.6	0.8	0.7
Strong Acid Leachable Metals	Titanium	mg/kg dry	2	n/a	n/a	1360		1400	1260	1150	1030		920	973	1060		935	891	891	809
Strong Acid Leachable Metals	Uranium	mg/kg dry	0.1	n/a	n/a	7.9		6.4	9	11.4	13.4		14.3	11.3	6.7		13.2	10.1	12.9	5.1
Strong Acid Leachable Metals	Vanadium	mg/kg dry	0.4	n/a	n/a	61.6		67.4	60.9	60.8	47.7		45.4	47.3	53.7		53.5	45.3	46.7	59.2
Strong Acid Leachable Metals	Zinc	mg/kg dry	2	123	315	86		73	85	92	65		62	63	86		118	88	95	88
Strong Acid Leachable Metals	Zirconium	mg/kg dry	2	n/a	n/a	5		5	4	4	3		3	3	3		5	4	4	3

Notes: CCME guidelines include: ISQG= interim sediment quality guideline, PEL=probable effect levels
PSD=Particle Size Distribution, R=Field Split, RDL=Reported Detection Limit

Exceedances

ISQG
ISQG and PEL

Appendix B1. Sediment quality data, Coffee Gold Project, 2014-2015

Method	Analyte	Units	RDL	CCME guideline		AQREF1-PSD	AQREF1-2	AQREF1-3	AQ00-1	AQ00-PSD	AQ00-2	AQ00-3	AQ02-1	AQ02-PSD	AQ02-2	AQ02-3	AQ05-1	AQ05-PSD	AQ05-2	AQ05-3
				ISQG	PEL	28-Aug-14	28-Aug-14	28-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	30-Aug-14	30-Aug-14	30-Aug-14	30-Aug-14
General Parameters	Carbon, Total Organic	% dry	0.05	n/a	n/a		2.25	2.6	2.97		3.63	4.67	3.51		2.58	7.08	6.12		5.99	7
General Parameters	Moisture	% wet	0.1	n/a	n/a		32.7	62.1	61.8		54.3	68.3	54.8		58.6	74.5	NS	NS	NS	NS
General Parameters	pH	pH units	0.1	n/a	n/a		7.1	6.8	7		7	7.3	7.2		7.3	7.2	5.7		6.8	6.9
Fertility / Nutrient Parameters	Nitrogen, Ammonia as N, Available	mg/kg dry	1	n/a	n/a		1.3	1.3	1.3		1.3	2.5	2		2	2	5		<1.0	10
Fertility / Nutrient Parameters	Nitrogen, Nitrate as N, Available	mg/kg dry	1	n/a	n/a		<1.0	<1.0	<1.0		1.2	2.6	1.1		1.1	<1.0	9.7		1.5	13
Fertility / Nutrient Parameters	Phosphorus, Available	mg/kg dry	2	n/a	n/a		3	4	4		4	5	5		4	4	5		5	6
Particle Size Distribution	> 80 mm	%	0.1	n/a	n/a	<0.1				<0.1				<0.1				<0.1		
Particle Size Distribution	> 56 mm	%	0.1	n/a	n/a	<0.1				<0.1				<0.1				<0.1		
Particle Size Distribution	> 40 mm	%	0.1	n/a	n/a	<0.1				<0.1				<0.1				<0.1		
Particle Size Distribution	> 25 mm	%	0.1	n/a	n/a	<0.1				<0.1				<0.1				<0.1		
Particle Size Distribution	> 19 mm	%	0.1	n/a	n/a	<0.1				<0.1				<0.1				<0.1		
Particle Size Distribution	> 12.5 mm	%	0.1	n/a	n/a	<0.1				<0.1				<0.1				<0.1		
Particle Size Distribution	> 4.75 mm	%	0.1	n/a	n/a	<0.1				<0.1				<0.1				<0.1		
Particle Size Distribution	> 2.36 mm	%	0.1	n/a	n/a	0.1				0.1				2.7				7.2		
Particle Size Distribution	> 2.0 mm	%	0.1	n/a	n/a	<0.1				<0.1				0.5				1		
Particle Size Distribution	> 1.18 mm	%	0.1	n/a	n/a	0.7				1				2.6				5.4		
Particle Size Distribution	> 600 µm	%	0.1	n/a	n/a	2.1				2.2				5.1				13.4		
Particle Size Distribution	> 425 µm	%	0.1	n/a	n/a	2				2.2				2.4				8.3		
Particle Size Distribution	> 300 µm	%	0.1	n/a	n/a	5.4				6.3				6				8.3		
Particle Size Distribution	> 150 µm	%	0.1	n/a	n/a	34.6				24				17.2				13.2		
Particle Size Distribution	> 75 µm	%	0.1	n/a	n/a	31.7				22.3				16.2				10.1		
Particle Size Distribution	< 75 µm	%	0.1	n/a	n/a	23.3				41.8				47.3				33.2		
Exchangeable Ions	Calcium, Available	mg/kg dry	5	n/a	n/a		800	900	2100		2500	4000	2100		2500	5000	2500		1050	3750
Exchangeable Ions	Magnesium, Available	mg/kg dry	5	n/a	n/a		110	155	310		430	520	295		330	630	267		150	475
Exchangeable Ions	Potassium, Available	mg/kg dry	5	n/a	n/a		27	24	57		127	114	59		83	72	192		38	183
Exchangeable Ions	Sodium, Available	mg/kg dry	5	n/a	n/a		15	19	21		36	47	27		21	30	37		21	50
Strong Acid Leachable Metals	Aluminum	mg/kg dry	20	n/a	n/a		11600	17100	18800		19600	21500	19400		17800	15800	20600		16500	20300
Strong Acid Leachable Metals	Antimony	mg/kg dry	0.1	n/a	n/a		1.4	2	0.7		0.5	0.7	0.6		0.5	0.7	0.8		0.7	0.8
Strong Acid Leachable Metals	Arsenic	mg/kg dry	0.4	5.9	17		17.3	25.8	8.8		7.4	11.1	9.4		6.8	11.3	21.3		20	28
Strong Acid Leachable Metals	Barium	mg/kg dry	1	n/a	n/a		267	469	193		192	219	205		175	295	176		225	177
Strong Acid Leachable Metals	Beryllium	mg/kg dry	0.1	n/a	n/a		0.4	0.5	0.5		0.3	0.4	0.4		0.3	0.7	0.8		0.7	1.1
Strong Acid Leachable Metals	Bismuth	mg/kg dry	0.1	n/a	n/a		0.1	0.7	0.2		0.2	0.2	0.2		0.1	0.2	0.2		0.2	0.2
Strong Acid Leachable Metals	Boron	mg/kg dry	2	n/a	n/a		<2	2	<2		<2	2	<2		<2	2	2		<2	2
Strong Acid Leachable Metals	Cadmium	mg/kg dry	0.04	0.6	3.5		0.31	0.65	0.22		0.23	0.25	0.26		0.2	1.3	0.58		0.42	0.56
Strong Acid Leachable Metals	Calcium	mg/kg dry	100	n/a	n/a		4680	8270	6560		6310	7280	7100		6190	11400	6000		5770	7120
Strong Acid Leachable Metals	Chromium	mg/kg dry	1	37.3	90		20.5	31.2	32.6		32.7	38.7	33.6		30.4	32.4	32.1		31.4	32.5
Strong Acid Leachable Metals	Cobalt	mg/kg dry	0.1	n/a	n/a		8.3	11.8	10.1		10.9	10.9	11.1		9.3	9.5	13.7		22.4	12.3
Strong Acid Leachable Metals	Copper	mg/kg dry	0.2	35.7	197		15.3	25.1	23.3		21.5	26.1	22.3		17.7	58.3	18.4		15.2	22.6
Strong Acid Leachable Metals	Iron	mg/kg dry	20	n/a	n/a		23100	31800	25800		27400	28800	28100		24800	24600	29600		27400	29200
Strong Acid Leachable Metals	Lead	mg/kg dry	0.2	35	91.3		8	12.2	8.4		6.7	8.9	7.6		6.4	8.7	14.4		13.8	13.4
Strong Acid Leachable Metals	Lithium	mg/kg dry	0.1	n/a	n/a		8.3	11.3	12.5		11.9	16.1	12.2		11.4	7.1	21.3		13.9	24.3
Strong Acid Leachable Metals	Magnesium	mg/kg dry	10	n/a	n/a		5700	7880	7340		7660	8250	7460		6730	5450	5030		5410	5150
Strong Acid Leachable Metals	Manganese	mg/kg dry	0.4	n/a	n/a		482	767	320		567	374	616		453	615	1030		4140	1050
Strong Acid Leachable Metals	Mercury	mg/kg dry	0.05	0.17	0.486		<0.05	0.05	0.08		0.06	0.08	0.07		0.05	0.05	0.17		0.11	0.17
Strong Acid Leachable Metals	Molybdenum	mg/kg dry	0.1	n/a	n/a		0.8	1.2	0.9		0.8	1.1	0.9		0.7	1	0.8		1.1	0.9
Strong Acid Leachable Metals	Nickel	mg/kg dry	0.4	n/a	n/a		14.5	23.1	20.8		20.4	26.1	21.4		19	37.4	21.3		20	22.7
Strong Acid Leachable Metals	Phosphorus	mg/kg dry	10	n/a	n/a		727	1200	721		667	730	788		698	625	602		568	624
Strong Acid Leachable Metals	Potassium	mg/kg dry	10	n/a	n/a		1360	1480	1400		1420	1610	1400		1230	1190	904		941	899
Strong Acid Leachable Metals	Selenium	mg/kg dry	0.5	n/a	n/a		<0.5	0.7	0.5		0.5	0.7	<0.5		<0.5	0.6	1		0.7	1.3
Strong Acid Leachable Metals	Silicon	mg/kg dry	3000	n/a	n/a		<3000	<3000	<3000		<3000	<3000	<3000		<3000	<3000	<3000		<3000	<3000
Strong Acid Leachable Metals	Silver	mg/kg dry	0.2	n/a	n/a		<0.2	<0.2	<0.2		<0.2	<0.2	<0.2		<0.2	<0.2	<0.2		<0.2	<0.2
Strong Acid Leachable Metals	Sodium	mg/kg dry	40	n/a	n/a		230	315	355		365	410	392		382	387	260		246	240
Strong Acid Leachable Metals	Strontium	mg/kg dry	0.2	n/a	n/a		40.5	63.2	45.9		45.4	53.9	50.1		44.6	89	46.9		44.7	59.3
Strong Acid Leachable Metals	Sulfur	mg/kg dry	1000	n/a	n/a		<1000	<1000	<1000		<1000	<1000	<1000		<1000	1200	1200		<1000	<1000
Strong Acid Leachable Metals	Tellurium	mg/kg dry	0.1	n/a	n/a		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1		<0.1	<0.1	<0.1		<0.1	<0.1
Strong Acid Leachable Metals	Thallium	mg/kg dry	0.1	n/a	n/a		0.1	0.2	0.2		0.2	0.2	0.2		0.2	0.2	0.3		0.3	0.2
Strong Acid Leachable Metals	Thorium	mg/kg dry	0.5	n/a	n/a		6.2	9.6	8.4		6.2	9.5	7.5		6.6	7.1	14.7		12.2	15.8
Strong Acid Leachable Metals	Tin	mg/kg dry	0.2	n/a	n/a		1.1	1	0.6		0.6	0.6	0.6		0.6	0.6	0.8		0.8	1.5
Strong Acid Leachable Metals	Titanium	mg/kg dry	2	n/a	n/a		683	838	1050		1120	1060	1140		1130	668	894		920	758
Strong Acid Leachable Metals	Uranium	mg/kg dry	0.1	n/a	n/a		3.4	5.5	17		13.2	24.4	13.5		11.4	51.4	20.8		10.8	26.7
Strong Acid Leachable Metals	Vanadium	mg/kg dry	0.4	n/a	n/a		51.9	70.9	61.2		63.8	63.6	66.1		58.9	49.1	55.3		56.6	56.6
Strong Acid Leachable Metals	Zinc	mg/kg dry	2	123	315		62	101	72		71	81	71		62	82	108		79	111
Strong Acid Leachable Metals	Zirconium	mg/kg dry	2	n/a	n/a		<2	3	4		3	4	4		4	4	5		3	3

Notes: CCME guidelines include: ISQG= interim sediment quality guideline, PEL=probable effect levels
PSD=Particle Size Distribution, R=Field Split, RDL=Reported Detection Limit

Exceedances

ISQG
ISQG and PEL

Appendix B1. Sediment quality data, Coffee Gold Project, 2014-2015

Method	Analyte	Units	RDL	CCME guideline		AQ13-1	AQ13-PSD	AQ13-2	AQ13-2R	AQ13-3	AQ10-1	AQ10-PSD	AQ10-2	AQ10-3	AQ10-3R	AQ30-1	AQ30-PSD	AQ30-2	AQ30-3	AQ30-3R
				ISQG	PEL	30-Aug-14	30-Aug-14	30-Aug-14	30-Aug-14	30-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14	29-Aug-14
General Parameters	Carbon, Total Organic	% dry	0.05	n/a	n/a	4.87		5.17	4.34	4.2	3.49		2.74	2.34	3.12	4.37		13	4.88	6.26
General Parameters	Moisture	% wet	0.1	n/a	n/a	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General Parameters	pH	pH units	0.1	n/a	n/a	6.9		6.6	6.8	6.4	7.1		6.9	7.2	7.1	6.8		6.4	6.8	6.7
Fertility / Nutrient Parameters	Nitrogen, Ammonia as N, Available	mg/kg dry	1	n/a	n/a	<1.0		<1.0	<1.0	<1.0	4		6	6	8	4		8	5	7
Fertility / Nutrient Parameters	Nitrogen, Nitrate as N, Available	mg/kg dry	1	n/a	n/a	1.1		1.2	1.4	3.1	2.1		2.4	2.2	2.7	1.6		1.1	1.5	1.8
Fertility / Nutrient Parameters	Phosphorus, Available	mg/kg dry	2	n/a	n/a	6		10	9	7	4		4	3	2	6		15	6	7
Particle Size Distribution	> 80 mm	%	0.1	n/a	n/a		<0.1					<0.1					<0.1			
Particle Size Distribution	> 56 mm	%	0.1	n/a	n/a		<0.1					<0.1					<0.1			
Particle Size Distribution	> 40 mm	%	0.1	n/a	n/a		<0.1					<0.1					<0.1			
Particle Size Distribution	> 25 mm	%	0.1	n/a	n/a		<0.1					<0.1					<0.1			
Particle Size Distribution	> 19 mm	%	0.1	n/a	n/a		<0.1					<0.1					<0.1			
Particle Size Distribution	> 12.5 mm	%	0.1	n/a	n/a		<0.1					<0.1					<0.1			
Particle Size Distribution	> 4.75 mm	%	0.1	n/a	n/a		<0.1					<0.1					<0.1			
Particle Size Distribution	> 2.36 mm	%	0.1	n/a	n/a		1.6					0.2					4.7			
Particle Size Distribution	> 2.0 mm	%	0.1	n/a	n/a		0.7					0.2					1			
Particle Size Distribution	> 1.18 mm	%	0.1	n/a	n/a		3.3					1.9					2.7			
Particle Size Distribution	> 600 µm	%	0.1	n/a	n/a		7.4					6.3					7.7			
Particle Size Distribution	> 425 µm	%	0.1	n/a	n/a		5.9					8.2					7.4			
Particle Size Distribution	> 300 µm	%	0.1	n/a	n/a		7.4					13.4					10.2			
Particle Size Distribution	> 150 µm	%	0.1	n/a	n/a		17.7					24.3					30.5			
Particle Size Distribution	> 75 µm	%	0.1	n/a	n/a		18.9					14.7					14			
Particle Size Distribution	< 75 µm	%	0.1	n/a	n/a		37.1					30.7					21.8			
Exchangeable Ions	Calcium, Available	mg/kg dry	5	n/a	n/a	4200		3650	3700	3400	2000		2000	2500	2500	3550		3100	4700	4500
Exchangeable Ions	Magnesium, Available	mg/kg dry	5	n/a	n/a	225		200	230	180	255		260	360	360	275		310	385	410
Exchangeable Ions	Potassium, Available	mg/kg dry	5	n/a	n/a	104		91	114	130	78		70	111	121	57		79	71	94
Exchangeable Ions	Sodium, Available	mg/kg dry	5	n/a	n/a	27		29	26	19	26		20	55	27	25		42	29	30
Strong Acid Leachable Metals	Aluminum	mg/kg dry	20	n/a	n/a	19900		19300	19200	19700	17900		16100	17800	18900	14700		13400	15100	15100
Strong Acid Leachable Metals	Antimony	mg/kg dry	0.1	n/a	n/a	0.6		0.6	0.6	0.7	0.7		0.7	0.7	0.7	1		1.1	1.3	1.3
Strong Acid Leachable Metals	Arsenic	mg/kg dry	0.4	5.9	17	25.5		21.5	23.9	24.6	16.2		16.3	12.7	13.7	10.7		12.9	14.6	15.5
Strong Acid Leachable Metals	Barium	mg/kg dry	1	n/a	n/a	149		151	149	154	199		165	180	192	198		197	202	211
Strong Acid Leachable Metals	Beryllium	mg/kg dry	0.1	n/a	n/a	0.8		0.7	0.8	0.7	0.5		0.6	0.6	0.7	0.6		0.6	0.7	0.6
Strong Acid Leachable Metals	Bismuth	mg/kg dry	0.1	n/a	n/a	0.3		0.2	0.3	0.3	0.2		0.2	0.2	0.2	0.2		0.2	0.2	0.3
Strong Acid Leachable Metals	Boron	mg/kg dry	2	n/a	n/a	<2		<2	2	<2	2		2	2	3	2		2	2	2
Strong Acid Leachable Metals	Cadmium	mg/kg dry	0.04	0.6	3.5	0.17		0.19	0.16	0.15	0.51		0.27	0.35	0.34	0.23		0.3	0.21	0.21
Strong Acid Leachable Metals	Calcium	mg/kg dry	100	n/a	n/a	7660		7460	7480	7920	7760		6790	6980	7210	7930		9770	7970	8330
Strong Acid Leachable Metals	Chromium	mg/kg dry	1	37.3	90	56.9		51.8	54.3	60.1	35.9		34.4	35.8	38.1	30.9		26.8	31.3	31
Strong Acid Leachable Metals	Cobalt	mg/kg dry	0.1	n/a	n/a	11.8		11.3	11.2	12.1	12.4		10.7	11.4	11.8	9.7		10.3	10.2	10.4
Strong Acid Leachable Metals	Copper	mg/kg dry	0.2	35.7	197	21		19.5	19.9	21.8	22.6		19.4	18.7	20	17.8		20.9	19.9	20.6
Strong Acid Leachable Metals	Iron	mg/kg dry	20	n/a	n/a	26000		25100	24900	26300	27700		25000	26800	28200	23400		21900	24600	24900
Strong Acid Leachable Metals	Lead	mg/kg dry	0.2	35	91.3	9.5		10.2	9.7	9.1	12.5		11.4	11.8	12.2	12.6		12.5	12.4	13
Strong Acid Leachable Metals	Lithium	mg/kg dry	0.1	n/a	n/a	16.1		14.6	14.3	14.7	19.2		16.5	19.5	21	11.7		10.3	12.9	12.5
Strong Acid Leachable Metals	Magnesium	mg/kg dry	10	n/a	n/a	8050		7290	7590	8050	6430		6410	6540	6920	5670		5140	5920	5920
Strong Acid Leachable Metals	Manganese	mg/kg dry	0.4	n/a	n/a	540		632	558	520	776		498	615	595	518		698	544	585
Strong Acid Leachable Metals	Mercury	mg/kg dry	0.05	0.17	0.486	0.06		0.07	0.06	0.08	0.11		0.06	0.07	0.08	0.06		0.06	0.1	0.07
Strong Acid Leachable Metals	Molybdenum	mg/kg dry	0.1	n/a	n/a	0.6		0.6	0.6	0.6	0.9		0.8	0.8	0.8	0.8		0.9	0.9	0.9
Strong Acid Leachable Metals	Nickel	mg/kg dry	0.4	n/a	n/a	32.4		29.9	31.6	34.8	26.6		23.3	24.9	26.3	18.8		18	20	20
Strong Acid Leachable Metals	Phosphorus	mg/kg dry	10	n/a	n/a	479		498	486	543	744		683	670	679	605		696	609	576
Strong Acid Leachable Metals	Potassium	mg/kg dry	10	n/a	n/a	2110		1890	1960	2280	1270		1200	1240	1320	1160		1170	1250	1290
Strong Acid Leachable Metals	Selenium	mg/kg dry	0.5	n/a	n/a	0.6		0.6	0.6	0.6	0.9		0.7	0.9	0.8	0.7		1	0.8	0.8
Strong Acid Leachable Metals	Silicon	mg/kg dry	3000	n/a	n/a	<3000		<3000	<3000	<3000	<3000		<3000	<3000	<3000	<3000		<3000	<3000	<3000
Strong Acid Leachable Metals	Silver	mg/kg dry	0.2	n/a	n/a	<0.2		<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2
Strong Acid Leachable Metals	Sodium	mg/kg dry	40	n/a	n/a	308		288	291	325	317		301	319	326	253		219	230	229
Strong Acid Leachable Metals	Strontium	mg/kg dry	0.2	n/a	n/a	54		52.7	52.6	53.7	52		43.2	46.9	48.8	58.1		71.4	60.2	62.2
Strong Acid Leachable Metals	Sulfur	mg/kg dry	1000	n/a	n/a	<1000		<1000	<1000	<1000	<1000		<1000	<1000	<1000	<1000		<1000	<1000	<1000
Strong Acid Leachable Metals	Tellurium	mg/kg dry	0.1	n/a	n/a	<0.1		<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1
Strong Acid Leachable Metals	Thallium	mg/kg dry	0.1	n/a	n/a	0.3		0.3	0.3	0.3	0.2		0.2	0.2	0.2	0.2		0.2	0.2	0.2
Strong Acid Leachable Metals	Thorium	mg/kg dry	0.5	n/a	n/a	11		11.8	11.3	12	10.3		9	9.8	10	12.7		11.9	11.9	11.9
Strong Acid Leachable Metals	Tin	mg/kg dry	0.2	n/a	n/a	1.1		1.1	1.1	1.1	0.7		0.6	0.7	0.8	0.8		0.8	0.7	0.7
Strong Acid Leachable Metals	Titanium	mg/kg dry	2	n/a	n/a	1240		1130	1200	1220	1050		1020	1160	1180	876		769	786	722
Strong Acid Leachable Metals	Uranium	mg/kg dry	0.1	n/a	n/a	7.1		6.5	6.5	7.2	14		9.7	11.4	11.4	6.1		10	6.9	7.5
Strong Acid Leachable Metals	Vanadium	mg/kg dry	0.4	n/a	n/a	51.3		49.4	48	50.6	59.4		55.6	57.2	59	46.2		42.5	47	46.3
Strong Acid Leachable Metals	Zinc	mg/kg dry	2	123	315	65		66	64	61	88		76	85	89	60		62	64	64
Strong Acid Leachable Metals	Zirconium	mg/kg dry	2	n/a	n/a	3		4	3	3	3		3	3	4	3		4	3	3

Notes: CCME guidelines include: ISQG= interim sediment quality guideline, PEL=probable effect levels
PSD=Particle Size Distribution, R=Field Split, RDL=Reported Detection Limit

Exceedances

ISQG
ISQG and PEL

Appendix B1. Sediment quality data, Coffee Gold Project, 2014-2015

Method	Analyte	Units	RDL	CCME guideline		AQ00-1	AQ00-2	AQ00-3	AQ00-PSD	AQ02-1	AQ02-2	AQ02-3	AQ02-3R	AQ02-PSD	AQREF1-1	AQREF1-2	AQREF1-3	AQREF1-3R	AQREF1-PSD	AQ30-1
				ISQG	PEL	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	01-Aug-15	01-Aug-15	26-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15	27-Jul-15
General Parameters	Carbon, Total Organic	% dry	0.05	n/a	n/a	1.65	23.8	4.86		10.3	5.21	6.15	7.34		0.95	2.51	4.28	5.56		2.75
General Parameters	Moisture	% wet	0.1	n/a	n/a	35.7	60.4	54.8		34.6	41.9	57.4	51.4		7.3	53.4	63.8	55.9		20.1
General Parameters	pH	pH units	0.1	n/a	n/a	6.6	6.6	6.2		6.8	6.3	6.3	6.2		6.8	6.8	6.6	6.5		6.7
Fertility / Nutrient Parameters	Nitrogen, Ammonia as N, Available	mg/kg dry	1	n/a	n/a	6.7		12		9.3	8	8	9.3		5.3	8	8			5.3
Fertility / Nutrient Parameters	Nitrogen, Nitrate as N, Available	mg/kg dry	1	n/a	n/a	1.9		2.3		1.8	1.3	1.9	1.1		<1.0	1.5	1.8			1.8
Fertility / Nutrient Parameters	Phosphorus, Available	mg/kg dry	2	n/a	n/a	5		6		5	16	4	3		3	6	6			4
Particle Size Distribution	> 80 mm	%	0.1	n/a	n/a				<0.1					<0.1					<0.1	
Particle Size Distribution	> 56 mm	%	0.1	n/a	n/a				<0.1					<0.1					<0.1	
Particle Size Distribution	> 40 mm	%	0.1	n/a	n/a				<0.1					<0.1					<0.1	
Particle Size Distribution	> 25 mm	%	0.1	n/a	n/a				<0.1					<0.1					<0.1	
Particle Size Distribution	> 19 mm	%	0.1	n/a	n/a				<0.1					<0.1					<0.1	
Particle Size Distribution	> 12.5 mm	%	0.1	n/a	n/a				<0.1					<0.1					<0.1	
Particle Size Distribution	> 4.75 mm	%	0.1	n/a	n/a				<0.1					<0.1					13	
Particle Size Distribution	> 2.36 mm	%	0.1	n/a	n/a				<0.1					1.8					10	
Particle Size Distribution	> 2.0 mm	%	0.1	n/a	n/a				0.4					0.8					2.2	
Particle Size Distribution	> 1.18 mm	%	0.1	n/a	n/a				1.7					3.1					5.3	
Particle Size Distribution	> 600 µm	%	0.1	n/a	n/a				4.6					6.5					5.6	
Particle Size Distribution	> 425 µm	%	0.1	n/a	n/a				11					4.7					4.3	
Particle Size Distribution	> 300 µm	%	0.1	n/a	n/a				6.6					7.2					7.8	
Particle Size Distribution	> 150 µm	%	0.1	n/a	n/a				22.4					22.3					23.9	
Particle Size Distribution	> 75 µm	%	0.1	n/a	n/a				16.6					20.1					15.8	
Particle Size Distribution	< 75 µm	%	0.1	n/a	n/a				36.7					33.3					12.1	
Exchangeable Ions	Calcium, Available	mg/kg dry	5	n/a	n/a	1500		1400		2140	2150	2430	2050		1350	2500	2100			1780
Exchangeable Ions	Magnesium, Available	mg/kg dry	5	n/a	n/a	290		260		393	385	421	370		290	488	400			207
Exchangeable Ions	Potassium, Available	mg/kg dry	5	n/a	n/a	47		100		79	79	130	103		31	45	38			44
Exchangeable Ions	Sodium, Available	mg/kg dry	5	n/a	n/a	20		45		24	21	34	20		13	48	28			19
Strong Acid Leachable Metals	Aluminum	mg/kg dry	20	n/a	n/a	15200	16500	16100		16500	16600	17400	16700		13600	14000	13200	14500		16700
Strong Acid Leachable Metals	Antimony	mg/kg dry	0.1	n/a	n/a	0.5	0.6	0.4		0.5	0.5	0.5	0.4		1.6	1.3	1.5	1.5		1.3
Strong Acid Leachable Metals	Arsenic	mg/kg dry	0.4	5.9	17	7.3	6.5	8.2		9.6	9.2	8.5	8.3		22.7	14.6	11.5	10.9		18
Strong Acid Leachable Metals	Barium	mg/kg dry	1	n/a	n/a	174	208	183		199	198	201	191		374	388	322	325		225
Strong Acid Leachable Metals	Beryllium	mg/kg dry	0.1	n/a	n/a	0.4	0.5	0.4		0.3	0.4	0.4	0.4		0.4	0.4	0.5	0.5		0.7
Strong Acid Leachable Metals	Bismuth	mg/kg dry	0.1	n/a	n/a	0.2	0.2	0.2		0.2	0.2	0.2	0.2		0.2	0.2	0.2	0.2		0.2
Strong Acid Leachable Metals	Boron	mg/kg dry	2	n/a	n/a	2	3	2		2	2	2	2		2	2	2	2		3
Strong Acid Leachable Metals	Cadmium	mg/kg dry	0.04	0.6	3.5	0.19	0.2	0.24		0.27	0.23	0.23	0.22		0.31	0.33	0.29	0.29		0.23
Strong Acid Leachable Metals	Calcium	mg/kg dry	100	n/a	n/a	7010	10400	6950		8090	7740	7700	6970		7570	8730	9070	9340		9920
Strong Acid Leachable Metals	Chromium	mg/kg dry	1	37.3	90	29.6	33.8	28.7		30.3	30.3	31	29.5		26.7	26.4	27.3	27.3		32
Strong Acid Leachable Metals	Cobalt	mg/kg dry	0.1	n/a	n/a	9.1	8.3	10.3		11.1	10.4	11	10.2		8.4	9.1	8.6	9.2		11.8
Strong Acid Leachable Metals	Copper	mg/kg dry	0.2	35.7	197	18.9	30.5	17.9		20	18.5	20.4	18.4		18.2	19.5	22	22.3		21.9
Strong Acid Leachable Metals	Iron	mg/kg dry	20	n/a	n/a	22300	21100	23800		24800	24700	25800	24600		25200	23400	20600	21400		25800
Strong Acid Leachable Metals	Lead	mg/kg dry	0.2	35	91.3	7.2	7.5	6.5		6.9	7.6	6.9	6.6		8.9	8.7	10.1	9.5		11.7
Strong Acid Leachable Metals	Lithium	mg/kg dry	0.1	n/a	n/a	14.2	16.6	13.3		13.7	14.3	13.8	13.1		11.4	12.8	11.5	12.2		14.2
Strong Acid Leachable Metals	Magnesium	mg/kg dry	10	n/a	n/a	6220	6700	6260		6470	6510	6770	6550		5920	6220	6080	6240		6290
Strong Acid Leachable Metals	Manganese	mg/kg dry	0.4	n/a	n/a	284	252	525		559	498	569	519		429	343	242	199		687
Strong Acid Leachable Metals	Mercury	mg/kg dry	0.05	0.17	0.486	0.07	0.15	0.1		0.07	0.06	0.08	0.07		<0.05	0.05	0.06	0.06		0.08
Strong Acid Leachable Metals	Molybdenum	mg/kg dry	0.1	n/a	n/a	0.8	0.9	0.8		0.9	0.9	0.9	0.8		1.1	0.7	0.8	0.8		0.9
Strong Acid Leachable Metals	Nickel	mg/kg dry	0.4	n/a	n/a	19	23.9	18.5		19.5	19.4	19.2	18.2		17.6	19.9	20.5	20.6		20.9
Strong Acid Leachable Metals	Phosphorus	mg/kg dry	10	n/a	n/a	715	722	658		711	700	637	655		1110	876	771	829		667
Strong Acid Leachable Metals	Potassium	mg/kg dry	10	n/a	n/a	1150	1300	1310		1220	1220	1260	1190		1050	1100	884	1040		1290
Strong Acid Leachable Metals	Selenium	mg/kg dry	0.5	n/a	n/a	0.8	1.1	0.6		1.2	0.6	0.9	1.2		1.1	1	1.2	1		0.9
Strong Acid Leachable Metals	Silicon	mg/kg dry	3000	n/a	n/a	<3000	<3000	<3000		<3000	<3000	<3000	<3000		<3000	<3000	<3000	<3000		<3000
Strong Acid Leachable Metals	Silver	mg/kg dry	0.2	n/a	n/a	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2		<0.2
Strong Acid Leachable Metals	Sodium	mg/kg dry	40	n/a	n/a	274	272	283		273	279	273	288		218	251	225	246		214
Strong Acid Leachable Metals	Strontium	mg/kg dry	0.2	n/a	n/a	40.6	59.5	40		45.2	43.3	44	41.2		44.9	56.9	60.6	59.6		64.3
Strong Acid Leachable Metals	Sulfur	mg/kg dry	1000	n/a	n/a	<1000	1000	<1000		<1000	<1000	<1000	<1000		<1000	<1000	<1000	<1000		<1000
Strong Acid Leachable Metals	Tellurium	mg/kg dry	0.1	n/a	n/a	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1		<0.1
Strong Acid Leachable Metals	Thallium	mg/kg dry	0.1	n/a	n/a	0.1	0.2	0.2		0.2	0.2	0.2	0.2		0.1	0.1	0.1	0.2		0.2
Strong Acid Leachable Metals	Thorium	mg/kg dry	0.5	n/a	n/a	6.6	7.6	5.4		5.8	6.4	5.3	5.3		6.7	6.1	5.8	6.3		9.9
Strong Acid Leachable Metals	Tin	mg/kg dry	0.2	n/a	n/a	0.5	0.7	0.5		0.5	0.5	0.5	0.6		0.4	0.5	0.4	0.5		0.5
Strong Acid Leachable Metals	Titanium	mg/kg dry	2	n/a	n/a	972	895	1070		1050	1090	1070	1080		701	780	700	758		796
Strong Acid Leachable Metals	Uranium	mg/kg dry	0.1	n/a	n/a	12.4	54.6	11.3		11	10.9	7.8	6.1		2.9	3.6	4.5	4.4		7.4
Strong Acid Leachable Metals	Vanadium	mg/kg dry	0.4	n/a	n/a	49.6	41.9	52.7		54.8	54.6	56.3	55.1		56.2	49.5	45.8	49.3		47.5
Strong Acid Leachable Metals	Zinc	mg/kg dry	2	123	315	66	63	66		68	68	70	67		74	75	70	71		72
Strong Acid Leachable Metals	Zirconium	mg/kg dry	2	n/a	n/a	<2	3	2		2	2	2	2		<2	<2	<2	<2		2

Notes: CCME guidelines include: ISQG= interim sediment quality guideline, PEL=probable effect levels
PSD=Particle Size Distribution, R=Field Split, RDL=Reported Detection Limit

Exceedances

ISQG
ISQG and PEL

Appendix B1. Sediment quality data, Coffee Gold Project, 2014-2015

Method	Analyte	Units	RDL	CCME guideline		AQ30-2	AQ30-3	AQ30-PSD	AQ11-1	AQ11-2	AQ11-PSD	AQ10-1	AQ10-2	AQ10-3	AQ10-3R	AQ10-PSD	AQ04-1	AQ04-2	AQ04-3	AQ04-3R
				ISQG	PEL	27-Jul-15	27-Jul-15	27-Jul-15	28-Jul-15	28-Jul-15	28-Jul-15	28-Jul-15	28-Jul-15	28-Jul-15	28-Jul-15	28-Jul-15	29-Jul-15	29-Jul-15	29-Jul-15	29-Jul-15
General Parameters	Carbon, Total Organic	% dry	0.05	n/a	n/a	3	4.04		7.83	3.25		3.48	4.61	4.35	3.81		5.34	5.44	5.43	5.26
General Parameters	Moisture	% wet	0.1	n/a	n/a	6.9	36		43.3	36.3		55.1	42.6	50.7	44.2		24.7	53.1	36.6	49
General Parameters	pH	pH units	0.1	n/a	n/a	6.8	6.3		6.4	6.4		5.8	6.5	6.3	6.1		6.9	7.1	6.7	6.8
Fertility / Nutrient Parameters	Nitrogen, Ammonia as N, Available	mg/kg dry	1	n/a	n/a	5.3	9.3		12	12		11	11	11	11		6.7	12	9.3	11
Fertility / Nutrient Parameters	Nitrogen, Nitrate as N, Available	mg/kg dry	1	n/a	n/a	1	2.2		1.8	2.2		3.2	2.3	2.8	3		<1.0	1.9	1.6	1.3
Fertility / Nutrient Parameters	Phosphorus, Available	mg/kg dry	2	n/a	n/a	7	7		5	5		<2	4	4	8		4	6	5	2
Particle Size Distribution	> 80 mm	%	0.1	n/a	n/a			<0.1			<0.1					<0.1				
Particle Size Distribution	> 56 mm	%	0.1	n/a	n/a			<0.1			<0.1					<0.1				
Particle Size Distribution	> 40 mm	%	0.1	n/a	n/a			<0.1			<0.1					<0.1				
Particle Size Distribution	> 25 mm	%	0.1	n/a	n/a			<0.1			<0.1					<0.1				
Particle Size Distribution	> 19 mm	%	0.1	n/a	n/a			<0.1			<0.1					<0.1				
Particle Size Distribution	> 12.5 mm	%	0.1	n/a	n/a			<0.1			<0.1					<0.1				
Particle Size Distribution	> 4.75 mm	%	0.1	n/a	n/a			0.4			2.4					7.2				
Particle Size Distribution	> 2.36 mm	%	0.1	n/a	n/a			3.1			5.8					3.3				
Particle Size Distribution	> 2.0 mm	%	0.1	n/a	n/a			2			2.7					1.4				
Particle Size Distribution	> 1.18 mm	%	0.1	n/a	n/a			6.2			8.3					5.8				
Particle Size Distribution	> 600 µm	%	0.1	n/a	n/a			9.9			10.6					10.1				
Particle Size Distribution	> 425 µm	%	0.1	n/a	n/a			5.4			11.2					7.4				
Particle Size Distribution	> 300 µm	%	0.1	n/a	n/a			5.7			20.8					10.1				
Particle Size Distribution	> 150 µm	%	0.1	n/a	n/a			12.4			23.7					24.7				
Particle Size Distribution	> 75 µm	%	0.1	n/a	n/a			14.1			9.4					16.6				
Particle Size Distribution	< 75 µm	%	0.1	n/a	n/a			40.9			5					13.3				
Exchangeable Ions	Calcium, Available	mg/kg dry	5	n/a	n/a	1290	1850		3570	2140		2210	1930	1790	1640		1450	2600	2210	2140
Exchangeable Ions	Magnesium, Available	mg/kg dry	5	n/a	n/a	143	220		550	336		364	321	279	275		235	380	364	314
Exchangeable Ions	Potassium, Available	mg/kg dry	5	n/a	n/a	30	68		97	96		157	83	100	91		54	98	80	63
Exchangeable Ions	Sodium, Available	mg/kg dry	5	n/a	n/a	11	13		43	29		26	21	20	19		14	40	20	19
Strong Acid Leachable Metals	Aluminum	mg/kg dry	20	n/a	n/a	15200	11700		17500	15400		18700	16700	16100	14700		14800	15800	18200	17500
Strong Acid Leachable Metals	Antimony	mg/kg dry	0.1	n/a	n/a	1.1	0.7		0.8	0.6		0.7	0.6	0.6	0.6		0.4	0.5	0.6	0.6
Strong Acid Leachable Metals	Arsenic	mg/kg dry	0.4	5.9	17	15.5	10.1		17.1	11.1		14.4	10.7	11.6	8.9		4.4	10.9	11.7	10.6
Strong Acid Leachable Metals	Barium	mg/kg dry	1	n/a	n/a	210	179		208	151		180	169	164	149		120	162	184	170
Strong Acid Leachable Metals	Beryllium	mg/kg dry	0.1	n/a	n/a	0.7	0.4		0.5	0.4		0.6	0.4	0.4	0.3		0.3	0.6	0.6	0.5
Strong Acid Leachable Metals	Bismuth	mg/kg dry	0.1	n/a	n/a	0.2	0.1		0.2	0.2		0.2	0.2	0.2	0.2		0.2	0.1	0.2	0.2
Strong Acid Leachable Metals	Boron	mg/kg dry	2	n/a	n/a	3	3		2	2		2	2	2	<2		<2	2	2	2
Strong Acid Leachable Metals	Cadmium	mg/kg dry	0.04	0.6	3.5	0.29	0.09		0.48	0.29		0.3	0.29	0.27	0.21		0.09	0.3	0.29	0.28
Strong Acid Leachable Metals	Calcium	mg/kg dry	100	n/a	n/a	9290	11300		8810	6920		8530	7700	7530	6340		6050	7200	7490	7230
Strong Acid Leachable Metals	Chromium	mg/kg dry	1	37.3	90	27.8	26.8		36.1	30.1		35.8	31.7	31.9	29.1		26.1	26.3	32.9	30.9
Strong Acid Leachable Metals	Cobalt	mg/kg dry	0.1	n/a	n/a	11.1	8.3		12.1	10.2		12.6	11	10.9	9.5		7.4	9.6	10.9	10.4
Strong Acid Leachable Metals	Copper	mg/kg dry	0.2	35.7	197	20	29.9		26.2	15		19.3	15.8	15.9	14		13.7	15.6	17.7	15.4
Strong Acid Leachable Metals	Iron	mg/kg dry	20	n/a	n/a	24000	19800		27000	23000		27200	24800	23900	21500		21600	21900	25400	23500
Strong Acid Leachable Metals	Lead	mg/kg dry	0.2	35	91.3	12	7		11.4	9.1		10.9	9.8	10	9		7.9	10.8	11.4	11.2
Strong Acid Leachable Metals	Lithium	mg/kg dry	0.1	n/a	n/a	12.6	11.2		16.6	14.7		17.3	14.9	14.4	12.5		12.5	13.8	15.9	15.8
Strong Acid Leachable Metals	Magnesium	mg/kg dry	10	n/a	n/a	5610	5840		6990	5850		6910	6300	5970	5710		5810	5050	6450	5930
Strong Acid Leachable Metals	Manganese	mg/kg dry	0.4	n/a	n/a	706	413		768	478		870	693	605	479		323	738	726	548
Strong Acid Leachable Metals	Mercury	mg/kg dry	0.05	0.17	0.486	0.07	<0.05		0.06	0.05		0.08	0.06	0.06	<0.05		0.05	0.1	0.09	0.09
Strong Acid Leachable Metals	Molybdenum	mg/kg dry	0.1	n/a	n/a	0.8	0.3		1.1	0.6		0.9	0.7	0.7	0.6		0.5	0.6	0.7	0.6
Strong Acid Leachable Metals	Nickel	mg/kg dry	0.4	n/a	n/a	19.4	22.3		27	20.3		24.4	21	21	18.9		15.6	17.4	21.9	20.3
Strong Acid Leachable Metals	Phosphorus	mg/kg dry	10	n/a	n/a	667	664		621	676		662	670	700	650		541	518	573	532
Strong Acid Leachable Metals	Potassium	mg/kg dry	10	n/a	n/a	1150	1290		1290	1090		1200	1150	1050	942		846	870	1140	1020
Strong Acid Leachable Metals	Selenium	mg/kg dry	0.5	n/a	n/a	1.2	0.9		0.9	0.8		0.7	0.8	0.7	0.8		1.7	2	2	1.9
Strong Acid Leachable Metals	Silicon	mg/kg dry	3000	n/a	n/a	<3000	<3000		<3000	<3000		<3000	<3000	<3000	<3000		<3000	<3000	<3000	<3000
Strong Acid Leachable Metals	Silver	mg/kg dry	0.2	n/a	n/a	<0.2	<0.2		<0.2	<0.2		<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2
Strong Acid Leachable Metals	Sodium	mg/kg dry	40	n/a	n/a	209	242		262	251		279	281	279	254		261	179	242	237
Strong Acid Leachable Metals	Strontium	mg/kg dry	0.2	n/a	n/a	59.4	57.4		50.9	38.3		46.3	40	40.4	34		45.7	64.1	62.1	60.6
Strong Acid Leachable Metals	Sulfur	mg/kg dry	1000	n/a	n/a	<1000	<1000		<1000	<1000		<1000	<1000	<1000	<1000		<1000	<1000	<1000	<1000
Strong Acid Leachable Metals	Tellurium	mg/kg dry	0.1	n/a	n/a	<0.1	<0.1		<0.1	<0.1		<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1
Strong Acid Leachable Metals	Thallium	mg/kg dry	0.1	n/a	n/a	0.2	0.1		0.2	0.2		0.2	0.2	0.2	0.1		0.1	0.1	0.2	0.2
Strong Acid Leachable Metals	Thorium	mg/kg dry	0.5	n/a	n/a	10.4	6.3		7	6.9		7.8	6.9	7.3	6.2		8.6	9.7	10.8	10.5
Strong Acid Leachable Metals	Tin	mg/kg dry	0.2	n/a	n/a	0.5	0.3		0.6	0.5		0.6	0.5	0.5	0.5		0.6	0.6	0.6	0.6
Strong Acid Leachable Metals	Titanium	mg/kg dry	2	n/a	n/a	679	800		999	1060		1050	1090	1090	1040		1040	804	952	922
Strong Acid Leachable Metals	Uranium	mg/kg dry	0.1	n/a	n/a	6	4.6		7.9	6.1		8	4.9	5.4	3.7		11.2	9.2	12.6	12.1
Strong Acid Leachable Metals	Vanadium	mg/kg dry	0.4	n/a	n/a	41.7	36.5		55.5	49.1		54.7	50.7	51.8	46.1		46.1	41.9	50	44.6
Strong Acid Leachable Metals	Zinc	mg/kg dry	2	123	315	72	65		79	72		80	75	73	68		52	73	74	74
Strong Acid Leachable Metals	Zirconium	mg/kg dry	2	n/a	n/a	2	4		2	2		3	2	2	2		3	3	2	2

Notes: CCME guidelines include: ISQG= interim sediment quality guideline, PEL=probable effect levels
PSD=Particle Size Distribution, R=Field Split, RDL=Reported Detection Limit

Exceedances

ISQG
ISQG and PEL

Appendix B1. Sediment quality data, Coffee Gold Project, 2014-2015

Method	Analyte	Units	RDL	CCME guideline		AQ04-PSD	AQ13-1	AQ13-2	AQ13-3	AQ13-3R	AQ13-PSD	AQ20-1	AQ20-2	AQ20-3	AQ20-3R	AQ20-PSD	AQREF2-1	AQREF2-2	AQREF2-3	AQREF2-PSD
				ISQG	PEL	29-Jul-15	30-Jul-15	30-Jul-15	30-Jul-15	30-Jul-15	30-Jul-15	30-Jul-15	30-Jul-15	30-Jul-15	30-Jul-15	30-Jul-15	31-Jul-15	31-Jul-15	31-Jul-15	31-Jul-15
General Parameters	Carbon, Total Organic	% dry	0.05	n/a	n/a		5.32	4.76	4.43	2.73		9.05	5.91	10.5	10.6		3.92	2.98	4.34	
General Parameters	Moisture	% wet	0.1	n/a	n/a		48	48.4	62.1	39.7		47.4	46	48.7	43		31.7	41.9	36.1	
General Parameters	pH	pH units	0.1	n/a	n/a		4.4	6.6	5.8	5.5		6.7	7.1	7	7		7.1	6.7	6.7	
Fertility / Nutrient Parameters	Nitrogen, Ammonia as N, Available	mg/kg dry	1	n/a	n/a		11	12	10	5.3		8	8	8	10		5.3	5.3	5.3	
Fertility / Nutrient Parameters	Nitrogen, Nitrate as N, Available	mg/kg dry	1	n/a	n/a		<1.0	2	3.4	1.8		3.2	1.9	2.2	3.5		<1.0	1.5	1.2	
Fertility / Nutrient Parameters	Phosphorus, Available	mg/kg dry	2	n/a	n/a		<2	2	2	5		9	<2	2	3		4	<2	<2	
Particle Size Distribution	> 80 mm	%	0.1	n/a	n/a	<0.1					<0.1					<0.1				<0.1
Particle Size Distribution	> 56 mm	%	0.1	n/a	n/a	<0.1					<0.1					<0.1				<0.1
Particle Size Distribution	> 40 mm	%	0.1	n/a	n/a	<0.1					<0.1					<0.1				<0.1
Particle Size Distribution	> 25 mm	%	0.1	n/a	n/a	<0.1					<0.1					<0.1				<0.1
Particle Size Distribution	> 19 mm	%	0.1	n/a	n/a	<0.1					<0.1					<0.1				<0.1
Particle Size Distribution	> 12.5 mm	%	0.1	n/a	n/a	<0.1					<0.1					<0.1				<0.1
Particle Size Distribution	> 4.75 mm	%	0.1	n/a	n/a	0.9					2.1					1				0.9
Particle Size Distribution	> 2.36 mm	%	0.1	n/a	n/a	3.7					3.5					3				3.3
Particle Size Distribution	> 2.0 mm	%	0.1	n/a	n/a	1.7					1.5					1.3				1.8
Particle Size Distribution	> 1.18 mm	%	0.1	n/a	n/a	8.3					5.2					5.5				7
Particle Size Distribution	> 600 µm	%	0.1	n/a	n/a	19.8					10.8					10.6				13
Particle Size Distribution	> 425 µm	%	0.1	n/a	n/a	18.5					8.9					6.6				26.6
Particle Size Distribution	> 300 µm	%	0.1	n/a	n/a	22.8					11.4					7.6				29.2
Particle Size Distribution	> 150 µm	%	0.1	n/a	n/a	17.5					22.6					17.4				12.7
Particle Size Distribution	> 75 µm	%	0.1	n/a	n/a	4.8					18.1					17.3				3.2
Particle Size Distribution	< 75 µm	%	0.1	n/a	n/a	2					15.8					29.8				2.2
Exchangeable Ions	Calcium, Available	mg/kg dry	5	n/a	n/a		1000	2640	2700	2400		3300	3350	3570	3790		1800	2070	2140	
Exchangeable Ions	Magnesium, Available	mg/kg dry	5	n/a	n/a		143	207	210	210		480	480	514	486		540	729	1010	
Exchangeable Ions	Potassium, Available	mg/kg dry	5	n/a	n/a		69	100	92	108		100	101	99	81		62	64	73	
Exchangeable Ions	Sodium, Available	mg/kg dry	5	n/a	n/a		16	34	28	24		38	16	21	21		30	30	57	
Strong Acid Leachable Metals	Aluminum	mg/kg dry	20	n/a	n/a		19100	22500	17900	17200		14000	16200	14900	15800		13200	12600	13800	
Strong Acid Leachable Metals	Antimony	mg/kg dry	0.1	n/a	n/a		0.5	0.8	0.5	0.5		0.9	0.9	0.9	1.1		0.4	0.3	0.3	
Strong Acid Leachable Metals	Arsenic	mg/kg dry	0.4	5.9	17		19.1	37.7	22.5	20.2		13.8	15	14	12.7		5.9	6.4	7.4	
Strong Acid Leachable Metals	Barium	mg/kg dry	1	n/a	n/a		111	185	137	132		167	193	179	191		196	158	151	
Strong Acid Leachable Metals	Beryllium	mg/kg dry	0.1	n/a	n/a		0.6	0.8	0.6	0.5		0.5	0.6	0.5	0.6		0.4	0.5	0.5	
Strong Acid Leachable Metals	Bismuth	mg/kg dry	0.1	n/a	n/a		0.2	0.2	0.3	0.2		0.1	0.1	0.1	0.2		<0.1	<0.1	<0.1	
Strong Acid Leachable Metals	Boron	mg/kg dry	2	n/a	n/a		<2	<2	<2	<2		2	2	2	3		3	3	4	
Strong Acid Leachable Metals	Cadmium	mg/kg dry	0.04	0.6	3.5		0.08	0.3	0.13	0.1		0.18	0.18	0.17	0.15		0.21	0.16	0.13	
Strong Acid Leachable Metals	Calcium	mg/kg dry	100	n/a	n/a		3840	9010	7090	6060		8330	9460	9550	10600		8390	7610	7840	
Strong Acid Leachable Metals	Chromium	mg/kg dry	1	37.3	90		54.6	62.3	48.4	48.9		32.2	36.1	34	36.5		33.9	36.1	43.4	
Strong Acid Leachable Metals	Cobalt	mg/kg dry	0.1	n/a	n/a		10.2	14.8	10	9.6		9.3	10.2	9	7.9		10	8.8	9.4	
Strong Acid Leachable Metals	Copper	mg/kg dry	0.2	35.7	197		16.5	25.5	17.8	17.2		16.1	19.6	19.1	24.1		24.4	19.1	21.7	
Strong Acid Leachable Metals	Iron	mg/kg dry	20	n/a	n/a		25300	28800	23300	23300		20500	23400	21200	20100		23200	22300	26900	
Strong Acid Leachable Metals	Lead	mg/kg dry	0.2	35	91.3		9.3	8.8	8.2	7.7		7	7.6	7.3	7.5		5.5	5.5	6.3	
Strong Acid Leachable Metals	Lithium	mg/kg dry	0.1	n/a	n/a		12.8	17.4	12.4	12.2		12.5	15.1	13.7	15.8		11.1	11.3	11.8	
Strong Acid Leachable Metals	Magnesium	mg/kg dry	10	n/a	n/a		7960	8650	7120	7220		5980	6450	6280	6440		7350	7010	9690	
Strong Acid Leachable Metals	Manganese	mg/kg dry	0.4	n/a	n/a		387	901	635	413		578	613	433	238		515	226	207	
Strong Acid Leachable Metals	Mercury	mg/kg dry	0.05	0.17	0.486		0.06	0.08	0.06	<0.05		0.07	0.06	0.06	0.08		<0.05	<0.05	<0.05	
Strong Acid Leachable Metals	Molybdenum	mg/kg dry	0.1	n/a	n/a		1.5	0.6	0.6	0.6		0.5	0.5	0.6	0.5		0.5	0.5	0.6	
Strong Acid Leachable Metals	Nickel	mg/kg dry	0.4	n/a	n/a		29.1	38.8	28.2	27.6		21.1	24.6	22.6	24.2		34.3	33.1	42.1	
Strong Acid Leachable Metals	Phosphorus	mg/kg dry	10	n/a	n/a		480	547	469	526		634	725	667	680		711	729	805	
Strong Acid Leachable Metals	Potassium	mg/kg dry	10	n/a	n/a		1760	2310	1710	1950		1120	1330	1220	1110		889	738	833	
Strong Acid Leachable Metals	Selenium	mg/kg dry	0.5	n/a	n/a		1.5	1.5	2.4	0.9		1.6	1.7	1.2	<0.5		<0.5	<0.5	<0.5	
Strong Acid Leachable Metals	Silicon	mg/kg dry	3000	n/a	n/a		<3000	<3000	<3000	<3000		<3000	<3000	<3000	<3000		<3000	<3000	<3000	
Strong Acid Leachable Metals	Silver	mg/kg dry	0.2	n/a	n/a		<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	<0.2		<0.2	<0.2	<0.2	
Strong Acid Leachable Metals	Sodium	mg/kg dry	40	n/a	n/a		236	283	240	263		204	223	210	198		390	360	490	
Strong Acid Leachable Metals	Strontium	mg/kg dry	0.2	n/a	n/a		30.3	62.1	45.7	41.1		72.2	80.8	82.3	93.2		60.5	58	52.9	
Strong Acid Leachable Metals	Sulfur	mg/kg dry	1000	n/a	n/a		<1000	<1000	<1000	<1000		<1000	<1000	<1000	<1000		<1000	<1000	<1000	
Strong Acid Leachable Metals	Tellurium	mg/kg dry	0.1	n/a	n/a		<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	<0.1		<0.1	<0.1	<0.1	
Strong Acid Leachable Metals	Thallium	mg/kg dry	0.1	n/a	n/a		0.3	0.4	0.2	0.2		0.1	0.2	0.1	0.2		<0.1	<0.1	<0.1	
Strong Acid Leachable Metals	Thorium	mg/kg dry	0.5	n/a	n/a		7.9	11.2	9.6	9.6		7.3	9.1	8.4	8.8		3.5	3.6	3.8	
Strong Acid Leachable Metals	Tin	mg/kg dry	0.2	n/a	n/a		1	1	0.9	0.9		0.6	0.6	0.6	0.6		0.4	0.4	0.6	
Strong Acid Leachable Metals	Titanium	mg/kg dry	2	n/a	n/a		1180	1170	1060	1160		792	912	763	742		860	821	960	
Strong Acid Leachable Metals	Uranium	mg/kg dry	0.1	n/a	n/a		2.9	10	4.4	2.8		17.1	17.6	27.9	28.9		1.3	2.1	1.4	
Strong Acid Leachable Metals	Vanadium	mg/kg dry	0.4	n/a	n/a		64.2	51.8	43.9	45.7		39.1	45.3	39.8	35.2		47.9	50.4	57.3	
Strong Acid Leachable Metals	Zinc	mg/kg dry	2	123	315		60	75	57	55		64	61	57	54		64	62	60	
Strong Acid Leachable Metals	Zirconium	mg/kg dry	2	n/a	n/a		<2	2	<2	<2		2	3	3	3		4	3	4	

Notes: CCME guidelines include: ISQG= interim sediment quality guideline, PEL=probable effect levels
PSD=Particle Size Distribution, R=Field Split, RDL=Reported Detection Limit

Exceedances

ISQG
ISQG and PEL

Appendix B1. Sediment quality data, Coffee Gold Project, 2014-2015

Method	Analyte	Units	RDL	CCME guideline		AQ04.5-1	AQ04.5-2	AQ04.5-3	AQ04.5-4
				ISQG	PEL	01-Aug-15	01-Aug-15	01-Aug-15	01-Aug-15
General Parameters	Carbon, Total Organic	% dry	0.05	n/a	n/a	6.49	12.2	6.85	8.16
General Parameters	Moisture	% wet	0.1	n/a	n/a	50.8	58.8	56.1	58.7
General Parameters	pH	pH units	0.1	n/a	n/a	5.8	5.7	5.9	5.7
Fertility / Nutrient Parameters	Nitrogen, Ammonia as N, Available	mg/kg dry	1	n/a	n/a	8	12	12	9.3
Fertility / Nutrient Parameters	Nitrogen, Nitrate as N, Available	mg/kg dry	1	n/a	n/a	2.9	3.5	3.7	2.7
Fertility / Nutrient Parameters	Phosphorus, Available	mg/kg dry	2	n/a	n/a	2	<2	3	4
Particle Size Distribution	> 80 mm	%	0.1	n/a	n/a				
Particle Size Distribution	> 56 mm	%	0.1	n/a	n/a				
Particle Size Distribution	> 40 mm	%	0.1	n/a	n/a				
Particle Size Distribution	> 25 mm	%	0.1	n/a	n/a				
Particle Size Distribution	> 19 mm	%	0.1	n/a	n/a				
Particle Size Distribution	> 12.5 mm	%	0.1	n/a	n/a				
Particle Size Distribution	> 4.75 mm	%	0.1	n/a	n/a				
Particle Size Distribution	> 2.36 mm	%	0.1	n/a	n/a				
Particle Size Distribution	> 2.0 mm	%	0.1	n/a	n/a				
Particle Size Distribution	> 1.18 mm	%	0.1	n/a	n/a				
Particle Size Distribution	> 600 µm	%	0.1	n/a	n/a				
Particle Size Distribution	> 425 µm	%	0.1	n/a	n/a				
Particle Size Distribution	> 300 µm	%	0.1	n/a	n/a				
Particle Size Distribution	> 150 µm	%	0.1	n/a	n/a				
Particle Size Distribution	> 75 µm	%	0.1	n/a	n/a				
Particle Size Distribution	< 75 µm	%	0.1	n/a	n/a				
Exchangeable Ions	Calcium, Available	mg/kg dry	5	n/a	n/a	1500	2210	1570	1820
Exchangeable Ions	Magnesium, Available	mg/kg dry	5	n/a	n/a	264	364	250	271
Exchangeable Ions	Potassium, Available	mg/kg dry	5	n/a	n/a	129	150	171	146
Exchangeable Ions	Sodium, Available	mg/kg dry	5	n/a	n/a	19	19	19	16
Strong Acid Leachable Metals	Aluminum	mg/kg dry	20	n/a	n/a	14300	17200	15500	16400
Strong Acid Leachable Metals	Antimony	mg/kg dry	0.1	n/a	n/a	0.5	0.7	0.6	0.6
Strong Acid Leachable Metals	Arsenic	mg/kg dry	0.4	5.9	17	10.2	21.7	12.9	13.8
Strong Acid Leachable Metals	Barium	mg/kg dry	1	n/a	n/a	138	188	152	172
Strong Acid Leachable Metals	Beryllium	mg/kg dry	0.1	n/a	n/a	0.4	0.6	0.5	0.4
Strong Acid Leachable Metals	Bismuth	mg/kg dry	0.1	n/a	n/a	0.1	0.2	0.1	0.1
Strong Acid Leachable Metals	Boron	mg/kg dry	2	n/a	n/a	<2	<2	<2	<2
Strong Acid Leachable Metals	Cadmium	mg/kg dry	0.04	0.6	3.5	0.28	0.61	0.36	0.49
Strong Acid Leachable Metals	Calcium	mg/kg dry	100	n/a	n/a	4390	5360	4980	5180
Strong Acid Leachable Metals	Chromium	mg/kg dry	1	37.3	90	24.5	27.8	25.8	27.3
Strong Acid Leachable Metals	Cobalt	mg/kg dry	0.1	n/a	n/a	8.1	15.2	9.1	12.8
Strong Acid Leachable Metals	Copper	mg/kg dry	0.2	35.7	197	10.8	15.2	12.2	13.2
Strong Acid Leachable Metals	Iron	mg/kg dry	20	n/a	n/a	20500	27400	22700	23600
Strong Acid Leachable Metals	Lead	mg/kg dry	0.2	35	91.3	9.9	13	10.9	11.9
Strong Acid Leachable Metals	Lithium	mg/kg dry	0.1	n/a	n/a	10.9	13.4	11.9	12.2
Strong Acid Leachable Metals	Magnesium	mg/kg dry	10	n/a	n/a	4570	4990	4880	5000
Strong Acid Leachable Metals	Manganese	mg/kg dry	0.4	n/a	n/a	933	2050	1110	1680
Strong Acid Leachable Metals	Mercury	mg/kg dry	0.05	0.17	0.486	0.08	0.13	0.11	0.12
Strong Acid Leachable Metals	Molybdenum	mg/kg dry	0.1	n/a	n/a	0.5	1.3	0.7	0.8
Strong Acid Leachable Metals	Nickel	mg/kg dry	0.4	n/a	n/a	14.5	17.7	15.6	17.1
Strong Acid Leachable Metals	Phosphorus	mg/kg dry	10	n/a	n/a	509	569	528	577
Strong Acid Leachable Metals	Potassium	mg/kg dry	10	n/a	n/a	651	780	741	739
Strong Acid Leachable Metals	Selenium	mg/kg dry	0.5	n/a	n/a	0.7	<0.5	<0.5	0.6
Strong Acid Leachable Metals	Silicon	mg/kg dry	3000	n/a	n/a	<3000	<3000	<3000	<3000
Strong Acid Leachable Metals	Silver	mg/kg dry	0.2	n/a	n/a	<0.2	<0.2	<0.2	<0.2
Strong Acid Leachable Metals	Sodium	mg/kg dry	40	n/a	n/a	180	173	187	180
Strong Acid Leachable Metals	Strontium	mg/kg dry	0.2	n/a	n/a	31.3	41.2	36.3	39.4
Strong Acid Leachable Metals	Sulfur	mg/kg dry	1000	n/a	n/a	<1000	<1000	<1000	<1000
Strong Acid Leachable Metals	Tellurium	mg/kg dry	0.1	n/a	n/a	<0.1	<0.1	<0.1	<0.1
Strong Acid Leachable Metals	Thallium	mg/kg dry	0.1	n/a	n/a	0.1	0.2	0.2	0.2
Strong Acid Leachable Metals	Thorium	mg/kg dry	0.5	n/a	n/a	9	10.8	9.5	9.5
Strong Acid Leachable Metals	Tin	mg/kg dry	0.2	n/a	n/a	0.5	0.6	0.6	0.6
Strong Acid Leachable Metals	Titanium	mg/kg dry	2	n/a	n/a	832	734	826	759
Strong Acid Leachable Metals	Uranium	mg/kg dry	0.1	n/a	n/a	5.5	9.3	7	6.1
Strong Acid Leachable Metals	Vanadium	mg/kg dry	0.4	n/a	n/a	42.7	57	46.4	48.1
Strong Acid Leachable Metals	Zinc	mg/kg dry	2	123	315	63	77	68	69
Strong Acid Leachable Metals	Zirconium	mg/kg dry	2	n/a	n/a	<2	<2	<2	<2

Notes: CCME guidelines include: ISQG= interim sediment quality guideline, PEL=probable effect levels
PSD=Particle Size Distribution, R=Field Split, RDL=Reported Detection Limit

Exceedances

ISQG
ISQG and PEL

Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ04	29-Aug-14	Aluminum	19200	20200	20	60.00	5.08
AQ04	29-Aug-14	Ammonia as N, Available	10	10	1.00	3.00	0.00
AQ04	29-Aug-14	Antimony	1	1	0.10	0.30	15.38
AQ04	29-Aug-14	Arsenic	13	13	0.40	1.20	2.37
AQ04	29-Aug-14	Barium	184	183	1.00	3.00	0.54
AQ04	29-Aug-14	Beryllium	1	1	0.10	0.30	13.33
AQ04	29-Aug-14	Bismuth	0	0	0.10	0.30	0.00
AQ04	29-Aug-14	Boron	2	2	2.00	6.00	0.00
AQ04	29-Aug-14	Cadmium	0	0	0.04	0.12	0.00
AQ04	29-Aug-14	Calcium	8380	8430	100	300.00	0.59
AQ04	29-Aug-14	Calcium, Available	2170	2670	5.00	15.00	20.66
AQ04	29-Aug-14	Carbon, Total Organic	5	4	0.05	0.15	23.93
AQ04	29-Aug-14	Chromium	33	32	1.00	3.00	1.55
AQ04	29-Aug-14	Cobalt	12	12	0.10	0.30	2.51
AQ04	29-Aug-14	Copper	21	20	0.20	0.60	4.95
AQ04	29-Aug-14	Iron	25700	25400	20.00	60.00	1.17
AQ04	29-Aug-14	Lead	12	12	0.20	0.60	0.00
AQ04	29-Aug-14	Lithium	19	20	0.10	0.30	4.12
AQ04	29-Aug-14	Magnesium	5970	5570	10.00	30.00	6.93
AQ04	29-Aug-14	Magnesium, Available	300	333	5.00	15.00	10.43
AQ04	29-Aug-14	Manganese	697	712	0.40	1.20	2.13
AQ04	29-Aug-14	Mercury	0	0	0.05	0.15	6.90
AQ04	29-Aug-14	Molybdenum	1	1	0.10	0.30	15.38
AQ04	29-Aug-14	Nickel	25	24	0.40	1.20	2.89
AQ04	29-Aug-14	Nitrate as N, Available	1	3	1.00	3.00	**83**
AQ04	29-Aug-14	pH	8	8	0.10	0.30	2.60
AQ04	29-Aug-14	Phosphorus	597	600	10.00	30.00	0.50
AQ04	29-Aug-14	Phosphorus, Available	7	6	2.00	6.00	15.38
AQ04	29-Aug-14	Potassium	1270	1180	10.00	30.00	7.35
AQ04	29-Aug-14	Potassium, Available	102	102	5.00	15.00	0.00
AQ04	29-Aug-14	Selenium	2	1	0.50	1.50	14.29
AQ04	29-Aug-14	Silicon	<3000	<3000	3000.00	9000.00	0.00
AQ04	29-Aug-14	Silver	<0.2	<0.2	0.20	0.60	0.00
AQ04	29-Aug-14	Sodium	246	279	40.00	120.00	12.57
AQ04	29-Aug-14	Sodium, Available	43	25	5.00	15.00	**53**
AQ04	29-Aug-14	Strontium	81	81	0.20	0.60	0.99
AQ04	29-Aug-14	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQ04	29-Aug-14	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQ04	29-Aug-14	Thallium	0	0	0.10	0.30	0.00

Notes:

Bold	*Exceeds Data Quality objective of 25%, but does not meet Practical Quantitation Limit (PQL)*
Bold	*Exceeds Data Quality objective of 25%.*
RPD	*Relative Percent Difference.*
RDL	*Reporting Detection Limit*

Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ04	29-Aug-14	Thorium	15	15	0.50	1.50	1.36
AQ04	29-Aug-14	Tin	1	1	0.20	0.60	**29**
AQ04	29-Aug-14	Titanium	891	891	2.00	6.00	0.00
AQ04	29-Aug-14	Uranium	10	13	0.10	0.30	24.35
AQ04	29-Aug-14	Vanadium	45	47	0.40	1.20	3.04
AQ04	29-Aug-14	Zinc	88	95	2.00	6.00	7.65
AQ04	29-Aug-14	Zirconium	4	4	2.00	6.00	0.00
AQ10	29-Aug-14	Aluminum	17800	18900	20	60.00	5.99
AQ10	29-Aug-14	Ammonia as N, Available	6	8	1.00	3.00	**29**
AQ10	29-Aug-14	Antimony	1	1	0.10	0.30	0.00
AQ10	29-Aug-14	Arsenic	13	14	0.40	1.20	7.58
AQ10	29-Aug-14	Barium	180	192	1.00	3.00	6.45
AQ10	29-Aug-14	Beryllium	1	1	0.10	0.30	15.38
AQ10	29-Aug-14	Bismuth	0	0	0.10	0.30	0.00
AQ10	29-Aug-14	Boron	2	3	2.00	6.00	**40**
AQ10	29-Aug-14	Cadmium	0	0	0.04	0.12	2.90
AQ10	29-Aug-14	Calcium	6980	7210	100.00	300.00	3.24
AQ10	29-Aug-14	Calcium, Available	2500	2500	5.00	15.00	0.00
AQ10	29-Aug-14	Carbon, Total Organic	2	3	0.05	0.15	**29**
AQ10	29-Aug-14	Chromium	36	38	1.00	3.00	6.22
AQ10	29-Aug-14	Cobalt	11	12	0.10	0.30	3.45
AQ10	29-Aug-14	Copper	19	20	0.20	0.60	6.72
AQ10	29-Aug-14	Iron	26800	28200	20.00	60.00	5.09
AQ10	29-Aug-14	Lead	12	12	0.20	0.60	3.33
AQ10	29-Aug-14	Lithium	20	21	0.10	0.30	7.41
AQ10	29-Aug-14	Magnesium	6540	6920	10.00	30.00	5.65
AQ10	29-Aug-14	Magnesium, Available	360	360	5.00	15.00	0.00
AQ10	29-Aug-14	Manganese	615	595	0.40	1.20	3.31
AQ10	29-Aug-14	Mercury	0	0	0.05	0.15	13.33
AQ10	29-Aug-14	Molybdenum	1	1	0.10	0.30	0.00
AQ10	29-Aug-14	Nickel	25	26	0.40	1.20	5.47
AQ10	29-Aug-14	Nitrate as N, Available	2	3	1.00	3.00	20.41
AQ10	29-Aug-14	pH	7	7	0.10	0.30	1.40
AQ10	29-Aug-14	Phosphorus	670	679	10.00	30	1.33
AQ10	29-Aug-14	Phosphorus, Available	3	2	2.00	6.00	40
AQ10	29-Aug-14	Potassium	1240	1320	10.00	**30.00**	6.25
AQ10	29-Aug-14	Potassium, Available	111	121	5.00	15.00	8.62
AQ10	29-Aug-14	Selenium	1	1	0.50	1.50	11.76
AQ10	29-Aug-14	Silicon	<3000	<3000	3000.00	9000.00	0.00

Notes:

Bold	*Exceeds Data Quality objective of 25%, but does not meet Practical Quantitation Limit (PQL)*
Bold	*Exceeds Data Quality objective of 25%.*
RPD	*Relative Percent Difference.*
RDL	*Reporting Detection Limit*

Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ10	29-Aug-14	Silver	<0.2	<0.2	0.20	0.60	0.00
AQ10	29-Aug-14	Sodium	319	326	40.00	120.00	2.17
AQ10	29-Aug-14	Sodium, Available	55	27	5.00	15.00	**68**
AQ10	29-Aug-14	Strontium	47	49	0.20	0.60	3.97
AQ10	29-Aug-14	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQ10	29-Aug-14	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQ10	29-Aug-14	Thallium	0	0	0.10	0.30	0.00
AQ10	29-Aug-14	Thorium	10	10	0.50	1.50	2.02
AQ10	29-Aug-14	Tin	1	1	0.20	0.60	13.33
AQ10	29-Aug-14	Titanium	1160	1180	2.00	6.00	1.71
AQ10	29-Aug-14	Uranium	11	11	0.10	0.30	0.00
AQ10	29-Aug-14	Vanadium	57	59	0.40	1.20	3.10
AQ10	29-Aug-14	Zinc	85	89	2.00	6.00	4.60
AQ10	29-Aug-14	Zirconium	3	4	2.00	6.00	**29**
AQ11	29-Aug-14	Aluminum	19200	19100	20	60.00	0.52
AQ11	29-Aug-14	Ammonia as N, Available	2	2	1.00	3.00	0.00
AQ11	29-Aug-14	Antimony	1	1	0.10	0.30	13.33
AQ11	29-Aug-14	Arsenic	13	15	0.40	1.20	10.14
AQ11	29-Aug-14	Barium	172	178	1.00	3.00	3.43
AQ11	29-Aug-14	Beryllium	1	1	0.10	0.30	18.18
AQ11	29-Aug-14	Bismuth	0	0	0.10	0.30	0.00
AQ11	29-Aug-14	Boron	2	2	2.00	6.00	0.00
AQ11	29-Aug-14	Cadmium	0	0	0.04	0.12	14.63
AQ11	29-Aug-14	Calcium	7030	7220	100.00	300.00	2.67
AQ11	29-Aug-14	Calcium, Available	2500	2300	5.00	15.00	8.33
AQ11	29-Aug-14	Carbon, Total Organic	3	3	0.05	0.15	16.53
AQ11	29-Aug-14	Chromium	35	36	1.00	3.00	0.28
AQ11	29-Aug-14	Cobalt	11	12	0.10	0.30	0.87
AQ11	29-Aug-14	Copper	19	21	0.20	0.60	7.04
AQ11	29-Aug-14	Iron	26900	27800	20.00	60.00	3.29
AQ11	29-Aug-14	Lead	10	11	0.20	0.60	10.33
AQ11	29-Aug-14	Lithium	15	16	0.10	0.30	7.17
AQ11	29-Aug-14	Magnesium	7050	6870	10.00	30.00	2.59
AQ11	29-Aug-14	Magnesium, Available	310	275	5.00	15.00	11.97
AQ11	29-Aug-14	Manganese	656	680	0.40	1.20	3.59
AQ11	29-Aug-14	Mercury	0	0	0.05	0.15	15.38
AQ11	29-Aug-14	Molybdenum	1	1	0.10	0.30	11.76
AQ11	29-Aug-14	Nickel	24	25	0.40	1.20	2.87
AQ11	29-Aug-14	Nitrate as N, Available	2	4	1.00	3.00	**60**

Notes:

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Bold	*Exceeds Data Quality objective of 25%.*
RPD	*Relative Percent Difference.*
RDL	*Reporting Detection Limit*

Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ11	29-Aug-14	pH	7	6	0.10	0.30	21.54
AQ11	29-Aug-14	Phosphorus	735	752	10.00	30	2.29
AQ11	29-Aug-14	Phosphorus, Available	5	4	2.00	6.00	22.22
AQ11	29-Aug-14	Potassium	1360	1330	10.00	30.00	2.23
AQ11	29-Aug-14	Potassium, Available	76	61	5.00	15.00	21.90
AQ11	29-Aug-14	Selenium	1	1	0.50	1.50	0.00
AQ11	29-Aug-14	Silicon	<3000	<3000	3000.00	9000.00	0.00
AQ11	29-Aug-14	Silver	<0.2	<0.2	0.20	0.60	0.00
AQ11	29-Aug-14	Sodium	367	342	40.00	120.00	7.05
AQ11	29-Aug-14	Sodium, Available	49	24	5.00	15.00	**68**
AQ11	29-Aug-14	Strontium	48	52	0.20	0.60	6.62
AQ11	29-Aug-14	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQ11	29-Aug-14	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQ11	29-Aug-14	Thallium	0	0	0.10	0.30	0.00
AQ11	29-Aug-14	Thorium	9	9	0.50	1.50	3.31
AQ11	29-Aug-14	Tin	1	1	0.20	0.60	25.00
AQ11	29-Aug-14	Titanium	1260	1150	2.00	6.00	9.13
AQ11	29-Aug-14	Uranium	9	11	0.10	0.30	23.53
AQ11	29-Aug-14	Vanadium	61	61	0.40	1.20	0.16
AQ11	29-Aug-14	Zinc	85	92	2.00	6.00	7.91
AQ11	29-Aug-14	Zirconium	4	4	2.00	6.00	0.00
AQ13	30-Aug-14	Aluminum	19300	19200	20	60.00	0.52
AQ13	30-Aug-14	Ammonia as N, Available	<1.0	<1.0	1.00	3.00	0.00
AQ13	30-Aug-14	Antimony	1	1	0.10	0.30	0.00
AQ13	30-Aug-14	Arsenic	22	24	0.40	1.20	10.57
AQ13	30-Aug-14	Barium	151	149	1.00	3.00	1.33
AQ13	30-Aug-14	Beryllium	1	1	0.10	0.30	13.33
AQ13	30-Aug-14	Bismuth	0	0	0.10	0.30	**40**
AQ13	30-Aug-14	Boron	<2	2	2.00	6.00	**67**
AQ13	30-Aug-14	Cadmium	0	0	0.04	0.12	17.14
AQ13	30-Aug-14	Calcium	7460	7480	100.00	300.00	0.27
AQ13	30-Aug-14	Calcium, Available	3650	3700	5.00	15.00	1.36
AQ13	30-Aug-14	Carbon, Total Organic	5	4	0.05	0.15	17.46
AQ13	30-Aug-14	Chromium	52	54	1.00	3.00	4.71
AQ13	30-Aug-14	Cobalt	11	11	0.10	0.30	0.89
AQ13	30-Aug-14	Copper	20	20	0.20	0.60	2.03
AQ13	30-Aug-14	Iron	25100	24900	20.00	60.00	0.80
AQ13	30-Aug-14	Lead	10	10	0.20	0.60	5.03
AQ13	30-Aug-14	Lithium	15	14	0.10	0.30	2.08

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Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ13	30-Aug-14	Magnesium	7290	7590	10.00	30.00	4.03
AQ13	30-Aug-14	Magnesium, Available	200	230	5.00	15.00	13.95
AQ13	30-Aug-14	Manganese	632	558	0.40	1.20	12.44
AQ13	30-Aug-14	Mercury	0	0	0.05	0.15	15.38
AQ13	30-Aug-14	Molybdenum	1	1	0.10	0.30	0.00
AQ13	30-Aug-14	Nickel	30	32	0.40	1.20	5.53
AQ13	30-Aug-14	Nitrate as N, Available	1	1	1.00	3.00	15.38
AQ13	30-Aug-14	pH	7	7	0.10	0.30	2.99
AQ13	30-Aug-14	Phosphorus	498	486	10.00	30.00	2.44
AQ13	30-Aug-14	Phosphorus, Available	10	9	2.00	6.00	10.53
AQ13	30-Aug-14	Potassium	1890	1960	10.00	30.00	3.64
AQ13	30-Aug-14	Potassium, Available	91	114	5.00	15.00	22.44
AQ13	30-Aug-14	Selenium	1	1	0.50	1.50	0.00
AQ13	30-Aug-14	Silicon	<3000	<3000	3000.00	9000.00	0.00
AQ13	30-Aug-14	Silver	<0.2	<0.2	0.20	0.60	0.00
AQ13	30-Aug-14	Sodium	288	291	40.00	120.00	1.04
AQ13	30-Aug-14	Sodium, Available	29	26	5.00	15.00	10.91
AQ13	30-Aug-14	Strontium	53	53	0.20	0.60	0.19
AQ13	30-Aug-14	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQ13	30-Aug-14	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQ13	30-Aug-14	Thallium	0	0	0.10	0.30	0.00
AQ13	30-Aug-14	Thorium	12	11	0.50	1.50	4.33
AQ13	30-Aug-14	Tin	1	1	0.20	0.60	0.00
AQ13	30-Aug-14	Titanium	1130	1200	2.00	6.00	6.01
AQ13	30-Aug-14	Uranium	7	7	0.10	0.30	0.00
AQ13	30-Aug-14	Vanadium	49	48	0.40	1.20	2.87
AQ13	30-Aug-14	Zinc	66	64	2.00	6.00	3.08
AQ13	30-Aug-14	Zirconium	4	3	2.00	6.00	**29**
AQ30	29-Aug-14	Aluminum	15100	15100	20	60.00	0.00
AQ30	29-Aug-14	Ammonia as N, Available	5	7	1.00	3.00	**33**
AQ30	29-Aug-14	Antimony	1	1	0.10	0.30	0.00
AQ30	29-Aug-14	Arsenic	15	16	0.40	1.20	5.98
AQ30	29-Aug-14	Barium	202	211	1.00	3.00	4.36
AQ30	29-Aug-14	Beryllium	1	1	0.10	0.30	15.38
AQ30	29-Aug-14	Bismuth	0	0	0.10	0.30	**40**
AQ30	29-Aug-14	Boron	2	2	2.00	6.00	0.00
AQ30	29-Aug-14	Cadmium	0	0	0.04	0.12	0.00
AQ30	29-Aug-14	Calcium	7970	8330	100.00	300.00	4.42
AQ30	29-Aug-14	Calcium, Available	4700	4500	5.00	15.00	4.35

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Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ30	29-Aug-14	Carbon, Total Organic	5	6	0.05	0.15	24.78
AQ30	29-Aug-14	Chromium	31	31	1.00	3	0.96
AQ30	29-Aug-14	Cobalt	10	10	0.10	0.30	1.94
AQ30	29-Aug-14	Copper	20	21	0.20	0.60	3.46
AQ30	29-Aug-14	Iron	24600	24900	20.00	60.00	1.21
AQ30	29-Aug-14	Lead	12	13	0.20	0.60	4.72
AQ30	29-Aug-14	Lithium	13	13	0.10	0.30	3.15
AQ30	29-Aug-14	Magnesium	5920	5920	10.00	30.00	0.00
AQ30	29-Aug-14	Magnesium, Available	385	410	5.00	15.00	6.29
AQ30	29-Aug-14	Manganese	544	585	0.40	1.20	7.26
AQ30	29-Aug-14	Mercury	0	0	0.05	0.15	**35**
AQ30	29-Aug-14	Molybdenum	1	1	0.10	0.30	0.00
AQ30	29-Aug-14	Nickel	20	20	0.40	1.20	0.00
AQ30	29-Aug-14	Nitrate as N, Available	2	2	1.00	3.00	18.18
AQ30	29-Aug-14	pH	7	7	0.10	0.30	1.48
AQ30	29-Aug-14	Phosphorus	609	576	10.00	30.00	5.57
AQ30	29-Aug-14	Phosphorus, Available	6	7	2.00	6.00	15.38
AQ30	29-Aug-14	Potassium	1250	1290	10.00	30.00	3.15
AQ30	29-Aug-14	Potassium, Available	71	94	5.00	15.00	**28**
AQ30	29-Aug-14	Selenium	1	1	0.50	1.50	0.00
AQ30	29-Aug-14	Silicon	<3000	<3000	3000.00	9000.00	0.00
AQ30	29-Aug-14	Silver	<0.2	<0.2	0.20	0.60	0.00
AQ30	29-Aug-14	Sodium	230	229	40.00	120.00	0.44
AQ30	29-Aug-14	Sodium, Available	29	30	5.00	15.00	3.39
AQ30	29-Aug-14	Strontium	60	62	0.20	0.60	3.27
AQ30	29-Aug-14	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQ30	29-Aug-14	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQ30	29-Aug-14	Thallium	0	0	0.10	0.30	0.00
AQ30	29-Aug-14	Thorium	12	12	0.50	1.50	0.00
AQ30	29-Aug-14	Tin	1	1	0.20	0.60	0.00
AQ30	29-Aug-14	Titanium	786	722	2.00	6.00	8.49
AQ30	29-Aug-14	Uranium	7	8	0.10	0.30	8.33
AQ30	29-Aug-14	Vanadium	47	46	0.40	1.20	1.50
AQ30	29-Aug-14	Zinc	64	64	2.00	6.00	0.00
AQ30	29-Aug-14	Zirconium	3	3	2.00	6.00	0.00
AQ02	26-Jul-15	Aluminum	17400	16700	20.00	60.00	4.11
AQ02	26-Jul-15	Ammonia as N, Available	8	9	1.00	3.00	15.03
AQ02	26-Jul-15	Antimony	1	0	0.10	0.30	22.22
AQ02	26-Jul-15	Arsenic	9	8	0.40	1.20	2.38

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Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ02	26-Jul-15	Barium	201	191	1.00	3.00	5.10
AQ02	26-Jul-15	Beryllium	0	0	0.10	0.30	0.00
AQ02	26-Jul-15	Bismuth	0	0	0.10	0.30	0.00
AQ02	26-Jul-15	Boron	2	2	2.00	6.00	0.00
AQ02	26-Jul-15	Cadmium	0	0	0.04	0.12	4.44
AQ02	26-Jul-15	Calcium	7700	6970	100.00	300.00	9.95
AQ02	01-Aug-15	Calcium, Available	2430	2050	5.00	15.00	16.96
AQ02	26-Jul-15	Carbon, Total Organic	6	7	0.05	0.15	17.64
AQ02	26-Jul-15	Chromium	31	30	1.00	3.00	4.96
AQ02	26-Jul-15	Cobalt	11	10	0.10	0.30	7.55
AQ02	26-Jul-15	Copper	20	18	0.20	0.60	10.31
AQ02	26-Jul-15	Iron	25800	24600	20.00	60.00	4.76
AQ02	26-Jul-15	Lead	7	7	0.20	0.60	4.44
AQ02	26-Jul-15	Lithium	14	13	0.10	0.30	5.20
AQ02	26-Jul-15	Magnesium	6770	6550	10.00	30.00	3.30
AQ02	01-Aug-15	Magnesium, Available	421	370	5.00	15.00	12.90
AQ02	26-Jul-15	Manganese	569	519	0.40	1.20	9.19
AQ02	26-Jul-15	Mercury	0	0	0.05	0.15	13.33
AQ02	26-Jul-15	Moisture	57	51	0.10	0.30	11.03
AQ02	26-Jul-15	Molybdenum	1	1	0.10	0.30	11.76
AQ02	26-Jul-15	Nickel	19	18	0.40	1.20	5.35
AQ02	26-Jul-15	Nitrate as N, Available	2	1	1.00	3.00	**53**
AQ02	26-Jul-15	pH	6	6	0.10	0.30	1.60
AQ02	26-Jul-15	Phosphorus	637	655	10.00	30.00	2.79
AQ02	26-Jul-15	Phosphorus, Available	4	3	2.00	6.00	**29**
AQ02	26-Jul-15	Potassium	1260	1190	10.00	30.00	5.71
AQ02	26-Jul-15	Potassium, Available	130	103	5.00	15.00	23.18
AQ02	26-Jul-15	Selenium	1	1	0.50	1.50	**29**
AQ02	26-Jul-15	Silicon	<3000	<3000	3000.00	9000.00	0.00
AQ02	26-Jul-15	Silver	<0.2	<0.2	0.20	0.60	0.00
AQ02	26-Jul-15	Sodium	273	288	40.00	120.00	5.35
AQ02	01-Aug-15	Sodium, Available	34	20	5.00	15.00	**52**
AQ02	26-Jul-15	Strontium	44	41	0.20	0.60	6.57
AQ02	26-Jul-15	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQ02	26-Jul-15	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQ02	26-Jul-15	Thallium	0	0	0.10	0.30	0.00
AQ02	26-Jul-15	Thorium	5	5	0.50	1.50	0.00
AQ02	26-Jul-15	Tin	1	1	0.20	0.60	18.18
AQ02	26-Jul-15	Titanium	1070	1080	2.00	6.00	0.93

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Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ02	26-Jul-15	Uranium	8	6	0.10	0.30	24.46
AQ02	26-Jul-15	Vanadium	56	55	0.40	1.20	2.15
AQ02	26-Jul-15	Zinc	70	67	2.00	6.00	4.38
AQ02	26-Jul-15	Zirconium	2	2	2.00	6.00	0.00
AQREF1	27-Jul-15	Aluminum	13200	14500	20.00	60.00	9.39
AQREF1	27-Jul-15	Antimony	2	2	0.10	0.30	0.00
AQREF1	27-Jul-15	Arsenic	12	11	0.40	1.20	5.36
AQREF1	27-Jul-15	Barium	322	325	1.00	3.00	0.93
AQREF1	27-Jul-15	Beryllium	1	1	0.10	0.30	0.00
AQREF1	27-Jul-15	Bismuth	0	0	0.10	0.30	0.00
AQREF1	27-Jul-15	Boron	2	2	2.00	6.00	0.00
AQREF1	27-Jul-15	Cadmium	0	0	0.04	0.12	0.00
AQREF1	27-Jul-15	Calcium	9070	9340	100.00	300.00	2.93
AQREF1	27-Jul-15	Carbon, Total Organic	4	6	0.05	0.15	**26**
AQREF1	27-Jul-15	Chromium	27	27	1.00	3.00	0.00
AQREF1	27-Jul-15	Cobalt	9	9	0.10	0.30	6.74
AQREF1	27-Jul-15	Copper	22	22	0.20	0.60	1.35
AQREF1	27-Jul-15	Iron	20600	21400	20.00	60.00	3.81
AQREF1	27-Jul-15	Lead	10	10	0.20	0.60	6.12
AQREF1	27-Jul-15	Lithium	12	12	0.10	0.30	5.91
AQREF1	27-Jul-15	Magnesium	6080	6240	10.00	30.00	2.60
AQREF1	27-Jul-15	Manganese	242	199	0.40	1.20	19.50
AQREF1	27-Jul-15	Mercury	0	0	0.05	0.15	0.00
AQREF1	27-Jul-15	Moisture	64	56	0.10	0.30	13.20
AQREF1	27-Jul-15	Molybdenum	1	1	0.10	0.30	0.00
AQREF1	27-Jul-15	Nickel	21	21	0.40	1.20	0.49
AQREF1	27-Jul-15	pH	7	7	0.10	0.30	1.53
AQREF1	27-Jul-15	Phosphorus	771	829	10.00	30.00	7.25
AQREF1	27-Jul-15	Potassium	884	1040	10.00	30.00	16.22
AQREF1	27-Jul-15	Selenium	1	1	0.50	1.50	18.18
AQREF1	27-Jul-15	Silicon	<3000	<3000	3000.00	9000.00	0.00
AQREF1	27-Jul-15	Silver	<0.2	<0.2	0.20	0.60	0.00
AQREF1	27-Jul-15	Sodium	225	246	40.00	120.00	8.92
AQREF1	27-Jul-15	Strontium	61	60	0.20	0.60	1.66
AQREF1	27-Jul-15	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQREF1	27-Jul-15	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQREF1	27-Jul-15	Thallium	0	0	0.10	0.30	**67**
AQREF1	27-Jul-15	Thorium	6	6	0.50	1.50	8.26
AQREF1	27-Jul-15	Tin	0	1	0.20	0.60	22.22

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Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQREF1	27-Jul-15	Titanium	700	758	2.00	6.00	7.96
AQREF1	27-Jul-15	Uranium	5	4	0.10	0.30	2.25
AQREF1	27-Jul-15	Vanadium	46	49	0.40	1.20	7.36
AQREF1	27-Jul-15	Zinc	70	71	2.00	6.00	1.42
AQREF1	27-Jul-15	Zirconium	<2	<2	2.00	6.00	0.00
AQ10	28-Jul-15	Aluminum	16100	14700	20.00	60.00	9.09
AQ10	28-Jul-15	Ammonia as N, Available	11	11	1.00	3.00	0.00
AQ10	28-Jul-15	Antimony	1	1	0.10	0.30	0.00
AQ10	28-Jul-15	Arsenic	12	9	0.40	1.20	**26**
AQ10	28-Jul-15	Barium	164	149	1.00	3.00	9.58
AQ10	28-Jul-15	Beryllium	0	0	0.10	0.30	**29**
AQ10	28-Jul-15	Bismuth	0	0	0.10	0.30	0.00
AQ10	28-Jul-15	Boron	2	<2	2.00	6.00	**67**
AQ10	28-Jul-15	Cadmium	0	0	0.04	0.12	25.00
AQ10	28-Jul-15	Calcium	7530	6340	100.00	300.00	17.16
AQ10	28-Jul-15	Calcium, Available	1790	1640	5.00	15.00	8.75
AQ10	28-Jul-15	Carbon, Total Organic	4	4	0.05	0.15	13.24
AQ10	28-Jul-15	Chromium	32	29	1.00	3.00	9.18
AQ10	28-Jul-15	Cobalt	11	10	0.10	0.30	13.73
AQ10	28-Jul-15	Copper	16	14	0.20	0.60	12.71
AQ10	28-Jul-15	Iron	23900	21500	20.00	60.00	10.57
AQ10	28-Jul-15	Lead	10	9	0.20	0.60	10.53
AQ10	28-Jul-15	Lithium	14	13	0.10	0.30	14.13
AQ10	28-Jul-15	Magnesium	5970	5710	10.00	30.00	4.45
AQ10	28-Jul-15	Magnesium, Available	279	275	5.00	15.00	1.44
AQ10	28-Jul-15	Manganese	605	479	0.40	1.20	23.25
AQ10	28-Jul-15	Mercury	0	<0.05	0.05	0.15	**82**
AQ10	28-Jul-15	Moisture	51	44	0.10	0.30	13.70
AQ10	28-Jul-15	Molybdenum	1	1	0.10	0.30	15.38
AQ10	28-Jul-15	Nickel	21	19	0.40	1.20	10.53
AQ10	28-Jul-15	Nitrate as N, Available	3	3	1.00	3.00	6.90
AQ10	28-Jul-15	pH	6	6	0.10	0.30	3.23
AQ10	28-Jul-15	Phosphorus	700	650	10.00	30.00	7.41
AQ10	28-Jul-15	Phosphorus, Available	4	8	2.00	6.00	**67**
AQ10	28-Jul-15	Potassium	1050	942	10.00	30.00	10.84
AQ10	28-Jul-15	Potassium, Available	100	91	5.00	15.00	9.42
AQ10	28-Jul-15	Selenium	1	1	0.50	1.50	13.33
AQ10	28-Jul-15	Silicon	<3000	<3000	3000.00	9000.00	0.00
AQ10	28-Jul-15	Silver	<0.2	<0.2	0.20	0.60	0.00

Notes:

Bold	*Exceeds Data Quality objective of 25%, but does not meet Practical Quantitation Limit (PQL)*
Bold	*Exceeds Data Quality objective of 25%.*
RPD	*Relative Percent Difference.*
RDL	*Reporting Detection Limit*

Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ10	28-Jul-15	Sodium	279	254	40.00	120.00	9.38
AQ10	28-Jul-15	Sodium, Available	20	19	5.00	15.00	5.13
AQ10	28-Jul-15	Strontium	40	34	0.20	0.60	17.20
AQ10	28-Jul-15	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQ10	28-Jul-15	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQ10	28-Jul-15	Thallium	0	0	0.10	0.30	**67**
AQ10	28-Jul-15	Thorium	7	6	0.50	1.50	16.30
AQ10	28-Jul-15	Tin	1	1	0.20	0.60	0.00
AQ10	28-Jul-15	Titanium	1090	1040	2.00	6.00	4.69
AQ10	28-Jul-15	Uranium	5	4	0.10	0.30	**37**
AQ10	28-Jul-15	Vanadium	52	46	0.40	1.20	11.64
AQ10	28-Jul-15	Zinc	73	68	2.00	6.00	7.09
AQ10	28-Jul-15	Zirconium	2	2	2.00	6.00	0.00
AQ04	29-Jul-15	Aluminum	18200	17500	20.00	60.00	3.92
AQ04	29-Jul-15	Ammonia as N, Available	9	11	1.00	3.00	16.75
AQ04	29-Jul-15	Antimony	1	1	0.10	0.30	0.00
AQ04	29-Jul-15	Arsenic	12	11	0.40	1.20	9.87
AQ04	29-Jul-15	Barium	184	170	1.00	3.00	7.91
AQ04	29-Jul-15	Beryllium	1	1	0.10	0.30	18.18
AQ04	29-Jul-15	Bismuth	0	0	0.10	0.30	0.00
AQ04	29-Jul-15	Boron	2	2	2.00	6.00	0.00
AQ04	29-Jul-15	Cadmium	0	0	0.04	0.12	3.51
AQ04	29-Jul-15	Calcium	7490	7230	100.00	300.00	3.53
AQ04	29-Jul-15	Calcium, Available	2210	2140	5.00	15.00	3.22
AQ04	29-Jul-15	Carbon, Total Organic	5	5	0.05	0.15	3.18
AQ04	29-Jul-15	Chromium	33	31	1.00	3.00	6.27
AQ04	29-Jul-15	Cobalt	11	10	0.10	0.30	4.69
AQ04	29-Jul-15	Copper	18	15	0.20	0.60	13.90
AQ04	29-Jul-15	Iron	25400	23500	20.00	60.00	7.77
AQ04	29-Jul-15	Lead	11	11	0.20	0.60	1.77
AQ04	29-Jul-15	Lithium	16	16	0.10	0.30	0.63
AQ04	29-Jul-15	Magnesium	6450	5930	10.00	30.00	8.40
AQ04	29-Jul-15	Magnesium, Available	364	314	5.00	15.00	14.75
AQ04	29-Jul-15	Manganese	726	548	0.40	1.20	**28**
AQ04	29-Jul-15	Mercury	0	0	0.05	0.15	0.00
AQ04	29-Jul-15	Moisture	37	49	0.10	0.30	**29**
AQ04	29-Jul-15	Molybdenum	1	1	0.10	0.30	15.38
AQ04	29-Jul-15	Nickel	22	20	0.40	1.20	7.58
AQ04	29-Jul-15	Nitrate as N, Available	2	1	1.00	3.00	20.69

Notes:

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RPD	*Relative Percent Difference.*
RDL	*Reporting Detection Limit*

Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ04	29-Jul-15	pH	7	7	0.10	0.30	1.48
AQ04	29-Jul-15	Phosphorus	573	532	10.00	30.00	7.42
AQ04	29-Jul-15	Phosphorus, Available	5	2	2.00	6.00	**86**
AQ04	29-Jul-15	Potassium	1140	1020	10.00	30.00	11.11
AQ04	29-Jul-15	Potassium, Available	80	63	5.00	15.00	23.78
AQ04	29-Jul-15	Selenium	2	2	0.50	1.50	5.13
AQ04	29-Jul-15	Silicon	<3000	<3000	3000.00	9000.00	0.00
AQ04	29-Jul-15	Silver	<0.2	<0.2	0.20	0.60	0.00
AQ04	29-Jul-15	Sodium	242	237	40.00	120.00	2.09
AQ04	29-Jul-15	Sodium, Available	20	19	5.00	15.00	5.13
AQ04	29-Jul-15	Strontium	62	61	0.20	0.60	2.44
AQ04	29-Jul-15	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQ04	29-Jul-15	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQ04	29-Jul-15	Thallium	0	0	0.10	0.30	0.00
AQ04	29-Jul-15	Thorium	11	11	0.50	1.50	2.82
AQ04	29-Jul-15	Tin	1	1	0.20	0.60	0.00
AQ04	29-Jul-15	Titanium	952	922	2.00	6.00	3.20
AQ04	29-Jul-15	Uranium	13	12	0.10	0.30	4.05
AQ04	29-Jul-15	Vanadium	50	45	0.40	1.20	11.42
AQ04	29-Jul-15	Zinc	74	74	2.00	6.00	0.00
AQ04	29-Jul-15	Zirconium	2	2	2.00	6.00	0.00
AQ13	30-Jul-15	Aluminum	17900	17200	20.00	60.00	3.99
AQ13	30-Jul-15	Ammonia as N, Available	10	5	1.00	3.00	**61**
AQ13	30-Jul-15	Antimony	1	1	0.10	0.30	0.00
AQ13	30-Jul-15	Arsenic	23	20	0.40	1.20	10.77
AQ13	30-Jul-15	Barium	137	132	1.00	3.00	3.72
AQ13	30-Jul-15	Beryllium	1	1	0.10	0.30	18.18
AQ13	30-Jul-15	Bismuth	0	0	0.10	0.30	**40**
AQ13	30-Jul-15	Boron	<2	<2	2.00	6.00	0.00
AQ13	30-Jul-15	Cadmium	0	0	0.04	0.12	**26**
AQ13	30-Jul-15	Calcium	7090	6060	100.00	300.00	15.67
AQ13	30-Jul-15	Calcium, Available	2700	2400	5.00	15.00	11.76
AQ13	30-Jul-15	Carbon, Total Organic	4	3	0.05	0.15	**47**
AQ13	30-Jul-15	Chromium	48	49	1.00	3.00	1.03
AQ13	30-Jul-15	Cobalt	10	10	0.10	0.30	4.08
AQ13	30-Jul-15	Copper	18	17	0.20	0.60	3.43
AQ13	30-Jul-15	Iron	23300	23300	20.00	60.00	0.00
AQ13	30-Jul-15	Lead	8	8	0.20	0.60	6.29
AQ13	30-Jul-15	Lithium	12	12	0.10	0.30	1.63

Notes:

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RPD	*Relative Percent Difference.*
RDL	*Reporting Detection Limit*

Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ13	30-Jul-15	Magnesium	7120	7220	10.00	30.00	1.39
AQ13	30-Jul-15	Magnesium, Available	210	210	5.00	15.00	0.00
AQ13	30-Jul-15	Manganese	635	413	0.40	1.20	**42**
AQ13	30-Jul-15	Mercury	0	<0.05	0.05	0.15	**82**
AQ13	30-Jul-15	Moisture	62	40	0.10	0.30	**44**
AQ13	30-Jul-15	Molybdenum	1	1	0.10	0.30	0.00
AQ13	30-Jul-15	Nickel	28	28	0.40	1.20	2.15
AQ13	30-Jul-15	Nitrate as N, Available	3	2	1.00	3.00	**62**
AQ13	30-Jul-15	pH	6	6	0.10	0.30	5.31
AQ13	30-Jul-15	Phosphorus	469	526	10.00	30.00	11.46
AQ13	30-Jul-15	Phosphorus, Available	2	5	2.00	6.00	**86**
AQ13	30-Jul-15	Potassium	1710	1950	10.00	30.00	13.11
AQ13	30-Jul-15	Potassium, Available	92	108	5.00	15.00	16.00
AQ13	30-Jul-15	Selenium	2	1	0.50	1.50	**91**
AQ13	30-Jul-15	Silicon	<3000	<3000	3000.00	9000.00	0.00
AQ13	30-Jul-15	Silver	<0.2	<0.2	0.20	0.60	0.00
AQ13	30-Jul-15	Sodium	240	263	40.00	120.00	9.15
AQ13	30-Jul-15	Sodium, Available	28	24	5.00	15.00	15.38
AQ13	30-Jul-15	Strontium	46	41	0.20	0.60	10.60
AQ13	30-Jul-15	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQ13	30-Jul-15	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQ13	30-Jul-15	Thallium	0	0	0.10	0.30	0.00
AQ13	30-Jul-15	Thorium	10	10	0.50	1.50	0.00
AQ13	30-Jul-15	Tin	1	1	0.20	0.60	0.00
AQ13	30-Jul-15	Titanium	1060	1160	2.00	6.00	9.01
AQ13	30-Jul-15	Uranium	4	3	0.10	0.30	**44**
AQ13	30-Jul-15	Vanadium	44	46	0.40	1.20	4.02
AQ13	30-Jul-15	Zinc	57	55	2.00	6.00	3.57
AQ13	30-Jul-15	Zirconium	<2	<2	2.00	6.00	0.00
AQ20	30-Jul-15	Aluminum	14900	15800	20.00	60.00	5.86
AQ20	30-Jul-15	Ammonia as N, Available	8	10	1.00	3.00	22.22
AQ20	30-Jul-15	Antimony	1	1	0.10	0.30	20.00
AQ20	30-Jul-15	Arsenic	14	13	0.40	1.20	9.74
AQ20	30-Jul-15	Barium	179	191	1.00	3.00	6.49
AQ20	30-Jul-15	Beryllium	1	1	0.10	0.30	18.18
AQ20	30-Jul-15	Bismuth	0	0	0.10	0.30	**67**
AQ20	30-Jul-15	Boron	2	3	2.00	6.00	**40**
AQ20	30-Jul-15	Cadmium	0	0	0.04	0.12	12.50
AQ20	30-Jul-15	Calcium	9550	10600	100.00	300.00	10.42

Notes:

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Bold	*Exceeds Data Quality objective of 25%.*
RPD	*Relative Percent Difference.*
RDL	*Reporting Detection Limit*

Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ20	30-Jul-15	Calcium, Available	3570	3790	5.00	15.00	5.98
AQ20	30-Jul-15	Carbon, Total Organic	11	11	0.05	0.15	0.95
AQ20	30-Jul-15	Chromium	34	37	1.00	3.00	7.09
AQ20	30-Jul-15	Cobalt	9	8	0.10	0.30	13.02
AQ20	30-Jul-15	Copper	19	24	0.20	0.60	23.15
AQ20	30-Jul-15	Iron	21200	20100	20.00	60.00	5.33
AQ20	30-Jul-15	Lead	7	8	0.20	0.60	2.70
AQ20	30-Jul-15	Lithium	14	16	0.10	0.30	14.24
AQ20	30-Jul-15	Magnesium	6280	6440	10.00	30.00	2.52
AQ20	30-Jul-15	Magnesium, Available	514	486	5.00	15.00	5.60
AQ20	30-Jul-15	Manganese	433	238	0.40	1.20	**58**
AQ20	30-Jul-15	Mercury	0	0	0.05	0.15	**29**
AQ20	30-Jul-15	Moisture	49	43	0.10	0.30	12.43
AQ20	30-Jul-15	Molybdenum	1	1	0.10	0.30	18.18
AQ20	30-Jul-15	Nickel	23	24	0.40	1.20	6.84
AQ20	30-Jul-15	Nitrate as N, Available	2	4	1.00	3.00	**46**
AQ20	30-Jul-15	pH	7	7	0.10	0.30	0.00
AQ20	30-Jul-15	Phosphorus	667	680	10.00	30.00	1.93
AQ20	30-Jul-15	Phosphorus, Available	2	3	2.00	6.00	**40**
AQ20	30-Jul-15	Potassium	1220	1110	10.00	30.00	9.44
AQ20	30-Jul-15	Potassium, Available	99	81	5.00	15.00	20.00
AQ20	30-Jul-15	Selenium	1	<0.5	0.50	1.50	**131**
AQ20	30-Jul-15	Silicon	<3000	<3000	3000.00	9000.00	0.00
AQ20	30-Jul-15	Silver	<0.2	<0.2	0.20	0.60	0.00
AQ20	30-Jul-15	Sodium	210	198	40.00	120.00	5.88
AQ20	30-Jul-15	Sodium, Available	21	21	5.00	15.00	0.00
AQ20	30-Jul-15	Strontium	82	93	0.20	0.60	12.42
AQ20	30-Jul-15	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQ20	30-Jul-15	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQ20	30-Jul-15	Thallium	0	0	0.10	0.30	**67**
AQ20	30-Jul-15	Thorium	8	9	0.50	1.50	4.65
AQ20	30-Jul-15	Tin	1	1	0.20	0.60	0.00
AQ20	30-Jul-15	Titanium	763	742	2.00	6.00	2.79
AQ20	30-Jul-15	Uranium	28	29	0.10	0.30	3.52
AQ20	30-Jul-15	Vanadium	40	35	0.40	1.20	12.27
AQ20	30-Jul-15	Zinc	57	54	2.00	6.00	5.41
AQ20	30-Jul-15	Zirconium	3	3	2.00	6.00	0.00
AQ04.5	01-Aug-15	Aluminum	15500	16400	20.00	60.00	5.64
AQ04.5	01-Aug-15	Ammonia as N, Available	12	9	1.00	3.00	**25**

Notes:

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Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ04.5	01-Aug-15	Antimony	1	1	0.10	0.30	0.00
AQ04.5	01-Aug-15	Arsenic	13	14	0.40	1.20	6.74
AQ04.5	01-Aug-15	Barium	152	172	1.00	3.00	12.35
AQ04.5	01-Aug-15	Beryllium	1	0	0.10	0.30	22.22
AQ04.5	01-Aug-15	Bismuth	0	0	0.10	0.30	0.00
AQ04.5	01-Aug-15	Boron	<2	<2	2.00	6.00	0.00
AQ04.5	01-Aug-15	Cadmium	0	0	0.04	0.12	**31**
AQ04.5	01-Aug-15	Calcium	4980	5180	100.00	300.00	3.94
AQ04.5	01-Aug-15	Calcium, Available	1570	1820	5.00	15.00	14.75
AQ04.5	01-Aug-15	Carbon, Total Organic	7	8	0.05	0.15	17.46
AQ04.5	01-Aug-15	Chromium	26	27	1.00	3.00	5.65
AQ04.5	01-Aug-15	Cobalt	9	13	0.10	0.30	**34**
AQ04.5	01-Aug-15	Copper	12	13	0.20	0.60	7.87
AQ04.5	01-Aug-15	Iron	22700	23600	20.00	60.00	3.89
AQ04.5	01-Aug-15	Lead	11	12	0.20	0.60	8.77
AQ04.5	01-Aug-15	Lithium	12	12	0.10	0.30	2.49
AQ04.5	01-Aug-15	Magnesium	4880	5000	10.00	30.00	2.43
AQ04.5	01-Aug-15	Magnesium, Available	250	271	5.00	15.00	8.06
AQ04.5	01-Aug-15	Manganese	1110	1680	0.40	1.20	**41**
AQ04.5	01-Aug-15	Mercury	0	0	0.05	0.15	8.70
AQ04.5	01-Aug-15	Moisture	56	59	0.10	0.30	4.53
AQ04.5	01-Aug-15	Molybdenum	1	1	0.10	0.30	13.33
AQ04.5	01-Aug-15	Nickel	16	17	0.40	1.20	9.17
AQ04.5	01-Aug-15	Nitrate as N, Available	4	3	1.00	3.00	**31**
AQ04.5	01-Aug-15	pH	6	6	0.10	0.30	3.45
AQ04.5	01-Aug-15	Phosphorus	528	577	10.00	30.00	8.87
AQ04.5	01-Aug-15	Phosphorus, Available	3	4	2.00	6.00	**29**
AQ04.5	01-Aug-15	Potassium	741	739	10.00	30.00	0.27
AQ04.5	01-Aug-15	Potassium, Available	171	146	5.00	15.00	15.77
AQ04.5	01-Aug-15	Selenium	<0.5	1	0.50	1.50	**82**
AQ04.5	01-Aug-15	Silicon	<3000	<3000	3000.00	9000.00	0.00
AQ04.5	01-Aug-15	Silver	<0.2	<0.2	0.20	0.60	0.00
AQ04.5	01-Aug-15	Sodium	187	180	40.00	120.00	3.81
AQ04.5	01-Aug-15	Sodium, Available	19	16	5.00	15.00	17.14
AQ04.5	01-Aug-15	Strontium	36	39	0.20	0.60	8.19
AQ04.5	01-Aug-15	Sulfur	<1000	<1000	1000.00	3000.00	0.00
AQ04.5	01-Aug-15	Tellurium	<0.1	<0.1	0.10	0.30	0.00
AQ04.5	01-Aug-15	Thallium	0	0	0.10	0.30	0.00
AQ04.5	01-Aug-15	Thorium	10	10	0.50	1.50	0.00

Notes:

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RPD	*Relative Percent Difference.*
RDL	*Reporting Detection Limit*

Appendix B2. Sediment Quality Replicate Data, Coffee Gold Project, 2014-2015

Site	Date	Parameter	Value	Replicate Value	RDL	PQL	RPD
AQ04.5	01-Aug-15	Tin	1	1	0.20	0.60	0.00
AQ04.5	01-Aug-15	Titanium	826	759	2.00	6.00	8.45
AQ04.5	01-Aug-15	Uranium	7	6	0.10	0.30	13.74
AQ04.5	01-Aug-15	Vanadium	46	48	0.40	1.20	3.60
AQ04.5	01-Aug-15	Zinc	68	69	2.00	6.00	1.46
AQ04.5	01-Aug-15	Zirconium	<2	<2	2.00	6.00	0.00

Notes:

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Appendix C

Periphyton

- **C1. Periphyton Biomass, Coffee Gold Project, 2014-2015**
- **C2. Periphyton Taxonomy, Coffee Gold Project, 2014-2015**

Appendix C1. Chlorophyll *a* and Periphyton Ash-free Dry Mass 2014-2015

2014			SITE	AQ11	AQ10	AQ20	AQ30	AQ00	AQREF1	AQ02	AQ04	AQ05	AQ13
			DATE SAMPLED	31-Aug-14	31-Aug-14	31-Aug-14	31-Aug-14	31-Aug-14	31-Aug-14	31-Aug-14	31-Aug-14	31-Aug-14	31-Aug-14
Analyte	Units	MRL	DATE RECEIVED	04-Sep-14	04-Sep-14	04-Sep-14	04-Sep-14	04-Sep-14	04-Sep-14	04-Sep-14	04-Sep-14	04-Sep-14	04-Sep-14
Solids, Total Volatile	mg/L	10		60	63	84	93	40	67	59	64	49	53
Chlorophyll-a	µg/L	0.1		10	12	19	9	12	33	22	12	9	10

Note: Recommended holding times were surpassed for chlorophyll a analyses, but not for ash-free dry mass.

Recommended sample temperatures (1-8°C) may have been exceeded during transport to the lab.

MRL= Method Reporting Limit

2015			SITE	AQ11	AQ10	AQ20	AQ30	AQ00	AQREF1	AQ02	AQ04	AQ04.5	AQ13	AQREF2
			DATE SAMPLED	01-Aug-15	01-Aug-15	01-Aug-15	01-Aug-15	01-Aug-15	01-Aug-15	01-Aug-15	01-Aug-15	01-Aug-15	01-Aug-15	01-Aug-15
Analyte	Units	MRL	DATE RECEIVED	06-Aug-15	06-Aug-15	06-Aug-15	06-Aug-15	06-Aug-15	06-Aug-15	06-Aug-15	06-Aug-15	06-Aug-15	06-Aug-15	06-Aug-15
Solids, Total Volatile	mg/L	10		37	83	160	37	47	73	90	53	43	70	93
Chlorophyll-a	µg/L	0.1		12	23.5	23.6	29	12.7	20.8	26.6	11	24.3	23.7	19

Note: Recommended holding times were surpassed for chlorophyll a analyses, but not for ash-free dry mass.

MRL= Method Reporting Limit

Appendix C2. Periphyton taxonomy data, Coffee Gold Project, 2014-2015

Site	Date	Species code	Species name	biomass µg/cm^2	density cells/cm^2	length µ	width µ	cell volume µ^3
AQ00	31-Aug-14	1014	Chroococcus limneticus Lemmermann	0.06	1134.82	6.00	4.00	50.30
AQ00	31-Aug-14	1084	Gloeocapsa punctata	1.16	26100.80	4.40	4.40	44.60
AQ00	31-Aug-14	1102	Gloeothece sp.	0.12	24398.58	2.10	2.10	4.80
AQ00	31-Aug-14	1122	Phormidium autumnale Agardh	3.02	1134.82	94.00	6.00	2657.80
AQ00	31-Aug-14	1131	Heteroleibeinia profunda Komarek	0.45	6808.90	21.00	2.00	66.00
AQ00	31-Aug-14	1223	Chamaesiphon incrustans Smith	2.95	76032.77	6.80	3.30	38.80
AQ00	31-Aug-14	2231	Bulbochaete sp.	1.94	2837.04	13.60	8.00	683.60
AQ00	31-Aug-14	5702	Achnanthes minutissima Kutzing	0.97	12482.99	18.60	4.00	77.90
AQ00	31-Aug-14	5768	Nitzschia linearis W. Smith	0.09	567.41	36.00	4.00	150.80
AQ00	31-Aug-14	5826	Cymbella gracilis (Rabhorst) Cleve	0.66	567.41	46.00	8.00	1156.10
AQ00	31-Aug-14	5860	Diatoma vulgare Bory	1.67	6808.90	26.00	6.00	245.00
AQ00	31-Aug-14	5873	Gomphonema minutum	0.72	1702.23	25.40	8.00	425.60
AQ00	31-Aug-14	5916	Fragilaria capucina Grunow	0.33	567.41	61.00	6.00	574.90
AQ02	31-Aug-14	1077	Pseudoanabaena sp.	0.12	1337.46	26.00	2.10	90.10
AQ02	31-Aug-14	1084	Gloeocapsa punctata	0.45	13374.63	4.00	4.00	33.50
AQ02	31-Aug-14	1102	Gloeothece sp.	0.03	4681.12	2.20	2.20	5.60
AQ02	31-Aug-14	1131	Heteroleibeinia profunda Komarek	0.72	10699.71	21.30	2.00	66.90
AQ02	31-Aug-14	1223	Chamaesiphon incrustans Smith	3.06	75566.68	7.10	3.30	40.50
AQ02	31-Aug-14	5702	Achnanthes minutissima Kutzing	4.82	62860.78	18.30	4.00	76.70
AQ02	31-Aug-14	5768	Nitzschia linearis W. Smith	0.33	2006.20	39.10	4.00	163.80
AQ02	31-Aug-14	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1.58	1337.46	30.00	10.00	1178.10
AQ02	31-Aug-14	5860	Diatoma vulgare Bory	2.82	10699.71	28.00	6.00	263.90
AQ02	31-Aug-14	5873	Gomphonema minutum	0.60	1337.46	26.60	8.00	445.70
AQ04	31-Aug-14	1084	Gloeocapsa punctata	0.40	11014.40	4.10	4.10	36.10
AQ04	31-Aug-14	1102	Gloeothece sp.	0.21	28637.45	2.40	2.40	7.20
AQ04	31-Aug-14	1122	Phormidium autumnale Agardh	2.93	1101.44	94.00	6.00	2657.80
AQ04	31-Aug-14	1131	Heteroleibeinia profunda Komarek	1.37	23130.25	18.90	2.00	59.40
AQ04	31-Aug-14	1223	Chamaesiphon incrustans Smith	7.60	204867.93	6.50	3.30	37.10
AQ04	31-Aug-14	2231	Bulbochaete sp.	5.05	6608.64	15.20	8.00	764.00
AQ04	31-Aug-14	5702	Achnanthes minutissima Kutzing	0.18	2202.88	19.10	4.00	80.00
AQ04	31-Aug-14	5860	Diatoma vulgare Bory	0.62	2202.88	30.00	6.00	282.70
AQ04R	31-Aug-14	1084	Gloeocapsa punctata	0.48	13217.29	4.10	4.10	36.10
AQ04R	31-Aug-14	1102	Gloeothece sp.	0.25	34144.65	2.40	2.40	7.20
AQ04R	31-Aug-14	1122	Phormidium autumnale Agardh	6.23	2202.88	100.00	6.00	2827.40
AQ04R	31-Aug-14	1131	Heteroleibeinia profunda Komarek	1.24	20927.37	18.90	2.00	59.40
AQ04R	31-Aug-14	1223	Chamaesiphon incrustans Smith	6.91	186143.44	6.50	3.30	37.10
AQ04R	31-Aug-14	1239	Homoeothrix varians Komarek & Kalina	0.23	2202.88	33.00	2.00	103.70

Appendix C2. Periphyton taxonomy data, Coffee Gold Project, 2014-2015

Site	Date	Species code	Species name	biomass µg/cm^2	density cells/cm^2	length µ	width µ	cell volume µ^3
AQ04R	31-Aug-14	2231	Bulbochaete sp.	5.89	7710.08	15.20	8.00	764.00
AQ04R	31-Aug-14	5702	Achnanthes minutissima Kutzing	0.18	2202.88	19.10	4.00	80.00
AQ04R	31-Aug-14	5768	Nitzschia linearis W. Smith	0.40	1101.44	38.40	6.00	361.90
AQ04R	31-Aug-14	5860	Diatoma vulgare Bory	0.31	1101.44	30.00	6.00	282.70
AQ05	31-Aug-14	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.13	435.45	93.00	2.00	292.20
AQ05	31-Aug-14	1077	Pseudoanabaena sp.	0.07	435.45	41.00	2.20	155.90
AQ05	31-Aug-14	1102	Gloeothece sp.	0.38	9144.52	4.30	4.30	41.60
AQ05	31-Aug-14	1131	Heteroleibeinia profunda Komarek	0.23	3483.63	21.40	2.00	67.20
AQ05	31-Aug-14	1223	Chamaesiphon incrustans Smith	0.37	50948.03	2.40	2.40	7.20
AQ05	31-Aug-14	1239	Homoeothrix varians Komarek & Kalina	0.10	870.91	31.60	2.20	120.10
AQ05	31-Aug-14	5702	Achnanthes minutissima Kutzing	0.07	870.91	18.60	4.00	77.90
AQ05	31-Aug-14	5768	Nitzschia linearis W. Smith	0.20	435.45	49.00	6.00	461.80
AQ05	31-Aug-14	5826	Cymbella gracilis (Rabhorst) Cleve	0.50	435.45	46.00	8.00	1156.10
AQ05	31-Aug-14	5860	Diatoma vulgare Bory	0.24	870.91	29.00	6.00	273.30
AQ05	31-Aug-14	5917	Hannaea arcus Patrick	0.44	870.91	53.00	6.00	499.50
AQ10	31-Aug-14	1122	Phormidium autumnale Agardh	33.85	8869.49	135.00	6.00	3817.00
AQ10	31-Aug-14	1223	Chamaesiphon incrustans Smith	2.38	59622.71	7.00	3.30	39.90
AQ10	31-Aug-14	1239	Homoeothrix varians Komarek & Kalina	0.19	1478.25	34.00	2.20	129.20
AQ10	31-Aug-14	2231	Bulbochaete sp.	1.22	1971.00	12.30	8.00	618.30
AQ10	31-Aug-14	2511	Ulothrix zonata Kutzing	7.43	5913.00	16.00	10.00	1256.60
AQ10	31-Aug-14	5513	Tabellaria fenestrata (Lyngbye) Kutzing	3.13	1478.25	81.00	10.00	2120.60
AQ10	31-Aug-14	5514	Tabellaria flocculsa (Roth) Kutzing	0.66	492.75	26.00	14.00	1334.10
AQ10	31-Aug-14	5523	Synedra ulna (Nitzsch) Ehrenberg	1.07	985.50	260.00	4.00	1089.10
AQ10	31-Aug-14	5702	Achnanthes minutissima Kutzing	1.71	23651.98	17.30	4.00	72.50
AQ10	31-Aug-14	5768	Nitzschia linearis W. Smith	0.71	3449.25	39.00	4.50	206.80
AQ10	31-Aug-14	5860	Diatoma vulgare Bory	3.20	11333.24	30.00	6.00	282.70
AQ10	31-Aug-14	5873	Gomphonema minutum	0.48	985.50	29.00	8.00	485.90
AQ10	31-Aug-14	5880	Didymosphenia geminata Schmidt	84.21	1478.25	136.00	40.00	56967.50
AQ10	31-Aug-14	5917	Hannaea arcus Patrick	2.24	3449.25	69.00	6.00	650.30
AQ11	31-Aug-14	1102	Gloeothece sp.	0.13	13909.62	2.60	2.60	9.20
AQ11	31-Aug-14	1131	Heteroleibeinia profunda Komarek	0.34	5884.84	18.30	2.00	57.50
AQ11	31-Aug-14	1223	Chamaesiphon incrustans Smith	2.77	69548.10	7.00	3.30	39.90
AQ11	31-Aug-14	1239	Homoeothrix varians Komarek & Kalina	0.14	1069.97	41.00	2.00	128.80
AQ11	31-Aug-14	2105	Chlamydomonas spp.	0.22	534.99	12.00	8.00	402.10
AQ11	31-Aug-14	2231	Bulbochaete sp.	1.72	2139.94	16.00	8.00	804.20
AQ11	31-Aug-14	5702	Achnanthes minutissima Kutzing	0.57	6419.82	21.30	4.00	89.20

Appendix C2. Periphyton taxonomy data, Coffee Gold Project, 2014-2015

Site	Date	Species code	Species name	biomass µg/cm^2	density cells/cm^2	length µ	width µ	cell volume µ^3
AQ11	31-Aug-14	5768	Nitzschia linearis W. Smith	0.23	534.99	45.00	6.00	424.10
AQ11	31-Aug-14	5860	Diatoma vulgare Bory	0.15	534.99	29.00	6.00	273.30
AQ11	31-Aug-14	5865	Cymbella prostrata (Berkeley) Cleve	6.53	534.99	96.00	18.00	12214.50
AQ11	31-Aug-14	5873	Gomphonema minutum	0.45	1069.97	25.00	8.00	418.90
AQ11	31-Aug-14	5916	Fragilaria capucina Grunow	0.33	1604.96	49.00	4.00	205.30
AQ13	31-Aug-14	1084	Gloeocapsa punctata	0.09	2080.50	4.30	4.30	41.60
AQ13	31-Aug-14	1102	Gloeothece sp.	0.64	31207.48	3.40	3.40	20.60
AQ13	31-Aug-14	1122	Phormidium autumnale Agardh	5.38	1040.25	183.00	6.00	5174.20
AQ13	31-Aug-14	1131	Heteroleibeinia profunda Komarek	0.39	5721.37	21.60	2.00	67.90
AQ13	31-Aug-14	1223	Chamaesiphon incrustans Smith	2.32	58253.96	7.00	3.30	39.90
AQ13	31-Aug-14	2231	Bulbochaete sp.	2.86	2600.62	14.00	10.00	1099.60
AQ13	31-Aug-14	5507	Cyclotella stelligera Cleve and Grunow	5.01	2080.50	18.30	18.30	2406.70
AQ13	31-Aug-14	5860	Diatoma vulgare Bory	0.49	2080.50	25.20	6.00	237.50
AQ20	31-Aug-14	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.72	3744.90	61.00	2.00	191.60
AQ20	31-Aug-14	1077	Pseudoanabaena sp.	0.05	624.15	24.00	2.00	75.40
AQ20	31-Aug-14	1102	Gloeothece sp.	0.22	45562.92	2.10	2.10	4.80
AQ20	31-Aug-14	1122	Phormidium autumnale Agardh	8.89	4993.20	63.00	6.00	1781.30
AQ20	31-Aug-14	1131	Heteroleibeinia profunda Komarek	0.76	9986.39	24.20	2.00	76.00
AQ20	31-Aug-14	1223	Chamaesiphon incrustans Smith	2.74	68656.46	7.00	3.30	39.90
AQ20	31-Aug-14	2231	Bulbochaete sp.	7.58	23717.68	11.30	6.00	319.50
AQ20	31-Aug-14	5507	Cyclotella stelligera Cleve and Grunow	1.43	624.15	18.00	18.00	2290.20
AQ20	31-Aug-14	5702	Achnanthes minutissima Kutzing	2.20	24965.98	21.00	4.00	88.00
AQ20	31-Aug-14	5768	Nitzschia linearis W. Smith	1.01	2496.60	43.00	6.00	405.30
AQ20	31-Aug-14	5836	Encyonema silesiacum (Bleisch) D.G. Mann	0.74	624.15	30.00	10.00	1178.10
AQ20	31-Aug-14	5860	Diatoma vulgare Bory	0.50	1872.45	28.60	6.00	269.50
AQ20	31-Aug-14	5873	Gomphonema minutum	2.48	5617.35	26.30	8.00	440.70
AQ20	31-Aug-14	5986	Meridion circulare Agardh	0.89	624.15	38.00	12.00	1432.60
AQ30	31-Aug-14	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	1.65	4012.39	131.00	2.00	411.50
AQ30	31-Aug-14	1102	Gloeothece sp.	0.46	72223.02	2.30	2.30	6.40
AQ30	31-Aug-14	1122	Phormidium autumnale Agardh	75.63	13374.63	200.00	6.00	5654.90
AQ30	31-Aug-14	1131	Heteroleibeinia profunda Komarek	14.98	220681.46	21.60	2.00	67.90
AQ30	31-Aug-14	1223	Chamaesiphon incrustans Smith	10.20	259467.90	6.90	3.30	39.30
AQ30	31-Aug-14	1239	Homoeothrix varians Komarek & Kalina	1.83	16049.56	33.00	2.10	114.30
AQ30	31-Aug-14	2231	Bulbochaete sp.	18.29	22736.88	16.00	8.00	804.20
AQ30	31-Aug-14	5860	Diatoma vulgare Bory	1.07	4012.39	28.20	6.00	265.80

Appendix C2. Periphyton taxonomy data, Coffee Gold Project, 2014-2015

Site	Date	Species code	Species name	biomass µg/cm^2	density cells/cm^2	length µ	width µ	cell volume µ^3
AQ30	31-Aug-14	5887	Navicula pupula Kutzing	0.40	2674.93	16.00	6.00	150.80
AQ30	31-Aug-14	5986	Meridion circulare Agardh	10.08	6687.32	40.00	12.00	1508.00
AQREF1	19-Aug-14	1131	Heteroleibeinia profunda Komarek	3.76	74767.92	16.00	2.00	50.30
AQREF1	19-Aug-14	1220	Rivularia dura Roth	35.63	8972.15	79.00	8.00	3971.00
AQREF1	19-Aug-14	1223	Chamaesiphon incrustans Smith	0.16	5981.43	4.90	3.20	26.30
AQREF1	19-Aug-14	1239	Homoeothrix varians Komarek & Kalina	0.82	5981.43	36.00	2.20	136.80
AQREF1	19-Aug-14	2231	Bulbochaete sp.	23.96	17944.30	17.00	10.00	1335.20
AQREF1	19-Aug-14	5311	Cymbella minuta Kutzing	7.22	17944.30	16.00	8.00	402.10
AQREF1	19-Aug-14	5702	Achnanthes minutissima Kutzing	11.17	154021.92	17.30	4.00	72.50
AQREF1	19-Aug-14	5860	Diatoma vulgare Bory	20.84	79254.00	27.90	6.00	263.00
AQREF1	19-Aug-14	5870	Navicula radiosa Kutzing	3.55	1495.36	63.00	12.00	2375.00
AQREF1	19-Aug-14	5873	Gomphonema minutum	15.58	31402.53	29.60	8.00	496.00
AQREF1	19-Aug-14	5875	Cocconies disculus Schum.	1.55	1495.36	25.00	12.60	1039.10
AQREF1	19-Aug-14	5880	Didymosphenia geminata Schmidt	80.18	1495.36	128.00	40.00	53616.50
AQREF1	19-Aug-14	5917	Hannaea arcus Patrick	38.14	49346.83	82.00	6.00	772.80
AQREF1	19-Aug-14	8002	Audouinella hermannii	3.04	8972.15	18.00	6.00	339.30

Note: ***1st number in species code = group 1=cyanobacteria 2=chlorophyte 5=diatoms 8=Red algae***
R specifies a replicate count for QA/QC

Appendix C2. Periphyton taxonomy data, Coffee Gold Project, 2014-2015

Site	Date	Species code	Species name	biomass µg/cm^2	density cells/cm^2	length µ	width µ	cell volume µ^3
AQ00	1-Aug-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.19	985.50	56.00	2.10	194.00
AQ00	1-Aug-15	1084	Gloeocapsa punctata	0.68	20202.74	4.00	4.00	33.50
AQ00	1-Aug-15	1102	Gloeothece sp.	0.57	62086.46	2.60	2.60	9.20
AQ00	1-Aug-15	1131	Heteroleibeinia profunda Komarek	0.20	3449.25	18.60	2.00	58.40
AQ00	1-Aug-15	1239	Homoeothrix varians Komarek & Kalina	0.11	985.50	30.00	2.20	114.00
AQ00	1-Aug-15	2231	Bulbochaete sp.	0.46	1478.25	11.00	6.00	311.00
AQ00	1-Aug-15	5509	Cyclotella ocellata Pant.	0.13	492.75	8.80	8.80	267.60
AQ00	1-Aug-15	5514	Tabellaria flocculsa (Roth) Kutzing	0.58	492.75	23.00	14.00	1180.20
AQ00	1-Aug-15	5702	Achnanthes minutissima Kutzing	0.40	4927.50	19.30	4.00	80.80
AQ00	1-Aug-15	5768	Nitzschia linearis W. Smith	0.09	492.75	39.00	4.30	188.80
AQ00	1-Aug-15	5826	Cymbella gracilis (Rabhorst) Cleve	0.79	492.75	41.00	10.00	1610.10
AQ00	1-Aug-15	5860	Diatoma vulgare Bory	0.46	1971.00	25.00	6.00	235.60
AQ00	1-Aug-15	5873	Gomphonema minutum	0.43	985.50	26.00	8.00	435.60
AQ00R	1-Aug-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.10	492.75	56.00	2.10	194.00
AQ00R	1-Aug-15	1084	Gloeocapsa punctata	0.56	16753.49	4.00	4.00	33.50
AQ00R	1-Aug-15	1102	Gloeothece sp.	0.54	58637.21	2.60	2.60	9.20
AQ00R	1-Aug-15	1131	Heteroleibeinia profunda Komarek	0.12	1971.00	18.60	2.00	58.40
AQ00R	1-Aug-15	1239	Homoeothrix varians Komarek & Kalina	0.11	985.50	30.00	2.20	114.00
AQ00R	1-Aug-15	2231	Bulbochaete sp.	0.46	1478.25	11.00	6.00	311.00
AQ00R	1-Aug-15	5514	Tabellaria flocculsa (Roth) Kutzing	1.74	1478.25	23.00	14.00	1180.20
AQ00R	1-Aug-15	5702	Achnanthes minutissima Kutzing	0.32	3942.00	19.30	4.00	80.80
AQ00R	1-Aug-15	5768	Nitzschia linearis W. Smith	0.19	985.50	39.00	4.30	188.80
AQ00R	1-Aug-15	5826	Cymbella gracilis (Rabhorst) Cleve	0.79	492.75	41.00	10.00	1610.10
AQ00R	1-Aug-15	5860	Diatoma vulgare Bory	0.23	985.50	25.00	6.00	235.60
AQ00R	1-Aug-15	5873	Gomphonema minutum	0.21	492.75	26.00	8.00	435.60
AQ02	1-Aug-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.54	1971.00	79.00	2.10	273.60
AQ02	1-Aug-15	1084	Gloeocapsa punctata	0.17	4927.50	4.00	4.00	33.50
AQ02	1-Aug-15	1102	Gloeothece sp.	0.04	9362.24	2.10	2.10	4.80
AQ02	1-Aug-15	1131	Heteroleibeinia profunda Komarek	0.33	4927.50	21.30	2.00	66.90
AQ02	1-Aug-15	1223	Chamaesiphon incrustans Smith	1.68	52231.47	6.40	3.10	32.20
AQ02	1-Aug-15	2231	Bulbochaete sp.	0.08	2956.50	1.00	6.00	28.30
AQ02	1-Aug-15	5551	Cyclotella michiganiana Skvortzow	0.02	492.75	4.90	4.90	46.20
AQ02	1-Aug-15	5702	Achnanthes minutissima Kutzing	0.74	8869.49	20.00	4.00	83.80
AQ02	1-Aug-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	0.58	492.75	30.00	10.00	1178.10

Appendix C2. Periphyton taxonomy data, Coffee Gold Project, 2014-2015

Site	Date	Species code	Species name	biomass µg/cm^2	density cells/cm^2	length µ	width µ	cell volume µ^3
AQ02	1-Aug-15	5860	Diatoma vulgare Bory	0.45	1971.00	24.30	6.00	229.00
AQ02	1-Aug-15	5873	Gomphonema minutum	0.96	1971.00	29.00	8.00	485.90
AQ02	1-Aug-15	5917	Hannaea arcus Patrick	0.27	492.75	59.00	6.00	556.10
AQ04	1-Aug-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	1.46	6553.57	71.00	2.00	223.10
AQ04	1-Aug-15	1102	Gloeothece sp.	0.05	11234.69	2.10	2.10	4.80
AQ04	1-Aug-15	1131	Heteroleibeinia profunda Komarek	0.31	5617.35	17.60	2.00	55.30
AQ04	1-Aug-15	1223	Chamaesiphon incrustans Smith	2.05	63663.26	6.00	3.20	32.20
AQ04	1-Aug-15	1239	Homoeothrix varians Komarek & Kalina	0.30	2340.56	34.00	2.20	129.20
AQ04	1-Aug-15	2231	Bulbochaete sp.	4.24	7021.68	12.00	8.00	603.20
AQ04	1-Aug-15	5513	Tabellaria fenestrata (Lyngbye) Kutzing	0.67	468.11	86.00	8.00	1440.90
AQ04	1-Aug-15	5702	Achnanthes minutissima Kutzing	0.07	936.22	18.00	4.00	75.40
AQ04	1-Aug-15	5768	Nitzschia linearis W. Smith	0.18	936.22	56.00	3.60	190.00
AQ04	1-Aug-15	5854	Pinnularia borealis Ehrenberg	0.13	468.11	30.00	6.00	282.70
AQ04	1-Aug-15	5860	Diatoma vulgare Bory	0.11	468.11	25.00	6.00	235.60
AQ04	1-Aug-15	5873	Gomphonema minutum	0.63	1404.34	26.60	8.00	445.70
AQ04	1-Aug-15	5884	Gomphonema angustum Agardh	1.00	936.22	41.00	10.00	1073.40
AQ04	1-Aug-15	5917	Hannaea arcus Patrick	0.23	468.11	53.00	6.00	499.50
AQ04.5	1-Aug-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.24	1337.46	56.00	2.00	175.90
AQ04.5	1-Aug-15	1084	Gloeocapsa punctata	0.09	2674.93	4.00	4.00	33.50
AQ04.5	1-Aug-15	1102	Gloeothece sp.	0.24	49486.15	2.10	2.10	4.80
AQ04.5	1-Aug-15	1131	Heteroleibeinia profunda Komarek	0.76	9362.24	26.00	2.00	81.70
AQ04.5	1-Aug-15	1223	Chamaesiphon incrustans Smith	0.86	38340.62	6.30	2.60	22.30
AQ04.5	1-Aug-15	5306	Navicula minima Grunow	0.02	445.82	11.00	4.30	53.20
AQ04.5	1-Aug-15	5311	Cymbella minuta Kutzing	0.18	445.82	16.00	8.10	412.20
AQ04.5	1-Aug-15	5513	Tabellaria fenestrata (Lyngbye) Kutzing	0.34	445.82	81.00	6.00	763.40
AQ04.5	1-Aug-15	5551	Cyclotella michiganiana Skvortzow	0.06	1337.46	4.80	4.80	43.40
AQ04.5	1-Aug-15	5702	Achnanthes minutissima Kutzing	0.07	891.64	18.30	4.00	76.70
AQ04.5	1-Aug-15	5834	Cymbella microcephala Grunow	0.59	891.64	26.30	8.00	661.00
AQ04.5	1-Aug-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1.05	891.64	30.00	10.00	1178.10
AQ04.5	1-Aug-15	5860	Diatoma vulgare Bory	0.11	445.82	27.00	6.00	254.50
AQ10	15-Sep-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.33	985.50	106.00	2.00	333.00
AQ10	15-Sep-15	1084	Gloeocapsa punctata	0.28	11333.24	3.60	3.60	24.40
AQ10	15-Sep-15	1102	Gloeothece sp.	0.03	7391.25	2.00	2.00	4.20
AQ10	15-Sep-15	1122	Phormidium autumnale Agardh	7.22	1971.00	90.00	7.20	3664.40

Appendix C2. Periphyton taxonomy data, Coffee Gold Project, 2014-2015

Site	Date	Species code	Species name	biomass µg/cm^2	density cells/cm^2	length µ	width µ	cell volume µ^3
AQ10	15-Sep-15	1131	Heteroleibeinia profunda Komarek	0.38	7883.99	15.30	2.00	48.10
AQ10	15-Sep-15	1223	Chamaesiphon incrustans Smith	0.93	50753.22	5.60	2.50	18.30
AQ10	15-Sep-15	1239	Homoeothrix varians Komarek & Kalina	0.23	1971.00	31.00	2.20	117.80
AQ10	15-Sep-15	5306	Navicula minima Grunow	0.06	985.50	12.00	4.50	63.60
AQ10	15-Sep-15	5551	Cyclotella michiganiana Skvortzow	0.13	2956.50	4.80	4.80	43.40
AQ10	15-Sep-15	5702	Achnanthes minutissima Kutzing	0.07	985.50	17.80	4.00	74.60
AQ10	15-Sep-15	5768	Nitzschia linearis W. Smith	0.07	492.75	36.00	4.00	150.80
AQ10	15-Sep-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	0.58	492.75	30.00	10.00	1178.10
AQ11	1-Aug-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.43	1920.46	71.00	2.00	223.10
AQ11	1-Aug-15	1084	Gloeocapsa punctata	0.06	1920.46	4.00	4.00	33.50
AQ11	1-Aug-15	1102	Gloeothece sp.	0.19	38889.32	2.10	2.10	4.80
AQ11	1-Aug-15	1122	Phormidium autumnale Agardh	1.09	480.12	80.00	6.00	2261.90
AQ11	1-Aug-15	1223	Chamaesiphon incrustans Smith	1.39	47531.39	6.20	3.00	29.20
AQ11	1-Aug-15	1239	Homoeothrix varians Komarek & Kalina	0.36	2880.69	33.00	2.20	125.40
AQ11	1-Aug-15	2231	Bulbochaete sp.	2.03	3360.81	12.00	8.00	603.20
AQ11	1-Aug-15	5702	Achnanthes minutissima Kutzing	0.20	2880.69	16.30	4.00	68.30
AQ11	1-Aug-15	5768	Nitzschia linearis W. Smith	0.36	2400.58	36.00	4.00	150.80
AQ11	1-Aug-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	1.58	1440.35	28.00	10.00	1099.60
AQ11	1-Aug-15	5860	Diatoma vulgare Bory	0.11	480.12	25.10	6.00	236.60
AQ13	1-Aug-15	1014	Chroococcus limneticus Lemmermann	0.12	4832.13	3.60	3.60	24.40
AQ13	1-Aug-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	2.37	10872.28	63.00	2.10	218.20
AQ13	1-Aug-15	1077	Pseudoanabaena sp.	0.12	6040.16	2.90	2.90	19.20
AQ13	1-Aug-15	1084	Gloeocapsa punctata	0.22	6644.17	4.00	4.00	33.50
AQ13	1-Aug-15	1102	Gloeothece sp.	1.76	102078.66	3.20	3.20	17.20
AQ13	1-Aug-15	1122	Phormidium autumnale Agardh	2.15	1208.03	63.00	6.00	1781.30
AQ13	1-Aug-15	1131	Heteroleibeinia profunda Komarek	0.12	2416.06	16.40	2.00	51.50
AQ13	1-Aug-15	1239	Homoeothrix varians Komarek & Kalina	0.39	3624.09	28.60	2.20	108.70
AQ13	1-Aug-15	5306	Navicula minima Grunow	0.15	604.02	15.20	8.00	254.70
AQ13	1-Aug-15	5702	Achnanthes minutissima Kutzing	0.10	1208.03	19.00	4.00	79.60
AQ13	1-Aug-15	5753	Navicula sp.	0.60	604.02	38.00	10.00	994.80
AQ13	1-Aug-15	5860	Diatoma vulgare Bory	0.47	1812.05	27.70	6.00	261.10
AQ20	1-Aug-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	3.52	10872.28	103.00	2.00	323.60
AQ20	1-Aug-15	1102	Gloeothece sp.	0.28	57985.51	2.10	2.10	4.80
AQ20	1-Aug-15	1131	Heteroleibeinia profunda Komarek	0.27	5436.14	16.00	2.00	50.30

Appendix C2. Periphyton taxonomy data, Coffee Gold Project, 2014-2015

Site	Date	Species code	Species name	biomass µg/cm^2	density cells/cm^2	length µ	width µ	cell volume µ^3
AQ20	1-Aug-15	1223	Chamaesiphon incrustans Smith	2.45	91206.38	6.10	2.90	26.90
AQ20	1-Aug-15	1239	Homoeothrix varians Komarek & Kalina	0.47	3020.08	41.00	2.20	155.90
AQ20	1-Aug-15	2231	Bulbochaete sp.	11.56	20536.54	11.20	8.00	563.00
AQ20	1-Aug-15	5306	Navicula minima Grunow	0.15	1812.05	13.00	5.00	85.10
AQ20	1-Aug-15	5702	Achnanthes minutissima Kutzing	0.67	8456.22	19.00	4.00	79.60
AQ20	1-Aug-15	5836	Encyonema silesiacum (Bleisch) D.G. Mann	0.71	604.02	30.00	10.00	1178.10
AQ20	1-Aug-15	5860	Diatoma vulgare Bory	0.43	1812.05	25.00	6.00	235.60
AQ20	1-Aug-15	5873	Gomphonema minutum	0.26	604.02	26.00	8.00	435.60
AQ30	1-Aug-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.43	1872.45	67.00	2.10	232.10
AQ30	1-Aug-15	1084	Gloeocapsa punctata	1.44	43066.32	4.00	4.00	33.50
AQ30	1-Aug-15	1102	Gloeothece sp.	0.85	152604.58	2.20	2.20	5.60
AQ30	1-Aug-15	1122	Phormidium autumnale Agardh	1.83	936.22	69.00	6.00	1950.90
AQ30	1-Aug-15	1131	Heteroleibeinia profunda Komarek	1.27	18724.49	21.60	2.00	67.90
AQ30	1-Aug-15	1223	Chamaesiphon incrustans Smith	4.25	132007.64	6.40	3.10	32.20
AQ30	1-Aug-15	5702	Achnanthes minutissima Kutzing	1.49	18724.49	19.00	4.00	79.60
AQ30	1-Aug-15	5860	Diatoma vulgare Bory	0.88	3744.90	24.90	6.00	234.70
AQ30	1-Aug-15	5873	Gomphonema minutum	0.41	936.22	26.20	8.00	439.00
AQ30	1-Aug-15	5986	Meridion circulare Agardh	1.73	936.22	36.00	14.00	1847.30
AQREF1	1-Aug-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.46	1755.42	84.00	2.00	263.90
AQREF1	1-Aug-15	1077	Pseudoanabaena sp.	0.19	8777.10	3.00	3.00	21.20
AQREF1	1-Aug-15	1223	Chamaesiphon incrustans Smith	2.32	70801.97	6.50	3.10	32.70
AQREF1	1-Aug-15	1239	Homoeothrix varians Komarek & Kalina	1.83	14628.51	33.00	2.20	125.40
AQREF1	1-Aug-15	2231	Bulbochaete sp.	1.80	2340.56	15.30	8.00	769.10
AQREF1	1-Aug-15	5306	Navicula minima Grunow	0.14	1170.28	12.40	6.00	116.90
AQREF1	1-Aug-15	5702	Achnanthes minutissima Kutzing	0.94	12287.95	18.30	4.00	76.70
AQREF1	1-Aug-15	5768	Nitzschia linearis W. Smith	0.18	1170.28	36.00	4.00	150.80
AQREF1	1-Aug-15	5860	Diatoma vulgare Bory	1.24	4681.12	28.00	6.00	263.90
AQREF1	1-Aug-15	5870	Navicula radiosa Kutzing	0.78	585.14	51.00	10.00	1335.20
AQREF1	1-Aug-15	5873	Gomphonema minutum	0.27	585.14	27.30	8.00	457.40
AQREF1	1-Aug-15	5908	Diatoma tenue Agardh	0.09	585.14	35.00	4.00	146.60
AQREF2	1-Aug-15	1057	Leptolyngbya lemnetica (Anaga.) Anagnostidis and Komarek	0.42	1755.42	76.00	2.00	238.80
AQREF2	1-Aug-15	1077	Pseudoanabaena sp.	0.14	6436.54	3.00	3.00	21.20
AQREF2	1-Aug-15	1084	Gloeocapsa punctata	0.12	3510.84	4.00	4.00	33.50
AQREF2	1-Aug-15	1131	Heteroleibeinia profunda Komarek	0.21	3510.84	19.00	2.00	59.70

Appendix C2. Periphyton taxonomy data, Coffee Gold Project, 2014-2015

Site	Date	Species code	Species name	biomass µg/cm^2	density cells/cm^2	length µ	width µ	cell volume µ^3
AQREF2	1-Aug-15	1223	Chamaesiphon incrustans Smith	1.40	64950.57	6.10	2.60	21.60
AQREF2	1-Aug-15	1239	Homoeothrix varians Komarek & Kalina	1.39	11117.66	33.00	2.20	125.40
AQREF2	1-Aug-15	2231	Bulbochaete sp.	3.97	5266.26	15.00	8.00	754.00
AQREF2	1-Aug-15	5306	Navicula minima Grunow	0.05	585.14	12.20	5.00	79.80
AQREF2	1-Aug-15	5702	Achnanthes minutissima Kutzing	0.67	8777.10	18.30	4.00	76.70
AQREF2	1-Aug-15	5768	Nitzschia linearis W. Smith	0.18	1170.28	36.00	4.00	150.80
AQREF2	1-Aug-15	5860	Diatoma vulgare Bory	0.93	3510.84	28.00	6.00	263.90
AQREF2	1-Aug-15	5873	Gomphonema minutum	0.51	1170.28	26.00	8.00	435.60
AQREF2	1-Aug-15	5910	Navicula exigua (Greg.) Muller	0.31	585.14	32.00	8.00	536.20

Note: ***1st number in species code = group 1=cyanobacteria 2=chlorophyte 5=diatoms 8=Red algae***
R specifies a replicate count for QA/QC

Appendix D

Benthic Invertebrates

- **D1. Benthic Invertebrate Taxonomy, Coffee Gold Project, 2014-2015**
- **D2. CABIN results, Coffee Gold Project, 2014-2015**

Appendix D1. Benthic Invertebrate Taxonomy, Coffee Gold Project, 2014

Site:	AQ00	AQ20	AQ30	AQ04	AQ02	AQ05	AQ10	AQ11	AQ13
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0	0	0	0	0
Ameletus	0	0	0	0	0	2	0	0	0
| Family: Baetidae	1	14	0	0	6	0	0	13	0
Acentrella parvula	0	0	0	0	3	0	0	3	0
Acentrella sp.	2	0	0	20	8	0	8	15	0
Acentrella turbida	11	0	0	0	5	0	0	0	0
Baetis	0	5	37	53	0	5	18	58	5
Baetis bicaudatus	0	3	34	45	0	35	18	30	163
| Family: Ephemerellidae	0	0	0	0	47	0	0	0	0
Drunella doddsii	0	0	0	0	4	0	0	0	0
Drunella sp.	0	0	0	0	29	0	0	0	0
Ephemerella	0	0	0	1	49	0	0	0	0
Ephemerella aurivillii	1	0	0	0	0	0	0	0	0
Ephemerella velmae	40	0	0	0	0	0	0	0	0
| Family: Heptageniidae	45	9	5	16	33	251	35	28	0
Cinygmula sp.	16	0	12	14	12	8	50	63	0
Epeorus albertae group	0	0	0	2	0	0	0	0	0
Epeorus sp.	1	2	0	26	0	0	0	0	0
Rhithrogena	0	0	0	0	0	2	0	0	0
	0	0	0	0	0	0	0	0	0
| Order: Plecoptera	0	1	5	0	10	0	0	3	11
| Family: Capniidae	5	0	7	7	1	11	13	23	21
Capnia sp.	0	0	22	0	0	15	0	8	5
| Family: Chloroperlidae	4	0	0	0	11	0	8	3	11
Suwallia	2	1	0	1	19	10	20	0	0
| Family: Nemouridae	6	8	0	0	1	0	0	0	0
Nemoura	0	85	361	31	2	278	33	133	611
Zapada columbiana	0	0	0	0	1	0	0	0	0
| Family: Perlodidae	8	0	0	14	36	0	18	5	0
Diura sp.	0	0	0	0	0	2	0	8	0
Isogenoides sp.	0	0	0	2	0	0	0	0	0
Isoperla sp.	0	0	0	0	0	0	3	0	0
Skwala	0	0	0	0	2	0	0	3	0
	0	0	0	0	0	0	0	0	0
| Order: Trichoptera	0	0	0	0	0	0	0	0	0
| Family: Apataniidae	0	0	0	0	0	0	0	0	0
Apatania	0	0	0	0	1	0	0	0	0
| Family: Brachycentridae	0	0	0	0	0	0	0	0	0
Brachycentrus sp.	0	0	0	0	1	0	0	0	0
| Family: Glossosomatidae	0	0	0	0	0	0	0	0	0
Glossosoma	0	0	0	0	5	0	0	0	0
| Family: Hydropsychidae	8	0	0	0	2	0	0	0	0
| Family: Limnephilidae	0	1	0	3	0	6	5	0	0
Ecclisomyia sp.	2	0	0	32	15	7	30	0	0
	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0
| Family: Dytiscidae	0	0	0	0	0	0	0	0	0
Agabus sp.	0	0	1	0	0	0	0	0	0
| Family: Staphylinidae	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0

Appendix D1. Benthic Invertebrate Taxonomy, Coffee Gold Project, 2014

Site:	AQ00	AQ20	AQ30	AQ04	AQ02	AQ05	AQ10	AQ11	AQ13
| Order: Diptera	0	0	0	134	0	1	0	0	0
| Family: Ceratopogonidae	0	0	0	0	0	0	0	0	0
Culicoides	0	0	0	0	1	0	0	0	0
| Family: Chironomidae	13	4	7	63	49	0	138	30	0
| Subfamily: Chironominae	0	0	0	0	0	0	0	0	0
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0
Stempellinella sp.	2	0	0	36	0	0	0	0	0
Tanytarsus	0	0	0	0	7	2	3	3	0
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0
| Tribe: Diamesini	0	0	0	0	0	0	0	0	0
Diamesa	0	74	55	17	3	30	20	30	742
Pagastia	0	0	0	0	4	0	8	0	0
Potthastia gaedii group	0	1	0	0	0	0	0	0	0
Pseudodiamesa sp.	0	0	0	0	0	0	0	0	0
| Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0
Brillia sp.	0	0	0	0	1	0	0	0	0
Eukiefferiella	21	27	58	95	48	17	243	295	0
Hydrobaenus	0	0	8	0	0	0	0	0	0
Metriocnemus sp.	0	0	11	1	0	3	5	0	5
Orthocladius (Euorthocladius)	2	0	0	0	0	0	0	0	0
Orthocladius complex	122	4	48	10	15	1	8	0	5
Orthocladius lignicola	0	0	0	1	0	0	0	0	0
Paraphaenocladius sp.	0	0	1	0	0	0	0	0	0
Rheocricotopus	0	0	0	0	2	0	0	0	0
Tvetenia	16	1	0	0	40	0	280	30	0
| Tribe: Corynoneurini	0	0	0	0	0	0	0	0	0
Corynoneura	1	0	0	0	0	0	0	0	0
| Family: Deuterophlebiidae	0	0	0	0	0	0	0	0	0
Deuterophlebia sp.	0	0	0	12	0	0	0	0	0
| Family: Empididae	0	0	0	0	45	0	3	20	0
Chelifera/ Metachela	0	0	0	0	1	0	0	0	0
Hemerodromia sp.	0	0	0	0	2	0	0	0	0
| Family: Psychodidae	0	0	0	0	0	0	0	0	0
Pericoma/Telmatoscopus sp.	0	0	0	0	0	0	0	0	0
| Family: Simuliidae	0	2	0	0	1	0	3	3	0
Gymnopais sp.	0	1	0	0	0	1	0	5	26
Prosimulium	0	0	3	5	0	0	0	0	0
Simulium	0	5	0	0	1	0	3	33	0
| Family: Tipulidae	0	0	0	0	0	0	0	0	0
Dicranota	1	0	2	7	1	7	13	3	0
Tipula	0	0	1	0	0	0	0	3	0
	0	0	0	0	0	0	0	0	0
| Order: Hemiptera	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0
| Class: Malacostraca	0	0	0	0	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	0	0	0	0	0
| Family: Crangonyctidae	0	0	0	0	0	0	0	0	0
Crangonyx	0	0	0	7	0	0	0	0	0
| Family: Hyalellidae	0	0	0	0	0	0	0	0	0
Hyalella	0	0	0	0	0	0	0	3	0
	0	0	0	0	0	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	14	0	0	0

Appendix D1. Benthic Invertebrate Taxonomy, Coffee Gold Project, 2014

Site:	AQ00	AQ20	AQ30	AQ04	AQ02	AQ05	AQ10	AQ11	AQ13
| Order: Trombidiformes	0	0	1	0	0	0	0	0	0
| Family: Hydryphantidae	0	0	0	0	0	0	0	0	0
Albertathyas	0	1	0	0	0	1	0	0	0
| Family: Sperchontidae	0	0	0	0	0	0	0	0	0
Sperchon	3	2	3	2	61	10	0	5	0
	0	0	0	0	0	0	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0
| Family: Hydrozetidae	0	2	5	1	0	1	0	0	0
	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0
| Class: Gastropoda	0	0	0	0	0	0	0	0	0
| Order: Basommatophora	0	0	0	0	0	0	0	0	0
| Family: Lymnaeidae	0	0	0	0	0	0	0	0	0
Stagnicola	0	0	0	0	0	0	0	0	11
	0	0	0	0	0	0	0	0	0
| Order: Heterostropha	0	0	0	0	0	0	0	0	0
| Family: Valvatidae	0	0	0	0	0	0	0	0	0
Valvata	0	0	1	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	1	0	0	0	0	0	3	0	0
| Order: Lumbriculida	0	0	0	0	0	0	0	0	0
| Family: Lumbriculidae	0	0	0	0	0	30	0	0	0
	0	0	0	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0
| Family: Enchytraeidae	12	7	4	0	0	0	0	5	11
Mesenchytraeus sp.	0	0	0	4	0	0	0	0	0
Totals:	**346**	**260**	**692**	**662**	**585**	**750**	**989**	**864**	**1627**

Taxa present but not included:

Terrestrials	0	0	17	0	0	8	0	0	11
	0	0	0	0	0	0	0	0	0
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0
| Family: Curculionidae	0	0	0	0	0	0	0	0	0
| Subfamily: Scolytinae	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
| Class: Entognatha	0	0	0	0	0	0	0	0	0
| Order: Collembola	1	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0
Phylum: Nemata	0	0	3	2	0	10	0	0	16
Phylum: Platyhelminthes	0	0	0	0	0	0	0	0	0
| Class: Turbellaria	0	0	0	0	0	3	0	0	5
Totals:	**1**	**0**	**20**	**2**	**0**	**21**	**0**	**0**	**32**

Appendix D1. Benthic Invertebrate Taxonomy, Coffee Gold Project, 2015

Site:	AQ00	AQ20	AQ30	AQ04	AQ02	AQ04.5	AQ10	AQ11	AQ13	AQREF1	AQREF2
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0
| Family: Baetidae	48	30	391	169	562	9	400	207	0	9	580
Acentrella sp.	12	0	0	0	0	0	80	0	0	1	50
Baetis	81	26	68	189	200	15	180	27	2	6	150
Baetis bicaudatus	19	0	0	69	8	24	180	0	1	1	30
| Family: Ephemerellidae	37	0	0	0	31	0	0	0	0	1	0
Ephemerella	2	0	0	0	8	0	0	0	0	0	0
| Family: Heptageniidae	58	2	23	8	108	4	200	80	0	67	230
Cinygmula sp.	23	0	0	6	31	1	80	0	0	27	70
Epeorus	1	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
| Order: Plecoptera	0	0	0	0	0	0	0	0	1	0	0
| Family: Capniidae	2	7	36	6	0	6	20	13	6	2	10
Capnia sp.	0	0	0	0	0	2	0	0	0	0	0
| Family: Chloroperlidae	6	0	0	0	23	0	0	0	0	5	0
Haploperla sp.	2	0	0	0	0	0	100	0	0	15	0
Suwallia	15	0	0	0	23	0	20	0	0	3	0
| Family: Nemouridae	0	198	295	14	8	25	20	100	18	0	450
Ostrocerca sp.	0	137	282	8	0	34	160	27	18	0	310
Zapada	0	0	0	0	0	0	0	7	0	0	0
| Family: Perlodidae	2	0	0	6	23	0	0	13	0	1	0
	0	0	0	0	0	0	0	0	0	0	0
| Order: Trichoptera	0	0	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0	0	0
| Family: Curculionidae	1	0	0	0	0	0	0	0	0	0	0
| Family: Staphylinidae	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
| Order: Diptera	0	2	0	6	0	1	0	0	2	0	10
| Family: Chironomidae	12	20	5	217	31	10	60	0	3	6	0
| Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0
Chironomus	0	0	0	0	0	0	0	0	1	1	0
Polypedilum sp.	0	0	5	0	8	0	0	0	0	0	10
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0
Tanytarsus	0	0	0	0	8	3	0	0	0	0	40
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Diamesini	0	0	0	0	0	0	0	0	0	0	0
Diamesa	1	22	14	6	0	37	0	0	11	6	40
Pagastia	0	0	0	0	0	0	0	0	0	8	0
Pseudodiamesa sp.	0	0	0	0	0	1	0	0	0	0	0
| Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella	0	0	0	19	0	0	0	0	8	0	0
Eukiefferiella claripennis group	4	52	214	11	15	11	60	47	31	10	0
Gymnometriocnemus sp.	0	0	0	0	0	0	0	0	1	0	0
Heterotrissocladius sp.	0	0	0	0	0	0	0	0	0	0	0
Heterotrissocladius marcidus group.	0	2	0	3	0	0	0	0	0	0	0
Hydrobaenus	0	0	0	0	0	0	0	0	0	0	0
Limnophyes sp.	0	0	0	0	0	3	0	0	4	0	0
Orthocladius	2	7	32	11	0	2	0	7	0	68	20
Orthocladius lignicola	0	2	0	0	0	0	0	0	0	0	0
Parametriocnemus	6	11	55	28	54	0	20	47	0	14	10
Pseudosmittia sp.	0	0	0	0	0	0	0	0	1	0	0
Rheocricotopus	0	0	0	8	0	0	0	0	0	7	0
Rheosmittia sp.	3	0	0	0	8	0	0	0	0	0	0
Tvetenia	0	0	0	0	0	0	0	0	0	0	0
Tvetenia bavarica group	20	24	355	8	154	18	360	100	0	51	30
| Family: Deuterophlebiidae	0	0	0	0	0	0	0	0	0	0	0
Deuterophlebia sp.	4	0	0	0	31	0	0	0	0	0	0
| Family: Empididae	0	2	0	0	0	0	0	0	0	2	0
Clinocera sp.	0	0	0	0	0	0	0	0	0	0	0
Neoplasta sp.	1	0	0	0	8	0	0	0	0	20	0

Appendix D1. Benthic Invertebrate Taxonomy, Coffee Gold Project, 2015

Site:	AQ00	AQ20	AQ30	AQ04	AQ02	AQ04.5	AQ10	AQ11	AQ13	AQREF1	AQREF2
| Family: Muscidae	0	0	0	0	0	0	0	0	0	0	0
Limnophora sp.	0	0	0	0	0	0	0	0	1	0	0
| Family: Simuliidae	0	24	0	33	69	6	260	1327	4	20	430
Helodon sp.	1	7	5	14	100	6	980	20	6	19	50
Prosimulium	0	4	18	6	31	15	0	20	2	12	20
Simulium	12	78	91	31	1177	3	3600	100	5	0	660
| Family: Tipulidae	1	2	0	0	0	0	0	0	0	0	0
Dicranota	0	0	0	0	0	1	0	0	0	0	0
Tipula	0	2	0	6	0	0	0	0	0	4	0
	0	0	0	0	0	0	0	0	0	0	0
| Order: Hemiptera	0	0	0	0	0	0	0	0	0	0	0
| Order: Lepidoptera	0	0	0	0	0	0	0	0	0	0	0
| Order: Hymenoptera	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0
| Class: Malacostraca	0	0	0	0	0	0	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	0	0	0	0	0	3	0
| Family: Gammaridae	0	0	0	0	0	0	0	0	0	0	0
Gammarus	0	2	0	0	0	0	0	0	0	0	0
| Family: Hyalellidae	0	0	0	0	0	0	0	0	0	0	0
Hyalella	0	0	0	0	0	0	0	7	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	0	1	0	0	0	0	0
| Family: Feltriidae	0	0	0	0	0	0	0	0	0	0	0
Feltria sp.	0	0	0	0	8	0	0	0	0	0	0
| Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0
Sperchon	8	0	0	3	38	1	0	7	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
| Order: Oribatei	0	0	0	0	0	0	0	0	0	0	0
| Family: Oribatidae	0	0	0	0	0	0	0	0	0	0	0
Oribatida	0	2	0	0	0	3	0	0	2	1	10
	0	0	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0
| Class: Gastropoda	0	4	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0
| Family: Enchytraeidae	0	0	0	0	0	0	0	0	0	0	0
Enchytraeus	1	2	0	0	0	4	0	0	3	0	0
| Family: Naididae	0	0	0	0	0	0	0	0	0	0	0
Nais	0	0	0	0	0	0	0	0	4	0	0
	0	0	0	0	0	0	0	0	0	0	0
Phylum: Tardigrada	0	0	0	0	0	1	0	0	0	0	0
Totals:	**385**	**671**	**1889**	**885**	**2765**	**247**	**6780**	**2156**	**135**	**390**	**3210**
Taxa present but not included:											
Terrestrials	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0
| Class: Entognatha	0	0	0	0	0	0	0	0	0	0	0
| Order: Collembola	0	0	0	0	0	1	0	7	1	0	0
	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0
| Class: Branchiopoda	0	0	0	0	0	0	0	0	0	0	0
| Order: Cladocera	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0
Phylum: Nemata	0	2	5	3	0	1	20	0	1	1	0
Phylum: Platyhelminthes	0	0	0	0	0	0	0	0	0	0	0
| Class: Turbellaria	0	0	0	0	0	1	0	0	0	0	0
Totals:	**0**	**2**	**5**	**3**	**0**	**3**	**20**	**7**	**2**	**1**	**0**

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ00
Sampling Date	Aug 29 2014
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.88524 N, 139.09500 W
Altitude	1427
Feature Name	Coffee Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	65.3%	30.1%	2.0%	2.7%	0.0%
CABIN Assessment of AQ00 on Aug 29, 2014	Mildly Divergent				

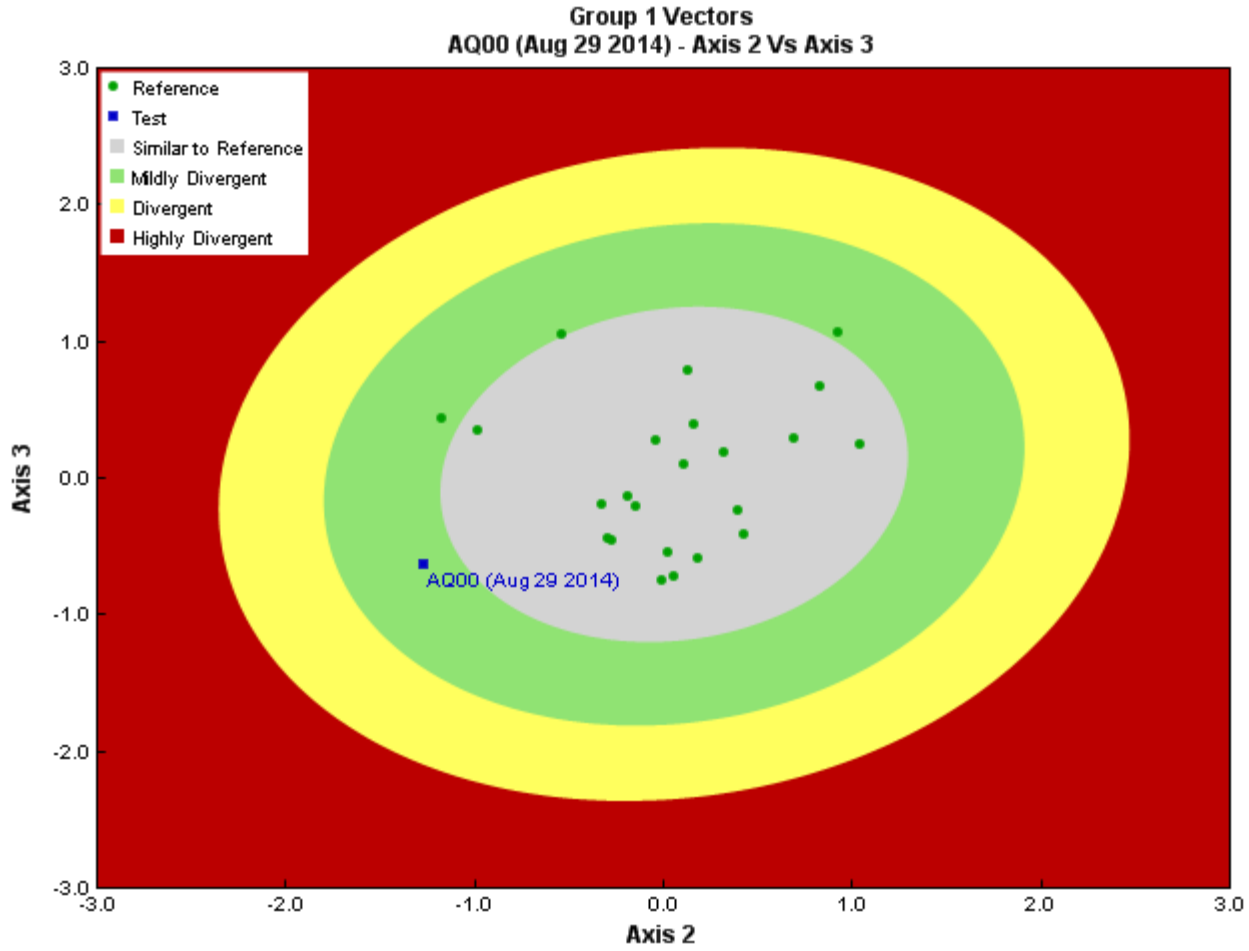


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	100/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta			1	1.0
		Haplotaxida	Enchytraeidae	12	12.0
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	3	3.0
	Insecta	Diptera	Chironomidae	177	177.0
			Tipulidae	1	1.0
		Ephemeroptera	Baetidae	14	14.0
			Ephemerellidae	41	41.0
			Heptageniidae	62	62.0
		Plecoptera	Capniidae	5	5.0
			Chloroperlidae	6	6.0
			Nemouridae	6	6.0
			Perlodidae	8	8.0
		Trichoptera	Hydropsychidae	8	8.0
			Limnephilidae	2	2.0
			Total	346	346.0

Site Metrics

Metric Name	AQ00	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.94	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ00
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.94

RIVPACS : Expected taxa P>0.50	1.99
RIVPACS : Observed taxa P>0.50	2.00
RIVPACS : O:E (p > 0.5)	1.00
RIVPACS : Expected taxa P>0.70	0.94
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.06

D. Habitat Description

Variable	AQ00	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	49.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.66	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.30000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.40000	25.54674 ± 9.71520
Precip06_JUN (mm)	52.90000	49.78117 ± 15.10067
Precip07_JUL (mm)	67.10000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	52.90000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	4.27000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.47598	0.19525 ± 0.41187
Natl-Bryoids (%)	1.48831	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	0.84309	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ30
Sampling Date	Jul 27 2015
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.93137 N, 139.23300 W
Altitude	1407
Feature Name	Unnamed
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	88.1%	10.9%	0.3%	0.7%	0.0%
CABIN Assessment of AQ30 on Jul 27, 2015	Highly Divergent				

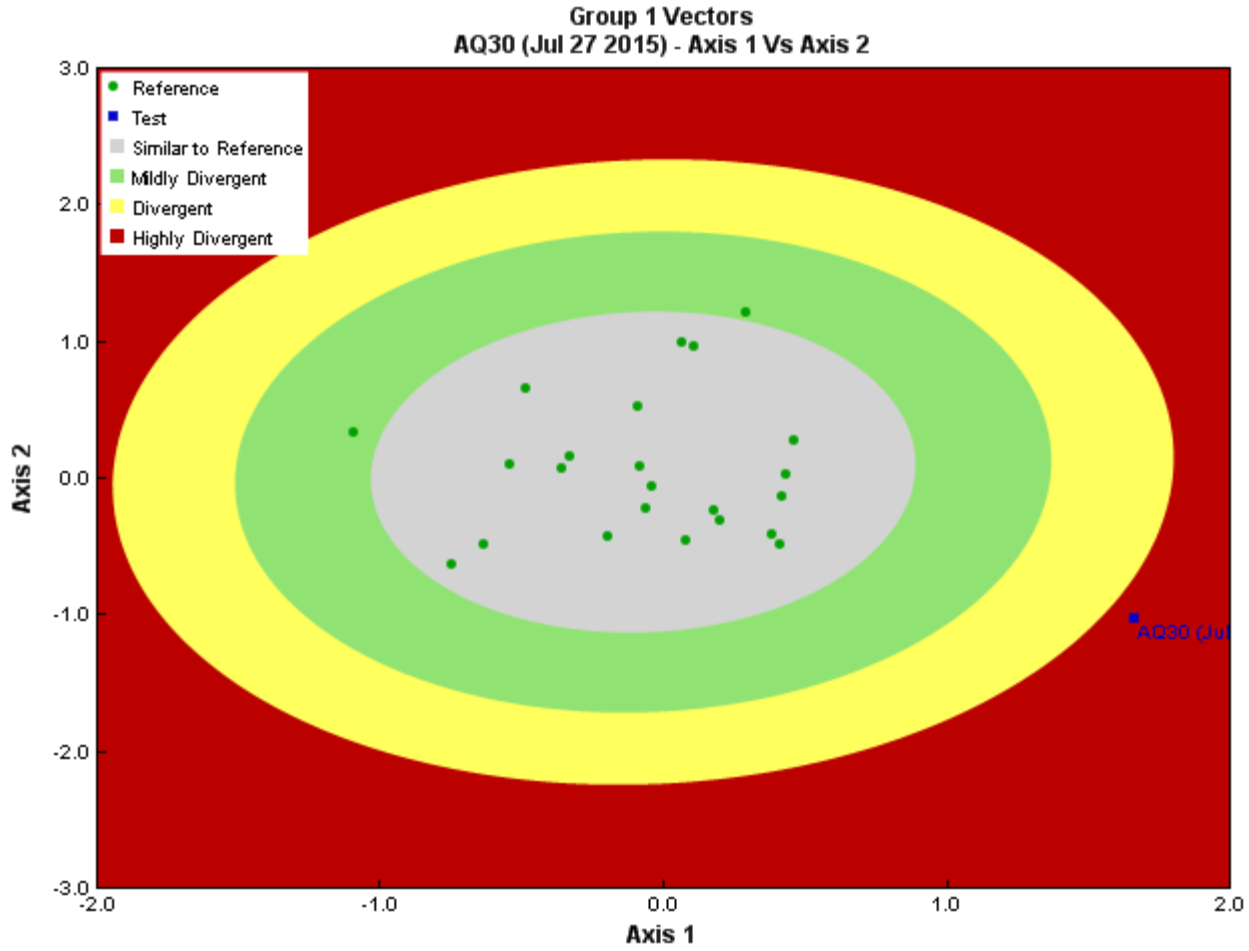


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	22/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Arthropoda	Insecta	Diptera	Chironomidae	149	677.0
			Simuliidae	25	113.6
		Ephemeroptera	Baetidae	101	459.1
			Heptageniidae	5	22.7
		Plecoptera	Capniidae	8	36.4
			Nemouridae	127	577.3
			Total	415	1,886.1

Site Metrics

Metric Name	AQ30	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.99	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ30
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.92

RIVPACS : Expected taxa P>0.50	0.92
RIVPACS : Observed taxa P>0.50	1.00
RIVPACS : O:E (p > 0.5)	1.08
RIVPACS : Expected taxa P>0.70	0.92
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.08

D. Habitat Description

Variable	AQ30	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	8.5	36.5 ± 24.3
Velocity-Avg (m/s)	0.24	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.00000	27.73943 ± 9.10561
Precip03_MAR (mm)	10.70000	25.54674 ± 9.71520
Precip06_JUN (mm)	48.20000	49.78117 ± 15.10067
Precip07_JUL (mm)	61.20000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	48.20000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	5.50000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.05327	0.19525 ± 0.41187
Natl-Bryoids (%)	0.26099	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	2.18745	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQREF2
Sampling Date	Jul 31 2015
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	63.04072 N, 139.62550 W
Altitude	1378
Feature Name	Los Angeles Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	95.3%	3.5%	0.6%	0.6%	0.0%
CABIN Assessment of AQREF2 on Jul 31, 2015	Highly Divergent				

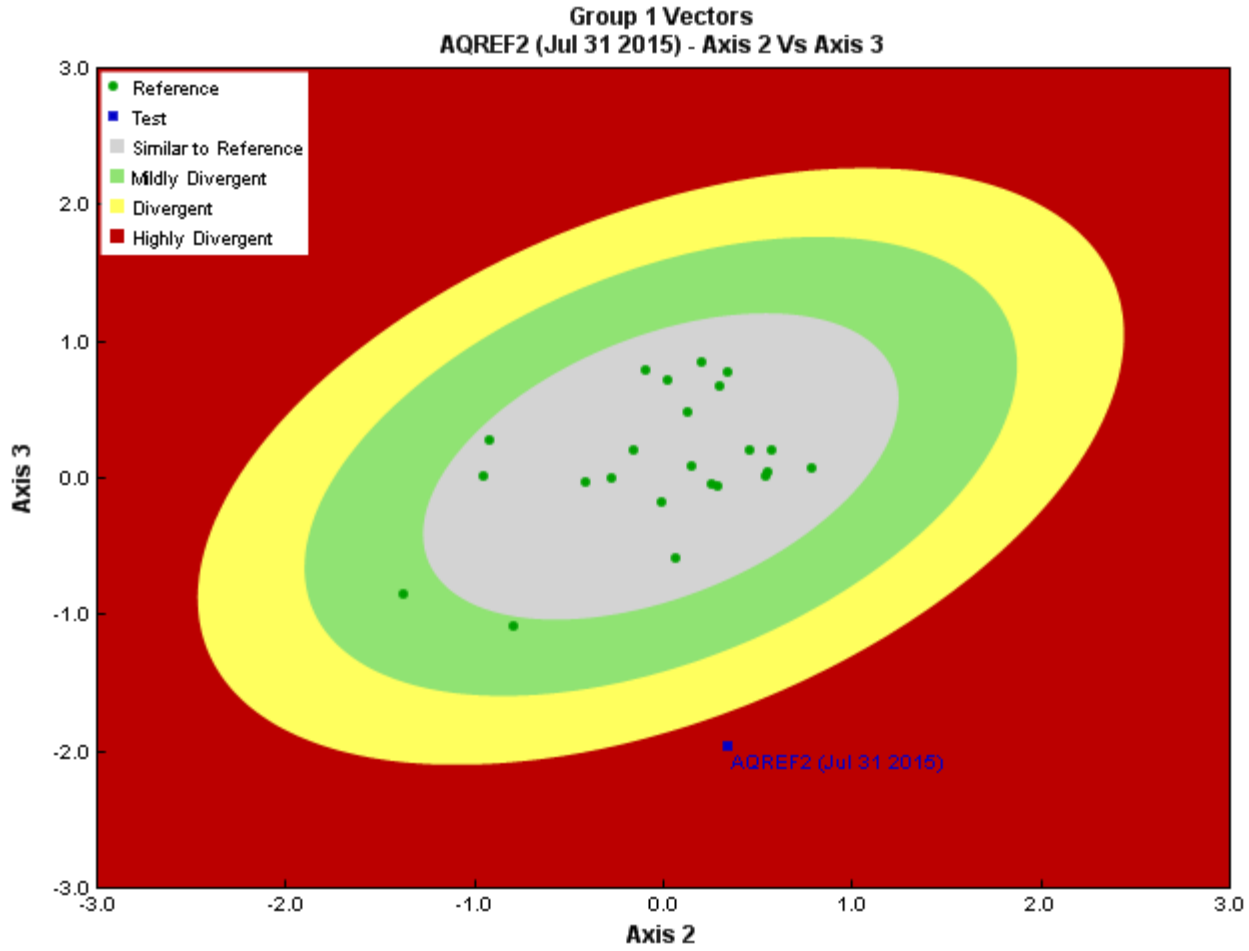


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	10/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Arthropoda	Arachnida	Sarcoptiformes		1	10.0
	Insecta	Diptera		1	10.0
			Chironomidae	15	150.0
			Simuliidae	116	1,160.0
		Ephemeroptera	Baetidae	81	810.0
			Heptageniidae	30	300.0
		Plecoptera	Capniidae	1	10.0
			Nemouridae	76	760.0
			Total	321	3,210.0

Site Metrics

Metric Name	AQREF2	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.99	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQREF2
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.92

RIVPACS : Expected taxa P>0.50	0.92
RIVPACS : Observed taxa P>0.50	1.00
RIVPACS : O:E (p > 0.5)	1.09
RIVPACS : Expected taxa P>0.70	0.92
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.09

D. Habitat Description

Variable	AQREF2	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	37.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.93	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	11.90000	27.73943 ± 9.10561
Precip03_MAR (mm)	10.40000	25.54674 ± 9.71520
Precip06_JUN (mm)	47.40000	49.78117 ± 15.10067
Precip07_JUL (mm)	59.20000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	47.40000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	6.00000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.89107	0.19525 ± 0.41187
Natl-Bryoids (%)	0.14992	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	1.86018	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	ICM1
Sampling Date	Aug 19 2014
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.82747 N, 138.51100 W
Altitude	1463
Feature Name	Isaac Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	68.2%	27.3%	1.1%	3.4%	0.0%
CABIN Assessment of ICM1 on Aug 19, 2014	Mildly Divergent				

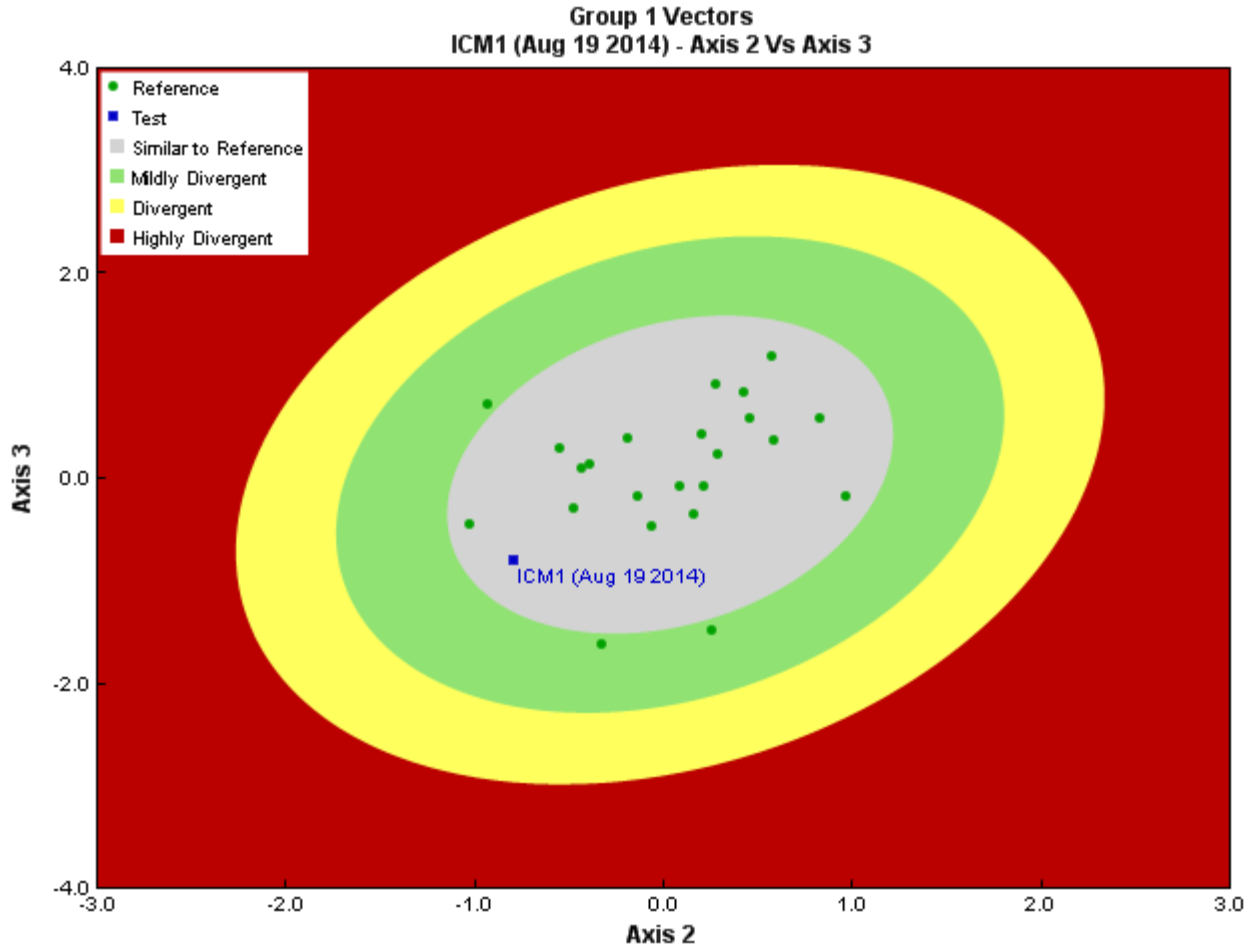


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	100/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta			1	1.0
Arthropoda	Arachnida	Sarcoptiformes	Hydrozetidae	1	1.0
	Insecta	Diptera	Chironomidae	169	169.0
			Empididae	2	2.0
			Tipulidae	5	5.0
		Ephemeroptera	Baetidae	2	2.0
			Ephemerellidae	5	5.0
			Heptageniidae	24	24.0
		Plecoptera	Chloroperlidae	9	9.0
		Trichoptera	Limnephilidae	3	3.0
			Total	221	221.0

Site Metrics

Metric Name	ICM1	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.9	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at ICM1
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.94

RIVPACS : Expected taxa P>0.50	1.97
RIVPACS : Observed taxa P>0.50	1.00
RIVPACS : O:E (p > 0.5)	0.51
RIVPACS : Expected taxa P>0.70	0.94
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.06

D. Habitat Description

Variable	ICM1	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	28.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.34	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.20000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.00000	25.54674 ± 9.71520
Precip06_JUN (mm)	47.10000	49.78117 ± 15.10067
Precip07_JUL (mm)	61.50000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	47.10000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	5.10000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.48148	0.19525 ± 0.41187
Natl-Bryoids (%)	1.35922	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	2.17402	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	ICM1
Sampling Date	Jul 28 2015
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.82747 N, 138.51100 W
Altitude	1463
Feature Name	Isaac Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	61.1%	33.4%	1.2%	4.4%	0.0%
CABIN Assessment of ICM1 on Jul 28, 2015	Mildly Divergent				

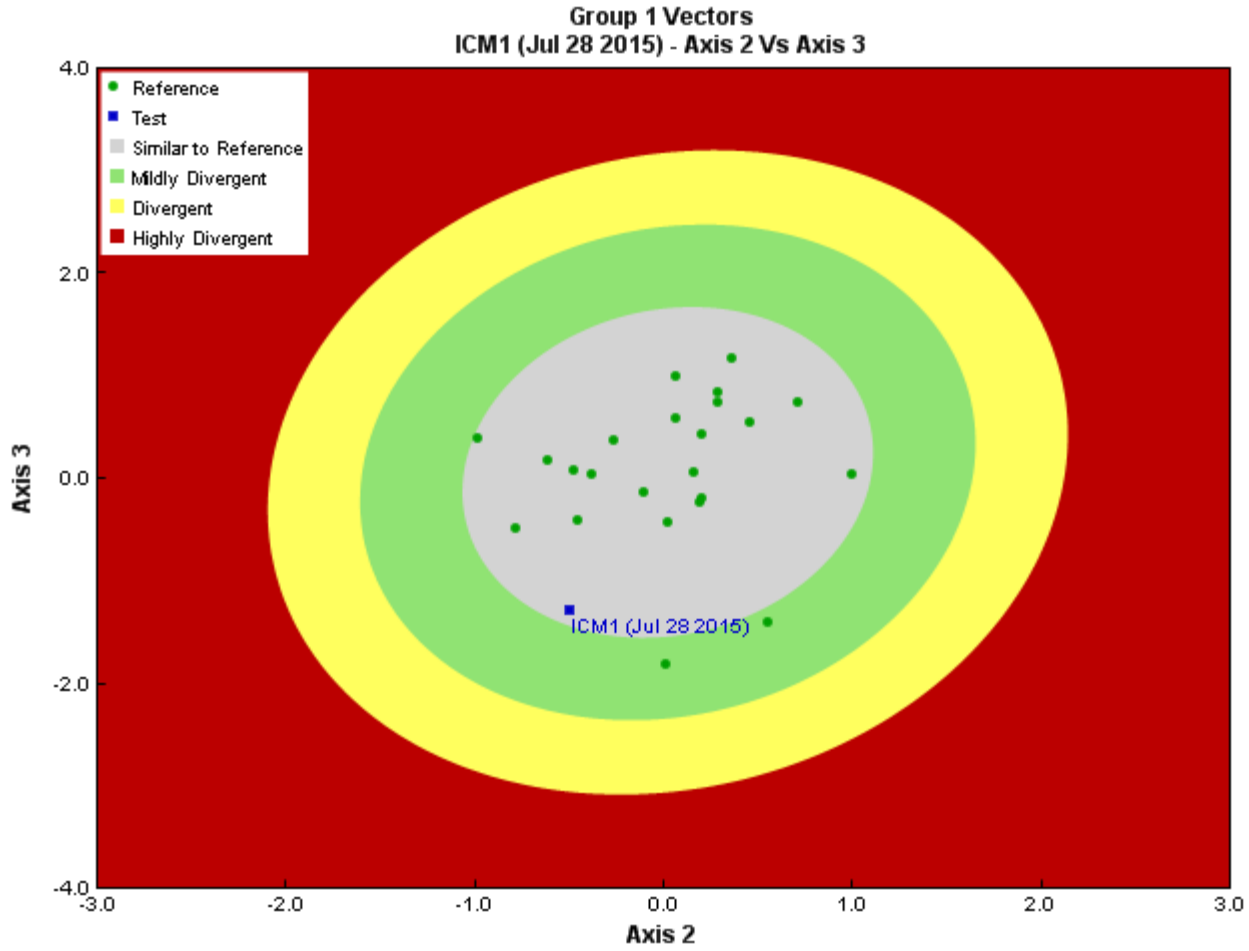


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	100/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Arthropoda	Arachnida	Sarcoptiformes		1	1.0
	Insecta	Diptera	Chironomidae	171	171.0
			Empididae	22	22.0
			Simuliidae	51	51.0
			Tipulidae	4	4.0
		Ephemeroptera	Baetidae	17	17.0
			Ephemerellidae	1	1.0
			Heptageniidae	94	94.0
		Plecoptera	Capniidae	2	2.0
			Chloroperlidae	23	23.0
			Perlodidae	1	1.0
	Malacostraca	Amphipoda		3	3.0
			Total	390	390.0

Site Metrics

Metric Name	ICM1	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.94	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at ICM1
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.95

RIVPACS : Expected taxa P>0.50	2.55
RIVPACS : Observed taxa P>0.50	3.00
RIVPACS : O:E (p > 0.5)	1.18
RIVPACS : Expected taxa P>0.70	0.95
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.06

D. Habitat Description

Variable	ICM1	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	13.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.24	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.20000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.00000	25.54674 ± 9.71520
Precip06_JUN (mm)	47.10000	49.78117 ± 15.10067
Precip07_JUL (mm)	61.50000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	47.10000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	5.10000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.48148	0.19525 ± 0.41187
Natl-Bryoids (%)	1.35922	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	2.17402	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ20
Sampling Date	Aug 29 2014
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.94400 N, 139.24900 W
Altitude	1404
Feature Name	Halfway Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	86.7%	12.6%	0.2%	0.6%	0.0%
CABIN Assessment of AQ20 on Aug 29, 2014	Mildly Divergent				

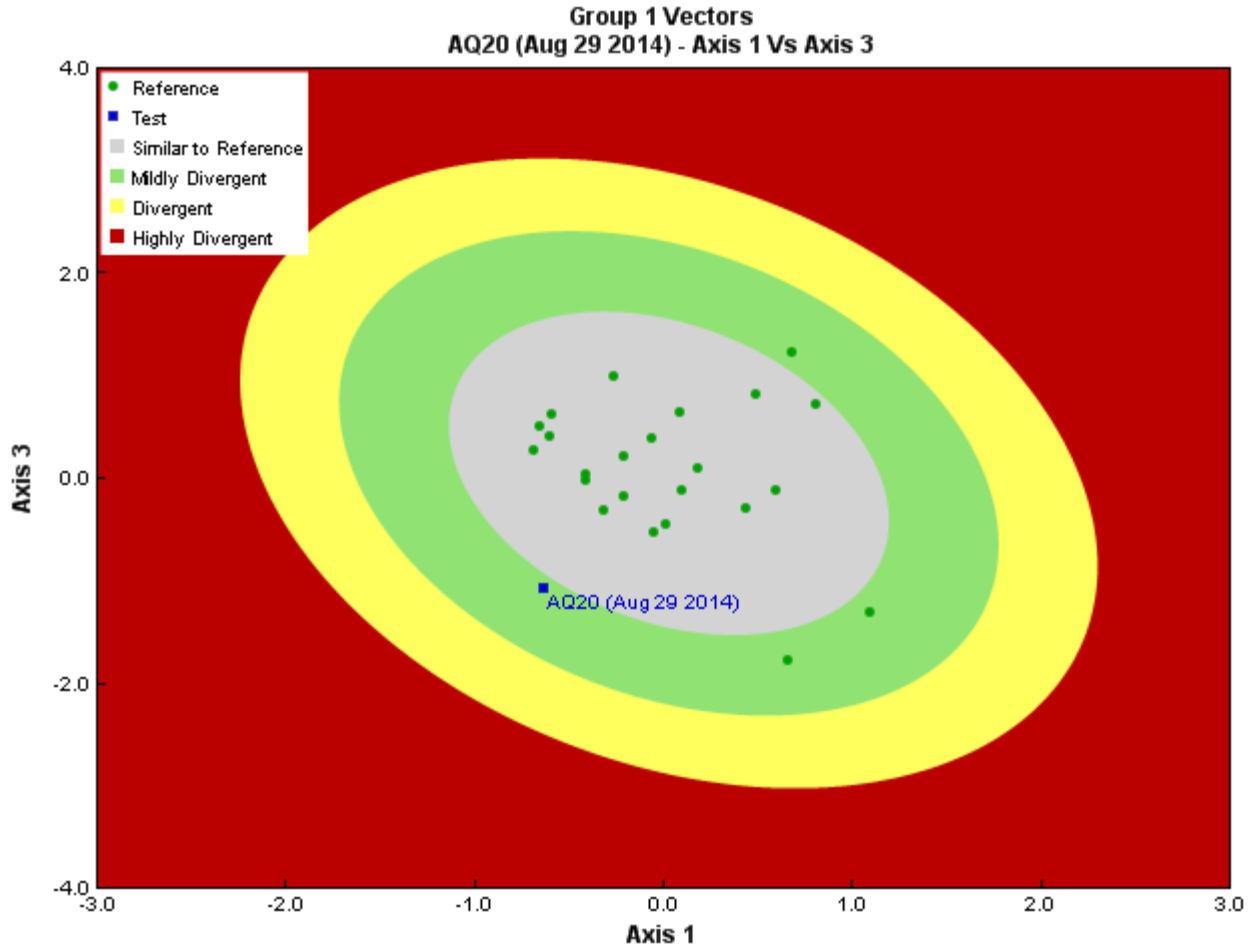


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	100/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae	7	7.0
Arthropoda	Arachnida	Sarcoptiformes	Hydrozetidae	2	2.0
		Trombidiformes	Hydryphantidae	1	1.0
			Sperchontidae	2	2.0
	Insecta	Diptera	Chironomidae	111	111.0
			Simuliidae	8	8.0
		Ephemeroptera	Baetidae	22	22.0
			Heptageniidae	11	11.0
		Plecoptera		1	1.0
			Chloroperlidae	1	1.0
			Nemouridae	93	93.0
		Trichoptera	Limnephilidae	1	1.0
			Total	260	260.0

Site Metrics

Metric Name	AQ20	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.92	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ20
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.92

RIVPACS : Expected taxa P>0.50	0.92
RIVPACS : Observed taxa P>0.50	1.00
RIVPACS : O:E (p > 0.5)	1.08
RIVPACS : Expected taxa P>0.70	0.92
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.08

D. Habitat Description

Variable	AQ20	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	18.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.07	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.10000	27.73943 ± 9.10561
Precip03_MAR (mm)	10.80000	25.54674 ± 9.71520
Precip06_JUN (mm)	49.00000	49.78117 ± 15.10067
Precip07_JUL (mm)	62.00000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	49.00000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	5.30000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.03620	0.19525 ± 0.41187
Natl-Bryoids (%)	0.37008	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	1.88321	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ20
Sampling Date	Jul 30 2015
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.94400 N, 139.24900 W
Altitude	1404
Feature Name	Halfway Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	92.4%	6.6%	0.4%	0.6%	0.0%
CABIN Assessment of AQ20 on Jul 30, 2015	Mildly Divergent				

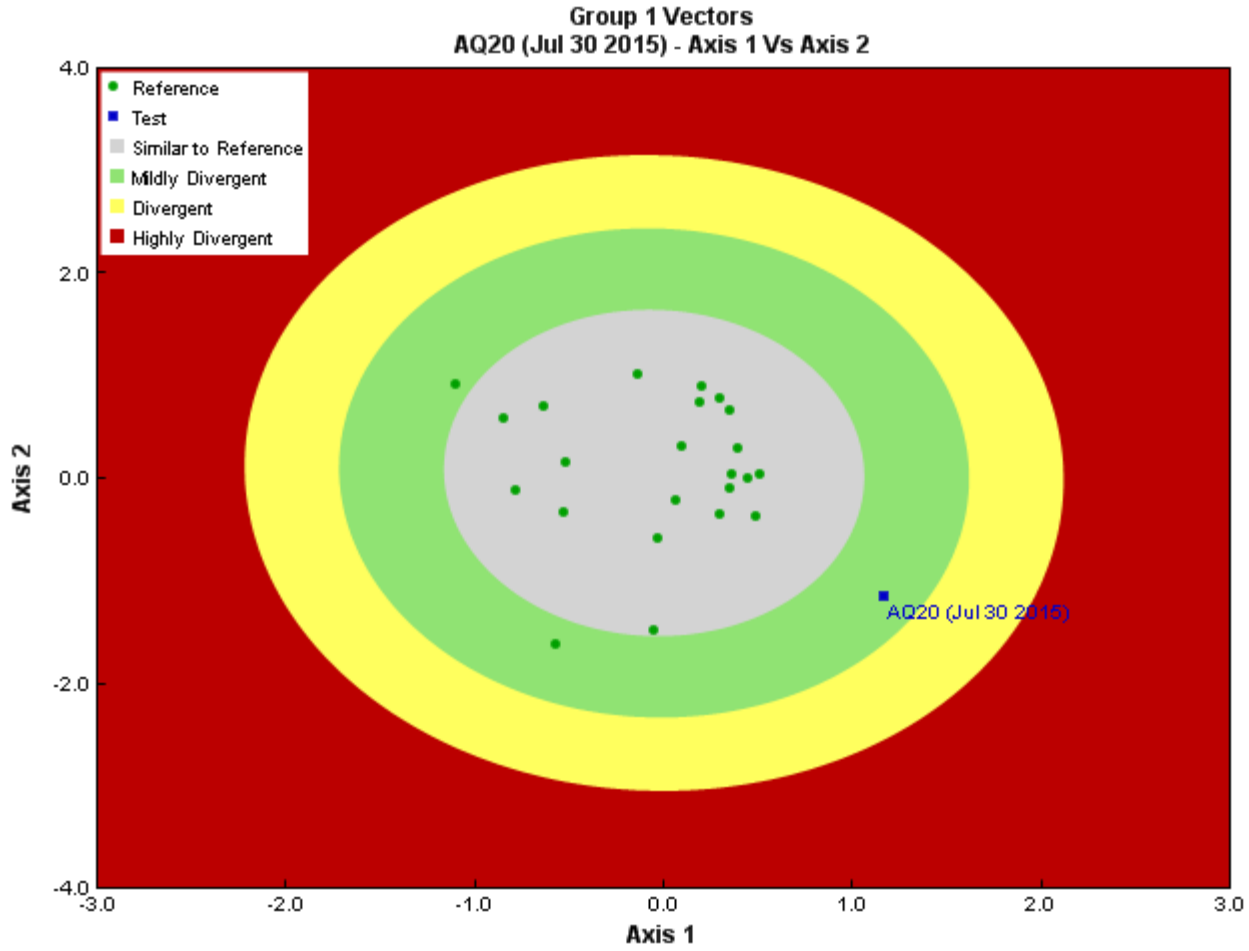


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	46/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae	1	2.2
Arthropoda	Arachnida	Sarcoptiformes		1	2.2
	Insecta	Diptera		1	2.2
			Chironomidae	63	137.0
			Empididae	1	2.2
			Simuliidae	52	113.0
			Tipulidae	2	4.4
		Ephemeroptera	Baetidae	26	56.5
			Heptageniidae	1	2.2
		Plecoptera	Capniidae	3	6.5
			Nemouridae	154	334.8
	Malacostraca	Amphipoda	Gammaridae	1	2.2
Mollusca	Gastropoda			2	4.3
			Total	308	669.7

Site Metrics

Metric Name	AQ20	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.97	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ20
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.92

RIVPACS : Expected taxa P>0.50	0.92
RIVPACS : Observed taxa P>0.50	1.00
RIVPACS : O:E (p > 0.5)	1.09
RIVPACS : Expected taxa P>0.70	0.92
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.09

D. Habitat Description

Variable	AQ20	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	44.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.79	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.10000	27.73943 ± 9.10561
Precip03_MAR (mm)	10.80000	25.54674 ± 9.71520
Precip06_JUN (mm)	49.00000	49.78117 ± 15.10067
Precip07_JUL (mm)	62.00000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	49.00000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	5.30000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.03620	0.19525 ± 0.41187
Natl-Bryoids (%)	0.37008	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	1.88321	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ30
Sampling Date	Aug 29 2014
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.93137 N, 139.23300 W
Altitude	1407
Feature Name	Unnamed
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	88.3%	10.9%	0.2%	0.6%	0.0%
CABIN Assessment of AQ30 on Aug 29, 2014	Mildly Divergent				

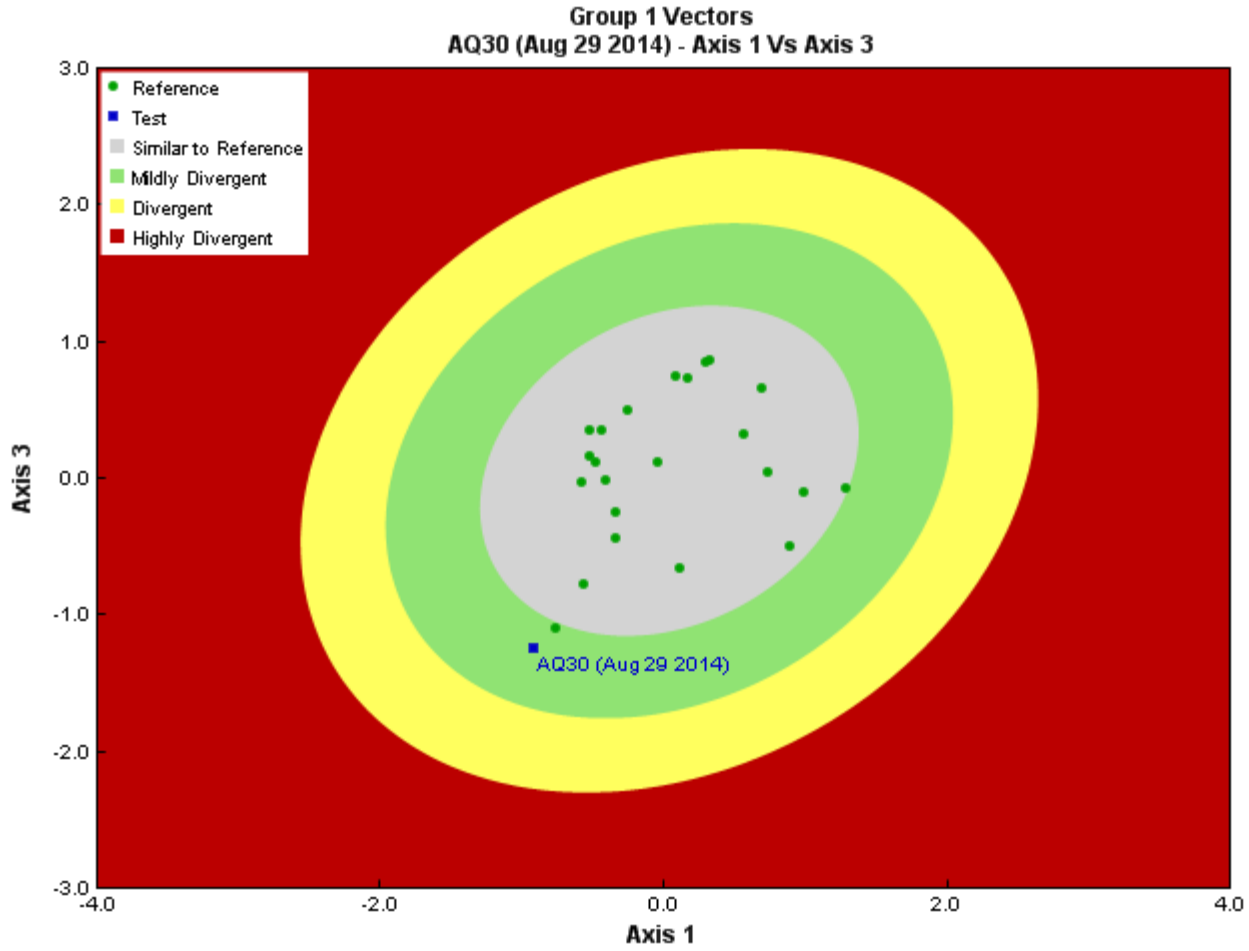


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	100/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae	4	4.0
Arthropoda	Arachnida	Sarcoptiformes	Hydrozetidae	5	5.0
		Trombidiformes		1	1.0
			Sperchontidae	3	3.0
	Insecta	Coleoptera	Dytiscidae	1	1.0
		Diptera	Chironomidae	188	188.0
			Simuliidae	3	3.0
			Tipulidae	3	3.0
		Ephemeroptera	Baetidae	71	71.0
			Heptageniidae	17	17.0
		Plecoptera		5	5.0
			Capniidae	29	29.0
			Nemouridae	361	361.0
Mollusca	Gastropoda	Heterostropha	Valvatidae	1	1.0
			Total	692	692.0

Site Metrics

Metric Name	AQ30	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.97	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ30
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.92

RIVPACS : Expected taxa P>0.50	0.92
RIVPACS : Observed taxa P>0.50	1.00
RIVPACS : O:E (p > 0.5)	1.08
RIVPACS : Expected taxa P>0.70	0.92
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.08

D. Habitat Description

Variable	AQ30	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	11.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.10	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.00000	27.73943 ± 9.10561
Precip03_MAR (mm)	10.70000	25.54674 ± 9.71520
Precip06_JUN (mm)	48.20000	49.78117 ± 15.10067
Precip07_JUL (mm)	61.20000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	48.20000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	5.50000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.05327	0.19525 ± 0.41187
Natl-Bryoids (%)	0.26099	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	2.18745	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ11
Sampling Date	Aug 29 2014
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.94198 N, 139.50500 W
Altitude	1483
Feature Name	Independence Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	57.3%	39.9%	1.0%	1.8%	0.0%
CABIN Assessment of AQ11 on Aug 29, 2014	Mildly Divergent				

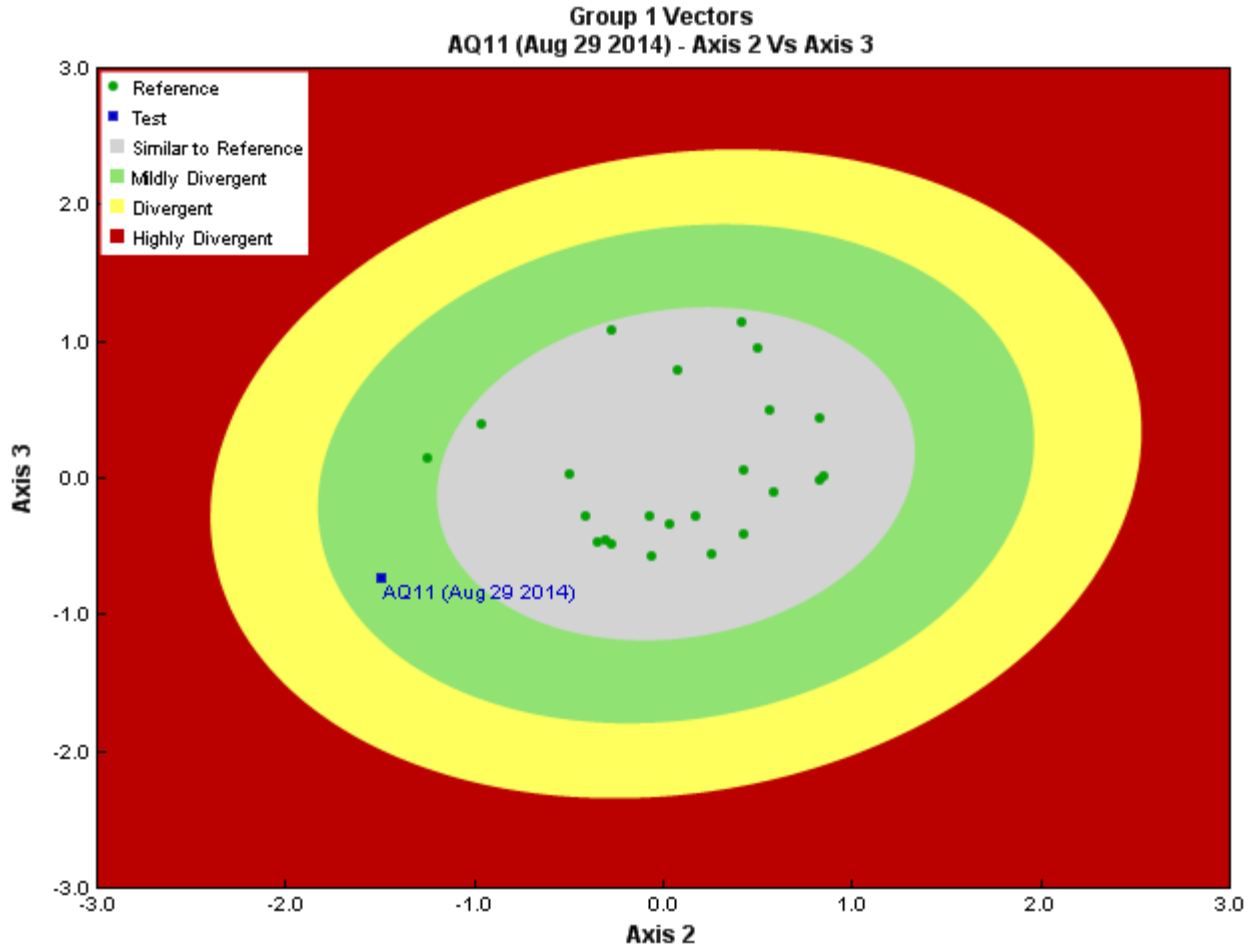


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	40/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae	2	5.0
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	2	5.0
	Insecta	Diptera	Chironomidae	155	387.5
			Empididae	8	20.0
			Simuliidae	16	40.0
			Tipulidae	2	5.0
		Ephemeroptera	Baetidae	47	117.5
			Heptageniidae	36	90.0
		Plecoptera		1	2.5
			Capniidae	12	30.0
			Chloroperlidae	1	2.5
			Nemouridae	53	132.5
			Perlodidae	6	15.0
	Malacostraca	Amphipoda	Hyalellidae	1	2.5
			Total	342	855.0

Site Metrics

Metric Name	AQ11	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.97	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.95

RIVPACS : Expected taxa P>0.50	2.59
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	1.54
RIVPACS : Expected taxa P>0.70	0.95
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.05

D. Habitat Description

Variable	AQ11	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	18.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.27	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.70000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.80000	25.54674 ± 9.71520
Precip06_JUN (mm)	55.60000	49.78117 ± 15.10067
Precip07_JUL (mm)	69.30000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	55.60000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	3.80000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.00505	0.19525 ± 0.41187
Natl-Bryoids (%)	1.36645	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	0.85391	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ11
Sampling Date	Jul 28 2015
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.94198 N, 139.50500 W
Altitude	1483
Feature Name	Independence Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	63.0%	34.2%	1.1%	1.6%	0.0%
CABIN Assessment of AQ11 on Jul 28, 2015	Highly Divergent				

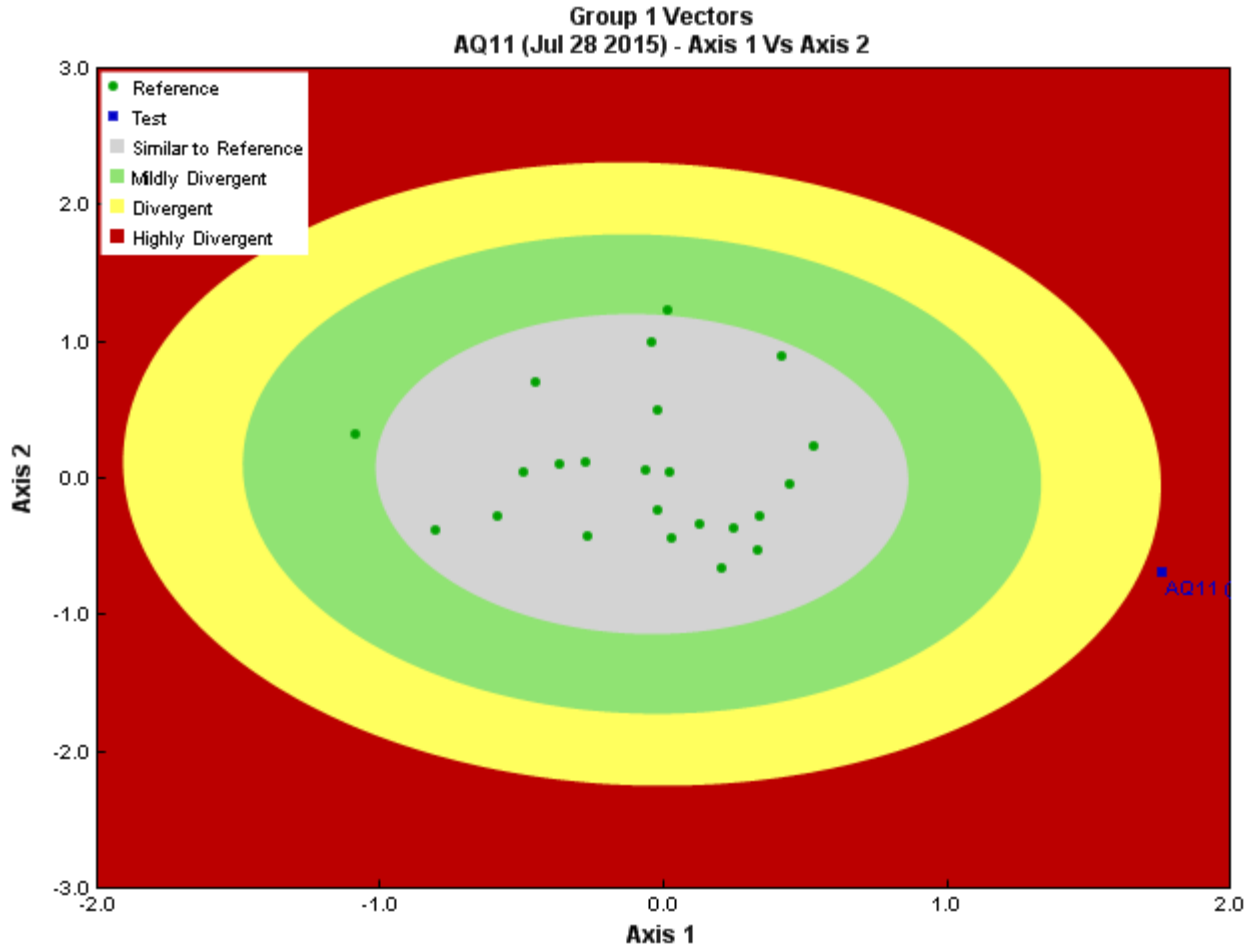


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	15/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	1	6.7
	Insecta	Diptera	Chironomidae	30	200.1
			Simuliidae	220	1,466.7
		Ephemeroptera	Baetidae	35	233.4
			Heptageniidae	12	80.0
		Plecoptera	Capniidae	2	13.3
			Nemouridae	20	133.4
			Perlodidae	2	13.3
	Malacostraca	Amphipoda	Hyalellidae	1	6.7
			Total	323	2,153.6

Site Metrics

Metric Name	AQ11	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.99	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ11
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.95

RIVPACS : Expected taxa P>0.50	2.51
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	1.59
RIVPACS : Expected taxa P>0.70	0.95
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.06

D. Habitat Description

Variable	AQ11	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	29.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.41	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.70000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.80000	25.54674 ± 9.71520
Precip06_JUN (mm)	55.60000	49.78117 ± 15.10067
Precip07_JUL (mm)	69.30000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	55.60000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	3.80000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.00505	0.19525 ± 0.41187
Natl-Bryoids (%)	1.36645	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	0.85391	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ13
Sampling Date	Aug 30 2014
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.90035 N, 139.45700 W
Altitude	2408
Feature Name	Independence Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	64.6%	31.6%	1.2%	2.5%	0.0%
CABIN Assessment of AQ13 on Aug 30, 2014	Divergent				

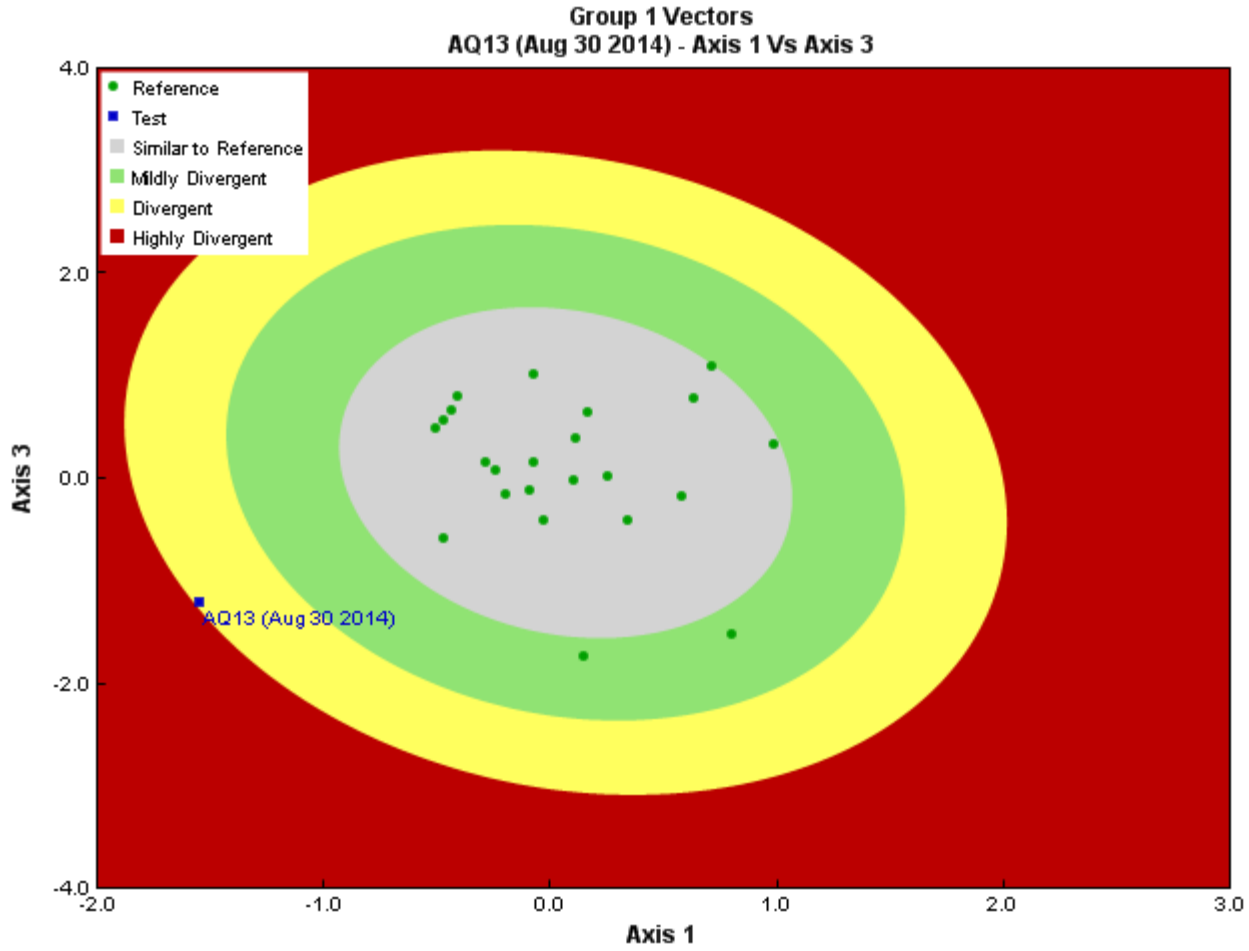


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	19/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae	2	10.5
Arthropoda	Insecta	Diptera	Chironomidae	143	752.7
			Simuliidae	5	26.3
		Ephemeroptera	Baetidae	32	168.5
		Plecoptera		2	10.5
			Capniidae	5	26.4
			Chloroperlidae	2	10.5
			Nemouridae	116	610.5
Mollusca	Gastropoda	Basommatophora	Lymnaeidae	2	10.5
			Total	309	1,626.4

Site Metrics

Metric Name	AQ13	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.99	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ13
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.94

RIVPACS : Expected taxa P>0.50	2.00
RIVPACS : Observed taxa P>0.50	3.00
RIVPACS : O:E (p > 0.5)	1.50
RIVPACS : Expected taxa P>0.70	0.94
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.06

D. Habitat Description

Variable	AQ13	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	14.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.06	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	13.00000	27.73943 ± 9.10561
Precip03_MAR (mm)	12.20000	25.54674 ± 9.71520
Precip06_JUN (mm)	55.10000	49.78117 ± 15.10067
Precip07_JUL (mm)	68.70000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	55.10000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	3.80000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.00000	0.19525 ± 0.41187
Natl-Bryoids (%)	0.68796	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	0.49116	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ13
Sampling Date	Jul 28 2015
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.90035 N, 139.45700 W
Altitude	2408
Feature Name	Independence Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	73.1%	21.5%	2.4%	3.0%	0.0%
CABIN Assessment of AQ13 on Jul 28, 2015	Similar to Reference				

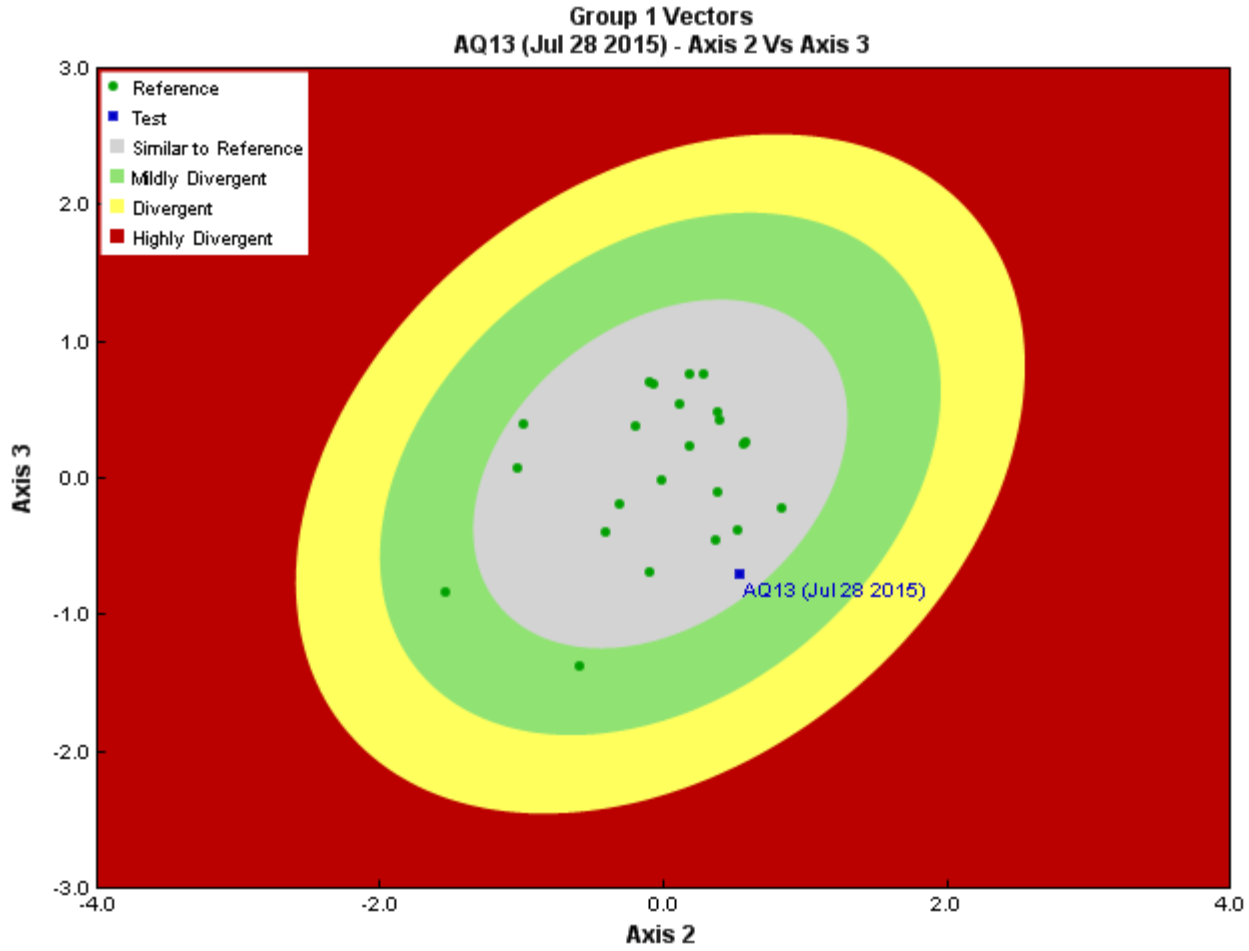


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	100/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae	3	3.0
			Naididae	4	4.0
Arthropoda	Arachnida	Sarcoptiformes		2	2.0
	Insecta	Diptera		2	2.0
			Chironomidae	60	60.0
			Muscidae	1	1.0
			Simuliidae	17	17.0
		Ephemeroptera	Baetidae	3	3.0
		Plecoptera		1	1.0
			Capniidae	6	6.0
			Nemouridae	36	36.0
			Total	135	135.0

Site Metrics

Metric Name	AQ13	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.84	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ13
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.94

RIVPACS : Expected taxa P>0.50	0.94
RIVPACS : Observed taxa P>0.50	1.00
RIVPACS : O:E (p > 0.5)	1.07
RIVPACS : Expected taxa P>0.70	0.94
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.07

D. Habitat Description

Variable	AQ13	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	32.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.60	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	13.00000	27.73943 ± 9.10561
Precip03_MAR (mm)	12.20000	25.54674 ± 9.71520
Precip06_JUN (mm)	55.10000	49.78117 ± 15.10067
Precip07_JUL (mm)	68.70000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	55.10000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	3.80000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.00000	0.19525 ± 0.41187
Natl-Bryoids (%)	0.68796	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	0.49116	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ04
Sampling Date	Aug 30 2014
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.86623 N, 139.34400 W
Altitude	2477
Feature Name	Coffee Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	43.8%	47.8%	2.9%	5.6%	0.0%
CABIN Assessment of AQ04 on Aug 30, 2014	Mildly Divergent				

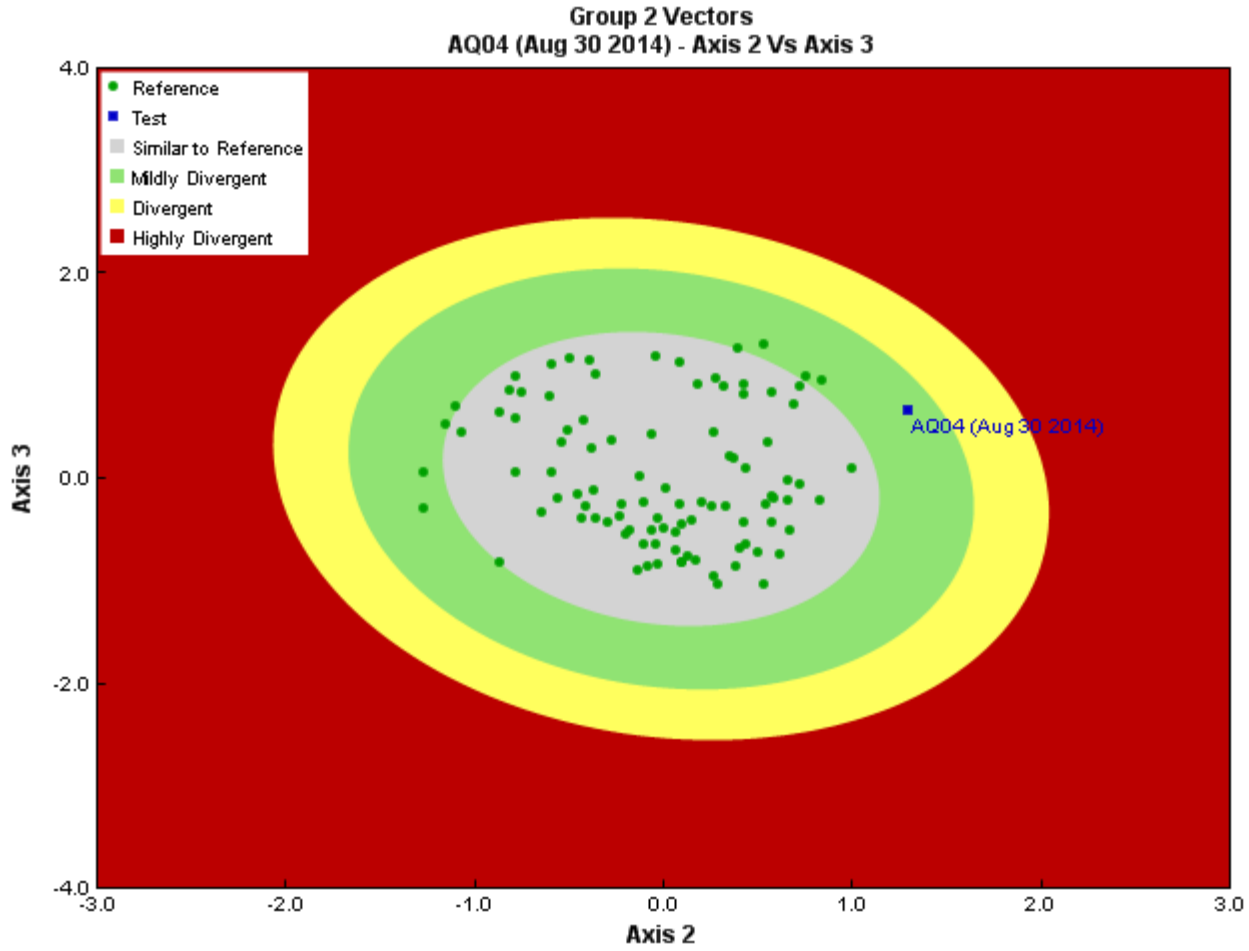


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	100/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	30	30.0
Arthropoda	Arachnida			14	14.0
		Sarcoptiformes	Hydrozetidae	1	1.0
		Trombidiformes	Hydryphantidae	1	1.0
			Sperchontidae	10	10.0
	Insecta	Diptera		1	1.0
			Chironomidae	53	53.0
			Simuliidae	1	1.0
			Tipulidae	7	7.0
		Ephemeroptera	Ameletidae	2	2.0
			Baetidae	40	40.0
			Heptageniidae	261	261.0
		Plecoptera	Capniidae	26	26.0
			Chloroperlidae	10	10.0
			Nemouridae	278	278.0

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
			Perlodidae	2	2.0
		Trichoptera	Limnephilidae	13	13.0
			Total	750	750.0

Site Metrics

Metric Name	AQ04	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.81	0.5 ± 0.2

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ04
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.96

RIVPACS : Expected taxa P>0.50	2.79
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	1.43
RIVPACS : Expected taxa P>0.70	0.96
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.04

D. Habitat Description

Variable	AQ04	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	18.0	31.5 ± 19.7
Velocity-Avg (m/s)	0.18	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	12.70000	28.46252 ± 7.49311
Precip03_MAR (mm)	11.80000	26.42293 ± 7.74153
Precip06_JUN (mm)	53.70000	57.03745 ± 13.62127
Precip07_JUL (mm)	67.40000	72.89271 ± 17.78889
Rainfall06_JUN (mm)	53.70000	49.24817 ± 11.41222
Temp04_APRmax (Degrees Celsius)	4.07500	0.92957 ± 4.22238
Landcover		
Natl-BroadleafOpen (%)	0.07973	0.14219 ± 0.34573
Natl-Bryoids (%)	1.62143	0.31692 ± 0.61087
Natl-MixedwoodOpen (%)	0.00000	0.75941 ± 1.44798
Natl-WetlandHerb (%)	0.00000	0.10497 ± 0.30427

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ04.5
Sampling Date	Jul 30 2015
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.86546 N, 139.33353 W
Altitude	2385
Feature Name	Coffee Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	56.8%	34.3%	4.2%	4.7%	0.0%
CABIN Assessment of AQ04.5 on Jul 30, 2015	Mildly Divergent				

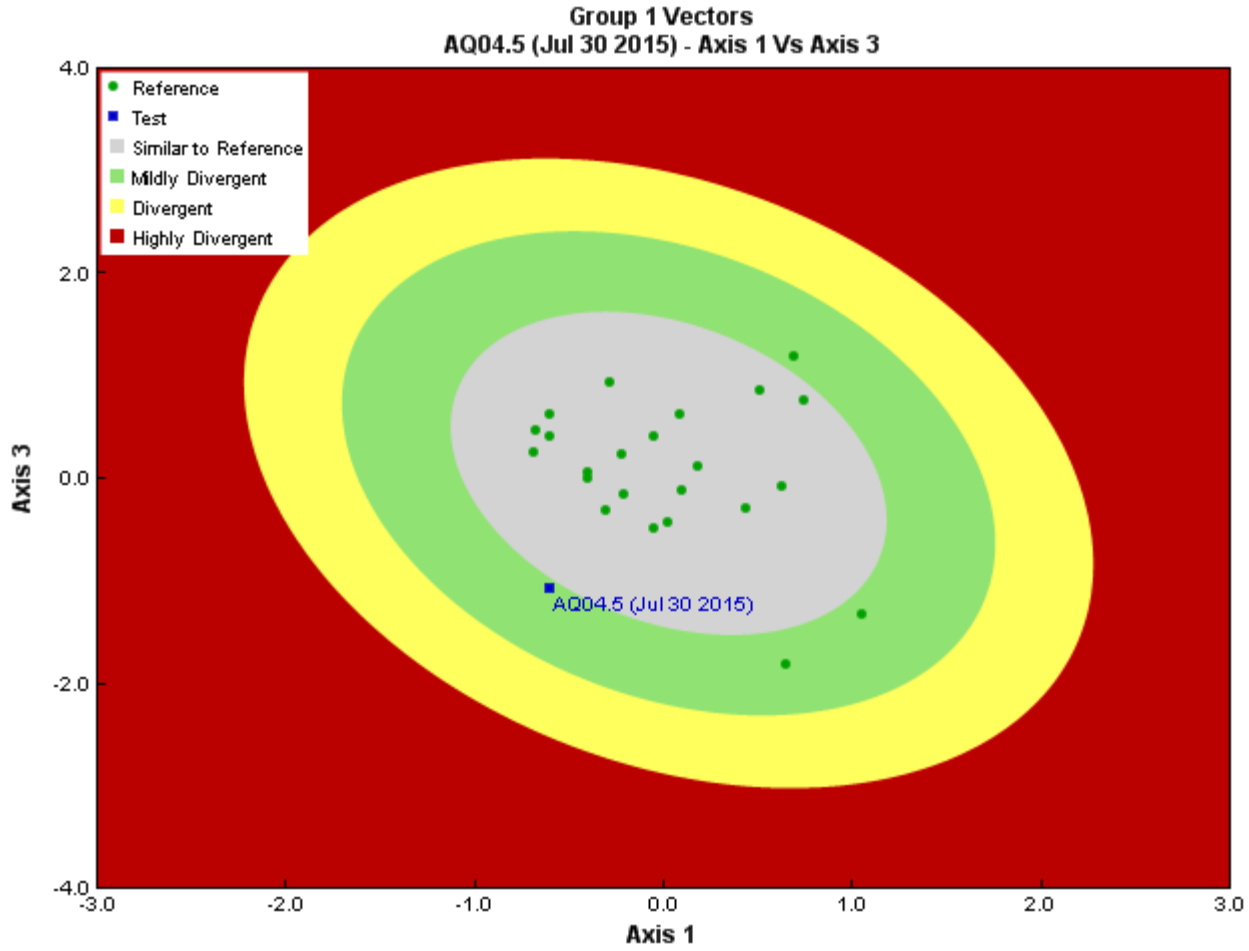


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	100/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae	4	4.0
Arthropoda	Arachnida	Sarcoptiformes		3	3.0
		Trombidiformes		1	1.0
			Sperchontidae	1	1.0
	Insecta	Diptera		1	1.0
			Chironomidae	85	85.0
			Simuliidae	30	30.0
			Tipulidae	1	1.0
		Ephemeroptera	Baetidae	48	48.0
			Heptageniidae	5	5.0
		Plecoptera	Capniidae	8	8.0
			Nemouridae	59	59.0
Tardigrada				1	1.0
			Total	247	247.0

Site Metrics

Metric Name	AQ04.5	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.91	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ04.5
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.95

RIVPACS : Expected taxa P>0.50	2.62
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	1.53
RIVPACS : Expected taxa P>0.70	0.95
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.05

D. Habitat Description

Variable	AQ04.5	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	53.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.65	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	13.10000	27.73943 ± 9.10561
Precip03_MAR (mm)	12.70000	25.54674 ± 9.71520
Precip06_JUN (mm)	57.00000	49.78117 ± 15.10067
Precip07_JUL (mm)	70.90000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	57.00000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	3.21000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.07437	0.19525 ± 0.41187
Natl-Bryoids (%)	1.51230	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	0.00000	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ10
Sampling Date	Aug 29 2014
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.96988 N, 139.43400 W
Altitude	1400
Feature Name	Independence Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	64.4%	32.6%	1.1%	1.9%	0.0%
CABIN Assessment of AQ10 on Aug 29, 2014	Divergent				

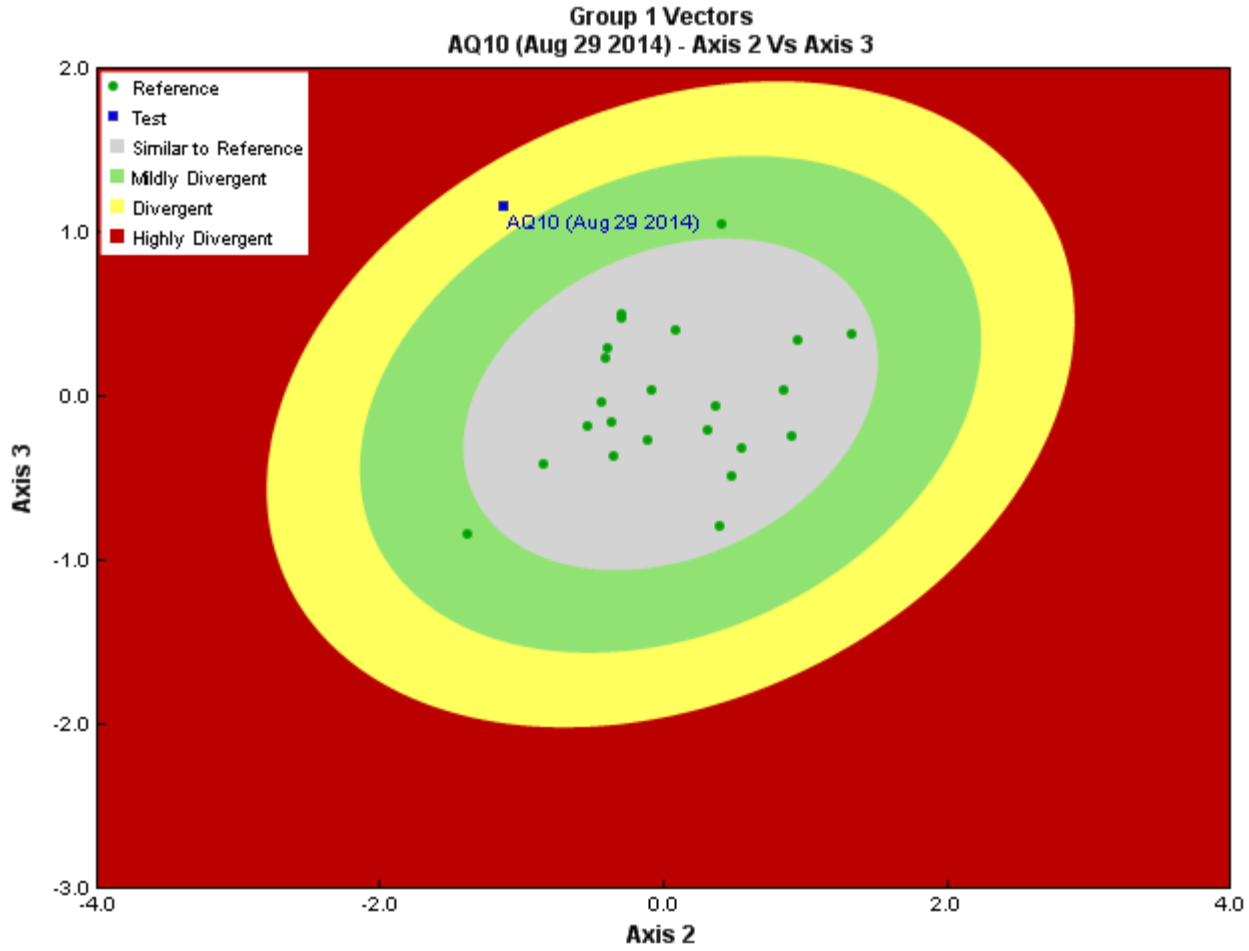


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	40/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta			1	2.5
Arthropoda	Insecta	Diptera	Chironomidae	281	702.5
			Empididae	1	2.5
			Simuliidae	2	5.0
			Tipulidae	5	12.5
		Ephemeroptera	Baetidae	17	42.5
			Heptageniidae	34	85.0
		Plecoptera	Capniidae	5	12.5
			Chloroperlidae	11	27.5
			Nemouridae	13	32.5
			Perlodidae	8	20.0
		Trichoptera	Limnephilidae	14	35.0
			Total	392	980.0

Site Metrics

Metric Name	AQ10	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.98	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ10
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.94

RIVPACS : Expected taxa P>0.50	2.00
RIVPACS : Observed taxa P>0.50	3.00
RIVPACS : O:E (p > 0.5)	1.50
RIVPACS : Expected taxa P>0.70	0.94
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.06

D. Habitat Description

Variable	AQ10	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	18.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.43	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.60000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.80000	25.54674 ± 9.71520
Precip06_JUN (mm)	55.10000	49.78117 ± 15.10067
Precip07_JUL (mm)	68.70000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	55.10000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	4.10000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.00457	0.19525 ± 0.41187
Natl-Bryoids (%)	1.28439	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	1.13939	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ10
Sampling Date	Jul 28 2015
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.96988 N, 139.43400 W
Altitude	1400
Feature Name	Independence Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	66.3%	30.1%	1.4%	2.2%	0.0%
CABIN Assessment of AQ10 on Jul 28, 2015	Highly Divergent				

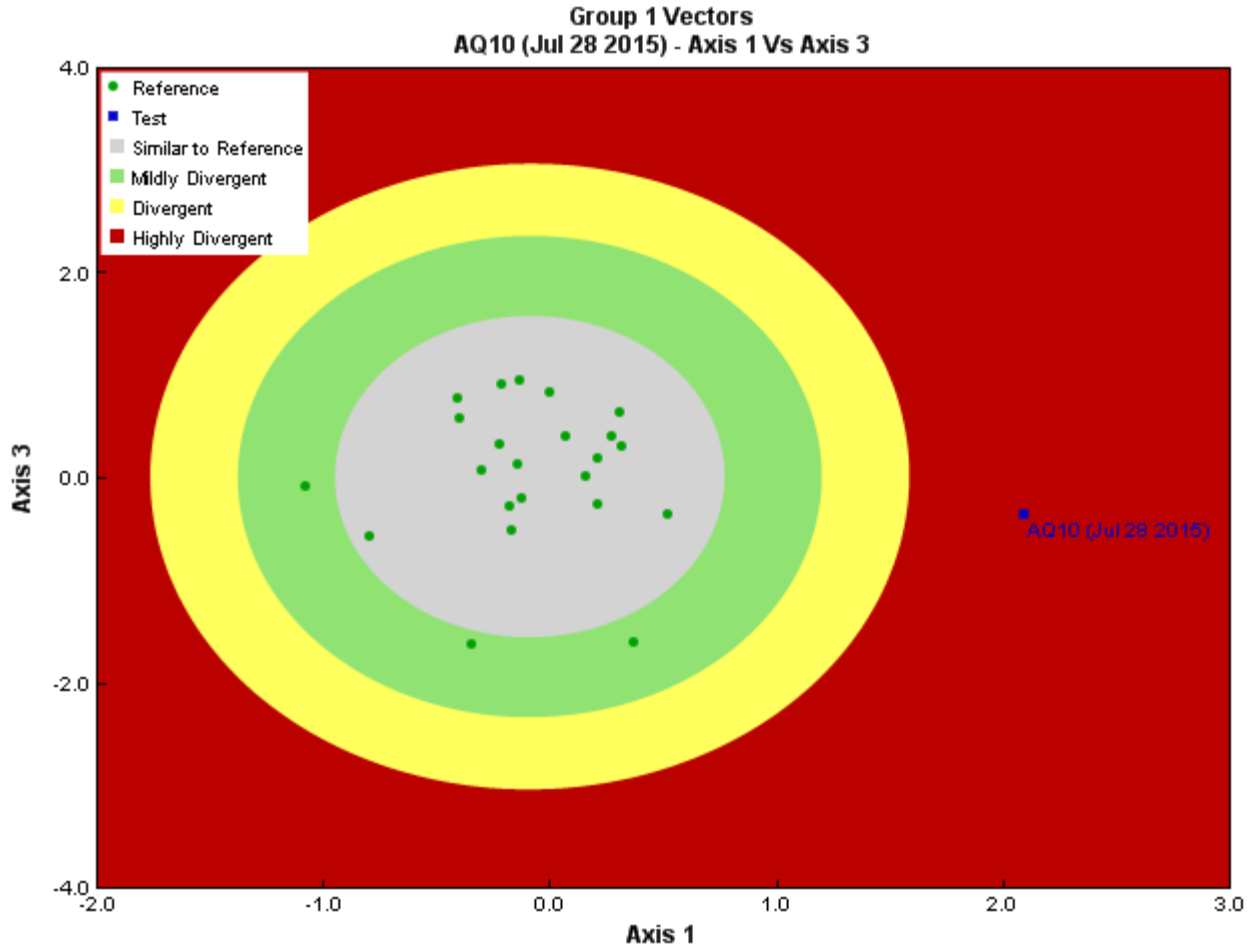


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	5/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Arthropoda	Insecta	Diptera	Chironomidae	25	500.0
			Simuliidae	242	4,840.0
		Ephemeroptera	Baetidae	42	840.0
			Heptageniidae	14	280.0
		Plecoptera	Capniidae	1	20.0
			Chloroperlidae	6	120.0
			Nemouridae	9	180.0
			Total	339	6,780.0

Site Metrics

Metric Name	AQ10	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	1.0	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ10
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.94

RIVPACS : Expected taxa P>0.50	1.98
RIVPACS : Observed taxa P>0.50	3.00
RIVPACS : O:E (p > 0.5)	1.51
RIVPACS : Expected taxa P>0.70	0.94
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.06

D. Habitat Description

Variable	AQ10	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	21.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.60	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.60000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.80000	25.54674 ± 9.71520
Precip06_JUN (mm)	55.10000	49.78117 ± 15.10067
Precip07_JUL (mm)	68.70000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	55.10000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	4.10000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.00457	0.19525 ± 0.41187
Natl-Bryoids (%)	1.28439	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	1.13939	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ02
Sampling Date	Jul 26 2015
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.85318 N, 139.14000 W
Altitude	1483
Feature Name	Coffee Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	50.6%	42.2%	2.7%	4.5%	0.0%
CABIN Assessment of AQ02 on Jul 26, 2015	Highly Divergent				

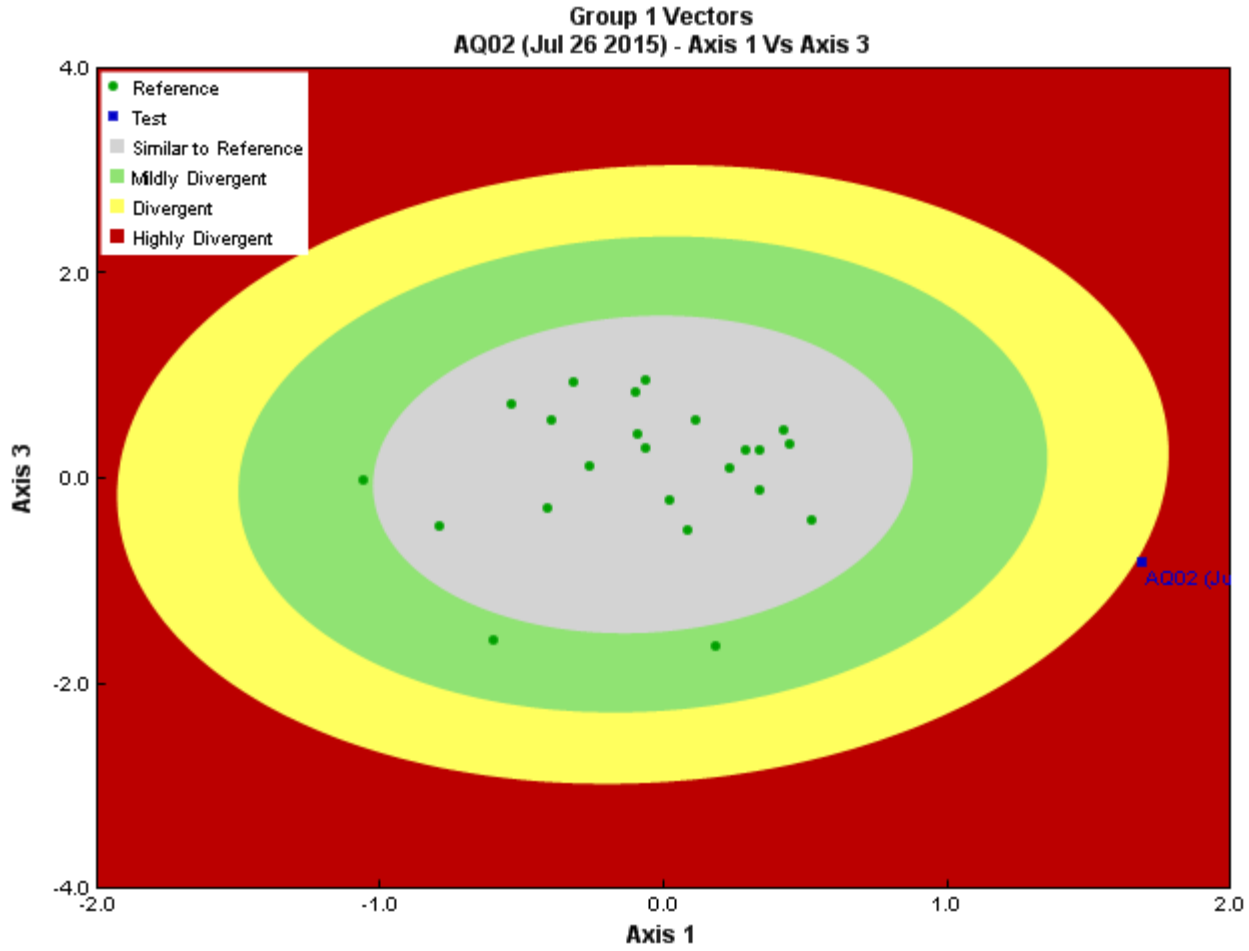


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	13/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Arthropoda	Arachnida	Trombidiformes	Feltriidae	1	7.7
			Sperchontidae	5	38.5
	Insecta	Diptera	Chironomidae	36	276.9
			Deuterophlebiidae	4	30.8
			Empididae	1	7.7
			Simuliidae	179	1,376.9
		Ephemeroptera	Baetidae	100	769.2
			Ephemerellidae	5	38.5
			Heptageniidae	18	138.5
		Plecoptera	Chloroperlidae	6	46.2
			Nemouridae	1	7.7
			Perlodidae	3	23.1
			Total	359	2,761.7

Site Metrics

Metric Name	AQ02	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.99	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ02
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.96

RIVPACS : Expected taxa P>0.50	2.70
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	1.48
RIVPACS : Expected taxa P>0.70	0.96
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.05

D. Habitat Description

Variable	AQ02	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	23.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.57	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.30000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.40000	25.54674 ± 9.71520
Precip06_JUN (mm)	53.20000	49.78117 ± 15.10067
Precip07_JUL (mm)	67.40000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	53.20000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	4.20000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.43870	0.19525 ± 0.41187
Natl-Bryoids (%)	1.46926	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	0.62595	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ03
Sampling Date	Aug 29 2014
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.85448 N, 139.19600 W
Altitude	1679
Feature Name	Coffee Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	62.5%	30.7%	2.5%	4.2%	0.0%
CABIN Assessment of AQ03 on Aug 29, 2014	Mildly Divergent				

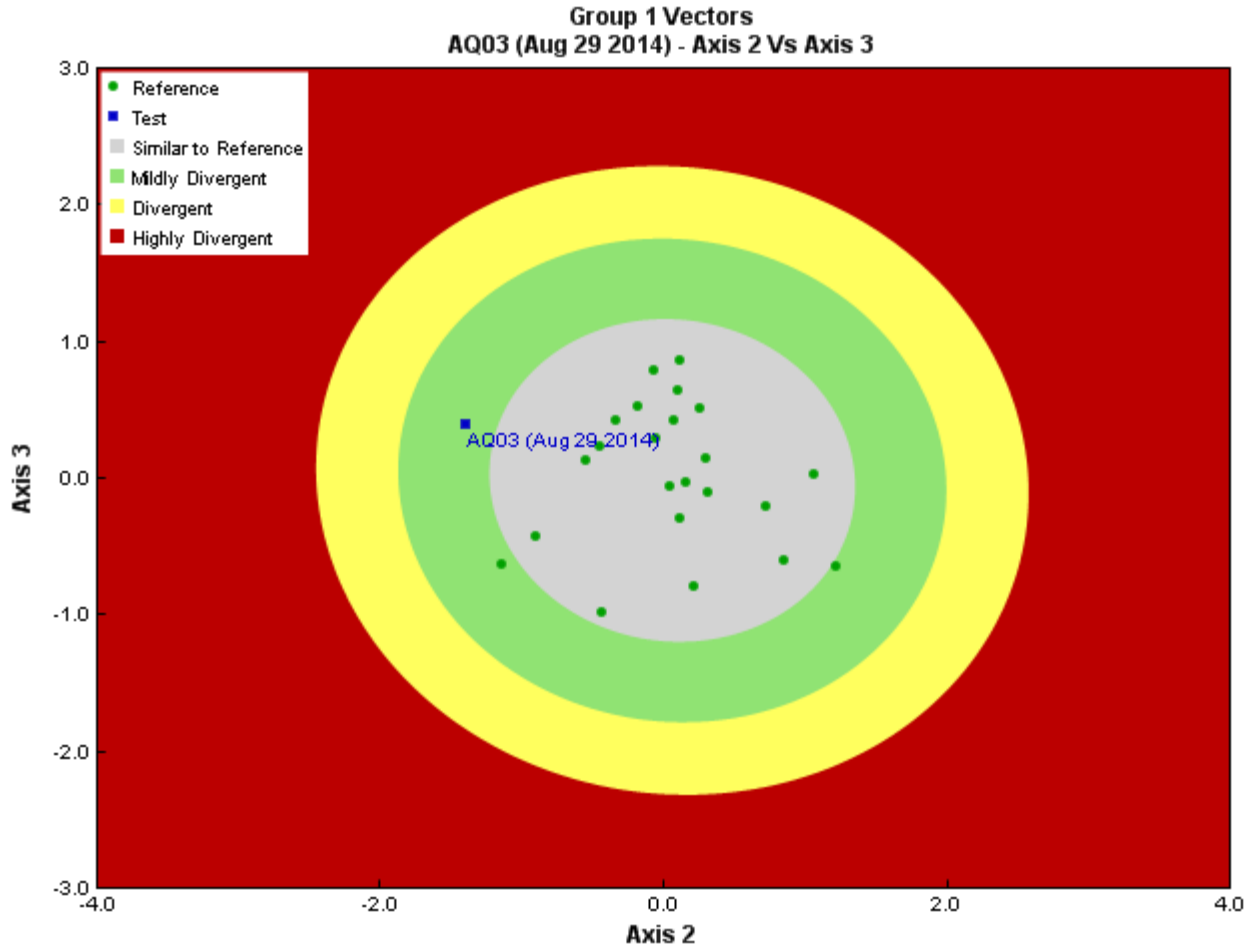


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	100/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae	4	4.0
Arthropoda	Arachnida	Sarcoptiformes	Hydrozetidae	1	1.0
		Trombidiformes	Sperchontidae	2	2.0
	Insecta	Diptera		134	134.0
			Chironomidae	222	222.0
			Deuterophlebiidae	12	12.0
			Simuliidae	5	5.0
			Tipulidae	7	7.0
		Ephemeroptera	Baetidae	118	118.0
			Ephemerellidae	1	1.0
			Heptageniidae	58	58.0
		Plecoptera	Capniidae	7	7.0
			Chloroperlidae	1	1.0
			Nemouridae	31	31.0
			Perlodidae	16	16.0

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
		Trichoptera	Limnephilidae	35	35.0
	Malacostraca	Amphipoda	Crangonyctidae	7	7.0
			Total	661	661.0

Site Metrics

Metric Name	AQ03	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.96	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ03
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.95

RIVPACS : Expected taxa P>0.50	2.53
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	1.58
RIVPACS : Expected taxa P>0.70	0.95
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.06

D. Habitat Description

Variable	AQ03	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	15.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.28	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.70000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.80000	25.54674 ± 9.71520
Precip06_JUN (mm)	53.70000	49.78117 ± 15.10067
Precip07_JUL (mm)	67.40000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	53.70000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	4.07500	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	1.35596	0.19525 ± 0.41187
Natl-Bryoids (%)	0.52060	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	0.58306	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ03
Sampling Date	Jul 29 2015
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.85448 N, 139.19600 W
Altitude	1679
Feature Name	Coffee Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	70.8%	20.5%	4.3%	4.5%	0.0%
CABIN Assessment of AQ03 on Jul 29, 2015	Mildly Divergent				

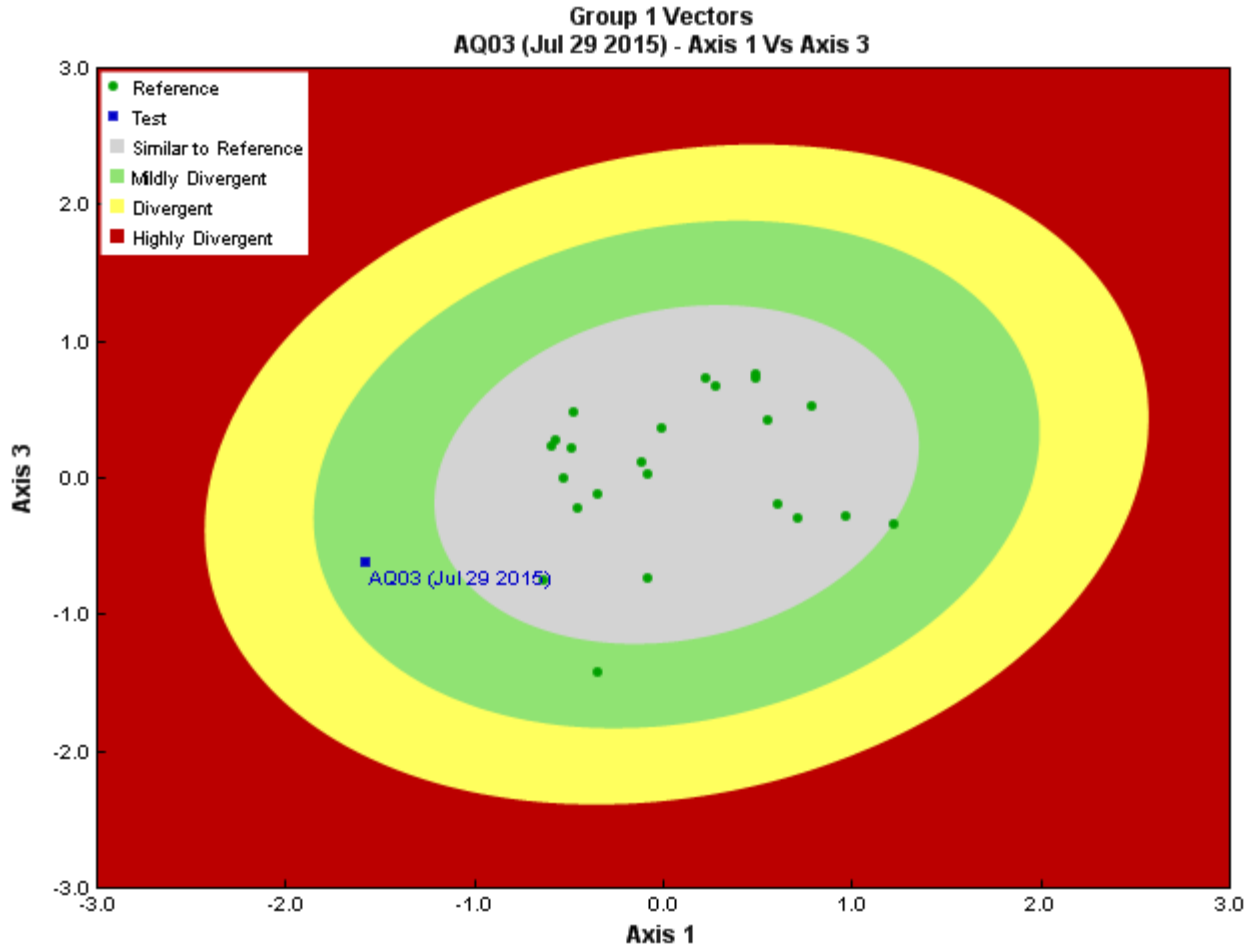


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	36/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	1	2.8
	Insecta	Diptera		2	5.6
			Chironomidae	112	311.2
			Simuliidae	30	83.4
			Tipulidae	2	5.6
		Ephemeroptera	Baetidae	154	427.7
			Heptageniidae	5	13.9
		Plecoptera	Capniidae	2	5.6
			Nemouridae	8	22.2
			Perlodidae	2	5.6
			Total	318	883.6

Site Metrics

Metric Name	AQ03	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.98	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ03
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.94

RIVPACS : Expected taxa P>0.50	1.96
RIVPACS : Observed taxa P>0.50	3.00
RIVPACS : O:E (p > 0.5)	1.53
RIVPACS : Expected taxa P>0.70	0.94
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.07

D. Habitat Description

Variable	AQ03	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	35.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.77	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.70000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.80000	25.54674 ± 9.71520
Precip06_JUN (mm)	53.70000	49.78117 ± 15.10067
Precip07_JUL (mm)	67.40000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	53.70000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	4.07500	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	1.35596	0.19525 ± 0.41187
Natl-Bryoids (%)	0.52060	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	0.58306	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ00
Sampling Date	Jul 26 2015
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.88524 N, 139.09500 W
Altitude	1427
Feature Name	Coffee Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	51.6%	44.1%	1.4%	3.0%	0.0%
CABIN Assessment of AQ00 on Jul 26, 2015	Mildly Divergent				

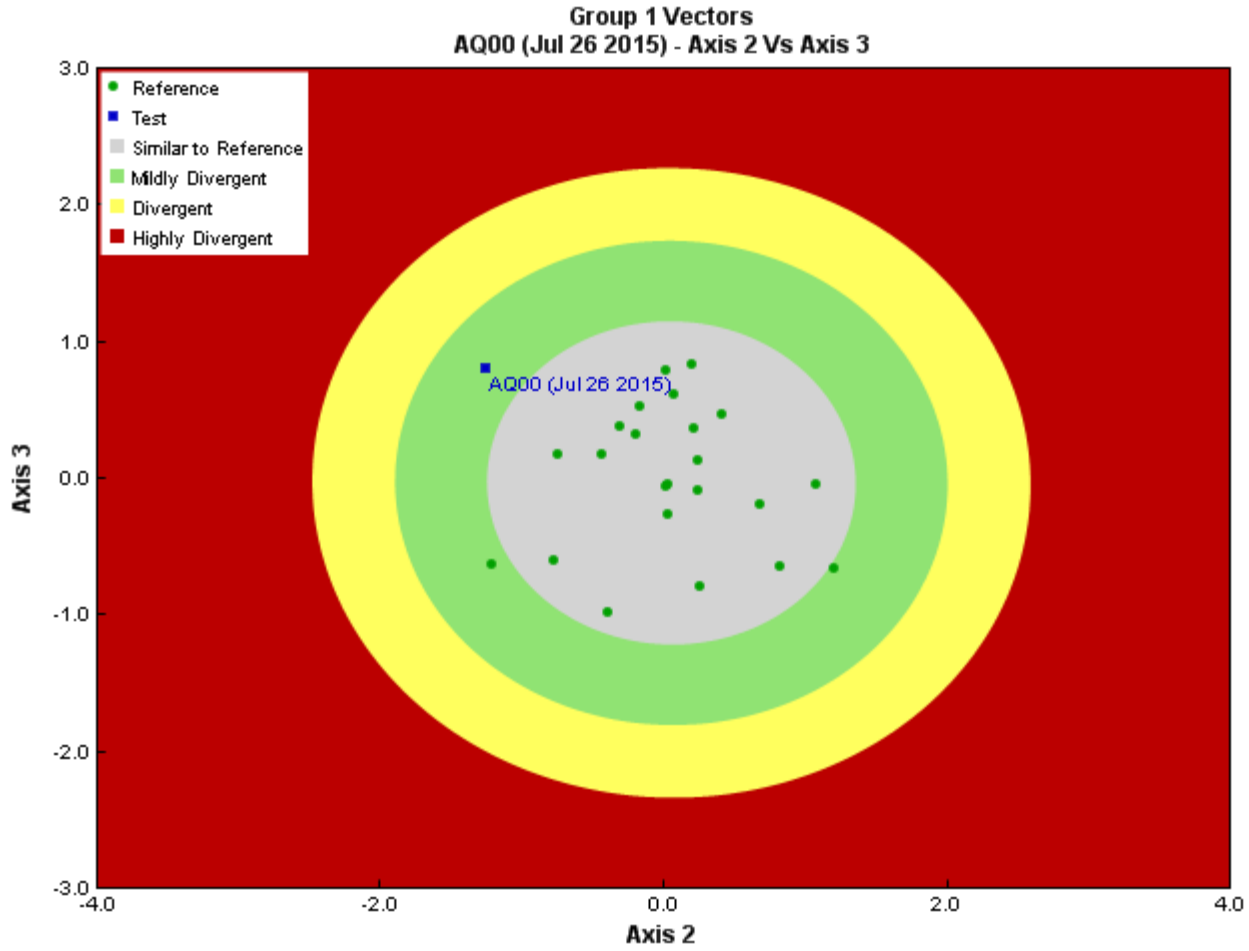


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	100/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Annelida	Oligochaeta	Haplotaxida	Enchytraeidae	1	1.0
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	8	8.0
	Insecta	Coleoptera	Curculionidae	1	1.0
		Diptera	Chironomidae	48	48.0
			Deuterophlebiidae	4	4.0
			Empididae	1	1.0
			Simuliidae	13	13.0
			Tipulidae	1	1.0
		Ephemeroptera	Baetidae	160	160.0
			Ephemerellidae	39	39.0
			Heptageniidae	82	82.0
		Plecoptera	Capniidae	2	2.0
			Chloroperlidae	23	23.0
			Perlodidae	2	2.0
			Total	385	385.0

Site Metrics

Metric Name	AQ00	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.94	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ00
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.96

RIVPACS : Expected taxa P>0.50	2.68
RIVPACS : Observed taxa P>0.50	3.00
RIVPACS : O:E (p > 0.5)	1.12
RIVPACS : Expected taxa P>0.70	0.96
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.05

D. Habitat Description

Variable	AQ00	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	23.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.24	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.30000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.40000	25.54674 ± 9.71520
Precip06_JUN (mm)	52.90000	49.78117 ± 15.10067
Precip07_JUL (mm)	67.10000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	52.90000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	4.27000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.47598	0.19525 ± 0.41187
Natl-Bryoids (%)	1.48831	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	0.84309	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Site Assessment Report

A. Site Description

CABIN Study Name	YK-Coffee Gold Baseline-PECG
CABIN Site Code	AQ02
Sampling Date	Aug 29 2014
Know Your Watershed (KYW) Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera Ecozone Klondike Plateau Ecoregion
Coordinates (decimal degrees)	62.85318 N, 139.14000 W
Altitude	1483
Feature Name	Coffee Creek
Stream Order	

B. CABIN Assessment Results

REFERENCE MODEL SUMMARY	
Model Name	Yukon 2013
Analysis Date	December 11, 2015
Taxanomic Level	Family
Predictor Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	97	44	108	13
Group Error Rate	34.8%	48.5%	56.8%	54.6%	38.5%
Overall Model Error Rate	50.5%				
Probability of Group Membership	53.4%	41.1%	2.0%	3.5%	0.0%
CABIN Assessment of AQ02 on Aug 29, 2014	Mildly Divergent				

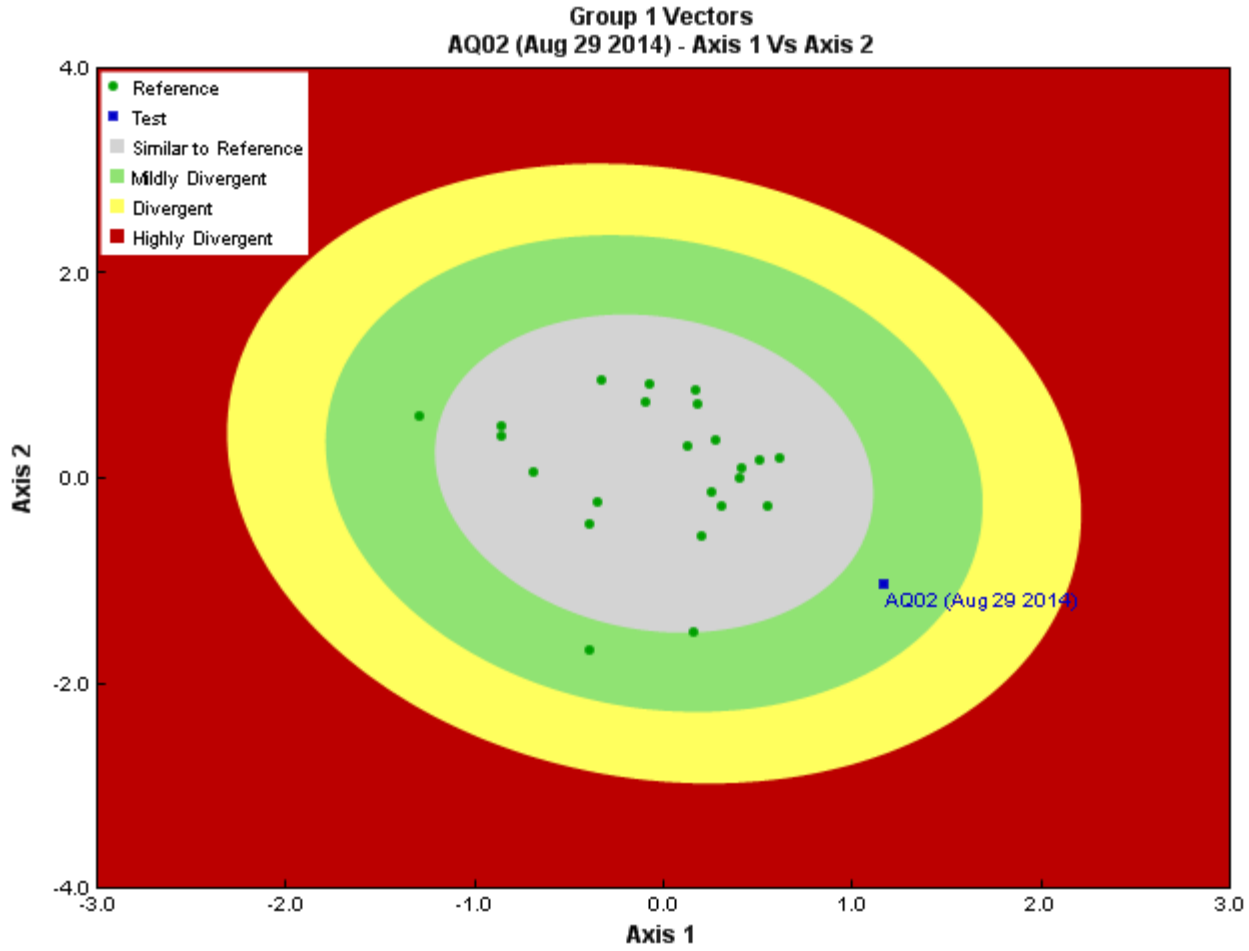


Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Identification Date	-
Subsampling Device	-
Proportion Subsampled	100/100

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	61	61.0
	Insecta	Diptera	Ceratopogonidae	1	1.0
			Chironomidae	169	169.0
			Empididae	48	48.0
			Simuliidae	2	2.0
			Tipulidae	1	1.0
		Ephemeroptera	Baetidae	22	22.0
			Ephemerellidae	129	129.0
			Heptageniidae	45	45.0
		Plecoptera		10	10.0
			Capniidae	1	1.0
			Chloroperlidae	30	30.0
			Nemouridae	4	4.0
			Perlodidae	38	38.0
		Trichoptera	Apataniidae	1	1.0

Community Structure Sample Data

Phylum	Class	Order	Family	Raw Count	Mean Count
			Brachycentridae	1	1.0
			Glossosomatidae	5	5.0
			Hydropsychidae	2	2.0
			Limnephilidae	15	15.0
			Total	585	585.0

Site Metrics

Metric Name	AQ02	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.96	0.6 ± 0.3

Frequency and Probability of Taxa Occurence

Reference Model Taxa	Frequency of Occurence in Reference Sites					Probability Of Occurrence at AQ02
	Group 1	Group 2	Group 3	Group 4	Group 5	
Chironomidae	91%	100%	100%	100%	100%	0.95

RIVPACS : Expected taxa P>0.50	2.65
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	1.51
RIVPACS : Expected taxa P>0.70	0.95
RIVPACS : Observed taxa P>0.70	1.00
RIVPACS : O:E (p > 0.7)	1.05

D. Habitat Description

Variable	AQ02	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	29.0	36.5 ± 24.3
Velocity-Avg (m/s)	0.47	0.42 ± 0.29
Climate		
Precip02_FEB (mm)	12.30000	27.73943 ± 9.10561
Precip03_MAR (mm)	11.40000	25.54674 ± 9.71520
Precip06_JUN (mm)	53.20000	49.78117 ± 15.10067
Precip07_JUL (mm)	67.40000	63.45366 ± 19.76560
Rainfall06_JUN (mm)	53.20000	45.78194 ± 13.48156
Temp04_APRmax (Degrees Celsius)	4.20000	-0.26448 ± 3.57165
Landcover		
Natl-BroadleafOpen (%)	0.43870	0.19525 ± 0.41187
Natl-Bryoids (%)	1.46926	0.16846 ± 0.41890
Natl-MixedwoodOpen (%)	0.62595	2.45662 ± 5.01153
Natl-WetlandHerb (%)	0.00000	0.22137 ± 0.64189

Appendix E

Fish Habitat

- **E1. Fish Habitat Data, Coffee Gold Project, 2014-2015**
- **E2. Stream Temperature Data, Coffee Gold Project, 2014-2015**

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ06, Latte Creek	Date	Aug 23/14
UTM	07V 582934 6971891		
Crew	AM, EC		
Weather	Sunny		

Water Quality

Temp (°C)	3.44
pH	6.53
COND (µS/cm)	6
Sp COND (µS/cm)	4
DO (mg/L)	10.54
DO % Sat.	87.1

Water Volume, Velocity, Discharge

Channel W (m)	4.33

Stage L

Substrate and Channel Characteristics

Dom Sub. (%)	65% Boulder			Channel W (m)	4.4	3.5	5.1		
Subdom Sub. (%)	30% Cobble			Wetted W (m)	3.45	3.2	4.9		
D95 (cm)	194	D (cm)	22	Res. Pool D (m)	0.29	0.28	0.16		
Avg. Gradient	11%			Bankfull D (m)	0.68	0.58	0.7		
Pattern	SI			Morphology	SPb				
Confinement	FC			Coupling	PC				
Bars	N			Islands	N				

Riparian

LB Shape	V	RB Shape	V
Bank Texture	F C	Bank Texture	F C
Rip. Veg	S D	Rip. Veg	S D
Stage	YF	Stage	YF

In-stream Cover Total Cover (A)

Canopy Cover (%) 41-70

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	T	T	D	T	N	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	N	LWD Dist		NA	In-strm Veg	A M	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
5	30		65		

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Trace gravel
Rearing:	Shallow, step pool moderate gradient - possible seasonal adult GR usage/migratory corridor
Overwintering:	No deep pools
Overall:	

Fish Sampling: Yes (*) No ( )

Photo Documentation:

Upstream



Downstream



Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ05, Latte Creek	Date	Aug23/14
UTM	07V 584272 6971769		
Crew	AM, EC		
Weather	Sunny		

Water Quality

Temp (°C)	2.71
pH	6.53
COND (µS/cm)	74
Sp COND (µS/cm)	43
DO (mg/L)	10.23
DO % Sat.	82.2

Water Volume, Velocity, Discharge Stage L

Channel W (m)	3.81					
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
0.2	0.19	0.06	1.7	0.25	0.02	0.18
0.7	0.24	0.3	2.3	0.08	0.1	AVG D (m)
1.2	0.15	0.4				0.18

Substrate and Channel Characteristics

Dom Sub. (%)	50 % Cobble			Channel W (m)	3.35	4.9	3.1	3.9
Subdom Sub. (%)	40% Boulder			Wetted W (m)	3.35	4.9	3.1	3.9
D95 (cm)	85	D (cm)	28	Res. Pool D (m)	0.17	0.18	0.32	
Avg. Gradient	7			Bankfull D (m)	0.59	0.72	1.07	

Pattern	SI	Morphology	CPc-W
Confinement	OC	Coupling	PC
Bars	N	Islands	N

Riparian

LB Shape	V	RB Shape	V
Bank Texture	F	Bank Texture	F
Rip. Veg	S	Rip. Veg	S
Stage	SHR	Stage	SHR

In-stream Cover Total Cover (M) **Canopy Cover (%)** 1-20

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	T	N	D	SD	T	SD	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	F		LWD Dist	E	In-strm Veg	A M	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
5	10	42	42	0	0

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	None to very little gravel
Rearing:	Shallow, few resting areas. May be usable for adult GR at higher flow
Overwintering:	None
Overall:	Low quality, marginal rearing potential

Fish Sampling: Yes (*) No ( )

Photo Documentation:

Upstream



Downstream



Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffe Gold	Site Length	120m
Site	AQ04, Latte Creek	Date	Aug 25/14
UTM	07V 591817 6970662		
Crew	AM, EC		
Weather			

Water Quality

Temp (°C)	3.99
pH	7.15
COND (µS/cm)	262
Sp COND (µS/cm)	158
DO (mg/L)	8.81
DO % Sat.	72.4

Water Volume, Velocity, Discharge Stage L

Channel W (m)	3					
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
0.5	0.05	0.09	3.5	0.16	0.74	0.28
1.5	0.1	-0.03	4.5	0.28	0.01	AVG D (m)
2.5	0.18	0.57				0.15

Substrate and Channel Characteristics

Dom Sub. (%)	45% Cobble			Channel W (m)	5.9	4.9	2.6	6.9	9
Subdom Sub. (%)	45% Gravel			Wetted W (m)	4.3	4.9	2.6	4.8	1.95
D95 (cm)	61	D (cm)	25	Res. Pool D (m)	0.2	0.36	0.12		
Avg. Gradient	2%			Bankfull D (m)	0.62	0.95	0.84		
Pattern	IR			Morphology	RPc-W				
Confinement	UN			Coupling	DC				
Bars	SIDE			Islands	O				

Riparian

LB Shape	V S	RB Shape	V S
Bank Texture	F	Bank Texture	F
Rip. Veg	D	Rip. Veg	D
Stage	YF	Stage	YF

In-stream Cover Total Cover (M) **Canopy Cover (%)** 71-90

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	S	D	T	T	T	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	F	LWD Dist	E	In-strm Veg	A		

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
10	30	55			5

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Moderate-Good - GR. Large gravel areas d/s
Rearing:	Good - Side channels, pools present for GR
Overwintering:	None - no deep pools
Overall:	Lots of adult GR observed at site

Photo Documentation:

Upstream



Downstream



Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ02, mainstem Coffee Creek	Date	Aug 26/14
UTM	7V 594695 6970599		
Crew	AM, EC		
Weather	Overcast		

Water Quality

Temp (°C)	6.51
pH	6.82
COND (µS/cm)	109
Sp COND (µS/cm)	71
DO (mg/L)	10.05
DO % Sat.	86.9

Water Volume, Velocity, Discharge Stage L

Channel W (m)	17					
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
2	0.3	0.59	9	0.38	0.45	0.47
4	0.36	0.49	12	0.1	0.53	AVG D (m)
6	0.4	0.42	14.5	0.18	0.31	0.29

Substrate and Channel Characteristics

Dom Sub. (%)	45% Gravel			Channel W (m)	22.5*	18.8	14		
Subdom Sub. (%)	35% Cobble			Wetted W (m)	19.4	15.3	11		
D95 (cm)	34	D (cm)	25	Res. Pool D (m)	0.25	0.4			
Avg. Gradient	2%			Bankfull D (m)	1.72	1.56			
Pattern	IM			Morphology	Rpg-W				
Confinement	OC			Coupling	PC				
Bars	SIDE DIAG			Islands	N				

Riparian

LB Shape	S	RB Shape	U
Bank Texture	F	Bank Texture	F
Rip. Veg	C D	Rip. Veg	C D
Stage	MF	Stage	MF

In-stream Cover Total Cover (A) **Canopy Cover (%)** 21-40

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	D	D	T	S	S	S	T
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	F		LWD Dist	C	In-strm Veg	A	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
10	45	35			

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Good -GR
Rearing:	Good-GR, Moderate-Good - juvenile Chinook salmon
Overwintering:	Moderate - some deep pools
Overall:	

Fish Sampling: Yes (*) No ( )

Photo Documentation:

Upstream



Downstream



Comments	* Side channel exits 100m u/s - did not measure width
	*Some deeper pools not wadeable

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ01, mainstem Coffee Creek	Date	Aug 28/14
UTM	07V 595974 6972573		
Crew	AM, EC, RF		
Weather			

Water Quality

Temp (°C)	8.01
pH	7.12
COND (µS/cm)	105
Sp COND (µS/cm)	71
DO (mg/L)	9.89
DO % Sat.	88.7

Water Volume, Velocity, Discharge

Channel W (m)	22.1	Stage	L

Substrate and Channel Characteristics

Dom Sub. (%)	45% Gravel			Channel W (m)	24.9	19.4	17.1	26.9
Subdom Sub. (%)	40% Cobble			Wetted W (m)	17	17.1	12.7	22.8
D95 (cm)	38	D (cm)	23	Res. Pool D (m)	0.28	0.45	0.14	
Avg. Gradient	1.50%			Bankfull D (m)	1.4	1.8	1.22	
Pattern	ME			Morphology	RPg-W			
Confinement	UN			Coupling	DC			
Bars	SIDE DIAG			Islands	N			

Riparian

LB Shape	S	RB Shape	U V
Bank Texture	F	Bank Texture	F
Rip. Veg	M	Rip. Veg	M
Stage	MF	Stage	MF

In-stream Cover Total Cover (M) **Canopy Cover (%)** 1-20

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	D	D	T	S	T	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	A	LWD Dist	E	In-strm Veg	A		

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
10	70	20			

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Moderate to Good GR - lots of gravel, but some embedded with fines
Rearing:	Good, smaller fish. Good, CCG. Few resting pools
Overwintering:	Poor - Moderate, few deep pools
Overall:	

Features

Feature Type 1:		Feature Type 2:		Feature Type 3:	
Height/Length:		Height/Length:		Height/Length:	

Fish Sampling: Yes (*) No ( )

Photo Documentation:

No photos taken

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	NA
Site	AQ00, mainstem Coffee Creek	Date	24-Aug-14
UTM	07V 596860 6974237		
Crew	AM, EC, AT, RF		
Weather			

Water Quality

Temp (^{o}C)	8.09
pH	6.89
COND (µS/cm)	135
Sp COND (µS/cm)	91
DO (mg/L)	9.59
DO % Sat.	85.7

Water Volume, Velocity, Discharge

Stage L

Channel W (m)	19.5					
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
2	0.26	0.4	10.5	0.52	0.76	0.66
4.5	0.4	0.64	13.5	0.5	0.85	AVG D (m)
7.5	0.41	0.73	16.5	0.86	0.56	0.49

Substrate and Channel Characteristics

Dom Sub. (%)	60% Gravel			Channel W (m)	14.1*	15.7		
Subdom Sub. (%)	20% Fines, 20% Cobble			Wetted W (m)	13.45*	15.6		
D95 (cm)	115	D (cm)	27	Res. Pool D (m)	Deep pools - can't measure			
Avg. Gradient	1%			Bankfull D (m)				
Pattern	IM			Morphology	PRg-W			
Confinement	OC			Coupling	NA			
Bars	SIDE			Islands	N			

Riparian

LB Shape	U V	RB Shape	S
Bank Texture	F	Bank Texture	F
Rip. Veg	C D	Rip. Veg	C D
Stage	MF	Stage	MF

In-stream Cover Total Cover (M) **Canopy Cover (%)** 1-20

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	S	D	T	S	D	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	A		LWD Dist	E	In-strm Veg	A	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
15	50	35			

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Good to Excellent - GR
Rearing:	Excellent, most species
Overwintering:	Good, lots of deep pools
Overall:	

Photo Documentation:

Upstream



Downstream



Comments	* Side channel measurements, not included

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ21, Halfway Creek	Date	Aug 23/14
UTM	07V 582125 6974262		
Crew	AM, EC		
Weather	Sunny		

Water Quality

Temp (°C)	2.84
pH	6.51
COND (µS/cm)	NA
Sp COND (µS/cm)	NA
DO (mg/L)	10.84
DO % Sat.	88.3

Water Volume, Velocity, Discharge

Stage L

Channel W (m)	2.47

Substrate and Channel Characteristics

Dom Sub. (%)	50% Boulder			Channel W (m)	3.9	2	1.9	2.08	
Subdom Sub. (%)	40% Cobble			Wetted W (m)	2.6	2	1.9	1.9	
D95 (cm)	66	D (cm)	14	Res. Pool D (m)	0.16	0.11	0.17		
Avg. Gradient	10%			Bankfull D (m)	0.41	0.45	0.44		
Pattern	SI			Morphology	Cpb				
Confinement	OC			Coupling	DC				
Bars	N			Islands	N				

Riparian

LB Shape	U	RB Shape	U
Bank Texture	F	Bank Texture	F
Rip. Veg	S C	Rip. Veg	S C
Stage	PS	Stage	PS

In-stream Cover Total Cover (M) **Canopy Cover (%) 1-20**

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	T	N	D	S	N	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	N	LWD Dist	NA	In-strm Veg	A M		

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
10	40	10	40		

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

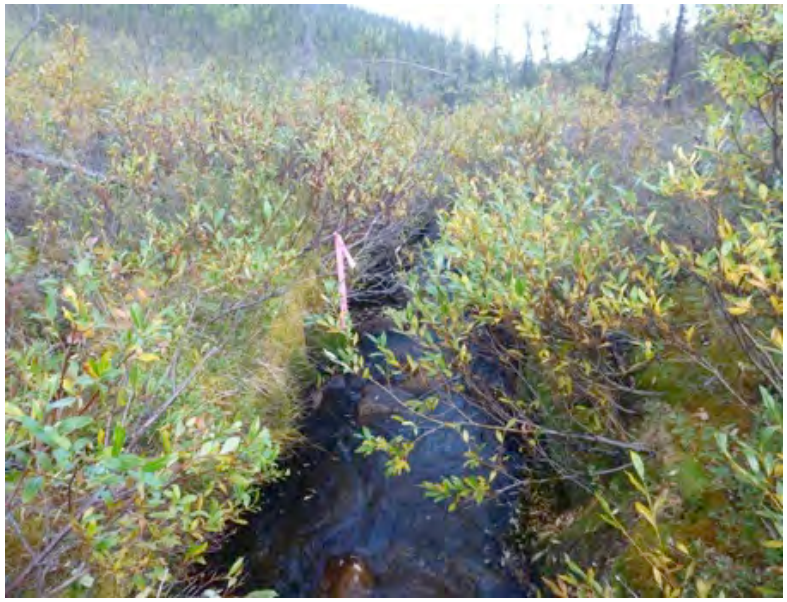
Spawning:	No gravel
Rearing:	Marginal - small, shallow, lack of resting areas
Overwintering:	No deep pools
Overall:	

Photo Documentation:

Upstream



Downstream



Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ20, Halfway Creek	Date	Aug 25/14
UTM	07V 582125 6974262		
Crew	AM, EC		
Weather	Sunny		

Water Quality

Temp (°C)	4.8
pH	7.16
COND (µS/cm)	179
Sp COND (µS/cm)	110
DO (mg/L)	9.72
DO % Sat.	81.2

Water Volume, Velocity, Discharge Stage L

Channel W (m)						
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
0.5	0.2	0.26	2	0.15	0.02	0.07
1	0.21	-0.02				AVG D (m)
1.5	0.14	0				0.18

Substrate and Channel Characteristics

Dom Sub. (%)	45% Cobble			Channel W (m)	3.4	4.75	3.95		
Subdom Sub. (%)	35% Gravel			Wetted W (m)	2.4	4.1	2.2		
D95 (cm)	43	D (cm)	15	Res. Pool D (m)	0.14	0.29	0.17		
Avg. Gradient	2%			Bankfull D (m)	0.89	0.6	0.81		
Pattern	IM			Morphology	RPc-W				
Confinement	OC			Coupling	PC				
Bars	SIDE			Islands	N				

Riparian

LB Shape	U	RB Shape	U
Bank Texture	F	Bank Texture	F
Rip. Veg	D	Rip. Veg	D
Stage	MF	Stage	MF

In-stream Cover Total Cover (M) **Canopy Cover (%)** 71-90

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	S	D	S	S	T	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	F		LWD Dist	E	In-strm Veg	A M	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
5	50	45			

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Poor - may be small patches of gravel
Rearing:	Poor-Moderate GR - shallow, not many pools
Overwintering:	Poor
Overall:	

Photo Documentation:

Upstream



Downstream



Comments	1 deep pool, 1 GR captured

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ31, YR24	Date	Aug 23/14
UTM	07V 585748 6976166		
Crew	AM, EC		
Weather	Cloudy		

Water Quality

Temp (^{o}C)	2.66
pH	6.5
COND (µS/cm)	NA
Sp COND (µS/cm)	NA
DO (mg/L)	11.9
DO % Sat.	95.3

Water Volume, Velocity, Discharge Stage L

Channel W (m)	1.87

Substrate and Channel Characteristics

Dom Sub. (%)	40% Boulder			Channel W (m)	1.65	1.75	2.2		
Subdom Sub. (%)	40% Cobble			Wetted W (m)	1.3	1.25	1.6		
D95 (cm)	66	D (cm)	19	Res. Pool D (m)	0.09	0.07	0.14		
Avg. Gradient	11%			Bankfull D (m)	0.35	0.46	0.46		
Pattern	SI			Morphology	Cpb				
Confinement	FC			Coupling	PC				
Bars	N			Islands	N				

Riparian

LB Shape	V	RB Shape	V
Bank Texture	F	Bank Texture	F
Rip. Veg	D	Rip. Veg	D
Stage	YF	Stage	YF

In-stream Cover Total Cover (M) **Canopy Cover (%)** 71-90

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	T	T	D	T	N	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	F	LWD Dist	E	In-strm Veg	A M		

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
15	35	15	35		

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Some large gravels in small patches
Rearing:	Lack of resting spots, shallow, moderate gradient sections
Overwintering:	No deep pools
Overall:	

Photo Documentation:

Upstream



Downstream



Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ30, YR24	Date	Aug 25/14
UTM	07V 589691 6979174		
Crew	AM, EC		
Weather			

Water Quality

Temp (°C)	4.38
pH	6.98
COND (µS/cm)	113
Sp COND (µS/cm)	69
DO (mg/L)	9.33
DO % Sat.	74.1

Water Volume, Velocity, Discharge

Stage L

Channel W (m)	3.8					
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
0.4	0.12	0.16				0.10
0.7	0.123	0.15				AVG D (m)
1.1	0.09	-0.02				0.11

Substrate and Channel Characteristics

Dom Sub. (%)	50% Cobble			Channel W (m)	3.4	5.1	4.1	
Subdom Sub. (%)	35% Boulder			Wetted W (m)	2.4	2.6	2.2	
D95 (cm)	160	D (cm)	23	Res. Pool D (m)	0.09	0.09	0.1	
Avg. Gradient	8%			Bankfull D (m)	0.57	0.34	0.61	

Pattern	IM	Morphology	CPc-W
Confinement	FC	Coupling	PC
Bars	SIDE	Islands	N

Riparian

LB Shape	U	RB Shape	U
Bank Texture	F	Bank Texture	F
Rip. Veg	C	Rip. Veg	C
Stage	MF	Stage	MF

In-stream Cover Total Cover (M) **Canopy Cover (%)** 71-90

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	S	S	D	S	N	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	A		LWD Dist	C	In-strm Veg	A M	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
5	20	35	40		

Habitat Quality	(Excellent, Good, Moderate, Poor, None, % gravel and deep pools)
Spawning:	Poor GR - no gravel pockets
Rearing:	Poor - GR and others - no deep areas, moderate gradient, shallow water
Overwintering:	None
Overall:	

Fish Sampling: Yes (*) No ( )

Photo Documentation:

Upstream



Downstream



Comments	- a lot of trees in the creek, some unstable slopes, erosion, irregular bed materials
	- small shallow descent at river mouth may hinder seasonal passage for some species
	- matted green algae noted at mouth of creek

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ13, Kona Tributary, Independence Creek Watershed	Date	Aug 23/14
UTM	07V 578443 6975427		
Crew	AM, EC		
Weather	Sunny		

Water Quality

Temp (°C)	2.83
pH	7.22
COND (µS/cm)	106
Sp COND (µS/cm)	62
DO (mg/L)	9.28
DO % Sat.	74.3

Water Volume, Velocity, Discharge Stage L

Channel W (m)	2.55					
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
1	0.12	-0.08				0.06
1.5	0.17	0.26				AVG D (m)
1.9	0.14	0.01				0.14

Substrate and Channel Characteristics

Dom Sub. (%)	70% Boulder			Channel W (m)	2.6	2.2	1.9	
Subdom Sub. (%)	15% cobble			Wetted W (m)	2.4	2.2	1.5	
D95 (cm)	104	D (cm)	24	Res. Pool D (m)	0.09	0.08	0.09	
Avg. Gradient	8%			Bankfull D (m)	0.46	0.74	1.05	

Pattern	SI	Morph.	SPb
Confinement	RC	Coupling	PC
Bars	N	Islands	O

Riparian

LB Shape	V	RB Shape	V
Bank Texture	F	Bank Texture	F
Rip. Veg	S	Rip. Veg	S
Stage	PS	Stage	PS

In-stream Cover Total Cover (A) **Canopy Cover (%)** 71-90

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	T	S	D	T	T	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	F	LWD Dist	E	In-strm Veg	A M		

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
70			30		

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Very little habitat potential - poor
Rearing:	Poor for most species, marginal seasonally for GR, small, shallow
Overwintering:	None, no deep pools
Overall:	

Photo Documentation:

Upstream



Downstream



Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ12, Kona Tributary, Independence Creek Watershed	Date	Aug 23/14
UTM	07V 575282 6979605		
Crew	AM, EC		
Weather	Sunny		

Water Quality

Temp (°C)	4.31
pH	7.07
COND (µS/cm)	101
Sp COND (µS/cm)	61
DO (mg/L)	10.8
DO % Sat.	87

Water Volume, Velocity, Discharge Stage L

Channel W (m)	3.05

Substrate and Channel Characteristics

Dom Sub. (%)	70% Gravel			Channel W (m)	3.15	3.2	2.8		
Subdom Sub. (%)	10% Fines			Wetted W (m)	2.5	2.55	2.05		
D95 (cm)	27	D (cm)	18	Res. Pool D (m)	0.06	0.09	0.12		
Avg. Gradient	1%			Bankfull D (m)	0.79	0.6	1.02		
Pattern	SI			Morphology	RPg-W				
Confinement	UN			Coupling	DC				
Bars	SIDE			Islands	N				

Riparian

LB Shape	V	RB Shape	V
Bank Texture	F	Bank Texture	F
Rip. Veg	S C D	Rip. Veg	S C D
Stage	YF	Stage	YF

In-stream Cover Total Cover (A) **Canopy Cover (%)** 71-90

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	T	D	N	T	T	D	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	A		LWD Dist	C	In-strm Veg	A	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
5	70	25			

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Good to Excellent GR
Rearing:	Moderate - Poor - very shallow, lack of pool habitat. Low gradient, good cover
Overwintering:	None
Overall:	

Upstream



Downstream



Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	150m
Site	AQ11, mainstem Independence Creek	Date	Aug 24/14
UTM	07V 575876 6980006		
Crew	AM, EC		
Weather			

Water Quality

Temp (°C)	6.77
pH	6.94
COND (µS/cm)	122
Sp COND (µS/cm)	81
DO (mg/L)	9.91
DO % Sat.	86.6

Water Volume, Velocity, Discharge Stage L

Channel W (m)	23.1					
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
1.5	0.13	0.27	6.5	0.27	0.48	0.27
3.5	0.2	0.15	8.5	0.12	0.05	AVG D (m)
5	0.26	0.43	11	0.1	0.22	0.18

Substrate and Channel Characteristics

Dom Sub. (%)	40% Gravel			Channel W (m)	15.5	14.9	12.2	50.3
Subdom Sub. (%)	30% Cobble			Wetted W (m)	7.8	8	10.9	8.7
D95 (cm)	58	D (cm)	25	Res. Pool D (m)	0.32	No pools to measure		
Avg. Gradient	2			Bankfull D (m)	1.8			
Pattern	ME			Morphology	RPg-W			
Confinement	UN			Coupling	DC			
Bars	SIDE			Islands	N			

Riparian

LB Shape	S	RB Shape	V
Bank Texture	F	Bank Texture	F
Rip. Veg	C	Rip. Veg	C
Stage	MF	Stage	MF

In-stream Cover Total Cover (M) **Canopy Cover (%)** 21-40

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	S	D	S	S	S	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	F		LWD Dist	C	In-strm Veg	A	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
10	45	45			

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Good - GR. Some gravelly riffle sections
Rearing:	Good - GR, Excellent- CCG
Overwintering:	Poor, although some deep pools just downstream of site
Overall:	

Fish Sampling: Yes (*) No ( ) - Single pass EF

Photo Documentation:

Upstream



Downstream



Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ10, mainstem Independence Creek	Date	Aug 24/14
UTM	07V 579393 6983200		
Crew	AM, EC		
Weather	80% CC, 10 C		

Water Quality

Temp (°C)	5.71
pH	6.71
COND (µS/cm)	113
Sp COND (µS/cm)	72
DO (mg/L)	9.02
DO % Sat.	74.1

Water Volume, Velocity, Discharge Stage L

Channel W (m)	10.3					
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
1.5	0.26	0.68	6	0.14	0.28	0.43
3	0.22	0.57	7.5	0.13	0.23	AVG D (m)
4.5	0.13	0.4				0.18

Substrate and Channel Characteristics

Dom Sub. (%)	50% Gravel			Channel W (m)	11.3	8.7	11.44	17.4
Subdom Sub. (%)	30% Cobble			Wetted W (m)	4.7	6.2	5.2	6
D95 (cm)	39	D (cm)	23	Res. Pool D (m)	30.5	0.5	0.13	
Avg. Gradient	2%			Bankfull D (m)	1.34	1.28	1.48	

Pattern	ME	Morphology	Rpg-W
Confinement	OC	Coupling	PC
Bars	SIDE	Islands	N

Riparian

LB Shape	U S	RB Shape	U S
Bank Texture	F	Bank Texture	F
Rip. Veg	C D	Rip. Veg	C D
Stage	MF	Stage	MF

In-stream Cover Total Cover (A) **Canopy Cover (%)** 21-40

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	S	D	T	S	T	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	A	A	LWD Dist	E	In-strm Veg	A	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
15	45	40			

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Some large gravel, good depth for GR = moderate
Rearing:	Excellent sculpin, good-moderate juvenile chinook salmon, good GR
Overwintering:	Only 1 deep pool in site, several in logjam area downstream, moderate potential
Overall:	

Fish Sampling: Yes (*) No ( )

Photo Documentation:

Upstream



Downstream



Comments	
10 Gee traps set	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQREF1, Isaac Creek	Date	Aug 28/14
UTM	07V 626796 6968817		
Crew	AM, EC, RF		
Weather			

Water Volume, Velocity, Discharge Stage L

Channel W (m)	11.6					
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
0.9	0.12	0.3	6	0.16	0.4	0.34
4	0.14	0.42	7	0.14	0.23	AVG D (m)
5.5	0.18	0.36				0.28

Substrate and Channel Characteristics

Dom Sub. (%)	40% Gravel			Channel W (m)	10.3	9.6	7.6	11.5	
Subdom Sub. (%)	40% Fines			Wetted W (m)	8.7	6.6	6.1	3.6	
D95 (cm)	21	D (cm)	14	Res. Pool D (m)	0.26	0.36	0.34		
Avg. Gradient	1%			Bankfull D (m)	1.27	0.98	1.47		
Pattern	TM			Morphology	RPg-W				
Confinement	UN			Coupling	DC				
Bars	SIDE MID			Islands	N				

Riparian

LB Shape	S	RB Shape	U
Bank Texture	F	Bank Texture	F
Rip. Veg	S	Rip. Veg	C
Stage	SHR	Stage	MF

In-stream Cover Total Cover (M) **Canopy Cover (%)** 1-20

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	D	S	T	S	T	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	A		LWD Dist	E	In-strm Veg	A	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
40	20	40			

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Moderate - GR - some gravel bars
Rearing:	Moderate - cover decent, some pools, undercut banks, fines dominate some areas
Overwintering:	Poor - few deep pools
Overall:	

Fish Sampling: Yes (*) No ( )

Photo Documentation:

Upstream



Downstream



Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQ04.5	Date	20-Jun-15
UTM	07V 584792 6971697		
Crew	AM, IM, CW, AT		
Weather	NR		

Water Quality

Temp (°C)	3.1
pH	7.3
COND (µS/cm)	208
Sp COND (µS/cm)	356
DO (mg/L)	11.64
DO % Sat.	94.8

Water Volume, Velocity, Discharge

Stage L - M (June), H (July)

Channel W (m)	2.1 (Note measurements taken on July 30, 2015 after high rain flow)					
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
0.3	0.5	0.02	1.2	0.7	0.89	0.65
0.6	0.44	1.22	1.5	0.61	-0.01	AVG D (m)
0.9	0.39	1.49	1.9	0.52	0.29	0.53

Substrate and Channel Characteristics

Dom Sub. (%)	40% Boulder			Channel W (m)	2.9	2.5	3.2	2.7	
Subdom Sub. (%)	25% Cobble			Wetted W (m)	2.5	2.5	1.9	2.7	
D95 (cm)	100	D (cm)	19	Res. Pool D (m)	0.23	0.27	0.31		
Avg. Gradient	3%			Bankfull D (m)	0.7	0.9	1.01		
Pattern	SI			Morphology	RPb				
Confinement	OC			Coupling	PC				
Bars	N			Islands	N				

Riparian

LB Shape	S	RB Shape	S
Bank Texture	F	Bank Texture	F
Rip. Veg	D	Rip. Veg	D
Stage	MF	Stage	MF

In-stream Cover Total Cover (M) **Canopy Cover (%) 71-90**

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	D	T	D	S	N	S	N
Location (P, S, O, A)	P	P	P	P	P	P	P
Func. LWD	N	LWD Dist		n/a	In-strm Veg	M	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
55	5	35	5	0	0

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Poor
Rearing:	Poor
Overwintering:	None
Overall:	Low fish habitat quality overall

Fish Sampling: Yes (*) No ( )

Photo Documentation:

Upstream



Downstream



Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

FISH HABITAT ASSESSMENT

Project	Coffee Gold	Site Length	100m
Site	AQREF2	Date	31-Jul-15
UTM	07V 569529 6990874		
Crew	EC, IM, CW		
Weather	NR		

Water Quality

Temp (°C)	5.1
pH	7.58
COND (µS/cm)	NR
Sp COND (µS/cm)	147
DO (mg/L)	11.73
DO % Sat.	NR

Water Volume, Velocity, Discharge

Stage H

Channel W (m)	6.80					
Distance (m)	Depth (m)	V (m/s)	Distance (m)	Depth (m)	V (m/s)	AVG V (m/s)
1	0.45	0.66	4	0.36	1.08	0.93
2	0.41	1.13	5	0.35	0.81	AVG D (m)
3	0.41	1.12	6	0.25	0.76	0.37

Substrate and Channel Characteristics

Dom Sub. (%)	70% Cobble			Channel W (m)	NR			
Subdom Sub. (%)	20% Sand			Wetted W (m)	NR			
D95 (cm)	20	D (cm)	20	Res. Pool D (m)	NR			
Avg. Gradient	1%			Bankfull D (m)	NR			
Pattern	ME			Morphology	RPg-w			
Confinement	OC			Coupling	DC			
Bars	SIDE			Islands	N			

Riparian

LB Shape	U	RB Shape	S
Bank Texture	F	Bank Texture	F
Rip. Veg	M	Rip. Veg	M
Stage	MF	Stage	MF

In-stream Cover Total Cover (M) **Canopy Cover (%)** 1-25

Type	SWD	LWD	B	U	DP	OV	IV
Amount (D S T N)	S	D	N	S	S	T	N
Location (P, S, O, A)	P	P		P	P	P	
Func. LWD	Y		LWD Dist	E	In-strm Veg	A	

Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Habitat Type (%)

Pool	Run	Riffle	Cascade	Other	Side Channel (%)
20	40	40	0	0	**0**

Habitat Quality (Excellent, Good, Moderate, Poor, None, % gravel and deep pools)

Spawning:	Good
Rearing:	Excellent
Overwintering:	Moderate
Overall:	Good

Fish Sampling: Yes (*) No ( )

Photo Documentation:

Upstream



Downstream



Appendix E1. Fish Habitat Assessment Data, Coffee Gold Project, 2014-2015

Legend

Section	Abbreviation/ Acronym	Definition	Section	Abbreviation/ Acronym	Definition
Substrate and Pattern	TM	Tortuous Meanders	In-stream Cover		
	ME	Meandering	Type	SWD	Small Woody Debris
	IM	Irregular Meanders		LWD	Large Woody Debris
	IR	Irregular		B	Boulder
	SI	Sinuous		U	Undercut Bank
	ST	Straight		DP	Deep Pool
Confinement	EN	Entrenched		OV	Overhanging Vegetation
	CO	Confined		IV	In-stream Vegetation
	FC	Frequently confined	Amount	D	Dominant
	OC	Occasionally Confined		S	Sub-Dominant
	UN	Unconfined		T	Trace
Morphology	RP	Riffle-pool		N	None
	SP	Step-pool	Location	P	Primary
	CP	Cascade-pool		S	Secondary
				O	Off Channel
Coupling	DC	Decoupled		A	All
	PC	Partially coupled	Func. LWD	N	None
	Co	Coupled		F	Few
Islands	N	None		A	Abundant
	OI	Occasional	LWD Dist	LWD Dist	Large Woody Debris Distribution
	FS	Frequent/Split channel		C	Clumped
	AN	Anastomosing		E	Even
Riparian			In-strm Veg	N	None
Bank Shape	U	Undercut		A	Algae
	V	V-shaped		M	Moss
	S	Sloping		V	Vascular Plant
	O	Overhanging	Fish Species	GR	Arctic grayling
Bank Texture	F	Fines		CCG	slimy sculpin
	G	Gravel	Water Volume, Velocity, Discharge		
	CB	Cobble/Boulder		L	Low
	R	Rock		Res. Pool D	Residual pool depth
Rip. Veg		Riparian Vegetation			
	N	None			
	G	Grass			
	S	Shrub			
	C	coniferous			
	D	Deciduous			
	M	Mixed			
	W	Wetland			
Stage	INIT	Initial			
	SHR	Shrub			
	PS	Pole Sapling			
	YF	Young Forest			
	MF	Mature Forest			

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Coffee Creek (T1)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
01/06/2014	6.31	3.80	5.37
02/06/2014	6.84	3.51	5.15
03/06/2014	6.79	2.82	4.85
04/06/2014	6.99	2.77	4.98
05/06/2014	7.02	3.80	5.44
06/06/2014	8.12	4.06	5.91
07/06/2014	9.46	4.45	6.72
08/06/2014	8.44	4.77	6.54
09/06/2014	10.30	4.90	7.25
10/06/2014	9.21	5.62	7.34
11/06/2014	8.97	5.46	7.08
12/06/2014	9.24	6.20	7.67
13/06/2014	9.19	5.36	7.17
14/06/2014	8.47	6.10	7.29
15/06/2014	9.26	5.92	7.46
16/06/2014	9.78	5.82	7.61
17/06/2014	9.29	6.48	7.31
18/06/2014	8.79	5.72	7.10
19/06/2014	9.06	5.67	7.30
20/06/2014	8.99	5.36	7.20
21/06/2014	9.53	6.28	7.63
22/06/2014	8.99	5.62	7.21
23/06/2014	9.39	5.77	7.65
24/06/2014	8.37	6.41	7.43
25/06/2014	8.34	6.46	7.24
26/06/2014	7.32	6.08	6.57
27/06/2014	7.37	3.85	5.38
29/07/2014	7.67	5.75	6.67
30/07/2014	7.67	5.08	6.27
31/07/2014	8.77	4.61	6.48
01/08/2014	9.21	6.05	7.57
02/08/2014	11.01	7.49	8.86
03/08/2014	10.83	7.32	8.99
04/08/2014	10.86	8.37	9.52
05/08/2014	10.00	7.67	8.80
06/08/2014	9.78	7.92	8.84
07/08/2014	9.04	7.42	8.24

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Coffee Creek (T1)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
08/08/2014	8.22	5.46	6.95
09/08/2014	8.52	5.80	7.16
10/08/2014	9.21	6.33	7.82
11/08/2014	9.66	7.37	8.54
12/08/2014	10.52	7.95	9.11
13/08/2014	9.78	7.32	8.62
14/08/2014	10.00	7.42	8.62
15/08/2014	9.51	7.59	8.57
16/08/2014	9.19	7.07	8.16
17/08/2014	9.14	6.94	8.04
18/08/2014	8.52	7.49	8.06
19/08/2014	9.98	7.34	8.37
20/08/2014	10.27	7.12	8.47
21/08/2014	9.78	6.46	7.99
22/08/2014	9.81	7.04	8.27
23/08/2014	9.11	6.89	8.04
24/08/2014	8.47	6.74	7.69
25/08/2014	8.82	7.12	7.96
26/08/2014	8.17	6.91	7.51
27/08/2014	8.64	5.69	7.10
28/08/2014	8.30	6.13	7.32
29/08/2014	8.67	6.28	7.47
30/08/2014	8.22	7.02	7.62
31/08/2014	6.97	5.26	5.70
01/09/2014	6.48	3.80	5.06
02/09/2014	5.80	4.01	4.99
03/09/2014	6.54	4.92	5.68
04/09/2014	5.64	3.33	4.54
05/09/2014	5.64	4.82	5.25
06/09/2014	5.26	4.04	4.51
07/09/2014	4.87	3.14	3.86
08/09/2014	4.43	1.81	3.14
09/09/2014	4.22	2.07	3.21
10/09/2014	5.41	3.49	4.33
11/09/2014	6.61	4.51	5.41
12/09/2014	5.85	4.17	5.04
13/09/2014	6.84	5.10	5.91

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Coffee Creek (T1)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
14/09/2014	7.90	5.75	6.67
15/09/2014	7.09	5.02	6.16
16/09/2014	7.72	5.82	6.58
17/09/2014	6.31	3.83	4.81
18/09/2014	5.26	3.22	4.22
19/09/2014	6.00	3.70	4.66
20/09/2014	5.59	4.12	4.88
21/09/2014	5.02	3.85	4.55
22/09/2014	5.00	4.14	4.73
23/09/2014	4.27	2.96	3.59
24/09/2014	3.99	2.66	3.25
25/09/2014	2.85	1.29	2.20
26/09/2014	2.69	0.61	1.68
27/09/2014	3.14	2.29	2.69
28/09/2014	3.80	3.14	3.38
29/09/2014	3.51	2.48	2.94
30/09/2014	2.82	1.97	2.36
01/10/2014	2.16	0.80	1.55
02/10/2014	1.99	0.27	1.19
03/10/2014	2.02	1.10	1.47
04/10/2014	2.53	1.48	1.90
05/10/2014	2.32	1.15	1.72
06/10/2014	2.13	1.15	1.61

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Latte Creek (T2)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
01/06/2014	3.91	1.21	2.72
02/06/2014	3.38	1.21	2.33
03/06/2014	3.30	0.91	1.95
04/06/2014	4.04	0.88	2.16
05/06/2014	4.38	1.59	2.66
06/06/2014	4.79	1.81	3.04
07/06/2014	4.92	1.75	3.14
08/06/2014	4.27	2.21	3.10
09/06/2014	5.51	2.32	3.44
10/06/2014	4.84	2.21	3.30
11/06/2014	4.61	2.02	3.06
12/06/2014	4.64	2.66	3.49
13/06/2014	4.84	2.16	3.33
14/06/2014	4.64	2.61	3.48
15/06/2014	4.58	2.58	3.42
16/06/2014	5.92	2.10	3.70
17/06/2014	4.17	2.88	3.51
18/06/2014	4.58	2.48	3.43
19/06/2014	5.31	2.26	3.46
20/06/2014	4.74	1.99	3.18
21/06/2014	5.23	2.80	3.50
22/06/2014	4.56	2.16	3.42
23/06/2014	5.39	2.42	3.66
24/06/2014	4.09	2.88	3.52
25/06/2014	4.64	3.14	3.47
26/06/2014	4.61	2.98	3.67
27/06/2014	4.92	2.42	3.67
28/06/2014	5.77	2.66	4.18
29/06/2014	6.15	3.35	4.57
30/06/2014	5.41	4.09	4.60
01/07/2014	5.98	3.99	4.94
02/07/2014	5.02	2.77	4.08
03/07/2014	6.61	3.62	4.86
04/07/2014	5.85	3.64	4.76
05/07/2014	5.95	4.04	4.85
06/07/2014	5.59	4.09	4.79
07/07/2014	5.95	3.96	4.87

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Latte Creek (T2)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
08/07/2014	6.10	4.04	4.76
09/07/2014	5.49	3.56	4.43
10/07/2014	6.31	3.49	4.84
11/07/2014	6.74	4.19	5.34
12/07/2014	6.15	4.51	5.39
13/07/2014	6.51	4.32	5.33
14/07/2014	6.23	3.56	4.95
15/07/2014	5.90	3.85	4.80
16/07/2014	5.44	3.99	4.71
17/07/2014	5.77	4.14	4.87
18/07/2014	6.13	4.14	4.95
19/07/2014	6.36	4.06	5.03
20/07/2014	4.90	4.35	4.61
21/07/2014	7.17	4.30	5.43
22/07/2014	6.66	3.80	5.23
23/07/2014	6.15	4.45	5.30
24/07/2014	5.82	4.64	5.24
25/07/2014	5.90	4.61	5.16
26/07/2014	6.03	4.45	5.16
27/07/2014	6.18	4.56	5.21
28/07/2014	6.36	4.82	5.42
29/07/2014	5.23	4.25	4.67
30/07/2014	5.39	3.85	4.52
31/07/2014	6.03	2.98	4.38
01/08/2014	6.41	3.56	4.90
02/08/2014	6.43	4.56	5.40
03/08/2014	6.51	4.12	5.25
04/08/2014	6.66	4.66	5.41
05/08/2014	5.87	4.40	5.11
06/08/2014	5.64	4.32	4.94
07/08/2014	5.41	4.17	4.65
08/08/2014	5.54	2.96	4.27
09/08/2014	5.67	3.30	4.47
10/08/2014	5.90	3.49	4.74
11/08/2014	6.20	4.17	5.13
12/08/2014	6.54	4.51	5.36
13/08/2014	5.85	3.96	4.90

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Latte Creek (T2)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
14/08/2014	5.95	3.83	4.90
15/08/2014	5.87	4.12	4.93
16/08/2014	5.77	3.93	4.82
17/08/2014	5.57	3.93	4.70
18/08/2014	5.57	4.40	4.91
19/08/2014	5.69	4.35	4.95
20/08/2014	5.80	4.12	4.90
21/08/2014	5.39	3.46	4.51
22/08/2014	5.64	4.01	4.79
23/08/2014	5.21	3.64	4.52
24/08/2014	5.39	3.91	4.64
25/08/2014	5.54	4.01	4.74
26/08/2014	5.10	4.17	4.65
27/08/2014	5.49	3.51	4.51
28/08/2014	5.23	3.67	4.48
29/08/2014	5.41	3.62	4.48
30/08/2014	5.00	4.27	4.64
31/08/2014	4.56	3.59	4.03
01/09/2014	4.45	2.66	3.49
02/09/2014	4.27	2.66	3.47
03/09/2014	4.25	3.27	3.71
04/09/2014	3.93	1.97	2.93
05/09/2014	3.88	3.17	3.49
06/09/2014	3.46	2.69	2.99
07/09/2014	3.22	2.18	2.60
08/09/2014	3.14	1.13	2.05
09/09/2014	3.14	1.15	2.12
10/09/2014	3.85	2.18	2.91
11/09/2014	4.30	2.69	3.39
12/09/2014	4.01	2.37	3.21
13/09/2014	4.64	3.27	3.88
14/09/2014	4.87	3.51	4.12
15/09/2014	4.56	2.98	3.83
16/09/2014	4.66	3.54	4.05
17/09/2014	3.80	2.10	2.98
18/09/2014	3.43	1.72	2.63
19/09/2014	3.85	2.24	3.03

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Latte Creek (T2)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
20/09/2014	3.93	2.50	3.15
21/09/2014	3.59	2.21	2.90
22/09/2014	3.38	2.64	3.10
23/09/2014	2.74	1.70	2.21
24/09/2014	2.37	1.51	1.87
25/09/2014	1.83	0.50	1.14
26/09/2014	1.75	0.14	0.93
27/09/2014	2.16	1.56	1.86
28/09/2014	2.61	1.99	2.21
29/09/2014	2.45	1.67	2.04
30/09/2014	1.89	1.21	1.58
01/10/2014	1.83	0.33	1.03
02/10/2014	1.29	0.11	0.70
03/10/2014	1.62	0.99	1.19
04/10/2014	1.48	0.99	1.14
05/10/2014	1.53	0.50	1.03
06/10/2014	1.37	0.77	1.03
07/10/2014	1.13	0.30	0.74
08/10/2014	1.02	0.08	0.56
09/10/2014	0.63	0.00	0.28
10/10/2014	1.10	0.44	0.69
11/10/2014	1.48	0.61	1.03
12/10/2014	1.48	1.02	1.20
13/10/2014	1.62	0.99	1.22
14/10/2014	1.48	1.10	1.23
15/10/2014	1.56	0.85	1.17
16/10/2014	1.34	0.66	1.06
17/10/2014	1.04	0.27	0.68
18/10/2014	0.85	0.41	0.66
19/10/2014	1.21	0.74	0.94
20/10/2014	1.34	0.83	1.05
21/10/2014	1.26	0.72	1.02
22/10/2014	1.34	1.07	1.17
23/10/2014	1.21	1.02	1.11
24/10/2014	1.15	0.83	0.96
25/10/2014	0.93	0.66	0.79
26/10/2014	0.74	0.22	0.52

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Latte Creek (T2)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
27/10/2014	0.55	0.11	0.31
28/10/2014	0.14	-0.20	0.01
29/10/2014	0.16	0.00	0.08
30/10/2014	0.27	0.02	0.12
31/10/2014	0.27	0.00	0.12
01/05/2015	0.11	-0.03	0.01
02/05/2015	0.38	-0.06	0.08
03/05/2015	0.58	-0.06	0.09
04/05/2015	0.77	-0.06	0.12
05/05/2015	0.99	-0.03	0.23
06/05/2015	1.43	-0.06	0.42
07/05/2015	1.32	-0.03	0.32
08/05/2015	1.18	-0.03	0.39
09/05/2015	0.96	0.02	0.35
10/05/2015	0.77	-0.03	0.26
11/05/2015	0.69	-0.03	0.23
12/05/2015	0.85	-0.03	0.27
13/05/2015	0.93	-0.03	0.32
14/05/2015	0.85	-0.03	0.33
15/05/2015	1.13	0.00	0.44
16/05/2015	1.53	0.00	0.59
17/05/2015	2.07	0.02	0.79
18/05/2015	2.61	-0.03	1.05
19/05/2015	3.30	0.05	1.30
20/05/2015	3.51	0.05	1.48
21/05/2015	4.77	0.16	2.07
22/05/2015	4.84	0.63	2.56
23/05/2015	4.61	1.40	2.94
24/05/2015	3.88	1.51	2.79
25/05/2015	4.95	1.75	3.20
26/05/2015	3.93	1.72	2.85
27/05/2015	4.74	2.50	3.43
28/05/2015	3.49	0.50	1.84
29/05/2015	4.04	1.99	2.98
30/05/2015	5.26	2.61	3.83
31/05/2015	4.77	2.34	3.48
01/06/2015	3.49	2.02	2.80

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Latte Creek (T2)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
02/06/2015	3.51	1.97	2.53
03/06/2015	3.72	1.91	2.64
04/06/2015	4.35	1.91	3.04
05/06/2015	5.21	2.48	3.64
06/06/2015	4.14	1.78	3.00
07/06/2015	3.78	1.67	2.60
08/06/2015	4.04	1.86	2.92
09/06/2015	4.48	1.72	3.07
10/06/2015	3.72	2.48	2.95
11/06/2015	3.83	2.07	2.89
12/06/2015	3.91	2.10	2.96
13/06/2015	4.48	1.86	3.06
14/06/2015	4.69	1.70	3.13
15/06/2015	4.95	2.07	3.29
16/06/2015	4.51	2.61	3.52
17/06/2015	5.13	2.58	3.62
18/06/2015	5.54	2.56	3.57
19/06/2015	5.80	2.24	3.48
20/06/2015	5.02	2.53	3.60
21/06/2015	4.40	2.93	3.58
22/06/2015	5.67	3.14	4.03
23/06/2015	5.23	3.75	4.24
24/06/2015	5.39	3.27	3.99
25/06/2015	6.38	3.62	5.15
26/06/2015	5.92	3.51	4.91
27/06/2015	4.17	2.80	3.47
28/06/2015	5.21	2.90	3.89
29/06/2015	5.80	2.88	4.20
30/06/2015	5.31	3.54	4.45
01/07/2015	4.64	3.99	4.31
02/07/2015	4.14	3.17	3.61
03/07/2015	4.95	3.35	3.99
04/07/2015	5.80	2.77	4.18
05/07/2015	5.41	3.83	4.54
06/07/2015	6.81	3.59	5.11
07/07/2015	5.67	4.51	5.11
08/07/2015	5.87	4.32	5.06

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Latte Creek (T2)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
09/07/2015	6.54	4.25	4.94
10/07/2015	6.31	3.78	4.83
11/07/2015	5.90	4.30	4.97
12/07/2015	5.15	4.22	4.67
13/07/2015	5.28	3.56	4.25
14/07/2015	5.49	3.51	4.25
15/07/2015	5.59	2.66	4.02
16/07/2015	6.54	3.49	4.62
30/07/2015	5.51	3.54	4.32
31/07/2015	5.36	3.35	4.26
01/08/2015	5.39	3.04	4.16
02/08/2015	4.64	3.70	4.11
03/08/2015	5.87	2.69	4.16
04/08/2015	6.61	3.17	4.78
05/08/2015	7.29	3.80	5.47
06/08/2015	6.56	4.90	5.82
07/08/2015	6.15	3.38	4.76
08/08/2015	6.91	3.27	4.83
20/08/2015	4.84	3.49	4.17
21/08/2015	4.74	2.16	3.39
22/08/2015	4.30	2.88	3.59
23/08/2015	4.61	3.14	3.86
24/08/2015	4.56	3.51	3.98
25/08/2015	5.23	2.58	3.85
26/08/2015	4.51	3.59	4.06
27/08/2015	4.17	3.64	3.86
28/08/2015	3.51	2.50	2.85
29/08/2015	3.01	1.97	2.46
30/08/2015	3.06	1.78	2.37
31/08/2015	3.78	2.10	2.79
01/09/2015	3.56	2.24	2.83
02/09/2015	3.78	2.05	2.89
03/09/2015	3.96	1.37	2.63
04/09/2015	4.22	2.29	3.29
05/09/2015	4.38	3.25	3.71
06/09/2015	3.70	1.62	2.62

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

YR24 (T3)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
01/06/2014	3.20	1.51	2.56
02/06/2014	2.90	1.21	2.07
03/06/2014	2.82	0.99	1.89
04/06/2014	2.98	0.96	2.00
05/06/2014	3.27	1.51	2.38
06/06/2014	3.43	1.81	2.60
07/06/2014	4.04	1.86	2.90
08/06/2014	4.35	2.29	3.09
09/06/2014	4.48	2.24	3.11
10/06/2014	3.93	2.21	3.00
11/06/2014	3.41	2.02	2.80
12/06/2014	3.38	2.40	2.87
13/06/2014	4.32	1.91	2.95
14/06/2014	3.46	2.56	3.00
15/06/2014	3.70	2.34	2.88
16/06/2014	3.85	2.05	2.91
17/06/2014	3.85	2.53	3.11
18/06/2014	3.91	2.42	3.11
19/06/2014	3.64	2.24	2.93
20/06/2014	4.12	2.02	2.96
21/06/2014	4.25	2.80	3.31
22/06/2014	4.43	2.24	3.34
23/06/2014	4.38	2.66	3.50
24/06/2014	4.12	2.98	3.55
25/06/2014	3.88	2.90	3.30
26/06/2014	4.32	2.53	3.49
27/06/2014	4.12	2.45	3.37
28/06/2014	4.79	2.64	3.65
29/06/2014	4.84	3.01	3.90
30/06/2014	4.77	3.72	4.14
01/07/2014	5.05	3.64	4.21
02/07/2014	5.05	3.12	4.12
03/07/2014	6.31	3.70	4.69
04/07/2014	5.31	3.59	4.47
05/07/2014	5.10	3.88	4.43
06/07/2014	4.97	3.85	4.40
07/07/2014	4.95	3.64	4.25

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

YR24 (T3)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
08/07/2014	4.61	3.67	4.12
09/07/2014	5.33	3.72	4.43
10/07/2014	5.39	3.62	4.51
11/07/2014	5.54	4.01	4.69
12/07/2014	5.10	3.99	4.60
13/07/2014	5.08	3.83	4.41
14/07/2014	4.71	3.27	4.01
15/07/2014	4.64	3.27	3.94
16/07/2014	4.77	3.43	3.99
17/07/2014	4.77	3.54	4.05
18/07/2014	4.66	3.56	4.06
19/07/2014	4.92	3.46	4.11
20/07/2014	4.09	3.67	3.88
21/07/2014	5.15	3.54	4.23
22/07/2014	5.15	3.30	4.22
23/07/2014	4.79	3.67	4.23
24/07/2014	4.64	3.72	4.17
25/07/2014	4.53	3.80	4.15
26/07/2014	4.51	3.62	4.05
27/07/2014	4.61	3.64	4.07
28/07/2014	5.54	3.85	4.47
29/07/2014	4.90	3.59	4.09
30/07/2014	5.08	3.33	4.00
31/07/2014	5.39	2.61	3.81
01/08/2014	5.05	3.20	4.13
02/08/2014	5.64	3.91	4.64
03/08/2014	5.23	3.59	4.41
04/08/2014	5.08	4.06	4.61
05/08/2014	4.64	3.75	4.21
06/08/2014	4.56	3.64	4.11
07/08/2014	5.02	3.75	4.23
08/08/2014	5.10	3.43	4.12
09/08/2014	5.00	3.14	4.02
10/08/2014	4.90	3.27	4.08
11/08/2014	4.97	3.70	4.36
12/08/2014	5.00	4.01	4.46
13/08/2014	4.74	3.54	4.14

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

YR24 (T3)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
14/08/2014	4.77	3.70	4.21
15/08/2014	4.71	3.67	4.19
16/08/2014	4.64	3.46	4.07
17/08/2014	4.61	3.54	4.03
18/08/2014	4.61	3.75	4.09
19/08/2014	4.77	3.78	4.22
20/08/2014	4.58	3.56	4.06
21/08/2014	4.38	3.20	3.80
22/08/2014	4.53	3.56	3.98
23/08/2014	4.32	3.30	3.81
24/08/2014	4.38	3.43	3.89
25/08/2014	4.48	3.64	4.05
26/08/2014	4.32	3.59	3.93
27/08/2014	4.14	3.04	3.61
28/08/2014	4.17	3.20	3.70
29/08/2014	4.19	3.27	3.70
30/08/2014	4.04	3.51	3.76
31/08/2014	3.67	3.06	3.33
01/09/2014	3.49	2.34	2.83
02/09/2014	3.43	2.32	2.89
03/09/2014	3.33	2.61	2.93
04/09/2014	3.01	1.56	2.23
05/09/2014	3.33	2.61	2.88
06/09/2014	2.82	2.26	2.48
07/09/2014	2.88	1.72	2.20
08/09/2014	2.61	0.85	1.51
09/09/2014	2.72	0.91	1.68
10/09/2014	3.09	1.81	2.38
11/09/2014	3.41	2.29	2.74
12/09/2014	3.67	2.05	2.78
13/09/2014	3.83	2.88	3.32
14/09/2014	3.85	2.98	3.32
15/09/2014	3.62	2.48	3.02
16/09/2014	3.85	3.01	3.35
17/09/2014	3.01	1.81	2.45
18/09/2014	2.64	1.51	2.06
19/09/2014	3.04	1.81	2.31

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

YR24 (T3)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
20/09/2014	3.09	2.13	2.50
21/09/2014	2.90	1.81	2.34
22/09/2014	2.74	1.86	2.49
23/09/2014	1.83	1.10	1.39
24/09/2014	1.64	1.04	1.32
25/09/2014	1.02	0.50	0.74
26/09/2014	0.99	0.33	0.62
27/09/2014	1.56	0.96	1.29
28/09/2014	1.81	1.34	1.56
29/09/2014	1.94	1.07	1.42
30/09/2014	1.43	0.88	1.18
01/10/2014	1.21	0.30	0.69
02/10/2014	0.74	0.19	0.46
03/10/2014	1.10	0.61	0.80
04/10/2014	0.85	0.61	0.72
05/10/2014	1.04	0.55	0.80
08/10/2014	0.80	0.08	0.44
09/10/2014	0.38	0.14	0.31
10/10/2014	0.80	0.30	0.53
11/10/2014	1.04	0.50	0.76
12/10/2014	0.96	0.69	0.85
13/10/2014	1.21	0.63	0.87
14/10/2014	0.99	0.52	0.79
15/10/2014	0.93	0.50	0.70
16/10/2014	0.91	0.41	0.68
17/10/2014	0.72	0.22	0.42
18/10/2014	0.55	0.33	0.44
19/10/2014	0.85	0.50	0.63
20/10/2014	0.96	0.47	0.71
21/10/2014	0.96	0.69	0.76
22/10/2014	0.96	0.69	0.77
23/10/2014	0.74	0.50	0.61
24/10/2014	0.83	0.38	0.52
25/10/2014	0.41	0.11	0.29
26/10/2014	0.08	-0.76	-0.22
27/10/2014	-0.17	-1.36	-0.69
28/10/2014	-0.70	-1.58	-1.07

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

YR24 (T3)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
29/10/2014	-0.90	-2.95	-1.52
30/10/2014	-0.40	-2.45	-1.18
31/10/2014	-0.40	-4.02	-1.84
21/06/2015	4.61	3.25	3.96
22/06/2015	5.62	3.56	4.36
23/06/2015	5.75	3.99	4.71
24/06/2015	5.44	4.06	4.60
25/06/2015	5.51	4.04	4.61
26/06/2015	5.02	3.43	4.06
27/06/2015	4.09	2.85	3.49
28/06/2015	5.23	2.88	3.82
29/06/2015	5.62	3.04	4.16
30/06/2015	5.05	3.54	4.32
01/07/2015	4.51	3.17	3.80
02/07/2015	3.67	2.66	3.10
03/07/2015	4.48	3.01	3.55
04/07/2015	5.10	2.48	3.72
05/07/2015	4.97	3.59	4.20
06/07/2015	5.95	3.38	4.58
07/07/2015	5.13	4.12	4.64
08/07/2015	5.23	3.93	4.60
09/07/2015	4.90	3.85	4.39
10/07/2015	4.97	3.43	4.20
11/07/2015	5.39	3.88	4.38
12/07/2015	4.38	3.27	3.82
13/07/2015	4.61	2.90	3.49
14/07/2015	4.30	2.85	3.49
15/07/2015	4.77	2.34	3.44
16/07/2015	5.21	2.93	3.80
17/07/2015	6.31	3.46	4.52
18/07/2015	5.39	3.51	4.42
19/07/2015	5.21	3.49	4.30
20/07/2015	5.13	3.22	4.12
21/07/2015	4.79	3.51	4.15
22/07/2015	4.77	3.01	3.88
23/07/2015	4.92	2.98	3.92
24/07/2015	5.21	3.51	4.26

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

YR24 (T3)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
25/07/2015	5.05	3.38	4.26
26/07/2015	5.08	3.78	4.30
27/07/2015	4.82	3.38	3.99
28/07/2015	4.74	3.62	4.16
29/07/2015	4.35	3.17	3.82
30/07/2015	4.66	2.77	3.48
31/07/2015	4.51	2.74	3.48
01/08/2015	4.43	2.42	3.39
02/08/2015	4.38	3.22	3.70
03/08/2015	5.05	2.40	3.58
04/08/2015	5.59	2.77	3.96
05/08/2015	5.69	3.20	4.27
06/08/2015	4.66	3.80	4.18
07/08/2015	5.28	3.01	3.95
08/08/2015	4.92	2.69	3.75
09/08/2015	5.18	3.09	4.08
10/08/2015	5.10	3.93	4.48
11/08/2015	4.71	3.27	3.98
12/08/2015	4.82	3.46	3.99
13/08/2015	4.84	2.98	3.84
14/08/2015	4.97	3.27	3.99
15/08/2015	5.13	2.90	3.86
16/08/2015	4.45	3.33	3.89
17/08/2015	4.22	2.85	3.59
18/08/2015	4.45	3.62	3.97
19/08/2015	4.38	3.64	3.98
20/08/2015	3.67	2.64	3.20
21/08/2015	3.96	1.62	2.62
22/08/2015	3.72	2.18	2.91
23/08/2015	3.83	2.72	3.20
24/08/2015	4.51	2.85	3.46
25/08/2015	4.06	2.05	3.02
26/08/2015	3.80	3.04	3.44
27/08/2015	3.51	3.04	3.26
28/08/2015	3.06	2.21	2.49
29/08/2015	2.69	1.64	2.08
30/08/2015	2.64	1.18	1.89

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

YR24 (T3)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
31/08/2015	3.27	1.81	2.38
01/09/2015	3.12	1.94	2.43
02/09/2015	3.30	1.48	2.29
03/09/2015	3.49	0.99	2.07
04/09/2015	3.06	1.75	2.47
05/09/2015	3.83	2.50	2.93
06/09/2015	3.09	1.21	1.97
07/09/2015	2.77	0.80	1.62
08/09/2015	2.88	0.83	1.62
09/09/2015	3.46	1.26	2.14
10/09/2015	3.49	1.67	2.46
11/09/2015	3.67	2.53	2.96
12/09/2015	3.09	1.34	2.29
13/09/2015	2.82	2.05	2.29
14/09/2015	3.22	1.43	2.23
15/09/2015	2.72	2.10	2.35

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Halfway Creek (T4)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
01/06/2014	3.09	0.52	2.06
02/06/2014	2.88	0.63	1.80
03/06/2014	3.17	0.50	1.81
04/06/2014	3.51	0.61	2.10
05/06/2014	3.93	1.26	2.56
06/06/2014	4.06	1.62	2.78
07/06/2014	5.02	1.56	3.09
08/06/2014	5.10	2.18	3.41
09/06/2014	5.67	2.21	3.75
10/06/2014	4.61	2.26	3.43
11/06/2014	4.14	1.89	3.06
12/06/2014	4.12	2.48	3.29
13/06/2014	5.28	1.94	3.48
14/06/2014	4.32	2.93	3.61
15/06/2014	4.53	2.69	3.46
16/06/2014	5.33	2.10	3.62
17/06/2014	4.66	2.93	3.65
18/06/2014	4.79	2.69	3.67
19/06/2014	4.84	2.45	3.55
20/06/2014	4.90	2.10	3.47
21/06/2014	5.33	3.09	3.99
22/06/2014	5.18	2.32	3.79
23/06/2014	5.54	2.77	4.13
24/06/2014	4.79	3.35	4.11
25/06/2014	4.64	3.51	3.89
26/06/2014	4.25	1.97	3.23
27/06/2014	4.48	2.05	3.33
28/06/2014	5.77	2.32	3.97
29/06/2014	6.74	3.04	4.76
30/06/2014	6.43	4.32	5.16
01/07/2014	5.62	3.70	4.49
02/07/2014	5.39	2.61	4.01
03/07/2014	7.97	3.46	5.15
04/07/2014	6.71	3.54	5.02
05/07/2014	6.74	4.06	5.16
06/07/2014	6.13	4.06	5.18
07/07/2014	6.61	3.80	5.10

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Halfway Creek (T4)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
08/07/2014	6.00	4.01	4.86
09/07/2014	5.95	3.35	4.47
10/07/2014	6.46	3.27	4.85
11/07/2014	7.37	4.19	5.53
12/07/2014	6.69	4.45	5.63
13/07/2014	6.71	4.19	5.45
14/07/2014	7.07	3.38	5.11
15/07/2014	6.74	3.64	5.14
16/07/2014	6.69	4.12	5.28
17/07/2014	7.02	4.30	5.51
18/07/2014	7.34	4.43	5.73
19/07/2014	7.59	4.25	5.75
20/07/2014	5.95	4.74	5.25
21/07/2014	6.89	4.22	5.36
22/07/2014	7.37	3.33	5.18
23/07/2014	6.61	4.22	5.36
24/07/2014	6.59	4.40	5.44
25/07/2014	5.77	4.61	5.23
26/07/2014	5.98	4.14	4.99
27/07/2014	6.36	4.25	5.15
28/07/2014	6.31	4.17	5.11
29/07/2014	4.97	3.72	4.26
30/07/2014	5.51	3.22	4.20
31/07/2014	6.38	2.45	4.18
01/08/2014	6.46	3.20	4.79
02/08/2014	7.90	4.35	5.74
03/08/2014	7.47	3.83	5.53
04/08/2014	7.14	4.71	5.91
05/08/2014	7.07	4.17	5.48
06/08/2014	5.75	4.19	5.05
07/08/2014	6.10	4.22	4.94
08/08/2014	6.10	3.41	4.62
09/08/2014	6.51	3.12	4.69
10/08/2014	6.74	3.35	4.97
11/08/2014	6.46	4.04	5.29
12/08/2014	6.91	4.53	5.48
13/08/2014	6.46	3.72	5.01

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Halfway Creek (T4)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
14/08/2014	6.69	4.12	5.25
15/08/2014	5.98	3.93	5.00
16/08/2014	6.15	3.54	4.84
17/08/2014	6.43	3.67	4.83
18/08/2014	6.08	4.12	4.99
19/08/2014	6.61	4.22	5.33
20/08/2014	6.61	3.83	5.08
21/08/2014	6.05	2.98	4.45
22/08/2014	6.18	3.83	4.81
23/08/2014	5.75	3.30	4.44
24/08/2014	5.77	3.54	4.60
25/08/2014	5.90	4.01	4.90
26/08/2014	5.64	3.91	4.73
27/08/2014	4.95	2.82	3.97
28/08/2014	5.39	3.06	4.21
29/08/2014	5.51	3.22	4.30
30/08/2014	5.21	3.99	4.50
31/08/2014	4.45	3.38	3.89
01/09/2014	4.48	2.32	3.18
02/09/2014	4.14	2.16	3.17
03/09/2014	4.09	2.80	3.37
04/09/2014	3.67	1.26	2.40
05/09/2014	3.93	2.82	3.27
06/09/2014	3.22	2.50	2.81
07/09/2014	3.25	1.94	2.42
08/09/2014	2.93	0.74	1.63
09/09/2014	3.12	0.77	1.82
10/09/2014	3.67	1.81	2.67
11/09/2014	3.88	2.42	3.07
12/09/2014	4.30	1.99	3.10
13/09/2014	4.84	3.33	4.01
14/09/2014	4.69	3.30	3.87
15/09/2014	4.35	2.45	3.38
16/09/2014	4.79	3.20	3.90
17/09/2014	3.49	1.53	2.50
18/09/2014	2.80	1.10	1.90
19/09/2014	3.38	1.48	2.28

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Halfway Creek (T4)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
20/09/2014	3.64	1.86	2.56
21/09/2014	3.27	1.48	2.37
22/09/2014	3.14	1.97	2.73
23/09/2014	1.91	0.93	1.31
24/09/2014	1.62	0.80	1.18
25/09/2014	0.74	0.00	0.13
26/09/2014	0.19	0.00	0.07
27/09/2014	1.56	0.16	1.04
28/09/2014	2.02	1.43	1.61
29/09/2014	2.10	1.07	1.52
30/09/2014	1.48	0.80	1.19
01/10/2014	1.26	0.00	0.49
02/10/2014	0.36	0.00	0.07
03/10/2014	1.07	0.08	0.56
04/10/2014	0.69	0.05	0.29
05/10/2014	0.88	0.00	0.36
08/10/2014	0.19	0.00	0.07
09/10/2014	0.08	0.00	0.04
10/10/2014	0.08	0.02	0.06
11/10/2014	0.30	0.05	0.16
12/10/2014	0.66	0.16	0.45
13/10/2014	0.96	0.25	0.52
14/10/2014	0.80	0.08	0.46
15/10/2014	0.77	0.05	0.35
16/10/2014	0.63	0.00	0.34
17/10/2014	0.11	0.00	0.05
18/10/2014	0.19	0.02	0.06
19/10/2014	0.27	0.08	0.14
20/10/2014	0.72	0.05	0.34
21/10/2014	0.74	0.30	0.47
22/10/2014	0.83	0.38	0.55
23/10/2014	0.58	0.27	0.41
24/10/2014	0.66	0.16	0.36
25/10/2014	0.25	0.02	0.13
26/10/2014	0.14	0.00	0.05
27/10/2014	0.02	0.00	0.00
28/10/2014	0.05	0.00	0.01

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Halfway Creek (T4)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
29/10/2014	0.02	0.00	0.02
30/10/2014	0.02	0.00	0.02
31/10/2014	0.02	0.02	0.02
01/05/2015	-0.03	-0.06	-0.06
02/05/2015	-0.03	-0.06	-0.05
03/05/2015	0.00	-0.06	-0.04
04/05/2015	0.00	-0.06	-0.04
05/05/2015	0.00	-0.03	-0.03
06/05/2015	0.05	-0.03	-0.02
07/05/2015	0.02	-0.03	-0.01
08/05/2015	0.02	-0.03	-0.01
09/05/2015	0.02	-0.03	-0.01
10/05/2015	0.19	0.00	0.07
11/05/2015	0.36	0.00	0.13
12/05/2015	0.41	0.00	0.16
13/05/2015	0.50	0.00	0.18
14/05/2015	0.50	0.00	0.20
15/05/2015	0.63	0.00	0.26
16/05/2015	0.74	0.02	0.30
17/05/2015	0.74	0.05	0.32
18/05/2015	0.80	0.00	0.37
19/05/2015	1.02	0.05	0.43
20/05/2015	0.99	0.02	0.41
21/05/2015	1.07	0.02	0.46
22/05/2015	1.15	0.08	0.52
23/05/2015	1.45	0.22	0.70
24/05/2015	1.94	0.27	0.94
25/05/2015	2.85	0.33	1.36
26/05/2015	2.48	0.50	1.46
27/05/2015	3.59	0.44	1.93
28/05/2015	1.40	0.14	0.56
29/05/2015	2.64	0.55	1.47
30/05/2015	4.19	1.15	2.50
31/05/2015	4.45	1.34	2.78
01/06/2015	3.25	1.21	2.30
02/06/2015	3.67	1.67	2.46
03/06/2015	3.17	1.89	2.53

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Halfway Creek (T4)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
04/06/2015	4.06	1.24	2.42
05/06/2015	5.00	2.07	3.29
06/06/2015	3.85	1.59	2.87
07/06/2015	4.45	1.64	2.80
08/06/2015	3.93	1.91	2.98
09/06/2015	5.44	1.75	3.39
10/06/2015	5.02	3.09	3.75
11/06/2015	4.97	2.64	3.72
12/06/2015	5.00	2.72	3.81
13/06/2015	5.92	2.58	4.10
14/06/2015	6.20	2.42	4.21
15/06/2015	6.66	3.01	4.66
16/06/2015	6.43	3.93	5.18
17/06/2015	7.37	3.91	5.47
18/06/2015	6.84	3.96	5.33
19/06/2015	7.29	3.49	5.26
20/06/2015	7.27	3.93	5.50
21/06/2015	6.97	4.32	5.62
22/06/2015	7.87	4.56	6.08
23/06/2015	8.12	5.10	6.48
24/06/2015	7.62	5.23	6.23
25/06/2015	7.47	4.92	6.15
26/06/2015	6.99	3.35	5.68
27/06/2015	3.99	2.32	3.11
28/06/2015	5.69	2.50	3.78
29/06/2015	6.48	2.77	4.35
30/06/2015	6.15	3.51	4.77
01/07/2015	5.23	3.17	3.99
02/07/2015	3.99	2.48	3.10
03/07/2015	4.61	2.93	3.50
04/07/2015	5.49	2.21	3.75
05/07/2015	5.51	3.51	4.37
06/07/2015	7.52	3.33	5.15
07/07/2015	6.03	4.43	5.23
08/07/2015	6.51	4.22	5.36
09/07/2015	6.13	4.17	5.10
10/07/2015	6.10	3.46	4.83

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Halfway Creek (T4)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
11/07/2015	5.77	4.19	4.87
12/07/2015	4.69	3.64	4.26
13/07/2015	5.28	2.98	3.76
14/07/2015	4.58	2.93	3.70
15/07/2015	5.00	2.34	3.63
16/07/2015	6.00	2.98	4.19
17/07/2015	7.70	3.72	5.28
18/07/2015	6.56	3.80	5.20
19/07/2015	6.86	3.93	5.21
20/07/2015	6.91	3.64	5.08
21/07/2015	6.59	3.99	5.14
22/07/2015	6.51	3.17	4.78
23/07/2015	6.54	3.06	4.77
24/07/2015	7.59	4.01	5.48
25/07/2015	7.07	3.75	5.39
26/07/2015	6.94	4.35	5.52
27/07/2015	6.20	3.96	4.90
28/07/2015	5.80	3.85	4.72
29/07/2015	4.40	3.30	3.96
30/07/2015	5.00	2.80	3.63
31/07/2015	4.77	2.77	3.57
01/08/2015	4.74	2.37	3.51
02/08/2015	4.69	3.27	3.87
03/08/2015	5.59	2.37	3.87
04/08/2015	6.41	2.85	4.41
05/08/2015	6.54	3.35	4.81
06/08/2015	5.23	4.09	4.54
07/08/2015	5.85	3.09	4.28
08/08/2015	5.51	2.74	4.10
09/08/2015	5.82	3.17	4.39
10/08/2015	5.72	4.17	4.92
11/08/2015	5.26	3.51	4.41
12/08/2015	5.44	3.78	4.47
13/08/2015	5.75	3.25	4.37
14/08/2015	5.77	3.46	4.44
15/08/2015	6.08	2.90	4.38
16/08/2015	5.05	3.59	4.32

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Halfway Creek (T4)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
17/08/2015	4.69	2.80	3.86
18/08/2015	4.95	3.80	4.32
19/08/2015	4.90	3.91	4.36
20/08/2015	4.06	3.01	3.58
21/08/2015	4.43	1.83	2.93
22/08/2015	4.25	2.32	3.17
23/08/2015	4.35	2.93	3.54
24/08/2015	4.87	3.04	3.76
25/08/2015	4.38	2.16	3.24
26/08/2015	4.06	3.17	3.66
27/08/2015	3.91	3.17	3.49
28/08/2015	3.25	2.40	2.67
29/08/2015	2.96	1.78	2.29
30/08/2015	2.85	1.32	2.07
31/08/2015	3.59	1.91	2.59
01/09/2015	3.41	2.02	2.63
02/09/2015	3.70	1.53	2.51
03/09/2015	3.88	1.04	2.32
04/09/2015	3.35	1.81	2.68
05/09/2015	4.32	2.64	3.20
06/09/2015	3.30	1.32	2.14
07/09/2015	2.96	0.72	1.74
08/09/2015	2.88	0.72	1.66
09/09/2015	3.70	1.26	2.26
10/09/2015	3.56	1.70	2.56
11/09/2015	3.75	2.61	3.05
12/09/2015	3.30	1.21	2.34
13/09/2015	3.09	2.05	2.41
14/09/2015	3.54	1.48	2.38
15/09/2015	2.93	2.13	2.48

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Kona Tributary (T5)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
08/10/2014	0.14	0.00	0.05
09/10/2014	0.02	0.00	0.02
10/10/2014	0.14	0.02	0.07
11/10/2014	0.19	0.05	0.12
12/10/2014	0.25	0.08	0.13
13/10/2014	0.30	0.05	0.13
14/10/2014	0.25	0.05	0.12
15/10/2014	0.22	0.05	0.12
16/10/2014	0.22	0.00	0.09
17/10/2014	0.08	0.00	0.03
18/10/2014	0.08	0.00	0.03
19/10/2014	0.16	0.05	0.10
20/10/2014	0.22	0.08	0.14
21/10/2014	0.25	0.05	0.13
22/10/2014	0.22	0.11	0.16
23/10/2014	0.19	0.11	0.15
24/10/2014	0.22	0.08	0.12
25/10/2014	0.16	0.02	0.07
26/10/2014	0.05	0.00	0.02
27/10/2014	0.05	0.00	0.02
28/10/2014	0.02	0.02	0.02
29/10/2014	0.02	0.02	0.02
30/10/2014	0.02	0.02	0.02
31/10/2014	0.02	0.02	0.02
22/06/2015	6.13	4.14	5.16
23/06/2015	6.91	4.30	5.48
24/06/2015	5.87	4.56	5.17
25/06/2015	6.05	3.93	5.02
26/06/2015	5.62	2.18	4.56
27/06/2015	3.04	1.78	2.46
02/07/2015	3.04	1.78	2.32
03/07/2015	3.51	2.24	2.71
07/07/2015	5.23	3.46	4.30
08/07/2015	5.59	3.33	4.43
09/07/2015	5.23	3.22	4.22
10/07/2015	5.15	2.48	3.83
11/07/2015	4.71	3.25	3.91

Appendix E2. Stream Temperature Data, Coffee Gold Project, 2014-2015

Kona Tributary (T5)			
Date	Max Temperature (°C)	Min Temperature (°C)	Average Temperature (°C)
12/07/2015	4.14	2.98	3.47
13/07/2015	4.19	2.56	3.18
14/07/2015	3.54	2.29	2.87
15/07/2015	4.09	1.72	2.88
16/07/2015	4.48	2.29	3.33
29/07/2015	3.20	2.42	2.78
30/07/2015	4.17	2.24	3.02
31/07/2015	4.27	2.26	3.09
01/08/2015	4.14	1.89	3.01
01/09/2015	2.72	1.43	1.97
02/09/2015	3.01	0.93	1.80
03/09/2015	3.12	0.52	1.66
04/09/2015	2.93	1.21	2.07
05/09/2015	3.38	1.94	2.46
06/09/2015	3.01	0.55	1.57
07/09/2015	2.32	0.19	1.17
08/09/2015	2.53	0.27	1.24
09/09/2015	3.33	0.66	1.78
10/09/2015	3.49	0.99	2.11
11/09/2015	3.70	2.24	2.76
12/09/2015	3.04	0.77	1.92
13/09/2015	3.14	1.43	2.04
14/09/2015	3.38	0.83	1.89
15/09/2015	2.40	1.62	1.88

Appendix F

Fish Community

- **F1. Minnow Trapping Effort and Catch, Coffee Gold Project, 2014-2015**
- **F2. Electrofishing Effort and Catch, Coffee Gold Project, 2014-2015**
- **F3. Fyke Netting, Angling Effort and Catch, Coffee Gold Project, 2014-2015**
- **F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015**
- **F5. Fish Tissue Metal Concentrations, Coffee Gold Project, 2014-2015**
- **F6. Arctic Grayling Stomach Samples, Coffee Gold Project, 2014-2015**

Appendix F1. Minnow Trapping Effort and Catch, Coffee Gold Project, 2014-2015

Date	Site	Waterbody	Trap	Effort (hours)	Catch			
					GR	CCG	CH	Total
21-Aug-14	AQREF1	Isaac	1	26.55	0	0	4	4
21-Aug-14	AQREF1	Isaac	2	26.55	1	0	9	10
21-Aug-14	AQREF1	Isaac	3	26.55	0	0	1	1
21-Aug-14	AQREF1	Isaac	4	26.55	0	1	6	7
21-Aug-14	AQREF1	Isaac	5	26.55	0	0	6	6
21-Aug-14	AQREF1	Isaac	6	26.55	0	0	0	0
21-Aug-14	AQREF1	Isaac	7	26.55	0	0	3	3
21-Aug-14	AQREF1	Isaac	8	26.55	0	0	6	6
23-Aug-14	AQ05	Latte	1	29.00	0	0	0	0
23-Aug-14	AQ05	Latte	2	29.00	0	0	0	0
23-Aug-14	AQ06	Latte	1	27.58	0	0	0	0
23-Aug-14	AQ06	Latte	2	27.58	0	0	0	0
23-Aug-14	AQ21	Halfway	1	26.08	0	0	0	0
23-Aug-14	AQ21	Halfway	2	26.08	0	0	0	0
23-Aug-14	AQ31	YR24	1	24.42	0	0	0	0
23-Aug-14	AQ31	YR24	2	24.42	0	0	0	0
23-Aug-14	AQ13	Kona Tributary	1	23.50	0	0	0	0
23-Aug-14	AQ13	Kona Tributary	2	23.50	0	0	0	0
23-Aug-14	AQ12	Kona Tributary	1	22.50	0	0	0	0
23-Aug-14	AQ12	Kona Tributary	2	22.50	0	0	0	0
24-Aug-14	AQ10	Independence	1	24.92	0	0	0	0
24-Aug-14	AQ10	Independence	2	24.92	0	0	0	0
24-Aug-14	AQ10	Independence	3	24.92	0	0	3	3
24-Aug-14	AQ10	Independence	4	24.92	0	0	1	1
24-Aug-14	AQ10	Independence	5	24.92	0	0	0	0
24-Aug-14	AQ10	Independence	6	24.92	0	0	1	1
24-Aug-14	AQ10	Independence	7	24.92	0	0	1	1
24-Aug-14	AQ10	Independence	8	24.92	0	0	4	4
24-Aug-14	AQ10	Independence	9	24.92	0	0	0	0
24-Aug-14	AQ10	Independence	10	24.92	0	0	0	0
24-Aug-14	AQ00	Coffee	1	24.33	0	0	7	7
24-Aug-14	AQ00	Coffee	2	24.33	0	0	14	14
24-Aug-14	AQ00	Coffee	3	24.33	0	0	13	13
24-Aug-14	AQ00	Coffee	4	24.33	0	1	4	5
24-Aug-14	AQ00	Coffee	5	24.33	0	0	4	4
24-Aug-14	AQ00	Coffee	6	24.33	0	0	18	18
24-Aug-14	AQ00	Coffee	7	24.33	0	1	14	15
24-Aug-14	AQ00	Coffee	8	24.33	0	1	17	18
24-Aug-14	AQ00	Coffee	9	24.33	0	0	6	6
24-Aug-14	AQ00	Coffee	10	24.33	0	0	25	25
25-Aug-14	AQ04	Latte	1	23.67	0	0	0	0
25-Aug-14	AQ04	Latte	2	23.67	0	0	0	0
25-Aug-14	AQ04	Latte	3	23.67	0	0	0	0
25-Aug-14	AQ04	Latte	4	23.67	0	0	0	0
25-Aug-14	AQ04	Latte	5	23.67	0	0	0	0

Note: GR=Arctic grayling, CCG=slimy sculpin, CH=juvenile Chinook salmon

Appendix F1. Minnow Trapping Effort and Catch, Coffee Gold Project, 2014-2015

Date	Site	Waterbody	Trap	Effort (hours)	Catch			
					GR	CCG	CH	Total
25-Aug-14	AQ11	Independence	1	24.75	0	0	0	0
25-Aug-14	AQ11	Independence	2	24.75	0	0	1	1
25-Aug-14	AQ11	Independence	3	24.75	0	0	0	0
25-Aug-14	AQ11	Independence	4	24.75	0	0	0	0
25-Aug-14	AQ11	Independence	5	24.75	0	0	0	0
25-Aug-14	AQ11	Independence	6	24.75	0	0	0	0
25-Aug-14	AQ11	Independence	7	24.75	0	0	0	0
25-Aug-14	AQ11	Independence	8	24.75	0	0	0	0
25-Aug-14	AQ11	Independence	9	24.75	0	0	0	0
25-Aug-14	AQ11	Independence	10	24.75	0	0	0	0
26-Aug-14	AQ02	Coffee	1	27.17	0	0	1	1
26-Aug-14	AQ02	Coffee	2	27.17	0	0	0	0
26-Aug-14	AQ02	Coffee	3	27.17	0	0	20	20
26-Aug-14	AQ02	Coffee	4	27.17	0	0	0	0
26-Aug-14	AQ02	Coffee	5	27.17	0	1	14	15
26-Aug-14	AQ02	Coffee	6	27.17	0	1	0	1
26-Aug-14	AQ02	Coffee	7	27.17	0	0	1	1
26-Aug-14	AQ02	Coffee	8	27.17	0	1	0	1
26-Aug-14	AQ02	Coffee	9	27.17	0	0	8	8
26-Aug-14	AQ02	Coffee	10	27.17	0	1	18	19
27-Aug-14	AQ01	Coffee	1	23.75	0	0	4	4
27-Aug-14	AQ01	Coffee	2	23.75	0	0	7	7
27-Aug-14	AQ01	Coffee	3	23.75	0	0	2	2
27-Aug-14	AQ01	Coffee	4	23.75	0	0	3	3
27-Aug-14	AQ01	Coffee	5	23.75	0	1	4	5
27-Aug-14	AQ01	Coffee	6	23.75	0	0	7	7
27-Aug-14	AQ01	Coffee	7	23.75	0	0	7	7
27-Aug-14	AQ01	Coffee	8	23.75	0	0	2	2
27-Aug-14	AQ01	Coffee	9	23.75	0	0	34	34
27-Aug-14	AQ01	Coffee	10	23.75	0	0	2	2
5-Oct-14	AQ02	Coffee	1	25.00	0	1	4	5
5-Oct-14	AQ02	Coffee	2	25.00	0	0	1	1
5-Oct-14	AQ02	Coffee	3	25.00	0	0	7	7
5-Oct-14	AQ02	Coffee	4	25.00	0	2	3	5
5-Oct-14	AQ02	Coffee	5	25.00	0	0	1	1
5-Oct-14	AQ01	Coffee	1	25.00	0	0	4	4
5-Oct-14	AQ01	Coffee	2	25.00	0	0	1	1
5-Oct-14	AQ01	Coffee	3	25.00	0	0	20	20
5-Oct-14	AQ01	Coffee	4	25.00	0	0	6	6
5-Oct-14	AQ01	Coffee	5	25.00	0	2	4	6
5-Oct-14	AQ00	Coffee	1	25.25	0	0	2	2
5-Oct-14	AQ00	Coffee	2	25.25	0	1	1	2
5-Oct-14	AQ00	Coffee	3	25.25	0	0	2	2
5-Oct-14	AQ00	Coffee	4	25.25	0	0	1	1

Note: GR=Arctic grayling, CCG=slimy sculpin, CH=juvenile Chinook salmon

Appendix F1. Minnow Trapping Effort and Catch, Coffee Gold Project, 2014-2015

Date	Site	Waterbody	Trap	Effort (hours)	Catch			
					GR	CCG	CH	Total
5-Oct-14	AQ00	Coffee	5	25.25	0	0	19	19
5-Oct-14	AQREF1	Isaac	1	25.50	0	0	6	6
5-Oct-14	AQREF1	Isaac	2	25.50	0	0	1	1
5-Oct-14	AQREF1	Isaac	3	25.50	0	0	7	7
5-Oct-14	AQREF1	Isaac	4	25.50	0	0	3	3
5-Oct-14	AQREF1	Isaac	5	25.50	0	0	2	2
5-Oct-14	AQ10	Independence	1	25.00	0	0	2	2
5-Oct-14	AQ10	Independence	2	25.00	0	0	0	0
5-Oct-14	AQ10	Independence	3	25.00	0	0	1	1
5-Oct-14	AQ10	Independence	4	25.00	0	0	1	1
5-Oct-14	AQ10	Independence	5	25.00	0	0	2	2
06-Oct-14	AQ11	Independence	1	20.67	0	0	0	0
06-Oct-14	AQ11	Independence	2	20.67	0	0	0	0
06-Oct-14	AQ11	Independence	3	20.67	0	0	0	0
06-Oct-14	AQ11	Independence	4	20.67	0	0	0	0
06-Oct-14	AQ11	Independence	5	20.67	0	0	0	0
20-Jun-15	AQREF2	Los Angeles	6	22.50	0	0	0	0
20-Jun-15	AQREF2	Los Angeles	7	22.50	0	0	0	0
20-Jun-15	AQREF2	Los Angeles	8	22.50	0	0	0	0
20-Jun-15	AQREF2	Los Angeles	9	22.50	0	0	0	0
20-Jun-15	AQREF2	Los Angeles	10	22.50	0	0	0	0
21-Jun-15	AQ10	Independence	1	25.58	0	0	1	1
21-Jun-15	AQ10	Independence	2	25.58	0	0	0	0
21-Jun-15	AQ10	Independence	3	25.58	0	0	0	0
21-Jun-15	AQ10	Independence	4	25.58	0	0	0	0
21-Jun-15	AQ10	Independence	5	25.58	0	0	0	0
22-Jun-15	AQ00	Coffee	1	24.25	0	3	0	3
22-Jun-15	AQ00	Coffee	2	24.25	0	0	0	0
22-Jun-15	AQ00	Coffee	3	24.25	0	0	0	0
22-Jun-15	AQ00	Coffee	4	24.25	0	0	0	0
22-Jun-15	AQ00	Coffee	5	24.25	0	0	0	0
22-Jun-15	AQ01	Coffee	1	22.50	0	0	0	0
22-Jun-15	AQ01	Coffee	2	22.50	0	2	0	2
22-Jun-15	AQ01	Coffee	3	22.50	0	0	0	0
22-Jun-15	AQ01	Coffee	4	22.50	0	0	0	0
22-Jun-15	AQ01	Coffee	5	22.50	0	0	0	0
22-Jun-15	AQREF1	Isaac	1	22.75	0	1	0	1
22-Jun-15	AQREF1	Isaac	2	22.75	0	1	0	1
22-Jun-15	AQREF1	Isaac	3	22.75	0	3	0	3
22-Jun-15	AQREF1	Isaac	4	22.75	0	1	0	1
22-Jun-15	AQREF1	Isaac	5	22.75	0	0	0	0
26-Jul-15	AQ00	Coffee	1	26.58	0	0	8	8
26-Jul-15	AQ00	Coffee	2	26.58	0	0	0	0
26-Jul-15	AQ00	Coffee	3	26.58	0	0	0	0

Note: GR=Arctic grayling, CCG=slimy sculpin, CH=juvenile Chinook salmon

Appendix F1. Minnow Trapping Effort and Catch, Coffee Gold Project, 2014-2015

Date	Site	Waterbody	Trap	Effort (hours)	Catch			
					GR	CCG	CH	Total
26-Jul-15	AQ00	Coffee	4	26.58	0	0	0	0
26-Jul-15	AQ00	Coffee	5	26.58	0	0	0	0
26-Jul-15	AQ01	Coffee	1	19.92	0	1	2	3
26-Jul-15	AQ01	Coffee	2	19.92	0	0	0	0
26-Jul-15	AQ01	Coffee	3	19.92	0	0	0	0
26-Jul-15	AQ01	Coffee	4	19.92	0	0	0	0
26-Jul-15	AQ01	Coffee	5	19.92	0	0	0	0
26-Jul-15	AQ02	Coffee	1	24.75	3	3	0	6
26-Jul-15	AQ02	Coffee	2	24.75	0	0	0	0
26-Jul-15	AQ02	Coffee	3	24.75	0	0	0	0
26-Jul-15	AQ02	Coffee	4	24.75	0	0	0	0
26-Jul-15	AQ02	Coffee	5	24.75	0	0	0	0
27-Jul-15	AQ10	Independence	1	29.00	0	0	5	5
27-Jul-15	AQ10	Independence	2	29.00	0	0	0	0
27-Jul-15	AQ10	Independence	3	29.00	0	0	0	0
27-Jul-15	AQ10	Independence	4	29.00	0	0	0	0
27-Jul-15	AQ10	Independence	5	29.00	0	0	0	0
27-Jul-15	AQ11	Independence	1	23.75	0	0	0	0
27-Jul-15	AQ11	Independence	2	23.75	0	0	0	0
27-Jul-15	AQ11	Independence	3	23.75	0	0	0	0
27-Jul-15	AQ11	Independence	4	23.75	0	0	0	0
27-Jul-15	AQ11	Independence	5	23.75	0	0	0	0
27-Jul-15	AQREF1	Isaac	1	24.42	0	4	85	89
27-Jul-15	AQREF1	Isaac	2	24.42	0	0	0	0
27-Jul-15	AQREF1	Isaac	3	24.42	0	0	0	0
27-Jul-15	AQREF1	Isaac	4	24.42	0	0	0	0
27-Jul-15	AQREF1	Isaac	5	24.42	0	0	0	0
30-Jul-15	AQREF2	Los Angeles	1	24.83	0	0	0	0
30-Jul-15	AQREF2	Los Angeles	2	24.83	0	0	0	0
30-Jul-15	AQREF2	Los Angeles	3	24.83	0	0	0	0
30-Jul-15	AQREF2	Los Angeles	4	24.83	0	0	0	0
30-Jul-15	AQREF2	Los Angeles	5	24.83	0	0	0	0
31-Jul-15	AQ03	Latte	1	30.00	0	1	0	1
31-Jul-15	AQ03	Latte	2	30.00	0	0	0	0
31-Jul-15	AQ03	Latte	3	30.00	0	0	0	0
31-Jul-15	AQ03	Latte	4	30.00	0	0	0	0
31-Jul-15	AQ03	Latte	5	30.00	0	0	0	0
31-Jul-15	AQ03	Latte	6	30.00	0	0	0	0
31-Jul-15	AQ03	Latte	7	30.00	0	0	0	0
31-Jul-15	AQ03	Latte	8	30.00	0	0	0	0
31-Jul-15	AQ10	Independence	1	20.83	0	0	5	5
31-Jul-15	AQ10	Independence	2	20.83	0	0	0	0
31-Jul-15	AQ10	Independence	3	20.83	0	0	0	0
31-Jul-15	AQ10	Independence	4	20.83	0	0	0	0

Note: GR=Arctic grayling, CCG=slimy sculpin, CH=juvenile Chinook salmon

Appendix F1. Minnow Trapping Effort and Catch, Coffee Gold Project, 2014-2015

Date	Site	Waterbody	Trap	Effort (hours)	Catch			
					GR	CCG	CH	Total
31-Jul-15	AQ10	Independence	5	20.83	0	0	0	0
31-Jul-15	AQ10	Independence	6	20.83	0	0	0	0
31-Jul-15	AQ10	Independence	7	20.83	0	0	0	0
31-Jul-15	AQ10	Independence	8	20.83	0	0	0	0
31-Jul-15	AQREF2	Los Angeles	1	22.50	0	0	4	4
31-Jul-15	AQREF2	Los Angeles	2	22.50	0	0	0	0
31-Jul-15	AQREF2	Los Angeles	3	22.50	0	0	0	0
31-Jul-15	AQREF2	Los Angeles	4	22.50	0	0	0	0
31-Jul-15	AQREF2	Los Angeles	5	22.50	0	0	0	0
31-Jul-15	AQREF2	Los Angeles	6	22.50	0	0	0	0
31-Jul-15	AQREF2	Los Angeles	7	22.50	0	0	0	0
31-Jul-15	AQREF2	Los Angeles	8	22.50	0	0	0	0
10-Sep-15	AQREF2	Los Angeles	1	32.00	0	0	1	1
10-Sep-15	AQREF2	Los Angeles	2	32.00	0	0	0	0
10-Sep-15	AQREF2	Los Angeles	3	32.00	0	0	0	0
10-Sep-15	AQREF2	Los Angeles	4	32.00	0	0	0	0
10-Sep-15	AQREF2	Los Angeles	5	32.00	0	0	0	0
10-Sep-15	AQREF2	Los Angeles	6	32.00	0	0	0	0
12-Sep-15	AQ03	Latte	1	22.08	0	0	0	0
12-Sep-15	AQ03	Latte	2	22.08	0	0	0	0
12-Sep-15	AQ03	Latte	3	22.08	0	0	0	0
12-Sep-15	AQ03	Latte	4	22.08	0	0	0	0
12-Sep-15	AQ03	Latte	5	22.08	0	0	0	0
13-Sep-15	AQ10	Independence	1	38.25	0	1	4	5
13-Sep-15	AQ10	Independence	2	38.25	0	0	0	0
13-Sep-15	AQ10	Independence	3	38.25	0	0	0	0
13-Sep-15	AQ10	Independence	4	38.25	0	0	0	0
13-Sep-15	AQ10	Independence	5	38.25	0	0	0	0
13-Sep-15	AQ10	Independence	6	38.25	0	0	0	0
13-Sep-15	AQ10	Independence	7	38.25	0	0	0	0
13-Sep-15	AQ10	Independence	8	38.25	0	0	0	0
13-Sep-15	AQ10	Independence	9	38.25	0	0	0	0
13-Sep-15	AQ10	Independence	10	38.25	0	0	0	0

Note: GR=Arctic grayling, CCG=slimy sculpin, CH=juvenile Chinook salmon

Appendix F2. Electrofishing Effort and Catch, Coffee Gold Project, 2014-2015

Date	Site	Watercourse	Pass #	Effort (s)	Section Length (m)	Voltage (V)	Catch							Comments
							GR	CCG	CH	BB	LSU	AL	Total	
19-Aug-14	AQREF1	Isaac	1	2276	100	350	5	69	35	0	0	1	110	three pass with stop nets
19-Aug-14	AQREF1	Isaac	2	1907	100	350	2	20	12	1	1	1	37	
19-Aug-14	AQREF1	Isaac	3	1619	100	350	5	32	14	1	0	0	52	
24-Aug-14	AQ11	Independence	1	1295	150	300	5	0	0	0	0	0	5	one pass with stop nets
25-Aug-14	AQ30	YR24	1	430	100	350	0	0	0	0	0	0	0	no stop nets, water low not required. Not much water to shock
25-Aug-14	AQ12	Kona Tributary	1	591	100	300	0	0	0	0	0	0	0	Water too low for requiring stop nets; no fish caught although two GR were observed on Aug 23 in the pool habitat near the downstream end of the site
25-Aug-14	AQ20	Halfway	1	653	100	300	1	0	0	0	0	0	1	Water low, stop nets not required
26-Aug-14	AQ10	Independence	1	957	100	300	2	7	0	0	0	0	9	two pass EF with stop nets
26-Aug-14	AQ10	Independence	2	982	100	300	1	2	1	0	0	0	4	
26-Aug-14	AQ00	Coffee	1	1457	120	300	0	24	10	0	0	0	34	
27-Aug-14	AQ04	Latte	1	1091	120	250	10	0	0	0	0	0	10	three pass with stop nets
27-Aug-14	AQ04	Latte	2	909	120	250	7	0	0	0	0	0	7	
27-Aug-14	AQ04	Latte	3	898	120	250	3	0	0	0	0	0	3	
28-Aug-14	AQREF1	Isaac	1	464	60	300	0	10	6	0	0	0	16	Started at first riffle approx. 50m upstream from the Yukon River
28-Aug-14	AQ10	Independence	1	483	100	300	0	10	0	0	0	0	10	Extra spot shocking for catching sculpins required for sampling. Effort not used in calculating CPUE because no stop nets were used
28-Aug-14	AQ02	Coffee	1	1118	150	300	0	31	0	0	0	0	31	Some unwadeable areas (high velocity riffles and deep pools) not sampled
18-Jun-15	AQ03	Latte	1	288	20	300	0	1	0	0	0	0	1	Single pass no nets.
18-Jun-15	AQ03	Latte	1	632	200	250	0	0	0	0	0	0	0	Single pass no nets. Four fish observed but not caught (3 x CCG, 1 x GR size 20-25cm).
18-Jun-15	AQ04	Latte	1	603	120	200	6	0	0	0	0	0	6	Single pass no nets.
18-Jun-15	AQ04.5	Latte	1	870	140	150	0	0	0	0	0	0	0	Single pass no nets.
18-Jun-15	AQ06	Latte	1	768	150	150	0	0	0	0	0	0	0	Single pass no nets.
19-Jun-15	AQ13	Kona Tributary	1	773	120	350	0	0	0	0	0	0	0	Single pass no nets.
19-Jun-15	AQ21	Halfway	1	896	120	350	0	0	0	0	0	0	0	Single pass no nets.
19-Jun-15	AQ31	YR24	1	755	120	350	0	0	0	0	0	0	0	Single pass no nets.
20-Jun-15	AQ20	Halfway	1	603	100	300	0	0	0	0	0	0	0	Single pass no nets.
20-Jun-15	AQ30	YR24	1	791	120	300	0	5	0	0	0	0	5	Single pass no nets; started at confluence with Yukon River.
21-Jun-15	AQ03	Latte	1	919	120	300	5	2	0	0	0	0	7	
21-Jun-15	AQ12	Kona Tributary	1	690	275	300	3	0	0	0	0	0	3	Single pass no nets; started at confluence with Independence Creek.
23-Jun-15	AQ04	Latte	1	675	120	250	5	0	0	0	0	0	5	Single pass no nets.
24-Jul-15	AQ04.5	Latte	1	854	140	300	0	0	0	0	0	0	0	Single pass no nets. 1 x GR observed but not caught (approximtely 250 mm length).
24-Jul-15	AQ06	Latte	1	835	100	350	0	0	0	0	0	0	0	Single pass no nets.
24-Jul-15	AQ13	Kona Tributary	1	559	100	300	0	0	0	0	0	0	0	Single pass no nets.
24-Jul-15	AQ20	Halfway	1	818	100	250	1	0	0	0	0	0	1	Single pass no nets.
24-Jul-15	AQ21	Halfway	1	845	100	350	0	0	0	0	0	0	0	Single pass no nets.
24-Jul-15	AQ30	YR24	1	600	100	250	0	0	0	0	0	0	0	Single pass no nets.
24-Jul-15	AQ31	YR24	1	748	100	250	0	0	0	0	0	0	0	Single pass no nets.
25-Jul-15	AQ04	Latte	1	1199	120	250	20	0	0	0	0	0	20	Three pass with stop nets.
25-Jul-15	AQ04	Latte	2	1073	120	250	15	0	0	0	0	0	15	Three pass with stop nets.
25-Jul-15	AQ04	Latte	3	879	120	250	4	0	0	0	0	0	4	Three pass with stop nets.
25-Jul-15	AQREF2	Los Angeles	1	1017	250	250	1	0	0	0	0	0	1	Three pass with nets.
25-Jul-15	AQREF2	Los Angeles	2	882	250	250	0	1	0	0	0	0	1	Three pass with nets. Observed 1 x GR below lower stop net. 3 x GR observed within site but not caught.
25-Jul-15	AQREF2	Los Angeles	3	993	250	250	0	0	0	0	0	0	0	Three pass with stop nets.
27-Jul-15	AQ02	Coffee	1	942	NR	250	0	6	0	0	0	0	6	Single pass no nets.
27-Jul-15	AQ12	Kona Tributary	1	627	100	300	0	0	0	0	0	0	0	Single pass no nets.
29-Jul-15	AQ03	Latte	1	1309	125	250	1	1	0	0	0	0	2	Single pass no nets.
11-Sep-15	AQREF2	Los Angeles	1	1700	250	300	0	0	0	0	0	0	0	Single pass no nets.
12-Sep-15	AQ03	Latte	1	1100	85	300	1	1	0	0	0	0	2	Single pass no nets.

Notes: GR=Arctic grayling, CCG=slimy sculpin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey

Appendix F3. Fyke Trapping, Angling Effort and Catch, Coffee Gold Project, 2014-2015

Date	Site	Watercourse	Method	Trap	Effort (hours)	Catch			
						GR	CCG	CH	Total
26-Aug-14	AQ00	Coffee	FN	1	27.00	1	0	1	2
26-Aug-14	AQ00	Coffee	FN	2	26.75	5	0	2	7
27-Aug-14	AQ02	Coffee	FN	1	23.33	1	1	1	3
27-Aug-14	AQ02	Coffee	FN	2	23.25	0	4	13	17
30-Aug-14	AQ00	Coffee	A	n/a	2.00	1	0	0	1
5-Oct-14	AQ03	Latte	FN	1	25.83	1	7	0	8
22-Jun-15	AQ00	Coffee	A	n/a	3.75	6	0	0	6
22-Jun-15	AQ01	Coffee	A	n/a	3.00	2	0	0	2
26-Jul-15	AQ00	Coffee	A	n/a	2.50	12	0	0	12
26-Jul-15	AQ00	Coffee	FN	1	23.08	0	0	1	1
26-Jul-15	AQ01	Coffee	A	n/a	1.50	7	0	0	7
26-Jul-15	AQ02	Coffee	FN	1	23.92	0	0	0	0
26-Jul-15	AQ02	Coffee	A	n/a	3.75	20	0	0	20
27-Jul-15	AQ01	Coffee	FN	1	26.00	0	0	0	0
28-Jul-15	AQ11	Independence	A	n/a	5.50	8	0	0	8
30-Jul-15	AQREF2	Los Angeles	A	n/a	4.00	0	0	0	0
10-Sep-15	AQREF2	Los Angeles	A	n/a	1.50	1	0	0	1

Note: FN=Fyke trap, A=angling, n/a=not applicable, GR=Arctic grayling, CCG=slimy sculpin, CH=juvenile Chinook salmon
Fyke net effort is total number of hours deployed per net
Angling effort is the cumulative number of hours per person fishing

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
19-Aug-14	Isaac	AQREF1	EF	404	CH	65	3.4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	405	CCG	70	4.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	406	CCG	68	3.3		N	NS	
19-Aug-14	Isaac	AQREF1	EF	407	CH	66	3		N	NS	
19-Aug-14	Isaac	AQREF1	EF	408	CCG	42	1.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	409	CH	71	3.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	410	CCG	78	6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	411	CCG	72	5.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	412	CCG	73	5.4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	413	CCG	70	5.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	414	CCG	70	4.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	415	CCG	59	2.3		N	NS	
19-Aug-14	Isaac	AQREF1	EF	416	CCG	69	4.3		N	NS	
19-Aug-14	Isaac	AQREF1	EF	417	CCG	75	5.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	418	CCG	75	5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	419	CCG	73	5.3		N	NS	
19-Aug-14	Isaac	AQREF1	EF	420	CCG	72	3.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	421	CCG	54	1.7		N	NS	
19-Aug-14	Isaac	AQREF1	EF	422	CCG	68	3.7		N	NS	
19-Aug-14	Isaac	AQREF1	EF	423	CCG	76	4.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	424	CCG	67	3.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	425	CCG	52	1.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	426	CCG	64	2.4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	427	CCG	73	4.4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	428	CCG	71	4.7		N	NS	
19-Aug-14	Isaac	AQREF1	EF	429	CCG	47	1.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	430	CCG	49	1.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	431	CCG	67	3.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	432	CCG	71	5.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	433	CCG	84	8.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	434	CCG	82	7.4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	435	CCG	63	3.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	436	CCG	84	2.3		N	NS	weight outlier; removed from W-L analyses
19-Aug-14	Isaac	AQREF1	EF	437	CH	85	7.7		N	NS	
19-Aug-14	Isaac	AQREF1	EF	438	CH	62	2.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	439	GR	58	1.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	440	CH	64	2.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	441	CH	68	5.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	442	CH	71	4.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	443	GR	58	2.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	444	CH	66	3.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	445	CH	58	2.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	446	GR	61	2.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	447	CH	66	3.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	448	CH	68	3.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	449	CH	67	3.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	450	GR	72	4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	451	CH	65	3.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	452	CH	72	4.5		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
19-Aug-14	Isaac	AQREF1	EF	453	CH	71	4.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	454	CH	73	4.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	455	CH	71	3.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	456	CH	68	3.3		N	NS	
19-Aug-14	Isaac	AQREF1	EF	457	GR	59	1.7		N	NS	
19-Aug-14	Isaac	AQREF1	EF	458	CH	65	3.4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	459	CH	76	5.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	460	CH	64	3.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	461	CH	53	1.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	462	CH	63	3.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	463	CH	66	3.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	464	CH	80	5.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	465	CH	63	2.7		N	NS	
19-Aug-14	Isaac	AQREF1	EF	466	CH	56	2.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	467	CH	60	2.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	468	CH	85	6.3		N	NS	
19-Aug-14	Isaac	AQREF1	EF	469	AL	120	3.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	470	CH	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	471	CH	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	472	CH	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	473	CH	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	474	CH	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	475	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	476	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	477	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	478	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	479	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	480	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	481	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	482	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	483	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	484	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	485	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	486	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	487	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	488	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	489	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	490	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	491	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	492	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	493	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	494	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	495	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	496	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	497	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	498	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	499	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	500	CCG	NS	NS		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
19-Aug-14	Isaac	AQREF1	EF	501	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	502	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	503	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	504	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	505	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	506	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	507	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	508	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	509	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	510	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	511	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	512	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	513	CCG	NS	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	601	BB	130	13.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	602	GR	68	3.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	603	CCG	72	5.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	604	CCG	70	3.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	605	CCG	83	6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	606	CCG	72	4.4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	607	CCG	73	4.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	608	CCG	63	3.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	609	CCG	54	1.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	610	CCG	62	2.7		N	NS	
19-Aug-14	Isaac	AQREF1	EF	611	CCG	66	3.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	612	CCG	63	3.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	613	CCG	72	5.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	614	CCG	63	3.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	615	CCG	78	4.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	616	CCG	70	4.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	617	CCG	67	3.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	618	CCG	62	2.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	619	CCG	47	1.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	620	CH	67	3.3		N	NS	
19-Aug-14	Isaac	AQREF1	EF	621	CH	69	4.4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	622	CH	67	3.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	623	CH	59	3.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	624	CH	59	2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	625	LSU	68	4.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	626	CH	74	4.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	627	GR	48	1.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	628	CH	65	3.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	629	CH	63	2.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	630	CH	73	4.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	631	CH	82	6.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	632	CH	48	1.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	633	CH	64	2.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	634	AL	140	4.3		N	NS	
19-Aug-14	Isaac	AQREF1	EF	635	CCG	25	0.1		N	NS	scale unable to read; weight less than .1; value not used in W-L analysis

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
19-Aug-14	Isaac	AQREF1	EF	636	CCG	29	0.1		N	NS	scale unable to read; weight less than .1; value not used in W-L analysis
19-Aug-14	Isaac	AQREF1	EF	637	CCG	24	0.1		N	NS	scale unable to read; weight less than .1; value not used in W-L analysis
19-Aug-14	Isaac	AQREF1	EF	638	CCG	75	5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	639	CCG	102	10.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	640	CCG	81	6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	641	CCG	75	5.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	642	CCG	70	4.4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	643	CCG	74	4.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	644	CCG	77	5.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	645	CCG	54	1.7		N	NS	
19-Aug-14	Isaac	AQREF1	EF	646	CCG	72	3.9		N	NS	
19-Aug-14	Isaac	AQREF1	EF	647	CCG	54	1.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	648	CCG	73	5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	649	CCG	71	4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	650	CCG	72	4.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	651	CCG	59	2.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	652	CCG	69	4.7		N	NS	
19-Aug-14	Isaac	AQREF1	EF	653	CCG	84	7.3		N	NS	
19-Aug-14	Isaac	AQREF1	EF	654	CCG	54	1.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	655	CCG	66	3.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	656	CCG	64	2.9		N	NS	
19-Aug-14	Isaac	AQREF1	EF	657	CCG	64	2.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	658	CCG	55	2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	659	CCG	74	4.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	660	CCG	76	5.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	661	CCG	63	2.9		N	NS	
19-Aug-14	Isaac	AQREF1	EF	662	CCG	58	2.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	663	CCG	59	2.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	664	CCG	60	2.0		N	NS	
19-Aug-14	Isaac	AQREF1	EF	665	CCG	40	NS		N	NS	
19-Aug-14	Isaac	AQREF1	EF	666	CCG	48	1.2		N	NS	
19-Aug-14	Isaac	AQREF1	EF	667	CCG	56	1.9		N	NS	
19-Aug-14	Isaac	AQREF1	EF	668	CCG	19	0.1		N	NS	scale unable to read; weight less than .1; value not used in W-L analysis
19-Aug-14	Isaac	AQREF1	EF	669	CCG	45	0.9		N	NS	
19-Aug-14	Isaac	AQREF1	EF	670	BB	134	14.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	671	GR	121	13.4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	672	CH	78	4.7		N	NS	
19-Aug-14	Isaac	AQREF1	EF	673	CH	63	2.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	674	CH	73	3.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	675	CH	76	4.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	676	CH	71	3.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	677	CH	65	3.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	678	GR	70	3.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	679	CH	72	3.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	680	CH	70	3.9		N	NS	
19-Aug-14	Isaac	AQREF1	EF	681	CH	70	3.8		N	NS	
19-Aug-14	Isaac	AQREF1	EF	682	GR	60	2.0		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
19-Aug-14	Isaac	AQREF1	EF	683	GR	55	1.4		N	NS	
19-Aug-14	Isaac	AQREF1	EF	684	CH	60	2.5		N	NS	
19-Aug-14	Isaac	AQREF1	EF	685	GR	58	1.6		N	NS	
19-Aug-14	Isaac	AQREF1	EF	686	CH	64	3		N	NS	
19-Aug-14	Isaac	AQREF1	EF	687	CH	58	2.1		N	NS	
19-Aug-14	Isaac	AQREF1	EF	688	CH	57	1.7		N	NS	
19-Aug-14	Isaac	AQREF1	EF	689	CH	65	3.5		N	NS	
21-Aug-14	Isaac	AQREF1	MT	886	CH	78	5.3		N	NS	
21-Aug-14	Isaac	AQREF1	MT	887	CH	73	4.7		N	NS	
21-Aug-14	Isaac	AQREF1	MT	888	CH	60	3		N	NS	
21-Aug-14	Isaac	AQREF1	MT	889	CH	72	4.4		N	NS	
21-Aug-14	Isaac	AQREF1	MT	890	CH	69	4.2		N	NS	
21-Aug-14	Isaac	AQREF1	MT	891	CH	62	3.7		N	NS	
21-Aug-14	Isaac	AQREF1	MT	892	CH	73	4.8		N	NS	
21-Aug-14	Isaac	AQREF1	MT	893	CH	77	6.3		N	NS	
21-Aug-14	Isaac	AQREF1	MT	894	CH	64	3.8		N	NS	
21-Aug-14	Isaac	AQREF1	MT	895	CH	67	4.3		N	NS	
21-Aug-14	Isaac	AQREF1	MT	896	CH	72	4.0		N	NS	
21-Aug-14	Isaac	AQREF1	MT	897	CH	74	3.8		N	NS	
21-Aug-14	Isaac	AQREF1	MT	898	CH	70	4.1		N	NS	
21-Aug-14	Isaac	AQREF1	MT	899	CH	65	3.1		N	NS	
21-Aug-14	Isaac	AQREF1	MT	900	GR	56	1.9		N	NS	
21-Aug-14	Isaac	AQREF1	MT	901	CH	69	3.7		N	NS	
21-Aug-14	Isaac	AQREF1	MT	902	CH	67	3.4		N	NS	
21-Aug-14	Isaac	AQREF1	MT	903	CCG	63	3.3		N	NS	
21-Aug-14	Isaac	AQREF1	MT	904	CH	65	3.6		N	NS	
21-Aug-14	Isaac	AQREF1	MT	905	CH	56	2.3		N	NS	
21-Aug-14	Isaac	AQREF1	MT	906	CH	70	3.5		N	NS	
21-Aug-14	Isaac	AQREF1	MT	907	CH	67	4.0		N	NS	
21-Aug-14	Isaac	AQREF1	MT	908	CH	72	4.5		N	NS	
21-Aug-14	Isaac	AQREF1	MT	909	CH	60	3.1		N	NS	
21-Aug-14	Isaac	AQREF1	MT	910	CH	62	2.7		N	NS	
21-Aug-14	Isaac	AQREF1	MT	911	CH	68	4.3		N	NS	
21-Aug-14	Isaac	AQREF1	MT	912	CH	66	4.4		N	NS	
21-Aug-14	Isaac	AQREF1	MT	913	CH	67	3.8		N	NS	
21-Aug-14	Isaac	AQREF1	MT	914	CH	65	3.6		N	NS	
21-Aug-14	Isaac	AQREF1	MT	915	CH	63	3.1		N	NS	
21-Aug-14	Isaac	AQREF1	MT	916	CH	63	3.0		N	NS	
21-Aug-14	Isaac	AQREF1	MT	917	CH	67	4.0		N	NS	
21-Aug-14	Isaac	AQREF1	MT	918	CH	NS	NS		N	NS	
21-Aug-14	Isaac	AQREF1	MT	919	CH	NS	NS		N	NS	
21-Aug-14	Isaac	AQREF1	MT	920	CH	NS	NS		N	NS	
21-Aug-14	Isaac	AQREF1	MT	921	CH	NS	NS		N	NS	
21-Aug-14	Isaac	AQREF1	MT	922	CH	NS	NS		N	NS	
24-Aug-14	Independence	AQ11	EF	1-01	GR	234	137.0	989001003464162	N	NS	
24-Aug-14	Independence	AQ11	EF	1-02	GR	200	88.0	989001003464164	N	NS	
24-Aug-14	Independence	AQ11	EF	1-03	GR	225	136	989001003464187	N	NS	
24-Aug-14	Independence	AQ11	EF	1-04	GR	197	86		Y	3	mature male

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
24-Aug-14	Independence	AQ11	EF	1-05	GR	122	17.5		N	NS	too small to tag
25-Aug-14	Coffee	AQ00	MT	0-01	CH	77	5.1		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-02	CH	85	6.6		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-03	CH	83	5.9		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-04	CH	102	11.4		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-05	CH	86	7.3		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-06	CH	85	6.7		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-07	CH	81	6		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-08	CH	82	5.9		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-09	CH	72	4.8		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-10	CH	67	3.9		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-11	CH	68	3.6		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-12	CH	79	6.2		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-13	CH	81	6.8		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-14	CH	69	4.2		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-15	CH	110	16.6		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-16	CH	78	5.8		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-17	CH	108	13.2		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-18	CH	65	3.6		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-19	CH	74	5.1		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-20	CH	72	5.2		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-21	CH	78	6.2		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-22	CH	77	4.7		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-23	CH	78	5.5		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-24	CH	74	4.7		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-25	CH	75	4.4		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-26	CH	94	9.7		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-27	CH	72	4.4		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-28	CH	69	5.1		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-29	CH	79	5.5		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-30	CH	79	4.9		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-31	CCG	98	10.8		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-32	CCG	105	11.4		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-33	CCG	92	10.2		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-34	CH	NS	NS		N	NS	only first 30 CH sub-sampled, #s 034 to 0125 were released without processing
25-Aug-14	Coffee	AQ00	MT	0-35	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-36	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-37	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-38	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-39	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-40	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-41	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-42	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-43	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-44	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-45	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-46	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-47	CH	NS	NS		N	NS	

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Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
25-Aug-14	Coffee	AQ00	MT	0-48	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-49	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-50	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-51	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-52	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-53	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-54	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-55	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-56	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-57	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-58	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-59	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-60	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-61	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-62	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-63	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-64	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-65	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-66	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-67	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-68	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-69	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-70	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-71	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-72	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-73	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-74	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-75	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-76	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-77	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-78	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-79	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-80	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-81	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-82	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-83	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-84	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-85	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-86	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-87	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-88	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-89	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-90	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-91	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-92	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-93	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-94	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-95	CH	NS	NS		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
25-Aug-14	Coffee	AQ00	MT	0-96	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-97	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-98	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-99	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-100	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-101	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-102	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-103	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-104	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-105	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-106	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-107	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-108	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-109	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-110	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-111	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-112	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-113	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-114	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-115	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-116	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-117	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-118	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-119	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-120	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-121	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-122	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-123	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-124	CH	NS	NS		N	NS	
25-Aug-14	Coffee	AQ00	MT	0-125	CH	NS	NS		N	NS	
25-Aug-14	Independence	AQ10	MT	1-06	CH	74	4		N	NS	
25-Aug-14	Independence	AQ10	MT	1-07	CH	96	11.1		N	NS	
25-Aug-14	Independence	AQ10	MT	1-08	CH	79	5.6		N	NS	
25-Aug-14	Independence	AQ10	MT	1-09	CH	68	3.5		N	NS	
25-Aug-14	Independence	AQ10	MT	1-10	CH	68	3.4		N	NS	
25-Aug-14	Independence	AQ10	MT	1-11	CH	78	5.3		N	NS	
25-Aug-14	Independence	AQ10	MT	1-12	CH	72	3.6		N	NS	
25-Aug-14	Independence	AQ10	MT	1-13	CH	82	5.3		N	NS	
25-Aug-14	Independence	AQ10	MT	1-14	CH	62	2.3		N	NS	
25-Aug-14	Independence	AQ10	MT	1-15	CH	74	4.0		N	NS	
25-Aug-14	Halfway	AQ20	EF	2-01	GR	241	167	989001003464182	N	NS	adult female
26-Aug-14	Coffee	AQ00	EF	0-126	CCG	55	1.5		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-127	CCG	92	7.9		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-128	CCG	94	9.1		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-129	CCG	85	5.3		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-130	CCG	95	7.8		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-131	CCG	80	6.3		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-132	CCG	69	3.4		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
26-Aug-14	Coffee	AQ00	EF	0-133	CCG	63	2.6		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-134	CCG	62	2.6		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-135	CCG	44	0.8		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-136	CCG	85	6.6		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-137	CCG	76	3.9		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-138	CCG	56	1.5		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-139	CCG	76	4.4		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-140	CCG	58	1.9		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-141	CCG	80	5.4		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-142	CCG	60	2.2		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-143	CCG	80	6.3		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-144	CCG	61	2		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-145	CCG	65	2.9		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-146	CCG	61	2.1		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-147	CCG	58	2.2		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-148	CCG	48	1.3		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-149	CCG	60	2.2		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-150	CH	79	5.2		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-151	CH	78	4.6		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-152	CH	78	5.1		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-153	CH	71	4.5		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-154	CH	66	3.5		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-155	CH	74	4.2		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-156	CH	72	4.2		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-157	CH	77	5.2		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-158	CH	73	4		N	NS	
26-Aug-14	Coffee	AQ00	EF	0-159	CH	68	3.5		N	NS	
26-Aug-14	Independence	AQ10	EF	1-16	GR	257	201.0	989001003464202	N	NS	adult male
26-Aug-14	Independence	AQ10	EF	1-17	GR	296	281	989001003464205	N	NS	adult male
26-Aug-14	Independence	AQ10	EF	1-18	CCG	75	5		N	NS	
26-Aug-14	Independence	AQ10	EF	1-19	CCG	88	8.2		N	NS	
26-Aug-14	Independence	AQ10	EF	1-20	CCG	82	7.7		N	NS	
26-Aug-14	Independence	AQ10	EF	1-21	CCG	79	6.3		N	NS	
26-Aug-14	Independence	AQ10	EF	1-22	CCG	71	4.6		N	NS	
26-Aug-14	Independence	AQ10	EF	1-23	CCG	62	2.3		N	NS	
26-Aug-14	Independence	AQ10	EF	1-24	CCG	77	4.5		N	NS	
26-Aug-14	Independence	AQ10	EF	1-25	CH	82	5.9		N	NS	
26-Aug-14	Independence	AQ10	EF	1-26	CCG	75	6.1		N	NS	
26-Aug-14	Independence	AQ10	EF	1-27	CCG	75	4.9		N	NS	
26-Aug-14	Independence	AQ10	EF	1-28	GR	74	4.3		N	NS	
26-Aug-14	Independence	AQ11	MT	1-29	CH	87	6.7		N	NS	
27-Aug-14	Latte	AQ04	EF	0-160	GR	286	260	989001003464163	N	NS	
27-Aug-14	Latte	AQ04	EF	0-161	GR	357	520.0	989001003464165	N	NS	male
27-Aug-14	Latte	AQ04	EF	0-162	GR	262	212.0	989001003464142	N	NS	male
27-Aug-14	Latte	AQ04	EF	0-163	GR	241	180	989001003464213	N	NS	female
27-Aug-14	Latte	AQ04	EF	0-164	GR	251	195	989001003464152	N	NS	male
27-Aug-14	Latte	AQ04	EF	0-165	GR	293	314	989001003464193	N	NS	male
27-Aug-14	Latte	AQ04	EF	0-166	GR	337	441	989001003464169	N	NS	male

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
27-Aug-14	Latte	AQ04	EF	0-167	GR	297	275	989001003464141	N	NS	male
27-Aug-14	Latte	AQ04	EF	0-168	GR	238	175	989001003464172	N	NS	male
27-Aug-14	Latte	AQ04	EF	0-169	GR	245	161	989001003464146	N	NS	
27-Aug-14	Latte	AQ04	EF	0-170	GR	217	126	989001003464196	N	NS	
27-Aug-14	Latte	AQ04	EF	0-171	GR	285	273.0	989001003464224	N	NS	
27-Aug-14	Latte	AQ04	EF	0-172	GR	267	239.0	989001003464216	N	NS	adult male
27-Aug-14	Latte	AQ04	EF	0-173	GR	277	270	989001003464220	N	NS	adult female
27-Aug-14	Latte	AQ04	EF	0-174	GR	208	107	989001003464137	N	NS	immature
27-Aug-14	Latte	AQ04	EF	0-175	GR	265	224	989001003464156	N	NS	adult female
27-Aug-14	Latte	AQ04	EF	0-176	GR	246	170	989001003464222	N	NS	immature
27-Aug-14	Latte	AQ04	EF	0-177	GR	220	129	989001003464183	N	NS	
27-Aug-14	Latte	AQ04	EF	0-178	GR	233	148		Y	3	male
27-Aug-14	Latte	AQ04	EF	0-179	GR	213	121		Y	4	
27-Aug-14	Coffee	AQ00	FN	0-180	GR	224	122	989001003464210	N	NS	
27-Aug-14	Coffee	AQ00	FN	0-181	GR	252	150.0	989001003464200	N	NS	
27-Aug-14	Coffee	AQ00	FN	0-182	GR	276	224.0	989001003464203	N	NS	
27-Aug-14	Coffee	AQ00	FN	0-183	GR	267	195.0	989001003464175	N	NS	
27-Aug-14	Coffee	AQ00	FN	0-184	GR	262	207.0	989001003464154	N	NS	
27-Aug-14	Coffee	AQ00	FN	0-185	GR	245	129.0	989001003464225	N	NS	
27-Aug-14	Coffee	AQ00	FN	0-186	CH	70	4.5		N	NS	
27-Aug-14	Coffee	AQ00	FN	0-187	CH	69	3.2		N	NS	
27-Aug-14	Coffee	AQ00	FN	0-188	CH	74	4.4		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-189	CH	78	5.5		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-190	CH	78	5.5		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-191	CH	78	5.8		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-192	CH	78	5.0		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-193	CH	79	4.9		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-194	CH	71	4.8		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-195	CH	75	4.6		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-196	CH	74	4.4		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-197	CH	81	5.7		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-198	CH	79	4.5		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-199	CH	72	3.8		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-200	CH	108	14.9		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-201	CH	83	7.0		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-202	CH	100	11.4		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-203	CH	79	6.5		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-204	CH	77	5.8		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-205	CH	78	5.4		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-206	CH	78	5.3		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-207	CH	79	5.6		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-208	CH	82	6.5		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-209	CH	74	4.9		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-210	CH	79	6		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-211	CH	76	5.8		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-212	CH	77	5.6		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-213	CH	80	5.4		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-214	CH	77	4.9		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
27-Aug-14	Coffee	AQ02	MT	0-215	CH	79	5.6		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-216	CH	66	4.3		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-217	CH	77	4.6		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-218	CH	82	5.6		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-219	CCG	97	10.2		Y	3	
27-Aug-14	Coffee	AQ02	MT	0-220	CCG	90	7		Y	3	
27-Aug-14	Coffee	AQ02	MT	0-221	CCG	81	5.2		Y	2	
27-Aug-14	Coffee	AQ02	MT	0-222	CCG	68	3.2		Y	1	
27-Aug-14	Coffee	AQ02	MT	0-223	CH	NS	NS		N	NS	First 30 chinook were sub-sampled, #s 0-223 to 0-254 were released without processing
27-Aug-14	Coffee	AQ02	MT	0-224	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-225	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-226	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-227	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-228	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-229	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-230	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-231	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-232	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-233	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-234	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-235	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-236	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-237	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-238	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-239	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-240	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-241	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-242	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-243	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-244	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-245	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-246	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-247	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-248	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-249	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-250	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-251	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-252	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-253	CH	NS	NS		N	NS	
27-Aug-14	Coffee	AQ02	MT	0-254	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-255	CCG	112	16.1		Y	4	
28-Aug-14	Coffee	AQ02	EF	0-256	CCG	101	13.8		Y	4	
28-Aug-14	Coffee	AQ02	EF	0-257	CCG	95	9.8		Y	2	
28-Aug-14	Coffee	AQ02	EF	0-258	CCG	96	9.7		Y	5	
28-Aug-14	Coffee	AQ02	EF	0-259	CCG	90	7.8		Y	2	
28-Aug-14	Coffee	AQ02	EF	0-260	CCG	60	1.9		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-261	CCG	78	5.4		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-262	CCG	69	4		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
28-Aug-14	Coffee	AQ02	EF	0-263	CCG	53	1.8		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-264	CCG	85	6.6		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-265	CCG	84	6.3		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-266	CCG	80	4.8		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-267	CCG	55	2		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-268	CCG	79	5.6		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-269	CCG	57	1.8		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-270	CCG	58	2.2		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-271	CCG	79	5.8		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-272	CCG	39	0.6		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-273	CCG	55	1.5		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-274	CCG	60	2.1		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-275	CCG	54	1.8		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-276	CCG	62	2.3		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-277	CCG	78	4.8		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-278	CCG	54	1.9		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-279	CCG	56	2.2		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-280	CCG	52	1.4		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-281	CCG	51	2		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-282	CCG	58	2.0		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-283	CCG	37	0.5		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-284	CCG	40	0.8		N	NS	
28-Aug-14	Coffee	AQ02	EF	0-285	CCG	43	1		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-286	CCG	104	11.2		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-287	CH	74	3.8		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-288	GR	134	19.2		N	NS	too small to tag
28-Aug-14	Coffee	AQ02	FN	0-289	CCG	57	1.9		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-290	CCG	65	2.8		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-291	CCG	56	2.4		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-292	CCG	64	2.8		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-293	CH	78	4.2		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-294	CH	104	11.3		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-295	CH	68	3.8		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-296	CH	85	6.5		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-297	CH	74	4.9		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-298	CH	81	5.5		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-299	CH	71	4.1		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-300	CH	75	4.5		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-301	CH	78	6		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-302	CH	71	4.2		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-303	CH	73	4.0		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-304	CH	74	4.3		N	NS	
28-Aug-14	Coffee	AQ02	FN	0-305	CH	65	2.8		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-306	CH	74	3.8		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-307	CH	75	4.5		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-308	CH	76	5.3		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-309	CH	76	4.2		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-310	CH	70	3.6		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
28-Aug-14	Coffee	AQ01	MT	0-311	CH	76	5.2		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-312	CH	70	3.9		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-313	CH	69	3.9		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-314	CH	72	4.2		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-315	CH	65	3.1		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-316	CH	78	5.2		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-317	CH	77	5.9		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-318	CH	74	4.6		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-319	CH	78	5.7		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-320	CH	67	3.8		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-321	CH	98	10.7		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-322	CH	77	5.6		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-323	CH	79	6.0		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-324	CH	71	4.2		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-325	CH	79	5.4		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-326	CH	80	6.2		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-327	CH	67	3.9		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-328	CH	80	6.9		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-329	CH	78	6.4		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-330	CH	74	5.1		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-331	CH	68	3.8		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-332	CH	77	4.9		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-333	CH	79	5.9		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-334	CH	70	4.1		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-335	CH	75	5.8		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-336	CCG	105	10.6		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-337	CH	NS	NS		N	NS	first 30 CH sub-sampled, #s 0-337 to 0-378 released without processing
28-Aug-14	Coffee	AQ01	MT	0-338	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-339	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-340	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-341	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-342	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-343	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-344	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-345	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-346	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-347	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-348	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-349	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-350	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-351	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-352	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-353	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-354	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-355	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-356	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-357	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-358	CH	NS	NS		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
28-Aug-14	Coffee	AQ01	MT	0-359	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-360	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-361	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-362	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-363	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-364	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-365	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-366	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-367	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-368	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-369	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-370	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-371	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-372	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-373	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-374	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-375	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-376	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-377	CH	NS	NS		N	NS	
28-Aug-14	Coffee	AQ01	MT	0-378	CH	NS	NS		N	NS	
28-Aug-14	Independence	AQ10	EF	1-301	CCG	80	5.2		Y	3	
28-Aug-14	Independence	AQ10	EF	1-302	CCG	84	6.8		Y	4	
28-Aug-14	Independence	AQ10	EF	1-303	CCG	90	10.7		Y	3	
28-Aug-14	Independence	AQ10	EF	1-304	CCG	80	7.6		Y	4	
28-Aug-14	Independence	AQ10	EF	1-305	CCG	80	8.5		Y	3	
28-Aug-14	Independence	AQ10	EF	1-306	CCG	80	7.4		Y	4	
28-Aug-14	Independence	AQ10	EF	1-307	CCG	75	5.6		Y	2	
28-Aug-14	Independence	AQ10	EF	1-308	CCG	75	4.8		Y	4	
28-Aug-14	Independence	AQ10	EF	1-309	CCG	60	3.0		N	NS	
28-Aug-14	Independence	AQ10	EF	1-310	CCG	67	4.2		N	NS	
28-Aug-14	Isaac	AQREF1	EF	R1-01	CCG	82	6.8		Y	4	
28-Aug-14	Isaac	AQREF1	EF	R1-02	CCG	81	5.4		Y	3	
28-Aug-14	Isaac	AQREF1	EF	R1-03	CCG	76	4.6		Y	2	
28-Aug-14	Isaac	AQREF1	EF	R1-04	CCG	68	3.5		Y	2	
28-Aug-14	Isaac	AQREF1	EF	R1-05	CCG	68	2.7		Y	3	
28-Aug-14	Isaac	AQREF1	EF	R1-06	CCG	59	2.7		Y	2	
28-Aug-14	Isaac	AQREF1	EF	R1-07	CCG	63	2.4		Y	2	
28-Aug-14	Isaac	AQREF1	EF	R1-08	CCG	63	3.2		Y	3	
28-Aug-14	Isaac	AQREF1	EF	R1-09	CCG	62	2.8		N	NS	fish not aged; otolith was lost prior to ageing
28-Aug-14	Isaac	AQREF1	EF	R1-10	CCG	44	1.1		N	NS	
28-Aug-14	Isaac	AQREF1	EF	R1-11	CH	73	3.8		N	NS	
28-Aug-14	Isaac	AQREF1	EF	R1-12	CH	78	5.4		N	NS	
28-Aug-14	Isaac	AQREF1	EF	R1-13	CH	75	4.7		N	NS	
28-Aug-14	Isaac	AQREF1	EF	R1-14	CH	69	3.5		N	NS	
28-Aug-14	Isaac	AQREF1	EF	R1-15	CH	62	3.0		N	NS	
28-Aug-14	Isaac	AQREF1	EF	R1-16	CH	58	2.8		N	NS	
31-Aug-14	Coffee	AQ00	A	0-379	GR	259	188.0	989001003464177	N	NS	adult female
06-Oct-14	Latte	AQ03	FN	1	CCG	103	13.4		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
06-Oct-14	Latte	AQ03	FN	2	CCG	94	11.6		N	NS	
06-Oct-14	Latte	AQ03	FN	3	CCG	89	8.9		N	NS	
06-Oct-14	Latte	AQ03	FN	4	CCG	99	11.4		N	NS	
06-Oct-14	Latte	AQ03	FN	5	CCG	89	8.6		N	NS	
06-Oct-14	Latte	AQ03	FN	6	CCG	96	10.3		N	NS	
06-Oct-14	Latte	AQ03	FN	7	CCG	105	15.6		N	NS	
06-Oct-14	Latte	AQ03	FN	8	GR	146	31.5		N	NS	
06-Oct-14	Coffee	AQ02	MT	9	CCG	94	8.5		N	NS	
06-Oct-14	Coffee	AQ02	MT	10	CCG	92	8.5		N	NS	
06-Oct-14	Coffee	AQ02	MT	11	CCG	97	10.8		N	NS	
06-Oct-14	Coffee	AQ02	MT	12	CH	81	5.0		N	NS	
06-Oct-14	Coffee	AQ02	MT	13	CH	82	5.2		N	NS	
06-Oct-14	Coffee	AQ02	MT	14	CH	87	5.7		N	NS	
06-Oct-14	Coffee	AQ02	MT	15	CH	74	4.8		N	NS	
06-Oct-14	Coffee	AQ02	MT	16	CH	77	6.2		N	NS	
06-Oct-14	Coffee	AQ02	MT	17	CH	80	5.7		N	NS	
06-Oct-14	Coffee	AQ02	MT	18	CH	76	5.0		N	NS	
06-Oct-14	Coffee	AQ02	MT	19	CH	85	7.0		N	NS	
06-Oct-14	Coffee	AQ02	MT	20	CH	74	3.7		N	NS	
06-Oct-14	Coffee	AQ02	MT	21	CH	81	5.1		N	NS	
06-Oct-14	Coffee	AQ02	MT	22	CH	79	5.0		N	NS	
06-Oct-14	Coffee	AQ02	MT	23	CH	69	3.8		N	NS	
06-Oct-14	Coffee	AQ02	MT	24	CH	85	NS		N	NS	scale froze; weights not collected
06-Oct-14	Coffee	AQ02	MT	25	CH	78	NS		N	NS	scale froze; weights not collected
06-Oct-14	Coffee	AQ02	MT	26	CH	78	NS		N	NS	scale froze; weights not collected
06-Oct-14	Coffee	AQ02	MT	27	CH	89	NS		N	NS	scale froze; weights not collected
06-Oct-14	Coffee	AQ01	MT	28	CCG	98	11.3		N	NS	
06-Oct-14	Coffee	AQ01	MT	29	CCG	102	11.0		N	NS	
06-Oct-14	Coffee	AQ01	MT	30	CH	78	4.9		N	NS	
06-Oct-14	Coffee	AQ01	MT	31	CH	74	3.7		N	NS	
06-Oct-14	Coffee	AQ01	MT	32	CH	77	4.0		N	NS	
06-Oct-14	Coffee	AQ01	MT	33	CH	73	3.6		N	NS	
06-Oct-14	Coffee	AQ01	MT	34	CH	76	4.6		N	NS	
06-Oct-14	Coffee	AQ01	MT	35	CH	82	4.9		N	NS	
06-Oct-14	Coffee	AQ01	MT	36	CH	70	4.0		N	NS	
06-Oct-14	Coffee	AQ01	MT	37	CH	74	4.7		N	NS	
06-Oct-14	Coffee	AQ01	MT	38	CH	88	7.5		N	NS	
06-Oct-14	Coffee	AQ01	MT	39	CH	80	4.5		N	NS	
06-Oct-14	Coffee	AQ01	MT	40	CH	85	6.1		N	NS	
06-Oct-14	Coffee	AQ01	MT	41	CH	73	3.8		N	NS	
06-Oct-14	Coffee	AQ01	MT	42	CH	77	4.7		N	NS	
06-Oct-14	Coffee	AQ01	MT	43	CH	85	7.2		N	NS	
06-Oct-14	Coffee	AQ01	MT	44	CH	75	4.2		N	NS	
06-Oct-14	Coffee	AQ01	MT	45	CH	74	4.6		N	NS	
06-Oct-14	Coffee	AQ01	MT	46	CH	78	5.6		N	NS	
06-Oct-14	Coffee	AQ01	MT	47	CH	69	3.4		N	NS	
06-Oct-14	Coffee	AQ01	MT	48	CH	75	4.6		N	NS	
06-Oct-14	Coffee	AQ01	MT	49	CH	70	4.3		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
06-Oct-14	Coffee	AQ01	MT	50	CH	73	5.6		N	NS	
06-Oct-14	Coffee	AQ01	MT	51	CH	72	4		N	NS	
06-Oct-14	Coffee	AQ01	MT	52	CH	77	4.7		N	NS	
06-Oct-14	Coffee	AQ01	MT	53	CH	85	7.5		N	NS	
06-Oct-14	Coffee	AQ01	MT	54	CH	80	5.0		N	NS	
06-Oct-14	Coffee	AQ01	MT	55	CH	85	6		N	NS	
06-Oct-14	Coffee	AQ01	MT	56	CH	82	5.5		N	NS	
06-Oct-14	Coffee	AQ01	MT	57	CH	78	5.5		N	NS	
06-Oct-14	Coffee	AQ01	MT	58	CH	83	5.7		N	NS	
06-Oct-14	Coffee	AQ01	MT	59	CH	86	7.5		N	NS	
06-Oct-14	Coffee	AQ01	MT	60	CH	NS	NS		N	NS	
06-Oct-14	Coffee	AQ01	MT	61	CH	NS	NS		N	NS	
06-Oct-14	Coffee	AQ01	MT	62	CH	NS	NS		N	NS	
06-Oct-14	Coffee	AQ01	MT	63	CH	NS	NS		N	NS	
06-Oct-14	Coffee	AQ01	MT	64	CH	NS	NS		N	NS	
06-Oct-14	Coffee	AQ00	MT	65	CH	73	4.5		N	NS	
06-Oct-14	Coffee	AQ00	MT	66	CH	74	4.1		N	NS	
06-Oct-14	Coffee	AQ00	MT	67	CH	83	5.5		N	NS	
06-Oct-14	Coffee	AQ00	MT	68	CH	76	4.9		N	NS	
06-Oct-14	Coffee	AQ00	MT	69	CH	79	5.0		N	NS	
06-Oct-14	Coffee	AQ00	MT	70	CH	78	4.2		N	NS	
06-Oct-14	Coffee	AQ00	MT	71	CH	80	5.2		N	NS	
06-Oct-14	Coffee	AQ00	MT	72	CCG	60	2.8		N	NS	
06-Oct-14	Coffee	AQ00	MT	73	CH	72	3.8		N	NS	
06-Oct-14	Coffee	AQ00	MT	74	CH	81	5.5		N	NS	
06-Oct-14	Coffee	AQ00	MT	75	CH	79	5.0		N	NS	
06-Oct-14	Coffee	AQ00	MT	76	CH	75	4.5		N	NS	Fish ID#77 skipped by accident
06-Oct-14	Coffee	AQ00	MT	78	CH	79	4.7		N	NS	
06-Oct-14	Coffee	AQ00	MT	79	CH	84	5.3		N	NS	
06-Oct-14	Coffee	AQ00	MT	80	CH	80	4.8		N	NS	
06-Oct-14	Coffee	AQ00	MT	81	CH	79	4.9		N	NS	
06-Oct-14	Coffee	AQ00	MT	82	CH	77	4.0		N	NS	
06-Oct-14	Coffee	AQ00	MT	83	CH	78	4.9		N	NS	
06-Oct-14	Coffee	AQ00	MT	84	CH	78	5.0		N	NS	
06-Oct-14	Coffee	AQ00	MT	85	CH	74	4.1		N	NS	
06-Oct-14	Coffee	AQ00	MT	86	CH	77	4.0		N	NS	
06-Oct-14	Coffee	AQ00	MT	87	CH	73	4.2		N	NS	
06-Oct-14	Coffee	AQ00	MT	88	CH	80	6.1		N	NS	
06-Oct-14	Coffee	AQ00	MT	89	CH	75	4.4		N	NS	
06-Oct-14	Coffee	AQ00	MT	90	CH	70	4.3		N	NS	
06-Oct-14	Coffee	AQ00	MT	91	CH	84	5.9		N	NS	
06-Oct-14	Isaac	AQREF1	MT	92	CH	70	3.4		N	NS	
06-Oct-14	Isaac	AQREF1	MT	93	CH	80	5.3		N	NS	
06-Oct-14	Isaac	AQREF1	MT	94	CH	78	5.2		N	NS	
06-Oct-14	Isaac	AQREF1	MT	95	CH	73	3.6		N	NS	
06-Oct-14	Isaac	AQREF1	MT	96	CH	69	3.6		N	NS	
06-Oct-14	Isaac	AQREF1	MT	97	CH	68	2.5		N	NS	
06-Oct-14	Isaac	AQREF1	MT	98	CH	68	3.0		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
06-Oct-14	Isaac	AQREF1	MT	99	CH	67	3.5		N	NS	
06-Oct-14	Isaac	AQREF1	MT	100	CH	68	3.9		N	NS	
06-Oct-14	Isaac	AQREF1	MT	101	CH	69	3.1		N	NS	
06-Oct-14	Isaac	AQREF1	MT	102	CH	76	4.5		N	NS	
06-Oct-14	Isaac	AQREF1	MT	103	CH	68	3.1		N	NS	
06-Oct-14	Isaac	AQREF1	MT	104	CH	65	2.8		N	NS	
06-Oct-14	Isaac	AQREF1	MT	105	CH	70	3.4		N	NS	
06-Oct-14	Isaac	AQREF1	MT	106	CH	69	3.7		N	NS	
06-Oct-14	Isaac	AQREF1	MT	107	CH	70	3.4		N	NS	
06-Oct-14	Isaac	AQREF1	MT	108	CH	69	3.6		N	NS	
06-Oct-14	Isaac	AQREF1	MT	109	CH	68	3.0		N	NS	
06-Oct-14	Isaac	AQREF1	MT	110	CH	70	3.6		N	NS	
06-Oct-14	Independence	AQ10	MT	111	CH	78	4.6		N	NS	
06-Oct-14	Independence	AQ10	MT	112	CH	110	14.5		N	NS	
06-Oct-14	Independence	AQ10	MT	113	CH	110	14.4		N	NS	
06-Oct-14	Independence	AQ10	MT	114	CH	79	5.0		N	NS	
06-Oct-14	Independence	AQ10	MT	115	CH	88	7.3		N	NS	
06-Oct-14	Independence	AQ10	MT	116	CH	79	4.5		N	NS	
18-Jun-15	Latte	AQ03	EF	0-00	CCG	97	6.0		N	NS	
18-Jun-15	Latte	AQ04	EF	0-01	GR	260	181.0		N	NS	
18-Jun-15	Latte	AQ04	EF	0-02	GR	270	211.0		N	NS	
18-Jun-15	Latte	AQ04	EF	0-03	GR	272	210.0		N	NS	
18-Jun-15	Latte	AQ04	EF	0-04	GR	274	249.0		N	NS	
18-Jun-15	Latte	AQ04	EF	0-05	GR	297	320.0		N	NS	
18-Jun-15	Latte	AQ04	EF	0-06	GR	310	350.0		N	NS	
20-Jun-15	YR24	AQ30	EF	3-05	CCG	60	2.2		N	NS	
20-Jun-15	YR24	AQ30	EF	3-02	CCG	62	2.2		N	NS	
20-Jun-15	YR24	AQ30	EF	3-03	CCG	64	2.8		N	NS	
20-Jun-15	YR24	AQ30	EF	3-04	CCG	70	3.1		N	NS	
20-Jun-15	YR24	AQ30	EF	3-01	CCG	77	4.0		N	NS	
21-Jun-15	Latte	AQ03	EF	0-13	CCG	95	9.8		N	NS	
21-Jun-15	Latte	AQ03	EF	0-12	CCG	100	9.9		N	NS	
21-Jun-15	Latte	AQ03	EF	0-10	GR	260	193.0		N	NS	
21-Jun-15	Latte	AQ03	EF	0-11	GR	316	337.0		Y	5	Female.
21-Jun-15	Latte	AQ03	EF	0-7	GR	255	162.0		N	NS	
21-Jun-15	Latte	AQ03	EF	0-8	GR	220	127.2		N	NS	
21-Jun-15	Latte	AQ03	EF	0-9	GR	287	246.0		Y	5	Immature male.
21-Jun-15	Kona Tributary	AQ12	EF	1-01	GR	190	74.9		N	NS	
21-Jun-15	Kona Tributary	AQ12	EF	1-02	GR	248	206.1		N	NS	Immature male.
21-Jun-15	Kona Tributary	AQ12	EF	1-03	GR	160	44.5		N	NS	
22-Jun-15	Coffee	AQ00	A	0-14	GR	300	275.0		N	NS	
22-Jun-15	Coffee	AQ00	A	0-15	GR	315	354.0		N	NS	
22-Jun-15	Coffee	AQ00	A	0-16	GR	320	398.0		N	NS	
22-Jun-15	Coffee	AQ00	A	0-17	GR	340	434.0		N	NS	
22-Jun-15	Independence	AQ10	MT	1-04	CH	90	7.6		N	NS	
22-Jun-15	Coffee	AQ00	A	0-18	GR	270	220.0		N	NS	
22-Jun-15	Coffee	AQ00	A	0-19	GR	290	302.0		N	NS	
22-Jun-15	Coffee	AQ01	A	0-20	GR	302	285.0		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
22-Jun-15	Coffee	AQ01	A	0-21	GR	246	162.0		N	NS	
23-Jun-15	Coffee	AQ00	MT	0-29	CCG	76	3.4		N	NS	
23-Jun-15	Coffee	AQ00	MT	0-27	CCG	85	5.6		N	NS	
23-Jun-15	Coffee	AQ00	MT	0-28	CCG	88	6.6		N	NS	
23-Jun-15	Coffee	AQ01	MT	0-31	CCG	77	5.0		N	NS	
23-Jun-15	Coffee	AQ01	MT	0-30	CCG	100	9.7		N	NS	
23-Jun-15	Latte	AQ04	EF	0-22	GR	299	298.4		Y	4	Male.
23-Jun-15	Latte	AQ04	EF	0-23	GR	278	213.0		Y	4	Male.
23-Jun-15	Latte	AQ04	EF	0-24	GR	270	205.5		N	NS	
23-Jun-15	Latte	AQ04	EF	0-25	GR	272	208.0		Y	5	Female.
23-Jun-15	Latte	AQ04	EF	0-26	GR	273	224.4		Y	5	Male.
23-Jun-15	Isaac	AQREF1	MT	Ref-02	CCG	46	1.3		N	NS	
23-Jun-15	Isaac	AQREF1	MT	Ref-04	CCG	54	2.2		N	NS	
23-Jun-15	Isaac	AQREF1	MT	Ref-06	CCG	63	3.0		N	NS	
23-Jun-15	Isaac	AQREF1	MT	Ref-05	CCG	66	2.8		N	NS	
23-Jun-15	Isaac	AQREF1	MT	Ref-01	CCG	71	4.0		N	NS	
23-Jun-15	Isaac	AQREF1	MT	Ref-03	CCG	87	6.5		N	NS	
24-Jul-15	Halfway	AQ20	EF	1	GR	245	156.0		N	NS	
25-Jul-15	Latte	AQ04	EF	2	GR	340	425.0	989001003464169	Y	8	Adult male.
25-Jul-15	Latte	AQ04	EF	3	GR	240	161.0		Y	5	Immature male.
25-Jul-15	Latte	AQ04	EF	4	GR	355	463.0	989001003464165	Y	8	Adult male.
25-Jul-15	Latte	AQ04	EF	5	GR	310	294.0		Y	7	Adult male.
25-Jul-15	Latte	AQ04	EF	6	GR	258	285.0		Y	6	weight outlier; removed from W-L analyses
25-Jul-15	Latte	AQ04	EF	7	GR	220	123.0		Y	5	
25-Jul-15	Latte	AQ04	EF	8	GR	270	199.0		Y	5	
25-Jul-15	Latte	AQ04	EF	9	GR	235	120.0		Y	4	Immature male.
25-Jul-15	Latte	AQ04	EF	10	GR	300	322.0		Y	8	Adult male.
25-Jul-15	Latte	AQ04	EF	11	GR	270	215.0		Y	7	Immature.
25-Jul-15	Latte	AQ04	EF	12	GR	227	109.0		Y	5	
25-Jul-15	Latte	AQ04	EF	13	GR	286	240.0		Y	6	
25-Jul-15	Latte	AQ04	EF	14	GR	273	230.0		N	NS	Adult female.
25-Jul-15	Latte	AQ04	EF	15	GR	234	130.0		N	NS	Immature
25-Jul-15	Latte	AQ04	EF	16	GR	220	98.0		N	NS	Immature.
25-Jul-15	Latte	AQ04	EF	17	GR	250	166.0		N	NS	
25-Jul-15	Latte	AQ04	EF	18	GR	266	208.0		N	NS	Adult male.
25-Jul-15	Latte	AQ04	EF	19	GR	211	100.0		N	NS	Immature.
25-Jul-15	Latte	AQ04	EF	20	GR	218	99.0		N	NS	Immature.
25-Jul-15	Latte	AQ04	EF	21	GR	240	136.0		N	NS	
25-Jul-15	Latte	AQ04	EF	22	GR	261	175.0		N	NS	Adult female.
25-Jul-15	Latte	AQ04	EF	23	GR	265	217.0		N	NS	Adult female.
25-Jul-15	Latte	AQ04	EF	24	GR	230	120.0		N	NS	Immature male.
25-Jul-15	Latte	AQ04	EF	25	GR	305	276.0		N	NS	Adult male.
25-Jul-15	Latte	AQ04	EF	26	GR	271	227.0		N	NS	Adult male.
25-Jul-15	Latte	AQ04	EF	27	GR	273	213.0		N	NS	Adult female.
25-Jul-15	Latte	AQ04	EF	28	GR	245	165.0		N	NS	Female
25-Jul-15	Latte	AQ04	EF	29	GR	235	141.0		N	NS	Female.
25-Jul-15	Latte	AQ04	EF	30	GR	280	210.0		N	NS	Adult male.
25-Jul-15	Latte	AQ04	EF	31	GR	244	152.0	989001003464222	N	NS	Adult male.

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F4. Fish Biological Characteristics, Coffee Gold Project, 2014-2015

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
25-Jul-15	Latte	AQ04	EF	32	GR	245	170.0		N	NS	
25-Jul-15	Latte	AQ04	EF	33	GR	265	191.0		N	NS	Adult male.
25-Jul-15	Latte	AQ04	EF	34	GR	214	114.0		N	NS	
25-Jul-15	Latte	AQ04	EF	35	GR	223	112.0		N	NS	Female.
25-Jul-15	Latte	AQ04	EF	36	GR	225	114.0		N	NS	Female.
25-Jul-15	Latte	AQ04	EF	37	GR	276	191.0		N	NS	Female.
25-Jul-15	Latte	AQ04	EF	38	GR	244	138.0		N	NS	Female.
25-Jul-15	Latte	AQ04	EF	39	GR	288	244.0	989001003464163	N	NS	Male.
25-Jul-15	Los Angeles	AQREF2	EF	42	CCG	125	24.4		Y	5	
25-Jul-15	Latte	AQ04	EF	40	GR	247	184.0		N	NS	Male
25-Jul-15	Los Angeles	AQREF2	EF	41	GR	251	177.0		Y	4	Sub-adult female.
26-Jul-15	Coffee	AQ00	A	43	GR	320	381.0		Y	7	Male.
26-Jul-15	Coffee	AQ00	A	44	GR	320	355.0		Y	8	
26-Jul-15	Coffee	AQ00	A	45	GR	327	349.0		Y	6	Male.
26-Jul-15	Coffee	AQ00	A	46	GR	227	116.0		Y	4	
26-Jul-15	Coffee	AQ00	A	47	GR	336	414.0		Y	7	Male.
26-Jul-15	Coffee	AQ00	A	48	GR	294	281.0		Y	7	
26-Jul-15	Coffee	AQ00	A	49	GR	333	406.0		Y	9	Male.
26-Jul-15	Coffee	AQ00	A	50	GR	253	155.0		Y	5	Immature male.
26-Jul-15	Coffee	AQ00	A	51	GR	257	179.0		Y	5	Female
26-Jul-15	Coffee	AQ00	A	52	GR	268	205.0		Y	6	Small male.
26-Jul-15	Coffee	AQ00	A	53	GR	250	158.0		Y	5	Male.
26-Jul-15	Coffee	AQ00	A	54	GR	247	153.0		Y	4	Immature male.
26-Jul-15	Coffee	AQ02	A	55	GR	212	93.0		N	NS	
26-Jul-15	Coffee	AQ02	A	56	GR	328	332.0		Y	7	Adult male.
26-Jul-15	Coffee	AQ02	A	57	GR	259	183.0		Y	7	
26-Jul-15	Coffee	AQ02	A	58	GR	300	290.0		N	NS	Adult male.
26-Jul-15	Coffee	AQ02	A	59	GR	270	211.0		N	NS	Adult male.
26-Jul-15	Coffee	AQ02	A	60	GR	285	222.0		N	NS	
26-Jul-15	Coffee	AQ02	A	61	GR	248	160.0		N	NS	
26-Jul-15	Coffee	AQ02	A	62	GR	293	275.0		N	NS	Adult male.
26-Jul-15	Coffee	AQ02	A	63	GR	299	295.0		N	NS	Adult male.
26-Jul-15	Coffee	AQ02	A	64	GR	254	158.0		N	NS	Male.
26-Jul-15	Coffee	AQ02	A	65	GR	220	118.0		N	NS	
26-Jul-15	Coffee	AQ02	A	66	GR	256	163.0		N	NS	
26-Jul-15	Coffee	AQ02	A	67	GR	240	142.0		N	NS	
26-Jul-15	Coffee	AQ02	A	68	GR	230	111.0		N	NS	
26-Jul-15	Coffee	AQ02	A	69	GR	254	163.0		Y	5	Immature male.
26-Jul-15	Coffee	AQ02	A	70	GR	278	211.0		Y	6	Male.
26-Jul-15	Coffee	AQ02	A	71	GR	241	130.0		Y	4	Immature female.
26-Jul-15	Coffee	AQ02	A	72	GR	208	88.0		Y	4	Immature male.
26-Jul-15	Coffee	AQ02	A	73	GR	214	88.0		Y	3	Immature female.
26-Jul-15	Coffee	AQ02	A	74	GR	284	248.0		Y	5	Male.
26-Jul-15	Coffee	AQ01	A	75	GR	283	238.0		N	NS	Male.
26-Jul-15	Coffee	AQ01	A	76	GR	330	430.0		N	NS	Male.
26-Jul-15	Coffee	AQ01	A	77	GR	284	236.0		N	NS	Female.
26-Jul-15	Coffee	AQ01	A	78	GR	269	169.0		N	NS	Female.
26-Jul-15	Coffee	AQ01	A	79	GR	305	290.0		N	NS	Male.

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
26-Jul-15	Coffee	AQ01	A	80	GR	242	147.0		N	NS	
26-Jul-15	Coffee	AQ01	A	81	GR	209	88.0		N	NS	
27-Jul-15	Coffee	AQ00	MT	86	CH	66	2.9		N	NS	
27-Jul-15	Coffee	AQ00	MT	89	CH	67	3.3		N	NS	
27-Jul-15	Coffee	AQ00	FN	90	CH	67	4.1		N	NS	
27-Jul-15	Coffee	AQ00	MT	87	CH	68	3.3		N	NS	
27-Jul-15	Coffee	AQ00	MT	84	CH	68	4.0		N	NS	
27-Jul-15	Coffee	AQ00	MT	88	CH	69	3.5		N	NS	
27-Jul-15	Coffee	AQ00	MT	85	CH	69	4.0		N	NS	
27-Jul-15	Coffee	AQ00	MT	83	CH	72	4.2		N	NS	
27-Jul-15	Coffee	AQ00	MT	82	CH	77	4.9		N	NS	
27-Jul-15	Coffee	AQ01	MT	92	CCG	68	3.2		N	NS	
27-Jul-15	Coffee	AQ01	MT	93	CH	71	3.8		N	NS	
27-Jul-15	Coffee	AQ01	MT	91	CH	74	4.6		N	NS	
27-Jul-15	Coffee	AQ02	MT	98	CCG	61	3.2		N	NS	
27-Jul-15	Coffee	AQ02	EF	100	CCG	62	2.7		N	NS	
27-Jul-15	Coffee	AQ02	EF	103	CCG	66	2.5		N	NS	
27-Jul-15	Coffee	AQ02	EF	101	CCG	67	3.3		N	NS	
27-Jul-15	Coffee	AQ02	MT	94	CCG	90	8.2		Y	4	
27-Jul-15	Coffee	AQ02	EF	105	CCG	69	3.3		N	NS	
27-Jul-15	Coffee	AQ02	MT	96	CCG	90	16.9		Y	4	
27-Jul-15	Coffee	AQ02	EF	102	CCG	94	9.0		Y	7	
27-Jul-15	Coffee	AQ02	EF	104	CCG	74	4.0		N	NS	
27-Jul-15	Coffee	AQ02	MT	95	GR	113	11.5		N	NS	
27-Jul-15	Coffee	AQ02	MT	97	GR	121	15.5		N	NS	
27-Jul-15	Coffee	AQ02	MT	99	GR	135	22.2		N	NS	
28-Jul-15	Isaac	AQREF1	MT	205	CCG	65	2.5		Y	2	
28-Jul-15	Isaac	AQREF1	MT	206	CCG	63	2.1		Y	2	
28-Jul-15	Isaac	AQREF1	MT	207	CCG	63	2.3		Y	1	
28-Jul-15	Independence	AQ11	A	106	GR	260	187.0		Y	6	Male.
28-Jul-15	Independence	AQ11	A	107	GR	283	239.7		Y	6	Male.
28-Jul-15	Independence	AQ11	A	108	GR	250	142.9		Y	5	Immature male.
28-Jul-15	Independence	AQ11	A	109	GR	260	174.1		Y	6	Adult female.
28-Jul-15	Independence	AQ11	A	110	GR	175	56.4		Y	3	Immature male.
28-Jul-15	Independence	AQ11	A	111	GR	189	67.9		Y	2	Immature female.
28-Jul-15	Independence	AQ11	A	112	GR	177	60.3		Y	2	Immature female.
28-Jul-15	Independence	AQ11	A	113	GR	180	47.2		Y	3	Immature male.
28-Jul-15	Independence	AQ10	MT	118	CH	62	2.2		N	NS	
28-Jul-15	Independence	AQ10	MT	114	CH	66	2.9		N	NS	
28-Jul-15	Independence	AQ10	MT	116	CH	68	3.3		N	NS	
28-Jul-15	Independence	AQ10	MT	117	CH	73	3.9		N	NS	
28-Jul-15	Independence	AQ10	MT	115	CH	75	4.3		N	NS	
28-Jul-15	Isaac	AQREF1	MT	194	CH	51	1.6		N	NS	
28-Jul-15	Isaac	AQREF1	MT	134	CH	52	1.6		N	NS	
28-Jul-15	Isaac	AQREF1	MT	143	CH	53	1.4		N	NS	
28-Jul-15	Isaac	AQREF1	MT	193	CH	53	1.7		N	NS	
28-Jul-15	Isaac	AQREF1	MT	198	CH	54	1.2		N	NS	
28-Jul-15	Isaac	AQREF1	MT	203	CH	54	1.3		N	NS	

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Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
28-Jul-15	Isaac	AQREF1	MT	183	CH	54	1.6		N	NS	
28-Jul-15	Isaac	AQREF1	MT	135	CH	54	1.9		N	NS	
28-Jul-15	Isaac	AQREF1	MT	190	CH	55	1.3		N	NS	
28-Jul-15	Isaac	AQREF1	MT	204	CCG	60	2.8		N	NS	
28-Jul-15	Isaac	AQREF1	MT	167	CH	55	1.5		N	NS	
28-Jul-15	Isaac	AQREF1	MT	185	CH	55	1.5		N	NS	
28-Jul-15	Isaac	AQREF1	MT	187	CH	56	2.2		N	NS	
28-Jul-15	Isaac	AQREF1	MT	125	CH	57	1.6		N	NS	
28-Jul-15	Isaac	AQREF1	MT	147	CH	57	1.7		N	NS	
28-Jul-15	Isaac	AQREF1	MT	182	CH	57	1.7		N	NS	
28-Jul-15	Isaac	AQREF1	MT	139	CH	57	2.0		N	NS	
28-Jul-15	Isaac	AQREF1	MT	178	CH	57	2.5		N	NS	
28-Jul-15	Isaac	AQREF1	MT	188	CH	58	1.4		N	NS	
28-Jul-15	Isaac	AQREF1	MT	184	CH	58	1.7		N	NS	
28-Jul-15	Isaac	AQREF1	MT	168	CH	58	1.8		N	NS	
28-Jul-15	Isaac	AQREF1	MT	136	CH	58	2.0		N	NS	
28-Jul-15	Isaac	AQREF1	MT	159	CH	59	1.8		N	NS	
28-Jul-15	Isaac	AQREF1	MT	146	CH	60	2.0		N	NS	
28-Jul-15	Isaac	AQREF1	MT	156	CH	60	2.0		N	NS	
28-Jul-15	Isaac	AQREF1	MT	189	CH	60	2.0		N	NS	
28-Jul-15	Isaac	AQREF1	MT	195	CH	60	2.3		N	NS	
28-Jul-15	Isaac	AQREF1	MT	131	CH	60	2.4		N	NS	
28-Jul-15	Isaac	AQREF1	MT	171	CH	60	2.5		N	NS	
28-Jul-15	Isaac	AQREF1	MT	199	CH	60	2.7		N	NS	
28-Jul-15	Isaac	AQREF1	MT	158	CH	61	1.7		N	NS	
28-Jul-15	Isaac	AQREF1	MT	122	CH	61	2.1		N	NS	
28-Jul-15	Isaac	AQREF1	MT	130	CH	62	2.0		N	NS	
28-Jul-15	Isaac	AQREF1	MT	153	CH	62	2.2		N	NS	
28-Jul-15	Isaac	AQREF1	MT	172	CH	62	2.2		N	NS	
28-Jul-15	Isaac	AQREF1	MT	119	CH	62	2.3		N	NS	
28-Jul-15	Isaac	AQREF1	MT	129	CH	62	2.5		N	NS	
28-Jul-15	Isaac	AQREF1	MT	196	CH	62	2.8		N	NS	
28-Jul-15	Isaac	AQREF1	MT	155	CH	62	2.9		N	NS	
28-Jul-15	Isaac	AQREF1	MT	173	CH	62	2.9		N	NS	
28-Jul-15	Isaac	AQREF1	MT	180	CH	63	2.0		N	NS	
28-Jul-15	Isaac	AQREF1	MT	181	CH	63	2.0		N	NS	
28-Jul-15	Isaac	AQREF1	MT	162	CH	63	2.3		N	NS	
28-Jul-15	Isaac	AQREF1	MT	126	CH	63	2.6		N	NS	
28-Jul-15	Isaac	AQREF1	MT	174	CH	63	3.2		N	NS	
28-Jul-15	Isaac	AQREF1	MT	141	CH	64	2.3		N	NS	
28-Jul-15	Isaac	AQREF1	MT	177	CH	64	2.5		N	NS	
28-Jul-15	Isaac	AQREF1	MT	123	CH	64	2.6		N	NS	
28-Jul-15	Isaac	AQREF1	MT	202	CH	64	2.9		N	NS	
28-Jul-15	Isaac	AQREF1	MT	161	CH	65	2.1		N	NS	
28-Jul-15	Isaac	AQREF1	MT	152	CH	65	2.3		N	NS	
28-Jul-15	Isaac	AQREF1	MT	154	CH	65	2.4		N	NS	
28-Jul-15	Isaac	AQREF1	MT	151	CH	65	2.5		N	NS	
28-Jul-15	Isaac	AQREF1	MT	120	CH	65	2.7		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
28-Jul-15	Isaac	AQREF1	MT	169	CH	65	2.8		N	NS	
28-Jul-15	Isaac	AQREF1	MT	145	CH	65	2.9		N	NS	
28-Jul-15	Isaac	AQREF1	MT	200	CH	65	3.2		N	NS	
28-Jul-15	Isaac	AQREF1	MT	164	CH	65	3.5		N	NS	
28-Jul-15	Isaac	AQREF1	MT	163	CH	66	2.2		N	NS	
28-Jul-15	Isaac	AQREF1	MT	128	CH	66	2.5		N	NS	
28-Jul-15	Isaac	AQREF1	MT	186	CH	66	2.6		N	NS	
28-Jul-15	Isaac	AQREF1	MT	166	CH	66	2.8		N	NS	
28-Jul-15	Isaac	AQREF1	MT	157	CH	66	2.9		N	NS	
28-Jul-15	Isaac	AQREF1	MT	140	CH	66	3.1		N	NS	
28-Jul-15	Isaac	AQREF1	MT	149	CH	66	3.1		N	NS	
28-Jul-15	Isaac	AQREF1	MT	192	CH	66	3.2		N	NS	
28-Jul-15	Isaac	AQREF1	MT	197	CH	66	3.2		N	NS	
28-Jul-15	Isaac	AQREF1	MT	201	CH	66	3.3		N	NS	
28-Jul-15	Isaac	AQREF1	MT	179	CH	67	2.8		N	NS	
28-Jul-15	Isaac	AQREF1	MT	133	CH	67	3.1		N	NS	
28-Jul-15	Isaac	AQREF1	MT	170	CH	67	3.1		N	NS	
28-Jul-15	Isaac	AQREF1	MT	165	CH	67	3.4		N	NS	
28-Jul-15	Isaac	AQREF1	MT	148	CH	68	2.9		N	NS	
28-Jul-15	Isaac	AQREF1	MT	150	CH	68	3.0		N	NS	
28-Jul-15	Isaac	AQREF1	MT	138	CH	68	3.1		N	NS	
28-Jul-15	Isaac	AQREF1	MT	137	CH	68	3.3		N	NS	
28-Jul-15	Isaac	AQREF1	MT	175	CH	68	3.5		N	NS	
28-Jul-15	Isaac	AQREF1	MT	132	CH	68	3.6		N	NS	
28-Jul-15	Isaac	AQREF1	MT	144	CH	68	4.1		N	NS	
28-Jul-15	Isaac	AQREF1	MT	176	CH	69	3.8		N	NS	
28-Jul-15	Isaac	AQREF1	MT	142	CH	70	3.4		N	NS	
28-Jul-15	Isaac	AQREF1	MT	160	CH	70	4.6		N	NS	
28-Jul-15	Isaac	AQREF1	MT	127	CH	72	3.5		N	NS	
28-Jul-15	Isaac	AQREF1	MT	124	CH	74	4.2		N	NS	
28-Jul-15	Isaac	AQREF1	MT	191	CH	74	4.6		N	NS	
28-Jul-15	Isaac	AQREF1	MT	121	CH	75	3.8		N	NS	
29-Jul-15	Latte	AQ03	EF	208	CCG	108	9.2		Y	6	
29-Jul-15	Latte	AQ03	EF	209	GR	128	20.0		N	NS	
31-Jul-15	Latte	AQ03	MT	219	CCG	80	5.0		Y	1	
01-Aug-15	Independence	AQ10	MT	218	CH	59	2.4		N	NS	
01-Aug-15	Independence	AQ10	MT	217	CH	60	2.4		N	NS	
01-Aug-15	Independence	AQ10	MT	214	CH	63	2.6		N	NS	
01-Aug-15	Independence	AQ10	MT	215	CH	65	3.5		N	NS	
01-Aug-15	Independence	AQ10	MT	216	CH	71	3.8		N	NS	
01-Aug-15	Los Angeles	AQREF2	MT	213	CH	74	3.9		N	NS	
01-Aug-15	Los Angeles	AQREF2	MT	211	CH	76	4.6		N	NS	
01-Aug-15	Los Angeles	AQREF2	MT	210	CH	77	4.5		N	NS	
01-Aug-15	Los Angeles	AQREF2	MT	212	CH	85	6.3		N	NS	
10-Sep-15	Los Angeles	AQREF2	A	2	GR	270	199.0		Y	6	
10-Sep-15	Los Angeles	AQREF2	MT	1	CH	85	7.5		N	NS	
12-Sep-15	Latte	AQ03	EF	3	CCG	126	15.5		Y	7	
12-Sep-15	Latte	AQ03	EF	NR	GR	NR	NR		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Date	Watercourse	Site	Method	Fish ID	Species	Length (mm)	Weight (g)	Tag #	Sampled (Y/N)	Age (yrs)	Comments
13-Sep-15	Independence	AQ10	MT	4	CCG	85	9.5		Y	1	
13-Sep-15	Independence	AQ10	MT	5	CH	78	4.8		N	NS	
13-Sep-15	Independence	AQ10	MT	6	CH	77	4.2		N	NS	
13-Sep-15	Independence	AQ10	MT	7	CH	80	5.1		N	NS	
13-Sep-15	Independence	AQ10	MT	8	CH	81	5.9		N	NS	

Notes: EF=Electrofishing, MT=Minnnow trapping, FN=Fyke net, A=Angling; AG=Arctic grayling, CCG=slimy scupin, CH=juvenile Chinook salmon, BB=burbot, LSU=longnose sucker, AL=Arctic lamprey, NS=Not sampled, NR=Not recorded

Appendix F5. Fish tissue metal concentrations, Coffee Gold Project, 2014-2015

Metal	Reported Detection Limit	Date	24-Aug-14	27-Aug-14	27-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14
		Waterbody	Independence	Latte		Isaac								
		Site	AQ11	AQ04		AQREF1								
		Species	GR	GR	GR	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG
		Fish ID	104	0178	0179	R1-1	R1-2	R1-3	R1-4	R1-5	R1-6	R1-7	R1-8	R1-9
Moisture	0.1		76.2	79.1	78.8	72.7	73	72.5	71.7	72.1	72.1	75.2	69.7	74.3
Aluminum	0.4		1.4	1.5	0.8	2.1	11.7	7.8	4.6	11.2	10.7	15.3	27.3	14.9
Antimony	0.002		0.227	0.065	0.099	0.013	0.033	0.023	0.027	0.02	0.019	0.017	0.078	0.016
Arsenic	0.005		0.041	0.027	0.027	0.066	0.07	0.069	0.085	0.087	0.1	0.077	0.191	0.095
Barium	0.01		0.45	0.13	0.05	1.65	4.56	4.47	4.13	2.94	2.71	2.7	4.04	3.89
Beryllium	0.002		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Bismuth	0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Boron	0.1		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.2	0.2	0.2	0.2	0.2
Cadmium	0.002		0.029	0.003	0.002	0.007	0.133	0.214	0.225	0.281	0.173	0.144	0.036	0.416
Calcium	2		2390	880	303	6070	22900	21400	18300	14500	14000	10900	11900	15600
Chromium	0.01		0.02	<0.01	<0.01	0.01	0.05	0.05	0.02	0.03	0.03	0.06	0.06	0.04
Cobalt	0.004		0.02	0.008	0.006	0.008	0.04	0.027	0.024	0.016	0.039	0.022	0.033	0.05
Copper	0.01		0.44	0.24	0.27	0.4	0.93	0.83	0.58	0.63	0.73	0.57	0.62	0.52
Iron	1		7	6	4	10	36	27	18	28	30	40	70	41
Lead	0.004		0.064	0.005	0.004	0.005	0.018	0.015	0.021	0.013	0.017	0.015	0.027	0.028
Magnesium	2		332	248	286	341	451	485	462	407	412	359	349	439
Manganese	0.02		0.76	0.36	0.25	4.38	9.12	12	19	7.78	11.3	9.03	7.48	15.5
Mercury	0.002		0.049	0.081	0.071	0.039	0.049	0.038	0.061	0.045	0.032	0.057	0.031	0.04
Molybdenum	0.01		<0.01	<0.01	<0.01	<0.01	0.03	0.02	0.02	0.02	0.01	0.02	0.02	0.02
Nickel	0.01		0.01	<0.01	<0.01	0.02	0.07	0.08	0.09	0.06	0.1	0.07	0.08	0.11
Phosphorus	5		4010	2530	2660	5350	12500	13400	12100	9730	9530	7670	8330	9920
Potassium	10		4600	3510	4250	3420	3090	3210	3590	3510	3500	3260	3290	3490
Selenium	0.02		1.23	0.66	0.92	0.98	1.26	2.19	1.79	1.56	2.63	1.22	1.45	1.78
Silver	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	2		481	293	284	614	1350	1290	1180	1150	1060	1090	973	1020
Strontium	0.01		2.65	0.95	0.3	9.73	26.4	26.9	22.5	20.4	17.5	14.4	17.7	19.5
Thallium	0.001		0.006	0.003	0.004	0.003	0.004	0.004	0.004	0.004	0.005	0.004	0.002	0.005
Tin	0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Titanium	0.05		0.35	0.25	0.23	0.41	1.57	1.24	0.98	1.13	1.32	1.32	2.36	1.7
Uranium	0.001		0.001	0.001	<0.001	0.006	0.03	0.017	0.008	0.022	0.007	0.01	0.029	0.01
Vanadium	0.02		<0.02	<0.02	<0.02	0.06	0.24	0.22	0.35	0.16	0.14	0.19	0.24	0.27
Zinc	0.5		11.9	5.1	3.9	20	30.5	31.4	48.9	25.7	28.4	28.5	23.3	40

Notes: All units µg/g, except moisture which is measured as % wet

Recommended fish sample temperatures may have been exceeded during transport to the lab in 2014

GR=Arctic grayling, CCG=slimy sculpin

Appendix F5. Fish tissue metal concentrations, Coffee Gold Project, 2014-2015

Metal	Reported Detection Limit	Date	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	27-Aug-14	27-Aug-14	27-Aug-14	27-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14	28-Aug-14
		Waterbody	Independence								Coffee								
		Site	AQ10								AQ02								
		Species	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG
		Fish ID	I-301	I-302	I-303	I-304	I-305	I-306	I-307	I-308	0219	0220	0221	0222	0223	0224	0225	0226	0227
Moisture	0.1		74.5	68.6	68.2	70.9	71.3	71.6	71	67.1	67.6	76	74.9	73.3	73.8	72.7	76.3	72.9	70.1
Aluminum	0.4		106	3	4.7	26.4	103	13.2	14.3	6.5	5.5	2	2.9	8.5	4.9	2.2	8.2	20.4	13.9
Antimony	0.002		0.011	0.008	0.006	0.007	0.011	0.005	0.007	0.009	0.005	0.006	0.006	0.005	0.029	0.032	0.053	0.025	0.038
Arsenic	0.005		0.173	0.077	0.069	0.097	0.178	0.094	0.089	0.108	0.041	0.057	0.067	0.082	0.074	0.062	0.058	0.096	0.082
Barium	0.01		1.48	1.76	0.59	3.83	3.43	1.8	2.11	1.83	0.53	1.09	0.92	0.91	3.91	1.08	0.55	2.93	2.3
Beryllium	0.002		<0.002	<0.002	<0.002	<0.002	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Bismuth	0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Boron	0.1		0.2	0.2	0.1	0.1	0.1	0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	<0.1	<0.1	<0.1
Cadmium	0.002		0.245	0.053	0.041	0.184	0.191	0.096	0.117	0.05	0.011	0.005	0.006	0.01	0.017	0.003	0.039	0.077	0.015
Calcium	2		4650	12700	3250	23400	16600	10400	13200	11100	2960	7620	6560	5190	21900	7420	2420	16100	10200
Chromium	0.01		0.25	0.01	0.02	0.07	0.22	0.04	0.04	0.02	0.01	0.01	0.01	0.02	0.02	0.01	0.03	0.05	0.05
Cobalt	0.004		0.079	0.014	0.011	0.04	0.087	0.032	0.026	0.015	0.016	0.01	0.009	0.012	0.019	0.01	0.012	0.03	0.017
Copper	0.01		1.79	0.62	0.47	1.03	1.9	0.72	0.65	0.54	0.46	0.56	0.58	0.5	0.68	0.47	0.72	1.21	0.62
Iron	1		174	11	14	59	167	35	31	19	18	11	12	21	23	12	25	56	31
Lead	0.004		0.063	0.019	0.007	0.029	0.059	0.034	0.019	0.035	<0.004	<0.004	0.007	0.009	0.008	0.008	0.03	0.022	0.02
Magnesium	2		285	355	270	480	404	333	355	345	282	337	331	312	469	299	266	350	321
Manganese	0.02		7.24	6.07	2.02	12.4	12.6	6.86	11.7	5.8	1.28	2.66	1.77	3.35	8.82	2.99	1.49	7.17	5.06
Mercury	0.002		0.088	0.056	0.091	0.066	0.073	0.093	0.041	0.072	0.087	0.078	0.079	0.058	0.107	0.143	0.224	0.092	0.097
Molybdenum	0.01		0.06	0.01	<0.01	0.03	0.07	0.02	0.02	0.01	<0.01	<0.01	<0.01	0.01	0.01	<0.01	0.01	0.03	<0.01
Nickel	0.01		0.19	0.04	0.04	0.11	0.19	0.08	0.09	0.04	0.02	0.02	0.02	0.03	0.04	0.03	0.04	0.07	0.05
Phosphorus	5		4550	8510	3960	14200	10500	7340	8960	7690	4320	6300	5500	4900	13700	5680	3240	9460	6580
Potassium	10		2910	3000	3120	3060	2990	3090	3310	3080	3230	3410	3340	3340	3380	3220	3200	2790	3010
Selenium	0.02		1.36	0.9	0.93	1.78	2.53	1.07	1.73	1.31	1.32	1.38	1.15	1.14	2.01	0.95	1.41	2.74	1.01
Silver	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	2		954	895	656	1360	1210	992	930	855	744	815	747	707	1150	739	732	1230	731
Strontium	0.01		5.06	14.7	3.88	28.9	18.7	11.6	15.2	12.4	3.63	9.03	8.29	6.3	29.9	8.93	2.82	19	11.9
Thallium	0.001		0.008	0.007	0.008	0.008	0.01	0.008	0.007	0.008	0.004	0.006	0.004	0.005	0.006	0.005	0.008	0.01	0.009
Tin	0.02		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Titanium	0.05		7.08	0.68	0.64	2.75	6.93	1.32	1.47	0.9	0.62	0.46	0.61	0.92	1.26	0.47	0.79	1.94	1.24
Uranium	0.001		0.048	0.014	0.008	0.028	0.049	0.018	0.016	0.015	0.022	0.035	0.021	0.031	0.044	0.033	0.029	0.146	0.069
Vanadium	0.02		0.37	0.13	0.07	0.28	0.39	0.1	0.14	0.09	0.06	0.06	0.05	0.07	0.18	0.06	0.11	0.28	0.1
Zinc	0.5		21.5	27.1	21.3	26.4	24.2	22.1	26.7	27.8	14.7	19.2	16	20.1	38.8	29.3	17.3	22.6	32.8

Notes: All units µg/g, except moisture which is measured as % wet

Recommended fish sample temperatures may have been exceeded during transport to the lab in 2014

GR=Arctic grayling, CCG=slimy sculpin

Appendix F5. Fish tissue metal concentrations, Coffee Gold Project, 2014-2015

Metal	Reported Detection Limit	Date	25-Jul-15	11-Sep-15	28-Jul-15	28-Jul-15	28-Jul-15	28-Jul-15	28-Jul-15	28-Jul-15	28-Jul-15	21-Jun-15	21-Jun-15	23-Jun-15	23-Jun-15	23-Jun-15	23-Jun-15
		Waterbody	Los Angeles		Independence							Latte					
		Site	AQREF2		AQ11							AQ04					
		Species	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR
		Fish ID	041	002	107	108	109	110	111	112	113	0-9	0-11	0-22	0-23	0-25	0-26
Moisture	0.1		77.6	79.4	78.1	79	78.5	79.7	78.8	79.7	79.5		77.9	79.7	79.9	79.7	79.7
Aluminum	0.4		0.9	2	0.7	1.2	1	2	1.2	1.7	7	2.4	1.4	0.7	0.7	1.7	0.8
Antimony	0.002		0.08	0.272	0.005	<0.002	<0.002	0.006	<0.002	0.003	0.007	0.703	1.16	0.383	0.505	0.201	0.417
Arsenic	0.005		0.069	0.043	0.043	0.046	0.035	0.032	0.035	0.031	0.038	0.027	0.025	0.059	0.042	0.03	0.031
Barium	0.01		0.1	0.17	0.18	0.25	0.06	0.14	0.05	0.15	0.18	0.11	0.18	0.26	0.15	0.07	0.24
Beryllium	0.002		<0.002	<0.005	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Bismuth	0.02		<0.02	<0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Boron	0.1		0.3	<0.2	0.3	0.3	0.3	0.4	0.3	0.3	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	0.002		0.004	<0.005	0.003	0.004	0.006	0.008	0.004	0.005	0.008	0.01	0.006	0.004	0.007	0.007	0.007
Calcium	2		656	385	705	1550	218	828	316	687	725	84	400	483	154	81	131
Chromium	0.01		0.04	<0.02	<0.01	<0.01	<0.01	0.01	<0.01	0.02	0.03	0.02	0.01	0.02	<0.01	0.06	0.01
Cobalt	0.004		0.019	0.021	0.008	0.013	0.013	0.013	0.012	0.011	0.031	0.014	0.006	0.011	0.011	0.012	0.011
Copper	0.01		0.39	0.39	0.38	0.36	0.32	0.39	0.3	0.28	0.34	0.49	0.36	0.4	0.33	0.46	0.54
Iron	1		5	7	5	6	5	6	4	5	14	7	5	4	4	7	4
Lead	0.004		<0.004	<0.010	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.006	0.009	0.006	<0.004	0.01	0.005	0.006
Magnesium	2		319	305	300	318	279	330	303	330	331	309	299	293	288	291	282
Manganese	0.02		0.53	0.56	0.39	0.7	0.32	0.43	0.23	0.5	0.78	0.36	0.45	0.37	0.3	0.37	0.28
Mercury	0.002		0.065	0.068	0.075	0.051	0.086	0.037	0.042	0.037	0.036	0.108	0.123	0.127	0.107	0.132	0.127
Molybdenum	0.01		<0.01	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel	0.01		0.03	0.03	0.06	0.07	0.06	0.07	0.06	0.06	0.06	0.01	0.01	<0.01	0.01	0.01	0.01
Phosphorus	5		3840	3000	3750	4280	3100	4010	3430	3720	3720	2940	3040	3010	2760	2800	2770
Potassium	10		5560	5200	5550	5500	5040	5660	5590	5730	5470	5060	4970	4970	4850	4810	4680
Selenium	0.02		1.69	0.9	1.23	1.51	1.54	1.82	1.44	1.71	2.07	0.85	0.48	0.74	0.94	1.02	1.08
Silver	0.01		<0.01	<0.02	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	2		305	280	310	326	295	315	301	328	356	290	350	369	326	314	392
Strontium	0.01		0.95	0.61	0.84	1.9	0.27	0.91	0.32	0.74	0.84	0.12	0.56	0.68	0.22	0.11	0.19
Thallium	0.001		0.006	0.006	0.006	0.006	0.006	0.005	0.005	0.004	0.007	0.005	0.004	0.004	0.005	0.007	0.006
Tin	0.02		<0.02	<0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Titanium	0.05		0.26	0.26	0.25	0.32	0.22	0.34	0.22	0.31	0.6	0.26	0.2	0.15	0.14	0.31	0.15
Uranium	0.001		<0.001	<0.002	0.001	0.001	0.001	0.001	<0.001	0.001	0.003	0.002	0.002	0.002	0.002	0.002	0.001
Vanadium	0.02		<0.02	<0.05	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Zinc	0.5		5.2	5.7	5.3	6	6	5.8	5.3	6.3	6.3	7.7	4.5	5	4.1	6.6	6.7

Notes: All units µg/g, except moisture which is measured as % wet

Recommended fish sample temperatures may have been exceeded during transport to the lab in 2014

GR=Arctic grayling, CCG=slimy sculpin

Appendix F5. Fish tissue metal concentrations, Coffee Gold Project, 2014-2015

Metal	Reported Detection Limit	Date	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	26-Jul-15	25-Jul-15	15-Sep-15	01-Aug-15	29-Jul-15	12-Sep-15	27-Jul-15	27-Jul-15	27-Jul-15	28-Jul-15	28-Jul-15	28-Jul-15
		Waterbody	Coffee								Los Angeles	Independence	Latte			Coffee			Isaac		
		Site	AQ00		AQ02						AQREF2	AQ10	AQ03			AQ02			AQREF1		
		Species	GR	GR	GR	GR	GR	GR	GR	GR	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG	CCG
		Fish ID	052	054	69	70	71	72	73	74	042	004	219	208	003	94	96	102	205	206	207
Moisture	0.1			78.7	79	78.2	78	77.3	78.8	78.8	78.7	71.2	71			77.1	73.8				
Aluminum	0.4		5.3	1.2	2.2	1.3	3.1	2.1	2.1	2.7	49.7	17.8	30.6	28.3	31.8	112	2.7	37.6	32.5	19.4	3.6
Antimony	0.002		0.034	0.012	0.007	0.005	0.06	0.006	0.053	0.004	0.019	0.965	0.068	0.005	0.182	0.017	0.003	0.012	0.023	0.036	<0.009
Arsenic	0.005		0.068	0.02	0.034	0.032	0.029	0.028	0.029	0.022	0.216	0.107	0.149	0.126	0.119	0.164	0.073	0.118	0.157	0.396	0.097
Barium	0.01		0.18	0.07	0.11	0.1	0.05	0.1	0.12	0.15	3.24	0.66	2.1	4.58	4	3.54	1.51	3.01	3.7	3.71	2.64
Beryllium	0.002		<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.005	<0.004	<0.002	<0.005	0.002	<0.002	<0.002	<0.008	<0.011	<0.009
Bismuth	0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.05	<0.04	<0.02	<0.05	<0.02	<0.02	<0.02	<0.08	<0.11	<0.09
Boron	0.1		0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3	<0.2	0.3	0.3	<0.2	0.4	0.4	0.3	0.5	<0.5	<0.5
Cadmium	0.002		0.003	0.003	0.005	0.003	0.005	0.007	0.006	0.005	0.111	0.072	0.059	0.047	0.045	0.057	0.013	0.038	0.087	0.151	0.141
Calcium	2		506	287	584	499	162	508	406	559	12300	1720	8010	16200	17700	7410	6320	8670	9010	12800	8080
Chromium	0.01		0.03	<0.01	0.01	<0.01	0.01	0.04	0.01	0.02	0.22	0.05	0.08	0.08	0.07	0.3	<0.01	0.1	0.13	0.17	<0.05
Cobalt	0.004		0.015	0.009	0.011	0.009	0.014	0.016	0.011	0.009	0.089	0.049	0.055	0.047	0.05	0.105	0.016	0.054	0.038	0.053	0.024
Copper	0.01		0.3	0.34	0.64	0.42	0.43	0.4	0.71	0.38	1.55	0.92	1.21	1.12	1.01	1.26	0.69	0.97	0.73	0.73	0.53
Iron	1		10	4	10	10	10	8	10	9	85	45	45	48	69	154	12	58	57	104	10
Lead	0.004		0.007	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	0.02	0.016	0.022	0.016	0.022	0.036	<0.004	0.014	0.024	0.088	<0.018
Magnesium	2		284	296	304	322	308	350	304	312	525	292	415	440	546	412	362	409	417	455	385
Manganese	0.02		0.74	0.25	0.33	0.45	0.33	0.48	0.33	0.41	16.2	3.83	7.08	14.4	9.51	14.6	2.89	7.99	8.48	13	7.15
Mercury	0.002		0.09	0.05	0.072	0.062	0.054	0.039	0.055	0.092	0.084	0.069	0.047	0.203	0.213	0.248	0.13	0.22	0.065	0.051	0.031
Molybdenum	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.04	<0.02	0.02	0.03	0.04	0.01	0.02	<0.04	<0.05	<0.05
Nickel	0.01		0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.24	0.07	0.1	0.15	0.08	0.22	0.08	0.13	0.25	0.35	0.25
Phosphorus	5		3330	3300	3890	3840	3650	3980	3830	3830	13700	3830	7690	13000	13400	8450	7430	8460	7670	9340	6610
Potassium	10		5110	5310	5750	5790	5880	5920	5780	5730	4500	4050	3960	3780	4350	4030	4010	3930	3750	3740	3770
Selenium	0.02		1.18	1.29	1.73	1.56	1.31	1.79	1.71	1.42	2.74	2.41	1.88	1.22	1.15	1.76	1.56	1.39	1.4	2.36	1.61
Silver	0.01		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	<0.02	<0.01	<0.02	<0.01	<0.01	<0.01	<0.04	<0.05	<0.05
Sodium	2		300	293	353	384	381	446	364	372	1070	867	785	1300	1450	1050	817	899	754	738	686
Strontium	0.01		0.63	0.34	0.64	0.7	0.18	0.6	0.47	0.76	26	1.95	11	24.6	21.4	11.3	10	12.9	13.4	17	10.4
Thallium	0.001		0.006	0.005	0.008	0.004	0.006	0.005	0.006	0.004	0.01	0.007	0.01	0.013	0.011	0.015	0.009	0.011	0.007	0.009	0.006
Tin	0.02		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.05	<0.04	<0.02	<0.05	<0.02	<0.02	<0.02	<0.08	<0.1	<0.09
Titanium	0.05		0.41	0.23	0.34	0.27	0.46	0.35	0.29	0.37	4.41	1.45	2.56	2.51	2.46	7.97	0.71	2.94	2.26	1.24	0.55
Uranium	0.001		0.003	<0.001	0.001	<0.001	0.001	0.002	0.001	0.001	0.011	0.012	0.029	0.175	0.098	0.129	0.032	0.081	0.016	0.021	0.006
Vanadium	0.02		0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.47	0.08	0.22	0.27	0.42	0.43	0.05	0.21	0.27	0.42	0.15
Zinc	0.5		4	5.8	5.2	4.6	7.3	5.5	6.5	5.3	61.4	23.1	29.8	71.7	52.4	51.6	21.1	36	38.2	61.3	33.5

Notes: All units µg/g, except moisture which is measured as % wet

Recommended fish sample temperatures may have been exceeded during transport to the lab in 2014

GR=Arctic grayling, CCG=slimy sculpin

Appendix F6. Arctic grayling stomach samples, Coffee Gold Project, 2014

Stomach Contents	Fish ID		
	104	178	179
Phylum: Arthropoda	0	0	0
Subphylum: Hexapoda	0	0	0
| Class: Insecta	0	0	0
| Order: Ephemeroptera	0	0	0
| Family: Ameletidae	0	0	0
Ameletus	0	0	0
| Family: Baetidae	0	15	1
Acentrella parvula	0	0	0
Acentrella sp.	0	12	0
Acentrella turbida	0	0	0
Baetis	2	5	0
Baetis bicaudatus	0	0	0
| Family: Ephemerellidae	0	0	0
Drunella doddsii	0	0	0
Drunella sp.	0	0	0
Ephemerella	0	0	0
Ephemerella aurivillii	0	0	0
Ephemerella velmae	0	0	0
| Family: Heptageniidae	0	1	0
Cinygmula sp.	0	1	0
Epeorus albertae group	0	0	0
Epeorus sp.	0	0	0
Rhithrogena	0	0	0
	0	0	0
| Order: Plecoptera	0	0	0
| Family: Capniidae	0	0	0
Capnia sp.	0	0	0
| Family: Chloroperlidae	0	0	0
Suwallia	0	0	0
| Family: Nemouridae	0	0	2
Nemoura	0	1	0
Zapada columbiana	0	0	0
| Family: Perlodidae	1	8	0
Diura sp.	0	0	0
Isogenoides sp.	0	0	0
Isoperla sp.	0	0	0
Skwala	0	0	0
	0	0	0
| Order: Trichoptera	0	0	0
| Family: Apataniidae	0	0	0
Apatania	0	0	0
| Family: Brachycentridae	0	0	0
Brachycentrus sp.	0	0	0
| Family: Glossosomatidae	0	0	0

Appendix F6. Arctic grayling stomach samples, Coffee Gold Project, 2014

Stomach Contents	Fish ID		
	104	178	179
Glossosoma	0	0	0
| Family: Hydropsychidae	0	0	0
| Family: Limnephilidae	4	10	12
Ecclisomyia sp.	6	59	81
	0	0	0
| Order: Coleoptera	0	0	0
| Family: Dytiscidae	0	0	0
Agabus sp.	0	0	0
| Family: Staphylinidae	1	2	0
	0	0	0
| Order: Diptera	0	0	0
| Family: Ceratopogonidae	0	0	0
Culicoides	0	0	0
| Family: Chironomidae	418	19	7
| Subfamily: Chironominae	0	0	0
| Tribe: Tanytarsini	0	0	0
Stempellinella sp.	0	0	0
Tanytarsus	0	0	0
| Subfamily: Diamesinae	0	0	0
| Tribe: Diamesini	0	0	0
Diamesa	0	0	0
Pagastia	0	0	0
Potthastia gaedii group	0	0	0
Pseudodiamesa sp.	4	14	5
| Subfamily: Orthocladiinae	0	0	0
Brillia sp.	0	0	0
Eukiefferiella	20	32	4
Hydrobaenus	0	4	2
Metriocnemus sp.	0	0	0
Orthocladius (Euorthocladius)	0	0	0
Orthocladius complex	1	5	0
Orthocladius lignicola	0	0	0
Paraphaenocladius sp.	0	0	0
Rheocricotopus	0	0	0
Tvetenia	19	6	3
| Tribe: Corynoneurini	0	0	0
Corynoneura	0	0	0
| Family: Deuterophlebiidae	0	0	0
Deuterophlebia sp.	0	0	0
| Family: Empididae	0	0	0
Chelifera/ Metachela	0	0	0
Hemerodromia sp.	0	0	0
| Family: Psychodidae	0	0	0
Pericoma/Telmatoscopus sp.	0	1	0

Appendix F6. Arctic grayling stomach samples, Coffee Gold Project, 2014

Stomach Contents	Fish ID		
	104	178	179
| Family: Simuliidae	0	0	0
Gymnopais sp.	1	0	0
Prosimulium	1	1	0
Simulium	0	0	0
| Family: Tipulidae	0	0	0
Dicranota	0	4	2
Tipula	0	1	1
	0	0	0
| Order: Hemiptera	0	1	0
	0	0	0
Subphylum: Crustacea	0	0	0
| Class: Malacostraca	0	0	0
| Order: Amphipoda	0	0	0
| Family: Crangonyctidae	0	0	0
Crangonyx	0	0	0
| Family: Hyalellidae	0	0	0
Hyalella	0	1	1
	0	0	0
Subphylum: Chelicerata	0	0	0
| Class: Arachnida	0	0	0
| Order: Trombidiformes	0	0	0
| Family: Hydryphantidae	0	0	0
Albertathyas	0	0	0
| Family: Sperchontidae	0	0	0
Sperchon	1	6	0
	0	0	0
| Order: Sarcoptiformes	0	0	0
| Family: Hydrozetidae	1	1	0
	0	0	0
Phylum: Mollusca	0	0	0
| Class: Gastropoda	0	0	0
| Order: Basommatophora	0	0	0
| Family: Lymnaeidae	0	0	0
Stagnicola	0	0	0
	0	0	0
| Order: Heterostropha	0	0	0
| Family: Valvatidae	0	0	0
Valvata	0	0	0
	0	0	0
Phylum: Annelida	0	0	0
Subphylum: Clitellata	0	0	0
| Class: Oligochaeta	0	8	0
| Order: Lumbriculida	0	0	0
| Family: Lumbriculidae	0	0	0

Appendix F6. Arctic grayling stomach samples, Coffee Gold Project, 2014

Stomach Contents	Fish ID		
	104	178	179
	0	0	0
| Order: Tubificida	0	0	0
| Family: Enchytraeidae	0	0	0
Mesenchytraeus sp.	0	0	0
Totals:	**480**	**218**	**121**

Taxa present but not included:

Terrestrials	0	3	0
	0	0	0
Phylum: Arthropoda	0	0	0
Subphylum: Hexapoda	0	0	0
| Class: Insecta	0	0	0
| Order: Coleoptera	0	0	0
| Family: Curculionidae	0	0	0
| Subfamily: Scolytinae	1	0	0
	0	0	0
| Class: Entognatha	0	0	0
| Order: Collembola	0	0	0
	0	0	0
Phylum: Nemata	0	0	0
Phylum: Platyhelminthes	0	0	0
| Class: Turbellaria	0	0	0
Totals:	**1**	**3**	**0**

Appendix F6. Arctic grayling stomach samples, Coffee Gold Project, 2015

Stomach Contents	Fish ID				
	AQ02-69	AQ02-70	AQ02-71	AQ02-72	AQ02-73
Phylum: Arthropoda	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0
| Class: Insecta	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0
| Family: Baetidae	146	75	75	24	15
Acentrella sp.	0	0	0	0	0
Baetis	1	1	0	27	14
Baetis bicaudatus	0	1	7	4	0
| Family: Ephemerellidae	0	0	0	0	0
Ephemerella	0	0	0	0	0
| Family: Heptageniidae	0	6	1	3	2
Cinygmula sp.	0	0	0	0	0
Epeorus	0	0	0	0	0
	0	0	0	0	0
| Order: Plecoptera	1	0	0	0	0
| Family: Capniidae	0	0	0	0	0
Capnia sp.	0	0	0	0	0
| Family: Chloroperlidae	4	1	3	1	6
Haploperla sp.	0	0	0	0	0
Suwallia	0	3	2	0	0
| Family: Nemouridae	2	0	0	0	0
Ostrocerca sp.	1	0	0	0	0
Zapada	0	0	0	0	0
| Family: Perlodidae	2	3	2	0	0
	0	0	0	0	0
| Order: Trichoptera	2	1	0	0	0
| Order: Coleoptera	2	0	0	0	0
| Family: Curculionidae	0	0	0	0	0
| Family: Staphylinidae	1	3	1	0	0
	0	0	0	0	0
| Order: Diptera	9	2	10	1	5
| Family: Chironomidae	9	53	7	1	0
| Subfamily: Chironominae	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0
Chironomus	0	0	0	0	0
Polypedilum sp.	0	0	0	0	0
| Tribe: Tanytarsini	0	0	0	0	0
Tanytarsus	0	0	1	0	0
| Subfamily: Diamesinae	0	0	0	0	0
| Tribe: Diamesini	0	0	0	0	0
Diamesa	0	0	0	0	0
Pagastia	0	0	0	0	0
Pseudodiamesa sp.	2	8	2	2	0
| Subfamily: Orthocladiinae	0	0	0	0	0

Appendix F6. Arctic grayling stomach samples, Coffee Gold Project, 2015

Stomach Contents	Fish ID				
	AQ02-69	AQ02-70	AQ02-71	AQ02-72	AQ02-73
Eukiefferiella	0	0	0	0	0
Eukiefferiella claripennis group	7	1	2	0	0
Gymnometriocnemus sp.	0	0	0	0	0
Heterotrissocladius sp.	0	0	0	0	0
Heterotrissocladius marcidus grou	0	0	0	0	0
Hydrobaenus	2	1	0	0	0
Limnophyes sp.	10	0	0	0	0
Orthocladius	4	15	1	0	2
Orthocladius lignicola	0	0	0	0	0
Parametriocnemus	0	90	17	12	14
Pseudosmittia sp.	0	0	0	0	0
Rheocricotopus	2	9	1	0	0
Rheosmittia sp.	0	0	0	0	0
Tvetenia	0	0	0	0	0
Tvetenia bavarica group	97	24	12	26	12
| Family: Deuterophlebiidae	0	0	0	0	0
Deuterophlebia sp.	2	4	3	0	0
| Family: Empididae	3	1	9	7	11
Clinocera sp.	37	3	25	7	8
Neoplasta sp.	0	1	0	0	0
| Family: Muscidae	0	0	0	0	0
Limnophora sp.	1	0	0	0	0
| Family: Simuliidae	29	9	5	11	7
Helodon sp.	5	9	4	0	0
Prosimulium	8	6	8	0	0
Simulium	0	0	0	0	0
| Family: Tipulidae	0	1	1	0	0
Dicranota	0	0	0	0	0
Tipula	0	0	0	0	0
	0	0	0	0	0
| Order: Hemiptera	9	0	6	0	2
| Order: Lepidoptera	0	1	1	0	1
| Order: Hymenoptera	0	1	0	0	0
	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0
| Class: Malacostraca	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	0
| Family: Gammaridae	0	0	0	0	0
Gammarus	0	0	0	0	0
| Family: Hyalellidae	0	0	0	0	0
Hyalella	0	0	0	0	0
	0	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0

Appendix F6. Arctic grayling stomach samples, Coffee Gold Project, 2015

Stomach Contents	Fish ID				
	AQ02-69	AQ02-70	AQ02-71	AQ02-72	AQ02-73
| Order: Trombidiformes	0	2	3	0	0
| Family: Feltriidae	0	0	0	0	0
Feltria sp.	0	0	0	0	0
| Family: Sperchontidae	0	0	0	0	0
Sperchon	9	0	1	6	2
	0	0	0	0	0
| Order: Oribatei	0	0	0	0	0
| Family: Oribatidae	0	0	0	0	0
Oribatida	0	0	0	0	0
	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0
| Class: Gastropoda	0	0	0	0	0
	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0
| Family: Enchytraeidae	0	0	0	0	0
Enchytraeus	0	0	0	0	0
| Family: Naididae	0	0	0	0	0
Nais	0	0	0	0	0
	0	0	0	0	0
Phylum: Tardigrada	0	0	0	0	0
Totals:	**407**	**335**	**210**	**132**	**101**

Taxa present but not included:

Terrestrials	0	1	0	0	0
	0	0	0	0	0
Phylum: Arthropoda	0	0	0	0	0
| Class: Entognatha	0	0	0	0	0
| Order: Collembola	0	0	0	0	0
	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0
| Class: Branchiopoda	0	0	0	0	0
| Order: Cladocera	0	0	15	0	0
	0	0	0	0	0
Phylum: Nemata	5	1	6	1	3
Phylum: Platyhelminthes	0	0	0	0	0
| Class: Turbellaria	0	0	0	0	0
Totals:	**5**	**2**	**21**	**1**	**3**

Appendix G

Laboratory Certified Data Reports

- **G1. CARO Analytical**

CERTIFICATE OF ANALYSIS

REPORTED TO	Palmer Environmental Consulting Group Inc. 470 Granville Street - Suite 630 Vancouver, BC V6C 1V5	**TEL** **FAX**	(604) 629-9075 -
ATTENTION	May Quach	**WORK ORDER**	4090358
PO NUMBER		**RECEIVED / TEMP**	Sep-04-14 13:25 / 14°C
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14
PROJECT INFO		**COC NUMBER**	B 24489

General Comments:

CARO Analytical Services employs methods which are conducted according to procedures accepted by appropriate regulatory agencies, and/or are conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts, except where otherwise agreed to by the client.

The results in this report apply to the samples analyzed in accordance with the Chain of Custody or Sample Requisition document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

[signature redacted]

Issued By: **Jennifer Shanko, AScT For Jaime Tkachuk, BSc, PChem**
Account Manager

Please contact CARO if more information is needed or to provide feedback on our services.

Locations:

#110 4011 Viking Way
Richmond, BC V6V 2K9
Tel: 604-279-1499 Fax: 604-279-1599

#102 3677 Highway 97N
Kelowna, BC V1X 5C3
Tel: 250-765-9646 Fax: 250-765-3893

17225 109 Avenue
Edmonton, AB T5S 1H7
Tel: 780-489-9100 Fax: 780-489-9700

www.caro.ca

ANALYSIS INFORMATION

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090358
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14

Analysis Description	Method Reference	Technique	Location
Available Cations (Ca/Mg/K/Na)	MSSMA 4.51	1N Ammonium Acetate Extraction, Atomic Spectroscopy	Sublet
Available NH4-N and NO3-N in Soil	Carter 4	Nitrate and Exchangeable Ammonium Nitrogen	Sublet
Carbon, Total Organic in Solids	Carter 21.2	Catalytic Combustion and Infrared Detection	Kelowna
Moisture	ASTM D2974-87 *	Gravimetry (Dried at 105C)	N/A
Particle Size - Dry Sieve Fractions	N/A	N/A - RMD Inorganics	Richmond
pH in Soil (1:2 Soil/Water)	Carter 16.2 / APHA 4500-H+ B	1:2 Soil/Water Slurry / Electrometry	Richmond
Phosphorus, Available (Bray)	UBCPLMM 6.1	Bray Extraction, Colorimetric	Sublet
Strong Acid Leachable Metals	BCMOE SALM V.2 / EPA 6020A	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Method Reference Descriptions:

APHA	Standard Methods for the Examination of Water and Wastewater, 22nd Edition, American Public Health Association/American Water Works Association/Water Environment Federation
ASTM	ASTM International Test Methods
Carter	Soil Sampling and Methods of Analysis, 2nd Edition (2007), Carter/Gregorich
EPA	United States Environmental Protection Agency Test Methods
MSSMA	Manual on Soil Sampling and Methods of Analysis, J.A. McKeague
UBCPLMM	Methods Manual, Pedology Laboratory, 1977/1981, L.M. Lavkulich, UBC Department of Soil Science

Glossary of Terms:

MRL	Method Reporting Limit
<	Less than the Reported Detection Limit (RDL) - the RDL may be higher than the MRL due to various factors such as dilutions, limited sample volume, high moisture, or interferences
%	Percent
% dry	Percent (dry weight)
% wet	Percent (wet weight)
mg/kg dry	Milligrams per kilogram (dry weight)
pH units	pH < 7 = acidic, ph > 7 = basic

SAMPLE ANALYTICAL DATA

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090358
REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ11-1 (4090358-01) [Soil] Sampled: Aug-29-14 10:45						
General Parameters						
Carbon, Total Organic	**4.22**	0.05	% dry	N/A	Sep-10-14	
Moisture	**56.8**	0.1	% wet	N/A	Sep-05-14	
pH	**7.1**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**2.9**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**4.6**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**8**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2700**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**360**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**77**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**27**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**21200**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.8**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**14.2**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**194**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**3**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.33**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**7860**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**42.1**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**12.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**21.8**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**28100**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**10.2**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**14.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**8210**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**704**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.07**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.8**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**26.6**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**703**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1680**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.6**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**396**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**55.3**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**9.1**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090358
REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ11-1 (4090358-01) [Soil] Sampled: Aug-29-14 10:45, Continued						
Strong Acid Leachable Metals, Continued						
Tin	**0.8**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**1360**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**7.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**61.6**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**86**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**5**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ11-2 (4090358-02) [Soil] Sampled: Aug-29-14 10:45						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 56 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 40 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 25 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 19 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 12.5 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 4.75 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 2.36 mm	**1.7**	0.1	%	N/A	Sep-11-14	
> 2.0 mm	**0.8**	0.1	%	N/A	Sep-11-14	
> 1.18 mm	**4.1**	0.1	%	N/A	Sep-11-14	
> 600 µm	**6.2**	0.1	%	N/A	Sep-11-14	
> 425 µm	**5.5**	0.1	%	N/A	Sep-11-14	
> 300 µm	**9.8**	0.1	%	N/A	Sep-11-14	
> 150 µm	**20.7**	0.1	%	N/A	Sep-11-14	
> 75 µm	**16.2**	0.1	%	N/A	Sep-11-14	
< 75 µm	**34.9**	0.1	%	N/A	Sep-11-14	
Sample ID: AQ11-3 (4090358-03) [Soil] Sampled: Aug-29-14 10:45						
General Parameters						
Carbon, Total Organic	**2.39**	0.05	% dry	N/A	Sep-10-14	
Moisture	**50.1**	0.1	% wet	N/A	Sep-05-14	
pH	**7.1**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**2.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**2.3**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2600**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**315**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**73**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**26**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**19200**	20	mg/kg dry	Sep-08-14	Sep-09-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090358
REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ11-3 (4090358-03) [Soil] Sampled: Aug-29-14 10:45, Continued						
Strong Acid Leachable Metals, Continued						
Antimony	**0.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**15.1**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**169**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**2**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.24**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**6510**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**37.4**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**11.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**19.3**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**28800**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**12.2**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**14.6**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**7620**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**511**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	< 0.05	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**1.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**23.1**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**685**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1530**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.5**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**385**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**44.7**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**9.5**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.7**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**1400**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**6.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**67.4**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**73**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**5**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ11-4 (4090358-04) [Soil] Sampled: Aug-29-14 10:45						
General Parameters						
Carbon, Total Organic	**2.83**	0.05	% dry	N/A	Sep-10-14	
Moisture	**44.9**	0.1	% wet	N/A	Sep-05-14	
pH	**7.2**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**2.0**	1.0	mg/kg dry	N/A	Sep-12-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090358
REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ11-4 (4090358-04) [Soil] Sampled: Aug-29-14 10:45, Continued						
Fertility / Nutrient Parameters, Continued						
Nitrogen, Nitrate as N, Available	**2.1**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2500**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**310**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**76**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**49**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**19200**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**13.1**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**172**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**2**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.38**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**7030**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**35.4**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**11.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**19.2**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**26900**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**10.1**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**14.8**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**7050**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**656**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.07**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.8**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**24.0**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**735**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1360**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.7**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**367**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**48.2**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**8.9**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.9**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**1260**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**9.0**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**60.9**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**85**	2	mg/kg dry	Sep-08-14	Sep-09-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090358
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ11-4 (4090358-04) [Soil] Sampled: Aug-29-14 10:45, Continued						
Strong Acid Leachable Metals, Continued						
Zirconium	**4**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ11-5 (4090358-05) [Soil] Sampled: Aug-29-14 10:45						
General Parameters						
Carbon, Total Organic	**3.34**	0.05	% dry	N/A	Sep-10-14	
Moisture	**56.6**	0.1	% wet	N/A	Sep-05-14	
pH	**5.8**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**2.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**3.9**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2300**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**275**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**61**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**24**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**19100**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.8**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**14.5**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**178**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.6**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**2**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.44**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**7220**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**35.5**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**11.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**20.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**27800**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**11.2**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**15.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**6870**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**680**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.06**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**24.7**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**752**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1330**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.7**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**342**	40	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ11-5 (4090358-05) [Soil] Sampled: Aug-29-14 10:45, Continued						
Strong Acid Leachable Metals, Continued						
Strontium	**51.5**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**9.2**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.7**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**1150**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**11.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**60.8**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**92**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**4**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ20-1 (4090358-06) [Soil] Sampled: Aug-29-14 12:30						
General Parameters						
Carbon, Total Organic	**6.01**	0.05	% dry	N/A	Sep-10-14	
Moisture	**74.6**	0.1	% wet	N/A	Sep-05-14	
pH	**7.6**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**4.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**4.3**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**6**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**5500**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**630**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**118**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**36**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**17100**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.8**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**13.0**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**189**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**3**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.20**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**8340**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**36.7**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**10.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**19.2**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**23900**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**7.4**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**12.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**6750**	10	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ20-1 (4090358-06) [Soil] Sampled: Aug-29-14 12:30, Continued						
Strong Acid Leachable Metals, Continued						
Manganese	**650**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.05**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**24.3**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**681**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1430**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.6**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**314**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**81.3**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**8.3**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**1030**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**13.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**47.7**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**65**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**3**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ20-2 (4090358-07) [Soil] Sampled: Aug-29-14 12:30						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 56 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 40 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 25 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 19 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 12.5 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 4.75 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 2.36 mm	**0.1**	0.1	%	N/A	Sep-11-14	
> 2.0 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 1.18 mm	**1.9**	0.1	%	N/A	Sep-11-14	
> 600 µm	**4.3**	0.1	%	N/A	Sep-11-14	
> 425 µm	**2.7**	0.1	%	N/A	Sep-11-14	
> 300 µm	**4.0**	0.1	%	N/A	Sep-11-14	
> 150 µm	**12.7**	0.1	%	N/A	Sep-11-14	
> 75 µm	**16.7**	0.1	%	N/A	Sep-11-14	
< 75 µm	**57.5**	0.1	%	N/A	Sep-11-14	
Sample ID: AQ20-3 (4090358-08) [Soil] Sampled: Aug-29-14 12:30						
General Parameters						

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ20-3 (4090358-08) [Soil] Sampled: Aug-29-14 12:30, Continued						
General Parameters, Continued						
Carbon, Total Organic	**4.67**	0.05	% dry	N/A	Sep-10-14	
Moisture	**59.1**	0.1	% wet	N/A	Sep-05-14	
pH	**7.4**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**2.5**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.4**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**4200**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**525**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**69**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**34**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**16000**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**1.0**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**11.2**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**159**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**2**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.13**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**7430**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**36.2**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**8.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**18.4**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**22300**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**7.9**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**11.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**6650**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**294**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	< 0.05	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**22.5**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**678**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1310**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	< 0.5	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**287**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**69.9**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**8.2**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ20-3 (4090358-08) [Soil] Sampled: Aug-29-14 12:30, Continued						
Strong Acid Leachable Metals, Continued						
Tin	**0.7**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**920**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**14.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**45.4**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**62**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**3**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ20-4 (4090358-09) [Soil] Sampled: Aug-29-14 12:30						
General Parameters						
Carbon, Total Organic	**4.92**	0.05	% dry	N/A	Sep-10-14	
Moisture	**69.9**	0.1	% wet	N/A	Sep-05-14	
pH	**7.5**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**3.3**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.1**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**5500**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**580**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**113**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**39**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**17300**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**14.2**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**185**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**3**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.20**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**8220**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**35.7**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**10.8**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**20.1**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**23500**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**7.5**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**13.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**6780**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**516**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.07**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**24.2**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**727**	10	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ20-4 (4090358-09) [Soil] Sampled: Aug-29-14 12:30, Continued						
Strong Acid Leachable Metals, Continued						
Potassium	**1350**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.7**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**317**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**78.3**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**8.5**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**973**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**11.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**47.3**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**63**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**3**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ03-1 (4090358-10) [Soil] Sampled: Aug-29-14 18:15						
General Parameters						
Carbon, Total Organic	**3.63**	0.05	% dry	N/A	Sep-10-14	
Moisture	**60.4**	0.1	% wet	N/A	Sep-05-14	
pH	**7.6**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**1.3**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.6**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**1800**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**200**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**56**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**17**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**20100**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.6**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**12.3**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**174**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**2**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.31**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**7060**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**33.1**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**10.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ03-1 (4090358-10) [Soil] Sampled: Aug-29-14 18:15, Continued						
Strong Acid Leachable Metals, Continued						
Copper	**18.8**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**26300**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**11.4**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**15.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**6520**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**771**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.10**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.6**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**23.0**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**611**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1280**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.9**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**303**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**70.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**13.0**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**1060**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**6.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**53.7**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**86**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**3**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ03-2 (4090358-11) [Soil] Sampled: Aug-29-14 18:15						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 56 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 40 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 25 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 19 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 12.5 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 4.75 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 2.36 mm	**2.7**	0.1	%	N/A	Sep-11-14	
> 2.0 mm	**1.3**	0.1	%	N/A	Sep-11-14	
> 1.18 mm	**9.4**	0.1	%	N/A	Sep-11-14	
> 600 µm	**17.7**	0.1	%	N/A	Sep-11-14	
> 425 µm	**6.8**	0.1	%	N/A	Sep-11-14	
> 300 µm	**6.4**	0.1	%	N/A	Sep-11-14	
> 150 µm	**13.9**	0.1	%	N/A	Sep-11-14	
> 75 µm	**13.5**	0.1	%	N/A	Sep-11-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ03-2 (4090358-11) [Soil] Sampled: Aug-29-14 18:15, Continued						
Particle Size Distribution, Continued						
< 75 µm	**28.4**	0.1	%	N/A	Sep-11-14	
Sample ID: AQ03-3 (4090358-12) [Soil] Sampled: Aug-29-14 18:15						
General Parameters						
Carbon, Total Organic	**4.41**	0.05	% dry	N/A	Sep-10-14	
Moisture	**60.9**	0.1	% wet	N/A	Sep-05-14	
pH	**7.2**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**10.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**8.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**11**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**4750**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**500**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**133**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**93**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**27500**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**19.5**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**240**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**1.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**4**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.46**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**11100**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**45.9**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**12.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**32.5**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**32400**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**13.5**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**23.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**7570**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**711**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.23**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**35.9**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**926**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1860**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**2.4**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**308**	40	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ03-3 (4090358-12) [Soil] Sampled: Aug-29-14 18:15, Continued						
Strong Acid Leachable Metals, Continued						
Strontium	**115**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	**1500**	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**22.3**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**1.2**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**935**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**13.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**53.5**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**118**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**5**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQREF1-1 (4090358-13) [Soil] Sampled: Aug-28-14 09:20						
General Parameters						
Carbon, Total Organic	**1.93**	0.05	% dry	N/A	Sep-11-14	
Moisture	**64.4**	0.1	% wet	N/A	Sep-05-14	
pH	**5.9**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**1.3**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.1**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**6**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**1400**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**220**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**39**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**17**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**16600**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**1.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**13.5**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**380**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**2**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.57**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**8190**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**30.3**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**10.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**24.5**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**26400**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**9.3**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**11.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**7830**	10	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF1-1 (4090358-13) [Soil] Sampled: Aug-28-14 09:20, Continued						
Strong Acid Leachable Metals, Continued						
Manganese	**353**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.07**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.8**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**23.8**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**978**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1340**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.8**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**328**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**64.4**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	**1100**	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**8.2**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.7**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**809**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**5.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**59.2**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**88**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**3**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQREF1-2 (4090358-14) [Soil] Sampled: Aug-28-14 09:20						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 56 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 40 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 25 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 19 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 12.5 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 4.75 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 2.36 mm	**0.1**	0.1	%	N/A	Sep-11-14	
> 2.0 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 1.18 mm	**0.7**	0.1	%	N/A	Sep-11-14	
> 600 µm	**2.1**	0.1	%	N/A	Sep-11-14	
> 425 µm	**2.0**	0.1	%	N/A	Sep-11-14	
> 300 µm	**5.4**	0.1	%	N/A	Sep-11-14	
> 150 µm	**34.6**	0.1	%	N/A	Sep-11-14	
> 75 µm	**31.7**	0.1	%	N/A	Sep-11-14	
< 75 µm	**23.3**	0.1	%	N/A	Sep-11-14	
Sample ID: AQREF1-3 (4090358-15) [Soil] Sampled: Aug-28-14 09:20						
General Parameters						

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF1-3 (4090358-15) [Soil] Sampled: Aug-28-14 09:20, Continued						
General Parameters, Continued						
Carbon, Total Organic	**2.25**	0.05	% dry	N/A	Sep-11-14	
Moisture	**32.7**	0.1	% wet	N/A	Sep-05-14	
pH	**7.1**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**1.3**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	< 1.0	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**3**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**800**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**110**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**27**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**15**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**11600**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**1.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**17.3**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**267**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	< 2	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.31**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**4680**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**20.5**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**8.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**15.3**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**23100**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**8.0**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**8.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**5700**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**482**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	< 0.05	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.8**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**14.5**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**727**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1360**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	< 0.5	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**230**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**40.5**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**6.2**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF1-3 (4090358-15) [Soil] Sampled: Aug-28-14 09:20, Continued						
Strong Acid Leachable Metals, Continued						
Tin	**1.1**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**683**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**3.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**51.9**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**62**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	< 2	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQREF1-4 (4090358-16) [Soil] Sampled: Aug-28-14 09:20						
General Parameters						
Carbon, Total Organic	**2.60**	0.05	% dry	N/A	Sep-11-14	
Moisture	**62.1**	0.1	% wet	N/A	Sep-05-14	
pH	**6.8**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**1.3**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	< 1.0	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**900**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**155**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**24**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**19**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**17100**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**2.0**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**25.8**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**469**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**2**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.65**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**8270**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**31.2**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**11.8**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**25.1**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**31800**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**12.2**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**11.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**7880**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**767**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.05**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**1.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**23.1**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**1200**	10	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF1-4 (4090358-16) [Soil] Sampled: Aug-28-14 09:20, Continued						
Strong Acid Leachable Metals, Continued						
Potassium	**1480**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.7**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**315**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**63.2**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**9.6**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**1.0**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**838**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**5.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**70.9**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**101**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**3**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ00-1 (4090358-17) [Soil] Sampled: Aug-29-14 16:15						
General Parameters						
Carbon, Total Organic	**2.97**	0.05	% dry	N/A	Sep-11-14	
Moisture	**61.8**	0.1	% wet	N/A	Sep-05-14	
pH	**7.0**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**1.3**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	< 1.0	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2100**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**310**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**57**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**21**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**18800**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**8.8**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**193**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	< 2	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.22**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**6560**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**32.6**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**10.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090358
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ00-1 (4090358-17) [Soil] Sampled: Aug-29-14 16:15, Continued						
Strong Acid Leachable Metals, Continued						
Copper	**23.3**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**25800**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**8.4**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**12.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**7340**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**320**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.08**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**20.8**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**721**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1400**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.5**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**355**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**45.9**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**8.4**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**1050**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**17.0**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**61.2**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**72**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**4**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ00-2 (4090358-18) [Soil] Sampled: Aug-29-14 16:15						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 56 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 40 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 25 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 19 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 12.5 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 4.75 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 2.36 mm	**0.1**	0.1	%	N/A	Sep-11-14	
> 2.0 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 1.18 mm	**1.0**	0.1	%	N/A	Sep-11-14	
> 600 µm	**2.2**	0.1	%	N/A	Sep-11-14	
> 425 µm	**2.2**	0.1	%	N/A	Sep-11-14	
> 300 µm	**6.3**	0.1	%	N/A	Sep-11-14	
> 150 µm	**24.0**	0.1	%	N/A	Sep-11-14	
> 75 µm	**22.3**	0.1	%	N/A	Sep-11-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ00-2 (4090358-18) [Soil] Sampled: Aug-29-14 16:15, Continued						
Particle Size Distribution, Continued						
< 75 µm	**41.8**	0.1	%	N/A	Sep-11-14	
Sample ID: AQ00-3 (4090358-19) [Soil] Sampled: Aug-29-14 16:15						
General Parameters						
Carbon, Total Organic	**3.63**	0.05	% dry	N/A	Sep-11-14	
Moisture	**54.3**	0.1	% wet	N/A	Sep-05-14	
pH	**7.0**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**1.3**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.2**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2500**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**430**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**127**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**36**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**19600**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**7.4**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**192**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	< 2	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.23**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**6310**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**32.7**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**10.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**21.5**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**27400**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**6.7**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**11.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**7660**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**567**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.06**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.8**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**20.4**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**667**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1420**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.5**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**365**	40	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ00-3 (4090358-19) [Soil] Sampled: Aug-29-14 16:15, Continued						
Strong Acid Leachable Metals, Continued						
Strontium	**45.4**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**6.2**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**1120**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**13.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**63.8**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**71**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**3**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ00-4 (4090358-20) [Soil] Sampled: Aug-29-14 16:15						
General Parameters						
Carbon, Total Organic	**4.67**	0.05	% dry	N/A	Sep-11-14	
Moisture	**68.3**	0.1	% wet	N/A	Sep-05-14	
pH	**7.3**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**2.5**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**2.6**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**4000**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**520**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**114**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**47**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**21500**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**11.1**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**219**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**2**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.25**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**7280**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**38.7**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**10.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**26.1**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**28800**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**8.9**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**16.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**8250**	10	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ00-4 (4090358-20) [Soil] Sampled: Aug-29-14 16:15, Continued						
Strong Acid Leachable Metals, Continued						
Manganese	**374**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.08**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**1.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**26.1**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**730**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1610**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.7**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**410**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**53.9**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**9.5**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**1060**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**24.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**63.6**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**81**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**4**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ02-1 (4090358-21) [Soil] Sampled: Aug-28-14 16:25						
General Parameters						
Carbon, Total Organic	**3.51**	0.05	% dry	N/A	Sep-11-14	
Moisture	**54.8**	0.1	% wet	N/A	Sep-05-14	
pH	**7.2**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**2.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.1**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2100**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**295**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**59**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**27**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**19400**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.6**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**9.4**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**205**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ02-1 (4090358-21) [Soil] Sampled: Aug-28-14 16:25, Continued						
Strong Acid Leachable Metals, Continued						
Boron	< 2	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.26**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**7100**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**33.6**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**11.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**22.3**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**28100**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**7.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**12.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**7460**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**616**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.07**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.9**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**21.4**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**788**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1400**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	< 0.5	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**392**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**50.1**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**7.5**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**1140**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**13.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**66.1**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**71**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**4**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ02-2 (4090358-22) [Soil] Sampled: Aug-28-14 16:25						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 56 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 40 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 25 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 19 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 12.5 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 4.75 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 2.36 mm	**2.7**	0.1	%	N/A	Sep-11-14	
> 2.0 mm	**0.5**	0.1	%	N/A	Sep-11-14	
> 1.18 mm	**2.6**	0.1	%	N/A	Sep-11-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ02-2 (4090358-22) [Soil] Sampled: Aug-28-14 16:25, Continued						
Particle Size Distribution, Continued						
> 600 µm	**5.1**	0.1	%	N/A	Sep-11-14	
> 425 µm	**2.4**	0.1	%	N/A	Sep-11-14	
> 300 µm	**6.0**	0.1	%	N/A	Sep-11-14	
> 150 µm	**17.2**	0.1	%	N/A	Sep-11-14	
> 75 µm	**16.2**	0.1	%	N/A	Sep-11-14	
< 75 µm	**47.3**	0.1	%	N/A	Sep-11-14	
Sample ID: AQ02-3 (4090358-23) [Soil] Sampled: Aug-28-14 16:25						
General Parameters						
Carbon, Total Organic	**2.58**	0.05	% dry	N/A	Sep-11-14	
Moisture	**58.6**	0.1	% wet	N/A	Sep-05-14	
pH	**7.3**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**2.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.1**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2500**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**330**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**83**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**21**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**17800**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**6.8**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**175**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	< 2	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**0.20**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**6190**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**30.4**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**9.3**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Copper	**17.7**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**24800**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**6.4**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**11.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**6730**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**453**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.05**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**0.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**19.0**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**698**	10	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ02-3 (4090358-23) [Soil] Sampled: Aug-28-14 16:25, Continued						
Strong Acid Leachable Metals, Continued						
Potassium	**1230**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	< 0.5	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**382**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**44.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**6.6**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**1130**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**11.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**58.9**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**62**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**4**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Sample ID: AQ02-4 (4090358-24) [Soil] Sampled: Aug-28-14 16:25						
General Parameters						
Carbon, Total Organic	**7.08**	0.05	% dry	N/A	Sep-11-14	
Moisture	**74.5**	0.1	% wet	N/A	Sep-05-14	
pH	**7.2**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**2.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	< 1.0	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**5000**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**630**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**72**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**30**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**15800**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Antimony	**0.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Arsenic	**11.3**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Barium	**295**	1	mg/kg dry	Sep-08-14	Sep-09-14	
Beryllium	**0.7**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Boron	**2**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Cadmium	**1.30**	0.04	mg/kg dry	Sep-08-14	Sep-09-14	
Calcium	**11400**	100	mg/kg dry	Sep-08-14	Sep-09-14	
Chromium	**32.4**	1.0	mg/kg dry	Sep-08-14	Sep-09-14	
Cobalt	**9.5**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ02-4 (4090358-24) [Soil] Sampled: Aug-28-14 16:25, Continued						
Strong Acid Leachable Metals, Continued						
Copper	**58.3**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Iron	**24600**	20	mg/kg dry	Sep-08-14	Sep-09-14	
Lead	**8.7**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Lithium	**7.1**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Magnesium	**5450**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Manganese	**615**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Mercury	**0.05**	0.05	mg/kg dry	Sep-08-14	Sep-09-14	
Molybdenum	**1.0**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Nickel	**37.4**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Phosphorus	**625**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Potassium	**1190**	10	mg/kg dry	Sep-08-14	Sep-09-14	
Selenium	**0.6**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Silicon	< 3000	3000	mg/kg dry	Sep-08-14	Sep-09-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sodium	**387**	40	mg/kg dry	Sep-08-14	Sep-09-14	
Strontium	**89.0**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Sulfur	**1200**	1000	mg/kg dry	Sep-08-14	Sep-09-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Thorium	**7.1**	0.5	mg/kg dry	Sep-08-14	Sep-09-14	
Tin	**0.6**	0.2	mg/kg dry	Sep-08-14	Sep-09-14	
Titanium	**668**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Uranium	**51.4**	0.1	mg/kg dry	Sep-08-14	Sep-09-14	
Vanadium	**49.1**	0.4	mg/kg dry	Sep-08-14	Sep-09-14	
Zinc	**82**	2	mg/kg dry	Sep-08-14	Sep-09-14	
Zirconium	**4**	2	mg/kg dry	Sep-08-14	Sep-09-14	

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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in fibatchesfl and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types includ

- **Method Blank (Blk)**: Laboratory reagent water is carried through sample preparation and analysis steps. Method Blanks indicate that results are free from contamination, i.e. not biased high from sources such as the sample container or the laboratory environment
- **Duplicate (Dup)**: Preparation and analysis of a replicate aliquot of a sample. Duplicates provide a measure of the analytical method's precision, i.e. how reproducible a result is. Duplicates are only reported if they are associated with your sample data.
- **Blank Spike (BS)**: A known amount of standard is carried through sample preparation and analysis steps. Blank Spikes, also known as laboratory control samples (LCS), are prepared from a different source of standard than used for the calibration. They ensure that the calibration is acceptable (i.e. not biased high or low) and also provide a measure of the analytical method's accuracy (i.e. closeness of the result to a target value).
- **Standard Reference Material (SRM)**: A material of similar matrix to the samples, externally certified for the parameter(s) listed. Standard Reference Materials ensure that the preparation steps in the method are adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
General Parameters, Batch B4I0216										
Duplicate (B4I0216-DUP1)		**Source: 4090358-24**		Prepared: Sep-05-14, Analyzed: Sep-05-14						
Moisture	72.8	0.1	% wet		74.5			2.3	40	
General Parameters, Batch B4I0224										
Blank (B4I0224-BLK1)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
Carbon, Total Organic	< 0.05	0.05	% dry							
Blank (B4I0224-BLK2)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
Carbon, Total Organic	< 0.05	0.05	% dry							
Duplicate (B4I0224-DUP1)		**Source: 4090358-01**		Prepared: Sep-10-14, Analyzed: Sep-10-14						
Carbon, Total Organic	4.14	0.05	% dry		4.22			2	30	
Duplicate (B4I0224-DUP2)		**Source: 4090358-20**		Prepared: Sep-10-14, Analyzed: Sep-10-14						
Carbon, Total Organic	4.47	0.05	% dry		4.67			4	30	
Reference (B4I0224-SRM1)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
Carbon, Total Organic	1.62	0.05	% dry	1.33		121	10-231			
Reference (B4I0224-SRM2)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
Carbon, Total Organic	1.51	0.05	% dry	1.33		114	10-231			
General Parameters, Batch B4I0397										
Reference (B4I0397-SRM1)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
pH	7.8	0.1	pH units	7.58		103	90-115			
Reference (B4I0397-SRM2)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
pH	7.7	0.1	pH units	7.58		102	90-115			
Particle Size Distribution, Batch B4I0469										

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
Particle Size Distribution, Batch B4I0469, Continued										
Duplicate (B4I0469-DUP1)		**Source: 4090358-18**		Prepared: Sep-11-14, Analyzed: Sep-11-14						
> 80 mm	< 0.1	0.1	%		< 0.1				30	
> 56 mm	< 0.1	0.1	%		< 0.1				30	
> 40 mm	< 0.1	0.1	%		< 0.1				30	
> 25 mm	< 0.1	0.1	%		< 0.1				30	
> 19 mm	< 0.1	0.1	%		< 0.1				30	
> 12.5 mm	< 0.1	0.1	%		< 0.1				30	
> 4.75 mm	< 0.1	0.1	%		< 0.1				30	
> 2.36 mm	< 0.1	0.1	%		0.1				30	
> 2.0 mm	0.1	0.1	%		< 0.1				30	
> 1.18 mm	0.8	0.1	%		1.0			19	30	
> 600 µm	2.2	0.1	%		2.2			< 1	30	
> 425 µm	2.3	0.1	%		2.2			4	30	
> 300 µm	6.3	0.1	%		6.3			< 1	30	
> 150 µm	24.3	0.1	%		24.0			1	30	
> 75 µm	22.8	0.1	%		22.3			2	30	
< 75 µm	41.2	0.1	%		41.8			2	30	
Strong Acid Leachable Metals, Batch B4I0277										
Blank (B4I0277-BLK1)				Prepared: Sep-08-14, Analyzed: Sep-09-14						
Aluminum	< 20	20	mg/kg dry							
Antimony	< 0.1	0.1	mg/kg dry							
Arsenic	< 0.4	0.4	mg/kg dry							
Barium	< 1	1	mg/kg dry							
Beryllium	< 0.1	0.1	mg/kg dry							
Bismuth	< 0.1	0.1	mg/kg dry							
Boron	< 2	2	mg/kg dry							
Cadmium	< 0.04	0.04	mg/kg dry							
Calcium	176	100	mg/kg dry							
Chromium	< 1.0	1.0	mg/kg dry							
Cobalt	< 0.1	0.1	mg/kg dry							
Copper	< 0.2	0.2	mg/kg dry							
Iron	< 20	20	mg/kg dry							
Lead	< 0.2	0.2	mg/kg dry							
Lithium	< 0.1	0.1	mg/kg dry							
Magnesium	< 10	10	mg/kg dry							
Manganese	< 0.4	0.4	mg/kg dry							
Mercury	< 0.05	0.05	mg/kg dry							
Molybdenum	< 0.1	0.1	mg/kg dry							
Nickel	< 0.4	0.4	mg/kg dry							
Phosphorus	< 10	10	mg/kg dry							
Potassium	< 10	10	mg/kg dry							
Selenium	< 0.5	0.5	mg/kg dry							
Silicon	< 3000	3000	mg/kg dry							
Silver	< 0.2	0.2	mg/kg dry							
Sodium	< 40	40	mg/kg dry							
Strontium	< 0.2	0.2	mg/kg dry							
Sulfur	< 1000	1000	mg/kg dry							
Tellurium	< 0.1	0.1	mg/kg dry							
Thallium	< 0.1	0.1	mg/kg dry							
Thorium	< 0.5	0.5	mg/kg dry							
Tin	< 0.2	0.2	mg/kg dry							
Titanium	< 2	2	mg/kg dry							
Uranium	< 0.1	0.1	mg/kg dry							
Vanadium	< 0.4	0.4	mg/kg dry							
Zinc	< 2	2	mg/kg dry							

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B4I0277, Continued										
Blank (B4I0277-BLK1), Continued				Prepared: Sep-08-14, Analyzed: Sep-09-14						
Zirconium	< 2	2	mg/kg dry							
Blank (B4I0277-BLK2)				Prepared: Sep-08-14, Analyzed: Sep-09-14						
Aluminum	< 20	20	mg/kg dry							
Antimony	< 0.1	0.1	mg/kg dry							
Arsenic	< 0.4	0.4	mg/kg dry							
Barium	< 1	1	mg/kg dry							
Beryllium	< 0.1	0.1	mg/kg dry							
Bismuth	< 0.1	0.1	mg/kg dry							
Boron	< 2	2	mg/kg dry							
Cadmium	< 0.04	0.04	mg/kg dry							
Calcium	< 100	100	mg/kg dry							
Chromium	< 1.0	1.0	mg/kg dry							
Cobalt	< 0.1	0.1	mg/kg dry							
Copper	< 0.2	0.2	mg/kg dry							
Iron	< 20	20	mg/kg dry							
Lead	< 0.2	0.2	mg/kg dry							
Lithium	< 0.1	0.1	mg/kg dry							
Magnesium	< 10	10	mg/kg dry							
Manganese	< 0.4	0.4	mg/kg dry							
Mercury	< 0.05	0.05	mg/kg dry							
Molybdenum	< 0.1	0.1	mg/kg dry							
Nickel	< 0.4	0.4	mg/kg dry							
Phosphorus	< 10	10	mg/kg dry							
Potassium	< 10	10	mg/kg dry							
Selenium	< 0.5	0.5	mg/kg dry							
Silicon	< 3000	3000	mg/kg dry							
Silver	< 0.2	0.2	mg/kg dry							
Sodium	< 40	40	mg/kg dry							
Strontium	< 0.2	0.2	mg/kg dry							
Sulfur	< 1000	1000	mg/kg dry							
Tellurium	< 0.1	0.1	mg/kg dry							
Thallium	< 0.1	0.1	mg/kg dry							
Thorium	< 0.5	0.5	mg/kg dry							
Tin	< 0.2	0.2	mg/kg dry							
Titanium	< 2	2	mg/kg dry							
Uranium	< 0.1	0.1	mg/kg dry							
Vanadium	< 0.4	0.4	mg/kg dry							
Zinc	< 2	2	mg/kg dry							
Zirconium	< 2	2	mg/kg dry							
Duplicate (B4I0277-DUP2)				**Source: 4090358-17**	Prepared: Sep-08-14, Analyzed: Sep-09-14					
Aluminum	19700	20	mg/kg dry		18800			5	24	
Antimony	0.7	0.1	mg/kg dry		0.7			2	60	
Arsenic	9.3	0.4	mg/kg dry		8.8			5	42	
Barium	202	1	mg/kg dry		193			5	38	
Beryllium	0.4	0.1	mg/kg dry		0.5			3	37	
Bismuth	0.2	0.1	mg/kg dry		0.2				33	
Boron	2	2	mg/kg dry		2				29	
Cadmium	0.23	0.04	mg/kg dry		0.22			2	32	
Calcium	7000	100	mg/kg dry		6560			7	33	
Chromium	34.5	1.0	mg/kg dry		32.6			6	32	
Cobalt	10.5	0.1	mg/kg dry		10.1			3	26	
Copper	24.4	0.2	mg/kg dry		23.3			4	38	
Iron	26900	20	mg/kg dry		25800			4	28	
Lead	8.8	0.2	mg/kg dry		8.4			5	46	
Lithium	13.4	0.1	mg/kg dry		12.5			7	28	

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B4I0277, Continued										
Duplicate (B4I0277-DUP2), Continued		**Source: 4090358-17**		Prepared: Sep-08-14, Analyzed: Sep-09-14						
Magnesium	7650	10	mg/kg dry		7340			4	23	
Manganese	333	0.4	mg/kg dry		320			4	23	
Mercury	0.07	0.05	mg/kg dry		0.08				42	
Molybdenum	1.0	0.1	mg/kg dry		0.9			16	52	
Nickel	21.7	0.4	mg/kg dry		20.8			4	29	
Phosphorus	753	10	mg/kg dry		721			4	20	
Potassium	1440	10	mg/kg dry		1400			3	28	
Selenium	0.5	0.5	mg/kg dry		0.5				19	
Silicon	< 3000	3000	mg/kg dry		< 3000				18	
Silver	< 0.2	0.2	mg/kg dry		< 0.2				35	
Sodium	383	40	mg/kg dry		355			8	23	
Strontium	48.4	0.2	mg/kg dry		45.9			5	25	
Sulfur	< 1000	1000	mg/kg dry		< 1000				26	
Tellurium	< 0.1	0.1	mg/kg dry		< 0.1				38	
Thallium	0.2	0.1	mg/kg dry		0.2				27	
Thorium	7.4	0.5	mg/kg dry		8.4			12	39	
Tin	0.7	0.2	mg/kg dry		0.6				85	
Titanium	1160	2	mg/kg dry		1050			11	29	
Uranium	18.1	0.1	mg/kg dry		17.0			6	36	
Vanadium	64.5	0.4	mg/kg dry		61.2			5	23	
Zinc	74	2	mg/kg dry		72			3	30	
Zirconium	4	2	mg/kg dry		4				32	
Reference (B4I0277-SRM1)				Prepared: Sep-08-14, Analyzed: Sep-09-14						
Aluminum	19400	20	mg/kg dry	18200		107	86-118			
Antimony	6.8	0.1	mg/kg dry	6.27		108	73-138			
Arsenic	15.6	0.4	mg/kg dry	15.4		102	87-106			
Barium	82	1	mg/kg dry	80.6		101	72-119			
Beryllium	0.7	0.1	mg/kg dry	0.544		124	73-128			
Bismuth	1.9	0.1	mg/kg dry	2.12		91	78-97			
Boron	3	2	mg/kg dry	2.68		122	58-139			
Cadmium	0.21	0.04	mg/kg dry	0.230		93	88-121			
Calcium	3700	100	mg/kg dry	3320		112	92-113			
Chromium	29.5	1.0	mg/kg dry	27.2		108	91-113			
Cobalt	13.3	0.1	mg/kg dry	12.5		106	90-109			
Copper	47.6	0.2	mg/kg dry	44.9		106	92-112			
Iron	35600	20	mg/kg dry	33300		107	91-112			
Lead	13.3	0.2	mg/kg dry	14.4		92	89-111			
Lithium	10.4	0.1	mg/kg dry	9.26		113	73-124			
Magnesium	6500	10	mg/kg dry	5830		112	89-116			
Manganese	1180	0.4	mg/kg dry	1100		107	93-112			
Mercury	0.10	0.05	mg/kg dry	0.0980		102	74-126			
Molybdenum	0.7	0.1	mg/kg dry	0.738		95	93-120			
Nickel	18.8	0.4	mg/kg dry	17.4		108	93-110			
Phosphorus	790	10	mg/kg dry	796		99	86-111			
Potassium	684	10	mg/kg dry	619		111	83-117			
Sodium	406	40	mg/kg dry	340		119	79-130			
Strontium	12.5	0.2	mg/kg dry	11.6		107	85-116			
Thorium	4.0	0.5	mg/kg dry	4.46		90	78-100			
Tin	1.1	0.2	mg/kg dry	1.10		98	78-120			
Titanium	899	2	mg/kg dry	764		118	72-143			
Uranium	0.9	0.1	mg/kg dry	0.940		92	80-102			
Vanadium	60.0	0.4	mg/kg dry	54.9		109	87-116			
Zinc	74	2	mg/kg dry	67.5		109	91-113			
Reference (B4I0277-SRM2)				Prepared: Sep-08-14, Analyzed: Sep-09-14						
Aluminum	19200	20	mg/kg dry	18200		106	86-118			

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090358
REPORTED Sep-17-14

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B4I0277, Continued										
Reference (B4I0277-SRM2), Continued				Prepared: Sep-08-14, Analyzed: Sep-09-14						
Antimony	6.7	0.1	mg/kg dry	6.27		107	73-138			
Arsenic	15.7	0.4	mg/kg dry	15.4		102	87-106			
Barium	82	1	mg/kg dry	80.6		102	72-119			
Beryllium	0.6	0.1	mg/kg dry	0.544		107	73-128			
Bismuth	1.9	0.1	mg/kg dry	2.12		89	78-97			
Boron	3	2	mg/kg dry	2.68		120	58-139			
Cadmium	0.20	0.04	mg/kg dry	0.230		88	88-121			
Calcium	3400	100	mg/kg dry	3320		102	92-113			
Chromium	29.2	1.0	mg/kg dry	27.2		107	91-113			
Cobalt	13.3	0.1	mg/kg dry	12.5		106	90-109			
Copper	47.4	0.2	mg/kg dry	44.9		106	92-112			
Iron	35500	20	mg/kg dry	33300		107	91-112			
Lead	13.4	0.2	mg/kg dry	14.4		93	89-111			
Lithium	9.6	0.1	mg/kg dry	9.26		103	73-124			
Magnesium	6350	10	mg/kg dry	5830		109	89-116			
Manganese	1170	0.4	mg/kg dry	1100		106	93-112			
Mercury	0.10	0.05	mg/kg dry	0.0980		104	74-126			
Molybdenum	0.7	0.1	mg/kg dry	0.738		96	93-120			
Nickel	18.6	0.4	mg/kg dry	17.4		107	93-110			
Phosphorus	783	10	mg/kg dry	796		98	86-111			
Potassium	696	10	mg/kg dry	619		112	83-117			
Sodium	388	40	mg/kg dry	340		114	79-130			
Strontium	11.9	0.2	mg/kg dry	11.6		103	85-116			
Thorium	4.2	0.5	mg/kg dry	4.46		93	78-100			
Tin	1.1	0.2	mg/kg dry	1.10		96	78-120			
Titanium	920	2	mg/kg dry	764		120	72-143			
Uranium	0.9	0.1	mg/kg dry	0.940		93	80-102			
Vanadium	58.8	0.4	mg/kg dry	54.9		107	87-116			
Zinc	74	2	mg/kg dry	67.5		109	91-113			

CERTIFICATE OF ANALYSIS

REPORTED TO	Palmer Environmental Consulting Group Inc. 470 Granville Street - Suite 630 Vancouver, BC V6C 1V5	**TEL** **FAX**	(604) 629-9075 -
ATTENTION	May Quach	**WORK ORDER**	4090397
PO NUMBER		**RECEIVED / TEMP**	Sep-04-14 13:25 / 14°C
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14
PROJECT INFO		**COC NUMBER**	B 24486

General Comments:

CARO Analytical Services employs methods which are conducted according to procedures accepted by appropriate regulatory agencies, and/or are conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts, except where otherwise agreed to by the client.

The results in this report apply to the samples analyzed in accordance with the Chain of Custody or Sample Requisition document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

Issued By: **Jennifer Shanko, AScT For Jaime Tkachuk, BSc, PChem**
Account Manager

Please contact CARO if more information is needed or to provide feedback on our services.

Locations:

#110 4011 Viking Way
Richmond, BC V6V 2K9
Tel: 604-279-1499 Fax: 604-279-1599

#102 3677 Highway 97N
Kelowna, BC V1X 5C3
Tel: 250-765-9646 Fax: 250-765-3893

17225 109 Avenue
Edmonton, AB T5S 1H7
Tel: 780-489-9100 Fax: 780-489-9700

www.caro.ca

ANALYSIS INFORMATION

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090397
REPORTED Sep-17-14

Analysis Description	Method Reference	Technique	Location
Available Cations (Ca/Mg/K/Na)	MSSMA 4.51	1N Ammonium Acetate Extraction, Atomic Spectroscopy	Sublet
Available NH4-N and NO3-N in Soil	Carter 4	Nitrate and Exchangeable Ammonium Nitrogen	Sublet
Carbon, Total Organic in Solids	Carter 21.2	Catalytic Combustion and Infrared Detection	Kelowna
Particle Size - Dry Sieve Fractions	N/A	N/A - RMD Inorganics	Richmond
pH in Soil (1:2 Soil/Water)	Carter 16.2 / APHA 4500-H+ B	1:2 Soil/Water Slurry / Electrometry	Richmond
Phosphorus, Available (Bray)	UBCPLMM 6.1	Bray Extraction, Colorimetric	Sublet
Strong Acid Leachable Metals	BCMOE SALM V.2 / EPA 6020A	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond

Method Reference Descriptions:

APHA	Standard Methods for the Examination of Water and Wastewater, 22nd Edition, American Public Health Association/American Water Works Association/Water Environment Federation
Carter	Soil Sampling and Methods of Analysis, 2nd Edition (2007), Carter/Gregorich
EPA	United States Environmental Protection Agency Test Methods
MSSMA	Manual on Soil Sampling and Methods of Analysis, J.A. McKeague
UBCPLMM	Methods Manual, Pedology Laboratory, 1977/1981, L.M. Lavkulich, UBC Department of Soil Science

Glossary of Terms:

MRL	Method Reporting Limit
<	Less than the Reported Detection Limit (RDL) - the RDL may be higher than the MRL due to various factors such as dilutions, limited sample volume, high moisture, or interferences
%	Percent
% dry	Percent (dry weight)
mg/kg dry	Milligrams per kilogram (dry weight)
pH units	pH < 7 = acidic, ph > 7 = basic

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090397
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04-1 (4090397-01) [Soil] Sampled: Aug-30-14 08:40						
General Parameters						
Carbon, Total Organic	**6.12**	0.05	% dry	N/A	Sep-11-14	
pH	**5.7**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**5.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**9.7**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2500**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**267**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**192**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**37**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**20600**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**21.3**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**176**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.58**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**6000**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**32.1**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**13.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**18.4**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**29600**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**14.4**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**21.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**5030**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**1030**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.17**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**21.3**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**602**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**904**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**1.0**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**260**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**46.9**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	**1200**	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**14.7**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.8**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090397
REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04-1 (4090397-01) [Soil] Sampled: Aug-30-14 08:40, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**894**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**20.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**55.3**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**108**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**5**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ04-2 (4090397-02) [Soil] Sampled: Aug-30-14 08:40						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 56 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 40 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 25 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 19 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 12.5 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 4.75 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 2.36 mm	**7.2**	0.1	%	N/A	Sep-11-14	
> 2.0 mm	**1.0**	0.1	%	N/A	Sep-11-14	
> 1.18 mm	**5.4**	0.1	%	N/A	Sep-11-14	
> 600 µm	**13.4**	0.1	%	N/A	Sep-11-14	
> 425 µm	**8.3**	0.1	%	N/A	Sep-11-14	
> 300 µm	**8.3**	0.1	%	N/A	Sep-11-14	
> 150 µm	**13.2**	0.1	%	N/A	Sep-11-14	
> 75 µm	**10.1**	0.1	%	N/A	Sep-11-14	
< 75 µm	**33.2**	0.1	%	N/A	Sep-11-14	
Sample ID: AQ04-3 (4090397-03) [Soil] Sampled: Aug-30-14 08:40						
General Parameters						
Carbon, Total Organic	**5.99**	0.05	% dry	N/A	Sep-11-14	
pH	**6.8**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	< 1.0	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.5**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**1050**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**150**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**38**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**21**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**16500**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**20.0**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090397
REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04-3 (4090397-03) [Soil] Sampled: Aug-30-14 08:40, Continued						
Strong Acid Leachable Metals, Continued						
Barium	**225**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	< 2	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.42**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**5770**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**31.4**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**22.4**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**15.2**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**27400**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**13.8**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**13.9**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**5410**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**4140**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.11**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**1.1**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**20.0**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**568**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**941**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.7**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**246**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**44.7**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**12.2**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.8**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**920**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**10.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**56.6**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**79**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ04-4 (4090397-04) [Soil] Sampled: Aug-30-14 08:40						
General Parameters						
Carbon, Total Organic	**7.00**	0.05	% dry	N/A	Sep-11-14	
pH	**6.9**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**10.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**13.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**6**	2	mg/kg dry	N/A	Sep-12-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090397
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04-4 (4090397-04) [Soil] Sampled: Aug-30-14 08:40, Continued						
Exchangeable Ions						
Calcium, Available	**3750**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**475**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**183**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**50**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**20300**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**28.0**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**177**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**1.1**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.56**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**7120**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**32.5**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**12.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**22.6**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**29200**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**13.4**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**24.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**5150**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**1050**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.17**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.9**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**22.7**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**624**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**899**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**1.3**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**240**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**59.3**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**15.8**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**1.5**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**758**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**26.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**56.6**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**111**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ13-1 (4090397-05) [Soil] Sampled: Aug-30-14 10:30						

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090397
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ13-1 (4090397-05) [Soil] Sampled: Aug-30-14 10:30, Continued						
General Parameters						
Carbon, Total Organic	**4.87**	0.05	% dry	N/A	Sep-11-14	
pH	**6.9**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	< 1.0	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.1**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**6**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**4200**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**225**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**104**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**27**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**19900**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**25.5**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**149**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	< 2	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.17**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**7660**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**56.9**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**11.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**21.0**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**26000**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**9.5**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**16.1**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**8050**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**540**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.06**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**32.4**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**479**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**2110**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.6**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**308**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**54.0**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**11.0**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**1.1**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090397
REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ13-1 (4090397-05) [Soil] Sampled: Aug-30-14 10:30, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**1240**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**7.1**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**51.3**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**65**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ13-2 (4090397-06) [Soil] Sampled: Aug-30-14 10:30						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 56 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 40 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 25 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 19 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 12.5 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 4.75 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 2.36 mm	**1.6**	0.1	%	N/A	Sep-11-14	
> 2.0 mm	**0.7**	0.1	%	N/A	Sep-11-14	
> 1.18 mm	**3.3**	0.1	%	N/A	Sep-11-14	
> 600 µm	**7.4**	0.1	%	N/A	Sep-11-14	
> 425 µm	**5.9**	0.1	%	N/A	Sep-11-14	
> 300 µm	**7.4**	0.1	%	N/A	Sep-11-14	
> 150 µm	**17.7**	0.1	%	N/A	Sep-11-14	
> 75 µm	**18.9**	0.1	%	N/A	Sep-11-14	
< 75 µm	**37.1**	0.1	%	N/A	Sep-11-14	
Sample ID: AQ13-3 (4090397-07) [Soil] Sampled: Aug-30-14 10:30						
General Parameters						
Carbon, Total Organic	**5.17**	0.05	% dry	N/A	Sep-11-14	
pH	**6.6**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	< 1.0	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.2**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**10**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**3650**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**200**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**91**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**29**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**19300**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**21.5**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090397
REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ13-3 (4090397-07) [Soil] Sampled: Aug-30-14 10:30, Continued						
Strong Acid Leachable Metals, Continued						
Barium	**151**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	< 2	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.19**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**7460**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**51.8**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**11.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**19.5**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**25100**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**10.2**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**14.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**7290**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**632**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.07**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**29.9**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**498**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1890**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.6**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**288**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**52.7**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**11.8**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**1.1**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**1130**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**6.5**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**49.4**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**66**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**4**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ13-4 (4090397-08) [Soil] Sampled: Aug-30-14 10:30						
General Parameters						
Carbon, Total Organic	**4.34**	0.05	% dry	N/A	Sep-10-14	
pH	**6.8**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	< 1.0	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.4**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**9**	2	mg/kg dry	N/A	Sep-12-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090397
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ13-4 (4090397-08) [Soil] Sampled: Aug-30-14 10:30, Continued						
Exchangeable Ions						
Calcium, Available	**3700**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**230**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**114**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**26**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**19200**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**23.9**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**149**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.16**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**7480**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**54.3**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**11.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**19.9**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**24900**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**9.7**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**14.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**7590**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**558**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.06**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**31.6**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**486**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1960**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.6**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**291**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**52.6**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**11.3**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**1.1**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**1200**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**6.5**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**48.0**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**64**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ13-5 (4090397-09) [Soil] Sampled: Aug-30-14 10:30						

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090397
REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ13-5 (4090397-09) [Soil] Sampled: Aug-30-14 10:30, Continued						
General Parameters						
Carbon, Total Organic	**4.20**	0.05	% dry	N/A	Sep-10-14	
pH	**6.4**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	< 1.0	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**3.1**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**7**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**3400**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**180**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**130**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**19**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**19700**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**24.6**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**154**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	< 2	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.15**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**7920**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**60.1**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**12.1**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**21.8**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**26300**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**9.1**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**14.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**8050**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**520**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.08**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**34.8**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**543**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**2280**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.6**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**325**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**53.7**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**12.0**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**1.1**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090397
REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ13-5 (4090397-09) [Soil] Sampled: Aug-30-14 10:30, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**1220**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**7.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**50.6**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**61**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ10-1 (4090397-10) [Soil] Sampled: Aug-29-14 09:10						
General Parameters						
Carbon, Total Organic	**3.49**	0.05	% dry	N/A	Sep-10-14	
pH	**7.1**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**4.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**2.1**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2000**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**255**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**78**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**26**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**17900**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**16.2**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**199**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.5**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.51**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**7760**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**35.9**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**12.4**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**22.6**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**27700**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**12.5**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**19.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**6430**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**776**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.11**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.9**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**26.6**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**744**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1270**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.9**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090397
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ10-1 (4090397-10) [Soil] Sampled: Aug-29-14 09:10, Continued						
Strong Acid Leachable Metals, Continued						
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**317**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**52.0**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**10.3**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.7**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**1050**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**14.0**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**59.4**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**88**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ10-2 (4090397-11) [Soil] Sampled: Aug-29-14 09:10						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 56 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 40 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 25 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 19 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 12.5 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 4.75 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 2.36 mm	**0.2**	0.1	%	N/A	Sep-11-14	
> 2.0 mm	**0.2**	0.1	%	N/A	Sep-11-14	
> 1.18 mm	**1.9**	0.1	%	N/A	Sep-11-14	
> 600 µm	**6.3**	0.1	%	N/A	Sep-11-14	
> 425 µm	**8.2**	0.1	%	N/A	Sep-11-14	
> 300 µm	**13.4**	0.1	%	N/A	Sep-11-14	
> 150 µm	**24.3**	0.1	%	N/A	Sep-11-14	
> 75 µm	**14.7**	0.1	%	N/A	Sep-11-14	
< 75 µm	**30.7**	0.1	%	N/A	Sep-11-14	
Sample ID: AQ10-3 (4090397-12) [Soil] Sampled: Aug-29-14 09:10						
General Parameters						
Carbon, Total Organic	**2.74**	0.05	% dry	N/A	Sep-10-14	
pH	**6.9**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**6.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**2.4**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Sep-12-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090397
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ10-3 (4090397-12) [Soil] Sampled: Aug-29-14 09:10, Continued						
Exchangeable Ions						
Calcium, Available	**2000**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**260**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**70**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**20**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**16100**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**16.3**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**165**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.27**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**6790**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**34.4**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**10.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**19.4**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**25000**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**11.4**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**16.5**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**6410**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**498**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.06**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**23.3**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**683**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1200**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.7**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**301**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**43.2**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**9.0**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.6**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**1020**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**9.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**55.6**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**76**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ10-4 (4090397-13) [Soil] Sampled: Aug-29-14 09:10						

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090397
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ10-4 (4090397-13) [Soil] Sampled: Aug-29-14 09:10, Continued						
General Parameters						
Carbon, Total Organic	**2.34**	0.05	% dry	N/A	Sep-10-14	
pH	**7.2**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**6.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**2.2**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**3**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2500**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**360**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**111**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**55**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**17800**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**12.7**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**180**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.35**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**6980**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**35.8**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**11.4**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**18.7**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**26800**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**11.8**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**19.5**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**6540**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**615**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.07**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**24.9**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**670**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1240**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.9**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**319**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**46.9**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**9.8**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.7**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090397
PROJECT	Coffee Gold	**REPORTED**	Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ10-4 (4090397-13) [Soil] Sampled: Aug-29-14 09:10, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**1160**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**11.4**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**57.2**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**85**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ10-5 (4090397-14) [Soil] Sampled: Aug-29-14 09:10						
General Parameters						
Carbon, Total Organic	**3.12**	0.05	% dry	N/A	Sep-10-14	
pH	**7.1**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**8.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**2.7**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**2**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2500**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**360**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**121**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**27**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**18900**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**13.7**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**192**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.34**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**7210**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**38.1**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**11.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**20.0**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**28200**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**12.2**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**21.0**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**6920**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**595**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.08**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**26.3**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**679**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1320**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.8**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

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REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ10-5 (4090397-14) [Soil] Sampled: Aug-29-14 09:10, Continued						
Strong Acid Leachable Metals, Continued						
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**326**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**48.8**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**10.0**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.8**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**1180**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**11.4**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**59.0**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**89**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**4**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ30-1 (4090397-15) [Soil] Sampled: Aug-29-14 14:30						
General Parameters						
Carbon, Total Organic	**4.37**	0.05	% dry	N/A	Sep-10-14	
pH	**6.8**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**4.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.6**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**6**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**3550**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**275**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**57**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**25**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**14700**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**1.0**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**10.7**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**198**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.23**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**7930**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**30.9**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**9.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**17.8**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**23400**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**12.6**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold
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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ30-1 (4090397-15) [Soil] Sampled: Aug-29-14 14:30, Continued						
Strong Acid Leachable Metals, Continued						
Lithium	**11.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**5670**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**518**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.06**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**18.8**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**605**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1160**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.7**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**253**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**58.1**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**12.7**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.8**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**876**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**6.1**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**46.2**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**60**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ30-2 (4090397-16) [Soil] Sampled: Aug-29-14 14:30						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 56 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 40 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 25 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 19 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 12.5 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 4.75 mm	< 0.1	0.1	%	N/A	Sep-11-14	
> 2.36 mm	**4.7**	0.1	%	N/A	Sep-11-14	
> 2.0 mm	**1.0**	0.1	%	N/A	Sep-11-14	
> 1.18 mm	**2.7**	0.1	%	N/A	Sep-11-14	
> 600 µm	**7.7**	0.1	%	N/A	Sep-11-14	
> 425 µm	**7.4**	0.1	%	N/A	Sep-11-14	
> 300 µm	**10.2**	0.1	%	N/A	Sep-11-14	
> 150 µm	**30.5**	0.1	%	N/A	Sep-11-14	
> 75 µm	**14.0**	0.1	%	N/A	Sep-11-14	
< 75 µm	**21.8**	0.1	%	N/A	Sep-11-14	
Sample ID: AQ30-3 (4090397-17) [Soil] Sampled: Aug-29-14 14:30						

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090397
REPORTED Sep-17-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ30-3 (4090397-17) [Soil] Sampled: Aug-29-14 14:30, Continued						
General Parameters						
Carbon, Total Organic	**13.0**	0.05	% dry	N/A	Sep-10-14	
pH	**6.4**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**8.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.1**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**15**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**3100**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**310**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**79**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**42**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**13400**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**1.1**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**12.9**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**197**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.30**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**9770**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**26.8**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**10.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**20.9**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**21900**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**12.5**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**10.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**5140**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**698**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.06**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.9**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**18.0**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**696**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1170**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**1.0**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**219**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**71.4**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**11.9**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.8**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ30-3 (4090397-17) [Soil] Sampled: Aug-29-14 14:30, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**769**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**10.0**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**42.5**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**62**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**4**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ30-4 (4090397-18) [Soil] Sampled: Aug-29-14 14:30						
General Parameters						
Carbon, Total Organic	**4.88**	0.05	% dry	N/A	Sep-10-14	
pH	**6.8**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**5.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.5**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**6**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**4700**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**385**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**71**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**29**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**15100**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**1.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**14.6**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**202**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.21**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**7970**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**31.3**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**10.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**19.9**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**24600**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**12.4**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**12.9**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**5920**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**544**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.10**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.9**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**20.0**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**609**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1250**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.8**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ30-4 (4090397-18) [Soil] Sampled: Aug-29-14 14:30, Continued						
Strong Acid Leachable Metals, Continued						
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**230**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**60.2**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**11.9**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.7**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**786**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**6.9**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**47.0**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**64**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ30-5 (4090397-19) [Soil] Sampled: Aug-29-14 14:30						
General Parameters						
Carbon, Total Organic	**6.26**	0.05	% dry	N/A	Sep-10-14	
pH	**6.7**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**7.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.8**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**7**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**4500**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**410**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**94**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**30**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**15100**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**1.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**15.5**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**211**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.3**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.21**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**8330**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**31.0**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**10.4**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**20.6**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**24900**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**13.0**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ30-5 (4090397-19) [Soil] Sampled: Aug-29-14 14:30, Continued						
Strong Acid Leachable Metals, Continued						
Lithium	**12.5**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**5920**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**585**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.07**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.9**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**20.0**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**576**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1290**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**0.8**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**229**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**62.2**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**11.9**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.7**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**722**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**7.5**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**46.3**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**64**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**3**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ03-4 (4090397-20) [Soil] Sampled: Aug-29-14 18:15						
General Parameters						
Carbon, Total Organic	**5.10**	0.05	% dry	N/A	Sep-10-14	
pH	**7.6**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**10.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**1.4**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**7**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2170**	5	mg/kg dry	N/A	Sep-12-14	
Magnesium, Available	**300**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**102**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**43**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**19200**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**12.5**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**184**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ03-4 (4090397-20) [Soil] Sampled: Aug-29-14 18:15, Continued						
Strong Acid Leachable Metals, Continued						
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.39**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**8380**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**32.6**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**11.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**20.7**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**25700**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**12.3**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**19.0**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**5970**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**697**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.14**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**24.6**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**597**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1270**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**1.5**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**246**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**81.3**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**14.6**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.6**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**891**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**10.1**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**45.3**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**88**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**4**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Sample ID: AQ03-5 (4090397-21) [Soil] Sampled: Aug-29-14 18:15						
General Parameters						
Carbon, Total Organic	**4.01**	0.05	% dry	N/A	Sep-10-14	
pH	**7.8**	0.1	pH units	Sep-10-14	Sep-10-14	
Fertility / Nutrient Parameters						
Nitrogen, Ammonia as N, Available	**10.0**	1.0	mg/kg dry	N/A	Sep-12-14	
Nitrogen, Nitrate as N, Available	**3.4**	1.0	mg/kg dry	N/A	Sep-12-14	
Phosphorus, Available	**6**	2	mg/kg dry	N/A	Sep-12-14	
Exchangeable Ions						
Calcium, Available	**2670**	5	mg/kg dry	N/A	Sep-12-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ03-5 (4090397-21) [Soil] Sampled: Aug-29-14 18:15, Continued						
Exchangeable Ions, Continued						
Magnesium, Available	**333**	5	mg/kg dry	N/A	Sep-12-14	
Potassium, Available	**102**	5	mg/kg dry	N/A	Sep-12-14	
Sodium, Available	**25**	5	mg/kg dry	N/A	Sep-12-14	
Strong Acid Leachable Metals						
Aluminum	**20200**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Antimony	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Arsenic	**12.8**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Barium	**183**	1	mg/kg dry	Sep-09-14	Sep-10-14	
Beryllium	**0.7**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Boron	**2**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Cadmium	**0.39**	0.04	mg/kg dry	Sep-09-14	Sep-10-14	
Calcium	**8430**	100	mg/kg dry	Sep-09-14	Sep-10-14	
Chromium	**32.1**	1.0	mg/kg dry	Sep-09-14	Sep-10-14	
Cobalt	**12.1**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Copper	**19.7**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Iron	**25400**	20	mg/kg dry	Sep-09-14	Sep-10-14	
Lead	**12.3**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Lithium	**19.8**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Magnesium	**5570**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Manganese	**712**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Mercury	**0.15**	0.05	mg/kg dry	Sep-09-14	Sep-10-14	
Molybdenum	**0.6**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Nickel	**23.9**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Phosphorus	**600**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Potassium	**1180**	10	mg/kg dry	Sep-09-14	Sep-10-14	
Selenium	**1.3**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Silicon	< 3000	3000	mg/kg dry	Sep-09-14	Sep-10-14	
Silver	< 0.2	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sodium	**279**	40	mg/kg dry	Sep-09-14	Sep-10-14	
Strontium	**80.5**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Sulfur	< 1000	1000	mg/kg dry	Sep-09-14	Sep-10-14	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thallium	**0.2**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Thorium	**14.8**	0.5	mg/kg dry	Sep-09-14	Sep-10-14	
Tin	**0.8**	0.2	mg/kg dry	Sep-09-14	Sep-10-14	
Titanium	**891**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Uranium	**12.9**	0.1	mg/kg dry	Sep-09-14	Sep-10-14	
Vanadium	**46.7**	0.4	mg/kg dry	Sep-09-14	Sep-10-14	
Zinc	**95**	2	mg/kg dry	Sep-09-14	Sep-10-14	
Zirconium	**4**	2	mg/kg dry	Sep-09-14	Sep-10-14	

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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in fibatchesfl and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types includ

- **Method Blank (Blk)**: Laboratory reagent water is carried through sample preparation and analysis steps. Method Blanks indicate that results are free from contamination, i.e. not biased high from sources such as the sample container or the laboratory environment
- **Duplicate (Dup)**: Preparation and analysis of a replicate aliquot of a sample. Duplicates provide a measure of the analytical method's precision, i.e. how reproducible a result is. Duplicates are only reported if they are associated with your sample data.
- **Blank Spike (BS)**: A known amount of standard is carried through sample preparation and analysis steps. Blank Spikes, also known as laboratory control samples (LCS), are prepared from a different source of standard than used for the calibration. They ensure that the calibration is acceptable (i.e. not biased high or low) and also provide a measure of the analytical method's accuracy (i.e. closeness of the result to a target value).
- **Standard Reference Material (SRM)**: A material of similar matrix to the samples, externally certified for the parameter(s) listed. Standard Reference Materials ensure that the preparation steps in the method are adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
General Parameters, Batch B4I0224										
Blank (B4I0224-BLK1)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
Carbon, Total Organic	< 0.05	0.05	% dry							
Blank (B4I0224-BLK2)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
Carbon, Total Organic	< 0.05	0.05	% dry							
Reference (B4I0224-SRM1)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
Carbon, Total Organic	1.62	0.05	% dry	1.33		121	10-231			
Reference (B4I0224-SRM2)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
Carbon, Total Organic	1.51	0.05	% dry	1.33		114	10-231			
General Parameters, Batch B4I0397										
Duplicate (B4I0397-DUP1)		**Source: 4090397-08**		Prepared: Sep-10-14, Analyzed: Sep-10-14						
pH	6.8	0.1	pH units		6.8			< 1	4	
Reference (B4I0397-SRM1)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
pH	7.8	0.1	pH units	7.58		103	90-115			
Reference (B4I0397-SRM2)				Prepared: Sep-10-14, Analyzed: Sep-10-14						
pH	7.7	0.1	pH units	7.58		102	90-115			
Strong Acid Leachable Metals, Batch B4I0337										
Blank (B4I0337-BLK1)				Prepared: Sep-09-14, Analyzed: Sep-10-14						
Aluminum	< 20	20	mg/kg dry							
Antimony	< 0.1	0.1	mg/kg dry							
Arsenic	< 0.4	0.4	mg/kg dry							
Barium	< 1	1	mg/kg dry							
Beryllium	< 0.1	0.1	mg/kg dry							
Bismuth	< 0.1	0.1	mg/kg dry							
Boron	< 2	2	mg/kg dry							

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090397
REPORTED Sep-17-14

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B4I0337, Continued										
Blank (B4I0337-BLK1), Continued				Prepared: Sep-09-14, Analyzed: Sep-10-14						
Cadmium	< 0.04	0.04	mg/kg dry							
Calcium	< 100	100	mg/kg dry							
Chromium	< 1.0	1.0	mg/kg dry							
Cobalt	< 0.1	0.1	mg/kg dry							
Copper	< 0.2	0.2	mg/kg dry							
Iron	< 20	20	mg/kg dry							
Lead	< 0.2	0.2	mg/kg dry							
Lithium	< 0.1	0.1	mg/kg dry							
Magnesium	< 10	10	mg/kg dry							
Manganese	< 0.4	0.4	mg/kg dry							
Mercury	< 0.05	0.05	mg/kg dry							
Molybdenum	< 0.1	0.1	mg/kg dry							
Nickel	< 0.4	0.4	mg/kg dry							
Phosphorus	< 10	10	mg/kg dry							
Potassium	< 10	10	mg/kg dry							
Selenium	< 0.5	0.5	mg/kg dry							
Silicon	< 3000	3000	mg/kg dry							
Silver	< 0.2	0.2	mg/kg dry							
Sodium	< 40	40	mg/kg dry							
Strontium	< 0.2	0.2	mg/kg dry							
Sulfur	< 1000	1000	mg/kg dry							
Tellurium	< 0.1	0.1	mg/kg dry							
Thallium	< 0.1	0.1	mg/kg dry							
Thorium	< 0.5	0.5	mg/kg dry							
Tin	< 0.2	0.2	mg/kg dry							
Titanium	< 2	2	mg/kg dry							
Uranium	< 0.1	0.1	mg/kg dry							
Vanadium	< 0.4	0.4	mg/kg dry							
Zinc	< 2	2	mg/kg dry							
Zirconium	< 2	2	mg/kg dry							
Reference (B4I0337-SRM1)				Prepared: Sep-09-14, Analyzed: Sep-10-14						
Aluminum	17400	20	mg/kg dry	18200		96	86-118			
Antimony	6.8	0.1	mg/kg dry	6.27		109	73-138			
Arsenic	15.3	0.4	mg/kg dry	15.4		100	87-106			
Barium	86	1	mg/kg dry	80.6		106	72-119			
Beryllium	0.7	0.1	mg/kg dry	0.544		127	73-128			
Bismuth	2.0	0.1	mg/kg dry	2.12		96	78-97			
Boron	4	2	mg/kg dry	2.68		136	58-139			
Cadmium	0.21	0.04	mg/kg dry	0.230		90	88-121			
Calcium	3740	100	mg/kg dry	3320		113	92-113			
Chromium	29.6	1.0	mg/kg dry	27.2		109	91-113			
Cobalt	12.9	0.1	mg/kg dry	12.5		103	90-109			
Copper	46.1	0.2	mg/kg dry	44.9		103	92-112			
Iron	34200	20	mg/kg dry	33300		103	91-112			
Lead	14.4	0.2	mg/kg dry	14.4		100	89-111			
Lithium	11.2	0.1	mg/kg dry	9.26		121	73-124			
Magnesium	5650	10	mg/kg dry	5830		97	89-116			
Manganese	1130	0.4	mg/kg dry	1100		102	93-112			
Mercury	0.10	0.05	mg/kg dry	0.0980		102	74-126			
Molybdenum	0.7	0.1	mg/kg dry	0.738		95	93-120			
Nickel	18.0	0.4	mg/kg dry	17.4		104	93-110			
Phosphorus	754	10	mg/kg dry	796		95	86-111			
Potassium	649	10	mg/kg dry	619		105	83-117			
Sodium	442	40	mg/kg dry	340		130	79-130			
Strontium	13.2	0.2	mg/kg dry	11.6		114	85-116			
Thorium	4.1	0.5	mg/kg dry	4.46		92	78-100			

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090397
REPORTED Sep-17-14

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B4I0337, Continued										
Reference (B4I0337-SRM1), Continued				Prepared: Sep-09-14, Analyzed: Sep-10-14						
Tin	1.1	0.2	mg/kg dry	1.10		96	78-120			
Titanium	996	2	mg/kg dry	764		130	72-143			
Uranium	0.9	0.1	mg/kg dry	0.940		100	80-102			
Vanadium	56.0	0.4	mg/kg dry	54.9		102	87-116			
Zinc	72	2	mg/kg dry	67.5		106	91-113			

CERTIFICATE OF ANALYSIS

REPORTED TO Palmer Environmental Consulting Group Inc.
470 Granville Street - Suite 630
Vancouver, BC V6C 1V5

TEL (604) 629-9075
FAX -

ATTENTION	May Quach	**WORK ORDER**	4090376
PO NUMBER		**RECEIVED / TEMP**	Sep-04-14 13:25 / NA
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14
PROJECT INFO		**COC NUMBER**	B24491

General Comments:

CARO Analytical Services employs methods which are conducted according to procedures accepted by appropriate regulatory agencies, and/or are conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts, except where otherwise agreed to by the client.

The results in this report apply to the samples analyzed in accordance with the Chain of Custody or Sample Requisition document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

Work Order Comments:

Receipt temperature unavailable.

Oct.31/14- This is an amended report from the original issued Sept.19/14.- JLS

Issued By: **Jennifer Shanko, AScT For Jaime Tkachuk, BSc, PChem**
Account Manager

Please contact CARO if more information is needed or to provide feedback on our services.

Locations:

#110 4011 Viking Way
Richmond, BC V6V 2K9
Tel: 604-279-1499 Fax: 604-279-1599

#102 3677 Highway 97N
Kelowna, BC V1X 5C3
Tel: 250-765-9646 Fax: 250-765-3893

17225 109 Avenue
Edmonton, AB T5S 1H7
Tel: 780-489-9100 Fax: 780-489-9700

www.caro.ca

ANALYSIS INFORMATION

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090376
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analysis Description	Method Reference	Technique	Location
Metals in Tissue	EPA 200.3 / EPA 6020A	HNO3+HCl+H2O2 Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Moisture	ASTM D2974-87 *	Gravimetry (Dried at 105C)	N/A

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Method Reference Descriptions:

ASTM	ASTM International Test Methods
EPA	United States Environmental Protection Agency Test Methods

Glossary of Terms:

MRL	Method Reporting Limit
<	Less than the Reported Detection Limit (RDL) - the RDL may be higher than the MRL due to various factors such as dilutions, limited sample volume, high moisture, or interferences
% wet	Percent (wet weight)
mg/kg wet	Milligrams per kilogram (wet weight)

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090376
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 104 (4090376-01) [Tissue (wet)] Sampled: Aug-24-14 13:30						
General Parameters						
Moisture	**76.2**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**1.4**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.227**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.041**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**0.45**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.029**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**2390**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.020**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.44**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**7**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.064**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**332**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**0.76**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.049**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**4010**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**4600**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.23**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**481**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**2.65**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.006**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.35**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.001**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**11.9**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: 0178 (4090376-02) [Tissue (wet)] Sampled: Aug-27-14 13:30						
General Parameters						
Moisture	**79.1**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**1.5**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.065**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.027**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**0.13**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090376
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0178 (4090376-02) [Tissue (wet)] Sampled: Aug-27-14 13:30, Continued						
Metals in Tissue, Continued						
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.003**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**880**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.008**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.24**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**6**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.005**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**248**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**0.36**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.081**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**2530**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3510**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**0.66**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**293**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**0.95**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.003**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.25**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.001**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**5.1**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: 0179 (4090376-03) [Tissue (wet)] Sampled: Aug-27-14 13:30						
General Parameters						
Moisture	**78.8**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**0.8**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.099**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.027**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**0.05**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.002**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**303**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.006**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.27**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**4**	1	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090376
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0179 (4090376-03) [Tissue (wet)] Sampled: Aug-27-14 13:30, Continued						
Metals in Tissue, Continued						
Lead	**0.004**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**286**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**0.25**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.071**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**2660**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**4250**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**0.92**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**284**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**0.30**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.004**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.23**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	< 0.001	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**3.9**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: 0219 (4090376-04) [Tissue (wet)] Sampled: Aug-27-14 17:30						
General Parameters						
Moisture	**67.6**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**5.5**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.005**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.041**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**0.53**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.011**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**2960**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.016**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.46**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**18**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	< 0.004	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**282**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**1.28**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.087**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**4320**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3230**	10	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090376
REPORTED Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0219 (4090376-04) [Tissue (wet)] Sampled: Aug-27-14 17:30, Continued						
Metals in Tissue, Continued						
Selenium	**1.32**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**744**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**3.63**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.004**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.62**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.022**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.06**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**14.7**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: 0220 (4090376-05) [Tissue (wet)] Sampled: Aug-27-14 17:30						
General Parameters						
Moisture	**76**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**2.0**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.006**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.057**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**1.09**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.005**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**7620**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.010**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.56**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**11**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	< 0.004	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**337**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**2.66**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.078**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**6300**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3410**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.38**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**815**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**9.03**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.006**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.46**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.035**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0220 (4090376-05) [Tissue (wet)] Sampled: Aug-27-14 17:30, Continued						
Metals in Tissue, Continued						
Vanadium	**0.06**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**19.2**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: 0221 (4090376-06) [Tissue (wet)] Sampled: Aug-27-14 17:30						
General Parameters						
Moisture	**74.9**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**2.9**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.006**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.067**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**0.92**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.006**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**6560**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.009**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.58**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**12**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.007**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**331**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**1.77**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.079**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**5500**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3340**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.15**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**747**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**8.29**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.004**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.61**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.021**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.05**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**16.0**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: 0222 (4090376-07) [Tissue (wet)] Sampled: Aug-27-14 17:30						
General Parameters						
Moisture	**73.3**	0.1	% wet	N/A	Sep-11-14	

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PROJECT Coffee Gold

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0222 (4090376-07) [Tissue (wet)] Sampled: Aug-27-14 17:30, Continued						
Metals in Tissue						
Aluminum	**8.5**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.005**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.082**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**0.91**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.010**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**5190**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.012**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.50**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**21**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.009**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**312**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**3.35**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.058**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.03**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**4900**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3340**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.14**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**707**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**6.30**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.005**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.92**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.031**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.07**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**20.1**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: R1-1 (4090376-08) [Tissue (wet)] Sampled: Aug-28-14 10:30						
General Parameters						
Moisture	**72.7**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**2.1**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.013**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.066**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**1.65**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.007**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	

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PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: R1-1 (4090376-08) [Tissue (wet)] Sampled: Aug-28-14 10:30, Continued						
Metals in Tissue, Continued						
Calcium	**6070**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.008**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.40**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**10**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.005**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**341**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**4.38**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.039**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**5350**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3420**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**0.98**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**614**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**9.73**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.003**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.41**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.006**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.06**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**20.0**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: R1-2 (4090376-09) [Tissue (wet)] Sampled: Aug-28-14 10:30						
General Parameters						
Moisture	**73**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**11.7**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.033**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.070**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**4.56**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.133**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**22900**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.05**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.040**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.93**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**36**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.018**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**451**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**9.12**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090376
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: R1-2 (4090376-09) [Tissue (wet)] Sampled: Aug-28-14 10:30, Continued						
Metals in Tissue, Continued						
Mercury	**0.049**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.03**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.07**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**12500**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3090**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.26**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**1350**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**26.4**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.004**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**1.57**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.030**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.24**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**30.5**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: R1-3 (4090376-10) [Tissue (wet)] Sampled: Aug-28-14 10:30						
General Parameters						
Moisture	**72.5**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**7.8**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.023**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.069**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**4.47**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.214**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**21400**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.05**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.027**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.83**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**27**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.015**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**485**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**12.0**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.038**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.08**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**13400**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3210**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**2.19**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**1290**	2	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: R1-3 (4090376-10) [Tissue (wet)] Sampled: Aug-28-14 10:30, Continued						
Metals in Tissue, Continued						
Strontium	**26.9**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.004**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**1.24**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.017**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.22**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**31.4**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: R1-4 (4090376-11) [Tissue (wet)] Sampled: Aug-28-14 10:30						
General Parameters						
Moisture	**71.7**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**4.6**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.027**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.085**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**4.13**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.2**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.225**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**18300**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.024**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.58**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**18**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.021**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**462**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**19.0**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.061**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.09**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**12100**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3590**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.79**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**1180**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**22.5**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.004**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.98**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.008**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.35**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**48.9**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: R1-5 (4090376-12) [Tissue (wet)] Sampled: Aug-28-14 10:30						
General Parameters						
Moisture	**72.1**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**11.2**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.020**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.087**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**2.94**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.2**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.281**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**14500**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.03**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.016**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.63**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**28**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.013**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**407**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**7.78**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.045**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.06**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**9730**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3510**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.56**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**1150**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**20.4**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.004**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**1.13**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.022**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.16**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**25.7**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: R1-6 (4090376-13) [Tissue (wet)] Sampled: Aug-28-14 10:30						
General Parameters						
Moisture	**72.1**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**10.7**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.019**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.100**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**2.71**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090376
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: R1-6 (4090376-13) [Tissue (wet)] Sampled: Aug-28-14 10:30, Continued						
Metals in Tissue, Continued						
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.2**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.173**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**14000**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.03**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.039**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.73**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**30**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.017**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**412**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**11.3**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.032**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.10**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**9530**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3500**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**2.63**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**1060**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**17.5**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.005**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**1.32**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.007**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.14**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**28.4**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: R1-7 (4090376-14) [Tissue (wet)] Sampled: Aug-28-14 10:30						
General Parameters						
Moisture	**75.2**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**15.3**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.017**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.077**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**2.70**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.2**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.144**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**10900**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.06**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.022**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.57**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**40**	1	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090376
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: R1-7 (4090376-14) [Tissue (wet)] Sampled: Aug-28-14 10:30, Continued						
Metals in Tissue, Continued						
Lead	**0.015**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**359**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**9.03**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.057**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.07**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**7670**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3260**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.22**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**1090**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**14.4**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.004**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**1.32**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.010**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.19**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**28.5**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: R1-8 (4090376-15) [Tissue (wet)] Sampled: Aug-28-14 10:30						
General Parameters						
Moisture	**69.7**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**27.3**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.078**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.191**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**4.04**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.2**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.036**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**11900**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.06**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.033**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.62**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**70**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.027**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**349**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**7.48**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.031**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.08**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**8330**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3290**	10	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090376
REPORTED Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: R1-8 (4090376-15) [Tissue (wet)] Sampled: Aug-28-14 10:30, Continued						
Metals in Tissue, Continued						
Selenium	**1.45**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**973**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**17.7**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.002**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**2.36**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.029**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.24**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**23.3**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: R1-9 (4090376-16) [Tissue (wet)] Sampled: Aug-28-14 10:30						
General Parameters						
Moisture	**74.3**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**14.9**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.016**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.095**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**3.89**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.2**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.416**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**15600**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.04**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.050**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.52**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**41**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.028**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**439**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**15.5**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.040**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.11**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**9920**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3490**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.78**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**1020**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**19.5**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.005**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**1.70**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.010**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090376
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: R1-9 (4090376-16) [Tissue (wet)] Sampled: Aug-28-14 10:30, Continued						
Metals in Tissue, Continued						
Vanadium	**0.27**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**40.0**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: I-301 (4090376-17) [Tissue (wet)] Sampled: Aug-28-14 12:30						
General Parameters						
Moisture	**74.5**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**106**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.011**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.173**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**1.48**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.2**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.245**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**4650**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.25**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.079**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**1.79**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**174**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.063**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**285**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**7.24**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.088**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.06**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.19**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**4550**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**2910**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.36**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**954**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**5.06**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.008**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	**0.02**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**7.08**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.048**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.37**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**21.5**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: I-302 (4090376-18) [Tissue (wet)] Sampled: Aug-28-14 12:30						
General Parameters						
Moisture	**68.6**	0.1	% wet	N/A	Sep-11-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

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REPORTED Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: I-302 (4090376-18) [Tissue (wet)] Sampled: Aug-28-14 12:30, Continued						
Metals in Tissue						
Aluminum	**3.0**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.008**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.077**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**1.76**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.2**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.053**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**12700**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.014**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.62**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**11**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.019**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**355**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**6.07**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.056**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.04**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**8510**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3000**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**0.90**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**895**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**14.7**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.007**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.68**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.014**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.13**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**27.1**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: I-303 (4090376-19) [Tissue (wet)] Sampled: Aug-28-14 12:30						
General Parameters						
Moisture	**68.2**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**4.7**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.006**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.069**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**0.59**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.1**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.041**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090376
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: I-303 (4090376-19) [Tissue (wet)] Sampled: Aug-28-14 12:30, Continued						
Metals in Tissue, Continued						
Calcium	**3250**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.011**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.47**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**14**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.007**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**270**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**2.02**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.091**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.04**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**3960**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3120**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**0.93**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**656**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**3.88**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.008**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.64**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.008**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.07**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**21.3**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: I-304 (4090376-20) [Tissue (wet)] Sampled: Aug-28-14 12:30						
General Parameters						
Moisture	**70.9**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**26.4**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.007**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.097**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**3.83**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.1**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.184**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**23400**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.07**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.040**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**1.03**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**59**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.029**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**480**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**12.4**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090376
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: I-304 (4090376-20) [Tissue (wet)] Sampled: Aug-28-14 12:30, Continued						
Metals in Tissue, Continued						
Mercury	**0.066**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.03**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.11**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**14200**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3060**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.78**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**1360**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**28.9**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.008**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**2.75**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.028**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.28**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**26.4**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: I-305 (4090376-21) [Tissue (wet)] Sampled: Aug-28-14 12:30						
General Parameters						
Moisture	**71.3**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**103**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.011**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.178**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**3.43**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	**0.002**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.1**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.191**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**16600**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.22**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.087**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**1.90**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**167**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.059**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**404**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**12.6**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.073**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.07**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.19**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**10500**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**2990**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**2.53**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**1210**	2	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: I-305 (4090376-21) [Tissue (wet)] Sampled: Aug-28-14 12:30, Continued						
Metals in Tissue, Continued						
Strontium	**18.7**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.010**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**6.93**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.049**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.39**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**24.2**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: I-306 (4090376-22) [Tissue (wet)] Sampled: Aug-28-14 12:30						
General Parameters						
Moisture	**71.6**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**13.2**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.005**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.094**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**1.80**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.1**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.096**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**10400**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.04**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.032**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.72**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**35**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.034**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**333**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**6.86**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.093**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.08**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**7340**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3090**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.07**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**992**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**11.6**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.008**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**1.32**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.018**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.10**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**22.1**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: I-307 (4090376-23) [Tissue (wet)] Sampled: Aug-28-14 12:30						
General Parameters						
Moisture	**71**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**14.3**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.007**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.089**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**2.11**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.117**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**13200**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.04**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.026**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.65**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**31**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.019**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**355**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**11.7**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.041**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.09**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**8960**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3310**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.73**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**930**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**15.2**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.007**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**1.47**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.016**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.14**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**26.7**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: I-308 (4090376-24) [Tissue (wet)] Sampled: Aug-28-14 12:30						
General Parameters						
Moisture	**67.1**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**6.5**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.009**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.108**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**1.83**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090376
REPORTED Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: I-308 (4090376-24) [Tissue (wet)] Sampled: Aug-28-14 12:30, Continued						
Metals in Tissue, Continued						
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.1**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.050**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**11100**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.015**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.54**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**19**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.035**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**345**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**5.80**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.072**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.04**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**7690**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3080**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.31**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**855**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**12.4**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.008**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.90**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.015**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.09**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**27.8**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: 0223 (4090376-25) [Tissue (wet)] Sampled: Aug-28-14 15:30						
General Parameters						
Moisture	**73.8**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**4.9**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.029**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.074**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**3.91**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.1**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.017**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**21900**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.02**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.019**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.68**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**23**	1	mg/kg wet	Sep-11-14	Sep-18-14	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	4090376
PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0223 (4090376-25) [Tissue (wet)] Sampled: Aug-28-14 15:30, Continued						
Metals in Tissue, Continued						
Lead	**0.008**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**469**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**8.82**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.107**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.04**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**13700**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3380**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**2.01**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**1150**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**29.9**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.006**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**1.26**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.044**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.18**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**38.8**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: 0224 (4090376-26) [Tissue (wet)] Sampled: Aug-28-14 15:30						
General Parameters						
Moisture	**72.7**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**2.2**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.032**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.062**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**1.08**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	**0.1**	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.003**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**7420**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.010**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.47**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**12**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.008**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**299**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**2.99**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.143**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.03**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**5680**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3220**	10	mg/kg wet	Sep-11-14	Sep-18-14	

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PROJECT	Coffee Gold	**REPORTED**	Oct-31-14

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0224 (4090376-26) [Tissue (wet)] Sampled: Aug-28-14 15:30, Continued						
Metals in Tissue, Continued						
Selenium	**0.95**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**739**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**8.93**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.005**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.47**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.033**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.06**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**29.3**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: 0225 (4090376-27) [Tissue (wet)] Sampled: Aug-28-14 15:30						
General Parameters						
Moisture	**76.3**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**8.2**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.053**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.058**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**0.55**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.039**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**2420**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.03**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.012**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.72**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**25**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.030**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**266**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**1.49**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.224**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.01**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.04**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**3240**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3200**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.41**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**732**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**2.82**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.008**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**0.79**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.029**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0225 (4090376-27) [Tissue (wet)] Sampled: Aug-28-14 15:30, Continued						
Metals in Tissue, Continued						
Vanadium	**0.11**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**17.3**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: 0226 (4090376-28) [Tissue (wet)] Sampled: Aug-28-14 15:30						
General Parameters						
Moisture	**72.9**	0.1	% wet	N/A	Sep-11-14	
Metals in Tissue						
Aluminum	**20.4**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.025**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.096**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**2.93**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.077**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**16100**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.05**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.030**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**1.21**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**56**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.022**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**350**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**7.17**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.092**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	**0.03**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.07**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**9460**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**2790**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**2.74**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**1230**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**19.0**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.010**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**1.94**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.146**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.28**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**22.6**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	
Sample ID: 0227 (4090376-29) [Tissue (wet)] Sampled: Aug-28-14 15:30						
General Parameters						
Moisture	**70.1**	0.1	% wet	N/A	Sep-11-14	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0227 (4090376-29) [Tissue (wet)] Sampled: Aug-28-14 15:30, Continued						
Metals in Tissue						
Aluminum	**13.9**	0.4	mg/kg wet	Sep-11-14	Sep-18-14	
Antimony	**0.038**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Arsenic	**0.082**	0.005	mg/kg wet	Sep-11-14	Sep-18-14	
Barium	**2.30**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Beryllium	< 0.002	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Bismuth	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Boron	< 0.1	0.1	mg/kg wet	Sep-11-14	Sep-18-14	
Cadmium	**0.015**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Calcium	**10200**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Chromium	**0.05**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Cobalt	**0.017**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Copper	**0.62**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Iron	**31**	1	mg/kg wet	Sep-11-14	Sep-18-14	
Lead	**0.020**	0.004	mg/kg wet	Sep-11-14	Sep-18-14	
Magnesium	**321**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Manganese	**5.06**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Mercury	**0.097**	0.002	mg/kg wet	Sep-11-14	Sep-18-14	
Molybdenum	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Nickel	**0.05**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Phosphorus	**6580**	5	mg/kg wet	Sep-11-14	Sep-18-14	
Potassium	**3010**	10	mg/kg wet	Sep-11-14	Sep-18-14	
Selenium	**1.01**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Silver	< 0.01	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Sodium	**731**	2	mg/kg wet	Sep-11-14	Sep-18-14	
Strontium	**11.9**	0.01	mg/kg wet	Sep-11-14	Sep-18-14	
Thallium	**0.009**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Tin	< 0.02	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Titanium	**1.24**	0.05	mg/kg wet	Sep-11-14	Sep-18-14	
Uranium	**0.069**	0.001	mg/kg wet	Sep-11-14	Sep-18-14	
Vanadium	**0.10**	0.02	mg/kg wet	Sep-11-14	Sep-18-14	
Zinc	**32.8**	0.5	mg/kg wet	Sep-11-14	Sep-18-14	

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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in fibatchesfl and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types includ

- **Method Blank (Blk)**: Laboratory reagent water is carried through sample preparation and analysis steps. Method Blanks indicate that results are free from contamination, i.e. not biased high from sources such as the sample container or the laboratory environment
- **Duplicate (Dup)**: Preparation and analysis of a replicate aliquot of a sample. Duplicates provide a measure of the analytical method's precision, i.e. how reproducible a result is. Duplicates are only reported if they are associated with your sample data.
- **Blank Spike (BS)**: A known amount of standard is carried through sample preparation and analysis steps. Blank Spikes, also known as laboratory control samples (LCS), are prepared from a different source of standard than used for the calibration. They ensure that the calibration is acceptable (i.e. not biased high or low) and also provide a measure of the analytical method's accuracy (i.e. closeness of the result to a target value).
- **Standard Reference Material (SRM)**: A material of similar matrix to the samples, externally certified for the parameter(s) listed. Standard Reference Materials ensure that the preparation steps in the method are adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
General Parameters, Batch B4I0465										
Duplicate (B4I0465-DUP1)		**Source: 4090376-01**		Prepared: Sep-11-14, Analyzed: Sep-11-14						
Moisture	77.2	0.1	% wet		76.2			1.3	40	
Duplicate (B4I0465-DUP2)		**Source: 4090376-17**		Prepared: Sep-11-14, Analyzed: Sep-11-14						
Moisture	72.3	0.1	% wet		74.5			3.0	40	
Duplicate (B4I0465-DUP3)		**Source: 4090376-26**		Prepared: Sep-11-14, Analyzed: Sep-11-14						
Moisture	68.3	0.1	% wet		72.7			6.2	40	
Metals in Tissue, Batch B4I0464										
Blank (B4I0464-BLK1)				Prepared: Sep-11-14, Analyzed: Sep-18-14						
Aluminum	< 0.4	0.4	mg/kg wet							
Antimony	< 0.002	0.002	mg/kg wet							
Arsenic	< 0.005	0.005	mg/kg wet							
Barium	< 0.01	0.01	mg/kg wet							
Beryllium	< 0.002	0.002	mg/kg wet							
Bismuth	< 0.02	0.02	mg/kg wet							
Boron	< 0.1	0.1	mg/kg wet							
Cadmium	< 0.002	0.002	mg/kg wet							
Calcium	< 2	2	mg/kg wet							
Chromium	< 0.01	0.01	mg/kg wet							
Cobalt	< 0.004	0.004	mg/kg wet							
Copper	< 0.01	0.01	mg/kg wet							
Iron	< 1	1	mg/kg wet							
Lead	< 0.004	0.004	mg/kg wet							
Magnesium	< 2	2	mg/kg wet							
Manganese	< 0.02	0.02	mg/kg wet							
Mercury	< 0.002	0.002	mg/kg wet							
Molybdenum	< 0.01	0.01	mg/kg wet							
Nickel	< 0.01	0.01	mg/kg wet							
Phosphorus	< 5	5	mg/kg wet							
Potassium	< 10	10	mg/kg wet							

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes

Metals in Tissue, Batch B4I0464, Continued

Blank (B4I0464-BLK1), Continued				Prepared: Sep-11-14, Analyzed: Sep-18-14
Selenium	< 0.02	0.02	mg/kg wet	
Silver	< 0.01	0.01	mg/kg wet	
Sodium	< 2	2	mg/kg wet	
Strontium	< 0.01	0.01	mg/kg wet	
Thallium	< 0.001	0.001	mg/kg wet	
Tin	< 0.02	0.02	mg/kg wet	
Titanium	< 0.05	0.05	mg/kg wet	
Uranium	< 0.001	0.001	mg/kg wet	
Vanadium	< 0.02	0.02	mg/kg wet	
Zinc	< 0.5	0.5	mg/kg wet	

Blank (B4I0464-BLK2)				Prepared: Sep-11-14, Analyzed: Sep-18-14
Aluminum	< 0.4	0.4	mg/kg wet	
Antimony	< 0.002	0.002	mg/kg wet	
Arsenic	< 0.005	0.005	mg/kg wet	
Barium	< 0.01	0.01	mg/kg wet	
Beryllium	< 0.002	0.002	mg/kg wet	
Bismuth	< 0.02	0.02	mg/kg wet	
Boron	< 0.1	0.1	mg/kg wet	
Cadmium	< 0.002	0.002	mg/kg wet	
Calcium	< 2	2	mg/kg wet	
Chromium	< 0.01	0.01	mg/kg wet	
Cobalt	< 0.004	0.004	mg/kg wet	
Copper	< 0.01	0.01	mg/kg wet	
Iron	< 1	1	mg/kg wet	
Lead	< 0.004	0.004	mg/kg wet	
Magnesium	< 2	2	mg/kg wet	
Manganese	< 0.02	0.02	mg/kg wet	
Mercury	< 0.002	0.002	mg/kg wet	
Molybdenum	< 0.01	0.01	mg/kg wet	
Nickel	< 0.01	0.01	mg/kg wet	
Phosphorus	< 5	5	mg/kg wet	
Potassium	< 10	10	mg/kg wet	
Selenium	< 0.02	0.02	mg/kg wet	
Silver	< 0.01	0.01	mg/kg wet	
Sodium	< 2	2	mg/kg wet	
Strontium	< 0.01	0.01	mg/kg wet	
Thallium	< 0.001	0.001	mg/kg wet	
Tin	< 0.02	0.02	mg/kg wet	
Titanium	< 0.05	0.05	mg/kg wet	
Uranium	< 0.001	0.001	mg/kg wet	
Vanadium	< 0.02	0.02	mg/kg wet	
Zinc	< 0.5	0.5	mg/kg wet	

Blank (B4I0464-BLK3)				Prepared: Sep-11-14, Analyzed: Sep-18-14
Aluminum	< 0.4	0.4	mg/kg wet	
Antimony	< 0.002	0.002	mg/kg wet	
Arsenic	< 0.005	0.005	mg/kg wet	
Barium	< 0.01	0.01	mg/kg wet	
Beryllium	< 0.002	0.002	mg/kg wet	
Bismuth	< 0.02	0.02	mg/kg wet	
Boron	< 0.1	0.1	mg/kg wet	
Cadmium	< 0.002	0.002	mg/kg wet	
Calcium	< 2	2	mg/kg wet	
Chromium	< 0.01	0.01	mg/kg wet	
Cobalt	< 0.004	0.004	mg/kg wet	
Copper	< 0.01	0.01	mg/kg wet	

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
Metals in Tissue, Batch B4I0464, Continued										
Blank (B4I0464-BLK3), Continued				Prepared: Sep-11-14, Analyzed: Sep-18-14						
Iron	< 1	1	mg/kg wet							
Lead	< 0.004	0.004	mg/kg wet							
Magnesium	< 2	2	mg/kg wet							
Manganese	< 0.02	0.02	mg/kg wet							
Mercury	< 0.002	0.002	mg/kg wet							
Molybdenum	< 0.01	0.01	mg/kg wet							
Nickel	< 0.01	0.01	mg/kg wet							
Phosphorus	< 5	5	mg/kg wet							
Potassium	< 10	10	mg/kg wet							
Selenium	< 0.02	0.02	mg/kg wet							
Silver	< 0.01	0.01	mg/kg wet							
Sodium	< 2	2	mg/kg wet							
Strontium	< 0.01	0.01	mg/kg wet							
Thallium	< 0.001	0.001	mg/kg wet							
Tin	< 0.02	0.02	mg/kg wet							
Titanium	< 0.05	0.05	mg/kg wet							
Uranium	< 0.001	0.001	mg/kg wet							
Vanadium	< 0.02	0.02	mg/kg wet							
Zinc	< 0.5	0.5	mg/kg wet							
Duplicate (B4I0464-DUP1)				**Source: 4090376-01**	Prepared: Sep-11-14, Analyzed: Sep-18-14					
Aluminum	1.8	0.4	mg/kg wet		1.4				30	
Antimony	0.248	0.002	mg/kg wet		0.227			8	40	
Arsenic	0.037	0.005	mg/kg wet		0.041			8	30	
Barium	0.53	0.01	mg/kg wet		0.45			16	30	
Beryllium	< 0.002	0.002	mg/kg wet		< 0.002				30	
Bismuth	< 0.02	0.02	mg/kg wet		< 0.02				30	
Boron	0.1	0.1	mg/kg wet		< 0.1				30	
Cadmium	0.036	0.002	mg/kg wet		0.029			21	30	
Calcium	1330	2	mg/kg wet		2390			57	30	RPD1
Chromium	0.03	0.01	mg/kg wet		0.02				30	
Cobalt	0.017	0.004	mg/kg wet		0.020			20	30	
Copper	0.43	0.01	mg/kg wet		0.44			3	30	
Iron	7	1	mg/kg wet		7			5	30	
Lead	0.097	0.004	mg/kg wet		0.064			41	40	RPD1
Magnesium	299	2	mg/kg wet		332			10	30	
Manganese	0.41	0.02	mg/kg wet		0.76			60	30	RPD1
Mercury	0.049	0.002	mg/kg wet		0.049			< 1	40	
Molybdenum	< 0.01	0.01	mg/kg wet		< 0.01				40	
Nickel	0.01	0.01	mg/kg wet		0.01				30	
Phosphorus	3320	5	mg/kg wet		4010			19	30	
Potassium	4440	10	mg/kg wet		4600			4	30	
Selenium	1.20	0.02	mg/kg wet		1.23			2	30	
Silver	< 0.01	0.01	mg/kg wet		< 0.01				40	
Sodium	413	2	mg/kg wet		481			15	30	
Strontium	1.17	0.01	mg/kg wet		2.65			77	30	RPD1
Thallium	0.006	0.001	mg/kg wet		0.006			5	30	
Tin	< 0.02	0.02	mg/kg wet		0.02				40	
Titanium	0.32	0.05	mg/kg wet		0.35			8	40	
Uranium	0.001	0.001	mg/kg wet		0.001				30	
Vanadium	< 0.02	0.02	mg/kg wet		< 0.02				30	
Zinc	6.5	0.5	mg/kg wet		11.9			59	30	RPD1
Duplicate (B4I0464-DUP3)				**Source: 4090376-26**	Prepared: Sep-11-14, Analyzed: Sep-18-14					
Aluminum	0.7	0.4	mg/kg wet		2.2			105	30	
Antimony	0.034	0.002	mg/kg wet		0.032			5	40	
Arsenic	0.064	0.005	mg/kg wet		0.062			5	30	

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
Metals in Tissue, Batch B4I0464, Continued										
Duplicate (B4I0464-DUP3), Continued	**Source: 4090376-26**			Prepared: Sep-11-14, Analyzed: Sep-18-14						
Barium	1.29	0.01	mg/kg wet		1.08			18	30	
Beryllium	< 0.002	0.002	mg/kg wet		< 0.002				30	
Bismuth	< 0.02	0.02	mg/kg wet		< 0.02				30	
Boron	0.2	0.1	mg/kg wet		0.1				30	
Cadmium	0.002	0.002	mg/kg wet		0.003				30	
Calcium	6200	2	mg/kg wet		7420			18	30	
Chromium	< 0.01	0.01	mg/kg wet		0.01				30	
Cobalt	0.008	0.004	mg/kg wet		0.010				30	
Copper	0.47	0.01	mg/kg wet		0.47			< 1	30	
Iron	6	1	mg/kg wet		12			65	30	RPD1
Lead	< 0.004	0.004	mg/kg wet		0.008				40	
Magnesium	292	2	mg/kg wet		299			2	30	
Manganese	2.86	0.02	mg/kg wet		2.99			4	30	
Mercury	0.101	0.002	mg/kg wet		0.143			35	40	
Molybdenum	< 0.01	0.01	mg/kg wet		< 0.01				40	
Nickel	0.02	0.01	mg/kg wet		0.03				30	
Phosphorus	5650	5	mg/kg wet		5680			< 1	30	
Potassium	3200	10	mg/kg wet		3220			< 1	30	
Selenium	0.91	0.02	mg/kg wet		0.95			4	30	
Silver	< 0.01	0.01	mg/kg wet		< 0.01				40	
Sodium	642	2	mg/kg wet		739			14	30	
Strontium	8.34	0.01	mg/kg wet		8.93			7	30	
Thallium	0.005	0.001	mg/kg wet		0.005			13	30	
Tin	< 0.02	0.02	mg/kg wet		< 0.02				40	
Titanium	0.33	0.05	mg/kg wet		0.47			34	40	
Uranium	0.033	0.001	mg/kg wet		0.033			< 1	30	
Vanadium	0.06	0.02	mg/kg wet		0.06				30	
Zinc	40.0	0.5	mg/kg wet		29.3			31	30	RPD1
Reference (B4I0464-SRM1)				Prepared: Sep-11-14, Analyzed: Sep-18-14						
Arsenic	73.7	0.005	mg/kg wet	59.5		124	75-125			
Cadmium	39.5	0.002	mg/kg wet	42.3		93	75-125			
Chromium	1.62	0.01	mg/kg wet	1.95		83	75-125			
Cobalt	0.917	0.004	mg/kg wet	1.06		87	75-125			
Copper	459	0.01	mg/kg wet	497		92	75-125			
Iron	164	1	mg/kg wet	179		92	75-125			
Lead	0.191	0.004	mg/kg wet	0.225		85	75-125			
Manganese	14.5	0.02	mg/kg wet	15.6		93	75-125			
Mercury	0.259	0.002	mg/kg wet	0.292		89	75-125			
Molybdenum	3.07	0.01	mg/kg wet	3.44		89	75-125			
Nickel	4.26	0.01	mg/kg wet	5.30		80	75-125			
Selenium	12.3	0.02	mg/kg wet	10.9		113	75-125			
Strontium	32.5	0.01	mg/kg wet	36.5		89	75-125			
Tin	< 0.08	0.02	mg/kg wet	0.0290		105	75-125			
Vanadium	8.88	0.02	mg/kg wet	9.10		98	75-125			
Zinc	122	0.5	mg/kg wet	136		90	75-125			
Reference (B4I0464-SRM2)				Prepared: Sep-11-14, Analyzed: Sep-18-14						
Arsenic	73.3	0.005	mg/kg wet	59.5		123	75-125			
Cadmium	39.4	0.002	mg/kg wet	42.3		93	75-125			
Chromium	1.50	0.01	mg/kg wet	1.95		77	75-125			
Cobalt	0.903	0.004	mg/kg wet	1.06		85	75-125			
Copper	450	0.01	mg/kg wet	497		91	75-125			
Iron	165	1	mg/kg wet	179		92	75-125			
Lead	0.191	0.004	mg/kg wet	0.225		85	75-125			
Manganese	14.7	0.02	mg/kg wet	15.6		94	75-125			
Mercury	0.266	0.002	mg/kg wet	0.292		91	75-125			

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 4090376
REPORTED Oct-31-14

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	RPD	RPD Limit	Notes
Metals in Tissue, Batch B4I0464, Continued										
Reference (B4I0464-SRM2), Continued				Prepared: Sep-11-14, Analyzed: Sep-18-14						
Molybdenum	3.00	0.01	mg/kg wet	3.44		87	75-125			
Nickel	4.16	0.01	mg/kg wet	5.30		78	75-125			
Selenium	12.5	0.02	mg/kg wet	10.9		115	75-125			
Strontium	34.4	0.01	mg/kg wet	36.5		94	75-125			
Tin	< 0.08	0.02	mg/kg wet	0.0290		92	75-125			
Vanadium	8.76	0.02	mg/kg wet	9.10		96	75-125			
Zinc	120	0.5	mg/kg wet	136		88	75-125			
Reference (B4I0464-SRM3)				Prepared: Sep-11-14, Analyzed: Sep-18-14						
Arsenic	74.1	0.005	mg/kg wet	59.5		125	75-125			
Cadmium	40.1	0.002	mg/kg wet	42.3		95	75-125			
Chromium	1.47	0.01	mg/kg wet	1.95		75	75-125			
Cobalt	0.883	0.004	mg/kg wet	1.06		83	75-125			
Copper	444	0.01	mg/kg wet	497		89	75-125			
Iron	160	1	mg/kg wet	179		90	75-125			
Lead	0.191	0.004	mg/kg wet	0.225		85	75-125			
Manganese	14.4	0.02	mg/kg wet	15.6		92	75-125			
Mercury	0.266	0.002	mg/kg wet	0.292		91	75-125			
Molybdenum	3.06	0.01	mg/kg wet	3.44		89	75-125			
Nickel	4.07	0.01	mg/kg wet	5.30		77	75-125			
Selenium	12.3	0.02	mg/kg wet	10.9		113	75-125			
Strontium	34.1	0.01	mg/kg wet	36.5		94	75-125			
Tin	< 0.08	0.02	mg/kg wet	0.0290		95	75-125			
Vanadium	8.81	0.02	mg/kg wet	9.10		97	75-125			
Zinc	119	0.5	mg/kg wet	136		87	75-125			

QC Qualifiers:

RPD1 Relative percent difference(s) (RPD) of one or more analytes on duplicate analysis are outside of control limits due to sample heterogeneity.

CERTIFICATE OF ANALYSIS

REPORTED TO	Palmer Environmental Consulting Group Inc. 470 Granville Street - Suite 630 Vancouver, BC V6C 1V5	**TEL** **FAX**	(604) 629-9075 -
ATTENTION	Alyssa Murdoch	**WORK ORDER**	5061952
PO NUMBER		**RECEIVED / TEMP**	Jun-25-15 10:18 / 6°C
PROJECT	Coffee Gold	**REPORTED**	Jul-10-15
PROJECT INFO		**COC NUMBER**	B 32953

General Comments:

CARO Analytical Services employs methods which are conducted according to procedures accepted by appropriate regulatory agencies, and/or are conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts, except where otherwise agreed to by the client.

The results in this report apply to the samples analyzed in accordance with the Chain of Custody or Sample Requisition document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

[signature redacted]

Authorized By:

Division Manager, Richmond

Please contact CARO if more information is needed or to provide feedback on our services.

Locations:

#110 4011 Viking Way
Richmond, BC V6V 2K9
Tel: 604-279-1499 Fax: 604-279-1599

#102 3677 Highway 97N
Kelowna, BC V1X 5C3
Tel: 250-765-9646 Fax: 250-765-3893

17225 109 Avenue
Edmonton, AB T5S 1H7
Tel: 780-489-9100 Fax: 780-489-9700

www.caro.ca

ANALYSIS INFORMATION

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5061952
PROJECT	Coffee Gold	**REPORTED**	Jul-10-15

Analysis Description	Method Reference	Technique	Location
Metals in Tissue	EPA 200.3 / EPA 6020A	HNO3+HCl+H2O2 Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Moisture	ASTM D2974-87*	Gravimetry (Dried at 105C)	N/A

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Method Reference Descriptions:

ASTM	ASTM International Test Methods
EPA	United States Environmental Protection Agency Test Methods

Glossary of Terms:

MRL	Method Reporting Limit
<	Less than the Reported Detection Limit (RDL) - the RDL may be higher than the MRL due to various factors such as dilutions, limited sample volume, high moisture, or interferences
% wet	Percent (wet weight)
mg/kg wet	Milligrams per kilogram (wet weight)

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5061952
PROJECT	Coffee Gold	**REPORTED**	Jul-10-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0-9 (5061952-01) [Tissue (wet)] Sampled: Jun-21-15 17:30						
Metals in Tissue						
Aluminum	**2.4**	0.4	mg/kg wet	Jul-07-15	Jul-08-15	
Antimony	**0.703**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Arsenic	**0.027**	0.005	mg/kg wet	Jul-07-15	Jul-08-15	
Barium	**0.11**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Beryllium	< 0.002	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Bismuth	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Boron	< 0.1	0.1	mg/kg wet	Jul-07-15	Jul-08-15	
Cadmium	**0.010**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Calcium	**84**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Chromium	**0.02**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Cobalt	**0.014**	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Copper	**0.49**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Iron	**7**	1	mg/kg wet	Jul-07-15	Jul-08-15	
Lead	**0.009**	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Magnesium	**309**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Manganese	**0.36**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Mercury	**0.108**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Nickel	**0.01**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Phosphorus	**2940**	5	mg/kg wet	Jul-07-15	Jul-08-15	
Potassium	**5060**	10	mg/kg wet	Jul-07-15	Jul-08-15	
Selenium	**0.85**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Silver	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Sodium	**290**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Strontium	**0.12**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Thallium	**0.005**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Tin	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Titanium	**0.26**	0.05	mg/kg wet	Jul-07-15	Jul-08-15	
Uranium	**0.002**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Vanadium	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Zinc	**7.7**	0.5	mg/kg wet	Jul-07-15	Jul-08-15	
Sample ID: 0-11 (5061952-02) [Tissue (wet)] Sampled: Jun-21-15 17:30						
General Parameters						
Moisture	**77.9**	0.1	% wet	N/A	Jul-10-15	
Metals in Tissue						
Aluminum	**1.4**	0.4	mg/kg wet	Jul-07-15	Jul-08-15	
Antimony	**1.16**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Arsenic	**0.025**	0.005	mg/kg wet	Jul-07-15	Jul-08-15	
Barium	**0.18**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Beryllium	< 0.002	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Bismuth	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Boron	< 0.1	0.1	mg/kg wet	Jul-07-15	Jul-08-15	
Cadmium	**0.006**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5061952
PROJECT	Coffee Gold	**REPORTED**	Jul-10-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0-11 (5061952-02) [Tissue (wet)] Sampled: Jun-21-15 17:30, Continued						
Metals in Tissue, Continued						
Calcium	**400**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Chromium	**0.01**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Cobalt	**0.006**	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Copper	**0.36**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Iron	**5**	1	mg/kg wet	Jul-07-15	Jul-08-15	
Lead	**0.006**	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Magnesium	**299**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Manganese	**0.45**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Mercury	**0.123**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Nickel	**0.01**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Phosphorus	**3040**	5	mg/kg wet	Jul-07-15	Jul-08-15	
Potassium	**4970**	10	mg/kg wet	Jul-07-15	Jul-08-15	
Selenium	**0.48**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Silver	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Sodium	**350**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Strontium	**0.56**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Thallium	**0.004**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Tin	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Titanium	**0.20**	0.05	mg/kg wet	Jul-07-15	Jul-08-15	
Uranium	**0.002**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Vanadium	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Zinc	**4.5**	0.5	mg/kg wet	Jul-07-15	Jul-08-15	
Sample ID: 0-22 (5061952-03) [Tissue (wet)] Sampled: Jun-23-15 12:00						
General Parameters						
Moisture	**79.7**	0.1	% wet	N/A	Jul-10-15	
Metals in Tissue						
Aluminum	**0.7**	0.4	mg/kg wet	Jul-07-15	Jul-08-15	
Antimony	**0.383**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Arsenic	**0.059**	0.005	mg/kg wet	Jul-07-15	Jul-08-15	
Barium	**0.26**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Beryllium	< 0.002	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Bismuth	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Boron	< 0.1	0.1	mg/kg wet	Jul-07-15	Jul-08-15	
Cadmium	**0.004**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Calcium	**483**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Chromium	**0.02**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Cobalt	**0.011**	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Copper	**0.40**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Iron	**4**	1	mg/kg wet	Jul-07-15	Jul-08-15	
Lead	< 0.004	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Magnesium	**293**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Manganese	**0.37**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5061952
PROJECT	Coffee Gold	**REPORTED**	Jul-10-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0-22 (5061952-03) [Tissue (wet)] Sampled: Jun-23-15 12:00, Continued						
Metals in Tissue, Continued						
Mercury	**0.127**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Nickel	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Phosphorus	**3010**	5	mg/kg wet	Jul-07-15	Jul-08-15	
Potassium	**4970**	10	mg/kg wet	Jul-07-15	Jul-08-15	
Selenium	**0.74**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Silver	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Sodium	**369**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Strontium	**0.68**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Thallium	**0.004**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Tin	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Titanium	**0.15**	0.05	mg/kg wet	Jul-07-15	Jul-08-15	
Uranium	**0.002**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Vanadium	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Zinc	**5.0**	0.5	mg/kg wet	Jul-07-15	Jul-08-15	
Sample ID: 0-23 (5061952-04) [Tissue (wet)] Sampled: Jun-23-15 12:00						
General Parameters						
Moisture	**79.9**	0.1	% wet	N/A	Jul-10-15	
Metals in Tissue						
Aluminum	**0.7**	0.4	mg/kg wet	Jul-07-15	Jul-08-15	
Antimony	**0.505**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Arsenic	**0.042**	0.005	mg/kg wet	Jul-07-15	Jul-08-15	
Barium	**0.15**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Beryllium	< 0.002	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Bismuth	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Boron	< 0.1	0.1	mg/kg wet	Jul-07-15	Jul-08-15	
Cadmium	**0.007**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Calcium	**154**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Chromium	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Cobalt	**0.011**	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Copper	**0.33**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Iron	**4**	1	mg/kg wet	Jul-07-15	Jul-08-15	
Lead	**0.010**	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Magnesium	**288**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Manganese	**0.30**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Mercury	**0.107**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Nickel	**0.01**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Phosphorus	**2760**	5	mg/kg wet	Jul-07-15	Jul-08-15	
Potassium	**4850**	10	mg/kg wet	Jul-07-15	Jul-08-15	
Selenium	**0.94**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Silver	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Sodium	**326**	2	mg/kg wet	Jul-07-15	Jul-08-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5061952
PROJECT	Coffee Gold	**REPORTED**	Jul-10-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0-23 (5061952-04) [Tissue (wet)] Sampled: Jun-23-15 12:00, Continued						
Metals in Tissue, Continued						
Strontium	**0.22**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Thallium	**0.005**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Tin	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Titanium	**0.14**	0.05	mg/kg wet	Jul-07-15	Jul-08-15	
Uranium	**0.002**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Vanadium	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Zinc	**4.1**	0.5	mg/kg wet	Jul-07-15	Jul-08-15	
Sample ID: 0-25 (5061952-05) [Tissue (wet)] Sampled: Jun-23-15 12:00						
General Parameters						
Moisture	**79.7**	0.1	% wet	N/A	Jul-10-15	
Metals in Tissue						
Aluminum	**1.7**	0.4	mg/kg wet	Jul-07-15	Jul-08-15	
Antimony	**0.201**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Arsenic	**0.030**	0.005	mg/kg wet	Jul-07-15	Jul-08-15	
Barium	**0.07**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Beryllium	< 0.002	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Bismuth	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Boron	< 0.1	0.1	mg/kg wet	Jul-07-15	Jul-08-15	
Cadmium	**0.007**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Calcium	**81**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Chromium	**0.06**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Cobalt	**0.012**	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Copper	**0.46**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Iron	**7**	1	mg/kg wet	Jul-07-15	Jul-08-15	
Lead	**0.005**	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Magnesium	**291**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Manganese	**0.37**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Mercury	**0.132**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Nickel	**0.01**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Phosphorus	**2800**	5	mg/kg wet	Jul-07-15	Jul-08-15	
Potassium	**4810**	10	mg/kg wet	Jul-07-15	Jul-08-15	
Selenium	**1.02**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Silver	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Sodium	**314**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Strontium	**0.11**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Thallium	**0.007**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Tin	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Titanium	**0.31**	0.05	mg/kg wet	Jul-07-15	Jul-08-15	
Uranium	**0.002**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Vanadium	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Zinc	**6.6**	0.5	mg/kg wet	Jul-07-15	Jul-08-15	

SAMPLE ANALYTICAL DATA

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5061952
PROJECT	Coffee Gold	**REPORTED**	Jul-10-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 0-26 (5061952-06) [Tissue (wet)] Sampled: Jun-23-15 12:00						
General Parameters						
Moisture	**79.7**	0.1	% wet	N/A	Jul-10-15	
Metals in Tissue						
Aluminum	**0.8**	0.4	mg/kg wet	Jul-07-15	Jul-08-15	
Antimony	**0.417**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Arsenic	**0.031**	0.005	mg/kg wet	Jul-07-15	Jul-08-15	
Barium	**0.24**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Beryllium	< 0.002	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Bismuth	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Boron	< 0.1	0.1	mg/kg wet	Jul-07-15	Jul-08-15	
Cadmium	**0.007**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Calcium	**131**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Chromium	**0.01**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Cobalt	**0.011**	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Copper	**0.54**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Iron	**4**	1	mg/kg wet	Jul-07-15	Jul-08-15	
Lead	**0.006**	0.004	mg/kg wet	Jul-07-15	Jul-08-15	
Magnesium	**282**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Manganese	**0.28**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Mercury	**0.127**	0.002	mg/kg wet	Jul-07-15	Jul-08-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Nickel	**0.01**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Phosphorus	**2770**	5	mg/kg wet	Jul-07-15	Jul-08-15	
Potassium	**4680**	10	mg/kg wet	Jul-07-15	Jul-08-15	
Selenium	**1.08**	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Silver	< 0.01	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Sodium	**392**	2	mg/kg wet	Jul-07-15	Jul-08-15	
Strontium	**0.19**	0.01	mg/kg wet	Jul-07-15	Jul-08-15	
Thallium	**0.006**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Tin	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Titanium	**0.15**	0.05	mg/kg wet	Jul-07-15	Jul-08-15	
Uranium	**0.001**	0.001	mg/kg wet	Jul-07-15	Jul-08-15	
Vanadium	< 0.02	0.02	mg/kg wet	Jul-07-15	Jul-08-15	
Zinc	**6.7**	0.5	mg/kg wet	Jul-07-15	Jul-08-15	

QUALITY CONTROL DATA

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5061952
PROJECT	Coffee Gold	**REPORTED**	Jul-10-15

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in fibatchesfl and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types includ

- **Method Blank (Blk)**: Laboratory reagent water is carried through sample preparation and analysis steps. Method Blanks indicate that results are free from contamination, i.e. not biased high from sources such as the sample container or the laboratory environment
- **Duplicate (Dup)**: Preparation and analysis of a replicate aliquot of a sample. Duplicates provide a measure of the analytical method's precision, i.e. how reproducible a result is. Duplicates are only reported if they are associated with your sample data.
- **Blank Spike (BS)**: A known amount of standard is carried through sample preparation and analysis steps. Blank Spikes, also known as laboratory control samples (LCS), are prepared from a different source of standard than used for the calibration. They ensure that the calibration is acceptable (i.e. not biased high or low) and also provide a measure of the analytical method's accuracy (i.e. closeness of the result to a target value).
- **Standard Reference Material (SRM)**: A material of similar matrix to the samples, externally certified for the parameter(s) listed. Standard Reference Materials ensure that the preparation steps in the method are adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Metals in Tissue, Batch B5G0265										
Blank (B5G0265-BLK1)				Prepared: Jul-07-15, Analyzed: Jul-08-15						
Aluminum	< 0.4	0.4	mg/kg wet							
Antimony	< 0.002	0.002	mg/kg wet							
Arsenic	< 0.005	0.005	mg/kg wet							
Barium	< 0.01	0.01	mg/kg wet							
Beryllium	< 0.002	0.002	mg/kg wet							
Bismuth	< 0.02	0.02	mg/kg wet							
Boron	< 0.1	0.1	mg/kg wet							
Cadmium	< 0.002	0.002	mg/kg wet							
Calcium	< 2	2	mg/kg wet							
Chromium	< 0.01	0.01	mg/kg wet							
Cobalt	< 0.004	0.004	mg/kg wet							
Copper	< 0.01	0.01	mg/kg wet							
Iron	< 1	1	mg/kg wet							
Lead	< 0.004	0.004	mg/kg wet							
Magnesium	< 2	2	mg/kg wet							
Manganese	< 0.02	0.02	mg/kg wet							
Mercury	< 0.002	0.002	mg/kg wet							
Molybdenum	< 0.01	0.01	mg/kg wet							
Nickel	< 0.01	0.01	mg/kg wet							
Phosphorus	< 5	5	mg/kg wet							
Potassium	< 10	10	mg/kg wet							
Selenium	< 0.02	0.02	mg/kg wet							
Silver	< 0.01	0.01	mg/kg wet							
Sodium	< 2	2	mg/kg wet							
Strontium	< 0.01	0.01	mg/kg wet							
Thallium	< 0.001	0.001	mg/kg wet							
Tin	< 0.02	0.02	mg/kg wet							
Titanium	< 0.05	0.05	mg/kg wet							
Uranium	< 0.001	0.001	mg/kg wet							
Vanadium	< 0.02	0.02	mg/kg wet							
Zinc	< 0.5	0.5	mg/kg wet							

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5061952
REPORTED Jul-10-15

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Metals in Tissue, Batch B5G0265, Continued										
Duplicate (B5G0265-DUP1)		**Source: 5061952-02**		Prepared: Jul-07-15, Analyzed: Jul-08-15						
Aluminum	0.9	0.4	mg/kg wet		1.4				40	
Antimony	0.746	0.002	mg/kg wet		1.16			43	40	RPD1
Arsenic	0.025	0.005	mg/kg wet		0.025			3	40	
Barium	0.08	0.01	mg/kg wet		0.18			82	40	RPD1
Beryllium	< 0.002	0.002	mg/kg wet		< 0.002				40	
Bismuth	< 0.02	0.02	mg/kg wet		< 0.02				40	
Boron	< 0.1	0.1	mg/kg wet		< 0.1				40	
Cadmium	0.006	0.002	mg/kg wet		0.006				40	
Calcium	80	2	mg/kg wet		400			133	60	RPD1
Chromium	< 0.01	0.01	mg/kg wet		0.01				40	
Cobalt	0.007	0.004	mg/kg wet		0.006				40	
Copper	0.37	0.01	mg/kg wet		0.36			2	40	
Iron	4	1	mg/kg wet		5			17	40	
Lead	0.005	0.004	mg/kg wet		0.006				40	
Magnesium	297	2	mg/kg wet		299			< 1	40	
Manganese	0.27	0.02	mg/kg wet		0.45			47	40	RPD1
Mercury	0.132	0.002	mg/kg wet		0.123			7	40	
Molybdenum	< 0.01	0.01	mg/kg wet		< 0.01				40	
Nickel	< 0.01	0.01	mg/kg wet		0.01				40	
Phosphorus	2880	5	mg/kg wet		3040			6	40	
Potassium	4920	10	mg/kg wet		4970			1	40	
Selenium	0.48	0.02	mg/kg wet		0.48			< 1	40	
Silver	< 0.01	0.01	mg/kg wet		< 0.01				40	
Sodium	346	2	mg/kg wet		350			1	40	
Strontium	0.11	0.01	mg/kg wet		0.56			136	60	RPD1
Thallium	0.004	0.001	mg/kg wet		0.004				40	
Tin	< 0.02	0.02	mg/kg wet		< 0.02				40	
Titanium	0.15	0.05	mg/kg wet		0.20				40	
Uranium	0.001	0.001	mg/kg wet		0.002				40	
Vanadium	< 0.02	0.02	mg/kg wet		< 0.02				40	
Zinc	5.4	0.5	mg/kg wet		4.5			18	40	
Reference (B5G0265-SRM1)				Prepared: Jul-07-15, Analyzed: Jul-08-15						
Arsenic	72.4	0.005	mg/kg wet	59.5		122	75-125			
Cadmium	40.6	0.002	mg/kg wet	42.3		96	75-125			
Chromium	1.57	0.01	mg/kg wet	1.95		80	75-125			
Cobalt	1.18	0.004	mg/kg wet	1.06		111	75-125			
Copper	484	0.01	mg/kg wet	497		97	75-125			
Iron	183	1	mg/kg wet	179		102	75-125			
Lead	0.189	0.004	mg/kg wet	0.225		84	75-125			
Manganese	16.9	0.02	mg/kg wet	15.6		108	75-125			
Mercury	0.268	0.002	mg/kg wet	0.292		92	75-125			
Molybdenum	3.58	0.01	mg/kg wet	3.44		104	75-125			
Nickel	4.99	0.01	mg/kg wet	5.30		94	75-125			
Selenium	13.3	0.02	mg/kg wet	10.9		122	75-125			
Strontium	38.1	0.01	mg/kg wet	36.5		104	75-125			
Tin	< 0.05	0.02	mg/kg wet	0.0290		79	75-125			
Vanadium	10.3	0.02	mg/kg wet	9.10		113	75-125			
Zinc	137	0.5	mg/kg wet	136		101	75-125			

QC Qualifiers:

RPD1 Relative percent difference(s) (RPD) of one or more analytes on duplicate analysis are outside of control limits due to sample heterogeneity.

CERTIFICATE OF ANALYSIS

REPORTED TO	Palmer Environmental Consulting Group Inc. 470 Granville Street - Suite 630 Vancouver, BC V6C 1V5	**TEL** **FAX**	(604) 629-9075 -
ATTENTION	Alyssa Murdoch	**WORK ORDER**	5080309
PO NUMBER		**RECEIVED / TEMP**	Aug-06-15 08:24 / 5°C
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15
PROJECT INFO		**COC NUMBER**	B 32952

General Comments:

CARO Analytical Services employs methods which are conducted according to procedures accepted by appropriate regulatory agencies, and/or are conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts, except where otherwise agreed to by the client.

The results in this report apply to the samples analyzed in accordance with the Chain of Custody or Sample Requisition document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

Work Order Comments:

Please note this is an amended report - additional parameters reported 11/30/2015 KF

[signature redacted]

Authorized By: **Brent Coates, B.Sc.**
Division Manager, Richmond

If you have any questions or concerns, please contact your Account Manager:
Sara Gulenchyn, B.Sc, P.Chem. (sgulenchyn@caro.ca)

Locations:

#110 4011 Viking Way
Richmond, BC V6V 2K9
Tel: 604-279-1499 Fax: 604-279-1599

#102 3677 Highway 97N
Kelowna, BC V1X 5C3
Tel: 250-765-9646 Fax: 250-765-3893

17225 109 Avenue
Edmonton, AB T5S 1H7
Tel: 780-489-9100 Fax: 780-489-9700

www.caro.ca

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PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

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Tabulated data in condensed format to assist with comparisons

ANALYSIS INFORMATION

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analysis Description	Method Reference	Technique	Location
Available Cations (Ca/Mg/K/Na)	MSSMA 4.51	1N Ammonium Acetate Extraction, Atomic Spectroscopy	Sublet
Available NH4-N and NO3-N in Soil	Carter 4	Nitrate and Exchangeable Ammonium Nitrogen	Sublet
Carbon, Total Organic in Solids	Carter 21.2	Catalytic Combustion and Infrared Detection	Kelowna
Chlorophyll-A	APHA 10200 H	Spectrophotometry	Kelowna
Metals in Tissue	EPA 200.3 / EPA 6020A	HNO3+HCl+H2O2 Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Moisture	ASTM D2974-87*	Gravimetry (Dried at 105C)	N/A
Particle Size - Dry Sieve Fractions	N/A	N/A	Richmond
pH in Soil (1:2 Soil/Water)	Carter 16.2 / APHA 4500-H+ B	1:2 Soil/Water Slurry / Electrometry	Richmond
Phosphorus, Available (Bray)	UBCPLMM 6.1	Bray Extraction, Colorimetric	Sublet
Strong Acid Leachable Metals	BCMOE SALM V.2 / EPA 6020A	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Total Solids	APHA 2540 B	Gravimetric (Dried at 103-105C)	Kelowna
Total Volatile Solids (550C)	APHA 2540 E	Gravimetry (Ignited at 550C)	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Method Reference Descriptions:

APHA	Standard Methods for the Examination of Water and Wastewater, 22nd Edition, American Public Health Association/American Water Works Association/Water Environment Federation
ASTM	ASTM International Test Methods
Carter	Soil Sampling and Methods of Analysis, 2nd Edition (2007), Carter/Gregorich
EPA	United States Environmental Protection Agency Test Methods
MSSMA	Manual on Soil Sampling and Methods of Analysis, J.A. McKeague
UBCPLMM	Methods Manual, Pedology Laboratory, 1977/1981, L.M. Lavkulich, UBC Department of Soil Science

Glossary of Terms:

MRL	Method Reporting Limit
<	Less than the Reported Detection Limit (RDL) - the RDL may be higher than the MRL due to various factors such as dilutions, limited sample volume, high moisture, or interferences
%	Percent
% dry	Percent (dry weight)
% wet	Percent (wet weight)
mg/kg dry	Milligrams per kilogram (dry weight)
mg/kg wet	Milligrams per kilogram (wet weight)
mg/L	Milligrams per litre
pH units	pH < 7 = acidic, ph > 7 = basic
µg/L	Micrograms per litre

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF2 (5080309-01) [Water] Sampled: Aug-01-15 09:20						
General Parameters						
Chlorophyll a	**19.0**	0.1	µg/L	Aug-07-15	Aug-11-15	HT1
Solids, Total	**350**	10	mg/L	N/A	Aug-12-15	HT1
Solids, Total Volatile	**93**	10	mg/L	N/A	Aug-12-15	HT1
Sample ID: AQ10 (5080309-02) [Water] Sampled: Aug-01-15 10:20						
General Parameters						
Chlorophyll a	**23.5**	0.1	µg/L	Aug-07-15	Aug-11-15	HT1
Solids, Total	**103**	10	mg/L	N/A	Aug-12-15	HT1
Solids, Total Volatile	**83**	10	mg/L	N/A	Aug-12-15	HT1
Sample ID: AQ11 (5080309-03) [Water] Sampled: Aug-01-15 10:45						
General Parameters						
Chlorophyll a	**12.0**	0.1	µg/L	Aug-07-15	Aug-11-15	HT1
Solids, Total	**143**	10	mg/L	N/A	Aug-12-15	HT1
Solids, Total Volatile	**37**	10	mg/L	N/A	Aug-12-15	HT1
Sample ID: AQ20 (5080309-04) [Water] Sampled: Aug-01-15 11:20						
General Parameters						
Chlorophyll a	**23.6**	0.1	µg/L	Aug-07-15	Aug-11-15	HT1
Solids, Total	**193**	10	mg/L	N/A	Aug-12-15	HT1
Solids, Total Volatile	**160**	10	mg/L	N/A	Aug-12-15	HT1
Sample ID: AQ30 (5080309-05) [Water] Sampled: Aug-01-15 11:45						
General Parameters						
Chlorophyll a	**29.0**	0.1	µg/L	Aug-07-15	Aug-11-15	HT1
Solids, Total	**107**	10	mg/L	N/A	Aug-12-15	HT1
Solids, Total Volatile	**37**	10	mg/L	N/A	Aug-12-15	HT1
Sample ID: AQ13 (5080309-06) [Water] Sampled: Aug-01-15 12:20						
General Parameters						
Chlorophyll a	**23.7**	0.1	µg/L	Aug-07-15	Aug-11-15	HT1
Solids, Total	**140**	10	mg/L	N/A	Aug-12-15	HT1
Solids, Total Volatile	**70**	10	mg/L	N/A	Aug-12-15	HT1
Sample ID: AQ04.5 (5080309-07) [Water] Sampled: Aug-01-15 13:40						
General Parameters						
Chlorophyll a	**24.3**	0.1	µg/L	Aug-07-15	Aug-11-15	HT1
Solids, Total	**273**	10	mg/L	N/A	Aug-12-15	HT1
Solids, Total Volatile	**43**	10	mg/L	N/A	Aug-12-15	HT1

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04 (5080309-08) [Water] Sampled: Aug-01-15 14:25						
General Parameters						
Chlorophyll a	**11.0**	0.1	µg/L	Aug-07-15	Aug-11-15	HT1
Solids, Total	**143**	10	mg/L	N/A	Aug-12-15	HT1
Solids, Total Volatile	**53**	10	mg/L	N/A	Aug-12-15	HT1
Sample ID: AQ02 (5080309-09) [Water] Sampled: Aug-01-15 15:10						
General Parameters						
Chlorophyll a	**26.6**	0.1	µg/L	Aug-07-15	Aug-11-15	HT1
Solids, Total	**183**	10	mg/L	N/A	Aug-12-15	HT1
Solids, Total Volatile	**90**	10	mg/L	N/A	Aug-12-15	HT1
Sample ID: AQ00 (5080309-10) [Water] Sampled: Aug-01-15 15:30						
General Parameters						
Chlorophyll a	**12.7**	0.1	µg/L	Aug-07-15	Aug-11-15	HT1
Solids, Total	**140**	10	mg/L	N/A	Aug-12-15	HT1
Solids, Total Volatile	**47**	10	mg/L	N/A	Aug-12-15	HT1
Sample ID: AQREF1 (5080309-11) [Water] Sampled: Aug-01-15 16:00						
General Parameters						
Chlorophyll a	**20.8**	0.1	µg/L	Aug-07-15	Aug-11-15	HT1
Solids, Total	**210**	10	mg/L	N/A	Aug-12-15	HT1
Solids, Total Volatile	**73**	10	mg/L	N/A	Aug-12-15	HT1
Sample ID: AQ00-1 (5080309-12) [Soil] Sampled: Jul-26-15 10:00						
General Parameters						
Carbon, Total Organic	**1.65**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**35.7**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.6**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1500**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**290**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**47**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**20**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**6.7**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.9**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**15200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**7.3**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**174**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ00-1 (5080309-12) [Soil] Sampled: Jul-26-15 10:00, Continued						
Strong Acid Leachable Metals, Continued						
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.19**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7010**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**29.6**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**9.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**18.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**22300**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**7.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**14.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6220**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**284**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.07**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**19.0**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**715**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1150**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.8**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**274**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**40.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**6.6**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**972**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**12.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**49.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**66**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ00-2 (5080309-13) [Soil] Sampled: Jul-26-15 10:00						
General Parameters						
Carbon, Total Organic	**23.8**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**60.4**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.6**	0.1	pH units	Aug-18-15	Aug-18-15	
Strong Acid Leachable Metals						
Aluminum	**16500**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**6.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**208**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ00-2 (5080309-13) [Soil] Sampled: Jul-26-15 10:00, Continued						
Strong Acid Leachable Metals, Continued						
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.20**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**10400**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**33.8**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**8.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**30.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**21100**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**7.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**16.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6700**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**252**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.15**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**23.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**722**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1300**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.1**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**272**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**59.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	**1000**	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**7.6**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.7**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**895**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**54.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**41.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**63**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ00-3 (5080309-14) [Soil] Sampled: Jul-26-15 10:00						
General Parameters						
Carbon, Total Organic	**4.86**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**54.8**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.2**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1400**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**260**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**100**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**45**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**12.0**	1.0	mg/kg dry	N/A	Aug-06-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ00-3 (5080309-14) [Soil] Sampled: Jul-26-15 10:00, Continued						
Fertility / Nutrient Parameters, Continued						
Nitrate as N, Available	**2.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**6**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**16100**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**8.2**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**183**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.24**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**6950**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**28.7**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**10.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**17.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**23800**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**6.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**13.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6260**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**525**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.10**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**18.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**658**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1310**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.6**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**283**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**40.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**5.4**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1070**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**11.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**52.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**66**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ00-4 (5080309-15) [Soil] Sampled: Jul-26-15 10:00						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ00-4 (5080309-15) [Soil] Sampled: Jul-26-15 10:00, Continued						
Particle Size Distribution, Continued						
> 56 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 40 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 25 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 19 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 12.5 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 4.75 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 2.36 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 2.0 mm	**0.4**	0.1	%	N/A	Aug-20-15	
> 1.18 mm	**1.7**	0.1	%	N/A	Aug-20-15	
> 600 µm	**4.6**	0.1	%	N/A	Aug-20-15	
> 425 µm	**11.0**	0.1	%	N/A	Aug-20-15	
> 300 µm	**6.6**	0.1	%	N/A	Aug-20-15	
> 150 µm	**22.4**	0.1	%	N/A	Aug-20-15	
> 75 µm	**16.6**	0.1	%	N/A	Aug-20-15	
< 75 µm	**36.7**	0.1	%	N/A	Aug-20-15	
Sample ID: AQ02-1 (5080309-16) [Soil] Sampled: Jul-26-15 14:00						
General Parameters						
Carbon, Total Organic	**10.3**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**34.6**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.8**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2140**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**393**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**79**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**24**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**9.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.8**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**16500**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**9.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**199**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.27**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**8090**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**30.3**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**11.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**20.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**24800**	20	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ02-1 (5080309-16) [Soil] Sampled: Jul-26-15 14:00, Continued						
Strong Acid Leachable Metals, Continued						
Lead	**6.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**13.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6470**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**559**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.07**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**19.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**711**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1220**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.2**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**273**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**45.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**5.8**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1050**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**11.0**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**54.8**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**68**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ02-2 (5080309-17) [Soil] Sampled: Jul-26-15 14:00						
General Parameters						
Carbon, Total Organic	**5.21**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**41.9**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.3**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2150**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**385**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**79**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**21**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**8.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**16**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**16600**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**9.2**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**198**	1	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ02-2 (5080309-17) [Soil] Sampled: Jul-26-15 14:00, Continued						
Strong Acid Leachable Metals, Continued						
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.23**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7740**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**30.3**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**10.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**18.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**24700**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**7.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**14.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6510**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**498**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.06**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**19.4**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**700**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1220**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.6**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**279**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**43.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**6.4**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1090**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**10.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**54.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**68**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ02-3 (5080309-18) [Soil] Sampled: Aug-01-15 15:10						
General Parameters						
Carbon, Total Organic	**6.15**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**57.4**	0.1	% wet	N/A	Aug-05-15	
pH (1:2 H2O Solution)	**6.3**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2430**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**421**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**130**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**34**	5	mg/kg dry	N/A	Aug-06-15	

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PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ02-3 (5080309-18) [Soil] Sampled: Aug-01-15 15:10, Continued						
Fertility / Nutrient Parameters, Continued						
Ammonia as N, Available	**8.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.9**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**17400**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**8.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**201**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.23**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7700**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**31.0**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**11.0**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**20.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**25800**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**6.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**13.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6770**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**569**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.08**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**19.2**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**637**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1260**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.9**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**273**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**44.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**5.3**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1070**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**7.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**56.3**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**70**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ02-3R (5080309-19) [Soil] Sampled: Aug-01-15 15:10						
General Parameters						

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ02-3R (5080309-19) [Soil] Sampled: Aug-01-15 15:10, Continued						
General Parameters, Continued						
Carbon, Total Organic	**7.34**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**51.4**	0.1	% wet	N/A	Aug-05-15	
pH (1:2 H2O Solution)	**6.2**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2050**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**370**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**103**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**20**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**9.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.1**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**3**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**16700**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**8.3**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**191**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.22**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**6970**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**29.5**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**10.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**18.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**24600**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**6.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**13.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6550**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**519**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.07**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**18.2**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**655**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1190**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.2**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**288**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**41.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**5.3**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ02-3R (5080309-19) [Soil] Sampled: Aug-01-15 15:10, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**1080**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**6.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**55.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**67**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ02-4 (5080309-20) [Soil] Sampled: Jul-26-15 14:00						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 56 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 40 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 25 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 19 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 12.5 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 4.75 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 2.36 mm	**1.8**	0.1	%	N/A	Aug-20-15	
> 2.0 mm	**0.8**	0.1	%	N/A	Aug-20-15	
> 1.18 mm	**3.1**	0.1	%	N/A	Aug-20-15	
> 600 µm	**6.5**	0.1	%	N/A	Aug-20-15	
> 425 µm	**4.7**	0.1	%	N/A	Aug-20-15	
> 300 µm	**7.2**	0.1	%	N/A	Aug-20-15	
> 150 µm	**22.3**	0.1	%	N/A	Aug-20-15	
> 75 µm	**20.1**	0.1	%	N/A	Aug-20-15	
< 75 µm	**33.3**	0.1	%	N/A	Aug-20-15	
Sample ID: AQREF1-1 (5080309-21) [Soil] Sampled: Jul-27-15 16:00						
General Parameters						
Carbon, Total Organic	**0.95**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**7.3**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.8**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1350**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**290**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**31**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**13**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**5.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	< 1.0	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**3**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**13600**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**1.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**22.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF1-1 (5080309-21) [Soil] Sampled: Jul-27-15 16:00, Continued						
Strong Acid Leachable Metals, Continued						
Barium	**374**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.31**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7570**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**26.7**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**8.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**18.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**25200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**8.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**11.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**5920**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**429**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	< 0.05	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**1.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**17.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**1110**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1050**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.1**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**218**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**44.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**6.7**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**701**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**2.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**56.2**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**74**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQREF1-2 (5080309-22) [Soil] Sampled: Jul-27-15 16:00						
General Parameters						
Carbon, Total Organic	**2.51**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**53.4**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.8**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2500**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**488**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**45**	5	mg/kg dry	N/A	Aug-06-15	

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PROJECT Coffee Gold

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF1-2 (5080309-22) [Soil] Sampled: Jul-27-15 16:00, Continued						
Fertility / Nutrient Parameters, Continued						
Sodium, Available	**48**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**8.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.5**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**6**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**14000**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**1.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**14.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**388**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.33**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**8730**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**26.4**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**9.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**19.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**23400**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**8.7**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**12.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6220**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**343**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.05**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**19.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**876**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1100**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.0**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**251**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**56.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**6.1**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**780**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**3.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**49.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**75**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQREF1-3 (5080309-23) [Soil] Sampled: Jul-27-15 16:00						

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF1-3 (5080309-23) [Soil] Sampled: Jul-27-15 16:00, Continued						
General Parameters						
Carbon, Total Organic	**4.28**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**63.8**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.6**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2100**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**400**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**38**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**28**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**8.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.8**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**6**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**13200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**1.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**11.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**322**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.29**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**9070**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**27.3**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**8.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**22.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**20600**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**10.1**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**11.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6080**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**242**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.06**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**20.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**771**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**884**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.2**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**225**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**60.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**5.8**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF1-3 (5080309-23) [Soil] Sampled: Jul-27-15 16:00, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**700**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**4.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**45.8**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**70**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQREF1-3R (5080309-24) [Soil] Sampled: Jul-27-15 16:00						
General Parameters						
Carbon, Total Organic	**5.56**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**55.9**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.5**	0.1	pH units	Aug-18-15	Aug-18-15	
Strong Acid Leachable Metals						
Aluminum	**14500**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**1.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**10.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**325**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.29**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**9340**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**27.3**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**9.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**22.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**21400**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**9.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**12.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6240**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**199**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.06**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**20.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**829**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1040**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.0**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**246**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**59.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**6.3**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF1-3R (5080309-24) [Soil] Sampled: Jul-27-15 16:00, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**758**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**4.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**49.3**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**71**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQREF1-4 (5080309-25) [Soil] Sampled: Jul-27-15 16:00						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 56 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 40 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 25 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 19 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 12.5 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 4.75 mm	**13.0**	0.1	%	N/A	Aug-20-15	
> 2.36 mm	**10.0**	0.1	%	N/A	Aug-20-15	
> 2.0 mm	**2.2**	0.1	%	N/A	Aug-20-15	
> 1.18 mm	**5.3**	0.1	%	N/A	Aug-20-15	
> 600 µm	**5.6**	0.1	%	N/A	Aug-20-15	
> 425 µm	**4.3**	0.1	%	N/A	Aug-20-15	
> 300 µm	**7.8**	0.1	%	N/A	Aug-20-15	
> 150 µm	**23.9**	0.1	%	N/A	Aug-20-15	
> 75 µm	**15.8**	0.1	%	N/A	Aug-20-15	
< 75 µm	**12.1**	0.1	%	N/A	Aug-20-15	
Sample ID: AQ30-1 (5080309-26) [Soil] Sampled: Jul-27-15 17:45						
General Parameters						
Carbon, Total Organic	**2.75**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**20.1**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.7**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1780**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**207**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**44**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**19**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**5.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.8**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**16700**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**1.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**18.0**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ30-1 (5080309-26) [Soil] Sampled: Jul-27-15 17:45, Continued						
Strong Acid Leachable Metals, Continued						
Barium	**225**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.23**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**9920**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**32.0**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**11.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**21.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**25800**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**11.7**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**14.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6290**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**687**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.08**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**20.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**667**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1290**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.9**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**214**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**64.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**9.9**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**796**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**7.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**47.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**72**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ30-2 (5080309-27) [Soil] Sampled: Jul-27-15 17:45						
General Parameters						
Carbon, Total Organic	**3.00**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**6.9**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.8**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1290**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**143**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**30**	5	mg/kg dry	N/A	Aug-06-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ30-2 (5080309-27) [Soil] Sampled: Jul-27-15 17:45, Continued						
Fertility / Nutrient Parameters, Continued						
Sodium, Available	**11**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**5.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**7**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**15200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**1.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**15.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**210**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.29**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**9290**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**27.8**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**11.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**20.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**24000**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**12.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**12.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**5610**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**706**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.07**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**19.4**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**667**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1150**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.2**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**209**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**59.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**10.4**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**679**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**6.0**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**41.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**72**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ30-3 (5080309-28) [Soil] Sampled: Jul-27-15 17:45						

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ30-3 (5080309-28) [Soil] Sampled: Jul-27-15 17:45, Continued						
General Parameters						
Carbon, Total Organic	**4.04**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**36**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.3**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1850**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**220**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**68**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**13**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**9.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**2.2**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**7**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**11700**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**10.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**179**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.09**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**11300**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**26.8**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**8.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**29.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**19800**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**7.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**11.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**5840**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**413**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	< 0.05	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**22.3**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**664**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1290**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.9**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**242**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**57.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**6.3**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ30-3 (5080309-28) [Soil] Sampled: Jul-27-15 17:45, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**800**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**4.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**36.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**65**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**4**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ30-4 (5080309-29) [Soil] Sampled: Jul-27-15 17:45						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 56 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 40 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 25 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 19 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 12.5 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 4.75 mm	**0.4**	0.1	%	N/A	Aug-20-15	
> 2.36 mm	**3.1**	0.1	%	N/A	Aug-20-15	
> 2.0 mm	**2.0**	0.1	%	N/A	Aug-20-15	
> 1.18 mm	**6.2**	0.1	%	N/A	Aug-20-15	
> 600 µm	**9.9**	0.1	%	N/A	Aug-20-15	
> 425 µm	**5.4**	0.1	%	N/A	Aug-20-15	
> 300 µm	**5.7**	0.1	%	N/A	Aug-20-15	
> 150 µm	**12.4**	0.1	%	N/A	Aug-20-15	
> 75 µm	**14.1**	0.1	%	N/A	Aug-20-15	
< 75 µm	**40.9**	0.1	%	N/A	Aug-20-15	
Sample ID: AQ11-1 (5080309-30) [Soil] Sampled: Jul-28-15 11:45						
General Parameters						
Carbon, Total Organic	**7.83**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**43.3**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.4**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**3570**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**550**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**97**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**43**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**12.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.8**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**17500**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**17.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ11-1 (5080309-30) [Soil] Sampled: Jul-28-15 11:45, Continued						
Strong Acid Leachable Metals, Continued						
Barium	**208**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.48**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**8810**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**36.1**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**12.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**26.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**27000**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**11.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**16.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6990**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**768**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.06**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**1.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**27.0**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**621**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1290**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.9**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**262**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**50.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**7.0**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**999**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**7.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**55.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**79**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ11-2 (5080309-31) [Soil] Sampled: Jul-28-15 11:45						
General Parameters						
Carbon, Total Organic	**3.25**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**36.3**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**6.4**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2140**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**336**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**96**	5	mg/kg dry	N/A	Aug-06-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ11-2 (5080309-31) [Soil] Sampled: Jul-28-15 11:45, Continued						
Fertility / Nutrient Parameters, Continued						
Sodium, Available	**29**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**12.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**2.2**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**15400**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**11.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**151**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.29**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**6920**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**30.1**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**10.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**15.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**23000**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**9.1**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**14.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**5850**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**478**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.05**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**20.3**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**676**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1090**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.8**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**251**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**38.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**6.9**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1060**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**6.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**49.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**72**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ11-4 (5080309-33) [Soil] Sampled: Jul-28-15 11:45						

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ11-4 (5080309-33) [Soil] Sampled: Jul-28-15 11:45, Continued						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 56 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 40 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 25 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 19 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 12.5 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 4.75 mm	**2.4**	0.1	%	N/A	Aug-20-15	
> 2.36 mm	**5.8**	0.1	%	N/A	Aug-20-15	
> 2.0 mm	**2.7**	0.1	%	N/A	Aug-20-15	
> 1.18 mm	**8.3**	0.1	%	N/A	Aug-20-15	
> 600 µm	**10.6**	0.1	%	N/A	Aug-20-15	
> 425 µm	**11.2**	0.1	%	N/A	Aug-20-15	
> 300 µm	**20.8**	0.1	%	N/A	Aug-20-15	
> 150 µm	**23.7**	0.1	%	N/A	Aug-20-15	
> 75 µm	**9.4**	0.1	%	N/A	Aug-20-15	
< 75 µm	**5.0**	0.1	%	N/A	Aug-20-15	
Sample ID: AQ10-1 (5080309-34) [Soil] Sampled: Jul-28-15 14:05						
General Parameters						
Carbon, Total Organic	**3.48**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**55.1**	0.1	% wet	Aug-07-15	Aug-10-15	
pH (1:2 H2O Solution)	**5.8**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2210**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**364**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**157**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**26**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**11.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**3.2**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	< 2	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**18700**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**14.4**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**180**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.30**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**8530**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**35.8**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**12.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**19.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ10-1 (5080309-34) [Soil] Sampled: Jul-28-15 14:05, Continued						
Strong Acid Leachable Metals, Continued						
Iron	**27200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**10.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**17.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6910**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**870**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.08**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**24.4**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**662**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1200**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.7**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**279**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**46.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**7.8**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1050**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**8.0**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**54.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**80**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ10-2 (5080309-35) [Soil] Sampled: Jul-28-15 14:05						
General Parameters						
Carbon, Total Organic	**4.61**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**42.6**	0.1	% wet	N/A	Aug-19-15	
pH (1:2 H2O Solution)	**6.5**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1930**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**321**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**83**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**21**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**11.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**2.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**16700**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**10.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ10-2 (5080309-35) [Soil] Sampled: Jul-28-15 14:05, Continued						
Strong Acid Leachable Metals, Continued						
Barium	**169**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.29**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7700**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**31.7**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**11.0**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**15.8**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**24800**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**9.8**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**14.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6300**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**693**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.06**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**21.0**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**670**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1150**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.8**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**281**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**40.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**6.9**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1090**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**4.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**50.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**75**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ10-3 (5080309-36) [Soil] Sampled: Jul-28-15 14:05						
General Parameters						
Carbon, Total Organic	**4.35**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**50.7**	0.1	% wet	N/A	Aug-19-15	
pH (1:2 H2O Solution)	**6.3**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1790**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**279**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**100**	5	mg/kg dry	N/A	Aug-06-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ10-3 (5080309-36) [Soil] Sampled: Jul-28-15 14:05, Continued						
Fertility / Nutrient Parameters, Continued						
Sodium, Available	**20**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**11.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**2.8**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**16100**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**11.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**164**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.27**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7530**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**31.9**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**10.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**15.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**23900**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**10.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**14.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**5970**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**605**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.06**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**21.0**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**700**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1050**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.7**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**279**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**40.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**7.3**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1090**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**5.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**51.8**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**73**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	

Sample ID: AQ10-3R (5080309-37) [Soil] Sampled: Jul-28-15 14:05

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ10-3R (5080309-37) [Soil] Sampled: Jul-28-15 14:05, Continued						
General Parameters						
Carbon, Total Organic	**3.81**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**44.2**	0.1	% wet	N/A	Aug-19-15	
pH (1:2 H2O Solution)	**6.1**	0.1	pH units	Aug-18-15	Aug-18-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1640**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**275**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**91**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**19**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**11.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**3.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**8**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**14700**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**8.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**149**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.21**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**6340**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**29.1**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**9.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**14.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**21500**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**9.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**12.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**5710**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**479**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	< 0.05	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**18.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**650**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**942**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.8**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**254**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**34.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**6.2**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ10-3R (5080309-37) [Soil] Sampled: Jul-28-15 14:05, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**1040**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**3.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**46.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**68**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ10-4 (5080309-38) [Soil] Sampled: Jul-28-15 14:05						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 56 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 40 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 25 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 19 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 12.5 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 4.75 mm	**7.2**	0.1	%	N/A	Aug-20-15	
> 2.36 mm	**3.3**	0.1	%	N/A	Aug-20-15	
> 2.0 mm	**1.4**	0.1	%	N/A	Aug-20-15	
> 1.18 mm	**5.8**	0.1	%	N/A	Aug-20-15	
> 600 µm	**10.1**	0.1	%	N/A	Aug-20-15	
> 425 µm	**7.4**	0.1	%	N/A	Aug-20-15	
> 300 µm	**10.1**	0.1	%	N/A	Aug-20-15	
> 150 µm	**24.7**	0.1	%	N/A	Aug-20-15	
> 75 µm	**16.6**	0.1	%	N/A	Aug-20-15	
< 75 µm	**13.3**	0.1	%	N/A	Aug-20-15	
Sample ID: AQ04-1 (5080309-39) [Soil] Sampled: Jul-29-15 11:50						
General Parameters						
Carbon, Total Organic	**5.34**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**24.7**	0.1	% wet	N/A	Aug-19-15	
pH (1:2 H2O Solution)	**6.9**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1450**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**235**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**54**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**14**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**6.7**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	< 1.0	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**14800**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**4.4**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04-1 (5080309-39) [Soil] Sampled: Jul-29-15 11:50, Continued						
Strong Acid Leachable Metals, Continued						
Barium	**120**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.09**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**6050**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**26.1**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**7.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**13.7**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**21600**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**7.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**12.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**5810**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**323**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.05**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**15.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**541**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**846**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.7**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**261**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**45.7**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**8.6**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1040**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**11.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**46.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**52**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ04-2 (5080309-40) [Soil] Sampled: Jul-29-15 11:50						
General Parameters						
Carbon, Total Organic	**5.44**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**53.1**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**7.1**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2600**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**380**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**98**	5	mg/kg dry	N/A	Aug-06-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04-2 (5080309-40) [Soil] Sampled: Jul-29-15 11:50, Continued						
Fertility / Nutrient Parameters, Continued						
Sodium, Available	**40**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**12.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.9**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**6**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**15800**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**10.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**162**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.30**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7200**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**26.3**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**9.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**15.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**21900**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**10.8**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**13.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**5050**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**738**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.10**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**17.4**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**518**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**870**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**2.0**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**179**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**64.1**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**9.7**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**804**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**9.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**41.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**73**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ04-3 (5080309-41) [Soil] Sampled: Jul-29-15 11:50						

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04-3 (5080309-41) [Soil] Sampled: Jul-29-15 11:50, Continued						
General Parameters						
Carbon, Total Organic	**5.43**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**36.6**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**6.7**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2210**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**364**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**80**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**20**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**9.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.6**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**18200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**11.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**184**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.29**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7490**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**32.9**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**10.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**17.7**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**25400**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**11.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**15.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6450**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**726**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.09**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**21.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**573**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1140**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**2.0**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**242**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**62.1**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**10.8**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04-3 (5080309-41) [Soil] Sampled: Jul-29-15 11:50, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**952**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**12.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**50.0**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**74**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ04-3R (5080309-42) [Soil] Sampled: Jul-29-15 11:50						
General Parameters						
Carbon, Total Organic	**5.26**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**49**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**6.8**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2140**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**314**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**63**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**19**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**11.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**2**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**17500**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**10.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**170**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.28**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7230**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**30.9**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**10.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**15.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**23500**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**11.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**15.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**5930**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**548**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.09**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**20.3**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**532**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1020**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.9**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04-3R (5080309-42) [Soil] Sampled: Jul-29-15 11:50, Continued						
Strong Acid Leachable Metals, Continued						
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**237**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**60.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**10.5**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**922**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**12.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**44.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**74**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ04-4 (5080309-43) [Soil] Sampled: Jul-29-15 11:50						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 56 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 40 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 25 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 19 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 12.5 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 4.75 mm	**0.9**	0.1	%	N/A	Aug-20-15	
> 2.36 mm	**3.7**	0.1	%	N/A	Aug-20-15	
> 2.0 mm	**1.7**	0.1	%	N/A	Aug-20-15	
> 1.18 mm	**8.3**	0.1	%	N/A	Aug-20-15	
> 600 µm	**19.8**	0.1	%	N/A	Aug-20-15	
> 425 µm	**18.5**	0.1	%	N/A	Aug-20-15	
> 300 µm	**22.8**	0.1	%	N/A	Aug-20-15	
> 150 µm	**17.5**	0.1	%	N/A	Aug-20-15	
> 75 µm	**4.8**	0.1	%	N/A	Aug-20-15	
< 75 µm	**2.0**	0.1	%	N/A	Aug-20-15	
Sample ID: AQ13-1 (5080309-44) [Soil] Sampled: Jul-30-15 14:35						
General Parameters						
Carbon, Total Organic	**5.32**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**48**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**4.4**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1000**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**143**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**69**	5	mg/kg dry	N/A	Aug-06-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ13-1 (5080309-44) [Soil] Sampled: Jul-30-15 14:35, Continued						
Fertility / Nutrient Parameters, Continued						
Sodium, Available	**16**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**11.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	< 1.0	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	< 2	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**19100**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**19.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**111**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.08**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**3840**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**54.6**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**10.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**16.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**25300**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**9.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**12.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**7960**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**387**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.06**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**1.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**29.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**480**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1760**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.5**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**236**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**30.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**7.9**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**1.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1180**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**2.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**64.2**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**60**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ13-2 (5080309-45) [Soil] Sampled: Jul-30-15 14:35						

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ13-2 (5080309-45) [Soil] Sampled: Jul-30-15 14:35, Continued						
General Parameters						
Carbon, Total Organic	**4.76**	0.05	% dry	Aug-12-15	Aug-13-15	
Moisture	**48.4**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**6.6**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2640**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**207**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**100**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**34**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**12.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**2.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**2**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**22500**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**37.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**185**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.30**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**9010**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**62.3**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**14.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**25.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**28800**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**8.8**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**17.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**8650**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**901**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.08**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**38.8**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**547**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**2310**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.5**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**283**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**62.1**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**11.2**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**1.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ13-2 (5080309-45) [Soil] Sampled: Jul-30-15 14:35, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**1170**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**10.0**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**51.8**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**75**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ13-3 (5080309-46) [Soil] Sampled: Jul-30-15 14:35						
General Parameters						
Carbon, Total Organic	**4.43**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**62.1**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**5.8**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2700**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**210**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**92**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**28**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**10.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**3.4**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**2**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**17900**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**22.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**137**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.13**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7090**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**48.4**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**10.0**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**17.8**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**23300**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**8.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**12.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**7120**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**635**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.06**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**28.2**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**469**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1710**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**2.4**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ13-3 (5080309-46) [Soil] Sampled: Jul-30-15 14:35, Continued						
Strong Acid Leachable Metals, Continued						
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**240**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**45.7**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**9.6**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1060**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**4.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**43.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**57**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ13-3R (5080309-47) [Soil] Sampled: Jul-30-15 14:35						
General Parameters						
Carbon, Total Organic	**2.73**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**39.7**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**5.5**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2400**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**210**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**108**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**24**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**5.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.8**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**5**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**17200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**20.2**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**132**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.10**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**6060**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**48.9**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**9.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**17.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**23300**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**7.7**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ13-3R (5080309-47) [Soil] Sampled: Jul-30-15 14:35, Continued						
Strong Acid Leachable Metals, Continued						
Lithium	**12.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**7220**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**413**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	< 0.05	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**27.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**526**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1950**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.9**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**263**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**41.1**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**9.6**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**1160**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**2.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**45.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**55**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ13-4 (5080309-48) [Soil] Sampled: Jul-30-15 14:35						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 56 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 40 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 25 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 19 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 12.5 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 4.75 mm	**2.1**	0.1	%	N/A	Aug-20-15	
> 2.36 mm	**3.5**	0.1	%	N/A	Aug-20-15	
> 2.0 mm	**1.5**	0.1	%	N/A	Aug-20-15	
> 1.18 mm	**5.2**	0.1	%	N/A	Aug-20-15	
> 600 µm	**10.8**	0.1	%	N/A	Aug-20-15	
> 425 µm	**8.9**	0.1	%	N/A	Aug-20-15	
> 300 µm	**11.4**	0.1	%	N/A	Aug-20-15	
> 150 µm	**22.6**	0.1	%	N/A	Aug-20-15	
> 75 µm	**18.1**	0.1	%	N/A	Aug-20-15	
< 75 µm	**15.8**	0.1	%	N/A	Aug-20-15	
Sample ID: AQ20-1 (5080309-49) [Soil] Sampled: Jul-30-15 16:30						

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ20-1 (5080309-49) [Soil] Sampled: Jul-30-15 16:30, Continued						
General Parameters						
Carbon, Total Organic	**9.05**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**47.4**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**6.7**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**3300**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**480**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**100**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**38**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**8.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**3.2**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**9**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**14000**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**13.8**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**167**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.18**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**8330**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**32.2**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**9.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**16.1**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**20500**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**7.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**12.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**5980**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**578**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.07**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**21.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**634**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1120**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.6**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**204**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**72.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**7.3**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ20-1 (5080309-49) [Soil] Sampled: Jul-30-15 16:30, Continued						
Strong Acid Leachable Metals, Continued						
Titanium	**792**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**17.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**39.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**64**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ20-2 (5080309-50) [Soil] Sampled: Jul-30-15 16:30						
General Parameters						
Carbon, Total Organic	**5.91**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**46**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**7.1**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**3350**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**480**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**101**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**16**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**8.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.9**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	< 2	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**16200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**15.0**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**193**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.18**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**9460**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**36.1**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**10.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**19.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**23400**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**7.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**15.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6450**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**613**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.06**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**24.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**725**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1330**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.7**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ20-2 (5080309-50) [Soil] Sampled: Jul-30-15 16:30, Continued						
Strong Acid Leachable Metals, Continued						
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**223**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**80.8**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**9.1**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**912**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**17.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**45.3**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**61**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ20-3 (5080309-51) [Soil] Sampled: Jul-30-15 16:30						
General Parameters						
Carbon, Total Organic	**10.5**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**48.7**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**7.0**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**3570**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**514**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**99**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**21**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**8.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**2.2**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**2**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**14900**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**14.0**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**179**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**2**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.17**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**9550**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**34.0**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**9.0**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**19.1**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**21200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**7.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

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REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ20-3 (5080309-51) [Soil] Sampled: Jul-30-15 16:30, Continued						
Strong Acid Leachable Metals, Continued						
Lithium	**13.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6280**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**433**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.06**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**22.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**667**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1220**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**1.2**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**210**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**82.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**8.4**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**763**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**27.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**39.8**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**57**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ20-3R (5080309-52) [Soil] Sampled: Jul-30-15 16:30						
General Parameters						
Carbon, Total Organic	**10.6**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**43**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**7.0**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**3790**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**486**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**81**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**21**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**10.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**3.5**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**3**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**15800**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**1.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**12.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**191**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ20-3R (5080309-52) [Soil] Sampled: Jul-30-15 16:30, Continued						
Strong Acid Leachable Metals, Continued						
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.15**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**10600**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**36.5**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**7.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**24.1**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**20100**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**7.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**15.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**6440**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**238**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.08**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**24.2**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**680**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**1110**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	< 0.5	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**198**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**93.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**8.8**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**742**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**28.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**35.2**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**54**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ20-4 (5080309-53) [Soil] Sampled: Jul-30-15 16:30						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 56 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 40 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 25 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 19 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 12.5 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 4.75 mm	**1.0**	0.1	%	N/A	Aug-20-15	
> 2.36 mm	**3.0**	0.1	%	N/A	Aug-20-15	
> 2.0 mm	**1.3**	0.1	%	N/A	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ20-4 (5080309-53) [Soil] Sampled: Jul-30-15 16:30, Continued						
Particle Size Distribution, Continued						
> 1.18 mm	**5.5**	0.1	%	N/A	Aug-20-15	
> 600 µm	**10.6**	0.1	%	N/A	Aug-20-15	
> 425 µm	**6.6**	0.1	%	N/A	Aug-20-15	
> 300 µm	**7.6**	0.1	%	N/A	Aug-20-15	
> 150 µm	**17.4**	0.1	%	N/A	Aug-20-15	
> 75 µm	**17.3**	0.1	%	N/A	Aug-20-15	
< 75 µm	**29.8**	0.1	%	N/A	Aug-20-15	
Sample ID: AQREF2-1 (5080309-54) [Soil] Sampled: Jul-31-15 11:15						
General Parameters						
Carbon, Total Organic	**3.92**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**31.7**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**7.1**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1800**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**540**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**62**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**30**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**5.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	< 1.0	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**13200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**5.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**196**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.21**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**8390**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**33.9**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**10.0**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**24.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**23200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**5.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**11.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**7350**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**515**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	< 0.05	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**34.3**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**711**	10	mg/kg dry	Aug-18-15	Aug-20-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF2-1 (5080309-54) [Soil] Sampled: Jul-31-15 11:15, Continued						
Strong Acid Leachable Metals, Continued						
Potassium	**889**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	< 0.5	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**390**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**60.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**3.5**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**860**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**1.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**47.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**64**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**4**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQREF2-2 (5080309-55) [Soil] Sampled: Jul-31-15 11:15						
General Parameters						
Carbon, Total Organic	**2.98**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**41.9**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**6.7**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2070**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**729**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**64**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**30**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**5.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.5**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	< 2	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**12600**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**6.4**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**158**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.16**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7610**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**36.1**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**8.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**19.1**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF2-2 (5080309-55) [Soil] Sampled: Jul-31-15 11:15, Continued						
Strong Acid Leachable Metals, Continued						
Iron	**22300**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**5.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**11.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**7010**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**226**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	< 0.05	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**33.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**729**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**738**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	< 0.5	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**360**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**58.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**3.6**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**821**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**2.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**50.4**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**62**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**3**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQREF2-3 (5080309-56) [Soil] Sampled: Jul-31-15 11:15						
General Parameters						
Carbon, Total Organic	**4.34**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**36.1**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**6.7**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2140**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**1010**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**73**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**57**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**5.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**1.2**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	< 2	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**13800**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**7.4**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF2-3 (5080309-56) [Soil] Sampled: Jul-31-15 11:15, Continued						
Strong Acid Leachable Metals, Continued						
Barium	**151**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	**4**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.13**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**7840**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**43.4**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**9.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**21.7**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**26900**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**6.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**11.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**9690**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**207**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	< 0.05	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**42.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**805**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**833**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	< 0.5	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**490**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**52.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**3.8**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**960**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**1.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**57.3**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**60**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	**4**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQREF2-4 (5080309-57) [Soil] Sampled: Jul-31-15 11:15						
Particle Size Distribution						
> 80 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 56 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 40 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 25 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 19 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 12.5 mm	< 0.1	0.1	%	N/A	Aug-20-15	
> 4.75 mm	**0.9**	0.1	%	N/A	Aug-20-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF2-4 (5080309-57) [Soil] Sampled: Jul-31-15 11:15, Continued						
Particle Size Distribution, Continued						
> 2.36 mm	**3.3**	0.1	%	N/A	Aug-20-15	
> 2.0 mm	**1.8**	0.1	%	N/A	Aug-20-15	
> 1.18 mm	**7.0**	0.1	%	N/A	Aug-20-15	
> 600 µm	**13.0**	0.1	%	N/A	Aug-20-15	
> 425 µm	**26.6**	0.1	%	N/A	Aug-20-15	
> 300 µm	**29.2**	0.1	%	N/A	Aug-20-15	
> 150 µm	**12.7**	0.1	%	N/A	Aug-20-15	
> 75 µm	**3.2**	0.1	%	N/A	Aug-20-15	
< 75 µm	**2.2**	0.1	%	N/A	Aug-20-15	
Sample ID: AQ04.5-1 (5080309-58) [Soil] Sampled: Aug-01-15 13:45						
General Parameters						
Carbon, Total Organic	**6.49**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**50.8**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**5.8**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1500**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**264**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**129**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**19**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**8.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**2.9**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**2**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**14300**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**10.2**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**138**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.28**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**4390**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**24.5**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**8.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**10.8**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**20500**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**9.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**10.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**4570**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**933**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.08**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04.5-1 (5080309-58) [Soil] Sampled: Aug-01-15 13:45, Continued						
Strong Acid Leachable Metals, Continued						
Nickel	**14.5**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**509**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**651**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.7**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**180**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**31.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**9.0**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.5**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**832**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**5.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**42.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**63**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ04.5-2 (5080309-59) [Soil] Sampled: Aug-01-15 13:45						
General Parameters						
Carbon, Total Organic	**12.2**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**58.8**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**5.7**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**2210**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**364**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**150**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**19**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**12.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**3.5**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	< 2	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**17200**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**21.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**188**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.61**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**5360**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**27.8**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04.5-2 (5080309-59) [Soil] Sampled: Aug-01-15 13:45, Continued						
Strong Acid Leachable Metals, Continued						
Cobalt	**15.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**15.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**27400**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**13.0**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**13.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**4990**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**2050**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.13**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**1.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**17.7**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**569**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**780**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	< 0.5	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**173**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**41.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**10.8**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**734**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**9.3**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**57.0**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**77**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ04.5-3 (5080309-60) [Soil] Sampled: Aug-01-15 13:45						
General Parameters						
Carbon, Total Organic	**6.85**	0.05	% dry	Aug-12-15	Aug-14-15	
Moisture	**56.1**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**5.9**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1570**	5	mg/kg dry	N/A	Aug-06-15	
Magnesium, Available	**250**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**171**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**19**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**12.0**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**3.7**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**3**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**15500**	20	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04.5-3 (5080309-60) [Soil] Sampled: Aug-01-15 13:45, Continued						
Strong Acid Leachable Metals, Continued						
Antimony	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**12.9**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**152**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.5**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.36**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**4980**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**25.8**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**9.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**12.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**22700**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**10.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**11.9**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**4880**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**1110**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.11**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.7**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**15.6**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**528**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**741**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	< 0.5	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**187**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**36.3**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**9.5**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**826**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**7.0**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**46.4**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**68**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Sample ID: AQ04.5-4 (5080309-61) [Soil] Sampled: Aug-01-15 13:45						
General Parameters						
Carbon, Total Organic	**8.16**	0.05	% dry	Aug-12-15	Aug-12-15	
Moisture	**58.7**	0.1	% wet	N/A	Aug-13-15	
pH (1:2 H2O Solution)	**5.7**	0.1	pH units	Aug-19-15	Aug-19-15	
Fertility / Nutrient Parameters						
Calcium, Available	**1820**	5	mg/kg dry	N/A	Aug-06-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ04.5-4 (5080309-61) [Soil] Sampled: Aug-01-15 13:45, Continued						
Fertility / Nutrient Parameters, Continued						
Magnesium, Available	**271**	5	mg/kg dry	N/A	Aug-06-15	
Potassium, Available	**146**	5	mg/kg dry	N/A	Aug-06-15	
Sodium, Available	**16**	5	mg/kg dry	N/A	Aug-06-15	
Ammonia as N, Available	**9.3**	1.0	mg/kg dry	N/A	Aug-06-15	
Nitrate as N, Available	**2.7**	1.0	mg/kg dry	N/A	Aug-06-15	
Phosphorus, Available	**4**	2	mg/kg dry	N/A	Aug-06-15	
Strong Acid Leachable Metals						
Aluminum	**16400**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Antimony	**0.6**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Arsenic	**13.8**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Barium	**172**	1	mg/kg dry	Aug-18-15	Aug-20-15	
Beryllium	**0.4**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Bismuth	**0.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Boron	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	
Cadmium	**0.49**	0.04	mg/kg dry	Aug-18-15	Aug-20-15	
Calcium	**5180**	100	mg/kg dry	Aug-18-15	Aug-20-15	
Chromium	**27.3**	1.0	mg/kg dry	Aug-18-15	Aug-20-15	
Cobalt	**12.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Copper	**13.2**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Iron	**23600**	20	mg/kg dry	Aug-18-15	Aug-20-15	
Lead	**11.9**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Lithium	**12.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Magnesium	**5000**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Manganese	**1680**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Mercury	**0.12**	0.05	mg/kg dry	Aug-18-15	Aug-20-15	
Molybdenum	**0.8**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Nickel	**17.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Phosphorus	**577**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Potassium	**739**	10	mg/kg dry	Aug-18-15	Aug-20-15	
Selenium	**0.6**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Silicon	< 3000	3000	mg/kg dry	Aug-18-15	Aug-20-15	
Silver	< 0.2	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sodium	**180**	40	mg/kg dry	Aug-18-15	Aug-20-15	
Strontium	**39.4**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Sulfur	< 1000	1000	mg/kg dry	Aug-18-15	Aug-20-15	
Tellurium	< 0.1	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thallium	**0.2**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Thorium	**9.5**	0.5	mg/kg dry	Aug-18-15	Aug-20-15	
Tin	**0.6**	0.2	mg/kg dry	Aug-18-15	Aug-20-15	
Titanium	**759**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Uranium	**6.1**	0.1	mg/kg dry	Aug-18-15	Aug-20-15	
Vanadium	**48.1**	0.4	mg/kg dry	Aug-18-15	Aug-20-15	
Zinc	**69**	2	mg/kg dry	Aug-18-15	Aug-20-15	
Zirconium	< 2	2	mg/kg dry	Aug-18-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 219 (5080309-62) [Tissue (wet)] Sampled: Aug-01-15 14:30						
Metals in Tissue						
Aluminum	**30.6**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.068**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.149**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**2.10**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.004	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.04	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.059**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**8010**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.08**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.055**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**1.21**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**45**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	**0.022**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**415**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**7.08**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.047**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.02	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.10**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**7690**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**3960**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.88**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.02	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**785**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**11.0**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.010**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.04	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**2.56**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.029**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	**0.22**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**29.8**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 041 (5080309-63) [Tissue (wet)] Sampled: Jul-25-15 17:30						
General Parameters						
Moisture	**77.6**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**0.9**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.080**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.069**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.10**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.004**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 041 (5080309-63) [Tissue (wet)] Sampled: Jul-25-15 17:30, Continued						
Metals in Tissue, Continued						
Calcium	**656**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.04**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.019**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.39**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**5**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**319**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.53**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.065**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.03**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3840**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5560**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.69**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**305**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.95**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.006**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.26**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	< 0.001	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**5.2**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 042 (5080309-64) [Tissue (wet)] Sampled: Jul-25-15 17:30						
General Parameters						
Moisture	**71.2**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**49.7**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.019**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.216**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**3.24**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.111**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**12300**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.22**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.089**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**1.55**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**85**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	**0.020**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**525**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**16.2**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 042 (5080309-64) [Tissue (wet)] Sampled: Jul-25-15 17:30, Continued						
Metals in Tissue, Continued						
Mercury	**0.084**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	**0.03**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.24**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**13700**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**4500**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**2.74**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**1070**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**26.0**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.010**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**4.41**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.011**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	**0.47**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**61.4**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 052 (5080309-65) [Tissue (wet)] Sampled: Jul-26-15 12:00						
General Parameters						
Moisture	**78.7**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**5.3**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.034**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.068**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.18**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.003**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**506**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.03**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.015**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.30**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**10**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	**0.007**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**284**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.74**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.090**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.06**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3330**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5110**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.18**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**300**	2	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 052 (5080309-65) [Tissue (wet)] Sampled: Jul-26-15 12:00, Continued						
Metals in Tissue, Continued						
Strontium	**0.63**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.006**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.41**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.003**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	**0.03**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**4.0**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 054 (5080309-66) [Tissue (wet)] Sampled: Jul-26-15 12:00						
General Parameters						
Moisture	**79**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**1.2**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.012**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.020**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.07**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.003**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**287**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.009**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.34**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**4**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**296**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.25**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.050**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.05**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3300**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5310**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.29**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**293**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.34**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.005**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.23**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	< 0.001	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**5.8**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 69 (5080309-67) [Tissue (wet)] Sampled: Jul-26-15 12:00						
General Parameters						
Moisture	**78.2**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**2.2**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.007**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.034**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.11**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.005**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**584**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.01**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.011**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.64**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**10**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**304**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.33**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.072**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.05**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3890**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5750**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.73**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**353**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.64**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.008**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.34**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.001**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**5.2**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 70 (5080309-68) [Tissue (wet)] Sampled: Jul-26-15 16:30						
General Parameters						
Moisture	**78**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**1.3**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.005**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.032**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.10**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 70 (5080309-68) [Tissue (wet)] Sampled: Jul-26-15 16:30, Continued						
Metals in Tissue, Continued						
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.003**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**499**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.009**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.42**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**10**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**322**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.45**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.062**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.05**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3840**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5790**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.56**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**384**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.70**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.004**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.27**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	< 0.001	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**4.6**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 71 (5080309-69) [Tissue (wet)] Sampled: Jul-26-15 16:30						
General Parameters						
Moisture	**77.3**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**3.1**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.060**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.029**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.05**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.005**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**162**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.01**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.014**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.43**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**10**	1	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 71 (5080309-69) [Tissue (wet)] Sampled: Jul-26-15 16:30, Continued						
Metals in Tissue, Continued						
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**308**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.33**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.054**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.05**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3650**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5880**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.31**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**381**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.18**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.006**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.46**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.001**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**7.3**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 72 (5080309-70) [Tissue (wet)] Sampled: Jul-26-15 16:30						
General Parameters						
Moisture	**78.8**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**2.1**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.006**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.028**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.10**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.007**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**508**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.04**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.016**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.40**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**8**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**350**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.48**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.039**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.06**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3980**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5920**	10	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 72 (5080309-70) [Tissue (wet)] Sampled: Jul-26-15 16:30, Continued						
Metals in Tissue, Continued						
Selenium	**1.79**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**446**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.60**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.005**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.35**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.002**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**5.5**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 73 (5080309-71) [Tissue (wet)] Sampled: Jul-26-15 16:30						
General Parameters						
Moisture	**78.8**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**2.1**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.053**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.029**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.12**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.4**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.006**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**406**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.01**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.011**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.71**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**10**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**304**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.33**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.055**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.06**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3830**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5780**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.71**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**364**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.47**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.006**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.29**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.001**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 73 (5080309-71) [Tissue (wet)] Sampled: Jul-26-15 16:30, Continued						
Metals in Tissue, Continued						
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**6.5**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 74 (5080309-72) [Tissue (wet)] Sampled: Jul-26-15 16:30						
General Parameters						
Moisture	**78.7**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**2.7**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.004**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.022**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.15**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.4**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.005**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**559**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.02**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.009**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.38**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**9**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**312**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.41**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.092**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.06**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3830**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5730**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.42**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**372**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.76**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.004**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.37**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.001**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**5.3**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 94 (5080309-73) [Tissue (wet)] Sampled: Jul-27-15 14:30						
General Parameters						
Moisture	**73.8**	0.1	% wet	N/A	Aug-24-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 94 (5080309-73) [Tissue (wet)] Sampled: Jul-27-15 14:30, Continued						
Metals in Tissue						
Aluminum	**112**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.017**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.164**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**3.54**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	**0.002**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.4**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.057**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**7410**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.30**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.105**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**1.26**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**154**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	**0.036**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**412**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**14.6**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.248**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	**0.04**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.22**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**8450**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**4030**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.76**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**1050**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**11.3**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.015**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**7.97**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.129**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	**0.43**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**51.6**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 96 (5080309-74) [Tissue (wet)] Sampled: Jul-27-15 14:30						
Metals in Tissue						
Aluminum	**2.7**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.003**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.073**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**1.51**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.4**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.013**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**6320**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 96 (5080309-74) [Tissue (wet)] Sampled: Jul-27-15 14:30, Continued						
Metals in Tissue, Continued						
Cobalt	**0.016**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.69**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**12**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**362**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**2.89**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.130**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	**0.01**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.08**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**7430**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**4010**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.56**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**817**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**10.0**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.009**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.71**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.032**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	**0.05**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**21.1**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 102 (5080309-75) [Tissue (wet)] Sampled: Jul-27-15 15:10						
Metals in Tissue						
Aluminum	**37.6**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.012**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.118**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**3.01**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.038**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**8670**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.10**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.054**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.97**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**58**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	**0.014**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**409**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**7.99**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.220**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	**0.02**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.13**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**8460**	5	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 102 (5080309-75) [Tissue (wet)] Sampled: Jul-27-15 15:10, Continued						
Metals in Tissue, Continued						
Potassium	**3930**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.39**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**899**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**12.9**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.011**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**2.94**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.081**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	**0.21**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**36.0**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 107 (5080309-76) [Tissue (wet)] Sampled: Jul-28-15 10:45						
General Parameters						
Moisture	**78.1**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**0.7**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.005**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.043**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.18**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.003**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**705**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.008**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.38**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**5**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**300**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.39**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.075**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.06**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3750**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5550**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.23**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**310**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.84**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.006**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.25**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 107 (5080309-76) [Tissue (wet)] Sampled: Jul-28-15 10:45, Continued						
Metals in Tissue, Continued						
Uranium	**0.001**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**5.3**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 108 (5080309-77) [Tissue (wet)] Sampled: Jul-28-15 10:45						
General Parameters						
Moisture	**79**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**1.2**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.046**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.25**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.004**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**1550**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.013**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.36**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**6**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**318**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.70**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.051**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.07**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**4280**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5500**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.51**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**326**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**1.90**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.006**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.32**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.001**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**6.0**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 109 (5080309-78) [Tissue (wet)] Sampled: Jul-28-15 10:45						
General Parameters						
Moisture	**78.5**	0.1	% wet	N/A	Aug-24-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 109 (5080309-78) [Tissue (wet)] Sampled: Jul-28-15 10:45, Continued						
Metals in Tissue						
Aluminum	**1.0**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.035**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.06**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.006**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**218**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.013**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.32**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**5**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**279**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.32**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.086**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.06**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3100**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5040**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.54**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	**0.01**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**295**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.27**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.006**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.22**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.001**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**6.0**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 110 (5080309-79) [Tissue (wet)] Sampled: Jul-28-15 10:45						
General Parameters						
Moisture	**79.7**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**2.0**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.006**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.032**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.14**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.4**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.008**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 110 (5080309-79) [Tissue (wet)] Sampled: Jul-28-15 10:45, Continued						
Metals in Tissue, Continued						
Calcium	**828**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.01**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.013**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.39**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**6**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**330**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.43**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.037**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.07**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**4010**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5660**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.82**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**315**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.91**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.005**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.34**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.001**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**5.8**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 111 (5080309-80) [Tissue (wet)] Sampled: Jul-28-15 10:45						
General Parameters						
Moisture	**78.8**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**1.2**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.035**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.05**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.004**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**316**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.012**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.30**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**4**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**303**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.23**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 111 (5080309-80) [Tissue (wet)] Sampled: Jul-28-15 10:45, Continued						
Metals in Tissue, Continued						
Mercury	**0.042**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.06**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3430**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5590**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.44**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**301**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.32**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.005**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.22**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	< 0.001	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**5.3**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 112 (5080309-81) [Tissue (wet)] Sampled: Jul-28-15 10:45						
General Parameters						
Moisture	**79.7**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**1.7**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.003**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.031**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.15**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.005**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**687**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.02**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.011**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.28**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**5**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.004	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**330**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.50**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.037**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.06**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3720**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5730**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.71**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**328**	2	mg/kg wet	Aug-11-15	Aug-20-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 112 (5080309-81) [Tissue (wet)] Sampled: Jul-28-15 10:45, Continued						
Metals in Tissue, Continued						
Strontium	**0.74**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.004**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.31**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.001**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**6.3**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 113 (5080309-82) [Tissue (wet)] Sampled: Jul-28-15 10:45						
General Parameters						
Moisture	**79.5**	0.1	% wet	N/A	Aug-24-15	
Metals in Tissue						
Aluminum	**7.0**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.007**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.038**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**0.18**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.008**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**725**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.03**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.031**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.34**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**14**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	**0.006**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**331**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**0.78**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.036**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.06**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**3720**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**5470**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**2.07**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**356**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**0.84**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.007**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.60**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.003**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	**0.02**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**6.3**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 205 (5080309-83) [Tissue (wet)] Sampled: Jul-28-15 17:30						
Metals in Tissue						
Aluminum	**32.5**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.023**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.157**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**3.70**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.008	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.08	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.5**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.087**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**9010**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.13**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.038**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.73**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**57**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	**0.024**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**417**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**8.48**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.065**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.04	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.25**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**7670**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**3750**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.40**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.04	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**754**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**13.4**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.007**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.08	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**2.26**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.016**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	**0.27**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**38.2**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 206 (5080309-84) [Tissue (wet)] Sampled: Jul-28-15 17:30						
Metals in Tissue						
Aluminum	**19.4**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.036**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.396**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**3.71**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.011	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.11	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	< 0.5	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.151**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**12800**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.17**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	

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PROJECT Coffee Gold

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 206 (5080309-84) [Tissue (wet)] Sampled: Jul-28-15 17:30, Continued						
Metals in Tissue, Continued						
Cobalt	**0.053**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.73**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**104**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	**0.088**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**455**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**13.0**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.051**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.05	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.35**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**9340**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**3740**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**2.36**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.05	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**738**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**17.0**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.009**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.1	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**1.24**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.021**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	**0.42**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**61.3**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 207 (5080309-85) [Tissue (wet)] Sampled: Jul-28-15 17:30						
Metals in Tissue						
Aluminum	**3.6**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	< 0.009	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.097**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**2.64**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.009	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.09	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	< 0.5	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.141**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**8080**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	< 0.05	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.024**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**0.53**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**10**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	< 0.018	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**385**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**7.15**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.031**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	< 0.05	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.25**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**6610**	5	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 207 (5080309-85) [Tissue (wet)] Sampled: Jul-28-15 17:30, Continued						
Metals in Tissue, Continued						
Potassium	**3770**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.61**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.05	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**686**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**10.4**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.006**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.09	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**0.55**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.006**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	**0.15**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Zinc	**33.5**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	
Sample ID: 208 (5080309-86) [Tissue (wet)] Sampled: Jul-29-15 10:15						
Metals in Tissue						
Aluminum	**28.3**	0.4	mg/kg wet	Aug-11-15	Aug-20-15	
Antimony	**0.005**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Arsenic	**0.126**	0.005	mg/kg wet	Aug-11-15	Aug-20-15	
Barium	**4.58**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Beryllium	< 0.002	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Bismuth	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Boron	**0.3**	0.1	mg/kg wet	Aug-11-15	Aug-20-15	
Cadmium	**0.047**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Calcium	**16200**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Chromium	**0.08**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Cobalt	**0.047**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Copper	**1.12**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Iron	**48**	1	mg/kg wet	Aug-11-15	Aug-20-15	
Lead	**0.016**	0.004	mg/kg wet	Aug-11-15	Aug-20-15	
Magnesium	**440**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Manganese	**14.4**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Mercury	**0.203**	0.002	mg/kg wet	Aug-11-15	Aug-20-15	
Molybdenum	**0.02**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Nickel	**0.15**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Phosphorus	**13000**	5	mg/kg wet	Aug-11-15	Aug-20-15	
Potassium	**3780**	10	mg/kg wet	Aug-11-15	Aug-20-15	
Selenium	**1.22**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Silver	< 0.01	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Sodium	**1300**	2	mg/kg wet	Aug-11-15	Aug-20-15	
Strontium	**24.6**	0.01	mg/kg wet	Aug-11-15	Aug-20-15	
Thallium	**0.013**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Tin	< 0.02	0.02	mg/kg wet	Aug-11-15	Aug-20-15	
Titanium	**2.51**	0.05	mg/kg wet	Aug-11-15	Aug-20-15	
Uranium	**0.175**	0.001	mg/kg wet	Aug-11-15	Aug-20-15	
Vanadium	**0.27**	0.02	mg/kg wet	Aug-11-15	Aug-20-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 208 (5080309-86) [Tissue (wet)] Sampled: Jul-29-15 10:15, Continued						
Metals in Tissue, Continued						
Zinc	**71.7**	0.5	mg/kg wet	Aug-11-15	Aug-20-15	

Sample / Analysis Qualifiers:

HT1 The sample was prepared / analyzed past the recommended holding time.

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: Laboratory reagent water is carried through sample preparation and analysis steps. Method Blanks indicate that results are free from contamination, i.e. not biased high from sources such as the sample container or the laboratory environment
- **Duplicate (Dup)**: Preparation and analysis of a replicate aliquot of a sample. Duplicates provide a measure of the analytical method's precision, i.e. how reproducible a result is. Duplicates are only reported if they are associated with your sample data.
- **Blank Spike (BS)**: A known amount of standard is carried through sample preparation and analysis steps. Blank Spikes, also known as laboratory control samples (LCS), are prepared from a different source of standard than used for the calibration. They ensure that the calibration is acceptable (i.e. not biased high or low) and also provide a measure of the analytical method's accuracy (i.e. closeness of the result to a target value).
- **Standard Reference Material (SRM)**: A material of similar matrix to the samples, externally certified for the parameter(s) listed. Standard Reference Materials ensure that the preparation steps in the method are adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
General Parameters, Batch B5H0298										
Blank (B5H0298-BLK1)				Prepared: Aug-07-15, Analyzed: Aug-11-15						
Chlorophyll a	< 0.1	0.1	µg/L							
General Parameters, Batch B5H0312										
Duplicate (B5H0312-DUP1)		**Source: 5080309-34**		Prepared: Aug-07-15, Analyzed: Aug-10-15						
Moisture	61.3	0.1	% wet		55.1			10.7	8.3	
General Parameters, Batch B5H0443										
Blank (B5H0443-BLK1)				Prepared: Aug-12-15, Analyzed: Aug-12-15						
Solids, Total	< 10	10	mg/L							
Solids, Total Volatile	< 10	10	mg/L							
LCS (B5H0443-BS1)				Prepared: Aug-12-15, Analyzed: Aug-12-15						
Solids, Total	72	10	mg/L	200		36	0-200			
Solids, Total Volatile	68	10	mg/L	81.0		84	0-200			
Duplicate (B5H0443-DUP1)		**Source: 5080309-11**		Prepared: Aug-12-15, Analyzed: Aug-12-15						
Solids, Total	210	10	mg/L		210			< 1	20	
Solids, Total Volatile	87	10	mg/L		73			17	20	
General Parameters, Batch B5H0496										
Blank (B5H0496-BLK1)				Prepared: Aug-12-15, Analyzed: Aug-12-15						
Carbon, Total Organic	< 0.05	0.05	% dry							
Blank (B5H0496-BLK2)				Prepared: Aug-12-15, Analyzed: Aug-13-15						
Carbon, Total Organic	< 0.05	0.05	% dry							
Blank (B5H0496-BLK3)				Prepared: Aug-12-15, Analyzed: Aug-13-15						
Carbon, Total Organic	< 0.05	0.05	% dry							

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
General Parameters, Batch B5H0496, Continued										
Duplicate (B5H0496-DUP2)		**Source: 5080309-47**		Prepared: Aug-12-15, Analyzed: Aug-13-15						
Carbon, Total Organic	2.64	0.05	% dry		2.73			3	30	
Duplicate (B5H0496-DUP3)		**Source: 5080309-60**		Prepared: Aug-12-15, Analyzed: Aug-13-15						
Carbon, Total Organic	7.73	0.05	% dry		6.85			12	30	
Reference (B5H0496-SRM1)				Prepared: Aug-12-15, Analyzed: Aug-13-15						
Carbon, Total Organic	1.39	0.05	% dry	1.33		105	10-231			
Reference (B5H0496-SRM2)				Prepared: Aug-12-15, Analyzed: Aug-13-15						
Carbon, Total Organic	2.00	0.05	% dry	1.33		150	10-231			
Reference (B5H0496-SRM3)				Prepared: Aug-12-15, Analyzed: Aug-13-15						
Carbon, Total Organic	1.23	0.05	% dry	1.33		92	10-231			
General Parameters, Batch B5H0536										
Duplicate (B5H0536-DUP1)		**Source: 5080309-50**		Prepared: Aug-13-15, Analyzed: Aug-13-15						
Moisture	49.7	0.1	% wet		46.0			7.7	8.3	
General Parameters, Batch B5H0883										
Duplicate (B5H0883-DUP1)		**Source: 5080309-21**		Prepared: Aug-18-15, Analyzed: Aug-18-15						
pH (1:2 H2O Solution)	6.8	0.1	pH units		6.8			< 1	4	
Reference (B5H0883-SRM1)				Prepared: Aug-18-15, Analyzed: Aug-18-15						
pH (1:2 H2O Solution)	6.3	0.1	pH units	6.26		100	95-105			
General Parameters, Batch B5H0885										
Duplicate (B5H0885-DUP1)		**Source: 5080309-39**		Prepared: Aug-19-15, Analyzed: Aug-19-15						
pH (1:2 H2O Solution)	6.8	0.1	pH units		6.9			2	4	
Reference (B5H0885-SRM1)				Prepared: Aug-19-15, Analyzed: Aug-19-15						
pH (1:2 H2O Solution)	6.2	0.1	pH units	6.26		100	95-105			
Reference (B5H0885-SRM2)				Prepared: Aug-19-15, Analyzed: Aug-19-15						
pH (1:2 H2O Solution)	6.2	0.1	pH units	6.26		99	95-105			
General Parameters, Batch B5H1103										
Duplicate (B5H1103-DUP1)		**Source: 5080309-64**		Prepared: Aug-24-15, Analyzed: Aug-24-15						
Moisture	72.5	0.1	% wet		71.2			1.8	20	
Duplicate (B5H1103-DUP2)		**Source: 5080309-69**		Prepared: Aug-24-15, Analyzed: Aug-24-15						
Moisture	78.3	0.1	% wet		77.3			1.3	20	
Metals in Tissue, Batch B5H0498										
Blank (B5H0498-BLK1)				Prepared: Aug-11-15, Analyzed: Aug-20-15						
Aluminum	< 0.4	0.4	mg/kg wet							
Antimony	< 0.002	0.002	mg/kg wet							
Arsenic	< 0.005	0.005	mg/kg wet							
Barium	< 0.01	0.01	mg/kg wet							
Beryllium	< 0.002	0.002	mg/kg wet							
Bismuth	< 0.02	0.02	mg/kg wet							

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Metals in Tissue, Batch B5H0498, Continued										
Blank (B5H0498-BLK1), Continued				Prepared: Aug-11-15, Analyzed: Aug-20-15						
Boron	< 0.1	0.1	mg/kg wet							
Cadmium	< 0.002	0.002	mg/kg wet							
Calcium	< 2	2	mg/kg wet							
Chromium	< 0.01	0.01	mg/kg wet							
Cobalt	< 0.004	0.004	mg/kg wet							
Copper	< 0.01	0.01	mg/kg wet							
Iron	< 1	1	mg/kg wet							
Lead	< 0.004	0.004	mg/kg wet							
Magnesium	< 2	2	mg/kg wet							
Manganese	< 0.02	0.02	mg/kg wet							
Mercury	< 0.002	0.002	mg/kg wet							
Molybdenum	< 0.01	0.01	mg/kg wet							
Nickel	< 0.01	0.01	mg/kg wet							
Phosphorus	< 5	5	mg/kg wet							
Potassium	< 10	10	mg/kg wet							
Selenium	< 0.02	0.02	mg/kg wet							
Silver	< 0.01	0.01	mg/kg wet							
Sodium	< 2	2	mg/kg wet							
Strontium	< 0.01	0.01	mg/kg wet							
Thallium	< 0.001	0.001	mg/kg wet							
Tin	< 0.02	0.02	mg/kg wet							
Titanium	< 0.05	0.05	mg/kg wet							
Uranium	< 0.001	0.001	mg/kg wet							
Vanadium	< 0.02	0.02	mg/kg wet							
Zinc	< 0.5	0.5	mg/kg wet							
Blank (B5H0498-BLK2)				Prepared: Aug-11-15, Analyzed: Aug-20-15						
Aluminum	< 0.4	0.4	mg/kg wet							
Antimony	< 0.002	0.002	mg/kg wet							
Arsenic	< 0.005	0.005	mg/kg wet							
Barium	< 0.01	0.01	mg/kg wet							
Beryllium	< 0.002	0.002	mg/kg wet							
Bismuth	< 0.02	0.02	mg/kg wet							
Boron	< 0.1	0.1	mg/kg wet							
Cadmium	< 0.002	0.002	mg/kg wet							
Calcium	< 2	2	mg/kg wet							
Chromium	< 0.01	0.01	mg/kg wet							
Cobalt	< 0.004	0.004	mg/kg wet							
Copper	< 0.01	0.01	mg/kg wet							
Iron	< 1	1	mg/kg wet							
Lead	< 0.004	0.004	mg/kg wet							
Magnesium	< 2	2	mg/kg wet							
Manganese	< 0.02	0.02	mg/kg wet							
Mercury	< 0.002	0.002	mg/kg wet							
Molybdenum	< 0.01	0.01	mg/kg wet							
Nickel	< 0.01	0.01	mg/kg wet							
Phosphorus	< 5	5	mg/kg wet							
Potassium	< 10	10	mg/kg wet							
Selenium	< 0.02	0.02	mg/kg wet							
Silver	< 0.01	0.01	mg/kg wet							
Sodium	< 2	2	mg/kg wet							
Strontium	< 0.01	0.01	mg/kg wet							
Thallium	< 0.001	0.001	mg/kg wet							
Tin	< 0.02	0.02	mg/kg wet							
Titanium	< 0.05	0.05	mg/kg wet							
Uranium	< 0.001	0.001	mg/kg wet							
Vanadium	< 0.02	0.02	mg/kg wet							

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Metals in Tissue, Batch B5H0498, Continued										
Blank (B5H0498-BLK2), Continued				Prepared: Aug-11-15, Analyzed: Aug-20-15						
Zinc	< 0.5	0.5	mg/kg wet							
Duplicate (B5H0498-DUP1)				**Source: 5080309-67**	Prepared: Aug-11-15, Analyzed: Aug-20-15					
Aluminum	2.3	0.4	mg/kg wet		2.2			3	40	
Antimony	0.009	0.002	mg/kg wet		0.007				40	
Arsenic	0.035	0.005	mg/kg wet		0.034			4	40	
Barium	0.06	0.01	mg/kg wet		0.11			60	40	RPD
Beryllium	< 0.002	0.002	mg/kg wet		< 0.002				40	
Bismuth	< 0.02	0.02	mg/kg wet		< 0.02				40	
Boron	0.3	0.1	mg/kg wet		0.3				40	
Cadmium	0.005	0.002	mg/kg wet		0.005				40	
Calcium	254	2	mg/kg wet		584			79	60	RPD
Chromium	0.02	0.01	mg/kg wet		0.01				40	
Cobalt	0.010	0.004	mg/kg wet		0.011				40	
Copper	0.27	0.01	mg/kg wet		0.64			81	40	RPD
Iron	7	1	mg/kg wet		10			32	40	
Lead	< 0.004	0.004	mg/kg wet		< 0.004				40	
Magnesium	314	2	mg/kg wet		304			3	40	
Manganese	0.30	0.02	mg/kg wet		0.33			9	40	
Mercury	0.066	0.002	mg/kg wet		0.072			8	40	
Molybdenum	< 0.01	0.01	mg/kg wet		< 0.01				40	
Nickel	0.01	0.01	mg/kg wet		0.05			120	40	
Phosphorus	3380	5	mg/kg wet		3890			14	40	
Potassium	5560	10	mg/kg wet		5750			3	40	
Selenium	1.54	0.02	mg/kg wet		1.73			12	40	
Silver	< 0.01	0.01	mg/kg wet		< 0.01				40	
Sodium	347	2	mg/kg wet		353			2	40	
Strontium	0.26	0.01	mg/kg wet		0.64			85	60	RPD
Thallium	0.006	0.001	mg/kg wet		0.008			20	40	
Tin	< 0.02	0.02	mg/kg wet		< 0.02				40	
Titanium	0.38	0.05	mg/kg wet		0.34			13	40	
Uranium	0.001	0.001	mg/kg wet		0.001				40	
Vanadium	< 0.02	0.02	mg/kg wet		< 0.02				40	
Zinc	4.4	0.5	mg/kg wet		5.2			18	40	
Duplicate (B5H0498-DUP2)				**Source: 5080309-72**	Prepared: Aug-11-15, Analyzed: Aug-20-15					
Aluminum	1.4	0.4	mg/kg wet		2.7			64	40	
Antimony	0.002	0.002	mg/kg wet		0.004				40	
Arsenic	0.022	0.005	mg/kg wet		0.022				40	
Barium	0.07	0.01	mg/kg wet		0.15			81	40	RPD
Beryllium	< 0.002	0.002	mg/kg wet		< 0.002				40	
Bismuth	< 0.02	0.02	mg/kg wet		< 0.02				40	
Boron	0.3	0.1	mg/kg wet		0.4				40	
Cadmium	0.005	0.002	mg/kg wet		0.005				40	
Calcium	286	2	mg/kg wet		559			65	60	RPD
Chromium	0.01	0.01	mg/kg wet		0.02				40	
Cobalt	0.009	0.004	mg/kg wet		0.009				40	
Copper	0.46	0.01	mg/kg wet		0.38			19	40	
Iron	9	1	mg/kg wet		9			3	40	
Lead	< 0.004	0.004	mg/kg wet		< 0.004				40	
Magnesium	275	2	mg/kg wet		312			13	40	
Manganese	0.25	0.02	mg/kg wet		0.41			50	40	RPD
Mercury	0.088	0.002	mg/kg wet		0.092			4	40	
Molybdenum	< 0.01	0.01	mg/kg wet		< 0.01				40	
Nickel	0.04	0.01	mg/kg wet		0.06			31	40	
Phosphorus	3210	5	mg/kg wet		3830			18	40	
Potassium	5150	10	mg/kg wet		5730			11	40	

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Metals in Tissue, Batch B5H0498, Continued										
Duplicate (B5H0498-DUP2), Continued	**Source: 5080309-72**			Prepared: Aug-11-15, Analyzed: Aug-20-15						
Selenium	1.37	0.02	mg/kg wet		1.42			3	40	
Silver	< 0.01	0.01	mg/kg wet		< 0.01				40	
Sodium	348	2	mg/kg wet		372			6	40	
Strontium	0.37	0.01	mg/kg wet		0.76			69	60	RPD
Thallium	0.004	0.001	mg/kg wet		0.004				40	
Tin	< 0.02	0.02	mg/kg wet		< 0.02				40	
Titanium	0.34	0.05	mg/kg wet		0.37			11	40	
Uranium	< 0.001	0.001	mg/kg wet		0.001				40	
Vanadium	< 0.02	0.02	mg/kg wet		< 0.02				40	
Zinc	4.4	0.5	mg/kg wet		5.3			20	40	
Reference (B5H0498-SRM1)				Prepared: Aug-11-15, Analyzed: Aug-20-15						
Arsenic	63.3	0.005	mg/kg wet	59.5		106	75-125			
Cadmium	37.7	0.002	mg/kg wet	42.3		89	75-125			
Chromium	1.62	0.01	mg/kg wet	1.95		83	75-125			
Cobalt	1.07	0.004	mg/kg wet	1.06		101	75-125			
Copper	448	0.01	mg/kg wet	497		90	75-125			
Iron	165	1	mg/kg wet	179		92	75-125			
Lead	0.168	0.004	mg/kg wet	0.225		75	75-125			
Manganese	15.2	0.02	mg/kg wet	15.6		98	75-125			
Mercury	0.267	0.002	mg/kg wet	0.292		91	75-125			
Molybdenum	3.31	0.01	mg/kg wet	3.44		96	75-125			
Nickel	4.55	0.01	mg/kg wet	5.30		86	75-125			
Selenium	12.4	0.02	mg/kg wet	10.9		114	75-125			
Strontium	35.6	0.01	mg/kg wet	36.5		98	75-125			
Tin	< 0.05	0.02	mg/kg wet	0.0290		98	75-125			
Vanadium	9.42	0.02	mg/kg wet	9.10		104	75-125			
Zinc	135	0.5	mg/kg wet	136		99	75-125			
Reference (B5H0498-SRM2)				Prepared: Aug-11-15, Analyzed: Aug-20-15						
Arsenic	68.6	0.005	mg/kg wet	59.5		115	75-125			
Cadmium	38.7	0.002	mg/kg wet	42.3		91	75-125			
Chromium	1.81	0.01	mg/kg wet	1.95		93	75-125			
Cobalt	1.06	0.004	mg/kg wet	1.06		100	75-125			
Copper	441	0.01	mg/kg wet	497		89	75-125			
Iron	166	1	mg/kg wet	179		93	75-125			
Lead	0.172	0.004	mg/kg wet	0.225		76	75-125			
Manganese	15.4	0.02	mg/kg wet	15.6		98	75-125			
Mercury	0.277	0.002	mg/kg wet	0.292		95	75-125			
Molybdenum	3.34	0.01	mg/kg wet	3.44		97	75-125			
Nickel	4.59	0.01	mg/kg wet	5.30		87	75-125			
Selenium	13.4	0.02	mg/kg wet	10.9		123	75-125			
Strontium	36.8	0.01	mg/kg wet	36.5		101	75-125			
Tin	< 0.05	0.02	mg/kg wet	0.0290		104	75-125			
Vanadium	9.40	0.02	mg/kg wet	9.10		103	75-125			
Zinc	138	0.5	mg/kg wet	136		101	75-125			
Strong Acid Leachable Metals, Batch B5H0854										
Blank (B5H0854-BLK1)				Prepared: Aug-18-15, Analyzed: Aug-20-15						
Aluminum	< 20	20	mg/kg dry							
Antimony	< 0.1	0.1	mg/kg dry							
Arsenic	< 0.4	0.4	mg/kg dry							
Barium	< 1	1	mg/kg dry							
Beryllium	< 0.1	0.1	mg/kg dry							
Bismuth	< 0.1	0.1	mg/kg dry							

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B5H0854, Continued										
Blank (B5H0854-BLK1), Continued				Prepared: Aug-18-15, Analyzed: Aug-20-15						
Boron	< 2	2	mg/kg dry							
Cadmium	< 0.04	0.04	mg/kg dry							
Calcium	< 100	100	mg/kg dry							
Chromium	< 1.0	1.0	mg/kg dry							
Cobalt	< 0.1	0.1	mg/kg dry							
Copper	< 0.2	0.2	mg/kg dry							
Iron	< 20	20	mg/kg dry							
Lead	< 0.2	0.2	mg/kg dry							
Lithium	< 0.1	0.1	mg/kg dry							
Magnesium	< 10	10	mg/kg dry							
Manganese	< 0.4	0.4	mg/kg dry							
Mercury	< 0.05	0.05	mg/kg dry							
Molybdenum	< 0.1	0.1	mg/kg dry							
Nickel	< 0.4	0.4	mg/kg dry							
Phosphorus	< 10	10	mg/kg dry							
Potassium	< 10	10	mg/kg dry							
Selenium	< 0.5	0.5	mg/kg dry							
Silicon	< 3000	3000	mg/kg dry							
Silver	< 0.2	0.2	mg/kg dry							
Sodium	< 40	40	mg/kg dry							
Strontium	< 0.2	0.2	mg/kg dry							
Sulfur	< 1000	1000	mg/kg dry							
Tellurium	< 0.1	0.1	mg/kg dry							
Thallium	< 0.1	0.1	mg/kg dry							
Thorium	< 0.5	0.5	mg/kg dry							
Tin	< 0.2	0.2	mg/kg dry							
Titanium	< 2	2	mg/kg dry							
Uranium	< 0.1	0.1	mg/kg dry							
Vanadium	< 0.4	0.4	mg/kg dry							
Zinc	< 2	2	mg/kg dry							
Zirconium	< 2	2	mg/kg dry							
Duplicate (B5H0854-DUP1)				**Source: 5080309-19**	Prepared: Aug-18-15, Analyzed: Aug-20-15					
Aluminum	16200	20	mg/kg dry		16700			3	24	
Antimony	0.5	0.1	mg/kg dry		0.4			7	60	
Arsenic	8.0	0.4	mg/kg dry		8.3			3	42	
Barium	190	1	mg/kg dry		191			< 1	38	
Beryllium	0.3	0.1	mg/kg dry		0.4				37	
Bismuth	0.2	0.1	mg/kg dry		0.2				33	
Boron	2	2	mg/kg dry		2				29	
Cadmium	0.22	0.04	mg/kg dry		0.22			2	32	
Calcium	7010	100	mg/kg dry		6970			< 1	33	
Chromium	29.0	1.0	mg/kg dry		29.5			1	32	
Cobalt	10.1	0.1	mg/kg dry		10.2			1	26	
Copper	17.9	0.2	mg/kg dry		18.4			3	38	
Iron	24200	20	mg/kg dry		24600			2	28	
Lead	6.5	0.2	mg/kg dry		6.6			2	46	
Lithium	13.4	0.1	mg/kg dry		13.1			2	28	
Magnesium	6290	10	mg/kg dry		6550			4	23	
Manganese	501	0.4	mg/kg dry		519			4	23	
Mercury	0.05	0.05	mg/kg dry		0.07				42	
Molybdenum	0.8	0.1	mg/kg dry		0.8			5	52	
Nickel	18.1	0.4	mg/kg dry		18.2			< 1	29	
Phosphorus	656	10	mg/kg dry		655			< 1	20	
Potassium	1170	10	mg/kg dry		1190			2	28	
Selenium	1.0	0.5	mg/kg dry		1.2				19	
Silicon	< 3000	3000	mg/kg dry		< 3000				18	

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B5H0854, Continued										
Duplicate (B5H0854-DUP1), Continued		**Source: 5080309-19**		Prepared: Aug-18-15, Analyzed: Aug-20-15						
Silver	< 0.2	0.2	mg/kg dry		< 0.2				35	
Sodium	286	40	mg/kg dry		288			< 1	23	
Strontium	40.2	0.2	mg/kg dry		41.2			2	25	
Sulfur	< 1000	1000	mg/kg dry		< 1000				26	
Tellurium	< 0.1	0.1	mg/kg dry		< 0.1				38	
Thallium	0.2	0.1	mg/kg dry		0.2				27	
Thorium	5.3	0.5	mg/kg dry		5.3			< 1	39	
Tin	0.6	0.2	mg/kg dry		0.6				85	
Titanium	1070	2	mg/kg dry		1080			< 1	29	
Uranium	5.9	0.1	mg/kg dry		6.1			3	36	
Vanadium	54.7	0.4	mg/kg dry		55.1			< 1	23	
Zinc	65	2	mg/kg dry		67			2	30	
Zirconium	2	2	mg/kg dry		2				32	
Reference (B5H0854-SRM1)				Prepared: Aug-18-15, Analyzed: Aug-20-15						
Aluminum	16600	20	mg/kg dry	18200		91	86-118			
Antimony	6.4	0.1	mg/kg dry	6.27		102	73-138			
Arsenic	15.4	0.4	mg/kg dry	15.4		100	87-106			
Barium	81	1	mg/kg dry	80.6		101	72-119			
Beryllium	0.5	0.1	mg/kg dry	0.544		100	73-128			
Bismuth	1.9	0.1	mg/kg dry	2.12		87	78-97			
Boron	3	2	mg/kg dry	2.68		126	58-139			
Cadmium	0.21	0.04	mg/kg dry	0.230		93	88-121			
Calcium	3270	100	mg/kg dry	3320		98	92-113			
Chromium	26.0	1.0	mg/kg dry	27.2		96	91-113			
Cobalt	12.3	0.1	mg/kg dry	12.5		98	90-109			
Copper	42.8	0.2	mg/kg dry	44.9		95	92-112			
Iron	31200	20	mg/kg dry	33300		94	91-112			
Lead	13.1	0.2	mg/kg dry	14.4		91	89-111			
Lithium	10.8	0.1	mg/kg dry	9.26		116	73-124			
Magnesium	5310	10	mg/kg dry	5830		91	89-116			
Manganese	1040	0.4	mg/kg dry	1100		95	93-112			
Mercury	0.10	0.05	mg/kg dry	0.0980		104	74-126			
Molybdenum	0.7	0.1	mg/kg dry	0.738		94	93-120			
Nickel	16.5	0.4	mg/kg dry	17.4		95	93-110			
Phosphorus	709	10	mg/kg dry	796		89	86-111			
Potassium	557	10	mg/kg dry	619		90	83-117			
Sodium	284	40	mg/kg dry	340		83	79-130			
Strontium	11.1	0.2	mg/kg dry	11.6		96	85-116			
Thorium	3.5	0.5	mg/kg dry	4.46		80	78-100			
Tin	1.1	0.2	mg/kg dry	1.10		97	78-120			
Titanium	822	2	mg/kg dry	764		108	72-143			
Uranium	0.8	0.1	mg/kg dry	0.940		83	80-102			
Vanadium	49.4	0.4	mg/kg dry	54.9		90	87-116			
Zinc	66	2	mg/kg dry	67.5		98	91-113			
Strong Acid Leachable Metals, Batch B5H0855										
Blank (B5H0855-BLK1)				Prepared: Aug-18-15, Analyzed: Aug-20-15						
Aluminum	< 20	20	mg/kg dry							
Antimony	< 0.1	0.1	mg/kg dry							
Arsenic	< 0.4	0.4	mg/kg dry							
Barium	< 1	1	mg/kg dry							
Beryllium	< 0.1	0.1	mg/kg dry							
Bismuth	< 0.1	0.1	mg/kg dry							
Boron	< 2	2	mg/kg dry							

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B5H0855, Continued										
Blank (B5H0855-BLK1), Continued				Prepared: Aug-18-15, Analyzed: Aug-20-15						
Cadmium	< 0.04	0.04	mg/kg dry							
Calcium	< 100	100	mg/kg dry							
Chromium	< 1.0	1.0	mg/kg dry							
Cobalt	< 0.1	0.1	mg/kg dry							
Copper	< 0.2	0.2	mg/kg dry							
Iron	< 20	20	mg/kg dry							
Lead	< 0.2	0.2	mg/kg dry							
Lithium	< 0.1	0.1	mg/kg dry							
Magnesium	< 10	10	mg/kg dry							
Manganese	< 0.4	0.4	mg/kg dry							
Mercury	< 0.05	0.05	mg/kg dry							
Molybdenum	< 0.1	0.1	mg/kg dry							
Nickel	< 0.4	0.4	mg/kg dry							
Phosphorus	< 10	10	mg/kg dry							
Potassium	< 10	10	mg/kg dry							
Selenium	< 0.5	0.5	mg/kg dry							
Silicon	< 3000	3000	mg/kg dry							
Silver	< 0.2	0.2	mg/kg dry							
Sodium	< 40	40	mg/kg dry							
Strontium	< 0.2	0.2	mg/kg dry							
Sulfur	< 1000	1000	mg/kg dry							
Tellurium	< 0.1	0.1	mg/kg dry							
Thallium	< 0.1	0.1	mg/kg dry							
Thorium	< 0.5	0.5	mg/kg dry							
Tin	< 0.2	0.2	mg/kg dry							
Titanium	< 2	2	mg/kg dry							
Uranium	< 0.1	0.1	mg/kg dry							
Vanadium	< 0.4	0.4	mg/kg dry							
Zinc	< 2	2	mg/kg dry							
Zirconium	< 2	2	mg/kg dry							
Duplicate (B5H0855-DUP1)		**Source: 5080309-50**		Prepared: Aug-18-15, Analyzed: Aug-20-15						
Aluminum	15100	20	mg/kg dry		16200			7	24	
Antimony	0.9	0.1	mg/kg dry		0.9			< 1	60	
Arsenic	14.5	0.4	mg/kg dry		15.0			4	42	
Barium	185	1	mg/kg dry		193			4	38	
Beryllium	0.5	0.1	mg/kg dry		0.6			22	37	
Bismuth	0.1	0.1	mg/kg dry		0.1				33	
Boron	2	2	mg/kg dry		2				29	
Cadmium	0.17	0.04	mg/kg dry		0.18				32	
Calcium	8660	100	mg/kg dry		9460			9	33	
Chromium	33.5	1.0	mg/kg dry		36.1			7	32	
Cobalt	9.5	0.1	mg/kg dry		10.2			7	26	
Copper	18.4	0.2	mg/kg dry		19.6			6	38	
Iron	21900	20	mg/kg dry		23400			7	28	
Lead	7.5	0.2	mg/kg dry		7.6			2	46	
Lithium	14.3	0.1	mg/kg dry		15.1			5	28	
Magnesium	6060	10	mg/kg dry		6450			6	23	
Manganese	575	0.4	mg/kg dry		613			6	23	
Mercury	0.06	0.05	mg/kg dry		0.06				42	
Molybdenum	0.5	0.1	mg/kg dry		0.5			4	52	
Nickel	23.4	0.4	mg/kg dry		24.6			5	29	
Phosphorus	660	10	mg/kg dry		725			9	20	
Potassium	1220	10	mg/kg dry		1330			8	28	
Selenium	2.0	0.5	mg/kg dry		1.7				19	
Silicon	< 3000	3000	mg/kg dry		< 3000				18	
Silver	< 0.2	0.2	mg/kg dry		< 0.2				35	

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B5H0855, Continued										
Duplicate (B5H0855-DUP1), Continued		**Source: 5080309-50**		Prepared: Aug-18-15, Analyzed: Aug-20-15						
Sodium	212	40	mg/kg dry		223			5	23	
Strontium	74.5	0.2	mg/kg dry		80.8			8	25	
Sulfur	< 1000	1000	mg/kg dry		< 1000				26	
Tellurium	< 0.1	0.1	mg/kg dry		< 0.1				38	
Thallium	0.2	0.1	mg/kg dry		0.2				27	
Thorium	8.7	0.5	mg/kg dry		9.1			4	39	
Tin	0.6	0.2	mg/kg dry		0.6				85	
Titanium	852	2	mg/kg dry		912			7	29	
Uranium	17.1	0.1	mg/kg dry		17.6			3	36	
Vanadium	42.6	0.4	mg/kg dry		45.3			6	23	
Zinc	57	2	mg/kg dry		61			7	30	
Zirconium	2	2	mg/kg dry		3				32	
Reference (B5H0855-SRM1)				Prepared: Aug-18-15, Analyzed: Aug-20-15						
Aluminum	17400	20	mg/kg dry	18200		96	86-118			
Antimony	6.6	0.1	mg/kg dry	6.27		105	73-138			
Arsenic	15.6	0.4	mg/kg dry	15.4		102	87-106			
Barium	82	1	mg/kg dry	80.6		102	72-119			
Beryllium	0.6	0.1	mg/kg dry	0.544		112	73-128			
Bismuth	1.9	0.1	mg/kg dry	2.12		90	78-97			
Boron	3	2	mg/kg dry	2.68		115	58-139			
Cadmium	0.25	0.04	mg/kg dry	0.230		109	88-121			
Calcium	3130	100	mg/kg dry	3320		94	92-113			
Chromium	27.3	1.0	mg/kg dry	27.2		100	91-113			
Cobalt	11.9	0.1	mg/kg dry	12.5		95	90-109			
Copper	44.9	0.2	mg/kg dry	44.9		100	92-112			
Iron	32900	20	mg/kg dry	33300		99	91-112			
Lead	15.3	0.2	mg/kg dry	14.4		106	89-111			
Lithium	10.3	0.1	mg/kg dry	9.26		111	73-124			
Magnesium	5630	10	mg/kg dry	5830		97	89-116			
Manganese	1090	0.4	mg/kg dry	1100		99	93-112			
Mercury	0.11	0.05	mg/kg dry	0.0980		110	74-126			
Molybdenum	0.7	0.1	mg/kg dry	0.738		93	93-120			
Nickel	17.7	0.4	mg/kg dry	17.4		101	93-110			
Phosphorus	723	10	mg/kg dry	796		91	86-111			
Potassium	593	10	mg/kg dry	619		96	83-117			
Sodium	303	40	mg/kg dry	340		89	79-130			
Strontium	11.5	0.2	mg/kg dry	11.6		99	85-116			
Thorium	3.7	0.5	mg/kg dry	4.46		83	78-100			
Tin	1.1	0.2	mg/kg dry	1.10		98	78-120			
Titanium	884	2	mg/kg dry	764		116	72-143			
Uranium	0.8	0.1	mg/kg dry	0.940		84	80-102			
Vanadium	51.5	0.4	mg/kg dry	54.9		94	87-116			
Zinc	69	2	mg/kg dry	67.5		102	91-113			

QC Qualifiers:

RPD Relative percent difference (RPD) of duplicate analysis are outside of control limits for unknown reason(s).

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		5080309-01	5080309-02	5080309-03	5080309-04	5080309-05	5080309-06
		Water	**Water**	**Water**	**Water**	**Water**	**Water**
		Aug-01-15	**Aug-01-15**	**Aug-01-15**	**Aug-01-15**	**Aug-01-15**	**Aug-01-15**
		AQREF2	**AQ10**	**AQ11**	**AQ20**	**AQ30**	**AQ13**
General Parameters	Chlorophyll a (ug/L)	19.0	23.5	12.0	23.6	29.0	23.7
	Solids, Total (mg/L)	350	103	143	193	107	140
	Solids, Total Volatile (mg/L)	93	83	37	160	37	70

		5080309-07	5080309-08	5080309-09	5080309-10	5080309-11	5080309-12
		Water	**Water**	**Water**	**Water**	**Water**	**Soil**
		Aug-01-15	**Aug-01-15**	**Aug-01-15**	**Aug-01-15**	**Aug-01-15**	**Jul-26-15**
		AQ04.5	**AQ04**	**AQ02**	**AQ00**	**AQREF1**	**AQ00-1**
General Parameters	Carbon, Total Organic (% dry)						1.65
	Chlorophyll a (ug/L)	24.3	11.0	26.6	12.7	20.8	
	Moisture (% wet)						35.7
	pH (1:2 H2O Solution) (pH units)						6.6
	Solids, Total (mg/L)	273	143	183	140	210	
	Solids, Total Volatile (mg/L)	43	53	90	47	73	
Fertility / Nutrient Parameters	Calcium, Available (mg/kg dry)						1500
	Magnesium, Available (mg/kg dry)						290
	Potassium, Available (mg/kg dry)						47
	Sodium, Available (mg/kg dry)						20
	Ammonia as N, Available (mg/kg dry)						6.7
	Nitrate as N, Available (mg/kg dry)						1.9
	Phosphorus, Available (mg/kg dry)						5
Strong Acid Leachable Metals	Aluminum (mg/kg dry)						15200
	Antimony (mg/kg dry)						0.5
	Arsenic (mg/kg dry)						7.3
	Barium (mg/kg dry)						174
	Beryllium (mg/kg dry)						0.4
	Bismuth (mg/kg dry)						0.2
	Boron (mg/kg dry)						2
	Cadmium (mg/kg dry)						0.19
	Calcium (mg/kg dry)						7010
	Chromium (mg/kg dry)						29.6
	Cobalt (mg/kg dry)						9.1
	Copper (mg/kg dry)						18.9
	Iron (mg/kg dry)						22300
	Lead (mg/kg dry)						7.2
	Lithium (mg/kg dry)						14.2
	Magnesium (mg/kg dry)						6220
	Manganese (mg/kg dry)						284
	Mercury (mg/kg dry)						0.07
	Molybdenum (mg/kg dry)						0.8

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		5080309-07	5080309-08	5080309-09	5080309-10	5080309-11	5080309-12
		Water	**Water**	**Water**	**Water**	**Water**	**Soil**
		Aug-01-15	**Aug-01-15**	**Aug-01-15**	**Aug-01-15**	**Aug-01-15**	**Jul-26-15**
		AQ04.5	**AQ04**	**AQ02**	**AQ00**	**AQREF1**	**AQ00-1**
Strong Acid Leachable Metals	Nickel (mg/kg dry)						19.0
	Phosphorus (mg/kg dry)						715
	Potassium (mg/kg dry)						1150
	Selenium (mg/kg dry)						0.8
	Silicon (mg/kg dry)						< 3000
	Silver (mg/kg dry)						< 0.2
	Sodium (mg/kg dry)						274
	Strontium (mg/kg dry)						40.6
	Sulfur (mg/kg dry)						< 1000
	Tellurium (mg/kg dry)						< 0.1
	Thallium (mg/kg dry)						0.1
	Thorium (mg/kg dry)						6.6
	Tin (mg/kg dry)						0.5
	Titanium (mg/kg dry)						972
	Uranium (mg/kg dry)						12.4
	Vanadium (mg/kg dry)						49.6
	Zinc (mg/kg dry)						66
	Zirconium (mg/kg dry)						< 2

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		5080309-13	5080309-14	5080309-15	5080309-16	5080309-17	5080309-18
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-26-15	**Jul-26-15**	**Jul-26-15**	**Jul-26-15**	**Jul-26-15**	**Aug-01-15**
		AQ00-2	**AQ00-3**	**AQ00-4**	**AQ02-1**	**AQ02-2**	**AQ02-3**
General Parameters	Carbon, Total Organic (% dry)	23.8	4.86		10.3	5.21	6.15
	Moisture (% wet)	60.4	54.8		34.6	41.9	57.4
	pH (1:2 H2O Solution) (pH units)	6.6	6.2		6.8	6.3	6.3
Fertility / Nutrient Parameters	Calcium, Available (mg/kg dry)		1400		2140	2150	2430
	Magnesium, Available (mg/kg dry)		260		393	385	421
	Potassium, Available (mg/kg dry)		100		79	79	130
	Sodium, Available (mg/kg dry)		45		24	21	34
	Ammonia as N, Available (mg/kg dry)		12.0		9.3	8.0	8.0
	Nitrate as N, Available (mg/kg dry)		2.3		1.8	1.3	1.9
	Phosphorus, Available (mg/kg dry)		6		5	16	4
Particle Size Distribution	> 80 mm (%)			< 0.1			
	> 56 mm (%)			< 0.1			
	> 40 mm (%)			< 0.1			
	> 25 mm (%)			< 0.1			
	> 19 mm (%)			< 0.1			
	> 12.5 mm (%)			< 0.1			
	> 4.75 mm (%)			< 0.1			
	> 2.36 mm (%)			< 0.1			
	> 2.0 mm (%)			0.4			
	> 1.18 mm (%)			1.7			
	> 600 µm (%)			4.6			
	> 425 µm (%)			11.0			
	> 300 µm (%)			6.6			
	> 150 µm (%)			22.4			
	> 75 µm (%)			16.6			
	< 75 µm (%)			36.7			
Strong Acid Leachable Metals	Aluminum (mg/kg dry)	16500	16100		16500	16600	17400
	Antimony (mg/kg dry)	0.6	0.4		0.5	0.5	0.5
	Arsenic (mg/kg dry)	6.5	8.2		9.6	9.2	8.5
	Barium (mg/kg dry)	208	183		199	198	201
	Beryllium (mg/kg dry)	0.5	0.4		0.3	0.4	0.4
	Bismuth (mg/kg dry)	0.2	0.2		0.2	0.2	0.2
	Boron (mg/kg dry)	3	2		2	2	2
	Cadmium (mg/kg dry)	0.20	0.24		0.27	0.23	0.23
	Calcium (mg/kg dry)	10400	6950		8090	7740	7700
	Chromium (mg/kg dry)	33.8	28.7		30.3	30.3	31.0
	Cobalt (mg/kg dry)	8.3	10.3		11.1	10.4	11.0
	Copper (mg/kg dry)	30.5	17.9		20.0	18.5	20.4
	Iron (mg/kg dry)	21100	23800		24800	24700	25800
	Lead (mg/kg dry)	7.5	6.5		6.9	7.6	6.9
	Lithium (mg/kg dry)	16.6	13.3		13.7	14.3	13.8
	Magnesium (mg/kg dry)	6700	6260		6470	6510	6770
	Manganese (mg/kg dry)	252	525		559	498	569
	Mercury (mg/kg dry)	0.15	0.10		0.07	0.06	0.08

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		5080309-13	5080309-14	5080309-15	5080309-16	5080309-17	5080309-18
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-26-15	**Jul-26-15**	**Jul-26-15**	**Jul-26-15**	**Jul-26-15**	**Aug-01-15**
		AQ00-2	**AQ00-3**	**AQ00-4**	**AQ02-1**	**AQ02-2**	**AQ02-3**
Strong Acid Leachable Metals	Molybdenum (mg/kg dry)	0.9	0.8		0.9	0.9	0.9
	Nickel (mg/kg dry)	23.9	18.5		19.5	19.4	19.2
	Phosphorus (mg/kg dry)	722	658		711	700	637
	Potassium (mg/kg dry)	1300	1310		1220	1220	1260
	Selenium (mg/kg dry)	1.1	0.6		1.2	0.6	0.9
	Silicon (mg/kg dry)	< 3000	< 3000		< 3000	< 3000	< 3000
	Silver (mg/kg dry)	< 0.2	< 0.2		< 0.2	< 0.2	< 0.2
	Sodium (mg/kg dry)	272	283		273	279	273
	Strontium (mg/kg dry)	59.5	40.0		45.2	43.3	44.0
	Sulfur (mg/kg dry)	1000	< 1000		< 1000	< 1000	< 1000
	Tellurium (mg/kg dry)	< 0.1	< 0.1		< 0.1	< 0.1	< 0.1
	Thallium (mg/kg dry)	0.2	0.2		0.2	0.2	0.2
	Thorium (mg/kg dry)	7.6	5.4		5.8	6.4	5.3
	Tin (mg/kg dry)	0.7	0.5		0.5	0.5	0.5
	Titanium (mg/kg dry)	895	1070		1050	1090	1070
	Uranium (mg/kg dry)	54.6	11.3		11.0	10.9	7.8
	Vanadium (mg/kg dry)	41.9	52.7		54.8	54.6	56.3
	Zinc (mg/kg dry)	63	66		68	68	70
	Zirconium (mg/kg dry)	3	2		2	2	2

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		5080309-19	5080309-20	5080309-21	5080309-22	5080309-23	5080309-24
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Aug-01-15	**Jul-26-15**	**Jul-27-15**	**Jul-27-15**	**Jul-27-15**	**Jul-27-15**
		AQ02-3R	**AQ02-4**	**AQREF1-1**	**AQREF1-2**	**AQREF1-3**	**AQREF1-3R**
General Parameters	Carbon, Total Organic (% dry)	7.34		0.95	2.51	4.28	5.56
	Moisture (% wet)	51.4		7.3	53.4	63.8	55.9
	pH (1:2 H2O Solution) (pH units)	6.2		6.8	6.8	6.6	6.5
Fertility / Nutrient Parameters	Calcium, Available (mg/kg dry)	2050		1350	2500	2100	
	Magnesium, Available (mg/kg dry)	370		290	488	400	
	Potassium, Available (mg/kg dry)	103		31	45	38	
	Sodium, Available (mg/kg dry)	20		13	48	28	
	Ammonia as N, Available (mg/kg dry)	9.3		5.3	8.0	8.0	
	Nitrate as N, Available (mg/kg dry)	1.1		< 1.0	1.5	1.8	
	Phosphorus, Available (mg/kg dry)	3		3	6	6	
Particle Size Distribution	> 80 mm (%)		< 0.1				
	> 56 mm (%)		< 0.1				
	> 40 mm (%)		< 0.1				
	> 25 mm (%)		< 0.1				
	> 19 mm (%)		< 0.1				
	> 12.5 mm (%)		< 0.1				
	> 4.75 mm (%)		< 0.1				
	> 2.36 mm (%)		1.8				
	> 2.0 mm (%)		0.8				
	> 1.18 mm (%)		3.1				
	> 600 µm (%)		6.5				
	> 425 µm (%)		4.7				
	> 300 µm (%)		7.2				
	> 150 µm (%)		22.3				
	> 75 µm (%)		20.1				
	< 75 µm (%)		33.3				
Strong Acid Leachable Metals	Aluminum (mg/kg dry)	16700		13600	14000	13200	14500
	Antimony (mg/kg dry)	0.4		1.6	1.3	1.5	1.5
	Arsenic (mg/kg dry)	8.3		22.7	14.6	11.5	10.9
	Barium (mg/kg dry)	191		374	388	322	325
	Beryllium (mg/kg dry)	0.4		0.4	0.4	0.5	0.5
	Bismuth (mg/kg dry)	0.2		0.2	0.2	0.2	0.2
	Boron (mg/kg dry)	2		2	2	2	2
	Cadmium (mg/kg dry)	0.22		0.31	0.33	0.29	0.29
	Calcium (mg/kg dry)	6970		7570	8730	9070	9340
	Chromium (mg/kg dry)	29.5		26.7	26.4	27.3	27.3
	Cobalt (mg/kg dry)	10.2		8.4	9.1	8.6	9.2
	Copper (mg/kg dry)	18.4		18.2	19.5	22.0	22.3
	Iron (mg/kg dry)	24600		25200	23400	20600	21400
	Lead (mg/kg dry)	6.6		8.9	8.7	10.1	9.5
	Lithium (mg/kg dry)	13.1		11.4	12.8	11.5	12.2
	Magnesium (mg/kg dry)	6550		5920	6220	6080	6240
	Manganese (mg/kg dry)	519		429	343	242	199
	Mercury (mg/kg dry)	0.07		< 0.05	0.05	0.06	0.06

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-19	5080309-20	5080309-21	5080309-22	5080309-23	5080309-24
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Aug-01-15	**Jul-26-15**	**Jul-27-15**	**Jul-27-15**	**Jul-27-15**	**Jul-27-15**
		AQ02-3R	**AQ02-4**	**AQREF1-1**	**AQREF1-2**	**AQREF1-3**	**AQREF1-3R**
Strong Acid Leachable Metals	Molybdenum (mg/kg dry)	0.8		1.1	0.7	0.8	0.8
	Nickel (mg/kg dry)	18.2		17.6	19.9	20.5	20.6
	Phosphorus (mg/kg dry)	655		1110	876	771	829
	Potassium (mg/kg dry)	1190		1050	1100	884	1040
	Selenium (mg/kg dry)	1.2		1.1	1.0	1.2	1.0
	Silicon (mg/kg dry)	< 3000		< 3000	< 3000	< 3000	< 3000
	Silver (mg/kg dry)	< 0.2		< 0.2	< 0.2	< 0.2	< 0.2
	Sodium (mg/kg dry)	288		218	251	225	246
	Strontium (mg/kg dry)	41.2		44.9	56.9	60.6	59.6
	Sulfur (mg/kg dry)	< 1000		< 1000	< 1000	< 1000	< 1000
	Tellurium (mg/kg dry)	< 0.1		< 0.1	< 0.1	< 0.1	< 0.1
	Thallium (mg/kg dry)	0.2		0.1	0.1	0.1	0.2
	Thorium (mg/kg dry)	5.3		6.7	6.1	5.8	6.3
	Tin (mg/kg dry)	0.6		0.4	0.5	0.4	0.5
	Titanium (mg/kg dry)	1080		701	780	700	758
	Uranium (mg/kg dry)	6.1		2.9	3.6	4.5	4.4
	Vanadium (mg/kg dry)	55.1		56.2	49.5	45.8	49.3
	Zinc (mg/kg dry)	67		74	75	70	71
	Zirconium (mg/kg dry)	2		< 2	< 2	< 2	< 2

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-25	5080309-26	5080309-27	5080309-28	5080309-29	5080309-30
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-27-15	**Jul-27-15**	**Jul-27-15**	**Jul-27-15**	**Jul-27-15**	**Jul-28-15**
		AQREF1-4	**AQ30-1**	**AQ30-2**	**AQ30-3**	**AQ30-4**	**AQ11-1**
General Parameters	Carbon, Total Organic (% dry)		2.75	3.00	4.04		7.83
	Moisture (% wet)		20.1	6.9	36		43.3
	pH (1:2 H2O Solution) (pH units)		6.7	6.8	6.3		6.4
Fertility / Nutrient Parameters	Calcium, Available (mg/kg dry)		1780	1290	1850		3570
	Magnesium, Available (mg/kg dry)		207	143	220		550
	Potassium, Available (mg/kg dry)		44	30	68		97
	Sodium, Available (mg/kg dry)		19	11	13		43
	Ammonia as N, Available (mg/kg dry)		5.3	5.3	9.3		12.0
	Nitrate as N, Available (mg/kg dry)		1.8	1.0	2.2		1.8
	Phosphorus, Available (mg/kg dry)		4	7	7		5
Particle Size Distribution	> 80 mm (%)	< 0.1				< 0.1	
	> 56 mm (%)	< 0.1				< 0.1	
	> 40 mm (%)	< 0.1				< 0.1	
	> 25 mm (%)	< 0.1				< 0.1	
	> 19 mm (%)	< 0.1				< 0.1	
	> 12.5 mm (%)	< 0.1				< 0.1	
	> 4.75 mm (%)	13.0				0.4	
	> 2.36 mm (%)	10.0				3.1	
	> 2.0 mm (%)	2.2				2.0	
	> 1.18 mm (%)	5.3				6.2	
	> 600 µm (%)	5.6				9.9	
	> 425 µm (%)	4.3				5.4	
	> 300 µm (%)	7.8				5.7	
	> 150 µm (%)	23.9				12.4	
	> 75 µm (%)	15.8				14.1	
	< 75 µm (%)	12.1				40.9	
Strong Acid Leachable Metals	Aluminum (mg/kg dry)		16700	15200	11700		17500
	Antimony (mg/kg dry)		1.3	1.1	0.7		0.8
	Arsenic (mg/kg dry)		18.0	15.5	10.1		17.1
	Barium (mg/kg dry)		225	210	179		208
	Beryllium (mg/kg dry)		0.7	0.7	0.4		0.5
	Bismuth (mg/kg dry)		0.2	0.2	0.1		0.2
	Boron (mg/kg dry)		3	3	3		2
	Cadmium (mg/kg dry)		0.23	0.29	0.09		0.48
	Calcium (mg/kg dry)		9920	9290	11300		8810
	Chromium (mg/kg dry)		32.0	27.8	26.8		36.1
	Cobalt (mg/kg dry)		11.8	11.1	8.3		12.1
	Copper (mg/kg dry)		21.9	20.0	29.9		26.2
	Iron (mg/kg dry)		25800	24000	19800		27000
	Lead (mg/kg dry)		11.7	12.0	7.0		11.4
	Lithium (mg/kg dry)		14.2	12.6	11.2		16.6
	Magnesium (mg/kg dry)		6290	5610	5840		6990
	Manganese (mg/kg dry)		687	706	413		768
	Mercury (mg/kg dry)		0.08	0.07	< 0.05		0.06

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PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-25	5080309-26	5080309-27	5080309-28	5080309-29	5080309-30
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-27-15	**Jul-27-15**	**Jul-27-15**	**Jul-27-15**	**Jul-27-15**	**Jul-28-15**
		AQREF1-4	**AQ30-1**	**AQ30-2**	**AQ30-3**	**AQ30-4**	**AQ11-1**
Strong Acid Leachable Metals	Molybdenum (mg/kg dry)		0.9	0.8	0.3		1.1
	Nickel (mg/kg dry)		20.9	19.4	22.3		27.0
	Phosphorus (mg/kg dry)		667	667	664		621
	Potassium (mg/kg dry)		1290	1150	1290		1290
	Selenium (mg/kg dry)		0.9	1.2	0.9		0.9
	Silicon (mg/kg dry)		< 3000	< 3000	< 3000		< 3000
	Silver (mg/kg dry)		< 0.2	< 0.2	< 0.2		< 0.2
	Sodium (mg/kg dry)		214	209	242		262
	Strontium (mg/kg dry)		64.3	59.4	57.4		50.9
	Sulfur (mg/kg dry)		< 1000	< 1000	< 1000		< 1000
	Tellurium (mg/kg dry)		< 0.1	< 0.1	< 0.1		< 0.1
	Thallium (mg/kg dry)		0.2	0.2	0.1		0.2
	Thorium (mg/kg dry)		9.9	10.4	6.3		7.0
	Tin (mg/kg dry)		0.5	0.5	0.3		0.6
	Titanium (mg/kg dry)		796	679	800		999
	Uranium (mg/kg dry)		7.4	6.0	4.6		7.9
	Vanadium (mg/kg dry)		47.5	41.7	36.5		55.5
	Zinc (mg/kg dry)		72	72	65		79
	Zirconium (mg/kg dry)		2	2	4		2

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WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-31	5080309-33	5080309-34	5080309-35	5080309-36	5080309-37
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-28-15	**Jul-28-15**	**Jul-28-15**	**Jul-28-15**	**Jul-28-15**	**Jul-28-15**
		AQ11-2	**AQ11-4**	**AQ10-1**	**AQ10-2**	**AQ10-3**	**AQ10-3R**
General Parameters	Carbon, Total Organic (% dry)	3.25		3.48	4.61	4.35	3.81
	Moisture (% wet)	36.3		55.1	42.6	50.7	44.2
	pH (1:2 H2O Solution) (pH units)	6.4		5.8	6.5	6.3	6.1
Fertility / Nutrient Parameters	Calcium, Available (mg/kg dry)	2140		2210	1930	1790	1640
	Magnesium, Available (mg/kg dry)	336		364	321	279	275
	Potassium, Available (mg/kg dry)	96		157	83	100	91
	Sodium, Available (mg/kg dry)	29		26	21	20	19
	Ammonia as N, Available (mg/kg dry)	12.0		11.0	11.0	11.0	11.0
	Nitrate as N, Available (mg/kg dry)	2.2		3.2	2.3	2.8	3.0
	Phosphorus, Available (mg/kg dry)	5		< 2	4	4	8
Particle Size Distribution	> 80 mm (%)		< 0.1				
	> 56 mm (%)		< 0.1				
	> 40 mm (%)		< 0.1				
	> 25 mm (%)		< 0.1				
	> 19 mm (%)		< 0.1				
	> 12.5 mm (%)		< 0.1				
	> 4.75 mm (%)		2.4				
	> 2.36 mm (%)		5.8				
	> 2.0 mm (%)		2.7				
	> 1.18 mm (%)		8.3				
	> 600 µm (%)		10.6				
	> 425 µm (%)		11.2				
	> 300 µm (%)		20.8				
	> 150 µm (%)		23.7				
	> 75 µm (%)		9.4				
	< 75 µm (%)		5.0				
Strong Acid Leachable Metals	Aluminum (mg/kg dry)	15400		18700	16700	16100	14700
	Antimony (mg/kg dry)	0.6		0.7	0.6	0.6	0.6
	Arsenic (mg/kg dry)	11.1		14.4	10.7	11.6	8.9
	Barium (mg/kg dry)	151		180	169	164	149
	Beryllium (mg/kg dry)	0.4		0.6	0.4	0.4	0.3
	Bismuth (mg/kg dry)	0.2		0.2	0.2	0.2	0.2
	Boron (mg/kg dry)	2		2	2	2	< 2
	Cadmium (mg/kg dry)	0.29		0.30	0.29	0.27	0.21
	Calcium (mg/kg dry)	6920		8530	7700	7530	6340
	Chromium (mg/kg dry)	30.1		35.8	31.7	31.9	29.1
	Cobalt (mg/kg dry)	10.2		12.6	11.0	10.9	9.5
	Copper (mg/kg dry)	15.0		19.3	15.8	15.9	14.0
	Iron (mg/kg dry)	23000		27200	24800	23900	21500
	Lead (mg/kg dry)	9.1		10.9	9.8	10.0	9.0
	Lithium (mg/kg dry)	14.7		17.3	14.9	14.4	12.5
	Magnesium (mg/kg dry)	5850		6910	6300	5970	5710
	Manganese (mg/kg dry)	478		870	693	605	479
	Mercury (mg/kg dry)	0.05		0.08	0.06	0.06	< 0.05

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PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-31	5080309-33	5080309-34	5080309-35	5080309-36	5080309-37
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-28-15	**Jul-28-15**	**Jul-28-15**	**Jul-28-15**	**Jul-28-15**	**Jul-28-15**
		AQ11-2	**AQ11-4**	**AQ10-1**	**AQ10-2**	**AQ10-3**	**AQ10-3R**
Strong Acid Leachable Metals	Molybdenum (mg/kg dry)	0.6		0.9	0.7	0.7	0.6
	Nickel (mg/kg dry)	20.3		24.4	21.0	21.0	18.9
	Phosphorus (mg/kg dry)	676		662	670	700	650
	Potassium (mg/kg dry)	1090		1200	1150	1050	942
	Selenium (mg/kg dry)	0.8		0.7	0.8	0.7	0.8
	Silicon (mg/kg dry)	< 3000		< 3000	< 3000	< 3000	< 3000
	Silver (mg/kg dry)	< 0.2		< 0.2	< 0.2	< 0.2	< 0.2
	Sodium (mg/kg dry)	251		279	281	279	254
	Strontium (mg/kg dry)	38.3		46.3	40.0	40.4	34.0
	Sulfur (mg/kg dry)	< 1000		< 1000	< 1000	< 1000	< 1000
	Tellurium (mg/kg dry)	< 0.1		< 0.1	< 0.1	< 0.1	< 0.1
	Thallium (mg/kg dry)	0.2		0.2	0.2	0.2	0.1
	Thorium (mg/kg dry)	6.9		7.8	6.9	7.3	6.2
	Tin (mg/kg dry)	0.5		0.6	0.5	0.5	0.5
	Titanium (mg/kg dry)	1060		1050	1090	1090	1040
	Uranium (mg/kg dry)	6.1		8.0	4.9	5.4	3.7
	Vanadium (mg/kg dry)	49.1		54.7	50.7	51.8	46.1
	Zinc (mg/kg dry)	72		80	75	73	68
	Zirconium (mg/kg dry)	2		3	2	2	2

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PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-38	5080309-39	5080309-40	5080309-41	5080309-42	5080309-43
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-28-15	**Jul-29-15**	**Jul-29-15**	**Jul-29-15**	**Jul-29-15**	**Jul-29-15**
		AQ10-4	**AQ04-1**	**AQ04-2**	**AQ04-3**	**AQ04-3R**	**AQ04-4**
General Parameters	Carbon, Total Organic (% dry)		5.34	5.44	5.43	5.26	
	Moisture (% wet)		24.7	53.1	36.6	49	
	pH (1:2 H2O Solution) (pH units)		6.9	7.1	6.7	6.8	
Fertility / Nutrient Parameters	Calcium, Available (mg/kg dry)		1450	2600	2210	2140	
	Magnesium, Available (mg/kg dry)		235	380	364	314	
	Potassium, Available (mg/kg dry)		54	98	80	63	
	Sodium, Available (mg/kg dry)		14	40	20	19	
	Ammonia as N, Available (mg/kg dry)		6.7	12.0	9.3	11.0	
	Nitrate as N, Available (mg/kg dry)		< 1.0	1.9	1.6	1.3	
	Phosphorus, Available (mg/kg dry)		4	6	5	2	
Particle Size Distribution	> 80 mm (%)	< 0.1					< 0.1
	> 56 mm (%)	< 0.1					< 0.1
	> 40 mm (%)	< 0.1					< 0.1
	> 25 mm (%)	< 0.1					< 0.1
	> 19 mm (%)	< 0.1					< 0.1
	> 12.5 mm (%)	< 0.1					< 0.1
	> 4.75 mm (%)	7.2					0.9
	> 2.36 mm (%)	3.3					3.7
	> 2.0 mm (%)	1.4					1.7
	> 1.18 mm (%)	5.8					8.3
	> 600 µm (%)	10.1					19.8
	> 425 µm (%)	7.4					18.5
	> 300 µm (%)	10.1					22.8
	> 150 µm (%)	24.7					17.5
	> 75 µm (%)	16.6					4.8
	< 75 µm (%)	13.3					2.0
Strong Acid Leachable Metals	Aluminum (mg/kg dry)		14800	15800	18200	17500	
	Antimony (mg/kg dry)		0.4	0.5	0.6	0.6	
	Arsenic (mg/kg dry)		4.4	10.9	11.7	10.6	
	Barium (mg/kg dry)		120	162	184	170	
	Beryllium (mg/kg dry)		0.3	0.6	0.6	0.5	
	Bismuth (mg/kg dry)		0.2	0.1	0.2	0.2	
	Boron (mg/kg dry)		< 2	2	2	2	
	Cadmium (mg/kg dry)		0.09	0.30	0.29	0.28	
	Calcium (mg/kg dry)		6050	7200	7490	7230	
	Chromium (mg/kg dry)		26.1	26.3	32.9	30.9	
	Cobalt (mg/kg dry)		7.4	9.6	10.9	10.4	
	Copper (mg/kg dry)		13.7	15.6	17.7	15.4	
	Iron (mg/kg dry)		21600	21900	25400	23500	
	Lead (mg/kg dry)		7.9	10.8	11.4	11.2	
	Lithium (mg/kg dry)		12.5	13.8	15.9	15.8	
	Magnesium (mg/kg dry)		5810	5050	6450	5930	
	Manganese (mg/kg dry)		323	738	726	548	
	Mercury (mg/kg dry)		0.05	0.10	0.09	0.09	

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PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-38	5080309-39	5080309-40	5080309-41	5080309-42	5080309-43
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-28-15	**Jul-29-15**	**Jul-29-15**	**Jul-29-15**	**Jul-29-15**	**Jul-29-15**
		AQ10-4	**AQ04-1**	**AQ04-2**	**AQ04-3**	**AQ04-3R**	**AQ04-4**
Strong Acid Leachable Metals	Molybdenum (mg/kg dry)		0.5	0.6	0.7	0.6	
	Nickel (mg/kg dry)		15.6	17.4	21.9	20.3	
	Phosphorus (mg/kg dry)		541	518	573	532	
	Potassium (mg/kg dry)		846	870	1140	1020	
	Selenium (mg/kg dry)		1.7	2.0	2.0	1.9	
	Silicon (mg/kg dry)		< 3000	< 3000	< 3000	< 3000	
	Silver (mg/kg dry)		< 0.2	< 0.2	< 0.2	< 0.2	
	Sodium (mg/kg dry)		261	179	242	237	
	Strontium (mg/kg dry)		45.7	64.1	62.1	60.6	
	Sulfur (mg/kg dry)		< 1000	< 1000	< 1000	< 1000	
	Tellurium (mg/kg dry)		< 0.1	< 0.1	< 0.1	< 0.1	
	Thallium (mg/kg dry)		0.1	0.1	0.2	0.2	
	Thorium (mg/kg dry)		8.6	9.7	10.8	10.5	
	Tin (mg/kg dry)		0.6	0.6	0.6	0.6	
	Titanium (mg/kg dry)		1040	804	952	922	
	Uranium (mg/kg dry)		11.2	9.2	12.6	12.1	
	Vanadium (mg/kg dry)		46.1	41.9	50.0	44.6	
	Zinc (mg/kg dry)		52	73	74	74	
	Zirconium (mg/kg dry)		3	3	2	2	

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PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-44	5080309-45	5080309-46	5080309-47	5080309-48	5080309-49
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-30-15	**Jul-30-15**	**Jul-30-15**	**Jul-30-15**	**Jul-30-15**	**Jul-30-15**
		AQ13-1	**AQ13-2**	**AQ13-3**	**AQ13-3R**	**AQ13-4**	**AQ20-1**
General Parameters	Carbon, Total Organic (% dry)	5.32	4.76	4.43	2.73		9.05
	Moisture (% wet)	48	48.4	62.1	39.7		47.4
	pH (1:2 H2O Solution) (pH units)	4.4	6.6	5.8	5.5		6.7
Fertility / Nutrient Parameters	Calcium, Available (mg/kg dry)	1000	2640	2700	2400		3300
	Magnesium, Available (mg/kg dry)	143	207	210	210		480
	Potassium, Available (mg/kg dry)	69	100	92	108		100
	Sodium, Available (mg/kg dry)	16	34	28	24		38
	Ammonia as N, Available (mg/kg dry)	11.0	12.0	10.0	5.3		8.0
	Nitrate as N, Available (mg/kg dry)	< 1.0	2.0	3.4	1.8		3.2
	Phosphorus, Available (mg/kg dry)	< 2	2	2	5		9
Particle Size Distribution	> 80 mm (%)					< 0.1	
	> 56 mm (%)					< 0.1	
	> 40 mm (%)					< 0.1	
	> 25 mm (%)					< 0.1	
	> 19 mm (%)					< 0.1	
	> 12.5 mm (%)					< 0.1	
	> 4.75 mm (%)					2.1	
	> 2.36 mm (%)					3.5	
	> 2.0 mm (%)					1.5	
	> 1.18 mm (%)					5.2	
	> 600 µm (%)					10.8	
	> 425 µm (%)					8.9	
	> 300 µm (%)					11.4	
	> 150 µm (%)					22.6	
	> 75 µm (%)					18.1	
	< 75 µm (%)					15.8	
Strong Acid Leachable Metals	Aluminum (mg/kg dry)	19100	22500	17900	17200		14000
	Antimony (mg/kg dry)	0.5	0.8	0.5	0.5		0.9
	Arsenic (mg/kg dry)	19.1	37.7	22.5	20.2		13.8
	Barium (mg/kg dry)	111	185	137	132		167
	Beryllium (mg/kg dry)	0.6	0.8	0.6	0.5		0.5
	Bismuth (mg/kg dry)	0.2	0.2	0.3	0.2		0.1
	Boron (mg/kg dry)	< 2	< 2	< 2	< 2		2
	Cadmium (mg/kg dry)	0.08	0.30	0.13	0.10		0.18
	Calcium (mg/kg dry)	3840	9010	7090	6060		8330
	Chromium (mg/kg dry)	54.6	62.3	48.4	48.9		32.2
	Cobalt (mg/kg dry)	10.2	14.8	10.0	9.6		9.3
	Copper (mg/kg dry)	16.5	25.5	17.8	17.2		16.1
	Iron (mg/kg dry)	25300	28800	23300	23300		20500
	Lead (mg/kg dry)	9.3	8.8	8.2	7.7		7.0
	Lithium (mg/kg dry)	12.8	17.4	12.4	12.2		12.5
	Magnesium (mg/kg dry)	7960	8650	7120	7220		5980
	Manganese (mg/kg dry)	387	901	635	413		578
	Mercury (mg/kg dry)	0.06	0.08	0.06	< 0.05		0.07

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-44	5080309-45	5080309-46	5080309-47	5080309-48	5080309-49
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-30-15	**Jul-30-15**	**Jul-30-15**	**Jul-30-15**	**Jul-30-15**	**Jul-30-15**
		AQ13-1	**AQ13-2**	**AQ13-3**	**AQ13-3R**	**AQ13-4**	**AQ20-1**
Strong Acid Leachable Metals	Molybdenum (mg/kg dry)	1.5	0.6	0.6	0.6		0.5
	Nickel (mg/kg dry)	29.1	38.8	28.2	27.6		21.1
	Phosphorus (mg/kg dry)	480	547	469	526		634
	Potassium (mg/kg dry)	1760	2310	1710	1950		1120
	Selenium (mg/kg dry)	1.5	1.5	2.4	0.9		1.6
	Silicon (mg/kg dry)	< 3000	< 3000	< 3000	< 3000		< 3000
	Silver (mg/kg dry)	< 0.2	< 0.2	< 0.2	< 0.2		< 0.2
	Sodium (mg/kg dry)	236	283	240	263		204
	Strontium (mg/kg dry)	30.3	62.1	45.7	41.1		72.2
	Sulfur (mg/kg dry)	< 1000	< 1000	< 1000	< 1000		< 1000
	Tellurium (mg/kg dry)	< 0.1	< 0.1	< 0.1	< 0.1		< 0.1
	Thallium (mg/kg dry)	0.3	0.4	0.2	0.2		0.1
	Thorium (mg/kg dry)	7.9	11.2	9.6	9.6		7.3
	Tin (mg/kg dry)	1.0	1.0	0.9	0.9		0.6
	Titanium (mg/kg dry)	1180	1170	1060	1160		792
	Uranium (mg/kg dry)	2.9	10.0	4.4	2.8		17.1
	Vanadium (mg/kg dry)	64.2	51.8	43.9	45.7		39.1
	Zinc (mg/kg dry)	60	75	57	55		64
	Zirconium (mg/kg dry)	< 2	2	< 2	< 2		2

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PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-50	5080309-51	5080309-52	5080309-53	5080309-54	5080309-55
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-30-15	**Jul-30-15**	**Jul-30-15**	**Jul-30-15**	**Jul-31-15**	**Jul-31-15**
		AQ20-2	**AQ20-3**	**AQ20-3R**	**AQ20-4**	**AQREF2-1**	**AQREF2-2**
General Parameters	Carbon, Total Organic (% dry)	5.91	10.5	10.6		3.92	2.98
	Moisture (% wet)	46	48.7	43		31.7	41.9
	pH (1:2 H2O Solution) (pH units)	7.1	7.0	7.0		7.1	6.7
Fertility / Nutrient Parameters	Calcium, Available (mg/kg dry)	3350	3570	3790		1800	2070
	Magnesium, Available (mg/kg dry)	480	514	486		540	729
	Potassium, Available (mg/kg dry)	101	99	81		62	64
	Sodium, Available (mg/kg dry)	16	21	21		30	30
	Ammonia as N, Available (mg/kg dry)	8.0	8.0	10.0		5.3	5.3
	Nitrate as N, Available (mg/kg dry)	1.9	2.2	3.5		< 1.0	1.5
	Phosphorus, Available (mg/kg dry)	< 2	2	3		4	< 2
Particle Size Distribution	> 80 mm (%)				< 0.1		
	> 56 mm (%)				< 0.1		
	> 40 mm (%)				< 0.1		
	> 25 mm (%)				< 0.1		
	> 19 mm (%)				< 0.1		
	> 12.5 mm (%)				< 0.1		
	> 4.75 mm (%)				1.0		
	> 2.36 mm (%)				3.0		
	> 2.0 mm (%)				1.3		
	> 1.18 mm (%)				5.5		
	> 600 µm (%)				10.6		
	> 425 µm (%)				6.6		
	> 300 µm (%)				7.6		
	> 150 µm (%)				17.4		
	> 75 µm (%)				17.3		
	< 75 µm (%)				29.8		
Strong Acid Leachable Metals	Aluminum (mg/kg dry)	16200	14900	15800		13200	12600
	Antimony (mg/kg dry)	0.9	0.9	1.1		0.4	0.3
	Arsenic (mg/kg dry)	15.0	14.0	12.7		5.9	6.4
	Barium (mg/kg dry)	193	179	191		196	158
	Beryllium (mg/kg dry)	0.6	0.5	0.6		0.4	0.5
	Bismuth (mg/kg dry)	0.1	0.1	0.2		< 0.1	< 0.1
	Boron (mg/kg dry)	2	2	3		3	3
	Cadmium (mg/kg dry)	0.18	0.17	0.15		0.21	0.16
	Calcium (mg/kg dry)	9460	9550	10600		8390	7610
	Chromium (mg/kg dry)	36.1	34.0	36.5		33.9	36.1
	Cobalt (mg/kg dry)	10.2	9.0	7.9		10.0	8.8
	Copper (mg/kg dry)	19.6	19.1	24.1		24.4	19.1
	Iron (mg/kg dry)	23400	21200	20100		23200	22300
	Lead (mg/kg dry)	7.6	7.3	7.5		5.5	5.5
	Lithium (mg/kg dry)	15.1	13.7	15.8		11.1	11.3
	Magnesium (mg/kg dry)	6450	6280	6440		7350	7010
	Manganese (mg/kg dry)	613	433	238		515	226
	Mercury (mg/kg dry)	0.06	0.06	0.08		< 0.05	< 0.05

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PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-50	5080309-51	5080309-52	5080309-53	5080309-54	5080309-55
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-30-15	**Jul-30-15**	**Jul-30-15**	**Jul-30-15**	**Jul-31-15**	**Jul-31-15**
		AQ20-2	**AQ20-3**	**AQ20-3R**	**AQ20-4**	**AQREF2-1**	**AQREF2-2**
Strong Acid Leachable Metals	Molybdenum (mg/kg dry)	0.5	0.6	0.5		0.5	0.5
	Nickel (mg/kg dry)	24.6	22.6	24.2		34.3	33.1
	Phosphorus (mg/kg dry)	725	667	680		711	729
	Potassium (mg/kg dry)	1330	1220	1110		889	738
	Selenium (mg/kg dry)	1.7	1.2	< 0.5		< 0.5	< 0.5
	Silicon (mg/kg dry)	< 3000	< 3000	< 3000		< 3000	< 3000
	Silver (mg/kg dry)	< 0.2	< 0.2	< 0.2		< 0.2	< 0.2
	Sodium (mg/kg dry)	223	210	198		390	360
	Strontium (mg/kg dry)	80.8	82.3	93.2		60.5	58.0
	Sulfur (mg/kg dry)	< 1000	< 1000	< 1000		< 1000	< 1000
	Tellurium (mg/kg dry)	< 0.1	< 0.1	< 0.1		< 0.1	< 0.1
	Thallium (mg/kg dry)	0.2	0.1	0.2		< 0.1	< 0.1
	Thorium (mg/kg dry)	9.1	8.4	8.8		3.5	3.6
	Tin (mg/kg dry)	0.6	0.6	0.6		0.4	0.4
	Titanium (mg/kg dry)	912	763	742		860	821
	Uranium (mg/kg dry)	17.6	27.9	28.9		1.3	2.1
	Vanadium (mg/kg dry)	45.3	39.8	35.2		47.9	50.4
	Zinc (mg/kg dry)	61	57	54		64	62
	Zirconium (mg/kg dry)	3	3	3		4	3

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WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-56	5080309-57	5080309-58	5080309-59	5080309-60	5080309-61
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-31-15	**Jul-31-15**	**Aug-01-15**	**Aug-01-15**	**Aug-01-15**	**Aug-01-15**
		AQREF2-3	**AQREF2-4**	**AQ04.5-1**	**AQ04.5-2**	**AQ04.5-3**	**AQ04.5-4**
General Parameters	Carbon, Total Organic (% dry)	4.34		6.49	12.2	6.85	8.16
	Moisture (% wet)	36.1		50.8	58.8	56.1	58.7
	pH (1:2 H2O Solution) (pH units)	6.7		5.8	5.7	5.9	5.7
Fertility / Nutrient Parameters	Calcium, Available (mg/kg dry)	2140		1500	2210	1570	1820
	Magnesium, Available (mg/kg dry)	1010		264	364	250	271
	Potassium, Available (mg/kg dry)	73		129	150	171	146
	Sodium, Available (mg/kg dry)	57		19	19	19	16
	Ammonia as N, Available (mg/kg dry)	5.3		8.0	12.0	12.0	9.3
	Nitrate as N, Available (mg/kg dry)	1.2		2.9	3.5	3.7	2.7
	Phosphorus, Available (mg/kg dry)	< 2		2	< 2	3	4
Particle Size Distribution	> 80 mm (%)		< 0.1				
	> 56 mm (%)		< 0.1				
	> 40 mm (%)		< 0.1				
	> 25 mm (%)		< 0.1				
	> 19 mm (%)		< 0.1				
	> 12.5 mm (%)		< 0.1				
	> 4.75 mm (%)		0.9				
	> 2.36 mm (%)		3.3				
	> 2.0 mm (%)		1.8				
	> 1.18 mm (%)		7.0				
	> 600 µm (%)		13.0				
	> 425 µm (%)		26.6				
	> 300 µm (%)		29.2				
	> 150 µm (%)		12.7				
	> 75 µm (%)		3.2				
	< 75 µm (%)		2.2				
Strong Acid Leachable Metals	Aluminum (mg/kg dry)	13800		14300	17200	15500	16400
	Antimony (mg/kg dry)	0.3		0.5	0.7	0.6	0.6
	Arsenic (mg/kg dry)	7.4		10.2	21.7	12.9	13.8
	Barium (mg/kg dry)	151		138	188	152	172
	Beryllium (mg/kg dry)	0.5		0.4	0.6	0.5	0.4
	Bismuth (mg/kg dry)	< 0.1		0.1	0.2	0.1	0.1
	Boron (mg/kg dry)	4		< 2	< 2	< 2	< 2
	Cadmium (mg/kg dry)	0.13		0.28	0.61	0.36	0.49
	Calcium (mg/kg dry)	7840		4390	5360	4980	5180
	Chromium (mg/kg dry)	43.4		24.5	27.8	25.8	27.3
	Cobalt (mg/kg dry)	9.4		8.1	15.2	9.1	12.8
	Copper (mg/kg dry)	21.7		10.8	15.2	12.2	13.2
	Iron (mg/kg dry)	26900		20500	27400	22700	23600
	Lead (mg/kg dry)	6.3		9.9	13.0	10.9	11.9
	Lithium (mg/kg dry)	11.8		10.9	13.4	11.9	12.2
	Magnesium (mg/kg dry)	9690		4570	4990	4880	5000
	Manganese (mg/kg dry)	207		933	2050	1110	1680
	Mercury (mg/kg dry)	< 0.05		0.08	0.13	0.11	0.12

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WORK ORDER 5080309
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		5080309-56	5080309-57	5080309-58	5080309-59	5080309-60	5080309-61
		Soil	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
		Jul-31-15	**Jul-31-15**	**Aug-01-15**	**Aug-01-15**	**Aug-01-15**	**Aug-01-15**
		AQREF2-3	**AQREF2-4**	**AQ04.5-1**	**AQ04.5-2**	**AQ04.5-3**	**AQ04.5-4**
Strong Acid Leachable Metals	Molybdenum (mg/kg dry)	0.6		0.5	1.3	0.7	0.8
	Nickel (mg/kg dry)	42.1		14.5	17.7	15.6	17.1
	Phosphorus (mg/kg dry)	805		509	569	528	577
	Potassium (mg/kg dry)	833		651	780	741	739
	Selenium (mg/kg dry)	< 0.5		0.7	< 0.5	< 0.5	0.6
	Silicon (mg/kg dry)	< 3000		< 3000	< 3000	< 3000	< 3000
	Silver (mg/kg dry)	< 0.2		< 0.2	< 0.2	< 0.2	< 0.2
	Sodium (mg/kg dry)	490		180	173	187	180
	Strontium (mg/kg dry)	52.9		31.3	41.2	36.3	39.4
	Sulfur (mg/kg dry)	< 1000		< 1000	< 1000	< 1000	< 1000
	Tellurium (mg/kg dry)	< 0.1		< 0.1	< 0.1	< 0.1	< 0.1
	Thallium (mg/kg dry)	< 0.1		0.1	0.2	0.2	0.2
	Thorium (mg/kg dry)	3.8		9.0	10.8	9.5	9.5
	Tin (mg/kg dry)	0.6		0.5	0.6	0.6	0.6
	Titanium (mg/kg dry)	960		832	734	826	759
	Uranium (mg/kg dry)	1.4		5.5	9.3	7.0	6.1
	Vanadium (mg/kg dry)	57.3		42.7	57.0	46.4	48.1
	Zinc (mg/kg dry)	60		63	77	68	69
	Zirconium (mg/kg dry)	4		< 2	< 2	< 2	< 2

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WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-62	5080309-63	5080309-64	5080309-65	5080309-66	5080309-67
		Tissue (wet)	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**
		Aug-01-15	**Jul-25-15**	**Jul-25-15**	**Jul-26-15**	**Jul-26-15**	**Jul-26-15**
		219	**041**	**042**	**052**	**054**	**69**
General Parameters	Moisture (% wet)		77.6	71.2	78.7	79	78.2
Metals in Tissue	Aluminum (mg/kg wet)	30.6	0.9	49.7	5.3	1.2	2.2
	Antimony (mg/kg wet)	0.068	0.080	0.019	0.034	0.012	0.007
	Arsenic (mg/kg wet)	0.149	0.069	0.216	0.068	0.020	0.034
	Barium (mg/kg wet)	2.10	0.10	3.24	0.18	0.07	0.11
	Beryllium (mg/kg wet)	< 0.004	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
	Bismuth (mg/kg wet)	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
	Boron (mg/kg wet)	0.3	0.3	0.3	0.3	0.3	0.3
	Cadmium (mg/kg wet)	0.059	0.004	0.111	0.003	0.003	0.005
	Calcium (mg/kg wet)	8010	656	12300	506	287	584
	Chromium (mg/kg wet)	0.08	0.04	0.22	0.03	< 0.01	0.01
	Cobalt (mg/kg wet)	0.055	0.019	0.089	0.015	0.009	0.011
	Copper (mg/kg wet)	1.21	0.39	1.55	0.30	0.34	0.64
	Iron (mg/kg wet)	45	5	85	10	4	10
	Lead (mg/kg wet)	0.022	< 0.004	0.020	0.007	< 0.004	< 0.004
	Magnesium (mg/kg wet)	415	319	525	284	296	304
	Manganese (mg/kg wet)	7.08	0.53	16.2	0.74	0.25	0.33
	Mercury (mg/kg wet)	0.047	0.065	0.084	0.090	0.050	0.072
	Molybdenum (mg/kg wet)	< 0.02	< 0.01	0.03	< 0.01	< 0.01	< 0.01
	Nickel (mg/kg wet)	0.10	0.03	0.24	0.06	0.05	0.05
	Phosphorus (mg/kg wet)	7690	3840	13700	3330	3300	3890
	Potassium (mg/kg wet)	3960	5560	4500	5110	5310	5750
	Selenium (mg/kg wet)	1.88	1.69	2.74	1.18	1.29	1.73
	Silver (mg/kg wet)	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	Sodium (mg/kg wet)	785	305	1070	300	293	353
	Strontium (mg/kg wet)	11.0	0.95	26.0	0.63	0.34	0.64
	Thallium (mg/kg wet)	0.010	0.006	0.010	0.006	0.005	0.008
	Tin (mg/kg wet)	< 0.04	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
	Titanium (mg/kg wet)	2.56	0.26	4.41	0.41	0.23	0.34
	Uranium (mg/kg wet)	0.029	< 0.001	0.011	0.003	< 0.001	0.001
	Vanadium (mg/kg wet)	0.22	< 0.02	0.47	0.03	< 0.02	< 0.02
	Zinc (mg/kg wet)	29.8	5.2	61.4	4.0	5.8	5.2

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WORK ORDER 5080309
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		5080309-68	5080309-69	5080309-70	5080309-71	5080309-72	5080309-73
		Tissue (wet)	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**
		Jul-26-15	**Jul-26-15**	**Jul-26-15**	**Jul-26-15**	**Jul-26-15**	**Jul-27-15**
		70	**71**	**72**	**73**	**74**	**94**
General Parameters	Moisture (% wet)	78	77.3	78.8	78.8	78.7	73.8
Metals in Tissue	Aluminum (mg/kg wet)	1.3	3.1	2.1	2.1	2.7	112
	Antimony (mg/kg wet)	0.005	0.060	0.006	0.053	0.004	0.017
	Arsenic (mg/kg wet)	0.032	0.029	0.028	0.029	0.022	0.164
	Barium (mg/kg wet)	0.10	0.05	0.10	0.12	0.15	3.54
	Beryllium (mg/kg wet)	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	0.002
	Bismuth (mg/kg wet)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
	Boron (mg/kg wet)	0.3	0.3	0.3	0.4	0.4	0.4
	Cadmium (mg/kg wet)	0.003	0.005	0.007	0.006	0.005	0.057
	Calcium (mg/kg wet)	499	162	508	406	559	7410
	Chromium (mg/kg wet)	< 0.01	0.01	0.04	0.01	0.02	0.30
	Cobalt (mg/kg wet)	0.009	0.014	0.016	0.011	0.009	0.105
	Copper (mg/kg wet)	0.42	0.43	0.40	0.71	0.38	1.26
	Iron (mg/kg wet)	10	10	8	10	9	154
	Lead (mg/kg wet)	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	0.036
	Magnesium (mg/kg wet)	322	308	350	304	312	412
	Manganese (mg/kg wet)	0.45	0.33	0.48	0.33	0.41	14.6
	Mercury (mg/kg wet)	0.062	0.054	0.039	0.055	0.092	0.248
	Molybdenum (mg/kg wet)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	0.04
	Nickel (mg/kg wet)	0.05	0.05	0.06	0.06	0.06	0.22
	Phosphorus (mg/kg wet)	3840	3650	3980	3830	3830	8450
	Potassium (mg/kg wet)	5790	5880	5920	5780	5730	4030
	Selenium (mg/kg wet)	1.56	1.31	1.79	1.71	1.42	1.76
	Silver (mg/kg wet)	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
	Sodium (mg/kg wet)	384	381	446	364	372	1050
	Strontium (mg/kg wet)	0.70	0.18	0.60	0.47	0.76	11.3
	Thallium (mg/kg wet)	0.004	0.006	0.005	0.006	0.004	0.015
	Tin (mg/kg wet)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
	Titanium (mg/kg wet)	0.27	0.46	0.35	0.29	0.37	7.97
	Uranium (mg/kg wet)	< 0.001	0.001	0.002	0.001	0.001	0.129
	Vanadium (mg/kg wet)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	0.43
	Zinc (mg/kg wet)	4.6	7.3	5.5	6.5	5.3	51.6

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-74	5080309-75	5080309-76	5080309-77	5080309-78	5080309-79
		Tissue (wet)	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**
		Jul-27-15	**Jul-27-15**	**Jul-28-15**	**Jul-28-15**	**Jul-28-15**	**Jul-28-15**
		96	**102**	**107**	**108**	**109**	**110**
General Parameters	Moisture (% wet)			78.1	79	78.5	79.7
Metals in Tissue	Aluminum (mg/kg wet)	2.7	37.6	0.7	1.2	1.0	2.0
	Antimony (mg/kg wet)	0.003	0.012	0.005	< 0.002	< 0.002	0.006
	Arsenic (mg/kg wet)	0.073	0.118	0.043	0.046	0.035	0.032
	Barium (mg/kg wet)	1.51	3.01	0.18	0.25	0.06	0.14
	Beryllium (mg/kg wet)	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002
	Bismuth (mg/kg wet)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
	Boron (mg/kg wet)	0.4	0.3	0.3	0.3	0.3	0.4
	Cadmium (mg/kg wet)	0.013	0.038	0.003	0.004	0.006	0.008
	Calcium (mg/kg wet)	6320	8670	705	1550	218	828
	Chromium (mg/kg wet)	< 0.01	0.10	< 0.01	< 0.01	< 0.01	0.01
	Cobalt (mg/kg wet)	0.016	0.054	0.008	0.013	0.013	0.013
	Copper (mg/kg wet)	0.69	0.97	0.38	0.36	0.32	0.39
	Iron (mg/kg wet)	12	58	5	6	5	6
	Lead (mg/kg wet)	< 0.004	0.014	< 0.004	< 0.004	< 0.004	< 0.004
	Magnesium (mg/kg wet)	362	409	300	318	279	330
	Manganese (mg/kg wet)	2.89	7.99	0.39	0.70	0.32	0.43
	Mercury (mg/kg wet)	0.130	0.220	0.075	0.051	0.086	0.037
	Molybdenum (mg/kg wet)	0.01	0.02	< 0.01	< 0.01	< 0.01	< 0.01
	Nickel (mg/kg wet)	0.08	0.13	0.06	0.07	0.06	0.07
	Phosphorus (mg/kg wet)	7430	8460	3750	4280	3100	4010
	Potassium (mg/kg wet)	4010	3930	5550	5500	5040	5660
	Selenium (mg/kg wet)	1.56	1.39	1.23	1.51	1.54	1.82
	Silver (mg/kg wet)	< 0.01	< 0.01	< 0.01	< 0.01	0.01	< 0.01
	Sodium (mg/kg wet)	817	899	310	326	295	315
	Strontium (mg/kg wet)	10.0	12.9	0.84	1.90	0.27	0.91
	Thallium (mg/kg wet)	0.009	0.011	0.006	0.006	0.006	0.005
	Tin (mg/kg wet)	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
	Titanium (mg/kg wet)	0.71	2.94	0.25	0.32	0.22	0.34
	Uranium (mg/kg wet)	0.032	0.081	0.001	0.001	0.001	0.001
	Vanadium (mg/kg wet)	0.05	0.21	< 0.02	< 0.02	< 0.02	< 0.02
	Zinc (mg/kg wet)	21.1	36.0	5.3	6.0	6.0	5.8

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5080309
REPORTED Nov-30-15

		5080309-80	5080309-81	5080309-82	5080309-83	5080309-84	5080309-85
		Tissue (wet)	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**
		Jul-28-15	**Jul-28-15**	**Jul-28-15**	**Jul-28-15**	**Jul-28-15**	**Jul-28-15**
		111	**112**	**113**	**205**	**206**	**207**
General Parameters	Moisture (% wet)	78.8	79.7	79.5			
Metals in Tissue	Aluminum (mg/kg wet)	1.2	1.7	7.0	32.5	19.4	3.6
	Antimony (mg/kg wet)	< 0.002	0.003	0.007	0.023	0.036	< 0.009
	Arsenic (mg/kg wet)	0.035	0.031	0.038	0.157	0.396	0.097
	Barium (mg/kg wet)	0.05	0.15	0.18	3.70	3.71	2.64
	Beryllium (mg/kg wet)	< 0.002	< 0.002	< 0.002	< 0.008	< 0.011	< 0.009
	Bismuth (mg/kg wet)	< 0.02	< 0.02	< 0.02	< 0.08	< 0.11	< 0.09
	Boron (mg/kg wet)	0.3	0.3	0.3	0.5	< 0.5	< 0.5
	Cadmium (mg/kg wet)	0.004	0.005	0.008	0.087	0.151	0.141
	Calcium (mg/kg wet)	316	687	725	9010	12800	8080
	Chromium (mg/kg wet)	< 0.01	0.02	0.03	0.13	0.17	< 0.05
	Cobalt (mg/kg wet)	0.012	0.011	0.031	0.038	0.053	0.024
	Copper (mg/kg wet)	0.30	0.28	0.34	0.73	0.73	0.53
	Iron (mg/kg wet)	4	5	14	57	104	10
	Lead (mg/kg wet)	< 0.004	< 0.004	0.006	0.024	0.088	< 0.018
	Magnesium (mg/kg wet)	303	330	331	417	455	385
	Manganese (mg/kg wet)	0.23	0.50	0.78	8.48	13.0	7.15
	Mercury (mg/kg wet)	0.042	0.037	0.036	0.065	0.051	0.031
	Molybdenum (mg/kg wet)	< 0.01	< 0.01	< 0.01	< 0.04	< 0.05	< 0.05
	Nickel (mg/kg wet)	0.06	0.06	0.06	0.25	0.35	0.25
	Phosphorus (mg/kg wet)	3430	3720	3720	7670	9340	6610
	Potassium (mg/kg wet)	5590	5730	5470	3750	3740	3770
	Selenium (mg/kg wet)	1.44	1.71	2.07	1.40	2.36	1.61
	Silver (mg/kg wet)	< 0.01	< 0.01	< 0.01	< 0.04	< 0.05	< 0.05
	Sodium (mg/kg wet)	301	328	356	754	738	686
	Strontium (mg/kg wet)	0.32	0.74	0.84	13.4	17.0	10.4
	Thallium (mg/kg wet)	0.005	0.004	0.007	0.007	0.009	0.006
	Tin (mg/kg wet)	< 0.02	< 0.02	< 0.02	< 0.08	< 0.1	< 0.09
	Titanium (mg/kg wet)	0.22	0.31	0.60	2.26	1.24	0.55
	Uranium (mg/kg wet)	< 0.001	0.001	0.003	0.016	0.021	0.006
	Vanadium (mg/kg wet)	< 0.02	< 0.02	0.02	0.27	0.42	0.15
	Zinc (mg/kg wet)	5.3	6.3	6.3	38.2	61.3	33.5

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5080309
PROJECT	Coffee Gold	**REPORTED**	Nov-30-15

		5080309-86
		Tissue (wet)
		Jul-29-15
		208
Metals in Tissue	Aluminum (mg/kg wet)	28.3
	Antimony (mg/kg wet)	0.005
	Arsenic (mg/kg wet)	0.126
	Barium (mg/kg wet)	4.58
	Beryllium (mg/kg wet)	< 0.002
	Bismuth (mg/kg wet)	< 0.02
	Boron (mg/kg wet)	0.3
	Cadmium (mg/kg wet)	0.047
	Calcium (mg/kg wet)	16200
	Chromium (mg/kg wet)	0.08
	Cobalt (mg/kg wet)	0.047
	Copper (mg/kg wet)	1.12
	Iron (mg/kg wet)	48
	Lead (mg/kg wet)	0.016
	Magnesium (mg/kg wet)	440
	Manganese (mg/kg wet)	14.4
	Mercury (mg/kg wet)	0.203
	Molybdenum (mg/kg wet)	0.02
	Nickel (mg/kg wet)	0.15
	Phosphorus (mg/kg wet)	13000
	Potassium (mg/kg wet)	3780
	Selenium (mg/kg wet)	1.22
	Silver (mg/kg wet)	< 0.01
	Sodium (mg/kg wet)	1300
	Strontium (mg/kg wet)	24.6
	Thallium (mg/kg wet)	0.013
	Tin (mg/kg wet)	< 0.02
	Titanium (mg/kg wet)	2.51
	Uranium (mg/kg wet)	0.175
	Vanadium (mg/kg wet)	0.27
	Zinc (mg/kg wet)	71.7

CERTIFICATE OF ANALYSIS

REPORTED TO	Palmer Environmental Consulting Group Inc. 470 Granville Street - Suite 630 Vancouver, BC V6C 1V5	**TEL** **FAX**	(604) 629-9075 -

ATTENTION	Alyssa Murdoch	**WORK ORDER**	5091469
PO NUMBER		**RECEIVED / TEMP**	Sep-17-15 14:00 / 2°C
PROJECT	Coffee Gold	**REPORTED**	Nov-20-15
PROJECT INFO		**COC NUMBER**	B31312

General Comments:

CARO Analytical Services employs methods which are conducted according to procedures accepted by appropriate regulatory agencies, and/or are conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts, except where otherwise agreed to by the client.

The results in this report apply to the samples analyzed in accordance with the Chain of Custody or Sample Requisition document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

Work Order Comments:

Please note this is an amended report - updated matrix description 11/18/15 KF
Nov.20/15- This is an amended report, results have been revised.- JLS

[signature redacted]

Authorized By: **Brent Coates, B.Sc.**
Division Manager, Richmond

If you have any questions or concerns, please contact your Account Manager:
Sara Gulenchyn, B.Sc, P.Chem. (sgulenchyn@caro.ca)

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PROJECT	Coffee Gold	**REPORTED**	Nov-20-15

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Tabulated data in condensed format to assist with comparisons

ANALYSIS INFORMATION

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5091469
PROJECT	Coffee Gold	**REPORTED**	Nov-20-15

Analysis Description	Method Reference	Technique	Location
Metals in Tissue	EPA 200.3 / EPA 6020A	HNO3+HCl+H2O2 Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond
Moisture	ASTM D2974-87*	Gravimetry (Dried at 105C)	N/A
Strong Acid Leachable Metals	BCMOE SALM V.2 / EPA 6020A	HNO3+HCl Hot Block Digestion / Inductively Coupled Plasma-Mass Spectroscopy (ICP-MS)	Richmond

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Method Reference Descriptions:

ASTM	ASTM International Test Methods
EPA	United States Environmental Protection Agency Test Methods

Glossary of Terms:

MRL	Method Reporting Limit
<	Less than the Reported Detection Limit (RDL) - the RDL may be higher than the MRL due to various factors such as dilutions, limited sample volume, high moisture, or interferences
% wet	Percent (wet weight)
mg/kg dry	Milligrams per kilogram (dry weight)
mg/kg wet	Milligrams per kilogram (wet weight)

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5091469
PROJECT	Coffee Gold	**REPORTED**	Nov-20-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ111-3 (5091469-01) [Soil] Sampled: Sep-15-15 08:40						
Strong Acid Leachable Metals						
Aluminum	**17200**	20	mg/kg dry	Sep-23-15	Sep-24-15	
Antimony	**0.7**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Arsenic	**10.0**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Barium	**153**	1	mg/kg dry	Sep-23-15	Sep-24-15	
Beryllium	**0.5**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Boron	**2**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Cadmium	**0.21**	0.04	mg/kg dry	Sep-23-15	Sep-24-15	
Calcium	**6470**	100	mg/kg dry	Sep-23-15	Sep-24-15	
Chromium	**30.6**	1.0	mg/kg dry	Sep-23-15	Sep-24-15	
Cobalt	**9.7**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Copper	**15.9**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Iron	**23200**	20	mg/kg dry	Sep-23-15	Sep-24-15	
Lead	**10.1**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Lithium	**16.3**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Magnesium	**5980**	10	mg/kg dry	Sep-23-15	Sep-24-15	
Manganese	**352**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Mercury	**0.08**	0.05	mg/kg dry	Sep-23-15	Sep-24-15	
Molybdenum	**0.7**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Nickel	**20.5**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Phosphorus	**713**	10	mg/kg dry	Sep-23-15	Sep-24-15	
Potassium	**1100**	10	mg/kg dry	Sep-23-15	Sep-24-15	
Selenium	**0.5**	0.5	mg/kg dry	Sep-23-15	Sep-24-15	
Silicon	< 3000	3000	mg/kg dry	Sep-23-15	Sep-24-15	
Silver	< 0.2	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Sodium	**369**	40	mg/kg dry	Sep-23-15	Sep-24-15	
Strontium	**42.5**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Sulfur	< 1000	1000	mg/kg dry	Sep-23-15	Sep-24-15	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Thallium	**0.2**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Thorium	**8.8**	0.5	mg/kg dry	Sep-23-15	Sep-24-15	
Tin	**0.7**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Titanium	**1080**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Uranium	**9.9**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Vanadium	**56.6**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Zinc	**69**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Zirconium	**4**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Sample ID: AQ00-2 (5091469-02) [Soil] Sampled: Sep-15-15 12:30						
Strong Acid Leachable Metals						
Aluminum	**19100**	20	mg/kg dry	Sep-23-15	Sep-24-15	
Antimony	**0.6**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Arsenic	**9.9**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Barium	**214**	1	mg/kg dry	Sep-23-15	Sep-24-15	

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5091469
REPORTED Nov-20-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQ00-2 (5091469-02) [Soil] Sampled: Sep-15-15 12:30, Continued						
Strong Acid Leachable Metals, Continued						
Beryllium	**0.5**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Boron	**2**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Cadmium	**0.27**	0.04	mg/kg dry	Sep-23-15	Sep-24-15	
Calcium	**7260**	100	mg/kg dry	Sep-23-15	Sep-24-15	
Chromium	**34.1**	1.0	mg/kg dry	Sep-23-15	Sep-24-15	
Cobalt	**10.4**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Copper	**23.5**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Iron	**25200**	20	mg/kg dry	Sep-23-15	Sep-24-15	
Lead	**8.4**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Lithium	**16.7**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Magnesium	**6990**	10	mg/kg dry	Sep-23-15	Sep-24-15	
Manganese	**402**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Mercury	**0.10**	0.05	mg/kg dry	Sep-23-15	Sep-24-15	
Molybdenum	**1.2**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Nickel	**23.3**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Phosphorus	**786**	10	mg/kg dry	Sep-23-15	Sep-24-15	
Potassium	**1390**	10	mg/kg dry	Sep-23-15	Sep-24-15	
Selenium	**0.6**	0.5	mg/kg dry	Sep-23-15	Sep-24-15	
Silicon	< 3000	3000	mg/kg dry	Sep-23-15	Sep-24-15	
Silver	< 0.2	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Sodium	**393**	40	mg/kg dry	Sep-23-15	Sep-24-15	
Strontium	**50.4**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Sulfur	< 1000	1000	mg/kg dry	Sep-23-15	Sep-24-15	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Thallium	**0.2**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Thorium	**9.2**	0.5	mg/kg dry	Sep-23-15	Sep-24-15	
Tin	**0.6**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Titanium	**1020**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Uranium	**26.1**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Vanadium	**62.9**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Zinc	**73**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Zirconium	**4**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Sample ID: AQREF1-3R (5091469-03) [Soil] Sampled: Sep-15-15 13:45						
Strong Acid Leachable Metals						
Aluminum	**14500**	20	mg/kg dry	Sep-23-15	Sep-24-15	
Antimony	**1.2**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Arsenic	**11.2**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Barium	**428**	1	mg/kg dry	Sep-23-15	Sep-24-15	
Beryllium	**0.4**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Bismuth	**0.2**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Boron	**3**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Cadmium	**0.54**	0.04	mg/kg dry	Sep-23-15	Sep-24-15	

REPORTED TO	Palmer Environmental Consulting Group Inc.	**WORK ORDER**	5091469
PROJECT	Coffee Gold	**REPORTED**	Nov-20-15

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: AQREF1-3R (5091469-03) [Soil] Sampled: Sep-15-15 13:45, Continued						
Strong Acid Leachable Metals, Continued						
Calcium	**8230**	100	mg/kg dry	Sep-23-15	Sep-24-15	
Chromium	**30.3**	1.0	mg/kg dry	Sep-23-15	Sep-24-15	
Cobalt	**9.2**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Copper	**22.2**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Iron	**22600**	20	mg/kg dry	Sep-23-15	Sep-24-15	
Lead	**9.2**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Lithium	**11.9**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Magnesium	**6680**	10	mg/kg dry	Sep-23-15	Sep-24-15	
Manganese	**375**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Mercury	**0.09**	0.05	mg/kg dry	Sep-23-15	Sep-24-15	
Molybdenum	**0.9**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Nickel	**22.4**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Phosphorus	**901**	10	mg/kg dry	Sep-23-15	Sep-24-15	
Potassium	**1260**	10	mg/kg dry	Sep-23-15	Sep-24-15	
Selenium	**0.7**	0.5	mg/kg dry	Sep-23-15	Sep-24-15	
Silicon	< 3000	3000	mg/kg dry	Sep-23-15	Sep-24-15	
Silver	< 0.2	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Sodium	**329**	40	mg/kg dry	Sep-23-15	Sep-24-15	
Strontium	**70.6**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Sulfur	< 1000	1000	mg/kg dry	Sep-23-15	Sep-24-15	
Tellurium	< 0.1	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Thallium	**0.2**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Thorium	**7.0**	0.5	mg/kg dry	Sep-23-15	Sep-24-15	
Tin	**0.7**	0.2	mg/kg dry	Sep-23-15	Sep-24-15	
Titanium	**779**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Uranium	**6.3**	0.1	mg/kg dry	Sep-23-15	Sep-24-15	
Vanadium	**55.0**	0.4	mg/kg dry	Sep-23-15	Sep-24-15	
Zinc	**84**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Zirconium	**3**	2	mg/kg dry	Sep-23-15	Sep-24-15	
Sample ID: 002 (5091469-04) [Tissue (wet)] Sampled: Sep-11-15						
General Parameters						
Moisture	**79.4**	0.1	% wet	N/A	Sep-24-15	
Metals in Tissue						
Aluminum	**2.0**	0.4	mg/kg wet	Sep-22-15	Sep-24-15	
Antimony	**0.272**	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Arsenic	**0.043**	0.005	mg/kg wet	Sep-22-15	Sep-24-15	
Barium	**0.17**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Beryllium	< 0.005	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Bismuth	< 0.05	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Boron	< 0.2	0.1	mg/kg wet	Sep-22-15	Sep-24-15	
Cadmium	< 0.005	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Calcium	**385**	2	mg/kg wet	Sep-22-15	Sep-24-15	
Chromium	< 0.02	0.01	mg/kg wet	Sep-22-15	Sep-24-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 002 (5091469-04) [Tissue (wet)] Sampled: Sep-11-15, Continued						
Metals in Tissue, Continued						
Cobalt	**0.021**	0.004	mg/kg wet	Sep-22-15	Sep-24-15	
Copper	**0.39**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Iron	**7**	1	mg/kg wet	Sep-22-15	Sep-24-15	
Lead	< 0.010	0.004	mg/kg wet	Sep-22-15	Sep-24-15	
Magnesium	**305**	2	mg/kg wet	Sep-22-15	Sep-24-15	
Manganese	**0.56**	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Mercury	**0.068**	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Molybdenum	< 0.02	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Nickel	**0.03**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Phosphorus	**3000**	5	mg/kg wet	Sep-22-15	Sep-24-15	
Potassium	**5200**	10	mg/kg wet	Sep-22-15	Sep-24-15	
Selenium	**0.90**	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Silver	< 0.02	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Sodium	**280**	2	mg/kg wet	Sep-22-15	Sep-24-15	
Strontium	**0.61**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Thallium	**0.006**	0.001	mg/kg wet	Sep-22-15	Sep-24-15	
Tin	< 0.05	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Titanium	**0.26**	0.05	mg/kg wet	Sep-22-15	Sep-24-15	
Uranium	< 0.002	0.001	mg/kg wet	Sep-22-15	Sep-24-15	
Vanadium	< 0.05	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Zinc	**5.7**	0.5	mg/kg wet	Sep-22-15	Sep-24-15	
Sample ID: 003 (5091469-05) [Tissue (wet)] Sampled: Sep-12-15						
General Parameters						
Moisture	**77.1**	0.1	% wet	N/A	Sep-24-15	
Metals in Tissue						
Aluminum	**31.8**	0.4	mg/kg wet	Sep-22-15	Sep-24-15	
Antimony	**0.182**	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Arsenic	**0.119**	0.005	mg/kg wet	Sep-22-15	Sep-24-15	
Barium	**4.00**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Beryllium	< 0.005	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Bismuth	< 0.05	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Boron	< 0.2	0.1	mg/kg wet	Sep-22-15	Sep-24-15	
Cadmium	**0.045**	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Calcium	**17700**	2	mg/kg wet	Sep-22-15	Sep-24-15	
Chromium	**0.07**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Cobalt	**0.050**	0.004	mg/kg wet	Sep-22-15	Sep-24-15	
Copper	**1.01**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Iron	**69**	1	mg/kg wet	Sep-22-15	Sep-24-15	
Lead	**0.022**	0.004	mg/kg wet	Sep-22-15	Sep-24-15	
Magnesium	**546**	2	mg/kg wet	Sep-22-15	Sep-24-15	
Manganese	**9.51**	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Mercury	**0.213**	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Molybdenum	**0.03**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	

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Sample ID: 003 (5091469-05) [Tissue (wet)] Sampled: Sep-12-15, Continued						
Metals in Tissue, Continued						
Nickel	**0.08**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Phosphorus	**13400**	5	mg/kg wet	Sep-22-15	Sep-24-15	
Potassium	**4350**	10	mg/kg wet	Sep-22-15	Sep-24-15	
Selenium	**1.15**	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Silver	< 0.02	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Sodium	**1450**	2	mg/kg wet	Sep-22-15	Sep-24-15	
Strontium	**21.4**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Thallium	**0.011**	0.001	mg/kg wet	Sep-22-15	Sep-24-15	
Tin	< 0.05	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Titanium	**2.46**	0.05	mg/kg wet	Sep-22-15	Sep-24-15	
Uranium	**0.098**	0.001	mg/kg wet	Sep-22-15	Sep-24-15	
Vanadium	**0.42**	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Zinc	**52.4**	0.5	mg/kg wet	Sep-22-15	Sep-24-15	
Sample ID: 004 (5091469-06) [Tissue (wet)] Sampled: Sep-15-15						
General Parameters						
Moisture	**71**	0.1	% wet	N/A	Sep-24-15	
Metals in Tissue						
Aluminum	**17.8**	0.4	mg/kg wet	Sep-22-15	Sep-24-15	
Antimony	**0.965**	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Arsenic	**0.107**	0.005	mg/kg wet	Sep-22-15	Sep-24-15	
Barium	**0.66**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Beryllium	< 0.005	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Bismuth	< 0.05	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Boron	< 0.2	0.1	mg/kg wet	Sep-22-15	Sep-24-15	
Cadmium	**0.072**	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Calcium	**1720**	2	mg/kg wet	Sep-22-15	Sep-24-15	
Chromium	**0.05**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Cobalt	**0.049**	0.004	mg/kg wet	Sep-22-15	Sep-24-15	
Copper	**0.92**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Iron	**45**	1	mg/kg wet	Sep-22-15	Sep-24-15	
Lead	**0.016**	0.004	mg/kg wet	Sep-22-15	Sep-24-15	
Magnesium	**292**	2	mg/kg wet	Sep-22-15	Sep-24-15	
Manganese	**3.83**	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Mercury	**0.069**	0.002	mg/kg wet	Sep-22-15	Sep-24-15	
Molybdenum	**0.04**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Nickel	**0.07**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Phosphorus	**3830**	5	mg/kg wet	Sep-22-15	Sep-24-15	
Potassium	**4050**	10	mg/kg wet	Sep-22-15	Sep-24-15	
Selenium	**2.41**	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Silver	< 0.02	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Sodium	**867**	2	mg/kg wet	Sep-22-15	Sep-24-15	
Strontium	**1.95**	0.01	mg/kg wet	Sep-22-15	Sep-24-15	
Thallium	**0.007**	0.001	mg/kg wet	Sep-22-15	Sep-24-15	

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Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: 004 (5091469-06) [Tissue (wet)] Sampled: Sep-15-15, Continued						
Metals in Tissue, Continued						
Tin	< 0.05	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Titanium	**1.45**	0.05	mg/kg wet	Sep-22-15	Sep-24-15	
Uranium	**0.012**	0.001	mg/kg wet	Sep-22-15	Sep-24-15	
Vanadium	**0.08**	0.02	mg/kg wet	Sep-22-15	Sep-24-15	
Zinc	**23.1**	0.5	mg/kg wet	Sep-22-15	Sep-24-15	

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The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in fibatchesfl and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types includ

- **Method Blank (Blk)**: Laboratory reagent water is carried through sample preparation and analysis steps. Method Blanks indicate that results are free from contamination, i.e. not biased high from sources such as the sample container or the laboratory environment
- **Duplicate (Dup)**: Preparation and analysis of a replicate aliquot of a sample. Duplicates provide a measure of the analytical method's precision, i.e. how reproducible a result is. Duplicates are only reported if they are associated with your sample data.
- **Blank Spike (BS)**: A known amount of standard is carried through sample preparation and analysis steps. Blank Spikes, also known as laboratory control samples (LCS), are prepared from a different source of standard than used for the calibration. They ensure that the calibration is acceptable (i.e. not biased high or low) and also provide a measure of the analytical method's accuracy (i.e. closeness of the result to a target value).
- **Standard Reference Material (SRM)**: A material of similar matrix to the samples, externally certified for the parameter(s) listed. Standard Reference Materials ensure that the preparation steps in the method are adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Metals in Tissue, Batch B5I1347										
Blank (B5I1347-BLK1)				Prepared: Sep-22-15, Analyzed: Sep-24-15						
Aluminum	< 1.0	0.4	mg/kg wet							
Antimony	< 0.005	0.002	mg/kg wet							
Arsenic	< 0.012	0.005	mg/kg wet							
Barium	< 0.02	0.01	mg/kg wet							
Beryllium	< 0.005	0.002	mg/kg wet							
Bismuth	< 0.05	0.02	mg/kg wet							
Boron	< 0.2	0.1	mg/kg wet							
Cadmium	< 0.005	0.002	mg/kg wet							
Calcium	< 5	2	mg/kg wet							
Chromium	< 0.02	0.01	mg/kg wet							
Cobalt	< 0.010	0.004	mg/kg wet							
Copper	< 0.02	0.01	mg/kg wet							
Iron	< 2	1	mg/kg wet							
Lead	< 0.010	0.004	mg/kg wet							
Magnesium	< 5	2	mg/kg wet							
Manganese	< 0.05	0.02	mg/kg wet							
Mercury	< 0.005	0.002	mg/kg wet							
Molybdenum	< 0.02	0.01	mg/kg wet							
Nickel	< 0.02	0.01	mg/kg wet							
Phosphorus	< 12	5	mg/kg wet							
Potassium	< 25	10	mg/kg wet							
Selenium	< 0.05	0.02	mg/kg wet							
Silver	< 0.02	0.01	mg/kg wet							
Sodium	< 5	2	mg/kg wet							
Strontium	< 0.02	0.01	mg/kg wet							
Thallium	< 0.002	0.001	mg/kg wet							
Tin	< 0.05	0.02	mg/kg wet							
Titanium	< 0.12	0.05	mg/kg wet							
Uranium	< 0.002	0.001	mg/kg wet							
Vanadium	< 0.05	0.02	mg/kg wet							
Zinc	< 1.2	0.5	mg/kg wet							

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Metals in Tissue, Batch B5I1347, Continued										
Duplicate (B5I1347-DUP1)	**Source: 5091469-05**		Prepared: Sep-22-15, Analyzed: Sep-24-15							
Aluminum	52.2	0.4	mg/kg wet		31.8			48	40	RPD1
Antimony	0.193	0.002	mg/kg wet		0.182			6	40	
Arsenic	0.146	0.005	mg/kg wet		0.119			20	40	
Barium	1.07	0.01	mg/kg wet		4.00			116	40	RPD1
Beryllium	< 0.005	0.002	mg/kg wet		< 0.005				40	
Bismuth	< 0.05	0.02	mg/kg wet		< 0.05				40	
Boron	< 0.2	0.1	mg/kg wet		< 0.2				40	
Cadmium	0.051	0.002	mg/kg wet		0.045			13	40	
Calcium	2570	2	mg/kg wet		17700			149	60	RPD1
Chromium	0.10	0.01	mg/kg wet		0.07			31	40	
Cobalt	0.080	0.004	mg/kg wet		0.050			45	40	RPD1
Copper	1.13	0.01	mg/kg wet		1.01			10	40	
Iron	125	1	mg/kg wet		69			58	40	RPD1
Lead	0.049	0.004	mg/kg wet		0.022				40	RPD1
Magnesium	257	2	mg/kg wet		546			72	40	RPD1
Manganese	5.25	0.02	mg/kg wet		9.51			58	40	RPD1
Mercury	0.208	0.002	mg/kg wet		0.213			2	40	
Molybdenum	0.04	0.01	mg/kg wet		0.03				40	
Nickel	0.11	0.01	mg/kg wet		0.08			24	40	
Phosphorus	3870	5	mg/kg wet		13400			111	40	
Potassium	3540	10	mg/kg wet		4350			20	40	
Selenium	1.10	0.02	mg/kg wet		1.15			5	40	
Silver	< 0.02	0.01	mg/kg wet		< 0.02				40	
Sodium	1100	2	mg/kg wet		1450			28	40	
Strontium	3.18	0.01	mg/kg wet		21.4			148	60	
Thallium	0.008	0.001	mg/kg wet		0.011			34	40	
Tin	< 0.05	0.02	mg/kg wet		< 0.05				40	
Titanium	3.09	0.05	mg/kg wet		2.46			23	40	
Uranium	0.042	0.001	mg/kg wet		0.098			79	40	
Vanadium	0.25	0.02	mg/kg wet		0.42			52	40	
Zinc	44.6	0.5	mg/kg wet		52.4			16	40	
Reference (B5I1347-SRM1)				Prepared: Sep-22-15, Analyzed: Sep-24-15						
Arsenic	65.4	0.005	mg/kg wet	59.5		110	75-125			
Cadmium	37.9	0.002	mg/kg wet	42.3		90	75-125			
Chromium	1.45	0.01	mg/kg wet	1.95		74	75-125			SRM
Cobalt	1.11	0.004	mg/kg wet	1.06		105	75-125			
Copper	459	0.01	mg/kg wet	497		92	75-125			
Iron	178	1	mg/kg wet	179		100	75-125			
Lead	0.191	0.004	mg/kg wet	0.225		85	75-125			
Manganese	15.9	0.02	mg/kg wet	15.6		102	75-125			
Mercury	0.308	0.002	mg/kg wet	0.292		106	75-125			
Molybdenum	3.60	0.01	mg/kg wet	3.44		105	75-125			
Nickel	4.81	0.01	mg/kg wet	5.30		91	75-125			
Selenium	13.6	0.02	mg/kg wet	10.9		124	75-125			
Strontium	36.7	0.01	mg/kg wet	36.5		101	75-125			
Vanadium	10.1	0.02	mg/kg wet	9.10		111	75-125			
Zinc	139	0.5	mg/kg wet	136		102	75-125			
Strong Acid Leachable Metals, Batch B5I1428										
Blank (B5I1428-BLK1)			Prepared: Sep-23-15, Analyzed: Sep-24-15							
Aluminum	< 20	20	mg/kg dry							
Antimony	< 0.1	0.1	mg/kg dry							
Arsenic	< 0.4	0.4	mg/kg dry							
Barium	< 1	1	mg/kg dry							

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B5I1428, Continued										
Blank (B5I1428-BLK1), Continued				Prepared: Sep-23-15, Analyzed: Sep-24-15						
Beryllium	< 0.1	0.1	mg/kg dry							
Bismuth	< 0.1	0.1	mg/kg dry							
Boron	< 2	2	mg/kg dry							
Cadmium	< 0.04	0.04	mg/kg dry							
Calcium	< 100	100	mg/kg dry							
Chromium	< 1.0	1.0	mg/kg dry							
Cobalt	< 0.1	0.1	mg/kg dry							
Copper	< 0.2	0.2	mg/kg dry							
Iron	< 20	20	mg/kg dry							
Lead	< 0.2	0.2	mg/kg dry							
Lithium	< 0.1	0.1	mg/kg dry							
Magnesium	< 10	10	mg/kg dry							
Manganese	< 0.4	0.4	mg/kg dry							
Mercury	< 0.05	0.05	mg/kg dry							
Molybdenum	< 0.1	0.1	mg/kg dry							
Nickel	< 0.4	0.4	mg/kg dry							
Phosphorus	< 10	10	mg/kg dry							
Potassium	< 10	10	mg/kg dry							
Selenium	< 0.5	0.5	mg/kg dry							
Silicon	< 3000	3000	mg/kg dry							
Silver	< 0.2	0.2	mg/kg dry							
Sodium	< 40	40	mg/kg dry							
Strontium	< 0.2	0.2	mg/kg dry							
Sulfur	< 1000	1000	mg/kg dry							
Tellurium	< 0.1	0.1	mg/kg dry							
Thallium	< 0.1	0.1	mg/kg dry							
Thorium	< 0.5	0.5	mg/kg dry							
Tin	< 0.2	0.2	mg/kg dry							
Titanium	< 2	2	mg/kg dry							
Uranium	< 0.1	0.1	mg/kg dry							
Vanadium	< 0.4	0.4	mg/kg dry							
Zinc	< 2	2	mg/kg dry							
Zirconium	< 2	2	mg/kg dry							
Reference (B5I1428-SRM1)				Prepared: Sep-23-15, Analyzed: Sep-24-15						
Aluminum	18700	20	mg/kg dry	18200		103	86-118			
Antimony	6.3	0.1	mg/kg dry	6.27		100	73-138			
Arsenic	14.2	0.4	mg/kg dry	15.4		92	87-106			
Barium	79	1	mg/kg dry	80.6		98	72-119			
Beryllium	0.5	0.1	mg/kg dry	0.544		96	73-128			
Bismuth	1.9	0.1	mg/kg dry	2.12		90	78-97			
Boron	4	2	mg/kg dry	2.68		133	58-139			
Cadmium	0.20	0.04	mg/kg dry	0.230		89	88-121			
Calcium	3500	100	mg/kg dry	3320		105	92-113			
Chromium	28.4	1.0	mg/kg dry	27.2		105	91-113			
Cobalt	13.0	0.1	mg/kg dry	12.5		104	90-109			
Copper	44.5	0.2	mg/kg dry	44.9		99	92-112			
Iron	33100	20	mg/kg dry	33300		99	91-112			
Lead	13.5	0.2	mg/kg dry	14.4		94	89-111			
Lithium	10.8	0.1	mg/kg dry	9.26		117	73-124			
Magnesium	6100	10	mg/kg dry	5830		105	89-116			
Manganese	1080	0.4	mg/kg dry	1100		98	93-112			
Mercury	0.10	0.05	mg/kg dry	0.0980		102	74-126			
Molybdenum	0.7	0.1	mg/kg dry	0.738		101	93-120			
Nickel	17.7	0.4	mg/kg dry	17.4		102	93-110			
Phosphorus	812	10	mg/kg dry	796		102	86-111			
Potassium	691	10	mg/kg dry	619		112	83-117			

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Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Strong Acid Leachable Metals, Batch B5I1428, Continued										
Reference (B5I1428-SRM1), Continued				Prepared: Sep-23-15, Analyzed: Sep-24-15						
Sodium	428	40	mg/kg dry	340		126	79-130			
Strontium	12.0	0.2	mg/kg dry	11.6		103	85-116			
Thorium	4.4	0.5	mg/kg dry	4.46		99	78-100			
Tin	1.2	0.2	mg/kg dry	1.10		106	78-120			
Titanium	908	2	mg/kg dry	764		119	72-143			
Uranium	0.8	0.1	mg/kg dry	0.940		90	80-102			
Vanadium	60.1	0.4	mg/kg dry	54.9		109	87-116			
Zinc	69	2	mg/kg dry	67.5		102	91-113			

QC Qualifiers:

RPD1 Relative percent difference(s) (RPD) of one or more analytes on duplicate analysis are outside of control limits due to sample heterogeneity.

SRM Recovery of one or more analytes on Standard Reference Material (SRM) analysis are outside of control limits.

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5091469
REPORTED Nov-20-15

		5091469-01	5091469-02	5091469-03	5091469-04	5091469-05	5091469-06
		Soil	**Soil**	**Soil**	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**
		Sep-15-15	**Sep-15-15**	**Sep-15-15**	**Sep-11-15**	**Sep-12-15**	**Sep-15-15**
		AQ111-3	**AQ00-2**	**AQREF1-3R**	**002**	**003**	**004**
General Parameters	Moisture (% wet)				79.4	77.1	71
Strong Acid Leachable Metals	Aluminum (mg/kg dry)	17200	19100	14500			
	Antimony (mg/kg dry)	0.7	0.6	1.2			
	Arsenic (mg/kg dry)	10.0	9.9	11.2			
	Barium (mg/kg dry)	153	214	428			
	Beryllium (mg/kg dry)	0.5	0.5	0.4			
	Bismuth (mg/kg dry)	0.2	0.2	0.2			
	Boron (mg/kg dry)	2	2	3			
	Cadmium (mg/kg dry)	0.21	0.27	0.54			
	Calcium (mg/kg dry)	6470	7260	8230			
	Chromium (mg/kg dry)	30.6	34.1	30.3			
	Cobalt (mg/kg dry)	9.7	10.4	9.2			
	Copper (mg/kg dry)	15.9	23.5	22.2			
	Iron (mg/kg dry)	23200	25200	22600			
	Lead (mg/kg dry)	10.1	8.4	9.2			
	Lithium (mg/kg dry)	16.3	16.7	11.9			
	Magnesium (mg/kg dry)	5980	6990	6680			
	Manganese (mg/kg dry)	352	402	375			
	Mercury (mg/kg dry)	0.08	0.10	0.09			
	Molybdenum (mg/kg dry)	0.7	1.2	0.9			
	Nickel (mg/kg dry)	20.5	23.3	22.4			
	Phosphorus (mg/kg dry)	713	786	901			
	Potassium (mg/kg dry)	1100	1390	1260			
	Selenium (mg/kg dry)	0.5	0.6	0.7			
	Silicon (mg/kg dry)	< 3000	< 3000	< 3000			
	Silver (mg/kg dry)	< 0.2	< 0.2	< 0.2			
	Sodium (mg/kg dry)	369	393	329			
	Strontium (mg/kg dry)	42.5	50.4	70.6			
	Sulfur (mg/kg dry)	< 1000	< 1000	< 1000			
	Tellurium (mg/kg dry)	< 0.1	< 0.1	< 0.1			
	Thallium (mg/kg dry)	0.2	0.2	0.2			
	Thorium (mg/kg dry)	8.8	9.2	7.0			
	Tin (mg/kg dry)	0.7	0.6	0.7			
	Titanium (mg/kg dry)	1080	1020	779			
	Uranium (mg/kg dry)	9.9	26.1	6.3			
	Vanadium (mg/kg dry)	56.6	62.9	55.0			
	Zinc (mg/kg dry)	69	73	84			
	Zirconium (mg/kg dry)	4	4	3			
Metals in Tissue	Aluminum (mg/kg wet)				2.0	31.8	17.8
	Antimony (mg/kg wet)				0.272	0.182	0.965
	Arsenic (mg/kg wet)				0.043	0.119	0.107
	Barium (mg/kg wet)				0.17	4.00	0.66

REPORTED TO Palmer Environmental Consulting Group Inc.
PROJECT Coffee Gold

WORK ORDER 5091469
REPORTED Nov-20-15

		5091469-01	5091469-02	5091469-03	5091469-04	5091469-05	5091469-06
		Soil	**Soil**	**Soil**	**Tissue (wet)**	**Tissue (wet)**	**Tissue (wet)**
		Sep-15-15	**Sep-15-15**	**Sep-15-15**	**Sep-11-15**	**Sep-12-15**	**Sep-15-15**
		AQ111-3	**AQ00-2**	**AQREF1-3R**	**002**	**003**	**004**
Metals in Tissue	Beryllium (mg/kg wet)				< 0.005	< 0.005	< 0.005
	Bismuth (mg/kg wet)				< 0.05	< 0.05	< 0.05
	Boron (mg/kg wet)				< 0.2	< 0.2	< 0.2
	Cadmium (mg/kg wet)				< 0.005	0.045	0.072
	Calcium (mg/kg wet)				385	17700	1720
	Chromium (mg/kg wet)				< 0.02	0.07	0.05
	Cobalt (mg/kg wet)				0.021	0.050	0.049
	Copper (mg/kg wet)				0.39	1.01	0.92
	Iron (mg/kg wet)				7	69	45
	Lead (mg/kg wet)				< 0.010	0.022	0.016
	Magnesium (mg/kg wet)				305	546	292
	Manganese (mg/kg wet)				0.56	9.51	3.83
	Mercury (mg/kg wet)				0.068	0.213	0.069
	Molybdenum (mg/kg wet)				< 0.02	0.03	0.04
	Nickel (mg/kg wet)				0.03	0.08	0.07
	Phosphorus (mg/kg wet)				3000	13400	3830
	Potassium (mg/kg wet)				5200	4350	4050
	Selenium (mg/kg wet)				0.90	1.15	2.41
	Silver (mg/kg wet)				< 0.02	< 0.02	< 0.02
	Sodium (mg/kg wet)				280	1450	867
	Strontium (mg/kg wet)				0.61	21.4	1.95
	Thallium (mg/kg wet)				0.006	0.011	0.007
	Tin (mg/kg wet)				< 0.05	< 0.05	< 0.05
	Titanium (mg/kg wet)				0.26	2.46	1.45
	Uranium (mg/kg wet)				< 0.002	0.098	0.012
	Vanadium (mg/kg wet)				< 0.05	0.42	0.08
	Zinc (mg/kg wet)				5.7	52.4	23.1

APPENDIX F

Supplemental Fish and Aquatic Resource Reports (2017-2021)

Coffee Gold Project: Fish and Aquatic Resources Studies - 2017



Prepared For
Goldcorp Kaminak Ltd.
Suite 3400-666 Burrard Street
Vancouver, BC V6C 2X8

Prepared By
EDI Environmental Dynamics Inc.
2195 -2nd Avenue
Whitehorse, YT Y1A 3T8

EDI Contact
Pat Tobler, R.P. Bio.
867.393.4882

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EXECUTIVE SUMMARY

Aquatic data was collected in 2017 to add to the baseline and provide pre-project monitoring data for future comparisons. Data was collected on fish, fish habitat, invertebrates, periphyton and sediment. Specifically, fish and environmental DNA (eDNA) sampling was completed to determine fish presence within the Halfway and YT-24 creeks. Habitat was assessed along the length of Halfway Creek as well as the headwater streams within the Mine footprint. Fish density sampling was completed in several locations and fish tissue was collected for metals analysis. Sediment, invertebrates, periphyton and fish were collected and analyzed for metals. Invertebrates were also sampled for community composition (using Canadian Aquatic Biomonitoring Network (CABIN) protocols).

Studies associated with the Northern Access Route included sampling at the Yukon River Barge landings, a spawning survey for chum salmon in the Yukon and Stewart rivers and investigations of a back channel of the Stewart River.

A summary of the results is presented below.

- Fish use of Halfway Creek was limited to the lower 600 m of the stream.
- Habitat investigations documented numerous impediments on Halfway Creek and found that headwater drainages within the mine footprint are either not streams or small streams with poor fish habitat.
- One Arctic grayling was captured near the mouth of YT-24. This was the first fish captured in the stream beyond the back flooded area at the mouth. The stream channel was affected by a recent localized flood event.
- Fish species composition in Latte, Coffee and Independence was consistent with previous sampling and fish densities were low.
- Late winter eDNA sampling in 2017 provided results very similar to 2016 overwintering study results with fish eDNA only detected in Coffee Creek and the Yukon River.
- Summer spawning surveys did not find any evidence of Chinook spawning in Coffee or Independence creeks.
- Fish tissues, including muscle and liver from Arctic grayling and whole-body samples for slimy sculpin, benthic invertebrates and periphyton tissues were collected and analyzed for general chemistry. This data increases the pre-Project dataset for fish and benthic invertebrate tissues and was the first year of periphyton tissue data collection.
- Benthic invertebrate community sampling was conducted following CABIN methodology. Additional reference sites were added in 2017.

- Primary productivity sampling including chlorophyll-a and ash-free dry mass confirmed that streams within the Project area are very nutrient-poor (oligotrophic).
- Juvenile Chinook were the most common species captured at/near the barge landings.
- Very high fall chum returns to the Yukon River were documented by Fisheries and Oceans Canada (DFO). The spawning survey revealed continued use of side channel habitats in the Yukon and Stewart rivers for this species but also identified some spawning in previously undocumented areas.

ACKNOWLEDGEMENTS

Jennie Gjertsen managed this project on behalf of the Goldcorp Inc. and provided project direction needed to successfully complete the project. Jasmin Dobson, Becky Partridge and Ryan Fetterley from Goldcorp provided exceptional logistical support to ensure our field crews could complete the work in an efficient and effective matter.

EDI would like to highlight the exceptional assistance provided by Goldcorp's Environmental Monitors. Evan Warren and Derek Scheffen provided local insight and assistance for components that were based from the mine.

Jared Hobbs (Hemmera), Caren Helbing, Jessica Round (University of Victoria) and Susan Dulc (Aurora Ecological Consulting) provided insight into the eDNA sampling component of the field studies and assisted with interpretation of the laboratory analysis.

AUTHORSHIP

This report was prepared by EDI Environmental Dynamics Inc. Staff who contributed to this project include:

Pat Tobler B.Sc., R.P. Bio., CPESC ..... Author, Senior Review

Lyndsay Doetzel, M.Sc., R.P. Bio ..... Section Author

Petra Szekeres, M.Sc., P. Biol. ..... Section Author

Vicki Smith, B.Sc., R.P. Bio. ..... Section Author

Brodie Smith, B.Sc. ..... Section Author

Emily McDougall, B.Sc ..... Data Entry, Analysis

Hannah Gray, B.Sc ..... GIS Mapping and Database Management

Members of the EDI field crew for the 2017 fieldwork included the following EDI personnel: Petra Szekeres, Lyndsay Doetzel, Brodie Smith, Ben Schonewille, Dawn Hansen, Jake Duncan and Pat Tobler.

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1 INTRODUCTION

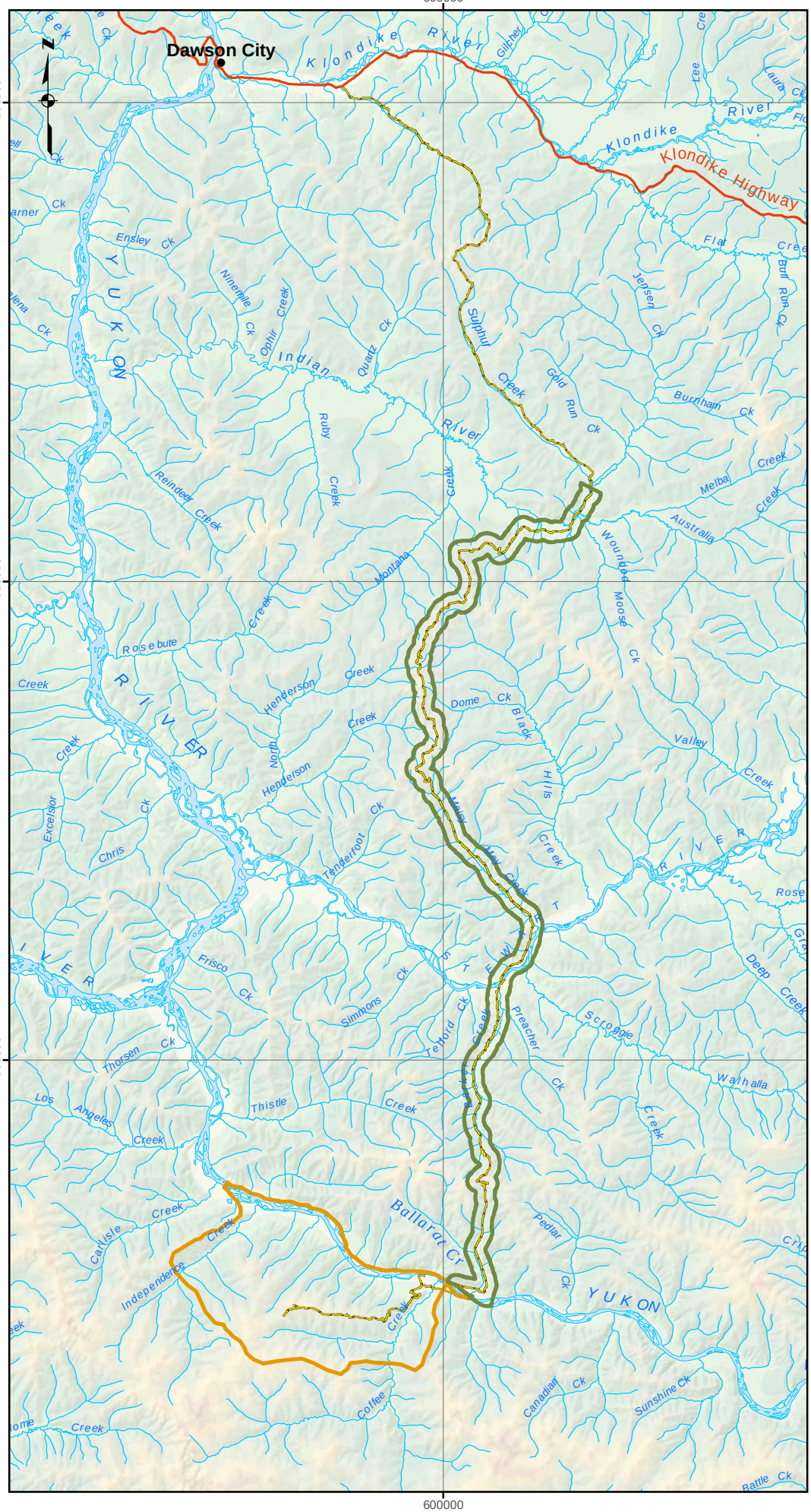
The Coffee Gold Project (Coffee Project; the Project) is a proposed gold mine in west-central Yukon, located 130 km south of Dawson City. Gold was initially discovered at Coffee Creek in 2010, and exploration activities have been ongoing since then. Baseline environmental studies began in 2010 and were expanded in the following years in anticipation of future regulatory requirements.

The proposed Project will consist of an open pit gold mine and heap leach facility. The projected mine life is ten years with an 18-month construction period. The feasibility study proposes four open pits mined by conventional shovel and truck methods. The mine and associated activities will generally be located on a relatively high elevation ridge top and will not extend into the lower elevations where the larger streams are located. The mine footprint does include the upper part of some headwater watersheds (including Halfway Creek, YT-24 and unnamed tributaries to Latte Creek). Most prominently, the main proposed Waste Rock Storage Facility (WRSF) will be positioned in the upper Halfway Creek watershed.

The Project will be accessed by road from Dawson City via a 214-km single-lane, gravel road with pull outs. The initial part of this route, from the highway to Sulphur Creek utilizes a government-maintained gravel road. Beyond Sulphur Creek, the Northern Access Route (NAR) mainly follows existing placer mine roads which will be upgraded to provide all season access to supply vehicles. Approximately 30 km of new road will be constructed (Figure 1). Electricity will be generated onsite by diesel-powered generators. The majority of mine staff will access the site by air.

The Coffee Project is located on Crown land within the Traditional Territory of the Tr'ondëk Hwëch'in and the asserted traditional territory of the White River First Nation. A portion of Goldcorp's claim block is located in the Traditional Territory of the Selkirk First Nation and the proposed road also overlaps with the Traditional Territory of the First Nation of the Na-Cho Nyak Dun.

The proposed Project will require an Executive Committee Screening from the Yukon Environmental and Socio-economic Assessment Board (YESAB), a Type A Water Licence issued by the Yukon Water Board and a Quartz Mining License issued by the Yukon Government, among other permits and licences.





Legend

- Settlement/Community
- Government-Maintained Gravel Road Along Proposed Route
- Proposed Route
- Project Footprint (as of March 10, 2017)

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 1

Overview of the Coffee Project study area

Data Sources
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Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
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Map Reference Scale: 1:600,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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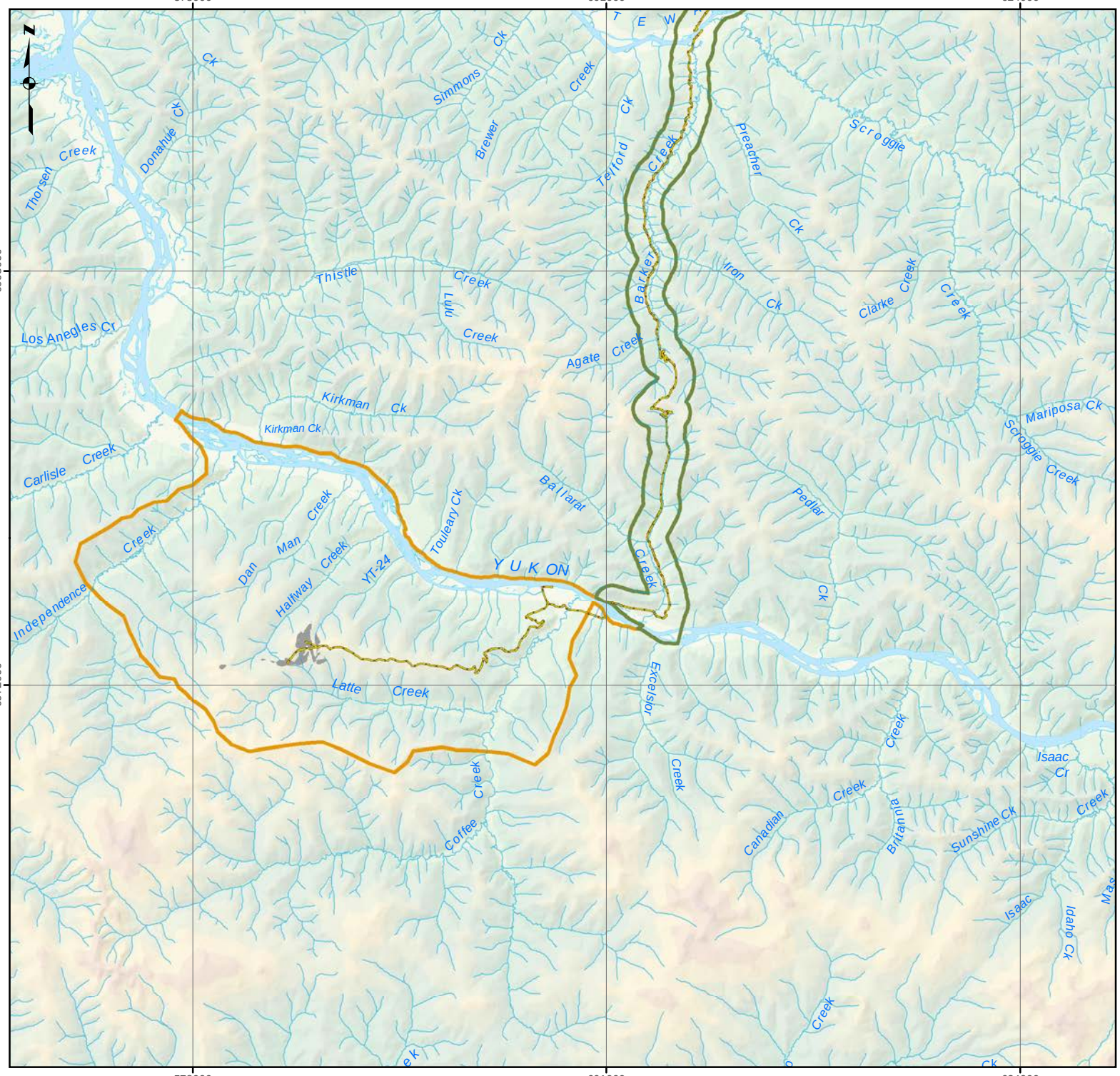
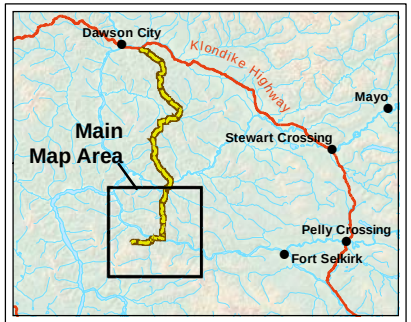
1.1 STUDY PURPOSE AND SCOPE

Results from the study provide additional fish and aquatic resource baseline and pre-project monitoring information for the Coffee Project. Palmer Environmental Consulting Group collected baseline data around the mine in 2014 and 2015 (PECG 2017) and along the access road in 2015 (PECG 2016). EDI collected additional baseline data in 2016 around the mine and NAR (EDI 2017) and summarized all data collected to date. The study conducted in 2017 is also intended to support the effects assessment for the Project and provide pre-project information that can be used for effects monitoring. A concordance table of all data collected to date is provided in APPENDIX A.

- Project components for the Mine study area (Figure 2) field studies include:
    - winter and summer environmental DNA (eDNA);
    - fish sampling;
    - fish and fish habitat investigations (Halfway Creek);
    - drainage assessments for headwater tributaries in the mine footprint;
    - spawning surveys for Chinook salmon;
    - fish tissue sampling for metals;
    - benthic invertebrate and periphyton tissue sampling for metals;
    - Canadian Aquatic Biomonitoring Network (CABIN) invertebrate sampling;
    - periphyton sampling and analysis for chlorophyll-a and ash free dry mass; and
    - sediment sampling for metals.

- Methods and results for the 2017 NAR study area (Figure 3) field studies include:
    - fish sampling and fish habitat characterization at proposed barge landings (Yukon River);
    - fish habitat investigations in a back channel of Stewart River; and
    - spawning surveys for chum salmon in the Yukon and Stewart rivers.





Legend

- Settlement/Community
- Proposed Route
- Project Footprint (as of March 10, 2017)

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 2

Overview of the Coffee Project - Mine study area

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Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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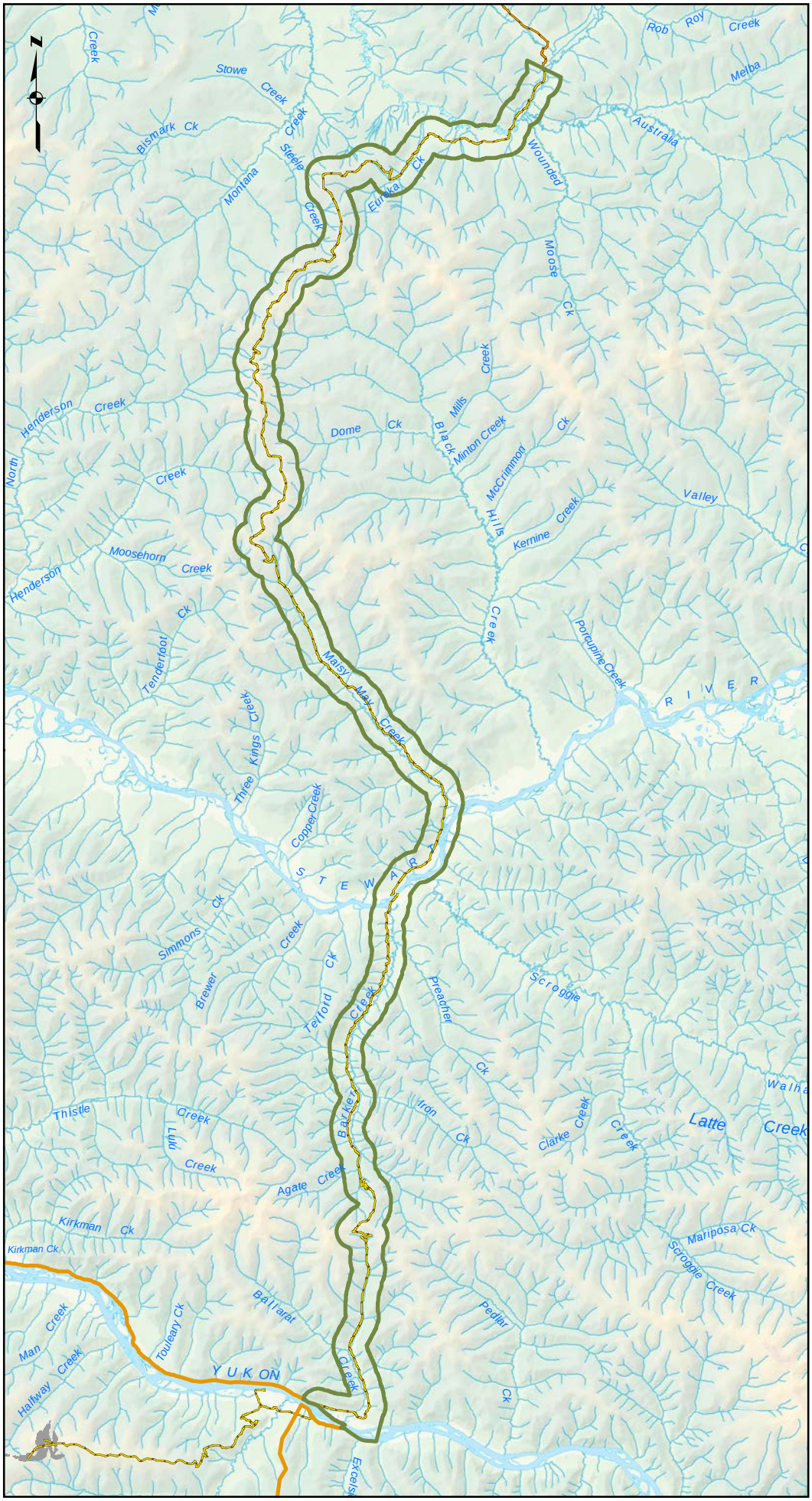

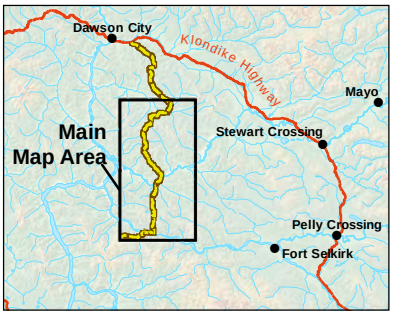

Legend

- Government-Maintained Gravel Road Along Proposed Route
- Proposed Route
- Project Footprint (as of March 10, 2017)

Aquatic Local Study

- Mine Study
- NAR Study

FIGURE: 3

Overview of the Coffee Project - Northern Access Road (NAR) study area

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Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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1.2 BASELINE SAMPLING STATION CONCORDANCE

Aquatic sampling stations established during the 2014/2015 baseline studies (within the Mine study area) were given the form "AQ##", where the hashtags represented a numerical station designation. An alternate set of sample station codes were developed as a component of the Coffee Project water quality baseline data collection program; these were used during recent aquatics sampling programs as sampling was conducted in areas not visited as part of the 2014/2015 program. Going forward, EDI has developed the following station designation codes that allow for easy determination of station location and the addition of new stations, if and where needed:

1. Each station ID designation begins with a two or three letter code for each stream in the Mine study area. Three letter codes are used for unnamed tributaries to named streams; LCC therefore corresponds to Latte Creek Tributary C.

2. Following the stream letter code is a numeric designation that represents the straight-line distance (kilometers) of a sampling station from its major confluence.

3. For stations in the Yukon River, the same naming convention was used although distances were measured in a straight line from the Coffee Creek confluence. A 'U' was used to indicate a station upstream of Coffee Creek and a 'D' for stations downstream. To assist in rectifying previous sampling stations with the new system, a table of concordance is shown below (Table 1).

4. Discrete sampling locations within the same station are designated as sites (e.g., station CF2.3 sediment sampling sites 1, 2 and 3).

Table 1. Concordance table of Coffee Project fisheries and aquatic field sampling station identifiers.

Stream	2014/2015 Aquatic Baseline Station Name (PECG 2017)	Water Quality and Hydrology Station (Lorax 2016)	2016 Station Name (this report)
Coffee Creek		CC4.5	CF2.7
Coffee Creek	AQ00		CF3.9
Coffee Creek	AQ01		CF5.7
Coffee Creek	AQ02		CF8.0
Coffee Creek		CC0.5	CF8.3
Latte Creek	AQ03	CC3.5	LC0.5[1]
Latte Creek	AQ04		LC2.7
Latte Creek		CC1.5	LC9.7
Latte Creek	AQ04.5		LC9.9
Latte Creek	AQ05		LC10.4
Latte Creek	AQ06		LC11.8
Latte Creek		CC6.0	LC13.5
Latte Creek, Tributary C		CC1.0	LCC0.1
Halfway Creek	AQ20		HF0.0
Halfway Creek		HC5.0	HF0.2
Halfway Creek		HC2.5	HF6.3
Halfway Creek	AQ21		HF9.3
YT-24	AQ30		YT0.0
YT-24		ML1.0	YT0.2
YT-24	AQ31		YT5.0
Independence Creek	AQ10	IC4.5	ID1.9
Independence Creek	AQ11		ID6.7
Kona Tributary	AQ12		KT0.1
Kona Tributary	AQ13		KT5.2
Yukon River		YUK2.0	YRU2.2
Yukon River		YUK5.0	YRD21.7
Isaac Creek	AQREF1		IS0.1
Los Angeles Creek	AQREF2		LaC4.8

[1] While this site was labeled LC0.5, the actual distance of this site from the mouth of Latte Creek is ~50 m.

2 METHODS

Methods are presented separately for mine and northern access route (NAR) study areas in the below sections.

2.1 MINE STUDY AREA

Aquatic resources sampling included fish sampling, habitat assessment (summer and overwintering), sediment and periphyton sampling, benthic invertebrate community composition via CABIN methods, and fish and benthic invertebrate tissue analysis for total metals. These activities were carried out in several streams in the Mine study area and reference areas:

- Halfway, Latte and YT-24 watersheds directly drain the Mine Site and are those that are predicted to be most affected by project activities. These streams are considered 'near' to project activities.
- Latte Creek flows into Coffee Creek. Therefore, while Coffee Creek is downstream of the Project area, the reaches that are downstream of the Latte confluence are considered 'far' from Project activities due to the limited influence on water quality/quantity predicted from the Project (Lorax 2017).

Independence, Los Angeles, and Coffee Creek upstream of the Latte Creek confluence were studied as part of the baseline program as 'reference' sites. Additionally, there were six sites sampled as potential future benthic invertebrate (CABIN) reference sampling sites; these included two sites on Dan Man Creek, one site on Excelsior Creek, one on a tributary to upper Excelsior, and two on an unnamed creek in a watershed adjacent to Excelsior.

2.1.1 ENVIRONMENTAL DNA SAMPLING

The eDNA sampling conducted during March, August, and October 2017 involved the collection of water samples with the objective of supplementing conventional fish sampling results for Coffee, Latte, Halfway and Independence creek watersheds. Water-based eDNA samples provided an indication of fish presence during the three sample periods (winter, summer, and autumn). Field sampling for eDNA included 10 stations on March 20 and 21, 11 stations from August 2 to 9, and three stations on October 20 (Table 2; Figure 4).

Table 2. Summary of 2017 eDNA sampling stations at the Coffee Gold Project.

Station Name	Stream	UTM Co-ordinates (Zone 7)		Timing of Sample Collection		
		Easting	Northing	Winter	Summer	Autumn
CF0.1	Coffee Creek	599375	6977099	✓		
CF2.7	Coffee Creek	597879	6974874	✓		
CF8.0	Coffee Creek	594731	6970592		✓	
CF8.1	Coffee Creek	594584	6970462	✓		
CF10.0	Coffee Creek	594191	6968831	✓		
LC0.5[a]	Latte Creek	594470	6970371	✓		
LC9.9	Latte Creek	584826	6971710	✓		
ID1.9	Independence Creek	579424	6983213	✓		
HF0.1	Halfway Creek	588808	6980531	No water from mouth to HF0.3	✓	✓
HF0.2	Halfway Creek	588717	6980460	No water from mouth to HF0.3		✓
HF0.5	Halfway Creek	588423	6980302		✓	
HF1.0	Halfway Creek	588003	6980053		✓	
HF2.0	Halfway Creek	587006	6979770		✓	
HF4.0	Halfway Creek	585603	6978365		✓	
HF6.3	Halfway Creek	584005	6976537	✓	✓	
YR	Yukon River	588890	6980503		✓	
YR	Yukon River	589591	6979878			✓
YRD11.0	Yukon River	588937	6980622	✓		
YRD20.5	Yukon River	580552	6985065	✓		
YT0.1	YT-24	589535	6979129	No water	✓	
YT1.0	YT-24	588885	6978649		✓	
YT2.0	YT-24	588259	6977919		✓	
PS2.4	NA – distilled water control	-	-	✓		
WD0.6	NA – distilled water control	-	-		✓	
WD0.1	NA – distilled water control	-	-			✓

[a] While this site was labeled LC0.5, the actual distance of this site from the mouth of Latte Creek is ~50 m.

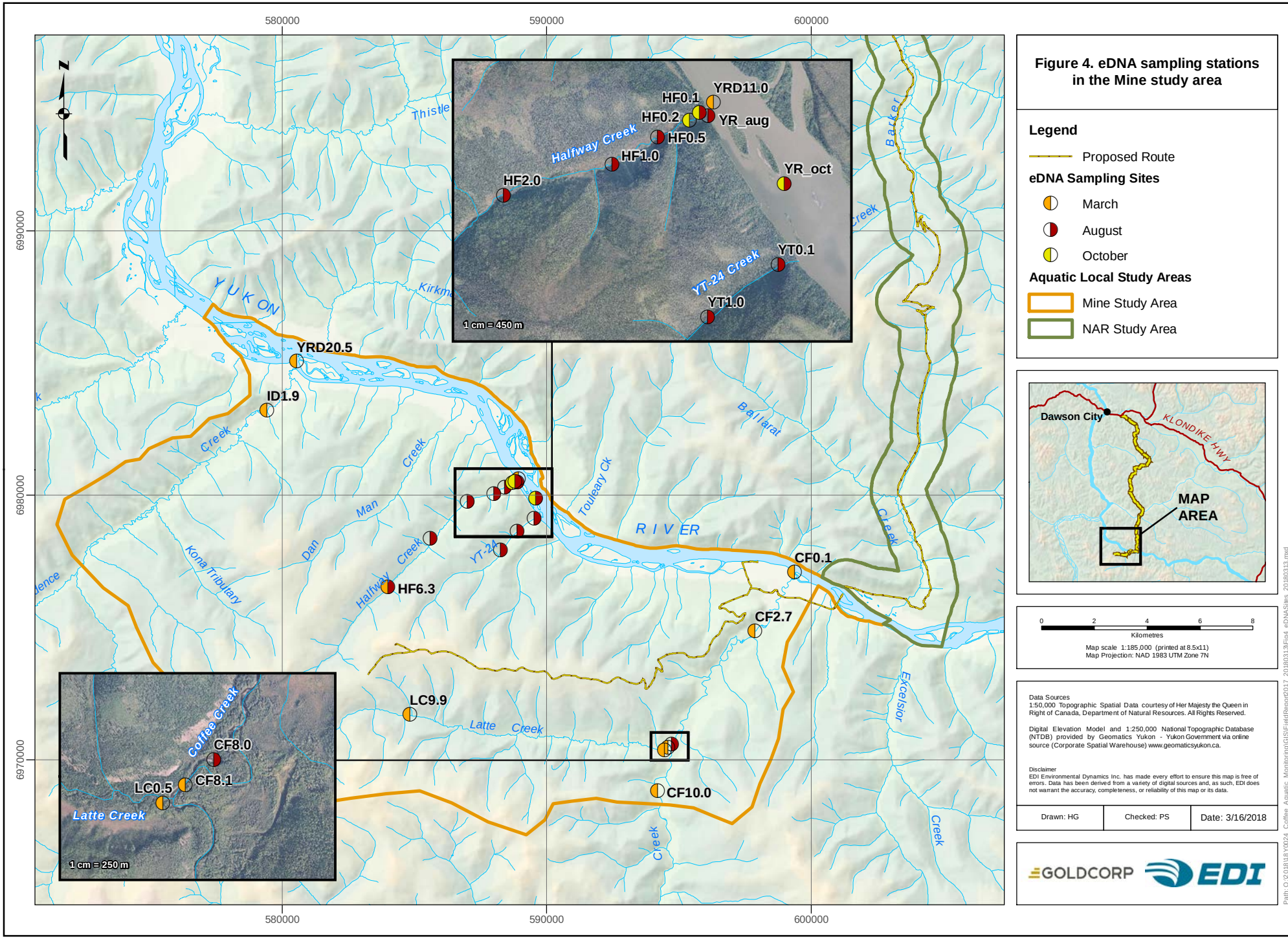

Figure 4. eDNA sampling stations in the Mine study area

Legend

Proposed Route

eDNA Sampling Sites

- March
- August
- October

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

Data Sources
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The eDNA methods involved disinfection, sampling, as well as preparing samples for laboratory analysis. Before leaving for the field, all equipment and sample bottles were cleaned and disinfected with 10% bleach solution and 85% ethanol and left to dry before being packed for transport. All equipment was kept in separate bags in the transport bin (e.g., envelopes, bottle triplicates, etc.) to mitigate contamination of equipment.

Only one watershed was sampled for eDNA each day. During sampling programs, one member was designated the eDNA sampler. This individual was responsible for sample collection, storage and handling to eliminate potential contamination. The eDNA sampler would not carry any other fish sampling equipment for the day and no one else was allowed in the water within 50 m of the sampling location. New nitrile gloves were worn at each site. Triplicate sample bottles for each site were kept together in bags to prevent bottles from different sites coming in contact with one another.

All samples were taken starting at downstream sites, working upstream throughout the day to keep from contaminating samples. Once arriving at the site, the eDNA sampler removed the three bottles for the site from their respective bag. Each of the three sample bottles were rinsed three times downstream of where the actual sample was taken; bottles were rinsed to remove any disinfectant residue. After rinsing bottles, they were replaced back into their bags and sealed while the sampler moved upstream to take the sample being analyzed for eDNA. Cascades were the preferred areas to take samples; otherwise the sampler would try to stay out of the water (i.e., step on rocks), or take the sample from the shoreline. The main consideration for sampling was that it was from the main flow of the stream and not from eddies or still pools (Hobbs 2017). Each sample bottle was filled, capped, and placed back into their bags and sealed; samples were left in a cooler or field pack until being processed later that night. In the winter samples were kept in a cooler with a hot water bottle to prevent freezing.

At the end of the day samples were processed at the Coffee camp. Using a peristaltic pump, each triplicate sample was processed separately. The 1 L sample was filtered through a 45 µL filter; once the water had been filtered, the pump continued for another 2-5 minutes to continue drying out the sample. Using disinfected forceps (10% bleach and 85% ethanol), the filter paper was folded and placed into a small pre-labelled coin envelope and sealed. All three samples from each site received their own envelopes, but they were all kept together in a Ziploc bag with two teaspoons of desiccant (silica) beads. Beads were checked periodically for signs of dampening (i.e., turning clear or pink) and were replaced accordingly.

Samples were shipped priority to the University of Victoria for analysis which was conducted as outlined in Hobbs (2017).

2.1.2 FISH SAMPLING

Fish sampling was conducted by field members at several locations downstream of the Mine site within the Mine study area. Fish sampling took place between August 2nd and August 10th, 2017 (Figure 5). The objectives of fish sampling were to better understand fish distribution and usage in select steams within the Mine study area. Stream specific sampling objectives were dependent upon drainage basin area, fish habitat potential, and proximal location to the mine's downstream effluent environment. Fish sampling methods varied between

sites and were dependent upon physical stream features and characteristics, as well as targeted fish species. Fish sampling methods utilized within the Mine study area included beach seining (BS), electrofishing (EF), and minnow trapping (MT). All fish captured during field sampling events were identified to the species, measured and weighed. Fork length measurements were recorded on fork-tailed fish species (Arctic grayling and Chinook salmon) and total length was recorded on non-forked tails fish species (slimy sculpin). Whole body weights were recorded for fish retained for tissue metal and aging structure analysis.

The beach seine used was 10 m in length, 1.5 m deep and constructed of a 5 mm mesh, with buoyant float lines and submersible lead lines. Beach seine hauls were conducted with field crews of two members within the Mine study area and consisted of varying lengths, widths, and depths dependent on the stream environment. Electrofishing was conducted using a Smith Root 12B-POW electrofisher set at 30 Hz or 60 Hz frequencies with 4 ms or 6 ms pulses (depending on site conditions). Electrofishing voltage settings ranged from 200 to 300 volts, depending on the in-situ specific conductivity at each site (i.e., higher volts were used at stations with lower conductivity). Electrofishing techniques varied between sites including single (open site) and triple pass (closed site) efforts. Minnow traps were deployed at select sites to increase fish sampling efforts at stations where water depths were sufficiently deep and stream velocities were not excessive. At each station, small mesh gee-type minnow traps (0.6 cm mesh size) were baited with Yukon River chum roe and were deployed along stream margins in slow water habitats. Trap set depths were recorded and traps were set overnight. At all fish sampling stations, in-situ water quality parameters including temperature, dissolved oxygen, specific conductivity and pH were collected, in addition to site photos.

The sampling points were measured and named based on the linear distance from the creek mouths. For electrofishing, the fishing effort was enumerated on the device and given in total seconds of active electrofishing. Beach seining efforts were measured by the length and width of a seine haul (i.e., area seined; m^2). Lastly, total minnow trapping efforts were enumerated based on the number of traps multiplied by soak times (HH:MM).

2.1.2.1 Coffee Creek

Fish sampling methods used at Coffee Creek included beach seining, open site electrofishing and minnow trapping. Triple pass electrofishing was not completed due to previous experience indicating that this method has limited utility on this stream. Coffee Creek consisted of four different sampling areas in the vicinity of CF3.9, described in greater detail in the results section (Section 3.2.1). Eleven beach seining hauls were conducted at select locations along the stream reach. Open site electrofishing was conducted 700 m downstream from CF3.9 and continued for a straight-line distance of 250 m back upstream towards CF3.9. Twelve minnow traps were set overnight at various locations with ranging distances from the stream mouth. Fish tissue and aging structure samples (otoliths) were retained from Arctic grayling and slimy sculpin captured in Coffee Creek.

2.1.2.2 Halfway Creek

Fish sampling at Halfway Creek was completed to further document fish species distribution and habitat usage within the stream. Fish sampling methods used at Halfway Creek included open site electrofishing and minnow trapping. Given the low densities found in the past, no triple pass electrofishing was completed in this creek. Open site electrofishing was completed between the mouth of the creek (HF0.1) to 4.5 km upstream (HF4.5) in several segments of the creek, with over 2 km of active electrofishing occurring at different sites throughout. Eight minnow traps were set to immerse overnight at various locations with ranging distances from the stream mouth. Sampling was conducted at eight stations throughout Halfway Creek, discussed in greater detail in the results (Section 3.2.2). Fish tissue and aging structure samples (otoliths) were retained from Arctic grayling captured in Halfway Creek.

2.1.2.3 Latte Creek

Fish sampling at Latte Creek was completed to collect pre-project fish density information. Fishing sampling methods used in Latte Creek included three pass electrofishing at the LC2.7 site, with three adjacent replicates. Triple pass electrofishing occurred over an aerial extent of 125 m^2 for the first replicate, 135 m^2 for the second replicate, and 183 m^2 for the final replicate. Fish tissue and aging structure samples (otoliths) were retained from Arctic grayling captured in Latte Creek.

2.1.2.4 Independence Creek

Fish sampling at Independence Creek was completed to collect pre-project fish density information. Fishing sampling methods used in Independence Creek included triple pass electrofishing, with efforts focused on three adjacent replicates at the ID1.9 site. Triple pass electrofishing was attempted within three closed sites. Fish tissue and aging structure samples (otoliths) were retained from Arctic grayling and slimy sculpin captured in Independence Creek.

2.1.2.5 YT-24 Creek

Fish sampling methods used at YT-24 Creek included open site electrofishing. Open site electrofishing was conducted in three segments from the mouth of the creek (YT0.0) to approximately 2 km upstream (YT1.9), with active electrofishing effort covering approximately 1 km. Fish tissue and aging structure samples (otoliths) were retained from Arctic grayling captured in YT-24 Creek.

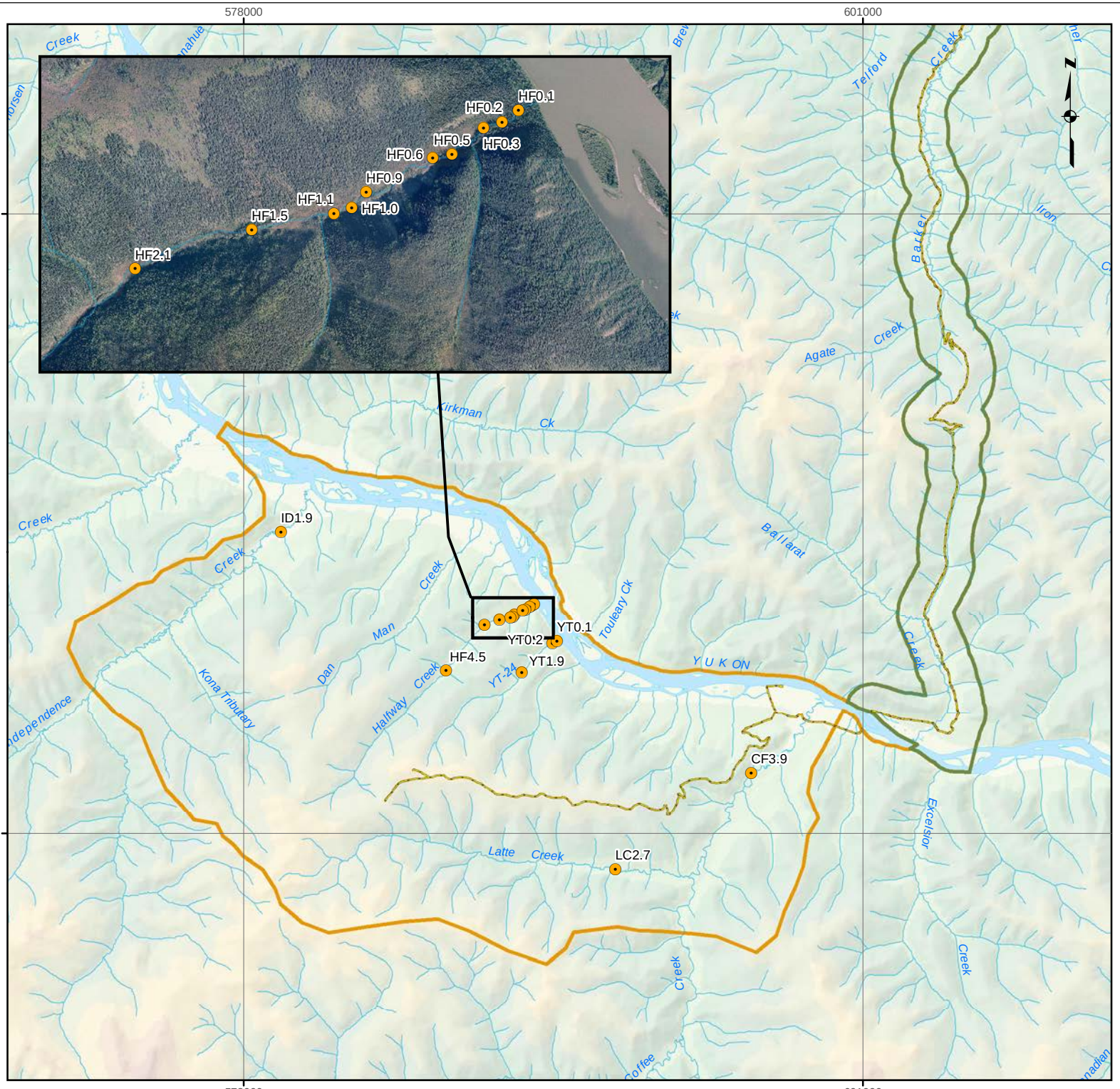
2.1.2.6 Triple Pass Electrofishing Depletion Model

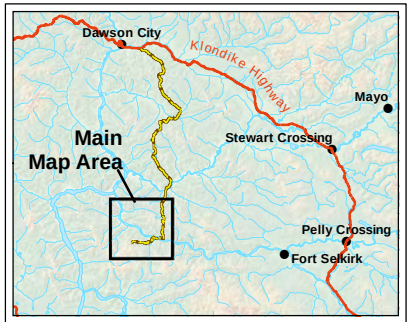
Triple pass electrofishing was conducted to estimate fish population density within streams by applying a depletion model. Each site included three adjacent replicates which were triple pass electrofished. Each replicate had net barriers installed on the up- and downstream ends of the approximate 100 m^2 electrofishing area. Rebar was pounded into the substrate with fine mesh netting secured and strung across, and large rocks

piled along the bottom to eliminate fish escapement during electrofishing efforts. Each electrofishing pass aimed to have approximately the same amount of effort (i.e., seconds electrofished) for consistency between passes. Fish that were not retained for contaminant sampling were released on the downstream end of the net barrier. Following three passes in one replicate, the downstream barrier was removed and moved up above the upstream location, leaving a buffer area between the two replicates to eliminate the possibility of recapturing the same fish. The next two replicates were installed and electrofished in the same manner.

The program Microfish© was used to calculate population estimates for each species in the replicate of a site (e.g., three replicates to a site); each replicate had its area determined and recorded in the field. The density of each species per replicate was calculated by dividing the population estimate by the replicate area and multiplying by 100 (to arrive at fish/100 m^2). Densities of fish species from the same site were then averaged and the standard error (SE) was determined. When there were fish caught in the first electrofishing pass, but not in the subsequent second or third pass, Microfish© was unable to calculate a population estimate. In these situations, the population estimate was assumed to be what the total catch was in the first pass. In the event that a fish species was not captured in all replicates of a single site, any replicates where none were caught received a fish density of zero and was used in the average for calculating fish densities. Both the current 2017 and previous 2016 data are reported. Data from 2016 was not previously analyzed for density estimations.

Power analysis was used to assess the utility of the depletion method for determining if there are any changes to fish density pre-project compared with post-project. This analysis used the pre-project average fish density and the standard deviation to determine the statistical power of the current sample size, as well as the required sample size of replicates per site to detect a 50% change in fish density. An alpha of 0.05 was used and 0.8 was used as the minimum required level of statistical power.





Legend

- Settlement/Community
- 2017 Fish Sampling Sites
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 5

Summer 2017 fish sampling locations in the mine study area

Data Sources
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Aerial imagery courtesy of Gold Corp; collected July 2011.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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2.1.3 FISH HABITAT INVESTIGATIONS

Fish habitat investigations included a walk of the entire length of Halfway Creek to assess fish passage and general habitat quality. Impediments to fish passage were documented where present. Habitat information was collected on BC MOE (2008) Site Cards for reaches where information did not exist.

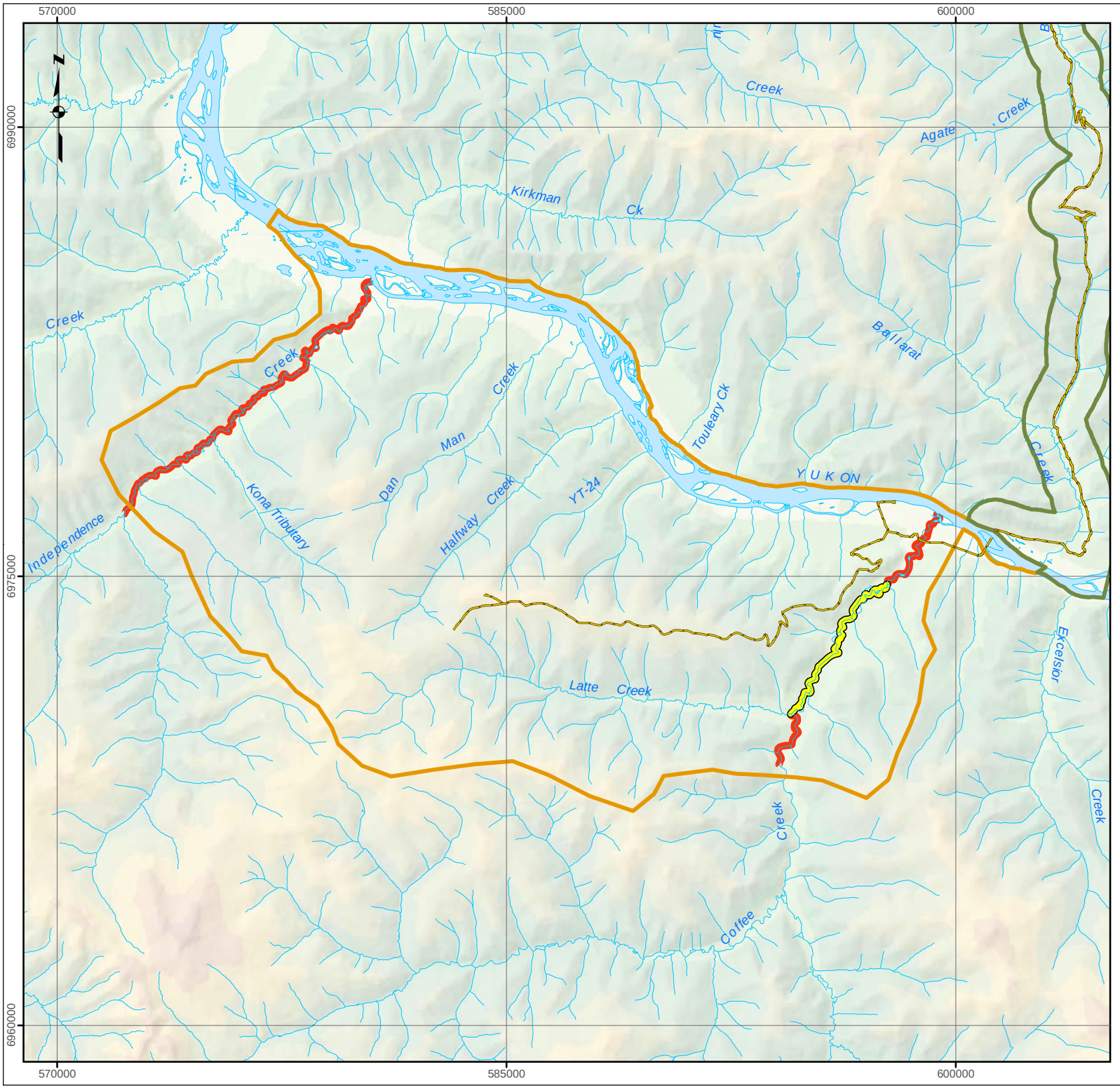
Assessments of the headwater drainages within the proposed mine footprint were walked/assessed to determine which drainages were streams. A stream was defined as having flow on a perennial or seasonal basis, having a continuous channel bed that was scoured by water, and containing deposits of alluvium[2]. Drainages in the Halfway, Latte and YT-24 watersheds were assessed.

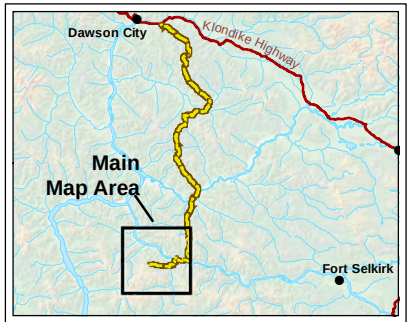
2.1.4 CHINOOK SALMON SPAWNING SURVEYS

Chinook spawning surveys were completed in areas where Traditional Knowledge indicated past presence and (Coffee Creek, TH 2012) where habitat appeared to be suitable for Chinook spawning (Coffee and Independence Creek). Aerial surveys were completed by helicopter on Coffee Creek on July 21, August 2 and 9th. Both streams were surveyed from the Yukon River upstream to a point where the stream was thought to be too small for adult Chinook (Independence was surveyed for 16 km and Coffee for 13 km; Figure 6). Observers were located in the front and backseats and the pilot positioned them over the river, flying sideways with the best possible vantage point at approximately 40-45 m above ground level. Observers wore polarized glasses to reduce glare. Weather was sunny and light conditions were considered very good. Tannins in both streams reduced the visibility in very deep pools, but the river could be seen to a depth of ~1 m.

A stream walk was completed on Coffee Creek to look for any sign of spawning activity. On August 8th, a crew of 3 (2 biologists and a local environmental monitor) walked from CF2.8 to CF3.9. On Aug 9th, a crew of 3 walked from CF8.4 (mouth of Latte) to CF3.9. Conditions were very good for observing adult salmon, redds or associated wildlife (i.e., eagles, bears). The crews were able to walk within the channel either in or alongside the wetted portion of the channel.

[2] This definition is consistent with BC Ministry of Forests (1998); no such definition of stream in the Yukon could be found. A key consideration is that fish species found in Yukon would not use habitats that do not meet this definition of stream (unless it is a lake or open water wetland).





Legend

- Settlement/Community
- Proposed Route
- Chinook Salmon Spawning Survey Extent
- Ground Survey Extent

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 6

August 2017 Chinook salmon spawning survey extent in the Mine study area

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Survey flight tracks (Chinook salmon spawning survey extent) were recorded by EDI Environmental Dynamics Inc.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change. Project data displayed is site specific.

0 1 2 3 4 5
KM

Map Reference Scale: 1:200,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MP	Checked: PT	Date: 3/16/2018

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2.1.5 TISSUE METALS ANALYSIS; FISH

Fish tissue collection and analysis is described in the below sections.

2.1.5.1 Sample Collection

Fish tissues were collected and submitted for metals analysis in 2017 to add to data collected in preceding years. Fish collection for tissue and aging structures as well as fish habitat assessments took place from August 3-10, 2017. Fish tissue sampling included both tissue (liver and muscle) and whole-body samples from Arctic grayling and slimy sculpin (Table 3). Otolith aging structures were collected from fish retained for tissue metals analysis and were sent to North/South Consultants Inc. in Winnipeg, MB for aging analysis. Fish sampling efforts attempted to capture between 8 and 10 individuals of each species, Arctic grayling and slimy sculpin, from each sampling location within the Mine study area. After retained fish were identified, measured and weighed in the field they were individually labelled, stored in sterile storage bags, then kept on ice in insulated containers until they could be dissected and placed in freezers at the end of each sampling day. Otoliths were removed from all retained fish and sent to North/South Consultants Inc. for age analysis. Liver, muscle (sample weight), gonad weights, sex identification, and diet analysis data were recorded for Arctic grayling. Slimy sculpin were kept whole (minus otoliths) for metal analysis. All samples were sent to the ALS Environmental laboratory in Vancouver, BC for tissue metals analysis.

2.1.5.2 Laboratory Analysis

ALS Environmental conducted analysis on tissue samples for both percent moisture and metals concentrations. For percent moisture, the lab sample analysis was carried out gravimetrically by drying samples at a temperature of < 60 ºC for a minimal three-day period (PSEP 1997). ALS analytics analyzed metal concentrations in fish tissue samples by homogenizing samples and sub-sampling prior to hotblock digestion with nitric acid, hydrochloric acids, and hydrogen peroxide (EPA 1994, 1998, and 2005); depending on the amount of sample available ALS selected standard or micro sample digestion techniques. ALS analysis was conducted by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry. ALS instrumental analysis was conducted by collision cell inductively coupled plasma - mass spectrometry (ICP/MS). There were 34 total metals analyzed with detection limits low enough to allow comparison with applicable guidelines (Table 4).

Table 3. Fish collected for baseline tissue metal analysis in the Coffee Project area in August 2017.

Stream	Sample Site	Species	Sample Type	Samples Collected
Coffee	CF3.9	CCG	Whole body (otolith removed)	10 slimy sculpin
Coffee	CF3.9	GR	Liver and muscle tissue	10 Arctic grayling
Halfway	HF0.2	GR	Liver and muscle tissue	6 Arctic grayling
Halfway	HF0.2	GR	Liver and muscle tissue	1 Arctic grayling
Independence	ID1.9	CCG	Whole body (otolith removed)	11 slimy sculpin
Independence	ID1.9	GR	Liver and muscle tissue	7 Arctic grayling
Latte	LC2.7	GR	Liver and muscle tissue	10 Arctic grayling
YT 24	YT0.2	GR	Liver and muscle tissue	1 Arctic grayling

CCG=slimy sculpin, GR=Arctic grayling

Table 4. Tissue metals and detection limits (ALS Analytics) for 2017 tissue analysis.

Metal	Detection Limit
Aluminum (Al)	0.40
Antimony (Sb)	0.0020
Arsenic (As)	0.0040
Barium (Ba)	0.010
Beryllium (Be)	0.0020
Bismuth (Bi)	0.0020
Boron (B)	0.20
Cadmium (Cd)	0.0010
Calcium (Ca)	4.0
Cesium (Cs)	0.0010
Chromium (Cr)	0.010
Cobalt (Co)	0.0040
Copper (Cu)	0.020
Iron (Fe)	0.60
Lead (Pb)	0.0040
Lithium (Li)	0.10
Magnesium (Mg)	0.40
Manganese (Mn)	0.010
Mercury (Hg)	0.0010
Molybdenum (Mo)	0.0040
Nickel (Ni)	0.040
Phosphorus (P)	2.0
Potassium (K)	4.0
Rubidium (Rb)	0.010
Selenium (Se)	0.010
Sodium (Na)	4.0
Strontium (Sr)	0.010
Tellurium (Te)	0.0040
Thallium (Tl)	0.00040
Tin (Sn)	0.020
Uranium (U)	0.00040
Vanadium (V)	0.020
Zinc (Zn)	0.10
Zirconium (Zr)	0.040

2.1.5.3 Data Analysis

Tissue guidelines exist for both selenium and mercury; these metals are known to bioaccumulate, and as such, can pose a danger through human consumption. The 2017 selenium and mercury concentrations in the muscle and liver samples were compared with applicable guidelines including the Health Canada total mercury guideline for commercial sale of fish (0.5 mg/kg; Heath Canada 2007), CCME methylmercury guideline (0.033 mg/kg ww, CCME 2000a) and the Environmental Protection Agency tissue guideline for selenium concentration (11.3 mg/kg for muscle and liver tissue samples, and 8.5 mg/kg dw for whole-body samples, United State Environmental Protection Agency 2016).

The selenium concentrations were converted to dry weight using the percent moisture data to allow comparisons to EPA guidelines. The lab could not complete percent moisture for 16 of the grayling muscle tissue samples, 23 of the grayling liver tissue samples and 20 of the slimy sculpin tissue samples in due to insufficient mass in 2017. Percent moisture data was also not available from some samples from previous years, also due to insufficient mass. An average percent moisture value was calculated from existing data for each sample type (muscle and liver) and species and was used where lab data was not available (Table 5). Methylmercury concentrations were estimated based on total mercury concentrations and known proportions published in literature (Table 6).

Table 5. Average percent moisture values used for samples where lab data was not available.

Sample	Average Percent Moisture
Arctic grayling muscle	68.80 %
Arctic grayling liver	75.35 %
slimy sculpin whole body	76.56 %

Table 6. Methylmercury proportions used to convert mercury concentrations to estimated methylmercury (MeHg) concentration by fish species.

Species	MeHg Proportions	Reference
Arctic grayling	0.94	Jewett et al 2003
slimy sculpin	0.81	EPA 2005

2.1.6 TISSUE METALS ANALYSIS; BENTHIC INVERTEBRATE AND PERIPHYTON

Benthic invertebrate and periphyton sample collection and analysis is described in the below sections.

2.1.6.1 Sample Collection

Benthic invertebrate and periphyton sampling was conducted for tissue metal analysis in the Mine study area and reference sites on August 2-8, 2017 (

Figure 7; Table 7). The sampling objective was to increase the tissue metal data sets for both benthic invertebrate and periphyton.

Benthic invertebrate sampling was conducting using a combination of kick netting and hand-collection; kick netting was conducted using a 400 micron mesh and detachable collection cup. Benthic invertebrates were displaced from their habitat by kicking at the stream substrate and sweeping the net vigorously along the stream bed. After each kick net event, the collection cup was rinsed with stream water into a larger collection basin where the macroscopic invertebrates were separated from sediment and organic debris using tweezers and compiled to form a composite sample. Benthic invertebrate composites were field-stored in sterile storage bags and later preserved by freezing at the end of each sampling day. Kick netting efforts were continued until a sufficient mass of benthic invertebrate tissue had been collected at each site. Dependent upon habitat suitability and benthic invertebrate abundance, up to five replicates were collected at each sampling site.

Periphyton samples scraped from rocks at select sampling sites were combined to form composite samples of sufficient mass for laboratory analysis. Periphyton samples were labelled with site name, date and replicate number and were stored in sterile storage bags. Samples were field stored in cooled insulated containers and transferred to freezers at the end of each sampling day. The number of replicate samples collected for periphyton tissue was dependent upon the availability of periphyton at each site. Additional in-situ water quality data collected at each sample site included water temperature, pH, specific conductivity and dissolved oxygen concentration. Benthic invertebrate and periphyton samples were kept frozen until delivery under chain of custody (COC) documentation to the ALS Environmental laboratory for percent moisture and total metals concentrations in tissues analysis.

Table 7. Summary of 2017 benthic invertebrate and periphyton sampling for tissue metals analysis in the Mine study area.

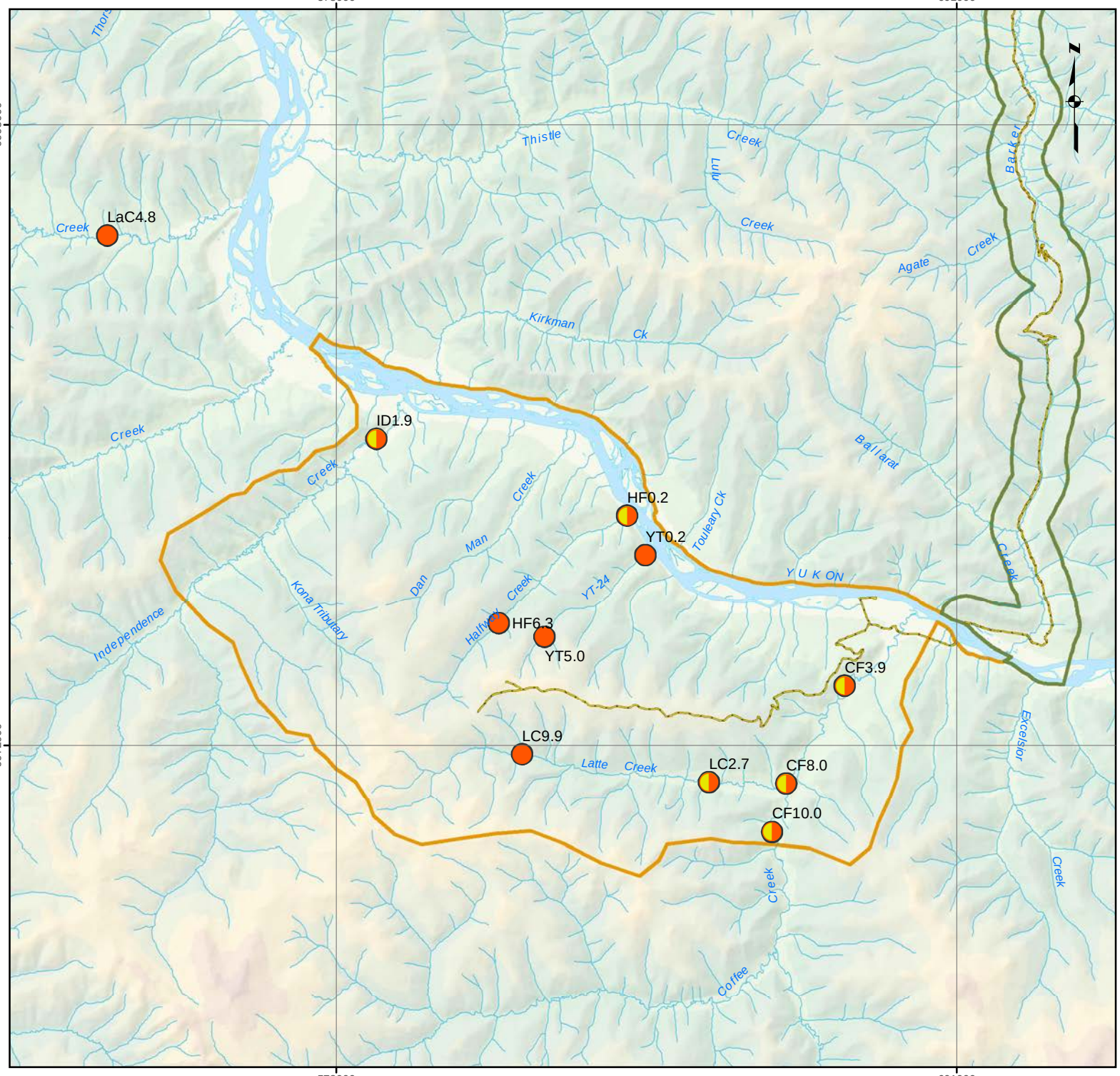
Station Name/Site Name	Stream	Sampling Date	Sample Type	Number of Replicates
ID1.9	Independence Creek	2-Aug-17	Benthic invertebrate	4
ID1.9	Independence Creek	2-Aug-17	Periphyton	5
CF3.9	Coffee Creek	3-Aug-17	Benthic invertebrate	3
CF3.9	Coffee Creek	3-Aug-17	Periphyton	5
CF8.0	Coffee Creek	4-Aug-17	Benthic invertebrate	4
CF8.0	Coffee Creek	4-Aug-17	Periphyton	5
CF10.0	Coffee Creek	5-Aug-17	Benthic invertebrate	3
CF10.0	Coffee Creek	5-Aug-17	Periphyton	5
LaC4.8	Los Angeles Creek	3-Aug-17	Benthic invertebrate	1
LC2.7	Latte Creek	4-Aug-17	Benthic invertebrate	3
LC2.7	Latte Creek	4-Aug-17	Periphyton	5
LC9.9	Latte Creek	5-Aug-17	Benthic invertebrate	2

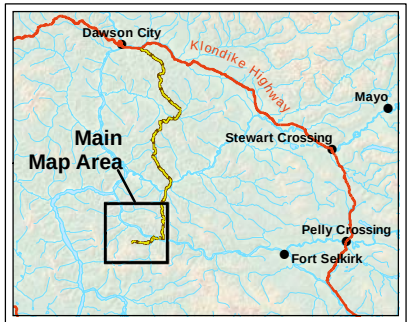
Station Name/Site Name	Stream	Sampling Date	Sample Type	Number of Replicates
YT0.2	YT-24 Creek	7-Aug-17	Benthic invertebrate	1
YT5.0	YT-24 Creek	7-Aug-17	Benthic invertebrate	1
HF0.2	Halfway Creek	6-Aug-17	Benthic invertebrate	5
HF0.2	Halfway Creek	6-Aug-17	Periphyton	2
HF6.3	Halfway Creek	6-Aug-17	Benthic invertebrate	5

2.1.6.2 Lab and Data Analysis

Laboratory analysis for percent moisture and total metals followed the same methodology as for fish tissue (Section 2.1.5)

Benthic invertebrates are prey organisms near the bottom of the food chain. Selenium and mercury guidelines have been established as these contaminants can bioaccumulate and work their way up the food chain. The 2017 selenium and mercury concentrations in the benthic invertebrate tissue samples were compared with the CCME tissue residue methylmercury guideline (0.033 mg/kg ww, CCME 2000a). The selenium concentrations were converted to dry weight using percent moisture data to allow to comparisons to EPA guidelines. Percent moisture data was provided by the lab. Methylmercury concentrations were estimated based on total mercury concentrations and known proportions published in literature. The methylmercury proportion for benthic invertebrate tissue samples is 50% as determined by Lucotte and Tremblay (1997).





Legend

- Settlement/Community
- Benthic Invertebrate Sampling Site
- Benthic & Periphyton Sampling Site
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

FIGURE: 7

Benthic invertebrate and periphyton sampling for tissue metals analysis in the Mine study area

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
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KM

Map Reference Scale: 1:200,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: HG/MP	Checked: PT	Date: 3/16/2018

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2.1.7 BENTHIC INVERTEBRATE COMMUNITY SAMPLING

Benthic invertebrates provide insight on water quality, toxicological conditions, food availability, and overall health of the aquatic environment. Benthic invertebrates are exposed to stream water and sediments, along with any anthropogenic contaminants (e.g., metals) within these mediums, throughout their lifecycle. Some taxa are more tolerant to anthropogenic contaminants than others, which can lead to the increased presence of more pollution tolerant taxa relative to pollution sensitive taxa at impacted areas (Maret et al. 2003). Community metrics such as total abundance, community composition, species richness, and diversity provide useful indicators of change within aquatic ecosystems.

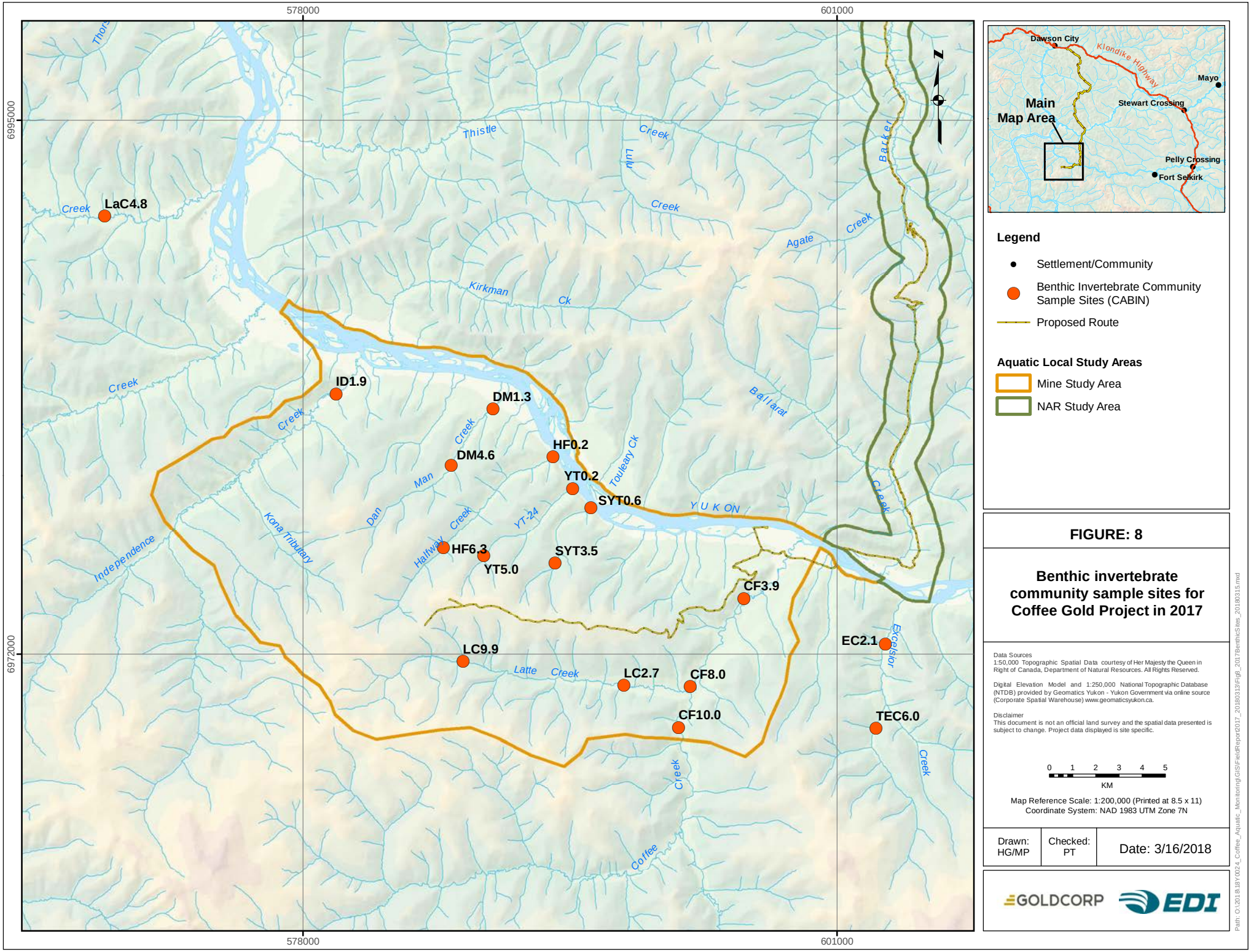
The objectives of the benthic invertebrate sampling program were to:

- Document the condition of benthic invertebrate communities in streams associated with the proposed Project footprint; and
- Establish baseline conditions that will facilitate control-impact (i.e., before-after) comparisons throughout the lifespan of the Project and support future monitoring programs.

The fish and aquatic resources baseline program for the Coffee Gold Project (the Project) included sampling at 17 benthic invertebrate sample sites throughout the Project study area in 2017 (Figure 8; Table 8). Eight of these 17 sample sites were previously assessed in 2014 and/or 2015 by Palmer Environmental Consulting Group Inc. (PECG 2017).

Table 8. Benthic invertebrate community sample sites for the Coffee Gold Project in 2017.

Site Type	Site	Watershed	Sample Years
Test site	HF0.2	Halfway Creek	2014, 2015, 2017
	HF6.3	Halfway Creek	2017
	LC2.7	Latte Creek	2014, 2017
	LC9.9	Latte Creek	2015, 2017
	YT0.2	YT-24 Creek	2014, 2015, 2017
	YT5.0	YT-24 Creek	2017
	CF3.9	Coffee Creek	2014, 2015, 2017
	CF8.0	Coffee Creek	2014, 2015, 2017
Reference site	CF10.0	Coffee Creek	2017
	DM1.3	Dan Man Creek	2017
	DM4.6	Dan Man Creek	2017
	EC2.1	Excelsior Creek	2017
	ID1.9	Independence Creek	2014, 2015, 2017
	LaC4.8	Los Angeles Creek	2015, 2017
	SYT0.6	Stream south of YT-24 Creek	2017
	SYT3.5	Stream south of YT-24 Creek	2017
	TEC6.0	Tributary to Excelsior Creek	2017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6972000
LaC4.8
ID1.9
DM1.3
DM4.6
HF0.2
YT0.2
SYT0.6
HF6.3
YT5.0
SYT3.5
CF3.9
EC2.1
LC9.9
LC2.7
CF8.0
CF10.0
TEC6.0
Thistle Creek
Kirkman Ck
Agate Creek
Ballarat Creek
Toulleay Ck
Man Creek
Dan Creek
Halfway Creek
YT-24
Kona Tributary
Independence Creek
Latte Creek
Excelsior Creek
Coffee Creek
Y U K ON
N
Dawson City
Klondike Highway
Mayo
Main Map Area
Stewart Crossing
Pelly Crossing
Fort Selkirk
Legend
Settlement/Community
Benthic Invertebrate Community Sample Sites (CABIN)
Proposed Route
Aquatic Local Study Areas
Mine Study Area
NAR Study Area
FIGURE: 8
Benthic invertebrate community sample sites for Coffee Gold Project in 2017
Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.
Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.
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2.1.7.1 Benthic Invertebrate Field Sampling

All 2017 field work was completed between August 2 and 10, 2017. Aquatic habitat data and benthic invertebrate data were collected as per Canadian Aquatic Biomonitoring Network (CABIN) field methods (Environment Canada 2012). Benthic invertebrate samples were collected from riffle and glide habitats. Sampling was conducted in an upstream direction within the identified riffle or glide at water depths between 5–30 cm for a period of three minutes with a 400µm mesh, CABIN protocol kick net. Substrate and debris upstream of the kick net were disturbed by kicking and turning rocks over to dislodge benthic invertebrates. After the three-minute kick, the kick net was removed from the stream and all benthic invertebrates and debris in the net and collection cup were carefully rinsed into a clean plastic sample container and preserved in a 10% formalin solution. Water depth and velocity were measured at each kick sample site. General site and location data, reach data, in-situ water quality data, channel data, and substrate data were also recorded at each kick sample site.

Benthic invertebrate samples were sorted and enumerated to the lowest practicable level by Cordillera Consulting in Summerland, BC. Laboratory QA/QC was completed according to Cordillera Consulting protocols.

2.1.7.2 Benthic Invertebrate Data Analyses

Climate data for the Project study area was obtained from the weather station at the Coffee Creek mine site and was provided by Lorax Environmental Services Ltd. Landcover data for the Project study area was obtained from Natural Resources Canada (Wulder and Nelson 2003). All field data, climate data, and landcover data were uploaded to the CABIN database and compared to the Yukon 2013 reference model (Reynoldson and Bailey 2014) as per the Reference Condition Approach. The predictor variables for the Yukon 2013 reference model are identified in Table 9.

Table 9. Predictor variables for the Yukon 2013 reference model.

Landscape Variables	Landcover Variables	Climate Variables	Channel Variables
Altitude (fasl)	Broadleaf open (%)	Precipitation – February (mm)	Average depth (cm)
Longitude (°W)	Bryoids (%)	Precipitation – March (mm)	Average velocity (m/s)
	Mixedwood open (%)	Precipitation – June (mm)	
	Wetland herb (%)	Precipitation – July (mm)	
		Rainfall – June (mm)	
		Temperature – April maximum (°C)	

The CABIN analyses included a Benthic Assessment of Sediment (BEAST) analysis, a River Invertebrate Prediction and Classification System (RIVPACS) analysis, and a Bray-Curtis analysis for each test site and reference site. All CABIN analyses were completed in CABIN using the Data Analysis tools (Environment Canada 2017). The BEAST analysis is a test site assessment that is used to determine whether each test site is in reference condition (Environment Canada 2017). The BEAST analysis determines which group of reference sites in the model are most closely matched to each test site. The benthic community within the

matched group of sites is referred to as the reference condition. Ordination is then used to assess the degree of divergence between the test site and the reference condition (i.e., similar to reference, mildly divergent, divergent, or highly divergent). The RIVPACS analysis determines the probability of a taxonomic group occurring at each test site based on which taxa are expected to occur in the reference condition (Environment Canada 2017). Each test site is assigned a ratio of observed to expected (O:E). A ratio closer to one generally indicates a test site is in good condition whereas a lower ratio generally indicates a test site is in poor condition. The Bray-Curtis analysis determines how similar the benthic invertebrate community structure at each test site is to the benthic invertebrate community structure of the median reference community (Environment Canada 2017). A value of one indicates a test site is entirely different from the median reference community whereas a value of zero indicates a test site is identical to the median reference community. All analysis results from 2017 were compared to analysis results from 2014/2015 (PECG 2017).

The CABIN analyses also included an assessment of community composition metrics for each test site and reference site. All metrics were calculated in CABIN using the Data Analysis tools (Environment Canada 2017). Analysis of the metrics was completed in Microsoft Excel®. Community composition metrics calculated in CABIN included the following:

- Total abundance
- Total Ephemeroptera-Plecoptera-Trichoptera (EPT) abundance
- % Ephemeroptera
- % Plecoptera
- % Trichoptera
- % Diptera + Non-insects
- Total taxonomic richness
- EPT taxonomic richness
- Simpson's diversity
- Simpson's evenness

All metrics from 2017 were compared to metrics from 2014/2015 (PECG 2017).

2.1.8 PERIPHYTON: CHLOROPHYLL–A AND ASH-FREE DRY MASS

Periphyton sample collection for chlorophyll-A and ash free dry mass field methods and laboratory analysis is described in the below sections.

2.1.8.1 Sample Collection

Periphyton sampling within the Mine study area including chlorophyll-a and ash-free dry mass (AFDM), was conducted on August 2-6, 2017 (Table 10). Chlorophyll-a and AFDM samples were collected in late summer when communities were expected to have reached maximum density and diversity. Sampling sites were selected to standardize, where possible, water depth, velocity, gradient, substrate, and sunlight exposure (Table 10).

Sampling for the two parameters was completed using the same methods. Six rocks were randomly selected at each site, and from each rock one sample for each of chlorophyll-a and AFDM was collected. Samples were collected using a 5 cm (2") diameter template and stainless-steel razor blade used to scrape periphyton from the rocks within the sample area, as determined by the template. Each rock represented one replicate, resulting in a total of six replicates collected per site for each parameter. Periphyton scraped from within the template area was placed on 47 mm diameter cellulose nitrate filter paper (0.45 µm). Rocks containing visible periphyton tissue were selected, allowed to dry, then scraped using a 5 cm (2") template. Periphyton scraped from rocks at select sample sites were individually labelled with the site name, date and replicated number and folded into aluminum foil and stored in sterile storage bags. Aluminum foil protected the samples from light exposure and mitigated potential for chlorophyll-a photo-degradation. Samples were field stored in cooled insulated containers and transferred to freezers at the end of each sampling day. Filter and tissue samples were kept frozen and dark until they were transferred to the ALS laboratory under chain of custody (COC) documentation.

2.1.8.2 Laboratory and Data Analysis

Chlorophyll-a samples were sent to ALS Environmental in Vancouver, BC where they were processed using routine acetone extraction followed by fluorometry analysis using the non-acidification procedure. The AFDM samples, also sent to ALS Environmental in Vancouver, BC, were analyzed by determining gravimetrical differences between the sample dry weight and ash weight. Dry weights were calculated by effectively drying samples at a temperature of 105ºC. Subsequently, ash weights were determined by ashing the dried sample at a temperature of 500ºC. AFDM values were computed by dividing ash-free dry weights by the area sampled; resulting in AFDM units of g/m^2. Results were presented as an index of periphyton productivity of mass/area ($\mu g/cm^2$ or mg/m^2) as the lab was provided with the known volume of periphyton sampled per unit area of substrate surface sampled at each site.

Upon receipt of data results from the ALS laboratory, summary statistics for each site including minimum, maximum and mean values were calculated from the six replicates collected at each site. Mean values from each site were used to perform a between site comparison.

Table 10. Summary of 2017 chlorophyll-a and periphyton sampling in the Mine study area.

Station Name/Site Name	Stream	Sampling Date
ID1.9	Independence Creek	02-Aug-17
LaC4.8	Los Angeles Creek	03-Aug-17
CF3.9	Coffee Creek	03-Aug-17
CF8.0	Coffee Creek	04-Aug-17
CF10.0	Coffee Creek	05-Aug-17
LC2.7	Latte Creek	04-Aug-17
LC9.9	Latte Creek	05-Aug-17
HF0.2	Halfway Creek	06-Aug-17
HF6.3	Halfway Creek	06-Aug-17
YT0.2	YT-24 Creek	07-Aug-17
YT5.0	YT-24 Creek	07-Aug-17

2.1.9 SEDIMENT

Sediment sample collection and lab analysis is described in the below sections.

2.1.9.1 Sample Collection

Sediment samples were collected at eleven sites within the Mine study area from August 2 to 7, 2017 (Table 11). The objectives of sediment sampling were to assess texture and to analyze metal concentrations within the soils. At each sampling site three replicates were collected from various depositional areas within the stream using a stainless-steel spoon. The collection device was rinsed with 95% ethanol between sites to avoid sediment cross contamination. Fine textured sediments from depositional areas were targeted for sampling because fine sediments have the highest consumption rate among benthic invertebrates, making fine sediments a useful parameter for determining potential risks to various aquatic organisms. Sample replicates from the different stream areas within each site were combined to form sediment composite samples. Sample composites for each site were contained within a sterile storage container and were labelled by field crew with sample name, date and location. Sediment samples were field stored at room temperature until delivered to the ALS Environmental laboratory under chain of custody (COC) documentation.

2.1.9.2 Laboratory Analysis

Sediment samples were sent to ALS Environmental in Vancouver, BC and Saskatoon, SK for laboratory analysis of metals, total organic carbon, nutrients and particle size. Physical soil tests were conducted using a procedure in which samples were dried (<60ºC), sieved (No. 10/2mm) and mixed with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution was measured using a standard pH probe. Particle size analysis was conducted using dry sieving, wet sieving and pipette sedimentation (Soil Survey Staff

2014). Samples used for soil metals analysis were manually homogenized, dried (60 ºC), sieved (63 µm/230 cm mesh) and the dry material subsample was weighed (US EPA 2005; Martin et al 1994). A hot block digester was employed to digest the sample at 95 ºC for two hours using concentrated nitric and hydrochloric acids. Instrumental analysis for mercury was conducted using either atomic fluorescence spectrophotometry or atomic absorption spectrophotometry. Instrumental analysis for all remaining soil metals was conducted using collision cell inductively coupled plasma – mass spectrometry (ICP/MS).

Table 11. Summary of 2017 sediment sampling in the Mine study area.

Station Name/Site Name	Stream	Sampling Date
ID1.9	Independence Creek	02-Aug-17
LaC4.8	Los Angeles Creek	03-Aug-17
CF3.9	Coffee Creek	03-Aug-17
CF8.0	Coffee Creek	04-Aug-17
CF10.0	Coffee Creek	05-Aug-17
LC2.7	Latte Creek	04-Aug-17
LC9.9	Latte Creek	05-Aug-17
HF0.2	Halfway Creek	06-Aug-17
HF6.3	Halfway Creek	06-Aug-17
YT0.2	YT-24 Creek	07-Aug-17
YT5.0	YT-24 Creek	07-Aug-17

2.2 NORTHERN ACCESS ROUTE

Methods for the three project components related to the northern access route are described below.

2.2.1 BARGE LANDING INVESTIGATIONS

Proposed barge landings on the Yukon River were visited and sampled for fish during August 2017. Visual observations were made to describe the fish habitat in these areas. Fish sampling was conducted using beach seining. In the case of the north bank, the beach seining sites were located approximately 75 m downstream of the proposed landing sites due to the presence of vertical banks which were not conducive to fish sampling. A total of seven beach seining hauls were completed at proposed barge landing sites and one at an existing barge landing near the Coffee Camp (Figure 9).

The beach seine used was 10 m in length, 2 m deep and constructed of 5 mm mesh. Information collected for each beach seine haul included seine haul dimensions (length, width, depth). All fish captured were identified to species and measured to fork length.

2.2.2 STEWART RIVER BACK CHANNEL INVESTIGATIONS

A back channel on the Stewart River which will be encroached upon by the Northern Access Route was visited on September 3, 2017. Photos and notes were taken on the characteristics of the channel. Fish sampling was not completed as the channel was predominantly dry at the time of the visit.

2.2.3 CHUM SALMON SPAWNING SURVEYS

Aerial surveys were completed by helicopter on the Yukon and Stewart rivers on October 19, 2017. The Yukon River was surveyed from just upstream of Excelsior Creek (7 km upstream of Coffee Creek) downstream to near the confluence of Carlisle Creek, a river distance of approximately 33.5 km (Figure 10). The Stewart River was surveyed from Black Hills Creek, downstream to a point 6 km downstream of Three Kings Creek for a total river distance of approximately 34.6 km (Figure 10).

Observers were located in the front and backseats and the pilot positioned them over the river, flying sideways with the best possible vantage point at approximately 40-45 m above ground level. Surveys were completed in a downstream manner with both observers wearing polarized glasses to reduce glare. Air temperatures during the survey were relatively mild (-3°C), although ice cover was observed in some of the Yukon River side channels. Particularly the Stewart River had many ice pans forming on the river, and side channel ice cover limited the ability to see spawning chum. All open water areas within river channel were surveyed, although an emphasis was placed on side channel habitats where groundwater discharge areas were present (known preferred spawning areas for chum salmon on large Yukon rivers).

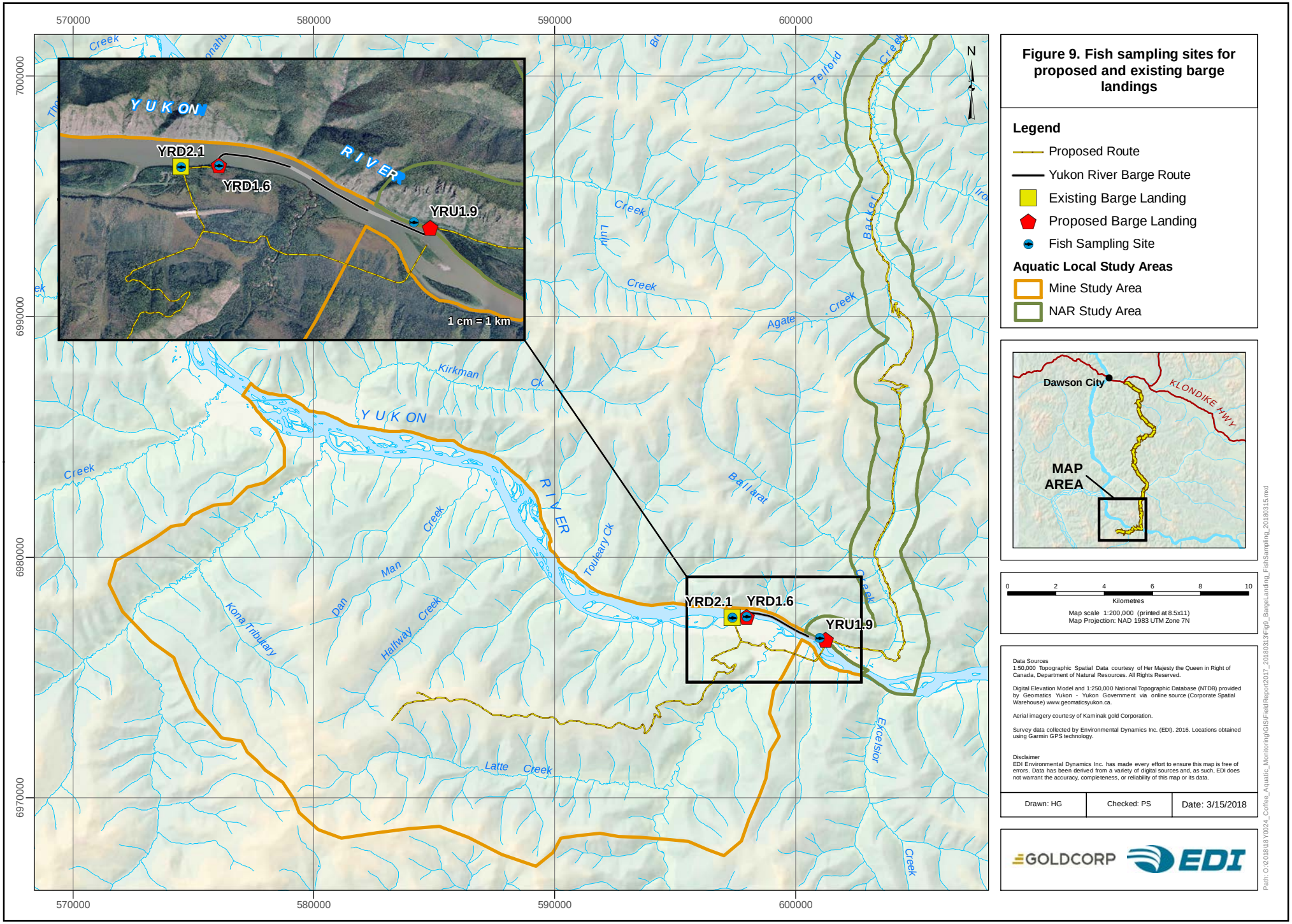

Figure 9. Fish sampling sites for proposed and existing barge landings

Legend

- Proposed Route
- Yukon River Barge Route
- Existing Barge Landing
- Proposed Barge Landing
- Fish Sampling Site

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Aerial imagery courtesy of Kaminak gold Corporation.

Survey data collected by Environmental Dynamics Inc. (EDI). 2016. Locations obtained using Garmin GPS technology.

Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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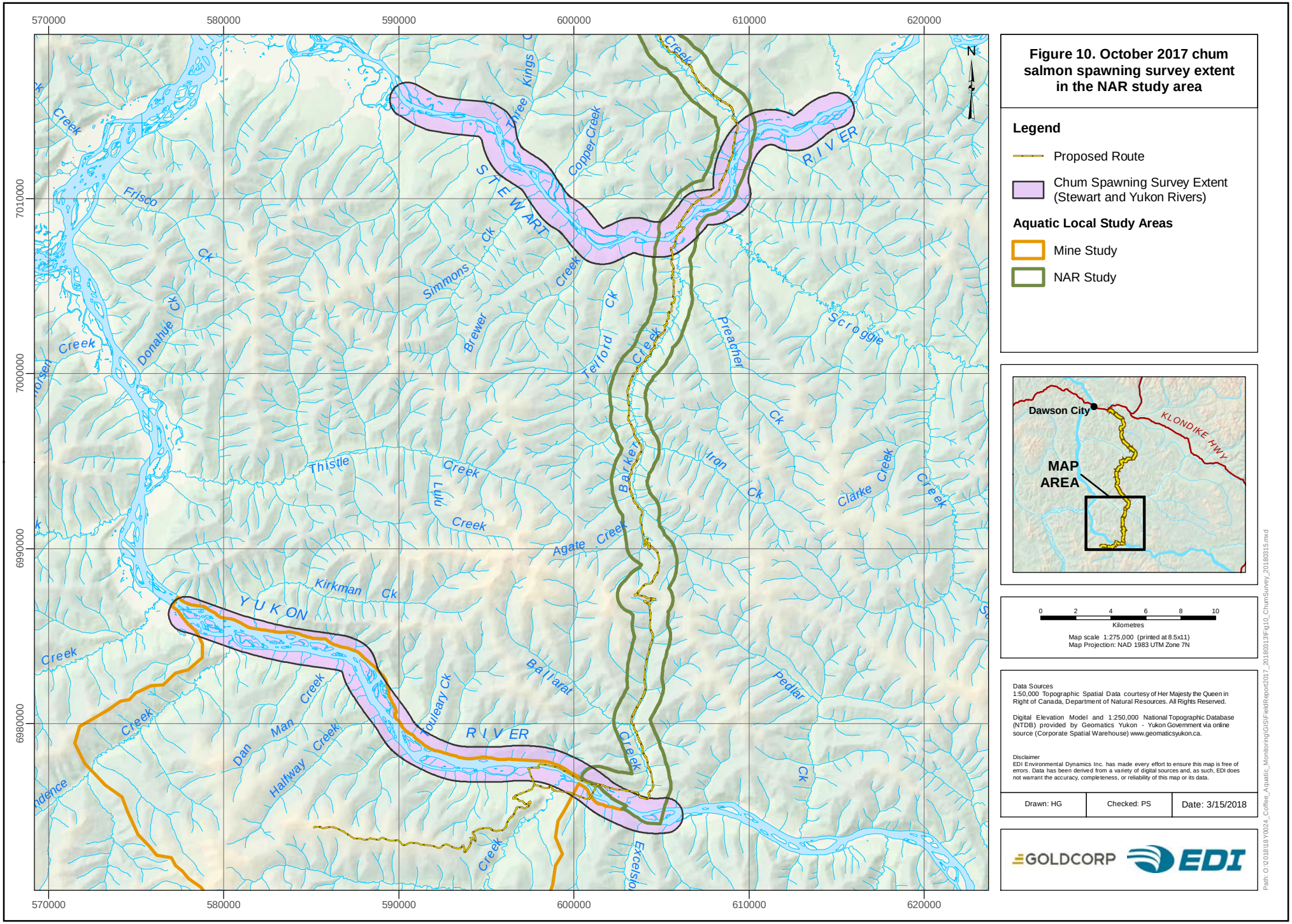

Figure 10. October 2017 chum salmon spawning survey extent in the NAR study area

Legend

- Proposed Route
- Chum Spawning Survey Extent (Stewart and Yukon Rivers)

Aquatic Local Study Areas

- Mine Study
- NAR Study

0 2 4 6 8 10
Kilometres

Map scale 1:275,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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3 RESULTS AND DISCUSSION – MINE STUDY AREA

Results and discussion for the mine study area are presented per project component in the below sections.

3.1 ENVIRONMENTAL DNA SAMPLING

3.1.1 MARCH 2017

Few environmental DNA samples filtered from water collected in March 2017 tested positive for Arctic grayling or Chinook salmon DNA markers (Table 12; APPENDIX B). A positive hit for Chinook DNA was found in one of the three sampled sites in Coffee Creek (CF8.1), and a positive hit for Arctic grayling was found in one of the two Yukon River sites. These late winter results were in contrast to the March 2016 data which found positive samples for Chinook DNA at all 4 Coffee Creek sites and positive samples for Arctic grayling at all three Yukon River sites sampled and in one Coffee Creek site. The lower Halfway Creek site (HF0.2) was frozen to the bed, from bank to bank (Photo 1). Coffee Creek and the Yukon River (CF0.1, CF2.7, CF8.1; YRD11.0, YRD20.5) were sampled as positive controls (i.e., where fish detection was anticipated), whereas a deionized water sample (PS2.4) was used as a negative control (i.e., where no detection was expected).

It is suspected that the year to year difference in the results in Coffee Creek is related to the difference in winter conditions. Specifically, 2017 was a colder winter than 2016, reflected by the higher amounts of ice and lesser amount of flowing water observed in Coffee Creek. Such conditions appear to affect the amount and quality of overwintering habitat that is present in the creek.

Table 12. Summary of eDNA detection results in the Mine study area, March 2017.

Station Name	Arctic Grayling eDNA Detected (Yes/No)	Chinook Salmon eDNA Detected (Yes/No)
CF0.1	No	No
CF2.7	No	No
CF8.1	No	**Yes**
LC0.5	No	No
LC9.9	No	No
ID1.9	No	No
HF0.2	Frozen to bed – no sample collected	
YT0.2	Frozen to bed – no sample collected	
HF6.3	No	Inconclusive[1]
YRD11.0	**Yes**	No
YRD20.5	No	No
PS2.4 Control (Deionized Water)	No	No

[1] One of the three samples was positive for Chinook; however, it is believed that this was a false positive as there has never been fish documented in this location and the sample was collected from a hole right next to another sampling station used a few days earlier by another crew (which could have led to contamination).



Photo 1. Looking upstream, HF0.2 frozen to the bed from bank to bank during eDNA sampling efforts, March 2017.

Overwintering conditions did not appear affected in the Yukon River; it is suspected that YRD20.5 was negative for Arctic grayling as it was collected in an area with groundwater inputs (i.e., may not be reflective of the entire river). At other sites, conditions and eDNA results were similar to 2016 which included negative results for Arctic grayling and Chinook salmon in Independence and Latte Creek.

3.1.2 AUGUST 2017

During the 2017 summer eDNA sampling, four different watersheds were assessed for the presence of eDNA (Table 13). Halfway Creek was thoroughly investigated, and only had Arctic grayling detected 0.1 and 0.5 km from the mouth which was consistent with fish sampling results (see Section 3.2.2). These samples did not detect the presence of juvenile Chinook, which were caught at HF0.1 and HF0.2 using electrofishing techniques (see Section 3.2.2). A plausible explanation for this may be that juvenile chinook were present in too low of densities to be detected, particularly as they are small fish and shed less DNA into the surrounding water. In YT-24, samples appeared to be compromised as no DNA of any kind (including algae) was detected in the samples. Coffee Creek (CF8.0) and the Yukon River (YR) were sampled as positive controls and were positive for both grayling and Chinook, whereas a distilled water sample (WD0.6) was used as a negative control and was negative for any DNA.

Table 13. Summary of eDNA detection results in the Mine study area, August 2017.

Station Name	Arctic Grayling eDNA Detected (Yes/No)	Chinook Salmon eDNA Detected (Yes/No)
HF0.1	**Yes**	No
HF0.5	**Yes**	No
HF1.0	No	No
HF2.0	No	No
HF4.0	No	No
HF6.3	No	No
CF8.0	**Yes**	**Yes**
YT0.1	No[1]	No[1]
YT1.0[1]	No[1]	No[1]
YT2.0[1]	No[1]	No[1]
YR	**Yes**	**Yes**
WD0.6 Control (Distilled water)	No	No

[1]Samples appeared to be compromised (no DNA of any kind detected); possible traces of disinfectant or sample not dried for long enough duration.

3.1.3 OCTOBER 2017

In October 2017 Halfway Creek was revisited, and two samples were taken at 0.1 and 0.2 km from the mouth of the creek. The Halfway Creek samples 0.1 km from the mouth of the creek (HF0.1) contained no genetic material of Chinook or Arctic grayling (Table 14). Conversely, 0.2 km from the mouth (HF0.2) contained Chinook genetic material, but no Arctic grayling (Table 14). A sample from the Yukon River (YR) and a distilled water sample (WD0.1) were used as a positive and negative control, respectively. As anticipated, the Yukon River sample contained Arctic grayling genetic material, whereas the distilled water sample did not (Table 14); these findings validate the sampling and filtering techniques.

Table 14. Summary of eDNA detection results in the Mine study area, October 2017.

Station Name	Arctic Grayling eDNA Detected (Yes/No)	Chinook Salmon eDNA Detected (Yes/No)
HF0.1	No	No
HF0.2	No	**Yes**
YR	**Yes**	No
WD0.1	No	No

The positive result of Chinook in Halfway Creek was interesting as previous winter investigations found this part of the creek frozen to bed (Photo 1). It is not clear if these fish would leave before winter conditions set in or had already left given that eDNA can persist in water between seven to 21 days, depending on various environmental factors (Hobbs 2017).

3.2 FISH SAMPLING

Fish sampling results from 2017 are described by stream in the below sections (data provided in APPENDIX C and APPENDIX D). Use of the triple pass depletion model to estimate fish densities is presented and discussed in Section 3.2.6, including data from 2017, as well as 2016, which was not previously analyzed in this manner.

3.2.1 COFFEE CREEK

Juvenile Chinook salmon, Arctic grayling, and slimy sculpin were captured in Coffee Creek during the 2017 field program; these findings are supported by previous years' sampling efforts (e.g., 2014-2016). During all combined sampling efforts in 2017, there were 30 juvenile Chinook captured, with minnow trapping being the most effective method (n = 18), followed by electrofishing (n = 7) and beach seining (n = 6; Table 15). Arctic grayling were primarily captured using beach seining (n = 21), and electrofishing to a lesser extent (n = 3; Table 15). Electrofishing captured the most slimy sculpin (n = 39), with minnow trapping (n = 3) and beach seining (n = 2) contributing substantially fewer captures (Table 15). These results highlight the importance of employing various capture methods to ensure representation of various fish species during sampling efforts. The 2017 field program was the first year that beach seining was used in Coffee Creek; this was also the first year that young of the year (YOY) Arctic grayling were captured. There was a total of three YOY Arctic grayling visually observed, and one captured in the first seine haul (Table 15; Photo 2). The capture of YOY Arctic grayling suggests that spawning occurs in this region of Coffee Creek.

Table 15. Summary of fish sampling and capture data in Coffee Creek, site CF3.9, during the August 2017 field investigation

Sample Date	Sampling Method	Total Sampling Effort	Number of Fish Captured	Comments
8-Aug-17	Electrofishing	2,049 seconds	39 CCG 7 Juvenile CH 3 GR	EF began at 700 m downstream of site, continued 250 m upstream.
8-Aug-17	Beach seining	36 m²	1 Juvenile GR	BS haul #1 –located 150 m downstream of site
8-Aug-17	Beach seining	70 m²	1 GR	BS haul #2 –located 150 m downstream of site
8-Aug-17	Beach seining	25 m²	1 CCG	BS haul #3 –located 150 m downstream of site
8-Aug-17	Beach seining	32 m²	3 GR	BS haul #4 –located 50 m downstream of site
8-Aug-17	Beach seining	40 m²	8 GR	BS haul #5 –located 50 m downstream of site
8-Aug-17	Beach seining	24.5 m²	3 GR	BS haul #6 –located 50 m downstream of site
8-Aug-17	Beach seining	32 m²	1 GR	BS haul #7 –located 50 m downstream of site
8-Aug-17	Beach seining	60 m²	NFC	BS haul #8 –located 100 m upstream of site
8-Aug-17	Beach seining	40 m²	1 CCG	BS haul #9 –located 100 m upstream of site
8-Aug-17	Beach seining	36 m²	1 Juvenile CH 1 GR	BS haul #10- located 150 m downstream of site
8-Aug-17	Beach seining	60 m²	3 GR 3 Juvenile CH	BS haul #11 located 150 m downstream of site
8, 9-Aug-17	Minnow trapping	278 hr	18 Juvenile CH 3 CCG	12 MT set

NFC = no fish caught; CCG = slimy sculpin; CH = Chinook salmon; GR = Arctic grayling; EF = electrofishing; BS = beach seining; MT = minnow trapping.



Photo 2. Young of the year Arctic grayling captured during beach seining efforts at CF3.5

3.2.2 HALFWAY CREEK

Halfway Creek was extensively sampled using electrofishing and minnow trapping during the 2017 field program. Minnow trapping did not result in any fish captures in Halfway Creek (Table 16). Conversely, electrofishing caught Arctic grayling up to 0.6 km from the creek mouth, and juvenile Chinook salmon up to 0.2 km upstream of the creek mouth (Table 16). Between 0.6 km and 4.5 km upstream from the creek mouth, a total of 2,290 seconds and approximately 1.4 km distance was electrofished, with no fish being captured or observed. These findings are consistent with past fish and 2017 eDNA sampling in this creek, with fish use limited to the lower portions of the drainage.

Table 16. Summary of fish sampling and capture data in Halfway Creek during the August 2017 field investigation

Sampling Site	Sample Date	Sampling Method	Total Sampling Effort	Number of Fish Captured	Comments
HF0.1	2-Aug-17	Minnow trapping	34hr 12m	NFC	2 MT set
	3-Aug-17	Electrofishing	960 seconds	3 Juvenile CH	EF began ~30 m upstream of stream mouth and for continued 100 m upstream
HF0.2	2-Aug-17	Minnow trapping	22hr 50min	NFC	2 MT set
	3-Aug-17	Electrofishing	1,260 seconds	6 GR 2 Juvenile CH	EF began just upstream of HF0.1 and continued for 150 m upstream
HF0.3	3-Aug-17	Electrofishing	858 seconds	1 GR	EF began at HF0.3, continued 250 m upstream

Sampling Site	Sample Date	Sampling Method	Total Sampling Effort	Number of Fish Captured	Comments
HF0.5	2-Aug-17	Minnow trapping	44hr	NFC	2 MT set
HF0.6	3-Aug-17	Electrofishing	638 seconds	1 GR	EF began at HF0.6, continued 220 m upstream
HF0.9	2-Aug-17	Minnow trapping	51hr	NFC	2 MT set
HF1.0	3-Aug-17	Electrofishing	223 seconds	NFC	EF began at HF1.0, continued 100 m upstream
HF1.1	3-Aug-17	Electrofishing	277 seconds	NFC	EF began at HF1.1, continued 140 m upstream
HF1.5	3-Aug-17	Electrofishing	109 seconds	NFC	EF began at HF1.5, continued 60 m upstream
HF2.1	4-Aug-17	Electrofishing	1,155 seconds	NFC	EF began at HF2.1 then continued 585 m upstream
HF4.5	4-Aug-17	Electrofishing	526 seconds	NFC	EF began at HF4.5, continued 530 m upstream

NFC = no fish captured; CH = Chinook salmon; GR = Arctic grayling

3.2.3 LATTE CREEK

On Latte Creek, triple pass electrofishing was employed in an attempt to estimate fish population density using a depletion model (Section 3.2.6). The raw data from the triple pass electrofishing served to provide species presence (Table 17). The capture of exclusively adult and sub-adult grayling is consistent with previous sampling results at this site.

Table 17. Summary of fish sampling and capture data in Latte Creek during the August 2017 field investigation

Sampling Site - Replicate	Sample Date	Sampling Method	Total Sampling Effort	Number of Fish Captured	Pass Number
LC2.7-1	6-Aug-17	Triple Pass EF	402 seconds	4 GR	EF Pass 1
			382 seconds	NFC	EF Pass 2
			364 seconds	NFC	EF Pass 3
LC2.7-2	6-Aug-17	Triple Pass EF	702 seconds	3 GR	EF Pass 1
			530 seconds	1 GR	EF Pass 2
			572 seconds	NFC	EF Pass 3
LC2.7-3	6-Aug-17	Triple Pass EF	673 seconds	6 GR	EF Pass 1
			455 seconds	4 GR	EF Pass 2
			573 seconds	3 GR	EF Pass 3

NFC = no fish caught; GR = Arctic grayling

3.2.4 INDEPENDENCE CREEK

Similar to Latte Creek, Independence Creek was triple pass electrofished with results used in a depletion model (Section 3.2.6). The raw data from electrofishing on Independence Creek served to inform on species presence in the areas sampled. Juvenile Chinook salmon, Arctic grayling, and slimy sculpin were caught in the first and third replicate; the second replicate only captured juvenile Chinook salmon and Arctic grayling. Independence

Creek appears to contain small populations of juvenile Chinook salmon, as well as Arctic grayling and slimy sculpin. The relatively large number of slimy sculpin captured indicates that this reach of Independence Creek contains suitable overwintering habitat; however, eDNA sampling in 2016 and 2017 has not detected the presence of Arctic grayling or Chinook salmon in the late winter.

Table 18. Summary of fish sampling and capture data in Independence Creek during the August 2017 field investigation

Sample Site - Replicate	Sample Date	Fish Sampling Type	Total Sampling Effort	Number of Fish Captured	Pass Number
ID1.9-1	7-Aug-17	Triple Pass EF [a]	1,850 seconds	23 CCG 2 Juvenile CH 2 GR	EF Pass 1
			125 seconds	1 Juvenile CH 1 GR	EF Pass 2
ID1.9-2	7-Aug-17	Triple Pass EF	780 seconds	3 CCG 3 GR	EF Pass 1
			659 seconds	1 GR	EF Pass 2
			589 seconds	1 CCG	EF Pass 3
ID1.9-3	7-Aug-17	Triple Pass EF[b]	845 seconds	6 CCG 2 Juvenile CH 4 GR	EF Pass 1
			695 seconds	1 CCG	EF Pass 2

EF = electrofishing; CCG = slimy sculpin; CH = Chinook salmon; GR = Arctic grayling

[a] The second and third pass were aborted as net became compromised.

[b] The third pass was aborted as due to dead battery, but the failure to capture GR and CH in the second pass would prevent predicting densities for these species.

3.2.5 YT-24

Electrofishing was completed on YT-24. Near the mouth of the creek (50 m upstream) one Arctic grayling was captured (Table 19). Farther upstream, no fish were captured (Table 19). The Arctic grayling was the first fish that has been captured in YT-24 (beyond the back flooded portion of the mouth) since the sampling program began in 2014 (EDI 2017). Investigation of the creek showed that there had been a severe flooding event in the spring which resulted in a significant amount of bedload movement with the stream channel, restructuring much of the creek (Photo 3). This was due to a peak flow event that was associated with a high magnitude rainfall event on July 15, 2017 (Jackson Pers. Comm. 2017). Sections of the stream had moved and were flowing through vegetation (Photo 4). As in previous years, several impediments to fish passage were observed in the lower 2 km of the stream (Photo 5, Photo 6).

Table 19. Summary of fish sampling and capture data in YT-24 during the August 2017 field investigation

Sampling Site	Sample Date	Sampling Method	Total Sampling Effort	Number of Fish Captured	Comments
YT0.1	5-Aug-17	Electrofishing	396 seconds	1 GR	EF began 27 m upstream from mouth and continued for 100 m
YT0.2	5-Aug-17	Electrofishing	1,313 seconds	NFC	EF began at YT0.2, continued 540 m upstream
YT1.9	5-Aug-17	Electrofishing	740 seconds	NFC	EF began at YT1.9, continued 370 m upstream

NFC = no fish caught; GR = Arctic grayling



Photo 3. Mouth of YT-24 showing recently deposited bed material into the Yukon River channel.



Photo 4. A washed-out area of YT-24 where the creek now flows through vegetation.



Photo 5. Cascade on YT-24 located ~1.2 km upstream from the mouth.



Photo 6. Falls (1.05 m high) over debris jam ~1.3 km upstream from the mouth (YT-24).

3.2.6 TRIPLE PASS ELECTROFISHING DEPLETION MODEL

The objective of the 2016 and 2017 triple pass electrofishing programs was to use a depletion model to ascertain fish density in each respective creek. The 2016 field program assessed Latte, Independence, and Coffee Creek, whereas in 2017 Latte and Independence creeks were sampled using this method. These creeks are considered cold, low-productivity creeks, and do not contain large populations of fish. As such, in both years the catches of Arctic grayling and juvenile Chinook salmon were quite low; where present, and slimy sculpin were captured in higher densities (Table 20).

Table 20. 2016 field program fish density results from triple pass electrofishing depletion model.

Creek	Species	Average fish density (fish/100m2 ± SE)
Latte	Arctic grayling	3.47 ± 2.22
Independence	Slimy sculpin	4.37 ± 2.15
Coffee (lower site, CF3.9)	Arctic grayling	3.00 ± 2.08
	Slimy sculpin	12.67 ± 4.06
Coffee (upper site, CF10.0)	Juvenile Chinook salmon	0.40 ± 0.40
	Slimy sculpin	27.41 ± 4.01

Table 21. 2017 field program fish density results from triple pass electrofishing depletion model.

Creek	Species	Average fish density (fish/100m2 ± SE)
Latte	Arctic grayling	4.97 ± 1.89
Independence	Arctic grayling	1.74 ± 0.36
	Juvenile Chinook salmon	0.35 ± 0.35
	Slimy sculpin	2.26 ± 0.16

The depletion results for 2016 had relatively high standard errors, suggesting variable catch data during sampling. These relatively large standard errors are likely due to the high-water levels experienced, resulting in inconsistent 'knock-down' of fish catches between passes. Fish occur in low numbers in these creeks, consequently leading to small sample sizes, which also contributes to large standard errors.

In 2016, slimy sculpin were caught in higher numbers with proportionately lower standard errors than juvenile Chinook salmon or Arctic grayling (Table 20). In 2017, water levels were lower than the 2016 field program and overall conditions appeared to be more conducive for using the depletion model on results. While still not altogether ideal, the 2017 results did more closely satisfy the objective. In Latte Creek the field crew captured more Arctic grayling, leading to a higher population estimate and slightly higher average fish density, but with substantially smaller standard errors than in 2016 (i.e., more precision in average density; Table 21). This suggests that there was little variation between replicates, and each one was a more accurate estimate of Arctic grayling population than in 2016. This is due to the higher catch numbers in 2017, but also because there was a more representative 'knock-down' between passes (i.e., capturing fewer fish each pass). In 2017 there were juvenile Chinook salmon, Arctic grayling, and slimy sculpin captured in Independence, compared with only slimy sculpin caught in 2016 (Table 20, Table 21). None of the species caught were present in particularly high densities, although the 'knock-downs' were generally consistent, resulting in lower standard errors. An exception in both 2016 and 2017 was the capture of juvenile Chinook salmon; they were captured in very low densities and were caught inconsistently in the adjacent replicates that made up a site. Often the juvenile Chinook were only captured in one replicate of a site, leading to many zeros used in the calculation of the mean and standard error (Table 20, Table 21).

Without having more replicates per site, the depletion method of analysis has very low statistical power, and therefore lacks in its utility to accurately inform on changes to fish densities (Table 22, Table 23). With fish occurring at such low numbers, there would need to be an excessive amount of time and electrofishing effort devoted to three pass electrofishing for the depletion method to pass the rigors of statistical testing and analysis post-project. This is primarily a result of the substantial variation in fish population estimates and densities between replicates and sites, reducing statistical power. As an example, the 2016 depletion results and subsequent power analysis on Arctic grayling in Coffee Creek suggested there would need to be 46 replicates to detect a 50% change in the fish population post-project (a requirement of power analysis; Table 22). When the average effort of a replicate is considered (approximately 1,500 seconds of electrofishing for the three passes; Table 15) and the density at which Arctic grayling exist in Coffee Creek, it would take nearly 70,000 seconds (~19.5 hr) of electrofishing for a site before a 50% change can be detected. Even the more modest example of the 2017 Latte Creek Arctic grayling results requires 14 replicates (average 1,500 seconds of electrofishing per replicate; Table 17), resulting in approximately 21,000 seconds of sampling effort before

a 50% change can be detected at the site. In addition to the time spent electrofishing, there is also a substantial amount of time devoted to setting up each replicate site. The depletion method results followed by the power analysis collectively indicate that three-pass electrofishing is not an appropriate metric for measuring changes in fish density post-project.

Table 22. Power analysis results for the 2016 depletion model.

Creek	Site Name	Species	Average density (fish/100m^2)	Power at current density	Post-project replicates per site needed for a power of 0.8
Latte	LC2.7	Arctic grayling	3.47	0.12	30
Independence	ID1.9	Slimy sculpin	4.37	0.17	23
Coffee	CF3.9	Slimy sculpin	27.41	0.93	3
Coffee	CF10.0	Arctic grayling	3.00	0.11	46
Coffee	CF10.0	Slimy sculpin	12.67	0.35	10

Table 23. Power analysis results for the 2017 depletion model.

Creek	Site Name	Species	Average density (fish/100m^2)	Power at current density	Post-project replicates per site needed for a power of 0.8
Latte	LC2.7	Arctic grayling	4.97	0.26	14
Independence	ID1.9	Arctic grayling	1.74	0.06	110
Independence	ID1.9	Slimy sculpin	2.26	1.00	2

3.2.7 FISH TISSUE SAMPLING DATA

Data on retained fish is summarized in the below sections (see APPENDIX D for raw data).

3.2.7.1 Age Data

Several watersheds in the Mine Study Area had Arctic grayling and slimy sculpin aged, with the objective of collecting ten specimens per watershed; this objective was not possible in all creeks due to low densities of fish. Arctic grayling ranged in age from one to 11 years, whereas slimy sculpin ranged in age from one to five years old (Table 24). There was a similar age distribution of Arctic grayling and slimy sculpin present in all the creeks assessed.

Table 24. Arctic grayling and slimy sculpin age data from watersheds within the Mine study area.

Creek	Species	*n*	Age Range (years)	Mean Age (years)
Coffee Creek	Arctic grayling	8	1-8	4.0
Coffee Creek	Slimy sculpin	10	1-3	2.3
Halfway Creek	Arctic grayling	7	3-9	5.4
Latte Creek	Arctic grayling	10	3-9	5.8
Independence Creek	Arctic grayling	7	1-11	5.1
Independence Creek	Slimy sculpin	11	1-5	2.5
YT-24 Creek	Arctic grayling	1	3	3.0

3.2.7.2 Gonads

Gonad weight was sampled from Arctic grayling in various watersheds to provide baseline data on the reproductive potential of individuals rearing in the creeks within the Mine Study Area (Table 25). Individuals in Halfway and Independence Creek had the highest mean gonad weights.

Table 25. Arctic grayling gonad weight from watersheds within the Mine study area.

Creek	Species	*n*	Gonad weight range (g)	Mean gonad weight (g)[a]
Coffee Creek	Arctic grayling	9	<0.1 – 2.7	0.8
Halfway Creek	Arctic grayling	7	<0.1 – 4.4	1.2
Latte Creek	Arctic grayling	10	<0.1 – 1.9	0.6
Independence Creek	Arctic grayling	7	<0.1 – 4.4	2.2
YT-24 Creek	Arctic grayling	1	<0.1	<0.1

[a] For determining mean gonad weight, in the case of a <0.1 reading, 0.1 was used to average.

3.2.7.3 Arctic grayling diets

Arctic grayling within the study area were found to be opportunistic in their diet composition and consumed a variety of items (Table 26; APPENDIX D). Primarily Arctic grayling consumed insects (e.g., chironomids, mayfly and stonefly larvae, adult flies, ants), although in several fish there was a significant amount of organic debris in their stomach content (e.g., coniferous needles, twigs, woody debris).

Table 26. Diet composition of Arctic grayling from watersheds within the Mine study area.

Creek	Species	*n*	Diet composition (primary; secondary)
Coffee Creek	Arctic grayling	8	Insects
Halfway Creek	Arctic grayling	2	Insects; Organic debris
Latte Creek	Arctic grayling	10	Insects
Independence Creek	Arctic grayling	7	Insects; Organic debris
YT-24 Creek	Arctic grayling	1	Insects

3.3 FISH HABITAT INVESTIGATIONS

Habitat investigations were completed on Halfway Creek and headwater drainages within the proposed mine footprint. Site card and stream attribute data can be found in APPENDIX C.

3.3.1 HALFWAY CREEK

The Halfway Creek watershed is narrow with few significant tributaries to the lower and middle section of the creek. Based on habitat characteristics Halfway Creek was split into four stream reaches, with the main difference between the reaches being gradient, which became progressively steeper moving in an upstream direction (Table 27).

Table 27. Summary of biophysical characteristics of the four reaches of Halfway Creek.

Reach Number	Site Card Location	Channel Width (m)	Gradient (%)	Bed Material (dominant/subdominant)	Total Cover	Dominant Cover Type
1	HF0.2	4.80	2.25	Cobble/gravel	Moderate	Undercut bank
2	HF2.7	2.66	4.25	Boulder/cobble	Moderate	Boulder
3	HF8.8	2.60	10.5	Boulder/cobble	Trace	Undercut bank, boulders
4	HF9.5	0.94	14	Boulder/cobble	Trace	Boulder

Reach 1 extends from the mouth to 1.1 km upstream (straight line distance; Figure 11). This reach is characterized by low gradients (~2 %), with cobble/gravel dominated bed material, a several deep pools and a moderate amount of cover for fish (Photo 7). Previous to 2017, fish had only been documented in the lower 350 m; however, in 2017 a grayling was captured 600 m upstream of the mouth. There is a logjam barrier, with a 0.8 m falls, at HF0.9 which currently would pose a barrier to upstream fish passage. While this barrier is not permanent, no fish have been captured in the area immediately (300 m) downstream of the falls.

Reach 2 extends from 1.1 km to 6.5 km upstream from the mouth. This reach has a moderate gradient (~4.5 %) and is dominated by boulder and cobble bed material (Photo 8). Cover for fish is dominated by boulders with pools and small woody debris providing areas of cover. There are notable areas of shallow fast flow with limited fish habitat. There are numerous (24) impediments to fish passage throughout this reach; while none represent a permanent barrier to fish they are an indication of the difficulty associated in accessing this seasonal habitat (Figure 11). A 15% cascade over 10 m was documented at the upper end of this reach (Photo 9). Temperatures were very low in this reach despite warm summer conditions during the survey (3.3°C at HF2.7 at 10:30 hrs, August 4).

Reach 3 extends from the 15% cascade 7.8 km upstream of the mouth to the junction of the 2nd order streams in the upper watershed (9.4 km from mouth). This reach is characterized by a narrower channel, steeper gradients and faster flow (Photo 10). Cover is provided by undercut banks and boulders. Snow/ice was found

during the August survey in a side channel ~8.1 km from the mouth, temperatures in the main channel above this snow/ice was 2.6 °C at 11:30 hrs on August 9.

Reach 4 extends from the junction of two 2nd order streams upstream to near the top of the watershed. The stream is small (<1 m channel width), has a higher average gradient than the rest of the stream (~14%) and has generally poor fish habitat (Photo 11).

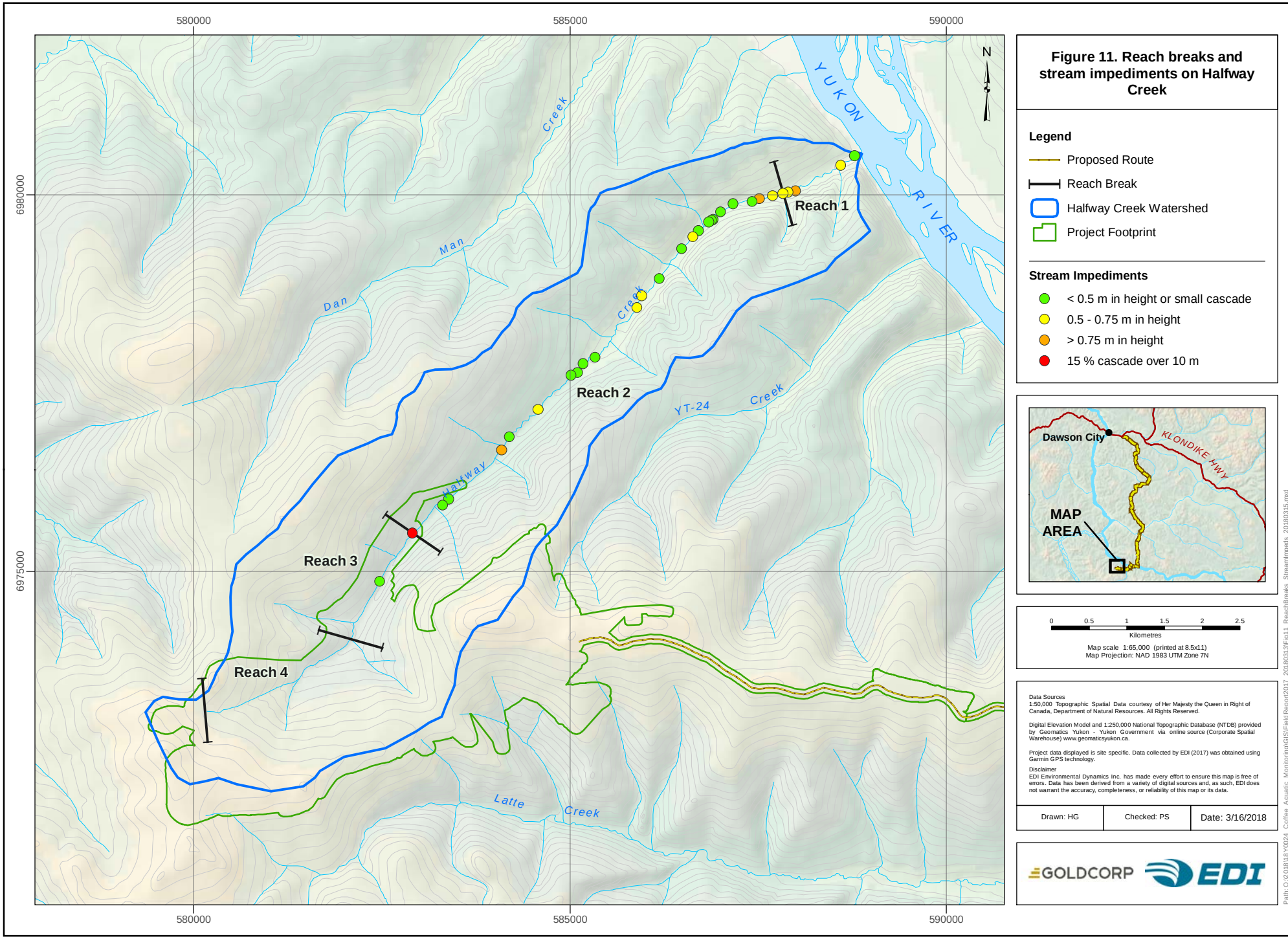

Figure 11. Reach breaks and stream impediments on Halfway Creek

Legend

- Proposed Route
- Reach Break
- Halfway Creek Watershed
- Project Footprint

Stream Impediments

- < 0.5 m in height or small cascade
- 0.5 - 0.75 m in height
- > 0.75 m in height
- 15 % cascade over 10 m

0 0.5 1 1.5 2 2.5
Kilometres

Map scale 1:65,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Data collected by EDI (2017) was obtained using Garmin GPS technology.

Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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Photo 7. Upstream view of pool habitat in Reach 1 of Halfway Creek near the mouth of the stream.



Photo 8. Upstream view of Reach 2 of Halfway Creek.



Photo 9. Cascade at the upper end of Reach 2 with 15% gradient (Halfway Creek).



Photo 10. Upstream view of Reach 3 of Halfway Creek in an area with shallow flow and moderate gradient.



Photo 11. Upstream view of Reach 4 of Halfway Creek.

3.3.2 FOOTPRINT DRAINAGES

All drainages within the mine footprint were walked and assessed for stream characteristics. A summary of the findings are presented below (Figure 12).

Latte Tributary B

This tributary was assessed in 2016 (EDI 2017) and was determined to be a seepage area.

Latte Tributary C

The lower portion of this tributary to Latte Creek was surveyed in 2016 and found to be not suitable for fish beyond the 15 m from the mouth (EDI 2017). Within the project footprint, the lower 400 m is a small stream (0.6 m channel width) with a high gradient (20%) and due to its location in the watershed, steep gradient, small size and lack of pools does not provide any fish habitat (Photo 12). Further upstream, the drainage goes subsurface with occasional flow over organics and through terrestrial vegetation (Photo 13).

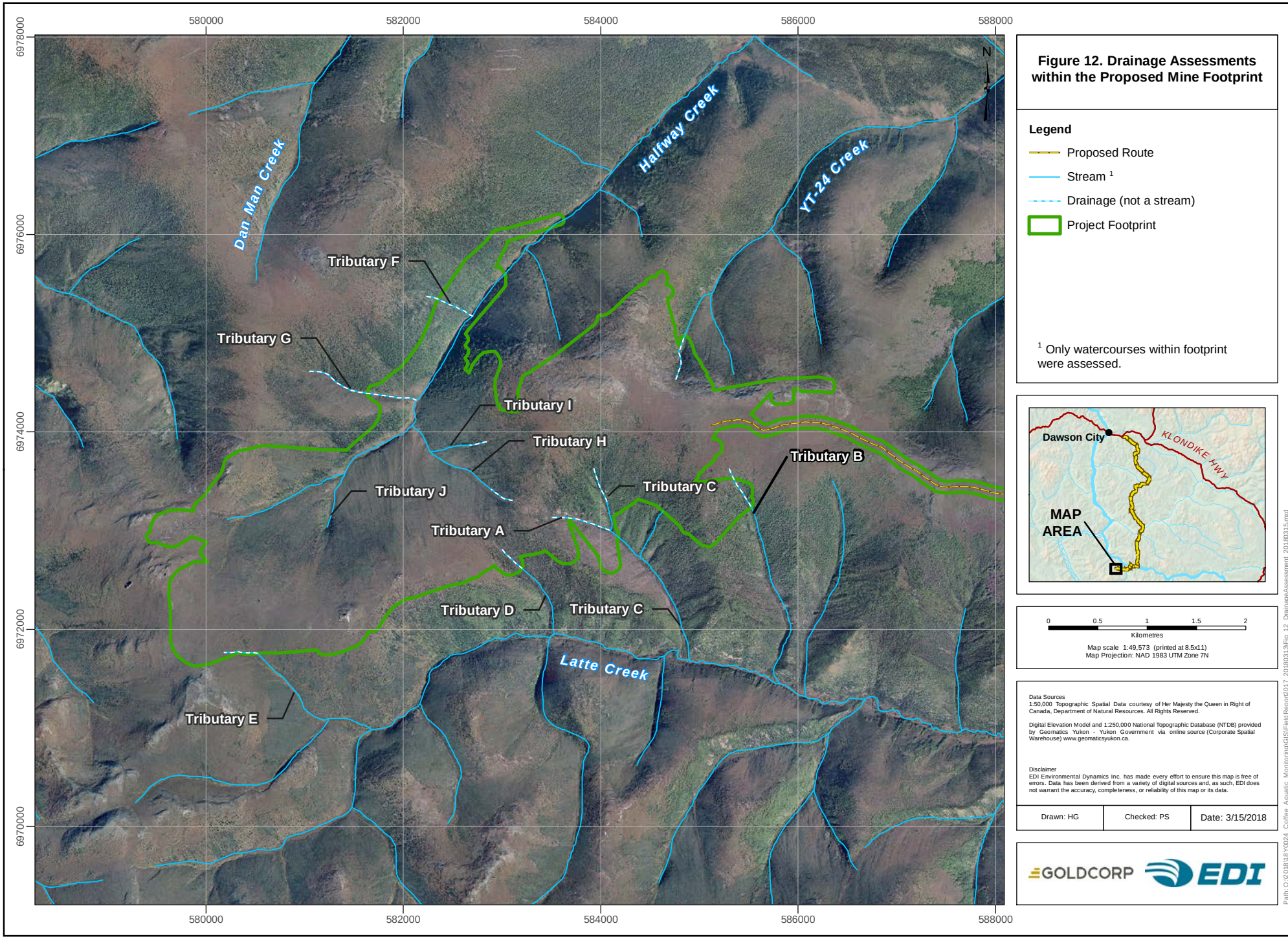

Figure 12. Drainage Assessments within the Proposed Mine Footprint

Legend

- Proposed Route
- Stream [1]
- Drainage (not a stream)
- Project Footprint

[1] Only watercourses within footprint were assessed.

0 0.5 1 1.5 2
Kilometres

Map scale 1:49,573 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

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Photo 12. Upstream view of Latte Tributary C at the project footprint boundary.



Photo 13. Upstream view of Tributary C flowing over vegetation ~200 m upstream of the footprint boundary.

Latte Tributary A

This drainage flows into Latte Tributary C near the border of the project footprint (Figure 12). This drainage had areas of spread out seepage flow (Photo 14) and areas of subsurface flow. Small isolated patches of alluvial bed material were found; however, the drainage was dominated by flow over moss and through vegetation. This drainage is not a stream.



Photo 14. Upstream view of Latte Tributary A showing spread out seepage flow through vegetation.

Latte Tributary D

Crews walked 100 m on each side of mapped drainage at and downstream of the project footprint boundary; no signs of surface or subsurface flow were found within this area. This area is a forested hillside with no drainage present (Photo 15).



Photo 15. View of the forested area in the location of this mapped drainage (Tributary D). No evidence of flow.

Latte Tributary E

The extent within the project footprint was found to be a depression with areas of intermittent flow. Flow was often subsurface and alluvial material was not present (Photo 16). This drainage is not a stream.



Photo 16. Upstream view of Latte Tributary E.

YT-24

The uppermost portion of YT-24 within the project footprint had minimal evidence of surface flow, no channel and no alluvial bed material (Photo 17). This portion of the drainage is not a stream.



Photo 17. Upstream view of YT-24 at the project footprint boundary.

Halfway Tributary F

This was a small drainage with minimal flow and no streambanks or alluvial bed material (Photo 18). Flow is over organics and vegetation; this drainage was considered a seepage area.



Photo 18. Upstream view of Halfway Tributary F near the confluence with Halfway Creek.

Halfway Tributary G

This drainage had notable flow in the lower 100 m; however, much was subsurface or over moss or organics with a few isolated pockets of alluvial bed materials and no continues streambanks (Photo 19). Further upstream, 200 m from the mouth, there was no detectable flow with signs of seasonal flow over moss. This was not a stream.



Photo 19. Upstream view of Halfway Tributary G near the confluence with Halfway Creek showing discontinuous ponded water.

Halfway Tributary J

This drainage had a stream channel for its entire mapped extent. In fact, it extended even further upstream for approximately 150 m before losing channel characteristics. Near the mouth, the stream was small (0.35 m) with poor habitat (shallow with a gradient of 15%) within a thick alder riparian (Photo 20). Water temperature was 1.6 °C measured in the late afternoon of a warm day (Aug 9th, 2017).



Photo 20. Upstream view of Halfway Tributary J in a rare open patch of riparian.

Halfway Tributary H

The upper portion this tributary had flow over moss and vegetation with discontinuous channels running in multiple directions (Photo 21). Approximately 200 m downstream of the origin of the mapped drainage a groundwater spring enters the watercourse and increases flow significantly. Below this point the drainage tuned into a stream and had relatively consistent alluvial materials within a poorly defined channel (Photo 22). The stream is very shallow and flowed underground in places. The stream was larger downstream near the mouth (0.6 m wide); however, had sections with a gradient of over 20% and poor fish habitat (EDI 2017).



Photo 21. Upstream view of the upper portion of Halfway Tributary H, with discontinues channel and flow over moss.



Photo 22. Upstream view of middle portion of Halfway Tributary H with alluvial materials in a poorly defined channel.

Halfway Tributary I

The upper 200 m of this drainage had signs of flow over/through vegetation with no scouring or channel formation (Photo 23a). Below this point the drainage had relatively consistent alluvial materials within a poorly developed inconsistent channel (Photo 23b). The lower portion of the drainage was determined to be a stream based on the presence of alluvial materials; however, there was no habitat for fish due to gradient, water depth and inconsistent channel formation (area with underground and flow over/through vegetation).



Photo 23. (a) denotes the upper portion of the Tributary I (not a stream), while (b) illustrates the lower part of drainage with alluvial materials (stream).

3.4 CHINOOK SPAWNING SURVEYS

Despite good viewing conditions during all surveys, no adult Chinook salmon, carcasses or salmon redds were observed during any of the Chinook spawning surveys. Also, there were no observations of wildlife such as bears or eagles which typically feed on salmon during the spawning season.

3.5 METAL CONCENTRATIONS IN TISSUES

Metal concentrations in fish and benthic invertebrates are described in the following sections. Laboratory data is presented in APPENDIX E.

3.5.1 METAL CONCENTRATIONS IN FISH TISSUE

In 2017, Arctic grayling and slimy sculpin samples were collected from Latte, Independence, Halfway, Coffee and YT-24 creeks; muscle and liver tissues were collected from Arctic grayling, and full body samples (minus heads) were collected from sculpin.

Currently, there is a Health Canada human consumption guideline for total mercury, and a CCME tissue residue guideline for wildlife consumers of aquatic biota for methylmercury (Environment Canada 2002). These guidelines are for muscle or whole-body samples and were not designed for liver samples. There are no federal guidelines for tissue concentrations of selenium. There is a BC MOE tissue guideline for selenium (BC MOE 2014), however this guideline was developed for use in British Columbia, and not for broader application in other regions with different aquatic biota populations, and different baseline concentrations of selenium in the aquatic environment (fish throughout Yukon commonly exceed this level). Further, the BC MOE guideline incorporates an unnecessarily high built-in safety factor, given the steep nature of the dose-response curve. The US Environmental Protection Agency (EPA) has developed more broadly applicable guidelines for both muscle tissue and whole-body samples (8.5 mg/kg dw for whole body and 11.3 mg/kg dw for fish tissue, US EPA 2016). There are no guidelines for uranium concentrations in tissues, however, uranium concentrations in fish tissues were analysed as uranium is naturally elevated in some streams in the Mine study area (especially during low flows).

3.5.1.1 Arctic Grayling

In 2017, liver and muscle tissue samples were collected from 10 Arctic grayling in Latte Creek (site LC2.7), one grayling captured at the mouth of YT-24, seven grayling in Independence Creek (site ID1.9), seven grayling in Halfway Creek (site HF0.2), and nine fish in Coffee Creek (CF3.9). Metal concentrations were higher in liver tissue samples than muscle tissue samples for mercury, selenium and uranium.

The lowest estimated methylmercury (MeHg) concentrations found in muscle tissue and liver tissue samples were from YT-24, at 0.0275 mg/kg and 0.057 mg/kg respectively (Figure 13). Coffee Creek had the highest mean estimated MeHg concentration in a liver tissue sample, with a concentration of 0.170 mg/kg ww, and

Latte Creek had the highest mean estimated MeHg concentration in a muscle tissue sample at 0.061 mg/kg (Figure 13). Many of the muscle tissue samples also exceeded the CCME tissue residue guidelines, except for three muscle samples from Coffee Creek, three samples from Halfway Creek, two samples from Independence Creek, one sample from Latte Creek, and the one sample from YT-24.

The lowest mean selenium concentrations found in a muscle tissue sample was from Latte Creek, at 2.54 mg/kg dw, and the highest mean selenium concentration found in a muscle tissue sample was from YT-24, with a concentration of 4.65 mg/kg dw (Figure 14). All muscle tissue samples were below the US EPA guideline for selenium (11.3 mg/kg dw). The lowest mean selenium concentration, 14.09 mg/kg dw, was in a liver tissue sample was from Halfway Creek (HF0.2); the highest mean selenium concentration, 24.52 mg/kg dw, was in a liver tissue sample from Independence Creek (Figure 14).

The lowest mean uranium concentration found in a muscle tissue sample was from Latte Creek, at 0.0015 mg/kg, and the lowest mean uranium concentration found in a liver tissue sample was from YT-24, at 0.0021 mg/kg (Figure 15). The highest mean uranium concentration found in muscle and liver tissue samples was from Coffee Creek, at 0.0040 mg/kg and 0.0073 mg/kg respectively (Figure 15).

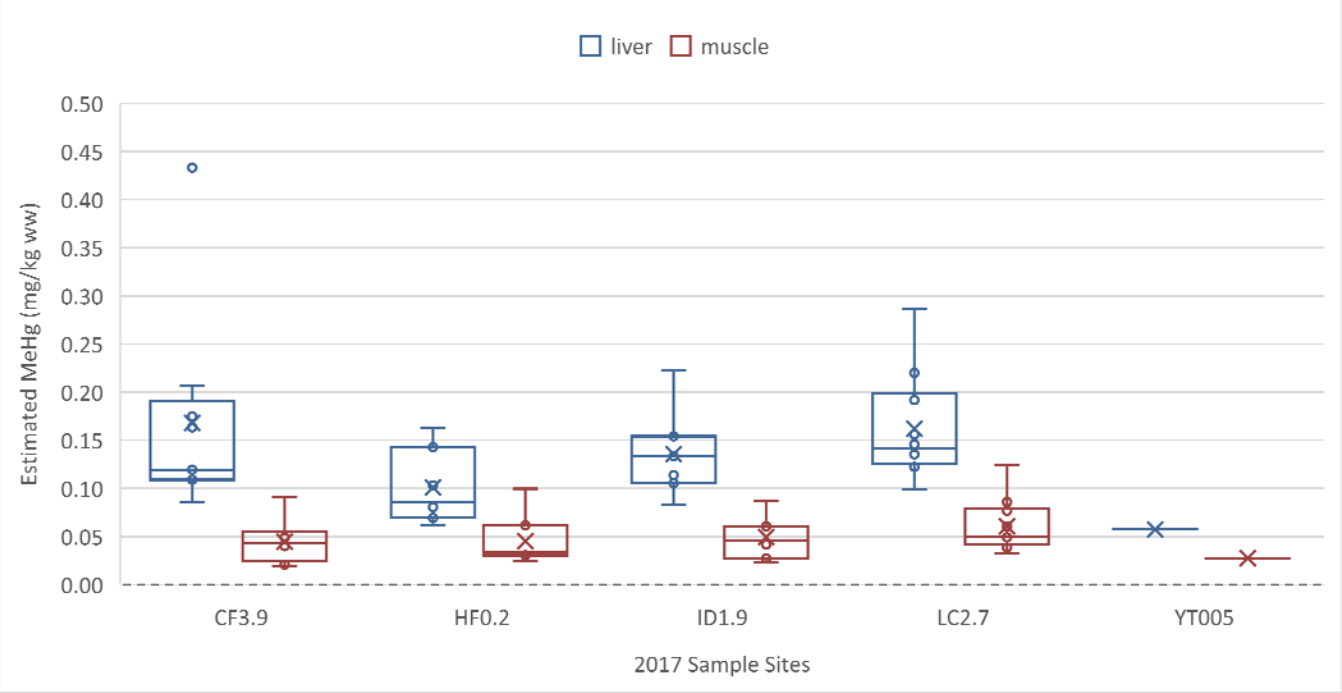

Figure 13. Estimated methylmercury concentrations in Arctic grayling liver and muscle tissue samples from 2017. Box plots were used to display the results in the context of the catch variability per set. The mean value is displayed by an x, the box showing the interquartile range. The vertical lines ('whiskers') show values within 1.5 times the interquartile range. The dots outside the vertical lines represent the outliers, which are more than 1.5 times the interquartile range. The dashed grey line is the CCME methylmercury guideline for the protection of wildlife consumers of aquatic biota (CCME 2000a) and is not applicable to liver tissues.

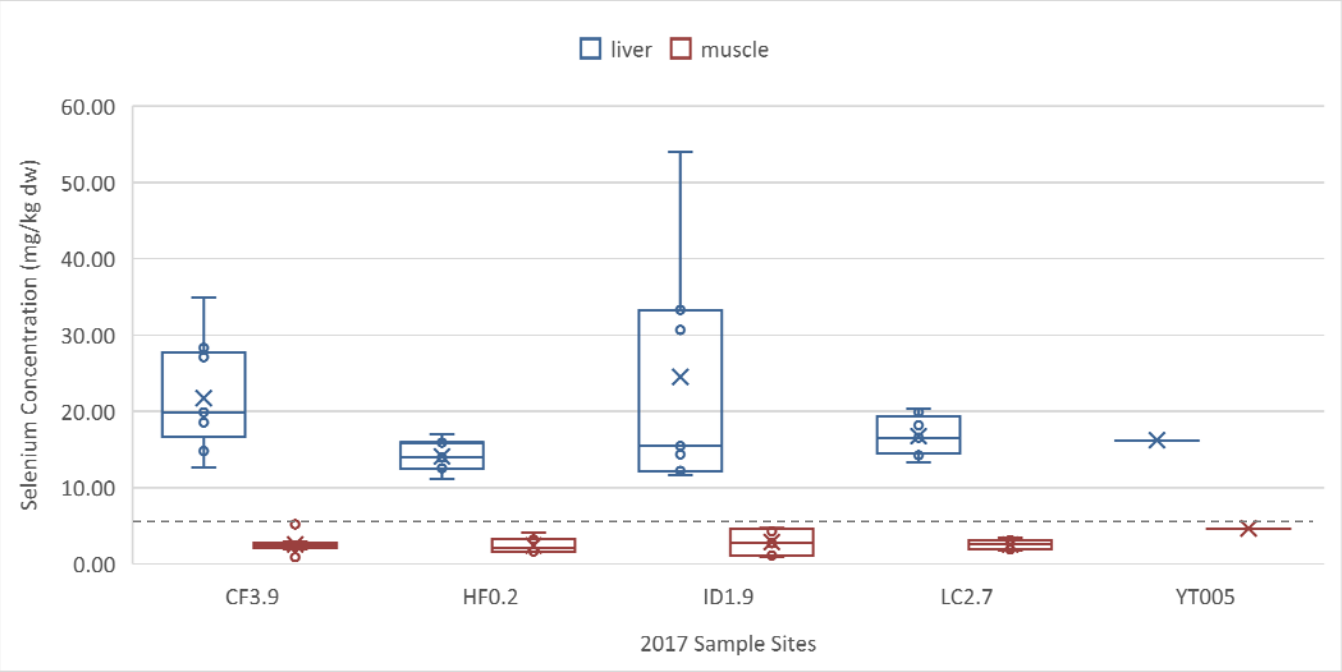

Figure 14. Selenium concentrations in Arctic grayling liver and muscle tissue samples from 2017. The dashed grey line is the US EPA selenium guideline for freshwater aquatic life for tissue samples (US EPA 2016) and is not applicable to liver tissues.

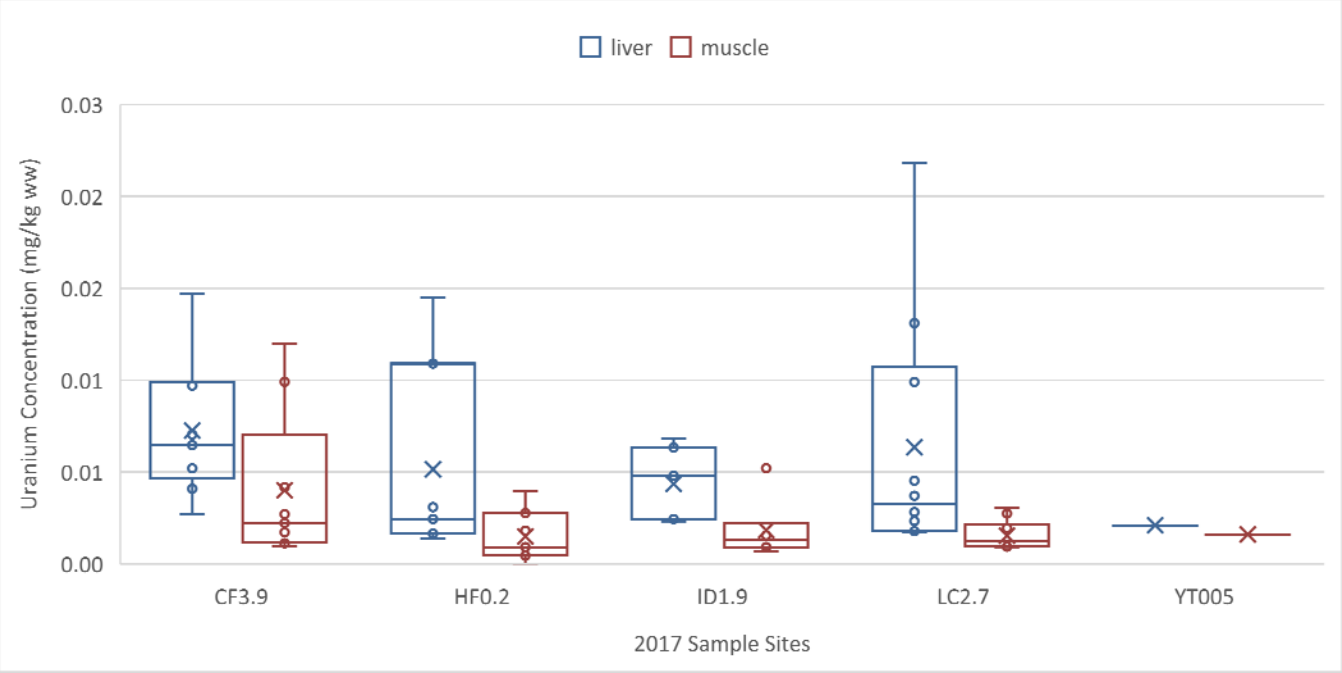

Figure 15. Uranium concentrations in Arctic grayling liver and muscle tissue samples from 2017. The dots outside the vertical lines represent the outliers, which are more than 1.5 times the interquartile range.

Baseline total mercury concentrations in all Arctic grayling muscle tissues did not exceed the Health Canada guideline for human consumption (0.5 mg/kg ww; Health Canada 2007; Table 28; APPENDIX E). In

contrast, estimated methylmercury concentrations (95% of total mercury concentrations, Jewett et. al. 2003) in most of the Arctic grayling muscle tissue samples from all the creeks sampled in 2017 were above the CCME tissue residue guideline for the protection of piscivorous wildlife (0.033 mg/kg ww; CCME 2000a). Selenium concentrations in Arctic grayling muscle tissue did not exceed the EPA's interim guideline for selenium (11.3 mg/kg dw; EPA 2016).

Table 28. Number of Arctic grayling muscle tissue samples that exceed mercury, methylmercury and selenium guidelines, in 2017.

Creek	Sample Type	No. of samples above mercury guideline (0.5 mg/kg ww)	No. of samples above MeHg guideline (0.033 mg/kg ww)	No. of samples above selenium guideline (11.3 mg/kg dw)
Coffee	muscle (N=9)	0	6	0
Halfway	muscle (N=7)	0	4	0
Independence	muscle (N=7)	0	5	0
Latte	muscle (N=10)	0	9	0
YT-24	muscle (N=1)	0	0	0

3.5.1.2 Slimy Sculpin

Twenty-one slimy sculpin tissue samples were collected in 2017, including 11 samples from Independence Creek (site ID1.9) and 10 samples from Coffee Creek (site CF3.9).

The mean estimated MeHg, selenium, and uranium concentrations from the slimy sculpin tissue samples were higher in Coffee Creek than in Independence Creek. The mean estimated MeHg from Coffee Creek (CF3.9) was 0.070 mg/kg ww, and 0.051 mg/kg ww at Independence Creek (ID1.9); all the samples from both creeks exceeded the CCME methylmercury guideline (Figure 16). The mean selenium concentration was 6.668 mg/kg dw at Coffee Creek (CF3.9) and 4.531 mg/kg dw at Independence Creek (ID1.9); all samples from both creeks had selenium concentrations less than the US EPA selenium guideline (Figure 17). The mean uranium concentration was 0.082 mg/kg in Coffee Creek (CF3.9), and 0.051 mg/kg at Independence Creek (ID1.9; Figure 18).

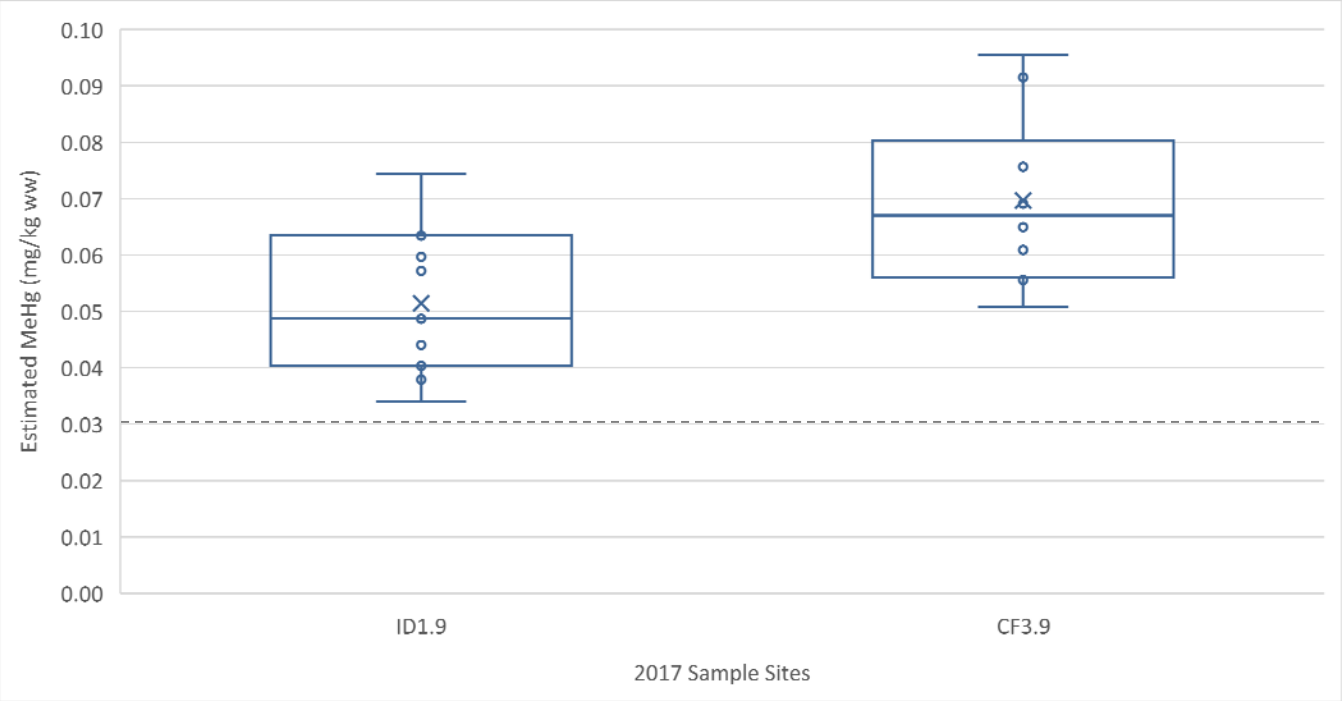

Figure 16. Estimated methylmercury concentrations in slimy sculpin whole-body tissue samples from 2017. The mean value is displayed by an x, the box showing the interquartile range. The vertical lines ('whiskers') show values within 1.5 times the interquartile range. The dots outside the vertical lines represent the outliers, which are more than 1.5 times the interquartile range. The dashed grey line is the CCME methylmercury tissue residue guideline for the protection of wildlife consumers of aquatic biota (Environment Canada 2002).

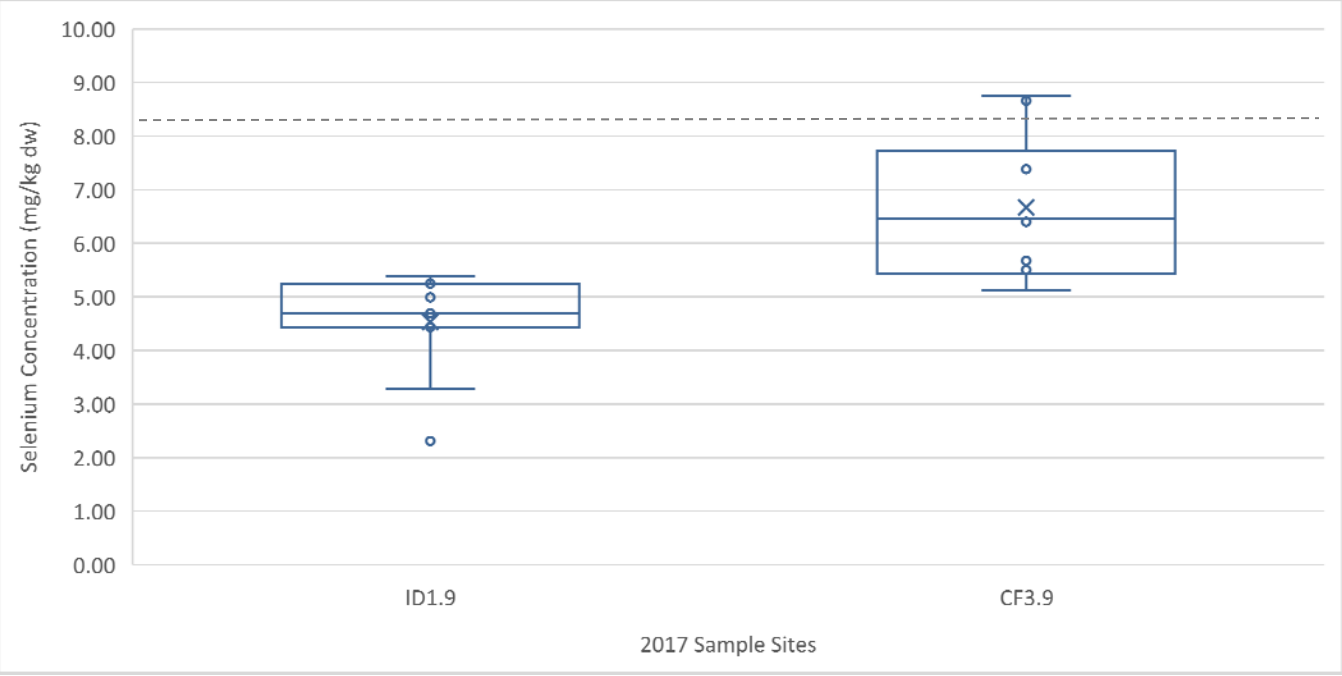

Figure 17. Selenium concentrations in slimy sculpin whole-body tissue samples from 2017. The dashed grey line is the US EPA selenium guideline for freshwater aquatic life for whole body tissue samples (US EPA 2016).

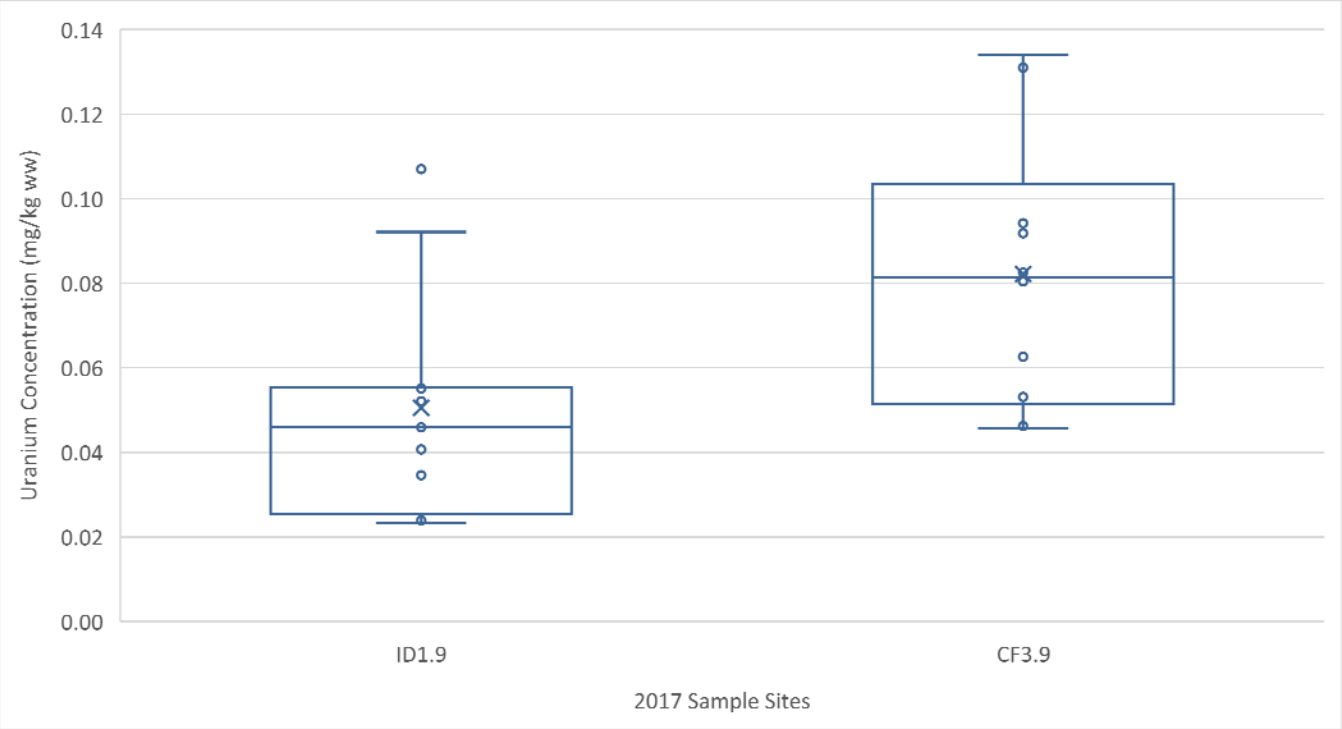

Figure 18. Uranium concentrations in slimy sculpin whole-body tissue samples from 2017. The mean value is displayed by an x, the box showing the interquartile range.

The Health Canada guideline for total mercury does not apply to slimy sculpin because they are not a human food source (Health Canada 2007). The estimated methylmercury concentrations (81% of total mercury concentrations, Raymond et al. 2005) exceeded the CCME tissue guideline (0.033 mg/kg ww; CCME 2000a) in all the slimy sculpin samples from Coffee Creek and Independence Creek in 2017 (Table 29). Selenium concentrations were below the EPA's guideline (8.5 mg/kg dw; EPA 2016) in all the whole-body slimy sculpin samples from Independence Creek. All but two sampled from Coffee Creek were below the EPA selenium guideline in 2017.

Table 29. Number of slimy sculpin whole-body samples compared to mercury, methylmercury, and selenium guidelines in 2017.

Creek	Sample Type	No. above mercury guideline (0.5 mg/kg ww)	No. above MeHg guideline (0.033 mg/kg ww)	No. above selenium guideline (8.5 mg/kg dw)
Coffee	whole-body (N=10)	0	10	2
Independence	whole-body (N=11)	0	11	0

3.5.2 METAL CONCENTRATIONS IN BENTHIC INVERTEBRATES AND PERIPHYTON

Benthic invertebrate samples were collected in August 2017. Benthic invertebrate tissue metal concentration guidelines exist for methylmercury (0.033 mg/kg ww, CCME 2000a). No guidelines exist for uranium; however, uranium concentrations were analysed as uranium can be naturally elevated in some streams in the Project Area.

The highest mean estimated MeHg concentration, 0.0319 mg/kg ww, was from samples collected at upper Latte Creek (LC9.9; Figure 19). The lowest mean estimated MeHg concentration, 0.0051 mg/kg ww, was from samples collected at lower YT-24 (YT0.2). In Coffee Creek, the mean estimated MeHg concentrations decreased moving upstream; the highest mean MeHg concentration, 0.0181 mg/kg ww, was from CF3.9, and the lowest, 0.0089 mg/kg ww, was from CF10.0 (Figure 19). Estimated methylmercury concentrations in all benthic invertebrate tissue samples (54% of total mercury, Lucotte and Tremblay 1997) did not exceed the CCME guideline set for the protection of piscivorous wildlife (0.033 µg/g ww; CCME 2000a), except for one sample from Latte Creek (Figure 19).

The highest mean selenium concentration was from lower Coffee Creek (CF3.9), at 10.41 mg/kg dw; the lowest mean selenium concentration, (0.051 mg/kg dw) was from upper YT-24 (YT5.0; Figure 20). In Coffee and Latte creeks, the mean selenium concentration increased moving downstream. However, in Halfway Creek and YT-24, the mean selenium concentrations were higher at the upstream site compared to the downstream site.

The highest mean uranium concentration, 3.092 mg/kg ww, was from benthic invertebrates collected at upper Halfway Creek (HF6.3; Figure 21). The lowest mean uranium concentration, 0.0908 mg/kg ww, was from upper YT-24 (YT5.0; Figure 21). In Coffee Creek, the highest mean uranium concentration was from the mid-creek site, CF8.0, and the lowest mean uranium concentration was at the downstream site CF3.9. In Latte and Halfway creeks, the mean uranium concentration was higher at the upstream sites compared to the downstream. Mean uranium concentrations in YT-24 were higher at the downstream site.

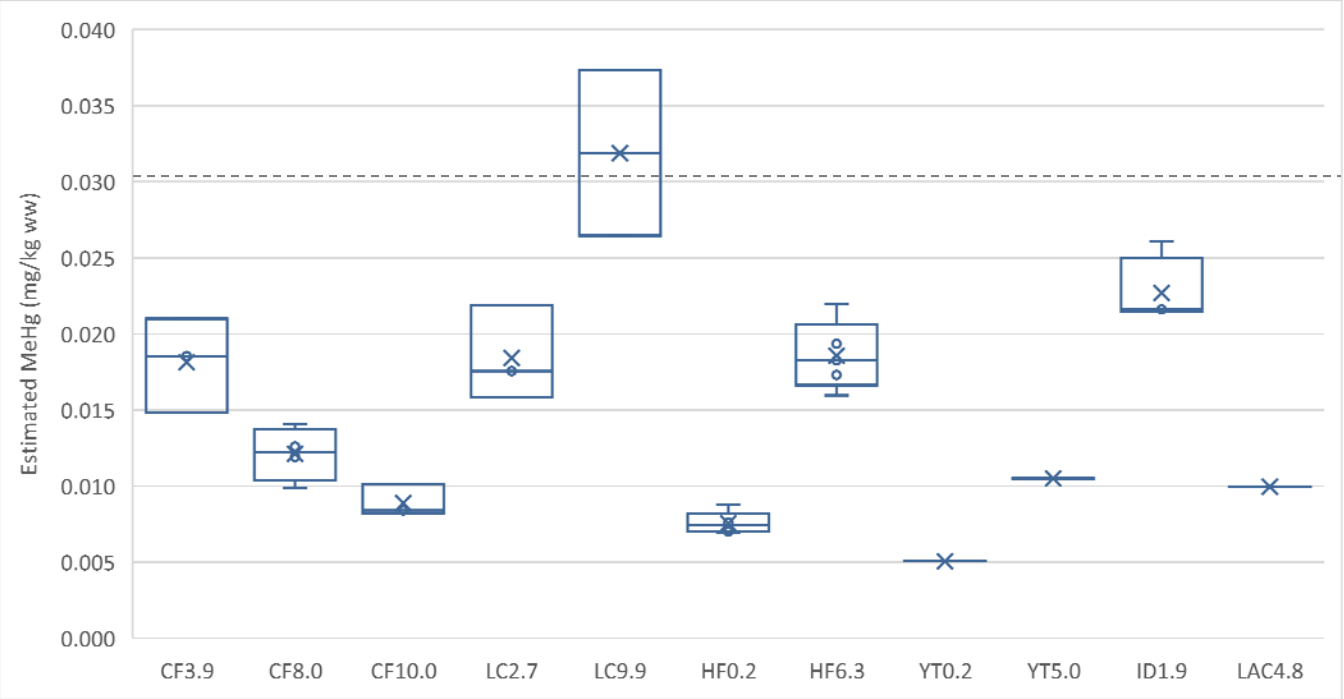

Figure 19. Estimated methylmercury concentrations in benthic invertebrate tissue samples from 2017. The mean value is displayed by an x, the box showing the interquartile range. The vertical lines ('whiskers') show values within 1.5 times the interquartile range. The dots outside the vertical lines represent the outliers, which are more than 1.5 times the interquartile range. The dashed grey line is the CCME methylmercury guideline for the protection of wildlife consumers of aquatic biota (CCME 2000a).

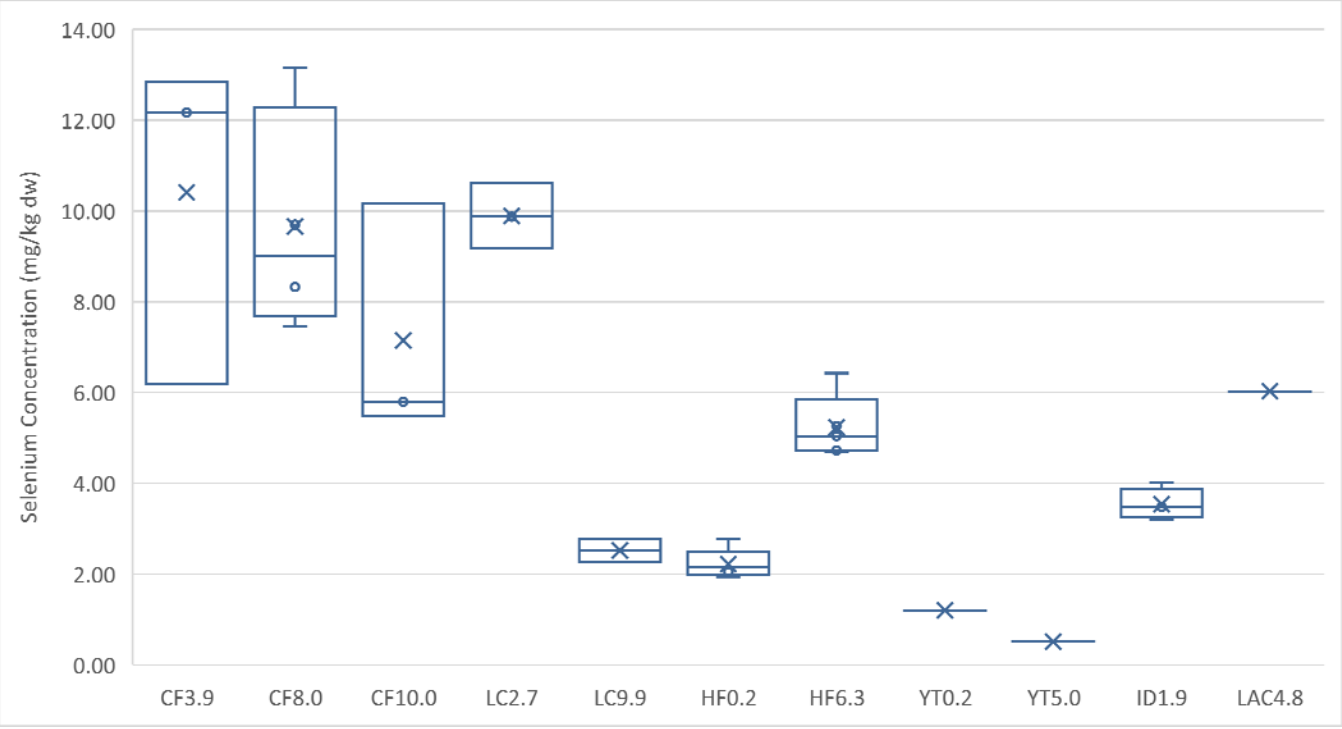

Figure 20. Selenium concentrations in benthic invertebrate tissue samples from 2017.

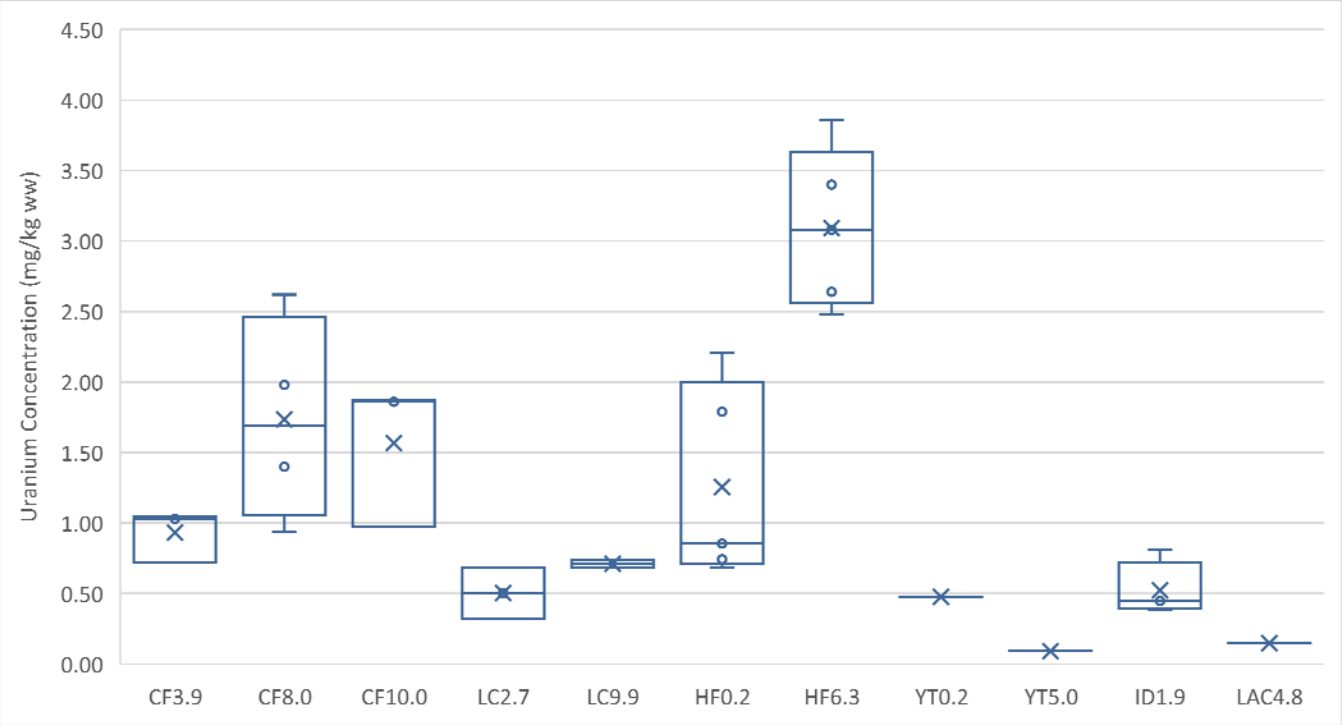

Figure 21. Uranium concentrations in benthic invertebrate tissue samples from 2017.

3.5.3 METAL CONCENTRATIONS IN PERIPHYTON TISSUES

Concentrations of metals in periphyton tissues were collected for the first time in 2017 (APPENDIX E). In general, periphyton is present in streams in the Project Area in very small amounts, limiting the sites that samples could be collected from, as well as the number of replicates that were collected at each site.

Total mercury concentrations were highest in periphyton collected from Independence Creek (ID1.9), where the mean concentration was 0.056 mg/kg ww, followed by Latte Creek (LC2.7) with a concentration of 0.044 mg/kg ww (Figure 22). Concentrations in Coffee Creek were similar across all sites with mean total mercury concentrations of 0.027 mg/kg ww, 0.029 mg/kg ww and 0.031 mg/kg ww, respectively at CF10.0, CF8.0 and CF3.9 (Figure 22). Total mercury concentrations were low in periphyton collected from lower Halfway Creek (HF0.2), with a concentration of 0.026 mg/kg ww (Figure 22).

Detection limits for selenium in periphyton tissues varied due to the small sample sizes, making review of the data difficult. Measurable tissue concentrations were similar across the project area, ranging from 0.104 mg/kg ww in samples from ID1.9 to 0.175 mg/kg ww in periphyton tissues collected from LC2.7 (APPENDIX E).

Uranium concentrations were highest in periphyton tissues collected from Halfway Creek, with a mean concentration of 5.335 mg/kg ww (Figure 23). As with mercury, uranium concentrations in periphyton collected from Coffee Creek were similar across all sampling locations, with mean concentrations of 2.442 mg/kg ww, 2.804 mg/kg ww, and 2.890 mg/kg ww, respectively at CF10.0, CF8.0 and CF3.9 (Figure

23). The lowest uranium concentration in periphyton tissues was in samples from Independence Creek (ID1.9), with a concentration of 0.767 mg/kg ww (Figure 23).

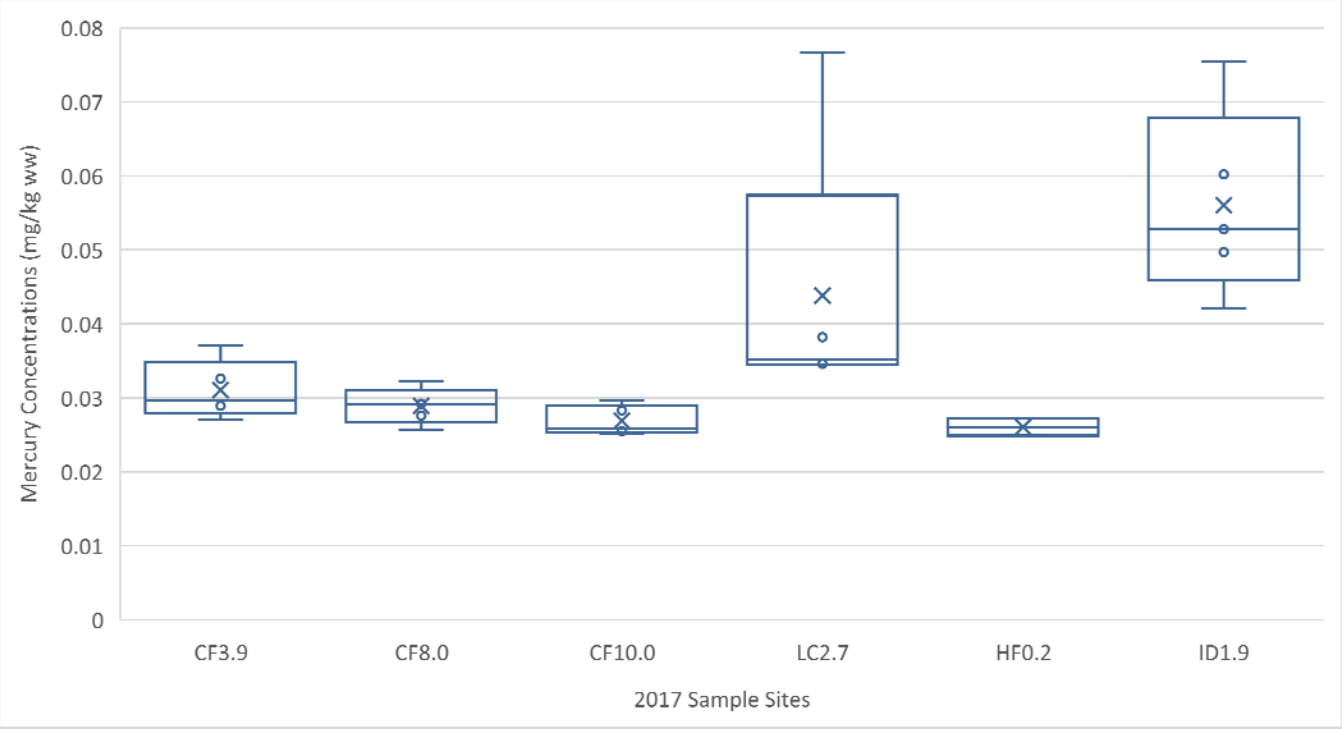

Figure 22. Mercury concentrations in periphyton tissue samples from 2017.

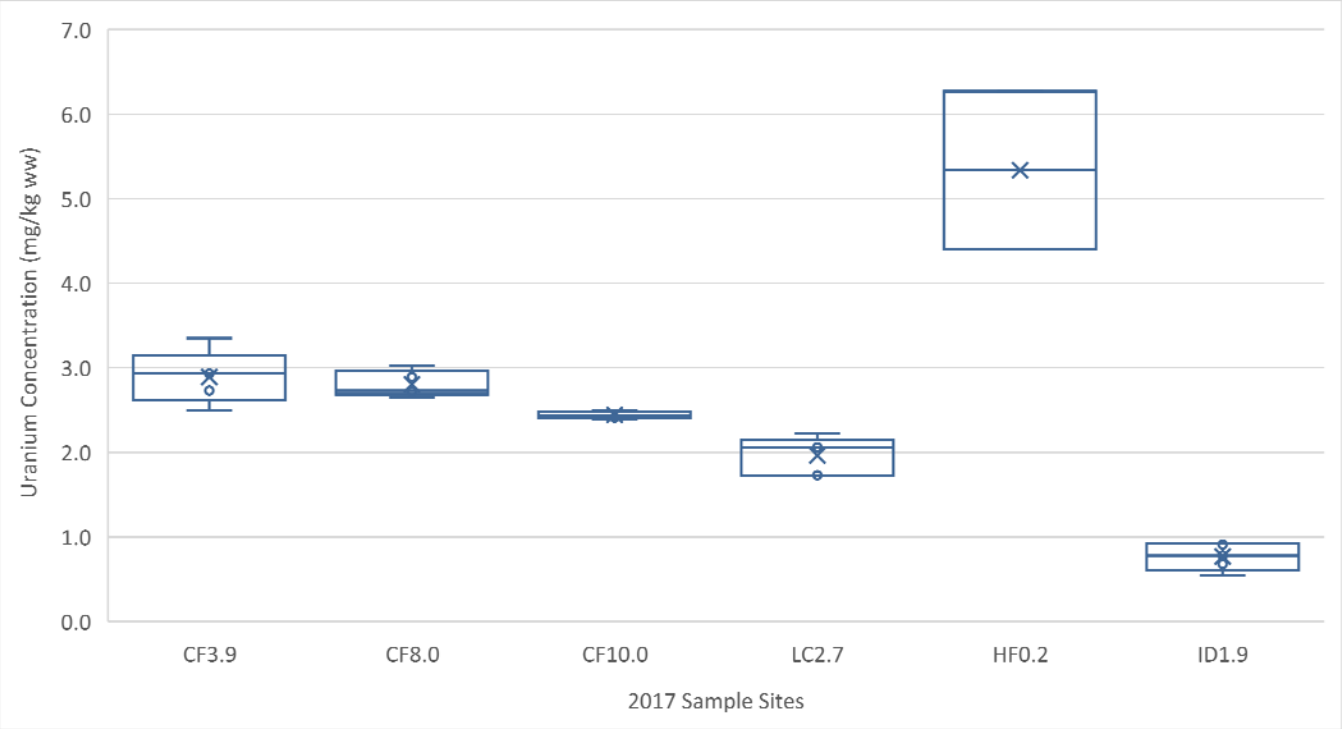

Figure 23. Uranium concentrations in periphyton tissue samples from 2017.

3.6 BENTHIC INVERTEBRATE COMMUNITY

The BEAST analysis indicated that all test sites and reference sites in 2017 belonged to Group 2 with membership probabilities ranging from 84.4% to 97.6%. As such, all test site data and reference site data were compared to Group 2 reference sites in the Yukon 2013 reference model. In 2014/2015, almost all test sites and reference sites belonged to Group 1 with membership probabilities ranging from 50.6% to 95.3%. Site LC2.7 was the exception, which belonged to Group 2 with a membership probability of 47.8%. All CABIN-generated site reports are available in APPENDIX F.

The results of the 2017 BEAST assessment indicated that 13 of the 17 sites were either similar to reference condition or mildly divergent from reference condition (Table 30). Sites ID1.9 and SYT0.6 were assessed as divergent from reference condition in 2017. Site ID1.9 was previously assessed in 2014 and 2015 as divergent and highly divergent, respectively. Site SYT0.6 was not previously assessed. Sites LaC4.8 and DM4.6 were assessed as highly divergent from reference condition in 2017. Site LaC4.8 was previously assessed in 2015 as highly divergent. Site DM4.6 was not previously assessed. All other sites assessed in 2017 that were also previously assessed in 2014 and/or 2015 generally had similar divergence classifications. Exceptions occurred at sites CF8.0 and YT0.2, which were both previously assessed in 2014 and 2015 as mildly divergent and highly divergent, respectively, before being assessed as mildly divergent in 2017. Similarly, site HF0.2 was previously assessed as mildly divergent in both 2014 and 2015 before being assessed as similar to reference in 2017.

Sites that were assessed as mildly divergent, divergent, or highly divergent from reference condition in 2014, 2015, and/or 2017 may suggest some level of natural or anthropogenic impairment. Reference sites that were determined to have some level of divergence are likely not good candidates for reference sites in the Project study area, especially those assessed as divergent or highly divergent from reference condition.

The RIVPACS analysis indicated that all test sites and reference sites in 2017 were in good condition with more taxa than expected generally observed. The O:E ratios at most of the sites ranged from 1.19 and 1.24 with lower values at sites CF3.9 and SYT3.5 (0.90 and 0.91, respectively). Values less than one indicate fewer taxa than expected were observed; however, 0.90 and 0.91 are close to one, which indicates these sites are in good condition. The O:E ratios for sites previously assessed in 2014 and/or 2015 were also greater than one; however, the O:E ratios in 2017 were generally higher indicating more taxa were observed than expected in 2017 compared to previous sample years. The exception occurred at site CF3.9, which had a lower O:E ratio in 2017 (0.90) compared to 2014 and 2015 (1.06 and 1.05, respectively).

The Bray-Curtis analysis indicated that the benthic invertebrate community structure at each test site and reference site in 2017 was dissimilar from the median reference community. The Bray-Curtis values ranged from 0.48 to 0.96. Sites YT5.0 and HF0.2 (0.48 and 0.65, respectively) were the most similar in community structure to the median reference community. Sites LaC4.8 and DM4.6 (0.96 and 0.94, respectively) were the least similar in community structure to the median reference community. The Bray-Curtis values for sites previously assessed in 2014 and/or 2015 were generally higher (ranged from 0.81-1.00) than the results in 2017 indicating the sites were more dissimilar in previous years. The exception occurred at site LC2.7, which had the same Bray-Curtis value between 2014 and 2017. Like the other CABIN analyses, the results of the Bray-Curtis analysis can be used to establish baseline conditions to compare both test and control sites to the reference condition in future monitoring years.

Table 30. CABIN results for BEAST analysis, RIVPACS analysis, and Bray-Curtis Analysis for the Coffee Gold Project in 2017.

Site	BEAST Analysis			RIVPACS Analysis			Bray-Curtis Analysis
	Group	Probability	Assessment	Expected Taxa P>0.70	Observed Taxa P>0.70	O:E (p > 0.7)	
HF0.2	2	89.6%	Similar to Reference	3.23	4.00	1.24	0.65
HF6.3	2	94.9%	Mildly Divergent	3.30	4.00	1.21	0.82
LC2.7	2	97.6%	Mildly Divergent	3.35	4.00	1.19	0.81
LC9.9	2	93.7%	Mildly Divergent	3.35	4.00	1.19	0.83
YT0.2	2	88.9%	Mildly Divergent	3.22	4.00	1.24	0.75
YT5.0	2	94.4%	Similar to Reference	3.30	4.00	1.21	0.48
CF3.9	2	95.5%	Mildly Divergent	3.32	3.00	0.90	0.83

Site	BEAST Analysis			RIVPACS Analysis			Bray-Curtis Analysis
	Group	Probability	Assessment	Expected Taxa P>0.70	Observed Taxa P>0.70	O:E (p > 0.7)	
CF8.0	2	95.3%	Mildly Divergent	3.33	4.00	1.20	0.80
CF10.0*	2	93.3%	Mildly Divergent	3.28	4.00	1.22	0.79
DM1.3*	2	94.7%	Mildly Divergent	3.30	4.00	1.21	0.85
DM4.6*	2	94.9%	Highly Divergent	3.30	4.00	1.21	0.94
EC2.1*	2	95.5%	Mildly Divergent	3.31	4.00	1.21	0.82
ID1.9*	2	91.9%	Divergent	3.26	4.00	1.23	0.88
LaC4.8*	2	84.4%	Highly Divergent	2.48	3.00	1.21	0.96
SYT0.6*	2	95.2%	Divergent	3.31	4.00	1.21	0.86
SYT3.5*	2	95.1%	Mildly Divergent	3.31	3.00	0.91	0.76
TEC6.0*	2	95.3%	Mildly Divergent	3.31	4.00	1.21	0.89

Sites are grouped by watershed. An asterisk (*) indicates a reference site.

3.6.1 BENTHIC INVERTEBRATE ABUNDANCE

Total abundance of benthic invertebrates ranged from 221 to 5,967 individuals per kick sample in 2017 (Figure 24) and from approximately 200 to 4,000 individuals per kick sample for comparable sites in 2014/2015. Total abundance at most sites was less than 2,000 individuals per kick sample in 2017 and less than 1,700 individuals per kick sample for comparable sites in 2014/2015. In 2017 there was notably high total abundance at sites LaC4.8 and DM4.6 (5,967 and 3,733 individuals per kick sample, respectively). In 2014/2015 there was notably high total abundance at sites ID1.9 and LaC4.8 (approximately 4,000 and 3,300 individuals per kick sample, respectively).

For watersheds with multiple sites in 2017, total abundance increased in an upstream direction on Dan Man Creek and Halfway Creek, and decreased in an upstream direction on Coffee Creek, Latte Creek, YT-24 Creek, and the stream south of YT-24 Creek. Coffee Creek and Latte Creek were the only watersheds with multiple sites that were assessed previously. Patterns of total abundance in 2014/2015 were similar to those observed in 2017 on Latte Creek and the opposite of those observed in 2017 on Coffee Creek.

EPT abundance ranged from 136 to 4,283 individuals per kick sample in 2017 (Figure 24) and from approximately 100 to 1,900 individuals per kick sample for comparable sites in 2014/2015. Similar to total abundance, EPT abundance at most sites was less than 1,200 individuals per kick sample in 2017, with notably high EPT abundance at sites LaC4.8 and DM4.6 (4,283 and 3,311 individuals per kick sample, respectively).

EPT abundance at most comparable sites in 2014/2015 was less than approximately 800 individuals, with notably high EPT abundance at site LaC4.8 (approximately 1,900 individuals per kick sample).

For watersheds with multiple sites in 2017, EPT abundance increased in an upstream direction on Dan Man Creek, Halfway Creek, and Latte Creek, and decreased in an upstream direction on Coffee Creek, YT-24 Creek, and the stream south of YT-24 Creek. Coffee Creek and Latte Creek were the only watersheds with multiple sites that were assessed previously. Patterns of EPT abundance in 2014/2015 were the opposite of those observed in 2017 in Coffee Creek and Latte Creek.

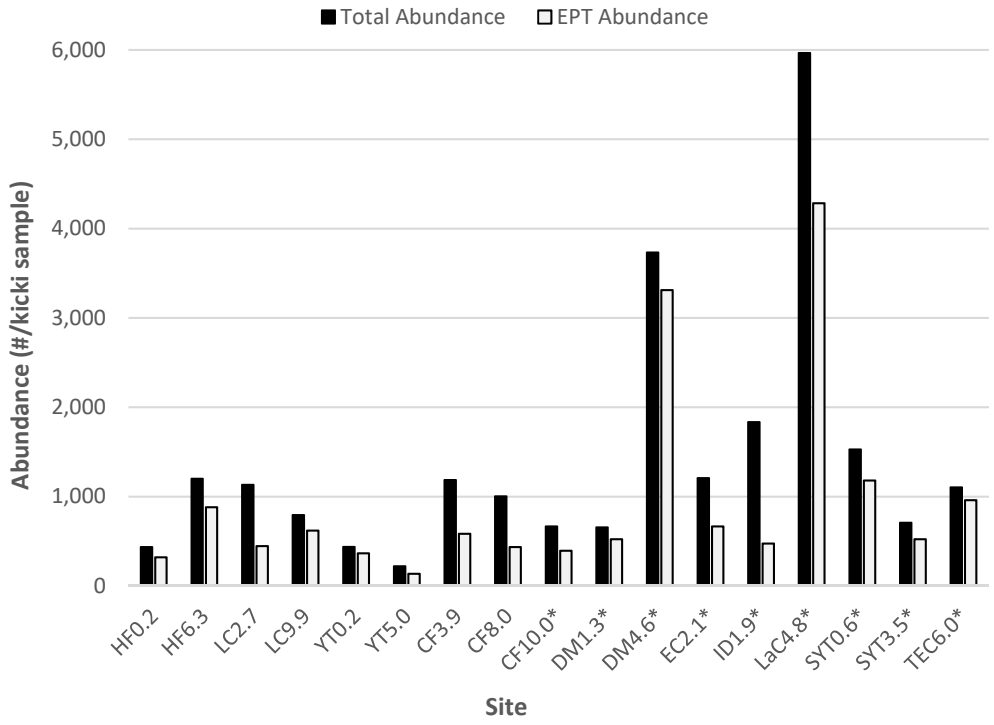

Figure 24. Benthic invertebrate total abundance and Ephemeroptera-Plecoptera-Trichoptera (EPT) abundance by site for the Coffee Gold Project in 2017. Sites are grouped by watershed. An asterisk (*) indicates a reference site.

3.6.2 BENTHIC INVERTEBRATE COMMUNITY COMPOSITION

The benthic invertebrate community at each site in 2017 was composed of primarily mayflies (Ephemeroptera), stoneflies (Plecoptera), and true flies (Diptera) + non-insects, with small amounts of caddisflies (Trichoptera) at approximately half of the sites (Figure 25). Mayflies were not documented at site SYT3.5. Caddisflies were not documented at sites DM4.6 or HF0.2, or at any sites on Los Angeles Creek, YT-24 Creek, the stream south of YT-24 Creek, or the tributary to Excelsior Creek.

Mayflies, true flies + non-insects were the most dominant groups in 2017 with each group contributing approximately 34% to overall community composition (Figure 25). Stoneflies contributed approximately 31% to overall community composition and caddisflies contributed less than 1% to overall community

composition (Figure 25). In 2014/2015, true flies were the most dominant group (approximately 50%) followed by mayflies (26%), stoneflies (21%), and small percentages of ringed worms (Annelids) and caddisflies. At sites comparable between 2014 to 2017, the percent density of EPT organisms generally increased in 2017 with the only decreases occurring at site CF3.9 (approximately 62% down to 49%) and site LC2.7 (approximately 48% down to 40%).

The majority of taxa in the EPT orders are generally considered more sensitive to pollution compared to taxa in the Diptera order; as water quality decreases, EPT abundance and richness generally decreases (Rosenberg and Resh 1993; Sylvestre et al. 2005; Environment Canada 2013). In 2017, site ID1.9 had the highest percentage of true flies and non-insects, and the lowest relative percentage of EPT organisms. Similar results were observed in 2014/2015.

For watersheds with multiple sites in 2017, the percentage of EPT organisms increased in an upstream direction on Coffee Creek, Dan Man Creek, and Latte Creek, and decreased in an upstream direction on YT-24 Creek and the stream south of YT-24 Creek. The percentage of EPT organisms fluctuated minimally between the two sites on Halfway Creek. Coffee Creek and Latte Creek were the only watersheds with multiple sites that were assessed previously. General patterns of EPT percent density in 2014/2015 were similar to those observed in 2017.

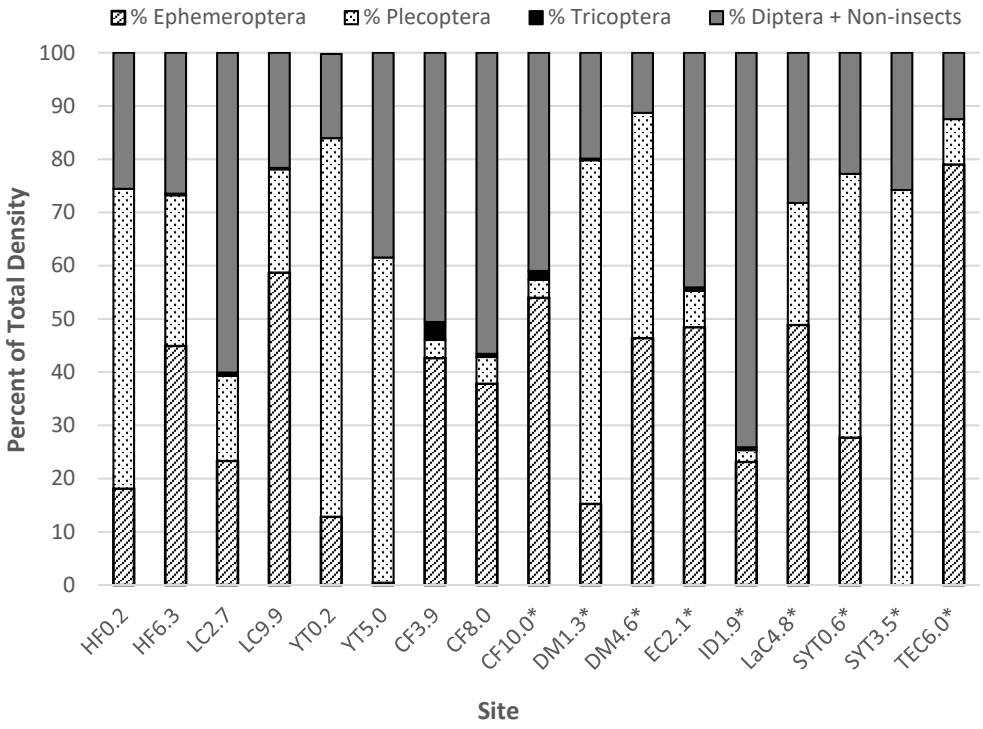

Figure 25. Relative percent densities of benthic invertebrate communities by site for the Coffee Gold Project in 2017. Sites are grouped by watershed. An asterisk (*) indicates a reference site.

3.6.3 BENTHIC INVERTEBRATE TAXONOMIC RICHNESS

Total benthic invertebrate taxonomic richness ranged from six to 17 taxa in 2017 (Figure 26). At sites comparable between 2014 to 2017, total taxonomic richness was lower in 2017 with approximately 20 to 35 taxa in 2014/2015 compared to 10 to 15 taxa in 2017. The highest total taxonomic richness in 2017 was documented at site CF10.0 (17 taxa) followed by sites CF3.9 and CF8.0 (15 and 14 taxa, respectively). The lowest total taxonomic richness in 2017 was documented at sites DM4.6 and SYT3.5 (six taxa at each site). In 2014/2015, sites on Coffee Creek and Latte Creek has the highest taxonomic richness (greater than 23 taxa per site).

For watersheds with multiple sites in 2017, total taxonomic richness increased in an upstream direction on Coffee, Creek, Halfway Creek, and Latte Creek, and decreased in an upstream direction on Dan Man Creek, YT-24 Creek, and the stream south of YT-24 Creek (SYT0.6 and SYT3.5). Coffee Creek and Latte Creek were the only watersheds with multiple sites that were assessed previously. General patterns of total taxonomic richness in 2014/2015 were the same as those observed in 2017 on Coffee Creek and stayed similar between sites on Latte Creek.

EPT richness ranged from two to nine taxa per site in 2017 (Figure 26). Similar to total taxonomic richness, the highest EPT richness was documented at sites CF10.0 and CF3.9 (nine taxa at each site) followed by site CF8.0 (eight taxa). The lowest EPT richness was documented at site SYT3.5 (two taxa). EPT richness for 2014/2015 was not presented in PECG (2017).

Within-watershed patterns for EPT richness in 2017 were similar to within-watershed patterns for total taxonomic richness in 2017, with the exception that EPT richness stayed the same between sites on Latte Creek and YT-24 Creek. The highest site in the watershed on Coffee Creek also had the same EPT richness as the lowest site.

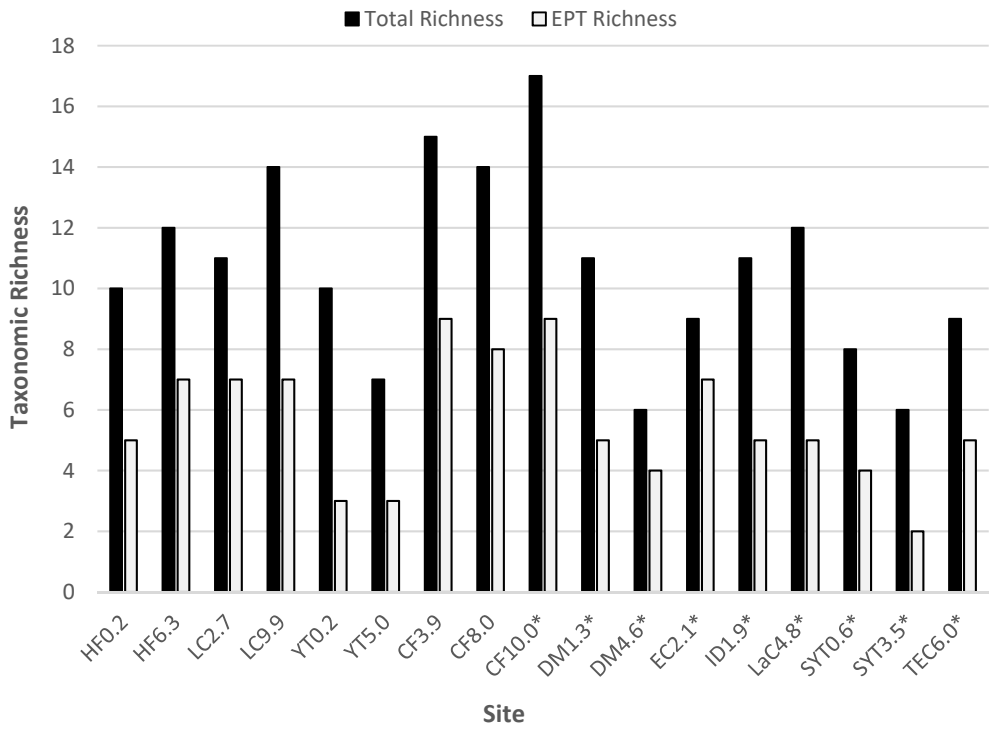

Figure 26. Total taxonomic richness and Ephemeroptera-Plecoptera-Trichoptera (EPT) richness of benthic invertebrate communities by site for the Coffee Gold Project in 2017. Sites are grouped by watershed. An asterisk (*) indicates a reference site.

3.6.4 BENTHIC INVERTEBRATE DIVERSITY AND EVENNESS

Simpson's diversity values ranged from 0.39 to 0.82 in 2017 (Figure 27). At sites comparable between 2014 to 2017, Simpson's diversity was 0.72 to 0.92 in 2014/2015 versus 0.50 to 0.79 in 2017. Site CF10.0 had the highest diversity value (0.82) in 2017 and site TEC6.0 had the lowest diversity value (0.39) in 2017. At the watershed level in 2017, the three sites on Coffee Creek had the highest diversity values (0.78-0.82) and the three sites on YT-24 Creek and the tributary to Excelsior Creek had the lowest diversity values (0.39-0.53). The remaining sites in 2017 had intermediate diversity values (0.61 to 0.77). In 2014/2015, sites on Coffee Creek, Latte Creek, and Los Angeles Creek had the highest diversity values (greater than approximately 0.83).

For watersheds with multiple sites in 2017, Simpson's diversity increased in an upstream direction on Coffee Creek, Dan Man Creek, Halfway Creek, and YT-24 Creek, and decreased in an upstream direction on Latte Creek and the stream south of YT-24 Creek. Coffee Creek and Latte Creek were the only watersheds with multiple sites that were assessed previously. General patterns of diversity in 2014/2015 were similar to those observed in 2017 on Coffee Creek and the opposite of those observed in 2017 on Latte Creek.

Simpson's evenness values ranged from 0.18 to 0.53 in 2017 (Figure 27). At sites comparable between 2014 to 2017, Simpson's evenness ranged from approximately 0.20 to 0.43 in 2014/2015 versus 0.18 to 0.39 in

2017. Site SYT0.6 had the highest evenness value (0.53) in 2017 and site LC9.9 had the lowest evenness value (0.18) in 2017. In 2014/2015, site LC9.9 had the highest evenness value (approximately 0.43).

Within-watershed patterns for Simpson's evenness in 2017 were similar to within-watershed patterns for Simpson's diversity in 2017. Coffee Creek and Latte Creek were the only watersheds with multiple sites that were assessed previously. General patterns of evenness in 2014/2015 were similar to those observed in 2017 on Coffee Creek and the opposite of those observed in 2017 on Latte Creek.

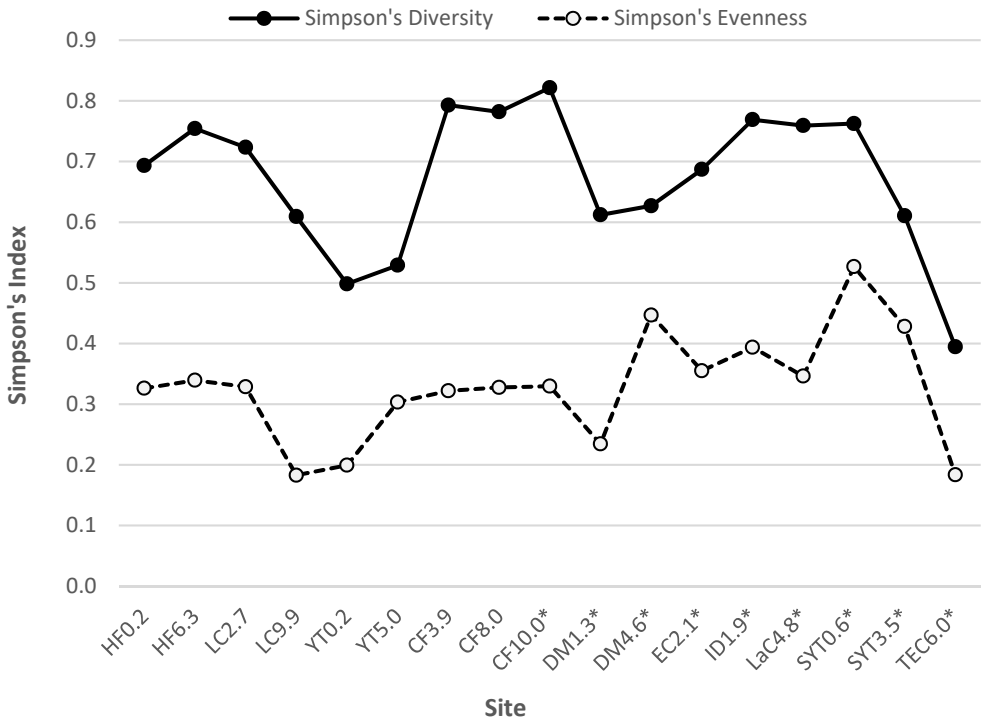

Figure 27. Simpson's diversity and evenness indices of benthic invertebrate communities by site for the Coffee Gold Project in 2017. Sites are grouped by watershed. An asterisk (*) indicates a reference site.

3.7 PERIPHYTON: CHLOROPHYLL–A AND ASH-FREE DRY MASS

Chlorophyll-a and ash-free dry mass (AFDM) were again measured in 2017. Prior to 2017 chlorophyll-a and AFDM were both measured in 2014 and 2015, and chlorophyll-a was measured in 2016 to address exceeded laboratory holding times associated with 2014 and 2015 sampling.

Chlorophyll-a concentrations in 2017 were similar to 2014 and 2015 data (Figure 28); higher concentrations in 2016 may have been associated with a warmer winter season in 2015/2016, followed by an earlier, warmer spring in 2016. In 2017, Chlorophyll-a was highest in Coffee Creek (CF 3.9 and CF10.0), with concentrations of 2.95 and 2.44 mg/m^2, respectively. The lowest concentrations were found in upper Latte Creek (LC9.9),

and lower YT-24 (YT0.2) with concentrations of 0.09 and 0.10 mg/m², respectively. Both Coffee Creek locations are located in a wide valley, with large amounts of available sunlight in the summer season, while upper Latte Creek and lower Halfway Creek sampling sites are located in headwater V shaped valleys with less exposure; it has been previously reported that differences in chlorophyll-a content may have been due to varying light conditions, nutrient availability, and periphyton taxonomy, which results in different proportions of photosynthetic:non-photosynthetic organisms that comprise periphyton (Barbour et al. 1999).

Ash-free dry mass was also low in 2017. As with chlorophyll-a results, the highest AFDM was from Coffee Creek (CF 3.9 and CF10.0), with concentrations of 6.35 and 11.04 g/m², respectively (Figure 29). Again, the lowest AFDM was found at upper Latte Creek (LC9.9) and lower YT-24 (YT0.2) with concentrations of 0.42 and 0.42 g/m², respectively. Concentrations of AFDM vary widely and there is little between year or between site correlations over the sampling years. Concentrations are low enough that small variations in temperature, weather and water quality may result in changing AFDM amounts.

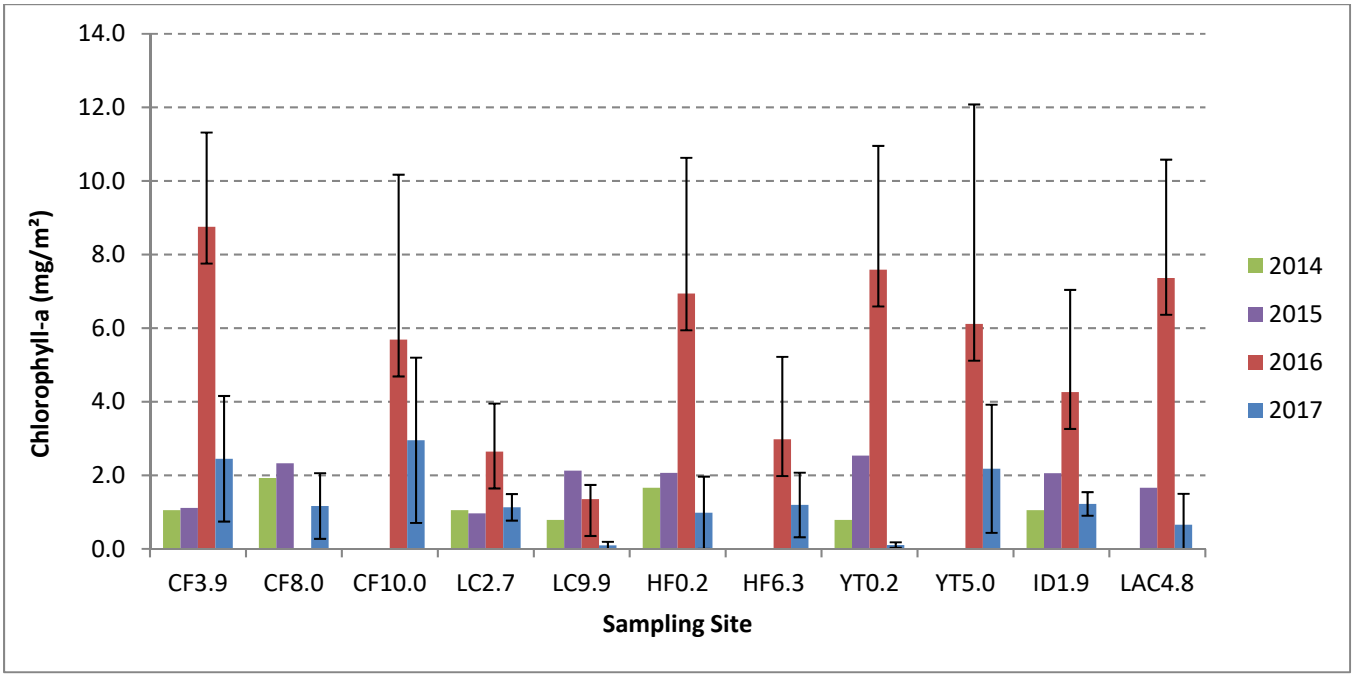

Figure 28. Mean and standard deviation for chlorophyll-a concentrations throughout the Coffee Creek mine site from 2014 through 2017. Data from 2014 and 2015 reflects composite samples for which no error bars can be calculated, mean data and standard deviation for 2016 and 2017 was calculated from five to six samples per site collected and analysed from each sample location.

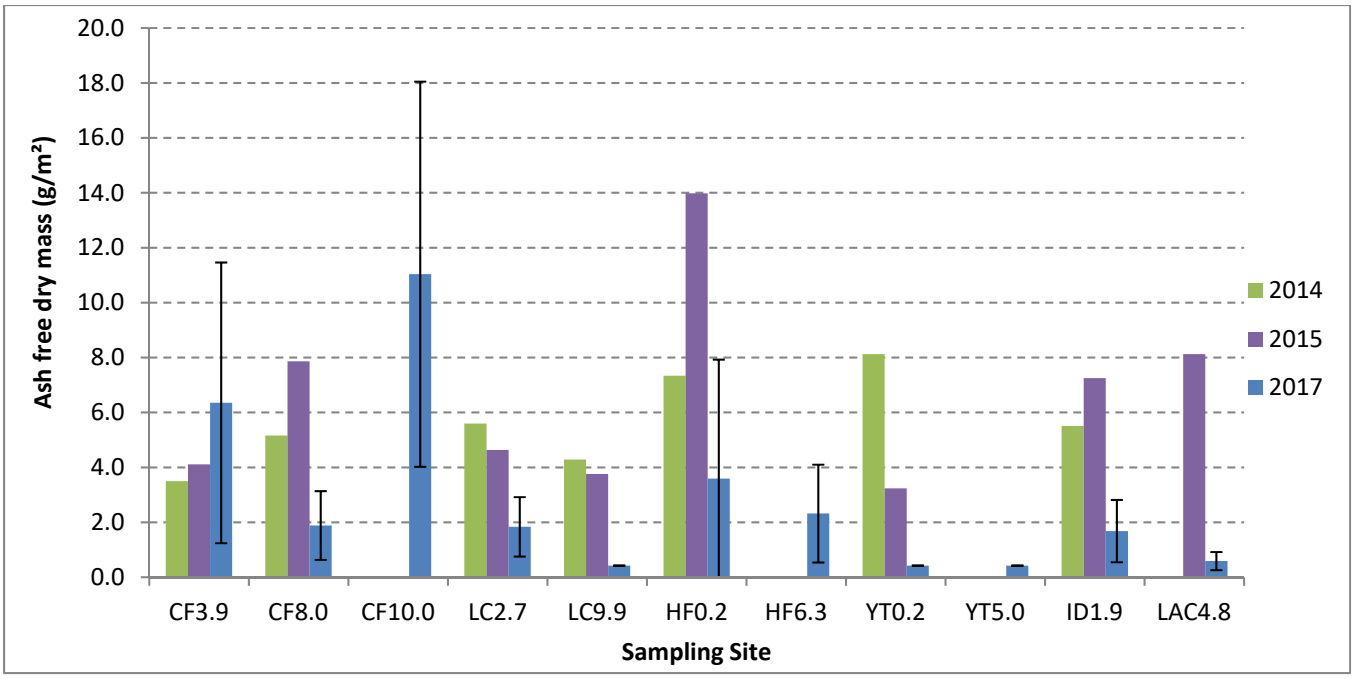

Figure 29. **Mean and standard deviation for ash free dry mass (AFDM) concentrations throughout the Coffee Creek mine site from 2014 through 2017. Data from 2014 and 2015 reflects composite samples for which no error bars can be calculated, mean data and standard deviation for 2017 was calculated from six samples per site collected and analysed from each sample location. LC9.9, YT0.2, and YT5.0 sample analysis indicated that AFDM was below detection in all samples. Figure was created using the detection limit for those sites.**

3.8 SEDIMENT

3.8.1 PARTICLE SIZE DISTRIBUTION

Sediment samples were collected from depositional areas along the margins and in pools. Samples collected from Coffee Creek (CF3.9, CF8.0 and CF10.0) were mostly composed of sand sized particles (2.0 - 0.063 mm), with percentages of 67, 77 and 91%, respectively. There were lesser amounts of silt (0.063 mm - 4 µm), and small amounts of clay (<4µm) and gravel (>2 mm; Figure 30). The sample from lower Latte Creek (LC2.7) has 76% sand, 15% silt, 7.5 % gravel and small amounts of clay. Upper Latte Creek had 50% sand, 38% silt, and smaller amounts of gravel and clay. Lower Halfway Creek had 51% sand, 38% silt and smaller amounts of gravel and clay. Upper Halfway Creek (HF6.3) was 84% sand, with smaller amount of silt, gravel and clay. Samples from upper and lower YT-24 had larger amounts of silt (67% and 47%, respectively, and 26 and 46% respectively of sand, and smaller amounts of gravel and clay. Independence and Los Angeles Creeks had large amount of sand (75 and 61%, respectively) and smaller amounts of silt and gravel. Independence Creek had a small amount of gravel, while the sample from Los Angeles Creek had undetectable amounts of gravel.

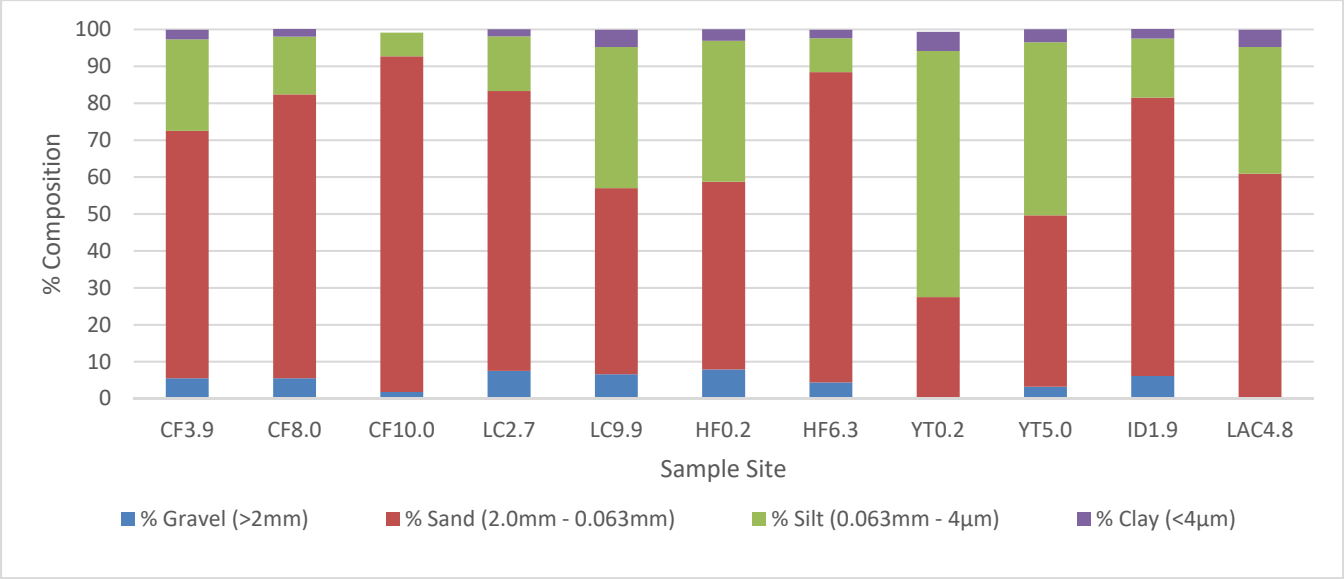

Figure 30. Sediment particle size distribution by site.

3.8.2 METAL CONCENTRATIONS IN SEDIMENT

Sediment samples were collected in 2017 for metals analysis. Previously, analyses of baseline metals concentrations in stream sediments collected in the study area in 2014 and 2015 (PECG 2017) indicated that arsenic and chromium were consistently present at concentrations that exceeded the CCME Interim Freshwater Sediment Quality Guidelines (ISQG; CCME 2000b). Data from 2017 also indicated that concentrations of arsenic and chromium were elevated across the Mine Site area (Table 31; Figure 31). Concentrations of arsenic exceeded the ISQG in samples collected from all sites, while samples from Latte Creek (LC2.7), Halfway Creek (HF0.2 and HF6.3) and YT-24 (YT5.0) also exceeded the Probable Effects Level (PEL; CCME 2000b).

Chromium concentrations in sediment exceeded the ISQG in all sample locations except Coffee Creek at (Table 31; Figure 32). Also, chromium concentrations in sediment from Latte Creek (LC2.7) exceeded the PEL.

Sediment quality guidelines (ISQGs and PELs) also exist for cadmium, copper, lead, mercury, and zinc. Concentrations of these metals in sediment from all sample sites were below these guidelines (Figure 32, Figure 33, Figure 34, Figure 35, Figure 36, Figure 37).

Table 31. Sediment quality parameters exceeding applicable CCME guidelines including the Interim Freshwater Sediment Quality Guideline (ISQG) and the Probable Effects Level (PEL); 2017.

Creek	Sample Site	Interim Freshwater Sediment Quality Guideline (ISQG)	Probable Effects Level (PEL)
Coffee	CF3.9	arsenic chromium	
	CF8.0	arsenic	
	CF10.0	arsenic chromium	
Latte	LC2.7	arsenic chromium	arsenic chromium
	LC9.9	arsenic chromium	
Halfway	HF0.2	arsenic chromium	arsenic
	HF6.3	arsenic chromium	arsenic
YT-24	YT0.2	arsenic	
	YT5.0	arsenic chromium	arsenic
Independence	ID1.9	arsenic chromium	
Los Angeles	LaC4.8	arsenic chromium	

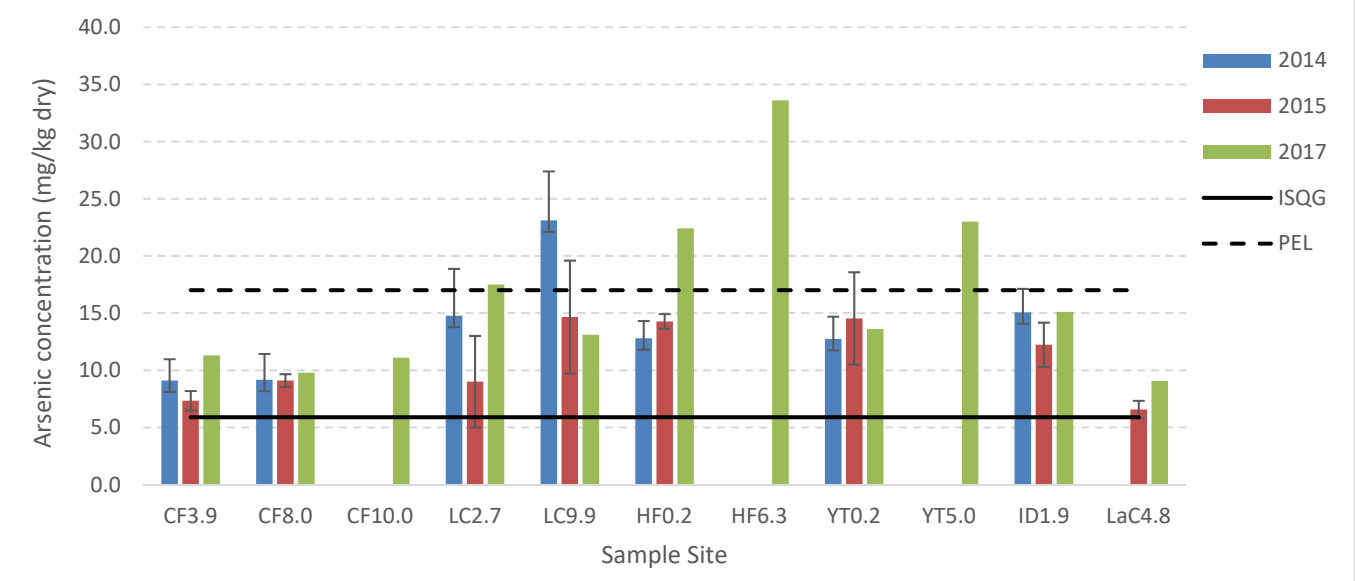

Figure 31. Arsenic concentrations in sediment. The 2014 and 2015 data present mean and standard deviation, while 2017 results present concentration in a composite sample. The solid black line is CCME Interim Sediment Quality Guideline (ISQG) and dashed black line is CCME Probable Effects Level (PEL) guideline.

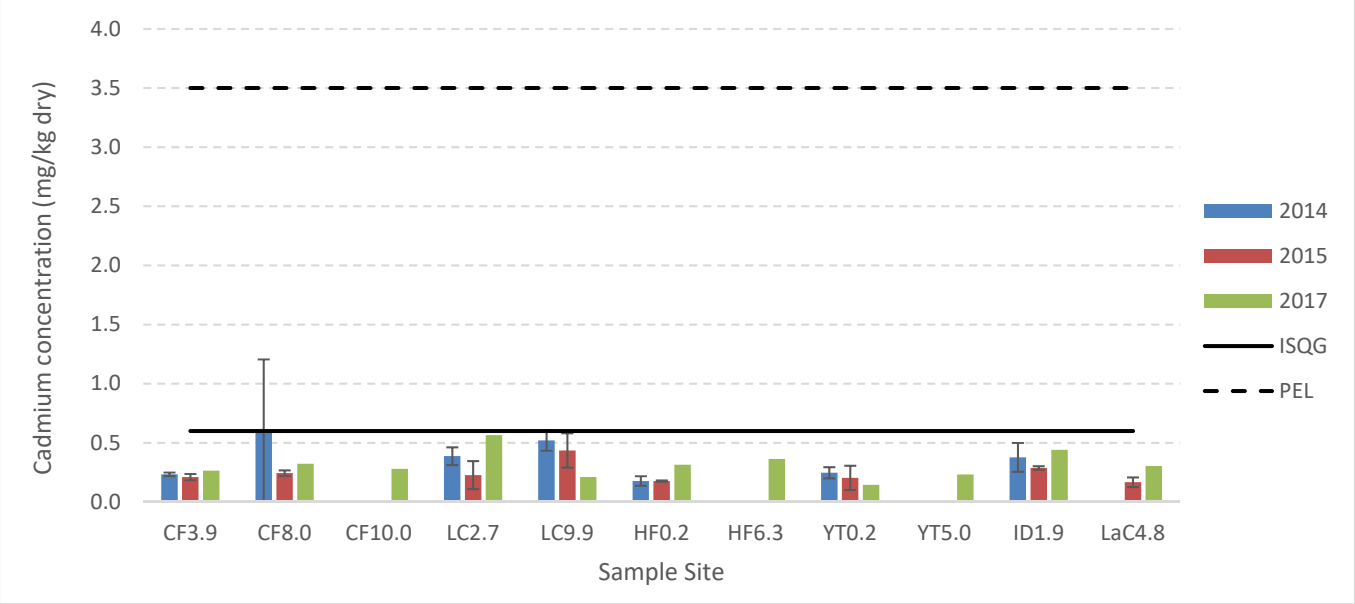

Figure 32. Cadmium concentrations in sediment. The 2014 and 2015 data present mean and standard deviation, while 2017 results present concentration in a composite sample. The solid black line is CCME Interim Sediment Quality Guideline (ISQG) and dashed black line is CCME Probable Effects Level (PEL) guideline.

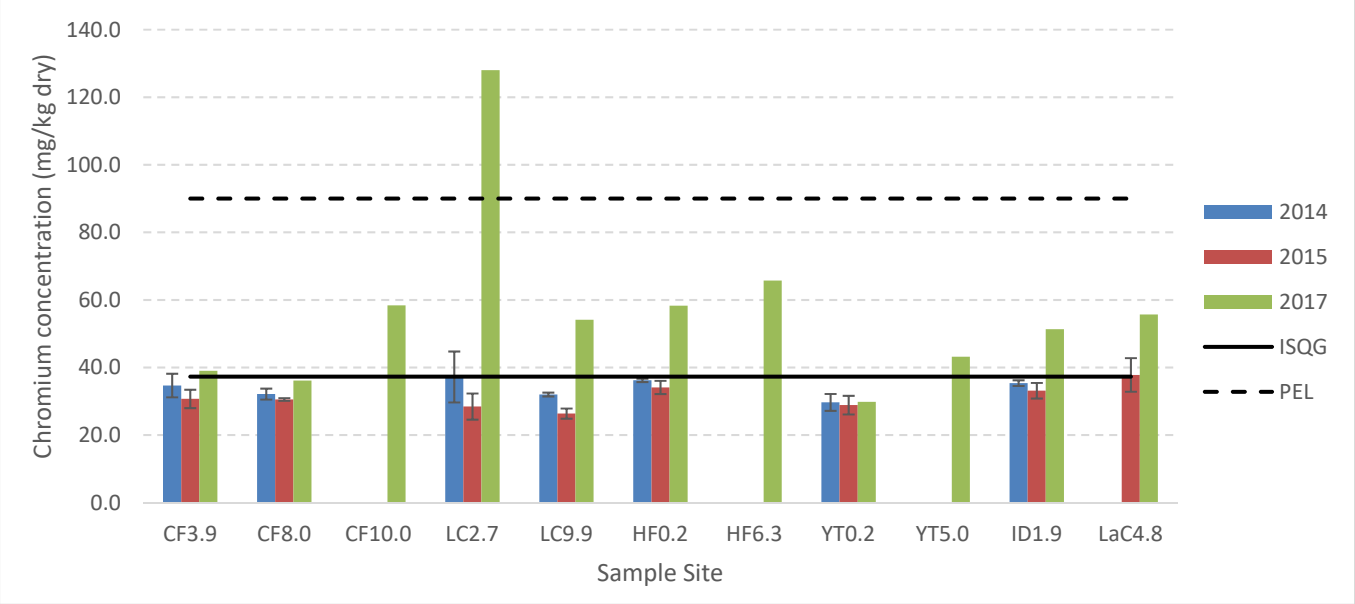

Figure 33. Chromium concentrations in sediment. The 2014 and 2015 data present mean and standard deviation, while 2017 results present concentration in a composite sample. The solid black line is CCME Interim Sediment Quality Guideline (ISQG) and dashed black line is CCME Probable Effects Level (PEL) guideline.

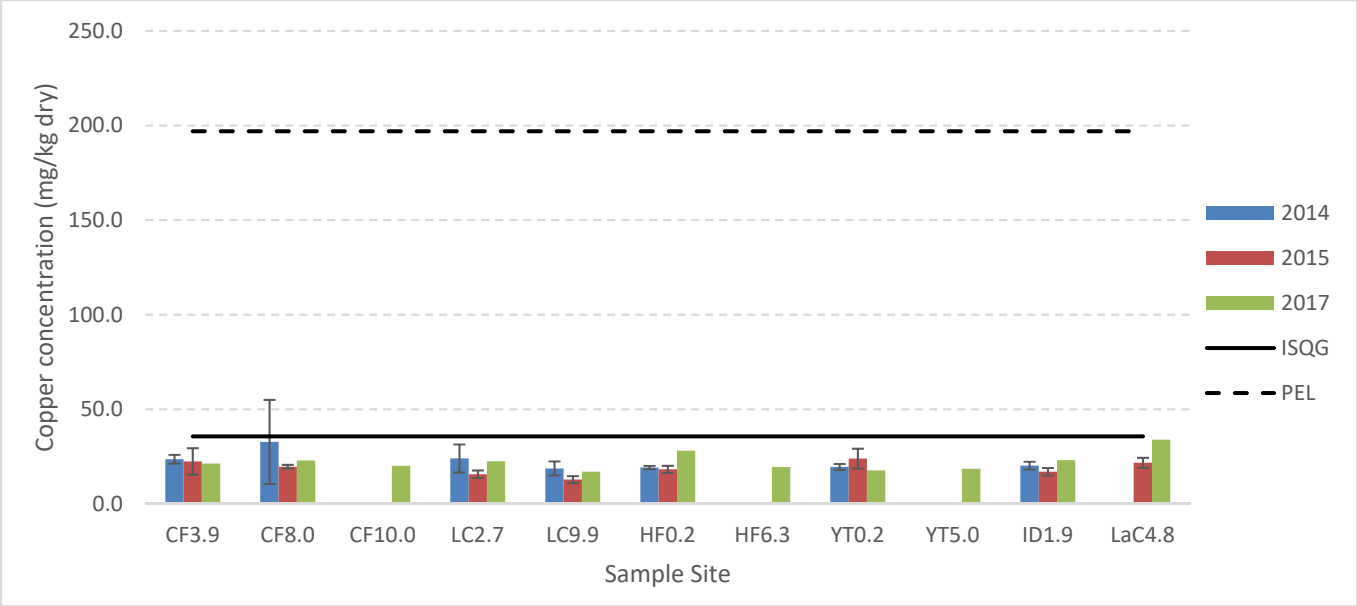

Figure 34. Copper concentrations in sediment. The 2014 and 2015 data present mean and standard deviation, while 2017 results present concentration in a composite sample. The solid black line is CCME Interim Sediment Quality Guideline (ISQG) and dashed black line is CCME Probable Effects Level (PEL) guideline.

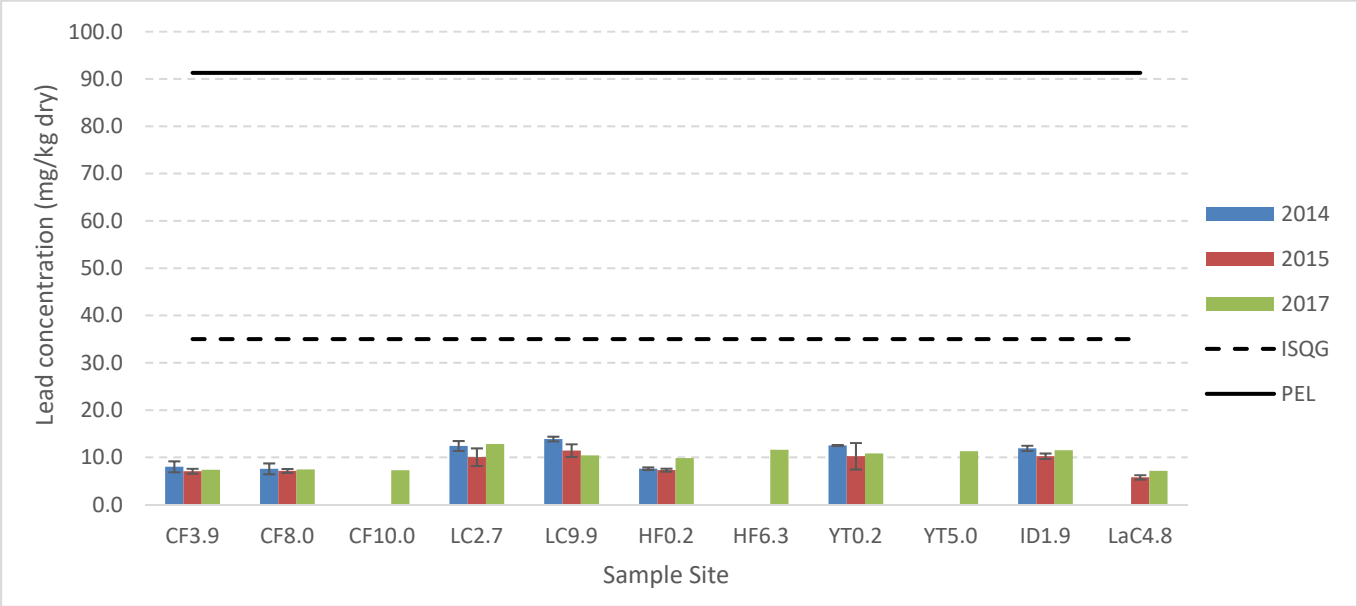

Figure 35. Lead concentrations in sediment. The 2014 and 2015 data present mean and standard deviation, while 2017 results present concentration in a composite sample. The solid black line is CCME Interim Sediment Quality Guideline (ISQG) and dashed black line is CCME Probable Effects Level (PEL) guideline.

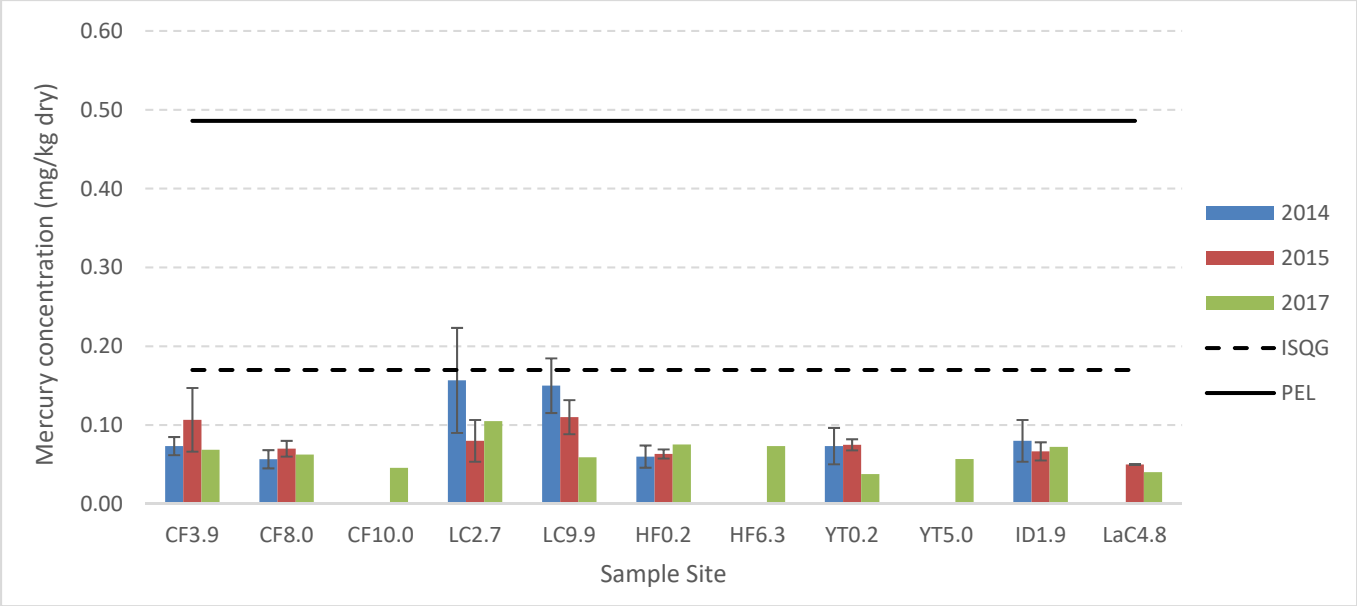

Figure 36. Mercury concentrations in sediment. The 2014 and 2015 data present mean and standard deviation, while 2017 results present concentration in a composite sample. The solid black line is CCME Interim Sediment Quality Guideline (ISQG) and dashed black line is CCME Probable Effects Level (PEL) guideline.

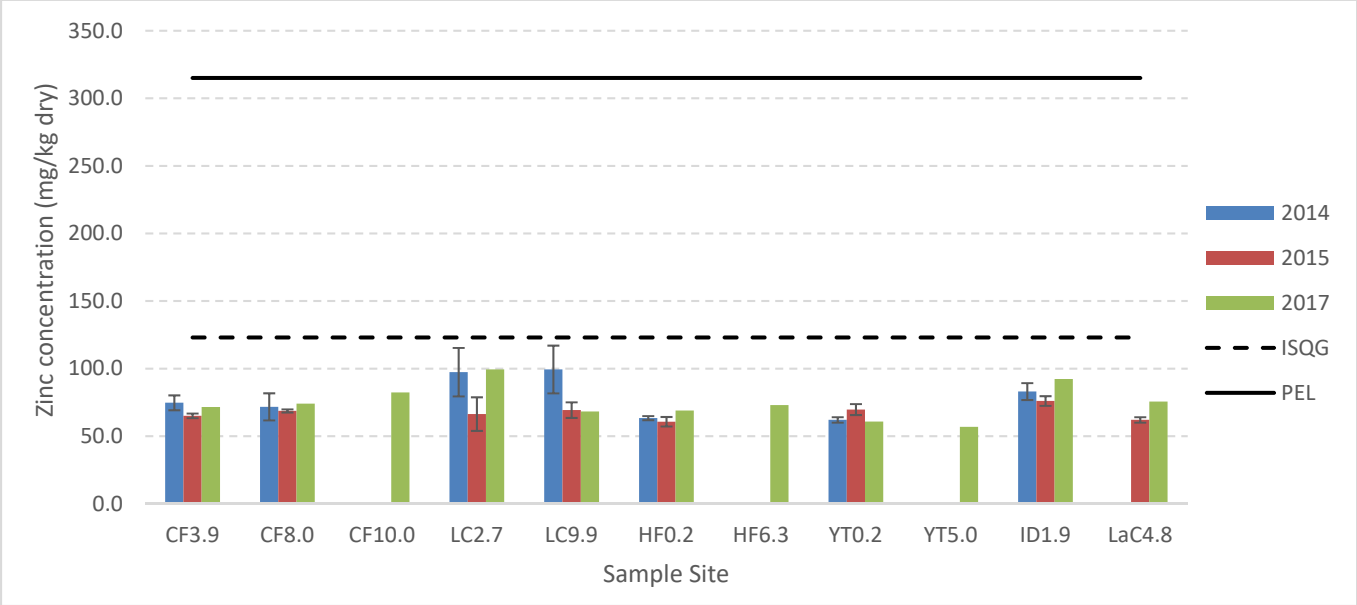

Figure 37. Zinc concentrations in sediment. The 2014 and 2015 data present mean and standard deviation, while 2017 results present concentration in a composite sample. The solid black line is CCME Interim Sediment Quality Guideline (ISQG) and dashed black line is CCME Probable Effects Level (PEL) guideline.

4 RESULTS AND DISCUSSION – NORTHERN ACCESS ROUTE STUDY AREA

Results and discussion for the Northern Access Route Study area are described in the below sections.

4.1 BARGE LANDINGS – YUKON

Past work at the barge landings on the Yukon River indicates that the sites are located in areas that have typical streambank habitat associated with these large rivers. The right bank landing site is in a location where the river banks are vertical, and the river is deep and not conducive to beach seining (Photo 24); similar habitat upstream of this site was minnow trapped in 2016 (EDI 2017). On the left bank, the landing site is in an area with sloping banks/riverbed (Photo 25). Sampling was conducted in the Yukon River to provide additional information on fish species presence within the vicinity of the proposed barge landings and an existing landing site near the current mine camp. Due to the vertical banks at the right bank, beach seining was completed approximately 70 m downstream of the proposed barge landing.



Photo 24. View of proposed barge landing site on the right bank of Yukon River, showing vertical banks.



Photo 25. View of proposed barge landing on the left bank of Yukon River showing sloping lower banks.

A total of four species were captured during the 2017 Yukon River sampling at/near the proposed barge landings (n = 61; Table 32). Similar to the results of 2016, juvenile Chinook were the most frequently captured species in the Yukon River, comprising almost 80% of the catch (n = 48), and were captured in all seven seine hauls at the proposed barge landings (Table 32). Arctic grayling were the next most common species caught (n = 7), then longnose sucker (n = 4), and lastly slimy sculpin (n = 2). An additional seine haul was conducted at an existing barge landing at Coffee camp and captured eight juvenile Chinook salmon (Table 32).

Table 32. Summary of 2017 beach seine sampling methods for current and proposed barge landing locations along the Yukon River.

Location	Sample Site	Sampling Effort			Number of Fish Captured
		Length (m)	Width (m)	Area (m²)	
Right Bank – Downstream of Proposed Barge Landing	YRU1.9	8	6	48	1 Juvenile CH
Right Bank - Downstream of Proposed Barge Landing	YRU1.9	10	7	70	3 Juvenile CH
					2 LSU
Right Bank - Downstream of Proposed Barge Landing	YRU1.9	10	7	70	1 Juvenile CH
Right Bank - Downstream of Proposed Barge Landing	YRU1.9	10	7	70	1 CCG
					2 Juvenile CH
					1 LSU
Left Bank – Proposed Barge Landing	YRU1.6	10	6	60	12 Juvenile CH
					2 GR
Left Bank – Proposed Barge Landing	YRU1.6	10	5	50	1 CCG
					19 Juvenile CH
					5 GR
					1 LSU
Left Bank – Proposed Barge Landing	YRU1.6	10	6	60	10 Juvenile CH
Left Bank – Existing Barge Landing	YRD2.1	10	7	70	8 Juvenile CH

Notes: CH – Chinook salmon; CCG - slimy sculpin, GR, Arctic grayling, LSU – longnose sucker

4.2 STEWART RIVER BACK CHANNEL

Previous investigations indicated this channel had limited fish habitat during low flows in the Stewart River (PECG 2016 and EDI 2017). During the September 3rd site visit the channel was mainly dry with only a few isolated puddles of water present. In the vicinity of the encroachment areas, this channel appears to be only wetted during high flows in the Stewart River and is most likely used as refuge habitat by species utilizing the area downstream (i.e., lake chub, northern pike and perhaps whitefish). The channel bottom consists of fines and organics. No critical habitats will be affected by the encroachment on the edge of this channel.



Photo 26. Downstream view of Stewart River back channel in the vicinity of an encroachment area (right side of photo).



Photo 27. Upstream view of Stewart River back channel in the vicinity of an encroachment area (left side of photo).

4.3 CHUM SPAWNING SURVEYS

In October 2017, the Yukon River was ice-free in the main channel, with a few side channels partially ice covered. The Stewart River had ice pans forming and a significant number of side channels were entirely ice covered, making it more difficult to detect spawning chum. There were approximately 907 spawning chum salmon and 482 carcasses observed in the Yukon River; conversely, there were 102 spawning chum salmon and 25 carcasses observed in the Stewart River (Figure 39, Figure 40, Figure 41). There were 38 redds observed in the Yukon River and nine in the Stewart River (Figure 40).

For perspective, at the Eagle SONAR station in 2017, the Yukon River chum salmon run was quantified at 419,099; this is substantially higher than during 2016 (161,027), or the five-year (2012-2016) average of chum returns on the Yukon River (165,810; Figure 38; Alaska Department of Fish and Game 2017).

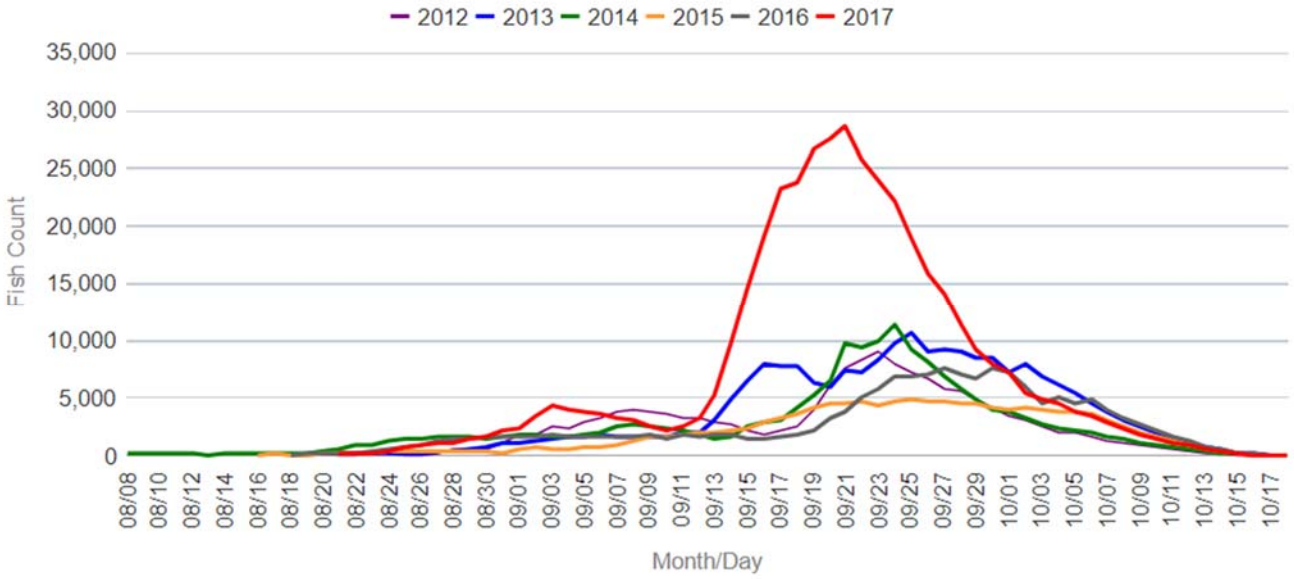

Figure 38. Eagle Sonar (Yukon/Canadian Border) historical daily passage of chum salmon (Alaska Department of Fish and Game, 2017)

In the Yukon River in 2017, there were substantially more chum salmon observed than in previous surveys; including in areas where chum salmon activity was not previously documented. Many of the locations where redds were found in the 2013 and 2016 surveys (Figure 40) had notable ice cover in 2017 and thus limited redds were observed in these locations. However, notable numbers of live chum were observed in these locations (Figure 39) and it is presumed that considerable spawning did occur in these areas. These side channels are fed by groundwater, which are typical of chum spawning locations (refer to EDI 2017). Geist et. al. (2002) report that chum salmon spawn in upwelling water that is typically warmer than the surrounding river. However, 2017 surveys also found an expansion of spawning activity in the Yukon River to include a

few main channel areas primarily near the mouth of Coffee Creek and near some mid-channel islands. Such expansion of activity is thought to be related to the high returns to the system in 2017. No activity was observed at the barge or winter road landings, the closest redd was located approximately 200 m upstream of the south winter road crossing in a side channel (Figure 40).

In the Stewart River fewer live fish, redds and carcasses were observed than the Yukon River; however, observed activity was higher than in 2016. The activity that was observed was typically associated with side channels downstream of the NAR. No spawning activity was documented near the barge landings.

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Figure 39. Observed live chum during the spawning surveys on the Yukon and Stewart rivers

Chum Spawning Results on Stewart River

Chum Spawning Results on Yukon River

Legend

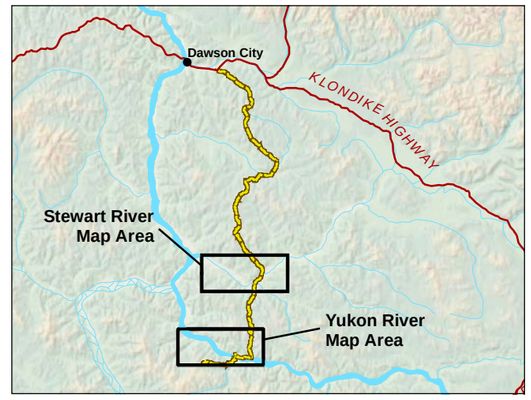
- Proposed Route

Live Chum Counts (2017)

- 1 - 15
- 15 - 25
- 25 - 50
- 50 - 100
- 100 - 200

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area



0 2 4 6 8 10
Kilometres

Map Scale = 1:125,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:50,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Survey data collected by Environmental Dynamics Inc., 2017. Locations obtained using Garmin GPS technology.

Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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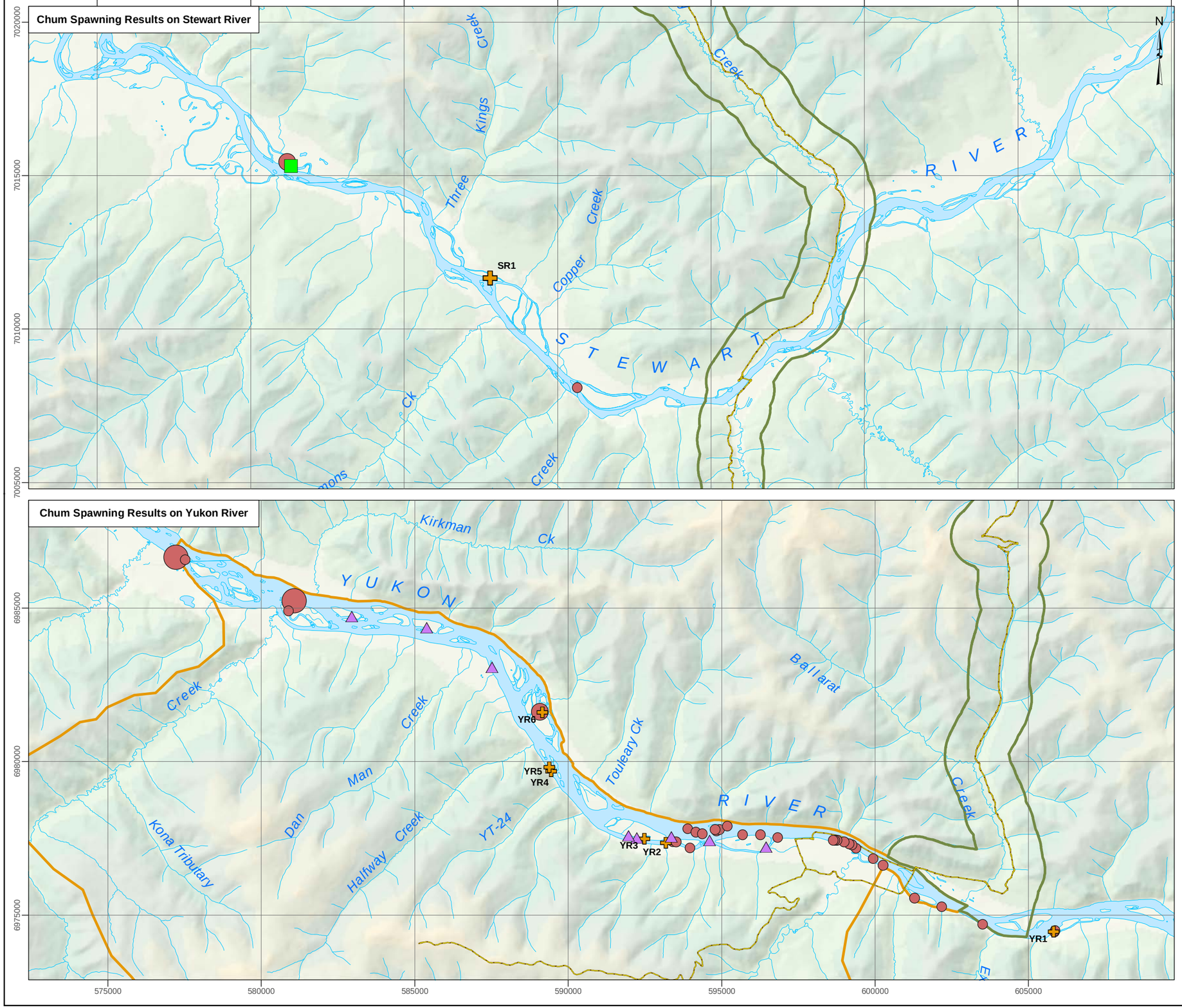
Figure 40. Observed chum redds during salmon spawning surveys on the Yukon and Stewart rivers



Legend

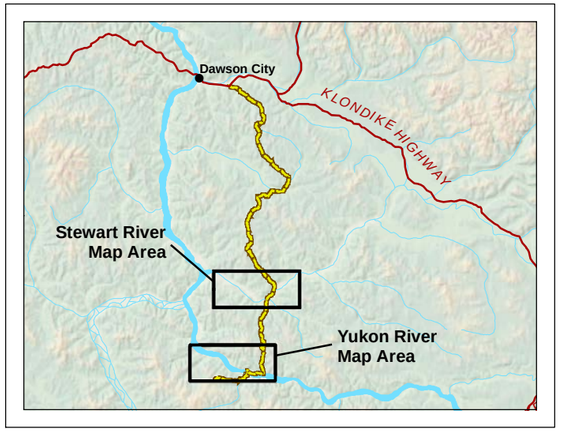
- Proposed Route
- 2013 Chum Spawning Sites
- 2014 Chum Spawning (Rivest; Pers. Comm. 2016)
- 2016 Chum Spawning Sites

2017 Chum Redds

- 1 - 3
- 4 - 7
- 8 - 16

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area



0 2 4 6 8 10
Kilometres

Map Scale = 1:125,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
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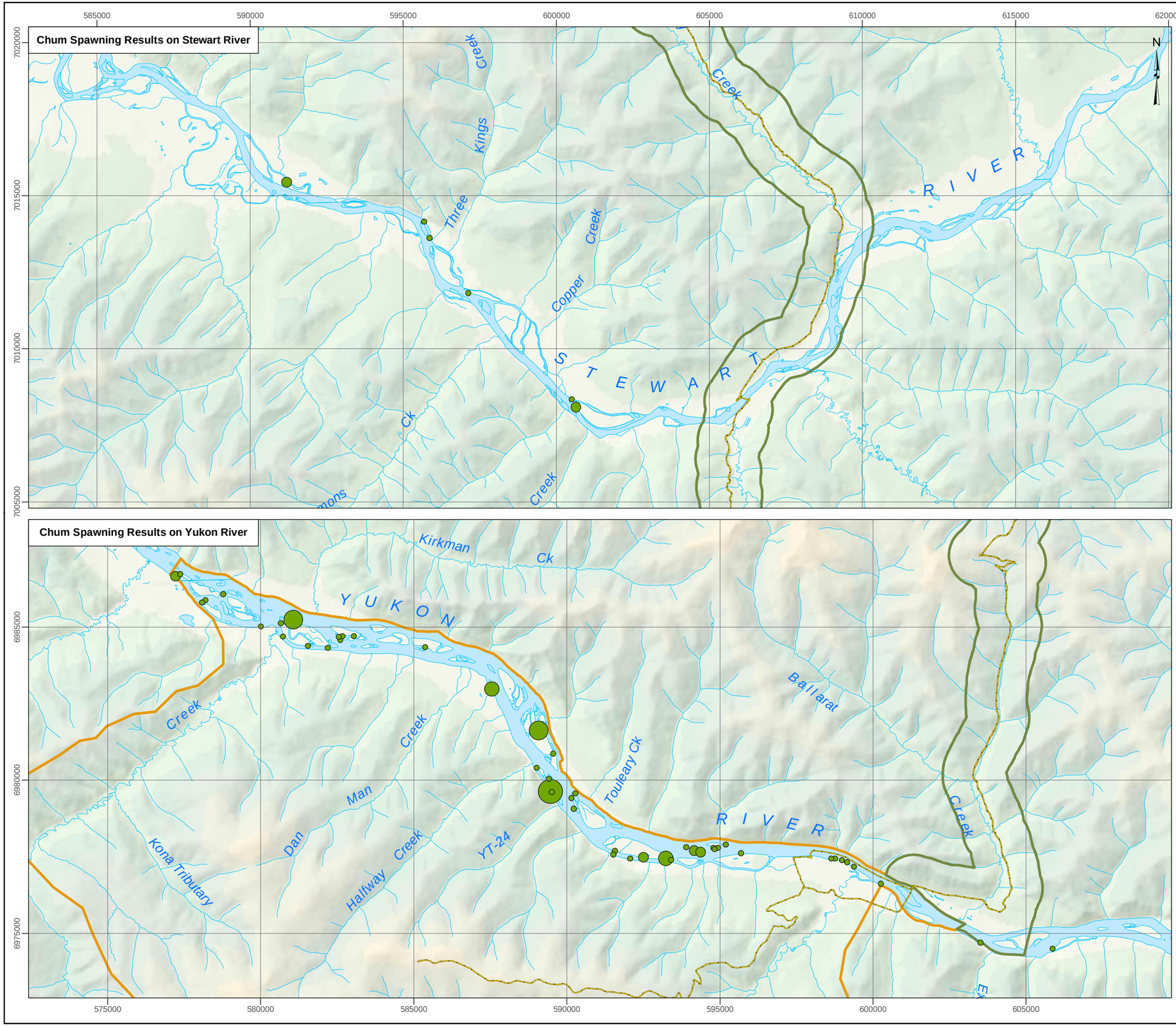
Figure 41. Observed chum carcasses during salmon spawning surveys on the Yukon and Stewart rivers



Legend

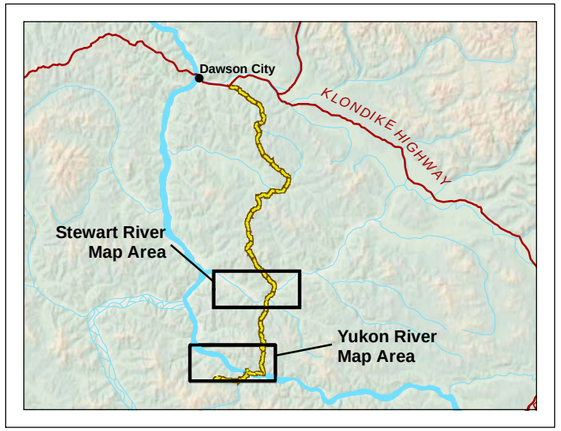
- Proposed Route

Chum Carcasses

- 1 - 5
- 5 - 15
- 15 - 50
- 50 - 75
- 75 - 150

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area



0 2 4 6 8 10

Kilometres

Map Scale = 1:125,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
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APPENDIX A. CONCORDANCE TABLE OF SAMPLING COMPLETED TO DATE

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Table A-1. Sampling concordance table for mine study area.

Stream	Site	Type (near/far/reference)	Fish Sampling	Species Captured	Fish Tissue Sampling	CABIN	Invertebrate Metals	Periphyton	Periphyton Metals	Sediments	Hess Sample	Comments
Latte	LC11.8	near	2014, 2015	None	no fish captured							
Latte	LC10.4	near	2014, 2015	None	no fish captured	2014		2014		2014		
Latte	LC9.9	near	2014, 2015, 2016	GR observed	no fish captured	2015, 2017	2016, 2017	2015, 2016, 2017		2015, 2017		
Latte	LC2.7	near	2014, 2015, 2016, 2017	GR	2014-2GR 2015-2GR; 2016-11GR; 2017-10GR	2014, 2015, 2017	2016, 2017	2014, 2015, 2016, 2017	Aug, 2017	2014, 2015, 2017		
Latte	LC1.6	near	2016	None								
Latte	LC0.5	near	2013, 2014, 2015, 2016	GR, CCG	2015-2 GR, 3 CCG							Site located at mouth
Coffee	CF10.0	reference	2016	GR, CCG	2016-11CCG, 7GR	2017	2016, 2017	2016, 2017	Aug, 2017	2017		
Coffee	CF8.3	far	2013, 2014, 2015	CH, CCG GR								
Coffee	CF8.0	far	2014, 2015, 2016	GR, CCG, CH	2014-9CCG; 2015-6GR, 3CCG; 2016-1CCG	2014, 2015, 2017	2017	2014, 2015, 2017	Aug, 2017	2014, 2015, 2017		
Coffee	CF5.7	far	2014, 2015	GR, CCG, CH	None							
Coffee	CF3.9	far	2014, 2015, 2016, 2017	GR, CCG, CH	2015-12GR; 2016-2GR, 10CCG; 2017-9GR, 10CCG	2014, 2015, 2017	2016, 2017	2014, 2015, 2016, 2017	Aug, 2017	2014, 2015, 2017		
Coffee	CF2.7	far	2013, 2016 (winter only)	CH, CCG	2016-5CCG, 3CH		2016					
Coffee	CF0.5	far	2000, 2001, 2010, 2016	CH	2016-3CH		2016					
Halfway	HF9.3	near	2014, 2015, 2016	None	no fish captured							
Halfway	HF8.8	near	2016	None								
Halfway	HF6.3	near	2013, 2016/2017	None	no fish captured	2017	2016, 2017	2016, 2017		2017	2017	
Halfway	HF4.5	near	2017	None	no fish captured							
Halfway	HF2.1	near	2017	None	no fish captured							
Halfway	HF1.5	near	2017	None	no fish captured							
Halfway	HF1.1	near	2017	None	no fish captured							
Halfway	HF1.0	near	2017	None	no fish captured							
Halfway	HF0.9	near	2016, 2017	None	no fish captured							
Halfway	HF0.6	near	2017	GR	1GR							
Halfway	HF0.5	near	2017	None	no fish captured							
Halfway	HF0.3	near	2017	GR								
Halfway	HF0.2	near	2013, 2014, 2015, 2016, 2017	GR, CH (CCG at mouth)	2016-12CH, 1GR; 2017-7GR	2014, 2015, 2017	2016, 2017	2014, 2015, 2016, 2017	Aug, 2017	2014, 2015, 2017		Includes sampling at HF0.0
Halfway	HF0.1	near	2017									
YT-24	YT5.9	near	2016									
YT-24	YT5.0	near	2014, 2015, 2016	None	no fish captured	2017	2016, 2017	2016, 2017		2017		
YT-24	YT4.6	near	2016	None								
YT-24	YT1.9	near	2017									
YT-24	YT1.3	near	2016	None								
YT-24	YT0.9	near	2016	None								
YT-24	YT0.6	near	2016	None								

Stream	Site	Type (near/far/reference)	Fish Sampling	Species Captured	Fish Tissue Sampling	CABIN	Invertebrate Metals	Periphyton	Periphyton Metals	Sediments	Hess Sample	Comments
YT-24	YT0.2	near	2014, 2015, 2016, 2017	GR, CCG	2017-1 GR	2014, 2015, 2017	2016, 2017	2014, 2015, 2016, 2017		2014, 2015, 2017		Includes sampling at YT0.0
YT-24	YT0.1	near	2017	None	no fish captured							
Independence	ID1.9	reference	2013, 2014, 2015, 2016, 2017	GR, CCG, CH	2014-8CCG, 2015-1CCG, 2016-10CCG; 2017-11CCG, 7GR	2014, 2015, 2017	2016, 2017	2014, 2015, 2016, 2017	Aug, 2017	2014, 2015, 2017		
Independence	ID4.5	reference					2016					
Independence	ID6.7	reference	2014, 2015	GR, CH, CCG	2014-1GR, 2015-7GR	2014, 2015				2014, 2015		
Independence	ID0.0	reference	2013	CCG								
Kona Trib	KT5.2	reference	2014, 2015	None	no fish captured	2014, 2015				2014, 2015		
Kona Trib	KT0.1	reference	2014, 2015	GR	none							
Isaac	IS0.1	reference	2014, 2015	GR, CCG, CH, BB, LSU, AL	2014-9CCG, 2015-3CCG	2014, 2015				2014, 2015		
Los Angeles	LaC4.8	reference	2015, 2017	GR, CCG, CH	2015-2GR, 1CCG. 2016-3GR, 2017 5GR, 1CCG	2015, 2017	2016, 2017	2015, 2016, 2017		2015, 2017		
Dan Man	DM4.6	reference				2017						
Dan Man	DM1.3	reference				2017						
Excelsior	EC2.1	reference				2017						
Excelsior Trib	TEC6.0	reference				2017						
Unnamed	SYT0.6	reference				2017						
Unnamed	SYT3.5	reference				2017						
Latte Trib C	LCC0.0	near	2016	None	no fish captured							
Latte Trib C	LCC0.2	near	2016	None	no fish captured							
Latte Trib C	LCC0.3	near	2016	None	no fish captured							
Halfway Trib	HFA0.1	near	2016	None	no fish captured							

APPENDIX B. ENVIRONMENTAL DNA RESULTS

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Table B-1. 2017 eDNA sample results from winter sampling.

Site Name	Sample replicate	Lab Code	Collection date	Collection Time	Zone	Easting	Northing	THAR Frequency	LAB Call	ONTS Frequency	LAB Call	Filter Date	Filter start time	Filter end time	Filtering time (calc.)	Sample Contents	Comments
YRD11.0	A	YRD11.0-A	20-Mar-17	15:30	7	588937	6980622	3/8	Y	0/8	N	20-Mar-17	19:15	19:18	00:03	Site Water	-
YRD11.0	B	YRD11.0-B	20-Mar-17	15:30	7	588937	6980622	5/8	Y	0/8	N	20-Mar-17	19:15	19:19	00:04	Site Water	-
YRD11.0	C	YRD11.0-C	20-Mar-17	15:30	7	588937	6980622	1/8	N	0/8	N	20-Mar-17	19:26	19:29	00:03	Site Water	-
HF6.3	A	HF6.3-A	21-Mar-17	10:30	7	584005	6976537	1/8	N	5/8	Y	21-Mar-17	19:31	19:35	00:04	Site Water	-
HF6.3	B	HF6.3-B	21-Mar-17	10:30	7	584005	6976537	0/8	N	1/8	N	21-Mar-17	19:31	19:35	00:04	Site Water	-
HF6.3	C	HF6.3-C	21-Mar-17	10:30	7	584005	6976537	0/8	N	0/8	N	21-Mar-17	19:42	19:45	00:03	Site Water	-
CF2.7	A	CF2.7-A	21-Mar-17	12:05	7	597879	6974874	0/8	N	1/8	N	21-Mar-17	19:50	19:53	00:03	Site Water	-
CF2.7	B	CF2.7-B	21-Mar-17	12:05	7	597879	6974874	0/8	N	1/8	N	21-Mar-17	19:50	19:53	00:03	Site Water	-
CF2.7	C	CF2.7-C	21-Mar-17	12:05	7	597879	6974874	0/8	N	1/8	N	21-Mar-17	20:01	20:04	00:03	Site Water	-
CF10.0	A	CF10.0-A	21-Mar-17	12:50	7	594191	6968831	0/8	N	0/8	N	21-Mar-17	20:10	20:13	00:03	Site Water	sample filter dropped on the floor, possible contamination
CF10.0	B	CF10.0-B	21-Mar-17	12:50	7	594191	6968831	0/8	N	0/8	N	21-Mar-17	20:10	20:14	00:04	Site Water	-
CF10.0	C	CF10.0-C	21-Mar-17	12:50	7	594191	6968831	0/8	N	2/8	N	21-Mar-17	20:24	20:27	00:03	Site Water	-
CF8.1	A	CF8.1-A	21-Mar-17	13:20	7	594584	6970462	0/8	N	0/8	N	21-Mar-17	20:30	20:33	00:03	Site Water	-
CF8.1	B	CF8.1-B	21-Mar-17	13:20	7	594584	6970462	0/8	N	0/8	N	21-Mar-17	20:30	20:33	00:03	Site Water	-
CF8.1	C	CF8.1-C	21-Mar-17	13:20	7	594584	6970462	0/8	N	4/8	Y	21-Mar-17	20:39	20:41	00:02	Site Water	membrane partially ripped during removal from filter
LC0.5	A	LC0.5-A	21-Mar-17	14:15	7	594467	6970369	0/8	N	0/8	N	21-Mar-17	20:47	20:50	00:03	Site Water	-
LC0.5	B	LC0.5-B	21-Mar-17	14:15	7	594467	6970369	1/8	N	0/8	N	21-Mar-17	20:47:	20:50	00:03	Site Water	-
LC0.5	C	LC0.5-C	21-Mar-17	14:15	7	594467	6970369	0/8	N	0/8	N	21-Mar-17	20:56	21:00	00:04	Site Water	-
LC9.9	A	LC9.9-A	21-Mar-17	15:10	7	584826	6971710	0/8	N	1/8	N	21-Mar-17	21:09	21:12	00:03	Site Water	-
LC9.9	B	LC9.9-B	21-Mar-17	15:10	7	584826	6971710	0/8	N	0/8	N	21-Mar-17	21:09	21:12	00:03	Site Water	-
LC9.9	C	LC9.9-C	21-Mar-17	15:10	7	584826	6971710	0/8	N	0/8	N	21-Mar-17	21:18	21:20	00:02	Site Water	-
ID1.9	A	ID1.9-A	21-Mar-17	16:55	7	579424	6983213	0/8	N	0/8	N	21-Mar-17	21:27	21:30	00:03	Site Water	water noticeably yellow
ID1.9	B	ID1.9-B	21-Mar-17	16:55	7	579424	6983213	0/8	N	0/8	N	21-Mar-17	21:27	21:30	00:03	Site Water	water noticeably yellow
ID1.9	C	ID1.9-C	21-Mar-17	16:55	7	579424	6983213	0/8	N	0/8	N	21-Mar-17	21:38	21:41	00:03	Site Water	water noticeably yellow
YRD20.5	A	YRD20.5-A	21-Mar-17	17:15	7	580552	6985065	0/8	N	0/8	N	21-Mar-17	21:49	21:52	00:03	Site Water	-
YRD20.5	B	YRD20.5-B	21-Mar-17	17:15	7	580552	6985065	0/8	N	1/8	N	21-Mar-17	21:49	21:52	00:03	Site Water	-
YRD20.5	C	YRD20.5-C	21-Mar-17	17:15	7	580552	6985065	0/8	N	0/8	N	21-Mar-17	22:00	22:03	00:03	Site Water	-
CF0.1	A	CF0.1-A	21-Mar-17	18:10	7	599375	6977099	0/8	N	0/8	N	21-Mar-17	22:43	22:48	00:05	Site Water	sample one third slush/ice crystals
CF0.1	B	CF0.1-B	21-Mar-17	18:10	7	599375	6977099	0/8	N	0/8	N	21-Mar-17	22:59	23:03	00:04	Site Water	sample one third slush/ice crystals
CF0.1	C	CF0.1-C	21-Mar-17	18:10	7	599375	6977099	0/8	N	1/8	N	21-Mar-17	22:55	22:59	00:04	Site Water	sample one third slush/ice crystals
PS2.4	A	PS2.4-A	21-Mar-17	18:30	7	600798	6976111	0/8	N	0/8	N	21-Mar-17	22:13	22:28	00:15	Distilled Water	Shoppers Drug Mart-Life
PS2.4	B	PS2.4-B	21-Mar-17	18:30	7	600798	6976111	0/8	N	0/8	N	21-Mar-17	22:13	22:28	00:15	Distilled Water	Shoppers Drug Mart-Life
PS2.4	C	PS2.4-C	21-Mar-17	18:30	7	600798	6976111	0/8	N	0/8	N	21-Mar-17	22:34	22:52	00:18	Distilled Water	Shoppers Drug Mart-Life

Notes:
All samples were collected and filtered by BSc and PS, sample volumes were 1000ml and preserved in silica.

Table B-2. 2017 eDNA sampling results from summer sampling.

Site Name	Sample Replicate	Lab Code	Collection Date	Collection Time	Zone	Easting	Northing	THAR Frequency	Lab Call	ONTS Frequency	Lab Call	Filter Date	Filter Start Time	Filter End Time	Filtering Time (calc.)	Sample Contents	Comments
HF1.0	A	HF1.0-A	02-Aug-17	14:20	7	588003	6980053	0/8	N	0/8	N	02-Aug-17	18:11	18:15	00:04	Site Water	
HF1.0	B	HF1.0-B	02-Aug-17	14:20	7	588003	6980053	0/8	N	1/8	N	02-Aug-17	18:11	18:15	00:04	Site Water	
HF1.0	C	HF1.0-C	02-Aug-17	14:20	7	588003	6980053	0/8	N	0/8	N	02-Aug-17	18:20	18:25	00:05	Site Water	
YR	A	YR-A	02-Aug-17	16:10	7	588890	6980503	4/8	Y	0/8	N	02-Aug-17	18:29	19:46	01:17	Site Water	sediment laden, slowing filtering
YR	B	YR-B	02-Aug-17	16:10	7	588890	6980503	1/8	N	8/8	Y	02-Aug-17	18:29	20:01	01:32	Site Water	sediment laden, slowing filtering
YR	C	YR-C	02-Aug-17	16:10	7	588890	6980503	0/8	N	8/8	Y	02-Aug-17	20:03	21:10	01:07	Site Water	less sediment as it settled out in bottle / took 15 min break for safety meeting
HF0.5	A	HF0.5-A	02-Aug-17	13:50	7	588423	6980302	3/8	Y	0/8	N	02-Aug-17	19:46	19:50	00:04	Site Water	
HF0.5	B	HF0.5-B	02-Aug-17	13:50	7	588423	6980302	0/8	N	0/8	N	02-Aug-17	19:53	19:56	00:03	Site Water	
HF0.5	C	HF0.5-C	02-Aug-17	13:50	7	588423	6980302	0/8	N	0/8	N	02-Aug-17	19:59	20:01	00:02	Site Water	
HF0.1	A	HF0.1-A	02-Aug-17	12:50	7	588808	6980531	4/8	Y	0/8	N	02-Aug-17	20:09	20:11	00:02	Site Water	
HF0.1	B	HF0.1-B	02-Aug-17	12:50	7	588808	6980531	4/8	Y	0/8	N	02-Aug-17	20:41	20:43	00:02	Site Water	
HF0.1	C	HF0.1-C	02-Aug-17	12:50	7	588808	6980531	3/8	Y	0/8	N	02-Aug-17	20:36	20:38	00:02	Site Water	
WD0.6	A	WD0.6-A	02-Aug-17	15:20	7	588746	6975769	1/8	N	0/8	N	02-Aug-17	20:57	20:59	00:02	Site Water	
WD0.6	B	WD0.6-B	02-Aug-17	15:20	7	588746	6975769	0/8	N	0/8	N	02-Aug-17	21:02	21:04	00:02	Site Water	
WD0.6	C	WD0.6-C	02-Aug-17	15:20	7	588746	6975769	0/8	N	0/8	N	02-Aug-17	21:06	21:08	00:02	Site Water	
HF2.0	A	HF2.0-A	03-Aug-17	17:00	7	587006	6979770	0/8	N	0/8	N	03-Aug-17	19:17	19:20	00:03	Site Water	
HF2.0	B	HF2.0-B	03-Aug-17	17:00	7	587006	6979770	0/8	N	0/8	N	03-Aug-17	19:17	19:20	00:03	Site Water	
HF2.0	C	HF2.0-C	03-Aug-17	17:00	7	587006	6979770	0/8	N	0/8	N	03-Aug-17	19:28	19:32	00:04	Site Water	
HF4.0	A	HF4.0-A	04-Aug-17	14:00	7	585603	6978365	0/8	N	0/8	N	04-Aug-17	19:40	19:43	00:03	Site Water	
HF4.0	B	HF4.0-B	04-Aug-17	14:00	7	585603	6978365	0/8	N	0/8	N	04-Aug-17	19:40	19:43	00:03	Site Water	
HF4.0	C	HF4.0-C	04-Aug-17	14:00	7	585603	6978365	0/8	N	0/8	N	04-Aug-17	19:49	19:52	00:03	Site Water	
CF8.0	A	CF8.0-A	04-Aug-17	08:25	7	594731	6970592	8/8	Y	0/8	N	04-Aug-17	19:59	20:01	00:02	Site Water	
CF8.0	B	CF8.0-B	04-Aug-17	08:25	7	594731	6970592	8/8	Y	1/8	N	04-Aug-17	19:59	20:01	00:02	Site Water	
CF8.0	C	CF8.0-C	04-Aug-17	08:25	7	594731	6970592	8/8	Y	3/8	Y	04-Aug-17	20:07	20:09	00:02	Site Water	
YT0.1	A	YT0.1-A	05-Aug-17	09:05	7	589535	6979129	0/8	N	0/8	N	05-Aug-17	18:05	18:08	00:03	Site Water	
YT0.1	B	YT0.1-B	05-Aug-17	09:05	7	589535	6979129	0/8	N	0/8	N	05-Aug-17	18:05	18:08	00:03	Site Water	
YT0.1	C	YT0.1-C	05-Aug-17	09:05	7	589535	6979129	0/8	N	0/8	N	05-Aug-17	19:51	19:54	00:03	Site Water	
YT1.0	A	YT1.0-A	05-Aug-17	10:27	7	588885	6978649	0/8	N	0/8	N	05-Aug-17	20:07	20:09	00:02	Site Water	
YT1.0	B	YT1.0-B	05-Aug-17	10:27	7	588885	6978649	0/8	N	0/8	N	05-Aug-17	20:00	20:02	00:02	Site Water	
YT1.0	C	YT1.0-C	05-Aug-17	10:27	7	588885	6978649	0/8	N	0/8	N	05-Aug-17	20:07	20:09	00:02	Site Water	
YT2.0	A	YT2.0-A	05-Aug-17	12:00	7	588259	6977919	0/8	N	0/8	N	05-Aug-17	20:18	20:20	00:02	Site Water	
YT2.0	B	YT2.0-B	05-Aug-17	12:00	7	588259	6977919	0/8	N	0/8	N	05-Aug-17	20:18	20:20	00:02	Site Water	
YT2.0	C	YT2.0-C	05-Aug-17	12:00	7	588259	6977919	0/8	N	0/8	N	05-Aug-17	20:26	20:28	00:02	Site Water	
HF6.3	A	HF6.3-A	09-Aug-17	08:45	7	583976	6976444	0/8	N	0/8	N	09-Aug-17	19:24	19:27	00:03	Site Water	
HF6.3	B	HF6.3-B	09-Aug-17	08:45	7	583976	6976444	0/8	N	2/8	N	09-Aug-17	19:24	19:27	00:03	Site Water	
HF6.3	C	HF6.3-C	09-Aug-17	08:45	7	583976	6976444	0/8	N	0/8	N	09-Aug-17	19:33	19:41	00:08	Site Water	

Notes:
All samples were collected and filtered by PT and PS, sample volumes were 1000ml and preserved in silica.

Table B-3. 2017 eDNA sampling results from fall sampling.

Site Name	Sample Replicate	Lab Code	Collection Date	Collection Time	Zone	Easting	Northing	THAR Frequency	Lab Call	ONTS Frequency	Lab Call	Filter Date	Filter Start Time	Filter End Time	Filtering Time (calc.)	Sample Contents	Comments
WD0.1	A	WD0.1-A	20-Oct-17	15:50	7	589791	6980500	0/8	N	0/8	N	20-Oct-17	19:13	19:15	00:02	Site Water	
WD0.1	B	WD0.1-B	20-Oct-17	15:50	7	589791	6980500	0/8	N	0/8	N	20-Oct-17	19:14	19:16	00:02	Site Water	
WD0.1	C	WD0.1-C	20-Oct-17	15:50	7	589791	6980500	0/8	N	0/8	N	20-Oct-17	19:33	19:36	00:03	Site Water	
HF0.2	A	HF0.2-A	20-Oct-17	14:32	7	588717	6980460	0/8	N	8/8	Y	20-Oct-17	19:34	19:38	00:04	Site Water	
HF0.2	B	HF0.2-B	20-Oct-17	14:32	7	588717	6980460	0/8	N	4/8	Y	20-Oct-17	19:56	19:59	00:03	Site Water	
HF0.2	C	HF0.2-C	20-Oct-17	14:32	7	588717	6980460	0/8	N	6/8	Y	20-Oct-17	19:56	19:59	00:03	Site Water	
HF0.1	A	HF0.1-A	20-Oct-17	14:06	7	588809	6980518	0/8	N	1/8	N	20-Oct-17	20:32	20:34	00:02	Site Water	
HF0.1	B	HF0.1-B	20-Oct-17	14:06	7	588809	6980518	0/8	N	2/8	N	20-Oct-17	20:14	20:18	00:04	Site Water	
HF0.1	C	HF0.1-C	20-Oct-17	14:06	7	588809	6980518	0/8	N	0/8	N	20-Oct-17	20:15	20:19	00:04	Site Water	
YR1	A	YR1-A	20-Oct-17	15:04	7	589591	6979878	6/8	Y	0/8	N	20-Oct-17	20:49	20:55	00:06	Site Water	
YR1	B	YR1-B	20-Oct-17	15:04	7	589591	6979878	5/8	Y	1/8	N	20-Oct-17	20:49	20:54	00:05	Site Water	
YR1	C	YR1-C	20-Oct-17	15:04	7	589591	6979878	6/8	Y	0/8	N	20-Oct-17	20:32	20:36	00:04	Site Water	

Notes:
All samples were collected and filtered by DH and PS, sample volumes were 1000ml and preserved in silica.

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APPENDIX C. 2017 PHYSICAL STREAM ATTRIBUTES AND FISH SAMPLING DATA

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Table C-1. 2017 physical stream attributes.

Data Row	Site Name	Stream Name	Sample Date	Avg. Channel Width (m)	Avg. Wet Width (m)	Avg. Residual Pool Depth (m)	Avg. Bankfull Depth (m)	Avg. Stream Gradient (%)	Cover - Total	Cover - Dominant	Cover - Subdominant	Substrate		Water Temp (°C)	pH	SPC (µg/cm)	Dissolved Oxygen (mg/L)	Dissolved Oxygen (% sat)	Turbidity
1	HF0.1	Halfway Creek	02-Aug-17			1						C - Cobble	F - Fines	4					C - Clear
2	HF0.2	Halfway Creek	02-Aug-17	4.8		1		2.25	Moderate	U - Undercut Banks		C - Cobble	G - Gravel						
3	HF0.6	Halfway Creek	03-Aug-17					2 to 6				C - Cobble		4.1					
4	HF0.9	Halfway Creek	02-Aug-17			0.7								4.2/4.4					
5	Yukon River Control	Halfway Creek	02-Aug-17											15.8					
6	HF1.3	Halfway Creek	03-Aug-17					4											
7	HF2.1	Halfway Creek	04-Aug-17					4											
8	HF2.1	Halfway Creek	04-Aug-17	2.25		0.7													
9	HF30	Halfway Creek	04-Aug-17					4											
10	HF2.4	Halfway Creek	04-Aug-17					5 to 6											
11	HF2.5	Halfway Creek	04-Aug-17					4											
12	HF2.7	Halfway Creek	04-Aug-17	2.66	2.69	0.35	1.13	4.3	Moderate	B - Boulder	SWD - Small Woody Debris, DP – Deep pools	B - Boulder	C - Cobble	3.3					C - Clear
13	HF3.1	Halfway Creek	04-Aug-17					5 to 6											
14	HF3.5	Halfway Creek	04-Aug-17	1.2		0.42													
15	HF3.6	Halfway Creek	04-Aug-17		1.5	0.8													
16	HF4.0	Halfway Creek	04-Aug-17									B - Boulder	C - Cobble						
17	HF4.5	Halfway Creek	04-Aug-17					9 to 12				B - Boulder	C - Cobble						
19	HF4.9	Halfway Creek	04-Aug-17					5											
20	HF5.0	Halfway Creek	04-Aug-17					8, 5						5.3					

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APPENDIX D. 2017 FISH CAPTURE DATA

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Table D-1. 2017 fish capture data.

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
HF0.1	Halfway Creek	03-Aug-17	CH	68		Release					
HF0.1	Halfway Creek	03-Aug-17	CH	73		Release					
HF0.1	Halfway Creek	03-Aug-17	CH	66		Release					
HF0.2	Halfway Creek	03-Aug-17	GR	172	36	Kill Sacrifice		5	0.7	<0.1	
HF0.2	Halfway Creek	03-Aug-17	GR	174	38.6	Kill Sacrifice		4	<1	<0.1	
HF0.2	Halfway Creek	03-Aug-17	GR	294	236	Kill Sacrifice	F	8	3.6	3.1	Misc. invert + organics
HF0.2	Halfway Creek	03-Aug-17	GR	154	34	Kill Sacrifice		3	0.3	<0.1	
HF0.2	Halfway Creek	03-Aug-17	GR	242	98.8	Kill Sacrifice	F	6	1	0.8	
HF0.2	Halfway Creek	03-Aug-17	GR	168	32.7	Kill Sacrifice		3	0.4	<0.1	
HF0.2	Halfway Creek	03-Aug-17	CH	70		Release					
HF0.2	Halfway Creek	03-Aug-17	CH	68		Release					
HF0.2	Halfway Creek	03-Aug-17	GR	320	374	Kill Sacrifice		9	3.7	4.4	Misc. invert + wood
HF0.3	Halfway Creek	03-Aug-17	GR	140		Release					
YT0.0	YT 24 Creek	05-Aug-17	GR	120	10.7	Kill Sacrifice		3	0.3	<0.1	Stonefly, blackflies, adult flies
LC2.7-1	Latte Creek	05-Aug-17	GR	267	198	Kill Sacrifice		7	1.6	1.8	many chirnomids, stonefly, ants, organics
LC2.7-1	Latte Creek	05-Aug-17	GR	236	150	Kill Sacrifice	M	6	0.8	<0.1	Staphylinid, ichneumonid, syriphid larvae, chironda
LC2.7-1	Latte Creek	05-Aug-17	GR	175	54	Kill Sacrifice	M	5	0.5	<0.1	Mosquito adult, aphid, mustelid, cranefly, blackfly, brachonid

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
LC2.7-1	Latte Creek	05-Aug-17	GR	200	90	Kill Sacrifice	F	6	0.9	<0.1	Syrphid larva, chironomids, adult fly, stonefly, membracidae
LC2.7-2	Latte Creek	05-Aug-17	GR	240	142	Kill Sacrifice	M	4	0.9	<0.1	Staphylinid, blackfly, chrominid, lepidopteyla larvae, cranefly, ichnemoroid, mustelid.
LC2.7-2	Latte Creek	05-Aug-17	GR	180	70	Kill Sacrifice	M	5	0.4	<0.1	Blackfly, shorefly, chironomid, membracidae, ichneumonoids
LC2.7-2	Latte Creek	05-Aug-17	GR	175	54	Kill Sacrifice		3	0.6	<0.1	Blackfly, stonefly, chironomid, ant, shorefly
LC2.7-2	Latte Creek	05-Aug-17	GR	273	190	Kill Sacrifice	F	9	2.4	1.6	Flies, brown lacewings, chironomids, stonefly, hymenopteyla,
LC2.7-3	Latte Creek	05-Aug-17	GR	126	236	Kill Sacrifice		4	0.8	<0.1	Syriphid adult, blackfly larvae, chironomid, diaprid, hymenopteyla, brachonids, mosquito adult
LC2.7-3	Latte Creek	05-Aug-17	GR	232	284	Kill Sacrifice	F	9	1.6	1.9	Majority chronomid, leaf hopper, detritus
LC2.7-3	Latte Creek	05-Aug-17	GR	444	324	Release					
LC2.7-3	Latte Creek	05-Aug-17	GR	124	220	Release					
LC2.7-3	Latte Creek	05-Aug-17	GR	254	310	Release					
LC2.7-3	Latte Creek	05-Aug-17	GR	164	245	Release					
LC2.7-3	Latte Creek	05-Aug-17	GR	142	239	Release					
LC2.7-3	Latte Creek	05-Aug-17	GR	378	322	Release					
LC2.7-3	Latte Creek	05-Aug-17	GR	236	280	Release					
LC2.7-3	Latte Creek	05-Aug-17	GR	180	260	Release					
LC2.7-3	Latte Creek	05-Aug-17	GR	80	202	Release					

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
LC2.7-3	Latte Creek	05-Aug-17	GR	90	216	Release					
LC2.7-3	Latte Creek	05-Aug-17	GR	128	242	Release					
CF3.9	Coffee Creek	08-Aug-17	GR	310		Release					
CF3.9	Coffee Creek	08-Aug-17	CH	78		Release					
CF3.9	Coffee Creek	08-Aug-17	GR	240		Release					
CF3.9	Coffee Creek	08-Aug-17	CH	83		Release					
CF3.9	Coffee Creek	08-Aug-17	GR	118		Release					
CF3.9	Coffee Creek	08-Aug-17	CH	82		Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	70	4	Kill Sacrifice		3			
CF3.9	Coffee Creek	08-Aug-17	CCG	65	4	Kill Sacrifice		3			
CF3.9	Coffee Creek	08-Aug-17	CH	77	6	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	75	4	Kill Sacrifice		3			
CF3.9	Coffee Creek	08-Aug-17	GR	65	<4	Kill Sacrifice		1	<0.1	<0.1	
CF3.9	Coffee Creek	08-Aug-17	CH	75	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	70	<4	Kill Sacrifice		1			
CF3.9	Coffee Creek	08-Aug-17	CCG	55	<4	Kill Sacrifice		1			
CF3.9	Coffee Creek	08-Aug-17	CCG	92	6	Kill Sacrifice		2			
CF3.9	Coffee Creek	08-Aug-17	GR	70	2	Kill Sacrifice		1	<0.1	<0.1	Plecoptera, chronomid, chironomid, red mite, diapriadae, brachonidae

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
CF3.9	Coffee Creek	08-Aug-17	CH	71	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	85	6	Kill Sacrifice		2			
CF3.9	Coffee Creek	08-Aug-17	CCG	72	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	60	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	68	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	72	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	70	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	60	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	58	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	65	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	65	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	53	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	63	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	55	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	65	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	65	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	70	4	Kill Sacrifice		3			
CF3.9	Coffee Creek	08-Aug-17	CCG	65	<4	Release					

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
CF3.9	Coffee Creek	08-Aug-17	CCG	77	4	Kill Sacrifice		3			
CF3.9	Coffee Creek	08-Aug-17	CCG	61	<4	Kill Sacrifice		2			
CF3.9	Coffee Creek	08-Aug-17	CCG	53	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	53	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	50	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	GR	68	5	Kill Sacrifice		1	<0.1	<0.1	Plecoptera, mayfly, chironomid, red mite, diapradae, brachonidae
CF3.9	Coffee Creek	08-Aug-17	CCG	79	6	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	69	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	84	6	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	80	6	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	80	6	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	81	6	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	78	6	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	80	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	76	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	95	8	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	70	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	85	6	Release					

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
CF3.9	Coffee Creek	08-Aug-17	CCG	77	8	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	78	6	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	66	4	Release					
CF3.9	Coffee Creek	08-Aug-17	GR	37		Release					
CF3.9	Coffee Creek	08-Aug-17	GR	280	220	Kill Sacrifice	F	8	1.2	1.3	Mustelid, plecoptera, blackfly larvae, chirnomid, membracidae, coleoptera
CF3.9	Coffee Creek	08-Aug-17	CCG	60	<4	Release					
CF3.9	Coffee Creek	08-Aug-17	GR	270	188	Kill Sacrifice	M	5	1.1	0.6	Blackfly larvae, plecoptera, coleoptera, aphid, midge, ant, mayfly, salidae
CF3.9	Coffee Creek	08-Aug-17	GR	275	210	Kill Sacrifice	M	ns	1.2	0.7	Tipulid larvae, coleoptera, ant, brachonoid, chironomid, plecoptera, collumbela
CF3.9	Coffee Creek	08-Aug-17	GR	320	314	Kill Sacrifice	M	6	1.2	2.7	Gyronomid, coleoptera, chironomid, weevil, peccoptera, ichneumonid, diptera, ant
CF3.9	Coffee Creek	08-Aug-17	GR	280		Release					
CF3.9	Coffee Creek	08-Aug-17	CH	68		Release					
CF3.9	Coffee Creek	08-Aug-17	CH	76	3.5	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	75	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	66	2.2	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	71	2.7	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	75	3.1	Release					

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
CF3.9	Coffee Creek	08-Aug-17	CH	75	3	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	75	2.9	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	64		Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	87	4	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	82	3.6	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	80	3.2	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	71	2.6	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	69	2.2	Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	86	3.8	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	78	3.3	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	83	3	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	77	2.6	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	79	3.2	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	74	3.1	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	78	3.5	Release					
CF3.9	Coffee Creek	08-Aug-17	CH	66	1.8	Release					
CF3.9	Coffee Creek	08-Aug-17	GR	300		Release					
CF3.9	Coffee Creek	08-Aug-17	GR	268		Release					

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
CF3.9	Coffee Creek	08-Aug-17	GR	220		Release					
CF3.9	Coffee Creek	08-Aug-17	GR	195		Release					
CF3.9	Coffee Creek	08-Aug-17	GR	78		Release					
CF3.9	Coffee Creek	08-Aug-17	GR	68		Release					
CF3.9	Coffee Creek	08-Aug-17	GR	265		Kill Sacrifice	F	5	1.2	1.6	Ichnevmonid, brachonioid, chronomid, formicidae, shorefly, syriphid larvae, membracidae, coleoptera, midges
CF3.9	Coffee Creek	08-Aug-17	GR	244		Kill Sacrifice	M	5	0.8	0.3	Ant, ichnevmonid, plecoptera, lacenin (GR), membracidae, aphid, mosquito adult, zyriphidae larvae, leaf hopper, diptera
CF3.9	Coffee Creek	08-Aug-17	GR	135		Release					
CF3.9	Coffee Creek	08-Aug-17	GR	63		Release					
CF3.9	Coffee Creek	08-Aug-17	GR	77		Release					
CF3.9	Coffee Creek	08-Aug-17	GR	74		Release					
CF3.9	Coffee Creek	08-Aug-17	CCG	84		Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	80	6	Kill Sacrifice		2			
ID1.9-1	Independence Creek	07-Aug-17	CCG	80	6	Kill Sacrifice		5			
ID1.9-1	Independence Creek	07-Aug-17	GR	290	282	Kill Sacrifice	F	7	2	4.4	Beetles, chromonids

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
ID1.9-1	Independence Creek	07-Aug-17	CCG	76	5	Kill Sacrifice		4			
ID1.9-1	Independence Creek	07-Aug-17	CCG	71	4	Kill Sacrifice		3			
ID1.9-1	Independence Creek	07-Aug-17	CCG	70	4	Kill Sacrifice		2			
ID1.9-1	Independence Creek	07-Aug-17	CCG	64	2	Kill Sacrifice		2			
ID1.9-1	Independence Creek	07-Aug-17	CCG	82	7	Kill Sacrifice		2			
ID1.9-1	Independence Creek	07-Aug-17	CCG	81	7	Kill Sacrifice		3			
ID1.9-1	Independence Creek	07-Aug-17	CCG	67	4	Kill Sacrifice		1			
ID1.9-1	Independence Creek	07-Aug-17	CCG	66	4	Kill Sacrifice		2			
ID1.9-1	Independence Creek	07-Aug-17	GR	70	4	Kill Sacrifice		1	<0.1	<0.1	Ant, chronomid
ID1.9-1	Independence Creek	07-Aug-17	GR	68	3	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	67	4	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	70	4	Release					

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
ID1.9-1	Independence Creek	07-Aug-17	CCG	65	4	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	75	5	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	88	8	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	72	6	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	69	4	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	65	4	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	64	4	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	66	4	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	75	6	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	70	3	Release					
ID1.9-1	Independence Creek	07-Aug-17	CCG	70	4	Release					
ID1.9-1	Independence Creek	07-Aug-17	CH	77	5	Release					

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
ID1.9-1	Independence Creek	07-Aug-17	CH	69	4	Release					
ID1.9-1	Independence Creek	07-Aug-17	CH	69	4	Release					
ID1.9-2	Independence Creek	07-Aug-17	GR	301	274	Kill Sacrifice	F	9	6.4	3.8	Caddisfly, spruce, chromonid, worm
ID1.9-2	Independence Creek	07-Aug-17	GR	282	238	Kill Sacrifice		5	2.1	4	Beetles, chronomid, organics
ID1.9-2	Independence Creek	07-Aug-17	GR	74	4	Kill Sacrifice		1	<0.1	<0.1	Indiscernible invert
ID1.9-2	Independence Creek	07-Aug-17	GR	317	330	Kill Sacrifice	M	11	1.3	3	Chronomid, spruce needle, beetle
ID1.9-2	Independence Creek	07-Aug-17	CCG	108	12	Release					
ID1.9-2	Independence Creek	07-Aug-17	CCG	70	4	Release					
ID1.9-2	Independence Creek	07-Aug-17	CCG	68	4	Release					
ID1.9-2	Independence Creek	07-Aug-17	CCG	70	4	Release					
ID1.9-3	Independence Creek	07-Aug-17	GR	115	12	Kill Sacrifice		2	<0.1	<0.1	Chronomids
ID1.9-3	Independence Creek	07-Aug-17	CCG	65	4	Kill Sacrifice		2			

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
ID1.9-3	Independence Creek	07-Aug-17	GR	62	5	Release					
ID1.9-3	Independence Creek	07-Aug-17	GR	62	4	Release					
ID1.9-3	Independence Creek	07-Aug-17	CH	77	6	Release					
ID1.9-3	Independence Creek	07-Aug-17	CCG	71	4	Release					
ID1.9-3	Independence Creek	07-Aug-17	CCG	80	6	Release					
ID1.9-3	Independence Creek	07-Aug-17	CCG	70	4	Release					
ID1.9-3	Independence Creek	07-Aug-17	CH	66	5	Release					
ID1.9-3	Independence Creek	07-Aug-17	CCG	68	4	Release					
ID1.9-3	Independence Creek	07-Aug-17	CCG	72	4	Release					
ID1.9-3	Independence Creek	07-Aug-17	GR	64	4	Release					
ID1.9-3	Independence Creek	07-Aug-17	CCG	75	4	Release					
YRU1.9	Yukon River	10-Aug-17	CH	72		Release					
YRU1.9	Yukon River	10-Aug-17	LSU	73		Release					

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
YRU1.9	Yukon River	10-Aug-17	LSU	70		Release					
YRU1.9	Yukon River	10-Aug-17	CH	76		Release					
YRU1.9	Yukon River	10-Aug-17	CH	67		Release					
YRU1.9	Yukon River	10-Aug-17	CH			Release					
YRU1.9	Yukon River	10-Aug-17	CH	73		Release					
YRU1.9	Yukon River	10-Aug-17	LSU	145		Release					
YRU1.9	Yukon River	10-Aug-17	CH	75		Release					
YRU1.9	Yukon River	10-Aug-17	CH	73		Release					
YRU1.9	Yukon River	10-Aug-17	CCG	46		Release					
YRD1.6	Yukon River	10-Aug-17	CH	77		Release					
YRD1.6	Yukon River	10-Aug-17	CH	78		Release					
YRD1.6	Yukon River	10-Aug-17	CH	73		Release					
YRD1.6	Yukon River	10-Aug-17	CH	75		Release					
YRD1.6	Yukon River	10-Aug-17	CH	70		Release					
YRD1.6	Yukon River	10-Aug-17	CH	78		Release					
YRD1.6	Yukon River	10-Aug-17	CH	75		Release					
YRD1.6	Yukon River	10-Aug-17	CH	64		Release					
YRD1.6	Yukon River	10-Aug-17	CH	75		Release					

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
YRD1.6	Yukon River	10-Aug-17	CH	80		Release					
YRD1.6	Yukon River	10-Aug-17	CH	69		Release					
YRD1.6	Yukon River	10-Aug-17	CH	66		Release					
YRD1.6	Yukon River	10-Aug-17	GR	66		Release					
YRD1.6	Yukon River	10-Aug-17	GR	71		Release					
YRD1.6	Yukon River	10-Aug-17	CH	78		Release					
YRD1.6	Yukon River	10-Aug-17	CH	63		Release					
YRD1.6	Yukon River	10-Aug-17	CH	80		Release					
YRD1.6	Yukon River	10-Aug-17	CH	84		Release					
YRD1.6	Yukon River	10-Aug-17	CH	73		Release					
YRD1.6	Yukon River	10-Aug-17	CH	75		Release					
YRD1.6	Yukon River	10-Aug-17	CH	70		Release					
YRD1.6	Yukon River	10-Aug-17	CH	83		Release					
YRD1.6	Yukon River	10-Aug-17	CH	75		Release					
YRD1.6	Yukon River	10-Aug-17	CH	78		Release					
YRD1.6	Yukon River	10-Aug-17	CH	74		Release					
YRD1.6	Yukon River	10-Aug-17	CH	68		Release					
YRD1.6	Yukon River	10-Aug-17	CH	76		Release					

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
YRD1.6	Yukon River	10-Aug-17	CH	74		Release					
YRD1.6	Yukon River	10-Aug-17	CH	80		Release					
YRD1.6	Yukon River	10-Aug-17	CH	66		Release					
YRD1.6	Yukon River	10-Aug-17	CH	75		Release					
YRD1.6	Yukon River	10-Aug-17	CH	76		Release					
YRD1.6	Yukon River	10-Aug-17	CH	70		Release					
YRD1.6	Yukon River	10-Aug-17	GR	68		Release					
YRD1.6	Yukon River	10-Aug-17	GR	74		Release					
YRD1.6	Yukon River	10-Aug-17	GR	62		Release					
YRD1.6	Yukon River	10-Aug-17	GR	70		Release					
YRD1.6	Yukon River	10-Aug-17	GR	65		Release					
YRD1.6	Yukon River	10-Aug-17	LSU	110		Release					
YRD1.6	Yukon River	10-Aug-17	CCG	41		Release					
YRD1.6	Yukon River	10-Aug-17	CH	84		Release					
YRD1.6	Yukon River	10-Aug-17	CH	70		Release					
YRD1.6	Yukon River	10-Aug-17	CH	76		Release					
YRD1.6	Yukon River	10-Aug-17	CH	74		Release					
YRD1.6	Yukon River	10-Aug-17	CH	80		Release					

Site Name	Stream Name	Sample Date	Species	Length (mm)	Weight (g)	Release Condition	Sex	Age (Years)	Liver Weight (g)	Gonad Weight (g)	Stomach Contents
YRD1.6	Yukon River	10-Aug-17	CH	74		Release					
YRD1.6	Yukon River	10-Aug-17	CH	74		Release					
YRD1.6	Yukon River	10-Aug-17	CH	76		Release					
YRD1.6	Yukon River	10-Aug-17	CH	76		Release					
YRD1.6	Yukon River	10-Aug-17	CH	78		Release					
YRD2.1	Yukon River	10-Aug-17	CH	69		Release					
YRD2.1	Yukon River	10-Aug-17	CH	70		Release					
YRD2.1	Yukon River	10-Aug-17	CH	75		Release					
YRD2.1	Yukon River	10-Aug-17	CH	74		Release					
YRD2.1	Yukon River	10-Aug-17	CH	75		Release					
YRD2.1	Yukon River	10-Aug-17	CH	75		Release					
YRD2.1	Yukon River	10-Aug-17	CH	76		Release					
YRD2.1	Yukon River	10-Aug-17	CH	71		Release					

Notes:

Fish species codes as follows: GR = Arctic grayling, CH = Chinook salmon (juvenile), CCG = Slimy sculpin, LSU = Longnose sucker.

APPENDIX E. 2017 TISSUE METALS DATA; FISH AND BENTHIC INVERTEBRATE AND PERIPHYTON

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Table E- 1 Tissue metals data collected from fish tissues, benthic invertebrates and periphyton in 2017, aluminum through manganese.

Sample ID	ALS Sample ID	Watercourse	SSID	Species	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Al	Sb	As	Ba	Be	Bi	Bo	Cd	Ca	Ce	Ch	Co	Cu	Fe	Pb	Li	Mg	Mn
LC 2.7 1GR2-M	L1985910-1	Latte	LC2.7	GR	8/6/17	236	150	6	muscle	--	µg/g ww	1.15	0.0065	0.023	0.192	<0.0020	<0.0020	<0.20	0.0108	800	0.0109	<0.010	0.0119	0.415	5.26	0.0044	<0.10	342	0.356
LC 2.7 1GR2-L	L1985910-2	Latte	LC2.7	GR	8/6/17	236	150	6	liver	--	µg/g ww	2.9	0.0052	0.0224	0.146	<0.0020	<0.0020	<0.20	3.89	59.1	0.005	<0.040	0.382	3.54	88	<0.010	<0.10	233	2.88
LC 2.7 1GR1-M	L1985910-3	Latte	LC2.7	GR	8/6/17	267	198	7	muscle	--	µg/g ww	3.84	0.0049	0.0399	0.227	<0.0020	<0.0020	<0.20	0.0122	561	0.0123	0.017	0.0139	0.644	10.5	0.0066	<0.10	310	0.362
LC 2.7 1GR1-L	L1985910-4	Latte	LC2.7	GR	8/6/17	267	198	7	liver	--	µg/g ww	2.5	0.005	0.0348	0.109	<0.0020	<0.0020	<0.20	2.45	58.5	0.0053	<0.040	0.0705	2.5	51.7	<0.010	<0.10	247	3.14
LC 2.7 1GR3-M	L1985910-5	Latte	LC2.7	GR	8/6/17	175	54	5	muscle	--	µg/g ww	1.67	0.0059	0.0181	0.155	<0.0020	<0.0020	<0.20	0.0099	320	0.0097	0.011	0.0106	0.472	6.53	<0.0040	<0.10	337	0.401
LC 2.7 1GR3-L	L1985910-6	Latte	LC2.7	GR	8/6/17	175	54	5	liver	--	µg/g ww	2.7	0.0054	0.0493	0.271	<0.0020	<0.0020	0.35	2.14	111	0.0055	0.225	0.163	3.15	71.1	<0.010	0.11	266	2.37
LC 2.7 1GR4-M	L1985910-7	Latte	LC2.7	GR	8/6/17	200	90	6	muscle	65.1	µg/g ww	2.61	0.0203	0.0219	0.176	<0.0020	<0.0020	<0.20	0.0113	282	0.0089	0.036	0.0135	0.432	7.34	0.0074	<0.10	285	0.502
LC 2.7 1GR4-L	L1985910-8	Latte	LC2.7	GR	8/6/17	200	90	6	liver	--	µg/g ww	2.3	0.0044	0.0367	0.408	<0.0020	<0.0020	0.29	1.94	87.6	0.0071	0.041	0.192	2.69	70.1	<0.010	<0.10	243	3.17
LC 2.7 2GR5-M	L1985910-9	Latte	LC2.7	GR	8/6/17	240	142	4	muscle	--	µg/g ww	1.02	0.0063	0.0115	0.126	<0.0020	<0.0020	<0.20	0.0037	263	0.0082	<0.010	0.0093	0.317	3.79	<0.0040	<0.10	214	0.265
LC 2.7 2GR5-L	L1985910-10	Latte	LC2.7	GR	8/6/17	240	142	4	liver	--	µg/g ww	1.6	0.0044	0.0163	0.143	<0.0020	<0.0020	0.21	2.46	47.7	0.0063	0.044	0.243	3.46	84.7	<0.010	<0.10	197	2.27
LC 2.7 2GR6-M	L1985910-11	Latte	LC2.7	GR	8/6/17	180	70	5	muscle	--	µg/g ww	1.78	0.0072	0.0245	0.145	<0.0020	<0.0020	<0.20	0.0073	267	0.0106	0.021	0.0108	0.441	6.16	0.0045	<0.10	300	0.359
LC 2.7 2GR6-L	L1985910-12	Latte	LC2.7	GR	8/6/17	180	70	5	liver	--	µg/g ww	2	0.0034	0.0166	0.247	<0.0020	<0.0020	<0.20	3.91	53.9	0.0052	<0.040	0.276	2.2	64.2	<0.010	<0.10	179	2.12
LC 2.7 2GR7-M	L1985910-13	Latte	LC2.7	GR	8/6/17	175	54	3	muscle	--	µg/g ww	1.24	0.0043	0.02	0.163	<0.0020	<0.0020	<0.20	0.004	467	0.011	0.014	0.0077	0.352	4.44	<0.0040	<0.10	334	0.323
LC 2.7 2GR7-L	L1985910-14	Latte	LC2.7	GR	8/6/17	175	54	3	liver	--	µg/g ww	2.2	0.0075	0.0559	0.092	<0.0020	<0.0020	<0.20	0.533	57.9	0.0064	<0.040	0.0931	2.36	45.1	<0.010	<0.10	231	2.19
LC 2.7 2GR8-M	L1985910-15	Latte	LC2.7	GR	8/6/17	273	190	9	muscle	62.1	µg/g ww	1.29	0.006	0.0188	0.119	<0.0020	<0.0020	<0.20	0.0116	168	0.0135	0.019	0.0194	0.45	7.74	0.006	<0.10	275	0.288
LC 2.7 2GR8-L	L1985910-16	Latte	LC2.7	GR	8/6/17	273	190	9	liver	--	µg/g ww	2.8	0.0052	0.0281	0.221	<0.0020	<0.0020	<0.20	3.31	377	0.0103	<0.040	0.0898	3.55	55.9	<0.010	<0.10	195	2.24
LC 2.7 3GR9-M	L1985910-17	Latte	LC2.7	GR	8/6/17	126	236	4	muscle	--	µg/g ww	1.98	0.004	0.0218	0.15	<0.0020	<0.0020	<0.20	0.007	373	0.0092	0.016	0.0145	0.428	5.9	0.0063	<0.10	316	0.332
LC 2.7 3GR9-L	L1985910-18	Latte	LC2.7	GR	8/6/17	126	236	4	liver	--	µg/g ww	2.4	0.0078	0.07	0.102	<0.0020	<0.0020	<0.20	1.98	49.9	0.0082	<0.040	0.163	2.42	48.6	<0.010	<0.10	239	2.42
LC 2.7 3GR10-M	L1985910-19	Latte	LC2.7	GR	8/6/17	232	284	9	muscle	63.1	µg/g ww	2.62	0.0048	0.0385	0.297	<0.0020	<0.0020	<0.20	0.0058	1020	0.0112	0.016	0.0194	0.546	8.08	0.0122	<0.10	286	0.625
LC 2.7 3GR10-L	L1985910-20	Latte	LC2.7	GR	8/6/17	232	284	9	liver	--	µg/g ww	7.3	0.0127	0.0325	0.45	<0.0020	<0.0020	<0.20	2.79	68.3	0.0074	0.053	0.138	2.98	109	<0.010	<0.10	210	2.21
YT005 GR1-M	L1985910-21	YT-24	YT005	GR	8/6/17	120	10.7	3	muscle	--	µg/g ww	1.8	0.0047	0.0286	0.147	<0.0020	<0.0020	<0.20	0.053	168	0.0079	<0.040	0.0151	0.459	6.8	<0.010	<0.10	278	0.321
YT005 GR1-L	L1985910-22	YT-24	YT005	GR	8/6/17	120	10.7	3	liver	--	µg/g ww	1.8	0.0103	0.0342	0.271	<0.0020	<0.0020	0.31	2.59	67.4	0.007	0.074	0.129	2.63	45.7	<0.010	<0.10	384	2.86
ID1.9-1CCG1	L1985910-23	Independence	ID1.9	CCG	8/7/17	80	6	2	WB, no head	59.1	µg/g ww	43.2	0.0062	0.091	3.41	<0.0020	<0.0020	<0.20	0.0785	14100	0.0154	0.091	0.0381	1.05	63.2	0.101	0.12	417	6.9
ID1.9-1CCG2	L1985910-24	Independence	ID1.9	CCG	8/7/17	80	6	5	WB, no head	--	µg/g ww	206	0.0103	0.214	6.55	0.0044	<0.0020	<0.20	0.38	12500	0.0234	0.446	0.137	1.34	272	0.119	0.16	504	20.9
ID1.9-1CCG3	L1985910-25	Independence	ID1.9	CCG	8/7/17	76	45	4	WB, no head	--	µg/g ww	91.1	0.0127	0.154	4.16	0.0031	<0.0020	<0.20	0.0839	15700	0.0143	0.181	0.06	0.945	130	0.056	<0.10	474	12.2
ID1.9-1CCG4	L1985910-26	Independence	ID1.9	CCG	8/7/17	71	4	3	WB, no head	--	µg/g ww	54.8	0.0049	0.104	2.81	<0.0020	<0.0020	<0.20	0.0851	9160	0.0098	0.112	0.0412	0.974	73.5	0.032	<0.10	355	6.14
ID1.9-1CCG5	L1985910-27	Independence	ID1.9	CCG	8/7/17	70	4	2	WB, no head	--	µg/g ww	36.1	0.0053	0.124	2.87	<0.0020	<0.0020	<0.20	0.104	10400	0.0087	0.077	0.0331	0.878	53.5	0.028	<0.10	373	6.28
ID1.9-1CCG6	L1985910-28	Independence	ID1.9	CCG	8/7/17	64	2	2	WB, no head	--	µg/g ww	113	0.01	0.171	2.86	0.0031	<0.0020	<0.20	0.0239	7850	0.0166	0.232	0.0783	0.916	149	0.054	0.1	381	8.67
ID1.9-1CCG7	L1985910-29	Independence	ID1.9	CCG	8/7/17	82	7	2	WB, no head	--	µg/g ww	181	0.011	0.217	4.16	0.0046	<0.0020	<0.20	0.163	11600	0.0268	0.407	0.133	1.33	251	0.107	0.18	462	16.5
ID1.9-1CCG8	L1985910-30	Independence	ID1.9	CCG	8/7/17	81	7	3	WB, no head	--	µg/g ww	97	0.0063	0.138	3.87	0.0027	<0.0020	<0.20	0.0986	10200	0.0137	0.211	0.0774	1.12	135	0.0537	0.11	438	11.8
ID1.9-1CCG9	L1985910-31	Independence	ID1.9	CCG	8/7/17	67	4	1	WB, no head	--	µg/g ww	104	0.0063	0.164	3.5	0.0029	<0.0020	<0.20	0.112	11500	0.0166	0.215	0.0807	1.07	145	0.058	<0.10	395	12.7
ID1.9-1CCG10	L1985910-32	Independence	ID1.9	CCG	8/7/17	66	4	2	WB, no head	--	µg/g ww	62.4	0.0078	0.145	4.51	<0.0020	<0.0020	<0.20	0.178	15500	0.0124	0.125	0.0551	0.911	89.2	0.093	<0.10	463	13.4
ID1.9-3CCG11	L1985910-33	Independence	ID1.9	CCG	8/7/17	65	4	2	WB, no head	--	µg/g ww	43.9	0.0045	0.108	3.03	<0.0020	<0.0020	<0.20	0.178	11300	0.0093	0.09	0.0541	0.931	64.2	0.036	<0.10	348	8.58
ID1.9-1GR1-M	L1985910-34	Independence	ID1.9	GR	8/7/17	290	282	7	muscle	--	µg/g ww	2.84	0.0027	0.0176	0.127	<0.0020	<0.0020	<0.20	0.0052	131	0.0128	0.013	0.0144	0.441	8.69	0.0093	<0.10	304	0.285
ID1.9-1GR1-L	L1985910-35	Independence	ID1.9	GR	8/7/17	290	282	7	liver	--	µg/g ww	2.5	0.0041	0.0183	0.225	<0.0020	<0.0020	<0.20	0.839	82.5	0.0065	<0.040	0.0614	1.29	37.1	<0.010	<0.10	194	2.48
ID1.9-1GR2-M	L1985910-36	Independence	ID1.9	GR	8/7/17	70	4	1	muscle	--	µg/g ww	5.7	0.0359	0.019	0.46	<0.0020	<0.0020	<0.20	0.0373	1430	0.0107	<0.040	0.017	0.542	11.2	0.01	<0.10	383	1.11
ID1.9-1GR2-L	L1985910-37	Independence	ID1.9	GR	8/7/17	70	4	1	liver	75.2	µg/g ww	20.3	0.028	0.163	6.9	<0.018	<0.018	<1.8	4.07	162	0.0177	<0.36	0.282	7.91	132	<0.090	<0.90	809	6.93
ID1.9-2GR3-M	L1985910-38	Independence	ID1.9	GR	8/7/17	301	274	9	muscle	20	µg/g ww	2.26	0.0052	0.033	0.169	<0.0020	<0.0020	<0.20	0.0083	398	0.0134	0.011	0.0102	0.507	9.12	0.0046	<0.10	332	0.355
ID1.9-2GR3-L	L1985910-39	Independence	ID1.9	GR	8/7/17	301	274	9	liver	--	µg/g ww	2	0.0026	0.0179	0.148	<0.0020	<0.0020	<0.20	1.19	56.8	0.0056	<0.040	0.0769	1.62	53	<0.010	<0.10	184	2.38

Sample ID	ALS Sample ID	Watercourse	SSID	Species	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Al	Sb	As	Ba	Be	Bi	Bo	Cd	Ca	Ce	Ch	Co	Cu	Fe	Pb	Li	Mg	Mn
ID1.9-2GR4-M	L1985910-40	Independence	ID1.9	GR	8/7/17	282	238	5	muscle	--	µg/g ww	1.32	<0.0020	0.0334	0.244	<0.0020	<0.0020	<0.20	0.0049	801	0.0102	<0.010	0.0078	0.299	4.69	<0.0040	<0.10	296	0.381
ID1.9-2GR4-L	L1985910-41	Independence	ID1.9	GR	8/7/17	282	238	5	liver	--	µg/g ww	1.8	<0.0020	0.0191	0.195	<0.0020	<0.0020	<0.20	1.07	52.6	0.0078	<0.040	0.189	1.6	50.5	<0.010	<0.10	215	2.54
ID1.9-2GR5-M	L1985910-42	Independence	ID1.9	GR	8/7/17	74	4	1	muscle	--	µg/g ww	15	0.0117	0.0279	0.392	<0.0020	<0.0020	<0.20	0.028	604	0.0122	0.116	0.0287	0.479	24.4	0.012	<0.10	334	1.45
ID1.9-2GR5-L	L1985910-43	Independence	ID1.9	GR	8/7/17	74	4	1	liver	75.5	µg/g ww	36	0.037	0.167	1.12	<0.022	<0.022	<2.2	2.51	150	0.017	<0.44	0.266	7.67	109	<0.11	<1.1	578	5.84
ID1.9-2GR6-M	L1985910-44	Independence	ID1.9	GR	8/7/17	317	330	11	muscle	41.3	µg/g ww	2.05	0.0036	0.0265	0.213	<0.0020	<0.0020	<0.20	0.0089	636	0.0724	0.011	0.0104	0.386	7.92	<0.0040	<0.10	282	0.398
ID1.9-2GR6-L	L1985910-45	Independence	ID1.9	GR	8/7/17	317	330	11	liver	--	µg/g ww	4.4	0.009	0.0257	0.29	<0.0020	<0.0020	<0.20	2.19	62.9	0.0277	0.051	0.319	2.48	106	<0.010	<0.10	195	2
ID1.9-3GR7-M	L1985910-46	Independence	ID1.9	GR	8/7/17	115	12	2	muscle	--	µg/g ww	5.6	0.0307	0.0255	0.689	<0.0020	<0.0020	<0.20	0.0314	1580	0.0106	<0.040	0.0199	0.457	12.6	0.01	<0.10	358	1.22
ID1.9-3GR7-L	L1985910-47	Independence	ID1.9	GR	8/7/17	115	12	2	liver	--	µg/g ww	19.2	0.0492	0.084	1.8	<0.0040	<0.0040	<0.40	3.64	144	0.0161	0.227	0.282	5.59	101	0.038	<0.20	443	4.02
HF0.1-GR1-M	L1985910-48	Halfway	HF0.1	GR	8/3/17	172	36	5	muscle	57.1	µg/g ww	1.11	0.0583	0.0275	0.17	<0.0020	<0.0020	<0.20	0.0088	467	0.0094	<0.010	0.0157	0.323	4.7	<0.0040	<0.10	310	0.392
HF0.1-GR1-L	L1985910-49	Halfway	HF0.1	GR	8/3/17	172	36	5	liver	--	µg/g ww	2.3	0.0394	0.0702	0.207	<0.0020	<0.0020	<0.20	1.94	69	0.0111	0.049	0.14	2.76	66	<0.010	<0.10	260	2.42
HF0.2-GR2-M	L1985910-50	Halfway	HF0.2	GR	8/3/17	174	38.6	4	muscle	59.2	µg/g ww	2.21	0.114	0.0316	0.173	<0.0020	<0.0020	<0.20	0.0027	282	0.0095	0.019	0.0076	0.354	6.49	<0.0040	<0.10	318	0.343
HF0.2-GR2-L	L1985910-51	Halfway	HF0.2	GR	8/3/17	174	38.6	4	liver	--	µg/g ww	5.6	0.185	0.0869	0.27	<0.0020	<0.0020	<0.20	0.385	60.2	0.0119	0.051	0.094	2.09	41.5	<0.010	<0.10	388	2.91
HF0.2-GR3-M	L1985910-52	Halfway	HF0.2	GR	8/3/17	294	236	8	muscle	59.9	µg/g ww	0.85	0.0253	0.0314	0.123	<0.0020	<0.0020	<0.20	0.0042	448	0.0109	<0.010	0.0101	0.415	6.26	<0.0040	<0.10	296	0.292
HF0.2-GR3-L	L1985910-53	Halfway	HF0.2	GR	8/3/17	294	236	8	liver	--	µg/g ww	2.6	0.0698	0.042	0.182	<0.0020	<0.0020	<0.20	1.33	60.7	0.0086	<0.040	0.0728	1.62	69.9	<0.010	<0.10	194	2.87
HF0.2-GR4-M	L1985910-54	Halfway	HF0.2	GR	8/3/17	154	34	3	muscle	--	µg/g ww	7.25	0.101	0.017	0.191	<0.0020	<0.0020	<0.20	0.0117	620	0.0095	0.025	0.0159	0.312	13.5	<0.0040	<0.10	310	0.551
HF0.2-GR4-L	L1985910-55	Halfway	HF0.2	GR	8/3/17	154	34	3	liver	--	µg/g ww	2.8	0.164	0.0632	0.161	<0.0020	<0.0020	<0.20	2.22	52.8	0.0079	<0.040	0.114	2.85	59.3	<0.010	<0.10	266	2.9
HF0.2-GR5-M	L1985910-56	Halfway	HF0.2	GR	8/3/17	242	98.8	6	muscle	64.5	µg/g ww	0.78	0.0227	0.0139	0.073	<0.0020	<0.0020	<0.20	0.0069	269	0.0126	<0.010	0.0078	0.25	4.22	<0.0040	<0.10	304	0.227
HF0.2-GR5-L	L1985910-57	Halfway	HF0.2	GR	8/3/17	242	98.8	6	liver	--	µg/g ww	1.1	0.0119	0.0214	0.476	<0.0020	<0.0020	<0.20	1.81	70.2	0.0085	0.043	0.154	2.38	54.6	<0.010	<0.10	209	1.91
HF0.2-GR6-M	L1985910-58	Halfway	HF0.2	GR	8/3/17	168	32.7	3	muscle	--	µg/g ww	2.15	0.0314	0.0217	0.109	<0.0020	<0.0020	<0.20	0.0101	447	0.0107	<0.010	0.0122	0.258	5.61	<0.0040	<0.10	308	0.347
HF0.2-GR6-L	L1985910-59	Halfway	HF0.2	GR	8/3/17	168	32.7	3	liver	--	µg/g ww	1.7	0.0643	0.0506	0.365	<0.0020	<0.0020	<0.20	2.53	56.4	0.0057	0.064	0.19	16.2	55.2	0.213	<0.10	298	2.56
HF0.2-GR7-M	L1985910-60	Halfway	HF0.2	GR	8/3/17	320	374	9	muscle	66.5	µg/g ww	2.89	0.0527	0.0561	0.101	<0.0020	<0.0020	<0.20	0.0075	218	0.0139	<0.010	0.0104	0.425	9	<0.0040	<0.10	324	0.391
HF0.2-GR7-L	L1985910-61	Halfway	HF0.2	GR	8/8/17	320	374	9	liver	--	µg/g ww	2.9	0.0259	0.0602	0.219	<0.0020	<0.0020	<0.20	1.39	476	0.0125	0.027	0.0614	2.58	83	<0.0040	<0.10	213	2.63
CF3.9 CCG1	L1985910-62	Coffee	CF3.9	CCG	8/8/17	70	4	3	WB, no head	--	µg/g ww	86.8	0.0111	0.115	4.03	<0.0020	<0.0020	<0.20	0.128	12500	0.0147	0.136	0.0594	1.06	114	0.029	<0.10	422	7.77
CF3.9 CCG2	L1985910-63	Coffee	CF3.9	CCG	8/8/17	65	4	3	WB, no head	--	µg/g ww	7.4	0.0109	0.0627	3.9	<0.0020	<0.0020	<0.20	0.0529	13800	0.0063	0.065	0.0173	0.643	20.6	<0.010	<0.10	430	5.92
CF3.9 CCG3	L1985910-64	Coffee	CF3.9	CCG	8/8/17	75	4	3	WB, no head	--	µg/g ww	23	0.0121	0.0635	2.64	<0.0020	<0.0020	<0.20	0.0464	9240	0.0094	0.064	0.0306	0.78	40.8	0.012	<0.10	346	3.77
CF3.9 CCG5	L1985910-65	Coffee	CF3.9	CCG	8/8/17	70	<4	1	WB, no head	--	µg/g ww	4.1	0.0045	0.0483	4.09	<0.0020	<0.0020	<0.20	0.228	15900	0.0056	<0.040	0.0208	0.629	17	0.017	<0.10	416	6.81
CF3.9 CCG6	L1985910-66	Coffee	CF3.9	CCG	8/8/17	55	<4	1	WB, no head	--	µg/g ww	131	0.018	0.124	4.66	0.0031	<0.0020	<0.20	0.0792	8630	0.0281	0.308	0.0822	1.06	188	0.058	0.12	438	8.83
CF3.9 CCG7	L1985910-67	Coffee	CF3.9	CCG	8/8/17	92	6	2	WB, no head	--	µg/g ww	17.6	0.0048	0.0479	2.42	<0.0020	<0.0020	<0.20	0.0475	9310	0.0087	0.032	0.0294	0.773	32.7	0.0092	<0.10	303	6.78
CF3.9 CCG9	L1985910-68	Coffee	CF3.9	CCG	8/8/17	85	6	2	WB, no head	--	µg/g ww	11.7	0.0051	0.0539	2.39	<0.0020	<0.0020	<0.20	0.0352	9190	0.0079	0.027	0.0302	0.902	24.7	0.0052	<0.10	383	4.46
CF3.9 CCG10	L1985910-69	Coffee	CF3.9	CCG	8/8/17	70	4	3	WB, no head	--	µg/g ww	32.4	0.005	0.107	2.56	<0.0020	<0.0020	<0.20	0.0928	10200	0.0104	0.07	0.0404	0.943	53	0.0122	<0.10	377	7.02
CF3.9 CCG11	L1985910-70	Coffee	CF3.9	CCG	8/8/17	77	4	3	WB, no head	--	µg/g ww	49.5	0.0069	0.0709	3.7	<0.0020	<0.0020	<0.20	0.0207	11700	0.0103	0.075	0.046	0.729	69.9	0.019	<0.10	396	6.35
CF3.9 CCG12	L1985910-71	Coffee	CF3.9	CCG	8/8/17	61	<4	2	WB, no head	--	µg/g ww	5.8	0.0064	0.0715	4.36	<0.0020	<0.0020	<0.20	0.0278	14700	0.0068	0.061	0.0234	0.754	20.2	<0.010	<0.10	442	5.05
CF3.9-GR4-M	L1985910-72	Coffee	CF3.9	GR	8/8/17	65	<4	1	muscle	--	µg/g ww	2.7	0.007	0.0489	1.53	<0.0020	<0.0020	<0.20	0.0858	7220	0.0112	<0.040	0.0393	0.564	14.1	<0.010	<0.10	415	3.21
CF3.9-GR4-L	L1985910-73	Coffee	CF3.9	GR	8/8/17	65	<4	1	liver	--	µg/g ww	30.5	0.084	0.118	2.02	<0.018	<0.018	<1.8	3.13	130	0.0203	<0.36	0.444	7.01	162	<0.090	<0.90	569	5.79
CF3.9-GR8-M	L1985910-74	Coffee	CF3.9	GR	8/8/17	70	2	1	muscle	43.5	µg/g ww	2.8	0.0061	0.0522	2.51	<0.0020	<0.0020	<0.20	0.045	8550	0.0083	<0.040	0.0251	0.601	12.1	<0.010	<0.10	428	3.78
CF3.9-GR8-L	L1985910-75	Coffee	CF3.9	GR	8/8/17	70	2	1	liver	--	µg/g ww	12	<0.022	0.094	1.02	<0.022	<0.022	<2.2	0.713	124	0.013	<0.44	0.165	6.21	128	<0.11	<1.1	607	4.83
CF3.9-GR13-M	L1985910-76	Coffee	CF3.9	GR	8/8/17	68	5	1	muscle	41.3	µg/g ww	5.8	0.0038	0.0315	1.73	<0.0020	<0.0020	<0.20	0.105	7040	0.0091	<0.040	0.0356	0.734	15.4	<0.010	<0.10	370	3.27
CF3.9-GR13-L	L1985910-77	Coffee	CF3.9	GR	8/8/17	68	5	1	liver	--	µg/g ww	25	<0.032	0.185	1.46	<0.032	<0.032	<3.2	2.38	238	0.021	<0.64	0.24	5.67	115	<0.16	<1.6	763	7.77
CF3.9-GR14-M	L1985910-78	Coffee	CF3.9	GR	8/8/17	280	220	8	muscle	31.5	µg/g ww	2.02	0.0044	0.0123	0.244	<0.0020	<0.0020	<0.20	0.0034	523	0.0128	0.032	0.0068	0.336	7.18	<0.0040	<0.10	267	0.479
CF3.9-GR14-L	L1985910-79	Coffee	CF3.9	GR	8/8/17	280	220	8	liver	--	µg/g ww	15	0.0048	0.0207	0.787	<0.0020	<0.0020	<0.20	0.363	93	0.0124	0.065	0.244	1.92	49.3	<0.010	<0.10	243	2.66
CF3.9-GR15-M	L1985910-80	Coffee	CF3.9	GR	8/8/17	270	188	5	muscle	--	µg/g ww	3.11	0.004	0.0114	0.129	<0.0020	<0.0020	<0.20	0.0026	186	0.0084	0.011	0.0132	0.559	9.39	<0.0040	<0.10	280	0.343

Sample ID	ALS Sample ID	Watercourse	SSID	Species	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Al	Sb	As	Ba	Be	Bi	Bo	Cd	Ca	Ce	Ch	Co	Cu	Fe	Pb	Li	Mg	Mn
CF3.9-GR15-L	L1985910-81	Coffee	CF3.9	GR	8/8/17	270	188	5	liver	--	µg/g ww	10	0.0161	0.0398	0.5	<0.0020	0.0025	<0.20	0.802	117	0.0081	0.102	0.342	3.2	80.3	<0.010	<0.10	251	2.7
CF3.9-GR16-M	L1985910-82	Coffee	CF3.9	GR	8/8/17	275	210		muscle	--	µg/g ww	1.9	0.002	0.0153	0.174	<0.0020	<0.0020	<0.20	0.0044	473	0.0112	<0.010	0.0113	0.309	6.85	<0.0040	<0.10	300	0.381
CF3.9-GR16-L	L1985910-83	Coffee	CF3.9	GR	8/8/17	275	210		liver	--	µg/g ww	1.9	0.0039	0.021	0.197	<0.0020	<0.0020	<0.20	1.34	65.1	0.005	<0.040	0.229	2.76	77.7	<0.010	<0.10	204	2.55
CF3.9-GR17-M	L1985910-84	Coffee	CF3.9	GR	8/8/17	320	314	6	muscle	--	µg/g ww	1.87	0.0021	0.0257	0.185	<0.0020	<0.0020	<0.20	0.0059	428	0.0213	<0.010	0.0085	0.408	7.38	<0.0040	<0.10	297	0.393
CF3.9-GR17-L	L1985910-85	Coffee	CF3.9	GR	8/8/17	320	314	6	liver	--	µg/g ww	6.5	0.0108	0.0274	0.504	<0.0020	0.0035	<0.20	1.7	72.5	0.008	0.043	0.592	2.67	102	<0.010	<0.10	186	2.17
CF3.9-GR18-L	L1985910-86	Coffee	CF3.9	GR	8/8/17	265		5	liver	--	µg/g ww	3.6	0.0041	0.0154	0.314	<0.0020	0.0033	<0.20	1.75	64.4	0.0083	<0.040	0.284	2.57	94.9	<0.010	<0.10	239	2.49
CF3.9-GR18-M	L1985910-87	Coffee	CF3.9	GR	8/8/17	265		5	muscle	--	µg/g ww	3.59	0.0079	0.0165	0.362	<0.0020	<0.0020	<0.20	0.0033	1090	0.0123	<0.010	0.0079	0.286	7.16	<0.0040	<0.10	355	0.758
CF3.9-GR19-M	L1985910-88	Coffee	CF3.9	GR	8/8/17	244		5	muscle	--	µg/g ww	4.73	0.0042	0.0191	0.318	<0.0020	<0.0020	<0.20	0.0054	831	0.0108	0.023	0.0083	0.275	9.05	0.0045	<0.10	338	0.482
CF3.9-GR19-L	L1985910-89	Coffee	CF3.9	GR	8/8/17	244		5	liver	--	µg/g ww	7	0.0117	0.0281	0.307	<0.0020	<0.0020	<0.20	1.67	82.4	0.0057	0.067	0.299	3.18	93.4	<0.010	<0.10	263	2.55
CF8.0-P-1	L1985910-90	Coffee	CF8.0	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	11800	<0.040	4.22	132	0.208	0.097	<4.0	0.131	4630	1.04	18.4	6.06	10.5	14900	4.09	8.5	4610	272
CF8.0-P-2	L1985910-91	Coffee	CF8.0	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	12300	<0.040	4.36	136	0.218	0.115	<4.0	0.135	4950	1.04	19	6.28	11.3	15700	4.22	8.9	4750	281
CF8.0-P-3	L1985910-92	Coffee	CF8.0	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	11400	0.026	4.46	125	0.206	0.098	<1.0	0.129	4360	1.17	17.5	5.94	10.5	14700	4.05	8.94	4550	271
CF8.0-P-4	L1985910-93	Coffee	CF8.0	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	11700	0.028	4.5	127	0.193	0.095	1.2	0.124	4360	1.25	18.2	5.86	10.6	14300	4	8.41	4650	268
CF8.0-P-5	L1985910-94	Coffee	CF8.0	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	12400	0.026	4.55	131	0.217	0.102	<2.0	0.136	4500	1.24	18.7	6.04	10.9	15100	4.17	8.9	4910	276
CF3.9-P-1	L1985910-95	Coffee	CF3.9	P	8/3/17	--	--	--	Periphyton	--	µg/g ww	12500	<0.040	4.54	134	0.216	0.103	<4.0	0.128	4690	1.12	19	6.54	10.8	15900	4.4	8.9	4940	289
CF3.9-P-2	L1985910-96	Coffee	CF3.9	P	8/3/17	--	--	--	Periphyton	--	µg/g ww	13300	<0.040	4.94	141	0.228	0.104	<4.0	0.137	5100	1.09	20.5	6.74	11	16600	4.6	9.4	5120	301
CF3.9-P-3	L1985910-97	Coffee	CF3.9	P	8/3/17	--	--	--	Periphyton	--	µg/g ww	13400	<0.040	5.08	144	0.231	0.105	<4.0	0.134	5080	1.21	20.9	7.08	11	17300	5.2	9.7	5350	312
CF3.9-P-4	L1985910-98	Coffee	CF3.9	P	8/3/17	--	--	--	Periphyton	--	µg/g ww	12600	<0.040	4.52	131	0.212	0.095	<4.0	0.117	4920	1.07	19.8	6.29	10.3	15700	4.31	8.9	4850	268
CF3.9-P-5	L1985910-99	Coffee	CF3.9	P	8/3/17	--	--	--	Periphyton	--	µg/g ww	13300	<0.040	4.84	140	0.231	0.103	<4.0	0.134	5050	1.15	20.7	6.86	11.2	16800	4.57	9.6	5210	303
ID1.9-P-1	L1985910-100	Independence	ID1.9	P	8/2/17	--	--	--	Periphyton	--	µg/g ww	5860	0.039	4.06	65.9	0.15	0.052	<2.0	0.098	2410	0.458	11.8	3.42	5.89	8030	2.82	4.1	2230	164
ID1.9-P-2	L1985910-101	Independence	ID1.9	P	8/2/17	--	--	--	Periphyton	--	µg/g ww	7110	0.037	4.65	93.8	0.182	0.061	<2.0	0.115	2880	0.572	14	4.16	7.05	10100	3.34	5.1	2760	193
ID1.9-P-3	L1985910-102	Independence	ID1.9	P	8/2/17	--	--	--	Periphyton	--	µg/g ww	4610	0.045	3.08	51	0.124	0.042	<2.0	0.091	1820	0.387	8.79	2.46	5.03	6020	2.08	3.3	1590	110
ID1.9-P-4	L1985910-103	Independence	ID1.9	P	8/2/17	--	--	--	Periphyton	--	µg/g ww	5130	0.03	3.25	53.6	0.132	0.043	<2.0	0.078	2100	0.432	10.2	2.82	4.82	6610	2.59	3.8	1910	139
ID1.9-P-5	L1985910-104	Independence	ID1.9	P	8/2/17	--	--	--	Periphyton	--	µg/g ww	6690	0.0284	4.56	71.6	0.159	0.0568	0.79	0.0938	2540	0.629	13.2	3.81	6.26	8760	3.01	5.03	2580	207
LC2.7-P-1	L1985910-105	Latte	LC2.7	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	9020	0.025	5.3	92.6	0.24	0.085	<2.0	0.13	3780	0.849	17.3	4.61	6.6	11100	6.46	8.1	3540	258
LC2.7-P-2	L1985910-106	Latte	LC2.7	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	9180	0.029	6.23	97.1	0.266	0.096	<2.0	0.129	3810	0.96	19.1	4.96	7.01	11800	6.94	8.2	3630	257
LC2.7-P-3	L1985910-107	Latte	LC2.7	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	10200	0.031	6.66	90.6	0.279	0.08	1.4	0.133	4650	0.932	21.3	5.88	8.39	13200	6.19	9.09	4180	374
LC2.7-P-4	L1985910-108	Latte	LC2.7	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	9510	0.027	6.11	95.3	0.267	0.109	<2.0	0.137	4510	0.953	19.9	5.8	7.96	13100	7.98	9.2	4060	335
LC2.7-P-5	L1985910-109	Latte	LC2.7	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	10600	0.033	7.62	105	0.285	0.082	1.6	0.148	4930	1.02	19.4	5.89	8.31	13100	6.54	9.76	4240	424
HF 0.2-P-1	L1985910-110	Halfway	HF0.2	P	8/6/17	--	--	--	Periphyton	--	µg/g ww	417	0.084	1.36	16.4	0.0554	<0.0080	2.77	0.0879	1690	0.0422	1.1	0.82	4.74	1140	0.467	0.34	381	118
HF 0.2-P-2	L1985910-111	Halfway	HF0.2	P	8/6/17	--	--	--	Periphyton	--	µg/g ww	688	0.268	1.88	27.6	0.0894	<0.012	2.59	0.118	2170	0.0702	1.56	1.51	6.38	1650	0.632	0.46	567	190
CF10.0-P-1	L1985910-112	Coffee	CF10.0	P	8/5/17	--	--	--	Periphyton	--	µg/g ww	11900	0.021	4.63	137	0.209	0.096	<1.0	0.12	4250	1.35	17.4	6.27	10	15500	3.88	9.15	4770	274
CF10.0-P-2	L1985910-113	Coffee	CF10.0	P	8/5/17	--	--	--	Periphyton	--	µg/g ww	11800	<0.020	4.2	131	0.193	0.097	<2.0	0.12	4140	1.2	16.8	6	9.94	14800	3.88	8.7	4560	262
CF10.0-P-3	L1985910-114	Coffee	CF10.0	P	8/5/17	--	--	--	Periphyton	--	µg/g ww	12200	<0.020	4.18	127	0.193	0.089	<2.0	0.112	4310	1.23	17.2	5.91	9.69	14800	3.66	8.8	4610	260
CF10.0-P-4	L1985910-115	Coffee	CF10.0	P	8/5/17	--	--	--	Periphyton	--	µg/g ww	12500	<0.020	4.26	133	0.211	0.094	<2.0	0.12	4540	1.29	17.9	6.12	10.1	15200	3.75	9.4	4760	270
CF10.0-P-5	L1985910-116	Coffee	CF10.0	P	8/5/17	--	--	--	Periphyton	--	µg/g ww	11300	<0.020	4.05	126	0.192	0.088	<2.0	0.117	3890	1.14	16.3	5.94	9.65	14400	3.67	8.8	4670	258
ID1.9-B1-1	L1985910-117	Independence	ID1.9	BI	8/2/17	--	--	--	BI	--	µg/g ww	1100	0.0349	0.949	13.1	0.0297	<0.012	0.3	0.266	833	0.127	2.47	0.845	6.49	1560	0.76	0.83	599	76.6
ID1.9-B1-2	L1985910-118	Independence	ID1.9	BI	8/2/17	--	--	--	BI	--	µg/g ww	894	0.0366	0.816	11.6	0.0246	<0.012	0.3	0.354	1040	0.133	2.12	0.691	6.7	1290	0.547	0.79	599	47.3
ID1.9-B1-3	L1985910-119	Independence	ID1.9	BI	8/2/17	--	--	--	BI	--	µg/g ww	1930	0.0787	1.64	24.8	0.054	<0.024	0.35	0.252	1080	0.261	4.01	1.59	7.47	2810	2.54	1.69	923	145
ID1.9-B1-4	L1985910-120	Independence	ID1.9	BI	8/2/17	--	--	--	BI	--	µg/g ww	1180	0.0393	0.994	15.2	0.0326	<0.016	0.33	0.225	927	0.15	2.6	0.822	6.59	1670	0.677	1	638	65.1
CF3.9-B1-1	L1985910-121	Coffee	CF3.9	BI	8/3/17	--	--	--	BI	--	µg/g ww	817	0.0322	0.834	17.1	0.019	0.0105	0.25	0.549	1380	0.129	1.79	0.773	8.07	1300	0.37	0.66	745	47.8

Sample ID	ALS Sample ID	Watercourse	SSID	Species	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Al	Sb	As	Ba	Be	Bi	Bo	Cd	Ca	Ce	Ch	Co	Cu	Fe	Pb	Li	Mg	Mn
CF3.9-B1-2	L1985910-122	Coffee	CF3.9	BI	8/3/17	--	--	--	BI	--	µg/g ww	688	0.0338	0.688	16.5	0.0188	0.0109	0.28	0.325	1140	0.107	2.73	0.859	5.7	1800	0.355	0.58	616	94.3
CF3.9-B1-3	L1985910-123	Coffee	CF3.9	BI	8/3/17	--	--	--	BI	--	µg/g ww	925	0.0565	1.04	17.4	0.0279	0.0113	0.22	0.484	1160	0.0878	2.1	1.22	7.61	1290	0.424	0.54	696	106
CF8.0-B1-1	L1985910-124	Coffee	CF8.0	BI	8/4/17	--	--	--	BI	--	µg/g ww	503	0.0366	0.5	12.1	0.0151	0.0096	0.5	0.46	1090	0.0796	1.3	0.594	5.72	811	0.275	0.42	549	70.4
CF8.0-B1-2	L1985910-125	Coffee	CF8.0	BI	8/4/17	--	--	--	BI	--	µg/g ww	615	0.0343	0.596	12.9	0.0177	0.0091	0.3	0.286	1150	0.0846	1.47	0.579	5.57	947	0.263	0.42	512	54.7
CF8.0-B1-3	L1985910-126	Coffee	CF8.0	BI	8/4/17	--	--	--	BI	--	µg/g ww	889	0.0427	0.94	17.4	0.0242	0.0122	0.34	0.554	1580	0.148	1.66	0.917	8.47	1580	0.393	0.69	844	83
CF8.0-B1-4	L1985910-127	Coffee	CF8.0	BI	8/4/17	--	--	--	BI	--	µg/g ww	804	0.0533	1.13	15.3	0.0263	0.0114	0.5	0.339	1150	0.0908	1.66	0.907	7.13	1200	0.396	0.55	613	128
LAC4.8-B1-1	L1985910-128	Los Angeles	LAC4.8	BI	8/3/17	--	--	--	BI	--	µg/g ww	798	0.0264	0.8	20.2	0.0421	0.0171	0.51	0.199	792	0.115	2.37	1.16	6.71	1590	0.706	0.72	655	162
CF10.0-B1-1	L1985910-129	Coffee	CF10.0	BI	8/5/17	--	--	--	BI	--	µg/g ww	808	0.0505	0.61	16	0.0202	0.0131	0.41	0.235	655	0.127	1.62	0.658	4.43	1160	0.367	0.68	517	58.4
CF10.0-B1-2	L1985910-130	Coffee	CF10.0	BI	8/5/17	--	--	--	BI	--	µg/g ww	635	0.0453	0.666	12	0.0162	0.0118	0.3	0.306	854	0.0867	1.25	0.647	6.88	927	0.314	0.5	504	55.9
CF10.0-B1-3	L1985910-131	Coffee	CF10.0	BI	8/5/17	--	--	--	BI	--	µg/g ww	1260	0.0515	5.63	29.3	0.056	0.0282	1.26	0.496	1180	0.192	2.1	1.45	9.09	3930	1.1	0.91	595	127
LC2.7-B1-1	L1985910-132	Latte	LC2.7	BI	8/4/17	--	--	--	BI	--	µg/g ww	630	0.0491	0.844	9.45	0.0234	0.0078	0.47	0.426	860	0.16	1.39	0.547	6.4	1000	0.438	0.53	547	61.9
LC2.7-B1-2	L1985910-133	Latte	LC2.7	BI	8/4/17	--	--	--	BI	--	µg/g ww	547	0.0352	0.739	8.01	0.018	0.0066	0.28	0.42	586	0.0619	6.72	0.479	6.05	831	0.438	0.48	479	52.6
LC2.7-B1-3	L1985910-134	Latte	LC2.7	BI	8/4/17	--	--	--	BI	--	µg/g ww	826	0.0425	1.18	12.5	0.0351	0.0116	0.37	0.497	889	0.217	1.93	0.839	6.5	1440	0.719	0.97	620	97.6
LC9.9-B1-1	L1985910-135	Latte	LC9.9	BI	8/5/17	--	--	--	BI	--	µg/g ww	647	0.0362	0.984	8.93	0.0276	0.0078	0.27	0.17	530	0.0771	1.29	0.558	4.75	1100	0.515	0.5	400	100
LC9.9-B1-2	L1985910-136	Latte	LC9.9	BI	8/5/17	--	--	--	BI	--	µg/g ww	737	0.0417	1.17	11.4	0.0293	0.0162	0.22	0.318	578	0.0983	1.78	0.694	6.98	1210	0.618	0.61	529	79
YT0.2-B1-1	L1985910-137	YT-24	YT0.2	BI	8/7/17	--	--	--	BI	--	µg/g ww	737	0.053	0.748	13.3	0.0276	0.0136	0.33	0.0523	707	0.0866	1.78	0.622	4.25	1270	0.769	0.67	511	61.2
YT5.0-B1-1	L1985910-138	YT-24	YT5.0	BI	8/7/17	--	--	--	BI	--	µg/g ww	253	0.0582	0.617	7.35	0.0145	0.0046	0.24	0.0236	344	0.0312	0.87	0.212	1.88	470	0.416	0.21	292	20.7
HF0.2-B1-1	L1985910-139	Halfway	HF0.2	BI	8/6/17	--	--	--	BI	84.2	µg/g ww	419	0.0326	0.664	6.58	0.0141	0.0052	0.22	0.209	496	0.0494	1.21	0.39	3.98	623	0.308	0.41	362	35
HF0.2-B1-2	L1985910-140	Halfway	HF0.2	BI	8/6/17	--	--	--	BI	--	µg/g ww	668	0.0715	1.77	13.2	0.0349	0.0139	0.33	0.144	767	0.109	2.07	0.717	4.68	1260	0.679	0.83	520	64.6
HF0.2-B1-3	L1985910-141	Halfway	HF0.2	BI	8/6/17	--	--	--	BI	--	µg/g ww	705	0.0667	6.67	10.7	0.0308	0.0107	0.35	0.189	700	0.0895	1.85	0.748	4.64	1330	0.578	0.79	517	62.7
HF0.2-B1-4	L1985910-142	Halfway	HF0.2	BI	8/6/17	--	--	--	BI	--	µg/g ww	375	0.0354	0.667	6.95	0.0141	0.0069	0.26	0.176	484	0.0477	1.08	0.361	3.95	569	0.283	0.37	337	35.8
HF0.2-B1-5	L1985910-143	Halfway	HF0.2	BI	8/6/17	--	--	--	BI	--	µg/g ww	334	0.0614	1.07	7.23	0.0177	0.0056	0.28	0.172	498	0.0434	1.15	0.443	4.17	826	0.303	0.3	328	55.7
HF6.3-B1-1	L1985910-144	Halfway	HF6.3	BI	8/6/17	--	--	--	BI	--	µg/g ww	1000	0.131	2.35	20	0.0364	0.0131	0.3	0.301	730	0.114	2.35	0.928	3.56	1370	0.639	0.79	597	111
HF6.3-B1-2	L1985910-145	Halfway	HF6.3	BI	8/6/17	--	--	--	BI	--	µg/g ww	1500	0.166	3.14	30.4	0.049	<0.016	0.36	0.34	798	0.157	3.52	1.34	3.47	2020	0.815	1.16	714	137
HF6.3-B1-3	L1985910-146	Halfway	HF6.3	BI	8/6/17	--	--	--	BI	--	µg/g ww	1590	0.144	3.36	30	0.0542	<0.018	0.41	0.294	848	0.185	4.43	1.33	3.62	2260	0.886	1.34	775	144
HF6.3-B1-4	L1985910-147	Halfway	HF6.3	BI	8/6/17	--	--	--	BI	--	µg/g ww	1950	0.202	4.98	40.3	0.0693	<0.032	0.34	0.319	1000	0.21	4.46	1.64	4.25	2880	0.995	1.67	937	133
HF6.3-B1-5	L1985910-148	Halfway	HF6.3	BI	8/6/17	--	--	--	BI	--	µg/g ww	1060	0.127	2.75	28.6	0.0351	<0.014	0.25	0.273	668	0.105	3.04	1.01	2.98	1500	0.671	0.81	550	98.3

Notes:
GR – Arctic grayling
CCG – slimy sculpin
P = periphyton
BI – benthic invertebrate
WB – whole body

Table E- 2 Tissue metals data collected from fish tissues, benthic invertebrates and periphyton in 2017, mercury through zirconium.

Sample ID	ALS Sample ID	Watercourse	SSID	Species	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Hg	Me Hg (%)	MeHg Estimate	Mo	Ni	P	K	Ru	Se	Na	St	Te	Th	Sn	U	V	Zn	Zr
LC 2.7 1GR2-M	L1985910-1	Latte	LC2.7	GR	8/6/17	236	150	6	muscle	--	µg/g ww	0.0535	0.94	0.0503	<0.0040	0.054	3210	4590	2.45	0.843	409	0.984	<0.0040	0.00429	<0.020	0.00093	<0.020	4.86	<0.040
LC 2.7 1GR2-L	L1985910-2	Latte	LC2.7	GR	8/6/17	236	150	6	liver	--	µg/g ww	0.155	0.94	0.1457	0.118	0.083	4010	2490	1.62	4.9	948	0.127	<0.0040	0.0189	<0.020	0.00453	0.044	31.3	<0.040
LC 2.7 1GR1-M	L1985910-3	Latte	LC2.7	GR	8/6/17	267	198	7	muscle	--	µg/g ww	0.0914	0.94	0.0859	<0.0040	0.117	3050	4420	2.61	0.699	363	0.739	<0.0040	0.00736	<0.020	0.00194	<0.020	5.12	<0.040
LC 2.7 1GR1-L	L1985910-4	Latte	LC2.7	GR	8/6/17	267	198	7	liver	--	µg/g ww	0.234	0.94	0.2200	0.109	<0.040	5130	3790	2.79	3.51	683	0.085	<0.0040	0.0227	<0.020	0.0099	0.037	29	<0.040
LC 2.7 1GR3-M	L1985910-5	Latte	LC2.7	GR	8/6/17	175	54	5	muscle	--	µg/g ww	0.0409	0.94	0.0384	<0.0040	0.043	2940	4460	2.23	1.02	314	0.4	<0.0040	0.00461	<0.020	0.00133	<0.020	6.01	<0.040
LC 2.7 1GR3-L	L1985910-6	Latte	LC2.7	GR	8/6/17	175	54	5	liver	--	µg/g ww	0.135	0.94	0.1269	0.107	0.115	3570	2780	1.79	4.72	1470	0.22	<0.0040	0.0256	<0.020	0.00282	0.022	34.3	<0.040
LC 2.7 1GR4-M	L1985910-7	Latte	LC2.7	GR	8/6/17	200	90	6	muscle	65.1	µg/g ww	0.0473	0.94	0.0445	<0.0040	0.085	2500	3810	2.11	0.904	401	0.449	<0.0040	0.00418	<0.020	0.00307	<0.020	5.26	<0.040
LC 2.7 1GR4-L	L1985910-8	Latte	LC2.7	GR	8/6/17	200	90	6	liver	--	µg/g ww	0.145	0.94	0.1363	0.121	<0.040	4210	2600	2.17	4.08	1180	0.166	<0.0040	0.0314	0.022	0.00371	0.038	32.8	<0.040
LC 2.7 2GR5-M	L1985910-9	Latte	LC2.7	GR	8/6/17	240	142	4	muscle	--	µg/g ww	0.034	0.94	0.0320	<0.0040	0.054	1970	3020	1.95	0.592	259	0.309	<0.0040	0.00345	<0.020	0.00097	<0.020	3.18	<0.040
LC 2.7 2GR5-L	L1985910-10	Latte	LC2.7	GR	8/6/17	240	142	4	liver	--	µg/g ww	0.105	0.94	0.0987	0.128	<0.040	3570	2720	2.16	3.64	818	0.09	<0.0040	0.033	<0.020	0.00178	0.05	29	<0.040
LC 2.7 2GR6-M	L1985910-11	Latte	LC2.7	GR	8/6/17	180	70	5	muscle	--	µg/g ww	0.0645	0.94	0.0606	<0.0040	0.054	2650	4290	2.53	0.782	393	0.333	<0.0040	0.00557	<0.020	0.00095	<0.020	4.81	<0.040
LC 2.7 2GR6-L	L1985910-12	Latte	LC2.7	GR	8/6/17	180	70	5	liver	--	µg/g ww	0.144	0.94	0.1354	0.105	<0.040	3530	2730	2.12	3.27	974	0.094	<0.0040	0.0387	<0.020	0.00233	0.039	26.5	<0.040
LC 2.7 2GR7-M	L1985910-13	Latte	LC2.7	GR	8/6/17	175	54	3	muscle	--	µg/g ww	0.0462	0.94	0.0434	<0.0040	0.056	3000	4620	2.67	0.977	367	0.549	<0.0040	0.00393	<0.020	0.00092	<0.020	5.94	<0.040
LC 2.7 2GR7-L	L1985910-14	Latte	LC2.7	GR	8/6/17	175	54	3	liver	--	µg/g ww	0.204	0.94	0.1918	0.123	<0.040	3980	2920	1.95	3.61	905	0.11	<0.0040	0.0347	<0.020	0.0017	0.036	32	<0.040
LC 2.7 2GR8-M	L1985910-15	Latte	LC2.7	GR	8/6/17	273	190	9	muscle	62.1	µg/g ww	0.0817	0.94	0.0768	<0.0040	0.067	2500	4000	2.56	0.717	599	0.184	<0.0040	0.00677	<0.020	0.00128	<0.020	4.62	<0.040
LC 2.7 2GR8-L	L1985910-16	Latte	LC2.7	GR	8/6/17	273	190	9	liver	--	µg/g ww	0.13	0.94	0.1222	0.12	<0.040	4250	3320	3.14	5	1050	0.534	<0.0040	0.0369	<0.020	0.0131	0.033	29	<0.040
LC 2.7 3GR9-M	L1985910-17	Latte	LC2.7	GR	8/6/17	126	236	4	muscle	--	µg/g ww	0.0523	0.94	0.0492	<0.0040	0.077	2760	4220	2.47	1.05	387	0.51	<0.0040	0.00481	<0.020	0.00125	<0.020	5.15	<0.040
LC 2.7 3GR9-L	L1985910-18	Latte	LC2.7	GR	8/6/17	126	236	4	liver	--	µg/g ww	0.166	0.94	0.1560	0.108	<0.040	3790	3020	2.54	4.48	798	0.107	<0.0040	0.0751	<0.020	0.00179	0.021	31.3	<0.040
LC 2.7 3GR10-M	L1985910-19	Latte	LC2.7	GR	8/6/17	232	284	9	muscle	63.1	µg/g ww	0.132	0.94	0.1241	<0.0040	0.191	2910	3880	2.5	0.661	385	1.49	<0.0040	0.00632	0.034	0.00274	<0.020	4.42	<0.040
LC 2.7 3GR10-L	L1985910-20	Latte	LC2.7	GR	8/6/17	232	284	9	liver	--	µg/g ww	0.305	0.94	0.2867	0.168	<0.040	4110	2780	2.21	4.08	989	0.122	<0.0040	0.0583	<0.020	0.0218	0.092	31.1	<0.040
YT005 GR1-M	L1985910-21	YT-24	YT005	GR	8/6/17	120	10.7	3	muscle	--	µg/g ww	0.0293	0.94	0.0275	<0.0080	<0.040	2600	3920	2.57	1.45	589	0.199	<0.0040	0.00337	<0.020	0.0016	<0.020	7.38	<0.040
YT005 GR1-L	L1985910-22	YT-24	YT005	GR	8/6/17	120	10.7	3	liver	--	µg/g ww	0.061	0.94	0.0573	0.14	0.06	5170	3110	2.83	4	1120	0.139	<0.0040	0.033	<0.020	0.0021	0.028	29.8	<0.040
ID1.9-1CCG1	L1985910-23	Independence	ID1.9	CCG	8/7/17	80	6	2	WB, no head	59.1	µg/g ww	0.0706	0.81	0.0572	0.0221	0.133	9320	2850	2.66	0.945	1120	17.9	<0.0040	0.00622	<0.020	0.0346	0.295	25.1	0.041
ID1.9-1CCG2	L1985910-24	Independence	ID1.9	CCG	8/7/17	80	6	5	WB, no head	--	µg/g ww	0.0918	0.81	0.0744	0.0294	0.431	11100	2530	1.69	1.23	1240	15.7	<0.0040	0.00807	<0.020	0.0921	0.951	42.4	0.123
ID1.9-1CCG3	L1985910-25	Independence	ID1.9	CCG	8/7/17	76	45	4	WB, no head	--	µg/g ww	0.0601	0.81	0.0487	0.0308	0.142	12300	3230	2.35	1.2	1230	20	<0.0040	0.00781	0.032	0.0551	0.44	30.7	0.062
ID1.9-1CCG4	L1985910-26	Independence	ID1.9	CCG	8/7/17	71	4	3	WB, no head	--	µg/g ww	0.0468	0.81	0.0379	0.0191	0.109	8460	2920	2.35	1.17	1110	11.7	<0.0040	0.00606	0.034	0.0239	0.269	14.9	<0.040
ID1.9-1CCG5	L1985910-27	Independence	ID1.9	CCG	8/7/17	70	4	2	WB, no head	--	µg/g ww	0.0544	0.81	0.0441	0.0225	0.148	9240	2990	2.95	1.1	1010	13.2	<0.0040	0.00698	0.049	0.0234	0.272	24.4	<0.040
ID1.9-1CCG6	L1985910-28	Independence	ID1.9	CCG	8/7/17	64	2	2	WB, no head	--	µg/g ww	0.0737	0.81	0.0597	0.0255	0.204	7280	3390	2.09	1.04	1040	9.71	<0.0040	0.00727	0.057	0.0459	0.367	22.5	0.083
ID1.9-1CCG7	L1985910-29	Independence	ID1.9	CCG	8/7/17	82	7	2	WB, no head	--	µg/g ww	0.0783	0.81	0.0634	0.0396	0.405	8960	2720	2.4	1.07	1130	14.5	<0.0040	0.0102	<0.020	0.107	0.734	38.4	0.14
ID1.9-1CCG8	L1985910-30	Independence	ID1.9	CCG	8/7/17	81	7	3	WB, no head	--	µg/g ww	0.0795	0.81	0.0644	0.0216	0.238	8920	2770	2.26	0.77	1060	12.3	<0.0040	0.00876	<0.020	0.0553	0.448	24.6	0.066
ID1.9-1CCG9	L1985910-31	Independence	ID1.9	CCG	8/7/17	67	4	1	WB, no head	--	µg/g ww	0.0421	0.81	0.0341	0.027	0.192	9340	2870	2.28	1.26	1020	14.3	<0.0040	0.00696	0.03	0.0521	0.418	24.9	0.077
ID1.9-1CCG10	L1985910-32	Independence	ID1.9	CCG	8/7/17	66	4	2	WB, no head	--	µg/g ww	0.0498	0.81	0.0403	0.0248	0.151	12100	3240	2.52	1.26	1190	18.1	<0.0040	0.0083	0.023	0.0407	0.515	28.9	0.049
ID1.9-3CCG11	L1985910-33	Independence	ID1.9	CCG	8/7/17	65	4	2	WB, no head	--	µg/g ww	0.0513	0.81	0.0416	0.0242	0.137	8540	2740	2.13	1.04	1090	14.7	<0.0040	0.00633	0.024	0.0254	0.266	28.4	<0.040
ID1.9-1GR1-M	L1985910-34	Independence	ID1.9	GR	8/7/17	290	282	7	muscle	--	µg/g ww	0.0927	0.94	0.0871	<0.0040	0.062	2740	4400	2.58	0.839	345	0.124	<0.0040	0.00562	<0.020	0.00091	<0.020	4.4	<0.040
ID1.9-1GR1-L	L1985910-35	Independence	ID1.9	GR	8/7/17	290	282	7	liver	--	µg/g ww	0.142	0.94	0.1335	0.0876	<0.040	3940	2970	3	3.01	1000	0.114	<0.0040	0.0291	0.09	0.00244	0.029	19.2	<0.040
ID1.9-1GR2-M	L1985910-36	Independence	ID1.9	GR	8/7/17	70	4	1	muscle	--	µg/g ww	0.0289	0.94	0.0272	<0.0080	0.09	3200	4510	2.98	1.45	485	1.6	<0.0040	0.00678	0.178	0.00155	<0.020	8.13	<0.040
ID1.9-1GR2-L	L1985910-37	Independence	ID1.9	GR	8/7/17	70	4	1	liver	75.2	µg/g ww	0.237	0.94	0.2228	0.346	<0.36	11100	9250	14.4	13.4	3210	0.51	<0.036	0.198	0.21	0.0048	<0.18	61.6	<0.36
ID1.9-2GR3-M	L1985910-38	Independence	ID1.9	GR	8/7/17	301	274	9	muscle	20	µg/g ww	0.0645	0.94	0.0606	<0.0040	0.046	3130	4930	2.74	0.745	323	0.428	<0.0040	0.00472	<0.020	0.00096	<0.020	4.22	<0.040
ID1.9-2GR3-L	L1985910-39	Independence	ID1.9	GR	8/7/17	301	274	9	liver	--	µg/g ww	0.121	0.94	0.1137	0.0623	<0.040	3770	2830	2.28	2.86	1060	0.078	<0.0040	0.0115	0.037	0.00255	0.05	20.6	<0.040
ID1.9-2GR4-M	L1985910-40	Independence	ID1.9	GR	8/7/17	282	238	5	muscle	--	µg/g ww	0.0484	0.94	0.0455	<0.0040	<0.040	2860	4150	2.75	0.522	297	0.884	<0.0040	0.00429	0.022	0.00065	<0.020	3.72	<0.040

Sample ID	ALS Sample ID	Watercourse	SSID	Species	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Hg	Me Hg (%)	MeHg Estimate	Mo	Ni	P	K	Ru	Se	Na	St	Te	Th	Sn	U	V	Zn	Zr
ID1.9-2GR4-L	L1985910-41	Independence	ID1.9	GR	8/7/17	282	238	5	liver	--	µg/g ww	0.112	0.94	0.1053	0.11	<0.040	4540	3450	3.38	3.54	1090	0.079	<0.0040	0.0218	0.027	0.00232	0.035	22.8	<0.040
ID1.9-2GR5-M	L1985910-42	Independence	ID1.9	GR	8/7/17	74	4	1	muscle	--	µg/g ww	0.0247	0.94	0.0232	<0.0080	0.083	2630	4380	3.22	1.46	585	0.684	<0.0040	0.00661	0.035	0.00521	0.041	8.69	<0.040
ID1.9-2GR5-L	L1985910-43	Independence	ID1.9	GR	8/7/17	74	4	1	liver	75.5	µg/g ww	0.164	0.94	0.1542	0.3	<0.44	7600	5160	8.58	8.16	2410	0.48	<0.044	0.107	<0.22	0.0052	<0.22	49.3	<0.44
ID1.9-2GR6-M	L1985910-44	Independence	ID1.9	GR	8/7/17	317	330	11	muscle	41.3	µg/g ww	0.0646	0.94	0.0607	<0.0040	<0.040	2750	4100	2.84	0.644	344	0.749	<0.0040	0.00485	<0.020	0.0013	<0.020	3.87	<0.040
ID1.9-2GR6-L	L1985910-45	Independence	ID1.9	GR	8/7/17	317	330	11	liver	--	µg/g ww	0.145	0.94	0.1363	0.163	<0.040	3500	2820	2.74	3.81	1070	0.1	<0.0040	0.0207	0.037	0.00685	0.077	25.5	<0.040
ID1.9-3GR7-M	L1985910-46	Independence	ID1.9	GR	8/7/17	115	12	2	muscle	--	µg/g ww	0.0443	0.94	0.0416	<0.0080	<0.040	3760	4950	3.23	1.33	536	1.8	<0.0040	0.00581	0.027	0.00223	0.023	6.92	<0.040
ID1.9-3GR7-L	L1985910-47	Independence	ID1.9	GR	8/7/17	115	12	2	liver	--	µg/g ww	0.088	0.94	0.0827	0.173	0.21	5110	3570	6.55	7.56	1720	0.395	<0.0080	0.0389	0.286	0.00633	0.091	38.8	<0.080
HF0.1-GR1-M	L1985910-48	Halfway	HF0.1	GR	8/3/17	172	36	5	muscle	57.1	µg/g ww	0.0324	0.94	0.0305	<0.0040	<0.040	3090	4870	3.29	0.792	442	0.687	<0.0040	0.00454	<0.020	0.00044	<0.020	5.32	<0.040
HF0.1-GR1-L	L1985910-49	Halfway	HF0.1	GR	8/3/17	172	36	5	liver	--	µg/g ww	0.11	0.94	0.1034	0.114	<0.040	4420	2560	2.42	3.44	1040	0.189	<0.0040	0.0774	<0.020	0.00244	0.028	28.8	<0.040
HF0.2-GR2-M	L1985910-50	Halfway	HF0.2	GR	8/3/17	174	38.6	4	muscle	59.2	µg/g ww	0.0342	0.94	0.0321	<0.0040	<0.040	3080	5140	3.4	0.622	348	0.374	<0.0040	0.00439	<0.020	0.00056	<0.020	5.06	<0.040
HF0.2-GR2-L	L1985910-51	Halfway	HF0.2	GR	8/3/17	174	38.6	4	liver	--	µg/g ww	0.091	0.94	0.0855	0.101	0.065	4990	3060	3.33	3.09	1080	0.158	<0.0040	0.0505	<0.020	0.00309	0.027	23	<0.040
HF0.2-GR3-M	L1985910-52	Halfway	HF0.2	GR	8/3/17	294	236	8	muscle	59.9	µg/g ww	0.0656	0.94	0.0617	<0.0040	<0.040	3040	4600	3.66	0.65	410	0.549	<0.0040	0.00587	<0.020	0.00091	<0.020	4.4	<0.040
HF0.2-GR3-L	L1985910-53	Halfway	HF0.2	GR	8/3/17	294	236	8	liver	--	µg/g ww	0.152	0.94	0.1429	0.0839	<0.040	3340	2650	4.33	2.75	1000	0.127	<0.0040	0.0459	<0.020	0.0109	0.042	19.7	<0.040
HF0.2-GR4-M	L1985910-54	Halfway	HF0.2	GR	8/3/17	154	34	3	muscle	--	µg/g ww	0.0256	0.94	0.0241	<0.0040	<0.040	2820	4610	2.71	1.28	473	0.745	<0.0040	0.00397	<0.020	0.00395	<0.020	4.38	<0.040
HF0.2-GR4-L	L1985910-55	Halfway	HF0.2	GR	8/3/17	154	34	3	liver	--	µg/g ww	0.0661	0.94	0.0621	0.0994	<0.040	4170	3100	2.81	4.2	997	0.119	<0.0040	0.0377	<0.020	0.00207	<0.020	32.3	<0.040
HF0.2-GR5-M	L1985910-56	Halfway	HF0.2	GR	8/3/17	242	98.8	6	muscle	64.5	µg/g ww	0.0368	0.94	0.0346	<0.0040	<0.040	2830	4910	2.94	0.891	398	0.26	<0.0040	0.00301	<0.020	<0.00040	<0.020	3.94	<0.040
HF0.2-GR5-L	L1985910-57	Halfway	HF0.2	GR	8/3/17	242	98.8	6	liver	--	µg/g ww	0.0737	0.94	0.0693	0.139	<0.040	3670	2840	2.73	3.43	1030	0.112	<0.0040	0.0194	<0.020	0.00137	0.033	24.2	<0.040
HF0.2-GR6-M	L1985910-58	Halfway	HF0.2	GR	8/3/17	168	32.7	3	muscle	--	µg/g ww	0.0357	0.94	0.0336	<0.0040	<0.040	2790	4730	2.92	0.996	495	0.502	<0.0040	0.0036	<0.020	0.00181	<0.020	4.37	<0.040
HF0.2-GR6-L	L1985910-59	Halfway	HF0.2	GR	8/3/17	168	32.7	3	liver	--	µg/g ww	0.0857	0.94	0.0806	0.146	0.055	4460	2650	2.11	3.92	1030	0.143	<0.0040	0.045	0.02	0.00165	<0.020	44.3	<0.040
HF0.2-GR7-M	L1985910-60	Halfway	HF0.2	GR	8/3/17	320	374	9	muscle	66.5	µg/g ww	0.106	0.94	0.0996	<0.0040	<0.040	3190	4930	4	0.68	508	0.275	<0.0040	0.00811	<0.020	0.00276	<0.020	5.04	<0.040
HF0.2-GR7-L	L1985910-61	Halfway	HF0.2	GR	8/8/17	320	374	9	liver	--	µg/g ww	0.173	0.94	0.1626	0.0998	0.065	4230	3120	4.18	3.49	1170	0.717	<0.0040	0.0479	<0.020	0.0145	0.031	22.1	<0.040
CF3.9 CCG1	L1985910-62	Coffee	CF3.9	CCG	8/8/17	70	4	3	WB, no head	--	µg/g ww	0.113	0.81	0.0915	0.0241	0.341	10400	3250	2.48	2.03	1110	15.5	<0.0040	0.0107	<0.020	0.0942	0.386	28.3	0.043
CF3.9 CCG2	L1985910-63	Coffee	CF3.9	CCG	8/8/17	65	4	3	WB, no head	--	µg/g ww	0.118	0.81	0.0956	0.0163	0.054	9030	2480	2.28	1.53	894	17.5	<0.0040	0.00944	<0.020	0.131	0.172	22.1	<0.040
CF3.9 CCG3	L1985910-64	Coffee	CF3.9	CCG	8/8/17	75	4	3	WB, no head	--	µg/g ww	0.0853	0.81	0.0691	0.0203	0.067	6700	2630	2.09	1.74	972	11.1	<0.0040	0.00935	<0.020	0.0626	0.21	20.7	<0.040
CF3.9 CCG5	L1985910-65	Coffee	CF3.9	CCG	8/8/17	70	<4	1	WB, no head	--	µg/g ww	0.0752	0.81	0.0609	0.0176	0.084	9820	2100	1.63	1.23	924	18.3	<0.0040	0.00606	<0.020	0.0531	0.203	29.7	<0.040
CF3.9 CCG6	L1985910-66	Coffee	CF3.9	CCG	8/8/17	55	<4	1	WB, no head	--	µg/g ww	0.0692	0.81	0.0561	0.0371	0.207	6570	2920	2.72	1.33	983	11.1	<0.0040	0.00757	<0.020	0.134	0.468	27.2	0.084
CF3.9 CCG7	L1985910-67	Coffee	CF3.9	CCG	8/8/17	92	6	2	WB, no head	--	µg/g ww	0.0628	0.81	0.0509	0.0144	0.109	6720	2330	2.25	1.5	964	11.9	<0.0040	0.00623	<0.020	0.0825	0.214	21.9	<0.040
CF3.9 CCG9	L1985910-68	Coffee	CF3.9	CCG	8/8/17	85	6	2	WB, no head	--	µg/g ww	0.0802	0.81	0.0650	0.0177	0.046	8150	3210	2.51	1.29	1100	12.4	<0.0040	0.00731	<0.020	0.0458	0.123	24.2	<0.040
CF3.9 CCG10	L1985910-69	Coffee	CF3.9	CCG	8/8/17	70	4	3	WB, no head	--	µg/g ww	0.0686	0.81	0.0556	0.0157	0.073	8460	3020	2.84	1.73	1100	13.6	<0.0040	0.00644	<0.020	0.0462	0.235	26.6	<0.040
CF3.9 CCG11	L1985910-70	Coffee	CF3.9	CCG	8/8/17	77	4	3	WB, no head	--	µg/g ww	0.0934	0.81	0.0757	0.0231	0.077	9820	3240	2.14	1.2	1030	15	<0.0040	0.00784	<0.020	0.0804	0.324	24.8	<0.040
CF3.9 CCG12	L1985910-71	Coffee	CF3.9	CCG	8/8/17	61	<4	2	WB, no head	--	µg/g ww	0.0946	0.81	0.0766	0.0197	0.044	9480	2960	2.58	2.05	1070	18.8	<0.0040	0.00882	<0.020	0.0918	0.145	25.8	<0.040
CF3.9-GR4-M	L1985910-72	Coffee	CF3.9	GR	8/8/17	65	<4	1	muscle	--	µg/g ww	0.0207	0.94	0.0195	0.0114	<0.040	5950	3810	3.36	1.62	952	7.82	<0.0040	0.00584	<0.020	0.00417	0.029	21.3	<0.040
CF3.9-GR4-L	L1985910-73	Coffee	CF3.9	GR	8/8/17	65	<4	1	liver	--	µg/g ww	0.186	0.94	0.1748	0.294	<0.36	7230	5790	7.96	6.98	2640	0.41	<0.036	0.0833	<0.18	0.0101	<0.18	51.8	<0.36
CF3.9-GR8-M	L1985910-74	Coffee	CF3.9	GR	8/8/17	70	2	1	muscle	43.5	µg/g ww	0.0301	0.94	0.0283	0.0116	<0.040	6600	3990	2.53	1.12	900	9.35	<0.0040	0.00492	<0.020	0.00991	0.02	25	<0.040
CF3.9-GR8-L	L1985910-75	Coffee	CF3.9	GR	8/8/17	70	2	1	liver	--	µg/g ww	0.461	0.94	0.4333	0.36	<0.44	7880	6460	5.73	6.68	3030	0.33	<0.044	0.0721	<0.22	0.0052	<0.22	50.3	<0.44
CF3.9-GR13-M	L1985910-76	Coffee	CF3.9	GR	8/8/17	68	5	1	muscle	41.3	µg/g ww	0.0222	0.94	0.0209	0.0146	<0.040	5620	3590	2.79	1.46	924	8.04	<0.0040	0.00565	<0.020	0.012	0.037	23.1	<0.040
CF3.9-GR13-L	L1985910-77	Coffee	CF3.9	GR	8/8/17	68	5	1	liver	--	µg/g ww	0.22	0.94	0.2068	0.46	<0.64	9350	7710	10.3	8.6	3810	0.57	<0.064	0.19	<0.32	0.0097	<0.32	56.7	<0.64
CF3.9-GR14-M	L1985910-78	Coffee	CF3.9	GR	8/8/17	280	220	8	muscle	31.5	µg/g ww	0.052	0.94	0.0489	<0.0040	<0.040	2660	4070	2.54	0.599	341	0.611	<0.0040	0.00463	<0.020	0.00112	<0.020	3.77	<0.040
CF3.9-GR14-L	L1985910-79	Coffee	CF3.9	GR	8/8/17	280	220	8	liver	--	µg/g ww	0.116	0.94	0.1090	0.123	0.052	4490	3100	3.24	3.13	1310	0.131	<0.0040	0.0311	<0.020	0.00528	0.12	27.9	<0.040
CF3.9-GR15-M	L1985910-80	Coffee	CF3.9	GR	8/8/17	270	188	5	muscle	--	µg/g ww	0.0557	0.94	0.0524	<0.0040	<0.040	2700	4590	2.18	0.796	291	0.192	<0.0040	0.00405	<0.020	0.00098	<0.020	4.2	<0.040
CF3.9-GR15-L	L1985910-81	Coffee	CF3.9	GR	8/8/17	270	188	5	liver	--	µg/g ww	0.091	0.94	0.0855	0.202	0.244	4320	2850	1.97	4.59	1360	0.18	<0.0040	0.0398	<0.020	0.00704	0.099	31	<0.040

Sample ID	ALS Sample ID	Watercourse	SSID	Species	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Hg	Me Hg (%)	MeHg Estimate	Mo	Ni	P	K	Ru	Se	Na	St	Te	Th	Sn	U	V	Zn	Zr
CF3.9-GR16-M	L1985910-82	Coffee	CF3.9	GR	8/8/17	275	210		muscle	--	µg/g ww	0.0426	0.94	0.0400	<0.0040	<0.040	2690	4380	2.73	0.76	291	0.551	<0.0040	0.00426	<0.020	0.0027	<0.020	5.12	<0.040
CF3.9-GR16-L	L1985910-83	Coffee	CF3.9	GR	8/8/17	275	210		liver	--	µg/g ww	0.116	0.94	0.1090	0.166	<0.040	3560	2770	2.37	4.57	961	0.092	<0.0040	0.0497	<0.020	0.0027	0.027	27.7	<0.040
CF3.9-GR17-M	L1985910-84	Coffee	CF3.9	GR	8/8/17	320	314	6	muscle	--	µg/g ww	0.0972	0.94	0.0914	<0.0040	<0.040	2840	4620	3.3	0.701	311	0.506	<0.0040	0.0069	<0.020	0.00222	<0.020	3.99	<0.040
CF3.9-GR17-L	L1985910-85	Coffee	CF3.9	GR	8/8/17	320	314	6	liver	--	µg/g ww	0.174	0.94	0.1636	0.117	0.044	2970	2280	2.33	3.65	1210	0.129	<0.0040	0.0556	<0.020	0.0147	0.165	25.7	<0.040
CF3.9-GR18-L	L1985910-86	Coffee	CF3.9	GR	8/8/17	265		5	liver	--	µg/g ww	0.127	0.94	0.1194	0.176	0.063	4180	3240	3.13	5.12	876	0.088	<0.0040	0.0299	<0.020	0.00409	0.056	32	<0.040
CF3.9-GR18-M	L1985910-87	Coffee	CF3.9	GR	8/8/17	265		5	muscle	--	µg/g ww	0.0604	0.94	0.0568	<0.0040	<0.040	3640	5330	2.97	0.903	289	1.18	<0.0040	0.00374	<0.020	0.00123	<0.020	4.13	<0.040
CF3.9-GR19-M	L1985910-88	Coffee	CF3.9	GR	8/8/17	244		5	muscle	--	µg/g ww	0.0465	0.94	0.0437	<0.0040	<0.040	3330	5400	3.17	0.696	280	0.986	<0.0040	0.00485	<0.020	0.00172	<0.020	3.97	<0.040
CF3.9-GR19-L	L1985910-89	Coffee	CF3.9	GR	8/8/17	244		5	liver	--	µg/g ww	0.117	0.94	0.1100	0.169	0.057	4200	3070	2.5	4.9	1240	0.146	<0.0040	0.0445	<0.020	0.00646	0.06	31.7	<0.040
CF8.0-P-1	L1985910-90	Coffee	CF8.0	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	0.0276	0.04	0.0011	0.4	11.3	430	1090	12.8	<0.40	242	27.6	<0.080	0.124	<0.40	2.73	37.4	41.5	4.45
CF8.0-P-2	L1985910-91	Coffee	CF8.0	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	0.0297	0.04	0.0012	0.45	11.7	456	1140	13.1	<0.40	243	29.1	<0.080	0.129	<0.40	3.03	38.7	42.8	4.94
CF8.0-P-3	L1985910-92	Coffee	CF8.0	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	0.0323	0.04	0.0013	0.424	10.7	413	1060	13	0.147	160	25.9	<0.020	0.127	0.2	2.72	34.9	41.1	5.8
CF8.0-P-4	L1985910-93	Coffee	CF8.0	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	0.0257	0.04	0.0010	0.432	11.1	437	1110	13.9	0.142	203	25.7	<0.020	0.123	0.22	2.65	36.4	41.9	5.22
CF8.0-P-5	L1985910-94	Coffee	CF8.0	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	0.0292	0.04	0.0012	0.429	11.3	438	1140	13.8	0.15	208	28.4	<0.040	0.125	0.25	2.89	38.2	42.7	5.68
CF3.9-P-1	L1985910-95	Coffee	CF3.9	P	8/3/17	--	--	--	Periphyton	--	µg/g ww	0.027	0.04	0.0011	0.45	11.7	483	1260	14.4	<0.40	272	27.2	<0.080	0.137	<0.40	2.93	40	44.6	4.79
CF3.9-P-2	L1985910-96	Coffee	CF3.9	P	8/3/17	--	--	--	Periphyton	--	µg/g ww	0.0296	0.04	0.0012	0.65	12.5	529	1250	13.9	<0.40	275	29.4	<0.080	0.135	<0.40	2.73	42	46.7	5.31
CF3.9-P-3	L1985910-97	Coffee	CF3.9	P	8/3/17	--	--	--	Periphyton	--	µg/g ww	0.0289	0.04	0.0012	0.45	12.8	537	1340	15.1	<0.40	281	28.9	<0.080	0.145	<0.40	3.35	42.9	48.7	5.39
CF3.9-P-4	L1985910-98	Coffee	CF3.9	P	8/3/17	--	--	--	Periphyton	--	µg/g ww	0.0326	0.04	0.0013	0.4	11.9	541	1160	12.9	<0.40	266	27.3	<0.080	0.122	<0.40	2.49	39.9	44.1	5.1
CF3.9-P-5	L1985910-99	Coffee	CF3.9	P	8/3/17	--	--	--	Periphyton	--	µg/g ww	0.0371	0.04	0.0015	0.49	12.7	529	1300	14.6	<0.40	263	28.8	<0.080	0.137	<0.40	2.95	41.8	47.1	5.27
ID1.9-P-1	L1985910-100	Independence	ID1.9	P	8/2/17	--	--	--	Periphyton	--	µg/g ww	0.0528	0.04	0.0021	0.208	9.01	342	751	6.36	<0.20	115	14.9	<0.040	0.0532	<0.20	0.779	16.4	24.3	2.67
ID1.9-P-2	L1985910-101	Independence	ID1.9	P	8/2/17	--	--	--	Periphyton	--	µg/g ww	0.0602	0.04	0.0024	0.216	10.4	402	893	7.55	<0.20	134	17.8	<0.040	0.0657	<0.20	0.909	21	29.4	3.57
ID1.9-P-3	L1985910-102	Independence	ID1.9	P	8/2/17	--	--	--	Periphyton	--	µg/g ww	0.0754	0.04	0.0030	0.14	7.58	353	769	4.84	<0.20	89	11.3	<0.040	0.0421	<0.20	0.542	13	18	2.25
ID1.9-P-4	L1985910-103	Independence	ID1.9	P	8/2/17	--	--	--	Periphyton	--	µg/g ww	0.0497	0.04	0.0020	0.139	7.15	295	634	5.47	<0.20	111	13.2	<0.040	0.046	<0.20	0.678	14.9	20.2	2.28
ID1.9-P-5	L1985910-104	Independence	ID1.9	P	8/2/17	--	--	--	Periphyton	--	µg/g ww	0.0421	0.04	0.0017	0.201	9.02	332	767	7.68	0.104	112	15.6	0.0121	0.0661	0.161	0.925	19.8	26.7	3.74
LC2.7-P-1	L1985910-105	Latte	LC2.7	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	0.0346	0.04	0.0014	0.235	10.7	389	892	9.77	<0.20	172	33.8	<0.040	0.0917	<0.20	1.72	29.2	38	5.6
LC2.7-P-2	L1985910-106	Latte	LC2.7	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	0.0766	0.04	0.0031	0.256	10.6	399	961	11.1	<0.20	177	33.2	<0.040	0.101	0.21	2.22	28.9	37.4	6.74
LC2.7-P-3	L1985910-107	Latte	LC2.7	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	0.0382	0.04	0.0015	0.266	12.6	466	1110	11.5	0.16	198	32	<0.020	0.0954	0.23	2.06	34.9	43.5	5.86
LC2.7-P-4	L1985910-108	Latte	LC2.7	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	0.0345	0.04	0.0014	0.347	12.6	465	999	10.6	<0.20	209	35.2	<0.040	0.0945	0.21	1.73	34.4	43.3	6.52
LC2.7-P-5	L1985910-109	Latte	LC2.7	P	8/4/17	--	--	--	Periphyton	--	µg/g ww	0.0352	0.04	0.0014	0.323	12.2	460	1210	12.2	0.19	217	30.7	<0.020	0.103	0.25	2.08	34.2	46.1	5.92
HF 0.2-P-1	L1985910-110	Halfway	HF0.2	P	8/6/17	--	--	--	Periphyton	--	µg/g ww	0.0249	0.04	0.0010	1.08	3.63	307	937	1.2	0.16	30.6	15.5	<0.0040	0.00751	0.029	4.4	1.93	11.9	0.736
HF 0.2-P-2	L1985910-111	Halfway	HF0.2	P	8/6/17	--	--	--	Periphyton	--	µg/g ww	0.0272	0.04	0.0011	0.157	4.91	438	1160	1.79	0.17	48.1	18.9	<0.0040	0.0111	0.034	6.27	3.19	17.1	0.76
CF10.0-P-1	L1985910-112	Coffee	CF10.0	P	8/5/17	--	--	--	Periphyton	--	µg/g ww	0.0252	0.04	0.0010	0.423	10.7	435	1220	14.4	0.133	177	23.4	<0.020	0.139	0.27	2.47	37.3	41.2	5.31
CF10.0-P-2	L1985910-113	Coffee	CF10.0	P	8/5/17	--	--	--	Periphyton	--	µg/g ww	0.0283	0.04	0.0011	0.397	10.5	432	1100	13.3	0.12	175	22.6	<0.040	0.132	0.23	2.5	35.2	40.4	5.34
CF10.0-P-3	L1985910-114	Coffee	CF10.0	P	8/5/17	--	--	--	Periphyton	--	µg/g ww	0.0259	0.04	0.0010	0.379	10.3	425	1130	13.5	0.12	197	23.3	<0.040	0.13	0.27	2.44	36.6	39.6	5.19
CF10.0-P-4	L1985910-115	Coffee	CF10.0	P	8/5/17	--	--	--	Periphyton	--	µg/g ww	0.0255	0.04	0.0010	0.404	10.7	443	1150	14	0.12	203	24.6	<0.040	0.128	0.29	2.41	38.1	41.6	5.39
CF10.0-P-5	L1985910-116	Coffee	CF10.0	P	8/5/17	--	--	--	Periphyton	--	µg/g ww	0.0296	0.04	0.0012	0.371	9.98	422	1090	12.9	0.12	164	21.5	<0.040	0.121	0.24	2.39	34.2	39.6	4.79
ID1.9-B1-1	L1985910-117	Independence	ID1.9	BI	8/2/17	--	--	--	BI	--	µg/g ww	0.0433	0.5	0.0217	0.241	1.74	2050	1650	2.17	0.606	805	4.28	<0.0040	0.0149	0.048	0.452	3.67	31.3	0.774
ID1.9-B1-2	L1985910-118	Independence	ID1.9	BI	8/2/17	--	--	--	BI	--	µg/g ww	0.0429	0.5	0.0215	0.231	1.56	2320	1480	2.41	0.699	616	4.74	<0.0040	0.0146	0.049	0.381	2.77	32.3	0.666
ID1.9-B1-3	L1985910-119	Independence	ID1.9	BI	8/2/17	--	--	--	BI	--	µg/g ww	0.0521	0.5	0.0261	0.244	2.88	2110	1920	3.46	0.607	912	6.06	<0.0040	0.0305	0.062	0.811	5.88	36.6	1.02
ID1.9-B1-4	L1985910-120	Independence	ID1.9	BI	8/2/17	--	--	--	BI	--	µg/g ww	0.0432	0.5	0.0216	0.204	1.87	1970	1520	2.36	0.555	723	5.29	<0.0040	0.0168	0.058	0.447	3.51	31.7	0.813
CF3.9-B1-1	L1985910-121	Coffee	CF3.9	BI	8/3/17	--	--	--	BI	--	µg/g ww	0.042	0.5	0.0210	0.307	1.26	3240	2410	3.34	2.24	954	5.33	<0.0040	0.0206	0.032	0.719	2.96	48.9	0.458
CF3.9-B1-2	L1985910-122	Coffee	CF3.9	BI	8/3/17	--	--	--	BI	--	µg/g ww	0.0297	0.5	0.0149	0.506	1.69	2380	1640	2.51	1.08	724	4.88	<0.0040	0.0151	0.031	1.03	2.66	37.8	0.471

Sample ID	ALS Sample ID	Watercourse	SSID	Species	Date	Length (mm)	Weight (g)	Age	Sample Type	Moisture (%)	Units	Hg	Me Hg (%)	MeHg Estimate	Mo	Ni	P	K	Ru	Se	Na	St	Te	Th	Sn	U	V	Zn	Zr
CF3.9-B1-3	L1985910-123	Coffee	CF3.9	BI	8/3/17	--	--	--	BI	--	µg/g ww	0.0371	0.5	0.0186	0.402	1.74	2820	2310	2.93	2.12	931	4.7	<0.0040	0.018	<0.020	1.05	4.02	42.1	0.319
CF8.0-B1-1	L1985910-124	Coffee	CF8.0	BI	8/4/17	--	--	--	BI	--	µg/g ww	0.0238	0.5	0.0119	0.355	1.06	2000	1040	1.86	1.69	674	3.98	<0.0040	0.0169	0.033	0.941	1.79	41.2	0.072
CF8.0-B1-2	L1985910-125	Coffee	CF8.0	BI	8/4/17	--	--	--	BI	--	µg/g ww	0.0197	0.5	0.0099	0.321	1.13	2200	1820	1.69	1.3	796	4.94	<0.0040	0.0151	0.038	1.98	2.42	35.2	0.536
CF8.0-B1-3	L1985910-126	Coffee	CF8.0	BI	8/4/17	--	--	--	BI	--	µg/g ww	0.0252	0.5	0.0126	0.433	1.41	3280	3040	3.04	2.29	1050	6.12	<0.0040	0.027	<0.020	1.4	3.73	52	0.344
CF8.0-B1-4	L1985910-127	Coffee	CF8.0	BI	8/4/17	--	--	--	BI	--	µg/g ww	0.0282	0.5	0.0141	0.77	1.62	2630	3330	2	1.45	1310	6.17	<0.0040	0.0297	0.024	2.62	2.89	40.2	0.785
LAC4.8-B1-1	L1985910-128	Los Angeles	LAC4.8	BI	8/3/17	--	--	--	BI	--	µg/g ww	0.0199	0.5	0.0100	0.232	3.67	1650	969	1.45	1.05	951	7.85	<0.0040	0.0143	0.068	0.148	3.3	34.7	0.629
CF10.0-B1-1	L1985910-129	Coffee	CF10.0	BI	8/5/17	--	--	--	BI	--	µg/g ww	0.0163	0.5	0.0082	0.373	1.12	1460	1170	2.17	1.01	496	3.17	<0.0040	0.0193	0.04	0.972	3.13	25.9	0.695
CF10.0-B1-2	L1985910-130	Coffee	CF10.0	BI	8/5/17	--	--	--	BI	--	µg/g ww	0.0168	0.5	0.0084	0.478	1.08	2070	1750	1.59	0.955	695	3.64	<0.0040	0.0179	0.027	1.87	2.53	35.4	0.492
CF10.0-B1-3	L1985910-131	Coffee	CF10.0	BI	8/5/17	--	--	--	BI	--	µg/g ww	0.0202	0.5	0.0101	0.548	2.25	1860	1230	2.92	1.77	473	7.86	0.0051	0.0333	0.031	1.86	5.35	51.2	0.449
LC2.7-B1-1	L1985910-132	Latte	LC2.7	BI	8/4/17	--	--	--	BI	--	µg/g ww	0.0351	0.5	0.0176	0.27	1.19	2640	2070	2.85	1.6	918	5.18	<0.0040	0.0171	0.036	0.504	1.9	37.6	0.642
LC2.7-B1-2	L1985910-133	Latte	LC2.7	BI	8/4/17	--	--	--	BI	--	µg/g ww	0.0317	0.5	0.0159	0.239	1.1	2490	1810	1.88	1.72	675	4.59	<0.0040	0.0102	0.028	0.322	1.84	34.8	0.603
LC2.7-B1-3	L1985910-134	Latte	LC2.7	BI	8/4/17	--	--	--	BI	--	µg/g ww	0.0437	0.5	0.0219	0.263	1.54	2520	2340	4.09	1.85	750	6.01	<0.0040	0.0371	0.056	0.686	2.82	35.9	0.592
LC9.9-B1-1	L1985910-135	Latte	LC9.9	BI	8/5/17	--	--	--	BI	--	µg/g ww	0.0529	0.5	0.0265	0.179	0.846	1810	1180	1.92	0.393	543	4.15	<0.0040	0.0119	0.038	0.682	2.46	31.9	0.571
LC9.9-B1-2	L1985910-136	Latte	LC9.9	BI	8/5/17	--	--	--	BI	--	µg/g ww	0.0746	0.5	0.0373	0.219	1.04	2530	1730	2.98	0.485	720	4.19	<0.0040	0.0127	0.035	0.74	3.01	36.1	0.692
YT0.2-B1-1	L1985910-137	YT-24	YT0.2	BI	8/7/17	--	--	--	BI	--	µg/g ww	0.0101	0.5	0.0051	0.127	1.23	1630	1010	1.49	0.209	398	4.54	<0.0040	0.00975	0.033	0.477	2.88	27.1	0.7
YT5.0-B1-1	L1985910-138	YT-24	YT5.0	BI	8/7/17	--	--	--	BI	--	µg/g ww	<0.021	0.5	#VALUE!	0.124	0.6	976	523	1.14	0.089	281	1.41	<0.0040	0.00443	0.022	0.0908	1.04	20.7	0.289
HF0.2-B1-1	L1985910-139	Halfway	HF0.2	BI	8/6/17	--	--	--	BI	84.2	µg/g ww	0.0139	0.5	0.0070	0.232	0.91	1530	1070	1.25	0.438	545	4.08	<0.0040	0.00806	0.02	0.683	1.51	25	0.332
HF0.2-B1-2	L1985910-140	Halfway	HF0.2	BI	8/6/17	--	--	--	BI	--	µg/g ww	0.0148	0.5	0.0074	0.252	1.71	1580	1160	1.97	0.338	521	6.09	<0.0040	0.0143	0.054	2.21	2.52	25.8	0.556
HF0.2-B1-3	L1985910-141	Halfway	HF0.2	BI	8/6/17	--	--	--	BI	--	µg/g ww	0.0175	0.5	0.0088	0.242	1.47	1700	1150	1.63	0.381	555	5.79	<0.0040	0.0125	0.029	1.79	3.01	28.1	0.556
HF0.2-B1-4	L1985910-142	Halfway	HF0.2	BI	8/6/17	--	--	--	BI	--	µg/g ww	0.014	0.5	0.0070	0.185	0.831	1640	1150	1.27	0.374	542	4.18	<0.0040	0.00747	<0.020	0.743	1.28	28	0.325
HF0.2-B1-5	L1985910-143	Halfway	HF0.2	BI	8/6/17	--	--	--	BI	--	µg/g ww	0.0152	0.5	0.0076	0.214	1.17	1720	1200	1.2	0.357	591	4.3	<0.0040	0.00809	<0.020	0.854	1.48	26.4	0.352
HF6.3-B1-1	L1985910-144	Halfway	HF6.3	BI	8/6/17	--	--	--	BI	--	µg/g ww	0.0319	0.5	0.0160	0.304	1.49	1730	1150	2.04	1.12	475	7.34	<0.0040	0.0171	0.046	2.48	3.58	32.3	0.383
HF6.3-B1-2	L1985910-145	Halfway	HF6.3	BI	8/6/17	--	--	--	BI	--	µg/g ww	0.0346	0.5	0.0173	0.335	2.09	1450	1070	2.97	0.823	424	8.87	<0.0040	0.0225	0.07	3.08	4.61	41.5	0.579
HF6.3-B1-3	L1985910-146	Halfway	HF6.3	BI	8/6/17	--	--	--	BI	--	µg/g ww	0.0365	0.5	0.0183	0.308	2.42	1430	1200	3.53	0.818	471	9.36	<0.0040	0.0256	0.08	3.4	5.08	38.9	0.613
HF6.3-B1-4	L1985910-147	Halfway	HF6.3	BI	8/6/17	--	--	--	BI	--	µg/g ww	0.0439	0.5	0.0220	0.317	2.86	1720	1200	3.81	0.878	418	11.7	<0.0040	0.029	0.091	3.86	5.78	50.8	0.679
HF6.3-B1-5	L1985910-148	Halfway	HF6.3	BI	8/6/17	--	--	--	BI	--	µg/g ww	0.0387	0.5	0.0194	0.27	1.56	1500	1100	2.2	0.917	434	7.81	<0.0040	0.0167	0.054	2.64	3.48	41.4	0.329

Notes:
GR – Arctic grayling
CCG – slimy sculpin
P = periphyton
BI – benthic invertebrate
WB – whole body

EDI ENVIRONMENTAL DYNAMICS INC.
ATTN: Lyndsay Doetzel
2195 2nd Avenue
Whitehorse YT Y1A 3T8

Date Received: 05-SEP-17
Report Date: 30-OCT-17 18:23 (MT)
Version: FINAL

Client Phone: 867-393-4882

Certificate of Analysis

Lab Work Order #: L1985910

Project P.O. #: NOT SUBMITTED
Job Reference: 17Y0032:501
C of C Numbers:
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-1 Tissue 06-AUG-17 LC 2.7 1GR2-M	L1985910-2 Tissue 06-AUG-17 LC 2.7 1GR2-L	L1985910-3 Tissue 06-AUG-17 LC 2.7 1GR1-M	L1985910-4 Tissue 06-AUG-17 LC 2.7 1GR1-L	L1985910-5 Tissue 06-AUG-17 LC 2.7 1GR3-M
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	1.15	2.9	3.84	2.5	1.67
	Antimony (Sb)-Total (mg/kg wwt)	0.0065	0.0052	0.0049	0.0050	0.0059
	Arsenic (As)-Total (mg/kg wwt)	0.0230	0.0224	0.0399	0.0348	0.0181
	Barium (Ba)-Total (mg/kg wwt)	0.192	0.146	0.227	0.109	0.155
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.0108	3.89	0.0122	2.45	0.0099
	Calcium (Ca)-Total (mg/kg wwt)	800	59.1	561	58.5	320
	Cesium (Cs)-Total (mg/kg wwt)	0.0109	0.0050	0.0123	0.0053	0.0097
	Chromium (Cr)-Total (mg/kg wwt)	<0.010	<0.040	0.017	<0.040	0.011
	Cobalt (Co)-Total (mg/kg wwt)	0.0119	0.382	0.0139	0.0705	0.0106
	Copper (Cu)-Total (mg/kg wwt)	0.415	3.54	0.644	2.50	0.472
	Iron (Fe)-Total (mg/kg wwt)	5.26	88.0	10.5	51.7	6.53
	Lead (Pb)-Total (mg/kg wwt)	0.0044	<0.010	0.0066	<0.010	<0.0040
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	342	233	310	247	337
	Manganese (Mn)-Total (mg/kg wwt)	0.356	2.88	0.362	3.14	0.401
	Mercury (Hg)-Total (mg/kg wwt)	0.0535	0.155	0.0914	0.234	0.0409
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	0.118	<0.0040	0.109	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	0.054	0.083	0.117	<0.040	0.043
	Phosphorus (P)-Total (mg/kg wwt)	3210	4010	3050	5130	2940
	Potassium (K)-Total (mg/kg wwt)	4590	2490	4420	3790	4460
	Rubidium (Rb)-Total (mg/kg wwt)	2.45	1.62	2.61	2.79	2.23
	Selenium (Se)-Total (mg/kg wwt)	0.843	4.90	0.699	3.51	1.02
	Sodium (Na)-Total (mg/kg wwt)	409	948	363	683	314
	Strontium (Sr)-Total (mg/kg wwt)	0.984	0.127	0.739	0.085	0.400
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00429	0.0189	0.00736	0.0227	0.00461
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.00093	0.00453	0.00194	0.00990	0.00133
	Vanadium (V)-Total (mg/kg wwt)	<0.020	0.044	<0.020	0.037	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	4.86	31.3	5.12	29.0	6.01
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-6 Tissue 06-AUG-17 LC 2.7 1GR3-L	L1985910-7 Tissue 06-AUG-17 LC 2.7 1GR4-M	L1985910-8 Tissue 06-AUG-17 LC 2.7 1GR4-L	L1985910-9 Tissue 06-AUG-17 LC 2.7 2GR5-M	L1985910-10 Tissue 06-AUG-17 LC 2.7 2GR5-L
TISSUE						
Physical Tests	% Moisture (%)	65.1				
Metals	Aluminum (Al)-Total (mg/kg wwt)	2.7	2.61	2.3	1.02	1.6
	Antimony (Sb)-Total (mg/kg wwt)	0.0054	0.0203	0.0044	0.0063	0.0044
	Arsenic (As)-Total (mg/kg wwt)	0.0493	0.0219	0.0367	0.0115	0.0163
	Barium (Ba)-Total (mg/kg wwt)	0.271	0.176	0.408	0.126	0.143
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	0.35	<0.20	0.29	<0.20	0.21
	Cadmium (Cd)-Total (mg/kg wwt)	2.14	0.0113	1.94	0.0037	2.46
	Calcium (Ca)-Total (mg/kg wwt)	111	282	87.6	263	47.7
	Cesium (Cs)-Total (mg/kg wwt)	0.0055	0.0089	0.0071	0.0082	0.0063
	Chromium (Cr)-Total (mg/kg wwt)	0.225	0.036	0.041	<0.010	0.044
	Cobalt (Co)-Total (mg/kg wwt)	0.163	0.0135	0.192	0.0093	0.243
	Copper (Cu)-Total (mg/kg wwt)	3.15	0.432	2.69	0.317	3.46
	Iron (Fe)-Total (mg/kg wwt)	71.1	7.34	70.1	3.79	84.7
	Lead (Pb)-Total (mg/kg wwt)	<0.010	0.0074	<0.010	<0.0040	<0.010
	Lithium (Li)-Total (mg/kg wwt)	0.11	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	266	285	243	214	197
	Manganese (Mn)-Total (mg/kg wwt)	2.37	0.502	3.17	0.265	2.27
	Mercury (Hg)-Total (mg/kg wwt)	0.135	0.0473	0.145	0.0340	0.105
	Molybdenum (Mo)-Total (mg/kg wwt)	0.107	<0.0040	0.121	<0.0040	0.128
	Nickel (Ni)-Total (mg/kg wwt)	0.115	0.085	<0.040	0.054	<0.040
	Phosphorus (P)-Total (mg/kg wwt)	3570	2500	4210	1970	3570
	Potassium (K)-Total (mg/kg wwt)	2780	3810	2600	3020	2720
	Rubidium (Rb)-Total (mg/kg wwt)	1.79	2.11	2.17	1.95	2.16
	Selenium (Se)-Total (mg/kg wwt)	4.72	0.904	4.08	0.592	3.64
	Sodium (Na)-Total (mg/kg wwt)	1470	401	1180	259	818
	Strontium (Sr)-Total (mg/kg wwt)	0.220	0.449	0.166	0.309	0.090
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0256	0.00418	0.0314	0.00345	0.0330
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	0.022	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.00282	0.00307	0.00371	0.00097	0.00178
	Vanadium (V)-Total (mg/kg wwt)	0.022	<0.020	0.038	<0.020	0.050
	Zinc (Zn)-Total (mg/kg wwt)	34.3	5.26	32.8	3.18	29.0
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-11 Tissue 06-AUG-17 LC 2.7 2GR6-M	L1985910-12 Tissue 06-AUG-17 LC 2.7 2GR6-L	L1985910-13 Tissue 06-AUG-17 LC 2.7 2GR7-M	L1985910-14 Tissue 06-AUG-17 LC 2.7 2GR7-L	L1985910-15 Tissue 06-AUG-17 LC 2.7 2GR8-M
TISSUE						
Physical Tests	% Moisture (%)				62.1	
Metals	Aluminum (Al)-Total (mg/kg wwt)	1.78	2.0	1.24	2.2	1.29
	Antimony (Sb)-Total (mg/kg wwt)	0.0072	0.0034	0.0043	0.0075	0.0060
	Arsenic (As)-Total (mg/kg wwt)	0.0245	0.0166	0.0200	0.0559	0.0188
	Barium (Ba)-Total (mg/kg wwt)	0.145	0.247	0.163	0.092	0.119
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.0073	3.91	0.0040	0.533	0.0116
	Calcium (Ca)-Total (mg/kg wwt)	267	53.9	467	57.9	168
	Cesium (Cs)-Total (mg/kg wwt)	0.0106	0.0052	0.0110	0.0064	0.0135
	Chromium (Cr)-Total (mg/kg wwt)	0.021	<0.040	0.014	<0.040	0.019
	Cobalt (Co)-Total (mg/kg wwt)	0.0108	0.276	0.0077	0.0931	0.0194
	Copper (Cu)-Total (mg/kg wwt)	0.441	2.20	0.352	2.36	0.450
	Iron (Fe)-Total (mg/kg wwt)	6.16	64.2	4.44	45.1	7.74
	Lead (Pb)-Total (mg/kg wwt)	0.0045	<0.010	<0.0040	<0.010	0.0060
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	300	179	334	231	275
	Manganese (Mn)-Total (mg/kg wwt)	0.359	2.12	0.323	2.19	0.288
	Mercury (Hg)-Total (mg/kg wwt)	0.0645	0.144	0.0462	0.204	0.0817
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	0.105	<0.0040	0.123	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	0.054	<0.040	0.056	<0.040	0.067
	Phosphorus (P)-Total (mg/kg wwt)	2650	3530	3000	3980	2500
	Potassium (K)-Total (mg/kg wwt)	4290	2730	4620	2920	4000
	Rubidium (Rb)-Total (mg/kg wwt)	2.53	2.12	2.67	1.95	2.56
	Selenium (Se)-Total (mg/kg wwt)	0.782	3.27	0.977	3.61	0.717
	Sodium (Na)-Total (mg/kg wwt)	393	974	367	905	599
	Strontium (Sr)-Total (mg/kg wwt)	0.333	0.094	0.549	0.110	0.184
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00557	0.0387	0.00393	0.0347	0.00677
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.00095	0.00233	0.00092	0.00170	0.00128
	Vanadium (V)-Total (mg/kg wwt)	<0.020	0.039	<0.020	0.036	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	4.81	26.5	5.94	32.0	4.62
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-16 Tissue 06-AUG-17 LC 2.7 2GR8-L	L1985910-17 Tissue 06-AUG-17 LC 2.7 2GR9-M	L1985910-18 Tissue 06-AUG-17 LC 2.7 2GR9-L	L1985910-19 Tissue 06-AUG-17 LC 2.7 3GR10-M	L1985910-20 Tissue 06-AUG-17 LC 2.7 3GR10-L
TISSUE						
Physical Tests	% Moisture (%)			63.1		
Metals	Aluminum (Al)-Total (mg/kg wwt)	2.8	1.98	2.4	2.62	7.3
	Antimony (Sb)-Total (mg/kg wwt)	0.0052	0.0040	0.0078	0.0048	0.0127
	Arsenic (As)-Total (mg/kg wwt)	0.0281	0.0218	0.0700	0.0385	0.0325
	Barium (Ba)-Total (mg/kg wwt)	0.221	0.150	0.102	0.297	0.450
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	3.31	0.0070	1.98	0.0058	2.79
	Calcium (Ca)-Total (mg/kg wwt)	377	373	49.9	1020	68.3
	Cesium (Cs)-Total (mg/kg wwt)	0.0103	0.0092	0.0082	0.0112	0.0074
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	0.016	<0.040	0.016	0.053
	Cobalt (Co)-Total (mg/kg wwt)	0.0898	0.0145	0.163	0.0194	0.138
	Copper (Cu)-Total (mg/kg wwt)	3.55	0.428	2.42	0.546	2.98
	Iron (Fe)-Total (mg/kg wwt)	55.9	5.90	48.6	8.08	109
	Lead (Pb)-Total (mg/kg wwt)	<0.010	0.0063	<0.010	0.0122	<0.010
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	195	316	239	286	210
	Manganese (Mn)-Total (mg/kg wwt)	2.24	0.332	2.42	0.625	2.21
	Mercury (Hg)-Total (mg/kg wwt)	0.130	0.0523	0.166	0.132	0.305
	Molybdenum (Mo)-Total (mg/kg wwt)	0.120	<0.0040	0.108	<0.0040	0.168
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	0.077	<0.040	0.191	<0.040
	Phosphorus (P)-Total (mg/kg wwt)	4250	2760	3790	2910	4110
	Potassium (K)-Total (mg/kg wwt)	3320	4220	3020	3880	2780
	Rubidium (Rb)-Total (mg/kg wwt)	3.14	2.47	2.54	2.50	2.21
	Selenium (Se)-Total (mg/kg wwt)	5.00	1.05	4.48	0.661	4.08
	Sodium (Na)-Total (mg/kg wwt)	1050	387	798	385	989
	Strontium (Sr)-Total (mg/kg wwt)	0.534	0.510	0.107	1.49	0.122
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0369	0.00481	0.0751	0.00632	0.0583
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.034	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.0131	0.00125	0.00179	0.00274	0.0218
	Vanadium (V)-Total (mg/kg wwt)	0.033	<0.020	0.021	<0.020	0.092
	Zinc (Zn)-Total (mg/kg wwt)	29.0	5.15	31.3	4.42	31.1
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-21 Tissue 06-AUG-17 YT005 GR1-M	L1985910-22 Tissue 06-AUG-17 YT005 GR1-L	L1985910-23 Tissue 07-AUG-17 ID1.9-1CCG1	L1985910-24 Tissue 07-AUG-17 ID1.9-1CCG2	L1985910-25 Tissue 07-AUG-17 ID1.9-1CCG3
TISSUE						
Physical Tests	% Moisture (%)		59.1			
Metals	Aluminum (Al)-Total (mg/kg wwt)	1.8	1.8	43.2	206	91.1
	Antimony (Sb)-Total (mg/kg wwt)	0.0047	0.0103	0.0062	0.0103	0.0127
	Arsenic (As)-Total (mg/kg wwt)	0.0286	0.0342	0.0910	0.214	0.154
	Barium (Ba)-Total (mg/kg wwt)	0.147	0.271	3.41	6.55	4.16
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	0.0044	0.0031
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	0.31	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.0530	2.59	0.0785	0.380	0.0839
	Calcium (Ca)-Total (mg/kg wwt)	168	67.4	14100	12500	15700
	Cesium (Cs)-Total (mg/kg wwt)	0.0079	0.0070	0.0154	0.0234	0.0143
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	0.074	0.091	0.446	0.181
	Cobalt (Co)-Total (mg/kg wwt)	0.0151	0.129	0.0381	0.137	0.0600
	Copper (Cu)-Total (mg/kg wwt)	0.459	2.63	1.05	1.34	0.945
	Iron (Fe)-Total (mg/kg wwt)	6.8	45.7	63.2	272	130
	Lead (Pb)-Total (mg/kg wwt)	<0.010	<0.010	0.101	0.119	0.056
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	0.12	0.16	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	278	384	417	504	474
	Manganese (Mn)-Total (mg/kg wwt)	0.321	2.86	6.90	20.9	12.2
	Mercury (Hg)-Total (mg/kg wwt)	0.0293	0.061	0.0706	0.0918	0.0601
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0080	0.140	0.0221	0.0294	0.0308
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	0.060	0.133	0.431	0.142
	Phosphorus (P)-Total (mg/kg wwt)	2600	5170	9320	11100	12300
	Potassium (K)-Total (mg/kg wwt)	3920	3110	2850	2530	3230
	Rubidium (Rb)-Total (mg/kg wwt)	2.57	2.83	2.66	1.69	2.35
	Selenium (Se)-Total (mg/kg wwt)	1.45	4.00	0.945	1.23	1.20
	Sodium (Na)-Total (mg/kg wwt)	589	1120	1120	1240	1230
	Strontium (Sr)-Total (mg/kg wwt)	0.199	0.139	17.9	15.7	20.0
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00337	0.0330	0.00622	0.00807	0.00781
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	0.032
	Uranium (U)-Total (mg/kg wwt)	0.00160	0.00210	0.0346	0.0921	0.0551
	Vanadium (V)-Total (mg/kg wwt)	<0.020	0.028	0.295	0.951	0.440
	Zinc (Zn)-Total (mg/kg wwt)	7.38	29.8	25.1	42.4	30.7
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	0.041	0.123	0.062

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

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Grouping	Analyte	L1985910-26 Tissue 07-AUG-17 ID1.9-1CCG4	L1985910-27 Tissue 07-AUG-17 ID1.9-1CCG5	L1985910-28 Tissue 07-AUG-17 ID1.9-1CCG6	L1985910-29 Tissue 07-AUG-17 ID1.9-1CCG7	L1985910-30 Tissue 07-AUG-17 ID1.9-1CCG8
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	54.8	36.1	113	181	97.0
	Antimony (Sb)-Total (mg/kg wwt)	0.0049	0.0053	0.0100	0.0110	0.0063
	Arsenic (As)-Total (mg/kg wwt)	0.104	0.124	0.171	0.217	0.138
	Barium (Ba)-Total (mg/kg wwt)	2.81	2.87	2.86	4.16	3.87
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	0.0031	0.0046	0.0027
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.0851	0.104	0.0239	0.163	0.0986
	Calcium (Ca)-Total (mg/kg wwt)	9160	10400	7850	11600	10200
	Cesium (Cs)-Total (mg/kg wwt)	0.0098	0.0087	0.0166	0.0268	0.0137
	Chromium (Cr)-Total (mg/kg wwt)	0.112	0.077	0.232	0.407	0.211
	Cobalt (Co)-Total (mg/kg wwt)	0.0412	0.0331	0.0783	0.133	0.0774
	Copper (Cu)-Total (mg/kg wwt)	0.974	0.878	0.916	1.33	1.12
	Iron (Fe)-Total (mg/kg wwt)	73.5	53.5	149	251	135
	Lead (Pb)-Total (mg/kg wwt)	0.032	0.028	0.054	0.107	0.0537
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	0.10	0.18	0.11
	Magnesium (Mg)-Total (mg/kg wwt)	355	373	381	462	438
	Manganese (Mn)-Total (mg/kg wwt)	6.14	6.28	8.67	16.5	11.8
	Mercury (Hg)-Total (mg/kg wwt)	0.0468	0.0544	0.0737	0.0783	0.0795
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0191	0.0225	0.0255	0.0396	0.0216
	Nickel (Ni)-Total (mg/kg wwt)	0.109	0.148	0.204	0.405	0.238
	Phosphorus (P)-Total (mg/kg wwt)	8460	9240	7280	8960	8920
	Potassium (K)-Total (mg/kg wwt)	2920	2990	3390	2720	2770
	Rubidium (Rb)-Total (mg/kg wwt)	2.35	2.95	2.09	2.40	2.26
	Selenium (Se)-Total (mg/kg wwt)	1.17	1.10	1.04	1.07	0.770
	Sodium (Na)-Total (mg/kg wwt)	1110	1010	1040	1130	1060
	Strontium (Sr)-Total (mg/kg wwt)	11.7	13.2	9.71	14.5	12.3
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00606	0.00698	0.00727	0.0102	0.00876
	Tin (Sn)-Total (mg/kg wwt)	0.034	0.049	0.057	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.0239	0.0234	0.0459	0.107	0.0553
	Vanadium (V)-Total (mg/kg wwt)	0.269	0.272	0.367	0.734	0.448
	Zinc (Zn)-Total (mg/kg wwt)	14.9	24.4	22.5	38.4	24.6
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	0.083	0.140	0.066

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-31 Tissue 07-AUG-17 ID1.9-1CCG9	L1985910-32 Tissue 07-AUG-17 ID1.9-1CCG10	L1985910-33 Tissue 07-AUG-17 ID1.9-3CCG11	L1985910-34 Tissue 07-AUG-17 ID1.9-1GR1-M	L1985910-35 Tissue 07-AUG-17 ID1.9-1GR1-L
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	104	62.4	43.9	2.84	2.5
	Antimony (Sb)-Total (mg/kg wwt)	0.0063	0.0078	0.0045	0.0027	0.0041
	Arsenic (As)-Total (mg/kg wwt)	0.164	0.145	0.108	0.0176	0.0183
	Barium (Ba)-Total (mg/kg wwt)	3.50	4.51	3.03	0.127	0.225
	Beryllium (Be)-Total (mg/kg wwt)	0.0029	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.112	0.178	0.178	0.0052	0.839
	Calcium (Ca)-Total (mg/kg wwt)	11500	15500	11300	131	82.5
	Cesium (Cs)-Total (mg/kg wwt)	0.0166	0.0124	0.0093	0.0128	0.0065
	Chromium (Cr)-Total (mg/kg wwt)	0.215	0.125	0.090	0.013	<0.040
	Cobalt (Co)-Total (mg/kg wwt)	0.0807	0.0551	0.0541	0.0144	0.0614
	Copper (Cu)-Total (mg/kg wwt)	1.07	0.911	0.931	0.441	1.29
	Iron (Fe)-Total (mg/kg wwt)	145	89.2	64.2	8.69	37.1
	Lead (Pb)-Total (mg/kg wwt)	0.058	0.093	0.036	0.0093	<0.010
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	395	463	348	304	194
	Manganese (Mn)-Total (mg/kg wwt)	12.7	13.4	8.58	0.285	2.48
	Mercury (Hg)-Total (mg/kg wwt)	0.0421	0.0498	0.0513	0.0927	0.142
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0270	0.0248	0.0242	<0.0040	0.0876
	Nickel (Ni)-Total (mg/kg wwt)	0.192	0.151	0.137	0.062	<0.040
	Phosphorus (P)-Total (mg/kg wwt)	9340	12100	8540	2740	3940
	Potassium (K)-Total (mg/kg wwt)	2870	3240	2740	4400	2970
	Rubidium (Rb)-Total (mg/kg wwt)	2.28	2.52	2.13	2.58	3.00
	Selenium (Se)-Total (mg/kg wwt)	1.26	1.26	1.04	0.839	3.01
	Sodium (Na)-Total (mg/kg wwt)	1020	1190	1090	345	1000
	Strontium (Sr)-Total (mg/kg wwt)	14.3	18.1	14.7	0.124	0.114
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00696	0.00830	0.00633	0.00562	0.0291
	Tin (Sn)-Total (mg/kg wwt)	0.030	0.023	0.024	<0.020	0.090
	Uranium (U)-Total (mg/kg wwt)	0.0521	0.0407	0.0254	0.00091	0.00244
	Vanadium (V)-Total (mg/kg wwt)	0.418	0.515	0.266	<0.020	0.029
	Zinc (Zn)-Total (mg/kg wwt)	24.9	28.9	28.4	4.40	19.2
	Zirconium (Zr)-Total (mg/kg wwt)	0.077	0.049	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-36 Tissue 07-AUG-17 ID1.9-1GR2-M	L1985910-37 Tissue 07-AUG-17 ID1.9-1GR2-L	L1985910-38 Tissue 07-AUG-17 ID1.9-2GR3-M	L1985910-39 Tissue 07-AUG-17 ID1.9-2GR3-L	L1985910-40 Tissue 07-AUG-17 ID1.9-2GR4-M
TISSUE						
Physical Tests	% Moisture (%)	75.2	20.0			
Metals	Aluminum (Al)-Total (mg/kg wwt)	5.7	20.3	2.26	2.0	1.32
	Antimony (Sb)-Total (mg/kg wwt)	0.0359	0.028	0.0052	0.0026	<0.0020
	Arsenic (As)-Total (mg/kg wwt)	0.0190	0.163	0.0330	0.0179	0.0334
	Barium (Ba)-Total (mg/kg wwt)	0.460	6.90	0.169	0.148	0.244
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.018 DLIS	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.018 DLIS	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<1.8 DLIS	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.0373	4.07	0.0083	1.19	0.0049
	Calcium (Ca)-Total (mg/kg wwt)	1430	162	398	56.8	801
	Cesium (Cs)-Total (mg/kg wwt)	0.0107	0.0177	0.0134	0.0056	0.0102
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	<0.36 DLIS	0.011	<0.040	<0.010
	Cobalt (Co)-Total (mg/kg wwt)	0.0170	0.282	0.0102	0.0769	0.0078
	Copper (Cu)-Total (mg/kg wwt)	0.542	7.91	0.507	1.62	0.299
	Iron (Fe)-Total (mg/kg wwt)	11.2	132	9.12	53.0	4.69
	Lead (Pb)-Total (mg/kg wwt)	0.010	<0.090 DLIS	0.0046	<0.010	<0.0040
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.90 DLIS	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	383	809	332	184	296
	Manganese (Mn)-Total (mg/kg wwt)	1.11	6.93	0.355	2.38	0.381
	Mercury (Hg)-Total (mg/kg wwt)	0.0289	0.237	0.0645	0.121	0.0484
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0080	0.346	<0.0040	0.0623	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	0.090	<0.36 DLIS	0.046	<0.040	<0.040
	Phosphorus (P)-Total (mg/kg wwt)	3200	11100	3130	3770	2860
	Potassium (K)-Total (mg/kg wwt)	4510	9250	4930	2830	4150
	Rubidium (Rb)-Total (mg/kg wwt)	2.98	14.4	2.74	2.28	2.75
	Selenium (Se)-Total (mg/kg wwt)	1.45	13.4	0.745	2.86	0.522
	Sodium (Na)-Total (mg/kg wwt)	485	3210	323	1060	297
	Strontium (Sr)-Total (mg/kg wwt)	1.60	0.51	0.428	0.078	0.884
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.036 DLIS	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00678	0.198	0.00472	0.0115	0.00429
	Tin (Sn)-Total (mg/kg wwt)	0.178	0.21	<0.020	0.037	0.022
	Uranium (U)-Total (mg/kg wwt)	0.00155	0.0048	0.00096	0.00255	0.00065
	Vanadium (V)-Total (mg/kg wwt)	<0.020	<0.18 DLIS	<0.020	0.050	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	8.13	61.6	4.22	20.6	3.72
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.36 DLIS	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-41 Tissue 07-AUG-17 ID1.9-2GR4-L	L1985910-42 Tissue 07-AUG-17 ID1.9-2GR5-M	L1985910-43 Tissue 07-AUG-17 ID1.9-2GR5-L	L1985910-44 Tissue 07-AUG-17 ID1.9-2GR6-M	L1985910-45 Tissue 07-AUG-17 ID1.9-2GR6-L
TISSUE						
Physical Tests	% Moisture (%)		75.5	41.3		
Metals	Aluminum (Al)-Total (mg/kg wwt)	1.8	15.0	36	2.05	4.4
	Antimony (Sb)-Total (mg/kg wwt)	<0.0020	0.0117	0.037	0.0036	0.0090
	Arsenic (As)-Total (mg/kg wwt)	0.0191	0.0279	0.167	0.0265	0.0257
	Barium (Ba)-Total (mg/kg wwt)	0.195	0.392	1.12	0.213	0.290
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.022 DLIS	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.022 DLIS	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<2.2 DLIS	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	1.07	0.0280	2.51	0.0089	2.19
	Calcium (Ca)-Total (mg/kg wwt)	52.6	604	150	636	62.9
	Cesium (Cs)-Total (mg/kg wwt)	0.0078	0.0122	0.017	0.0724	0.0277
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	0.116	<0.44 DLIS	0.011	0.051
	Cobalt (Co)-Total (mg/kg wwt)	0.189	0.0287	0.266	0.0104	0.319
	Copper (Cu)-Total (mg/kg wwt)	1.60	0.479	7.67	0.386	2.48
	Iron (Fe)-Total (mg/kg wwt)	50.5	24.4	109	7.92	106
	Lead (Pb)-Total (mg/kg wwt)	<0.010	0.012	<0.11 DLIS	<0.0040	<0.010
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<1.1 DLIS	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	215	334	578	282	195
	Manganese (Mn)-Total (mg/kg wwt)	2.54	1.45	5.84	0.398	2.00
	Mercury (Hg)-Total (mg/kg wwt)	0.112	0.0247	0.164	0.0646	0.145
	Molybdenum (Mo)-Total (mg/kg wwt)	0.110	<0.0080	0.300	<0.0040	0.163
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	0.083	<0.44 DLIS	<0.040	<0.040
	Phosphorus (P)-Total (mg/kg wwt)	4540	2630	7600	2750	3500
	Potassium (K)-Total (mg/kg wwt)	3450	4380	5160	4100	2820
	Rubidium (Rb)-Total (mg/kg wwt)	3.38	3.22	8.58	2.84	2.74
	Selenium (Se)-Total (mg/kg wwt)	3.54	1.46	8.16	0.644	3.81
	Sodium (Na)-Total (mg/kg wwt)	1090	585	2410	344	1070
	Strontium (Sr)-Total (mg/kg wwt)	0.079	0.684	0.48	0.749	0.100
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.044 DLIS	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0218	0.00661	0.107	0.00485	0.0207
	Tin (Sn)-Total (mg/kg wwt)	0.027	0.035	<0.22 DLIS	<0.020	0.037
	Uranium (U)-Total (mg/kg wwt)	0.00232	0.00521	0.0052	0.00130	0.00685
	Vanadium (V)-Total (mg/kg wwt)	0.035	0.041	<0.22 DLIS	<0.020	0.077
	Zinc (Zn)-Total (mg/kg wwt)	22.8	8.69	49.3	3.87	25.5
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.44 DLIS	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-46 Tissue 07-AUG-17 ID1.9-3GR7-M	L1985910-47 Tissue 07-AUG-17 ID1.9-3GR7-L	L1985910-48 Tissue 03-AUG-17 HE0.1-GR1-M	L1985910-49 Tissue 03-AUG-17 HE0.1-GR1-L	L1985910-50 Tissue 03-AUG-17 HE0.2-GR2-M
TISSUE						
Physical Tests	% Moisture (%)		57.1		59.2	
Metals	Aluminum (Al)-Total (mg/kg wwt)	5.6	19.2	1.11	2.3	2.21
	Antimony (Sb)-Total (mg/kg wwt)	0.0307	0.0492	0.0583	0.0394	0.114
	Arsenic (As)-Total (mg/kg wwt)	0.0255	0.084	0.0275	0.0702	0.0316
	Barium (Ba)-Total (mg/kg wwt)	0.689	1.80	0.170	0.207	0.173
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0040 DLIS	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0040 DLIS	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.40 DLIS	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.0314	3.64	0.0088	1.94	0.0027
	Calcium (Ca)-Total (mg/kg wwt)	1580	144	467	69.0	282
	Cesium (Cs)-Total (mg/kg wwt)	0.0106	0.0161	0.0094	0.0111	0.0095
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	0.227	<0.010	0.049	0.019
	Cobalt (Co)-Total (mg/kg wwt)	0.0199	0.282	0.0157	0.140	0.0076
	Copper (Cu)-Total (mg/kg wwt)	0.457	5.59	0.323	2.76	0.354
	Iron (Fe)-Total (mg/kg wwt)	12.6	101	4.70	66.0	6.49
	Lead (Pb)-Total (mg/kg wwt)	0.010	0.038	<0.0040	<0.010	<0.0040
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.20 DLIS	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	358	443	310	260	318
	Manganese (Mn)-Total (mg/kg wwt)	1.22	4.02	0.392	2.42	0.343
	Mercury (Hg)-Total (mg/kg wwt)	0.0443	0.088	0.0324	0.110	0.0342
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0080	0.173	<0.0040	0.114	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	0.210	<0.040	<0.040	<0.040
	Phosphorus (P)-Total (mg/kg wwt)	3760	5110	3090	4420	3080
	Potassium (K)-Total (mg/kg wwt)	4950	3570	4870	2560	5140
	Rubidium (Rb)-Total (mg/kg wwt)	3.23	6.55	3.29	2.42	3.40
	Selenium (Se)-Total (mg/kg wwt)	1.33	7.56	0.792	3.44	0.622
	Sodium (Na)-Total (mg/kg wwt)	536	1720	442	1040	348
	Strontium (Sr)-Total (mg/kg wwt)	1.80	0.395	0.687	0.189	0.374
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0080 DLIS	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00581	0.0389	0.00454	0.0774	0.00439
	Tin (Sn)-Total (mg/kg wwt)	0.027	0.286	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.00223	0.00633	0.00044	0.00244	0.00056
	Vanadium (V)-Total (mg/kg wwt)	0.023	0.091	<0.020	0.028	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	6.92	38.8	5.32	28.8	5.06
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.080 DLIS	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-51 Tissue 03-AUG-17 HE0.2-GR2-L	L1985910-52 Tissue 03-AUG-17 HE0.2-GR3-M	L1985910-53 Tissue 03-AUG-17 HE0.2-GR3-L	L1985910-54 Tissue 03-AUG-17 HE0.2-GR4-M	L1985910-55 Tissue 03-AUG-17 HE0.2-GR4-L
TISSUE						
Physical Tests	% Moisture (%)	59.9				64.5
Metals	Aluminum (Al)-Total (mg/kg wwt)	5.6	0.85	2.6	7.25	2.8
	Antimony (Sb)-Total (mg/kg wwt)	0.185	0.0253	0.0698	0.101	0.164
	Arsenic (As)-Total (mg/kg wwt)	0.0869	0.0314	0.0420	0.0170	0.0632
	Barium (Ba)-Total (mg/kg wwt)	0.270	0.123	0.182	0.191	0.161
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.385	0.0042	1.33	0.0117	2.22
	Calcium (Ca)-Total (mg/kg wwt)	60.2	448	60.7	620	52.8
	Cesium (Cs)-Total (mg/kg wwt)	0.0119	0.0109	0.0086	0.0095	0.0079
	Chromium (Cr)-Total (mg/kg wwt)	0.051	<0.010	<0.040	0.025	<0.040
	Cobalt (Co)-Total (mg/kg wwt)	0.0940	0.0101	0.0728	0.0159	0.114
	Copper (Cu)-Total (mg/kg wwt)	2.09	0.415	1.62	0.312	2.85
	Iron (Fe)-Total (mg/kg wwt)	41.5	6.26	69.9	13.5	59.3
	Lead (Pb)-Total (mg/kg wwt)	<0.010	<0.0040	<0.010	<0.0040	<0.010
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	388	296	194	310	266
	Manganese (Mn)-Total (mg/kg wwt)	2.91	0.292	2.87	0.551	2.90
	Mercury (Hg)-Total (mg/kg wwt)	0.091	0.0656	0.152	0.0256	0.0661
	Molybdenum (Mo)-Total (mg/kg wwt)	0.101	<0.0040	0.0839	<0.0040	0.0994
	Nickel (Ni)-Total (mg/kg wwt)	0.065	<0.040	<0.040	<0.040	<0.040
	Phosphorus (P)-Total (mg/kg wwt)	4990	3040	3340	2820	4170
	Potassium (K)-Total (mg/kg wwt)	3060	4600	2650	4610	3100
	Rubidium (Rb)-Total (mg/kg wwt)	3.33	3.66	4.33	2.71	2.81
	Selenium (Se)-Total (mg/kg wwt)	3.09	0.650	2.75	1.28	4.20
	Sodium (Na)-Total (mg/kg wwt)	1080	410	1000	473	997
	Strontium (Sr)-Total (mg/kg wwt)	0.158	0.549	0.127	0.745	0.119
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0505	0.00587	0.0459	0.00397	0.0377
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.00309	0.00091	0.0109	0.00395	0.00207
	Vanadium (V)-Total (mg/kg wwt)	0.027	<0.020	0.042	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	23.0	4.40	19.7	4.38	32.3
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-56 Tissue 03-AUG-17 HE0.2-GR5-M	L1985910-57 Tissue 03-AUG-17 HE0.2-GR5-L	L1985910-58 Tissue 03-AUG-17 HE0.2-GR6-M	L1985910-59 Tissue 03-AUG-17 HE0.2-GR6-L	L1985910-60 Tissue 03-AUG-17 HE0.2-GR7-M
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
TISSUE						
Physical Tests	% Moisture (%)				66.5	
Metals	Aluminum (Al)-Total (mg/kg wwt)	0.78	1.1	2.15	1.7	2.89
	Antimony (Sb)-Total (mg/kg wwt)	0.0227	0.0119	0.0314	0.0643	0.0527
	Arsenic (As)-Total (mg/kg wwt)	0.0139	0.0214	0.0217	0.0506	0.0561
	Barium (Ba)-Total (mg/kg wwt)	0.073	0.476	0.109	0.365	0.101
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.0069	1.81	0.0101	2.53	0.0075
	Calcium (Ca)-Total (mg/kg wwt)	269	70.2	447	56.4	218
	Cesium (Cs)-Total (mg/kg wwt)	0.0126	0.0085	0.0107	0.0057	0.0139
	Chromium (Cr)-Total (mg/kg wwt)	<0.010	0.043	<0.010	0.064	<0.010
	Cobalt (Co)-Total (mg/kg wwt)	0.0078	0.154	0.0122	0.190	0.0104
	Copper (Cu)-Total (mg/kg wwt)	0.250	2.38	0.258	16.2	0.425
	Iron (Fe)-Total (mg/kg wwt)	4.22	54.6	5.61	55.2	9.00
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	<0.010	<0.0040	0.213	<0.0040
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	304	209	308	298	324
	Manganese (Mn)-Total (mg/kg wwt)	0.227	1.91	0.347	2.56	0.391
	Mercury (Hg)-Total (mg/kg wwt)	0.0368	0.0737	0.0357	0.0857	0.106
	Molybdenum (Mo)-Total (mg/kg wwt)	<0.0040	0.139	<0.0040	0.146	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	0.055	<0.040
	Phosphorus (P)-Total (mg/kg wwt)	2830	3670	2790	4460	3190
	Potassium (K)-Total (mg/kg wwt)	4910	2840	4730	2650	4930
	Rubidium (Rb)-Total (mg/kg wwt)	2.94	2.73	2.92	2.11	4.00
	Selenium (Se)-Total (mg/kg wwt)	0.891	3.43	0.996	3.92	0.680
	Sodium (Na)-Total (mg/kg wwt)	398	1030	495	1030	508
	Strontium (Sr)-Total (mg/kg wwt)	0.260	0.112	0.502	0.143	0.275
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00301	0.0194	0.00360	0.0450	0.00811
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	<0.00040	0.00137	0.00181	0.00165	0.00276
	Vanadium (V)-Total (mg/kg wwt)	<0.020	0.033	<0.020	<0.020	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	3.94	24.2	4.37	44.3	5.04
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-61 Tissue 08-AUG-17 HE0.2-GR7-L	L1985910-62 Tissue 08-AUG-17 CE3.9 CCG1	L1985910-63 Tissue 08-AUG-17 CE3.9 CCG2	L1985910-64 Tissue 08-AUG-17 CE3.9 CCG3	L1985910-65 Tissue 08-AUG-17 CE3.9 CCG5
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	2.90	86.8	7.4	23.0	4.1
	Antimony (Sb)-Total (mg/kg wwt)	0.0259	0.0111	0.0109	0.0121	0.0045
	Arsenic (As)-Total (mg/kg wwt)	0.0602	0.115	0.0627	0.0635	0.0483
	Barium (Ba)-Total (mg/kg wwt)	0.219	4.03	3.90	2.64	4.09
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	1.39	0.128	0.0529	0.0464	0.228
	Calcium (Ca)-Total (mg/kg wwt)	476	12500	13800	9240	15900
	Cesium (Cs)-Total (mg/kg wwt)	0.0125	0.0147	0.0063	0.0094	0.0056
	Chromium (Cr)-Total (mg/kg wwt)	0.027	0.136	0.065	0.064	<0.040
	Cobalt (Co)-Total (mg/kg wwt)	0.0614	0.0594	0.0173	0.0306	0.0208
	Copper (Cu)-Total (mg/kg wwt)	2.58	1.06	0.643	0.780	0.629
	Iron (Fe)-Total (mg/kg wwt)	83.0	114	20.6	40.8	17.0
	Lead (Pb)-Total (mg/kg wwt)	<0.0040	0.029	<0.010	0.012	0.017
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	213	422	430	346	416
	Manganese (Mn)-Total (mg/kg wwt)	2.63	7.77	5.92	3.77	6.81
	Mercury (Hg)-Total (mg/kg wwt)	0.173	0.113	0.118	0.0853	0.0752
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0998	0.0241	0.0163	0.0203	0.0176
	Nickel (Ni)-Total (mg/kg wwt)	0.065	0.341	0.054	0.067	0.084
	Phosphorus (P)-Total (mg/kg wwt)	4230	10400	9030	6700	9820
	Potassium (K)-Total (mg/kg wwt)	3120	3250	2480	2630	2100
	Rubidium (Rb)-Total (mg/kg wwt)	4.18	2.48	2.28	2.09	1.63
	Selenium (Se)-Total (mg/kg wwt)	3.49	2.03	1.53	1.74	1.23
	Sodium (Na)-Total (mg/kg wwt)	1170	1110	894	972	924
	Strontium (Sr)-Total (mg/kg wwt)	0.717	15.5	17.5	11.1	18.3
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0479	0.0107	0.00944	0.00935	0.00606
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.0145	0.0942	0.131	0.0626	0.0531
	Vanadium (V)-Total (mg/kg wwt)	0.031	0.386	0.172	0.210	0.203
	Zinc (Zn)-Total (mg/kg wwt)	22.1	28.3	22.1	20.7	29.7
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	0.043	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-66 Tissue 08-AUG-17 CE3.9 CCG6	L1985910-67 Tissue 08-AUG-17 CE3.9 CCG7	L1985910-68 Tissue 08-AUG-17 CE3.9 CCG9	L1985910-69 Tissue 08-AUG-17 CE3.9 CCG10	L1985910-70 Tissue 08-AUG-17 CE3.9 CCG11
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	131	17.6	11.7	32.4	49.5
	Antimony (Sb)-Total (mg/kg wwt)	0.0180	0.0048	0.0051	0.0050	0.0069
	Arsenic (As)-Total (mg/kg wwt)	0.124	0.0479	0.0539	0.107	0.0709
	Barium (Ba)-Total (mg/kg wwt)	4.66	2.42	2.39	2.56	3.70
	Beryllium (Be)-Total (mg/kg wwt)	0.0031	<0.0020	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.0792	0.0475	0.0352	0.0928	0.0207
	Calcium (Ca)-Total (mg/kg wwt)	8630	9310	9190	10200	11700
	Cesium (Cs)-Total (mg/kg wwt)	0.0281	0.0087	0.0079	0.0104	0.0103
	Chromium (Cr)-Total (mg/kg wwt)	0.308	0.032	0.027	0.070	0.075
	Cobalt (Co)-Total (mg/kg wwt)	0.0822	0.0294	0.0302	0.0404	0.0460
	Copper (Cu)-Total (mg/kg wwt)	1.06	0.773	0.902	0.943	0.729
	Iron (Fe)-Total (mg/kg wwt)	188	32.7	24.7	53.0	69.9
	Lead (Pb)-Total (mg/kg wwt)	0.058	0.0092	0.0052	0.0122	0.019
	Lithium (Li)-Total (mg/kg wwt)	0.12	<0.10	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	438	303	383	377	396
	Manganese (Mn)-Total (mg/kg wwt)	8.83	6.78	4.46	7.02	6.35
	Mercury (Hg)-Total (mg/kg wwt)	0.0692	0.0628	0.0802	0.0686	0.0934
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0371	0.0144	0.0177	0.0157	0.0231
	Nickel (Ni)-Total (mg/kg wwt)	0.207	0.109	0.046	0.073	0.077
	Phosphorus (P)-Total (mg/kg wwt)	6570	6720	8150	8460	9820
	Potassium (K)-Total (mg/kg wwt)	2920	2330	3210	3020	3240
	Rubidium (Rb)-Total (mg/kg wwt)	2.72	2.25	2.51	2.84	2.14
	Selenium (Se)-Total (mg/kg wwt)	1.33	1.50	1.29	1.73	1.20
	Sodium (Na)-Total (mg/kg wwt)	983	964	1100	1100	1030
	Strontium (Sr)-Total (mg/kg wwt)	11.1	11.9	12.4	13.6	15.0
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00757	0.00623	0.00731	0.00644	0.00784
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.134	0.0825	0.0458	0.0462	0.0804
	Vanadium (V)-Total (mg/kg wwt)	0.468	0.214	0.123	0.235	0.324
	Zinc (Zn)-Total (mg/kg wwt)	27.2	21.9	24.2	26.6	24.8
	Zirconium (Zr)-Total (mg/kg wwt)	0.084	<0.040	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-71 Tissue 08-AUG-17 CE3.9 CCG12	L1985910-72 Tissue 08-AUG-17 CE3.9-GR4-M	L1985910-73 Tissue 08-AUG-17 CE3.9-GR4-L	L1985910-74 Tissue 08-AUG-17 CE3.9-GR8-M	L1985910-75 Tissue 08-AUG-17 CE3.9-GR8-L
TISSUE						
Physical Tests	% Moisture (%)			43.5		41.3
Metals	Aluminum (Al)-Total (mg/kg wwt)	5.8	2.7	30.5	2.8	12
	Antimony (Sb)-Total (mg/kg wwt)	0.0064	0.0070	0.084	0.0061	<0.022 DLIS
	Arsenic (As)-Total (mg/kg wwt)	0.0715	0.0489	0.118	0.0522	0.094
	Barium (Ba)-Total (mg/kg wwt)	4.36	1.53	2.02	2.51	1.02
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.018 DLIS	<0.0020	<0.022 DLIS
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.018 DLIS	<0.0020	<0.022 DLIS
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<1.8 DLIS	<0.20	<2.2 DLIS
	Cadmium (Cd)-Total (mg/kg wwt)	0.0278	0.0858	3.13	0.0450	0.713
	Calcium (Ca)-Total (mg/kg wwt)	14700	7220	130	8550	124
	Cesium (Cs)-Total (mg/kg wwt)	0.0068	0.0112	0.0203	0.0083	0.013
	Chromium (Cr)-Total (mg/kg wwt)	0.061	<0.040	<0.36 DLIS	<0.040	<0.44 DLIS
	Cobalt (Co)-Total (mg/kg wwt)	0.0234	0.0393	0.444	0.0251	0.165
	Copper (Cu)-Total (mg/kg wwt)	0.754	0.564	7.01	0.601	6.21
	Iron (Fe)-Total (mg/kg wwt)	20.2	14.1	162	12.1	128
	Lead (Pb)-Total (mg/kg wwt)	<0.010	<0.010	<0.090 DLIS	<0.010	<0.11 DLIS
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.90 DLIS	<0.10	<1.1 DLIS
	Magnesium (Mg)-Total (mg/kg wwt)	442	415	569	428	607
	Manganese (Mn)-Total (mg/kg wwt)	5.05	3.21	5.79	3.78	4.83
	Mercury (Hg)-Total (mg/kg wwt)	0.0946	0.0207	0.186	0.0301	0.461
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0197	0.0114	0.294	0.0116	0.360
	Nickel (Ni)-Total (mg/kg wwt)	0.044	<0.040	<0.36 DLIS	<0.040	<0.44 DLIS
	Phosphorus (P)-Total (mg/kg wwt)	9480	5950	7230	6600	7880
	Potassium (K)-Total (mg/kg wwt)	2960	3810	5790	3990	6460
	Rubidium (Rb)-Total (mg/kg wwt)	2.58	3.36	7.96	2.53	5.73
	Selenium (Se)-Total (mg/kg wwt)	2.05	1.62	6.98	1.12	6.68
	Sodium (Na)-Total (mg/kg wwt)	1070	952	2640	900	3030
	Strontium (Sr)-Total (mg/kg wwt)	18.8	7.82	0.41	9.35	0.33
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.036 DLIS	<0.0040	<0.044 DLIS
	Thallium (Tl)-Total (mg/kg wwt)	0.00882	0.00584	0.0833	0.00492	0.0721
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.18 DLIS	<0.020	<0.22 DLIS
	Uranium (U)-Total (mg/kg wwt)	0.0918	0.00417	0.0101	0.00991	0.0052
	Vanadium (V)-Total (mg/kg wwt)	0.145	0.029	<0.18 DLIS	0.020	<0.22 DLIS
	Zinc (Zn)-Total (mg/kg wwt)	25.8	21.3	51.8	25.0	50.3
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.36 DLIS	<0.040	<0.44 DLIS

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

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Grouping	Analyte	L1985910-76 Tissue 08-AUG-17 CE3.9-GR13-M	L1985910-77 Tissue 08-AUG-17 CE3.9-GR13-L	L1985910-78 Tissue 08-AUG-17 CE3.9-GR14-M	L1985910-79 Tissue 08-AUG-17 CE3.9-GR14-L	L1985910-80 Tissue 08-AUG-17 CE3.9-GR15-M
TISSUE						
Physical Tests	% Moisture (%)		31.5			
Metals	Aluminum (Al)-Total (mg/kg wwt)	5.8	25	2.02	15.0	3.11
	Antimony (Sb)-Total (mg/kg wwt)	0.0038	<0.032 DLIS	0.0044	0.0048	0.0040
	Arsenic (As)-Total (mg/kg wwt)	0.0315	0.185	0.0123	0.0207	0.0114
	Barium (Ba)-Total (mg/kg wwt)	1.73	1.46	0.244	0.787	0.129
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.032 DLIS	<0.0020	<0.0020	<0.0020
	Bismuth (Bi)-Total (mg/kg wwt)	<0.0020	<0.032 DLIS	<0.0020	<0.0020	<0.0020
	Boron (B)-Total (mg/kg wwt)	<0.20	<3.2 DLIS	<0.20	<0.20	<0.20
	Cadmium (Cd)-Total (mg/kg wwt)	0.105	2.38	0.0034	0.363	0.0026
	Calcium (Ca)-Total (mg/kg wwt)	7040	238	523	93.0	186
	Cesium (Cs)-Total (mg/kg wwt)	0.0091	0.021	0.0128	0.0124	0.0084
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	<0.64 DLIS	0.032	0.065	0.011
	Cobalt (Co)-Total (mg/kg wwt)	0.0356	0.240	0.0068	0.244	0.0132
	Copper (Cu)-Total (mg/kg wwt)	0.734	5.67	0.336	1.92	0.559
	Iron (Fe)-Total (mg/kg wwt)	15.4	115	7.18	49.3	9.39
	Lead (Pb)-Total (mg/kg wwt)	<0.010	<0.16 DLIS	<0.0040	<0.010	<0.0040
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<1.6 DLIS	<0.10	<0.10	<0.10
	Magnesium (Mg)-Total (mg/kg wwt)	370	763	267	243	280
	Manganese (Mn)-Total (mg/kg wwt)	3.27	7.77	0.479	2.66	0.343
	Mercury (Hg)-Total (mg/kg wwt)	0.0222	0.22	0.0520	0.116	0.0557
	Molybdenum (Mo)-Total (mg/kg wwt)	0.0146	0.46	<0.0040	0.123	<0.0040
	Nickel (Ni)-Total (mg/kg wwt)	<0.040	<0.64 DLIS	<0.040	0.052	<0.040
	Phosphorus (P)-Total (mg/kg wwt)	5620	9350	2660	4490	2700
	Potassium (K)-Total (mg/kg wwt)	3590	7710	4070	3100	4590
	Rubidium (Rb)-Total (mg/kg wwt)	2.79	10.3	2.54	3.24	2.18
	Selenium (Se)-Total (mg/kg wwt)	1.46	8.60	0.599	3.13	0.796
	Sodium (Na)-Total (mg/kg wwt)	924	3810	341	1310	291
	Strontium (Sr)-Total (mg/kg wwt)	8.04	0.57	0.611	0.131	0.192
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.064 DLIS	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.00565	0.190	0.00463	0.0311	0.00405
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.32 DLIS	<0.020	<0.020	<0.020
	Uranium (U)-Total (mg/kg wwt)	0.0120	0.0097	0.00112	0.00528	0.00098
	Vanadium (V)-Total (mg/kg wwt)	0.037	<0.32 DLIS	<0.020	0.120	<0.020
	Zinc (Zn)-Total (mg/kg wwt)	23.1	56.7	3.77	27.9	4.20
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.64 DLIS	<0.040	<0.040	<0.040

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-81 Tissue 08-AUG-17 CE3.9-GR15-L	L1985910-82 Tissue 08-AUG-17 CE3.9-GR16-M	L1985910-83 Tissue 08-AUG-17 CE3.9-GR16-L	L1985910-84 Tissue 08-AUG-17 CE3.9-GR17-M	L1985910-85 Tissue 08-AUG-17 CE3.9-GR17-L
TISSUE						
Physical Tests	% Moisture (%)	10.0	1.90	1.9	1.87	6.5
Metals	Aluminum (Al)-Total (mg/kg wwt)	0.0161	0.0020	0.0039	0.0021	0.0108
	Antimony (Sb)-Total (mg/kg wwt)	0.0398	0.0153	0.0210	0.0257	0.0274
	Arsenic (As)-Total (mg/kg wwt)	0.500	0.174	0.197	0.185	0.504
	Barium (Ba)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020
	Beryllium (Be)-Total (mg/kg wwt)	0.0025	<0.0020	<0.0020	<0.0020	0.0035
	Bismuth (Bi)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<0.20
	Boron (B)-Total (mg/kg wwt)	0.802	0.0044	1.34	0.0059	1.70
	Cadmium (Cd)-Total (mg/kg wwt)	117	473	65.1	428	72.5
	Calcium (Ca)-Total (mg/kg wwt)	0.0081	0.0112	0.0050	0.0213	0.0080
	Cesium (Cs)-Total (mg/kg wwt)	0.102	<0.010	<0.040	<0.010	0.043
	Chromium (Cr)-Total (mg/kg wwt)	0.342	0.0113	0.229	0.0085	0.592
	Cobalt (Co)-Total (mg/kg wwt)	3.20	0.309	2.76	0.408	2.67
	Copper (Cu)-Total (mg/kg wwt)	80.3	6.85	77.7	7.38	102
	Iron (Fe)-Total (mg/kg wwt)	<0.010	<0.0040	<0.010	<0.0040	<0.010
	Lead (Pb)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	<0.10
	Lithium (Li)-Total (mg/kg wwt)	251	300	204	297	186
	Magnesium (Mg)-Total (mg/kg wwt)	2.70	0.381	2.55	0.393	2.17
	Manganese (Mn)-Total (mg/kg wwt)	0.0910	0.0426	0.116	0.0972	0.174
	Mercury (Hg)-Total (mg/kg wwt)	0.202	<0.0040	0.166	<0.0040	0.117
	Molybdenum (Mo)-Total (mg/kg wwt)	0.244	<0.040	<0.040	<0.040	0.044
	Nickel (Ni)-Total (mg/kg wwt)	4320	2690	3560	2840	2970
	Phosphorus (P)-Total (mg/kg wwt)	2850	4380	2770	4620	2280
	Potassium (K)-Total (mg/kg wwt)	1.97	2.73	2.37	3.30	2.33
	Rubidium (Rb)-Total (mg/kg wwt)	4.59	0.760	4.57	0.701	3.65
	Selenium (Se)-Total (mg/kg wwt)	1360	291	961	311	1210
	Sodium (Na)-Total (mg/kg wwt)	0.180	0.551	0.092	0.506	0.129
	Strontium (Sr)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Tellurium (Te)-Total (mg/kg wwt)	0.0398	0.00426	0.0497	0.00690	0.0556
	Thallium (Tl)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.020
	Tin (Sn)-Total (mg/kg wwt)	0.00704	0.00270	0.00270	0.00222	0.0147
	Uranium (U)-Total (mg/kg wwt)	0.099	<0.020	0.027	<0.020	0.165
	Vanadium (V)-Total (mg/kg wwt)	31.0	5.12	27.7	3.99	25.7
	Zinc (Zn)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	<0.040
	Zirconium (Zr)-Total (mg/kg wwt)					

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-86 Tissue 08-AUG-17 CE3.9-GR18-L	L1985910-87 Tissue 08-AUG-17 CE3.9-GR18-M	L1985910-88 Tissue 08-AUG-17 CE3.9-GR19-M	L1985910-89 Tissue 08-AUG-17 CE3.9-GR19-L	L1985910-90 Tissue 04-AUG-17 CE8.0-P-1
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	3.6	3.59	4.73	7.0	11800
	Antimony (Sb)-Total (mg/kg wwt)	0.0041	0.0079	0.0042	0.0117	<0.040 DLA
	Arsenic (As)-Total (mg/kg wwt)	0.0154	0.0165	0.0191	0.0281	4.22
	Barium (Ba)-Total (mg/kg wwt)	0.314	0.362	0.318	0.307	132
	Beryllium (Be)-Total (mg/kg wwt)	<0.0020	<0.0020	<0.0020	<0.0020	0.208
	Bismuth (Bi)-Total (mg/kg wwt)	0.0033	<0.0020	<0.0020	<0.0020	0.097
	Boron (B)-Total (mg/kg wwt)	<0.20	<0.20	<0.20	<0.20	<4.0 DLA
	Cadmium (Cd)-Total (mg/kg wwt)	1.75	0.0033	0.0054	1.67	0.131
	Calcium (Ca)-Total (mg/kg wwt)	64.4	1090	831	82.4	4630
	Cesium (Cs)-Total (mg/kg wwt)	0.0083	0.0123	0.0108	0.0057	1.04
	Chromium (Cr)-Total (mg/kg wwt)	<0.040	<0.010	0.023	0.067	18.4
	Cobalt (Co)-Total (mg/kg wwt)	0.284	0.0079	0.0083	0.299	6.06
	Copper (Cu)-Total (mg/kg wwt)	2.57	0.286	0.275	3.18	10.5
	Iron (Fe)-Total (mg/kg wwt)	94.9	7.16	9.05	93.4	14900
	Lead (Pb)-Total (mg/kg wwt)	<0.010	<0.0040	0.0045	<0.010	4.09
	Lithium (Li)-Total (mg/kg wwt)	<0.10	<0.10	<0.10	<0.10	8.5
	Magnesium (Mg)-Total (mg/kg wwt)	239	355	338	263	4610
	Manganese (Mn)-Total (mg/kg wwt)	2.49	0.758	0.482	2.55	272
	Mercury (Hg)-Total (mg/kg wwt)	0.127	0.0604	0.0465	0.117	0.0276
	Molybdenum (Mo)-Total (mg/kg wwt)	0.176	<0.0040	<0.0040	0.169	0.40
	Nickel (Ni)-Total (mg/kg wwt)	0.063	<0.040	<0.040	0.057	11.3
	Phosphorus (P)-Total (mg/kg wwt)	4180	3640	3330	4200	430
	Potassium (K)-Total (mg/kg wwt)	3240	5330	5400	3070	1090
	Rubidium (Rb)-Total (mg/kg wwt)	3.13	2.97	3.17	2.50	12.8
	Selenium (Se)-Total (mg/kg wwt)	5.12	0.903	0.696	4.90	<0.40 DLA
	Sodium (Na)-Total (mg/kg wwt)	876	289	280	1240	242
	Strontium (Sr)-Total (mg/kg wwt)	0.088	1.18	0.986	0.146	27.6
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.080 DLA
	Thallium (Tl)-Total (mg/kg wwt)	0.0299	0.00374	0.00485	0.0445	0.124
	Tin (Sn)-Total (mg/kg wwt)	<0.020	<0.020	<0.020	<0.020	<0.40 DLA
	Uranium (U)-Total (mg/kg wwt)	0.00409	0.00123	0.00172	0.00646	2.73
	Vanadium (V)-Total (mg/kg wwt)	0.056	<0.020	<0.020	0.060	37.4
	Zinc (Zn)-Total (mg/kg wwt)	32.0	4.13	3.97	31.7	41.5
	Zirconium (Zr)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	4.45

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-91 Tissue 04-AUG-17 CE8.0-P-2	L1985910-92 Tissue 04-AUG-17 CE8.0-P-3	L1985910-93 Tissue 04-AUG-17 CE8.0-P-4	L1985910-94 Periphyton 04-AUG-17 CE8.0-P-5	L1985910-95 Periphyton 03-AUG-17 CE3.9-P-1
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	12300	11400	11700	12400	12500
	Antimony (Sb)-Total (mg/kg wwt)	<0.040 DLA	0.026	0.028	0.026	<0.040 DLA
	Arsenic (As)-Total (mg/kg wwt)	4.36	4.46	4.50	4.55	4.54
	Barium (Ba)-Total (mg/kg wwt)	136	125	127	131	134
	Beryllium (Be)-Total (mg/kg wwt)	0.218	0.206	0.193	0.217	0.216
	Bismuth (Bi)-Total (mg/kg wwt)	0.115	0.098	0.095	0.102	0.103
	Boron (B)-Total (mg/kg wwt)	<4.0 DLA	<1.0 DLA	1.2	<2.0 DLA	<4.0 DLA
	Cadmium (Cd)-Total (mg/kg wwt)	0.135	0.129	0.124	0.136	0.128
	Calcium (Ca)-Total (mg/kg wwt)	4950	4360	4360	4500	4690
	Cesium (Cs)-Total (mg/kg wwt)	1.04	1.17	1.25	1.24	1.12
	Chromium (Cr)-Total (mg/kg wwt)	19.0	17.5	18.2	18.7	19.0
	Cobalt (Co)-Total (mg/kg wwt)	6.28	5.94	5.86	6.04	6.54
	Copper (Cu)-Total (mg/kg wwt)	11.3	10.5	10.6	10.9	10.8
	Iron (Fe)-Total (mg/kg wwt)	15700	14700	14300	15100	15900
	Lead (Pb)-Total (mg/kg wwt)	4.22	4.05	4.00	4.17	4.40
	Lithium (Li)-Total (mg/kg wwt)	8.9	8.94	8.41	8.9	8.9
	Magnesium (Mg)-Total (mg/kg wwt)	4750	4550	4650	4910	4940
	Manganese (Mn)-Total (mg/kg wwt)	281	271	268	276	289
	Mercury (Hg)-Total (mg/kg wwt)	0.0297	0.0323	0.0257	0.0292	0.0270
	Molybdenum (Mo)-Total (mg/kg wwt)	0.45	0.424	0.432	0.429	0.45
	Nickel (Ni)-Total (mg/kg wwt)	11.7	10.7	11.1	11.3	11.7
	Phosphorus (P)-Total (mg/kg wwt)	456	413	437	438	483
	Potassium (K)-Total (mg/kg wwt)	1140	1060	1110	1140	1260
	Rubidium (Rb)-Total (mg/kg wwt)	13.1	13.0	13.9	13.8	14.4
	Selenium (Se)-Total (mg/kg wwt)	<0.40 DLA	0.147	0.142	0.15	<0.40 DLA
	Sodium (Na)-Total (mg/kg wwt)	243	160	203	208	272
	Strontium (Sr)-Total (mg/kg wwt)	29.1	25.9	25.7	28.4	27.2
	Tellurium (Te)-Total (mg/kg wwt)	<0.080 DLA	<0.020 DLA	<0.020 DLA	<0.040 DLA	<0.080 DLA
	Thallium (Tl)-Total (mg/kg wwt)	0.129	0.127	0.123	0.125	0.137
	Tin (Sn)-Total (mg/kg wwt)	<0.40 DLA	0.20	0.22	0.25	<0.40 DLA
	Uranium (U)-Total (mg/kg wwt)	3.03	2.72	2.65	2.89	2.93
	Vanadium (V)-Total (mg/kg wwt)	38.7	34.9	36.4	38.2	40.0
	Zinc (Zn)-Total (mg/kg wwt)	42.8	41.1	41.9	42.7	44.6
	Zirconium (Zr)-Total (mg/kg wwt)	4.94	5.80	5.22	5.68	4.79

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-96 Periphyton 03-AUG-17 CE3.9-P-2	L1985910-97 Periphyton 03-AUG-17 CE3.9-P-3	L1985910-98 Periphyton 03-AUG-17 CE3.9-P-4	L1985910-99 Periphyton 03-AUG-17 CE3.9-P-5	L1985910-100 Periphyton 02-AUG-17 ID1.9-P-1
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	13300 DLA	13400 DLA	12600 DLA	13300 DLA	5860
	Antimony (Sb)-Total (mg/kg wwt)	<0.040	<0.040	<0.040	<0.040	0.039
	Arsenic (As)-Total (mg/kg wwt)	4.94	5.08	4.52	4.84	4.06
	Barium (Ba)-Total (mg/kg wwt)	141	144	131	140	65.9
	Beryllium (Be)-Total (mg/kg wwt)	0.228	0.231	0.212	0.231	0.150
	Bismuth (Bi)-Total (mg/kg wwt)	0.104	0.105	0.095	0.103	0.052
	Boron (B)-Total (mg/kg wwt)	<4.0 DLA	<4.0 DLA	<4.0 DLA	<4.0 DLA	<2.0 DLA
	Cadmium (Cd)-Total (mg/kg wwt)	0.137	0.134	0.117	0.134	0.098
	Calcium (Ca)-Total (mg/kg wwt)	5100	5080	4920	5050	2410
	Cesium (Cs)-Total (mg/kg wwt)	1.09	1.21	1.07	1.15	0.458
	Chromium (Cr)-Total (mg/kg wwt)	20.5	20.9	19.8	20.7	11.8
	Cobalt (Co)-Total (mg/kg wwt)	6.74	7.08	6.29	6.86	3.42
	Copper (Cu)-Total (mg/kg wwt)	11.0	11.0	10.3	11.2	5.89
	Iron (Fe)-Total (mg/kg wwt)	16600	17300	15700	16800	8030
	Lead (Pb)-Total (mg/kg wwt)	4.60	5.20	4.31	4.57	2.82
	Lithium (Li)-Total (mg/kg wwt)	9.4	9.7	8.9	9.6	4.1
	Magnesium (Mg)-Total (mg/kg wwt)	5120	5350	4850	5210	2230
	Manganese (Mn)-Total (mg/kg wwt)	301	312	268	303	164
	Mercury (Hg)-Total (mg/kg wwt)	0.0296	0.0289	0.0326	0.0371	0.0528
	Molybdenum (Mo)-Total (mg/kg wwt)	0.65	0.45	0.40	0.49	0.208
	Nickel (Ni)-Total (mg/kg wwt)	12.5	12.8	11.9	12.7	9.01
	Phosphorus (P)-Total (mg/kg wwt)	529	537	541	529	342
	Potassium (K)-Total (mg/kg wwt)	1250	1340	1160	1300	751
	Rubidium (Rb)-Total (mg/kg wwt)	13.9	15.1	12.9	14.6	6.36
	Selenium (Se)-Total (mg/kg wwt)	<0.40 DLA	<0.40 DLA	<0.40 DLA	<0.40 DLA	<0.20 DLA
	Sodium (Na)-Total (mg/kg wwt)	275	281	266	263	115
	Strontium (Sr)-Total (mg/kg wwt)	29.4	28.9	27.3	28.8	14.9
	Tellurium (Te)-Total (mg/kg wwt)	<0.080 DLA	<0.080 DLA	<0.080 DLA	<0.080 DLA	<0.040 DLA
	Thallium (Tl)-Total (mg/kg wwt)	0.135	0.145	0.122	0.137	0.0532
	Tin (Sn)-Total (mg/kg wwt)	<0.40 DLA	<0.40 DLA	<0.40 DLA	<0.40 DLA	<0.20 DLA
	Uranium (U)-Total (mg/kg wwt)	2.73	3.35	2.49	2.95	0.779
	Vanadium (V)-Total (mg/kg wwt)	42.0	42.9	39.9	41.8	16.4
	Zinc (Zn)-Total (mg/kg wwt)	46.7	48.7	44.1	47.1	24.3
	Zirconium (Zr)-Total (mg/kg wwt)	5.31	5.39	5.10	5.27	2.67

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-101 Periphyton 02-AUG-17 ID1.9-P-2	L1985910-102 Periphyton 02-AUG-17 ID1.9-P-3	L1985910-103 Periphyton 02-AUG-17 ID1.9-P-4	L1985910-104 Periphyton 02-AUG-17 ID1.9-P-5	L1985910-105 Periphyton 04-AUG-17 LC2.7-P-1
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	7110	4610	5130	6690	9020
	Antimony (Sb)-Total (mg/kg wwt)	0.037	0.045	0.030	0.0284	0.025
	Arsenic (As)-Total (mg/kg wwt)	4.65	3.08	3.25	4.56	5.30
	Barium (Ba)-Total (mg/kg wwt)	93.8	51.0	53.6	71.6	92.6
	Beryllium (Be)-Total (mg/kg wwt)	0.182	0.124	0.132	0.159	0.240
	Bismuth (Bi)-Total (mg/kg wwt)	0.061	0.042	0.043	0.0568	0.085
	Boron (B)-Total (mg/kg wwt)	<2.0 DLA	<2.0 DLA	<2.0 DLA	0.79	<2.0 DLA
	Cadmium (Cd)-Total (mg/kg wwt)	0.115	0.091	0.078	0.0938	0.130
	Calcium (Ca)-Total (mg/kg wwt)	2880	1820	2100	2540	3780
	Cesium (Cs)-Total (mg/kg wwt)	0.572	0.387	0.432	0.629	0.849
	Chromium (Cr)-Total (mg/kg wwt)	14.0	8.79	10.2	13.2	17.3
	Cobalt (Co)-Total (mg/kg wwt)	4.16	2.46	2.82	3.81	4.61
	Copper (Cu)-Total (mg/kg wwt)	7.05	5.03	4.82	6.26	6.60
	Iron (Fe)-Total (mg/kg wwt)	10100	6020	6610	8760	11100
	Lead (Pb)-Total (mg/kg wwt)	3.34	2.08	2.59	3.01	6.46
	Lithium (Li)-Total (mg/kg wwt)	5.1	3.3	3.8	5.03	8.1
	Magnesium (Mg)-Total (mg/kg wwt)	2760	1590	1910	2580	3540
	Manganese (Mn)-Total (mg/kg wwt)	193	110	139	207	258
	Mercury (Hg)-Total (mg/kg wwt)	0.0602	0.0754	0.0497	0.0421	0.0346
	Molybdenum (Mo)-Total (mg/kg wwt)	0.216	0.140	0.139	0.201	0.235
	Nickel (Ni)-Total (mg/kg wwt)	10.4	7.58	7.15	9.02	10.7
	Phosphorus (P)-Total (mg/kg wwt)	402	353	295	332	389
	Potassium (K)-Total (mg/kg wwt)	893	769	634	767	892
	Rubidium (Rb)-Total (mg/kg wwt)	7.55	4.84	5.47	7.68	9.77
	Selenium (Se)-Total (mg/kg wwt)	<0.20 DLA	<0.20 DLA	<0.20 DLA	0.104	<0.20 DLA
	Sodium (Na)-Total (mg/kg wwt)	134	89	111	112	172
	Strontium (Sr)-Total (mg/kg wwt)	17.8	11.3	13.2	15.6	33.8
	Tellurium (Te)-Total (mg/kg wwt)	<0.040 DLA	<0.040 DLA	<0.040 DLA	0.0121	<0.040 DLA
	Thallium (Tl)-Total (mg/kg wwt)	0.0657	0.0421	0.0460	0.0661	0.0917
	Tin (Sn)-Total (mg/kg wwt)	<0.20 DLA	<0.20 DLA	<0.20 DLA	0.161	<0.20 DLA
	Uranium (U)-Total (mg/kg wwt)	0.909	0.542	0.678	0.925	1.72
	Vanadium (V)-Total (mg/kg wwt)	21.0	13.0	14.9	19.8	29.2
	Zinc (Zn)-Total (mg/kg wwt)	29.4	18.0	20.2	26.7	38.0
	Zirconium (Zr)-Total (mg/kg wwt)	3.57	2.25	2.28	3.74	5.60

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-106 Periphyton 04-AUG-17 LC2.7-P-2	L1985910-107 Periphyton 04-AUG-17 LC2.7-P-3	L1985910-108 Periphyton 04-AUG-17 LC2.7-P-4	L1985910-109 Periphyton 04-AUG-17 LC2.7-P-5	L1985910-110 Periphyton 06-AUG-17 HF 0.2-P-1
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	9180	10200	9510	10600	417
	Antimony (Sb)-Total (mg/kg wwt)	0.029	0.031	0.027	0.033	0.0840
	Arsenic (As)-Total (mg/kg wwt)	6.23	6.66	6.11	7.62	1.36
	Barium (Ba)-Total (mg/kg wwt)	97.1	90.6	95.3	105	16.4
	Beryllium (Be)-Total (mg/kg wwt)	0.266	0.279	0.267	0.285	0.0554
	Bismuth (Bi)-Total (mg/kg wwt)	0.096	0.080	0.109	0.082	<0.0080 RRR
	Boron (B)-Total (mg/kg wwt)	<2.0 DLA	1.4	<2.0 DLA	1.6	2.77
	Cadmium (Cd)-Total (mg/kg wwt)	0.129	0.133	0.137	0.148	0.0879
	Calcium (Ca)-Total (mg/kg wwt)	3810	4650	4510	4930	1690
	Cesium (Cs)-Total (mg/kg wwt)	0.960	0.932	0.953	1.02	0.0422
	Chromium (Cr)-Total (mg/kg wwt)	19.1	21.3	19.9	19.4	1.10
	Cobalt (Co)-Total (mg/kg wwt)	4.96	5.88	5.80	5.89	0.820
	Copper (Cu)-Total (mg/kg wwt)	7.01	8.39	7.96	8.31	4.74
	Iron (Fe)-Total (mg/kg wwt)	11800	13200	13100	13100	1140
	Lead (Pb)-Total (mg/kg wwt)	6.94	6.19	7.98	6.54	0.467
	Lithium (Li)-Total (mg/kg wwt)	8.2	9.09	9.2	9.76	0.34
	Magnesium (Mg)-Total (mg/kg wwt)	3630	4180	4060	4240	381
	Manganese (Mn)-Total (mg/kg wwt)	257	374	335	424	118
	Mercury (Hg)-Total (mg/kg wwt)	0.0766	0.0382	0.0345	0.0352	0.0249
	Molybdenum (Mo)-Total (mg/kg wwt)	0.256	0.266	0.347	0.323	1.08
	Nickel (Ni)-Total (mg/kg wwt)	10.6	12.6	12.6	12.2	3.63
	Phosphorus (P)-Total (mg/kg wwt)	399	466	465	460	307
	Potassium (K)-Total (mg/kg wwt)	961	1110	999	1210	937
	Rubidium (Rb)-Total (mg/kg wwt)	11.1	11.5	10.6	12.2	1.20
	Selenium (Se)-Total (mg/kg wwt)	<0.20 DLA	0.16	<0.20 DLA	0.19	0.160
	Sodium (Na)-Total (mg/kg wwt)	177	198	209	217	30.6
	Strontium (Sr)-Total (mg/kg wwt)	33.2	32.0	35.2	30.7	15.5
	Tellurium (Te)-Total (mg/kg wwt)	<0.040 DLA	<0.020 DLA	<0.040 DLA	<0.020 DLA	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.101	0.0954	0.0945	0.103	0.00751
	Tin (Sn)-Total (mg/kg wwt)	0.21	0.23	0.21	0.25	0.029
	Uranium (U)-Total (mg/kg wwt)	2.22	2.06	1.73	2.08	4.40
	Vanadium (V)-Total (mg/kg wwt)	28.9	34.9	34.4	34.2	1.93
	Zinc (Zn)-Total (mg/kg wwt)	37.4	43.5	43.3	46.1	11.9
	Zirconium (Zr)-Total (mg/kg wwt)	6.74	5.86	6.52	5.92	0.736

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-111 Periphyton 06-AUG-17 HF 0.2-P-2	L1985910-112 Periphyton 05-AUG-17 CF10.0-P-1	L1985910-113 Periphyton 05-AUG-17 CF10.0-P-2	L1985910-114 Periphyton 05-AUG-17 CF10.0-P-3	L1985910-115 Periphyton 05-AUG-17 CF10.0-P-4
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	688	11900	11800	12200	12500
	Antimony (Sb)-Total (mg/kg wwt)	0.268	0.021	<0.020 DLA	<0.020 DLA	<0.020 DLA
	Arsenic (As)-Total (mg/kg wwt)	1.88	4.63	4.20	4.18	4.26
	Barium (Ba)-Total (mg/kg wwt)	27.6	137	131	127	133
	Beryllium (Be)-Total (mg/kg wwt)	0.0894	0.209	0.193	0.193	0.211
	Bismuth (Bi)-Total (mg/kg wwt)	<0.012 RRR	0.096	0.097	0.089	0.094
	Boron (B)-Total (mg/kg wwt)	2.59	<1.0 DLA	<2.0 DLA	<2.0 DLA	<2.0 DLA
	Cadmium (Cd)-Total (mg/kg wwt)	0.118	0.120	0.120	0.112	0.120
	Calcium (Ca)-Total (mg/kg wwt)	2170	4250	4140	4310	4540
	Cesium (Cs)-Total (mg/kg wwt)	0.0702	1.35	1.20	1.23	1.29
	Chromium (Cr)-Total (mg/kg wwt)	1.56	17.4	16.8	17.2	17.9
	Cobalt (Co)-Total (mg/kg wwt)	1.51	6.27	6.00	5.91	6.12
	Copper (Cu)-Total (mg/kg wwt)	6.38	10.0	9.94	9.69	10.1
	Iron (Fe)-Total (mg/kg wwt)	1650	15500	14800	14800	15200
	Lead (Pb)-Total (mg/kg wwt)	0.632	3.88	3.88	3.66	3.75
	Lithium (Li)-Total (mg/kg wwt)	0.46	9.15	8.7	8.8	9.4
	Magnesium (Mg)-Total (mg/kg wwt)	567	4770	4560	4610	4760
	Manganese (Mn)-Total (mg/kg wwt)	190	274	262	260	270
	Mercury (Hg)-Total (mg/kg wwt)	0.0272	0.0252	0.0283	0.0259	0.0255
	Molybdenum (Mo)-Total (mg/kg wwt)	0.157	0.423	0.397	0.379	0.404
	Nickel (Ni)-Total (mg/kg wwt)	4.91	10.7	10.5	10.3	10.7
	Phosphorus (P)-Total (mg/kg wwt)	438	435	432	425	443
	Potassium (K)-Total (mg/kg wwt)	1160	1220	1100	1130	1150
	Rubidium (Rb)-Total (mg/kg wwt)	1.79	14.4	13.3	13.5	14.0
	Selenium (Se)-Total (mg/kg wwt)	0.170	0.133	0.12	0.12	0.12
	Sodium (Na)-Total (mg/kg wwt)	48.1	177	175	197	203
	Strontium (Sr)-Total (mg/kg wwt)	18.9	23.4	22.6	23.3	24.6
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.020 DLA	<0.040 DLA	<0.040 DLA	<0.040 DLA
	Thallium (Tl)-Total (mg/kg wwt)	0.0111	0.139	0.132	0.130	0.128
	Tin (Sn)-Total (mg/kg wwt)	0.034	0.27	0.23	0.27	0.29
	Uranium (U)-Total (mg/kg wwt)	6.27	2.47	2.50	2.44	2.41
	Vanadium (V)-Total (mg/kg wwt)	3.19	37.3	35.2	36.6	38.1
	Zinc (Zn)-Total (mg/kg wwt)	17.1	41.2	40.4	39.6	41.6
	Zirconium (Zr)-Total (mg/kg wwt)	0.760	5.31	5.34	5.19	5.39

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L1985910-116 Description: Periphyton Sampled Date: 05-AUG-17 Sampled Time: Client ID: CF10.0-P-5	L1985910-117 Periphyton 02-AUG-17 ID1.9-B1-1	L1985910-118 Periphyton 02-AUG-17 ID1.9-B1-2	L1985910-119 Periphyton 02-AUG-17 ID1.9-B1-3	L1985910-120 Periphyton 02-AUG-17 ID1.9-B1-4
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	11300	1100	894	1930	1180
	Antimony (Sb)-Total (mg/kg wwt)	<0.020 DLA	0.0349	0.0366	0.0787	0.0393
	Arsenic (As)-Total (mg/kg wwt)	4.05	0.949	0.816	1.64	0.994
	Barium (Ba)-Total (mg/kg wwt)	126	13.1	11.6	24.8	15.2
	Beryllium (Be)-Total (mg/kg wwt)	0.192	0.0297	0.0246	0.0540	0.0326
	Bismuth (Bi)-Total (mg/kg wwt)	0.088	<0.012 RRR	<0.012 RRR	<0.024 RRR	<0.016 RRR
	Boron (B)-Total (mg/kg wwt)	<2.0 DLA	0.30	0.30	0.35	0.33
	Cadmium (Cd)-Total (mg/kg wwt)	0.117	0.266	0.354	0.252	0.225
	Calcium (Ca)-Total (mg/kg wwt)	3890	833	1040	1080	927
	Cesium (Cs)-Total (mg/kg wwt)	1.14	0.127	0.133	0.261	0.150
	Chromium (Cr)-Total (mg/kg wwt)	16.3	2.47	2.12	4.01	2.60
	Cobalt (Co)-Total (mg/kg wwt)	5.94	0.845	0.691	1.59	0.822
	Copper (Cu)-Total (mg/kg wwt)	9.65	6.49	6.70	7.47	6.59
	Iron (Fe)-Total (mg/kg wwt)	14400	1560	1290	2810	1670
	Lead (Pb)-Total (mg/kg wwt)	3.67	0.760	0.547	2.54	0.677
	Lithium (Li)-Total (mg/kg wwt)	8.8	0.83	0.79	1.69	1.00
	Magnesium (Mg)-Total (mg/kg wwt)	4670	599	599	923	638
	Manganese (Mn)-Total (mg/kg wwt)	258	76.6	47.3	145	65.1
	Mercury (Hg)-Total (mg/kg wwt)	0.0296	0.0433	0.0429	0.0521	0.0432
	Molybdenum (Mo)-Total (mg/kg wwt)	0.371	0.241	0.231	0.244	0.204
	Nickel (Ni)-Total (mg/kg wwt)	9.98	1.74	1.56	2.88	1.87
	Phosphorus (P)-Total (mg/kg wwt)	422	2050	2320	2110	1970
	Potassium (K)-Total (mg/kg wwt)	1090	1650	1480	1920	1520
	Rubidium (Rb)-Total (mg/kg wwt)	12.9	2.17	2.41	3.46	2.36
	Selenium (Se)-Total (mg/kg wwt)	0.12	0.606	0.699	0.607	0.555
	Sodium (Na)-Total (mg/kg wwt)	164	805	616	912	723
	Strontium (Sr)-Total (mg/kg wwt)	21.5	4.28	4.74	6.06	5.29
	Tellurium (Te)-Total (mg/kg wwt)	<0.040 DLA	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.121	0.0149	0.0146	0.0305	0.0168
	Tin (Sn)-Total (mg/kg wwt)	0.24	0.048	0.049	0.062	0.058
	Uranium (U)-Total (mg/kg wwt)	2.39	0.452	0.381	0.811	0.447
	Vanadium (V)-Total (mg/kg wwt)	34.2	3.67	2.77	5.88	3.51
	Zinc (Zn)-Total (mg/kg wwt)	39.6	31.3	32.3	36.6	31.7
	Zirconium (Zr)-Total (mg/kg wwt)	4.79	0.774	0.666	1.02	0.813

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-121 Periphyton 03-AUG-17 CF3.9-B1-1	L1985910-122 Periphyton 03-AUG-17 CF3.9-B1-2	L1985910-123 Periphyton 03-AUG-17 CF3.9-B1-3	L1985910-124 Periphyton 04-AUG-17 CF8.0-B1-1	L1985910-125 Periphyton 04-AUG-17 CF8.0-B1-2
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	817	688	925	503	615
	Antimony (Sb)-Total (mg/kg wwt)	0.0322	0.0338	0.0565	0.0366	0.0343
	Arsenic (As)-Total (mg/kg wwt)	0.834	0.688	1.04	0.500	0.596
	Barium (Ba)-Total (mg/kg wwt)	17.1	16.5	17.4	12.1	12.9
	Beryllium (Be)-Total (mg/kg wwt)	0.0190	0.0188	0.0279	0.0151	0.0177
	Bismuth (Bi)-Total (mg/kg wwt)	0.0105	0.0109	0.0113	0.0096	0.0091
	Boron (B)-Total (mg/kg wwt)	0.25	0.28	0.22	0.50	0.30
	Cadmium (Cd)-Total (mg/kg wwt)	0.549	0.325	0.484	0.460	0.286
	Calcium (Ca)-Total (mg/kg wwt)	1380	1140	1160	1090	1150
	Cesium (Cs)-Total (mg/kg wwt)	0.129	0.107	0.0878	0.0796	0.0846
	Chromium (Cr)-Total (mg/kg wwt)	1.79	2.73	2.10	1.30	1.47
	Cobalt (Co)-Total (mg/kg wwt)	0.773	0.859	1.22	0.594	0.579
	Copper (Cu)-Total (mg/kg wwt)	8.07	5.70	7.61	5.72	5.57
	Iron (Fe)-Total (mg/kg wwt)	1300	1800	1290	811	947
	Lead (Pb)-Total (mg/kg wwt)	0.370	0.355	0.424	0.275	0.263
	Lithium (Li)-Total (mg/kg wwt)	0.66	0.58	0.54	0.42	0.42
	Magnesium (Mg)-Total (mg/kg wwt)	745	616	696	549	512
	Manganese (Mn)-Total (mg/kg wwt)	47.8	94.3	106	70.4	54.7
	Mercury (Hg)-Total (mg/kg wwt)	0.0420	0.0297	0.0371	0.0238	0.0197
	Molybdenum (Mo)-Total (mg/kg wwt)	0.307	0.506	0.402	0.355	0.321
	Nickel (Ni)-Total (mg/kg wwt)	1.26	1.69	1.74	1.06	1.13
	Phosphorus (P)-Total (mg/kg wwt)	3240	2380	2820	2000	2200
	Potassium (K)-Total (mg/kg wwt)	2410	1640	2310	1040	1820
	Rubidium (Rb)-Total (mg/kg wwt)	3.34	2.51	2.93	1.86	1.69
	Selenium (Se)-Total (mg/kg wwt)	2.24	1.08	2.12	1.69	1.30
	Sodium (Na)-Total (mg/kg wwt)	954	724	931	674	796
	Strontium (Sr)-Total (mg/kg wwt)	5.33	4.88	4.70	3.98	4.94
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0206	0.0151	0.0180	0.0169	0.0151
	Tin (Sn)-Total (mg/kg wwt)	0.032	0.031	<0.020	0.033	0.038
	Uranium (U)-Total (mg/kg wwt)	0.719	1.03	1.05	0.941	1.98
	Vanadium (V)-Total (mg/kg wwt)	2.96	2.66	4.02	1.79	2.42
	Zinc (Zn)-Total (mg/kg wwt)	48.9	37.8	42.1	41.2	35.2
	Zirconium (Zr)-Total (mg/kg wwt)	0.458	0.471	0.319	0.072	0.536

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-126 Periphyton 04-AUG-17 CF8.0-B1-3	L1985910-127 Periphyton 04-AUG-17 CF8.0-B1-4	L1985910-128 Periphyton 03-AUG-17 LAC4.8-B1-1	L1985910-129 Periphyton 05-AUG-17 CF10.0-B1-1	L1985910-130 Periphyton 05-AUG-17 CF10.0-B1-2
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	889	804	798	808	635
	Antimony (Sb)-Total (mg/kg wwt)	0.0427	0.0533	0.0264	0.0505	0.0453
	Arsenic (As)-Total (mg/kg wwt)	0.940	1.13	0.800	0.610	0.666
	Barium (Ba)-Total (mg/kg wwt)	17.4	15.3	20.2	16.0	12.0
	Beryllium (Be)-Total (mg/kg wwt)	0.0242	0.0263	0.0421	0.0202	0.0162
	Bismuth (Bi)-Total (mg/kg wwt)	0.0122	0.0114	0.0171	0.0131	0.0118
	Boron (B)-Total (mg/kg wwt)	0.34	0.50	0.51	0.41	0.30
	Cadmium (Cd)-Total (mg/kg wwt)	0.554	0.339	0.199	0.235	0.306
	Calcium (Ca)-Total (mg/kg wwt)	1580	1150	792	655	854
	Cesium (Cs)-Total (mg/kg wwt)	0.148	0.0908	0.115	0.127	0.0867
	Chromium (Cr)-Total (mg/kg wwt)	1.66	1.66	2.37	1.62	1.25
	Cobalt (Co)-Total (mg/kg wwt)	0.917	0.907	1.16	0.658	0.647
	Copper (Cu)-Total (mg/kg wwt)	8.47	7.13	6.71	4.43	6.88
	Iron (Fe)-Total (mg/kg wwt)	1580	1200	1590	1160	927
	Lead (Pb)-Total (mg/kg wwt)	0.393	0.396	0.706	0.367	0.314
	Lithium (Li)-Total (mg/kg wwt)	0.69	0.55	0.72	0.68	0.50
	Magnesium (Mg)-Total (mg/kg wwt)	844	613	655	517	504
	Manganese (Mn)-Total (mg/kg wwt)	83.0	128	162	58.4	55.9
	Mercury (Hg)-Total (mg/kg wwt)	0.0252	0.0282	0.0199	0.0163	0.0168
	Molybdenum (Mo)-Total (mg/kg wwt)	0.433	0.770	0.232	0.373	0.478
	Nickel (Ni)-Total (mg/kg wwt)	1.41	1.62	3.67	1.12	1.08
	Phosphorus (P)-Total (mg/kg wwt)	3280	2630	1650	1460	2070
	Potassium (K)-Total (mg/kg wwt)	3040	3330	969	1170	1750
	Rubidium (Rb)-Total (mg/kg wwt)	3.04	2.00	1.45	2.17	1.59
	Selenium (Se)-Total (mg/kg wwt)	2.29	1.45	1.05	1.01	0.955
	Sodium (Na)-Total (mg/kg wwt)	1050	1310	951	496	695
	Strontium (Sr)-Total (mg/kg wwt)	6.12	6.17	7.85	3.17	3.64
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0270	0.0297	0.0143	0.0193	0.0179
	Tin (Sn)-Total (mg/kg wwt)	<0.020	0.024	0.068	0.040	0.027
	Uranium (U)-Total (mg/kg wwt)	1.40	2.62	0.148	0.972	1.87
	Vanadium (V)-Total (mg/kg wwt)	3.73	2.89	3.30	3.13	2.53
	Zinc (Zn)-Total (mg/kg wwt)	52.0	40.2	34.7	25.9	35.4
	Zirconium (Zr)-Total (mg/kg wwt)	0.344	0.785	0.629	0.695	0.492

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Grouping	Analyte	L1985910-131 Periphyton 05-AUG-17 CF10.0-B1-3	L1985910-132 Periphyton 04-AUG-17 LC2.7-B1-1	L1985910-133 Periphyton 04-AUG-17 LC2.7-B1-2	L1985910-134 Periphyton 04-AUG-17 LC2.7-B1-3	L1985910-135 Periphyton 05-AUG-17 LC9.9-B1-1
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	1260	630	547	826	647
	Antimony (Sb)-Total (mg/kg wwt)	0.0515	0.0491	0.0352	0.0425	0.0362
	Arsenic (As)-Total (mg/kg wwt)	5.63	0.844	0.739	1.18	0.984
	Barium (Ba)-Total (mg/kg wwt)	29.3	9.45	8.01	12.5	8.93
	Beryllium (Be)-Total (mg/kg wwt)	0.0560	0.0234	0.0180	0.0351	0.0276
	Bismuth (Bi)-Total (mg/kg wwt)	0.0282	0.0078	0.0066	0.0116	0.0078
	Boron (B)-Total (mg/kg wwt)	1.26	0.47	0.28	0.37	0.27
	Cadmium (Cd)-Total (mg/kg wwt)	0.496	0.426	0.420	0.497	0.170
	Calcium (Ca)-Total (mg/kg wwt)	1180	860	586	889	530
	Cesium (Cs)-Total (mg/kg wwt)	0.192	0.160	0.0619	0.217	0.0771
	Chromium (Cr)-Total (mg/kg wwt)	2.10	1.39	6.72	1.93	1.29
	Cobalt (Co)-Total (mg/kg wwt)	1.45	0.547	0.479	0.839	0.558
	Copper (Cu)-Total (mg/kg wwt)	9.09	6.40	6.05	6.50	4.75
	Iron (Fe)-Total (mg/kg wwt)	3930	1000	831	1440	1100
	Lead (Pb)-Total (mg/kg wwt)	1.10	0.438	0.438	0.719	0.515
	Lithium (Li)-Total (mg/kg wwt)	0.91	0.53	0.48	0.97	0.50
	Magnesium (Mg)-Total (mg/kg wwt)	595	547	479	620	400
	Manganese (Mn)-Total (mg/kg wwt)	127	61.9	52.6	97.6	100
	Mercury (Hg)-Total (mg/kg wwt)	0.0202	0.0351	0.0317	0.0437	0.0529
	Molybdenum (Mo)-Total (mg/kg wwt)	0.548	0.270	0.239	0.263	0.179
	Nickel (Ni)-Total (mg/kg wwt)	2.25	1.19	1.10	1.54	0.846
	Phosphorus (P)-Total (mg/kg wwt)	1860	2640	2490	2520	1810
	Potassium (K)-Total (mg/kg wwt)	1230	2070	1810	2340	1180
	Rubidium (Rb)-Total (mg/kg wwt)	2.92	2.85	1.88	4.09	1.92
	Selenium (Se)-Total (mg/kg wwt)	1.77	1.60	1.72	1.85	0.393
	Sodium (Na)-Total (mg/kg wwt)	473	918	675	750	543
	Strontium (Sr)-Total (mg/kg wwt)	7.86	5.18	4.59	6.01	4.15
	Tellurium (Te)-Total (mg/kg wwt)	0.0051	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0333	0.0171	0.0102	0.0371	0.0119
	Tin (Sn)-Total (mg/kg wwt)	0.031	0.036	0.028	0.056	0.038
	Uranium (U)-Total (mg/kg wwt)	1.86	0.504	0.322	0.686	0.682
	Vanadium (V)-Total (mg/kg wwt)	5.35	1.90	1.84	2.82	2.46
	Zinc (Zn)-Total (mg/kg wwt)	51.2	37.6	34.8	35.9	31.9
	Zirconium (Zr)-Total (mg/kg wwt)	0.449	0.642	0.603	0.592	0.571

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1985910-136 Periphyton 05-AUG-17 LC9.9-B1-2	L1985910-137 Periphyton 07-AUG-17 YT0.2-B1-1	L1985910-138 Periphyton 07-AUG-17 YT5.0-B1-1	L1985910-139 Periphyton 06-AUG-17 HF0.2-B1-1	L1985910-140 Periphyton 06-AUG-17 HF0.2-B1-2
TISSUE						
Physical Tests	% Moisture (%)			84.2		
Metals	Aluminum (Al)-Total (mg/kg wwt)	737	737	253	419	668
	Antimony (Sb)-Total (mg/kg wwt)	0.0417	0.0530	0.0582	0.0326	0.0715
	Arsenic (As)-Total (mg/kg wwt)	1.17	0.748	0.617	0.664	1.77
	Barium (Ba)-Total (mg/kg wwt)	11.4	13.3	7.35	6.58	13.2
	Beryllium (Be)-Total (mg/kg wwt)	0.0293	0.0276	0.0145	0.0141	0.0349
	Bismuth (Bi)-Total (mg/kg wwt)	0.0162	0.0136	0.0046	0.0052	0.0139
	Boron (B)-Total (mg/kg wwt)	0.22	0.33	0.24	0.22	0.33
	Cadmium (Cd)-Total (mg/kg wwt)	0.318	0.0523	0.0236	0.209	0.144
	Calcium (Ca)-Total (mg/kg wwt)	578	707	344	496	767
	Cesium (Cs)-Total (mg/kg wwt)	0.0983	0.0866	0.0312	0.0494	0.109
	Chromium (Cr)-Total (mg/kg wwt)	1.78	1.78	0.870	1.21	2.07
	Cobalt (Co)-Total (mg/kg wwt)	0.694	0.622	0.212	0.390	0.717
	Copper (Cu)-Total (mg/kg wwt)	6.98	4.25	1.88	3.98	4.68
	Iron (Fe)-Total (mg/kg wwt)	1210	1270	470	623	1260
	Lead (Pb)-Total (mg/kg wwt)	0.618	0.769	0.416	0.308	0.679
	Lithium (Li)-Total (mg/kg wwt)	0.61	0.67	0.21	0.41	0.83
	Magnesium (Mg)-Total (mg/kg wwt)	529	511	292	362	520
	Manganese (Mn)-Total (mg/kg wwt)	79.0	61.2	20.7	35.0	64.6
	Mercury (Hg)-Total (mg/kg wwt)	0.0746	0.0101	<0.021	0.0139	0.0148
	Molybdenum (Mo)-Total (mg/kg wwt)	0.219	0.127	0.124	0.232	0.252
	Nickel (Ni)-Total (mg/kg wwt)	1.04	1.23	0.600	0.910	1.71
	Phosphorus (P)-Total (mg/kg wwt)	2530	1630	976	1530	1580
	Potassium (K)-Total (mg/kg wwt)	1730	1010	523	1070	1160
	Rubidium (Rb)-Total (mg/kg wwt)	2.98	1.49	1.14	1.25	1.97
	Selenium (Se)-Total (mg/kg wwt)	0.485	0.209	0.089	0.438	0.338
	Sodium (Na)-Total (mg/kg wwt)	720	398	281	545	521
	Strontium (Sr)-Total (mg/kg wwt)	4.19	4.54	1.41	4.08	6.09
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0127	0.00975	0.00443	0.00806	0.0143
	Tin (Sn)-Total (mg/kg wwt)	0.035	0.033	0.022	0.020	0.054
	Uranium (U)-Total (mg/kg wwt)	0.740	0.477	0.0908	0.683	2.21
	Vanadium (V)-Total (mg/kg wwt)	3.01	2.88	1.04	1.51	2.52
	Zinc (Zn)-Total (mg/kg wwt)	36.1	27.1	20.7	25.0	25.8
	Zirconium (Zr)-Total (mg/kg wwt)	0.692	0.700	0.289	0.332	0.556

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	Sample ID: L1985910-141	L1985910-142	L1985910-143	L1985910-144	L1985910-145
	Description:	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
	Sampled Date:	06-AUG-17	06-AUG-17	06-AUG-17	06-AUG-17	06-AUG-17
	Sampled Time:					
	Client ID:	HF0.2-B1-3	HF0.2-B1-4	HF0.2-B1-5	HF6.3-B1-1	HF6.3-B1-2
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	705	375	334	1000	1500
	Antimony (Sb)-Total (mg/kg wwt)	0.0667	0.0354	0.0614	0.131	0.166
	Arsenic (As)-Total (mg/kg wwt)	6.67	0.667	1.07	2.35	3.14
	Barium (Ba)-Total (mg/kg wwt)	10.7	6.95	7.23	20.0	30.4
	Beryllium (Be)-Total (mg/kg wwt)	0.0308	0.0141	0.0177	0.0364	0.0490
	Bismuth (Bi)-Total (mg/kg wwt)	0.0107	0.0069	0.0056	0.0131	<0.016 RRR
	Boron (B)-Total (mg/kg wwt)	0.35	0.26	0.28	0.30	0.36
	Cadmium (Cd)-Total (mg/kg wwt)	0.189	0.176	0.172	0.301	0.340
	Calcium (Ca)-Total (mg/kg wwt)	700	484	498	730	798
	Cesium (Cs)-Total (mg/kg wwt)	0.0895	0.0477	0.0434	0.114	0.157
	Chromium (Cr)-Total (mg/kg wwt)	1.85	1.08	1.15	2.35	3.52
	Cobalt (Co)-Total (mg/kg wwt)	0.748	0.361	0.443	0.928	1.34
	Copper (Cu)-Total (mg/kg wwt)	4.64	3.95	4.17	3.56	3.47
	Iron (Fe)-Total (mg/kg wwt)	1330	569	826	1370	2020
	Lead (Pb)-Total (mg/kg wwt)	0.578	0.283	0.303	0.639	0.815
	Lithium (Li)-Total (mg/kg wwt)	0.79	0.37	0.30	0.79	1.16
	Magnesium (Mg)-Total (mg/kg wwt)	517	337	328	597	714
	Manganese (Mn)-Total (mg/kg wwt)	62.7	35.8	55.7	111	137
	Mercury (Hg)-Total (mg/kg wwt)	0.0175	0.0140	0.0152	0.0319	0.0346
	Molybdenum (Mo)-Total (mg/kg wwt)	0.242	0.185	0.214	0.304	0.335
	Nickel (Ni)-Total (mg/kg wwt)	1.47	0.831	1.17	1.49	2.09
	Phosphorus (P)-Total (mg/kg wwt)	1700	1640	1720	1730	1450
	Potassium (K)-Total (mg/kg wwt)	1150	1150	1200	1150	1070
	Rubidium (Rb)-Total (mg/kg wwt)	1.63	1.27	1.20	2.04	2.97
	Selenium (Se)-Total (mg/kg wwt)	0.381	0.374	0.357	1.12	0.823
	Sodium (Na)-Total (mg/kg wwt)	555	542	591	475	424
	Strontium (Sr)-Total (mg/kg wwt)	5.79	4.18	4.30	7.34	8.87
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
	Thallium (Tl)-Total (mg/kg wwt)	0.0125	0.00747	0.00809	0.0171	0.0225
	Tin (Sn)-Total (mg/kg wwt)	0.029	<0.020	<0.020	0.046	0.070
	Uranium (U)-Total (mg/kg wwt)	1.79	0.743	0.854	2.48	3.08
	Vanadium (V)-Total (mg/kg wwt)	3.01	1.28	1.48	3.58	4.61
	Zinc (Zn)-Total (mg/kg wwt)	28.1	28.0	26.4	32.3	41.5
	Zirconium (Zr)-Total (mg/kg wwt)	0.556	0.325	0.352	0.383	0.579

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1985910-146	L1985910-147	L1985910-148		
	Description	Periphyton	Periphyton	Periphyton		
	Sampled Date	06-AUG-17	06-AUG-17	06-AUG-17		
	Sampled Time					
	Client ID	HF6.3-B1-3	HF6.3-B1-4	HF6.3-B1-5		
Grouping	**Analyte**					
TISSUE						
Physical Tests	% Moisture (%)					
Metals	Aluminum (Al)-Total (mg/kg wwt)	1590	1950	1060		
	Antimony (Sb)-Total (mg/kg wwt)	0.144	0.202	0.127		
	Arsenic (As)-Total (mg/kg wwt)	3.36	4.98	2.75		
	Barium (Ba)-Total (mg/kg wwt)	30.0	40.3	28.6		
	Beryllium (Be)-Total (mg/kg wwt)	0.0542	0.0693	0.0351		
	Bismuth (Bi)-Total (mg/kg wwt)	<0.018 RRR	<0.032 RRR	<0.014 RRR		
	Boron (B)-Total (mg/kg wwt)	0.41	0.34	0.25		
	Cadmium (Cd)-Total (mg/kg wwt)	0.294	0.319	0.273		
	Calcium (Ca)-Total (mg/kg wwt)	848	1000	668		
	Cesium (Cs)-Total (mg/kg wwt)	0.185	0.210	0.105		
	Chromium (Cr)-Total (mg/kg wwt)	4.43	4.46	3.04		
	Cobalt (Co)-Total (mg/kg wwt)	1.33	1.64	1.01		
	Copper (Cu)-Total (mg/kg wwt)	3.62	4.25	2.98		
	Iron (Fe)-Total (mg/kg wwt)	2260	2880	1500		
	Lead (Pb)-Total (mg/kg wwt)	0.886	0.995	0.671		
	Lithium (Li)-Total (mg/kg wwt)	1.34	1.67	0.81		
	Magnesium (Mg)-Total (mg/kg wwt)	775	937	550		
	Manganese (Mn)-Total (mg/kg wwt)	144	133	98.3		
	Mercury (Hg)-Total (mg/kg wwt)	0.0365	0.0439	0.0387		
	Molybdenum (Mo)-Total (mg/kg wwt)	0.308	0.317	0.270		
	Nickel (Ni)-Total (mg/kg wwt)	2.42	2.86	1.56		
	Phosphorus (P)-Total (mg/kg wwt)	1430	1720	1500		
	Potassium (K)-Total (mg/kg wwt)	1200	1200	1100		
	Rubidium (Rb)-Total (mg/kg wwt)	3.53	3.81	2.20		
	Selenium (Se)-Total (mg/kg wwt)	0.818	0.878	0.917		
	Sodium (Na)-Total (mg/kg wwt)	471	418	434		
	Strontium (Sr)-Total (mg/kg wwt)	9.36	11.7	7.81		
	Tellurium (Te)-Total (mg/kg wwt)	<0.0040	<0.0040	<0.0040		
	Thallium (Tl)-Total (mg/kg wwt)	0.0256	0.0290	0.0167		
	Tin (Sn)-Total (mg/kg wwt)	0.080	0.091	0.054		
	Uranium (U)-Total (mg/kg wwt)	3.40	3.86	2.64		
	Vanadium (V)-Total (mg/kg wwt)	5.08	5.78	3.48		
	Zinc (Zn)-Total (mg/kg wwt)	38.9	50.8	41.4		
	Zirconium (Zr)-Total (mg/kg wwt)	0.613	0.679	0.329		

* Please refer to the Reference Information section for an explanation of any qualifiers detected.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)
Duplicate	Lead (Pb)-Total	DUP-H	L1985910-25, -26, -62, -70, -90, -91, -95, -96
Duplicate	Aluminum (Al)-Total	DUP-H	L1985910-40, -44, -48, -50, -52, -54, -56, -58, -60, -61, -67, -68, -69, -78, -80, -82, -84, -87, -88, -92
Duplicate	Barium (Ba)-Total	DUP-H	L1985910-40, -44, -48, -50, -52, -54, -56, -58, -60, -61, -67, -68, -69, -78, -80, -82, -84, -87, -88, -92
Duplicate	Calcium (Ca)-Total	DUP-H	L1985910-1, -11, -13, -15, -17, -19, -23, -24, -29, -3, -30, -34, -38, -5, -7, -9
Duplicate	Calcium (Ca)-Total	DUP-H	L1985910-40, -44, -48, -50, -52, -54, -56, -58, -60, -61, -67, -68, -69, -78, -80, -82, -84, -87, -88, -92
Duplicate	Manganese (Mn)-Total	DUP-H	L1985910-40, -44, -48, -50, -52, -54, -56, -58, -60, -61, -67, -68, -69, -78, -80, -82, -84, -87, -88, -92
Duplicate	Strontium (Sr)-Total	DUP-H	L1985910-1, -11, -13, -15, -17, -19, -23, -24, -29, -3, -30, -34, -38, -5, -7, -9
Duplicate	Strontium (Sr)-Total	DUP-H	L1985910-40, -44, -48, -50, -52, -54, -56, -58, -60, -61, -67, -68, -69, -78, -80, -82, -84, -87, -88, -92
Duplicate	Uranium (U)-Total	DUP-H	L1985910-40, -44, -48, -50, -52, -54, -56, -58, -60, -61, -67, -68, -69, -78, -80, -82, -84, -87, -88, -92
Duplicate	Barium (Ba)-Total	DUP-H	L1985910-20
Duplicate	Molybdenum (Mo)-Total	DUP-H	L1985910-105, -106, -107, -108, -109, -110, -111, -117, -118, -119, -120, -145, -146, -147, -148, -45
Duplicate	Nickel (Ni)-Total	DUP-H	L1985910-20
Duplicate	Sodium (Na)-Total	DUP-H	L1985910-105, -106, -107, -108, -109, -110, -111, -117, -118, -119, -120, -145, -146, -147, -148, -45
Duplicate	Tin (Sn)-Total	DUP-H	L1985910-20
Method Blank	Aluminum (Al)-Total	MB-LOR	L1985910-25, -26, -62, -70, -90, -91, -95, -96
Method Blank	Bismuth (Bi)-Total	MB-LOR	L1985910-25, -26, -62, -70, -90, -91, -95, -96
Method Blank	Boron (B)-Total	MB-LOR	L1985910-25, -26, -62, -70, -90, -91, -95, -96
Method Blank	Calcium (Ca)-Total	MB-LOR	L1985910-25, -26, -62, -70, -90, -91, -95, -96
Method Blank	Magnesium (Mg)-Total	MB-LOR	L1985910-25, -26, -62, -70, -90, -91, -95, -96
Method Blank	Manganese (Mn)-Total	MB-LOR	L1985910-25, -26, -62, -70, -90, -91, -95, -96
Method Blank	Strontium (Sr)-Total	MB-LOR	L1985910-25, -26, -62, -70, -90, -91, -95, -96
Method Blank	Thallium (Tl)-Total	MB-LOR	L1985910-25, -26, -62, -70, -90, -91, -95, -96
Method Blank	Zinc (Zn)-Total	MB-LOR	L1985910-1, -11, -13, -15, -17, -19, -23, -24, -29, -3, -30, -34, -38, -5, -7, -9

Qualifiers for Individual Parameters Listed:

Qualifier	Description
DLA	Detection Limit adjusted for required dilution
DLIS	Detection Limit Adjusted: Insufficient Sample
DUP-H	Duplicate results outside ALS DQO, due to sample heterogeneity.
MB-LOR	Method Blank exceeds ALS DQO. Limits of Reporting have been adjusted for samples with positive hits below 5x blank level.
RRR	Refer to Report Remarks for issues regarding this analysis

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
HG-WET-CVAFS-N-VA	Tissue	Mercury in Tissue by CVAFS (WET)	EPA 200.3, EPA 245.7

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

HG-WET-MICR-CVAF-VA	Tissue	Mercury in Tissue by CVAFS Micro (WET)	EPA 200.3, EPA 245.7

This method is adapted from US EPA Method 200.3 "Sample Procedures for Spectrochemical Determination of Total Recoverable Elements in Biological Tissues" (1996). Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with repeated additions of hydrogen peroxide. Analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry, adapted from US EPA Method 245.7.

MET-WET-CCMS-MID-VA	Tissue	Metals in Tissue by CRC ICPMS (WET)	EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen

Reference Information

peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MET-WET-CCMS-N-VA Tissue Metals in Tissue by CRC ICPMS (WET) EPA 200.3/6020A

This method is conducted following British Columbia Lab Manual method "Metals in Animal Tissue and Vegetation (Biota) - Prescriptive". Tissue samples are homogenized and sub-sampled prior to hotblock digestion with nitric and hydrochloric acids, in combination with addition of hydrogen peroxide. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modified from EPA Method 6020A).

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MET-WET-MICR-HRMS-VA Tissue Metals in Tissue by HR-ICPMS Micro (WET) EPA 200.3/200.8

Trace metals in tissue are analyzed by high resolution inductively coupled plasma mass spectrometry (HR-ICPMS) modified from US EPA Method 200.8, (Revision 5.5). The sample preparation procedure is modified from US EPA 200.3. Analytical results are reported on wet weight basis.

Method Limitation: This method employs a strong acid/peroxide digestion, and is intended to provide a conservative estimate of bio-available metals. Near complete recoveries are achieved for most toxicologically important metals, but elements associated with recalcitrant minerals may be only partially recovered.

MOISTURE-BIOPSY-VA Tissue Moisture Content (low weight) in tissue Puget Sound WQ Authority, Apr 1997

This analysis is carried out gravimetrically by drying the sample at <60 deg. C for a minimum of three days.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

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L1985910-COFC

COC Number: In Freezer!

Page 1 of 13

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:	867-393-4882	Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact: J.McCord	Sampler: L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	LC2.7 1GR2-M	6.1g	06-Aug-19		tissue	X	X	X	1
	LC2.7 1GR2-L	0.8g				X	X	X	1
	LC2.7 1GR1-M	7.0g				X	X	X	1
	LC2.7 1GR1-L	1.6g				X	X	X	1
	LC2.7 1GR3-M	6.0g				X	X	X	1
	LC2.7 1GR3-L	0.5g				X	X	X	1
	LC2.7 1GR4-M	5.6g				X	X	X	1
	LC2.7 1GR4-L	0.8g				X	X	X	1
	LC2.7 2GR5-M	6.4g				X	X	X	1
	LC2.7 2GR5-L	0.9g				X	X	X	1
	LC2.7 2GR6-M	5.8g				X	X	X	1
	LC2.7 2GR6-M	0.9g				X	X	X	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No Are samples for human drinking water use? ☑ Yes ☐ No	Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice packs Yes ☑ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☑

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
-2.0					

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	5-Sept-19	12:00	EHF	5 SEP 2019	11:50			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

NAFM-032Ev09 Front/04 January 2014

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS Environmental

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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1985910-COFC

COC Number:

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Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-393-4882	Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact: J.McCord	Sampler: L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	LC2.7 2GR7-M 5.0g	06-Aug 17		tissue	X	X	X	1
	LC2.7 2GR7-L 0.6g				X	X	X	1
	LC2.7 2GR8-M 5.3g				X	X	X	1
	LC2.7 2GR8-L 2.4g				X	X	X	1
	LC2.7 2GR9-M 5.4g				X	X	X	1
	LC2.7 2GR9-L 0.4g				X	X	X	1
	LC2.7 3GR10-M 6.5g				X	X	X	1
	LC2.7 3GR10-L 1.6g				X	X	X	1
	YT005 GR1-M 2.1g				X	X	X	1
	YT005 GR1-L 0.3g				X	X	X	1
								1
								1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)	SAMPLE CONDITION AS RECEIVED (lab use only)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass	Frozen ☐ SIF Observations Yes ☐ No ☐
Are samples for human drinking water use? ☑ Yes ☐ No		Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐
		Cooling Initiated ☐
		INITIAL COOLER TEMPERATURES °C: -2.0 / FINAL COOLER TEMPERATURES °C:

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date: 5-Sept 17	Time: 12:00	Received by: GTF	Date: 5 Sep 2017	Time: 11:50	Received by:	Date:	Time:

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS Environmental

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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1985910-COFC

COC Number:

Page 3 of 13

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:	867-393-4882	Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2, E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact: J.McCord	Sampler: L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	ID1.9 - ICCG1	5.61g	07-Aug-17		tissue	X	X	X	1
	ID1.9 - ICCG2	4.56g				X	X	X	1
	ID1.9 - ICCG3	4.25g				X	X	X	1
	ID1.9 - ICCG4	4.12g				X	X	X	1
	ID1.9 - ICCG5	3.99g				X	X	X	1
	ID1.9 - ICCG6	2.05g				X	X	X	1
	ID1.9 - ICCG7	5.25g				X	X	X	1
	ID1.9 - ICCG8	5.26g				X	X	X	1
	ID1.9 - ICCG9	3.05g				X	X	X	1
	ID 1.9 - ICCG10	3.39g				X	X	X	1
	ID 1.9 - ICCG11	2.97g				X	X	X	1
									1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)	SAMPLE CONDITION AS RECEIVED (lab use only)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass	Frozen ☐ SIF Observations Yes ☐ No ☐
Are samples for human drinking water use? ☑ Yes ☐ No		Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐
		Cooling Initiated ☐
		INITIAL COOLER TEMPERATURES °C / FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	5-Sept/17	12:00						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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Chain of Custody (COC) / Analytical Request Form

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L1985910-COFC

COC Number:

Page 4 of 13

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
		Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-393-4882	Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): | **ALS Contact:** J.McCord | **Sampler:** L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	ID1.9-1GR1-M 11.76g	07 Aug 17		tissue	X	X	X	1
	ID1.9-1GR1-L 2.59g				X	X	X	1
	ID1.9-1GR2-M 0.44g				X	X	X	1
	ID1.9-1GR2-L 6.05g				X	X	X	1
	ID1.9-2GR3-M 9.38g				X	X	X	1
	ID1.9-2GR3-L 2.32g				X	X	X	1
	ID1.9-2GR4-M 8.43g				X	X	X	1
	ID1.9-2GR4-L 2.83g				X	X	X	1
	ID1.9-2GR5-M 0.34g				X	X	X	1
	ID1.9-2GR5-L 0.05g				X	X	X	1
	ID1.9-2GR6-M 7.59g				X	X	X	1
	ID1.9-2GR6-L 1.76g				X	X	X	1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ Yes ☐ No

Are samples for human drinking water use? ☑ Yes ☐ No

Special Instructions / Specify Criteria to add on report (client Use)

Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice packs Yes ☐ No ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	5-Sept-17	12:00						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1985910-COFC

COC Number:

Page 5 of 13

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
		Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-393-4882	Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): | **ALS Contact:** J.McCord | **Sampler:** L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	ID1.9 - 3GR7 - M 1.71g	07-Aug-17		tissue	X	X	X	1
	ID1.9 - 3GR7 - L 0.06g	07 Aug 17			X	X	X	1
	HF0.1 - 1GR1 - M 8.51g	03-Aug-17			X	X	X	1
	HF0.1 - GR1 - L 0.70g				X	X	X	1
	HF0.2 - GR2 - M 9.50				X	X	X	1
	HF0.2 - GR2 - L 0.16				X	X	X	1
	HF0.2 - GR5 - M 10.95				X	X	X	1
	HF0.2 - GR5 - L 3.90				X	X	X	1
	HF0.2 - GR4 - M 7.37				X	X	X	1
	HF0.2 - GR4 - L 0.31				X	X	X	1
	HF0.2 - GR5 - M 10.60g				X	X	X	1
	HF0.2 - GR5 - L 1.50g				X	X	X	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)	SAMPLE CONDITION AS RECEIVED (lab use only)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass	Frozen ☐ SIF Observations Yes ☐ No ☐
Are samples for human drinking water use? ☑ Yes ☐ No		Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐
		Cooling Initiated ☐
		INITIAL COOLER TEMPERATURES °C / FINAL COOLER TEMPERATURES °C

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
[signature]	5-Sept-17	12:00						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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NA-FM-0326e v09 Front04 January 2014

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1985910-COFC

COC Number:

Page 6 of 13

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-393-4882	Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact:	J.McCord	Sampler:	L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	HF0.2-GR6-M 8.06g	03-Aug-17		tissue	X	X	X	1
	HF0.2-GR6-L 0.40g				X	X	X	1
	HF0.2-GR7-M 16.10g				X	X	X	1
	HF0.2-GR7-L 5.11g				X	X	X	1
	CF3.9 CCG1 3.01g	08-Aug-17			X	X	X	1
	CF3.9 CCG2 2.73g				X	X	X	1
	CF3.9 CCG3 3.77g				X	X	X	1
	CF3.9 CCG5 3.35g				X	X	X	1
	CF3.9 CCG6 1.17g				X	X	X	1
	CF3.9 CCG7 7.90g				X	X	X	1
	CF3.9 CCG9 5.67g				X	X	X	1
	CF3.9 CCG10 3.88g				X	X	X	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No Are samples for human drinking water use? ☑ Yes ☐ No	Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	5-Aug-17	12:00						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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ALS FM 0326e v09 Front04 January 2014

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS Environmental

www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1985910-COFC

COC Number:

Page 7 of 13

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:	867-393-4882	Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact:	J.McCord	Sampler:	L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	CF3.9 - CCG - 11 3.72g	08-Aug-17		tissue	X	X	X	1
	CF3.9 - CCG 12 1.89g				X	X	X	1
	CF3.9 - GR4 - M 1.15g				X	X	X	1
	CF3.9 - GR4 - L 0.02g				X	X	X	1
	CF3.9 - GR8 - M 1.70g				X	X	X	1
	CF3.9 - GR8 - L 0.00g				X	X	X	1
	CF3.9 - GR13 - M 1.41				X	X	X	1
	CF3.9 - GR13 - L 0.00				X	X	X	1
	CF3.9 GR14 - M 12.23				X	X	X	1
	CF3.9 GR14 - L 1.74				X	X	X	1
	CF3.9 GR15 - M 16.00				X	X	X	1
	CF3.9 GR15 - L 1.31				X	X	X	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass - some samples may be too small to analyse by any means.
Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)			
Frozen ☐	SIF Observations Yes ☐ No ☐		
Ice packs Yes ☐ No ☐	Custody seal intact Yes ☐ No ☐		
Cooling Initiated ☐			
INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C	

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
[signature]	5-Sept-17	12:00						

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NA-FM-03256-v09-Front/01 January 2014

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1985910-COFC

COC Number:

Page 8 of 13

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report	☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:	867-393-4882	Select Distribution:	☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax	ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2		
		Email 3		

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX
Company:	EDI	Email 1 or Fax	sjenner@edynamics.com
Contact:	S Jenner	Email 2	ldoetzel@edynamics.com

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: J.McCord **Sampler:** L.Doetzel

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	CF3.9-GR16-M 12.98g	08-Aug-17		tissue	X	X	X	1
	CF3.9-GR16-L 1.37g				X	X	X	1
	CF3.9-GR17-M 8.31g				X	X	X	1
	CF3.9-GR17-L 1.33g				X	X	X	1
	CF3.9-GR18-M 10.62g				X	X	X	1
	CF3.9 GR18-L 1.51g				X	X	X	1
	CF3.9 GR19-M 7.88g				X	X	X	1
	CF3.9 GR19-L 1.00g				X	X	X	1
	· CF8.0-p-1 1.81g	4-Aug-17		periphyton	X	X	X	1
	· CF8.0-p-2 2.44g				X	X	X	1
	· CF8.0-p-3 3.30g				X	X	X	1
	· CF8.0-p-4 4.31g				X	X	X	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No Are samples for human drinking water use? ☑ Yes ☐ No	Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	5-Aug-17	12:00						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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NA-FM-0326e v09 Front/04 January 2014

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Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L1985910-COFC

COC Number:

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-393-4882	Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact: J.McCord	Sampler: L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	[1] CF8.0-p-5	6.16g	04-Aug-17		periphyton tissue	X	X	X	1
	CF3.9-p-1	1.27g	03-Aug-17			X	X	X	1
	CF3.9-p-2	1.46g				X	X	X	1
	CF3.9-p-3	1.66g				X	X	X	1
	CF3.9-p-4	1.55g				X	X	X	1
	CF3.9-p-5	2.15g				X	X	X	1
	ID1.9-p-1	1.36g	02-Aug-17			X	X	X	1
	ID1.9-p-2	1.46g				X	X	X	1
	ID1.9-p-3	1.87g				X	X	X	1
	ID1.9-p-4	2.71g				X	X	X	1
	ID1.9-p-5	4.10g				X	X	X	1
	[1] LC2.7-p-1	0.82g	04 Aug 17			X	X	X	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass
Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	5-Sept-17	12:00						

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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1985910-COFC

COC Number:

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Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
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		Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-393-4882	Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only):

ALS Contact: J.McCord Sampler: L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	· LC2.7-p-2	0.75g	04-Aug-17		tissue/periphy.	X	X	X	1
	· LC2.7-p-3	0.84g				X	X	X	1
	· LC2.7-p-4	0.80g				X	X	X	1
	· LC2.7-p-5	0.65g				X	X	X	1
	· HF 0.2-p-1	0.53g	06-Aug-17			X	X	X	1
	· HF0.2-p-2	0.52g	06-Aug-17			X	X	X	1
	· CF10.0-p-1	9.32g	05-Aug-17			X	X	X	1
	· CF10.0-p-2	9.90g				X	X	X	1
	· CF10.0-p-3	21.34g				X	X	X	1
	· CF10.0-p-4	21.86g				X	X	X	1
	· CF10.0-p-5	27.63g				X	X	X	1
									1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass
Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
[signature]	5-Aug-17	12:00						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

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Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1985910-COFC

COC Number:

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Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
		Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-393-4882	Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only): | **ALS Contact:** J.McCord | **Sampler:** L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	ID1.9-B1-1 0.78g	2 Aug 17		B1 tissue	X	X	X	1
	ID1.9-B1-2 0.62g	↓		↓	X	X	X	1
	ID1.9-B1-3 0.68g				X	X	X	1
	ID1.9-B1-4 0.65g	↓			X	X	X	1
	CF3.9-B1-1 0.59g	3 Aug 17			X	X	X	1
	CF3.9-B1-2 0.68g	↓			X	X	X	1
	CF3.9-B1-3 0.60g	↓			X	X	X	1
	CF8.0-B1-1 0.54g	4 Aug 17			X	X	X	1
	CF8.0-B1-2 0.73g	↓			X	X	X	1
	CF8.0-B1-3 0.53g				X	X	X	1
	CF8.0-B1-4 0.68g	↓			X	X	X	1
	LaC4.8-B1-1 0.59g	3 Aug 17		↓	X	X	X	1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ Yes ☐ No

Are samples for human drinking water use? ☑ Yes ☐ No

Special Instructions / Specify Criteria to add on report (client Use)

Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ | SIF Observations Yes ☐ No ☐

Ice packs Yes ☐ No ☐ | Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	5-Aug-17	12:00						

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Chain of Custody (COC) / Analytical Request Form

ALS Environmental

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COC Number:

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Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
		Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-393-4882	Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To		Invoice Distribution	Analysis Request
	Same as Report To ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
	Copy of Invoice with Report ☑ Yes ☐ No	Email 1 or Fax sjenner@edynamics.com	
Company:	EDI	Email 2 ldoetzel@edynamics.com	
Contact:	S Jenner		

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact:	J.McCord	Sampler:	L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)		Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	CF10.0-BI-1	0.52g	05-Aug 17		BI tissue	X	X	X	1
	CF10.0-BI-2	0.51g	↓			X	X	X	1
	CF10.0-BI-3	0.54g	↓			X	X	X	1
	LC2.7-BI-1	0.53g	04-Aug 17			X	X	X	1
	LC2.7-BI-2	0.57g	↓			X	X	X	1
	LC2.7-BI-3	0.54g	↓			X	X	X	1
	LC9.9-BI-1	0.51g	05-Aug-17			X	X	X	1
	LC9.9-BI-2	0.62g	05-Aug-17			X	X	X	1
	YT0.2-BI-1	0.68g	07-Aug-17			X	X	X	1
	YT5.0-BI-1	0.51g	07-Aug-17			X	X	X	1
	HF0.2-BI-1	0.77g	06-Aug 17			X	X	X	1
	HF0.2 BI-2	0.60g	06-Aug-17			X	X	X	1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No Are samples for human drinking water use? ☑ Yes ☐ No	Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	5-Aug-17	12:00						

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NA-FM-0326e v09 Front04 January 2014

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COC Number:

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Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:	867-393-4882	Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380 / Q63512	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact:	J.McCord	Sampler:	L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	PREP-TISS-DIGEST-VA	HG-WET-CVAFS-N-VA	MET-WET-CCMS-N-VA	Number of Containers
	HF0.2-B1-3 0.62g	06 Aug 17		B1 tissue	X	X	X	1
	HF0.2-B1-4 0.56g				X	X	X	1
	HF0.2-B1-5 0.81g				X	X	X	1
	HF6.3-B1-1 0.68g				X	X	X	1
	HF6.3-B1-2 0.83g				X	X	X	1
	HF6.3-B1-3 0.65g				X	X	X	1
	HF6.3-B1-4 0.91g				X	X	X	1
	HF6.3-B1-5 1.13g				X	X	X	1
								1
								1
								1
								1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	Please analyze all samples using regular tissue analyses, but switch to micro analyses when required by available sample mass
Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	25 Aug 17	12:00						

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APPENDIX F. BENTHIC INVERTEBRATE COMMUNITY SAMPLING RESULTS (CABIN METHOD)

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Table F- 1. Benthic invertebrate community data collected in August 2017.

Sample Site:	Coffee	Coffee	Coffee	YT24	YR24	Halfway	Halfway	Latte	Latte	Independence	Los Angeles	New	New	Unknown	Unknown	Dan Man	Dan Man
Sample ID:	CF3.9	CF8.0	CF10.0	YT0.2	YT5.0	HF0.2	HF6.3	LC2.7	LC9.9	ID1.9	LaC4.8	NC1	NC2	UK1	UK2	DM1	DM2
Date:	03-Aug-17	04-Aug-17	05-Aug-17	07-Aug-17	07-Aug-17	06-Aug-17	06-Aug-17	04-Aug-17	05-Aug-17	02-Aug-17	03-Aug-17	10-Aug-17	10-Aug-17	08-Aug-17	08-Aug-17	08-Aug-17	08-Aug-17
CC#:	CC180605	CC180606	CC180607	CC180608	CC180609	CC180610	CC180611	CC180612	CC180613	CC180614	CC180615	CC180616	CC180617	CC180618	CC180619	CC180620	CC180621
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Collembola	0	0	0	0	0	1	0	0	0	0	0	2	0	3	0	0	0
Family: Hypogastruridae	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Ameletidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus	0	0	0	0	0	6	18	0	2	0	0	0	0	0	0	0	0
Family: Baetidae	7	0	0	11	0	2	421	68	31	0	33	0	129	37	11	22	0
Acentrella sp.	227	196	196	1	0	2	0	11	0	270	1800	0	0	0	56	0	0
Baetis	0	12	11	19	1	28	4	54	216	20	0	0	95	393	270	922	18
Baetis bicaudatus	0	8	13	25	0	23	29	64	211	75	100	0	195	413	204	733	68
Baetis tricaudatus	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Ephemerellidae	157	20	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella doddsii	17	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerella aurivillii	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Heptageniidae	13	24	7	0	0	1	4	7	0	20	167	0	5	3	4	0	0
Cinygmula sp.	77	112	113	0	0	16	64	50	4	40	817	0	0	20	30	56	14
Epeorus sp.	0	2	0	0	0	0	0	7	0	0	0	0	0	0	4	0	0
Order: Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Capniidae	3	10	2	10	4	22	7	4	2	0	67	124	210	0	11	67	30
Capnia sp.	0	0	0	0	0	2	4	0	0	0	0	2	33	0	0	0	0
Family: Chloroperlidae	0	12	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0
Haploperla sp.	0	8	4	0	0	0	11	68	0	0	0	0	0	3	15	0	0
Suwallia	30	6	4	0	0	0	0	0	2	15	0	0	0	0	0	0	0
Family: Nemouridae	0	2	0	292	97	203	307	82	133	10	1033	326	471	80	37	1478	386
Nemoura	0	0	2	1	3	7	4	0	9	5	217	10	0	0	0	33	4
Ostrocerca sp.	3	0	0	7	15	8	4	0	7	10	33	40	43	0	0	0	2
Zapada	0	0	0	0	1	0	4	4	0	0	0	2	0	0	0	0	0
Family: Perlodidae	0	0	0	0	0	0	0	21	0	0	0	0	0	10	11	0	0
Skwala	3	12	9	0	0	0	0	0	0	0	0	0	0	0	7	0	0
Order: Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Glossosomatidae	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma	3	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Limnephilidae	37	4	7	0	0	0	4	7	2	0	0	0	0	0	7	0	2
Ecclisomyia sp.	0	2	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0
Order: Coleoptera	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Order: Diptera	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4	0	0
Family: Ceratopogonidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alluaudomyia	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Family: Chironomidae	40	140	18	3	2	6	18	29	2	30	0	4	5	7	19	11	2
Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pagastiella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Micropsectra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arctodiamesa	0	0	0	0	15	0	0	0	0	0	0	20	0	0	0	0	0
Pseudokiefferiella	0	0	0	2	20	21	14	4	4	0	0	70	5	0	0	33	0
Tribe: Diamesini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamesa	0	0	0	3	25	11	68	11	7	0	17	4	38	0	0	22	0
Pagastia	0	0	0	0	0	0	0	4	0	5	17	0	0	0	0	0	0
Potthastia gaedii group	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Pseudodiamesa sp.	0	0	0	0	0	4	0	0	0	0	0	0	0	0	7	0	4
Subfamily: Orthocladiinae	0	0	0	0	0	0	0	7	0	0	0	2	19	3	0	0	2
Corynoneura	7	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sample Site:	Coffee	Coffee	Coffee	YT24	YR24	Halfway	Halfway	Latte	Latte	Independence	Los Angeles	New	New	Unknown	Unknown	Dan Man	Dan Man
Sample ID:	CF3.9	CF8.0	CF10.0	YT0.2	YT5.0	HF0.2	HF6.3	LC2.7	LC9.9	ID1.9	LaC4.8	NC1	NC2	UK1	UK2	DM1	DM2
Date:	03-Aug-17	04-Aug-17	05-Aug-17	07-Aug-17	07-Aug-17	06-Aug-17	06-Aug-17	04-Aug-17	05-Aug-17	02-Aug-17	03-Aug-17	10-Aug-17	10-Aug-17	08-Aug-17	08-Aug-17	08-Aug-17	08-Aug-17
CC#:	CC180605	CC180606	CC180607	CC180608	CC180609	CC180610	CC180611	CC180612	CC180613	CC180614	CC180615	CC180616	CC180617	CC180618	CC180619	CC180620	CC180621
Diplocladius cultriger	0	0	0	1	6	0	11	0	0	0	0	6	0	0	0	11	0
Eukiefferiella	117	10	13	14	21	10	25	36	16	230	17	26	48	0	41	78	6
Heterotrissocladius sp.	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrobaenus	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0
Limnophyes sp.	0	0	0	1	0	1	4	0	0	15	0	0	0	3	0	0	2
Metriocnemus sp.	0	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0
Orthocladius (Euorthocladius)	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orthocladius complex	77	32	11	13	0	1	4	0	0	60	17	0	19	13	11	0	0
Parametriocnemus	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parorthocladius	27	0	0	0	1	0	11	0	0	5	0	4	5	0	4	0	0
Rheocricotopus	3	0	0	0	0	1	0	4	0	5	0	0	0	0	4	0	0
Tvetenia	137	30	16	5	1	8	4	43	13	180	50	18	52	10	93	11	12
Family: Deuterophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deuterophlebia sp.	0	18	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Empididae	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Clinocera sp.	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Clinocerinae Unknown Genus A	10	0	18	1	0	0	0	0	0	55	17	0	5	0	0	0	0
Family: Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnophora sp.	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Family: Simuliidae	0	204	24	0	1	3	0	89	2	65	184	0	10	0	37	0	2
Gymnopais sp.	0	0	0	6	5	1	29	0	16	0	0	36	48	10	0	111	2
Helodon	0	4	0	0	0	0	11	36	7	30	0	0	0	0	0	0	0
Prosimulium	0	0	0	1	0	2	0	14	9	15	17	0	24	3	7	33	0
Prosimulium/Helodon	0	112	56	9	6	3	89	364	69	435	1200	0	57	80	289	111	14
Simulium	0	2	0	3	0	0	0	18	0	25	83	0	0	0	4	0	2
Family: Tipulidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicranota	0	2	4	2	1	0	7	0	2	0	0	0	0	0	0	0	12
Ormosia	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Tipula	0	0	0	0	0	1	0	0	0	0	17	0	0	0	0	0	0
Order: Hemiptera	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Hymenoptera	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Trombidiformes	3	0	0	0	0	2	0	7	0	0	0	0	0	3	4	0	2
Family: Feltriidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Feltria sp.	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Hydryphantidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wandesia	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0
Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon	10	4	9	0	0	5	0	0	0	15	17	0	0	0	0	0	4
Oribatida	0	0	0	1	0	0	0	4	2	0	0	0	0	0	0	0	0
Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Malacostraca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Amphipoda	0	0	0	0	0	1	0	0	0	0	0	0	0	0	4	0	0
Family: Crangonyctidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crangonyx	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Gastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Order: Lumbriculida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Lumbriculidae	127	0	71	2	1	0	21	0	9	15	17	8	14	0	0	0	44
Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Family: Naididae	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0
Subfamily: Tubificinae with hair chaetae	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Subfamily: Tubificinae without hair chaetae	27	0	22	3	0	28	4	0	0	175	0	2	0	3	0	0	20
Totals:	1187	1004	665	437	226	436	1205	1136	792	1835	5971	708	1530	1100	1211	3732	656

Sample Site:	Coffee	Coffee	Coffee	YT24	YR24	Halfway	Halfway	Latte	Latte	Independence	Los Angeles	New	New	Unknown	Unknown	Dan Man	Dan Man
Sample ID:	**CF3.9**	**CF8.0**	**CF10.0**	**YT0.2**	**YT5.0**	**HF0.2**	**HF6.3**	**LC2.7**	**LC9.9**	**ID1.9**	**LaC4.8**	**NC1**	**NC2**	**UK1**	**UK2**	**DM1**	**DM2**
Date:	**03-Aug-17**	**04-Aug-17**	**05-Aug-17**	**07-Aug-17**	**07-Aug-17**	**06-Aug-17**	**06-Aug-17**	**04-Aug-17**	**05-Aug-17**	**02-Aug-17**	**03-Aug-17**	**10-Aug-17**	**10-Aug-17**	**08-Aug-17**	**08-Aug-17**	**08-Aug-17**	**08-Aug-17**
CC#:	**CC180605**	**CC180606**	**CC180607**	**CC180608**	**CC180609**	**CC180610**	**CC180611**	**CC180612**	**CC180613**	**CC180614**	**CC180615**	**CC180616**	**CC180617**	**CC180618**	**CC180619**	**CC180620**	**CC180621**
Taxa present but not included:																	
Terrestrials	3	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0
Phylum: Nemata	3	2	0	1	1	0	4	4	2	0	17	2	0	0	0	11	2
Phylum: Platyhelminthes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Class: Turbellaria	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2
Totals:	**6**	**2**	**0**	**1**	**1**	**1**	**4**	**4**	**2**	**0**	**17**	**2**	**0**	**0**	**4**	**11**	**4**

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Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	CF3.9
Sampling Date	Aug 03 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.88665 N, 139.09224 W
Altitude	1730
Local Basin Name	Coffee Creek
	Coffee Creek
Stream Order	0



Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	3.7%	95.5%	0.0%	0.0%	0.7%
CABIN Assessment of CF3.9 on Aug 03, 2017	Mildly Divergent				

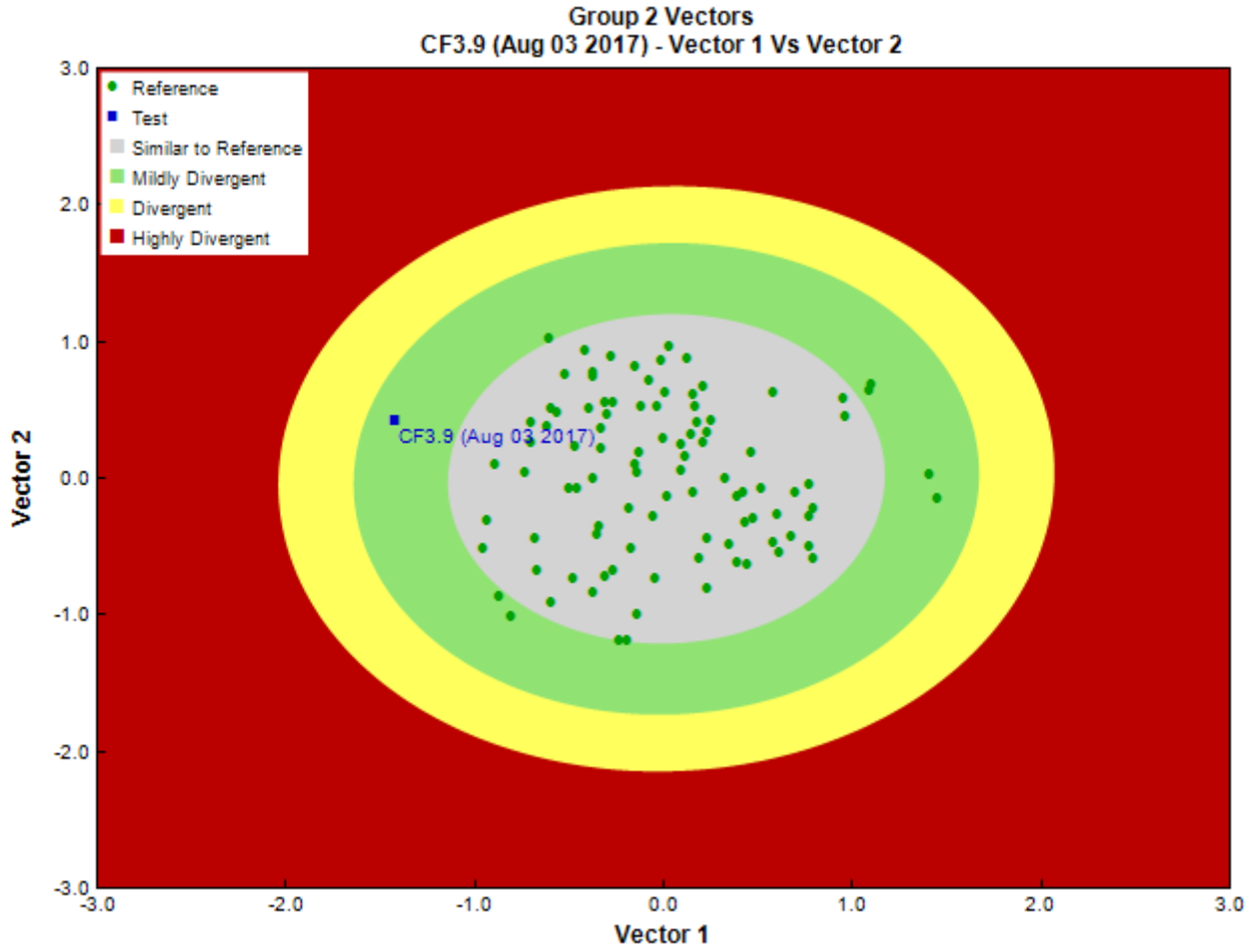

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	30/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	38	126.7
		Tubificida	Naididae	9	30.0
Arthropoda	Arachnida	Trombidiformes		1	3.3
			Feltriidae	1	3.3
			Sperchontidae	3	10.0
	Insecta	Diptera	Chironomidae	125	416.8
			Empididae	3	10.0
		Ephemeroptera	Baetidae	71	236.7
			Ephemerellidae	53	176.7
			Heptageniidae	27	90.0
		Lepidoptera		1	3.3
		Plecoptera	Capniidae	1	3.3
			Chloroperlidae	9	30.0
			Nemouridae	1	3.3

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Perlodidae	1	3.3
		Trichoptera	Glossosomatidae	1	3.3
			Limnephilidae	11	36.7
			Total	356	1,186.7

Metrics

Name	CF3.9	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.83	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	50.6	58.6 ± 25.3
% Ephemeroptera	42.7	25.6 ± 21.1
% Plecoptera	3.4	11.3 ± 12.5
% Tricoptera	3.4	4.2 ± 5.8
Total Abundance	1186.7	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	583.3	115.3 ± 124.5
EPT taxa (no)	9.0	5.8 ± 2.9
Simpson's Diversity	0.8	0.6 ± 0.2
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	15.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at CF3.9
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.83
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.62
Nemouridae	39%	74%	100%	81%	100%	0.73
Simuliidae	39%	78%	86%	87%	77%	0.76

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.94
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	1.02
RIVPACS : Expected taxa P>0.70	3.32
RIVPACS : Observed taxa P>0.70	3.00
RIVPACS : O:E (p > 0.7)	0.90

Habitat Description

Variable	CF3.9	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	36.0	31.4 ± 19.7
Velocity-Avg (m/s)	0.45	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.47598	0.14237 ± 0.34395
Natl-Bryoids (%)	1.48831	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.84309	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	CF8.0
Sampling Date	Aug 04 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.85311 N, 139.13892 W
Altitude	1460
Local Basin Name	Coffee Creek
	Coffee Creek
Stream Order	0



Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	3.5%	95.3%	0.0%	0.1%	1.2%
CABIN Assessment of CF8.0 on Aug 04, 2017	Mildly Divergent				

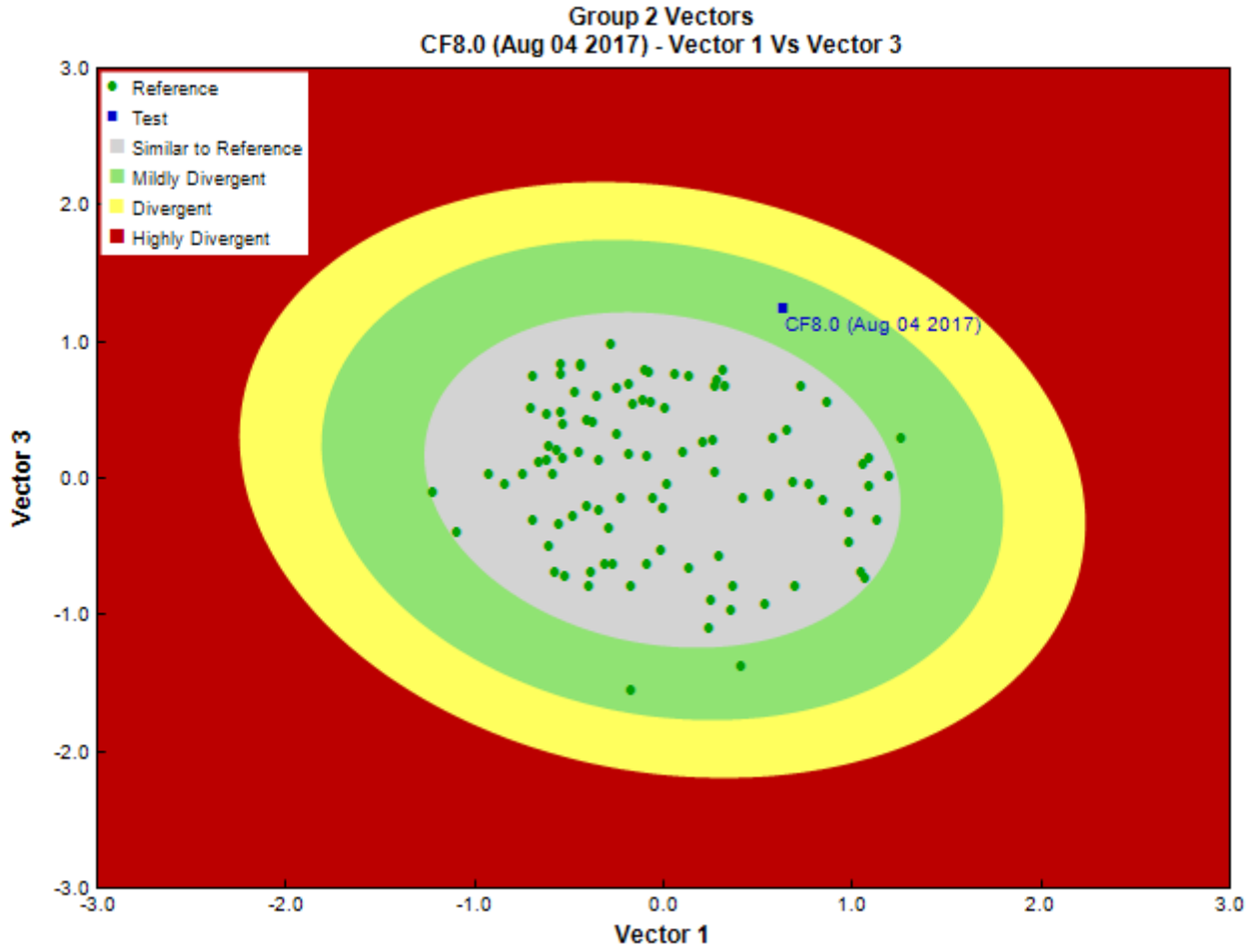

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	50/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Tubificida	Naididae	1	2.0
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	2	4.0
	Insecta	Diptera	Chironomidae	110	220.0
			Deuterophlebiidae	9	18.0
			Simuliidae	161	322.0
			Tipulidae	1	2.0
		Ephemeroptera	Baetidae	108	216.0
			Ephemerellidae	13	26.0
			Heptageniidae	69	138.0
		Plecoptera	Capniidae	5	10.0
			Chloroperlidae	13	26.0
			Nemouridae	1	2.0
			Perlodidae	6	12.0
		Trichoptera	Limnephilidae	3	6.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Total	502	1,004.0

Metrics

Name	CF8.0	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.8	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	56.6	58.6 ± 25.3
% Ephemeroptera	37.8	25.6 ± 21.1
% Plecoptera	5.0	11.3 ± 12.5
% Tricoptera	0.6	4.2 ± 5.8
Total Abundance	1004.0	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	436.0	115.3 ± 124.5
EPT taxa (no)	8.0	5.8 ± 2.9
Simpson's Diversity	0.8	0.6 ± 0.2
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	14.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at CF8.0
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.83
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.62
Nemouridae	39%	74%	100%	81%	100%	0.74
Simuliidae	39%	78%	86%	87%	77%	0.76

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.94
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.27
RIVPACS : Expected taxa P>0.70	3.33
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.20

Habitat Description

Variable	CF8.0	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	32.2	31.4 ± 19.7
Velocity-Avg (m/s)	0.84	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.43870	0.14237 ± 0.34395
Natl-Bryoids (%)	1.46926	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.62595	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	CF10.0
Sampling Date	Aug 05 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.83754 N, 139.15077 W
Altitude	1670
Local Basin Name	Coffee Creek
	Coffee Creek
Stream Order	0

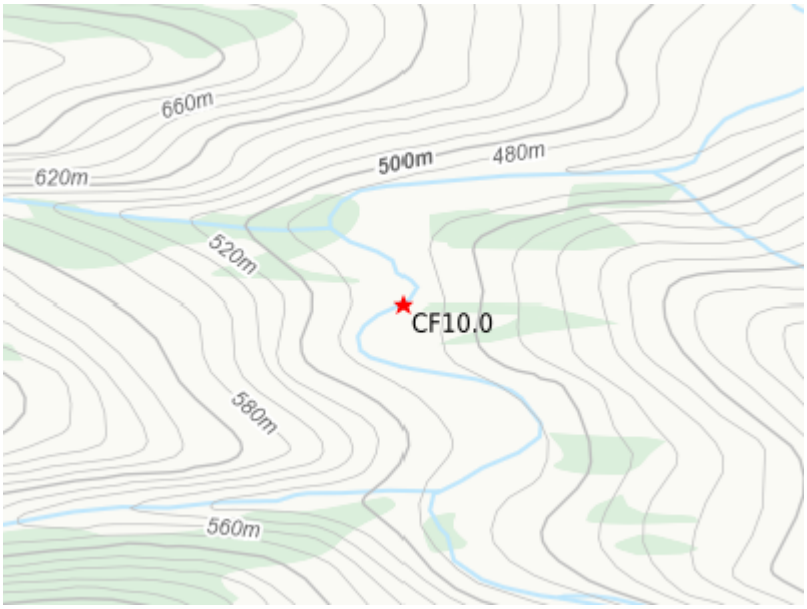

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	6.4%	93.3%	0.0%	0.0%	0.2%
CABIN Assessment of CF10.0 on Aug 05, 2017	Mildly Divergent				

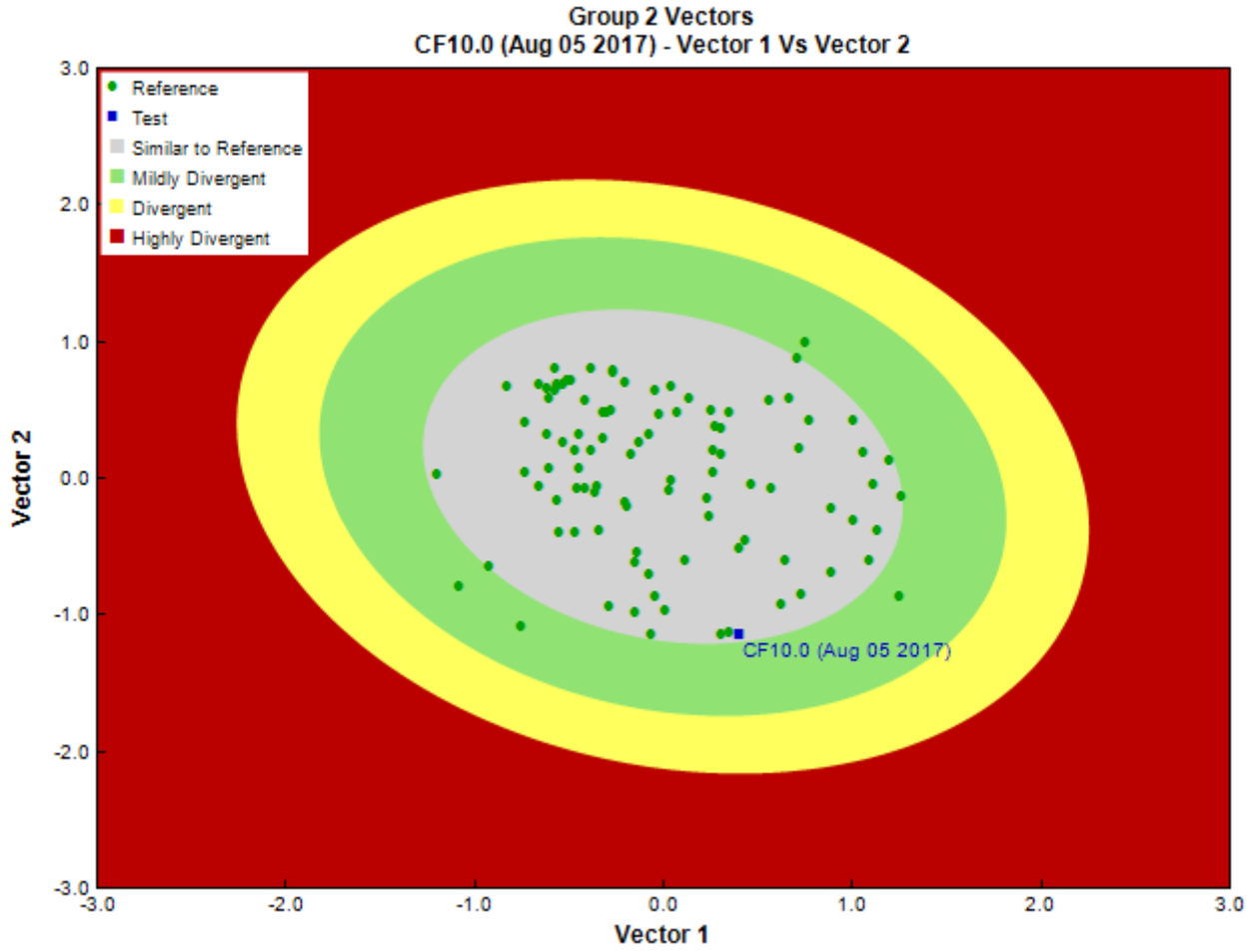

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	45/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	32	71.1
		Tubificida	Naididae	11	24.4
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	4	8.9
	Insecta	Diptera	Chironomidae	26	57.8
			Deuterophlebiidae	4	8.9
			Empididae	8	17.8
			Simuliidae	36	80.0
			Tipulidae	2	4.4
		Ephemeroptera	Baetidae	99	220.0
			Ephemerellidae	9	20.0
			Heptageniidae	54	120.0
		Plecoptera	Capniidae	1	2.2
			Chloroperlidae	4	8.8
			Nemouridae	1	2.2

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Perlodidae	4	8.9
		Trichoptera	Glossosomatidae	2	4.4
			Limnephilidae	3	6.7
			Total	300	666.5

Metrics

Name	CF10.0	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.79	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	41.0	58.6 ± 25.3
% Ephemeroptera	54.0	25.6 ± 21.1
% Plecoptera	3.3	11.3 ± 12.5
% Tricoptera	1.7	4.2 ± 5.8
Total Abundance	666.7	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	393.3	115.3 ± 124.5
EPT taxa (no)	9.0	5.8 ± 2.9
Simpson's Diversity	0.8	0.6 ± 0.2
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	17.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at CF10.0
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.81
Chironomidae	91%	100%	100%	100%	100%	0.99
Heptageniidae	17%	63%	95%	76%	85%	0.60
Nemouridae	39%	74%	100%	81%	100%	0.72
Simuliidae	39%	78%	86%	87%	77%	0.75

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.88
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.29
RIVPACS : Expected taxa P>0.70	3.28
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.22

Habitat Description

Variable	CF10.0	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	29.3	31.4 ± 19.7
Velocity-Avg (m/s)	0.50	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.00000	0.14237 ± 0.34395
Natl-Bryoids (%)	0.00000	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.00000	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	DM1.3
Sampling Date	Aug 08 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.96270 N, 139.30041 W
Altitude	1696
Local Basin Name	Dan Man Creek
	Dan Man Creek
Stream Order	0

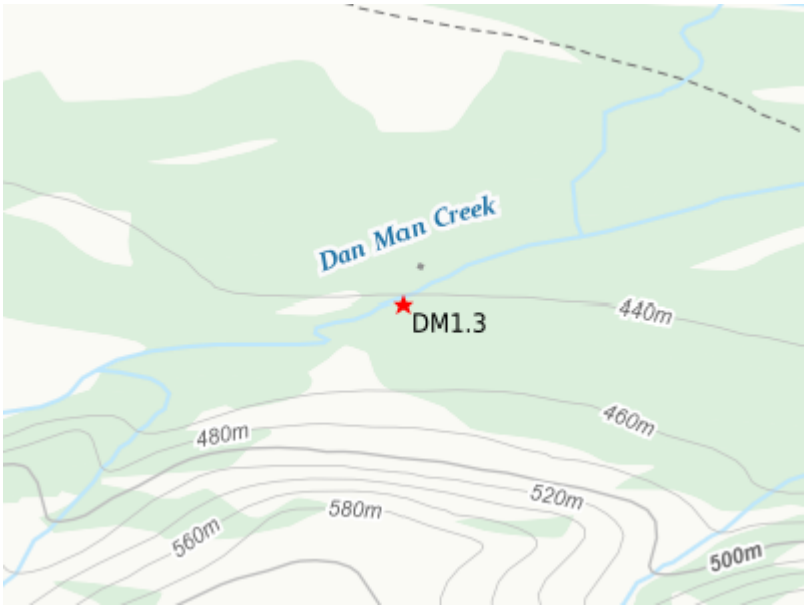

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	5.2%	94.7%	0.0%	0.0%	0.1%
CABIN Assessment of DM1.3 on Aug 08, 2017	Mildly Divergent				

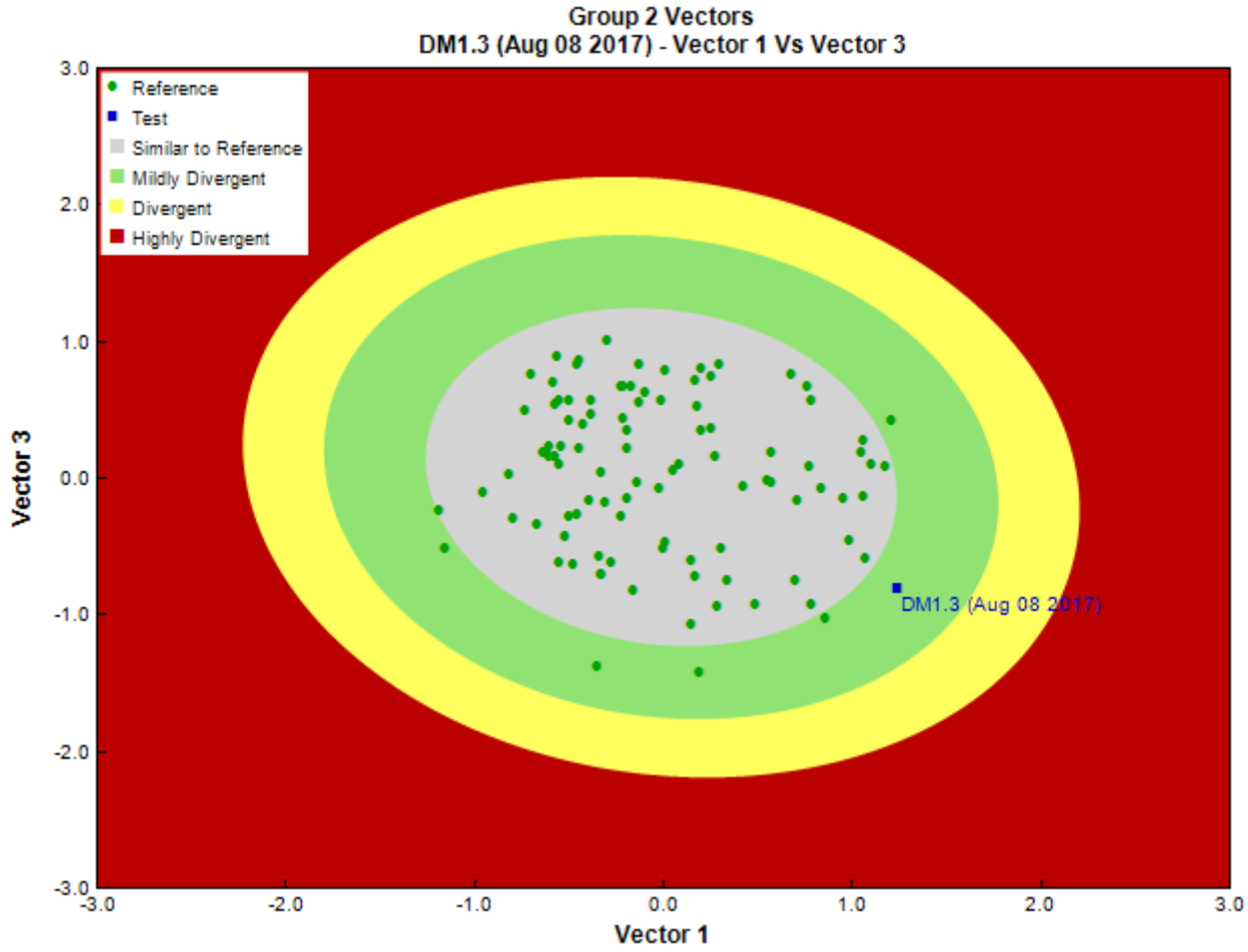

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	50/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	22	44.0
		Tubificida	Naididae	11	22.0
Arthropoda	Arachnida	Trombidiformes		1	2.0
			Sperchontidae	2	4.0
	Insecta	Diptera	Chironomidae	14	28.0
			Simuliidae	10	20.0
			Tipulidae	6	12.0
		Ephemeroptera	Baetidae	43	86.0
			Heptageniidae	7	14.0
		Plecoptera	Capniidae	15	30.0
			Nemouridae	196	392.0
		Trichoptera	Limnephilidae	1	2.0
			Total	328	656.0

Metrics

Name	DM1.3	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.85	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	19.9	58.6 ± 25.3
% Ephemeroptera	15.3	25.6 ± 21.1
% Plecoptera	64.5	11.3 ± 12.5
% Tricoptera	0.3	4.2 ± 5.8
Total Abundance	656.0	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	524.0	115.3 ± 124.5
EPT taxa (no)	5.0	5.8 ± 2.9
Simpson's Diversity	0.6	0.6 ± 0.2
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	11.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at DM1.3
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.82
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.61
Nemouridae	39%	74%	100%	81%	100%	0.73
Simuliidae	39%	78%	86%	87%	77%	0.76

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.90
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.28
RIVPACS : Expected taxa P>0.70	3.30
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.21

Habitat Description

Variable	DM1.3	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	18.3	31.4 ± 19.7
Velocity-Avg (m/s)	0.15	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.00000	0.14237 ± 0.34395
Natl-Bryoids (%)	0.00000	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.00000	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	DM4.6
Sampling Date	Aug 08 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.94127 N, 139.33713 W
Altitude	1857
Local Basin Name	Dan Man Creek
	Dan Man Creek
Stream Order	0

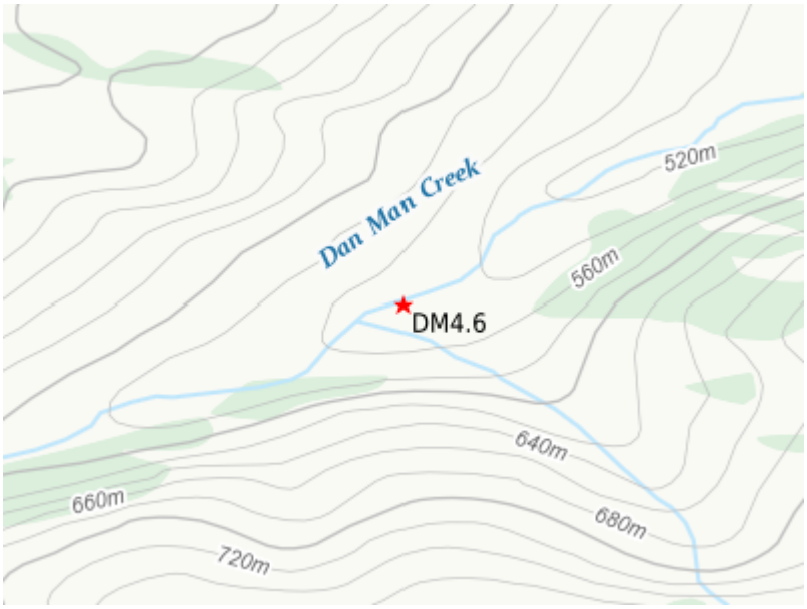

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	5.0%	94.9%	0.0%	0.0%	0.1%
CABIN Assessment of DM4.6 on Aug 08, 2017	Highly Divergent				

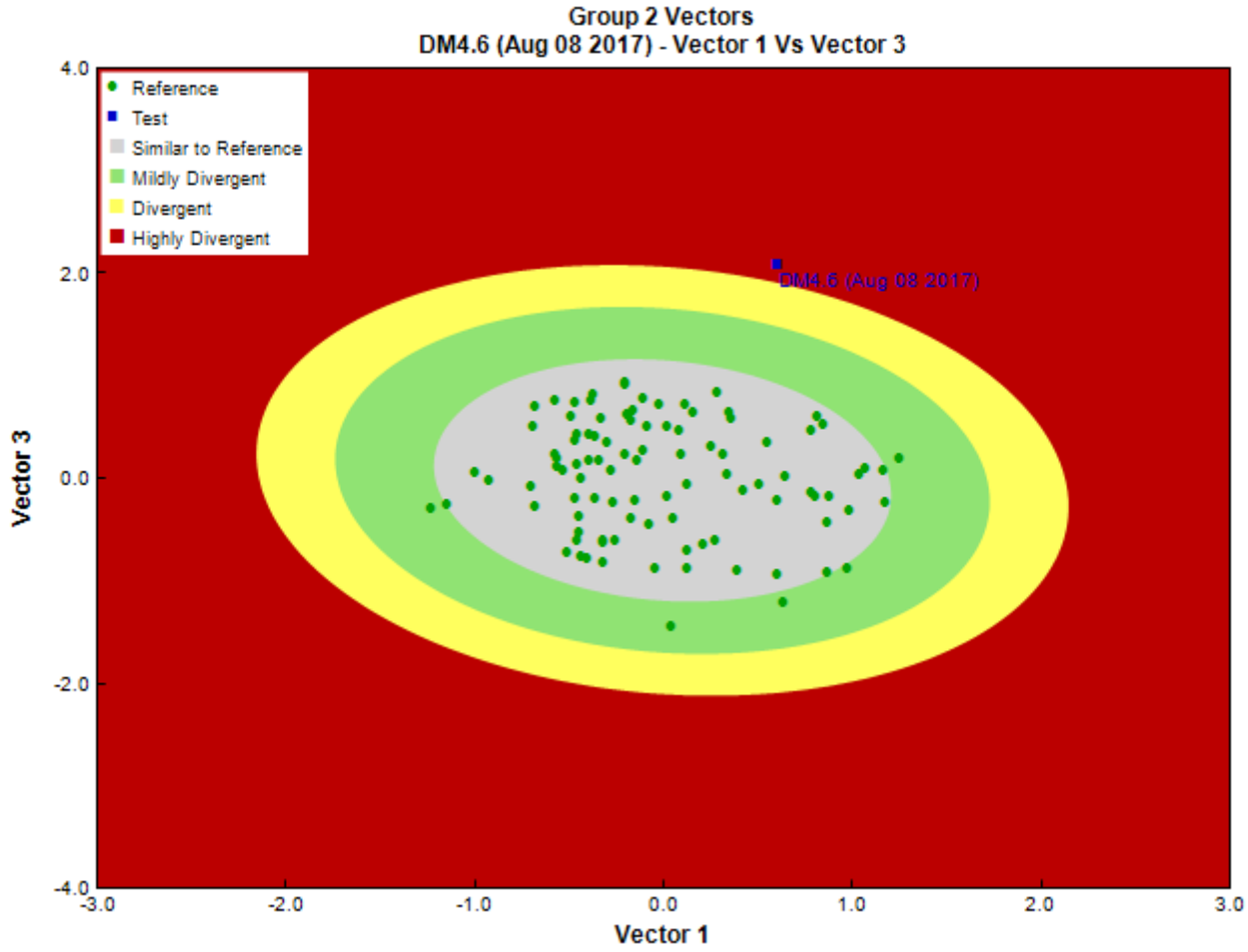

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	9/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Insecta	Diptera	Chironomidae	15	166.6
			Simuliidae	23	255.5
		Ephemeroptera	Baetidae	151	1,677.7
			Heptageniidae	5	55.6
		Plecoptera	Capniidae	6	66.7
			Nemouridae	136	1,511.1
			Total	336	3,733.2

Metrics

Name	DM4.6	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.94	0.5 ± 0.2
Number Of Individuals		

Metrics

Name	DM4.6	Predicted Group Reference Mean ±SD
% Diptera + Non-insects	11.3	58.6 ± 25.3
% Ephemeroptera	46.4	25.6 ± 21.1
% Plecoptera	42.3	11.3 ± 12.5
% Tricoptera	0.0	4.2 ± 5.8
Total Abundance	3733.3	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	3311.1	115.3 ± 124.5
EPT taxa (no)	4.0	5.8 ± 2.9
Simpson's Diversity	0.6	0.6 ± 0.2
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	6.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at DM4.6
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.82
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.61
Nemouridae	39%	74%	100%	81%	100%	0.73
Simuliidae	39%	78%	86%	87%	77%	0.76

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.91
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.28
RIVPACS : Expected taxa P>0.70	3.30
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.21

Habitat Description

Variable	DM4.6	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	12.8	31.4 ± 19.7
Velocity-Avg (m/s)	0.17	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.00000	0.14237 ± 0.34395
Natl-Bryoids (%)	0.00000	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.00000	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	EC2.1
Sampling Date	Aug 08 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.86754 N, 138.97355 W
Altitude	1883
Local Basin Name	Excelsior Creek
	Excelsior Creek
Stream Order	0

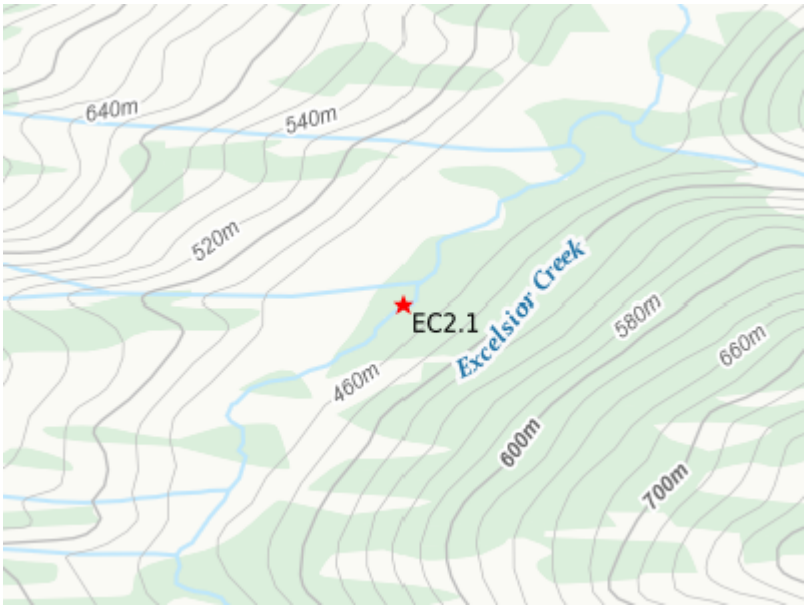

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	4.1%	95.5%	0.0%	0.0%	0.3%
CABIN Assessment of EC2.1 on Aug 08, 2017	Mildly Divergent				

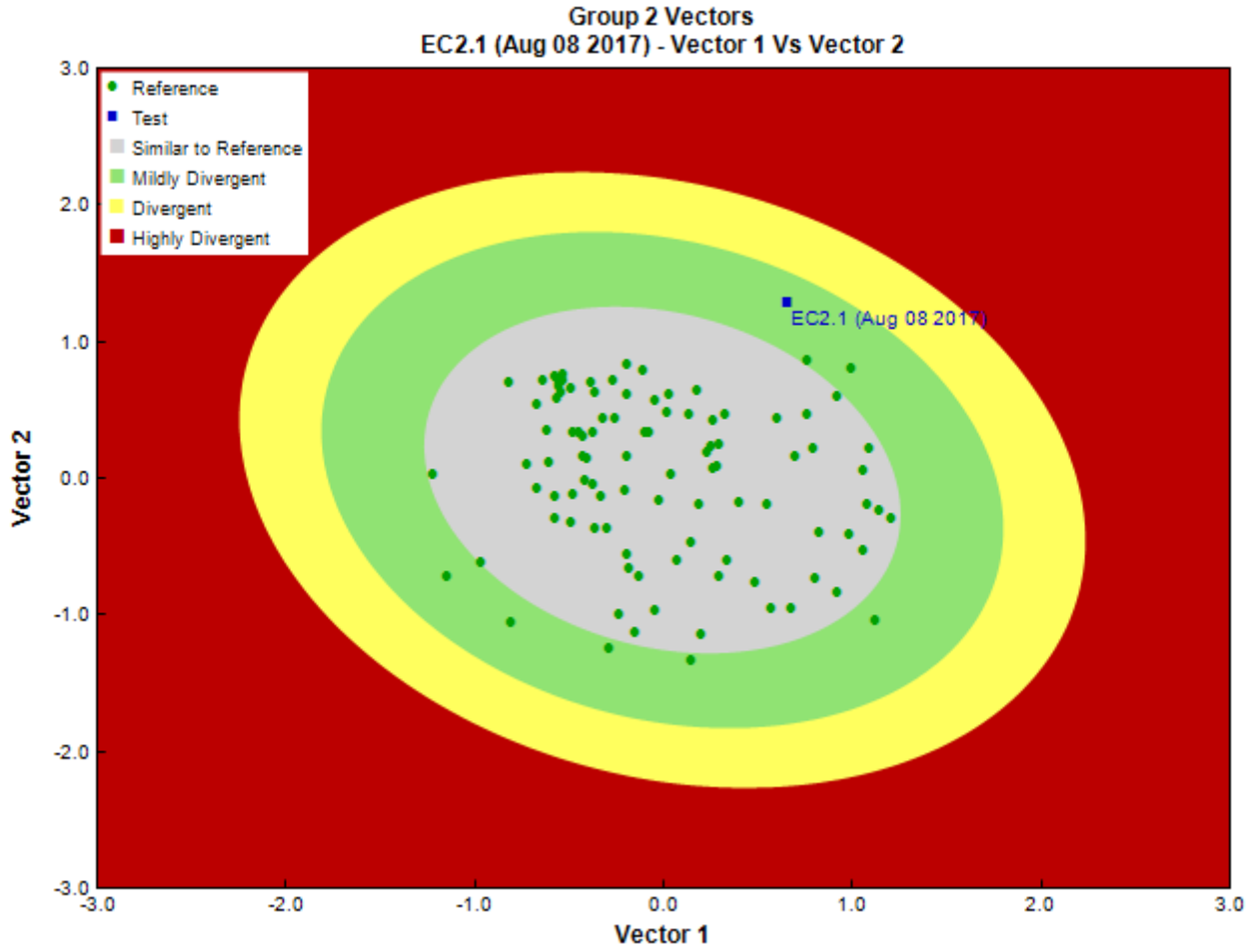

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	27/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Trombidiformes		1	3.7
	Insecta	Diptera		1	3.7
			Chironomidae	51	188.8
			Simuliidae	91	337.0
		Ephemeroptera	Baetidae	146	540.8
			Heptageniidae	10	37.0
		Plecoptera	Capniidae	3	11.1
			Chloroperlidae	4	14.8
			Nemouridae	10	37.0
			Perlodidae	5	18.5
		Trichoptera	Limnephilidae	2	7.4
	Malacostraca	Amphipoda		1	3.7
Mollusca	Gastropoda			1	3.7
			Total	326	1,207.2

Metrics

Name	EC2.1	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.82	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	44.1	58.6 ± 25.3
% Ephemeroptera	48.4	25.6 ± 21.1
% Plecoptera	6.8	11.3 ± 12.5
% Tricoptera	0.6	4.2 ± 5.8
Total Abundance	1207.4	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	666.7	115.3 ± 124.5
EPT taxa (no)	7.0	5.8 ± 2.9
Simpson's Diversity	0.7	0.6 ± 0.2
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	9.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at EC2.1
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.83
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.61
Nemouridae	39%	74%	100%	81%	100%	0.73
Simuliidae	39%	78%	86%	87%	77%	0.76

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.93
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.27
RIVPACS : Expected taxa P>0.70	3.31
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.21

Habitat Description

Variable	EC2.1	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	11.7	31.4 ± 19.7
Velocity-Avg (m/s)	0.26	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.00000	0.14237 ± 0.34395
Natl-Bryoids (%)	0.00000	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.00000	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	HF0.2
Sampling Date	Aug 06 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.94351 N, 139.25063 W
Altitude	1362
Local Basin Name	Halfway Creek
	Halfway Creek
Stream Order	0



Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	10.3%	89.6%	0.0%	0.0%	0.0%
CABIN Assessment of HF0.2 on Aug 06, 2017	Similar to Reference				

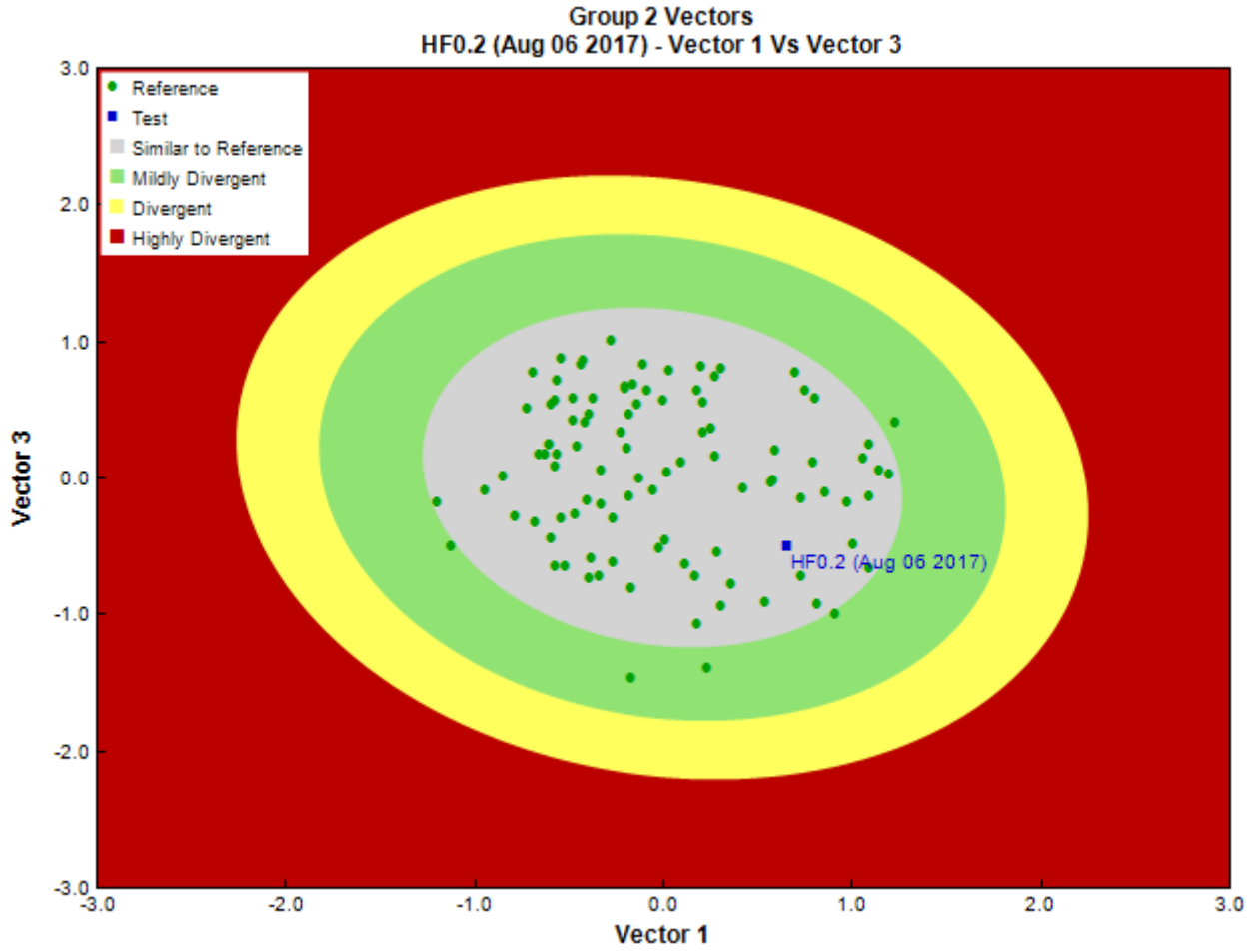

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	100/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Tubificida	Naididae	28	28.0
Arthropoda	Arachnida	Trombidiformes		2	2.0
			Sperchontidae	5	5.0
	Collembola	Collembola		1	1.0
	Insecta	Coleoptera		1	1.0
		Diptera		1	1.0
			Chironomidae	66	66.0
			Simuliidae	9	9.0
			Tipulidae	2	2.0
		Ephemeroptera	Ameletidae	6	6.0
			Baetidae	55	55.0
			Heptageniidae	17	17.0
		Plecoptera	Capniidae	24	24.0
			Nemouridae	218	218.0

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
	Malacostraca	Amphipoda		1	1.0
			Total	436	436.0

Metrics

Name	HF0.2	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.65	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	25.6	58.6 ± 25.3
% Ephemeroptera	18.1	25.6 ± 21.1
% Plecoptera	56.3	11.3 ± 12.5
% Tricoptera	0.0	4.2 ± 5.8
Total Abundance	436.0	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	320.0	115.3 ± 124.5
EPT taxa (no)	5.0	5.8 ± 2.9
Simpson's Diversity	0.7	0.6 ± 0.2
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	10.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at HF0.2
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.79
Chironomidae	91%	100%	100%	100%	100%	0.99
Heptageniidae	17%	63%	95%	76%	85%	0.59
Nemouridae	39%	74%	100%	81%	100%	0.71
Simuliidae	39%	78%	86%	87%	77%	0.74

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.81
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.31
RIVPACS : Expected taxa P>0.70	3.23
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.24

Habitat Description

Variable	HF0.2	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	26.5	31.4 ± 19.7
Velocity-Avg (m/s)	0.17	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.03620	0.14237 ± 0.34395
Natl-Bryoids (%)	0.37008	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	1.88321	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	HF6.3
Sampling Date	Aug 06 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.90947 N, 139.34552 W
Altitude	1594
Local Basin Name	Halfway Creek
	Halfway Creek
Stream Order	0



Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	5.0%	94.9%	0.0%	0.0%	0.1%
CABIN Assessment of HF6.3 on Aug 06, 2017	Mildly Divergent				

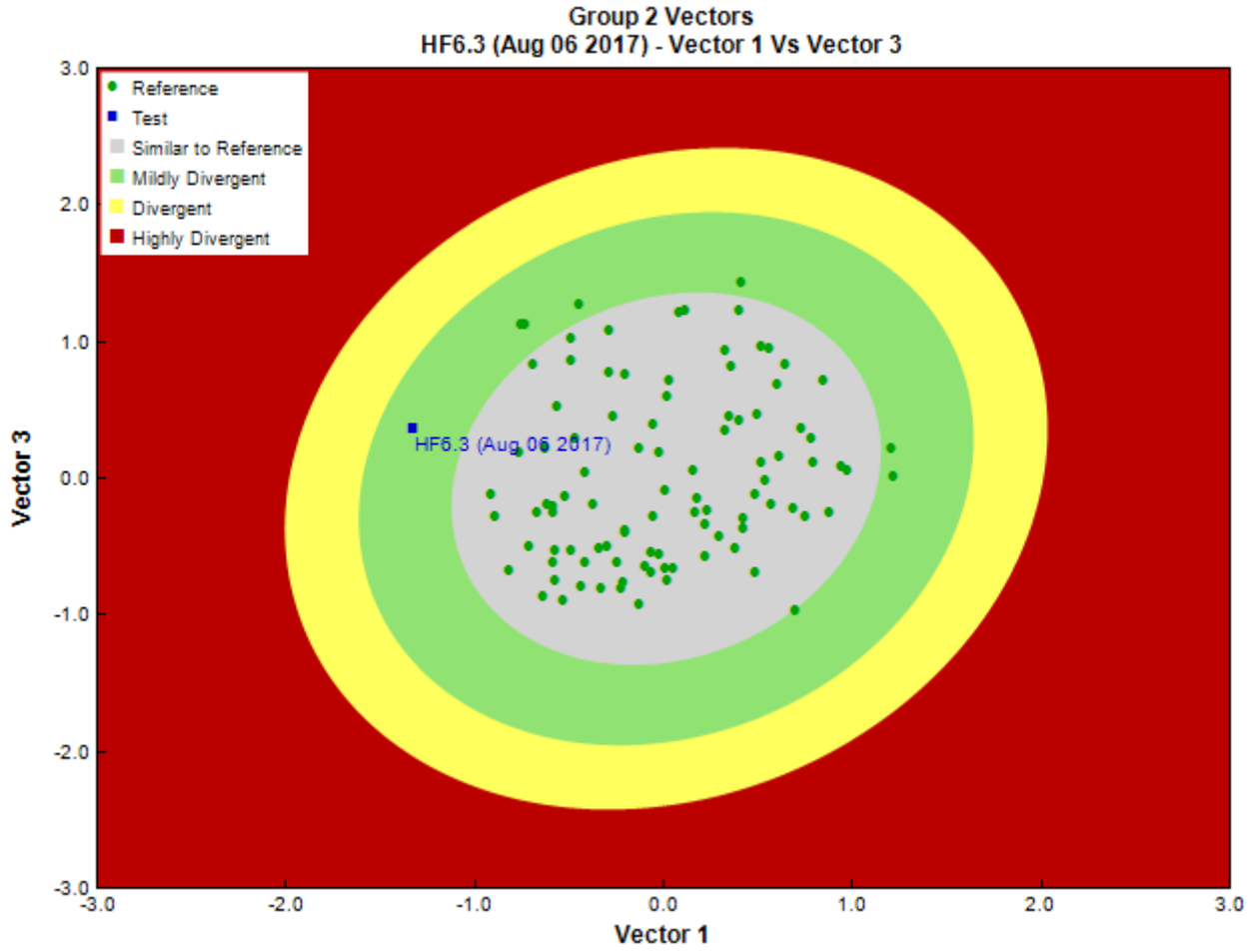

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	28/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	6	21.4
		Tubificida	Naididae	1	3.6
Arthropoda	Insecta	Diptera	Chironomidae	44	157.2
			Simuliidae	36	128.6
			Tipulidae	2	7.1
		Ephemeroptera	Ameletidae	5	17.9
			Baetidae	127	453.6
			Heptageniidae	19	67.9
		Plecoptera	Capniidae	3	10.7
			Chloroperlidae	3	10.7
			Nemouridae	89	317.9
		Trichoptera	Limnephilidae	1	3.6
			Total	336	1,200.2

Metrics

Name	HF6.3	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.82	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	26.5	58.6 ± 25.3
% Ephemeroptera	44.9	25.6 ± 21.1
% Plecoptera	28.3	11.3 ± 12.5
% Tricoptera	0.3	4.2 ± 5.8
Total Abundance	1200.0	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	882.1	115.3 ± 124.5
EPT taxa (no)	7.0	5.8 ± 2.9
Simpson's Diversity	0.8	0.6 ± 0.2
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	12.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at HF6.3
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.82
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.61
Nemouridae	39%	74%	100%	81%	100%	0.73
Simuliidae	39%	78%	86%	87%	77%	0.76

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.91
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.28
RIVPACS : Expected taxa P>0.70	3.30
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.21

Habitat Description

Variable	HF6.3	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	14.2	31.4 ± 19.7
Velocity-Avg (m/s)	0.20	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.00000	0.14237 ± 0.34395
Natl-Bryoids (%)	0.00000	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.00000	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	ID1.9
Sampling Date	Aug 02 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.96995 N, 139.43324 W
Altitude	1083
Local Basin Name	Independence Creek
	Independence Creek
Stream Order	0

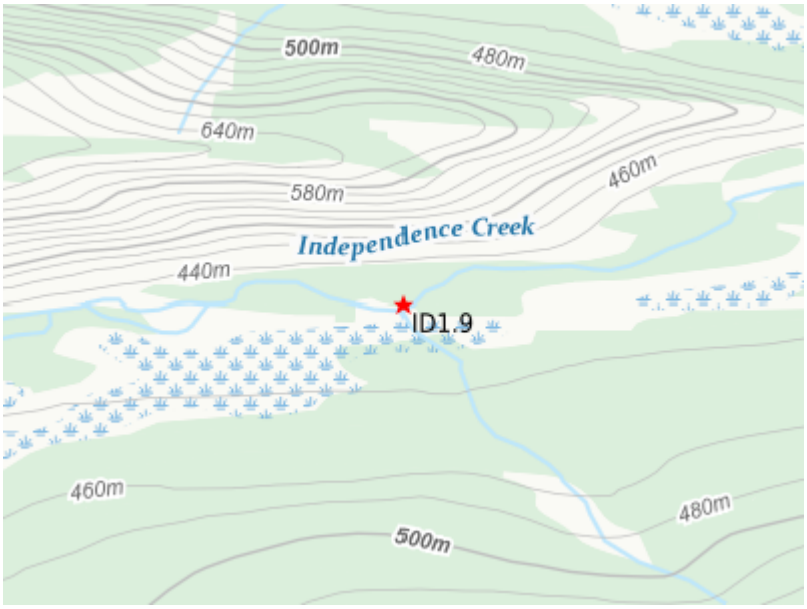

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	8.1%	91.9%	0.0%	0.0%	0.0%
CABIN Assessment of ID1.9 on Aug 02, 2017	Divergent				

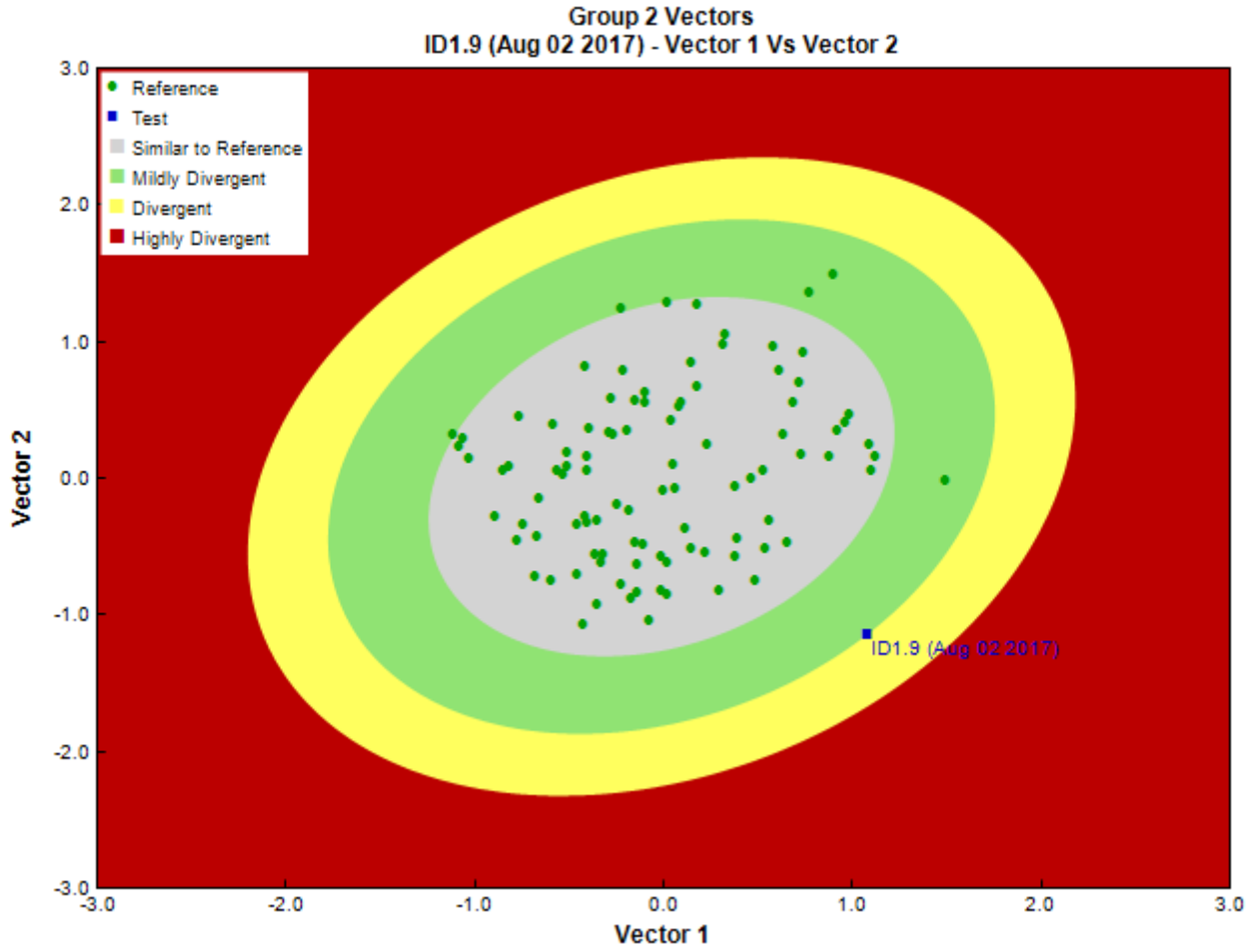

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	20/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	3	15.0
		Tubificida	Naididae	35	175.0
Arthropoda	Arachnida	Trombidiformes	Sperchontidae	3	15.0
	Insecta	Diptera	Chironomidae	106	530.0
			Empididae	11	55.0
			Simuliidae	114	570.0
		Ephemeroptera	Baetidae	73	365.0
			Heptageniidae	12	60.0
		Plecoptera	Chloroperlidae	3	15.0
			Nemouridae	5	25.0
		Trichoptera	Limnephilidae	2	10.0
			Total	367	1,835.0

Metrics

Name	ID1.9	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.88	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	74.1	58.6 ± 25.3
% Ephemeroptera	23.2	25.6 ± 21.1
% Plecoptera	2.2	11.3 ± 12.5
% Tricoptera	0.5	4.2 ± 5.8
Total Abundance	1835.0	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	475.0	115.3 ± 124.5
EPT taxa (no)	5.0	5.8 ± 2.9
Simpson's Diversity	0.8	0.6 ± 0.2
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	11.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at ID1.9
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.80
Chironomidae	91%	100%	100%	100%	100%	0.99
Heptageniidae	17%	63%	95%	76%	85%	0.60
Nemouridae	39%	74%	100%	81%	100%	0.72
Simuliidae	39%	78%	86%	87%	77%	0.74

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.85
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.30
RIVPACS : Expected taxa P>0.70	3.26
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.23

Habitat Description

Variable	ID1.9	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	60.5	31.4 ± 19.7
Velocity-Avg (m/s)	0.23	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.00457	0.14237 ± 0.34395
Natl-Bryoids (%)	1.28439	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	1.13939	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	LaC4.8
Sampling Date	Aug 03 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	63.04088 N, 139.62636 W
Altitude	2546
Local Basin Name	Los Angeles Creek
	Los Angeles Creek
Stream Order	0



Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	14.4%	84.4%	0.1%	0.1%	1.1%
CABIN Assessment of LaC4.8 on Aug 03, 2017	Highly Divergent				

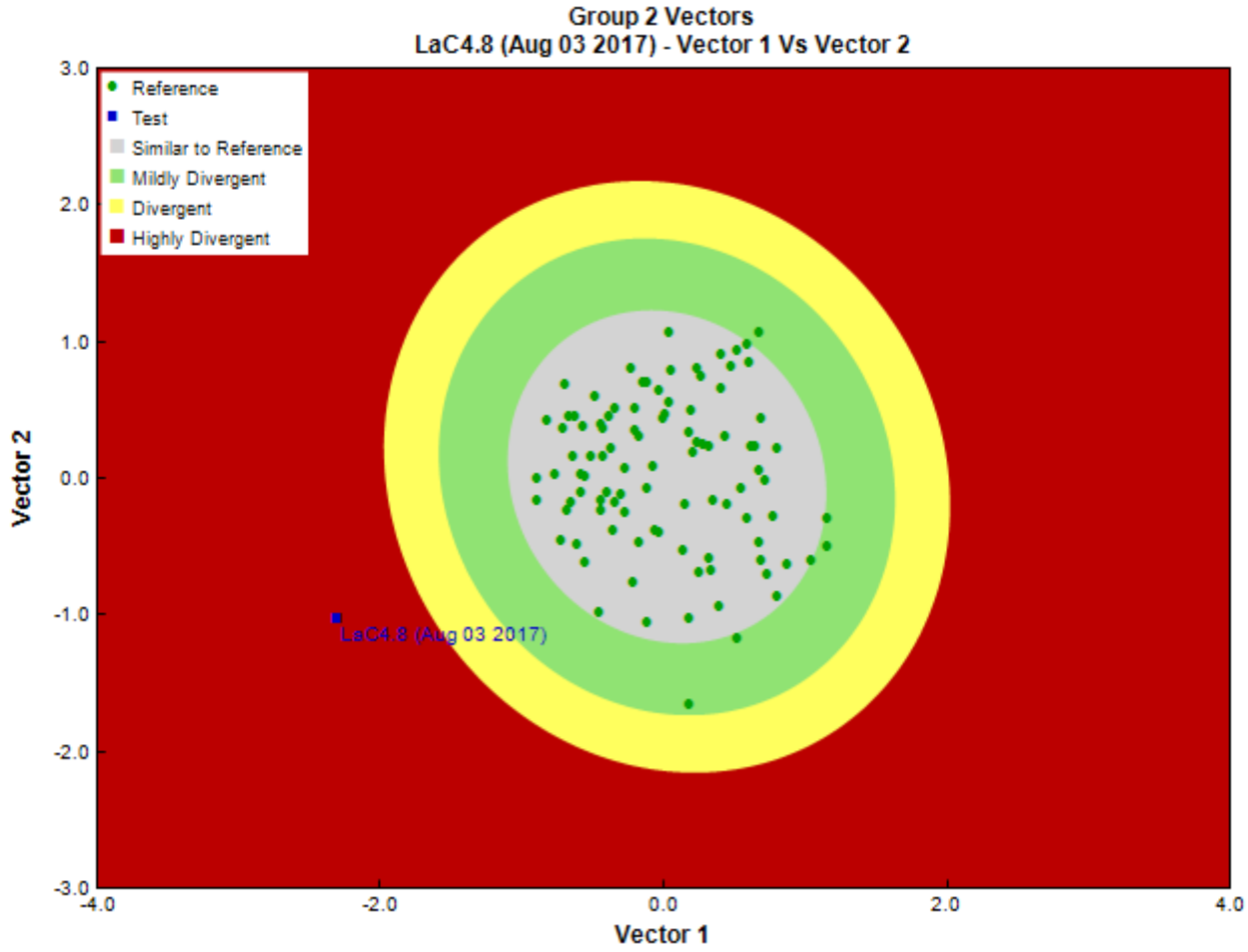

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	6/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	1	16.7
Arthropoda	Arachnida	Trombidiformes	Hydryphantidae	1	16.7
			Sperchontidae	1	16.7
	Insecta	Diptera	Chironomidae	7	116.8
			Empididae	1	16.7
			Simuliidae	89	1,483.3
			Tipulidae	1	16.7
		Ephemeroptera	Baetidae	116	1,933.3
			Heptageniidae	59	983.4
		Plecoptera	Capniidae	4	66.7
			Chloroperlidae	1	16.7
			Nemouridae	77	1,283.3
			Total	358	5,967.0

Metrics

Name	LaC4.8	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.96	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	28.2	58.6 ± 25.3
% Ephemeroptera	48.9	25.6 ± 21.1
% Plecoptera	22.9	11.3 ± 12.5
% Tricoptera	0.0	4.2 ± 5.8
Total Abundance	5966.7	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	4283.3	115.3 ± 124.5
EPT taxa (no)	5.0	5.8 ± 2.9
Simpson's Diversity	0.8	0.6 ± 0.2
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	12.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at LaC4.8
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.77
Chironomidae	91%	100%	100%	100%	100%	0.99
Heptageniidae	17%	63%	95%	76%	85%	0.57
Nemouridae	39%	74%	100%	81%	100%	0.70
Simuliidae	39%	78%	86%	87%	77%	0.72

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.74
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.34
RIVPACS : Expected taxa P>0.70	2.48
RIVPACS : Observed taxa P>0.70	3.00
RIVPACS : O:E (p > 0.7)	1.21

Habitat Description

Variable	LaC4.8	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	16.7	31.4 ± 19.7
Velocity-Avg (m/s)	0.43	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.89107	0.14237 ± 0.34395
Natl-Bryoids (%)	0.14992	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	1.86018	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	LC2.7
Sampling Date	Aug 04 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.85445 N, 139.19600 W
Altitude	1670
Local Basin Name	Coffee Creek
	Coffee Creek
Stream Order	0

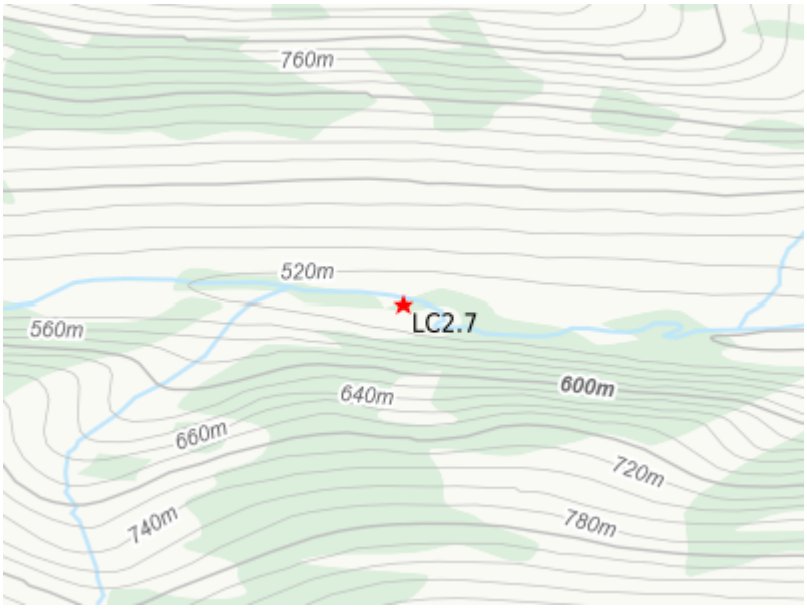

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	1.5%	97.6%	0.0%	0.0%	0.9%
CABIN Assessment of LC2.7 on Aug 04, 2017	Mildly Divergent				

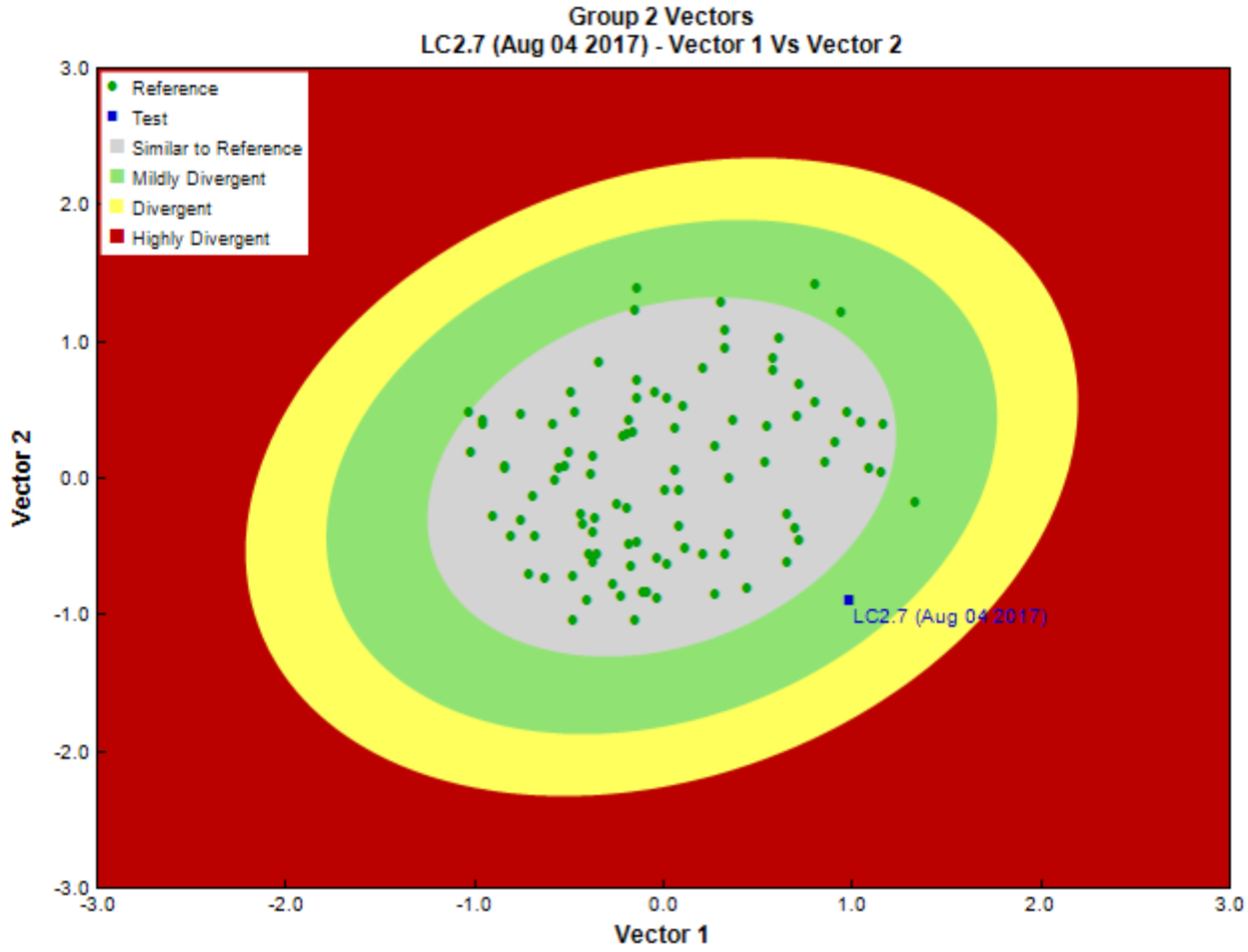

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	28/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Arthropoda	Arachnida	Sarcoptiformes		1	3.6
		Trombidiformes		2	7.1
	Insecta	Diptera	Ceratopogonidae	1	3.6
			Chironomidae	38	135.8
			Simuliidae	146	521.5
		Ephemeroptera	Baetidae	55	196.5
			Heptageniidae	18	64.2
		Hymenoptera		1	3.6
		Plecoptera	Capniidae	1	3.6
			Chloroperlidae	19	67.9
			Nemouridae	24	85.7
			Perlodidae	6	21.4
		Trichoptera	Limnephilidae	2	7.1
	Malacostraca	Amphipoda	Crangonyctidae	3	10.7

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
			Total	317	1,132.3

Metrics

Name	LC2.7	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.81	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	60.1	58.6 ± 25.3
% Ephemeroptera	23.3	25.6 ± 21.1
% Plecoptera	16.0	11.3 ± 12.5
% Tricoptera	0.6	4.2 ± 5.8
Total Abundance	1132.1	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	446.4	115.3 ± 124.5
EPT taxa (no)	7.0	5.8 ± 2.9
Simpson's Diversity	0.7	0.6 ± 0.2
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	11.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at LC2.7
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.84
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.63
Nemouridae	39%	74%	100%	81%	100%	0.74
Simuliidae	39%	78%	86%	87%	77%	0.77

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.98
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.26
RIVPACS : Expected taxa P>0.70	3.35
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.19

Habitat Description

Variable	LC2.7	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	12.5	31.4 ± 19.7
Velocity-Avg (m/s)	0.31	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.07973	0.14237 ± 0.34395
Natl-Bryoids (%)	1.62143	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.00000	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	LC9.9
Sampling Date	Aug 05 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.86535 N, 139.33126 W
Altitude	2657
Local Basin Name	Coffee Creek
	Coffee Creek
Stream Order	0

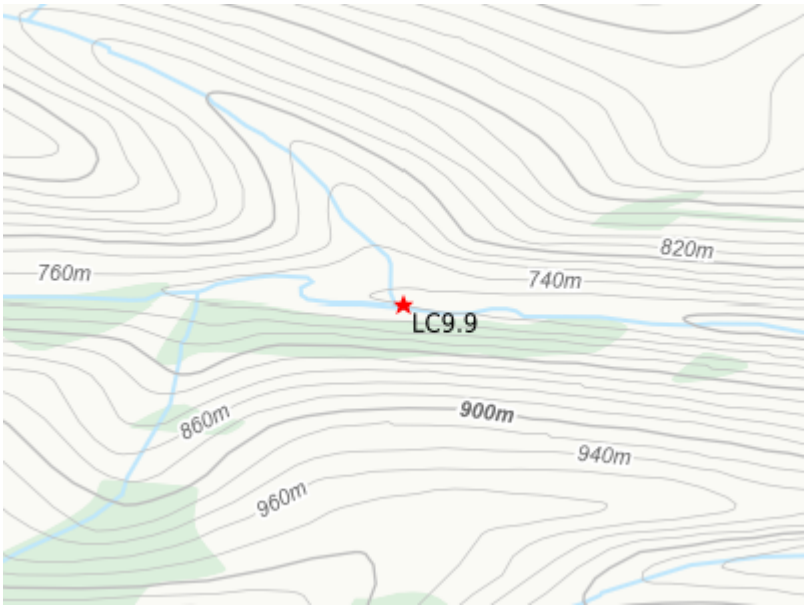

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	2.3%	93.7%	0.0%	0.1%	4.0%
CABIN Assessment of LC9.9 on Aug 05, 2017	Mildly Divergent				

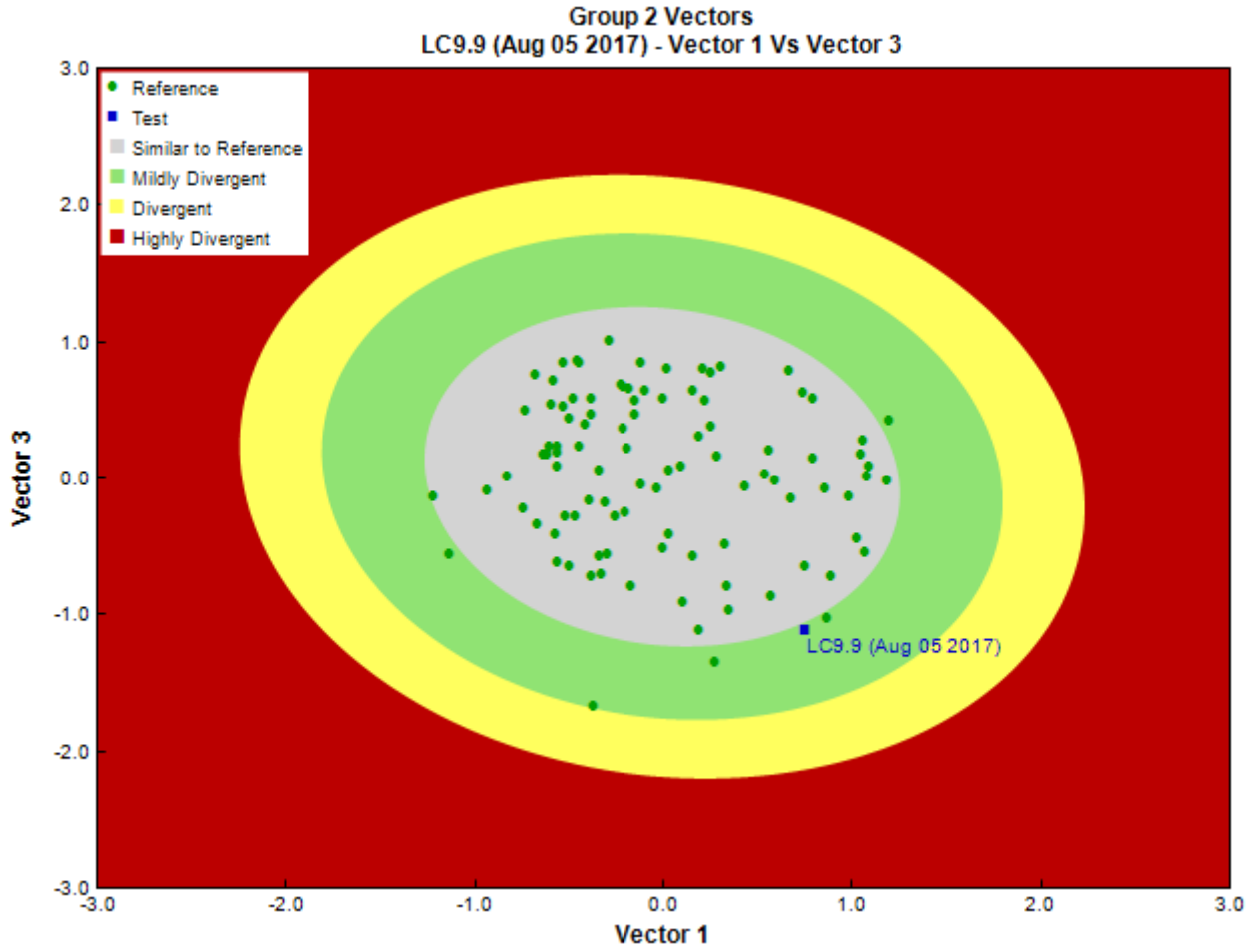

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	45/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	4	8.9
		Tubificida	Naididae	3	6.7
Arthropoda	Arachnida	Sarcoptiformes		1	2.2
	Insecta	Diptera	Chironomidae	21	46.6
			Empididae	1	2.2
			Muscidae	1	2.2
			Simuliidae	46	102.3
			Tipulidae	1	2.2
		Ephemeroptera	Ameletidae	1	2.2
			Baetidae	206	457.8
			Heptageniidae	2	4.4
		Plecoptera	Capniidae	1	2.2
			Chloroperlidae	1	2.2
			Nemouridae	67	148.9

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
		Trichoptera	Limnephilidae	1	2.2
			Total	357	793.2

Metrics

Name	LC9.9	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.83	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	21.6	58.6 ± 25.3
% Ephemeroptera	58.7	25.6 ± 21.1
% Plecoptera	19.4	11.3 ± 12.5
% Tricoptera	0.3	4.2 ± 5.8
Total Abundance	793.3	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	620.0	115.3 ± 124.5
EPT taxa (no)	7.0	5.8 ± 2.9
Simpson's Diversity	0.6	0.6 ± 0.2
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	14.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at LC9.9
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.84
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.63
Nemouridae	39%	74%	100%	81%	100%	0.75
Simuliidae	39%	78%	86%	87%	77%	0.77

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.98
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.26
RIVPACS : Expected taxa P>0.70	3.35
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.19

Habitat Description

Variable	LC9.9	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	22.7	31.4 ± 19.7
Velocity-Avg (m/s)	0.23	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.07437	0.14237 ± 0.34395
Natl-Bryoids (%)	1.51230	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.00000	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	SYT0.6
Sampling Date	Aug 10 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.92350 N, 139.21986 W
Altitude	1791
Local Basin Name	South of YT-24 Creek
	South of YT-24 Creek
Stream Order	0



Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	4.6%	95.2%	0.0%	0.0%	0.2%
CABIN Assessment of SYT0.6 on Aug 10, 2017	Divergent				

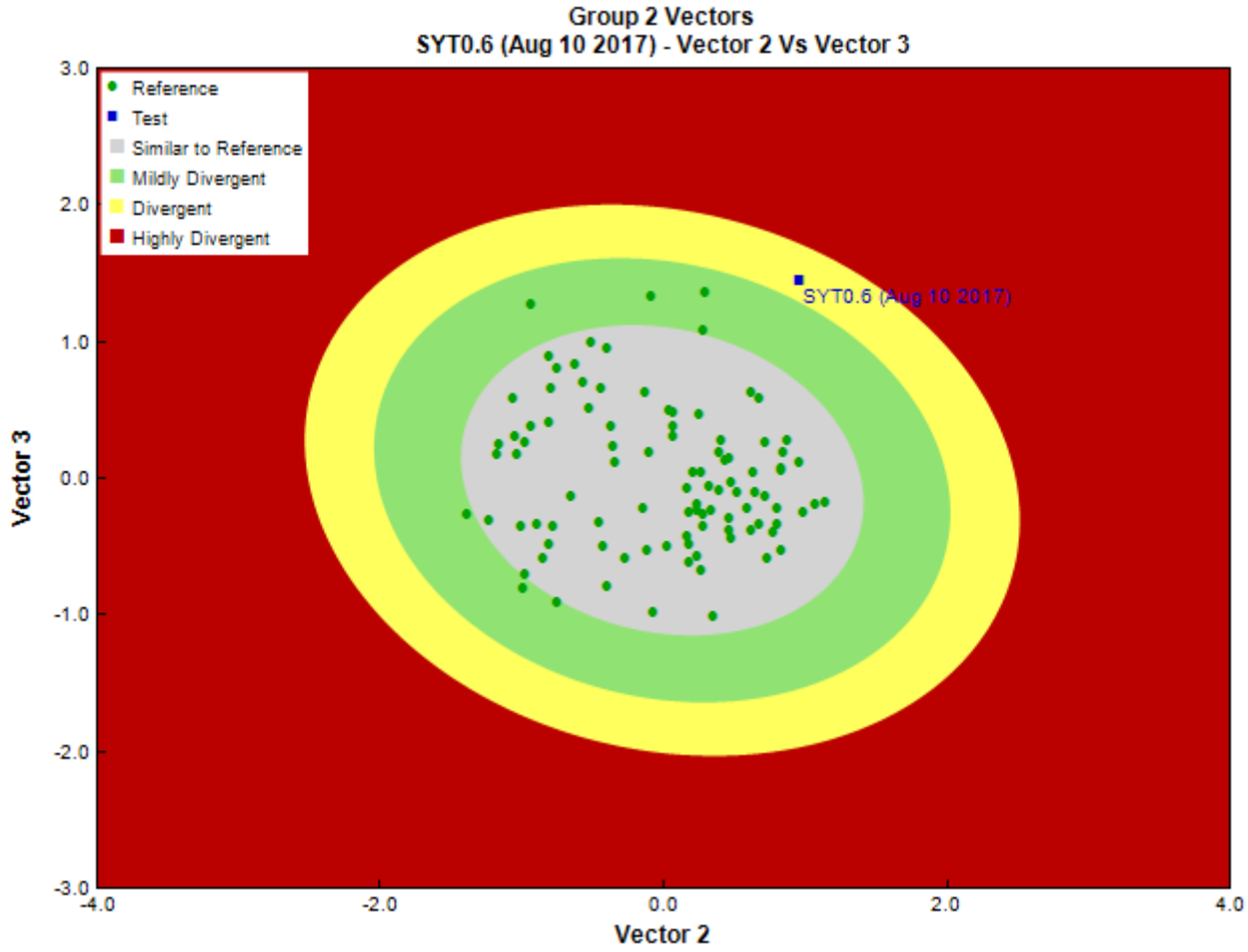

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	21/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	3	14.3
Arthropoda	Insecta	Diptera	Chironomidae	40	190.6
			Empididae	1	4.8
			Simuliidae	29	138.1
		Ephemeroptera	Baetidae	88	419.0
			Heptageniidae	1	4.8
		Plecoptera	Capniidae	51	242.8
			Nemouridae	108	514.3
			Total	321	1,528.7

Metrics

Name	SYT0.6	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.86	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	22.7	58.6 ± 25.3
% Ephemeroptera	27.7	25.6 ± 21.1
% Plecoptera	49.5	11.3 ± 12.5
% Tricoptera	0.0	4.2 ± 5.8
Total Abundance	1528.6	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	1181.0	115.3 ± 124.5
EPT taxa (no)	4.0	5.8 ± 2.9
Simpson's Diversity	0.8	0.6 ± 0.2
Simpson's Evenness	0.5	0.3 ± 0.1
Total No. of Taxa	8.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at SYT0.6
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.82
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.61
Nemouridae	39%	74%	100%	81%	100%	0.73
Simuliidae	39%	78%	86%	87%	77%	0.76

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.92
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.28
RIVPACS : Expected taxa P>0.70	3.31
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.21

Habitat Description

Variable	SYT0.6	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	10.8	31.4 ± 19.7
Velocity-Avg (m/s)	0.29	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.00000	0.14237 ± 0.34395
Natl-Bryoids (%)	0.00000	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.00000	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	SYT3.5
Sampling Date	Aug 10 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.90237 N, 139.25128 W
Altitude	2185
Local Basin Name	South of YT-24 Creek
	South of YT-24 Creek
Stream Order	0



Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	4.5%	95.1%	0.0%	0.0%	0.4%
CABIN Assessment of SYT3.5 on Aug 10, 2017	Mildly Divergent				

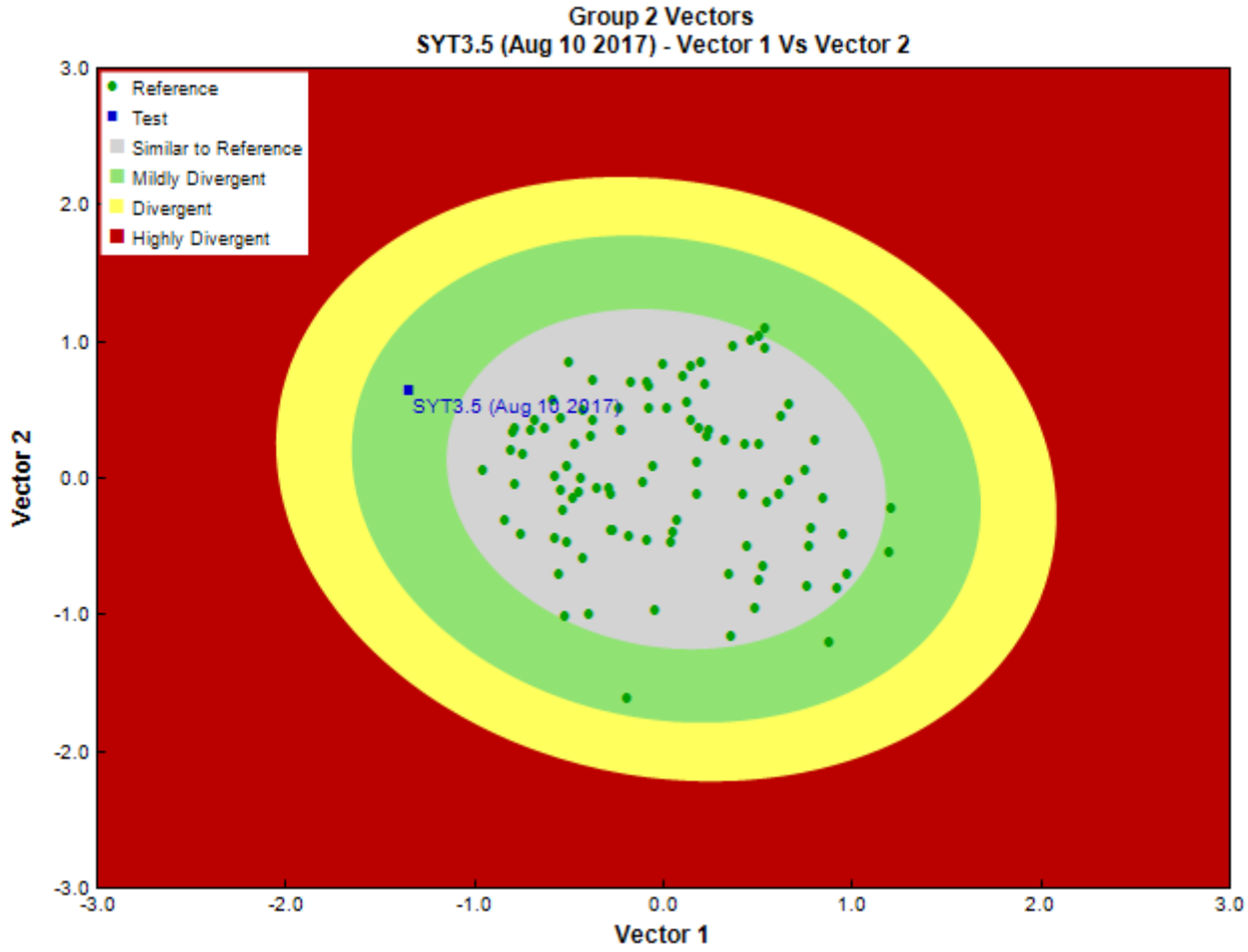

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	50/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	4	8.0
		Tubificida	Naididae	1	2.0
Arthropoda	Collembola	Collembola		1	2.0
	Insecta	Diptera	Chironomidae	68	136.0
			Simuliidae	18	36.0
		Plecoptera	Capniidae	63	126.0
			Nemouridae	199	398.0
			Total	354	708.0

Metrics

Name	SYT3.5	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.76	0.5 ± 0.2

Metrics

Name	SYT3.5	Predicted Group Reference Mean ±SD
Number Of Individuals		
% Diptera + Non-insects	25.8	58.6 ± 25.3
% Ephemeroptera	0.0	25.6 ± 21.1
% Plecoptera	74.2	11.3 ± 12.5
% Tricoptera	0.0	4.2 ± 5.8
Total Abundance	708.0	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	524.0	115.3 ± 124.5
EPT taxa (no)	2.0	5.8 ± 2.9
Simpson's Diversity	0.6	0.6 ± 0.2
Simpson's Evenness	0.4	0.3 ± 0.1
Total No. of Taxa	6.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at SYT3.5
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.82
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.61
Nemouridae	39%	74%	100%	81%	100%	0.73
Simuliidae	39%	78%	86%	87%	77%	0.76

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.92
RIVPACS : Observed taxa P>0.50	3.00
RIVPACS : O:E (p > 0.5)	0.77
RIVPACS : Expected taxa P>0.70	3.31
RIVPACS : Observed taxa P>0.70	3.00
RIVPACS : O:E (p > 0.7)	0.91

Habitat Description

Variable	SYT3.5	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	7.5	31.4 ± 19.7
Velocity-Avg (m/s)	0.18	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.00000	0.14237 ± 0.34395
Natl-Bryoids (%)	0.00000	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.00000	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	TEC6.0
Sampling Date	Aug 08 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.83501 N, 138.98394 W
Altitude	1890
Local Basin Name	Tributary to Excelsior Creek
	Tributary to Excelsior Creek
Stream Order	0

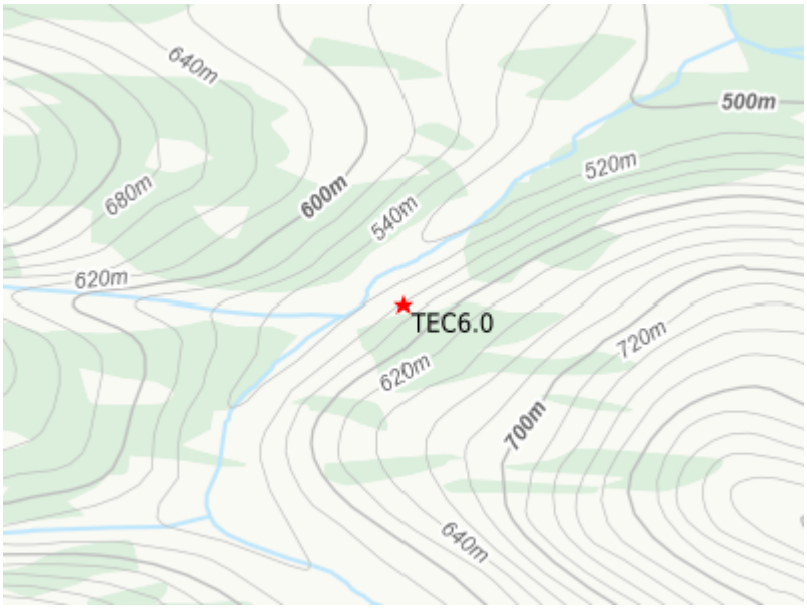

Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	4.5%	95.3%	0.0%	0.0%	0.2%
CABIN Assessment of TEC6.0 on Aug 08, 2017	Mildly Divergent				

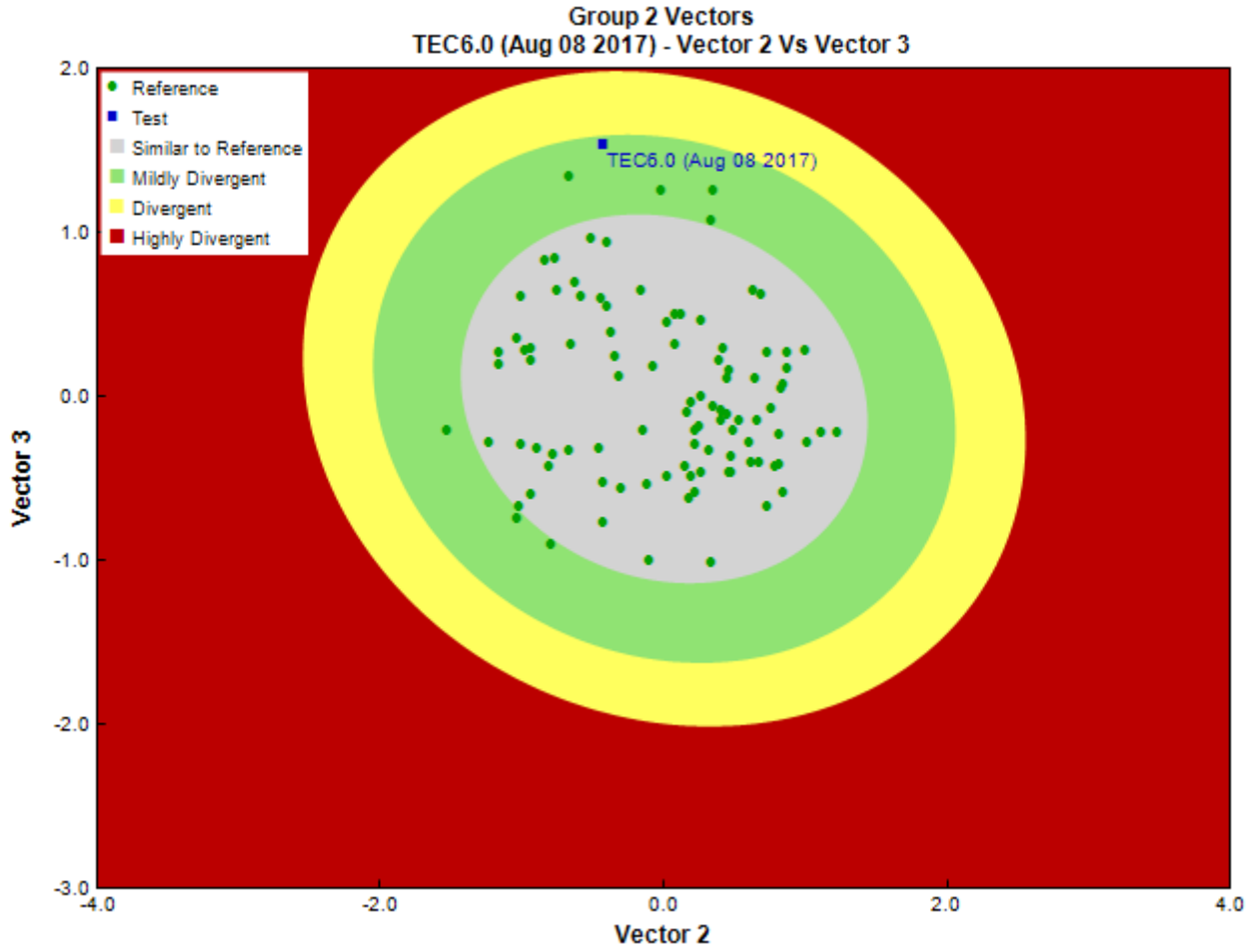

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	30/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Tubificida	Naididae	1	3.3
Arthropoda	Arachnida	Trombidiformes		1	3.3
	Collembola	Collembola		1	3.3
	Insecta	Diptera	Chironomidae	11	36.6
			Empididae	1	3.3
			Simuliidae	28	93.3
		Ephemeroptera	Baetidae	253	843.3
			Heptageniidae	7	23.3
		Plecoptera	Chloroperlidae	1	3.3
			Nemouridae	24	80.0
			Perlodidae	3	10.0
			Total	331	1,103.0

Metrics

Name	TEC6.0	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.89	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	12.5	58.6 ± 25.3
% Ephemeroptera	79.0	25.6 ± 21.1
% Plecoptera	8.5	11.3 ± 12.5
% Tricoptera	0.0	4.2 ± 5.8
Total Abundance	1103.3	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	960.0	115.3 ± 124.5
EPT taxa (no)	5.0	5.8 ± 2.9
Simpson's Diversity	0.4	0.6 ± 0.2
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	9.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at TEC6.0
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.82
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.61
Nemouridae	39%	74%	100%	81%	100%	0.73
Simuliidae	39%	78%	86%	87%	77%	0.76

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.92
RIVPACS : Observed taxa P>0.50	5.00
RIVPACS : O:E (p > 0.5)	1.28
RIVPACS : Expected taxa P>0.70	3.31
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.21

Habitat Description

Variable	TEC6.0	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	16.7	31.4 ± 19.7
Velocity-Avg (m/s)	0.22	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.00000	0.14237 ± 0.34395
Natl-Bryoids (%)	0.00000	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.00000	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	YT0.2
Sampling Date	Aug 07 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.93112 N, 139.23455 W
Altitude	2037
Local Basin Name	Unnamed
	Unnamed
Stream Order	0



Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	10.8%	88.9%	0.0%	0.0%	0.3%
CABIN Assessment of YT0.2 on Aug 07, 2017	Mildly Divergent				

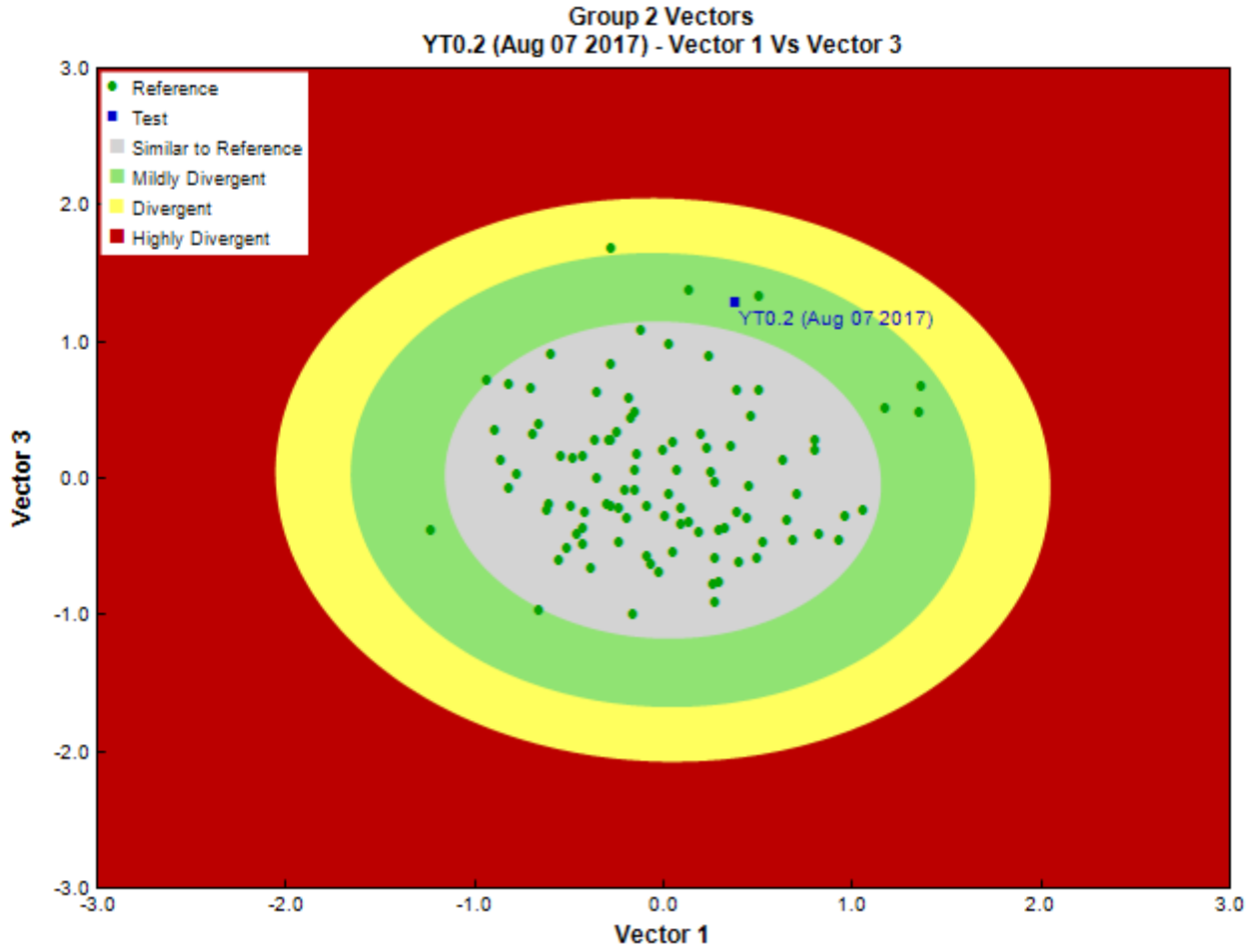

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	100/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	2	2.0
		Tubificida	Naididae	3	3.0
Arthropoda	Arachnida	Sarcoptiformes		1	1.0
	Collembola	Collembola	Hypogastruridae	1	1.0
	Insecta	Diptera	Chironomidae	42	42.0
			Empididae	1	1.0
			Simuliidae	19	19.0
			Tipulidae	2	2.0
		Ephemeroptera	Baetidae	56	56.0
		Plecoptera	Capniidae	10	10.0
			Nemouridae	300	300.0
			Total	437	437.0

Metrics

Name	YT0.2	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.75	0.5 ± 0.2
Number Of Individuals		
% Diptera + Non-insects	15.8	58.6 ± 25.3
% Ephemeroptera	12.8	25.6 ± 21.1
% Plecoptera	71.1	11.3 ± 12.5
% Tricoptera	0.0	4.2 ± 5.8
Total Abundance	437.0	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	366.0	115.3 ± 124.5
EPT taxa (no)	3.0	5.8 ± 2.9
Simpson's Diversity	0.5	0.6 ± 0.2
Simpson's Evenness	0.2	0.3 ± 0.1
Total No. of Taxa	10.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at YT0.2
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.79
Chironomidae	91%	100%	100%	100%	100%	0.99
Heptageniidae	17%	63%	95%	76%	85%	0.58
Nemouridae	39%	74%	100%	81%	100%	0.71
Simuliidae	39%	78%	86%	87%	77%	0.73

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.81
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	1.05
RIVPACS : Expected taxa P>0.70	3.22
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.24

Habitat Description

Variable	YT0.2	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	10.5	31.4 ± 19.7
Velocity-Avg (m/s)	0.33	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.05327	0.14237 ± 0.34395
Natl-Bryoids (%)	0.26099	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	2.18745	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

Site Description

Study Name	YK-Coffee Gold Baseline-PECG
Site	YT5.0
Sampling Date	Aug 07 2017
Know Your Watershed Basin	Upper Yukon
Province / Territory	Yukon Territories
Terrestrial Ecological Classification	Boreal Cordillera EcoZone Klondike Plateau EcoRegion
Coordinates (decimal degrees)	62.90614 N, 139.31156 W
Altitude	2274
Local Basin Name	Unnamed
	Unnamed
Stream Order	0



Figure 1. Location Map

Cabin Assessment Results

Reference Model Summary	
Model	Yukon 2013
Analysis Date	January 10, 2018
Taxonomic Level	Family
Predictive Model Variables	Altitude Depth-Avg Longitude Natl-BroadLeafopen Natl-Bryoids Natl-MixedWoodOpen Natl-WetlandHerb Precip02_FEB Precip03_MAR Precip06_JUN Precip07_JUL RainFall06_JUN Temp04_APRmax Velocity-Avg

Reference Groups	**1**	**2**	**3**	**4**	**5**
Number of Reference Sites	23	98	44	108	13
Group Error Rate	34.8%	49.0%	59.1%	53.7%	30.8%
Overall Model Error Rate	50.3%				
Probability of Group Membership	5.3%	94.4%	0.0%	0.0%	0.2%
CABIN Assessment of YT5.0 on Aug 07, 2017	Similar to Reference				

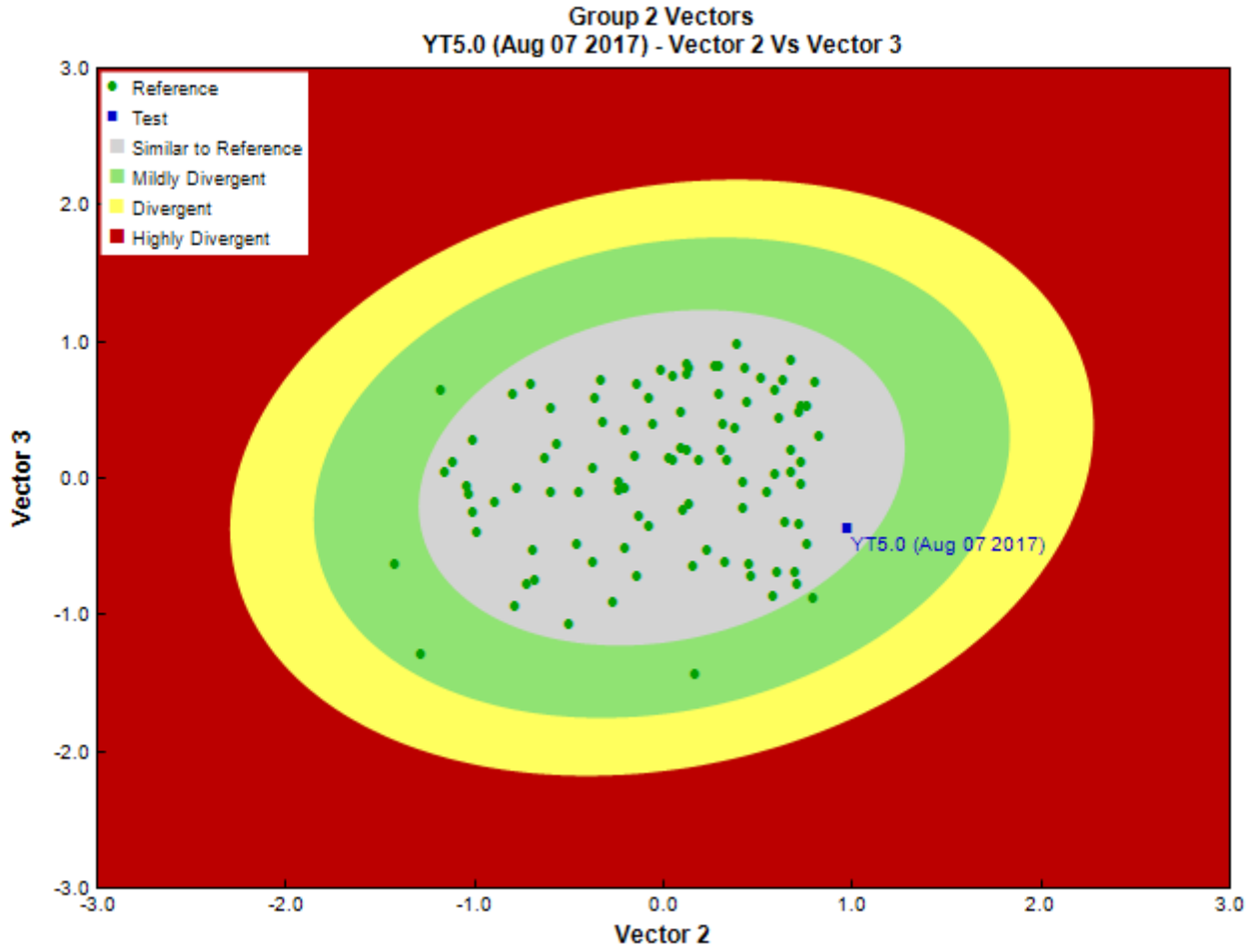

Figure 3. CABIN ordination assessment of the test site with the predicted group of reference sites. Each axis represents the relative abundance of the entire benthic invertebrate community with different organisms weighted differently on each axis.

Sample Information

Sampling Device	Kick Net
Mesh Size	400
Sampling Time	3
Taxonomist	-
Date Taxonomy Completed	-
	-
Sub-Sample Proportion	100/100

Community Structure

Phylum	Class	Order	Family	Raw Count	Total Count
Annelida	Oligochaeta	Lumbriculida	Lumbriculidae	1	1.0
Arthropoda	Insecta	Diptera	Chironomidae	76	76.0
			Simuliidae	7	7.0
			Tipulidae	1	1.0
		Ephemeroptera	Baetidae	1	1.0
		Plecoptera	Capniidae	4	4.0
			Nemouridae	131	131.0
			Total	221	221.0

Metrics

Name	YT5.0	Predicted Group Reference Mean ±SD
Bray-Curtis Distance	0.48	0.5 ± 0.2

Metrics

Name	YT5.0	Predicted Group Reference Mean ±SD
Number Of Individuals		
% Diptera + Non-insects	38.5	58.6 ± 25.3
% Ephemeroptera	0.5	25.6 ± 21.1
% Plecoptera	61.1	11.3 ± 12.5
% Tricoptera	0.0	4.2 ± 5.8
Total Abundance	221.0	265.3 ± 160.6
Richness		
EPT Individuals (Sum)	136.0	115.3 ± 124.5
EPT taxa (no)	3.0	5.8 ± 2.9
Simpson's Diversity	0.5	0.6 ± 0.2
Simpson's Evenness	0.3	0.3 ± 0.1
Total No. of Taxa	7.0	11.5 ± 4.3

Frequency and Probability of Taxa Occurrence

Reference Model Taxa	Frequency of Occurrence in Reference Sites					Probability Of Occurrence at YT5.0
	Group 1	Group 2	Group 3	Group 4	Group 5	
Baetidae	30%	85%	82%	94%	100%	0.82
Chironomidae	91%	100%	100%	100%	100%	1.00
Heptageniidae	17%	63%	95%	76%	85%	0.61
Nemouridae	39%	74%	100%	81%	100%	0.73
Simuliidae	39%	78%	86%	87%	77%	0.76

RIVPACS Ratios

RIVPACS : Expected taxa P>0.50	3.91
RIVPACS : Observed taxa P>0.50	4.00
RIVPACS : O:E (p > 0.5)	1.02
RIVPACS : Expected taxa P>0.70	3.30
RIVPACS : Observed taxa P>0.70	4.00
RIVPACS : O:E (p > 0.7)	1.21

Habitat Description

Variable	YT5.0	Predicted Group Reference Mean ±SD
Channel		
Depth-Avg (cm)	15.8	31.4 ± 19.7
Velocity-Avg (m/s)	0.04	0.43 ± 0.26
Climate		
Precip02_FEB (mm)	7.10000	28.51137 ± 7.47006
Precip03_MAR (mm)	0.50000	26.48398 ± 7.72519
Precip06_JUN (mm)	43.40000	57.13713 ± 13.58676
Precip07_JUL (mm)	91.70000	73.01094 ± 17.73562
Rainfall06_JUN (mm)	43.40000	49.31793 ± 11.37423
Temp04_APRmax (Degrees Celsius)	11.80000	0.93101 ± 4.20058
Landcover		
Natl-BroadleafOpen (%)	0.00000	0.14237 ± 0.34395
Natl-Bryoids (%)	0.00000	0.31369 ± 0.60856
Natl-MixedwoodOpen (%)	0.00000	0.75166 ± 1.44254
Natl-WetlandHerb (%)	0.00000	0.11375 ± 0.31492
Substrate Data		
Water Chemistry		

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APPENDIX G. 2017 PRIMARY PRODUCTIVITY DATA

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Table G-1 Periphyton data including chlorophyll-a and ash free dry mass (AFDM) collected in August 2017

Site Name	Rep Number	Sample Date	Time Sampled	Area Sampled (m^2)	chl a ($\mu g/cm^2$)	chl a (mg/m^2)	Dry Weight (g)	Ash Weight (g)	Ash Free Dry Weight (g)	Ash Free Dry Mass (g/m^2)
IDI.9-1	L2015095-1	02-Aug-17	14:00	0.00238	0.0664	0.664	0.03	0.0286	0.0014	0.588
IDI.9-2	L2015095-2	02-Aug-17	14:00	0.00238	0.14	1.4	0.0297	0.028	0.0018	0.756
IDI.9-3	L2015095-3	02-Aug-17	14:00	0.00238	0.114	1.14	0.0967	0.0904	0.0063	2.647
IDI.9-4	L2015095-4	02-Aug-17	14:00	0.00238	0.136	1.36	0.12	0.115	0.005	2.101
IDI.9-5	L2015095-5	02-Aug-17	14:00	0.00238	0.116	1.16	0.0354	0.0336	0.0018	0.756
IDI.9-6	L2015095-6	02-Aug-17	14:00	0.00238	0.16	1.6	0.0903	0.0827	0.0077	3.235
LAC4.8-1	L2015095-7	03-Aug-17	9:00	0.00238	0.00193	0.0193	<0.0010	<0.0010	< 0.001	0.400
LAC4.8-2	L2015095-8	03-Aug-17	9:00	0.00238	0.0087	0.087	<0.0010	<0.0010	< 0.001	0.420
LAC4.8-3	L2015095-9	03-Aug-17	9:00	0.00238	0.145	1.45	0.0089	0.0077	0.0012	0.504
LAC4.8-4	L2015095-10	03-Aug-17	9:00	0.00238	0.169	1.69	<0.0010	<0.0010	< 0.001	0.420
LAC4.8-5	L2015095-11	03-Aug-17	9:00	0.00238	0.00284	0.0284	0.02	0.0173	0.0028	1.176
LAC4.8-6	L2015095-12	03-Aug-17	9:00	0.00238	<0.00042	<0.0042	--	--	--	--
CF3.9-1	L2015095-13	03-Aug-17	14:00	0.00238	0.0595	0.595	0.0848	0.0797	0.0051	2.143
CF3.9-2	L2015095-14	03-Aug-17	14:00	0.00238	0.159	1.59	0.0274	0.0251	0.0023	0.966
CF3.9-3	L2015095-15	03-Aug-17	14:00	0.00238	0.558	5.58	0.077	0.068	0.009	3.782
CF3.9-4	L2015095-16	03-Aug-17	14:00	0.00238	0.187	1.87	0.379	0.357	0.0212	8.908
CF3.9-5	L2015095-17	03-Aug-17	14:00	0.00238	0.217	2.17	0.484	0.449	0.0349	14.664
CF3.9-6	L2015095-18	03-Aug-17	14:00	0.00238	0.288	2.88	0.442	0.424	0.0182	7.647
CF8.0-1	L2015095-19	04-Aug-17	9:00	0.00238	0.0298	0.298	0.0803	0.076	0.0043	1.807
CF8.0-2	L2015095-20	04-Aug-17	9:00	0.00238	0.0776	0.776	0.0274	0.025	0.0024	1.008
CF8.0-3	L2015095-21	04-Aug-17	9:00	0.00238	0.275	2.75	0.0841	0.0756	0.0085	3.571
CF8.0-4	L2015095-22	04-Aug-17	9:00	0.00238	0.0604	0.604	0.159	0.152	0.0078	3.277
CF8.0-5	L2015095-23	04-Aug-17	9:00	0.00238	0.0945	0.945	0.0424	0.0403	0.0021	0.882
CF8.0-6	L2015095-24	04-Aug-17	9:00	0.00238	0.161	1.61	0.025	0.0232	0.0018	0.756
CF10.0-1	L2015095-25	05-Aug-17	9:00	0.00238	0.0273	0.273	0.156	0.139	0.0166	6.975
CF10.0-2	L2015095-26	05-Aug-17	9:00	0.00238	0.292	2.92	0.776	0.716	0.0598	25.126
CF10.0-3	L2015095-27	05-Aug-17	9:00	0.00238	0.596	5.96	0.34	0.318	0.0222	9.328
CF10.0-4	L2015095-28	05-Aug-17	9:00	0.00238	0.141	1.41	0.561	0.537	0.024	10.084
CF10.0-5	L2015095-29	05-Aug-17	9:00	0.00238	0.186	1.86	0.307	0.289	0.0175	7.353
CF10.0-6	L2015095-30	05-Aug-17	9:00	0.00238	0.528	5.28	0.26	0.242	0.0175	7.353
LC2.7-1	L2015095-31	04-Aug-17	14:00	0.00238	0.16	1.6	0.0145	0.0137	0.001	0.420
LC2.7-2	L2015095-32	04-Aug-17	14:00	0.00238	0.0967	0.967	0.181	0.173	0.0084	3.529
LC2.7-3	L2015095-33	04-Aug-17	14:00	0.00238	0.137	1.37	0.0393	0.0346	0.0047	1.975
LC2.7-4	L2015095-34	04-Aug-17	14:00	0.00238	0.0907	0.907	0.0332	0.0306	0.0025	1.050
LC2.7-5	L2015095-35	04-Aug-17	14:00	0.00238	0.0613	0.613	0.0889	0.0849	0.0039	1.639
LC2.7-6	L2015095-36	04-Aug-17	14:00	0.00238	0.131	1.31	0.0961	0.0904	0.0057	2.395
LC9.9-1	L2015095-37	05-Aug-17	14:00	0.00238	0.00149	0.0149	<0.0010	<0.0010	< 0.001	0.420
LC9.9-2	L2015095-38	05-Aug-17	14:00	0.00238	0.0232	0.232	<0.0010	<0.0010	< 0.001	0.420
LC9.9-3	L2015095-39	05-Aug-17	14:00	0.00238	0.0156	0.156	<0.0010	<0.0010	< 0.001	0.420
LC9.9-4	L2015095-40	05-Aug-17	14:00	0.00238	0.00511	0.0511	0.0021	0.0023	< 0.001	0.420
LC9.9-5	L2015095-41	05-Aug-17	14:00	0.00238	<0.00042	<0.0042	0.0015	0.0013	< 0.001	0.420
LC9.9-6	L2015095-42	05-Aug-17	14:00	0.00238	0.000435	0.00435	0.0049	0.0042	< 0.001	0.420
HF0.2-1	L2015095-43	06-Aug-17	14:00	0.00238	0.274	2.74	0.0256	0.0045	0.0211	8.866

Site Name	Rep Number	Sample Date	Time Sampled	Area Sampled (m^2)	chl a ($\mu g/cm^2$)	chl a (mg/m^2)	Dry Weight (g)	Ash Weight (g)	Ash Free Dry Weight (g)	Ash Free Dry Mass (g/m^2)
HF0.2-2	L2015095-44	06-Aug-17	14:00	0.00238	0.055	0.55	0.0056	0.0012	0.0044	1.849
HF0.2-3	L2015095-45	06-Aug-17	14:00	0.00238	0.0496	0.496	0.0265	0.004	0.0224	9.412
HF0.2-4	L2015095-46	06-Aug-17	14:00	0.00238	0.00112	0.0112	<0.0010	<0.0010	< 0.001	0.420
HF0.2-5	L2015095-47	06-Aug-17	14:00	0.00238	0.147	1.47	0.0015	<0.0010	< 0.001	0.420
HF0.2-6	L2015095-48	06-Aug-17	14:00	0.00238	0.0618	0.618	0.0034	0.002	0.0014	0.588
HF6.3-1	L2015095-49	06-Aug-17	9:00	0.00238	0.209	2.09	0.0662	0.061	0.0052	2.185
HF6.3-2	L2015095-50	06-Aug-17	9:00	0.00238	0.16	1.6	0.0146	0.0024	0.0122	5.126
HF6.3-3	L2015095-51	06-Aug-17	9:00	0.00238	0.00761	0.0761	0.0021	0.0014	0.001	0.420
HF6.3-4	L2015095-52	06-Aug-17	9:00	0.00238	0.208	2.08	0.0107	0.0033	0.0075	3.151
HF6.3-5	L2015095-53	06-Aug-17	9:00	0.00238	0.0286	0.286	0.0077	0.0015	0.0062	2.605
HF6.3-6	L2015095-54	06-Aug-17	9:00	0.00238	0.102	1.02	<0.0010	<0.0010	< 0.001	0.420
YT0.2-1	L2015095-55	07-Aug-17	14:00	0.00238	0.0234	0.234	0.0016	0.0017	< 0.001	0.420
YT0.2-2	L2015095-56	07-Aug-17	14:00	0.00238	0.0134	0.134	0.0022	0.0023	< 0.001	0.420
YT0.2-3	L2015095-57	07-Aug-17	14:00	0.00238	0.0109	0.109	<0.0010	<0.0010	< 0.001	0.420
YT0.2-4	L2015095-58	07-Aug-17	14:00	0.00238	0.00649	0.0649	0.0016	0.0015	< 0.001	0.420
YT0.2-5	L2015095-59	07-Aug-17	14:00	0.00238	0.00402	0.0402	0.0012	0.0014	< 0.001	0.420
YT0.2-6	L2015095-60	07-Aug-17	14:00	0.00238	0.00405	0.0405	<0.0010	<0.0010	< 0.001	0.420
YT5.0-1	L2015095-61	07-Aug-17	9:00	0.00238	0.521	5.21	0.0097	0.0092	< 0.001	0.420
YT5.0-2	L2015095-62	07-Aug-17	9:00	0.00238	0.0997	0.997	0.0064	0.0063	< 0.001	0.420
YT5.0-3	L2015095-63	07-Aug-17	9:00	0.00238	0.0782	0.782	0.0018	0.0021	< 0.001	0.420
YT5.0-4	L2015095-64	07-Aug-17	9:00	0.00238	0.0842	0.842	0.0135	0.0133	< 0.001	0.420
YT5.0-5	L2015095-65	07-Aug-17	9:00	0.00238	0.31	3.1	0.0022	0.0022	< 0.001	0.420
YT5.0-6	L2015095-66	07-Aug-17	9:00	0.00238	0.213	2.13	<0.0010	<0.0010	< 0.001	0.420

EDI ENVIRONMENTAL DYNAMICS INC.
ATTN: Lyndsay Doetzel
2195 2nd Avenue
Whitehorse YT Y1A 3T8

Date Received: 17-AUG-17
Report Date: 07-NOV-17 17:33 (MT)
Version: FINAL

Client Phone: 867-393-4882

Certificate of Analysis

Lab Work Order #: L2015095

Project P.O. #: NOT SUBMITTED
Job Reference: 17Y0032:501
C of C Numbers:
Legal Site Desc:

Shane Stack
Account Manager

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ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2015095-1	L2015095-2	L2015095-3	L2015095-4	L2015095-5
Description	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Sampled Date	02-AUG-17	02-AUG-17	02-AUG-17	02-AUG-17	02-AUG-17
Sampled Time	14:00	14:00	14:00	14:00	14:00
Client ID	IDI.9-1	IDI.9-2	IDI.9-3	IDI.9-4	IDI.9-5
Grouping / **Analyte**					
BIOTA					
Field Tests Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests Dry Weight (g)	0.0300	0.0297	0.0967	0.120	0.0354
Ash Weight (g)	0.0286	0.0280	0.0904	0.115	0.0336
Ash Free Dry Weight (g)	0.0014	0.0018	0.0063	0.0050	0.0018
Plant Pigments Chlorophyll a (mg/m2)	0.664	1.40	1.14	1.36	1.16

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2015095-6	L2015095-7	L2015095-8	L2015095-9	L2015095-10
Description	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Sampled Date	02-AUG-17	03-AUG-17	03-AUG-17	03-AUG-17	03-AUG-17
Sampled Time	14:00	09:00	09:00	09:00	09:00
Client ID	IDI.9-6	LAC4.8-1	LAC4.8-2	LAC4.8-3	LAC4.8-4
Grouping / **Analyte**					
BIOTA					
Field Tests Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests Dry Weight (g)	0.0903	<0.0010	<0.0010	0.0089	<0.0010
Ash Weight (g)	0.0827	<0.0010	<0.0010	0.0077	<0.0010
Ash Free Dry Weight (g)	0.0077	<0.0010	<0.0010	0.0012	<0.0010
Plant Pigments Chlorophyll a (mg/m2)	1.60	0.0193	0.0870	1.45	1.69

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2015095-11	L2015095-12	L2015095-13	L2015095-14	L2015095-15
Description	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Sampled Date	03-AUG-17	03-AUG-17	03-AUG-17	03-AUG-17	03-AUG-17
Sampled Time	09:00	09:00	14:00	14:00	14:00
Client ID	LAC4.8-5	LAC4.8-6	CF3.9-1	CF3.9-2	CF3.9-3
Grouping / **Analyte**					
BIOTA					
Field Tests Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests Dry Weight (g)	0.0200		0.0848	0.0274	0.0770
Ash Weight (g)	0.0173		0.0797	0.0251	0.0680
Ash Free Dry Weight (g)	0.0028		0.0051	0.0023	0.0090
Plant Pigments Chlorophyll a (mg/m2)	0.0284	<0.0042	0.595	1.59	5.58

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2015095-16	L2015095-17	L2015095-18	L2015095-19	L2015095-20
Description	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Sampled Date	03-AUG-17	03-AUG-17	03-AUG-17	04-AUG-17	04-AUG-17
Sampled Time	14:00	14:00	14:00	09:00	09:00
Client ID	CF3.9-4	CF3.9-5	CF3.9-6	CF8.0-1	CF8.0-2
Grouping / **Analyte**					
BIOTA					
Field Tests Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests Dry Weight (g)	0.379	0.484	0.442	0.0803	0.0274
Ash Weight (g)	0.357	0.449	0.424	0.0760	0.0250
Ash Free Dry Weight (g)	0.0212	0.0349	0.0182	0.0043	0.0024
Plant Pigments Chlorophyll a (mg/m2)	1.87	2.17	2.88	0.298	0.776

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2015095-21	L2015095-22	L2015095-23	L2015095-24	L2015095-25
Description	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Sampled Date	04-AUG-17	04-AUG-17	04-AUG-17	04-AUG-17	05-AUG-17
Sampled Time	09:00	09:00	09:00	09:00	09:00
Client ID	CF8.0-3	CF8.0-4	CF8.0-5	CF8.0-6	CF10.0-1
Grouping / **Analyte**					
BIOTA					
Field Tests Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests Dry Weight (g)	0.0841	0.159	0.0424	0.0250	0.156
Ash Weight (g)	0.0756	0.152	0.0403	0.0232	0.139
Ash Free Dry Weight (g)	0.0085	0.0078	0.0021	0.0018	0.0166
Plant Pigments Chlorophyll a (mg/m2)	2.75	0.604	0.945	1.61	0.273

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2015095-26	L2015095-27	L2015095-28	L2015095-29	L2015095-30
Description	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Sampled Date	05-AUG-17	05-AUG-17	05-AUG-17	05-AUG-17	05-AUG-17
Sampled Time	09:00	09:00	09:00	09:00	09:00
Client ID	CF10.0-2	CF10.0-3	CF10.0-4	CF10.0-5	CF10.0-6
Grouping / **Analyte**					
BIOTA					
Field Tests Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests Dry Weight (g)	0.776	0.340	0.561	0.307	0.260
Ash Weight (g)	0.716	0.318	0.537	0.289	0.242
Ash Free Dry Weight (g)	0.0598	0.0222	0.0240	0.0175	0.0175
Plant Pigments Chlorophyll a (mg/m2)	2.92	5.96	1.41	1.86	5.28

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2015095-31	L2015095-32	L2015095-33	L2015095-34	L2015095-35
Description	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Sampled Date	04-AUG-17	04-AUG-17	04-AUG-17	04-AUG-17	04-AUG-17
Sampled Time	14:00	14:00	14:00	14:00	14:00
Client ID	LC2.7-1	LC2.7-2	LC2.7-3	LC2.7-4	LC2.7-5
Grouping / **Analyte**					
BIOTA					
Field Tests Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests Dry Weight (g)	0.0145	0.181	0.0393	0.0332	0.0889
Ash Weight (g)	0.0137	0.173	0.0346	0.0306	0.0849
Ash Free Dry Weight (g)	<0.0010	0.0084	0.0047	0.0025	0.0039
Plant Pigments Chlorophyll a (mg/m2)	1.60	0.967	1.37	0.907	0.613

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2015095-36	L2015095-37	L2015095-38	L2015095-39	L2015095-40
Description	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Sampled Date	04-AUG-17	05-AUG-17	05-AUG-17	05-AUG-17	05-AUG-17
Sampled Time	14:00	14:00	14:00	14:00	14:00
Client ID	LC2.7-6	LC9.9-1	LC9.9-2	LC9.9-3	LC9.9-4
Grouping / **Analyte**					
BIOTA					
Field Tests Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests Dry Weight (g)	0.0961	<0.0010	<0.0010	<0.0010	0.0021
Ash Weight (g)	0.0904	<0.0010	<0.0010	<0.0010	0.0023
Ash Free Dry Weight (g)	0.0057	<0.0010	<0.0010	<0.0010	<0.0010
Plant Pigments Chlorophyll a (mg/m2)	1.31	0.0149	0.232	0.156	0.0511

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2015095-41 Periphyton 05-AUG-17 14:00 LC9.9-5	L2015095-42 Periphyton 05-AUG-17 14:00 LC9.9-6	L2015095-43 Periphyton 06-AUG-17 14:00 HF0.2-1	L2015095-44 Periphyton 06-AUG-17 14:00 HF0.2-2	L2015095-45 Periphyton 06-AUG-17 14:00 HF0.2-3
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
BIOTA						
Field Tests	Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests	Dry Weight (g)	0.0015	0.0049	0.0256	0.0056	0.0265
	Ash Weight (g)	0.0013	0.0042	0.0045	0.0012	0.0040
	Ash Free Dry Weight (g)	<0.0010	<0.0010	0.0211	0.0044	0.0224
Plant Pigments	Chlorophyll a (mg/m2)	<0.0042	0.00435	2.74	0.550	0.496

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L2015095-46 Periphyton 06-AUG-17 14:00 HF0.2-4	L2015095-47 Periphyton 06-AUG-17 14:00 HF0.2-5	L2015095-48 Periphyton 06-AUG-17 14:00 HF0.2-6	L2015095-49 Periphyton 06-AUG-17 09:00 HF6.3-1	L2015095-50 Periphyton 06-AUG-17 09:00 HF6.3-2
Sample ID						
Description						
Sampled Date						
Sampled Time						
Client ID						
BIOTA						
Field Tests	Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests	Dry Weight (g)	<0.0010	0.0015	0.0034	0.0662	0.0146
	Ash Weight (g)	<0.0010	<0.0010	0.0020	0.0610	0.0024
	Ash Free Dry Weight (g)	<0.0010	<0.0010	0.0014	0.0052	0.0122
Plant Pigments	Chlorophyll a (mg/m2)	0.0112	1.47	0.618	2.09	1.60

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2015095-51	L2015095-52	L2015095-53	L2015095-54	L2015095-55
Description	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Sampled Date	06-AUG-17	06-AUG-17	06-AUG-17	06-AUG-17	07-AUG-17
Sampled Time	09:00	09:00	09:00	09:00	14:00
Client ID	HF6.3-3	HF6.3-4	HF6.3-5	HF6.3-6	YT0.2-1
Grouping / **Analyte**					
BIOTA					
Field Tests Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests Dry Weight (g)	0.0021	0.0107	0.0077	<0.0010	0.0016
Ash Weight (g)	0.0014	0.0033	0.0015	<0.0010	0.0017
Ash Free Dry Weight (g)	<0.0010	0.0075	0.0062	<0.0010	<0.0010
Plant Pigments Chlorophyll a (mg/m2)	0.0761	2.08	0.286	1.02	0.234

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2015095-56	L2015095-57	L2015095-58	L2015095-59	L2015095-60
Description	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Sampled Date	07-AUG-17	07-AUG-17	07-AUG-17	07-AUG-17	07-AUG-17
Sampled Time	14:00	14:00	14:00	14:00	14:00
Client ID	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	YT0.2-6
Grouping / **Analyte**					
BIOTA					
Field Tests Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests Dry Weight (g)	0.0022	<0.0010	0.0016	0.0012	<0.0010
Ash Weight (g)	0.0023	<0.0010	0.0015	0.0014	<0.0010
Ash Free Dry Weight (g)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Plant Pigments Chlorophyll a (mg/m2)	0.134	0.109	0.0649	0.0402	0.0405

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L2015095-61	L2015095-62	L2015095-63	L2015095-64	L2015095-65
Description	Periphyton	Periphyton	Periphyton	Periphyton	Periphyton
Sampled Date	07-AUG-17	07-AUG-17	07-AUG-17	07-AUG-17	07-AUG-17
Sampled Time	09:00	09:00	09:00	09:00	09:00
Client ID	YT5.0-1	YT5.0-2	YT5.0-3	YT5.0-4	YT5.0-5
Grouping / **Analyte**					
BIOTA					
Field Tests Area Sampled (cm2)	23.75	23.75	23.75	23.75	23.75
Physical Tests Dry Weight (g)	0.0097	0.0064	0.0018	0.0135	0.0022
Ash Weight (g)	0.0092	0.0063	0.0021	0.0133	0.0022
Ash Free Dry Weight (g)	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010
Plant Pigments Chlorophyll a (mg/m2)	5.21	0.997	0.782	0.842	3.10

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L2015095-66				
	Description	Periphyton				
	Sampled Date	07-AUG-17				
	Sampled Time	09:00				
	Client ID	YT5.0-6				
Grouping	**Analyte**					
BIOTA						
Field Tests	Area Sampled (cm2)	23.75				
Physical Tests	Dry Weight (g)	<0.0010				
	Ash Weight (g)	<0.0010				
	Ash Free Dry Weight (g)	<0.0010				
Plant Pigments	Chlorophyll a (mg/m2)	2.13				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
AREA SAMPLED-VA	Biota	Area Sampled (cm2)	Not Applicable
ASHFREE-DRYWT-VA	Biota	Ashfree Dry Weight in Biota	APHA 10300 C

This analysis is done using procedures modified from APHA 10300 Peryphyton Sample Analysis. Ash Free Dry Weight is determined by the difference between 'Dry Weight' and 'Ash Weight' which are both determined gravimetrically. Dry Weight is determined by drying the sample at 105 "C and the Ash Weight is subsequently determined by ashing the dried sample at 500 "C. Note: Biota samples are typically submitted as scrapings on a filter.

CHLOROA-F-VA	Biota	Chlorophyll a in Biota by Fluorometer	EPA 445.0

This analysis is done using procedures adapted from EPA Method 445.0. Chlorophyll-a is determined by a routine acetone extraction followed with analysis by fluorometry using the non-acidification procedure. This method is not subject to interferences from chlorophyll b. Note: Biota samples are typically submitted as scrapings on a filter.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2015095-COFC

COC Number:

Page 1 of 6

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report	☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:	867-393-4882	Select Distribution:	☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax	ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2		
		Email 3		

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution		Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax	sjenner@edynamics.com	
Contact:	S Jenner	Email 2	ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact:	J.McCord	Sampler:	L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	ASHFREE.DRYWT-VA	CHLOROA-F-VA	Number of Containers
	ID1.9-1	02-Aug 17	14:00	periphyton	X	X	2
	ID1.9-2	02 Aug 17			X	X	2
	ID1.9-3	02 Aug 17			X	X	2
	ID1.9-4				X	X	2
	ID1.9-5				X	X	2
	ID1.9-6				X	X	2
	LaC4.8-1	03 Aug 17	09:00		X	X	2
	LaC4.8-2				X	X	2
	LaC4.8-3				X	X	2
	LaC4.8-4				X	X	2
	LaC4.8-5				X	X	2
	LaC4.8-6				X	X	2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	
Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
8.0 5.2	-0.3

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	17-Aug 17	14:00		Aug 18/17	15:00	LADY	OCT 28	12:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

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Canada Toll Free: 1 800 668 9878

L2015095-COFC

COC Number:

Page 2 of 6

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-393-4882	Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact: J.McCord	Sampler: L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	ASHFREE-DRYWT-VA	CHLOROA-F-VA	Number of Containers
	CF3.9-1	03-Aug17	14:00	periphyton	X	X	2
	CF3.9-2				X	X	2
	CF3.9-3				X	X	2
	CF3.9-4				X	X	2
	CF3.9-5				X	X	2
	CF3.9-6				X	X	2
	CF8.0-1	04Aug17	09:00		X	X	2
	CF8.0-2				X	X	2
	CF8.0-3				X	X	2
	CF8.0-4				X	X	2
	CF8.0-5				X	X	2
	CF8.0-6				X	X	2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			-0.3		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by: LADY	Date: OCT 28	Time: 12:00
	17-Aug17	14:00						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

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COC Number:

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report	☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:	867-393-4882	Select Distribution:	☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax	ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2		
		Email 3		

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution		Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax	sjenner@edynamics.com	
Contact:	S Jenner	Email 2	ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact: J.McCord	Sampler: L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	ASHFREE-DRYWT-VA	CHLORA-F-VA	Number of Containers
	CF10.0-1	05-Aug-17	09:00	periphyton	X	X	2
	CF10.0-2	↓	↓		X	X	2
	CF10.0-3				X	X	2
	CF10.0-4				X	X	2
	CF10.0-5				X	X	2
	CF10.0-6				X	X	2
	LC2.7-1	04-Aug-17	14:00		X	X	2
	LC2.7-2	↓	↓		X	X	2
	LC2.7-3				X	X	2
	LC2.7-4				X	X	2
	LC2.7-5				X	X	2
	LC2.7-6				X	X	2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	
Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)			
Frozen ☐		SIF Observations Yes ☐ No ☐	
Ice packs Yes ☐ No ☐		Custody seal intact Yes ☐ No ☐	
Cooling Initiated ☐			
INITIAL COOLER TEMPERATURES °C		FINAL COOLER TEMPERATURES °C	
		-0.3	1

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	17-Aug-17	14:00				LAP4	OCT 28,	12:00

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
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Canada Toll Free: 1 800 668 9878

L2015095-COFC

COC Number:

Page 4 of 6

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report	☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
		Select Distribution:	☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-393-4882	Email 1 or Fax	ldoetzel@edynamics.com	Specify Date Required for E2, E or P:
		Email 2		
		Email 3		

Invoice To	Same as Report To	☑ Yes ☐ No	Invoice Distribution		Analysis Request
	Copy of Invoice with Report	☑ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI		Email 1 or Fax	sjenner@edynamics.com	
Contact:	S Jenner		Email 2	ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact:	J.McCord	Sampler:	L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	ASHFREE-DRYWT-VA	CHLOROA-F-VA	Number of Containers
	LC9.9-1	05-Aug 17	14:00	periphyton	X	X	2
	LC9.9-2				X	X	2
	LC9.9-3				X	X	2
	LC9.9-4				X	X	2
	LC9.9-5				X	X	2
	LC9.9-6				X	X	2
	HFO.2-1	06-Aug 17	14:00		X	X	2
	HFO.2-2				X	X	2
	HFO 2-3				X	X	2
	HFO.2-~~3~~4				X	X	2
	HFO.2-~~4~~5				X	X	2
	HFO.2-~~5~~6				X	X	2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			-0.3		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by: LAPY	Date: OCT28	Time: 12:00
	17-Aug 17	14:00						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2015095-COFC

COC Number:

Page 5 of 6

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format:	☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report	☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:	867-393-4882	Select Distribution:	☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax	ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2		
		Email 3		

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution		Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution:	☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax	sjenner@edynamics.com	
Contact:	S Jenner	Email 2	ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380	Approver ID:	Cost Center:
Job #:	17Y0032;501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact:	J.McCord	Sampler:	L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	ASHFREE-DRYWT-VA	CHLOROA-F-VA	Number of Containers
	HF6.3-1	06-Aug 17	09:00	periphyton	X	X	2
	HF6.3-2				X	X	2
	HF6.3-3				X	X	2
	HF6.3-4				X	X	2
	HF6.3-5				X	X	2
	HF6.3-6				X	X	2
	YT0.2-1	07-Aug 17	14:00		X	X	2
	YT0.2-2				X	X	2
	YT0.2-3				X	X	2
	YT0.2-4				X	X	2
	YT0.2-5				X	X	2
	YT0.2-6				X	X	2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	
Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐ No ☐
Cooling Initiated	☐			

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			-0.3		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
	17-Aug 17	14:00				LADY	OCT 28	12:00

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2015095-COFC

COC Number:

Page 6 of 6

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Phone:	867-393-4882	Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)		ALS Contact: J.McCord	Sampler: L.Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	ASHFREE-DRYWT-VA	CHLOROA-F-VA	Number of Containers
	YT5.0-1	07-Aug-17	09:00	periphyton	X	X	2
	YT5.0-2				X	X	2
	YT5.0-3				X	X	2
	YT5.0-4				X	X	2
	YT5.0-5				X	X	2
	YT5.0-6				X	X	2

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated	☐				

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
			-0.3		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by: LADY	Date: OCT 28	Time: 12:00
	17-Aug-17	14:00						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form

APPENDIX H. SEDIMENT DATA

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Table H- 1. Sediment chemistry in samples collected in August 2017

Sample Site	Sample Date	Sample Time	Lab ID		Carbon, Total Organic	pH	Texture	% Gravel (>2mm)	% Sand (2.0 mm - 0.063 mm)	% Silt (0.063 mm – 4 um)	% Clay (<4um)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium	Chromium	Cobalt	Copper
				Units	% dry	pH units		%	%	%	%	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry
				RDL	0.05	0.1		0.1				20	0.1	0.4	1	0.1	0.1	2	0.04	100	1	0.1	0.2
				ISQG	--	--		--				--	--	5.9	--	--	--	--	0.6	--	37.3	--	35.7
				PEL	--	--		--				--	--	17	--	--	--	--	3.5	--	90	--	197
ID1.9-1	02-Aug-17	14:00	L1977686-1		2.3	7.26	Loamy sand	6.1	75.4	16	2.6	20700	0.76	*15.1*	213	0.57	0.21	<10	0.44	8480	*51.3*	14.1	23.1
LAC4.8-1	03-Aug-17	09:00	L1977686-4		2.23	7.53	Sandy loam	<1.0	60.9	34.3	4.7	16700	0.56	*9.06*	263	0.65	0.13	<10	0.304	10200	*55.7*	14	33.9
CF3.9-1	03-Aug-17	14:00	L1977686-7		1.7	7.28	Loamy sand	5.5	67	24.8	2.6	18200	0.68	*11.3*	216	0.38	0.19	<10	0.264	7290	*39*	11.6	21.3
CF8.0-1	04-Aug-17	09:00	L1977686-10		1.51	6.57	Loamy sand	5.5	76.9	15.6	2.1	18500	0.65	*9.79*	228	0.35	0.19	<10	0.322	7020	36.1	11.1	22.9
CF10.0-1	05-Aug-17	09:00	L1977686-13		0.454	7.33	Sand	1.8	90.9	6.4	<1.0	20100	0.63	*11.1*	255	0.37	0.18	<10	0.279	7610	*58.4*	14	20.1
LC2.7-1	04-Aug-17	14:00	L1977686-16		1.83	7.94	Loamy sand	7.5	75.8	14.8	1.9	21200	0.89	*17.5*	248	0.71	0.19	<10	0.565	9190	*128*	18	22.5
LC9.9-1	05-Aug-17	14:00	L1977686-19		4.13	6.55	Sandy loam	6.6	50.4	38.2	4.7	17900	1.01	*13.1*	168	0.46	0.16	<10	0.21	6710	*54.1*	9.85	17
HF0.2-1	06-Aug-17	14:00	L1977686-22		2.9	7.38	Sandy loam	7.9	50.8	38.2	3.1	18500	1.24	*22.4*	244	0.69	0.2	<10	0.314	13500	*58.3*	13.9	28.1
HF6.3-1	06-Aug-17	09:00	L1977686-25		1.8	7.06	Sand	4.4	84	9.2	2.3	19900	1.92	*33.6*	222	0.65	0.21	<10	0.363	8590	*65.7*	15.2	19.5
YT0.2-1	07-Aug-17	14:00	L1977686-28		5.9	7.22	Silt loam	<1.0	27.5	66.6	5.2	16900	1.23	*13.6*	202	0.5	0.19	<10	0.143	7450	29.8	9.8	17.7
YT5.0-1	07-Aug-17	09:00	L1977686-31		3.18	6.42	Sandy loam	3.2	46.4	46.9	3.5	16500	2.71	*23*	206	0.54	0.19	<10	0.232	8600	*43.2*	11.5	18.5

Sample Site	Sample Date	Sample Time	Lab ID		Iron	Lead	Lithium	Manganese	Mercury	Molybdenum	Nickel	Phosphorus	Potassium	Selenium	Silver	Sodium	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc
				Units	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry	mg/kg dry
				RDL	20	0.2	0.1	0.4	0.05	0.1	0.4	10	10	0.5	0.2	40	0.2	0.1	0.2	2	0.1	0.4	2
				ISQG	--	35	--	--	0.17	--	--	--	--	--	--	--	--	--	--	--	--	--	123
				PEL	--	91.3	--	--	0.486	--	--	--	--	--	--	--	--	--	--	--	--	--	315
ID1.9-1	02-Aug-17	14:00	L1977686-1		28500	11.5	17.2	928	0.0722	1.57	33.1	753	1700	0.37	0.111	390	54.8	0.227	0.85	1320	7.22	67	92.3
LAC4.8-1	03-Aug-17	09:00	L1977686-4		27800	7.12	13.5	698	0.0402	1.31	52.8	877	1340	0.56	0.12	560	85.1	0.128	0.79	1050	1.99	66.7	75.5
CF3.9-1	03-Aug-17	14:00	L1977686-7		27100	7.35	14.7	613	0.0686	1.86	24.2	740	1620	0.33	0.108	350	45.6	0.203	0.69	1190	10.6	67.7	71.5
CF8.0-1	04-Aug-17	09:00	L1977686-10		26100	7.45	12.7	319	0.0626	1.21	22.6	743	1630	0.34	0.127	390	44.7	0.19	0.63	1270	7.58	67.6	74
CF10.0-1	05-Aug-17	09:00	L1977686-13		31700	7.26	16.9	769	0.0458	4.12	36.1	778	2430	0.23	0.091	410	44.4	0.278	0.83	1540	6.13	78.7	82.3
LC2.7-1	04-Aug-17	14:00	L1977686-16		29400	12.8	18.3	2270	0.105	10.1	83.3	722	2240	0.47	0.117	290	82.9	0.265	1.05	1170	9.15	61	99.4
LC9.9-1	05-Aug-17	14:00	L1977686-19		25300	10.4	13	611	0.0591	3	31.6	601	1270	0.2	0.082	340	48.2	0.181	1	1180	4.77	62.9	68.2
HF0.2-1	06-Aug-17	14:00	L1977686-22		26700	9.85	16.6	861	0.0754	2.09	38.5	753	1850	0.37	0.131	290	126	0.219	0.91	950	32.3	55.8	68.9
HF6.3-1	06-Aug-17	09:00	L1977686-25		25900	11.6	15.7	1290	0.0734	3.16	38.7	612	1630	0.29	0.145	270	97.9	0.235	1.11	998	33.2	62	72.9
YT0.2-1	07-Aug-17	14:00	L1977686-28		24000	10.8	11.9	402	0.0377	0.58	19.5	591	1570	0.16	0.1	320	52.6	0.164	0.69	962	4	52.9	60.7
YT5.0-1	07-Aug-17	09:00	L1977686-31		24700	11.3	10.9	607	0.0569	1.68	26.6	664	1150	0.23	0.132	290	43.6	0.169	0.85	910	2.79	62.1	56.9

Notes:
CCME guidelines include: ISQG= interim sediment quality guideline, PEL=probable effect levels

RDL=Reported Detection Limit

Exceedances

ISQG

ISQG and PEL

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EDI ENVIRONMENTAL DYNAMICS INC.
ATTN: Lyndsay Doetzel
2195 2nd Avenue
Whitehorse YT Y1A 3T8

Date Received: 18-AUG-17
Report Date: 06-SEP-17 16:56 (MT)
Version: FINAL

Client Phone: 867-393-4882

Certificate of Analysis

Lab Work Order #: L1977686

Project P.O. #: NOT SUBMITTED
Job Reference: 17T0032:501
C of C Numbers:
Legal Site Desc:

Shane Stack
Account Manager

[This report shall not be reproduced except in full without the written authority of the Laboratory.]

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample ID	L1977686-1	L1977686-4	L1977686-7	L1977686-10	L1977686-13
Description	sediment	sediment	sediment	sediment	sediment
Sampled Date	02-AUG-17	03-AUG-17	03-AUG-17	04-AUG-17	05-AUG-17
Sampled Time	14:00	09:00	14:00	09:00	09:00
Client ID	ID1.9-1	LAC4.8-1	CF3.9-1	CF8.0-1	CF10.0-1
Grouping / **Analyte**					
SOIL					
Physical Tests pH (1:2 soil:water) (pH)	7.26	7.53	7.28	6.57	7.33
Particle Size % Gravel (>2mm) (%)	6.1	<1.0	5.5	5.5	1.8
% Sand (2.0mm - 0.063mm) (%)	75.4	60.9	67.0	76.9	90.9
% Silt (0.063mm - 4um) (%)	16.0	34.3	24.8	15.6	6.4
% Clay (<4um) (%)	2.6	4.7	2.6	2.1	<1.0
Texture	Loamy sand	Sandy loam	Loamy sand	Loamy sand	Sand
Organic / Inorganic Carbon Total Organic Carbon (%)	2.30	2.23	1.70	1.51	0.454
Metals Aluminum (Al) (mg/kg)	20700	16700	18200	18500	20100
Antimony (Sb) (mg/kg)	0.76	0.56	0.68	0.65	0.63
Arsenic (As) (mg/kg)	15.1	9.06	11.3	9.79	11.1
Barium (Ba) (mg/kg)	213	263	216	228	255
Beryllium (Be) (mg/kg)	0.57	0.65	0.38	0.35	0.37
Bismuth (Bi) (mg/kg)	0.21	0.13	0.19	0.19	0.18
Boron (B) (mg/kg)	<10	<10	<10	<10	<10
Cadmium (Cd) (mg/kg)	0.440	0.304	0.264	0.322	0.279
Calcium (Ca) (mg/kg)	8480	10200	7290	7020	7610
Chromium (Cr) (mg/kg)	51.3	55.7	39.0	36.1	58.4
Cobalt (Co) (mg/kg)	14.1	14.0	11.6	11.1	14.0
Copper (Cu) (mg/kg)	23.1	33.9	21.3	22.9	20.1
Iron (Fe) (mg/kg)	28500	27800	27100	26100	31700
Lead (Pb) (mg/kg)	11.5	7.12	7.35	7.45	7.26
Lithium (Li) (mg/kg)	17.2	13.5	14.7	12.7	16.9
Magnesium (Mg) (mg/kg)	8050	9580	7550	7350	8700
Manganese (Mn) (mg/kg)	928	698	613	319	769
Mercury (Hg) (mg/kg)	0.0722	0.0402	0.0686	0.0626	0.0458
Molybdenum (Mo) (mg/kg)	1.57	1.31	1.86	1.21	4.12
Nickel (Ni) (mg/kg)	33.1	52.8	24.2	22.6	36.1
Phosphorus (P) (mg/kg)	753	877	740	743	778
Potassium (K) (mg/kg)	1700	1340	1620	1630	2430
Selenium (Se) (mg/kg)	0.37	0.56	0.33	0.34	0.23
Silver (Ag) (mg/kg)	0.111	0.120	0.108	0.127	0.091
Sodium (Na) (mg/kg)	390	560	350	390	410
Strontium (Sr) (mg/kg)	54.8	85.1	45.6	44.7	44.4
Thallium (Tl) (mg/kg)	0.227	0.128	0.203	0.190	0.278
Tin (Sn) (mg/kg)	0.85	0.79	0.69	0.63	0.83
Titanium (Ti) (mg/kg)	1320	1050	1190	1270	1540
Uranium (U) (mg/kg)	7.22	1.99	10.6	7.58	6.13

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1977686-16 sediment 04-AUG-17 14:00 LC2.7-1	L1977686-19 sediment 05-AUG-17 14:00 LC9.9-1	L1977686-22 sediment 06-AUG-17 14:00 HF0.2-1	L1977686-25 sediment 06-AUG-17 09:00 HF6.3-1	L1977686-28 sediment 07-AUG-17 14:00 YT0.2-1
SOIL						
Physical Tests	pH (1:2 soil:water) (pH)	7.94	6.55	7.38	7.06	7.22
Particle Size	% Gravel (>2mm) (%)	7.5	6.6	7.9	4.4	<1.0
	% Sand (2.0mm - 0.063mm) (%)	75.8	50.4	50.8	84.0	27.5
	% Silt (0.063mm - 4um) (%)	14.8	38.2	38.2	9.2	66.6
	% Clay (<4um) (%)	1.9	4.7	3.1	2.3	5.2
	Texture	Loamy sand	Sandy loam	Sandy loam	Sand	Silt loam
Organic / Inorganic Carbon	Total Organic Carbon (%)	1.83	4.13	2.90	1.80	5.90
Metals	Aluminum (Al) (mg/kg)	21200	17900	18500	19900	16900
	Antimony (Sb) (mg/kg)	0.89	1.01	1.24	1.92	1.23
	Arsenic (As) (mg/kg)	17.5	13.1	22.4	33.6	13.6
	Barium (Ba) (mg/kg)	248	168	244	222	202
	Beryllium (Be) (mg/kg)	0.71	0.46	0.69	0.65	0.50
	Bismuth (Bi) (mg/kg)	0.19	0.16	0.20	0.21	0.19
	Boron (B) (mg/kg)	<10	<10	<10	<10	<10
	Cadmium (Cd) (mg/kg)	0.565	0.210	0.314	0.363	0.143
	Calcium (Ca) (mg/kg)	9190	6710	13500	8590	7450
	Chromium (Cr) (mg/kg)	128	54.1	58.3	65.7	29.8
	Cobalt (Co) (mg/kg)	18.0	9.85	13.9	15.2	9.80
	Copper (Cu) (mg/kg)	22.5	17.0	28.1	19.5	17.7
	Iron (Fe) (mg/kg)	29400	25300	26700	25900	24000
	Lead (Pb) (mg/kg)	12.8	10.4	9.85	11.6	10.8
	Lithium (Li) (mg/kg)	18.3	13.0	16.6	15.7	11.9
	Magnesium (Mg) (mg/kg)	8550	6870	8090	7800	6540
	Manganese (Mn) (mg/kg)	2270	611	861	1290	402
	Mercury (Hg) (mg/kg)	0.105	0.0591	0.0754	0.0734	0.0377
	Molybdenum (Mo) (mg/kg)	10.1	3.00	2.09	3.16	0.58
	Nickel (Ni) (mg/kg)	83.3	31.6	38.5	38.7	19.5
	Phosphorus (P) (mg/kg)	722	601	753	612	591
	Potassium (K) (mg/kg)	2240	1270	1850	1630	1570
	Selenium (Se) (mg/kg)	0.47	0.20	0.37	0.29	0.16
	Silver (Ag) (mg/kg)	0.117	0.082	0.131	0.145	0.100
	Sodium (Na) (mg/kg)	290	340	290	270	320
	Strontium (Sr) (mg/kg)	82.9	48.2	126	97.9	52.6
	Thallium (Tl) (mg/kg)	0.265	0.181	0.219	0.235	0.164
	Tin (Sn) (mg/kg)	1.05	1.00	0.91	1.11	0.69
	Titanium (Ti) (mg/kg)	1170	1180	950	998	962
	Uranium (U) (mg/kg)	9.15	4.77	32.3	33.2	4.00

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1977686-31				
	Description	sediment				
	Sampled Date	07-AUG-17				
	Sampled Time	09:00				
	Client ID	YT5.0-1				
Grouping	**Analyte**					
SOIL						
Physical Tests	pH (1:2 soil:water) (pH)	6.42				
Particle Size	% Gravel (>2mm) (%)	3.2				
	% Sand (2.0mm - 0.063mm) (%)	46.4				
	% Silt (0.063mm - 4um) (%)	46.9				
	% Clay (<4um) (%)	3.5				
	Texture	Sandy loam				
Organic / Inorganic Carbon	Total Organic Carbon (%)	3.18				
Metals	Aluminum (Al) (mg/kg)	16500				
	Antimony (Sb) (mg/kg)	2.71				
	Arsenic (As) (mg/kg)	23.0				
	Barium (Ba) (mg/kg)	206				
	Beryllium (Be) (mg/kg)	0.54				
	Bismuth (Bi) (mg/kg)	0.19				
	Boron (B) (mg/kg)	<10				
	Cadmium (Cd) (mg/kg)	0.232				
	Calcium (Ca) (mg/kg)	8600				
	Chromium (Cr) (mg/kg)	43.2				
	Cobalt (Co) (mg/kg)	11.5				
	Copper (Cu) (mg/kg)	18.5				
	Iron (Fe) (mg/kg)	24700				
	Lead (Pb) (mg/kg)	11.3				
	Lithium (Li) (mg/kg)	10.9				
	Magnesium (Mg) (mg/kg)	6180				
	Manganese (Mn) (mg/kg)	607				
	Mercury (Hg) (mg/kg)	0.0569				
	Molybdenum (Mo) (mg/kg)	1.68				
	Nickel (Ni) (mg/kg)	26.6				
	Phosphorus (P) (mg/kg)	664				
	Potassium (K) (mg/kg)	1150				
	Selenium (Se) (mg/kg)	0.23				
	Silver (Ag) (mg/kg)	0.132				
	Sodium (Na) (mg/kg)	290				
	Strontium (Sr) (mg/kg)	43.6				
	Thallium (Tl) (mg/kg)	0.169				
	Tin (Sn) (mg/kg)	0.85				
	Titanium (Ti) (mg/kg)	910				
	Uranium (U) (mg/kg)	2.79				

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1977686-1 sediment 02-AUG-17 14:00 ID1.9-1	L1977686-4 sediment 03-AUG-17 09:00 LAC4.8-1	L1977686-7 sediment 03-AUG-17 14:00 CF3.9-1	L1977686-10 sediment 04-AUG-17 09:00 CF8.0-1	L1977686-13 sediment 05-AUG-17 09:00 CF10.0-1
Sample ID		L1977686-1	L1977686-4	L1977686-7	L1977686-10	L1977686-13
Description		sediment	sediment	sediment	sediment	sediment
Sampled Date		02-AUG-17	03-AUG-17	03-AUG-17	04-AUG-17	05-AUG-17
Sampled Time		14:00	09:00	14:00	09:00	09:00
Client ID		ID1.9-1	LAC4.8-1	CF3.9-1	CF8.0-1	CF10.0-1
SOIL						
Metals	Vanadium (V) (mg/kg)	67.0	66.7	67.7	67.6	78.7
	Zinc (Zn) (mg/kg)	92.3	75.5	71.5	74.0	82.3

ALS ENVIRONMENTAL ANALYTICAL REPORT

Grouping	Analyte	L1977686-16 sediment 04-AUG-17 14:00 LC2.7-1	L1977686-19 sediment 05-AUG-17 14:00 LC9.9-1	L1977686-22 sediment 06-AUG-17 14:00 HF0.2-1	L1977686-25 sediment 06-AUG-17 09:00 HF6.3-1	L1977686-28 sediment 07-AUG-17 14:00 YT0.2-1
Sample ID **Description** **Sampled Date** **Sampled Time** **Client ID**						
SOIL						
Metals	Vanadium (V) (mg/kg)	61.0	62.9	55.8	62.0	52.9
	Zinc (Zn) (mg/kg)	99.4	68.2	68.9	72.9	60.7

ALS ENVIRONMENTAL ANALYTICAL REPORT

	Sample ID	L1977686-31				
	Description	sediment				
	Sampled Date	07-AUG-17				
	Sampled Time	09:00				
	Client ID	YT5.0-1				
Grouping	**Analyte**					
SOIL						
Metals	Vanadium (V) (mg/kg)	62.1				
	Zinc (Zn) (mg/kg)	56.9				

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

HG-63UM-CVAF-VA	Soil	Hg in Soil by CVAFS	EPA 200.2/245.7

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 63 um (230 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by atomic fluorescence spectrophotometry or atomic absorption spectrophotometry (EPA Method 245.7).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

Deviation from Reference Method: This procedure deviates from the BC CSR SALM method, which specifies sieving to 2 mm (10 mesh).

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-63UM-CCMS-VA	Soil	Metals in Soil by CRC ICPMS	EPA 200.2/6020A

This analysis is carried out using procedures from CSR Analytical Method: "Strong Acid Leachable Metals (SALM) in Soil", BC Ministry of Environment, 26 June 2009, and procedures adapted from EPA Method 200.2. The sample is manually homogenized, dried at 60 degrees Celsius, sieved through a 63 um (230 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested at 95 degrees Celsius for 2 hours by block digester using concentrated nitric and hydrochloric acids. Instrumental analysis is by collision cell inductively coupled plasma - mass spectrometry (modifed from EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may be environmentally available. By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

PH-1:2-VA	Soil	pH in Soil (1:2 Soil:Water Extraction)	BC WLAP METHOD: PH, ELECTROMETRIC, SOIL

This analysis is carried out in accordance with procedures described in the pH, Electrometric in Soil and Sediment method - Section B Physical/Inorganic and Misc. Constituents, BC Environmental Laboratory Manual 2007. The procedure involves mixing the dried (at <60°C) and sieved (No. 10 / 2mm) sample with deionized/distilled water at a 1:2 ratio of sediment to water. The pH of the solution is then measured using a standard pH probe.

PSA-PIPET+GRAVEL-SK	Soil	Particle size - Sieve and Pipette	SSIR-51 METHOD 3.2.1

Particle size distribution is determined by a combination of techniques. Dry sieving is performed for coarse particles, wet sieving for sand particles and the pipette sedimentation method for clay particles.

Reference:

Burt, R. (2009). Soil Survey Field and Laboratory Methods Manual. Soil Survey Investigations Report No. 5. Method 3.2.1.2.2. United States Department of Agriculture Natural Resources Conservation Service.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
VA	ALS ENVIRONMENTAL - VANCOUVER, BRITISH COLUMBIA, CANADA

Chain of Custody Numbers:

Reference Information

GLOSSARY OF REPORT TERMS

Surrogate - A compound that is similar in behaviour to target analyte(s), but that does not occur naturally in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery.
mg/kg - milligrams per kilogram based on dry weight of sample.
mg/kg wwt - milligrams per kilogram based on wet weight of sample.
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight of sample.
mg/L - milligrams per litre.
< - Less than.
D.L. - The reported Detection Limit, also known as the Limit of Reporting (LOR).
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

ALS Environmental
www.alsglobal.com

Chain of Custody (COC) / Analytical Request Form

Canada Toll Free: 1 800 668 9878

L1977686-COFC

COC Number:

Report To	
Company:	EDI
Contact:	Lyndsay Doetzel
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8
Phone:	867-393-4882

Report Format / Distribution

Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)
Quality Control (QC) Report with Report ☐ Yes ☐ No
☐ Criteria on Report - provide details below if box checked
Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax ldoetzel@edynamics.com
Email 2
Email 3

Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)

R ☑ Regular (Standard TAT if received by 3 pm - business days)
P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
Specify Date Required for E2,E or P:

Invoice To	
Same as Report To	☑ Yes ☐ No
Copy of Invoice with Report	☑ Yes ☐ No
Company:	EDI
Contact:	S Jenner

Invoice Distribution

Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX
Email 1 or Fax sjenner@edynamics.com
Email 2 ldoetzel@edynamics.com

Project Information

ALS Quote #:	Q63380
Job #:	17Y0032:501
PO / AFE:	
LSD:	

Oil and Gas Required Fields (client use)

Approver ID:	Cost Center:
GL Account:	Routing Code:
Activity Code:	
Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: J.McCord ~~V. Dykshoorn~~ Sampler: L.Doetzel

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	C-TOC-SK	MET-63UM-SED-VA	PREP-DRY/GRIND-SK	PSA-PIPET+GRAVEL-SK	Number of Containers
	ID1.9-1	02-08-17	14:00	sediment	X	X	X	X	2
	ID1.9-2	02-08-17	14:00						1
	ID1.9-3	02-08-17	14:00						1
	LaC4.8-1	03-08-17	09:00		X	X	X	X	2
	LaC4.8-2	03-08-17	09:00						1
	LaC4.8-3	03-08-17	09:00						1
	CF3.9-1	03-08-17	14:00		X	X	X	X	2
	CF3.9-2	03-08-17	14:00						1
	CF3.9-3	03-08-17	14:00						1
	CF8.0-1	04-08-17	09:00		X	X	X	X	2
	CF8.0-2	04-08-17	09:00						1
	CF8.0-3	04-08-17	09:00						1

Drinking Water (DW) Samples[1] (client use)

Are samples taken from a Regulated DW System? ☐ Yes ☐ No
Are samples for human drinking water use? ☑ Yes ☐ No

Special Instructions / Specify Criteria to add on report (client Use)

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐
Ice packs Yes ☐ No ☐ Custody seal intact Yes ☐ No ☐
Cooling Initiated ☐

INIITIAL COOLER TEMPERATURES °C	FINAL COOLER TEMPERATURES °C
5°C @ 8°C.	10.1

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by: [signature]	Date: 17-Aug 17	Time: 12:00	Received by: [signature]	Date: Aug 18/17	Time: 15:00	Received by: TP	Date: Aug 23	Time: 12:20

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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NA-FM-0326e v09 Front/04 January 2014

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L1977686-COFC

COC Number:

Page 2 of 3

Report To		Report Format / Distribution	Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)	R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No	P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked	E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:	867-393-4882	Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX	E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax ldoetzel@edynamics.com	Specify Date Required for E2,E or P:
		Email 2	
		Email 3	

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	Analysis Request
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	

Project Information		Oil and Gas Required Fields (client use)	
ALS Quote #:	Q63380	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	

ALS Lab Work Order # (lab use only)

ALS Contact: ~~J. McCord~~ **Sampler:** L. Doetzel

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	C-TOC-SK	MET-63UM-SED-VA	PREP-DRY/GRIND-SK	PSA-PIPET+GRAVEL-SK	Number of Containers
	CF10.0-1	05-08-17	09:00	Sediment	X	X	X	X	2
	CF10.0-2	05-08-17	09:00						1
	CF10.0-3	05-08-17	09:00						1
	LC2.7-1	04-08-17	14:00		X	X	X	X	2
	LC2.7-2	04-08-17	14:00						1
	~~LC2~~ LC2.7-3	04-08-17	14:00						1
	LC9.9-1	05-08-17	14:00		X	X	X	X	2
	LC9.9-2	05-08-17	14:00						1
	LC9.9-3	05-08-17	14:00						1
	HF0.2-1	06-08-17	14:00		X	X	X	X	2
	HF0.2-2	06-08-17	14:00						1
	HF0.2-3	06-08-17	14:00						1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	
Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen	☐	SIF Observations	Yes ☐	No ☐
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐ No ☐
Cooling Initiated	☐			

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
					0.1

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by: TP	Date: Aug 23	Time: 12:20
[signature]	17-Aug-17	12:00						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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Chain of Custody (COC) / Analytical Request Form

ALS Environmental
www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L1977686-COFC

COC Number:

Page 3 of 3

Report To		Report Format / Distribution		Select Service Level Below (Rush Turnaround Time (TAT) is not available for all tests)
Company:	EDI	Select Report Format: ☑ PDF ☑ EXCEL ☐ EDD (DIGITAL)		R ☑ Regular (Standard TAT if received by 3 pm - business days)
Contact:	Lyndsay Doetzel	Quality Control (QC) Report with Report ☐ Yes ☐ No		P ☐ Priority (2-4 bus. days if received by 3pm) 50% surcharge - contact ALS to confirm TAT
Address:	2195 - 2nd Avenue Whitehorse, YT Y1A 3T8	☐ Criteria on Report - provide details below if box checked		E ☐ Emergency (1-2 bus. days if received by 3pm) 100% surcharge - contact ALS to confirm TAT
Phone:	867-393-4882	Select Distribution: ☐ EMAIL ☐ MAIL ☐ FAX		E2 ☐ Same day or weekend emergency - contact ALS to confirm TAT and surcharge
		Email 1 or Fax ldoetzel@edynamics.com		Specify Date Required for E2,E or P:
		Email 2		
		Email 3		

Invoice To	Same as Report To ☑ Yes ☐ No	Invoice Distribution	
	Copy of Invoice with Report ☑ Yes ☐ No	Select Invoice Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Company:	EDI	Email 1 or Fax sjenner@edynamics.com	
Contact:	S Jenner	Email 2 ldoetzel@edynamics.com	
Project Information		**Oil and Gas Required Fields (client use)**	
ALS Quote #:	Q63380	Approver ID:	Cost Center:
Job #:	17Y0032:501	GL Account:	Routing Code:
PO / AFE:		Activity Code:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact: ~~V. Dykshoorn~~ J McCord	Sampler: L. Doetzel

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	C-TOC-SK	MET-63UM-SED-VA	PREP-DRY/GRIND-SK	PSA-PIPET+GRAVEL-SK	Number of Containers
	HF6.3-1	06-08-17	09:00	Sediment	X	X	X	X	2
	HF6.3-2	06-08-17	09:00						1
	HF6.3-3	06-08-17	09:00						1
	YT0.2-1	07-08-17	14:00		X	X	X	X	2
	YT0.2-2	07-08-17	14:00						1
	YT0.2-3	07-08-17	14:00						1
	YT5.0-1	07-08-17	09:00		X	X	X	X	2
	YT5.0-2	07-08-17	09:00						1
	YT5.0-3	07-08-17	09:00						1

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report (client Use)
Are samples taken from a Regulated DW System? ☐ Yes ☐ No	
Are samples for human drinking water use? ☑ Yes ☐ No	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐		SIF Observations	Yes ☐	No ☐	
Ice packs	Yes ☐	No ☐	Custody seal intact	Yes ☐	No ☐
Cooling Initiated ☐					

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		
					10.1

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by: TP	Date: Aug 23	Time: 12:20
	17 Aug 17	12:00						

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

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1. If any water samples are taken from a **Regulated Drinking Water (DW) System**, please submit using an **Authorized DW COC form**.

Coffee Gold Project: Fish and Aquatic Resources Studies - 2018



Prepared For
Newmont Goldcorp Corporation
Suite 3400-666 Burrard Street
Vancouver, BC V6C 2X8

Prepared By
EDI Environmental Dynamics Inc.
2195 -2nd Avenue
Whitehorse, YT Y1A 3T8

EDI Contact
Pat Tobler, R.P. Bio.
867.393.4882

EDI Project
18Y0024
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EXECUTIVE SUMMARY

Aquatic data has been collected for several years at the Coffee Gold Project (herein referred to as the Project), with Environmental Dynamics Inc. (EDI) collecting baseline and monitoring data annually since 2016. Fieldwork in 2018 was intended to supplement existing pre-project data and provide additional monitoring data to allow for future comparisons following mine operation. The 2018 field season occurred over the months of July and August, with a focus on environmental DNA (eDNA), fish sampling, fish habitat assessments, barge wake investigations, and aerial surveys on salmon spawning.

Specifically, eDNA sampling was conducted on creeks with existing information on fish presence (e.g., Halfway and YT-24 creeks) as well as creeks where eDNA has not been conducted (e.g., Dan Man, Kona Tributary, Independence Creek Tributary A and B). Minnow trapping was completed on Coffee Creek, and electrofishing was performed on Halfway and YT-24 creeks, as well as upper Independence Creek (IC), and IC Tributary A and B (new to 2018). Beach seining was conducted in the Halfway and YT-24 Creek mixing zones within the Yukon River, and the Stewart River back channel that extends along the proposed Northern Access Route (NAR). Proposed barge landing sites were also beach seined on the Yukon and Stewart rivers. The Fish Habitat Assessment Protocol (FHAP) was followed for assessing fish habitat on Latte, Halfway, and YT-24 creeks. Opportunistic barge wake investigations were completed on the Yukon River with a focus on wake extent on shore. Similar to previous years, Coffee and Independence creeks had aerial Chinook salmon spawning surveys completed in July and August, and the Yukon and Stewart rivers were surveyed for spawning chum salmon in October.

Pertinent results from the 2018 field season include:

- High rainfall event leading up to the August sampling period may have impacted fish sampling results (e.g., DNA dilution from an influx of freshwater, juvenile fish being flushed from smaller watersheds, etc.).
- Arctic grayling were detected using eDNA sampling at five of thirteen sites sampled. Juvenile Chinook were only detected in Independence Creek (the positive control).
- No juvenile Chinook captured in Halfway or YT-24 Creek while electrofishing; single Arctic grayling were captured in lower 250 m of Halfway Creek, and lower 50 m of YT-24 Creek.
- Juvenile Chinook salmon caught electrofishing up IC Tributary B, approximately 16 km from confluence with the Yukon River.
- IC Tributary A is unlikely to contain fish above ~500 m from the confluence with Independence Creek due to a potential barrier to fish and increased grade (17-20%).
- Both the Halfway and YT-24 mixing zones contained higher species diversity and higher abundance of juvenile Chinook than elsewhere sampled on the Yukon River.

- No evidence of spawning activity during Chinook salmon spawning surveys in Coffee and Independence creeks.
- Juvenile Chinook were most abundant species captured at/near proposed barge landings, except for the Stewart River proposed north barge landing where no juvenile Chinook were captured.
- Little wake or lasting impact detected during barge wake investigations; largest lapping wave came up 50 cm on shore. Wake extent proved very dependent on shore slope.
- The Stewart River back channel located along the NAR appeared to provide nursery habitat for juvenile whitefish, northern pike, and burbot during July sampling.
- No chum salmon observed on the Stewart River and fewer were observed on the Yukon River than in 2017 (albeit 2017 was an anomalously high spawning year). Water levels were very low on both rivers, resulting in dewatered side channels where past spawning has been previously observed.

ACKNOWLEDGEMENTS

Jennie Gjertsen managed this project on behalf of Goldcorp Inc. and provided project direction needed to successfully complete the project. Jasmin Dobson, Becky Partridge, and Ryan Fetterley from Goldcorp provided exceptional logistical support to ensure our field crews could complete the work in an efficient and effective matter.

EDI would like to highlight the exceptional assistance provided by Goldcorp's Environmental Monitors. Derek Scheffen and Andrew Taylor provided local insight and assistance for components that were based from the mine. The Environmental Monitor Managers Alex Charron and Chris LeGoff assisted with field logistics and also field work.

Jared Hobbs (J Hobbs Ecological Consulting Ltd), Dr. Caren Helbing (University of Victoria), and Susan Dulc (Aurora Ecological Consulting) provided insight into the eDNA sampling component of the field studies and assisted with interpretation of the laboratory analysis.

AUTHORSHIP

This report was prepared by EDI Environmental Dynamics Inc. Staff who contributed to this project include:

Petra Szekeres, M.Sc., P. Biol. ..... Primary Author

Jonathan Lowey, B.Sc. ..... Section Author

Pat Tobler B.Sc., R.P. Bio., CPESC ..... Senior Review

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1. INTRODUCTION

The Coffee Gold Project (Coffee Project; the Project) is a proposed gold mine in west-central Yukon, located 130 km south of Dawson City. Gold was initially discovered at Coffee Creek in 2010, and exploration activities have been ongoing since then. Baseline environmental studies began in 2010 and were expanded in the following years in anticipation of future regulatory requirements.

The proposed Project will consist of an open pit gold mine and heap leach facility. The projected mine life is ten years with an 18-month construction period. The feasibility study proposes four open pits mined by conventional shovel and truck methods. The mine and associated activities will generally be located on a relatively high elevation ridge top and will not extend into the lower elevations where the larger streams are located. The mine footprint does include the upper part of some headwater watersheds (including Halfway Creek, YT-24 and unnamed tributaries to Latte Creek). Most prominently, the main proposed Waste Rock Storage Facility (WRSF) will be positioned in the upper Halfway Creek watershed.

The Project will be accessed by road from Dawson City via a 214-km single-lane, gravel road with pull outs. The initial part of this route, from the highway to Sulphur Creek utilizes a government-maintained gravel road. Beyond Sulphur Creek, the Northern Access Route (NAR) mainly follows existing placer mine roads which will be upgraded to provide all-season access to supply vehicles. Approximately 30 km of new road will be constructed (Figure 1). Electricity will be generated onsite by diesel-powered generators. The majority of mine staff will access the site by air.

The Coffee Project is located on Crown land within the Traditional Territory of the Tr'ondëk Hwëch'in and the asserted traditional territory of the White River First Nation. A portion of Goldcorp's claim block is located in the Traditional Territory of the Selkirk First Nation and the proposed road also overlaps with the Traditional Territory of the First Nation of the Na-Cho Nyak Dun.

The proposed Project will require an Executive Committee Screening from the Yukon Environmental and Socio-economic Assessment Board (YESAB), a Type A Water Licence issued by the Yukon Water Board and a Quartz Mining License issued by the Yukon Government, among other permits and licences.

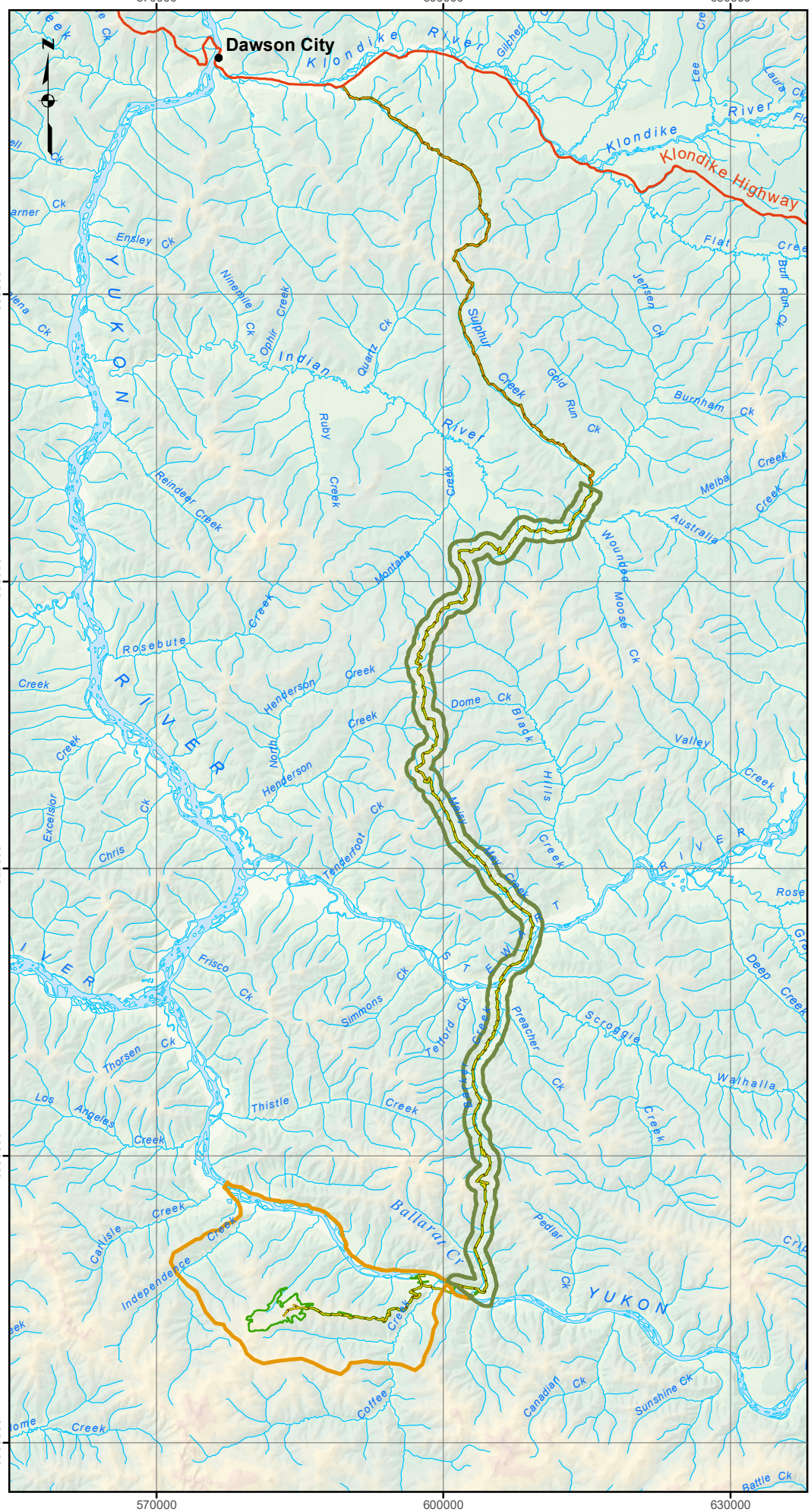

Figure 1. Overview of the Coffee Project study area

Legend

- Settlement/Community
- Government-Maintained Gravel Road Along Proposed Route
- Proposed Route
- Project Footprint (as of March 10, 2017)

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area



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1.1. STUDY PURPOSE AND SCOPE

Results from the 2018 field season provide some additional fish and aquatic resource baseline and pre-project monitoring information, in addition to preliminary investigations at previously unstudied areas within Goldcorp's claim area. Palmer Environmental Consulting Group collected baseline data around the mine in 2014 and 2015 (PECG 2017) and along the access road in 2015 (PECG. EDI collected additional baseline data in 2016 and 2017 around the mine and Northern Access Route (NAR; EDI 2017, 2018) and summarized all data collected to date. The study conducted in 2018 was intended to expand the baseline (both spatially and quantitatively), support the effects assessment for the Project and provide pre-project information that can be used for effects monitoring.

- Project components for the Mine Study Area (Figure 2) 2018 field studies include:
    - environmental DNA (eDNA);
    - fish sampling;
    - fish and fish habitat investigations;
    - spawning surveys for Chinook salmon; and,
    - sampling Halfway and YT-24 creek mixing zones at the confluence with the Yukon River.
- Project components for the NAR Study Area (Figure 3) 2018 field studies include:
    - fish sampling and general fish habitat characterization at proposed barge landings (Yukon River, Stewart River);
    - barge wake investigations;
    - fish habitat investigations in a back channel of Stewart River; and,
    - spawning surveys for chum salmon in the Yukon and Stewart rivers.

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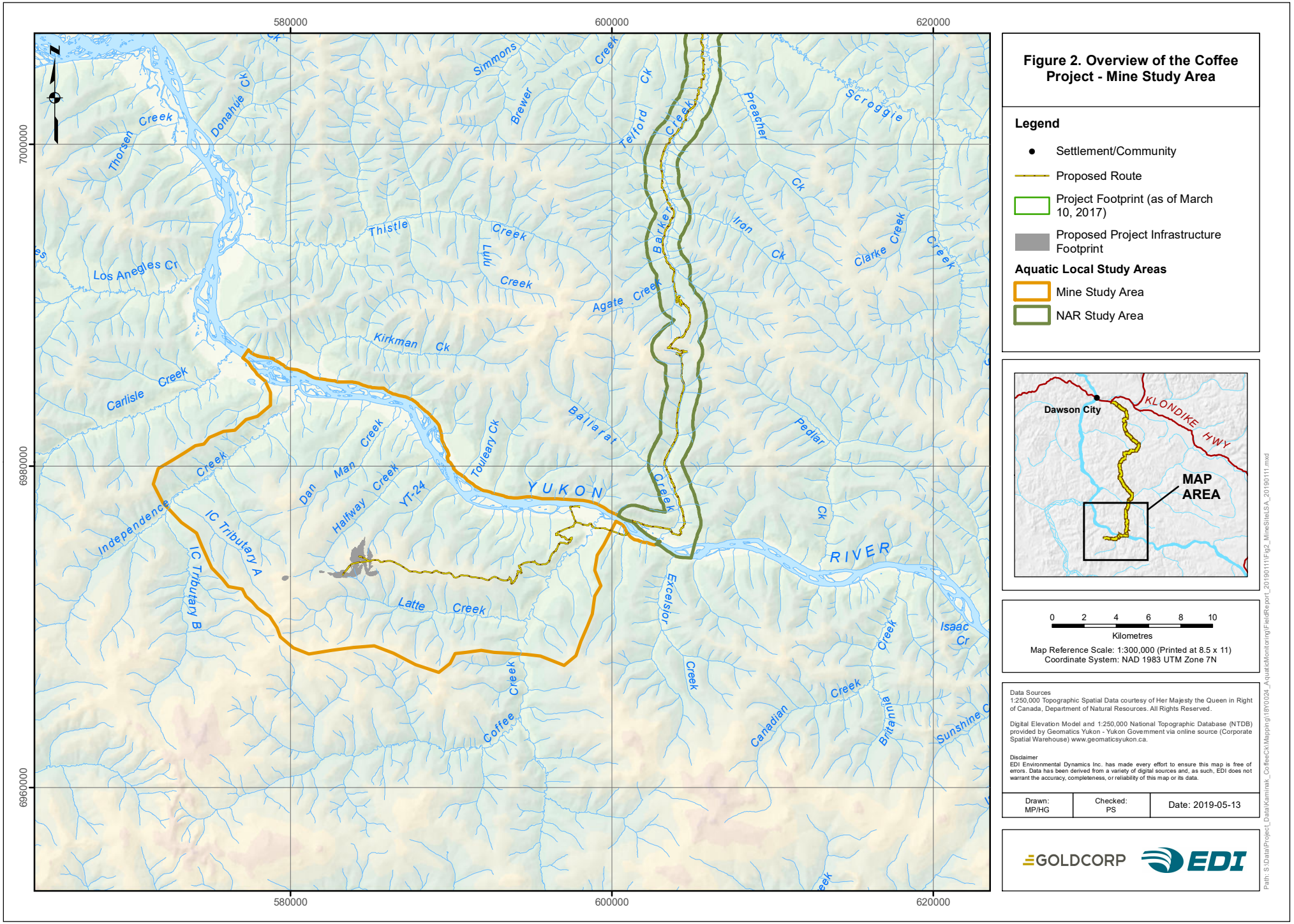
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Iron Ck
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Thistle Creek
Los Anegles Cr
Lulu Creek
Agate Creek
Kirkman Ck
Carlisle Creek
Ballarat Creek
Pedlar Creek
Dan Man Creek
Halfway Creek
YT-24
Touleany Ck
YUKON RIVER
Independence Creek
IC Tributary A
IC Tributary B
Latte Creek
Excelsior Creek
Isaac Cr
Coffee Creek
Canadian Creek
Britannia Creek
Sunshine Creek
Dawson City
KLONDIKE HWY
MAP AREA
Figure 2. Overview of the Coffee Project - Mine Study Area
Legend
Settlement/Community
Proposed Route
Project Footprint (as of March 10, 2017)
Proposed Project Infrastructure Footprint
Aquatic Local Study Areas
Mine Study Area
NAR Study Area
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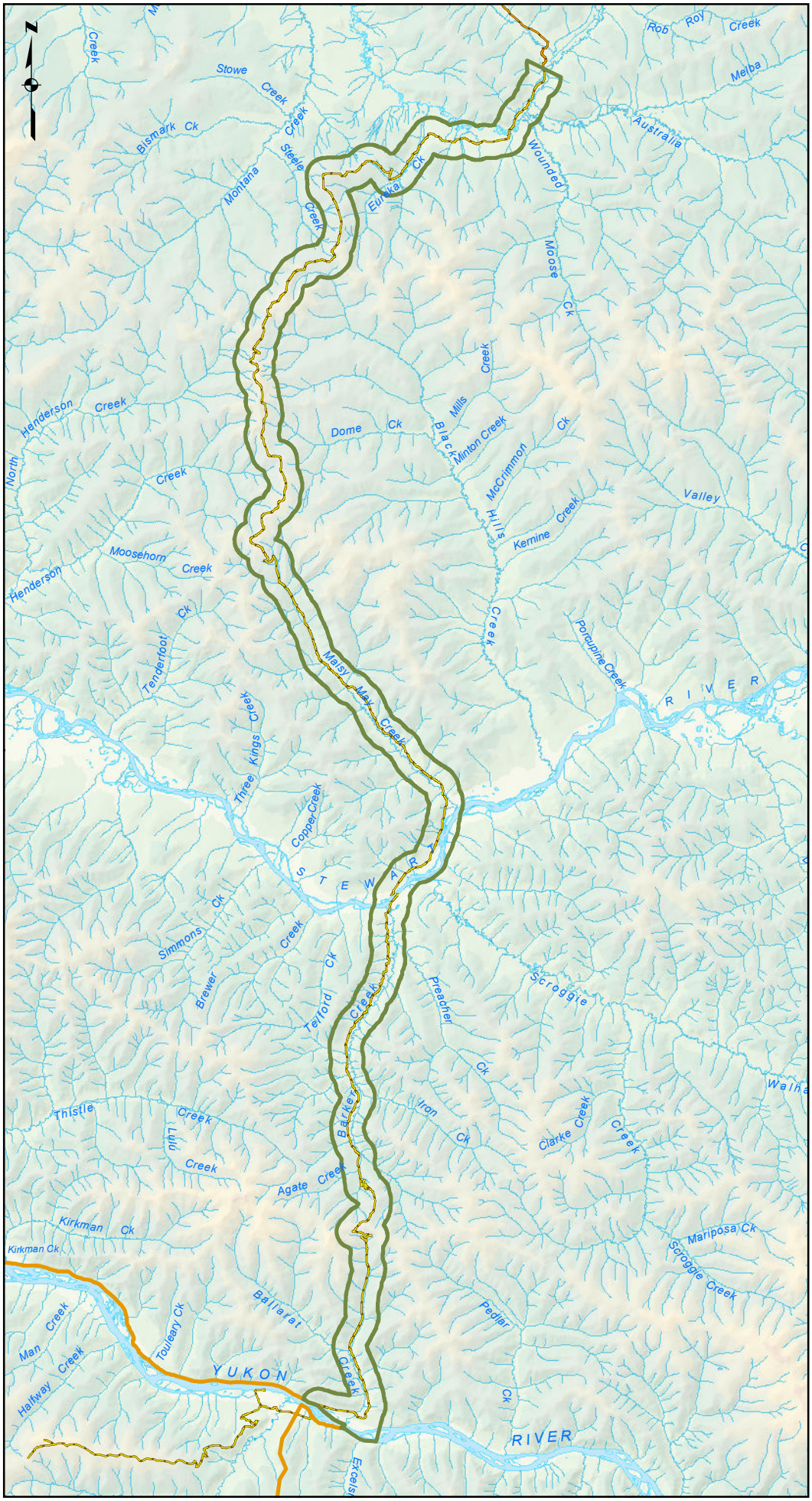


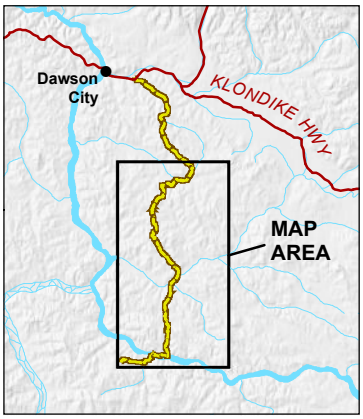
Figure 3. Overview of the Coffee Project - Northern Access Road (NAR) Study Area

Legend

- Settlement/Community
- Government-Maintained Gravel Road Along Proposed Route
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area



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1.2. BASELINE SAMPLING STATION CONCORDANCE

In an effort for consistency between all groups working on aquatic and fisheries work within the Project area, a new station naming system has been developed for 2018. To assist in rectifying previous sampling stations with the new system, a table of concordance is shown below (Table 1). The new naming system will allow for easy determination of station location and the addition of new stations, if and where needed:

1. Each station ID designation begins with a two or three letter code for each creek in the Mine Study Area. Three letter codes are used for unnamed tributaries to named creeks; therefore, LCC corresponds to Latte Creek, Tributary C.

2. Following the creek letter code is a numeric designation that represents the stream distance (kilometers) of a sampling station from its major confluence (i.e., following the meandering of the creek).

3. For stations in the Yukon River, the naming convention follows the number of kilometers from the confluence with the White River.

Table 1. Concordance table of Coffee Project fisheries and aquatic field sampling station identifiers.

Waterbody	Water quality and hydrology station (Lorax 2016)	2016 station name	2017 station name	2018 station name
Coffee Creek	CC4.5	CF2.7		CC4.0
Coffee Creek		CF3.9	CF3.9	CC5.6
Coffee Creek		CF5.7		CC9.9
Coffee Creek		CF8.0		CC12.9
Coffee Creek	CC0.5	CF8.3		CC13.1
Latte Creek	CC3.5	LC0.5[1]		LC0.05
Latte Creek		LC2.7		LC3.5
Latte Creek	CC1.5	LC9.7		LC11.3
Latte Creek		LC9.9		LC11.7
Latte Creek		LC10.4		LC12.3
Latte Creek		LC11.8		LC13.7
Latte Creek	CC6.0	LC13.5		LC14.4
Latte Creek, Tributary C	CC1.0	LCC0.1		LCT20-0.1
Halfway Creek		HF0.0		HC0.0
Halfway Creek			HF0.1	HC0.1
Halfway Creek	HC5.0	HF0.2	HF0.2	HC0.3
Halfway Creek			HF0.6	HC0.7

[1] While this site was labeled LC0.5, the actual distance of this site from the mouth of Latte Creek is ~50 m.

Waterbody	Water quality and hydrology station (Lorax 2016)	2016 station name	2017 station name	2018 station name
Halfway Creek			HF1.0	HC1.1
Halfway Creek			HF2.0	HC2.2
Halfway Creek	HC2.5	HF6.3	HF6.3	HC6.7
Halfway Creek		HF9.3		HC9.9
YT-24 Creek		YT0.0		YT0.0
YT-24 Creek				YT0.05
YT-24 Creek	ML1.0	YT0.2	YT0.2	YT0.2
YT-24 Creek				YT0.6
YT-24 Creek				YT1.0
YT-24 Creek		YT5.0		YT5.3
Independence Creek	IC4.5	ID1.9	ID1.9	IC2.6
Independence Creek		ID6.7		ID9.2
Independence Creek				IC15.6
Independence Creek, Tributary A				ICA0.4
Independence Creek, Tributary A				ICA0.9
Independence Creek, Tributary A				ICA4.0
Independence Creek, Tributary B				ICB0.2
Independence Creek, Tributary B				ICB0.6
Independence Creek, Tributary B				ICB4.7
Kona Tributary		KT0.1		KT0.1
Kona Tributary		KT5.2		KT5.7
Kona Tributary				KT0.2
Kona Tributary				KT3.4
Dan Man				DM0.2
Dan Man				DM2.2
Yukon River	YUK2.0	YRU2.2		YUK51.5
Yukon River	YUK5.0	YRD21.7		YUK24.6
Yukon River			YRU1.9	YUK51.2
Yukon River			YRD1.6	YUK47.6
Yukon River			YRD2.1	YUK46.1
Isaac Creek		IS0.1		IS0.1
Los Angeles Creek		LaC4.8		LA8.5

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2. METHODS

Methods are presented separately for the mine and Northern Access Route (NAR) study areas in the below sections.

2.1. MINE STUDY AREA

Aquatic resource sampling included environmental DNA (eDNA), fish sampling (beach seining, electrofishing, minnow trapping), Fish Habitat Assessment Procedures (FHAP; Johnston and Slaney 1996), Chinook salmon spawning surveys (aerial and on foot). In-situ water quality was taken at all sampled sites (APPENDIX A). These activities were carried out in several streams in the Mine Study Area and reference areas, in addition to some creeks that may become affected if there is future expansion of the Coffee mine:

- Halfway, Latte and YT-24 watersheds directly drain the Mine Site and are those that are predicted to be most affected by project activities. These streams are considered 'near' to project activities.

- Latte Creek flows into Coffee Creek. Therefore, while Coffee Creek is downstream of the Project area, the reaches that are downstream of the Latte confluence are considered 'far' from Project activities due to the limited influence on water quality/quantity predicted from the Project.

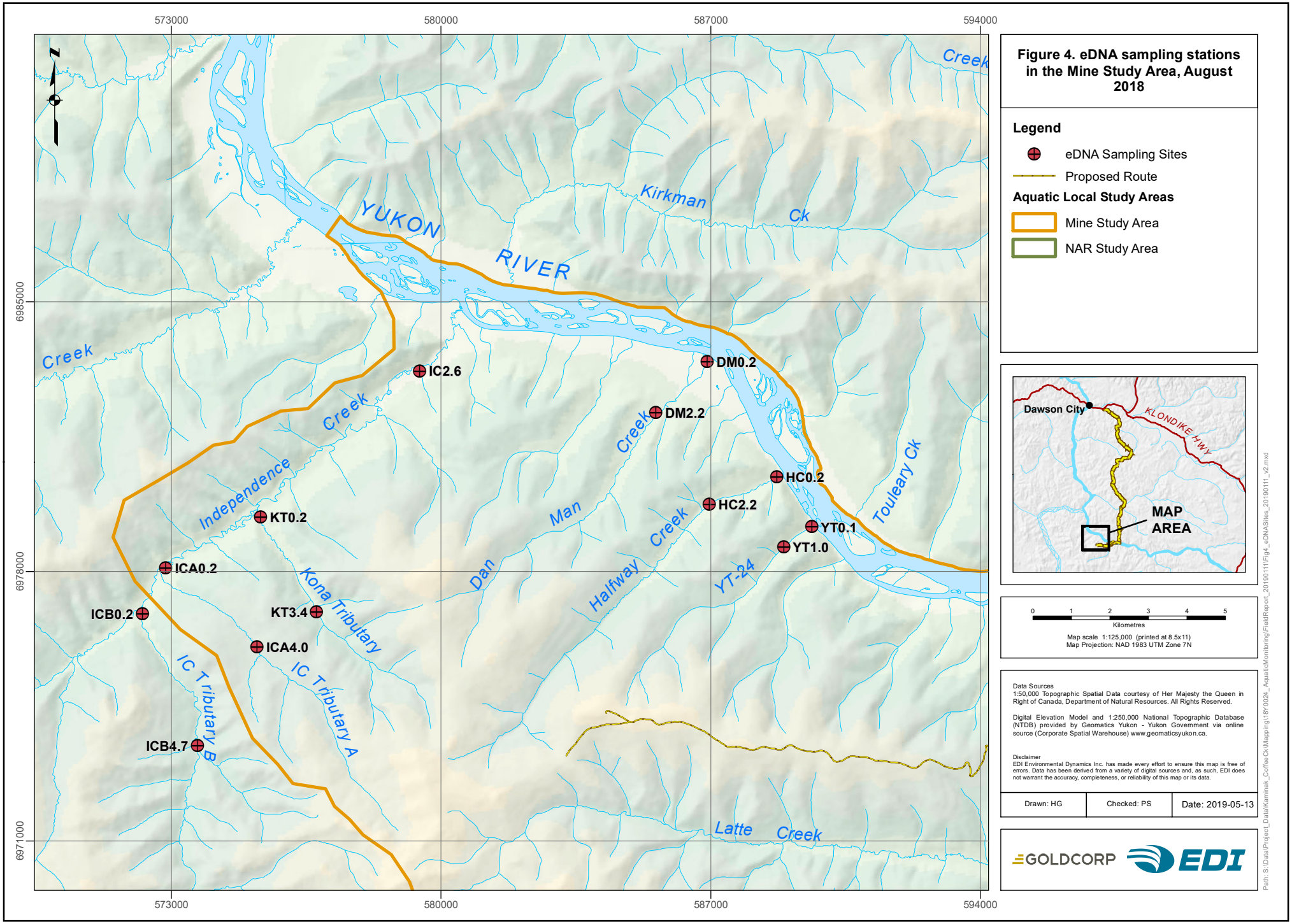
- Dan Man, Kona, Independence Creek (IC) Tributary A and IC Tributary B are all within regions of potential future exploration and had baseline fisheries information collected on them (eDNA and fish sampling on IC Tributary A and B). Currently, only Dan Man and Kona are considered to be in areas of current mining operations.

2.1.1. ENVIRONMENTAL DNA SAMPLING

The environmental DNA (eDNA) sampling conducted during August 2018 involved collecting one liter water samples from several creeks, with the objective of both supplementing existing information on previously studied creeks (Halfway, YT-24, and Independence creeks), and also to provide a baseline for creeks that have not been studied in past years by EDI (Dan Man, Kona Tributary, IC Tributary A and B). The water-based eDNA samples provide information on Chinook salmon and Arctic grayling presence and absence. August was chosen as it is the month when fish densities are highest and small creeks are more likely to be inhabited than during other periods in the year. Field sampling included thirteen sites that were sampled August 10-13, 2018 (Table 2; Figure 4).

Table 2. Summary of 2018 eDNA sampling stations in the Mine Study Area, August 2018.

Station Name	Creek	Latitude	Longitude
DM0.2	Dan Man	62.97039	-139.28577
DM2.2	Dan Man	62.95885	-139.31279
DW1.0	Distilled water	n/a	n/a
DW2.0	Distilled water	n/a	n/a
HC0.2	Halfway Creek	62.94279	-139.25217
HC2.2	Halfway Creek	62.93670	-139.28781
IC2.6	Independence Creek	62.96995	-139.43295
ICA0.4	IC Tributary A	62.92541	-139.56530
ICA4.0	IC Tributary A	62.90653	-139.51950
ICB0.2	IC Tributary B	62.91487	-139.57761
ICB4.7	IC Tributary B	62.88394	-139.55115
KT0.2	Kona Tributary	62.93678	-139.51606
KT3.4	Kona Tributary	62.91442	-139.48864
YT240.1	YT-24 Creek	62.93130	-139.23461
YT241.0	YT-24 Creek	62.92685	-139.24937


573000
580000
587000
594000
6985000
6978000
6971000
YUKON RIVER
Kirkman Ck
Creek
Creek
Creek
Creek
Independence Creek
Kona Tributary
IC Tributary A
IC Tributary B
Dan Man Creek
Halfway Creek
YT-24
Latte Creek
Touleary Ck
IC2.6
DM0.2
DM2.2
HC0.2
HC2.2
YT0.1
YT1.0
KT0.2
ICA0.2
ICB0.2
KT3.4
ICA4.0
ICB4.7
Figure 4. eDNA sampling stations in the Mine Study Area, August 2018
Legend
eDNA Sampling Sites
Proposed Route
Aquatic Local Study Areas
Mine Study Area
NAR Study Area
Dawson City
KLONDIKE HWY
MAP AREA
0 1 2 3 4 5
Kilometres
Map scale 1:125,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N
Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.
Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.
Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.
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The eDNA methods involved disinfection, sampling, as well as preparing samples for laboratory analysis. Before leaving for the field, all equipment and sample bottles were cleaned and disinfected with 10% bleach solution and 85% ethanol and left to dry before being packed for transport. All equipment was kept in separate bags in the transport bin (e.g., envelopes, bottle triplicates, etc.) to mitigate contamination of equipment.

During sampling programs, one field member was designated the eDNA sampler. This individual was responsible for sample collection, storage and handling to eliminate potential contamination. The eDNA sampler would not carry any other fish sampling equipment for the day and no one else was allowed in the water within 50 m of the sampling location. New nitrile gloves were worn at each site. Triplicate sample bottles for each site were kept together in bags to prevent bottles from different sites coming into contact with one another.

All samples were taken starting at downstream sites, working upstream throughout the day to keep from contaminating samples. Once arriving at the site, the eDNA sampler removed the three bottles for the site from their respective bag. Each of the three sample bottles were rinsed three times downstream of where the actual sample was taken; bottles were rinsed to remove any disinfectant residue. After rinsing bottles, they were replaced back into their bags and sealed while the sampler moved upstream to take the samples being analyzed for eDNA. Cascades were the preferred areas to take samples; otherwise, the sampler would try to stay out of the water (i.e., step on rocks), or take the sample from the shoreline. The main consideration for sampling was that it was from the main flow of the stream and not from eddies or still pools (Hobbs 2017). Each sample bottle was filled, capped, and placed back into their bags and sealed; samples were left in a cooler or field pack until being processed later that afternoon.

At the end of the day samples were processed at the Coffee Gold Camp. Using a peristaltic pump, each triplicate sample was processed separately. The 1 L sample was filtered through a 45 µL filter; once the water had been filtered, the pump continued for another 4-7 minutes to continue drying out the sample. Using disinfected forceps (10% bleach, distilled water, 85% ethanol, distilled water), the filter paper was folded and placed into a small pre-labelled coin envelope and sealed. All three samples from each site received their own envelopes, but they were all kept together in a Ziploc bag with two teaspoons of desiccant (silica) beads. Beads were checked periodically for signs of dampening (i.e., turning clear or pink) and were replaced accordingly. Samples were shipped priority to the University of Victoria for analysis which was conducted as outlined in Hobbs (2017).

2.1.2. FISH SAMPLING AND HABITAT INVESTIGATIONS

Fish sampling was conducted at numerous sites within the Mine Study Area. Fish sampling took place over two field events, spanning July 11-14 and August 8-18, 2018 (Figure 5). The objectives of fish sampling were to better understand fish distribution, assemblages, and usage in several select steams within the Mine Study Area, and in streams that may be within the footprint of future exploration. The fish sampling method used at each site was dependent on physical stream features and suitability of the method for the targeted species. The sampling methods used included electrofishing (EF), beach seining (BS), and minnow trapping (MT). All captured fish were identified to species (unless larval stage, then were identified to genus), with the

remaining fish enumerated before all fish were released back at their site of capture. There were two new creeks investigated during the 2018 field season, which were both tributaries high in the Independence Creek watershed. These two creeks are referred to as IC Tributary A and IC Tributary B; IC Tributary A is lower in the watershed, approximately 14.2 km from the confluence with the Yukon River, while IC Tributary B is approximately 15.7 km upstream from the confluence.

Two different electrofishers were used during the two separate field events. During the July field event a Smith Root LR-24 was used, while a Smith Root 12-B POW electrofisher was used during August. All electrofishing effort was conducted using open-site single-pass methods. The beach seine used was 10 m in length, 1.5 m deep and constructed of a 5 mm mesh, with a buoyant float line and sinking lead line. Beach seine hauls were conducted with field crews of two members and consisted of varying lengths, widths, and depths dependent on the stream environment. Minnow traps were placed in areas of good cover and suitable depth and stream velocity. Each site had three small mesh gee type minnow traps (0.6 cm mesh size) baited with Yukon River chum roe in a perforated bag and were deployed along stream margins in slow water habitats. Water depth, site characteristics, and photos were recorded for each trap and traps were left to soak overnight. During the July field event, a YSI ProPlus was used to collect in-situ water quality parameters (temperature, dissolved oxygen, specific conductivity, and pH) at all fish sampling sites, while the August field event used a pH and specific conductivity pen and thermometer; dissolved oxygen was not recorded in August. Digital photos and GPS coordinates were taken of all sites sampled for fish.

Previously, site naming used the linear distance from creek mouths. In 2018 this was changed for all creeks and will continue for sampling in the future. Each sampling location was named based on the shortened watershed name, followed by the stream-distance from each respective creek mouth (e.g., HC0.7 – Halfway Creek 0.7 km from the mouth, accounting for meandering of stream). For electrofishing, the fishing effort was enumerated on the device and given in total seconds of active electrofishing as well as the approximate distance from the electrofishing starting GPS point. Beach seining efforts were measured by the length and width of a seine haul (i.e., area seined; m^2). Lastly, total minnow trapping effort were enumerated based on the number of traps multiplied by soak times (HH:MM). Ten of each species was weighed (g) and measured to fork length (e.g., Chinook, whitefish) or total length (e.g., slimy sculpin; mm) at every site for each sampling method. In some instances, weight couldn't be recorded because fish were either too big or too small. The mean fork length and weight (± standard error; SE) was calculated for each group of fish per species, per sampling event. In cases where no weight was taken, fish length was still used in calculations.

2.1.2.1. Coffee Creek

Chinook salmon spawning surveys were completed in both July and August (refer to Section 2.1.5). Minnow trapping was completed on Coffee Creek (CC5.6) on August 15-16, 2018 consisting of three sites (three traps per site; Figure 5). Minnow trapping was used in favour of electrofishing or beach seining due to high-water levels and strong currents at the time of sampling. There were several attempts to beach seine; however, all efforts were aborted partway through due to strong currents and safety concerns.

2.1.2.2. Halfway Creek

Fish sampling on Halfway Creek was completed during both field events from July 12-14, as well as August 10-15, 2018. Halfway Creek was sampled for fish with the objective of supplementing and supporting previous years' findings. Halfway Creek fish sampling involved open site electrofishing during both the July and August field events (Figure 5; Table 3); the mixing zone of the Halfway Creek outlet and the Yukon River was also assessed for fish presence using beach seining (refer to Section 2.1.3).

Table 3. Electrofishing methods summary on Halfway Creek during July and August sampling, 2018.

Sampling site	Date	Distance (m)	Fishing effort (seconds)	Electrofisher settings	Duty cycle (%)
HC0.1	August 15, 2018	150	1,178	400 V, 60 Hz, 4 ms	24
HC0.2	July 13, 2018	150	958	340 V, 45 watts, 0.1 amps	n/a[1]
HC0.2[2]	August 12, 2018	160	993	300 V, 60 Hz, 0.5 ms	3
HC0.7	August 12, 2018	150	698	400 V, 60 Hz, 4 ms	24
HC1.1	August 12, 2018	160	774	400 V, 60 Hz, 4 ms	24
HC2.2	August 10, 2018	150	745	300 V, 60 Hz, 6 ms	36
HC6.7	August 10, 2018	300	634	300 V, 60 Hz, 6 ms	36

[1]Not recorded.
[2] Settings on device changed while manoeuvring through creek to a lower setting.

2.1.2.3. YT-24 Creek

Fish sampling on YT-24 Creek followed much the same methodology as on Halfway Creek. Open site electrofishing was completed on July 13 and August 12, 2018. During the July field visit YT0.05 and YT0.6 were sampled, and YT1.0 was sampled in August (Table 4; Figure 5). The mixing zone of YT-24 Creek outlet and the Yukon River was also sampled using beach seining in both July and August (refer to Section 2.1.3).

Table 4. Electrofishing methods summary on YT-24 Creek during July and August sampling, 2018.

Sampling site	Date	Distance (m)	Fishing effort (seconds)	Electrofisher settings	Duty cycle (%)
YT0.05	July 13, 2018	150	768	340 V, 45 watts, 0.1 amps	n/a[1]
YT0.6	July 13, 2018	160	626	340 V, 45 watts, 0.1 amps	n/a[1]
YT1.0	August 12, 2018	150	671	400 V, 60 Hz, 4 ms	24

[1]Not recorded.

2.1.2.4. Independence Creek

A Chinook salmon spawning survey was completed in August on Independence Creek (refer to Section 2.1.5). Independence Creek was sampled for fish on August 17, 2018 (Figure 5). Independence Creek was electrofished 15.6 km from the creek mouth (IC15.6) for 60 m and 588 seconds to determine fish presence directly downstream of the confluence with IC Tributary B.

2.1.2.5. Independence Creek, Tributary A

This was the first year that IC Tributary A was investigated and sampled, as it is within the footprint of potential future exploration at the Project; it is a tributary to Independence Creek, approximately 14.2 km upstream from the confluence of Independence Creek and the Yukon River. Independence Creek Tributary A was flown on August 10 to get a better understanding of the creek characteristics and possible barriers to fish; electrofishing was also completed on August 16 and 17 at ICA0.4 and ICA0.9 (Table 5; Figure 5). The creek was then walked on foot from the mouth of the creek to a point approximately 500 m up, where there was a perceived barrier to fish. Locations below and above the perceived barrier were spot-electrofished to get an idea of fish presence. Due to time constraints there were limitations on the amount of electrofishing that could be completed; instead, the focus was to confirm the presence of fish below and above the perceived barrier and take measurements, notes, and photos of the perceived barrier.

Table 5. Electrofishing methods summary on IC Tributary A during August sampling, 2018.

Sampling site	Date	Distance (m)	Fishing effort (seconds)	Electrofisher settings	Duty cycle (%)
ICA0.4	August 17, 2018	150	256	600 V, 60 Hz, 4 ms	24
ICA0.9	August 16, 2018	150	626	400 V, 60 Hz, 4 ms	24

2.1.2.6. Independence Creek, Tributary B

Similar to IC Tributary A, this was the first year that IC Tributary B was observed; as such, the methodology on both creeks was fairly similar for the 2018 field season. Independence Creek Tributary B also flows into Independence Creek, approximately 1.5 km upstream from where IC Tributary A enters (approximately 15.7 km from the Yukon River confluence). The creek was flown on August 10 and had electrofishing completed on August 17 at ICB0.2 and ICB0.6 (Table 6; Figure 5). Water quality parameters were recorded, in addition to gradient from a number of locations in both IC Tributary A and B.

Table 6. Electrofishing methods summary on IC Tributary B during August sampling, 2018.

Sampling site	Date	Distance (m)	Fishing effort (seconds)	Electrofisher settings	Duty cycle (%)
ICB0.2	August 17, 2018	150	754	400 V, 60 Hz, 4 ms	24
ICB0.6	August 17, 2018	120	531	400 V, 60 Hz, 4 ms	24

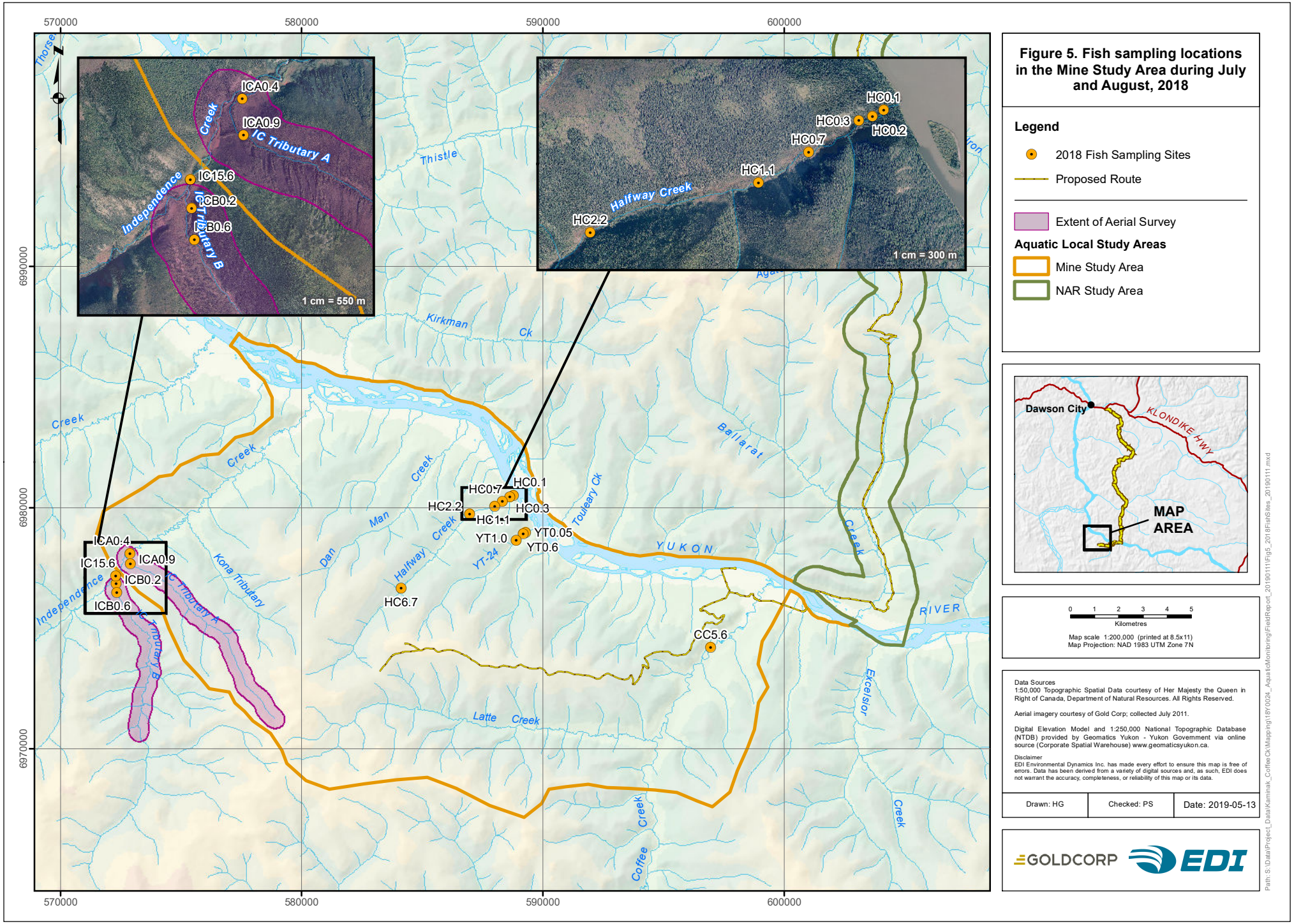

Figure 5. Fish sampling locations in the Mine Study Area during July and August, 2018

Legend

- 2018 Fish Sampling Sites
- Proposed Route
- Extent of Aerial Survey

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

Map scale 1:200,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Aerial imagery courtesy of Gold Corp; collected July 2011.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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2.1.3. YUKON RIVER MIXING ZONES

As suggested by the Selkirk First Nation, fish sampling was completed at the confluences (mixing zones) of both Halfway and YT-24 creeks with the Yukon River. The mixing zone of Halfway Creek and nearby Yukon River sites were sampled July 12 and August 8, while YT-24 Creek was sampled July 13 and August 9, 2018. The mixing zones for each creek (i.e., where the creek flows into the Yukon River) were sampled using beach seining (Figure 6). During each sampling event three to four seine hauls were completed, beginning at the mouth of the creek and going progressively downstream on the Yukon River. There was only a fourth seine completed if one of the three seine hauls was considered poor but not fully aborted. Additionally, an area 130 m downstream of the Halfway Creek mouth was also sampled in August to determine the extent of the mixing zone, and if species composition and abundance was more comparable to the mixing zone or other Yukon River sites.

Three additional seine hauls were conducted upstream of Halfway and YT-24 creeks on the Yukon River, intended to act as controls to the mixing zone results. These sites were used as controls based on proximity to the mixing zone sites; however, the upstream habitats immediately above the mixing zones on the Yukon River were substantially different from those in the mixing zones (e.g., characterized by very steep banks and deep, fast moving water). These sites also proved very difficult to beach seine. Therefore, while they satisfied the need for a control based on proximity, they were not the same habitat type as the mixing zones. As a result, other seine hauls from the Yukon River future north barge landing (YUK51.2) were used as a reference site to compare catch-per-unit-effort (CPUE) results to, in an effort to compare similar habitat types. On YT-24 Creek in August, due to the difficulty of beach seining directly upstream of the mixing zone, a new site was chosen as a control based on proximity; this site was located approximately 40 m across from the YT-24 Creek mouth on the sandbar of an island (Figure 6). Beach seine hauls were conducted with field crews of two members for a length of approximately 15 m. Fish captured were enumerated, and a subset of ten fish per species had their length and weight taken from each seine haul. Fish measurement metrics were summarized (fork length and weight, ± SE) for all species captured. Due to the difference in habitat characteristics and difficulty seining directly upstream of the mixing zones, CPUE of juvenile Chinook salmon and Arctic grayling were only compared between mixing zones and the Yukon River reference site (north barge landing).

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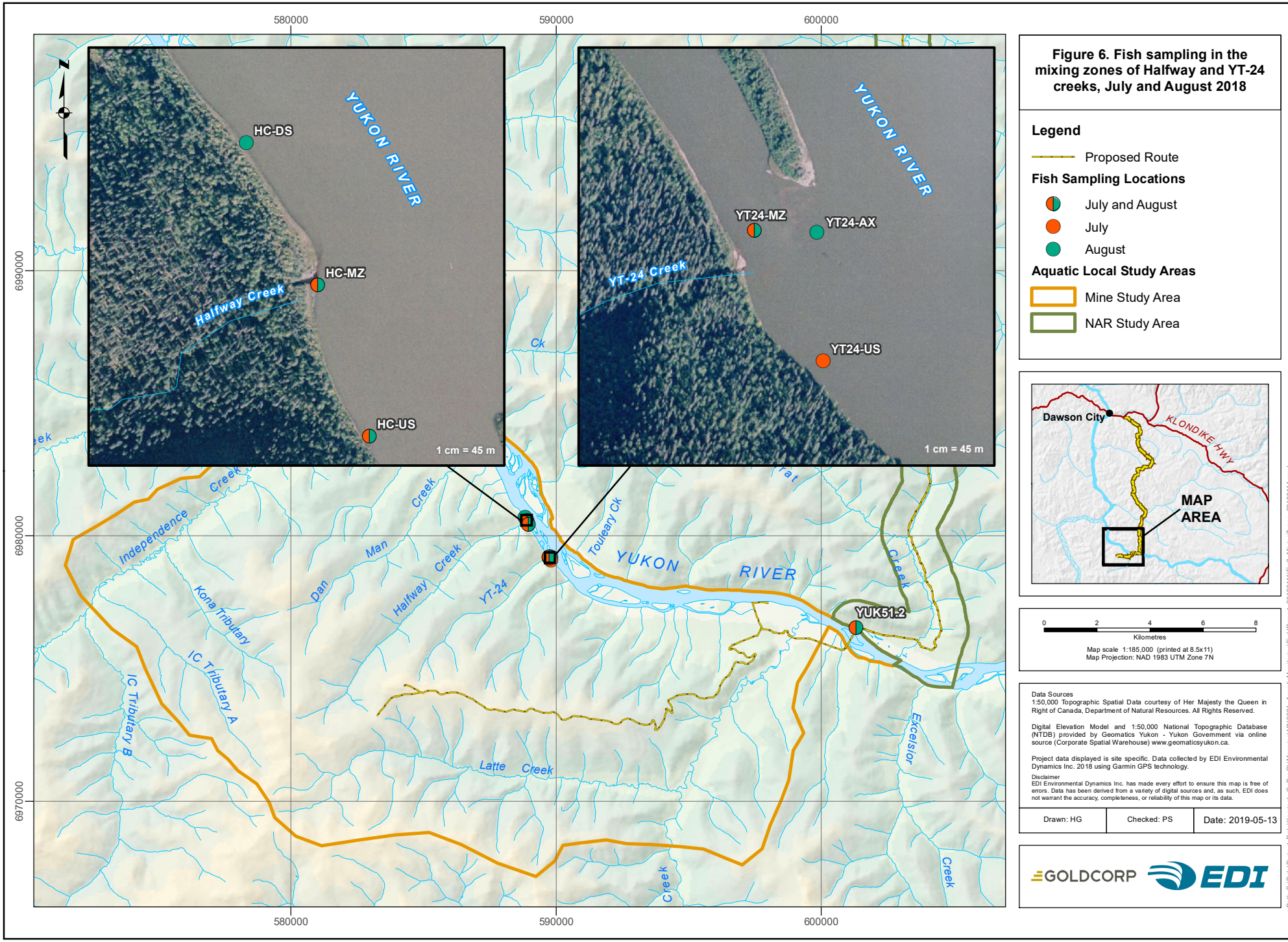

Figure 6. Fish sampling in the mixing zones of Halfway and YT-24 creeks, July and August 2018

Legend

Proposed Route

Fish Sampling Locations

- July and August
- July
- August

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

0 2 4 6 8
Kilometres

Map scale 1:185,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
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Digital Elevation Model and 1:50,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc. 2018 using Garmin GPS technology.

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2.1.4. FISH HABITAT ASSESSMENTS

Fish habitat surveys were conducted on three streams during August 2018 following the Fish Habitat Assessment Procedures (FHAP) survey methodology (Table 7). The FHAP survey documents the characteristics and frequency of different fish habitats by enumerating different habitat units (e.g., pool, riffle, glide), and measuring various parameters (e.g., average depth, width, length, etc.). A detailed methodology is outlined in the FHAP guide (Johnston and Slaney 1996). The length of habitat units was measured using a laser range finder, whereas wetted widths, bankfull widths, and depths were measured with a measuring tape and/or meter stick.

Table 7. Summary of fish habitat assessments in August 2018.

Creek	Date	Distance (m)	Latitude	Longitude
Halfway Creek	August 14, 2018	591	62.943954	-139.249186
YT-24 Creek	August 13, 2018	535	62.931105	-139.233907
Latte Creek	August 10, 2018	656	62.861508	-139.297579

2.1.5. CHINOOK SALMON SPAWNING SURVEYS

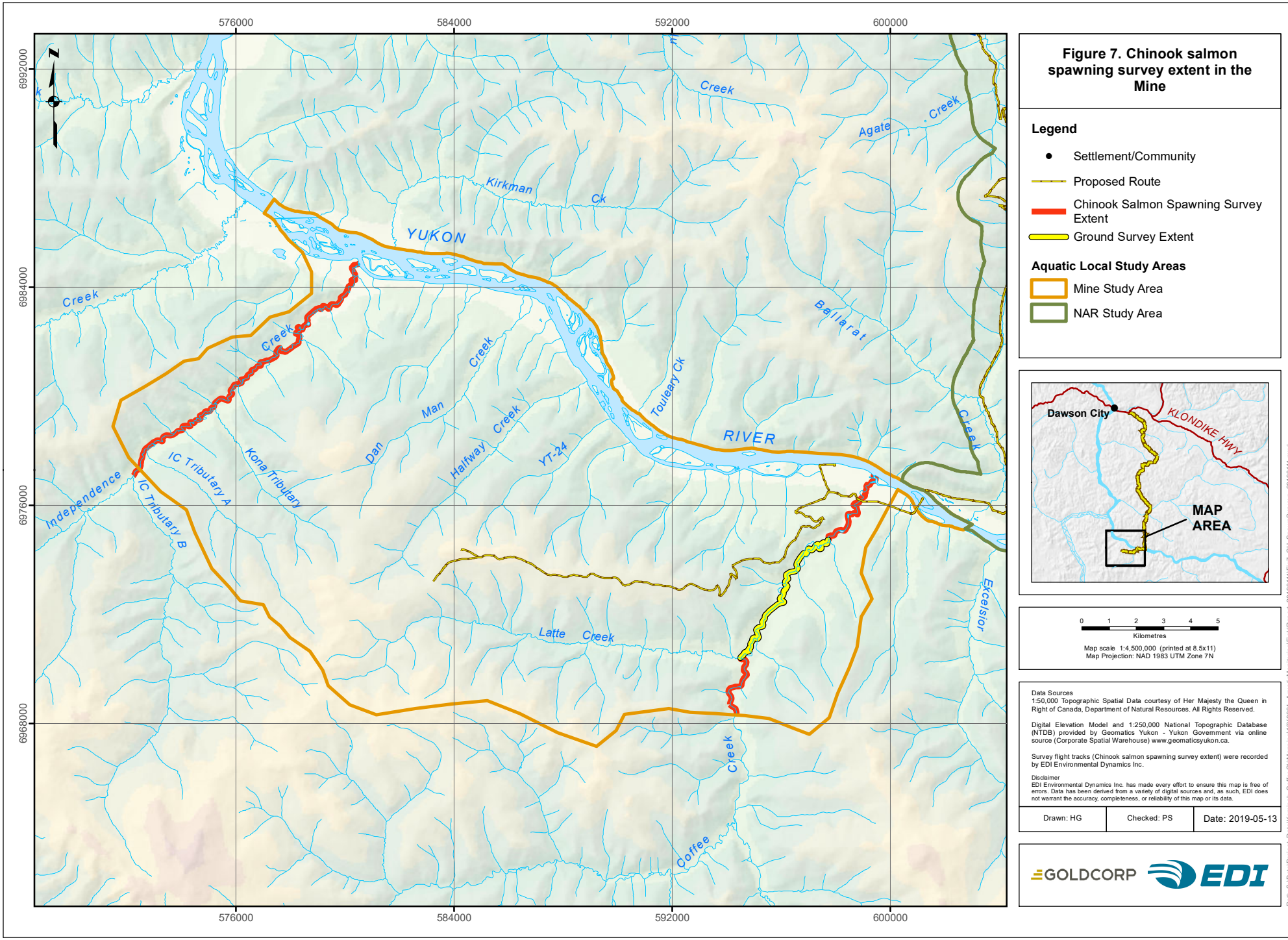
Chinook spawning surveys were completed in areas where Traditional Knowledge (TK) indicated past presence, such as Coffee Creek (Tr'ondëk Hwëch'in 2012) and in watersheds that appear to have habitat to support spawning Chinook; as such, Coffee Creek and Independence Creek have been investigated and surveyed for spawning Chinook salmon annually since 2014. During the 2018 field season, Coffee Creek had three surveys while Independence Creek had two aerial surveys completed. Coffee Creek also had a stream walk to record any evidence of Chinook salmon spawning (Figure 7).

During the survey, observers were located on the right of the helicopter, with one observer in the front and the other directly behind them. The pilot positioned the helicopter over the river at an angle approximately 40-45 m above the creek. Surveys were generally completed from the mouth of the creek upstream and conducted early in the day to keep the sun at the observer's back. The last survey in August was completed slightly later in the day; therefore, in order to reduce glare, the creeks were flown in the opposite direction, starting upstream and continuing downstream towards the Yukon River. Observers also wore polarized glasses to reduce glare. Weather was moderate for the first two surveys and overcast for the final survey.

The first aerial survey on Coffee Creek was conducted on July 14, 2018 with a flight of approximately 50 minutes and good visibility; this survey was not completed on Independence Creek due to helicopter availability. The second survey was on July 25, 2018 lasting 40 minutes on Coffee Creek, and 37 minutes on Independence Creek, with good visibility. The final survey occurred on August 11, 2018 and consisted of approximately 25 minutes on Coffee Creek, and 37 minutes on Independence Creek; water levels during this survey were fairly high, resulting in difficulty seeing into deep pools.

On August 16, 2018 a stream walk was completed on Coffee Creek to look for any sign of spawning activity. A field crew of two walked Coffee Creek from the confluence with Latte Creek downstream to approximately 4.0 km from the Yukon River. Conditions were very good for observing adult salmon, redds

or associated wildlife (i.e., eagles, bears). The crew was able to walk the channel either in or alongside the wetted portion of the creek.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RIVER
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Creek
Creek
Creek
Man
Creek
Halfway
Creek
Dan
Creek
YT-24
Kona Tributary
IC Tributary A
IC Tributary B
Independence
Creek
Touleary Ck
Ballarat
Creek
Excelsior
Latte
Creek
Creek
Coffee
Figure 7. Chinook salmon spawning survey extent in the Mine
Legend
Settlement/Community
Proposed Route
Chinook Salmon Spawning Survey Extent
Ground Survey Extent
Aquatic Local Study Areas
Mine Study Area
NAR Study Area
Dawson City
KLONDIKE HWY
MAP AREA
0 1 2 3 4 5
Kilometres
Map scale 1:4,500,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N
Data Sources
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Survey flight tracks (Chinook salmon spawning survey extent) were recorded by EDI Environmental Dynamics Inc.
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2.2. NORTHERN ACCESS ROUTE

During the 2018 field season, there were three investigations completed similar to previous years' sampling (barge landings, Stewart River back channel, and chum spawning surveys). In addition, opportunistic barge wake investigations were completed. The Stewart River back channel was visited earlier in the year than previously, which allowed for more thorough investigations to be completed in 2018.

2.2.1. BARGE LANDING INVESTIGATIONS

Proposed barge landings on the Yukon and Stewart rivers were visited and sampled for fish during July 2018, and the Yukon River proposed barge landings were revisited in August 2018. Fish sampling was conducted using beach seining along the banks of the proposed barge landings. A total of eleven beach seining hauls were completed at/near the proposed barge landing sites on the Yukon River including three beach seining hauls at the proposed South winter road crossing, and an additional three hauls at the existing barge landing near the Coffee Camp during 2018 sampling (Figure 8). A total of six beach seining hauls were completed near the proposed barge landing sites on the Stewart River. Information collected for each beach seine haul included seine haul dimensions (length, width, depth), and fish were identified and enumerated; a random ten individuals from each species was weighed and had fork length measured for each seine haul.. All seine hauls were conducted at the site of the proposed barge landings, with the exception of the Yukon River north bank proposed barge. The Yukon River north bank barge landing has steep eroding banks and deep water; as such, the seine hauls were completed 75 m downstream. Fish measurement metrics were summarized (fork length and weight, ± SE) for all species captured.

2.2.2. BARGE WAKE INVESTIGATIONS

EDI field crews conducted four river barge wake investigations from shore (Figure 9). These investigations were opportunistically completed when a crew was working along the Yukon River and a barge was approaching. Photos and videos were taken before, during, and after the barge passing. Approximate distance of the barge was recorded, in addition to what the load appeared to be visually, as well as any other observations. After the barge had passed, the wave runout (slope distance waves travelled up the previously dry shoreline) extent was recorded.

2.2.3. STEWART RIVER BACK CHANNEL INVESTIGATIONS

A back channel on the Stewart River that is adjacent to the NAR was visited and assessed by field crews on July 11 and 12, 2018 (Figure 10). The length of the channel was walked and 10 beach seine hauls were completed (Table 8). The wetted channel was investigated and had photos and notes recorded of the channel characteristics. Information collected for each beach seine haul included seine haul dimensions (length, width, depth) and water quality parameters (temperature, dissolved oxygen % and mg/L, pH, and SPC). Fish were identified and enumerated; a random ten individuals from each species was weighed and had fork length measured for each seine haul. Fish measurement metrics were summarized (fork length and weight, ± SE) for all species captured, as well as determining CPUE across all seine hauls.

Table 8. Stewart River back channel beach seine haul locations, July 2018.

Sampling site	Latitude	Longitude
SR-BC-1	63.22488	-138.82947
SR-BC-2	63.22534	-138.82938
SR-BC-3	63.22575	-138.82953
SR-BC-4	63.22588	-138.82932
SR-BC-5	63.22628	-138.82938
SR-BC-6	63.22698	-138.82913
SR-BC-7	63.22838	-138.82892
SR-BC-8	63.22873	-138.8288
SR-BC-9	63.22931	-138.82866
SR-BC-10	63.22926	-138.82916

2.2.4. CHUM SALMON SPAWNING SURVEYS

Chum salmon spawning surveys were completed by helicopter on the Yukon and Stewart rivers on October 13, 2018. Similar to previous years, the Yukon River was surveyed from just upstream of Excelsior Creek (7 km upstream of Coffee Creek) downstream to near the confluence of Carlisle Creek, a river distance of approximately 33.5 km (Figure 11). The Stewart River was surveyed from Black Hills Creek, downstream to a point 7 km downstream of Three Kings Creek for a total river distance of approximately 34.6 km (Figure 11).

The crew consisted of two observers who were positioned in the front and back seat, with the pilot positioning the aircraft over the river, flying sideways with the best vantage point approximately 40-45 m over the river. The surveys were completed in a downstream manner and polarized glasses were also worn to further reduce glare. Air temperatures were fairly mild (1°C) and there had been little snowfall, which resulted in good visibility for surveying ice-covered areas of the river. Water levels were significantly lower in both the Yukon and Stewart rivers than in previous years of sampling, resulting in many dewatered side channels in areas where chum were previously observed. Where possible, emphasis was placed on areas of known chum spawning, and side channel habitats where groundwater discharge areas were present (known preferred spawning areas for chum salmon on large Yukon rivers).

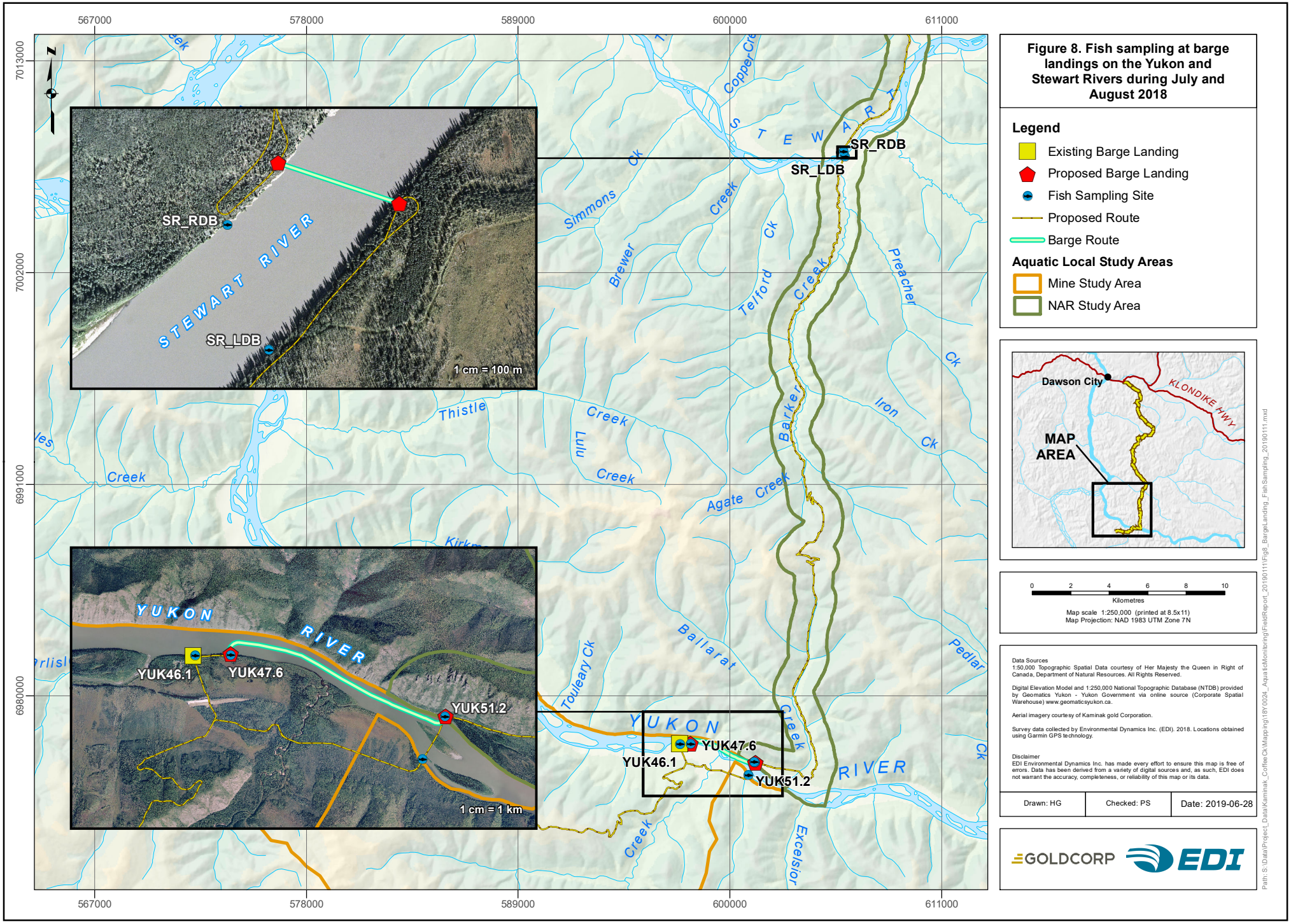

Figure 8. Fish sampling at barge landings on the Yukon and Stewart Rivers during July and August 2018

Legend

- Existing Barge Landing
- Proposed Barge Landing
- Fish Sampling Site
- Proposed Route
- Barge Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

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Aerial imagery courtesy of Kaminak gold Corporation.

Survey data collected by Environmental Dynamics Inc. (EDI). 2018. Locations obtained using Garmin GPS technology.

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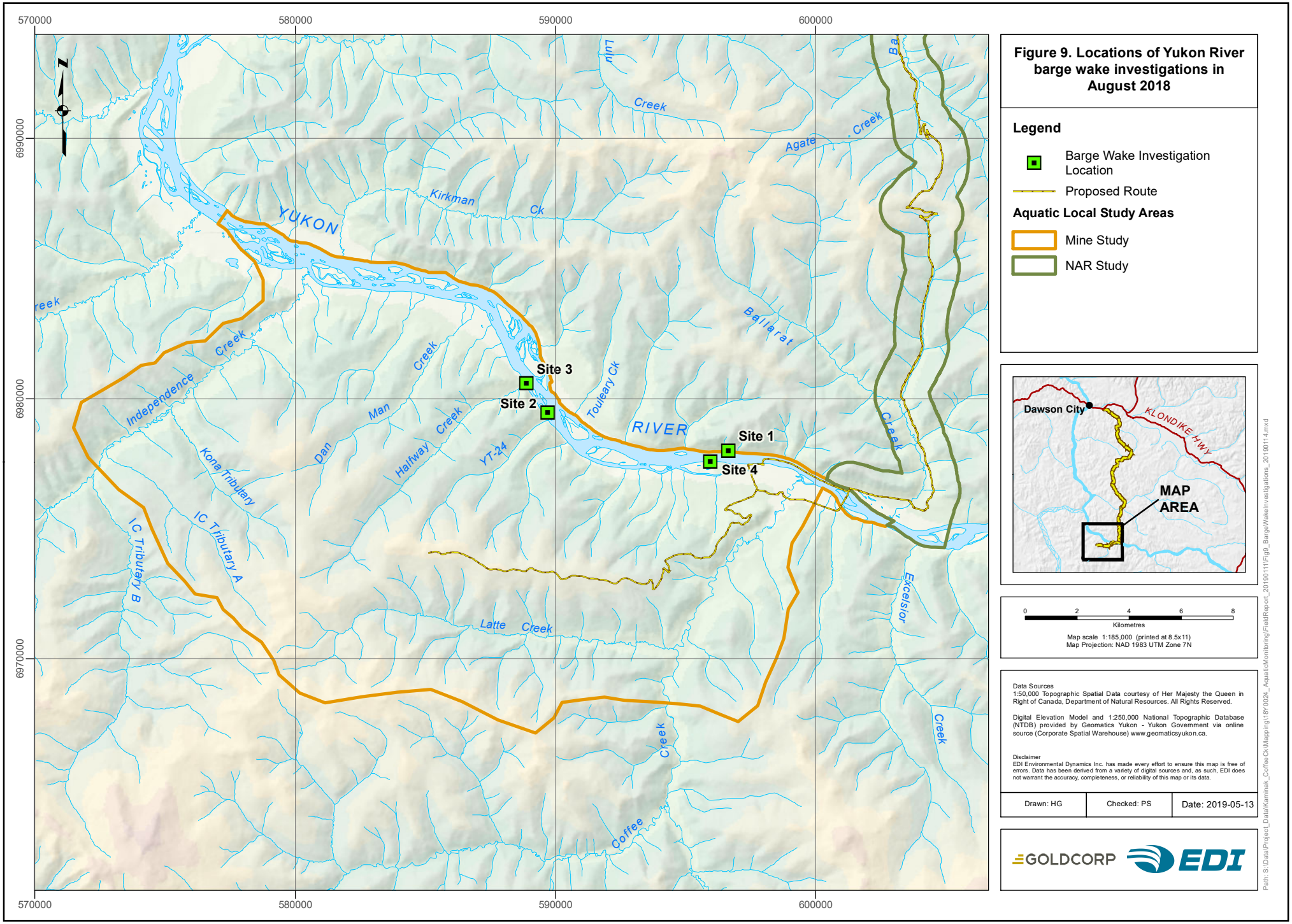

Figure 9. Locations of Yukon River barge wake investigations in August 2018

Legend

- Barge Wake Investigation Location
- Proposed Route

Aquatic Local Study Areas

- Mine Study
- NAR Study

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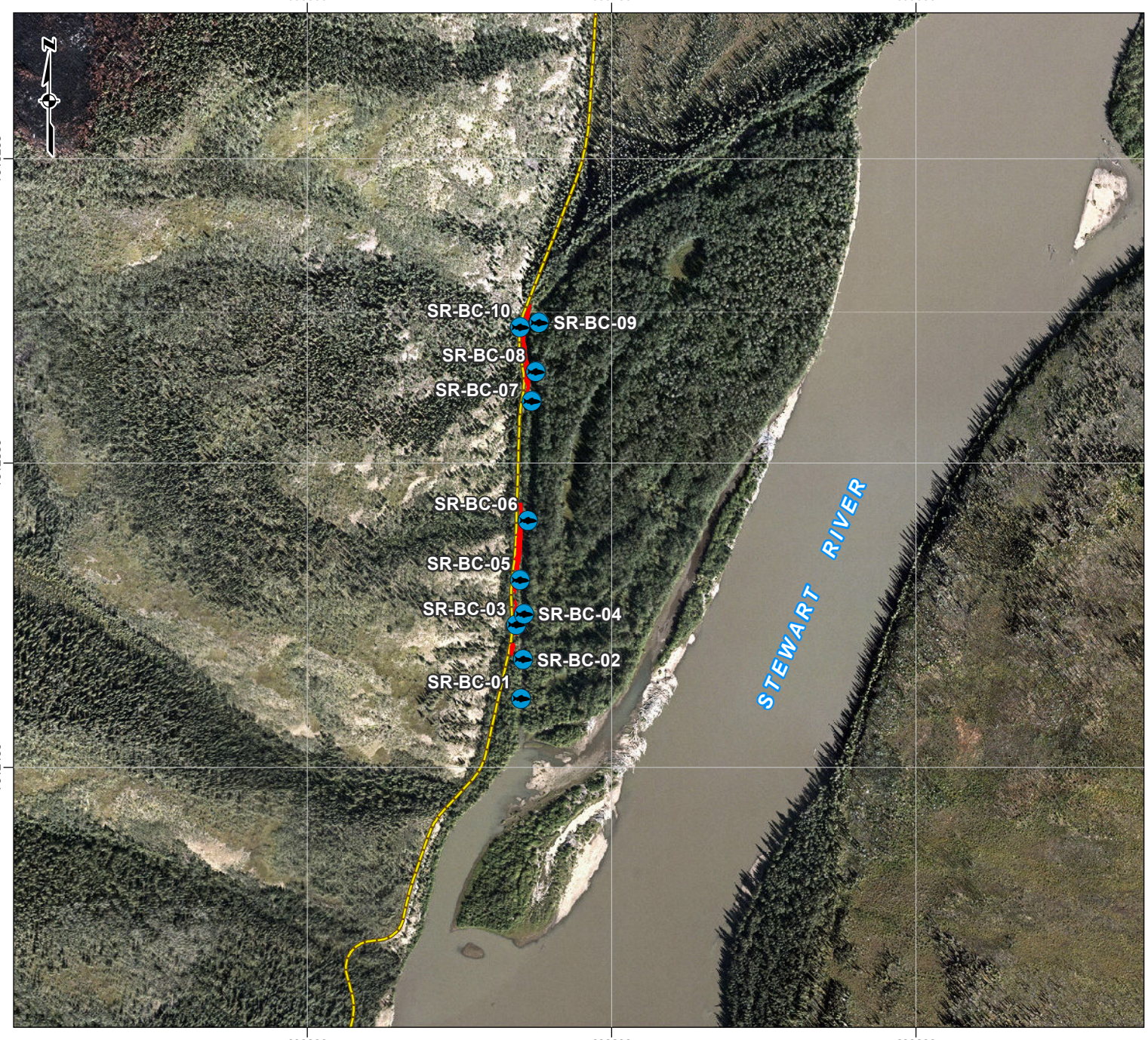


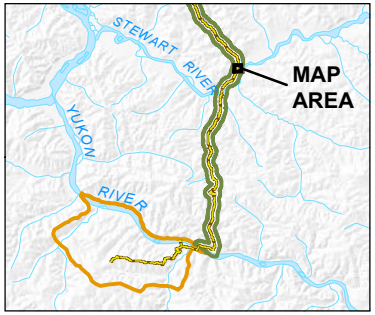
Figure 10. Fish sampling in the Stewart River back channel, in the NAR Study Area, July 2018

Legend

- Fish Sampling Sites
- Proposed Northern Access Route
- NAR Encroachment Areas - Stewart River Back Channel

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area



0 50 100 150 200 250

Metres

Map scale 1:7,500 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

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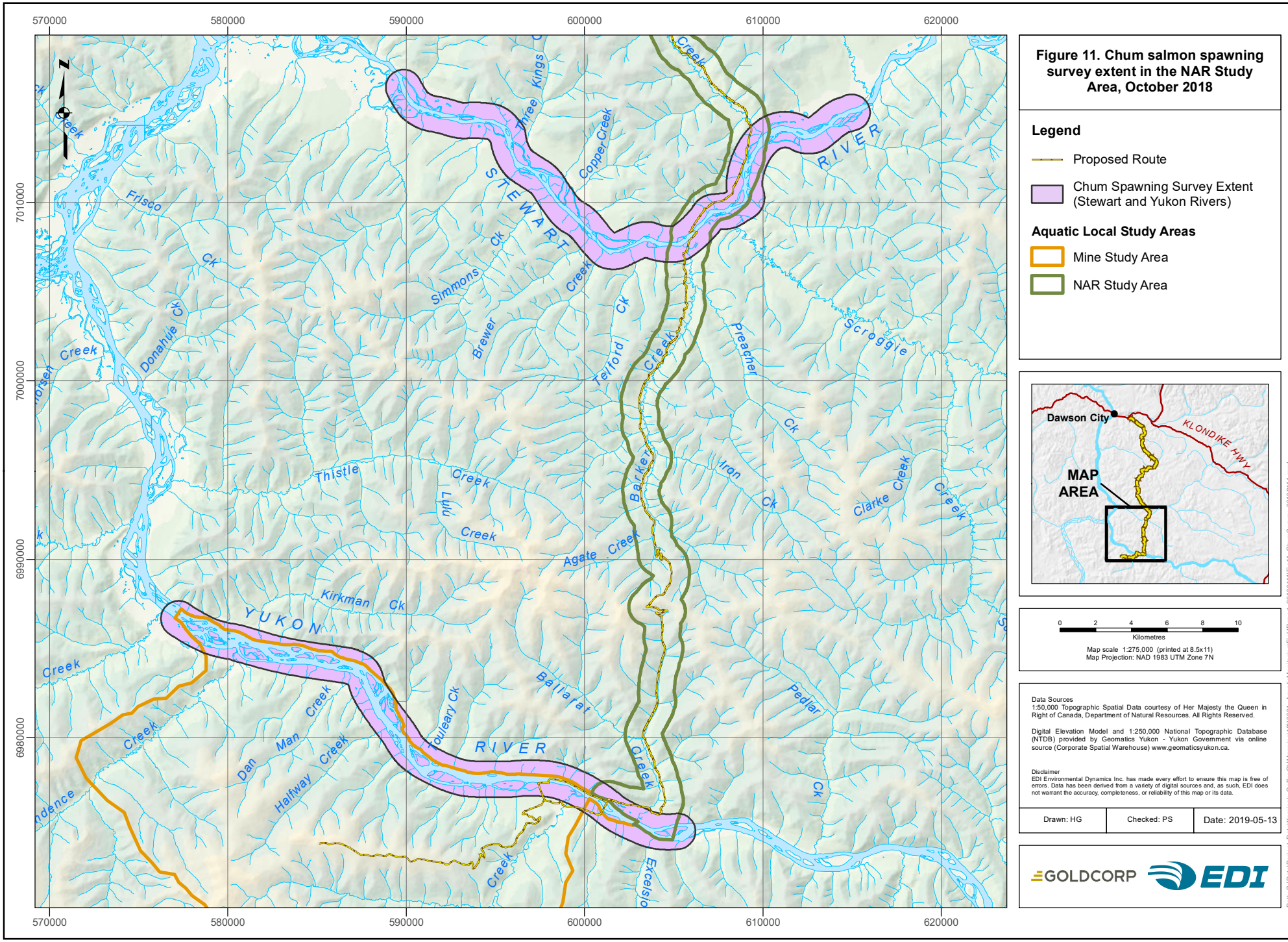

Figure 11. Chum salmon spawning survey extent in the NAR Study Area, October 2018

Legend

- Proposed Route
- Chum Spawning Survey Extent (Stewart and Yukon Rivers)

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

0 2 4 6 8 10
Kilometres

Map scale 1:275,000 (printed at 8.5x11)
Map Projection: NAR 1983 UTM Zone 7N

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3. RESULTS AND DISCUSSION – MINE STUDY AREA

Results and discussion for the Mine Study Area are presented per project component in the below sections.

3.1. ENVIRONMENTAL DNA SAMPLING

3.1.1. AUGUST 2018

Few eDNA samples produced positive results for Chinook salmon and Arctic grayling, with only six of 13 sites indicating fish presence whatsoever (Table 9; APPENDIX B). Independence Creek (IC2.6) was considered the positive control, while the distilled water samples were the negative controls. Independence Creek was the only site where both species of fish were detected. Juvenile Chinook were only detected at the Independence Creek site; Arctic grayling were detected in six out of thirteen sites.

Table 9. Summary of eDNA detection results in the Mine Study Area, August 2018.

Station Name	Creek	Chinook salmon eDNA detected (Yes/No)	Arctic Grayling eDNA detected (Yes/No)
DM0.2	Dan Man	No	**Yes**
DM2.2	Dan Man	No	No
DW1.0	Distilled water	No	No
DW2.0	Distilled water	No	No
HC0.2	Halfway Creek	No	No[1]
HC2.2	Halfway Creek	No	No
IC2.6	Independence Creek	**Yes**	**Yes**
ICA0.4	IC Tributary A	No	**Yes**
ICA4.0	IC Tributary A	No	No
ICB0.2	IC Tributary B	No	**Yes**
ICB4.7	IC Tributary B	No	**Yes**
KT0.2	Kona Tributary	No	**Yes**
KT3.4	Kona Tributary	No	No
YT0.1[2]	YT-24 Creek	No	No
YT1.0[2]	YT-24 Creek	No	No

[1] No eDNA detection despite a single Arctic grayling observed at ~230 m.
[2] Similar to 2017 results, samples indicated no algae or fish eDNA present.

The results from the lower 200 m of Dan Man and Kona Tributary indicate Arctic grayling presence; this is a relatively anticipated result due to the proximity to known Arctic grayling rearing habitat (Yukon River). In August, a single Arctic grayling was observed approximately 230 m up Halfway Creek but was not detected by eDNA sampling at 200 m; this is likely due to low density of Arctic grayling, as no fish were successfully electrofished (in August). Arctic grayling presence was validated using electrofishing methods in Independence Creek, IC Tributary A (at ICA0.4), and IC Tributary B (at ICB0.2; see section 3.2). The result from YT-24 sites was consistent with previous years, indicating no eDNA in the sample whatsoever, including algae (EDI 2018). YT-24 Creek is known to be a low productivity creek, requiring high effort in past years of invertebrate sampling (EDI 2018). Supported by the last two years of data, it is likely that YT-24 Creek has too low of productivity to detect algae in the samples.

3.2. FISH SAMPLING AND HABITAT INVESTIGATIONS

Fish sampling results from the 2018 field season are described per stream in the below sections (data provided in APPENDIX C). It is important to note that the week leading up to August fisheries work was characterized by high rainfall, resulting in considerably higher water levels in all the studied watersheds. Fish sampling field work was delayed several days until water levels resumed a safe level which also allowed for more effective sampling. Sampling occurred at moderate flow levels and creeks had resumed relatively high clarity.

3.2.1.1. Coffee Creek

Juvenile Chinook salmon and slimy sculpin were captured using minnow trapping at CC5.6 during the 2018 field program, while Arctic grayling were visually observed; these findings are supported by previous years' findings (PECG 2016, 2017, EDI 2017, 2018). All combined minnow traps (three sites, nine minnow traps total) captured 162 juvenile Chinook salmon and five slimy sculpin in 200.75 trap hours (Table 10).

Table 10. Coffee Creek minnow trapping and fish metrics summary, August 2018.

Sampling site	Minnow trapping site	Sampling effort	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
CC5.6	1	66.9 hours	CH – 60	CH – 10	CH – 84.9 ± 1.4	CH – 5.9 ± 0.3
	2	66.9 hours	CH – 52 CCG – 2	CH – 17 CCG – 2	CH – 78.1 ± 1.3 CCG – 83.0 ± 8	CH – 4.8 ± 0.2 CCG – 5.8 ± 0.8
	3	66.9 hours	CH – 50 CCG – 3	CH – 20 CCG – 3	CH – 77.5 ± 1.7 CCG – 80.0 ± 1.5	CH – 4.9 ± 0.3 CCG – 5.0 ± 0.9

CH = Chinook salmon; CCG = slimy sculpin

3.2.1.2. Halfway Creek

Halfway Creek was extensively electrofished during both July and August field visits. The only fish successfully captured while electrofishing was a single adult Arctic grayling at HC0.2 in July (FL = 342 mm, weight = 108.0 g; Table 11). There was another Arctic grayling that was visually observed on three occasions in a large, deep pool 230 m upstream from the mouth of the creek; it was visually assessed to be approximately 200 mm in length.

There were no juvenile Chinook salmon captured during the 2018 sampling, contrasted to the five that were captured in the bottom 200 m in 2017 (EDI 2018). Similarly, there were fewer Arctic grayling captured during the 2018 season than in the 2017 season (n = 1 and n = 8, respectively). Overall, both juvenile Chinook and Arctic grayling continue to be captured in low densities in Halfway Creek, with there being inconsistency in the capture of juvenile Chinook salmon from year to year. To date, no fish have been captured beyond 600 m from the mouth of the Yukon River despite multiple years of sampling.

Table 11. Halfway Creek electrofishing and fish captured summary, July and August 2018.

Sampling site	Sampling event	Sampling effort and distance	Total fish captured
HC0.1	August	1,178 seconds; 150 m	NFC
HC0.2	July	958 seconds; 150 m	GR – 1
HC0.2	August	993 seconds; 160 m	NFC[1]
HC0.7	August	698 seconds; 150 m	NFC
HC1.1	August	774 seconds; 160 m	NFC
HC2.2	August	745 seconds; 150 m	NFC
HC6.7	August	634 seconds; 300 m	NFC

[1]One GR was visually observed in a large pool on several occasions but was not successfully captured.
GR = Arctic grayling; NFC = no fish caught

3.2.1.3. YT-24 Creek

YT-24 Creek was electrofished in both July and August 2018. During the July field event, YT0.05 and YT0.6 were both electrofished, with YT0.05 yielding a single Arctic grayling (FL = 176.0, weight = 57.3 g; Table 12). The 2018 results were very similar to those found in 2017, with a single Arctic grayling being captured in the lower 100 m of the creek. These two grayling are the only fish captured in the stream despite multiple years of sampling throughout the steam.

Table 12. YT-24 Creek electrofishing and fish captured summary, July and August 2018.

Sampling site	Sampling event	Sampling effort and distance	Total fish captured
YT0.05	July	768 seconds; 150 m	GR – 1
YT0.6	July	626 seconds; 160 m	NFC
YT1.0	August	671 seconds; 150 m	NFC

GR = Arctic grayling; NFC = no fish caught

3.2.1.4. Independence Creek

A short section of Independence Creek was electrofished in August, just downstream of where IC Tributary B flowed in (approximately 15.6 km from the Yukon River). The cover primarily consisted of large boulders, with several glides in the section sampled (Photo 1). There were eight Arctic grayling captured, as well as a single round whitefish (Table 13; Photo 2). This was the highest point in Independence Creek that has been sampled to date.

Table 13. Independence Creek electrofishing and fish metrics summary, August 2018.

Sampling site	Sampling effort and distance	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
IC15.6	588 seconds; 60 m	GR – 8 RW – 1	GR – 8 RW – 1	GR – 171.6 ± 15.6 RW – 182.0 ± 0.0	GR – 62.1 ± 17.9 RW – 65.0 ± 0.0

GR = Arctic grayling; RW = round whitefish



Photo 1. A downstream view of the area electrofished on Independence Creek on August 17, 2018.



Photo 2. A round whitefish caught 15.6 km up Independence Creek on August 17, 2018.

3.2.1.5. Independence Creek, Tributary A

The 2018 field season was the first time that IC Tributary A was assessed and sampled for fish using electrofishing techniques (and eDNA; see Section 3.1). The objective was to get a general idea of stream characteristics and fish presence, with the intention of building on this information in future years of study. Due to the rainfall event before the August field trip the water levels of IC Tributary A were fairly high. An aerial investigation determined the lower section (~200 m) of the creek was wide and the bed material consisted primarily of fines (Photo 3). From approximately 200-500 m from the mouth the creek narrowed to about one metre width and was characterized by abundant large woody debris and fines. At 500 m there was a perceived barrier to fish, with the gradient slightly picking up following the perceived barrier. Moving up the drainage beyond the barrier, the creek became characterized by larger boulders and an increasingly steep gradient (Photo 4). The gradient lessened once reaching a plateau approximately 2.5 km up the drainage (Photo 5, Photo 6). Once on top of the plateau, the creek was approximately half the width, although appeared to be substantially deeper, with the bed material consisting of fines and the creek flowing through vegetation in some off-channels. There was evidence of a mining/exploration site on the top of the plateau at ICA4.0, although not in operation during the 2018 season (Photo 5, Photo 7). The flight continued up the drainage, with the creek becoming increasingly braided and flowing through vegetation and diminishing to nothing at the top of the watershed (Photo 8).



Photo 3. **The bottom of IC Tributary A (image right) on August 10, 2018 before flowing into Independence Creek (left).**



Photo 4. A steep section of IC Tributary A at high water on August 10, 2018.

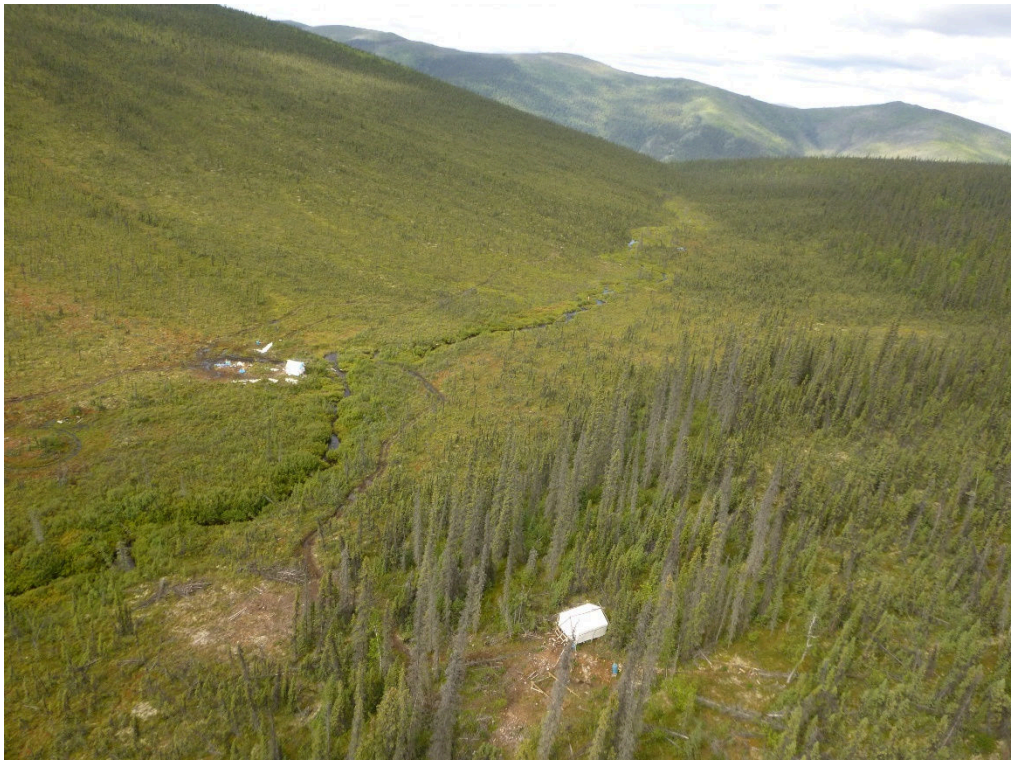

Photo 5. Downstream view of IC Tributary A from on top of the plateau August 10, 2018. The steep change in gradient can be seen at the top of the image.



Photo 6. Upstream view of IC Tributary A cresting over the plateau, approximately 2.7 km from the confluence with Independence Creek on August 10, 2018.



Photo 7. Mining operation next to IC Tributary A, approximately 4.0 km from the confluence with Independence Creek on August 10, 2018.

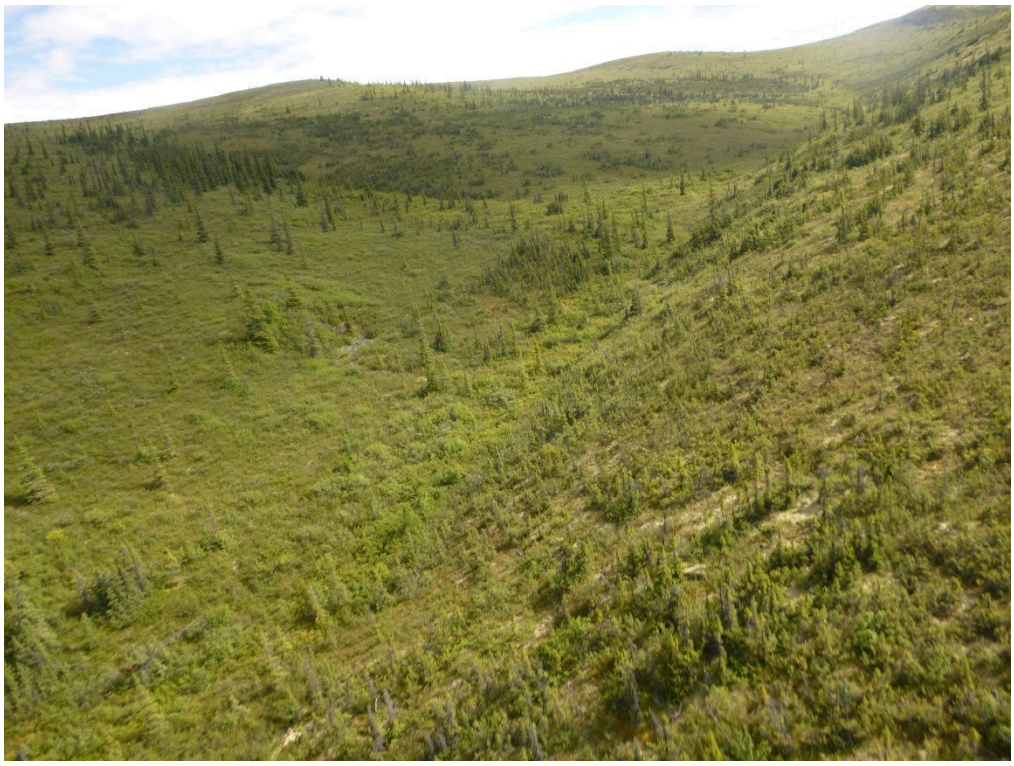

Photo 8. IC Tributary A facing upstream towards the top of the drainage on August 10, 2018.

On August 10 and 16-17, 2018 IC Tributary A was walked by foot during eDNA and electrofishing sampling (up to 1.1 km from the mouth), allowing for more fine-scale observations on stream characteristics. In the lower 500 m the gradient varied between 1-2%, characterized by woody debris, undercut banks and was deeply channeled with glides and fines for bed material (Photo 9). Shortly thereafter, the gradient of the creek increased substantially to approximately 10% between 495 and 510 m. At 525 m there was a significant cascade with a 12% grade and was approximately 4 m high with the cascade spanning a horizontal distance of 6 m from the top of the cascade to the pool (Photo 10). There appeared to be limited resting areas for fish within the cascade and the downstream pool had a max measured[2] pool depth of 1.15 m. The slope increased significantly between 500 m and 1.1 km. Between 885 m and 1.1 km from the mouth of the creek, the gradient varied from 13-20% (Photo 11).

[2] There may have been deeper parts of the pool, but due to excessively slippery substrate the whole pool was not able to be thoroughly investigated.



Photo 9. A representative upstream view of the lower 500 m of IC Tributary A on August 10, 2018.



Photo 10. Upstream view of IC Tributary A at the cascade 525 m upstream of the confluence with Independence Creek on August 17, 2018.



Photo 11. Downstream view of IC Tributary A, approximately 1.0 km from the creek mouth with a gradient of 17% on August 16, 2018.

Electrofishing was conducted on August 16 and 17, 2018 in IC Tributary A, at sites ICA0.4 and ICA0.9. Due to the knowledge of the large cascade at 525 m, the focus with the allotted time was to confirm the presence of fish below the cascade and determine whether there were any fish above the cascade. Minimal electrofishing was conducted below the cascade as many Arctic grayling were readily observed in the lower 500 m. When sampling the pool below the cascade Arctic grayling were so numerous they began jumping and swimming at the surface; efforts were aborted shortly thereafter in favour of sampling the creek above the cascade. The creek was electrofished for 121 seconds up to the pool and had covered approximately 130 m (Table 14). Electrofishing occurred above the cascade with the remaining time, with priority sampling occurring in areas with potential fish habitat (i.e., pools, eddies). Above the cascade was electrofished for 135 seconds and covered a distance of approximately 50 m (Table 14). There were no fish observed or captured above the cascade, despite there being areas with appropriate habitat (Photo 12).

Table 14. IC Tributary A electrofishing and fish metrics summary, August 2018.

Sampling site	Sampling effort and distance	Total fish captured	Average fork length (mm ± SE)	Average weight (g ± SE)
ICA0.4	256 seconds[1]; 150 m	GR – 4	GR – 197.3 ± 25.1	GR – 128.8 ± 35.6
ICA0.9	626 seconds; 150 m	NFC	-	-

[1]Cumulative time below and above cascade.
GR = Arctic grayling; NFC = no fish caught

Given these sampling results (albeit limited), it appears that the cascade at 525 m from the mouth represents a barrier to fish passage. In addition to the extensive cascades further upstream with 15-20% grades and a

lack of overwintering habitat, it is unlikely fish are using the upper watershed. In Alaskan watersheds, the number of Arctic grayling observed above 15% grade is greatly diminished compared to their abundance below 15% (Hershey et al. 2006). Additionally, the BC Fish-stream Crossing Guidebook indicates that any stream with a gradient of 20% or above is unlikely to be considered suitable fish rearing habitat (BC Ministry of Environment 2012).

Recommendations for future investigations include sampling upstream of the lower and upper cascades would also be required to confirm that these are barriers to fish. The high rainfall event leading up to August sampling may give the impression that IC Tributary A provides better fish habitat than may be the case at regular water levels.



Photo 12. Downstream view of IC Tributary A above the cascade on August 17, 2018.

3.2.1.6. Independence Creek, Tributary B

Similar to IC Tributary A, the 2018 field season was the first time that Unnamed Tributary B was investigated and sampled for fish using electrofishing techniques. The objective was to get a general idea of stream characteristics and fish presence, with the intention of building on this information in future years of study. Independence Creek Tributary B was flown up to approximately 5.0 km from the creek mouth; stream characteristics (gradient, size, bed material) appeared relatively consistent throughout (Photo 13), with a few short areas where the creek split into two channels. The gradient appeared to be gradual, with no severe increases in gradient or potential barriers to fish observed. On the ground investigation determined the grade near the mouth of the creek was between 3-4%, while the grade increased to approximately 6% at

410 m. The gradient stayed fairly consistent up to the end of the electrofishing and was 5% at approximately 795 m from the creek mouth.



Photo 13. Upstream view of IC Tributary B at 4.7 km upstream from the confluence with Independence Creek on August 10, 2018.

Independence Creek Tributary B was electrofished at ICB0.2 and ICB0.6 during the August field event (Table 15). The creek split into two channels at ICB0.2; the channel on river right was chosen to electrofish as it appeared to be more representative and had less debris obstructing the creek (Photo 14). Electrofishing captured 16 Arctic grayling at ICB0.2 and eight at ICB0.6, with a number of others observed but not captured (Table 15). Three juvenile Chinook salmon were captured approximately 755 m from the confluence with Independence Creek, in one of the few pools with an eddy observed up to that point (Table 15; Photo 15). Finding juvenile Chinook this far up the watershed was an interesting finding (over 16 km upstream from the Yukon River), particularly as several years of aerial surveys have not found any spawning activity. These findings indicate that these juvenile Chinook are non-natal and travelled up to IC Tributary B in the spring/summer to rear there.



Photo 14. Upstream view of IC Tributary B, approximately 225 m from confluence with Independence Creek on August 17, 2018.



Photo 15. Juvenile Chinook captured during electrofishing at ICB0.6 on August 17, 2018.

Another interesting finding from fish sampling in IC Tributary B was that no slimy sculpin were observed or captured during electrofishing. Slimy sculpin are often considered to have high site fidelity and small home ranges, and do not move very far throughout their lifetime (Gray et al. 2004); these life history characteristics indicate that where slimy sculpin are found there is likely suitable overwintering habitat.

Table 15. IC Tributary B electrofishing and fish metrics summary, August 2018.

Sampling site	Sampling effort and distance	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
ICB0.2	754 seconds; 150 m	GR – 16	GR – 10	GR – 192.7 ± 19.6	GR – 95.8 ± 25.9
ICB0.6	531 seconds; 120 m	GR – 8 CH – 3	GR – 8 CH – 3	GR – 151.1 ± 15.0 CH – 74.0 ± 1.5	GR – 74.3 ± 20.5 CH – 4.3 ± 0.2

CH = Chinook salmon; GR = Arctic grayling

Given the limited extent of sampling, it is not clear how much of the watershed Arctic grayling and juvenile Chinook use. Future sampling efforts on this stream should focus on determining fish distribution in the upper watershed.

3.3. YUKON RIVER MIXING ZONES

Mixing zone results from the 2018 field season are described for Halfway and YT-24 creeks. Results are compared with nearby Yukon River sites directly upstream of creek mouths, as well as a Yukon River reference site (north barge site).

3.3.1. HALFWAY CREEK

The Halfway Creek mixing zone and an area of the Yukon River directly upstream from the mouth of Halfway Creek were both sampled for fish in July and August; in August, an area 130 downstream of the creek mouth was also sampled.

The Halfway Creek mixing zone had similar species captured during both sampling events (six and seven species, respectively; Table 16, Table 17). Juvenile Chinook, Arctic grayling, slimy sculpin, round whitefish, and an Arctic lamprey were captured in both sampling events; juvenile lake whitefish were captured only in July, and an inconnu and longnose sucker were captured in August (Table 16, Table 17). There were similar numbers of juvenile Chinook (n = 44 and n = 43) and Arctic grayling (n = 5 and n = 6) captured during both sampling periods (Table 16, Table 17).

Table 16. Halfway Creek mixing zone fish metrics (fork length and weight, ± SE) from July sampling, 2018.

Species captured	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
CH	44	30	61.3 ± 0.8	2.5 ± 0.1
GR	5	5	161.2 ± 19.6	51.7 ± 20.2
CCG	3	3	57.3 ± 10.4	2.4 ± 1.2
RW	4	4	40.8 ± 3.5	0.5 ± 0.1
LW	2	2	29.0 ± 5.0	0.4 ± 0.0[1]
AL	1	1	57.0 ± 0.00	0.3 ± 0.00

[1]Only one LW was measured for weight; the other was larval stage and undetected by scale.
CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; RW = round whitefish; LW = lake whitefish; AL = Arctic lamprey

Table 17. Halfway Creek mixing zone fish metrics (fork length and weight, ± SE) from August sampling, 2018.

Species captured	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
CH	43	27	75.4 ± 1.1	4.6 ± 0.3
GR	6	6	108.8 ± 16.1	15.4 ± 5.2
CCG	14	8	57.8 ± 6.2	3.3 ± 0.8
RW	22	20	59.0 ± 2.2	1.9 ± 0.1
AL	1	1	90.0 ± 0.0	n/a
IN	1	1	570.0 ± 0.0	n/a
LSU	1	1	180.0 ± 0.0	59.5 ± 0.0

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; RW = round whitefish; LW = lake whitefish; AL = Arctic lamprey; IN = inconnu; LSU = longnose sucker

Sampling the Yukon River upstream of the Halfway Creek mixing zone captured five species and fewer individuals compared to the mixing zone in both July and August (Table 18, Table 19). Juvenile Chinook were captured in the upstream Yukon River site during both the July and August sampling, although substantially fewer than in the mixing zone. The August results from 130 m downstream of the mixing zone were more inline with findings upstream than in the mixing zone, with five species captured and in relatively low numbers (Table 17, Table 19, Table 20), despite there being some Halfway Creek water visible at the rivers edge. The most juvenile Chinook captured in a single seine haul was 27, occurring in the mixing zone during August sampling. An inconnu was also captured in the Halfway Creek mixing zone in August, a finding that has not occurred elsewhere along the Yukon River during other beach seining events (EDI 2017, 2018). It is likely that inconnu use areas like the Halfway Creek mixing zone for opportunistic feeding opportunities.

Table 18. Yukon River (upstream from Halfway Creek) fish metrics (fork length and weight, ± SE) from July sampling, 2018.

Species captured	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
CH	2	2	53.5 ± 5.5	1.7 ± 0.5
CCG	8	5	50.4 ± 7.0	1.5 ± 0.6
RW	6	6	38.2 ± 2.5	0.5 ± 0.0
LSU	7	6	77.8 ±15.3	8.6 ± 5.6
NP	2	2	71.5 ± 3.5	2.5 ± 0.5

CH = Chinook salmon; CCG = slimy sculpin; RW = round whitefish; LSU = long-nose sucker; NP = northern pike

Table 19. Yukon River (upstream from Halfway Creek) fish metrics (fork length and weight, ± SE) from August sampling, 2018.

Species captured	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
CH	3	3	75.7 ± 1.2	4.8 ± 0.3
CCG	5	5	37.0 ± 7.4	1.7 ± 1.3
LW	2	2	68.0 ± 5.0	2.5 ± 0.5
LSU	1	1	132.0 ± 0.0	24.5 ± 0.0
NP	2	2	272.2 ± 127.5	444.3 ± 423.8

CH = Chinook salmon; CCG = slimy sculpin; LW = lake whitefish; LSU = long-nose sucker; NP = northern pike

Table 20. Yukon River (130 m downstream from Halfway Creek) fish metrics (fork length and weight, ± SE) from August sampling, 2018.

Species captured	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
CH	5	5	72.2 ± 2.1	3.8 ± 0.3
GR	2	2	148.5 ± 81.5	75.5 ± 72.5
CCG	4	4	49.5 ± 9.5	1.8 ± 0.7
RW	10	10	76.7 ± 7.4	4.5 ± 1.6
LW	1	0	n/a	n/a

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; RW = round whitefish; LW = lake whitefish

Catch-per-unit-effort results were only compared between the mixing zone and the Yukon River reference site (north barge landing; YUK51.2) due to different habitat characteristics and difficulty encountered seining directly upstream of mixing zones. During both July and August sampling events, juvenile Chinook CPUE was higher in the Halfway Creek mixing zone than the Yukon River reference site (Table 21; Figure 12).

The distribution of Arctic grayling was much patchier for most sites, with many areas having no individuals. There were Arctic grayling caught in the mixing zone during both sampling events, but only in Augest at the Yukon River reference site (Table 21).

Table 21. Average CPUE (± SE) of juvenile Chinook salmon and Arctic grayling in the Halfway Creek mixing zone, upstream Yukon River control site, and reference Yukon River site during the summer of 2018.

Site name	Location	Sampling event	No. of hauls	Juvenile Chinook salmon		Arctic grayling	
				Average CPUE (fish/100m^2 ± SE)	Range	Average CPUE (fish/100m^2 ± SE)	Range
HC_MZ	Halfway Creek mixing zone	July	3	11.3 ± 1.5	8.3 – 13.5	1.7 ± 1.7	0.0 – 5.2
YUK51.2	Yukon River reference (north barge landing)	July	3	1.0 ± 0.6	0.0 – 2.0	0.0 ± 0.0	0.0 – 0.0
HC_MZ	Halfway Creek mixing zone	August	3	15.4 ± 6.5	7.1 – 28.1	2.3 ± 0.6	1.0 – 3.0
YUK51.2	Yukon River reference (north barge landing)	August	3	3.3 ± 2.5	0.0 – 8.3	2.1 ± 1.2	0.0 – 4.2

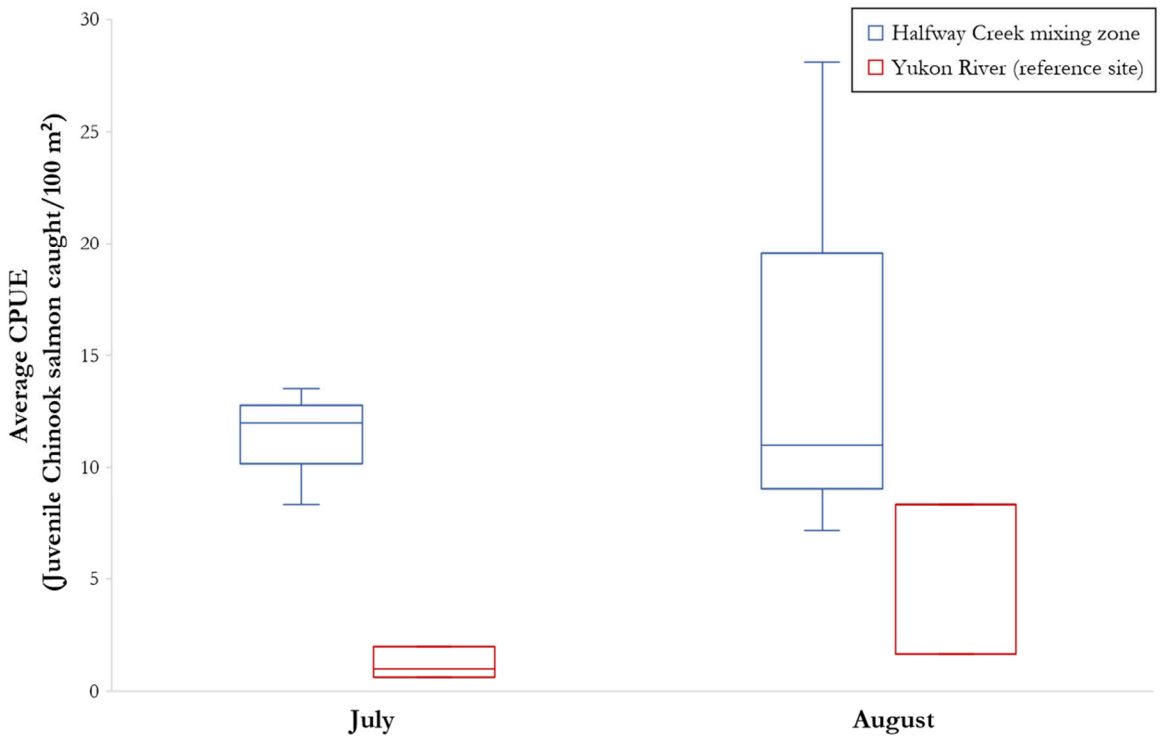

Figure 12. Average CPUE of juvenile Chinook caught in the Halfway Creek mixing zone and the Yukon River reference site in July and August 2018.

3.3.2. YT-24 CREEK

Similar sampling occurred near the mouth of YT-24 Creek during both July and August, with results differing slightly from Halfway Creek. During the July sampling period there were eight species of fish captured, while only two were captured in August (Table 22, Table 23). The species captured in the YT-24 mixing zone in July were similar to those captured in the Halfway Creek mixing zone, suggesting they both provide similar benefits to nearby fish communities. Similar to Halfway Creek, the July sampling event in YT-24 Creek also produced an adult inconnu, likely engaging in opportunistic feeding opportunities.

Table 22. YT-24 Creek mixing zone fish metrics (fork length and weight, ± SE) from July sampling, 2018.

Species captured	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
CH	139	32	63.6 ± 1.1	2.7 ± 0.2
GR	1	1	200.0 ± 0.0	92.0 ± 0.0
CCG	1	1	39.0 ± 0.0	0.4 ± 0.0
RW	1	1	37.0 ± 0.0	0.4 ± 0.0
LW	3	2	54.5 ± 9.5	1.5 ± 0.8
AL	1	1	60.0 ± 0.0	0.4 ± 0.0
IN	1	1	670.0 ± 0.0	n/a
LSU	4	4	41.5 ± 20.7	14.6 ± 7.3

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; RW = round whitefish; LW = lake whitefish; AL = Arctic lamprey; IN = inconnu; LSU = long-nose sucker

Table 23. YT-24 Creek mixing zone fish metrics (fork length and weight, ± SE) from August sampling, 2018.

Species captured	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
CH	13	13	76.8 ± 1.1	4.7 ± 0.2
CCG	3	3	54.7 ± 7.4	2.2 ± 0.3

CH = Chinook salmon; CCG = slimy sculpin

The two sampling events in the Yukon River (in proximity to YT-24 Creek) were markedly different between the two time periods, likely because the location was changed between sampling events (from upstream of the mixing zone in July to across from the creek mouth in August). During the July sampling, when seine hauls were completed upstream of the mixing zone on the Yukon River, only a single juvenile Chinook was captured (Table 24). The seining conditions upstream of the mixing zone were quite poor, with deep fast flowing water and steep banks. Seining was completed at these sites again in August, but after several failed attempts, the site was moved to be on an island across from the mouth of YT-24 on an exposed gravel bar, approximately 40 m away (visible in Photo 16). The results across from the creek mouth were more similar to what they had been in the YT-24 mixing zone in July, with six species being captured (Table 25). In addition, there were substantially more juvenile Chinook captured at this location (n = 44) than in the other non-mixing zones sites sampled on the Yukon River. Possible explanations for this include the close proximity to Halfway Creek and/or the eddy habitat that was present at this area. It is possible that juvenile Chinook and other fish prefer eddy habitat due to the lower velocities, allowing for less energy expenditure while rearing. Future research should include a component to sample fish in eddy habitats along the shore of the Yukon River that are not in close proximity to creek mouths. This could further assess the role of eddy lines and fish presence, with results being compared back to abundances in mixing zones, to ultimately provide information on whether fish are drawn to clear water mixing zones specifically, or eddy habitats (which typically form at stream mouths).

Table 24. Yukon River (upstream from YT-24 Creek) fish metrics (fork length and weight, ± SE) from July sampling, 2018.

Species captured	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
CH	1	1	68.0 ± 0.0	3.0 ± 0.0

CH = Chinook salmon

Table 25. Yukon River (across from YT-24 Creek) fish metrics (fork length and weight, ± SE) from August sampling, 2018.

Species captured	Total fish captured	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
CH	44	15	77.5 ± 1.3	4.5 ± 0.3
GR	1	1	55.0 ± 0.0	1.5 ± 0.0
CCG	3	3	24.0 ± 1.5	n/a
RW	1	1	45.0 ± 0.0	0.5 ± 0.0
LW	1	1	83.0 ± 0.0	n/a
LSU	3	3	55.7 ± 12.7	2.3 ± 0.3

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; RW = round whitefish; LW = lake whitefish; LSU = longnose sucker

The CPUE of juvenile Chinook and Arctic grayling were compared between the YT-24 mixing zone and the Yukon River reference site (the proposed north barge landing site; YUK51.2). The juvenile Chinook CPUE

results in the YT-24 mixing zone did not show as strong of a relationship as the Halfway Creek results between the two sampling periods. The July results indicate the YT-24 mixing zone had a higher juvenile Chinook CPUE than the Yukon River reference site (Table 26, Figure 13). During the August sampling event, comparatively few juvenile Chinook were captured in the mixing zone (13 as compared to 139; Table 22, Table 23). The YT-24 mixing zone CPUE was still greater than the Yukon River reference site, but by a substantially smaller margin than in July (Table 26, Figure 13). The greatest number of juvenile Chinook captured in a single seine haul was 68 and occurred during the July YT-24 mixing zone sampling; in the same collection of seine hauls, another seine collected 60 juvenile Chinook (Table 22).

The Arctic grayling findings were similar to those for the Halfway Creek sampling, in that their distribution was patchy and they were caught in low numbers with low CPUE. Arctic grayling were only captured in the YT-24 mixing zone in the July sampling (Table 26). In August, they were not captured in the mixing zone, although were captured in low numbers in the Yukon River reference site (north barge landing).

Table 26. Mean CPUE (± SE) of juvenile Chinook salmon and Arctic grayling in the YT-24 Creek mixing zone, Yukon River sites in proximity to the mixing zone, and reference Yukon River site during summer 2018.

Site name	Location	Sampling event	No. of hauls	Juvenile Chinook salmon		Arctic grayling	
				Average CPUE (fish/100m² ± SE)	Range	Mean CPUE (fish/100m² ± SE)	Range
YT24_MZ	YT-24 Creek mixing zone	July	4	33.1 ± 18.5	1.9 – 80.0	0.2 ± 0.2	0.0 – 0.7
YUK51.2	Yukon River reference (north barge landing)	July	3	1.0 ± 0.6	0.0 – 2.0	0.0 ± 0.0	0.0 – 0.0
YT24_MZ	YT-24 Creek mixing zone	August	4	6.9 ± 4.0	0.8 – 18.8	0.0 ± 0.0	0.0 – 0.0
YUK51.2	Yukon River reference (north barge landing)	August	3	4.6 ± 2.5	0.0 – 8.3	2.1 ± 1.2	0.0 – 4.2

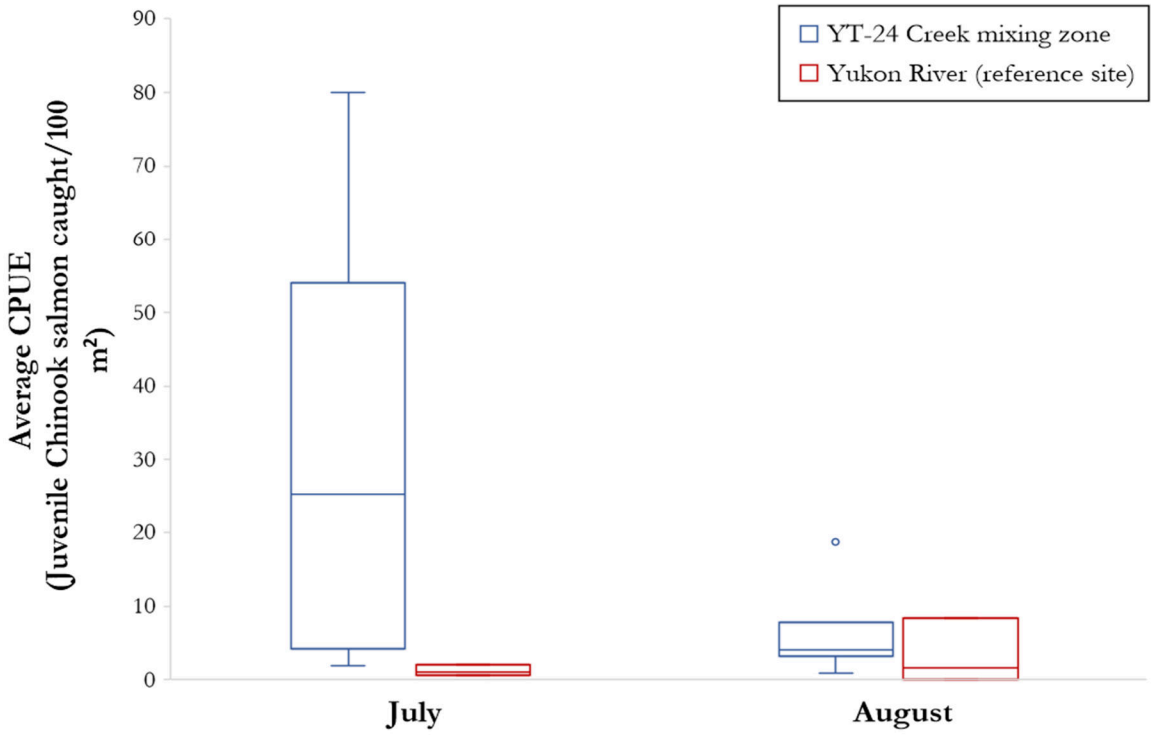

Figure 13. Average CPUE of juvenile Chinook caught in the YT-24 Creek mixing zone and a farther upstream Yukon River reference site in July and August 2018.



Photo 16. Eddy line of where the YT-24 Creek outlet surged into the Yukon River on August 9, 2018. The island where August sampling occurred is visible across the channel.

In both Halfway Creek and YT-24, the species diversity was generally higher in the mixing zone than elsewhere in the Yukon River. The exception to this is the low numbers captured in the YT-24 mixing zone in August, although this was somewhat made up for by the high species diversity at the site across from the YT-24 creek mouth, which may have been in close enough proximity to the mixing zone to receive mixing zone characteristics. Notably, inconnu were caught in the mixing zones of both creeks; these fish have not been caught during any other sampling events within the Mine Study Area. A larger diversity of species captured at mixing zones than in other locations along the Yukon River suggests that these areas provide unique value to nearby fish communities. Species abundance and number of individuals is often cited as higher at creek mouths than elsewhere in creeks or lakes (Willis and Magnuson 2000), a finding that our results support, particularly with respect to juvenile Chinook salmon. One potential explanation behind the apparent preference of juvenile Chinook for the mixing zone is increased opportunistic feeding opportunities. While both Halfway and YT-24 creeks are quite low in nutrients and invertebrates (EDI 2017, 2018), there may still be some benefit of concentrated drift feeding opportunities or increased foraging success in clearwater areas. Additionally, the presence of a thermal refuge with less predation and velocity as compared to deep-water thermal refuges may be an attractive quality of mixing zones; these thermal refugia may be important during the summer months when the surrounding nearshore water can occasionally exceed 18 °C. Feeding behaviour of predatory species which feed on juvenile salmonids also increases in higher water temperatures (Sauter et al. 2001, Richter and Kolmes 2005), potentially offering further explanation for the higher densities of juvenile Chinook in these cooler mixing zones. Additionally, the mixing zone provided a substantial backwater and/or eddy area along the edge of the creek input in the Yukon river; juvenile salmonids have been observed to prefer backwater areas on large rivers (Beechie et al. 2005). These areas provide a lower velocity refugia, in addition to the potential for drift-feed items being circulated a number of times. The mixing zone areas also present the possibility for higher predation pressure (as evidenced by inconnu in the area), although this is likely partially mitigated by the shallow-water nature of the mixing zone areas and other anti-predator behaviours such as shoaling (Pitcher 1986). Future research should consider sampling sites that have nearshore eddy lines, without the influence of creek outlets, in order to discern whether high fish abundances and diversity occur due to mixing zones specifically, or whether eddy line refugia provide similar benefits.

3.4. FISH HABITAT ASSESSMENTS

Fish habitat assessment survey results are summarized by creek in the following sections, with detailed survey data and photos affixed as appendices (APPENDIX D, APPENDIX E).

3.4.1. HALFWAY CREEK

During 2018 monitoring a FHAP survey was conducted on a 600 m section of lower Halfway Creek (Figure 14). Twenty-seven distinct habitat units were identified during the survey (Table 27). Habitat units identified include glides, pools, riffles (<5% grade), and steep riffles (≥5% grade). No cascade habitat was identified during the survey.

The surveyed section of Halfway Creek was dominated by riffle and steep riffle habitat that together comprise 80% of surveyed habitat units by length (Photo 17; Table 27). While steep riffle habitat units occurred more frequently than riffle habitat units, the average length of riffle habitat units (53.7 m) was nearly twice that of the average length of steep riffle habitat units (26.6 m; Table 27). Boulders and undercut banks were the dominant sources of cover for fish in these habitat types. There were relatively few glides and pools, which together comprised the remaining 20% of habitat units by length. Pools comprised 6% of habitat units by length in Halfway Creek and had an average residual pool depth of 0.6 m. This is the largest percentage of pool habitat units by length of the three creeks surveyed during 2018 fieldwork. The surveyed section of Halfway Creek did have some secondary (side channel) steep riffle habitat approximately 12 m in length that is accessible during most hydraulic conditions. A tertiary (within channel) pool 2.6 m in length was also identified during the survey.

The frequency and extent of habitat units in the surveyed section of Halfway Creek represents relatively low-quality, low complexity fish habitat with a low frequency of pool and glide habitat units (< 30% by area), and little instream cover and functional large woody debris (LWD; Johnston and Slaney 1996). The average bankfull width over all habitat units in Halfway Creek was 5.64 ± 0.36 m (mean ± SE), with an average wetted width of 4.0 m and an average water depth of 0.39 m during the survey.

Table 27. Summary of habitat units identified during the FHAP survey of Halfway Creek, August 2018.

Habitat type	No. of units	Average length per unit (m ± SE)	Total length in survey extent (m)	Percent of total survey extent
Cascade	0	-	-	0 %
Glide	7	12.2 ± 2.6	85.1	14 %
Pool	4	8.5 ± 0.3	34	6 %
Riffle (<5% grade)	4	53.7 ± 16.1	214.7	36 %
Steep riffle (≥ 5% grade)	10	26.6 ± 5.1	266.4	44 %
Secondary steep riffle	1	11.5 ± 0.0	11.5	n/a
Tertiary pool	1	2.6 ± 0.0	2.6	n/a
Total	**27**	**24.0 ± 4.3**	**600.2**	**100 %**



Photo 17. Example of dominant habitat type, steep riffle, on Halfway Creek (0+492; August 14, 2018).

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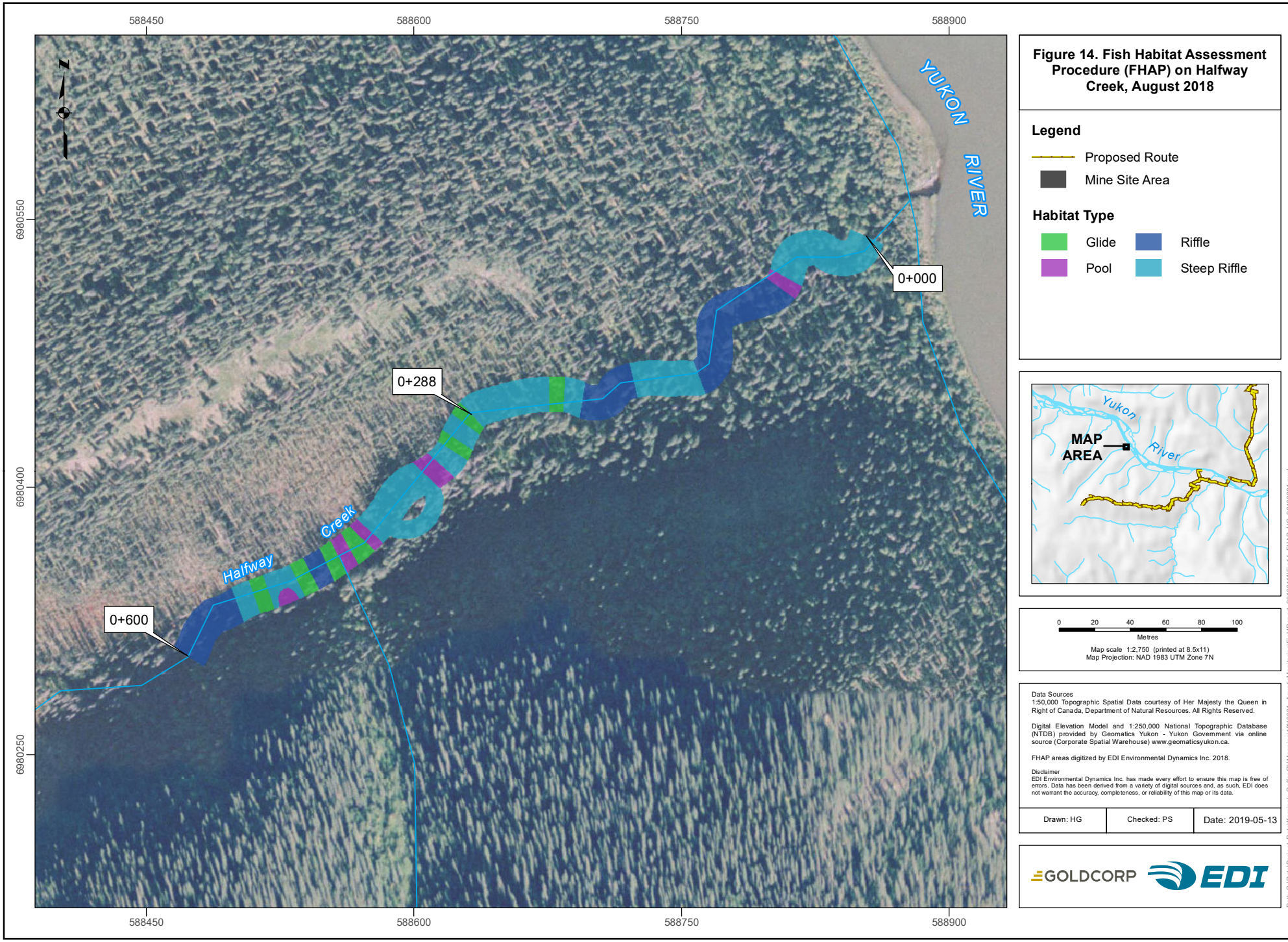

Figure 14. Fish Habitat Assessment Procedure (FHAP) on Halfway Creek, August 2018

Legend

- Proposed Route
- Mine Site Area

Habitat Type

- Glide
- Riffle
- Pool
- Steep Riffle

0 20 40 60 80 100
Metres

Map scale 1:2,750 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

FHAP areas digitized by EDI Environmental Dynamics Inc. 2018.

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3.4.2. YT-24 CREEK

During 2018 monitoring a FHAP survey was conducted on a 545 m section of lower YT-24 Creek (Figure 15). Fifteen distinct habitat units were identified during the survey (Table 28). Habitat units identified included cascades, pools, riffles (<5% grade), and steep riffles (≥5% grade). No glide habitat was identified in the surveyed section.

The surveyed section of YT-24 was dominated by riffle and steep riffle habitat which comprised 49% and 45% of surveyed habitat units by length respectively (Photo 18; Table 28). The average length of riffle (44.3 m) and steep riffle (49.3 m) habitat units were similar. Boulders were the dominant source of cover in these habitats. There were few cascade and pool habitat units, which together comprised the remaining 6% of habitat units by length. The surveyed portion of YT-24 did not contain any secondary (side channel) or tertiary (within channel) habitat.

The frequency and extent of habitat units in this section of YT-24 Creek represents relatively low-quality, low complexity fish habitat given the low frequency of pool (<30% by area), the lack of glide habitat, and little instream cover (Johnston and Slaney 1996). The average bankfull width over all habitat units in YT-24 was 6.06 ± 0.65 m (mean ± SE), with an average wetted width of 3.6 m and an average water depth of 0.24 m in the survey extent.

Table 28. Summary of habitat units identified during the FHAP survey of YT-24 Creek, August 2018.

Habitat type	No. of units	Average length per unit (m ± SE)	Total length in survey extent (m)	Percent of total survey extent
Cascade	3	9.5 ± 0.4	28.4	5 %
Glide	0	-	-	0 %
Pool	1	5.1 ± 0.0	5.1	1 %
Riffle (<5% grade)	6	44.3 ± 13.2	265.5	49 %
Steep riffle (≥ 5% grade)	5	49.3 ± 14.1	246.3	45 %
Total	**15**	**36.4 ± 8.0**	**545.3**	**100 %**



Photo 18. Example of riffle habitat on YT-24 Creek (0+314; August 13, 2018)

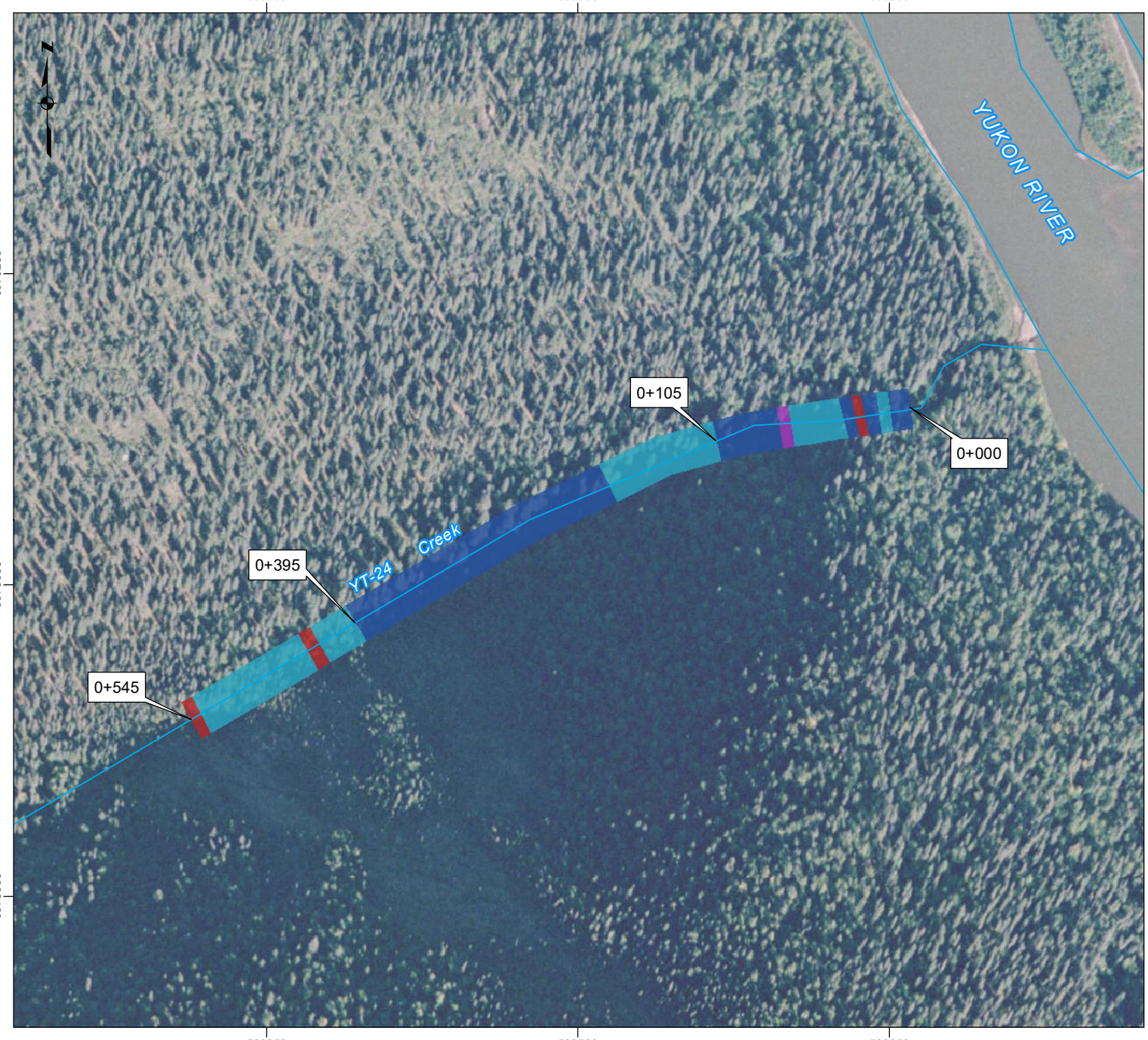


Figure 15. Fish Habitat Assessment Procedure (FHAP) on YT-24 Creek, August 2018

Legend

Proposed Route

Mine Site Area

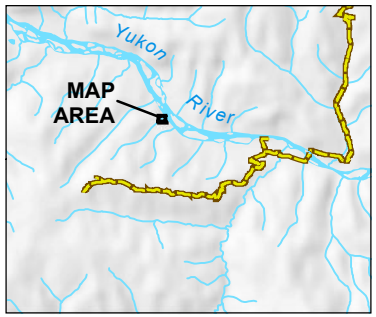
Habitat Type

Cascade

Riffle

Pool

Steep Riffle



0 20 40 60 80 100

Metres

Map scale 1:2,750 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
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FHAP areas digitized by EDI Environmental Dynamics Inc. 2018.

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3.4.3. LATTE CREEK

During 2018 monitoring a FHAP survey was conducted on a 662 m section in the middle of Latte Creek (Figure 16). Twenty-two distinct habitat units were identified during the survey (Table 29). Habitat units identified include cascades, glides, pools, riffles (<5% grade), and steep riffles (≥5% grade).

The surveyed section of Latte Creek was dominated by riffle and steep riffle habitat which comprised 71% and 22% of surveyed habitat units by length respectively (Photo 19; Table 29). Riffle habitat units were also nearly twice as long as steep riffle habitat units on average (47.1 and 29.0 m respectively). Instream boulders and cobbles were the dominant source of cover in these habitats. In the upper section of the survey, the last five habitat units were all riffle habitat, but were separated because of changes to the stream bankfull width. Two of the five sections were noticeably wider, approximately 10 m in width compared to the preceding and following habitat units which were approximately 5 m in width (Figure 16; APPENDIX E). There were relatively few cascades, glides, and pools, which together comprised the remaining 7% of habitat units by length in Latte Creek. The average residual depth of pool habitat in Latte Creek was 0.4 m, slightly less than the average residual pool depth in both Halfway and YT-24 creeks (0.6 m). The surveyed section of Latte Creek did have one secondary side channel which at the time of the survey was dry. The side channel habitat was approximately 50 m in length and was dry and thus only accessible during periods of high flow.

The frequency and extent of habitat units in this section of Latte Creek represents relatively low-quality, low complexity fish habitat with a low frequency of glide and pool habitat (<30% by area), few pieces of functional LWD, and little instream cover (Johnston and Slaney 1996). Past studies have documented higher quality habitat (with more pools and glides) in the lower section of Latte Creek (LC3.5, formerly LC2.7; (EDI 2017). The average bankfull width over all primary habitat units in Latte Creek was 5.13 ± 0.45 m (mean ± SE), with an average wetted width of 4.1 m and an average water depth of 0.46 m during the survey.

Table 29. Summary of habitat units identified during the FHAP survey of Latte Creek, August 2018.

Habitat type	No. of units	Average length per unit (m ± SE)	Total length in survey extent (m)	Percent of total survey extent
Cascades	1	3.1 ± 0.0	3.1	0.5 %
Glides	2	11.0 ± 0.2	22.0	3 %
Pools	3	7.0 ± 1.8	20.9	3 %
Riffles (<5% grade)	10	47.1 ± 6.9	511.6	71 %
Steep riffles (≥ 5% grade)	5	29.0 ± 14.7	104.3	22 %
Secondary channel (dry)	1	50.0 ± 0.0	50.0	N/A
Total	**22**	**31.5 ± 5.9**	**661.9**	**100 %**



Photo 19. Example of riffle habitat on Latte Creek (0+357; August 11, 2018).

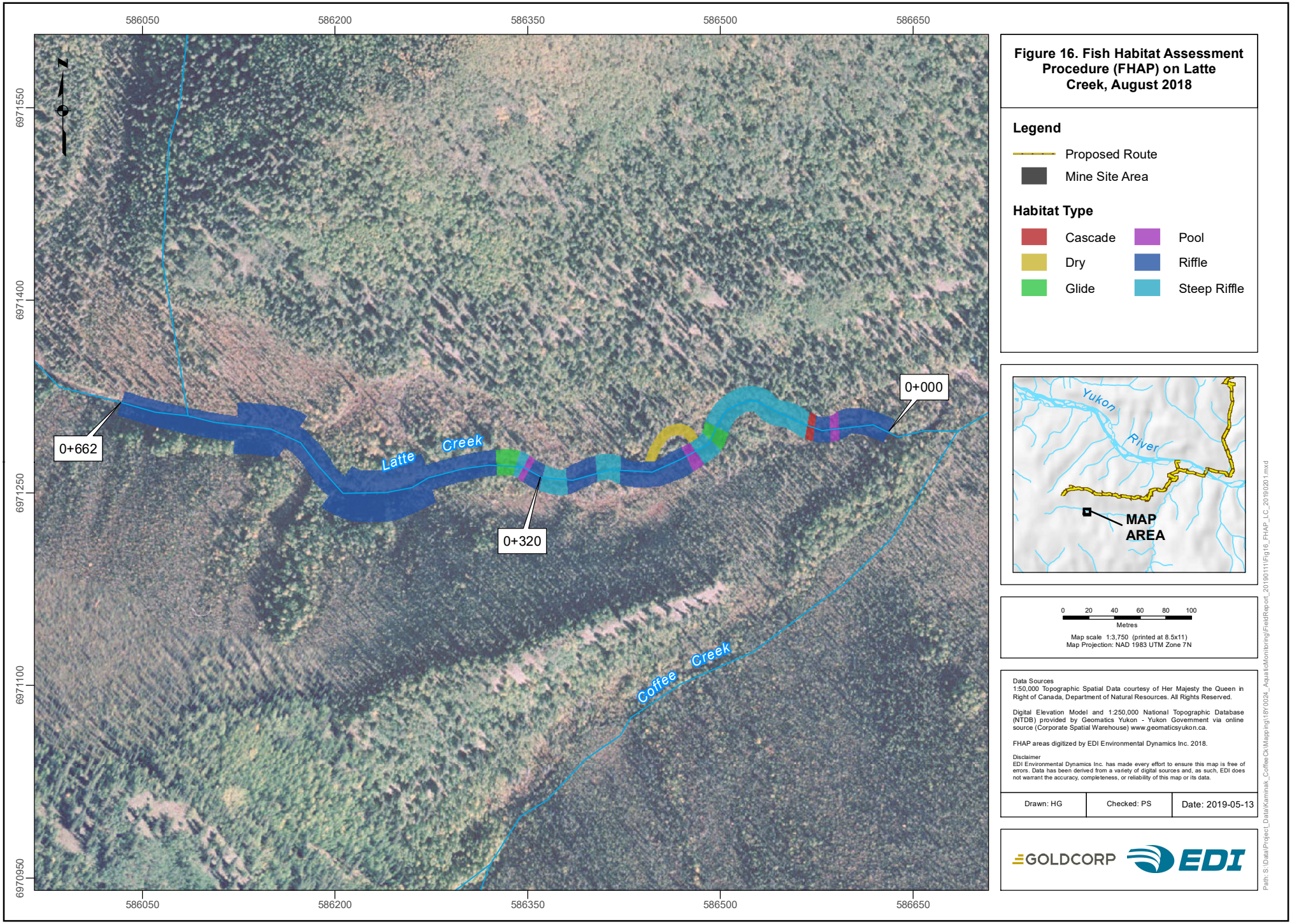

Figure 16. Fish Habitat Assessment Procedure (FHAP) on Latte Creek, August 2018

Legend

- Proposed Route
- Mine Site Area

Habitat Type

- Cascade
- Dry
- Glide
- Pool
- Riffle
- Steep Riffle

0 20 40 60 80 100
Metres

Map scale 1:3,750 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

FHAP areas digitized by EDI Environmental Dynamics Inc. 2018.

Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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3.5. CHINOOK SPAWNING SURVEYS

No adult Chinook salmon, carcasses or salmon redds were observed during any of the Chinook spawning surveys in 2018. Also, there were no observations of wildlife such as bears or eagles which typically feed on salmon during the spawning season. These results are consistent with data collected in previous years (EDI 2017, 2018).

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4. RESULTS AND DISCUSSION – NORTHERN ACCESS ROUTE STUDY AREA

Results and discussion for the Northern Access Route Study area are described in the below sections.

4.1. BARGE LANDINGS

Past work at the proposed barge landing sites on the Yukon and Stewart rivers have indicated these areas contain typical riverbank habitat associated with large rivers (EDI 2018). Sampling in the form of beach seining was conducted to provide information on fish species presence and abundance in the vicinity of the proposed NAR barge landings. Juvenile Chinook salmon, Arctic grayling, longnose sucker, round whitefish, and slimy sculpin were captured in both the Yukon and Stewart rivers during 2018 sampling. Lake whitefish and northern pike were only captured in the Yukon River, whereas lake chub were only captured in the Stewart River during sampling of proposed barge landings in 2018.

4.1.1. BARGE LANDINGS – YUKON RIVER

4.1.1.1. Yukon River North Barge Landing – YUK51.2

The Yukon River North proposed barge landing (right downstream bank) is located at a slight outside bend in the river where the river bank is actively eroding into the river (Photo 20). Due to the eroding river bank and deep water, beach seining could not be completed at the proposed barge landing site. Instead beach seining was completed approximately 75 m downstream of the proposed barge landing in habitat more conducive to successful beach seining, similar to 2017 sampling (EDI 2018). During both July and August, several beach seines were conducted to gain an understanding of fish assemblages (sampling effort was 600 m^2 and 412 m^2, respectively).



Photo 20. **Upstream view of the proposed Yukon River north barge landing site (mid-photo) and proximity of the sampling area (boat location, moving downstream) on the Yukon River on August 9, 2018.**

A total of six species were captured during 2018 fieldwork near the proposed Yukon River north barge landing site (Table 30). Juvenile Chinook salmon were the most frequently captured species during sampling and consistently comprised more than half of caught individuals in July and August (55% and 60%, respectively). Longnose sucker and slimy sculpin were also captured during both July and August sampling events. Juvenile Chinook exhibited the same size pattern observed in other parts of the Yukon River, increasing in size and weight between sampling periods (Table 30).

Table 30. **Yukon River north proposed barge landing (YUK51.2) fish metrics summary, July and August 2018.**

Sampling event	Fish measured	Average fork length (mm ± SE)	Average weight (g ± SE)
July	CH – 6 CCG – 2 LSU – 2 LW – 1	CH – 61.5 ± 3.7 CCG – 36.0 ± 4.0 LSU – 172.5 ± 69.5 LW – 125.0 ± 0.0	CH – 2.5 ± 0.4 CCG – 0.7 ± 0.3 LSU – 97.0 ± 84.7 LW – 36.1 ± 0.0
August	CH – 18 GR – 8 CCG – 2 RW – 1 LSU – 1	CH – 76.8 ± 1.0 GR – 135.4 ± 16.9 CCG – 62.0 ± 0.0 RW – 75.0 ± 0.0 LSU – 72.0 ± 0.0	CH – 5.0 ± 0.3 GR – 34.1 ± 11.6 CCG – 2.3 ± 0.3 RW – 3.5 ± 0.0 LSU – 3.5 ± 0.0

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; RW = round whitefish; LW = lake whitefish; LSU = long-nose sucker

4.1.1.2. Yukon River South Winter Road Access – YUK51.2

The Yukon River south (left downstream bank) proposed winter access road crossing is located on the far side of a vegetated island in the Yukon River directly across from the proposed north barge landing site. The area has gently sloping, low river banks and is partially sheltered from the main river current by the upstream extent of the island. The riverbank bed material is comprised of cobbles imbedded in a mix of fines (Photo 21). This location was sampled in July with a sampling effort of 450 m^2.



Photo 21. View of the proposed Yukon River winter road crossing and location of sampling on July 14, 2018.

Juvenile Chinook salmon were the most frequently capture species, with slimy sculpin and round whitefish being the next most frequently captured species (Table 31). Juvenile Chinook salmon comprised 80% of the species captured.

Table 31. Yukon River south winter road access (YUK51.2) fish metrics summary, July 2018.

Sampling event	Fish measured	Average fork length (mm; ± SE)	Average weight (g; ± SE)
July	CH – 12 CCG – 2 RW – 1	CH – 62.0 ± 1.7 CCG – 64.0 ± 6.0 RW – 41.0 ± 0.0	CH – 2.7 ± 0.2 CCG – 2.7 ± 0.9 RW – 0.6 ± 0.0

CH = Chinook salmon; CCG = slimy sculpin; RW = round whitefish

4.1.1.3. Yukon River South Barge Landing – YUK47.6

The Yukon River south proposed barge landing (left downstream bank) is located in an area with uniform, high banks, and a steadily sloping shoreline (Photo 22). The shoreline bed material is comprised primarily of small cobbles and gravels with limited amounts of fines. This site was sampled in August with an effort of 234 m^2.



Photo 22. View of proposed Yukon River south barge landing site on the left downstream bank of the Yukon River on August 9, 2018.

Five species were captured at the proposed Yukon River South barge landing site (Table 32). Juvenile Chinook salmon were the most frequently captured species during 2018 sampling and comprised 48% of captured individuals (Table 32). Slimy sculpin were the second most abundant species captured, followed by Arctic grayling, northern pike and round whitefish.

Table 32. Yukon River south proposed barge landing (YUK47.6) fish metrics summary, August 2018.

Sampling event	Fish measured	Average fork length (mm; ± SE)	Average weight (g; ± SE)
August	CH – 12	CH – 72.9 ± 1.7	CH – 4.3 ± 0.3
	GR – 3	GR – 75.0 ± 2.5	GR – 3.5 ± 0.5
	CCG – 8	CCG – 36.4 ± 4.7	CCG – 1.0 ± 0.3
	NP – 1	NP – 160.0 ± 0.0	NP – 28.0 ± 0.0
	RW – 1	RW – 54.0 ± 0.0	RW – 1.0 ± 0.0

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; NP = northern pike; RW = round whitefish

4.1.1.4. Yukon River Existing Barge Landing – YUK46.1

The existing Yukon River barge landing site (left downstream bank) is located immediately adjacent to the current Coffee Gold exploration camp. The gently sloping riverbed is primarily comprised of a mix of gravels, fines, and a few small cobbles (Photo 23). The barge landing site is partially sheltered from the main river current by a large bend in the river and slightly protruding upstream bank. The existing barge landing was sampled in July with a sampling effort 410 m^2.



Photo 23. View of the current barge landing on the Yukon River at the Coffee Gold exploration camp on July 11, 2018.

Three species were captured at the current barge landing, including juvenile Chinook salmon, lake whitefish, and round whitefish during 2018 sampling (Table 33). Juvenile Chinook salmon were the most frequently captured species, accounting for 61% of caught individuals, similar to other proposed barge landing sites.

Table 33. Existing Yukon River barge landing (YUK46.1) fish metrics summary, July 2018.

Sampling event	Total fish captured	Fish measured	Average fork length (mm; ± SE)	Average weight (g; ± SE)
July	CH – 11 LW – 4 RW – 3	CH – 9 LW – 4 RW – 3	CH – 60.9 ± 2.1 LW – 61.3 ± 34.7 RW – 40.7 ± 0.9	CH – 2.4 ± 0.3 LW – 2.1 ± 0.2 RW – 0.5 ± 0.0

CH = Chinook salmon; LW = lake whitefish; RW = round whitefish

4.1.2. BARGE LANDINGS – STEWART RIVER

4.1.2.1. Stewart River North Barge

The Stewart River north proposed barge landing (right downstream bank) is located along a stretch of river with low, moderately sloping banks (Photo 24 from 100m downstream of the proposed barge landing). This riverbank substrate is primarily comprised of a mix of fines with few imbedded cobbles. The proposed barge landing is located in a partial eddy created by upstream bedrock and is partially sheltered from the main river current. The proposed barge landing site sits between some short but steep rock bluffs immediately upstream and a gravel bar downstream. This site was sampled in July with an effort of 480 m^2.



Photo 24. Upstream view 100m downstream of the proposed barge landing site on the north bank of the Stewart River on August 11, 2018.

Juvenile longnose sucker was the most frequently captured species during 2018 sampling (Table 34). The next most frequently captured species were slimy sculpin, lake chub, and round whitefish. Longnose sucker comprised 55% of individuals captured during the July 2018 sampling event. No juvenile Chinook were captured, contrasting Yukon River results where they were captured at all seining locations.

Table 34. Stewart River north proposed barge landing (right downstream bank) fish metrics summary, July 2018.

Sampling event	Total fish captured	Fish measured	Average fork length (mm; ± SE)	Average weight (g; ± SE)
July	LSU – 20 CCG – 9 LKC – 6 RW – 1	LSU – 14 CCG – 9 LKC – 6 RW – 1	LSU – 101.6 ± 7.4 CCG – 47.1 ± 2.5 LKC – 88.5 ± 4.6 RW – 179.0 ± 0.0	LSU – 12.7 ± 2.7 CCG – 1.1 ± 0.2 LKC – 7.6 ± 1.0 RW – 67.9 ± 0.0

LSU = longnose sucker; CCG = slimy sculpin; LKC = lake chub; RW = round whitefish

4.1.2.2. Stewart River South Barge Landing

The Stewart River south proposed barge landing site (left downstream bank) is located along a uniform stretch of river with steep eroding banks and a gently sloping shoreline and riverbed (Photo 25). The riverbed is comprised primarily of cobbles and gravel with some fines. This site was sampled in July with an effort of 400 m^2.



Photo 25. Upstream view 300m downstream from the proposed barge landing site on the left downstream bank of the Stewart River on July 12, 2018.

Juvenile Chinook salmon were the most frequently captured species during 2018 sampling (Table 35). Longnose sucker was the second most frequently captured species, followed by Arctic grayling and lake chub. Juvenile Chinook salmon comprised 75% of individuals captured during the July 2018 sampling event.

Table 35. Stewart River South proposed barge landing (left downstream bank) fish metrics summary, July 2018.

Sampling event	Fish measured	Average fork length (mm; ± SE)	Average weight (g; ± SE)
July	CH – 15 LSU – 3 GR – 1 LKC – 1	CH – 67.8 ± 1.5 LSU – 92.7 ± 13.4 GR – 99.0 ± 0.0 LKC – 75.0 ±0.0	CH – 3.5 ± 2.1 LSU – 8.9 ± 4.4 GR – 9.2 ± 0.0 LKC – 7.0 ± 0.0

CH = Chinook salmon; LSU = longnose sucker; GR = Arctic grayling; LKC = lake chub

4.2. BARGE WAKE INVESTIGATIONS

Waves observed from passing barges (n = 4) washed 20-75 cm onto shore. Measurements were taken as the distance waves washed up onto shore from the waters edge prior the barge passage. Observed waves were either small plunging/spilling waves (Photo 26) or surging waves (Photo 27). Barges passed 60 m or more from shore (estimated 60-240 m) during all observations (Table 36). In comparison, a 14 ft boat with a 25 hp motor driven by on-step approximately 40 m from shore (Site 1) created a wake that washed 30-50 cm onto shore.

Table 36. 2018 barge wake investigation details.

Site	Date	Bed material	Shore slope	Distance from shore (m)	Direction of travel	Wave run out (cm)
Site 1	August 9, 2018	Cobbles, gravels, and boulders	Low - moderate	60	upstream	~55
Site 2	August 9, 2018	Fines (sand/silt) with some cobbles.	Low gradient	50-60	downstream	30-40, 70-80
Site 3	August 12, 2018	Cobbles and fines (silt), and vegetation and fines (silt)	Low gradient	>100	upstream	~20 to 40-50
Site 4	August 15, 2018	Cobbles, gravels, and fines	Moderate gradient (15°)	240[1]	upstream	45-53

[1]Measured using a range finder; other distances were visual estimates.

Turbidity measurements were collected at the second barge passing observation (Site 2; Figure 9). The river bank at this site has a low gradient and was primarily comprised of small cobbles and fines. Turbidity was monitored to characterize the magnitude and length of disturbance from waves. Before the barge passed the site, background turbidity was 9.35 NTUs. Three minutes after the barge passed and waves reached shore turbidity spiked to 150 NTUs. After the three-minute mark turbidity dropped to 68.4 NTUs, then after seven minutes turbidity was close to background levels at 14.53 NTUs. Waves from passing barges increased turbidity in an extremely localized area up to a maximum of one meter from shore.

Larger waves have a higher potential to cause shoreline erosion. The size of waves produced by a vessel is a factor of the vessel size, weight, hull shape, and speed (Maynord 2001). The size of waves that reach shore, and their erosion potential, is further dependent on the vessels distance from shore, the depth of water, the presence or absence of shoreline vegetation, and the nearshore profile and substrate composition (Maynord et al. 2008, Bilkovic et al. 2017). The likelihood that waves from vessels will contribute to shoreline erosion can also depend on water level and the frequency, timing, and location of vessel traffic (Maynord et al.

2008). The waves observed during August 2018 fieldwork were generally small, low energy waves that created short-lived, localized disturbances. An Alaska study indicated that while waves from vessels did cause some shoreline erosion, the magnitude of the disturbance was minimal compared to large flood events (Maynord et al. 2008). Much of the shoreline of the Yukon River is armored against erosion from barge induced waves at normal and low water levels due to the presence of cobbles on riverbanks.



Photo 26. **A small plunging/spilling breaking wave at Site 1, note the sediment suspended in the turbulent wave on August 9, 2018.**



Photo 27. **A surging wave at Site 4. Note the portion of the meter stick that is underwater was previously at the waters edge (approximately 50 cm) on August 15, 2018.**

4.3. STEWART RIVER BACK CHANNEL INVESTIGATIONS

The Stewart River back channel adjacent to the proposed NAR was investigated for connectivity, suitable fish habitat, and fish presence using beach seining techniques in early July 2018. Unlike previous investigations on the back channel in October 2016 and September 2017 (EDI 2017, 2018), the channel was wetted up to approximately 600 m from the Stewart River. The mouth of the back channel was fairly wide and partially filled with water (Photo 28, Photo 29); there was evidence of the water level having been much higher earlier in the summer or spring, with vegetation in the branches of trees and woody debris along the banks (Photo 30). Nearly the entirety of the channel was characterized by a reed grass (suspected to be bluejoint reedgrass; *Calamagrostis canadensis*) that was present within the wetted area, as well as covering much of the unwetted bankfull channel. The channel was primarily narrow with fallen trees and other woody debris for the first 500 m (Photo 31). At approximately 500 m upstream from the Stewart River, the channel became wider and deeper with less cover, and also less of the aforementioned tall grass (Photo 32). This widened open channel continued until the end of the investigation at approximately 600 m, at which point the back channel severely narrowed and was inundated by woody debris with very little water (Photo 33).



Photo 28. View of the back channel facing upstream from the Stewart River on July 11, 2018.



Photo 29. Upstream view of the Stewart River back channel near the mouth of the outflow to the Stewart River on July 11, 2018.



Photo 30. Downstream view and evidence of a larger channel at high water on July 12, 2018.



Photo 31. Downstream view of a typical narrow section of the Stewart River back channel on July 11, 2018.



Photo 32. Upstream view of the Stewart River back channel in the wider and deeper stretch approximately 500 m upstream of the Stewart River on July 12, 2018.



Photo 33. Upstream view of the Stewart River back channel at the top of the NAR encroachment area, 600 m from the mouth on July 12, 2018.

The areas that were beach seined varied in wetted width from 1-6 m, and depth varying from 0.3-1.2 m (Photo 34). Fish were captured in six of the ten seine hauls that were conducted in the Stewart River back channel (Table 37, Table 38). The species captured included burbot, northern pike, and lake whitefish (Table 37, Table 38). There were more than 100 larval fish (species could not be determined) captured in the first seine haul (SR_BC1); they were not fully enumerated or measured in an effort to reduce mortality, although were estimated to be < 15 mm (Table 38; Photo 35). The larval fish weren't able to be identified; however, they would have been YOY from spring spawners, potentially lake chub. Not including the larval fish, lake whitefish had the highest CPUE, followed by northern pike and burbot (Table 38). Lake whitefish were spot-seined and all captured in a single seine haul, approximately 600 m upstream from the Stewart River. Lake whitefish had a CPUE range of 0.0-95.0 fish/100 m^2 (Table 37, Table 38; Photo 36). Northern pike were captured in five of the ten seine hauls and CPUE varied from 2.8-20.0 fish/100 m^2 (Table 37, Table 38; Photo 38). Burbot were caught in four of the ten seine hauls, and CPUE varied from 0.0-20.0 fish/100 m^2 (Table 37, Table 38; Photo 37).



Photo 34. Field crews beach seine in the Stewart River back channel on August 11, 2018.

Table 37. Stewart River back channel beach seining and fish metrics summary.

Waterbody	Sample effort	Total fish captured	Fish measured	Average fork length (mm ± SE)	Fork length range (mm)	Average weight (g ± SE)	Weight range (g)
Stewart River back channel	10 beach seine hauls	BB – 12 NP – 15 LW – 19	BB – 12 NP – 15 LW –10	BB – 33.4 ± 1.4 NP – 43.5 ± 5.0 LW – 45.2 ± 2.1	BB – 27-44 NP – 7-73 LW – 34-54	BB – 0.4 ± 0.0 NP – 1.3 ± 0.3 LW – 0.8 ± 0.1	BB – 0.2-0.8 NP – 0.1-3.3 LW – 0.4-1.1

BB = burbot; NP = northern pike; LW = lake whitefish

Table 38. Catch-per-unit-effort summary of fish captured in the Stewart River back channel, July 2018.

Sampling site	Lake whitefish CPUE (fish/100m²)	Northern pike CPUE (fish/100m²)	Burbot CPUE (fish/100m²)
SR_BC1[1]	0.0	5.6	6.7
SR_BC2	0.0	2.8	2.8
SR_BC3	0.0	0.0	0.0
SR_BC4	0.0	0.0	0.0
SR_BC5	0.0	20.0	20.0
SR_BC6	0.0	0.0	0.0
SR_BC7	0.0	15.0	10.0
SR_BC8	0.0	16.7	0.0
SR_BC9	0.0	0.0	0.0
SR_BC10	95.0[2]	0.0[3]	0.0
Average ± SE	**9.5 ± 9.5**	**6.7 ± 2.6**	**3.9 ± 2.1**

[1]Over 100 unidentified larval fish were captured in this seine haul but were not fully enumerated or measured in an effort to reduce mortalities.
[2]These fish were first visually observed but were not able to be positively identified; therefore, they were spot-seined, resulting in the high CPUE from a relatively small seine haul.
[3]Three juvenile northern pike were observed but not captured.

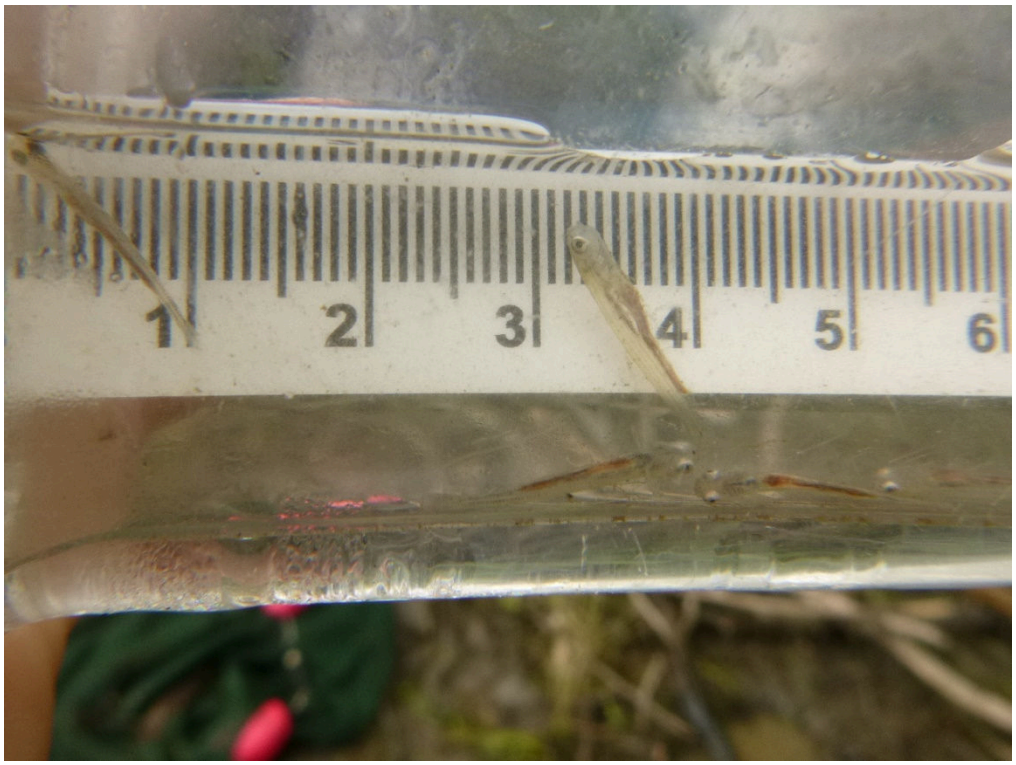


Photo 35. Unidentified larval fish captured in SR_BC1 on July 11, 2018.



Photo 36. Juvenile lake whitefish captured approximately 600 m from the mouth of the Stewart River back channel on July 12, 2018.

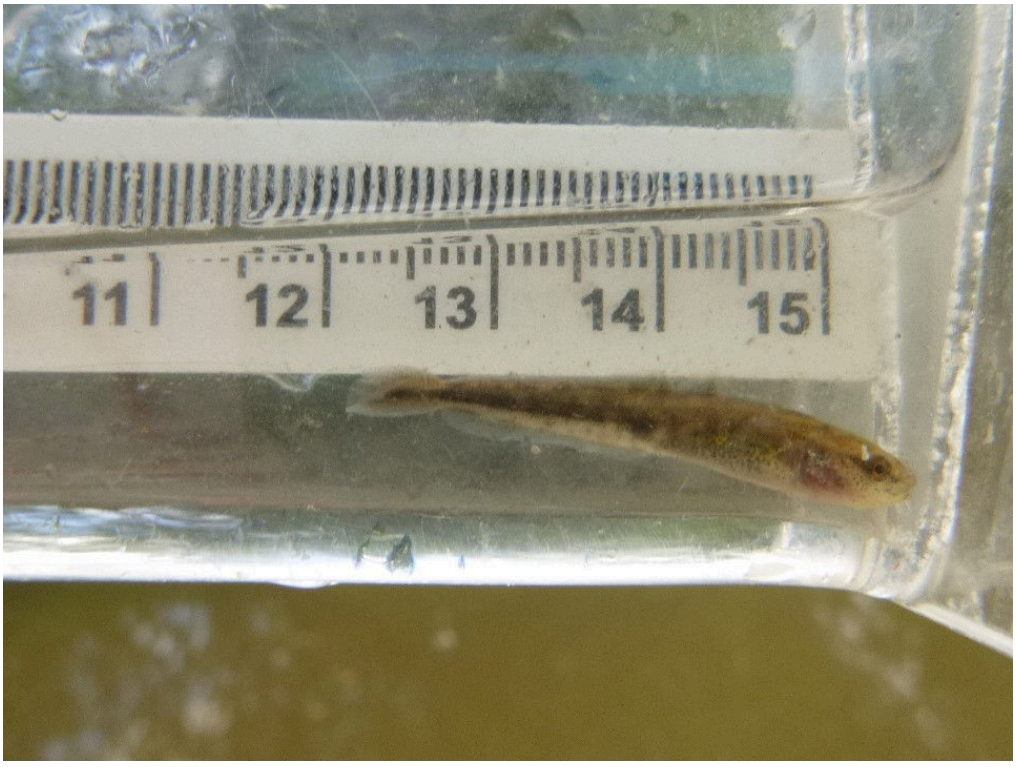


Photo 37. A juvenile YOY burbot captured in seine haul SR_BC1 on July 11, 2018.

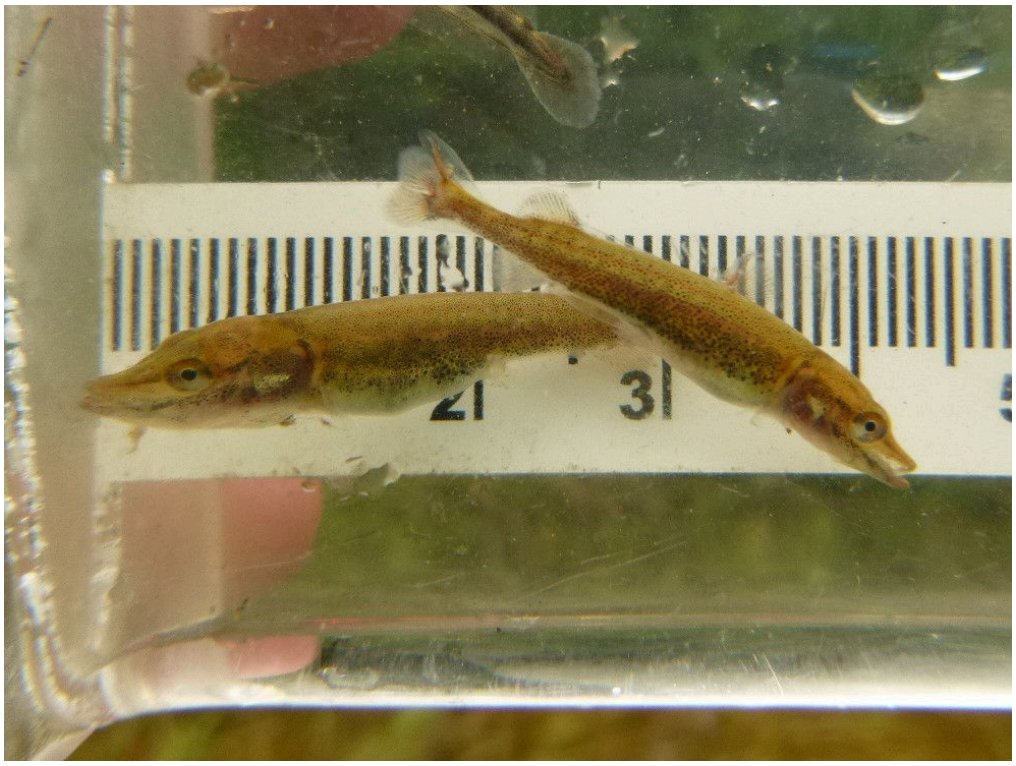


Photo 38. Two juvenile YOY northern pike captured in SR_BC7 on July 12, 2018.

It was common to capture both juvenile burbot and northern pike in the same seine hauls, with burbot occurring in four out of the five hauls that northern pike were caught in, and northern pike in all of the hauls that captured burbot (Table 38). The beach seining results from the back channel indicate that at the water levels sampled, this back channel is being used nursery habitat for juvenile YOY burbot, northern pike, and lake whitefish. Seasonally flooding back water areas provide vital habitats for juvenile burbot and northern pike (Casselman and Lewis 1996, Worthington et al. 2012). These juvenile fish also have a very patchy distribution, making it difficult to classify different parts of the back channel area as more or less important habitat (Cucherousset et al. 2009). Based on their life history and spawning preferences, it is a possibility that northern pike spawn in the back channel. However, in the case of burbot and lake whitefish is it likely that they spawn elsewhere and use the back channel as a nursery habitat (given the channel is expected to be dry during their spawning period). It is also important to note that this back channel is only seasonally flooded, and would be expected to be cut off from the Stewart River once water levels on the river drop approximately 0.5 m from the river level when fish sampling occurred (Figure 17). The water depth at the first seine haul was approximately 0.4 m; by the last week of July water levels would have likely dropped enough to isolate the back channel from the Stewart River (Figure 17). The early August high rainfall events contributed to the subsequent high water levels, but by end of September the water levels would have dropped again to the point that would dry up the back channel (Figure 17). Primary water levels at the mouth of the Stewart River were 27.007 m when sampling occurred on July 11, 2018. At this time it isn't known if these juvenile YOY fish emigrate out of the back channel before connectivity is lost with the Stewart River, or whether stranding occurs. At the July 11, 2018 water levels, it is estimated the NAR

encroachment would not have reached the water edge; the encroachment would only occur for a short period likely during the freshet and subsequent high water.

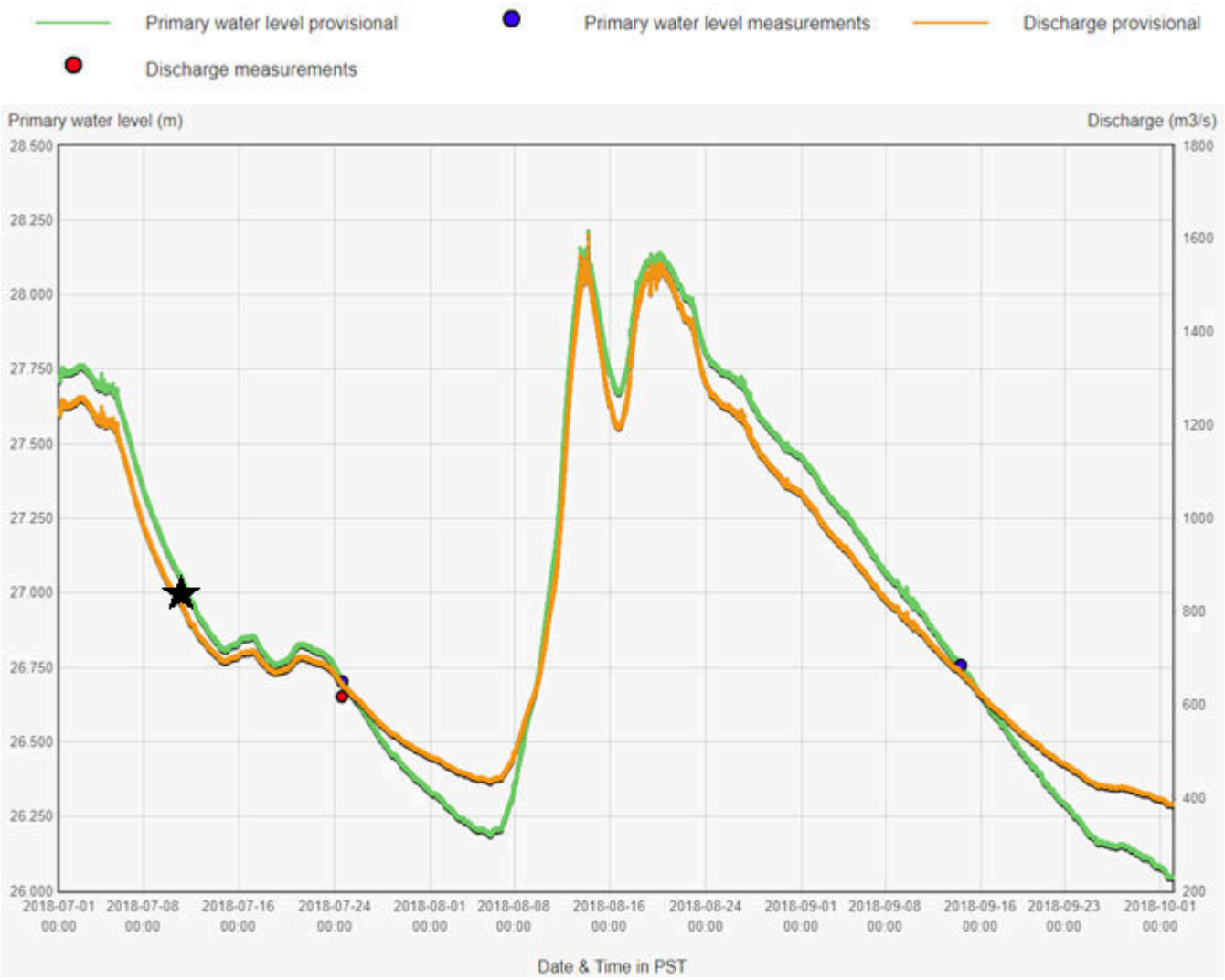


Figure 17. Water level on the Stewart River from July 1 to October 1, 2018. The star denotes levels when fish sampling occurred in 2018 (modified from Environment Canada 2019).

4.4. CHUM SPAWNING SURVEYS

During the 2018 chum spawning survey, both the Yukon and Stewart River had low water levels, which allowed for ideal surveying conditions and water clarity. However, due to such low water conditions, many of the side channels where spawning chum salmon were previously identified during past surveys were completely dewatered (Photo 39). There was little formation of pancake or shore ice on either river, and where ice was present in the side channels that hadn't dewatered, the water clarity and absence of snow allowed for effective surveying through the ice (Photo 40).



Photo 39. Dewatered side channel on the Stewart River October 13, 2018.



Photo 40. Spawning chum salmon under ice on the Yukon River on October 13, 2018.

During the survey of the Yukon River approximately 457 live chum, 90 redds, and five carcasses were observed. No live chum, carcasses, or evidence of spawning activity (redds) was observed on the Stewart River in 2018. When comparing these numbers to previous results, it is prudent to consider the relative size of the respective chum spawning runs. The 2018 run totals were fairly inline with recent years, with the exception of the 2017 chum spawning run which far surpassed the five-year average (2012-2016: 165,810; Figure 18). These results are also reflected in previous EDI chum spawning surveys (Table 39).

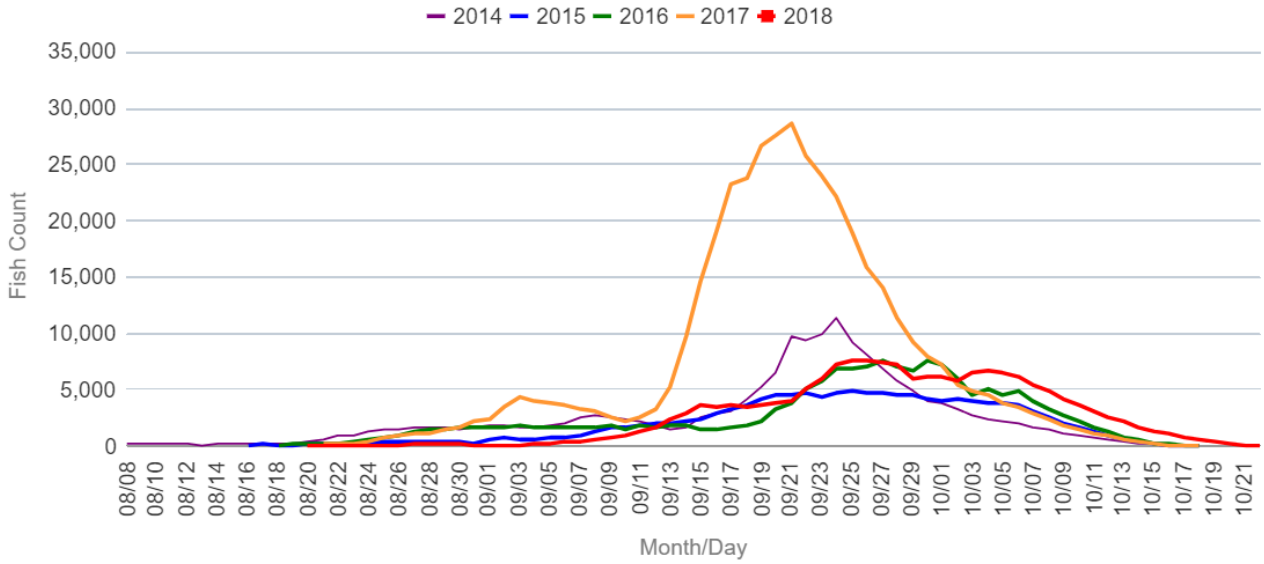


Figure 18. Eagle Sonar (Yukon/Canadian Border) historical daily passage of chum salmon (Alaska Department of Fish and Game, 2018).

Table 39. Spawning live chum salmon survey results from 2016-2018 (EDI Environmental Dynamics Inc. 2017, 2018).

	2016	2017	2018
Yukon River	263	907	457
Stewart River	3	102	0

The chum spawning surveys over the past three years have provided variable results, as a product of run size, environmental conditions (e.g., water level, ice conditions), survey timing, and gaining knowledge on spawning areas (Table 39). During the 2017 survey period there were substantially more fish observed on both the Yukon and Stewart River than in 2018, albeit the run was approximately 250,000 larger in 2017 (Alaska Department of Fish and Game 2018). Live chum salmon were observed in the same areas as in 2016 and 2017 (Figure 19). Conversely, there were more chum redds observed in 2018 than in 2017 (90 and 38, respectively; Figure 20). The redds were in more concentrated areas and didn't have the same spatial distribution as the 2017 results; good water clarity and snow-free ice cover of the channels allowed for a clear view of redds. Lastly, very few carcasses were observed during the 2018 survey; the survey occurred approximately seven days earlier than the 2017, which likely accounted for fewer carcasses (Figure 21).

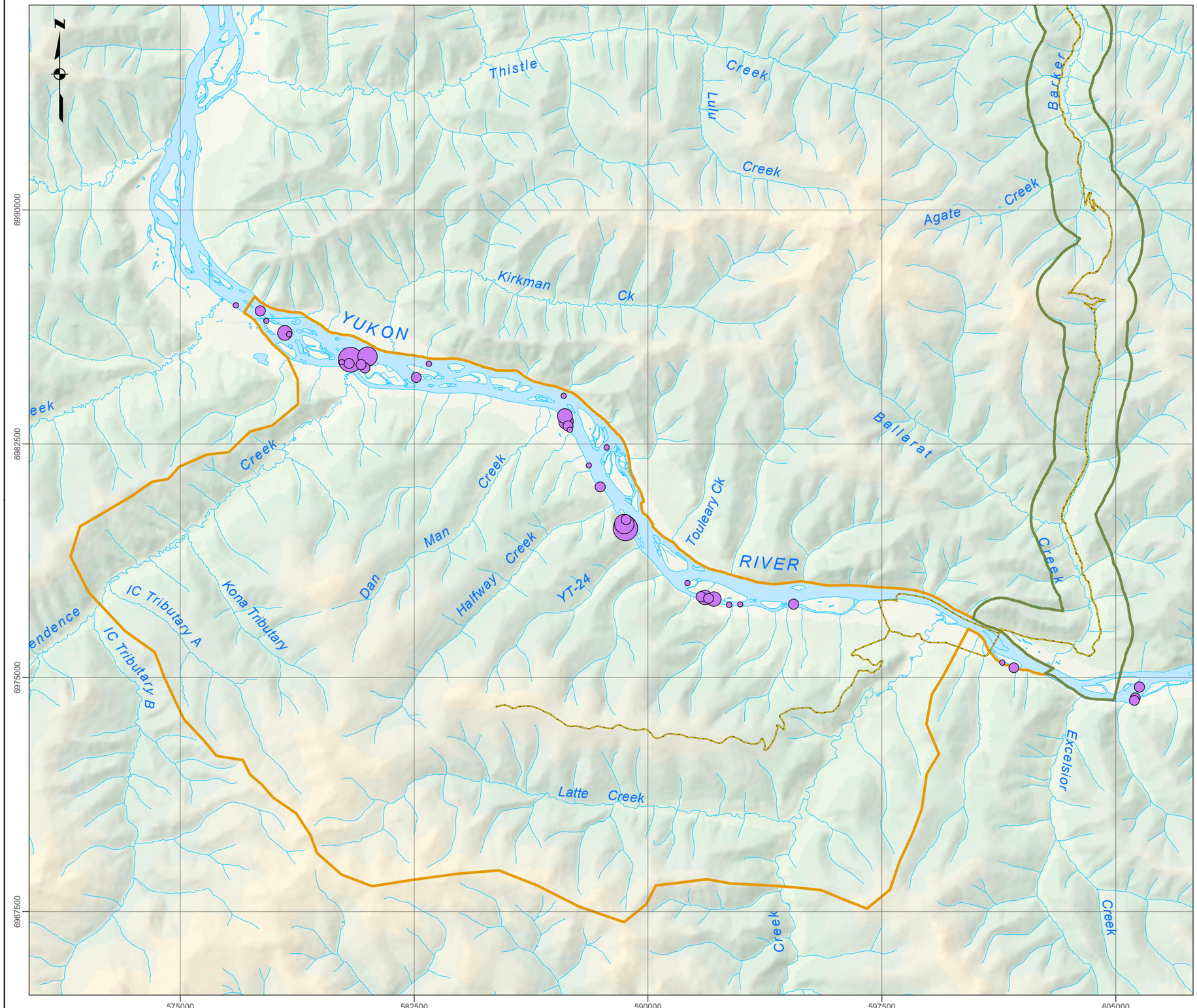


Figure 19. Observed live chum salmon during the spawning survey on the Yukon River, October 2018

Legend

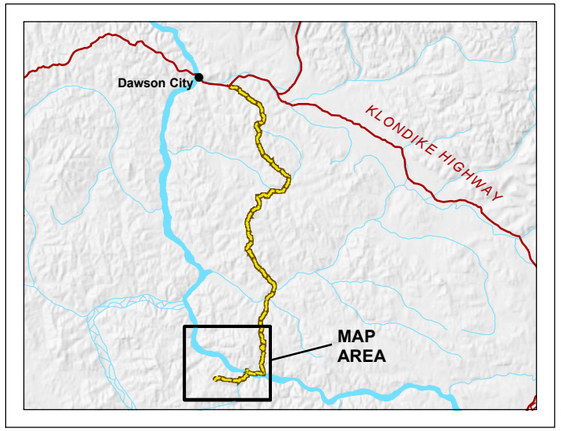
Proposed Route

Live Chum Counts (2018)

- 1 - 5
- 5 - 15
- 15 - 25
- 25 - 45
- 45 - 85

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area



0 2 4 6 8 10

Kilometres

Map Scale = 1:125,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:50,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Survey data collected by Environmental Dynamics Inc., 2018. Locations obtained using Garmin GPS technology.

Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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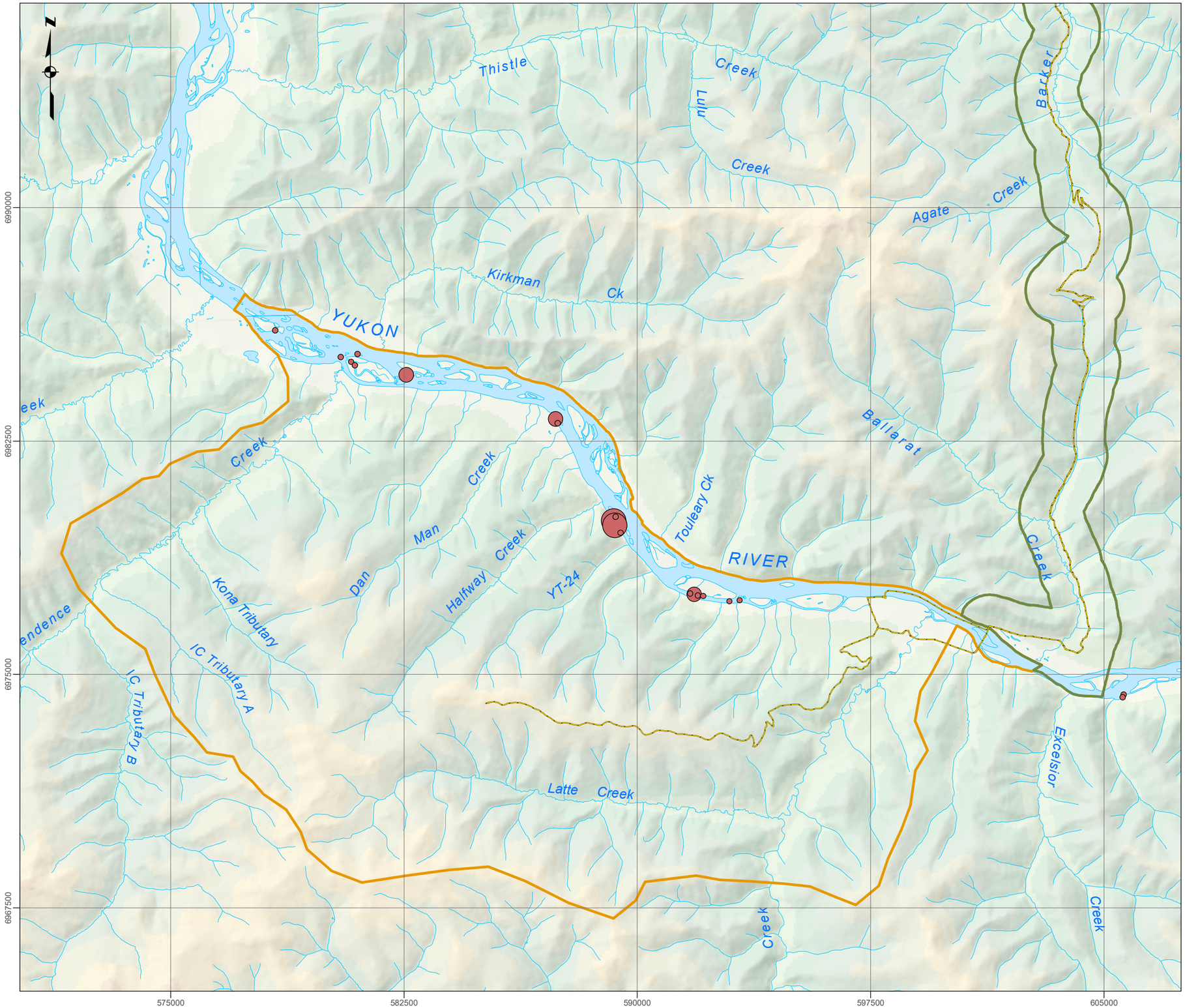


Figure 20. Observed chum salmon redds during the spawning survey on the Yukon River, October 2018

Legend

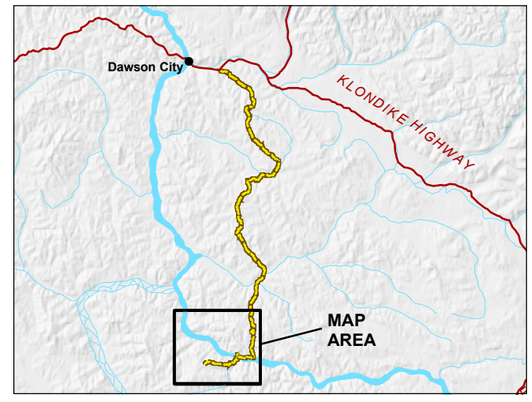
Proposed Route

Chum Redd Counts (2018)

- 1 - 5
- 5 - 10
- 10 - 15

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area



0 2 4 6 8 10

Kilometres

Map Scale = 1:125,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
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Figure 21. Observed chum salmon carcasses during the spawning survey on the Yukon River, October 2018

Legend

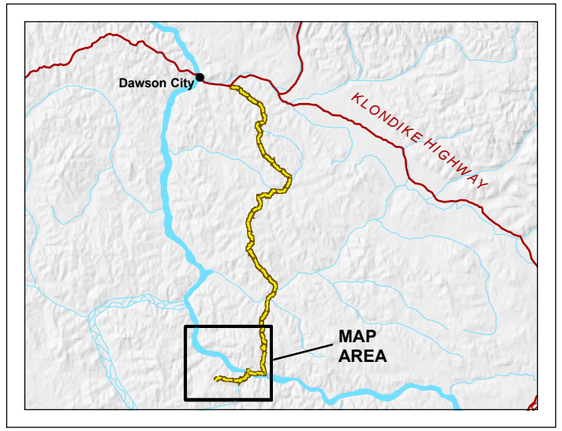
- Proposed Route

Chum Carcass Counts (2018)

- 1
- 2

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area



0 2 4 6 8 10
Kilometres

Map Scale = 1:125,000 (printed on 11 x 17)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
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Digital Elevation Model and 1:50,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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5. IMPLICATIONS

Field work from the 2018 field season provided valuable information for moving forward in future research and monitoring programs. Several programs assessed in the 2018 field season had noteworthy conclusions or implications:

- Halfway Creek and YT-24 Creek mixing zones indicated higher diversity and abundance than elsewhere on the Yukon River. The only exception to this is the sampling that occurred across from the mouth of YT-24 Creek, which also had high species diversity and abundance (particularly of juvenile Chinook). This finding raised the question of whether fish abundance and diversity were high due to the proximity (and potential influence) of the creek mouth, or whether there was some effect of an eddy where sampling occurred across from the creek mouth. Future research will extend sampling to mixing zones, average shoreline areas on the Yukon River (no eddies, no mixing zones), as well as shoreline areas on the Yukon River that have an eddy (but no influence of a nearby creek mouth).

- Opportunistic barge wake investigations indicated that the effects of barge-induced wave break on shore are minimal and localized close to the shore, and fish stranding is unlikely to be a concern for the barges currently being used.

- The Stewart River back channel provides nursery habitat for YOY northern pike, burbot, lake whitefish, as well as unidentified larval fish (progeny of spring spawners). Based on the habitat, the back channel may also provide potential spawning habitat for northern pike in the early spring. Future research will include a spring survey of the channel.

- Three years of aerial chum spawning surveys have indicated that spawning occurs annually in the Yukon River, and when conditions allow (i.e., wetted side channels), they have also been observed spawning in the Stewart River.

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APPENDIX A. SITE WATER QUALITY DATA

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Table A-1. In-situ water quality parameters from 2018 Coffee Gold Project fieldwork.

Field ID	Steam Name	Location	Sampling Date	Temperature (°C)	Dissolved Oxygen		pH	Conductivity (SPC; uS/cm)	Turbidity (NTU's)
					(%)	(mg/L)			
SR_RBD	Stewart River	Proposed Barge Landing	11 July 2018	14.8	72.0	7.25	8.23	334.7	-
SR-BC	Stewart River	Proposed Barge Landing	11 July 2018	11.2	41.1	4.50	7.31	394.0	-
YR BL RL AUG	Yukon River	Proposed Barge Landing	9 August 2018	9.6	86.5	9.87	7.41	250.7	20.5
YR BL RR AUG	Yukon River	Proposed Barge Landing	9 August 2018	14.4	84.9	8.66	7.54	397.2	27.2
HF-MZ-1	Halfway Creek	Mixing Zone	12 July 2018	10.6	88.4	10.00	8.04	204.5	-
HF-MZ-2	Halfway Creek	Mixing Zone	12 July 2018	12.5	83.7	8.90	8.09	195.6	-
HF-MZ-3	Halfway Creek	Mixing Zone	12 July 2018	13.8	87.6	9.04	8.21	191.5	-
YR-MZ	Yukon River	Yukon River Upstream of Halfway Creek Mixing Zone	12 July 2018	14.0	85.5	8.70	8.20	190.5	-
SR-BC-5	Stewart River	Back Channel	12 July 2018	8.9	55.7	6.45	7.35	449.4	-
SR-BC-6	Stewart River	Back Channel	12 July 2018	10.0	53.1	5.99	7.37	463.9	-
SR-BC-7	Stewart River	Back Channel	12 July 2018	10.5	45.0	5.0	7.15	468.7	-
SR-BC-8	Stewart River	Back Channel	12 July 2018	7.7	22.0	2.63	7.09	577.6	-
SR-BC-9	Stewart River	Back Channel	12 July 2018	7.0	28.8	3.48	7.05	484.7	-
SR-BC-10	Stewart River	Back Channel	12 July 2018	8.2	34.7	4.38	7.12	474.9	-
SR-LB	Stewart River	Proposed Barge Landing	12 July 2018	14.3	87.7	8.97	8.25	332.8	-
YT24-MZ-1	YT24 Creek	Mixing Zone	13 July 2018	13.6	70.2	7.36	8.17	190.5	-
YT24-MZ-2	YT24 Creek	Mixing Zone	13 July 2018	13.6	69.3	7.22	8.16	191.4	-
YT24-MZ-3	YT24 Creek	Mixing Zone	13 July 2018	13.7	68.6	7.21	8.20	191.0	-
YT24-MZ-4	YT24 Creek	Mixing Zone	13 July 2018	13.7	69.8	7.24	8.22	190.9	-
YR-MZ-4	Yukon River	Yukon River Upstream of YT24 Creek Mixing Zone	13 July 2018	13.9	68.9	7.15	8.23	190.7	-
YR-MZ-5	Yukon River	Yukon River Upstream of YT24 Creek Mixing Zone	13 July 2018	13.9	72.0	7.45	8.23	190.8	-
YR-MZ-6	Yukon River	Yukon River Upstream of YT24 Creek Mixing Zone	13 July 2018	14.0	70.9	7.29	8.24	190.9	-

Field ID	Steam Name	Location	Sampling Date	Temperature (°C)	Dissolved Oxygen		pH	Conductivity (SPC; uS/cm)	Turbidity (NTU's)
					(%)	(mg/L)			
YR-MZ-7	Yukon River	Yukon River Upstream of YT24 Creek Mixing Zone	13 July 2018	13.8	71.8	7.44	8.24	191.6	-
YR BL RR AUG-H4	Yukon River	Proposed Barge Landing	9 August 2018	14.4	84.9	8.66	7.54	397.2	27.2
YR-BL-LB-E2	Yukon River	Proposed Barge Landing	14 August 2018	14.4	88.6	9.04	8.25	185.9	-
YR-BL-BC-E1	Yukon River	Back Channel	14 August 2018	12.9	20.2	2.13	7.40	504.6	
YR-BL-BC-E2	Yukon River	Back Channel	14 August 2018	12.7	30.0	3.19	7.50	510.3	-
YR MZC1 AUG HF	Yukon River	Yukon River Upstream of Halfway Creek Mixing Zone	8 August 2018	13.1	76.3	8.08	7.14	285.7	23.6
HF-MZ-AUG-H1	Halfway Creek	Mixing Zone	8 August 2018	4.0	87.0	11.52	7.31	164.3	36.1
HF-MZ-AUG-H2	Halfway Creek	Mixing Zone	8 August 2018	9.0	80.5	9.18	7.29	232.1	21.8
HF-MZ-AUG-H3	Halfway Creek	Mixing Zone	8 August 2018	10.2	83.6	9.31	7.44	251.0	25.0
HF-MZ-AUG-H4	Halfway Creek	Mixing Zone	8 August 2018	10.9	85.5	9.40	7.52	254.4	28.5
HF-MZ-AUG-H5	Halfway Creek	Mixing Zone	8 August 2018	10.9	85.1	9.36	7.54	253.3	-
HF-MZ-AUG-H6	Halfway Creek	Mixing Zone	8 August 2018	11.0	85.4	9.40	7.55	253.2	-
YR-BL-LB	Yukon River	Proposed Barge Landing	14 July 2018	14.4	88.6	9.04	8.25	185.9	-
YR-BL-RB	Yukon River	Proposed Barge Landing	11 July 2018	15.6	68.8	6.82	8.25	229.7	-
YR-CC-BL	Yukon River	Active Barge Landing	11 July 2018	15.1	70.2	7.09	8.20	188.4	-
YT24 MZ AUG-H1	YT24 Creek	Mixing Zone	9 August 2018	9.3	88.9	9.96	7.54	274.4	18.43
YT24 MZ AUG-H2	YT24 Creek	Mixing Zone	9 August 2018	10.7	90.9	9.87	7.61	286.9	15.88
YT24 MZ AUG-H3	YT24 Creek	Mixing Zone	9 August 2018	12.4	84.0	8.81	7.51	207.2	16.37
YT24 MZ AUG-H4	YT24 Creek	Mixing Zone	9 August 2018	12.8	82.1	8.73	7.59	307.9	14.69
YR YT24 MZ AUG-H1	Yukon River	YT24 Creek Mixing Zone	9 August 2018	12.4	90.1	9.61	7.68	300.0	16.09
YR AX YT24 MZ	Yukon River	Across from YT24 Creek mixing zone	9 August 2018	14.0	86.6	8.92	7.82	317.5	-

Field ID	Steam Name	Location	Sampling Date	Temperature (°C)	Dissolved Oxygen		pH	Conductivity (SPC; uS/cm)	Turbidity (NTU's)
					(%)	(mg/L)			
CF3.9 AUG BS (new: CC5.6)	Coffee Creek	CC5.6	16 August 2018	4.5	-	-	7.72	160.0	-
CF3.9 MNO TRAPS (new: CC5.6)	Coffee Creek	CC5.6	15 August 2018	4.5	-	-	7.72	160.0	-
YT24_0.05EF (new: YT0.05)	YT24 Creek	YT0.05	13 July 2018	6.4	75.0	9.32	7.95	272.5	-
YT24_0.6EF (new: YT0.6)	YT24 Creek	YT0.06	13 July 2018	6.6	74.0	9.09	8.05	279.7	-
HF0.2_EF (new: HC0.2)	Halfway Creek	HC0.2	13 July 2018	6.7	64.7	7.90	7.88	238.3	-
HF0.2 (new: HC0.2)	Halfway Creek	HC0.2	12 August 2018	3.7	-	-	6.97	160.0	-
HF0.1 (new: HC0.1)	Halfway Creek	HC0.1	15 August 2018	2.25	-	-	7.97	190.0	-
PK0.6 (new: ICA0.9)	Independence Creek Tributary A	ICA0.9	16 August 2018	3.5	-	-	7.3	30.0	-
HF0.6 (new: HC0.6)	Halfway Creek	HC0.6	12 August 2018	4.1	-	-	6.79	170.0	-
HF1.0 (new: HC1.1)	Halfway Creek	HC1.1	12 August 2018	3.25	-	-	8.07	160.0	-
YT24 1.0 (new: YT1.0)	YT24 Creek	YT1.0	12 August 2018	4.6	-	-	8.00	160.0	-
HC6.3 (new: HC6.7)	Halfway Creek	HC6.7	10 August 2018	4.2	-	-	-	80.0	-
HC2.0 (new: HC2.2)	Halfway Creek	HC2.2	10 August 2018	4.7	-	-	-	130.0	-
ID11.2 (new: IC15.6)	Independence Creek	IC15.6	17 August 2018	4.0	-	-	7.88	120.0	-

Field ID	Steam Name	Location	Sampling Date	Temperature (°C)	Dissolved Oxygen		pH	Conductivity (SPC; uS/cm)	Turbidity (NTU's)
					(%)	(mg/L)			
CH0.2 (new: ICB0.2)	Independence Creek Tributary B	ICB0.2	17 August 2018	4.5	-	-	7.93	110.0	-
CH0.6 (new: ICB0.6)	Independence Creek Tributary B	ICB0.6	17 August 2018	5.0	-	-	7.94	110.0	-
PK0.2 (new: ICA0.4)	Independence Creek Tributary A	ICA0.4	17 August 2018	5.8	-	-	8.60	30.0	-

APPENDIX B. EDNA RESULTS

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Table B-1. 2018 eDNA sampling results in the Coffee Gold Project.

Site ID	2018 report name	Sample replicate	Collection date	Collection Time	Zone	Easting	Northing	Amplifiable DNA Frequency	Amplifiable DNA Call	THAR Frequency	THAR Lab Call	THAR Biol Call	ONTS Frequency	ONTS Call	ONTS Call	Filter start time	Filter end time	Filtering time (calc)	Drying time end	Total drying time	Sample Contents
YT240.1	YT0.1	A	10-Aug-18	9:30	07V	589623	6979164	0/4	N	-	-	-	-	-	-	16:58	17:01	0:03	0.7125	0.003472	Site Water
YT240.1	YT0.1	B	10-Aug-18	9:30	07V	589623	6979164	0/4	N	-	-	-	-	-	-	16:59	17:01	0:02	0.7125	0.003472	Site Water
YT240.1	YT0.1	C	10-Aug-18	9:30	07V	589623	6979164	0/4	N	-	-	-	-	-	-	17:09	17:13	0:04	0.72083333	0.003472	Site Water
YT240.1	YT0.1	A	10-Aug-18	10:30	07V	588887	6978648	0/4	N	-	-	-	-	-	-	17:21	17:24	0:03	0.72847222	0.003472	Site Water
YT240.1	YT0.1	B	10-Aug-18	10:30	07V	588887	6978648	1/4	N	-	-	-	-	-	-	17:22	17:24	0:02	0.72847222	0.003472	Site Water
YT240.1	YT0.1	C	10-Aug-18	10:30	07V	588887	6978648	4/4	Y	0/8	N	N	0/8	N	N	17:32	17:35	0:03	0.73541667	0.002778	Site Water
HF2.0	HC2.2	A	10-Aug-18	12:30	07V	586907	6979693	4/4	Y	0/8	N	N	0/8	N	N	17:41	17:43	0:02	0.74097222	0.002778	Site Water
HF2.0	HC2.2	B	10-Aug-18	12:30	07V	586907	6979693	4/4	Y	0/8	N	N	0/8	N	N	17:41	17:44	0:03	0.74166667	0.002778	Site Water
HF2.0	HC2.2	C	10-Aug-18	12:30	07V	586907	6979693	4/4	Y	0/8	N	N	0/8	N	N	17:50	17:52	0:02	0.74722222	0.002778	Site Water
HF0.2	HC0.3	A	10-Aug-18	11:45	07V	588697	6980420	4/4	Y	0/8	N	N	0/8	N	N	17:58	18:01	0:03	0.75347222	0.002778	Site Water
HF0.2	HC0.3	B	10-Aug-18	11:45	07V	588697	6980420	0/4	N	-	-	-	-	-	-	17:59	18:01	0:02	0.75416667	0.003472	Site Water
HF0.2	HC0.3	C	10-Aug-18	11:45	07V	588697	6980420	0/4	N	-	-	-	-	-	-	18:09	18:11	0:02	0.76041667	0.002778	Site Water
PK3.2	ICA4.0	A	10-Aug-18	15:15	07V	575226	6976041	4/4	Y	0/8	N	N	0/8	N	N	18:17	18:32	0:15	0.77569444	0.003472	Site Water
PK3.2	ICA4.0	B	10-Aug-18	15:15	07V	575226	6976041	4/4	Y	0/8	N	N	0/8	N	N	18:18	18:31	0:13	0.775	0.003472	Site Water
PK3.2	ICA4.0	C	10-Aug-18	15:15	07V	575226	6976041	4/4	Y	0/8	N	N	0/8	N	N	18:37	18:56	0:19	0.79236111	0.003472	Site Water
PK0.2	ICA0.4	A	10-Aug-18	14:15	07V	572852	6978091	4/4	Y	4/8	Y	Y	0/8	N	N	19:53	21:12	1:19	0.88819444	0.004861	Site Water
PK0.2	ICA0.4	B	10-Aug-18	14:15	07V	572852	6978091	4/4	Y	6/8	Y	Y	0/8	N	N	19:05	20:04	0:59	0.84027778	0.004167	Site Water
PK0.2	ICA0.4	C	10-Aug-18	14:15	07V	572852	6978091	4/4	Y	4/8	Y	Y	0/8	N	N	18:42	19:45	1:03	0.82638889	0.003472	Site Water
CH3.9	ICB4.7	A	10-Aug-18	13:30	07V	573675	6973487	4/4	Y	8/8	Y	Y	0/8	N	N	18:17	18:32	0:15	0.77569444	0.003472	Site Water
CH3.9	ICB4.7	B	10-Aug-18	13:30	07V	573675	6973487	4/4	Y	8/8	Y	Y	0/8	N	N	18:18	18:31	0:13	0.775	0.003472	Site Water
CH3.9	ICB4.7	C	10-Aug-18	13:30	07V	573675	6973487	4/4	Y	8/8	Y	Y	0/8	N	N	18:37	18:56	0:19	0.79236111	0.003472	Site Water
CH0.2	ICB0.2	A	10-Aug-18	13:10	07V	572253	6976903	4/4	Y	8/8	Y	Y	0/8	N	N	19:53	21:12	1:19	0.88819444	0.004861	Site Water
CH0.2	ICB0.2	B	10-Aug-18	13:10	07V	572253	6976903	4/4	Y	8/8	Y	Y	0/8	N	N	19:05	20:04	0:59	0.84027778	0.004167	Site Water
CH0.2	ICB0.2	C	10-Aug-18	13:10	07V	572253	6976903	4/4	Y	8/8	Y	Y	0/8	N	N	18:42	19:45	1:03	0.82638889	0.003472	Site Water
JP1.0	DW1.0	A	11-Aug-18	13:45	07V	573579	6973516	0/4	N	-	-	-	-	-	-	16:32	16:34	0:02	0.69236111	0.002083	Distilled water
JP1.0	DW1.0	B	11-Aug-18	13:45	07V	573579	6973516	0/4	N	-	-	-	-	-	-	16:32	16:35	0:03	0.69444444	0.003472	Distilled water

Site ID	2018 report name	Sample replicate	Collection date	Collection Time	Zone	Easting	Northing	Amplifiable DNA Frequency	Amplifiable DNA Call	THAR Frequency	THAR Lab Call	THAR Biol Call	ONTS Frequency	ONTS Call	ONTS Call	Filter start time	Filter end time	Filtering time (calc)	Drying time end	Total drying time	Sample Contents
JP1.0	DW1.0	C	11-Aug-18	13:45	07V	573579	6973516	0/4	N	-	-	-	-	-	-	16:48	16:51	0:03	0.70902778	0.006944	Distilled water
DM2.0	DM2.2	A	11-Aug-18	11:00	07V	585575	6982126	4/4	Y	0/8	N	N	0/8	N	N	17:01	17:04	0:03	0.71527778	0.004167	Site Water
DM2.0	DM2.2	B	11-Aug-18	11:00	07V	585575	6982126	3/4	Y	0/8	N	N	0/8	N	N	17:02	17:05	0:03	0.71527778	0.003472	Site Water
DM2.0	DM2.2	C	11-Aug-18	11:00	07V	585575	6982126	4/4	Y	0/8	N	N	0/8	N	N	17:16	17:18	0:02	0.72430556	0.003472	Site Water
DM0.2	DM0.2	A	11-Aug-18	9:45	07V	586910	6983448	4/4	Y	5/8	Y	Y	0/8	N	N	17:27	17:30	0:03	0.73333333	0.004167	Site Water
DM0.2	DM0.2	B	11-Aug-18	9:45	07V	586910	6983448	4/4	Y	7/8	Y	Y	0/8	N	N	17:27	17:30	0:03	0.73402778	0.004861	Site Water
DM0.2	DM0.2	C	11-Aug-18	9:45	07V	586910	6983448	4/4	Y	3/8	Y	Y	0/8	N	N	17:41	17:43	0:02	0.74305556	0.004861	Site Water
KT3.0	KT3.4	A	11-Aug-18	13:00	07V	576774	6976956	4/4	Y	0/8	N	N	0/8	N	N	18:04	18:07	0:03	0.75833333	0.003472	Site Water
KT3.0	KT3.4	B	11-Aug-18	13:00	07V	576774	6976956	4/4	Y	0/8	N	N	0/8	N	N	18:05	18:07	0:02	0.75902778	0.004167	Site Water
KT3.0	KT3.4	C	11-Aug-18	13:00	07V	576774	6976956	4/4	Y	0/8	N	N	0/8	N	N	18:19	18:21	0:02	0.76875	0.004167	Site Water
KT0.2	KT0.2	A	11-Aug-18	12:00	07V	575323	6979414	4/4	Y	6/8	Y	Y	0/8	N	N	18:31	18:34	0:03	0.77708333	0.003472	Site Water
KT0.2	KT0.2	B	11-Aug-18	12:00	07V	575323	6979414	0/4	N	-	-	-	-	-	-	18:31	18:34	0:03	0.77708333	0.003472	Site Water
KT0.2	KT0.2	C	11-Aug-18	12:00	07V	575323	6979414	4/4	Y	1/8	N	Y	0/8	N	N	18:45	18:47	0:02	0.78611111	0.003472	Site Water
JP0.2	DW2.0	A	11-Aug-18	12:30	07V	571781	6976660	0/4	N	-	-	-	-	-	-	18:57	18:59	0:02	0.79861111	0.007639	Distilled water
JP0.2	DW2.0	B	11-Aug-18	12:30	07V	571781	6976660	0/4	N	-	-	-	-	-	-	18:57	18:59	0:02	0.79861111	0.007639	Distilled water
JP0.2	DW2.0	C	11-Aug-18	12:30	07V	571781	6976660	0/4	N	-	-	-	-	-	-	19:11	19:13	0:02	0.80416667	0.003472	Distilled water
ID1.9	IC2.6	A	13-Aug-18	14:00	07V	579451	6983209	4/4	Y	8/8	Y	Y	7/8	Y	Y	19:29	19:32	0:03	0.81736111	0.003472	Site Water
ID1.9	IC2.6	B	13-Aug-18	14:00	07V	579451	6983209	4/4	Y	8/8	Y	Y	6/8	Y	Y	19:23	19:25	0:02	0.81319444	0.004167	Site Water
ID1.9	IC2.6	C	13-Aug-18	14:00	07V	579451	6983209	4/4	Y	8/8	Y	Y	7/8	Y	Y	19:20	19:22	0:02	0.81111111	0.004167	Site Water

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Table C-1. Fish collection data from 2018 Coffee Gold Project fieldwork.

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
SR_RBD2_18	Stewart River	11/07/2018	BS	CCG	45	0.7	RG
SR_RBD2_18	Stewart River	11/07/2018	BS	CCG	45	1.1	RG
SR_RBD2_18	Stewart River	11/07/2018	BS	LSU	51	1.2	RG
SR-RBD2	Stewart River	11/07/2018	BS	RW	179	67.9	RG
SR-RBD2	Stewart River	11/07/2018	BS	LSU	110	13.1	RG
SR-RBD2	Stewart River	11/07/2018	BS	LSU	110	NA	RG
SR-RBD2	Stewart River	11/07/2018	BS	LSU	87	7.3	RG
SR-RBD2	Stewart River	11/07/2018	BS	CCG	45	1.0	RG
SR-RBD2	Stewart River	11/07/2018	BS	CCG	37	0.6	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LC	95	9.9	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LSU	97	9.7	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	CCG	61	2.4	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LC	67	3.3	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LC	87	7.0	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LSU	51	1.3	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LC	90	8.6	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LSU	114	13.8	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LSU	89	7.3	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LSU	117	15.0	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LC	99	9.0	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LSU	127	23.3	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LSU	105	13.0	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LC	93	7.9	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LSU	107	12.6	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LSU	98	9.0	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	LSU	159	37.9	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	CCG	57	2.0	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	CCG	46	0.7	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	CCG	48	0.8	RG
SR_RDB2_18	Stewart River	11/07/2018	BS	CCG	40	0.6	RG
SR-BC-1	Stewart River	11/07/2018	BS	NP	71	3.3	RG
SR-BC-1	Stewart River	11/07/2018	BS	NP	7	3.0	RG
SR-BC-1	Stewart River	11/07/2018	BS	NP	65	2.8	RG
SR-BC-1	Stewart River	11/07/2018	BS	NP	58	1.6	RG
SR-BC-1	Stewart River	11/07/2018	BS	NP	66	2.4	RG
SR-BC-1	Stewart River	11/07/2018	BS	BB	31	0.2	RG
SR-BC-1	Stewart River	11/07/2018	BS	BB	36	0.5	RG
SR-BC-1	Stewart River	11/07/2018	BS	BB	44	0.8	RG
SR-BC-1	Stewart River	11/07/2018	BS	BB	35	0.5	RG
SR-BC-1	Stewart River	11/07/2018	BS	BB	27	0.3	RG
SR-BC-1	Stewart River	11/07/2018	BS	BB	31	0.3	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
SR-BC-2	Stewart River	11/07/2018	BS	NP	30	0.2	KD?
SR-BC-2	Stewart River	11/07/2018	BS	BB	32	0.4	RG
YR-BL-RB-S	Yukon River	11/07/2018	BS	CH	77	4.3	RG
YR-BL-RB-S	Yukon River	11/07/2018	BS	CCG	40	0.9	RG
YR-BL-RB-S3	Yukon River	11/07/2018	BS	LSU	242	181.7	RG
YR-BL-RB-S3	Yukon River	11/07/2018	BS	LW	125	36.1	RG
YR-BL-RB-S3	Yukon River	11/07/2018	BS	LSU	103	12.3	RG
YR-BL-RB-S3	Yukon River	11/07/2018	BS	CH	65	2.4	RG
YR-BL-RB-S3	Yukon River	11/07/2018	BS	CH	54	1.7	RG
YR-BL-RB-S3	Yukon River	11/07/2018	BS	CH	54	1.7	RG
YR-BL-RB-S3	Yukon River	11/07/2018	BS	CH	55	1.9	RG
YR-BL-RB-S3	Yukon River	11/07/2018	BS	CCG	32	0.4	RG
YR-BL-RB-E4	Yukon River	11/07/2018	BS	CH	64	2.9	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	CH	60	2.1	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	CH	59	2.0	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	CH	50	1.6	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	CH	73	4.3	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	RW	42	0.6	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	CH	63	2.8	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	CH	64	2.1	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	CH	58	1.9	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	CH	63	2.4	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	RW	41	0.5	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	CH	NA	NA	RG
YR-CC-BL-S1	Yukon River	11/07/2018	BS	CH	NA	NA	RG
YR-CC-BL-S2	Yukon River	11/07/2018	BS	LW	64	1.8	RG
YR-CC-BL-S2	Yukon River	11/07/2018	BS	LW	58	1.8	RG
YR-CC-BL-S2	Yukon River	11/07/2018	BS	LW	64	2.4	RG
YR-CC-BL-S2	Yukon River	11/07/2018	BS	LW	59	2.4	RG
YR-CC-BL-S3	Yukon River	11/07/2018	BS	RW	39	0.5	RG
YR-CC-BL-S3	Yukon River	11/07/2018	BS	CH	58	2.0	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	GR	221	120.0	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	GR	195	76.0	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	GR	133	24.0	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	GR	123	17.1	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	CCG	76	4.7	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	GR	134	21.6	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	CH	68	3.2	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	CH	63	2.7	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	CH	65	2.8	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	CH	68	3.4	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	CH	57	1.9	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
HF-MZ-1	Halfway Creek	12/07/2018	BS	CH	66	3.2	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	CH	64	2.9	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	CH	64	2.6	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	CH	62	2.7	RG
HF-MZ-1	Halfway Creek	12/07/2018	BS	CH	67	3.2	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	RW	40	0.5	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	CH	59	2.2	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	CH	54	1.5	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	CH	65	2.9	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	CH	65	3.0	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	CCG	56	1.7	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	CH	57	2.1	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	CH	59	2.4	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	AL	57	0.3	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	CH	63	2.4	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	CH	60	2.3	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	CH	51	1.2	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	CH	58	1.8	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	RW	42	0.5	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	LW	34	0.4	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	RW	32	0.2	RG
HF-MZ-2	Halfway Creek	12/07/2018	BS	LW	24	NA	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	RW	49	0.6	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	CH	67	3.3	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	CH	66	2.9	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	CH	53	1.4	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	CH	58	2.2	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	CH	60	2.1	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	CH	61	2.3	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	CH	57	1.9	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	CH	59	2.2	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	CH	60	2.2	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	CH	64	2.8	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	CCG	40	0.7	RG
HF-MZ-3	Halfway Creek	12/07/2018	BS	AL	56	0.3	RG
YR-MZ-1	Yukon River	12/07/2018	BS	LSU	80	5.2	RG
YR-MZ-1	Yukon River	12/07/2018	BS	CCG	72	3.7	RG
YR-MZ-1	Yukon River	12/07/2018	BS	CCG	62	2.0	RG
YR-MZ-1	Yukon River	12/07/2018	BS	CH	59	2.1	RG
YR-MZ-2	Yukon River	12/07/2018	BS	LSU	86	6.5	RG
YR-MZ-2	Yukon River	12/07/2018	BS	CCG	40	0.8	RG
YR-MZ-2	Yukon River	12/07/2018	BS	CCG	36	0.4	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
YR-MZ-2	Yukon River	12/07/2018	BS	CH	48	1.2	RG
YR-MZ-2	Yukon River	12/07/2018	BS	RW	37	0.4	RG
YR-MZ-3	Yukon River	12/07/2018	BS	LSU	147	36.0	RG
YR-MZ-3	Yukon River	12/07/2018	BS	NP	75	2.9	RG
YR-MZ-3	Yukon River	12/07/2018	BS	NP	68	2.0	RG
YR-MZ-3	Yukon River	12/07/2018	BS	LSU	48	1.0	RG
YR-MZ-3	Yukon River	12/07/2018	BS	RW	43	0.5	RG
YR-MZ-3	Yukon River	12/07/2018	BS	LSU	54	1.4	RG
YR-MZ-3	Yukon River	12/07/2018	BS	LSU	52	1.2	RG
YR-MZ-3	Yukon River	12/07/2018	BS	RW	40	0.5	RG
YR-MZ-3	Yukon River	12/07/2018	BS	RW	36	0.5	RG
YR-MZ-3	Yukon River	12/07/2018	BS	RW	45	0.6	RG
YR-MZ-3	Yukon River	12/07/2018	BS	RW	28	0.3	RG
YR-MZ-3	Yukon River	12/07/2018	BS	CCG	42	0.7	RG
SR-BC-5	Stewart River	12/07/2018	BS	BB	38	0.2	RG
SR-BC-5	Stewart River	12/07/2018	BS	BB	35	0.3	RG
SR-BC-5	Stewart River	12/07/2018	BS	NP	73	2.7	RG
SR-BC-5	Stewart River	12/07/2018	BS	NP	24	0.1	KD
SR-BC-7	Stewart River	12/07/2018	BS	NP	30	0.2	RG
SR-BC-7	Stewart River	12/07/2018	BS	BB	32	0.3	RG
SR-BC-7	Stewart River	12/07/2018	BS	NP	34	0.3	RG
SR-BC-7	Stewart River	12/07/2018	BS	NP	28	0.2	RG
SR-BC-7	Stewart River	12/07/2018	BS	BB	33	0.3	RG
SR-BC-7	Stewart River	12/07/2018	BS	BB	27	0.2	RG
SR-BC-8	Stewart River	12/07/2018	BS	NP	40	0.5	RG
SR-BC-8	Stewart River	12/07/2018	BS	NP	46	0.7	RG
SR-BC-8	Stewart River	12/07/2018	BS	NP	44	0.6	RG
SR-BC-8	Stewart River	12/07/2018	BS	NP	36	0.4	RG
SR-BC-10	Stewart River	12/07/2018	BS	LW	41	1.0	RG
SR-BC-10	Stewart River	12/07/2018	BS	LW	40	0.5	RG
SR-BC-10	Stewart River	12/07/2018	BS	LW	52	1.1	RG
SR-BC-10	Stewart River	12/07/2018	BS	LW	53	0.9	RG
SR-BC-10	Stewart River	12/07/2018	BS	LW	54	0.8	RG
SR-BC-10	Stewart River	12/07/2018	BS	LW	41	0.8	RG
SR-BC-10	Stewart River	12/07/2018	BS	LW	48	1.0	RG
SR-BC-10	Stewart River	12/07/2018	BS	LW	45	0.8	RG
SR-BC-10	Stewart River	12/07/2018	BS	LW	44	0.9	RG
SR-BC-10	Stewart River	12/07/2018	BS	LW	34	0.4	RG
SR-LB-1	Stewart River	12/07/2018	BS	LSU	119	17.6	RG
SR-LB-1	Stewart River	12/07/2018	BS	GR	99	9.2	RG
SR-LB-1	Stewart River	12/07/2018	BS	CH	60	2.6	RG
SR-LB-1	Stewart River	12/07/2018	BS	CH	72	3.6	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
SR-LB-1	Stewart River	12/07/2018	BS	CH	75	4.5	RG
SR-LB-1	Stewart River	12/07/2018	BS	CH	69	3.4	RG
SR-LB-1	Stewart River	12/07/2018	BS	LC	75	4.0	RG
SR-LB-1	Stewart River	12/07/2018	BS	CH	68	3.3	RG
SR-LB-2	Stewart River	12/07/2018	BS	LSU	84	5.3	RG
SR-LB-2	Stewart River	12/07/2018	BS	CH	58	2.1	RG
SR-LB-2	Stewart River	12/07/2018	BS	LSU	75	3.8	RG
SR-LB-2	Stewart River	12/07/2018	BS	CH	57	2.4	RG
SR-LB-2	Stewart River	12/07/2018	BS	CH	70	3.8	RG
SR-LB-3	Stewart River	12/07/2018	BS	CH	65	3.2	RG
SR-LB-3	Stewart River	12/07/2018	BS	CH	75	4.5	RG
SR-LB-3	Stewart River	12/07/2018	BS	CH	75	4.9	RG
SR-LB-3	Stewart River	12/07/2018	BS	CH	67	3.5	RG
SR-LB-3	Stewart River	12/07/2018	BS	CH	68	3.2	RG
SR-LB-3	Stewart River	12/07/2018	BS	CH	71	4.2	RG
SR-LB-3	Stewart River	12/07/2018	BS	CH	67	3.4	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	LW	71	3.0	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	CH	76	4.4	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	CH	68	3.2	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	CH	62	2.7	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	CH	58	2.0	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	CH	66	3.0	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	CH	68	3.0	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	CH	65	3.4	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	CH	67	3.0	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	CH	57	1.9	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	CH	68	3.3	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	RW	37	0.4	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	LW	64	2.3	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	LW	45	0.7	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	CCG	39	0.4	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	AL	60	0.4	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	LSU	58	1.5	RG
YT24-MZ-1	YT-24 Creek	13/07/2018	BS	LSU	54	1.3	RG
YT24-MZ-3	YT-24 Creek	13/07/2018	BS	CH	65	3.0	RG
YT24-MZ-3	YT-24 Creek	13/07/2018	BS	CH	68	3.9	RG
YT24-MZ-3	YT-24 Creek	13/07/2018	BS	CH	59	1.8	RG
YT24-MZ-3	YT-24 Creek	13/07/2018	BS	CH	60	2.2	RG
YT24-MZ-3	YT-24 Creek	13/07/2018	BS	CH	61	2.3	RG
YT24-MZ-3	YT-24 Creek	13/07/2018	BS	CH	54	1.5	RG
YT24-MZ-3	YT-24 Creek	13/07/2018	BS	CH	55	2.0	RG
YT24-MZ-4	YT-24 Creek	13/07/2018	BS	CH	60	2.2	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
YT24-MZ-4	YT-24 Creek	13/07/2018	BS	CH	63	2.2	RG
YT24-MZ-4	YT-24 Creek	13/07/2018	BS	CH	63	2.6	RG
YT24-MZ-4	YT-24 Creek	13/07/2018	BS	CH	65	3.1	RG
YR-MZ-5	Yukon River	13/07/2018	BS	CH	68	3.0	RG
YR-MZ-7	Yukon River	13/07/2018	BS	IN	670	NA	RG
YR-MZ-7	Yukon River	13/07/2018	BS	CH	57	1.8	RG
YR-MZ-7	Yukon River	13/07/2018	BS	CH	70	2.7	RG
YR-MZ-7	Yukon River	13/07/2018	BS	CH	58	2.0	RG
YR-MZ-7	Yukon River	13/07/2018	BS	CH	60	2.5	RG
YR-MZ-7	Yukon River	13/07/2018	BS	CH	62	2.2	RG
YR-MZ-7	Yukon River	13/07/2018	BS	CH	66	3.0	RG
YR-MZ-7	Yukon River	13/07/2018	BS	CH	62	2.5	RG
YR-MZ-7	Yukon River	13/07/2018	BS	CH	67	3.1	RG
YR-MZ-7	Yukon River	13/07/2018	BS	CH	60	2.3	RG
YR-MZ-7	Yukon River	13/07/2018	BS	CH	54	1.7	RG
YR-MZ-7	Yukon River	13/07/2018	BS	GR	200	92.0	RG
YR-MZ-7	Yukon River	13/07/2018	BS	LSU	136	32.0	RG
YR-MZ-7	Yukon River	13/07/2018	BS	LSU	117	15.6	RG
YR-BL-LB-S1	Yukon River	14/07/2018	BS	CCG	70	3.5	RG
YR-BL-LB-S1	Yukon River	14/07/2018	BS	CH	59	2.4	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CH	64	2.5	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	RW	41	0.6	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CH	70	3.8	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CH	59	2.2	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CH	68	3.7	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CCG	58	1.8	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CH	71	4.1	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CH	65	2.9	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CH	57	2.1	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CH	63	2.7	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CH	60	2.3	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CH	51	1.3	RG
YR-BL-LB-E3	Yukon River	14/07/2018	BS	CH	57	2.1	RG
YT24_0.05EF (new: YT240.05)	YT-24 Creek	13/07/2018	EF	GR	176	57.3	RG
HF0.2_EF (new: HC0.3)	Halfway Creek	13/07/2018	EF	GR	342	108.0	RG
YR MZC AUG HF-H1	Yukon River	08/08/2018	BS	LW	73	3.0	RG
YR MZC AUG HF-H1	Yukon River	08/08/2018	BS	CH	75	4.5	RG
YR MZC AUG HF-H1	Yukon River	08/08/2018	BS	LW	63	2.0	RG
YR MZC AUG HF-H1	Yukon River	08/08/2018	BS	CH	74	4.5	RG
YR MZC AUG HF-H2	Yukon River	08/08/2018	BS	NP	145	20.5	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
YR MZC AUG HF-H2	Yukon River	08/08/2018	BS	NP	400	868.0	RG
YR MZC AUG HF-H2	Yukon River	08/08/2018	BS	CCG	32	0.4	RG
YR MZC AUG HF-H2	Yukon River	08/08/2018	BS	CCG	30	<1.0	RG
YR MZC AUG HF-H2	Yukon River	08/08/2018	BS	CCG	25	<1.0	RG
YR MZC AUG HF-H3	Yukon River	08/08/2018	BS	LSU	132	24.5	RG
YR MZC AUG HF-H3	Yukon River	08/08/2018	BS	CCG	66	3.0	RG
YR MZC AUG HF-H3	Yukon River	08/08/2018	BS	CH	78	5.5	RG
YR MZC AUG HF-H3	Yukon River	08/08/2018	BS	CCG	32	<1.0	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	CH	77	4.5	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	GR	150	31.0	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	GR	60	2.0	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	CH	68	NA	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	CH	70	NA	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	RW	75	3.0	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	CH	72	3.5	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	CH	70	3.0	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	CCG	70	NA	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	RW	45	1.0	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	CCG	42	0.5	RG
HF-MZ-AUG-H1	Halfway Creek	08/08/2018	BS	CCG	32	4.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	RW	57	2.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CH	80	5.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CH	75	4.5	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	GR	125	16.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CH	88	8.5	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CH	75	4.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CH	77	4.5	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CH	68	3.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	RW	58	1.5	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CH	86	6.5	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CH	80	6.5	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CH	73	4.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	GR	145	29.5	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	RW	60	1.5	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CH	70	3.5	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CH	74	4.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	RW	60	2.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	GR	110	12.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	RW	69	3.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	RW	62	2.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CCG	82	5.5	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CCG	76	5.5	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	RW	58	1.5	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CCG	62	3.0	RG
HF-MZ-AUG-H2	Halfway Creek	08/08/2018	BS	CCG	50	1.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	RW	56	1.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CCG	48	NA	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	RW	68	2.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CH	75	4.0	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	RW	65	2.0	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	RW	56	1.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	GR	63	2.0	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	RW	30	1.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	RW	58	1.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CH	75	4.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CH	84	5.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CH	72	4.0	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CH	79	5.0	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	RW	50	1.0	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CH	76	4.0	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CH	77	4.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CH	77	5.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CH	72	4.0	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	RW	66	2.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CH	65	3.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	CH	82	6.0	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	RW	68	2.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	RW	60	1.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	RW	58	1.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	AL	90	1.0	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	LSU	180	59.5	RG
HF-MZ-AUG-H3	Halfway Creek	08/08/2018	BS	IN	570	NA	RG
HF MZ AUG H4	Halfway Creek	08/08/2018	BS	GR	230	148.0	RG
HF MZ AUG H4	Halfway Creek	08/08/2018	BS	CH	70	3.5	RG
HF MZ AUG H4	Halfway Creek	08/08/2018	BS	CH	75	4.0	RG
HF MZ AUG H4	Halfway Creek	08/08/2018	BS	RW	65	2.0	RG
HF MZ AUG H4	Halfway Creek	08/08/2018	BS	CCG	70	2.5	RG
HF MZ AUG H5	Halfway Creek	08/08/2018	BS	RW	115	11.0	RG
HF MZ AUG H5	Halfway Creek	08/08/2018	BS	CH	77	4.0	RG
HF MZ AUG H5	Halfway Creek	08/08/2018	BS	RW	65	1.5	RG
HF MZ AUG H5	Halfway Creek	08/08/2018	BS	RW	63	1.5	RG
HF MZ AUG H5	Halfway Creek	08/08/2018	BS	CCG	60	2.5	RG
HF MZ AUG H5	Halfway Creek	08/08/2018	BS	RW	70	3.0	RG
HF MZ AUG H5	Halfway Creek	08/08/2018	BS	RW	60	2.0	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
HF MZ AUG H5	Halfway Creek	08/08/2018	BS	CH	74	4.5	RG
HF MZ AUG H5	Halfway Creek	08/08/2018	BS	CCG	28	<0.5	RG
HF MZ AUG H6	Halfway Creek	08/08/2018	BS	RW	68	2.0	RG
HF MZ AUG H6	Halfway Creek	08/08/2018	BS	RW	75	3.5	RG
HF MZ AUG H6	Halfway Creek	08/08/2018	BS	RW	68	3.0	RG
HF MZ AUG H6	Halfway Creek	08/08/2018	BS	GR	67	3.0	RG
HF MZ AUG H6	Halfway Creek	08/08/2018	BS	CCG	40	0.5	RG
HF MZ AUG H6	Halfway Creek	08/08/2018	BS	RW	58	1.5	RG
HF MZ AUG H6	Halfway Creek	08/08/2018	BS	CH	65	3.0	RG
HF MZ AUG H6	Halfway Creek	08/08/2018	BS	RW	125	16.0	RG
YR BL AUG H2	Yukon River	09/08/2018	BS	CH	80	5.5	RG
YR BL AUG H2	Yukon River	09/08/2018	BS	CH	77	5.0	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	GR	204	96.5	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	CH	68	3.0	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	GR	64	2.0	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	CH	77	5.0	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	CH	81	5.5	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	CH	74	4.5	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	CH	81	6.5	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	CH	77	5.0	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	CH	78	5.5	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	CH	81	6.5	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	GR	130	23.5	RG
YR BL AUG H3	Yukon River	09/08/2018	BS	GR	140	24.5	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	CH	87	7.5	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	CH	75	4.0	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	GR	130	20.0	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	GR	145	31.5	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	GR	190	70.0	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	CH	72	4.5	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	CH	75	4.0	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	CH	78	5.5	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	CH	73	4.0	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	RW	75	3.5	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	GR	80	4.5	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	CH	77	5.0	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	CCG	62	2.5	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	LSU	72	3.5	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	CH	71	4.0	RG
YR BL AUG H4	Yukon River	09/08/2018	BS	CCG	62	2.0	RG
YR BL RL AUG-H1	Yukon River	09/08/2018	BS	LSU	62	2.5	RG
YR BL RL AUG-H1	Yukon River	09/08/2018	BS	CH	78	5.0	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
YR BL RL AUG-H1	Yukon River	09/08/2018	BS	CH	69	4.0	RG
YR BL RL AUG-H1	Yukon River	09/08/2018	BS	CH	76	5.4	RG
YR BL RL AUG-H1	Yukon River	09/08/2018	BS	CH	73	5.4	RG
YR BL RL AUG-H1	Yukon River	09/08/2018	BS	CH	79	5.0	RG
YR BL RL AUG-H1	Yukon River	09/08/2018	BS	CH	66	3.0	RG
YR BL RL AUG-H1	Yukon River	09/08/2018	BS	CH	70	3.5	RG
YR BL RL AUG-H2	Yukon River	09/08/2018	BS	CH	70	3.5	RG
YR BL RL AUG-H2	Yukon River	09/08/2018	BS	CH	80	5.5	RG
YR BL RL AUG-H2	Yukon River	09/08/2018	BS	CH	65	3.0	RG
YR BL RL AUG-H2	Yukon River	09/08/2018	BS	CCG	57	2.0	RG
YR BL RL AUG-H2	Yukon River	09/08/2018	BS	CCG	42	1.0	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	CH	82	5.0	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	CH	67	3.0	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	GR	77	3.0	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	GR	78	4.5	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	GR	70	3.0	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	RW	54	1.0	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	CCG	50	1.0	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	CCG	40	0.5	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	CCG	35	0.5	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	CCG	25	<0.5	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	CCG	22	<0.5	RG
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	CCG	20	<0.5	KD
YR BL RL AUG-H3	Yukon River	09/08/2018	BS	NP	160	28.0	RG
YT24 MZ AUG-H1	YT-24 Creek	09/08/2018	BS	CH	79	5.0	RG
YT24 MZ AUG-H1	YT-24 Creek	09/08/2018	BS	CH	73	4.5	RG
YT24 MZ AUG-H1	YT-24 Creek	09/08/2018	BS	CH	78	5.0	RG
YT24 MZ AUG-H1	YT-24 Creek	09/08/2018	BS	CH	80	5.5	RG
YT24 MZ AUG-H1	YT-24 Creek	09/08/2018	BS	CH	80	5.5	RG
YT24 MZ AUG-H1	YT-24 Creek	09/08/2018	BS	CH	76	5.0	RG
YT24 MZ AUG-H1	YT-24 Creek	09/08/2018	BS	CCG	64	2.5	RG
YT24 MZ AUG-H2	YT-24 Creek	09/08/2018	BS	CH	78	4.0	RG
YT24 MZ AUG-H2	YT-24 Creek	09/08/2018	BS	CH	77	4.5	RG
YT24 MZ AUG-H2	YT-24 Creek	09/08/2018	BS	CCG	60	2.5	RG
YT24 MZ AUG-H3	YT-24 Creek	09/08/2018	BS	CH	76	3.0	RG
YT24 MZ AUG-H3	YT-24 Creek	09/08/2018	BS	CCG	40	1.5	RG
YT24 MZ AUG-H4	YT-24 Creek	09/08/2018	BS	CH	80	5.0	RG
YT24 MZ AUG-H4	YT-24 Creek	09/08/2018	BS	CH	77	5.0	RG
YT24 MZ AUG-H4	YT-24 Creek	09/08/2018	BS	CH	79	5.5	RG
YT24 MZ AUG-H4	YT-24 Creek	09/08/2018	BS	CH	65	3.0	RG
YR YT24 MZ AUG-H1	Yukon River	09/08/2018	BS	CH	70	4.0	RG
YR AX YT24 MZ-H1	Yukon River	09/08/2018	BS	CH	69	3.5	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
YR AX YT24 MZ-H1	Yukon River	09/08/2018	BS	CH	70	3.5	RG
YR AX YT24 MZ-H1	Yukon River	09/08/2018	BS	CH	82	5.5	RG
YR AX YT24 MZ-H1	Yukon River	09/08/2018	BS	CH	79	5.0	RG
YR AX YT24 MZ-H1	Yukon River	09/08/2018	BS	CH	73	4.0	RG
YR AX YT24 MZ-H1	Yukon River	09/08/2018	BS	CCG	22	<1.0	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	LW	83	5.0	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	CH	81	4.5	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	CH	73	4.0	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	CH	79	4.0	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	CH	79	4.5	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	CH	77	4.5	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	CH	79	5.5	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	CH	77	3.5	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	RW	45	0.5	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	CH	88	7.0	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	CH	75	4.5	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	CH	81	NA	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	GR	55	1.5	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	LSU	57	2.0	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	LSU	77	2.5	RG
YR AX YT24 MZ-H2	Yukon River	09/08/2018	BS	CCG	27	NA	RG
YR AX YT24 MZ-H3	Yukon River	09/08/2018	BS	LSU	33	<1.0	RG
YR AX YT24 MZ-H3	Yukon River	09/08/2018	BS	CCG	23	NA	RG
CF3.9-1 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	80	5	RG
CF3.9-1 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	90	7	RG
CF3.9-1 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	85	5.5	RG
CF3.9-1 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	80	5.5	RG
CF3.9-1 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	90	7.5	RG
CF3.9-1 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	80	4.5	RG
CF3.9-1 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	83	5	RG
CF3.9-1 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	90	7	RG
CF3.9-1 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	83	5.5	RG
CF3.9-1 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	88	6	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	81	5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	77	4.5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	71	3.5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	75	4.5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	75	4.5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	85	6.5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	79	5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	78	4.5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	80	5.0	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	89	6.5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CCG	75	5.0	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CCG	91	6.5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	80	5.5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	70	3.0	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	83	5.5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	80	5.0	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	70	3.5	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	74	4.0	RG
CF3.9-2 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	81	6.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	76	4.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	84	6.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	86	6.5	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	88	6.5	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	80	5.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	77	5.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	68	3.5	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	90	7.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	69	3.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	74	4.5	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CCG	81	5.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	69	3.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	70	3.5	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	84	6.5	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CCG	82	6.5	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	85	6.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	77	4.5	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	84	6.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	70	3.5	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	77	5.0	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	62	2.5	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CH	80	5.5	RG
CF3.9-3 (new: CC5.6)	Coffee Creek	15/08/2018	MT	CCG	77	3.5	RG
ID11.2 (new: IC15.6)	Independence Creek	17/08/2018	EF	GR	237	n/a	RG
ID11.2 (new: IC15.6)	Independence Creek	17/08/2018	EF	GR	180	n/a	RG
ID11.2 (new: IC15.6)	Independence Creek	17/08/2018	EF	GR	127	n/a	RG
ID11.2 (new: IC15.6)	Independence Creek	17/08/2018	EF	GR	215	104.0	RG
ID11.2 (new: IC15.6)	Independence Creek	17/08/2018	EF	GR	115	19.5	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
ID11.2 (new: IC15.6)	Independence Creek	17/08/2018	EF	GR	174	96.0	RG
ID11.2 (new: IC15.6)	Independence Creek	17/08/2018	EF	GR	195	69.0	RG
ID11.2 (new: IC15.6)	Independence Creek	17/08/2018	EF	GR	130	22.0	RG
ID11.2 (new: IC15.6)	Independence Creek	17/08/2018	EF	RW	182	65.0	RP
CH0.2 (new ICB0.2)	Independence Creek Tributary B	17/08/2018	EF	GR	320	269.0	RG
CH0.2 (new ICB0.2)	Independence Creek Tributary B	17/08/2018	EF	GR	237	144.0	RG
CH0.2 (new ICB0.2)	Independence Creek Tributary B	17/08/2018	EF	GR	205	89.0	RG
CH0.2 (new ICB0.2)	Independence Creek Tributary B	17/08/2018	EF	GR	130	27.5	RG
CH0.2 (new ICB0.2)	Independence Creek Tributary B	17/08/2018	EF	GR	130	23.5	RG
CH0.2 (new ICB0.2)	Independence Creek Tributary B	17/08/2018	EF	GR	250	186.0	RG
CH0.2 (new ICB0.2)	Independence Creek Tributary B	17/08/2018	EF	GR	154	39.0	RG
CH0.2 (new ICB0.2)	Independence Creek Tributary B	17/08/2018	EF	GR	200	103.0	RG
CH0.2 (new ICB0.2)	Independence Creek Tributary B	17/08/2018	EF	GR	147	37.0	RG
CH0.2 (new ICB0.2)	Independence Creek Tributary B	17/08/2018	EF	GR	154	39.5	RG
CH0.6 (new ICB0.2)	Independence Creek Tributary B	17/08/2018	EF	GR	237	150.5	RG
CH0.6 (new ICB0.6)	Independence Creek Tributary B	17/08/2018	EF	GR	125	25.0	RG
CH0.6 (new ICB0.6)	Independence Creek Tributary B	17/08/2018	EF	GR	120	23.0	RG
CH0.6 (new ICB0.6)	Independence Creek Tributary B	17/08/2018	EF	GR	194	67.5	RG
CH0.6 (new ICB0.6)	Independence Creek Tributary B	17/08/2018	EF	GR	123	26.5	RG
CH0.6 (new ICB0.6)	Independence Creek Tributary B	17/08/2018	EF	GR	123	27.0	RG
CH0.6 (new ICB0.6)	Independence Creek Tributary B	17/08/2018	EF	GR	139	136.5	RG
CH0.6 (new ICB0.6)	Independence Creek Tributary B	17/08/2018	EF	GR	148	138.5	RG
CH0.6 (new ICB0.6)	Independence Creek Tributary B	17/08/2018	EF	CH	77	4.5	RG
CH0.6 (new ICB0.6)	Independence Creek Tributary B	17/08/2018	EF	CH	73	4.0	RG
CH0.6 (new ICB0.6)	Independence Creek Tributary B	17/08/2018	EF	CH	72	4.5	RG

Site ID	Steam Name	Sampling Date	Sampling Type	Species	Length (mm)	Weight (g)	Release Condition
PK0.2 (ICB0.4)	Independence Creek Tributary A	17/08/2018	EF	GR	255	199.0	RG
PK0.2 (ICB0.4)	Independence Creek Tributary A	17/08/2018	EF	GR	210	104.0	RG
PK0.2 (ICB0.4)	Independence Creek Tributary A	17/08/2018	EF	GR	190	83.5	RG
PK0.2 (ICB0.4)	Independence Creek Tributary A	17/08/2018	EF	GR	134	n/a	RG

APPENDIX D. HABITAT UNIT PHOTOGRAPHS

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Halfway Creek Habitat Units



Photo 1. Downstream view of glide habitat on Halfway Creek (0+488; August 14, 2018).



Photo 2. Upstream view of pool habitat on Halfway Creek (0+388; August 12, 2018).



Photo 3. Upstream view of riffle habitat on Halfway Creek (0+063; August 14, 2018).



Photo 4. Left downstream bank view of steep riffle habitat on Halfway Creek (0+217; August 14, 2018).



Photo 5. Downstream view of steep riffle habitat on Halfway Creek (0+492; August 14, 2018).



Photo 6. Right downstream bank view of tertiary pool habitat on Halfway Creek (0+460; August 14, 2018).

YT-24 Habitat Units



Photo 7. Upstream view of cascade habitat on Creek YT-24 (0+429; August 13, 2018).

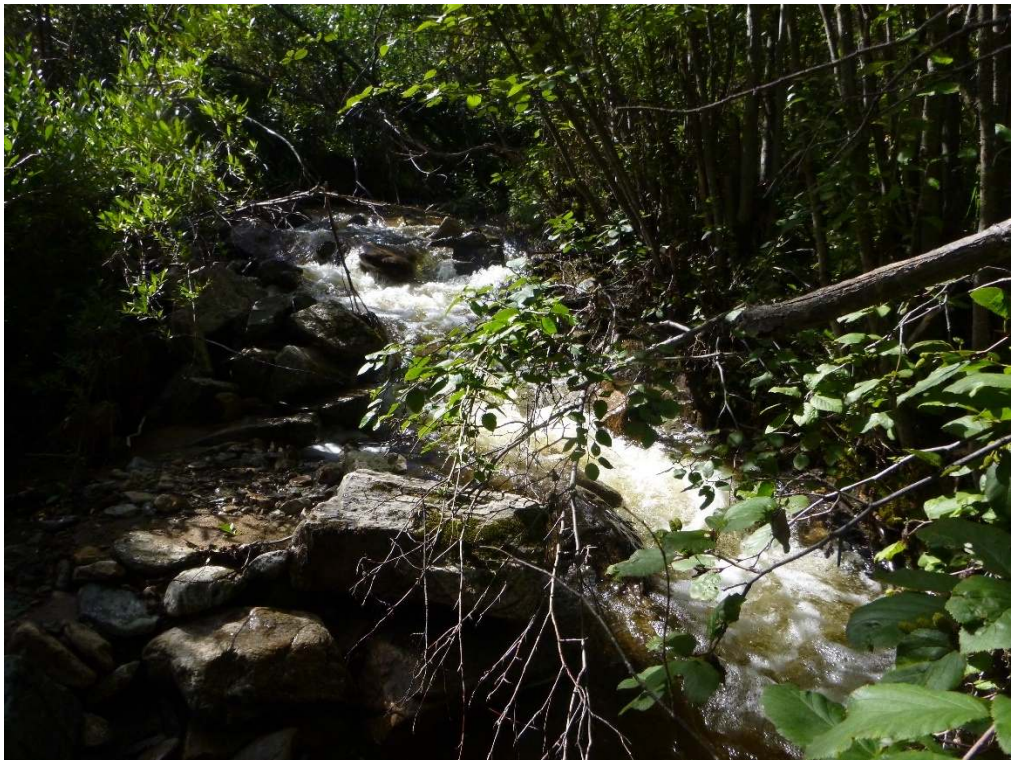

Photo 8. Example of cascade habitat on Creek YT-24 (0+525; August 13, 2018).



Photo 9. Upstream view of pool habitat on Creek YT-24 (0+100; August 13, 2018).



Photo 10. Upstream/ left downstream bank view of pool habitat on Creek YT-24 (0+100; August 13, 2018).



Photo 11. Downstream view of riffle habitat on Creek YT-24 (0+030; August 13, 2018).



Photo 12. Upstream view of riffle habitat on Creek YT-24 (0+051; August 13, 2018).



Photo 13. Upstream view of steep riffle habitat on Creek YT-24 (0+438; August 13, 2018).



Photo 14. Upstream view of steep riffle habitat on Creek YT-24 (0+314; August 13, 2018).

Latte Creek Habitat Units



Photo 15. Downstream view of cascade habitat on Latte Creek (0+074; August 10, 2018).



Photo 16. Upstream view of cascade habitat on Latte Creek (0+074; August 10, 2018).



Photo 17. Upstream view of glide habitat on Latte Creek (0+346; August 10, 2018).



Photo 18. Downstream view of glide habitat on Latte Creek (0+346; August 10, 2018).



Photo 19. Upstream view of pool habitat on Latte Creek (0+181; August 10, 2018).



Photo 20. Downstream view of pool habitat on Latte Creek (0+181; August 10, 2018).



Photo 21. Upstream view of riffle habitat on Latte Creek (0+192; August 10, 2018).



Photo 22. Downstream view of riffle habitat on Latte Creek (0+590; August 10, 2018).



Photo 23. Downstream view of wide riffle habitat on Latte Creek (0+411; August 10, 2018).



Photo 24. Downstream view of wide riffle habitat on Latte Creek (0+552; August 10, 2018).



Photo 25. Upstream view of steep riffle habitat on Latte Creek (0+300; August 10, 2018).



Photo 26. Downstream view of steep riffle habitat on Latte Creek (0+260; August 10, 2018).

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APPENDIX E. FISH HABITAT ASSESSMENT PROCEDURE SURVEY DATA

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Table E-1. Fish habitat assessment procedure (FHAP) survey data from the August 2018 site visit.

Site	Date	Distance (m)	Habitat Unit		Length (m)	Gradient (%)	Mean Depth		Mean Width		Pools Only				Bed Material		Total LWD Tally	Functional LWD Tally			Cover				Riparian Vegetation		
			Type	Cat			Bankfull (m)	Water (m)	Bankfull Width (m)	Wetted Width (m)	Max Depth (m)	Crest (m)	Residual (m)	Pool Type	Dom.	Sub-Dom.		10-20 cm	20-50 cm	>50 cm	Cover Type	%	Cover Type	%	Type	Structure	Canopy closure
Halfway	14/08/2019	0+000	R+	1	55.0	5	0.78	0.25	3.95	2.90	-	-	-	-	C	G	6	4	2	0	B	5	C	T	M	MF	20-41
Halfway	14/08/2018	0+055	P	1	8.8	0	0.96	0.56	7.90	4.70	0.96	0.42	0.54	S	C	G	3	2	1	0	DP	60	C	15	M	MF	1-20
Halfway	14/08/2018	0+063	R	1	74.3	2	0.67	0.39	4.50	3.85	-	-	-	-	C	B	12	6	5	1	B	3	SWD	T	M	MF	1-20
Halfway	14/08/2018	0+137	R+	1	38.6	6	0.65	0.19	9.05	5.42	-	-	-	-	C	G	14	9	5	0	DP	15	C	5	M	MF	1-20
Halfway	14/08/2018	0+176	R	1	41.2	4	0.70	0.27	3.68	3.15	-	-	-	-	C	G	2	2	0	0	B	3	C	T	M	MF	1-20
Halfway	14/08/2018	0+217	R+	1	11.9	8	0.79	0.21	6.65	3.30	-	-	-	-	C	G	2	0	2	0	B	3	C	T	M	MF	1-20
Halfway	14/08/2018	0+229	G	1	8.7	2	0.70	0.29	4.20	3.00	-	-	-	-	C	G	2	1	1	0	C	3	OV	T	M	MF	1-20
Halfway	14/08/2018	0+237	R+	1	51.3	5	0.45	0.12	6.50	5.75	-	-	-	-	C	G	2	1	1	0	B	5	C	T	M	MF	1-20
Halfway	14/08/2018	0+288	G	1	7.0	1	0.83	0.36	8.70	3.50	-	-	-	-	C	B	1	0	1	0	C	5	OV	3	M	MF	1-20
Halfway	14/08/2018	0+295	R+	1	13.5	5	0.61	0.17	3.90	3.30	-	-	-	-	C	G	3	1	0	0	C	3	OV	T	M	MF	1-20
Halfway	14/08/2018	0+300	G	1	7.9	4	0.66	0.32	4.50	2.53	-	-	-	-	C	G	2	1	1	0	C	T	DP	T	M	MF	1-20
Halfway	14/08/2018	0+308	R+	1	14.3	6	0.47	0.12	5.20	3.80	-	-	-	-	C	G	5	3	2	0	SWD	5	C	5	M	MF	1-20
Halfway	14/08/2018	0+322	P	1	8.1	0	0.94	0.59	4.75	4.45	0.94	0.28	0.66	S	F	G	5	2	3	0	DP	60	C	5	M	MF	1-20
Halfway	14/08/2018	0+330	R+	1	27.7	5	0.61	0.16	6.20	5.10	-	-	-	-	C	G	4	0	4	0	B	3	C	T	M	MF	1-20
Halfway	14/08/2018	0+358	R+	1	20.6	9	0.56	0.28	6.40	3.10	-	-	-	-	C	G	9	5	4	0	SWD	3	B	T	M	MF	1-20
Halfway	14/08/2018	0+358	R+	2	11.5	9	0.36	0.11	6.40	1.87	-	-	-	-	C	G	3	2	1	0	SWD	5	B	T	M	MF	1-20
Halfway	14/08/2018	0+379	P	1	9.1	1	0.68	0.56	9.90	6.25	0.72	0.15	0.57	D	F	G	3	2	1	0	DP	50	SWD	5	M	MF	1-20
Halfway	14/08/2018	0+388	G	1	25.8	1	0.72	0.30	8.00	4.87	-	-	-	-	F	G	10	3	7	0	SWD	20	CWD	5	M	MF	1-20
Halfway	14/08/2018	0+414	P	1	8.0	0	0.83	0.64	4.52	3.85	0.87	0.41	0.46	S	C	F	5	4	1	0	DP	70	SWD	5	M	MF	1-20
Halfway	14/08/2018	0+422	G	1	12.4	1	0.63	0.29	4.80	3.75	-	-	-	-	G	C	8	6	2	0	C	5	CWD	5	M	MF	1-20
Halfway	14/08/2018	0+434	R	1	14.3	4	0.49	0.11	5.05	4.60	-	-	-	-	G	C	2	2	0	0	C	3	B	T	M	MF	1-20
Halfway	14/08/2018	0+448	G	1	16.6	2	0.73	0.43	4.20	3.00	-	-	-	-	G	C	3	3	0	0	C	5	DP	T	M	MF	1-20
Halfway	14/08/2018	0+465	R+	1	19.8	6	0.37	0.10	5.25	4.60	-	-	-	-	C	G	3	3	0	0	SWD	3	B	T	M	MF	1-20
Halfway	14/08/2018	0+460	P	3	2.6	0	0.60	0.27	7.95	7.85	0.77	0.29	0.48	S	F	G	1	1	0	0	DP	50	SWD	10	M	MF	1-20
Halfway	14/08/2018	0+485	G	1	6.7	2	0.73	0.37	5.07	3.92	-	-	-	-	C	G	2	2	0	0	C	10	DP	5	M	MF	1-20
Halfway	14/08/2018	0+492	R+	1	13.7	6	0.64	0.23	4.15	3.40	-	-	-	-	C	B	3	1	2	0	CWD	5	B	3	M	MF	1-20
Halfway	14/08/2018	0+506	R	1	84.9	2	0.54	0.18	4.00	3.50	-	-	-	-	C	G	7	3	4	0	B	3	C	3	M	MF	1-20
YT24	13/08/2018	0+000	R	1	20.6	3	0.79	0.19	6.80	2.70	-	-	-	-	C	F	3	2	2	0	B	5	C	T	M	MF	21-40
YT24	13/08/2018	0+021	R+	1	9.4	7	0.52	0.14	5.85	4.87	-	-	-	-	B	C	1	0	1	0	B	15	C	T	M	MF	1-20
YT24	13/08/2018	0+030	R	1	20.7	6	0.46	0.14	4.30	3.47	-	-	-	-	G	C	2	1	1	0	B	5	SWD	T	M	MF	1-20
YT24	13/08/2018	0+041	C	1	10.0	11	0.70	0.16	4.20	3.63	-	-	-	-	B	C	1	1	0	0	B	3	C	T	M	MF	1-20
YT24	13/08/2018	0+051	R	1	9.2	4	0.57	0.15	4.48	3.45	-	-	-	-	G	C	1	0	1	0	B	5	SWD	T	M	MF	1-20
YT24	13/08/2018	0+060	R+	1	41.3	8	0.65	0.15	6.55	3.38	-	-	-	-	B	C	0	0	0	0	B	10	SWD	T	M	MF	1-20
YT24	13/08/2018	0+100	P	1	5.1	0	1.60	0.60	6.85	3.86	0.80	0.23	0.57	S	G	F	2	1	1	0	DP	50	C	15	M	MF	1-20
YT24	13/08/2018	0+105	R	1	51.6	3	0.73	0.19	6.00	3.25	-	-	-	-	C	G	7	3	3	1	B	5	C	T	M	MF	1-20
YT24	13/08/2018	0+157	R+	1	75.0	8	0.70	0.13	5.00	2.55	-	-	-	-	C	B	3	2	1	0	B	10	SWD	T	M	MF	1-20
YT24	13/08/2018	0+232	R	1	82.0	3	0.59	0.13	14.50	5.26	-	-	-	-	C	B	8	7	1	0	B	5	C	T	M	MF	1-20
YT24	13/08/2018	0+314	R	1	81.4	6	0.75	0.12	4.86	3.96	-	-	-	-	G	C	5	3	2	0	B	3	C	T	M	MF	20-41

Site	Date	Distance (m)	Habitat Unit		Length (m)	Gradient (%)	Mean Depth		Mean Width		Pools Only				Bed Material		Total LWD Tally	Functional LWD Tally			Cover				Riparian Vegetation		
			Type	Cat			Bankfull (m)	Water (m)	Bankfull Width (m)	Wetted Width (m)	Max Depth (m)	Crest (m)	Residual (m)	Pool Type	Dom.	Sub-Dom.		10-20 cm	20-50 cm	>50 cm	Cover Type	%	Cover Type	%	Type	Structure	Canopy closure
YT24	13/08/2018	0+395	R+	1	33.8	8	0.91	0.23	5.24	2.68	-	-	-	-	C	B	7	5	2	0	B	3	SWD	T	M	MF	1-20
YT24	13/08/2018	0+429	C	1	8.6	12	0.80	0.20	6.90	3.98	-	-	-	-	B	C	1	1	0	0	B	T	C	T	M	MF	1-20
YT24	13/08/2018	0+438	R+	1	86.8	8	0.81	0.18	5.33	2.43	-	-	-	-	C	B	7	5	2	0	B	5	C	T	M	MF	1-20
YT24	13/08/2018	0+525	C	1	9.8	13	0.57	0.22	4.10	3.37	-	-	-	-	B	C	0	0	0	0	B	3	SWD	T	M	MF	1-20
Latte	10/08/2018	0+000	R	1	46.3	2.5	0.72	0.42	4.05	3.45	-	-	-	-	B	C	1	1	0	0	B	15	OV	T	M	MF	1-20
Latte	10/08/2018	0+046	P	1	5.4	0	0.97	0.60	3.75	3.70	0.8	0.35	0.45	D	G	B	0	0	0	0	DP	50	B	5	M	MF	1-20
Latte	10/08/2018	0+051	R	1	22.6	1.5	0.98	0.48	3.00	2.30	-	-	-	-	C	B	1	1	0	0	B	5	C	T	M	MF	1-20
Latte	10/08/2018	0+074	C	1	3.1	12	0.87	0.47	3.15	3.45	-	-	-	-	B	C	1	1	0	0	B	5	SWD	T	M	MF	1-20
Latte	10/08/2018	0+077	R+	1	87.1	2	0.82	0.37	3.30	4.20	-	-	-	-	C	B	9	9	0	0	B	5	SWD	3	M	MF	1-20
Latte	10/08/2018	0+164	G	1	10.8	1	0.96	0.56	5.25	4.30	-	-	-	-	C	F	1	1	0	0	SWD	15	OV	10	M	MF	1-20
Latte	10/08/2018	0+175	R+	1	15.5	6	0.65	0.30	4.88	4.50	-	-	-	-	C	B	0	0	0	0	SWD	10	OV	5	M	MF	1-20
Latte	10/08/2018	0+185	DRY	2	50.0	NA	NA	NA	4.55	NA	-	-	-	-	C	G	-	-	-	-	-	-	-	-	M	MF	1-20
Latte	10/08/2018	0+181	P	1	10.5	0	1.17	0.72	3.95	3.00	0.8	0.35	0.45	S	C	G	3	3	0	0	DP	30	C	5	M	MF	1-20
Latte	10/08/2018	0+192	R	1	67.5	2.5	0.88	0.38	4.35	3.05	-	-	-	-	C	B	0	0	0	0	B	5	SWD	3	M	MF	1-20
Latte	10/08/2018	0+260	R+	1	15.4	6	0.73	0.33	5.96	4.83	-	-	-	-	C	B	1	1	0	0	B	5	SWD	T	M	MF	1-20
Latte	10/08/2018	0+275	R	1	25.1	2	0.83	0.38	4.80	3.85	-	-	-	-	C	B	2	2	0	0	B	10	CWD	T	M	MF	1-20
Latte	10/08/2018	0+300	R+	1	20.4	5	0.97	0.37	5.25	3.90	-	-	-	-	B	C	0	0	0	0	B	10	SWD	T	M	MF	1-20
Latte	10/08/2018	0+320	R	1	13.7	3.5	0.73	0.33	5.30	4.55	-	-	-	-	C	B	1	1	0	0	B	5	OV	T	M	MF	1-20
Latte	10/08/2018	0+334	P	1	5.0	0	0.95	0.55	4.45	4.43	0.7	0.3	0.4	S	C	B	0	0	0	0	DP	15	C	3	M	MF	1-20
Latte	10/08/2018	0+339	R+	1	6.7	5	1.02	0.47	4.15	3.65	-	-	-	-	B	C	0	0	0	0	B	T	C	T	M	MF	1-20
Latte	10/08/2018	0+346	G	1	11.2	1	1.18	0.43	4.98	4.26	-	-	-	-	C	B	0	0	0	0	B	15	C	T	M	MF	1-20
Latte	10/08/2018	0+357	R	1	53.9	3.5	1.05	0.30	4.70	4.08	-	-	-	-	C	B	1	1	0	0	B	5	SWD	T	M	MF	1-20
Latte	10/08/2018	0+411	R	1	77.1	2	1.85	0.25	9.25	8.40	-	-	-	-	C	B	2	2	0	0	B	10	SWD	T	M	MF	1-20
Latte	10/08/2018	0+488	R	1	63.7	2	1.00	0.30	5.07	4.34	-	-	-	-	C	B	0	0	0	0	B	10	SWD	T	M	MF	1-20
Latte	10/08/2018	0+552	R	1	35.3	3	1.10	0.20	11.60	10.70	-	-	-	-	C	G	0	0	0	0	B	5	OV	T	M	MF	1-20
Latte	10/08/2018	0+590	R	1	65.7	2	0.95	0.35	6.52	5.89	-	-	-	-	C	B	2	1	0	0	B	10	OV	T	M	MF	1-20

Coffee Gold Project: 2019 Fish and Aquatic Resources Studies DRAFT



Prepared For
Newmont Corporation
Suite 3400-666 Burrard Street
Vancouver, BC V6C 2X8

Prepared By
EDI Environmental Dynamics Inc.
2195-2nd Avenue
Whitehorse, YT Y1A 3T8

EDI Contact
Pat Tobler, R.P. Bio.
867.393.4882

EDI Project
19Y0033
April 2020

EDI
ENVIRONMENTAL DYNAMICS INC.
Down to Earth Biology

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EXECUTIVE SUMMARY

The Coffee Gold Project (the Project) is a proposed gold mine in west-central Yukon owned by Newmont Goldcorp Corp. (previously Goldcorp Kaminak Ltd.). The Project was submitted to the Yukon Environmental and Socio-economic Assessment Board (YESAB) Executive Committee in 2017 for review under the *Yukon Environmental and Socio-Economic Assessment Act* (YESAA). Several reports have been submitted to YESAB detailing field studies (2014 to 2016), baseline surveys, and the Project effects assessment for fish and fish habitat. In 2018 and 2019, supplementary studies and monitoring programs were conducted in the Project area to supplement existing baseline knowledge, address questions raised during Project review, and refine proposed fish monitoring programs in anticipation of future monitoring requirements.

Aquatic data have been collected for several years at the Project, with EDI Environmental Dynamics Inc. (EDI) collecting baseline and monitoring data annually since 2016. Fieldwork in 2019 was intended to supplement existing pre-project data and provide additional monitoring data to allow for future comparisons following mine operation. The 2019 field season occurred over the months of May, July, and August within the Mine Study Area (MSA) and the Northern Access Route (NAR).

The following activities took place within the MSA: fish sampling in creeks within and adjacent to the Project area, sampling in the mixing zones within the Yukon River, fish habitat assessment procedures (FHAP), and aerial surveys for Chinook salmon spawning. Within the NAR, the 2019 field study focussed on barge landing and barge wake investigations, as well as the Stewart River back channel.

Investigations occurred within the MSA in July and August 2019. Specifically, minnow trapping was completed on Coffee Creek, and electrofishing was performed on Halfway and YT-24 creeks. Minnow traps were set at Carlisle, Excelsior, and Los Angeles creeks, adjacent to the MSA, to find a suitable control for Coffee Creek juvenile Chinook salmon. Beach seining was conducted in the Halfway and YT-24 Creek mixing zones within the Yukon River (i.e., where the outlet of the creeks flow into the Yukon River). The FHAPs were conducted on two sites on Carlisle Creek, as well as Coffee Creek and an unnamed tributary one creek upstream of YT-24. Similar to previous years, Coffee and Independence creeks had aerial Chinook salmon spawning surveys completed in August and a ground survey took place on Coffee Creek.

The NAR investigations occurred over a one-day visit in May, as well as the July and August field trips. In July and August, the proposed barge landing sites were beach seined on the Yukon and Stewart rivers. In July, an opportunistic barge wake investigation was completed on the Yukon River with a focus on wake extent along the shore. During the May visit, the Stewart River back channel was investigated for the presence of spawning pike and was beach seined; it was visited again in July and August with site conditions documented.

Pertinent results from the 2019 field season include:

- Juvenile Chinook salmon were captured in Coffee Creek, but none in Carlisle, Excelsior, or Los Angeles creeks.
- Arctic grayling were captured in high numbers in Halfway Creek, particularly during the August visit.

- YT-24 Creek had approximately 60 m of dry creek 190 m upstream from the mouth during the July visit; also during the July visit, the creek did not contain enough water to flow into the Yukon River, drying up 3.5 m from the Yukon River. These areas were wetted during the August survey.
- The Yukon River mixing zones on Halfway and YT-24 creeks contained higher species diversity and abundance than did the Yukon River reference site. However, a site immediately downstream of the reference site in identical habitat had a catch-per-unit-effort more similar to the creek mixing zones. During the July visit, YT-24 Creek did not have a mixing zone as the water did not reach the Yukon River, but the area still contained a high species abundance and diversity.
- No evidence of spawning activity was found during Chinook salmon spawning surveys in Coffee and Independence creeks.
- Barge landing sampling on the Yukon River indicated that the north and south proposed barge landing sites had fairly low species diversity and abundance. However, the existing barge landing on the Yukon River adjacent to Coffee Camp had the highest species diversity and abundance since sampling of the site began in 2017. The barge landing is being used more frequently in the open water months and based on the sampling in August it does not appear to be deterring juvenile fish from rearing in the area.
- The barge landing sampling on the Stewart River produced the highest species diversity and abundance of any sampling within the NAR in 2019.
- Little wake or lasting impact was detected during barge wake investigations. The waves reaching shore came up 11 to 35 cm; waves came up higher on gently sloping silt or sand portions than on cobble. The turbidity was higher and lasted longer in back eddy areas with considerable silt.
- During the May visit of the Stewart River back channel, adult northern pike were observed and captured in the wetted portion of the back channel. Juvenile longnose sucker were also captured in low numbers within the back channel. The back channel was dry during the July and August field visits.

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AUTHORSHIP

This report was prepared by EDI Environmental Dynamics Inc. Staff who contributed to this project include:

Petra Szekeres, M.Sc., P. Biol. ..... Primary Author

Jonathan Lowey, B.Sc., B.I.T. ..... Section Author

Matt Power, A.Sc.T. ..... GIS Mapping

Pat Tobler B.Sc., R.P. Bio., CPESC ..... Senior Review

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1 INTRODUCTION

The Coffee Gold Project (the Project) is a proposed gold mine in west-central Yukon, located 130 km south of Dawson City. Gold was initially discovered at Coffee Creek in 2010, and exploration activities have been ongoing since. Baseline environmental studies began in 2010 and were expanded in the following years in anticipation of future regulatory requirements.

The proposed Project will consist of an open pit gold mine and heap leach facility. The projected mine life is ten years with an 18-month construction period. The feasibility study proposes four open pits mined by conventional shovel and truck methods. The mine and associated activities will generally be located on a relatively high elevation ridge top and will not extend into the lower elevations where the larger streams are located. The mine footprint does include the upper part of some headwater watersheds (including Halfway Creek, YT-24 and unnamed tributaries to Latte Creek). Most prominently, the main proposed Waste Rock Storage Facility will be positioned in the upper Halfway Creek watershed.

The Project will be accessed by road from Dawson City via a 214-km single-lane, gravel road with pull-outs. The initial part of this route, from the Klondike Highway to Sulphur Creek uses a government-maintained gravel road. Beyond Sulphur Creek, the Northern Access Route (NAR) mainly follows existing placer mine roads that will be upgraded to provide all-season access to supply vehicles. Approximately 30 km of new road will be constructed (Figure 1). Electricity is planned to be generated on site by diesel-powered generators. Most mine staff will access the site by air.

The Project is located on Crown land within the Traditional Territory of the Tr'ondëk Hwëch'in and the asserted traditional territory of the White River First Nation. A portion of Goldcorp's claim block is located in the Traditional Territory of the Selkirk First Nation and the proposed access road also overlaps with the Traditional Territory of the First Nation of the Na-Cho Nyak Dun.

The proposed Project is currently going through an Executive Committee Screening from the Yukon Environmental and Socio-economic Assessment Board (YESAB) and will require a Type A Water License issued by the Yukon Water Board and a Quartz Mining License issued by the Yukon Government, among other permits and licences.

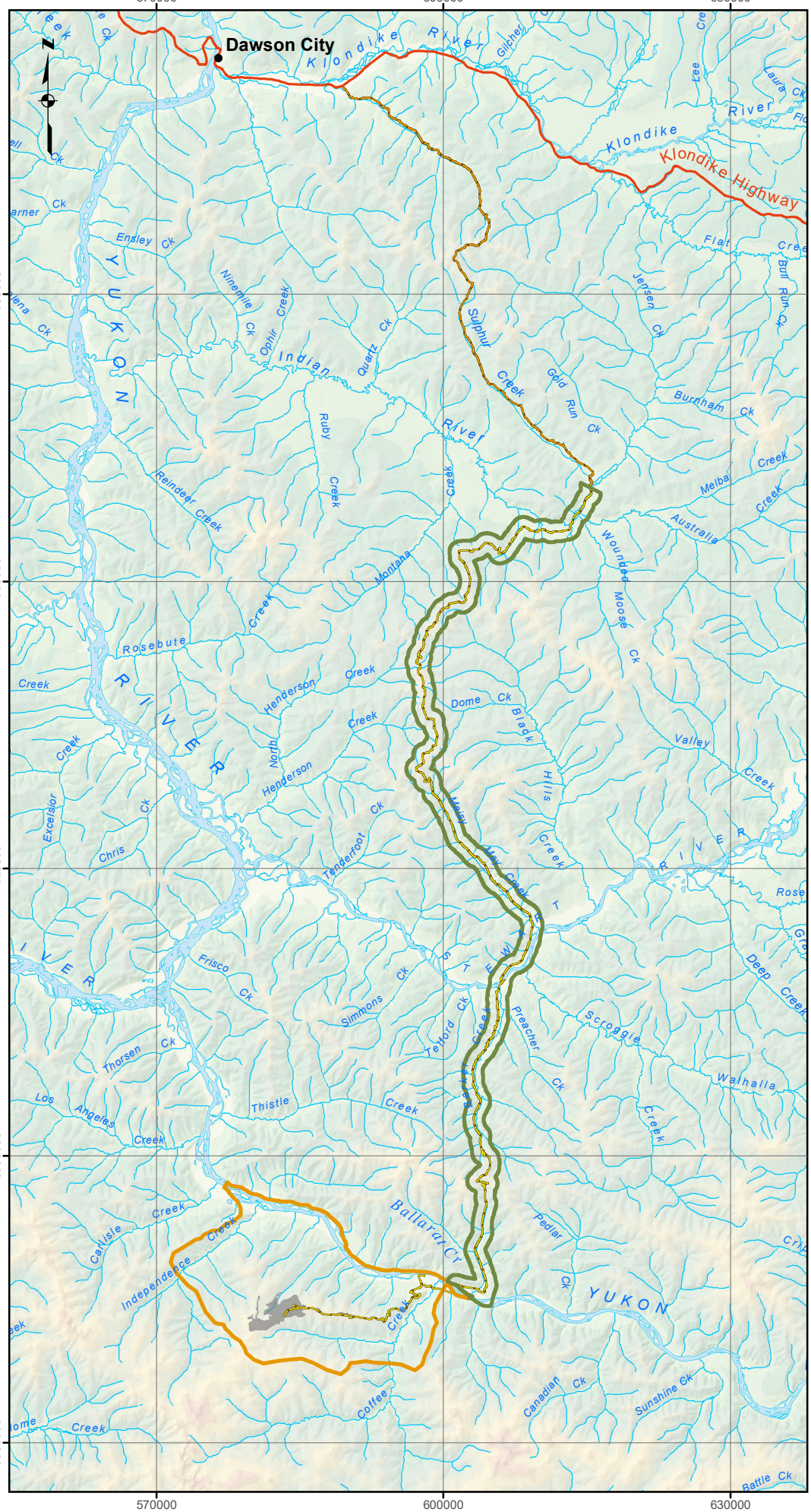

Figure 1. Overview of the Coffee Project study area

Legend

- Settlement/Community
- Government-Maintained Gravel Road Along Proposed Route
- Proposed Route
- Proposed Project Infrastructure Footprint (2019)

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area



0 5 10 15 20 25

Kilometres

Map Reference Scale: 1:600,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Data Sources
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1.1 STUDY PURPOSE AND SCOPE

Palmer Environmental Consulting Group collected baseline data around the mine in 2014 and 2015 (PECG 2017) and along the access road in 2015 (PECG 2016). EDI Environmental Dynamics Inc. (EDI) collected additional baseline data in 2016 to 2018 around the Mine Study Area (MSA) and NAR and summarized all data collected to date (EDI 2017, 2018, 2019). The study conducted in 2018 was intended to expand the baseline (both spatially and quantitatively), support the effects assessment for the Project, and provide pre-project information that can be used for effects monitoring. Fieldwork conducted during the 2019 field season provides additional fish and aquatic resource baseline conditions and pre-project monitoring information.

Project components for the MSA (Figure 2) 2019 field studies included:

- fish sampling on various creeks in the MSA, and within mixing zones of the Yukon River;
- barge landing fish sampling and investigations,
- fish habitat assessments; and,
- Chinook salmon (*Oncorhynchus tshawytscha*) spawning surveys.

Project components for the NAR Study Area (Figure 3) 2019 field studies included:

- barge landing fish sampling and investigations; and,
- fish habitat investigations in a back channel of the Stewart River.

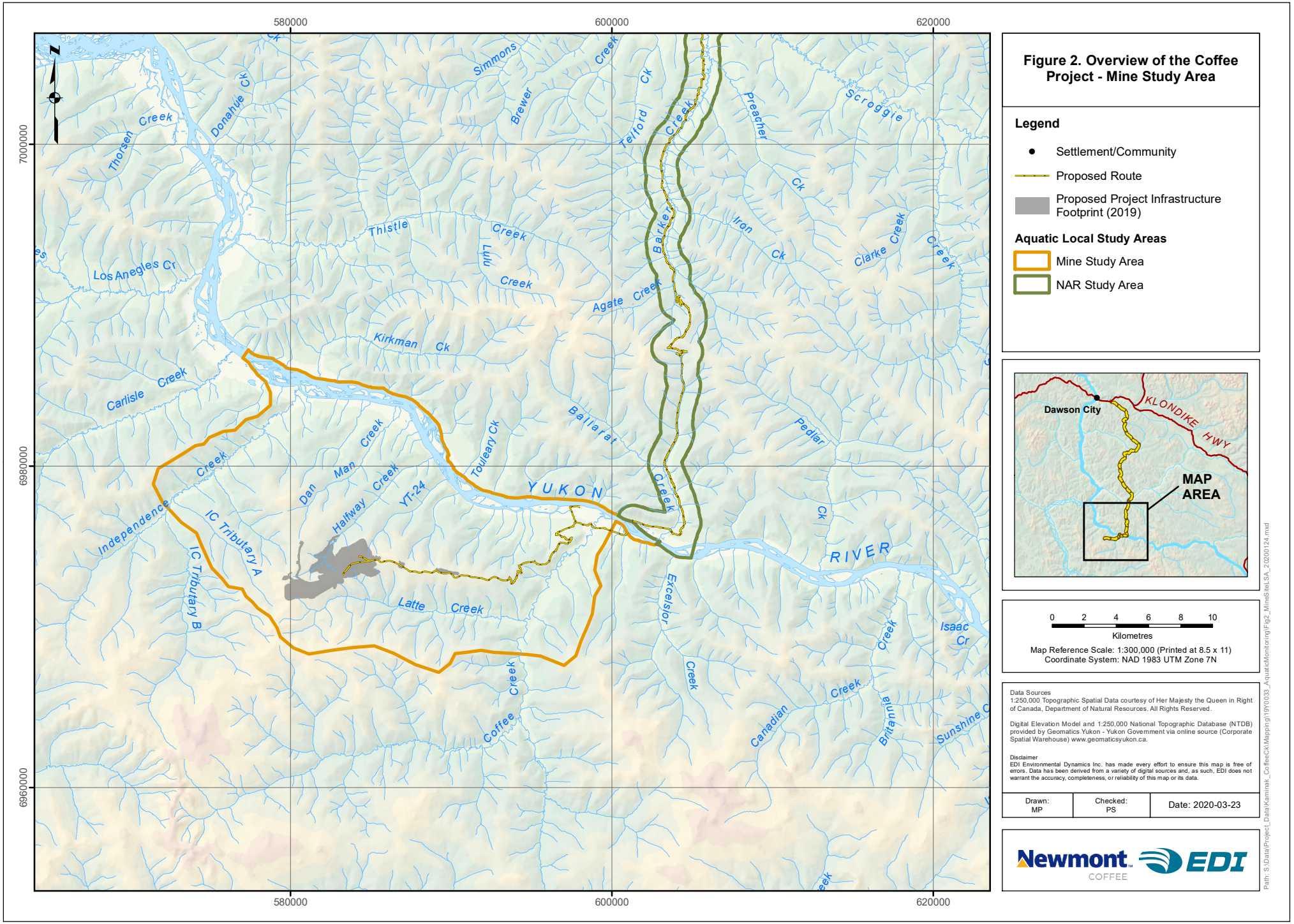

Figure 2. Overview of the Coffee Project - Mine Study Area

Legend

- Settlement/Community
- Proposed Route
- Proposed Project Infrastructure Footprint (2019)

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

Map Reference Scale: 1:300,000 (Printed at 8.5 x 11)
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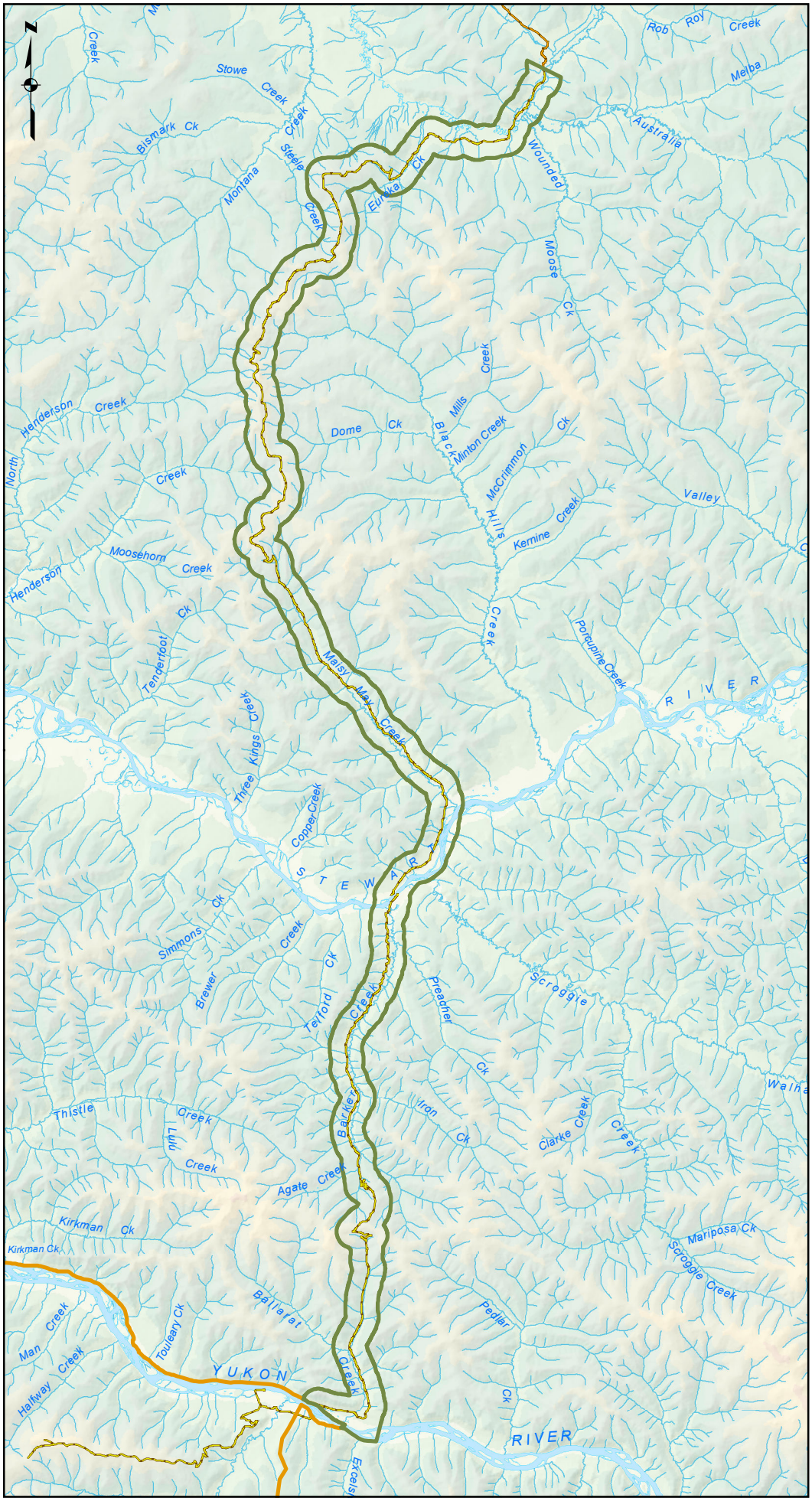

Figure 3. Overview of the Coffee Project - Northern Access Road (NAR) Study Area

Legend

- Settlement/Community
- Government-Maintained Gravel Road Along Proposed Route
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

Map Reference Scale: 1:360,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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1.2 BASELINE SAMPLING STATION CONCORDANCE

To promote consistency among groups working on aquatic and fisheries work within the Project area, a new station naming system was developed in 2018, and followed during the 2019 field season. To rectify previous sampling stations with the new system, a table of concordance is provided (Table 1). The new naming system allows for easy determination of station location and the addition of new stations, if and where needed:

1. Each station ID designation begins with a two or three letter code for each creek in the MSA. Three letter codes are used for unnamed tributaries to named creeks; therefore, LCC corresponds to Latte Creek, Tributary C.

2. Following the creek letter code is a numeric designation that represents the stream distance (kilometres) of a sampling station from its major confluence (i.e., following the meandering of the creek).

3. For stations in the Yukon River, the naming convention follows the number of kilometres from the confluence with the White River.

Table 1. Concordance table of Project fisheries and aquatic field sampling station identifiers.

Waterbody	Water Quality and Hydrology Station (Lorax 2016)	2016 Station Name	2017 Station Name	2018 Station Name
Coffee Creek	CC4.5	CF2.7		CC4.0
Coffee Creek		CF3.9	CF3.9	CC5.6
Coffee Creek		CF5.7		CC9.9
Coffee Creek		CF8.0		CC12.9
Coffee Creek	CC0.5	CF8.3		CC13.1
Latte Creek	CC3.5	LC0.5[1]		LC0.05
Latte Creek		LC2.7		LC3.5
Latte Creek	CC1.5	LC9.7		LC11.3
Latte Creek		LC9.9		LC11.7
Latte Creek		LC10.4		LC12.3
Latte Creek		LC11.8		LC13.7
Latte Creek	CC6.0	LC13.5		LC14.4
Latte Creek, Tributary C	CC1.0	LCC0.1		LCC20-0.1
Halfway Creek		HF0.0		HC0.0
Halfway Creek			HF0.1	HC0.1
Halfway Creek	HC5.0	HF0.2	HF0.2	HC0.3

[1] While this site was labeled LC0.5, the actual distance of this site from the mouth of Latte Creek is ~50 m.

Waterbody	Water Quality and Hydrology Station (Lorax 2016)	2016 Station Name	2017 Station Name	2018 Station Name
Halfway Creek			HF0.6	HC0.7
Halfway Creek			HF1.0	HC1.1
Halfway Creek			HF2.0	HC2.2
Halfway Creek	HC2.5	HF6.3	HF6.3	HC6.7
Halfway Creek		HF9.3		HC9.9
YT-24 Creek		YT0.0		YT0.0
YT-24 Creek				YT0.05
YT-24 Creek	ML1.0	YT0.2	YT0.2	YT0.2
YT-24 Creek				YT0.6
YT-24 Creek				YT1.0
YT-24 Creek		YT5.0		YT5.3
Independence Creek	IC4.5	ID1.9	ID1.9	IC2.6
Independence Creek		ID6.7		ID9.2
Independence Creek				IC15.6
Independence Creek, Tributary A				ICA0.4
Independence Creek, Tributary A				ICA0.9
Independence Creek, Tributary A				ICA4.0
Independence Creek, Tributary B				ICB0.2
Independence Creek, Tributary B				ICB0.6
Independence Creek, Tributary B				ICB4.7
Kona Tributary		KT0.1		KT0.1
Kona Tributary		KT5.2		KT5.7
Kona Tributary				KT0.2
Kona Tributary				KT3.4
Dan Man				DM0.2
Dan Man				DM2.2
Yukon River	YUK2.0	YRU2.2		YUK51.5
Yukon River	YUK5.0	YRD21.7		YUK24.6
Yukon River			YRU1.9	YUK51.2
Yukon River			YRD1.6	YUK47.6
Yukon River			YRD2.1	YUK46.1
Isaac Creek		IS0.1		IS0.1

Waterbody	Water Quality and Hydrology Station (Lorax 2016)	2016 Station Name	2017 Station Name	2018 Station Name
Los Angeles Creek		LaC4.8		LA8.5

2 METHODS

Methods are presented for the MSA and the NAR Study Area in separate sections below. The MSA includes controls inside and outside of the mapped MSA.

2.1 MINE STUDY AREA

Aquatic sampling during the 2019 field season included fish sampling on Coffee, Halfway, YT-24, Carlisle, Los Angeles, and Excelsior creeks, as well as fish sampling in the mixing zone of the Yukon River at the mouths of Halfway and YT-24 creeks. Fish sampling consisted of beach seining, electrofishing, and minnow trapping. Fish Habitat Assessment Procedure (FHAP; Johnston and Slaney 1996) surveys were completed on Coffee Creek, upper Halfway Creek, an unnamed tributary upstream of YT-24, lower Carlisle Creek, and a tributary of upper Carlisle Creek. Lastly, Coffee and Independence creeks had Chinook salmon spawning surveys completed. In-situ water quality was measured at all sampled sites (Appendix A).

2.1.1 FISH SAMPLING AND HABITAT INVESTIGATIONS

Fish sampling was conducted on several creeks and rivers within the MSA. Fish sampling occurred during two field events, spanning July 8 to 14 and August 7 to 13, 2019 (Figure 4). The objective of fish sampling was to add to existing baseline fisheries information, particularly for fish distribution and assemblages in several select streams within the MSA. The fish sampling method used at each site depended on physical stream features and suitability of the method for the targeted species. The sampling methods used included electrofishing, beach seining, and minnow trapping. Captured fish were identified to species, with the remaining fish enumerated before all fish were released back at their site of capture.

A Smith Root 12-B POW electrofisher was used for open-site single-pass electrofishing on appropriately sized creeks. The beach seine was 10 m in length, 1.5 m deep and constructed of a 5 mm mesh, with a buoyant float line and sinking lead line. Beach seine hauls were conducted with field crews of two members and consisted of varying lengths, widths, and depths dependent on the stream environment. Minnow traps were placed in areas of good cover and suitable depth and stream velocity. Each minnow trapping site had three small mesh gee type minnow traps (0.6 cm mesh size) baited with cured roe in a perforated bag and were positioned along stream margins in slow water habitats. Water depth, site characteristics, and photos were recorded for each trap and traps were left to soak overnight. A YSI ProSOLO was used to collect in situ water quality parameters (temperature, dissolved oxygen, specific conductivity) at all fish sampling sites; during August a pH pen was also used. Digital photos and GPS coordinates were taken of all sites sampled for fish.

For electrofishing, the fishing effort was enumerated on the device and given in total seconds of active electrofishing as well as the approximate distance from the electrofishing starting GPS point. Beach seining efforts were measured by the length and width of a seine haul (i.e., area seined; m^2). Total minnow trapping effort was enumerated based on the number of traps multiplied by soak times (HH:MM). Ten of each species were weighed (g) and measured to fork length (mm; e.g., Chinook salmon, whitefish) or total length (mm; e.g., slimy sculpin; *Cottus cognatus*) at every site for each sampling method. In some instances, weight could not be

recorded because fish were either too big or too small for the scale. The mean fork length and weight (± standard error; SE) was calculated for each group of fish per species, per sampling event. In cases where no weight was taken, fish length was still used in calculations. Catch-per-unit-effort (CPUE) was also considered at each site, where appropriate. Fish catch data are provided (Appendix B).

2.1.1.1 Coffee Creek

Coffee Creek was visited during both July and August 2019 (Site CC5.6). Minnow trapping occurred on July 11 and August 9, with the primary objective of targeting juvenile Chinook salmon. Three minnow trapping sets occurred at CC5.6, containing three traps per set (n = 9; Figure 4). Minnow traps were set late in the afternoon and pulled early in the morning (mean soak time = 15.19 ± 0.04 hr). The results were presented using an average catch of all the sets, to provide an average for the site. Coffee Creek investigations also included a ground spawning survey, two aerial Chinook spawning surveys conducted in August (see Section 2.1.4), and a fish habitat assessment (see Section 2.1.3).

2.1.1.2 Halfway Creek

Fisheries investigations at Halfway Creek were conducted July 8 and 10, as well as August 7, 9, and 10, 2019. Halfway Creek was sampled for fish with the objective of supplementing and supporting findings from previous years. Electrofishing occurred from 0.2 km to approximately 1.2 km upstream from the confluence with the Yukon River (Table 2; Figure 4). The known logjam approximately 1 km from the mouth had photos and measurements taken. Sampling continued above this perceived barrier (HC1.1) to ascertain whether fish had successfully passed it during the 2019 season. Beach seining took place at the mouth of Halfway Creek to compare species assemblages and abundances in mixing zones of the Yukon River (see Section 2.1.2).

Table 2. Halfway Creek electrofishing methods summary from July and August 2019.

Sampling site	Date	Distance (m)	Fishing effort (seconds)	Electrofisher settings	Duty cycle (%)
HC0.2	July 8, 2019	150	1,189	300 V, 50 Hz, 4ms	20
HC0.2	August 9, 2019	150	1,122	400 V, 60 Hz, 6 ms	36
HC0.7	July 10, 2019	150	1,300	400 V, 50 Hz, 4 ms	20
HC0.7	August 7, 2019	150	936	400 V, 60 Hz, 6 ms	36
HC1.1	July 10, 2019	180	1,124	300 V, 50 Hz, 4ms	20
HC1.1	August 7, 2019	170	956	400 V, 60 Hz, 6 ms	36

2.1.1.3 YT-24 Creek

YT-24 Creek was investigated on July 14 and August 10, 2019. During the July visit, the flow in YT-24 was too low to electrofish. Electrofishing occurred in August on the lower 200 m of the creek (Table 3; Figure 4). The mouth of YT-24 Creek was also beach seined to compare species assemblages and abundances in mixing zones of the Yukon River (see Section 2.1.2).

Table 3. YT-24 Creek electrofishing methods summary from August 2019.

Sampling site	Date	Distance (m)	Fishing effort (seconds)	Electrofisher settings	Duty cycle (%)
YT0.2	August 10, 2019	150	950	400 V, 50 Hz, 3 ms	15

2.1.1.4 Carlisle, Excelsior, and Los Angeles Creeks

Carlisle, Excelsior, and Los Angeles creeks were sampled in either July or August 2019 (Table 4). Minnow trapping occurred at one site on each creek, with the primary objective of targeting juvenile Chinook salmon to act as a control site and compare with Coffee Creek (Figure 4). Three minnow trap sets were deployed at each site, and each set included three traps (i.e., n = 9). Traps were left to soak overnight and occasionally into the day (Table 4). Carlisle Creek also had a fish habitat assessment conducted in August (see Section 2.1.3).

Table 4. Minnow trapping summary on Carlisle, Excelsior, and Los Angeles creeks in July and August 2019.

Sampling site	Creek	Date	Mean soak time (± SE hr)	Distance from Independence Creek (km)
CL7.9	Carlisle Creek	July 12, 2019	26.6 ± 0.01	4.9 km downstream
EX2.9	Excelsior Creek	August 10, 2019	14.9 ± 0.01	27.5 km upstream
LAX4.6	Los Angeles Creek	August 11, 2019	23.6 ± 0.02	9.5 km downstream

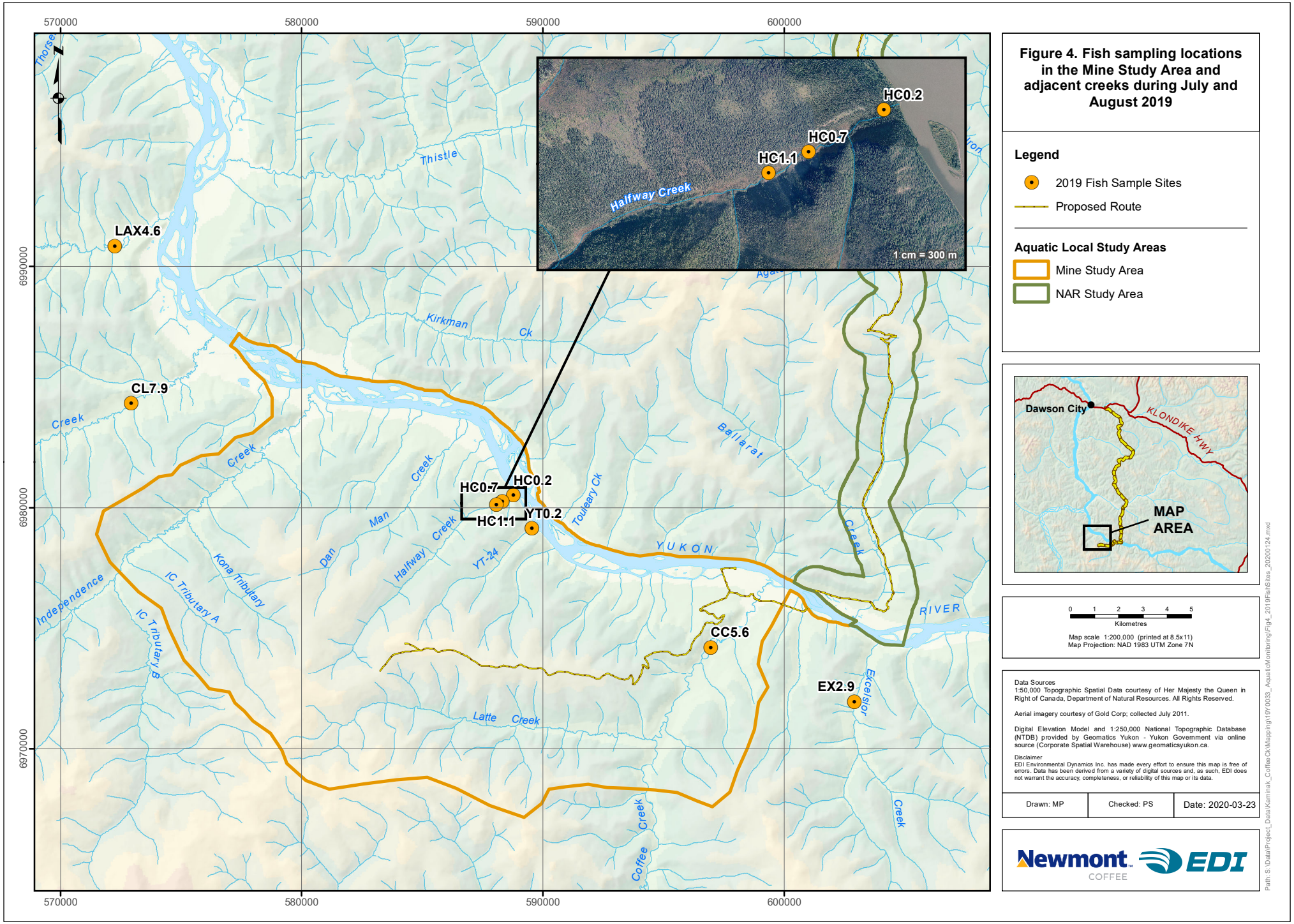

Figure 4. Fish sampling locations in the Mine Study Area and adjacent creeks during July and August 2019

Legend

- 2019 Fish Sample Sites
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

0 1 2 3 4 5
Kilometres

Map scale 1:200,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
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Aerial imagery courtesy of Gold Corp; collected July 2011.

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2.1.2 YUKON RIVER MIXING ZONES

As suggested by the Selkirk First Nation, fish sampling was completed for the second year at the mixing zones of both Halfway and YT-24 creeks with the Yukon River. Sampling at the Halfway Creek mixing zone occurred on July 12 and August 9, and at YT-24 on July 14 and August 10, 2019. The mixing zone is defined as the immediate area where the creek flows into the Yukon River and the two water masses mix. Sampling involved three successive beach seine hauls, beginning in the Yukon River at the creek mouths and continuing downstream (Figure 5). During each sampling event, three seine hauls were completed, beginning at the mouth of the creek and going progressively downstream on the Yukon River. Beach seine hauls were conducted with field crews of two members for a length of approximately 15 m, although lengths ranged depending on conditions and riverbed morphology (mean = 15.5 ± 1.5 m; range = 8 – 25 m). Fish captured were enumerated, and a subset of ten fish per species had their length and weight taken from each seine haul. Fish measurement metrics were summarized (fork length and weight, ± SE) for all species captured.

2.1.3 FISH HABITAT ASSESSMENTS

Fish habitat surveys were conducted on three drainages during July and August 2019 following the FHAP survey methodology (Table 5). The FHAP survey documents the characteristics and frequency of different fish habitats by enumerating different habitat units (e.g., pool, riffle, glide), and measuring various parameters (e.g., average depth, width, length). A detailed methodology is outlined in the FHAP guide (Johnston and Slaney 1996). The length of habitat units was measured using a laser range finder for all creeks assessed, whereas wetted widths, bankfull widths, and depths were measured with a measuring tape and/or metre stick for the unnamed tributary upstream of YT-24 (herein referred to as 'Unnamed Tributary') and both Carlisle Creek sites; Coffee Creek used the range finder for wetted and bankfull widths due to its size. Results were considered as average ± standard error (SE).

Table 5. Summary of fish habitat assessments in July and August 2019.

Creek	Date	Distance (m)	Latitude	Longitude
Unnamed Tributary	July 9, 2019	516	62.923359	-139.220304
Coffee Creek	July 12, 2019	1,091	62.878546	-139.107593
Carlisle Creek	July 13, 2019	1,117	62.977835	-139.569427
Carlisle Creek tributary	August 11, 2019	561	62.928957	-139.738841

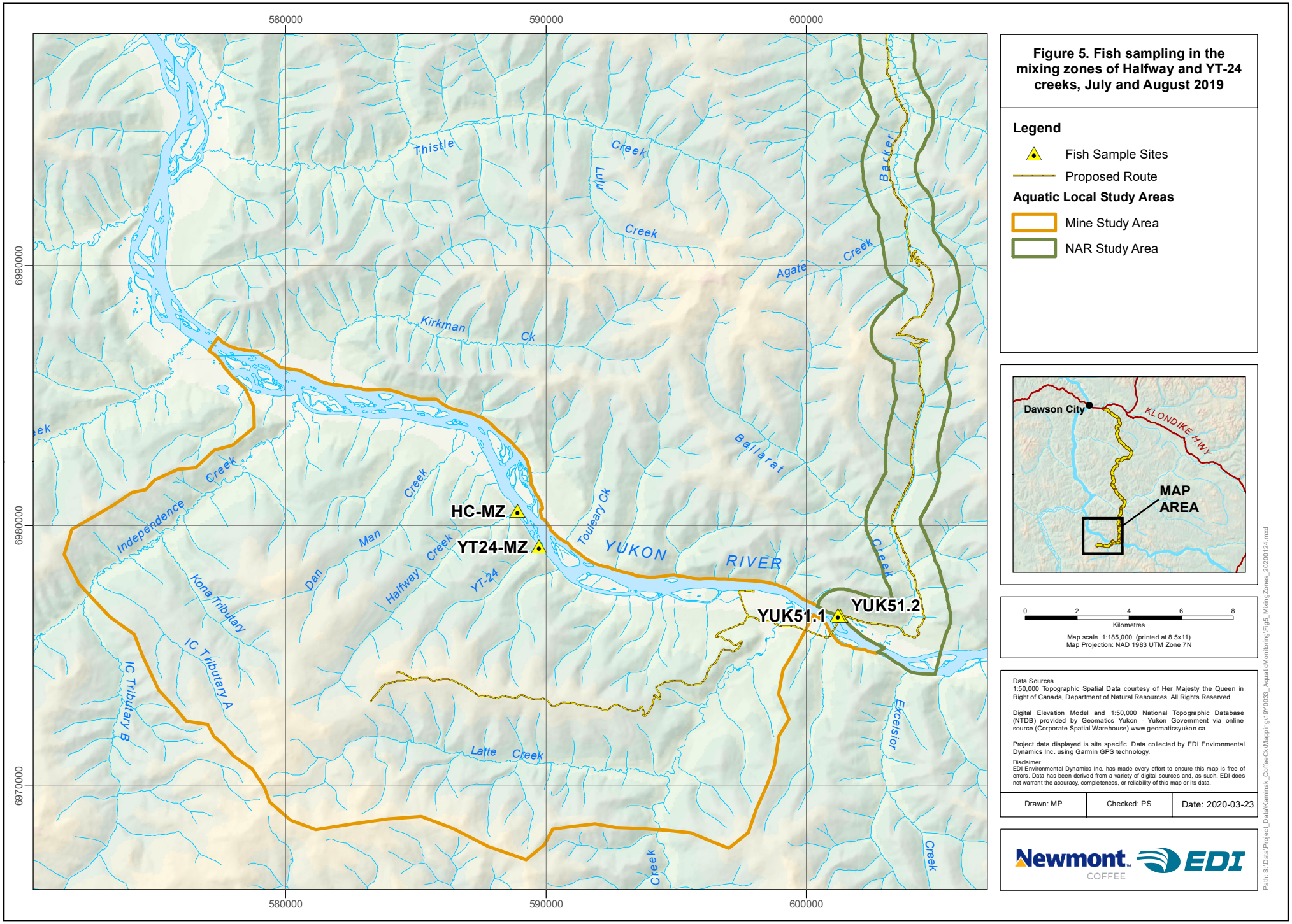

Figure 5. Fish sampling in the mixing zones of Halfway and YT-24 creeks, July and August 2019

Legend

- Fish Sample Sites
- Proposed Route

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

0 2 4 6 8
Kilometres

Map scale 1:185,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

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2.1.4 CHINOOK SALMON SPAWNING SURVEYS

Chinook salmon spawning surveys were completed in areas where Traditional Knowledge indicated past presence (Tr'ondëk Hwëch'in 2012) and in watersheds that appear to have habitat to support spawning Chinook salmon; as such, Coffee Creek and Independence Creek have been investigated and surveyed for spawning Chinook salmon annually since 2014. During the 2019 field season, Coffee and Independence creeks had two aerial surveys completed. Coffee Creek investigations also included a ground survey (stream walk) to record any evidence of Chinook salmon spawning (Figure 6).

During the 2019 aerial surveys, two field crew members were positioned on the right side the helicopter, with one observer in front of the other. The pilot flew the helicopter over the river at an angle approximately 40-45 m above the creek. Surveys were completed in the early afternoon. To reduce glare, the creeks were flown starting upstream and continuing downstream towards the Yukon River. Observers also wore polarized glasses to reduce glare from the water. Weather was sunny for the first survey and overcast with some sun during the second survey.

The first set of aerial surveys on Coffee and Independence creeks was conducted on August 8, 2019, with very good visibility and a flight time of 30 and 33 minutes, respectively. The second set of surveys occurred on August 13, 2019, lasting 33 minutes on Coffee Creek, and 36 minutes on Independence Creek, with good visibility. Water levels in the creeks were slightly lower during the second survey than the first.

On August 13, 2019, a stream walk was completed on Coffee Creek to look for any sign of spawning activity. A field crew of two walked Coffee Creek from the confluence with Latte Creek downstream to approximately 4.0 km from the Yukon River. Conditions were good for observing living adult salmon, carcasses, redds or associated wildlife (i.e., eagles, bears). The crew was able to walk the channel either in or alongside the wetted portion of the creek.

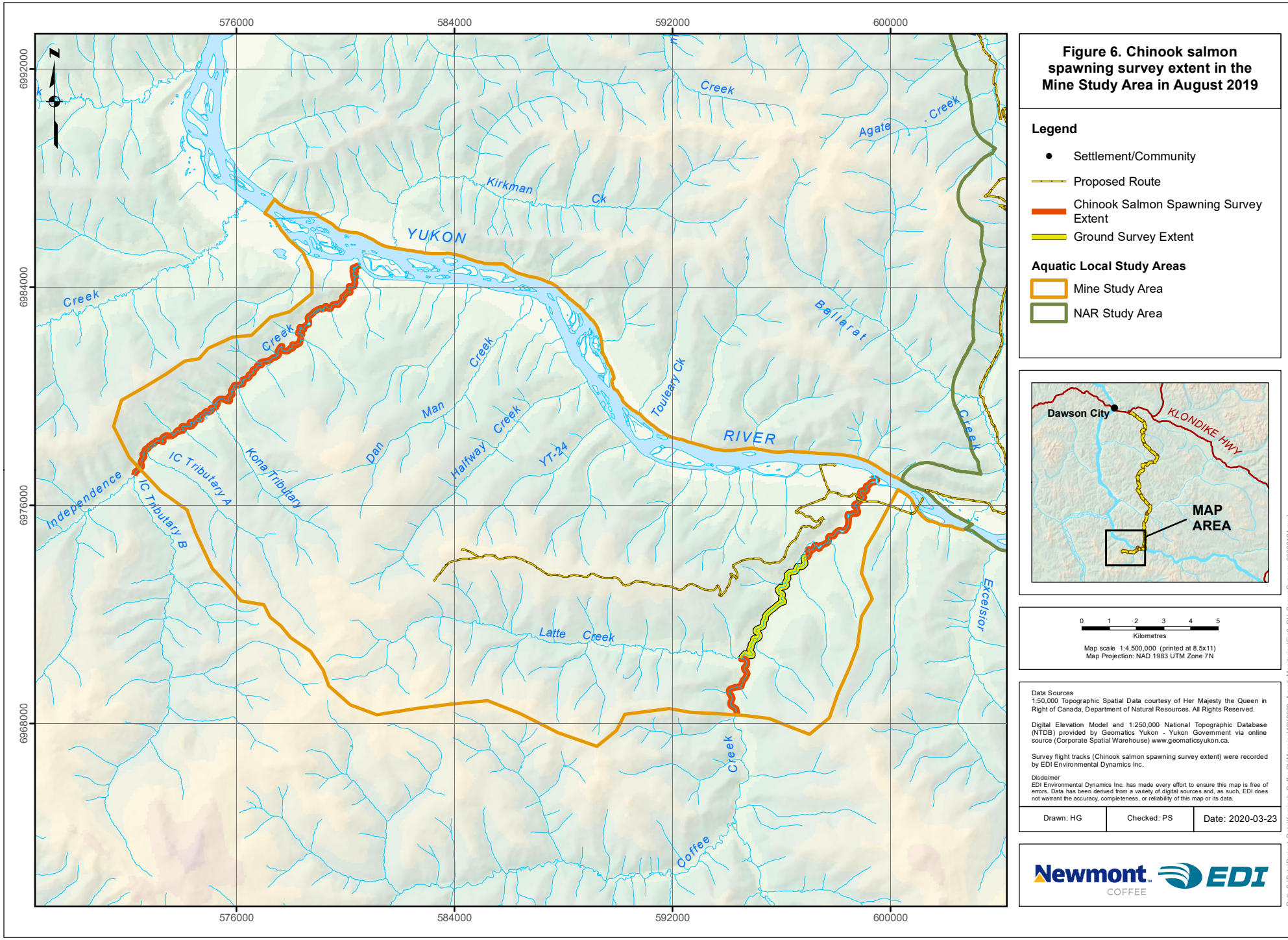

Figure 6. Chinook salmon spawning survey extent in the Mine Study Area in August 2019

Legend

- Settlement/Community
- Proposed Route
- Chinook Salmon Spawning Survey Extent
- Ground Survey Extent

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area

0 1 2 3 4 5
Kilometres

Map scale 1:4,500,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
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Survey flight tracks (Chinook salmon spawning survey extent) were recorded by EDI Environmental Dynamics Inc.

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2.2 NORTHERN ACCESS ROUTE

During the 2019 field season, proposed and existing barge landings were sampled, an opportunistic barge wake investigation took place on the Yukon River, and the Stewart River back channel was investigated.

2.2.1 BARGE LANDING INVESTIGATIONS

Locations of proposed barge landings on the Yukon and Stewart rivers were visited and sampled for fish during July and August 2019. Fish sampling was conducted using beach seining along the banks of the proposed barge landings. The Yukon River was sampled July 14 and August 8, 2019, and the Stewart River was sampled on July 11 and August 10, 2019. During July sampling, a total of six beach seine hauls were completed at/near the proposed barge landing sites (north and south) on the Yukon River, and another six were completed between the two proposed barge landings on the Stewart River. The same amount of effort was completed during the August field visit, with the addition of three seine hauls on the Yukon River at the existing barge landing near the Coffee Camp (Figure 7).

Information collected for each beach seine haul included seine haul dimensions (length, width, depth). Fish were identified and enumerated; a random ten individuals from each species were weighed and had fork length measured for each seine haul. Fish measurement metrics were summarized (fork length and weight, ± SE) for all species captured.

All seine hauls were conducted at the site of the proposed barge landings, with the exception of the Yukon River north bank proposed barge. The Yukon River north bank barge landing has steep eroding banks and deep water; as such, the seine hauls were completed 75 m downstream.

2.2.2 BARGE WAKE INVESTIGATIONS

EDI field crews conducted one river barge wake investigations from shore on July 10, 2019, at the mouth of Halfway Creek. This investigation was completed opportunistically while a crew was working along the Yukon River and a barge was approaching. Photos and videos were taken before, during, and after the barge passing. The distance of the barge from the shore was recorded, together with load content based on visual appearance, and other pertinent observations. After the barge had passed, the wave runout extent (i.e., slope distance waves travelled up the previously dry shoreline) was recorded.

2.2.3 STEWART RIVER BACK CHANNEL INVESTIGATIONS

2.2.3.1 Spring

The Stewart River back channel was visited May 24, 2019, to further investigate fish presence, particularly adult northern pike, in support of the 2018 findings of young-of-the-year juvenile northern pike. The back channel was walked and beach seined at nine sites, in addition to the uppermost site, which was the uppermost extent with water. Beach seine hauls were conducted with two field crew members for variable seine lengths depending on conditions and water depth (mean = 7.9 ± 1.2 m; range = 1 – 15 m). Fish captured were enumerated, and a subset of ten fish per species had their length and weight measured from each seine haul.

Fish measurement metrics were summarized (fork length and weight, ± SE) for all species captured. Digital photos and GPS coordinates were taken of all sites.

2.2.3.2 Summer

The back channel was investigated again on July 11, 2019. A YSI ProSOLO was used to measure in situ water quality parameters (temperature, dissolved oxygen, and specific conductivity). Digital photos were taken and GPS coordinates were recorded. On August 10, 2019, the Stewart River back channel was observed from the air and photos were taken.

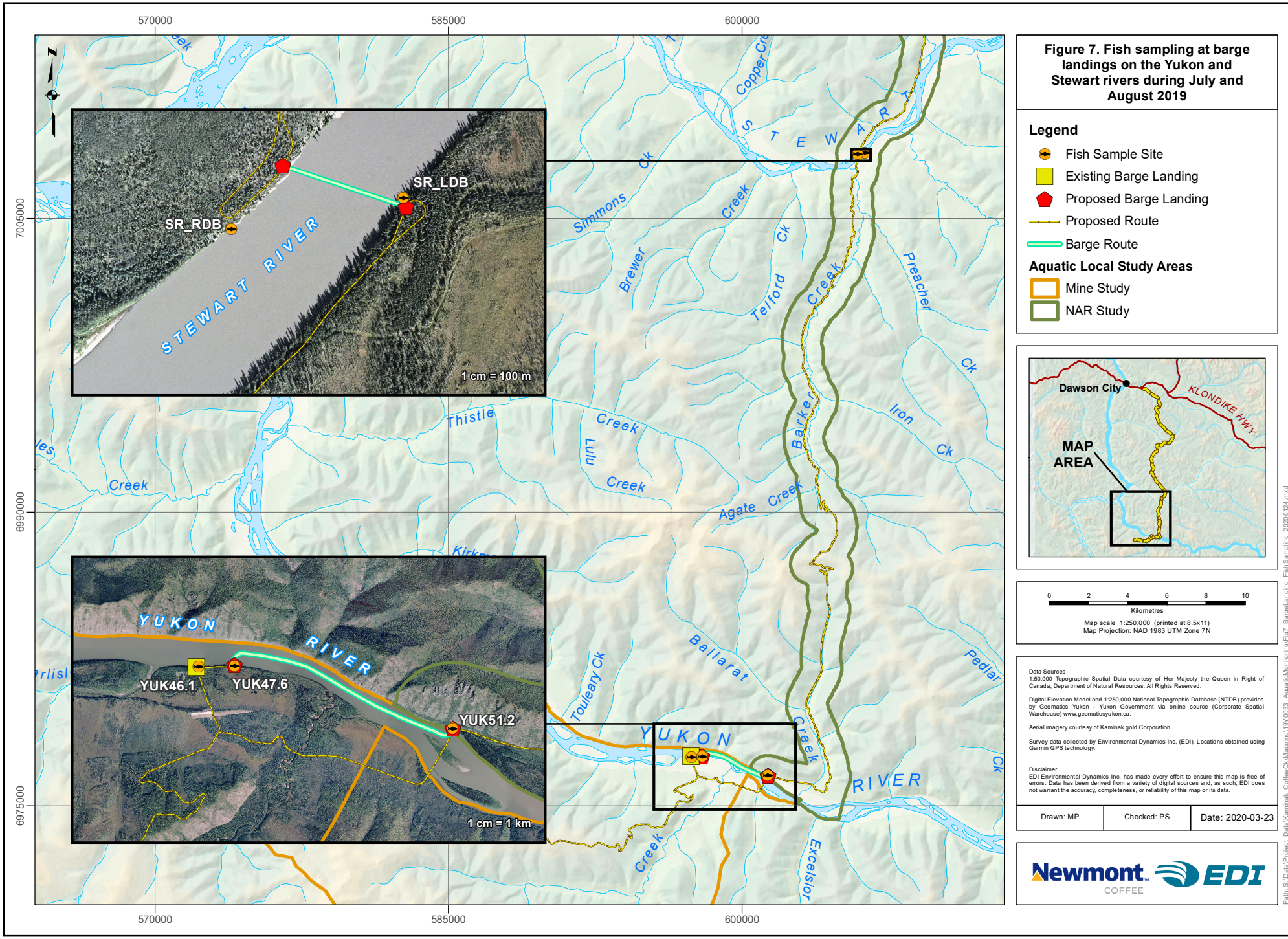

Figure 7. Fish sampling at barge landings on the Yukon and Stewart rivers during July and August 2019

Legend

- Fish Sample Site
- Existing Barge Landing
- Proposed Barge Landing
- Proposed Route
- Barge Route

Aquatic Local Study Areas

- Mine Study
- NAR Study

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Aerial imagery courtesy of Kaminak gold Corporation.

Survey data collected by Environmental Dynamics Inc. (EDI). Locations obtained using Garmin GPS technology.

Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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3 RESULTS AND DISCUSSION

Results and discussion for the MSA and NAR are presented per project component in the following sections.

3.1 MINE STUDY AREA

Fish sampling occurred in both July and August 2019. Creek levels were very low during the July sampling, while during August sampling creek water levels were higher and fast-moving.

3.1.1 FISH SAMPLING AND HABITAT INVESTIGATIONS

3.1.1.1 Coffee Creek

Coffee Creek was sampled using minnow trapping techniques in July and August 2019. Both juvenile Chinook and slimy sculpin were captured during each sampling event. Juvenile Chinook salmon increased in size and weight between the July and August sampling events (Table 6). Catch-per-unit-effort was lower for juvenile Chinook salmon during the July sampling event (1.0 ± 0.6) than in August (12.4 ± 6.5; Table 6). Slimy sculpin were captured in low numbers during both sampling events. Due to the differences in habitat suitability of each minnow trap set, catches were variable between sets (e.g., large CPUE standard error for juvenile Chinook in August).

Table 6. Coffee Creek fish metrics (fork length and weight, ± SE) and catch-per-unit-effort (fish/100 m² ± SE) summary, July and August 2019.

Month	Average sampling effort per set (hrs)	Species	Total fish captured	Average fork length (mm ± SE)	Fork length range (mm)	Average weight (g ± SE)	Weight range (g)	Average CPUE (fish per 24 hr ± SE)
July	54.1	CH	7	66.3 ± 1.6	61 – 72	3.4 ± 0.3	3.8 – 14.7	1.0 ± 0.6
		CCG	11	84.7 ± 3.3	69 – 110	7.4 ± 0.9	2.6 – 4.4	1.6 ± 0.5
August	45.6	CH	71	78.0 ± 0.8	69 – 89	4.9 ± 0.2	3.4 – 7.8	12.4 ± 6.5
		CCG	4	80.3 ± 4.3	60 – 90	6.6 ± 1.0	2.1 – 8.8	0.7 ± 0.3

CH = Chinook salmon; CCG = slimy sculpin; CPUE = catch per unit effort

3.1.1.2 Halfway Creek

Halfway Creek was electrofished at several sites during the July and August sampling events. The two sites (HC0.2 and HC0.7) below the previously identified logjam barrier[2] (located 1.0 km from the mouth) were sampled for 150 m during both events, while the site above the logjam (HC1.1) was sampled for 180 m in July and 170 m in August. All sampling durations ranged from 936 – 1,300 (± 56.7) seconds. During the July field visit Arctic grayling (*Thymallus arcticus*) were captured at both the lower sites in moderate numbers (Table 7). In addition to those captured at HC0.2 and HC0.7 (n = 5 at both sites), another three were observed but not captured. No Arctic grayling were captured above the logjam (Site HC1.1).

[2] Logjam barrier is not considered permanent; other impediments have been identified upstream .

During the August visit to Halfway Creek, Arctic grayling were captured at both the lower sites in high numbers, as well as juvenile Chinook salmon in the lower 200 m (Table 7). At the lower site (HC0.2) there was a total of 22 Arctic grayling electrofished. Additionally, two juvenile Chinook salmon were captured in the lower 200 m of Halfway Creek (Table 7). Similar to the July sampling event, no fish were observed or captured above the logjam barrier at HC1.1 (Table 7).

Table 7. Halfway Creek fish metrics (fork length and weight, ± SE) and catch-per-unit-effort (fish/100 m² ± SE) summary, July and August 2019.

Date	Sampling site	Species	Total fish captured	Average fork length (mm ± SE)	Fork length range (mm)	Average weight (g ± SE)	Weight range (g)	CPUE (fish per 1000 EF seconds)
July 2019	HC0.2	GR	5	160.8 ± 20.5	124 – 235	56.8 ± 23.8	17.9 – 147	4.21
	HC0.7	GR	5	213 ± 17.0	178 – 255	119.6 ± 22.7	77.5 – 188	3.82
	HC1.1	NFC	0	-	-	-	-	0.00
August 2019	HC0.2	GR	22	164.5 ± 12.5	72 – 303	61.4 ± 12.0	5.5 – 174	19.6
	HC0.2	CH	2	67.5 ± 2.5	65 – 70	4.7 ± 0.1	4.6 – 4.8	1.8
	HC0.7	GR	1	170 ± 0.0	170	n/a	n/a	1.1
	HC1.1	NFC	0	-	-	-	-	0.00

NFC = no fish captured; CH = Chinook salmon; GR = Arctic grayling; EF = electrofishing; CPUE = catch per unit effort

The previously identified logjam was measured during the July field visit, at which point there were three locations with water flowing over drops (Table 8). The logjam is approximately 15 m wide in a series of drops and shallow pools; broadly, a drop occurred at the right and left banks (facing downstream), with another mid-channel. The drop on the right had the deepest pool depth, but was little more than a trickle over fallen logs, and had very minimal pool depth above the drop (Table 8, Photo 1). In the middle of the channel, the drop was in the form of a sieve and had shallow pools both above and below the drop (Table 8, Photo 2). The left drop was also in the form of a sieve and had very shallow pools above and below (Table 8, Photo 3). Each of the drop also had small and large woody debris overlaying them.

Table 8. Halfway Creek potential fish barrier (HC1.1) measurements, July 2019.

	Downstream pool depth (m)	Upstream pool depth (m)	Drop height (m)	Drop width (m)
Right bank	0.76	0.05	0.80	1.0
Mid-channel	0.27	0.35	0.50	1.6
Left bank	0.10	0.15	0.40	1.2

Due to the shallow pools below and above the drops, it is unlikely for a fish (e.g., Arctic grayling) to have the space to burst for the necessary propulsion required to make it up and over the obstructions. An Arctic grayling seen below the right bank drop during the July sampling (Photo 4), but none were captured above the barrier in either July or August 2019.



Photo 1. Halfway Creek potential fish barrier right bank drop, July 2019.



Photo 2. Halfway Creek potential fish barrier mid-channel drop, July 2019.



Photo 3. Halfway Creek potential fish barrier left bank drop, July 2019.



Photo 4. Arctic grayling spotted in the right bank pool below the drop, July 2019.

3.1.1.3 YT-24 Creek

YT-24 Creek was visited during both the July and August field event. The creek was first visited on July 10, 2019, when a dry stretch of creek was discovered. Approximately 60 m of the creek was entirely dry, between 190 and 250 m from the mouth (Photo 5, Photo 6). In situ water quality parameters indicated the area below the dry portion of stream had lower temperature and dissolved oxygen compared with above the dry portion, but similar specific conductivity (Table 9). Investigating the banks did not indicate any obvious springs; however, due to the substantially lower temperature and dissolved oxygen, it is possible that the lower flowing portion of the stream was being sourced through groundwater upwelling.

Table 9. In situ water quality parameters above and below the dry portion of YT-24 Creek on July 10, 2019.

	Temperature (° C)	Dissolved oxygen (%)	Dissolved oxygen (mg/L)	Specific conductivity (µS)
Below dry portion	2.5	50.0	6.81	257.6
Above dry portion	5.0	95.4	12.18	264.4

The creek was again visited on July 14, 2019. Due to continued dry conditions, YT-24 Creek did not contain enough water to reach the Yukon River, drying up approximately 3.5 m from the mouth (Photo 7).

During the August visit, considerably more water was present in the creek and was sampled 200 m from the mouth for 150 m and 950 seconds of electrofishing at site YT0.2. No fish were observed or captured during this time.



Photo 5. A dry portion of YT-24 Creek between 190 and 250 m from the mouth on July 10, 2019.

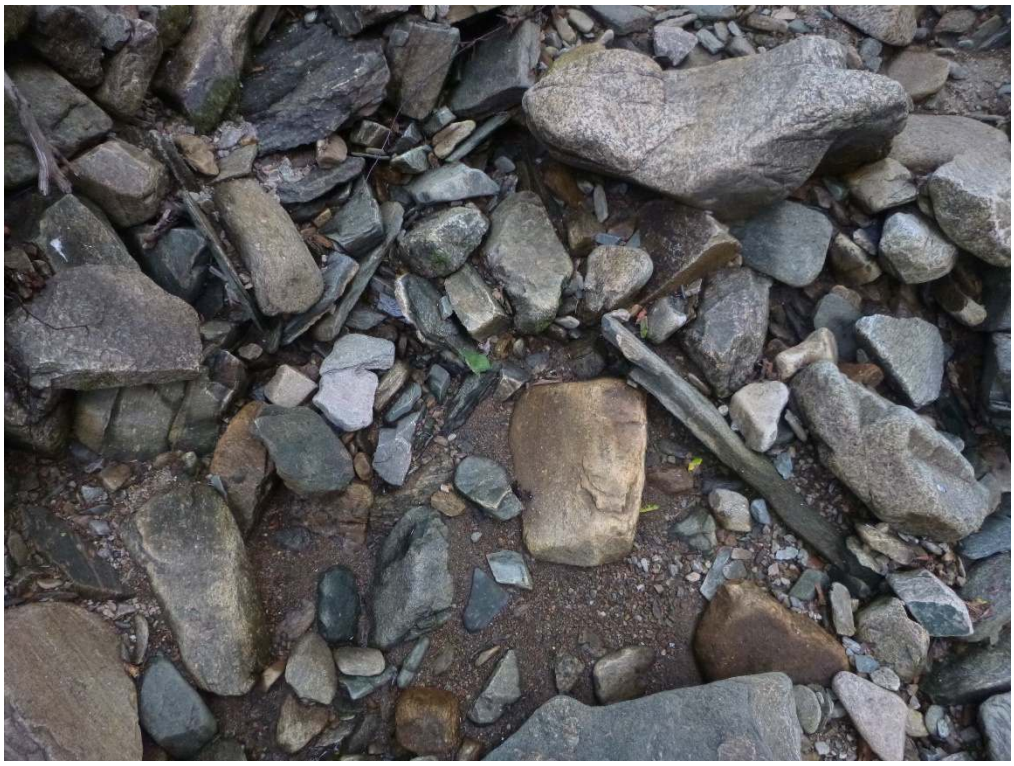

Photo 6. Dry interstitial spaces in YT-24 Creek on July 10, 2019.



Photo 7. The mouth of YT-24 drying up before reaching the Yukon River on July 14, 2019.

3.1.1.4 Carlisle, Excelsior, and Los Angeles Creeks

Carlisle Creek was sampled in July, while Excelsior and Los Angeles creeks were sampled in August. All sites were sampled using minnow traps with the purpose of capturing juvenile Chinook salmon. The minnow traps did not capture any fish at any of the three creeks, and no juvenile Chinook salmon were observed. Arctic grayling were observed in high numbers in Carlisle Creek, and a few were spotted in both Excelsior and Los Angeles creeks. These results indicate that these sites are not deemed suitable control sites to compare juvenile Chinook growth rates with those captured in Coffee Creek.

3.1.2 YUKON RIVER MIXING ZONES

Both Halfway and YT-24 creeks were sampled in their mixing zones during July and August sampling; the same Yukon River reference site from 2018 was used for comparison (YUK51.2, north barge landing). Due to the low water levels in July, the mixing zone of Halfway Creek was limited in size. No discharge from YT-24 into the Yukon River occurred during July sampling, therefore no true 'mixing zone' existed; however, the site was still sampled.

Similar species were captured in the Halfway Creek mixing zone in July and August (Table 10). In July, juvenile Chinook, Arctic grayling, slimy sculpin, and juvenile round whitefish (*Prosopium cylindraceum*) were captured; in August, all but slimy sculpin were captured (Table 10). During the July sampling a total of 69 juvenile Chinook salmon were captured, compared with 32 during the August sampling event. Alternatively, there were substantially more Arctic grayling captured in August than in July (n = 57 and n = 6, respectively; Table 10).

Table 10. Halfway Creek mixing zone fish metrics (fork length and weight, ± SE) July and August sampling, 2019.

Month	Species captured	Total captured	Total measured	Fork length (± SE; mm)	Weight (± SE; g)
July	CH	69	28	69.4 ± 1.1	3.9 ± 0.2
	GR	6	6	161.2 ± 19.6	51.7 ± 20.2
	CCG	4	1	6.5 ± 0.0	3.5 ± 0.0
	RW	3	3	62.7 ± 2.3	2.2 ± 0.2
August	CH	23	14	78.1 ± 1.5	5.1 ± 0.3
	GR	57	23	100.5 ± 7.9	10.4 ± 2.1
	RW	2	2	106.0 ± 28.0	13.2 ± 9.2

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; RW = round whitefish

Despite the lack of a visible mixing zone on YT-24 Creek in July, the species diversity was the highest of any mixing zone or reference site sampling completed in 2019 (Table 11). Six species were captured, with longnose sucker (*Catostomus Catostomus*; n = 40) and juvenile Chinook salmon (n = 32) being the most abundant (Table 11). An adult inconnu (*Stenodus leucichthys*) was observed but was not successfully captured during July sampling.

Water levels were higher in August, which allowed for YT-24 to discharge into the Yukon River, creating a mixing zone. The August sampling period had high species diversity having five species captured (Table 11), with juvenile Chinook (n = 20) and Arctic grayling (n = 19) being the most abundant. During both July and August sampling, lake whitefish (*Coregonus clupeaformis*) was the least abundant species captured (n = 1; Table 11, Table 12).

Table 11. YT-24 Creek mixing zone fish metrics (fork length and weight, ± SE) from July sampling, 2019.

Month	Species captured	Total captured	Total measured	Fork length (± SE; mm)	Weight (± SE; g)
July	CH	32	20	68.4 ± 1.7	3.9 ± 0.2
	GR	5	5	71.8 ± 15.9	6.9 ± 5.0
	CCG	9	1	51.0 ± 0.0	1.9 ± 0.0
	RW	10	10	56.2 ± 2.1	1.6 ± 0.2
	LSU	40	0	All approx. 20 mm	<1.0
	LW	1	1	46.0 ± 0.0	1.2 ±0.0
August	CH	20	11	78.2 ± 2.2	5.3 ± 0.4
	GR	19	19	110.7 ± 10.5	23.2 ± 7.7
	CCG	7	6	32.7 ± 2.2	<1.0
	RW	2	2	81.5 ± 0.5	4.4 ± 0.2
	LW	1	1	94.0 ± 0.0	7.6 ± 0.0

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; RW = round whitefish; LW = lake whitefish; LSU = longnose sucker

The same Yukon River reference site (YUK51.2) was used to compare the mixing zone results. Both during July and August sampling, fewer species were captured at the Yukon River reference site than in the mixing zones. In July, only juvenile Chinook salmon and Arctic grayling were captured; in August three species were captured, including juvenile Chinook salmon, Arctic grayling, and slimy sculpin (Table 12).

During the July sampling of the Yukon River reference site, fish activity was observed directly below where the initial sampling had occurred, in very similar habitat to the reference site. Field staff opted to sample one site directly downstream of where the reference site sampling occurred. A total of 51 juvenile Chinook salmon were captured, which was similar to the numbers caught in the mixing zones (Table 13).

Table 12. Yukon River reference site (YUK51.2) fish metrics (fork length and weight, ± SE) from July and August sampling, 2019.

Month	Species captured	Total captured	Total measured	Fork length (± SE; mm)	Weight (± SE; g)
July	CH	8	8	63.8 ± 8.1	4.4 ± 0.3
	GR	1	1	136.0 ± 0.0	22.2 ± 0.0
August	CH	22	11	78.2 ± 1.3	5.6 ± 0.3
	GR	10	10	135.2 ± 9.7	28.9 ± 3.5
	CCG	2	1	47.0 ± 0.0	1.6 ± 0.0

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin

Table 13. Directly below the Yukon River reference site (YUK51.2) fish metrics (fork length and weight, ± SE) from July sampling, 2019.

Month	Species captured	Total captured	Total measured	Fork length (± SE; mm)	Weight (± SE; g)
July	CH	51	30	72.5 ± 0.8	4.8 ± 0.2
	GR	1	1	136.0 ± 0.0	27.9 ± 0.0
	LSU	2	2	84.0 ± 0.0	6.4 ± 0.1

CH = Chinook salmon; GR = Arctic grayling; LSU = longnose sucker

Juvenile Chinook salmon and Arctic grayling CPUE was calculated for both mixing zones and the Yukon River reference (YUK51.2) site in July and August, and the site below the Yukon River reference site in July (Table 14, Figure 8). Overall, the mixing zones had higher CPUE than the reference site, although often with

very high variance (i.e., standard error). This is a product of the variability associated with beach seining for shoaling groups of fish. In both July and August on YT-24 Creek, there was a large haul as well as a haul yielding no fish – this resulted in a large CPUE, but also high variability (Table 14; Appendix B).

To further explain the inherent catch variability of beach seining, a site directly downstream of the Yukon River reference site was sampled in July. The Yukon River reference site did not yield a high number of fish (specifically juvenile Chinook salmon; Table 12), but directly downstream field staff could observe jumping juvenile Chinook salmon. Habitat characteristics between the two sites appeared to be identical. The site directly adjacent to the low yield Yukon River reference site had a substantially higher CPUE of juvenile Chinook salmon (Table 14). It is important to consider the natural variability in catch numbers and CPUE (both spatially and temporally) when interpreting mixing zones and the Yukon River reference site.

Table 14. Catch-per-unit-effort (fish/100 m² ± SE) of juvenile Chinook salmon and Arctic grayling captured in the Halfway and YT-24 Creek mixing zones, and the Yukon River reference site in July and August 2019. A site downstream of the Yukon reference site was also considered in July.

Month	No. of hauls	Location	Juvenile Chinook salmon		Arctic grayling	
			Mean CPUE (fish/100m²) ± SE	CPUE range (fish/100m²)	Mean CPUE (fish/100m²) ± SE	CPUE range (fish/100m²)
July	3	Halfway Creek mixing zone	14.5 ± 8.5	2.4 – 30.8	1.7 ± 1.7	0.0 – 1.7
		YT-24 Creek mixing zone	19.4 ± 14.4	0.0 – 47.5	1.9 ± 1.0	0.0 – 3.3
		Yukon River (reference location)	1.5 ± 0.9	0.0 – 3.0	0.3 ± 0.3	0.0 – 0.8
		Yukon River (downstream of reference location)	12.2 ± 3.5	7.5 – 19.2	0.2 ± 0.2	0.0 – 0.6
August	3	Halfway Creek mixing zone	6.3 ± 4.4	0.9 – 15.1	17.5 ± 11.4	2.9 – 40.0
		YT-24 Creek mixing zone	16.1 ± 14.5	0.0 – 45.0	9.4 ± 7.8	0.0 – 25.0
		Yukon River (reference location)	8.2 ± 5.4	1.4 – 18.9	3.3 ± 2.3	0.0 – 7.8

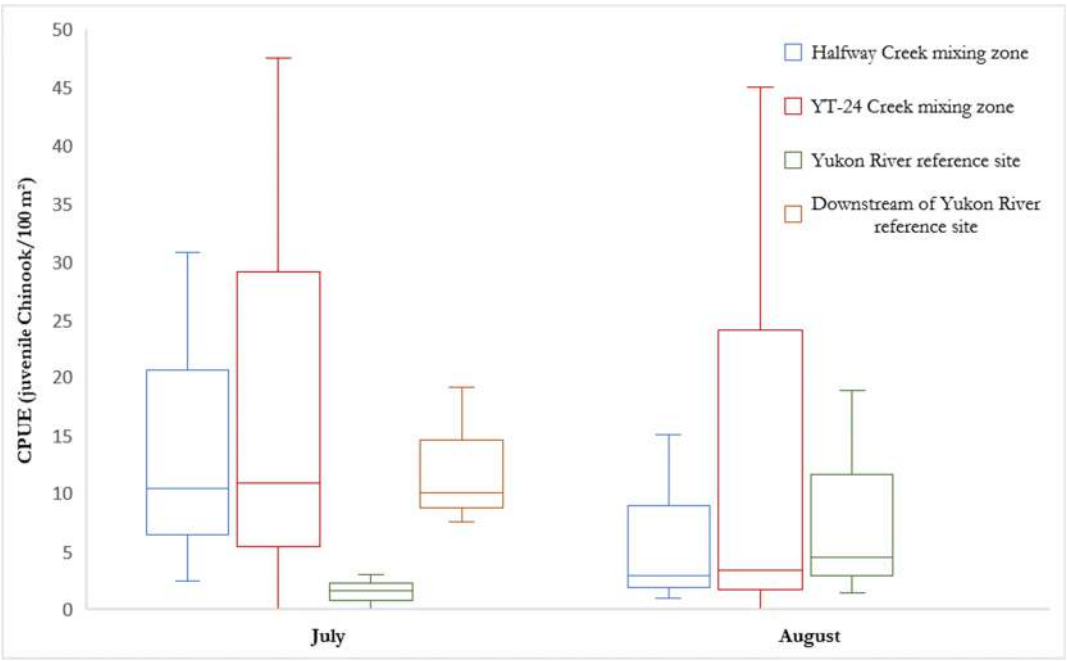

Figure 8. A box-and-whisker plot comparison of CPUE of juvenile Chinook salmon between Halfway and YT-24 mixing zones, and the Yukon River reference site (YUK51.2) in July and August 2019. A site directly downstream of the reference site was also included during July sampling.

The mixing zones appeared to consistently have a higher species diversity than the Yukon River reference site or the site directly downstream of the reference site. The species diversity of the mixing zones was similar to results from the 2018 field season; however, in 2018, the Yukon River reference site contained the same species diversity as the mixing zones (EDI 2019). The catch numbers of juvenile Chinook salmon and Arctic grayling were also higher during 2018 sampling – however, when considering catch data, it is important to consider the inherent variability of sampling shoaling species, as was exemplified in the site adjacent to the Yukon River reference site.

3.1.3 FISH HABITAT ASSESSMENTS

Fish Habitat Assessment Procedure (FHAP) survey results are summarized by sampling location in the following sections, with detailed survey data affixed as an appendix item (Appendix C).

3.1.3.1 Coffee Creek

During July 2019 monitoring, a FHAP survey was conducted on a 1,088 m section of Coffee Creek (Figure 9). Twenty-four distinct habitat units were identified during the survey, comprised of three habitat unit types: pools, riffles, and glides (Table 15). No steep riffle[3] or cascade habitat units were identified during the survey.

The surveyed section of Coffee Creek was dominated by glide habitat, which comprised 58 % of all habitat units by length (Table 15; Photo 8). The average length of glide habitat units was 64.6 (± 10.7) m and ranged

[3] While not listed in the FHAP manual, EDI has added habitat type of 'steep riffle' as it separates regular low gradient riffles from ones with higher gradients (> 5 %).

from 14.7 to 105.7 m in length. Large cobbles and overhanging vegetation were the dominant forms of instream cover, providing 8 % of cover on average in glide hatibat. The remaining habitat was comprised of riffle (32 %) and pool (10 %) habitat units by length. Habitat units in Coffee Creek generally alternated between long glides and riffles, with pools interspersed throughout either as primary or tertiary habitat units (Figure 9). The average bankfull width over all habitat units in Coffee Creek was 17.5 (± 1.1) m with an average wetted width of 10.3 m and an average water depth of 0.33 m during the July 2019 survey.

Fish habitat assessment procedure surveys were designed to be conducted on streams with less than a 15 m wide bankfull width (Johnston and Slaney 1996). As streams increase in size, they tend to exhibit large channel morphology characteristics. While the average bankfull width of Coffee Creek was greater than 15 m (17.5 ± 1.1 m), the creek does not exhibit large river channel morphology characteristics. Additionally, habitat units including glides, riffles, and pools are easily identified and delineated.

The frequency and extent of habitat units in the surveyed section of Coffee Creek represent relatively low quality salmon rearing (< 40 % pools by area), and moderate to good quality migrating adult holding habitat (Johnston and Slaney 1996). A total of four pool habitat units (primary and tertiary) were identified in the surveyed section of the creek, all of which were deep and had residual pool depths of at least one metre (Table 15). While few pool habitat units were identified by area, when pool habitat does occur, it could provide suitable holding habitat for migrating adult salmon (Johnston and Slaney 1996).

Table 15. Summary of habitat units identified during the Fish Habitat Assessment Procedure survey of Coffee Creek on July 12, 2019.

Habitat type	No. of units	Average length (± SE; m)	Total length in surveyed extent (m)	Percent of total survey extent
Cascade	0	-	-	0.0 %
Glide	10	64.6 ± 10.7	645.5	59.0 %
Pool	2	35.2 ± 4.5	70.3	6.0 %
Riffle (<5 % grade)	9	41.3 ± 7.9	372.0	34.0 %
Steep riffle (>5 % grade)	0	-	-	0.0 %
Tertiary glide	1	19.0 ± 0.0	19.0	n/a
Tertiary pool	2	25.0 ± 1.1	49.9	n/a
Total	**24**	**51.8 ± 6.5**	**1,087.8**	**100.0 %**



Photo 8. Example of glide habitat on Coffee Creek (0+055 m; July 12, 2019).

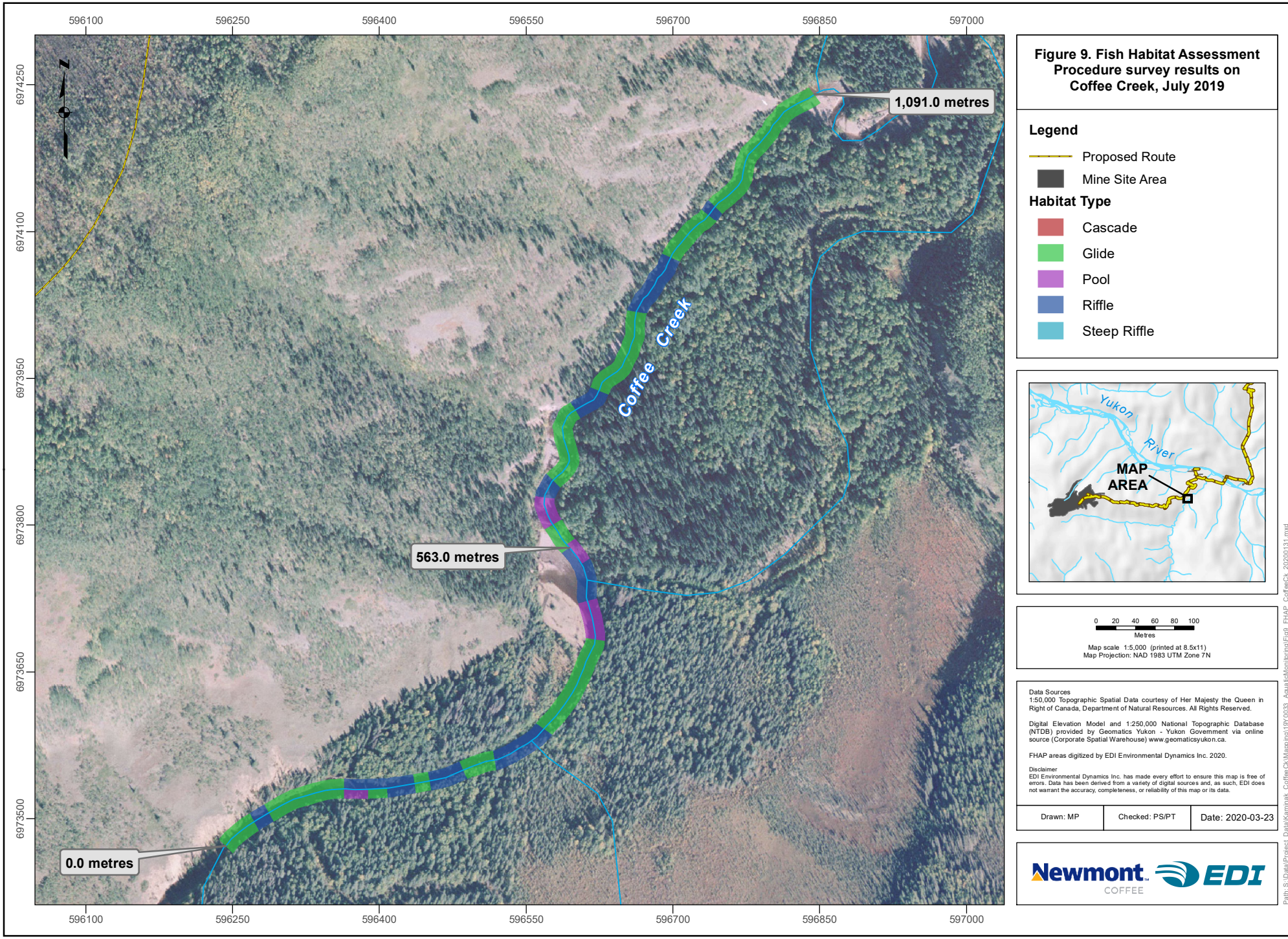

Figure 9. Fish Habitat Assessment Procedure survey results on Coffee Creek, July 2019

Legend

- Proposed Route
- Mine Site Area

Habitat Type

- Cascade
- Glide
- Pool
- Riffle
- Steep Riffle

0 20 40 60 80 100
Metres

Map scale 1:5,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

FHAP areas digitized by EDI Environmental Dynamics Inc. 2020.

Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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3.1.3.2 Unnamed Tributary Upstream of YT-24

During July 2019 monitoring, a FHAP survey was conducted on a 519 m section of an Unnamed Tributary upstream of YT-24 (Table 16). Twenty-nine distinct habitat units were identified during the survey, comprised of five habitat unit types: cascades, pools, riffles, steep riffles, and glides (Table 16).

The surveyed section of the Unnamed Tributary was dominated by riffle habitat, which comprised 62 % of habitat units by length (Table 16; Photo 9). The average length of riffle habitat units was 35.1 (± 10.4) m and ranged from 7.5 to 104 m in length. The dominant form of instream cover in riffle habitat was provided by boulders and deep pools. The remaining habitat was comprised of steep riffle (26 %), cascade (7 %), glide (3 %), and pool (1 %) habitat units by length. Cascade habitat units were generally short, 2.0 to 14.6 m in length and had an average gradient of 15.4 %. A 6.0 m long secondary (side channel) cascade was also identified during the survey and was the only side channel habitat identified during the survey. Habitat units in the Unnamed Tributary generally had long stretches of riffles separated by steep riffles, with cascades and glides occurring less frequently (Figure 10).

The frequency and extent of habitat units in the surveyed section of the Unnamed Tributary represent relatively low-quality, low complexity fish habitat with a low frequency of pool and glide habitat units (<20 % by area), and little instream cover (Johnston and Slaney 1996). The two pool habitat units were generally short (3.3 and 4.0 m, respectively; Table 16). The average bankfull width over all habitat units was 3.6 (± 0.1) m, with an average wetted width of 2.2 m and an average water depth of 0.12 m during the survey.

Table 16. Summary of habitat units identified during the Fish Habitat Assessment Procedure survey of Unnamed Tributary on July 9, 2019.

Habitat type	No. of units	Average length (± SE; m)	Total length in surveyed extent (m)	Percent of total survey extent
Cascade	7	6.2 ± 2.0	43.7	7.0 %
Glide	4	4.3 ± 0.6	17.1	3.0 %
Pool	2	3.7 ± 0.4	7.3	1.0 %
Riffle (<5 % grade)	9	35.1 ± 10.4	315.5	62.0 %
Steep riffle (>5 % grade)	7	19.3 ± 4.3	135.4	26.0 %
Secondary cascade	1	6.0 ± 0.0	6.0	n/a
Total	**29**	**18.3 ± 4.1**	**519.0**	**100.0 %**



Photo 9. Example of riffle habitat in the Unnamed Tributary (0+146 m; July 9, 2019).

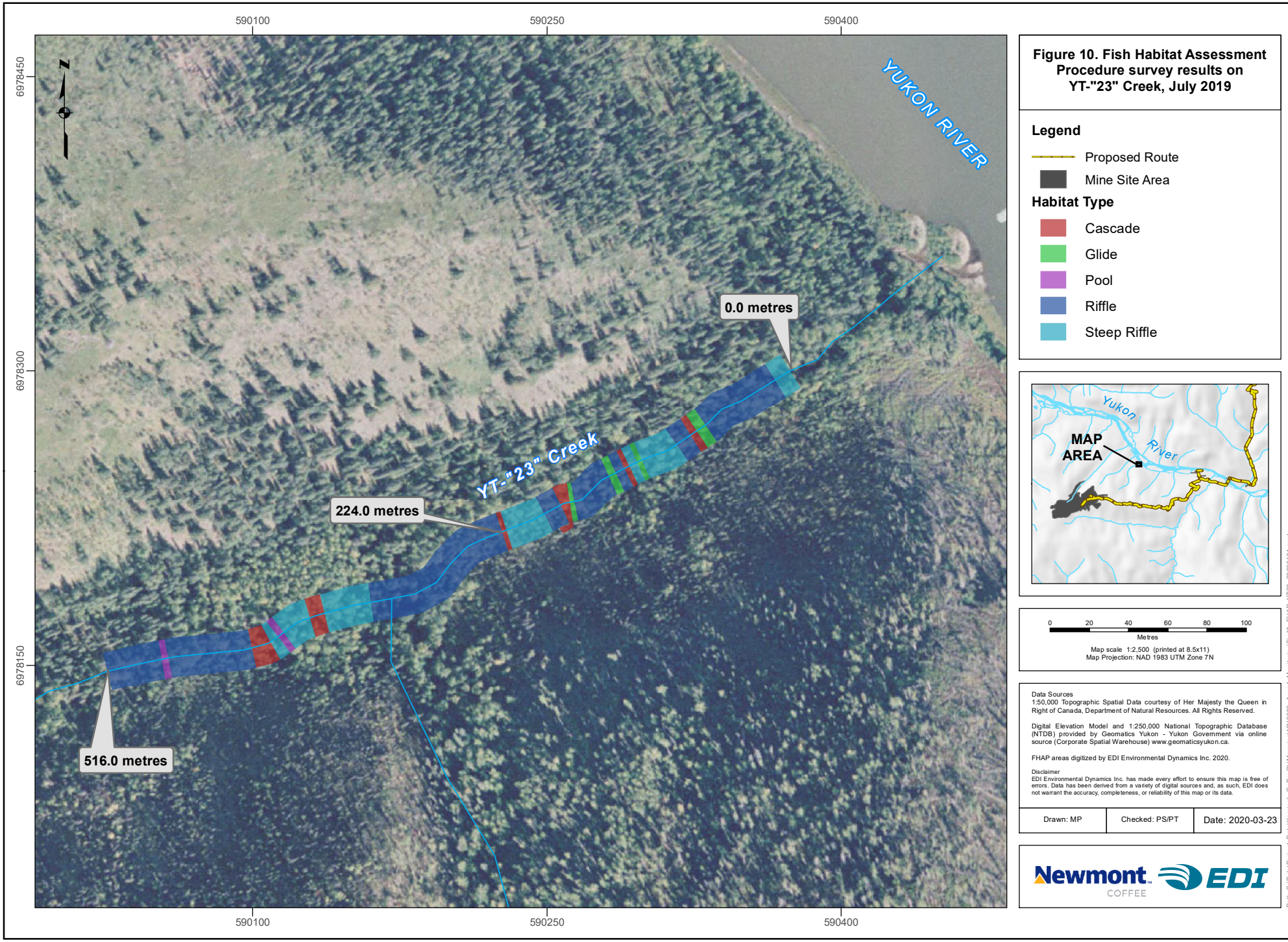

Figure 10. Fish Habitat Assessment Procedure survey results on YT-"23" Creek, July 2019

Legend

- Proposed Route
- Mine Site Area

Habitat Type

- Cascade
- Glide
- Pool
- Riffle
- Steep Riffle

0 20 40 60 80 100
Metres

Map scale 1:2,500 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

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3.1.3.3 Carlisle Creek

During July 2019 monitoring, a FHAP survey was conducted on a 1,088 m section of Carlisle Creek (Figure 11). Forty-five distinct habitat units were identified during the survey, primarily comprised of riffles and glides with a few pools and a cascade (Table 17). No steep riffle, tertiary, or secondary habitat units were identified during the survey.

The surveyed section of Carlisle Creek was dominated by glide and riffle habitat, which comprised 52 % and 43.5 % of habitat units by length respectively (95.5 % combined; Table 17; Photo 10, Photo 11). The average length of glide habitat units was 28.5 (± 4.5) m and ranged from 3.0 to 74.8 m in length. Similarly, riffle habitat units were on average 21.5 (± 3.6) m and ranged from 3.5 to 77.6 m in length (Table 17). Cascade and pool habitat units comprise the remaining 4.5 % of habitat units by length (0.5 and 4.0 % for cascade and pool habitat units, respectively). Large cobbles and boulders are the dominant forms of instream cover for both glide and riffle habitat. Additionally, usable coarse woody debris is frequently present and distributed evenly throughout the surveyed extent. Habitat units in Carlisle Creek generally alternated between glides and riffles, with other habitat units occurring infrequently (Figure 11).

The frequency and extent of habitat units in the surveyed section of Carlisle Creek represents relatively low-quality, low complexity fish habitat with a low frequency of pool habitat units (<30 % by area) (Johnston and Slaney 1996). However, glide habitat occurs regularly throughout the surveyed extent and likely provides some resting and holding habitat function for species like Arctic grayling or juvenile Chinook salmon. There is moderate instream cover and usable coarse woody debris distributed evenly throughout the surveyed extent (Johnston and Slaney 1996). The average bankfull width over all habitat units was 10.9 (± 0.3) m, with an average wetted width of 6.2 m and an average water depth of 0.27 m during the survey.

Table 17. Summary of habitat units identified during the Fish Habitat Assessment Procedure survey of Carlisle Creek on July 13, 2019.

Habitat type	No. of units	Average length (± SE; m)	Total length in surveyed extent (m)	Percent of total survey extent
Cascade	1	5.5 ± 0.0	5.5	0.5 %
Glide	20	28.5 ± 4.5	569.4	52.0 %
Pool	2	20.2 ± 9.0	40.4	4.0 %
Riffle (<5 % grade)	22	21.5 ± 3.6	472.6	43.5 %
Steep riffle (>5 % grade)	0	-	-	0.0 %
Total	**45**	**24.2 ± 2.7**	**1,087.9**	**100.0 %**



Photo 10. Example of glide habitat in Carlisle Creek (0+843 m; July 13, 2019).



Photo 11. Example of riffle habitat in Carlisle Creek (0+868 m; July 13, 2019).

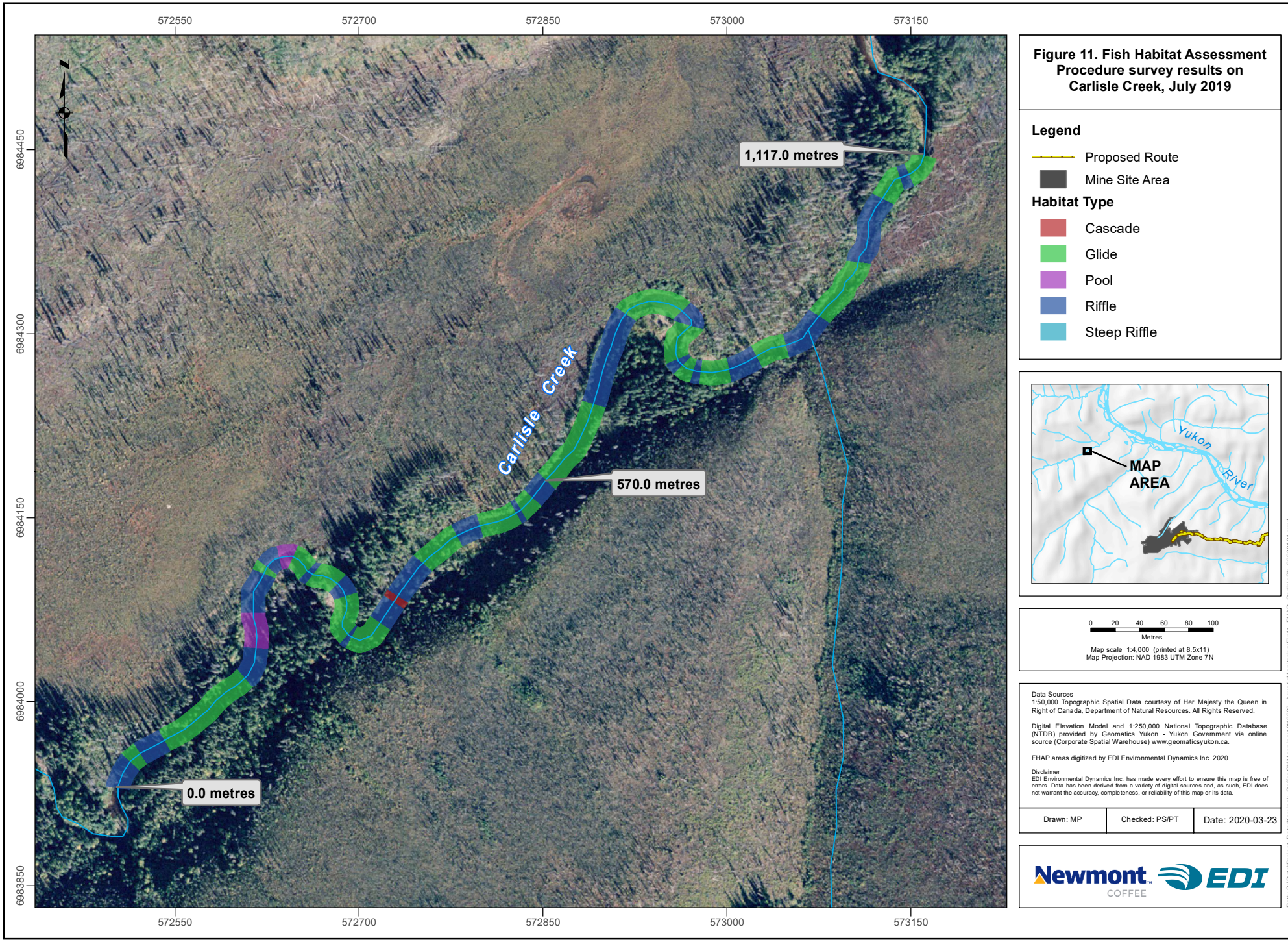

Figure 11. Fish Habitat Assessment Procedure survey results on Carlisle Creek, July 2019

Legend

- Proposed Route
- Mine Site Area

Habitat Type

- Cascade
- Glide
- Pool
- Riffle
- Steep Riffle

0 20 40 60 80 100
Metres

Map scale 1:4,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
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3.1.3.4 Carlisle Creek Tributary

During August 2019 monitoring, a FHAP survey was conducted on a 562 m section of the Carlisle Creek tributary (Figure 12). Twenty-one distinct habitat units were identified during the survey, comprised of glide, riffle, and steep riffle habitat units (Table 18). No cascade, pool, secondary, or tertiary habitat units were identified during the survey.

The surveyed section of the Carlisle Creek tributary was dominated by steep riffle habitat, which comprised 57 % of habitat units by length. Riffle and glide habitat units, which comprise 37 % and 6 % of habitat units by length respectively, comprise the remaining habitat units. The average length of steep riffle habitat units was 35.3 (± 16.1) m and ranged from 8.4 to 160.4 m in length. Carlisle Creek tributary habitat units commonly alternated between riffle and steep riffle habitat units (Figure 12).

The frequency and extent of habitat units in the surveyed section of the Carlisle Creek tributary represents relatively low-quality, low complexity fish habitat with a low frequency of pool and glide habitat units (<30 % by area), and little instream cover and functional large woody debris (Johnston and Slaney 1996). The average bankfull width over all habitat units was 4.7 (± 0.3) m, with an average wetted width of 6.2 m and an average water depth of 0.2 m during the survey.

Table 18. Summary of habitat units identified during the Fish Habitat Assessment Procedure survey of Carlisle Creek tributary on August 11, 2019.

Habitat type	No. of units	Average length (± SE; m)	Total length in surveyed extent (m)	Percent of total survey extent
Cascade	0	-	-	0.0 %
Glide	4	8.7 ± 1.4	34.6	6.0 %
Pool	0	-	-	0.0 %
Riffle (<5 % grade)	8	26.2 ± 3.7	209.7	37.0 %
Steep Riffle (>5 % grade)	9	35.3 ± 16.1	317.8	57.0 %
Total	**21**	**26.8 ± 7.2**	**562.1**	**100.0 %**



Photo 12. Example of steep riffle habitat in Carlisle Tributary Creek (0+255 m; August 11, 2019).

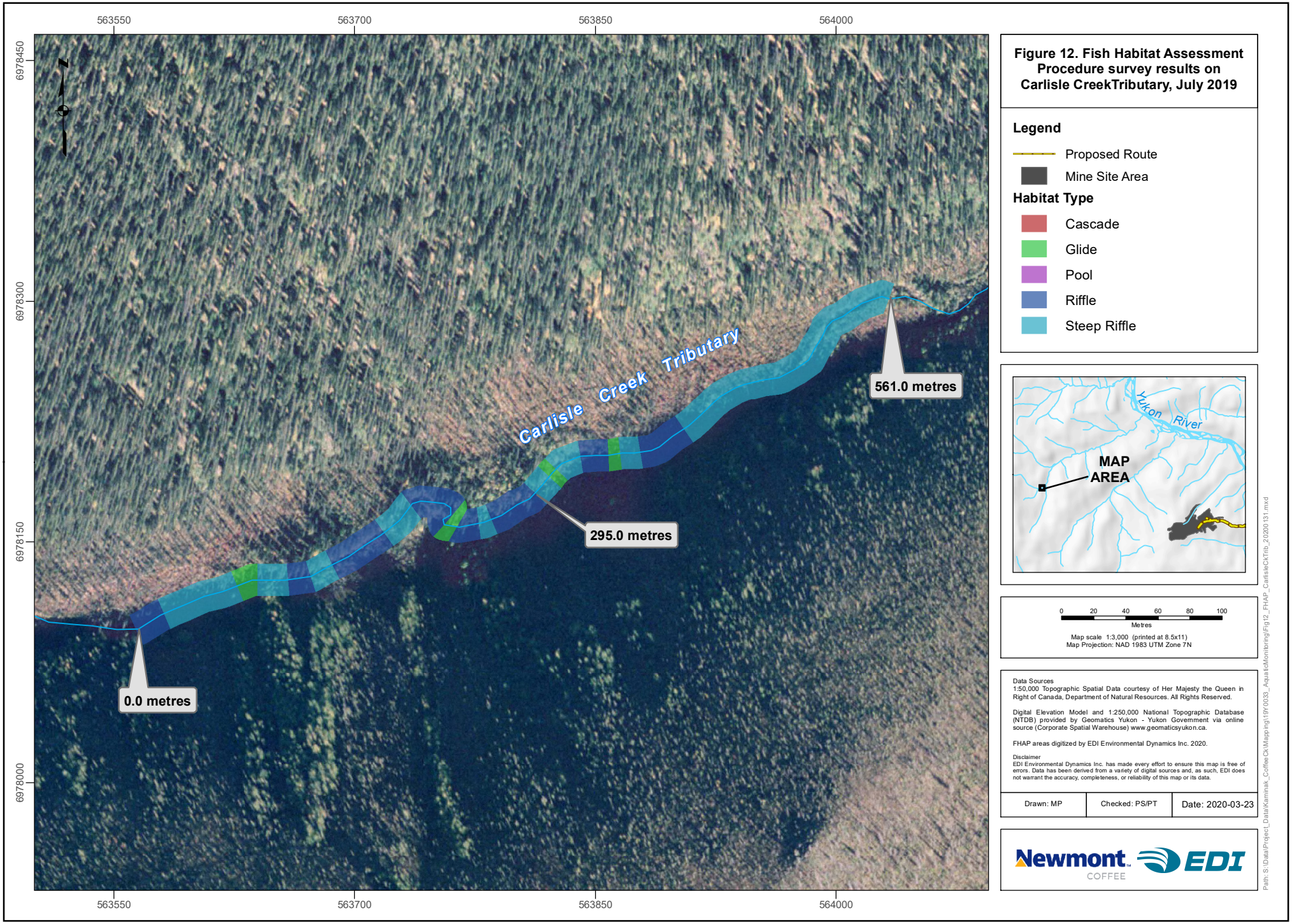

Figure 12. Fish Habitat Assessment Procedure survey results on Carlisle CreekTributary, July 2019

Legend

- Proposed Route
- Mine Site Area

Habitat Type

- Cascade
- Glide
- Pool
- Riffle
- Steep Riffle

0 20 40 60 80 100
Metres

Map scale 1:3,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
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3.1.4 CHINOOK SALMON SPAWNING SURVEYS

No living adult Chinook salmon, carcasses or salmon redds were observed during any of the Chinook spawning surveys conducted on Coffee and Independence creeks in 2019. There were no observations of feeding wildlife (e.g., bears or eagles), which typically feed on salmon during the spawning season. The only wildlife detected was a female moose observed in Coffee Creek during the second survey. These results are consistent with data collected in previous years (EDI 2017, 2018, 2019).

3.2 NORTHERN ACCESS ROUTE

3.2.1 BARGE LANDING INVESTIGATIONS

3.2.1.1 Yukon River North Barge Landing – YUK51.2

The Yukon River north proposed barge landing (right downstream bank) is located in an outside bend of the river, the bank is actively eroding (Photo 13). As a result, beach seining was completed approximately 75 m downstream from the proposed barge landing site, similar to the 2017 and 2018 field seasons (Photo 14; EDI 2018, 2019). During both July and August 2019 several beach seines were conducted to gain an understanding of fish assemblages; sampling effort was 400 m^2 and 250 m^2, respectively.



Photo 13. View of the proposed Yukon River north barge landing on August 8, 2019.



Photo 14. Area downstream from the proposed Yukon River north barge landing where sampling occurred on July 14, 2019.

Two species were captured in July, and three in August (Table 19). In July, juvenile Chinook salmon and Arctic grayling were captured, and in August there were juvenile Chinook salmon, Arctic grayling, and slimy sculpin. Juvenile Chinook salmon made up the highest proportion of the catch both months (89 % and 65 %, respectively; Table 19). The sampling from 2018 yielded a higher species diversity than in 2019, with four species in July and five in August (EDI 2019).

Table 19. Yukon River fish metrics (fork length and weight, ± SE) from YUK51.2 sampling, July and August 2019.

Month	Species captured	Total captured	Total measured	Fork length (± SE; mm)	Weight (± SE; g)
July	CH	8	8	63.8 ± 8.1	4.4 ± 0.3
	GR	1	1	136.0 ± 0.0	22.2 ± 0.0
August	CH	22	11	78.2 ± 1.3	5.6 ± 0.3
	GR	10	10	135.2 ± 9.7	28.9 ± 3.5
	CCG	2	1	47.0 ± 0.0	1.6 ± 0.0

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin

3.2.1.2 Yukon River South Barge Landing – YUK47.6

The Yukon River south proposed barge landing (left downstream bank) is located in an area with uniform high banks, and a steadily sloping shoreline (Photo 15). The shoreline bed material is comprised primarily of small cobbles and gravels with limited amounts of fines. This site was sampled in July and August 2019, with a sampling effort of 260 m^2 and 230 m^2, respectively.

Three different species were captured at the south barge landing in July and August (Table 20). In July, juvenile Chinook salmon, lake whitefish, and slimy sculpin were captured; in August, the catch composition was made of juvenile Chinook salmon, Arctic grayling, and slimy sculpin. In contrast to the proposed north barge landing, fewer juvenile Chinook were captured during both months at the proposed south barge landing (20 % and 13 %). The site does not appear to provide good rearing habitat for juvenile Chinook salmon, as there is a very steep bank and fast-moving water. At the time of July sampling, a barge was parked immediately upstream, which provided a substantial eddy (Photo 16); however, this did not seem to improve the habitat quality for juvenile Chinook salmon.

Table 20. Yukon River fish metrics (fork length and weight, ± SE) from YUK47.6 sampling, July and August 2019.

Month	Species captured	Total captured	Total measured	Fork length (± SE; mm)	Weight (± SE; g)
July	CH	1	1	70.0 ± 0.0	4.6 ± 0.0
	LW	2	1	50.0 ± 0.0	1.2 ± 0.0
	CCG	4	0	Approximately 20 mm	<1.0 g
August	CH	2	2	82.5 ± 8.5	6.4 ± 1.5
	GR	6	6	110.7 ± 52.4	21.9 ± 9.4
	CCG	7	7	27.5 ± 3.1	0.5 ± 0.5

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; LW = lake whitefish



Photo 15. Downstream view of the proposed Yukon River south barge landing on July 14, 2019.



Photo 16. Eddy caused by a parked barge upstream of the proposed Yukon River south barge landing on July 14, 2019.

3.2.1.3 Yukon River Existing Barge Landing – YUK46.1

The existing Yukon River barge landing site (left downstream bank) is located immediately adjacent to the current Coffee Gold exploration camp. The gently sloping riverbed is primarily comprised of a mix of gravels, fines, and a few small cobbles (Photo 17). The barge landing site is partially sheltered from the main river current by a large bend in the river and slightly protruding upstream bank. The existing barge landing was sampled in August 2019 with a sampling effort of 315 m^2.

A total of six species of fish were captured at the existing barge landing on the Yukon River in August 2019 (Table 21). The most abundant species were juvenile Chinook salmon (n = 38) and longnose sucker (n = 37), followed by slimy sculpin (n = 18) and Arctic grayling (n = 14); two juvenile round whitefish and lake whitefish were captured as well. Juvenile Chinook salmon made up 34 % of the catch composition.

Table 21. Yukon River fish metrics (fork length and weight, ± SE) from YUK46.1 sampling, August 2019.

Month	Species captured	Total captured	Total measured	Fork length (± SE; mm)	Weight (± SE; g)
August	CH	38	15	76.5 ± 1.8	5.1 ± 0.4
	LSU	37	25	36.7 ± 0.9	0.4 ± 0.0
	GR	14	14	80.3 ± 6.4	6.1 ± 2.1
	LW	2	2	72.0 ± 4.0	3.7 ± 0.9
	CCG	18	14	47.4 ± 4.7	1.4 ± 0.4
	RW	2	2	73.0 ± 3.0	23.8 ± 4.6

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; RW = round whitefish; LW = lake whitefish; LSU = longnose sucker

This site is currently being used as a barge landing for Coffee Camp, with barges arriving every few days during the spring/summer/fall. Sampling at this location in 2019 identified the highest species diversity and highest catch number at the existing barge landing since the site was first sampled in 2017 (EDI 2018, 2019).



Photo 17. View of the existing barge landing on the Yukon River at the Coffee Gold exploration camp on August 8, 2019.

3.2.1.4 Stewart River North Barge Landing

The Stewart River north proposed barge landing (right downstream bank) is located along a stretch of river with low, moderately sloping banks (Photo 18). The river bed material is primarily comprised of a mix of fines with few embedded cobbles. The proposed barge landing is located in a partial eddy created by upstream bedrock and is partly sheltered from the main river current. The Stewart River had higher water levels during July sampling than in August, and with the gently sloping riverbed the haul depths varied between months (average of 1.15 m in July and 0.6 m in August). The proposed barge landing site sits between some short but steep rock bluffs immediately upstream and a gravel bar downstream. This site was sampled in July and August 2019 with an effort of 560 m^2 and 460 m^2, respectively.



Photo 18. Upstream view of the proposed barge landing site on the north bank of the Stewart River, July 11, 2019.

The Stewart River proposed north barge landing had the highest species diversity of any site beach seined within the MSA or the NAR in 2019. During the July 2019 sampling, six species were captured, and in August, eight species captured (Table 22). In both July and August the most abundant fish were Arctic grayling (n = 20; n = 74), longnose sucker (n = 18; n = 33), and slimy sculpin (n = 12; n = 21; Table 22). During the August seine juvenile northern pike and inconnu were captured (Photo 19). In both July and August, juvenile Chinook salmon were captured in low numbers and made up a small portion of the total catch composition (12 % and 5 %, respectively).

Table 22. Stewart River north barge landing fish metrics (fork length and weight, ± SE) from July and August 2019.

Month	Species captured	Total captured	Total measured	Fork length (± SE; mm)	Weight (± SE; g)
July	CH	7	7	67.7 ± 2.0	3.8 ± 0.4
	GR	20	19	67.7 ± 8.9	6.4 ± 1.5
	LSU	18	15	43.1 ± 7.1	2.0 ± 0.7
	CCG	12	10	41.8 ± 5.6	1.2 ± 0.4
	LKC	2	2	71.5 ± 0.5	4.1 ± 0.0
	RW	1	1	50.0 ± 0.0	1.3 ± 0.0
August	CH	8	8	83.1 ± 1.9	6.4 ± 0.6
	GR	74	29	66.4 ± 3.6	4.9 ± 1.6
	LSU	33	23	68.1 ± 5.4	5.1 ± 1.2
	CCG	21	11	46.2 ± 4.2	1.3 ± 0.3
	LKC	8	8	69.1 ± 7.9	4.1 ± 1.0
	RW	1	1	61.0 ± 0.0	2.0 ± 0.0
	NP	1	1	154.0 ± 0.0	37.1 ± 0.0
	IN	1	1	153.0 ± 0.0	27.9 ± 0.0

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; RW = round whitefish; LW = lake whitefish; LSU = longnose sucker; LKC = lake chub; NP = northern pike; IN = inconnu



Photo 19. Juvenile inconnu captured in a seine haul at the Stewart River proposed north barge landing on August 10, 2019.

3.2.1.5 Stewart River South Barge Landing

The Stewart River south proposed barge landing site (left downstream bank) is located along a uniform stretch of river with steep eroding banks and a gently sloping shoreline and riverbed (Photo 20). The riverbed is comprised primarily of cobbles and gravel with some fines. This site was sampled in July and August 2019, both with an effort of 460 m^2.



Photo 20. Upstream view of the proposed barge landing site on the south bank of the Stewart River, July 11, 2019.

Six species were captured during the July sampling and four during August (Table 23). Few juvenile Chinook salmon were captured in July (n = 2) and none were captured during August sampling. Arctic grayling were captured during both sampling periods (n = 5 and n = 18, respectively), as were longnose sucker (n = 12 and n = 10; Table 23).

Table 23. Stewart River south barge landing fish metrics (fork length and weight, ± SE) from July and August 2019.

Month	Species captured	Total captured	Total measured	Fork length (± SE; mm)	Weight (± SE; g)
July	CH	2	2	76.0 ± 2.8	4.9 ± 0.1
	GR	5	5	37.2 ± 2.9	0.5 ± 0.07
	LSU	12	12	37.9 ± 5.4	1.0 ± 0.4
	CCG	1	1	36.0 ± 0.0	0.3 ± 0.0
	LKC	2	2	84.5 ± 10.5	6.6 ± 2.9
	RW	2	2	55.0 ± 0.0	1.5 ± 0.1
August	GR	18	18	65.6 ± 4.4	3.3 ± 1.2
	LSU	10	10	38.6 ± 1.4	0.5 ± 0.1
	CCG	3	3	33.0 ± 7.2	1.0 ± 0.5
	LKC	1	1	31.0 ± 0.0	0.4 ± 0.0

CH = Chinook salmon; GR = Arctic grayling; CCG = slimy sculpin; RW = round whitefish; LSU = longnose sucker; LKC = lake chub

3.2.2 BARGE WAKE INVESTIGATIONS

One barge investigation was completed on July 10, 2019, at approximately 17:00. The passing barge was passing in a downstream direction and was not loaded (Photo 21); this was not the same barge docked at the Coffee Gold Project during the July field visit (shown in Photo 23). The entire channel was 440 m across, and the passing barge was 280 m from shore. The waves reaching shore came up 11 to 35 cm; waves came up higher on gently sloping silt or sand portions than on cobble (Photo 22). Turbidity along the nearshore area (1.0 m into the river from the waters edge) increased locally for approximately twelve minutes, with turbidity increasing more and for longer at sheltered sites with banks comprised of fines compared to locations with shorelines comprised of rocky substrate. Water flowing from sites with higher turbidity was observed flowing downstream along the margin of the river after the barge had passed.



Photo 21. A passing barge adjacent to Halfway Creek on July 10, 2019.



Photo 22. Waves created by the passing barge on July 10, 2019.



Photo 23. The new barge being used at the Coffee Gold Project, loaded at the existing barge landing on July 15, 2019.

3.2.3 STEWART RIVER BACK CHANNEL INVESTIGATIONS

3.2.3.1 Spring

The Stewart River back channel contained water during the May field visit (Photo 24). Eight sites along the Stewart River back channel were beach seined for fish, along with one seine in the adjacent side channel of the Stewart River (Site 9). Juvenile longnose sucker and adult northern pike were each captured in two of the eight back channel sites sampled (Table 24; Figure 13; Photo 25). Longnose sucker and lake chub were captured at Site 9 in the Stewart River side channel (Table 24; Figure 13). The highest upstream portion of the back channel that contained water (Photo 26) was near the upstream most NAR encroachment area. Site 1 was the most upstream site that was sampled with sampling progressing downstream, with Site 9 being downstream of the mouth of the back channel (Photo 27). The channel wetted width was approximately 5 m at its widest, with the deepest part of the channel being 0.7 m (Photo 28). No barriers to fish existed from the mouth of the back channel up to where it dried up, indicating that fish would be able to travel the length of the wetted portion of the back channel. Generally, water temperature and dissolved oxygen levels increased at the sites closer to the mouth (Table 25).

In 2018, the capture of young-of-the-year pike in this back channel led to speculation of pike spawning in or near this channel. While adult pike were captured in the channel in 2019, these fish did not appear to ripe and given turbid water clarity, observations of pike activity could not be made. Pike spawning in this channel or the downstream side channel is possible.

The highest water at the Stewart River mouth between January 1 to December 31, 2019, occurred on June 1, 2019, at a primary water level of 27.809 m. During the May 24 visit, the water level was 27.286 m at the Stewart River mouth. In previous years it has been surmised that water levels at the mouth of the Stewart River would need to be approximately 27.0 m for the Stewart River back channel to receive water (EDI 2019). The only time the Stewart River mouth exceeded 27.0 m was between May 21 to June 8, 2019 (Environment Canada 2020), suggesting the Stewart River back channel had little connectivity to the Stewart River during the open water season.

Table 24. Fish sampling results from the Stewart River back channel on May 24, 2019.

Site	Species	Total captured	Fork length (± SE; mm)	Notes
1	NFC	-	-	NFC
2	LSU	1	32.0 ± 0.0	Juvenile.
3	LSU	1	42.0 ± 0.0	Juvenile.
4	NFC	-	-	NFC
5	NP	1	470.0 ± 0.0	Adult.
6	NFC	-	-	NFC
7	NFC	-	-	NFC; observed splashing nearby – likely adult pike.
8	NP	1	490.0 ± 0.0	Did not appear ripe.
9	LSU	12	47.4 ± 5.2	Below the mouth of the back channel, in a side channel of the Stewart River; fines and emergent vegetation.
	LKC	10	44.2 ± 7.8	

DNS = did not sample; NFC = no fish caught; LSU = longnose sucker; LKC = lake chub

Table 25. Water quality data at sites along the Stewart River back channel on May 24, 2019.

Site	Temperature (° C)	Dissolved oxygen (%)	Dissolved oxygen (mg/L)
Site 1	10.0	31.6	3.56
Site 2	11.5	31.6	3.43
Site 3	10.9	21.5	2.30
Site 4	11.9	40.5	4.37
Site 5	12.3	59.6	6.38
Site 6	12.4	74.2	7.93
Site 7	-	-	-
Site 8	13.0	90.1	9.5
Site 9	-	-	-



Photo 24. View of the wetted Stewart River back channel on May 24, 2019.



Photo 25. Northern pike caught at Site 5 on May 24, 2019.

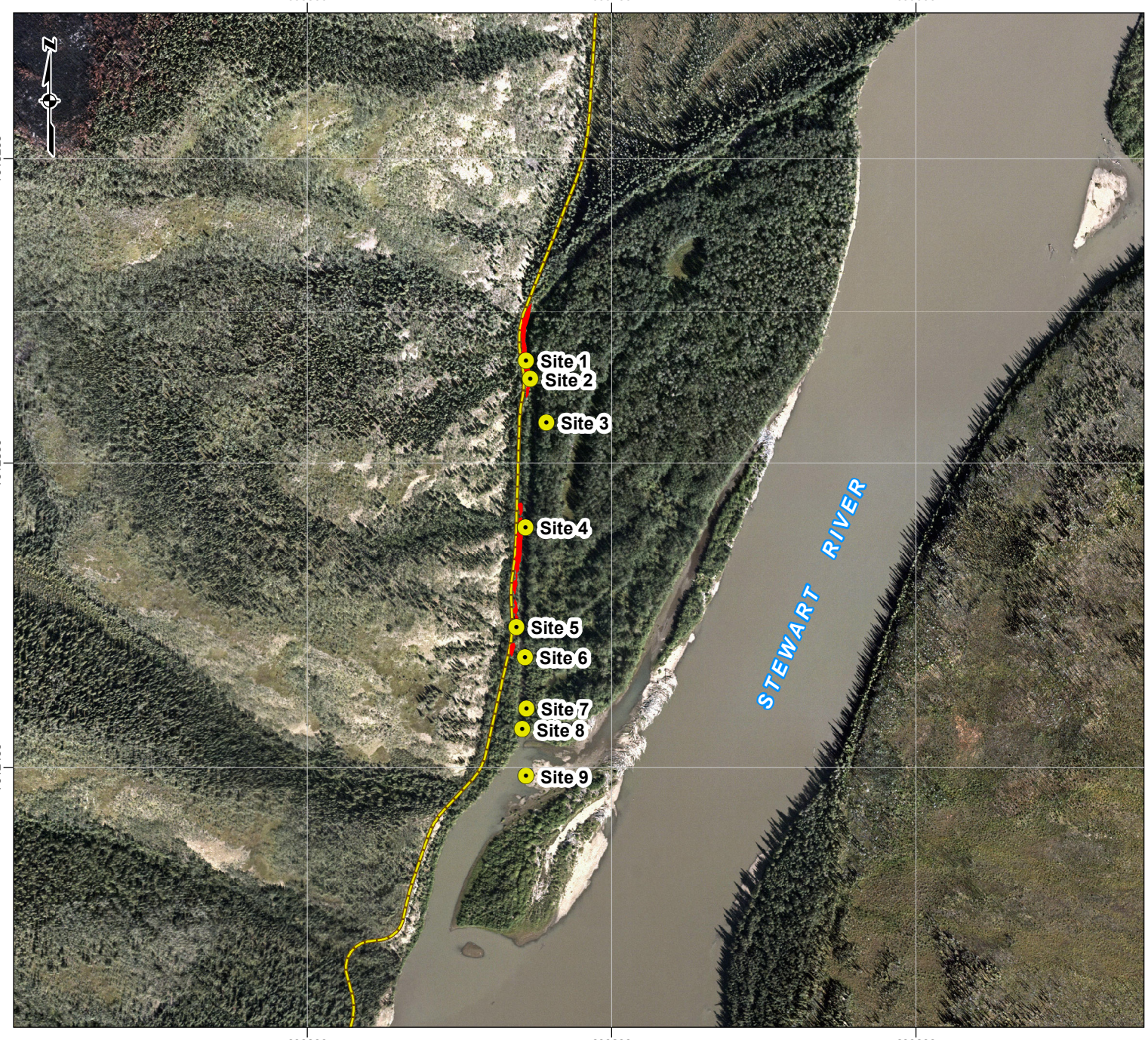


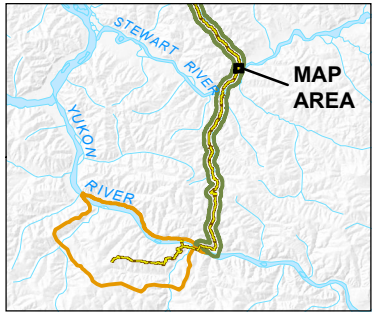
Figure 13. Stewart River back channel fish sampling results, May 2019

Legend

- Fish Sample Sites
- Proposed Northern Access Route
- NAR Encroachment Areas - Stewart River Back Channel

Aquatic Local Study Areas

- Mine Study Area
- NAR Study Area



0 50 100 150 200 250

Metres

Map scale 1:7,500 (printed at 8.5x11)
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Photo 26. Facing upstream on the uppermost location that contained water on May 24, 2019.



Photo 27. Site 9, the mouth of the Stewart River back channel that was sampled on May 24, 2019.



Photo 28. Upstream view of the Stewart River back channel at Site 5 on May 24, 2019.

3.2.3.2 Summer

The Stewart River back channel was visited on July 11, 2019, at which point the mouth had dried up entirely (Photo 29). The back channel remained dry for approximately 700 m with a dry mud bottom (Photo 30). Shortly beyond 700 m there were two small pools of murky standing water, both less than 0.5 m in depth (Photo 31, Photo 32). The water quality indicated it was likely stagnant surface water with very low dissolved oxygen levels, which is poor for fish rearing (Table 26). An active forest fire was burning on a slope facing the back channel, approximately 2 km away.

Table 26. Water quality parameters of the two pools found in the Stewart River back channel on July 11, 2019.

	Temperature (°C)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)
Pool 1	13.1	19.6	2.06	431.9
Pool 2	13.8	32.0	3.31	491.5



Photo 29. View of the dry mouth of the Stewart River back channel on July 11, 2019.



Photo 30. Upstream view of the mouth of the Stewart River back channel on July 11, 2019.



Photo 31. Downstream view of one of the isolated pools containing water on July 11, 2019.



Photo 32. Upstream view of the other isolated pool containing water on July 11, 2019.

The site was visited from the air again on August 10, 2019. The channel still appeared to be entirely dry from the mouth (Photo 33), with one of the pools still visible from the air (Photo 34). There was evidence of the July forest fire encroaching on the back channel (Photo 35).

The Stewart River level at the mouth was 25.868 m during the July visit and 26.062 m in August (Environment Canada 2020), which was below the approximate 27.0 m required for connectivity between the back channel and the Stewart River (EDI 2019).



Photo 33. View of the dry mouth of the Stewart River back channel and downstream side channel on August 10, 2019.



Photo 34. Overhead view of the dry Stewart River back channel; one of the isolated pools can be discerned in the upper middle of the photo on August 10, 2019.



Photo 35. Downstream view towards the Stewart River on August 10, 2019. The extent of the July forest fire can be seen on the right of the photo.

4 SUMMARY

Fieldwork from the 2019 field season provided additional baseline information for the Coffee Gold Project within the MSA and NAR. Several components in the 2019 field season had noteworthy findings which are presented below.

- More Arctic grayling were captured in Halfway Creek than previous years and their upstream extent increased slightly (from 600 m upstream of the mouth in previous years to 1000 m this year). No fish were captured upstream of the logjam barrier located 1 km upstream of the mouth.
- Fish sampling in Carlise, Excelsior, and Los Angeles Creeks creeks were not deemed useful control sites for comparison of juvenile Chinook salmon growth rates in Coffee Creek.
- Halfway and YT-24 creek mixing zones generally had higher diversity and abundance than the Yukon River reference site (YUK51.2). However, a site directly adjacent to the Yukon River reference site had comparable CPUE to the mixing zone sites, highlighting the high variability when targeting shoaling fish species (i.e., juvenile Chinook salmon). Additionally, YT-24 Creek did not have a mixing zone in July as the creek did not reach the Yukon River; despite the lack of a mixing zone, there was a high CPUE and species diversity.
- A considerable amount of fish habitat (FHAP) data (2017 – 2019) is now available for streams downstream of the mine site as well as control streams. Resurvey of these areas may be warranted depending on time of mine development.
- Chinook spawning surveys did not find any evidence Chinook spawning in Coffee or Independence Creek. No Chinook spawning has been detected in these creeks despite surveys being completed for seven consecutive years (2013 – 2019).
- A considerable amount of fish presence data has been collected at the barge landing sites and the results are generally consistent from year to year.
- Little wake or lasting turbidity was detected during barge wake investigations. The waves reaching shore came up 11 to 35 cm. Typically waves came up higher on gently sloping silt or sand portions of river bank than on steeper sections or those with cobble. The turbidity was higher and lasted longer in back eddy areas with considerable silt.
- Based on the recommendation in the 2018 report, the Stewart River back channel was investigated for the presence of spawning northern pike. Two adult northern pike were captured and others were visually observed. While there was no direct evidence of pike spawning, there is potential for it to occur in the back channel and/or in the adjcacent downstream side channel of the Stewart River. Additional spring sampling may be able provide more clarity, especially in a year when water levels are higher.

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APPENDIX A. SITE WATER QUALITY DATA

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Table A-1. In situ water quality parameters from 2019 Coffee Gold Project fieldwork.

ID report	Stream Name	Latitude	Longitude	Sampling Date	Temperature (°C)	pH	Dissolved Oxygen		Conductivity (SPC; µs/cm)	Turbidity (NTU)
							(mg/L)	(%)		
Site 1	Stewart River back channel	63.2294161	-138.8290679	24-May-19	10	-	3.56	31.6	-	clear
Site 2	Stewart River back channel	63.228644	-138.8289385	24-May-19	11.5	-	3.43	31.6	-	-
Site 3	Stewart River back channel	63.2281222	-138.8285658	24-May-19	10.9	-	2.3	21.5	-	-
Site 4	Stewart River back channel	63.2268951	-138.8291946	24-May-19	11.9	-	4.37	40.5	-	light
Site 5	Stewart River back channel	63.2257235	-138.8295215	24-May-19	12.3	-	6.38	59.6	-	medium
Site 6	Stewart River back channel	63.2253636	-138.8293251	24-May-19	12.4	-	7.93	74.2	-	-
Site 8	Stewart River back channel	63.2245179	-138.8294647	24-May-19	13	-	9.5	90.1	-	medium
Site 9	Stewart River back channel	63.2239649	-138.8294057	24-May-19	-	-	-	-	-	medium/high
HC0.2	Halfway Creek	62.94258	-139.25462	08-Jul-19	6.5	n/a	10.35	84.2	286	clear
HC0.7	Halfway Creek	62.94086	-139.26228	10-Jul-19	4.5	n/a	11.77	91	291.8	clear
MSR	Halfway Creek	62.93945	-139.26782	10-Jul-19	5.8	n/a	11.23	89.7	290.3	clear
SR_RDB	Stewart River	63.18831	-138.89452	11-Jul-19	17.2	n/a	8.68	90.3	360.9	light
SR_LDB	Stewart River	63.18866	-138.88818	11-Jul-19	17.4	n/a	8.87	92.7	325.4	light
CC5.6	Coffee Creek	62.88483	-139.09387	11-Jul-19	8.5	n/a	9.79	83.6	259.9	clear
HC-MZ	Yukon River, Halfway Creek	62.94401	-139.24818	12-Jul-19	15.1	n/a	9.38	93.2	167.8	light
CL7.9	Carlisle Creek	62.98123	-139.56116	12-Jul-19	8.3	n/a	10.81	91.8	173.8	clear
YT24-MZ	Yukon River, YT24	62.93133	-139.23238	14-Jul-19	15.7	n/a	9.07	91.4	138.6	light
YUK51.2	Yukon River	62.90472	-139.00609	14-Jul-19	17.7	n/a	9.17	96.4	132.3	14.41
YUK51.1	Yukon River (eddy)	62.9049	-139.00804	14-Jul-19	17.7	n/a	9.17	96.4	132.3	light
YUK47.6	Yukon River	62.91434	-139.07199	14-Jul-19	17.1	n/a	9.21	95.6	139	light
HC0.7	Halfway Creek	62.94086	-139.26228	07-Aug-19	4.6	7.86	12.23	94.8	116.7	clear
MSR	Halfway Creek	62.93945	-139.26782	07-Aug-19	5	7.77	12.19	95.4	119	clear
YUK51.2	Yukon River	62.90475	-139.00618	08-Aug-19	15.9	8.25	9.29	93.9	96.9	medium
YUK47.6	Yukon River	62.91434	-139.07199	08-Aug-19	13.8	7.97	9.8	94.7	165.7	medium
YUK46.1	Yukon River	62.9143	-139.08173	08-Aug-19	14.5	7.98	9.78	96	167.5	light
CC5.6	Coffee Creek	62.88483	-139.09329	8-Aug-19	8	7.86	11	92.8	123.2	clear
HC-MZ	Yukon River, Halfway Creek	62.94401	-139.24818	09-Aug-19	15.5	7.04	9.64	96.7	175.3	5.89
HC-MZ	Yukon River, Halfway Creek	62.94401	-139.24818	09-Aug-19	6.3	7.57	11.8	95.6	162.2	2.9
HC-MZ	Yukon River, Halfway Creek	62.94401	-139.24818	09-Aug-19	12.2	8.12	10.51	97.6	170.8	5.74
HC0.2	Halfway Creek	62.94258	-139.25462	09-Aug-19	4.2	7.81	12.4	95	156.8	clear
YT24-MZ	Yukon River, YT24	62.93133	-139.23238	10-Aug-19	11.5	7.81	10.33	97	166.3	5.91

ID report	Stream Name	Latitude	Longitude	Sampling Date	Temperature (°C)	pH	Dissolved Oxygen		Conductivity (SPC; µs/cm)	Turbidity (NTU)
							(mg/L)	(%)		
YT24-MZ	Yukon River, YT24	62.93133	-139.23238	10-Aug-19	13.8	7.94	9.86	95.5	176	6.65
YT24-MZ	Yukon River, YT24	62.93133	-139.23238	10-Aug-19	14.5	7.9	9.48	93	175.7	7.54
SR_RDB	Stewart River	63.188314	-138.894817	10-Aug-19	15.1	7.32	9.75	97	370.7	17.33
SR_LDB	Stewart River	63.188665	-138.88819	10-Aug-19	15.4	8.16	9.91	99	360.6	15.35
YT0.2	YT24	62.930303	-139.238892	10-Aug-19	3.7	7.7	12.64	95.7	180.6	clear
EX2.9	Excelsior Creek	62.863048	-138.977345	10-Aug-19	2.6	7.69	12.76	93.7	193.3	clear
LAX4.6	Los Angeles Creek	63.03982	-139.571607	11-Aug-19	5.4	7.84	11.86	93.9	416.2	1.45

APPENDIX B. FISH CAPTURE DATA

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Table B-1. Fish collection data from 2019 Coffee Gold Project fieldwork.

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
Site 2	Stewart River back channel	24-May-19	BS	LSU	32	-	RG
Site 3	Stewart River back channel	24-May-19	BS	LSU	42	-	RG
Site 5	Stewart River back channel	24-May-19	BS	NP	470	-	RG
Site 8	Stewart River back channel	24-May-19	BS	NP	490	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LKC	105	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	70	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	55	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	90	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LKC	65	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LKC	55	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	60	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	35	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	35	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LKC	25	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LKC	35	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	35	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	40	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LKC	32	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	45	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	32	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	40	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LSU	32	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LKC	35	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LKC	30	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LKC	30	-	RG
Site 9	Stewart River back channel	24-May-19	BS	LKC	30	-	RG
HC0.3-1	Halfway Creek	08-Jul-19	EF	GR	124	17.9	RG
HC0.3-1	Halfway Creek	08-Jul-19	EF	GR	235	147	RG
HC0.3-1	Halfway Creek	08-Jul-19	EF	GR	132	26.4	RG
HC0.3-1	Halfway Creek	08-Jul-19	EF	GR	175	62.3	RG
HC0.3-1	Halfway Creek	08-Jul-19	EF	GR	138	30.5	RG
HC0.7-1	Halfway Creek	10-Jul-19	EF	GR	180	82	RP
HC0.7-1	Halfway Creek	10-Jul-19	EF	GR	255	188	RG
HC0.7-1	Halfway Creek	10-Jul-19	EF	GR	178	77.5	RG
HC0.7-1	Halfway Creek	10-Jul-19	EF	GR	200	90.6	RG
HC0.7-1	Halfway Creek	10-Jul-19	EF	GR	252	160	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	LSU	27	0.2	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	LSU	30	0.3	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	LSU	30	0.3	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	LSU	26	0.2	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	LSU	26	0.2	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	LSU	24	0.1	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	LSU	20	0.1	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	LSU	28	0.2	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	LSU	19	0.1	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	LSU	17	0.1	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	CCG	15	0.1	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	GR	32	0.3	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	GR	32	0.4	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	GR	35	0.4	RG
SR-N-H1	Stewart River, north barge	11-Jul-19	BS	GR	37	0.6	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	GR	60	2.3	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	GR	37	0.5	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	GR	37	0.4	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	GR	55	1.5	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	GR	103	11.1	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	GR	68	3.5	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	GR	129	25.7	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	GR	110	12.5	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	GR	150	40	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	GR	65	2.9	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	CH	70	4.5	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	CH	60	3	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	CH	68	3.2	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	LSU	80	5.9	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	LSU	77	4.2	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	LSU	75	5.4	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	LSU	88	7.7	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	LSU	80	5.5	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	CCG	50	0.3	RG
SR-N-H2	Stewart River, north barge	11-Jul-19	BS	CCG	75	4.8	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	GR	55	1.7	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	GR	34	0.5	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	GR	124	23.4	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	GR	29	0.3	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	GR	96	8.7	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	LKC	71	4.1	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	LKC	72	4.1	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	CH	77	5.7	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	CH	64	3.4	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	CH	68	3.3	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	CH	67	3.6	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	CCG	15	0.6	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	CCG	43	1.1	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	CCG	42	0.8	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	CCG	45	1.3	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	CCG	39	0.7	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	CCG	55	1.5	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	CCG	39	0.9	RG
SR-N-H3	Stewart River, north barge	11-Jul-19	BS	RW	50	1.3	RG
SR-S-H1	Stewart River, south barge	11-Jul-19	BS	LKC	74	3.7	RG
SR-S-H1	Stewart River, south barge	11-Jul-19	BS	LKC	95	9.4	RG
SR-S-H1	Stewart River, south barge	11-Jul-19	BS	RW	55	1.5	RG
SR-S-H1	Stewart River, south barge	11-Jul-19	BS	GR	37	0.5	RG
SR-S-H1	Stewart River, south barge	11-Jul-19	BS	RW	55	1.4	RG
SR-S-H1	Stewart River, south barge	11-Jul-19	BS	LSU	32	0.6	RG
SR-S-H1	Stewart River, south barge	11-Jul-19	BS	LSU	30	0.5	RG
SR-S-H1	Stewart River, south barge	11-Jul-19	BS	LSU	30	0.3	RG
SR-S-H1	Stewart River, south barge	11-Jul-19	BS	LSU	26	0.3	RG
SR-S-H1	Stewart River, south barge	11-Jul-19	BS	LSU	23	0.2	RG
SR-S-H1	Stewart River, south barge	11-Jul-19	BS	LSU	26	0.3	RG
SR-S-H2	Stewart River, south barge	11-Jul-19	BS	CH	74	4.8	RG
SR-S-H2	Stewart River, south barge	11-Jul-19	BS	LSU	27	0.3	RG
SR-S-H2	Stewart River, south barge	11-Jul-19	BS	LSU	25	0.1	RG
SR-S-H2	Stewart River, south barge	11-Jul-19	BS	LSU	32	0.2	RG
SR-S-H2	Stewart River, south barge	11-Jul-19	BS	GR	32	0.3	RG
SR-S-H2	Stewart River, south barge	11-Jul-19	BS	GR	41	0.4	RG
SR-S-H2	Stewart River, south barge	11-Jul-19	BS	GR	46	0.7	RG
SR-S-H2	Stewart River, south barge	11-Jul-19	BS	LSU	69	3.8	RG
SR-S-H2	Stewart River, south barge	11-Jul-19	BS	CCG	36	0.3	RG
SR-S-H3	Stewart River, south barge	11-Jul-19	BS	CH	78	5	RG
SR-S-H3	Stewart River, south barge	11-Jul-19	BS	LSU	59	1.7	RG
SR-S-H3	Stewart River, south barge	11-Jul-19	BS	LSU	76	4	RG
SR-S-H3	Stewart River, south barge	11-Jul-19	BS	GR	30	0.4	RG
CC5.6.1-MT1	Coffee Creek	11-Jul-19	MT	CH	63	2.7	RG
CC5.6.1-MT1	Coffee Creek	11-Jul-19	MT	CCG	93	9.6	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
CC5.6.1-MT1	Coffee Creek	11-Jul-19	MT	CCG	86	6.9	RG
CC5.6.1-MT1	Coffee Creek	11-Jul-19	MT	CCG	83	7.2	RG
CC5.6.1-MT3	Coffee Creek	11-Jul-19	MT	CCG	69	3.8	RG
CC5.6.2-MT1	Coffee Creek	11-Jul-19	MT	CCG	110	14.7	RG
CC5.6.2-MT1	Coffee Creek	11-Jul-19	MT	CCG	90	7.2	RG
CC5.6.2-MT2	Coffee Creek	11-Jul-19	MT	CCG	86	8.4	RG
CC5.6.3-MT1	Coffee Creek	11-Jul-19	MT	CH	72	3.6	RG
CC5.6.3-MT1	Coffee Creek	11-Jul-19	MT	CH	71	4.4	RG
CC5.6.3-MT1	Coffee Creek	11-Jul-19	MT	CH	68	3.6	RG
CC5.6.3-MT1	Coffee Creek	11-Jul-19	MT	CCG	82	7.6	RG
CC5.6.3-MT1	Coffee Creek	11-Jul-19	MT	CCG	74	5.3	RG
CC5.6.3-MT1	Coffee Creek	11-Jul-19	MT	CCG	80	5.2	RG
CC5.6.3-MT2	Coffee Creek	11-Jul-19	MT	CH	61	3	RG
CC5.6.3-MT2	Coffee Creek	11-Jul-19	MT	CH	66	3.8	RG
CC5.6.3-MT2	Coffee Creek	11-Jul-19	MT	CH	63	2.6	RG
CC5.6.3-MT3	Coffee Creek	11-Jul-19	MT	CCG	79	5.1	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	GR	146	33.5	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	GR	139	28.6	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	GR	123	22.7	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	GR	114	16.1	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	GR	175	58.8	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	GR	185	78.1	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	66	3.5	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	74	5.6	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	78	4.8	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	64	2.9	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	64	3	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	63	2.8	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	70	3.9	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	69	3.5	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	73	3.7	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	70	4.4	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	85	7	RG
HC.MZ1-H1	Halfway Creek mixing zone	12-Jul-19	BS	CH	80	5.9	RG
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	CH	73	4.5	RG
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	CH	78	5.4	RG
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	CH	58	1.8	RG
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	CH	72	4.4	RG
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	CH	68	3	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	CH	70	3.5	RG
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	CH	68	3.6	RG
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	CH	66	3.4	RG
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	CH	71	4	RG
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	CH	65	3.3	RG
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	RW	58	1.9	RG
HC.MZ1-H2	Halfway Creek mixing zone	12-Jul-19	BS	CCG	65	3.3	RG
HC.MZ1-H3	Halfway Creek mixing zone	12-Jul-19	BS	CH	67	3.6	RG
HC.MZ1-H3	Halfway Creek mixing zone	12-Jul-19	BS	CH	68	4.6	RG
HC.MZ1-H3	Halfway Creek mixing zone	12-Jul-19	BS	CH	71	4.2	RG
HC.MZ1-H3	Halfway Creek mixing zone	12-Jul-19	BS	CH	63	2.5	RG
HC.MZ1-H3	Halfway Creek mixing zone	12-Jul-19	BS	CH	65	3.3	RG
HC.MZ1-H3	Halfway Creek mixing zone	12-Jul-19	BS	RW	65	2.5	RG
HC.MZ1-H3	Halfway Creek mixing zone	12-Jul-19	BS	RW	65	2.1	RG
HC.MZ1-H3	Halfway Creek mixing zone	12-Jul-19	BS	CH	64	2.7	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	GR	136	27.9	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	LSU	84	6.3	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	LSU	84	6.5	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	CH	71	4.1	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	CH	80	6.6	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	CH	72	4	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	CH	74	4.6	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	CH	65	3.3	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	CH	75	6.5	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	CH	70	4.6	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	CH	74	4.5	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	CH	74	4.5	RG
YUK51.1-H1	Yukon River, d/s reference site	14-Jul-19	BS	CH	75	5.1	RG
YUK51.1-H2	Yukon River, d/s reference site	14-Jul-19	BS	CH	69	4.3	RG
YUK51.1-H2	Yukon River, d/s reference site	14-Jul-19	BS	CH	83	6.2	RG
YUK51.1-H2	Yukon River, d/s reference site	14-Jul-19	BS	CH	78	5.7	RG
YUK51.1-H2	Yukon River, d/s reference site	14-Jul-19	BS	CH	67	3.6	RG
YUK51.1-H2	Yukon River, d/s reference site	14-Jul-19	BS	CH	75	9.9	RG
YUK51.1-H2	Yukon River, d/s reference site	14-Jul-19	BS	CH	77	5.8	RG
YUK51.1-H2	Yukon River, d/s reference site	14-Jul-19	BS	CH	75	5	RG
YUK51.1-H2	Yukon River, d/s reference site	14-Jul-19	BS	CH	66	3.4	RG
YUK51.1-H2	Yukon River, d/s reference site	14-Jul-19	BS	CH	73	4.7	RG
YUK51.1-H2	Yukon River, d/s reference site	14-Jul-19	BS	CH	78	5.4	RG
YUK51.1-H3	Yukon River, d/s reference site	14-Jul-19	BS	CH	67	3.3	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
YUK51.1-H3	Yukon River, d/s reference site	14-Jul-19	BS	CH	68	3.9	RG
YUK51.1-H3	Yukon River, d/s reference site	14-Jul-19	BS	CH	74	4.9	RG
YUK51.1-H3	Yukon River, d/s reference site	14-Jul-19	BS	CH	77	5.8	RG
YUK51.1-H3	Yukon River, d/s reference site	14-Jul-19	BS	CH	72	4.1	RG
YUK51.1-H3	Yukon River, d/s reference site	14-Jul-19	BS	CH	68	3.7	RG
YUK51.1-H3	Yukon River, d/s reference site	14-Jul-19	BS	CH	70	4	RG
YUK51.1-H3	Yukon River, d/s reference site	14-Jul-19	BS	CH	73	4.5	RG
YUK51.1-H3	Yukon River, d/s reference site	14-Jul-19	BS	CH	68	3.4	RG
YUK51.1-H3	Yukon River, d/s reference site	14-Jul-19	BS	CH	68	3.5	RG
YUK51.2-H1	Yukon River, north barge/reference	14-Jul-19	BS	GR	136	22.2	RG
YUK51.2-H1	Yukon River, north barge/reference	14-Jul-19	BS	CH	65	2.9	RG
YUK51.2-H1	Yukon River, north barge/reference	14-Jul-19	BS	CH	75	3.8	RG
YUK51.2-H3	Yukon River, north barge/reference	14-Jul-19	BS	CH	69	4.2	RG
YUK51.2-H3	Yukon River, north barge/reference	14-Jul-19	BS	CH	75	4.8	RG
YUK51.2-H3	Yukon River, north barge/reference	14-Jul-19	BS	CH	8	5.5	RG
YUK51.2-H3	Yukon River, north barge/reference	14-Jul-19	BS	CH	72	4.6	RG
YUK51.2-H3	Yukon River, north barge/reference	14-Jul-19	BS	CH	70	3.8	RG
YUK51.2-H3	Yukon River, north barge/reference	14-Jul-19	BS	CH	77	5.4	RG
YUK47.6-H1	Yukon River, south barge	14-Jul-19	BS	CH	70	4.6	RG
YUK47.6-H1	Yukon River, south barge	14-Jul-19	BS	LW	50	1.2	RG
YT24-MX-H1	YT24 Creek mixing zone	14-Jul-19	BS	GR	135	27	RG
YT24-MX-H1	YT24 Creek mixing zone	14-Jul-19	BS	CH	64	3	RG
YT24-MX-H1	YT24 Creek mixing zone	14-Jul-19	BS	CH	69	3.6	RG
YT24-MX-H1	YT24 Creek mixing zone	14-Jul-19	BS	CH	64	2.8	RG
YT24-MX-H1	YT24 Creek mixing zone	14-Jul-19	BS	CH	66	2.5	RG
YT24-MX-H1	YT24 Creek mixing zone	14-Jul-19	BS	CH	68	3.1	RG
YT24-MX-H1	YT24 Creek mixing zone	14-Jul-19	BS	CH	78	2.8	RG
YT24-MX-H1	YT24 Creek mixing zone	14-Jul-19	BS	CH	65	5.7	RG
YT24-MX-H1	YT24 Creek mixing zone	14-Jul-19	BS	CH	70	3.9	RG
YT24-MX-H1	YT24 Creek mixing zone	14-Jul-19	BS	CH	76	5.4	RG
YT24-MX-H1	YT24 Creek mixing zone	14-Jul-19	BS	CH	77	5.6	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	CH	73	4.2	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	CH	70	3.8	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	CH	77	4.9	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	CH	75	4.7	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	CH	68	3.6	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	CH	60	3.6	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	CH	69	3.6	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	CH	53	3	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	CH	51	3.2	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	CH	75	4.4	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	RW	55	1.5	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	RW	59	1.7	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	RW	61	1.8	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	RW	62	1.8	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	RW	59	1.8	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	RW	52	1.3	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	GR	50	1.3	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	GR	63	2.6	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	GR	55	1.5	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	GR	56	2.1	RG
YT24-MX-H2	YT24 Creek mixing zone	14-Jul-19	BS	CCG	51	1.9	RG
YT24-MX-H3	YT24 Creek mixing zone	14-Jul-19	BS	RW	64	1.4	RG
YT24-MX-H3	YT24 Creek mixing zone	14-Jul-19	BS	RW	54	2.4	RG
YT24-MX-H3	YT24 Creek mixing zone	14-Jul-19	BS	RW	41	0.6	RG
YT24-MX-H3	YT24 Creek mixing zone	14-Jul-19	BS	LW	46	1.2	RG
YT24-MX-H3	YT24 Creek mixing zone	14-Jul-19	BS	RW	55	1.5	RG
YT24-MX-H3	YT24 Creek mixing zone	14-Jul-19	BS	LSU	20	-	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	CH	84	6.4	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	CH	88	7.2	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	CH	85	7.3	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	CH	74	4.2	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	CH	76	4.6	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	CH	77	3.6	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	CH	71	5	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	CH	74	6.4	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	CH	75	4.3	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	CH	80	5.8	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	LSU	38	0.3	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	LSU	42	<0.5	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	LSU	42	<0.5	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	LSU	35	<0.5	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	LSU	39	<0.5	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	LW	76	4.5	RG
YUK46.1-H1	Yukon River, existing barge	08-Aug-19	BS	LW	68	2.8	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	CH	70	4.9	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	CH	76	4.2	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	CH	86	6.3	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	RW	76	3.7	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	GR	65	2.3	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	GR	58	1.5	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	GR	126	19.2	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	GR	143	28.4	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	LSU	38	<0.5	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	LSU	32	<0.5	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	LSU	38	<0.5	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	LSU	35	<0.5	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	LSU	32	<0.5	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	LSU	38	<0.5	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	LSU	36	<0.5	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	LSU	27	<0.5	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	LSU	41	<0.5	RG
YUK46.1-H2	Yukon River, existing barge	08-Aug-19	BS	LSU	31	<0.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	GR	81	4.6	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	GR	73	3.7	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	GR	79	4.8	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	GR	72	3.1	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	GR	70	2.6	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	GR	74	3.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	GR	70	2.9	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	GR	68	2.3	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	GR	71	3.3	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	GR	74	3.6	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	CH	66	3.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	CH	65	3	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	RW	70	3.2	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	LSU	39	<0.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	LSU	36	<0.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	LSU	38	<0.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	LSU	44	<0.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	LSU	28	<0.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	LSU	33	<0.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	LSU	35	<0.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	LSU	36	<0.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	LSU	41	<0.5	RG
YUK46.1-H3	Yukon River, existing barge	08-Aug-19	BS	LSU	43	<0.5	RG
YR51.2-H1	Yukon River, north barge	08-Aug-19	BS	CH	67	3.4	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
YR51.2-H1	Yukon River, north barge	08-Aug-19	BS	CH	75	4.8	RG
YR51.2-H1	Yukon River, north barge	08-Aug-19	BS	CH	76	5.3	RG
YR51.2-H1	Yukon River, north barge	08-Aug-19	BS	CH	78	5.5	RG
YR51.2-H1	Yukon River, north barge	08-Aug-19	BS	CCG	58	2.2	RG
YR51.2-H1	Yukon River, north barge	08-Aug-19	BS	GR	136	25.1	RG
YR51.2-H1	Yukon River, north barge	08-Aug-19	BS	GR	155	37.5	RG
YR51.2-H1	Yukon River, north barge	08-Aug-19	BS	GR	158	40.6	RG
YR51.2-H2	Yukon River, north barge	08-Aug-19	BS	CH	82	6.8	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	GR	136	24.1	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	GR	133	26.8	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	GR	144	32.6	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	GR	147	30.7	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	GR	147	29.2	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	GR		40.5	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	CH	86	6.8	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	CH	79	5.4	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	CH	78	5.9	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	CH	73	4.4	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	CH	72	4.8	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	CH	80	6	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	CH	77	5.4	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	CH	74	4.9	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	CH	83	6.4	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	CH	76	4.8	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	GR	61	2.2	RG
YR51.2-H3	Yukon River, north barge	08-Aug-19	BS	CCG	47	1.6	RG
YUK47.6-H1	Yukon River, south barge	08-Aug-19	BS	GR	61	1.6	RG
YUK47.6-H1	Yukon River, south barge	08-Aug-19	BS	CCG	43	1.1	RG
YUK47.6-H2	Yukon River, south barge	08-Aug-19	BS	GR	65	2.5	RG
YUK47.6-H2	Yukon River, south barge	08-Aug-19	BS	CCG	25	0.2	RG
YUK47.6-H2	Yukon River, south barge	08-Aug-19	BS	CCG	22	0.2	RG
YUK47.6-H3	Yukon River, south barge	08-Aug-19	BS	GR	66	1.3	RG
YUK47.6-H3	Yukon River, south barge	08-Aug-19	BS	GR	146	33.5	RG
YUK47.6-H3	Yukon River, south barge	08-Aug-19	BS	GR	148	38.8	RG
YUK47.6-H3	Yukon River, south barge	08-Aug-19	BS	GR	178	53.8	RG
YUK47.6-H3	Yukon River, south barge	08-Aug-19	BS	CH	91	7.8	RG
YUK47.6-H3	Yukon River, south barge	08-Aug-19	BS	CH	74	4.9	RG
YUK47.6-H3	Yukon River, south barge	08-Aug-19	BS	CCG	25	-	RG
YUK47.6-H3	Yukon River, south barge	08-Aug-19	BS	CCG	25	-	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
YUK47.6-H3	Yukon River, south barge	08-Aug-19	BS	CCG	25	-	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	220	113	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	262	174	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	303	>300	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	245	150.5	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	175	48.4	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	118	14.3	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	117	18.2	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	123	17.3	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	132	27.2	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	114	16.4	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	170	59	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	185	59.3	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	200	97.4	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	195	82.2	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	CH	65	4.6	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	119	18.8	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	130	25.2	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	139	33.6	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	135	30	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	130	10.5	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	72	5.5	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	CH	70	4.8	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	111	170	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	225	119	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	~125	ESC	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	~130	ESC	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	~125	ESC	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	~125	ESC	RG
HC0.2-2	Halfway Creek	09-Aug-19	EF	GR	~130	ESC	RG
HC0.6-2	Halfway Creek	09-Aug-19	EF	GR	170	-	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	CH	88	5.1	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	CH	77	4.9	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	CH	73	3.9	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	CH	75	4.8	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	CH	78	5.4	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	CH	82	5.6	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	CH	76	4.9	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	CH	73	4.3	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	CH	72	3.8	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	CH	78	5.2	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	GR	76	3.5	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	GR	77	3.7	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	GR	75	3.9	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	GR	78	4.4	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	GR	70	3.2	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	GR	72	3	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	GR	73	3.6	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	GR	74	3.8	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	GR	68	2.9	RG
HCMZ-H1	Halfway Creek mixing zone	09-Aug-19	BS	GR	116	12.1	RG
HCMZ-H2	Halfway Creek mixing zone	09-Aug-19	BS	CH	72	4.4	RG
HCMZ-H2	Halfway Creek mixing zone	09-Aug-19	BS	GR	76	3.8	RG
HCMZ-H2	Halfway Creek mixing zone	09-Aug-19	BS	GR	133	22.2	RG
HCMZ-H2	Halfway Creek mixing zone	09-Aug-19	BS	GR	141	27.9	RG
HCMZ-H2	Halfway Creek mixing zone	09-Aug-19	BS	RW	134	22.3	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	GR	214	>300.0	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	GR	136	24.9	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	GR	135	24	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	GR	81	4.8	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	GR	78	4.3	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	GR	75	4.1	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	GR	68	3.1	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	GR	137	25.3	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	GR	110	11.4	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	GR	148	28.3	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	RW	78	3.9	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	CH	88	7.7	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	CH	85	6.6	RG
HCMZ-H3	Halfway Creek mixing zone	09-Aug-19	BS	CH	77	4.5	RG
CC5.6-MT1	Coffee Creek	09-Aug-19	MT	CH	76	5.6	RG
CC5.6-MT1	Coffee Creek	09-Aug-19	MT	CH	72	4.9	RG
CC5.6-MT1	Coffee Creek	09-Aug-19	MT	CCG	60	2.1	RG
CC5.6-MT2	Coffee Creek	09-Aug-19	MT	CH	81	7.5	RG
CC5.6-MT2	Coffee Creek	09-Aug-19	MT	CH	85	6.4	RG
CC5.6-MT2	Coffee Creek	09-Aug-19	MT	CH	82	5.8	RG
CC5.6-MT2	Coffee Creek	09-Aug-19	MT	CH	73	4.4	RG
CC5.6-MT2	Coffee Creek	09-Aug-19	MT	CH	76	4.2	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
CC5.6-MT2	Coffee Creek	09-Aug-19	MT	CH	77	4.8	RG
CC5.6-MT2	Coffee Creek	09-Aug-19	MT	CH	72	4	RG
CC5.6-MT2	Coffee Creek	09-Aug-19	MT	CH	78	4.7	RG
CC5.6-MT2	Coffee Creek	09-Aug-19	MT	CH	75	4.3	RG
CC5.6-MT2	Coffee Creek	09-Aug-19	MT	CH	72	3.9	RG
CC5.6-MT2	Coffee Creek	09-Aug-19	MT	CCG	81	6.7	RG
CC5.6-MT21	Coffee Creek	09-Aug-19	MT	CCG	90	8.8	RG
CC5.6-MT4	Coffee Creek	09-Aug-19	MT	CH	79	5.1	RG
CC5.6-MT4	Coffee Creek	09-Aug-19	MT	CH	73	4.3	RG
CC5.6-MT4	Coffee Creek	09-Aug-19	MT	CH	80	5.3	RG
CC5.6-MT4	Coffee Creek	09-Aug-19	MT	CH	69	3.4	RG
CC5.6-MT4	Coffee Creek	09-Aug-19	MT	CH	81	5.6	RG
CC5.6-MT4	Coffee Creek	09-Aug-19	MT	CH	70	3.4	RG
CC5.6-MT5	Coffee Creek	09-Aug-19	MT	CH	89	7.3	RG
CC5.6-MT7	Coffee Creek	09-Aug-19	MT	CH	82	5.4	RG
CC5.6-MT7	Coffee Creek	09-Aug-19	MT	CH	88	4.7	RG
CC5.6-MT7	Coffee Creek	09-Aug-19	MT	CH	75	4.1	RG
CC5.6-MT7	Coffee Creek	09-Aug-19	MT	CH	87	5	RG
CC5.6-MT7	Coffee Creek	09-Aug-19	MT	CH	72	3.6	RG
CC5.6-MT7	Coffee Creek	09-Aug-19	MT	CH	75	4.7	RG
CC5.6-MT7	Coffee Creek	09-Aug-19	MT	CH	82	5.5	RG
CC5.6-MT7	Coffee Creek	09-Aug-19	MT	CH	74	4.2	RG
CC5.6-MT7	Coffee Creek	09-Aug-19	MT	CH	72	3.5	RG
CC5.6-MT7	Coffee Creek	09-Aug-19	MT	CH	71	3.5	RG
CC5.6-MT7	Coffee Creek	09-Aug-19	MT	CH	77	4.6	RG
CC5.6-MT8	Coffee Creek	09-Aug-19	MT	CH	73	4	RG
CC5.6-MT8	Coffee Creek	09-Aug-19	MT	CH	78	4.7	RG
CC5.6-MT8	Coffee Creek	09-Aug-19	MT	CCG	90	8.8	RG
CC5.6-MT9	Coffee Creek	09-Aug-19	MT	CH	80	5.4	RG
CC5.6-MT9	Coffee Creek	09-Aug-19	MT	CH	88	7.8	RG
CC5.6-MT9	Coffee Creek	09-Aug-19	MT	CH	84	6.6	RG
CC5.6-MT9	Coffee Creek	09-Aug-19	MT	CH	82	6	RG
CC5.6-MT9	Coffee Creek	09-Aug-19	MT	CH	71	3.6	RG
CC5.6-MT9	Coffee Creek	09-Aug-19	MT	CH	86	4.6	RG
CC5.6-MT9	Coffee Creek	09-Aug-19	MT	CH	83	4.5	RG
CC5.6-MT9	Coffee Creek	09-Aug-19	MT	CH	83	6	RG
CC5.6-MT9	Coffee Creek	09-Aug-19	MT	CH	75	4.3	RG
CC5.6-MT9	Coffee Creek	09-Aug-19	MT	CH	77	5.2	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	GR	65	2.1	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	GR	58	1.5	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	GR	66	2.4	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	GR	65	2.3	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	GR	58	1.7	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	GR	51	1	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	GR	60	2.3	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	GR	61	1.9	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	GR	57	1.3	KD
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	GR	50	0.8	KD
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	CH	85	8.1	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	CH	81	5.8	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	45	1	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	64	2.6	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	53	1.7	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	42	0.8	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	53	1.4	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	39	0.7	RG
SR-N-H1-Aug	Stewart River, north barge	10-Aug-19	BS	CCG	50	1.1	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	GR	65	2.4	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	GR	50	1	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	GR	60	1.9	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	GR	62	2.2	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	GR	56	1.5	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	GR	60	2	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	GR	92	7	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	GR	125	18.4	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	GR	62	2.1	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	GR	80	4.3	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CH	85	6.4	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CH	78	5.4	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	105	12.1	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	55	2.1	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	50	1.5	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	46	1.1	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	50	1.4	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	52	1.8	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	93	9.2	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CCG	49	1.3	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CCG	65	3	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CCG	60	2.2	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CCG	30	0.5	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CCG	60	2.5	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CCG	58	1.4	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CCG	46	1.1	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CCG	27	0.3	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CCG	31	0.4	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	CCG	32	0.3	RG
SR-N-H2-Aug	Stewart River, north barge	10-Aug-19	BS	LKC	37	0.3	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	IN	153	27.9	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	GR	55	41.1	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	GR	85	6.7	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	GR	57	1.9	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	GR	69	3.3	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	GR	56	1.9	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	GR	58	1.5	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	GR	54	1.2	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	GR	59	1.6	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	RW	61	2	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	CH	95	9.3	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	CH	81	6.2	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	CH	82	6.4	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	CH	78	3.8	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	GR	130	22.1	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	98	10	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	97	10.9	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	104	11.9	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	130	24.6	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	48	1.3	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	48	1.2	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	96	9.3	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	69	3.4	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	50	1.3	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LSU	80	5.9	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LKC	75	4.2	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LKC	92	7.3	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LKC	88	7	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LKC	82	5.8	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LKC	78	4.3	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LKC	68	3.4	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	LKC	33	0.2	RG
SR-N-H3-Aug	Stewart River, north barge	10-Aug-19	BS	NP	154	37.1	RG
SR-S-H1-Aug	Stewart River, south barge	10-Aug-19	BS	GR	56	1.6	RG
SR-S-H1-Aug	Stewart River, south barge	10-Aug-19	BS	GR	62	1.4	RG
SR-S-H1-Aug	Stewart River, south barge	10-Aug-19	BS	GR	60	2.2	RG
SR-S-H1-Aug	Stewart River, south barge	10-Aug-19	BS	GR	53	1.5	RG
SR-S-H1-Aug	Stewart River, south barge	10-Aug-19	BS	GR	56	1.6	RG
SR-S-H1-Aug	Stewart River, south barge	10-Aug-19	BS	GR	133	23	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	GR	62	2.1	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	GR	64	2.3	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	GR	67	2.6	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	GR	52	1.2	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	GR	66	2.9	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	GR	71	3.2	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	GR	53	1	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	GR	53	1.4	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	GR	54	1.4	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	LSU	35	0.4	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	LSU	33	0.2	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	CCG	47	1.4	RG
SR-S-H2-Aug	Stewart River, south barge	10-Aug-19	BS	CCG	23	-	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	GR	81	4.7	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	GR	68	2.8	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	GR	70	2.9	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	LSU	42	0.7	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	LSU	40	0.5	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	LSU	39	0.5	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	LSU	41	0.5	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	LSU	45	0.8	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	LSU	44	0.8	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	LSU	34	0.5	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	LSU	33	0.5	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	LKC	31	0.5	RG
SR-S-H3-Aug	Stewart River, south barge	10-Aug-19	BS	CCG	29	0.5	RG
YT24MZ1-H1	YT24 Creek mixing zone	10-Aug-19	BS	CH	81	5.8	RG
YT24MZ1-H1	YT24 Creek mixing zone	10-Aug-19	BS	CH	82	6	RG
YT24MZ1-H1	YT24 Creek mixing zone	10-Aug-19	BS	GR	151	34.5	RG
YT24MZ1-H1	YT24 Creek mixing zone	10-Aug-19	BS	GR	86	6.9	RG

Site ID	Stream Name	Sampling Date	Sample Type	Species	Fork Length (mm)	Weight (g)	Release Condition
YT24MZ1-H1	YT24 Creek mixing zone	10-Aug-19	BS	GR	138	24.5	RG
YT24MZ1-H1	YT24 Creek mixing zone	10-Aug-19	BS	GR	172	63.7	RG
YT24MZ1-H1	YT24 Creek mixing zone	10-Aug-19	BS	GR	165	45.3	RG
YT24MZ1-H1	YT24 Creek mixing zone	10-Aug-19	BS	CCG	42	<1.0	RG
YT24MZ1-H1	YT24 Creek mixing zone	10-Aug-19	BS	CCG	32	<1.0	RG
YT24MZ1-H1	YT24 Creek mixing zone	10-Aug-19	BS	CCG	27	<1.0	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	GR	224	140.2	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	GR	135	27.6	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	GR	140	27.3	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	GR	141	31.2	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	GR	75	4.4	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	GR	78	5.2	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	GR	69	3.5	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	GR	74	3.7	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	CH	74	2.4	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	CH	60	6	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	CH	81	5.1	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	CH	80	6.3	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	CH	86	4.2	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	CH	76	4.9	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	CH	75	5	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	CH	85	7.2	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	CH	80	5.3	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	GR	75	3.1	RG
YT24MZ1-H2	YT24 Creek mixing zone	10-Aug-19	BS	GR	81	5	RG
YT24MZ1-H3	YT24 Creek mixing zone	10-Aug-19	BS	RW	81	4.2	RG
YT24MZ1-H3	YT24 Creek mixing zone	10-Aug-19	BS	RW	82	4.5	RG
YT24MZ1-H3	YT24 Creek mixing zone	10-Aug-19	BS	GR	77	3.6	RG
YT24MZ1-H3	YT24 Creek mixing zone	10-Aug-19	BS	GR	80	4.2	RG
YT24MZ1-H3	YT24 Creek mixing zone	10-Aug-19	BS	GR	73	3	RG
YT24MZ1-H3	YT24 Creek mixing zone	10-Aug-19	BS	GR	70	2.9	RG
YT24MZ1-H3	YT24 Creek mixing zone	10-Aug-19	BS	LW	94	7.6	RG
YT24MZ1-H3	YT24 Creek mixing zone	10-Aug-19	BS	CCG	35	<1.0	RG
YT24MZ1-H3	YT24 Creek mixing zone	10-Aug-19	BS	CCG	30	<1.0	RG
YT24MZ1-H3	YT24 Creek mixing zone	10-Aug-19	BS	CCG	30	<1.0	RG

APPENDIX C. FISH HABITAT ASSESSMENT PROCEDURE SURVEY DATA

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Table C-1. Fish habitat assessment procedure (FHAP) survey data from the site visits in July and August 2019.

Site	Date	Distance (m)	Habitat Unit		Length (m)	Gradient (%)	Bankfull Height (m)	Bank Height (m)	Average Water Depth (m)	Mean Depth		Pools Only				Bed Material			Functional LWD Tally			Cover				Riparian Vegetation		
			Type	Cat						Bankfull Depth (m)	Wetted Depth (m)	Max Depth (m)	Crest (m)	Residual (m)	Pool Type	Dom.	Sub-Dom.	Total LWD Tally	10-20 cm	20-50 cm	>50 cm	Cover Type	%	Cover Type	%	Type	Structure	Canopy Closure
Carlisle Creek Tributary	11-Aug-19	0+000	R	1	20.1	2.5	0.44	0.25	0.19	4.14	3.28	-	-	-	-	C	B	0	0	0	0	B	10	OV	5	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+020	R+	1	49.0	6.0	0.59	0.40	0.19	4.80	3.65	-	-	-	-	C	B	0	0	0	0	OV	5	B	5	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+069	G	1	12.6	1.0	0.73	0.28	0.45	4.00	3.70	-	-	-	-	C	B	0	0	0	0	OV	20	DP	5	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+082	R+	1	19.4	5.0	0.50	0.30	0.20	3.50	3.00	-	-	-	-	C	G	0	0	0	0	OV	5	B	5	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+101	R	1	16.0	3.0	0.50	0.35	0.15	2.96	2.69	-	-	-	-	C	B	0	0	0	0	OV	10	B	T	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+117	R+	1	13.5	7.0	0.34	0.20	0.14	3.57	3.60	-	-	-	-	C	B	1	1	0	0	OV	5	B	T	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+131	R	1	37.7	3.0	0.42	0.15	0.27	3.00	3.46	-	-	-	-	C	B	0	0	0	0	C	5	DP	T	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+169	R+	1	24.0	5.0	0.42	0.26	0.16	4.25	3.93	-	-	-	-	C	B	0	0	0	0	B	5	C	5	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+193	R	1	40.1	3.0	0.62	0.45	0.17	5.60	3.50	-	-	-	-	C	B	1	1	0	0	B	5	OV	5	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+233	G	1	8.2	1.0	0.41	0.15	0.26	4.60	2.95	-	-	-	-	C	G	2	2	0	0	C	5	DP	5	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+241	R	1	13.8	2.5	0.44	0.28	0.16	3.87	2.96	-	-	-	-	C	B	1	1	0	0	B	5	DP	5	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+255	R+	1	8.4	7.0	0.43	0.25	0.18	4.40	4.20	-	-	-	-	C	B	0	0	0	0	C	5	DP	T	C	MF	1
Carlisle Creek Tributary	11-Aug-19	0+263	R	1	32.3	4.0	0.42	0.25	0.17	4.40	3.98	-	-	-	-	C	B	2	2	0	0	B	5	C	5	M	MF	2
Carlisle Creek Tributary	11-Aug-19	0+295	R+	1	14.3	7.0	0.24	0.16	0.08	8.36	6.90	-	-	-	-	C	B	1	1	0	0	B	5	DP	T	M	MF	1
Carlisle Creek Tributary	11-Aug-19	0+309	G	1	6.9	1.0	0.48	0.20	0.28	7.80	4.40	-	-	-	-	C	G	0	0	0	0	DP	10	C	5	M	MF	1
Carlisle Creek Tributary	11-Aug-19	0+316	R+	1	15.5	6.0	0.47	0.35	0.12	7.48	6.22	-	-	-	-	C	B	1	1	0	0	B	T	OV	T	M	MF	2
Carlisle Creek Tributary	11-Aug-19	0+332	R	1	18.3	3.0	0.40	0.20	0.20	4.85	2.60	-	-	-	-	C	G	1	1	0	0	C		B	T	M	MF	2
Carlisle Creek Tributary	11-Aug-19	0+350	G	1	6.9	1.0	0.72	0.45	0.27	3.86	2.56	-	-	-	-	C	B	4	3	1	0	OV	15	C	5	M	MF	3
Carlisle Creek Tributary	11-Aug-19	0+357	R+	1	13.3	6.0	0.56	0.36	0.20	4.30	3.16	-	-	-	-	C	B	2	1	1	0	B	5	DP	T	M	MF	2
Carlisle Creek Tributary	11-Aug-19	0+370	R	1	31.4	3.0	0.41	0.24	0.17	4.56	3.76	-	-	-	-	C	B	3	2	1	0	C	5	B	5	M	MF	1
Carlisle Creek Tributary	11-Aug-19	0+401	R+	1	160.4	6.0	0.50	0.28	0.22	5.20	3.84	-	-	-	-	C	B	0	0	0	0	B	5	OV	T	C	MF	1
Coffee Creek	12-Jul-19	0+000	G	1	39.2	1	0.53	0.17	0.36	15.60	7.71	-	-	-	-	C	G	3	2	1	0	OV	20	C	T	M	MF	1
Coffee Creek	12-Jul-19	0+039	R	1	15.8	1.0	0.44	0.25	0.19	17.10	13.10	-	-	-	-	C	G	1	0	1	0	B	5	C	T	M	MF	1
Coffee Creek	12-Jul-19	0+055	G	1	82.6	1.0	0.65	0.25	0.40	17.60	12.80	-	-	-	-	C	F	3	2	1	0	OV	5	DP	5	M	MF	1
Coffee Creek	12-Jul-19	0+138	R	1	72.4	2.0	0.54	0.38	0.16	16.60	14.60	-	-	-	-	C	G	5	5	0	0	OV	5	B	T	M	MF	1
Coffee Creek	12-Jul-19	0+138	P	3	23.9	0.5	1.09	0.40	0.69	-	2.50	1.20	0.20	1.00	S	S	C	10+	7	4	2	DP	20	OV	5	M	MF	1
Coffee Creek	12-Jul-19	0+162	G	3	19.0	1.0	0.52	0.27	0.25	-	7.80	-	-	-	-	C	G	2	2	0	0	C	5	OV	T	M	MF	1
Coffee Creek	12-Jul-19	0+210	G	1	14.7	1.0	0.69	0.40	0.29	14.90	7.80	-	-	-	-	C	G	0	0	0	0	C	T	-	-	M	MF	1
Coffee Creek	12-Jul-19	0+225	R	1	36.2	1.0	0.43	0.22	0.21	13.90	9.00	-	-	-	-	C	G	0	0	0	0	OV	5	C	T	M	MF	2
Coffee Creek	12-Jul-19	0+261	G	1	35.2	1.0	0.57	0.28	0.29	14.20	8.50	-	-	-	-	C	G	2	1	1	0	OV	5	B	T	M	MF	1
Coffee Creek	12-Jul-19	0+296	R	1	59.0	1.0	0.59	0.40	0.19	14.00	10.20	-	-	-	-	C	B	1	1	0	0	B	10	OV	T	M	MF	1
Coffee Creek	12-Jul-19	0+355	G	1	105.7	1.0	0.44	0.10	0.34	14.20	12.00	-	-	-	-	C	G	2	2	0	0	C	10	OV	5	M	MF	1
Coffee Creek	12-Jul-19	0+463	P	1	39.6	1.0	0.97	0.10	0.87	17.60	11.00	1.40	0.33	1.07	S	G	S	5	4	1	0	DP	15	C	5	M	MF	1
Coffee Creek	12-Jul-19	0+503	R	1	60.1	3.5	0.91	0.74	0.17	34.60	8.10	-	-	-	-	-	-	4	2	2	0	B	10	OV	5	M	MF	1
Coffee Creek	12-Jul-19	0+542	P	3	26.0	0.5	0.74	0.20	0.54	-	8.00	1.20	0.38	0.28	S	B	S	2	1	1	0	DP	30	C	5	M	MF	1
Coffee Creek	12-Jul-19	0+563	G	1	27.7	1.0	0.70	0.29	0.41	17.60	8.20	-	-	-	-	C	G	2	2	0	0	C	5	OV	T	M	MF	1

Site	Date	Distance (m)	Habitat Unit		Length (m)	Gradient (%)	Bankfull Height (m)	Bank Height (m)	Average Water Depth (m)	Mean Depth		Pools Only				Bed Material			Functional LWD Tally			Cover				Riparian Vegetation		
			Type	Cat						Bankfull Depth (m)	Wetted Depth (m)	Max Depth (m)	Crest (m)	Residual (m)	Pool Type	Dom.	Sub-Dom.	Total LWD Tally	10-20 cm	20-50 cm	>50 cm	Cover Type	%	Cover Type	%	Type	Structure	Canopy Closure
Coffee Creek	12-Jul-19	0+591	P	1	30.7	0.5	1.07	0.30	0.77	18.40	7.80	2.00	0.21	1.79	S	S	G	3	3	0	0	DP	35	OV	10	M	MF	1
Coffee Creek	12-Jul-19	0+622	R	1	18.8	3.0	0.56	0.40	0.16	26.20	8.40	-	-	-	-	C	G	2	1	1	0	B	5	C	5	M	MF	1
Coffee Creek	12-Jul-19	0+641	G	1	85.0	1.0	0.91	0.38	0.53	16.90	12.30	-	-	-	-	C	G	3	3	0	0	DP	5	OV	5	M	MF	1
Coffee Creek	12-Jul-19	0+726	R	1	33.0	1.5	0.46	0.35	0.11	23.60	10.60	-	-	-	-	C	G	3	2	1	0	B	T	-	-	M	MF	1
Coffee Creek	12-Jul-19	0+759	G	1	94.4	1.0	0.72	0.30	0.42	15.80	7.70	-	-	-	-	C	S	3	1	2	0	C	5	OV	T	M	MF	1
Coffee Creek	12-Jul-19	0+853	R	1	66.1	1.0	0.48	0.30	0.18	15.80	14.30	-	-	-	-	C	G	7	4	3	0	B	20	C	5	M	MF	1
Coffee Creek	12-Jul-19	0+919	G	1	57.7	1.0	0.70	0.31	0.39	15.00	11.80	-	-	-	-	C	S	5	5	0	0	C	10	B	5	M	MF	1
Coffee Creek	12-Jul-19	0+977	R	1	10.6	1.5	0.48	0.30	0.18	13.80	8.40	-	-	-	-	C	S	3	2	1	0	DP	5	B	T	M	MF	1
Coffee Creek	12-Jul-19	0+988	G	1	103.3	1.0	0.55	0.27	0.28	13.00	11.60	-	-	-	-	C	S	8	5	3	0	C	5	DP	10	M	MF	1
YT-"23" Creek	9-Jul-19	0+000	R+	1	11.3	5.8	0.70	0.61	0.09	4.13	3.25	-	-	-	-	C	B	3	3	0	0	B	10	C	5	M	MF	2
YT-"23" Creek	9-Jul-19	0+011	R	1	11.2	2.3	0.59	0.49	0.10	3.40	1.60	-	-	-	-	G	B	0	0	0	0	B	15	C	5	M	MF	2
YT-"23" Creek	9-Jul-19	0+022	R	1	48.0	2.3	0.70	0.62	0.08	3.62	2.78	-	-	-	-	G	B	2	1	1	0	B	5	C	TR	M	MF	2
YT-"23" Creek	9-Jul-19	0+070	G	1	5.6	0.9	0.67	0.50	0.17	3.70	2.15	-	-	-	-	G	C	1	0	1	0	B	5	-	-	M	MF	3
YT-"23" Creek	9-Jul-19	0+076	C	1	5.0	14.2	0.47	0.37	0.10	3.90	2.15	-	-	-	-	B	C	2	1	1	0	B	5	NA	N	M	MF	3
YT-"23" Creek	9-Jul-19	0+081	R	1	12.1	2.8	0.53	0.50	0.03	3.50	1.97	-	-	-	-	G	C	1	0	1	0	C	10	B	5	M	MF	1
YT-"23" Creek	9-Jul-19	0+093	R+	1	27.0	7.7	0.48	0.35	0.13	4.45	3.65	-	-	-	-	B	C	2	0	2	0	B	10	C	T	M	MF	1
YT-"23" Creek	9-Jul-19	0+120	G	1	3.5	0.0	0.42	0.32	0.10	3.42	2.92	-	-	-	-	S	C	1	0	1	0	C	10	B	T	M	MF	2
YT-"23" Creek	9-Jul-19	0+124	R+	1	5.9	7.7	0.39	0.30	0.09	3.29	2.67	-	-	-	-	B	C	2	1	1	0	B	5	C	T	M	MF	4
YT-"23" Creek	9-Jul-19	0+130	C	1	3.0	21.3	0.37	0.30	0.07	4.20	2.25	-	-	-	-	B	C	5	1	2	2	C	25	DP	25	M	MF	4
YT-"23" Creek	9-Jul-19	0+133	R	1	7.5	3.3	0.48	0.35	0.13	3.70	1.60	-	-	-	-	G	C	1	0	1	0	C	5	OV	T	M	MF	4
YT-"23" Creek	9-Jul-19	0+141	G	1	5.0	0.9	0.48	0.36	0.12	3.82	2.20	-	-	-	-	S	G	0	0	0	0	C	T	OV	T	M	MF	3
YT-"23" Creek	9-Jul-19	0+146	R	1	29.5	4.2	0.52	0.45	0.07	3.64	1.39	-	-	-	-	G	B	2	1	1	0	B	5	DP	T	M	MF	2
YT-"23" Creek	9-Jul-19	0+176	G	1	3.0	0.9	0.43	0.35	0.08	3.14	1.95	-	-	-	-	G	S	1	0	0	1	C	5	DP	5	M	MF	1
YT-"23" Creek	9-Jul-19	0+179	C	1	2.0	19.4	0.43	0.30	0.13	4.90	1.07	-	-	-	-	B	LWD	3	1	1	1	DP	30	B	T	M	MF	2
YT-"23" Creek	9-Jul-19	0+179	C	2	6.0	16.7	0.33	0.25	0.08	-	0.48	-	-	-	-	C	G	2	1	1	0	B	5	OV	T	M	MF	2
YT-"23" Creek	9-Jul-19	0+181	R	1	12.8	4.5	0.55	0.38	0.17	3.70	1.82	-	-	-	-	G	C	1	0	0	1	DP	10	B	T	M	MF	1
YT-"23" Creek	9-Jul-19	0+194	R+	1	27.2	6.3	0.32	0.23	0.09	3.67	1.70	-	-	-	-	G	C	2	2	0	0	DP	5	C	T	M	MF	2
YT-"23" Creek	9-Jul-19	0+221	C	1	3.0	14.8	0.29	0.23	0.06	3.80	3.10	-	-	-	-	B	C	5	1	2	2	OV	100	-	0	M	MF	1
YT-"23" Creek	9-Jul-19	0+224	R	1	104.0	6.1	0.51	0.36	0.15	3.17	2.03	-	-	-	-	C	S	7	4	2	1	C	15	B	5	M	MF	2
YT-"23" Creek	9-Jul-19	0+328	R+	1	35.5	7.9	0.69	0.55	0.14	4.30	1.94	-	-	-	-	B	C	9	4	5	0	B	10	C	T	M	MF	2
YT-"23" Creek	9-Jul-19	0+364	C	1	10.1	10.5	0.52	0.42	0.10	3.50	2.90	-	-	-	-	B	G	2	1	1	0	B	5	DP	5	M	MF	1
YT-"23" Creek	9-Jul-19	0+374	R+	1	20.8	7.9	0.30	0.23	0.07	3.70	1.70	-	-	-	-	C	G	2	0	1	1	B	5	DP	5	M	MF	3
YT-"23" Creek	9-Jul-19	0+395	P	1	3.3	0.9	0.52	0.24	0.28	2.48	2.40	0.48	0.07	0.41	S	C	G	1	0	0	1	PD	10	C	15	M	MF	2
YT-"23" Creek	9-Jul-19	0+398	R+	1	7.7	5.8	0.36	0.26	0.10	2.45	2.40	-	-	-	-	C	G	2	2	0	0	B	5	C	T	M	MF	1
YT-"23" Creek	9-Jul-19	0+406	C	1	14.6	11.0	0.52	0.42	0.10	3.30	2.60	-	-	-	-	G	C	6	2	3	1	OV	10	DP	5	M	MF	2
YT-"23" Creek	9-Jul-19	0+421	R	1	56.9	1.7	0.34	0.26	0.08	2.46	1.42	-	-	-	-	C	G	8	4	2	2	DP	5	C	T	M	MF	1
YT-"23" Creek	9-Jul-19	0+478	P	1	4.0	0.9	0.72	0.40	0.32	3.18	2.77	0.59	0.09	0.50	S	C	B	8	3	3	2	DP	30	C	T	M	MF	2

Site	Date	Distance (m)	Habitat Unit		Length (m)	Gradient (%)	Bankfull Height (m)	Bank Height (m)	Average Water Depth (m)	Mean Depth		Pools Only				Bed Material			Functional LWD Tally			Cover				Riparian Vegetation		
			Type	Cat						Bankfull Depth (m)	Wetted Depth (m)	Max Depth (m)	Crest (m)	Residual (m)	Pool Type	Dom.	Sub-Dom.	Total LWD Tally	10-20 cm	20-50 cm	>50 cm	Cover Type	%	Cover Type	%	Type	Structure	Canopy Closure
YT-"23" Creek	9-Jul-19	0+482	R	1	33.5	3.5	0.39	0.30	0.09	2.79	1.73	-	-	-	-	B	C	10	6	4	0	DP	5	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	0+000	R	1	23.6	1	0.53	0.38	0.15	11.20	8.90	-	-	-	-	C	G	1	1	0	0	B	5	OV	T	M	MF	1
Carlisle Creek	13-Jul-19	0+024	G	1	10.0	1.0	0.68	0.35	0.33	16.60	7.60	-	-	-	-	C	G	7	1	5	1	OV	10	DP	5	M	MF	1
Carlisle Creek	13-Jul-19	0+034	R	1	23.5	3.5	0.29	0.25	0.04	14.60	11.20	-	-	-	-	C	C	5	3	2	0	B	5	C	T	M	MF	1
Carlisle Creek	13-Jul-19	0+058	G	1	70.9	0.8	0.86	0.25	0.61	8.60	6.30	-	-	-	-	S	G	11	6	5	0	OV	10	C	10	M	MF	1
Carlisle Creek	13-Jul-19	0+129	G	1	12.2	1.5	0.57	0.35	0.22	12.30	7.80	-	-	-	-	C	G	1	1	0	0	B	5	OV	T	M	MF	1
Carlisle Creek	13-Jul-19	0+141	R	1	27.0	2.0	0.42	0.30	0.12	12.10	8.80	-	-	-	-	C	G	2	2	0	0	B	5	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	0+168	P	1	29.2	0.5	0.86	0.17	0.69	7.20	6.90	1.16	0.19	0.97	S	S	G	3	2	1	0	DP	20	C	5	M	MF	1
Carlisle Creek	13-Jul-19	0+197	R	1	33.6	1.5	0.48	0.35	0.13	10.00	5.30	-	-	-	-	C	G	1	1	0	0	OV	5	C	T	M	MF	1
Carlisle Creek	13-Jul-19	0+231	G	1	6.9	1.0	0.48	0.30	0.18	9.30	3.50	-	-	-	-	C	G	0	0	0	0	OV	T	B	T	M	MF	1
Carlisle Creek	13-Jul-19	0+238	R	1	12.3	1.5	0.46	0.27	0.19	9.00	4.00	-	-	-	-	C	G	0	0	0	0	B	5	OV	T	M	MF	1
Carlisle Creek	13-Jul-19	0+250	P	1	11.2	0.5	1.11	0.40	0.71	11.40	6.60	1.10	0.18	0.92	S	C	G	1	1	0	0	DP	55	OV	10	M	MF	1
Carlisle Creek	13-Jul-19	0+261	G	1	17.7	1.0	0.75	0.30	0.45	8.20	4.80	-	-	-	-	C	G	2	1	1	0	C	10	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	0+279	R	1	5.3	2.0	0.37	0.25	0.12	11.20	5.90	-	-	-	-	C	G	2	1	1	0	B	T	-	-	M	MF	1
Carlisle Creek	13-Jul-19	0+284	G	1	21.3	1.0	0.54	0.20	0.34	8.20	6.20	-	-	-	-	C	G	5	2	2	1	C	10	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	0+305	R	1	12.6	4.0	0.33	0.20	0.13	11.80	9.90	-	-	-	-	C	G	2	1	1	0	B	5	OV	T	M	MF	1
Carlisle Creek	13-Jul-19	0+318	G	1	32.6	1.0	0.82	0.30	0.52	9.60	5.80	-	-	-	-	C	G	9	5	3	1	C	30	OV	20	M	MF	1
Carlisle Creek	13-Jul-19	0+351	R	1	3.5	3.0	0.33	0.20	0.13	14.70	6.60	-	-	-	-	C	S	0	0	0	0	B	T	-	-	M	MF	1
Carlisle Creek	13-Jul-19	0+355	G	1	3.0	1.0	0.64	0.32	0.32	10.10	4.10	-	-	-	-	C	B	3	1	2	0	DP	10	B	10	M	MF	1
Carlisle Creek	13-Jul-19	0+385	R	1	19.8	1.0	0.83	0.58	0.25	8.80	4.30	-	-	-	-	C	B	4	2	1	1	DP	5	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	0+405	C	1	5.5	5.0	0.61	0.50	0.11	11.10	9.40	-	-	-	-	B	C	8	6	1	0	DP	10	C	T	M	MF	1
Carlisle Creek	13-Jul-19	0+411	R	1	34.1	1.0	0.64	0.50	0.14	9.90	6.70	-	-	-	-	C	B	5	2	3	0	B	10	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	0+445	G	1	35.8	1.0	0.71	0.37	0.34	8.90	7.60	-	-	-	-	C	G	9	5	4	0	OV	5	C	T	M	MF	1
Carlisle Creek	13-Jul-19	0+481	R	1	20.3	1.0	0.35	0.25	0.10	8.30	7.40	-	-	-	-	C	S	3	3	0	0	C	10	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	0+501	G	1	32.2	1.0	0.47	0.20	0.27	8.10	5.20	-	-	-	-	C	G	1	1	0	0	C	10	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	0+533	R	1	5.0	3.0	0.70	0.50	0.20	13.50	6.90	-	-	-	-	B	C	2	1	1	0	B	5	DP	5	M	MF	1
Carlisle Creek	13-Jul-19	0+538	G	1	13.4	1.0	0.72	0.35	0.37	11.10	7.20	-	-	-	-	C	B	1	0	1	0	B	15	DP	5	M	MF	1
Carlisle Creek	13-Jul-19	0+551	R	1	18.6	1.5	0.54	0.35	0.19	10.90	6.30	-	-	-	-	C	B	3	2	1	0	B	5	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	0+570	G	1	74.8	1.0	0.67	0.23	0.44	13.30	5.30	-	-	-	-	C	G	2	2	0	0	C	5	OV	T	M	MF	1
Carlisle Creek	13-Jul-19	0+645	R	1	77.6	1.5	0.68	0.50	0.18	9.90	5.00	-	-	-	-	C	G	4	2	2	0	OV	5	C	T	M	MF	1
Carlisle Creek	13-Jul-19	0+723	G	1	49.9	1.0	0.68	0.30	0.38	11.20	5.20	-	-	-	-	C	G	5	3	2	0	C	10	OV	10	M	MF	1
Carlisle Creek	13-Jul-19	0+773	R	1	15.5	3.5	0.57	0.35	0.22	16.60	2.10	-	-	-	-	C	G	5	5	0	0	DP	10	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	0+789	G	1	32.1	1.0	0.85	0.35	0.50	10.00	3.50	-	-	-	-	G	C	100	100	100	100	DP	10	DP	5	M	MF	1
Carlisle Creek	13-Jul-19	0+821	R	1	7.0	2.0	0.41	0.30	0.11	11.50	5.10	-	-	-	-	C	G	0	0	0	0	B	T	-	0	M	MF	1
Carlisle Creek	13-Jul-19	0+828	G	1	10.4	1.0	0.68	0.32	0.36	9.30	4.40	-	-	-	-	G	C	1	1	0	0	C	T	-	0	M	MF	1
Carlisle Creek	13-Jul-19	0+838	R	1	5.3	1.5	0.41	0.30	0.11	11.20	4.80	-	-	-	-	C	G	0	0	0	0	B	T	-	0	M	MF	1
Carlisle Creek	13-Jul-19	0+843	G	1	25.3	1.0	0.71	0.30	0.41	12.70	5.00	-	-	-	-	C	G	3	2	1	0	C	10	OV	5	M	MF	1

Site	Date	Distance (m)	Habitat Unit		Length (m)	Gradient (%)	Bankfull Height (m)	Bank Height (m)	Average Water Depth (m)	Mean Depth		Pools Only				Bed Material			Functional LWD Tally			Cover				Riparian Vegetation		
			Type	Cat						Bankfull Depth (m)	Wetted Depth (m)	Max Depth (m)	Crest (m)	Residual (m)	Pool Type	Dom.	Sub-Dom.	Total LWD Tally	10-20 cm	20-50 cm	>50 cm	Cover Type	%	Cover Type	%	Type	Structure	Canopy Closure
Carlisle Creek	13-Jul-19	0+868	R	1	24.5	1.0	0.30	0.15	0.15	13.90	4.70	-	-	-	-	C	B	3	3	0	0	C	5	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	0+892	G	1	26.1	1.0	0.71	0.30	0.41	10.30	5.20	-	-	-	-	C	G	2	2	0	0	C	5	OV	T	M	MF	1
Carlisle Creek	13-Jul-19	0+918	R	1	36.8	2.0	0.36	0.20	0.16	12.60	7.20	-	-	-	-	C	G	5	4	1	0	OV	5	B	T	M	MF	1
Carlisle Creek	13-Jul-19	0+955	G	1	55.6	1.0	0.56	0.30	0.26	9.90	7.90	-	-	-	-	G	C	2	2	0	0	DP	10	C	10	M	MF	1
Carlisle Creek	13-Jul-19	1+011	R	1	14.6	2.0	0.39	0.30	0.09	11.50	9.80	-	-	-	-	C	G	3	2	1	0	C	10	OV	10	M	MF	1
Carlisle Creek	13-Jul-19	1+025	R	1	44.3	1.0	0.63	0.40	0.23	9.60	5.80	-	-	-	-	C	G	7	2	5	0	OV	15	C	5	M	MF	1
Carlisle Creek	13-Jul-19	1+069	G	1	21.6	1.0	0.69	0.30	0.39	6.90	4.90	-	-	-	-	C	S	2	1	1	0	C	10	OV	T	M	MF	1
Carlisle Creek	13-Jul-19	1+091	R	1	7.8	2.0	0.44	0.35	0.09	12.00	4.80	-	-	-	-	C	G	6	5	1	0	C	5	OV	5	M	MF	1
Carlisle Creek	13-Jul-19	1+099	G	1	17.6	1.0	0.72	0.35	0.37	9.70	5.90	-	-	-	-	C	S	1	1	0	0	OV	5	C	5	M	MF	1

ENVIRONMENTAL DYNAMICS INC.

2195 – 2nd Avenue
Whitehorse, YT Y1A 3T8
P: (867) 393-4882

December 14, 2020

EDI Project No: 20Y0061

Newmont Corporation
Suite 3400-666 Burrard Street
Vancouver, BC V6C 2X8

Attention: Jasmin Dobson, Environmental Supervisor

RE: Summer 2020 - Stewart River Back Channel Fieldwork

This letter provides a summary of the work completed and the data collected during summer 2020 fieldwork in the Stewart River back channel.

June 17, 2020

An EDI crew visited the Stewart River back channel on June 17, 2020, to assess fish and fish habitat. Water levels on the Stewart River were very high at the time (28.505 m) and there was flow through the back channel (WSC 2020). Due to the high-water and associated unwadable conditions, the crew could not complete the planned fish sampling. In situ water quality measurements and field observations were collected (Photo 1 to Photo 4; Table 1), in situ measurements were collected using a YSI Pro Solo multimeter, Oakton pH Testr pen, and an Oakton T-100 turbidimeter.

Table 1. In situ water quality parameters from the Stewart River back channel collected during June 17, 2020, fieldwork.

Site	Location Coordinates (Decimal Degrees)		Temperature (°C)	pH	Dissolved Oxygen		Specific Conductivity (µS/cm)	Turbidity (NTUs)
	Northing	Easting			mg/L	%		
Site 1	63.23074	-138.82615	12.6	7.84	9.68	91.2	268.4	75.4
Site 2	63.23059	-138.82824	11.5	-	2.34	21.8	233.1	-
Site 3	63.23019	-138.82798	12.9	-	3.07	29.2	190.4	-
Site 4	-	-	12.6	-	8.63	81.1	269.7	-
Site 5	63.22984	-138.82839	12.6	-	9.63	88.1	268.9	-

µS/cm = microsiemens per centimeter, NTU = nephelometric turbidity units.

August 27, 2020

An EDI crew visited the Stewart River back channel on August 27, 2020, to collect baseline fish and fish habitat data. The water level in the Stewart River was still relatively high (27.493 m; WSC 2020), and the

back channel was wetted for its entire length where it parallels the base of the hillside (Photo 5, Photo 6). There was no discernable flow in the back channel during sampling.

The crew recorded in situ water quality measurements using a YSI Pro Solo multimeter, an Oakton pH Testr pen, and an Oakton T-100 turbidimeter at some of the sampling locations along the length of the back channel (Table 2). Orange-brown algae was present in the upper half of the back channel (Photo 7). In situ water quality reflected poor habitat conditions in the top half of the back channel (low dissolved oxygen) and conditions improved closer to the mouth of the back channel and the Stewart River (Table 1). Water clarity (turbidity) improved and then decreased as the influence of the Stewart River backwatering the back channel became more pronounced (Photo 8).

Table 2. In situ water quality parameters from the Stewart River back channel collected during August 27, 2020, fieldwork.

Site	Location Coordinates (Decimal Degrees)		Temperature (°C)	pH	Dissolved Oxygen		Specific Conductivity (µS/cm)	Turbidity (NTUs)
	Northing	Easting			mg/L	%		
Haul 1	62.22934	-138.82878	5.0	8.60	4.88	38.6	521.0	31.3
Haul 2	62.22631	-138.82899	-	-	-	-	-	-
Haul 3	62.22894	-138.82910	-	-	-	-	-	-
Haul 4	63.22831	-138.82896	6.2	7.59	5.60	45.3	471.3	38.1
Haul 5	63.22726	-138.82909	7.5	7.64	6.90	57.6	481.0	2.70
Haul 6	63.22642	-138.82932	-	-	-	-	-	-
Haul 7	63.22588	-138.82928	9.7	7.34	6.82	60.1	517.0	4.20
Haul 8	63.22510	-138.82938	10.5	7.91	7.33	66.5	418.0	18.0

µS/cm = microsiemens per centimeter, NTU = nephelometric turbidity units.

Fish sampling involved seining with a 10 m long by 1.5 m deep beach seine constructed of 5 mm mesh. Seining sampled the wetted width of the Stewart River back channel at regular intervals. A total of eight seine hauls were conducted starting at the top of the back channel, where isolated pools were previously identified (EDI Environmental Dynamics Inc. 2019), and working back towards the mouth of the back channel. Northern pike (*Esox Lucius*), burbot (*Lota lota*), and lake whitefish (*Coregonus culpeaformis*) were captured during sampling (Photo 9 to Photo 11; Table 3). Fish were only captured in the lower half of the Stewart River back channel (Table 3). An adult and juvenile Northern pike were captured in the lower half of the Stewart River back channel (Photo 9; Table 3). Juvenile burbot and lake whitefish were also captured in the lower half of the back channel (Photo 10, Photo 11; Table 3). No fish were captured or observed in the portion of the back channel with orange-brown algae.

Table 3. Fish sampling results, capture data, and relative abundance in the Stewart River Back Channel during August 27, 2020 fieldwork.

Sample Site	Area Sampled (m^2)	Location Coordinates (Decimal Degrees)		Distance from Mouth[1] (m)	Fish Captured (Spp. - number)	Length[2] (mm)	Catch Per Unit Effort; CUPE (# fish/100m^2)
		Northing	Easting				
Haul 1	15	63.22934	-138.82878	500	NFC	-	-
Haul 2	11.3	63.22931	-138.82899	490	NFC	-	-
Haul 3	60	63.22894	-138.82910	450	NFC	-	-
Haul 4	140	63.22831	-138.82896	380	NFC	-	-
Haul 5	150	63.22726	-138.82909	260	NFC	-	-
Haul 6	150	63.22642	-138.82932	170	NP - 1	112 mm	0.67
Haul 7	200	63.22588	-138.82928	110	NP - 2 BB - 1	75, 98 mm 87 mm	1.00 0.50
Haul 8	320	63.22510	-138.82938	25	NP - 2 LW - 1	130, 590 mm 139 mm	0.63 0.31

NFC = no fish captured; NP = Northern pike; BB = burbot; LW = lake whitefish.

1 Distance from the mouth of the Stewart River back channel is approximate and estimated from google earth imagery and sample waypoints.

2 Fish length was measured as either fork length for NP and LW and total length for BB.

If you have any questions or concerns please contact me or Pat Tobler at 1-(867)-393-4882.

Yours truly,

EDI Environmental Dynamics Inc.

Via email

Jonathan Lowey, B.Sc.
Biologist

Cc: Jennie Gjertsen, Manager, Sustainability and External Relations

Attachments:
- Site Photos

References

EDI Environmental Dynamics Inc. 2019. Coffee Gold Project: fish and aquatic resources studies 2018. 156 pp.

Water Survey of Canada (WSC). 2020. Real-Time Hydrometric Data for STEWART RIVER AT THE MOUTH (09DD003) [YT] - Water Level and Flow - Environment Canada. (https://wateroffice.ec.gc.ca/report/real_time_e.html?stn=09DD003). Accessed December 12, 2020



Photo 1. Flow into the Stewart River back channel from the Stewart River during the June site visit (June 17, 2020).



Photo 2. The mouth (outlet) of the Stewart River back channel looking upsream (June 17, 2020).



Photo 3. Water clarity in the Stewart River back channel matched that of the Stewart River due to flow through the back channel (June 17, 2020).



Photo 4. Turbid water throughout the Stewart River back channel (June 17, 2020).



Photo 5. The mouth of the Stewart River back channel looking upstream (August 27, 2020).



Photo 6. The Stewart River back channel was wetted for its entire length along the base of the hillside (August 27, 2020).



Photo 7. Orange-brown algae was present in the upper half of the Stewart River back channel (August 27, 2020).



Photo 8. Algae free habitat in the lower half of the Stewart River back channel (August 27, 2020).



Photo 9. Juvenile Northern pike captured in the Stewart River back channel (August 27, 2020).



Photo 10. Juvenile burbot captured in the Stewart River back channel (August 27, 2020).



Photo 11. Juvenile lake whitefish captured in the Stewart River back channel (August 27, 2020).



Photo 12. Aerial view of the Stewart River back channel and the area (August 27, 2020).

ENVIRONMENTAL DYNAMICS INC.

2195 – 2nd Avenue
Whitehorse, YT Y1A 3T8
P: (867) 393-4882

November 3, 2021

EDI Project No: 21Y0138

Newmont Corporation
Suite 3400-666 Burrard Street
Vancouver, BC. V6C 2X8

Attention: Jennie Gjertsen, Manager, Sustainability and External Relations
Jasmin Dobson, Environmental Superintendent

RE: 2021 Halfway Creek Fish Investigations

This letter provides a summary of the work completed and data collected during summer 2021 aquatics fieldwork in Halfway Creek, on behalf of Newmont for the Coffee Gold Project.

Fish sampling last occurred in Halfway Creek in 2019, when electrofishing was conducted from 0.2 km to approximately 1.2 km upstream from the confluence of the Yukon River. Photos and measurements were taken at a logjam approximately 1 km upstream of the mouth of the creek (HC1.0), which was suspected to be a fish barrier. No fish were captured upstream of the suspected barrier during previous sampling from 2013 to 2019 (EDI Environmental Dynamics Inc. 2017, 2018, 2019, 2020). The shallow pools below and above the barrier were unlikely large enough to provide the space required for fish (e.g., Arctic grayling; *Thymallus arcticus*) to create the necessary propulsion to make it up and over the obstruction (EDI Environmental Dynamics Inc. 2020). However, Halfway Creek is a dynamic watershed, and can change from year to year. In addition, the Coffee Gold Project's proposed Waste Rock Storage Facility will be located in the upper Halfway Creek watershed. It is therefore important to understand fish use of and distribution within the watershed, so additional fish sampling was completed in Halfway Creek in 2021, with particular focus on sampling above and below the suspected fish barrier.

Methods

Electrofishing was conducted at three locations in Halfway Creek on August 14 and at two additional locations on September 5 (Table 1). Fish sampling was completed with a Smith-Root LR-24 electrofisher. Electrofishing effort was counted on the electrofisher in total seconds of active electrofishing as well as by the approximate distance from the electrofishing starting GPS point. All captured fish were enumerated and identified to species, and ten of each species were weighed (g) and measured to fork length (mm; Arctic grayling) or total length (mm; slimy sculpin [*Cottus cognatus*]). A calibrated YSI water quality meter was used to collect in situ water quality parameters (temperature and dissolved oxygen in August; temperature, dissolved oxygen, pH, and specific conductivity in September) at each fish sampling location.

On August 14, photos and measurements were taken at the suspected fish barrier located approximately 1 km upstream of the mouth of Halfway Creek (HC1.0).

Table 1. Fish sampling details for Halfway Creek in August and September 2021.

Sampling Site[1]	Start Location (Latitude, longitude)	End Location (Latitude, longitude)	Date	Distance Sampled (m)	Fishing Effort (seconds)	Electrofisher Settings
HC0.2	62.94371°, -139.24921°	62.94345°, -139.25050°	August 14	150	1219	350 V, 60 Hz, 30% duty cycle
HC0.7	62.94128°, -139.25972°	62.94124°, -139.26065°	August 14	160	1123	350 V, 60 Hz, 30% duty cycle
HC1.1	62.94017°, -139.26472°	62.93909°, -139.27222°	August 14	400	1138	350 V, 60 Hz, 30% duty cycle
HC2.0	62.93858°, -139.28038°	62.93654°, -139.28780°	September 5	500	1044	380 V, 50 Hz, 30% duty cycle
HC6.8	62.91264°, -139.33960°	62.90928°, -139.34587°	September 5	500	1060	380 V, 50 Hz, 30% duty cycle

[1]Sampling site location corresponds with distance in kilometers from the confluence of Halfway Creek with the Yukon River; for example, HC2.0 is located 2.0 km upstream of the confluence.

Results and Discussion

Fish sampling in Halfway Creek occurred at three sites on August 14. At site HC0.2 (200 m upstream of the confluence with the Yukon River), only slimy sculpin (n=13) were captured (Table 2, Photo 1). The slimy sculpin were all captured within approximately 240 m of the confluence with the Yukon River. While electrofishing at site HC0.2, the crew thought they saw a larger fish (presumably an Arctic grayling) but could not confirm their observation. The crew then sampled site HC0.7, which is located approximately 700 m upstream of the confluence with the Yukon River but downstream of the suspected fish barrier at HC1.0. No fish were caught. The crew proceeded to sample site HC1.1, which is approximately 100 m upstream of the suspected fish barrier. Two adult Arctic grayling were captured (Photo 2, Photo 3); no other species were caught.

Given that no fish had previously been captured this far up in Halfway Creek, additional sampling was completed on September 5 at sites HC2.0 and HC6.8 to investigate fish distribution higher in the watershed; however, no fish were captured nor did the crew make any visual observations of fish. All sampling durations ranged from 1044–1219 seconds.

Table 2. Fish captured in Halfway Creek in August and September 2021.

Site	Date	Species	Total fish captured	Fork length range (mm)[1]	Weight range (g)
HC0.2	August 14, 2021	Slimy sculpin	13	48–86	1.0–6.0
HC0.7	August 14, 2021	No fish captured	0	-	-
HC1.1	August 14, 2021	Arctic grayling	2	186–310	90–185
HC2.0	September 5, 2021	No fish captured	0	-	-
HC6.8	September 5, 2021	No fish captured	0	-	-

[1] Total length for slimy sculpin.

The previously suspected fish barrier was originally measured in July 2019 and again in August 2021 (Table 3). The logjam is approximately 15 m wide, with three distinct drops where water flows down into small pools—one drop near the left downstream bank, one at the right downstream bank, and another mid-channel (Photo 4Photo 5 and Photo 6). Each drop is comprised of large and small woody debris. Comparatively, the measured downstream pool depths appear similar in 2021 to those measured in 2019, but the measured upstream pool depths have increased since 2019. The drop heights have also decreased substantially since 2019. Halfway Creek is a very dynamic stream that sees high freshet flows, which may have dislodged parts of the logjam and increased upstream pool depth. Such changes likely explain how fish were able to pass upstream in 2021.

Table 3. Comparative measurements of the suspected fish barrier at HC1.0 in July 2019 and August 2021.

	Downstream Pool Depth (m)		Upstream Pool Depth (m)		Drop Height (m)		Drop Width (m)	
	2019	2021	2019	2021	2019	2021	2019	2021
Right Bank	0.76	0.62	0.05	0.32	0.80	0.55	1.0	2.06
Mid-Channel	0.27	0.28	0.35	0.54	0.50	0.11	1.6	0.58
Left Bank	0.10	0.18	0.15	0.39	0.40	0.19	1.2	0.43

Summary and Closure

Sampling has occurred in Halfway Creek on several occasions since 2013. Sampling results in the lower portion of Halfway Creek are variable from year to year in terms of species and numbers captured. This was the first year that slimy sculpin were captured upstream of the immediate mouth of the creek. Winter surveys have shown that the stream freezes to bed in the lower portions, so it is not suspected that the sculpin will remain in this portion of the stream.

Plans to construct a Waste Rock Storage Facility in the upper Halfway Creek watershed have warranted thorough investigations of fish use of and distribution within the creek. Results from 2021 show that the former suspected fish barrier changed enough to allow Arctic grayling to pass in 2021, but they seem to exist

only sporadically past the HC1.0 mark and have so far not been found upstream of HC2.0. Past studies have documented many impediments to fish passage between HC1.0 and the location of the Waste Rock Storage Facility (EDI Environmental Dynamics Inc. 2018), which may limit fish presence in the upper watershed.

If you have any questions or concerns, please contact Annina Altherr or Pat Tobler at (867) 393-4882.

Yours truly,

EDI Environmental Dynamics Inc.

Submitted via email

Annina Altherr, P.Biol.
Biologist

Attachments:
- Site photos
- Map 1. Fish sampling locations in Halfway Creek

References

EDI Environmental Dynamics Inc. 2017. Coffee Gold Mine: fisheries and aquatic resources baseline update. Prepared for Goldcorp Inc., Vancouver, BC. 269 pp.

EDI Environmental Dynamics Inc. 2018. Coffee Gold Project: fish and aquatic resources studies 2017. Prepared for Goldcorp Inc., Vancouver, BC, Whitehorse, YT. 308 pp.

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EDI Environmental Dynamics Inc. 2020. Coffee Gold Project: fish and aquatic resources studies 2019. Prepared for Newmont Corporation, Vancouver, BC. Whitehorse, YT. 117 pp.



Photo 1 Slimy sculpin captured at HC0.2, August 14, 2021.



Photo 2. Large Arctic grayling captured at HC1.1, August 14, 2021.



Photo 3. Arctic grayling captured at HC1.1, August 14, 2021.



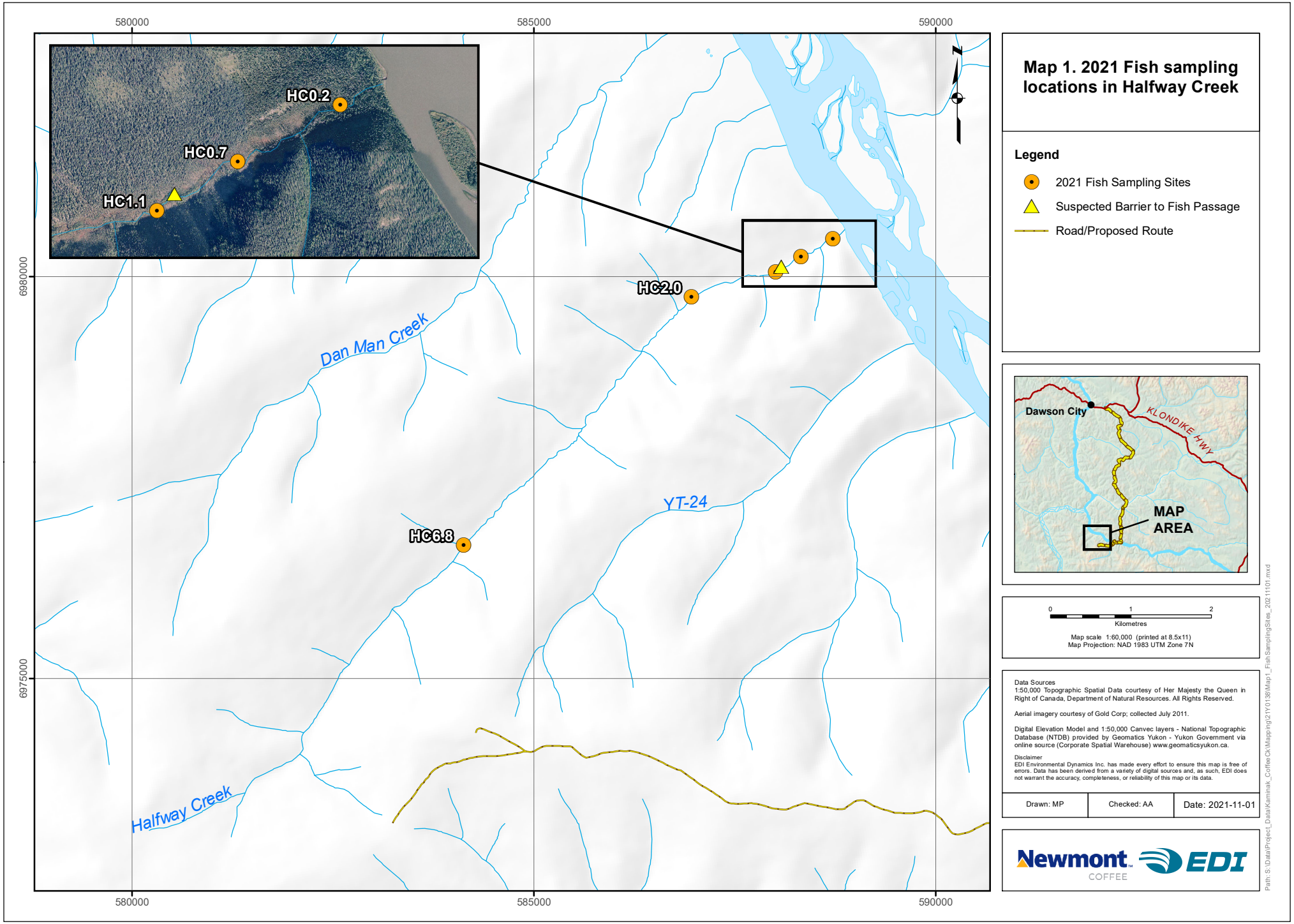
Photo 4. Suspected fish barrier overview, August 14, 2021.



Photo 5. Large woody debris downstream of suspected fish barrier, August 14, 2021.



Photo 6. Drop on right downstream bank of potential fish barrier, August 14, 2021.



Map 1. 2021 Fish sampling locations in Halfway Creek

Legend

- 2021 Fish Sampling Sites
- Suspected Barrier to Fish Passage
- Road/Proposed Route

0 1 2
Kilometres

Map scale 1:60,000 (printed at 8.5x11)
Map Projection: NAD 1983 UTM Zone 7N

Data Sources
1:50,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Aerial imagery courtesy of Gold Corp; collected July 2011.

Digital Elevation Model and 1:50,000 Canvec layers - National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
EDI Environmental Dynamics Inc. has made every effort to ensure this map is free of errors. Data has been derived from a variety of digital sources and, as such, EDI does not warrant the accuracy, completeness, or reliability of this map or its data.

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Coffee Project Periphyton and Benthic Invertebrates Baseline Update Report

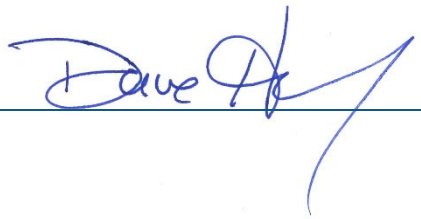
Prepared for:
Newmont Inc.
Vancouver, British Columbia

Prepared by:
Minnow Environmental Inc.
Victoria, British Columbia

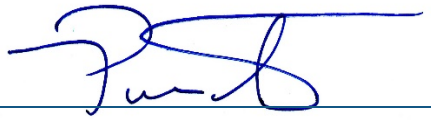
December 2021

Coffee Project
Periphyton and Benthic Invertebrates Baseline Update Report

Dave Hasek, M.Sc., R.P.Bio.
Project Manager



Pierre Stecko, M.Sc., EP, R.P.Bio.
Senior Project Advisor/Reviewer



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ACRONYMS AND ABBREVIATIONS

ADR - Adsorption, Desorption, and Recovery
AEMP - Aquatic Environmental Monitoring Program
AFDM - Ash-Free Dry Mass
AL-AMP - Aquatic Life Adaptive Management Plan
AMP - Adaptive Management Plan
ANOVA - Analysis of Variance
APHA - American Public Health Association
BA - Before-After
BACI - Before-After Control-Impact
BC - Bray-Curtis
BCWQG - British Columbia Water Quality Guideline
BIC - Benthic Invertebrate Community
CABIN - Canadian Aquatic Biomonitoring Network
CCME - Canadian Council of Ministers of the Environment
CI - Control Impact
CMUS - Coffee Mine Update Study
CRC-ICP-MS - Collision Reaction Cell Inductively Coupled Plasma – Mass Spectrometry
CVAAS - Cold Vapor Atomic Absorption Spectrophotometry
dbRDA - Distance-Based Redundancy Analysis
DO - Dissolved Oxygen
DQR - Data Quality Review
EEM - Environmental Effects Monitoring
EPT - Ephemeroptera, Plecoptera, and Trichoptera
FAL-AMP - Fish and Aquatic Life Adaptive Management Plan
FALMP - Fish and Aquatic Life Monitoring Program
FFG - Functional Feeding Group
GIS - Geographic Information System
HLF - Heap Leach Facility
HPG - Habitat Preference Group
HR-ICP-MS - High Resolution Inductively Coupled Plasma Mass Spectrometry
ICP-MS - Inductively Coupled Plasma Mass Spectrometry
ISQG - Interim Sediment Quality Guidelines
K-M - Kaplan-Meier
LNG - Liquid Natural Gas

LOM - Life of Mine

LPL - Lowest Practicable Level

LRL - Laboratory Reporting Limit

LSA - Local Study Area

MAD - Median Absolute Deviation

MCE - Mixed Cellulose Ester

MCT - Measure of Central Tendency

MDMER - Metal and Diamond Mining Effluent Regulations

MOD - Magnitude of Difference

Mt - Million Tonnes

NAR - Northern Access Route

PDF - Portable Document Format

PERMANOVA - Permutation Based Multivariate ANOVA

QA/QC - Quality Assurance / Quality Control

ROM - Run-of-Mine

SALM - Strong Acid Leachable Metals

SQG - Sediment Quality Guidelines

SRC - Saskatchewan Research Council

TOC - Total Organic Carbon

THE PROJECT - The Coffee Gold Project

USEPA - United States Environmental Protection Agency

UTM - Universal Transverse Mercator

WQ-AMP - Water Quality Adaptive Management Plan

WQMP - Water Quality Management Plan

WQO - Water Quality Objectives

WRSF - Waste Rock Storage Facility

WSQG - Working Sediment Quality Guidelines

YESAA - *Yukon Environmental and Socio-Economic Assessment Act*

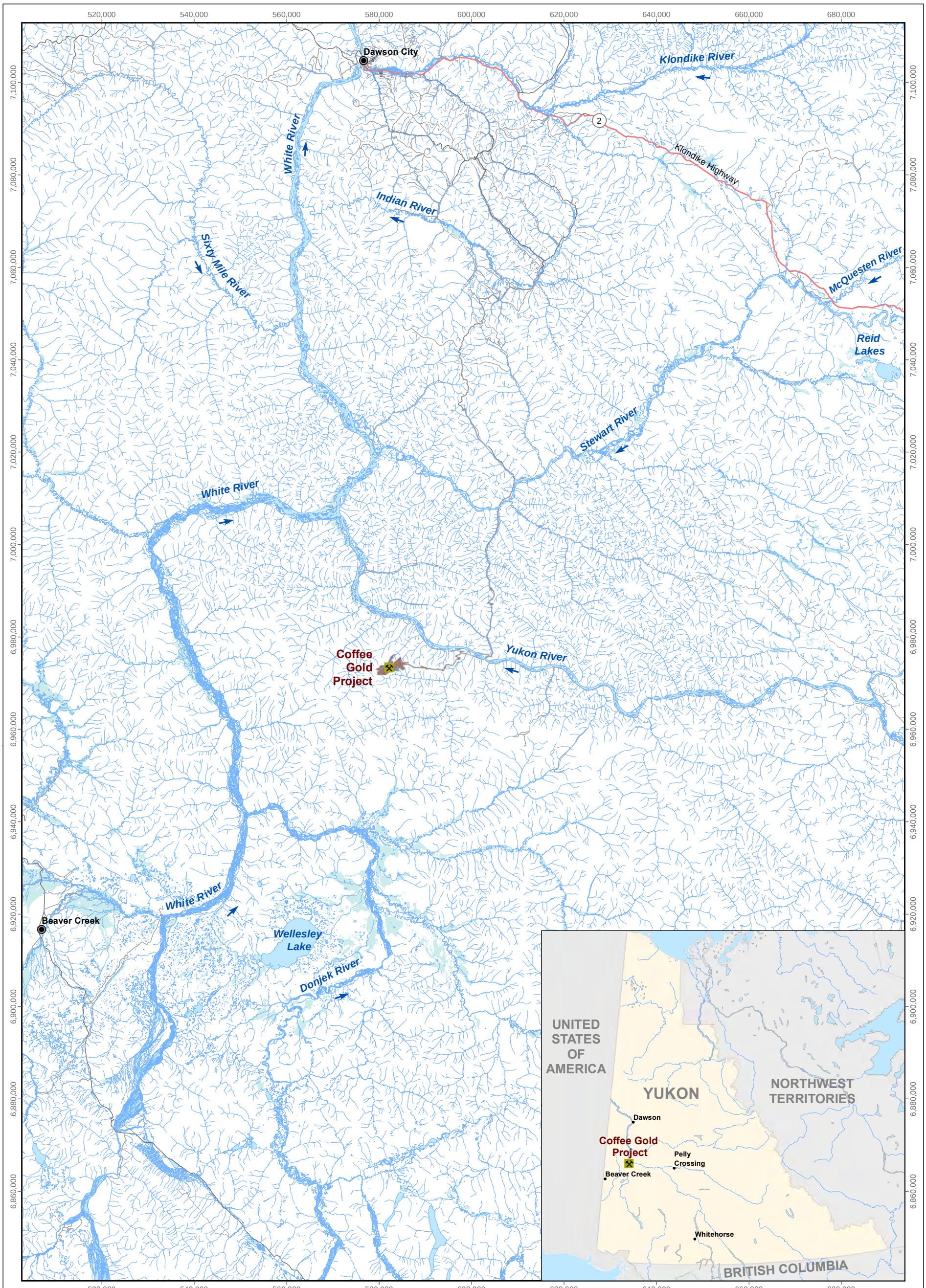
YESAB - Yukon Environmental and Socio-Economic Assessment Board

1 INTRODUCTION

1.1 Project Location and Background

The Coffee Gold Project (the Project) is a proposed open-pit gold mine owned by Goldcorp Kaminak Ltd., a subsidiary of Newmont Inc. (Newmont). The Project is in west-central Yukon, approximately 130 km south of Dawson City, 140 km west of Pelly Crossing, 95 km south-west of Beaver Creek, and 330 km northwest of Whitehorse (Figure 1.1). The Project is located wholly within the traditional territory of Tr'ondëk Hwëch'in, partially within the traditional territory of the Selkirk First Nation and the First Nation of Na-cho Nyäk Dun, and partially within the asserted territory of the White River First Nation. The Project contains several gold occurrences within an exploration concession covering an area of more than 600 km^2. The mine site will be accessed by road from Dawson City via a 214-km all-season, gravel road with pull-outs, referred to as the Northern Access Route (NAR). The NAR includes upgrades to portions of the existing road and construction of 37 km of new single-lane, forestry-type access road. The NAR includes seasonal barge crossings on both the Stewart and Yukon rivers with ice bridges in winter months.

Gold was initially discovered in Coffee Creek in 2010 and baseline environmental studies were initiated shortly thereafter. The Coffee Project was originally owned and evaluated by Kaminak Gold Corporation (Kaminak). Under the direction of Kaminak, the Coffee Project underwent a detailed Feasibility Study in 2015, with project engineering and design progressing in consideration of environmental conditions within the project area. Kaminak was acquired by Goldcorp Inc. in 2016 and Goldcorp issued a Project Proposal and supplementary information package under the *Yukon Environmental and Socio-Economic Assessment Act (YESAA)* in December 2017 (Goldcorp 2017). This initiated project review and screening at the Yukon Environmental and Socio-Economic Assessment Board (YESAB) Executive Committee level. In 2019, Goldcorp was acquired by Newmont and the Project underwent further refinement (the Coffee Mine Update Study; CMUS). Over the 2018 to 2021 period, YESAB issued Information Requests to the Proponent, who provided detailed responses to YESAB. The YESAB Executive Committee screening was completed in October 2021 with a recommendation that the Project proceed under Section 58(1)(b) of YESAA (YESAB 2021). Subsequently (November 2021), the federal decision bodies referred the screening report and recommendation back to the Executive Committee for reconsideration of NAR decommissioning, NAR access control, the influence of other developments on water quality objectives, and language utilized in the consideration of cumulative effects (Transport Canada 2021).



LEGEND

- Coffee Gold Project
- City
- Mine Footprint

Location of Coffee Gold Project

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Projection: North American Datum 1983 UTM Zone 8
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Date: December 2021
Project 217202.0074

minnow environmental inc.

Figure 1.1

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Newmont - 217202.0074 - 2021 Coffee Project AEMP\D - GIS\Report\21-74 - Figure 1.1 Location of Coffee Mine.mxd

1.2 Project Description

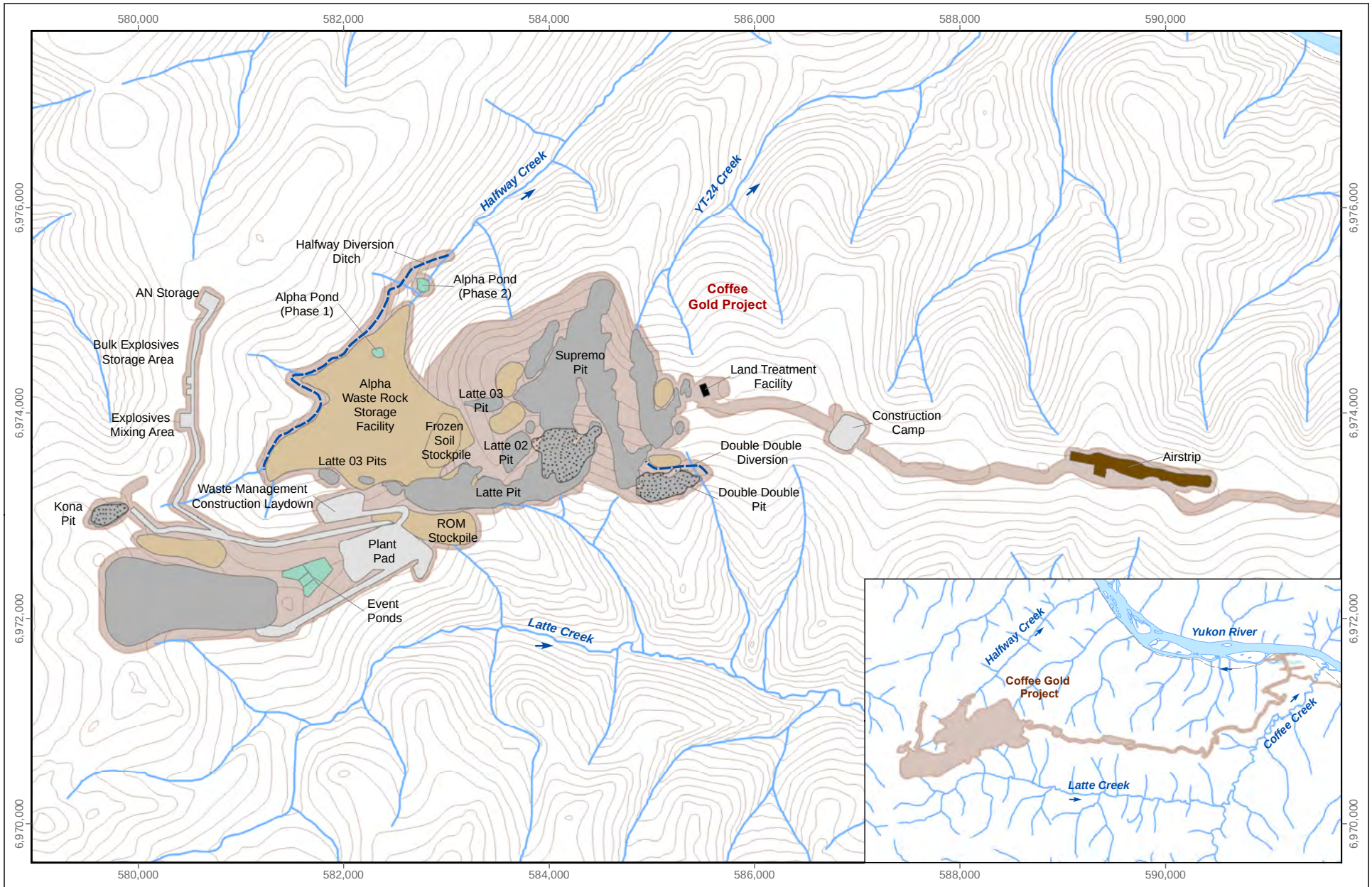
The Coffee Project will have four distinct phases over its life span as follows:

1. Construction Phase: 2½ years (Q2 of Year -3 to the end of Year -1);
2. Operation Phase: 10 years (Year 1 to end of Year 9);
3. Reclamation and Closure Phase: 11 years (Year 11 to end of Year 21, including a 6-year Post-Mining Closure Stage and a 5-year Active Closure Stage); and
4. Post-Closure Phase: Year 24 onwards as required.

Several mine activities will continue from one phase to another as mine site development advances. When areas that support mine operations are no longer required, they will be progressively reclaimed. Detailed activities are subject to change depending on mine planning, operational initiatives, and the receipt of authorizations.

The Coffee Project, which has been optimized over time to improve economics and meet environmental protection commitments, is comprised of four open pits (Latte, Double-Double, Supremo, and Kona) and one permanent Waste Rock Storage Facility (WRSF; Figure 1.2; Newmont Goldcorp 2019). The projected ore production rate is between 7.0 and 7.5 million tonnes (Mt) per year. Ore will be crushed at an average rate of approximately 28,000 tonnes per day up to a maximum of 40,000 tonnes per day in peak mining years, producing an estimated total of 60.1 Mt of heap leach feed over the 10-year Operation Phase. The conceptual-level estimate for waste material to be moved over the life of mine (LOM) is 300 Mt based on an average strip ratio of 5.0:1. The ore will be transported to a Crusher System for crushing and screening and then transported to and stacked on a lined heap leach facility pad using an overland conveyor or trucks for nine months of the year. During the three coldest months of winter, run-of-mine (ROM) ore will be stockpiled in the ROM stockpile. Waste rock will be transported to the alpha waste rock storage facility, backfilled into the pits, or used as construction materials where appropriate.

Up to nine million tonnes of ore will be stacked on the heap leach pad annually. Gold will be leached from ore at the heap leach facility (HLF) using a weak sodium cyanide solution. As the barren sodium cyanide solution percolates through the heap leach, gold will react with the cyanide and dissolve into the solution. This gold-bearing solution (referred to as the pregnant solution) will be collected at the base of the heap leach pad. The pregnant solution will then be transported by pipe to the process facility, where it will be processed using conventional gold recovery methods at an on-site adsorption, desorption, and recovery (ADR) carbon plant. The end product of the ADR plant is poured doré bars, which will be shipped off-site by aircraft for further refining.



LEGEND

- Ditch
- Airport
- Infrastructure
- Land Treatment Facility
- Pit
- Pit Infill
- Pond
- Stockpile/Waste Rock
- Mine Footprint

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Mine Infrastructure, Newmount Coffee Gold Project

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minnow environmental inc.

Figure 1.2

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Newmont - 217202.0074 - 2021 Coffee Project AEMP\D - GIS\Report\21-74 - Figure 1.2 Coffe Mine Site Infrastructure.mxd

Conceptual design indicates a total of approximately 60.1 Mt of mined ore containing 2.6 million ounces of gold.

A water treatment plant will be constructed during the Operation Phase to treat excess process water (e.g., water produced during rinsing of the heap leach as part of mine closure activities) and will be operated through the Reclamation and Closure Phase. The treatment plant will also allow for progressive rinsing and reclamation of the heap leach facility during operations and will discharge to Halfway Creek. The treatment process will include oxidizing residual cyanide and metals removal using a biological reduction process targeting uranium. The biological reduction process will also treat numerous other metals in the heap leachate including arsenic. The process will also remove nitrate from heap solutions, anticipated to be elevated due to *in situ* cyanide degradation. Treated water from the water treatment plant will initially be used for additional rinsing of the heap leach. Treated excess water in the heap leach facility will be discharged to Halfway Creek once it meets effluent discharge quality standards.

In addition to the open pits, HLF, WRSF, process plant, and water treatment plant, the Plant Site will include a reagent storage area, assay laboratory, truck shop, warehouse buildings, a power plant (including power generation and distribution), Liquid Natural Gas (LNG) storage and bulk fuel storage tanks with a fuel distribution system. A mine camp complex will include camp facilities for 400 persons with associated potable water and wastewater treatment, fire suppression systems, mine dry, office, and emergency response and training buildings, and a waste management facility. Additional project infrastructure will include a bulk explosive storage area, emulsion plant, and blasting accessories storage, mine site roads and haul roads, and site water management infrastructure including conveyance structures, several ponds specific to the HLF, a pond and dam at the foot of the WRSF (the Alpha Pond and Dam), clean water diversions, and sediment ponds. Ancillary components include the NAR, airstrip, laydown areas, a freshwater pipeline, Coffee exploration camp and Java exploration/construction camp, and waste management facilities. Some minor or ancillary facilities may be relocated, modified, or added as detailed design is completed but are not expected to affect the overall Project footprint.

When mining or processing activities have been completed or when areas are no longer needed for mining, reclamation and closure activities will be undertaken, either progressively during the Operation Phase or subsequently during the Reclamation and Closure Phase. Reclamation and closure planning, which has been a primary consideration from the onset of mine planning and design, has focused on achieving short- and long-term erosion control, ensuring that future land use is compatible with surrounding lands, and returning the area to a landscape that is compatible with original land uses.

1.3 Aquatic Environmental Setting

The Coffee Project mine infrastructure is located along a ridgetop straddling three watersheds (Figure 1.2). Two of the watersheds (Halfway Creek and YT-24), drain directly to the Yukon River. The third watershed (Latte Creek) drains to Coffee Creek, then on to the Yukon River. All three watersheds have the potential to be influenced by the Coffee Project through changes in water quantity and/or water quality associated with watershed configuration changes and site water discharge, and water quality objectives and effluent quality standards will be developed for all three creeks. Halfway Creek will receive direct discharge from the Coffee Project water treatment plant. The potential effects of the Project on hydrology, water quality, and aquatic life were evaluated in detail in the Project Proposal and have been the subject of refinement through the YESAB review and screening (e.g., Lorax 2017a,b; EDI 2017a; Minnow and EDI 2017). Briefly, the physical presence of the Coffee Project within these three watersheds will result in modest loss of watershed area and consequent changes in water flow, principally confined to the upper reaches of Halfway Creek, YT-24 Creek, and Latte Creek. Flow changes in Latte Creek are negligible, while those in Halfway Creek are modest (i.e., maximum 15% change in mean annual discharge; Lorax 2017a). Project operations will have some influence on water quality of Halfway Creek, YT-24 Creek, and Latte Creek through erosion and sedimentation, leaching from disturbed mine materials and waste, leaching of nitrogen residues from blasting, discharge of treated camp water, heap leach facility residues, groundwater and surface water interactions and seepage, and atmospheric deposition (Lorax 2017b). Water treatment plant effluent and water from the Alpha Pond will be directed to Halfway Creek, although small volumes of pit dewatering will be routed to YT-24 Creek, and small volumes of pit dewatering, plant site runoff, and sewage treatment plant effluent will be routed to Latte Creek (Lorax 2019). Detailed evaluation of the influence of the project on water quality indicated some modest Project-associated influences on concentrations of arsenic, nitrate, and sulphate in Halfway Creek, arsenic in YT-24 Creek, and arsenic, uranium, and nitrate in Latte Creek and Coffee Creek (Lorax 2019). Most recent evaluation of water quality under the CMUS indicated a potential for sulphate concentrations in Halfway Creek to exceed water quality objectives (WQO), but no exceedances for any other parameter (Lorax 2019). This evaluation also indicated no exceedances of any WQO in YT-24 Creek or Latte Creek (Lorax 2019).

Evaluation of the potential influence of the Project on aquatic biology indicated no major expected changes to fish or fish habitat (EDI 2017a), and only very subtle changes in the taxonomic composition and/or productivity of periphyton and benthic invertebrate communities (Minnow and EDI 2017). The latter differ slightly by water body, with changes deemed most likely to occur in Halfway Creek, in the form of subtle changes in periphyton community composition, a modest increase in periphyton productivity (in association with nitrogen input and

temperature changes), subtle changes in benthic invertebrate community composition, and a modest increase in benthic invertebrate productivity (Minnow and EDI 2017). In YT-24 Creek and Latte Creek, the only predicted changes are minor, low probability changes in periphyton community composition (Minnow and EDI 2017).

1.4 Aquatic Life Baseline Update Objectives and Design

This Aquatic Life Baseline Update Report provides an update to previously reported data on baseline periphyton and benthic invertebrates (and supporting physical and chemical environmental data) within the catchments potentially affected by the Coffee Project (PECG 2017; EDI 2017b, 2018; Minnow and EDI 2017). This report is focused exclusively on the Project site subject to the Project operations as described in Section 1.3 and does not include the NAR (i.e., it is focused on the Halfway Creek, YT-42 Creek, and Latte Creek/Coffee Creek watersheds; Figure 1.2). The report also includes baseline data collected from reference areas outside of these three watersheds. These data were collected over the period from 2017 to 2021 (as described in detail in Section 3).

The fundamental objective of this Aquatic Life Baseline Update Report is to provide a detailed quantitative documentation of periphyton, benthic invertebrate community, benthic invertebrate tissue quality, and supporting aquatic environmental variables for creeks that may potentially be affected by the Coffee Project and for associated "future" reference creeks. The collection of additional aquatic life baseline data considered the specific findings of the environmental assessment (e.g., Minnow and EDI 2017) as summarized above. In addition, the design took future needs into consideration, including the provision of high-quality data in order to: 1) effectively support environmental assessment and permitting; 2) facilitate optimal design of an Aquatic Environmental Monitoring Program (AEMP; alternately entitled Fisheries and Aquatic Life Monitoring Program); and 3) provide replicated data that can be used in future analysis of AEMP data using an optimal study design (Before-After Control-Impact; BACI). This update seeks to provide the periphyton, benthic invertebrate community, benthic invertebrate tissue quality, and supporting aquatic environmental data collected from 2017 to 2021 in a clear manner that can be easily picked up and used in future data analyses and includes presentation and discussion of baseline differences among areas that must be considered in future evaluation of potential mine-related influences and effects.

1.5 Report Organization

In addition to this introduction to the Periphyton and Benthic Invertebrates Baseline Update Report, a brief review of periphyton and benthic invertebrate community data collected from 2014 to 2017 is provided in Section 2. All methods used in the collection, analysis, and

interpretation/reporting of baseline periphyton, benthic invertebrates, and supporting physical and chemical data are outlined in detail in Section 3. Sections 4 to 8 provide data and discussion associated with each of the main components of the Periphyton and Benthic Invertebrates Baseline collected from 2017 to 2021: supporting habitat and water quality, periphyton/productivity, benthic invertebrate community, benthic invertebrate tissue chemistry, and sediment quality. Section 9 provides conclusions and a brief discussion the use of baseline data to support monitoring program design and the interpretation of future monitoring data and some recommendations for future monitoring. All references cited throughout the document are listed in Section 10.

2 PREVIOUS AQUATIC BASELINE STUDIES (2014 to 2017)

2.1 Overview

Baseline aquatic data collections in support of the Coffee Project were initiated as early as 2010. Intensive baseline data collection was completed from 2014 to 2017 in support of the Project Proposal (Table 2.1; Figure 2.1). This included focused collection of aquatic biological baseline data in 2014 and 2015 (PECG 2017), and in 2016 and 2017 (EDI 2017b, 2018; Minnow and EDI 2017). Aquatic environmental baseline data collection included:

- habitat and water quality;
- sediment quality;
- periphyton / primary productivity;
- benthic invertebrate community;
- benthic invertebrate tissue quality;
- fish community and populations; and
- fish habitat and habitat use evaluations.

With the exception of fish and fish habitat data (which are presented in a separate report), the results of the 2014 to 2017 aquatic baseline studies are briefly reviewed in the following sections.

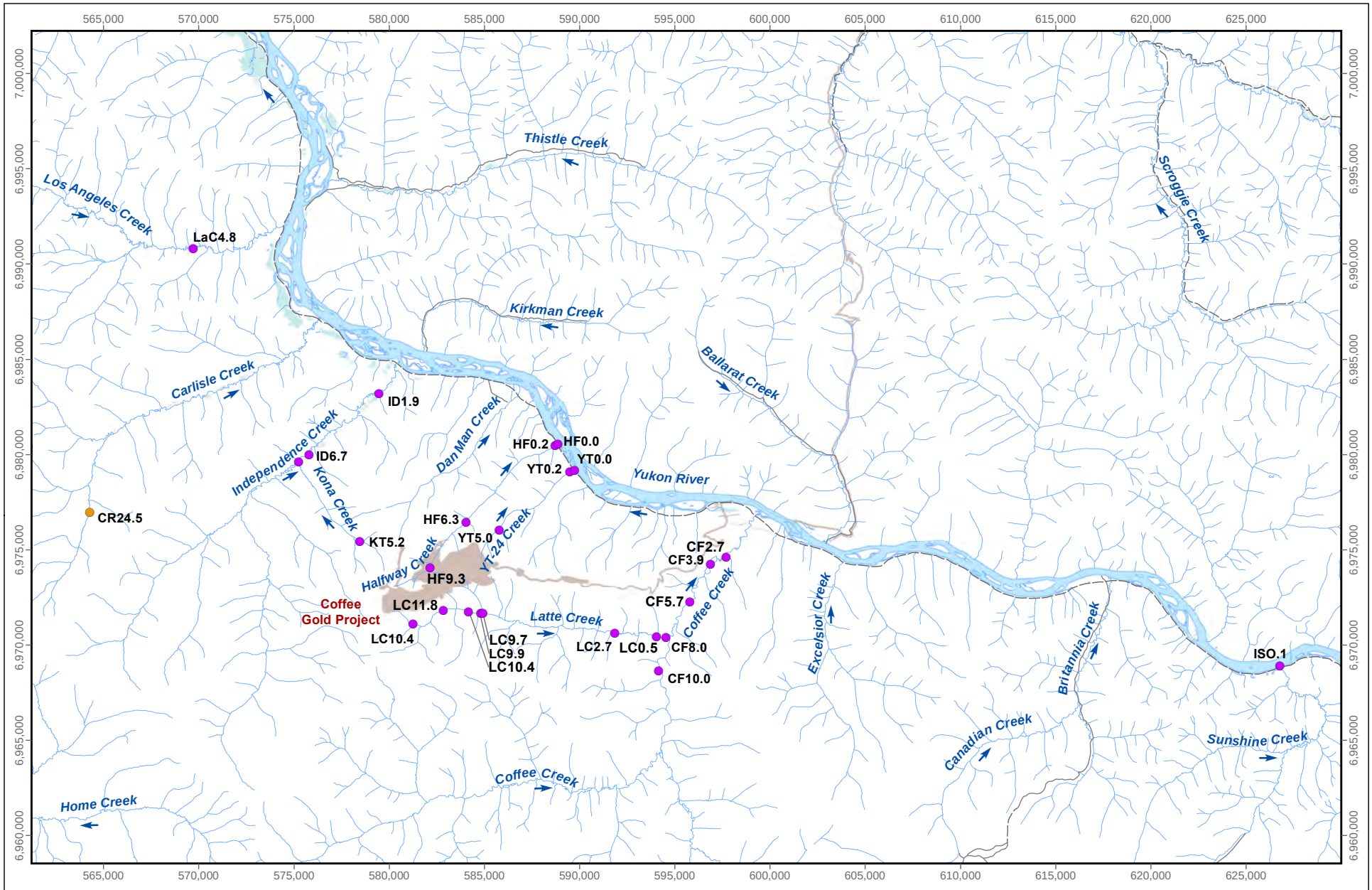
2.2 Habitat and Water Quality

The aquatic environmental setting of the Coffee Gold Project is described in detail in the Project Proposal and in previous environmental baseline reports (PECG 2017; EDI 2017b, 2018). This section provides a brief overview of the aquatic environmental characteristics relevant to periphyton and benthic invertebrates.

The topography of the Project area is consistent with Yukon unglaciated ecozones and is characterized by deep soil weathering and strong erosional patterns linked to precipitation and snowmelt (Grods et al. 2012). Creeks that could potentially be influenced by the Project (Halfway Creek, YT-24 Creek, Latte Creek, and Coffee Creek) are predominantly erosional with rocky substrate that varies from cobble and boulder in upper reaches to cobble and gravel in lower reaches. Upper Creek areas are typically comprised of cascade-pool or step-pool sequences, whereas lower/larger creek areas are typically comprised of riffle-run sequences. Pool habitat is limited in all creeks except for Coffee Creek. Creek geomorphology is consistent with high gradients in the Upper Creek areas (commonly >8%) and moderate gradients (≤4%)

Table 2.1: Aquatic Biological Baseline Studies at the Coffee Project, 2014 to 2017

Study Name	Study Purpose, Duration and Spatial Boundaries
Coffee Gold Mine Fish and Aquatic Resources Baseline Report (PECG 2017)	**Study Purpose:** Detailed baseline characterization of fish and aquatic resources of the Project area.
	Timing: August and October 2014; March, June, July, and September 2015.
	Periphyton and Benthic Invertebrate Data: Periphyton and benthic invertebrate sampling at sites in Latte Creek, Coffee Creek, YT-24 Creek, Halfway Creek, Independence Creek, Isaac Creek, and Los Angeles Creek. Periphyton endpoints included biomass (ash-free dry mass), chlorophyll-a, and community composition (to the phylum/division [algae] or class [diatoms] level). Benthic invertebrate community endpoints included abundance, taxon richness, biodiversity, evenness, and community composition (to the lowest practical level).
	Additional Aquatic Environmental Data: Sediment quality, fish habitat, fish distribution, fish community, fish population (size, age, condition), and fish tissue quality. Fish sampling and habitat investigations in lower reaches of Coffee, Halfway, and Independence creeks; salmon spawning survey in a 31 km section of the Yukon River in the vicinity of the Project area and lower Coffee and Independence creeks.
Coffee Gold Mine: Fisheries and Aquatic Resource Baseline Update (EDI 2017b)	**Study Purpose:** Supplementary baseline characterization of fish and aquatic resources of the Project area. Additional data collection and synthesis with traditional and scientific knowledge and previously collected data.
	Timing: March, July, August, and October 2016
	Periphyton and Benthic Invertebrate Data: Periphyton chlorophyll-a and benthic invertebrate tissue sampling at sites in Latte Creek, Coffee Creek, YT-24 Creek, Halfway Creek, Independence Creek, and Los Angeles Creek.
	Additional Aquatic Environmental Data: Additional baseline characterization of fish and fish habitat including environmental DNA sampling, winter studies, summer fish and fish habitat assessments, chinook salmon spawning surveys, fish tissue quality, and stream gradient modeling around Project area.
Coffee Gold Project: Fish and Aquatic Resources Studies - 2017 (EDI 2018)	**Study Purpose:** Continued baseline characterization of fish and aquatic resources of the Project area.
	Timing: March, August, and October 2017
	Periphyton and Benthic Invertebrate Data: Periphyton chlorophyll-a and ash-free dry mass (AFDM), benthic invertebrate community sampling (CABIN methodology) at sites in Latte Creek, Coffee Creek, YT-24 Creek, Halfway Creek, Independence Creek, and Los Angeles Creek.
	Additional Aquatic Environmental Data: Additional baseline characterization of fish and fish habitat including fish usage surveys, habitat and fish passage (barrier) assessment, environmental DNA sampling, winter studies, summer Chinook salmon spawning surveys, and fish tissue quality assessment around the Project area.
Coffee Gold Project Supplementary Periphyton and Benthic Invertebrate Community Studies (Minnow and EDI 2017; Appendices A and B)	**Study Purpose:** Supplementary baseline characterization of fish and aquatic resources of the Project area.
	Timing: August 2017
	Periphyton and Benthic Invertebrate Data: Replicated benthic invertebrate sampling in two areas: a “future-exposed area” on Halfway Creek and a matched reference area located on a tributary to Carlisle Creek. Benthic invertebrate community endpoints included density, taxon richness, biodiversity, evenness, community composition (to the lowest practical level), habitat preference groups, and functional feeding groups. Periphyton and benthic invertebrates were also sampled at sites in Latte Creek, Coffee Creek, YT-24 Creek, Halfway Creek, Independence Creek, and Los Angeles Creek. Periphyton endpoints included biomass (ash-free dry mass), chlorophyll-a, and community composition (to the phylum/division [algae] or class [diatoms] level). Benthic invertebrate community endpoints included abundance, taxon richness, biodiversity, evenness, and community composition (to the lowest practical level).
	Additional Aquatic Environmental Data: Additional baseline characterization of stream sediments at the same sites as periphyton and benthic invertebrates. Fish tissue in Halfway Creek (near the mouth) and in Independence Creek.



LEGEND

- Benthic Invertebrate Sampling Location
- Periphyton and Benthic Invertebrate Sampling Location
- Mine Footprint
- Limited-use road
- Trail

0 3.5 7 14
km

N
W E
S

Projection: North American Datum 1983 UTM Zone 8
Reproduced under licence from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Periphyton and Benthic Invertebrate Sampling Locations (Pre-2018)

Date: December 2021
Project 217202.0074

minnow environmental inc.

Figure 2.1

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Newmont - 217202.0074 - 2021 Coffee Project AEMP\D - GIS\Report\21-74 - Figure 2.1 Periphyton and BI Sampling Locations.mxd

in the lower/larger areas/creeks (EDI 2018). Complete winter ice cover occurs in the Upper Creeks, with aufeis (thick sheet ice that forms due to the successive flows of ground water at freezing temperatures) observed in Coffee, Latte, YT-24, and Halfway Creeks (EDI 2017b, 2018).

The hydrology of Project area creeks tends to be flashy and is surface water driven during freshet and groundwater driven at other times of year (Lorax 2017a,b). Seasonality in hydrology and water chemistry is more pronounced upstream in the upper catchments. Total suspended solids concentrations are typically low, although elevated total suspended solids are associated with peak flow events. Baseline aqueous concentrations of several metals (aluminum, arsenic, cadmium, chromium, copper, iron, selenium, and uranium) have been observed at concentrations greater than water quality guidelines (Lorax 2017b). In general, seasonal patterns include greater concentrations of some metals during low-flow conditions (e.g., uranium) and of others during high suspended solids events, as occurs during spring freshet (e.g., total arsenic, total cadmium, total copper, total chromium, total selenium). Peak flows also typically include annual maximum concentrations of total suspended solids, dissolved organic carbon, dissolved aluminum, and particulate-bound metals. During winter low-flow periods, uranium concentrations have consistently been above corresponding water quality guidelines.

Most tributary streams in the Project area are nutrient-poor and have cool water temperatures (e.g., all creeks except Coffee Creek remained lower than 5°C during baseline summer sampling in 2014 and 2015; PECG 2017), which limit their overall productivity.

2.3 Sediment Quality

Although the creeks potentially influenced by the Project are predominantly erosional and do not support substantive sediment accumulation, some sediment sampling has been completed (PECG 2017; EDI 2018). Samples collected in 2014 and 2015 were predominantly sand, but chemical analysis of their finer fractions indicated that the silt and clay components contained concentrations of cadmium, chromium, copper, and mercury greater than Canadian Council of Ministers of the Environment (CCME) Interim Sediment Quality Guidelines (ISQG; CCME 1999) in Latte Creek and/or Coffee Creek, and of arsenic in Halfway Creek, YT-24 Creek, Kona Tributary, and Independence Creek (PECG 2017). Sampling in 2017 indicated that baseline concentrations of arsenic and chromium were consistently greater than ISQG across the Project area, and that arsenic concentrations in Latte Creek, Halfway Creek, and YT-24 Creek were also greater than the Probable Effect Level of the CCME (EDI 2018).

2.4 Periphyton / Primary Productivity

Periphyton sampling between 2014 and 2017 generally indicated that streams have very low primary productivity (e.g., chlorophyll-a concentrations of ≤0.088 mg/m^2; PECG 2017;

EDI 2017b, 2018), which is common of low nutrient, northern watercourses. Baseline periphyton sampling within the Project area included Latte, Coffee, Halfway, and YT-24 creeks as well at reference stations (Independence, Los Angeles, and upper Coffee creeks; Figure 2.2). Ash-free dry mass (AFDM) ranged from 3.5 to 8.1 g/m² in 2014 and 3.2 to 14 g/m² in 2015, while mean AFDM ranged <0.42 to 25 g/m^2 in 2017 (Figure 2.2). There was little variation in AFDM among stations in 2014 and 2015, but large variation, both among and within stations, in 2017 (Figure 2.2).

Mean chlorophyll-a concentrations were very low in all watersheds within the Project area (PECG 2017; EDI 2017b, 2018), which is typical of northern, nutrient poor aquatic habitats. Laboratory holding times were exceeded during chlorophyll-a sampling in 2014 and 2015, and therefore, chlorophyll-a concentrations were expected to represent an underestimation during this time. Chlorophyll-a sampling was conducted again in 2016 and 2017, and sampling met all lab holding times and requirements. Chlorophyll-a concentrations ranged from 0.79 to 3.5 mg/m² in 2014, and 0.96 to 2.5 mg/m² in 2015 (Figure 2.3). Maximum chlorophyll-a concentrations in these years occurred at Isaac Creek (IS0.1; 3.5 mg/m^2) and at the downstream YT-24 Creek station (YT0.0; 2.5 mg/m^2) in 2014 and 2015, respectively. Mean chlorophyll-a concentrations in 2016 and 2017 ranged from 1.4 to 8.8 mg/m^2 and <0.42 to 11 mg/m^2, respectively (Figure 2.3). These concentrations are within the range of oligotrophic streams (<20 mg/m^2; Dodds et al. 1998) and are well below the short-term maximum British Columbia guideline for the protection of aquatic life (100 mg/m^2; BCMOCCS 2021). In 2016, chlorophyll-a was generally lower at upstream compared to downstream stations across the watershed[1], including Coffee Creek (5.7 and 8.8 mg/m², respectively), Latte Creek (1.4 and 2.7 mg/m², respectively), YT-24 Creek (6.1 to 7.6 mg/m², respectively), and Halfway Creek (3.0 to 7.0 mg/m², respectively). In 2017, this was only observed for Latte Creek, while chlorophyll-a was higher upstream compared to downstream in YT-24 Creek. Chlorophyll-a concentrations were generally higher in 2016 than in 2017, which simply reflects temporal variability. The maximum mean chlorophyll-a concentrations in 2016 and 2017 were observed at the downstream (CF3.9; 8.8 mg/m²) and upstream (CF10.0; 3.0 mg/m²) Coffee Creek stations (Figure 2.3).

The baseline periphyton community was dominated by blue-green algae (Cyanophyta), which typically make up approximately 80% of the community (PECG 2017; EDI 2017b, 2018). Periphyton community taxon richness was similar among stations and years and varied between 8 and 14 taxa (Figure 2.4). Taxon richness was lower upstream than downstream in Coffee and

[1] under the naming convention for baseline sampling stations, higher numbers indicate greater distance from the creek mouth at the Yukon River. For example, HF0.2 is 0.2 kilometers upstream of the mouth of Halfway Creek and HF6.3 is 6.3 kilometers upstream of the mouth of Halfway Creek.

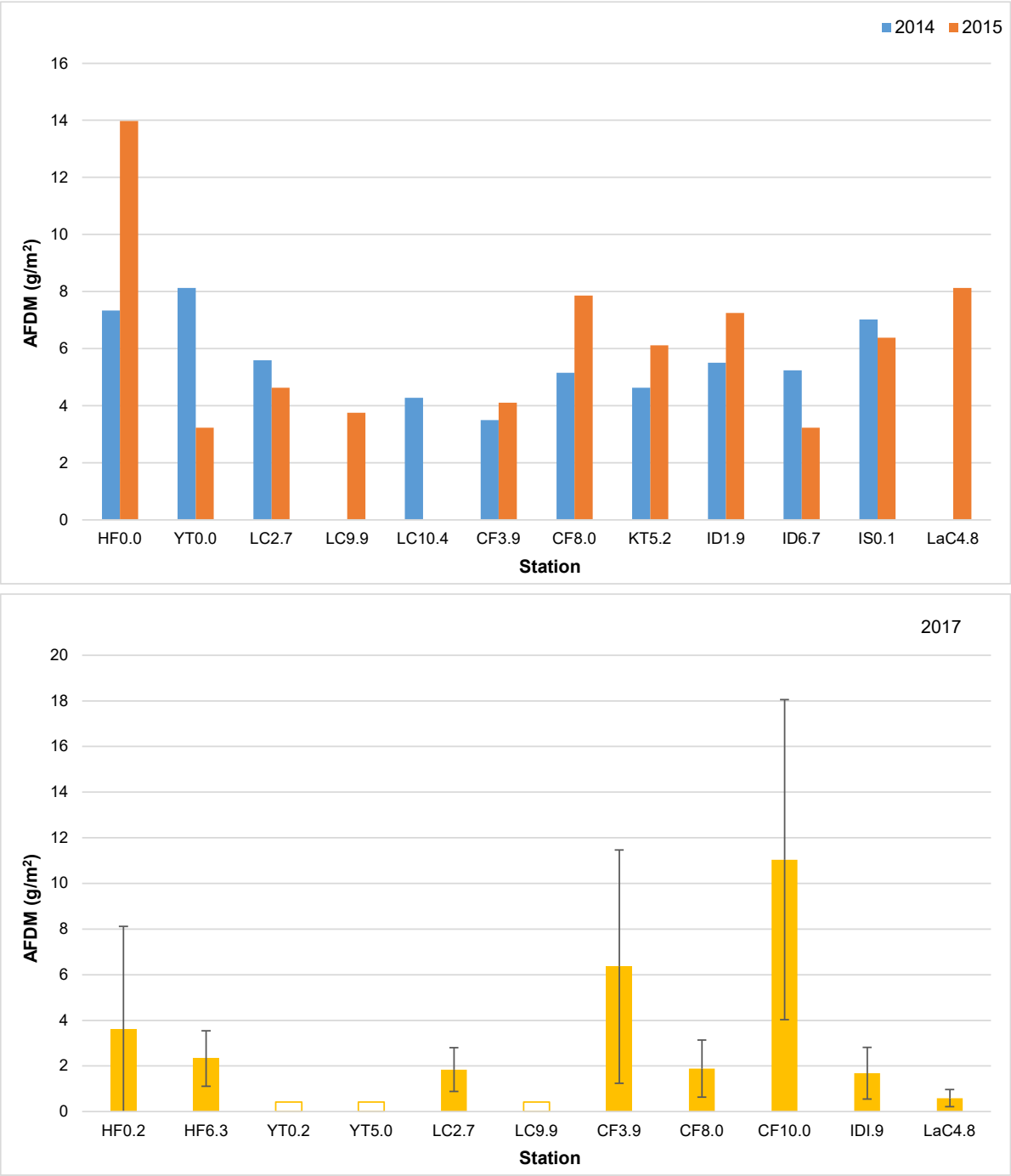


Figure 2.2: Periphyton Ash-Free Dry Mass (AFDM) per Square Meter, 2014, 2015, and 2017

Notes: Open bars indicate mean values below the method detection limit (MDL). For 2017, mean ± standard deviation are reported for 4 to 6 replicates per station. Mean and standard deviation were estimated using the survfit function in the survival package in R (R Core Team, 2016) using the methods for censored data described in (Helsel 2012). HF = Halfway Creek, YT = YT24 Creek, LC = Latte Creek, CF = Coffee Creek, ID = Independence Creek, LaC = Los Angeles Creek.

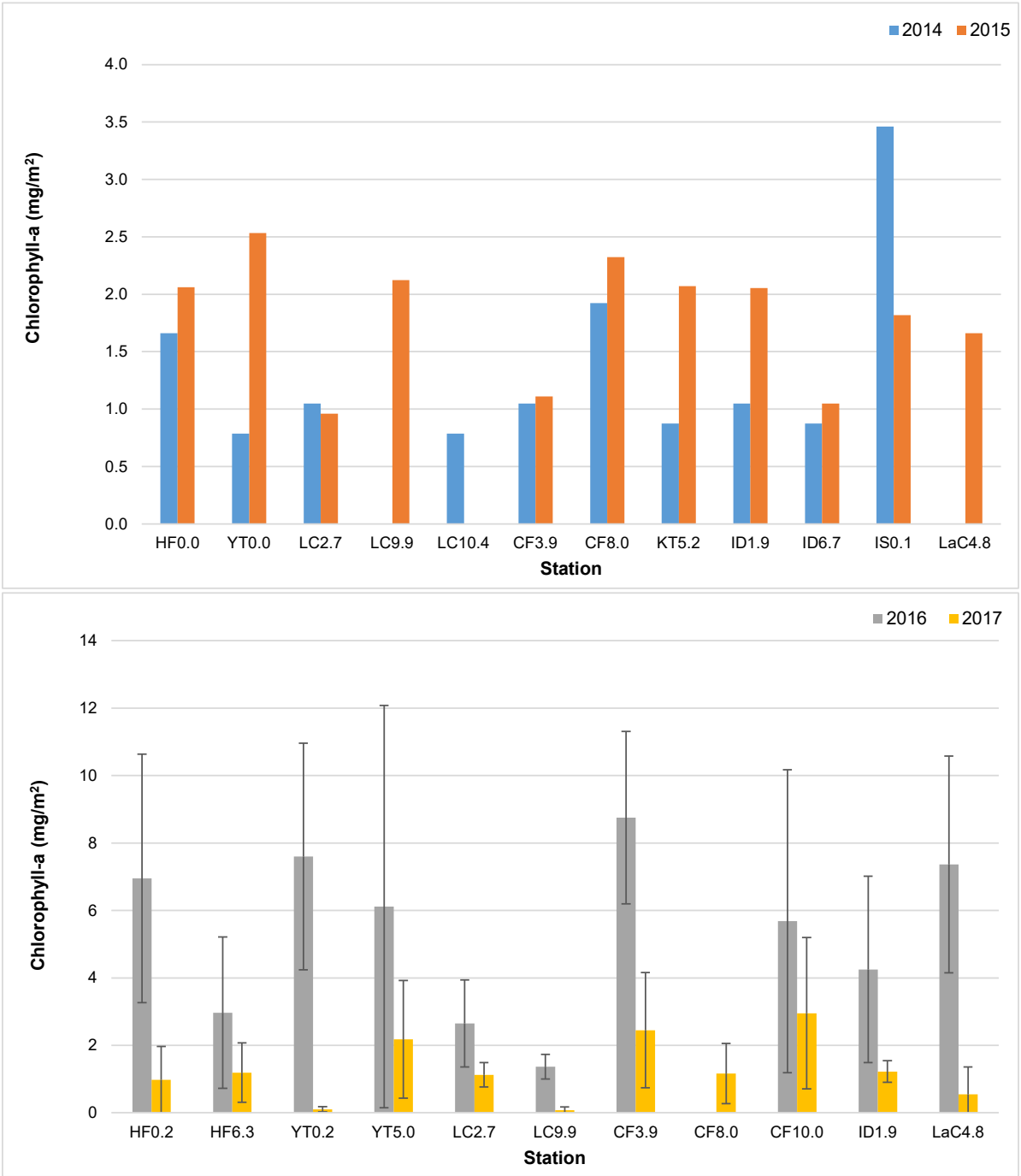


Figure 2.3: Periphyton Chlorophyll-a Concentrations, 2014 to 2017

Notes: For 2016 and 2017, mean abundance ± standard deviation are reported for 5 to 6 replicates per station. Mean and standard deviation were estimated using the survfit function in the survival package in R (R Core Team, 2016) using the methods for censored data described in (Helsel 2012). HF = Halfway Creek, YT = YT24 Creek, LC = Latte Creek, CF = Coffee Creek, ID = Independence Creek, LaC = Los Angeles Creek.

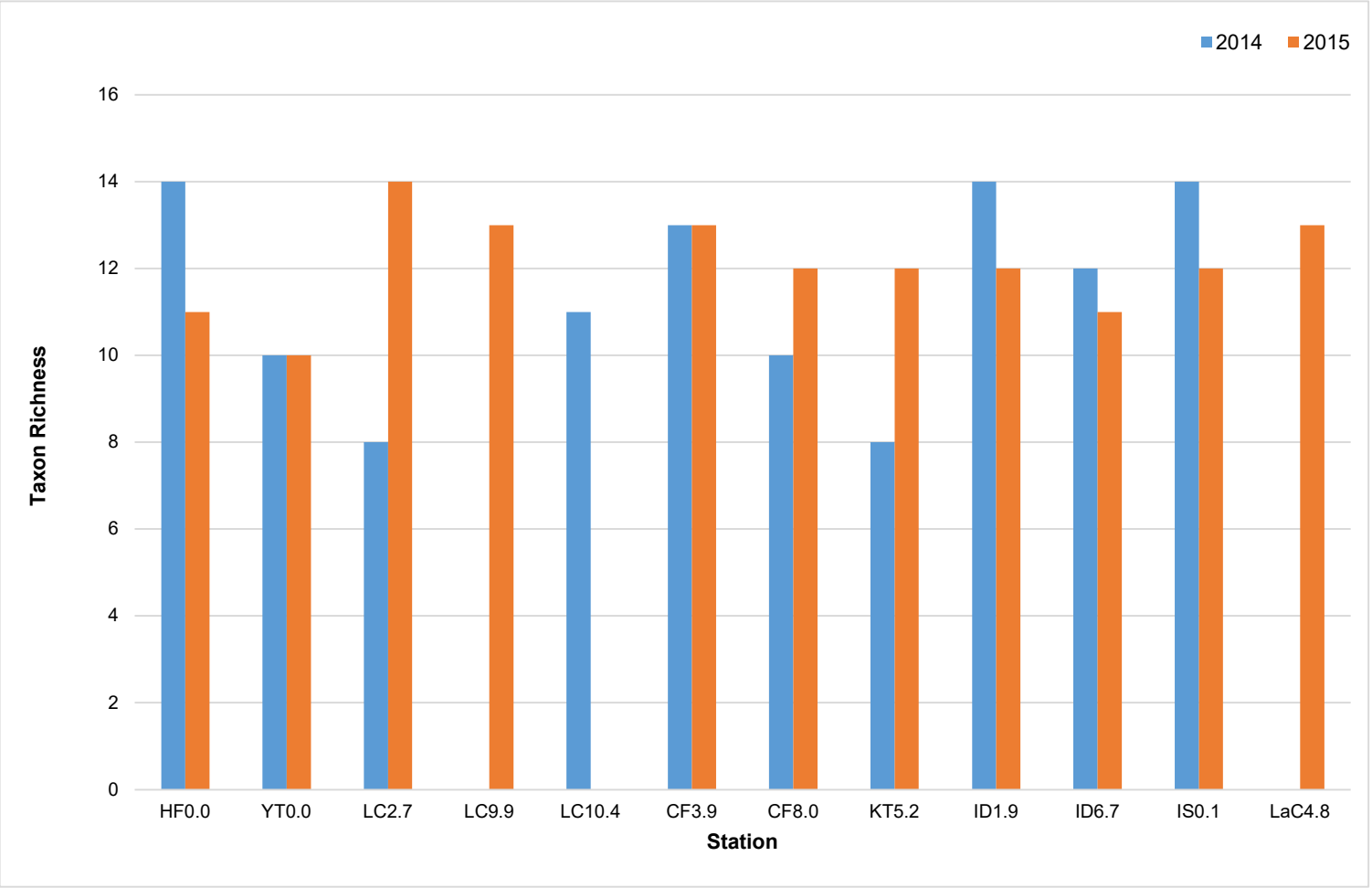


Figure 2.4: Periphyton Taxon Richness in 2014 and 2015

Notes: HF = Halfway Creek, YT = YT24 Creek, LC = Latte Creek, CF = Coffee Creek, KT = Kona Tributary, ID = Independence Creek, IS = Isaac Creek, LaC = Los Angeles Creek.

Independence creeks, while the opposite was observed for Latte Creek (Figure 2.4). Cyanophyta (blue-green algae) were the dominant periphyton taxon group at all stations and in all years except for Isaac Creek in 2014, where Bacillariophyta (diatoms) were dominant (Figure 2.5). Periphyton communities at all stations in 2014 and 2015 were dominated by blue-green algae (72% and 89%, respectively), followed by diatoms (24% and 8%, respectively), and green algae (Chlorophyta; 4% and 3%, respectively). Rhodophyta (red algae) were only observed at Isaac Creek in 2014 and were a minor component of the periphyton community (1.9%).

2.5 Benthic Invertebrate Community

Benthic invertebrate communities of the Coffee Project area are also typical of nutrient-poor, erosional, northern watercourses, with 18 to 34 taxa observed in Project area sampling sites, dominated by dipterans (mainly chironomids [non-biting midges]), mayflies, and stoneflies (PECG 2017; EDI 2017b, 2018). Most baseline benthic invertebrate community data was collected using a kick-and-sweep method (Environment Canada 2012b). This method collects one sample per site and does not provide an estimate of variability within the site. Kick-and-sweep benthic invertebrate community sampling was undertaken in 2014, 2015, and 2017 at Independence, Kona, Isaac, Los Angeles, Latte, Coffee, Halfway and YT-24 creeks. Highest mean abundances (organisms per 3-minute kick-and-sweep) across all years (2014 to 2017) were observed in Los Angeles Creek (4,590), Independence Creek (2,510), and Coffee Creek (991), followed by Kona Creek (893), YT-24 Creek (813), Latte Creek (758), Halfway Creek (644), and Isaac Creek (391). Total abundance generally increased in a downstream direction within YT-24 Creek and Independence Creek watersheds. The highest mean taxon richness across all three years was observed in Coffee, Latte, and Isaac creeks (24), Halfway Creek (23), followed by YT-24, Independence, and Los Angeles creeks (19), and Kona Creek (16). Unlike abundance, there was no apparent pattern in taxon richness from upstream to downstream.

Dominant benthic invertebrate taxon groups included Ephemeroptera (mayflies) and Plecoptera (stoneflies) in 2017, whereas Plecoptera, Chironomidae (non-biting midges) and/or Simulidae (black flies) were dominant in 2014 and 2015 (Figure 2.6). In 2017, Ephemeroptera and Plecoptera made up much of the benthic invertebrate community in Coffee Creek, Latte Creek, Halfway Creek, YT-24 Creek, and Los Angeles Creek. Abundance of EPT taxa (Ephemeroptera, Plecoptera, and Trichoptera) fluctuated among years and was comprised mostly of Ephemeroptera (mayflies) in Coffee Creek, Latte Creek, Independence Creek, Isaac Creek, and Los Angeles Creek, and Plecoptera (stoneflies) elsewhere. Trichoptera (caddisflies) only made up a small average proportion of the total community, and were only observed in Coffee

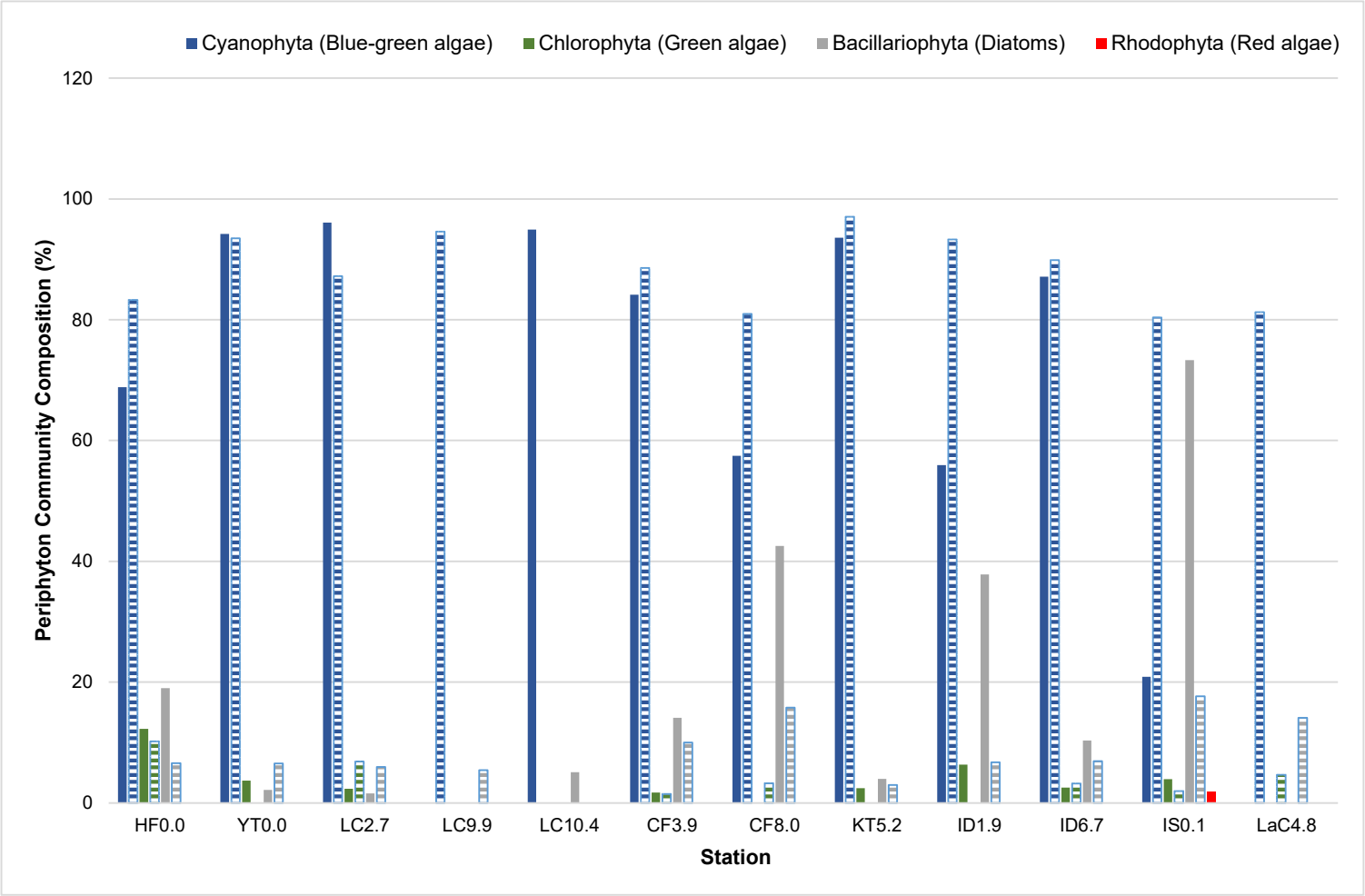


Figure 2.5: Periphyton Community Composition (% of total cells/m^2) in 2014 (Solid Bars) and 2015 (Hatched Bars)

Notes: HF = Halfway Creek, YT = YT24 Creek, LC = Latte Creek, CF = Coffee Creek, KT = Kona Tributary, ID = Independence Creek, IS = Isaac Creek, LaC = Los Angeles Creek.

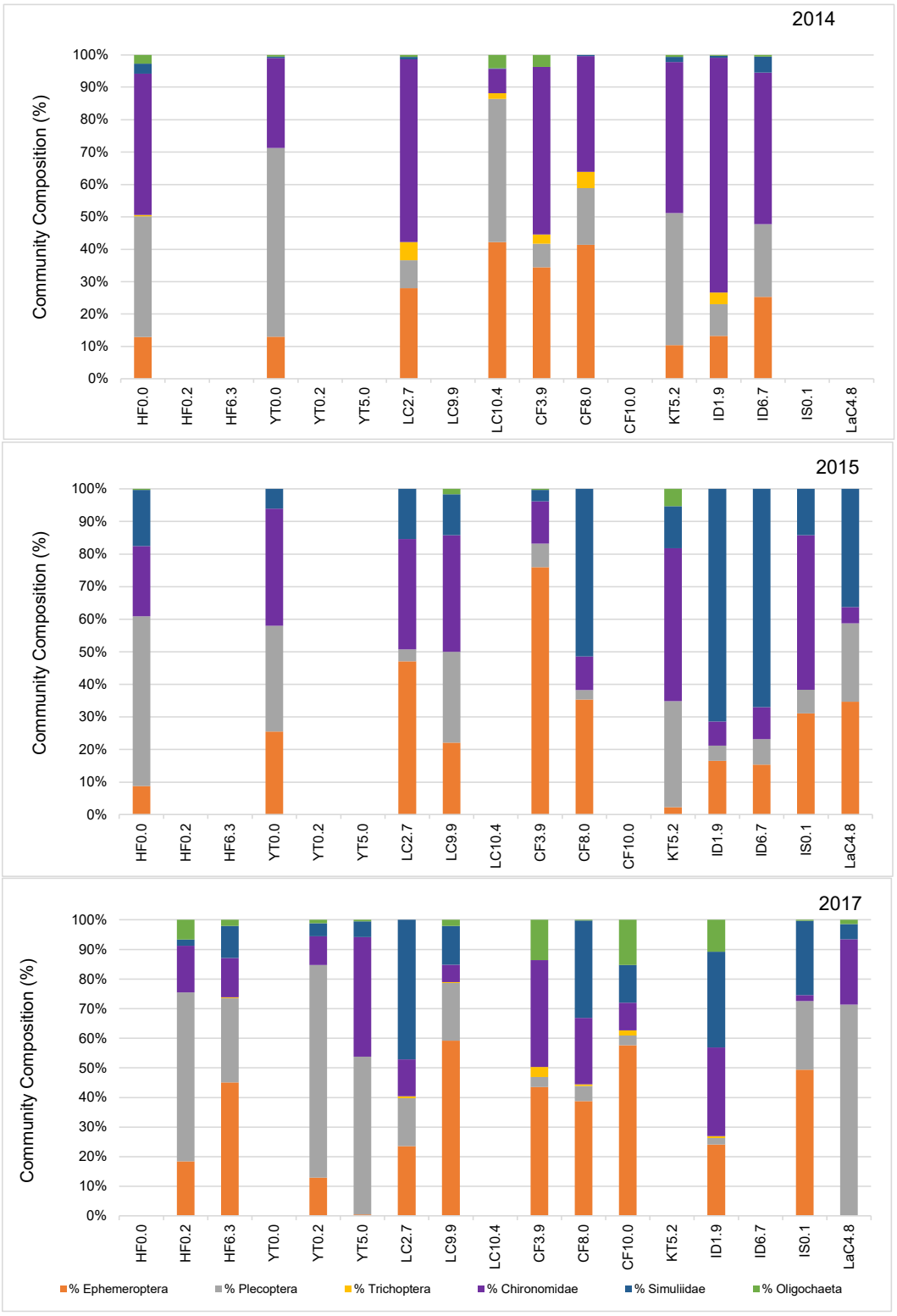


Figure 2.6: Percent Composition of Major Benthic Community Groups

HF = Halfway Creek, YT = YT24 Creek, LC = Latte Creek, CF = Coffee Creek, KT = Kona Tributary, ID = Independence Creek, IS = Isaac Creek, LaC = Los Angeles Creek.

(3.5%), Latte (3.5%), Halfway (0.4%), and Independence (1.8%) creeks in 2014, and in Coffee (1.9%), Latte (0.4%), Halfway (0.2%), and Independence (0.5%) creeks in 2017. Trichoptera were not present in samples collected in 2015. In 2017, Dipterans (true flies; mainly Chriomonidae and Simuliidae) represented a large proportion of the community at creeks sampled within the local study area except for Independence Creek, where Ephemeroptera and Plecoptera were the dominant groups (Figure 2.6). Among dominant taxa, the Simuliidae (black flies) showed the greatest variability in relative abundance within- and among-watercourses and study years (Figure 2.6), potentially reflecting variability in emergence, habitat, and/or sampling artifacts. In general, Ephemeroptera were typically present in higher relative abundance in upstream creek areas. The relative abundance of metal-sensitive chironomids[2] was generally low across all sites over the three sampling years.

Functional feeding group (FFG, as defined by Mandaville 2002) composition showed relatively minor variability among the three sampling years at individual local study area (LSA) creeks and was largely represented by collector gatherers (Figure 2.7). Differences in the proportions of filterers and shredders were observed among sampling years, which depending on the sampling year, made up the next largest proportion of FFG in the community at most LSA creeks (2014 –-shredders, 2015 – filterers, 2017 – shredders). The proportion of FFG scrapers and predators was generally low (i.e., less than 10% of the community), and was higher in 2014 compared to 2015 and 2017. Habitat Preference Group (HPG, as defined by Merritt et al. 2008) composition appeared was dominated by sprawlers in most years, although dominance of clingers was observed at some locations in 2015 and 2017 (Figure 2.8). Consistent with the erosional habitat sampled, burrowers predominantly represented by Oligochaetes (aquatic worms) were found in low numbers in all three years of baseline sampling.

In 2017, benthic invertebrates were also collected using a Hess sampler at a future mine-exposed area (Halfway Creek) and at a potential reference area (Area 129/CR24.5, a tributary to Carlisle Creek), with replication of five stations per area (Minnow and EDI 2017). The average density of organisms was lower at Halfway Creek (839 org/m^2) than at Area 129 (2,079 org/m^2), but average taxon richness was similar between these creeks (Halfway Creek = 18.8; Area 129 = 19.6; Table 2.2). Simpson's Evenness and Shannon-Weiner Diversity were higher at Halfway Creek than at Area 129 (Table 2.2). The mean proportion of EPT was similar between areas (Halfway Creek = 24.4%; Area 129 = 25.7%); however, Halfway

[2] Specific to this study, this group includes *Micropsectra* sp., *Stempellinella* sp., *Tanytarsus* sp., *Arctodiamesa* sp., *Psuedokiefferiella* sp., *Diamesa* sp., *Pagastia* sp., *Pottastia gaedii*, and *Pseudodiamesa* sp.; members of the metal-tribe Tanytarsini and subfamily Diamesinae (Kraft and Sypniewski 1981; Clements and Kiffney 1995; Clements et al. 2000).

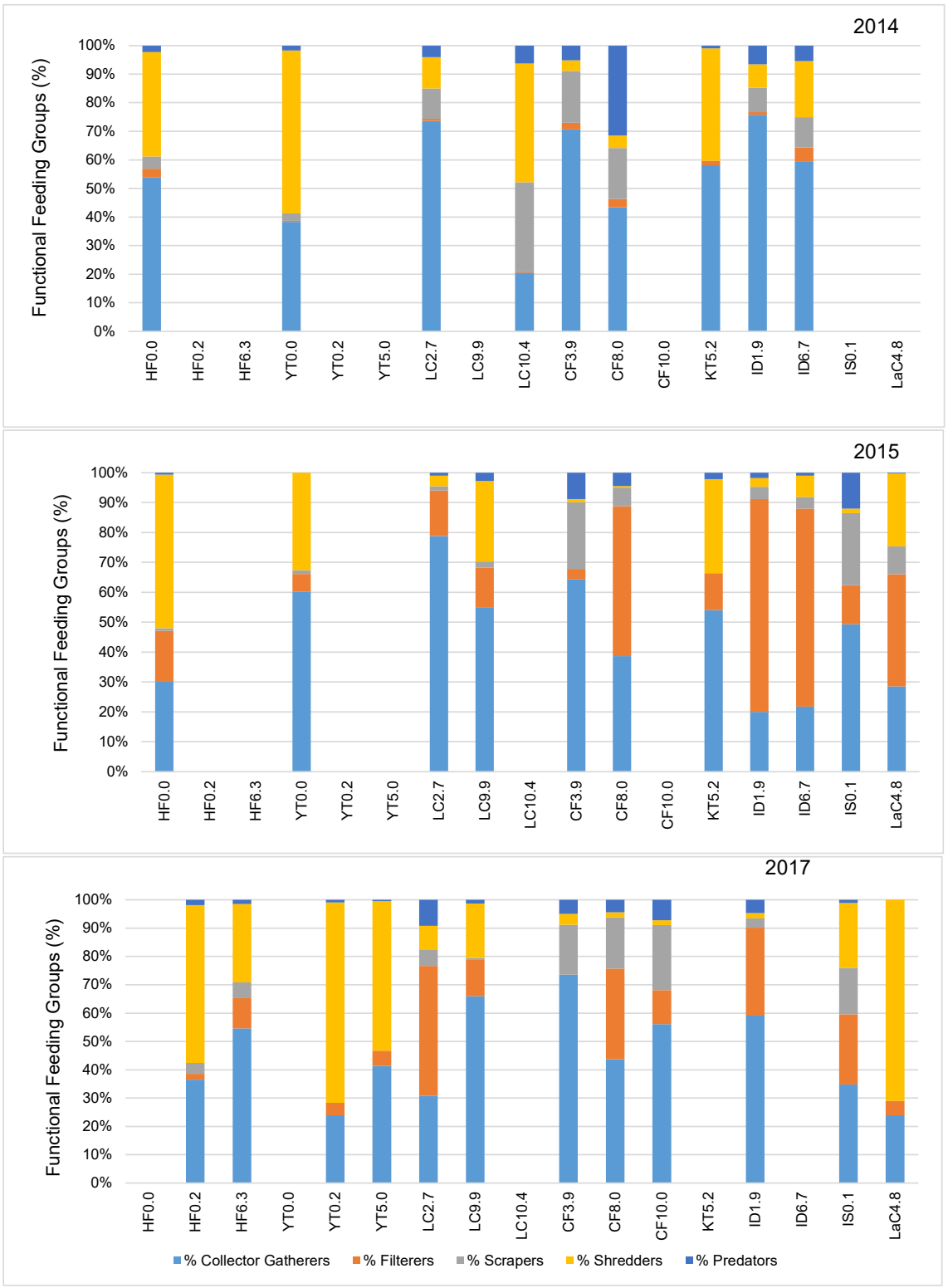


Figure 2.7: Percent Composition of Benthic Functional Feeding Groups

HF = Halfway Creek, YT = YT24 Creek, LC = Latte Creek, CF = Coffee Creek, KT = Kona Tributary, ID = Independence Creek, IS = Isaac Creek, LaC = Los Angeles Creek.

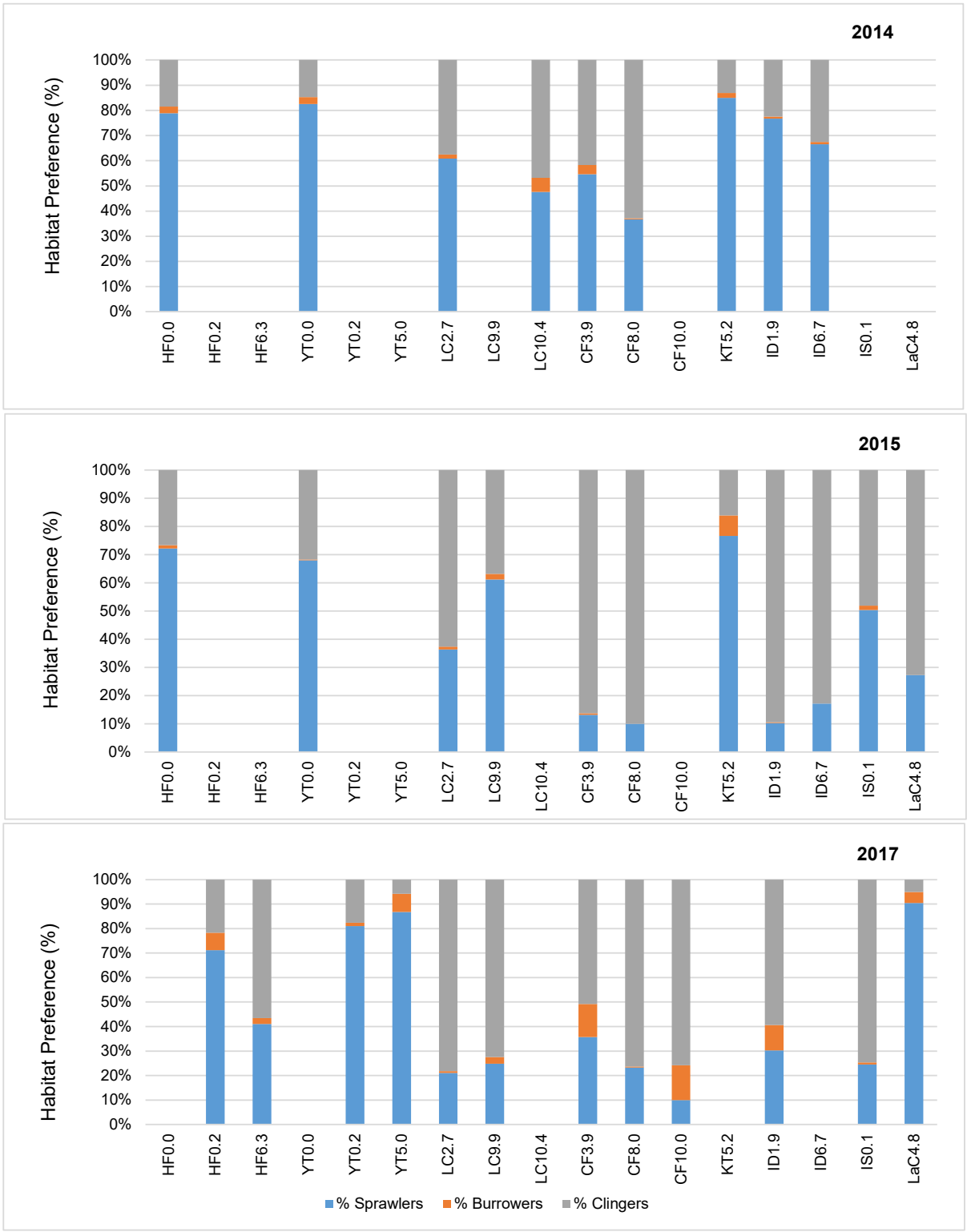


Figure 2.8: Percent Composition of Benthic Habitat Preference Groups

HF = Halfway Creek, YT = YT24 Creek, LC = Latte Creek, CF = Coffee Creek, KT = Kona Tributary, ID = Independence Creek, IS = Isaac Creek, LaC = Los Angeles Creek.

Table 2.2: Statistical Comparisons for Benthic invertebrate Community Endpoints for 129 Reference (n = 5) and Halfway Creek (n = 5), Sampled in 2017 for the Coffee Gold Project

Endpoint		Units	Data Transformation	Test	Test P-value	Mean or Median [a]		Observed ES (Halfway Creek - 129 Reference)/SD
						129 Reference [b]	Halfway Creek	
Number of Organisms		org/m²	none	T	0.017	2,079	839	-1.9
Total Number of Taxa		-	none	T	0.719	19.6	18.8	-0.24
Simpson's Evenness (E)		-	square root	T	0.003	0.116	0.270	2.7
Shannon-Weiner Diversity (H')		-	none	T	0.009	1.95	2.87	2.2
Bray-Curtis Index		-	log	Tunequal	0.028	0.264	0.824	1.5
Percent Composition	Oligochaeta	%	log	T	0.201	7.98	3.98	-0.88
	Ephemeroptera	%	square root	T	<0.001	8.73	32.8	3.3
	Plecoptera	%	none	T	0.006	67.9	37.3	-2.3
	Trichoptera	%	rank	MW	0.009	0	1.51	-
	Chironomidae	%	none	T	0.015	6.38	12.8	1.9
	Metal Sensitive Chironomidae	%	log	T	<0.001	0.903	8.60	9.4
	Simuliidae	%	none	T	0.182	2.23	4.75	0.92
Functional Feeding Groups	Collector Gatherers	%	none	T	0.008	22.5	49.5	2.2
	Filterers	%	none	T	0.203	2.37	4.75	0.88
	Scrapers	%	none	Tunequal	0.151	5.17	2.68	-0.79
	Shredders	%	square root	T	0.007	67.5	39.0	-2.3
Habitat Preference Groups	Clingers	%	square root	T	<0.001	13.0	42.2	4.1
	Sprawlers	%	none	T	0.017	74.0	51.2	-1.9
	Burrowers	%	log	T	0.282	9.17	5.39	-0.73

P-value < 0.1.
Magnitude of observed effect size > 2 SD.

Notes: T= t-test; Tunequal = t-test for unequal variances; MW = Mann-Whitney test; log = logarithm base 10. The observed effect size is calculated on the transformed scale when the data were transformed for analysis. No effect size is reported for the Mann-Whitney test.

[a] For transformed data, the back-transformed mean is reported; for ranked data, the median is reported.

[b] Reference area on a tributary to Carlisle Creek also known as CR24.5.

Creek had similar proportions of Ephemeroptera (33.4%) and Plecoptera (37.3%), whereas Area 129 was dominated by Plecoptera (67.9%; Table 2.2). Neither area had a high density of Trichoptera, as was also observed in the kick-and-sweep sampling (PECG 2017; EDI 2017b, 2018). Chironomidae made up a greater proportion of the community at Halfway Creek (12.8%) than at Area 129 (6.4%); however, they only accounted for small proportions of the community overall at both sites. Of the taxa present at Halfway Creek, 9.0% were metal sensitive and 67% of the chironomids present were metal sensitive.

As with the Canadian Aquatic Biomonitoring Network (CABIN) data from 2017 and previous years, the Hess FFG data showed that collector/gatherers and shredders made up the largest percentages of the community at Halfway Creek (Table 2.2). This was also observed at Area 129, but data showed a much greater proportion of shredders relative to collector/gatherers. Again, for Halfway Creek, Hess and CABIN mean data both indicated that HPG were largely made up of clingers and sprawlers in similar proportions. Area 129 was largely dominated by sprawlers (74.0%), with clingers and burrowers in similar, smaller proportions (13.4% and 12.6% respectively; Table 2.2). Statistical comparisons between the two areas using two sample t-tests indicated that Halfway Creek was significantly different from Area 129 based 13 of 19 endpoints examined despite similar physical characteristics (Table 2.2). This is indicative of spatial variability even under baseline conditions.

The differences observed between Halfway Creek and a reference area (Carlisle Creek tributary) even in baseline (i.e., statistically significant differences in density, evenness, diversity, taxonomic composition, functional feeding group composition, and habitat preference group composition; Table 2.2) highlight the importance of not relying on simple exposed reference (control impact or CI) comparisons for future evaluation of potential Project-related effects.

2.6 Benthic Invertebrate Tissue Quality

Benthic invertebrate tissue samples were collected in Latte, Coffee, Halfway, YT-24, Independence and Los Angeles creeks in March and/or August of 2016 and in August 2017, and analyzed for total metal concentrations (EDI 2017b, 2018). Of the metals with elevated baseline concentrations in water (e.g., aluminum, arsenic, cadmium, chromium, copper, iron, selenium, and uranium), baseline concentrations in benthic invertebrate tissue collected in 2016 were generally higher in the spring (March 2016) than in the summer (August 2016). Mercury results were evaluated against the CCME guideline for the protection of piscivorous wildlife (0.033 µg/g ww; CCME 2000) and no exceedances were observed (maximum 0.023 µg/g ww in a sample collected from Coffee Creek in March; EDI 2018). Selenium concentrations were not specifically evaluated in the original reports but reported baseline concentrations in 2016 exceeded the interim British Columbia guideline for dietary exposure to fish

(invertebrate tissue; 4 µg/g dw) in several samples in Latte, Coffee, Halfway, Independence, and Los Angeles creeks (EDI 2017b). Maximum recorded concentrations of selenium in benthic invertebrates were 7.6 µg/g dw in a sample collected from Coffee Creek and 7.3 µg/g dw in a sample collected from Coffee Creek in March 2016.

3 METHODS

3.1 Design Overview, 2018 to 2021

Benthic invertebrate and periphyton monitoring in support of the Coffee Project's conceptual Fish and Aquatic Life Monitoring Program (FALMP) is designed to monitor for potential (although not predicted) physical disturbance and toxicity effects, and for predicted stimulation of primary and secondary productivity. A Fish and Aquatic Life Adaptive Management Plan (FAL-AMP) has been developed for the Coffee Project to ensure that, similar to water quality results, the results of the FALMP follow an Adaptive Management Plan (AMP) framework (*i.e.*, are specifically used to trigger appropriate responses), and that links between the Water Quality Adaptive Management Plan (WQ-AMP) and Aquatic Life Adaptive Management Plan (AL-AMP) are established (Newmont 2021). The latter includes the use of FALMP and FAL-AMP results to inform the Water Quality Management Plan (WQMP) and WQ-AMP, and vice-versa. As with the WQ-AMP, the FAL-AMP includes predetermined thresholds that trigger monitoring and/or management responses to threshold exceedance.

Periphyton and benthic invertebrate community monitoring under the preliminary FALMP includes "future-exposed" creek areas and matching reference creek areas. Areas designated as future-exposed were selected because it is anticipated that the Project may cause direct or indirect effects in those creeks, including changes to water chemistry and nutrient enrichment (Newmont 2021), whereas the matching reference areas are not expected to be influenced by the Project.

The inclusion of both area types was selected to support the future application of a BACI design, which is considered the optimal design for environmental effects assessment and to specifically support the AL-AMP thresholds (*e.g.,* Green 1979; Mellina and Hinch 1995). Unlike the standard before-after (BA) or control-Impact (CI) approach, which asks the questions "does after differ from before (baseline)?" and "does exposed differ from reference?" (respectively), the BACI asks a question that is more powerful in determining potential mine-related change: "if there is a change from baseline in an exposed area, is that change larger than observed at the reference area?." Application of BACI controls for natural differences among areas and temporal variability to provide optimal resolution of potential mine-related effects. Upper Creek and Lower Creek "future-exposed" sampling areas were established at locations of anticipated Project influence to ensure FALMP monitoring satisfies future monitoring needs (*e.g.*, for Environmental Effects Monitoring [EEM] under the Metal and Diamond Mining Effluent Regulations [MDMER]; Environment Canada 2012; Newmont 2021).

A key consideration in the AL-AMP is which indicators to select as subject to AMP. Much like the WQ-AMP focusses on key analytes (parameters of concern) identified in the environmental and socio-economic assessment process, key indicators have been identified for use in the AL-AMP. Measurable Parameters were selected primarily based on an analysis of potential and predicted Project-associated physical and chemical changes reviewed in the analysis of periphyton and benthic invertebrates as part of environmental assessment (Minnow and EDI 2017). In selecting Measurable Parameters to use as key indicators, one consideration was to limit the number of key indicators in order to effectively capture those that are quantitative, reproducible, and sensitive to the potential changes identified in environmental assessment, while at the same time not including so many indicators that the AL-AMP becomes unmanageable or that there is redundancy in the indicators. Considering too many indicators results in an increased likelihood of finding a statistically significant difference when testing multiple hypotheses (*i.e.*, potential false positives, *e.g.*, Somers *et al.*, 2019) and can also result in redundancy (Rice and Rochet 2005). Redundant indicators that are influenced by similar generating processes (*e.g.*, effects on flow or effects on water chemistry) may overestimate impacts if used collectively (Sutherland *et al.,* 2016).

Based on consideration of these factors, the AL-AMP does not include triggers for periphyton (due to high variability in measurable parameters / indicators and trophic “distance” from the fundamental valued component [fish]). Monitoring endpoints and interpretation, therefore, include those identified as key indicators as well as additional parameters not assessed as potential future triggers for AL-AMP response (Table 3.1).

The following key indicators have been selected for AL-AMP:

- benthic invertebrate community biomass;
- benthic invertebrate community taxon richness; and
- percent EPT taxa in the benthic invertebrate community.

For each of these key indicators, thresholds are based on statistical contrasts of exposed area results versus reference area results (Table 3.2). If the key indicators do not differ from baseline and reference, or if the BACI interaction term does not differ from reference, then no AMP response is required. If statistically significant differences are observed at p=0.10, the AL-AMP framework is triggered.

Table 3.1. Rationale for Inclusion of Periphyton and Benthic Invertebrate Measurable Parameters in the Coffee Project FALMP and for the Selection of Key Indicators for the Aquatic Life Adaptative Management Plan (AL-AMP)

Monitoring Component	Subcomponent	Measurable Parameters	Units	Rationale for Inclusion in the FALMP	AL-AMP Key Indicator and Rationale
Periphyton	Productivity	Chlorophyll-a	Chlorophyll-a mg/m^2	potential stimulation by nutrients/temperature; impairment by sedimentation or toxicity,	**YES.** Indicator of nutrient enrichment (BCMECCS 2021; Dodds et al. 1998) .
		Biomass	Dry weight (mg/m^2) and Ash-Free Dry Mass (mg/cm^2)	potential stimulation by nutrients/temperature; impairment by sedimentation or toxicity	**NO.** Periphyton data are typically more variable than benthic invertebrate data and are more distant link (relative to benthic invertebrates) to the Valued Component (fish)
	Community	Taxonomic Richness	number of taxa per sample (station)	potential impairment by nutrients/temperature, sedimentation, or toxicity	
		% green algae	percent of total organisms	potential decrease with flow, nutrients, temperature, metal concentrations	
		% blue-green algae	percent of total organisms	potential increase with flow, nutrients, temperature, metal concentrations	
		% diatoms	percent of total organisms	potential increase with flow, nutrients, temperature, metal concentrations	
Benthic Invertebrates	Productivity	Biomass	dry weight (g/m^2)	potential stimulation by nutrients/temperature; impairment by sedimentation	**YES.** Highly quantitative and sensitive to potential stimulation and flow regime change.
	Community	Density	total organisms per m^2	potential stimulation by nutrients/temperature; impairment by sedimentation or toxicity	**NO.** Recapitulates biomass; considered a supporting metric to biomass.
		Taxon Richness	number of taxa per sample (station)	potential impairment by nutrients/temperature, sedimentation, or toxicity	**YES.** Highly quantitative and sensitive to potential stimulation, flow regime change, and toxicity.
		% EPT [a]	percent of total organisms	metal sensitive - potential decrease with elevated metals	**YES.** Highly quantitative and sensitive to potential stimulation, flow regime change, and toxicity.
		% mayflies	percent of total organisms	metal sensitive - potential decrease with elevated metals	**NO.** Recapitulates % EPT; considered a supporting metrics to % EPT.
		% HPG (burrowers v. clingers)	percent of total organisms	potential increase in burrowers under sedimentation	**NO.** Limited specificity to mine-related stressors.
		% FFG (collector-gatherer v. filterer v. scraper)	percent of total organisms	potential increase in collector-gatherers with sedimentation, lower filterer and scraper and higher clingers with flow augmentation	**NO.** Limited specificity to mine-related stressors.
		Simpson's Evenness	unitless; scale from 0 to 1	potential decrease with flow, nutrients, temperature, metal concentrations	**NO.** Can be naturally variable and somewhat recapitulates taxon richness.
		Simpson's Diversity	unitless; scale from 0 to 1	potential impairment by nutrients/temperature, sedimentation, or toxicity	**NO.** Recapitulates taxon richness.
		Bray Curtis Index of Dissimilarity	unitless; scale from 0 to 1	difference from baseline or reference	**NO.** Provides a yes/no evaluation of difference without description of the difference.
	Tissue Quality	Tissue Metals	mg/kg dry tissue weight	potential increase with aqueous metal concentrations	**NO**. Indicator of exposure, not of effects.

[a] EPT taxa = invertebrate taxa from the insect orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies).

Table 3.2. Statistical Contrasts and Outcomes for Periphyton and Benthic Invertebrate Monitoring Key Indicators under the Coffee Project FALMP and Triggers to the FAL-AMP

Statistical Contrast	Statistical Test	Question	Outcome and Associated Response under the FALMP	Trigger under to AL-AMP Action
Exposed versus Baseline (Before-After)	ANOVA	Does the key indicator differ from baseline?	No difference from baseline; no additional action required.	None
			Significant difference from baseline; proceed to 2-way ANOVA	None if the BACI analysis is supported; rely on the BACI analysis outcome. If the BACI analysis is not supported, a difference from baseline triggers the AL-AMP framework.
Exposed versus Reference (Control-Impact)	ANOVA	Does the key indicator differ from reference?	No difference from baseline; no additional action required.	None
			Significant difference from baseline; proceed to 2-way ANOVA	None if the BACI analysis is supported; rely on the BACI analysis outcome. If the BACI analysis is not supported, a difference from reference triggers the AL-AMP framework.
2-Way (Current-Baseline-Exposed-Reference) (Before-After-Control-Impact)	2-Way ANOVA	Is an observed "exposed area" difference from baseline (after versus before) greater than the equivalent reference area difference from baseline?	The difference from baseline at the exposed area is consistent with reference; no additional action required.	None
			Significant difference from baseline at exposed area relative to reference suggests a mine-related change.	AL-AMP framework triggered

3.1.1 Sampling Frequency and Study Area Locations

Benthic invertebrate and periphyton baseline field sampling at Project FALMP areas was conducted by Minnow Environmental Inc. (Minnow) biologists in August 2018, 2019, and 2021[3] (Table 3.3; Figure 3.1). Sampling in 2017 was only conducted at one future-exposed (HC6.8[4]) and one potential reference (CR24.5[4]) area as a preliminary step towards establishing sampling areas and protocols for a more comprehensive monitoring program. Sampling in 2018, 2019, and 2021 was conducted in a manner consistent with the conceptual FALMP, to ensure that three years of baseline data were collected in manner that can be optimally used for future detection of potential mine-related effects to aquatic life (Newmont 2021).

The FALMP monitoring program is designed around three "future-exposed" creeks (or creek groupings in the case of Latte/Coffee):

- Halfway Creek;
- YT-24 Creek; and
- Latte Creek/Coffee Creek.

Each of these three creeks has been further divided into an Upper Creek monitoring area and a Lower Creek monitoring area to account for a possible future gradient of effects due to proximity to Project development (Table 3.3; Figure 3.1). The monitoring program design includes two reference areas for the Upper Creek "future-exposed" areas and two reference areas for the Lower Creek "future-exposed" areas.

Conceptually, the frequency of periphyton and benthic invertebrate monitoring under the FALMP varies by location and project stage. Upper and Lower Creek areas were both monitored annually for three years (with the exception of 2020) of baseline collection from 2018 to 2021 (Tables 3.3 and 3.4). During mining operations, the Upper Creek areas will be monitored at a greater frequency than Lower Creek areas, reflecting greater mine influence relative to creek size. Upper Creek areas will be monitored at an initial frequency of annually for the first three years of operations, followed by every two years thereafter. Periphyton and benthic invertebrate monitoring of Lower Creek areas will be at a frequency of every 2 years during mine operations.

[3] The additional baseline monitoring was initially planned for 2018, 2019, and 2020, but monitoring in 2020 could not be completed due to site closure associated with the COVID-19 pandemic.

[4] FALMP sampling area names were revised in 2019 to more accurately reflect their proximity to each creek's mouth at the Yukon River. For previous area/station names see Appendix Table A.1.

Table 3.3: Coffee Project FALMP Periphyton, Benthic Invertebrate, and Sediment Sampling, 2017, 2018, 2019, and 2021

Area Type	Area Description	Area Name	Stations per Area	Habitat and *in situ* water	Periphyton			Benthic Invertebrates			Sediment
					Chlorophyll-*a*	Ash-free Dry Mass (AFDM)	Community	Community	Biomass	Tissue Chemistry	
Upper Creek Areas	Upper Halfway Creek (Future-Exposed)	HC6.8	n = 5	✓	✓	✓	✓	✓[a]	✓[a]	✓	✓[b]
	Upper YT Creek (Future-Exposed)	YT4.3	n = 5	✓	✓	✓	✓	✓	✓	✓	✓[c]
	Upper Latte Creek (Future-Exposed)	LC10.2	n = 5	✓	✓	✓	✓	✓	✓	✓	✓[b]
	Upper Carlisle Creek (Reference)	CR24.5	n = 5	✓	✓	✓	✓	✓	✓	✓	/
	Upper Coffee Creek Tributary (Reference)	CC23.7	n = 5	✓	✓	✓	✓	✓	✓	✓	/
Lower Creek Areas	Lower Halfway Creek (Future-Exposed)	HC0.2	n = 5	✓	✓	✓	✓	✓	✓	✓	✓[c]
	Lower YT-24 Creek (Future-Exposed)	YT0.2	n = 5	✓	✓	✓	✓	✓	✓	✓	✓[d]
	Lower Coffee Creek (Future-Exposed)	CC5.6	n = 5	✓[e]	✓[e]	✓[e]	✓[e]	✓	✓	✓	✓[b]
	Lower Creek South of YT-24 (Reference)	SYT0.6	n = 5	✓	✓	✓	✓	✓	✓	✓	✓[c]
	Lower Creek East of Excelsior (Reference)	XE0.2	n = 5	✓	✓	✓	✓	✓	✓	✓	✓[c]

Notes: ✓ - Sampling conducted in 2018, 2019, and 2021. / - samples not collected. Sediment sample replication varied in 2019 (see Section 3.6)

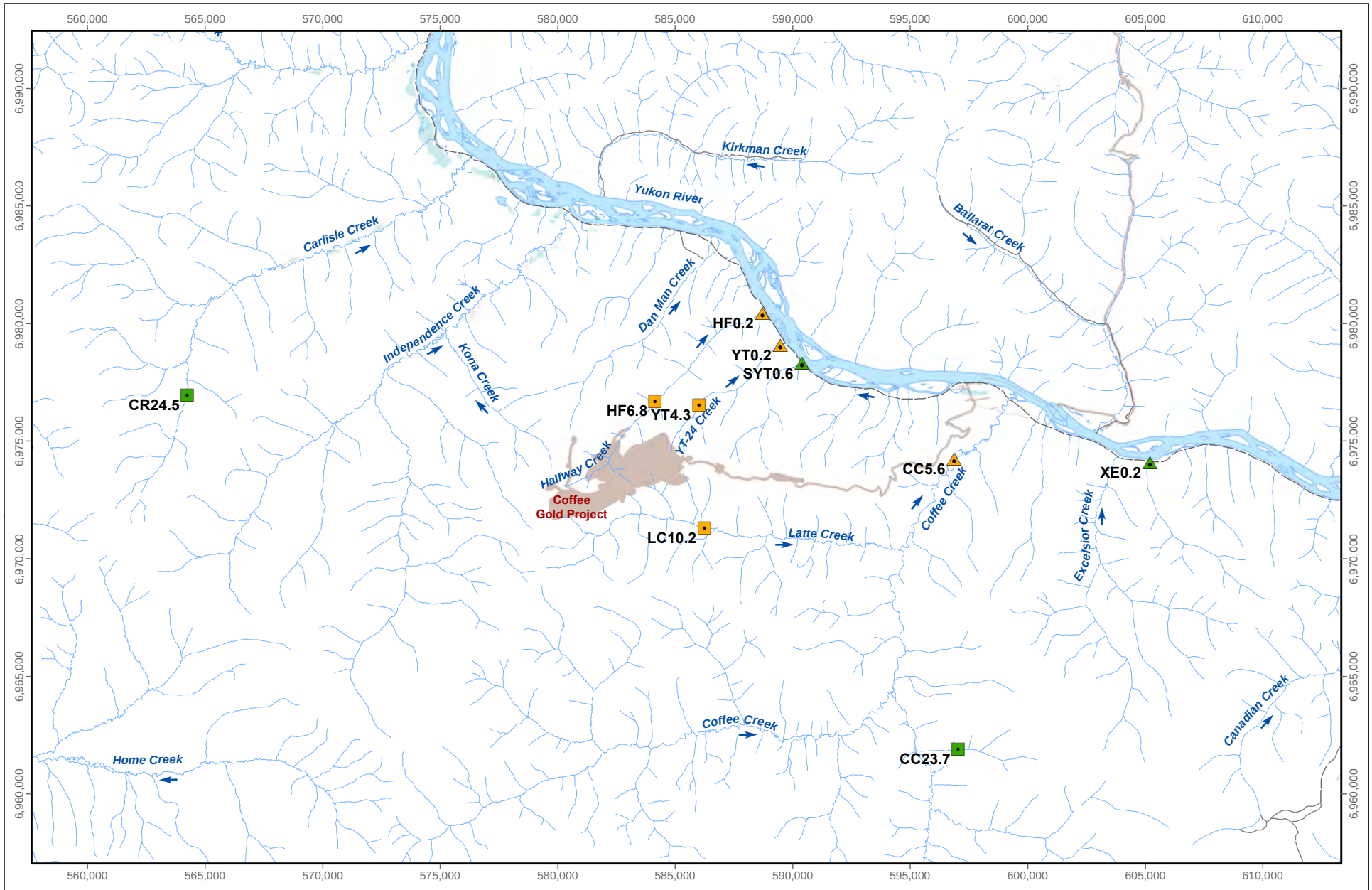
[a] Sampling conducted in 2017, 2018, 2019, and 2021.

[b] Sampling conducted in 2019 and 2021 (replication variable).

[c] Sampling conducted in 2019 (replication n=4).

[d] Sampling conducted in 2021.

[e] Replication for 2019 samples lower than 2018 and 2021 (n=3).



LEGEND

Sampling Location

- Upper "Future" Exposure
- Lower "Future" Exposure
- Upper Reference
- Lower Reference
- Mine Footprint
- Limited-use road
- Trail

0 2.5 5 10
km

N
W E
S

Projection: North American Datum 1983 UTM Zone 8

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Benthic Invertebrate and Periphyton Monitoring Areas, Coffee Project FALMP, 2018, 2019, and 2021

Date: December 2021
Project 217202.0074

minnow environmental inc.

Figure 3.1

Document Path: C:\Users\MLaPalme\Trinity Consultants, Inc\Newmont - 217202.0074 - 2021 Coffee Project AEMP\D - GIS\Report\21-74 - Figure 3.1 BI and Periphyton Monitoring Areas, Coffee Project FALMP, 2018, 2019, and 2021.mxd

Table 3.4. Periphyton and Benthic Invertebrate Monitoring Areas, Methodology, Indicator Endpoints, Frequency, and Timing under the Fish and Aquatic Life Monitoring Program (FALMP) for the Newmont Coffee Project

Area Type	Future-Exposed Creeks	Reference Creeks	Periphyton		Benthic Invertebrates		Frequency	Timing
			Method Summary	FAL-AMP Indicator Parameters[a]	Method Summary	FAL-AMP Indicator Endpoints[ab]		
Upper Creek Areas	Upper Halfway (HC6.8)	Upper Carlisle (CR24.5) and Upper Coffee (CC23.7)	**Productivity:** sample periphyton with razor blade from a measured surface area of five randomly selected rocks, freeze two samples (one for AFDM and one for chlorophyll-a). **Community:** sample periphyton with razor blade from five randomly selected rocks, preservation with Lugol's solution.	**Productivity:** dry weight per (mg/cm^2)and chlorophyll-a (mg/m^2) **Community:** taxon richness, %green algae, %blue-green algae, %diatoms	**Productivity and Community:** Hess Sampler with 500 µm mesh (3 sub-sample composite); taxonomy to lowest practical level **Tissue Quality:** kick-and sweep and by hand (overturning rocks), taxon composition representative of community	**Productivity:** dry weight per (mg/m^2) **Community:** density, taxon richness, Simpson's Evenness, Simpson's Diversity, Bray-Curtis Index of Dissimilarity, %EPT taxa, %mayflies, %HPG, %FFG **Tissue Quality:** metal concentrations	**Baseline:** Annually for 3 years **Construction:** once **Operations:** Annually for years 1-3, every 2 years starting year 5. **Reclamation and Closure:** every 2 years	Mid-late August
	Upper YT-24 (YT4.3)							
	Upper Latte (LC10.2)							
Lower Creek Areas	Lower Halfway (HC0.2)	Lower Creek East of Excelsior (EX0.2) and Lower Stream South of YT-24 (SYT0.6)					**Baseline:** Annually for 3 years **Construction:** once **Operations:** every 2 years **Reclamation and Closure:** every 2 years	
	Lower YT-24 (YT0.2)							
	Lower Coffee (CC5.6)							

[a] The identification of FAL-AMP Trigger Parameters does not preclude interpretation based on additional Parameters. This is particularly true for community data, for which additional interpretive parameters will be calculated and contrasted (e.g., proportion of other taxonomic groups and ordination such as Correspondence Analysis).

[b] EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies); HPG = Habitat Preference Group (sprawlers, burrowers, and clingers); FFG = Functional Feeding Group (collector-gatherers, filterers, scrapers, shredders, and predators).

Three future-exposed areas have been established in upper reaches of creeks in the vicinity of the Project, as well as three areas in corresponding lower reaches (Figure 3.1; Tables 3.3 and 3.4; Appendix Table A.1). The future-exposed areas are:

- Upper Halfway Creek (HC6.8);
- Upper Latte Creek (LC10.2);
- Upper YT-24 Creek (YT4.3);
- Lower Halfway Creek (HC0.2);
- Lower Coffee Creek (CC5.6); and
- Lower YT-24 Creek (YT0.2).

Reference areas were selected based on Geographic Information System (GIS) comparisons of regional creeks with future-exposed creeks, focused on creek morphology, hydrology, and proximity to the project (i.e., access logistics). Reference areas were selected to be as similar as possible to future-exposed areas according to criteria including elevation, stream order, and stream width. Similarity of reference areas with future-exposed areas is important to ensure applicability of the BACI design. The four reference areas selected are:

- Upper Coffee Creek Tributary (CC23.7);
- Upper Carlisle Creek Tributary (CR24.5);
- Creek South of YT-24 (SYT0.6); and
- Creek east of Excelsior (XE0.2).

Areas were divided into five replicate sampling locations (stations) for benthic invertebrate and periphyton sample collection (Appendix Table A.1). This level of replication was selected to provide adequate statistical power for application of state-of-the-science data collection and interpretation methodologies. Stations were selected in creek habitats to ensure within-creek and overall among-creek sample comparability, selecting riffle habitats with similar substrate (gravel and small cobble), similar flow velocity (~0.5-0.8 m/s), and similar depth (~20 cm) characteristics. Distances among stations were generally approximately 50 to 100 m as (i.e. maximum distance from Station 1 to Station 5 less than 500 m) but varied among areas depending on availability of suitable habitat, and safe access. Effort was made to establish stations in separate riffles wherever possible. Station replicates were numbered from 1 to 5 with 1 being the farthest upstream and 5 being the farthest downstream.

A number of sampling areas for which some historical baseline data exist were not included in the current study design including Independence Creek, Isaac Creek, Los Angeles Creek, various

areas along Coffee Creek (e.g., CC5.7 and CC8.0), and the Yukon River (EDI 2018; PECG 2017). The decision to exclude these historical sampling areas was generally the result of those areas being sub-optimal reference areas due to poor comparability with areas selected for the FALMP or due to changes within that area (e.g., initiation of placer mining activity).

3.2 Supporting Habitat and Water Quality

3.2.1 Habitat Features

Habitat assessment and *in situ* water quality measurements were completed at all stations sampled during the 2017, 2018, 2019, and 2021 field programs (Table 3.3). Habitat assessments included the following variables at all periphyton and benthic invertebrate monitoring stations:

- station location coordinates recorded in Universal Transverse Mercator (UTM) units;
- mean flow velocity (averaged across a 3-5 point transect in the vicinity of the Hess samples placements, m/s; measured using a HACH FH950 handheld flow meter [HACH Company, Loveland, CO]);
- water depth (meters [m]) measured using a meter stick at each Hess subsample location;
- habitat types present (i.e., pool/pond, riffle, run);
- creek gradient (by clinometer);
- creek width (bankfull and wetted, m)
- bank condition;
- substrate type(s);
- substrate size (cm, average of intermediate axis measurements for 50 randomly selected pebbles within the vicinity of the Hess sampler placements and for every 10th pebble an estimate of the degree of embeddedness in surrounding materials was recorded).
- amount and types of dominant aquatic vegetation;
- adjacent vegetation types (e.g., grasses, shrubs) and land use, including potential anthropogenic influences; and
- representative photos.

3.2.2 Supporting Water Quality Measurements

Water quality samples for laboratory analysis were not collected as part of this monitoring program, as routine baseline water quality monitoring has been conducted by Coffee Project staff

as well as Lorax Environmental Services Limited (Lorax) for the Coffee Project Water Quality AMP (WQ-AMP).

Supporting *in situ* measurements of water temperature, pH, specific conductance, and dissolved oxygen (DO) were recorded at each station using a YSI EXO™ handheld portable field meter equipped with YSI EXO2™ Sonde. *In situ* measurements were taken approximately 5 centimeters (cm) below the water surface.

The water quality meter was calibrated daily and maintained according to manufacturer instructions. Calibrations for DO were completed multiple times per day on days when there was movement among low- versus high-elevation areas.

3.2.3 Data Analysis

Habitat and water quality variables specifically identified as drivers of change in periphyton and benthic invertebrates due to Project operation (flow velocity and temperature; Minnow and EDI 2017), as well as remaining *in situ* water quality variables, were tabulated and plotted as time-series figures for Upper and Lower Creek areas. *In situ* water quality data were screened against available CCME water quality guidelines (pH and DO). Values for DO (concentration and saturation) from area HC6.8 in 2019 were unusually high compared with the range of values for other areas and other years at HC6.8. Those values were included in plots and data summary tables but excluded from statistical analyses.

Habitat and *in situ* water quality data were also integrated into correlation analyses of periphyton community, periphyton productivity, and benthic invertebrate community. Correlation testing is used to establish whether any spatial or temporal variability in biotic variables may be correlated with variability in any habitat or water quality variables.

Habitat and *in situ* water quality variables were compared spatially and temporally from 2018 to 2021 using a two-way analysis of variance (ANOVA) with factors *Area* and *Year* and their interaction. The significance of the main effects and interaction terms of the ANOVA were assessed using an α of 0.05, and the results of these determined which post-hoc comparisons were then conducted. Specifically, when the interaction between *Year* and *Area* was significant it indicated that the differences between the areas changed over time and post-hoc comparisons were conducted to 1) test for differences between the first year of sampling and each subsequent year for each area, and 2) test for differences between the exposed and reference areas in each year. For all significant post-hoc temporal comparisons, a magnitude of difference (MOD) between years was calculated as:

$$MOD_{Year} = \frac{MCT_{recent\ year} - MCT_{older\ year}}{MCT_{Older\ year}} \text{ x } 100\%$$

For significant spatial comparisons a MOD was calculated between the exposed and reference areas within each year as:

$$MOD = \frac{MCT_{Exposed} - MCT_{Reference}}{MCT_{Reference}} \text{ x } 100\%$$

The measure of central tendency (MCT) was calculated as back-transformed estimated marginal means or medians for rank-transformed data. When the interaction term (*Year* x *Area*) was not significant, post-hoc spatial comparisons and MOD calculations were conducted pooling over year and temporal comparisons were conducted pooling over stations.

3.3 Periphyton/Primary Productivity

3.3.1 Sample Collection

Periphyton community, chlorophyll-a, and ash-free dry mass (AFDM) sampling was completed in 2018, 2019, and 2021 (Table 3.3). One sample was collected for each periphyton parameter at each station (n=5 per area[5]) by selecting five representative submerged rocks for processing on shore as described below. A concerted effort was made to ensure that habitat characteristics (water depth, velocity, and substrate characteristics) were comparable among sampling stations and areas to minimize natural influences on the variability of community and productivity endpoints. Rocks were selected to be as close to benthic invertebrate community sampling locations as possible.

Creeks within the Project area are characterized as having very low productivity, and therefore the volume of periphyton for collection is very low and biomass distribution is patchy. Most randomly selected submerged rocks have no visible or tangible algal growth (Figure 3.2), which can bias collection towards rocks/sections of rocks having visible assemblages with atypically high concentrations of algal growth to ensure that sample volumes are adequate for laboratory analysis. Collection of sample volume adequate for analysis, particularly with respect to meeting the minimum AFDM target mass (1 mg), required targeted selection of rocks with visible periphyton assemblages. Rocks with algal growth typically had small patches of periphytic growth relative to the overall surface area, and those patches were targeted for sampling (Figure 3.3). A completely random approach to collecting rocks for periphyton sampling in the Project area would be extremely unlikely to generate adequate samples for periphyton analysis. Unit area-based periphyton biomass estimates are therefore likely overestimates of naturally

[5] Only 3 replicate periphyton samples were collected at area CC5.6 in 2018 due to difficulty collecting samples of adequate size for analysis due to low algal coverage.



Figure 3.2: **Randomly Selected Rocks for Assessment of Periphyton, Area CC5.6, 2019**



Figure 3.3: **Rocks Selected with Algal Growth for Periphyton Sampling, Area CC5.6, 2019**

occurring representative algal coverage but will continue to be valuable for tracking spatiotemporal trends so long as rocks with the highest concentration of periphytic growth for a given area continue to be targeted for sampling. Use of this method in future is recommended to ensure consistency and comparability of data across years.

Periphyton community samples were collected by firmly placing a thin acetate template with a 2x2 cm (4 cm²)[6] opening on a section of rock with encrusting material present (whether filling the template or not) and scraping off all periphyton present within this area using a stainless-steel razor blade or scalpel. Each single composite sample represented a 0.002 m² (5 x 4 cm²; or 0.0125 m^2 in the case of n=12 out of 50 samples in 2019) surface area per endpoint. Sample material scraped from each of the five rocks was then transferred from the razor blade or scalpel to an opaque 40 mL sample cup, diluted with creek water, and preserved with Lugol's iodine solution until the sample was the colour of weak tea. Samples were stored at room temperature prior to shipment to the laboratory for taxonomic analysis.

Periphyton samples collected for productivity measures (chlorophyll-a and AFDM) were collected using the same protocols as periphyton community samples and scraped from the same five rocks whenever possible (i.e., whenever the rocks had sufficient material for three scrapings), with additional rocks collected as required. Chlorophyll-a sample material (periphyton) was transferred from the scalpel to a large (47 mm) 0.45 µm pore diameter Whatman Mixed Cellulose Ester (MCE) filter paper, which was inserted into an opaque vial for storage. Ash-free dry mass sample material was transferred to an opaque 40 mL sample cup. Chlorophyll-a and AFDM samples were then frozen prior to shipment to the laboratory for analysis.

The total area scraped at each station was recorded (0.002 m²: 5 x 4 cm², or any deviations from this surface area) to allow calculation of productivity and area-based community metrics. This process was repeated for all three periphyton parameters at each of the five stations per monitoring area.

3.3.2 Sample Processing

3.3.2.1 Community

Taxonomic identification and enumeration of periphyton community samples was completed by Biologica Environmental Services Ltd. in Victoria, BC. Briefly, samples were homogenized,

[6] In 2019, 12 of 50 periphyton samples were collected using 5x5 cm (25 cm^2) templates to assess whether a larger template would facilitate sampling using random rocks (i.e., a larger sample area could generate sample volumes adequate for laboratory analyses). It was determined that the increased template size did not guarantee adequate sample volume and targeted rock collection was still necessary even with the larger templates. This was therefore not an effective solution and in 2021 methods reverted to 2x2 cm templates exclusively.

settled in Ütermohl chambers for 24 hours, and all cells within randomly selected fields of view were enumerated until a minimum count of 300 algal units (1 unit = >1 cell for colonial or filamentous taxa) was reached. Identification was performed using an inverted phase contrast microscope, and algal taxa were identified to a minimum of genus-level (whenever possible) according to the most up-to-date taxonomic references. Periphyton density was determined using the area sampled, proportion subsampled, and the total area of the selected fields of view.

Laboratory quality assurance/quality control included a re-analysis of two samples (representing 10% of samples) and a calculation of percent agreement among results. Upon completion of the analyses, the data and quality control reports were provided by Biologica to Minnow electronically as Adobe Acrobat PDF and Microsoft Excel files (see Appendix H for complete laboratory reports).

3.3.2.2 Productivity

Laboratory determination of periphyton productivity (chlorophyll-a and AFDM) was completed by ALS Environmental (Burnaby, BC). Upon receipt, laboratory staff opened the coolers, measured temperature to verify the maintenance of cold samples, logged each sample, and assigned each sample a unique sample identification code. A sample receipt confirmation was then sent to Minnow. Analysis of chlorophyll-a followed procedures adapted from United States Environmental Protection Agency (USEPA) Method 445.0 (USEPA 1997). Briefly, chlorophyll-a concentration was determined by routine acetone extraction followed by fluorescence detection using a non-acidification procedure (a method that is not subject to interferences from chlorophyll-b). Determination of total AFDM followed procedures adapted from American Public Health Association (APHA) Method 10300 C (APHA 2010). Total AFDM was calculated as the difference between the dried sample weight and the ash weight, both determined gravimetrically. Dry weight was determined following drying at 105°C, and ash weight was subsequently determined by ashing at 500°C. Laboratory quality assurance/quality control (QA/QC) of periphyton productivity samples included reagent blanks, laboratory replicates, and laboratory accuracy measures (i.e., laboratory control samples). Upon completion of the analyses, data reports were provided by ALS Environmental to Minnow electronically as Adobe Acrobat PDF (portable document format) and Microsoft Excel files (Appendix H).

3.3.3 Data Analysis

A formal data quality review (DQR) was completed to assess the quality of the periphyton community data (Appendix G). Periphyton monitoring is focused on Measurable Parameters representing productivity and community conditions (Table 3.1). Several periphyton community metrics were identified as potential indicators of periphyton community change that could result

from Project operation although not considered key indicators for FAL-AMP response (general community composition [the relative densities of taxonomic groupings] and proportion of blue-green algae [Cyanobacteria]; Minnow and EDI 2017), and were evaluated in addition to metrics of organism density, taxonomic richness, biomass (inferred from biovolume estimates), Simpson's Evenness, and Simpson's Diversity. These metrics were calculated using taxonomy assessed at the Lowest Practicable Level (LPL). Relative densities were calculated as the density of each respective taxonomic grouping divided by the total density expressed as a percent. Taxonomic groups evaluated were diatoms, green algae (Chlorophytes), Cyanobacteria, and "Others" (all other taxa, which included golden algae [Chrysophytes], Dinoflagellates, and red algae [Rhodophytes]). All periphyton community metrics were plotted as raw values for all years sampled for every Project area, separately for Upper and Lower Creek areas. Analytes identified in Minnow and EDI (2017) as indicators of periphyton community health are assessed in detail in Section 5, whereas summary tables and plots for all other analytes are appended in Appendix C.

Periphyton productivity (in terms of periphytic chlorophyll-a and AFDM concentrations) was identified as a potential indicator of Project-related changes although not a FAL-AMP key indicator (Minnow and EDI 2017). A formal DQR was completed to assess the quality of the periphyton productivity data (Appendix G). Chlorophyll-a and AFDM sample data were converted to standard area-based measurements (mg/m^2 and mg/cm^2, respectively) and data were plotted to establish temporal and spatial conditions and variability in the Project area. Chlorophyll-a concentrations were also compared to water quality guidelines for trophic conditions (British Columbia Water Quality Guidelines [BCWQG] guideline for eutrophic conditions = 100 mg/m^2; BCMOECCS 2021), and the Dodds et al. (1998) productivity classification system for temperate streams. Endpoints were summarized by area and year, including sample size, mean, median, minimum, maximum, and standard deviation.

Changes in periphyton community endpoints from 2018 to 2021 were quantified using an ANOVA with factors *Area* and *Year* and their interaction. Response variables were transformed (log_{10} for density and log_{it} transformed for proportions) where necessary to meet the assumption of normality, which was tested using a Sharpiro-Wilks test and visually using Q-Q normal plots of the model residuals. When this assumption could not be met, response variables were rank transformed.

The significance of the main effects and interaction terms of the ANOVA were assessed using an α of 0.1, and the results of these determined which post-hoc comparisons were then conducted. Specifically, when the interaction between *Year* and *Area* was significant it indicated that the differences between the areas changed over time and post-hoc comparisons were conducted to

1) test for differences between the first year of sampling and each subsequent year for each area, and 2) test for differences between the exposed and reference areas in each year. For all significant post-hoc temporal comparisons, a MOD between years was calculated as:

$$MOD_{Year} = \frac{MCT_{recent\ year} - MCT_{older\ year}}{Pooled\ Standard\ Deviaton}$$

For significant spatial comparisons a MOD was calculated between the exposed and reference areas within each year as:

$$MOD_{Station} = \frac{MCT_{Exposed} - MCT_{Reference}}{Pooled\ Standard\ Deviaton}$$

The measure of central tendency (MCT) was calculated as back-transformed estimated marginal means. When the analysis was done on the rank-transformed scale, the observed effect size was estimated using median values instead of marginal means and the variability was estimated using the median absolute deviation (MAD).

When the interaction term (*Year* x *Area*) was not significant, post-hoc spatial comparisons and MOD calculations were conducted pooling over year and temporal comparisons were conducted pooling over stations.

To identify what characteristics may be associated with periphyton community and productivity, Spearman Rank Correlations were conducted between periphyton endpoints and *in situ* water chemistry characteristics and substrate size. Correlations were assessed for the strength of the correlation and the significance corrected using Bonferroni correction for 8 independent comparisons (corrected alpha = 0.1/8 = 0.0125).

3.4 Benthic Invertebrate Community Survey

3.4.1 Sample Collection

Samples for analysis of benthic invertebrate density, biomass, and community structure were collected in 2017, 2018, 2019, and 2021 (Table 3.3). The only FALMP area sampled in 2017 were HC6.8 and CR24.5[7] and because there are limited data for that year, integration of those data into statistical tests was not possible. Five samples were collected in erosional habitat at each of five Upper (three future-exposed and two reference) and five Lower (three future-exposed and two reference) Creek areas in 2018, 2019 and 2021 (Table 3.3).

In 2018, 2019, and 2021, samples were collected from riffle/run habitat with cobble and gravel substrate using a Hess sampler (0.1 m^2 sampling area) with 500 µm mesh. Samples were

[7] Previously referred to as I29 and HC6.3.

composites of three Hess sampler placements (0.3 m^2 area in total) at five replicate stations within each sampling area. For each sampler placement, gravel or cobble enclosed within the Hess sampler was disturbed and carefully washed (by hand rake and nail brush), while allowing the current to carry dislodged organisms into the mesh collection net. The substrate was disturbed to a depth of approximately 5 to 15 cm over a period of approximately five minutes. This procedure was repeated at new subsampling locations for the second and third grab, with all placements located as close together as possible. Positions with flow rates of 0.5-0.8 m/s, small cobble, and depths 10-20 cm were targeted.

Following collection of the third subsample, material contained in the collection net was carefully transferred to a pre-labeled 1 litre (L) wide-mouth plastic jar using a wash bottle, while working over a plastic bin to avoid any potential loss of organisms. Any organisms clinging to the sieve bag were removed using forceps and added to the sample. All samples were labeled internally (using labelled tongue depressors) and externally with the station number, area identifier, Minnow project number, date, and field personnel to ensure correct identification at the laboratory. Samples were preserved at the end of the day upon the return to camp using buffered formalin solution to a nominal concentration of 5-10% in ambient water.

3.4.2 Sample Processing

Benthic invertebrate community samples were sent to Cordillera Consulting (lead taxonomist Scott Finlayson), in Summerland, BC, for sorting and taxonomic identification. Organisms were identified to the Lowest Practicable Level (LPL; typically, genus or species). At the beginning of the sorting process, the total number of preserved organisms in each sample was estimated. If the total number was estimated to be greater than 300, then the sample was sub-sampled for sorting and enumeration using a Marchant box. Sorting efficiency and sub-sampling accuracy and precision were quantified using methods outlined by Environment Canada (2014). Total organism abundance was reported for every distinct taxon identified in each sample (see Appendix H for laboratory reports).

3.4.3 Data Analysis

Benthic invertebrate monitoring was focused on Measurable Parameters representing productivity, community condition, and tissue quality (Table 3.1). A formal DQR was completed to assess the quality of the benthic invertebrate community data (Appendix G). Community endpoints that were evaluated included key indicator endpoints for the FAL-AMP and those identified in Minnow and EDI (2017) as potential indicators of Project-related effects on benthic invertebrate communities (total density, taxonomic richness [LPL], proportional abundances [%] of taxonomic groups, % functional feeding groups, % habitat

preference groups, % metal-sensitive chironomids, Simpson's Evenness, and Simpson's Diversity), as well as Biomass. Major taxonomic groups assessed were combined orders of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies), collectively known as EPT, Ephemeroptera alone, Plecoptera alone, Chironomidae, Simuliidae, and Oligochaeta. Community data were tabulated as raw and summary values and plotted as time-series figures for all years available at each FALMP area for Upper and Lower Creek areas. Those analytes identified in Minnow and EDI (2017) as indicators of benthic invertebrate community health are assessed in detail in Section 8, whereas summary tables and plots for all other analytes are appended in Appendix D. Benthic invertebrate data collected in 2017 at area HC6.8 were plotted with 2018 to 2021 data.

Changes in benthic invertebrate community endpoints from 2018 to 2021 were quantified using an ANOVA, with factors *Area* and *Year*, and their interaction using the approach described in Section 3.3.3.

The Bray-Curtis Index was calculated as described in Environment Canada (2012) and updated technical guidance (Borcard and Legendre 2013). This metric considers the abundance of each taxon at each station compared to the median abundance computed from the reference station data to compute an index of the relative "distance" of each station from a hypothetical reference median station. Larger Bray-Curtis index values indicate greater dissimilarity from reference. Recently, the utility of the Bray-Curtis distance measure as calculated under EEM has been scrutinized due to the fact that using a reference median value calculated from only one area biases the outcome toward detecting a difference between two areas regardless of potential anthropogenic stressors (Borcard and Legendre 2013). This occurs because the area used to calculate the median is inherently more similar to itself than any other area (Huebert et al. 2011), even if the two areas in question are 'natural-pristine' areas. Borcard and Legendre (2013) identified that previous EEM Bray-Curtis evaluation methods were statistically invalid and suffered from inflated type 1 and type 2 error rates. They recommend use of Mantel and distance-based Redundancy Analysis (dbRDA) for evaluating effects on communities using Bray-Curtis dissimilarity (BC). Following the recommendations of Borcard and Legendre (2013), Bray-Curtis dissimilarity was calculated on ln(x+1) transformed densities. Prior to analysis, the homogeneity of group dispersion was evaluated using a betadisper test based on PERMDISP2 procedure (Anderson 2006). If the variances are considered heterogeneous, only a dbRDA test is performed, as it is considered more robust to deviations of multivariate homogeneity. If the variances are considered homogeneous, both Mantel and dbRDA tests are used. All analyses were conducted using custom R scripts and functions provided by Environment and Climate Change Canada.

The Mantel test is a distance-based correlation analysis, which compares BC to a matrix of perfectly separated sites. A significant p-value in the Mantel test suggests the observed BC is more similar to a matrix of perfect dissimilarity than would be expected by chance. The dbRDA is a special case of a permutation based multivariate ANOVA (PERMANOVA), which contrasts a principal coordinates analysis based on BC to a factor representing control and impacted sites. A significant p-value in the dbRDA indicates the factor levels explain a significant amount of variation between sites. Due to differences between the two tests (dbRDA and Mantel), the outcomes may differ under certain circumstances (one test significant, the other not). In these cases, the recommended conclusion is based on sample size (i.e., statistical power). If 11 or more samples were collected at each of control and impacted sites, the results are deemed non-significant (i.e., no observed impact, due to the high power of the tests at those sample sizes). If fewer than 11 samples were collected per site, the results are deemed significant (i.e., observed impact).

There are no criteria for BC effect size since these multivariate methods cannot be defined in terms of differences between means. There are R^2 statistics associated with Mantel and dbRDA tests that can be interpreted as measures of effect size, but they are not comparable between tests because the measures used in their calculation differ. The Mantel tests R^2 measures the link between two dissimilarity matrices, while the dbRDA R^2 measures the amount of variance explained by a factor variable representing differences between sites.

To identify what characteristics may be associated with benthic community endpoints, Spearman Rank Correlations were conducted between community endpoints and *in situ* water chemistry characteristics and substrate size following the approach described in Section 3.3.3.

3.5 Benthic Invertebrate Tissue Chemistry Survey

3.5.1 Sample Collection

Samples for analysis of benthic invertebrate tissue chemistry were collected in 2018, 2019, and 2021 at all FALMP sampling stations following collection of benthic invertebrate community samples (Table 3.3). Samples were collected using a kick net with a triangular aperture measuring 36 cm per side and a mesh (400 µm). During sampling, the technician moved across the stream channel through the erosional habitat from which the community sample was taken (from bank to bank when possible[8]) in an upstream direction. The net was held immediately downstream of the technician's feet, so the detritus and invertebrates disturbed from

[8] Complete kick transects of Coffee Creek at area CC5.6 were generally not safe due to fast-flowing water and high depth relative to other Project areas, particularly in 2018 and 2019. Accordingly, some kick transects were from shore to the location of maximum safe sampling depth/water velocity.

the substrate were passively collected into the kick-net by the stream current. Collections were not timed, and kicks were repeated until the volume of organisms collected was sufficient for analysis. The kick net was rinsed with water to move debris and invertebrates into the collection cup at the bottom of the net. The collection cup was then removed, the contents poured into a white basin, and organisms were carefully separated from sample debris using tweezers. During 2018 and 2019, collection continued until a minimum of approximately 2 g wet tissue was collected and until a minimum of 0.5 g was collected during 2021 sampling[9]. Organisms were picked from debris with the goal of approximating a representative sample of all benthic invertebrate taxa present (composite-taxa samples). Invertebrate tissue samples were then photographed to document taxa composition, placed into labelled, sterile, 20 mL scintillation vials and stored in a cooler with ice packs until transfer to a freezer later at camp at the end of the day.

3.5.2 Sample Processing

Tissue samples were transported by courier in coolers with ice packs to Saskatchewan Research Council (SRC) laboratory in Saskatoon, SK (2018 and 2019) or TrichAnalytics Inc. in Saanichton, BC (2021). Samples from 2018 sampling at one area (LC10.2; n=5) were lost en route to Saskatoon or during processing at SRC. Samples were either freeze-dried (SRC) or dehydrated (<60°C; TrichAnalytics) upon receipt by the respective laboratories. Analysis of samples submitted to SRC were analyzed using High Resolution Inductively Coupled Plasma Mass Spectrometry (HR-ICP-MS), while those submitted to TrichAnalytics Inc. were analyzed using Laser Ablation Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Results for all parameters were reported on a dry weight basis along with moisture content to allow conversion to wet weight values, as required (see Appendix H for laboratory reports).

3.5.3 Data Analysis

A formal DQR was completed to assess the quality of the benthic invertebrate tissue chemistry data (Appendix G). Benthic invertebrate tissue metal concentrations were tabulated and plotted as time-series figures for all years available at each FALMP area for Upper and Lower Creek areas. Analytes assessed included metals, which have been identified in aqueous form as potential indicators of Project-related changes in creek water quality (arsenic, uranium, and zinc) and/or are present in Project area creeks at concentrations that naturally exceed water quality guidelines (aluminum, arsenic, chromium, copper, uranium, and zinc;

[9] Target collection volume was reduced following a change in benthic invertebrate tissue chemistry analysis laboratory subcontractor from Saskatchewan Research Council (SRC, Saskatoon, SK) to TrichAnalytics (Saanichton, BC) prior to 2021 field sampling. The laboratory transition was implemented to increase field sampling efficiency by reducing time spent picking insects from sample material as TrichAnalytics can generate quality data from smaller sample sizes than SRC.

Minnow and EDI 2017). Those analytes identified in Minnow and EDI (2017) are assessed in detail in Section 7, whereas summary tables and plots for all other analytes are appended as Appendix E. The follow summary statistics were reported: sample size, percent of values below the laboratory reporting limit (LRL), mean, standard deviation, minimum value, median, and maximum value.

Commonly used substitution methods (e.g., substituting values < LRL with half the LRL) for censored data introduces bias in summary statistics (Helsel 2012). Means and standard deviations were therefore estimated used the Kaplan-Meier (K-M) method. This method involves transforming the left censored (i.e., < value) dataset to a right censored (i.e., > value) dataset, and then using the K-M estimator (used to estimate the mean survival time in survival analysis) to estimate the mean. The calculation was conducted using the *survfit* function in the *survival* package (Therneau 2017) in R and involves calculating the area under the K-M survival curve. The K-M method is non-parametric and can accommodate multiple LRLs. This method of estimating the mean is equivalent to using the distribution of detectable values below the LRL to represent values that are < LRL. For example, the mean of the data set {1, 2, < 4, 5} is estimated as the mean of 1, 2, [½×1 + ½×2], and 5 which is 2.375. The value < 4 is replaced by the distribution of values below 4 (i.e., 1 and 2 with equal weight of ½). Similarly, the mean of the data set {1, 1.6, 2, 2.1, < 4, 5} is estimated as the mean of 1, 1.6, 2, 2.1, [¼×1 + ¼×1.6 + ¼×2 + ¼×2.1], and 5 which is 2.229. Again, the value < 4 is replaced by the distribution of values below 4 (i.e., 1, 1.6, 2, and 2.1 with equal weight of ¼). If the minimum value in the data set is below the LRL then it is replaced with the LRL. Therefore, if there is only one LRL and no detected values below the LRL, then the K-M estimate of the mean is equivalent to replacing the value below the LRL with the LRL (i.e., the best guess for the values < LRL is the LRL). When a standard deviation could not be estimated (e.g., when all data were below the LRL), it was not reported. When a value was reported below a poor LRL (defined as a LRL that exceeded the maximum detected value), the value was removed from the dataset.

Changes in benthic invertebrate tissue analyte concentrations from 2018 to 2021 were quantified using a censored regression ANOVA with factors *Area* and *Year* and their interaction. The model was fit with maximum likelihood and assumed a log-normal distribution for chemistry concentrations.

The significance of the main effects and interaction terms of the ANOVA were assessed using an α of 0.05, and the results of these determined which post-hoc comparisons were then conducted. Specifically, when the interaction between *Year* and *Area* was significant it indicated that the differences between the areas changed over time and post-hoc comparisons were conducted to 1) test for differences between the first year of sampling and each subsequent year for each area,

and 2) test for differences between the exposed and reference areas in each year. For all significant post-hoc temporal comparisons, a MOD between years was calculated as:

$$MOD_{Year} = \frac{MCT_{recent\ year} - MCT_{older\ year}}{MCT_{Older\ year}} \text{ x } 100\%$$

For significant spatial comparisons a MOD was calculated between the exposed and reference areas within each year as:

$$MOD = \frac{MCT_{Exposed} - MCT_{Reference}}{MCT_{Reference}} \text{ x } 100\%$$

The MCT was calculated as back-transformed estimated marginal means. When the interaction term (*Year* x *Area*) was not significant, post-hoc spatial comparisons and MOD calculations were conducted pooling over year and temporal comparisons were conducted pooling over stations.

3.6 Sediment Quality

3.6.1 Sample Collection

Sediment sampling at Project areas was completed opportunistically in 2019 and 2021 to determine the feasibility of including a robust sediment chemistry component in the FALMP (Table 3.3). Project area creeks are mostly erosional habitat, and availability of locations of deposited sediment is limited or non-existent (depending on the creek) and can vary by year. Sediment was therefore collected at areas where deposits were found of quantity and quality sufficient for analysis. Wherever possible, sediment was collected concurrent with, and adjacent to the locations of benthic invertebrate and periphyton samples. In 2019, sediment was collected at future-exposed areas HC6.8 (n=3), LC10.2 (n=3), YT4.3 (n=4), HC0.2 (n=3), and CC5.6 (n=5), as well as reference stations SYT0.6 (n=3) and XE0.2 (n=3; Table 3.2). In 2021, sediment was collected at future-exposed areas HC6.8 (n=5), LC10.2 (n=5), CC5.6 (n=5), and YT0.2 (n=5; Table 3.2). In both 2019 and 2021, the replication target for sediment chemistry was n=5, however, available sediment was not adequate to meet targets for some areas in 2019. Also, some depositional pools sampled in 2019 were not present in 2021 either due to changes in creek morphology or flow between sampling events. The most persistent depositional habitats sampled appear to be adjacent to station CC5.6-3 and downstream of station LC10.2-5.

At each sampling station, samples were collected using a stainless-steel spoon. The location was approached by foot in a manner that did not disturb the sediment prior to sampling. Surficial sediment was then collected carefully by slowly placing the spoon on the sediment surface in a manner that minimized disturbance and inserting the spoon into the sediment to capture sediment to a depth of 5 cm or less. The spoon was then moved horizontally until full,

and slowly retrieved to the surface to avoid sample washout. The content of each spoonful was inspected to ensure that it was predominantly fine sediment (i.e., silt and clay), and, if acceptable, was placed into a resealable plastic bag labeled with the project number, sample location, and collection date. Approximately 500 mL of sediment was collected per replicate to ensure adequate volume for particle size and metals analysis. Sampling equipment was rinsed between stations using site water. Following collection, samples were placed in a refrigerator at approximately 4°C until shipment to the analytical laboratory.

3.6.2 Laboratory Analysis

Laboratory analysis of sediment quality samples was completed by ALS Environmental in Burnaby, British Columbia. Laboratory analyses included particle size distribution and texture, total organic carbon (TOC), and total metal concentrations for all samples. Total organic carbon content and total metal concentrations were determined in the silt/clay fraction (< 63 µm diameter) to reduce variability associated with differences in particle size distribution (BCMOE 2016). Analysis of particle size was completed by sieve and pipette; TOC was completed combustion and titration (total carbon minus total inorganic carbon). Analysis of metals was based on the BC Strong Acid Leachable Metals digestion (SALM; BCMOE 2016), with total metals analysis completed by Collision Reaction Cell Inductively Coupled Plasma – Mass Spectrometry (CRC-ICP-MS [United States Environmental Protection Agency Method 6020B; USEPA 2014]), and mercury analysis completed by cold vapor atomic absorption spectrophotometry (CVAAS; USEPA Method 245.7; USEPA 2005). Quality Assurance and Quality Control sampling completed by the laboratory included reagent blanks, laboratory replicates, and laboratory accuracy measures (i.e., matrix spikes, laboratory control samples, and/or certified reference materials). Upon completion of the analyses, data reports were provided by ALS Environmental to Minnow electronically in Adobe Acrobat PDF and as Microsoft Excel files (Appendix H).

3.6.3 Data Analysis

A formal DQR was completed to assess the quality of the sediment chemistry data (Appendix G). Raw sediment chemistry and composition data were summarized by area by calculating mean, median, standard deviation, minimum, and maximum values for all analytes. Following the calculation of summary statistics, Upper and Lower Creek area data were tabulated and plotted as time-series figures for all sampling areas. Plots included comparison to British Columbia Working Sediment Quality Guidelines for the protection of aquatic life (BCMOE 2021) and the British Columbia Approved Working Sediment Quality Guideline for selenium in sediment (BCMOECCS 2021), collectively termed WSQG in this report. WSQGs are numerical criteria that are protective of sediment-dwelling organisms based on long-term exposed. Most WSQGs have

been adopted from the CCME (CCME 1999) or from Ontario (OMOE 1993) and have two levels - a lower WSQG and an upper WSQG. The lower WSQG is intended to represent a concentration that will protect aquatic life from adverse effects in most situations (BCMOE 2021). The upper WSQG is intended to represent a concentration that, if exceeded, will likely cause severe effects to aquatic life (BCMOE 2021). However, WSQGs - even the Upper WSQGs - are often naturally exceeded in mineralized areas. In addition, WSQGs were developed based on co-occurring bulk surficial sediment data and biological effect data (CCME 1999). Bulk sediment chemistry can differ substantially from the <63 µm fraction, and this discrepancy between measurement (<63 µm fraction) and exposed (to bulk sediment to which sediment quality guidelines [SQG] are most applicable) should be considered in interpretation as "caution should be used in interpreting the biological significance of chemical concentrations in sediments for different types based on these guidelines" (CCME 1999).

Analytes assessed included metals that have been identified in aqueous form as potential indicators of Project-related changes in water quality (arsenic, uranium, and zinc) and/or are present in Project area creeks at concentrations that naturally exceed water quality guidelines (aluminum, arsenic, chromium, copper, uranium, and zinc; Minnow and EDI 2017). Those analytes, analytes for which WSQGs exist, and general composition data, are assessed in detail in Section 8, whereas summary tables and plots for all other analytes are appended as Appendix F.

Statistical comparisons of sediment quality among lower creek areas in 2019[10] conducted using a one-way ANOVA at $\alpha = 0.05$. Assumptions of normality and homogeneity of variances were tested using a Shapiro-Wilk's test and Levene's test, respectively at $\alpha = 0.05$. Data were $\log_{10}$ transformed as necessary to meet assumptions. When the assumptions were not met, analysis was conducted using a Kruskal-Wallis test. If a parameter contained censored data, all values below the maximum censored value were replaced with the maximum censored value and analysis proceeded using a rank transformation (Kruskal-Wallis test). Post-hoc comparisons were conducted using Tukey-adjusted p-values for all pairwise contrasts. For each comparison, the magnitude of difference was calculated with the same MCT equation described in Section 3.5.3 using means for untransformed data, geometric means for $\log_{10}$ transformed data and medians for non-parametric tests.

Temporal differences in sediment quality for areas sampled in both 2019 and 2021 were tested using a two-sample t-test, with a p-value <0.10. A p-value of 0.10 was used as per suggested EEM guidelines (Environment Canada 2012). The assumption of normality was assessed using

[10] Sediment deposits were not found at any reference areas in 2021 so a statistical test of differences in sediment data from 2019 and 2021 was not feasible.

the Shapiro Wilks' test (α = 0.05) and homogeneity of variance was assessed using Levene's Test (α = 0.05). If variances were unequal, then the two-sample t-test for unequal variances was conducted (Ruxton 2006). Data that could not be normalized were log, square root, or fourth root transformed. A value of 1 was added before taking the logarithm if values of zero were in the data set. If data could not be normalized after transformation, a non-parametric Mann-Whitney test was applied. Statistical comparisons were conducted using R (R Core Team 2020). A magnitude of difference (MOD) was calculated for each community metric as:

$$MOD = \frac{\left(\bar{X}_{Exp} - \bar{X}_{Ref}\right)}{SD}$$

where the SD is an estimate of the pooled standard deviation. The estimate standard deviation was the pooled standard deviation in the two-sample t-test for equal variances when the two-sample t-test for unequal variances was applied.

The MOD for the Mann-Whitney test was calculated using medians instead of means and the pooled median absolute deviation (MAD) instead of the SD. The MAD is calculated as the median of the absolute values of the differences between each observation and the median observation for that area (and corrected by a factor of 1.4826 to scale the MAD to a comparable magnitude to the SD). A study design with two areas and n = 5 samples per area has an approximate power of 0.9 to detect a two standard deviation difference between areas using α = 0.1 (Environment Canada 2012).

4 SUPPORTING HABITAT AND WATER QUALITY

4.1 Overview

Supporting habitat variables and *in situ* water quality parameters were recorded at all Project periphyton and benthic invertebrate monitoring areas in 2018, 2019, and 2021, and at area HC6.8 in 2017 (Table 3.3; Figure 3.1). All habitat and water quality data collected with the periphyton and benthic invertebrate monitoring in 2018, 2019, and 2021 are provided in Appendix B.

4.2 Upper Creek Areas

Mean flow velocities were highest in 2018 (area means: 0.78-0.86 m/s) and lowest in 2017 and 2021 (0.44-0.52 m/s) at all Upper Creek future-exposed areas, and Upper Creek reference area CC23.7 (Table 4.1; Figure 4.1; Appendix Table B.1). Mean flow velocity was slightly higher in 2019 than 2018 at Upper creek future-exposed area CR24.5 (0.86 m/s and 0.88 m/s, respectively), but like all other Upper Creek areas was lowest in 2021 (0.47 m/s). Flow velocities at Upper Creek future-exposed areas were not significantly different from either reference area for any individual year (Appendix Table B.2).

Mean water temperatures at Project Upper Creek areas in 2018, 2019, and 2021 ranged from 1.44°C to 3.66°C (YT4.3 - 2019 and CR24.5 - 2021, respectively; Table 4.1; Figure 4.1; Appendix Table B.1). Mean water temperatures were highest in 2021 at all Upper Creek future-exposed areas, and Upper Creek reference area CR24.5. Water temperatures at Upper Creek future-exposed areas were not significantly different from either reference area for any individual year (Appendix Table B.2).

Dissolved oxygen (DO) concentrations met the CCME water quality guideline for cold water (9.5 mg/L) at all Upper Creek areas across all years sampled (Table 4.1; Figure 4.2; Appendix Table B.1). Mean DO concentration at Upper Creek areas ranged from 12.08 to 12.82 mg/L (CR24.5 - 2021 and YT4.3 – 2018, respectively) and mean saturation ranged from 89.1 to 94.4% (CC23.7 – 2019 and HC6.8 – 2021, respectively; Table 4.1). Outlier dissolved oxygen values were recorded at area HC6.8 in 2019, likely resulting from sensor failure and those values were therefore not included in statistical comparisons. Dissolved oxygen concentration and saturation was generally not significantly different between future-exposed and reference areas (Appendix Table B.3). The few comparisons for which differences were observed occurred inconsistently (i.e., no patterns in significant spatial or temporal variability between any future-exposed and reference areas), indicating good compatibility among Upper Creek areas with respect to DO.

Table 4.1. Coffee Project FALMP Mean *In Situ* Water Quality Endpoints, Upper Creek Areas, 2017 to 2021

Metrics	2017	2018					2019					2021				
	HC6.8	CC23.7	CR24.5	HC6.8	LC10.2	YT4.3	CC23.7	CR24.5	HC6.8[a]	LC10.2	YT4.3	CC23.7	CR24.5	HC6.8	LC10.2	YT4.3
	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5
Water Velocity (m/s)	0.37	0.84	0.88	0.86	0.86	0.78	0.67	0.86	0.74	0.77	0.62	0.52	0.47	0.49	0.51	0.44
Temperature (°C)	3.38	1.94	2.70	2.60	3.20	2.22	2.70	2.40	2.06	2.44	1.44	2.38	3.66	2.94	3.52	2.40
DO (mg/L)	12.44	12.68	12.62	12.64	12.32	12.82	12.10	12.40	15.58	12.24	12.40	12.54	12.08	12.72	12.16	12.56
DO (%)	93.7	91.6	93.1	92.8	92.0	93.2	89.1	90.7	126.4	89.3	88.5	91.7	91.5	94.4	91.6	91.7
pH	7.63	7.38	7.37	7.53	7.31	7.32	7.79	7.74	7.97	7.79	7.52	7.38	7.69	7.51	7.76	7.05
Specific Conductance (µS/cm)	187.7	155.0	114.8	181.6	185.8	62.6	145.8	136.0	270.8	201.4	62.4	109.4	185.8	131.6	287.4	60.8
Conductivity (µS/cm)	110.5	86.8	66.0	104.0	108.8	35.2	83.5	77.3	152.6	114.0	34.4	62.2	110.0	76.2	167.2	34.6
Substrate (cm)	4.8	6.5	6.6	6.3	6.6	6.3	10.8	8.5	8.0	6.4	9.7	7.9	5.9	8.0	8.1	8.3

Note: All pH values were within CCME Water Quality Guideline values (6.5 to 9.0). All DO concentrations above the CCME Water Quality Guidelines lowest acceptable value (9.5 mg/L).

[a] Dissolved Oxygen values collected at HC6.8 in 2019 are considered erroneous, likely due to sensor malfunction.

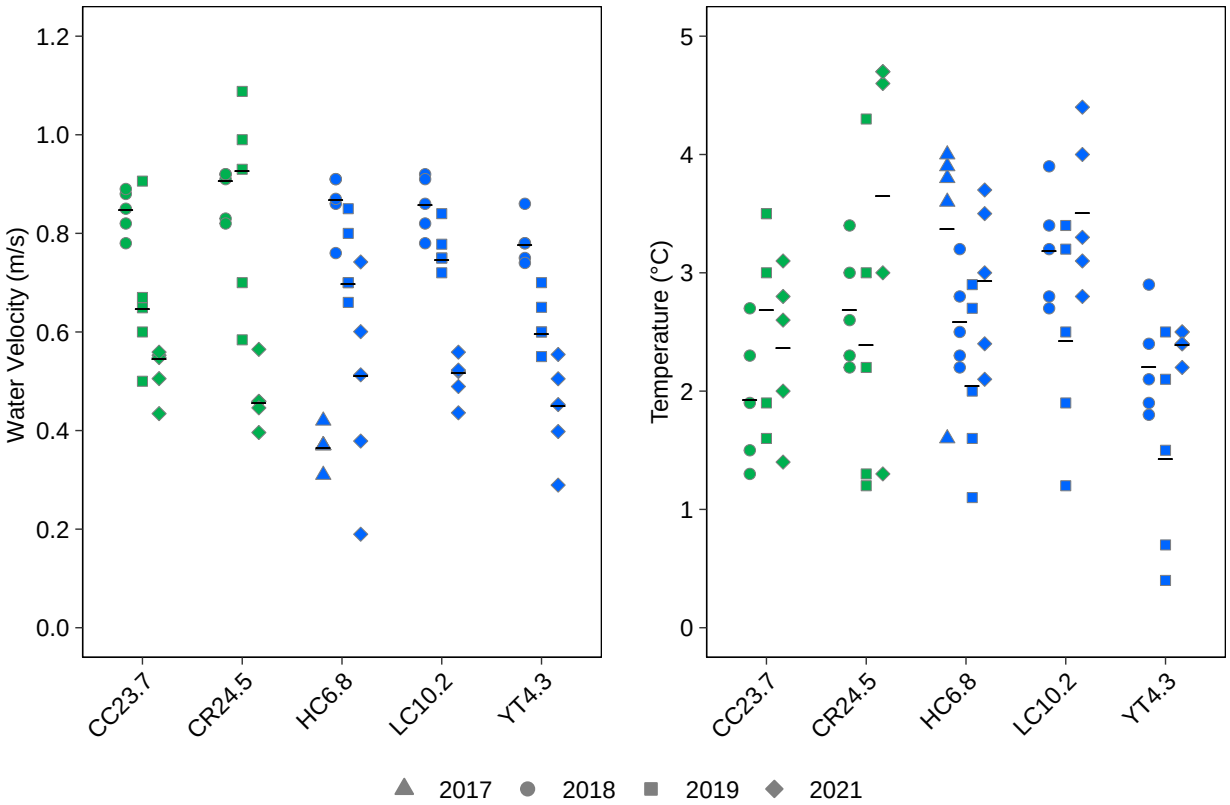


Figure 4.1: Coffee Project FALMP Upper Creek Area Water Velocity and Temperature, 2017, 2018, 2019, and 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses. Data collected in 2017 were not included in statistical comparisons but are shown for visual comparison only.

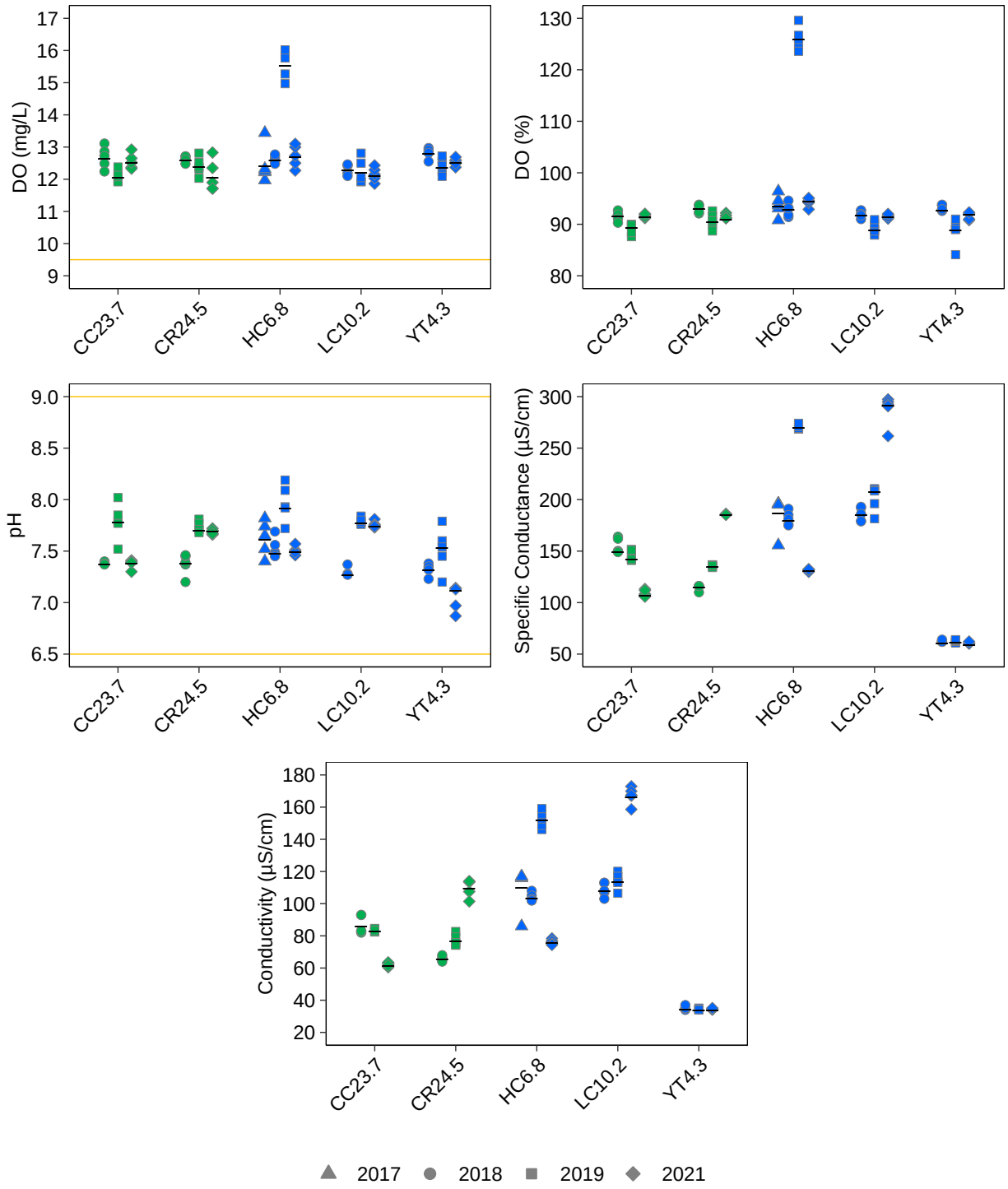


Figure 4.2: Coffee Project FALMP Upper Creek Area In Situ Water Quality, 2017, 2018, 2019, and 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses. Orange solid lines indicate the Canadian Water Quality Guideline (CCME 2001) for cold water DO (> 9.5 mg/L) and pH (6.5 to 9.0). Data collected in 2017 were not included in statistical comparisons but are shown for visual comparison only.

All Upper Creek areas were slightly basic across all years sampled, with mean pH values ranging from 7.05 (YT4.3 - 2021) to 7.97 (HC6.8 – 2019; Table 4.1; Figure 4.2; Appendix Table B.1). All pH values at Upper Creek areas were within the CCME water quality guideline range (6.5 to 9.0) across all years sampled (Table 4.1). Mean pH was highest at Upper Creek areas in 2019 and was lowest at area YT4.3 in all years sampled. Significant differences in pH between future-exposed and reference Upper Creek areas occurred infrequently and inconsistently (i.e., no patterns in spatial or temporal variability), indicating generally good compatibility among Upper Creek areas with respect to pH (Appendix Table B.2).

Mean conductivity at Project Upper Creek areas ranged from 34.4 (YT4.3 – 2019) to 167.2 µS/cm (LC10.2 – 2021; Table 4.1; Figure 4.2; Appendix Table B.1). Mean conductivity was lowest at area YT4.3 across all years sampled, with a maximum of 35.2 µS/cm in 2018. Conductivity was generally significantly higher at future-exposed areas HC6.8 and LC10.2 than both Upper Creek reference areas (CR24.5 and CC23.7), whereas YT4.3 was significantly lower than both reference areas for all years sampled (Appendix Table B.2). High conductivity is potentially indicative of existing mineralization at the proposed Project mine site. Although there is existing variability between future-exposed and reference areas with respect to conductivity, reference area values are a good representation of regional conditions and should still provide a good basis for future comparisons (Table 4.1; Figure 4.2).

4.3 Lower Creek Areas

In the lower creek areas, mean flow velocities were highest in 2018 (0.75-0.87 m/s) and lowest in 2021 (0.40-0.55 m/s) at future-exposed areas HC0.2 and YT0.2, and at both reference areas (Table 4.2; Figure 4.3; Appendix Table B.3). Mean flow velocity was slightly higher in 2019 than 2018 at lower future-exposed area CC5.6 (0.85 and 0.84 m/s, respectively), but like all other Lower Creek areas was lowest in 2021 (0.71 m/s; Table 4.2; Figure 4.3). Flow velocities at Lower Creek future-exposed areas were not significantly different from either reference area for any individual year (Appendix Table B.4). Mean flow velocities for CC5.6 in 2018 and 2019 may be underestimates as complete creek transects could not be taken at any stations due to high flows and deep channels, which made safe crossing impossible. In 2021, complete transects were able to be safely taken at stations CC5.6-5 and CC5.6-2.

Mean water temperatures at Project Lower Creek areas in 2018, 2019, and 2021 ranged from 2.4°C to 4.7°C (XE0.2 – 2018 and CC5.6 – 2021, respectively; Table 4.2; Figure 4.3; Appendix Tables B.3 and B.4). Mean temperatures were highest in 2021 at all Lower Creek future-exposed areas, and at Lower Creek reference area CC24.5 (Figure 4.3). Water temperatures at Upper Creek future-exposed areas were not significantly different from either reference area for any individual year (Appendix Table B.4).

Table 4.2. Coffee Project FALMP Mean *In Situ* Water Quality Endpoints, Lower Creek Areas, 2018 to 2021

Metrics	2018					2019					2021				
	SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2	SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2	SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2
	n=5	n=5	n=5	n=3	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5
Water Velocity (m/s)	0.75	0.85	0.87	0.84	0.83	0.70	0.75	0.75	0.85	0.75	0.40	0.55	0.44	0.71	0.37
Temperature (°C)	2.50	2.40	3.10	4.20	3.30	2.60	2.80	2.60	4.70	2.50	3.30	3.80	3.70	4.60	3.70
DO (mg/L)	12.76	12.96	12.74	12.30	12.90	12.90	13.40	12.06	11.30	11.84	12.62	12.64	12.42	12.12	12.48
DO (%)	93.7	94.8	95.3	94.6	96.4	96.0	99.0	88.5	88.2	87.0	94.5	96.3	94.0	93.9	94.6
pH	7.77	8.10	7.36	7.22	7.58	8.08	8.41	7.87	7.83	7.94	7.88	8.25	7.75	7.55	7.69
Specific Conductance (µS/cm)	296.4	373.8	175.2	202.0	164.8	334.0	509.0	171.6	163.6	191.4	481.4	621.2	220.6	176.2	220.4
Conductivity (µS/cm)	168.8	212.4	102.5	122.0	96.4	192.2	292.6	98.3	100.2	108.8	281.8	370.0	130.8	107.6	130.8
Substrate (cm)	6.5	6.4	6.2	6.0	6.8	8.4	7.7	8.0	7.5	8.9	6.5	6.0	6.3	6.5	6.8

Note: All pH values were within CCME Water Quality Guideline values (6.5 to 9.0). All DO concentrations above the CCME Water Quality Guidelines lowest acceptable value (9.5 mg/L).

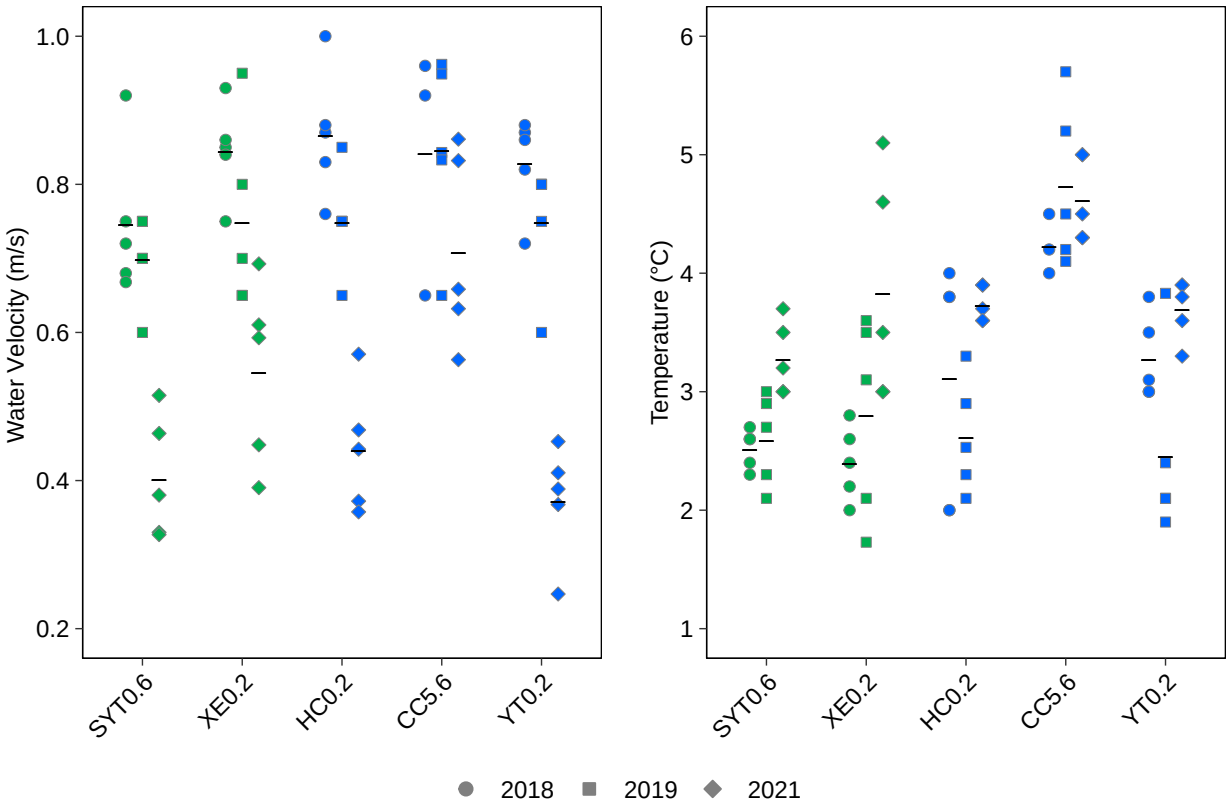


Figure 4.3: Coffee Project FALMP Lower Creek Area Water Velocity and Temperature, 2017, 2018, 2019, and 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

Dissolved oxygen concentrations met the CCME water quality guideline for cold water (9.5 mg/L) at all Lower Creek areas across all years sampled (Table 4.2; Figure 4.4; Appendix Table B.3). Mean DO concentration at Lower Creek areas ranged from 11.30 (CC5.6 – 2019) to 13.40 mg/L (XE0.2 – 2019) and mean saturation ranged from 87.0% (YT0.2 – 2019) to 99.0% (XE0.2 – 2019; Table 4.2). Spatial and temporal variability in DO at Lower Creek areas was inconsistent over the baseline sampling period, with DO at all future-exposed areas lower than both reference areas in 2019, but mostly not significantly different in 2018 and 2021 (Appendix Table B.4). This indicates generally good comparability among Lower Creek areas with respect to DO.

All Lower Creek areas were slightly to moderately basic across all years sampled, with mean pH values ranging from 7.22 (CC5.6 2018) to 8.41 (XE0.2 – 2019; Table 4.2; Figure 4.4; Appendix Table B.3). All pH values at Lower Creek areas were within the CCME water quality guideline range (6.5 to 9.0) across all years sampled (Table 4.2). Mean pH at all Lower Creek areas was lowest in 2018, and highest in 2019, indicating similar interannual variability across areas. Future-exposed area pH values were significantly lower than both reference areas across all years of baseline sampling, but the magnitude of difference was consistently less than 10% (Appendix Table B.4). This indicates that although future-exposed area pH values are generally lower than reference, interannual variability should be consistent across all areas and differences should be within a consistent range. This indicates that there is a good comparability for pH among Project Lower Creek areas.

Mean conductivity at Project Lower Creek future-exposed areas ranged from 96.4 (YT0.2 2018) to 130.8 (YT0.2 and HC0.2 – 2021) µS/cm, whereas values at Upper Creek reference areas were consistently higher, ranging from 168.8 (SYT0.6 – 2018) to 370.0 (XE0.2 – 2021) µS/cm (Table 4.2; Figure 4.4; Appendix Table B.3). Conductivity at upper Creek future-exposed areas was significantly lower than both reference areas across all years sampled (Appendix Table B.4). Because observed differences in conductivity between future-exposed and reference have been consistent over the baseline sampling, there is a good basis for comparison, specifically with respect to tracking potential increases in conductivity at future-exposed areas.

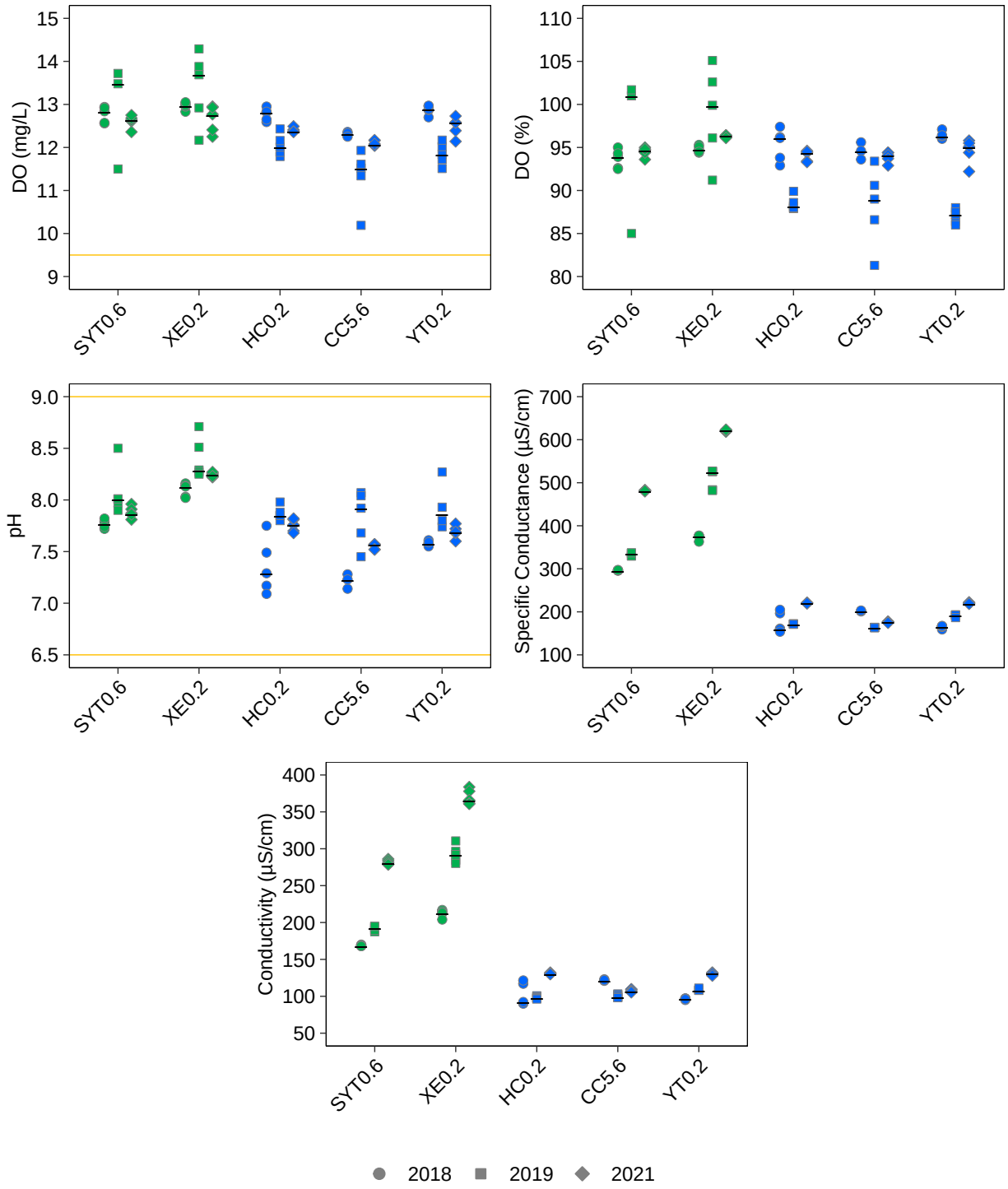


Figure 4.4: Coffee Project FALMP Lower Creek Area In Situ Water Quality, 2017, 2018, 2019, and 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses. Orange solid lines indicate the Canadian Water Quality Guideline (CCME 2001) for cold water DO (> 9.5 mg/L) and pH (6.5 to 9.0).

5 PERIPHYTON / PRIMARY PRODUCTIVITY

5.1 Overview

Periphyton productivity and community monitoring were completed at Project Upper and Lower Creek areas during monitoring in 2018, 2019, and 2021. Results of a DQR indicate that periphyton community data collected for the Project FALMP were of acceptable quality as characterized by good accuracy, and productivity data were of good precision and accuracy. Therefore, the associated data can be used with a good level of confidence in the derivation of conclusions (Appendix G). All periphyton data collected as part of FALMP baseline monitoring in 2018, 2019, and 2021 are provided in Appendix C.

5.2 Upper Creek Areas

5.2.1 Productivity

Periphyton productivity at Project areas was assessed in terms of chlorophyll-a concentrations, AFDM, and algal biomass estimates as inferred from taxonomic data. Upper Creek area mean chlorophyll-a concentrations were lowest at future-exposed area YT4.3 (0.53 to 1.80 mg/m^2) and highest at reference area CC23.7 (3.40 to 21.50 mg/m^2) across all three years of baseline sampling (Table 5.1; Figure 5.1; Appendix Table C.1). All Upper Creek area chlorophyll-a concentrations were well below the short-term term maximum British Columbia guideline for the protection of aquatic life (100 mg/m^2; BCMOECCS 2021; Table 5.1; Figure 5.1; Appendix Table C.1). Chlorophyll-a concentrations were significantly lower at all future-exposed Upper Creek areas than reference area CC23.7, whereas they were not significantly different from reference area CR24.5 across all years of baseline sampling (Appendix Table C.2). Mean AFDM was highest at reference area CC23.7 in 2018 (2.10 mg/cm^2) and 2019 (0.77 mg/cm^2), and at reference area CR24.5 in 2021 (0.63 mg/cm^2; Table 5.1; Figure 5.1). Differences in AFDM between future-exposed and reference areas were mostly not statistically significant and occurred inconsistently (Appendix Table C.2). Spatial patterns in Upper Creek area periphyton total biomass estimates were similar to those for chlorophyll-a with CC23.7 highest in 2018 (169 mg/m^2) and 2019 (587 mg/m^2) and CR24.5 highest in 2021 (99.9 mg/m^2; Table 5.1; Figure 5.1; Appendix Table C.1). Differences in Upper Creek area total biomass between future-exposed and reference areas were observed but most were not statistically significant and any significant differences occurred inconsistently and likely reflect natural differences and supports the application of a BACI experimental design (Appendix Table C.2). All periphyton productivity indices were positively correlated with water velocity (Appendix Table C.3; Appendix Figure C.1).

Table 5.1: Mean Periphyton Productivity and Community Endpoints, Selected Parameters, Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

Endpoint	2018					2019					2021				
	CC23.7	CR24.5	HC6.8	LC10.2	YT4.3	CC23.7	CR24.5	HC6.8	LC10.2	YT4.3	CC23.7	CR24.5	HC6.8	LC10.2	YT4.3
	Reference		Future-Exposed			Reference		Future-Exposed			Reference		Future-Exposed		
	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5
Density (cells/cm²)	3,350,744	1,479,882	1,031,961	2,188,372	3,406,094	6,091,910	634,028	4,921,683	19,247	252,721	714,945	232,027	609,708	95,995	8,479
Total Biomass (mg/m²)	169	72.9	52.6	87.1	83.1	587	86.8	507	4.55	60.6	40.7	99.9	74.7	29	11.1
Chlorophyll a (mg/m²)	21.50	12.80	3.06	3.05	1.80	8.18	1.16	3.53	1.57	0.53	3.40	2.63	2.85	1.00	0.68
Ash-Free Dry Weight (mg/cm²)	2.10	1.87	1.06	0.95	1.20	0.77	0.21	0.27	0.20	0.05	0.31	0.63	0.34	0.07	0.08
Richness (# of taxa)	3	2	3	3	4	5	8	5	3	5	5	5	5	7	4
LPL Simpson's Evenness	0.34	0.50	0.35	0.51	0.43	0.27	0.19	0.33	0.44	0.41	0.30	0.36	0.42	0.43	0.56
LPL Simpson's Diversity	0.04	0.01	0.05	0.06	0.28	0.25	0.34	0.30	0.26	0.44	0.22	0.40	0.49	0.63	0.40
BC Distance	0.41	0.21	0.24	0.42	0.55	0.87	0.50	0.73	0.97	0.80	0.66	0.52	0.48	0.29	0.94
% Blue-green Algae	99.9	99.8	99.9	100	99.1	98.6	95.6	97.9	91.1	96.8	97.5	85.9	96.8	86.7	74.3
% Green Algae	0.0	0.1	0.0	0.0	0.5	1.3	4.0	2.0	5.8	1.6	2.4	12.6	3.0	7.0	11.1
% Diatoms	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	2.7	1.5	0.2	0.2	0.1	2.8	14.5
% Other	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.4	0.1	0.0	1.4	0.1	3.5	0.0
Green Algae:Diatoms	0.3	0.0	0.0	0.0	0.0	36.7	12.3	81.1	1.3	0.0	5.6	23.9	22.2	6.1	7.6

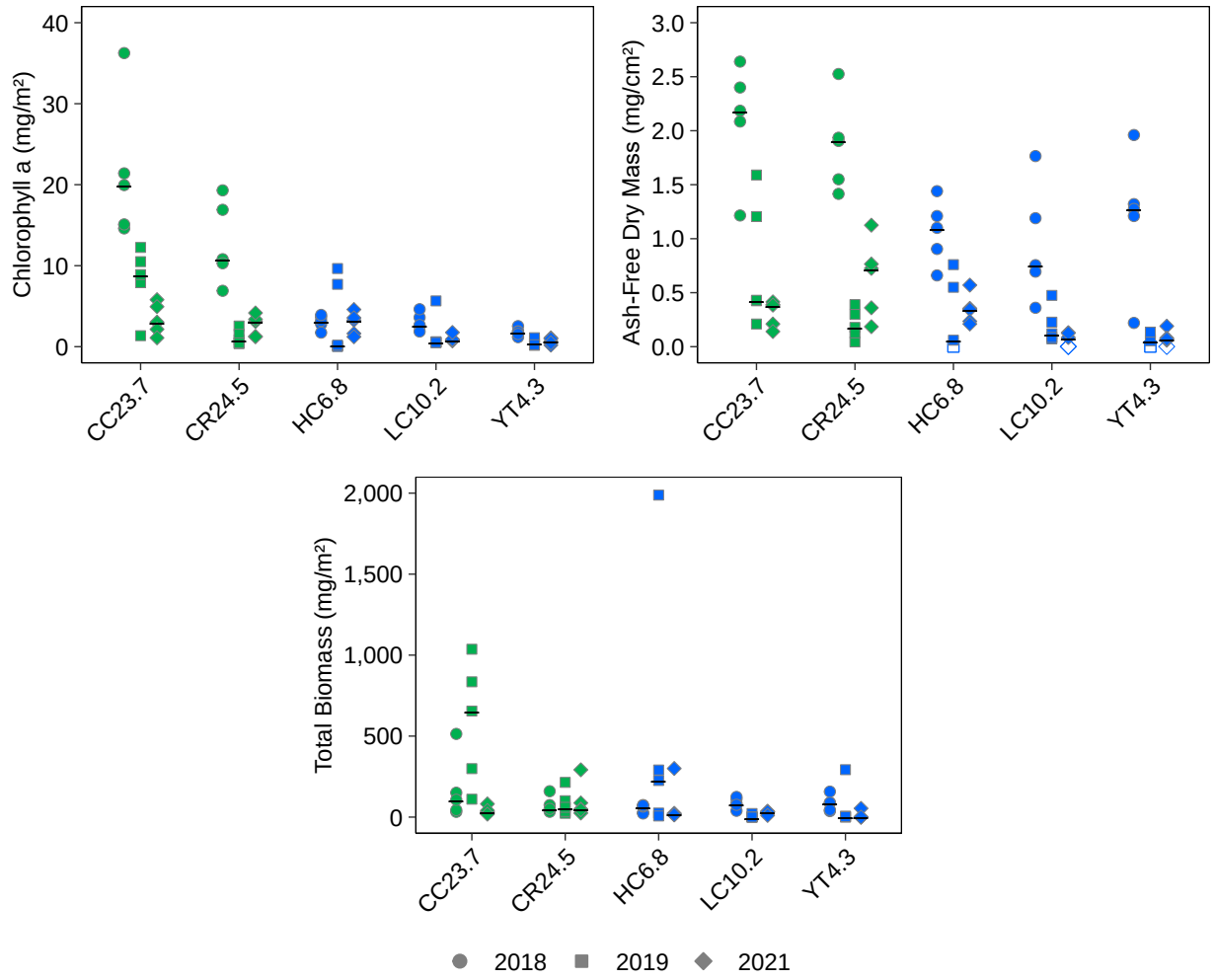


Figure 5.1: Periphyton Productivity Indicator Endpoints, Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

Upper Creek area chlorophyll-a concentrations were generally below the threshold for mesotrophic streams outlined in Dodds et al. (1998; 20 mg/m^2), indicating that all Upper Creek areas can be classified as low productivity oligotrophic systems overall despite productivity measures likely being over-estimates of actual periphytic coverage at Project Upper Creek areas (Section 3.3.1; Appendix Table C.1). Furthermore, comparability of Upper Creek future-exposed and reference area periphyton productivity is good given the overall lack of significant differences, as well as the agreement in trends among productivity endpoints.

5.2.2 Community

Upper Creek area periphyton mean total densities were highest in 2018 at YT4.3, LC10.2, and CR24.5, and in 2019 at CC23.7 and HC6.8 and ranged from 8,479 (YT4.3 – 2021) to 6,091,910 cells/cm^2 (CC23.7 – 2019; Table 5.1; Figure 5.2; Appendix Table C.1). Periphyton mean taxonomic richness ranged from 2 (CR24.5 – 2018) to 8 (CR24.5 – 2019) taxa across all Upper Creek areas over the baseline period (Table 5.1; Figure 5.2). Periphyton total density and taxonomic richness at Upper Creek areas varied across areas and years of sampling, but significant differences between future-exposed and reference areas occurred infrequently and inconsistently (Figure 5.2; Appendix Table C.2). Similarly, there were no consistent trends in variability between Lower Creek future-exposed and reference areas with respect to community evenness, diversity, and Bray-Curtis distance, and significant differences were infrequent across all comparisons (Appendix Table C.2). Periphyton communities at Upper Creek future-exposed and reference areas were dominated by blue-green algae, with mean proportions ranging from 85.9% (CR24.5 – 2021) to 100% (LC10.2 – 2018; Table 5.1; Figure 5.2). The mean ratio of green algae to diatoms at Upper Creek areas was generally low, however, green algae and diatoms were frequently absent from baseline Upper Creek samples at both future-exposed and reference areas (Table 5.1; Appendix Table C.1). Those low values are therefore the result of the scarcity of green algae at Upper Creek areas as opposed to representing relatively high proportions of diatoms.

5.3 Lower Creek Areas

5.3.1 Productivity

Lower Creek area mean chlorophyll-a concentrations were highest at reference areas SYT0.6 and XE0.2 in 2018 (14.80 and 14.20 mg/m^2, respectively) and at future-exposed area CC5.6 in 2019 and 2021 (31.50 and 22.80 mg/m^2, respectively; Table 5.2; Figure 5.3; Appendix Table C.4). Mean chlorophyll-a concentrations were lowest at future-exposed area CC5.6 in 2018 (0.31 mg/m^2 and future-exposed area YT0.2 in 2019 and 2021 (0.79 and 2.38 mg/m^2, respectively; Table 5.2; Figure 5.3). All Lower Creek area chlorophyll-a concentrations were well below the

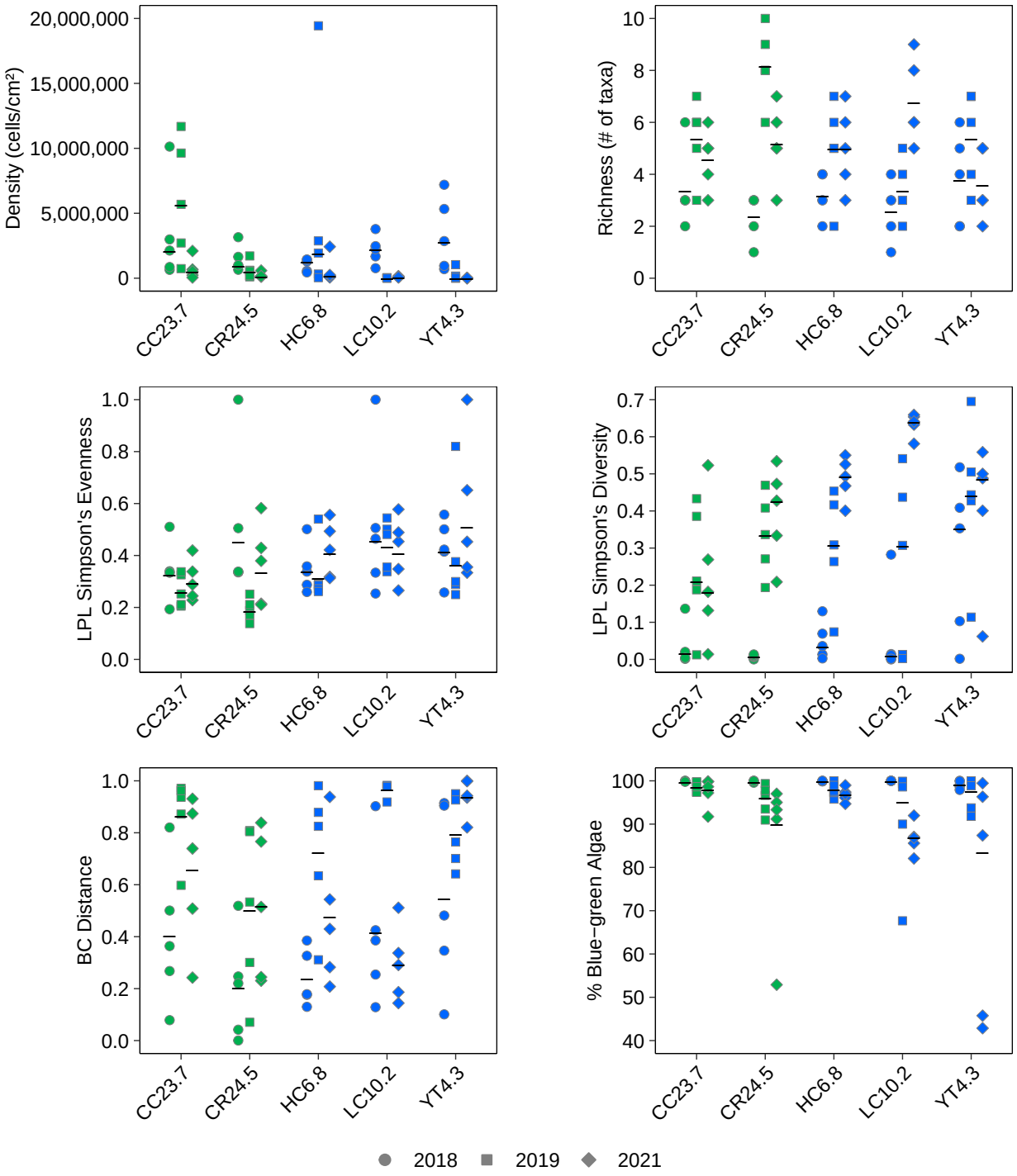


Figure 5.2: Periphyton Community Indicator Endpoints, Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

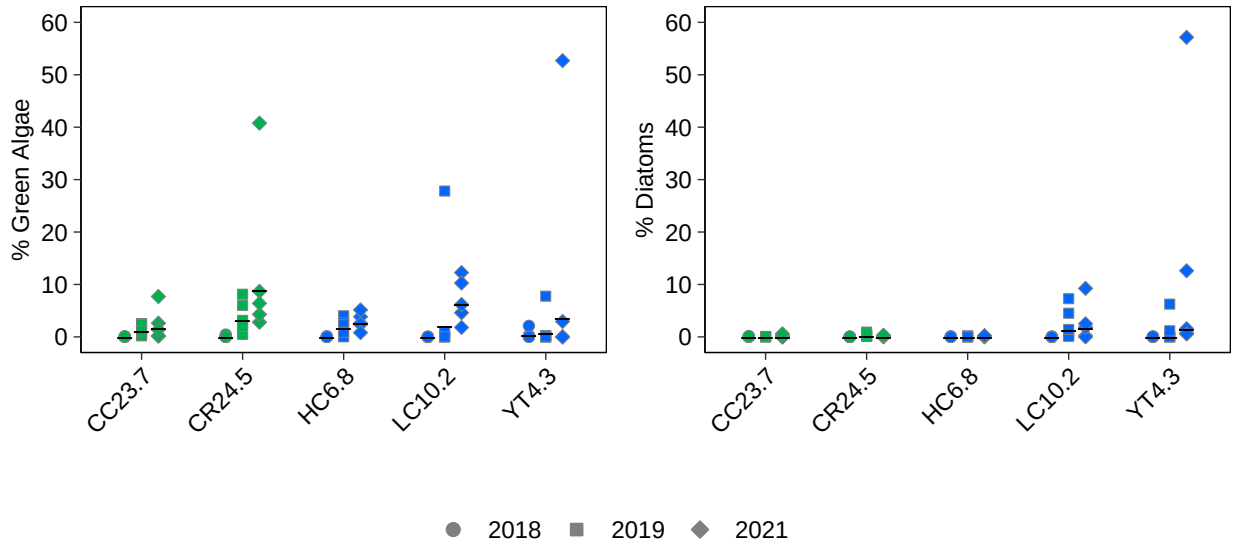


Figure 5.2: Periphyton Community Indicator Endpoints, Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

Table 5.2: Mean Periphyton Productivity and Community Endpoints, Selected Parameters, Lower Creek Areas, Coffee Project FALMP, 2018 to 2021

Endpoint	2018					2019					2021				
	SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2	SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2	SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2
	Reference		Future-Exposed			Reference		Future-Exposed			Reference		Future-Exposed		
	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5
Density (cells/cm²)	3,454,311	6,257,705	3,058,664	79,899	2,017,383	1,339,960	1,815,408	946,161	1,013,496	236,546	874,209	1,243,997	289,846	9,546,540	81,081
Total Biomass (mg/m²)	119	151	116	2.56	87.3	195	447	431	772	46	164	175	142	3,496	20.8
Chlorophyll a (mg/m²)	14.80	14.40	4.19	2.55	3.12	6.06	11.80	1.23	5.33[a]	0.79	3.87	6.95	3.03	22.80	2.38
Ash-Free Dry Mass (mg/cm²)	2.83	1.59	1.14	0.31	1.07	0.34	0.48	0.16	0.61	0.05	0.28	0.96	0.20	0.70	0.22
Richness (# of taxa)	6	7	3	10	5	8	10	8	10	8	5	7	4	11	5
LPL Simpson's Evenness	0.35	0.24	0.63	0.29	0.44	0.21	0.30	0.40	0.27	0.24	0.32	0.29	0.66	0.10	0.40
LPL Simpson's Diversity	0.42	0.30	0.27	0.61	0.46	0.35	0.61	0.63	0.50	0.41	0.37	0.47	0.58	0.07	0.42
BC Distance	0.72	0.63	0.50	0.92	0.48	0.67	0.65	0.47	0.68	0.51	0.43	0.51	0.42	0.97	0.76
% Blue-green Algae	99.5	99	99.8	93.5	95.3	98.2	92	87.3	89	96.4	95.4	97.6	84.5	99.3	90.3
% Green Algae	0.2	0.5	0.0	0.5	1.3	1.5	2.6	11.4	8.3	2.4	4.5	1.8	15.3	0.0	9.0
% Diatoms	0.3	0.4	0.0	0.8	0.0	0.2	5.3	0.4	1.1	0.8	0.0	0.2	0.1	0.7	0.3
% Other	0.0	0.1	0.2	5.3	3.3	0.1	0.2	0.8	1.6	0.3	0.0	0.4	0.2	0.0	0.4
Green Algae:Diatoms	0.5	2.3	0.0	0.7	4.6	15.4	2.2	59.7	11.0	2.6	53.2	6.2	53.5	0.1	18.3

[a] Mean Value for CC5.6 in 2019 excludes outlier value.

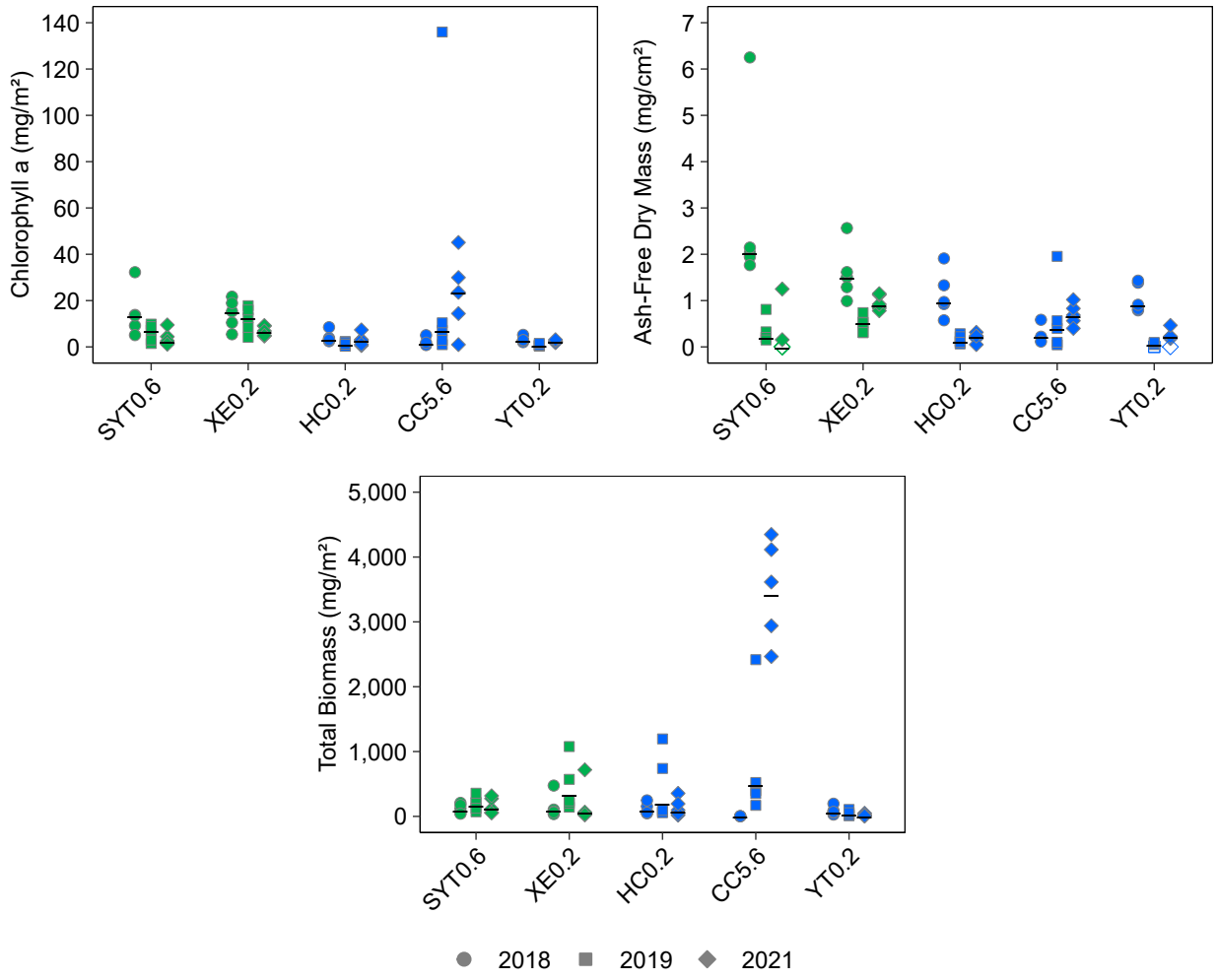


Figure 5.3: Periphyton Productivity Indicator Endpoints, Lower Creek Areas, Coffee Project FALMP, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses. Mean value calculation for CC5.6 in 2019 did not include outlier value.

short-term term maximum British Columbia guideline for the protection of aquatic life (100 mg/m^2; BCMOECCS 2021; Table 5.2; Figure 5.3; Appendix Table C.4). Lower Creek area chlorophyll-a concentrations were significantly lower at most future-exposed areas than both reference areas in 2018, but in 2019 and 2021 differences among areas were inconsistent (Appendix Table C.5). Except for the unusually high chlorophyll-a concentrations for CC5.6 in 2019 and 2021, comparability of chlorophyll-a data was good among Lower Creek future-exposed and reference areas. Furthermore, despite the high values observed at CC5.6 in 2021, three of four values were still within the range of Lower Creek reference area baseline data, reinforcing that the range of chlorophyll-a concentrations resulting from natural variability is similar among all Lower Creek areas. Mean AFDM at Lower Creek areas was highest at reference area SYT0.6 in 2018 (2.83 mg/cm^2), future-exposed areas CC5.6 in 2019 (0.61 mg/cm^2), and reference area XE0.2 in 2021 (Figure 5.3; Table 5.2). AFDM values were similar among future-exposed and reference areas in general, and few statistically significant differences occurred among comparisons of future-exposed and reference areas (Table 5.2; Figure 5.3; Appendix Table C.5). Periphyton mean total biomass estimates for Upper Creek future-exposed and reference areas were highest at reference areas SYT0.6 and XE0.2 in 2018 (119 and 151 mg/m^2, respectively), and at future-exposed area CC5.6 in 2019 and 2021 (772 and 3,496 mg/m^2, respectively; Table 5.2; Figure 5.3). Total biomass estimates indicated some differences among areas, but no consistent differences between Lower Creek future-exposed and reference areas, and aside from high values for CC5.6 in 2021 the range of values for all areas across all years was similar (Figure 5.3; Appendix Table C.6). Variability in all three periphyton productivity endpoints at Lower Creek areas was not consistently significantly correlated with any one physicochemical parameter, although chlorophyll-a concentrations and AFDM were positively correlated with DO and mean substrate size (Appendix Table C.6; Appendix Figure C.2).

Lower Creek area chlorophyll-a concentrations were generally below the oligotrophic-mesotrophic boundary of 20 mg/m^2 outlined in Dodds et al. (1998) the exception being CC5.6 in 2021 (Appendix Table C.5). This indicates that all Lower Creek areas can be generally classified as low productivity oligotrophic systems however, productivity may vary by year and variability may be higher at some areas that others. It is also possible that chlorophyll-a concentrations above the boundary (including samples from CC5.6 in 2021) may reflect measures likely being over-estimates of actual periphytic coverage at Project Upper Creek areas (Section 3.3.1). Overall comparability of Upper Creek future-exposed and reference areas is good given the few significant differences as well as the agreement in trends among productivity endpoints.

5.3.2 Community

Periphyton community mean total densities at all Lower Creek areas except CC5.6 were highest in 2018 and lowest in 2021 (Figure 5.4; Table 5.2; Appendix Table C.2). At future-exposed Lower Creek area CC5.6 mean total density was lowest in 2018 and highest in 2021, and those values also represent the minimum and maximum mean density values recorded across all Lower Creek areas throughout the baseline sampling period (79,899 and 9,546,540 cells/cm^2, respectively; Figure 5.4; Table 5.2). Periphyton mean taxonomic richness was lowest at future-exposed area HC0.2 in 2018 (3 taxa) and highest at future-exposed area CC5.6 in 2021 (11 taxa; Figure 5.4; Table 5.2). Periphyton total density and richness varied among areas and over time at Project Lower Creek areas, however, significant differences between future-exposed and reference areas were infrequent and inconsistent (Appendix Table C.5). Similarly, there were no consistent trends in variability between Lower Creek future-exposed and reference areas with respect to community evenness, diversity, and Bray-Curtis distance, and significant differences were infrequent across all comparisons (Appendix Table C.5). All Lower Creek area periphyton communities were dominated by blue-green algae, and mean proportions ranged from 84.5% (HC0.2 – 2018) to 99.8% (HC0.2 – 2018; Table 5.2; Figure 5.4). The ratio of green algae to diatoms was generally low at Lower Creek areas, however, this reflects low (frequently zero) abundances of both groups (Table 5.2; Appendix Table C.2). Those low abundances, however, will make it straightforward to detect potential changes in the relative abundances of these two groups and the ratio of green algae to diatoms (which was identified as a potential mine-related change; EDI and Minnow 2017).

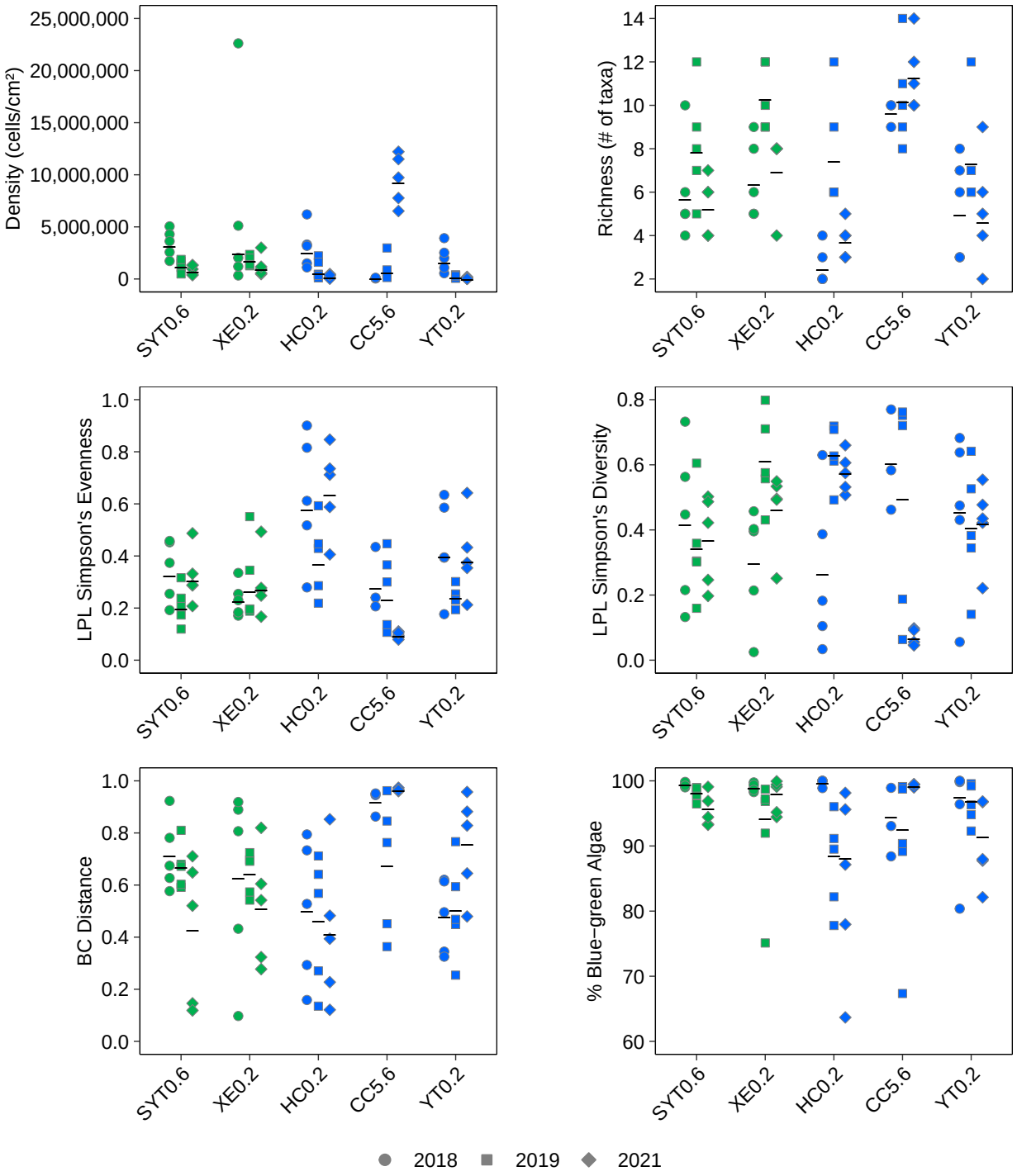


Figure 5.4: Periphyton Community Indicator Endpoints, Lower Creek Areas, Coffee Project FALMP, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

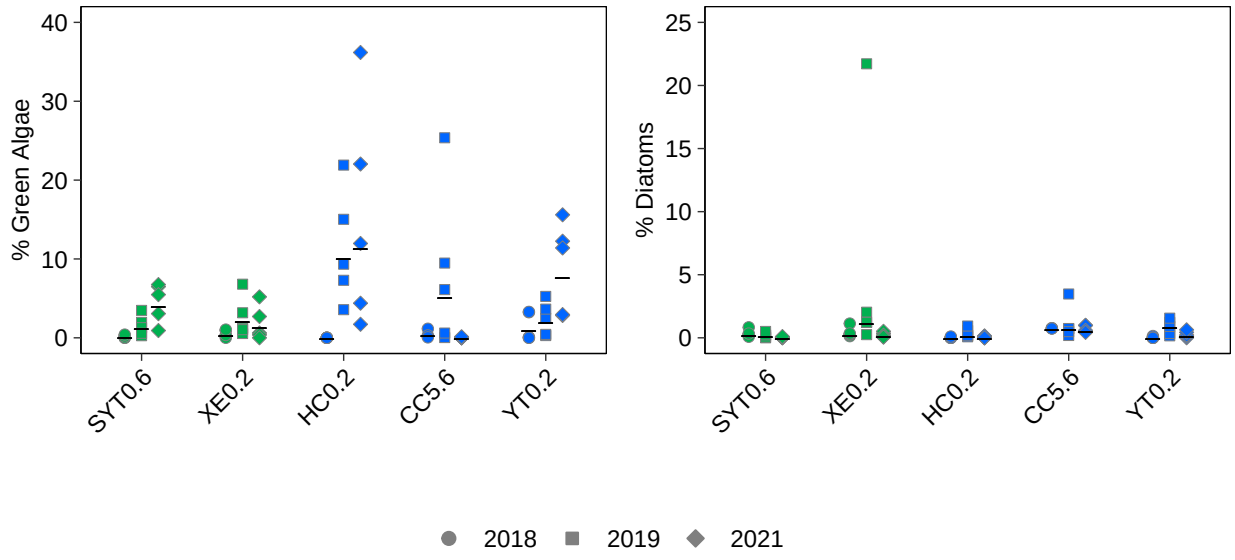


Figure 5.4: Periphyton Community Indicator Endpoints, Lower Creek Areas, Coffee Project FALMP, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

6 BENTHIC INVERTEBRATE COMMUNITY

6.1 Overview

Benthic invertebrate community samples were collected in 2018, 2019, and 2021 at three future-exposed (HC6.8, LC10.2, YT4.3) and two reference (XE0.2 and SYT0.6) Upper Creek Areas, as well as three future-exposed (HC0.2, YT0.2, CC5.6) and two reference (XE0.2, SYT0.6) Lower Creek Areas. Samples were also collected from FALMP areas HC6.8 and reference area CR24.5[11] in 2017. Results of a DQR indicate that FALMP benthic invertebrate data can be reliably interpreted (Appendix G). All benthic invertebrate data collected as part of FALMP baseline monitoring in 2018, 2019, and 2021 are provided in Appendix D.

6.2 Upper Creek Areas

Benthic invertebrate mean total density at Upper Creek areas ranged from 422 (YT4.3 – 2018) to 2,617 (CR24.5 – 2021) organisms/m^2 and mean taxonomic richness ranged from 10 (YT4.3 –-2018) to 23 (HC6.8 – 2021) taxa over the baseline sampling period (Table 6.1; Figure 6.1; Appendix Table D.1). Benthic invertebrate biomass was generally very low at Upper Creek areas, ranging from 0.08 (YT4.3 – 2018) to 0.41 (HC6.8 – 2018) g/m^2 (Table 6.1; Figure 6.1). Mean community evenness ranged from 0.18 (CR24.5 – 2018) to 0.41 (HC6.8 – 2018) and diversity ranged from 0.60 (YT4.3 – 2019) to 0.86 (CC23.7 – 2019), indicating generally low to moderate evenness[12] and moderate to high diversity[13] across all Upper Creek areas and years of baseline monitoring (Table 6.1; Figure 6.1). Those key benthic invertebrate community endpoints all varied significantly among and within areas over the baseline sampling period, however significant differences between future-exposed and reference areas were observed but were uncommon and inconsistent (Appendix Table D.2). Despite good matching among sampling areas, natural variability in benthic invertebrate communities was identified, further reinforcing the applicability of a BACI experimental design.

Variability in benthic community composition was high at Project Upper Creek areas during baseline sampling, with no areas dominated by a single taxonomic grouping across all years (Table 6.1). Upper Creek area benthic invertebrate communities were generally co-dominated by mayflies, stoneflies, chironomids, and oligochaetes in proportions varying over time among

[11] Previously Area I29 (Appendix Table A.1)

[12] Simpson's evenness index values range from 0 to 1, with a value of 1 corresponding to a perfectly even community (with respect to number of taxa and distribution of abundance among those taxa) and 0 corresponding to a highly uneven community.

[13] Simpson's diversity index values range from 0 to 1, with a value of 1 corresponding to infinite community diversity (with respect to number of taxa and distribution of abundance among those taxa) and 0 corresponding to zero diversity.

Table 6.1. Mean Benthic Invertebrate Community Endpoints, Upper Creek Areas, Coffee Project FALMP, 2017[a], 2018, 2019, 2021

Endpoint	2017	2018					2019					2021				
	HC6.8	CC23.7	CR24.5	HC6.8	LC10.2	YT4.3	CC23.7	CR24.5	HC6.8	LC10.2	YT4.3	CC23.7	CR24.5	HC6.8	LC10.2	YT4.3
	Future-Exposed	Reference		Future-Exposed			Reference		Future-Exposed			Reference		Future-Exposed		
	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5
Density (org/m²)	841	1,661	690	483	518	422	1,720	1,527	1,241	828	1,449	1,043	2,617	1,093	1,030	1,095
Richness (# of taxa)	19	14	15	15	18	10	18	17	20	16	14	21	17	23	18	15
Simpson's Evenness	0.25	0.23	0.18	0.41	0.23	0.28	0.40	0.27	0.32	0.33	0.20	0.33	0.26	0.34	0.30	0.24
Simpson's Diversity	0.77	0.68	0.61	0.80	0.71	0.61	0.86	0.78	0.81	0.79	0.60	0.85	0.76	0.86	0.80	0.71
Biomass (g/m²)	-	0.32	0.15	0.11	0.11	0.08	0.35	0.31	0.27	0.16	0.17	0.18	0.38	0.23	0.14	0.15
EPT (%)	73.3	54.4	81.3	29.0	54.0	17.2	32.1	59.6	27.5	48.3	69.9	33.1	49.9	34.8	25.2	47.6
Ephemeroptera (%)	33.5	46.1	23.2	11.0	46.0	0.7	5.7	8.6	8.1	33.2	3.5	8.6	14.9	6.6	8.4	0.0
Plecoptera (%)	37.3	8.1	58.1	17.4	6.8	16.5	26.3	51.0	18.8	15.0	66.5	21.8	34.8	25.6	15.7	47.5
Trichoptera (%)	2.6	0.2	0.0	0.7	1.2	0.0	0.1	0.0	0.6	0.1	0.0	2.7	0.1	2.6	1.1	0.2
Chironomidae (%)	12.8	6.1	6.2	33.1	18.5	69.6	35.7	8.9	30.7	22.7	27.0	19.8	7.1	27.4	35.0	34.0
Simuliidae (%)	4.8	14.6	6.9	10.0	5.7	1.0	11.8	2.1	14.7	10.4	0.2	22.8	9.5	18.5	14.1	2.7
Oligochaeta (%)	4.6	24.2	3.0	24.5	14.9	7.0	19.6	27.1	25.1	17.4	1.3	16.6	32.6	13.4	24.1	13.1
Metal-Sensitive Chironomidae (%)	9.0	1.9	2.9	23.3	3.0	63.0	19.9	5.1	24.1	14.2	16.0	9.9	1.3	17.9	20.5	12.0
% Collector-Gatherer	45.4	52.3	29.7	44.7	66.9	70.9	41.3	18.3	36.6	56.2	30.1	29.3	22.1	34.2	44.3	34.3
% Filterer	9.4	38.8	8.8	34.5	21.0	8.0	31.4	29.2	39.8	27.8	1.5	39.4	42.1	32.1	38.1	15.8
% Scraper-Grazer	5.6	0.5	3.6	1.0	2.0	0.0	4.4	6.2	6.4	2.3	0.1	6.2	11.2	3.2	1.3	0.2
% Shredder	36.9	8.2	58.4	17.4	6.8	16.5	26.3	51.2	18.8	14.9	66.7	20.4	35.0	24.7	12.7	47.5
% Predator	3.4	0.2	2.2	1.6	4.3	1.2	0.5	1.1	1.5	0.9	0.6	7.9	0.5	6.2	4.1	0.6
% Sprawler	15.3	6.1	6.3	33.7	20.5	70.1	35.7	9.2	31.7	23.2	26.9	25.7	7.7	33.0	36.2	34.9
% Burrower	6.0	24.3	3.4	25.0	16.8	8.3	19.8	27.3	25.3	17.4	1.7	17.1	32.7	13.5	24.2	13.6
% Clinger	45.7	23.4	68.6	28.9	15.6	17.5	42.2	59.3	37.4	27.8	66.8	51.3	52.4	46.9	31.9	50.0

Notes: "-" indicates no data.

[a] The only FALMP areas sampled in 2017 were HC6.8 and CR24.5. For CR24.5 data see Table 2.2.

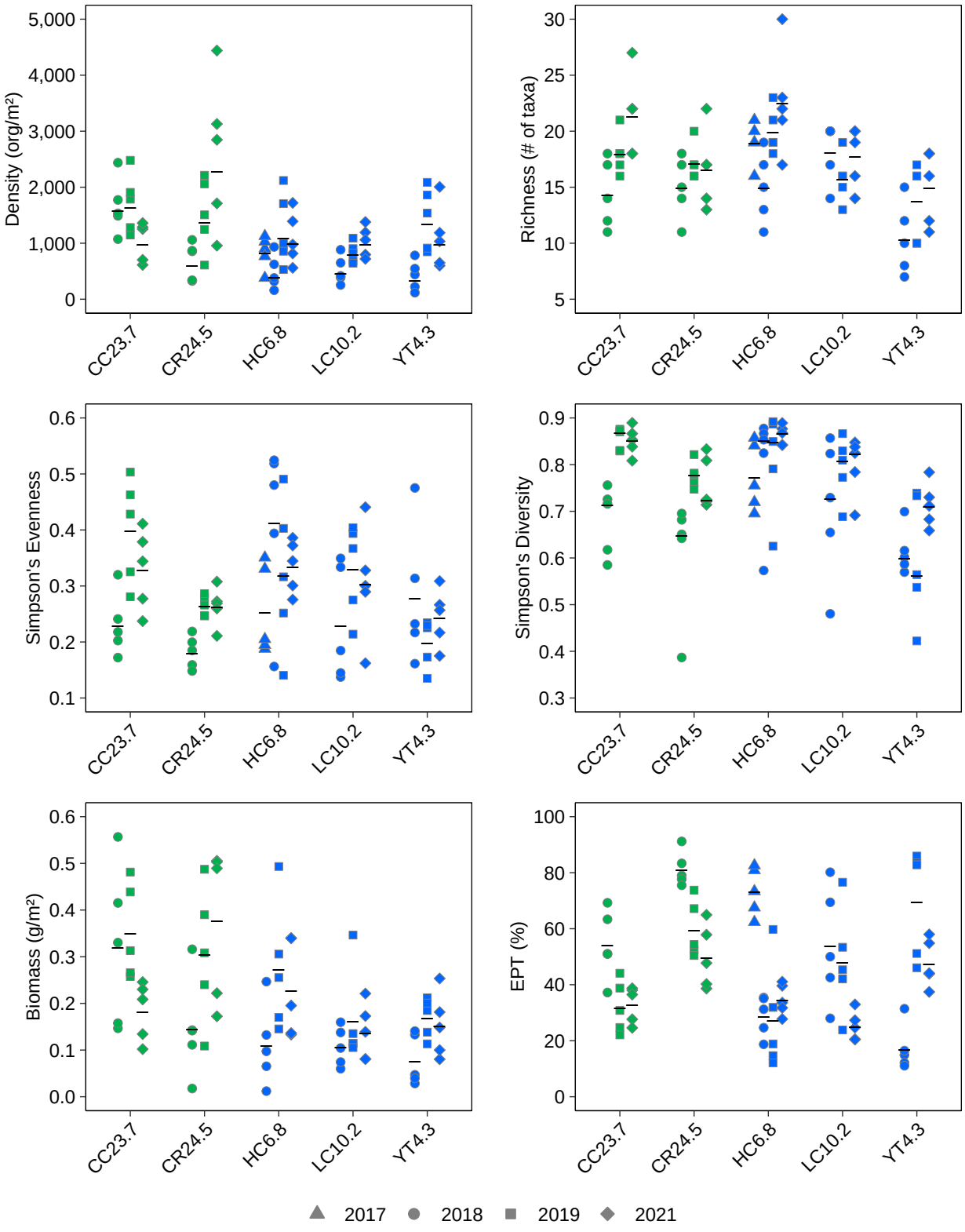
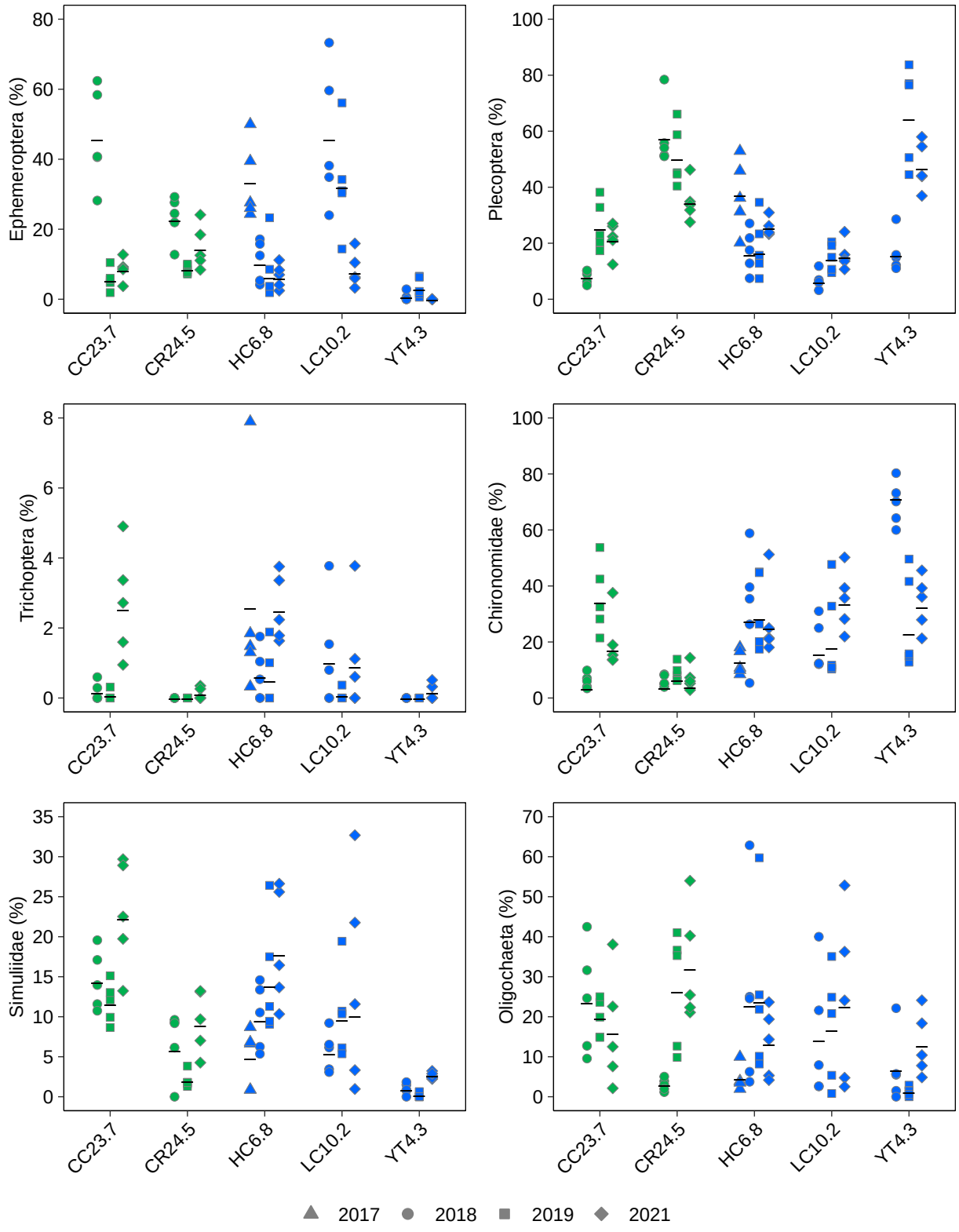


Figure 6.1: Benthic Endpoints Upper Creek Areas, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.



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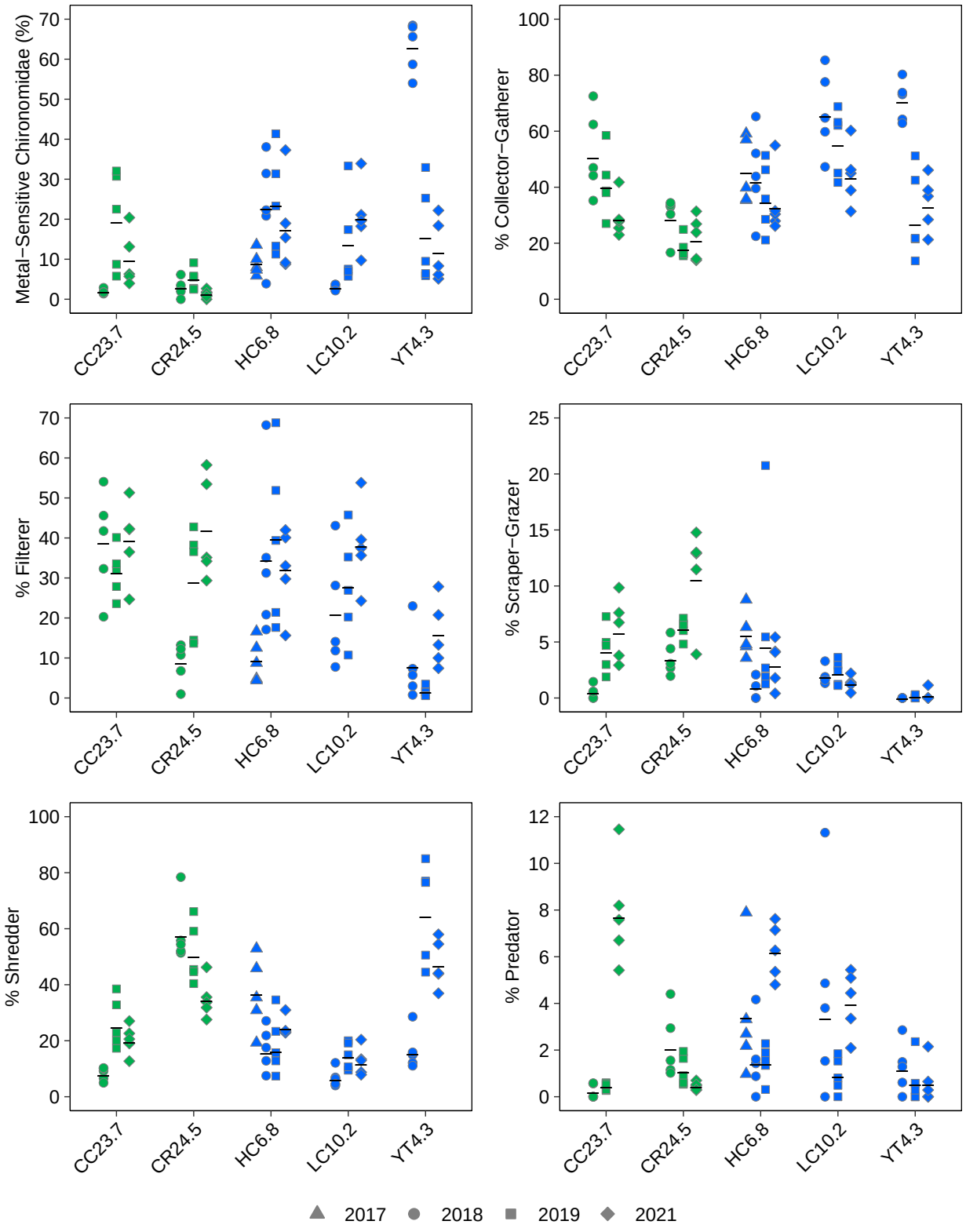

Figure 6.1: Benthic Endpoints Upper Creek Areas, 2018 to 2021

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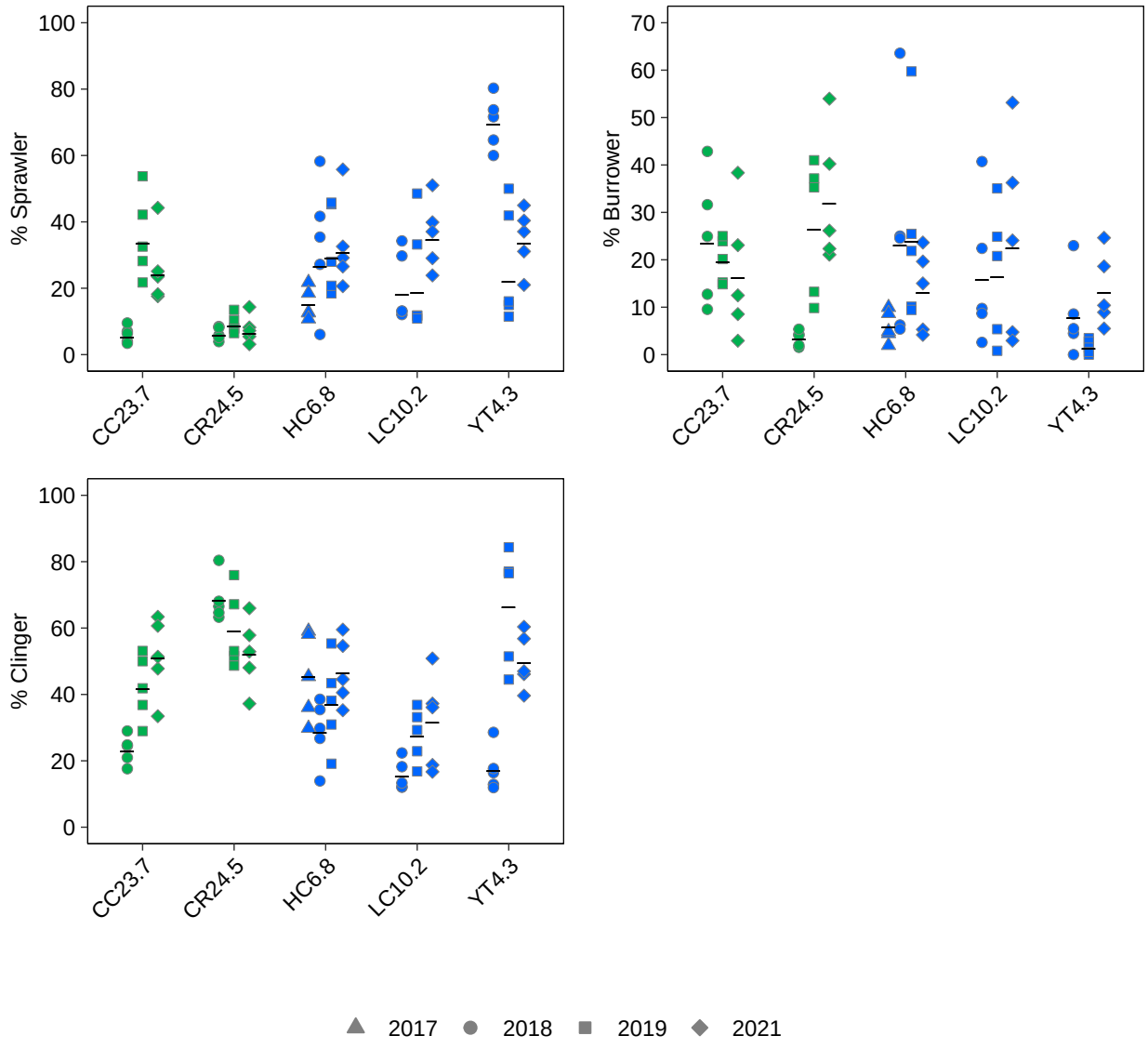

Figure 6.1: Benthic Endpoints Upper Creek Areas, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

and within areas (Table 6.1, Figure 6.1). Proportions of EPT taxa ranged from 17.2% (YT4.3 –-2018) to 81.3% (CR24.5 – 2018), with no consistent pattern of spatial variability across the baseline sampling period (Table 6.1). Proportions of stoneflies and chironomids were similarly variable over the baseline period with the former ranging from 6.8% (LC10.2 – 2018) to 66.5% (YT4.3 – 2019) and the latter from 6.1% (CC23.7 – 2018) to 69.6% (YT4.3 – 2018; Table 6.1). Significant differences in key community composition endpoints (e.g., %EPT, %Plecoptera, %Chironomidae, etc.) between future-exposed and reference Upper Creek areas were rare and inconsistent (Appendix Table D.2). In general, community composition at all Upper Creek area future-exposed areas was dominated by four groups (Ephemeroptera, Plecoptera, Chironomidae, and Simuliidae), but relative proportions were variable over the baseline period. However, although differences were observed between future-exposed and references areas, variability at reference areas was similar and patterns of difference between future-exposed and reference areas were inconsistent (Figure 6.1; Appendix Table D.2).

Project Upper Creek area benthic invertebrate communities were either co-dominated by collector-gatherers, filterers, and shredders, or were dominated by shredders or by collector-gatherers (Table 6.1). No Upper Creek areas fell into one of those categories consistently across all years of baseline monitoring due to significant interannual variability in proportions of all FFGs (Table 6.1; Appendix Table D.2). Similarly, proportions of HPGs at Upper Creek areas were variable over the baseline monitoring period, with no clear dominance patterns within and/or among areas (Table 6.1; Appendix Table D.2). Significant differences in FFGs and HPGs between future-exposed and reference Upper Creek areas were observed, but were inconsistent, especially depending on which reference area (i.e., CR24.5 or CC23.7) was used as the basis for comparison (Appendix Table D.2). In general, community composition with respect to proportions of FFGs and HPGs at all future-exposed areas was similar to (and not significantly different from) at least one reference area at some point over the baseline sampling period (Figure 6.1; Appendix Table D.2).

Mean proportions of metal-sensitive chironomids varied at Upper Creek areas over the baseline monitoring period, ranging from 1.3% (CR24.5 – 2021) to 63.0% (YT4.3 – 2018); however, mean proportions were most commonly <20% (Table 6.1). Proportions of metal-sensitive chironomids at future-exposed areas were generally not significantly different than both reference areas, with significant differences occurring infrequently and inconsistently (Appendix Table D.2).

Upper Creek area benthic invertebrate communities were also assessed using BC comparisons of dissimilarity (both family-level, and lowest practicable level) of future-exposed and reference areas (Appendix Table D.3). All future-exposed Lower Creek area communities were significantly different from both corresponding reference areas for every year of baseline sampling

with the exception of one comparison (HC6.8 vs. CC23.7 – 2021), reflecting temporally consistent natural variability in community composition among Project Lower Creek areas (Appendix Table D.3).

Upper Creek area benthic community endpoints were frequently significantly correlated with physicochemical parameters (e.g., flow velocity, temperature, DO, pH, etc.), however, correlations were inconsistent (Appendix Table D.4). Variability in most benthic invertebrate community key indicator endpoints was correlated significantly with at least two habitat or water chemistry endpoints with no apparent pattern, indicating that natural variability in benthic invertebrate communities among Upper Creek areas is driven by myriad factors across Project areas (Appendix Table D.4; Appendix Figure D.1).

6.3 Lower Creek Areas

Benthic invertebrate mean density at Lower Creek areas ranged from 149 (CC5.6 – 2018) to 3,200 organisms/m^2 (SYT0.6 – 2021) and varied significantly among and within areas over the baseline sampling period (Table 6.2; Figure 6.2; Appendix Tables D.5 and D.6). Mean benthic invertebrate biomass was generally low at Lower Creek areas, ranging from 0.02 (CC5.6 –-2018) to 0.72 g/m^2 (SYT0.6 – 2021; Table 6.2; Figure 6.2). Benthic invertebrate density and biomass were generally significantly lower at future-exposed Lower Creek areas than reference areas. Although differences were observed, the range of values for both endpoints at future-exposed areas was generally within the range of density and biomass values observed at reference areas over the baseline monitoring period (Figure 6.2; Appendix Table D.6).

Benthic invertebrate mean taxonomic richness ranged from 11 (YT0.2 and CC5.6 – 2018) to 22 (XE0.2 – 2021) taxa, and while there were no significant spatial differences over the baseline sampling period, richness was higher 2019 than in 2018, as well as in 2021 relative to 2019 at all Lower Creek areas (Table 6.2; Figure 6.2; Appendix Table D.6). Mean Simpson's Diversity was generally moderate to high, ranging from 0.56 (SYT0.6 – 2018) to 0.84 (XE0.2 – 2021) and Evenness was low to moderate, ranging from 0.17 (SYT0.6 – 2018) to 0.54 (CC5.6 – 2018) at Lower Creek areas over the baseline sampling period (Figure 6.2; Appendix Table D.6). Statistically significant results for comparisons of taxonomic richness, evenness, and diversity between future-exposed and reference areas were observed but were infrequent and inconsistent despite temporal and spatial variability at and among Lower Creek areas, indicating that future-exposed and reference are data are of generally good comparability.

Lower Creek area benthic invertebrate community composition was variable within and among areas over the baseline sampling period. Lower Creek area benthic communities were generally dominated by stoneflies (future-exposed area YT0.2 and reference area SYT0.6) or co-dominated by varying proportions of EPT taxa (mostly E and P), chironomids, black flies, and oligochaetes

Table 6.2. Mean Benthic Invertebrate Community Endpoints, Lower Creek Areas, Coffee Project FALMP, 2018 to 2021

Endpoint	2018					2019					2021				
	Reference		Future-Exposed			Reference		Future-Exposed			Reference		Future-Exposed		
	SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2	SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2	SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2
	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5
Density (org/m²)	1,605	1,021	561	149	289	2,034	2,342	1,444	690	841	3,200	1,491	2,189	924	1,254
Richness (# of taxa)	14	15	18	11	11	15	17	17	16	13	18	22	19	20	16
Simpson's Evenness	0.17	0.32	0.35	0.54	0.29	0.35	0.30	0.22	0.22	0.23	0.18	0.30	0.20	0.27	0.18
Simpson's Diversity	0.56	0.75	0.79	0.79	0.69	0.81	0.78	0.73	0.66	0.66	0.66	0.84	0.69	0.80	0.63
Biomass (g/m²)	0.43	0.15	0.08	0.02	0.04	0.53	0.33	0.22	0.13	0.12	0.72	0.26	0.35	0.12	0.19
EPT (%)	75.5	36.7	36.2	49.3	78.2	62.2	21.1	75.7	29.7	74.7	69.0	18.4	63.08	24.6	60.0
Ephemeroptera (%)	9.0	24.1	9.7	45.9	32.9	0.3	1.3	8.6	24.4	6.8	0.4	7.6	13.4	13.2	4.8
Plecoptera (%)	66.3	12.6	26.4	1.2	45.0	61.9	19.7	67.1	4.9	67.9	68.5	10.3	49.7	5.8	55.1
Trichoptera (%)	0.2	0.0	0.1	2.2	0.3	0.0	0.0	0.1	0.4	0.0	0.1	0.4	0.1	5.7	0.0
Chironomidae (%)	14.8	18.5	18.8	17.3	12.1	24.0	38.6	9.6	29.8	7.6	18.1	26.7	6.3	28.6	6.5
Simuliidae (%)	5.1	11.7	25.8	13.1	0.7	11.3	14.5	11.2	0.8	0.7	9.0	20.3	25.0	1.6	10.5
Oligochaeta (%)	0.7	31.2	6.3	10.0	5.2	0.2	25.1	2.5	38.6	14.3	0.4	28.2	3.5	34.4	19.3
Metal-Sensitive Chironomidae (%)	9.6	4.5	2.8	0.6	6.3	13.4	13.0	2.5	1.1	3.9	3.8	11.6	2.2	0.7	1.1
% Collector-Gatherer	23.8	42.5	27.4	63.1	45.5	24.5	40.0	18.3	54.0	14.6	18.6	35.1	20.0	46.2	11.5
% Filterer	5.1	43.0	33.0	23.2	5.9	11.5	39.6	13.6	39.4	15.0	9.4	48.5	28.6	36.0	29.8
% Scraper-Grazer	0.0	0.2	2.1	11.6	2.1	0.0	0.4	2.6	17.2	0.9	0.1	4.9	7.0	15.9	1.3
% Shredder	66.5	12.1	27.3	1.0	45.0	61.9	19.6	67.2	1.3	67.9	68.5	9.7	49.7	4.2	55.1
% Predator	3.9	1.2	1.9	9.0	1.5	1.9	0.3	0.6	4.4	2.2	3.0	5.7	1.6	10.8	2.8
% Sprawler	18.0	18.9	18.0	22.5	13.5	25.8	34.1	9.9	34.9	9.8	20.8	31.4	7.0	37.7	9.4
% Burrower	0.8	31.7	7.5	7.8	5.2	0.4	29.8	2.8	38.9	14.5	0.6	29.1	3.8	34.9	19.5
% Clinger	71.4	24.4	54.8	26.3	48.1	73.1	34.6	80.8	23.4	69.5	77.6	31.6	81.9	24.6	66.9

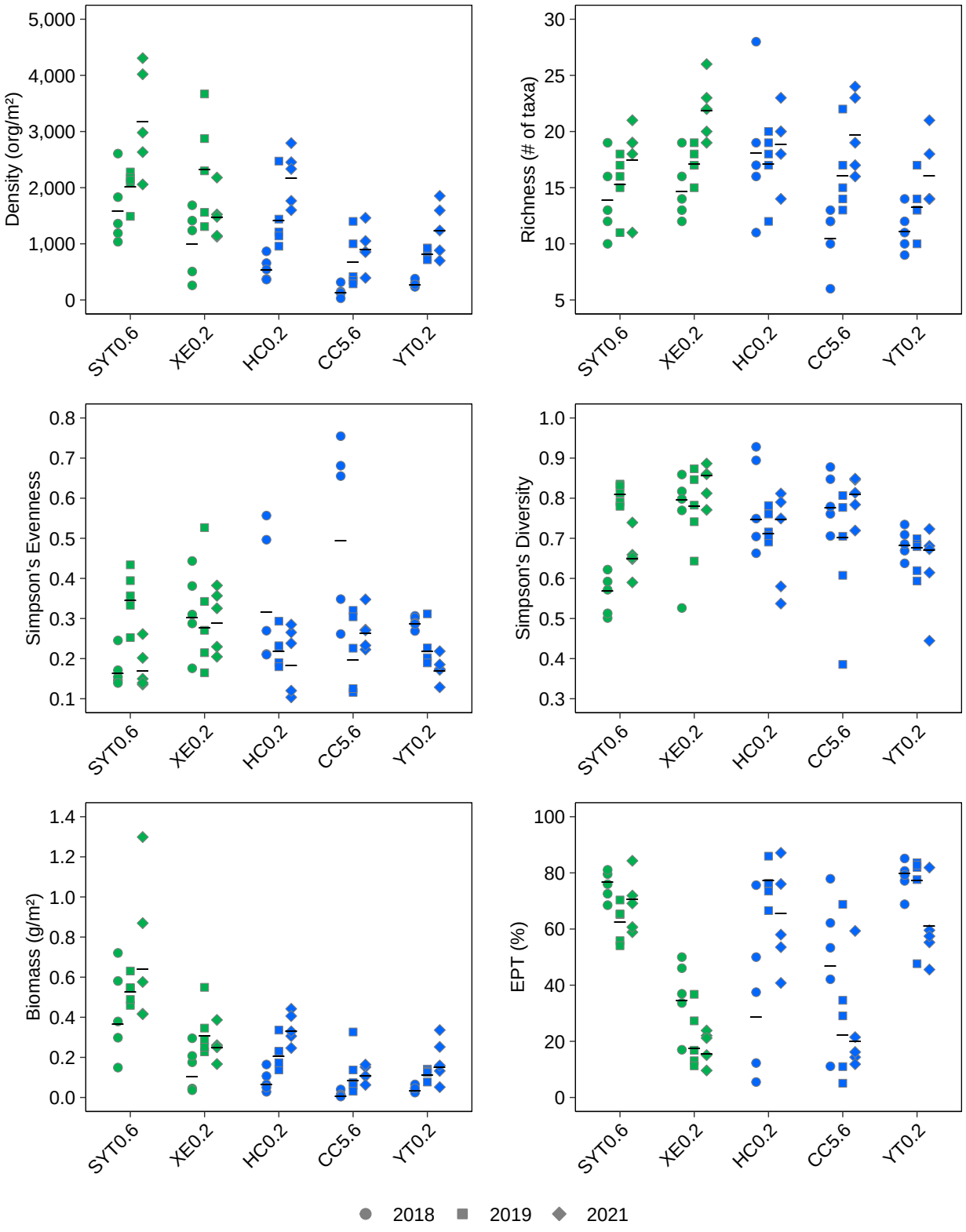

Figure 6.2: Benthic Endpoints Lower Creek Areas, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

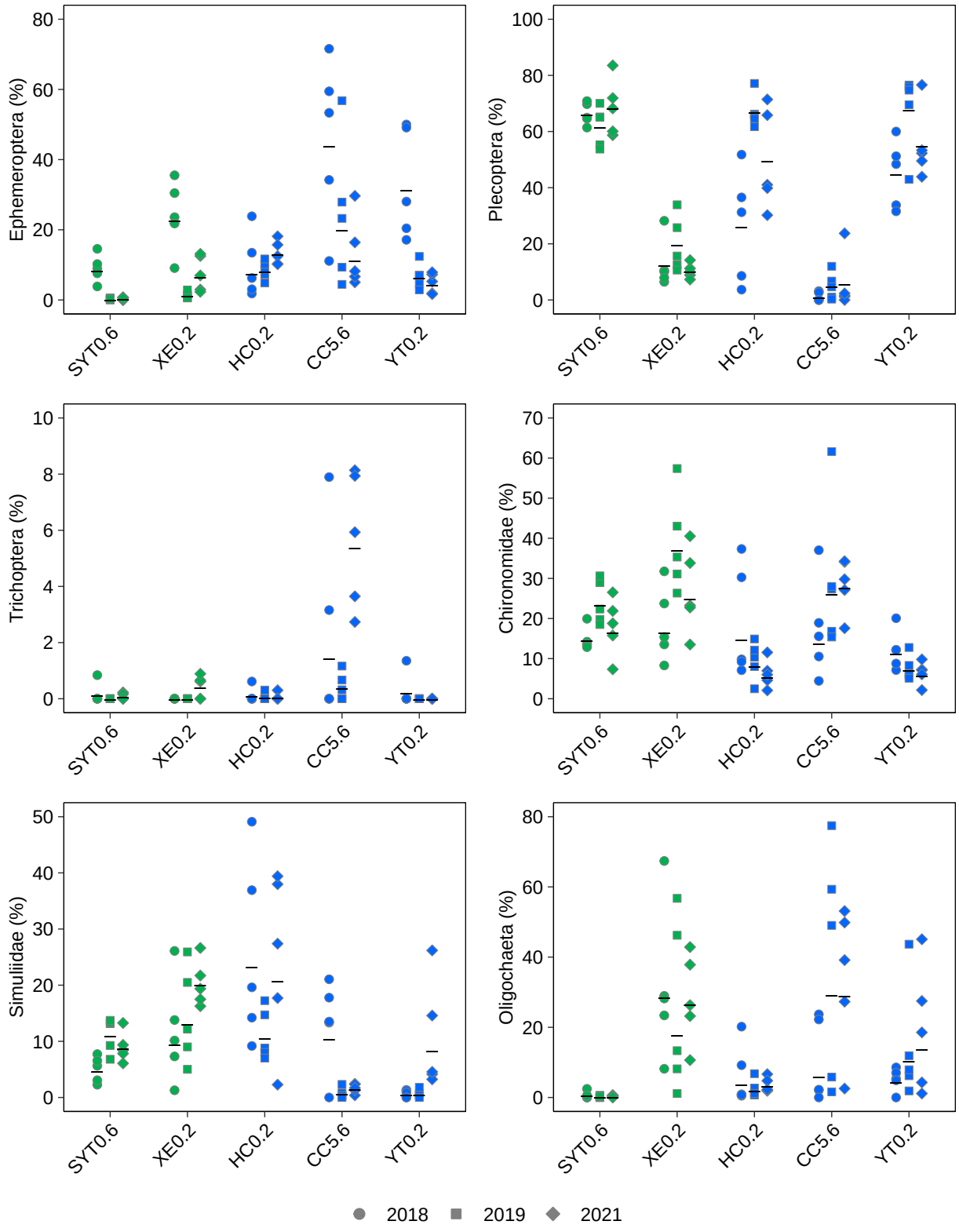

Figure 6.2: Benthic Endpoints Lower Creek Areas, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

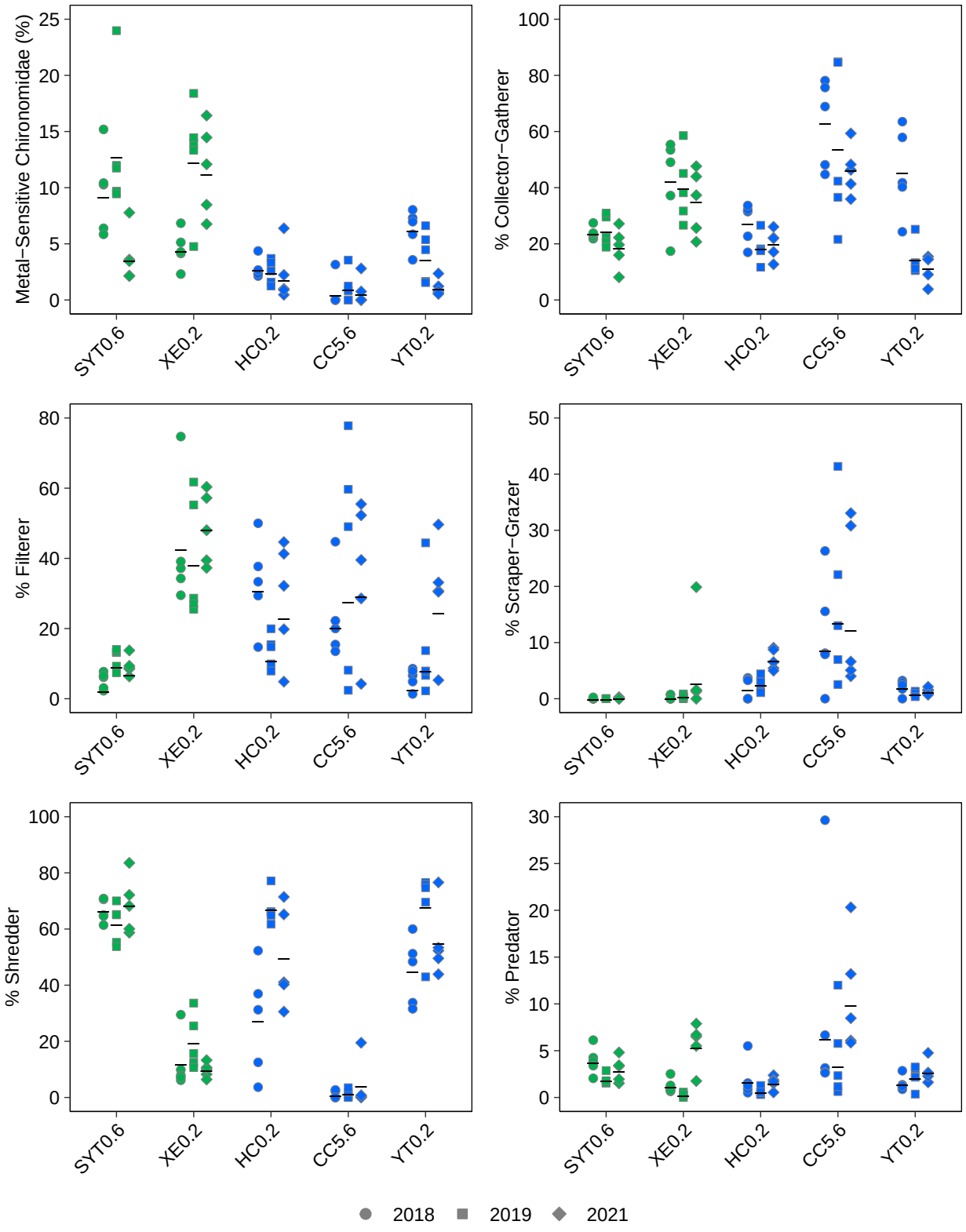

Figure 6.2: Benthic Endpoints Lower Creek Areas, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

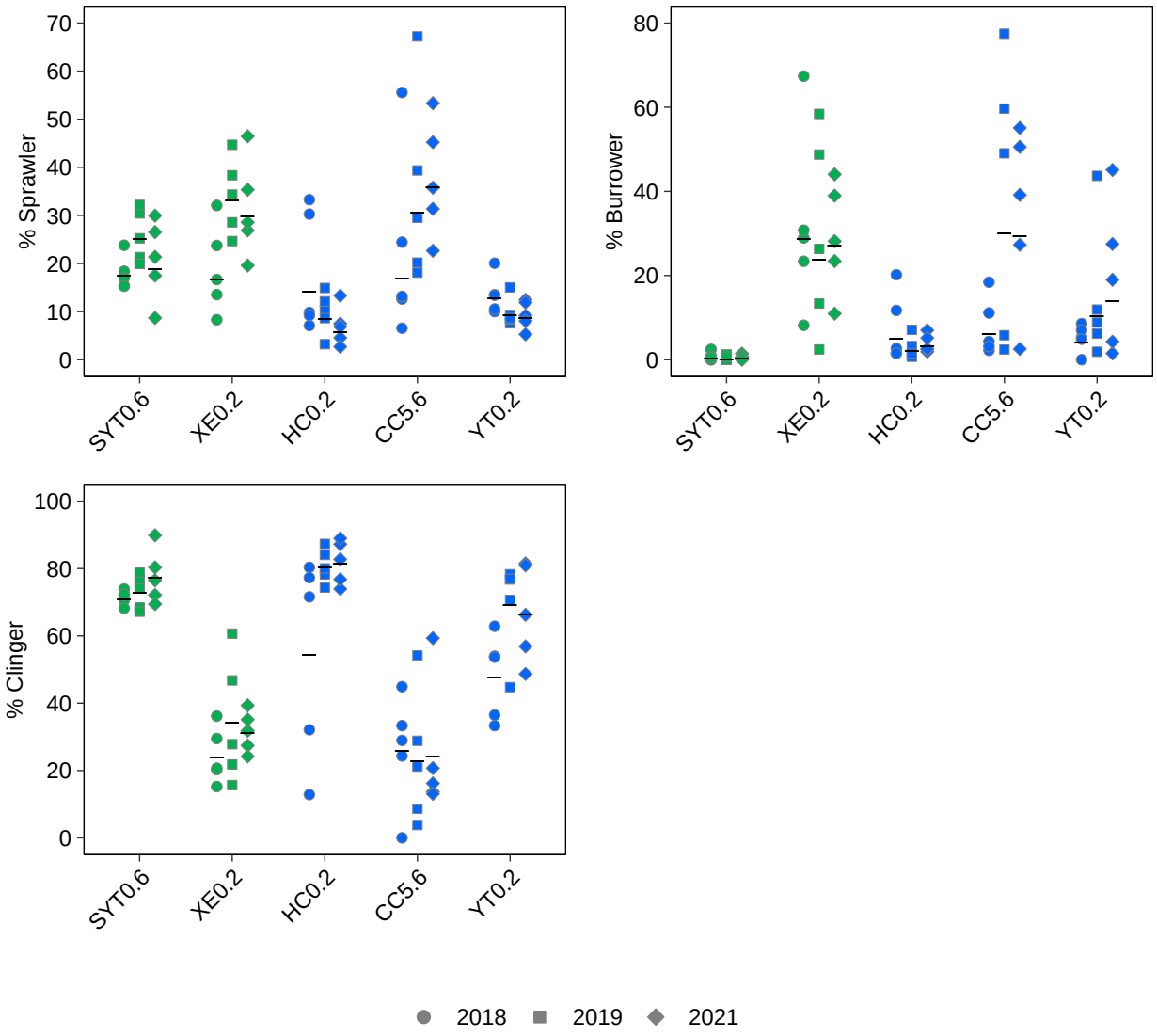

Figure 6.2: Benthic Endpoints Lower Creek Areas, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

(future-exposed area CC5.6 and reference area XE0.2; Table 6.2; Figure 6.2). At Lower Creek area HC0.2 both community composition scenarios were observed, with stoneflies, chironomids, and black flies co-dominant in 2018, and stoneflies dominant in 2019 and 2021 (Table 6.2; Figure 6.2). Significant differences in community composition endpoints (e.g., %EPT, %Plecoptera, %Chironomidae, etc.) between future-exposed and reference Lower Creek areas were inconsistent and dependent on which reference area (i.e., SYT0.6 or XE0.2) was applied (Appendix Table D.6). In general, community composition at all future-exposed areas was similar to (and not significantly different from) at least one reference area at some point over the baseline sampling period (Figure 6.2; Appendix Table D.6).

Project Lower Creek area benthic invertebrate communities were either co-dominated by collector-gatherers, filterers, and shredders (XE0.2, HC0.2, and YT0.2), dominated by shredders (SYT0.6), or dominated by collector-gatherers (CC5.6), although proportions of each FFG varied over the baseline period at each area (Table 6.2; Appendix Table D.6). Proportions of scraper-grazers and predators were low relative to the other FFGs at Lower Creek areas over the baseline monitoring period. Habitat preference groups at Lower Creek areas were generally dominated by clingers (SYT0.6, HC0.2, and YT0.2) or co-dominated by all three HPGs (i.e., clingers, burrowers, and sprawlers; XE0.2 and CC5.6) in varying proportions over the baseline monitoring period (Table 6.2; Appendix Table D.6). Significant differences in FFGs and HPGs between future-exposed and reference Lower Creek areas were observed but were inconsistent, especially depending on which reference area (i.e., SYT0.6 or XE0.2) was used as a basis for comparison (Appendix Table D.6). In general, community composition with respect to proportions of FFGs and HPGs at all future-exposed areas was similar to (and not significantly different from) at least one reference area at some point over the baseline sampling period (Figure 6.2; Appendix Table D.6).

Mean proportions of metal-sensitive chironomids were relatively low at all Lower Creek areas throughout the baseline monitoring period (i.e., 0.6% to 13.4% at CC5.6 in 2018 and SYT0.6 in 2019, respectively). Proportions of metal-sensitive chironomids at future-exposed areas were generally significantly lower than both reference areas, however, differences and proportions at future-exposed areas were consistent throughout the baseline monitoring period, providing a good baseline for monitoring Project-related variation in the future (Appendix Table D.6).

The relative dissimilarity of Lower Creek area benthic invertebrate communities was also assessed using BC comparisons of dissimilarity between taxonomic composition (both family-level and lowest practicable level) of future-exposed and reference areas (Appendix Table D.7). All future-exposed Lower Creek area communities were significantly

different from both corresponding reference areas for every year of baseline sampling, reflecting consistent natural differences among Project Lower Creek areas (Appendix Table D.7).

Variability in Lower Creek area benthic community endpoints was frequently significantly correlated with changes in physicochemical parameters (e.g., flow velocity, temperature, DO, pH, etc.), however, correlations were inconsistent (Appendix Table D.8). Variability in most benthic invertebrate community key indicator endpoints was correlated significantly with at least three habitat or water chemistry endpoints, indicating that natural variability in benthic invertebrate communities among Lower Creek areas is driven by myriad factors (Appendix Table D.8; Appendix Figure D.2).

7 BENTHIC INVERTEBRATE TISSUE CHEMISTRY

7.1 Overview

Composite-taxa benthic invertebrate tissue chemistry samples were collected from all FALMP sampling stations in 2018, 2019, and 2021 following collection of benthic invertebrate community samples[14]. The results of a DQR indicate that FALMP benthic invertebrate tissue chemistry samples were associated with good analytical precision and can be reliably interpreted (Appendix G). All benthic invertebrate tissue chemistry data collected as part of FALMP baseline monitoring in 2018, 2019, and 2021 are provided in Appendix E.

7.2 Upper Creek Areas

7.2.1 Mercury

In the Upper Creek areas, mean mercury concentrations in benthic invertebrate tissue exceeded the Canadian Tissue Residue Guidelines for mercury (0.033 mg/kg ww[15]; CCME 2000) at future-exposed areas Halfway Creek (HC6.8) and Latte Creek (LC10.2), as well as reference area Coffee Creek (CC23.7; Table 7.1; Figure 7.1; Appendix Table E.1). Mean mercury concentrations in benthic invertebrate tissue samples from YT-24 Creek (YT4.3; future-exposed) and Carlisle Creek (CR24.5; reference) remained below the CCME guideline (Table 7.1; Figure 7.1). Spatially, concentrations of mercury in benthic invertebrate tissue samples indicated that baseline differences between future-exposed and reference areas were observed but were inconsistent. In the Upper Creek areas, although concentrations of mercury were significantly higher in some future-exposed areas in 2018 and 2019 compared to reference areas, no differences were observed in 2021 (Appendix Table E.2).

7.2.2 Selenium

Selenium concentrations in composite-taxa benthic invertebrate tissue samples were compared to the British Columbia Ministry of Environment Guideline for selenium (4 mg/kg dw; BCMOE 2014). In the Upper Creek areas, mean selenium concentrations in benthic invertebrate tissue only exceeded the BC guideline in future-exposed areas HC6.8 and LC10.2 (Table 7.1; Figure 7.1). Similar to mercury, spatial differences in benthic invertebrate selenium

[14] No results are available for LC10.2 in 2018 because the samples were either lost en route to Saskatoon, or misplaced during processing at SRC.

[15] Mercury concentrations were converted from dry weight to wet weight using % moisture for screening against the CCME guideline for mercury.

Table 7.1: Benthic Invertebrate Tissue Chemistry, Selected Parameter Means, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

Analytes	Units	BCMOE and CCME Guidelines	2018				2019					2021				
			Reference		Future-Exposed		Reference		Future-Exposed			Reference		Future-Exposed		
			CC23.7	CR24.5	HC6.8	YT4.3	CC23.7	CR24.5	HC6.8	LC10.2[a]	YT4.3	CC23.7	CR24.5	HC6.8	LC10.2[a]	YT4.3
			n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5
Aluminum	mg/kg dw	-	2,600	2,340	4,500	2,740	2,640	2,400	3,480	4,600	1,620	3,509	6,815	3,786	6,276	8,817
Arsenic	mg/kg dw	-	7.2	1.62	6.08	4.64	8.54	2.02	5.1	9.68	2.58	6.98	2.04	5.28	2.84	4.5
Chromium	mg/kg dw	-	3.85	3.78	8.24	5.08	3.94	5.22	6.78	6.54	2.34	119	105	24	125	379
Copper	mg/kg dw	-	20	20.2	13.6	12	15.4	19.2	13.8	18	13.1	20.4	26.6	21	26.2	24
Mercury[ab]	mg/kg ww	0.033	0.0132	0.00575	0.201	0.0186	0.0173	0.00724	0.0194	0.0426	0.0106	0.0425	0.0308	0.0542	0.0467	0.0287
Selenium	mg/kg dw	4	3.62	1.41	3.58	0.718	3.48	3.28	4.28	3.4	1.38	3.56	2.62	3.78	4.46	0.512
Uranium	mg/kg dw	-	3.42	0.428	10.3	0.902	7.08	0.384	7.54	2.34	0.468	3.44	0.575	8.3	1.35	0.651
Zinc	mg/kg dw	-	138	138	108	101	103	116	118	128	84.8	145	128	150	118	156

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] 2018 Benthic Invertebrate Tissues from LC10.2 (n=5) were lost either en route to or at SRC Laboratories.

[b] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

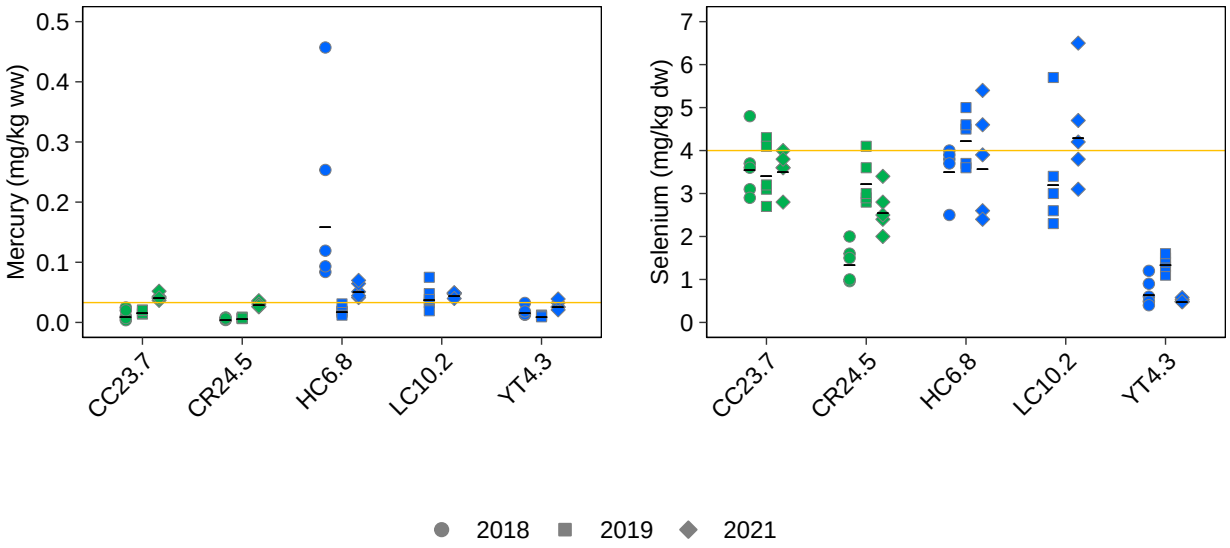

Figure 7.1: Coffee Project FALMP Benthic Invertebrate Tissue Mercury and Selenium Concentrations, Upper Creek Areas, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses. Boron and tin were excluded from analyses because 100% of the data were at the LDL in 2018 and/or 2019. MCT's are not shown for these parameters. Orange solid line indicates the Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww) and British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). Mercury concentrations were converted from dry weight to wet weight using % Moisture for screeing against the CCME guildeline for Mercury.

concentrations were not consistent among future-exposed and reference areas in the Upper Creek areas. The only consistent significant difference that was observed was significantly lower concentrations of selenium in benthic invertebrate tissue at YT4.3 compared to both reference areas; however, the magnitude of difference between YT4.3 and references was consistent across comparisons for all years (Appendix Table E.2).

7.2.3 Key Indicators

Concentrations of parameters expected to be elevated in aqueous form as a result of future mine operations (i.e., arsenic, uranium, and zinc) were also examined in benthic invertebrate tissue samples. Differences in benthic invertebrate tissue concentrations of arsenic, uranium, and zinc between future-exposed and references areas in the Upper Creek areas were observed but were inconsistent. Concentrations of benthic invertebrate tissue arsenic and uranium were significantly higher at future-exposed areas compared to CR24.5, but significantly lower compared to CC23.7 indicating reference areas capture the range of natural variability for Upper Creek areas and represent a good basis for future monitoring (Table 7.1; Figure 7.2; Appendix Table E.2). No consistent differences were observed in the concentrations of benthic invertebrate tissue zinc concentrations between future-exposed and reference areas potentially reflecting the naturally elevated concentrations of this parameter across all FALMP areas. No temporal changes in concentrations of arsenic, uranium, or zinc were apparent in any Upper Creek areas (Appendix Table E.2).

Additional consideration was given to those parameters that are also naturally enriched in the Project area in aqueous form (i.e., aluminum, chromium, and copper) but for which long-term increases due to mine operations are not expected. Differences that were observed between future-exposed and reference areas in the Upper Creek areas with respect to aluminum, chromium, and copper concentrations in benthic invertebrate tissue were not consistent spatially nor across years of baseline sampling. These results are indicative that these parameters are elevated across all Upper Creek areas and future-exposed and reference area conditions are of good comparability with respect to benthic invertebrate tissue chemistry (Table 7.1; Figure 7.2; Appendix Table E.2).

7.3 Lower Creek Areas

7.3.1 Mercury

At Lower Creek areas, mean mercury concentrations in benthic invertebrate tissue samples only exceeded the CCME guideline at the future-exposed Coffee Creek area (CC5.6 – all years; Table 7.2; Figure 7.3; Appendix Table E.3). Consistently higher mercury concentrations were observed in benthic invertebrate tissues at CC5.6 compared to both reference areas, but HC0.2

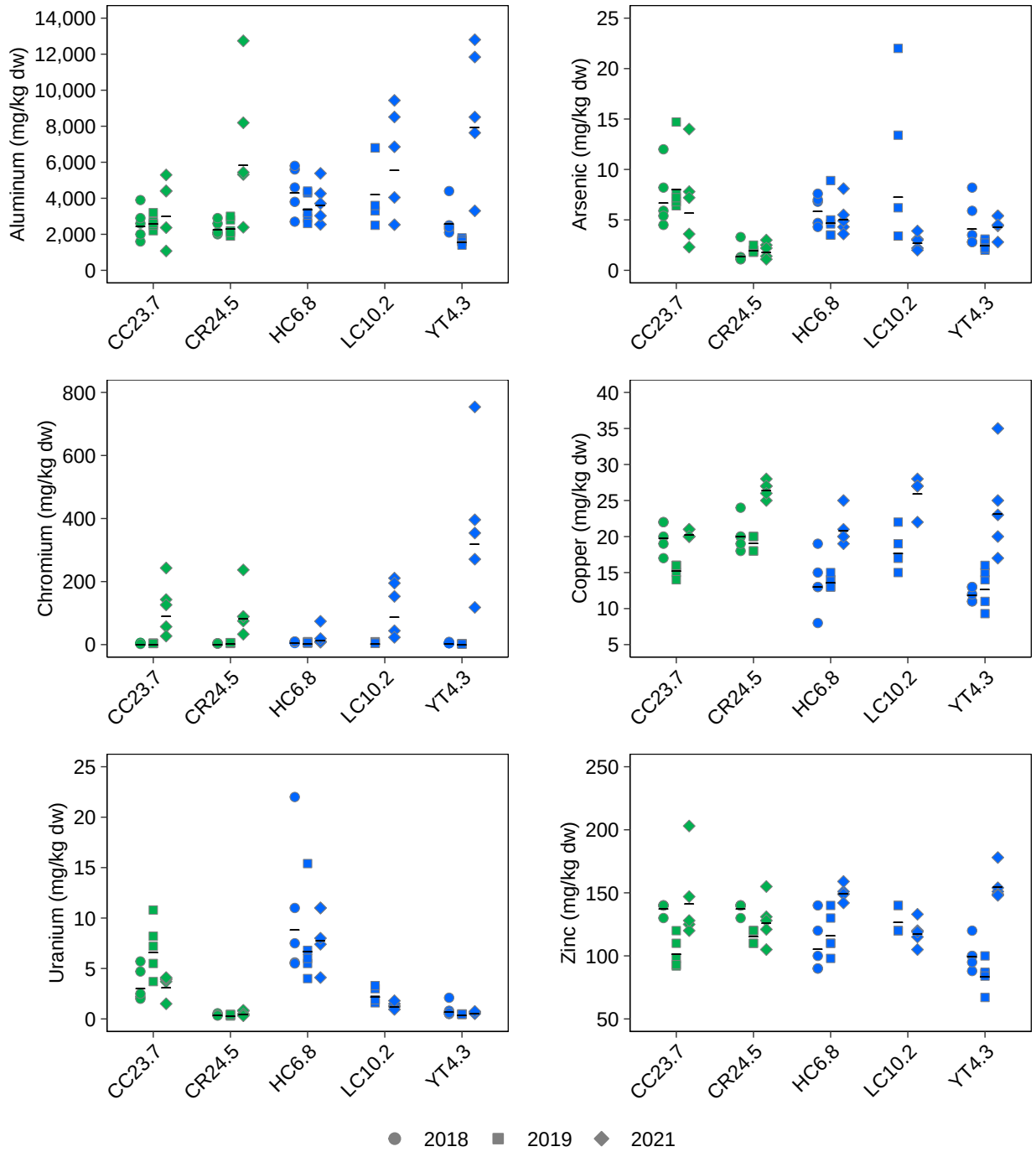

Figure 7.2: Coffee Project FALMP Benthic Invertebrate Tissue Metal Concentrations, Selected Parameters, Upper Creek Areas, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

Table 7.2: Benthic Invertebrate Tissue Chemistry, Selected Parameter Means, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021

Analytes	Units	BCMOE and CCME Guidelines	2018					2019					2021				
			Reference		Future-Exposed			Reference		Future-Exposed			Reference		Future-Exposed		
			SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2	SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2	SYT0.6	XE0.2	HC0.2	CC5.6	YT0.2
			n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5	n=5
Aluminum	mg/kg dw	-	2,320	2,682	1,502	4,340	3,620	1,540	1,520	1,860	2,240	2,380	1,240	766	3,015	3,607	6,868
Arsenic	mg/kg dw	-	1.56	1.82	1.94	3.3	3.62	1.16	1.21	3.12	2.84	2.74	0.869	1.1	3.14	2.36	3.72
Chromium	mg/kg dw	-	4.18	5.28	2.42	5.36	4.84	2.64	4.24	3.82	3.16	3.72	58.8	10.8	85.8	52.8	99.4
Copper	mg/kg dw	-	18.2	28.8	16	25.4	17.4	14.4	19.8	18.6	15.8	15.8	18.8	26	23.8	29.6	21
Mercury[a]	mg/kg ww	0.033	0.00663	0.00407	0.00704	0.071	0.00952	0.00623	0.00795	0.00746	0.032	0.00863	0.0153	0.0224	0.0295	0.0763	0.0246
Selenium	mg/kg dw	4	1.18	5.26	1.06	6.44	1.32	0.816	3.22	1.94	4.68	1.44	0.947	3.82	2.54	8.7	1.34
Uranium	mg/kg dw	-	4.02	0.822	4.4	2.64	1.9	3.8	0.672	3.68	3.42	1.36	6.2	0.942	3.92	2.94	3.08
Zinc	mg/kg dw	-	124	156	121	182	114	92.8	106	118	93.6	99.8	114	120	116	144	156

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury

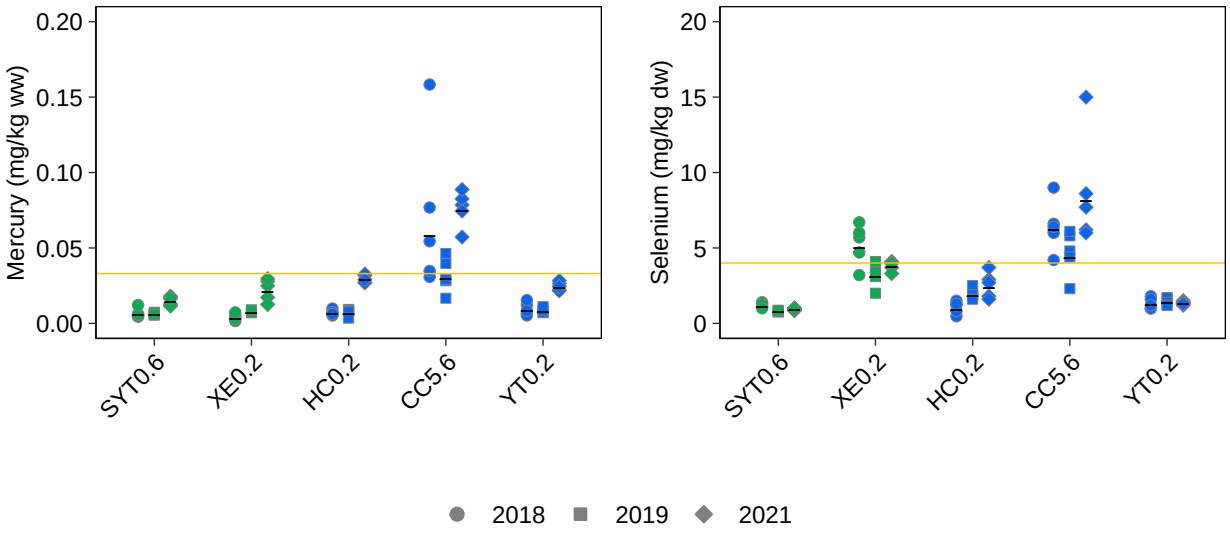

Figure 7.3: Coffee Project FALMP Benthic Invertebrate Tissue Mercury and Selenium Concentrations, Lower Creek Areas, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses. Boron and tin were excluded from analyses because 100% of the data were at the LDL in 2018 and/or 2019. MCT's are not shown for these parameters. Orange solid line indicates the Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww) and British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). Mercury concentrations were converted from dry weight to wet weight using % Moisture for screeing against the CCME guildeline for Mercury.

and YT0.2 did not differ consistently from reference (Appendix Table E.4). Similar to the Upper Creek areas, temporal differences indicated significantly higher concentrations of mercury in benthic invertebrate tissue in 2021 at all areas compared to 2018 and 2019 (with the exception of CC5.6 in 2018; Table 7.2; Figure 7.3; Appendix Table E.4). It is important to note that there was a change in laboratories used for the analysis of benthic invertebrate tissue chemistry samples in 2021 to increase field sampling efficiency by reducing time spent picking insects from sample material (SRC was used in 2018 and 2019, and TrichAnalytics was used in 2021), therefore, changes in mercury concentrations observed between 2018 and 2019 compared to 2021 may be related to differences in analytical procedures.

7.3.2 Selenium

Mean benthic invertebrate tissue selenium concentrations only exceeded the BC guideline at CC5.6 and reference area XE0.2 (all years; Table 7.2; Figure 7.3). Selenium concentrations at future-exposed areas were generally significantly higher than reference area SYT0.6 (Appendix Table E.4). Conversely, selenium concentrations in benthic invertebrate tissue from HC0.2 and YT0.2 were significantly lower than the reference area XE0.2 (Appendix Table E.4). The range of values at reference areas therefore capture regional variability in benthic invertebrate tissue selenium concentrations. No differences were observed between CC5.6 and reference area XE0.2 in either 2018 or 2019, indicating that selenium concentrations are naturally elevated at this reference area. Temporally, significantly higher selenium concentrations were observed at HC0.2 in both 2019 and 2021 compared to 2018 (Appendix Table E.4). Additionally, significantly higher selenium concentrations were noted in 2021 compared to 2019 at CC5.6 (Appendix Table E.4).

7.3.3 Key Indicators

At Lower Creek areas, arsenic was significantly higher at future-exposed areas when compared to both reference areas, potentially associated with proximity to the Project economic ore body (Table 7.2; Figure 7.4; Appendix Table E.4). Uranium was also significantly higher at all Lower Creek areas compared to reference area XE0.2. Uranium concentrations at future-exposed areas HC0.2 and CC5.6 were not significantly different from reference area SYT0.6, and uranium concentrations were significantly lower at YT0.2 than SYT0.6 (Table 7.2; Figure 7.4; Appendix Table E.4). This indicates that reference areas XE0.2 and SYT0.6 effectively capture the range of natural variability in Lower Creek area uranium concentrations (Table 7.2; Figure 7.4). No temporal changes in the concentrations of benthic invertebrate tissue arsenic, uranium, or zinc were apparent at any of areas over the baseline monitoring period (Appendix Table E.4). Similar to the Upper Creek areas, differences in benthic invertebrate tissue aluminum, chromium, copper, and zinc concentrations were variable between future-exposed and

reference areas were observed but were not consistent across years (Table 7.2; Figure 7.4; Appendix Table E.4).

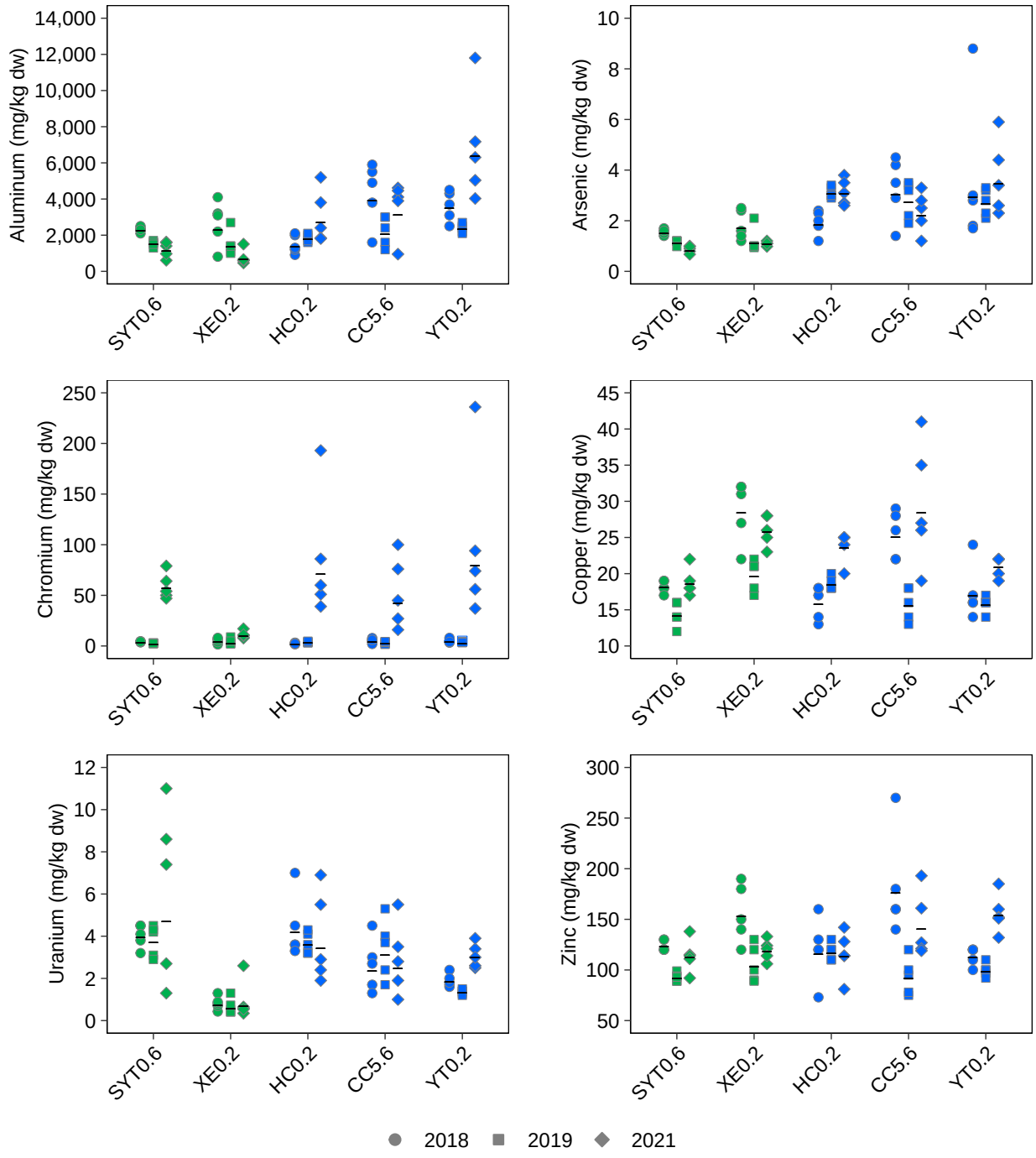

Figure 7.4: Coffee Project FALMP Benthic Invertebrate Tissue Metal Concentrations, Selected Parameters, Lower Creek Areas, 2018 to 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

8 SEDIMENT CHEMISTRY

8.1 Overview

Sediment sampling was conducted in 2019 and 2021 to determine the feasibility of including a robust sediment chemistry component in the FALMP. Project FALMP Upper and Lower Creek areas are mostly erosional habitat, and availability of depositional habitat is very low or non-existent and can vary by year. Sediment was therefore collected at areas where it could be located and in whatever limited volume was available. The results of a DQR indicate that FALMP baseline sediment chemistry samples were associated with excellent analytical precision and can be reliably interpreted (Appendix G). All sediment chemistry data collected as part of FALMP baseline monitoring in 2018, 2019, and 2021 are provided in Appendix F.

8.2 Upper Creek Areas

Sediment samples were collected in 2019 and 2021 from three future-exposed Upper Creek Areas including HC6.8 (upper Halfway Creek), LC10.2 (Latte Creek), and YT4.3 (upper YT-24 Creek; only sampled in 2019). Sediment could not be collected from either Upper Creek reference area (CC23.7 and CR24.5). The sediments of Upper Creek future-exposed areas were primarily composed of silt (49 to 84%; Table 8.1; Appendix Figure F.1; Appendix Table F.1; Appendix Figure F.1) and to a lesser extent sand (12 to 41%; Table 8.1). Particles larger than sand were rare in samples collected from the Upper Creek areas (Appendix Table F.1; Appendix Figure F.1). Percent TOC varied among the Upper Creek Areas ranging from 4.8 to 8.9% at HC6.8, 2.3 to 4.0% at LC10.2, and 3.2 to 7.0% at YT4.3 (Table 8.1).

Sediment samples from the three future-exposed areas were analyzed for 35 different metals, and the results were screened against BC Working and Canadian Sediment Quality Guidelines. Of all analytes, only arsenic exceeded the upper sediment quality guideline (at two areas; HC6.8 and YT4.3; Table 8.1; Appendix Table F.1; Appendix Figure F.1), while exceeding the lower sediment quality guideline at the third area (i.e., LC10.2; Table 8.1; Appendix Table F.1; Appendix Figure F.1). Lower-level guideline exceedances were observed for four other analytes from each of the future-exposed Upper Creek areas, including chromium (Appendix Table F.1).

Sediment concentrations of TOC, arsenic, chromium, and uranium varied among future-exposed Upper Creek Areas (Appendix Table F.1; Appendix Figure 8.1). As sediment samples could not be collected from the reference Upper Creek Areas, no comparison could be made between the future-exposed and reference areas. Temporal variability was observed in several sediment chemistry analytes at the areas that were sampled in 2019 and 2021 (i.e., HC6.8 and LC10.2). At LC10.2, several analytes including aluminum, chromium, copper, uranium, and zinc were significantly higher in 2021 than in 2019 (Appendix Table F.2; Appendix Figure F.1). At HC6.8,

Table 8.1: Summary of Mean Sediment Analyte Concentrations Collected in Upper and Lower Tributaries, 2019 and 2021

Analytes	BC WSQG and CCME Guidelines		Units	Upper Creek Areas					Lower Creek Areas					
				HC6.8	HC6.8	LC10.2	LC10.2	YT4.3	SYT0.6	XE0.2	HC0.2	CC5.6	CC5.6	YT0.2
				20-Aug-19	19-Aug-21	21-Aug-19	23-Aug-21	22-Aug-19	23-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	23-Aug-21	20-Aug-21
	Lower	Upper		n=3	n=5	n=3	n=5	n=4	n=3	n=3	n=3	n=5	n=5	n=5
Particle Size														
% Sand (0.063 mm - 2.0 mm)	-	-	%	11.9	34.0	40.7	29.6	25.1	33.3	26.4	44.2	46.8	20.6	65.7
% Silt (4 µm - 0.063 mm)	-	-	%	83.7	59.8	53.9	64.4	68.7	61.9	68.3	51.8	48.3	74.1	30.1
Organic / Inorganic Carbon														
Total Organic Carbon	-	-	%	8.02	6.15	2.47	3.45	5.25	3.29	9.36	4.01	2.78	7.41	2.69
Metals														
Aluminum	-	-	mg/kg	17,867	17,820	12,600	20,080	14,716	12,100	13,367	13,667	14,220	20,740	11,478
Arsenic	5.9	17	mg/kg	29.5	38.4	14.6	15.1	18.7	6.3	8.7	17.0	11.0	11.0	18.4
Chromium	37.3	90	mg/kg	43.0	42.2	27.4	37.2	28.0	31.1	37.5	37.9	25.0	33.7	23.0
Copper	35.7	197	mg/kg	17.3	15.2	10.5	18.0	13.8	13.0	32.8	14.7	15.4	27.1	11.6
Mercury	0.17	0.486	mg/kg	-	0.0625	-	0.0531	0.0531	-	-	-	-	0.0806	<0.05
Selenium	2	-	mg/kg	0.377	0.233	<0.2	<0.2	<0.2	<0.2	0.880	0.210	0.242	0.446	<0.2
Uranium	-	-	mg/kg	33.7	17.4	3.4	4.1	2.6	7.6	3.6	14.4	7.2	9.5	5.2
Zinc	123	315	mg/kg	63.4	59.8	51.5	65.9	48.1	48.5	98.5	50.3	62.1	79.6	41.8

Value is > BC Working Sediment Quality Guideline and Canadian Sediment Quality Guideline Effect Lower Level.

Value is > BC Working Sediment Quality Guideline and Canadian Sediment Quality Guideline Effect Upper Level.

Notes: "-" = no data. BCWSQG = British Columbia Working Sediment Quality Guideline (BCMOECCS 2021) and approved BC Sediment Quality Guideline for selenium (BCMOECCS 2019c). CCME = Canadian Sediment Quality Guideline (CCME 2001). All WSQG and CCME Guidelines are the same except for selenium as there is no CCME guideline.

several analytes were significantly higher in 2021 than in 2019 (e.g., arsenic), while others were significantly lower (e.g., uranium; Table 8.1; Appendix Table F.2; Appendix Figure F.1).

8.3 Lower Creek Areas

Sediment samples were collected in 2019 from Lower Creek future-exposed areas HC0.2 and CC5.6, and reference areas SYT0.6 and XE0.2 (Table 8.1). Samples were also collected in 2021 at Lower Creek future-exposed areas YT0.2 and again from CC5.6 (Table 8.1). The sediments of two of the three Lower Creek future-exposed areas (HC0.2 and CC5.6) were primarily composed of silt (41% to 78%) and to a lesser extent sand (Table 8.1), whereas at future-exposed area YT0.2 sand was the dominant particle type (5% to 72%), and silt secondary (24 to 37%; Table 8.1; Appendix Table F.1; Appendix Figure F.1). At both reference Lower Creek areas (SYT0.6 and XE0.2) sand (62 to 72%) and silt (22 to 33%) were the primary and secondary components, respectively (Table 8.1; Appendix Figure F.1). Like the Upper Creek Areas, particles larger than sand were rare in samples collected from the Lower Creek Areas (Appendix Table F.1; Appendix Figure F.1). Percent TOC varied among both the future-exposed and reference Lower Creek Areas, ranging from 2.6 to 4.9% at HC0.2 (2019), 2.1 to 12% at CC5.6 (2019 and 2021), 2 to 4% at YT0.2 (2021), 2.9 to 4.1 % at SYT0.6 (2019), and 6.6 to 13% at XE0.2 (2019; Table 8.1; Appendix Table F.1; Appendix Figure F.1).

Lower Creek area sediment samples were also analyzed for 35 different metals, and results were screened against BC Working and Canadian Sediment Quality Guidelines. Similar to Upper Creek Areas, only arsenic exceeded the Upper Sediment Quality Guideline, which occurred at areas HC0.2 (2019) and YT0.2 (2021), while the Lower Sediment Quality Guideline was exceeded at area CC5.6 (2019 and 2021; Table 8.1; Appendix F.1; Appendix Figure F.1). There were lower-level exceedances of six other analytes among the future-exposed and reference areas, including chromium, which exceeded the lower guideline at areas HC0.2 and XE0.2, and copper, which exceeded the lower guideline at XE0.2 (Table 8.1). Sediment samples were only collected from one future-exposed Lower Creek area in both 2019 and 2021 (CC5.6). Several analytes were significantly higher in concentration in 2021 relative to 2019 at CC5.6, including aluminum, chromium, copper, uranium, and zinc (Appendix Table F.2; Appendix Figure F.1).

Lower Creek sediment chemistry differed between future-exposed and reference area for several analytes (Appendix Table F.3). Arsenic was significantly higher at future-exposed Lower Creek areas than reference areas (potentially due to ore body influence), whereas chromium was significantly lower at future-exposed Lower Creek Areas than the reference areas (Appendix Table F.3; Appendix Figure F.1). With respect to copper and zinc, concentrations at reference area XE0.2 were significantly higher than reference area SYT0.6 and both future-exposed areas sampled (HC0.2 and CC5.6; Appendix Table F.3; Appendix Figure F.1).

Finally, differences among future-exposed and reference areas in aluminum and uranium were observed but were inconsistent (Appendix Table F.3; Appendix Figure F.1).

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 Conclusions

Habitat variables at FALMP monitoring areas, specifically flow and temperature, are of good comparability and have generally been similar between Project future-exposed and reference areas, as well as between Upper and Lower Creek areas over the FALMP baseline sampling period. *In situ* water quality variables, particularly temperature and DO, were also similar between future-exposed and reference areas at both Upper and Lower Creek areas. Variability in conductivity between future-exposed and reference areas (i.e., higher mean values Upper Creek future-exposed than Upper Creek reference, and lower mean values at Lower Creek future-exposed than Lower Creek reference) was generally consistent across years of baseline sampling, and the range of reference values will be a good "control" term within the BACI design. In general, habitat and water quality conditions at Upper and Lower Creek future-exposed and reference areas demonstrate good comparability.

Periphyton conditions in creeks of the Project area (Upper and Lower Creek areas) during FALMP baseline sampling were characterized by low productivity (i.e., oligotrophic conditions), blue-green algae dominance, and low variety in taxonomic groups present. Data across FALMP future-exposed and reference areas were of good comparability across all periphyton productivity and community endpoints (i.e., chlorophyll-a, AFDM, and periphyton biomass). For most periphyton community endpoints (e.g., taxonomic richness, evenness, community proportions, etc.) baseline data ranges for future-exposed and reference areas were either similar or represent a range of natural variability that occurred consistently across FALMP sampling areas and can be compared against for future monitoring during future Project development phases. Periphyton productivity was frequently lower at future-exposed areas than reference (particularly for Upper Creek areas). However, because an increase in algal productivity at future-exposed areas due to nutrient enrichment is one of the anticipated potential Project-related changes, higher values at reference areas provide a good range of naturally occurring variability for future comparisons (Minnow and EDI 2017). Upper and Lower Creek FALMP sampling areas and baseline data will be reliable for tracking Project-related changes in periphyton productivity and community in the future.

Project Upper and Lower Creek area benthic invertebrate communities were generally co-dominated by EPT taxa (particularly stoneflies), chironomids, black flies, and oligochaetes, similar to the initial 2015 to 2017 baseline assessment (Minnow and EDI 2017). Benthic invertebrate total density and biomass were frequently higher at reference than future-exposed areas, which likely results from the generally higher periphyton productivity at

reference relative to future-exposed areas. At all FALMP areas, evenness was generally low to moderate, and diversity was generally moderate to high. Most other benthic invertebrate community endpoints were comparable between Upper and Lower Creek areas and were also consistent with the 2014 to 2017 baseline work, despite the change in sampling methodology to a more quantitative method (Minnow and EDI 2017; EDI and Minnow 2021).

Benthic invertebrate community endpoints including key indicators (e.g., total density, taxonomic richness, and evenness) varied within and among all areas (i.e., future-exposed/reference and Upper/Lower Creek areas) over the FALMP baseline sampling period. However, ranges of values for most benthic invertebrate community endpoints were comparable between future-exposed and reference areas, or the complete range of values for reference areas reflected the range of future-exposed area baseline values, and therefore still provides a good basis for comparison of Project-related effects in the future. Furthermore, significant differences between future-exposed and reference FALMP area benthic community endpoints mostly occurred inconsistently. This implies that FALMP reference areas likely reflect the range of naturally occurring variability occurring at future-exposed areas. Interannual variability in benthic invertebrate community endpoints may also be driven by changes in the same physicochemical variables (i.e., habitat and *in situ* water quality parameters) at FALMP future-exposed and reference areas. However, significant correlations between those endpoints and benthic invertebrate community endpoints were too numerous and inconsistent to identify meaningful trends.

Several benthic invertebrate tissue quality analytes, including mercury, selenium, and uranium were naturally elevated at FALMP Upper and Lower Creek future-exposed and reference areas. In the case of mercury and selenium, concentrations exceeded benchmarks at future-exposed and reference areas, although mercury did not exceed the benchmark at either Lower Creek reference area. Exceedances were generally not observed consistently across all areas and years, as spatial and temporal variability was high for both analytes. Arsenic concentrations were generally higher at Upper and Lower Creek future-exposed areas than reference, potentially due to proximity to the ore body. Variability in concentrations of other key aqueous indicator analytes (e.g., chromium, copper, selenium, and uranium) between future-exposed and reference areas was inconsistent in both Upper and Lower Creek areas. Successfully identifying this range of natural variability in benthic invertebrate tissue analytes during baseline will likely be beneficial for differentiating between Project-related effects and changes related to natural variability in the future.

Sediment was collected opportunistically in 2019 and 2021 monitoring due to the scarcity of depositional habitat in FALMP Upper and Lower Creek areas. Available data indicate that several analytes (e.g., arsenic, chromium, copper, selenium, and uranium) are elevated in FALMP

Upper and Lower Creek area sediments. This result reflects results of water quality monitoring as well as FALMP benthic invertebrate tissue chemistry monitoring. A robust statistical comparison of spatiotemporal variability across FALMP areas over the baseline monitoring period similar to the ones employed for other study components (e.g., benthic invertebrate community structure and tissue chemistry) was not possible with the limited sample size available for sediment chemistry. Sediment chemistry analytes that occurred in naturally elevated concentrations at future-exposed areas (e.g., Halfway Creek and YT-24 Creek) were also elevated at associated reference areas, indicating that the current study design with respect to area selection will be effective for differentiating between Project effects and naturally elevated metal concentrations.

Overall, the application of a “future-exposed” versus reference design at the baseline stage indicated numerous differences in physical and chemical variables, in key metrics of periphyton production and community, and in key metrics of benthic invertebrate production, community and tissue quality despite careful matching of the areas. This highlights the ubiquity of natural differences even among closely matched un-impacted sampling areas and the importance of accounting for such differences to facilitate true detection of potential project/mine-related influences on aquatic life.

9.2 Recommendations for Future Monitoring and Interpretation

Given the general consistency of results between future-exposed and reference areas across all monitoring endpoints for both Upper and Lower Creek monitoring areas, it is recommended that FALMP monitoring proceed under the current conceptual design according to the schedule outlined in the FALMP (EDI and Minnow 2021). The BACI design will be optimal for detecting Project-related changes as selected reference areas are good matches for the “future-exposed” areas and baseline conditions for both are now well characterized. This design will facilitate identification of Project-related changes by providing differentiation from naturally occurring spatial and temporal variability (thereby eliminating the risk of falsely attributing a difference between an exposed area and a reference area to a mine-related effect).

Project FALMP creeks have very minimal periphytic coverage and selection of rocks for periphyton collection is generally targeted towards rocks with visible algal material. This is because selection of entirely random rocks would result in sample volumes being too low for analysis. We recommend that FALMP sampling introduce artificial substrates in order to attempt collection of algal biomass data that are as reliably quantitative as possible. Introduction of artificial substrates is proposed as a means of: 1) ensuring data are quantitative, and 2) maximizing comparability among sampling areas. We propose that at each area, n=5 modified Hester-Dendy samplers (adapted for use in shallow creek environments) are installed

for biomass analysis, and n=5 rock cages are installed (using rocks from the same area). Artificial substrates, such as Hester-Dendy samplers, will improve biomass sampling and reflect natural primary production, but communities on artificial substrates do not always reflect naturally occurring communities, which necessitates the rock cages (Porter et al. 1993). Additionally, we propose that we test comparability of data collected using tubular syringe/brush samplers for sampling in 2022 as this could potentially reduce sample loss and increase sampling accuracy (Steinman et al. 2017). This will also enable sampling from rocks having suboptimal surfaces for scraping with a scalpel, like those with rough, irregular surfaces, which occur frequently in creeks in the vicinity of the Coffee Project and are generally not scraped, potentially skewing community data. A downside of changing protocols is the potential loss of baseline productivity data; however, it is possible those data collected using the updated methods may be comparable in which case we may still be able to apply BACI, otherwise additional baseline sampling would potentially be necessary in that case.

Depositional habitats are uncommon on FALMP creeks, and their presence can vary from year-to-year, making the reliability of sediment collection as part of annual monitoring poor. For example, depositional areas have not been identified over three years of sampling at Upper Creek reference areas CR24.5 and CC23.7, and aside from CC5.6 and LC10.2, locations and presence of sediment have been variable at other FALMP areas. It is unlikely that FALMP sediment sampling will be adequate to reliably support meaningful BACI statistical comparisons in the future. Nonetheless, we recommend that sediment continue to be collected opportunistically, particularly in Project receiving area creeks (i.e., Latte, Coffee, Halfway, and YT-24 Creeks), as they have demonstrated the highest degree of reliability with respect to sediment presence over the baseline period. An alternative statistical approach may be utilized for sediment (e.g., a BA design), which would then remove collection of sediment at reference areas (as robust comparison to reference is limited already) and focus on comparisons reflecting change over time at areas with more reliable sediment deposits. Also, those data could be supplemented with periphyton tissue chemistry data, which would constitute as close an approximation as possible to the functional connection between sediment and water chemistry.

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APPENDIX A
METHODS

Table A.1: Coffee Project FAL-AMP Periphyton and Benthic Invertebrate Sampling Station Coordinates[a], 2017, 2018, 2019, and 2021

Region	Location	Area Name	Pre-2019 Area Name(s)	Designation	Station	2021		2019		2018	
						Easting	Northing	Easting	Northing	Easting	Northing
Upper Creek Areas	Upper Coffee Creek Tributary	CC23.7	CF19.2	Future Reference	CC23.7-1	597038	6961876	597095	6961878	597099	6961878
					CC23.7-2	597084	6961882	597078	6961876	597078	6961874
					CC23.7-3	597071	6961866	597069	6961855	597069	6961855
					CC23.7-4	597009	6961855	597008	6961849	597005	6961853
					CC23.7-5	596953	6961888	596950	6961892	596949	6961886
	Upper Carlisle Creek Tributary	CR24.5	CR16.7; I29		CR24.5-1	564235	6976929	564236	6976928	564234	6976931
					CR24.5-2	564277	6977099	564272	6976959	564275	6976959
					CR24.5-3	564261	6976994	564267	6976988	564259	6976987
					CR24.5-4	564279	6977077	564276	6977078	564275	6977080
					CR24.5-5	564278	6977101	564282	6977101	564277	6977094
	Upper Halfway Creek	HC6.8	HF6.3	Future Exposed	HC6.8-1	584067	6976594	584064	6976589	584064	6976589
					HC6.8-2	584106	6976638	584107	6976633	584111	6976628
					HC6.8-3	584148	6976685	584140	6976690	584143	6976683
					HC6.8-4	584191	6976747	584190	6976745	584189	6976742
					HC6.8-5	584198	6976781	5484199	6976778	584198	6976777
	Upper Latte Creek	LC10.2	LC8.3		LC10.2-1	585919	6971383	585922	6971389	585938	6971396
					LC10.2-2	585969	6971366	585973	6971356	585973	6971361
					LC10.2-3	586065	6971315	586103	6971303	586103	6971303
					LC10.2-4	586117	6971307	586117	6971302	586123	6971310
					LC10.2-5	586208	6971252	586207	6971256	586210	6971260
	Upper YT-24 Creek	YT4.3	YT4.6		YT4.3-1	585867	6976366	585855	6976351	585844	6976346
					YT4.3-2	585892	6976398	585890	6976403	585891	6976403
					YT4.3-3	585932	6976481	585928	6976975	585928	6976475
					YT4.3-4	585974	6946529	585997	6976958	585995	6976601
					YT4.3-5	586052	6976684	586053	6976685	586054	6976685
Lower Creek Areas	Lower Creek South of YT-24	SYT0.6	-	Future Reference	SYT0.6-1	590226	6978256	590225	6978251	590226	6978251
					SYT0.6-2	590253	6978240	590255	6978240	590256	6978240
					SYT0.6-3	590269	6978268	590267	6978270	590267	6978265
					SYT0.6-4	590317	6978266	590308	6978268	590304	6978274
					SYT0.6-5	590329	6978285	590332	6978288	590326	6978289
	Lower Creek East of Excelsior	XE0.2	-		XE0.2-1	605065	6973849	605064	6973861	605064	6973853
					XE0.2-2	605055	6973881	605063	6973865	605073	6975869
					XE0.2-3	605098	6973940	605088	6973941	605089	6973968
					XE0.2-4	605137	6974037	605138	6974039	605135	6974040
					XE0.2-5	605169	6974060	605175	6974063	605173	6974061
	Lower Halfway Creek	HC0.2	HF0.2	Future Exposed	HC0.2-1	588560	6980343	588556	6980340	588556	6980340
					HC0.2-2	588653	6980416	588655	6980413	588655	6980413
					HC0.2-3	588701	6980416	588685	6980415	588699	6980408
					HC0.2-4	588728	6980465	588724	6980459	588724	6980459
					HC0.2-5	588767	6980489	588766	6980490	588768	6980490
	Lower Coffee Creek	CC5.6	CF3.9		CC5.6-1	596831	6974223	596845	6974237	585844	6976346
					CC5.6-2	596867	6974221	596865	6974216	585891	6976403
					CC5.6-3	597008	6974393	597009	6974403	585928	6976475
					CC5.6-4	597039	6974398	597038	6974405	585995	6976601
					CC5.6-5	597079	6974335	597074	6974340	586054	6976685
	Lower YT-24 Creek	YT0.2	YT0.2		YT0.2-1	589439	6979065	589442	6979068	589434	6979075
					YT0.2-2	589538	6979127	589539	6979129	589539	6979139
					YT0.2-3	589582	6979143	589581	6919133	589582	6979153
					YT0.2-4	589634	697164	589638	6979180	589627	6979164
					YT0.2-5	589663	6979156	589664	6979163	589675	6979149

[a] UTMs all zone 7N.

APPENDIX B
HABITAT AND *IN SITU* WATER CHEMISTRY

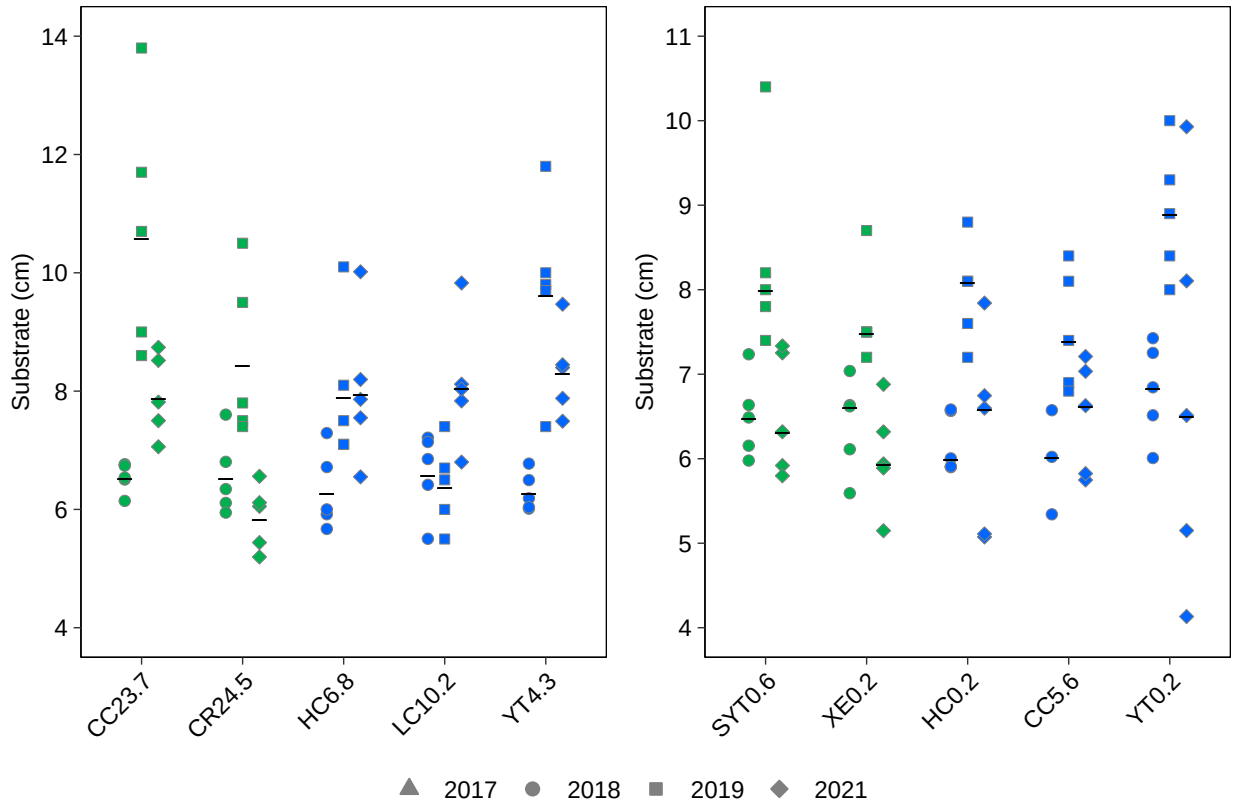


Figure B.1: Coffee Project FALMP Upper and Lower Creek Area Substrate Size, 2018, 2019, and 2021

Notes: Green represents reference stations and blue represents future-exposed stations. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses.

Table B.1: Raw Habitat and In Situ Water Quality Data, Upper Creek Areas, 2017[a] to 2021

Metrics	2017					2018									
	HC6.8					CC23.7					CR24.5				
	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5	CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5
Water Velocity (m³/s)	0.370	0.310	0.370	0.420	0.370	0.850	0.880	0.780	0.820	0.890	0.910	0.830	0.920	0.820	0.920
Temperature (°C)	3.60	3.80	3.90	4.00	1.60	1.30	1.50	1.90	2.30	2.70	2.60	2.30	2.20	3.00	3.40
DO (mg/L)	12.0	12.2	12.3	12.3	13.4	13.1	12.9	12.7	12.5	12.2	12.7	12.6	12.7	12.6	12.5
DO (%)	90.8	93.1	93.7	94.6	96.4	92.7	91.8	91.9	91.1	90.3	93.3	92.1	92.4	93.8	93.7
pH	7.52	7.65	7.74	7.82	7.40	-	-	7.40	7.38	7.37	7.37	7.39	7.20	7.45	7.46
Specific Conductance (µS/cm)	196	196	196	195	156	150	150	149	164	162	116	116	116	110	116
Conductivity (µS/cm)	116	117	117	117	86.0	82.0	83.0	83.0	93.0	93.0	66.0	66.0	66.0	64.0	68.0
Substrate (cm)	-	-	-	-	-	6.51	6.54	6.14	6.76	6.74	6.80	7.60	6.11	6.34	5.95

Note: "-" indicates no data.

[a] Data only collected from one FALMP area (HC6.8) in 2017.

Table B.1: Raw Habitat and In Situ Water Quality Data, Upper Creek Areas, 2017[a] to 2021

Metrics	2018														
	HC6.8					LC10.2					YT4.3				
	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5
Water Velocity (m³/s)	0.860	0.910	0.760	0.870	0.910	0.780	0.860	0.920	0.820	0.910	0.860	0.750	0.740	0.780	0.780
Temperature (°C)	2.20	2.30	2.50	2.80	3.20	3.90	3.40	3.20	2.80	2.70	1.80	1.90	2.10	2.40	2.90
DO (mg/L)	12.6	12.6	12.7	12.8	12.5	12.2	12.1	12.4	12.4	12.5	13.0	12.8	12.9	12.8	12.6
DO (%)	91.4	91.8	93.2	94.6	93.1	92.7	91.0	92.7	92.0	91.7	92.9	92.6	93.7	93.8	92.9
pH	7.49	7.56	7.47	7.69	7.45	-	7.37	-	7.28	7.27	7.23	7.38	7.33	7.35	7.32
Specific Conductance (µS/cm)	191	185	181	176	175	179	192	193	186	179	62.0	62.0	63.0	62.0	64.0
Conductivity (µS/cm)	108	105	103	102	102	107	113	113	108	103	34.0	35.0	35.0	35.0	37.0
Substrate (cm)	6.72	5.92	5.67	7.29	6.00	5.50	6.42	7.21	7.14	6.85	6.50	6.77	6.01	6.19	6.04

Note: "-" indicates no data.

[a] Data only collected from one FALMP area (HC6.8) in 2017.

Table B.1: Raw Habitat and In Situ Water Quality Data, Upper Creek Areas, 2017[a] to 2021

Metrics	2019														
	CC23.7					CR24.5					HC6.8				
	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5	CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5
Water Velocity (m³/s)	0.649	0.670	0.600	0.500	0.906	0.700	0.584	1.09	0.930	0.990	0.800	0.700	0.850	0.660	0.700
Temperature (°C)	3.50	3.50	3.00	1.90	1.60	4.30	3.00	2.20	1.20	1.30	1.10	1.60	2.00	2.70	2.90
DO (mg/L)	11.9	11.9	12.1	12.2	12.4	12.0	12.3	12.4	12.8	12.5	15.8	15.8	16.0	15.0	15.3
DO (%)	90.0	89.6	89.9	87.6	88.4	92.6	91.6	90.1	90.7	88.7	125	126	130	124	127
pH	7.79	7.77	8.02	7.85	7.52	7.81	7.77	7.71	7.71	7.68	7.72	7.93	7.92	8.09	8.19
Specific Conductance (µS/cm)	141	143	142	152	151	137	137	134	136	136	268	269	272	271	274
Conductivity (µS/cm)	83.1	84.3	82.4	84.6	83.3	82.7	79.3	75.8	74.2	74.3	146	149	153	156	159
Substrate (cm)	10.7	11.7	9.00	13.8	8.60	7.80	9.50	10.5	7.50	7.40	7.50	8.10	10.1	7.10	7.10

Note: "-" indicates no data.

[a] Data only collected from one FALMP area (HC6.8) in 2017.

Table B.1: Raw Habitat and In Situ Water Quality Data, Upper Creek Areas, 2017[a] to 2021

Metrics	2019										2021				
	LC10.2					YT4.3					CC23.7				
	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5
Water Velocity (m³/s)	0.720	0.750	0.778	0.840	0.750	0.650	0.600	0.700	0.600	0.550	0.553	0.548	0.505	0.559	0.434
Temperature (°C)	3.40	3.20	2.50	1.90	1.20	2.50	2.10	1.50	0.700	0.400	3.10	2.80	2.60	2.00	1.40
DO (mg/L)	11.9	11.9	12.1	12.5	12.8	12.2	12.6	12.4	12.7	12.1	12.4	12.3	12.5	12.6	12.9
DO (%)	87.9	89.1	88.7	90.1	90.9	89.5	91.0	89.0	89.0	84.1	91.7	91.2	92.0	91.5	92.0
pH	7.78	7.84	7.76	7.78	7.80	7.60	7.20	7.79	7.54	7.45	7.41	7.30	7.40	7.39	7.39
Specific Conductance (µS/cm)	182	196	211	210	208	61.7	60.8	62.4	63.2	64.0	108	108	106	113	112
Conductivity (µS/cm)	106	114	120	117	113	35.1	34.1	34.4	34.1	34.1	63.0	62.3	60.5	63.5	61.6
Substrate (cm)	7.40	5.50	6.50	6.00	6.70	7.40	9.80	11.8	9.70	10.0	8.52	7.06	7.81	8.74	7.50

Note: "-" indicates no data.

[a] Data only collected from one FALMP area (HC6.8) in 2017.

Table B.1: Raw Habitat and In Situ Water Quality Data, Upper Creek Areas, 2017[a] to 2021

Metrics	2021														
	CR24.5					HC6.8					LC10.2				
	CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5
Water Velocity (m³/s)	0.459	0.565	0.396	0.459	0.446	0.379	0.513	0.190	0.601	0.742	0.559	0.489	0.520	0.523	0.436
Temperature (°C)	4.70	4.60	3.00	4.70	1.30	3.70	3.50	3.00	2.40	2.10	4.40	4.00	3.30	3.10	2.80
DO (mg/L)	11.7	11.9	12.3	11.7	12.8	12.3	12.5	12.7	13.0	13.1	11.9	12.0	12.2	12.3	12.4
DO (%)	91.2	92.2	91.7	91.2	91.2	92.9	94.2	94.6	95.0	95.1	91.6	91.8	91.1	91.5	92.0
pH	7.70	7.72	7.66	7.70	7.67	7.51	7.46	7.50	7.49	7.57	7.73	7.81	7.76	7.75	7.74
Specific Conductance (µS/cm)	186	186	186	186	185	132	130	132	132	132	262	297	295	292	291
Conductivity (µS/cm)	114	113	108	114	101	78.4	76.8	76.6	75.0	74.4	159	167	173	170	167
Substrate (cm)	6.05	5.44	6.11	5.20	6.56	10.0	6.55	8.20	7.55	7.86	8.12	7.83	8.03	6.80	9.83

Note: "-" indicates no data.
[a] Data only collected from one FALMP ar

Table B.1: Raw Habitat and In Situ Water Quality Data, Upper Creek Areas, 2017[a] to 2021

Metrics	2021				
	YT4.3				
	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5
Water Velocity (m^3/s)	0.453	0.398	0.289	0.554	0.505
Temperature (°C)	2.40	2.50	2.50	2.40	2.20
DO (mg/L)	12.6	12.6	12.4	12.5	12.7
DO (%)	92.2	92.1	90.8	91.0	92.3
pH	7.14	7.14	6.97	7.13	6.87
Specific Conductance (µS/cm)	60.4	60.3	60.8	60.4	62.2
Conductivity (µS/cm)	34.2	34.4	34.8	34.3	35.1
Substrate (cm)	8.40	7.88	7.49	9.47	8.45

Note: "-" indicates no data.

[a] Data only collected from one FALMP area (HC6.8) in 2017.

Table B.2. **Spatial and Temporal Comparisons of Habitat and *In situ* Water Quality Parameters among Stations in Upper Creek Areas, Coffee Project FALMP, 2018 to 2021**

ANOVA Model					Station		Do concentrations differ over time?			Do concentrations differ among stations?					
							Magnitude of Difference[a]			Magnitude of Difference[b]					
										CC23.7 vs CR24.5 and Future Exposed			CR24.5 vs CC23.7 and Future Exposed		
Parameter	Transformation	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Water Velocity (m³/s)	rank	0.009	<0.001	0.294	Reference	CC23.7	-19	-41	-28	nc			nc		
						CR24.5				ns			nc		
					Exposure	HC6.8				ns			ns		
						LC10.2				ns			ns		
						YT4.3				ns			-27		
Temperature (°C)	none	0.004	0.004	0.332	Reference	CC23.7	ns	ns	35	nc			nc		
						CR24.5				ns			nc		
					Exposure	HC6.8				ns			ns		
						LC10.2				ns			ns		
						YT4.3				ns			-31		
DO (mg/L)	none	0.004	0.002	0.027	Reference	CC23.7	-4.6	ns	3.8	nc	nc	nc	nc	nc	nc
						CR24.5	ns	-4.2	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC6.8	-	ns	-	ns	nc	ns	ns	nc	5.1
						LC10.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
						YT4.3	-3.2	ns	ns	ns	ns	ns	ns	ns	ns
DO (%)	rank	<0.001	<0.001	0.002	Reference	CC23.7	-2.4	ns	2.3	nc	nc	nc	nc	nc	nc
						CR24.5	-2.8	-2.3	ns	1.6	ns	ns	nc	nc	nc
					Exposure	HC6.8	-	ns	-	ns	nc	3.2	ns	nc	3.7
						LC10.2	-3.2	ns	2.8	ns	ns	ns	ns	ns	ns
						YT4.3	-4.2	-0.86	3.5	1.2	ns	ns	ns	ns	ns
pH	rank	<0.001	<0.001	<0.001	Reference	CC23.7	5.6	ns	-5.1	nc	nc	nc	nc	nc	nc
						CR24.5	4.3	4.2	ns	ns	ns	4.2	nc	nc	nc
					Exposure	HC6.8	5.9	ns	-5.4	ns	ns	ns	ns	ns	ns
						LC10.2	6.9	6.5	ns	ns	ns	4.9	ns	ns	ns
						YT4.3	2.9	ns	-5.4	ns	-3.2	-3.5	ns	-2.2	-7.4
Specific Conductance (µS/cm)	rank	<0.001	<0.001	<0.001	Reference	CC23.7	ns	-28	-24	nc	nc	nc	nc	nc	nc
						CR24.5	17	60	37	-23	ns	72	nc	nc	nc
					Exposure	HC6.8	50	-27	-51	21	89	22	56	99	-29
						LC10.2	12	57	40	24	45	170	60	53	57
						YT4.3	ns	-2.6	-3.2	-59	-56	-44	-47	-54	-68
Conductivity (µS/cm)	log10	<0.001	<0.001	<0.001	Reference	CC23.7	ns	-28	-26	nc	nc	nc	nc	nc	nc
						CR24.5	17	67	42	-24	-7.6	77	nc	nc	nc
					Exposure	HC6.8	47	-27	-50	20	82	23	58	97	-31
						LC10.2	ns	54	46	25	37	169	65	48	52
						YT4.3	ns	ns	ns	-59	-59	-44	-47	-55	-69
Substrate (cm)	log10	<0.001	<0.001	<0.001	Reference	CC23.7	62	21	-25	nc	nc	nc	nc	nc	nc
						CR24.5	29	ns	-31	ns	-20	-26	nc	nc	nc
					Exposure	HC6.8	26	26	ns	ns	-25	ns	ns	ns	36
						LC10.2	ns	22	26	ns	-40	ns	ns	-24	38
						YT4.3	53	32	ns	ns	ns	ns	ns	ns	42

ANOVA P-value < 0.05.
Significantly Decrease in Concentration.
Significantly Increase in Concentration.

Note: "nc" indicates no comparison available; "ns" indicates not significant.

[a] Magnitude of Difference is calculated as $(MCT_{recent\ year} - MCT_{older\ year})/ MCT_{older\ year})*100$. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for others.

[b] Magnitude of Difference is calculated as $(MCT_{Exposed} - MCT_{Reference})/(MCT_{Reference}))*100$. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for others.

Table B.3. Raw Habitat and In Situ Water Quality Data, Lower Creek Areas, 2018 to 2021

Metrics	2018														
	SYT0.6					XE0.2					HC0.2				
	SYT0.6-1	SYT0.6-2	SYT0.6-3	SYT0.6-4	SYT0.6-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5
Water Velocity (m³/s)	0.750	0.680	0.720	0.920	0.668	0.850	0.750	0.860	0.840	0.930	0.760	0.870	0.830	0.880	1.00
Temperature (°C)	2.70	2.60	2.60	2.40	2.30	2.80	2.60	2.40	2.20	2.00	2.00	2.00	4.00	3.80	3.80
DO (mg/L)	12.6	12.6	12.9	12.8	12.9	12.8	12.9	13.0	13.0	13.1	12.8	12.9	12.6	12.8	12.6
DO (%)	92.6	92.5	95.0	93.9	94.3	94.8	95.3	95.1	94.4	94.5	92.9	93.8	96.2	97.4	96.1
pH	7.79	7.77	7.82	7.72	7.74	8.16	8.14	8.13	8.03	8.02	7.49	7.17	7.75	7.29	7.09
Specific Conductance (µS/cm)	297	296	296	296	297	377	376	376	377	363	161	160	154	196	205
Conductivity (µS/cm)	170	169	169	168	168	217	215	213	213	204	91.0	90.0	92.3	117	122
Substrate (cm)	7.24	5.98	6.64	6.15	6.49	6.63	5.59	7.04	6.11	6.62	6.00	6.57	5.90	5.91	6.58

Note: "-" indicates no data.

Table B.3. Raw Habitat and In Situ Water Quality Data, Lower Creek Areas, 2018 to 2021

Metrics	2018										2019				
	CC5.6					YT0.2					SYT0.6				
	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	SYT0.6-1	SYT0.6-2	SYT0.6-3	SYT0.6-4	SYT0.6-5
Water Velocity (m³/s)	0.650	0.960	0.920	NA	NA	0.870	0.820	0.860	0.720	0.880	0.700	0.750	0.600	0.750	0.700
Temperature (°C)	4.50	4.20	4.00	NA	NA	3.80	3.50	3.10	3.00	3.00	3.00	2.70	2.30	2.10	2.90
DO (mg/L)	12.4	12.3	12.2	NA	NA	12.7	12.9	12.9	13.0	13.0	13.5	13.7	-	-	11.5
DO (%)	95.6	94.6	93.6	NA	NA	96.1	97.1	96.0	96.3	96.4	101	102	-	-	85.0
pH	7.28	7.14	7.23	NA	NA	7.57	7.61	7.58	7.55	7.59	7.97	8.01	8.01	7.90	8.50
Specific Conductance (µS/cm)	202	201	203	NA	NA	159	165	166	167	167	337	336	330	330	337
Conductivity (µS/cm)	123	121	122	NA	NA	95.0	97.0	97.0	97.0	96.0	195	193	188	190	195
Substrate (cm)	5.34	6.02	6.57	NA	NA	6.84	6.01	6.51	7.43	7.25	10.4	7.40	7.80	8.20	8.00

Note: "-" indicates no data.

Table B.3. Raw Habitat and In Situ Water Quality Data, Lower Creek Areas, 2018 to 2021

Metrics	2019														
	XE0.2					HC0.2					CC5.6				
	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5
Water Velocity (m³/s)	0.700	0.650	0.650	0.800	0.950	0.750	0.750	0.850	0.650	0.750	0.843	0.833	0.962	0.949	0.650
Temperature (°C)	3.60	2.10	1.73	3.50	3.10	3.30	2.90	2.53	2.30	2.10	5.70	5.20	4.50	4.10	4.20
DO (mg/L)	13.9	13.7	14.3	12.2	12.9	11.8	11.9	12.0	12.2	12.4	10.2	11.5	11.9	11.3	11.6
DO (%)	105	99.9	103	91.2	96.1	88.2	87.9	88.0	88.6	89.9	81.3	90.6	93.4	86.6	89.0
pH	8.29	8.27	8.25	8.71	8.51	7.98	7.80	7.85	7.85	7.88	8.07	8.04	7.68	7.92	7.45
Specific Conductance (µS/cm)	526	526	527	484	482	172	172	172	171	171	163	164	164	164	163
Conductivity (µS/cm)	311	296	292	284	280	101	99.1	97.9	97.2	96.3	103	102	99.7	98.1	98.3
Substrate (cm)	8.70	7.50	7.50	7.50	7.20	8.80	8.10	7.60	7.20	8.10	8.40	8.10	7.40	6.90	6.80

Note: "-" indicates no data.

Table B.3. Raw Habitat and In Situ Water Quality Data, Lower Creek Areas, 2018 to 2021

Metrics	2019					2021									
	YT0.2					SYT0.6					XE0.2				
	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	SYT0.6-1	SYT0.6-2	SYT0.6-3	SYT0.6-4	SYT0.6-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5
Water Velocity (m³/s)	0.800	0.750	0.800	0.800	0.600	0.330	0.464	0.327	0.515	0.380	0.610	0.390	0.693	0.448	0.593
Temperature (°C)	2.40	2.10	2.10	1.90	3.83	3.70	3.50	3.20	3.00	3.00	5.10	4.60	3.50	3.00	3.00
DO (mg/L)	11.8	12.0	11.7	12.2	11.5	12.4	12.6	12.6	12.7	12.8	12.2	12.4	12.8	12.9	12.9
DO (%)	86.4	87.2	86.0	88.0	87.5	93.6	95.0	94.7	94.4	94.8	96.4	96.4	96.2	96.4	96.1
pH	7.74	7.93	8.27	-	7.80	7.81	7.96	7.91	7.87	7.86	8.26	8.25	8.27	8.22	8.23
Specific Conductance (µS/cm)	192	192	193	193	187	483	482	481	480	481	619	619	622	623	623
Conductivity (µS/cm)	109	108	108	108	111	286	284	281	279	279	384	378	366	361	361
Substrate (cm)	8.40	8.90	10.0	9.30	8.00	6.32	5.92	7.25	5.80	7.33	6.88	6.32	5.94	5.89	5.15

Note: "-" indicates no data.

Table B.3. Raw Habitat and In Situ Water Quality Data, Lower Creek Areas, 2018 to 2021

Metrics	2021														
	HC0.2					CC5.6					YT0.2				
	HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5
Water Velocity (m³/s)	0.442	0.372	0.571	0.468	0.358	0.563	0.658	0.832	0.861	0.632	0.389	0.368	0.247	0.410	0.453
Temperature (°C)	3.90	3.90	3.70	3.60	3.60	5.00	5.00	4.50	4.30	4.30	3.90	3.90	3.80	3.60	3.30
DO (mg/L)	12.4	12.4	12.5	12.4	12.4	12.1	12.0	12.2	12.2	12.1	12.4	12.6	12.1	12.6	12.7
DO (%)	94.4	94.6	94.5	93.4	93.3	94.4	94.4	94.1	93.7	92.9	94.4	95.8	92.2	95.1	95.5
pH	7.76	7.81	7.82	7.70	7.68	7.57	7.57	7.57	7.52	7.52	7.72	7.77	7.60	7.68	7.69
Specific Conductance (µS/cm)	221	220	221	221	220	177	177	177	176	174	220	220	222	221	219
Conductivity (µS/cm)	132	131	131	130	130	109	110	108	106	105	132	131	132	131	128
Substrate (cm)	5.07	5.11	6.60	7.84	6.75	7.03	7.21	5.75	5.82	6.63	8.10	5.15	9.93	6.51	4.13

Note: "-" indicates no data.

Table B.4. **Spatial and Temporal Comparisons of Habitat and *In situ* Water Quality Parameters among Stations in Lower Creek Areas, Coffee Project FALMP, 2018 to 2021**

ANOVA Model					Station		Do concentrations differ over time?			Do concentrations differ between the stations?					
							Magnitude of Difference[a]			Magnitude of Difference[b]					
										SYT0.6 vs XE0.2 and Future Exposed			XE0.2 vs SYT0.6 and Future Exposed		
Parameter	Transformation	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Water Velocity (m³/s)	none	<0.001	<0.001	0.053	Reference	SYT0.6	-9.1	-41	-35	nc			-		
						XE0.2				ns			-		
					Exposure	HC0.2				ns			ns		
						CC5.6				32			ns		
						YT0.2				ns			ns		
Temperature (°C)	none	<0.001	<0.001	0.055	Reference	SYT0.6	ns	23	26	nc			-		
						XE0.2				ns			-		
					Exposure	HC0.2				ns			ns		
						CC5.6				62			51		
						YT0.2				ns			ns		
DO (mg/L)	rank	<0.001	<0.001	0.004	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	-6.3	ns	ns	ns	-11	ns	ns	-12	ns
						CC5.6	ns	ns	ns	ns	-15	-4.4	-5.0	-16	-5.4
						YT0.2	-8.1	-2.4	6.2	ns	-12	ns	ns	-14	ns
DO (%)	rank	<0.001	<0.001	<0.001	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	-8.2	ns	7.0	ns	-13	ns	ns	-12	-2.1
						CC5.6	-5.9	ns	ns	ns	-12	ns	ns	-11	-2.4
						YT0.2	-9.4	ns	9.1	2.6	-14	ns	ns	-13	ns
pH	rank	<0.001	<0.001	0.079	Reference	SYT0.6	4.8	2.1	-2.6	nc			nc		
						XE0.2				4.8			nc		
					Exposure	HC0.2				-1.4			-5.9		
						CC5.6				-3.8			-8.2		
						YT0.2				-2.4			-6.8		
Specific Conductance (µS/cm)	rank	<0.001	<0.001	<0.001	Reference	SYT0.6	ns	63	43	nc	nc	nc	nc	nc	nc
						XE0.2	40	65	ns	27	57	29	nc	nc	nc
					Exposure	HC0.2	ns	37	29	-46	-49	-54	-57	-67	-65
						CC5.6	-19	-13	7.9	-32	-51	-63	-46	-69	-72
						YT0.2	16	33	15	-44	-43	-54	-56	-63	-65
Conductivity (µS/cm)	rank	<0.001	<0.001	<0.001	Reference	SYT0.6	ns	66	46	nc	nc	nc	nc	nc	nc
						XE0.2	37	72	ns	26	51	30	nc	nc	nc
					Exposure	HC0.2	ns	42	34	-45	-49	-54	-57	-66	-64
						CC5.6	-18	-12	7.9	-28	-48	-62	-43	-66	-71
						YT0.2	12	35	21	-43	-44	-53	-54	-63	-64
Substrate (cm)	rank	0.129	<0.001	0.968	Reference	SYT0.6	23	ns	-21	nc			nc		
						XE0.2				ns			nc		
					Exposure	HC0.2				ns			ns		
						CC5.6				ns			ns		
						YT0.2				ns			ns		

ANOVA P-value < 0.05.
Significant decrease in concentration.
Significant increase in concentration.

Note: "nc" indicates no comparison available; "ns" indicates not significant.

[a] Magnitude of Difference is calculated as $(MCT_{recent\ year} - MCT_{older\ year})/ MCT_{older\ year})*100$. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for others.

[b] Magnitude of Difference is calculated as $(MCT_{Exposed} - MCT_{Reference})/(MCT_{Reference}))*100$. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for others.

APPENDIX C
PERIPHYTON PRODUCTIVITY AND COMMUNITY

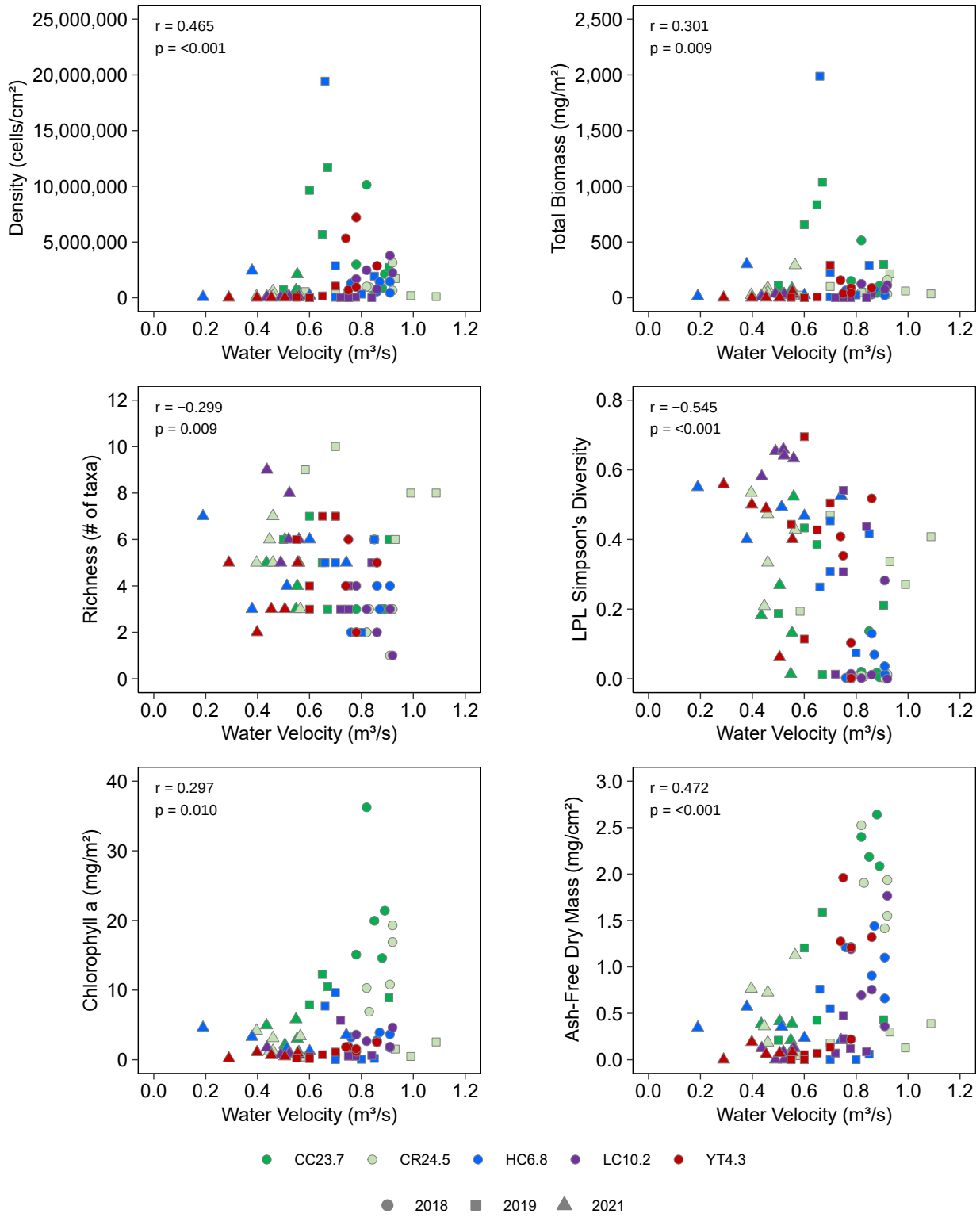


Figure C.1: Correlations between Periphton Community Endpoints and Physiochemical Parameters, Upper Creek Areas, 2018 to 2021

Notes: Stations shown in green are reference areas and all other colours are future-exposed.

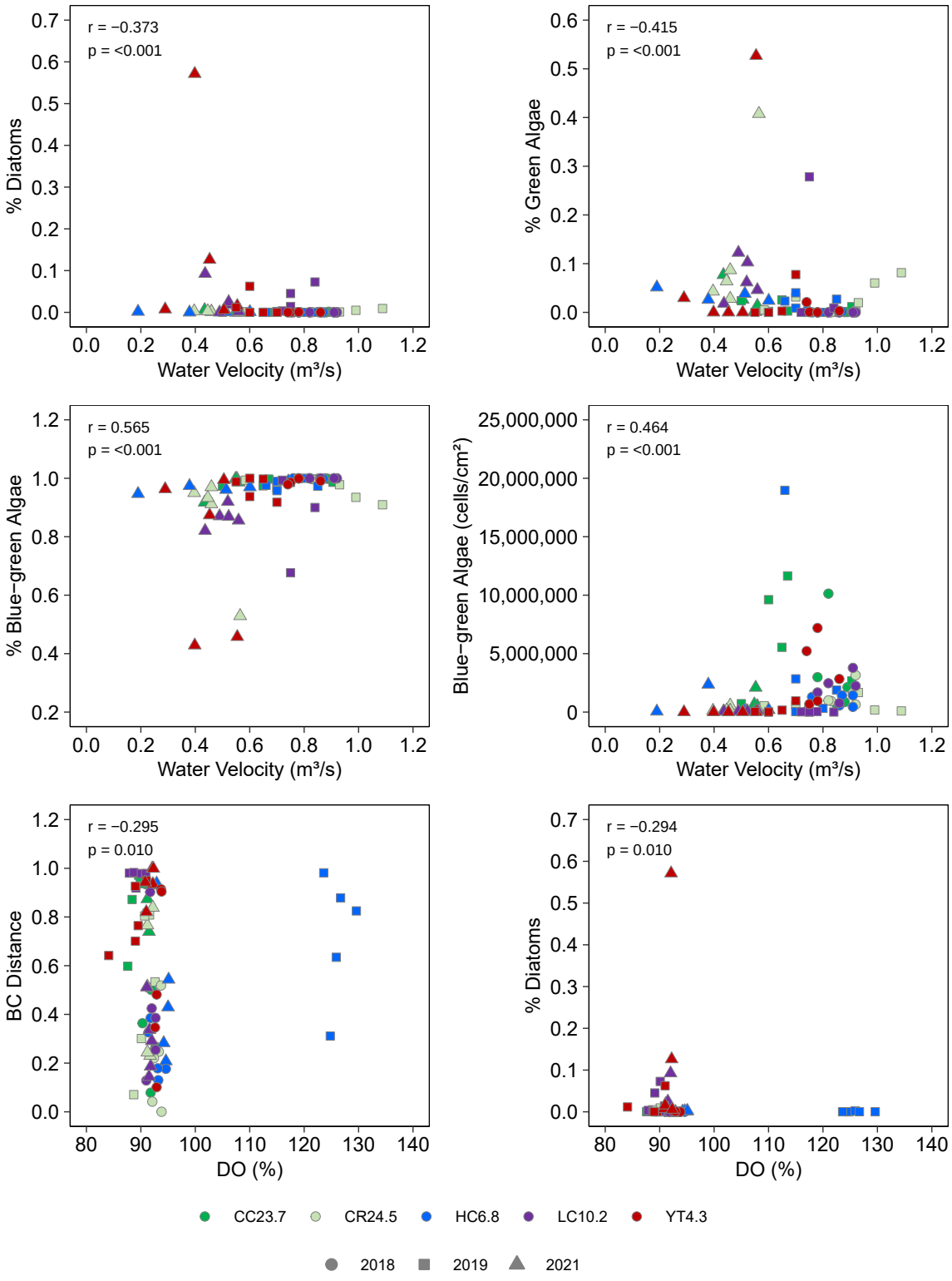


Figure C.1: Correlations between Periphton Community Endpoints and Physiochemical Parameters, Upper Creek Areas, 2018 to 2021

Notes: Stations shown in green are reference areas and all other colours are future-exposed.

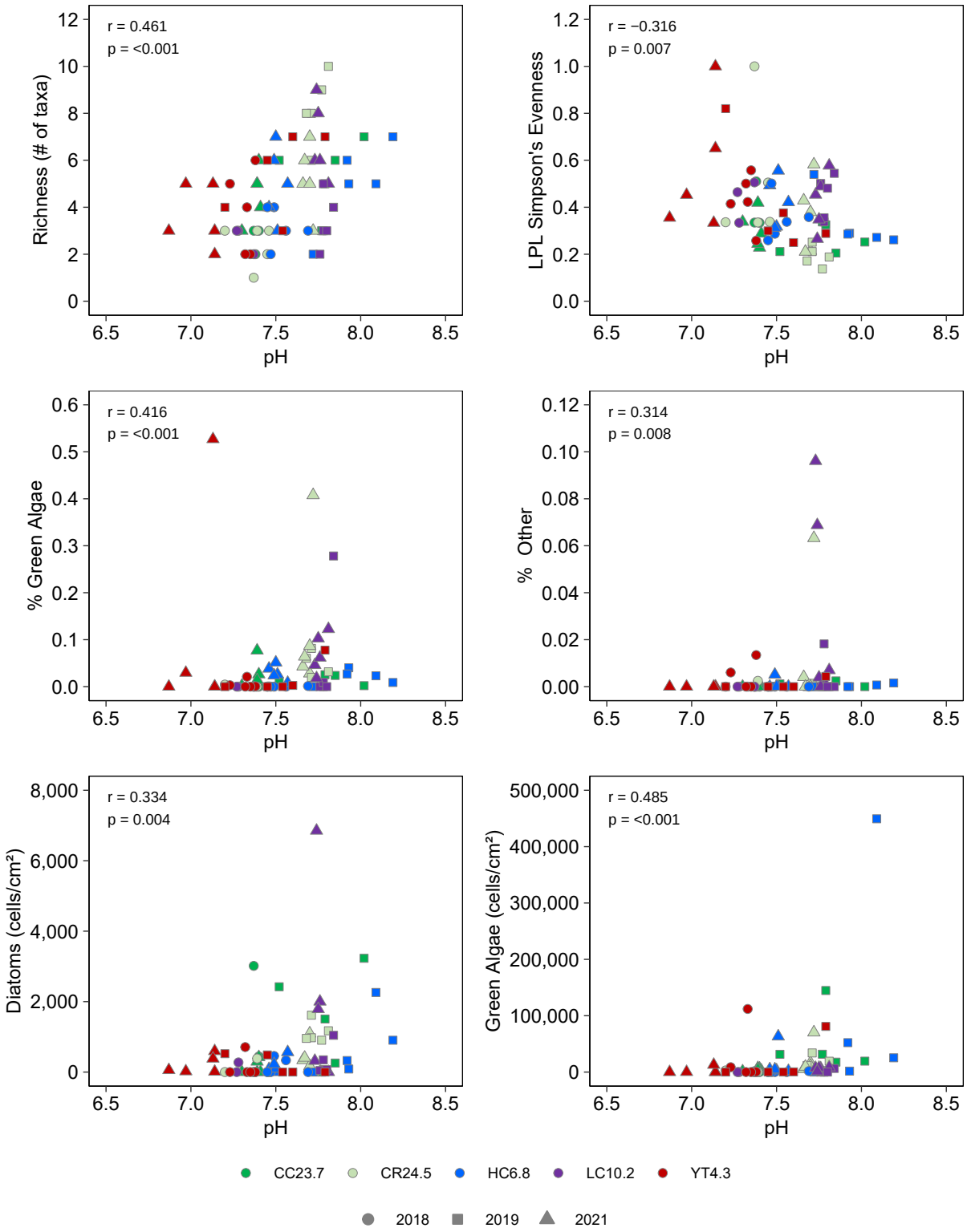


Figure C.1: Correlations between Periphton Community Endpoints and Physiochemical Parameters, Upper Creek Areas, 2018 to 2021

Notes: Stations shown in green are reference areas and all other colours are future-exposed.

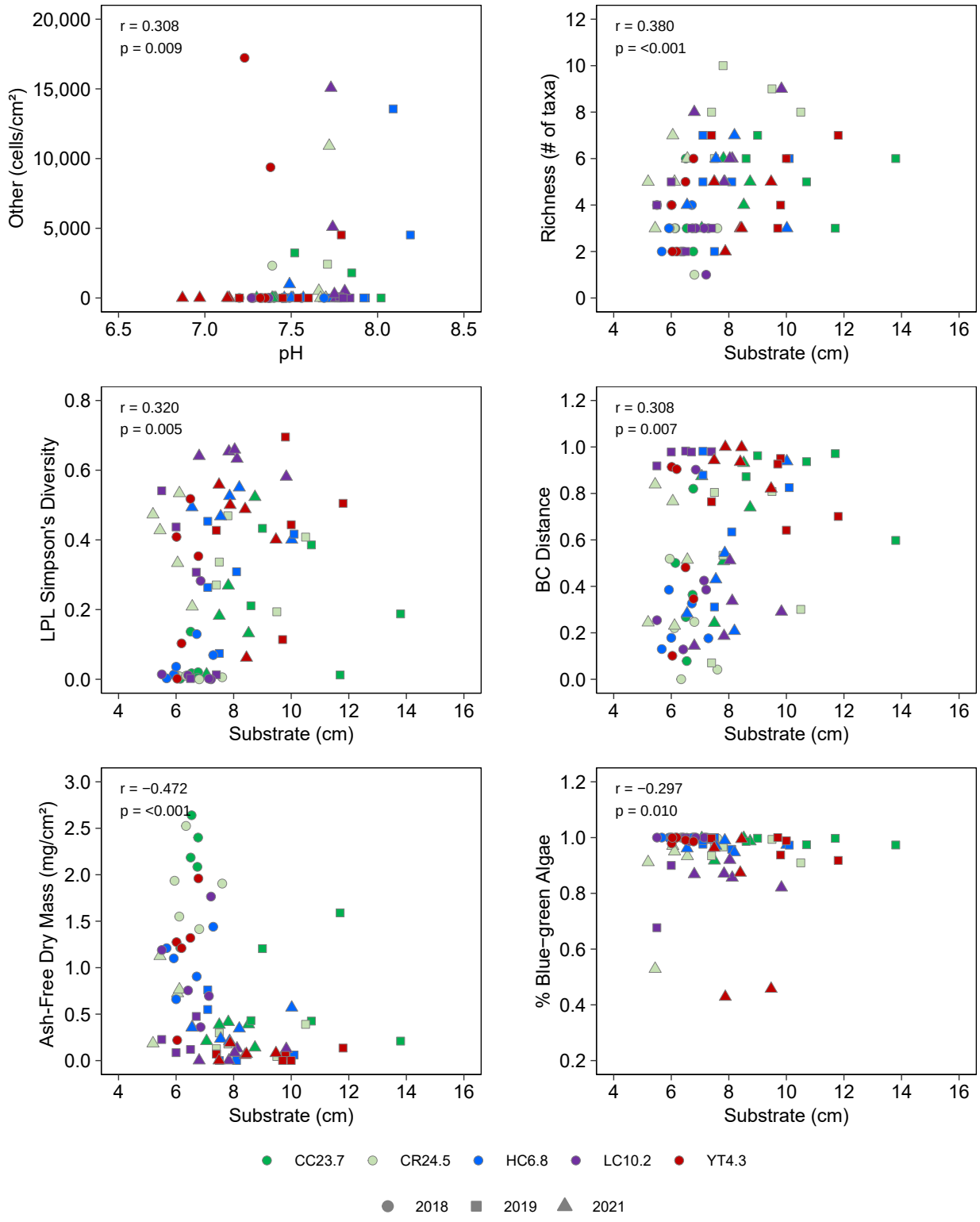


Figure C.1: Correlations between Periphton Community Endpoints and Physiochemical Parameters, Upper Creek Areas, 2018 to 2021

Notes: Stations shown in green are reference areas and all other colours are future-exposed.

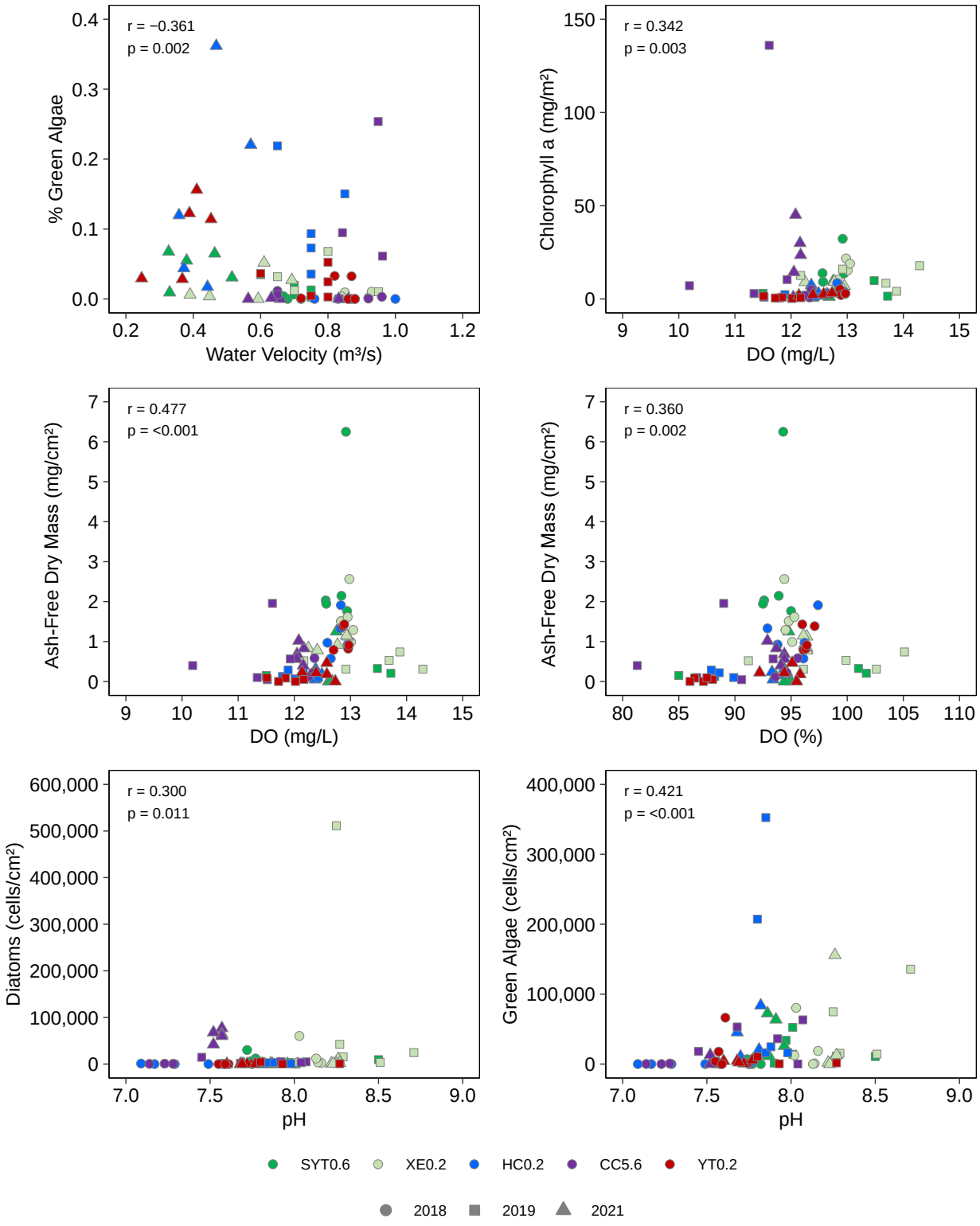


Figure C.2: Correlations between Periphton Community Endpoints and Physiochemical Parameters, Lower Creek Areas, 2018 to 2021

Notes: Stations shown in green are reference areas and all other colours are future-exposed.

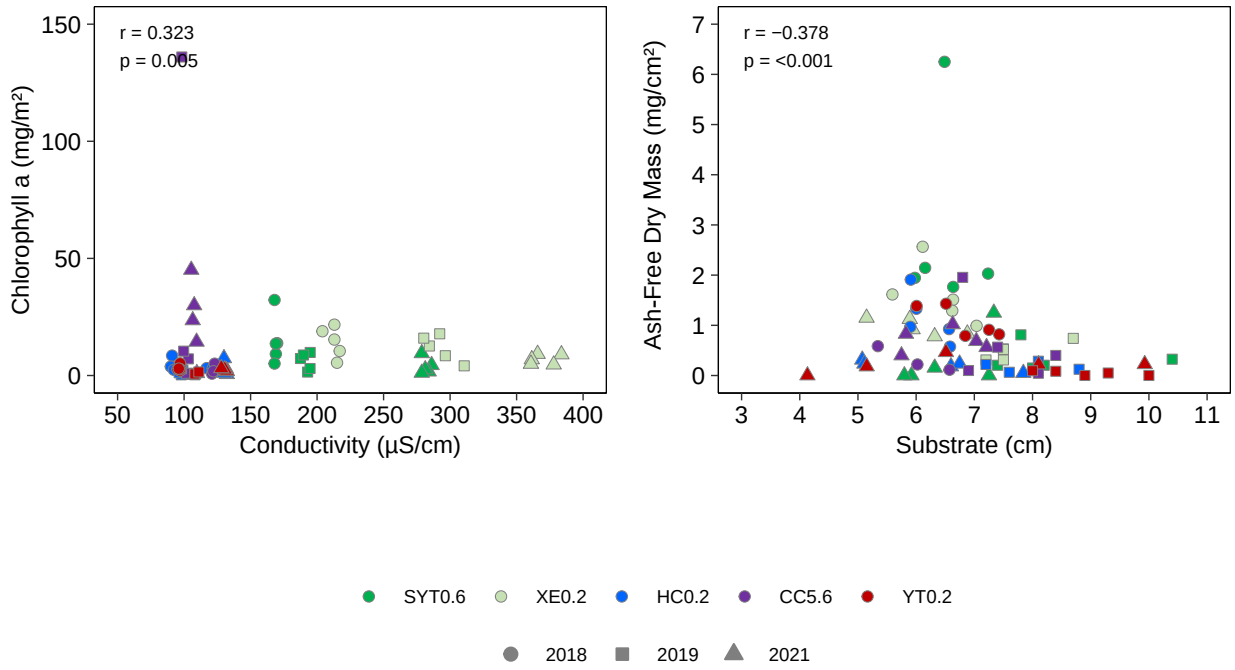


Figure C.2: Correlations between Periphton Community Endpoints and Physiochemical Parameters, Lower Creek Areas, 2018 to 2021

Notes: Stations shown in green are reference areas and all other colours are future-exposed.

Table C.1: Periphyton Productivity and Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Density (cells/cm²)	2018	CC23.7	5	3,350,744	3,909,793	1,748,513	644,355	2,129,581	10,132,640
		CR24.5	5	1,479,882	1,004,975	449,439	650,057	1,000,714	3,156,743
		HC6.8	5	1,031,961	488,742	218,572	444,463	1,292,394	1,434,705
		LC10.2	5	2,188,372	1,105,577	494,429	772,267	2,240,377	3,782,907
		YT4.3	5	3,406,094	2,815,411	1,259,090	697,747	2,857,527	7,194,055
	2019	CC23.7	5	6,091,910	4,583,858	2,049,964	737,986	5,688,829	11,682,014
		CR24.5	5	634,028	641,566	286,917	106,313	545,552	1,713,773
		HC6.8	5	4,921,683	8,196,783	3,665,713	42,200	1,936,195	19,435,839
		LC10.2	5	19,247	15,492	6,928	4,782	21,164	42,214
		YT4.3	5	252,721	446,284	199,584	7,262	41,986	1,042,837
	2021	CC23.7	5	714,945	809,163	361,869	51,327	518,255	2,097,212
		CR24.5	5	232,027	199,165	89,069	124,340	148,580	586,645
		HC6.8	5	609,708	1,017,220	454,915	57,457	192,293	2,424,899
		LC10.2	5	95,995	37,508	16,774	69,256	74,054	156,825
		YT4.3	5	8,479	9,706	4,341	18.6	4,712	24,494
Total Biomass (mg/m²)	2018	CC23.7	5	169	198	88.7	32.5	107	514
		CR24.5	5	72.9	50.8	22.7	32.9	50.6	160
		HC6.8	5	52.6	24.7	11.0	22.5	65.1	73.9
		LC10.2	5	87.1	33.4	14.9	39.0	84.2	124
		YT4.3	5	83.1	48.0	21.5	37.0	88.2	157
	2019	CC23.7	5	587	380	170	110	655	1,036
		CR24.5	5	86.8	77.2	34.5	23.3	60.6	214
		HC6.8	5	507	837	374	6.74	226	1,988
		LC10.2	5	4.55	9.79	4.38	0.0419	0.113	22.1
		YT4.3	5	60.6	130	58.0	0.534	3.25	293
	2021	CC23.7	5	40.7	24.2	10.8	18.1	34.5	81.3
		CR24.5	5	99.9	110	49.0	25.0	49.7	292
		HC6.8	5	74.7	126	56.4	13.5	22.5	300
		LC10.2	5	28.6	10.5	4.69	10.3	33.0	36.6
		YT4.3	5	11.1	23.9	10.7	0.0143	0.442	53.9
Richness (# of taxa)	2018	CC23.7	5	3.40	1.52	0.678	2.00	3.00	6.00
		CR24.5	5	2.40	0.894	0.400	1.00	3.00	3.00
		HC6.8	5	3.20	0.837	0.374	2.00	3.00	4.00
		LC10.2	5	2.60	1.14	0.510	1.00	3.00	4.00
		YT4.3	5	3.80	1.79	0.800	2.00	4.00	6.00
	2019	CC23.7	5	5.40	1.52	0.678	3.00	6.00	7.00
		CR24.5	5	8.20	1.48	0.663	6.00	8.00	10.0
		HC6.8	5	5.00	1.87	0.837	2.00	5.00	7.00
		LC10.2	5	3.40	1.14	0.510	2.00	3.00	5.00
		YT4.3	5	5.40	1.82	0.812	3.00	6.00	7.00
	2021	CC23.7	5	4.60	1.14	0.510	3.00	5.00	6.00
		CR24.5	5	5.20	1.48	0.663	3.00	5.00	7.00
		HC6.8	5	5.00	1.58	0.707	3.00	5.00	7.00
		LC10.2	5	6.80	1.64	0.735	5.00	6.00	9.00
		YT4.3	5	3.60	1.34	0.600	2.00	3.00	5.00
LPL Simpson's Evenness	2018	CC23.7	5	0.342	0.113	0.0503	0.193	0.335	0.510
		CR24.5	5	0.503	0.287	0.128	0.335	0.338	1.00
		HC6.8	5	0.349	0.0939	0.0420	0.259	0.338	0.501
		LC10.2	5	0.512	0.291	0.130	0.254	0.464	1.00
		YT4.3	5	0.431	0.113	0.0506	0.258	0.423	0.557
	2019	CC23.7	5	0.266	0.0624	0.0279	0.205	0.252	0.337
		CR24.5	5	0.192	0.0425	0.0190	0.138	0.188	0.251
		HC6.8	5	0.330	0.118	0.0529	0.261	0.286	0.540
		LC10.2	5	0.444	0.0921	0.0412	0.338	0.481	0.545
		YT4.3	5	0.407	0.236	0.105	0.250	0.299	0.820
	2021	CC23.7	5	0.304	0.0775	0.0347	0.228	0.288	0.419
		CR24.5	5	0.363	0.157	0.0700	0.211	0.379	0.582
		HC6.8	5	0.420	0.107	0.0479	0.313	0.422	0.556
		LC10.2	5	0.427	0.122	0.0546	0.265	0.454	0.577
		YT4.3	5	0.559	0.277	0.124	0.334	0.453	1.00
LPL Simpson's Diversity	2018	CC23.7	5	0.0360	0.0568	0.0254	0.00148	0.0174	0.137
		CR24.5	5	0.00757	0.00503	0.00225	0	0.00868	0.0133
		HC6.8	5	0.0502	0.0512	0.0229	0.00266	0.0360	0.130
		LC10.2	5	0.0620	0.123	0.0552	0	0.0116	0.282
		YT4.3	5	0.277	0.216	0.0967	0.00161	0.353	0.518
	2019	CC23.7	5	0.246	0.169	0.0754	0.0123	0.211	0.433
		CR24.5	5	0.336	0.109	0.0487	0.194	0.336	0.469
		HC6.8	5	0.303	0.150	0.0669	0.0741	0.309	0.453
		LC10.2	5	0.260	0.245	0.110	0.00218	0.307	0.541
		YT4.3	5	0.437	0.210	0.0937	0.114	0.443	0.695
	2021	CC23.7	5	0.224	0.191	0.0854	0.0139	0.182	0.523
		CR24.5	5	0.395	0.127	0.0570	0.209	0.428	0.534
		HC6.8	5	0.487	0.0578	0.0259	0.401	0.493	0.550
		LC10.2	5	0.633	0.0310	0.0139	0.581	0.641	0.659
		YT4.3	5	0.402	0.198	0.0886	0.0619	0.488	0.558

Table C.1: Periphyton Productivity and Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
BC Distance	2018	CC23.7	5	0.406	0.278	0.124	0.0786	0.364	0.820
		CR24.5	5	0.206	0.206	0.0919	0.000290	0.220	0.519
		HC6.8	5	0.239	0.110	0.0492	0.130	0.178	0.385
		LC10.2	5	0.419	0.294	0.132	0.129	0.386	0.902
		YT4.3	5	0.549	0.356	0.159	0.101	0.481	0.914
	2019	CC23.7	5	0.868	0.156	0.0698	0.598	0.937	0.971
		CR24.5	5	0.504	0.321	0.144	0.0705	0.533	0.808
		HC6.8	5	0.726	0.264	0.118	0.311	0.825	0.981
		LC10.2	5	0.968	0.0274	0.0123	0.919	0.978	0.982
		YT4.3	5	0.797	0.137	0.0611	0.642	0.764	0.950
	2021	CC23.7	5	0.659	0.284	0.127	0.242	0.739	0.931
		CR24.5	5	0.519	0.284	0.127	0.231	0.514	0.839
		HC6.8	5	0.480	0.287	0.128	0.208	0.430	0.938
		LC10.2	5	0.294	0.144	0.0645	0.144	0.291	0.511
		YT4.3	5	0.939	0.0730	0.0326	0.821	0.942	1.000
Chlorophyll a (mg/m²)	2018	CC23.7	5	21.5	8.78	3.93	14.6	19.9	36.2
		CR24.5	5	12.8	5.10	2.28	6.90	10.8	19.3
		HC6.8	5	3.06	0.857	0.383	1.74	3.20	3.92
		LC10.2	5	3.05	1.08	0.482	1.87	2.66	4.62
		YT4.3	5	1.80	0.499	0.223	1.18	1.83	2.54
	2019	CC23.7	5	8.18	4.16	1.86	1.36	8.90	12.2
		CR24.5	5	1.16	0.904	0.404	0.374	0.856	2.56
		HC6.8	5	3.53	4.75	2.12	0.0278	0.188	9.65
		LC10.2	5	1.57	2.28	1.02	0.502	0.548	5.65
		YT4.3	5	0.534	0.385	0.172	0.166	0.433	1.10
	2021	CC23.7	5	3.40	1.95	0.871	1.09	3.03	5.80
		CR24.5	5	2.63	1.32	0.590	1.24	3.10	4.16
		HC6.8	5	2.85	1.40	0.628	1.22	3.28	4.59
		LC10.2	5	1.00	0.428	0.191	0.720	0.870	1.75
		YT4.3	5	0.675	0.364	0.163	0.192	0.655	1.08
Ash-Free Dry Mass (mg/cm²)	2018	CC23.7	5	2.10	0.541	0.242	1.22	2.18	2.64
		CR24.5	5	1.87	0.431	0.193	1.42	1.91	2.52
		HC6.8	5	1.06	0.297	0.133	0.660	1.10	1.44
		LC10.2	5	0.953	0.542	0.242	0.360	0.755	1.76
		YT4.3	5	1.20	0.624	0.279	0.220	1.27	1.96
	2019	CC23.7	5	0.772	0.594	0.266	0.210	0.430	1.59
		CR24.5	5	0.208	0.137	0.0614	0.0440	0.178	0.390
		HC6.8	5	0.274	0.356	0.159	0.00100	0.0600	0.760
		LC10.2	5	0.196	0.167	0.0749	0.0720	0.120	0.475
		YT4.3	5	0.0524	0.0557	0.0249	0.00100	0.0550	0.135
	2021	CC23.7	5	0.308	0.124	0.0556	0.140	0.385	0.415
		CR24.5	5	0.632	0.369	0.165	0.185	0.725	1.12
		HC6.8	5	0.343	0.142	0.0637	0.210	0.345	0.570
		LC10.2	5	0.0684	0.0640	0.0286	0.00100	0.0850	0.130
		YT4.3	5	0.0802	0.0686	0.0307	0.00100	0.0700	0.190
% Diatoms	2018	CC23.7	5	0.0448	0.0608	0.0272	0	0.0148	0.142
		CR24.5	5	0.00815	0.0182	0.00815	0	0	0.0408
		HC6.8	5	0.0314	0.0430	0.0192	0	0	0.0816
		LC10.2	5	0.00222	0.00497	0.00222	0	0	0.0111
		YT4.3	5	0.0149	0.0333	0.0149	0	0	0.0745
	2019	CC23.7	5	0.0368	0.0325	0.0145	0	0.0335	0.0892
		CR24.5	5	0.372	0.340	0.152	0.0942	0.192	0.916
		HC6.8	5	0.0532	0.0862	0.0385	0	0.0169	0.206
		LC10.2	5	2.72	3.09	1.38	0.103	1.41	7.27
		YT4.3	5	1.48	2.71	1.21	0	0	6.25
	2021	CC23.7	5	0.151	0.250	0.112	0	0	0.577
		CR24.5	5	0.173	0.114	0.0510	0	0.187	0.274
		HC6.8	5	0.117	0.0888	0.0397	0	0.118	0.229
		LC10.2	5	2.76	3.78	1.69	0	1.85	9.25
		YT4.3	5	14.5	24.4	10.9	0.550	1.56	57.1
% Green Algae	2018	CC23.7	5	0.0394	0.0363	0.0162	0	0.0584	0.0708
		CR24.5	5	0.0929	0.190	0.0852	0	0	0.433
		HC6.8	5	0.0241	0.0539	0.0241	0	0	0.121
		LC10.2	5	0	0	0	0	0	0
		YT4.3	5	0.493	0.907	0.406	0	0.0640	2.10
	2019	CC23.7	5	1.31	1.12	0.500	0.201	1.16	2.54
		CR24.5	5	3.96	3.10	1.39	0.481	3.16	8.14
		HC6.8	5	1.98	1.57	0.704	0	2.31	4.02
		LC10.2	5	5.75	12.3	5.52	0	0	27.8
		YT4.3	5	1.60	3.45	1.54	0	0	7.77
	2021	CC23.7	5	2.40	3.13	1.40	0.135	1.37	7.69
		CR24.5	5	12.6	15.9	7.11	2.80	6.40	40.8
		HC6.8	5	2.95	1.63	0.729	0.800	2.60	5.14
		LC10.2	5	7.02	4.24	1.89	1.80	6.17	12.3
		YT4.3	5	11.1	23.3	10.4	0	0	52.7

Table C.1: Periphyton Productivity and Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
% Blue-green Algae	2018	CC23.7	5	99.9	0.0949	0.0424	99.8	99.9	100
		CR24.5	5	99.8	0.198	0.0887	99.6	100.0	100
		HC6.8	5	99.9	0.0535	0.0239	99.9	99.9	100
		LC10.2	5	100.0	0.00497	0.00222	100.0	100	100
		YT4.3	5	99.1	0.893	0.399	97.9	99.1	100
	2019	CC23.7	5	98.6	1.18	0.529	97.3	98.6	99.8
		CR24.5	5	95.6	3.40	1.52	91.0	96.7	99.3
		HC6.8	5	97.9	1.62	0.722	95.8	97.6	100
		LC10.2	5	91.1	13.7	6.13	67.7	98.6	99.9
		YT4.3	5	96.8	3.79	1.69	91.8	98.8	100
	2021	CC23.7	5	97.5	3.38	1.51	91.7	98.6	99.9
		CR24.5	5	85.9	18.6	8.30	52.9	93.3	97.0
		HC6.8	5	96.8	1.58	0.709	94.7	97.0	99.0
		LC10.2	5	86.7	3.56	1.59	82.1	86.8	92.0
		YT4.3	5	74.3	27.8	12.4	42.9	87.4	99.5
% Other	2018	CC23.7	5	0.00678	0.0152	0.00678	0	0	0.0339
		CR24.5	5	0.0489	0.109	0.0489	0	0	0.245
		HC6.8	5	0	0	0	0	0	0
		LC10.2	5	0	0	0	0	0	0
		YT4.3	5	0.389	0.594	0.266	0	0	1.34
	2019	CC23.7	5	0.0725	0.109	0.0486	0	0	0.244
		CR24.5	5	0.0283	0.0632	0.0283	0	0	0.141
		HC6.8	5	0.0454	0.0695	0.0311	0	0	0.157
		LC10.2	5	0.429	0.789	0.353	0	0	1.82
		YT4.3	5	0.0867	0.194	0.0867	0	0	0.434
	2021	CC23.7	5	0	0	0	0	0	0
		CR24.5	5	1.35	2.79	1.25	0	0	6.33
		HC6.8	5	0.102	0.228	0.102	0	0	0.510
		LC10.2	5	3.52	4.43	1.98	0	0.701	9.61
		YT4.3	5	0	0	0	0	0	0
Diatoms (cells/cm²)	2018	CC23.7	5	779	1,269	567	0	437	3,014
		CR24.5	5	77.3	173	77.3	0	0	386
		HC6.8	5	158	221	98.8	0	0	457
		LC10.2	5	54.8	123	54.8	0	0	274
		YT4.3	5	142	317	142	0	0	709
	2019	CC23.7	5	1,483	1,382	618	0	1,507	3,230
		CR24.5	5	1,124	292	131	904	974	1,615
		HC6.8	5	716	933	417	0	328	2,261
		LC10.2	5	315	426	191	43.5	69.6	1,043
		YT4.3	5	202	276	124	0	0	522
	2021	CC23.7	5	144	203	90.6	0	0	425
		CR24.5	5	402	418	187	0	340	1,096
		HC6.8	5	195	223	99.5	0	98.4	566
		LC10.2	5	2,192	2,749	1,230	0	1,787	6,853
		YT4.3	5	213	263	118	10.6	56.6	594
Green Algae (cells/cm²)	2018	CC23.7	5	489	616	275	0	437	1,507
		CR24.5	5	764	1,226	548	0	0	2,813
		HC6.8	5	344	770	344	0	0	1,722
		LC10.2	5	0	0	0	0	0	0
		YT4.3	5	24,203	49,194	22,000	0	447	111,959
	2019	CC23.7	5	48,960	53,913	24,111	17,601	31,488	144,685
		CR24.5	5	15,232	12,044	5,386	2,622	11,686	33,911
		HC6.8	5	105,709	193,272	86,434	0	25,320	449,358
		LC10.2	5	1,296	2,873	1,285	0	0	6,434
		YT4.3	5	16,281	36,170	16,176	0	0	80,983
	2021	CC23.7	5	4,271	2,390	1,069	1,274	3,949	7,075
		CR24.5	5	22,552	27,012	12,080	5,349	11,122	70,347
		HC6.8	5	15,509	26,668	11,926	1,981	4,604	63,167
		LC10.2	5	6,217	2,809	1,256	1,334	7,217	8,490
		YT4.3	5	2,598	5,762	2,577	0	0	12,905
Blue-green Algae (cells/cm²)	2018	CC23.7	5	3,349,433	3,910,426	1,748,796	643,262	2,125,059	10,132,640
		CR24.5	5	1,478,577	1,005,496	449,671	647,244	1,000,714	3,155,738
		HC6.8	5	1,031,458	488,604	218,510	444,128	1,292,394	1,434,705
		LC10.2	5	2,188,317	1,105,560	494,421	772,267	2,240,377	3,782,907
		YT4.3	5	3,376,428	2,800,423	1,252,387	687,923	2,831,690	7,194,055
	2019	CC23.7	5	6,040,461	4,585,944	2,050,897	718,329	5,542,637	11,650,364
		CR24.5	5	617,187	630,091	281,785	96,688	542,026	1,675,826
		HC6.8	5	4,811,641	7,997,841	3,576,743	40,418	1,883,698	18,970,656
		LC10.2	5	17,605	15,475	6,921	4,304	15,651	42,171
		YT4.3	5	235,334	408,625	182,743	7,262	41,500	957,332
	2021	CC23.7	5	710,530	810,255	362,357	47,082	511,180	2,094,382
		CR24.5	5	206,788	203,244	90,894	91,270	118,142	569,117
		HC6.8	5	593,808	990,865	443,128	54,405	186,482	2,361,732
		LC10.2	5	83,400	32,890	14,709	60,280	62,356	134,220
		YT4.3	5	5,668	4,855	2,171	7.96	4,118	11,207

Table C.1: Periphyton Productivity and Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Other (cells/cm²)	2018	CC23.7	5	43.7	97.7	43.7	0	0	218
		CR24.5	5	464	1,037	464	0	0	2,319
		HC6.8	5	0	0	0	0	0	0
		LC10.2	5	0	0	0	0	0	0
		YT4.3	5	5,320	7,796	3,486	0	0	17,224
	2019	CC23.7	5	1,006	1,467	656	0	0	3,230
		CR24.5	5	484	1,083	484	0	0	2,422
		HC6.8	5	3,617	5,895	2,636	0	0	13,564
		LC10.2	5	31.3	43.3	19.4	0	0	87.0
		YT4.3	5	904	2,022	904	0	0	4,521
	2021	CC23.7	5	0	0	0	0	0	0
		CR24.5	5	2,285	4,830	2,160	0	0	10,916
		HC6.8	5	196	439	196	0	0	981
		LC10.2	5	4,186	6,438	2,879	0	485	15,070
		YT4.3	5	0	0	0	0	0	0
Green Algae:Diatoms	2018	CC23.7	5	0.300	0.447	0.200	0	0	1.00
		CR24.5	5	0	0	0	0	0	0
		HC6.8	5	0	0	0	0	0	0
		LC10.2	5	0	0	0	0	0	0
		YT4.3	5	0	0	0	0	0	0
	2019	CC23.7	5	36.7	43.0	19.2	0	13.0	96.0
		CR24.5	5	12.3	6.95	3.11	2.90	12.2	21.0
		HC6.8	5	81.1	91.0	40.7	0	28.0	199
		LC10.2	5	1.26	2.74	1.23	0	0	6.17
		YT4.3	5	0	0	0	0	0	0
	2021	CC23.7	5	5.60	7.68	3.44	0	0	14.7
		CR24.5	5	23.9	24.7	11.1	0	15.8	65.5
		HC6.8	5	22.2	23.0	10.3	0	20.3	57.0
		LC10.2	5	6.06	9.46	4.23	0	3.33	22.7
		YT4.3	5	7.56	14.8	6.60	0	0	33.8

Table C.2. Statistical Temporal and Spatial Comparisons of Periphyton Endpoints, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

ANOVA Model					Station		Do concentrations differ over time?[a]			Do concentrations differ between the stations?[b]					
										CC23.7 vs CR24.5 and Future Exposed			CR24.5 vs CC23.7 and Future Exposed		
Parameter	Transformation	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Density (cells/cm²)	rank	<0.001	<0.001	<0.001	Reference	CC23.7	ns	-2.00	-6.41	nc	nc	nc	nc	nc	nc
						CR24.5	ns	-1.06	ns	ns	-6.37	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	ns	ns
						LC10.2	-2.75	-2.68	ns	ns	-7.02	ns	ns	-0.650	ns
						YT4.3	-3.49	-3.53	ns	ns	-7.00	-0.636	ns	ns	-0.178
Total Biomass (mg/m²)	rank	<0.001	0.002	<0.001	Reference	CC23.7	ns	ns	-11.4	nc	nc	nc	nc	nc	nc
						CR24.5	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	ns	ns
						LC10.2	-1.54	-0.939	ns	ns	-12.0	ns	ns	-1.11	ns
						YT4.3	-1.56	-1.61	ns	ns	-11.9	ns	ns	ns	-0.903
Richness (# of taxa)	none	0.297	<0.001	<0.001	Reference	CC23.7	1.38	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	4.01	1.94	-2.07	ns	1.94	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	-2.21	ns
						LC10.2	ns	2.90	2.35	ns	ns	ns	ns	-3.32	ns
						YT4.3	ns	ns	ns	ns	ns	ns	ns	-1.94	ns
LPL Simpson's Evenness	log10	0.006	0.015	0.176	Reference	CC23.7	-0.747	ns	0.684	nc			nc		
						CR24.5				ns			nc		
					Exposure	HC6.8				ns			ns		
						LC10.2				1.08			0.966		
						YT4.3				1.04			0.923	0.923	0.923
LPL Simpson's Diversity	rank	0.014	<0.001	0.035	Reference	CC23.7	ns	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	1.04	1.33	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC6.8	0.863	1.45	ns	ns	ns	0.986	ns	ns	ns
						LC10.2	0.936	1.99	1.06	ns	ns	1.45	ns	ns	ns
						YT4.3	ns	ns	ns	ns	ns	ns	1.09	ns	ns
BC Distance	none	0.001	<0.001	0.031	Reference	CC23.7	1.96	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	1.33	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC6.8	2.07	ns	ns	ns	ns	ns	ns	ns	ns
						LC10.2	2.33	ns	-2.86	ns	ns	ns	ns	1.97	ns
						YT4.3	ns	1.66	ns	ns	ns	ns	ns	ns	1.79
Chlorophyll a (mg/m²)	rank	<0.001	<0.001	0.100	Reference	CC23.7	-1.42	-1.16	ns	nc			nc		
						CR24.5				-2.82			nc		
					Exposure	HC6.8				-2.77			ns		
						LC10.2				-3.88			-1.07		
						YT4.3				-3.85			-1.03		
Ash-Free Dry Mass (mg/cm²)	rank	<0.001	<0.001	0.020	Reference	CC23.7	-3.64	-3.74	ns	nc	nc	nc	nc	nc	nc
						CR24.5	-3.58	-2.45	1.13	ns	-0.522	ns	nc	nc	nc
					Exposure	HC6.8	-2.16	-1.57	ns	ns	-0.768	ns	ns	ns	ns
						LC10.2	-1.32	-1.39	ns	-2.97	-0.643	-0.623	ns	ns	-1.33
						YT4.3	-2.53	-2.50	ns	ns	-0.778	-0.654	ns	ns	-1.36
% Diatoms	rank	0.105	<0.001	0.006	Reference	CC23.7	ns	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	1.93	1.87	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	ns	ns
						LC10.2	14.1	18.6	ns	ns	13.8	ns	ns	ns	ns
						YT4.3	ns	15.6	15.6	ns	ns	15.6	ns	ns	ns

ANOVA P-value < 0.1.
> 2 SD Decrease in endpoint relative to reference.
> 2 SD Increase in endpoint relative to reference.

Note: "nc" indicates no comparison available; "ns" indicates not significant. "-" indicates magnitude of difference could not be calculated when pooled standard deviation or median absolute deviation equal to 0. Logp1 indicates log10(x+1).

[a] Magnitude of Difference is calculated as $(MCT_{recent\ year} - MCT_{older\ year})/MAD_{pooled}$ for rank transformation and $(MCT_{recent\ year} - MCT_{older\ year})/SD_{pooled}$ for all other transformations. MAD_{pooled} = pooled median absolute deviation and SD_{pooled} = pooled standard deviation. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for all others.

[b] Magnitude of Difference is calculated as $(MCT_{Exposed} - MCT_{Reference})/(MAD_{pooled})$ for rank transformation and $(MCT_{Exposed} - MCT_{Reference})/(SD_{pooled})$ for all other transformations. MAD_{pooled} = pooled median absolute deviation and SD_{pooled} = pooled standard deviation. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for all others.

Table C.2. Statistical Temporal and Spatial Comparisons of Periphyton Endpoints, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

ANOVA Model					Station		Do concentrations differ over time?[a]			Do concentrations differ between the stations?[b]					
										CC23.7 vs CR24.5 and Future Exposed			CR24.5 vs CC23.7 and Future Exposed		
Parameter	Transformation	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
% Green Algae	logit	0.272	<0.001	0.793	Reference	CC23.7	0.757	1.48	0.718	nc			nc		
						CR24.5				ns			nc		
					Exposure	HC6.8				ns			ns		
						LC10.2				ns			ns		
						YT4.3				ns			ns		
% Blue-green Algae	logit	0.018	<0.001	0.211	Reference	CC23.7	-0.907	-1.89	-0.984	nc			nc		
						CR24.5				ns			nc		
					Exposure	HC6.8				ns			ns		
						LC10.2				-0.931			ns		
						YT4.3				-0.973			ns		
% Other	rank	0.372	0.362	0.046	Reference	CC23.7	ns	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	ns	ns
						LC10.2	ns	-	ns	ns	ns	-	ns	ns	ns
						YT4.3	ns	ns	ns	ns	ns	ns	ns	ns	ns
Diatoms (cells/cm²)	logp1	0.581	<0.001	0.177	Reference	CC23.7	1.04	0.796	ns	nc			nc		
						CR24.5				ns			nc		
					Exposure	HC6.8				ns			ns		
						LC10.2				ns			ns		
						YT4.3				ns			ns		
Green Algae (cells/cm²)	rank	0.004	<0.001	<0.001	Reference	CC23.7	12.2	ns	-10.8	nc	nc	nc	nc	nc	nc
						CR24.5	4.58	4.36	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC6.8	9.92	1.80	ns	ns	ns	ns	ns	ns	ns
						LC10.2	ns	2.83	2.83	ns	-12.3	ns	ns	-4.58	ns
						YT4.3	ns	ns	ns	ns	-12.3	ns	ns	-4.58	-4.36
Blue-green Algae (cells/cm²)	rank	<0.001	<0.001	<0.001	Reference	CC23.7	ns	-2.06	-6.43	nc	nc	nc	nc	nc	nc
						CR24.5	ns	-1.13	ns	ns	-6.39	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	ns	ns
						LC10.2	-2.84	-2.78	ns	ns	-7.07	ns	ns	-0.673	ns
						YT4.3	-3.57	-3.61	ns	ns	-7.03	-0.648	ns	ns	-0.146
Other (cells/cm²)	rank	0.785	0.449	0.059	Reference	CC23.7	ns	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	ns	ns
						LC10.2	ns	-	ns	ns	ns	-	ns	ns	ns
						YT4.3	ns	ns	ns	ns	ns	ns	ns	ns	ns
Green Algae:Diatoms	rank	0.004	<0.001	0.028	Reference	CC23.7	-	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	-	-	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC6.8	-	-	ns	ns	ns	ns	ns	ns	ns
						LC10.2	ns	-	ns	ns	ns	ns	ns	-	ns
						YT4.3	ns	ns	ns	ns	-	ns	ns	-	ns

ANOVA P-value < 0.1.

> 2 SD Decrease in endpoint relative to reference.

> 2 SD Increase in endpoint relative to reference.

Note: "nc" indicates no comparison available; "ns" indicates not significant. "-" indicates magnitude of difference could not be calculated when pooled standard deviation or median absolute deviation equal to 0. Logp1 indicates log10(x+1).

[a] Magnitude of Difference is calculated as $(MCT_{recent\ year} - MCT_{older\ year})/MAD_{pooled}$) for rank transformation and $(MCT_{recent\ year} - MCT_{older\ year})/SD_{pooled}$) for all other transformations. MAD_{pooled} = pooled median absolute deviation and SD_{pooled} = pooled standard deviation. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for all others.

[b] Magnitude of Difference is calculated as $(MCT_{Exposed} - MCT_{Reference})/(MAD_{pooled})$ for rank transformation and $(MCT_{Exposed} - MCT_{Reference})/(SD_{pooled})$ for all other transformations. MAD_{pooled} = pooled median absolute deviation and SD_{pooled} = pooled standard deviation. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for all others.

Table C.3: Spearman Rank Correlations Between Periphyton Community and Productivity Endpoints and Physiochemical Parameters, Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

Parameter	Statistic	Density (cells/cm²)	Total Biomass (mg/m²)	Richness (# of taxa)	LPL Simpson's Evenness	LPL Simpson's Diversity	BC Distance
Water Velocity (m³/s)	r_s	0.465	0.301	-0.299	-0.0414	-0.545	-0.263
	p-value	<0.001	0.009	0.009	0.724	<0.001	0.023
Temperature (°C)	r_s	0.143	0.221	-0.0590	0.207	0.0674	-0.0546
	p-value	0.222	0.056	0.615	0.075	0.566	0.642
DO (mg/L)	r_s	0.0898	-0.0838	-0.105	-0.0377	-0.116	-0.123
	p-value	0.444	0.475	0.368	0.748	0.321	0.294
DO (%)	r_s	0.256	0.118	-0.200	0.174	-0.0792	-0.295
	p-value	0.027	0.312	0.085	0.135	0.500	0.010
pH	r_s	-0.00293	0.147	0.461	-0.316	0.242	0.109
	p-value	0.981	0.221	<0.001	0.007	0.042	0.367
Specific Conductance (µS/cm)	r_s	0.0418	0.108	0.0806	-0.00969	-0.00161	-0.144
	p-value	0.722	0.356	0.492	0.934	0.989	0.217
Conductivity (µS/cm)	r_s	0.0394	0.110	0.0692	0.0162	0.0180	-0.123
	p-value	0.737	0.347	0.555	0.890	0.878	0.292
Substrate (cm)	r_s	-0.127	-0.0228	0.380	-0.234	0.320	0.308
	p-value	0.279	0.846	<0.001	0.044	0.005	0.007

P-Value < 0.1.

P-Value < 0.1/8 =0.0125 (Bonferroni Corrected for 8 independent tests).

abs(r_s) > 0.6.

Table C.3: Spearman Rank Correlations Between Periphyton Community and Productivity Endpoints and Physiochemical Parameters, Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

Parameter	Statistic	Chlorophyll a (mg/m²)	Ash-Free Dry Mass (mg/cm²)	% Diatoms	% Green Algae	% Blue-green Algae	% Other	Diatoms (cells/cm²)
Water Velocity (m³/s)	r_s	0.297	0.472	-0.373	-0.415	0.565	-0.0806	-0.127
	p-value	0.010	<0.001	<0.001	<0.001	<0.001	0.492	0.278
Temperature (°C)	r_s	0.218	0.100	-0.110	0.176	-0.0604	-0.0128	-0.0270
	p-value	0.060	0.391	0.347	0.131	0.607	0.913	0.818
DO (mg/L)	r_s	0.0269	0.164	-0.107	-0.202	0.187	-0.0317	-0.114
	p-value	0.819	0.160	0.361	0.082	0.108	0.787	0.328
DO (%)	r_s	0.169	0.274	-0.294	-0.104	0.188	-0.0347	-0.246
	p-value	0.148	0.017	0.010	0.375	0.106	0.767	0.033
pH	r_s	-0.122	-0.215	0.115	0.416	-0.275	0.314	0.334
	p-value	0.309	0.071	0.338	<0.001	0.020	0.008	0.004
Specific Conductance (µS/cm)	r_s	0.0183	-0.0243	0.0728	0.164	-0.0438	0.236	0.230
	p-value	0.876	0.836	0.535	0.160	0.709	0.042	0.047
Conductivity (µS/cm)	r_s	0.0323	-0.0207	0.0749	0.187	-0.0725	0.227	0.214
	p-value	0.783	0.860	0.523	0.108	0.536	0.050	0.065
Substrate (cm)	r_s	-0.265	-0.472	0.216	0.193	-0.297	0.0320	0.222
	p-value	0.021	<0.001	0.063	0.097	0.010	0.785	0.056

P-Value < 0.1.

P-Value < 0.1/8 =0.0125 (Bonferroni Corrected for 8 independent tests).

abs(r_s) > 0.6.

Table C.3: Spearman Rank Correlations Between Periphyton Community and Productivity Endpoints and Physiochemical Parameters, Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

Parameter	Statistic	Green Algae (cells/cm²)	Blue-green Algae (cells/cm²)	Other (cells/cm²)
Water Velocity (m³/s)	r_s	-0.251	0.464	-0.0473
	p-value	0.030	<0.001	0.687
Temperature (°C)	r_s	0.155	0.140	-0.0487
	p-value	0.183	0.231	0.678
DO (mg/L)	r_s	-0.151	0.0940	0.0257
	p-value	0.196	0.422	0.827
DO (%)	r_s	-0.0791	0.254	-0.00404
	p-value	0.500	0.028	0.973
pH	r_s	0.485	-0.00453	0.308
	p-value	<0.001	0.970	0.009
Specific Conductance (µS/cm)	r_s	0.115	0.0401	0.210
	p-value	0.325	0.732	0.071
Conductivity (µS/cm)	r_s	0.127	0.0369	0.197
	p-value	0.279	0.754	0.091
Substrate (cm)	r_s	0.284	-0.123	0.0485
	p-value	0.014	0.291	0.680

P-Value < 0.1.

P-Value < 0.1/8 =0.0125 (Bonferroni Corrected for 8 independent tests).

abs(r_s) > 0.6.

Table C.4: Periphyton Productivity and Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Density (cells/cm²)	2018	SYT0.6	5	3,454,311	1,326,423	593,195	1,725,499	3,626,165	5,051,914
		XE0.2	5	6,257,705	9,317,401	4,166,868	336,671	2,033,627	22,610,562
		HC0.2	5	3,058,664	2,009,876	898,844	1,107,837	3,179,660	6,197,337
		CC5.6	3	79,899	33,984	19,620	54,868	66,243	118,587
		YT0.2	5	2,017,383	1,312,893	587,143	547,439	2,017,751	3,917,806
	2019	SYT0.6	5	1,339,960	561,909	251,293	482,499	1,508,739	1,875,903
		XE0.2	5	1,815,408	469,595	210,009	1,265,562	1,996,375	2,354,240
		HC0.2	5	946,161	918,075	410,576	107,888	455,852	2,218,833
		CC5.6	5	1,013,496	1,131,355	505,958	142,772	667,407	2,977,781
		YT0.2	5	236,546	144,041	64,417	70,903	290,050	399,271
	2021	SYT0.6	5	874,209	473,200	211,621	371,504	943,561	1,330,583
		XE0.2	5	1,243,997	1,025,344	458,548	471,399	1,001,458	3,001,977
		HC0.2	5	289,846	178,543	79,847	29,547	379,107	472,093
		CC5.6	5	9,546,540	2,412,749	1,079,014	6,519,526	9,730,779	12,211,299
		YT0.2	5	81,081	87,590	39,171	6,713	29,245	199,543
Total Biomass (mg/m²)	2018	SYT0.6	5	119	74.1	33.1	41.6	119	208
		XE0.2	5	151	183	81.8	35.4	75.6	475
		HC0.2	5	116	84.2	37.6	46.8	76.4	247
		CC5.6	3	2.56	1.15	0.665	1.78	2.02	3.88
		YT0.2	5	87.3	64.2	28.7	27.8	69.4	196
	2019	SYT0.6	5	195	109	48.6	70.9	209	358
		XE0.2	5	447	390	174	143	238	1,077
		HC0.2	5	431	516	231	56.8	93.6	1,195
		CC5.6	5	772	928	415	170	397	2,417
		YT0.2	5	46.0	37.7	16.9	9.71	30.6	107
	2021	SYT0.6	5	164	124	55.4	55.0	115	317
		XE0.2	5	175	304	136	22.1	39.8	718
		HC0.2	5	142	137	61.3	17.9	95.4	355
		CC5.6	5	3,496	789	353	2,466	3,615	4,348
		YT0.2	5	20.8	17.1	7.65	3.61	19.7	48.3
Richness (# of taxa)	2018	SYT0.6	5	6.00	2.35	1.05	4.00	5.00	10.0
		XE0.2	5	6.60	1.82	0.812	5.00	6.00	9.00
		HC0.2	5	2.60	0.894	0.400	2.00	2.00	4.00
		CC5.6	3	9.67	0.577	0.333	9.00	10.0	10.0
		YT0.2	5	5.40	2.30	1.03	3.00	6.00	8.00
	2019	SYT0.6	5	8.20	2.59	1.16	5.00	8.00	12.0
		XE0.2	5	10.4	1.52	0.678	9.00	10.0	12.0
		HC0.2	5	7.80	2.68	1.20	6.00	6.00	12.0
		CC5.6	5	10.4	2.30	1.03	8.00	10.0	14.0
		YT0.2	5	7.60	2.51	1.12	6.00	7.00	12.0
	2021	SYT0.6	5	5.40	1.34	0.600	4.00	6.00	7.00
		XE0.2	5	7.20	1.79	0.800	4.00	8.00	8.00
		HC0.2	5	3.80	0.837	0.374	3.00	4.00	5.00
		CC5.6	5	11.4	1.67	0.748	10.0	11.0	14.0
		YT0.2	5	5.20	2.59	1.16	2.00	5.00	9.00
LPL Simpson's Evenness	2018	SYT0.6	5	0.346	0.119	0.0532	0.192	0.374	0.458
		XE0.2	5	0.235	0.0654	0.0292	0.171	0.230	0.335
		HC0.2	5	0.625	0.247	0.110	0.279	0.612	0.901
		CC5.6	3	0.294	0.123	0.0711	0.207	0.240	0.435
		YT0.2	5	0.437	0.182	0.0814	0.177	0.395	0.635
	2019	SYT0.6	5	0.210	0.0736	0.0329	0.119	0.205	0.316
		XE0.2	5	0.295	0.157	0.0704	0.188	0.196	0.551
		HC0.2	5	0.395	0.146	0.0655	0.219	0.429	0.593
		CC5.6	5	0.271	0.147	0.0655	0.107	0.300	0.447
		YT0.2	5	0.243	0.0394	0.0176	0.194	0.232	0.302
	2021	SYT0.6	5	0.320	0.103	0.0462	0.208	0.288	0.487
		XE0.2	5	0.291	0.121	0.0542	0.167	0.268	0.493
		HC0.2	5	0.657	0.168	0.0751	0.406	0.712	0.847
		CC5.6	5	0.0956	0.0125	0.00557	0.0792	0.0954	0.110
		YT0.2	5	0.403	0.156	0.0698	0.212	0.374	0.642
LPL Simpson's Diversity	2018	SYT0.6	5	0.418	0.247	0.110	0.132	0.447	0.732
		XE0.2	5	0.299	0.179	0.0799	0.0248	0.396	0.457
		HC0.2	5	0.268	0.242	0.108	0.0338	0.182	0.630
		CC5.6	3	0.605	0.155	0.0895	0.462	0.583	0.770
		YT0.2	5	0.456	0.248	0.111	0.0560	0.475	0.682
	2019	SYT0.6	5	0.346	0.163	0.0727	0.159	0.304	0.605
		XE0.2	5	0.614	0.143	0.0638	0.431	0.576	0.798
		HC0.2	5	0.632	0.0913	0.0408	0.492	0.627	0.719
		CC5.6	5	0.497	0.342	0.153	0.0635	0.721	0.762
		YT0.2	5	0.407	0.190	0.0850	0.141	0.383	0.641
	2021	SYT0.6	5	0.371	0.140	0.0628	0.197	0.422	0.502
		XE0.2	5	0.465	0.122	0.0544	0.251	0.496	0.549
		HC0.2	5	0.576	0.0605	0.0271	0.507	0.575	0.660
		CC5.6	5	0.0678	0.0253	0.0113	0.0454	0.0559	0.0978
		YT0.2	5	0.422	0.124	0.0552	0.221	0.435	0.554

Table C.4: Periphyton Productivity and Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
BC Distance	2018	SYT0.6	5	0.716	0.138	0.0617	0.577	0.674	0.923
		XE0.2	5	0.629	0.355	0.159	0.0973	0.807	0.919
		HC0.2	5	0.501	0.274	0.123	0.159	0.528	0.794
		CC5.6	3	0.920	0.0495	0.0286	0.863	0.945	0.952
		YT0.2	5	0.480	0.142	0.0634	0.325	0.496	0.620
	2019	SYT0.6	5	0.671	0.0872	0.0390	0.591	0.672	0.810
		XE0.2	5	0.646	0.0819	0.0366	0.542	0.691	0.724
		HC0.2	5	0.465	0.250	0.112	0.135	0.568	0.712
		CC5.6	5	0.677	0.258	0.115	0.364	0.763	0.962
		YT0.2	5	0.506	0.190	0.0848	0.254	0.469	0.767
	2021	SYT0.6	5	0.429	0.279	0.125	0.119	0.521	0.711
		XE0.2	5	0.513	0.221	0.0987	0.277	0.542	0.820
		HC0.2	5	0.415	0.282	0.126	0.121	0.394	0.852
		CC5.6	5	0.965	0.00497	0.00222	0.960	0.964	0.974
		YT0.2	5	0.758	0.194	0.0867	0.479	0.828	0.957
Chlorophyll a (mg/m²)	2018	SYT0.6	5	14.8	10.4	4.65	5.10	13.6	32.2
		XE0.2	5	14.4	6.52	2.92	5.45	15.3	21.7
		HC0.2	5	4.19	2.46	1.10	2.44	3.15	8.50
		CC5.6	3	2.55	2.22	1.28	0.790	1.82	5.05
		YT0.2	5	3.12	1.21	0.541	2.05	2.70	5.20
	2019	SYT0.6	5	6.06	3.65	1.63	1.48	7.25	9.85
		XE0.2	5	11.8	5.56	2.49	4.14	12.6	17.8
		HC0.2	5	1.23	0.877	0.392	0.292	1.18	2.34
		CC5.6	5	31.5	58.5	26.2	0.968	7.10	136
		YT0.2	5	0.791	0.461	0.206	0.320	0.655	1.51
	2021	SYT0.6	5	3.87	3.38	1.51	1.15	2.60	9.50
		XE0.2	5	6.95	2.14	0.959	4.67	6.90	9.20
		HC0.2	5	3.03	2.66	1.19	0.585	2.94	7.35
		CC5.6	5	22.8	16.6	7.40	0.980	23.6	45.1
		YT0.2	5	2.38	0.484	0.217	1.82	2.29	3.10
Ash-Free Dry Mass (mg/cm²)	2018	SYT0.6	5	2.83	1.92	0.858	1.76	2.03	6.25
		XE0.2	5	1.59	0.593	0.265	0.990	1.51	2.56
		HC0.2	5	1.14	0.506	0.226	0.575	0.970	1.91
		CC5.6	3	0.307	0.247	0.142	0.115	0.220	0.585
		YT0.2	5	1.07	0.314	0.141	0.790	0.910	1.43
	2019	SYT0.6	5	0.339	0.271	0.121	0.150	0.205	0.810
		XE0.2	5	0.482	0.180	0.0805	0.310	0.520	0.740
		HC0.2	5	0.159	0.0909	0.0407	0.0650	0.125	0.285
		CC5.6	5	0.613	0.780	0.349	0.0456	0.400	1.96
		YT0.2	5	0.0464	0.0447	0.0200	0.00100	0.0500	0.0950
	2021	SYT0.6	5	0.282	0.545	0.244	0.00100	0.00100	1.25
		XE0.2	5	0.962	0.168	0.0751	0.780	0.920	1.15
		HC0.2	5	0.203	0.0981	0.0439	0.0500	0.235	0.315
		CC5.6	5	0.700	0.239	0.107	0.400	0.685	1.02
		YT0.2	5	0.218	0.166	0.0740	0.00100	0.220	0.465
% Diatoms	2018	SYT0.6	5	0.344	0.287	0.128	0.0827	0.239	0.831
		XE0.2	5	0.422	0.402	0.180	0.132	0.267	1.13
		HC0.2	5	0.0202	0.0451	0.0202	0	0	0.101
		CC5.6	3	0.752	0.0154	0.00890	0.734	0.758	0.763
		YT0.2	5	0.0282	0.0631	0.0282	0	0	0.141
	2019	SYT0.6	5	0.198	0.198	0.0884	0	0.196	0.506
		XE0.2	5	5.29	9.20	4.12	0.252	1.23	21.7
		HC0.2	5	0.392	0.358	0.160	0.0799	0.198	0.934
		CC5.6	5	1.12	1.33	0.596	0.184	0.720	3.47
		YT0.2	5	0.838	0.587	0.262	0.157	0.900	1.56
	2021	SYT0.6	5	0.0369	0.0403	0.0180	0	0.0352	0.0960
		XE0.2	5	0.242	0.196	0.0874	0.0636	0.207	0.515
		HC0.2	5	0.0555	0.0760	0.0340	0	0	0.142
		CC5.6	5	0.697	0.270	0.121	0.432	0.590	0.991
		YT0.2	5	0.281	0.253	0.113	0	0.218	0.633
% Green Algae	2018	SYT0.6	5	0.161	0.170	0.0761	0	0.166	0.403
		XE0.2	5	0.516	0.445	0.199	0	0.355	1.04
		HC0.2	5	0	0	0	0	0	0
		CC5.6	3	0.503	0.572	0.330	0.0565	0.305	1.15
		YT0.2	5	1.33	1.77	0.793	0	0.0947	3.29
	2019	SYT0.6	5	1.51	1.28	0.572	0.264	1.28	3.48
		XE0.2	5	2.55	2.58	1.15	0.544	1.22	6.80
		HC0.2	5	11.4	7.18	3.21	3.57	9.34	21.9
		CC5.6	5	8.32	10.3	4.61	0.0321	6.11	25.4
		YT0.2	5	2.41	2.12	0.949	0.283	2.45	5.25
	2021	SYT0.6	5	4.54	2.49	1.11	0.919	5.47	6.75
		XE0.2	5	1.78	2.18	0.975	0	0.615	5.19
		HC0.2	5	15.3	14.1	6.31	1.72	12.0	36.2
		CC5.6	5	0.0284	0.0586	0.0262	0	0	0.133
		YT0.2	5	9.01	5.80	2.59	2.84	11.4	15.6

Table C.4: Periphyton Productivity and Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
% Blue-green Algae	2018	SYT0.6	5	99.5	0.348	0.156	99.0	99.5	99.8
		XE0.2	5	99.0	0.593	0.265	98.3	98.9	99.8
		HC0.2	5	99.8	0.496	0.222	98.9	100	100
		CC5.6	3	93.5	5.27	3.04	88.4	93.1	98.9
		YT0.2	5	95.3	8.49	3.80	80.4	99.8	100
	2019	SYT0.6	5	98.2	1.06	0.474	96.5	98.7	99.0
		XE0.2	5	92.0	9.76	4.37	75.1	96.8	98.7
		HC0.2	5	87.3	7.29	3.26	77.8	89.5	96.0
		CC5.6	5	89.0	12.9	5.78	67.3	90.4	99.1
		YT0.2	5	96.4	3.05	1.37	92.3	96.3	99.6
	2021	SYT0.6	5	95.4	2.53	1.13	93.2	94.4	99.1
		XE0.2	5	97.6	2.59	1.16	94.5	99.1	99.9
		HC0.2	5	84.5	14.1	6.30	63.7	87.1	98.2
		CC5.6	5	99.3	0.240	0.107	99.0	99.4	99.5
		YT0.2	5	90.3	6.38	2.85	82.1	88.0	96.8
% Other	2018	SYT0.6	5	0.0165	0.0370	0.0165	0	0	0.0827
		XE0.2	5	0.0729	0.145	0.0650	0	0	0.332
		HC0.2	5	0.202	0.451	0.202	0	0	1.01
		CC5.6	3	5.28	5.13	2.96	0.282	5.02	10.5
		YT0.2	5	3.33	7.22	3.23	0	0.0947	16.2
	2019	SYT0.6	5	0.105	0.236	0.105	0	0	0.527
		XE0.2	5	0.186	0.310	0.139	0	0	0.715
		HC0.2	5	0.842	0.840	0.376	0.140	0.623	2.19
		CC5.6	5	1.61	1.81	0.810	0.112	0.635	3.81
		YT0.2	5	0.310	0.693	0.310	0	0	1.55
	2021	SYT0.6	5	0.0213	0.0476	0.0213	0	0	0.106
		XE0.2	5	0.368	0.700	0.313	0	0	1.61
		HC0.2	5	0.179	0.401	0.179	0	0	0.896
		CC5.6	5	0	0	0	0	0	0
		YT0.2	5	0.431	0.800	0.358	0	0	1.84
Diatoms (cells/cm²)	2018	SYT0.6	5	11,514	10,881	4,866	3,546	6,029	30,143
		XE0.2	5	16,591	24,709	11,050	2,679	4,137	60,285
		HC0.2	5	223	499	223	0	0	1,116
		CC5.6	3	597	241	139	419	502	871
		YT0.2	5	155	346	155	0	0	773
	2019	SYT0.6	5	2,965	3,861	1,727	0	1,130	9,495
		XE0.2	5	119,402	219,515	98,170	3,478	24,617	511,266
		HC0.2	5	1,836	1,104	494	626	1,773	3,165
		CC5.6	5	5,793	5,096	2,279	1,596	4,804	14,569
		YT0.2	5	1,855	1,800	805	348	870	4,521
	2021	SYT0.6	5	323	539	241	0	131	1,274
		XE0.2	5	3,160	4,332	1,937	637	1,179	10,806
		HC0.2	5	59.3	111	49.5	0	0	255
		CC5.6	5	62,189	12,897	5,768	42,047	64,003	76,978
		YT0.2	5	163	124	55.3	0	127	327
Green Algae (cells/cm²)	2018	SYT0.6	5	3,803	3,492	1,562	0	6,029	6,956
		XE0.2	5	22,488	33,313	14,898	0	12,412	80,380
		HC0.2	5	0	0	0	0	0	0
		CC5.6	3	332	375	216	67.0	167	760
		YT0.2	5	17,560	28,220	12,620	0	3,710	66,314
	2019	SYT0.6	5	22,529	20,527	9,180	1,272	14,129	52,481
		XE0.2	5	50,311	54,631	24,432	11,304	15,448	135,768
		HC0.2	5	123,376	151,833	67,902	16,214	24,717	352,500
		CC5.6	5	34,150	25,614	11,455	132	36,215	63,256
		YT0.2	5	6,162	7,305	3,267	435	1,739	16,955
	2021	SYT0.6	5	37,150	29,037	12,986	11,364	25,895	72,591
		XE0.2	5	35,385	67,551	30,210	0	6,155	155,911
		HC0.2	5	32,767	32,682	14,616	3,226	20,716	83,841
		CC5.6	5	2,814	5,680	2,540	0	0	12,937
		YT0.2	5	3,549	1,952	873	822	4,408	5,660
Blue-green Algae (cells/cm²)	2018	SYT0.6	5	3,438,285	1,326,701	593,319	1,712,746	3,589,994	5,039,857
		XE0.2	5	6,218,269	9,261,734	4,141,973	330,866	2,011,522	22,469,896
		HC0.2	5	3,056,208	2,012,861	900,179	1,095,556	3,179,660	6,197,337
		CC5.6	3	75,823	36,528	21,090	48,505	61,652	117,314
		YT0.2	5	1,979,944	1,340,910	599,673	440,007	1,945,409	3,910,387
	2019	SYT0.6	5	1,313,958	550,140	246,030	477,554	1,455,451	1,855,556
		XE0.2	5	1,642,982	334,299	149,503	1,225,623	1,768,197	2,020,414
		HC0.2	5	814,722	788,829	352,775	88,682	437,781	1,986,380
		CC5.6	5	964,846	1,133,320	506,836	96,157	595,108	2,940,605
		YT0.2	5	227,527	139,677	62,466	68,294	274,976	397,513
	2021	SYT0.6	5	836,650	460,738	206,048	360,009	879,884	1,318,357
		XE0.2	5	1,203,469	959,618	429,154	448,657	992,331	2,835,260
		HC0.2	5	256,341	163,332	73,044	18,814	296,606	451,377
		CC5.6	5	9,481,537	2,415,324	1,080,166	6,455,523	9,675,795	12,150,170
		YT0.2	5	77,135	85,837	38,387	5,890	24,018	193,018

Table C.4: Periphyton Productivity and Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Other (cells/cm²)	2018	SYT0.6	5	709	1,586	709	0	0	3,546
		XE0.2	5	357	514	230	0	0	1,116
		HC0.2	5	2,233	4,993	2,233	0	0	11,164
		CC5.6	3	3,147	2,726	1,574	335	3,328	5,777
		YT0.2	5	19,724	38,746	17,328	0	3,710	88,882
	2019	SYT0.6	5	509	1,137	509	0	0	2,543
		XE0.2	5	2,713	4,044	1,809	0	0	9,043
		HC0.2	5	6,227	9,670	4,325	904	2,261	23,494
		CC5.6	5	8,707	11,430	5,112	463	4,521	28,867
		YT0.2	5	1,001	2,239	1,001	0	0	5,006
	2021	SYT0.6	5	84.9	190	84.9	0	0	425
		XE0.2	5	1,983	3,288	1,471	0	0	7,581
		HC0.2	5	679	1,519	679	0	0	3,396
		CC5.6	5	0	0	0	0	0	0
		YT0.2	5	233	321	144	0	0	629
Green Algae:Diatoms	2018	SYT0.6	5	0.480	0.576	0.258	0	0.200	1.20
		XE0.2	5	2.31	2.88	1.29	0	1.33	7.00
		HC0.2	5	0	0	0	0	0	0
		CC5.6	3	0.663	0.754	0.435	0.0769	0.400	1.51
		YT0.2	5	4.60	10.3	4.60	0	0	23.0
	2019	SYT0.6	5	15.4	28.0	12.5	0	1.14	65.0
		XE0.2	5	2.21	2.45	1.10	0.146	1.00	5.52
		HC0.2	5	59.7	58.7	26.2	7.81	25.9	130
		CC5.6	5	11.0	13.5	6.04	0.0435	7.30	33.2
		YT0.2	5	2.64	1.83	0.817	1.25	2.00	5.83
	2021	SYT0.6	5	53.2	53.7	24.0	0	57.0	122
		XE0.2	5	6.23	5.88	2.63	0	5.25	14.4
		HC0.2	5	53.5	113	50.4	0	0	255
		CC5.6	5	0.0653	0.136	0.0607	0	0	0.308
		YT0.2	5	18.3	13.3	5.93	0	18.0	36.0

Table C.5. Statistical Temporal and Spatial Comparisons of Periphyton Endpoints, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021

ANOVA Model					Station		Do concentrations differ over time?			Do concentrations differ between the stations?					
							Magnitude of Difference[a]			Magnitude of Difference[b]					
										SYT0.6 Vs XE0.2 and Future Exposed			XE0.2 Vs SYT0.6 and Future Exposed		
Parameter	Transformation	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Density (cells/cm²)	log10	0.000	<0.001	<0.001	Reference	SYT0.6	ns	-1.61	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	-1.66	-2.78	ns	ns	ns	ns	ns	ns	-1.73
						CC5.6	2.35	5.32	2.97	-4.15	ns	2.78	-3.86	ns	2.48
						YT0.2	-2.37	-4.08	-1.71	ns	-2.03	-3.22	ns	-2.45	-3.52
Total Biomass (mg/m²)	log10	<0.001	<0.001	<0.001	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	1.34	ns	-1.76	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
						CC5.6	5.75	7.83	2.08	-4.00	ns	3.56	-3.98	ns	4.27
						YT0.2	ns	-1.68	ns	ns	-1.72	-2.29	ns	-2.46	ns
Richness (# of taxa)	log10	<0.001	<0.001	0.034	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	1.53	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	3.52	ns	-2.23	-2.65	ns	ns	-3.03	ns	-2.00
						CC5.6	ns	ns	ns	ns	ns	2.45	ns	ns	ns
						YT0.2	ns	ns	-1.46	ns	ns	ns	ns	ns	ns
LPL Simpson's Evenness	log10	<0.001	0.070	0.001	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	ns	ns	1.38	ns	ns	1.87	2.39	ns	2.18
						CC5.6	ns	-2.76	-2.33	ns	ns	-3.02	ns	ns	-2.71
						YT0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
LPL Simpson's Diversity	none	0.248	0.044	<0.001	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	1.72	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	1.99	1.68	ns	ns	ns	ns	ns	ns	ns
						CC5.6	ns	-2.93	-2.34	ns	ns	-1.65	ns	ns	-2.16
						YT0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
BC Distance	none	<0.001	0.699	0.059	Reference	SYT0.6	ns	-1.34	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
						CC5.6	ns	ns	1.35	ns	ns	2.51	ns	ns	2.11
						YT0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
Chlorophyll a (mg/m²)	rank	<0.001	0.025	0.003	Reference	SYT0.6	ns	-2.61	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	-0.468	ns	ns	ns	-1.44	ns	-2.90	-2.71	ns
						CC5.6	ns	5.16	ns	-2.80	ns	4.97	-3.21	ns	ns
						YT0.2	-0.487	ns	ns	-2.59	-1.57	ns	-3.00	-2.83	ns
Ash-Free Dry Mass (mg/cm²)	rank	<0.001	<0.001	<0.001	Reference	SYT0.6	-3.08	-3.42	ns	nc	nc	nc	nc	nc	nc
						XE0.2	-1.67	ns	0.674	ns	ns	1.55	nc	nc	nc
					Exposure	HC0.2	-1.42	-1.24	ns	ns	ns	ns	ns	ns	-1.16
						CC5.6	ns	ns	ns	-3.05	ns	1.15	-2.18	ns	ns
						YT0.2	-1.45	-1.16	ns	ns	-0.261	ns	ns	-0.793	-1.18
% Diatoms	rank	<0.001	<0.001	<0.001	Reference	SYT0.6	ns	-0.587	ns	nc	nc	nc	nc	nc	nc
						XE0.2	2.79	ns	-2.96	ns	2.99	ns	nc	nc	nc
					Exposure	HC0.2	0.572	ns	-0.572	-0.688	ns	ns	-0.769	-2.98	ns
						CC5.6	ns	ns	ns	ns	1.51	1.60	ns	ns	1.11
						YT0.2	2.60	0.629	-1.97	-0.688	2.03	ns	-0.769	ns	ns
% Green Algae	logit	0.001	<0.001	<0.001	Reference	SYT0.6	ns	1.71	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	3.12	3.32	ns	ns	2.32	ns	ns	1.97	2.50
						CC5.6	1.82	ns	-2.11	ns	ns	-1.80	ns	ns	ns
						YT0.2	ns	2.06	1.59	ns	ns	ns	ns	ns	1.87

Table C.5. Statistical Temporal and Spatial Comparisons of Periphyton Endpoints, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021

ANOVA Model					Station		Do concentrations differ over time?			Do concentrations differ between the stations?					
							Magnitude of Difference[a]			Magnitude of Difference[b]					
										SYT0.6 Vs XE0.2 and Future Exposed			XE0.2 Vs SYT0.6 and Future Exposed		
Parameter	Transformation	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
% Blue-green Algae	logit	0.065	<0.001	0.001	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	-1.38	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	-2.65	-2.69	ns	ns	-1.96	ns	ns	ns	-1.94
						CC5.6	ns	ns	1.79	ns	ns	ns	ns	ns	ns
						YT0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
% Other	rank	0.049	0.038	0.007	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	-	ns	-	ns	-	ns	ns	ns	ns
						CC5.6	ns	-	-	-	-	ns	-	ns	ns
						YT0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
Diatoms (cells/cm²)	rank	<0.001	<0.001	<0.001	Reference	SYT0.6	-2.92	-3.52	-0.597	nc	nc	nc	nc	nc	nc
						XE0.2	ns	-1.77	-14.0	ns	14.0	0.626	nc	nc	nc
					Exposure	HC0.2	1.06	ns	-1.06	-3.60	ns	ns	-2.47	-13.6	-0.704
						CC5.6	2.57	37.9	35.3	-3.30	ns	38.1	-2.17	ns	37.5
						YT0.2	0.519	ns	-0.443	-3.60	ns	ns	-2.47	-14.2	-0.628
Green Algae (cells/cm²)	rank	0.062	<0.001	0.003	Reference	SYT0.6	0.540	1.32	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	1.65	1.38	ns	ns	ns	ns	-0.827	ns	ns
						CC5.6	2.40	ns	-2.41	ns	ns	-1.73	ns	ns	ns
						YT0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
Blue-green Algae (cells/cm²)	log10	<0.001	<0.001	<0.001	Reference	SYT0.6	ns	-1.59	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	-1.75	-2.87	ns	ns	ns	ns	ns	ns	-1.84
						CC5.6	2.21	5.20	2.99	-4.07	ns	2.72	-3.79	ns	2.41
						YT0.2	-2.27	-3.99	-1.72	ns	-1.98	-3.17	ns	-2.31	-3.48
Other (cells/cm²)	rank	0.130	0.016	0.028	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	-	ns	-	ns	-	ns	ns	ns	ns
						CC5.6	ns	-	-	ns	-	ns	ns	ns	ns
						YT0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
Green Algae:Diatoms	logp1	0.268	<0.001	0.016	Reference	SYT0.6	ns	1.77	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	2.73	ns	-1.50	ns	ns	ns	ns	2.04	ns
						CC5.6	ns	ns	-1.34	ns	ns	-1.98	ns	ns	ns
						YT0.2	ns	1.40	ns	ns	ns	ns	ns	ns	ns

ANOVA P-value < 0.1.

> 2 SD Decrease in endpoint relative to reference

> 2 SD Increase in endpoint relative to reference

Note: "nc" indicates no comparison available; "ns" indicates not significant. "-" indicates magnitude of difference could not be calculated when pooled standard deviation or median absolute deviation equal to 0. Logp1 indicates log10(x+1).

[a] Magnitude of Difference is calculated as $(MCT_{recent\ year} - MCT_{older\ year})/MAD_{pooled}$ for rank transformation and $(MCT_{recent\ year} - MCT_{older\ year})/SD_{pooled}$ for all other transformations. MAD_{pooled} = pooled median absolute deviation and SD_{pooled} = pooled standard deviation. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for all others.

[b] Magnitude of Difference is calculated as $(MCT_{Exposed} - MCT_{Reference})/(MAD_{pooled})$ for rank transformation and $(MCT_{Exposed} - MCT_{Reference})/(SD_{pooled})$ for all other transformations. MAD_{pooled} = pooled median absolute deviation and SD_{pooled} = pooled standard deviation. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for all others.

Table C.6: Spearman Rank Correlations Between Periphyton Community and Productivity Endpoints and Physiochemical Parameters, Lower Creek Areas, 2018 to 2021

Parameter	Statistic	Density (cells/cm²)	Total Biomass (mg/m²)	Richness (# of taxa)	LPL Simpson's Evenness	LPL Simpson's Diversity	BC Distance	Chlorophyll a (mg/m²)	Ash-Free Dry Mass (mg/cm²)
Water Velocity (m³/s)	r_s	0.215	0.103	0.163	-0.0462	0.0252	-0.00909	0.0653	0.215
	p-value	0.068	0.387	0.168	0.698	0.832	0.939	0.583	0.068
Temperature (°C)	r_s	-0.0750	0.116	0.183	-0.114	-0.0297	0.230	-0.0272	-0.0773
	p-value	0.528	0.329	0.122	0.338	0.803	0.050	0.819	0.515
DO (mg/L)	r_s	0.264	-0.102	-0.258	0.124	-0.0601	-0.163	0.342	0.477
	p-value	0.026	0.397	0.030	0.302	0.619	0.174	0.003	<0.001
DO (%)	r_s	0.190	-0.0493	-0.101	0.0312	-0.00393	-0.0550	0.251	0.360
	p-value	0.112	0.683	0.400	0.796	0.974	0.649	0.035	0.002
pH	r_s	-0.0469	0.107	0.221	-0.159	0.224	-0.203	0.0971	-0.138
	p-value	0.695	0.369	0.062	0.182	0.058	0.088	0.417	0.246
Specific Conductance (µS/cm)	r_s	0.0167	-0.0798	0.00216	-0.139	-0.00270	-0.0525	0.289	0.0765
	p-value	0.889	0.502	0.986	0.241	0.982	0.659	0.013	0.520
Conductivity (µS/cm)	r_s	0.0251	-0.0425	0.0453	-0.178	-0.0204	-0.0200	0.323	0.0827
	p-value	0.833	0.721	0.704	0.131	0.864	0.867	0.005	0.487
Substrate (cm)	r_s	-0.126	0.183	0.212	-0.148	0.0598	-0.0469	-0.238	-0.378
	p-value	0.290	0.122	0.072	0.210	0.615	0.693	0.042	<0.001

P-Value < 0.1.

P-Value < 0.1/8 =0.0125 (Bonferroni Corrected for 8 independent tests.)

abs(r_s) > 0.6.

Table C.6: Spearman Rank Correlations Between Periphyton Community and Productivity Endpoints and Physiochemical Parameters, Lower Creek Areas, 2018 to 2021

Parameter	Statistic	% Diatoms	% Green Algae	% Blue-green Algae	% Other	Diatoms (cells/cm²)	Green Algae (cells/cm²)	Blue-green Algae (cells/cm²)	Other (cells/cm²)
Water Velocity (m³/s)	r_s	0.190	-0.361	0.241	0.208	0.202	-0.194	0.218	0.222
	p-value	0.107	0.002	0.040	0.077	0.086	0.099	0.064	0.059
Temperature (°C)	r_s	0.0376	0.0486	-0.134	0.172	-0.0139	-0.0618	-0.0787	0.142
	p-value	0.752	0.683	0.257	0.146	0.907	0.603	0.508	0.231
DO (mg/L)	r_s	-0.293	-0.278	0.289	-0.186	-0.123	-0.102	0.267	-0.128
	p-value	0.013	0.019	0.015	0.121	0.307	0.395	0.025	0.287
DO (%)	r_s	-0.273	-0.213	0.152	-0.0230	-0.179	-0.103	0.188	0.0193
	p-value	0.021	0.074	0.206	0.849	0.135	0.394	0.117	0.873
pH	r_s	0.236	0.279	-0.168	-0.0749	0.300	0.421	-0.0460	-0.0538
	p-value	0.046	0.018	0.159	0.532	0.011	<0.001	0.701	0.653
Specific Conductance (µS/cm)	r_s	0.0530	0.0713	-0.0286	-0.244	0.184	0.190	0.0249	-0.244
	p-value	0.656	0.549	0.810	0.037	0.120	0.108	0.834	0.038
Conductivity (µS/cm)	r_s	0.0802	0.0701	-0.0373	-0.225	0.224	0.195	0.0344	-0.220
	p-value	0.500	0.556	0.754	0.055	0.057	0.099	0.773	0.061
Substrate (cm)	r_s	0.224	0.285	-0.248	0.0666	0.175	0.281	-0.134	0.109
	p-value	0.056	0.014	0.035	0.575	0.139	0.016	0.258	0.358

P-Value < 0.1.

P-Value < 0.1/8 =0.0125 (Bonferroni Corrected for 8 independent tests.)

abs(r_s) > 0.6.

APPENDIX D
BENTHIC INVERTEBRATE COMMUNITY

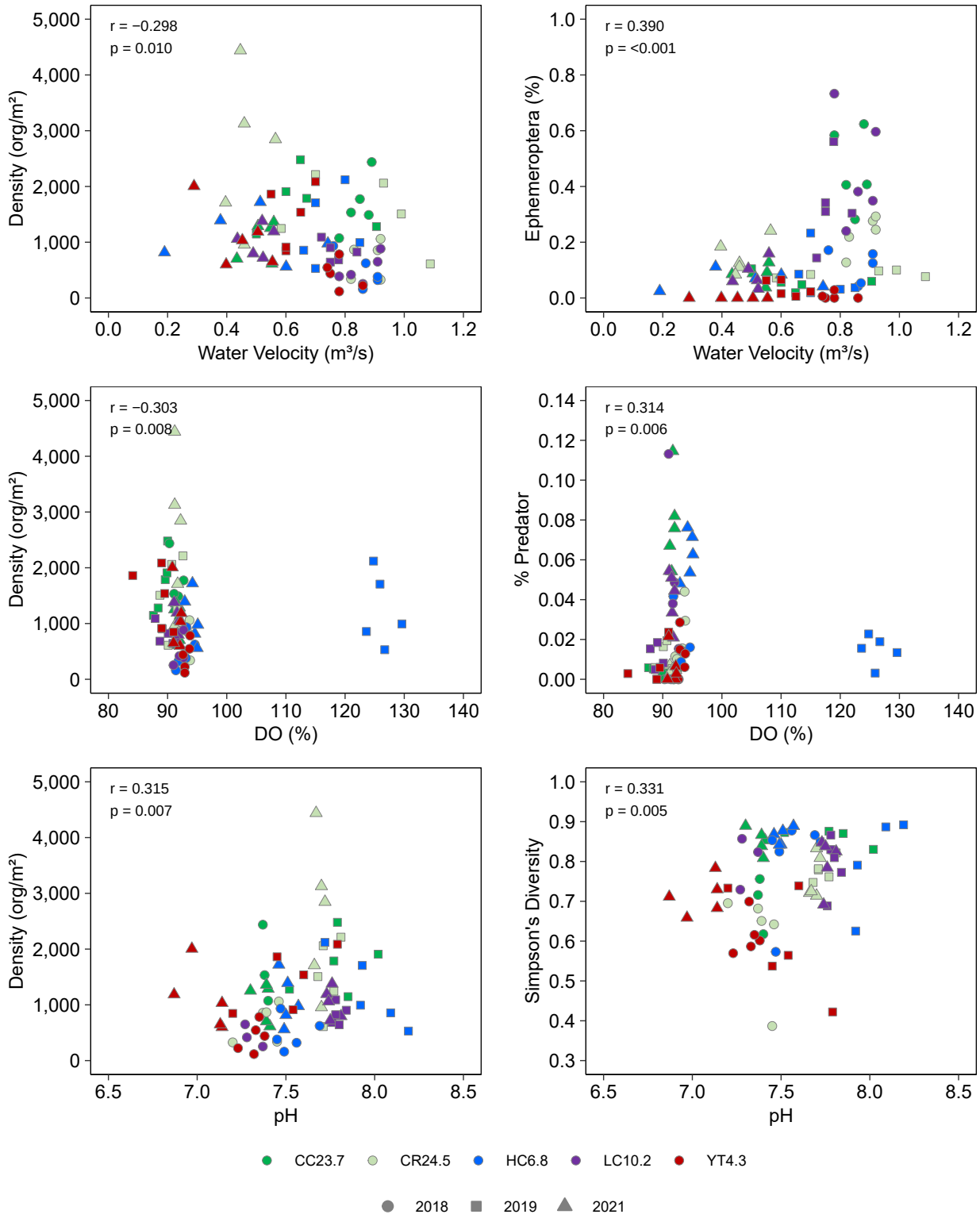
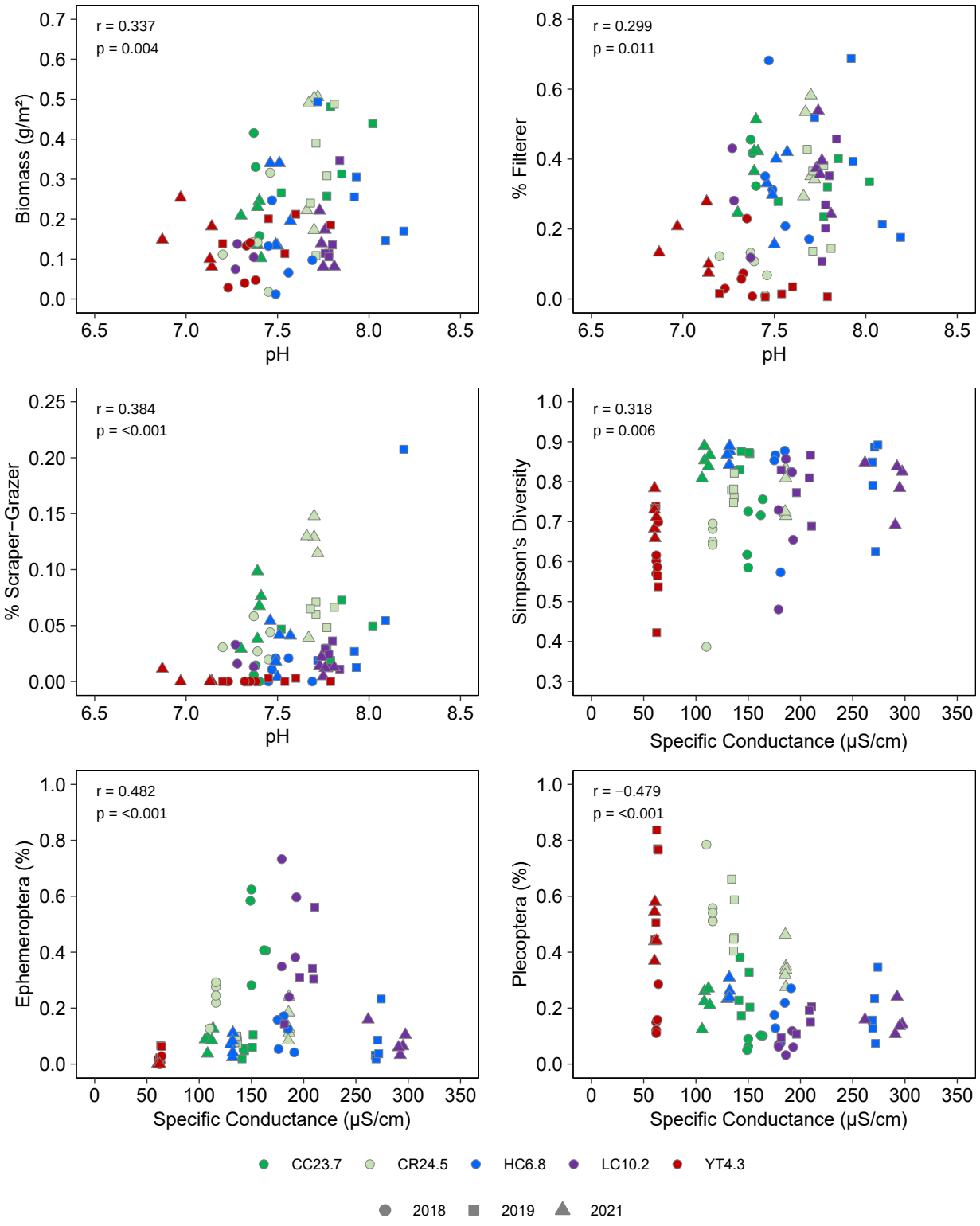


Figure D.1: Correlations between Benthic Invertebrate Community Endpoints and Physiochemical Parameters, Upper Creek Areas, 2018 to 2021

Notes: Stations shown in green are reference areas and all other colours are future-exposed.



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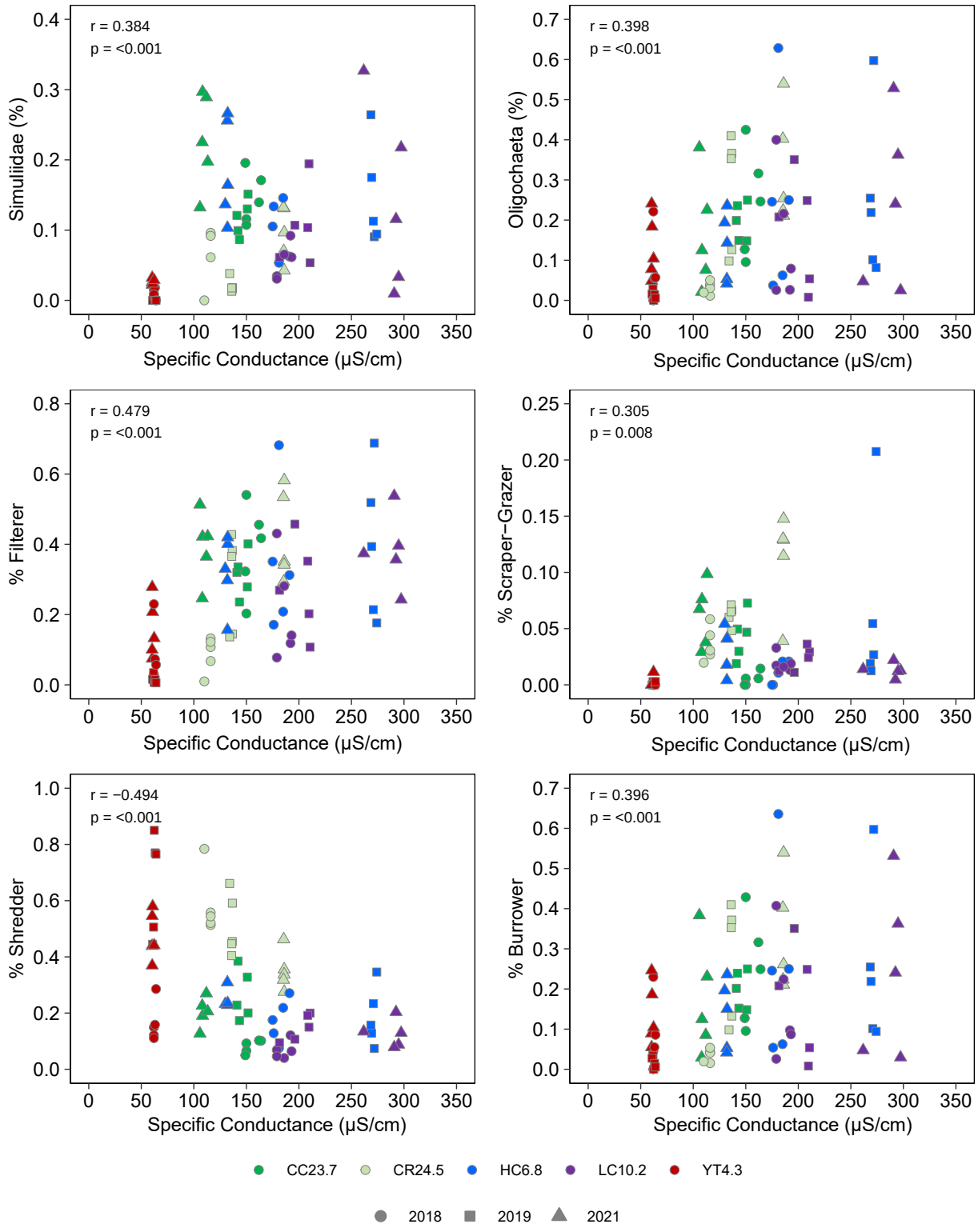

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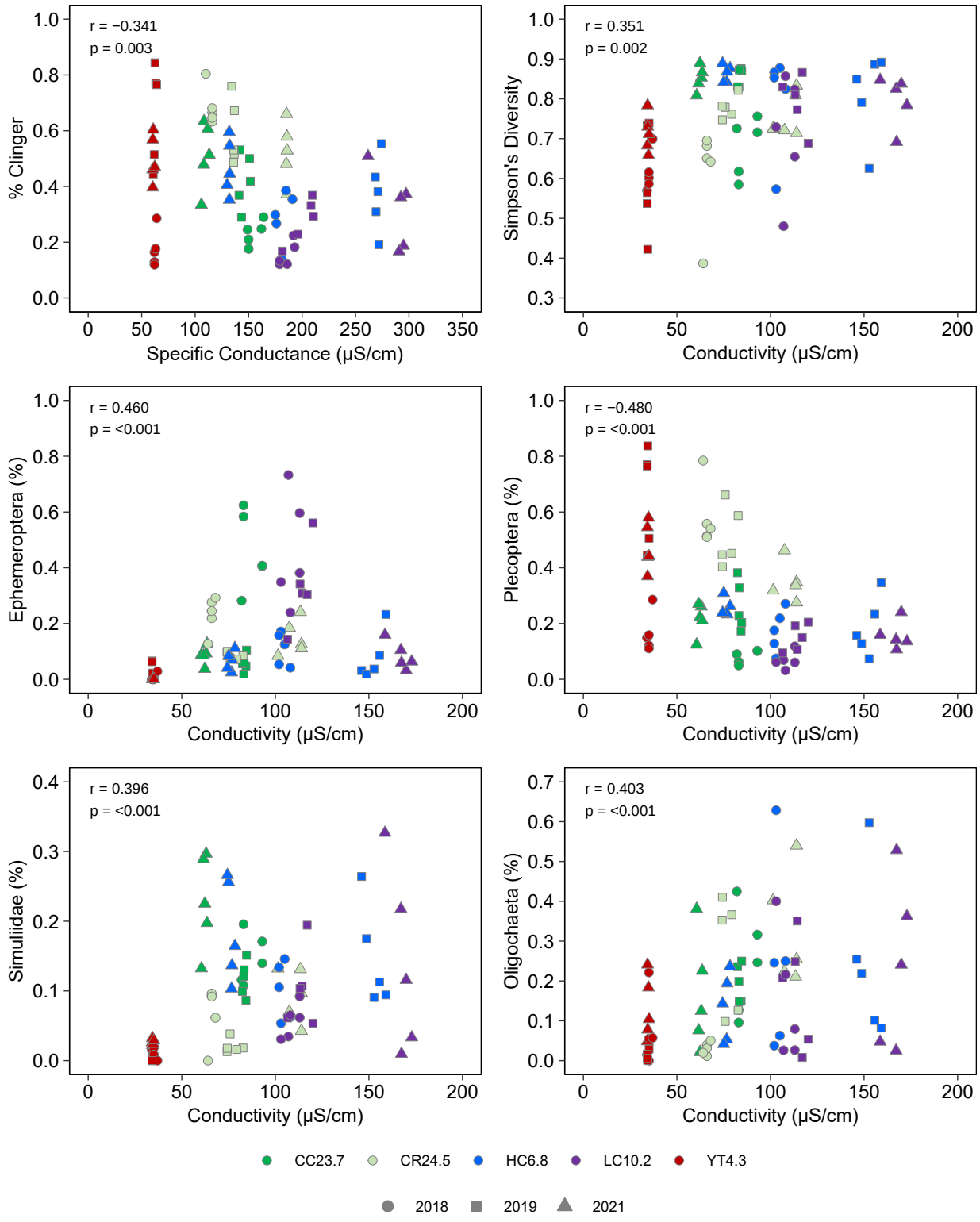

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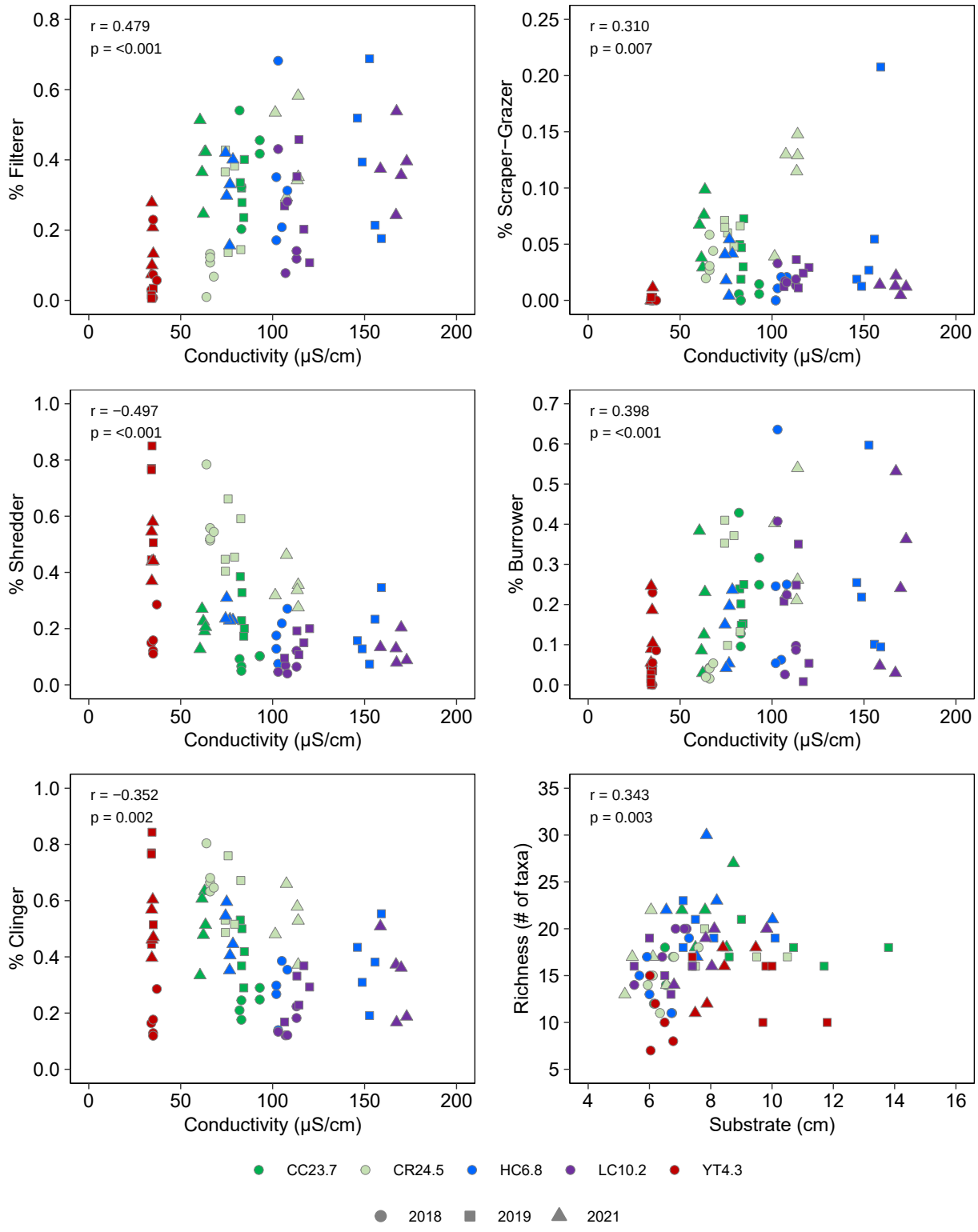

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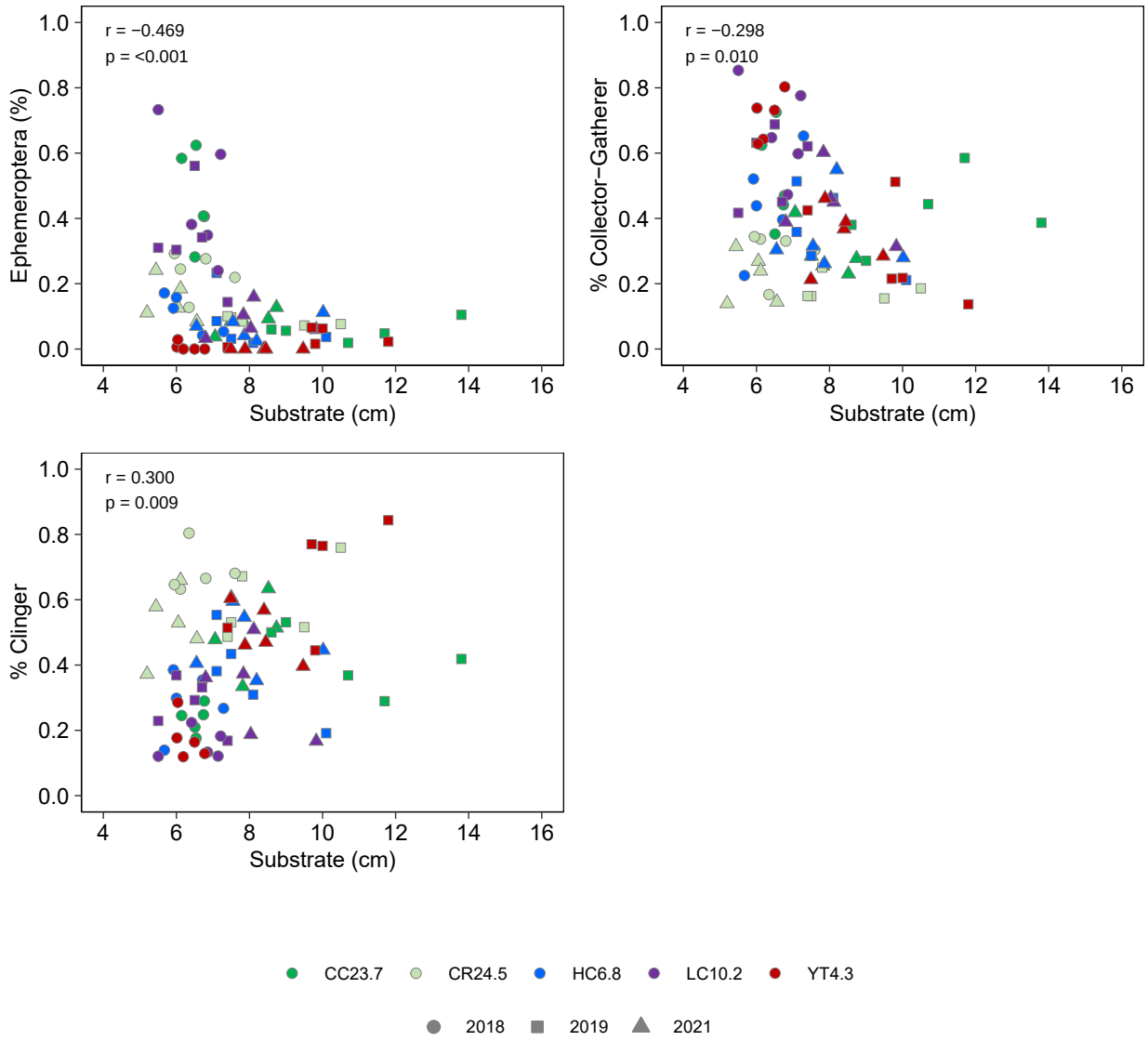

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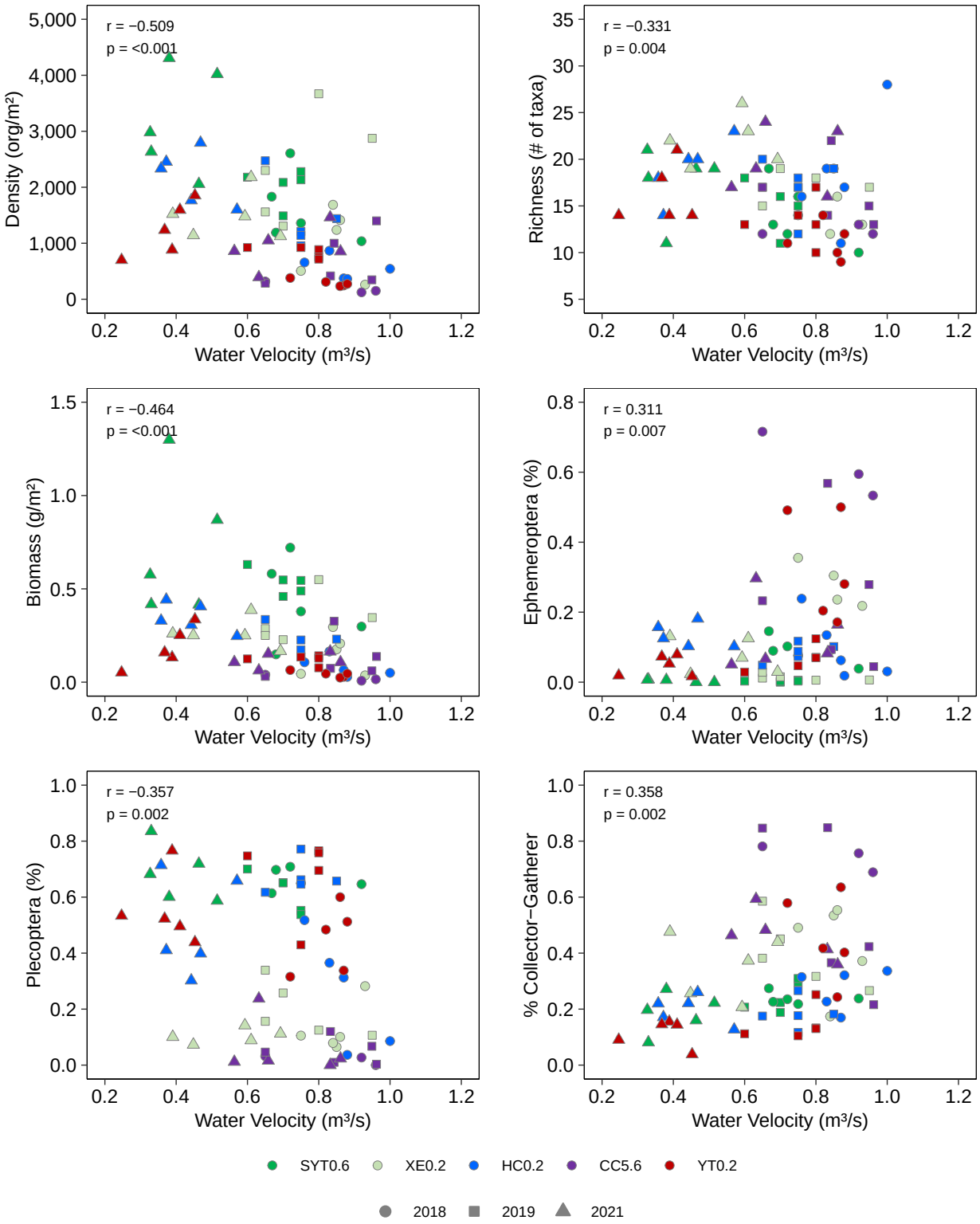

Figure D.2: Correlations between Benthic Invertebrate Community Endpoints and Physiochemical Parameters, Lower Creek Areas, 2018 to 2021

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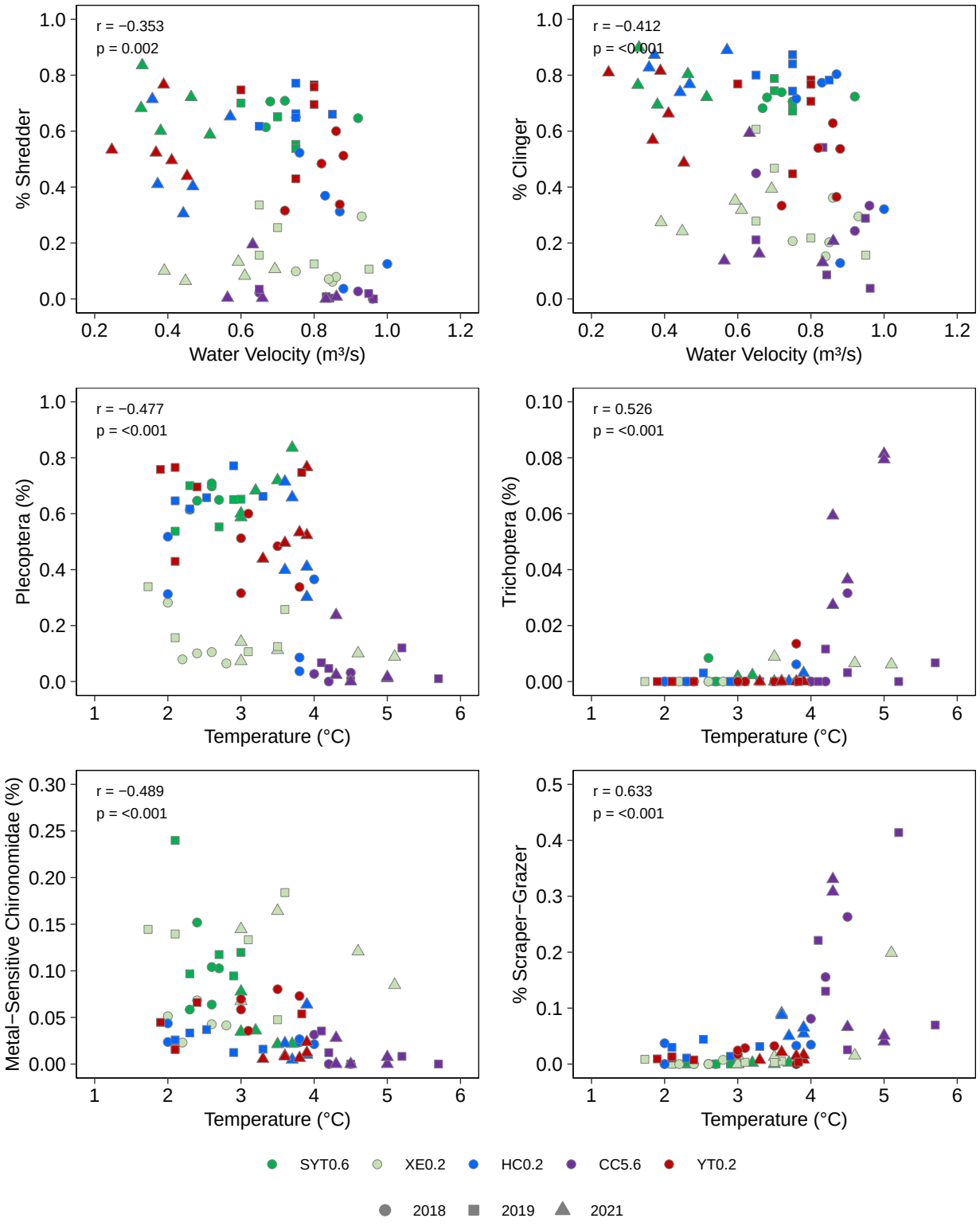

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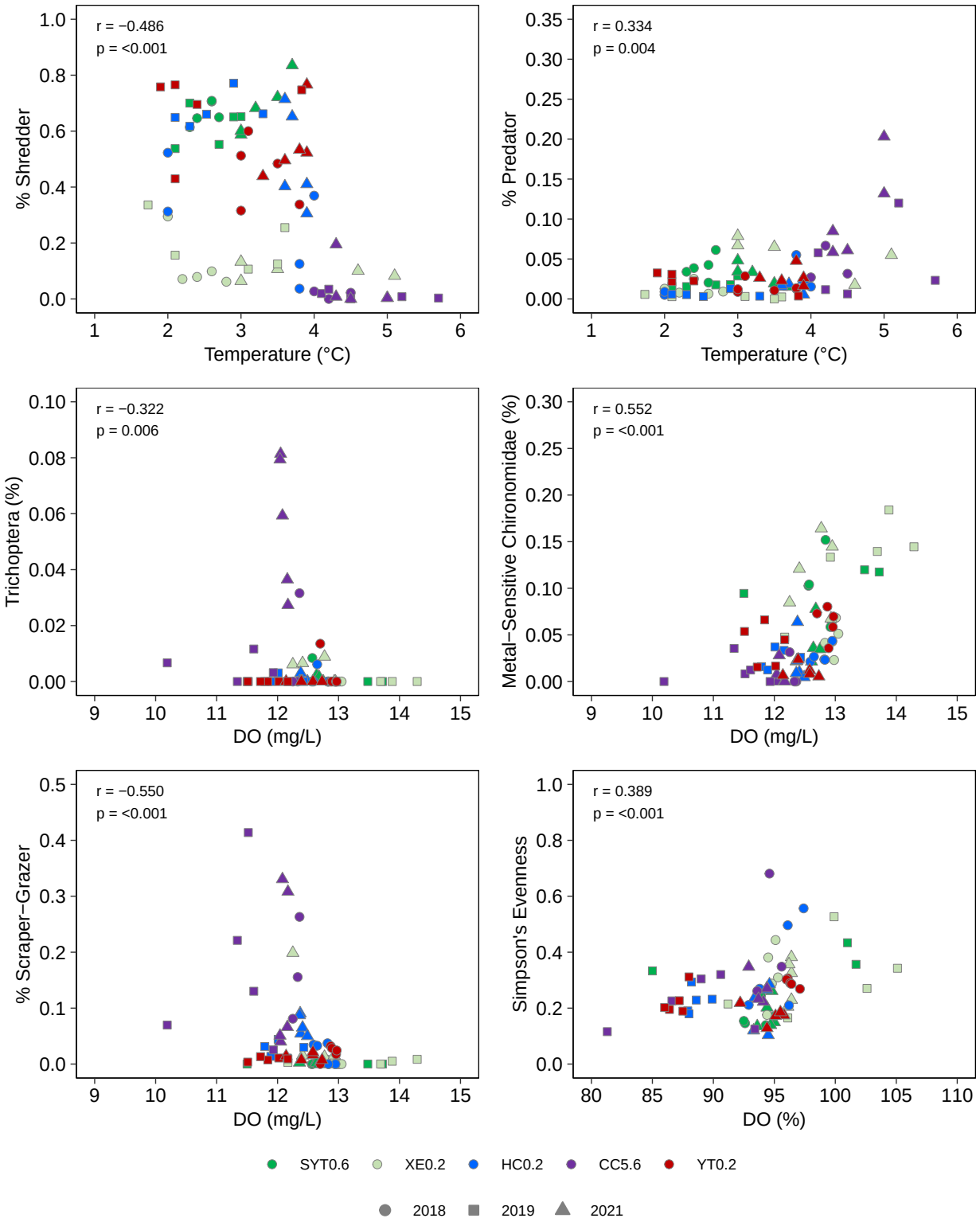

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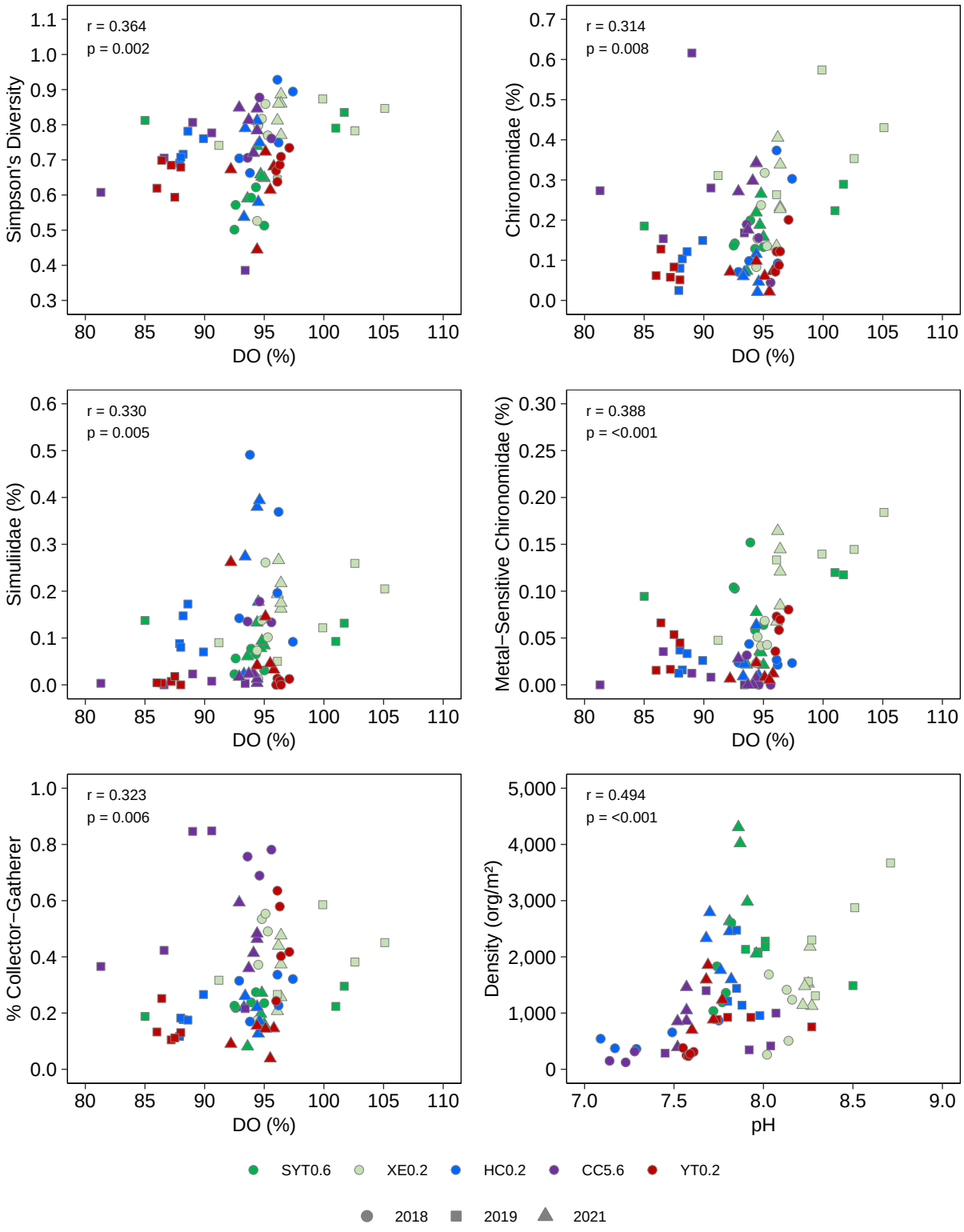

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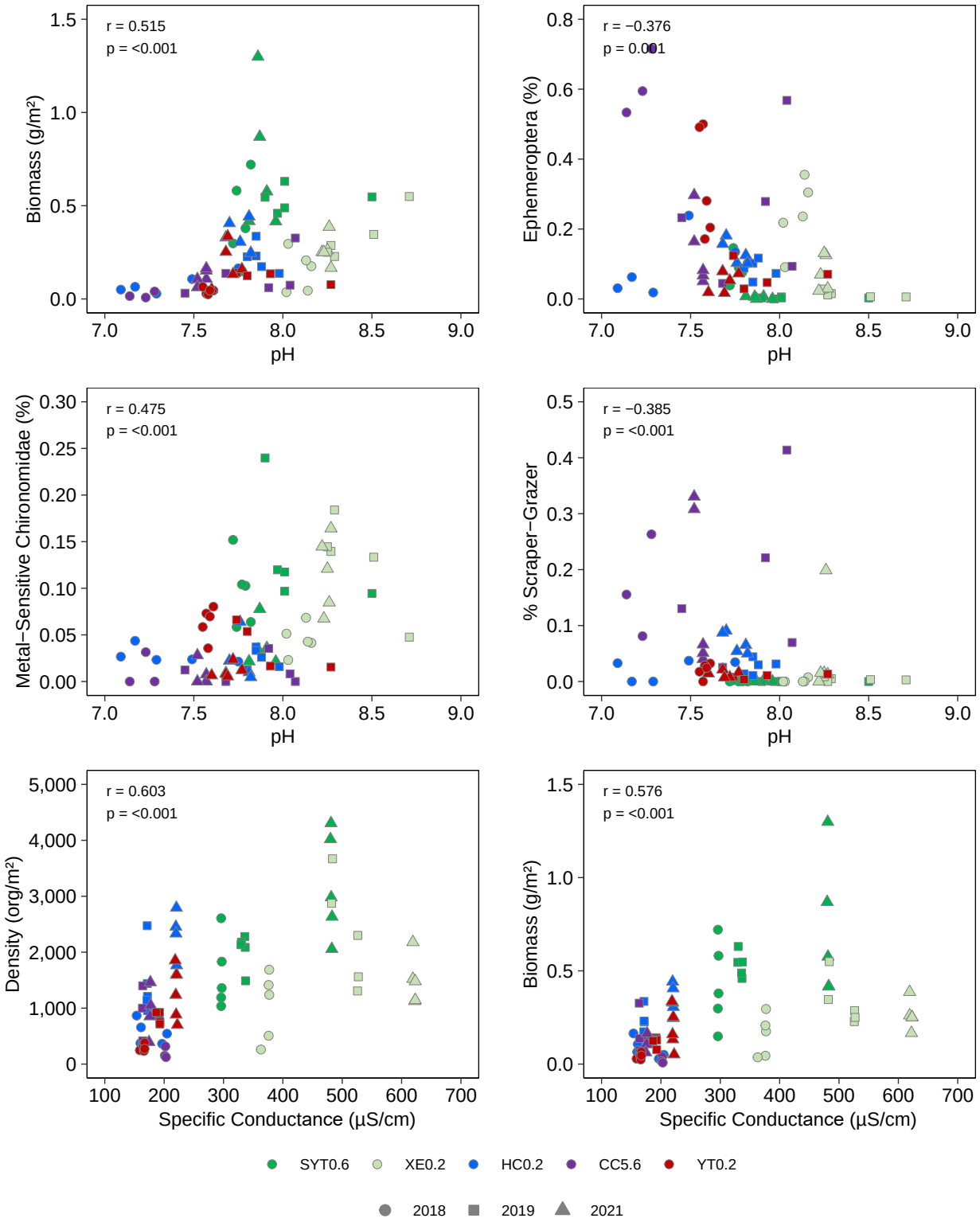

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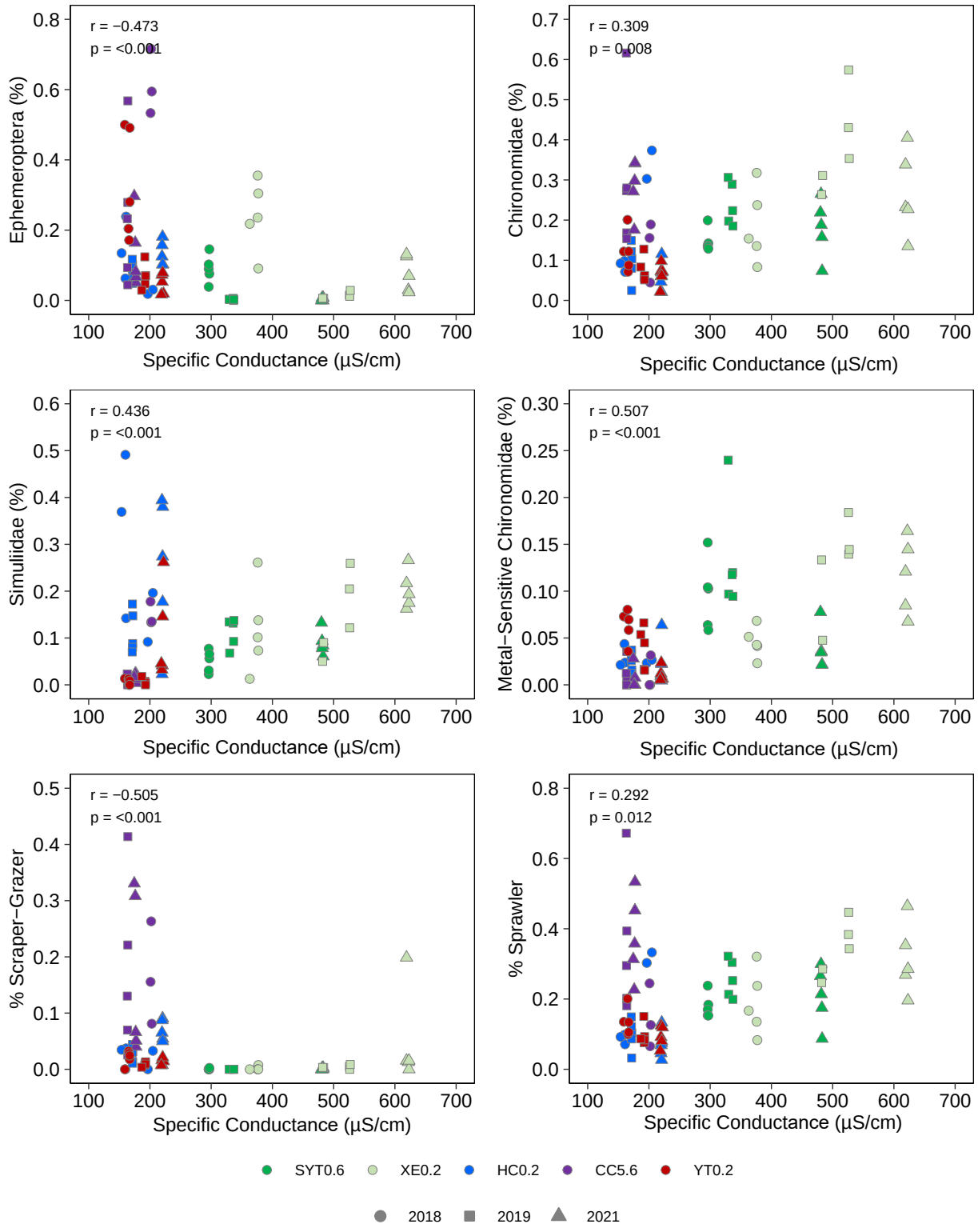

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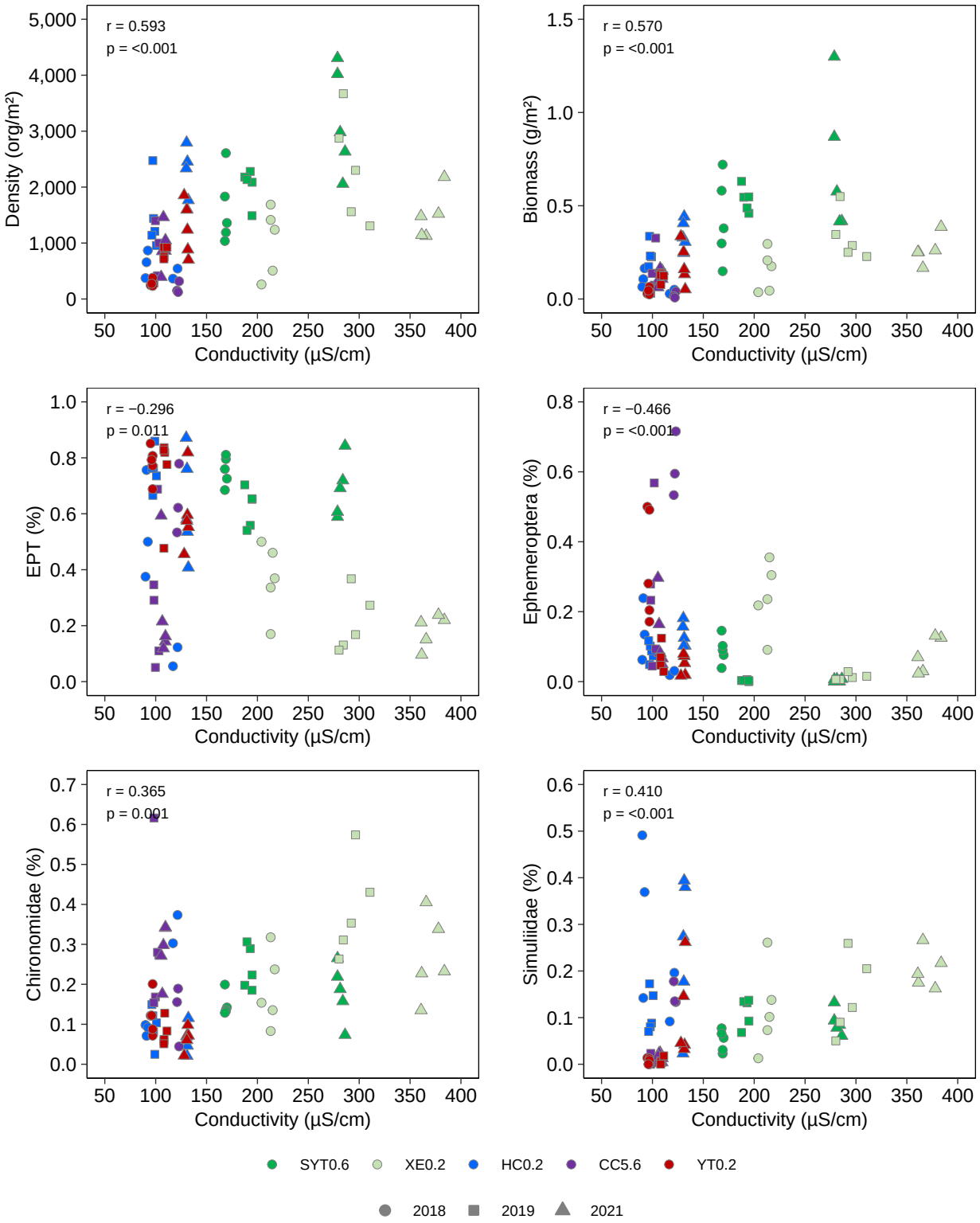

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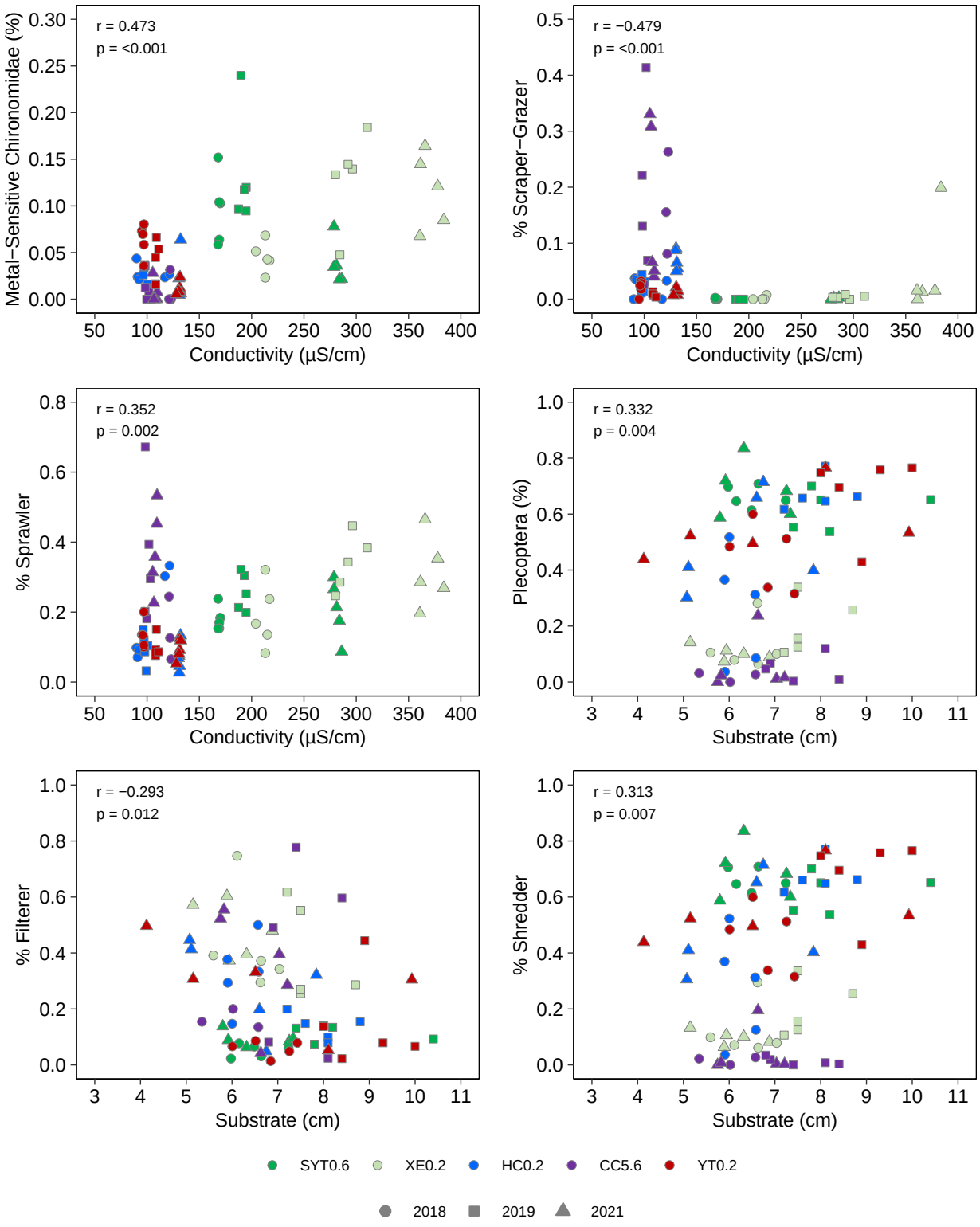

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Table D.1: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2017 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Density (org/m²)	2017	HC6.8	5	841	291	130	380	903	1,127
	2018	CC23.7	5	1,661	502	224	1,073	1,533	2,438
		CR24.5	5	690	336	150	327	857	1,060
		HC6.8	5	483	302	135	160	380	933
		LC10.2	5	518	249	111	253	417	883
		YT4.3	5	422	264	118	117	440	783
	2019	CC23.7	5	1,720	534	239	1,147	1,787	2,480
		CR24.5	5	1,527	647	289	610	1,507	2,213
		HC6.8	5	1,241	653	292	530	993	2,120
		LC10.2	5	829	180	80.4	643	823	1,090
		YT4.3	5	1,449	555	248	847	1,538	2,087
	2021	CC23.7	5	1,043	355	159	613	1,253	1,360
		CR24.5	5	2,617	1,343	601	957	2,847	4,440
		HC6.8	5	1,093	463	207	560	977	1,720
		LC10.2	5	1,030	274	122	720	1,060	1,379
		YT4.3	5	1,095	567	253	600	1,033	2,005
Richness (# of taxa)	2017	HC6.8	5	19.0	1.87	0.837	16.0	19.0	21.0
	2018	CC23.7	5	14.4	3.05	1.36	11.0	14.0	18.0
		CR24.5	5	15.0	2.74	1.22	11.0	15.0	18.0
		HC6.8	5	15.0	3.16	1.41	11.0	15.0	19.0
		LC10.2	5	18.2	2.68	1.20	14.0	20.0	20.0
		YT4.3	5	10.4	3.21	1.44	7.00	10.0	15.0
	2019	CC23.7	5	18.0	1.87	0.837	16.0	18.0	21.0
		CR24.5	5	17.2	1.64	0.735	16.0	17.0	20.0
		HC6.8	5	20.0	2.00	0.894	18.0	19.0	23.0
		LC10.2	5	15.8	2.17	0.970	13.0	16.0	19.0
		YT4.3	5	13.8	3.49	1.56	10.0	16.0	17.0
	2021	CC23.7	5	21.4	3.71	1.66	18.0	22.0	27.0
		CR24.5	5	16.6	3.51	1.57	13.0	17.0	22.0
		HC6.8	5	22.6	4.72	2.11	17.0	22.0	30.0
		LC10.2	5	17.8	2.68	1.20	14.0	19.0	20.0
		YT4.3	5	15.0	3.32	1.48	11.0	16.0	18.0
Simpson's Evenness	2017	HC6.8	5	0.254	0.0799	0.0357	0.188	0.205	0.351
	2018	CC23.7	5	0.231	0.0558	0.0250	0.172	0.218	0.320
		CR24.5	5	0.182	0.0289	0.0129	0.148	0.185	0.219
		HC6.8	5	0.415	0.154	0.0687	0.156	0.480	0.524
		LC10.2	5	0.230	0.103	0.0463	0.137	0.185	0.349
		YT4.3	5	0.280	0.122	0.0546	0.161	0.232	0.475
	2019	CC23.7	5	0.400	0.0938	0.0420	0.281	0.428	0.503
		CR24.5	5	0.265	0.0183	0.00818	0.246	0.266	0.286
		HC6.8	5	0.320	0.135	0.0604	0.140	0.316	0.491
		LC10.2	5	0.331	0.0827	0.0370	0.214	0.367	0.404
		YT4.3	5	0.199	0.0437	0.0195	0.135	0.225	0.234
	2021	CC23.7	5	0.330	0.0716	0.0320	0.237	0.344	0.411
		CR24.5	5	0.264	0.0348	0.0156	0.211	0.269	0.308
		HC6.8	5	0.336	0.0468	0.0209	0.276	0.345	0.386
		LC10.2	5	0.304	0.0995	0.0445	0.162	0.300	0.441
		YT4.3	5	0.245	0.0508	0.0227	0.175	0.257	0.309
Simpson's Diversity	2017	HC6.8	5	0.774	0.0724	0.0324	0.695	0.755	0.857
	2018	CC23.7	5	0.680	0.0743	0.0332	0.585	0.716	0.756
		CR24.5	5	0.611	0.127	0.0570	0.387	0.651	0.695
		HC6.8	5	0.799	0.128	0.0571	0.573	0.853	0.877
		LC10.2	5	0.709	0.151	0.0673	0.480	0.729	0.857
		YT4.3	5	0.615	0.0504	0.0225	0.570	0.601	0.699
	2019	CC23.7	5	0.856	0.0238	0.0106	0.829	0.870	0.876
		CR24.5	5	0.778	0.0280	0.0125	0.747	0.779	0.822
		HC6.8	5	0.809	0.110	0.0493	0.625	0.849	0.892
		LC10.2	5	0.793	0.0677	0.0303	0.688	0.810	0.866
		YT4.3	5	0.599	0.136	0.0608	0.422	0.564	0.739
	2021	CC23.7	5	0.851	0.0304	0.0136	0.808	0.853	0.889
		CR24.5	5	0.760	0.0561	0.0251	0.714	0.725	0.833
		HC6.8	5	0.864	0.0210	0.00941	0.842	0.868	0.889
		LC10.2	5	0.797	0.0638	0.0285	0.691	0.825	0.847
		YT4.3	5	0.713	0.0478	0.0214	0.659	0.711	0.784

Table D.1: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2017 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Biomass (g/m²)	2017	HC6.8	-	-	-	-	-	-	-
	2018	CC23.7	5	0.321	0.174	0.0780	0.147	0.330	0.557
		CR24.5	5	0.146	0.108	0.0483	0.0177	0.142	0.316
		HC6.8	5	0.111	0.0879	0.0393	0.0120	0.0973	0.247
		LC10.2	5	0.107	0.0418	0.0187	0.0600	0.104	0.160
		YT4.3	5	0.0777	0.0544	0.0243	0.0283	0.0470	0.141
	2019	CC23.7	5	0.351	0.103	0.0459	0.258	0.313	0.481
		CR24.5	5	0.307	0.144	0.0645	0.109	0.308	0.487
		HC6.8	5	0.274	0.139	0.0620	0.145	0.255	0.493
		LC10.2	5	0.163	0.103	0.0461	0.105	0.114	0.346
		YT4.3	5	0.170	0.0422	0.0189	0.113	0.185	0.212
	2021	CC23.7	5	0.184	0.0627	0.0280	0.102	0.209	0.246
		CR24.5	5	0.378	0.167	0.0745	0.172	0.489	0.505
		HC6.8	5	0.229	0.104	0.0466	0.133	0.195	0.340
		LC10.2	5	0.139	0.0605	0.0271	0.0807	0.139	0.221
		YT4.3	5	0.153	0.0689	0.0308	0.0803	0.148	0.253
EPT (%)	2017	HC6.8	5	73.3	8.61	3.85	62.4	73.4	82.6
	2018	CC23.7	5	54.4	12.4	5.56	37.2	51.0	69.2
		CR24.5	5	81.3	6.20	2.77	75.5	79.0	91.2
		HC6.8	5	29.0	7.21	3.23	18.7	31.2	35.4
		LC10.2	5	54.0	20.9	9.34	28.0	50.0	80.2
		YT4.3	5	17.2	8.24	3.69	11.1	14.9	31.4
	2019	CC23.7	5	32.1	9.29	4.15	22.1	30.8	44.1
		CR24.5	5	59.6	10.3	4.59	50.4	54.4	73.8
		HC6.8	5	27.5	19.6	8.76	12.1	18.9	59.8
		LC10.2	5	48.2	19.2	8.58	23.9	45.3	76.6
		YT4.3	5	69.9	19.6	8.75	46.1	82.8	85.9
	2021	CC23.7	5	33.1	6.50	2.91	24.6	36.5	38.7
		CR24.5	5	49.9	11.3	5.07	38.6	47.7	64.9
		HC6.8	5	34.8	5.54	2.48	27.8	33.6	41.1
		LC10.2	5	25.2	5.23	2.34	20.4	24.7	33.0
		YT4.3	5	47.6	8.51	3.80	37.4	44.1	58.0
Ephemeroptera (%)	2017	HC6.8	5	33.5	11.0	4.91	24.4	27.6	50.0
	2018	CC23.7	5	46.1	14.1	6.31	28.2	40.7	62.4
		CR24.5	5	23.2	6.49	2.90	12.8	24.5	29.2
		HC6.8	5	11.0	5.95	2.66	4.17	12.5	17.1
		LC10.2	5	46.0	20.0	8.94	24.0	38.2	73.3
		YT4.3	5	0.693	1.24	0.554	0	0	2.86
	2019	CC23.7	5	5.74	3.09	1.38	1.88	5.59	10.5
		CR24.5	5	8.61	1.24	0.553	7.22	8.43	10.0
		HC6.8	5	8.11	8.85	3.96	1.88	3.69	23.3
		LC10.2	5	33.2	14.9	6.68	14.4	31.0	56.1
		YT4.3	5	3.45	2.79	1.25	0.578	2.24	6.57
	2021	CC23.7	5	8.61	3.22	1.44	3.72	8.81	12.8
		CR24.5	5	14.9	6.32	2.83	8.41	12.5	24.1
		HC6.8	5	6.61	3.45	1.54	2.45	6.98	11.2
		LC10.2	5	8.39	4.94	2.21	3.24	6.34	15.9
		YT4.3	5	0	0	0	0	0	0
Plecoptera (%)	2017	HC6.8	5	37.3	12.7	5.69	20.2	36.2	52.9
	2018	CC23.7	5	8.13	2.39	1.07	4.97	9.02	10.3
		CR24.5	5	58.1	11.5	5.15	51.0	54.1	78.4
		HC6.8	5	17.4	7.63	3.41	7.50	17.5	27.1
		LC10.2	5	6.83	3.14	1.40	3.20	6.15	11.8
		YT4.3	5	16.5	7.02	3.14	11.1	14.9	28.6
	2019	CC23.7	5	26.3	8.83	3.95	17.3	22.9	38.2
		CR24.5	5	51.0	10.9	4.87	40.4	45.2	66.1
		HC6.8	5	18.8	10.6	4.72	7.38	15.7	34.6
		LC10.2	5	15.0	4.91	2.20	9.48	15.0	20.5
		YT4.3	5	66.5	17.6	7.89	44.5	76.5	83.7
	2021	CC23.7	5	21.8	5.79	2.59	12.4	22.3	27.0
		CR24.5	5	34.8	6.95	3.11	27.6	33.7	46.2
		HC6.8	5	25.6	3.21	1.43	23.3	23.9	30.9
		LC10.2	5	15.7	5.05	2.26	10.7	14.2	24.1
		YT4.3	5	47.5	8.59	3.84	36.9	44.1	58.0

Table D.1: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2017 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Trichoptera (%)	2017	HC6.8	5	2.57	3.03	1.35	0.325	1.48	7.89
	2018	CC23.7	5	0.177	0.266	0.119	0	0	0.597
		CR24.5	5	0	0	0	0	0	0
		HC6.8	5	0.666	0.747	0.334	0	0.535	1.75
		LC10.2	5	1.22	1.56	0.699	0	0.800	3.77
		YT4.3	5	0	0	0	0	0	0
	2019	CC23.7	5	0.0621	0.139	0.0621	0	0	0.311
		CR24.5	5	0	0	0	0	0	0
		HC6.8	5	0.579	0.851	0.381	0	0	1.89
		LC10.2	5	0.0738	0.165	0.0738	0	0	0.369
		YT4.3	5	0	0	0	0	0	0
	2021	CC23.7	5	2.71	1.55	0.692	0.948	2.72	4.90
		CR24.5	5	0.122	0.169	0.0758	0	0	0.348
		HC6.8	5	2.55	0.952	0.426	1.63	2.24	3.75
		LC10.2	5	1.10	1.57	0.701	0	0.604	3.77
		YT4.3	5	0.167	0.238	0.107	0	0	0.513
Chironomidae (%)	2017	HC6.8	5	12.8	4.29	1.92	8.44	10.8	18.1
	2018	CC23.7	5	6.08	2.57	1.15	3.42	6.09	9.85
		CR24.5	5	6.16	2.03	0.909	3.92	5.17	8.46
		HC6.8	5	33.1	19.5	8.73	5.36	35.4	58.8
		LC10.2	5	18.5	8.89	3.98	12.1	12.3	31.0
		YT4.3	5	69.6	7.88	3.52	60.0	70.2	80.3
	2019	CC23.7	5	35.7	12.7	5.66	21.4	32.5	53.7
		CR24.5	5	8.88	3.14	1.40	6.19	8.02	13.9
		HC6.8	5	30.8	13.3	5.95	17.4	26.4	45.0
		LC10.2	5	22.7	16.9	7.55	10.3	11.7	47.7
		YT4.3	5	26.9	17.3	7.74	12.8	15.8	49.6
	2021	CC23.7	5	19.8	10.1	4.53	13.6	15.3	37.5
		CR24.5	5	7.13	4.34	1.94	2.84	6.01	14.3
		HC6.8	5	27.4	13.6	6.07	18.1	21.4	51.2
		LC10.2	5	35.1	10.8	4.83	21.9	35.6	50.2
		YT4.3	5	34.0	9.54	4.27	21.3	36.1	45.6
Simuliidae (%)	2017	HC6.8	5	4.78	3.66	1.64	0.870	6.64	8.70
	2018	CC23.7	5	14.6	3.72	1.66	10.8	14.0	19.6
		CR24.5	5	6.86	4.08	1.83	0	9.18	9.62
		HC6.8	5	10.0	4.13	1.85	5.36	10.5	14.6
		LC10.2	5	5.68	2.51	1.12	3.08	6.15	9.21
		YT4.3	5	0.990	0.708	0.316	0	0.857	1.83
	2019	CC23.7	5	11.8	2.55	1.14	8.66	12.1	15.1
		CR24.5	5	2.06	1.01	0.450	1.29	1.77	3.83
		HC6.8	5	14.7	7.35	3.29	9.06	11.3	26.4
		LC10.2	5	10.4	5.60	2.50	5.37	10.4	19.4
		YT4.3	5	0.243	0.334	0.149	0	0	0.639
	2021	CC23.7	5	22.8	6.82	3.05	13.2	22.5	29.7
		CR24.5	5	9.46	3.89	1.74	4.26	9.68	13.2
		HC6.8	5	18.5	7.26	3.25	10.3	16.4	26.6
		LC10.2	5	14.1	13.2	5.91	0.968	11.6	32.7
		YT4.3	5	2.66	0.397	0.178	2.22	2.60	3.22
Oligochaeta (%)	2017	HC6.8	5	4.64	3.08	1.38	1.95	3.85	9.96
	2018	CC23.7	5	24.2	13.6	6.06	9.55	24.6	42.5
		CR24.5	5	3.02	1.53	0.686	1.15	3.06	5.03
		HC6.8	5	24.5	23.6	10.6	3.74	24.6	62.9
		LC10.2	5	14.9	16.0	7.16	2.59	7.92	40.0
		YT4.3	5	6.96	8.83	3.95	0	5.49	22.1
	2019	CC23.7	5	19.6	4.74	2.12	14.8	19.9	25.0
		CR24.5	5	27.1	14.6	6.55	9.84	35.3	41.0
		HC6.8	5	25.1	20.7	9.28	8.18	21.9	59.7
		LC10.2	5	17.4	14.1	6.32	0.810	20.8	35.1
		YT4.3	5	1.30	1.10	0.492	0	1.46	2.89
	2021	CC23.7	5	16.6	14.2	6.34	2.13	12.5	38.1
		CR24.5	5	32.6	14.2	6.34	21.1	25.4	54.0
		HC6.8	5	13.4	8.55	3.82	4.17	14.3	23.6
		LC10.2	5	24.1	21.3	9.52	2.51	24.1	52.8
		YT4.3	5	13.1	7.95	3.55	4.84	10.4	24.1

Table D.1: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2017 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Metal-Sensitive Chironomidae (%)	2017	HC6.8	5	8.96	2.97	1.33	5.87	8.00	13.6
	2018	CC23.7	5	1.86	0.581	0.260	1.40	1.71	2.86
		CR24.5	5	2.87	2.25	1.01	0	2.72	6.15
		HC6.8	5	23.3	12.9	5.78	3.90	22.3	38.1
		LC10.2	5	2.96	0.725	0.324	2.17	3.02	3.69
		YT4.3	5	63.0	6.35	2.84	54.0	65.6	68.4
	2019	CC23.7	5	20.0	12.2	5.46	5.77	22.5	32.0
		CR24.5	5	5.13	2.71	1.21	2.48	5.53	9.12
		HC6.8	5	24.1	12.6	5.63	11.3	23.3	41.4
		LC10.2	5	14.2	11.6	5.21	5.74	7.53	33.3
		YT4.3	5	16.0	12.3	5.52	5.90	9.49	32.9
	2021	CC23.7	5	9.90	6.83	3.05	3.96	6.30	20.4
		CR24.5	5	1.34	1.02	0.457	0	1.53	2.66
		HC6.8	5	17.9	11.6	5.21	8.77	15.4	37.3
		LC10.2	5	20.5	8.70	3.89	9.71	19.6	33.9
		YT4.3	5	12.0	7.74	3.46	5.12	8.32	22.2
% Collector-Gatherer	2017	HC6.8	5	45.4	11.7	5.23	35.4	39.8	59.1
	2018	CC23.7	5	52.3	15.0	6.70	35.2	47.0	72.5
		CR24.5	5	29.6	7.41	3.31	16.7	33.1	34.4
		HC6.8	5	44.6	15.8	7.06	22.5	43.9	65.2
		LC10.2	5	67.0	15.0	6.69	47.3	64.7	85.3
		YT4.3	5	70.9	7.25	3.24	62.9	73.1	80.3
	2019	CC23.7	5	41.3	11.5	5.13	27.0	38.7	58.5
		CR24.5	5	18.3	3.90	1.74	15.5	16.2	24.9
		HC6.8	5	36.6	12.4	5.55	21.1	35.9	51.4
		LC10.2	5	56.2	12.0	5.36	41.7	62.1	68.8
		YT4.3	5	30.1	15.9	7.10	13.7	21.8	51.2
	2021	CC23.7	5	29.3	7.31	3.27	23.0	27.7	41.8
		CR24.5	5	22.1	7.72	3.45	13.9	23.9	31.4
		HC6.8	5	34.2	11.8	5.27	26.1	30.4	54.9
		LC10.2	5	44.3	10.6	4.76	31.4	45.0	60.2
		YT4.3	5	34.3	9.63	4.31	21.3	36.8	46.1
% Filterer	2017	HC6.8	5	9.42	5.21	2.33	4.39	8.77	16.6
	2018	CC23.7	5	38.8	13.0	5.80	20.3	41.7	54.1
		CR24.5	5	8.80	5.02	2.24	0.980	10.8	13.2
		HC6.8	5	34.5	20.2	9.05	17.1	31.2	68.2
		LC10.2	5	21.0	14.5	6.50	7.76	14.1	43.1
		YT4.3	5	7.95	8.77	3.92	0.772	5.71	23.0
	2019	CC23.7	5	31.4	6.22	2.78	23.6	32.0	40.1
		CR24.5	5	29.1	13.9	6.24	13.7	36.6	42.8
		HC6.8	5	39.8	21.3	9.53	17.6	39.4	68.8
		LC10.2	5	27.8	13.5	6.03	10.7	26.9	45.8
		YT4.3	5	1.54	1.17	0.523	0.573	1.46	3.47
	2021	CC23.7	5	39.4	9.80	4.38	24.6	42.2	51.3
		CR24.5	5	42.1	12.9	5.76	29.4	35.1	58.2
		HC6.8	5	32.1	10.5	4.68	15.6	33.0	42.0
		LC10.2	5	38.1	10.6	4.72	24.3	37.4	53.8
		YT4.3	5	15.9	8.35	3.74	7.44	13.3	27.8
% Scraper-Grazer	2017	HC6.8	5	5.61	2.02	0.904	3.57	4.78	8.77
	2018	CC23.7	5	0.517	0.593	0.265	0	0.564	1.45
		CR24.5	5	3.59	1.54	0.687	1.96	3.06	5.84
		HC6.8	5	1.05	1.04	0.466	0	1.07	2.08
		LC10.2	5	1.96	0.770	0.344	1.32	1.72	3.29
		YT4.3	5	0	0	0	0	0	0
	2019	CC23.7	5	4.36	2.06	0.921	1.88	4.69	7.27
		CR24.5	5	6.21	0.876	0.392	4.81	6.49	7.12
		HC6.8	5	6.40	8.18	3.66	1.25	2.68	20.8
		LC10.2	5	2.26	1.09	0.487	1.11	2.43	3.63
		YT4.3	5	0.116	0.159	0.0711	0	0	0.292
	2021	CC23.7	5	6.18	2.83	1.27	2.93	6.74	9.85
		CR24.5	5	11.2	4.25	1.90	3.90	12.9	14.8
		HC6.8	5	3.17	2.03	0.907	0.408	4.10	5.43
		LC10.2	5	1.31	0.619	0.277	0.463	1.28	2.20
		YT4.3	5	0.228	0.510	0.228	0	0	1.14

Table D.1: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2017 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
% Shredder	2017	HC6.8	5	36.9	13.1	5.85	19.3	35.4	52.9
	2018	CC23.7	5	8.23	2.35	1.05	4.97	9.21	10.3
		CR24.5	5	58.4	11.3	5.07	51.4	54.4	78.4
		HC6.8	5	17.4	7.63	3.41	7.50	17.5	27.1
		LC10.2	5	6.81	3.19	1.43	4.02	6.42	12.1
		YT4.3	5	16.5	7.02	3.14	11.1	14.9	28.6
	2019	CC23.7	5	26.3	8.99	4.02	17.3	22.9	38.5
		CR24.5	5	51.1	10.9	4.88	40.4	45.5	66.1
		HC6.8	5	18.8	10.6	4.72	7.38	15.7	34.6
		LC10.2	5	14.9	4.78	2.14	9.48	15.0	20.0
		YT4.3	5	66.7	18.0	8.03	44.5	76.5	85.0
	2021	CC23.7	5	20.4	5.24	2.34	12.7	20.6	27.0
		CR24.5	5	35.0	6.96	3.11	27.6	33.7	46.2
		HC6.8	5	24.7	3.49	1.56	22.9	23.3	30.9
		LC10.2	5	12.7	4.96	2.22	7.86	13.0	20.4
		YT4.3	5	47.5	8.59	3.84	36.9	44.1	58.0
% Predator	2017	HC6.8	5	3.41	2.65	1.19	0.974	2.70	7.89
	2018	CC23.7	5	0.229	0.314	0.140	0	0	0.580
		CR24.5	5	2.21	1.44	0.644	1.02	1.56	4.40
		HC6.8	5	1.62	1.56	0.696	0	1.43	4.17
		LC10.2	5	4.30	4.36	1.95	0	3.80	11.3
		YT4.3	5	1.25	1.07	0.480	0	1.28	2.86
	2019	CC23.7	5	0.456	0.155	0.0693	0.269	0.521	0.597
		CR24.5	5	1.12	0.635	0.284	0.535	0.904	1.94
		HC6.8	5	1.47	0.739	0.331	0.312	1.56	2.28
		LC10.2	5	0.934	0.753	0.337	0	0.810	1.85
		YT4.3	5	0.645	0.989	0.442	0	0.287	2.36
	2021	CC23.7	5	7.87	2.26	1.01	5.42	7.58	11.5
		CR24.5	5	0.454	0.170	0.0761	0.284	0.468	0.697
		HC6.8	5	6.24	1.18	0.527	4.81	6.27	7.62
		LC10.2	5	4.08	1.37	0.612	2.09	4.44	5.44
		YT4.3	5	0.617	0.896	0.401	0	0.289	2.15
% Sprawler	2017	HC6.8	5	15.3	4.66	2.08	10.8	12.7	21.8
	2018	CC23.7	5	6.08	2.46	1.10	3.42	6.38	9.53
		CR24.5	5	6.31	1.96	0.874	3.92	5.84	8.46
		HC6.8	5	33.7	19.2	8.59	6.07	35.4	58.2
		LC10.2	5	20.4	10.7	4.77	12.1	13.1	34.3
		YT4.3	5	70.1	7.93	3.54	60.0	71.6	80.3
	2019	CC23.7	5	35.7	12.5	5.60	21.7	32.5	53.7
		CR24.5	5	9.23	2.77	1.24	6.49	8.02	13.5
		HC6.8	5	31.7	13.2	5.89	18.5	28.0	45.8
		LC10.2	5	23.2	17.0	7.60	10.9	11.8	48.5
		YT4.3	5	26.9	17.7	7.93	11.5	16.1	50.0
	2021	CC23.7	5	25.7	10.8	4.85	17.6	23.5	44.2
		CR24.5	5	7.66	4.20	1.88	3.12	7.21	14.3
		HC6.8	5	32.9	13.5	6.04	20.6	29.2	55.8
		LC10.2	5	36.2	10.4	4.68	23.9	37.0	51.0
		YT4.3	5	34.9	9.27	4.14	21.0	37.1	45.0
% Burrower	2017	HC6.8	5	5.98	3.28	1.47	1.95	4.87	9.96
	2018	CC23.7	5	24.3	13.7	6.12	9.55	24.9	42.9
		CR24.5	5	3.44	1.63	0.728	1.54	4.08	5.35
		HC6.8	5	24.9	23.6	10.6	5.39	24.6	63.6
		LC10.2	5	16.8	15.2	6.79	2.59	9.74	40.7
		YT4.3	5	8.30	8.76	3.92	0	5.49	23.0
	2019	CC23.7	5	19.8	4.73	2.12	14.8	20.2	25.0
		CR24.5	5	27.3	14.6	6.52	9.84	35.3	41.0
		HC6.8	5	25.3	20.5	9.16	9.43	21.9	59.7
		LC10.2	5	17.4	14.1	6.32	0.810	20.8	35.1
		YT4.3	5	1.65	1.45	0.650	0	1.46	3.47
	2021	CC23.7	5	17.1	14.0	6.26	2.93	12.5	38.4
		CR24.5	5	32.8	14.1	6.30	21.1	26.1	54.0
		HC6.8	5	13.6	8.62	3.85	4.17	15.0	23.6
		LC10.2	5	24.2	21.3	9.52	2.95	24.1	53.1
		YT4.3	5	13.6	7.82	3.50	5.50	10.4	24.6

Table D.1: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Upper Creek Areas, 2017 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
% Clinger	2017	HC6.8	5	45.7	13.0	5.82	29.8	45.4	59.1
	2018	CC23.7	5	23.4	4.29	1.92	17.6	24.5	29.0
		CR24.5	5	68.6	6.85	3.06	63.3	66.5	80.4
		HC6.8	5	28.9	9.55	4.27	13.9	29.8	38.5
		LC10.2	5	15.6	4.54	2.03	12.1	13.3	22.4
		YT4.3	5	17.5	6.64	2.97	11.9	16.4	28.6
	2019	CC23.7	5	42.1	9.80	4.38	29.0	41.9	53.1
		CR24.5	5	59.3	11.7	5.25	48.7	53.1	76.0
		HC6.8	5	37.4	13.6	6.06	19.1	38.1	55.4
		LC10.2	5	27.8	8.02	3.59	16.8	29.3	36.8
		YT4.3	5	66.8	17.6	7.87	44.5	76.5	84.3
	2021	CC23.7	5	51.3	11.9	5.32	33.4	51.4	63.4
		CR24.5	5	52.4	10.8	4.81	37.2	52.9	66.0
		HC6.8	5	46.9	10.0	4.48	35.2	44.5	59.5
		LC10.2	5	31.9	14.2	6.36	16.7	36.1	50.8
		YT4.3	5	50.0	8.45	3.78	39.6	47.0	60.4

Note: "-" = no data

Table D.2. Statistical Temporal and Spatial Comparisons of Benthic Invertebrate Community Endpoints, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

ANOVA Model					Station		Do concentrations differ over time? Magnitude of Difference[a]			Do concentrations differ between the stations? Magnitude of Difference[b]					
										CC23.7 vs CR24.5 and Future Exposed			CR24.5 vs CC23.7 and Future Exposed		
Parameter	Transformation	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Density (org/m²)	log10	<0.001	<0.001	0.005	Reference	CC23.7	ns	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	1.68	2.71	ns	-1.97	ns	1.73	nc	nc	nc
					Exposure	HC6.8	2.04	1.87	ns	-2.81	ns	ns	ns	ns	-1.68
						LC10.2	ns	1.54	ns	-2.51	ns	ns	ns	ns	-1.71
						YT4.3	2.81	2.16	ns	-3.15	ns	ns	ns	ns	-1.73
Richness (# of taxa)	none	<0.001	<0.001	0.060	Reference	CC23.7	ns	2.31	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC6.8	1.65	2.51	ns	ns	ns	ns	ns	ns	1.98
						LC10.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
						YT4.3	ns	1.52	ns	ns	ns	-2.11	ns	ns	ns
Simpson's Evenness	none	<0.001	0.306	0.021	Reference	CC23.7	1.98	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	2.14	ns	ns	2.71	ns	ns
						LC10.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
						YT4.3	ns	ns	ns	ns	-2.34	ns	ns	ns	ns
Simpson's Diversity	rank	<0.001	<0.001	0.177	Reference	CC23.7	0.987	1.29	ns	nc			nc		
						CR24.5				-0.953			nc		
					Exposure	HC6.8				ns			1.16		
						LC10.2				ns			ns		
						YT4.3				-1.55			ns		
Biomass (g/m²)	none	<0.001	0.005	0.043	Reference	CC23.7	ns	ns	-1.58	nc	nc	nc	nc	nc	nc
						CR24.5	1.52	2.19	ns	-1.66	ns	1.83	nc	nc	nc
					Exposure	HC6.8	1.54	ns	ns	-1.99	ns	ns	ns	ns	ns
						LC10.2	ns	ns	ns	-2.02	-1.78	ns	ns	ns	-2.26
						YT4.3	ns	ns	ns	-2.30	-1.71	ns	ns	ns	-2.13
EPT (%)	none	<0.001	0.016	<0.001	Reference	CC23.7	-1.77	-1.69	ns	nc	nc	nc	nc	nc	nc
						CR24.5	-1.72	-2.50	ns	2.14	2.19	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	-2.01	ns	ns	-4.16	-2.56	ns
						LC10.2	ns	-2.29	-1.83	ns	ns	ns	-2.17	ns	-1.96
						YT4.3	4.19	2.42	-1.77	-2.95	3.00	ns	-5.10	ns	ns
Ephemeroptera (%)	logit	<0.001	<0.001	<0.001	Reference	CC23.7	-4.67	-3.99	ns	nc	nc	nc	nc	nc	nc
						CR24.5	-1.95	ns	ns	-1.98	ns	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	-3.66	ns	ns	-1.68	ns	ns
						LC10.2	ns	-4.11	-3.01	ns	3.57	ns	1.97	2.82	ns
						YT4.3	ns	ns	-1.57	-6.60	ns	-2.99	-4.62	ns	-4.00
Plecoptera (%)	log10	<0.001	<0.001	<0.001	Reference	CC23.7	3.46	2.93	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	-1.52	ns	5.90	2.04	ns	nc	nc	nc
					Exposure	HC6.8	ns	1.40	ns	2.09	ns	ns	-3.81	-3.30	ns
						LC10.2	2.44	2.61	ns	ns	-1.68	ns	-6.56	-3.72	-2.43
						YT4.3	4.21	3.27	ns	2.04	2.79	2.37	-3.87	ns	ns
Trichoptera (%)	logit	<0.001	<0.001	<0.001	Reference	CC23.7	ns	3.26	3.47	nc	nc	nc	nc	nc	nc
						CR24.5	ns	ns	ns	ns	ns	-3.36	nc	nc	nc
					Exposure	HC6.8	ns	2.45	2.62	ns	ns	ns	ns	ns	3.31
						LC10.2	-1.58	ns	1.40	ns	ns	-2.05	1.72	ns	ns
						YT4.3	ns	ns	ns	ns	ns	-3.28	ns	ns	ns

Table D.2. Statistical Temporal and Spatial Comparisons of Benthic Invertebrate Community Endpoints, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

ANOVA Model					Station		Do concentrations differ over time?			Do concentrations differ between the stations?					
							Magnitude of Difference[a]			Magnitude of Difference[b]					
										CC23.7 vs CR24.5 and Future Exposed			CR24.5 vs CC23.7 and Future Exposed		
Parameter	Transformation	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Chironomidae (%)	logit	<0.001	0.664	<0.001	Reference	CC23.7	3.36	2.05	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	ns	ns	ns	-2.69	-1.89	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	2.91	ns	ns	2.85	2.31	2.56
						LC10.2	ns	1.41	ns	1.92	ns	ns	1.85	ns	3.17
						YT4.3	-3.06	-2.37	ns	5.62	ns	ns	5.56	1.90	3.10
Simuliidae (%)	logit	<0.001	<0.001	0.199	Reference	CC23.7	ns	1.01	1.12	nc			nc		
						CR24.5				-2.10			nc		
					Exposure	HC6.8				ns			1.76		
						LC10.2				-1.30			ns		
						YT4.3				-3.71			-1.61		
Oligochaeta (%)	logp1	0.027	0.344	0.035	Reference	CC23.7	ns	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	1.83	2.22	ns	-1.63	ns	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	ns	ns
						LC10.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
						YT4.3	ns	ns	ns	ns	ns	ns	ns	-1.98	ns
Metal-Sensitive Chironomidae (%)	logp1	<0.001	0.126	<0.001	Reference	CC23.7	2.21	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	ns	ns	ns	-1.77	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	2.58	ns	ns	2.45	2.25	2.05
						LC10.2	1.38	2.15	ns	ns	ns	ns	ns	ns	2.37
						YT4.3	-4.76	-5.21	ns	6.50	ns	ns	6.37	ns	ns
% Collector-Gatherer	log10	<0.001	<0.001	0.083	Reference	CC23.7	ns	-1.85	ns	nc	nc	nc	nc	nc	nc
						CR24.5	-1.52	ns	ns	-1.85	-2.61	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	2.15	ns
						LC10.2	ns	-1.35	ns	ns	ns	ns	2.69	3.64	2.37
						YT4.3	-3.15	-2.46	ns	ns	ns	ns	2.93	ns	ns
% Filterer	none	<0.001	0.007	0.036	Reference	CC23.7	ns	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	1.64	2.68	ns	-2.41	ns	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	ns	ns	ns	2.07	ns	ns
						LC10.2	ns	1.38	ns	ns	ns	ns	ns	ns	ns
						YT4.3	ns	ns	ns	-2.48	-2.41	-1.89	ns	-2.22	-2.11
% Scraper-Grazer	logit	<0.001	<0.001	0.001	Reference	CC23.7	2.48	3.23	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	2.60	1.38	2.14	ns	ns	nc	nc	nc
					Exposure	HC6.8	2.27	1.38	ns	ns	ns	ns	-1.71	ns	-2.93
						LC10.2	ns	ns	ns	ns	ns	-2.51	ns	-1.98	-4.02
						YT4.3	ns	ns	ns	ns	-2.87	-3.52	-2.66	-3.75	-5.03
% Shredder	log10	<0.001	<0.001	<0.001	Reference	CC23.7	3.42	2.71	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	-1.52	ns	5.87	2.05	1.64	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	2.05	ns	ns	-3.82	-3.31	ns
						LC10.2	2.41	1.90	ns	ns	-1.68	ns	-6.55	-3.74	-3.14
						YT4.3	4.22	3.27	ns	1.99	2.80	2.55	-3.88	ns	ns
% Predator	logit	<0.001	<0.001	<0.001	Reference	CC23.7	ns	4.91	4.62	nc	nc	nc	nc	nc	nc
						CR24.5	ns	-1.57	ns	1.87	ns	-4.62	nc	nc	nc
					Exposure	HC6.8	ns	2.97	2.97	ns	ns	ns	ns	ns	3.99
						LC10.2	-2.02	ns	2.39	2.79	ns	-1.75	ns	ns	2.87
						YT4.3	ns	ns	ns	ns	ns	-4.52	ns	ns	ns

Table D.2. Statistical Temporal and Spatial Comparisons of Benthic Invertebrate Community Endpoints, Coffee Project FALMP, Upper Creek Areas, 2018 to 2021

ANOVA Model					Station		Do concentrations differ over time?			Do concentrations differ between the stations?					
							Magnitude of Difference[a]			Magnitude of Difference[b]					
										CC23.7 vs CR24.5 and Future Exposed			CR24.5 vs CC23.7 and Future Exposed		
Parameter	Transformation	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
% Sprawler	log10	<0.001	0.052	<0.001	Reference	CC23.7	3.76	3.05	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	ns	ns	ns	-2.81	-2.67	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	3.27	ns	ns	3.14	2.51	3.20
						LC10.2	ns	1.35	ns	2.47	ns	ns	2.33	ns	3.45
						YT4.3	-2.38	-1.52	ns	5.27	ns	ns	5.14	1.94	3.37
% Burrower	logp1	0.033	0.427	0.032	Reference	CC23.7	ns	ns	ns	nc	nc	nc	nc	nc	nc
						CR24.5	1.83	2.22	ns	-1.62	ns	ns	nc	nc	nc
					Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	ns	ns
						LC10.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
						YT4.3	ns	ns	ns	ns	ns	ns	ns	-1.99	ns
% Clinger	none	<0.001	<0.001	<0.001	Reference	CC23.7	1.79	2.67	ns	nc	nc	nc	nc	nc	nc
						CR24.5	ns	-1.55	ns	4.32	1.64	ns	nc	nc	nc
					Exposure	HC6.8	ns	1.72	ns	ns	ns	ns	-3.79	-2.09	ns
						LC10.2	ns	1.56	ns	ns	ns	-1.85	-5.06	-3.01	-1.96
						YT4.3	4.71	3.10	-1.60	ns	2.35	ns	-4.88	ns	ns

ANOVA P-value < 0.1.
> 2 SD Decrease in endpoint relative to reference
> 2 SD Increase in endpoint relative to reference

Note: "nc" indicates no comparison available or comparison completed in adjacent cell; "ns" indicates not significant. Logp1 indicates log10(x+1).

[a] Magnitude of Difference is calculated as $(MCT_{recent\ year} - MCT_{older\ year})/MAD_{pooled}$ for rank transformation and $(MCT_{recent\ year} - MCT_{older\ year})/SD_{pooled}$ for all other transformations. MAD_{pooled} = pooled median absolute deviation and SD_{pooled} = pooled standard deviation. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for all others.

[b] Magnitude of Difference is calculated as $(MCT_{Exposed} - MCT_{Reference})/(MAD_{pooled})$ for rank transformation and $(MCT_{Exposed} - MCT_{Reference})/(SD_{pooled})$ for all other transformations. MAD_{pooled} = pooled median absolute deviation and SD_{pooled} = pooled standard deviation. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for all others.

Table D.3: Statistical Comparison of Benthic Invertebrate Bray-Curtis Indices at Mine-Exposed (HC6.8, LC10.2, YT4.3) and Reference (CC23.7 and CR24.5) Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

Year	Comparison	Taxonomic Resolution	n		Betadisper P-Value	Mantel Test			dbRDA			
			Reference	Mine-Exposed		r	R^2	P-Value	F-Value	R^2	R^2_{adj}	P-Value
2018	CC23.7 vs. HC6.8	Family	5	5	0.00713	0.289	0.0838	0.008	2.51	0.239	0.144	0.01
		Lowest-Practical-Level	5	5	0.143	0.268	0.0718	0.008	2.47	0.236	0.140	0.008
	CR24.5 vs. HC6.8	Family	5	5	0.211	0.435	0.189	0.008	3.35	0.295	0.207	0.008
		Lowest-Practical-Level	5	5	0.765	0.387	0.149	0.008	3.50	0.304	0.218	0.006
	CC23.7 vs. LC10.2	Family	5	5	0.0224	0.499	0.249	0.008	3.86	0.325	0.241	0.006
		Lowest-Practical-Level	5	5	0.00557	0.631	0.399	0.008	4.96	0.383	0.305	0.008
	CR24.5 vs. LC10.2	Family	5	5	0.359	0.352	0.124	0.008	3.10	0.279	0.189	0.003
		Lowest-Practical-Level	5	5	0.213	0.514	0.264	0.008	3.35	0.295	0.207	0.002
	CC23.7 vs. YT4.3	Family	5	5	0.0413	0.763	0.583	0.007	11.2	0.583	0.531	0.003
		Lowest-Practical-Level	5	5	0.0682	0.764	0.583	0.008	10.3	0.564	0.510	0.008
	CR24.5 vs. YT4.3	Family	5	5	0.246	0.788	0.622	0.008	9.30	0.537	0.480	0.007
		Lowest-Practical-Level	5	5	0.708	0.787	0.619	0.007	9.15	0.534	0.475	0.006
2019	CC23.7 vs. HC6.8	Family	5	5	0.936	0.374	0.140	0.008	3.04	0.275	0.185	0.007
		Lowest-Practical-Level	5	5	0.622	0.661	0.437	0.008	4.79	0.374	0.296	0.008
	CR24.5 vs. HC6.8	Family	5	5	0.372	0.674	0.454	0.008	5.92	0.425	0.354	0.002
		Lowest-Practical-Level	5	5	0.415	0.736	0.541	0.008	5.77	0.419	0.346	0.008
	CC23.7 vs. LC10.2	Family	5	5	0.900	0.668	0.447	0.008	6.71	0.456	0.388	0.004
		Lowest-Practical-Level	5	5	0.523	0.765	0.585	0.008	6.29	0.440	0.370	0.005
	CR24.5 vs. LC10.2	Family	5	5	0.473	0.713	0.509	0.008	6.33	0.442	0.372	0.005
		Lowest-Practical-Level	5	5	0.311	0.645	0.416	0.008	5.26	0.397	0.321	0.007
	CC23.7 vs. YT4.3	Family	5	5	0.0436	0.726	0.527	0.008	8.22	0.507	0.445	0.007
		Lowest-Practical-Level	5	5	0.0492	0.804	0.647	0.008	8.30	0.509	0.448	0.008
	CR24.5 vs. YT4.3	Family	5	5	0.0111	0.723	0.523	0.008	8.43	0.513	0.452	0.007
		Lowest-Practical-Level	5	5	0.0226	0.760	0.577	0.008	6.23	0.438	0.367	0.008
2021	CC23.7 vs. HC6.8	Family	5	5	0.373	-0.00183	0.00000334	0.485	1.03	0.114	0.00280	0.444
		Lowest-Practical-Level	5	5	0.804	0.292	0.0853	0.024	2.00	0.200	0.0997	0.022
	CR24.5 vs. HC6.8	Family	5	5	0.409	0.714	0.509	0.008	7.07	0.469	0.403	0.009
		Lowest-Practical-Level	5	5	0.481	0.735	0.540	0.008	6.22	0.437	0.367	0.008
	CC23.7 vs. LC10.2	Family	5	5	0.887	0.583	0.339	0.02	4.33	0.351	0.270	0.014
		Lowest-Practical-Level	5	5	0.764	0.729	0.531	0.008	5.21	0.394	0.319	0.008
	CR24.5 vs. LC10.2	Family	5	5	0.884	0.737	0.544	0.007	7.49	0.483	0.419	0.008
		Lowest-Practical-Level	5	5	0.895	0.785	0.616	0.008	7.70	0.490	0.427	0.007
	CC23.7 vs. YT4.3	Family	5	5	0.129	0.914	0.836	0.008	12.7	0.614	0.565	0.007
		Lowest-Practical-Level	5	5	0.830	0.941	0.886	0.008	11.2	0.583	0.531	0.006
	CR24.5 vs. YT4.3	Family	5	5	0.155	0.825	0.681	0.008	10.4	0.566	0.512	0.003
		Lowest-Practical-Level	5	5	0.732	0.901	0.812	0.008	12.4	0.608	0.559	0.008

P-Value < 0.1.

Table D.4: Spearman Rank Correlations Between Benthic Community Endpoints and Physiochemical Parameters, Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

Parameter	Statistic	Density (org/m²)	Richness (# of taxa)	Simpson's Evenness	Simpson's Diversity	Biomass (g/m²)	EPT (%)	Ephemeroptera (%)	Plecoptera (%)	Trichoptera (%)
Water Velocity (m³/s)	r_s	-0.298	-0.225	-0.0892	-0.178	-0.180	0.174	0.390	-0.220	-0.205
	p-value	0.010	0.052	0.447	0.127	0.123	0.135	<0.001	0.058	0.077
Temperature (°C)	r_s	-0.0105	0.220	0.194	0.243	0.0433	-0.0483	0.195	-0.0735	0.232
	p-value	0.929	0.058	0.095	0.036	0.712	0.681	0.094	0.531	0.045
DO (mg/L)	r_s	-0.275	-0.0365	-0.127	-0.127	-0.180	-0.170	-0.195	-0.0771	0.0568
	p-value	0.017	0.756	0.277	0.278	0.122	0.144	0.094	0.511	0.628
DO (%)	r_s	-0.303	0.211	-0.0998	-0.0133	-0.116	-0.258	-0.0792	-0.169	0.265
	p-value	0.008	0.069	0.394	0.910	0.321	0.026	0.500	0.147	0.022
pH	r_s	0.315	0.245	0.237	0.331	0.337	-0.0871	0.163	-0.0818	-0.0501
	p-value	0.007	0.039	0.047	0.005	0.004	0.470	0.176	0.498	0.678
Specific Conductance (µS/cm)	r_s	0.0428	0.248	0.240	0.318	0.121	-0.187	0.482	-0.479	0.101
	p-value	0.716	0.032	0.038	0.006	0.300	0.109	<0.001	<0.001	0.388
Conductivity (µS/cm)	r_s	0.0446	0.271	0.268	0.351	0.127	-0.208	0.460	-0.480	0.125
	p-value	0.704	0.019	0.020	0.002	0.277	0.073	<0.001	<0.001	0.285
Substrate (cm)	r_s	0.275	0.343	0.0333	0.199	0.155	-0.0997	-0.469	0.258	0.152
	p-value	0.017	0.003	0.777	0.087	0.184	0.395	<0.001	0.025	0.192

P-Value < 0.1

P-Value < 0.1/8 =0.0125 (Bonferroni Corrected for 8 independent tests).

abs(r_s) > 0.6

Table D.4: Spearman Rank Correlations Between Benthic Community Endpoints and Physiochemical Parameters, Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

Parameter	Statistic	Chironomidae (%)	Simuliidae (%)	Oligochaeta (%)	% Collector-Gatherer	% Filterer	% Scraper-Grazer	% Shredder	% Predator	% Sprawler	% Burrower	% Clinger
Water Velocity (m^3/s)	r_s	-0.220	-0.0883	-0.0720	0.252	-0.131	-0.0504	-0.194	-0.0528	-0.226	-0.0555	-0.218
	p-value	0.058	0.451	0.539	0.029	0.261	0.668	0.095	0.653	0.051	0.636	0.060
Temperature (°C)	r_s	0.0412	0.0700	0.0546	0.119	0.0433	0.212	-0.101	0.278	0.0511	0.0615	-0.0813
	p-value	0.726	0.551	0.642	0.308	0.712	0.068	0.387	0.016	0.663	0.600	0.488
DO (mg/L)	r_s	0.0775	0.0541	-0.0661	0.0369	-0.0312	-0.188	-0.0483	0.0618	0.0972	-0.0758	-0.0663
	p-value	0.509	0.645	0.573	0.753	0.790	0.107	0.681	0.598	0.407	0.518	0.572
DO (%)	r_s	0.113	0.145	-0.0664	0.128	-0.0109	-0.0433	-0.158	0.314	0.138	-0.0775	-0.131
	p-value	0.336	0.216	0.571	0.273	0.926	0.712	0.175	0.006	0.239	0.509	0.261
pH	r_s	-0.0527	0.213	0.247	-0.140	0.299	0.384	-0.0866	-0.113	-0.0853	0.225	0.0310
	p-value	0.663	0.075	0.038	0.243	0.011	<0.001	0.473	0.349	0.479	0.059	0.797
Specific Conductance (µS/cm)	r_s	-0.123	0.384	0.398	0.161	0.479	0.305	-0.494	0.0577	-0.137	0.396	-0.341
	p-value	0.291	<0.001	<0.001	0.168	<0.001	0.008	<0.001	0.623	0.240	<0.001	0.003
Conductivity (µS/cm)	r_s	-0.0906	0.396	0.403	0.186	0.479	0.310	-0.497	0.0713	-0.103	0.398	-0.352
	p-value	0.440	<0.001	<0.001	0.110	<0.001	0.007	<0.001	0.543	0.378	<0.001	0.002
Substrate (cm)	r_s	0.251	-0.0300	-0.0136	-0.298	0.0293	0.0294	0.236	0.0723	0.231	-0.0161	0.300
	p-value	0.030	0.798	0.908	0.010	0.803	0.802	0.042	0.538	0.046	0.891	0.009

P-Value < 0.1

P-Value < 0.1/8 =0.0125 (Bonferroni Corrected for 8 independent tests).

abs(r_s) > 0.6

Table D.5: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Density (org/m²)	2018	SYT0.6	5	1,605	634	284	1,037	1,360	2,607
		XE0.2	5	1,021	610	273	260	1,238	1,687
		HC0.2	5	561	210	94.1	363	543	867
		CC5.6	5	149	104	46.6	30	127	317
		YT0.2	5	289	58.9	26.3	233	273	380
	2019	SYT0.6	5	2,034	313	140	1,489	2,133	2,280
		XE0.2	5	2,342	966	432	1,307	2,300	3,669
		HC0.2	5	1,444	601	269	957	1,210	2,473
		CC5.6	5	690	489	219	287	417	1,400
		YT0.2	5	841	98.5	44	717	887	923
	2021	SYT0.6	5	3,200	945	423	2,058	2,980	4,307
		XE0.2	5	1,491	427	191	1,127	1,480	2,180
		HC0.2	5	2,189	496	222	1,600	2,333	2,793
		CC5.6	5	924	386	173	393	860	1,462
		YT0.2	5	1,254	480	214	700	1,237	1,853
Richness (# of taxa)	2018	SYT0.6	5	14	3.54	1.58	10	13	19
		XE0.2	5	14.8	2.77	1.24	12	14	19
		HC0.2	5	18.2	6.22	2.78	11	17	28
		CC5.6	5	10.6	2.79	1.25	6	12	13
		YT0.2	5	11.2	1.92	0.86	9	11	14
	2019	SYT0.6	5	15.4	2.7	1.21	11	16	18
		XE0.2	5	17.2	1.48	0.663	15	17	19
		HC0.2	5	17.2	3.11	1.39	12	18	20
		CC5.6	5	16.2	3.56	1.59	13	15	22
		YT0.2	5	13.4	2.51	1.12	10	13	17
	2021	SYT0.6	5	17.6	3.85	1.72	11	19	21
		XE0.2	5	22	2.74	1.22	19	22	26
		HC0.2	5	19	3.32	1.48	14	20	23
		CC5.6	5	19.8	3.56	1.59	16	19	24
		YT0.2	5	16.2	3.19	1.43	14	14	21
Simpson's Evenness	2018	SYT0.6	5	0.171	0.0431	0.0193	0.139	0.154	0.245
		XE0.2	5	0.32	0.101	0.0452	0.176	0.31	0.443
		HC0.2	5	0.349	0.165	0.074	0.21	0.27	0.557
		CC5.6	5	0.54	0.22	0.0984	0.261	0.655	0.755
		YT0.2	5	0.291	0.0149	0.00664	0.269	0.289	0.307
	2019	SYT0.6	5	0.354	0.0685	0.0306	0.252	0.357	0.434
		XE0.2	5	0.304	0.141	0.0631	0.165	0.271	0.527
		HC0.2	5	0.225	0.0447	0.02	0.18	0.229	0.293
		CC5.6	5	0.218	0.0962	0.043	0.116	0.226	0.32
		YT0.2	5	0.225	0.0505	0.0226	0.189	0.202	0.312
	2021	SYT0.6	5	0.178	0.0538	0.0241	0.135	0.15	0.261
		XE0.2	5	0.3	0.0786	0.0351	0.205	0.325	0.382
		HC0.2	5	0.202	0.0846	0.0378	0.104	0.238	0.285
		CC5.6	5	0.269	0.0491	0.022	0.223	0.27	0.348
		YT0.2	5	0.176	0.0322	0.0144	0.129	0.174	0.218
Simpson's Diversity	2018	SYT0.6	5	0.56	0.0517	0.0231	0.501	0.572	0.622
		XE0.2	5	0.754	0.131	0.0588	0.526	0.798	0.859
		HC0.2	5	0.788	0.117	0.0525	0.663	0.749	0.928
		CC5.6	5	0.794	0.0688	0.0308	0.706	0.779	0.878
		YT0.2	5	0.687	0.037	0.0166	0.638	0.686	0.734
	2019	SYT0.6	5	0.81	0.0243	0.0109	0.78	0.812	0.835
		XE0.2	5	0.777	0.0913	0.0408	0.643	0.783	0.873
		HC0.2	5	0.731	0.0383	0.0171	0.691	0.716	0.782
		CC5.6	5	0.656	0.17	0.0759	0.385	0.705	0.807
		YT0.2	5	0.655	0.0459	0.0205	0.594	0.679	0.699
	2021	SYT0.6	5	0.658	0.0533	0.0238	0.59	0.652	0.739
		XE0.2	5	0.838	0.0461	0.0206	0.771	0.86	0.886
		HC0.2	5	0.694	0.126	0.0564	0.537	0.749	0.812
		CC5.6	5	0.802	0.0534	0.0239	0.719	0.813	0.849
		YT0.2	5	0.627	0.109	0.0488	0.445	0.673	0.723

Note: "-" = no data

Table D.5: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Biomass (g/m²)	2018	SYT0.6	5	0.426	0.227	0.102	0.149	0.379	0.721
		XE0.2	5	0.152	0.111	0.0495	0.0363	0.176	0.295
		HC0.2	5	0.0829	0.0538	0.0241	0.0283	0.065	0.164
		CC5.6	5	0.0157	0.0141	0.00632	0.00467	0.011	0.04
		YT0.2	5	0.0419	0.0162	0.00723	0.0243	0.0457	0.065
	2019	SYT0.6	5	0.534	0.0657	0.0294	0.459	0.545	0.631
		XE0.2	5	0.332	0.129	0.0579	0.228	0.287	0.549
		HC0.2	5	0.221	0.0752	0.0336	0.137	0.226	0.336
		CC5.6	5	0.126	0.119	0.0531	0.031	0.074	0.327
		YT0.2	5	0.121	0.0256	0.0114	0.077	0.129	0.141
	2021	SYT0.6	5	0.715	0.375	0.168	0.416	0.576	1.3
		XE0.2	5	0.263	0.0788	0.0353	0.167	0.251	0.387
		HC0.2	5	0.346	0.0783	0.035	0.247	0.329	0.442
		CC5.6	5	0.118	0.0405	0.0181	0.0627	0.107	0.164
		YT0.2	5	0.186	0.11	0.0492	0.0517	0.159	0.336
EPT (%)	2018	SYT0.6	5	75.5	5.14	2.3	68.5	76	81.1
		XE0.2	5	36.7	12.9	5.75	17	36.9	50
		HC0.2	5	36.2	28.6	12.8	5.5	37.5	75.6
		CC5.6	5	49.3	25.1	11.2	11.1	53.3	77.9
		YT0.2	5	78.2	6.01	2.69	68.8	79.3	85.1
	2019	SYT0.6	5	62.2	6.92	3.1	54.1	65.2	70.3
		XE0.2	5	21.1	10.8	4.81	11.3	16.8	36.8
		HC0.2	5	75.7	6.96	3.11	66.6	76.2	86
		CC5.6	5	29.7	25.1	11.2	5.08	29.1	68.8
		YT0.2	5	74.7	15.3	6.85	47.6	82	83.6
	2021	SYT0.6	5	69	10.2	4.55	58.9	69.1	84.3
		XE0.2	5	18.4	5.88	2.63	9.62	21.2	23.9
		HC0.2	5	63.1	18.4	8.25	40.8	58	87.1
		CC5.6	5	24.6	19.7	8.81	11.8	16.2	59.3
		YT0.2	5	59.9	13.4	5.99	45.6	57.5	81.9
Ephemeroptera (%)	2018	SYT0.6	5	9.04	3.9	1.74	3.86	8.96	14.6
		XE0.2	5	24.1	10	4.48	9.09	23.6	35.5
		HC0.2	5	9.69	9.12	4.08	1.83	6.25	23.9
		CC5.6	5	45.9	23.7	10.6	11.1	53.3	71.6
		YT0.2	5	33	15.7	7.01	17.1	28.1	50
	2019	SYT0.6	5	0.3	0.207	0.0925	0	0.306	0.585
		XE0.2	5	1.35	0.926	0.414	0.581	1.16	2.85
		HC0.2	5	8.57	2.64	1.18	4.85	8.82	11.7
		CC5.6	5	24.3	20.6	9.19	4.44	23.3	56.8
		YT0.2	5	6.81	3.58	1.6	2.89	6.98	12.4
	2021	SYT0.6	5	0.41	0.378	0.169	0	0.619	0.759
		XE0.2	5	7.59	5.11	2.29	2.33	6.98	13.1
		HC0.2	5	13.4	3.49	1.56	10.2	12.5	18.1
		CC5.6	5	13.2	10.2	4.56	5.04	8.21	29.7
		YT0.2	5	4.81	2.92	1.31	1.68	5.28	7.9
Plecoptera (%)	2018	SYT0.6	5	66.3	3.91	1.75	61.4	65	70.8
		XE0.2	5	12.6	8.86	3.96	6.46	10.1	28.2
		HC0.2	5	26.4	20	8.96	3.67	31.2	51.8
		CC5.6	5	1.17	1.61	0.721	0	0	3.16
		YT0.2	5	45	12.1	5.39	31.6	48.4	60
	2019	SYT0.6	5	61.9	7.02	3.14	53.8	65.1	70
		XE0.2	5	19.7	9.86	4.41	10.7	15.6	33.9
		HC0.2	5	67.1	5.88	2.63	61.7	65.7	77.1
		CC5.6	5	4.94	4.74	2.12	0.317	4.65	12
		YT0.2	5	67.9	14.2	6.36	43	74.7	76.5
	2021	SYT0.6	5	68.5	10.1	4.5	58.7	68.2	83.5
		XE0.2	5	10.3	2.61	1.17	7.29	10.1	14.2
		HC0.2	5	49.7	17.9	8.01	30.2	41	71.4
		CC5.6	5	5.76	10.1	4.51	0	1.59	23.7
		YT0.2	5	55.1	12.6	5.61	43.9	52.3	76.6

Note: "-" = no data

Table D.5: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Trichoptera (%)	2018	SYT0.6	5	0.168	0.376	0.168	0	0	0.84
		XE0.2	5	0	0	0	0	0	0
		HC0.2	5	0.123	0.274	0.123	0	0	0.613
		CC5.6	5	2.21	3.46	1.55	0	0	7.89
		YT0.2	5	0.27	0.604	0.27	0	0	1.35
	2019	SYT0.6	5	0	0	0	0	0	0
		XE0.2	5	0	0	0	0	0	0
		HC0.2	5	0.0617	0.138	0.0617	0	0	0.309
		CC5.6	5	0.429	0.494	0.221	0	0.317	1.16
		YT0.2	5	0	0	0	0	0	0
	2021	SYT0.6	5	0.0779	0.109	0.0486	0	0	0.224
		XE0.2	5	0.431	0.407	0.182	0	0.612	0.888
		HC0.2	5	0.0604	0.135	0.0604	0	0	0.302
		CC5.6	5	5.68	2.45	1.1	2.73	5.93	8.14
		YT0.2	5	0	0	0	0	0	0
Chironomidae (%)	2018	SYT0.6	5	14.8	2.92	1.31	12.9	13.6	19.9
		XE0.2	5	18.5	9.24	4.13	8.3	15.4	31.8
		HC0.2	5	18.8	14	6.26	7.11	9.82	37.3
		CC5.6	5	17.3	12.3	5.51	4.44	15.6	37
		YT0.2	5	12.1	4.98	2.23	7.14	12.2	20.1
	2019	SYT0.6	5	24.1	5.45	2.44	18.5	22.4	30.6
		XE0.2	5	38.6	12.2	5.43	26.3	35.3	57.4
		HC0.2	5	9.58	4.7	2.1	2.48	10.4	14.9
		CC5.6	5	29.8	18.7	8.36	15.4	27.3	61.6
		YT0.2	5	7.63	3.11	1.39	5.12	6.19	12.8
	2021	SYT0.6	5	18.1	7.19	3.22	7.34	18.8	26.5
		XE0.2	5	26.8	10.5	4.71	13.5	23.2	40.5
		HC0.2	5	6.24	3.49	1.56	2.08	6	11.6
		CC5.6	5	28.6	6.85	3.06	17.6	29.8	34.3
		YT0.2	5	6.49	2.78	1.25	2.16	7.14	9.81
Simuliidae (%)	2018	SYT0.6	5	5.05	2.31	1.03	2.27	5.64	7.72
		XE0.2	5	11.7	9.25	4.13	1.28	10.2	26.1
		HC0.2	5	25.8	16.7	7.47	9.17	19.6	49.1
		CC5.6	5	13.1	8.01	3.58	0	13.5	21.1
		YT0.2	5	0.697	0.66	0.295	0	0.877	1.35
	2019	SYT0.6	5	11.3	3.1	1.38	6.8	13.2	13.7
		XE0.2	5	14.5	8.54	3.82	5.02	12.2	25.9
		HC0.2	5	11.2	4.54	2.03	7.02	8.82	17.2
		CC5.6	5	0.755	0.923	0.413	0	0.333	2.33
		YT0.2	5	0.669	0.685	0.306	0	0.442	1.81
	2021	SYT0.6	5	8.99	2.67	1.2	6.08	8.42	13.3
		XE0.2	5	20.3	4.1	1.83	16.3	19.4	26.6
		HC0.2	5	24.9	15.4	6.9	2.29	27.4	39.4
		CC5.6	5	1.63	0.841	0.376	0.388	1.69	2.43
		YT0.2	5	10.5	9.89	4.42	3.23	4.56	26.2
Oligochaeta (%)	2018	SYT0.6	5	0.699	1.01	0.453	0	0.485	2.45
		XE0.2	5	31.2	21.9	9.79	8.18	28.2	67.4
		HC0.2	5	6.31	8.58	3.84	0.508	0.893	20.2
		CC5.6	5	10.1	11.8	5.29	0	2.22	23.7
		YT0.2	5	5.17	3.23	1.45	0	5.38	8.57
	2019	SYT0.6	5	0.182	0.273	0.122	0	0	0.612
		XE0.2	5	25.1	24.7	11.1	1.14	13.3	56.7
		HC0.2	5	2.49	2.52	1.13	0.697	1.17	6.79
		CC5.6	5	38.6	33.5	15	1.6	49	77.5
		YT0.2	5	14.3	16.8	7.52	1.88	7.91	43.7
	2021	SYT0.6	5	0.371	0.256	0.114	0	0.432	0.671
		XE0.2	5	28.2	12.7	5.68	10.6	26.3	42.9
		HC0.2	5	3.54	2.09	0.937	1.9	2.29	6.65
		CC5.6	5	34.4	20.5	9.16	2.54	39.1	53.1
		YT0.2	5	19.3	17.9	8.03	1.13	18.5	45.1

Note: "-" = no data

Table D.5: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
Metal-Sensitive Chironomidae (%)	2018	SYT0.6	5	9.62	3.77	1.68	5.85	10.3	15.2
		XE0.2	5	4.54	1.65	0.736	2.31	4.27	6.83
		HC0.2	5	2.77	0.911	0.407	2.13	2.37	4.37
		CC5.6	5	0.631	1.41	0.631	0	0	3.15
		YT0.2	5	6.34	1.74	0.777	3.57	6.97	8.03
	2019	SYT0.6	5	13.4	6.05	2.7	9.45	11.8	24
		XE0.2	5	13	5	2.24	4.76	13.9	18.4
		HC0.2	5	2.49	1.07	0.478	1.24	2.59	3.7
		CC5.6	5	1.12	1.46	0.653	0	0.824	3.55
		YT0.2	5	3.93	2.26	1.01	1.55	4.48	6.61
	2021	SYT0.6	5	3.82	2.31	1.04	2.13	3.46	7.77
		XE0.2	5	11.6	4.03	1.8	6.76	12.1	16.4
		HC0.2	5	2.19	2.43	1.09	0.463	0.99	6.38
		CC5.6	5	0.712	1.21	0.543	0	0	2.81
		YT0.2	5	1.11	0.739	0.331	0.54	0.811	2.35
% Collector-Gatherer	2018	SYT0.6	5	23.8	2.16	0.964	21.8	23.5	27.4
		XE0.2	5	42.5	15.7	7.02	17.4	49.1	55.4
		HC0.2	5	27.4	7.23	3.23	17	31.5	33.6
		CC5.6	5	63.1	15.6	6.99	44.7	68.9	78.1
		YT0.2	5	45.5	15.6	6.96	24.3	41.8	63.5
	2019	SYT0.6	5	24.5	5.43	2.43	18.8	22.4	30.9
		XE0.2	5	40	12.5	5.57	26.6	38.2	58.5
		HC0.2	5	18.3	5.34	2.39	11.7	17.7	26.6
		CC5.6	5	54	29.1	13	21.6	42.3	84.8
		YT0.2	5	14.6	6.02	2.69	10.5	13	25.2
	2021	SYT0.6	5	18.6	7.15	3.2	8.1	19.7	27.1
		XE0.2	5	35.1	11.6	5.18	20.7	37.3	47.6
		HC0.2	5	20	5.16	2.31	12.7	22	26.1
		CC5.6	5	46.2	8.74	3.91	35.9	46.4	59.3
		YT0.2	5	11.5	4.96	2.22	3.84	14.4	15.5
% Filterer	2018	SYT0.6	5	5.15	2.35	1.05	2.27	6.13	7.72
		XE0.2	5	43	18.1	8.1	29.5	37.2	74.7
		HC0.2	5	33	12.8	5.74	14.7	33.3	50
		CC5.6	5	23.2	12.5	5.61	13.5	20	44.7
		YT0.2	5	5.87	2.89	1.29	1.35	6.63	8.57
	2019	SYT0.6	5	11.5	2.94	1.32	7.41	13.2	14
		XE0.2	5	39.6	17.4	7.78	25.5	28.6	61.8
		HC0.2	5	13.6	4.77	2.14	7.89	14.8	19.9
		CC5.6	5	39.4	32.9	14.7	2.4	49	77.8
		YT0.2	5	15	16.9	7.58	2.26	7.91	44.4
	2021	SYT0.6	5	9.36	2.72	1.22	6.33	8.86	13.8
		XE0.2	5	48.5	10.3	4.61	37.3	48	60.4
		HC0.2	5	28.6	16.4	7.32	4.86	32.2	44.6
		CC5.6	5	36	20.7	9.28	4.24	39.5	55.5
		YT0.2	5	29.9	15.9	7.1	5.28	30.7	49.6
% Scraper-Grazer	2018	SYT0.6	5	0.0485	0.109	0.0485	0	0	0.243
		XE0.2	5	0.151	0.337	0.151	0	0	0.754
		HC0.2	5	2.09	1.92	0.857	0	3.28	3.72
		CC5.6	5	11.6	9.91	4.43	0	8.11	26.3
		YT0.2	5	2.06	1.27	0.569	0	2.44	3.23
	2019	SYT0.6	5	0	0	0	0	0	0
		XE0.2	5	0.398	0.314	0.141	0	0.333	0.855
		HC0.2	5	2.6	1.38	0.615	1.08	2.99	4.42
		CC5.6	5	17.2	15.4	6.88	2.54	13	41.4
		YT0.2	5	0.891	0.364	0.163	0.361	0.93	1.33
	2021	SYT0.6	5	0.0954	0.131	0.0586	0	0	0.253
		XE0.2	5	4.85	8.43	3.77	0	1.53	19.9
		HC0.2	5	6.95	1.87	0.835	5	6.52	9.07
		CC5.6	5	15.9	14.7	6.56	4.01	6.61	33
		YT0.2	5	1.33	0.598	0.268	0.719	1.43	2.13

Note: "-" = no data

Table D.5: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
% Shredder	2018	SYT0.6	5	66.5	4.11	1.84	61.4	65	70.8
		XE0.2	5	12.1	9.82	4.39	6.15	7.86	29.5
		HC0.2	5	27.3	19.4	8.69	3.67	31.2	52.3
		CC5.6	5	0.985	1.36	0.608	0	0	2.7
		YT0.2	5	45	12.1	5.39	31.6	48.4	60
	2019	SYT0.6	5	61.9	7.02	3.14	53.8	65.1	70
		XE0.2	5	19.6	9.71	4.34	10.7	15.6	33.6
		HC0.2	5	67.2	5.84	2.61	61.7	66	77.1
		CC5.6	5	1.31	1.42	0.634	0	0.8	3.49
		YT0.2	5	67.9	14.2	6.36	43	74.7	76.5
	2021	SYT0.6	5	68.5	10.1	4.51	58.7	68.2	83.5
		XE0.2	5	9.74	2.59	1.16	6.41	10.1	13.3
		HC0.2	5	49.7	17.6	7.88	30.6	41	71.4
		CC5.6	5	4.2	8.56	3.83	0	0.388	19.5
		YT0.2	5	55.1	12.6	5.61	43.9	52.3	76.6
% Predator	2018	SYT0.6	5	3.94	1.48	0.662	2.05	3.86	6.13
		XE0.2	5	1.23	0.753	0.337	0.658	0.923	2.52
		HC0.2	5	1.94	2.03	0.907	0.508	1.27	5.5
		CC5.6	5	8.96	11.7	5.22	2.63	3.16	29.6
		YT0.2	5	1.48	0.792	0.354	0.877	1.22	2.86
	2019	SYT0.6	5	1.91	0.553	0.247	1.55	1.75	2.88
		XE0.2	5	0.286	0.203	0.0906	0	0.29	0.57
		HC0.2	5	0.613	0.394	0.176	0.309	0.539	1.29
		CC5.6	5	4.38	4.71	2.1	0.635	2.33	12
		YT0.2	5	2.23	1.15	0.515	0.361	2.26	3.26
	2021	SYT0.6	5	3.01	1.31	0.587	1.52	3.36	4.81
		XE0.2	5	5.67	2.35	1.05	1.76	6.51	7.88
		HC0.2	5	1.61	0.674	0.301	0.543	1.71	2.38
		CC5.6	5	10.8	6.09	2.72	5.86	8.47	20.3
		YT0.2	5	2.79	1.18	0.528	1.62	2.64	4.76
% Sprawler	2018	SYT0.6	5	18	3.51	1.57	15.3	17	23.8
		XE0.2	5	18.9	9.26	4.14	8.3	16.7	32.1
		HC0.2	5	17.9	12.7	5.68	7.11	9.82	33.3
		CC5.6	5	22.5	19.6	8.76	6.55	13.2	55.6
		YT0.2	5	13.5	4.01	1.79	10	13.4	20.1
	2019	SYT0.6	5	25.8	5.41	2.42	19.9	25.2	32.2
		XE0.2	5	34.1	7.9	3.53	24.7	34.3	44.7
		HC0.2	5	9.85	4.38	1.96	3.21	10.4	14.9
		CC5.6	5	34.9	19.9	8.92	18.1	29.5	67.2
		YT0.2	5	9.79	3	1.34	7.58	8.66	15
	2021	SYT0.6	5	20.8	8.29	3.71	8.68	21.4	30
		XE0.2	5	31.4	10.1	4.53	19.6	28.6	46.5
		HC0.2	5	6.98	4.02	1.8	2.69	6.86	13.3
		CC5.6	5	37.7	11.9	5.34	22.7	35.8	53.3
		YT0.2	5	9.37	2.94	1.31	5.28	9.16	12.4
% Burrower	2018	SYT0.6	5	0.771	1.01	0.454	0	0.485	2.45
		XE0.2	5	31.7	21.8	9.76	8.18	28.9	67.4
		HC0.2	5	7.53	8.26	3.7	1.52	2.68	20.2
		CC5.6	5	7.85	6.87	3.07	2.22	4.33	18.4
		YT0.2	5	5.17	3.23	1.45	0	5.38	8.57
	2019	SYT0.6	5	0.384	0.56	0.25	0	0	1.23
		XE0.2	5	29.9	23.5	10.5	2.42	26.3	58.4
		HC0.2	5	2.79	2.58	1.15	0.697	1.47	7.1
		CC5.6	5	38.9	33.4	14.9	2.4	49	77.5
		YT0.2	5	14.5	16.7	7.48	1.88	8.84	43.7
	2021	SYT0.6	5	0.602	0.549	0.245	0	0.648	1.45
		XE0.2	5	29.1	13.1	5.84	10.9	28.2	44
		HC0.2	5	3.83	2.18	0.973	1.9	2.57	7
		CC5.6	5	34.9	21.1	9.42	2.54	39.1	55.1
		YT0.2	5	19.5	17.9	7.98	1.51	19	45.1

Note: "-" = no data

Table D.5: Benthic Invertebrate Community Summary Statistics, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021

Endpoint	Year	Area	N	Mean	SD	SE	Min	Median	Max
% Clinger	2018	SYT0.6	5	71.4	2.15	0.961	68.2	72	73.9
		XE0.2	5	24.4	8.36	3.74	15.2	20.7	36.2
		HC0.2	5	54.8	30.5	13.6	12.8	71.6	80.4
		CC5.6	5	26.3	16.6	7.41	0	28.9	44.9
		YT0.2	5	48.1	12.6	5.64	33.3	53.7	62.9
	2019	SYT0.6	5	73.1	5.13	2.29	67.2	74.4	78.8
		XE0.2	5	34.5	18.7	8.36	15.7	27.8	60.7
		HC0.2	5	80.8	5.06	2.26	74.3	80	87.3
		CC5.6	5	23.3	19.9	8.9	3.81	21.2	54.2
		YT0.2	5	69.5	14.1	6.32	44.8	76.7	78.3
	2021	SYT0.6	5	77.7	8	3.58	69.4	76.5	89.9
		XE0.2	5	31.6	6.02	2.69	24.2	31.8	39.4
		HC0.2	5	81.9	6.49	2.9	73.9	82.8	89
		CC5.6	5	24.6	19.6	8.78	13.1	16.2	59.3
		YT0.2	5	66.9	14.5	6.5	48.7	66.3	81.5

Note: "-" = no data

Table D.6. **Statistical Temporal and Spatial Comparisons of Benthic Invertebrate Community Endpoints, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021**

ANOVA Model					Station		Do concentrations differ over time?			Do concentrations differ between the stations?					
							Magnitude of Difference[a]			Magnitude of Difference[b]					
										SYT0.6 Vs XE0.2 and Future-Exposed			XE0.2 Vs SYT0.6 and Future-Exposed		
Parameter	Station	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Density (org/m²)	none	<0.001	<0.001	0.009	Reference	SYT0.6	ns	3.02	2.21	nc	nc	nc	nc	nc	nc
						XE0.2	2.50	ns	-1.61	ns	ns	-3.24	nc	nc	nc
					Exposure	HC0.2	1.67	3.09	1.41	-1.98	ns	-1.92	ns	-1.70	ns
						CC5.6	ns	1.47	ns	-2.76	-2.55	-4.31	-1.65	-3.13	ns
						YT0.2	ns	1.83	ns	-2.50	-2.26	-3.69	ns	-2.85	ns
Richness (# of taxa)	none	0.002	<0.001	0.247	Reference	SYT0.6	0.628	1.53	0.900	nc			nc		
						XE0.2				ns			nc		
					Exposure	HC0.2				ns			ns		
						CC5.6				ns			ns		
						YT0.2				ns			-1.30		
Simpson's Evenness	log10	0.018	0.002	<0.001	Reference	SYT0.6	2.23	ns	-2.15	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	1.83	ns	1.60	nc	nc	nc
					Exposure	HC0.2	ns	-1.64	ns	1.96	ns	ns	ns	ns	ns
						CC5.6	-2.78	-1.91	ns	3.32	-1.69	ns	ns	ns	ns
						YT0.2	ns	-1.57	ns	1.67	ns	ns	ns	ns	ns
Simpson's Diversity	rank	<0.001	0.855	<0.001	Reference	SYT0.6	2.10	ns	-1.40	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	1.98	ns	1.81	nc	nc	nc
					Exposure	HC0.2	ns	ns	ns	1.55	ns	ns	ns	ns	-0.965
						CC5.6	-0.647	ns	0.946	1.81	-0.937	1.41	ns	ns	ns
						YT0.2	ns	ns	ns	ns	-1.16	ns	ns	-0.903	-1.63
Biomass (g/m²)	log10	<0.001	<0.001	0.034	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	1.85	1.47	ns	-2.14	ns	-1.67	nc	nc	nc
					Exposure	HC0.2	1.98	2.83	ns	-2.99	-1.65	ns	ns	ns	ns
						CC5.6	3.63	4.00	ns	-6.14	-3.15	-3.12	-3.99	-2.22	ns
						YT0.2	1.97	2.46	ns	-4.00	-2.67	-2.54	-1.86	-1.74	ns
EPT (%)	logit	<0.001	0.307	0.003	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	-2.08	-2.30	-2.86	nc	nc	nc
					Exposure	HC0.2	2.41	1.76	ns	-2.37	ns	ns	ns	3.10	2.60
						CC5.6	ns	-1.40	ns	ns	-1.98	-2.53	ns	ns	ns
						YT0.2	ns	ns	ns	ns	ns	ns	2.27	3.10	2.38
Ephemeroptera (%)	logit	<0.001	<0.001	<0.001	Reference	SYT0.6	-2.35	-2.30	ns	nc	nc	nc	nc	nc	nc
						XE0.2	-3.49	-1.98	1.51	1.63	ns	1.95	nc	nc	nc
					Exposure	HC0.2	ns	ns	ns	ns	2.32	2.95	-1.80	1.82	ns
						CC5.6	-1.75	-2.71	ns	3.14	3.74	2.72	ns	3.25	ns
						YT0.2	-2.71	-3.16	ns	2.31	1.95	ns	ns	ns	ns
Plecoptera (%)	none	<0.001	<0.001	0.001	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	-4.99	-3.92	-5.41	nc	nc	nc
					Exposure	HC0.2	3.78	2.17	-1.62	-3.71	ns	-1.75	ns	4.40	3.66
						CC5.6	ns	ns	ns	-6.05	-5.29	-5.83	ns	ns	ns
						YT0.2	2.13	ns	ns	-1.98	ns	ns	3.01	4.48	4.16

Table D.6. Statistical Temporal and Spatial Comparisons of Benthic Invertebrate Community Endpoints, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021

ANOVA Model					Station		Do concentrations differ over time?			Do concentrations differ between the stations?					
							Magnitude of Difference[a]			Magnitude of Difference[b]					
										SYT0.6 Vs XE0.2 and Future-Exposed			XE0.2 Vs SYT0.6 and Future-Exposed		
Parameter	Station	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Trichoptera (%)	logit	<0.001	<0.001	<0.001	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
						CC5.6	-1.47	3.36	4.84	1.89	ns	5.39	2.16	ns	4.82
						YT0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
Chironomidae (%)	log10	<0.001	0.192	0.005	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	1.56	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	ns	-1.97	ns	ns	-2.05	-2.18	ns	-2.94	-2.98
						CC5.6	ns	1.36	ns	ns	ns	ns	ns	ns	ns
						YT0.2	ns	ns	ns	ns	-2.31	-2.04	ns	-3.20	-2.84
Simuliidae (%)	logit	<0.001	0.016	<0.001	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	-1.39	ns	ns	2.49	ns	ns	ns	ns	ns
						CC5.6	-2.52	-2.10	ns	ns	-2.60	-1.83	ns	-2.88	-3.22
						YT0.2	ns	2.20	2.22	ns	-2.63	ns	-2.39	-2.91	ns
Oligochaeta (%)	logit	<0.001	0.282	0.319	Reference	SYT0.6	ns	ns	ns	nc			nc		
						XE0.2				2.45			nc		
					Exposure	HC0.2				ns			-1.79		
						CC5.6				2.17			ns		
						YT0.2				1.44			-1.01		
Metal-Sensitive Chironomidae (%)	logit	<0.001	<0.001	<0.001	Reference	SYT0.6	ns	-2.12	-3.02	nc	nc	nc	nc	nc	nc
						XE0.2	2.50	2.25	ns	-1.72	ns	2.65	nc	nc	nc
					Exposure	HC0.2	ns	ns	ns	-2.58	-3.67	ns	ns	-3.56	-3.69
						CC5.6	ns	ns	ns	-4.30	-4.75	-2.06	-2.58	-4.63	-4.71
						YT0.2	ns	-2.76	-1.65	ns	-2.99	-1.62	ns	-2.87	-4.27
% Collector-Gatherer	none	<0.001	<0.001	0.104	Reference	SYT0.6	-0.806	-1.12	ns	nc			nc		
						XE0.2				1.34			nc		
					Exposure	HC0.2				ns			-1.37		
						CC5.6				2.54			1.21		
						YT0.2				ns			-1.21		
% Filterer	logit	<0.001	0.092	0.161	Reference	SYT0.6	ns	ns	ns	nc			nc		
						XE0.2				2.23			nc		
					Exposure	HC0.2				1.21			-1.01		
						CC5.6				1.48			ns		
						YT0.2				ns			-1.82		
% Scraper-Grazer	logit	<0.001	0.076	0.442	Reference	SYT0.6	ns	0.624	ns	nc			nc		
						XE0.2				ns			nc		
					Exposure	HC0.2				1.54			0.996		
						CC5.6				3.26			2.72		
						YT0.2				ns			ns		

Table D.6. **Statistical Temporal and Spatial Comparisons of Benthic Invertebrate Community Endpoints, Coffee Project FALMP, Lower Creek Areas, 2018 to 2021**

ANOVA Model					Station		Do concentrations differ over time?			Do concentrations differ between the stations?					
							Magnitude of Difference[a]			Magnitude of Difference[b]					
										SYT0.6 Vs XE0.2 and Future-Exposed			XE0.2 Vs SYT0.6 and Future-Exposed		
Parameter	Station	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
% Shredder	none	<0.001	<0.001	<0.001	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	ns	ns	-5.16	-4.01	-5.57	nc	nc	nc
					Exposure	HC0.2	3.78	2.12	-1.66	-3.71	ns	-1.79	ns	4.51	3.79
						CC5.6	ns	ns	ns	-6.21	-5.74	-6.10	ns	-1.73	ns
						YT0.2	2.17	ns	ns	-2.04	ns	ns	3.12	4.58	4.30
% Predator	logit	<0.001	<0.001	0.052	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	ns	2.05	2.79	nc	nc	nc	nc	nc	nc
					Exposure	HC0.2	ns	ns	ns	nc	nc	nc	nc	nc	nc
						CC5.6	ns	ns	2.11	nc	nc	nc	nc	nc	nc
						YT0.2	ns	ns	ns	nc	nc	nc	nc	nc	nc
% Sprawler	log10	<0.001	0.443	0.007	Reference	SYT0.6	ns	ns	ns	nc	nc	nc	nc	nc	nc
						XE0.2	1.44	ns	ns	ns	ns	ns	nc	nc	nc
					Exposure	HC0.2	ns	-1.86	ns	ns	-2.27	-2.45	ns	-2.85	-3.41
						CC5.6	ns	1.59	ns	ns	ns	ns	ns	ns	ns
						YT0.2	ns	ns	ns	ns	-2.10	-1.62	ns	-2.69	-2.59
% Burrower	logit	<0.001	0.263	0.255	Reference	SYT0.6	ns	ns	ns	nc			nc		
						XE0.2				2.68			nc		
					Exposure	HC0.2				ns			-1.91		
						CC5.6				2.28			ns		
						YT0.2				1.48			-1.20		
% Clinger	none	<0.001	0.009	0.343	Reference	SYT0.6	0.768	0.786	ns	nc			nc		
						XE0.2				-2.99			nc		
					Exposure	HC0.2				ns			2.89		
						CC5.6				-3.36			ns		
						YT0.2				ns			2.13		

ANOVA P-value < 0.1.

> 2 SD Decrease in endpoint relative to reference

> 2 SD Increase in endpoint relative to reference

Note: "nc" indicates no comparison available; "ns" indicates not significant. "Logp1" indicates log10(x+1).

[a] Magnitude of Difference is calculated as $(MCT_{recent\ year} - MCT_{older\ year})/MAD_{pooled}$ for rank transformation and $(MCT_{recent\ year} - MCT_{older\ year})/SD_{pooled}$ for all other transformations. MAD_{pooled} = pooled median absolute deviation and SD_{pooled} = pooled standard deviation. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for all others.

[b] Magnitude of Difference is calculated as $(MCT_{Exposed} - MCT_{Reference})/(MAD_{pooled})$ for rank transformation and $(MCT_{Exposed} - MCT_{Reference})/(SD_{pooled})$ for all other transformations. MAD_{pooled} = pooled median absolute deviation and SD_{pooled} = pooled standard deviation. MCT = measure of central tendency, which are median for rank transformed and back-transformed estimated marginal means for all others.

Table D.7: Statistical Comparison of Benthic Invertebrate Bray-Curtis Indices at Mine-Exposed (HC0.2, CC5.6, YT0.2) and Reference (SYT0.2 and XE0.2) Lower Creek Areas, Coffee Project FALMP, 2018 to 2021

Year	Comparison	Taxonomic Resolution	n		Betadisper P-Value	Mantel Test			dbRDA			
			Reference	Mine-Exposed		r	R^2	P-Value	F-Value	R^2	R^2_{adj}	P-Value
2018	SYT0.6 vs. HC0.2	Family	5	5	0.106	0.465	0.216	0.008	4.91	0.380	0.303	0.002
		Lowest-Practical-Level	5	5	0.0695	0.611	0.373	0.008	5.77	0.419	0.346	0.005
	XE0.2 vs. HC0.2	Family	5	5	0.219	0.556	0.309	0.009	4.95	0.382	0.305	0.008
		Lowest-Practical-Level	5	5	0.148	0.643	0.414	0.008	5.25	0.396	0.321	0.008
	SYT0.6 vs. CC5.6	Family	5	5	0.0297	0.779	0.608	0.008	10.7	0.572	0.519	0.008
		Lowest-Practical-Level	5	5	0.0441	0.807	0.652	0.008	11.4	0.587	0.536	0.006
	XE0.2 vs. CC5.6	Family	5	5	0.0890	0.681	0.464	0.008	7.31	0.478	0.412	0.008
		Lowest-Practical-Level	5	5	0.0718	0.723	0.523	0.008	8.21	0.506	0.445	0.008
	SYT0.6 vs. YT0.2	Family	5	5	0.201	0.851	0.725	0.008	11.4	0.587	0.536	0.008
		Lowest-Practical-Level	5	5	0.561	0.791	0.626	0.008	8.38	0.512	0.451	0.001
	XE0.2 vs. YT0.2	Family	5	5	0.580	0.772	0.595	0.008	10.6	0.570	0.516	0.007
		Lowest-Practical-Level	5	5	0.800	0.740	0.547	0.008	9.31	0.538	0.480	0.004
2019	SYT0.6 vs. HC0.2	Family	5	5	0.789	0.917	0.841	0.008	18.8	0.702	0.665	0.008
		Lowest-Practical-Level	5	5	0.139	0.894	0.799	0.008	11.2	0.583	0.531	0.0001
	XE0.2 vs. HC0.2	Family	5	5	0.0617	0.856	0.733	0.008	11.2	0.584	0.532	0.007
		Lowest-Practical-Level	5	5	0.338	0.929	0.864	0.008	16.4	0.672	0.631	0.008
	SYT0.6 vs. CC5.6	Family	5	5	0.0122	0.953	0.909	0.008	38.0	0.826	0.805	0.004
		Lowest-Practical-Level	5	5	0.0153	0.958	0.918	0.008	26.4	0.767	0.738	0.007
	XE0.2 vs. CC5.6	Family	5	5	0.149	0.921	0.848	0.008	17.7	0.688	0.649	0.008
		Lowest-Practical-Level	5	5	0.0240	0.960	0.922	0.008	17.1	0.681	0.641	0.005
	SYT0.6 vs. YT0.2	Family	5	5	0.908	0.898	0.806	0.008	20.4	0.718	0.683	0.008
		Lowest-Practical-Level	5	5	0.851	0.933	0.871	0.008	12.9	0.617	0.569	0.007
	XE0.2 vs. YT0.2	Family	5	5	0.227	0.909	0.826	0.008	17.3	0.684	0.644	0.001
		Lowest-Practical-Level	5	5	0.207	0.939	0.882	0.008	18.7	0.700	0.662	0.008
2021	SYT0.6 vs. HC0.2	Family	5	5	0.0492	0.839	0.704	0.008	11.2	0.584	0.533	0.008
		Lowest-Practical-Level	5	5	0.538	0.892	0.796	0.008	10.9	0.577	0.524	0.007
	XE0.2 vs. HC0.2	Family	5	5	0.127	0.728	0.529	0.008	8.24	0.507	0.446	0.007
		Lowest-Practical-Level	5	5	0.689	0.884	0.781	0.008	11.0	0.579	0.526	0.008
	SYT0.6 vs. CC5.6	Family	5	5	0.136	0.853	0.727	0.008	12.8	0.615	0.567	0.008
		Lowest-Practical-Level	5	5	0.254	0.892	0.796	0.008	12.2	0.605	0.555	0.008
	XE0.2 vs. CC5.6	Family	5	5	0.118	0.786	0.618	0.008	9.08	0.532	0.473	0.006
		Lowest-Practical-Level	5	5	0.178	0.870	0.756	0.008	11.6	0.591	0.540	0.003
	SYT0.6 vs. YT0.2	Family	5	5	0.838	0.584	0.341	0.008	5.16	0.392	0.316	0.007
		Lowest-Practical-Level	5	5	0.850	0.768	0.590	0.008	6.74	0.457	0.389	0.007
	XE0.2 vs. YT0.2	Family	5	5	0.960	0.737	0.543	0.008	7.45	0.482	0.417	0.006
		Lowest-Practical-Level	5	5	0.657	0.859	0.737	0.008	9.05	0.531	0.472	0.006

P-Value < 0.1.

Table D.8: Spearman Rank Correlations Between Benthic Community Endpoints and Physiochemical Parameters, Lower Creek Areas, Coffee Project FALMP, 2018 to 2021

Parameter	Statistic	Density (org/m²)	Richness (# of taxa)	Simpson's Evenness	Simpson's Diversity	Biomass (g/m²)	EPT (%)	Ephemeroptera (%)	Plecoptera (%)	Trichoptera (%)
Water Velocity (m³/s)	r_s	-0.509	-0.331	0.256	0.0570	-0.464	-0.165	0.311	-0.357	-0.0276
	p-value	<0.001	0.004	0.029	0.632	<0.001	0.162	0.007	0.002	0.817
Temperature (°C)	r_s	-0.178	0.269	0.0121	0.142	-0.228	-0.286	0.230	-0.477	0.526
	p-value	0.131	0.022	0.919	0.231	0.052	0.014	0.050	<0.001	<0.001
DO (mg/L)	r_s	0.146	-0.132	0.221	0.108	0.148	-0.113	-0.107	-0.0178	-0.322
	p-value	0.225	0.274	0.064	0.371	0.217	0.350	0.375	0.883	0.006
DO (%)	r_s	0.0937	0.0659	0.389	0.364	0.0504	-0.287	-0.0873	-0.260	-0.0279
	p-value	0.437	0.585	<0.001	0.002	0.676	0.015	0.469	0.029	0.817
pH	r_s	0.494	0.201	0.0118	0.133	0.515	-0.200	-0.376	0.129	-0.263
	p-value	<0.001	0.090	0.922	0.264	<0.001	0.093	0.001	0.280	0.025
Specific Conductance (µS/cm)	r_s	0.603	0.271	0.0580	0.204	0.576	-0.244	-0.473	0.0645	-0.158
	p-value	<0.001	0.020	0.626	0.083	<0.001	0.038	<0.001	0.588	0.183
Conductivity (µS/cm)	r_s	0.593	0.279	0.0564	0.204	0.570	-0.296	-0.466	0.00526	-0.0949
	p-value	<0.001	0.017	0.636	0.084	<0.001	0.011	<0.001	0.965	0.424
Substrate (cm)	r_s	0.0397	-0.174	0.0433	-0.0761	0.0765	0.239	-0.233	0.332	-0.213
	p-value	0.739	0.142	0.716	0.522	0.520	0.042	0.047	0.004	0.070

P-Value < 0.1

P-Value < 0.1/8 =0.0125 (Bonferroni Corrected for 8 independent tests.)

abs(r_s) > 0.6

Table D.8: Spearman Rank Correlations Between Benthic Community Endpoints and Physiochemical Parameters, Lower Creek Areas, Coffee Project FALMP, 2018 to 2021

Parameter	Statistic	Chironomidae (%)	Simuliidae (%)	Oligochaeta (%)	% Collector-Gatherer	% Filterer	% Scraper-Grazer	% Shredder	% Predator	% Sprawler	% Burrower	% Clinger
Water Velocity (m^3/s)	r_s	0.180	-0.254	0.169	0.358	0.0974	0.0291	-0.353	-0.128	0.138	0.203	-0.412
	p-value	0.127	0.030	0.152	0.002	0.412	0.807	0.002	0.280	0.245	0.086	<0.001
Temperature (°C)	r_s	0.164	-0.0539	0.264	0.282	0.223	0.633	-0.486	0.334	0.199	0.270	-0.291
	p-value	0.166	0.651	0.024	0.016	0.058	<0.001	<0.001	0.004	0.091	0.021	0.013
DO (mg/L)	r_s	0.165	0.293	-0.108	0.156	0.0248	-0.550	0.00196	-0.185	0.122	-0.0911	-0.122
	p-value	0.169	0.013	0.372	0.194	0.837	<0.001	0.987	0.122	0.311	0.450	0.310
DO (%)	r_s	0.314	0.330	0.0394	0.323	0.151	-0.224	-0.238	-0.0244	0.294	0.0547	-0.287
	p-value	0.008	0.005	0.744	0.006	0.209	0.061	0.046	0.840	0.013	0.651	0.015
pH	r_s	0.266	0.182	0.134	-0.0949	0.214	-0.385	0.103	-0.191	0.245	0.106	-0.00545
	p-value	0.024	0.127	0.264	0.428	0.071	<0.001	0.391	0.108	0.038	0.375	0.964
Specific Conductance (µS/cm)	r_s	0.309	0.436	-0.00412	-0.0589	0.170	-0.505	0.0766	0.0762	0.292	-0.00789	-0.0440
	p-value	0.008	<0.001	0.972	0.620	0.150	<0.001	0.519	0.522	0.012	0.947	0.712
Conductivity (µS/cm)	r_s	0.365	0.410	0.0187	-0.0159	0.196	-0.479	0.0128	0.106	0.352	0.0162	-0.0958
	p-value	0.001	<0.001	0.875	0.894	0.097	<0.001	0.914	0.370	0.002	0.892	0.420
Substrate (cm)	r_s	0.0665	-0.240	-0.146	-0.113	-0.293	-0.0824	0.313	-0.214	0.0712	-0.163	0.225
	p-value	0.576	0.041	0.219	0.341	0.012	0.488	0.007	0.069	0.550	0.168	0.055

P-Value < 0.1

P-Value < 0.1/8 =0.0125 (Bonferroni Corrected for 8 independent tests.)

abs(r_s) > 0.6

APPENDIX E
BENTHIC INVERTEBRATE
TISSUE CHEMISTRY

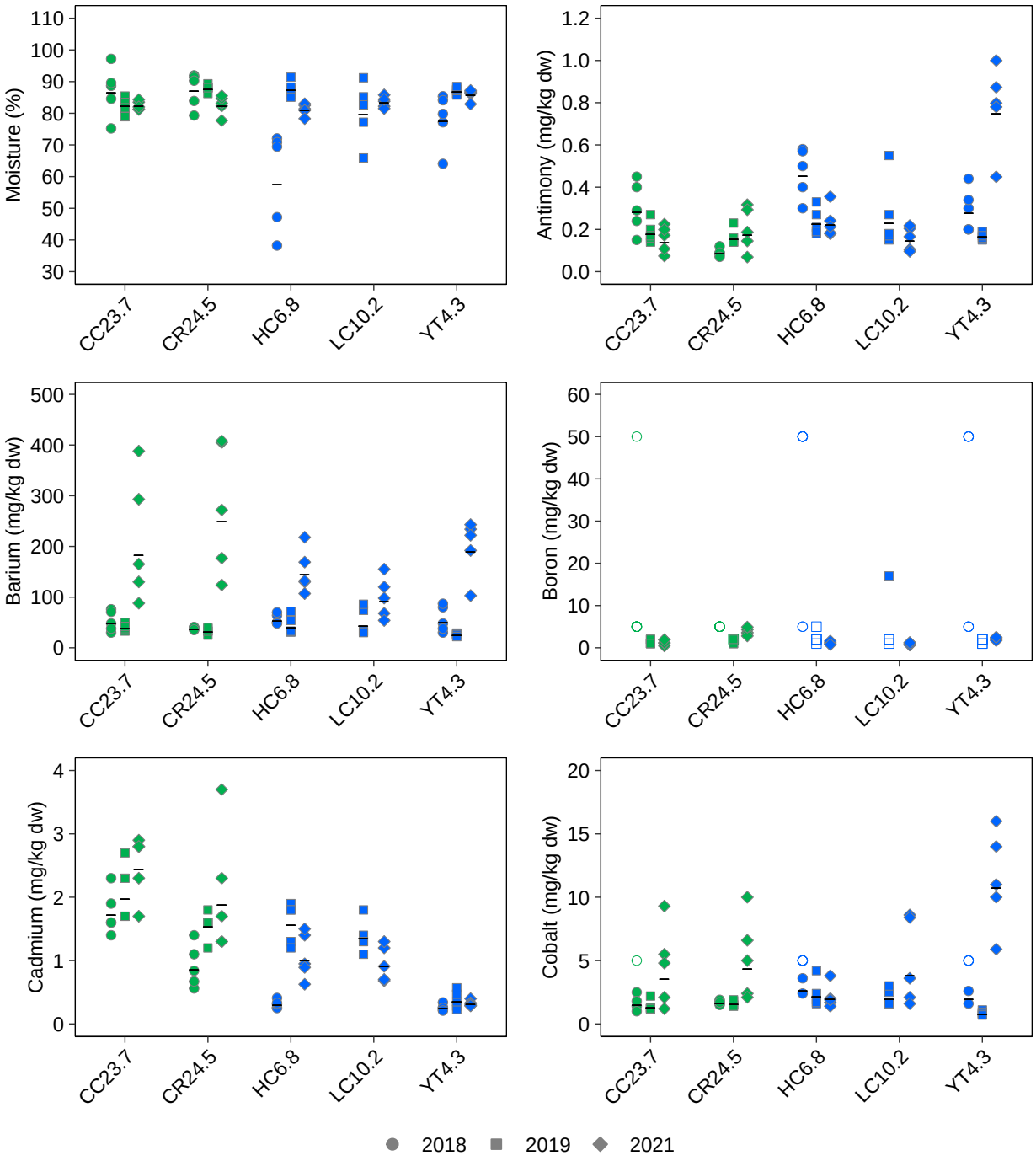

Figure E.1: Coffee Project FALMP Benthic Invertebrate Tissue Composition, Non-Key Analyte Concentrations, Upper Creek Areas, 2018 to 2021.

Notes: Plots for Key Indicator Analytes (e.g. arsenic, uranium, zinc) included in main text (see section 7). Green represents reference stations and blue represents future-exposed stations. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses. Boron and tin were excluded from analyses because 100% of the data were at the LDL in 2018 and/or 2019. MCT's are not shown for these parameters.

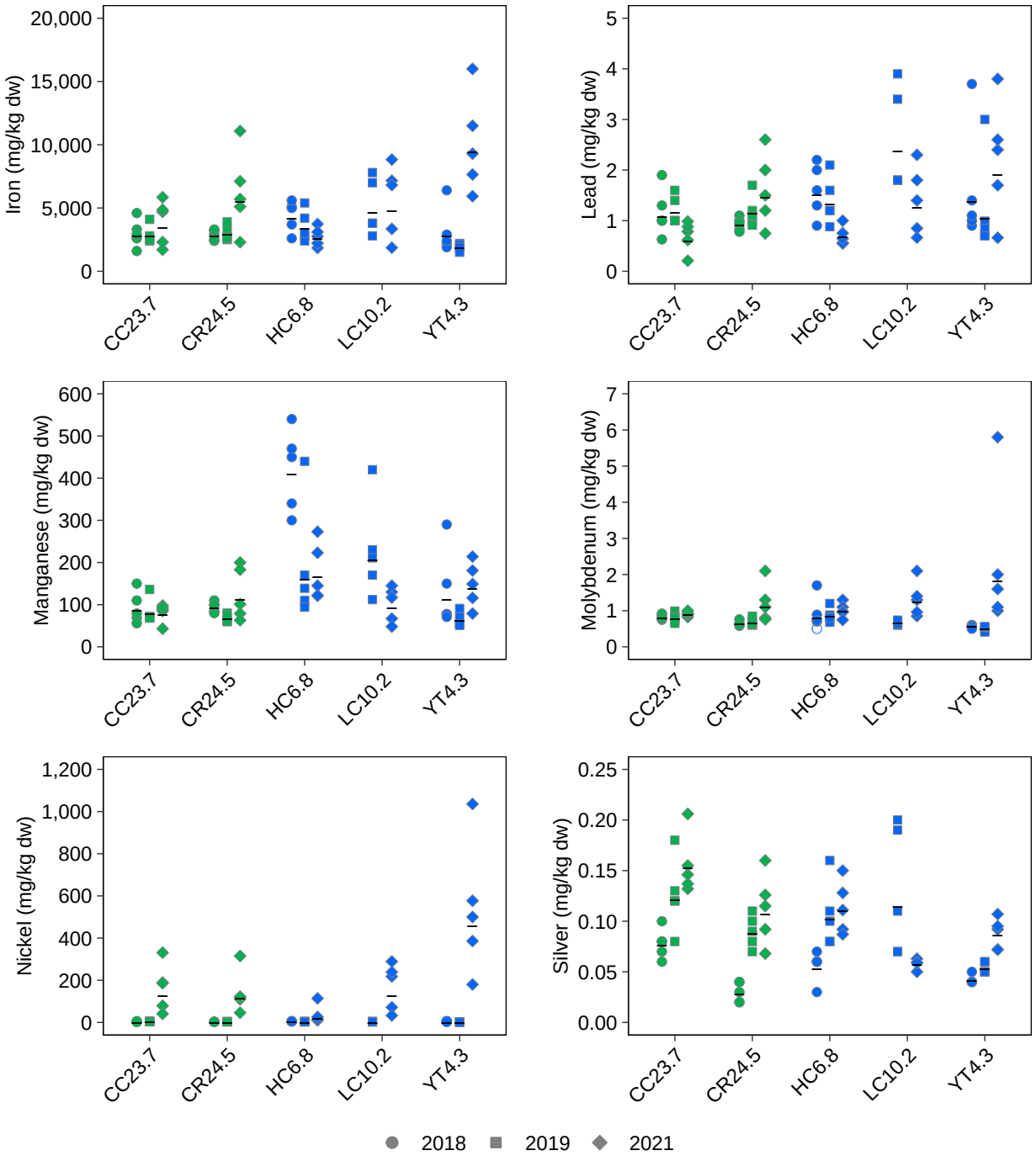

Figure E.1: Coffee Project FALMP Benthic Invertebrate Tissue Composition, Non-Key Analyte Concentrations, Upper Creek Areas, 2018 to 2021.

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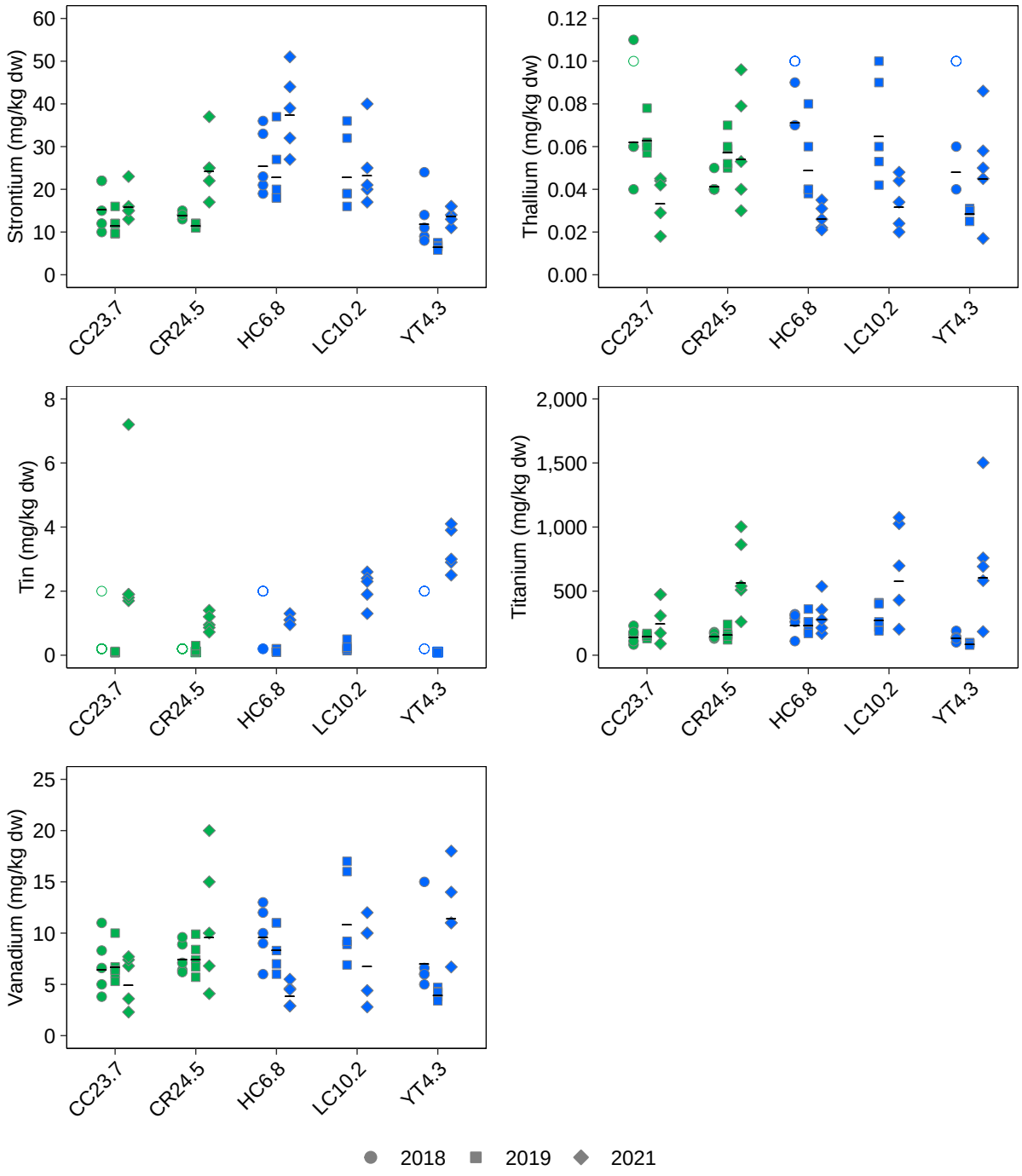

Figure E.1: Coffee Project FALMP Benthic Invertebrate Tissue Composition, Non-Key Analyte Concentrations, Upper Creek Areas, 2018 to 2021.

Notes: Plots for Key Indicator Analytes (e.g. arsenic, uranium, zinc) included in main text (see section 7). Green represents reference stations and blue represents future-exposed stations. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses. Boron and tin were excluded from analyses because 100% of the data were at the LDL in 2018 and/or 2019. MCT's are not shown for these parameters.

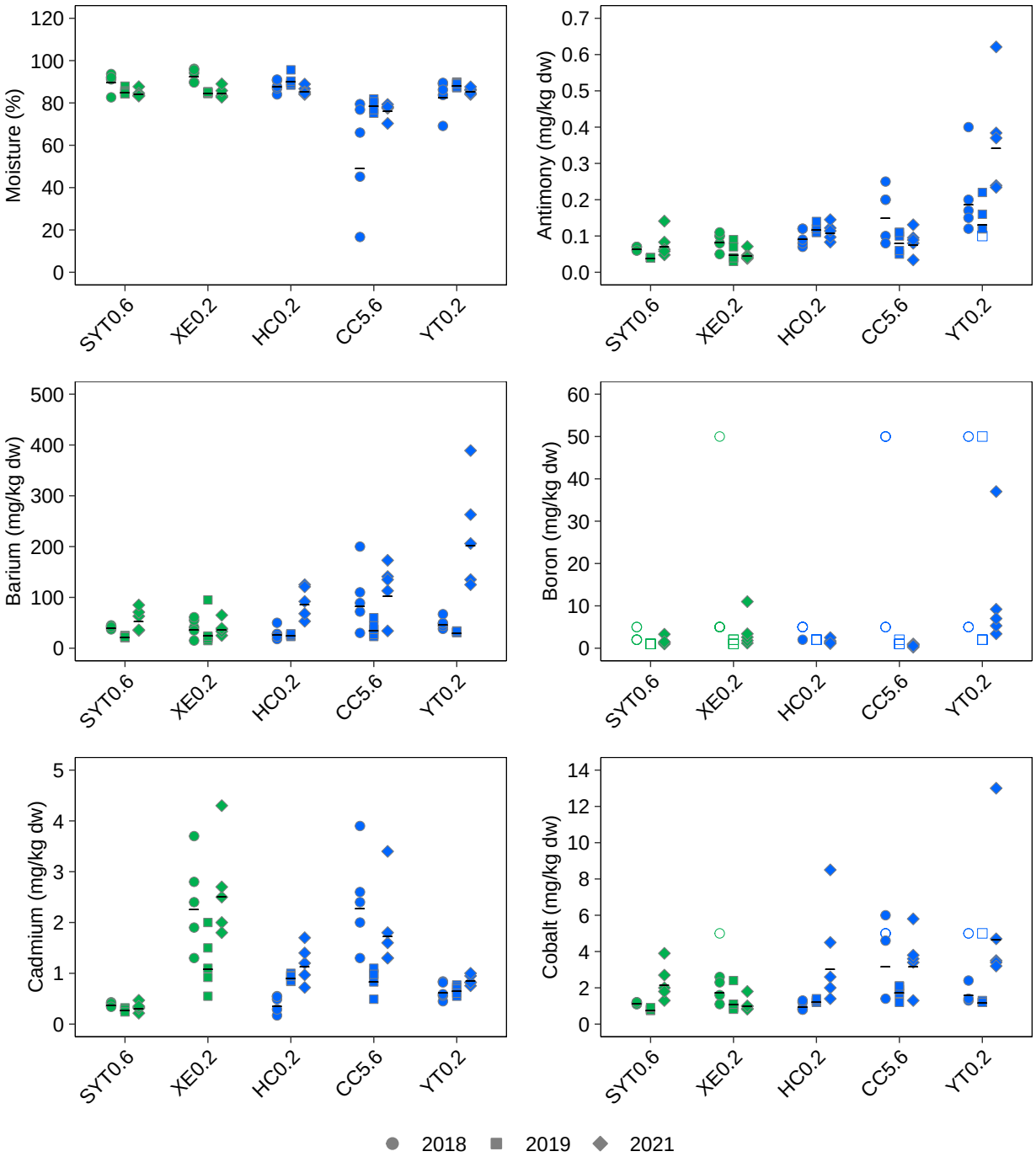

Figure E.2: Coffee Project FALMP Benthic Invertebrate Tissue Composition, Non-Key Analyte Concentrations, Lower Creek Areas, 2018 to 2021.

Notes: Plots for Key Indicator Analytes (e.g. arsenic, uranium, zinc) included in main text (see section 7). Green represents reference stations and blue represents future-exposed stations. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses. Boron and tin were excluded from analyses because 100% of the data were at the LDL in 2018 and/or 2019. MCT's are not shown for these parameters.

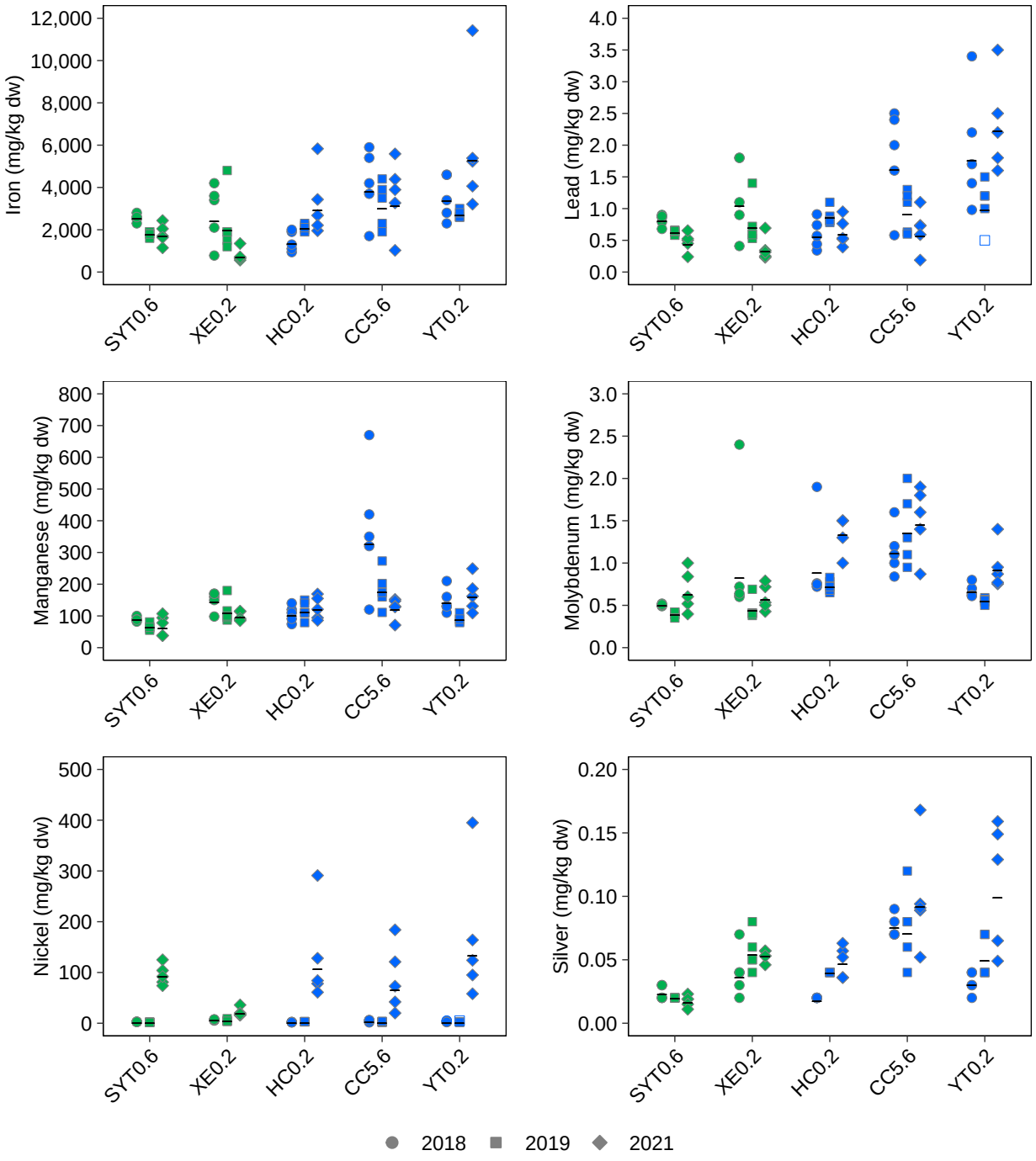

Figure E.2: Coffee Project FALMP Benthic Invertebrate Tissue Composition, Non-Key Analyte Concentrations, Lower Creek Areas, 2018 to 2021.

Notes: Plots for Key Indicator Analytes (e.g. arsenic, uranium, zinc) included in main text (see section 7). Green represents reference stations and blue represents future-exposed stations. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. Horizontal lines indicate measure of central tendency (MCT) used in the statistical analyses. Boron and tin were excluded from analyses because 100% of the data were at the LDL in 2018 and/or 2019. MCT's are not shown for these parameters.

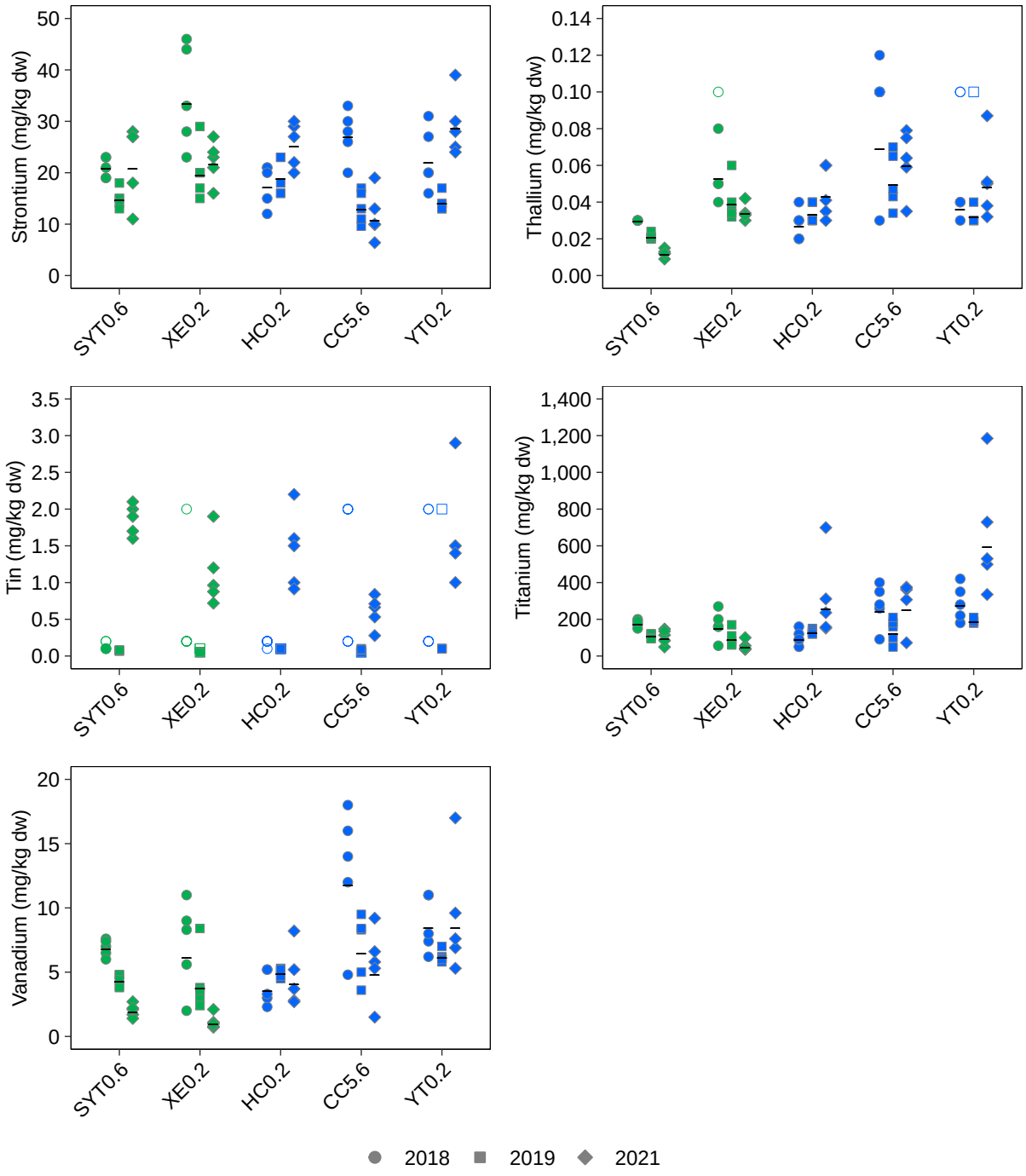

Figure E.2: Coffee Project FALMP Benthic Invertebrate Tissue Composition, Non-Key Analyte Concentrations, Lower Creek Areas, 2018 to 2021.

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Table E.1: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Upper Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	CC23.7									
			2018					2019				
			Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	87.0	88.7	8.03	75.2	97.2	82.5	83.2	2.42	78.9	85.4
Aluminum	mg/kg dw	-	2,600	2,600	886	1,600	3,900	2,640	2,600	365	2,200	3,200
Antimony	mg/kg dw	-	0.306	0.290	0.121	0.150	0.450	0.188	0.170	0.0507	0.140	0.270
Arsenic	mg/kg dw	-	7.20	5.90	3.01	4.50	12.0	8.54	7.20	3.47	6.40	14.7
Barium	mg/kg dw	-	52.6	48.0	20.2	30.0	76.0	40.4	39.0	6.27	33.0	50.0
Boron	mg/kg dw	-	-	-	-	-	-	1.40	1.00	0.548	1.00	2.00
Cadmium	mg/kg dw	-	1.76	1.60	0.351	1.40	2.30	2.02	1.70	0.460	1.70	2.70
Chromium	mg/kg dw	-	3.85	3.50	1.63	2.10	5.80	3.94	3.90	0.643	3.30	5.00
Cobalt	mg/kg dw	-	1.67	1.60	0.715	1.00	<5	1.42	1.20	0.438	1.20	2.20
Copper	mg/kg dw	-	20.0	20.0	2.12	17.0	22.0	15.4	16.0	0.894	14.0	16.0
Iron	mg/kg dw	-	3,000	2,900	1,093	1,600	4,600	2,860	2,500	709	2,400	4,100
Lead	mg/kg dw	-	1.17	1.00	0.474	0.630	1.90	1.20	1.00	0.283	1.00	1.60
Manganese	mg/kg dw	-	92.8	79.0	37.7	56.0	150	83.6	71.0	29.3	68.0	136
Mercury[b]	mg/kg ww	0.033	0.0132	0.0102	0.00889	0.00368	0.0248	0.0173	0.0166	0.00302	0.0138	0.0207
Molybdenum	mg/kg dw	-	0.822	0.800	0.0680	0.750	0.920	0.800	0.800	0.127	0.650	0.990
Nickel	mg/kg dw	-	3.23	2.80	1.44	1.80	5.20	3.94	3.40	1.43	3.20	6.50
Selenium	mg/kg dw	4	3.62	3.60	0.740	2.90	4.80	3.48	3.20	0.687	2.70	4.30
Silver	mg/kg dw	-	0.0780	0.0800	0.0148	0.0600	0.100	0.126	0.120	0.0358	0.0800	0.180
Strontium	mg/kg dw	-	16.2	15.0	5.59	10.0	22.0	11.9	12.0	2.60	9.60	16.0
Thallium	mg/kg dw	-	0.0647	0.0600	0.0285	0.0400	0.110	0.0636	0.0610	0.00826	0.0570	0.0780
Titanium	mg/kg dw	-	153	160	58.0	83.0	230	152	150	14.8	130	170
Tin	mg/kg dw	-	<0.2	<0.2	-	<0.2	<2	0.0960	0.100	0.0167	0.0800	0.120
Uranium	mg/kg dw	-	3.42	2.50	1.67	2.00	5.70	7.08	7.20	2.69	3.70	10.8
Vanadium	mg/kg dw	-	6.94	6.60	2.83	3.80	11.0	6.90	6.40	1.81	5.30	10.0
Zinc	mg/kg dw	-	138	140	4.47	130	140	103	98.0	12.1	92.0	120

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] 2018 Benthic Invertebrate Tissues from LC10.2 (n=5) were lost either en route to or at SRC Laboratories.

[b] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.1: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Upper Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	CC23.7					CR24.5							
			2021					2018					2019		
			Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation
Moisture	%	-	82.5	82.0	1.38	81.2	84.3	87.4	90.3	5.55	79.3	92.0	87.9	88.0	1.10
Aluminum	mg/kg dw	-	3,509	4,396	1,733	1,074	5,296	2,340	2,100	391	2,000	2,900	2,400	2,200	474
Antimony	mg/kg dw	-	0.156	0.172	0.0630	0.0740	0.225	0.0900	0.0900	0.0187	0.0700	0.120	0.162	0.140	0.0390
Arsenic	mg/kg dw	-	6.98	7.20	4.56	2.30	14.0	1.62	1.30	0.944	1.10	3.30	2.02	2.00	0.286
Barium	mg/kg dw	-	213	165	124	88.0	388	38.4	40.0	2.70	35.0	41.0	33.8	33.0	5.81
Boron	mg/kg dw	-	1.31	1.20	0.612	0.446	1.90	-	-	-	-	-	1.20	1.00	0.490
Cadmium	mg/kg dw	-	2.50	2.80	0.505	1.70	2.90	0.914	0.840	0.340	0.560	1.40	1.56	1.60	0.219
Chromium	mg/kg dw	-	119	126	84.1	27.0	243	3.78	3.80	0.460	3.20	4.40	5.22	5.70	1.23
Cobalt	mg/kg dw	-	4.58	4.80	3.19	1.20	9.30	1.70	1.70	0.158	1.50	1.90	1.62	1.50	0.217
Copper	mg/kg dw	-	20.4	20.0	0.548	20.0	21.0	20.2	20.0	2.28	18.0	24.0	19.2	20.0	1.10
Iron	mg/kg dw	-	3,881	4,699	1,783	1,700	5,846	2,860	2,900	404	2,400	3,300	3,000	2,700	592
Lead	mg/kg dw	-	0.695	0.784	0.304	0.208	0.984	0.932	0.950	0.129	0.780	1.10	1.18	1.10	0.309
Manganese	mg/kg dw	-	81.6	89.0	22.1	43.0	98.0	94.8	100	12.5	80.0	110	67.4	63.0	9.10
Mercury[b]	mg/kg ww	0.033	0.0425	0.0407	0.00571	0.0367	0.0519	0.00575	0.00514	0.00166	0.00402	0.00828	0.00724	0.00715	0.00103
Molybdenum	mg/kg dw	-	0.912	0.904	0.0640	0.825	1.00	0.648	0.630	0.0676	0.580	0.760	0.690	0.640	0.102
Nickel	mg/kg dw	-	165	186	113	41.0	331	2.80	2.80	0.308	2.50	3.30	3.38	3.40	0.687
Selenium	mg/kg dw	4	3.56	3.60	0.456	2.80	4.00	1.41	1.50	0.437	0.960	2.00	3.28	3.00	0.554
Silver	mg/kg dw	-	0.155	0.146	0.0297	0.132	0.206	0.0300	0.0300	0.0100	0.0200	0.0400	0.0900	0.0900	0.0158
Strontium	mg/kg dw	-	16.4	15.0	3.85	13.0	23.0	14.0	14.0	0.707	13.0	15.0	11.6	12.0	0.548
Thallium	mg/kg dw	-	0.0356	0.0420	0.0118	0.0180	0.0450	0.0420	0.0400	0.00447	0.0400	0.0500	0.0582	0.0590	0.00789
Titanium	mg/kg dw	-	304	308	174	90.0	474	152	140	21.7	130	180	168	160	44.4
Tin	mg/kg dw	-	2.90	1.90	2.41	1.70	7.20	<0.2	<0.2	-	<0.2	<0.2	0.144	0.100	0.0925
Uranium	mg/kg dw	-	3.44	3.90	1.09	1.50	4.10	0.428	0.410	0.0841	0.330	0.560	0.384	0.390	0.0631
Vanadium	mg/kg dw	-	5.56	6.80	2.45	2.30	7.70	7.64	7.10	1.53	6.20	9.60	7.62	7.40	1.61
Zinc	mg/kg dw	-	145	128	34.2	120	203	138	140	4.47	130	140	116	120	5.48

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] 2018 Benthic Invertebrate Tissues from LC10.2 (n=5) were lost either en route to or at SRC Laboratories.

[b] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.1: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Upper Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	CR24.5							HC6.8				
			2019		2021					2018				
			Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	86.2	89.3	82.7	83.2	3.05	77.7	85.5	59.6	69.4	15.7	38.2	72.0
Aluminum	mg/kg dw	-	1,900	3,000	6,815	5,436	3,897	2,388	12,740	4,500	4,600	1,288	2,700	5,800
Antimony	mg/kg dw	-	0.140	0.230	0.202	0.187	0.103	0.0690	0.317	0.470	0.500	0.119	0.300	0.580
Arsenic	mg/kg dw	-	1.80	2.50	2.04	2.20	0.783	1.10	3.00	6.08	6.80	1.48	4.30	7.60
Barium	mg/kg dw	-	25.0	40.0	277	272	129	124	408	56.2	50.0	10.1	48.0	70.0
Boron	mg/kg dw	-	1.00	2.00	3.78	3.60	0.829	2.80	4.90	-	-	-	-	-
Cadmium	mg/kg dw	-	1.20	1.80	2.06	1.70	1.00	1.30	3.70	0.312	0.310	0.0642	0.250	0.410
Chromium	mg/kg dw	-	3.50	6.40	105	89.0	77.5	33.0	237	8.24	9.00	0.844	<5	9.80
Cobalt	mg/kg dw	-	1.40	1.90	5.22	5.00	3.26	2.10	10.0	3.00	3.00	0.849	2.40	3.60
Copper	mg/kg dw	-	18.0	20.0	26.6	27.0	1.14	25.0	28.0	13.6	13.0	3.97	8.00	19.0
Iron	mg/kg dw	-	2,500	3,900	6,259	5,704	3,214	2,298	11,081	4,400	5,000	1,227	2,600	5,600
Lead	mg/kg dw	-	0.910	1.70	1.61	1.50	0.717	0.747	2.60	1.60	1.60	0.524	0.900	2.20
Manganese	mg/kg dw	-	60.0	80.0	125	101	62.3	63.0	200	420	450	98.2	300	540
Mercury[b]	mg/kg ww	0.033	0.00641	0.00895	0.0308	0.0304	0.00468	0.0258	0.0361	0.201	0.119	0.158	0.0838	0.457
Molybdenum	mg/kg dw	-	0.600	0.850	1.21	1.10	0.543	0.759	2.10	0.904	0.730	0.444	<0.5	1.70
Nickel	mg/kg dw	-	2.40	4.30	143	121	101	46.0	315	5.38	5.30	0.338	<5	6.00
Selenium	mg/kg dw	4	2.80	4.10	2.62	2.50	0.522	2.00	3.40	3.58	3.80	0.614	2.50	4.00
Silver	mg/kg dw	-	0.0700	0.110	0.112	0.115	0.0348	0.0680	0.160	0.0560	0.0600	0.0152	0.0300	0.0700
Strontium	mg/kg dw	-	11.0	12.0	25.2	25.0	7.36	17.0	37.0	26.4	23.0	7.60	19.0	36.0
Thallium	mg/kg dw	-	0.0500	0.0700	0.0596	0.0530	0.0274	0.0300	0.0960	0.0800	0.0800	0.0141	0.0700	0.0900
Titanium	mg/kg dw	-	120	240	635	539	297	261	1,003	258	290	85.8	110	320
Tin	mg/kg dw	-	0.0900	0.300	1.03	0.947	0.272	0.721	1.40	0.200	0.200	-	<0.2	0.200
Uranium	mg/kg dw	-	0.290	0.450	0.575	0.501	0.233	0.315	0.853	10.3	7.50	6.90	5.50	22.0
Vanadium	mg/kg dw	-	5.70	9.90	11.2	10.0	6.39	4.10	20.0	10.0	10.0	2.74	6.00	13.0
Zinc	mg/kg dw	-	110	120	128	128	18.1	105	155	108	100	21.7	90.0	140

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] 2018 Benthic Invertebrate Tissues from LC10.2 (n=5) were lost either en route to or at SRC Laboratories.

[b] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.1: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Upper Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	HC6.8										LC10.2[a]		
			2019					2021					2019		
			Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation
Moisture	%	-	87.6	87.5	2.42	85.1	91.4	81.2	81.4	1.83	78.3	83.0	80.4	82.6	9.56
Aluminum	mg/kg dw	-	3,480	3,200	823	2,600	4,400	3,786	3,709	1,106	2,547	5,382	4,600	3,600	2,048
Antimony	mg/kg dw	-	0.236	0.210	0.0631	0.180	0.330	0.234	0.213	0.0720	0.179	0.355	0.264	0.180	0.166
Arsenic	mg/kg dw	-	5.10	4.60	2.23	3.50	8.90	5.28	4.90	1.73	3.60	8.10	9.68	6.20	8.01
Barium	mg/kg dw	-	44.4	33.0	18.1	31.0	72.0	151	132	43.4	107	218	50.8	33.0	27.0
Boron	mg/kg dw	-	<1	<1	-	<1	<1	1.10	1.00	0.348	0.764	1.60	4.20	<2	-
Cadmium	mg/kg dw	-	1.60	1.80	0.324	1.20	1.90	1.07	0.949	0.366	0.626	1.50	1.38	1.30	0.259
Chromium	mg/kg dw	-	6.78	6.00	2.09	4.50	9.50	24.0	10.0	28.3	7.60	74.0	6.54	5.50	2.34
Cobalt	mg/kg dw	-	2.36	1.90	1.07	1.60	4.20	2.16	1.90	0.945	1.40	3.80	2.08	1.70	0.638
Copper	mg/kg dw	-	13.8	14.0	0.837	13.0	15.0	21.0	20.0	2.35	19.0	25.0	18.0	17.0	2.65
Iron	mg/kg dw	-	3,560	3,000	1,228	2,400	5,400	2,730	2,754	740	1,845	3,733	5,040	3,800	2,211
Lead	mg/kg dw	-	1.40	1.20	0.469	0.880	2.10	0.702	0.645	0.186	0.549	1.00	2.54	1.80	1.03
Manganese	mg/kg dw	-	191	139	142	94.0	440	177	145	68.0	121	273	229	211	116
Mercury[b]	mg/kg ww	0.033	0.0194	0.0187	0.00695	0.0121	0.0308	0.0542	0.0510	0.0125	0.0413	0.0699	0.0426	0.0382	0.0209
Molybdenum	mg/kg dw	-	0.878	0.820	0.194	0.680	1.20	1.02	0.980	0.203	0.745	1.30	0.668	0.670	0.0554
Nickel	mg/kg dw	-	3.56	3.30	1.10	2.40	5.30	35.6	14.0	44.2	10.0	114	3.56	3.30	1.01
Selenium	mg/kg dw	4	4.28	4.50	0.606	3.60	5.00	3.78	3.90	1.29	2.40	5.40	3.40	3.00	1.35
Silver	mg/kg dw	-	0.106	0.100	0.0329	0.0800	0.160	0.114	0.111	0.0260	0.0870	0.150	0.128	0.110	0.0634
Strontium	mg/kg dw	-	24.0	20.0	8.15	18.0	37.0	38.6	39.0	9.50	27.0	51.0	24.4	19.0	8.96
Thallium	mg/kg dw	-	0.0516	0.0400	0.0182	0.0380	0.0800	0.0270	0.0260	0.00596	0.0210	0.0350	0.0690	0.0600	0.0248
Titanium	mg/kg dw	-	248	260	74.6	170	360	311	278	145	169	537	296	260	103
Tin	mg/kg dw	-	0.140	0.100	0.0548	0.100	0.200	1.08	1.10	0.139	0.952	1.30	0.258	0.200	0.141
Uranium	mg/kg dw	-	7.54	6.00	4.51	4.00	15.4	8.30	8.00	2.88	4.10	11.0	2.34	1.90	0.757
Vanadium	mg/kg dw	-	8.66	8.30	2.29	6.00	11.0	4.08	4.50	1.15	2.90	5.50	11.6	9.20	4.57
Zinc	mg/kg dw	-	118	110	17.0	98.0	140	150	149	6.08	142	159	128	120	11.0

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] 2018 Benthic Invertebrate Tissues from LC10.2 (n=5) were lost either en route to or at SRC Laboratories.

[b] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.1: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Upper Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	LC10.2[a]							YT4.3				
			2019		2021					2018				
			Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	65.9	91.2	83.5	83.8	1.72	81.5	85.8	78.1	79.8	8.52	64.0	85.4
Aluminum	mg/kg dw	-	2,500	6,800	6,276	6,856	2,928	2,532	9,434	2,740	2,400	939.7	2,100	4,400
Antimony	mg/kg dw	-	0.150	0.550	0.158	0.166	0.0558	0.0960	0.218	0.296	0.300	0.101	0.200	0.440
Arsenic	mg/kg dw	-	3.40	22.0	2.84	3.00	0.764	2.00	3.90	4.64	3.50	2.36	2.80	8.20
Barium	mg/kg dw	-	30.0	86.0	99.0	98.0	40.5	54.0	155	56.6	48.0	25.5	30.0	87.0
Boron	mg/kg dw	-	<1	17.0	0.958	0.932	0.242	0.650	1.20	-	-	-	-	-
Cadmium	mg/kg dw	-	1.10	1.80	0.959	0.909	0.283	0.682	1.30	0.258	0.250	0.0497	0.210	0.340
Chromium	mg/kg dw	-	4.20	9.20	125	153	86.7	23.0	211	5.08	4.20	2.49	4.20	8.60
Cobalt	mg/kg dw	-	1.60	3.00	4.86	3.60	3.40	1.60	8.60	2.10	2.10	1.12	1.60	<5
Copper	mg/kg dw	-	15.0	22.0	26.2	27.0	2.39	22.0	28.0	12.0	12.0	1.00	11.0	13.0
Iron	mg/kg dw	-	2,800	7,800	5,602	6,814	2,887	1,863	8,826	3,160	2,400	1,847	1,900	6,400
Lead	mg/kg dw	-	1.80	3.90	1.40	1.40	0.674	0.664	2.30	1.62	1.10	1.18	0.900	3.70
Manganese	mg/kg dw	-	112	420	101	117	41.8	48.0	145	133	78.0	93.5	71.0	290
Mercury[b]	mg/kg ww	0.033	0.0193	0.0750	0.0467	0.0483	0.00396	0.0398	0.0492	0.0186	0.0161	0.00798	0.0127	0.0324
Molybdenum	mg/kg dw	-	0.600	0.740	1.32	1.30	0.491	0.853	2.10	0.572	0.600	0.0438	0.500	0.600
Nickel	mg/kg dw	-	2.60	4.90	170	218	111	33.0	289	2.96	2.40	1.58	2.40	5.20
Selenium	mg/kg dw	4	2.30	5.70	4.46	4.20	1.28	3.10	6.50	0.718	0.600	0.329	0.400	1.20
Silver	mg/kg dw	-	0.0700	0.200	0.0580	0.0590	0.00480	0.0500	0.0630	0.0420	0.0400	0.00447	0.0400	0.0500
Strontium	mg/kg dw	-	16.0	36.0	24.6	21.0	9.07	17.0	40.0	13.2	11.0	6.46	8.00	24.0
Thallium	mg/kg dw	-	0.0420	0.100	0.0340	0.0340	0.0122	0.0200	0.0480	0.0500	0.0500	0.0141	0.0400	0.0600
Titanium	mg/kg dw	-	190	410	686	698	376	203	1,075	140	140	32.4	100	190
Tin	mg/kg dw	-	0.140	0.500	2.10	2.30	0.515	1.30	2.60	<0.2	<2	-	<0.2	<2
Uranium	mg/kg dw	-	1.60	3.30	1.35	1.30	0.322	0.943	1.80	0.902	0.600	0.682	0.500	2.10
Vanadium	mg/kg dw	-	6.90	17.0	7.84	10.0	4.00	2.80	12.0	7.72	6.00	4.11	5.00	15.0
Zinc	mg/kg dw	-	120	140	118	119	10.1	105	133	101	100	11.9	88.0	120

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] 2018 Benthic Invertebrate Tissues from LC10.2 (n=5) were lost either en route to or at SRC Laboratories.

[b] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.1: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Upper Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	YT4.3									
			2019					2021				
			Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	87.0	87.2	1.05	85.8	88.4	85.9	86.5	1.73	82.9	87.2
Aluminum	mg/kg dw	-	1,620	1,600	148	1,400	1,800	8,817	8,508	3,773	3,302	12,803
Antimony	mg/kg dw	-	0.172	0.170	0.0179	0.150	0.190	0.780	0.798	0.204	0.449	1.00
Arsenic	mg/kg dw	-	2.58	2.70	0.466	2.00	3.10	4.50	4.50	1.06	2.80	5.40
Barium	mg/kg dw	-	26.0	27.0	2.65	22.0	29.0	199	222	56.9	103	243
Boron	mg/kg dw	-	<1	<2	-	<1	<2	2.14	2.20	0.336	1.70	2.50
Cadmium	mg/kg dw	-	0.380	0.350	0.139	0.230	0.570	0.322	0.310	0.0459	0.285	0.398
Chromium	mg/kg dw	-	2.34	2.40	0.270	1.90	2.60	379	354	235	118	754
Cobalt	mg/kg dw	-	0.854	0.820	0.165	0.700	1.10	11.4	11.0	3.88	5.90	16.0
Copper	mg/kg dw	-	13.1	14.0	2.81	9.30	16.0	24.0	23.0	6.86	17.0	35.0
Iron	mg/kg dw	-	1,900	1,900	274	1,500	2,200	10,072	9,292	3,896	5,932	15,994
Lead	mg/kg dw	-	1.25	0.850	0.984	0.700	3.00	2.23	2.40	1.16	0.662	3.80
Manganese	mg/kg dw	-	64.4	55.0	16.8	51.0	91.0	148	149	53.0	79.0	214
Mercury[b]	mg/kg ww	0.033	0.0106	0.0104	0.00117	0.00926	0.0123	0.0287	0.0256	0.00712	0.0209	0.0390
Molybdenum	mg/kg dw	-	0.504	0.540	0.0658	0.410	0.560	2.30	1.60	2.00	0.999	5.80
Nickel	mg/kg dw	-	1.42	1.50	0.110	1.30	1.50	536	500	317	180	1,036
Selenium	mg/kg dw	4	1.38	1.40	0.192	1.10	1.60	0.512	0.487	0.0426	0.481	0.578
Silver	mg/kg dw	-	0.0540	0.0500	0.00548	0.0500	0.0600	0.0876	0.0920	0.0153	0.0720	0.107
Strontium	mg/kg dw	-	6.74	6.80	0.643	5.80	7.50	14.0	14.0	2.12	11.0	16.0
Thallium	mg/kg dw	-	0.0292	0.0300	0.00239	0.0250	0.0310	0.0512	0.0500	0.0248	0.0170	0.0860
Titanium	mg/kg dw	-	91.2	93.0	7.69	79.0	98.0	744	692	479	184	1,502
Tin	mg/kg dw	-	0.0850	0.0850	0.0112	0.0800	<0.1	3.28	3.00	0.687	2.50	4.10
Uranium	mg/kg dw	-	0.468	0.460	0.0205	0.450	0.490	0.651	0.666	0.0859	0.512	0.741
Vanadium	mg/kg dw	-	4.08	4.20	0.497	3.40	4.70	12.1	11.0	4.18	6.70	18.0
Zinc	mg/kg dw	-	84.8	86.0	11.8	67.0	100	156	151	12.5	148	178

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] 2018 Benthic Invertebrate Tissues from LC10.2 (n=5) were lost either en route to or at SRC Laboratories.

[b] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.2: Statistical Temporal and Spatial Comparisons of Benthic Invertebrate Tissue Composition Data, Upper Creek Areas,

ANOVA Model				Station		Do concentrations differ over time?[a]			Do concentrations differ between the stations?[b]					
									CC23.7 vs CR24.5 and Future Exposed			CR24.5 vs CC23.7 and Future Exposed		
Parameter	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Moisture (%)	0.023	0.006	<0.001	Reference	CC23.7	ns	ns	ns	-	-	-	-	-	-
					CR24.5	ns	ns	ns	ns	ns	ns	-	-	-
				Exposure	HC6.8	52	41	ns	-33	ns	ns	-34	ns	ns
					LC10.2[c]	-	-	ns	-	ns	ns	-	ns	ns
					YT4.3	ns	ns	ns	ns	ns	ns	ns	ns	ns
Aluminum (mg/kg dw)	0.079	<0.001	<0.001	Reference	CC23.7	ns	ns	ns	-	-	-	-	-	-
					CR24.5	ns	155	150	ns	ns	94	-	-	-
				Exposure	HC6.8	ns	ns	ns	ns	ns	ns	87	ns	ns
					LC10.2[c]	-	-	ns	-	ns	ns	-	ns	ns
					YT4.3	ns	203	395	ns	ns	162	ns	ns	ns
Arsenic (mg/kg dw)	<0.001	0.478	0.006	Reference	CC23.7	ns	ns	ns	-	-	-	-	-	-
					CR24.5	ns	ns	ns	-78	-75	-67	-	-	-
				Exposure	HC6.8	ns	ns	ns	ns	ns	ns	305	139	166
					LC10.2[c]	-	-	-62	-	ns	-52	-	265	ns
					YT4.3	ns	ns	ns	ns	-69	ns	188	ns	129
Chromium (mg/kg dw)	0.663	<0.001	<0.001	Reference	CC23.7	ns	2,519	2,269	-	-	-	-	-	-
					CR24.5	ns	2,183	1,584	ns	ns	ns	-	-	-
				Exposure	HC6.8	ns	ns	143	ns	ns	-83	ns	ns	-82
					LC10.2[c]	-	-	1,370	-	ns	ns	-	ns	ns
					YT4.3	ns	7,941	13,674	ns	ns	247	ns	ns	274
Copper (mg/kg dw)	<0.001	<0.001	<0.001	Reference	CC23.7	-23	ns	33	-	-	-	-	-	-
					CR24.5	ns	32	39	ns	ns	30	-	-	-
				Exposure	HC6.8	ns	60	52	-34	ns	ns	-35	-28	-21
					LC10.2[c]	-	-	46	-	ns	28	-	ns	ns
					YT4.3	ns	95	82	-40	ns	ns	-40	-33	ns
Iron (mg/kg dw)	0.295	0.003	<0.001	Reference	CC23.7	ns	ns	ns	-	-	-	-	-	-
					CR24.5	ns	96	88	ns	ns	ns	-	-	-
				Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	ns	-52
					LC10.2	-	-	ns	-	ns	ns	-	ns	ns
					YT4.3	ns	234	405	ns	ns	172	ns	ns	ns
Lead (mg/kg dw)	0.025	0.221	0.001	Reference	CC23.7	ns	ns	-48	-	-	-	-	-	-
					CR24.5	ns	ns	ns	ns	ns	140	-	-	-
				Exposure	HC6.8	ns	-55	-49	ns	ns	ns	ns	ns	-54
					LC10.2	-	-	-47	-	ns	106	-	107	ns
					YT4.3	ns	ns	84	ns	ns	214	ns	ns	ns
Manganese (mg/kg dw)	<0.001	0.030	<0.001	Reference	CC23.7	ns	ns	ns	-	-	-	-	-	-
					CR24.5	ns	ns	ns	ns	ns	ns	-	-	-
				Exposure	HC6.8	-61	-59	ns	371	100	113	336	140	ns
					LC10.2	-	-	-55	-	159	ns	-	211	ns
					YT4.3	-44	ns	122	ns	ns	ns	ns	ns	ns
Mercury (mg/kg ww)	<0.001	<0.001	<0.001	Reference	CC23.7	ns	297	148	-	-	-	-	-	-
					CR24.5	ns	448	325	-48	-58	ns	-	-	-
				Exposure	HC6.8	-89	-67	187	1,414	ns	ns	2,790	157	ns
					LC10.2	-	-	ns	-	127	ns	-	438	ns
					YT4.3	ns	ns	165	ns	ns	ns	215	ns	ns
Molybdenum (mg/kg dw)	0.901	<0.001	<0.001	Reference	CC23.7	ns	ns	ns	-	-	-	-	-	-
					CR24.5	ns	75	65	ns	ns	ns	-	-	-
				Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	ns	ns
					LC10.2	-	-	89	-	ns	ns	-	ns	ns
					YT4.3	ns	220	265	ns	ns	101	ns	ns	62
Nickel (mg/kg dw)	0.675	<0.001	<0.001	Reference	CC23.7	ns	4,229	3,352	-	-	-	-	-	-
					CR24.5	ns	4,158	3,473	ns	ns	ns	-	-	-
				Exposure	HC6.8	ns	399	556	ns	ns	-83	ns	ns	-81
					LC10.2	-	-	3,641	-	ns	ns	-	ns	ns
					YT4.3	ns	15,658	32,427	ns	-63	253	ns	ns	288
Selenium (mg/kg dw)	<0.001	0.001	<0.001	Reference	CC23.7	ns	ns	ns	-	-	-	-	-	-
					CR24.5	139	90	ns	-62	ns	ns	-	-	-
				Exposure	HC6.8	ns	ns	ns	ns	ns	ns	160	ns	ns
					LC10.2	-	-	ns	-	ns	ns	-	ns	68
					YT4.3	107	ns	-63	-81	-60	-86	-51	-58	-80
Silver (mg/kg dw)	0.002	<0.001	<0.001	Reference	CC23.7	59	99	ns	-	-	-	-	-	-
					CR24.5	211	276	ns	-63	ns	ns	-	-	-
				Exposure	HC6.8	90	107	ns	ns	ns	ns	88	ns	ns
					LC10.2	-	-	-50	-	ns	-62	-	ns	-46
					YT4.3	ns	107	61	-46	-56	-44	ns	-39	ns
Strontium (mg/kg dw)	<0.001	<0.001	0.010	Reference	CC23.7	ns	ns	ns	-	-	-	-	-	-
					CR24.5	ns	74	111	ns	ns	ns	-	-	-
				Exposure	HC6.8	ns	47	63	66	98	134	83	99	54
					LC10.2	-	-	ns	-	99	ns	-	100	ns
					YT4.3	-45	ns	106	ns	-42	ns	ns	-42	-43

ANOVA P-value < 0.05.
Significantly Decrease in Concentration.
Significantly Increase in Concentration.

Note: "-" indicates no comparison available and no data; "ns" indicates not significant. Analysis of Variance (ANOVA) model consisted of a censored regression model with factors Year and Station and assuming a log-normal distribution. Boron and Tin were excluded from the analyses because 100% of the data were at detection limit in 2018 and/or 2019.

[a] MOD is calculated as $((year_{recent} - year_{older})/year_{older})*100$.

[b] MOD calculated as (Exposed - Reference)/(Reference)*100.

[c] 2018 Benthic Invertebrate Tissues from LC10.2 (n=5) were lost either en route to or at SRC Laboratories.

Table E.2: Statistical Temporal and Spatial Comparisons of Benthic Invertebrate Tissue Composition Data, Upper Creek Areas,

ANOVA Model				Station		Do concentrations differ over time?[a]			Do concentrations differ between the stations?[b]					
									CC23.7 vs CR24.5 and Future Exposed			CR24.5 vs CC23.7 and Future Exposed		
Parameter	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Thallium (mg/kg dw)	0.311	0.009	<0.001	Reference	CC23.7	ns	-46	-47	-	-	-	-	-	-
					CR24.5	ns	ns	ns	ns	ns	ns	-	-	-
				Exposure	HC6.8	ns	-63	-46	ns	ns	ns	ns	ns	-51
					LC10.2	-	-	-51	-	ns	ns	-	ns	-41
					YT4.3	ns	ns	ns	ns	-54	ns	ns	-50	ns
Titanium (mg/kg dw)	0.031	<0.001	<0.001	Reference	CC23.7	ns	ns	ns	-	-	-	-	-	-
					CR24.5	ns	280	250	ns	ns	125	-	-	-
				Exposure	HC6.8	ns	ns	ns	ns	ns	ns	ns	ns	ns
					LC10.2	-	-	107	-	ns	129	-	ns	ns
					YT4.3	ns	345	571	ns	ns	139	ns	ns	ns
Uranium (mg/kg dw)	<0.001	0.753	0.002	Reference	CC23.7	113	ns	-51	-	-	-	-	-	-
					CR24.5	ns	ns	ns	-86	-94	-83	-	-	-
				Exposure	HC6.8	ns	ns	ns	186	ns	142	2,011	1,674	1,360
					LC10.2[c]	-	-	-41	-	-66	-59	-	492	146
					YT4.3	ns	ns	ns	-76	-93	-80	ns	ns	ns
Zinc (mg/kg dw)	0.229	<0.001	<0.001	Reference	CC23.7	-26	ns	39	-	-	-	-	-	-
					CR24.5	-16	ns	ns	ns	ns	ns	-	-	-
				Exposure	HC6.8	ns	41	29	-23	ns	ns	-23	ns	ns
					LC10.2[c]	-	-	ns	-	25	ns	-	ns	ns
					YT4.3	-16	56	85	-27	-18	ns	-27	-27	23

ANOVA P-value < 0.05.

Significantly Decrease in Concentration.

Significantly Increase in Concentration.

Note: "-" indicates no comparison available and no data; "ns" indicates not significant. Analysis of Variance (ANOVA) model consisted of a censored regression model with factors Year and Station and assuming a log-normal distribution. Boron and Tin were excluded from the analyses because 100% of the data were at detection limit in 2018 and/or 2019.

[a] MOD is calculated as $((year_{recent} - year_{older})/year_{older})*100$.

[b] MOD calculated as (Exposed - Reference)/(Reference)*100.

[c] 2018 Benthic Invertebrate Tissues from LC10.2 (n=5) were lost either en route to or at SRC Laboratories.

Table E.3: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Lower Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	SYT0.6									
			2018					2019				
			Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	90.3	92.0	4.38	82.6	93.7	85.5	85.1	1.48	84.3	87.9
Aluminum	mg/kg dw	-	2,320	2,300	148	2,100	2,500	1,540	1,600	152	1,300	1,700
Antimony	mg/kg dw	-	0.0660	0.0700	0.00548	0.0600	0.0700	0.0400	0.0400	-	0.0400	0.0400
Arsenic	mg/kg dw	-	1.56	1.60	0.114	1.40	1.70	1.16	1.20	0.0984	0.980	1.20
Barium	mg/kg dw	-	41.4	42.0	3.05	37.0	45.0	22.6	22.0	1.82	21.0	25.0
Boron	mg/kg dw	-	<2	<2	-	<2	<2	<1	<1	-	<1	<1
Cadmium	mg/kg dw	-	0.384	0.380	0.0365	0.340	0.430	0.284	0.290	0.0288	0.240	0.320
Chromium	mg/kg dw	-	4.18	4.30	0.421	3.60	4.60	2.64	2.60	0.336	2.20	3.10
Cobalt	mg/kg dw	-	1.16	1.20	0.0548	1.10	1.20	0.820	0.830	0.0608	0.750	0.910
Copper	mg/kg dw	-	18.2	18.0	0.837	17.0	19.0	14.4	14.0	1.67	12.0	16.0
Iron	mg/kg dw	-	2,560	2,600	182	2,300	2,800	1,800	1,800	122	1,600	1,900
Lead	mg/kg dw	-	0.822	0.860	0.0896	0.680	0.900	0.630	0.640	0.0316	0.580	0.660
Manganese	mg/kg dw	-	89.6	89.0	6.50	82.0	100	65.4	64.0	9.66	55.0	81.0
Mercury[a]	mg/kg ww	0.033	0.00663	0.00556	0.00316	0.00443	0.0122	0.00623	0.00606	0.000719	0.00543	0.00739
Molybdenum	mg/kg dw	-	0.504	0.500	0.0114	0.490	0.520	0.394	0.390	0.0288	0.350	0.420
Nickel	mg/kg dw	-	2.72	2.70	0.192	2.50	3.00	1.90	1.80	0.187	1.70	2.10
Selenium	mg/kg dw	4	1.18	1.10	0.164	1.00	1.40	0.816	0.820	0.0477	0.750	0.870
Silver	mg/kg dw	-	0.0240	0.0200	0.00548	0.0200	0.0300	0.0200	0.0200	-	0.0200	0.0200
Strontium	mg/kg dw	-	21.0	21.0	2.00	19.0	23.0	15.0	15.0	1.87	13.0	18.0
Thallium	mg/kg dw	-	0.0300	0.0300	-	0.0300	0.0300	0.0212	0.0210	0.00164	0.0200	0.0240
Titanium	mg/kg dw	-	178	180	19.2	150	200	110	120	13.2	94.0	120
Tin	mg/kg dw	-	0.100	0.100	-	<0.1	<0.2	0.0740	0.0700	0.00548	0.0700	0.0800
Uranium	mg/kg dw	-	4.02	4.10	0.545	3.20	4.50	3.80	4.20	0.742	2.90	4.50
Vanadium	mg/kg dw	-	6.90	7.00	0.656	6.00	7.60	4.34	4.40	0.477	3.80	4.80
Zinc	mg/kg dw	-	124	120	5.48	120	130	92.8	93.0	4.15	89.0	99.0

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.3: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Lower Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	STY0.6 2021					XE0.2 2018				
			Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	84.5	83.7	1.86	83.3	87.7	93.1	94.2	3.13	89.6	96.1
Aluminum	mg/kg dw	-	1,240	1,405	437	611	1,619	2,682	3,100	1,244	810	4,100
Antimony	mg/kg dw	-	0.0786	0.0630	0.0371	0.0480	0.141	0.0880	0.100	0.0239	0.0500	0.110
Arsenic	mg/kg dw	-	0.869	0.897	0.136	0.673	1.00	1.82	1.60	0.593	1.20	2.50
Barium	mg/kg dw	-	58.0	63.0	22.0	35.0	85.0	41.4	41.0	18.1	15.0	61.0
Boron	mg/kg dw	-	1.68	1.40	0.926	1.00	3.30	<5	<5	-	<5	<5
Cadmium	mg/kg dw	-	0.336	0.332	0.0910	0.215	0.469	2.42	2.40	0.909	1.30	3.70
Chromium	mg/kg dw	-	58.8	54.0	13.0	47.0	79.0	5.28	6.00	2.60	1.50	8.00
Cobalt	mg/kg dw	-	2.34	2.00	1.01	1.30	3.90	1.90	1.95	0.678	1.10	2.60
Copper	mg/kg dw	-	18.8	18.0	1.92	17.0	22.0	28.8	31.0	4.32	22.0	32.0
Iron	mg/kg dw	-	1,794	1,703	482	1,146	2,435	2,816	3,400	1,372	780	4,200
Lead	mg/kg dw	-	0.474	0.501	0.151	0.240	0.653	1.20	1.10	0.601	0.410	1.80
Manganese	mg/kg dw	-	71.0	78.0	31.8	38.0	107	150	160	30.0	98.0	170
Mercury[a]	mg/kg ww	0.033	0.0153	0.0164	0.00293	0.0115	0.0179	0.00407	0.00349	0.00217	0.00154	0.00724
Molybdenum	mg/kg dw	-	0.672	0.603	0.245	0.397	1.00	0.996	0.640	0.786	0.600	2.40
Nickel	mg/kg dw	-	95.2	92.0	20.2	74.0	125	6.62	7.00	0.973	5.30	7.50
Selenium	mg/kg dw	4	0.947	1.00	0.0746	0.844	1.00	5.26	5.70	1.36	3.20	6.70
Silver	mg/kg dw	-	0.0174	0.0190	0.00456	0.0110	0.0230	0.0400	0.0400	0.0187	0.0200	0.0700
Strontium	mg/kg dw	-	22.2	27.0	7.46	11.0	28.0	34.8	33.0	9.98	23.0	46.0
Thallium	mg/kg dw	-	0.0122	0.0120	0.00217	0.00900	0.0150	0.0550	0.0500	0.0173	0.0400	0.0800
Titanium	mg/kg dw	-	106	114	39.7	49.0	147	169	160	77.6	56.0	270
Tin	mg/kg dw	-	1.86	1.90	0.207	1.60	2.10	<0.2	<0.2	-	<0.2	<0.2
Uranium	mg/kg dw	-	6.20	7.40	4.08	1.30	11.0	0.822	0.800	0.317	0.430	1.30
Vanadium	mg/kg dw	-	2.02	2.10	0.497	1.40	2.70	7.18	8.30	3.48	2.00	11.0
Zinc	mg/kg dw	-	114	114	16.4	92.0	138	156	150	28.8	120	190

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.3: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Lower Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	XE0.2									
			2019					2021				
			Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	84.9	84.9	0.343	84.4	85.3	84.8	83.4	2.66	82.7	89.0
Aluminum	mg/kg dw	-	1,520	1,400	683	1,000	2,700	766	611	420	465	1,507
Antimony	mg/kg dw	-	0.0540	0.0400	0.0251	0.0300	0.0900	0.0484	0.0450	0.0131	0.0380	0.0710
Arsenic	mg/kg dw	-	1.21	1.00	0.499	0.940	2.10	1.10	1.10	0.0772	0.982	1.20
Barium	mg/kg dw	-	35.0	22.0	33.7	15.0	95.0	39.8	37.0	15.1	25.0	65.0
Boron	mg/kg dw	-	<1	<1	-	<1	<2	4.00	2.60	4.00	1.20	11.0
Cadmium	mg/kg dw	-	1.21	1.10	0.557	0.550	2.00	2.66	2.50	0.986	1.80	4.30
Chromium	mg/kg dw	-	4.24	3.00	2.81	2.00	8.90	10.8	10.0	3.70	7.80	17.0
Cobalt	mg/kg dw	-	1.23	0.930	0.665	0.820	2.40	1.09	0.986	0.403	0.823	1.80
Copper	mg/kg dw	-	19.8	21.0	2.17	17.0	22.0	26.0	26.0	2.12	23.0	28.0
Iron	mg/kg dw	-	2,260	1,900	1,450	1,200	4,800	791	689	317	562	1,348
Lead	mg/kg dw	-	0.766	0.590	0.361	0.530	1.40	0.366	0.314	0.188	0.231	0.693
Manganese	mg/kg dw	-	116	100	37.5	87.0	180	98.8	92.0	14.5	85.0	115
Mercury[a]	mg/kg ww	0.033	0.00795	0.00757	0.000829	0.00705	0.00894	0.0224	0.0249	0.00729	0.0125	0.0296
Molybdenum	mg/kg dw	-	0.458	0.410	0.130	0.380	0.690	0.594	0.534	0.153	0.427	0.789
Nickel	mg/kg dw	-	5.14	4.00	2.13	4.00	8.90	21.2	18.0	8.44	16.0	36.0
Selenium	mg/kg dw	4	3.22	3.40	0.773	2.00	4.10	3.82	4.00	0.327	3.30	4.10
Silver	mg/kg dw	-	0.0560	0.0500	0.0152	0.0400	0.0800	0.0532	0.0530	0.00449	0.0460	0.0570
Strontium	mg/kg dw	-	20.2	20.0	5.36	15.0	29.0	22.2	23.0	4.09	16.0	27.0
Thallium	mg/kg dw	-	0.0404	0.0360	0.0113	0.0320	0.0600	0.0344	0.0330	0.00451	0.0300	0.0420
Titanium	mg/kg dw	-	98.0	84.0	44.7	60.0	170	54.2	42.0	26.8	36.0	100
Tin	mg/kg dw	-	0.0533	0.0500	0.00861	<0.05	<0.1	1.13	0.963	0.463	0.719	1.90
Uranium	mg/kg dw	-	0.672	0.510	0.375	0.410	1.30	0.942	0.580	0.934	0.345	2.60
Vanadium	mg/kg dw	-	4.24	3.60	2.39	2.40	8.40	1.13	0.980	0.561	0.711	2.10
Zinc	mg/kg dw	-	106	100	18.4	89.0	130	120	121	10.2	106	133

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.3: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Lower Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	HC0.2									
			2018					2019				
			Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	88.1	87.8	2.89	84.0	91.0	90.7	89.7	2.86	88.4	95.6
Aluminum	mg/kg dw	-	1,502	1,300	522	910	2,100	1,860	1,900	207	1,600	2,100
Antimony	mg/kg dw	-	0.0960	0.0900	0.0230	0.0700	0.120	0.120	0.120	0.0122	0.110	0.140
Arsenic	mg/kg dw	-	1.94	2.00	0.477	1.20	2.40	3.12	3.00	0.217	2.90	3.40
Barium	mg/kg dw	-	29.4	28.0	12.2	18.0	50.0	25.8	25.0	2.17	23.0	28.0
Boron	mg/kg dw	-	2.00	2.00	-	2.00	2.00	<2	<2	-	<2	<2
Cadmium	mg/kg dw	-	0.408	0.490	0.169	0.170	0.550	0.918	0.940	0.0701	0.840	1.00
Chromium	mg/kg dw	-	2.42	2.20	0.646	1.70	3.10	3.82	3.80	0.653	3.10	4.70
Cobalt	mg/kg dw	-	0.998	0.890	0.236	0.800	1.30	1.28	1.30	0.0837	1.20	1.40
Copper	mg/kg dw	-	16.0	17.0	2.35	13.0	18.0	18.6	18.0	0.894	18.0	20.0
Iron	mg/kg dw	-	1,448	1,300	477	940	2,000	2,100	2,100	158	1,900	2,300
Lead	mg/kg dw	-	0.600	0.570	0.229	0.340	0.910	0.876	0.810	0.130	0.780	1.10
Manganese	mg/kg dw	-	107	110	25.6	74.0	140	118	110	28.1	79.0	150
Mercury[a]	mg/kg ww	0.033	0.00704	0.00640	0.00173	0.00525	0.00980	0.00746	0.00823	0.00229	0.00350	0.00926
Molybdenum	mg/kg dw	-	0.976	0.750	0.517	0.720	1.90	0.732	0.720	0.0733	0.650	0.830
Nickel	mg/kg dw	-	2.08	2.00	0.228	1.80	2.40	2.96	2.90	0.195	2.70	3.20
Selenium	mg/kg dw	4	1.06	1.20	0.413	0.470	1.50	1.94	1.90	0.336	1.60	2.50
Silver	mg/kg dw	-	0.0200	0.0200	-	<0.02	0.0200	0.0400	0.0400	-	0.0400	0.0400
Strontium	mg/kg dw	-	17.8	20.0	4.09	12.0	21.0	19.2	18.0	3.56	16.0	23.0
Thallium	mg/kg dw	-	0.0280	0.0300	0.00837	0.0200	0.0400	0.0340	0.0300	0.00548	0.0300	0.0400
Titanium	mg/kg dw	-	102	91.0	41.0	50.0	160	132	130	13.0	120	150
Tin	mg/kg dw	-	<0.1	<0.2	-	<0.1	<0.2	0.100	<0.1	-	<0.1	0.100
Uranium	mg/kg dw	-	4.40	3.60	1.52	3.30	7.00	3.68	3.60	0.507	3.20	4.30
Vanadium	mg/kg dw	-	3.80	3.30	1.33	2.30	5.20	4.96	5.10	0.344	4.50	5.30
Zinc	mg/kg dw	-	121	120	31.3	73.0	160	118	120	8.37	110	130

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.3: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Lower Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	HC0.2 2021					CC5.6 2018				
			Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	85.9	85.2	1.98	84.0	88.9	56.8	66.0	26.2	16.7	79.5
Aluminum	mg/kg dw	-	3,015	2,405	1,463	1,815	5,198	4,340	4,900	1,724	1,600	5,900
Antimony	mg/kg dw	-	0.112	0.114	0.0238	0.0830	0.145	0.166	0.200	0.0727	0.0800	0.250
Arsenic	mg/kg dw	-	3.14	3.10	0.513	2.60	3.80	3.30	3.50	1.23	1.40	4.50
Barium	mg/kg dw	-	91.8	92.0	31.7	53.0	125	100	89.0	63.1	30.0	200
Boron	mg/kg dw	-	1.58	1.40	0.563	1.10	2.50	-	-	-	-	-
Cadmium	mg/kg dw	-	1.20	1.20	0.378	0.721	1.70	2.44	2.40	0.956	1.30	3.90
Chromium	mg/kg dw	-	85.8	60.0	62.4	39.0	193	5.36	6.00	2.13	2.00	7.80
Cobalt	mg/kg dw	-	3.80	2.60	2.87	1.40	8.50	3.60	4.60	2.88	1.40	6.00
Copper	mg/kg dw	-	23.8	25.0	2.17	20.0	25.0	25.4	26.0	3.29	22.0	29.0
Iron	mg/kg dw	-	3,221	2,679	1,563	1,953	5,830	4,180	4,200	1,645	1,700	5,900
Lead	mg/kg dw	-	0.632	0.533	0.222	0.393	0.950	1.82	2.00	0.777	0.580	2.50
Manganese	mg/kg dw	-	125	121	36.5	86.0	169	376	350	199	120	670
Mercury[a]	mg/kg ww	0.033	0.0295	0.0291	0.00262	0.0270	0.0326	0.0710	0.0544	0.0521	0.0308	0.158
Molybdenum	mg/kg dw	-	1.36	1.50	0.219	1.00	1.50	1.15	1.10	0.286	0.840	1.60
Nickel	mg/kg dw	-	128	84.0	94.2	61.0	291	3.40	1.60	2.70	1.60	6.20
Selenium	mg/kg dw	4	2.54	2.70	0.856	1.60	3.70	6.44	6.40	1.72	4.20	9.00
Silver	mg/kg dw	-	0.0488	0.0520	0.0123	0.0360	0.0630	0.0760	0.0700	0.00894	0.0700	0.0900
Strontium	mg/kg dw	-	25.6	27.0	4.39	20.0	30.0	27.4	28.0	4.88	20.0	33.0
Thallium	mg/kg dw	-	0.0452	0.0410	0.0141	0.0300	0.0600	0.0620	0.0300	0.0486	0.0300	0.120
Titanium	mg/kg dw	-	311	236	226	152	699	276	280	118	91.0	400
Tin	mg/kg dw	-	1.44	1.50	0.519	0.913	2.20	<0.2	<0.2	-	<0.2	<0.2
Uranium	mg/kg dw	-	3.92	2.90	2.17	1.90	6.90	2.64	2.70	1.25	1.30	4.50
Vanadium	mg/kg dw	-	4.52	3.70	2.29	2.70	8.20	13.0	14.0	5.08	4.80	18.0
Zinc	mg/kg dw	-	116	114	22.7	81.0	142	182	160	51.2	140	270

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.3: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Lower Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	CC5.6									
			2019					2021				
			Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	78.8	79.8	2.77	75.2	81.9	76.6	77.9	3.61	70.3	79.3
Aluminum	mg/kg dw	-	2,240	2,400	817	1,200	3,000	3,607	4,109	1,511	951	4,614
Antimony	mg/kg dw	-	0.0860	0.100	0.0288	0.0500	0.110	0.0858	0.0890	0.0348	0.0340	0.131
Arsenic	mg/kg dw	-	2.84	3.20	0.737	1.90	3.50	2.36	2.50	0.802	1.20	3.30
Barium	mg/kg dw	-	38.2	37.0	14.7	23.0	60.0	119	135	52.2	34.0	173
Boron	mg/kg dw	-	<1	<1	-	<1	<1	0.674	0.781	0.293	0.237	1.00
Cadmium	mg/kg dw	-	0.880	0.980	0.238	0.490	1.10	1.88	1.60	0.876	1.30	3.40
Chromium	mg/kg dw	-	3.16	3.50	1.17	1.60	4.30	52.8	45.0	34.8	16.0	100
Cobalt	mg/kg dw	-	1.80	1.90	0.374	1.20	2.10	3.58	3.60	1.60	1.30	5.80
Copper	mg/kg dw	-	15.8	16.0	2.28	13.0	18.0	29.6	27.0	8.53	19.0	41.0
Iron	mg/kg dw	-	3,200	3,500	1,063	1,900	4,400	3,632	3,894	1,688	1,025	5,587
Lead	mg/kg dw	-	0.966	1.10	0.328	0.600	1.30	0.668	0.728	0.328	0.188	1.10
Manganese	mg/kg dw	-	184	174	59.7	111	273	126	130	32.3	71.0	152
Mercury[a]	mg/kg ww	0.033	0.0320	0.0292	0.0114	0.0167	0.0463	0.0763	0.0785	0.0119	0.0572	0.0887
Molybdenum	mg/kg dw	-	1.41	1.30	0.434	0.950	2.00	1.51	1.60	0.408	0.870	1.90
Nickel	mg/kg dw	-	2.70	3.00	0.765	1.90	3.60	88.0	73.0	65.7	20.0	184
Selenium	mg/kg dw	4	4.68	4.80	1.50	2.30	6.10	8.70	7.70	3.68	6.00	15.0
Silver	mg/kg dw	-	0.0760	0.0800	0.0297	0.0400	0.120	0.0988	0.0910	0.0423	0.0520	0.168
Strontium	mg/kg dw	-	13.3	13.0	3.16	9.60	17.0	11.7	10.0	4.72	6.40	19.0
Thallium	mg/kg dw	-	0.0518	0.0470	0.0152	0.0340	0.0700	0.0624	0.0640	0.0173	0.0350	0.0790
Titanium	mg/kg dw	-	140	160	64.8	49.0	210	298	362	129	72.0	375
Tin	mg/kg dw	-	0.0740	0.0800	0.0238	<0.05	0.100	0.604	0.663	0.213	0.278	0.839
Uranium	mg/kg dw	-	3.42	3.70	1.41	1.70	5.30	2.94	2.80	1.71	1.00	5.50
Vanadium	mg/kg dw	-	6.96	8.30	2.52	3.60	9.50	5.68	5.80	2.78	1.50	9.20
Zinc	mg/kg dw	-	93.6	95.0	18.2	75.0	120	144	127	32.1	119	193

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.3: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Lower Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	YT0.2									
			2018					2019				
			Mean	Median	Standard Deviation	Minimum	Maximum	Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	83.5	86.2	8.36	69.1	89.5	88.6	89.0	1.17	87.2	89.9
Aluminum	mg/kg dw	-	3,620	3,700	832	2,500	4,500	2,380	2,400	239	2,100	2,700
Antimony	mg/kg dw	-	0.208	0.170	0.111	0.120	0.400	0.144	0.120	0.0453	<0.1	0.220
Arsenic	mg/kg dw	-	3.62	2.80	2.95	1.70	8.80	2.74	2.80	0.532	2.10	3.30
Barium	mg/kg dw	-	49.4	49.0	10.8	38.0	67.0	32.0	31.0	1.41	31.0	34.0
Boron	mg/kg dw	-	<5	<5	-	<5	<5	<2	<2	-	<2	<2
Cadmium	mg/kg dw	-	0.652	0.590	0.171	0.450	0.840	0.670	0.690	0.0894	0.550	0.770
Chromium	mg/kg dw	-	4.84	4.10	1.98	3.30	8.00	3.72	3.50	0.580	3.40	<5
Cobalt	mg/kg dw	-	1.70	1.40	0.785	1.30	<5	1.23	1.20	0.0559	1.20	<5
Copper	mg/kg dw	-	17.4	16.0	3.85	14.0	24.0	15.8	16.0	1.10	14.0	17.0
Iron	mg/kg dw	-	3,540	3,400	1,043	2,300	4,600	2,720	2,600	179	2,600	3,000
Lead	mg/kg dw	-	1.94	1.70	0.931	0.980	3.40	1.08	1.20	0.212	<0.5	1.50
Manganese	mg/kg dw	-	148	130	39.0	110	210	90.2	89.0	11.9	79.0	110
Mercury[a]	mg/kg ww	0.033	0.00952	0.00827	0.00420	0.00526	0.0154	0.00863	0.00868	0.00157	0.00709	0.0111
Molybdenum	mg/kg dw	-	0.674	0.640	0.0786	0.610	0.800	0.552	0.560	0.0342	0.500	0.590
Nickel	mg/kg dw	-	2.67	2.50	0.734	2.20	<5	2.25	2.20	0.281	2.00	<5
Selenium	mg/kg dw	4	1.32	1.20	0.368	0.980	1.80	1.44	1.40	0.251	1.20	1.70
Silver	mg/kg dw	-	0.0320	0.0300	0.00837	0.0200	0.0400	0.0520	0.0400	0.0164	0.0400	0.0700
Strontium	mg/kg dw	-	22.8	20.0	6.06	16.0	31.0	14.2	14.0	1.64	13.0	17.0
Thallium	mg/kg dw	-	0.0367	0.0400	0.00577	0.0300	0.0400	0.0325	0.0300	0.00500	0.0300	0.0400
Titanium	mg/kg dw	-	290	280	97.0	180	420	190	190	12.2	180	210
Tin	mg/kg dw	-	<0.2	<0.2	-	<0.2	<2	0.100	0.100	-	0.100	<2
Uranium	mg/kg dw	-	1.90	1.80	0.316	1.60	2.40	1.36	1.40	0.114	1.20	1.50
Vanadium	mg/kg dw	-	8.72	8.00	2.18	6.20	11.0	6.22	6.10	0.460	5.80	7.00
Zinc	mg/kg dw	-	114	120	8.94	100	120	99.8	100	6.57	92.0	110

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.3: Statistical Summary of Benthic Invertebrate Tissue Concentrations, All Analytes, Lower Creek Areas, Coffee Project FALMP, 2018 and 2021

Analytes	Units	BCMOE and CCME Guidelines	YT0.2				
			2021				
			Mean	Median	Standard Deviation	Minimum	Maximum
Moisture	%	-	85.7	86.0	1.44	84.0	87.6
Aluminum	mg/kg dw	-	6,868	6,303	3,007	4,029	11,802
Antimony	mg/kg dw	-	0.370	0.370	0.157	0.234	0.621
Arsenic	mg/kg dw	-	3.72	3.40	1.47	2.30	5.90
Barium	mg/kg dw	-	224	206	108	125	389
Boron	mg/kg dw	-	12.4	7.00	13.9	3.40	37.0
Cadmium	mg/kg dw	-	0.869	0.820	0.102	0.755	1.00
Chromium	mg/kg dw	-	99.4	74.0	79.2	37.0	236
Cobalt	mg/kg dw	-	5.56	3.50	4.20	3.20	13.0
Copper	mg/kg dw	-	21.0	22.0	1.41	19.0	22.0
Iron	mg/kg dw	-	5,862	5,235	3,231	3,210	11,418
Lead	mg/kg dw	-	2.32	2.20	0.746	1.60	3.50
Manganese	mg/kg dw	-	167	162	54.2	109	249
Mercury[a]	mg/kg ww	0.033	0.0246	0.0244	0.00281	0.0216	0.0283
Molybdenum	mg/kg dw	-	0.949	0.870	0.264	0.753	1.40
Nickel	mg/kg dw	-	167	124	133	58.0	395
Selenium	mg/kg dw	4	1.34	1.30	0.114	1.20	1.50
Silver	mg/kg dw	-	0.110	0.129	0.0501	0.0490	0.159
Strontium	mg/kg dw	-	29.2	28.0	5.97	24.0	39.0
Thallium	mg/kg dw	-	0.0516	0.0500	0.0214	0.0320	0.0870
Titanium	mg/kg dw	-	656	530	327	335	1,185
Tin	mg/kg dw	-	1.66	1.50	0.723	1.00	2.90
Uranium	mg/kg dw	-	3.08	3.00	0.581	2.50	3.90
Vanadium	mg/kg dw	-	9.28	7.60	4.58	5.30	17.0
Zinc	mg/kg dw	-	156	152	19.2	132	185

Value is > BCMOE and CCME Guidelines.

Notes: "-" = no data. BCMOE = British Columbia Ministry of Environment Guideline (BCMOE 2014) for Selenium (4 mg/kg dw). CCME = Canadian Sediment Quality Guideline (CCME 2001) for Mercury (0.033 mg/kg ww).

[a] Mercury concentrations were converted from dry weight to wet weight for screening against CCME Guideline for Mercury.

Table E.4: Statistical Temporal and Spatial Comparisons of Benthic Invertebrate Tissue Composition Data, Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

ANOVA Model				Station		Do concentrations differ over time?[a]			Do concentrations differ between the stations?[b]					
									SYT0.6 vs XE0.2 and Future Exposed			XE0.2 vs SYT0.6 and Future Exposed		
Parameter	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Moisture (%)	<0.001	0.267	0.003	Reference	SYT0.6	ns	ns	ns	-	-	-	-	-	-
					XE0.2	ns	ns	ns	ns	ns	ns	-	-	-
				Exposure	HC0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
					CC5.6	59	54	ns	-45	ns	ns	-47	ns	ns
					YT0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
Aluminum (mg/kg dw)	<0.001	0.056	<0.001	Reference	SYT0.6	ns	-50	ns	-	-	-	-	-	-
					XE0.2	ns	-70	-51	ns	ns	ns	-	-	-
				Exposure	HC0.2	ns	93	ns	ns	ns	137	ns	ns	295
					CC5.6	-47	ns	ns	ns	ns	171	ns	ns	352
					YT0.2	ns	81	170	ns	ns	450	ns	ns	818
Arsenic (mg/kg dw)	<0.001	0.328	<0.001	Reference	SYT0.6	ns	-45	ns	-	-	-	-	-	-
					XE0.2	ns	-37	ns	ns	ns	ns	-	-	-
				Exposure	HC0.2	65	65	ns	ns	170	261	ns	172	184
					CC5.6	ns	ns	ns	97	139	160	76	141	104
					YT0.2	ns	ns	ns	90	134	308	70	135	220
Chromium (mg/kg dw)	0.779	<0.001	<0.001	Reference	SYT0.6	ns	1,287	2,101	-	-	-	-	-	-
					XE0.2	ns	127	185	ns	ns	-82	-	-	-
				Exposure	HC0.2	ns	2,976	1,816	ns	ns	ns	ns	ns	598
					CC5.6	ns	779	1,354	ns	ns	ns	ns	ns	315
					YT0.2	ns	1,678	2,160	ns	ns	ns	ns	ns	678
Copper (mg/kg dw)	<0.001	<0.001	<0.001	Reference	SYT0.6	-21	ns	31	-	-	-	-	-	-
					XE0.2	-31	ns	32	57	38	38	-	-	-
				Exposure	HC0.2	ns	50	28	ns	30	27	-44	ns	ns
					CC5.6	-38	ns	83	39	ns	53	ns	-20	ns
					YT0.2	ns	23	33	ns	ns	ns	-40	-20	ns
Iron (mg/kg dw)	<0.001	0.608	<0.001	Reference	SYT0.6	ns	ns	ns	-	-	-	-	-	-
					XE0.2	ns	-69	-62	ns	ns	-57	-	-	-
				Exposure	HC0.2	ns	114	ns	ns	ns	ns	ns	ns	296
					CC5.6	ns	ns	ns	ns	ns	ns	ns	ns	322
					YT0.2	ns	ns	95	ns	ns	205	ns	ns	606
Lead (mg/kg dw)	<0.001	0.002	<0.001	Reference	SYT0.6	ns	-45	ns	-	-	-	-	-	-
					XE0.2	ns	-68	-53	ns	ns	ns	-	-	-
				Exposure	HC0.2	ns	ns	ns	ns	ns	ns	ns	ns	ns
					CC5.6	ns	-64	ns	98	ns	ns	ns	ns	ns
					YT0.2	-44	ns	127	117	ns	396	ns	ns	563
Manganese (mg/kg dw)	<0.001	0.002	<0.001	Reference	SYT0.6	ns	ns	ns	-	-	-	-	-	-
					XE0.2	ns	ns	ns	64	72	ns	-	-	-
				Exposure	HC0.2	ns	ns	ns	ns	77	87	ns	ns	ns
					CC5.6	-46	-63	ns	267	172	88	123	ns	ns
					YT0.2	-38	ns	79	ns	ns	148	ns	ns	64
Mercury (mg/kg ww)	<0.001	<0.001	<0.001	Reference	SYT0.6	ns	144	142	-	-	-	-	-	-
					XE0.2	121	495	169	ns	ns	ns	-	-	-
				Exposure	HC0.2	ns	328	316	ns	ns	96	92	ns	ns
					CC5.6	-49	ns	150	855	388	402	1,542	282	254
					YT0.2	ns	178	187	ns	ns	ns	146	ns	ns
Molybdenum (mg/kg dw)	<0.001	<0.001	0.007	Reference	SYT0.6	ns	ns	62	-	-	-	-	-	-
					XE0.2	-47	ns	ns	66	ns	ns	-	-	-
				Exposure	HC0.2	ns	50	84	78	85	111	ns	64	132
					CC5.6	ns	ns	ns	123	245	130	ns	205	153
					YT0.2	ns	ns	68	ns	ns	ns	ns	ns	60
Nickel (mg/kg dw)	1.000	<0.001	<0.001	Reference	SYT0.6	ns	3,347	4,843	-	-	-	-	-	-
					XE0.2	ns	207	314	142	157	-78	-	-	-
				Exposure	HC0.2	ns	5,131	3,565	ns	ns	ns	-68	ns	438
					CC5.6	ns	1,765	2,474	ns	ns	ns	ns	ns	233
					YT0.2	ns	5,127	5,932	ns	ns	ns	-61	-54	568
Selenium (mg/kg dw)	<0.001	0.047	<0.001	Reference	SYT0.6	-30	ns	ns	-	-	-	-	-	-
					XE0.2	-39	ns	ns	335	285	303	-	-	-
				Exposure	HC0.2	96	148	ns	ns	135	157	-81	-39	-36
					CC5.6	ns	ns	85	434	444	768	ns	ns	115
					YT0.2	ns	ns	ns	ns	75	ns	-75	-55	-65
Silver (mg/kg dw)	<0.001	<0.001	<0.001	Reference	SYT0.6	ns	ns	ns	-	-	-	-	-	-
					XE0.2	ns	ns	ns	ns	172	214	-	-	-
				Exposure	HC0.2	121	163	ns	ns	100	181	-51	ns	ns
					CC5.6	ns	ns	ns	221	257	446	106	ns	74
					YT0.2	61	220	99	ns	150	489	ns	ns	88
Strontium (mg/kg dw)	0.014	<0.001	<0.001	Reference	SYT0.6	-29	ns	41	-	-	-	-	-	-
					XE0.2	-41	-35	ns	61	ns	ns	-	-	-
				Exposure	HC0.2	ns	45	ns	ns	ns	ns	-48	ns	ns
					CC5.6	-52	-60	ns	ns	ns	-48	ns	-34	-50
					YT0.2	-36	ns	104	ns	ns	ns	-34	ns	ns
Thallium (mg/kg dw)	<0.001	0.185	<0.001	Reference	SYT0.6	ns	-60	-43	-	-	-	-	-	-
					XE0.2	ns	-36	ns	77	86	184	-	-	-
				Exposure	HC0.2	ns	61	ns	ns	59	261	-49	ns	ns
					CC5.6	ns	ns	ns	132	136	399	ns	ns	76
					YT0.2	ns	ns	51	ns	ns	303	ns	ns	ns

ANOVA P-value < 0.05.

Significant decrease in concentration.

Significant increase in concentration.

Note: "-" indicates no comparison available; "ns" indicates not significant. Analysis of Variance (ANOVA) model consisted of a censored regression model with factors Year and Station and assuming a log-normal distribution. Boron and Tin were excluded from the analyses because 100% of the data were at detection limit in 2018 and/or 2019.

[a] MOD is calculated as $((year_{recent} - year_{older})/year_{older})*100$.

[b] MOD calculated as (Exposed - Reference)/(Reference)*100.

Table E.4: Statistical Temporal and Spatial Comparisons of Benthic Invertebrate Tissue Composition Data, Upper Creek Areas, Coffee Project FALMP, 2018 to 2021

ANOVA Model				Station		Do concentrations differ over time?[a]			Do concentrations differ between the stations?[b]					
									SYT0.6 vs XE0.2 and Future Exposed			XE0.2 vs SYT0.6 and Future Exposed		
Parameter	Station	Year	Station x Year			2018 vs 2019	2018 vs 2021	2019 vs 2021	2018	2019	2021	2018	2019	2021
Titanium (mg/kg dw)	<0.001	0.030	<0.001	Reference	SYT0.6	ns	ns	ns	-	-	-	-	-	-
					XE0.2	ns	-67	ns	ns	ns	ns	-	-	-
				Exposure	HC0.2	ns	176	99	ns	ns	165	ns	ns	423
					CC5.6	-50	ns	107	ns	ns	160	ns	ns	413
					YT0.2	ns	116	215	ns	ns	507	ns	109	1,096
Uranium (mg/kg dw)	<0.001	0.335	0.257	Reference	SYT0.6	ns	ns	ns	-	-	-	-	-	-
					XE0.2	ns	ns	ns	-83	-83	-83	-	-	-
				Exposure	HC0.2	ns	ns	ns	ns	ns	ns	444	444	444
					CC5.6	ns	ns	ns	ns	ns	ns	287	287	287
					YT0.2	ns	ns	ns	-52	-52	-52	186	186	186
Zinc (mg/kg dw)	0.209	<0.001	<0.001	Reference	SYT0.6	-25	ns	ns	-	-	-	-	-	-
					XE0.2	-32	-22	ns	ns	ns	ns	-	-	-
				Exposure	HC0.2	ns	ns	ns	ns	ns	ns	-24	ns	ns
					CC5.6	-48	-20	53	43	ns	ns	ns	ns	ns
					YT0.2	ns	36	56	ns	ns	37	-26	ns	30

ANOVA P-value < 0.05.
Significant decrease in concentration.
Significant increase in concentration.

Note: "-" indicates no comparison available; "ns" indicates not significant. Analysis of Variance (ANOVA) model consisted of a censored regression model with factors Year and Station and assuming a log-normal distribution. Boron and Tin were excluded from the analyses because 100% of the data were at detection limit in 2018 and/or 2019.

[a] MOD is calculated as $((year_{recent} - year_{older})/year_{older})*100$.

[b] MOD calculated as (Exposed - Reference)/(Reference)*100.

APPENDIX F
SEDIMENT CHEMISTRY

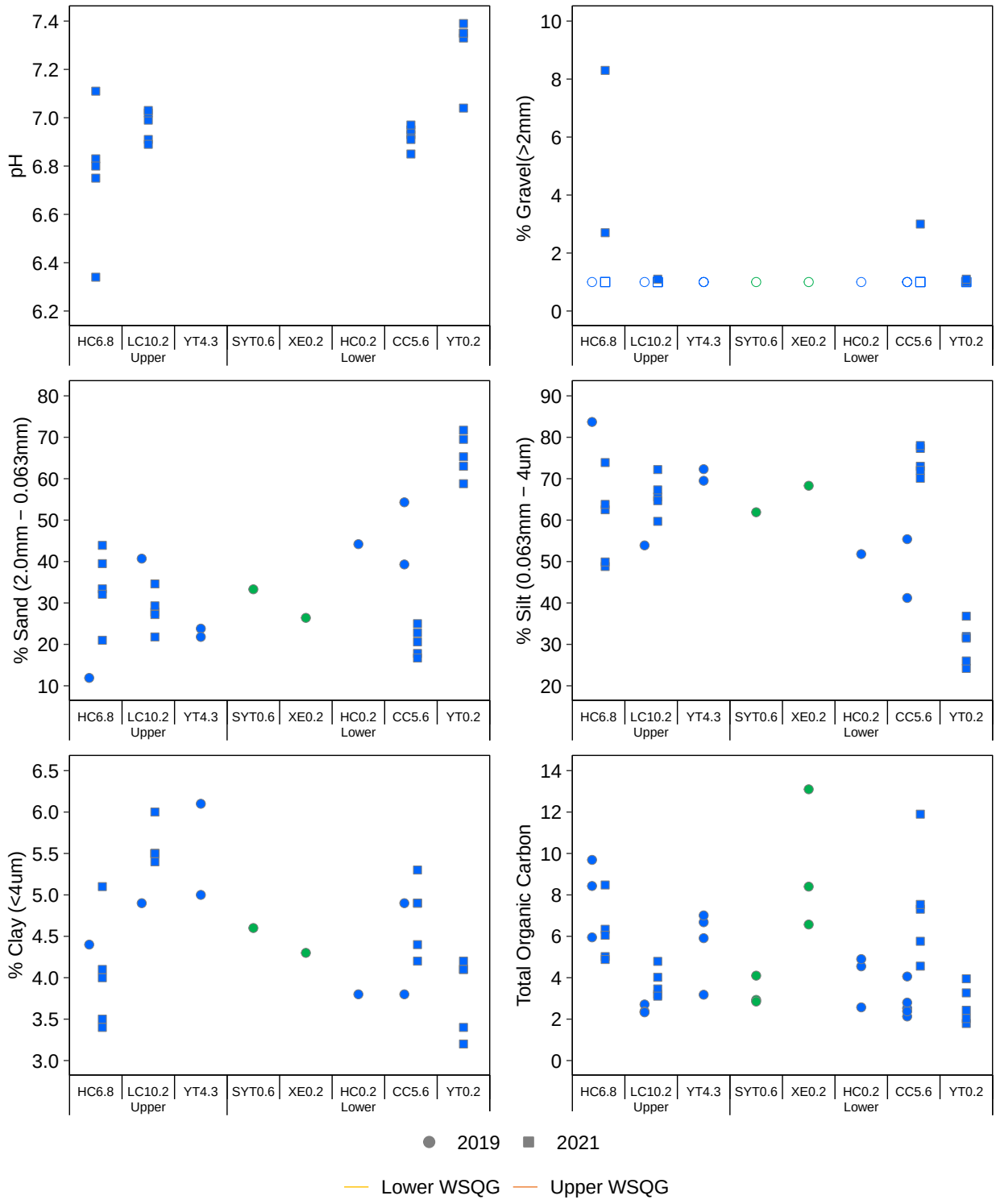
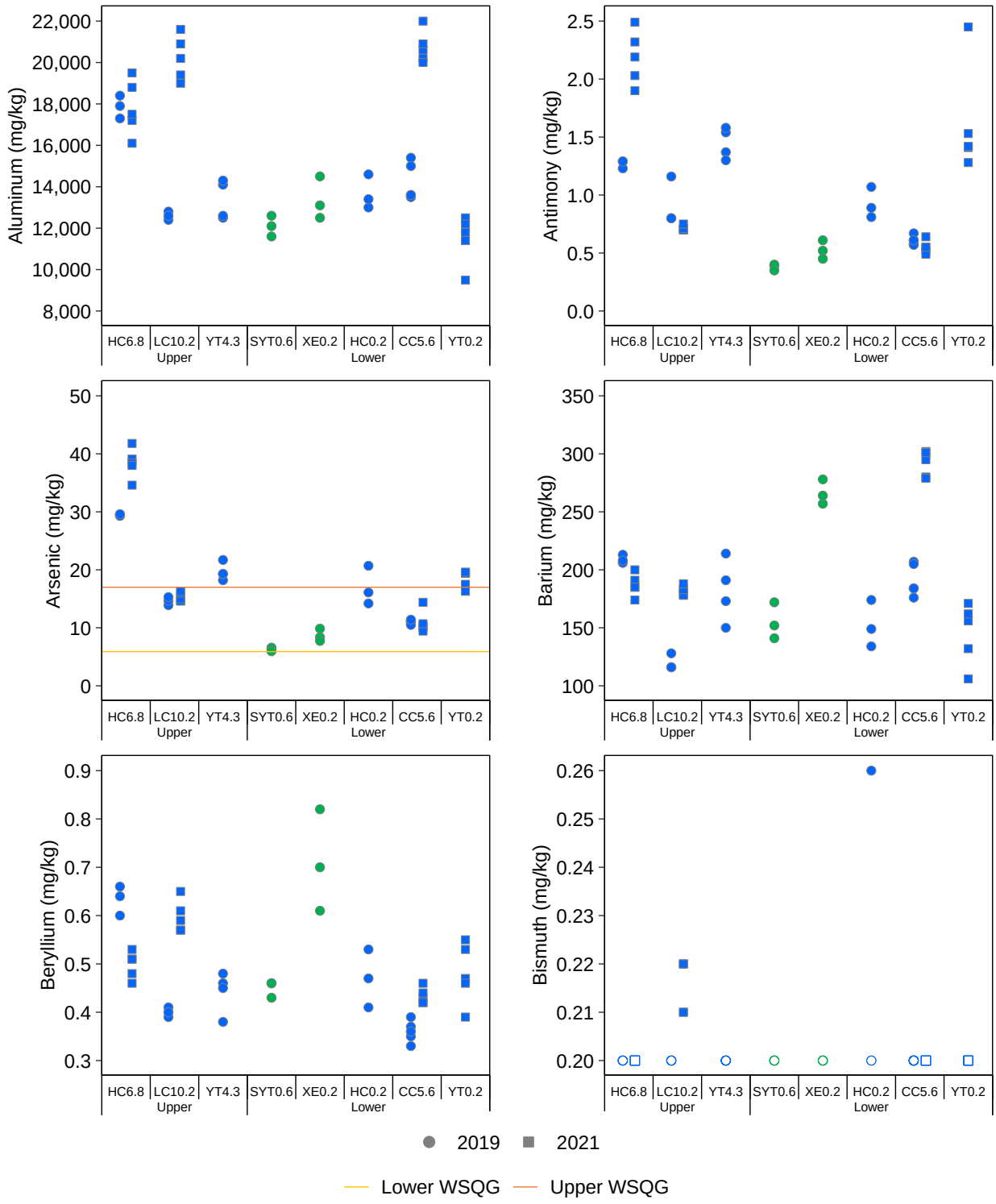


Figure F.1: Sediment Analyte Concentrations from Upper and Lower Tributaries of the Coffee Project AEMP, 2019 to 2021

Notes: Green represents future reference stations and blue represents future-exposed stations. Concentrations below the laboratory reporting limit (LRL) are plotted as open symbols at the LRL. WSQGs are British Columbia Working or Approved (selenium) Sediment Quality Guidelines (BCMOECCS 2019c, 2021). All WSQGs are consistent with Canadian Sediment Quality Guidelines (CCME 2001) with the exception of Iron, Manganese, Molybdenum, Nickel, Selenium and Silver for which there are no CCME guidelines.



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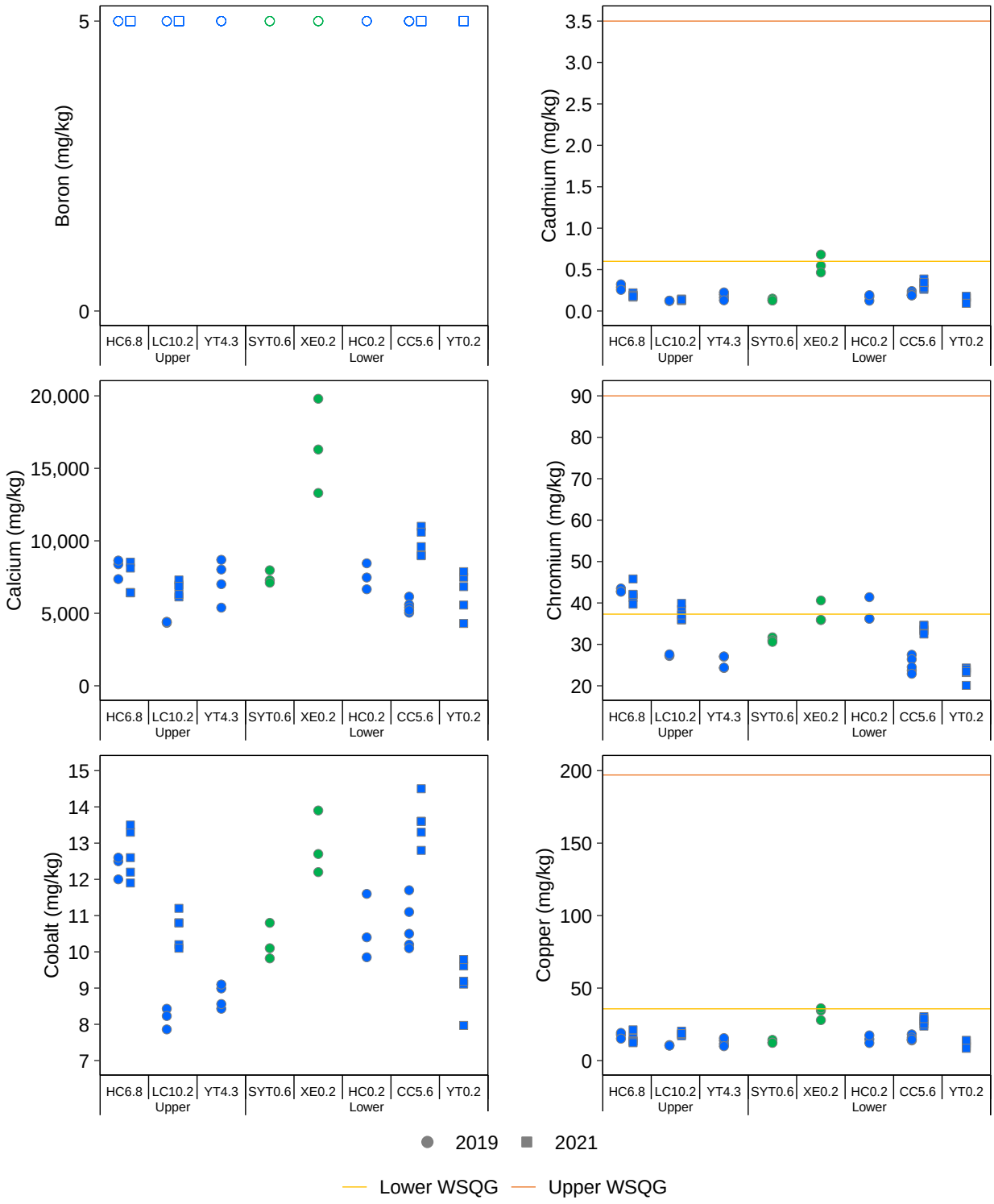

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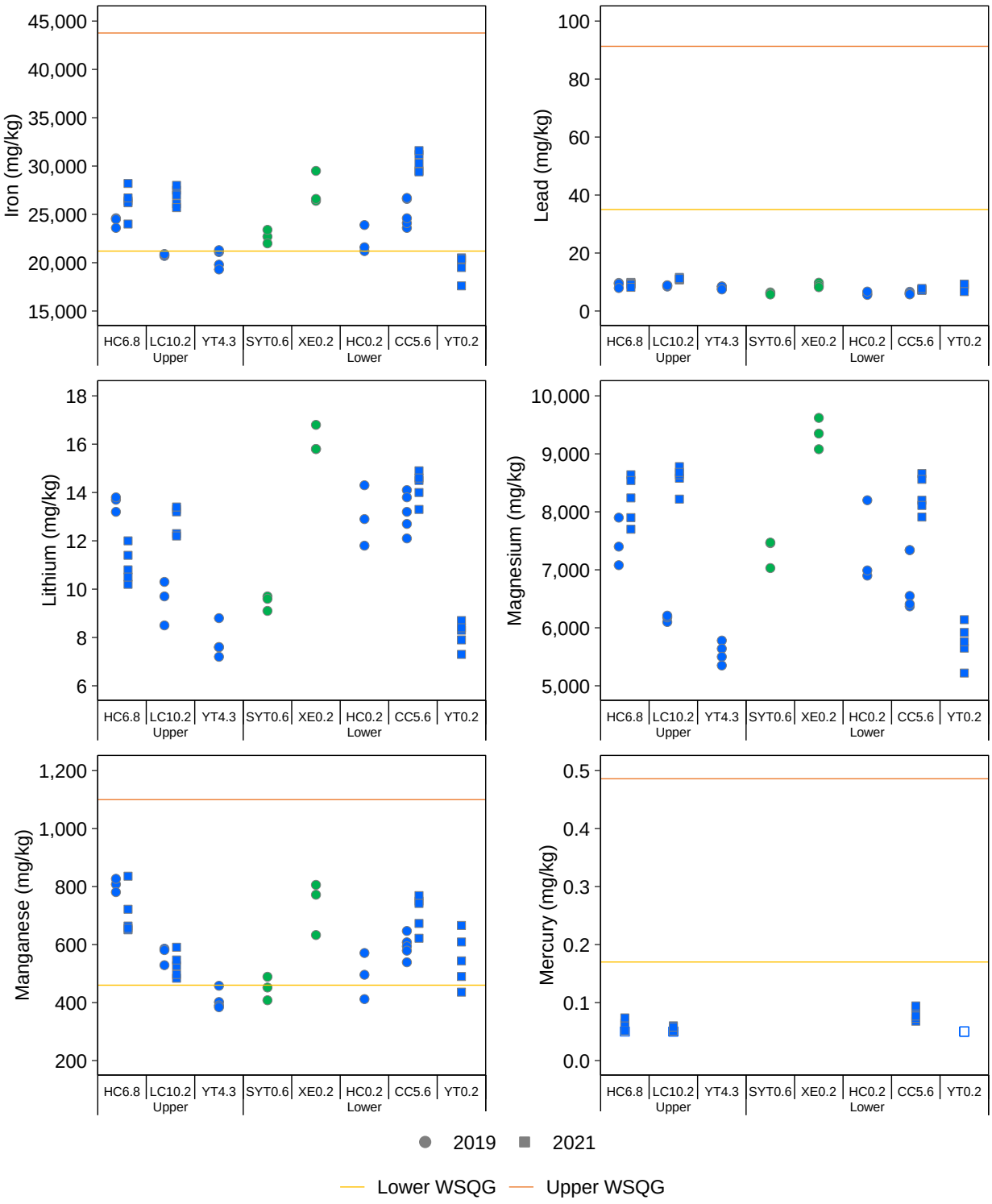

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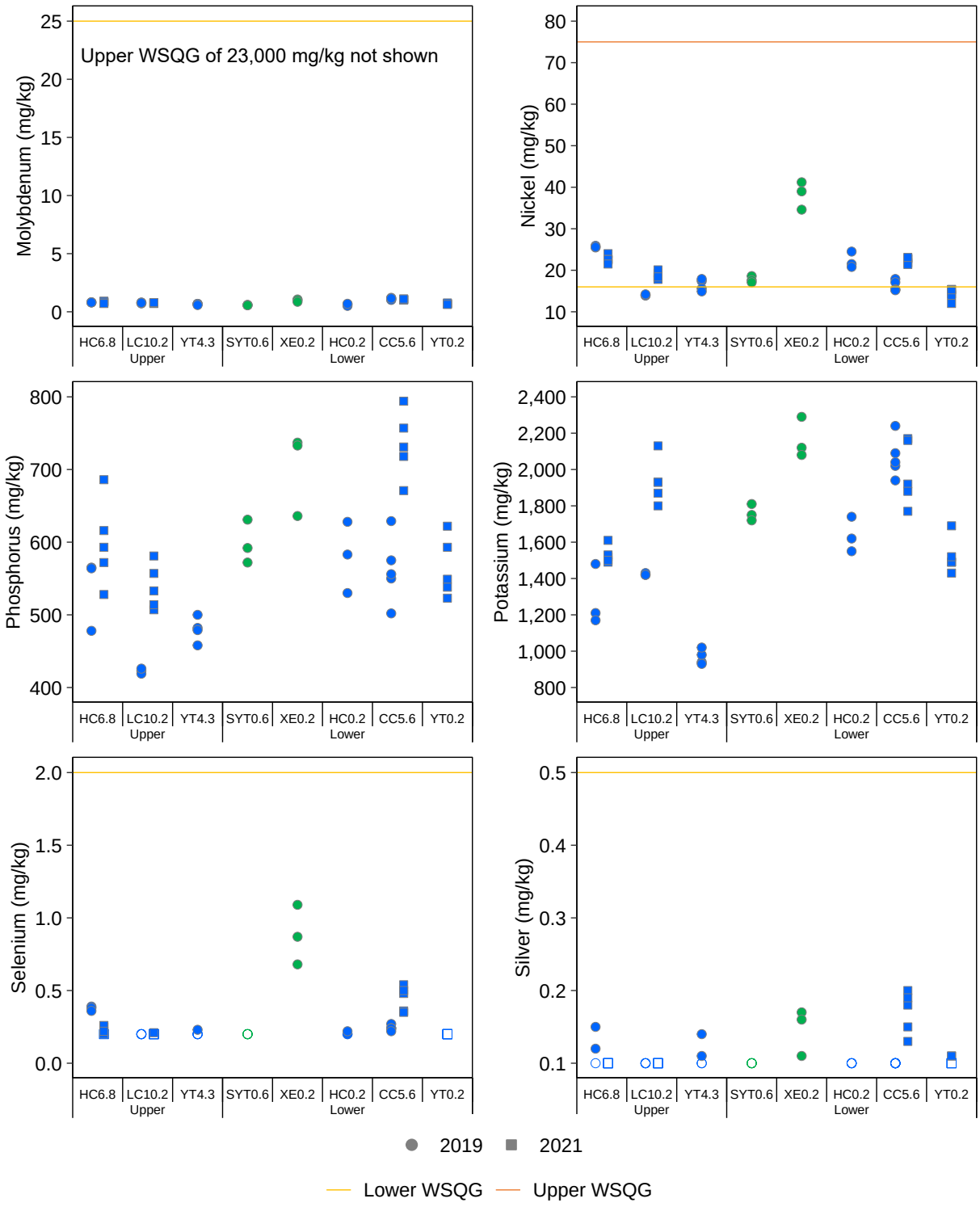

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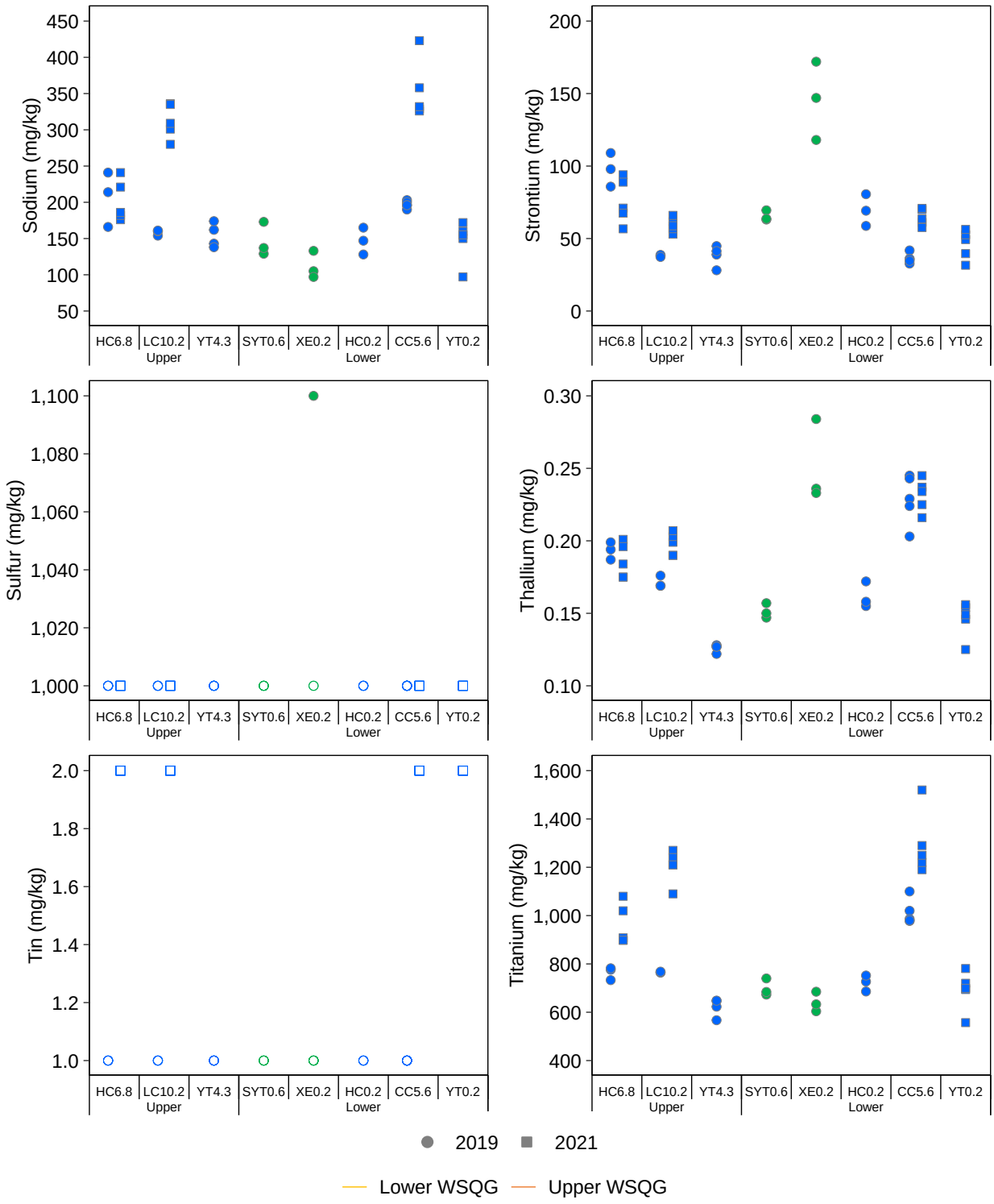

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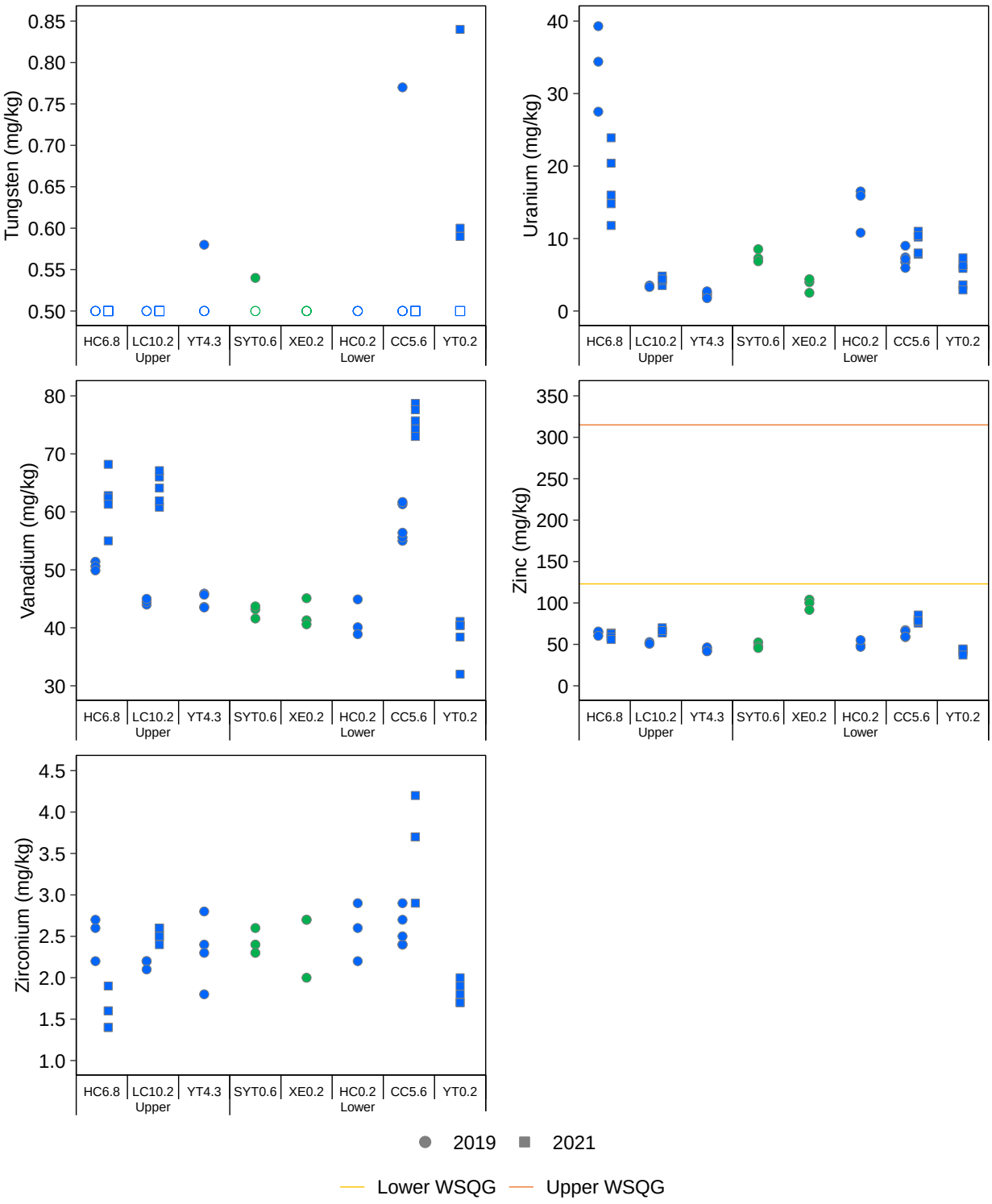

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Table F.1: Coffee Project FALMP Upper and Lower Creek Areas Sediment Analyte Concentrations, 2019 and 2021

Analytes	BC WSQG and CCME Guidelines		Units	Upper															
				HC6.8								LC10.2							
	Lower	Upper		20-Aug-19	20-Aug-19	20-Aug-19	19-Aug-21	19-Aug-21	19-Aug-21	19-Aug-21	19-Aug-21	21-Aug-19	21-Aug-19	21-Aug-19	23-Aug-21	23-Aug-21	23-Aug-21	23-Aug-21	23-Aug-21
Physical Tests																			
pH	-	-	pH Units	-	-	-	7.11	6.34	6.80	6.75	6.83	-	-	-	7.03	6.99	6.99	6.91	6.89
Particle Size																			
% Gravel (>2mm)	-	-	%	-	-	<1	2.70	8.30	<1	<1	<1	-	-	<1	<1	<1	<1	1.10	<1
% Sand (2.0mm - 0.063mm)	-	-	%	-	-	11.9	43.9	39.5	32.1	21.0	33.4	-	-	40.7	34.6	29.3	29.3	27.8	27.2
% Silt (0.063mm - 4um)	-	-	%	-	-	83.7	49.9	48.8	63.8	73.9	62.5	-	-	53.9	59.7	64.7	64.7	65.6	67.3
% Clay (<4um)	-	-	%	-	-	4.40	3.50	3.40	4.10	5.10	4.00	-	-	4.90	5.50	5.40	5.40	5.50	5.50
Texture	-	-		-	-	Silt	-	-	-	-	-	-	-	Silt loam	-	-	-	-	-
Organic / Inorganic Carbon																			
Total Organic Carbon	-	-	%	8.43	9.69	5.95	4.88	6.05	5.02	8.48	6.34	2.71	2.37	2.33	3.11	3.46	3.46	3.20	4.02
Metals																			
Aluminum	-	-	mg/kg	18,400	17,900	17,300	16,100	17,200	17,500	18,800	19,500	12,800	12,400	12,600	20,200	20,900	20,900	19,000	19,400
Antimony	-	-	mg/kg	1.29	1.23	1.29	1.90	2.19	2.49	2.03	2.32	1.16	0.800	0.800	0.750	0.700	0.700	0.700	0.710
Arsenic	5.9	17	mg/kg	29.5	29.3	29.6	34.6	38.4	38.0	39.1	41.8	13.9	14.7	15.3	16.3	15.0	15.0	14.7	14.6
Barium	-	-	mg/kg	206	213	208	174	185	185	200	191	116	128	116	188	178	178	179	182
Beryllium	-	-	mg/kg	0.640	0.660	0.600	0.480	0.510	0.460	0.510	0.530	0.390	0.410	0.400	0.650	0.590	0.590	0.570	0.570
Bismuth	-	-	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.220	0.210	0.210	0.220	0.210
Boron	-	-	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium	0.6	3.5	mg/kg	0.288	0.323	0.255	0.176	0.192	0.168	0.220	0.187	0.125	0.120	0.125	0.136	0.135	0.135	0.126	0.129
Calcium	-	-	mg/kg	8,380	8,640	7,360	6,430	6,430	6,410	8,530	8,120	4,340	4,410	4,400	6,860	6,960	6,960	6,130	6,300
Chromium	37.3	90	mg/kg	43.5	42.8	42.7	39.7	41.3	42.1	42.0	45.8	27.2	27.3	27.6	37.1	38.4	38.4	35.9	36.0
Cobalt	-	-	mg/kg	12.5	12.0	12.6	11.9	13.5	12.6	12.2	13.3	7.86	8.43	8.23	10.8	10.8	10.8	10.2	10.1
Copper	35.7	197	mg/kg	17.8	19.1	15.1	12.3	13.7	13.2	21.2	15.4	10.4	10.7	10.3	18.6	18.2	18.2	17.9	17.1
Iron	21,200	43,766	mg/kg	24,600	24,500	23,600	24,000	26,200	26,700	26,400	28,200	20,700	20,800	20,900	27,000	27,500	27,500	26,100	25,700
Lead	35	91.3	mg/kg	9.69	9.41	7.94	8.17	9.24	9.16	9.87	9.54	8.44	8.88	8.81	11.2	11.0	11.0	11.0	10.7
Lithium	-	-	mg/kg	13.7	13.2	13.8	11.4	10.2	10.5	10.8	12.0	8.50	9.70	10.3	13.4	13.3	13.3	12.3	12.2
Magnesium	-	-	mg/kg	7,400	7,080	7,900	7,700	8,240	8,540	7,900	8,640	6,100	6,180	6,210	8,680	8,780	8,780	8,220	8,580
Manganese	460	1100	mg/kg	808	781	827	656	836	651	664	722	529	586	581	591	527	527	484	497
Mercury	0.17	0.486	mg/kg	-	-	-	<0.05	0.0736	0.0512	0.0646	0.0607	-	-	-	0.0578	0.0508	0.0508	<0.05	<0.05
Molybdenum	25	23,000	mg/kg	0.820	0.810	0.800	0.710	0.910	0.820	0.820	0.890	0.720	0.800	0.770	0.790	0.790	0.790	0.710	0.730
Nickel	16	75	mg/kg	25.5	25.9	25.6	21.5	22.6	22.6	22.4	24.0	13.9	14.0	14.2	18.4	19.3	19.3	18.1	17.8
Phosphorus	-	-	mg/kg	565	564	478	528	572	593	686	616	423	419	426	514	581	581	507	533
Potassium	-	-	mg/kg	1,210	1,170	1,480	1,500	1,520	1,530	1,490	1,610	1,420	1,430	1,420	2,130	1,930	1,930	1,800	1,930
Selenium	2	-	mg/kg	0.390	0.380	0.360	0.220	0.200	<0.2	0.250	0.260	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Silver	0.5	-	mg/kg	0.150	0.120	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sodium	-	-	mg/kg	214	241	166	186	176	182	241	221	154	160	161	309	336	336	280	301
Strontium	-	-	mg/kg	97.9	109	85.8	67.5	56.7	71.0	94.0	88.9	38.1	38.7	37.3	58.8	61.7	61.7	53.0	56.8
Sulfur	-	-	mg/kg	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
Thallium	-	-	mg/kg	0.194	0.187	0.199	0.175	0.184	0.175	0.201	0.196	0.169	0.176	0.169	0.207	0.199	0.199	0.190	0.190
Tin	-	-	mg/kg	<1	<1	<1	<2	<2	<2	<2	<2	<1	<1	<1	<2	<2	<2	<2	<2
Titanium	-	-	mg/kg	776	733	782	898	908	898	1,020	1,080	764	765	768	1,210	1,270	1,270	1,090	1,210
Tungsten	-	-	mg/kg	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	-	-	mg/kg	34.4	39.3	27.5	16.0	11.8	14.8	20.4	23.9	3.33	3.52	3.33	4.42	4.19	4.19	4.30	3.52
Vanadium	-	-	mg/kg	51.4	50.6	49.9	55.0	62.4	61.3	62.8	68.2	44.0	44.5	45.0	64.1	66.0	66.0	60.8	61.9
Zinc	123	315	mg/kg	64.5	65.5	60.3	55.9	57.7	58.8	63.8	62.9	50.7	52.8	50.9	66.6	66.8	66.8	65.8	63.7
Zirconium	-	-	mg/kg	2.60	2.70	2.20	1.40	1.60	1.90	1.60	1.40	2.20	2.20	2.10	2.40	2.60	2.60	2.60	2.50

Value is > BC Working Sediment Quality Guideline and Canadian Sediment Quality Guideline Effect Lower Level.

Value is > BC Working Sediment Quality Guideline and Canadian Sediment Quality Guideline Effect Upper Level.

Notes: "-" = no data. BCWSQG = British Columbia Working Sediment Quality Guideline (BCMOECCS 2021) and approved BC Sediment Quality Guideline for Selenium (BCMOECCS 2019c). CCME = Canadian Sediment Quality Guideline (CCME 2001). All WSQG and CCME Guidelines are the same except for the Iron, Manganese, Molybdenum, Nickel, Selenium and Silver that there is no CCME guideline.

Table F.1: Coffee Project FALMP Upper and Lower Creek Areas Sediment Analyte Concentrations, 2019 and 2021

Analytes	BC WSQG and CCME Guidelines		Units	Upper				Lower											
				YT4.3				SYT0.6			XE0.2			HC0.2			CC5.6		
	Lower	Upper		22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19
Physical Tests																			
pH	-	-	pH Units	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Particle Size																			
% Gravel (>2mm)	-	-	%	<1	-	<1	-	-	-	<1	-	-	<1	<1	-	-	<1	-	<1
% Sand (2.0mm - 0.063mm)	-	-	%	23.8	-	21.8	-	-	-	33.3	-	-	26.4	44.2	-	-	39.3	-	54.3
% Silt (0.063mm - 4um)	-	-	%	69.5	-	72.3	-	-	-	61.9	-	-	68.3	51.8	-	-	55.4	-	41.2
% Clay (<4um)	-	-	%	6.10	-	5.00	-	-	-	4.60	-	-	4.30	3.80	-	-	4.90	-	3.80
Texture	-	-		Silt loam	-	Silt loam	-	-	-	Silt loam	-	-	Silt loam	Silt loam	-	-	Silt loam	-	Sandy loam
Organic / Inorganic Carbon																			
Total Organic Carbon	-	-	%	6.68	5.91	7.01	3.18	4.10	2.93	2.85	8.40	13.1	6.57	4.55	2.57	4.90	4.06	2.53	2.13
Metals																			
Aluminum	-	-	mg/kg	14,100	12,500	14,300	12,600	12,600	12,100	11,600	14,500	13,100	12,500	13,000	13,400	14,600	15,400	15,000	13,600
Antimony	-	-	mg/kg	1.37	1.54	1.30	1.58	0.390	0.400	0.350	0.610	0.520	0.450	0.890	0.810	1.07	0.610	0.580	0.670
Arsenic	5.9	17	mg/kg	18.2	19.3	21.7	19.3	6.33	6.58	5.96	9.85	8.37	7.74	16.1	14.2	20.7	11.3	10.9	11.1
Barium	-	-	mg/kg	191	173	214	150	172	152	141	257	264	278	149	134	174	207	205	176
Beryllium	-	-	mg/kg	0.460	0.450	0.480	0.380	0.460	0.460	0.430	0.820	0.700	0.610	0.470	0.410	0.530	0.390	0.350	0.330
Bismuth	-	-	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.260	<0.2	<0.2	<0.2	<0.2
Boron	-	-	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium	0.6	3.5	mg/kg	0.198	0.163	0.225	0.129	0.150	0.127	0.128	0.547	0.682	0.465	0.173	0.124	0.192	0.241	0.213	0.191
Calcium	-	-	mg/kg	8,020	7,010	8,690	5,390	7,970	7,280	7,110	16,300	19,800	13,300	7,470	6,660	8,450	6,150	5,600	5,040
Chromium	37.3	90	mg/kg	27.0	24.3	27.1	24.4	31.7	31.0	30.6	40.6	35.9	35.9	36.2	36.2	41.4	27.5	26.4	23.7
Cobalt	-	-	mg/kg	8.99	8.43	9.10	8.56	10.1	10.8	9.82	13.9	12.7	12.2	10.4	9.85	11.6	11.7	11.1	10.2
Copper	35.7	197	mg/kg	13.8	11.6	15.5	9.91	14.3	12.4	12.2	34.5	36.1	27.9	14.7	12.1	17.4	18.1	15.9	13.9
Iron	21,200	43,766	mg/kg	21,100	19,800	21,300	19,300	22,700	23,400	22,000	29,500	26,400	26,600	21,200	21,600	23,900	26,600	26,700	23,600
Lead	35	91.3	mg/kg	8.49	7.66	8.43	7.44	6.42	6.15	5.71	9.76	8.86	8.22	5.99	5.56	6.71	6.63	6.12	5.79
Lithium	-	-	mg/kg	7.60	7.60	8.80	7.20	9.70	9.10	9.60	16.8	15.8	15.8	11.8	12.9	14.3	13.2	14.1	12.7
Magnesium	-	-	mg/kg	5,780	5,640	5,500	5,350	7,460	7,470	7,030	9,620	9,350	9,080	6,900	6,990	8,200	7,340	7,340	6,550
Manganese	460	1100	mg/kg	402	390	458	384	452	489	408	772	806	633	496	412	571	647	608	594
Mercury	0.17	0.486	mg/kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Molybdenum	25	23,000	mg/kg	0.680	0.670	0.680	0.580	0.580	0.590	0.560	1.06	1.01	0.860	0.650	0.510	0.690	1.20	1.14	1.05
Nickel	16	75	mg/kg	17.4	15.6	17.9	14.9	18.6	17.6	17.1	41.2	39.0	34.6	21.5	20.8	24.5	17.9	17.1	15.4
Phosphorus	-	-	mg/kg	482	479	500	458	572	592	631	737	733	636	530	628	583	550	629	575
Potassium	-	-	mg/kg	940	980	930	1,020	1,750	1,810	1,720	2,290	2,120	2,080	1,550	1,620	1,740	2,090	2,240	2,020
Selenium	2	-	mg/kg	<0.2	<0.2	0.230	<0.2	<0.2	<0.2	<0.2	0.870	1.09	0.680	0.200	<0.2	0.220	0.270	0.240	0.240
Silver	0.5	-	mg/kg	0.110	<0.1	0.140	<0.1	<0.1	<0.1	<0.1	0.170	0.160	0.110	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sodium	-	-	mg/kg	162	143	174	138	173	129	137	105	133	97.0	147	128	165	196	203	200
Strontium	-	-	mg/kg	38.9	44.8	41.3	28.1	69.5	63.1	63.6	147	172	118	69.2	58.7	80.6	41.8	36.0	32.7
Sulfur	-	-	mg/kg	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	1,100	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
Thallium	-	-	mg/kg	0.128	0.122	0.127	0.127	0.147	0.157	0.150	0.284	0.236	0.233	0.155	0.158	0.172	0.245	0.243	0.203
Tin	-	-	mg/kg	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Titanium	-	-	mg/kg	647	623	567	648	673	740	684	685	604	633	686	727	752	1,020	1,100	986
Tungsten	-	-	mg/kg	0.580	<0.5	<0.5	<0.5	<0.5	0.540	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Uranium	-	-	mg/kg	2.43	2.11	2.72	1.77	8.53	7.27	6.86	3.98	4.39	2.51	16.5	10.8	15.9	9.00	7.40	6.73
Vanadium	-	-	mg/kg	45.9	43.6	45.7	43.5	43.2	43.7	41.6	45.1	41.3	40.6	40.1	38.9	44.9	61.3	61.7	55.0
Zinc	123	315	mg/kg	44.8	41.9	46.4	41.7	52.4	47.5	45.6	104	100	91.6	48.7	47.0	55.2	67.2	66.1	58.8
Zirconium	-	-	mg/kg	2.40	2.30	2.80	1.80	2.60	2.40	2.30	2.70	2.70	2.00	2.60	2.20	2.90	2.90	2.70	2.40

Value is > BC Working Sediment Quality Guideline and Canadian Sediment Quality Guideline Effect Lower Level.

Value is > BC Working Sediment Quality Guideline and Canadian Sediment Quality Guideline Effect Upper Level.

Notes: "-" = no data. BCWSQG = British Columbia Working Sediment Quality Guideline (BCMOECCS 2021) and approved BC Sediment Quality Guideline for Selenium (BCMOECCS 2019c). CCME = Canadian Sediment Quality Guideline (CCME 2001). All WSQG and CCME Guidelines are the same except for the Iron, Manganese, Molybdenum, Nickel, Selenium and Silver that there is no CCME guideline.

Table F.1: Coffee Project FALMP Upper and Lower Creek Areas Sediment Analyte Concentrations, 2019 and 2021

Analytes	BC WSQG and CCME Guidelines		Units	Lower												
				CC5.6							YT0.2					
	Lower	Upper		24-Aug-19	24-Aug-19	23-Aug-21	23-Aug-21	23-Aug-21	23-Aug-21	23-Aug-21	20-Aug-21	20-Aug-21	20-Aug-21	20-Aug-21	20-Aug-21
Physical Tests																
pH	-	-	pH Units	-	-	6.85	6.91	6.97	6.93	6.95	7.35	7.35	7.33	7.04	7.39
Particle Size																
% Gravel (>2mm)	-	-	%	-	-	<1	<1	<1	<1	3.00	1.10	1.00	<1	<1	<1
% Sand (2.0mm - 0.063mm)	-	-	%	-	-	16.7	25.0	17.8	22.8	20.6	69.5	63.0	65.3	71.7	58.8
% Silt (0.063mm - 4um)	-	-	%	-	-	78.0	70.1	77.3	73.0	72.0	26.0	31.9	31.5	24.2	36.8
% Clay (<4um)	-	-	%	-	-	5.30	4.90	4.90	4.20	4.40	3.40	4.10	3.20	4.10	4.20
Texture	-	-		-	-	-	-	-	-	-	-	-	-	-	-
Organic / Inorganic Carbon																
Total Organic Carbon	-	-	%	2.38	2.80	7.54	11.9	5.76	4.56	7.31	2.03	3.27	2.43	1.79	3.95
Metals																
Aluminum	-	-	mg/kg	13,500	13,600	20,900	20,200	20,000	22,000	20,600	9,490	11,400	12,500	11,800	12,200
Antimony	-	-	mg/kg	0.570	0.610	0.550	0.550	0.490	0.520	0.640	1.28	1.53	1.41	2.45	1.42
Arsenic	5.9	17	mg/kg	10.5	11.4	10.7	10.3	9.43	10.1	14.4	16.3	17.5	19.4	19.4	19.6
Barium	-	-	mg/kg	184	184	301	302	279	280	295	106	156	162	132	171
Beryllium	-	-	mg/kg	0.370	0.360	0.460	0.440	0.420	0.420	0.430	0.390	0.470	0.550	0.460	0.530
Bismuth	-	-	mg/kg	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Boron	-	-	mg/kg	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cadmium	0.6	3.5	mg/kg	0.189	0.189	0.346	0.387	0.280	0.262	0.337	0.0930	0.160	0.165	0.105	0.178
Calcium	-	-	mg/kg	5,400	5,200	10,600	11,000	8,970	9,020	9,600	4,300	6,840	7,490	5,570	7,870
Chromium	37.3	90	mg/kg	24.5	22.9	34.6	33.3	32.5	34.6	33.6	20.1	23.2	24.3	24.0	23.4
Cobalt	-	-	mg/kg	10.1	10.5	13.6	13.6	12.8	13.3	14.5	7.97	9.11	9.61	9.19	9.79
Copper	35.7	197	mg/kg	14.4	14.5	29.0	30.3	25.2	23.8	27.4	8.45	12.0	13.8	9.72	13.9
Iron	21,200	43,766	mg/kg	24,100	24,600	30,300	29,500	29,400	31,200	31,600	17,600	19,500	20,500	20,300	20,400
Lead	35	91.3	mg/kg	6.17	5.77	7.78	7.32	7.15	7.22	7.55	6.70	8.96	9.29	7.92	9.26
Lithium	-	-	mg/kg	13.8	12.1	14.0	13.3	14.6	14.9	14.5	7.30	7.90	8.70	8.30	8.40
Magnesium	-	-	mg/kg	6,370	6,410	8,110	7,910	8,200	8,660	8,560	5,220	5,650	5,920	6,140	5,760
Manganese	460	1100	mg/kg	539	579	742	769	622	673	750	436	544	609	490	666
Mercury	0.17	0.486	mg/kg	-	-	0.0943	0.0909	0.0768	0.0679	0.0729	<0.05	<0.05	<0.05	<0.05	<0.05
Molybdenum	25	23,000	mg/kg	1.02	1.15	1.10	1.04	1.03	1.02	1.10	0.630	0.670	0.710	0.670	0.760
Nickel	16	75	mg/kg	15.3	15.2	23.1	22.8	21.4	21.8	22.8	12.0	14.3	15.4	14.0	15.3
Phosphorus	-	-	mg/kg	556	502	757	794	671	731	718	523	549	593	538	622
Potassium	-	-	mg/kg	1,940	2,040	1,880	1,770	1,920	2,170	2,160	1,430	1,490	1,490	1,690	1,520
Selenium	2	-	mg/kg	0.240	0.220	0.500	0.540	0.350	0.360	0.480	<0.2	<0.2	<0.2	<0.2	<0.2
Silver	0.5	-	mg/kg	<0.1	<0.1	0.190	0.200	0.150	0.130	0.180	<0.1	<0.1	0.110	<0.1	0.110
Sodium	-	-	mg/kg	190	196	358	326	332	423	329	97.0	150	172	160	155
Strontium	-	-	mg/kg	35.8	34.6	70.8	70.0	57.6	61.1	63.5	31.6	49.3	52.6	39.6	56.3
Sulfur	-	-	mg/kg	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
Thallium	-	-	mg/kg	0.229	0.224	0.234	0.216	0.225	0.237	0.245	0.125	0.146	0.154	0.156	0.149
Tin	-	-	mg/kg	<1	<1	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Titanium	-	-	mg/kg	978	980	1,250	1,190	1,220	1,520	1,290	557	694	720	781	699
Tungsten	-	-	mg/kg	0.770	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.600	<0.5	0.590	0.840
Uranium	-	-	mg/kg	7.16	5.95	10.4	11.0	8.01	7.82	10.2	2.91	5.88	6.29	3.62	7.34
Vanadium	-	-	mg/kg	55.6	56.4	75.7	74.3	73.0	78.7	77.6	32.0	38.4	41.1	40.4	40.4
Zinc	123	315	mg/kg	59.2	59.2	78.4	75.7	77.8	80.6	85.5	37.1	40.7	44.2	42.6	44.5
Zirconium	-	-	mg/kg	2.40	2.50	3.70	3.70	3.70	2.90	4.20	1.70	1.80	1.90	1.70	2.00

Value is > BC Working Sediment Quality Guideline and Canadian Sediment Quality Guideline Effect Lower Level.

Value is > BC Working Sediment Quality Guideline and Canadian Sediment Quality Guideline Effect Upper Level.

Notes: "-" = no data. BCWSQG = British Columbia Working Sediment Quality Guideline (BCMOECCS 2021) and approved BC Sediment Quality Guideline for Selenium (BCMOECCS 2019c). CCME = Canadian Sediment Quality Guideline (CCME 2001). All WSQG and CCME Guidelines are the same except for the Iron, Manganese, Molybdenum, Nickel, Selenium and Silver that there is no CCME guideline.

Table F.2: Statistical Temporal Comparison of Sediment Analyte Concentrations for Areas with Multiple Years of Data for the Coffee Project FALMP, Lower Creek Areas, 2019 and 2021

Analyte	Units	HC6.8						LC10.2						CC5.6					
		MCT		Test	Summary Statistic	P-value	MOD	MCT		Test	Summary Statistic	P-value	MOD	MCT		Test	Summary Statistic	P-value	MOD
		2019	2021					2019	2021					2019	2021				
Total Organic Carbon	mg/kg	8.02	6.15	tequal	Mean	0.164	-23.3	2.47	3.72	tequal	Mean	0.026	50.4	2.78	7.41	tequal	Mean	0.007	167
Aluminum	mg/kg	17,867	17,820	tequal	Mean	0.957	-0.261	12,600	20,220	tequal	Mean	<0.001	60.5	14,197	20,728	tequal	Geometric Mean	<0.001	46.0
Antimony	mg/kg	1.27	2.19	tequal	Mean	<0.001	72.1	0.920	0.714	tequal	Mean	0.059	-22.4	0.608	0.550	tequal	Mean	0.094	-9.54
Arsenic	mg/kg	29.5	38.4	tequal	Mean	0.001	30.2	14.6	15.3	tequal	Mean	0.259	4.69	11.1	10.3	M-W	Median	0.222	-7.21
Barium	mg/kg	209	187	tequal	Mean	0.010	-10.5	120	182	tequal	Mean	<0.001	51.7	191	291	tequal	Mean	<0.001	52.4
Beryllium	mg/kg	0.633	0.498	tequal	Mean	<0.001	-21.4	0.400	0.598	tequal	Mean	<0.001	49.5	0.360	0.434	tequal	Mean	<0.001	20.6
Bismuth	mg/kg	nt	nt	nt	nt	nt	nt	0.200	0.220	M-W	Median	0.027	10.0	nt	nt	nt	nt	nt	nt
Cadmium	mg/kg	0.289	0.189	tequal	Mean	0.002	-34.7	0.123	0.134	tequal	Mean	0.054	8.81	0.205	0.322	tequal	Mean	0.002	57.6
Calcium	mg/kg	8,127	7,184	tequal	Mean	0.220	-11.6	4,383	6,710	tequal	Mean	<0.001	53.1	5,478	9,838	tequal	Mean	<0.001	79.6
Chromium	mg/kg	43.0	42.2	tequal	Mean	0.565	-1.91	27.4	37.5	tequal	Mean	<0.001	36.9	25.0	33.7	tequal	Mean	<0.001	34.9
Cobalt	mg/kg	12.4	12.7	tequal	Mean	0.470	2.70	8.17	10.6	tequal	Mean	<0.001	29.9	10.7	13.6	tequal	Mean	<0.001	26.5
Copper	mg/kg	17.3	15.2	tequal	Mean	0.379	-12.5	10.5	18.4	tequal	Mean	<0.001	76	15.4	27.1	tequal	Mean	<0.001	76.7
Iron	mg/kg	24,233	26,300	tequal	Mean	0.068	8.53	20,800	26,860	tequal	Mean	<0.001	29.1	25,120	30,400	tequal	Mean	<0.001	21.0
Lead	mg/kg	9.01	9.20	tequal	Mean	0.751	2.03	8.71	11.1	tequal	Mean	<0.001	27.4	6.10	7.40	tequal	Mean	<0.001	21.5
Lithium	mg/kg	13.6	11.0	tequal	Mean	0.001	-19.1	9.50	12.9	tequal	Mean	<0.001	35.6	13.2	14.3	tequal	Mean	0.046	8.19
Magnesium	mg/kg	7,460	8,204	tequal	Mean	0.046	9.97	6,163	8,580	tequal	Mean	<0.001	39.2	6,802	8,288	tequal	Mean	<0.001	21.8
Manganese	mg/kg	805	706	tequal	Mean	0.082	-12.4	565	529	tequal	Mean	0.254	-6.39	593	711	tequal	Mean	0.007	19.9
Molybdenum	mg/kg	0.810	0.830	tequal	Mean	0.685	2.47	0.763	0.754	tequal	Mean	0.744	-1.22	1.11	1.06	tequal	Mean	0.189	-4.86
Nickel	mg/kg	25.7	22.6	tequal	Mean	0.001	-11.9	14.0	18.7	tequal	Mean	<0.001	33.5	16.2	22.4	tequal	Mean	<0.001	38.3
Phosphorus	mg/kg	536	599	tequal	Mean	0.171	11.8	423	538	tequal	Mean	<0.001	27.4	562	734	tequal	Mean	<0.001	30.5
Potassium	mg/kg	1,287	1,530	tequal	Mean	0.019	18.9	1,423	1,929	tequal	Geometric Mean	<0.001	35.5	2,066	1,980	tequal	Mean	0.386	-4.16
Selenium	mg/kg	0.380	0.220	M-W	Median	0.036	-42.1	0.200	0.200	M-W	Median	0.606	0	0.242	0.446	tequal	Mean	<0.001	84.3
Silver	mg/kg	0.120	0.100	M-W	Median	0.079	-16.7	nt	nt	nt	nt	nt	nt	0.100	0.180	M-W	Median	0.007	80.0
Sodium	mg/kg	207	201	tequal	Mean	0.812	-2.80	158	312	tequal	Mean	<0.001	97.2	196	332	M-W	Median	0.012	69.4
Strontium	mg/kg	97.6	75.6	tequal	Mean	0.080	-22.5	38.0	59.3	tequal	Mean	<0.001	55.8	36.2	64.6	tequal	Mean	<0.001	78.6
Thallium	mg/kg	0.193	0.186	tequal	Mean	0.382	-3.69	0.171	0.198	tequal	Mean	0.002	15.4	0.229	0.231	tequal	Mean	0.782	1.14
Titanium	mg/kg	764	961	tequal	Mean	0.009	25.8	765	1,210	M-W	Median	0.036	58.2	986	1,250	M-W	Median	0.008	26.8
Tungsten	mg/kg	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	nt	0.500	0.500	M-W	Median	0.424	0
Uranium	mg/kg	33.7	17.4	tequal	Mean	0.005	-48.5	3.39	4.25	tequal	Mean	0.024	25.2	7.25	9.49	tequal	Mean	0.027	30.9
Vanadium	mg/kg	50.6	61.9	tequal	Mean	0.007	22.3	44.5	64	tequal	Mean	<0.001	43.8	58.0	75.9	tequal	Mean	<0.001	30.8
Zinc	mg/kg	63.4	59.8	tequal	Mean	0.173	-5.70	51.5	66.6	tequal	Mean	<0.001	29.4	62.1	79.6	tequal	Mean	<0.001	28.2
Zirconium	mg/kg	2.50	1.58	tequal	Mean	0.001	-36.8	2.17	2.52	tequal	Mean	<0.001	16.3	2.58	3.64	tequal	Mean	0.002	41.1

P-value < 0.05.

Magnitude of Difference (MOD) > 0 and p-value < 0.05.

Magnitude of Difference (MOD) < 0 and p-value < 0.05.

Notes: "nt" = not tested when parameters had 100% concentrations recorded at the LRL. Comparisons were made using a T-Test (tequal) unless assumption of normality was violated or there were values at the laboratory reporting limit (LRL) forcing the use of a Mann-Whitney U test (M-W). MOD = Magnitude of Difference = $(MCT_{2021} - MCT_{2019})/MCT_{2019} * 100$. MCT = Measure of Central Tendency; MCT reported as mean for untransformed data, median for rank-transformed data and geometric mean for log10-transformed data. Parameters that had 100% concentrations recorded at the LRL at all three stations in two years, had less than three samples per station per year, and/or had only one year data were excluded from the analyses.

Table F.3: **Statistical Spatial Comparison of Sediment Analyte Concentrations for Lower Creek Reference and Future Exposed Areas, Coffee Project FALMP, AEMP, 2019**

Analytes	Units	MCT				Test	Summary Statistic	P-value	MOD (%)				
									XE0.2 vs SYT0.6	SYT0.6 vs Downstream		XE0.2 vs Downstream	
		SYT0.6	XE0.2	HC0.2	CC5.6				XE0.2 vs SYT0.6	HC0.2 vs SYT0.6	CC5.6 vs SYT0.6	HC0.2 vs XE0.2	CC5.6 vs XE0.2
Total Organic Carbon	mg/kg	3.29	9.36	4.01	2.78	ANOVA	Mean	0.002	184	ns	ns	-57.2	-70.3
Aluminum	mg/kg	12,100	13,100	13,400	13,600	K-W	Median	0.049	ns	ns	12.4	ns	ns
Antimony	mg/kg	0.380	0.527	0.923	0.608	ANOVA	Mean	<0.001	ns	143	60.0	75.3	ns
Arsenic	mg/kg	6.28	8.61	16.8	11.0	ANOVA	Geometric Mean	<0.001	37.0	167	75.6	95.0	28.2
Barium	mg/kg	155	266	152	191	ANOVA	Mean	<0.001	71.8	ns	23.4	-42.8	-28.2
Beryllium	mg/kg	0.450	0.710	0.470	0.360	ANOVA	Mean	<0.001	57.8	ns	ns	-33.8	-49.3
Bismuth	mg/kg	0.200	0.200	0.200	0.200	K-W	Median	0.300	ns	ns	ns	ns	ns
Cadmium	mg/kg	0.135	0.565	0.163	0.205	ANOVA	Mean	<0.001	318	ns	ns	-71.1	-63.8
Calcium	mg/kg	7,444	16,252	7,491	5,465	ANOVA	Geometric Mean	<0.001	118	ns	-26.6	-53.9	-66.4
Chromium	mg/kg	31.1	37.4	37.9	24.9	ANOVA	Geometric Mean	<0.001	20.3	21.7	-19.8	ns	-33.3
Cobalt	mg/kg	10.2	12.9	10.6	10.7	ANOVA	Geometric Mean	0.006	26.2	ns	ns	-18.0	-17.1
Copper	mg/kg	13.0	32.8	14.7	15.4	ANOVA	Mean	<0.001	153	ns	ns	-55.1	-53.2
Iron	mg/kg	22,700	26,600	21,600	24,600	K-W	Median	0.024	17.2	ns	ns	-18.8	ns
Lead	mg/kg	6.09	8.95	6.09	6.10	ANOVA	Mean	<0.001	46.8	ns	ns	-32.0	-31.9
Lithium	mg/kg	9.47	16.1	13.0	13.2	ANOVA	Mean	<0.001	70.4	37.3	39.2	-19.4	-18.3
Magnesium	mg/kg	7,320	9,350	7,363	6,802	ANOVA	Mean	<0.001	27.7	ns	ns	-21.2	-27.3
Manganese	mg/kg	450	737	493	593	ANOVA	Mean	<0.001	63.9	ns	32.0	-33.1	-19.5
Molybdenum	mg/kg	0.577	0.977	0.617	1.11	ANOVA	Mean	<0.001	69.4	ns	92.8	-36.9	ns
Nickel	mg/kg	17.8	38.3	22.3	16.2	ANOVA	Mean	<0.001	115	ns	ns	-41.8	-57.7
Phosphorus	mg/kg	598	702	580	562	ANOVA	Mean	0.013	ns	ns	ns	-17.3	-19.9
Potassium	mg/kg	1,760	2,163	1,637	2,066	ANOVA	Mean	<0.001	22.9	ns	17.4	-24.3	ns
Selenium	mg/kg	0.200	0.870	0.200	0.240	K-W	Median	0.008	335	ns	20.0	-77.0	ns
Silver	mg/kg	0.100	0.160	0.100	0.100	K-W	Median	0.005	60.0	ns	ns	-37.5	-37.5
Sodium	mg/kg	146	112	147	197	ANOVA	Mean	<0.001	ns	ns	34.6	ns	76.4
Strontium	mg/kg	65.4	146	69.5	36.2	ANOVA	Mean	<0.001	123	ns	ns	-52.3	-75.2
Sulfur	mg/kg	1,000	1,000	1,000	1,000	K-W	Median	0.300	ns	ns	ns	ns	ns
Thallium	mg/kg	0.151	0.251	0.162	0.229	ANOVA	Mean	<0.001	65.9	ns	51.2	-35.6	ns
Titanium	mg/kg	698	640	721	1,012	ANOVA	Geometric Mean	<0.001	ns	ns	44.9	ns	58.1
Tungsten	mg/kg	0.500	0.500	0.500	0.500	K-W	Median	0.627	ns	ns	ns	ns	ns
Uranium	mg/kg	7.55	3.63	14.4	7.25	ANOVA	Mean	<0.001	ns	90.6	ns	297	ns
Vanadium	mg/kg	42.8	42.3	41.2	57.9	ANOVA	Geometric Mean	<0.001	ns	ns	35.3	ns	37.0
Zinc	mg/kg	48.5	98.5	50.3	62.1	ANOVA	Mean	<0.001	103	ns	28.0	-49.0	-37.0
Zirconium	mg/kg	2.43	2.47	2.57	2.58	ANOVA	Mean	0.874	ns	ns	ns	ns	ns

P-value < 0.05.

Magnitude of Difference (MOD) > 0 and p-value < 0.05.

Magnitude of Difference (MOD) < 0 and p-value < 0.05.

Notes: MOD = Magnitude of Difference = (MCT_{Exp} - MCT_{Ref}/MCT_{Ref} *100. MCT = Measure of Central Tendency; MCT reported as mean for untransformed data, median for rank-transformed data and geometric mean for log10-transformed data. Ns = not significant. ANOVA = Analysis of Variance Test. K-W = Kruskal Wallis Test

APPENDIX G
DATA QUALITY REVIEW

APPENDIX G DATA QUALITY REVIEW

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G1 INTRODUCTION

This Data Quality Review (DQR) provides an evaluation of data collected as part of the Coffee Project FALMP baseline benthic invertebrate, periphyton, and sediment sampling conducted in 2018, 2019, and 2021. The objective of the DQR is to define the overall quality of the data presented in the report, and, by extension, the confidence with which the data can be used to derive conclusions.

G1.1 Background

A variety of factors can influence the physical, chemical, and biological measurements made in an environmental study and thus affect the accuracy and/or precision of the data. Depending on their magnitude, inaccuracy or imprecision have the potential to affect the reliability of conclusions made from the data. Therefore, it is important to ensure that programs incorporate appropriate steps to control the non-natural sources of data variability (i.e., minimize the variability that does not reflect natural spatial and temporal variability in the environment) and thus assure the quality of the data. Data quality as a concept is meaningful only when it relates to the intended use of the data. That is, one must know the context in which the data will be interpreted in order to establish a relevant basis for judging whether or not the data set is adequate. A DQR involves comparison of actual field and laboratory measurement performance to Data Quality Objectives (DQOs) established for a particular study, such as evaluation of Laboratory Reporting Limits (LRL), blank sample data, data precision (based on field and laboratory duplicate samples), and data accuracy (based on matrix spike recoveries and/or analysis of standards or certified reference materials). Trusted analytical laboratories certified by Canadian Association for Laboratory Accreditation (CALA) with a rigorous internal quality assurance program was selected to ensure the highest possible data quality. DQOs were established *a priori* to reflect reasonable and achievable performance expectations. Programs involving a large number of samples and analytes usually yield some results that exceed DQOs. This is particularly so for multi-element scans since the analytical conditions are not necessarily optimal for every element included in the scan. Generally, scan results may be considered acceptable if no more than 20% of the parameters fail to meet DQOs. Overall, the intent of DQR is not to reject any measurement that did not meet a DQO, but to ensure that any questionable data received more scrutiny to determine what effect, if any, this had on interpretation of results within the context of the project.

A Data Quality Review (DQR) was conducted on all laboratory data collected as part of Project FALMP baseline data analysis. The objective of DQR is to define the overall quality of the

data presented in the report, and, by extension, the confidence with which the data can be used to derive conclusions.

A DQR involves the examination of analytical results associated with several types of Quality Control (QC) samples collected (or prepared) in the field and laboratory. General QC samples collected for this project, and a description of each, include the following:

G1.2 Types of Quality Control Samples

- **Blanks** are samples of de-ionized water and/or appropriate reagent(s) that are handled and analyzed in the same way as regular samples. These samples will reflect any contamination of samples occurring in the field (in the case of field or travel blanks) or in the laboratory (in the case of laboratory or method blanks). Analyte concentrations should be non-detectable.
- **Laboratory Duplicates** are sub-sample pairs created in the laboratory from randomly selected field samples which are sub-sampled and then analyzed independently using identical analytical methods. The laboratory duplicate sample results reflect any variability introduced during laboratory sample handling and analysis and thus provide a measure of laboratory precision.
- **Laboratory Control Samples** are created in the laboratory to have a known analyte concentration in a matrix free of interferences, such as deionized water or reference sand. The sample results are compared to the target results to confirm that the analytical method is accurate in a purified reference sample. The results are reported as the percent of the known concentration that was recovered in the analysis.

Two types of QC were only applied to benthic community samples as follows:

- **Laboratory Sorting Duplicates** are randomly selected grabs of the initially sorted community material. These samples are recounted and the number of invertebrates that were not recovered during the initial sort was determined. In order to reduce bias, the recounting was conducted by an analyst uninvolved in the initial sample processing. This check was performed on 10% of samples and determines the accuracy through assessment of recovery (sorting) efficiency and quantifies any under-estimation of organism enumeration.

One QC type was specific to benthic community and also to periphyton community samples as follows:

- **Laboratory Subsamples** are community samples prepared by the laboratory to ensure that the fraction of the total sample examined was an accurate representation of the total number of organisms. By comparing the amount recovered between at least two sub-samples, one can assess the analytical precision. In addition, comparisons of the sub-samples from the whole community sample allows for an evaluation of sub-sampling accuracy.

G2 PERIPHYTON COMMUNITY

G2.1 Laboratory Reporting Limits

Dry weight, ash weight, ash-free dry weight (AFDM), and chlorophyll-a results from 2018, 2019, and 2021 (L2157659, L2337313, and WR2101119, respectively; Appendix H) were examined to provide an inventory of analytes that were less than the LRL. All individual chlorophyll-a measures across all years were found to be above the LRL (Appendix H). All 2018 AFDM results from 2018 were above the LRL, whereas 6 (12%) and 7 (14%) were below the LRL in 2019 and 2021, respectively (Appendix H). Therefore, the achieved LRLs are appropriate for the study.

G2.2 Laboratory Blanks

Three method blank (MB) samples each from 2018 (WG2876899-1, WG2876899-3, and WG2876899-5), 2019 (WG3156219-1, WG3156219-3, and WG3156219-5), and 2021 (QC-280315-001, QC-280316-001, and QC-280317-001) were analyzed in the ALS Laboratory Reports (L2157659, L2337313, and WR2101119; Appendix G). The blank dry weight, ash weight, ash-free dry weight, and chlorophyll-a results were below the LRL and laboratory DQO for all MB samples, meaning that laboratory contamination had no observable impact on the results.

G2.3 Data Accuracy

Chlorophyll-a accuracy was evaluated based on results of five LCS samples from 2018 (WG2880159-2, WG2882403-2, WG2882403-4, WG2882444-2, and WG2882444-4), and three each from 2019 (WG3157665-2, WG3157665-4, and WG3157665-6) and 2021 (QC-280315-002, QC-280316-002, and QC-280317-002) which both met the laboratory DQO (within 20% of accepted value, L2157659, L2337313, and WR2101119; Appendix H). The accuracy achieved by the laboratory in this study can therefore be considered excellent.

G2.4 Density Accuracy

Periphyton density was re-measured in a total of five samples per year in 2018, 2019 and 2021 (10% of all samples) to evaluate sub-sampling accuracy and taxonomic consistency within the periphyton enumeration and identification laboratory report (Appendix H). Since there was a high percent of agreement between the duplicate pairs across all years (2018 mean 87%; 2019 mean 89%, 2021 mean 89%) the samples is considered to have good field subsampling precision and reproducibility (Appendix Table G.1).

G2.5 Data Quality Statement

Periphyton community data collected for the Project FALMP were of acceptable quality as characterized by good sub-sampling accuracy. Additionally, productivity measurements (dry weight, ash weight, and chlorophyll-a) results were of acceptable detectability, negligible analyte concentrations in method blanks, good laboratory precision, and good laboratory accuracy. Therefore, the associated data can be used with a good level of confidence in the derivation of conclusions.

Table G.1: Laboratory Duplicate Results for Analysis of Periphyton Total Density (cells/cm^2), 2018, 2019, and 2021

Year	Sample ID	Laboratory ID	Original Density (cells/cm^2)	Quality Assurance Density (cells/cm^2)	Percent Agreement (%)[a]
2018	CR24.5-1	18-134-009	1,643,915	1,787,342	91.28
	HC0.2-2	18-134-020	1,501,401	1,237,347	82.41
	LC10.2-3	18-134-026	2,240,377	2,002,605	89.39
	SYT0.6-3	18-134-031	4,290,174	4,772,829	88.75
	XEO0.2-1	18-134-034	2,033,627	1,669,357	82.09
				Average:	**86.78**
2019	CC5.6-1	19-028-001	667,407	744,733	88.41
	HCO.2-4	19-028-019	1,609,366	1,632,307	98.57
	HC6.8-5	19-028-025	2,873,790	3,056,551	93.64
	SYT0.6-1	19-028-031	1,732,828	2,065,076	80.83
	XEO.2-3	19-028-038	2,354,240	1,986,809	84.39
				Average:	**89.17**
2021	LC10.2-3	pp21-162-013	108,044	92,028	85.18
	CC23.7-4	pp21-162-024	518,255	428,940	82.77
	HC0.2-3	pp21-162-028	380,447	387,864	98.05
	CC5.6-2	pp21-162-032	6,519,526	5,589,484	85.73
	SYT0.6-4	pp21-162-039	371,504	391,451	94.63
				Average:	**89.27**

[a] Percent agreement calculated as: (100- [(difference in abundance between samples) / total abundance of original sample)] *100)%.

G3 BENTHIC INVERTEBRATE COMMUNITY

Five benthic invertebrate samples each from 2018, 2019, and 2021 were re-sorted to assess sorting efficiency. Sorting accuracy for all but one sample in 2018 (CF3.9-5) met the objective for percent organism recovery; with recovery over 90% (Table G.2). The one sample which did not meet the 90% target reached 89% sorting efficiency, missing only one organism. This low efficiency was therefore exaggerated because CF3.9-5 was a particularly depauperate sample. Of 50 benthic invertebrate community samples analyzed for each year 43 sampling in 2018, 22 in 2019, and 29 in 2021 were analyzed whole. The remaining samples were subsampled at percentages ranging from 48% to 88% in 2018, 31% to 75% in 2019, and 25% to 80% in 2021 (Table G.3). This indicates that the benthic invertebrate data can be reliably interpreted.

G4 BENTHIC INVERTEBRATE TISSUE SAMPLES

G4.1 Laboratory Reporting Limits

Eight benthic invertebrate tissue analytes each in 2018 and 2019 were below LRLs and did not meet targets: antimony (2019 - 1 of 50 samples), boron (2018 – 44 of 50 samples, 2019 -41 of 50 samples), chromium (2018 – 6 of 50 samples, 2019 - 1 of 50 samples), cobalt (2018 – 12 of 50 samples, 2019 - 1 of 50 samples), lead (2019 - 1 of 50 samples), molybdenum (2018 – 1 of 50 samples), nickel (2018 – 10 of 50 samples, 2019 - 1 of 50 samples), silver (2018 – 2 of 50 samples), thallium (2018 – 12 of 50 samples, 2019 - 1 of 50 samples), and tin (2018 – 42 of 50 samples, 2019 - 13 of 50 samples; Table G.4). No benthic invertebrate tissue analytes were below LRLs in 2021, potentially due to the change in laboratory subcontractor. Target concentrations are not guidelines but represent detection limits quoted by the laboratory. Benthic invertebrate tissue data for this project can be reliably interpreted.

G4.2 Data Precision

Laboratory duplicate benthic invertebrate tissue samples were analyzed in 2021 only and showed good agreement among all duplicate analyte concentrations (Appendix H). Benthic invertebrate tissue chemistry samples were associated with good analytical precision.

Table G.2: Percent Sorting Efficiency of Benthic Invertebrate Community Samples, 2018, 2019, and 2021

Year	Station	Initial Sort	Re-sort	Percent Sorting Efficiency [a]
2018	CF3.9-5	9	1	89%
	HFO.2-2	112	1	99%
	XE0.2-1	325	1	100%
	XE0.2-4	506	23	95%
	YT4.6-1	67	1	99%
			Average Recovery	**96.4%**
2019	CC5.6-2	125	5	96%
	XE0.2-1	392	5	99%
	YT0.2-3	226	2	99%
	SYT0.6-4	320	0	100%
	YT4.3-2	255	3	99%
			Average Recovery	**98.6%**
2021	SYT0.6-1	395	5	99%
	YT0.2-2	371	0	100%
	YT4.3-1	310	7	98%
	LC10.2-2	239	11	95%
	LC10.2-4	216	9	96%
			Average Recovery	**97.6%**

Sorting efficiency < 90%.

[a] Percent sorting efficiency = (1-(# in QA/AC re-sort / (# sorted originally + # in QA/QC re-sort)))* 100.

Table G.3: Percent of Sample Sorted and the Total Number of Invertebrates Recovered from the Sampled Fraction, 2018, 2019, and 2021

Sample ID	Sieve Size (µm)	2018			2019			2021		
		Laboratory ID	% Sampled	# Invertebrates	Laboratory ID	% Sampled	# Invertebrates	Laboratory ID	% Sampled	# Invertebrates
CC5.6-1	500	CC190674	100%	95	CC200540	100%	300	CC220594	100%	259
CC5.6-2	500	CC190675	100%	46	CC200541	100%	125	CC220595	100%	320
CC5.6-3	500	CC190676	100%	37	CC200542	75%	315	CC220596	75%	329
CC5.6-4	500	CC190677	100%	38	CC200543	100%	104	CC220597	100%	256
CC5.6-5	500	CC190678	100%	9	CC200544	100%	86	CC220598	100%	120
SYT0.6-1	500	CC190699	100%	408	CC200580	50%	313	CC220599	50%	395
SYT0.6-2	500	CC190700	100%	357	CC200581	50%	342	CC220600	75%	464
SYT0.6-3	500	CC190701	50%	391	CC200582	50%	327	CC220601	50%	448
SYT0.6-4	500	CC190702	100%	311	CC200583	50%	320	CC220602	50%	604
SYT0.6-5	500	CC190703	75%	412	CC200584	75%	335	CC220603	25%	323
XE0.2-1	500	CC190709	88%	325	CC200545	100%	392	CC220604	50%	327
XE0.2-2	500	CC190710	100%	153	CC200546	50%	345	CC220605	100%	457
XE0.2-3	500	CC190711	75%	319	CC200547	75%	351	CC220606	100%	338
XE0.2-4	500	CC190712	100%	506	CC200548	31%	344	CC220607	100%	343
XE0.2-5	500	CC190713	100%	78	CC200549	37%	319	CC220608	100%	445
YT0.2-1	500	CC190714	100%	74	CC200560	100%	266	CC220609	100%	265
YT0.2-2	500	CC190715	100%	93	CC200561	100%	277	CC220610	100%	371
YT0.2-3	500	CC190716	100%	70	CC200562	100%	226	CC220611	100%	210
YT0.2-4	500	CC190717	100%	116	CC200563	100%	215	CC220612	69%	329
YT0.2-5	500	CC190718	100%	82	CC200564	100%	277	CC220613	75%	417
HC6.8-1	500	CC190694	100%	48	CC200555	50%	318	CC220614	75%	313
HC6.8-2	500	CC190695	100%	96	CC200556	63%	320	CC220615	75%	387
HC6.8-3	500	CC190696	100%	280	CC200557	100%	298	CC220616	100%	245
HC6.8-4	500	CC190697	100%	187	CC200558	100%	257	CC220617	100%	169
HC6.8-5	500	CC190698	100%	114	CC200559	100%	159	CC220618	100%	295
YT4.3-1	500	CC190719	100%	67	CC200585	75%	346	CC220619	100%	310
YT4.3-2	500	CC190720	100%	132	CC200586	100%	255	CC220620	100%	180
YT4.3-3	500	CC190721	100%	165	CC200587	50%	313	CC220621	63%	376
YT4.3-4	500	CC190722	100%	235	CC200588	100%	274	CC220622	100%	195
YT4.3-5	500	CC190723	100%	36	CC200589	63%	350	CC220623	100%	357
LC10.2-1	500	CC190689	100%	116	CC200570	100%	327	CC220624	100%	358
LC10.2-2	500	CC190690	100%	76	CC200571	100%	271	CC220625	100%	239
LC10.2-3	500	CC190691	100%	265	CC200572	100%	205	CC220626	80%	331
LC10.2-4	500	CC190692	100%	125	CC200573	100%	247	CC220627	100%	216
LC10.2-5	500	CC190693	100%	195	CC200574	100%	193	CC220628	100%	319
CR24.5-1	500	CC190704	100%	257	CC200565	50%	332	CC220629	100%	287
CR24.5-2	500	CC190705	100%	260	CC200566	100%	374	CC220630	50%	427
CR24.5-3	500	CC190706	100%	98	CC200567	100%	183	CC220631	75%	385
CR24.5-4	500	CC190707	100%	102	CC200568	50%	309	CC220632	38%	353
CR24.5-5	500	CC190708	100%	319	CC200569	75%	340	CC220633	25%	333
CC23.7-1	500	CC190679	100%	532	CC200575	50%	372	CC220634	100%	184
CC23.7-2	500	CC190680	75%	335	CC200576	63%	335	CC220635	100%	376
CC23.7-3	500	CC190681	100%	322	CC200577	56%	322	CC220636	100%	386
CC23.7-4	500	CC190682	75%	345	CC200578	100%	344	CC220637	100%	408
CC23.7-5	500	CC190683	48%	351	CC200579	100%	384	CC220638	100%	211
HCO.2-1	500	CC190684	100%	197	CC200550	100%	287	CC220639	63%	331
HCO.2-2	500	CC190685	100%	112	CC200551	100%	363	CC220640	50%	369
HCO.2-3	500	CC190686	100%	260	CC200552	75%	324	CC220641	100%	480
HCO.2-4	500	CC190687	100%	110	CC200553	50%	371	CC220642	50%	419
HCO.2-5	500	CC190688	100%	163	CC200554	100%	342	CC220643	50%	350

G5 SEDIMENT SAMPLES

G5.1 Laboratory Reporting Limits

Results for eight analytes were reported as less than LRL (7 in 2019, 8 in 2021) but only mercury, selenium, and silver had associated guidelines (Table G.5). Mercury and selenium LRLs were below the Canadian Sediment Quality Guideline (CSQG; CCME 1999; Table G.5). Analytes with guidelines detectable in the majority of samples indicating that the data can be reliably interpreted.

G5.2 Laboratory Blank Sample Analysis

All method blank samples across both years contained non-detectable analyte concentrations indicating no inadvertent contamination of samples within the laboratory during analysis (Appendix H).

G5.3 Data Precision

Agreement was achieved between all laboratory duplicate samples across both years, indicating excellent analytical precision.

Table G.4: Evaluation of < Laboratory Reporting Limit (LRL) Benthic Invertebrate and Periphyton Tissue Chemistry Results Relative to Reporting Limits, 2018, 2019, and 2021

Parameter	Units	British Columbia Interim Dietary Guidelines [a]	Range of LRLs (2018 to 2019)	LRLs[b] (2021)	2018 No. Sample Results <LRL	2019 No. Sample Results <LRL	2021 No. Sample Results <LRL
Metals							
Antimony	µg/g	-	0.01 to 0.1	0.135	0	1 (2%)	0
Boron	µg/g	-	1 to 50	0.004	44 (88%)	41 (82%)	0
Chromium	µg/g	-	1 to 5	0.356	6 (12%)	1 (2%)	0
Cobalt	µg/g	-	0.5 to 5	0.008	12 (24%)	1 (2%)	0
Lead	µg/g	-	0.5	0.001	0	1 (2%)	0
Molybdenum	µg/g	-	0.5	0.001	1 (2%)	0	0
Nickel	µg/g	-	1 to 5	0.043	10 (20%)	1 (2%)	0
Silver	µg/g	-	0.02	0.001	2 (4%)	0	0
Thallium	µg/g	-	0.01 to 0.1	0.001	12 (24%)	1 (2%)	0
Tin	µg/g	-	0.1 to 2	0.035	42 (84%)	13 (26%)	0

Note: LRL = Laboratory Reporting Limit. "-" indicates that no guideline is available.

[a] British Columbia Approved Water Quality Guidelines (BCMOECCS 2019).

[a] Detection limits changed following change in laboratory subcontractor to TrichAnalytics in 2021.

G6 DATA QUALITY STATEMENT

All data quality objectives for periphyton community and benthic invertebrate community were met. Chlorophyll-a and AFDM met all data quality objectives and was deemed acceptable. For benthic invertebrate tissue chemistry, the LRL target values were met for all analytes except for antimony, boron, chromium, cobalt, lead, molybdenum, nickel, silver, thallium, and tin in some 2018 and 2019 samples. All LRL target values were met for all 2021 benthic invertebrate tissue chemistry samples. However, all applicable guidelines could be met with the 2021 laboratory limits.

Laboratory accuracy and precision was considered excellent across all components. Where applicable, method blanks, duplicates, and laboratory control samples met the laboratory data quality objectives.

The overall quality of data for this project was considered good and can serve to meet the project objectives.

Table G.5: Evaluation of < Laboratory Reporting Limit (LRL) Sediment Chemistry Results Relative to Guidelines, 2018, 2019, 2021[a]

Analyte	Unit	BCWSG[b]		2019		2021	
		Long-term	Short-term	Maximum LRL	No. Sample Results <LRL	Maximum LRL	No. Sample Results <LRL
Particle Size							
% Gravel (>2 mm)	%	-	-	1	9 (100%)	1	14 (70%)
Metals							
Bismuth	mg/kg	-	-	0.20	23 (96%)	0.2	15 (75%)
Boron	mg/kg	-	-	5	24 (100%)	5	20 (100%)
Mercury	mg/kg	0.17	0.486	0.05	0	0.05	8 (40%)
Selenium	mg/kg	2	-	0.20	10 (42%)	0.2	10 (50%)
Silver	mg/kg	0.5	-	0.10	17 (71%)	0.1	13 (65%)
Sulphur	mg/kg	-	-	1000	23 (96%)	1000	20 (100%)
Tin	mg/kg	-	-	1.0	24 (100%)	1	20 (100%)
Tungsten	mg/kg	-	-	0.50	21 (88%)	0.5	17 (85%)

Note: "-" = no applicable guideline.

[a] Only analytes with reported values less than LRL were presented.

[b] British Columbia Working Sediment Guidelines (BCWSG; BCMOECCS 2021) and approved BC Sediment Quality Guideline for Selenium (BCMOECCS 2019).

G7 REFERENCES

CCME (Canadian Council of Ministers of the Environment). 1999 (plus updates). Canadian Environmental Quality Guidelines. CCME, Winnipeg.

APPENDIX H
LABORATORY REPORTS

PERIPHYTON
CHLOROPHYLL-A, ASH-FREE
DRY MASS, AND SEDIMENT

2018

Results Summary L2157659

Job Reference	187202-43
Report To	Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received	4-Sep-2018 9:00
Report Date	21-Sep-2018 13:22
Report Version	1

Client Sample ID			Ash-Free Dry Mass															
			XEO.2-1 AFDM	XEO.2-2 AFDM	XEO.2-3 AFDM	XEO.2-4 AFDM	XEO.2-5 AFDM	HFO.2-1 AFDM	HFO.2-2 AFDM	HFO.2-3 AFDM	HFO.2-4 AFDM	HFO.2-5 AFDM	SYTO.6-1 AFDM	SYTO.6-2 AFDM	SYTO.6-3 AFDM	SYTO.6-4 AFDM	SYTO.6-5 AFDM	YTO.2-1 AFDM	YTO.2-2 AFDM
Date Sampled			31-Aug-2018	31-Aug-2018	31-Aug-2018	31-Aug-2018	31-Aug-2018	30-Aug-2018	30-Aug-2018	29-Aug-2018	22-Aug-2018	22-Aug-2018	30-Aug-2018	30-Aug-2018	30-Aug-2018	30-Aug-2018	30-Aug-2018	29-Aug-2018	29-Aug-2018
Time Sampled			13:00	12:00	10:30	09:30	08:30	09:00	08:10	17:45	17:18	14:40	15:30	14:40	13:40	12:50	12:00	14:00	12:15
ALS Sample ID			L2157659-1	L2157659-2	L2157659-3	L2157659-4	L2157659-5	L2157659-6	L2157659-7	L2157659-8	L2157659-9	L2157659-10	L2157659-11	L2157659-12	L2157659-13	L2157659-14	L2157659-15	L2157659-16	L2157659-17
Parameter	**Lowest Detection Limit**	**Units**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**
Field Tests (Biota)																			
Area Sampled	**0.010**	**cm2**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Physical Tests (Biota)																			
Dry Weight	**0.0010**	**g**	0.0360	0.0449	0.0312	0.0816	0.0386	0.0366	0.0290	0.0272	0.0513	0.0174	0.0499	0.0441	0.0432	0.0519	0.156	0.0219	0.0402
Ash Weight	**0.0010**	**g**	0.0058	0.0126	0.0114	0.0303	0.0128	0.0100	0.0106	0.0078	0.0131	0.0059	0.0092	0.0052	0.0080	0.0090	0.0308	0.0061	0.0125
Ash Free Dry Weight	**0.0010**	**g**	0.0302	0.0323	0.0198	0.0513	0.0258	0.0266	0.0185	0.0194	0.0382	0.0115	0.0406	0.0389	0.0353	0.0429	0.125	0.0158	0.0277
Plant Pigments (Biota)																			
Chlorophyll a	**0.010**	**ug**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: "-" indicates no available data.

Results Summary L2157659

Job Reference	187202-43
Report To	Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received	4-Sep-2018 9:00
Report Date	21-Sep-2018 13:22
Report Version	1

Client Sample ID			Ash-Free Dry Mass															
			YTO.2-3 AFDM	YTO.2-4 AFDM	YTO.2-5 AFDM	YT4.6-1 AFDM	YT4.6-2 AFDM	YT4.6-3 AFDM	YT4.6-4 AFDM	YT4.6-5 AFDM	CF19.2-1 AFDM	CF19.2-2 AFDM	CF19.2-3 AFDM	CF19.2-4 AFDM	CF19.2-5 AFDM	CR16.7-1 AFDM	CR16.7-2 AFDM	CR16.7-3 AFDM	CR16.7-4 AFDM
Date Sampled			29-Aug-2018	29-Aug-2018	29-Aug-2018	28-Aug-2018	28-Aug-2018	28-Aug-2018	28-Aug-2018	28-Aug-2018	26-Aug-2018	26-Aug-2018	26-Aug-2018	26-Aug-2018	26-Aug-2018	27-Aug-2018	27-Aug-2018	27-Aug-2018	27-Aug-2018
Time Sampled			10:50	09:25	08:15	07:45	09:00	10:45	12:20	14:00	09:00	10:15	11:30	12:45	14:10	11:00	09:30	08:15	12:45
ALS Sample ID			L2157659-18	L2157659-19	L2157659-20	L2157659-21	L2157659-22	L2157659-23	L2157659-24	L2157659-25	L2157659-26	L2157659-27	L2157659-28	L2157659-29	L2157659-30	L2157659-31	L2157659-32	L2157659-33	L2157659-34
Parameter	**Lowest Detection Limit**	**Units**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**
Field Tests (Biota)																			
Area Sampled	**0.010**	**cm2**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Physical Tests (Biota)																			
Dry Weight	**0.0010**	**g**	0.0301	0.0269	0.0291	0.0422	0.0482	0.0323	0.0537	0.0107	0.0486	0.0669	0.0278	0.0553	0.0476	0.0379	0.0782	0.0884	0.0739
Ash Weight	**0.0010**	**g**	0.0015	0.0106	0.0109	0.0159	0.0090	0.0068	0.0295	0.0063	0.0049	0.0141	0.0035	0.0074	0.0059	0.0096	0.0401	0.0574	0.0234
Ash Free Dry Weight	**0.0010**	**g**	0.0286	0.0164	0.0182	0.0264	0.0392	0.0255	0.0242	0.0044	0.0437	0.0528	0.0243	0.0480	0.0417	0.0283	0.0381	0.0310	0.0505
Plant Pigments (Biota)																			
Chlorophyll a	**0.010**	**ug**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: "-" indicates no available data.

Results Summary L2157659

Job Reference	187202-43
Report To	Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received	4-Sep-2018 9:00
Report Date	21-Sep-2018 13:22
Report Version	1

Client Sample ID			Ash-Free Dry Mass													Chlorophyll-a			
			CR16.7-5 AFDM	CF-3.9-1 AFDM	CF-3.9-2 AFDM	CF-3.9-5 AFDM	HF6.3-1 AFDM	HF6.3-2 AFDM	HF6.3-3 AFDM	HF6.3-4 AFDM	HF6.3-5 AFDM	LC8.3-1 AFDM	LC8.3-2 AFDM	LC8.3-3 AFDM	LC8.3-4 AFDM	LC8.3-5 AFDM	XEO.2-1 CHLOROPHYLL A	XEO.2-2 CHLOROPHYLL A	XEO.2-3 CHLOROPHYLL A	XEO.2-4 CHLOROPHYLL A
Date Sampled			27-Aug-2018	25-Aug-2018	25-Aug-2018	25-Aug-2018	24-Aug-2018	24-Aug-2018	24-Aug-2018	24-Aug-2018	24-Aug-2018	23-Aug-2018	23-Aug-2018	23-Aug-2018	23-Aug-2018	23-Aug-2018	31-Aug-2018	31-Aug-2018	31-Aug-2018	31-Aug-2018
Time Sampled			13:45	14:05	10:30	09:00	07:30	09:10	11:00	12:45	14:30	14:38	13:00	11:30	10:00	08:30	13:00	12:00	10:30	09:30
ALS Sample ID			L2157659-35	L2157659-36	L2157659-37	L2157659-38	L2157659-39	L2157659-40	L2157659-41	L2157659-42	L2157659-43	L2157659-44	L2157659-45	L2157659-46	L2157659-47	L2157659-48	L2157659-49	L2157659-50	L2157659-51	L2157659-52
Parameter	**Lowest Detection Limit**	**Units**	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota
Field Tests (Biota)																				
Area Sampled	**0.010**	**cm2**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0
Physical Tests (Biota)																				
Dry Weight	**0.0010**	**g**	0.0620	0.0408	0.0152	0.0041	0.0225	0.0260	0.0317	0.0372	0.0188	0.0282	0.0240	0.0429	0.0160	0.0107	-	-	-	-
Ash Weight	**0.0010**	**g**	0.0233	0.0291	0.0108	0.0017	0.0045	0.0041	0.0075	0.0084	0.0056	0.0045	0.0089	0.0076	0.0021	0.0035	-	-	-	-
Ash Free Dry Weight	**0.0010**	**g**	0.0387	0.0117	0.0044	0.0023	0.0181	0.0220	0.0242	0.0288	0.0132	0.0238	0.0151	0.0353	0.0139	0.0072	-	-	-	-
Plant Pigments (Biota)																				
Chlorophyll a	**0.010**	**ug**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.9	10.9	30.7	43.4

Note: "-" indicates no available data.

Results Summary L2157659

Job Reference	187202-43
Report To	Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received	4-Sep-2018 9:00
Report Date	21-Sep-2018 13:22
Report Version	1

Client Sample ID			Chlorophyll-a															
			XEO.2-5 CHLOROPHYL L A	HFO.2-1 CHLOROPHYL L A	HFO.2-2 CHLOROPHYL L A	HFO.2-3 CHLOROPHYL L A	HFO.2-4 CHLOROPHYL L A	HFO.2-5 CHLOROPHYL L A	SYTO.6-1 CHLOROPHYL L A	SYTO.6-2 CHLOROPHYL L A	SYTO.6-3 CHLOROPHYL L A	SYTO.6-4 CHLOROPHYL L A	SYTO.6-5 CHLOROPHYL L A	YTO.2-1 CHLOROPHYL L A	YTO.2-2 CHLOROPHYL L A	YTO.2-3 CHLOROPHYL L A	YTO.2-4 CHLOROPHYL L A	YTO.2-5 CHLOROPHYL L A	YT4.6-1 CHLOROPHYL L A
Date Sampled			31-Aug-2018	30-Aug-2018	30-Aug-2018	29-Aug-2018	22-Aug-2018	22-Aug-2018	30-Aug-2018	30-Aug-2018	30-Aug-2018	30-Aug-2018	30-Aug-2018	29-Aug-2018	29-Aug-2018	29-Aug-2018	29-Aug-2018	29-Aug-2018	28-Aug-2018
Time Sampled			08:30	09:00	08:10	17:45	17:18	14:40	15:30	14:40	13:40	12:50	12:00	14:00	12:15	10:50	09:25	08:15	07:45
ALS Sample ID			L2157659-53	L2157659-54	L2157659-55	L2157659-56	L2157659-57	L2157659-58	L2157659-59	L2157659-60	L2157659-61	L2157659-62	L2157659-63	L2157659-64	L2157659-65	L2157659-66	L2157659-67	L2157659-68	L2157659-69
Parameter	**Lowest Detection Limit**	**Units**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**
Field Tests (Biota)																			
Area Sampled	**0.010**	**cm2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Tests (Biota)																			
Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ash Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ash Free Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant Pigments (Biota)																			
Chlorophyll a	**0.010**	**ug**	37.8	17	7.62	4.89	6.3	6.13	27.6	18.4	27.2	10.2	64.5	5.39	10.4	4.1	5.41	5.87	5.07

Note: "-" indicates no available data.

Results Summary L2157659

Job Reference	187202-43
Report To	Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received	4-Sep-2018 9:00
Report Date	21-Sep-2018 13:22
Report Version	1

Client Sample ID			Chlorophyll-a															
			YT4.6-2 CHLOROPHYL L A	YT4.6-3 CHLOROPHYL L A	YT4.6-4 CHLOROPHYL L A	YT4.6-5 CHLOROPHYL L A	CF19.2-1 CHLOROPHYL L A	CF19.2-2 CHLOROPHYL L A	CF19.2-3 CHLOROPHYL L A	CF19.2-4 CHLOROPHYL L A	CF19.2-5 CHLOROPHYL L A	CR16.7-1 CHLOROPHYL L A	CR16.7-2 CHLOROPHYL L A	CR16.7-3 CHLOROPHYL L A	CR16.7-4 CHLOROPHYL L A	CR16.7-5 CHLOROPHYL L A	CF3.9-1 CHLOROPHYL L A	CF3.9-2 CHLOROPHYL L A	CF3.9-5 CHLOROPHYL L A
Date Sampled			28-Aug-2018	28-Aug-2018	28-Aug-2018	28-Aug-2018	26-Aug-2018	26-Aug-2018	26-Aug-2018	26-Aug-2018	26-Aug-2018	27-Aug-2018	27-Aug-2018	27-Aug-2018	27-Aug-2018	27-Aug-2018	25-Aug-2018	25-Aug-2018	25-Aug-2018
Time Sampled			09:00	10:45	12:20	14:00	09:00	10:15	11:30	12:45	14:10	11:00	09:30	08:15	12:45	13:45	14:05	10:30	09:00
ALS Sample ID			L2157659-70	L2157659-71	L2157659-72	L2157659-73	L2157659-74	L2157659-75	L2157659-76	L2157659-77	L2157659-78	L2157659-79	L2157659-80	L2157659-81	L2157659-82	L2157659-83	L2157659-84	L2157659-85	L2157659-86
Parameter	**Lowest Detection Limit**	**Units**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**
Field Tests (Biota)																			
Area Sampled	**0.010**	**cm2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Tests (Biota)																			
Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ash Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ash Free Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant Pigments (Biota)																			
Chlorophyll a	**0.010**	**ug**	3.78	3.67	2.35	3.13	39.9	29.2	30.2	72.5	42.8	21.6	13.8	38.6	20.6	33.8	10.1	1.58	3.64

Note: "-" indicates no available data.

Results Summary L2157659

Job Reference	187202-43
Report To	Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received	4-Sep-2018 9:00
Report Date	21-Sep-2018 13:22
Report Version	1

Client Sample ID			Chlorophyll-a									
			HF6.3-1 CHLOROPHYL L A	HF6.3-2 CHLOROPHYL L A	HF6.3-3 CHLOROPHYL L A	HF6.3-4 CHLOROPHYL L A	HF6.3-5 CHLOROPHYL L A	LC8.3-1 CHLOROPHYL L A	LC8.3-2 CHLOROPHYL L A	LC8.3-3 CHLOROPHYL L A	LC8.3-4 CHLOROPHYL L A	LC8.3-5 CHLOROPHYL L A
Date Sampled			24-Aug-2018	24-Aug-2018	24-Aug-2018	24-Aug-2018	24-Aug-2018	23-Aug-2018	23-Aug-2018	23-Aug-2018	23-Aug-2018	23-Aug-2018
Time Sampled			07:30	09:10	11:10	12:45	14:30	14:38	13:00	11:30	10:00	08:30
ALS Sample ID			L2157659-87	L2157659-88	L2157659-89	L2157659-90	L2157659-91	L2157659-92	L2157659-93	L2157659-94	L2157659-95	L2157659-96
Parameter	**Lowest Detection Limit**	**Units**	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota	Biota
Field Tests (Biota)												
Area Sampled	**0.010**	**cm2**	0	0	0	0	0	0	0	0	0	0
Physical Tests (Biota)												
Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-
Ash Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-
Ash Free Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-
Plant Pigments (Biota)												
Chlorophyll a	**0.010**	**ug**	5.57	7.3	6.4	7.84	3.47	7.22	4.99	9.25	5.33	3.74

Note: "-" indicates no available data.

Quality Control L2157659

Job Reference 187202-43
Report To Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received 4-Sep-2018 9:00
Report Date 21-Sep-2018 13:22
Report Version 1

QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
Plant Pigments (Biota)													
LCS	Chlorophyll a	951680	WG2880159-2	1.04	1	ug	103.7	80-120	%		✓	Biota	Plant Pigments
LCS	Chlorophyll a	953607	WG2882403-2	0.929	1	ug	92.9	80-120	%		✓	Biota	Plant Pigments
LCS	Chlorophyll a	953607	WG2882403-4	0.921	1	ug	92.1	80-120	%		✓	Biota	Plant Pigments
LCS	Chlorophyll a	953642	WG2882444-2	0.944	1	ug	94.4	80-120	%		✓	Biota	Plant Pigments
LCS	Chlorophyll a	953642	WG2882444-4	0.942	1	ug	94.2	80-120	%		✓	Biota	Plant Pigments
Physical Tests (Biota)													
MB	Dry Weight	948854	WG2876899-1	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Dry Weight	948855	WG2876899-3	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Dry Weight	948856	WG2876899-5	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Weight	948854	WG2876899-1	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Weight	948855	WG2876899-3	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Weight	948856	WG2876899-5	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Free Dry Weight	948854	WG2876899-1	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Free Dry Weight	948855	WG2876899-3	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Free Dry Weight	948856	WG2876899-5	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
Plant Pigments (Biota)													
MB	Chlorophyll a	951680	WG2880159-1	<0.010		ug	-	<0.010	ug		✓	Biota	Plant Pigments
MB	Chlorophyll a	953607	WG2882403-1	<0.010		ug	-	<0.010	ug		✓	Biota	Plant Pigments
MB	Chlorophyll a	953607	WG2882403-3	<0.010		ug	-	<0.010	ug		✓	Biota	Plant Pigments
MB	Chlorophyll a	953642	WG2882444-1	<0.010		ug	-	<0.010	ug		✓	Biota	Plant Pigments
MB	Chlorophyll a	953642	WG2882444-3	<0.010		ug	-	<0.010	ug		✓	Biota	Plant Pigments

Evaluation Legend

✓ QC Lot met ALS Data Quality Objectives

2019

Results Summary L2337313

Job Reference	197202-0046
Report To	Dave hasek, MINNOW ENVIRONMENTAL INC.
Date Received	28-Aug-2019 9:30
Report Date	19-Sep-2019 16:03
Report Version	1

Client Sample ID			Chlorphyll-a																		
			YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5	HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	HC6.8-5	HC6.8-4	HC6.8-3	HC6.8-2	HC6.8-1
Date Sampled			21-Aug-2019	21-Aug-2019	21-Aug-2019	21-Aug-2019	21-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	20-Aug-2019	20-Aug-2019	21-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019
Time Sampled			14:00	12:30	10:30	09:30	16:20	15:45	13:30	10:45	09:45	08:30	15:00	13:00	11:00	09:35	08:25	16:00	14:20	12:30	10:55	09:10
ALS Sample ID			L2337313-1	L2337313-2	L2337313-3	L2337313-4	L2337313-5	L2337313-6	L2337313-7	L2337313-8	L2337313-9	L2337313-10	L2337313-11	L2337313-12	L2337313-13	L2337313-14	L2337313-15	L2337313-16	L2337313-17	L2337313-18	L2337313-19	L2337313-20
Parameter	**Lowest Detection Limit**	**Units**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**
Field Tests (Biota)																						
Area Sampled	**0.010**	**cm2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Tests (Biota)																						
Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ash Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ash Free Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant Pigments (Biota)																						
Chlorophyll a	**0.010**	**ug**	1.89	0.641	1.05	1.31	3.02	1.45	0.866	2.21	0.331	0.482	0.94	4.67	0.585	3.72	2.36	19.3	15.4	2.35	0.347	0.125

Note: "-" indicates no available data.

Results Summary L2337313

Job Reference	197202-0046
Report To	Dave hasek, MINNOW ENVIRONMENTAL INC.
Date Received	28-Aug-2019 9:30
Report Date	19-Sep-2019 16:03
Report Version	1

Client Sample ID			Chlorophyll-a																		
			CC5.6-5	CC5.6-4	CC5.6-3	CC5.6-2	CC5.6-1	CC23.7-5	CC23.7-4	CC23.7-3	CC23.7-2	CC23.7-1	CR24.5-5	CR24.5-4	CR24.5-3	CR24.5-2	CR24.5-1	LC10.2-5	LC10.2-4	LC10.2-3	LC10.2-2	LC10.2-1
Date Sampled			24-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	23-Aug-2019	23-Aug-2019	23-Aug-2019	23-Aug-2019	23-Aug-2019	21-Aug-2019	21-Aug-2019	21-Aug-2019	21-Aug-2019	21-Aug-2019	20-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019
Time Sampled			08:00	10:00	12:30	14:50	16:30	08:15	10:15	12:45	14:15	16:00	08:15	10:50	12:30	14:15	16:00	08:30	10:45	12:30	14:25	16:00
ALS Sample ID			L2337313-21	L2337313-22	L2337313-23	L2337313-24	L2337313-25	L2337313-26	L2337313-27	L2337313-28	L2337313-29	L2337313-30	L2337313-31	L2337313-32	L2337313-33	L2337313-34	L2337313-35	L2337313-36	L2337313-37	L2337313-38	L2337313-39	L2337313-40
Parameter	**Lowest Detection Limit**	**Units**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**
Field Tests (Biota)																						
Area Sampled	**0.010**	**cm2**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Physical Tests (Biota)																						
Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ash Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ash Free Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant Pigments (Biota)																						
Chlorophyll a	**0.010**	**ug**	272	5.74	20.8	12.1	14.2	17.8	2.72	15.8	21	24.5	5.95	19.2	5.11	4.67	10.7	11.3	6.85	6.27	7.69	6.52

Note: "-" indicates no available data.

Results Summary L2337313

Job Reference	197202-0046
Report To	Dave hasek, MINNOW ENVIRONMENTAL INC.
Date Received	28-Aug-2019 9:30
Report Date	19-Sep-2019 16:03
Report Version	1

Client Sample ID			Chlorophyll-a										Ash-Free Dry Mass									
			SYT0.6-5	SYT0.6-4	SYT0.6-3	SYT0.6-2	SYT0.6-1	XE0.2-5	XE0.2-4	XE0.2-3	XE0.2-2	XE0.2-1	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	YT4.3-5	YT4.3-4	YT4.3-3	YT4.3-2	YT4.3-1
Date Sampled			21-Aug-2019	23-Aug-2019	23-Aug-2019	23-Aug-2019	23-Aug-2019	19-Aug-2019	19-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	21-Aug-2019	21-Aug-2019	21-Aug-2019	21-Aug-2019	21-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019
Time Sampled			17:00	09:45	11:30	13:00	15:00	15:55	16:45	10:00	11:30	14:30	14:00	12:30	10:30	03:45	16:20	08:30	09:45	10:45	13:30	15:45
ALS Sample ID			L2337313-41	L2337313-42	L2337313-43	L2337313-44	L2337313-45	L2337313-46	L2337313-47	L2337313-48	L2337313-49	L2337313-50	L2337313-51	L2337313-52	L2337313-53	L2337313-54	L2337313-55	L2337313-56	L2337313-57	L2337313-58	L2337313-59	L2337313-60
Parameter	**Lowest Detection Limit**	**Units**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**
Field Tests (Biota)																						
Area Sampled	**0.010**	**cm2**	0	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-
Physical Tests (Biota)																						
Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	0.0044	0.0043	0.0031	0.0051	0.0029	0.0019	0.0032	0.0051	0.0134	0.0045
Ash Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	0.0028	0.0036	0.0027	0.0040	0.0010	0.0010	0.0026	0.0024	0.0123	0.0031
Ash Free Dry Weight	**0.0010**	**g**	-	-	-	-	-	-	-	-	-	-	0.0017	<0.0010	<0.0010	0.0010	0.0019	<0.0010	<0.0010	0.0027	0.0011	0.0014
Plant Pigments (Biota)																						
Chlorophyll a	**0.010**	**ug**	5.98	17.5	14.5	2.96	19.7	31.9	25.2	35.6	16.9	8.27	-	-	-	-	-	-	-	-	-	-

Note: "-" indicates no available data.

Results Summary L2337313

Job Reference	197202-0046
Report To	Dave hasek, MINNOW ENVIRONMENTAL INC.
Date Received	28-Aug-2019 9:30
Report Date	19-Sep-2019 16:03
Report Version	1

Client Sample ID			Ash-Free Dry Mass																		
			HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	CC5.6-5	CC5.6-4	CC5.6-3	CC5.6-2	CC5.6-1	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5
Date Sampled			20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	20-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	23-Aug-2019	23-Aug-2019	23-Aug-2019	23-Aug-2019	23-Aug-2019
Time Sampled			15:00	13:00	11:00	09:35	08:25	09:10	10:55	12:30	14:20	16:00	07:45	10:00	12:30	14:50	16:30	15:40	14:00	12:45	10:30	08:00
ALS Sample ID			L2337313-61	L2337313-62	L2337313-63	L2337313-64	L2337313-65	L2337313-66	L2337313-67	L2337313-68	L2337313-69	L2337313-70	L2337313-71	L2337313-72	L2337313-73	L2337313-74	L2337313-75	L2337313-76	L2337313-77	L2337313-78	L2337313-79	L2337313-80
Parameter	**Lowest Detection Limit**	**Units**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**
Field Tests (Biota)																						
Area Sampled	**0.010**	**cm2**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Physical Tests (Biota)																						
Dry Weight	**0.0010**	**g**	0.0131	0.0111	0.0025	0.0075	0.0088	0.0055	0.0047	0.0139	0.0301	0.0516	0.0663	0.0068	0.0260	0.0159	0.0169	0.0106	0.0360	0.0324	0.0073	0.0104
Ash Weight	**0.0010**	**g**	0.0105	0.0055	0.0012	0.0031	0.0068	0.0049	0.0039	0.0063	0.0149	0.0406	0.0271	0.0048	0.0147	0.0101	0.0089	0.0021	0.0042	0.0083	0.0030	0.0018
Ash Free Dry Weight	**0.0010**	**g**	0.0025	0.0057	0.0013	0.0044	0.0020	<0.0010	<0.0010	0.0075	0.0152	0.0110	0.0391	0.0020	0.0113	0.0057	0.0080	0.0085	0.0318	0.0241	0.0042	0.0086
Plant Pigments (Biota)																						
Chlorophyll a	**0.010**	**ug**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: "-" indicates no available data.

Results Summary L2337313

Job Reference	197202-0046
Report To	Dave hasek, MINNOW ENVIRONMENTAL INC.
Date Received	28-Aug-2019 9:30
Report Date	19-Sep-2019 16:03
Report Version	1

Client Sample ID			Ash-Free Dry Mass																		
			CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5	SYT0.6-5	SYT0.6-4	SYT0.6-3	SYT0.6-2	SYT0.6-1	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-2	XE0.2-1
Date Sampled			21-Aug-2019	21-Aug-2019	21-Aug-2019	21-Aug-2019	21-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	21-Aug-2019	23-Aug-2019	23-Aug-2019	23-Aug-2019	23-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	19-Aug-2019	19-Aug-2019
Time Sampled			16:00	14:15	12:30	10:50	08:10	16:00	14:25	12:15	10:45	08:30	17:00	09:45	11:30	13:00	15:00	14:30	11:30	10:00	16:45	15:55
ALS Sample ID			L2337313-81	L2337313-82	L2337313-83	L2337313-84	L2337313-85	L2337313-86	L2337313-87	L2337313-88	L2337313-89	L2337313-90	L2337313-91	L2337313-92	L2337313-93	L2337313-94	L2337313-95	L2337313-96	L2337313-97	L2337313-98	L2337313-99	L2337313-100
Parameter	**Lowest Detection Limit**	**Units**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**	**Biota**
Field Tests (Biota)																						
Area Sampled	**0.010**	**cm2**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Physical Tests (Biota)																						
Dry Weight	**0.0010**	**g**	0.0346	0.0076	0.0154	0.0595	0.0281	0.0126	0.0408	0.0187	0.0183	0.0131	0.0052	0.0090	0.0183	0.0060	0.0180	0.0110	0.0255	0.0233	0.0334	0.0331
Ash Weight	**0.0010**	**g**	0.0122	0.0021	0.0076	0.0222	0.0121	0.0037	0.0125	0.0037	0.0076	0.0036	0.0022	0.0049	0.0021	0.0019	0.0115	0.0048	0.0150	0.0172	0.0228	0.0183
Ash Free Dry Weight	**0.0010**	**g**	0.0223	0.0055	0.0078	0.0373	0.0160	0.0090	0.0284	0.0150	0.0107	0.0095	0.0030	0.0041	0.0162	0.0041	0.0065	0.0062	0.0104	0.0062	0.0106	0.0148
Plant Pigments (Biota)																						
Chlorophyll a	**0.010**	**ug**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: "-" indicates no available data.

Quality Control L2337313

Job Reference 197202-0046
Report To Dave hasek, MINNOW ENVIRONMENTAL INC.
Date Received 28-Aug-2019 9:30
Report Date 19-Sep-2019 16:03
Report Version 1

QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
Plant Pigments (Biota)													
LCS	Chlorophyll a	1176447	WG3157665-2	1.04	1	ug	104.3	80-120	%		✓	Biota	Plant Pigments
LCS	Chlorophyll a	1176447	WG3157665-4	1.03	1	ug	103.4	80-120	%		✓	Biota	Plant Pigments
LCS	Chlorophyll a	1176447	WG3157665-6	1.03	1	ug	103.2	80-120	%		✓	Biota	Plant Pigments
Physical Tests (Biota)													
MB	Dry Weight	1175359	WG3156219-1	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Dry Weight	1175360	WG3156219-3	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Dry Weight	1175361	WG3156219-5	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Weight	1175359	WG3156219-1	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Weight	1175360	WG3156219-3	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Weight	1175361	WG3156219-5	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Free Dry Weight	1175359	WG3156219-1	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Free Dry Weight	1175360	WG3156219-3	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
MB	Ash Free Dry Weight	1175361	WG3156219-5	<0.0010		g	-	<0.0010	g		✓	Biota	Physical Tests
Plant Pigments (Biota)													
MB	Chlorophyll a	1176447	WG3157665-1	<0.010		ug	-	<0.010	ug		✓	Biota	Plant Pigments
MB	Chlorophyll a	1176447	WG3157665-3	<0.010		ug	-	<0.010	ug		✓	Biota	Plant Pigments
MB	Chlorophyll a	1176447	WG3157665-5	<0.010		ug	-	<0.010	ug		✓	Biota	Plant Pigments

Evaluation Legend

✓ QC Lot met ALS Data Quality Objectives

Results Summary L2340686

Job Reference	197202-0046
Report To	Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received	4-Sep-2019 9:33
Report Date	7-Oct-2019 18:19
Report Version	1

Client Sample ID			HC6.8 - 5 SED 1	HC6.8 - 5 SED 2	HC6.8 - 5 SED 3	LC10.2 - 5 SED 1	LC10.2 - 5 SED 2	LC10.2 - 5 SED 3	SYT0.6 - 2	SYT0.6 - 3	SYT0.6 - 4	XE0.2 - 1	XE0.2 - 2	XE0.2 - 3	YT4.3 - 1	YT4.3 - 2	YT4.3 - 4	YT4.3 - 5
Date Sampled			20-Aug-2019	20-Aug-2019	20-Aug-2019	21-Aug-2019	21-Aug-2019	21-Aug-2019	23-Aug-2019	23-Aug-2019	23-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019	22-Aug-2019
Time Sampled			00:00	00:00	00:00	00:00	00:00	00:00	13:10	11:00	10:00	13:30	13:00	10:15	16:30	13:30	10:00	08:30
ALS Sample ID			L2340686-1	L2340686-2	L2340686-3	L2340686-4	L2340686-5	L2340686-6	L2340686-7	L2340686-8	L2340686-9	L2340686-10	L2340686-11	L2340686-12	L2340686-13	L2340686-14	L2340686-15	L2340686-16
Parameter	**Lowest Detection Limit**	**Units**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
Particle Size (Soil)																		
% Gravel (>2mm)	1.0	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% Sand (2.0mm - 0.063mm)	1.0	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% Silt (0.063mm - 4um)	1.0	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
% Clay (<4um)	1.0	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texture		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Organic / Inorganic Carbon (Soil)																		
Total Organic Carbon	0.050	%	8.43	9.69	5.95	2.71	2.37	2.33	4.1	2.93	2.85	8.4	13.1	6.57	6.68	5.91	7.01	3.18
Metals (Soil)																		
Aluminum (Al)	50	mg/kg	18400	17900	17300	12800	12400	12600	12600	12100	11600	14500	13100	12500	14100	12500	14300	12600
Antimony (Sb)	0.10	mg/kg	1.29	1.23	20.00	1.16	0.80	0.80	0.39	0.40	0.35	0.61	0.52	0.45	1.37	1.54	1.30	1.58
Arsenic (As)	0.10	mg/kg	29.5	29.3	29.6	13.9	14.7	15.3	6.33	6.58	5.96	9.85	8.37	7.74	18.2	19.3	21.7	19.3
Barium (Ba)	0.50	mg/kg	206	213	208	116	128	116	172	152	141	257	264	278	191	173	214	150
Beryllium (Be)	0.10	mg/kg	0.64	0.66	0.60	0.39	0.41	0.40	0.46	0.46	0.43	0.82	0.70	0.61	0.46	0.45	0.48	0.38
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Boron (B)	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
Cadmium (Cd)	0.020	mg/kg	0.288	0.323	0.255	0.125	0.120	0.125	0.150	0.127	0.128	0.547	0.682	0.465	0.198	0.163	0.225	0.129
Calcium (Ca)	50	mg/kg	8380	8640	7360	4340	4410	4400	7970	7280	7110	16300	19800	13300	8020	7010	8690	5390
Chromium (Cr)	0.50	mg/kg	43.5	42.8	42.7	27.2	27.3	27.6	31.7	31.0	30.6	40.6	35.9	35.9	27.0	24.3	27.1	24.4
Cobalt (Co)	0.10	mg/kg	12.5	12.0	12.6	7.86	8.43	8.23	10.1	10.8	9.82	13.9	12.7	12.2	8.99	8.43	9.10	8.56
Copper (Cu)	0.50	mg/kg	17.8	19.1	15.1	10.4	10.7	10.3	14.3	12.4	12.2	34.5	36.1	27.9	13.8	11.6	15.5	9.91
Iron (Fe)	50	mg/kg	24600	24500	23600	20700	20800	20900	22700	23400	22000	29500	26400	26600	21100	19800	21300	19300
Lead (Pb)	0.50	mg/kg	9.69	9.41	7.94	8.44	8.88	8.81	6.42	6.15	5.71	9.76	8.86	8.22	8.49	7.66	8.43	7.44
Lithium (Li)	2.0	mg/kg	13.7	13.2	13.8	8.5	9.7	10.3	9.7	9.1	9.6	16.8	15.8	15.8	7.6	7.6	8.8	7.2
Magnesium (Mg)	20	mg/kg	7400	7080	7900	6100	6180	6210	7460	7470	7030	9620	9350	9080	5780	5640	5500	5350
Manganese (Mn)	1.0	mg/kg	808	781	827	529	586	581	452	489	408	772	806	633	402	390	458	384
Molybdenum (Mo)	0.10	mg/kg	0.82	0.81	0.80	0.72	0.80	0.77	0.58	0.59	0.56	1.06	1.01	0.86	0.68	0.67	0.68	0.58
Nickel (Ni)	0.50	mg/kg	25.5	25.9	25.6	13.9	14.0	14.2	18.6	17.6	17.1	41.2	39.0	34.6	17.4	15.6	17.9	14.9
Phosphorus (P)	50	mg/kg	565	564	478	423	419	426	572	592	631	737	733	636	482	479	500	458
Potassium (K)	100	mg/kg	1210	1170	1480	1420	1430	1420	1750	1810	1720	2290	2120	2080	940	980	930	1020
Selenium (Se)	0.20	mg/kg	0.39	0.38	0.36	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.87	1.09	0.68	<0.20	<0.20	0.23	<0.20
Silver (Ag)	0.10	mg/kg	0.15	0.12	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.17	0.16	0.11	0.11	<0.10	0.14	<0.10
Sodium (Na)	50	mg/kg	214	241	166	154	160	161	173	129	137	105	133	97	162	143	174	138
Strontium (Sr)	0.50	mg/kg	97.9	109	85.8	38.1	38.7	37.3	69.5	63.1	63.6	147	172	118	38.9	44.8	41.3	28.1
Sulfur (S)	1000	mg/kg	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	1100	<1000	<1000	<1000	<1000	<1000
Thallium (Tl)	0.050	mg/kg	0.194	0.187	0.199	0.169	0.176	0.169	0.147	0.157	0.150	0.284	0.236	0.233	0.128	0.122	0.127	0.127
Tin (Sn)	1.0	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Titanium (Ti)	1.0	mg/kg	776	733	782	764	765	768	673	740	684	685	604	633	647	623	567	648
Tungsten (W)	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.54	<0.50	<0.50	<0.50	<0.50	0.58	<0.50	<0.50	<0.50
Uranium (U)	0.050	mg/kg	34.4	39.3	27.5	3.33	3.52	3.33	8.53	7.27	6.86	3.98	4.39	2.51	2.43	2.11	2.72	1.77
Vanadium (V)	0.20	mg/kg	51.4	50.6	49.9	44.0	44.5	45.0	43.2	43.7	41.6	45.1	41.3	40.6	45.9	43.6	45.7	43.5
Zinc (Zn)	2.0	mg/kg	64.5	65.5	60.3	50.7	52.8	50.9	52.4	47.5	45.6	104	100	91.6	44.8	41.9	46.4	41.7
Zirconium (Zr)	1.0	mg/kg	2.6	2.7	2.2	2.2	2.2	2.1	2.6	2.4	2.3	2.7	2.7	2.0	2.4	2.3	2.8	1.8

Note: "-" indicates no available data. PSAL = limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.

Results Summary L2340686

Job Reference	197202-0046
Report To	Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received	4-Sep-2019 9:33
Report Date	7-Oct-2019 18:19
Report Version	1

Client Sample ID			CC5.6 - 1 SED	CC5.6 - 2 SED	CC5.6 - 3 SED 1	CC5.6 - 3 SED 2	CC5.6 - 3 SED 3	HC0.2 - 2	HC0.2 - 4	HC0.2 - 5	HC6.8 -5 (1-3)	LC10.2 - 5 (1-3)	SYT0.6(2-4)	XE0.2(1-3)	YT4.3(1-2)	YT4.3(4-5)	CC5.6(1-2)	CC5.6 - 3(1-3)	HC0.2(2, 4, 5)
Date Sampled			24-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019	20-Aug-2019	21-Aug-2019	23-Aug-2019	24-Aug-2019	22-Aug-2019	22-Aug-2019	24-Aug-2019	24-Aug-2019	24-Aug-2019
Time Sampled			00:00	00:00	00:00	00:00	00:00	17:45	17:30	17:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID			L2340686-17	L2340686-18	L2340686-19	L2340686-20	L2340686-21	L2340686-22	L2340686-23	L2340686-24	L2340686-25	L2340686-26	L2340686-27	L2340686-28	L2340686-29	L2340686-30	L2340686-31	L2340686-32	L2340686-33
Parameter	**Lowest Detection Limit**	**Units**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**	**Soil**
Particle Size (Soil)																			
% Gravel (>2mm)	1.0	%	-	-	-	-	-	-	-	-	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
% Sand (2.0mm - 0.063mm)	1.0	%	-	-	-	-	-	-	-	-	11.9	40.7	33.3	26.4	23.8	21.8	39.3	54.3	44.2
% Silt (0.063mm - 4um)	1.0	%	-	-	-	-	-	-	-	-	83.7	53.9	61.9	68.3	69.5	72.3	55.4	41.2	51.8
% Clay (<4um)	1.0	%	-	-	-	-	-	-	-	-	4.4	4.9	4.6	4.3	6.1	5.0	4.9	3.8	3.8
Texture		-	-	-	-	-	-	-	-	-	Silt	Silt loam	Silt loam	Silt loam	Silt loam	Silt loam	Silt loam	Sandy loam	Silt loam
Organic / Inorganic Carbon (Soil)																			
Total Organic Carbon	0.050	%	4.06	2.53	2.13	2.38	2.8	4.55	2.57	4.9	-	-	-	-	-	-	-	-	-
Metals (Soil)																			
Aluminum (Al)	50	mg/kg	15400	15000	13600	13500	13600	13000	13400	14600	-	-	-	-	-	-	-	-	-
Antimony (Sb)	0.10	mg/kg	0.61	0.58	0.67	0.57	0.61	0.89	0.81	1.07	-	-	-	-	-	-	-	-	-
Arsenic (As)	0.10	mg/kg	11.3	10.9	11.1	10.5	11.4	16.1	14.2	20.7	-	-	-	-	-	-	-	-	-
Barium (Ba)	0.50	mg/kg	207	205	176	184	184	149	134	174	-	-	-	-	-	-	-	-	-
Beryllium (Be)	0.10	mg/kg	0.39	0.35	0.33	0.37	0.36	0.47	0.41	0.53	-	-	-	-	-	-	-	-	-
Bismuth (Bi)	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.26	<0.20	-	-	-	-	-	-	-	-	-
Boron (B)	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	-	-	-	-	-	-	-	-	-
Cadmium (Cd)	0.020	mg/kg	0.241	0.213	0.191	0.189	0.189	0.173	0.124	0.192	-	-	-	-	-	-	-	-	-
Calcium (Ca)	50	mg/kg	6150	5600	5040	5400	5200	7470	6660	8450	-	-	-	-	-	-	-	-	-
Chromium (Cr)	0.50	mg/kg	27.5	26.4	23.7	24.5	22.9	36.2	36.2	41.4	-	-	-	-	-	-	-	-	-
Cobalt (Co)	0.10	mg/kg	11.7	11.1	10.2	10.1	10.5	10.4	9.85	11.6	-	-	-	-	-	-	-	-	-
Copper (Cu)	0.50	mg/kg	18.1	15.9	13.9	14.4	14.5	14.7	12.1	17.4	-	-	-	-	-	-	-	-	-
Iron (Fe)	50	mg/kg	26600	26700	23600	24100	24600	21200	21600	23900	-	-	-	-	-	-	-	-	-
Lead (Pb)	0.50	mg/kg	6.63	6.12	5.79	6.17	5.77	5.99	5.56	6.71	-	-	-	-	-	-	-	-	-
Lithium (Li)	2.0	mg/kg	13.2	14.1	12.7	13.8	12.1	11.8	12.9	14.3	-	-	-	-	-	-	-	-	-
Magnesium (Mg)	20	mg/kg	7340	7340	6550	6370	6410	6900	6990	8200	-	-	-	-	-	-	-	-	-
Manganese (Mn)	1.0	mg/kg	647	608	594	539	579	496	412	571	-	-	-	-	-	-	-	-	-
Molybdenum (Mo)	0.10	mg/kg	1.20	1.14	1.05	1.02	1.15	0.65	0.51	0.69	-	-	-	-	-	-	-	-	-
Nickel (Ni)	0.50	mg/kg	17.9	17.1	15.4	15.3	15.2	21.5	20.8	24.5	-	-	-	-	-	-	-	-	-
Phosphorus (P)	50	mg/kg	550	629	575	556	502	530	628	583	-	-	-	-	-	-	-	-	-
Potassium (K)	100	mg/kg	2090	2240	2020	1940	2040	1550	1620	1740	-	-	-	-	-	-	-	-	-
Selenium (Se)	0.20	mg/kg	0.27	0.24	0.24	0.24	0.22	0.20	<0.20	0.22	-	-	-	-	-	-	-	-	-
Silver (Ag)	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	-	-	-	-	-	-	-	-	-
Sodium (Na)	50	mg/kg	196	203	200	190	196	147	128	165	-	-	-	-	-	-	-	-	-
Strontium (Sr)	0.50	mg/kg	41.8	36.0	32.7	35.8	34.6	69.2	58.7	80.6	-	-	-	-	-	-	-	-	-
Sulfur (S)	1000	mg/kg	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	-	-	-	-	-	-	-	-	-
Thallium (Tl)	0.050	mg/kg	0.245	0.243	0.203	0.229	0.224	0.155	0.158	0.172	-	-	-	-	-	-	-	-	-
Tin (Sn)	1.0	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-	-	-	-	-	-	-
Titanium (Ti)	1.0	mg/kg	1020	1100	986	978	980	686	727	752	-	-	-	-	-	-	-	-	-
Tungsten (W)	0.50	mg/kg	<0.50	<0.50	<0.50	0.77	<0.50	<0.50	<0.50	<0.50	-	-	-	-	-	-	-	-	-
Uranium (U)	0.050	mg/kg	9.00	7.40	6.73	7.16	5.95	16.5	10.8	15.9	-	-	-	-	-	-	-	-	-
Vanadium (V)	0.20	mg/kg	61.3	61.7	55.0	55.6	56.4	40.1	38.9	44.9	-	-	-	-	-	-	-	-	-
Zinc (Zn)	2.0	mg/kg	67.2	66.1	58.8	59.2	59.2	48.7	47.0	55.2	-	-	-	-	-	-	-	-	-
Zirconium (Zr)	1.0	mg/kg	2.9	2.7	2.4	2.4	2.5	2.6	2.2	2.9	-	-	-	-	-	-	-	-	-

Note: "-" indicates no available data. PSAL = limited sample was available for PSA (100g minimum is standard). Measurement Uncertainty for PSA results may be higher than usual.

Quality Control L2340686

Job Reference 197202-0046
Report To Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received 4-Sep-2019 9:33
Report Date 7-Oct-2019 18:19
Report Version 1

QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
Metals (Soil)													
CRM	Aluminum (Al)	1189899	WG3174359-3	15700	18300	mg/kg	85.7	70-130	%		✓	Soil	Metals
CRM	Aluminum (Al)	1189900	WG3174361-3	17600	18300	mg/kg	96.3	70-130	%		✓	Soil	Metals
CRM	Antimony (Sb)	1189899	WG3174359-3	6.44	6.4	mg/kg	100.6	70-130	%		✓	Soil	Metals
CRM	Antimony (Sb)	1189900	WG3174361-3	6.75	6.4	mg/kg	105.5	70-130	%		✓	Soil	Metals
CRM	Arsenic (As)	1189899	WG3174359-3	15.4	16.7	mg/kg	92.5	70-130	%		✓	Soil	Metals
CRM	Arsenic (As)	1189900	WG3174361-3	16.3	16.7	mg/kg	97.8	70-130	%		✓	Soil	Metals
CRM	Barium (Ba)	1189899	WG3174359-3	76.6	83.8	mg/kg	91.4	70-130	%		✓	Soil	Metals
CRM	Barium (Ba)	1189900	WG3174361-3	78.1	83.8	mg/kg	93.2	70-130	%		✓	Soil	Metals
CRM	Beryllium (Be)	1189899	WG3174359-3	0.51	0.518	mg/kg	99.1	70-130	%		✓	Soil	Metals
CRM	Beryllium (Be)	1189900	WG3174361-3	0.53	0.518	mg/kg	102.4	70-130	%		✓	Soil	Metals
CRM	Bismuth (Bi)	1189899	WG3174359-3	1.78	1.94	mg/kg	91.6	70-130	%		✓	Soil	Metals
CRM	Bismuth (Bi)	1189900	WG3174361-3	1.82	1.94	mg/kg	93.7	70-130	%		✓	Soil	Metals
CRM	Boron (B)	1189899	WG3174359-3	<5.0	3.2	mg/kg	2.9	0-8.2	mg/kg		✓	Soil	Metals
CRM	Boron (B)	1189900	WG3174361-3	<5.0	3.2	mg/kg	3.3	0-8.2	mg/kg		✓	Soil	Metals
CRM	Cadmium (Cd)	1189899	WG3174359-3	0.198	0.215	mg/kg	92.0	70-130	%		✓	Soil	Metals
CRM	Cadmium (Cd)	1189900	WG3174361-3	0.214	0.215	mg/kg	99.6	70-130	%		✓	Soil	Metals
CRM	Calcium (Ca)	1189899	WG3174359-3	3320	3540	mg/kg	93.8	70-130	%		✓	Soil	Metals
CRM	Calcium (Ca)	1189900	WG3174361-3	3450	3540	mg/kg	97.4	70-130	%		✓	Soil	Metals
CRM	Chromium (Cr)	1189899	WG3174359-3	25.8	28.6	mg/kg	90.3	70-130	%		✓	Soil	Metals
CRM	Chromium (Cr)	1189900	WG3174361-3	27.4	28.6	mg/kg	95.9	70-130	%		✓	Soil	Metals
CRM	Cobalt (Co)	1189899	WG3174359-3	11.7	12.8	mg/kg	91.3	70-130	%		✓	Soil	Metals
CRM	Cobalt (Co)	1189900	WG3174361-3	12.4	12.8	mg/kg	97.2	70-130	%		✓	Soil	Metals
CRM	Copper (Cu)	1189899	WG3174359-3	41.0	44.5	mg/kg	92.1	70-130	%		✓	Soil	Metals
CRM	Copper (Cu)	1189900	WG3174361-3	43.4	44.5	mg/kg	97.6	70-130	%		✓	Soil	Metals
CRM	Iron (Fe)	1189899	WG3174359-3	30200	32800	mg/kg	92.0	70-130	%		✓	Soil	Metals
CRM	Iron (Fe)	1189900	WG3174361-3	31900	32800	mg/kg	97.2	70-130	%		✓	Soil	Metals
CRM	Lead (Pb)	1189899	WG3174359-3	12.4	13.5	mg/kg	91.6	70-130	%		✓	Soil	Metals
CRM	Lead (Pb)	1189900	WG3174361-3	12.3	13.5	mg/kg	90.9	70-130	%		✓	Soil	Metals
CRM	Lithium (Li)	1189899	WG3174359-3	8.8	10	mg/kg	87.7	70-130	%		✓	Soil	Metals
CRM	Lithium (Li)	1189900	WG3174361-3	8.5	10	mg/kg	85.1	70-130	%		✓	Soil	Metals
CRM	Magnesium (Mg)	1189899	WG3174359-3	5400	5930	mg/kg	91.0	70-130	%		✓	Soil	Metals
CRM	Magnesium (Mg)	1189900	WG3174361-3	5790	5930	mg/kg	97.7	70-130	%		✓	Soil	Metals

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Report To Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received 4-Sep-2019 9:33
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QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
CRM	Manganese (Mn)	1189899	WG3174359-3	1020	1110	mg/kg	91.9	70-130	%		✓	Soil	Metals
CRM	Manganese (Mn)	1189900	WG3174361-3	1040	1110	mg/kg	94.1	70-130	%		✓	Soil	Metals
CRM	Molybdenum (Mo)	1189899	WG3174359-3	0.71	0.703	mg/kg	101.1	70-130	%		✓	Soil	Metals
CRM	Molybdenum (Mo)	1189900	WG3174361-3	0.71	0.703	mg/kg	101.2	70-130	%		✓	Soil	Metals
CRM	Nickel (Ni)	1189899	WG3174359-3	16.3	17.9	mg/kg	91.1	70-130	%		✓	Soil	Metals
CRM	Nickel (Ni)	1189900	WG3174361-3	17.3	17.9	mg/kg	96.4	70-130	%		✓	Soil	Metals
CRM	Phosphorus (P)	1189899	WG3174359-3	800	827	mg/kg	96.8	70-130	%		✓	Soil	Metals
CRM	Phosphorus (P)	1189900	WG3174361-3	835	827	mg/kg	101.0	70-130	%		✓	Soil	Metals
CRM	Potassium (K)	1189899	WG3174359-3	530	652	mg/kg	81.5	70-130	%		✓	Soil	Metals
CRM	Potassium (K)	1189900	WG3174361-3	610	652	mg/kg	93.3	70-130	%		✓	Soil	Metals
CRM	Selenium (Se)	1189899	WG3174359-3	0.30	0.31	mg/kg	0.30	.11-.51	mg/kg		✓	Soil	Metals
CRM	Selenium (Se)	1189900	WG3174361-3	0.29	0.31	mg/kg	0.29	.11-.51	mg/kg		✓	Soil	Metals
CRM	Silver (Ag)	1189899	WG3174359-3	0.23	0.23	mg/kg	0.23	.13-.33	mg/kg		✓	Soil	Metals
CRM	Silver (Ag)	1189900	WG3174361-3	0.24	0.23	mg/kg	0.24	.13-.33	mg/kg		✓	Soil	Metals
CRM	Sodium (Na)	1189899	WG3174359-3	306	364	mg/kg	84.0	70-130	%		✓	Soil	Metals
CRM	Sodium (Na)	1189900	WG3174361-3	337	364	mg/kg	92.7	70-130	%		✓	Soil	Metals
CRM	Strontium (Sr)	1189899	WG3174359-3	11.5	12.2	mg/kg	94.7	70-130	%		✓	Soil	Metals
CRM	Strontium (Sr)	1189900	WG3174361-3	12.4	12.2	mg/kg	101.3	70-130	%		✓	Soil	Metals
CRM	Thallium (Tl)	1189899	WG3174359-3	0.110	0.127	mg/kg	0.110	.077-.18	mg/kg		✓	Soil	Metals
CRM	Thallium (Tl)	1189900	WG3174361-3	0.112	0.127	mg/kg	0.112	.077-.18	mg/kg		✓	Soil	Metals
CRM	Tin (Sn)	1189899	WG3174359-3	<1.0	1.1	mg/kg	0.9	0-3.1	mg/kg		✓	Soil	Metals
CRM	Tin (Sn)	1189900	WG3174361-3	<1.0	1.1	mg/kg	1.0	0-3.1	mg/kg		✓	Soil	Metals
CRM	Titanium (Ti)	1189899	WG3174359-3	663	874	mg/kg	75.9	70-130	%		✓	Soil	Metals
CRM	Titanium (Ti)	1189900	WG3174361-3	749	874	mg/kg	85.7	70-130	%		✓	Soil	Metals
CRM	Tungsten (W)	1189899	WG3174359-3	<0.50	0.16	mg/kg	0.13	0-.66	mg/kg		✓	Soil	Metals
CRM	Tungsten (W)	1189900	WG3174361-3	<0.50	0.16	mg/kg	0.14	0-.66	mg/kg		✓	Soil	Metals
CRM	Uranium (U)	1189899	WG3174359-3	0.782	0.855	mg/kg	91.5	70-130	%		✓	Soil	Metals
CRM	Uranium (U)	1189900	WG3174361-3	0.806	0.855	mg/kg	94.2	70-130	%		✓	Soil	Metals
CRM	Vanadium (V)	1189899	WG3174359-3	53.1	59	mg/kg	90.0	70-130	%		✓	Soil	Metals
CRM	Vanadium (V)	1189900	WG3174361-3	57.3	59	mg/kg	97.1	70-130	%		✓	Soil	Metals
CRM	Zinc (Zn)	1189899	WG3174359-3	59.5	67.3	mg/kg	88.4	70-130	%		✓	Soil	Metals
CRM	Zinc (Zn)	1189900	WG3174361-3	63.8	67.3	mg/kg	94.8	70-130	%		✓	Soil	Metals
CRM	Zirconium (Zr)	1189899	WG3174359-3	<1.0	0.79	mg/kg	0.9	0-1.8	mg/kg		✓	Soil	Metals
CRM	Zirconium (Zr)	1189900	WG3174361-3	1.2	0.79	mg/kg	1.2	0-1.8	mg/kg		✓	Soil	Metals

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QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
Particle Size (Soil)													
IRM	% Sand (2.0mm - 0.063mm)	1188755	WG3173010-2	44.2	44.1	%	44.2	39.1-49.1	%		✓	Soil	Particle Size
IRM	% Silt (0.063mm - 4um)	1188755	WG3173010-2	37.6	37.5	%	37.6	32.5-42.5	%		✓	Soil	Particle Size
IRM	% Clay (<4um)	1188755	WG3173010-2	18.3	18.4	%	18.3	13.4-23.4	%		✓	Soil	Particle Size
IRM	Texture	1188755	WG3173010-2	Loam				-			✓	Soil	Particle Size
Organic / Inorganic Carbon (Soil)													
IRM	Inorganic Carbon	1187028	WG3170899-8	0.353	0.383	%	92.3	80-120	%		✓	Soil	Organic / Inorganic Carbon
IRM	Inorganic Carbon	1188717	WG3172955-4	0.347	0.383	%	90.7	80-120	%		✓	Soil	Organic / Inorganic Carbon
IRM	Total Carbon by Combustion	1190391	WG3169398-2	1.45	1.41	%	102.9	80-120	%		✓	Soil	Organic / Inorganic Carbon
IRM	Total Carbon by Combustion	1188550	WG3172782-3	1.43	1.41	%	101.4	80-120	%		✓	Soil	Organic / Inorganic Carbon
LCS	Inorganic Carbon	1187028	WG3170899-6	0.469	0.5	%	93.7	80-120	%		✓	Soil	Organic / Inorganic Carbon
LCS	Inorganic Carbon	1188717	WG3172955-2	0.462	0.5	%	92.4	80-120	%		✓	Soil	Organic / Inorganic Carbon
LCS	Total Carbon by Combustion	1190391	WG3169398-5	50.1	48	%	104.4	90-110	%		✓	Soil	Organic / Inorganic Carbon
LCS	Total Carbon by Combustion	1188550	WG3172782-5	49.8	48	%	103.8	90-110	%		✓	Soil	Organic / Inorganic Carbon
Metals (Soil)													
LCS	Aluminum (Al)	1189899	WG3174359-4	191	200	mg/kg	95.3	80-120	%		✓	Soil	Metals
LCS	Aluminum (Al)	1189900	WG3174361-4	194	200	mg/kg	97.1	80-120	%		✓	Soil	Metals
LCS	Antimony (Sb)	1189899	WG3174359-4	107	100	mg/kg	106.8	80-120	%		✓	Soil	Metals
LCS	Antimony (Sb)	1189900	WG3174361-4	107	100	mg/kg	107.2	80-120	%		✓	Soil	Metals
LCS	Arsenic (As)	1189899	WG3174359-4	97.4	100	mg/kg	97.4	80-120	%		✓	Soil	Metals
LCS	Arsenic (As)	1189900	WG3174361-4	96.1	100	mg/kg	96.1	80-120	%		✓	Soil	Metals
LCS	Barium (Ba)	1189899	WG3174359-4	23.7	25	mg/kg	94.8	80-120	%		✓	Soil	Metals
LCS	Barium (Ba)	1189900	WG3174361-4	24.3	25	mg/kg	97.2	80-120	%		✓	Soil	Metals
LCS	Beryllium (Be)	1189899	WG3174359-4	10.7	10	mg/kg	106.8	80-120	%		✓	Soil	Metals
LCS	Beryllium (Be)	1189900	WG3174361-4	10.6	10	mg/kg	106.3	80-120	%		✓	Soil	Metals
LCS	Bismuth (Bi)	1189899	WG3174359-4	93.2	100	mg/kg	93.2	80-120	%		✓	Soil	Metals
LCS	Bismuth (Bi)	1189900	WG3174361-4	91.6	100	mg/kg	91.6	80-120	%		✓	Soil	Metals
LCS	Boron (B)	1189899	WG3174359-4	98.6	100	mg/kg	98.6	80-120	%		✓	Soil	Metals
LCS	Boron (B)	1189900	WG3174361-4	100	100	mg/kg	100.5	80-120	%		✓	Soil	Metals
LCS	Cadmium (Cd)	1189899	WG3174359-4	9.39	10	mg/kg	93.9	80-120	%		✓	Soil	Metals
LCS	Cadmium (Cd)	1189900	WG3174361-4	9.64	10	mg/kg	96.4	80-120	%		✓	Soil	Metals

Quality Control L2340686

Job Reference 197202-0046
Report To Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received 4-Sep-2019 9:33
Report Date 7-Oct-2019 18:19
Report Version 1

QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
LCS	Calcium (Ca)	1189899	WG3174359-4	5210	5000	mg/kg	104.1	80-120	%		✓	Soil	Metals
LCS	Calcium (Ca)	1189900	WG3174361-4	5130	5000	mg/kg	102.6	80-120	%		✓	Soil	Metals
LCS	Chromium (Cr)	1189899	WG3174359-4	23.6	25	mg/kg	94.5	80-120	%		✓	Soil	Metals
LCS	Chromium (Cr)	1189900	WG3174361-4	23.9	25	mg/kg	95.6	80-120	%		✓	Soil	Metals
LCS	Cobalt (Co)	1189899	WG3174359-4	23.3	25	mg/kg	93.0	80-120	%		✓	Soil	Metals
LCS	Cobalt (Co)	1189900	WG3174361-4	23.4	25	mg/kg	93.8	80-120	%		✓	Soil	Metals
LCS	Copper (Cu)	1189899	WG3174359-4	23.2	25	mg/kg	92.6	80-120	%		✓	Soil	Metals
LCS	Copper (Cu)	1189900	WG3174361-4	23.0	25	mg/kg	91.9	80-120	%		✓	Soil	Metals
LCS	Iron (Fe)	1189899	WG3174359-4	108	100	mg/kg	107.6	80-120	%		✓	Soil	Metals
LCS	Iron (Fe)	1189900	WG3174361-4	109	100	mg/kg	109.2	80-120	%		✓	Soil	Metals
LCS	Lead (Pb)	1189899	WG3174359-4	46.3	50	mg/kg	92.6	80-120	%		✓	Soil	Metals
LCS	Lead (Pb)	1189900	WG3174361-4	47.1	50	mg/kg	94.1	80-120	%		✓	Soil	Metals
LCS	Lithium (Li)	1189899	WG3174359-4	23.2	25	mg/kg	92.7	80-120	%		✓	Soil	Metals
LCS	Lithium (Li)	1189900	WG3174361-4	23.6	25	mg/kg	94.3	80-120	%		✓	Soil	Metals
LCS	Magnesium (Mg)	1189899	WG3174359-4	4850	5000	mg/kg	97.1	80-120	%		✓	Soil	Metals
LCS	Magnesium (Mg)	1189900	WG3174361-4	4800	5000	mg/kg	96.0	80-120	%		✓	Soil	Metals
LCS	Manganese (Mn)	1189899	WG3174359-4	23.8	25	mg/kg	95.4	80-120	%		✓	Soil	Metals
LCS	Manganese (Mn)	1189900	WG3174361-4	23.5	25	mg/kg	94.2	80-120	%		✓	Soil	Metals
LCS	Molybdenum (Mo)	1189899	WG3174359-4	27.3	25	mg/kg	109.1	80-120	%		✓	Soil	Metals
LCS	Molybdenum (Mo)	1189900	WG3174361-4	26.3	25	mg/kg	105.3	80-120	%		✓	Soil	Metals
LCS	Nickel (Ni)	1189899	WG3174359-4	46.3	50	mg/kg	92.7	80-120	%		✓	Soil	Metals
LCS	Nickel (Ni)	1189900	WG3174361-4	46.2	50	mg/kg	92.5	80-120	%		✓	Soil	Metals
LCS	Phosphorus (P)	1189899	WG3174359-4	1060	1000	mg/kg	106.2	80-120	%		✓	Soil	Metals
LCS	Phosphorus (P)	1189900	WG3174361-4	1030	1000	mg/kg	102.5	80-120	%		✓	Soil	Metals
LCS	Potassium (K)	1189899	WG3174359-4	4300	5000	mg/kg	86.0	80-120	%		✓	Soil	Metals
LCS	Potassium (K)	1189900	WG3174361-4	4560	5000	mg/kg	91.1	80-120	%		✓	Soil	Metals
LCS	Selenium (Se)	1189899	WG3174359-4	93.4	100	mg/kg	93.4	80-120	%		✓	Soil	Metals
LCS	Selenium (Se)	1189900	WG3174361-4	93.4	100	mg/kg	93.4	80-120	%		✓	Soil	Metals
LCS	Silver (Ag)	1189899	WG3174359-4	9.89	10	mg/kg	98.9	80-120	%		✓	Soil	Metals
LCS	Silver (Ag)	1189900	WG3174361-4	10.2	10	mg/kg	101.5	80-120	%		✓	Soil	Metals
LCS	Sodium (Na)	1189899	WG3174359-4	4700	5000	mg/kg	94.0	80-120	%		✓	Soil	Metals
LCS	Sodium (Na)	1189900	WG3174361-4	4700	5000	mg/kg	94.1	80-120	%		✓	Soil	Metals
LCS	Strontium (Sr)	1189899	WG3174359-4	26.4	25	mg/kg	105.4	80-120	%		✓	Soil	Metals
LCS	Strontium (Sr)	1189900	WG3174361-4	27.8	25	mg/kg	111.3	80-120	%		✓	Soil	Metals

Quality Control L2340686

Job Reference 197202-0046
Report To Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received 4-Sep-2019 9:33
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Report Version 1

QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
LCS	Sulfur (S)	1189899	WG3174359-4	4780	5000	mg/kg	95.7	80-120	%		✓	Soil	Metals
LCS	Sulfur (S)	1189900	WG3174361-4	4570	5000	mg/kg	91.5	80-120	%		✓	Soil	Metals
LCS	Thallium (Tl)	1189899	WG3174359-4	89.7	100	mg/kg	89.7	80-120	%		✓	Soil	Metals
LCS	Thallium (Tl)	1189900	WG3174361-4	91.3	100	mg/kg	91.3	80-120	%		✓	Soil	Metals
LCS	Tin (Sn)	1189899	WG3174359-4	50.1	50	mg/kg	100.1	80-120	%		✓	Soil	Metals
LCS	Tin (Sn)	1189900	WG3174361-4	49.7	50	mg/kg	99.4	80-120	%		✓	Soil	Metals
LCS	Titanium (Ti)	1189899	WG3174359-4	22.8	25	mg/kg	91.3	80-120	%		✓	Soil	Metals
LCS	Titanium (Ti)	1189900	WG3174361-4	22.6	25	mg/kg	90.6	80-120	%		✓	Soil	Metals
LCS	Tungsten (W)	1189899	WG3174359-4	9.77	10	mg/kg	97.7	80-120	%		✓	Soil	Metals
LCS	Tungsten (W)	1189900	WG3174361-4	9.64	10	mg/kg	96.4	80-120	%		✓	Soil	Metals
LCS	Uranium (U)	1189899	WG3174359-4	0.480	0.5	mg/kg	96.0	80-120	%		✓	Soil	Metals
LCS	Uranium (U)	1189900	WG3174361-4	0.484	0.5	mg/kg	96.7	80-120	%		✓	Soil	Metals
LCS	Vanadium (V)	1189899	WG3174359-4	48.9	50	mg/kg	97.8	80-120	%		✓	Soil	Metals
LCS	Vanadium (V)	1189900	WG3174361-4	48.9	50	mg/kg	97.9	80-120	%		✓	Soil	Metals
LCS	Zinc (Zn)	1189899	WG3174359-4	45.9	50	mg/kg	91.8	80-120	%		✓	Soil	Metals
LCS	Zinc (Zn)	1189900	WG3174361-4	45.7	50	mg/kg	91.4	80-120	%		✓	Soil	Metals
LCS	Zirconium (Zr)	1189899	WG3174359-4	10.7	10	mg/kg	107.3	80-120	%		✓	Soil	Metals
LCS	Zirconium (Zr)	1189900	WG3174361-4	10.5	10	mg/kg	105.3	80-120	%		✓	Soil	Metals
Organic / Inorganic Carbon (Soil)													
MB	Inorganic Carbon	1187028	WG3170899-7	<0.050		%	-	<0.050	%		✓	Soil	Organic / Inorganic Carbon
MB	Inorganic Carbon	1188717	WG3172955-3	<0.050		%	-	<0.050	%		✓	Soil	Organic / Inorganic Carbon
MB	Total Carbon by Combustion	1190391	WG3169398-4	<0.05		%	-	<0.05	%		✓	Soil	Organic / Inorganic Carbon
MB	Total Carbon by Combustion	1188550	WG3172782-4	<0.05		%	-	<0.05	%		✓	Soil	Organic / Inorganic Carbon
Metals (Soil)													
MB	Aluminum (Al)	1189899	WG3174359-1	<50		mg/kg	-	<50	mg/kg		✓	Soil	Metals
MB	Aluminum (Al)	1189900	WG3174361-1	<50		mg/kg	-	<50	mg/kg		✓	Soil	Metals
MB	Antimony (Sb)	1189899	WG3174359-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Antimony (Sb)	1189900	WG3174361-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Arsenic (As)	1189899	WG3174359-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Arsenic (As)	1189900	WG3174361-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Barium (Ba)	1189899	WG3174359-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Barium (Ba)	1189900	WG3174361-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals

Quality Control L2340686

Job Reference 197202-0046
Report To Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received 4-Sep-2019 9:33
Report Date 7-Oct-2019 18:19
Report Version 1

QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
MB	Beryllium (Be)	1189899	WG3174359-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Beryllium (Be)	1189900	WG3174361-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Bismuth (Bi)	1189899	WG3174359-1	<0.20		mg/kg	-	<0.20	mg/kg		✓	Soil	Metals
MB	Bismuth (Bi)	1189900	WG3174361-1	<0.20		mg/kg	-	<0.20	mg/kg		✓	Soil	Metals
MB	Boron (B)	1189899	WG3174359-1	<5.0		mg/kg	-	<5.0	mg/kg		✓	Soil	Metals
MB	Boron (B)	1189900	WG3174361-1	<5.0		mg/kg	-	<5.0	mg/kg		✓	Soil	Metals
MB	Cadmium (Cd)	1189899	WG3174359-1	<0.020		mg/kg	-	<0.020	mg/kg		✓	Soil	Metals
MB	Cadmium (Cd)	1189900	WG3174361-1	<0.020		mg/kg	-	<0.020	mg/kg		✓	Soil	Metals
MB	Calcium (Ca)	1189899	WG3174359-1	<50		mg/kg	-	<50	mg/kg		✓	Soil	Metals
MB	Calcium (Ca)	1189900	WG3174361-1	<50		mg/kg	-	<50	mg/kg		✓	Soil	Metals
MB	Chromium (Cr)	1189899	WG3174359-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Chromium (Cr)	1189900	WG3174361-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Cobalt (Co)	1189899	WG3174359-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Cobalt (Co)	1189900	WG3174361-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Copper (Cu)	1189899	WG3174359-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Copper (Cu)	1189900	WG3174361-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Iron (Fe)	1189899	WG3174359-1	<50		mg/kg	-	<50	mg/kg		✓	Soil	Metals
MB	Iron (Fe)	1189900	WG3174361-1	<50		mg/kg	-	<50	mg/kg		✓	Soil	Metals
MB	Lead (Pb)	1189899	WG3174359-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Lead (Pb)	1189900	WG3174361-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Lithium (Li)	1189899	WG3174359-1	<2.0		mg/kg	-	<2.0	mg/kg		✓	Soil	Metals
MB	Lithium (Li)	1189900	WG3174361-1	<2.0		mg/kg	-	<2.0	mg/kg		✓	Soil	Metals
MB	Magnesium (Mg)	1189899	WG3174359-1	<20		mg/kg	-	<20	mg/kg		✓	Soil	Metals
MB	Magnesium (Mg)	1189900	WG3174361-1	<20		mg/kg	-	<20	mg/kg		✓	Soil	Metals
MB	Manganese (Mn)	1189899	WG3174359-1	<1.0		mg/kg	-	<1.0	mg/kg		✓	Soil	Metals
MB	Manganese (Mn)	1189900	WG3174361-1	<1.0		mg/kg	-	<1.0	mg/kg		✓	Soil	Metals
MB	Molybdenum (Mo)	1189899	WG3174359-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Molybdenum (Mo)	1189900	WG3174361-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Nickel (Ni)	1189899	WG3174359-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Nickel (Ni)	1189900	WG3174361-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Phosphorus (P)	1189899	WG3174359-1	<50		mg/kg	-	<50	mg/kg		✓	Soil	Metals
MB	Phosphorus (P)	1189900	WG3174361-1	<50		mg/kg	-	<50	mg/kg		✓	Soil	Metals
MB	Potassium (K)	1189899	WG3174359-1	<100		mg/kg	-	<100	mg/kg		✓	Soil	Metals
MB	Potassium (K)	1189900	WG3174361-1	<100		mg/kg	-	<100	mg/kg		✓	Soil	Metals

Quality Control L2340686

Job Reference 197202-0046
Report To Dave Hasek, MINNOW ENVIRONMENTAL INC.
Date Received 4-Sep-2019 9:33
Report Date 7-Oct-2019 18:19
Report Version 1

QC Type	Analyte	QC Lot #	ALS QC ID	Result	Target	Units	%	Limit	Units	Qual	Eval	Matrix	Class
MB	Selenium (Se)	1189899	WG3174359-1	<0.20		mg/kg	-	<0.20	mg/kg		✓	Soil	Metals
MB	Selenium (Se)	1189900	WG3174361-1	<0.20		mg/kg	-	<0.20	mg/kg		✓	Soil	Metals
MB	Silver (Ag)	1189899	WG3174359-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Silver (Ag)	1189900	WG3174361-1	<0.10		mg/kg	-	<0.10	mg/kg		✓	Soil	Metals
MB	Sodium (Na)	1189899	WG3174359-1	<50		mg/kg	-	<50	mg/kg		✓	Soil	Metals
MB	Sodium (Na)	1189900	WG3174361-1	<50		mg/kg	-	<50	mg/kg		✓	Soil	Metals
MB	Strontium (Sr)	1189899	WG3174359-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Strontium (Sr)	1189900	WG3174361-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Sulfur (S)	1189899	WG3174359-1	<1000		mg/kg	-	<1000	mg/kg		✓	Soil	Metals
MB	Sulfur (S)	1189900	WG3174361-1	<1000		mg/kg	-	<1000	mg/kg		✓	Soil	Metals
MB	Thallium (Tl)	1189899	WG3174359-1	<0.050		mg/kg	-	<0.050	mg/kg		✓	Soil	Metals
MB	Thallium (Tl)	1189900	WG3174361-1	<0.050		mg/kg	-	<0.050	mg/kg		✓	Soil	Metals
MB	Tin (Sn)	1189899	WG3174359-1	<1.0		mg/kg	-	<1.0	mg/kg		✓	Soil	Metals
MB	Tin (Sn)	1189900	WG3174361-1	<1.0		mg/kg	-	<1.0	mg/kg		✓	Soil	Metals
MB	Titanium (Ti)	1189899	WG3174359-1	<1.0		mg/kg	-	<1.0	mg/kg		✓	Soil	Metals
MB	Titanium (Ti)	1189900	WG3174361-1	<1.0		mg/kg	-	<1.0	mg/kg		✓	Soil	Metals
MB	Tungsten (W)	1189899	WG3174359-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Tungsten (W)	1189900	WG3174361-1	<0.50		mg/kg	-	<0.50	mg/kg		✓	Soil	Metals
MB	Uranium (U)	1189899	WG3174359-1	<0.050		mg/kg	-	<0.050	mg/kg		✓	Soil	Metals
MB	Uranium (U)	1189900	WG3174361-1	<0.050		mg/kg	-	<0.050	mg/kg		✓	Soil	Metals
MB	Vanadium (V)	1189899	WG3174359-1	<0.20		mg/kg	-	<0.20	mg/kg		✓	Soil	Metals
MB	Vanadium (V)	1189900	WG3174361-1	<0.20		mg/kg	-	<0.20	mg/kg		✓	Soil	Metals
MB	Zinc (Zn)	1189899	WG3174359-1	<2.0		mg/kg	-	<2.0	mg/kg		✓	Soil	Metals
MB	Zinc (Zn)	1189900	WG3174361-1	<2.0		mg/kg	-	<2.0	mg/kg		✓	Soil	Metals
MB	Zirconium (Zr)	1189899	WG3174359-1	<1.0		mg/kg	-	<1.0	mg/kg		✓	Soil	Metals
MB	Zirconium (Zr)	1189900	WG3174361-1	<1.0		mg/kg	-	<1.0	mg/kg		✓	Soil	Metals

Evaluation Legend

✓ QC Lot met ALS Data Quality Objectives

2021

Results Summary WR2101119

Project	217202-74
Report To	Dave Hasek, Minnow Environmental Inc.
Date Received	25-Aug-2021 14:20
Issue Date	16-Sep-2021 08:45
Amendment	0

Ash-Free Dry Mass

Client Sample ID			HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5	CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	CC23.7-1	CC23.7-2
Date Sampled			19-Aug-2021	19-Aug-2021	19-Aug-2021	19-Aug-2021	19-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	22-Aug-2021	22-Aug-2021	22-Aug-2021	22-Aug-2021	22-Aug-2021	22-Aug-2021	22-Aug-2021
ALS Sample ID			WR2101119-001	WR2101119-002	WR2101119-003	WR2101119-004	WR2101119-005	WR2101119-006	WR2101119-007	WR2101119-008	WR2101119-009	WR2101119-010	WR2101119-011	WR2101119-012	WR2101119-013	WR2101119-014	WR2101119-015	WR2101119-016	WR2101119-017	WR2101119-018	WR2101119-019	WR2101119-020	WR2101119-021	WR2101119-022
Analyte	**Lowest Detection Limit**	**Units**	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue
Physical Tests (Matrix: Biota)																								
ash free dry weight	**0.0010**	**g/sample**	0.0114	0.0071	0.0069	0.0047	0.0042	0.0012	0.0038	<0.0010	0.0016	0.0014	0.0026	<0.0010	0.0017	<0.0010	0.0025	0.0145	0.0225	0.0153	0.0037	0.0072	0.0078	0.0042
ash weight	**0.0010**	**g/sample**	0.0081	0.0042	0.0065	0.0034	0.0028	0.0153	0.0431	0.0088	0.0224	0.0182	0.0025	0.0029	0.0250	0.0203	0.0228	0.0036	0.0059	0.0084	0.0025	0.0072	0.0024	0.0019
weight, dry	**0.0010**	**g/sample**	0.0194	0.0113	0.0134	0.0081	0.0070	0.0165	0.0469	0.0092	0.0241	0.0196	0.0050	0.0036	0.0267	0.0211	0.0253	0.0181	0.0285	0.0237	0.0061	0.0144	0.0102	0.0061
Plant Pigments (Matrix: Biota)																								
chlorophyll a	**0.010**	**µg**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: "-" indicates no data available.

Results Summary WR2101119

Project	217202-74
Report To	Dave Hasek, Minnow Environmental Inc.
Date Received	25-Aug-2021 14:20
Issue Date	16-Sep-2021 08:45
Amendment	0

Ash-Free Dry Mass

Client Sample ID			CC23.7-3	CC23.7-4	CC23.7-5	HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	STY0.6-1	STY0.6-2	STY0.6-3	STY0.6-4	STY0.6-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4
Date Sampled			22-Aug-2021	22-Aug-2021	22-Aug-2021	24-Aug-2021	24-Aug-2021	24-Aug-2021	24-Aug-2021	24-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021
ALS Sample ID			WR2101119-023	WR2101119-024	WR2101119-025	WR2101119-026	WR2101119-027	WR2101119-028	WR2101119-029	WR2101119-030	WR2101119-031	WR2101119-032	WR2101119-033	WR2101119-034	WR2101119-035	WR2101119-036	WR2101119-037	WR2101119-038	WR2101119-039	WR2101119-040	WR2101119-041	WR2101119-042	WR2101119-043	WR2101119-044
Analyte	**Lowest Detection Limit**	**Units**	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue
Physical Tests (Matrix: Biota)																								
ash free dry weight	**0.0010**	**g/sample**	0.0083	0.0028	0.0077	0.0063	0.0047	0.0036	0.0010	0.0047	0.0137	0.0113	0.0080	0.0166	0.0204	0.0031	<0.0010	<0.0010	<0.0010	0.0250	0.0167	0.0156	0.0184	0.0225
ash weight	**0.0010**	**g/sample**	0.0036	0.0012	0.0053	0.0030	<0.0010	0.0023	<0.0010	0.0021	0.0949	0.114	0.0566	0.0525	0.0744	0.0034	0.0039	0.0068	0.0021	0.0123	0.0127	0.0090	0.0036	0.0100
weight, dry	**0.0010**	**g/sample**	0.0119	0.0041	0.0130	0.0093	0.0056	0.0059	0.0017	0.0068	0.108	0.125	0.0645	0.0692	0.0948	0.0065	0.0038	0.0071	0.0017	0.0374	0.0294	0.0246	0.0220	0.0325
Plant Pigments (Matrix: Biota)																								
chlorophyll a	**0.010**	**µg**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: "-" indicates no data available.

Results Summary WR2101119

Project	217202-74
Report To	Dave Hasek, Minnow Environmental Inc.
Date Received	25-Aug-2021 14:20
Issue Date	16-Sep-2021 08:45
Amendment	0

			Ash-Free Dry Mass												Chlorophyll-a									
Client Sample ID			XE0.2-5	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5	CR24.5-1
Date Sampled			21-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	19-Aug-2021	19-Aug-2021	19-Aug-2021	19-Aug-2021	19-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	22-Aug-2021
ALS Sample ID			WR2101119-045	WR2101119-046	WR2101119-047	WR2101119-048	WR2101119-049	WR2101119-050	WR2101119-051	WR2101119-052	WR2101119-053	WR2101119-054	WR2101119-055	WR2101119-056	WR2101119-057	WR2101119-058	WR2101119-059	WR2101119-060	WR2101119-061	WR2101119-062	WR2101119-063	WR2101119-064	WR2101119-065	WR2101119-066
Analyte	**Lowest Detection Limit**	**Units**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**
Physical Tests (Matrix: Biota)																								
ash free dry weight	**0.0010**	**g/sample**	0.0230	0.0044	0.0036	0.0045	0.0093	<0.0010	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ash weight	**0.0010**	**g/sample**	0.0066	0.0033	0.0181	0.0056	0.0110	0.0026	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
weight, dry	**0.0010**	**g/sample**	0.0296	0.0077	0.0217	0.0101	0.0202	0.0028	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant Pigments (Matrix: Biota)																								
chlorophyll a	**0.010**	**µg**	-	-	-	-	-	-	6.55	3.24	9.18	2.44	7.12	1.31	2.17	0.385	1.94	0.948	1.44	1.52	1.74	1.81	3.51	6.20

Note: "-" indicates no data available.

Results Summary WR2101119

Project	217202-74
Report To	Dave Hasek, Minnow Environmental Inc.
Date Received	25-Aug-2021 14:20
Issue Date	16-Sep-2021 08:45
Amendment	0

Chlorophyll-a																						
Client Sample ID			CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5	HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	STY0.6-1	STY0.6-2	STY0.6-3
Date Sampled			22-Aug-2021	22-Aug-2021	22-Aug-2021	22-Aug-2021	22-Aug-2021	22-Aug-2021	22-Aug-2021	22-Aug-2021	22-Aug-2021	24-Aug-2021	24-Aug-2021	24-Aug-2021	24-Aug-2021	24-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021
ALS Sample ID			WR2101119-067	WR2101119-068	WR2101119-069	WR2101119-070	WR2101119-071	WR2101119-072	WR2101119-073	WR2101119-074	WR2101119-075	WR2101119-076	WR2101119-077	WR2101119-078	WR2101119-079	WR2101119-080	WR2101119-081	WR2101119-082	WR2101119-083	WR2101119-084	WR2101119-085	WR2101119-086	WR2101119-087	WR2101119-088
Analyte	**Lowest Detection Limit**	**Units**	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue	Sub-Matrix: Tissue
Physical Tests (Matrix: Biota)																								
ash free dry weight	**0.0010**	**g/sample**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ash weight	**0.0010**	**g/sample**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
weight, dry	**0.0010**	**g/sample**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Plant Pigments (Matrix: Biota)																								
chlorophyll a	**0.010**	**µg**	6.75	8.33	2.51	2.47	6.06	11.6	4.29	2.18	9.88	1.17	6.31	5.88	2.27	14.7	28.8	1.96	59.9	47.1	90.2	8.84	3.37	5.21

Note: "-" indicates no data available.

Results Summary WR2101119

Project	217202-74
Report To	Dave Hasek, Minnow Environmental Inc.
Date Received	25-Aug-2021 14:20
Issue Date	16-Sep-2021 08:45
Amendment	0

Chloropyll-a													
Client Sample ID			STY0.6-4	STY0.6-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5
Date Sampled			21-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021	21-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021
ALS Sample ID			WR2101119-089	WR2101119-090	WR2101119-091	WR2101119-092	WR2101119-093	WR2101119-094	WR2101119-095	WR2101119-096	WR2101119-097	WR2101119-098	WR2101119-099	WR2101119-100
Analyte	**Lowest Detection Limit**	**Units**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**	**Sub-Matrix: Tissue**
Physical Tests (Matrix: Biota)														
ash free dry weight	**0.0010**	**g/sample**	-	-	-	-	-	-	-	-	-	-	-	-
ash weight	**0.0010**	**g/sample**	-	-	-	-	-	-	-	-	-	-	-	-
weight, dry	**0.0010**	**g/sample**	-	-	-	-	-	-	-	-	-	-	-	-
Plant Pigments (Matrix: Biota)														
chlorophyll a	**0.010**	**µg**	2.30	19.0	18.0	9.34	18.4	13.8	9.94	4.57	4.23	3.65	5.12	6.20

Note: "-" indicates no data available.

Results Summary WR2101119

Project	217202-74
Report To	Dave Hasek, Minnow Environmental Inc.
Date Received	25-Aug-2021 14:20
Issue Date	16-Sep-2021 08:45
Amendment	0

Client Sample ID			HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5
Date Sampled			19-Aug-2021	19-Aug-2021	19-Aug-2021	19-Aug-2021	19-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	23-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021	20-Aug-2021
Time Sampled			00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00	00:00
ALS Sample ID			WR2101119-101	WR2101119-102	WR2101119-103	WR2101119-104	WR2101119-105	WR2101119-106	WR2101119-107	WR2101119-108	WR2101119-109	WR2101119-110	WR2101119-111	WR2101119-112	WR2101119-113	WR2101119-114	WR2101119-115	WR2101119-116	WR2101119-117	WR2101119-118	WR2101119-119	WR2101119-120
Analyte	Lowest Detection Limit	Units	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil	Sub-Matrix: Soil
Physical Tests (Matrix: Soil/Solid)																						
pH (1:2 soil:water)	0.10	pH units	6.75	6.83	6.34	6.80	7.11	6.91	6.89	6.99	7.02	7.03	6.93	6.95	6.91	6.97	6.85	7.35	7.33	7.04	7.39	7.35
Particle Size (Matrix: Soil/Solid)																						
clay (<0.004mm)	1.0	%	5.1	4.0	3.4	4.1	3.5	5.5	5.5	5.4	6.0	5.5	4.2	4.4	4.9	4.9	5.3	4.1	3.2	4.1	4.2	3.4
silt (0.063mm - 0.004mm)	1.0	%	73.9	62.5	48.8	63.8	49.9	65.6	67.3	64.7	72.2	59.7	73.0	72.0	70.1	77.3	78.0	31.9	31.5	24.2	36.8	26.0
sand (2.0mm - 0.063mm)	1.0	%	21.0	33.4	39.5	32.1	43.9	27.8	27.2	29.3	21.8	34.6	22.8	20.6	25.0	17.8	16.7	63.0	65.3	71.7	58.8	69.5
gravel (>2mm)	1.0	%	<1.0	<1.0	8.3	<1.0	2.7	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	3.0	<1.0	<1.0	<1.0	1.0	<1.0	<1.0	<1.0	1.1
Organic / Inorganic Carbon (Matrix: Soil/Solid)																						
carbon, total organic [TOC]	0.050	%	8.48	6.34	6.05	5.02	4.88	3.20	4.02	3.46	4.79	3.11	4.56	7.31	11.9	5.76	7.54	3.27	2.43	1.79	3.95	2.03
organic matter	0.10	%	14.6	10.9	10.4	8.65	8.41	5.52	6.93	5.96	8.26	5.36	7.86	12.6	20.5	9.93	13.0	5.64	4.19	3.08	6.81	3.50
Metals (Matrix: Soil/Solid)																						
aluminum	50	mg/kg	18800	19500	17200	17500	16100	19000	19400	20900	21600	20200	22000	20600	20200	20000	20900	11400	12500	11800	12200	9490
antimony	0.10	mg/kg	2.03	2.32	2.19	2.49	1.90	0.70	0.71	0.70	0.71	0.75	0.52	0.64	0.55	0.49	0.55	1.53	1.41	2.45	1.42	1.28
arsenic	0.10	mg/kg	39.1	41.8	38.4	38.0	34.6	14.7	14.6	15.0	16.0	16.3	10.1	14.4	10.3	9.43	10.7	17.5	19.4	19.4	19.6	16.3
barium	0.50	mg/kg	200	191	185	185	174	179	182	178	183	188	280	295	302	279	301	156	162	132	171	106
beryllium	0.10	mg/kg	0.51	0.53	0.51	0.46	0.48	0.57	0.57	0.59	0.61	0.65	0.42	0.43	0.44	0.42	0.46	0.47	0.55	0.46	0.53	0.39
bismuth	0.20	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.22	0.21	0.21	0.22	0.22	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
boron	5.0	mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
cadmium	0.020	mg/kg	0.220	0.187	0.192	0.168	0.176	0.126	0.129	0.135	0.145	0.136	0.262	0.337	0.387	0.280	0.346	0.160	0.165	0.105	0.178	0.093
calcium	50	mg/kg	8530	8120	6430	6410	6430	6130	6300	6960	7300	6860	9020	9600	11000	8970	10600	6840	7490	5570	7870	4300
chromium	0.50	mg/kg	42.0	45.8	41.3	42.1	39.7	35.9	36.0	38.4	39.9	37.1	34.6	33.6	33.3	32.5	34.6	23.2	24.3	24.0	23.4	20.1
cobalt	0.10	mg/kg	12.2	13.3	13.5	12.6	11.9	10.2	10.1	10.8	11.2	10.8	13.3	14.5	13.6	12.8	13.6	9.11	9.61	9.19	9.79	7.97
copper	0.50	mg/kg	21.2	15.4	13.7	13.2	12.3	17.9	17.1	18.2	20.3	18.6	23.8	27.4	30.3	25.2	29.0	12.0	13.8	9.72	13.9	8.45
iron	50	mg/kg	26400	28200	26200	26700	24000	26100	25700	27500	28000	27000	31200	31600	29500	29400	30300	19500	20500	20300	20400	17600
lead	0.50	mg/kg	9.87	9.54	9.24	9.16	8.17	11.0	10.7	11.0	11.6	11.2	7.22	7.55	7.32	7.15	7.78	8.96	9.29	7.92	9.26	6.70
lithium	2.0	mg/kg	10.8	12.0	10.2	10.5	11.4	12.3	12.2	13.3	13.2	13.4	14.9	14.5	13.3	14.6	14.0	7.9	8.7	8.3	8.4	7.3
magnesium	20	mg/kg	7900	8640	8240	8540	7700	8220	8580	8780	8640	8680	8660	8560	7910	8200	8110	5650	5920	6140	5760	5220
manganese	1.0	mg/kg	664	722	836	651	656	484	497	527	547	591	673	750	769	622	742	544	609	490	666	436
mercury	0.0500	mg/kg	0.0646	0.0607	0.0736	0.0512	<0.0500	<0.0500	<0.0500	0.0508	0.0599	0.0578	0.0679	0.0729	0.0909	0.0768	0.0943	<0.0500	<0.0500	<0.0500	<0.0500	<0.0500
molybdenum	0.10	mg/kg	0.82	0.89	0.91	0.82	0.71	0.71	0.73	0.79	0.75	0.79	1.02	1.10	1.04	1.03	1.10	0.67	0.71	0.67	0.76	0.63
nickel	0.50	mg/kg	22.4	24.0	22.6	22.6	21.5	18.1	17.8	19.3	20.1	18.4	21.8	22.8	22.8	21.4	23.1	14.3	15.4	14.0	15.3	12.0
phosphorus	50	mg/kg	686	616	572	593	528	507	533	581	557	514	731	718	794	671	757	549	593	538	622	523
potassium	100	mg/kg	1490	1610	1520	1530	1500	1800	1930	1930	1870	2130	2170	2160	1770	1920	1880	1490	1490	1690	1520	1430
selenium	0.20	mg/kg	0.25	0.26	0.20	<0.20	0.22	<0.20	<0.20	<0.20	0.21	<0.20	0.36	0.48	0.54	0.35	0.50	<0.20	<0.20	<0.20	<0.20	<0.20
silver	0.10	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.13	0.18	0.20	0.15	0.19	<0.10	0.11	<0.10	0.11	<0.10
sodium	50	mg/kg	241	221	176	182	186	280	301	336	335	309	423	329	326	332	358	150	172	160	155	97
strontium	0.50	mg/kg	94.0	88.9	56.7	71.0	67.5	53.0	56.8	61.7	66.0	58.8	61.1	63.5	70.0	57.6	70.8	49.3	52.6	39.6	56.3	31.6
sulfur	1000	mg/kg	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
thallium	0.050	mg/kg	0.201	0.196	0.184	0.175	0.175	0.190	0.190	0.199	0.203	0.207	0.237	0.245	0.216	0.225	0.234	0.146	0.154	0.156	0.149	0.125
tin	2.0	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
titanium	1.0	mg/kg	1020	1080	908	898	898	1090	1210	1270	1240	1210	1520	1290	1190	1220	1250	694	720	781	699	557
tungsten	0.50	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.60	<0.50	0.59	0.84	<0.50
uranium	0.050	mg/kg	20.4	23.9	11.8	14.8	16.0	4.30	3.52	4.19	4.82	4.42	7.82	10.2	11.0	8.01	10.4	5.88	6.29	3.62	7.34	2.91
vanadium	0.20	mg/kg	62.8	68.2	62.4	61.3	55.0	60.8	61.9	66.0	67.1	64.1	78.7	77.6	74.3	73.0	75.7	38.4	41.1	40.4	40.4	32.0
zinc	2.0	mg/kg	63.8	62.9	57.7	58.8	55.9	65.8	63.7	66.8	70.1	66.6	80.6	85.5	75.7	77.8	78.4	40.7	44.2	42.6	44.5	37.1
zirconium	1.0	mg/kg	1.6	1.4	1.6	1.9	1.4	2.6	2.5	2.6	2.5	2.4	2.9	4.2	3.7	3.7	3.7	1.8	1.9	1.7	2.0	1.7

Quality Control WR2101119

Project	217202-74
Report To	Dave Hasek, Minnow Environmental Inc.
Date Received	25-Aug-2021 14:20
Issue Date	16-Sep-2021 08:45
Amendment	0

QC Type	Analyte	QC Lot	ALS QC ID	Method	Result	Target	Units	%	Limit	Units	Qual	Eval
Physical Tests (Matrix: Biota)												
LCS	ash free dry weight	283077	QC-283077-002	E137	0.0366	0.0405 g/sample	g/sample	90.4	70-130	%		✓
LCS	ash weight	283077	QC-283077-002	E137	0.0789	0.0745 g/sample	g/sample	106	70-130	%		✓
LCS	weight, dry	283077	QC-283077-002	E137	0.116	0.115 g/sample	g/sample	100	70-130	%		✓
LCS	ash free dry weight	283078	QC-283078-002	E137	0.0351	0.0405 g/sample	g/sample	86.7	70-130	%		✓
LCS	ash weight	283078	QC-283078-002	E137	0.0803	0.0745 g/sample	g/sample	108	70-130	%		✓
LCS	weight, dry	283078	QC-283078-002	E137	0.115	0.115 g/sample	g/sample	100	70-130	%		✓
LCS	ash free dry weight	283079	QC-283079-002	E137	0.0364	0.0405 g/sample	g/sample	89.9	70-130	%		✓
LCS	ash weight	283079	QC-283079-002	E137	0.0804	0.0745 g/sample	g/sample	108	70-130	%		✓
LCS	weight, dry	283079	QC-283079-002	E137	0.117	0.115 g/sample	g/sample	102	70-130	%		✓
MB	ash free dry weight	283077	QC-283077-001	E137	<0.0010		g/sample	-	0.001	g/sample		✓
MB	ash weight	283077	QC-283077-001	E137	<0.0010		g/sample	-	0.001	g/sample		✓
MB	weight, dry	283077	QC-283077-001	E137	<0.0010		g/sample	-	0.001	g/sample		✓
MB	ash free dry weight	283078	QC-283078-001	E137	<0.0010		g/sample	-	0.001	g/sample		✓
MB	ash weight	283078	QC-283078-001	E137	<0.0010		g/sample	-	0.001	g/sample		✓
MB	weight, dry	283078	QC-283078-001	E137	<0.0010		g/sample	-	0.001	g/sample		✓
MB	ash free dry weight	283079	QC-283079-001	E137	<0.0010		g/sample	-	0.001	g/sample		✓
MB	ash weight	283079	QC-283079-001	E137	<0.0010		g/sample	-	0.001	g/sample		✓
MB	weight, dry	283079	QC-283079-001	E137	<0.0010		g/sample	-	0.001	g/sample		✓
Plant Pigments (Matrix: Biota)												
LCS	chlorophyll a	280315	QC-280315-002	E870	0.978	1 µg	µg	97.8	80-120	%		✓
LCS	chlorophyll a	280316	QC-280316-002	E870	0.987	1 µg	µg	98.7	80-120	%		✓
LCS	chlorophyll a	280317	QC-280317-002	E870	0.984	1 µg	µg	98.4	80-120	%		✓
MB	chlorophyll a	280315	QC-280315-001	E870	<0.010		µg	-	0.01	µg		✓
MB	chlorophyll a	280316	QC-280316-001	E870	<0.010		µg	-	0.01	µg		✓
MB	chlorophyll a	280317	QC-280317-001	E870	<0.010		µg	-	0.01	µg		✓
Physical Tests (Matrix: Soil/Solid)												
LCS	pH (1:2 soil:water)	281363	QC-281363-001	E108	6.04	6 pH units	pH units	101	95-105	%		✓
Metals (Matrix: Soil/Solid)												
LCS	aluminum	281362	QC-MRG2-281361002	E440	205	200 mg/kg	mg/kg	102	80-120	%		✓
LCS	antimony	281362	QC-MRG2-281361002	E440	105	100 mg/kg	mg/kg	105	80-120	%		✓
LCS	arsenic	281362	QC-MRG2-281361002	E440	103	100 mg/kg	mg/kg	103	80-120	%		✓
LCS	barium	281362	QC-MRG2-281361002	E440	27.2	25 mg/kg	mg/kg	109	80-120	%		✓
LCS	beryllium	281362	QC-MRG2-281361002	E440	9.53	10 mg/kg	mg/kg	95.3	80-120	%		✓
LCS	bismuth	281362	QC-MRG2-281361002	E440	98.1	100 mg/kg	mg/kg	98.1	80-120	%		✓
LCS	boron	281362	QC-MRG2-281361002	E440	99.6	100 mg/kg	mg/kg	99.6	80-120	%		✓
LCS	cadmium	281362	QC-MRG2-281361002	E440	9.93	10 mg/kg	mg/kg	99.3	80-120	%		✓
LCS	calcium	281362	QC-MRG2-281361002	E440	5050	5000 mg/kg	mg/kg	101	80-120	%		✓
LCS	chromium	281362	QC-MRG2-281361002	E440	25.3	25 mg/kg	mg/kg	101	80-120	%		✓
LCS	cobalt	281362	QC-MRG2-281361002	E440	25.1	25 mg/kg	mg/kg	100	80-120	%		✓
LCS	copper	281362	QC-MRG2-281361002	E440	24.8	25 mg/kg	mg/kg	99.0	80-120	%		✓
LCS	iron	281362	QC-MRG2-281361002	E440	99	100 mg/kg	mg/kg	99.3	80-120	%		✓
LCS	lead	281362	QC-MRG2-281361002	E440	49.7	50 mg/kg	mg/kg	99.4	80-120	%		✓
LCS	lithium	281362	QC-MRG2-281361002	E440	23.7	25 mg/kg	mg/kg	94.9	80-120	%		✓
LCS	magnesium	281362	QC-MRG2-281361002	E440	5000	5000 mg/kg	mg/kg	100	80-120	%		✓
LCS	manganese	281362	QC-MRG2-281361002	E440	25.1	25 mg/kg	mg/kg	100	80-120	%		✓
LCS	molybdenum	281362	QC-MRG2-281361002	E440	26.1	25 mg/kg	mg/kg	104	80-120	%		✓
LCS	nickel	281362	QC-MRG2-281361002	E440	49.5	50 mg/kg	mg/kg	98.9	80-120	%		✓
LCS	phosphorus	281362	QC-MRG2-281361002	E440	1120	1000 mg/kg	mg/kg	112	80-120	%		✓
LCS	potassium	281362	QC-MRG2-281361002	E440	5140	5000 mg/kg	mg/kg	103	80-120	%		✓
LCS	selenium	281362	QC-MRG2-281361002	E440	97.6	100 mg/kg	mg/kg	97.6	80-120	%		✓
LCS	silver	281362	QC-MRG2-281361002	E440	10.5	10 mg/kg	mg/kg	105	80-120	%		✓
LCS	sodium	281362	QC-MRG2-281361002	E440	5070	5000 mg/kg	mg/kg	101	80-120	%		✓
LCS	strontium	281362	QC-MRG2-281361002	E440	26.4	25 mg/kg	mg/kg	106	80-120	%		✓
LCS	sulfur	281362	QC-MRG2-281361002	E440	4600	5000 mg/kg	mg/kg	93.0	80-120	%		✓
LCS	thallium	281362	QC-MRG2-281361002	E440	98.7	100 mg/kg	mg/kg	98.7	80-120	%		✓
LCS	tin	281362	QC-MRG2-281361002	E440	51.0	50 mg/kg	mg/kg	102	80-120	%		✓
LCS	titanium	281362	QC-MRG2-281361002	E440	25.0	25 mg/kg	mg/kg	99.8	80-120	%		✓
LCS	tungsten	281362	QC-MRG2-281361002	E440	10.1	10 mg/kg	mg/kg	101	80-120	%		✓
LCS	uranium	281362	QC-MRG2-281361002	E440	0.503	0.5 mg/kg	mg/kg	101	80-120	%		✓
LCS	vanadium	281362	QC-MRG2-281361002	E440	51.0	50 mg/kg	mg/kg	102	80-120	%		✓
LCS	zinc	281362	QC-MRG2-281361002	E440	51.8	50 mg/kg	mg/kg	104	80-120	%		✓
LCS	zirconium	281362	QC-MRG2-281361002	E440	9.8	10 mg/kg	mg/kg	98.1	80-120	%		✓
LCS	mercury	281361	QC-MRG2-281361002	E510	0.105	0.1 mg/kg	mg/kg	105	80-120	%		✓
RM	aluminum	281362	QC-MRG2-281361003	E440	10100	9817 mg/kg	mg/kg	103	70-130	%		✓
RM	antimony	281362	QC-MRG2-281361003	E440	3.77	3.99 mg/kg	mg/kg	94.4	70-130	%		✓
RM	arsenic	281362	QC-MRG2-281361003	E440	3.87	3.73 mg/kg	mg/kg	104	70-130	%		✓
RM	barium	281362	QC-MRG2-281361003	E440	105	105 mg/kg	mg/kg	99.9	70-130	%		✓
RM	beryllium	281362	QC-MRG2-281361003	E440	0.34	0.349 mg/kg	mg/kg	98.8	70-130	%		✓
RM	boron	281362	QC-MRG2-281361003	E440	9.7	8.5 mg/kg	mg/kg	115	40-160	%		✓
RM	cadmium	281362	QC-MRG2-281361003	E440	1.03	0.91 mg/kg	mg/kg	113	70-130	%		✓
RM	calcium	281362	QC-MRG2-281361003	E440	30000	31082 mg/kg	mg/kg	96.4	70-130	%		✓
RM	chromium	281362	QC-MRG2-281361003	E440	108	101 mg/kg	mg/kg	106	70-130	%		✓
RM	cobalt	281362	QC-MRG2-281361003	E440	6.86	6.9 mg/kg	mg/kg	99.5	70-130	%		✓
RM	copper	281362	QC-MRG2-281361003	E440	121	123 mg/kg	mg/kg	98.4	70-130	%		✓
RM	iron	281362	QC-MRG2-281361003	E440	23800	23558 mg/kg	mg/kg	101	70-130	%		✓
RM	lead	281362	QC-MRG2-281361003	E440	245	267 mg/kg	mg/kg	91.9	70-130	%		✓
RM	lithium	281362	QC-MRG2-281361003	E440	9.1	9.5 mg/kg	mg/kg	96.1	70-130	%		✓
RM	magnesium	281362	QC-MRG2-281361003	E440	5520	5509 mg/kg	mg/kg	100	70-130	%		✓
RM	manganese	281362	QC-MRG2-281361003	E440	282	269 mg/kg	mg/kg	105	70-130	%		✓
RM	molybdenum	281362	QC-MRG2-281361003	E440	0.98	1.03 mg/kg	mg/kg	95.6	70-130	%		✓
RM	nickel	281362	QC-MRG2-281361003	E440	27.0	26.7 mg/kg	mg/kg	101	70-130	%		✓
RM	phosphorus	281362	QC-MRG2-281361003	E440	831	752 mg/kg	mg/kg	110	70-130	%		✓
RM	potassium	281362	QC-MRG2-281361003	E440	1730	1587 mg/kg	mg/kg	109	70-130	%		✓
RM	sodium	281362	QC-MRG2-281361003	E440	810	797 mg/kg	mg/kg	102	70-130	%		✓

Quality Control WR2101119

Project	217202-74
Report To	Dave Hasek, Minnow Environmental Inc.
Date Received	25-Aug-2021 14:20
Issue Date	16-Sep-2021 08:45
Amendment	0

QC Type	Analyte	QC Lot	ALS QC ID	Method	Result	Target	Units	%	Limit	Units	Qual	Eval
RM	strontium	281362	QC-MRG2-281361003	E440	84.4	86.1 mg/kg	mg/kg	98.0	70-130	%		✓
RM	thallium	281362	QC-MRG2-281361003	E440	0.072	0.0786 mg/kg	mg/kg	92.2	40-160	%		✓
RM	tin	281362	QC-MRG2-281361003	E440	10.4	10.6 mg/kg	mg/kg	98.2	70-130	%		✓
RM	titanium	281362	QC-MRG2-281361003	E440	931	839 mg/kg	mg/kg	111	70-130	%		✓
RM	uranium	281362	QC-MRG2-281361003	E440	0.516	0.52 mg/kg	mg/kg	99.3	70-130	%		✓
RM	vanadium	281362	QC-MRG2-281361003	E440	33.5	32.7 mg/kg	mg/kg	102	70-130	%		✓
RM	zinc	281362	QC-MRG2-281361003	E440	306	297 mg/kg	mg/kg	103	70-130	%		✓
RM	zirconium	281362	QC-MRG2-281361003	E440	5.3	5.73 mg/kg	mg/kg	93.3	70-130	%		✓
RM	mercury	281361	QC-MRG2-281361003	E510	0.0606	0.059 mg/kg	mg/kg	103	70-130	%		✓
MB	aluminum	281362	QC-MRG2-281361001	E440	<50		mg/kg	-	50	mg/kg		✓
MB	antimony	281362	QC-MRG2-281361001	E440	<0.10		mg/kg	-	0.1	mg/kg		✓
MB	arsenic	281362	QC-MRG2-281361001	E440	<0.10		mg/kg	-	0.1	mg/kg		✓
MB	barium	281362	QC-MRG2-281361001	E440	<0.50		mg/kg	-	0.5	mg/kg		✓
MB	beryllium	281362	QC-MRG2-281361001	E440	<0.10		mg/kg	-	0.1	mg/kg		✓
MB	bismuth	281362	QC-MRG2-281361001	E440	<0.20		mg/kg	-	0.2	mg/kg		✓
MB	boron	281362	QC-MRG2-281361001	E440	<5.0		mg/kg	-	5	mg/kg		✓
MB	cadmium	281362	QC-MRG2-281361001	E440	<0.020		mg/kg	-	0.02	mg/kg		✓
MB	calcium	281362	QC-MRG2-281361001	E440	<50		mg/kg	-	50	mg/kg		✓
MB	chromium	281362	QC-MRG2-281361001	E440	<0.50		mg/kg	-	0.5	mg/kg		✓
MB	cobalt	281362	QC-MRG2-281361001	E440	<0.10		mg/kg	-	0.1	mg/kg		✓
MB	copper	281362	QC-MRG2-281361001	E440	<0.50		mg/kg	-	0.5	mg/kg		✓
MB	iron	281362	QC-MRG2-281361001	E440	<50		mg/kg	-	50	mg/kg		✓
MB	lead	281362	QC-MRG2-281361001	E440	<0.50		mg/kg	-	0.5	mg/kg		✓
MB	lithium	281362	QC-MRG2-281361001	E440	<2.0		mg/kg	-	2	mg/kg		✓
MB	magnesium	281362	QC-MRG2-281361001	E440	<20		mg/kg	-	20	mg/kg		✓
MB	manganese	281362	QC-MRG2-281361001	E440	<1.0		mg/kg	-	1	mg/kg		✓
MB	molybdenum	281362	QC-MRG2-281361001	E440	<0.10		mg/kg	-	0.1	mg/kg		✓
MB	nickel	281362	QC-MRG2-281361001	E440	<0.50		mg/kg	-	0.5	mg/kg		✓
MB	phosphorus	281362	QC-MRG2-281361001	E440	<50		mg/kg	-	50	mg/kg		✓
MB	potassium	281362	QC-MRG2-281361001	E440	<100		mg/kg	-	100	mg/kg		✓
MB	selenium	281362	QC-MRG2-281361001	E440	<0.20		mg/kg	-	0.2	mg/kg		✓
MB	silver	281362	QC-MRG2-281361001	E440	<0.10		mg/kg	-	0.1	mg/kg		✓
MB	sodium	281362	QC-MRG2-281361001	E440	<50		mg/kg	-	50	mg/kg		✓
MB	strontium	281362	QC-MRG2-281361001	E440	<0.50		mg/kg	-	0.5	mg/kg		✓
MB	sulfur	281362	QC-MRG2-281361001	E440	<1000		mg/kg	-	1000	mg/kg		✓
MB	thallium	281362	QC-MRG2-281361001	E440	<0.050		mg/kg	-	0.05	mg/kg		✓
MB	tin	281362	QC-MRG2-281361001	E440	<2.0		mg/kg	-	2	mg/kg		✓
MB	titanium	281362	QC-MRG2-281361001	E440	<1.0		mg/kg	-	1	mg/kg		✓
MB	tungsten	281362	QC-MRG2-281361001	E440	<0.50		mg/kg	-	0.5	mg/kg		✓
MB	uranium	281362	QC-MRG2-281361001	E440	<0.050		mg/kg	-	0.05	mg/kg		✓
MB	vanadium	281362	QC-MRG2-281361001	E440	<0.20		mg/kg	-	0.2	mg/kg		✓
MB	zinc	281362	QC-MRG2-281361001	E440	<2.0		mg/kg	-	2	mg/kg		✓
MB	zirconium	281362	QC-MRG2-281361001	E440	<1.0		mg/kg	-	1	mg/kg		✓
MB	mercury	281361	QC-MRG2-281361001	E510	<0.0050		mg/kg	-	0.005	mg/kg		✓

Evaluation Legend

✓	QC Lot met ALS Data Quality Objectives
ND	Recovery not determined, background level >= 1x spike level

PERIPHYTON COMMUNITY

2018

biologica

Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2018.

Biologica Sample ID							18-134-001	18-134-002	18-134-003	18-134-004	18-134-005	18-134-006	18-134-007	18-134-008	18-134-009	18-134-010
Client Sample ID							18.43-CF-3.9-1	18.43-CF-3.9-2	18.43-CF-3.9-5	18.43-CF-19.2-1	18.43-CF-19.2-2	18.43-CF-19.2-3	18.43-CF-19.2-4	18.43-CF-19.2-5	18.43-CR-16.7-1	18.43-CR-16.7-2
Date Sampled							25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18		
						Grand Total	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	6,071	-	251	-	218	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	0	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	1,116	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Encyonema sp.	1	6,029	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Encyonopsis sp.	1	773	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	6,194	-	-	67	-	-	-	-	3,014	-	-
Diatoms	Bacillariophyta	Cymbellales	Rhoicospheniaceae	Rhoicosphenia sp.	1	1,159	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	16,192	63	-	201	-	-	-	-	-	-	386
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	670	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Tabularia sp.	1	218	-	-	-	218	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	23,641	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	2,319	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	447	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	-	0	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	274	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Stephanodiscales	Stephanodiscaceae	Cyclotella sp.	1	71,133	63	-	67	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Surirellales	Surirellaceae	Surirella sp.	1	443	-	-	-	-	-	443	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate Diatom	-	13,584	377	167	536	-	-	-	-	-	-	-
				Total Diatoms		**150,263**	**502**	**419**	**871**	**437**	**0**	**443**	**0**	**3,014**	**0**	**386**
Green Algae	Charophyta	Zygnematales	Zygnemataceae	Mougeotia sp.	1	502	-	-	-	-	502	-	-	-	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Nephrocytium sp.	1	346,724	431	167	67	437	-	-	-	1,507	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Oocystis sp.	1	1,133	330	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	893	-	-	-	-	-	-	-	-	-	-
				Total Green Algae		**349,253**	**760**	**167**	**67**	**437**	**502**	**0**	**0**	**1,507**	**0**	**0**
Cryptomonads	Cryptophyta	Cryptomonadales	Cryptomonadaceae	Cryptomonas sp.	1	84	-	84	-	-	-	-	-	-	-	-
				Total Cryptomonads		**84**	**0**	**84**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Aphanothecaceae	Aphanothece sp.	1	121,782	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	478,798	1,633	1,758	-	-	-	1,773	-	-	-	-
Blue-green Algae	Cyanophyta	Chroococcales	Entophysalidaceae	Chlorogloea sp.	1	249,353	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Nostocales	Nostocaceae	Anabaena sp.	1	5,627	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Nostocales	Rivulariaceae	Calothrix sp.	1	23,863	23,863	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Microcoleaceae	Planktothrix sp.	1	68,555	-	2,596	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	113,206	502	-	36,171	18,566	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	71,894,072	27,019	10,622	74,593	597,612	852,458	2,984,935	10,018,959	2,109,988	1,311,408	933,294
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	5,053,700	1,570	14,439	848	27,085	7,033	-	103,346	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Planktolyngbya sp.	1	2,904	-	251	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Merismopediaceae	Aphanocapsa sp.	1	39,881	-	6,029	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	5,845	502	586	697	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Romeriaceae	Romeria sp.	1	482	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Rhabdogloea sp.	1	721,106	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	50,846,736	-	-	-	-	-	-	-	-	-	-

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2018.

Biologica Sample ID							18-134-001	18-134-002	18-134-003	18-134-004	18-134-005	18-134-006	18-134-007	18-134-008	18-134-009	18-134-010
Client Sample ID							18.43-CF-3.9-1	18.43-CF-3.9-2	18.43-CF-3.9-5	18.43-CF-19.2-1	18.43-CF-19.2-2	18.43-CF-19.2-3	18.43-CF-19.2-4	18.43-CF-19.2-5	18.43-CR-16.7-1	18.43-CR-16.7-2
Date Sampled							25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18		
						Grand Total	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcales familia incertae sedis	Schizothrix sp.	1	24,823	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (coccoid unicell)	-	112,562	628	12,225	134	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	464,395	-	-	1,715	-	-	-	10,335	15,071	332,507	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	584,374	5,934	-	3,156	-	-	-	-	-	-	11,980
				Total Blue-green Algae		**130,812,065**	**61,652**	**48,505**	**117,314**	**643,262**	**859,492**	**2,986,709**	**10,132,640**	**2,125,059**	**1,643,915**	**945,273**
Dinoflagellates	Miozoa	-	-	Dinophyte	1	2,319	-	-	-	-	-	-	-	-	-	2,319
				Total Dinoflagellates		**2,319**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,319**
Other Algae	-	-	-	Flagellated algal cell (< 10µm in length)	-	129,057	-	4,186	335	-	-	-	-	-	-	-
Other Algae	-	-	-	Non-flagellated algal cell (< 10µm in length)	-	22,237	3,328	1,507	-	218	-	-	-	-	-	-
				Total Other Algae		**151,294**	**3,328**	**5,694**	**335**	**218**	**0**	**0**	**0**	**0**	**0**	**0**
				Total Periphyton		**131,465,277**	**66,243**	**54,868**	**118,587**	**644,355**	**859,994**	**2,987,152**	**10,132,640**	**2,129,581**	**1,643,915**	**947,979**
				Total Unique Taxa	**37**		**10**	**10**	**9**	**6**	**3**	**3**	**2**	**3**	**1**	**3**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2018.

Biologica Sample ID						18-134-011	18-134-012	18-134-013	18-134-014	18-134-015	18-134-016	18-134-017	18-134-018	18-134-019	18-134-020	18-134-021
Client Sample ID						18.43-CR-16.7-3	18.43-CR-16.7-4	18.43-CR-16.7-5	18.43-HF-6.3-1	18.43-HF-6.3-2	18.43-HF-6.3-3	18.43-HF-6.3-4	18.43-HF-6.3-5	18.43-HFO-0.2-1	18.43-HFO-0.2-2	18.43-HFO-0.2-3
Date Sampled									24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18
						Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	-	-	-	-	335	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Encyonema sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Encyonopsis sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Rhoicospheniaceae	Rhoicosphenia sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	-	-	-	457	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Tabularia sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	-	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Stephanodiscales	Stephanodiscaceae	Cyclotella sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Surirellales	Surirellaceae	Surirella sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate Diatom	-	-	-	-	-	-	-	-	-	-	-	-
				Total Diatoms		**0**	**0**	**0**	**457**	**335**	**0**	**0**	**0**	**0**	**0**	**0**
Green Algae	Charophyta	Zygnematales	Zygnemataceae	Mougeotia sp.	1	-	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Nephrocytium sp.	1	2,010	-	1,005	-	-	-	1,722	-	-	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Oocystis sp.	1	804	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	-	-	-	-	-	-	-	-	-	-	-
				Total Green Algae		**2,813**	**0**	**1,005**	**0**	**0**	**0**	**1,722**	**0**	**0**	**0**	**0**
Cryptomonads	Cryptophyta	Cryptomonadales	Cryptomonadaceae	Cryptomonas sp.	1	-	-	-	-	-	-	-	-	-	-	-
				Total Cryptomonads		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Aphanothecaceae	Aphanothece sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Chroococcales	Entophysalidaceae	Chlorogloea sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Nostocales	Nostocaceae	Anabaena sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Nostocales	Rivulariaceae	Calothrix sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Microcoleaceae	Planktothrix sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	643,386	995,613	3,135,643	520,890	441,449	1,290,671	1,377,205	1,389,274	335,876	1,473,047	1,556,935
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	-	5,101	20,095	36,537	2,679	1,722	49,606	22,764	-	25,754	784,496
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Planktolyngbya sp.	1	-	-	-	-	-	-	-	2,653	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Merismopediaceae	Aphanocapsa sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	-	-	-	1,827	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Romeriaceae	Romeria sp.	1	-	-	-	-	-	-	-	482	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Rhabdogloea sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	-	-	-	-	-	-	-	-	2,971,208	-	838,229

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2018.

Biologica Sample ID						18-134-011	18-134-012	18-134-013	18-134-014	18-134-015	18-134-016	18-134-017	18-134-018	18-134-019	18-134-020	18-134-021
Client Sample ID						18.43-CR-16.7-3	18.43-CR-16.7-4	18.43-CR-16.7-5	18.43-HF-6.3-1	18.43-HF-6.3-2	18.43-HF-6.3-3	18.43-HF-6.3-4	18.43-HF-6.3-5	18.43-HFO-0.2-1	18.43-HFO-0.2-2	18.43-HFO-0.2-3
Date Sampled									24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18
						Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcales familia incertae sedis	Schizothrix sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (coccoid unicell)	-	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	3,858	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	-	-	-	-	-	-	-	19,532	-	2,601	-
				Total Blue-green Algae		**647,244**	**1,000,714**	**3,155,738**	**559,253**	**444,128**	**1,292,394**	**1,426,811**	**1,434,705**	**3,307,083**	**1,501,401**	**3,179,660**
Dinoflagellates	Miozoa	-	-	Dinophyte	1	-	-	-	-	-	-	-	-	-	-	-
				Total Dinoflagellates		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Other Algae	-	-	-	Flagellated algal cell (< 10µm in length)	-	-	-	-	-	-	-	-	-	-	-	-
Other Algae	-	-	-	Non-flagellated algal cell (< 10µm in length)	-	-	-	-	-	-	-	-	-	-	-	-
				Total Other Algae		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
				Total Periphyton		**650,057**	**1,000,714**	**3,156,743**	**559,710**	**444,463**	**1,292,394**	**1,428,534**	**1,434,705**	**3,307,083**	**1,501,401**	**3,179,660**
				Total Unique Taxa	**37**	**3**	**2**	**3**	**4**	**3**	**2**	**3**	**4**	**2**	**2**	**3**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2018.

Biologica Sample ID						18-134-022	18-134-023	18-134-024	18-134-025	18-134-026	18-134-027	18-134-028	18-134-029	18-134-030	18-134-031	18-134-032
Client Sample ID						18.43-HFO-0.2-4	18.43-HFO-0.2-5	18.43-LC-8.3-1	18.43-LC-8.3-2	18.43-LC-8.3-3	18.43-LC-8.3-4	18.43-LC-8.3-5	18.43-SYT-0.6-1	18.43-SYT-0.6-2	18.43-SYT-0.6-3	18.43-SYT-0.6-4
Date Sampled						22-Aug-18	22-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18				
						Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	-	1,116	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Encyonema sp.	1	-	-	-	-	-	-	-	6,029	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Encyonopsis sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Rhoicospheniaceae	Rhoicosphenia sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	-	-	-	-	-	-	-	-	12,057	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Tabularia sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	-	-	-	-	-	-	-	-	-	3,546	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	-	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	-	-	-	-	-	274	-	-	-	-	-
Diatoms	Bacillariophyta	Stephanodiscales	Stephanodiscaceae	Cyclotella sp.	1	-	-	-	-	-	-	-	-	-	-	30,143
Diatoms	Bacillariophyta	Surirellales	Surirellaceae	Surirella sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate Diatom	-	-	-	-	-	-	-	-	-	-	-	-
				Total Diatoms		**0**	**1,116**	**0**	**0**	**0**	**274**	**0**	**6,029**	**12,057**	**3,546**	**30,143**
Green Algae	Charophyta	Zygnematales	Zygnemataceae	Mougeotia sp.	1	-	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Nephrocytium sp.	1	-	-	-	-	-	-	-	6,029	-	-	6,029
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Oocystis sp.	1	-	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	-	-	-	-	-	-	-	-	-	-	-
				Total Green Algae		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**6,029**	**0**	**0**	**6,029**
Cryptomonads	Cryptophyta	Cryptomonadales	Cryptomonadaceae	Cryptomonas sp.	1	-	-	-	-	-	-	-	-	-	-	-
				Total Cryptomonads		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Aphanothecaceae	Aphanothece sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	-	-	-	-	-	-	-	-	-	-	7,234
Blue-green Algae	Cyanophyta	Chroococcales	Entophysalidaceae	Chlorogloea sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Nostocales	Nostocaceae	Anabaena sp.	1	-	-	5,627	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Nostocales	Rivulariaceae	Calothrix sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Microcoleaceae	Planktothrix sp.	1	-	-	-	-	-	-	-	-	-	17,731	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	4,572,414	1,035,271	1,666,197	767,745	2,209,028	2,466,055	229,084	6,029	1,422,735	2,566,328	3,371,761
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	-	58,053	3,014	4,521	-	1,827	377,989	295,398	144,685	819,566	18,086
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Planktolyngbya sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Merismopediaceae	Aphanocapsa sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Romeriaceae	Romeria sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Rhabdogloea sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	1,624,923	1,489	3,316	-	-	-	3,163,776	2,264,319	3,472,438	879,457	192,913

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2018.

Biologica Sample ID						18-134-022	18-134-023	18-134-024	18-134-025	18-134-026	18-134-027	18-134-028	18-134-029	18-134-030	18-134-031	18-134-032
Client Sample ID						18.43-HFO-0.2-4	18.43-HFO-0.2-5	18.43-LC-8.3-1	18.43-LC-8.3-2	18.43-LC-8.3-3	18.43-LC-8.3-4	18.43-LC-8.3-5	18.43-SYT-0.6-1	18.43-SYT-0.6-2	18.43-SYT-0.6-3	18.43-SYT-0.6-4
Date Sampled						22-Aug-18	22-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18				
						Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcales familia incertae sedis	Schizothrix sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (coccoid unicell)	-	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	-	-	-	-	31,348	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	-	744	-	-	-	-	12,057	-	-	-	-
				Total Blue-green Algae		**6,197,337**	**1,095,556**	**1,678,154**	**772,267**	**2,240,377**	**2,467,882**	**3,782,907**	**2,565,746**	**5,039,857**	**4,283,082**	**3,589,994**
Dinoflagellates	Miozoa	-	-	Dinophyte	1	-	-	-	-	-	-	-	-	-	-	-
				Total Dinoflagellates		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Other Algae	-	-	-	Flagellated algal cell (< 10µm in length)	-	-	-	-	-	-	-	-	-	-	-	-
Other Algae	-	-	-	Non-flagellated algal cell (< 10µm in length)	-	-	11,164	-	-	-	-	-	-	-	3,546	-
				Total Other Algae		**0**	**11,164**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,546**	**0**
				Total Periphyton		**6,197,337**	**1,107,837**	**1,678,154**	**772,267**	**2,240,377**	**2,468,156**	**3,782,907**	**2,577,803**	**5,051,914**	**4,290,174**	**3,626,165**
				Total Unique Taxa	**37**	**2**	**4**	**4**	**2**	**1**	**3**	**3**	**5**	**4**	**5**	**6**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2018.

Biologica Sample ID						18-134-033	18-134-034	18-134-035	18-134-036	18-134-037	18-134-038	18-134-039	18-134-040	18-134-041	18-134-042	18-134-043
Client Sample ID						18.43-SYT-0.6-5	18.43-XEO-0.2-1	18.43-XEO-0.2-2	18.43-XEO-0.2-3	18.43-XEO-0.2-4	18.43-XEO-0.2-5	18.43-YT-4.6-1	18.43-YT-4.6-2	18.43-YT-4.6-3	18.43-YT-4.6-4	18.43-YT-4.6-5
Date Sampled							31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18					
						Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	-	670	2,233	-	-	2,364	-	-	-	-	-
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Encyonema sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Encyonopsis sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	-	1,340	-	-	-	1,773	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Rhoicospheniaceae	Rhoicosphenia sp.	1	1,159	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	2,319	-	-	-	-	-	-	-	-	-	709
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	-	-	670	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Tabularia sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	-	-	-	-	20,095	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	2,319	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	-	-	447	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	-	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Stephanodiscales	Stephanodiscaceae	Cyclotella sp.	1	-	670	-	-	40,190	-	-	-	-	-	-
Diatoms	Bacillariophyta	Surirellales	Surirellaceae	Surirella sp.	1	-	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate Diatom	-	-	-	447	12,057	-	-	-	-	-	-	-
				Total Diatoms		**5,797**	**2,679**	**3,796**	**12,057**	**60,285**	**4,137**	**0**	**0**	**0**	**0**	**709**
Green Algae	Charophyta	Zygnematales	Zygnemataceae	Mougeotia sp.	1	-	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Nephrocytium sp.	1	6,956	18,755	-	-	80,380	12,412	8,612	447	111,959	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Oocystis sp.	1	-	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	-	-	893	-	-	-	-	-	-	-	-
				Total Green Algae		**6,956**	**18,755**	**893**	**0**	**80,380**	**12,412**	**8,612**	**447**	**111,959**	**0**	**0**
Cryptomonads	Cryptophyta	Cryptomonadales	Cryptomonadaceae	Cryptomonas sp.	1	-	-	-	-	-	-	-	-	-	-	-
				Total Cryptomonads		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Aphanothecaceae	Aphanothece sp.	1	117,093	-	4,689	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	188,640	-	250,888	-	-	6,620	-	1,250	-	-	-
Blue-green Algae	Cyanophyta	Chroococcales	Entophysalidaceae	Chlorogloea sp.	1	249,353	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Nostocales	Nostocaceae	Anabaena sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Nostocales	Rivulariaceae	Calothrix sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Microcoleaceae	Planktothrix sp.	1	-	-	-	48,228	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	57,967	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	296,274	2,007,503	69,931	458,169	5,951,703	852,431	1,410,678	550,517	266,978	391,855	877,443
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	-	4,019	3,126	84,400	-	188,658	25,837	101,771	981,790	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Planktolyngbya sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Merismopediaceae	Aphanocapsa sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	-	-	2,233	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Romeriaceae	Romeria sp.	1	-	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Rhabdogloea sp.	1	721,106	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	-	-	-	4,497,289	16,015,815	105,204	1,395,176	34,385	3,968,500	6,802,200	-

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2018.

Biologica Sample ID						18-134-033	18-134-034	18-134-035	18-134-036	18-134-037	18-134-038	18-134-039	18-134-040	18-134-041	18-134-042	18-134-043
Client Sample ID						18.43-SYT-0.6-5	18.43-XEO-0.2-1	18.43-XEO-0.2-2	18.43-XEO-0.2-3	18.43-XEO-0.2-4	18.43-XEO-0.2-5	18.43-YT-4.6-1	18.43-YT-4.6-2	18.43-YT-4.6-3	18.43-YT-4.6-4	18.43-YT-4.6-5
Date Sampled							31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18					
						Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcales familia incertae sedis	Schizothrix sp.	1	-	-	-	-	-	24,823	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (coccoid unicell)	-	-	-	-	-	-	-	-	-	-	-	73,761
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	69,560	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	12,753	-	-	12,057	502,378	1,182	-	-	-	-	-
				Total Blue-green Algae		**1,712,746**	**2,011,522**	**330,866**	**5,100,143**	**22,469,896**	**1,178,918**	**2,831,690**	**687,923**	**5,217,269**	**7,194,055**	**951,204**
Dinoflagellates	Miozoa	-	-	Dinophyte	1	-	-	-	-	-	-	-	-	-	-	-
				Total Dinoflagellates		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Other Algae	-	-	-	Flagellated algal cell (< 10µm in length)	-	-	-	-	-	-	-	17,224	9,154	-	-	-
Other Algae	-	-	-	Non-flagellated algal cell (< 10µm in length)	-	-	670	1,116	-	-	-	-	223	-	-	-
				Total Other Algae		**0**	**670**	**1,116**	**0**	**0**	**0**	**17,224**	**9,378**	**0**	**0**	**0**
				Total Periphyton		**1,725,499**	**2,033,627**	**336,671**	**5,112,200**	**22,610,562**	**1,195,466**	**2,857,527**	**697,747**	**5,329,227**	**7,194,055**	**951,913**
				Total Unique Taxa	**37**	**10**	**6**	**9**	**5**	**5**	**8**	**5**	**6**	**4**	**2**	**2**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2018.

Biologica Sample ID						18-134-044	18-134-045	18-134-046	18-134-047	18-134-048	18-134-009-QA	18-134-020-QA	18-134-031-QA	18-134-026-QA	18-134-034-QA
Client Sample ID						18.43-YTO-0.2-1	18.43-YTO-0.2-2	18.43-YTO-0.2-3	18.43-YTO-0.2-4	18.43-YTO-0.2-5	18.43-CR-16.7-1-QA	18.43-HFO-0.2-2-QA	18.43-SYT-0.6-3-QA	18.43-LC-8.3-3-QA	18.43-XEO-0.2-1-QA
Date Sampled						29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18		22-Aug-18	23-Aug-18		31-Aug-18
						Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	-	-	-	-	-	-	-	-	-	1,340
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	-	-	-	-	-	773	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Encyonema sp.	1	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Encyonopsis sp.	1	773	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	-	-	-	-	-	-	-	-	-	4,689
Diatoms	Bacillariophyta	Cymbellales	Rhoicospheniaceae	Rhoicosphenia sp.	1	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	-	-	-	-	-	-	355	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	-	-	-	-	-	3,092	709	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Tabularia sp.	1	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	-	-	-	-	-	-	-	355	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Stephanodiscales	Stephanodiscaceae	Cyclotella sp.	1	-	-	-	-	-	-	-	-	-	2,010
Diatoms	Bacillariophyta	Surirellales	Surirellaceae	Surirella sp.	1	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate Diatom	-	-	-	-	-	-	-	-	-	-	-
				Total Diatoms		**773**	**0**	**0**	**0**	**0**	**3,864**	**1,418**	**0**	**0**	**8,038**
Green Algae	Charophyta	Zygnematales	Zygnemataceae	Mougeotia sp.	1	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Nephrocytium sp.	1	17,776	66,314	-	3,710	-	1,546	2,482	-	-	14,067
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Oocystis sp.	1	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	-	-	-	-	-	-	-	-	-	-
				Total Green Algae		**17,776**	**66,314**	**0**	**3,710**	**0**	**1,546**	**2,482**	**0**	**0**	**14,067**
Cryptomonads	Cryptophyta	Cryptomonadales	Cryptomonadaceae	Cryptomonas sp.	1	-	-	-	-	-	-	-	-	-	-
				Total Cryptomonads		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Aphanothecaceae	Aphanothece sp.	1	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	7,950	6,029	-	-	5,024	-	-	-	-	4,019
Blue-green Algae	Cyanophyta	Chroococcales	Entophysalidaceae	Chlorogloea sp.	1	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Nostocales	Nostocaceae	Anabaena sp.	1	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Nostocales	Rivulariaceae	Calothrix sp.	1	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Microcoleaceae	Planktothrix sp.	1	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	250,660	881,372	761,499	3,801,351	672,182	1,603,394	1,233,447	3,131,293	1,997,330	1,643,233
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	127,140	253,199	16,374	33,911	407,261	-	-	983,006	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Planktolyngbya sp.	1	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Merismopediaceae	Aphanocapsa sp.	1	18,549	12,057	-	3,246	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Romeriaceae	Romeria sp.	1	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Rhabdogloea sp.	1	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	14,067	792,753	1,741,577	67,705	-	-	-	651,437	-	-

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2018.

Biologica Sample ID						18-134-044	18-134-045	18-134-046	18-134-047	18-134-048	18-134-009-QA	18-134-020-QA	18-134-031-QA	18-134-026-QA	18-134-034-QA
Client Sample ID						18.43-YTO-0.2-1	18.43-YTO-0.2-2	18.43-YTO-0.2-3	18.43-YTO-0.2-4	18.43-YTO-0.2-5	18.43-CR-16.7-1-QA	18.43-HFO-0.2-2-QA	18.43-SYT-0.6-3-QA	18.43-LC-8.3-3-QA	18.43-XEO-0.2-1-QA
Date Sampled						29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18		22-Aug-18	23-Aug-18		31-Aug-18
						Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcales familia incertae sedis	Schizothrix sp.	1	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (coccoid unicell)	-	21,641	-	-	4,174	-	-	-	7,092	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	-	-	-	-	-	178,537	-	-	5,275	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	-	-	-	-	-	-	-	-	-	-
				Total Blue-green Algae		**440,007**	**1,945,409**	**2,519,451**	**3,910,387**	**1,084,467**	**1,781,932**	**1,233,447**	**4,772,829**	**2,002,605**	**1,647,252**
Dinoflagellates	Miozoa	-	-	Dinophyte	1	-	-	-	-	-	-	-	-	-	-
				Total Dinoflagellates		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Other Algae	-	-	-	Flagellated algal cell (< 10µm in length)	-	88,882	6,029	-	3,246	-	-	-	-	-	-
Other Algae	-	-	-	Non-flagellated algal cell (< 10µm in length)	-	-	-	-	464	-	-	-	-	-	-
				Total Other Algae		**88,882**	**6,029**	**0**	**3,710**	**0**	**0**	**0**	**0**	**0**	**0**
				Total Periphyton		**547,439**	**2,017,751**	**2,519,451**	**3,917,806**	**1,084,467**	**1,787,342**	**1,237,347**	**4,772,829**	**2,002,605**	**1,669,357**
				Total Unique Taxa	**37**	**8**	**7**	**3**	**6**	**3**	**4**	**5**	**1**	**3**	**6**

2019

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2019.

Biologica Sample ID							19-028-001	19-028-002	19-028-003	19-028-004	19-028-005	19-028-006	19-028-007	19-028-008	19-028-009	19-028-010
Client Sample ID							CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5
Date Sampled							24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	554,630	2,826	2,247	266	4,098	10,048	-	-	-	86	-
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	3,103	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	43,128	-	132	-	264	-	1,507	-	1,615	171	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	2,327	-	-	-	66	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	1,803	-	-	798	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	4,419	-	66	-	-	-	-	-	-	-	2,422
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	3,457	-	-	-	66	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	1,474	-	264	-	264	502	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	4,440	-	-	-	-	-	-	-	1,615	-	-
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	59,673	1,978	331	532	198	4,019	-	-	-	-	-
Total Diatoms						**678,454**	**4,804**	**3,041**	**1,596**	**4,958**	**14,569**	**1,507**	**0**	**3,230**	**257**	**2,422**
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Nephrocytium sp.	1	149	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Oocystis sp.	1	522	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	2,119,358	63,256	132	53,060	36,215	18,086	144,685	31,650	19,377	17,601	31,488
Total Green Algae						**2,120,029**	**63,256**	**132**	**53,060**	**36,215**	**18,086**	**144,685**	**31,650**	**19,377**	**17,601**	**31,488**
Golden Algae	Ochrophyta	-	-	Chrysophyte	1	70	-	-	-	-	-	-	-	-	-	-
Total Golden Algae						**70**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Cryptomonads	Cryptophyta	Pyrenomonadales	Geminigeraceae	Plagioselmis nanoplanctica	1	644	-	-	-	-	502	-	-	-	-	-
Total Cryptomonads						**644**	**0**	**0**	**0**	**0**	**502**	**0**	**0**	**0**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	28,718	3,391	-	-	1,190	-	9,043	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	4,622,474	193,321	395,184	378,025	51,560	2,655,957	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	38,625,535	179,349	1,785	168,728	10,907	6,531	4,262,176	11,609,671	6,613,286	651,236	2,386,034
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	14,763	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	36,062,145	184,966	8,113	178,108	23,775	211,803	1,253,333	-	2,985,920	54,420	278,282
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	2,229,968	-	-	59,576	5,486	48,731	-	40,693	8,074	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Planktolyngbya sp.	1	14,016	4,974	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	1,338,698	13,282	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	106,884	6,217	-	-	1,653	-	-	-	6,459	-	3,230
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	59,103	3,674	66	-	66	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (coccoid unicell)	-	502	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	276,813	5,934	1,454	-	1,520	6,029	18,086	-	-	12,674	9,689
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	51,700	-	1,322	-	-	11,555	-	-	-	-	-
Total Blue-green Algae						**83,431,320**	**595,108**	**407,924**	**784,437**	**96,157**	**2,940,605**	**5,542,637**	**11,650,364**	**9,613,739**	**718,329**	**2,677,234**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	124,910	3,956	463	28,867	5,442	4,019	-	-	-	1,798	3,230
Total Red Algae						**124,910**	**3,956**	**463**	**28,867**	**5,442**	**4,019**	**0**	**0**	**0**	**1,798**	**3,230**
Dinoflagellates	Miozoa	Gymnodiniales	Gymnodiniaceae	Gymnodinium sp.	1	87	-	-	-	-	-	-	-	-	-	-
Total Dinoflagellates						**87**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Other Algae	-	-	-	Non-flagellated algal cell (< 10µm in length)	-	283	283	-	-	-	-	-	-	-	-	-
Total Other Algae						**283**	**283**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Periphyton						**86,355,796**	**667,407**	**411,559**	**867,960**	**142,772**	**2,977,781**	**5,688,829**	**11,682,014**	**9,636,346**	**737,986**	**2,714,374**
Total Unique Taxa					**25**		**11**	**10**	**8**	**14**	**9**	**5**	**3**	**7**	**6**	**6**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2019.

Biologica Sample ID							19-028-011	19-028-012	19-028-013	19-028-014	19-028-015	19-028-016	19-028-017	19-028-018	19-028-019	19-028-020
Client Sample ID							CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	HCO.2-1	HCO.2-2	HCO.2-3	HCO.2-4	HCO.2-5
Date Sampled							21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	554,630	502	181	70	807	87	603	-	626	2,713	1,658
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	3,103	167	-	-	-	-	-	443	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	43,128	-	-	-	-	87	151	-	-	-	754
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	2,327	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	1,803	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	4,419	167	633	696	-	435	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	3,457	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	1,474	-	-	-	-	-	-	-	-	-	301
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	4,440	-	90	70	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	59,673	335	-	139	807	348	151	1,330	-	-	452
Total Diatoms						**678,454**	**1,172**	**904**	**974**	**1,615**	**956**	**904**	**1,773**	**626**	**2,713**	**3,165**
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Nephrocytium sp.	1	149	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Oocystis sp.	1	522	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	2,119,358	19,291	2,622	8,651	33,911	11,686	16,262	207,187	16,214	352,500	24,717
Total Green Algae						**2,120,029**	**19,291**	**2,622**	**8,651**	**33,911**	**11,686**	**16,262**	**207,187**	**16,214**	**352,500**	**24,717**
Golden Algae	Ochrophyta	-	-	Chrysophyte	1	70	-	-	-	-	-	-	-	-	-	-
Total Golden Algae						**70**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Cryptomonads	Cryptophyta	Pyrenomonadales	Geminigeraceae	Plagioselmis nanoplanctica	1	644	-	-	-	-	-	-	-	-	-	-
Total Cryptomonads						**644**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	28,718	-	723	696	-	-	2,713	-	-	-	3,316
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	4,622,474	2,177	452	-	64,591	10,908	904	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	38,625,535	409,338	53,698	79,414	236,082	161,994	110,432	539,667	28,339	454,724	85,455
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	14,763	-	-	-	-	-	-	-	-	452	754
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	36,062,145	159,541	486,339	13,066	1,364,656	3,739	300,673	690,123	57,283	796,716	137,933
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	2,229,968	-	-	2,609	-	1,739	18,236	754,373	1,043	-	80,059
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Planktolyngbya sp.	1	14,016	9,043	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	1,338,698	-	-	-	-	-	-	-	-	-	1,206
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	106,884	2,010	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	59,103	1,507	181	-	-	-	-	-	-	-	151
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (coccoid unicell)	-	502	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	276,813	3,852	633	904	4,844	2,000	1,809	-	696	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	51,700	2,679	-	-	5,652	870	3,014	2,216	1,322	-	-
Total Blue-green Algae						**83,431,320**	**590,146**	**542,026**	**96,688**	**1,675,826**	**181,249**	**437,781**	**1,986,380**	**88,682**	**1,251,893**	**308,872**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	124,910	-	-	-	2,422	-	904	23,494	2,365	2,261	2,110
Total Red Algae						**124,910**	**0**	**0**	**0**	**2,422**	**0**	**904**	**23,494**	**2,365**	**2,261**	**2,110**
Dinoflagellates	Miozoa	Gymnodiniales	Gymnodiniaceae	Gymnodinium sp.	1	87	-	-	-	-	-	-	-	-	-	-
Total Dinoflagellates						**87**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Other Algae	-	-	-	Non-flagellated algal cell (< 10µm in length)	-	283	-	-	-	-	-	-	-	-	-	-
Total Other Algae						**283**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Periphyton						**86,355,796**	**610,610**	**545,552**	**106,313**	**1,713,773**	**193,892**	**455,852**	**2,218,833**	**107,888**	**1,609,366**	**338,864**
Total Unique Taxa					**25**		**10**	**9**	**8**	**6**	**8**	**9**	**6**	**6**	**6**	**12**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2019.

Biologica Sample ID							19-028-021	19-028-022	19-028-023	19-028-024	19-028-025	19-028-026	19-028-027	19-028-028	19-028-029	19-028-030
Client Sample ID							HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5
Date Sampled							20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	554,630	-	87	328	2,261	-	70	696	-	261	70
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	3,103	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	43,128	-	-	-	-	-	-	174	-	-	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	2,327	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	1,803	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	4,419	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	3,457	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	1,474	-	-	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	4,440	-	-	-	-	904	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	59,673	-	-	-	-	-	-	174	43	87	-
Total Diatoms						**678,454**	**0**	**87**	**328**	**2,261**	**904**	**70**	**1,043**	**43**	**348**	**70**
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Nephrocytium sp.	1	149	-	-	-	-	-	-	-	-	43	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Oocystis sp.	1	522	-	522	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	2,119,358	-	1,174	52,170	449,358	25,320	-	6,434	-	-	-
Total Green Algae						**2,120,029**	**0**	**1,696**	**52,170**	**449,358**	**25,320**	**0**	**6,434**	**0**	**43**	**0**
Golden Algae	Ochrophyta	-	-	Chrysophyte	1	70	-	-	-	-	-	70	-	-	-	-
Total Golden Algae						**70**	**0**	**0**	**0**	**0**	**0**	**70**	**0**	**0**	**0**	**0**
Cryptomonads	Cryptophyta	Pyrenomonadales	Geminigeraceae	Plagioselmis nanoplanctica	1	644	-	-	-	-	-	-	-	-	-	-
Total Cryptomonads						**644**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	28,718	-	-	1,311	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	4,622,474	-	-	-	-	78,672	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	38,625,535	308,037	33,498	1,402,529	2,484,717	334,419	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	14,763	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	36,062,145	12,354	5,616	416,952	16,485,940	2,054,978	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	2,229,968	-	-	44,559	-	361,411	-	8,695	2,391	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Planktolyngbya sp.	1	14,016	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	1,338,698	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	106,884	-	-	-	-	-	-	-	-	-	383
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	59,103	-	-	-	-	-	-	-	-	-	2,024
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (coccoid unicell)	-	502	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	276,813	-	1,304	11,795	-	13,564	21,025	6,956	39,780	3,391	2,469
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	51,700	-	-	6,553	-	-	-	-	-	913	-
Total Blue-green Algae						**83,431,320**	**320,391**	**40,418**	**1,883,698**	**18,970,656**	**2,843,045**	**21,025**	**15,651**	**42,171**	**4,304**	**4,876**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	124,910	-	-	-	13,564	4,521	-	-	-	-	-
Total Red Algae						**124,910**	**0**	**0**	**0**	**13,564**	**4,521**	**0**	**0**	**0**	**0**	**0**
Dinoflagellates	Miozoa	Gymnodiniales	Gymnodiniaceae	Gymnodinium sp.	1	87	-	-	-	-	-	-	-	-	87	-
Total Dinoflagellates						**87**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**87**	**0**
Other Algae	-	-	-	Non-flagellated algal cell (< 10µm in length)	-	283	-	-	-	-	-	-	-	-	-	-
Total Other Algae						**283**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Periphyton						**86,355,796**	**320,391**	**42,200**	**1,936,195**	**19,435,839**	**2,873,790**	**21,164**	**23,129**	**42,214**	**4,782**	**4,945**
Total Unique Taxa					**25**		**2**	**5**	**6**	**5**	**7**	**3**	**4**	**2**	**5**	**3**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2019.

Biologica Sample ID							19-028-031	19-028-032	19-028-033	19-028-034	19-028-035	19-028-036	19-028-037	19-028-038	19-028-039	19-028-040
Client Sample ID							SYT0.6-1	SYT0.6-2	SYT0.6-3	SYT0.6-4	SYT0.6-5	XEO.2-1	XEO.2-2	XEO.2-3	XEO.2-4	XEO.2-5
Date Sampled							21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	554,630	2,261	-	-	141	-	12,434	12,811	483,442	5,526	2,087
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	3,103	-	-	-	-	-	-	754	1,739		
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	43,128	-	-	807	424	7,686	754	12,057	5,217	9,043	1,043
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	2,327	-	-	-	-	-	-	2,261			
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	1,803	-	-	-	-	-	-	-		1,005	
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	4,419	-	-	-	-	-	-	-			
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	3,457	1,130	-	-	-	-	754	-		1,507	
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	1,474	-	-	-	141	-	-	-			
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	4,440	-	-	-	-	-	-	-			
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	59,673	-	-	-	424	1,809	1,507	14,318	20,868	7,536	348
Total Diatoms						**678,454**	**3,391**	**0**	**807**	**1,130**	**9,495**	**15,448**	**42,200**	**511,266**	**24,617**	**3,478**
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Nephrocytium sp.	1	149	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Oocystis sp.	1	522	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	2,119,358	33,911	14,129	52,481	1,272	10,851	15,448	11,304	74,777	135,768	14,260
Total Green Algae						**2,120,029**	**33,911**	**14,129**	**52,481**	**1,272**	**10,851**	**15,448**	**11,304**	**74,777**	**135,768**	**14,260**
Golden Algae	Ochrophyta	-	-	Chrysophyte	1	70	-	-	-	-	-	-	-	-	-	-
Total Golden Algae						**70**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Cryptomonads	Cryptophyta	Pyrenomonadales	Geminigeraceae	Plagioselmis nanoplanctica	1	644	-	-	-	141	-	-	-	-	-	-
Total Cryptomonads						**644**	**0**	**0**	**0**	**141**	**0**	**0**	**0**	**0**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	28,718	-	-	-	424	-	-	-	-	-	5,913
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	4,622,474	74,603	-	-	397,883	-	6,782	51,996	-	-	193,203
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	38,625,535	87,037	57,196	168,342	26,615	894,635	712,875	1,030,880	450,208	1,462,222	126,136
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	14,763	-	-	-	-	904	1,130	754	-	-	348
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	36,062,145	1,347,378	1,006,464	1,238,666	47,687	724,329	442,290	857,660	459,096	301,427	353,017
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	2,229,968	79,125	19,781	28,259	2,119	215,794	18,839	75,357	175,639	10,048	72,342
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Planktolyngbya sp.	1	14,016	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	1,338,698	-	-	-	-	-	41,823	-	617,172	62,295	597,382
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	106,884	35,041	-	8,074	-	6,782	-	-	31,302	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	59,103	32,780	2,261	4,037	1,413	2,261	754	3,768	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (coccoid unicell)	-	502	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	276,813	39,562	-	8,074	1,413	10,851	-	-	27,824	-	9,738
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	51,700	-	-	-	-	-	1,130	-	6,956	-	6,608
Total Blue-green Algae						**83,431,320**	**1,695,526**	**1,085,702**	**1,455,451**	**477,554**	**1,855,556**	**1,225,623**	**2,020,414**	**1,768,197**	**1,835,991**	**1,364,687**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	124,910	-	-	-	2,402	-	9,043	4,521	-	-	-
Total Red Algae						**124,910**	**0**	**0**	**0**	**2,402**	**0**	**9,043**	**4,521**	**0**	**0**	**0**
Dinoflagellates	Miozoa	Gymnodiniales	Gymnodiniaceae	Gymnodinium sp.	1	87	-	-	-	-	-	-	-	-	-	-
Total Dinoflagellates						**87**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Other Algae	-	-	-	Non-flagellated algal cell (< 10µm in length)	-	283	-	-	-	-	-	-	-	-	-	-
Total Other Algae						**283**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Periphyton						**86,355,796**	**1,732,828**	**1,099,831**	**1,508,739**	**482,499**	**1,875,903**	**1,265,562**	**2,078,439**	**2,354,240**	**1,996,375**	**1,382,425**
Total Unique Taxa					**25**		**9**	**5**	**7**	**12**	**8**	**12**	**12**	**9**	**9**	**10**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2019.

Biologica Sample ID							19-028-041	19-028-042	19-028-043	19-028-044	19-028-045	19-028-046	19-028-047	19-028-048	19-028-049	19-028-050
Client Sample ID							YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5
Date Sampled							20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	554,630	126	348	696	1,292	1,998		464			417
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	3,103										
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	43,128				646	526					70
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	2,327										
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	1,803										
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	4,419										
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	3,457										
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	1,474										
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	4,440	251		87	161	1,262					
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	59,673	251		87	807	736		58			
Total Diatoms						**678,454**	**628**	**348**	**870**	**2,907**	**4,521**	**0**	**522**	**0**	**0**	**487**
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Nephrocytium sp.	1	149	-	-	-	-	-	105	-	-	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Oocystis sp.	1	522	-	-	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	2,119,358	1,130	435	1,739	16,955	10,553	315	-	80,983	-	-
Total Green Algae						**2,120,029**	**1,130**	**435**	**1,739**	**16,955**	**10,553**	**421**	**0**	**80,983**	**0**	**0**
Golden Algae	Ochrophyta	-	-	Chrysophyte	1	70	-	-	-	-	-	-	-	-	-	-
Total Golden Algae						**70**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Cryptomonads	Cryptophyta	Pyrenomonadales	Geminigeraceae	Plagioselmis nanoplanctica	1	644	-	-	-	-	-	-	-	-	-	-
Total Cryptomonads						**644**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	28,718	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	4,622,474	-	522	19,129	46,603	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	38,625,535	310,685	89,269	43,823	63,687	224,025	25,723	2,666	201,856	6,566	29,048
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	14,763	-	-	-	-	-	2,313	-	8,038	-	70
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	36,062,145	85,823	5,027	4,038	173,859	19,894	118,103	2,087	698,707	278	11,686
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	2,229,968	-	-	-	2,584	31,057	10,725	2,898	47,726	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Planktolyngbya sp.	1	14,016	-	-	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	1,338,698	-	-	-	4,844	-	-	-	-	-	696
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	106,884	-	-	-	4,683	-	1,051	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	59,103	126	870	261	161	-	2,103	-	502	139	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (coccoid unicell)	-	502	-	-	-	-	-	-	-	502	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	276,813	879	3,130	1,043	1,615	-	1,998	-	-	278	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	51,700	-	-	-	-	-	736	174	-	-	-
Total Blue-green Algae						**83,431,320**	**397,513**	**98,817**	**68,294**	**298,036**	**274,976**	**162,753**	**7,826**	**957,332**	**7,262**	**41,500**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	124,910	-	-	-	5,006	-	-	-	4,521	-	-
Total Red Algae						**124,910**	**0**	**0**	**0**	**5,006**	**0**	**0**	**0**	**4,521**	**0**	**0**
Dinoflagellates	Miozoa	Gymnodiniales	Gymnodiniaceae	Gymnodinium sp.	1	87	-	-	-	-	-	-	-	-	-	-
Total Dinoflagellates						**87**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Other Algae	-	-	-	Non-flagellated algal cell (< 10µm in length)	-	283	-	-	-	-	-	-	-	-	-	-
Total Other Algae						**283**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Periphyton						**86,355,796**	**399,271**	**99,600**	**70,903**	**322,904**	**290,050**	**163,174**	**8,347**	**1,042,837**	**7,262**	**41,986**
Total Unique Taxa					**25**		**6**	**6**	**7**	**12**	**7**	**7**	**4**	**7**	**3**	**6**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2019.

Biologica Sample ID							19-028-001-QA	19-028-019-QA	19-028-025-QA	19-028-031-QA	19-028-038-QA
Client Sample ID							CC5.6-1-QA	HCO.2-4-QA	HC6.8-5-QA	SYT0.6-1-QA	XEO.2-3-QA
Date Sampled							24-Aug-19	20-Aug-19	20-Aug-19	21-Aug-19	24-Aug-19
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	554,630	1,696	2,713			466,052
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	3,103					
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	43,128	283				6,956
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	2,327					
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	1,803					
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	4,419					
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	3,457					
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	1,474	283				3,478
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	4,440					
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	59,673	848	452			5,217
				Total Diatoms		**678,454**	**3,108**	**3,165**	**0**	**0**	**481,703**
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Nephrocytium sp.	1	149	-	-	-	-	-
Green Algae	Chlorophyta	Chlorellales	Oocystaceae	Oocystis sp.	1	522	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	2,119,358	65,108	282,166	11,756	2,261	86,950
				Total Green Algae		**2,120,029**	**65,108**	**282,166**	**11,756**	**2,261**	**86,950**
Golden Algae	Ochrophyta	-	-	Chrysophyte	1	70	-	-	-	-	-
				Total Golden Algae		**70**	**0**	**0**	**0**	**0**	**0**
Cryptomonads	Cryptophyta	Pyrenomonadales	Geminigeraceae	Plagioselmis nanoplanctica	1	644	-	-	-	-	-
				Total Cryptomonads		**644**	**0**	**0**	**0**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	28,718	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	4,622,474	248,329	-	130,216	55,387	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	38,625,535	174,978	559,832	435,041	200,750	71,299
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	14,763	-	2,261	6,330	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	36,062,145	185,891	712,993	2,336,661	1,751,290	531,265
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	2,229,968	12,187	64,656	136,546	39,562	17,390
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Planktolyngbya sp.	1	14,016	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	1,338,698	25,433	-	-	-	791,246
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	106,884	-	2,713	-	10,173	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	59,103	-	-	-	5,652	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (coccoid unicell)	-	502	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	276,813	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	51,700	3,391	-	-	-	-
				Total Blue-green Algae		**83,431,320**	**650,210**	**1,342,454**	**3,044,795**	**2,062,815**	**1,411,199**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	124,910	26,306	4,521	-	-	6,956
				Total Red Algae		**124,910**	**26,306**	**4,521**	**0**	**0**	**6,956**
Dinoflagellates	Miozoa	Gymnodiniales	Gymnodiniaceae	Gymnodinium sp.	1	87	-	-	-	-	-
				Total Dinoflagellates		**87**	**0**	**0**	**0**	**0**	**0**
Other Algae	-	-	-	Non-flagellated algal cell (< 10µm in length)	-	283	-	-	-	-	-
				Total Other Algae		**283**	**0**	**0**	**0**	**0**	**0**
				Total Periphyton		**86,355,796**	**744,733**	**1,632,307**	**3,056,551**	**2,065,076**	**1,986,809**
				Total Unique Taxa	**25**		**10**	**8**	**6**	**7**	**9**

2021

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2021.

Biologica Sample ID							pp21-162-001	pp21-162-002	pp21-162-003	pp21-162-004	pp21-162-005	pp21-162-006	pp21-162-007	pp21-162-008
Client Sample ID							HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	YT4.3-1	YT4.3-2	YT4.3-3
Date Sampled							19-Aug-21	19-Aug-21	19-Aug-21	19-Aug-21	19-Aug-21	20-Aug-21	20-Aug-21	20-Aug-21
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Bacillariales	Bacillariaceae	Nitzschia sp.	1	1,385	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	117,609	-	85	49	151	-	552	8	21
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	755	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	4,379	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	23,802	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	45,044	-	-	49	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Odontidium sp.	1	3,304	-	-	-	75	566	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Staurosiraceae	Staurosirella sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	16,383	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Platessa sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	87,517	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	778	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	1,306	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	37,288	-	-	-	-	-	42	3	-
				Total Diatoms		**345,211**	**0**	**85**	**98**	**226**	**566**	**594**	**11**	**21**
Green Algae	Chlorophyta	Sphaeropleales	Scenedesmaceae	Scenedesmus sp.	1	1,358	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	812,702	63,167	4,839	2,953	4,604	1,981	-	-	85
				Total Green Algae		**814,060**	**63,167**	**4,839**	**2,953**	**4,604**	**1,981**	**0**	**0**	**85**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	4,019	-	-	-	-	-	679	-	178
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	46,028,631	-	-	197	-	3,962	-	8	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	8,437,166	551,623	41,805	24,087	58,865	101,296	2,590	-	1,473
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	32,278	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	11,926,931	1,721,811	78,959	29,039	125,881	117,165	-	-	743
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	382,896	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	13,278	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	30,478	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	49	-	-	49	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	127,032	-	594	-	-	-	849	-	382
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	293,875	88,298	-	1,034	1,736	22,641	-	-	-
				Total Blue-green Algae		**67,276,631**	**2,361,732**	**121,358**	**54,405**	**186,482**	**245,063**	**4,118**	**8**	**2,776**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	48,238	-	-	-	981	-	-	-	-
				Total Red Algae		**48,238**	**0**	**0**	**0**	**981**	**0**	**0**	**0**	**0**
				Total Periphyton		**68,484,141**	**2,424,899**	**126,282**	**57,457**	**192,293**	**247,610**	**4,712**	**19**	**2,882**
				Total Unique Taxa	**27**		**3**	**4**	**7**	**6**	**5**	**3**	**2**	**5**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2021.

Biologica Sample ID							pp21-162-009	pp21-162-010	pp21-162-011	pp21-162-012	pp21-162-013	pp21-162-014	pp21-162-015	pp21-162-016
Client Sample ID							YT4.3-4	YT4.3-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5	CR24.5-1
Date Sampled							20-Aug-21	20-Aug-21	23-Aug-21	23-Aug-21	23-Aug-21	23-Aug-21	23-Aug-21	22-Aug-21
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Bacillariales	Bacillariaceae	Nitzschia sp.	1	1,385	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	117,609	212	42	212	-	606	391	606	-
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	755	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	4,379	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	23,802	-	-	-	-	1,334	1,061	5,519	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	45,044	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Odontidium sp.	1	3,304	-	-	-	-	-	-	-	548
Diatoms	Bacillariophyta	Fragilariales	Staurosiraceae	Staurosirella sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	16,383	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Platessa sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	87,517	-	-	-	-	-	56	303	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	778	170	-	-	-	-	-	61	548
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	1,306	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	37,288	-	14	106	-	61	279	364	-
				Total Diatoms		**345,211**	**382**	**57**	**318**	**0**	**2,001**	**1,787**	**6,853**	**1,096**
Green Algae	Chlorophyta	Sphaeropleales	Scenedesmaceae	Scenedesmus sp.	1	1,358	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	812,702	12,905	-	7,217	8,490	6,671	7,373	1,334	16,433
				Total Green Algae		**814,060**	**12,905**	**0**	**7,217**	**8,490**	**6,671**	**7,373**	**1,334**	**16,433**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	4,019	340	1,726	-	-	-	-	-	1,096
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	46,028,631	-	-	-	-	-	-	-	5,478
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	8,437,166	3,736	14	72,029	33,233	13,499	34,427	45,855	469,425
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	32,278	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	11,926,931	-	-	57,733	21,225	46,090	24,130	6,550	93,118
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	382,896	-	-	2,547	5,822	26,198	3,798	8,369	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	13,278	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	30,478	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	49	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	127,032	7,132	8,490	1,910	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	293,875	-	-	-	-	13,584	-	-	-
				Total Blue-green Algae		**67,276,631**	**11,207**	**10,231**	**134,220**	**60,280**	**99,372**	**62,356**	**60,773**	**569,117**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	48,238	-	-	15,070	485	-	279	5,094	-
				Total Red Algae		**48,238**	**0**	**0**	**15,070**	**485**	**0**	**279**	**5,094**	**0**
				Total Periphyton		**68,484,141**	**24,494**	**10,287**	**156,825**	**69,256**	**108,044**	**71,795**	**74,054**	**586,645**
				Total Unique Taxa	**27**		**5**	**3**	**6**	**5**	**6**	**8**	**9**	**7**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2021.

Biologica Sample ID							pp21-162-017	pp21-162-018	pp21-162-019	pp21-162-020	pp21-162-021	pp21-162-022	pp21-162-023	pp21-162-024
Client Sample ID							CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4
Date Sampled							22-Aug-21	22-Aug-21	22-Aug-21	22-Aug-21	22-Aug-21	22-Aug-21	22-Aug-21	22-Aug-21
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Bacillariales	Bacillariaceae	Nitzschia sp.	1	1,385	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	117,609	-	340	170	136	-	-	425	-
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	755	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	4,379	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	23,802	-	-	-	272	-	-	-	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	45,044	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Odontidium sp.	1	3,304	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Staurosiraceae	Staurosirella sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	16,383	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Platessa sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	87,517	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	778	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	1,306	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	37,288	-	-	-	-	-	-	-	-
				Total Diatoms		**345,211**	**0**	**340**	**170**	**408**	**0**	**0**	**425**	**0**
Green Algae	Chlorophyta	Sphaeropleales	Scenedesmaceae	Scenedesmus sp.	1	1,358	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	812,702	70,347	5,349	11,122	9,509	2,830	1,274	6,226	7,075
				Total Green Algae		**814,060**	**70,347**	**5,349**	**11,122**	**9,509**	**2,830**	**1,274**	**6,226**	**7,075**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	4,019	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	46,028,631	-	-	-	3,260	-	-	2,547	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	8,437,166	14,858	47,249	87,201	131,735	1,950,048	664,960	198,257	253,291
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	32,278	-	-	85	-	16,980	3,396	142	1,061
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	11,926,931	-	67,497	28,867	3,668	127,353	-	26,461	240,555
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	382,896	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	13,278	-	-	-	-	-	-	-	3,891
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	30,478	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	49	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	127,032	76,412	-	-	-	-	-	4,245	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	293,875	-	3,396	594	-	-	-	-	12,382
				Total Blue-green Algae		**67,276,631**	**91,270**	**118,142**	**116,747**	**138,663**	**2,094,382**	**668,356**	**231,652**	**511,180**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	48,238	10,916	509	-	-	-	-	-	-
				Total Red Algae		**48,238**	**10,916**	**509**	**0**	**0**	**0**	**0**	**0**	**0**
				Total Periphyton		**68,484,141**	**172,533**	**124,340**	**128,039**	**148,580**	**2,097,212**	**669,630**	**238,302**	**518,255**
				Total Unique Taxa	**27**		**3**	**5**	**5**	**6**	**4**	**3**	**6**	**5**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2021.

Biologica Sample ID							pp21-162-025	pp21-162-026	pp21-162-027	pp21-162-028	pp21-162-029	pp21-162-030	pp21-162-031	pp21-162-032
Client Sample ID							CC23.7-5	HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	CC5.6-1	CC5.6-2
Date Sampled							22-Aug-21	24-Aug-21	24-Aug-21	24-Aug-21	24-Aug-21	24-Aug-21	23-Aug-21	23-Aug-21
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Bacillariales	Bacillariaceae	Nitzschia sp.	1	1,385	-	-	-	-	-	-	-	1,306
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	117,609	148	-	-	-	-	-	26,037	28,736
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	755	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	4,379	-	-	-	-	-	-	1,132	1,306
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	23,802	99	255	-	-	-	-	2,264	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	45,044	-	-	-	-	-	-	15,848	3,919
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Odontidium sp.	1	3,304	-	-	-	-	-	-	-	1,306
Diatoms	Bacillariophyta	Fragilariales	Staurosiraceae	Staurosirella sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	16,383	-	-	-	-	-	-	2,264	5,225
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Platessa sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	1,132	-	-	-	-	-	-	1,132	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	87,517	-	-	-	-	-	-	21,508	18,287
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	778	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	1,306	-	-	-	-	-	-	-	1,306
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	37,288	49	-	-	-	42	-	6,792	2,612
				Total Diatoms		**345,211**	**296**	**255**	**0**	**0**	**42**	**0**	**76,978**	**64,003**
Green Algae	Chlorophyta	Sphaeropleales	Scenedesmaceae	Scenedesmus sp.	1	1,358	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	812,702	3,949	3,226	20,716	83,841	10,691	45,362	-	-
				Total Green Algae		**814,060**	**3,949**	**3,226**	**20,716**	**83,841**	**10,691**	**45,362**	**0**	**0**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	4,019	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	46,028,631	-	-	-	-	839	-	7,574,904	6,320,986
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	8,437,166	44,861	108,315	191,917	199,677	12,106	117,852	20,376	11,756
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	32,278	740	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	11,926,931	-	65,205	256,743	90,562	5,870	212,497	86,034	104,495
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	382,896	-	3,226	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	13,278	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	30,478	-	-	-	-	-	-	10,188	7,837
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	49	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	127,032	-	-	-	6,368	-	-	-	10,449
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	293,875	1,481	7,811	2,717	-	-	-	-	-
				Total Blue-green Algae		**67,276,631**	**47,082**	**184,557**	**451,377**	**296,606**	**18,814**	**330,349**	**7,691,503**	**6,455,523**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	48,238	-	-	-	-	-	3,396	-	-
				Total Red Algae		**48,238**	**0**	**0**	**0**	**0**	**0**	**3,396**	**0**	**0**
				Total Periphyton		**68,484,141**	**51,327**	**188,038**	**472,093**	**380,447**	**29,547**	**379,107**	**7,768,481**	**6,519,526**
				Total Unique Taxa	**27**		**5**	**5**	**3**	**3**	**4**	**4**	**11**	**12**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2021.

Biologica Sample ID							pp21-162-033	pp21-162-034	pp21-162-035	pp21-162-036	pp21-162-037	pp21-162-038	pp21-162-039	pp21-162-040
Client Sample ID							CC5.6-3	CC5.6-4	CC5.6-5	SYT0.6-1	SYT0.6-2	SYT0.6-3	SYT0.6-4	SYT0.6-5
Date Sampled							23-Aug-21	23-Aug-21	23-Aug-21	21-Aug-21	21-Aug-21	21-Aug-21	21-Aug-21	21-Aug-21
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Bacillariales	Bacillariaceae	Nitzschia sp.	1	1,385	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	117,609	21,508	23,773	5,660	-	212	-	-	849
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	755	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	4,379	1,132	-	809	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	23,802	5,660	1,132	-	-	-	-	131	425
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	1,132	1,132	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	45,044	4,528	10,188	10,512	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Odontidium sp.	1	3,304	-	-	809	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Staurosiraceae	Staurosirella sp.	1	1,132	-	1,132	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	16,383	-	5,660	3,234	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	1,132	1,132	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Platessa sp.	1	1,132	1,132	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	87,517	15,848	15,848	15,363	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	778	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	1,306	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	37,288	7,924	10,188	5,660	-	-	-	-	-
				Total Diatoms		**345,211**	**59,997**	**67,922**	**42,047**	**0**	**212**	**0**	**131**	**1,274**
Green Algae	Chlorophyta	Sphaeropleales	Scenedesmaceae	Scenedesmus sp.	1	1,358	-	-	-	1,358	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	812,702	1,132	-	12,937	10,867	25,895	63,676	11,364	72,591
				Total Green Algae		**814,060**	**1,132**	**0**	**12,937**	**12,226**	**25,895**	**63,676**	**11,364**	**72,591**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	4,019	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	46,028,631	11,579,629	10,938,114	9,500,331	-	4,457	-	6,270	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	8,437,166	14,716	21,131	17,789	16,980	78,725	120,366	76,176	66,648
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	32,278	-	-	-	-	-	-	-	425
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	11,926,931	516,204	468,659	157,675	1,131,573	259,800	630,397	265,416	1,175,042
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	382,896	33,961	-	-	168,106	17,829	95,515	4,310	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	13,278	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	30,478	5,660	6,792	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	49	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	127,032	-	-	-	1,698	-	3,538	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	293,875	-	-	-	-	11,886	30,069	7,837	10,188
				Total Blue-green Algae		**67,276,631**	**12,150,170**	**11,434,696**	**9,675,795**	**1,318,357**	**372,697**	**879,884**	**360,009**	**1,252,303**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	48,238	-	-	-	-	425	-	-	-
				Total Red Algae		**48,238**	**0**	**0**	**0**	**0**	**425**	**0**	**0**	**0**
				Total Periphyton		**68,484,141**	**12,211,299**	**11,502,618**	**9,730,779**	**1,330,583**	**399,229**	**943,561**	**371,504**	**1,326,168**
				Total Unique Taxa	**27**		**14**	**10**	**10**	**4**	**7**	**4**	**6**	**6**

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Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2021.

Biologica Sample ID							pp21-162-041	pp21-162-042	pp21-162-043	pp21-162-044	pp21-162-045	pp21-162-046	pp21-162-047	pp21-162-048
Client Sample ID							XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	YT0.2-1	YT0.2-2	YT0.2-3
Date Sampled							21-Aug-21	21-Aug-21	21-Aug-21	21-Aug-21	21-Aug-21	20-Aug-21	20-Aug-21	20-Aug-21
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Bacillariales	Bacillariaceae	Nitzschia sp.	1	1,385	-	-	-	-	-	-	79	-
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	117,609	4,631	212	303	943	-	-	157	327
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	755	-	-	-	-	755	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	4,379	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	23,802	3,087	425	1,819	236	-	-	-	-
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	45,044	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Odontidium sp.	1	3,304	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Staurosiraceae	Staurosirella sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	16,383	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Platessa sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	1,132	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	87,517	-	-	303	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	778	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	1,306	-	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	37,288	3,087	-	-	-	-	-	-	-
				Total Diatoms		**345,211**	**10,806**	**637**	**2,426**	**1,179**	**755**	**0**	**236**	**327**
Green Algae	Chlorophyta	Sphaeropleales	Scenedesmaceae	Scenedesmus sp.	1	1,358	-	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	812,702	155,911	6,155	12,735	2,123	-	822	5,660	4,408
				Total Green Algae		**814,060**	**155,911**	**6,155**	**12,735**	**2,123**	**0**	**822**	**5,660**	**4,408**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	4,019	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	46,028,631	30,873	-	-	1,651	-	-	55,125	-
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	8,437,166	999,836	129,515	237,009	219,003	663,924	5,678	133,176	96,629
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	32,278	4,631	212	3,032	236	1,132	-	79	-
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	11,926,931	1,750,523	849,019	192,849	336,778	509,411	-	3,773	33,144
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	382,896	12,349	-	-	-	-	-	865	-
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	13,278	-	4,670	-	4,717	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	30,478	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	49	-	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	127,032	-	-	3,032	-	-	212	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	293,875	37,048	8,915	12,735	4,245	-	-	-	15,278
				Total Blue-green Algae		**67,276,631**	**2,835,260**	**992,331**	**448,657**	**566,629**	**1,174,467**	**5,890**	**193,018**	**145,051**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	48,238	-	2,335	7,581	-	-	-	629	-
				Total Red Algae		**48,238**	**0**	**2,335**	**7,581**	**0**	**0**	**0**	**629**	**0**
				Total Periphyton		**68,484,141**	**3,001,977**	**1,001,458**	**471,399**	**569,931**	**1,175,222**	**6,713**	**199,543**	**149,786**
				Total Unique Taxa	**27**		**8**	**8**	**8**	**8**	**4**	**2**	**9**	**4**

biologica

Total periphyton density (cells/cm²) for Minnow Environmental, Coffee AMAMP, 2021.

Biologica Sample ID							pp21-162-049	pp21-162-050	pp21-162-013-QA	pp21-162-024-QA	pp21-162-028-QA	pp21-162-032-QA	pp21-162-039-QA
Client Sample ID							YT0.2-4	YT0.2-5	LC10.2-3-QA	CC23.7-4-QA	HC0.2-3-QA	CC5.6-2-QA	SYT0.6-4-QA
Date Sampled							20-Aug-21	20-Aug-21	23-Aug-21	22-Aug-21	24-Aug-21	23-Aug-21	21-Aug-21
					Grand Total		Total Density	Total Density	Total Density	Total Density	Total Density	Total Density	Total Density
Common Name	Phylum	Order	Family	Taxon	Unique Taxa	Density (cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)	(cells/cm²)
Diatoms	Bacillariophyta	Bacillariales	Bacillariaceae	Nitzschia sp.	1	1,385	-	-	-	-	-	2,612	-
Diatoms	Bacillariophyta	Cocconeidales	Achnanthidiaceae	Achnanthidium sp.	1	117,609	63	42	910	-	-	32,655	-
Diatoms	Bacillariophyta	Cocconeidales	Cocconeidaceae	Cocconeis sp.	1	755	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Cymbellaceae	Cymbella sp.	1	4,379	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Cymbellales	Gomphonemataceae	Gomphonema sp.	1	23,802	-	85	910	-	-	1,306	131
Diatoms	Bacillariophyta	Eunotiales	Eunotiaceae	Eunotia sp.	1	1,132	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Fragilaria sp.	1	45,044	-	-	-	-	-	3,919	-
Diatoms	Bacillariophyta	Fragilariales	Fragilariaceae	Odontidium sp.	1	3,304	-	-	-	-	-	2,612	-
Diatoms	Bacillariophyta	Fragilariales	Staurosiraceae	Staurosirella sp.	1	1,132	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Licmophorales	Ulnariaceae	Hannaea arcus	1	16,383	-	-	-	-	-	2,612	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Achnanthes sp.	1	1,132	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Mastogloiales	Achnanthaceae	Platessa sp.	1	1,132	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Naviculales	Naviculaceae	Navicula sp.	1	1,132	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Diatoma sp.	1	87,517	-	-	-	-	-	27,430	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Meridion circulare	1	778	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	Rhabdonematales	Tabellariaceae	Tabellaria flocculosa	1	1,306	-	-	-	-	-	-	-
Diatoms	Bacillariophyta	-	-	Pennate diatom	-	37,288	63	-	-	-	-	7,837	-
				Total Diatoms		**345,211**	**127**	**127**	**1,819**	**0**	**0**	**80,983**	**131**
Green Algae	Chlorophyta	Sphaeropleales	Scenedesmaceae	Scenedesmus sp.	1	1,358	-	-	-	-	-	-	-
Green Algae	Chlorophyta	-	-	Chlorophyte	-	812,702	4,562	2,292	5,701	10,259	85,256	-	12,931
				Total Green Algae		**814,060**	**4,562**	**2,292**	**5,701**	**10,259**	**85,256**	**0**	**12,931**
Blue-green Algae	Cyanophyta	Chroococcales	Chroococcaceae	Chroococcus sp.	1	4,019	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	Oscillatoriales	Oscillatoriaceae	Phormidium sp.	1	46,028,631	-	-	-	-	-	5,433,722	3,265
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Chamaesiphon sp.	1	8,437,166	17,714	13,735	23,439	231,543	180,208	-	58,766
Blue-green Algae	Cyanophyta	Synechococcales	Chamaesiphonaceae	Clastidium sp.	1	32,278	127	-	-	1,061	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Heteroleibleiniaceae	Heteroleibeinia sp.	1	11,926,931	5,702	2,717	42,208	169,804	116,740	33,961	300,945
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Leptolyngbya sp.	1	382,896	-	-	11,340	-	-	-	10,058
Blue-green Algae	Cyanophyta	Synechococcales	Leptolyngbyaceae	Tapinothrix sp.	1	13,278	-	-	1,698	-	-	-	-
Blue-green Algae	Cyanophyta	Synechococcales	Pseudanabaenaceae	Pseudanabaena sp.	1	30,478	-	-	-	-	-	40,818	-
Blue-green Algae	Cyanophyta	Synechococcales	Synechococcaceae	Synechococcus sp.	1	49	-	-	-	-	-	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (colony)	-	127,032	475	1,245	-	-	2,830	-	-
Blue-green Algae	Cyanophyta	-	-	Cyanophyte (filament)	-	293,875	-	-	5,579	16,273	2,830	-	5,094
				Total Blue-green Algae		**67,276,631**	**24,018**	**17,697**	**84,265**	**418,681**	**302,609**	**5,508,501**	**378,128**
Red Algae	Rhodophyta	Acrochaetiales	Acrochaetiaceae	Audouinella sp.	1	48,238	539	-	243	-	-	-	261
				Total Red Algae		**48,238**	**539**	**0**	**243**	**0**	**0**	**0**	**261**
				Total Periphyton		**68,484,141**	**29,245**	**20,116**	**92,028**	**428,940**	**387,864**	**5,589,484**	**391,451**
				Total Unique Taxa	**27**		**6**	**5**	**8**	**4**	**3**	**10**	**7**

BENTHIC INVERTEBRATE COMMUNITY

2017

Cordillera Consulting

Project: Goldcorp Coffee Project 2017 (177202.0031)

Minnow Environmental (BC), Pierre Stecko Lisa Bowron; Katharina Batchelar
Taxonomist: Sue Salter
suesalter@cordilleraconsulting.ca
250-494-7553

											Future Exposed					Future Reference				
										Site:	HF6.3 - Hess	HF6.3 - Hess	HF6.3 - Hess	HF6.3 - Hess	HF6.3 - Hess	129 - Hess	129 - Hess	129 - Hess	129 - Hess	129 - Hess
										Sample:	HF6.3-1	HF6.3-2	HF6.3-3	HF6.3-4	HF6.3-5	129-1	129-2	129-3	129-4	129-5
										Sample Collection Date:	30-Aug-17	30-Aug-17	30-Aug-17	30-Aug-17	31-Aug-17	01-Sep-17	01-Sep-17	01-Sep-17	01-Sep-17	01-Sep-17
										CC#:	CC180595	CC180596	CC180597	CC180598	CC180599	CC180600	CC180601	CC180602	CC180603	CC180604
Phylum	Sub Phylum	Class	Order	Family	Subfamily	Tribe	Taxonomy	ITIS Code	Functional Feeding Group	EMS:										
Arthropoda	-	-	-	-	-	-	-	82696		**Phylum: Arthropoda**	0		0		0		0		0	
Arthropoda	-	-	Collembola	-	-	-	-	99237	CG	**| Order: Collembola**	0	1	1	1	3		0		0	
Arthropoda	-	-	Collembola	Hypogastruridae	-	-	-	99917	CG	**| Family: Hypogastruridae**	0		0	1	0		0		0	
Arthropoda	Hexapoda	-	-	-	-	-	-	563886		**Subphylum: Hexapoda**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	-	-	-	-	-	99208		**| Class: Insecta**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Ephemeroptera	-	-	-	-	100502	CG	**| Order: Ephemeroptera**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Ephemeroptera	Ameletidae	-	-	-	568544	CG	**| Family: Ameletidae**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Ephemeroptera	Ameletidae	-	-	Ameletus	100996	CG	*Ameletus*	11	3	7	4	8		0		0	
Arthropoda	Hexapoda	Insecta	Ephemeroptera	Baetidae	-	-	-	100755	CG	**| Family: Baetidae**	4	1	2		0	1	2	1	0	
Arthropoda	Hexapoda	Insecta	Ephemeroptera	Baetidae	-	-	Baetis	100800	CG	*Baetis*	22	21	45	41	25	8	4	20	4	18
Arthropoda	Hexapoda	Insecta	Ephemeroptera	Baetidae	-	-	Baetis bicaudatus	100823	CG	*Baetis bicaudatus*	24	52	27	64	10	16	0	10	20	12
Arthropoda	Hexapoda	Insecta	Ephemeroptera	Heptageniidae	-	-	-	100504	SC	**| Family: Heptageniidae**	2	3	0		1	10	4	4	12	18
Arthropoda	Hexapoda	Insecta	Ephemeroptera	Heptageniidae	-	-	Cinygmula	100557	SC	*Cinygmula*	3	5	7	6	1	26	0	8	50	56
Arthropoda	Hexapoda	Insecta	Plecoptera	-	-	-	-	102467		**| Order: Plecoptera**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Plecoptera	Capniidae	-	-	-	102643	SH	**| Family: Capniidae**	3		3		0		0	3	6	
Arthropoda	Hexapoda	Insecta	Plecoptera	Capniidae	-	-	Capnia	102688	SH	*Capnia*	0		1		0		0		0	
Arthropoda	Hexapoda	Insecta	Plecoptera	Chloroperlidae	-	-	-	103202	P	**| Family: Chloroperlidae**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Plecoptera	Chloroperlidae	-	-	Haploperla	103260	P	*Haploperla*	2		0	1	1		0		0	2
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae	-	-	-	102517	SH	**| Family: Nemouridae**	80	142	144	68	18	342	265	241	526	632
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae	-	-	Nemoura	102526	SH	*Nemoura*	3	11	0		1		0		0	2
Arthropoda	Hexapoda	Insecta	Plecoptera	Nemouridae	-	-	Ostrocerca	102622	SH	*Ostrocerca*	10	10	7	3	3	2	4	7	8	12
Arthropoda	Hexapoda	Insecta	Plecoptera	Perlodidae	-	-	-	102994	P	**| Family: Perlodidae**	0		0		0	1	1	1	0	
Arthropoda	Hexapoda	Insecta	Trichoptera	-	-	-	-	115095		**| Order: Trichoptera**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Trichoptera	Limnephilidae	-	-	-	115933	CG	**| Family: Limnephilidae**	4		2	2	6		0		0	
Arthropoda	Hexapoda	Insecta	Trichoptera	Limnephilidae	-	-	Ecclisomyia	116025	OM	*Ecclisomyia*	1	1	3		3		0		0	
Arthropoda	Hexapoda	Insecta	Trichoptera	Uenoidae	-	-	-	568757	SC	**| Family: Uenoidae**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Trichoptera	Uenoidae	-	-	Neothremma	116388	SC	*Neothremma*	0		0	1	0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	-	-	-	-	118831		**| Order: Diptera**	0		1		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	-	-	-	127917		**| Family: Chironomidae**	5	3	9	4	9	10	0	10	20	8
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	-	-	129228	CG	**| Subfamily: Chironominae**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	-	129872	CG	**| Tribe: Tanytarsini**	0		0		0		0		0	2
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Chironominae	Tanytarsini	Micropsectra	129890	CG	*Micropsectra*	0		0		0		0		2	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	-	-	128341	CG	**| Subfamily: Diamesinae**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	-	128351	CG	**| Tribe: Diamesini**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Diamesa	128355	CG	*Diamesa*	33	16	20	14	3	6	3	2	2	4
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Diamesinae	Diamesini	Pseudodiamesa	128416	CG	*Pseudodiamesa*	0		0		3		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	-	-	128457	CG	**| Subfamily: Orthocladiinae**	0		1		0	1	1		0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	-	Diplocladius	128670	CG	*Diplocladius*	3	1	0		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	-	Diplocladius cultriger	128671	CG	*Diplocladius cultriger*	0		1		1		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	-	Eukiefferiella	128689	OM	*Eukiefferiella*	5	6	3	4	0	13	12	2	18	12
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	-	Hydrobaenus	128750	CG	*Hydrobaenus*	1		1		0	1	0		2	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	-	Limnophyes	128776	CG	*Limnophyes*	0		0		2	6	1	1	10	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	-	Metriocnemus	128821	CG	*Metriocnemus*	0		0	1	1		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	-	Orthocladius complex	128874A	CG	*Orthocladius complex*	1		1		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	-	Parorthocladius	129011	CG	*Parorthocladius*	1		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	-	Pseudosmittia	129071	CG	*Pseudosmittia*	0		0		0		0	1	0	
Arthropoda	Hexapoda	Insecta	Diptera	Chironomidae	Orthocladiinae	-	Tvetenia	129197	CG	*Tvetenia*	0		0		0	3	5	13	8	10
Arthropoda	Hexapoda	Insecta	Diptera	Empididae	-	-	-	135830	P	**| Family: Empididae**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Empididae	-	-	Clinocerinae Unknown Genus A	135830A	P	*Clinocerinae Unknown Genus A*	0	1	0		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Muscidae	-	-	-	150025	P	**| Family: Muscidae**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Muscidae	-	-	Limnophora	150730	P	*Limnophora*	0		2	1	5		0	1	2	

Cordillera Consulting

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250-494-7553

											Future Exposed					Future Reference				
										Site:	HF6.3 - Hess	HF6.3 - Hess	HF6.3 - Hess	HF6.3 - Hess	HF6.3 - Hess	129 - Hess	129 - Hess	129 - Hess	129 - Hess	129 - Hess
										Sample:	HF6.3-1	HF6.3-2	HF6.3-3	HF6.3-4	HF6.3-5	129-1	129-2	129-3	129-4	129-5
										Sample Collection Date:	30-Aug-17	30-Aug-17	30-Aug-17	30-Aug-17	31-Aug-17	01-Sep-17	01-Sep-17	01-Sep-17	01-Sep-17	01-Sep-17
										CC#:	CC180595	CC180596	CC180597	CC180598	CC180599	CC180600	CC180601	CC180602	CC180603	CC180604
Phylum	Sub Phylum	Class	Order	Family	Subfamily	Tribe	Taxonomy	ITIS Code	Functional Feeding Group	EMS:										
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae	-	-	-	126640	CF	| **Family: Simuliidae**	7	3	7		1	27	2	4	8	16
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae	-	-	Gymnopais	126674	SC	*Gymnopais*	11	12	18	2	0	4	0	2	0	
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae	-	-	Helodon	126640a	CF	*Helodon*	0		1		0	1	0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae	-	-	Prosimulium/Helodon	126640B	CF	*Prosimulium/Helodon*	0	6	2		0	2	2	1	2	4
Arthropoda	Hexapoda	Insecta	Diptera	Simuliidae	-	-	Simulium	126774	CF	*Simulium*	0		1		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Stratiomyidae	-	-	-	130150	CG	| **Family: Stratiomyidae**	0		0		0		0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Stratiomyidae	-	-	Nemotelus	130694	CG	*Nemotelus*	0		0		0	1	0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Syrphidae	-	-	-	139621	CG	| **Family: Syrphidae**	0		0		0		0	1	0	
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae	-	-	-	118840	SH	| **Family: Tipulidae**	0		0		0	1	0	1	0	
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae	-	-	Dicranota	121027	P	*Dicranota*	7	1	6	3	3	4	0	1	0	
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae	-	-	Ormosia	120830	CG	*Ormosia*	0		0		0	1	0		0	
Arthropoda	Hexapoda	Insecta	Diptera	Tipulidae	-	-	Tipula	119037	OM	*Tipula*	0		0		0	2	1	2	2	2
Arthropoda	Hexapoda	Insecta	Lepidoptera	-	-	-	-	117232	SH	| **Order: Lepidoptera**	0		0		1		0		0	2
Arthropoda	Chelicerata	-	-	-	-	-	-	82697		**Subphylum: Chelicerata**	0		0		0		0		0	
Arthropoda	Chelicerata	Arachnida	-	-	-	-	-	82708	P	| **Class: Arachnida**	0		0		0		0		0	
Arthropoda	Chelicerata	Arachnida	Trombidiformes	-	-	-	-	82769	P	| **Order: Trombidiformes**	0	1	0		0		0	2	2	
Arthropoda	Chelicerata	Arachnida	Trombidiformes	Sperchontidae	-	-	-	895710		| **Family: Sperchontidae**	0		0		0		0		0	
Arthropoda	Chelicerata	Arachnida	Trombidiformes	Sperchontidae	-	-	Sperchon	83006	P	*Sperchon*	0		1		0	5	2	8	6	6
Arthropoda	Chelicerata	Arachnida	Sarcoptiformes	-	-	-	-	83538	P	| **Order: Sarcoptiformes**	0		0		0		0		0	
Arthropoda	Chelicerata	Arachnida	Oribatida	-	-	-	-	733326	P	| **Order: Oribatida**	1	1	1		2	1	1		0	
Arthropoda	-	Malacostraca	-	-	-	-	-	89787		| **Class: Malacostraca**	0		0		0		0		0	
Arthropoda	-	Malacostraca	Amphipoda	-	-	-	-	93294	CG	| **Order: Amphipoda**	0		0		0		0		0	
Arthropoda	-	Malacostraca	Amphipoda	Crangonyctidae	-	-	-	95080	CG	| **Family: Crangonyctidae**	0		0		0		0		0	
Arthropoda	-	Malacostraca	Amphipoda	Crangonyctidae	-	-	Crangonyx	95081	CG	*Crangonyx*	0		0		0	1	0	1	0	
Mollusca	-	-	-	-	-	-	-	69458		**Phylum: Mollusca**	0		0		0		0		0	
Mollusca	-	Gastropoda	-	-	-	-	-	69459	SC	| **Class: Gastropoda**	0	1	0		0		0		0	
Annelida	-	-	-	-	-	-	-	64357		**Phylum: Annelida**	0		0		0		0		0	
Annelida	Clitellata	-	-	-	-	-	-	568832		**Subphylum: Clitellata**	0		0		0		0		0	
Annelida	Clitellata	Oligochaeta	-	-	-	-	-	68422	CG	| **Class: Oligochaeta**	0		0		0		0		0	52
Annelida	Clitellata	Oligochaeta	Lumbriculida	-	-	-	-	68439	CG	| **Order: Lumbriculida**	0		0		0		0		0	
Annelida	Clitellata	Oligochaeta	Lumbriculida	Lumbriculidae	-	-	-	68440	CG	| **Family: Lumbriculidae**	27	6	13	9	3	260	21	10	12	34
Annelida	Clitellata	Oligochaeta	Lumbriculida	Lumbriculidae	-	-	Rhynchelmis	68463	CG	*Rhynchelmis*	0		0		0	1	0		10	
Annelida	Clitellata	Oligochaeta	Tubificida	-	-	-	-	68498		| **Order: Tubificida**	0		0		0		0		0	
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae	-	-	-	68510	CG	| **Family: Enchytraeidae**	0		0		0		0		0	
Annelida	Clitellata	Oligochaeta	Tubificida	Enchytraeidae	-	-	Mesenchytraeus	68544		*Mesenchytraeus*	0		0		1		0		0	
Annelida	Clitellata	Oligochaeta	Tubificida	Naididae	-	-	-	68854	CG	| **Family: Naididae**	0		0		0		0		0	
Annelida	Clitellata	Oligochaeta	Tubificida	Naididae	Tubificinae with hair chaetae	-	-	974289	CG	| **Subfamily: Tubificinae with hair chaetae**	0		0		0		2		0	
Annelida	Clitellata	Oligochaeta	Tubificida	Naididae	Tubificinae without hair chaetae	-	-	974289	CG	| **Subfamily: Tubificinae without hair chaetae**	0		0		0	10	0		14	2
-	-	-	-	-	-	-	-	-	-	**Totals:**	**271**	**308**	**338**	**230**	**115**	**767**	**333**	**358**	**746**	**906**
-	-	-	-	-	-	-	-	-	-	**Taxa present but not included:**	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	0000000		*Terrestrials*	0		0	1	0		0		0	
Nemata	-	-	-	-	-	-	-	563956	SH	**Phylum: Nemata**	0	1	0		0	1	0	1	2	2
Platyhelminthes	-	-	-	-	-	-	-	53963	-	**Phylum: Platyhelminthes**	0		0		0		0		0	
Platyhelminthes	-	Turbellaria	-	-	-	-	-	53964	P	| **Class: Turbellaria**	0		0		0	1	0	1	2	
										Totals:	**0**	**1**	**0**	**1**	**0**	**2**	**0**	**2**	**4**	**2**

2018

Cordillera Consulting

Project: Goldcorp Coffee Project (187202.003)

Minnow Environmental (BC), Pierre Stecko Lisa Bowron; Katharina Batchelar
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	CF3.9	CF3.9	CF3.9	CF3.9	CF3.9	CF19.2	CF19.2	CF19.2	CF19.2	CF19.2	HF0.2	HF0.2	HF0.2	HF0.2	HF0.2	LC8.3	LC8.3	LC8.3	LC8.3	LC8.3	HF6.3	HF6.3	HF6.3	HF6.3	HF6.3	SYT0.6
Sample:	CF3.9-1	CF3.9-2	CF3.9-3	CF3.9-4	CF3.9-5	CF19.2-1	CF19.2-2	CF19.2-3	CF19.2-4	CF19.2-5	HFO.2-1	HFO.2-2	HFO.2-3	HFO.2-4	HFO.2-5	LC8.3-1	LC8.3-2	LC8.3-3	LC8.3-4	LC8.3-5	HF6.3-1	HF6.3-2	HF6.3-3	HF6.3-4	HF6.3-5	SYT0.6-1
Sample Collection Date:	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	30-Aug-18
CC#:	CC190674	CC190675	CC190676	CC190677	CC190678	CC190679	CC190680	CC190681	CC190682	CC190683	CC190684	CC190685	CC190686	CC190687	CC190688	CC190689	CC190690	CC190691	CC190692	CC190693	CC190694	CC190695	CC190696	CC190697	CC190698	CC190699
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Collembola	0	0	0	0	0	0	0	0	0	0	0	0	1	16	5	0	0	1	1	0	0	0	1	2	0	0
| Family: Hypogastruridae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
| Family: Baetidae	1	3	0	2	0	0	9	29	9	4	1	0	1	0	0	0	11	1	0	3	1	2	1	0	5	0
Acentrella	36	5	19	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis	5	3	1	3	0	76	237	103	91	167	24	3	7	0	2	23	16	99	16	43	0	8	25	6	10	5
Baetis rhodani group	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	0	2	0	3	0	0	1	0	2	0
Baetis bicaudatus	0	3	0	0	0	71	32	56	80	123	9	4	16	2	2	60	1	50	12	14	0	0	18	4	1	26
| Family: Ephemerellidae	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella doddsii	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerella	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Heptageniidae	1	0	0	0	0	2	0	0	4	2	2	0	0	0	1	0	0	3	1	0	1	0	1	0	0	0
Cinygmula	23	6	1	0	0	0	0	0	3	2	6	0	9	0	0	2	1	2	1	5	0	1	2	0	0	0
Epeorus	0	0	0	0	0	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Leptophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
| Order: Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Capniidae	0	0	1	0	0	10	3	1	3	6	5	1	3	0	2	6	1	3	0	2	0	1	6	11	1	4
Capnia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Chloroperlidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haploperla	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0
Suwallia	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Leuctridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleuctra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Nemouridae	0	0	0	0	0	38	25	15	44	69	97	33	92	4	12	2	7	13	4	7	13	20	15	13	19	261
| Family: Perlodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Taeniopterygidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trichoptera	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Glossosomatidae	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lepidostomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Limnephilidae	2	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	10	1	2	0	0	0	1	2	0
Ecclisomyia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
| Family: Philopotamidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chimarra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
| Family: Curculionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hydraenidae	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Staphylinidae	0	0	0	0	0	0	0	0	0	0	0	0	0	3	6	0	0	0	0	1	0	0	0	0	1	0
| Order: Diptera	1	0	0	0	2	1	0	0	0	0	0	0	0	0	3	0	0	1	1	0	0	0	0	0	0	0
| Family: Ceratopogonidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipomyia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Chironomidae	1	3	1	1	1	2	3	4	12	0	5	2	11	20	45	6	8	22	4	7	0	4	4	8	4	22
| Subfamily: Chironominae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Taxonomist: Scott Finlayson
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250-494-7553

Site:	CF3.9	CF3.9	CF3.9	CF3.9	CF3.9	CF19.2	CF19.2	CF19.2	CF19.2	CF19.2	HF0.2	HF0.2	HF0.2	HF0.2	HF0.2	LC8.3	LC8.3	LC8.3	LC8.3	LC8.3	HF6.3	HF6.3	HF6.3	HF6.3	HF6.3	SYT0.6
Sample:	CF3.9-1	CF3.9-2	CF3.9-3	CF3.9-4	CF3.9-5	CF19.2-1	CF19.2-2	CF19.2-3	CF19.2-4	CF19.2-5	HFO.2-1	HFO.2-2	HFO.2-3	HFO.2-4	HFO.2-5	LC8.3-1	LC8.3-2	LC8.3-3	LC8.3-4	LC8.3-5	HF6.3-1	HF6.3-2	HF6.3-3	HF6.3-4	HF6.3-5	SYT0.6-1
Sample Collection Date:	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	30-Aug-18
CC#:	CC190674	CC190675	CC190676	CC190677	CC190678	CC190679	CC190680	CC190681	CC190682	CC190683	CC190684	CC190685	CC190686	CC190687	CC190688	CC190689	CC190690	CC190691	CC190692	CC190693	CC190694	CC190695	CC190696	CC190697	CC190698	CC190699
Polypedilum	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corynocera	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micropsectra	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paratanytarsus	0	0	0	0	0	0	0	0	0	0	0	0	2	5	0	1	5	0	20	0	5	0	0	0	0	0
Rheotanytarsus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudokiefferiella	0	0	0	0	0	2	12	1	1	6	1	0	0	0	1	0	0	2	0	1	4	11	5	45	13	0
| Tribe: Diamesini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamesa	0	0	1	0	0	5	0	3	3	6	2	4	2	1	0	0	1	0	3	0	6	16	3	19	9	24
Pseudodiamesa	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	1	1	2	0	0	0	2	0	0
| Subfamily: Orthocladiinae	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Diplocladius cultriger	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella	1	0	0	0	0	26	23	4	7	10	5	5	5	4	5	1	1	2	6	6	0	4	2	29	4	7
Heterotrissocladius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Hydrobaenus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0
Krenosmittia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Limnophyes	0	0	0	0	0	0	3	1	0	0	0	0	2	1	1	1	4	2	2	4	1	1	0	2	0	3
Metriocnemus	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Orthocladius complex	0	0	2	1	0	0	0	0	1	0	0	0	1	0	0	1	0	0	0	1	0	2	0	0	0	0
Parakiefferiella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parametriocnemus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Paroorthocladius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Rheocricotopus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Tvetenia	2	4	1	2	0	2	0	0	4	0	1	0	0	1	4	1	0	3	2	0	0	0	0	0	0	0
| Subfamily: Tanypodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
| Family: Deuterophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deuterophlebia	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Dolichopodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
| Family: Empididae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Clinocera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Clinocerinae Unknown Genus A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	16
| Family: Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnophora	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	3	1	0	0	0	2	2	2	0	0
| Family: Simuliidae	0	4	1	4	0	11	1	7	13	27	21	52	75	7	20	2	5	6	7	4	0	0	2	3	0	19
Gymnopais	0	1	0	0	0	40	41	41	52	60	0	0	0	0	0	0	0	0	1	0	0	6	6	10	6	2
Helodon	0	0	0	0	0	3	1	9	4	4	2	1	13	0	4	0	1	5	0	0	3	7	3	9	2	0
Metacnephia	0	0	0	0	0	0	0	2	0	0	1	0	2	2	6	0	1	4	0	1	0	0	0	0	0	1
Prosimulium	0	0	0	0	0	4	0	3	7	6	1	1	1	0	0	0	0	0	0	0	0	1	3	2	2	1
Prosimulium/Helodon	12	3	4	4	0	3	4	1	3	4	3	1	5	1	1	2	0	1	0	1	0	0	1	1	2	0
| Family: Stratiomyidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nemotelus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Tipulidae	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Dicranota	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	2	3	2	0	2	1	0	0	1
Ormosia	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0
Rhabdomastix	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
Tipula	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	1	1	1	0	0	0	0	0	0	0
| Family: Trichoceridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Lepidoptera	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Noctuidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Thysanoptera	0	0	0	0	0	0	1	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0

Cordillera Consulting

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Minnow Environmental (BC), Pierre Stecko Lisa Bowron; Katharina Batchelar
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	CF3.9	CF3.9	CF3.9	CF3.9	CF3.9	CF19.2	CF19.2	CF19.2	CF19.2	CF19.2	HF0.2	HF0.2	HF0.2	HF0.2	HF0.2	LC8.3	LC8.3	LC8.3	LC8.3	LC8.3	HF6.3	HF6.3	HF6.3	HF6.3	HF6.3	SYT0.6
Sample:	CF3.9-1	CF3.9-2	CF3.9-3	CF3.9-4	CF3.9-5	CF19.2-1	CF19.2-2	CF19.2-3	CF19.2-4	CF19.2-5	HFO.2-1	HFO.2-2	HFO.2-3	HFO.2-4	HFO.2-5	LC8.3-1	LC8.3-2	LC8.3-3	LC8.3-4	LC8.3-5	HF6.3-1	HF6.3-2	HF6.3-3	HF6.3-4	HF6.3-5	SYT0.6-1
Sample Collection Date:	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	30-Aug-18
CC#:	CC190674	CC190675	CC190676	CC190677	CC190678	CC190679	CC190680	CC190681	CC190682	CC190683	CC190684	CC190685	CC190686	CC190687	CC190688	CC190689	CC190690	CC190691	CC190692	CC190693	CC190694	CC190695	CC190696	CC190697	CC190698	CC190699
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	0	1	1	0	1	1	0	0	0	0	0	0	0	6	4	0	1	0	1	0	0	0	0	1	0	0
| Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon	0	0	0	1	0	1	0	0	0	0	1	0	3	0	0	0	0	1	1	0	0	0	0	0	0	0
Suborder: Prostigmata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Stygothrombidiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stygothrombium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Oribatida	0	0	0	0	0	0	1	0	0	0	1	1	0	3	3	0	0	0	1	0	0	0	0	0	0	2
| Family: Hydrozetidae	0	0	0	0	0	3	0	1	1	0	1	0	2	7	3	0	0	0	1	0	1	0	0	4	0	1
| Class: Malacostraca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	3	0	0	0	0	1	0	0
| Family: Crangonyctidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synurella johanseni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	0	0	0	0	0	0	0
| Family: Hyalellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Pisidiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pisidium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
| Class: Gastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Hypsogastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hydrobiidae	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Haplotaxida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Haplotaxidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haplotaxis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
| Order: Lumbriculida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lumbriculidae	2	0	0	7	1	226	37	38	107	221	1	1	2	22	14	3	2	21	27	78	12	4	176	5	25	2
Lumbriculus	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchelmis	0	0	0	0	0	0	5	3	7	10	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Enchytraeidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enchytraeus	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
All others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Totals:	**95**	**46**	**37**	**38**	**9**	**532**	**444**	**322**	**460**	**729**	**197**	**112**	**260**	**110**	**163**	**116**	**76**	**265**	**125**	**195**	**48**	**96**	**280**	**187**	**114**	**408**
Taxa present but not included:																										
Terrestrials	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	CF3.9	CF3.9	CF3.9	CF3.9	CF3.9	CF19.2	CF19.2	CF19.2	CF19.2	CF19.2	HF0.2	HF0.2	HF0.2	HF0.2	HF0.2	LC8.3	LC8.3	LC8.3	LC8.3	LC8.3	HF6.3	HF6.3	HF6.3	HF6.3	HF6.3	SYT0.6
Sample:	CF3.9-1	CF3.9-2	CF3.9-3	CF3.9-4	CF3.9-5	CF19.2-1	CF19.2-2	CF19.2-3	CF19.2-4	CF19.2-5	HFO.2-1	HFO.2-2	HFO.2-3	HFO.2-4	HFO.2-5	LC8.3-1	LC8.3-2	LC8.3-3	LC8.3-4	LC8.3-5	HF6.3-1	HF6.3-2	HF6.3-3	HF6.3-4	HF6.3-5	SYT0.6-1
Sample Collection Date:	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	23-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	30-Aug-18
CC#:	CC190674	CC190675	CC190676	CC190677	CC190678	CC190679	CC190680	CC190681	CC190682	CC190683	CC190684	CC190685	CC190686	CC190687	CC190688	CC190689	CC190690	CC190691	CC190692	CC190693	CC190694	CC190695	CC190696	CC190697	CC190698	CC190699
| Family: Cecidomyiidae	0	1	0	0	0	0	0	0	0	0	0	0	1	3	8	0	1	0	2	1	0	0	0	0	0	0
| Order: Homoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Cicadellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Ostracoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Chilopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
| Class: Maxillipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Copepoda	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lumbricidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Phylum: Nemata	0	0	1	1	1	1	1	1	0	2	1	0	0	1	1	1	0	0	1	0	0	1	0	1	1	1
Phylum: Platyhelminthes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Turbellaria	0	0	0	0	0	1	1	1	1	2	1	1	1	1	0	1	0	1	0	0	0	0	0	1	0	0
Totals:	**0**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**4**	**2**	**2**	**2**	**8**	**9**	**2**	**1**	**4**	**3**	**1**	**0**	**1**	**0**	**2**	**1**	**1**

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250-494-7553

Site:	SYT0.6	SYT0.6	SYT0.6	SYT0.6	CR16.7	CR16.7	CR16.7	CR16.7	CR16.7	XE0.2	XE0.2	XE0.2	XE0.2	XE0.2	YT0.2	YT0.2	YT0.2	YT0.2	YT0.2	YT4.6	YT4.6	YT4.6	YT4.6	YT4.6
Sample:	SYT0.6-2	SYT0.6-3	SYT0.6-4	SYT0.6-5	CR16.7-1	CR16.7-2	CR16.7-3	CR16.7-4	CR16.7-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	YT4.6-1	YT4.6-2	YT4.6-3	YT4.6-4	YT4.6-5
Sample Collection Date:	30-Aug-18	30-Aug-18	30-Aug-18	30-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18
CC#:	CC190700	CC190701	CC190702	CC190703	CC190704	CC190705	CC190706	CC190707	CC190708	CC190709	CC190710	CC190711	CC190712	CC190713	CC190714	CC190715	CC190716	CC190717	CC190718	CC190719	CC190720	CC190721	CC190722	CC190723
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Collembola	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	3	8	2	1	0
| Family: Hypogastruridae	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Baetidae	10	0	1	0	1	0	2	4	0	1	16	1	0	9	6	0	2	0	1	0	0	0	0	1
Acentrella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis	20	12	1	24	41	32	15	6	25	39	31	44	5	8	18	2	7	17	11	0	0	0	0	0
Baetis rhodani group	0	0	0	3	2	6	0	1	4	3	2	3	2	0	1	0	0	0	0	0	0	1	0	0
Baetis bicaudatus	2	68	10	52	12	12	4	0	50	70	5	52	39	0	12	13	1	38	9	0	0	0	0	0
| Family: Ephemerellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella doddsii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Heptageniidae	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cinygmula	0	0	0	1	14	6	2	1	14	0	0	0	0	0	0	3	2	1	2	0	0	0	0	0
Epeorus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
| Family: Leptophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Capniidae	2	18	9	13	1	2	1	1	1	16	4	28	25	17	1	1	4	6	3	0	0	1	1	0
Capnia	0	0	0	0	0	0	0	0	0	6	6	5	10	3	0	0	0	0	0	0	0	0	0	0
| Family: Chloroperlidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haploperla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suwallia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Leuctridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paraleuctra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
| Family: Nemouridae	247	536	192	324	131	143	49	79	171	1	5	0	1	2	24	43	38	30	38	10	16	25	25	10
| Family: Perlodidae	0	0	0	0	0	0	0	0	0	1	1	9	4	0	0	0	0	0	0	0	0	0	0	0
| Family: Taeniopterygidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
| Order: Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Glossosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lepidostomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lepidostoma	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Limnephilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Ecclisomyia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Philopotamidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chimarra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0
| Family: Curculionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
| Family: Hydraenidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Staphylinidae	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
| Order: Diptera	1	0	0	0	0	0	0	0	1	6	1	0	0	0	0	3	0	0	0	0	2	0	1	0
| Family: Ceratopogonidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Forcipomyia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
| Family: Chironomidae	10	54	20	27	0	0	1	0	0	13	1	29	6	0	4	6	1	1	3	6	12	23	22	1
| Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cordillera Consulting

Project: Goldcorp Coffee Project (187202.003)

Minnow Environmental (BC), Pierre Stecko Lisa Bowron; Katharina Batchelar
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	SYT0.6	SYT0.6	SYT0.6	SYT0.6	CR16.7	CR16.7	CR16.7	CR16.7	CR16.7	XE0.2	XE0.2	XE0.2	XE0.2	XE0.2	YT0.2	YT0.2	YT0.2	YT0.2	YT0.2	YT4.6	YT4.6	YT4.6	YT4.6	YT4.6
Sample:	SYT0.6-2	SYT0.6-3	SYT0.6-4	SYT0.6-5	CR16.7-1	CR16.7-2	CR16.7-3	CR16.7-4	CR16.7-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	YT4.6-1	YT4.6-2	YT4.6-3	YT4.6-4	YT4.6-5
Sample Collection Date:	30-Aug-18	30-Aug-18	30-Aug-18	30-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18
CC#:	CC190700	CC190701	CC190702	CC190703	CC190704	CC190705	CC190706	CC190707	CC190708	CC190709	CC190710	CC190711	CC190712	CC190713	CC190714	CC190715	CC190716	CC190717	CC190718	CC190719	CC190720	CC190721	CC190722	CC190723
Polypedilum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stictochironomus	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corynocera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micropsectra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paratanytarsus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Rheotanytarsus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudokiefferiella	2	0	7	0	6	16	2	2	0	0	0	0	0	0	0	0	0	0	1	3	9	5	4	3
| Tribe: Diamesini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamesa	27	22	25	16	1	0	1	0	0	11	6	19	10	4	3	4	2	6	3	37	69	82	113	15
Pseudodiamesa	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diplocladius cultriger	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0
Eukiefferiella	6	14	9	20	5	3	2	1	2	37	6	60	9	5	0	6	2	3	3	0	12	6	8	2
Heterotrissocladius	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrobaenus	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Krenosmittia	0	2	0	3	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Limnophyes	2	8	1	4	0	1	2	0	0	8	1	8	4	2	1	0	0	0	0	0	0	2	1	0
Metriocnemus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orthocladius complex	0	0	0	0	0	1	0	0	1	5	4	9	2	1	0	0	0	0	0	1	2	0	0	0
Parakiefferiella	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parametriocnemus	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Parorthocladius	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rheocricotopus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tvetenia	0	4	0	0	0	1	0	1	4	7	1	4	11	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Tanypodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Deuterophlebiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Deuterophlebia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Dolichopodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Empididae	6	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0
Clinocera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinocerinae Unknown Genus A	7	16	11	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0
| Family: Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnophora	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
| Family: Simuliidae	5	14	16	20	3	0	0	0	0	0	1	7	1	0	0	1	0	0	0	0	0	0	2	0
Gymnopais	3	6	8	12	4	10	6	0	5	42	14	61	34	1	0	0	0	1	0	1	1	2	0	0
Helodon	0	0	0	0	9	12	0	0	10	1	0	25	1	0	0	0	0	0	0	0	0	0	0	0
Metacnephia	0	0	0	1	2	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
Prosimulium	0	4	0	3	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Prosimulium/Helodon	0	0	0	0	6	1	2	0	3	5	0	16	1	0	0	0	0	0	0	0	0	0	0	0
| Family: Stratiomyidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nemotelus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
| Family: Tipulidae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dicranota	0	0	1	0	2	0	0	0	0	0	0	0	0	0	1	0	2	1	1	0	0	0	0	0
Ormosia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Rhabdomastix	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipula	0	0	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
| Family: Trichoceridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
| Order: Lepidoptera	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	1	0	1
| Family: Noctuidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
| Order: Thysanoptera	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cordillera Consulting

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Minnow Environmental (BC), Pierre Stecko Lisa Bowron; Katharina Batchelar
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	SYT0.6	SYT0.6	SYT0.6	SYT0.6	CR16.7	CR16.7	CR16.7	CR16.7	CR16.7	XE0.2	XE0.2	XE0.2	XE0.2	XE0.2	YT0.2	YT0.2	YT0.2	YT0.2	YT0.2	YT4.6	YT4.6	YT4.6	YT4.6	YT4.6
Sample:	SYT0.6-2	SYT0.6-3	SYT0.6-4	SYT0.6-5	CR16.7-1	CR16.7-2	CR16.7-3	CR16.7-4	CR16.7-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	YT4.6-1	YT4.6-2	YT4.6-3	YT4.6-4	YT4.6-5
Sample Collection Date:	30-Aug-18	30-Aug-18	30-Aug-18	30-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18
CC#:	CC190700	CC190701	CC190702	CC190703	CC190704	CC190705	CC190706	CC190707	CC190708	CC190709	CC190710	CC190711	CC190712	CC190713	CC190714	CC190715	CC190716	CC190717	CC190718	CC190719	CC190720	CC190721	CC190722	CC190723
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	3	0	0	0	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0
| Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon	0	0	0	0	1	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suborder: Prostigmata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Stygothrombidiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Stygothrombium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Oribatida	0	4	0	0	1	2	0	1	0	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0
| Family: Hydrozetidae	0	0	0	1	0	0	0	0	0	2	1	0	0	0	0	1	1	0	0	0	1	1	0	0
| Class: Malacostraca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Crangonyctidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synurella johanseni	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hyalellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hyalella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Bivalvia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Veneroida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Pisidiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pisidium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Gastropoda	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Hypsogastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hydrobiidae	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Haplotaxida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Haplotaxidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haplotaxis	2	0	0	3	0	0	0	1	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lumbriculidae	0	0	0	0	10	3	3	1	2	83	44	31	331	22	0	5	6	8	4	1	0	9	52	2
Lumbriculus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rhynchelmis	0	0	0	0	0	0	0	0	0	3	0	4	10	0	0	0	0	0	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Enchytraeidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enchytraeus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
All others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Totals:	**357**	**782**	**311**	**548**	**257**	**260**	**98**	**102**	**319**	**370**	**153**	**423**	**506**	**78**	**74**	**93**	**70**	**116**	**82**	**67**	**132**	**165**	**235**	**36**
Taxa present but not included:																								
Terrestrials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cordillera Consulting

Project: Goldcorp Coffee Project (187202.003)

Minnow Environmental (BC), Pierre Stecko Lisa Bowron; Katharina Batchelar
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	SYT0.6	SYT0.6	SYT0.6	SYT0.6	CR16.7	CR16.7	CR16.7	CR16.7	CR16.7	XE0.2	XE0.2	XE0.2	XE0.2	XE0.2	YT0.2	YT0.2	YT0.2	YT0.2	YT0.2	YT4.6	YT4.6	YT4.6	YT4.6	YT4.6
Sample:	SYT0.6-2	SYT0.6-3	SYT0.6-4	SYT0.6-5	CR16.7-1	CR16.7-2	CR16.7-3	CR16.7-4	CR16.7-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	YT4.6-1	YT4.6-2	YT4.6-3	YT4.6-4	YT4.6-5
Sample Collection Date:	30-Aug-18	30-Aug-18	30-Aug-18	30-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18
CC#:	CC190700	CC190701	CC190702	CC190703	CC190704	CC190705	CC190706	CC190707	CC190708	CC190709	CC190710	CC190711	CC190712	CC190713	CC190714	CC190715	CC190716	CC190717	CC190718	CC190719	CC190720	CC190721	CC190722	CC190723
| Family: Cecidomyiidae	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	2	0	0	0	1	2	0	0
| Order: Homoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Cicadellidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Ostracoda	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Chilopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Maxillipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Copepoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lumbricidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Phylum: Nemata	1	2	1	1	1	1	0	0	1	1	1	1	1	1	0	1	1	1	0	1	1	0	1	0
Phylum: Platyhelminthes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Turbellaria	0	0	0	0	1	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0
Totals:	**1**	**2**	**1**	**1**	**2**	**2**	**1**	**0**	**2**	**2**	**2**	**3**	**2**	**1**	**0**	**2**	**3**	**1**	**0**	**1**	**2**	**2**	**2**	**1**

Site:	CF3.9	CF3.9	CF3.9	CF3.9	CF3.9	CF19.2	CF19.2	CF19.2	CF19.2	CF19.2	HF0.2	HF0.2	HF0.2	HF0.2	HF0.2	LC8.3	LC8.3
Sample:	CF3.9-1	CF3.9-2	CF3.9-3	CF3.9-4	CF3.9-5	CF19.2-1	CF19.2-2	CF19.2-3	CF19.2-4	CF19.2-5	HFO.2-1	HFO.2-2	HFO.2-3	HFO.2-4	HFO.2-5	LC8.3-1	LC8.3-2
Sample Collection Date:	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	25-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	26-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	22-Aug-18	23-Aug-18	23-Aug-18
CC#:	CC190674	CC190675	CC190676	CC190677	CC190678	CC190679	CC190680	CC190681	CC190682	CC190683	CC190684	CC190685	CC190686	CC190687	CC190688	CC190689	CC190690
Mesh	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Sub-sample %	100	100	100	100	100	100	75	100	75	48	100	100	100	100	100	100	100
Sample Total Dry Weight																	
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gastropoda (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0120	0.0046	0.0023	0.0033	0.0014	0.1670	0.0440	0.0473	0.0991	0.1246	0.0320	0.0195	0.0493	0.0085	0.0150	0.0180	0.0313
Raw Dry Weight																	
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gastropoda (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0120	0.0046	0.0023	0.0033	0.0014	0.1670	0.0330	0.0473	0.0743	0.0598	0.0320	0.0195	0.0493	0.0085	0.0150	0.0180	0.0313
Measured Weight																	
Chironomidae																	
Oligochaeta																	
Odonta (if required)																	
Gastropoda (if required)																	
All others (if required)	0.1472	0.1391	0.135	0.1384	0.1376	0.3008	0.1685	0.1822	0.2097	0.1953	0.1661	0.1543	0.1839	0.1438	0.1487	0.1531	0.1651
Mesh Weight																	
Chironomidae																	
Oligochaeta																	
Odonta (if required)																	
Gastropoda (if required)																	
All others (if required)	0.1352	0.1345	0.1327	0.1351	0.1362	0.1338	0.1355	0.1349	0.1354	0.1355	0.1341	0.1348	0.1346	0.1353	0.1337	0.1351	0.1338
Sample Total Wet Weight (g)																	
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Corrected Wet Weight																	
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Site:	LC8.3	LC8.3	LC8.3	HF6.3	HF6.3	HF6.3	HF6.3	HF6.3	SYT0.6	SYT0.6	SYT0.6	SYT0.6	SYT0.6	CR16.7	CR16.7	CR16.7	CR16.7
Sample:	LC8.3-3	LC8.3-4	LC8.3-5	HF6.3-1	HF6.3-2	HF6.3-3	HF6.3-4	HF6.3-5	SYT0.6-1	SYT0.6-2	SYT0.6-3	SYT0.6-4	SYT0.6-5	CR16.7-1	CR16.7-2	CR16.7-3	CR16.7-4
Sample Collection Date:	23-Aug-18	23-Aug-18	23-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	24-Aug-18	30-Aug-18	30-Aug-18	30-Aug-18	30-Aug-18	30-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18	27-Aug-18
CC#:	CC190691	CC190692	CC190693	CC190694	CC190695	CC190696	CC190697	CC190698	CC190699	CC190700	CC190701	CC190702	CC190703	CC190704	CC190705	CC190706	CC190707
Mesh	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Sub-sample %	100	100	100	100	100	100	100	100	100	100	50	100	75	100	100	100	100
Sample Total Dry Weight																	
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gastropoda (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0479	0.0413	0.0223	0.0036	0.0196	0.0740	0.0292	0.0397	0.1137	0.0447	0.2162	0.0894	0.1743	0.0428	0.0425	0.0334	0.0053
Raw Dry Weight																	
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gastropoda (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0479	0.0413	0.0223	0.0036	0.0196	0.0740	0.0292	0.0397	0.1137	0.0447	0.1081	0.0894	0.1307	0.0428	0.0425	0.0334	0.0053
Measured Weight																	
Chironomidae																	
Oligochaeta																	
Odonta (if required)																	
Gastropoda (if required)																	
All others (if required)	0.1814	0.1765	0.1575	0.1378	0.1543	0.2088	0.1645	0.1743	0.2483	0.1793	0.2426	0.223	0.2656	0.1766	0.1759	0.1676	0.1402
Mesh Weight																	
Chironomidae																	
Oligochaeta																	
Odonta (if required)																	
Gastropoda (if required)																	
All others (if required)	0.1335	0.1352	0.1352	0.1342	0.1347	0.1348	0.1353	0.1346	0.1346	0.1346	0.1345	0.1336	0.1349	0.1338	0.1334	0.1342	0.1349
Sample Total Wet Weight (g)																	
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Corrected Wet Weight																	
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Site:	CR16.7	XE0.2	XE0.2	XE0.2	XE0.2	XE0.2	YT0.2	YT0.2	YT0.2	YT0.2	YT0.2	YT4.6	YT4.6	YT4.6	YT4.6	YT4.6
Sample:	CR16.7-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	YT4.6-1	YT4.6-2	YT4.6-3	YT4.6-4	YT4.6-5
Sample Collection Date:	27-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	31-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	29-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18	28-Aug-18
CC#:	CC190708	CC190709	CC190710	CC190711	CC190712	CC190713	CC190714	CC190715	CC190716	CC190717	CC190718	CC190719	CC190720	CC190721	CC190722	CC190723
Mesh	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Sub-sample %	100	87.5	100	75	100	100	100	100	100	100	100	100	100	100	100	100
Sample Total Dry Weight																
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gastropoda (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0948	0.0527	0.0134	0.0621	0.0886	0.0109	0.0086	0.0137	0.0073	0.0195	0.0137	0.0085	0.0141	0.0399	0.0422	0.0119
Raw Dry Weight																
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Gastropoda (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0948	0.0461	0.0134	0.0466	0.0886	0.0109	0.0086	0.0137	0.0073	0.0195	0.0137	0.0085	0.0141	0.0399	0.0422	0.0119
Measured Weight																
Chironomidae																
Oligochaeta																
Odonta (if required)																
Gastropoda (if required)																
All others (if required)	0.2289	0.1809	0.1472	0.1806	0.2227	0.1453	0.1421	0.147	0.1428	0.1548	0.1472	0.1424	0.1489	0.1747	0.1768	0.1459
Mesh Weight																
Chironomidae																
Oligochaeta																
Odonta (if required)																
Gastropoda (if required)																
All others (if required)	0.1341	0.1348	0.1338	0.134	0.1341	0.1344	0.1335	0.1333	0.1355	0.1353	0.1335	0.1339	0.1348	0.1348	0.1346	0.134
Sample Total Wet Weight (g)																
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Corrected Wet Weight																
Chironomidae	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Oligochaeta	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Odonta (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
All others (if required)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

2019

Cordillera Consulting

Project: Goldcorp Coffee Project(19-46)
Minnow Environmental (BC)
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	CC5.6	CC5.6	CC5.6	CC5.6	CC5.6	XE0.2	XE0.2	XE0.2	XE0.2	XE0.2	HC0.2	HC0.2	HC0.2	HC0.2	HC0.2	HC6.8	HC6.8	HC6.8	HC6.8	HC6.8	YT0.2
Sample:	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	YT0.2-1
Sample Collection Date:	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	19-Aug-19	19-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	21-Aug-19
CC#:	CC200540	CC200541	CC200542	CC200543	CC200544	CC200545	CC200546	CC200547	CC200548	CC200549	CC200550	CC200551	CC200552	CC200553	CC200554	CC200555	CC200556	CC200557	CC200558	CC200559	CC200560
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Collembola	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
| Family: Hypogastruridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	3	5	15	0
| Family: Baetidae	0	0	0	0	0	0	0	1	0	0	0	1	1	2	2	2	0	0	2	1	1
Acentrella	2	3	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Acerpenna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Baetis	1	2	1	1	3	4	8	8	3	5	12	26	23	26	28	6	3	3	6	4	30
| Family: Ephemerellidae	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella doddsii	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerella	4	12	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Heptageniidae	4	3	0	1	3	0	0	3	0	0	0	0	1	0	1	0	0	0	1	2	0
Cinygmula	14	48	11	21	7	2	0	1	3	0	9	5	16	8	8	8	3	5	8	13	2
Epeorus	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
| Order: Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
| Family: Capniidae	0	0	0	1	2	85	84	136	106	84	4	10	7	20	9	18	13	3	6	3	4
Capnia	0	0	0	0	0	2	12	13	19	3	1	0	0	2	2	14	3	2	4	5	1
Mesocapnia	0	0	0	0	0	0	6	7	6	3	0	0	1	0	1	0	0	0	0	0	0
| Family: Chloroperlidae	0	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haploperla	1	4	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neaviperla	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suwallia	2	6	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Nemouridae	0	0	0	1	1	4	0	0	0	0	135	173	221	306	149	54	40	10	42	40	133
Ostrocerca	0	0	0	0	0	9	6	1	6	3	50	97	55	130	60	14	8	7	8	7	47
| Family: Perlodidae	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Skwala	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Glossosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Limnephilidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	
Dicosmoecus	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Ecclisomyia	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	1	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Diptera	0	0	0	0	0	1	0	0	0	0	26	0	0	0	0	0	0	0	0	0	0
| Family: Chironomidae	25	1	3	3	3	30	34	19	29	14	6	1	17	10	5	32	13	6	28	7	5
| Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Site:	CC5.6	CC5.6	CC5.6	CC5.6	CC5.6	XE0.2	XE0.2	XE0.2	XE0.2	XE0.2	HC0.2	HC0.2	HC0.2	HC0.2	HC0.2	HC6.8	HC6.8	HC6.8	HC6.8	HC6.8	YT0.2
Sample:	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	YT0.2-1
Sample Collection Date:	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	19-Aug-19	19-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	21-Aug-19
CC#:	CC200540	CC200541	CC200542	CC200543	CC200544	CC200545	CC200546	CC200547	CC200548	CC200549	CC200550	CC200551	CC200552	CC200553	CC200554	CC200555	CC200556	CC200557	CC200558	CC200559	CC200560
Paralauterborniella nigrohalterale	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	2	0	0	0	0	1
Micropsectra	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paratanytarsus	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
Tanytarsus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudokiefferiella	0	0	0	0	0	0	0	0	3	3	1	2	8	18	6	32	19	12	21	9	0
| Tribe: Diamesini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamesa	0	1	0	3	1	59	88	59	45	103	1	1	0	4	2	88	179	23	40	5	15
Pagastia	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Pseudodiamesa	0	0	0	0	0	0	0	1	0	3	0	0	0	0	0	0	2	0	0	0	0
| Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diplocladius cultriger	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Eukiefferiella	16	13	36	5	21	46	112	65	131	54	11	2	5	24	20	6	14	10	14	7	5
Hydrobaenus	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Krenosmittia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnophyes	0	2	0	0	0	9	36	0	10	3	0	0	0	4	0	2	0	0	2	0	2
Metriocnemus	0	0	0	0	0	15	82	5	26	14	0	0	0	0	0	0	0	0	0	0	0
Orthocladius complex	36	16	31	3	26	8	32	11	48	8	0	0	0	2	1	2	2	1	8	3	4
Parametriocnemus	0	0	0	0	0	0	4	1	0	3	0	0	0	0	0	0	0	0	0	0	0
Parorthocladius	1	0	0	0	0	1	2	4	42	22	0	0	0	0	11	0	0	0	0	0	2
Rheocricotopus	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tvetenia	2	2	1	2	1	0	6	0	3	0	0	1	1	26	6	0	2	0	0	1	0
| Subfamily: Prodiamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monodiamesa	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
| Subfamily: Tanypodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ablabesmyia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
| Tribe: Pentaneurini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thienemannimyia group	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
| Family: Empididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinocera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Clinocerinae Unknown Genus A	2	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	4
| Family: Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnophora	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
| Family: Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma/Telmatoscopus	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Simuliidae	1	0	0	0	2	2	0	5	0	0	25	27	24	86	20	14	11	0	5	0	1
Gymnopais	0	0	0	0	0	75	78	109	93	43	0	0	3	6	0	32	37	18	21	12	0
Helodon	0	0	0	0	0	2	6	7	3	0	0	2	0	14	1	76	19	3	3	0	0
Metacnephia	0	0	1	0	0	0	0	0	0	0	2	3	4	14	2	8	5	2	0	1	0
Prosimulium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	2	0	0	0	0
Prosimulium/Helodon	0	1	0	0	0	1	0	0	3	0	0	0	4	6	1	30	16	3	0	1	0
Stegopterna	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	1	0
| Family: Tipulidae	0	0	0	0	0	0	2	0	0	0	0	1	0	2	0	0	2	0	0	0	0

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Site:	CC5.6	CC5.6	CC5.6	CC5.6	CC5.6	XE0.2	XE0.2	XE0.2	XE0.2	XE0.2	HC0.2	HC0.2	HC0.2	HC0.2	HC0.2	HC6.8	HC6.8	HC6.8	HC6.8	HC6.8	YT0.2
Sample:	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	YT0.2-1
Sample Collection Date:	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	19-Aug-19	19-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	21-Aug-19
CC#:	CC200540	CC200541	CC200542	CC200543	CC200544	CC200545	CC200546	CC200547	CC200548	CC200549	CC200550	CC200551	CC200552	CC200553	CC200554	CC200555	CC200556	CC200557	CC200558	CC200559	CC200560
Dicranota	1	0	0	0	0	0	0	0	0	0	0	2	1	0	0	10	0	3	4	1	2
Ormosia	0	0	0	0	0	1	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0
Tipula	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
| Order: Hemiptera	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Lepidoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Hymenoptera	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Thysanoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0
| Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon	1	0	0	0	0	0	0	0	0	3	1	2	0	4	1	0	0	0	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Oribatida	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	2	1	0	1	0
| Family: Hydrozetidae	0	0	0	0	0	1	0	1	0	3	0	0	1	2	0	6	0	0	0	0	0
| Class: Malacostraca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Crangonyctidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synurella johanseni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Gastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1
| Order: Hypsogastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hydrobiidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Haplotaxida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Haplotaxidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haplotaxis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lumbriculidae	133	2	217	51	5	26	92	5	307	373	2	4	29	20	2	138	83	96	26	10	5
Lumbriculus	45	0	108	0	0	6	0	0	202	116	0	0	0	0	0	24	29	82	0	0	0
Rhynchelmis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Naididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Tubificinae with ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	3	0
Totals:	**300**	**125**	**418**	**104**	**86**	**392**	**690**	**465**	**1100**	**866**	**287**	**363**	**428**	**742**	**342**	**636**	**514**	**298**	**257**	**159**	**266**

Cordillera Consulting

Project: Goldcorp Coffee Project(19-46)
Minnow Environmental (BC)
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	CC5.6	CC5.6	CC5.6	CC5.6	CC5.6	XE0.2	XE0.2	XE0.2	XE0.2	XE0.2	HC0.2	HC0.2	HC0.2	HC0.2	HC0.2	HC6.8	HC6.8	HC6.8	HC6.8	HC6.8	YT0.2
Sample:	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	HC0.2-1	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	YT0.2-1
Sample Collection Date:	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	19-Aug-19	19-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	21-Aug-19
CC#:	CC200540	CC200541	CC200542	CC200543	CC200544	CC200545	CC200546	CC200547	CC200548	CC200549	CC200550	CC200551	CC200552	CC200553	CC200554	CC200555	CC200556	CC200557	CC200558	CC200559	CC200560
Taxa present but not included:																					
Terrestrials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Curculionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Scolytinae	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
| Order: Diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Cecidomyiidae	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Ostracoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Chilopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Maxillipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Copepoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Nemata	0	0	0	0	0	1	2	1	3	3	0	1	0	2	1	2	2	1	1	1	1
Phylum: Platyhelminthes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Turbellaria	0	0	0	0	0	0	4	0	0	0	1	1	0	2	1	2	2	1	0	0	0
Totals:	**1**	**0**	**0**	**0**	**1**	**1**	**8**	**1**	**3**	**3**	**1**	**2**	**0**	**4**	**2**	**4**	**4**	**2**	**1**	**1**	**2**

Cordillera Consulting

Project: Goldcorp Coffee Project(19-46)
Minnow Environmental (BC)
Taxonomist: Scott Finlayson
scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	YT0.2	YT0.2	YT0.2	YT0.2	CR24.5	CR24.5	CR24.5	CR24.5	CR24.5	LC10.2	LC10.2	LC10.2	LC10.2	LC10.2	CC23.7	CC23.7	CC23.7	CC23.7	CC23.7	SYT0.6	SYT0.6
Sample:	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5	SYT0.6-1	SYT0.6-2
Sample Collection Date:	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19
CC#:	CC200561	CC200562	CC200563	CC200564	CC200565	CC200566	CC200567	CC200568	CC200569	CC200570	CC200571	CC200572	CC200573	CC200574	CC200575	CC200576	CC200577	CC200578	CC200579	CC200580	CC200581
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Collembola	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	1	0	0
| Family: Hypogastruridae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ameletus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	0	0
| Family: Baetidae	0	2	0	1	2	0	0	0	0	2	4	1	1	2	0	0	0	0	0	0	0
Acentrella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acerpenna	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Baetis	10	11	13	6	10	9	3	14	16	41	77	107	68	57	0	10	4	14	5	0	4
| Family: Ephemerellidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Drunella doddsii	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemerella	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Heptageniidae	0	0	0	0	2	0	3	4	4	0	0	0	1	2	0	2	0	0	2	0	0
Cinygmula	3	3	2	1	42	18	8	40	25	4	3	6	5	5	14	14	27	22	14	0	0
Epeorus	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
| Order: Plecoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Capniidae	3	5	15	3	28	3	8	22	8	2	4	5	3	5	26	10	7	9	4	40	52
Capnia	0	0	0	0	2	0	1	0	0	0	2	0	0	0	4	0	4	5	3	0	0
Mesocapnia	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0
| Family: Chloroperlidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Haploperla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Neaviperla	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Suwallia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Nemouridae	94	133	113	169	196	90	71	140	105	22	14	29	21	28	106	70	172	24	87	212	194
Ostrocerca	22	35	35	35	164	76	41	114	69	7	9	7	13	3	34	13	36	31	31	156	132
| Family: Perlodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Skwala	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
| Order: Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Glossosomatidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Glossosoma	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Limnephilidae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	0
Dicosmoecus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ecclisomyia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Chironomidae	2	2	3	6	16	1	1	2	1	20	10	10	15	4	34	14	27	9	5	28	60
| Subfamily: Chironominae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Cordillera Consulting

Project: Goldcorp Coffee Project(19-46)

Minnow Environmental (BC)
Taxonomist: Scott Finlayson
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250-494-7553

Site:	YT0.2	YT0.2	YT0.2	YT0.2	CR24.5	CR24.5	CR24.5	CR24.5	CR24.5	LC10.2	LC10.2	LC10.2	LC10.2	LC10.2	CC23.7	CC23.7	CC23.7	CC23.7	CC23.7	SYT0.6	SYT0.6
Sample:	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5	SYT0.6-1	SYT0.6-2
Sample Collection Date:	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19
CC#:	CC200561	CC200562	CC200563	CC200564	CC200565	CC200566	CC200567	CC200568	CC200569	CC200570	CC200571	CC200572	CC200573	CC200574	CC200575	CC200576	CC200577	CC200578	CC200579	CC200580	CC200581
Paralauterborniella nigrohalterale	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Polypedilum	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Micropsectra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Paratanytarsus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanytarsus	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudokiefferiella	0	0	0	0	6	6	1	4	5	85	0	0	17	3	0	110	12	0	42	2	2
| Tribe: Diamesini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diamesa	4	3	7	10	42	14	9	12	5	10	10	9	18	8	204	53	27	18	41	58	52
Pagastia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pseudodiamesa	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Diplocladius cultriger	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Eukiefferiella	6	8	1	4	10	6	3	16	5	29	5	1	21	3	32	54	20	10	14	38	52
Hydrobaenus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Krenosmittia	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Limnophyes	1	1	0	1	8	3	1	6	4	1	0	0	0	0	4	0	2	0	0	14	8
Metriocnemus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orthocladius complex	0	0	0	0	0	0	2	0	1	2	1	2	5	0	12	13	5	2	3	0	4
Parametriocnemus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parorthocladius	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	3	2	0	10
Rheocricotopus	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tvetenia	2	0	0	0	6	0	1	0	5	7	2	2	4	3	28	43	27	55	18	0	8
| Subfamily: Prodiamesinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Monodiamesa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Tanypodinae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ablabesmyia	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Tribe: Pentaneurini	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Thienemannimyia group	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Empididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
Clinocera	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Clinocerinae Unknown Genus A	5	4	7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	4
| Family: Muscidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Limnophora	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0
| Family: Psychodidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pericoma/Telmatoscopus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Simuliidae	2	0	0	5	2	0	2	0	3	7	12	5	19	14	6	3	2	3	3	12	24
Gymnopais	0	0	0	0	4	2	4	4	1	0	6	5	13	5	60	37	44	39	45	44	64
Helodon	0	0	0	0	2	3	1	0	1	6	4	0	6	1	0	0	0	0	0	0	0
Metacnephia	0	1	0	0	0	0	0	0	0	1	0	0	1	0	2	0	0	0	0	2	0
Prosimulium	0	0	0	0	0	1	0	2	0	0	0	0	1	0	4	0	0	0	0	0	0
Prosimulium/Helodon	0	0	0	0	4	0	0	2	3	6	7	1	8	0	4	2	2	0	0	0	2
Stegopterna	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	5	9	10	2	0	0
| Family: Tipulidae	0	0	0	0	2	0	1	8	1	1	0	0	0	0	0	0	0	0	0	0	0

Cordillera Consulting

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250-494-7553

Site:	YT0.2	YT0.2	YT0.2	YT0.2	CR24.5	CR24.5	CR24.5	CR24.5	CR24.5	LC10.2	LC10.2	LC10.2	LC10.2	LC10.2	CC23.7	CC23.7	CC23.7	CC23.7	CC23.7	SYT0.6	SYT0.6
Sample:	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5	SYT0.6-1	SYT0.6-2
Sample Collection Date:	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19
CC#:	CC200561	CC200562	CC200563	CC200564	CC200565	CC200566	CC200567	CC200568	CC200569	CC200570	CC200571	CC200572	CC200573	CC200574	CC200575	CC200576	CC200577	CC200578	CC200579	CC200580	CC200581
Dicranota	0	3	0	0	0	0	0	0	0	4	3	0	1	0	0	0	2	0	0	0	0
Ormosia	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tipula	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
| Order: Hemiptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Lepidoptera	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Hymenoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Thysanoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Trombidiformes	1	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	0	0	0	2
| Family: Sperchontidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperchon	0	0	0	0	6	1	2	2	1	0	0	0	1	0	0	2	0	1	2	0	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Oribatida	0	0	0	0	2	0	0	2	0	0	0	0	1	0	0	0	0	1	0	0	0
| Family: Hydrozetidae	0	0	0	0	0	1	0	2	0	0	0	0	0	0	2	0	0	0	0	2	0
| Class: Malacostraca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Crangonyctidae	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Synurella johanseni	0	0	0	0	0	1	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Gastropoda	0	0	0	0	2	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
| Order: Hypsogastropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Hydrobiidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Haplotaxida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Haplotaxidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Haplotaxis	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Lumbriculidae	73	13	13	27	76	54	14	200	175	68	83	10	2	44	136	61	124	78	47	0	0
Lumbriculus	48	0	4	6	8	83	0	8	0	0	0	0	0	0	0	19	11	5	10	0	0
Rhynchelmis	0	1	0	0	0	0	4	10	11	0	12	1	0	4	12	0	0	0	0	0	0
| Order: Tubificida	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Naididae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Tubificinae with ha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Totals:	**277**	**226**	**215**	**277**	**664**	**374**	**183**	**618**	**450**	**327**	**271**	**205**	**247**	**193**	**744**	**537**	**576**	**344**	**384**	**626**	**684**

Cordillera Consulting

Project: Goldcorp Coffee Project(19-46)
Minnow Environmental (BC)
Taxonomist: Scott Finlayson
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250-494-7553

Site:	YT0.2	YT0.2	YT0.2	YT0.2	CR24.5	CR24.5	CR24.5	CR24.5	CR24.5	LC10.2	LC10.2	LC10.2	LC10.2	LC10.2	CC23.7	CC23.7	CC23.7	CC23.7	CC23.7	SYT0.6	SYT0.6
Sample:	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5	CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	LC10.2-1	LC10.2-2	LC10.2-3	LC10.2-4	LC10.2-5	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5	SYT0.6-1	SYT0.6-2
Sample Collection Date:	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19
CC#:	CC200561	CC200562	CC200563	CC200564	CC200565	CC200566	CC200567	CC200568	CC200569	CC200570	CC200571	CC200572	CC200573	CC200574	CC200575	CC200576	CC200577	CC200578	CC200579	CC200580	CC200581
Taxa present but not included:																					
Terrestrials	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Phylum: Arthropoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Curculionidae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Subfamily: Scolytinae	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
| Order: Diptera	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Family: Cecidomyiidae	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Ostracoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
| Class: Chilopoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Maxillipoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Copepoda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phylum: Nemata	0	1	1	1	2	1	1	2	1	1	1	1	1	0	2	2	2	1	1	2	2
Phylum: Platyhelminthes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
| Class: Turbellaria	0	0	1	0	2	1	1	2	1	0	0	1	1	1	2	2	2	1	1	0	0
Totals:	**0**	**1**	**2**	**1**	**6**	**2**	**2**	**4**	**2**	**1**	**2**	**2**	**2**	**1**	**6**	**6**	**4**	**2**	**3**	**2**	**2**

Cordillera Consulting

Project: Goldcorp Coffee Project(19-46)
Minnow Environmental (BC)
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scottfinlayson@cordilleraconsulting.ca
250-494-7553

Site:	SYT0.6	SYT0.6	SYT0.6	YT4.3	YT4.3	YT4.3	YT4.3	YT4.3
Sample:	SYT0.6-3	SYT0.6-4	SYT0.6-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5
Sample Collection Date:	23-Aug-19	23-Aug-19	23-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
CC#:	CC200582	CC200583	CC200584	CC200585	CC200586	CC200587	CC200588	CC200589
Phylum: Arthropoda	0	0	0	0	0	0	0	0
| Order: Collembola	0	0	0	0	0	0	0	2
| Family: Hypogastruridae	0	0	1	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0
| Order: Ephemeroptera	0	0	0	0	0	0	0	0
| Family: Ameletidae	0	0	0	0	0	0	0	0
Ameletus	0	0	0	0	0	0	0	0
| Family: Baetidae	0	0	0	0	0	2	1	0
Acentrella	0	0	0	0	0	0	0	0
Acerpenna	0	0	0	0	0	0	0	0
Baetis	2	2	1	1	4	12	17	35
| Family: Ephemerellidae	0	0	0	0	0	0	0	0
Drunella doddsii	0	0	0	0	0	0	0	0
Ephemerella	0	0	0	0	0	0	0	0
| Family: Heptageniidae	0	0	0	0	0	0	0	0
Cinygmula	0	0	0	1	0	0	0	0
Epeorus	0	0	0	0	0	0	0	0
| Order: Plecoptera	0	0	0	0	0	0	0	0
| Family: Capniidae	46	70	48	11	2	0	1	3
Capnia	0	2	3	0	0	0	0	0
Mesocapnia	0	0	0	0	0	0	0	0
| Family: Chloroperlidae	0	0	0	0	0	0	0	0
Haploperla	0	0	0	0	0	0	0	0
Neaviperla	0	0	0	0	0	0	0	0
Suwallia	0	0	0	0	0	0	0	0
| Family: Nemouridae	218	154	115	201	96	470	174	371
Ostrocerca	194	118	125	21	15	54	36	53
| Family: Perlodidae	0	0	0	0	0	0	0	0
Skwala	0	0	0	0	0	0	0	0
| Order: Trichoptera	0	0	0	0	0	0	0	0
| Family: Glossosomatidae	0	0	0	0	0	0	0	0
Glossosoma	0	0	0	0	0	0	0	0
| Family: Limnephilidae	0	0	0	0	0	0	0	0
Dicosmoecus	0	0	0	0	0	0	0	0
Ecclisomyia	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	2	0	0	0	0	0	0
| Order: Diptera	2	0	0	0	0	0	0	0
| Family: Chironomidae	34	30	20	5	4	2	0	2
| Subfamily: Chironominae	0	0	0	0	0	0	0	0
| Tribe: Chironomini	0	0	0	0	0	0	0	0

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Site:	SYT0.6	SYT0.6	SYT0.6	YT4.3	YT4.3	YT4.3	YT4.3	YT4.3
Sample:	SYT0.6-3	SYT0.6-4	SYT0.6-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5
Sample Collection Date:	23-Aug-19	23-Aug-19	23-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
CC#:	CC200582	CC200583	CC200584	CC200585	CC200586	CC200587	CC200588	CC200589
Paralauterborniella nigrohalterale	0	0	0	0	0	0	0	0
Polypedilum	0	0	0	0	0	8	0	0
| Tribe: Tanytarsini	0	0	0	0	0	0	0	0
Micropsectra	0	0	0	0	0	0	0	0
Paratanytarsus	0	0	0	0	0	0	0	0
Tanytarsus	0	0	0	0	0	0	0	0
| Subfamily: Diamesinae	0	0	0	0	0	0	0	0
Pseudokiefferiella	2	0	1	7	2	2	1	6
| Tribe: Diamesini	0	0	0	0	0	0	0	0
Diamesa	40	118	29	107	79	34	25	29
Pagastia	0	0	0	0	0	0	0	0
Pseudodiamesa	0	0	0	0	0	0	0	0
| Subfamily: Orthocladiinae	0	0	0	0	0	0	0	0
Diplocladius cultriger	0	0	0	25	0	0	1	5
Eukiefferiella	28	18	24	32	31	32	13	38
Hydrobaenus	0	0	0	0	0	0	0	2
Krenosmittia	4	12	1	0	0	0	0	0
Limnophyes	8	8	0	16	3	2	0	2
Metriocnemus	0	0	1	0	0	0	0	0
Orthocladius complex	4	4	0	0	2	0	1	0
Parametriocnemus	0	0	1	0	0	0	0	0
Parorthocladius	4	0	0	0	1	0	0	2
Rheocricotopus	0	0	0	0	0	0	0	0
Tvetenia	4	6	4	0	4	0	0	3
| Subfamily: Prodiamesinae	0	0	0	0	0	0	0	0
Monodiamesa	0	0	0	0	0	0	0	0
| Subfamily: Tanypodinae	0	0	0	0	0	0	0	0
Ablabesmyia	0	0	0	0	0	0	0	0
| Tribe: Pentaneurini	0	0	0	0	0	0	0	0
Thienemannimyia group	0	0	0	0	0	0	0	0
| Family: Empididae	0	0	0	0	0	0	0	0
Clinocera	0	0	0	0	0	0	0	0
Clinocerinae Unknown Genus A	8	10	8	1	1	0	0	2
| Family: Muscidae	0	0	0	0	0	0	0	0
Limnophora	0	0	0	1	3	0	0	0
| Family: Psychodidae	0	0	0	0	0	0	0	0
Pericoma/Telmatoscopus	0	0	0	0	0	0	0	0
| Family: Simuliidae	2	24	8	0	0	0	0	0
Gymnopais	42	56	51	3	0	4	0	0
Helodon	0	0	0	0	0	0	0	0
Metacnephia	0	4	0	0	0	0	0	0
Prosimulium	0	2	1	0	0	0	0	0
Prosimulium/Helodon	0	0	1	0	0	0	0	0
Stegopterna	0	0	0	0	0	0	0	0
| Family: Tipulidae	0	0	0	0	0	0	0	0

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Site:	SYT0.6	SYT0.6	SYT0.6	YT4.3	YT4.3	YT4.3	YT4.3	YT4.3
Sample:	SYT0.6-3	SYT0.6-4	SYT0.6-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5
Sample Collection Date:	23-Aug-19	23-Aug-19	23-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
CC#:	CC200582	CC200583	CC200584	CC200585	CC200586	CC200587	CC200588	CC200589
Dicranota	2	0	0	0	0	0	0	0
Ormosia	4	0	0	1	0	0	0	0
Tipula	0	0	0	0	0	0	0	0
| Order: Hemiptera	0	0	0	0	0	0	0	0
| Order: Lepidoptera	0	0	0	0	1	0	0	2
| Order: Hymenoptera	0	0	0	0	0	0	0	0
| Order: Thysanoptera	0	0	0	12	1	4	0	0
Subphylum: Chelicerata	0	0	0	0	0	0	0	0
| Class: Arachnida	0	0	0	0	0	0	0	0
| Order: Trombidiformes	0	0	0	0	2	0	0	0
| Family: Sperchontidae	0	0	0	0	0	0	0	0
Sperchon	0	0	0	0	0	0	0	0
| Order: Sarcoptiformes	0	0	0	0	0	0	0	0
| Order: Oribatida	0	0	0	0	0	0	0	0
| Family: Hydrozetidae	0	0	0	1	0	0	0	2
| Class: Malacostraca	0	0	0	0	0	0	0	0
| Order: Amphipoda	0	0	0	0	0	0	0	0
| Family: Crangonyctidae	0	0	0	0	0	0	0	0
Synurella johanseni	0	0	0	0	0	0	0	0
Phylum: Mollusca	0	0	0	0	0	0	0	0
| Class: Gastropoda	2	0	0	0	0	0	0	0
| Order: Hypsogastropoda	0	0	0	0	0	0	0	0
| Family: Hydrobiidae	0	0	0	0	0	0	0	0
Phylum: Annelida	0	0	0	0	0	0	0	0
Subphylum: Clitellata	0	0	0	0	0	0	0	0
| Class: Oligochaeta	0	0	0	0	0	0	0	0
| Order: Haplotaxida	0	0	0	0	0	0	0	0
| Family: Haplotaxidae	0	0	0	0	0	0	0	0
Haplotaxis	0	0	0	0	0	0	0	0
| Order: Lumbriculida	0	0	0	0	0	0	0	0
| Family: Lumbriculidae	4	0	1	9	4	0	4	2
Lumbriculus	0	0	0	0	0	0	0	0
Rhynchelmis	0	0	0	4	0	0	0	2
| Order: Tubificida	0	0	0	0	0	0	0	0
| Family: Naididae	0	0	0	0	0	0	0	0
| Subfamily: Tubificinae with ha	0	0	0	0	0	0	0	0
Totals:	**654**	**640**	**444**	**459**	**255**	**626**	**274**	**563**

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Site:	SYT0.6	SYT0.6	SYT0.6	YT4.3	YT4.3	YT4.3	YT4.3	YT4.3
Sample:	SYT0.6-3	SYT0.6-4	SYT0.6-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5
Sample Collection Date:	23-Aug-19	23-Aug-19	23-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
CC#:	CC200582	CC200583	CC200584	CC200585	CC200586	CC200587	CC200588	CC200589
Taxa present but not included:								
Terrestrials	0	2	3	0	0	0	0	0
Phylum: Arthropoda	0	0	0	0	0	0	0	0
Subphylum: Hexapoda	0	0	0	0	0	0	0	0
| Class: Insecta	0	0	0	0	0	0	0	0
| Order: Coleoptera	0	0	0	0	0	0	0	0
| Family: Curculionidae	0	0	0	0	0	0	0	0
| Subfamily: Scolytinae	0	0	0	0	0	0	0	0
| Order: Diptera	0	0	0	0	0	0	0	0
| Family: Cecidomyiidae	0	0	0	0	0	0	0	0
Subphylum: Crustacea	0	0	0	0	0	0	0	0
| Class: Ostracoda	0	0	0	0	0	0	0	0
| Class: Chilopoda	0	2	0	0	0	0	0	0
| Class: Maxillipoda	0	0	0	0	0	0	0	0
| Class: Copepoda	0	0	0	0	0	0	1	0
Phylum: Nemata	2	2	1	1	1	2	0	2
Phylum: Platyhelminthes	0	0	0	0	0	0	0	0
| Class: Turbellaria	0	0	0	0	0	0	0	0
Totals:	**2**	**6**	**4**	**1**	**1**	**2**	**1**	**2**

Site:	CC5.6	CC5.6	CC5.6	CC5.6	CC5.6	XE0.2	XE0.2	XE0.2	XE0.2	XE0.2	HC0.2
Sample:	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	HC0.2-1
Sample Collection Date:	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	24-Aug-19	19-Aug-19	19-Aug-19	20-Aug-19
CC#:	CC200540	CC200541	CC200542	CC200543	CC200544	CC200545	CC200546	CC200547	CC200548	CC200549	CC200550
Mesh	500	500	500	500	500	500	500	500	500	500	500
Sub-sample %	100	100	75	100	100	100	50	75	31.25	37	100
Sample Total Dry Weight											
All others (if required)	0.0980	0.0222	0.0412	0.0182	0.0093	0.0683	0.0860	0.0751	0.1648	0.1038	0.0412
Raw Dry Weight											
All others (if required)	0.0980	0.0222	0.0309	0.0182	0.0093	0.0683	0.0430	0.0563	0.0515	0.0384	0.0412
Measured Weight											
All others (if required)	0.2284	0.1523	0.1624	0.1483	0.1395	0.2005	0.1725	0.185	0.1835	0.1707	0.1717
Mesh Weight											
All others (if required)	0.1304	0.1301	0.1315	0.1301	0.1302	0.1322	0.1295	0.1287	0.132	0.1323	0.1305

Site:	HC0.2	HC0.2	HC0.2	HC0.2	HC6.8	HC6.8	HC6.8	HC6.8	HC6.8	YT0.2	YT0.2
Sample:	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	YT0.2-1	YT0.2-2
Sample Collection Date:	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	20-Aug-19	21-Aug-19	21-Aug-19
CC#:	CC200551	CC200552	CC200553	CC200554	CC200555	CC200556	CC200557	CC200558	CC200559	CC200560	CC200561
Mesh	500	500	500	500	500	500	500	500	500	500	500
Sub-sample %	100	75	50	100	50	62.5	100	100	100	100	100
Sample Total Dry Weight											
All others (if required)	0.0678	0.0692	0.1008	0.0520	0.1480	0.0917	0.0766	0.0436	0.0510	0.0424	0.0405
Raw Dry Weight											
All others (if required)	0.0678	0.0519	0.0504	0.0520	0.0740	0.0573	0.0766	0.0436	0.0510	0.0424	0.0405
Measured Weight											
All others (if required)	0.1992	0.1828	0.1825	0.1824	0.2053	0.1877	0.2085	0.1753	0.1821	0.1752	0.1739
Mesh Weight											
All others (if required)	0.1314	0.1309	0.1321	0.1304	0.1313	0.1304	0.1319	0.1317	0.1311	0.1328	0.1334

Site:	YT0.2	YT0.2	YT0.2	CR24.5	CR24.5	CR24.5	CR24.5	CR24.5	LC10.2	LC10.2	LC10.2
Sample:	YT0.2-3	YT0.2-4	YT0.2-5	CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	LC10.2-1	LC10.2-2	LC10.2-3
Sample Collection Date:	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	21-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
CC#:	CC200562	CC200563	CC200564	CC200565	CC200566	CC200567	CC200568	CC200569	CC200570	CC200571	CC200572
Mesh	500	500	500	500	500	500	500	500	500	500	500
Sub-sample %	100	100	100	50	100	100	50	75	100	100	100
Sample Total Dry Weight											
All others (if required)	0.0231	0.0386	0.0374	0.1462	0.0925	0.0326	0.1170	0.0720	0.0343	0.1039	0.0342
Raw Dry Weight											
All others (if required)	0.0231	0.0386	0.0374	0.0731	0.0925	0.0326	0.0585	0.0540	0.0343	0.1039	0.0342
Measured Weight											
All others (if required)	0.1601	0.1688	0.1707	0.2025	0.2249	0.1662	0.192	0.1937	0.1642	0.2362	0.1676
Mesh Weight											
All others (if required)	0.137	0.1302	0.1333	0.1294	0.1324	0.1336	0.1335	0.1397	0.1299	0.1323	0.1334

Site:	LC10.2	LC10.2	CC23.7	CC23.7	CC23.7	CC23.7	CC23.7	SYT0.6	SYT0.6	SYT0.6	SYT0.6
Sample:	LC10.2-4	LC10.2-5	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5	SYT0.6-1	SYT0.6-2	SYT0.6-3	SYT0.6-4
Sample Collection Date:	22-Aug-19	22-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19	23-Aug-19
CC#:	CC200573	CC200574	CC200575	CC200576	CC200577	CC200578	CC200579	CC200580	CC200581	CC200582	CC200583
Mesh	500	500	500	500	500	500	500	500	500	500	500
Sub-sample %	100	100	50	62.5	56.25	100	100	50	50	50	50
Sample Total Dry Weight											
All others (if required)	0.0316	0.0406	0.1444	0.0773	0.1316	0.0939	0.0797	0.1378	0.1466	0.1892	0.1636
Raw Dry Weight											
All others (if required)	0.0316	0.0406	0.0722	0.0483	0.0740	0.0939	0.0797	0.0689	0.0733	0.0946	0.0818
Measured Weight											
All others (if required)	0.1639	0.1719	0.2057	0.1825	0.2062	0.2271	0.2132	0.202	0.2045	0.2264	0.2166
Mesh Weight											
All others (if required)	0.1323	0.1313	0.1335	0.1342	0.1322	0.1332	0.1335	0.1331	0.1312	0.1318	0.1348

Site:	SYT0.6	YT4.3	YT4.3	YT4.3	YT4.3	YT4.3
Sample:	SYT0.6-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5
Sample Collection Date:	23-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19	22-Aug-19
CC#:	CC200584	CC200585	CC200586	CC200587	CC200588	CC200589
Mesh	500	500	500	500	500	500
Sub-sample %	75	75	100	50	100	62.5
Sample Total Dry Weight						
All others (if required)	0.1643	0.0636	0.0415	0.0554	0.0340	0.0602
Raw Dry Weight						
All others (if required)	0.1232	0.0477	0.0415	0.0277	0.0340	0.0376
Measured Weight						
All others (if required)	0.2563	0.1813	0.1756	0.1608	0.1683	0.1714
Mesh Weight						
All others (if required)	0.1331	0.1336	0.1341	0.1331	0.1343	0.1338

Methods and QC Report 2019

Project ID: Coffee Creek AEMP (19-46)

Client: Minnow Environmental

Prepared by:
Cordillera Consulting Inc.
Summerland, BC
© 2019

Unit 1, 13216 Henry Ave B1202
Summerland, BC, V0H 1Z0
www.cordilleraconsulting.ca

P: 250.494.7553
F: 250.494.7562

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Sample Reception

On September 6, 2019, Cordillera Consulting received 50 benthic samples from Minnow Environmental. When samples arrived to Cordillera Consulting, exterior packaging was initially inspected for damage or wet spots that would have indicated damage to the interior containers.

Samples were logged into a proprietary software database (INSTAR1) where the clients assigned sample name was recorded along with a Cordillera Consulting (CC) number for cross-reference. Each sample was checked to ensure that all sites and replicates recorded on field sheets or packing lists were delivered intact and with adequate preservative. Any missing, mislabelled or extra samples were reported to the client immediately to confirm the total numbers and correct names on the sample jars. The client representative was notified of the arrival of the shipment and provided a sample inventory once intake was completed.
See table below for sample inventory:

Table 1: Summary of sample information including Cordillera Consulting (CC) number

Site	Sample	CC#	Date	Size	# of Jars
CC5.6	CC5.6-1	CC200540	8/24/2019	500µM	1
CC5.6	CC5.6-2	CC200541	8/24/2019	500µM	1
CC5.6	CC5.6-3	CC200542	8/24/2019	500µM	1
CC5.6	CC5.6-4	CC200543	8/24/2019	500µM	1
CC5.6	CC5.6-5	CC200544	8/24/2019	500µM	1
XE0.2	XE0.2-1	CC200545	8/24/2019	500µM	1
XE0.2	XE0.2-2	CC200546	8/24/2019	500µM	1
XE0.2	XE0.2-3	CC200547	8/24/2019	500µM	1
XE0.2	XE0.2-4	CC200548	8/19/2019	500µM	1
XE0.2	XE0.2-5	CC200549	8/19/2019	500µM	1
HC0.2	HC0.2-1	CC200550	8/20/2019	500µM	1
HC0.2	HC0.2-2	CC200551	8/20/2019	500µM	1
HC0.2	HC0.2-3	CC200552	8/20/2019	500µM	1
HC0.2	HC0.2-4	CC200553	8/20/2019	500µM	1
HC0.2	HC0.2-5	CC200554	8/20/2019	500µM	1
HC6.8	HC6.8-1	CC200555	8/20/2019	500µM	1
HC6.8	HC6.8-2	CC200556	8/20/2019	500µM	1
HC6.8	HC6.8-3	CC200557	8/20/2019	500µM	1
HC6.8	HC6.8-4	CC200558	8/20/2019	500µM	1
HC6.8	HC6.8-5	CC200559	8/20/2019	500µM	1
YT0.2	YT0.2-1	CC200560	8/21/2019	500µM	1
YT0.2	YT0.2-2	CC200561	8/21/2019	500µM	1
YT0.2	YT0.2-3	CC200562	8/21/2019	500µM	1
YT0.2	YT0.2-4	CC200563	8/21/2019	500µM	1
YT0.2	YT0.2-5	CC200564	8/21/2019	500µM	1
CR24.5	CR24.5-1	CC200565	8/21/2019	500µM	1

CR24.5	CR24.5-2	CC200566	8/21/2019	500µM	1
CR24.5	CR24.5-3	CC200567	8/21/2019	500µM	1
CR24.5	CR24.5-4	CC200568	8/21/2019	500µM	1
CR24.5	CR24.5-5	CC200569	8/21/2019	500µM	1
LC10.2	LC10.2-1	CC200570	8/22/2019	500µM	1
LC10.2	LC10.2-2	CC200571	8/22/2019	500µM	1
LC10.2	LC10.2-3	CC200572	8/22/2019	500µM	1
LC10.2	LC10.2-4	CC200573	8/22/2019	500µM	1
LC10.2	LC10.2-5	CC200574	8/22/2019	500µM	1
CC23.7	CC23.7-1	CC200575	8/23/2019	500µM	1
CC23.7	CC23.7-2	CC200576	8/23/2019	500µM	1
CC23.7	CC23.7-3	CC200577	8/23/2019	500µM	1
CC23.7	CC23.7-4	CC200578	8/23/2019	500µM	1
CC23.7	CC23.7-5	CC200579	8/23/2019	500µM	1
SYT0.6	SYT0.6-1	CC200580	8/23/2019	500µM	1
SYT0.6	SYT0.6-2	CC200581	8/23/2019	500µM	1
SYT0.6	SYT0.6-3	CC200582	8/23/2019	500µM	1
SYT0.6	SYT0.6-4	CC200583	8/23/2019	500µM	1
SYT0.6	SYT0.6-5	CC200584	8/23/2019	500µM	1
YT4.3	YT4.3-1	CC200585	8/22/2019	500µM	1
YT4.3	YT4.3-2	CC200586	8/22/2019	500µM	1
YT4.3	YT4.3-3	CC200587	8/22/2019	500µM	1
YT4.3	YT4.3-4	CC200588	8/22/2019	500µM	1
YT4.3	YT4.3-5	CC200589	8/22/2019	500µM	1

Sample Sorting

- Using a gridded Petri dish, fine forceps and a low power stereo-microscope (Olympus, Nikon, Leica) the sorting technicians removed the invertebrates and sorted them into family/orders.
- The sorting technician kept a running tally of total numbers excluding organisms from Porifera, Nemata, Platyhelminthes, Ostracoda, Copepoda, Cladocera and terrestrial drop-ins such as aphids. These organisms were marked for their presence (given a value of 1) only and left in the sample. They were not included towards the 300-organism subsample count.
- Where specimens are broken or damaged, only heads were counted.
- Subsampling was conducted with the use of a Marchant Box.
- When using the Marchant box, cells were extracted at the same time in the order indicated by a random number table. If the 300th organism was found part way into sorting a cell then the balance of that cell was sorted. If the organism count had not reached 300 by the 50th cell then the entire sample was sorted.
- The total number of cells sorted and the number of organisms removed were recorded manually on a bench sheet and then recorded into INSTAR1

- Organisms were stored in vials containing 80% ethanol and an interior label indicating the site names, date of sampling, site code numbers and portion subsampled. This information was also recorded on the laboratory bench sheet and on INSTAR1.
- The sorted portion of the debris was preserved and labeled separately from the unsorted portion and was tested for sorting efficiency (Sorting Quality Control – Sorting Efficiency). The unsorted portion was also labeled and preserved in separate jars.

Percent sub-sampled and total countable invertebrates pulled from the samples were summarized in the table below.

Table 2: Percent sub-sample and invertebrate count for each sample

Site	Sample	Date	CC#	500 micron fraction	
				% Sampled	# Invertebrates
CC5.6	CC5.6-1	24-Aug-19	CC200540	100%	300
CC5.6	CC5.6-2	24-Aug-19	CC200541	100%	125
CC5.6	CC5.6-3	24-Aug-19	CC200542	75%	315
CC5.6	CC5.6-4	24-Aug-19	CC200543	100%	104
CC5.6	CC5.6-5	24-Aug-19	CC200544	100%	86
XE0.2	XE0.2-1	24-Aug-19	CC200545	100%	392
XE0.2	XE0.2-2	24-Aug-19	CC200546	50%	345
XE0.2	XE0.2-3	24-Aug-19	CC200547	75%	351
XE0.2	XE0.2-4	19-Aug-19	CC200548	31.25%	344
XE0.2	XE0.2-5	19-Aug-19	CC200549	37%	319
HC0.2	HC0.2-1	20-Aug-19	CC200550	100%	287
HC0.2	HC0.2-2	20-Aug-19	CC200551	100%	363
HC0.2	HC0.2-3	20-Aug-19	CC200552	75%	324
HC0.2	HC0.2-4	20-Aug-19	CC200553	50%	371
HC0.2	HC0.2-5	20-Aug-19	CC200554	100%	342
HC6.8	HC6.8-1	20-Aug-19	CC200555	50%	318
HC6.8	HC6.8-2	20-Aug-19	CC200556	62.5%	320
HC6.8	HC6.8-3	20-Aug-19	CC200557	100%	298
HC6.8	HC6.8-4	20-Aug-19	CC200558	100%	257
HC6.8	HC6.8-5	20-Aug-19	CC200559	100%	159
YT0.2	YT0.2-1	21-Aug-19	CC200560	100%	266
YT0.2	YT0.2-2	21-Aug-19	CC200561	100%	277
YT0.2	YT0.2-3	21-Aug-19	CC200562	100%	226
YT0.2	YT0.2-4	21-Aug-19	CC200563	100%	215
YT0.2	YT0.2-5	21-Aug-19	CC200564	100%	277
CR24.5	CR24.5-1	21-Aug-19	CC200565	50%	332
CR24.5	CR24.5-2	21-Aug-19	CC200566	100%	374
CR24.5	CR24.5-3	21-Aug-19	CC200567	100%	183
CR24.5	CR24.5-4	21-Aug-19	CC200568	50%	309
CR24.5	CR24.5-5	21-Aug-19	CC200569	75%	340

LC10.2	LC10.2-1	22-Aug-19	CC200570	100%	327
LC10.2	LC10.2-2	22-Aug-19	CC200571	100%	271
LC10.2	LC10.2-3	22-Aug-19	CC200572	100%	205
LC10.2	LC10.2-4	22-Aug-19	CC200573	100%	247
LC10.2	LC10.2-5	22-Aug-19	CC200574	100%	193
CC23.7	CC23.7-1	23-Aug-19	CC200575	50%	372
CC23.7	CC23.7-2	23-Aug-19	CC200576	62.5%	335
CC23.7	CC23.7-3	23-Aug-19	CC200577	56.25%	322
CC23.7	CC23.7-4	23-Aug-19	CC200578	100%	344
CC23.7	CC23.7-5	23-Aug-19	CC200579	100%	384
SYT0.6	SYT0.6-1	23-Aug-19	CC200580	50%	313
SYT0.6	SYT0.6-2	23-Aug-19	CC200581	50%	342
SYT0.6	SYT0.6-3	23-Aug-19	CC200582	50%	327
SYT0.6	SYT0.6-4	23-Aug-19	CC200583	50%	320
SYT0.6	SYT0.6-5	23-Aug-19	CC200584	75%	335
YT4.3	YT4.3-1	22-Aug-19	CC200585	75%	346
YT4.3	YT4.3-2	22-Aug-19	CC200586	100%	255
YT4.3	YT4.3-3	22-Aug-19	CC200587	50%	313
YT4.3	YT4.3-4	22-Aug-19	CC200588	100%	274
YT4.3	YT4.3-5	22-Aug-19	CC200589	62.5%	350

Sorting Quality Control - Sorting Efficiency

As a part of Cordillera's laboratory policy, all projects undergo sorting efficiency checks.

- As sorting progresses, 10% of samples were randomly chosen by senior members of the sorting team for resorting.
- All sorters working on a project had at least 1 sample resorted by another sorter.
- An efficiency of 90 % was expected (95% for CABIN samples).
- If 90/95% efficiency was not met, samples from that sorter were resorted.
- To calculated sorting efficiency the following formula was used:

$$\frac{\#OrganismsMissed}{TotalOrganismsFound} * 100 = \%OM$$

Table 3 Summary of sorting efficiency

				Total from Sample	**Percent Efficiency**

Site - QC, Sample - QC1, CC# - CC200541, Percent sampled = 100%, Sieve size = 500					
Chironomidae		1			
Ephemerellidae		4			
Total:		**5**		**125**	**96%**
Site - QC, Sample - QC2, CC# - CC200545, Percent sampled = 100%, Sieve size = 500					
Chironomidae		4			
Ephemeroptera		1			
Total:		**5**		**392**	**99%**
Site - QC, Sample - QC3, CC# - CC200562, Percent sampled = 100%, Sieve size = 500					
Plecoptera		2			
Total:		**2**		**226**	**99%**
Site - QC, Sample - QC4, CC# - CC200583, Percent sampled = 50%, Sieve size = 500					
No Invertebrates Found		0			
Total:		**0**		**320**	**100%**
Site - QC, Sample - QC5, CC# - CC200586, Percent sampled = 100%, Sieve size = 500					
Chironomidae		2			
Plecoptera		1			
Total:		**3**		**255**	**99%**

Taxonomic Effort

The next procedure was the identification to genus-species level where possible of all the organisms in the sample.

- Identifications were made at the genus/species level for all insect organisms found including Chironomidae (Based on CABIN protocol).
- Non-insect organisms (except those not included in CABIN count) were identified to genus/species where possible and to a minimum of family level with intact and mature specimens.

- The Standard Taxonomic Effort lists compiled by the CABIN manual[1], SAFIT[2] , and PNAMP[3] were used as a guide line for what level of identification to achieve where the condition and maturity of the organism enabled.
- Organisms from the same families/order were kept in separate vials with 80% ethanol and an interior label of printed laser paper.
- Chironomidae was identified to genus/species level where possible and was aided by slide mounts. CMC-10 was used to clear and mount the slide.
- Oligochaetes was identified to family/genus level with the aid of slide mounts. CMC-10 was used to clear and mount the slide.
- Other Annelida (leeches, polychaetes) were identified to the family/genus/species level with undamaged, mature specimens.
- Mollusca was identified to family and genus/species where possible
- Decapoda, Amphipoda and Isopoda were identified at family/genus/species level where possible.
- Bryozoans and Nemata remained at the phylum level
- Hydrachnidae and Cnidaria were identified at the family/genus level where possible.
- When requested, reference collections were made containing at least one individual from each taxa listed. Organisms represented will have been identified to the lowest practical level.
- Reference collection specimens were stored in 55 mm glass vials with screw-cap lids with polyseal inserts (museum quality). They were labeled with taxa name, site code, date identified and taxonomist name. The same information was applied to labels on the slide mounts.

Taxonomists

The taxonomists for this project were certified by the Society of Freshwater Science (SFS) Taxonomic Certification Program at level 2 which is the required certification for CABIN projects:

Scott Finlayson: Group 1 General Arthropods (East/West); Group 2 EPT (East/West); Group 3 Chironomidae (East/West); Group 4 Oligochaeta

Adam Bliss: Group 1 General Arthropods (East/West); Group 2 EPT (East/West); Group 3 Chironomidae

Rita Avery: Group 1 General Arthropods (East/West); Group 2 EPT (East/West)

References

[1] McDermott, H., Paull, T., Strachan, S. (May 2014). Laboratory Methods: Processing, Taxonomy, and Quality Control of Benthic Macroinvertebrate Samples, Environment Canada. ISBN: 978-1-100-25417-3

[2] Southwest Association of Freshwater Invertebrate Taxonomists. (2015). www.safit.org

[3] Pacific Northwest Aquatic Monitoring Partnership (Accessed 2015). www.pnamp.org

Taxonomic Keys

Below is a reference list of taxonomic keys utilized by taxonomists at Cordillera Consulting. Cordillera taxonomists routinely seek out new literature to ensure the most accurate identification keys are being utilized. This is not reflective of the exhaustive list of resources that we use for identification. A more complete list of taxonomic resources can be found at Southwest Association of Freshwater Invertebrate Taxonomists. (2015).
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2021

BENTHIC INVERTEBRATE TISSUE CHEMISTRY

2018

Environmental Analytical Laboratories
143-111 Research Drive
Saskatoon, SK S7N 3R2
306-933-6932 1-800-240-8808

Group #	Sample #	Description	Sample Type	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese
				ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g
2018-13225	43307	8/24/2018 HF6.3 1	TISSUE	5600	0.58	6.8	64	0.17	<5	0.26	9.4	2.4	19	5100	2.0	300
2018-13225	43308	8/24/2018 HF6.3 2	TISSUE	3800	0.4	4.7	50	0.13	<50	0.25	9	<5	8	3700	1.3	540
2018-13225	43309	8/24/2018 HF6.3 3	TISSUE	4600	0.5	7.0	49	0.14	<50	0.31	8	<5	13	5000	1.6	340
2018-13225	43310	8/24/2018 HF6.3 4	TISSUE	2700	0.3	4.3	48	0.11	<50	0.41	<5	<5	13	2600	0.9	450
2018-13225	43311	8/24/2018 HF6.3 5	TISSUE	5800	0.57	7.6	70	0.20	<5	0.33	9.8	3.6	15	5600	2.2	470
2018-13225	43312	8/28/2018 YT4.6 1	TISSUE	2300	0.2	2.8	80	0.08	<50	0.26	<5	<5	11	2200	0.9	78
2018-13225	43313	8/28/2018 YT4.6 2	TISSUE	2100	0.3	5.9	30	0.07	<50	0.23	<5	<5	11	1900	1.0	77
2018-13225	43314	8/28/2018 YT4.6 3	TISSUE	4400	0.44	8.2	87	0.24	<5	0.34	8.6	2.6	13	6400	3.7	290
2018-13225	43315	8/28/2018 YT4.6 4	TISSUE	2500	0.34	3.5	48	0.10	<5	0.25	4.2	1.6	12	2900	1.4	150
2018-13225	43316	8/28/2018 YT4.6 5	TISSUE	2400	0.2	2.8	38	0.08	<50	0.21	<5	<5	13	2400	1.1	71
2018-13225	43322	8/27/2018 CR16.7 1	TISSUE	2000	0.09	1.3	41	0.05	<5	1.1	3.5	1.6	20	2400	0.83	84
2018-13225	43323	8/27/2018 CR16.7 2	TISSUE	2100	0.08	1.3	35	0.05	<5	0.84	3.2	1.5	20	2900	0.78	110
2018-13225	43324	8/27/2018 CR16.7 3	TISSUE	2600	0.12	3.3	40	0.08	<5	1.4	4.4	1.8	24	3200	1.1	80
2018-13225	43325	8/27/2018 CR16.7 4	TISSUE	2900	0.09	1.1	40	0.06	<5	0.56	4.0	1.9	18	3300	1.0	100
2018-13225	43326	8/27/2018 CR16.7 5	TISSUE	2100	0.07	1.1	36	0.05	<5	0.67	3.8	1.7	19	2500	0.95	100
2018-13225	43327	8/26/2018 CF19.2 1	TISSUE	2600	0.24	5.9	48	0.09	<5	1.9	3.5	1.4	22	2600	1.0	69
2018-13225	43328	8/26/2018 CF19.2 2	TISSUE	3900	0.45	12	76	0.15	<5	2.3	5.8	2.5	22	4600	1.9	150
2018-13225	43329	8/26/2018 CF19.2 3	TISSUE	2900	0.29	8.2	71	0.10	<5	1.6	4.5	1.8	17	3300	1.3	110
2018-13225	43330	8/26/2018 CF19.2 4	TISSUE	1600	0.15	4.5	30	0.05	<5	1.6	2.1	1.0	20	1600	0.63	56
2018-13225	43331	8/26/2018 CF19.2 5	TISSUE	2000	0.4	5.4	38	0.07	<50	1.4	<5	<5	19	2900	1.0	79
2018-13225	43332	8/30/2018 HF0.2 1	TISSUE	910	0.07	1.8	18	0.04	<5	0.17	1.7	0.8	13	940	0.34	74
2018-13225	43333	8/30/2018 HF0.2 2	TISSUE	1200	0.08	1.2	50	0.04	2	0.29	2.0	0.89	14	1100	0.44	120
2018-13225	43334	8/30/2018 HF0.2 3	TISSUE	2000	0.12	2.4	28	0.07	<5	0.49	3.1	1.2	17	1900	0.74	110
2018-13225	43335	8/30/2018 HF0.2 4	TISSUE	2100	0.12	2.3	28	0.07	<5	0.55	3.1	1.3	18	2000	0.91	140
2018-13225	43336	8/30/2018 HF0.2 5	TISSUE	1300	0.09	2.0	23	0.04	<5	0.54	2.2	0.8	18	1300	0.57	91
2018-13225	43337	8/29/2018 YT0.2 1	TISSUE	4300	0.17	2.8	49	0.12	<5	0.84	5.1	2.4	17	4600	1.7	160
2018-13225	43338	8/29/2018 YT0.2 2	TISSUE	4500	0.4	3.0	67	0.15	<50	0.82	8	<5	16	4600	2.2	210
2018-13225	43339	8/29/2018 YT0.2 3	TISSUE	2500	0.12	1.8	38	0.08	<5	0.45	3.3	1.3	14	2300	0.98	130
2018-13225	43340	8/29/2018 YT0.2 4	TISSUE	3100	0.15	1.7	44	0.09	<5	0.56	4.1	1.4	16	2800	1.4	110
2018-13225	43341	8/29/2018 YT0.2 5	TISSUE	3700	0.2	8.8	49	0.12	<50	0.59	<5	<5	24	3400	3.4	130
2018-13225	43342	8/25/2018 CF3.9 1	TISSUE	4900	0.2	2.9	72	0.11	<50	2.0	5	<5	22	4200	2.0	350
2018-13225	43343	8/25/2018 CF3.9 2	TISSUE	3800	0.1	3.5	110	0.12	<50	3.9	6	<5	26	3700	1.6	320
2018-13225	43344	8/25/2018 CF3.9 3	TISSUE	5500	0.25	4.2	89	0.14	<5	2.4	7.8	4.6	22	5900	2.5	420
2018-13225	43345	8/25/2018 CF3.9 4	TISSUE	1600	0.08	1.4	30	0.04	<5	1.3	2.0	1.4	29	1700	0.58	120
2018-13225	43346	8/25/2018 CF3.9 5	TISSUE	5900	0.2	4.5	200	0.15	<50	2.6	6	6	28	5400	2.4	670
2018-13225	43347	8/30/2018 SYTO0.6 1	TISSUE	2300	0.06	1.4	43	0.06	<5	0.38	4.5	1.2	18	2500	0.79	89
2018-13225	43348	8/30/2018 SYTO0.6 2	TISSUE	2400	0.07	1.6	40	0.07	<2	0.36	3.9	1.1	18	2600	0.86	82
2018-13225	43349	8/30/2018 SYTO0.6 3	TISSUE	2500	0.07	1.7	45	0.07	<2	0.43	4.6	1.2	19	2800	0.90	100
2018-13225	43350	8/30/2018 SYTO0.6 4	TISSUE	2100	0.07	1.5	37	0.06	<5	0.41	3.6	1.1	19	2300	0.68	89
2018-13225	43351	8/30/2018 SYTO0.6 5	TISSUE	2300	0.06	1.6	42	0.07	<2	0.34	4.3	1.2	17	2600	0.88	88
2018-13225	43352	8/31/2018 XE0.2 1	TISSUE	810	0.05	1.2	15	0.02	<5	2.4	1.5	1.1	27	780	0.41	98
2018-13225	43353	8/31/2018 XE0.2 2	TISSUE	3200	0.10	1.6	41	0.10	<5	1.3	7.0	2.6	22	3400	1.1	160
2018-13225	43354	8/31/2018 XE0.2 3	TISSUE	2200	0.08	1.4	35	0.07	<5	1.9	3.9	1.6	32	2100	0.90	150
2018-13225	43355	8/31/2018 XE0.2 4	TISSUE	3100	0.1	2.4	55	0.15	<50	3.7	6	<5	31	3600	1.8	170
2018-13225	43356	8/31/2018 XE0.2 5	TISSUE	4100	0.11	2.5	61	0.14	<5	2.8	8.0	2.3	32	4200	1.8	170

Note for Group 18-13225 results are reported on a dry basis.
Variability in detection limits due to sample size.

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Group #	Sample #	Description	Sample Type	Mercury	Molybdenum	Nickel	Selenium	Silver	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Moisture
				ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	%
2018-13225	43307	8/24/2018 HF6.3 1	TISSUE	0.30	0.89	5.3	4.0	0.07	33	0.07	0.2	290	7.5	12	140	72.05
2018-13225	43308	8/24/2018 HF6.3 2	TISSUE	0.74	<0.5	<5	3.8	0.06	19	<0.1	<2	260	5.6	9	90	38.24
2018-13225	43309	8/24/2018 HF6.3 3	TISSUE	0.48	0.7	6	3.9	0.06	21	<0.1	<2	320	5.5	10	100	47.20
2018-13225	43310	8/24/2018 HF6.3 4	TISSUE	0.32	1.7	<5	2.5	0.03	23	<0.1	<2	110	22	6	90	70.86
2018-13225	43311	8/24/2018 HF6.3 5	TISSUE	0.39	0.73	5.6	3.7	0.06	36	0.09	<0.2	310	11	13	120	69.43
2018-13225	43312	8/28/2018 YT4.6 1	TISSUE	0.09	0.6	<5	0.6	0.04	9	<0.1	<2	140	0.5	6	100	64.04
2018-13225	43313	8/28/2018 YT4.6 2	TISSUE	0.11	0.6	<5	1.2	0.04	8	<0.1	<2	100	0.5	5	100	85.36
2018-13225	43314	8/28/2018 YT4.6 3	TISSUE	0.08	0.60	5.2	0.49	0.05	24	0.06	<0.2	190	2.1	15	88	84.12
2018-13225	43315	8/28/2018 YT4.6 4	TISSUE	0.06	0.56	2.4	0.40	0.04	14	0.04	<0.2	140	0.81	6.6	95	77.15
2018-13225	43316	8/28/2018 YT4.6 5	TISSUE	0.09	0.5	<5	0.9	0.04	11	<0.1	<2	130	0.6	6	120	79.80
2018-13225	43322	8/27/2018 CR16.7 1	TISSUE	0.05	0.62	2.5	1.6	0.04	14	0.04	<0.2	130	0.44	6.4	140	91.97
2018-13225	43323	8/27/2018 CR16.7 2	TISSUE	0.06	0.65	2.6	1.5	0.03	13	0.04	<0.2	140	0.40	6.2	140	91.44
2018-13225	43324	8/27/2018 CR16.7 3	TISSUE	0.05	0.76	3.3	2.0	0.04	14	0.05	<0.2	180	0.56	8.9	140	90.27
2018-13225	43325	8/27/2018 CR16.7 4	TISSUE	0.04	0.58	2.8	0.96	0.02	15	0.04	<0.2	170	0.41	9.6	130	79.30
2018-13225	43326	8/27/2018 CR16.7 5	TISSUE	0.04	0.63	2.8	1.0	0.02	14	0.04	<0.2	140	0.33	7.1	140	83.89
2018-13225	43327	8/26/2018 CF19.2 1	TISSUE	0.09	0.86	2.8	3.7	0.08	15	0.06	<0.2	160	2.2	6.6	140	88.67
2018-13225	43328	8/26/2018 CF19.2 2	TISSUE	0.13	0.92	5.2	4.8	0.10	22	0.11	<0.2	230	5.7	11	140	97.17
2018-13225	43329	8/26/2018 CF19.2 3	TISSUE	0.10	0.75	3.6	3.1	0.08	22	0.06	<0.2	180	4.7	8.3	140	75.21
2018-13225	43330	8/26/2018 CF19.2 4	TISSUE	0.07	0.78	1.8	3.6	0.07	10	0.04	<0.2	83	2.0	3.8	130	89.60
2018-13225	43331	8/26/2018 CF19.2 5	TISSUE	0.13	0.8	<5	2.9	0.06	12	<0.1	<2	110	2.5	5	140	84.57
2018-13225	43332	8/30/2018 HF0.2 1	TISSUE	0.04	1.9	2.0	0.47	<0.02	12	0.03	<0.2	50	7.0	2.3	73	84.01
2018-13225	43333	8/30/2018 HF0.2 2	TISSUE	0.04	0.72	2.0	0.81	<0.02	15	0.02	<0.1	87	4.5	3.0	160	86.87
2018-13225	43334	8/30/2018 HF0.2 3	TISSUE	0.08	0.75	2.2	1.2	0.02	21	0.03	<0.2	160	3.6	5.2	120	87.75
2018-13225	43335	8/30/2018 HF0.2 4	TISSUE	0.08	0.76	2.4	1.5	0.02	21	0.04	<0.2	120	3.6	5.2	130	90.64
2018-13225	43336	8/30/2018 HF0.2 5	TISSUE	0.07	0.75	1.8	1.3	0.02	20	0.02	<0.2	91	3.3	3.3	120	91.05
2018-13225	43337	8/29/2018 YT0.2 1	TISSUE	0.11	0.64	3.3	1.8	0.04	31	0.04	<0.2	420	1.7	11	100	88.96
2018-13225	43338	8/29/2018 YT0.2 2	TISSUE	0.04	0.7	<5	1.6	0.04	27	<0.1	<2	350	2.4	11	110	83.71
2018-13225	43339	8/29/2018 YT0.2 3	TISSUE	0.05	0.62	2.2	0.98	0.03	16	0.03	<0.2	180	1.6	6.2	120	69.13
2018-13225	43340	8/29/2018 YT0.2 4	TISSUE	0.05	0.61	2.5	1.0	0.02	20	0.04	<0.2	220	1.8	7.4	120	89.48
2018-13225	43341	8/29/2018 YT0.2 5	TISSUE	0.06	0.8	<5	1.2	0.03	20	<0.1	<2	280	2.0	8	120	86.22
2018-13225	43342	8/25/2018 CF3.9 1	TISSUE	0.16	1.0	<5	6.6	0.09	28	<0.1	<2	260	1.7	14	160	65.99
2018-13225	43343	8/25/2018 CF3.9 2	TISSUE	0.19	1.2	<5	9.0	0.08	26	<0.1	<2	280	4.5	12	180	16.67
2018-13225	43344	8/25/2018 CF3.9 3	TISSUE	0.14	1.1	6.2	6.0	0.07	30	0.12	<0.2	350	3.0	16	140	45.16
2018-13225	43345	8/25/2018 CF3.9 4	TISSUE	0.15	0.84	1.6	4.2	0.07	20	0.03	<0.2	91	1.3	4.8	160	79.47
2018-13225	43346	8/25/2018 CF3.9 5	TISSUE	0.15	1.6	6	6.4	0.07	33	0.1	<2	400	2.7	18	270	76.82
2018-13225	43347	8/30/2018 SYTO0.6 1	TISSUE	0.07	0.52	2.8	1.1	0.02	23	0.03	<0.2	180	4.5	7.0	120	93.67
2018-13225	43348	8/30/2018 SYTO0.6 2	TISSUE	0.06	0.50	2.6	1.1	0.03	23	0.03	0.1	170	3.8	6.5	130	92.01
2018-13225	43349	8/30/2018 SYTO0.6 3	TISSUE	0.07	0.49	3.0	1.4	0.03	21	0.03	0.1	200	4.5	7.6	120	91.12
2018-13225	43350	8/30/2018 SYTO0.6 4	TISSUE	0.07	0.50	2.5	1.3	0.02	19	0.03	<0.2	150	4.1	6.0	130	92.06
2018-13225	43351	8/30/2018 SYTO0.6 5	TISSUE	0.07	0.51	2.7	1.0	0.02	19	0.03	<0.1	190	3.2	7.4	120	82.64
2018-13225	43352	8/31/2018 XE0.2 1	TISSUE	0.04	2.4	5.3	6.7	0.02	23	0.04	<0.2	56	0.43	2.0	140	96.14
2018-13225	43353	8/31/2018 XE0.2 2	TISSUE	0.05	0.72	7.4	3.2	0.03	33	0.05	<0.2	160	1.3	8.3	120	89.90
2018-13225	43354	8/31/2018 XE0.2 3	TISSUE	0.06	0.62	5.9	5.7	0.04	28	0.05	<0.2	160	0.70	5.6	150	94.19
2018-13225	43355	8/31/2018 XE0.2 4	TISSUE	0.07	0.6	7	6.0	0.04	46	<0.1	<2	200	0.8	9	190	95.69
2018-13225	43356	8/31/2018 XE0.2 5	TISSUE	0.07	0.64	7.5	4.7	0.07	44	0.08	<0.2	270	0.88	11	180	89.65

Note for Group 18-13225 results are reported on a dry basis.
Variability in detection limits due to sample size.

2019

Environmental Analytical Laboratories
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306-933-6932 1-800-240-8808

Group #	Sample #	Description	Sample Type	Aluminum	Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Iron	Lead	Manganese
				ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g
2019-12247	49231	8/24/2019 16:30 CC5.6-1	TISSUE	1600	0.05	2.2	23	0.04	<1	0.83	2.3	1.2	14	2300	0.63	111
2019-12247	49232	8/24/2019 14:50 CC5.6-2	TISSUE	1200	0.06	1.9	27	0.04	<1	0.49	1.6	1.7	16	1900	0.60	273
2019-12247	49233	8/24/2019 12:30 CC5.6-3	TISSUE	3000	0.11	3.4	37	0.07	<1	1.0	4.1	2.1	13	3900	1.3	202
2019-12247	49234	8/24/2019 10:00 CC5.6-4	TISSUE	2400	0.10	3.5	60	0.08	<2	1.1	3.5	1.9	18	3500	1.1	160
2019-12247	49235	8/24/2019 07:45 CC5.6-5	TISSUE	3000	0.11	3.2	44	0.08	<1	0.98	4.3	2.1	18	4400	1.2	174
2019-12247	49236	8/23/2019 15:40 CC23.7-1	TISSUE	2700	0.20	6.4	39	0.08	1	2.3	3.6	1.3	16	2500	1.0	71
2019-12247	49237	8/23/2019 14:00 CC23.7-2	TISSUE	3200	0.27	14.7	50	0.12	2	1.7	5.0	2.2	16	4100	1.6	136
2019-12247	49238	8/23/2019 12:45 CC23.7-3	TISSUE	2200	0.14	6.8	33	0.07	2	1.7	3.3	1.2	15	2400	1.0	72
2019-12247	49239	8/23/2019 10:30 CC23.7-4	TISSUE	2500	0.16	7.6	38	0.07	1	1.7	3.9	1.2	14	2800	1.4	71
2019-12247	49240	8/23/2019 08:00 CC23.7-5	TISSUE	2600	0.17	7.2	42	0.06	1	2.7	3.9	1.2	16	2500	1.0	68
2019-12247	49241	8/21/2019 16:00 CR24.5-1	TISSUE	2800	0.14	2.0	38	0.06	1	1.2	5.7	1.8	18	3300	1.2	80
2019-12247	49242	8/21/2019 14:15 CR24.5-2	TISSUE	2200	0.16	2.0	33	0.04	<2	1.8	4.4	1.5	20	2700	1.0	63
2019-12247	49243	8/21/2019 12:30 CR24.5-3	TISSUE	1900	0.14	1.8	25	0.04	<2	1.6	3.5	1.4	20	2500	0.91	60
2019-12247	49244	8/21/2019 10:50 CR24.5-4	TISSUE	2100	0.14	1.8	33	0.04	1	1.6	6.1	1.5	18	2600	1.1	60
2019-12247	49245	8/21/2019 08:10 CR24.5-5	TISSUE	3000	0.23	2.5	40	0.06	2	1.6	6.4	1.9	20	3900	1.7	74
2019-12247	49246	8/20/2019 15:15 HC0.2-1	TISSUE	2000	0.12	3.3	25	0.05	<2	1.0	4.2	1.2	18	2200	0.88	79
2019-12247	49247	8/20/2019 13:00 HC0.2-2	TISSUE	1600	0.11	2.9	28	0.05	<2	0.84	3.1	1.2	18	2000	0.81	110
2019-12247	49248	8/20/2019 12:00 HC0.2-3	TISSUE	1900	0.11	3.0	23	0.05	<2	0.85	3.8	1.3	18	2300	0.78	110
2019-12247	49249	8/20/2019 09:35 HC0.2-4	TISSUE	1700	0.12	3.0	25	0.05	<2	0.96	3.3	1.3	20	1900	0.81	150
2019-12247	49250	8/20/2019 08:25 HC0.2-5	TISSUE	2100	0.14	3.4	28	0.07	<2	0.94	4.7	1.4	19	2100	1.1	140
2019-12247	49251	8/20/2019 09:10 HC6.8-1	TISSUE	2900	0.21	4.6	31	0.07	<1	1.9	5.5	1.9	14	2800	1.2	139
2019-12247	49252	8/20/2019 10:55 HC6.8-2	TISSUE	4300	0.33	8.9	72	0.17	<2	1.8	9.5	4.2	14	5400	2.1	440
2019-12247	49253	8/20/2019 12:30 HC6.8-3	TISSUE	4400	0.27	5.0	54	0.12	<5	1.3	8.4	2.4	15	4200	1.6	170
2019-12247	49254	8/20/2019 14:20 HC6.8-4	TISSUE	2600	0.18	3.5	32	0.08	<2	1.2	4.5	1.6	13	2400	0.88	110
2019-12247	49255	8/20/2019 16:00 HC6.8-5	TISSUE	3200	0.19	3.5	33	0.08	<2	1.8	6.0	1.7	13	3000	1.2	94
2019-12247	49256	8/22/2019 16:00 LC10.2-1	TISSUE	6800	0.55	6.2	74	0.21	<2	1.1	9.2	2.5	15	7000	3.9	230
2019-12247	49257	8/22/2019 14:25 LC10.2-2	TISSUE	6800	0.27	22	86	0.21	<2	1.3	8.9	3.0	17	7800	3.4	420
2019-12247	49258	8/22/2019 12:25 LC10.2-3	TISSUE	3300	0.15	13.4	31	0.11	<1	1.4	4.2	1.7	17	3800	1.8	211
2019-12247	49259	8/22/2019 10:45 LC10.2-4	TISSUE	3600	0.17	3.4	33	0.12	<2	1.3	5.5	1.6	19	3800	1.8	170
2019-12247	49260	8/22/2019 08:30 LC10.2-5	TISSUE	2500	0.18	3.4	30	0.07	17	1.8	4.9	1.6	22	2800	1.8	112
2019-12247	49261	8/23/2019 15:10 SYT0.6-1	TISSUE	1600	0.04	1.2	25	0.05	<1	0.32	2.8	0.83	16	1900	0.62	66
2019-12247	49262	8/23/2019 13:30 SYT0.6-2	TISSUE	1700	0.04	1.2	24	0.05	<1	0.28	3.1	0.83	14	1900	0.66	61
2019-12247	49263	8/23/2019 11:45 SYT0.6-3	TISSUE	1600	0.04	1.2	21	0.04	<1	0.29	2.6	0.75	14	1800	0.58	55
2019-12247	49264	8/23/2019 09:50 SYT0.6-4	TISSUE	1300	0.04	1.2	21	0.04	<1	0.29	2.2	0.78	16	1600	0.64	81
2019-12247	49265	8/21/2019 17:00 SYT0.6-5	TISSUE	1500	0.04	0.98	22	0.05	<1	0.24	2.5	0.91	12	1800	0.65	64
2019-12247	49266	8/24/2019 14:30 XE0.2-1	TISSUE	1400	0.04	1.0	22	0.06	<1	0.55	3.0	0.93	17	1900	0.72	116
2019-12247	49267	8/24/2019 11:30 XE0.2-2	TISSUE	1100	0.03	1.0	15	0.05	<1	0.92	2.5	0.88	18	1500	0.59	87
2019-12247	49268	8/24/2019 10:00 XE0.2-3	TISSUE	1000	0.04	0.94	19	0.05	<1	1.1	2.0	0.82	21	1200	0.53	95
2019-12247	49269	8/19/2019 16:45 XE0.2-4	TISSUE	2700	0.09	2.1	95	0.18	<2	2.0	8.9	2.4	22	4800	1.4	180
2019-12247	49270	8/19/2019 14:00 XE0.2-5	TISSUE	1400	0.07	1.0	24	0.05	<2	1.5	4.8	1.1	21	1900	0.59	100
2019-12247	49271	8/21/2019 14:30 YT0.2-1	TISSUE	2200	0.12	2.8	31	0.07	<2	0.77	3.4	1.2	17	2600	1.5	83
2019-12247	49272	8/21/2019 13:00 YT0.2-2	TISSUE	2500	0.16	3.2	34	0.09	<2	0.73	4.5	1.3	16	3000	1.2	89
2019-12247	49273	8/21/2019 11:00 YT0.2-3	TISSUE	2400	0.12	2.1	31	0.07	<2	0.69	3.5	1.2	16	2600	1.0	79
2019-12247	49274	8/21/2019 09:00 YT0.2-4	TISSUE	2100	0.22	3.3	31	0.08	<2	0.55	3.5	1.2	16	2600	1.2	110
2019-12247	49275	8/20/2019 16:20 YT0.2-5	TISSUE	2700	<0.1	2.3	33	0.05	<50	0.61	<5	<5	14	2800	<0.5	90
2019-12247	49276	8/22/2019 16:00 YT4.3-1	TISSUE	1600	0.15	2.0	27	0.06	<1	0.28	2.4	0.72	11	1800	0.72	55
2019-12247	49277	8/22/2019 13:45 YT4.3-2	TISSUE	1800	0.19	2.9	29	0.08	<2	0.23	2.6	1.1	9.3	2200	3.0	91
2019-12247	49278	8/22/2019 11:15 YT4.3-3	TISSUE	1700	0.19	3.1	27	0.07	<1	0.35	2.3	0.93	14	2100	0.99	71
2019-12247	49279	8/22/2019 10:00 YT4.3-4	TISSUE	1600	0.16	2.7	25	0.05	<2	0.47	2.5	0.82	15	1900	0.85	54
2019-12247	49280	8/22/2019 09:00 YT4.3-5	TISSUE	1400	0.17	2.2	22	0.05	<2	0.57	1.9	0.70	16	1500	0.70	51

Note for Group 19-12247 results are reported on a dry basis.
Variability in detection limits due to sample size. There was no sample remaining to perform rechecks due to limited sample weight submitted to the laboratory.

Environmental Analytical Laboratories
143-111 Research Drive
Saskatoon, SK S7N 3R2
306-933-6932 1-800-240-8808

Group #	Sample #	Description	Sample Type	Mercury	Molybdenum	Nickel	Selenium	Silver	Strontium	Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Moisture
				ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	ug/g	%
2019-12247	49231	8/24/2019 16:30 CC5.6-1	TISSUE	0.14	1.1	1.9	4.8	0.06	9.6	0.034	0.05	100	1.7	5.0	75	79.82
2019-12247	49232	8/24/2019 14:50 CC5.6-2	TISSUE	0.092	1.3	1.9	2.3	0.04	11	0.043	<0.05	49	4.0	3.6	78	81.89
2019-12247	49233	8/24/2019 12:30 CC5.6-3	TISSUE	0.16	0.95	3.0	5.8	0.08	13	0.047	0.08	160	2.4	8.3	95	75.15
2019-12247	49234	8/24/2019 10:00 CC5.6-4	TISSUE	0.20	2.0	3.1	6.1	0.12	17	0.07	0.1	180	3.7	8.4	120	76.83
2019-12247	49235	8/24/2019 07:45 CC5.6-5	TISSUE	0.15	1.7	3.6	4.4	0.08	16	0.065	0.09	210	5.3	9.5	100	80.53
2019-12247	49236	8/23/2019 15:40 CC23.7-1	TISSUE	0.095	0.73	3.4	4.3	0.12	12	0.062	0.10	150	7.2	6.7	110	85.44
2019-12247	49237	8/23/2019 14:00 CC23.7-2	TISSUE	0.10	0.99	6.5	3.1	0.18	16	0.078	0.08	160	10.8	10	92	83.43
2019-12247	49238	8/23/2019 12:45 CC23.7-3	TISSUE	0.090	0.83	3.4	2.7	0.08	9.6	0.057	0.08	130	8.2	5.3	98	83.21
2019-12247	49239	8/23/2019 10:30 CC23.7-4	TISSUE	0.098	0.80	3.2	3.2	0.13	9.7	0.061	0.10	150	5.5	6.1	93	78.91
2019-12247	49240	8/23/2019 08:00 CC23.7-5	TISSUE	0.11	0.65	3.2	4.1	0.12	12	0.060	0.12	170	3.7	6.4	120	81.72
2019-12247	49241	8/21/2019 16:00 CR24.5-1	TISSUE	0.054	0.73	3.6	2.8	0.07	12	0.059	0.09	160	0.45	8.4	110	88.05
2019-12247	49242	8/21/2019 14:15 CR24.5-2	TISSUE	0.06	0.85	3.2	4.1	0.10	11	0.06	<0.1	170	0.36	7.4	110	87.99
2019-12247	49243	8/21/2019 12:30 CR24.5-3	TISSUE	0.06	0.60	2.4	3.6	0.11	12	0.05	0.1	120	0.29	5.7	120	89.31
2019-12247	49244	8/21/2019 10:50 CR24.5-4	TISSUE	0.065	0.63	3.4	2.9	0.08	11	0.052	0.14	150	0.39	6.7	120	86.23
2019-12247	49245	8/21/2019 08:10 CR24.5-5	TISSUE	0.06	0.64	4.3	3.0	0.09	12	0.07	0.3	240	0.43	9.9	120	88.08
2019-12247	49246	8/20/2019 15:15 HC0.2-1	TISSUE	0.08	0.78	3.1	2.5	0.04	16	0.04	<0.1	150	3.2	5.3	110	88.43
2019-12247	49247	8/20/2019 13:00 HC0.2-2	TISSUE	0.08	0.65	2.7	1.8	0.04	23	0.03	<0.1	120	4.1	4.5	120	89.71
2019-12247	49248	8/20/2019 12:00 HC0.2-3	TISSUE	0.08	0.68	2.9	1.9	0.04	16	0.03	<0.1	140	3.2	5.1	110	89.24
2019-12247	49249	8/20/2019 09:35 HC0.2-4	TISSUE	0.08	0.83	2.9	1.9	0.04	18	0.03	<0.1	130	4.3	4.7	120	90.34
2019-12247	49250	8/20/2019 08:25 HC0.2-5	TISSUE	0.08	0.72	3.2	1.6	0.04	23	0.04	0.1	120	3.6	5.2	130	95.63
2019-12247	49251	8/20/2019 09:10 HC6.8-1	TISSUE	0.15	0.88	3.3	4.5	0.10	18	0.038	0.10	190	5.5	7.0	110	87.51
2019-12247	49252	8/20/2019 10:55 HC6.8-2	TISSUE	0.16	0.82	5.3	4.6	0.16	37	0.08	0.2	260	15.4	11	140	88.21
2019-12247	49253	8/20/2019 12:30 HC6.8-3	TISSUE	0.22	0.68	3.8	3.7	0.11	27	0.06	0.2	360	6.8	11	130	86.00
2019-12247	49254	8/20/2019 14:20 HC6.8-4	TISSUE	0.11	1.2	2.4	3.6	0.08	18	0.04	0.1	170	6.0	6.0	98	85.09
2019-12247	49255	8/20/2019 16:00 HC6.8-5	TISSUE	0.14	0.81	3.0	5.0	0.08	20	0.04	0.1	260	4.0	8.3	110	91.38
2019-12247	49256	8/22/2019 16:00 LC10.2-1	TISSUE	0.22	0.70	4.3	2.3	0.19	32	0.09	0.5	410	3.0	16	120	65.89
2019-12247	49257	8/22/2019 14:25 LC10.2-2	TISSUE	0.22	0.60	4.9	2.6	0.20	36	0.10	0.2	400	3.3	17	140	85.20
2019-12247	49258	8/22/2019 12:25 LC10.2-3	TISSUE	0.21	0.67	2.6	3.4	0.07	16	0.053	0.14	220	1.6	8.9	120	77.18
2019-12247	49259	8/22/2019 10:45 LC10.2-4	TISSUE	0.22	0.63	2.7	3.0	0.07	19	0.06	0.2	260	1.9	9.2	120	82.65
2019-12247	49260	8/22/2019 08:30 LC10.2-5	TISSUE	0.22	0.74	3.3	5.7	0.11	19	0.042	0.25	190	1.9	6.9	140	91.21
2019-12247	49261	8/23/2019 15:10 SYT0.6-1	TISSUE	0.045	0.42	2.1	0.82	0.02	18	0.021	0.07	120	4.5	4.8	99	87.93
2019-12247	49262	8/23/2019 13:30 SYT0.6-2	TISSUE	0.042	0.39	2.1	0.75	0.02	15	0.024	0.07	120	4.2	4.8	89	85.68
2019-12247	49263	8/23/2019 11:45 SYT0.6-3	TISSUE	0.042	0.39	1.8	0.79	0.02	15	0.020	0.07	120	3.1	4.4	89	85.07
2019-12247	49264	8/23/2019 09:50 SYT0.6-4	TISSUE	0.047	0.42	1.8	0.87	0.02	14	0.020	0.08	98	2.9	3.9	94	84.27
2019-12247	49265	8/21/2019 17:00 SYT0.6-5	TISSUE	0.039	0.35	1.7	0.85	0.02	13	0.021	0.08	94	4.3	3.8	93	84.45
2019-12247	49266	8/24/2019 14:30 XE0.2-1	TISSUE	0.056	0.38	4.8	3.1	0.05	20	0.036	0.06	84	0.51	3.8	90	84.42
2019-12247	49267	8/24/2019 11:30 XE0.2-2	TISSUE	0.049	0.41	4.0	3.5	0.04	17	0.032	<0.05	66	0.41	3.0	89	84.72
2019-12247	49268	8/24/2019 10:00 XE0.2-3	TISSUE	0.048	0.41	4.0	4.1	0.05	15	0.034	0.05	60	0.41	2.4	100	85.31
2019-12247	49269	8/19/2019 16:45 XE0.2-4	TISSUE	0.05	0.69	8.9	2.0	0.08	29	0.06	<0.1	170	1.3	8.4	130	84.86
2019-12247	49270	8/19/2019 14:00 XE0.2-5	TISSUE	0.06	0.40	4.0	3.4	0.06	20	0.04	<0.1	110	0.73	3.6	120	85.10
2019-12247	49271	8/21/2019 14:30 YT0.2-1	TISSUE	0.07	0.59	2.2	1.7	0.04	13	0.03	0.1	180	1.3	6.2	97	89.87
2019-12247	49272	8/21/2019 13:00 YT0.2-2	TISSUE	0.07	0.57	2.6	1.7	0.07	14	0.04	0.1	190	1.4	7.0	100	87.20
2019-12247	49273	8/21/2019 11:00 YT0.2-3	TISSUE	0.07	0.54	2.0	1.4	0.04	14	0.03	0.1	180	1.4	5.8	100	89.46
2019-12247	49274	8/21/2019 09:00 YT0.2-4	TISSUE	0.07	0.56	2.2	1.2	0.04	13	0.03	0.1	190	1.2	6.1	92	87.60
2019-12247	49275	8/20/2019 16:20 YT0.2-5	TISSUE	0.10	0.5	<5	1.2	0.07	17	<0.1	<2	210	1.5	6	110	88.95
2019-12247	49276	8/22/2019 16:00 YT4.3-1	TISSUE	0.076	0.46	1.3	1.1	0.05	7.1	0.025	0.08	89	0.45	3.8	86	86.27
2019-12247	49277	8/22/2019 13:45 YT4.3-2	TISSUE	0.07	0.41	1.5	1.3	0.05	7.5	0.03	<0.1	98	0.49	4.7	67	85.77
2019-12247	49278	8/22/2019 11:15 YT4.3-3	TISSUE	0.096	0.55	1.5	1.4	0.06	6.8	0.031	0.09	93	0.49	4.3	87	87.19
2019-12247	49279	8/22/2019 10:00 YT4.3-4	TISSUE	0.09	0.54	1.5	1.5	0.06	6.5	0.03	<0.1	97	0.45	4.2	100	87.56
2019-12247	49280	8/22/2019 09:00 YT4.3-5	TISSUE	0.08	0.56	1.3	1.6	0.05	5.8	0.03	<0.1	79	0.46	3.4	84	88.43

Note for Group 19-12247 results are reported on a dry basis.
Variability in detection limits due to sample size. There was no sample remaining to perform rechecks due to limited sample weight submitted to the laboratory.

2021

		Client ID	HC6.8-1	HC6.8-2	HC6.8-3	HC6.8-4	HC6.8-5	YT4.3-1	YT4.3-2	YT4.3-3	YT4.3-4	YT4.3-5	LC10.2-1	LC10.2-2	LC10.2-3
		Lab ID	204	205	206	207	208	209	210	211	212	213	214	215	216
		Wet Weight (g)	0.4283	0.5912	0.6315	0.5793	0.3382	0.0727	0.0584	0.0517	0.0803	0.0918	0.2437	0.1714	0.1008
		Dry Weight (g)	0.0795	0.1034	0.1071	0.1104	0.0733	0.0100	0.0079	0.0068	0.0103	0.0157	0.0347	0.0278	0.0179
		Moisture (%)	81.4	82.5	83.0	80.9	78.3	86.2	86.5	86.8	87.2	82.9	85.8	83.8	82.2
Parameter	DL (ppm)	LOQ (ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
7Li	0.007	0.023	0.432	0.514	0.819	1.1	0.762	1.5	1.6	2.2	0.486	1.1	0.695	0.491	1.6
11B	0.135	0.450	0.834	1.0	1.3	1.6	0.764	2.2	1.9	2.4	1.7	2.5	0.650	0.932	1.2
23Na	1.3	4.3	4,523	4,242	3,659	3,223	3,844	3,393	3,695	3,068	4,827	3,667	3,097	6,967	2,133
24Mg	0.015	0.050	1,708	1,617	1,614	1,743	3,249	1,703	1,595	2,500	1,375	1,746	2,063	1,536	2,041
27Al	0.033	0.110	2,547	3,029	4,263	5,382	3,709	8,508	7,634	12,803	3,302	11,839	4,045	2,532	8,512
31P	32	107	14,053	12,431	12,270	11,358	11,587	10,638	10,776	10,225	12,316	10,322	12,756	10,463	10,175
39K	2.7	9.0	14,657	13,479	12,095	11,170	11,064	9,640	9,434	8,829	11,080	9,314	10,688	13,581	8,141
44Ca	16	53	3,521	3,706	3,811	4,715	4,420	3,625	3,606	4,278	3,717	4,043	3,736	2,455	3,447
49Ti	0.322	1.1	169	214	355	537	278	759	582	1,502	184	692	430	203	1,026
51V	0.076	0.253	2.9	2.9	4.6	5.5	4.5	14	11	18	6.7	11	4.4	2.8	10
52Cr	0.356	1.2	10	7.6	9.4	19	74	354	118	754	271	396	44	23	153
55Mn	0.007	0.023	273	223	145	121	122	116	149	214	79	181	67	48	130
57Fe	1.1	3.7	1,845	2,217	2,754	3,733	3,102	9,292	7,650	15,994	5,932	11,494	3,348	1,863	7,157
59Co	0.008	0.027	2.0	1.7	1.4	1.9	3.8	14	5.9	11	10	16	2.1	1.6	3.6
60Ni	0.043	0.143	14	10	14	26	114	500	180	1,036	386	577	72	33	218
63Cu	0.025	0.083	25	21	20	19	20	23	17	35	25	20	28	22	27
66Zn	0.347	1.2	149	151	149	142	159	151	154	149	148	178	133	105	120
75As	0.475	1.6	4.3	4.9	5.5	8.1	3.6	4.4	5.4	5.4	2.8	4.5	2.2	2.0	3.1
77Se	0.260	0.867	5.4	3.9	2.6	2.4	4.6	0.531	0.487	0.481	0.578	0.481	4.7	3.8	3.1
88Sr	0.001	0.003	27	32	39	51	44	14	11	16	13	16	20	17	25
95Mo	0.001	0.003	1.3	1.1	0.980	0.960	0.745	2.0	0.999	5.8	1.6	1.1	1.3	0.853	2.1
107Ag	0.001	0.003	0.092	0.111	0.087	0.128	0.150	0.092	0.107	0.095	0.072	0.072	0.059	0.063	0.050
111Cd	0.045	0.150	1.4	0.949	0.626	0.892	1.5	0.285	0.398	0.330	0.310	0.289	1.2	0.682	0.702
118Sn	0.035	0.117	1.3	1.1	0.970	1.1	0.952	3.9	2.9	4.1	2.5	3.0	2.6	1.3	2.4
121Sb	0.004	0.013	0.179	0.183	0.241	0.355	0.213	1.0	0.798	0.873	0.449	0.780	0.105	0.096	0.204
137Ba	0.001	0.003	107	130	169	218	132	192	234	243	103	222	68	54	120
202Hg	0.032	0.107	0.274	0.236	0.261	0.338	0.322	0.185	0.242	0.194	0.163	0.228	0.340	0.303	0.266
205Tl	0.001	0.003	0.022	0.021	0.026	0.035	0.031	0.045	0.050	0.058	0.017	0.086	0.024	0.020	0.044
208Pb	0.001	0.003	0.562	0.549	0.645	1.0	0.753	1.7	2.4	3.8	0.662	2.6	0.849	0.664	1.8
238U	0.001	0.003	7.4	8.0	11	11	4.1	0.641	0.666	0.693	0.512	0.741	1.3	1.5	1.2

Notes:

ppm = parts per million
DL = detection limit
LOQ = limit of quantitation
< = less than detection limit
g = grams
% = percent

		Client ID	LC10.2-4	LC10.2-5	CR24.5-1	CR24.5-2	CR24.5-3	CR24.5-4	CR24.5-5	CC23.7-1	CC23.7-2	CC23.7-3	CC23.7-4	CC23.7-5	HC0.2-1
		Lab ID	217	218	219	220	221	222	223	224	225	226	227	228	229
		Wet Weight (g)	0.0894	0.3087	0.2364	0.5819	0.5462	0.3772	0.8712	0.1134	0.1135	0.0917	0.0929	0.0762	0.3754
		Dry Weight (g)	0.0165	0.0482	0.0419	0.1297	0.0916	0.0577	0.1264	0.0212	0.0187	0.0144	0.0175	0.0137	0.0500
		Moisture (%)	81.5	84.4	82.3	77.7	83.2	84.7	85.5	81.3	83.5	84.3	81.2	82.0	86.7
Parameter	DL (ppm)	LOQ (ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
7Li	0.007	0.023	1.2	1.7	0.849	2.3	1.4	1.2	0.439	0.244	0.789	0.314	1.1	1.0	0.578
11B	0.135	0.450	0.810	1.2	4.3	3.6	3.3	2.8	4.9	0.446	1.1	1.9	1.2	1.9	1.4
23Na	1.3	4.3	2,398	3,375	3,209	6,414	9,436	3,554	4,162	4,311	3,467	3,691	3,474	2,943	5,385
24Mg	0.015	0.050	1,869	2,305	1,924	2,621	2,109	1,722	1,619	3,026	1,358	1,317	1,437	1,457	1,711
27Al	0.033	0.110	6,856	9,434	5,318	12,740	8,192	5,436	2,388	1,074	4,396	2,370	4,409	5,296	2,405
31P	32	107	10,577	12,016	10,004	11,857	10,296	11,155	11,404	12,900	10,402	10,843	10,229	9,692	11,271
39K	2.7	9.0	8,694	11,238	9,371	13,594	15,689	10,757	11,991	10,703	9,194	10,404	9,154	8,229	12,011
44Ca	16	53	3,354	5,685	4,886	8,074	5,535	5,470	5,450	3,466	3,095	3,482	3,899	3,242	4,074
49Ti	0.322	1.1	698	1,075	509	1,003	863	539	261	90	308	173	473	474	236
51V	0.076	0.253	10	12	6.8	20	15	10	4.1	2.3	6.8	3.6	7.4	7.7	3.7
52Cr	0.356	1.2	211	195	75	237	89	89	33	57	243	27	143	126	51
55Mn	0.007	0.023	117	145	79	200	183	101	63	89	98	43	85	93	94
57Fe	1.1	3.7	6,814	8,826	5,104	11,081	7,110	5,704	2,298	1,700	5,846	2,305	4,699	4,857	2,679
59Co	0.008	0.027	8.6	8.4	2.4	10	6.6	5.0	2.1	2.1	9.3	1.2	5.5	4.8	2.6
60Ni	0.043	0.143	289	239	110	315	121	122	46	79	331	41	189	186	78
63Cu	0.025	0.083	27	27	27	28	25	27	26	20	21	20	21	20	20
66Zn	0.347	1.2	115	119	131	128	105	155	121	203	125	120	147	128	81
75As	0.475	1.6	3.0	3.9	1.4	2.5	3.0	2.2	1.1	2.3	7.8	3.6	14	7.2	3.1
77Se	0.260	0.867	4.2	6.5	2.8	2.4	2.0	2.5	3.4	4.0	3.6	3.6	3.8	2.8	2.9
88Sr	0.001	0.003	21	40	22	37	25	25	17	15	16	13	23	15	29
95Mo	0.001	0.003	1.4	0.960	1.3	1.1	2.1	0.803	0.759	0.825	0.892	0.904	0.937	1.0	1.5
107Ag	0.001	0.003	0.059	0.059	0.068	0.092	0.160	0.115	0.126	0.146	0.155	0.132	0.206	0.137	0.057
111Cd	0.045	0.150	0.909	1.3	1.3	1.3	2.3	1.7	3.7	2.8	2.3	2.9	2.8	1.7	1.2
118Sn	0.035	0.117	2.3	1.9	1.4	0.947	0.861	1.2	0.721	1.7	1.8	1.9	1.9	7.2	1.0
121Sb	0.004	0.013	0.166	0.218	0.145	0.317	0.293	0.187	0.069	0.074	0.172	0.108	0.225	0.199	0.122
137Ba	0.001	0.003	98	155	177	405	408	272	124	130	293	88	388	165	92
202Hg	0.032	0.107	0.266	0.255	0.146	0.157	0.215	0.199	0.184	0.196	0.261	0.257	0.276	0.226	0.204
205Tl	0.001	0.003	0.034	0.048	0.040	0.096	0.079	0.053	0.030	0.018	0.044	0.029	0.045	0.042	0.041
208Pb	0.001	0.003	1.4	2.3	1.2	2.6	2.0	1.5	0.747	0.208	0.784	0.617	0.882	0.984	0.519
238U	0.001	0.003	0.943	1.8	0.420	0.784	0.853	0.501	0.315	1.5	3.7	3.9	4.0	4.1	6.9

Notes:

ppm = parts per million
DL = detection limit
LOQ = limit of quantitation
< = less than detection limit
g = grams
% = percent

		Client ID	HC0.2-2	HC0.2-3	HC0.2-4	HC0.2-5	CC5.6-1	CC5.6-2	CC5.6-3	CC5.6-4	CC5.6-5	SYT0.6-1	SYT0.6-2	SYT0.6-3	SYT0.6-4
		Lab ID	230	231	232	233	234	235	236	237	238	239	240	241	242
		Wet Weight (g)	0.2319	0.1361	0.1454	0.4692	0.2499	0.2508	0.6164	0.3761	0.4072	0.1924	0.1310	0.1098	0.1320
		Dry Weight (g)	0.0258	0.0201	0.0233	0.0726	0.0562	0.0746	0.1362	0.0777	0.0889	0.0237	0.0202	0.0183	0.0215
		Moisture (%)	88.9	85.2	84.0	84.5	77.5	70.3	77.9	79.3	78.2	87.7	84.6	83.3	83.7
Parameter	DL (ppm)	LOQ (ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
7Li	0.007	0.023	0.465	0.470	1.5	0.870	0.843	1.1	0.221	0.930	0.866	0.284	0.301	0.127	0.305
11B	0.135	0.450	1.1	1.7	2.5	1.2	0.808	1.0	0.237	0.781	0.545	1.4	1.2	3.3	1.0
23Na	1.3	4.3	2,810	3,010	3,684	5,872	7,274	3,010	6,432	6,270	4,639	2,066	2,206	3,079	2,390
24Mg	0.015	0.050	1,484	1,423	1,921	1,929	2,034	2,083	1,347	1,931	1,920	1,356	1,402	1,148	1,314
27Al	0.033	0.110	1,848	1,815	5,198	3,807	4,109	4,614	951	4,462	3,897	1,405	1,619	611	1,593
31P	32	107	11,400	10,705	11,304	12,203	10,959	9,734	11,359	11,244	13,804	8,263	8,965	9,157	10,013
39K	2.7	9.0	7,843	8,420	10,372	14,326	10,515	15,565	13,420	14,136	14,825	5,363	5,835	7,593	7,112
44Ca	16	53	2,984	3,144	4,244	3,768	3,914	2,203	1,691	2,867	2,772	4,139	3,999	2,813	4,030
49Ti	0.322	1.1	152	157	699	311	307	375	72	362	372	114	147	49	135
51V	0.076	0.253	2.8	2.7	8.2	5.2	5.8	9.2	1.5	6.6	5.3	1.7	2.7	1.4	2.1
52Cr	0.356	1.2	39	60	193	86	100	76	16	45	27	50	79	47	64
55Mn	0.007	0.023	86	121	169	155	152	147	71	130	128	94	78	38	107
57Fe	1.1	3.7	1,953	2,210	5,830	3,433	4,388	5,587	1,025	3,894	3,267	1,703	2,435	1,146	2,047
59Co	0.008	0.027	2.0	1.4	8.5	4.5	3.4	5.8	1.3	3.6	3.8	1.3	3.9	2.0	1.8
60Ni	0.043	0.143	61	84	291	128	184	121	20	73	42	81	125	74	104
63Cu	0.025	0.083	24	25	25	25	41	27	19	26	35	22	18	17	19
66Zn	0.347	1.2	128	142	114	114	161	127	121	119	193	138	115	92	114
75As	0.475	1.6	2.7	2.6	3.8	3.5	2.0	2.5	1.2	2.8	3.3	0.897	0.795	0.673	1.0
77Se	0.260	0.867	1.8	1.6	3.7	2.7	7.7	6.2	6.0	8.6	15	0.890	1.0	0.844	1.0
88Sr	0.001	0.003	20	22	30	27	19	9.9	6.4	13	10	27	28	18	27
95Mo	0.001	0.003	1.0	1.3	1.5	1.5	1.9	1.6	0.870	1.8	1.4	0.840	0.519	0.397	1.0
107Ag	0.001	0.003	0.036	0.036	0.063	0.052	0.094	0.089	0.052	0.091	0.168	0.019	0.023	0.019	0.015
111Cd	0.045	0.150	0.969	0.721	1.7	1.4	1.6	1.3	1.3	1.8	3.4	0.469	0.332	0.215	0.312
118Sn	0.035	0.117	1.6	2.2	1.5	0.913	0.531	0.839	0.278	0.663	0.711	2.0	1.9	2.1	1.6
121Sb	0.004	0.013	0.083	0.097	0.145	0.114	0.095	0.131	0.034	0.080	0.089	0.083	0.063	0.048	0.058
137Ba	0.001	0.003	53	68	125	121	141	173	34	135	113	63	71	35	85
202Hg	0.032	0.107	0.243	0.215	0.204	0.188	0.349	0.278	0.259	0.360	0.407	0.104	0.115	0.069	0.110
205Tl	0.001	0.003	0.035	0.030	0.060	0.060	0.079	0.075	0.035	0.059	0.064	0.012	0.013	0.009	0.015
208Pb	0.001	0.003	0.393	0.533	0.950	0.763	0.736	1.1	0.188	0.728	0.589	0.501	0.449	0.240	0.525
238U	0.001	0.003	1.9	2.9	2.4	5.5	2.8	5.5	1.0	3.5	1.9	8.6	11	2.7	7.4

Notes:

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		Client ID	SYT0.6-5	XE0.2-1	XE0.2-2	XE0.2-3	XE0.2-4	XE0.2-5	YT0.2-1	YT0.2-2	YT0.2-3	YT0.2-4	YT0.2-5
		Lab ID	243	244	245	246	247	248	249	250	251	252	253
		Wet Weight (g)	0.0888	0.4171	0.5989	0.3900	0.3981	0.6224	0.4594	0.2434	0.5085	0.3549	0.3096
		Dry Weight (g)	0.0148	0.0707	0.0992	0.0675	0.0564	0.0686	0.0645	0.0389	0.0693	0.0546	0.0385
		Moisture (%)	83.3	83.0	83.4	82.7	85.8	89.0	86.0	84.0	86.4	84.6	87.6
Parameter	DL (ppm)	LOQ (ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
7Li	0.007	0.023	0.229	0.199	0.220	0.530	0.207	0.220	0.991	1.2	0.838	1.5	2.4
11B	0.135	0.450	1.5	1.2	11	1.8	2.6	3.4	37	3.4	5.3	9.2	7.0
23Na	1.3	4.3	2,381	4,345	4,482	4,974	6,814	4,053	3,989	3,441	4,133	3,491	2,559
24Mg	0.015	0.050	1,083	1,476	1,514	1,831	1,771	1,661	2,077	1,659	1,626	1,756	2,168
27Al	0.033	0.110	972	465	595	1,507	611	653	5,036	6,303	4,029	7,171	11,802
31P	32	107	9,571	12,878	12,476	13,104	12,282	11,310	12,025	10,090	11,025	9,896	9,589
39K	2.7	9.0	6,230	12,665	12,378	14,779	14,276	10,389	11,484	9,238	10,369	8,946	8,150
44Ca	16	53	2,012	2,468	3,251	3,491	3,365	3,727	4,890	4,223	4,046	4,548	5,870
49Ti	0.322	1.1	84	37	56	100	36	42	499	530	335	729	1,185
51V	0.076	0.253	2.2	0.711	0.783	2.1	1.1	0.980	6.9	7.6	5.3	9.6	17
52Cr	0.356	1.2	54	8.2	7.8	17	10	11	56	94	37	74	236
55Mn	0.007	0.023	38	88	114	115	92	85	131	162	109	186	249
57Fe	1.1	3.7	1,637	562	689	1,348	640	714	4,061	5,235	3,210	5,385	11,418
59Co	0.008	0.027	2.7	0.856	0.986	1.8	0.823	1.0	3.5	3.4	3.2	4.7	13
60Ni	0.043	0.143	92	16	16	36	20	18	95	164	58	124	395
63Cu	0.025	0.083	18	26	25	28	28	23	22	22	20	19	22
66Zn	0.347	1.2	111	106	124	121	114	133	160	152	132	151	185
75As	0.475	1.6	0.978	1.1	1.1	1.2	0.982	1.1	2.3	3.4	2.6	4.4	5.9
77Se	0.260	0.867	1.0	4.1	4.0	4.0	3.7	3.3	1.5	1.3	1.2	1.4	1.3
88Sr	0.001	0.003	11	16	23	27	21	24	28	25	24	30	39
95Mo	0.001	0.003	0.603	0.427	0.534	0.718	0.789	0.502	0.753	1.4	0.870	0.771	0.951
107Ag	0.001	0.003	0.011	0.046	0.057	0.057	0.053	0.053	0.065	0.129	0.049	0.159	0.149
111Cd	0.045	0.150	0.351	4.3	2.0	1.8	2.5	2.7	0.755	0.820	0.820	0.949	1.0
118Sn	0.035	0.117	1.7	0.963	0.876	1.2	0.719	1.9	1.5	1.5	1.0	1.4	2.9
121Sb	0.004	0.013	0.141	0.047	0.038	0.071	0.045	0.041	0.239	0.384	0.234	0.370	0.621
137Ba	0.001	0.003	36	25	37	65	33	39	135	206	125	263	389
202Hg	0.032	0.107	0.098	0.164	0.150	0.171	0.121	0.114	0.159	0.165	0.159	0.184	0.197
205Tl	0.001	0.003	0.012	0.033	0.030	0.042	0.034	0.033	0.038	0.050	0.032	0.051	0.087
208Pb	0.001	0.003	0.653	0.231	0.342	0.693	0.251	0.314	1.8	2.2	1.6	2.5	3.5
238U	0.001	0.003	1.3	0.345	0.580	0.647	2.6	0.539	3.4	2.5	2.6	3.0	3.9

Notes:

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Minnow Environmental

Tissue QA/QC Relative Percent Difference Results

Client ID		HC6.8-1			HC6.8-3			HC6.8-5		
Lab ID		204			206			208		
Parameter	DL (ppm)	Sample (ppm)	Sample Duplicate (ppm)	RPD (%)	Sample (ppm)	Sample Duplicate (ppm)	RPD (%)	Sample (ppm)	Sample Duplicate (ppm)	RPD (%)
7Li	0.007	0.432	0.402	7.2	0.819	0.700	16	0.762	0.581	27
11B	0.135	0.834	0.787	-	1.3	1.4	-	0.764	0.660	-
23Na	1.3	4,523	4,625	2.2	3,659	4,026	9.6	3,844	3,491	9.6
24Mg	0.015	1,708	1,567	8.6	1,614	1,700	5.2	3,249	3,153	3.0
27Al	0.033	2,547	2,240	13	4,263	3,847	10	3,709	3,116	17
31P	32	14,053	13,851	1.4	12,270	12,850	4.6	11,587	11,361	2.0
39K	2.7	14,657	13,890	5.4	12,095	13,620	12	11,064	9,943	11
44Ca	16	3,521	3,170	11	3,811	4,047	6.0	4,420	4,412	0.2
49Ti	0.322	169	163	3.6	355	337	5.2	278	249	11
51V	0.076	2.9	2.4	19	4.6	3.5	27	4.5	3.8	17
52Cr	0.356	10	12	18	9.4	8.8	6.6	74	71	4.1
55Mn	0.007	273	244	11	145	157	7.9	122	119	2.5
57Fe	1.1	1,845	1,575	16	2,754	2,375	15	3,102	2,727	13
59Co	0.008	2.0	1.9	5.1	1.4	1.3	7.4	3.8	3.4	11
60Ni	0.043	14	18	25	14	12	15	114	96	17
63Cu	0.025	25	25	0.0	20	21	4.9	20	20	0.0
66Zn	0.347	149	145	2.7	149	157	5.2	159	167	4.9
75As	0.475	4.3	4.2	-	5.5	5.4	1.8	3.6	3.6	-
77Se	0.260	5.4	5.3	1.9	2.6	2.9	11	4.6	3.8	19
88Sr	0.001	27	26	3.8	39	39	0.0	44	43	2.3
95Mo	0.001	1.3	1.3	0.0	0.980	1.1	12	0.745	0.705	5.5
107Ag	0.001	0.092	0.097	5.3	0.087	0.111	24	0.150	0.136	9.8
111Cd	0.045	1.4	1.5	6.9	0.626	0.626	0.0	1.5	2.0	29
118Sn	0.035	1.3	1.3	0.0	0.970	1.1	13	0.952	0.857	11
121Sb	0.004	0.179	0.159	12	0.241	0.240	0.4	0.213	0.190	11
137Ba	0.001	107	86	22	169	153	9.9	132	118	11
202Hg	0.032	0.274	0.261	-	0.261	0.261	-	0.322	0.341	5.7
205Tl	0.001	0.022	0.021	4.7	0.026	0.024	8.0	0.031	0.023	30
208Pb	0.001	0.562	0.447	23	0.645	0.621	3.8	0.753	0.657	14
238U	0.001	7.4	7.5	1.3	11	10	9.5	4.1	3.3	22

Notes:

ppm = parts per million

RPD = relative percent difference

DL = detection limit

< = less than detection limit

% = percent

Data Quality Objectives:

Laboratory Duplicates - RPD ≤40% for all elements, except Ca and Sr, which are ≤60%

Minimum DQOs apply to individual samples at concentrations above 10x DL

Minnow Environmental

Tissue QA/QC Relative Percent Difference Results

	Client ID	LC10.2-5			CR24.5-2		
	Lab ID	218			220		
Parameter	DL (ppm)	Sample (ppm)	Sample Duplicate (ppm)	RPD (%)	Sample (ppm)	Sample Duplicate (ppm)	RPD (%)
7Li	0.007	1.7	1.6	6.1	2.3	1.6	36
11B	0.135	1.2	1.2	-	3.6	3.7	2.7
23Na	1.3	3,375	3,105	8.3	6,414	7,108	10
24Mg	0.015	2,305	2,202	4.6	2,621	2,367	10
27Al	0.033	9,434	9,024	4.4	12,740	11,081	14
31P	32	12,016	10,758	11	11,857	11,519	2.9
39K	2.7	11,238	10,305	8.7	13,594	14,368	5.5
44Ca	16	5,685	5,210	8.7	8,074	7,339	9.5
49Ti	0.322	1,075	991	8.1	1,003	862	15
51V	0.076	12	11	8.7	20	18	11
52Cr	0.356	195	149	27	237	253	6.5
55Mn	0.007	145	124	16	200	181	10
57Fe	1.1	8,826	7,502	16	11,081	10,818	2.4
59Co	0.008	8.4	7.6	10	10	11	9.5
60Ni	0.043	239	220	8.3	315	330	4.7
63Cu	0.025	27	26	3.8	28	28	0.0
66Zn	0.347	119	108	9.7	128	139	8.2
75As	0.475	3.9	4.0	-	2.5	2.6	-
77Se	0.260	6.5	5.9	9.7	2.4	1.9	-
88Sr	0.001	40	37	7.8	37	34	8.5
95Mo	0.001	0.960	0.981	2.2	1.1	1.2	8.7
107Ag	0.001	0.059	0.059	0.0	0.092	0.097	5.3
111Cd	0.045	1.3	1.3	0.0	1.3	1.2	8.0
118Sn	0.035	1.9	1.5	24	0.947	0.991	4.5
121Sb	0.004	0.218	0.216	0.9	0.317	0.317	0.0
137Ba	0.001	155	148	4.6	405	340	17
202Hg	0.032	0.255	0.272	-	0.157	0.188	-
205Tl	0.001	0.048	0.043	11	0.096	0.086	11
208Pb	0.001	2.3	2.1	9.1	2.6	2.3	12
238U	0.001	1.8	1.6	12	0.784	0.800	2.0

Notes:

ppm = parts per million

RPD = relative percent difference

DL = detection limit

< = less than detection limit

% = percent

Data Quality Objectives:

Laboratory Duplicates - RPD ≤40% for all elements, except Ca and Sr, which are ≤60%

Minimum DQOs apply to individual samples at concentrations above 10x DL

Minnow Environmental

Tissue QA/QC Accuracy and Precision Results

			Sample Group ID	01			02	
Parameter	DL (ppm)	Certified Conc. (ppm)	Mean Estimated Conc. (ppm)	Accuracy (%)	Precision RSD (%)	Mean Estimated Conc. (ppm)	Accuracy (%)	Precision RSD (%)
7Li	0.007	1.21	1.3	111	3.8	1.2	100	6.0
11B	0.135	4.5	5.1	113	3.1	4.8	106	2.8
23Na	1.3	14,000	14,581	104	2.3	14,736	105	4.5
24Mg	0.015	910	996	109	4.1	981	108	5.2
27Al	0.033	197.2	192	98	4.1	212	108	6.6
31P	32	8,000	8,306	104	2.7	8,472	106	4.2
39K	2.7	15,500	16,296	105	1.8	16,378	106	3.0
44Ca	16	2,360	2,514	106	3.2	2,507	106	2.5
49Ti	0.322	12.24	13	106	7.9	13	103	7.2
51V	0.076	1.57	1.7	108	6.0	1.6	102	7.8
52Cr	0.356	1.87	2.1	113	3.4	2.0	106	2.8
55Mn	0.007	3.17	3.4	108	6.6	3.4	107	5.2
57Fe	1.1	343	366	107	4.3	366	107	5.0
59Co	0.008	0.25	0.278	111	3.7	0.273	109	4.4
60Ni	0.043	1.34	1.5	109	4.1	1.4	108	5.7
63Cu	0.025	15.7	17	110	2.6	17	110	2.5
66Zn	0.347	51.6	56	108	2.1	54	105	3.4
75As	0.475	6.87	7.1	104	2.5	7.3	106	2.7
77Se	0.260	3.45	3.6	105	3.9	3.7	108	2.6
88Sr	0.001	10.1	11	108	3.0	11	104	2.5
95Mo	0.001	0.29	0.302	104	3.6	0.316	109	11
107Ag	0.001	0.0252	0.029	114	13	0.023	93	8.6
111Cd	0.045	0.299	0.320	107	4.4	0.332	111	8.7
118Sn	0.035	0.061	0.071	117	15	0.052	85	13
121Sb	0.004	0.011	0.013	115	12	0.012	109	18
137Ba	0.001	8.6	9.3	108	2.4	9.1	106	3.1
202Hg	0.032	0.412	0.475	115	7.9	0.439	106	4.6
205Tl	0.001	0.0013	-	-	-	-	-	-
208Pb	0.001	0.404	0.437	108	10	0.446	110	5.0
238U	0.001	0.05	0.052	105	8.4	0.051	103	7.3

Notes:

ppm = parts per million; % = percent; DL = detection limit; RSD = relative standard deviation

Data Quality Objectives:

Accuracy: DQO of 60 - 140% of the certified values for B, Ti, Ag, Sn, Sb, and Ba.

Accuracy: DQO of 70 - 130% of the certified values for all other elements provided.

Precision: DQO of ≤20% for all elements.

DORM-4 used for all parameters except B, Ti, Sb, Ba, and Al where NIST-1566b was used.

Tl certified concentration from NIST-2976.

Accuracy and precision for Tl are not reported as the certified concentration is too close to the reportable detection limit.

Minnow Environmental

Tissue QA/QC Accuracy and Precision Results

			Sample Group ID	03			04	
Parameter	DL (ppm)	Certified Conc. (ppm)	Mean Estimated Conc. (ppm)	Accuracy (%)	Precision RSD (%)	Mean Estimated Conc. (ppm)	Accuracy (%)	Precision RSD (%)
7Li	0.007	1.21	1.3	109	8.6	1.2	100	11
11B	0.135	4.5	4.8	107	2.6	4.8	106	3.6
23Na	1.3	14,000	15,522	111	5.3	13,569	97	2.3
24Mg	0.015	910	995	109	4.6	900	99	4.9
27Al	0.033	197.2	183	93	6.7	199	101	4.4
31P	32	8,000	8,349	104	4.0	8,240	103	2.7
39K	2.7	15,500	17,406	112	3.9	15,471	100	3.4
44Ca	16	2,360	2,513	106	4.1	2,462	104	4.4
49Ti	0.322	12.24	12	99	14	13	102	9.8
51V	0.076	1.57	1.8	112	19	1.5	95	11
52Cr	0.356	1.87	2.0	108	6.1	1.9	101	4.3
55Mn	0.007	3.17	3.4	109	4.6	3.2	100	5.3
57Fe	1.1	343	368	107	4.6	360	105	2.5
59Co	0.008	0.25	0.275	110	2.2	0.258	103	3.3
60Ni	0.043	1.34	1.5	111	2.6	1.4	104	1.8
63Cu	0.025	15.7	18	112	3.9	16	101	2.6
66Zn	0.347	51.6	57	110	1.6	53	102	2.1
75As	0.475	6.87	7.3	106	3.6	7.1	103	1.7
77Se	0.260	3.45	3.7	108	4.4	3.6	103	5.8
88Sr	0.001	10.1	11	110	3.8	10	100	2.7
95Mo	0.001	0.29	0.303	105	11	0.283	98	12
107Ag	0.001	0.0252	0.032	127	9.8	0.023	91	12
111Cd	0.045	0.299	0.349	117	7.1	0.283	95	8.9
118Sn	0.035	0.061	0.072	117	14	0.055	90	15
121Sb	0.004	0.011	0.012	113	8.5	0.007	67	12
137Ba	0.001	8.6	9.0	105	3.0	8.8	102	2.2
202Hg	0.032	0.412	0.465	113	6.1	0.422	102	4.1
205Tl	0.001	0.0013	-	-	-	-	-	-
208Pb	0.001	0.404	0.400	99	14	0.360	89	6.2
238U	0.001	0.05	0.057	114	20	0.050	100	8.3

Notes:

ppm = parts per million; % = percent; DL = detection limit; RSD = relative standard deviation

Data Quality Objectives:

Accuracy: DQO of 60 - 140% of the certified values for B, Ti, Ag, Sn, Sb, and Ba.

Accuracy: DQO of 70 - 130% of the certified values for all other elements provided.

Precision: DQO of ≤20% for all elements.

DORM-4 used for all parameters except B, Ti, Sb, Ba, and Al where NIST-1566b was used.

Tl certified concentration from NIST-2976.

Accuracy and precision for Tl are not reported as the certified concentration is too close to the reportable detection limit.

Minnow Environmental

Tissue QA/QC Accuracy and Precision Results

			Sample Group ID	05			06	
Parameter	DL (ppm)	Certified Conc. (ppm)	Mean Estimated Conc. (ppm)	Accuracy (%)	Precision RSD (%)	Mean Estimated Conc. (ppm)	Accuracy (%)	Precision RSD (%)
7Li	0.007	1.21	1.4	112	8.1	1.2	102	3.3
11B	0.135	4.5	4.9	109	4.7	5.0	111	4.2
23Na	1.3	14,000	15,167	108	4.6	15,229	109	4.7
24Mg	0.015	910	1,020	112	3.3	927	102	1.5
27Al	0.033	197.2	205	104	5.3	202	102	6.2
31P	32	8,000	8,165	102	4.2	8,444	106	3.5
39K	2.7	15,500	17,234	111	2.8	16,852	109	2.3
44Ca	16	2,360	2,631	112	3.4	2,551	108	3.0
49Ti	0.322	12.24	13	105	8.1	12	96	7.9
51V	0.076	1.57	1.6	104	3.7	1.9	118	5.8
52Cr	0.356	1.87	2.0	106	4.8	2.0	105	3.5
55Mn	0.007	3.17	3.6	112	4.7	3.3	104	3.8
57Fe	1.1	343	389	113	3.9	362	106	2.7
59Co	0.008	0.25	0.276	110	3.1	0.277	111	4.7
60Ni	0.043	1.34	1.4	107	3.5	1.5	111	2.8
63Cu	0.025	15.7	18	112	3.5	17	109	3.2
66Zn	0.347	51.6	57	110	5.6	57	110	4.1
75As	0.475	6.87	7.2	105	3.5	7.2	105	2.3
77Se	0.260	3.45	3.7	106	3.4	3.6	103	6.1
88Sr	0.001	10.1	11	110	5.3	11	112	2.9
95Mo	0.001	0.29	0.296	102	7.8	0.341	118	3.7
107Ag	0.001	0.0252	0.029	114	12	0.027	107	8.3
111Cd	0.045	0.299	0.364	122	5.1	0.308	103	8.5
118Sn	0.035	0.061	0.071	117	20	0.074	122	20
121Sb	0.004	0.011	0.009	82	11	0.012	109	20
137Ba	0.001	8.6	8.8	103	5.6	9.5	110	6.4
202Hg	0.032	0.412	0.434	105	6.0	0.454	110	0.6
205Tl	0.001	0.0013	-	-	-	-	-	-
208Pb	0.001	0.404	0.474	117	5.9	0.428	106	15
238U	0.001	0.05	0.052	103	7.9	0.058	117	5.2

Notes:

ppm = parts per million; % = percent; DL = detection limit; RSD = relative standard deviation

Data Quality Objectives:

Accuracy: DQO of 60 - 140% of the certified values for B, Ti, Ag, Sn, Sb, and Ba.

Accuracy: DQO of 70 - 130% of the certified values for all other elements provided.

Precision: DQO of ≤20% for all elements.

DORM-4 used for all parameters except B, Ti, Sb, Ba, and Al where NIST-1566b was used.

Tl certified concentration from NIST-2976.

Accuracy and precision for Tl are not reported as the certified concentration is too close to the reportable detection limit.

APPENDIX G
Vegetation Baseline Report

Coffee Gold Mine:
Vegetation Baseline Report
Version 1.2



Prepared For
Kaminak Gold Corporation
Suite 3400-666 Burrard Street
Vancouver, BC V6C 2X8

Prepared By
EDI Environmental Dynamics Inc.
2195-2nd Avenue
Whitehorse, YT Y1A 3T8

EDI Contact
Anne MacLeod, R.P.Bio.
867.393.4882

EDI Project
14Y0306
February 2017

EDI
ENVIRONMENTAL DYNAMICS INC.
Down to Earth Biology

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REVISION SUMMARY

Version No.	Date	Revision Notes	Revision Authors
1.0	31 March 2016	Draft report for review by Project team	Section authors
1.1	15 Sept 2016	Final baseline report for Project Proposal	MacLeod, Russell
1.2	1 Feb 2017	Final revisions to baseline report	Churchill, MacLeod, Pagacz, Robitaille,

EXECUTIVE SUMMARY

Kaminak Gold Corporation, a wholly owned subsidiary of Goldcorp Inc. (Kaminak; the Proponent) is proposing to develop an open pit, heap leach gold mine in west-central Yukon, known as the Coffee Gold Mine (Coffee Project; the Project). To receive authorization for the Project to proceed, it must be evaluated under the *Yukon Environmental and Socio-Economical Assessment Act* (YESAA) and obtain a Quartz Mining License, a Type A Water License, as well as other associated authorizations. During the environmental assessment process, potential Project effects on valued environmental and socio-economic components, including vegetation, are determined and mitigations are developed to reduce or eliminate potential adverse effects. To assess the potential effects of the proposed Project on vegetation, an understanding of baseline vegetation conditions in the Project area is required. In anticipation of this requirement, baseline vegetation surveys were conducted in the Project area in 2014, 2015, and 2016. Four different vegetation studies were completed, including: ecosystem mapping, rare plant surveys, exotic and invasive species surveys, and vegetation and soil trace metals sampling. The results of these surveys are presented in this vegetation baseline report, along with published and unpublished scientific data, and Traditional Knowledge (TK). The overall objective of this vegetation baseline report is to provide information and data on the current condition of vegetation species and communities associated with the Coffee Project.

The vegetation Local Study Area (LSA) is approximately 797 km² and encompasses the extent of baseline vegetation surveys for the Coffee Project. Around the mine site, the LSA is delineated based on the height of land while encompassing a minimum buffer of 1 km around the proposed development. Along the various road alignments, the LSA includes a 1 km buffer on either side of the road.

The Project falls within the Boreal Cordillera Ecozone and within that, is located in the Klondike Plateau Ecoregion. According to Yukon bioclimate zone mapping, the LSA encompasses four bioclimate zones: the Boreal Low, the Boreal High, the Subalpine, and Alpine zones. Overall, approximately 90% of the LSA occurs within the Boreal Bioclimate zones (Boreal Low and High), while the remaining area occurs predominantly in the Subalpine Bioclimate zone. The Alpine Bioclimate zone is found only in a small area (< 0.1% of the LSA) in the southeastern extent of the LSA, along a previously considered road alignment (proposed Casino Connecter) that has since been excluded from the Project.

Within the LSA, the subalpine landscape is dominated by shrub communities overlaying a well-developed feathermoss and lichen layer. Communities of scrub birch (*Betula glandulosa*), Labrador tea (*Rhododendron groenlandicum*), bog blueberry (*Vaccinium uliginosum*), lowbush cranberry (*Vaccinium vitis-idaea*), and crowberry (*Empetrum nigrum*) are common. The widely-distributed dry, shallow hillcrests throughout the LSA commonly support communities of low-growing shrubs and/or ground shrubs, including scrub birch, mountain avens (*Dryas* spp.), crowberry, Arctic white heather (*Cassiope tetragona*), and lowbush cranberry. A sparse conifer canopy (~15% cover) develops over the shrub layer as the subalpine nears the treeline and the boreal transition.

Between the treeline of the Boreal High and the valley bottoms of the Boreal Low bioclimate zone, the vegetation patterns reflect the discontinuous distribution of permafrost throughout the region. Closed

canopy pure or mixed stands of white spruce (*Picea glauca*), black spruce (*Picea mariana*), Alaska birch (*Betula neoalaskana*), and trembling aspen (*Populus tremuloides*) occur on neutral and warm, gentle-to-moderate slopes. Understory species typically include Labrador tea, prickly rose (*Rosa acicularis*), lowbush cranberry, tall bluebells (*Mertensia paniculata*), bastard toadflax (*Geocaulon lividum*), and feathermosses. Dry, moderate-to-steep, south-facing slopes support grasslands and aspen forests, overlaying kinnikinnick (*Arctostaphylos uva-ursi*), soapberry (*Shepherdia canadensis*), and grasses. In contrast, stunted black spruce forests occur on cold, north-facing slopes with imperfect-to-poor drainage due to near surface permafrost. Understory species typically include Labrador tea, sedges, cottongrass (*Eriophorum vaginatum*), and cloudberry (*Rubus chamaemorus*). On gentle toe-slopes underlain by permafrost, black spruce communities containing Labrador tea, sedges, red bearberry (*Arctous rubra*), and lichens predominate. Black spruce forests with high lichen cover also occur on better drained, coarser-textured upland, north-facing, lower-to-upper slopes. Wetland and floodplain ecosystems exist in valley bottoms throughout the LSA; however, they represent a small component of overall area. This region has frequent fires, therefore young, deciduous-dominated, and mixedwood stands are more common than mature conifer-dominated stands. Additionally, the region has a long history of placer gold mining; subsequently, many valley bottoms within the LSA include historic and/or active placer mines.

Combined, the baseline surveys documented 411 vegetation species including seven tree, 60 shrub, 188 forb, 63 grass, 18 fern/horsetail/clubmoss, two aquatic, 34 mosses, 2 liverworts, and 37 lichens. Many of these plant species are currently, or have been previously, used by local First Nations as a source of food, or for medicinal and spiritual use while others have more practical or decorative uses.

Ecosystem Mapping — Ecosystem mapping is typically used as a method of describing vegetation across a landscape. By grouping plant species into communities it facilitates describing possible effects such as loss of vegetation habitat. Ecosystems of the Coffee Project area were mapped at two levels: Ecological and Landscape Classification (ELC) and Broad Ecosystem Mapping (BEM). The more detailed ELC mapping was completed around the proposed mine site and along new sections of proposed road, including a proposed Casino Connector (no longer being considered) and sections of the proposed Northern Access Route (NAR). BEM was completed along the proposed NAR in sections with existing roads. Approximately 23,844 ha of the LSA were mapped following ELC methods and approximately 36,582 ha were mapped following BEM methods. The mapping extent identified 34 unique ELC ecosites (24 ecosites in boreal zones, 10 ecosites in the subalpine/alpine zones), 11 non-vegetative/anthropogenic units, and 13 vegetative BEM units. The ELC mapping identified seven unique wetland ecosites and the BEM identified four units (bog, fen, marsh and swamp). The area of each ecosite, non-vegetative/anthropogenic and BEM unit was summarized.

Rare Plants — No COSEWIC or SARA-listed plant species were observed during the rare plant surveys. Populations of four territorial Watch-list plant species were observed within the LSA. Species on the Watch-list require more information on their distribution and abundance before a conservation status can be determined. Watch-list plant species found during plant surveys include: spotted lady's-slipper (*Cypripedium guttatum*), Coffee Creek scorpionweed (*Phacelia mollis*), small enchanter's nightshade (*Circaea alpina* ssp. *alpina*), and dry-spike sedge (*Carex siccata*).

Coffee Creek scorpionweed is endemic to central and western Yukon and Alaska (AK). It was found at a total of six sites. Spotted lady's-slipper is known from western and northern Yukon, as well as Asia, AK, and the Northwest Territories (NWT). It was found at a total of six and all sites except one were located on south-facing, moderate slopes, dominated by open trembling aspen stands with a few scattered white spruce. Small enchanter's nightshade is known from Eurasia and is circumpolar from Newfoundland to AK south to northern United States. Prior to the rare plant survey, this plant was only known from southeast Yukon, near a hot spring. Small enchanter's nightshade was found at one site. This finding represents a large and impressive range extension for this species, not previously known in western Yukon. Dry-spike sedge is known from North America including Yukon, Northwest Territories, British Columbia (BC) east to southwestern Quebec, and the northern United States with occurrences reported as far south as Arizona and New Mexico. It was found at one site dominated by open trembling aspen and a few scattered white spruce which represents the fifth known location of this species in Yukon.

Exotic and Invasive Plant Species — Invasive plants in the LSA range in degree of invasiveness (*i.e.*, concern) from high priority (1) to least concern (7). Populations of 18 invasive plant species were found during the field surveys, including five rank 1 invasive species. The observed rank 1 invasive species are: smooth brome (*Bromus inermis*), narrow-leaved hawksbeard (*Crepis tectorum*), perennial sow-thistle (*Sonchus arvensis* spp. *uliginosus*), white sweetclover (*Melilotus albus*), and yellow sweetclover (*Melilotus officinalis*).

In general, concentrations of invasive plants were less frequent in the southern portion (Coffee Camp, Coffee airstrip, Java Road, and the proposed mine site) of the LSA compared to the northern portion (NAR). Along the NAR, southern sections with limited access had fewer invasive plants than northern areas easily accessed by truck. Smooth brome was found scattered along the NAR and around Coffee Camp. The density and distribution of smooth brome around Coffee Camp is described as being continuous dense occurrence of a species. Narrow-leaved hawksbeard was found scattered along the NAR and at a few locations along the Coffee airstrip and beginning and end of Java Road. Only one individual was found at the end of Java Road within the vicinity of the proposed mine site. This individual was pulled, bagged, and burned in the incinerated onsite. Four individuals of perennial sow-thistle were found at one site along the airstrip. The seed containing portion of these four plants were removed, bagged, and burned in the incinerator on site. White sweetclover was found in several sections along the NAR. The density distribution of this invasive species was moderate compared to other observed species. Yellow sweetclover was the only invasive species found along the NAR within approximately 6 km of the North Klondike highway. The density distribution was considered moderate where it was found.

Trace Metals in Vegetation — The monitoring of trace metal concentrations in soil and vegetation provides a baseline so that changes can be evaluated for potential Project effects. Trace metals sampling within the LSA was conducted in July 2014 and July to August, 2015 and 2016. Soil and four plant species were collected for trace metals analysis. The plant species collected include: willow (*Salix* spp.), reindeer lichens (*Cladina mitis* and *Cladina rangiferina*), horsetails (*Equisetum arvense, Equisetum pratense,* and *Equisetum sylvaticum*), and lowbush cranberry.

The total number of trace metals sites visited from 2014-2016 was 89. Seventy-seven soil sites where located in the Coffee Area including 68 willow, 61 lichen, 61 lowbush cranberry, and 22 horsetail sites. Twelve soil sites were located along the NAR including 10 willow, 5 lichen, 8 lowbush cranberry, and 9 horsetail sites.

Based on the existing studies, the nature of the trace metals, and site conditions, the analysis focused on the following trace metals: arsenic, cadmium, chromium, copper, lead, mercury, selenium, uranium, and zinc. The results were compared to the Canadian Council of Ministers of the Environment (CCME) soil quality guidelines. No CCME guidelines currently exist for trace metals in vegetation. Trace metal concentrations in soil were low with the exception of arsenic and chromium. Arsenic and chromium concentrations were above CCME soil quality guidelines in twenty-four (27%) and four (4%) samples, respectively. Arsenic samples above CCME guidelines were generally found within close proximity to the proposed mine site. Chromium samples above CCME guidelines were found close to the proposed mine site and at control sites ≥15 km relative to the proposed proposed Project footprint. Few soil samples reported mercury and selenium above the laboratory reportable detection limit (RDL).

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AUTHORSHIP

This report was prepared by EDI Environmental Dynamics Inc. Staff who contributed to this project include:

Rachelle Robitaille, B.Sc., R.P.Bio.....Vegetation Discipline Lead, Program Design and Report Editor

Sherri Elwell, M.Sc., R.P.Bio.....Ecosystem Land Classification Author

Brett Pagacz, B.Sc., B.I.T.....Rare Plant, Exotic and Invasive Plants, Trace Metals Author

Brodie Smith, B.Sc., B.I.T .....Trace Metal Author

Matt Power, A.Sc.T. .....GIS Mapping

Anne MacLeod, B.Sc., R.P.Bio .....Project Manager, Program Design and Senior Review

Mike Setterington, B.Sc.F, M.Sc., R.P.Bio .....Senior Review

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ACRONYMS AND ABBREVIATIONS

AB ..... Alberta

AK ..... Alaska

AKEPIC ..... Alaska Exotic Plants Information Clearinghouse

ANHP ..... Alaska Natural Heritage Program

ANOVA ..... Analysis of Variance

ANPC ..... Alberta Native Plant Council

ALP ..... Alpine bioclimate zone

asl ..... Above Sea Level

B.A.B.Y. ..... B. A. Bennett Herbarium

BEM ..... Broad Ecosystem Mapping

BOH ..... Boreal High bioclimate zone

BOL ..... Boreal Low bioclimate zone

BC ..... British Columbia

CCME ..... Canadian Council of Ministers of the Environment

CDC ..... Conservation Data Centre

CNVC ..... Canadian National Vegetation Classification

CoPC ..... Chemical of Potential Concern

COSEWIC ..... Committee on the Status of Endangered Wildlife in Canada

CYSIP ..... Central Yukon Species Inventory Project

dbh ..... Diameter at Breast Height

DEM ..... Digital Elevation Model

E ..... East

EDI ..... Environmental Dynamics Inc.

ELC ..... Ecological and Landscape Classification

ESIL.....Ecosystem Survey Intensity Level

ESOD..... Earth Science Online Directory

ESRD..... Environment and Sustainable Resource Development

FNA.....Flora of North America

FNNND ..... First Nation of Na-cho Nyäk Dun

GPS..... Global Positioning System

ha..... Hectares

hr ..... Hour

IMT.....Environment Yukon's Information Management Branch

IUCN..... International Union for Conservation of Nature

Kaminak/the Proponent .....Kaminak Gold Corporation

km ..... Kilometers

LSA .....Local Study Area

m.....metre

MoE..... (BC) Ministry of Environment

MoFR..... (BC) Ministry of Forests and Range

N.....North

NAR..... Northern Access Route

NEF.....National Ecological Framework of Canada

NWT..... Northwest Territories

pH ..... Soil pH

Project/Coffee Project.....Coffee Gold Mine

QA/QC.....Quality Assurance/Quality Control

RDL..... Reportable Detection Limit

R.P.Bio..... Registered Professional Biologist

RSA ..... Regional Study Area

S ..... South

SARA ..... *Species at Risk Act*

SFN ..... Selkirk First Nation

SIVI ..... Site Visit Form

SUB ..... Subalpine bioclimate zone

TEM ..... Terrestrial Ecosystem Mapping

TH ..... Tr'ondëk Hwëch'in

TK ..... Traditional Knowledge

TSP ..... Total Suspended Particulates

UTM ..... Universal Transverse Mercator

UTV ..... Utility Task Vehicle

W ..... West

WRFN ..... White River First Nation

YBF ..... Yukon Bioclimate Framework

YBIS ..... Yukon Biophysical Inventory System

YESAA ..... *Yukon Environment and Socio-economic Assessment Act*

YESAB ..... Yukon Environment and Socio-economic Assessment Board

YISC ..... Yukon Invasive Species Council

YVI ..... Yukon Vegetation Inventory

1 OVERVIEW

1.1 PROJECT OVERVIEW

Kaminak Gold Corporation, a wholly owned subsidiary of Goldcorp Inc. (Kaminak; the Proponent) is proposing to develop an open pit, heap leach gold mine in west-central Yukon, located approximately 130 kilometres (km) south of Dawson City, known as the Coffee Gold Mine (Coffee Project; the Project). The Project (including the proposed access corridor) is located on Crown Land and overlaps the asserted area or established traditional territories of Tr'ondëk Hwëch'in (TH), Selkirk First Nation (SFN), First Nation of Na-cho Nyäk Dun (FNNND) and White River First Nation (WRFN).

The proposed Project will consist of an open pit gold mine using a cyanide heap leach process to extract gold from the ore. The Project will have a mine life of 22 years, comprised of construction , operation, and reclamation and closure, followed by post closure monitoring. The Project will include four open pits (Latte, Double Double, Supremo, and Kona) mined by conventional shovel and truck methods with an average operation rate of five million tonnes per annum of heap leach feed. It will also include four Waste Rock Storage Facilities, a conventional Heap Leach Facility, a Processing Plant and associated support infrastructure. The Project will be accessed by road from Dawson via a 214 km single-lane, gravel road with pull outs referred to as the Northern Access Route (NAR). The majority of the access is along existing road which will be upgraded.

To determine the existing, current conditions of the vegetation at this site, a baseline study was commissioned. Kaminak retained EDI Environmental Dynamics Inc. (EDI) to perform the vegetation baseline investigation in support of the Project Proposal to be submitted to the Yukon Environment and Socio-economic Assessment Board (YESAB) Executive Committee for screening under the *Yukon Environment and Socio-Economic Assessment Act* (YESAA), and applications to be submitted for a Quartz Mining Licence and a Type A Water Licence from the Yukon Water Board, among other permits and licences. This report provides the approach used for the collection of baseline vegetation data, the results of that data collection, and a description of the baseline vegetation conditions within the proposed Project area.

1.2 OBJECTIVES

To receive authorization for the Coffee Project to proceed, the Project must be evaluated under YESAA. To assess potential Project effects, an understanding of baseline vegetation conditions in the Project area is required. Specific objectives, as identified in YESAB's Proponent's Guide to Information Requirements for Executive Committee Project Proposal Submissions (2005), are to:

- Provide information on land cover types, forest cover and site quality;

- Document plant communities to the species level, on the sites that may be disturbed as a result of development;
- Describe vegetation and vegetation assemblages including any identified rare, sensitive, and/or endangered species and ecological reserves; and
- Identify any wetlands in the project area.

Building on these, the overall objective of the vegetation baseline report is to summarize information and data on the current condition of vegetation species and communities associated with the Coffee Project. Vegetation condition is described based on four components: ecological communities, rare plants, exotic and invasive plants, and vegetation trace metal analysis.

1.3 SPATIAL BOUNDARIES

Baseline vegetation studies for the Coffee Project were initiated in 2014. Before the start of the 2015 vegetation field work, changes to the proposed access route were incorporated into the Project Area. Specifically:

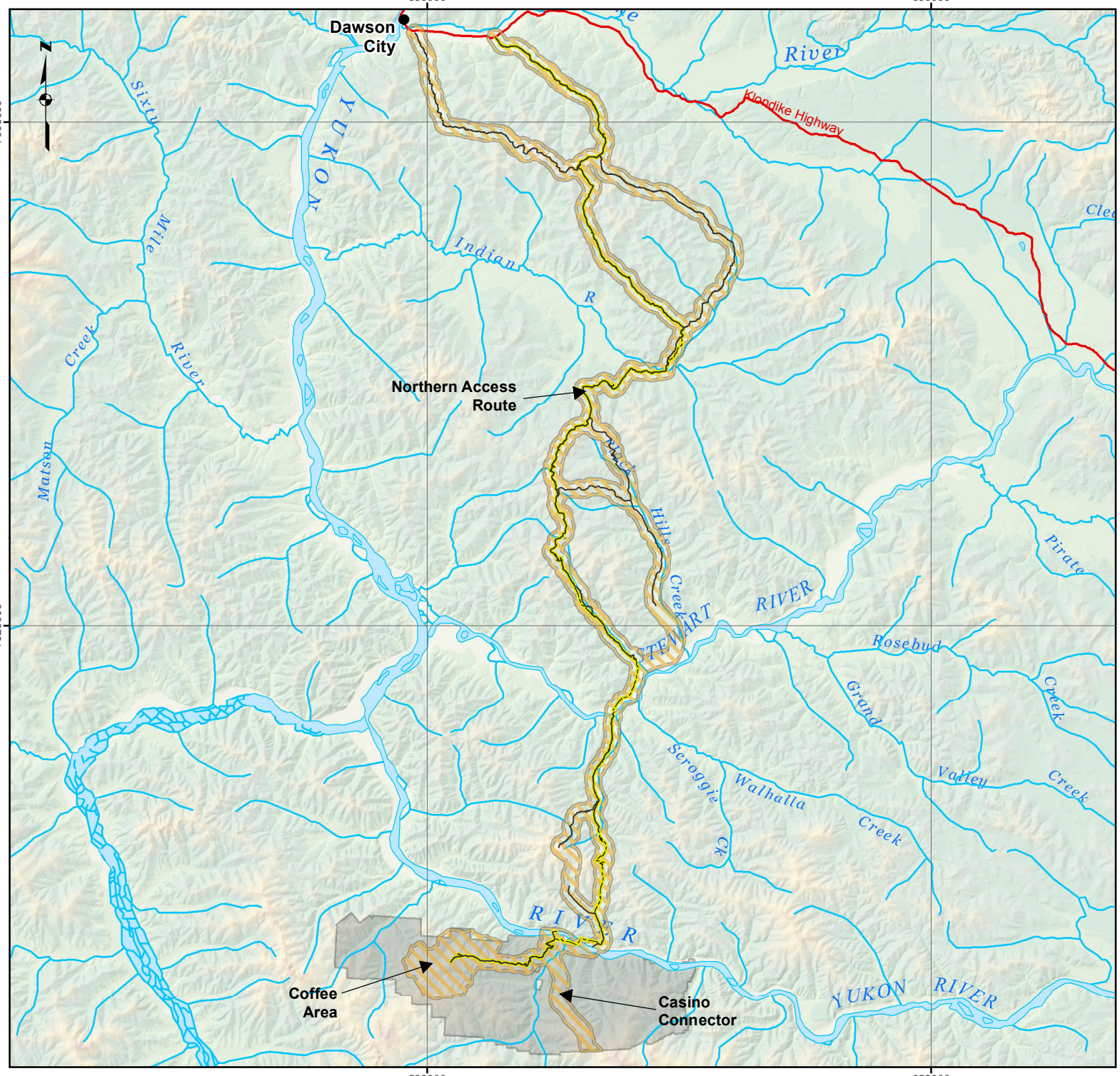
- In 2014, Kaminak was considering an access road connecting to the existing Freegold Road, which would provide access to the mine site via Carmacks, Yukon. This is similar to the access road proposed by Casino Mining Corporation for the Casino Project, located approximately 31 km southeast of the Coffee mine site. Consequently, the 2014 vegetation baseline surveys for the Coffee Project included a possible road alignment connecting to the Casino Project area. This potential access road (Casino Connector) was no longer being considered by Kaminak prior to the 2015 vegetation baseline surveys.
- In 2015, Kaminak considered an access road through the Dawson Goldfields which would provide access to the mine site via Dawson, Yukon. This is currently the proposed NAR; however, when vegetation baseline surveys commenced in 2015, the final alignment through the Goldfields was not yet determined. Thus, the 2015 vegetation baseline surveys included several road alignment options.

The final vegetation Local Study Area (LSA, Figure 1-1) is approximately 797 km² and encompasses the fullest extent of baseline vegetation surveys for the Coffee Project. It includes the proposed mine site area, the existing road between the Coffee Camp and the deposit (i.e., the Java Road), the current airstrip and Coffee Camp, the proposed NAR to the junction with the Klondike Highway, as well as several previous road alignment options including the previous Casino Connector option and alternate alignments through the Dawson Goldfields. Around the mine site, the LSA is delineated based on the height of land while encompassing a minimum buffer of 1 km around the proposed development. Along the various road alignments, the LSA includes a 1 km buffer on either side of the road.

Four different vegetation baseline studies were completed: ecosystem mapping including Ecological and Landscape Classification (ELC) and Broad Ecosystem Mapping (BEM), rare plant surveys, exotic and

invasive species surveys, and vegetation trace metal analysis. However, since many of the vegetation baseline surveys did not extend to the full boundaries of the LSA, the discussion of specific survey results in this report references the survey extent for each survey. The majority of trace metal sample sites were located within the LSA but the study area needed to be expanded into a regional study area (trace metal RSA).

The RSA for the trace metal surveys follows a buffer around the LSA (Far Sample Zone in Figure 5-1) excluding the NAR portion of the LSA and includes the Thistle Mountain Sample and Moose Mountain Sample zones (see figure 5-1).





Legend

- Settlement/Community
- Existing
- Proposed Route
- Highway
- Coffee Property
- Local Study

FIGURE: 1 - 1

Overview of Local Study Area

Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

0 10 20
KM

Map Reference Scale: 1:750,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MS	Checked: MP/AM	Date: 02/09/2016

KAMINAK GOLD CORPORATION EDI

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1.4 VEGETATION OVERVIEW

1.4.1 REGIONAL CONTEXT

The Project falls within the Boreal Cordillera Ecozone and within that, is located in the Klondike Plateau Ecoregion. The Boreal Cordillera Ecozone is associated with the mountainous southern Yukon and northern British Columbia (BC). The summers are cool and brief and the winters are cold and long. During the summer, moist Pacific air frequently causes sudden, often violent storms, while more stable air mass usually prevails in winter, with cold spells broken by warm chinook winds. Mountains and plateaus are the dominant features, which are separated by lowlands and valleys (YEWG 2004).

The Klondike Plateau Ecoregion is greater than 38,000 km^2. The Klondike Plateau Ecoregion is considered uniform in character with smooth topped ridges dissected by deep, narrow, V-shaped valleys that have not been glaciated in the recent past. The Dawson Range is the most distinct feature of the plateau. Major rivers have cut deeply into the plateau surface. The Yukon River crosses this ecoregion from just downstream of the mouth of the Pelly, past the mouth of the Stewart, Klondike, Chandindu, and Fortymile, to the Alaska (AK) border. The only significant lakes are found in the southeast corner with the largest being Wellesley Lake.

This ecoregion is largely unglaciated. Surface deposits over much of the ecoregion are composed of colluvium, with alluvium and glacial outwash terraces found along major river systems. Many of the tributary valleys are blanketed with thick colluvial deposits consisting of silts several metres thick covered by several metres of peat and mucky silt. Uplands are covered with colluvium rubble derived from underlying fractured bedrock. A veneer of wind-blown silt covers most of the ecoregion (YEWG 2004).

The climate of the ecoregion is strongly continental with warm summers and very cold winters. Precipitation amounts vary from 300 to 500 mm annually. Most summer precipitation is from convective rainshowers and thunderstorms.

Permafrost is widespread but discontinuous in this ecoregion. Typically permafrost is absent from well-drained, dry slopes of any aspect, while valley bottom deposits and upland soils usually contain ice-rich layers. Soil moisture content and organic-layer thickness are critical variables controlling the occurrence of permafrost. The dominant parent materials are stony residual materials along ridge tops and summits, coarse colluvium on upper slopes, and silty colluvium and loess, rich in organic matter on lower slopes.

A mosaic of soils exists in the permafrost-free areas. Eutric Brunisols develop on loamy colluvial materials dominate well-drained ridge crests, south-facing slopes and glaciofluvial terraces. Mesic Organic Cryosols are most common in undisturbed valley bottom settings. Even on upland positions, active cryoturbation may occur and be expressed as sorted patterned ground and Orthic Turbic Cryosol development. Along the Yukon River, warm summer climates and coarse alluvial or glaciofluvial materials on terraces limit organic matter accumulation and Orthic Eutric Brunisols are most common. Fluvial fans support wetlands

composed of both fen and peat plateaus. Complexes of Cryosols, Regosols and Eutric or Dystric Brunisols compose these areas (YEWG 2004).

Much of the Klondike Plateau Ecoregion straddles the treeline with vegetation ranging from boreal forest in the valleys and on lower slopes, to alpine tundra on ridge crests. In general, the treeline is close to 1,000 m above sea level (asl) in the northern part of the ecoregion and around 1,200 m asl in the south. Below the treeline, the vegetation pattern reflects the discontinuous distribution of permafrost with stunted black spruce (*Picea mariana*) woodlands on cold, north facing slopes and mixed forests on warm south-facing slopes (YEWG 2004).

The Yukon Government defines bioclimate zones as areas with a similar climate that support reference ecological communities, known as a reference ecosite (Rowe and Sheard 1981). According to Yukon bioclimate zone mapping, the LSA encompasses four bioclimate zones: the Boreal Low (BOL), the Boreal High (BOH), the Subalpine (SUB) and the Alpine (ALP) zones. The Boreal Low zone is typically found from valley bottoms to middle elevations (less than 950 m). The BOL occupies broad to narrow valley bottoms along the Yukon River and its tributaries. This zone is the warmest and driest of the bioclimate zones. The Boreal Low is characterized by continuous, closed to open coniferous and mixed forest. The Boreal High zone is located at middle to upper elevations and characterized by steep slopes in the southern mountainous regions and gentle rolling plateaus in the central regions. Typically forests are dominated by white spruce (*Picea glauca*), subalpine fir (*Abies lasiocarpa*) and lodgepole pine (*Pinus contorta* var. *latifolia*). The Subalpine zone is located at moderate to higher elevations and considered a transitional area between the Boreal zones and the Alpine. It is composed of shrub communities with sparse tree cover. Tall shrub communities and open canopy coniferous forests with tree cover less than 20% are characteristics of this zone. Either subalpine fir or white spruce is the dominant tree species. The Alpine zone is found at high latitude areas. The predominant vegetation condition is characterized by dwarf shrubs, herb/cryptograms and low-growing and scattered krummholtz trees. Typically, the highest elevations are dominated by bare rock, colluvium or ice/snow.

1.4.2 VEGETATION WITHIN THE LSA

Overall, greater than 90% of the LSA occurs within the Boreal Bioclimate zones (Boreal Low and Boreal High), while the remaining area occurs predominantly in the Subalpine Bioclimate zone. The Alpine Bioclimate zone is found only in a small area in the southeastern extent of the LSA and makes up less than 0.1% of the LSA. The majority of the Subalpine occurs in the Coffee Area (i.e., the Coffee Property), where it accounts for 30% of the survey extent. Shrub communities overlaying a well-developed feathermoss and lichen layer dominate the subalpine landscape, which consists of smooth-topped ridges exposed to long periods of weathering. Communities of scrub birch (*Betula glandulosa*), Labrador tea (*Rhododendron groenlandicum*), bog blueberry (*Vaccinium uliginosum*), lowbush cranberry (*Vaccinium vitis-idaea*), and crowberry (*Empetrum nigrum*) dominate gentle-to-moderate, mid-to-upper slopes across neutral and warm aspects. A sparse conifer canopy (~15% cover) develops over the shrub layer as the subalpine nears the treeline and the boreal transition. Moist scrub birch- and Labrador tea-dominated communities, underlain by permafrost,

contain sedges (*Carex* spp.) in the understory, while small side slope creeks and drainages support willow (*Salix* spp.)-dominated communities. Stunted black spruce forests with scrub birch, Labrador tea, sedges, feathermosses and peat mosses (*Sphagnum* spp.) are common on moderate, north-facing slopes that are underlain by permafrost and have imperfect-to-poor drainage. The widely-distributed dry, shallow hillcrests throughout LSA commonly support communities of low-growing shrubs and/or ground shrubs, including scrub birch, mountain avens (*Dryas* spp.), crowberry, Arctic white heather (*Cassiope tetragona*), and lowbush cranberry.

Between the treeline of the Boreal High and the valley bottoms of the Boreal Low, the vegetation patterns reflect the discontinuous distribution of permafrost throughout the region. Closed canopy pure or mixed stands of white spruce, black spruce, Alaska birch (*Betula neoalaskana*) and trembling aspen (*Populus tremuloides*) occur on neutral and warm, gentle-to-moderate slopes, typically with unfrozen Brunisolic soils. Understory species typically include Labrador tea, prickly rose (*Rosa acicularis*), lowbush cranberry, tall bluebells (*Mertensia paniculata*), bastard toadflax (*Geocaulon lividum*), and feathermosses. This region has frequent fires, therefore young, deciduous-dominated, and mixedwood stands are more common than mature conifer-dominated stands. Dry, moderate-to-steep, south-facing slopes support grasslands and aspen forests, overlaying kinnikinnick (*Arctostaphylos uva-ursi*), soapberry (*Shepherdia canadensis*), and grasses. Contrastingly, stunted black spruce forests occur on cold, north-facing slopes with imperfect-to-poor drainage due to near surface permafrost. Understory species typically include Labrador tea, sedges, cottongrass (*Eriophorum vaginatum*), and cloudberry (*Rubus chamaemorus*). On gentle toe-slopes underlain by permafrost, black spruce communities containing Labrador tea, sedges, red bearberry (*Arctous rubra*), and lichens predominate. Black spruce forests with high lichen cover also occur on better drained, coarser-textured upland, north-facing, lower-to-upper slopes.

Wetland and floodplain ecosystem exist in valley bottoms throughout the LSA, however they represent a small component of overall area. Wet, tussocky, poor-treed fen communities with spruce, sedges, feathermosses, brown mosses, and peat mosses exist in poorly drained areas on valley floors and at the toe of slopes on Cyrosolic soils. Shrub-dominated fens with birch, leatherleaf (*Chamaedaphne calyculata*) and cottongrass can be closely associated with treed fens in broad valley bottoms. Willow-dominated riparian communities are common throughout the LSA, alongside slope creeks and drainages. Along major rivers, white spruce, horsetail (*Equisetum* spp.) and feathermoss communities are found on stable high bench floodplains. A balsam poplar (*Populus balsamifera*) canopy typically dominates mid bench floodplain sites with alder (*Alnus* spp.), willow and prickly rose overlaying a rich herb understory. These communities occupy smaller creeks and large river riparian sites subject to flooding. The region has a long history of placer gold mining; subsequently, many valley bottoms along the NAR include historic and/or active placer mines.

Combined, the baseline surveys documented 411 different vegetation species including 7 tree, 60 shrub, 188 forb, 63 grass, 18 fern/horsetail/clubmoss, two aquatic, 36 mosses/liverworts, and 37 lichen (a complete list of all species can be found in Appendix A). Many of these plant species are currently, or have been previously, used by local First Nations as a source of food, or for medicinal and spiritual use while others have more practical or decorative uses.

Both TH and WRFN members report harvesting berries and other edible plants from the Coffee Creek area which would supplement the meat and fish they also harvested from the land (Tr'ondëk Hwëch'in 2012b; Bates and DeRoy 2014). According to the Coffee Creek Traditional Knowledge Survey (Tr'ondëk Hwëch'in 2012b)

> "*Harvesting berries was also an important activity in the Coffee Creek area, where high bush and low bush cranberries could be found. Blueberries were picked in the flats and soap berries were plentiful. William also mentioned gooseberries, which Roland thought to be mossberries.*"

Similarly, WRFN members report picking blueberries, highbush cranberries and blackberries in the Project area (Bates and DeRoy 2014). These reports are consistent with observations from the vegetation baseline surveys which noted an abundance of berries in parts of the LSA.

Plants within the LSA have also been harvested for medicinal use such as the pitch from trees and the root or leaves of certain species (Popadynec 2007; InterGroup Consultants Ltd. 2009; Tr'ondëk Hwëch'in 2012b; Bates and DeRoy 2014).

> "*Some of the leaves are good, certain leaves are good for medicines…some you make salves. Some are plants. Some are the flowers and all that.*" (W01 18-Aug-2014 *in* Bates and DeRoy 2014).

As well as for other purposes:

> "*Plants also had many other uses, including for making tools, baskets, sleds and snowshoes. A WRFN study participant reported that his mother collected birch bark in the area around Coffee Creek, which she would use to make baskets.*" (Bates and DeRoy 2014).

2 ECOSYSTEM MAPPING

Ecosystem mapping is typically used as a method of describing vegetation across a landscape. By grouping plant species into communities it facilitates describing possible effects such as loss of habitat. Ecosystem mapping can also be used as a base for describing various habitats for wildlife species. The aim of ecosystem classification and mapping is to provide primary information on the biological and physical characteristics of various landscape components in order to facilitate a range of interpretations and assist in sustainable management (Rowe and Sheard 1981).

Yukon's ecological classification framework groups ecosystems at four levels: regional, broad, local, and phase. Resource mapping is typically completed at the local level but can also be completed at the broad level. Both local and broad level ecosystems are classified based on an approach where climate, vegetation, soils, and landscape position are considered (Flynn and Francis 2011). Broad level ecosystem mapping is where the landscape is classified into broad vegetation community units within bioclimate zones and typically these broad ecosystems are classified based on a combination of dominant and diagnostic growth forms. The local level represents ecosite mapping. Ecosites are organized along a toposequence of landscape positions, and within an edatopic grid to describe relative soil moisture and nutrient conditions (Flynn and Francis 2011).

In absence of a standard system for classifying vegetation in the Yukon, mapping and supporting vegetation sampling used the *Standard for Terrestrial Ecosystem Mapping in British Columbia* (RIC 1998) is a guideline (as recommended by Nadele Flynn from the ELC Program (pers. comm., 2015). This BC system provides a uniform method of describing vegetation, soil, and terrain characteristics based on orthophoto interpretation and field data collection. Some approaches, including the ecological classification framework; however, were adjusted to accommodate methods and requirements specific to the Yukon ELC Program. Following the ecological frameworks adopted for ELC work in the Yukon (National Ecological Framework of Canada (NEF) and the Yukon Bioclimate Framework (YBF)), the classification used for this Project was based on a hierarchical ecosystem classification framework, including Bioclimate zones (regional), broad ecosystems, ecosites (local), and vegetation associations within ecosites.

Within bioclimate zones, vegetation communities are described through ecosite and vegetation association designations. Ecosites are the site-level 'building blocks' and are interpreted within the context of the bioclimate zone in which they occur. They represent vegetation potential and are relatively stable and enduring features that are defined by landscape position and characteristic site conditions, including soil moisture and nutrient regimes (Environment Yukon 2015a, 2015b). Vegetation associations are ecosite subdivisions that incorporate the differences an ecosystem experiences through seral vegetation development. Vegetation associations provide a method of describing the current vegetation characteristics of an ecosite, which is beneficial for disturbance dominated landscapes like the Yukon's boreal forest (Environment Yukon 2015a, 2015b).

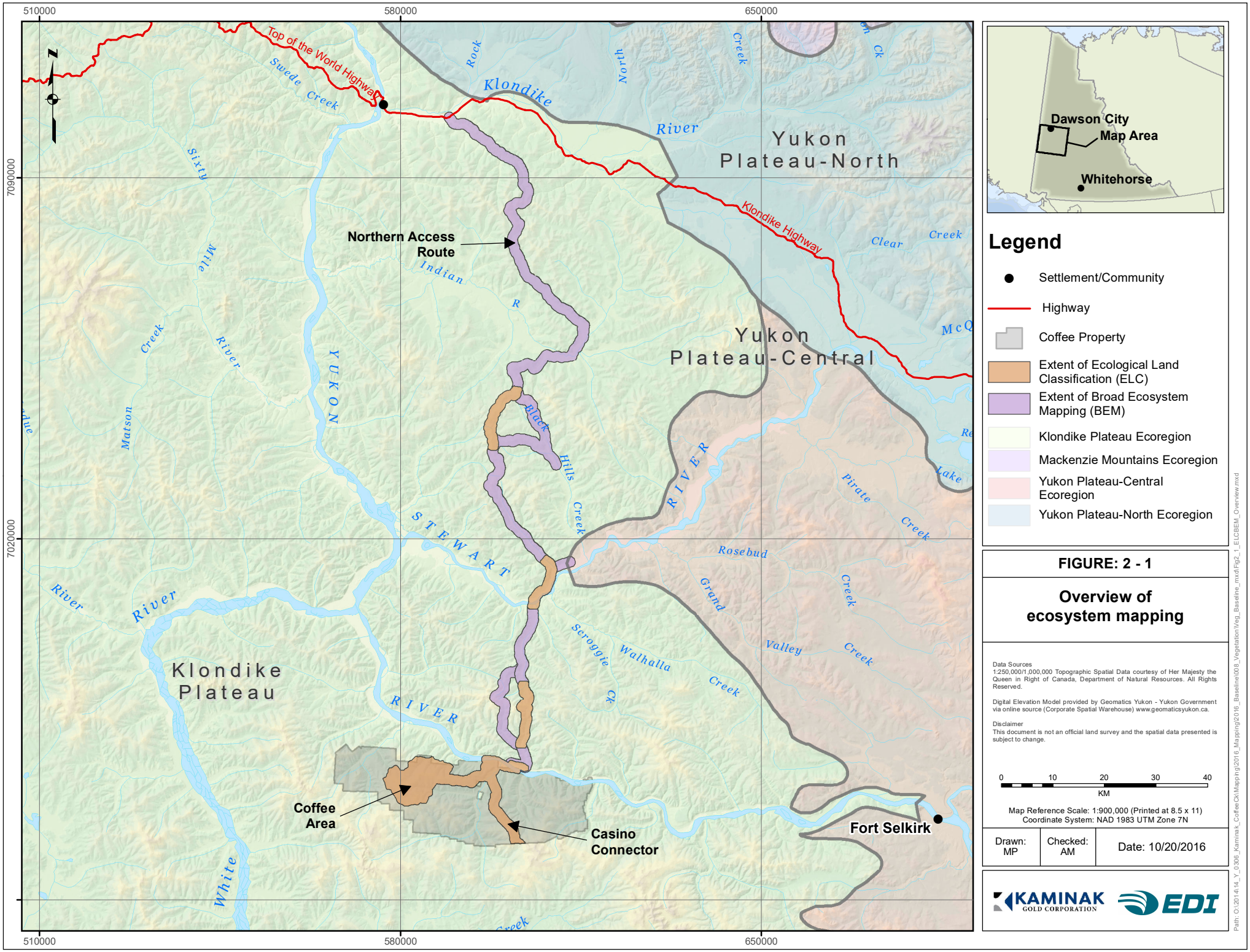
2.1 METHODS

The ecosystem mapping and survey extent includes the proposed mine site area, the existing road between Coffee Camp and the deposit (i.e., the Java Road), the current airstrip and Coffee Camp, the proposed NAR to the junction with the Klondike Highway, as well as a few previous road alignment options including the previous Casino road option and alternate alignments through the Dawson Goldfields. Around the mine site, the mapping and survey extent is delineated based on the height of land while encompassing a minimum buffer of 1 km around the proposed development. Along the various road alignments, the mapping and survey extent includes a 1 km buffer on either side of the road (Figure 2-1).

Ecosystems of the Coffee Project area were mapped at two levels: Ecological and Landscape Classification (Ecosite, ELC) and BEM. The more detailed ELC mapping was completed around the proposed mine site and along new sections of proposed roads, including a proposed Casino Connector (no longer being considered) and sections of the proposed NAR. Broad Ecosystem Mapping was completed along the proposed NAR in sections with existing roads (Figure 2-1) to supplement the ELC mapping. Table 2-1 outlines the breakdown of the ecosystem mapping by area.

Table 2-1. Breakdown of ecosystem mapping by area

Ecosystem Mapping Level	Survey Extent Component	Total Area Mapped (ha)
ELC Mapping	Coffee Area	11,391.4
	Proposed Casino Road	2,920.6
	NAR (new road only)	9,531.7
	Total ELC Mapped Area	**23,843.7**
BEM	NAR (existing road)	36,581.8
	Total BEM Mapped Area	**36,581.8**
Combined ELC and BEM		**60,425.5**


510000
580000
650000
7090000
7020000
Top of the World Highway
Swede Creek
Klondike River
Rock Creek
North Fk Ck
Yukon Plateau-North
Klondike Highway
Clear Creek
Northern Access Route
Indian R
Sixty Mile
Creek
River
YUKON
Matson
Yukon Plateau-Central
Black Hills Creek
RIVER
Pirate Creek
Lake
STEWART
Rosebud Creek
Grand Valley Creek
Scroggie Ck
Walhalla Creek
Klondike Plateau
RIVER
White
Coffee Area
Casino Connector
Fort Selkirk
Dawson City
Map Area
Whitehorse
Legend
Settlement/Community
Highway
Coffee Property
Extent of Ecological Land Classification (ELC)
Extent of Broad Ecosystem Mapping (BEM)
Klondike Plateau Ecoregion
Mackenzie Mountains Ecoregion
Yukon Plateau-Central Ecoregion
Yukon Plateau-North Ecoregion
FIGURE: 2 - 1
Overview of ecosystem mapping
Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.
Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.
Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.
0 10 20 30 40
KM
Map Reference Scale: 1:900,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N
Drawn: MP
Checked: AM
Date: 10/20/2016
KAMINAK GOLD CORPORATION
EDI
Path: O:\2014\14_Y_0306_Kaminak_CoffeeCk\Mapping\2016_Mapping\2016_Baseline\008_Vegetation\Veg_Baseline_mxd\Fig2_1_ELCBEM_Overview.mxd

2.1.1 ELC MAPPING AND CLASSIFICATION METHODS

ELC mapping was completed by EDI ecologists between 2014 and 2016. Territorial and provincial standards were used as reference material for the mapping protocol, field data collection, plant species and ecosystem nomenclature. The standards and guidelines included the following:

- Yukon Ecological and Landscape Classification Guidelines, Version 1.0 (Environment Yukon 2015a);
- Field Manual for Describing Terrestrial Ecosystems, 2nd Edition (BC Ministry of Forests and Range and BC Ministry of Environment 2010);
- Ecoregions of the Yukon Territory: Biophysical Properties of Yukon Landscapes (Smith *et al.* 2004);
- Flora of the Yukon Territory, 2nd Edition (Cody 2000);
- Yukon Biophysical Inventory System (YBIS). Data management system and government used vegetation codes database. Environment Yukon's Information Management Branch (IMT);
- Field Manual for Describing Yukon Ecosystems, draft document (Environment Yukon 2014); and
- A Field Guide to the Ecosite Identification for the Boreal Low Subzone of Yukon (Environment Yukon 2015b).

A discussion with the ELC Coordinator for Environment Yukon confirmed that no previous ELC projects or freely available vegetation data exist within the LSA (N. Flynn, pers. comm., 2015).

2.1.1.1 Data Preparation

Spatial Data — A variety of digital data were acquired, for use in ArcMap (ArcGIS 10.1), in preparation for ELC mapping. High resolution orthoimagery (2013, 2015) for the LSA was provided by Kaminak. Other data sources acquired or prepared in this phase include:

- Coffee Creek Mine Terrain Mapping (AECOM 2011a);
- Proposed Access Road Terrain Mapping (Palmer Environmental Consulting Group 2016);
- LiDAR 2m Contours (AECOM 2011b; McElhanney Consulting Services Ltd. 2015);
- Digital Elevation Model (DEM; AECOM 2011c);
- 1:50,000 Yukon Stream and Waterbodies mapping (Natural Resources Canada 2012);
- 1:50,000 Yukon Vegetation Inventory (YVI; Government of Yukon 2014);
- Yukon Bioclimate Zone Boundaries (Environment Yukon 2012);
- Bing Maps data available through ArcGIS for small sections along the outer reaches of the LSA were orthoimagery was not provided (Bing Maps);
- The Earth Observation for Sustainable Development of Forests (ESOD) Land Cover map (25 m pixel; Wulder *et al.* 2008);

- User-defined spatial slope (flat, gentle, moderate, and steep) and aspect (neutral, warm and cool) layers (refer to Appendix B for slope and aspect class values);
- Information from the 2014–2015 field sampling efforts, including field data forms and spatial coordinates; and
- ELC mapping database populated with the working legend information (see Ecological Classification Data).

Data sources such as YVI, ESOD and Yukon Stream and Waterbodies mapping, which are generated at a smaller scale, were used as reference material to assist ELC mapping. However the data were used with appropriate caution given the differences in scale.

2.1.1.2 Ecosystem Polygon Delineation

Upon completion of spatial data acquisition and database formation, ecosystem polygon delineation was completed in two dimensions with a direct to digital system using ArcMap in ArcGIS 10.1. Ecosystem polygon delineation was completed at a scale of 1:10,000, with a targeted average polygon size of 10 hectares (ha). In general, polygons were no greater than 20 ha, unless obviously the case, and no smaller than 2 ha, unless delineating a small waterbody or wetland feature.

Terrain mapping, completed by AECOM (2011) and Palmer (2015–2016), was used as the base data for polygon delineation in the ELC. As described in the BC TEM Standards (RIC 1998), terrain features and soil drainage are important in describing ecosystem characteristics and informing ecosystem delineation. Therefore, to retain terrain information, ELC polygons were delineated within existing terrain polygons based upon discernable differences among the following criteria, as described in the TEM Standards (RIC 1998):

- Vegetation (species composition, canopy characteristics, stand age and height);
- Topography (landscape position, aspect, slope, drainage patterns);
- Soils (depth and drainage); and
- Gradients and patterns (relationship patterns between ecosystem units, polygon shape and orientation).

Although terrain polygons were used as an initial building block for ELC polygon delineation, the terrain data is not retained within the ELC polygon database as this information was independently submitted.

Initial ecosystem polygons were delineated without consideration of bioclimate zone boundaries as they were not incorporated into the terrain polygons. Following the completion of field sampling, a combination of aerial interpretation and plot data were used to incorporate bioclimate boundaries (alpine, subalpine and boreal) within the mapping extent. In some instances, alterations to the terrain polygons were necessary to accommodate the delineation of bioclimate zone boundaries.

Forest fires are an important and relatively frequent disturbance in the Yukon (YEWG 2004). A number of areas within the ELC mapping extent were burned within the last 35 years and are currently in an herb- or shrub-dominated state. These areas were mapped based on landscape position, aspect, environmental conditions, and pre-fire Vegetation Resource Inventory data when available.

2.1.1.3 Preliminary Ecosite Descriptions

Preliminary ecosystem entities for the Coffee Project, including ecosite codes and descriptions, were obtained from the Casino Project: Vegetation Baseline Report (EDI 2013). Given the proximity of the Casino Project, it was assumed that similar ecosystem types would be found within the LSA. Additionally, at the time of the initial field survey, it was thought that the Casino and Coffee Projects would eventually share an access road; therefore sharing similar ecosystem classification schemes would be beneficial. In 2015, with the change in the proposed access road alignment, the ecosystem entities for the Coffee Project were further developed based on field sampling to best represent the ecosystems within the LSA.

Designations used to define vegetation characteristics, including structural stage and vegetation strata, were obtained from the Field Manual for Describing Yukon Ecosystems (Environment Yukon 2014). Structural stage and vegetation strata codes and descriptions differ between Yukon and BC, therefore an effort was made to use Yukon specific designations wherever possible.

Site modifier codes were adapted from Terrestrial Ecosystem Mapping in BC (RIC 1998) and the Field Manual for Describing Terrestrial Ecosystems, 2nd Edition (BC MoFR and MoE 2010). The compensating effects of different environmental characteristics can result in some ecosites having a range of physical site conditions. This variation was dealt with by defining the "typical" conditions for an ecosite and then using site modifiers, which are a set of descriptive terms for certain site conditions, such as aspect and soil depth, to describe conditions outside those considered typical. Typical site modifiers (also called assumed modifiers) were determined for each preliminary ecosite prior to the 2014 field surveys and ELC mapping. Assigned assumed modifiers were updated in 2015 based on field sampling.

2.1.1.4 Field Sampling and Data Entry

The ELC field surveys were completed over four weeks during the summers of 2014 and 2015 (July 30–August 12, 2014; July 22–29 and August 19–25, 2015). The first week of surveys in 2014 was completed by a two-person crew (vegetation and soil personnel) while a second two-person crew was added for the second week of sampling. In 2015, each week-long survey was completed by a two-person crew. Kaminak environmental monitors assisted the EDI field crews whenever available. The field surveys were timed to ensure that most vegetation species would be developed and readily identifiable. Field sampling was conducted in an effort to ground-check the site and soil conditions and vegetation communities in as many of the ELC polygons as possible. With the exception of areas accessible from the existing roads, the majority of the ELC survey extent was accessed by helicopter.

The objective of field sampling was to assess a diversity of vegetation communities (ecosites and vegetation associations) within each bioclimate zone to ensure an understanding of the ecosystems occurring throughout the LSA, including areas that may be subject to direct impacts. Although a preliminary ecosystem classification was available at the time of the 2014 survey, ELC sampling had not been completed for the Coffee Project; therefore sufficient data needed to be gathered to corroborate or amend the ecosystem classification system used for the nearby Casino Project. Field sampling was completed with a targeted minimum intensity of approximately 1 plot per 100 ha of the ELC survey extent, which would achieve an Ecosystem Survey Intensity Level (ESIL) 4, as per the BC TEM Standards (RIC 1998), and ESIL 2, as per the Draft Yukon Bioclimate Framework Mapping Guidelines (Environment Yukon 2015a).

Field crews collected ecological and vegetation information typical of ecosystem mapping projects (BC MoFR and MoE 2010) and ensured that plot locations expressed representative and homogenous site, soil and vegetation characteristics whenever possible. Three standard types of field plots were established with the initial target ratios below:

- Full Plots (5%) — recorded on Yukon Standard Site, Vegetation and Soil Forms;
- Ground Plots (30%) — recorded on BC Site Visit Forms (SIVIs); and
- Visual Plots (65%) — recorded on SIVIs or field note paper.

The aim of the field survey was to complete a full plot in as many ecosites as possible to aid with ecosite identification and description. The locations of full plots were often pre-selected during field planning using orthoimagery to assist in ensuring that the desired distribution of plots was completed. Ground plots are abbreviated plots from which data are recorded to confirm the identification of the ecosite or determine polygon boundaries. They also provide data for characterizing ecosystem attributes, including site modifiers and structural stage. Visual plots typically contain brief observations on any number of the ecological attributes to help define the ecosite in the field. They are intended to be quick field estimates of the site, soil and/or vegetation conditions. The information collected during most visual plots for this Project was more extensive than described in the BC TEM Standards (RIC 1998) because the information collected was to contribute to ecosite development and classification (unlike ecosystem mapping projects that use published provincial ecosystem classifications). The information collected at each plot type is presented in Appendix B.

Although SIVI forms, used by the BC Ministry of Environment, were used to collect information for ground and visual plots, Yukon specific information, such as structural stage and vegetation strata designations, were recorded to ensure that the data could be entered into the Yukon Biophysical Inventory System (YBIS; Environment Yukon). Visual plots recorded on note paper were entered in a spreadsheet database. The digital data for all field plots is presented in Appendix B.

Field sampling locations were accessed by either truck or helicopter and specific plot locations were accessed on foot. Often field plots were completed along an environmental gradient to gain a better understanding of how environmental variables influenced vegetation communities across the landscape. Digital photographs of plot conditions and GPS coordinates were taken at all plot locations.

Upon completion of field sampling, the plot cards and field notes were reviewed for completeness and accuracy during an internal data quality assurance (QA) process. All associated digital photographs were reviewed to ensure that they correspond to, and were named for, the appropriate field plots. The plant species recorded at all plots were reviewed during data entry to ensure that they conformed to the most recent nomenclature provided through the YBIS data management system. A final review of the YBIS and spreadsheet plot databases was also completed.

Plots completed along the proposed potential access routes that were subsequently discarded were still used to identify and develop the ecosite classification. An overview of the field plot locations, colour coded by year of collection, within the ELC survey extent, are presented in Figures 2-2 to 2-7.

Limitation: The ecosystem mapping in the ELC survey extent is based entirely on the field plot data collected. Field plot coverage is quite widespread in the Coffee area, however some sections of the proposed access roads (the NAR and Casino Connector Road) were not extensively sampled. As the ELC mapping is concentrated in areas where no current road exists, accessing some areas proved challenging due to limited helicopter landing locations. In addition, the most northern ELC segment along the NAR (Figure 2-5) was incorporated after field sampling was complete therefore no field plots were completed in this area.

2.1.1.5 Classification and Database Development

Using the field sampling results, all ecosystem polygons were assessed individually (in 2-dimensions using supporting spatial data files in ArcMap) and ecological attributes were estimated and entered in the ELC database (refer to Table 2-2). The attributes were assessed and entered taking care to be sure that: 1) no more than three map entities per polygon were entered, 2) defined ecosite codes and modifier codes were used, and 3) all information was completed for every polygon.

Yukon Vegetation Inventory data were used in addition to orthoimagery and plot data in estimating the structural stage attributes for forested areas during ecosystem classification, as it provides information pertaining to stand age.

Refer to Section 2.1.1.6 for a description of the classification system and ecosystem codes used in classifying polygons. The descriptions and codes of assumed and atypical site modifiers, structural stages and stand modifiers are presented in Appendix B.

Following the completion of the ELC database, all of the mapped supporting ecosystem information was reviewed through an internal QA process for completeness and correctness, including the correct application of site modifiers (for assumed and atypical modifiers), structural stages and canopy composition modifiers. Finally, the spatial attributes of the ELC database were reviewed to ensure that all deciles sum to 100 percent, that no sliver polygons (typically less than 1 ha) or polygon overlaps remained, and that there were no errors in the assignment of ecosites and vegetation associations. A finalized seamless polygon spatial coverage was prepared following database review.

Table 2-2. ELC database fields and descriptions

ELC Database Field	Field Description
UniqueID	Unique Polygon Identifier
Eco_Reg	Ecoregion
Bio_Zon	Bioclimate Zone
Sdec_1	Decile 1 (percentage of the polygon from 4 – 10)
EcositeS1	Ecosite for Decile 1
SiteAM_S1a	Assumed Modifier 1 for Ecosite 1
SiteAM_S1b	Assumed Modifier 2 (if applicable)
SiteM_1a	Atypical Site Modifier 1 (if applicable)
SiteM_1b	Atypical Site Modifier 2 (if applicable)
Strct_S1	Structural Stage for Decile 1
Strct_M1	Structural Stage modifier
Stand_A1	Stand Composition Modifier: B (Broadleaf), C (Coniferous) or M (Mixedwood)
Distcls_1	Disturbance Modifier: F (Fire)
Dec_1_Area	Area of Decile 1 (ha)
Sdec_2	Decile 2 (percentage of the polygon from 0 – 5)
EcositeS2	Same sequence as above for Decile 2; ends at Dec_2_Area
Sdec_3	Decile 3 (percentage of the polygon from 0 – 3)
EcositeS3	Same sequence as above for Decile 3; ends at Dec_3_Area
Poly_Area	Total Polygon Area (ha)
Interpreter	Initials of ecosystem mapper
Source	Source of Estimate: P (Photo estimate), F (Full Plot), G (Ground Plot), V (Visual Plot)

2.1.1.6 Final Ecosite Descriptions

Following the completion of the 2014 field survey, the preliminary ecosite classification framework based on the Casino Project was amended to conform more closely to the YBF (Environment Yukon 2015a). The ecological classification framework used for this Project was based on the newly proposed YBF methodology, combined with aspects of the ecosystem classification systems used in BC and Alberta (AB).

The primary goal was to identify and describe ecosites and vegetation associations as delineated communities with defined floristic composition, physiognomy and habitat that cover the range of variation on the landscape (CNVC 2013). The standards used by the Canadian National Vegetation Classification (CNVC) define a vegetation association as "a plant community type with consistency of species dominance and overall floristic composition, having a clearly interpretable ecological context in terms of site-scale climate, substrate and/or hydrology conditions, moisture/nutrient factors or disturbance regimes, as expressed by diagnostic indicator species" (Jennings *et al.* 2004). Where diagnostic species refer to any species or group of species whose relative constancy or abundance can be used to differentiate one association from another (Jennings *et al.* 2004). Ecosites and vegetation associations were identified for the Coffee Project using a combination of the CNVC approach (CNVC 2013) and Environment Yukon (2015a, 2015b).

Ordination (non-metric multidimensional scaling) was used to identify and document vegetation patterns for plots completed in the Boreal and Subalpine/Alpine Bioclimate zones. Ordination techniques were used to arrange plots in terms of similarity in floristic composition, which allowed discontinuities in plot compositions to be recognized, or continuous variation to be partitioned into logical segments. A number of environmental variables, including elevation, slope position, aspect, soil characteristics, soil moisture and nutrient regime were related to the ordinations, as they influence the vegetation communities that exist across the landscape. Plot tabling was completed that initially sorted plots based on environmental variables, such as slope, moisture and nutrient regime, and then developed ecosites and vegetation associations through detailed plot-by-plot comparisons of plant species presence and percent cover.

The final ecosites and vegetation associations were constructed, incorporating all available environmental variables and floristic composition information. Although four Bioclimate zones are encountered with the survey extent (Alpine, Subalpine, Boreal High and Boreal Low), the ecosystem classification for the Alpine and Subalpine Bioclimate zones were combined because the Alpine Bioclimate zone only comprises a very small portion of the overall mapping extent and there is overlap in some ecosites. Similarly the classification system for the Boreal High and Boreal Low Bioclimate zones have been combined due to the small proportion of Boreal Low in the mapping extent and overlap in some ecosites.

This Project followed the ecosite organization and coding system used in the draft Field Guide to Ecosite Identification for the Boreal Low Southern Lakes Subzone of the Yukon (Environment Yukon 2015b). Ecosites were coded with a two-digit number that indicates, by its number series, a certain range of soil moisture and nutrient conditions:

a. 01 was used as the reference ecosite (medium in moisture and nutrients, typical for area)

b. The 10s and 20s were used for ecosites drier or the same moisture regime as the '01'

   i. 10s are nutrient poor to medium

   ii. 20s are nutrient rich to very rich

c. The 30s and 40s were used for ecosites moister than the '01'

   i. 30s are nutrient poor to medium

   ii. 40s are nutrient rich to very rich.

Vegetation associations within ecosites were then coded by one or more dominant and/or indicator species (e.g., 01-A represents a community with an aspen dominated canopy, whereas 01-Sw represents a community with a white spruce dominated canopy). Wetlands are designated with a two-character alphanumeric code, where the first character is a letter referring to the wetland class (e.g., F=fen, M=marsh, S=swamp) and the second character is a number used to differentiate between wetlands within a class (e.g., F1, F2, F3). Ecosite names use plant species that are important indicators of the vegetation found on the ecosite.

A list and description of the created ecosites for the Coffee Project can be found in Appendix C. The final ecosites are presented using a series of ecosite factsheets. The ecosite and vegetation association names and codes are displayed at the top of each factsheet page. The factsheets can be used as a field guide that describes ecosites within the Coffee LSA and in adjacent areas. This will assist in possible future ecological field work.

2.1.2 BROAD ECOSYSTEM MAPPING AND CLASSIFICATION METHODS

BEM was completed along the proposed NAR in sections with existing roads (Figure 2-1) to supplement the ELC mapping. Broad Ecosystem Mapping was conducted to identify wetland locations and provide additional high-level ecosystem information for road enhancements and for use in supporting wildlife assessments along the NAR. A cross-walk table identifying the BEM category for each ecosite and vegetation association (ELC) was created to assist any wildlife habitat mapping efforts to ensure ecosite and vegetation associations can be merged into forming a broad ecosystem map for the complete mapping extent. This cross-walk table can be found in Appendix B.

2.1.2.1 Data Preparation

The same suite of guidelines, standards and spatial layers used in support of ELC mapping were also used for BEM. Broad Ecosystem Mapping categories were developed by the EDI vegetation and wildlife subject matter experts. Categories had to provide broad distinctions between ecosystems that are useful for both vegetation and wildlife assessments. This involved separating categories based on elevation (e.g., high vs. low), dominant vegetation type (e.g., shrub vs. treed), canopy composition (e.g., coniferous vs. deciduous) and moisture and nutrient regimes (e.g., upland vs. riparian vs. wetland). Wetland ecosystems, which are infrequent on the landscape and could have high wildlife value, were of particular interest in the BEM; therefore all wetland classes (bog, fen, swamp and marsh) were mapped separately. To ensure that a seamless broad ecosystem level mapping coverage could be generated for the entire LSA, including the ELC mapping extent, all ecosites and vegetation associations described in the ELC were also assigned to broad ecosystem categories. As with ELC mapping, structural stage and canopy composition modifiers were mapped for all BEM categories.

2.1.2.2 Field Sampling and Data Entry

The majority of the BEM was completed via orthophoto interpretation. Plot data in this portion of the LSA, aside from wetland plot data, is minimal (36 vegetation plots). A wetland specific survey was completed from August 23–25, 2015, along the proposed NAR on existing roads from the Klondike Highway near Dawson through to Maisy May Creek, where the northern most ELC plots were completed. The objective of field sampling was to identify vegetation communities, particularly wetlands along the proposed NAR through a combination of Ground and Visual Plots. Additional wetland specific sampling in the BEM survey extent was completed concurrent with ELC sampling from July 22–29, 2015. Wetland plots were concentrated in areas where wetland ecosystems are quite abundant including the junctions of Ballarat Creek

with the Yukon River and, the junctions of Barker Creek and Maisy May Creek with the Stewart River. Many of these wetland rich areas were initially included in the BEM extent due to existing roads; however following the completion of field sampling these areas were instead included in the ELC mapping extent (Figures 2-2 to 2-7).

Upon survey completion, wetland Ground Plots were entered into YBIS and wetland Visual Plots, which had been recorded on field note paper, were entered into an excel database.

2.1.2.3 Polygon (Ecosystem) Delineation and Attribution

Upon completion of the BEM database formation, ecosystem delineation was completed in two dimensions with a direct to digital system using ArcMap in ArcGIS 10.1. Ecosystem delineation was completed at a scale of 1:20,000, with an overall targeted average polygon range of 20 to 25 ha. Polygons in areas with wetland ecosystems and ponds were delineated to a minimum of 1 ha to ensure wetland ecosystems were adequately captured. Unlike the more detailed ELC mapping, terrain mapping was not used as a base layer in ecosystem polygon delineation and Bioclimate zones were not incorporated. BEM polygons were delineated by an EDI ecologist based upon discernable differences among the following criteria, as described in the BC TEM Standards (RIC 1998):

- Vegetation (species composition, canopy characteristics, stand age and height);
- Topography (landscape position, aspect, slope, drainage patterns);
- Soils (depth and drainage);
- Terrain (parent material); and
- Gradients and patterns (relationship patterns between ecosystem units, polygon shape and orientation).

Upon completion of delineation, all ecosystem polygons were assessed individually (in 2-dimensions using supporting spatial data files in ArcMap) and ecological attributes were estimated and entered in the BEM database (refer to Table 2-3).

Yukon Vegetation Inventory data was used in addition to orthoimagery and plot data in estimating the structural stage attributes for forested areas during ecosystem classification, as it provides information pertaining to stand age.

Forest fires are an important and relatively frequent disturbance in the Yukon (YEWG 2004). Approximately 28% of the BEM extent has been burned within the last 35 years and is currently in an herb- or shrub-dominated structural stage. Broad ecosystems in these areas were mapped based on landscape position, aspect, environmental conditions, and pre-fire Vegetation Resource Inventory data where available. Additionally, to remain consistent throughout the BEM extent, vegetation that has very recently been burned is mapped as structural stage 3 (herb dominated) because herbs and dwarf shrubs are likely to be the first plants revegetating these areas. Shrubby areas, including areas with burned standing snags (without crowns) are mapped as structural stage 4. In areas of light fire where stands of dead trees remain, complete

with crowns, structural stages 6 to 8 is mapped, along with a fire modifier. A fire modifier was no longer used for regenerating stands once they reached a pole/sapling structural stage (Appendix B).

Following the completion of the BEM database, all entered ecosystem information was reviewed for completeness and correctness during an internal QA process, including the correct application of structural stages and canopy composition modifiers. The spatial attributes of the BEM database were reviewed to ensure that all deciles summed to 100 percent, that no sliver polygons or polygon overlaps remained, and that there were no errors in the assignment of BEM categories.

Table 2-3. BEM database fields and descriptions

BEM Database Field	Field Description
UniqueID	Unique Polygon Identifier
Sdec_1	Decile 1 (percentage of the polygon from 4 – 10)
MapCode_S1	Ecosite for Decile 1
Strct_S1	Structural Stage for Decile 1
Strct_M1	Structural Stage modifier
Stand_A1	Stand Composition Modifier: B (Broadleaf), C (Coniferous) or M (Mixedwood)
Distcls_1	Disturbance Modifier: F (Fire)
Dec_1_Area	Area of Decile 1 (ha)
Sdec_2	Decile 2 (percentage of the polygon from 0 – 5)
MapCode_S2	Same sequence as above for Decile 2; ends at Dec_2_Area
Sdec_3	Decile 3 (percentage of the polygon from 0 – 3)
MapCode_S3	Same sequence as above for Decile 3; ends at Dec_3_Area
Poly_Area	Total Polygon Area (ha)
Interpreter	Initials of ecosystem mapper
Source	Source of Estimate: P (Photo estimate), F (Full Plot), G (Ground Plot), V (Visual Plot)

2.2 RESULTS

The ecosystem mapping identified 34 ELC ecosites (24 ecosites in boreal zone, 10 ecosites in subalpine/alpine zone), 11 non-vegetative/anthropogenic units and 13 BEM units. The ELC mapping identified 7 unique wetland ecosites and the BEM identified 4 wetland units (bog, fen, marsh and swamp).

2.2.1 ELC MAPPING AND FIELD RESULTS

2.2.1.1 Field work

Field sampling within the ELC survey extent was initiated in 2014 (July 31 – August 12, 2014) and subsequently completed in 2015 (July 22–29th and August 19–25th, 2015). The 2014 field survey was completed near the proposed mining footprint, along existing infrastructure within the Coffee Property, and

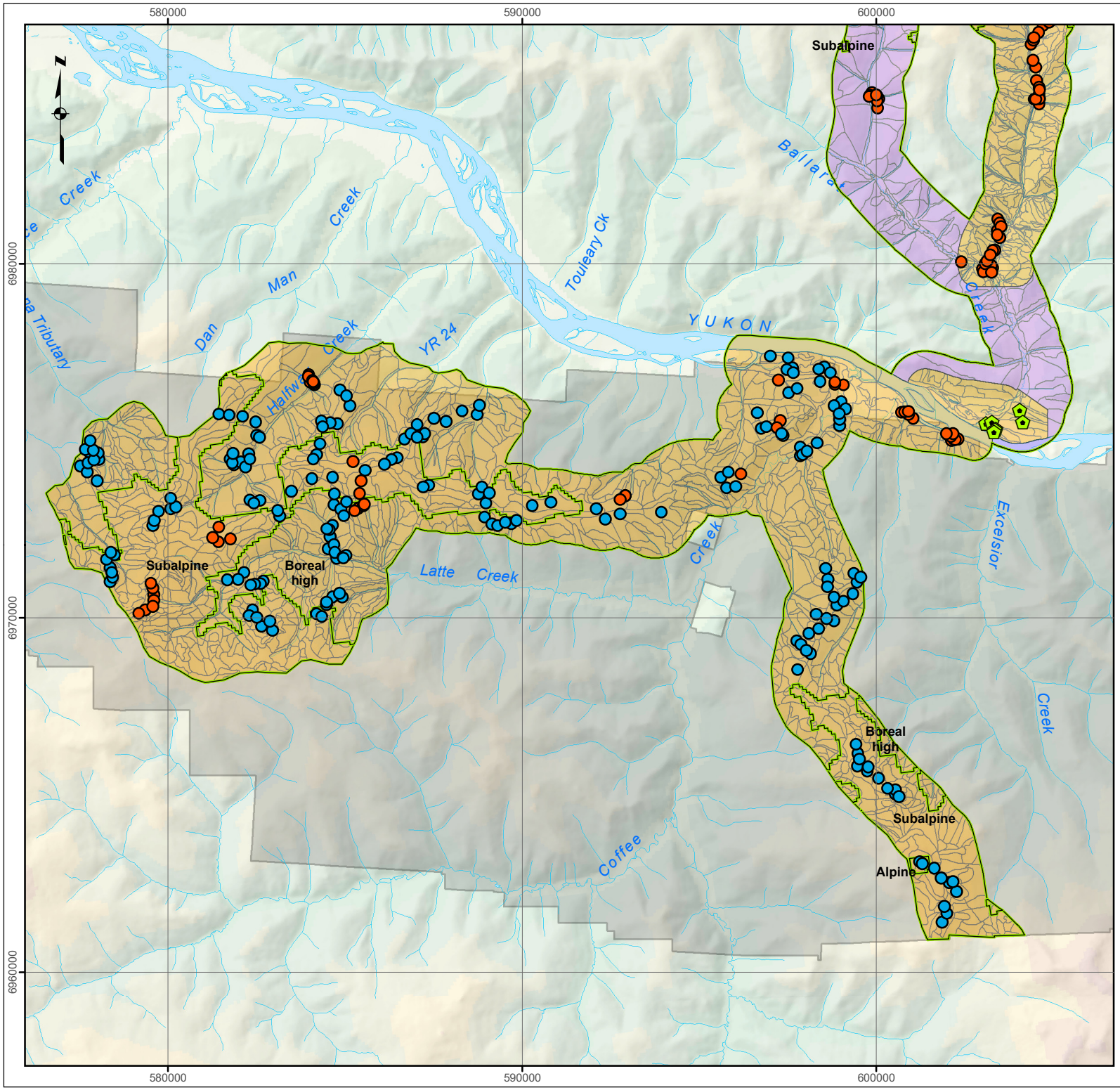
along a conceptual road connecting to Casino (Casino Connector). The 2015 plots were completed throughout the ELC and BEM survey extent with emphasis on the proposed route options for the NAR.

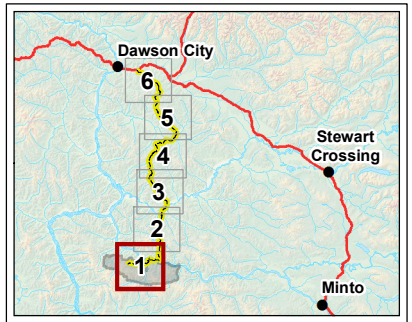
A total of 354 ELC field plots were completed, consisting of 23 Full Plots, 137 Ground Plots and 194 Visual Plots. Of the plots surveyed, 311 were within the final ELC mapping extent for the Project. Plots completed along the potential access routes that were subsequently discarded were still used to identify and develop the ecosite classification. An overview of the field plot locations, colour coded by year of collection, within the ELC survey extent, are presented in Figures 2-2 to 2-7. A total of 91 and 263 field plots were completed in the Subalpine/Alpine and Boreal Bioclimate zones, respectively.

2.2.1.2 ELC Mapping

A total of 2,937 ELC polygons were mapped within the 23,844 ha ELC mapping extent, with an average ELC polygon size of approximately 8 ha (close to the 10 ha target for this project; Figures 2-1 to 2-5). An average of 1 plot per 85 ha was completed within the ELC mapping extent, achieving an ESIL of 4, as per the BC TEM Standards (RIC 1998), and ESIL 2, as per the Yukon Bioclimate Framework Mapping Guidelines (Environment Yukon 2015a).

The area of each ecosystem (ecosite) mapped within the Boreal Bioclimate zone (18,593.1 ha) is summarized in Table 2-3. The area of each ecosystem (ecosite) mapped within the Subalpine/Alpine Bioclimate zone (5,250.6 ha), is summarized in Table 2-4. The divisions of the ELC survey extent into the Coffee Area, the proposed NAR and the Casino Connector are illustrated in Figure 2-1.





Legend

- Settlement/Community
- 2014 ELC/BEM Plots
- 2015 ELC/BEM Plots
- Wetland Plots (2015)
- Highway
- Coffee Property
- Ecosystem Land Classification (ELC)
- Broad Ecosystem Mapping (BEM)
- Bioclimate Zone

FIGURE: 2-2

ELC/BEM polygons and field plots Map 1 of 6

Data Sources
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Project data is site specific. Survey data was collected by EDI Environmental Dynamics Inc. (2014/2015).

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Map Reference Scale: 1:150,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MP	Checked: AM	Date: 10/20/2016

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EDI

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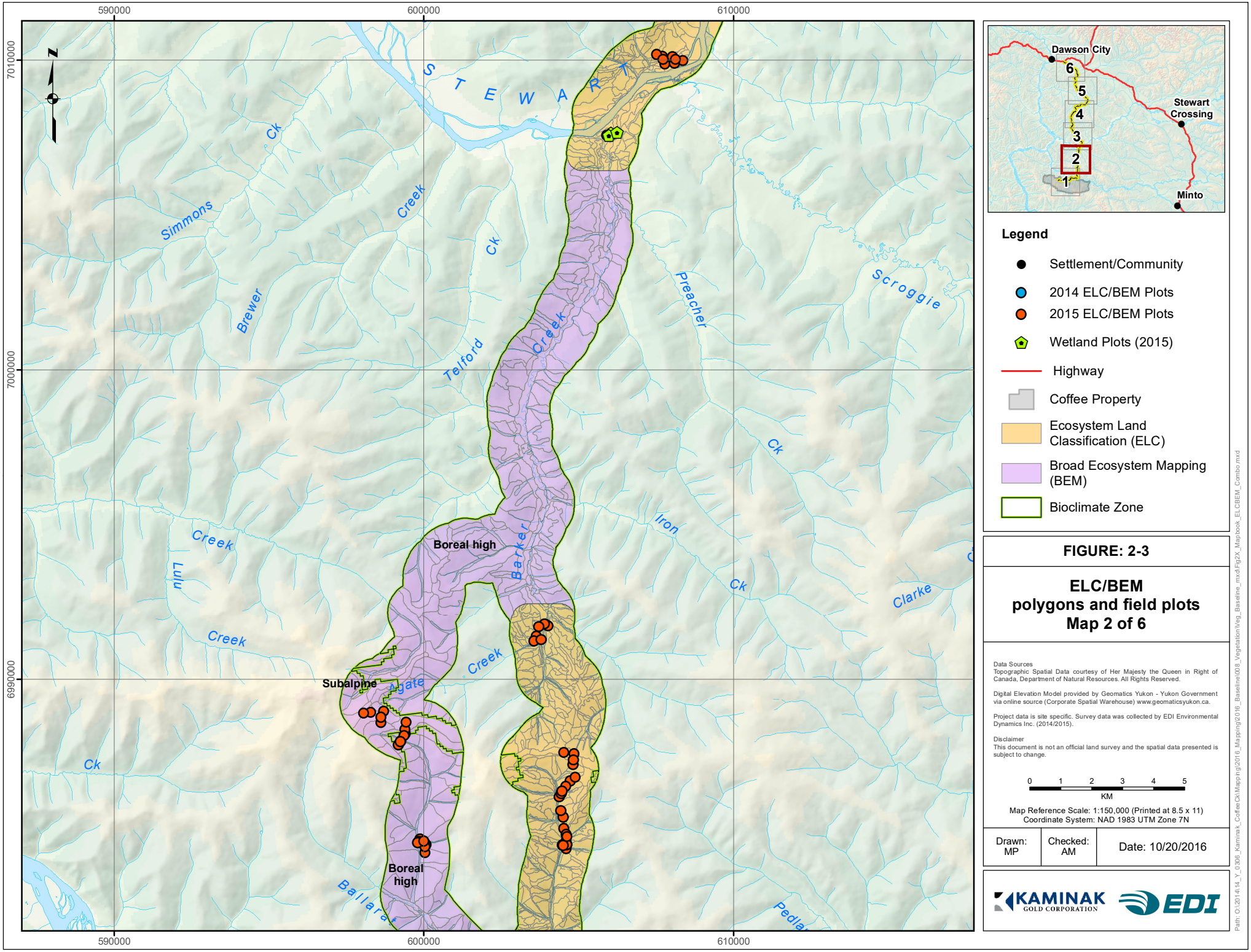

Legend

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- Bioclimate Zone

FIGURE: 2-3

ELC/BEM polygons and field plots Map 2 of 6

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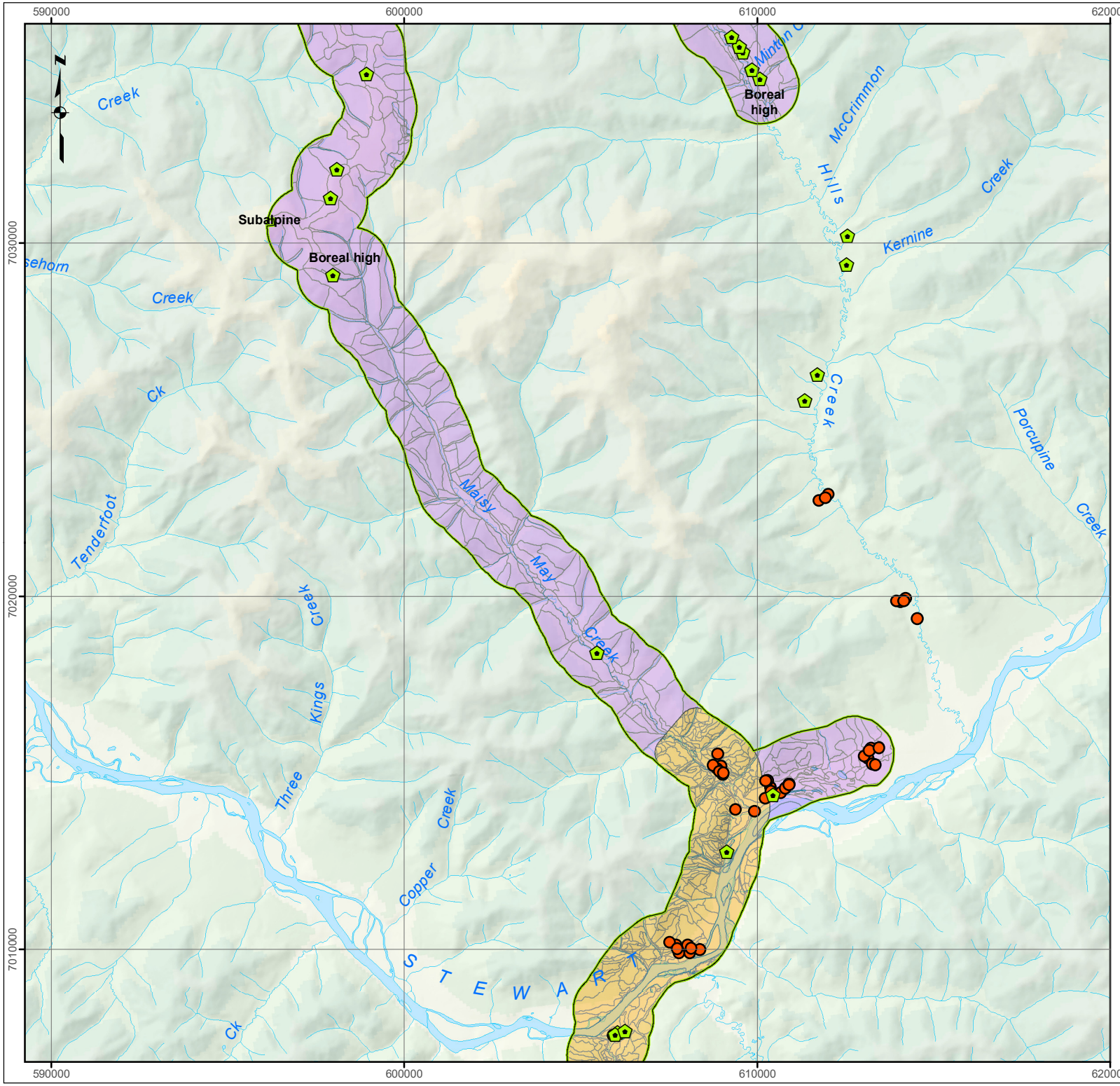

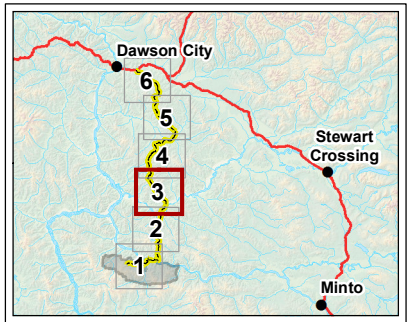

Legend

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- Highway
- Coffee Property
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FIGURE: 2-4

ELC/BEM polygons and field plots Map 3 of 6

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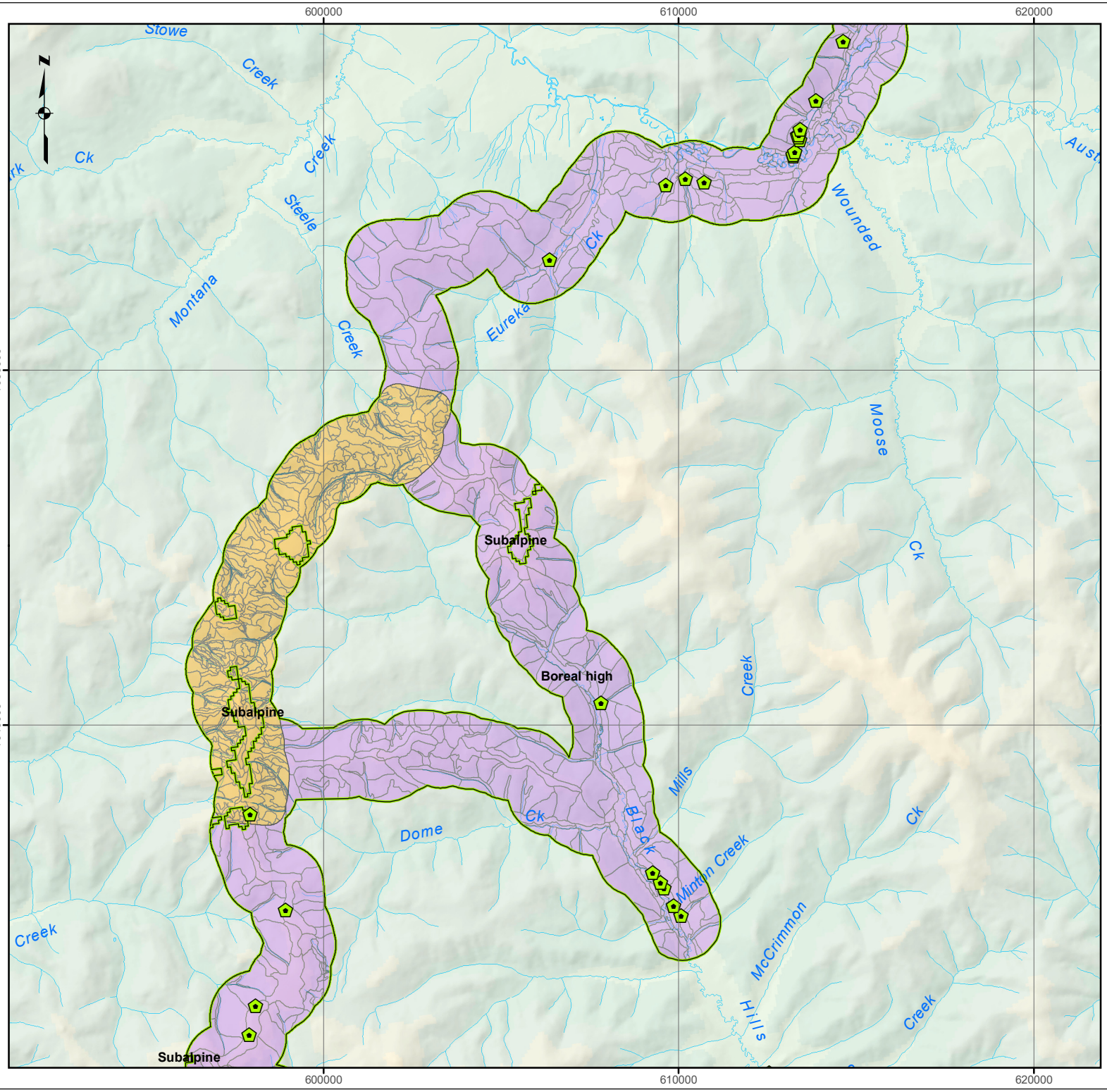

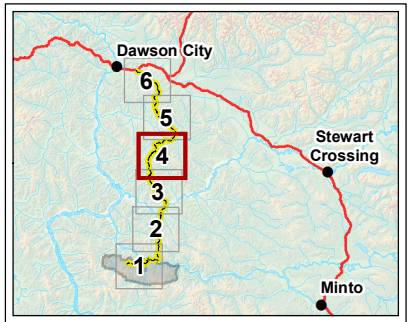

Legend

- Settlement/Community
- 2014 ELC/BEM Plots
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- Wetland Plots (2015)
- Highway
- Coffee Property
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- Bioclimate Zone

FIGURE: 2-5

ELC/BEM polygons and field plots Map 4 of 6

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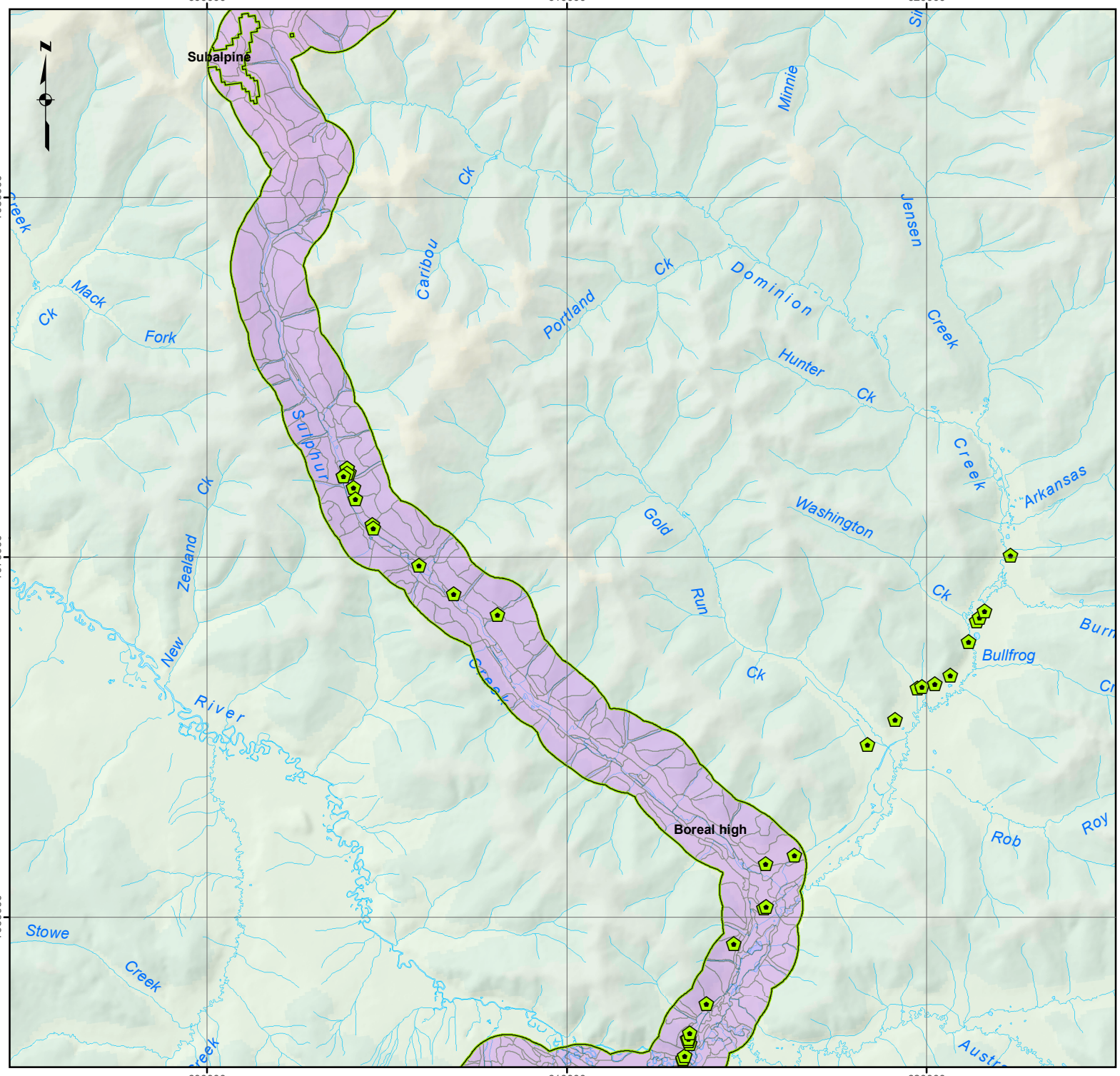

Legend

- Settlement/Community
- 2014 ELC/BEM Plots
- 2015 ELC/BEM Plots
- Wetland Plots (2015)
- Highway
- Coffee Property
- Ecosystem Land Classification (ELC)
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FIGURE: 2-6

ELC/BEM polygons and field plots Map 5 of 6

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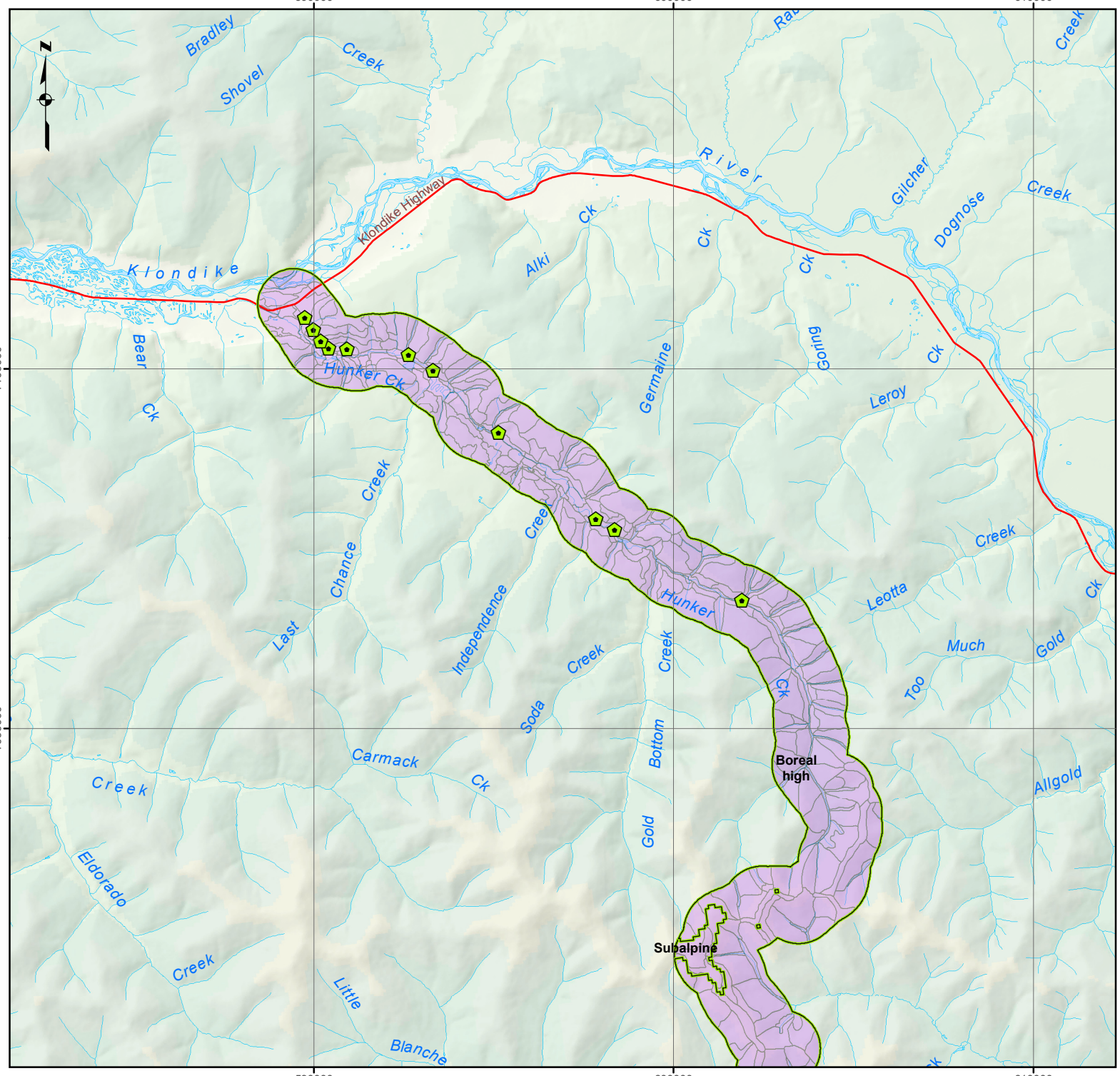

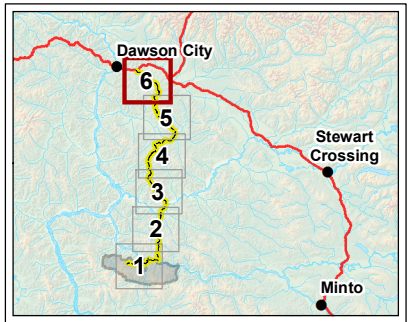

Legend

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FIGURE: 2-7

ELC/BEM polygons and field plots Map 6 of 6

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Boreal Bioclimate Zones

Treed ecosystems within the ELC survey extent of the Boreal Bioclimate Zones are most commonly mapped as young forests (44%; structural stage 6), followed closely by mature forests (38%; structural stage 7). Old forests, which are primarily coniferous-dominated, make up approximately 11% of the forested area. Overall, coniferous-dominated stands are the most commonly mapped treed ecosystems (55%); however, this includes treed wetlands and other moist-to-wet stunted spruce forests. Forests with dry-to-medium moisture regimes are mapped fairly evenly between coniferous-dominated, deciduous-dominated and mixedwood canopies. Zonal forests (ecosite 01) however, commonly have mixedwood canopies (approximately 43%). The abundance of mixedwood and deciduous-dominated forests in the 01 ecosite reflect the frequency of fire disturbance in the region. Hillsides are often mosaics of different canopy compositions and stand ages reflecting the successional development that occurs after fire disturbance.

Across the Coffee Area, the proposed NAR and the Casino Connector sections, the most commonly occurring ecosystem was ecosite 01, the zonal ecosite, which occurs across a range of soil moistures from slightly dry (submesic) to slightly moist (subhygric) with a medium nutrient regime (Table 2-4). In the Coffee Area section, the 01-WSw (Alaska birch – White spruce – Labrador tea - Lowbush cranberry – Feathermoss) vegetation association was the most commonly occurring 01 vegetation association (Photo 2-1). This association typically occurs on midslopes, across a range of aspects. The canopy is co-dominated by Alaska birch and white spruce and the ecosite typically contains Labrador tea, lowbush cranberry, green alder (*Alnus viridis*) and step moss (*Hylocomium splendens*) in the understory. Approximately 33% of the 01 ecosite mapped in the Coffee Area is in a shrub-dominated structural stage due to wildfire disturbance. Ecosite 32 (Black spruce - Labrador tea - Cloudberry - Sedge), with its two vegetation associations, also commonly occurs in the Coffee Area along north-facing, moderate lower-to-middle slopes underlain by near surface permafrost (Photo 2-2). The nutrient regime of the ecosite is typically poor and the moisture regime is moist-to-wet, with imperfect-to-poor drainage. A stunted black spruce canopy occurs over a Labrador tea-dominated shrub layer and an herb layer of sedges and cloudberry or cottongrasses.

The proposed NAR section of the ELC is predominantly (98%) in the Boreal Bioclimate zone. The 01-WSw and 01-W (Alaska birch - Labrador tea - Tall bluebells - Step moss) vegetation associations are the most common ecosystems mapped in the section (Table 2-4). The 01-W, like the 01-WSw, typically occurs on midslopes, across a range of aspects. The canopy is dominated by Alaska birch, with Labrador tea, lowbush cranberry, and step moss common in the understory. Ecosites in a shrub-dominated structural stage are also common, particularly ecosite 01, due to the influence of wildfires in the area. Ecosite 21 (Aspen - Kinnikinnick- Purple reedgrass) commonly occurs on dry, moderate-to-steep, south-facing slopes throughout the section. The canopy is aspen-dominated and an understory containing high kinnikinnick cover is common (Photo 2-3). Moist, gentle toe-slopes leading to valley bottom drainages are commonly mapped as ecosite 33 (Black spruce - Labrador tea - Sedge – Brown moss - Reindeer lichen) throughout the section. The ecosite occurs on imperfectly-to-poorly drained lower-to-toe slope sites underlain by permafrost. Additionally, although not a large percentage of the ELC mapping extent, ecosites 01-A (Aspen

- Soapberry - Purple reedgrass) and 01-Sw (White spruce - Rose - Bastard toadflax - Feathermoss) occur almost entirely within the proposed NAR section due to their occurrence at low elevations.

The 01-WSw and 01-W vegetation associations are also the most commonly mapped boreal ecosystems in the Casino Connector section of the ELC survey extent. They are typically mapped along the forested mid-to-upper, neutral slopes throughout the section. As in the Coffee Area, ecosite 32 is also commonly mapped on northerly, moderate lower-to-middle slopes underlain by near surface permafrost (Photo 2-2). The Casino Connector access (no longer being proposed) is the only section in the ELC survey extent unaffected by recent wildfire.

Table 2-4. Ecosite and vegetation associations in the Boreal Bioclimate zones mapped in the ELC mapping extent of the Coffee Project

Ecosite	Veg assoc	Name	Description and typical situation	Total Area (ha)	Area (ha) and (% of Section)		
					Coffee	NAR	Casino
20	**Capu**	Purple reedgrass - Lichen	forb and graminoid dominated grassland; moderate to steep, south-facing slopes; medium to rich nutrient regime	139	92.8 (0.81%)	44.1 (0.46%)	1.6 (0.05%)
20	**Aruv**	Kinnikinnick	ground shrub dominated 'grassland'; moderate to steep, south-facing slopes; tree cover <10%; medium to rich nutrient regime	142	-	141.8 (1.49%)	-
21		Aspen - Kinnikinnick- Purple reedgrass	dry aspen-dominated forest; mid to upper slope position, predominantly southerly aspect; commonly medium nutrient regime	1275	270.4 (2.37%)	930.5 (9.76%)	74.1 (2.54%)
01	**A**	Aspen - Soapberry - Purple reedgrass	mesic aspen-dominated forest; lower to upper slopes across a range of aspects; low elevations only; medium nutrient regime	360	-	360.3 (3.78%)	-
01	**W**	Alaska birch - Labrador tea - Tall bluebells - Step moss	mesic Alaska birch-dominated forest; lower to upper slopes across a range of aspects; medium nutrient regime	1485	330.7 (2.90%)	990.6 (10.39%)	163.9 (5.61%)
01	**WSw**	Alaska birch - White spruce - Labrador tea - Lowbush cranberry - Feathermoss	mesic mixedwood forest; lower to upper slopes across a range of aspects; medium nutrient regime	2755	1384.0 (11.83%)	1036.7 (10.88%)	334.1 (11.44%)
01	**Sw**	White spruce - Rose - Bastard toadflax - Feathermoss	mesic white spruce-dominated forest; lower to upper slopes across a range of aspects; low elevations only; medium nutrient regime	293	4.8 (0.04%)	287.9 (3.02%)	-
01	**Sw(Sb)**	Spruce - Labrador tea - Lowbush cranberry - Feathermoss	mesic coniferous forest, spruce (primarily white) dominated; lower to upper slopes across a range of aspects; medium nutrient regime	1452	681.8 (5.99%)	670.9 (7.04%)	99.7 (3.41%)

Table 2-4. Ecosite and vegetation associations in the Boreal Bioclimate zones mapped in the ELC mapping extent of the Coffee Project

Ecosite	Veg assoc	Name	Description and typical situation	Total Area (ha)	Area (ha) and (% of Section)		
					Coffee	NAR	Casino
01		Spruce - Feathermoss (Fire)	mesic forest; lower to upper slopes across a range of aspects; low elevations only; medium nutrient regime. (note: mapped in burned areas that are currently dominated by shrub, for which a canopy association cannot be determined)	2402	1181.1 (10.37%)	1221.3 (12.8%)	-
30		Black spruce - Labrador tea - Reindeer lichen	black spruce-dominated forest; predominately on northerly lower to upper slopes; high lichen cover; poor nutrient regime.	993	392.6 (3.45%)	538.1 (5.64%)	62.2 (2.12%)
31		Spruce - Birch - Lowbush cranberry - Feathermoss	sparse coniferous forest near Subalpine Bioclimate boundary, spruce-dominated; high shrub cover; predominantly upper slope with variable aspect; medium nutrient regime	1175	431.1 (3.78%)	616.8 (6.47%)	126.7 (4.34%)
32	**Sb1**	Black spruce - Scrub birch - Labrador tea - Cloudberry	moderate-to-steep northerly slopes underlain by permafrost; lower-to-mid slope; stunted black spruce canopy with scrub birch, Labrador tea and cloudberry in the understory; poor nutrient regime	221	187.6 (1.65%)	2.8 (0.03%)	30.7 (1.05%)
32	**Sb2**	Black spruce - Labrador tea - Cottongrass	moderate-to-steep northerly slopes underlain by permafrost; lower-to-mid slope; stunted black spruce canopy with Labrador tea, and cottongrass in the understory; poor nutrient regime	196	49.1 (0.43%)	84.9 (0.89%)	61.7 (2.11%)
32		Black spruce - Labrador tea - Cloudberry - Sedge	moderate-to-steep northerly slopes underlain by permafrost; lower-to-mid slope; stunted black spruce canopy with Labrador tea and lowbush cranberry in the understory; poor nutrient regime (note: mapped in areas where vegetation association for ecosite is unknown)	2283	1553.1 (13.6%)	459.3 (4.82%)	270.6 (9.27%)
33		Black spruce - Labrador tea - Sedge – Brown moss - Reindeer lichen	gentle-to-moderate, lower and toe slopes underlain by permafrost; black spruce dominated, spruce typically stunted; poor to medium nutrient regime	733	342.9 (3.01%)	325.0 (3.41%)	65.0 (2.23%)
40		White spruce - Horsetail	spruce (predominately white) dominated riparian stands; floodplains and gullies; with horsetail and feathermoss; medium to rich nutrient regime	536	199.6 (1.75%)	329.4 (3.46%)	6.8 (0.23%)

Table 2-4. Ecosite and vegetation associations in the Boreal Bioclimate zones mapped in the ELC mapping extent of the Coffee Project

Ecosite	Veg assoc	Name	Description and typical situation	Total Area (ha)	Area (ha) and (% of Section)		
					Coffee	NAR	Casino
41		Balsam poplar - Rose - Horsetail	balsam poplar-dominated midbench floodplain; rose and horsetails common in the understory; located along the banks of rivers and larger creeks; rich nutrient regime	347	188.3 (1.65%)	159.0 (1.67%)	-
42		Alaska birch - Alder - Reedgrass	Alaska birch-dominated riparian community; located along sideslope gullies and associated receiving areas; medium to rich nutrient regime	180	84.6 (0.74%)	90.9 (0.95%)	4.7 (0.16%)
43		Tall shrub Balsam poplar - Willow	balsam poplar and willow dominated low bench floodplain; located along the banks of the Yukon and Stewart Rivers; tall shrub structural stage	71	26.9 (0.24%)	44.2 (0.46%)	-
F1		Spruce - Willow - Labrador tea - Sedge	poor treed fen; open spruce canopy, spruce often stunted and in the shrub layer; located on level valley bottom terrain on fluvial parent materials; poor to medium nutrient regime; underlain by permafrost	270	85.1 (0.75%)	179.1 (1.79%)	6.2 (0.21%)
F2		Spruce - Red bearberry – Brown moss	treed fen; open spruce canopy, spruce can be stunted; located on level valley bottom terrain on fluvial parent materials; medium nutrient regime; underlain by permafrost	66	-	65.5 (0.69%)	-
F3		Birch - Leatherleaf - Sedge	shrubby birch dominated fen, with leatherleaf, willows and Labrador tea; level to depressional sites; medium nutrient regime; underlain by permafrost	194	134.7 (1.18%)	58.6 (0.61%)	1.0 (0.04%)
S1		Willow - Horsetail	willow-dominated shrubby riparian community; found along streams and sideslope creeks; medium to rich nutrient regime	222	107.9 (0.95%)	98.5 (1.03%)	15.8 (0.54%)
S2		Willow - Reedgrass	willow and reedgrass dominated swamp; level, typically surrounding marshes or ponds on old fluvial plains; medium to rich nutrient regime.	12	0.3 (0.00%)	11.6 (0.12%)	-
M1		Beaked sedge	sedge-dominated marsh; fluctuating water table; rich nutrient regime	6	2.4 (0.02%)	3.7 (0.04%)	-

Table 2-4. Ecosite and vegetation associations in the Boreal Bioclimate zones mapped in the ELC mapping extent of the Coffee Project

Ecosite	Veg assoc	Name	Description and typical situation	Total Area (ha)	Area (ha) and (% of Section)		
					Coffee	NAR	Casino
M2		Horsetail - Sedge	horsetail-dominated marsh; fluctuating water table; rich nutrient regime	1	-	0.9 (0.01%)	-
M		Marsh	sedge and/or herb dominated marsh; fluctuating water table; rich nutrient regime (note: mapped when dominate marsh vegetation unknown)	12	3.7 (0.03%)	8.1 (0.08%)	-
An		Anthropogenic	an area of anthropogenic disturbance, including areas cleared for camps, homesteads and air-strips	55	14.9 (0.01%)	40.1 (0.42%)	-
Gb		Gravel bar	An elongated landform generated by waves and currents and usually running parallel to the shore. It is composed of unconsolidated small rounded cobbles, pebbles, stones and sand	20	-	19.9 (0.21%)	-
Mp		Placer mine	an area cleared and disturbed through placer mine activity, includes unvegetated areas and areas undergoing revegetation, primarily shrub-dominated	54	-	54.3 (0.57%)	-
Pd		Pond	small body of water greater than 2 m deep, but not large enough to be classified as a lake	3	0.7 (0.01%)	2.2 (0.02%)	-
Rd		Road surface	an area cleared and compacted for the purpose of transporting goods and services by vehicles	6	-	5.8 (0.06%)	-
Ri		River	watercourse formed when water flows between continuous, definable banks; the flow may be intermittent or perennial	592	191.8 (1.69%)	400.3 (4.20%)	-
Ro		Rock	gentle to steep, bedrock escarpment or outcropping, with little soil development and sparse vegetative cover	52	3.2 (0.03%)	48.7 (0.51%)	-
Rt		Talus	active and inactive talus and scree; typically have a low herb layer cover because of mobile substrates or lack of soil.	35	33.8 (0.30%)	0.8 (0.01%)	-
			Total	18639	7979.9	9333.3	1324.8



Photo 2-1. Boreal vegetation association 01 – WSw (Alaska birch – White spruce – Labrador tea – Lowbush cranberry – Feathermoss)



Photo 2-2. Boreal vegetation association 32 – Sb1 (Black spruce – Scrub birch – Labrador tea – Cloudberry)



Photo 2-3. Boreal ecosite 21 (Aspen – Kinnikinnick – Purple reedgrass)



Photo 2-4. Subalpine ecosite 01 (Scrub birch – Lowbush cranberry – Feathermoss)

Alpine and Subalpine Bioclimate Zones

Across all three ELC areas, the most commonly mapped ecosystem in the Alpine and Subalpine Bioclimate zones is ecosite 01 (Scrub birch – Lowbush cranberry – Feathermoss), the zonal ecosite, which commonly occurs on upper slopes across a range of aspects (Table 2-5). The ecosite occurs across a range of soil moistures from slightly dry (submesic) to slightly moist (subhygric) and typically has a medium nutrient regime. Scrub birch, northern Labrador tea (*Rhododendron tomentosum*), Labrador tea and lowbush cranberry dominate the well-developed shrub layer and a mixture of feathermosses (*Hylocomium* and *Pleurozium*) and reindeer lichens (*Cladina* spp.) occur in the moss and lichen layer.

The Coffee Area of the ELC survey extent is approximately 30% Subalpine and contains no Alpine areas. Ecosite 01 dominates, however ecosite 31 (Spruce - Scrub birch - Feathermoss) and ecosite 32 (Black spruce - Labrador tea - Lowbush cranberry - Sedge) are also commonly mapped (Table 2-5). Similar to ecosite 01, ecosite 31 occurs on upper slopes across a range of soil moistures from slightly dry (submesic) to slightly moist (subhygric), typically with a medium nutrient regime. A sparse canopy of white and black spruce (~15% cover) occurs over a dense shrub layer of scrub birch, willows, Labrador tea, bog blueberry and lowbush cranberry. While ecosite 31 is commonly mapped on neutral and warm aspects, ecosite 32 is mapped on north-facing moderate lower-to-mid slopes with near surface permafrost. Stunted black spruce and scrub birch dominate the shrub layer of ecosite 32, with sedge, feathermosses, peat mosses and reindeer lichens common underneath. The widely distributed rounded hillcrests within the Coffee Area are typically mapped as ecosite 12 (Scrub birch - Mountain avens - Lichen) and ecosite 13 (Scrub birch - Crowberry - Lowbush cranberry). Ecosite 12 occurs on gently sloping, dry crests and is dominated by mountain avens, low growing scrub birch and lichens. Ecosite 13 occurs on north-facing upper-slopes and crests with exposed boulder channels. The ecosite is co-dominated by scrub birch and ground shrubs including crowberry, Arctic white heather and lowbush cranberry.

Only 2% of the NAR section occurs within the Subalpine Bioclimate zone. As with the Coffee Area, no Alpine areas occur and the most commonly mapped ecosystems are ecosite 01 and ecosite 31. The small patches of subalpine that occur within the NAR section commonly occur along the ELC mapping extent boundary.

The Casino Connection access route occurs in both the Subalpine and Alpine Bioclimate zones. Close to one quarter of the Casino Connection section is mapped as ecosite 01 (Table 2-5). Ecosite 30 (Scrub birch - Sedge – Feathermoss) is also commonly mapped and occurs on moist, gentle-to-moderate slopes with near surface permafrost and imperfect-to-poor drainage. This ecosite has a well-developed shrub layer of scrub birch, Labrador tea and willows and typically has spruce muskeg sedge (*Carex lugens*), feathermosses and reindeer lichens below. Only 4% of the Casino section is in the Alpine Bioclimate zone and much of this area is mapped as ecosite 11 (Felsenmeer). Felsenmeer is infrequent in the ELC survey extent, occurs on upper slopes and crest positions and consists of boulder fields with typically less than 40% vegetative cover. Species commonly present in ecosite 11 include mountain avens, willows, alpine sweet grass (*Anthoxanthum monticolai*), mountain sagewort (*Artemisia norvegica* ssp. *saxatilisi*), alpine harebell (*Campanula lasiocarpa*), rock mosses (*Racomitrium* spp.) and lichens.

Table 2-5. Ecosite and vegetation associations is the Subalpine/Alpine Bioclimate zones, mapped in the ELC mapping extent of the Coffee Project

Ecosite	Name	Description and typical situation	Total Area (ha)	Area (ha) and (% of Section)		
				Coffee	NAR	Casino
10	Tors	protruding bedrock outcrops on mountain crests; vegetation growth is mainly restricted to fractures and crevices where soil has accumulated.	1.5	1.1 (0.01%)	-	0.4 (0.01%)
11	Felsenmeer	veneer of angular rock fragments/boulders fields over sloping ground, typically upper-slope to crest position; vegetative cover is typically <40% and includes dwarf shrubs, graminoids, mosses and lichens.	125	-	0.6 (0.01%)	124.2 (4.25%)
12	Scrub birch - Mountain avens - Lichen	plateaus and gentle crests at high elevations; vegetation community dominated by mountain avens, low-growing dwarf birch and lichens; poor to medium nutrient regime	101	83.7 (0.74%)	6.5 (0.06%)	10.8 (0.37%)
13	Scrub birch - Crowberry - Lowbush cranberry	moderately sloping, northerly aspect, upper slope; low shrub and ground shrub dominated sites with exposed boulder channels; poor nutrient regime	302	174.6 (1.53%)	15.3 (0.16%)	111.8 (3.83%)
14	Scrub birch - Willow - Mountain avens	low stature shrub-dominated sites with scrub birch, willows, Labrador tea, and lowbush cranberry; commonly upper slope or crest; medium nutrient regime	136	72.4 (0.64%)	6.6 (0.07%)	57.0 (1.95%)
01	Scrub birch - Lowbush cranberry - Feathermoss	shrub-dominated ecosystem with scrub birch, willows, Labrador tea, lowbush cranberry, and bog blueberry; predominantly mid to upper slopes; poor to medium nutrient regime	2489	1730.9 (15.21%)	101.5 (1.06%)	656.2 (22.47%)
31	Spruce - Scrub birch - Feathermoss	sparsely treed areas often near the boundary with the Boreal Bioclimate zone; conifers with ≤15% cover, high shrub cover; predominantly upper and mid slopes; medium nutrient regime	828	539.3 (4.74%)	70.7 (0.74%)	217.5 (7.44%)
30	Scrub birch - Sedge - Feathermoss	mid to lower slopes; predominantly cool and neutral aspects; scrub birch, willows, Labrador tea, sedge and feathermoss common; permafrost and seepage typically present; poor to medium nutrient regime	597	318.0 (2.79%)	1.0 (0.01%)	278.1 (9.52%)

Table 2-5. Ecosite and vegetation associations is the Subalpine/Alpine Bioclimate zones, mapped in the ELC mapping extent of the Coffee Project

Ecosite	Name	Description and typical situation	Total Area (ha)	Area (ha) and (% of Section)		
				Coffee	NAR	Casino
32	Black spruce - Labrador tea - Lowbush cranberry - Sedge	stunted black spruce (black spruce in shrub structural stage) and shrub dominated; predominantly on cool, moderate mid to lower slopes; permafrost and seepage present; poor nutrient regime	588	471.1 (4.14%)	1.5 (0.02%)	115.5 (3.96%)
40	Willow - Horsetail - Peatmoss	willow-dominated riparian sites; located along sideslope creeks and drainage channels; shrub layer predominately medium stature; medium to rich nutrient regime	79	54.4 (0.48%)	0.1 (0.00%)	24.2 (0.83%)
An	Anthropogenic	areas of anthropogenic disturbance, including areas cleared for camps, homesteads and air-strips	0.5	0.5 (0.00%)	-	-
Rd	Road surface	an area cleared and compacted for the purpose of transporting goods and services by vehicles	2	-	2.4 (0.03%)	-
Ro	Rock	gentle to steep, bedrock escarpment or outcropping, with little soil development and sparse vegetative cover	2	1.0 (0.01%)	1.3 (0.01%)	-
		Total	**5251**	3447.2	207.6	1595.8

[1] Definitions of soil moisture regimes can be found in Appendix B.

Summary of ELC Wetland, Riparian and Grassland Ecosystems

Wetland, floodplain and grassland ecosystems all occur in the ELC survey extent (Table 2-4). These three ecosystem types are relatively infrequent on the landscape but have important ecological roles. Wetlands are critical landscape features for hydrologic storage and filtering, provide important habitat for wildlife and also have the potential to support rare plant species. The Yukon does not have extensive wetlands relative to most other areas of northern Canada (McKenna *et al.* 2004). Floodplain ecosystems also provide important habitat for a variety of wildlife species and act as natural filters, removing excess sediment and nutrients from floodwaters. Steep, south-facing grasslands are floristically diverse ecosystems that support plants not commonly found in other ecosystems and have the potential to provide forage areas for wildlife.

Less than 4% of the overall ELC mapping extent is mapped as wetland (Table 2-6). The NAR section of the ELC mapping extent, which follows valley bottoms along much of its length, has the highest percentage of wetlands mapped. The largest concentrations of wetlands within this section occur near the junction of Ballarat Creek and the Yukon River and the junctions of Barker Creek and Maisy May Creek with the Stewart River. Within the Coffee Area, mapped wetlands occur primarily at low elevations near Coffee Camp and the junction of Coffee Creek and the Yukon River. The area (ha) of wetland ecosystems (ecosites) mapped in the ELC survey extent is summarized by structural stage in Table 2-6.

The most common wetland mapped is the poor treed fen, ecosite F1 (Spruce -Willow - Labrador tea – Sedge), which occurs on level-to-gentle wet valley bottoms, underlain by permafrost (Photo 2-5). The spruce canopy is typically stunted and willows, Labrador tea, sedges and cottongrass are abundant in the understory. Ecosite F1 is often mapped in complex with ecosite F3 (Birch - Leatherleaf – Sedge), a shrub-dominated fen ecosystem. Alaska birch, leatherleaf, and Labrador tea dominate the shrub layer over a sedge and cottongrass dominated herb layer. Willow-dominated riparian swamps (ecosite S1) are commonly mapped along creeks and sideslope drainages throughout the ELC mapping extent. Riparian marshes (ecosites M1 and M2) and commonly associated Willow-Reedgrass swamps (ecosite S2) are very infrequent.

Floodplains ecosystems are also important wildlife features. Floodplains are found in the Coffee Area and NAR section of the ELC survey extent, and make up 3.5% and 4.6% of the area mapped, respectively (Table 2-7). Floodplains occur along the Yukon and Stewart Rivers, as well as along smaller watercourses including Coffee Creek, Ballarat Creek and Maisy May Creek. Floodplains often occur adjacent to wetlands on the broader valley bottoms within the ELC mapping extent. These ecosystems are typically nutrient rich due to repeat flood events and/or ground water access. As a result, the canopy is often more productive than other forested ecosites within the ELC mapping extent.

Within the Coffee Area there are both highbench and midbench floodplains mapped along the banks of the Yukon River and Coffee Creek. These ecosystems occur in close proximity, with some transitional mixedwood stands also present. Highbench floodplains (ecosite 40) are the most commonly mapped floodplain ecosystem in the NAR section. Most of the highbench floodplains in the ELC mapping extent are mapped as mature (Structural stage 7) or old (Structural stage 8). Midbench floodplains in the NAR section are primarily mapped as young stands (Structural stage 6; Photo 2-6), whereas mature midbench stands dominate the Coffee Area. Lowbench floodplains (ecosite 43) are infrequent in the ELC mapping extent and only occur along the banks of the Yukon and Stewart Rivers. There were no field plots completed in this ecosite due to its limited distribution. Lowbench floodplain communities experience frequent flooding and as a result are maintained in a shrub-dominated structural stage with little herb, moss or lichen layer development.

Grasslands within the ELC mapping extent are restricted to moderate-to-steep, dry, southerly slopes and account for less than 2% of the overall area (Table 2-4). Grasslands are very dry during the summer and because of their position on steep slopes, are susceptible to erosion. Species commonly present include purple reedgrass (*Calamagrostis purpurascens*), pasture sage (*Artemisia frigida*), prickly rose, kinnikinnick, and spikelike goldenrod (*Solidago simplex*). Grasslands support a diversity of plant species, including species typically not found in other ecosystems. Within the Coffee area, grass and herb dominated communities occur along the warm, steep slopes above Coffee Creek, near the Yukon River. Grasslands, either grass or ground shrub dominated, occur in the NAR section along southerly slopes above Barker, Ballarat and Maisy May Creeks, as well as the Stewart and Yukon River.

Table 2-6. Wetland ecosystems mapped within the ELC mapping extent of the Coffee Project

Ecosite	Ecosite Name	Wetland Class	Structural Stage	Total Area (ha)	Area (ha) in ELC survey extent		
					Coffee	NAR	Casino
F1	Spruce -Willow - Labrador tea - Sedge	Fen	4	213	44.4 (0.39%)	162.2 (1.70%)	6.2 (0.21%)
			5	3	2.8 (0.02%)	-	-
			6	1	1.2 (0.01%)	-	-
			7	52	36.6 (0.32%)	15.8 (0.17%)	-
			8	1	-	1.2 (0.01%)	-
			Total	270	85.1 (0.36%)	179.1 (1.88%)	6.2 (0.21%)
F2	Spruce - Red bearberry – Brown moss	Fen	4	15	-	14.9 (0.16%)	-
			6	11	-	10.8 (0.11%)	-
			7	28	-	27.6 (0.29%)	-
			8	12	-	12.2 (0.13%)	-
			Total	66	-	65.5 (0.69%)	-
F3	Birch - Leatherleaf - Sedge	Fen	4	194	134.7 (1.18%)	58.6 (0.61%)	1.0 (0.04%)
S1	Willow - Horsetail	Swamp	4	222	107.9 (0.95%)	98.5 (1.03%)	15.8 (0.54%)
S2	Willow - Reedgrass	Swamp	4	12	0.3 (0.00%)	11.6 (0.12%)	-
M1	Beaked sedge	Marsh	3	6	2.4 (0.02%)	3.7 (0.04%)	-
M2	Horsetail - Sedge	Marsh	3	1	-	0.9 (0.01%)	-
M	Marsh	Marsh	3	12	3.7 (0.03%)	8.1 (0.08%)	-
			Total	783	334.1 (2.93%)	426.0 (4.47%)	23.0 (0.79%)

Table 2-7. Riparian ecosystems mapped within the the ELC mapping extent of the Coffee Project

Ecosite	Ecosite Name	Wetland type	Structural Stage	Total Area (ha)	Area (ha) in Section		
					Coffee	NAR	Casino
40	White Spruce - Horsetail	Highbench Floodplain	4	71	64.9 (0.57%)	5.9 (0.06%)	-
			6	41	2.7 (0.02%)	38.4 (0.40%)	-
			7	120	33.8 (0.30%)	86.4 (0.91%)	-
			8	182	77.2 (0.68%)	104.4 (1.01%)	-
			Total	414	178.6 (1.57%)	235.1 (2.47%)	-
41	Balsam poplar - Rose - Horsetail	Midbench Floodplain	4	2.5	-	2.5 (0.03%)	-
			5	62	55.1 (0.48%)	6.7 (0.07%)	
			6	151	10.8 (0.09%)	139.9 (1.47%)	-
			7	132	122.4 (1.07%)	10.0 (0.10%)	-
			Total	347	188.3 (1.65%)	159.1 (1.67%)	-
43	Tall shrub Balsam poplar - Willow	Lowbench Floodplain	4	71	26.9 (0.24%)	44.2 (0.46%)	-
			Total	832	393.7 (3.46%)	438.3 (4.60%)	-



Photo 2-5. Boreal ecosite F1 (Spruce – Willow – Labrador tea – Sedge)



Photo 2-6. Boreal ecosite 41 (Balsam Poplar – Rose – Horsetail)

2.2.2 BROAD ECOSYSTEM MAPPING AND FIELD RESULTS

The majority of the BEM was completed via orthophoto interpretation. Plot data in this portion of the LSA, aside from wetland plot data, is minimal (36 vegetation plots).

The 2015 wetland-specific surveys completed a total of 16 Ground Plots and 69 Visual Plots. Ground plots were concentrated in areas where wetlands were more common, including the junctions of Ballarat Creek with the Yukon River, and the junctions of Barker Creek and Maisy May Creek with the Stewart River. Most of the plots completed along the length of the NAR from the Klondike Highway to Maisy May Creek were Visual Plots. It was noted during the survey that much of the area surrounding the access road had been previously disturbed by placer mining; therefore brief Visual Plots were sufficient to document vegetation communities. Thirty-five ELC plots occur within the BEM extent (Figures 2-2 to 2-4) due to uncertainty in the final spatial separation of the ELC and BEM areas during field sampling. ELC plots, including wetland plots, within and nearby the BEM extent were used wherever possible during polygon attribution. An overview of the wetland and ELC field plot locations, colour coded by survey type, are presented in Figures 2-2 to 2-7.

A total of 1,623 BEM polygons were mapped within the 36,581.8 ha BEM extent, for an average polygon size of approximately 23 ha (within the 20–25 ha target range for this project; Figures 2-2 to 2-7).

The area (ha) of each broad ecosystem mapped within the BEM extent is summarized in Table 2-8. The majority of the NAR occurs in the Boreal Bioclimate zone, therefore ecosystems occurring at higher elevations, such as the subalpine shrub category, account for less than 5% of the BEM extent. The BEM extent does not overlap the Alpine Bioclimate zone.

The most commonly mapped BEM category was the Upland/Closed Canopy Forest (UpF). Much of the BEM extent centers on north-south oriented valley bottoms, therefore closed canopy forests along neutral lower-to-upper valley side slopes are very common. The Upland/Closed Forest category was most

commonly mapped in the shrub-dominated structural stage (33.5%) which is reflective of the wildfire regime in the area. Young (Structural stage 6) and Mature (Structural stage 7) stands are also common, constituting 32.3% and 27.1% of the category mapped, respectively. A fairly even mix of coniferous-dominated, deciduous-dominated and mixedwood canopies are mapped in the BEM extent (Table 2-9). Stunted Coniferous Forests (Stcs) are commonly mapped on northerly lower-to-middle slopes and along moderate-to-gentle toe-slopes across a range of aspects. These areas are underlain by near-surface permafrost and typically have imperfect-to-poor drainage.

Placer mining (Pm) is the second most abundant broad category mapped along the NAR and predominantly occurs in shrub or sparsely vegetated structural stages (Table 2-8). The vast majority of the valley bottoms along the NAR have been previously or are currently being placer mined. The placer mining process typically involves the removal of natural vegetation and surface soils — many placer mined areas within the BEM extent are in the process of revegetating but these plant communities do not yet resemble natural communities. Willows and grasses tend to dominate re-vegetating placer mined areas (Photo 2-7, Photo 2-8).

Wetlands, which are of special interest in the BEM extent, are also infrequent and account for less than 3% of the area mapped. Poor treed fens are the most commonly mapped wetland (1% of the mapping extent; Table 2-10). Poor treed fens are found on broad, level valley bottoms on primarily fluvial deposits. Black and white spruce dominate the often stunted canopy and Labrador tea, lowbush cranberry, sedges and brown mosses are commonly found in the understory. These sites have poor to very poor drainage and are underlain by near surface permafrost. Shrub dominated fens, with birch, leatherleaf, sedges and cottongrass sometimes occur in complex with poor treed fens. Within the BEM extent fens are found primarily along Ballarat Creek, Barker Creek, Maisy May Creek, and along the Stewart River, near the Maisy May Creek junction. Marshes account for 0.14% of the area mapped and can be found along the Stewart River, near the Maisy May Creek junction (Photo 2-9). Marshes are dominated by sedges and/or horsetails, have a fluctuating water table and are typically rich in nutrients. Low elevation, sideslope, shrubby riparian areas, which are classified as willow-dominated swamps, account for 1% of the area mapped. These ecosystems occur throughout the mapping extent along creeks and sideslope drainages, are dominated by willows and commonly contain horsetails in the understory.

Table 2-8. Broad ecosystems mapped in the BEM extent for the Coffee Project

BEM code	Category	Description and typical situation	Total Area (ha)	Fire affected area (ha)	Area (ha) and % of BEM
Fe	Felsenmeer	veneer of angular rock fragments/boulders fields over sloping ground, typically upper-slope to crest position; vegetative cover is typically <40% and includes dwarf shrubs, graminoids, mosses and lichens	4	0.0	4.2 (0.01%)
Ss	Subalpine / Alpine Shrub	shrub-dominated communities of the Subalpine and Alpine Bioclimate Zones; dwarf-shrub to medium stature shrubs occur; common species include scrub birch, Labrador tea, bog blueberry, lowbush cranberry, crowberry and mountain avens	375	10.1	364.6 (0.1%)
Fcs	High Elevation Sparse Coniferous Forest	sparse coniferous forest near Subalpine / Boreal Bioclimate boundaries, spruce-dominated; shrub cover typically high	1897	531.8	1365.6 (3.73%)
HSr	High Elevation Shrubby Riparian	shrub-dominated riparian communities of the Subalpine Bioclimate zone; willow-dominated communities typically found along edges of sideslope creeks and receiving areas	4	0.0	4.3 (0.01%)
Gg	Grassland	an area dominated by grasses, however sedges, dwarf shrubs and low-to-medium stature shrubs can also occur; tree cover is <10%; typically maintained in a grassy state due to environmental conditions	388	12.0	376.0 (1.02%)
UpF	Upland / Closed Canopy Forest	upland, closed canopy forests; canopy can be deciduous, coniferous or mixedwood	34507	8810.8	25,695.7 (70.24%)
RF	Riparian Forest	riparian forests, including mid and high bench floodplains, as well as forested communities found along sideslope creeks and receiving areas; canopy can be deciduous, coniferous or mixedwood	1898	476.4	1421.8 (3.89%)
Stcs	Stunted Coniferous Forest	moist to wet stunted spruce forests, underlain by permafrost; imperfect to poor drainage; Labrador tea, bog blueberry, lowbush cranberry and sedges common in the understory; primarily middle to toe slopes	3143	378.5	2764.8 (7.56%)
LSr	Low Elevation Shrubby Riparian	shrub-dominated riparian communities of the Boreal Bioclimate zones, including low-bench floodplains located along rivers and willow-dominated communities located along creeks and sideslope drainages	418	32.2	385.4 (1.05%)

Table 2-8. Broad ecosystems mapped in the BEM extent for the Coffee Project

BEM code	Category	Description and typical situation	Total Area (ha)	Fire affected area (ha)	Area (ha) and % of BEM
B	Bog	a peat-covered or peat- filled area, generally with a high water table dominated by mosses, especially Sphagnum. Most bogs in the Yukon are underlain by permafrost, therefore there is little standing water except in ponds	4	0.0	4.5 (0.01%)
F	Fen	a peatland with moderate to well-developed sedge, grass, and reed peat material formed in eutrophic environments. Water is at or near the fen surface. Includes poor fens which are transitional between bogs and fens. A poor fen is intermediate in nutrient regime and is similar floristically to fens and bogs. sedges, brown mosses and peat mosses compose much of the organic matter	648	45.7	602.1 (1.65%)
S	Swamp	shrubby mineral wetland on sites with a flowing or fluctuating, semi-permanent, near-surface watertable. Swamp tend to have abundant available nutrients from groundwater and can have surface standing water	40	0.0	40.5 (0.11%)
M	Marsh	Periodically inundated mineral ground characterized by a vegetation cover of emergent rushes, sedges, grasses and aquatic plants, and typically occupying the shoreline of a pond, lake or river	51	0.0	51.0 (0.14%)
Pd	Pond	small body of water greater than 2 m deep, but not large enough to be classified as a lake	5	-	5.4 (0.01%)
Ri	River	watercourse formed when water flows between continuous, definable banks; the flow may be intermittent or perennial	141	-	141.1 (0.39%)
Gb	Gravel bar	an elongated landform generated by waves and currents and usually running parallel to the shore.	10	-	10.3 (0.03%)
Ro	Rock	gentle to steep, bedrock escarpment or outcropping, with little soil development and sparse vegetative cover	18	-	17.8 (0.05%)
Rt	Talus	active and inactive talus and scree; typically have a low herb layer cover because of mobile substrates or lack of soil	2	-	2.1 (0.01%)
Rd	Road surface	an area cleared and compacted for the purpose of transporting goods and services by vehicles	53	-	52.7 (0.14%)

Table 2-8. Broad ecosystems mapped in the BEM extent for the Coffee Project

BEM code	Category	Description and typical situation	Total Area (ha)	Fire affected area (ha)	Area (ha) and % of BEM
Pm	Placer mining	an area cleared and disturbed through placer mine activity, includes unvegetated areas and areas undergoing revegetation. Willows and grasses, along with young birch trees, commonly dominate revegetating areas.	3115	6.9	3108.1 (8.49%)
Ppd	Placer mining pond	a pond created through placer mining activity	164	-	163.6 (0.45%)
		Total	46886	10,304.4 (28.17%)	36,581.8 (100.00%)

Table 2-9. Upland/closed canopy forests and riparian forests, separated by canopy composition, mapped in the BEM extent of the Coffee Project

	Area (ha) and % of BEM	
Canopy Composition	**Upland / Closed Canopy Forest**	**Riparian Forest**
Coniferous	6752.8 (18.46%)	414.8 (1.13%)
Deciduous	4873.9 (13.32%)	261.3 (0.71%)
Mixedwood	5302.9 (14.50%)	227.0 (0.62%)
Shrub-dominated	8766.1 (23.96%)	518.7 (1.42%)
Total	25695.7	1421.8

Table 2-10. The area of wetland ecosystems mapped in the BEM extent, separated by structural stage

BEM code	Wetland Class	Structural Stage	Area (ha) and % of BEM
F	Fen	4	499.7 (1.37%)
		6	21.2 (0.06%)
		7	66.6 (0.18%)
		8	14.6 (0.04%)
		Total	602.1 (1.65%)
B	Bog	4	4.5 (0.01%)
M	Marsh	3	51.0 (0.14%)
S	Swamp	4	40.5 (0.11%)
LSr	Low-elevation Shrubby Riparian	4	385.4 (1.05%)
		Total	1083.5 (2.96%)



Photo 2-7. Area mapped as placer mining along the NAR.



Photo 2-8. Placer pond along the NAR.



Photo 2-9. Marsh and adjacent willow-dominated swamp along the Stewart River, near the Maisy May Creek junction.

3 RARE PLANTS

Prior to field work, a desktop review of vegetation species expected to be present in the LSA was conducted for species of potential conservation concern listed under the federal *Species at Risk Act* (SARA; Government of Canada 2014), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC; Government of Canada 2015), and the Yukon Conservation Data Centre (Yukon CDC).

Records of known rare plants in the Project area were compiled from the Yukon CDC for Track-list and Watch-list species with reference to west-central Yukon (Yukon CDC 2014, 2015, 2016) and from known locations in the Flora of the Yukon Territory (Cody 2000). Records indicated that several rare plant species are known to occur or have the potential to occur within the LSA, based on the likelihood that similar habitat may be found. A list of potential rare plants was compiled and used during 2014, 2015, and 2016 field surveys to stratify the LSA for targeted searching in areas of high rare plant potential. The compiled list of potential rare plants can be found in Appendix D.

3.1 SURVEY METHODOLOGY

The desktop review was supported by field investigations from July 5–9, 2014, August 12–18, 2015, and July 4-8, 2016. Priority areas surveyed for rare plants were defined by areas of high rare plant potential within 500 m of the proposed Project footprint (Figure 3-1). These priority areas make up the rare plant survey extent.

A helicopter overview flight was scheduled for the first day of the survey in both 2014 and 2015 to narrow the search effort to priority areas that included dry, south-facing slopes, open deciduous, coniferous and mixedwood forests, subalpine and alpine areas, scree and rock outcrops, wetlands, riparian corridors, and disturbed sites. Within these habitat types, multiple sites were targeted for rare plant surveys to ensure adequate coverage of representative vegetation.

Follow-up rare plant surveys were conducted in 2016 to improve coverage of the LSA, specifically the Coffee Area within the boundary of the proposed heap leach and Ballarat Creek. Priority areas included collapsed pingos and tors where the potential for rare plant habitat exists. A pingo is an ice covered landform associated with previously glaciated areas in arctic and subarctic regions (Parks Canada 2012). When the ice core of a pingo melts it can collapse leaving a doughnut-shaped ring of raised vegetation enclosing a small round lake. In addition to pingos and tors, open deciduous and mixedwood forests were surveyed to a greater extent along the south-facing slopes of the lower Ballarat Creek, north of the Yukon River to improve overall coverage of the rare plant survey.

The rare plant survey methodology was based on the Alberta Native Plant Council (ANPC) Guidelines for Rare Plant Surveys in AB (ANPC 2012); this is a standardized methodology commonly practiced across western Canada. Within targeted areas, field crews searched for species of potential concern. When a rare plant was found the following information was collected:

- Species name with reference to the Flora of North America (FNA 2014, 2015, 2016);
- Location, elevation and estimated area of extent (documented by GPS);
- Site information including general site conditions, habitat type, and associated species;
- Population estimate and phenology at the time of observation;
- Photographs of the species and surrounding habitat; and
- Voucher specimen collected for verification where appropriate.

Following fieldwork, samples collected for verification were sent to Bruce Bennett (Coordinator, Yukon CDC) for identification confirmations. Voucher specimens were deposited at the B.A. Bennett (B.A.B.Y.) herbarium in Whitehorse, Yukon.

3.2 RESULTS

No COSEWIC or SARA-listed plant species were observed during rare plant surveys; however, populations of four territorial Watch-list plant species were found (Figure 3-2). Species on the Watch-list require more information on their distribution and abundance before a conservation status can be determined, but could be determined to be threatened or endangered in the Yukon (Yukon CDC 2016). Watch-list plant species found during rare plant surveys included:

- Coffee Creek scorpionweed (*Phacelia mollis*; S3S4; Photo 3-1);
- Spotted lady's-slipper (*Cypripedium guttatum*; S2S3; Photo 3-2);
- Small enchanter's nightshade (*Circaea alpina* ssp. *alpina*; S2S3; Photo 3-3); and
- Dry-spike sedge (*Carex siccata*; S2S3; Photo 3-4).

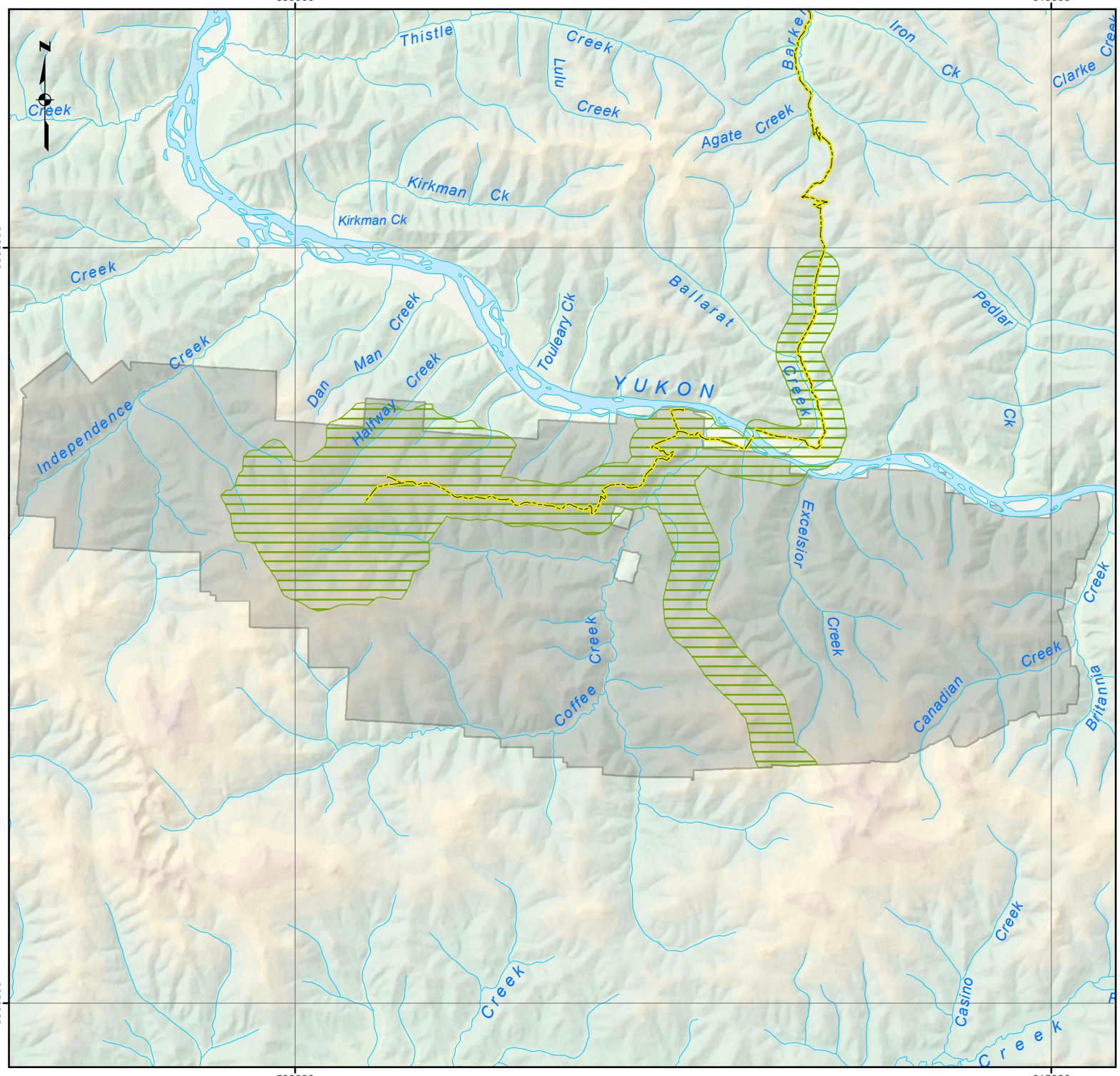
Additionally, a small population of hairy wood rush (*Luzula rufescens*) was found within the survey extent. At the time of the survey, hairy wood rush was included on the territorial Watch-list; however, following the survey, the status of hairy wood rush was re-assessed by the Yukon CDC and down-listed from S2S3 (May be at Risk) to S4 (Apparently Secure) and removed from the Watch-list.

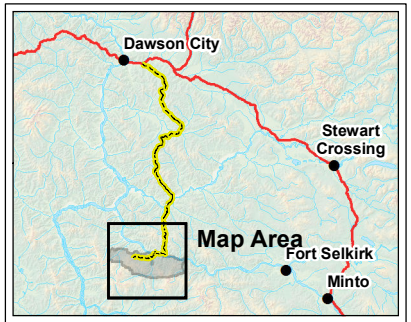
Locations, habitat, distribution, and abundance information for the four Watch-list plant findings are presented in Table 3-1. Definitions of global, national, and territorial/provincial status ranks for these species are provided in Table 3-2, along with their status in bordering jurisdictions to provide additional context. Rare plant information sheets are provided in Section 3.2.1.

Global and national status rankings were obtained from NatureServe Explorer (NatureServe 2016). Alaska rankings were from the Alaska Natural Heritage Program (ANHP; ANHP 2016). Subnational status

rankings were obtained from their respective Conservation Data Centres in BC and AB (ESRD 2016, BC CDC 2016), the Northwest Territories Department of Environment and Natural Resources (Working Group on General Status of NWT Species 2011), and Yukon (Yukon CDC 2014, 2015, 2016).

The Yukon status rankings are determined based on standardized methods developed by NatureServe Canada. Factors for evaluating species are categorized into three broad groups including threats, trends, and rarity. Additional factors taken into account when evaluating a species of conservation concern are range extent, area of occupancy, number of occurrences, viability of occurrences, environmental specificity, and intrinsic value (Master *et al.* 2012). As the knowledge of species' occurrences in Yukon increases over time, these rankings will be revised to reflect their true status (B. Bennett, pers. comm., October 2014).





Legend

- Settlement/Community
- Highway
- Proposed Route
- Survey Extent
- Coffee Property

FIGURE: 3 - 1

Baseline rare plant survey extent

Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

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KM

Map Reference Scale: 1:250,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MS	Checked: MP/AM	Date: 1/6/2017

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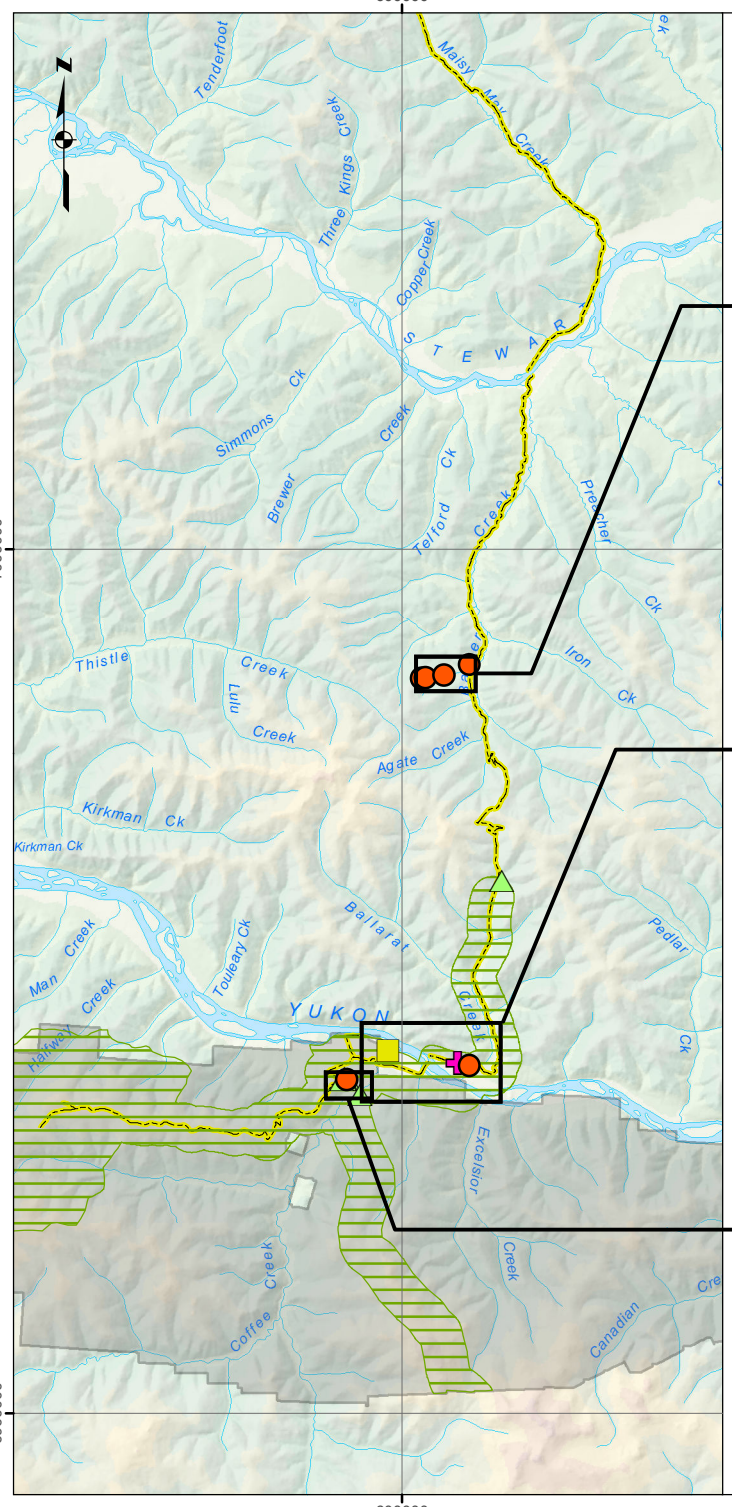



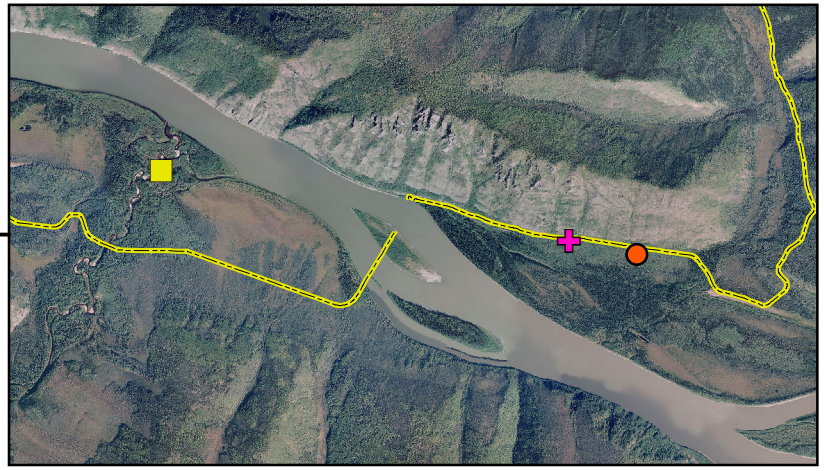

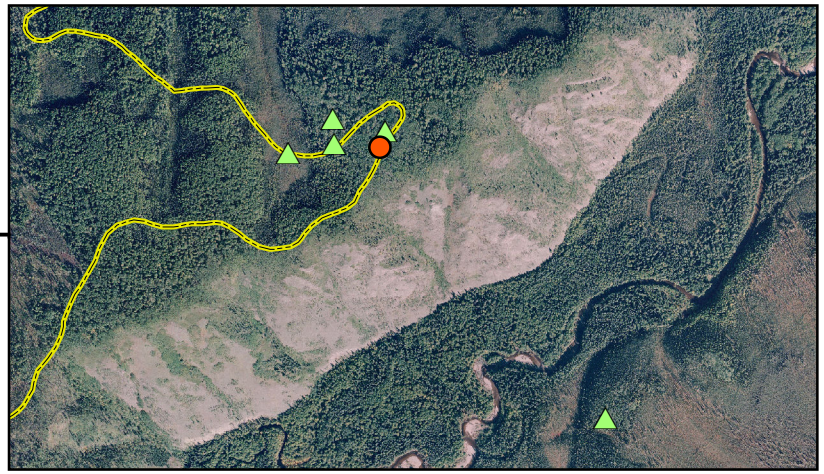

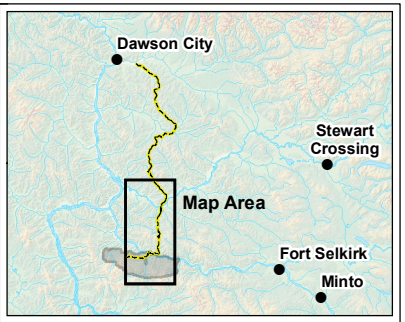

Legend

- Settlement/Community
- Highway
- Proposed Route
- Coffee Property
- Survey Extent

Species Name

- *Circaea alpina ssp. alpina*
- *Cypripedium guttatum*
- *Phacelia mollis*
- *Carex siccata*

FIGURE: 3 - 2

Baseline rare plant survey and incidental findings

Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

0 5 10
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Map Reference Scale: 1:350,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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Table 3-1. Rare plants results from 2014-2016 surveys, Coffee Project

Site[1]	Species Name	Common Name	Abundance and Distribution	Location Description	Habitat	Lat[2]	Long[2]	Elev (m)	Year
PM-1	*Phacelia mollis*	Coffee Creek scorpionweed	2 individuals in a patch	Approximately 325 m southeast of Coffee Creek	Open mixed forest on a moderate slope with well-developed dwarf shrub/forb understory and tufted grasses	62.88919	-139.0712	424	2014
PM-2	*Phacelia mollis*	Coffee Creek scorpionweed	1 patch of 4 individuals	North side of existing Java Road near km two	Disturbed, exposed soil along the edge of adjacent forest	62.8957	-139.0873	454	2015
PM-3	*Phacelia mollis*	Coffee Creek scorpionweed	1 individual	North side of existing Java Road near km two	Disturbed, exposed soil along the edge of adjacent forest	62.8959	-139.0849	462	2015
PM-4	*Phacelia mollis*	Coffee Creek scorpionweed	6 individuals scattered linearly for 80 m	Approximately 10 m northeast of existing Java Road near km two	Open trembling aspen forest on moderate slope with well-developed dwarf shrub/forb understory and some leaf litter	62.8965	-139.0849	493	2015
PM-5	*Phacelia mollis*	Coffee Creek scorpionweed	24 individuals scattered linearly for 100 m	West side of existing Java Road near km three	Disturbed, exposed soil with few associated forb species	62.89615	-139.0822	618	2014
PM-6	*Phacelia mollis*	Coffee Creek scorpionweed	17 individuals in a patch of approximately 20 m radius	Approximately 160 m east of tributary along proposed new road between Barker and Ballarat	Open trembling aspen (*Populus tremuloides*) forest on a moderate slope with dwarf shrub/forb understory and high leaf litter	62.97654	-138.9358	708	2015
CG-1	*Cypripedium guttatum*	Spotted lady's-slipper	4 scattered patches each with 11 individuals	East side of Java Road near kilometer three	Edge of open, trembling aspen forest at the crest of the bank with well-developed dwarf shrub/forb understory and tufted grasses	62.89578	-139.0825	620	2014
CG-2	*Cypripedium guttatum*	Spotted lady's-slipper	Approximately 3,000 individuals in several patches within a larger patch about 1,318 m^2	Base of south-facing slope above the lower Ballarat Creek floodplain, north of the Yukon River	Open trembling aspen forest on moderate slope with well-developed shrub/forb understory and tufted grasses	62.9002	-138.9706	427	2015

Table 3-1. Rare plants results from 2014-2016 surveys, Coffee Project

Site[1]	Species Name	Common Name	Abundance and Distribution	Location Description	Habitat	Lat[2]	Long[2]	Elev (m)	Year
CG-3	*Cypripedium guttatum*	Spotted lady's-slipper	Approximately 1,000 individuals in several patches within a larger patch about 8,800 m^2	North side of alternate road alignment along Thistle Mountain	Open trembling aspen forest on moderate slope with well-developed dwarf shrub/forb understory and tufted grasses	63.0616	-139.0035	870	2015
CG-4	*Cypripedium guttatum*	Spotted lady's-slipper	5 scattered patches of approximately 100 individuals (4 patches north of road, 1 patch south of road)	Along alternate road alignment over Thistle Mountain along edge of cutbank	Open trembling aspen dominated forest on moderate slope with well-developed dwarf shrub/forb understory and tufted grasses	63.0618	-138.9994	844	2015
CG-5	*Cypripedium guttatum*	Spotted lady's-slipper	1 patch of 21 individuals down slope about 10 m	South side of alternate road alignment along Thistle Mountain	Open trembling aspen dominated forest on moderate slope with well-developed dwarf shrub/forb understory and tufted grasses	63.0627	-138.9824	715	2015
CG-6	*Cypripedium guttatum*	Spotted lady's-slipper	Approximately 3,000 individuals total; 1,000 individuals west of the road and 2,000 individuals east of the road	West and east side of proposed road along Barker on edge of cut bank; area	Open trembling aspen forest on moderate slope with well-developed dwarf shrub/forb understory and tufted grasses	63.0665	-138.9591	650	2015
CA-1	*Circaea alpina* ssp. *alpina*	Small enchanter's nightshade	1 patch, 1m^2 of approximately 150 individuals	East of Coffee Creek, north of the proposed winter road	Transitional habitat between upland and sedge meadow, moist shaded area below deciduous shrubbery	62.9072	-139.0445	393	2015
CS-1	*Carex siccata*	Dry-spike sedge	Approximately 100 individuals scattered within a somewhat linear patch about 600 m in length	Base of south-facing slope above the lower Ballarat Creek floodplain, north of the Yukon River	Open trembling aspen to mixedwood forest on flat to moderate slope with well-developed shrub/forb understory	62.9013	-138.9812	447	2016

[1] Site number is unique to the species name proceeded by a number. For example, "CA" = *Circaea alpina* ssp. *alpina* and "1" = site 1.

[2] Location represents the individuals within a patch closest to the proposed Project footprint. Where a species was found along existing or proposed road, the location represents the individual in the center of the patch, closest to the road.

Table 3-2. Global, national and subnational rankings of rare plants found in the survey extent for the Coffee Project, 2014-2016

Species Name	Common Name	Yukon[1]	British Columbia[1]	Alberta[1]	Northwest Territories[1]	Alaska[1]	National (Canada)[2]	Global[3]
Phacelia mollis	Coffee Creek scorpionweed	S3S4	n/a	n/a	n/a	S3	N2N3	G3
Cypripedium guttatum	Spotted lady's-slipper	S2S3	n/a	n/a	SNR	S4	N4	G5
Circaea alpina ssp. *alpina*	Small enchanter's nightshade	S2S3	SNR	S4	SNR	SNR	N5	G5
Carex siccata	Dry-spike sedge	S2S3	S5	S5	S5	SNR	N5	G5

Source: AKEPIC (2016); BC CDC (2016); ESRD (2016); NatureServe (2016); Working Group on General Status of NWT Species (2011); Yukon CDC (2016).

Notes (Nature Serve 2016):

[1] S = Provincial/Territorial/State ranks follow the NatureServe Subnational Conservation Status Rank; S3S4 = a range rank to denote a status with some uncertainty between Vulnerable and Apparently Secure; S2S3 = a range rank to denote a status with some uncertainty between Imperiled and Vulnerable; SNR = Unranked; S3 = Vulnerable; S4 = Apparently Secure.

[2] N = NatureServe National Conservation Status Rank; N2N3 = a range rank to denote a status with uncertainty between Imperiled and Vulnerable; N4 = Apparently Secure; N5 = Secure.

[3] G = NatureServe Global Conservation Status Rank; G3 = Vulnerable; G5 = Secure.

3.2.1 RARE PLANT INFORMATION SHEETS

Species information sheets were produced for the four Watch-list plants observed during the survey and include the species name, conservation status rank, geographic distribution, botanical description, typical habitat and the location where it was found within the LSA. Descriptions were adapted from FNA (2014, 2015, 2016), Flora of the Yukon Territory (Cody 2000), Central Yukon Species Inventory Project (CYSIP 2014), Illustrated Flora of British Columbia (Douglas *et al.* 1998–2002), and from personal communications with Bruce Bennett and Randi Mulder of the Yukon CDC in Whitehorse, Yukon.

Cypripedium guttatum (Spotted lady's-slipper)

Family: Orchidaceae — Orchid Family

Spotted lady's-slipper is ranked S2S3 in Yukon and is on the Yukon CDC Watch-list (Table 3-2). The conservation rank for this species is not fully known. Information suggests it is either Imperiled or Vulnerable in Yukon. This species is known from western and northern Yukon, as well as Asia, AK and the Northwest Territories (NWT).

Spotted lady's-slipper is a perennial forb from rhizomatous roots with slender hairy stems 10–20 cm high. There are two leaves at the base of the stem with strong parallel veins. The flower is solitary at the top of the stem, white in color with obvious purple-pink blotches. Fruit capsules are large, hairy to sticky and strongly drooping.

Typical habitat for this species is open deciduous and mixed forest, tundra, meadows and scree at elevations between 0-800 m (FNA 2014 and 2015). Its occurrence in these habitats may be restricted to calcareous soils (Cody 2000).



Photo 3-1. *Cypripedium gluttatum* (Spotted lady's slipper)

Traditional/ Medicinal Use: Traditional and medicinal use of spotted-lady's slipper by Yukon First Nations is not well known. This is likely due to the inherent rarity of the species and its limited abundance and distribution on the landscape. Other lady's-slipper species within the same genus have been used throughout North America to treat insomnia, anxiety, fever, headache, tremors, delirium, irritable bowel syndrome and to ease the pain of menstruation and childbirth from sedative and antispasmodic properties in the roots (Wilson 2007).

Survey Results: Spotted lady's-slipper was found at a six sites within the LSA (Table 3-1); three of which are located along previous road alignments that that are no longer being considered. All sites where spotted lady's-slipper was found were south-facing, moderate slopes, dominated by open trembling aspen forest with a few scattered white spruce, with the exception of one north-facing slope. The ground cover was comprised of kinnikinnick with scattered prickly rose, soapberry, highbush cranberry (*Viburnum edule*), purple reedgrass, false toadflax, and fireweed (*Chamerion angustifolium*). Most spotted lady's-slipper occurrences were in the late stage of fruiting at the time of the survey, due to senescence. All sites where spotted lady's-slipper was found hosted plants which appeared healthy with no obvious sign of stress.

Phacelia mollis (Coffee Creek scorpionweed)

Family: Hydrophyllaceae — Waterleaf Family

Coffee Creek scorpionweed is endemic to central and western Yukon and AK. It is ranked as S3S4 in Yukon and is on the Yukon CDC Watch- list (Table 3-2). The conservation rank for this species is not fully known. Information suggests it is either Vulnerable or Apparently Secure in Yukon. This species has been previously found from a number of sites in west-central Yukon.

Coffee Creek scorpionweed is a perennial forb from a taproot with soft hairy stems 15–50 cm high. Leaves are mostly basal with some stem leaves and are lobed with soft hairs giving it a gray-green appearance. The flowering head is showy consisting of a few to numerous blue, lavender, or yellowish-white flowers that have long purple stamens (male reproductive parts) that project out of each flower, topped by a yellow-orange anther that contains pollen.

Typical habitat for this species is steep, dry open slopes, rocky bluffs and disturbed sites, such as river flats, mine tailings and along dirt roads (CYSIP 2014). Due to a limited global range, this endemic species has a limited abundance and distribution.



Photo 3-2. *Phacelia mollis* (Coffee Creek scorpionweed)

Traditional/ Medicinal Use: Traditional and medicinal use of Coffee Creek scorpionweed by North American First Nations, including Yukon First Nations could not be found in the literature.

Survey Results: Coffee Creek scorpionweed was found at six sites within the LSA (Table 3-1). Habitat for three of these sites was open trembling aspen forest, while the other three were found in disturbed sites with exposed soil. All sites where Coffee Creek scorpionweed were found hosted plants which appeared healthy with no obvious sign of stress.

Circaea alpina ssp. *alpina* (Small enchanter's-nightshade)

Family: Onagraceae — Evening Primrose Family

Small enchanter's-nightshade is ranked S2S3 in Yukon and is on the Yukon CDC Watch-list (Table 3-2). The conservation rank for this species is not fully known. Information suggests it is either Imperiled or Vulnerable in Yukon. This species is also known from Eurasia and is circumpolar from Newfoundland to AK, south to the northern United States. Prior to the Coffee Project rare plant survey, small enchanter's-nightshade in Yukon was only known from southeast Yukon, near a hot spring.



Photo 3-3. *Circaea alpina* ssp. *alpina* (Small enchanter's-nighshade)

Small enchanter's-nightshade is a delicate perennial forb from a tuberous rhizome. Stems are erect, simple or branched and smooth, to 15 cm tall. Leaves are pale green, born on long stems and orientated opposite to the main stem. Leaves are heart to egg shaped, 2–5 cm long with shallow undulating margins or weak teeth. Flowers are white to pale pink, 8–12 and small in size, born on stalks extending upward and congregating at the top of the plant. Petals are two, deeply notched with two reflexed sepals. The flower head is subtended by two reflexed linear bracts. Fruits are one seeded, round to pear-shaped capsules, about 2 mm long and covered with soft hooked hairs.

Typical habitat for this species is moist woodland, thickets, and sometimes shores of rivers, lakes, and edges of swamps (Cody 2000; EOL 2015).

Traditional/ Medicinal Use: Traditional and medicinal use of Small enchanter's-nightshade by North American First Nations has been documented, although not known to Yukon First Nations, possibly due to its low abundance on the landscape (Cody 2000; Trelawny 2003).

Survey Results: Small enchanter's-nightshade was only found at one site within the LSA (Site CA-1; Table 3-1). The habitat was transitional between upland and sedge meadow. The area was moist and partially shaded with some cover of grey alder (*Alnus incana*), northern bush willow (*Salix arbusculoides*), red-osier dogwood (*Cornus stolonifera*), prickly rose and highbush cranberry. Associated ground cover species included bunchberry (*Cornus canadensis*), northern bedstraw (*Galium boreale*), field horsetail (*Equisetum arvense*), common red raspberry (*Rubus idaeus*) and purple reedgrass. The population consisted of approximately 150 individuals within 1 m^2. All plants had completed flowering and were in fruit at the time of the survey. Despite the small size of this occurrence, all plants appeared healthy with no obvious sign of stress.

Carex siccata (Dry-spike sedge)

Family: Cyperaceae — Sedge Family

Dry-spike sedge is ranked S2S3 in Yukon and is on the Yukon CDC Watch-list (Table 3-2). The conservation rank for this species is not fully known. Information suggests it is either Imperiled or Vulnerable in Yukon. This species is known from North America including Yukon, NWT, BC east to southwestern Quebec, and the northern United States with occurrences documented as far south as Arizona and New Mexico.



Photo 3-4. *Carex siccata* (Dry-spike sedge) (photo copied from eflora BC and taken by J. Fenneman)

Dry-spike sedge is a perennial grass-like plant that grows from a long, cordlike underground rhizome. Stems are leafy and erect, standing 25-40 cm tall. Leaves are flat, pale green, 1.5-3.0 mm wide and taper to a tip. Flowering heads exceed the leaves with 4-8 unstalked spikes clustered at the top of the stem. These cylindrical heads measure approximately 2-3 cm with both male and female flowers; male flowers are typically towards the tip of the head. Female fruits (perigynia) are yellow to red-brown in color, egg-shaped, 3-6 mm long, and 1.5-2 mm wide with winged margins and a bidentate beak at the tip. Two feathery stigmas can be seen sticking out of the bidentate beak. The fruits are covered with a yellow or red-brown scale with 3 nerves that are green on the margin. The fruit itself is a small lens-shaped achene.

Typical habitat for dry-spike sedge includes a variety of upland sites such as open, sandy pine forests and savannas, dry mixed woodlands, prairies, sand dunes, sandy fields, sunny rocky outcrops, alpine or subalpine meadows. (Cody 2000; FNA 2016).

Traditional/ Medicinal Use: Traditional and medicinal use of dry-spike sedge by North American First Nations is not well documented; however, the family that dry-spike sedge belongs to referred to as Cyperaceae is recognized as having economic, ethnobotanical, and horticultural importance (Simpson and Inglis 2001).

Survey Results: Dry-spike sedge was only found at one site within the LSA (Site CS-1; Table 3-1). The site was flat to moderately sloped, dominated by open trembling aspen with a few scattered white spruce. The understory was well-developed including kinnikinnick, fireweed, purple reedgrass, and bastard toadflax with scattered soapberry, prickly rose, and highbush cranberry.

3.3 DISCUSSION

Populations of four Yukon Watch-list plant species, Coffee Creek scorpionweed, spotted lady's-slipper, small enchanter's-nightshade, and dry-spike sedge were found during rare plant surveys in the LSA, 2014-2016. Species on the Watch-list require more information on their distribution and abundance before a conservation status can be determined, but could be determined to be threatened or endangered in the Yukon (Yukon CDC 2016). The conservation concern for these species throughout their range in Yukon may eventually be higher or lower; however, the exact level of conservation concern cannot be ascertained at this time, due to the large size of the Yukon Territory and current level of search effort. Consequently, current knowledge on the conservation status of Watch-list species found during rare plant surveys is uncertain. New locations discovered in the LSA are important additions to the database for the species and are useful for the Yukon CDC to reassess status rankings, as well as assist land managers and planners to avoid uncertainties.

Cypripedium guttatum (Spotted lady's-slipper) – S2S3

Spotted lady's slipper has been found at several sites within central and northern Yukon; however, there is some uncertainty whether this species is considered Imperiled or Vulnerable in Yukon, as indicated by its range rank S2S3 (Table 3-2).

Spotted lady's slipper was found at one site in 2014 and five additional sites in 2015 (Table 3-1). Spotted lady's slipper was found on south facing, moderate slopes of similar species composition, with the exception of one site where a small population was found growing along the existing road on a south facing slope. Spotted lady's slipper was never found in habitats where Labrador tea occurred. Species composition appeared to be important in predicting the presence or absence of spotted lady's slipper. Preferred habitat consisted of open, trembling aspen forest and few scattered white spruce. The understory was consistently dominated by kinnikinnick with varying amounts of purple reedgrass, false toadflax and other shrubs. The combination of species composition, slope and aspect appear to play a strong role in dictating suitable habitat for spotted lady's slipper. Although it was not part of the survey, it is likely that soil type and soil moisture also play a strong role in supporting suitable habitat for this species.

Phacelia mollis (Coffee Creek scorpionweed) – S3S4

Coffee Creek scorpionweed has been found at a number of locations in western Yukon; however the global population of this species is found only within Yukon and AK. Within Yukon, there is some uncertainty whether it is considered Vulnerable or Apparently Secure, due to the range in habitats where it has been found (Table 3-2).

Coffee Creek scorpionweed was found growing in undisturbed open, trembling aspen to mixed forest, as well as disturbed exposed soil areas (Table 3-1). It appears that Coffee Creek scorpionweed is able to colonize disturbed areas and may be present at other human-disturbed sites in the LSA. Given its range in habitat type preference and potential to exist in previously disturbed areas, the concern for Coffee Creek scorpionweed is low. Discussions with the Yukon CDC reveal that Coffee Creek scorpionweed has recently

been found at a number of sites (including disturbed habitats), which may potentially lead to a down-listing for this species (B. Bennett, pers. comm., October 2015).

Circaea alpina spp. *alpina* (Small enchanter's-nightshade) – S2S3

Previous to rare plant surveys in 2015, small enchanter's-nightshade was only known from southeast Yukon. Although this species is circumpolar from Newfoundland to AK and in the northern United States, several Data Centres have not declared a conservation status. In BC, the conservation status is S4 (Apparently Secure); suggesting Yukon is currently at the edge of this species range. This may also be due to lack of suitable habitat in Yukon. These predictions are supported by the Yukon conservation status of S2S3 for small enchanter's-nightshade, indicating some uncertainty whether it is considered Imperiled or Vulnerable in Yukon (Table 3-2).

Small enchanter's-nightshade was found growing in transitional habitat between upland and sedge meadow (Table 3-1). Partial shading from a canopy of deciduous shrubs created a moist, cool microclimate and apparent suitable habitat for this species. This finding represents a large and impressive range extension for this species, not previously known in western Yukon.

Carex siccata (Dry-spike sedge) – S2S3

Dry-spike sedge is listed as S2S3 in Yukon which indicates uncertainty whether this species is considered Imperiled or Vulnerable in the territory (Table 3-2). Prior to rare plant surveys in 2016, dry-spike sedge was only known from four sites in Yukon. This finding represents the fifth collection in Yukon and provides important information on the overall distribution of dry-spike sedge at present. Discussions with the Yukon CDC determined that all known sites in Yukon are widely distributed and threats to occurrences are currently low. This finding also represents the most northern site of dry-spike sedge known in Yukon.

Dry-spike sedge is typically found in open, sandy pine forests, but a variety of upland sites have also been recorded including open, dry willow dominated, black spruce, white spruce, and aspen forests (Table 3-1).

4 EXOTIC AND INVASIVE PLANT SPECIES

Prior to field work, a desktop review of plant species expected to be present in the LSA was conducted for invasive plants recognized by Environment Yukon and the Yukon Invasive Species Council (YISC). Invasive plants are those that are introduced by humans to areas outside of their natural range of distribution, where they become established and disperse, generating a negative impact on the economy, environment and social realms (IUCN 2011). In Canada, most invasive plants are not native to North America, originating from Europe or Asia. Although there are a few native plant species that have invasive properties, this survey focused on non-native (exotic) invasive plant species.

Records of known invasive plants in the Yukon are stored on the Alaska Exotic Plants Information Clearinghouse (AKEPIC) data portal, as part of the ANHP, University of Alaska Anchorage. AKEPIC is a database and mapping application that provides geospatial information for invasive plants in AK and neighboring Canadian Territories (AKEPIC 2015). Database search efforts and consultation with Environment Yukon and YISC found no known records of invasive plants in the LSA. This is likely due to a lack of survey effort and subsequent reporting. To the best of our knowledge, the Coffee Project invasive plant survey was the first of its kind in the LSA, providing important baseline information for the Yukon Territory.

4.1 METHODOLOGY

4.1.1 SURVEY METHODOLOGY

The desktop review was supported by field investigations from August 8-18, 2015 and July 7, 2016 in areas of high invasive plant potential (i.e., areas with existing human disturbance) within the LSA. At the time of the invasive plant survey in 2015, the final alignment of the NAR was unknown; therefore, surveys were conducted for all road alignment options. The exotic and invasive plant survey extent was defined by existing roads from the North Klondike highway south to Coffee Camp and the Coffee airstrip (Figure 4-1 and Figure 4-2). In 2016, the survey area was extended to include the Java Road from the Coffee airstrip to the proposed mine site, including all existing disturbed areas around the proposed mine site (Figure 4-2). Areas where rank 1 (high priority) invasive plant species were found in 2015 were revisited in 2016 with onsite Environmental Monitors to monitor populations and, where possible, remove infestations.

Areas of high invasive plant potential included previously disturbed sites, mainly roadsides, pullouts, junctions, and cleared areas. Active and inactive placer mining along the NAR and previous human habitation at Coffee Camp increased the likelihood of invasive plants by creating a dispersal vector for seed transport and species introductions. The greatest potential for occurrence of invasive plants was based on the likelihood and/or proximity to previous disturbance. A list of invasive plant species reported in Yukon and assessed by Environment Yukon was used to target search effort during field surveys (available online at:

http://www.env.gov.yk.ca/animals-habitat/documents/yukon_invasive_plants_by_invasiveness.pdf).

The invasive plant survey methodology was based on the 2006 Survey of Exotic Plants along NWT Highways (Oldham 2007) where a combination of roadside driving and walking surveys were used to investigate the survey extent for potential invasive plants. Roads were driven in a truck at slow speed, averaging 20 km/hr or in a UTV, allowing surveyors to assess either side of the road. The survey along the northern portion of the survey extent was conducted by dividing the entire length of driveable road within the survey extent into 2 km transects with a start and end waypoint. Within each 2 km segment, invasive plants were observed and recorded, including a density distribution class for each species from 1–8, adapted from the BC Ministry of Forests Weed Density Distribution Classes (Luttmerding *et al.* 1990; Appendix E). For the purposes of this survey, class nine was excluded to simplify and highlight key differences observed in invasive plants. Walking surveys were conducted at pullouts, junctions, cleared areas, along the current Coffee airstrip and around Coffee Camp. Walking surveys recorded density distribution for invasive plants at point locations and for non-linear areas. Where it was feasible, invasive plants found at point locations were hand pulled, bagged and incinerated on site.

In Yukon, invasive plants range in degree of invasiveness from a rank of 1 (high priority) to 7 (least concern; Environment Yukon 2012). All invasive plant species were recorded during field surveys with a focus on rank 1 invasive plants for management purposes. When an invasive plant was found the following information was collected:

- Species name with reference to the FNA (2015 and 2016);
- Yukon invasiveness rank (1-7);
- Location (with a handheld GPS);
- Habitat type (road, pullout, clearing etc.);
- Density distribution based on the BC Ministry of Forests Weed Density Distribution Classes;
- Phenology (i.e., leafing, flowering, fruiting etc.);
- Vigor (perceived plant growth at the time of survey i.e., poor, good, excellent);
- Photographs of the species and surrounding habitat; and
- Voucher specimen collected for verification where appropriate.

Samples collected for verification were sent to Bruce Bennett (Coordinator, Yukon CDC) for identification confirmation. Voucher specimens were deposited at the B.A.B.Y. herbarium in Whitehorse, Yukon.

4.1.2 MAPPING METHODOLOGY

Invasive plants found during field surveys were mapped separately for the northern and southern portion of the survey extent. The northern portion of the survey extent includes existing road disturbances north of the Yukon River and the southern portion includes existing road disturbances south of the Yukon River. Invasive plants were mapped according to 1) abundance and 2) density distribution. In the northern portion, density distribution maps were generated by a Kernel Density Analysis using ModelBuilder in ArcGIS for

Desktop. This analysis derives kernel densities from point data by species using density distribution class data collected in the field (Appendix E) to illustrate the location of invasive plants (i.e., distribution) and the number of plants (i.e., density) for each infestation. This method generates values for all locations within a defined search area, known as the radius or bandwidth. Resulting densities were categorized as either Nil, Moderate or High. Density distributions considered Nil were classes 1 to 3; Moderate was classes 4 to 6; High was classes 7 and 8. In the southern portion of the survey extent, invasive plant maps are based on point location information.

4.2 RESULTS

Populations of 18 invasive plant species were found during field surveys (Table 4-1). These 18 species ranged from invasiveness rank 1 (high priority, highly invasive) to rank 7 (least concern, species for which both native and introduced populations exist). For a complete list of all invasive plant locations found during field surveys refer to Appendix F.

At the time of the survey, plant phenology was flowering to fruiting and vigor was good to excellent. Habitats within the survey extent where invasive plants were found included roadsides, pullouts, junctions and previously disturbed areas. Invasive plant abundance was greater in the northern portion of the survey extent compared to the south. Abundance of rank 1 invasive plants in the northern portion of the survey extent is provided in Figure 4-1. In the southern portion of the survey extent, abundance of rank 1 invasive plants is provided in Figure 4-2. Abundance of all other invasive plants in the northern and southern portions of the survey extent is provided in Appendix F.

Rank 1 invasive plant species are of the highest concern for management and are the focus of the following sections. During field surveys, five rank 1 invasive plants were found including:

- Smooth brome (*Bromus inermis*) – northern portion (Figure 4-3); southern portion (Figure 4- 4)
- Narrow-leaved hawksbeard (*Crepis tectorum*) – northern portion (Figure 4-5); southern portion (Figure 4-6)
- Perennial sow-thistle (*Sonchus arvensis* ssp. *uliginosus*) – southern portion only (Figure 4-7)
- White sweetclover (*Melilotus albus*) – northern portion (Figure 4-8); southern portion (Figure 4-9)
- Yellow sweetclover (*Melilotus officinalis*) – northern portion only (Figure 4-10)

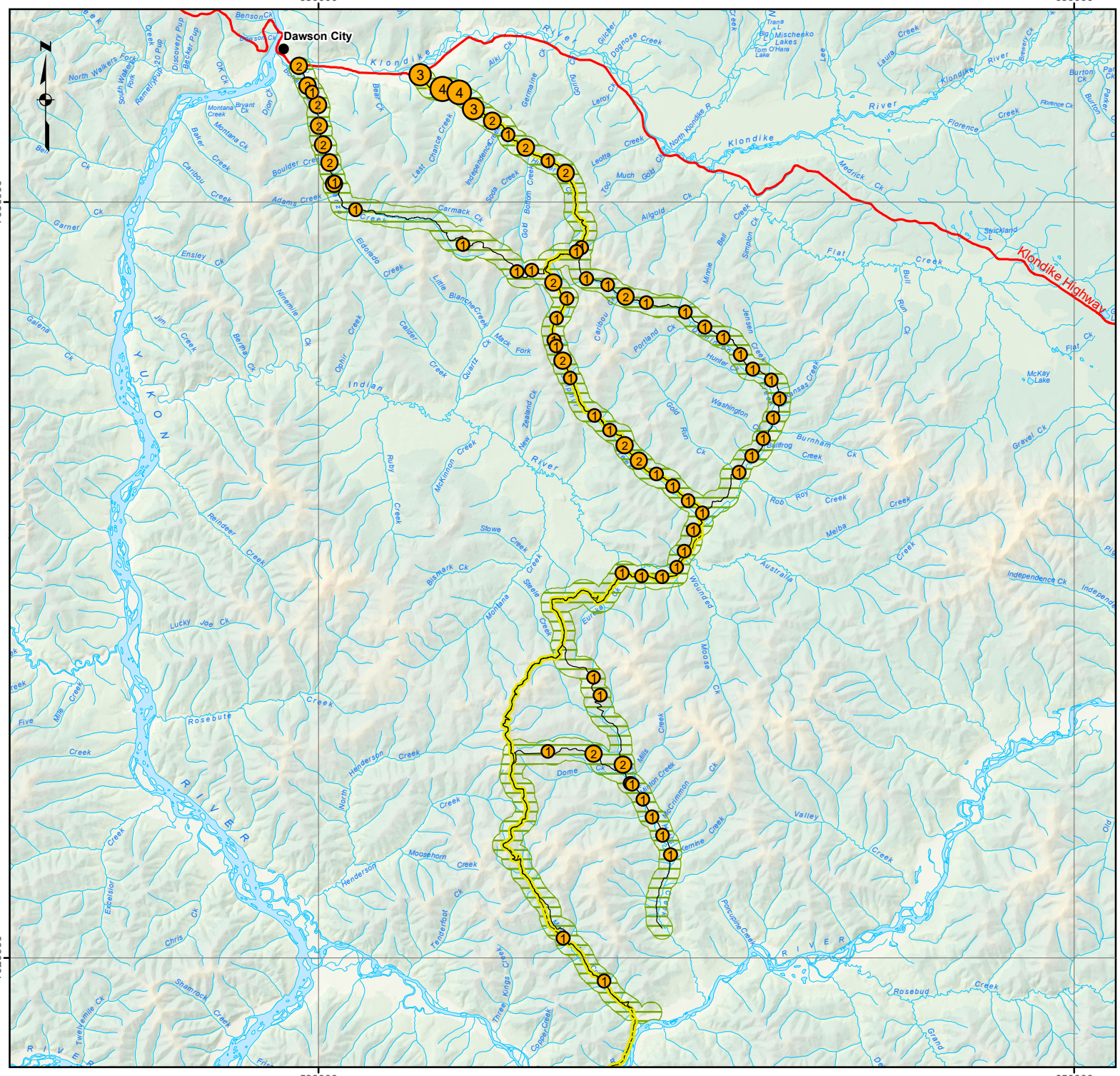
Invasive plant information sheets for rank 1 species found in the survey extent are provided in Section 4.2.1.

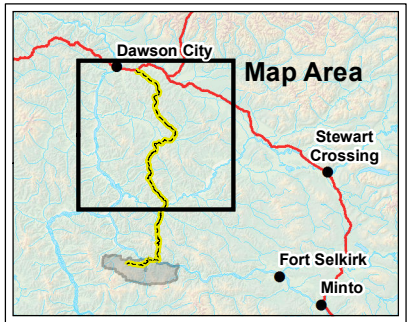
Table 4-1. Invasive plants found in the Coffee Project survey extent, 2015 and 2016

Invasiveness Rank[1]	Species Name[2]	Common Name	Habitat	General Location		
				Northern Portion	Southern Portion	
				Existing Roads	Java Road/ Proposed Mine Site	Coffee Property
1	*Bromus inermis*	Smooth brome	Clearing	√	--	√
1	*Crepis tectorum*	Narrow-leaved hawksbeard	Roadside, Clearing	√	√	√
1	*Melilotus albus*	White sweetclover	Roadside, Clearing	√	--	--
1	*Melilotus officinalis*	Yellow sweetclover	Roadside	√	--	--
1	*Sonchus arvensis* ssp. *uliginosus*	Perennial sow-thistle	Clearing	--	--	√
2	*Caragana arborescens*	Siberian peashrub	Planted	√	--	--
2	*Elymus repens*	Creeping wild rye	Clearing	√	--	--
2	*Poa pratensis*	Kentucky bluegrass	Roadside, Clearing	√	--	--
2	*Silene vulgaris*	Bladder campion	Clearing	√	--	--
2	*Taraxacum officinale*	Common dandelion	Roadside, Clearing	√	--	√
2	*Trifolium hybridum*	Alsike clover	Roadside	√	--	--
2	*Trifolium pretense*	Red clover	Roadside	√	--	--
3	*Capsella bursa-pastoris*	Shepherd's purse	Roadside, Clearing	√	--	√
3	*Chenopodium album*	Lamb's-quarter	Roadside	√	--	--
3	*Heracleum sibiricum*	Siberian cow-parsnip	Roadside	√	--	--
3	*Matricaria discoidea*	Pineapple weed	Clearing	--		√
3	*Thlaspi arvense*	Field pennycress	Roadside	√	--	--
5	*Plantago major*	Great plantain	Roadside, Clearing	√	--	√
7	*Sinapis alba*	White mustard	Planted	--	--	√

[1] Yukon invasiveness rank (Environment Yukon 2012).

[2] Primary reference flora used was the online version of the FNA (2015 and 2016).





Legend

- Settlement/Community
- Highway
- Existing Access
- Proposed Route
- Survey Extent

Rank 1 Invasive Species Location (by abundance)

- 1 Species
- 2 Species
- 3 Species
- 4 Species

FIGURE: 4 - 1

Abundance of rank 1 invasive plants in the northern portion of the survey extent

Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Rank 1 invasive species: Bromus inermis, Crepus tectorum, Melilotus albus and Melilotus officinale.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

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KM

Map Reference Scale: 1:500,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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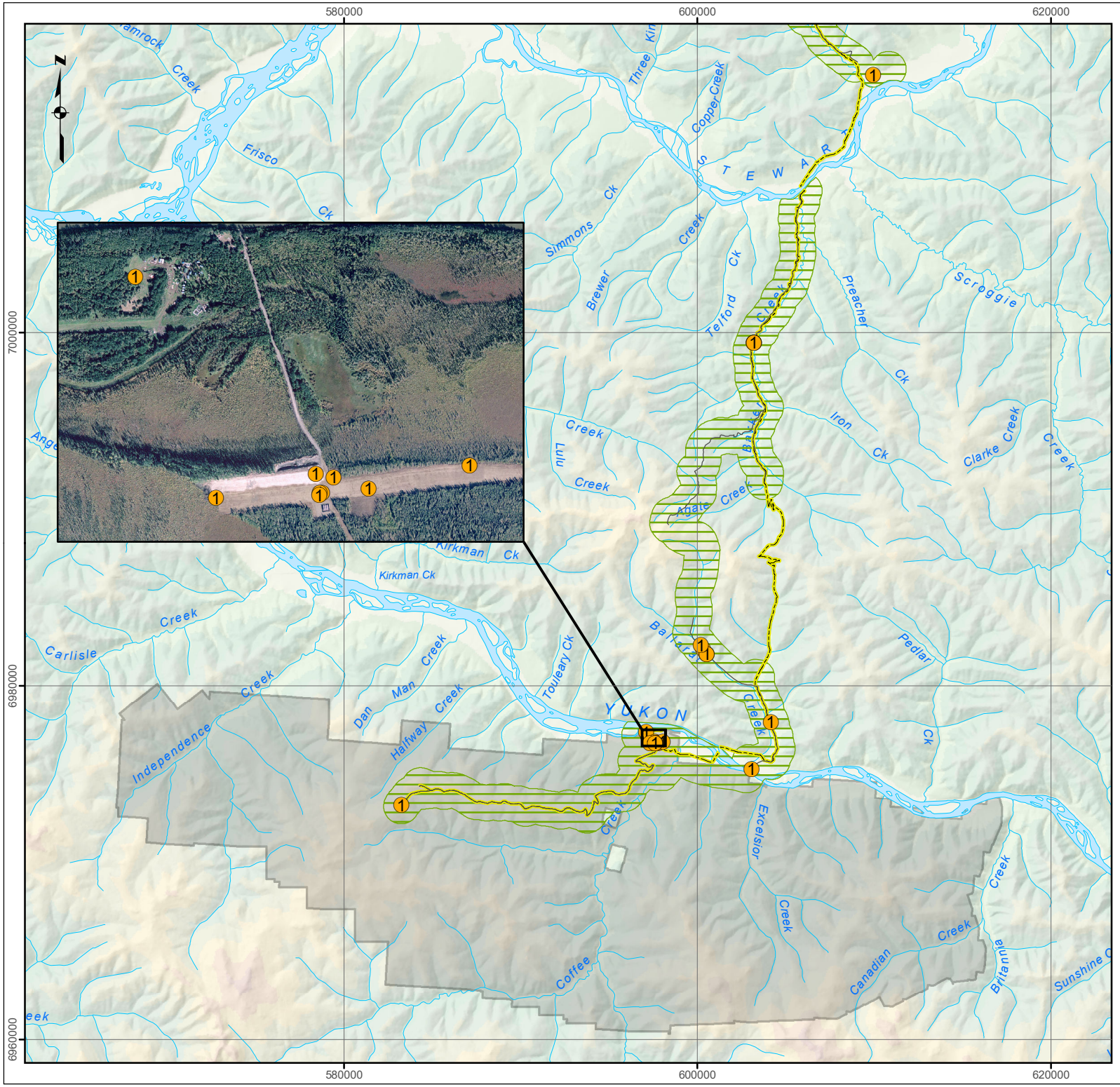

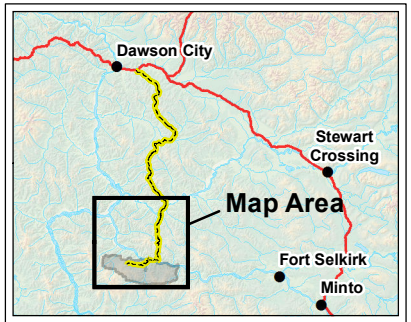

Legend

- Settlement/Community
- Rank 1 Invasive Species Locations
- Proposed Route
- Existing Access
- Survey Extent
- Coffee Property

FIGURE: 4 - 2

Abundance of rank 1 invasive plants in the southern portion of the survey extent

Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Rank 1 invasive species: Bromus inermis, Crepus tectorum, Melilotus albus and Melilotus officinale.

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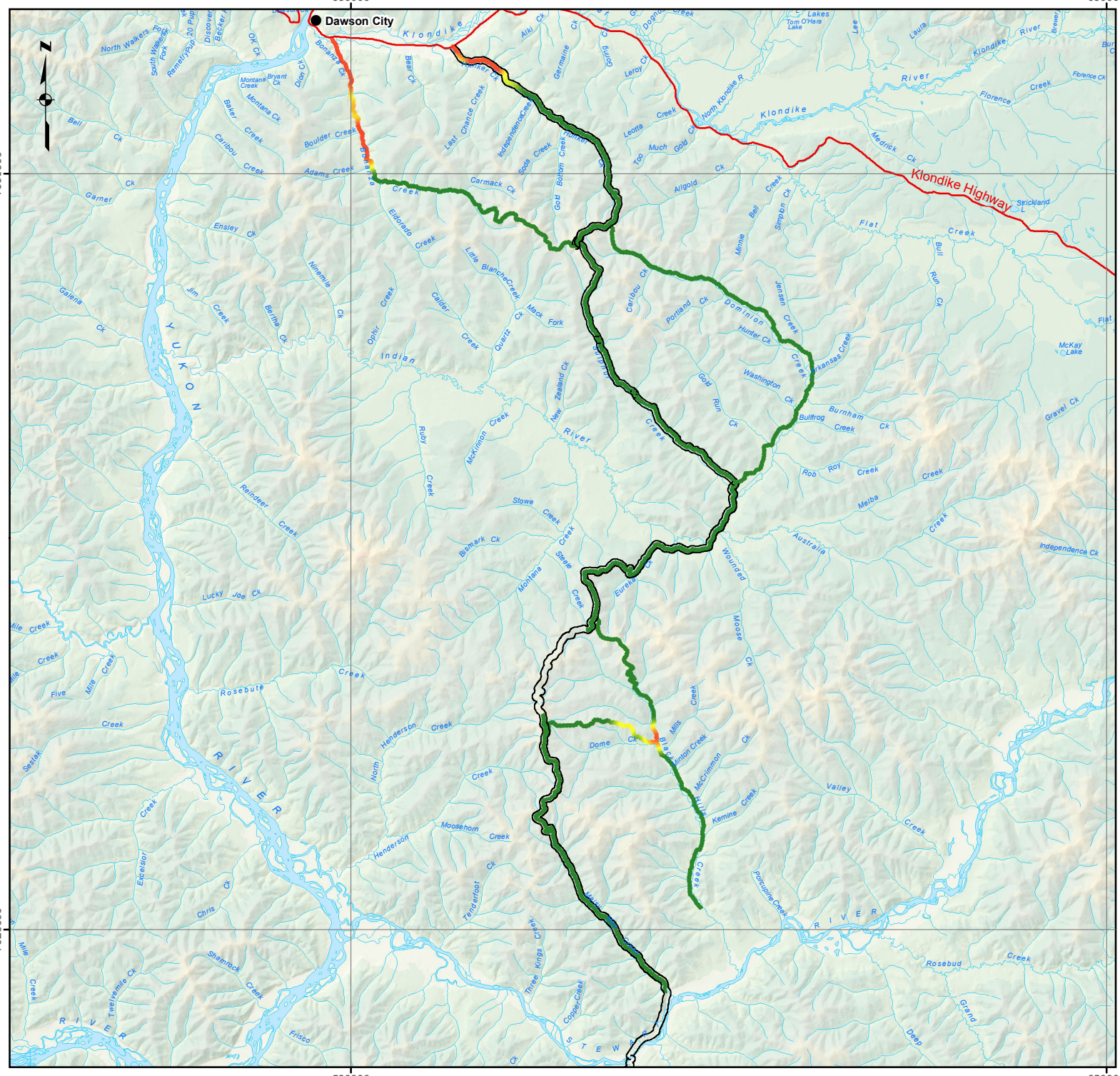

Legend

- Settlement/Community
- Highway
- Proposed Route

Density of smooth brome (Bromus inermis)

- High
- Moderate
- Nil

FIGURE: 4 - 3

Density distribution of smooth brome, northern portion of the survey extent

Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

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Map Reference Scale: 1:500,000 (Printed at 8.5 x 11)
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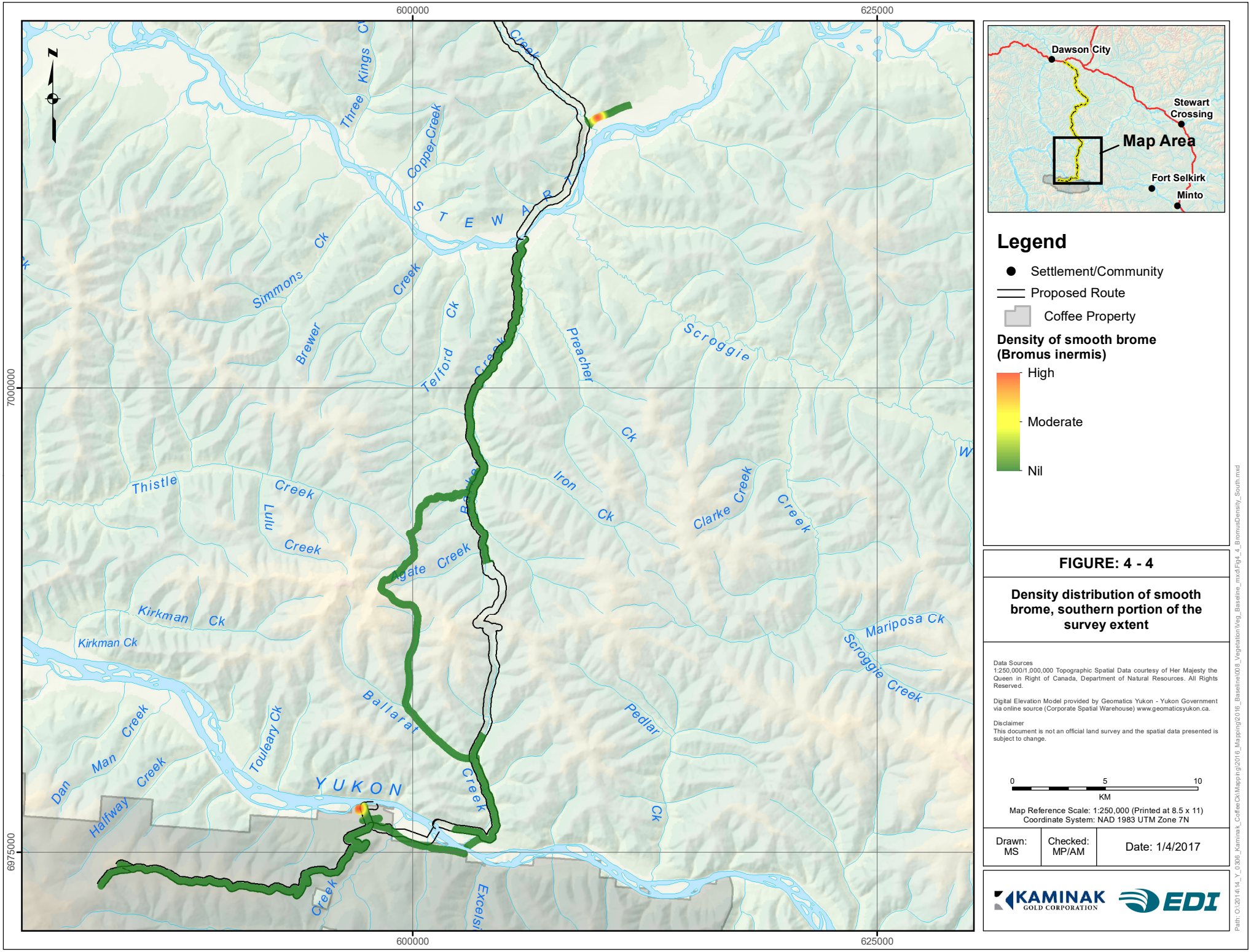

Legend

- Settlement/Community
- Proposed Route
- Coffee Property

Density of smooth brome (Bromus inermis)

- High
- Moderate
- Nil

FIGURE: 4 - 4

Density distribution of smooth brome, southern portion of the survey extent

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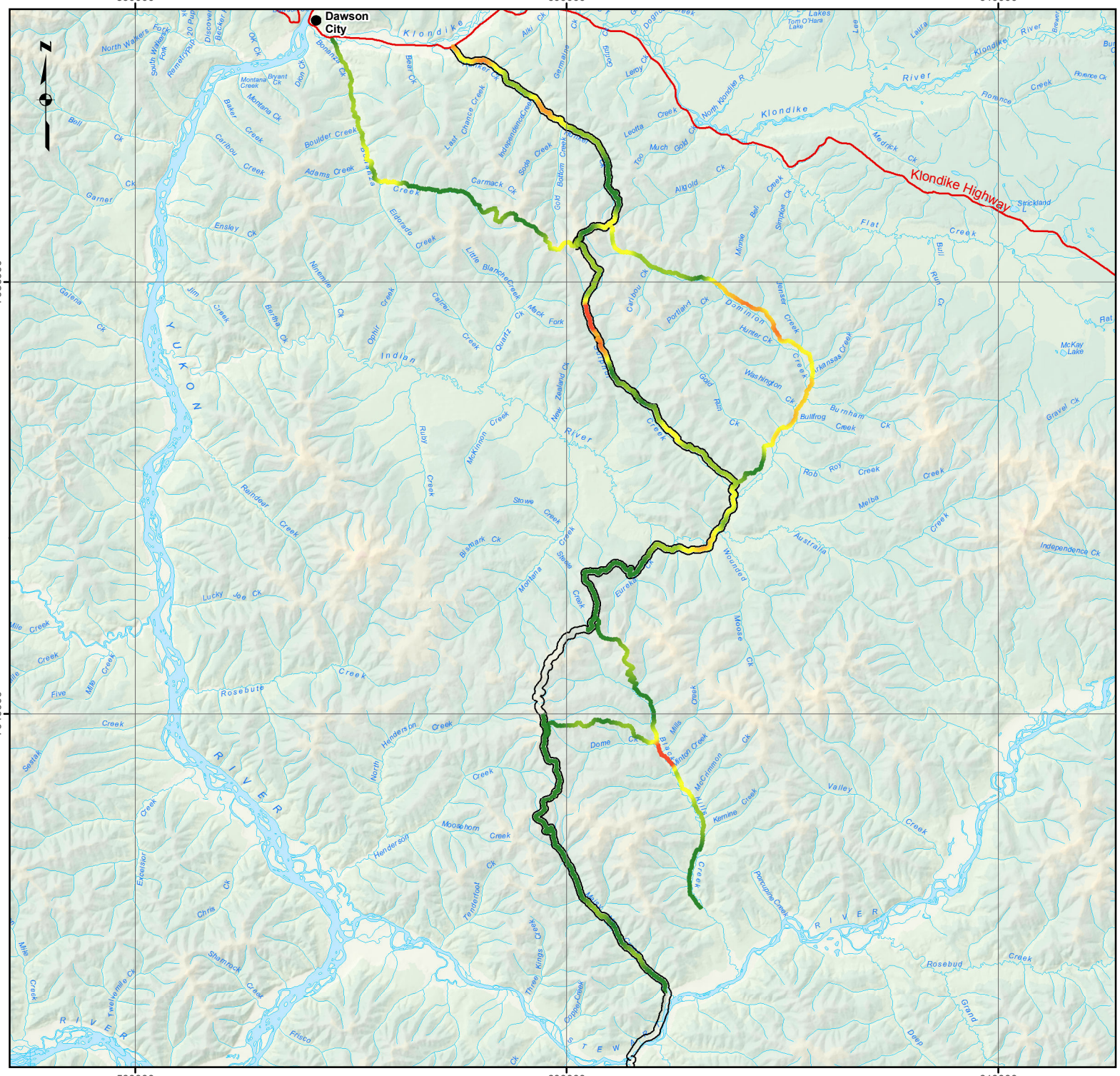

Legend

- Settlement/Community
- Highway
- Proposed Route
- Coffee Property

Density of narrow-leaved hawksbeard (Crepis tectorum)

- High
- Moderate
- Nil

FIGURE: 4 - 5

Density distribution of narrow-leaved hawksbeard, northern portion of the survey extent

Data Sources
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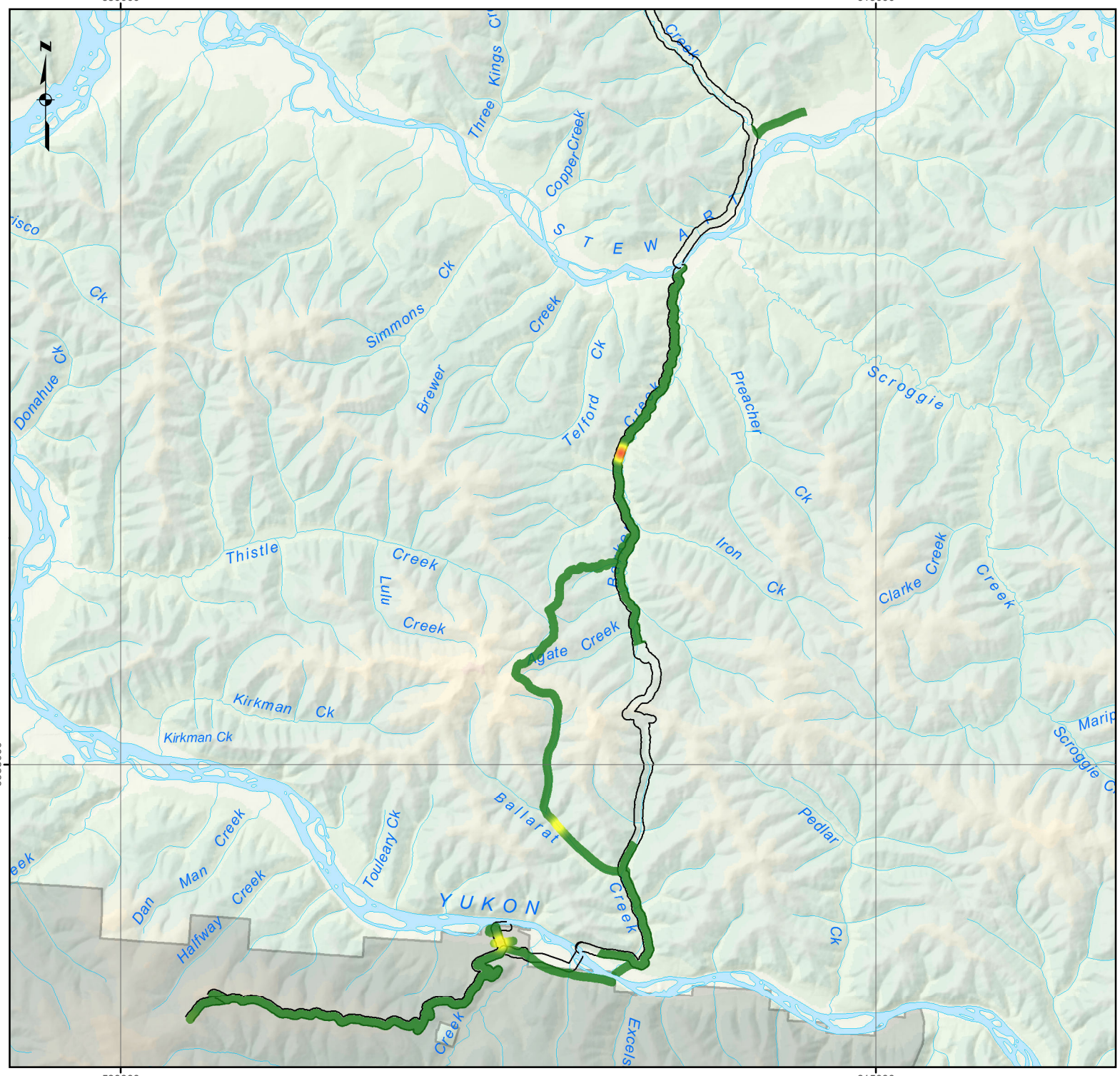

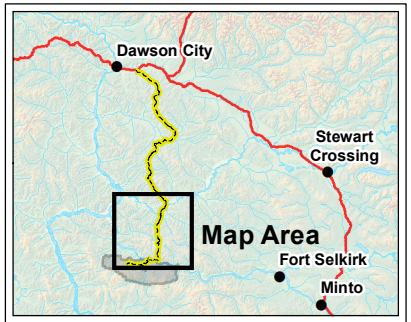

Legend

- Settlement/Community
- Proposed Route

Density of narrow-leaved hawksbeard (Crepis tectorum)

- High
- Moderate
- Nil

FIGURE: 4 - 6

Density distribution of narrow-leaved hawksbeard, southern portion of the survey extent

Data Sources
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Map Reference Scale: 1:250,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MS	Checked: MP/AM	Date: 1/4/2017

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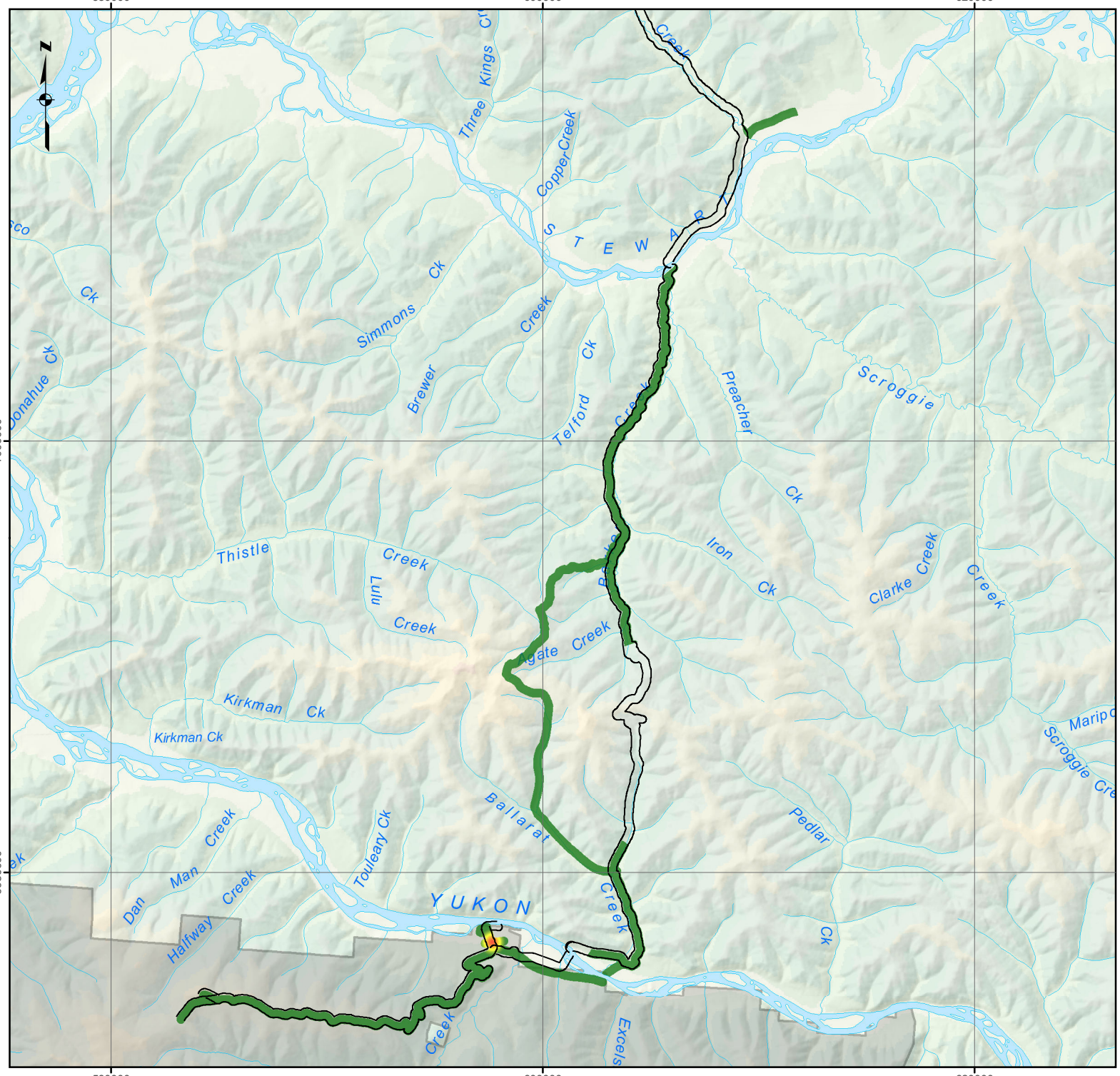

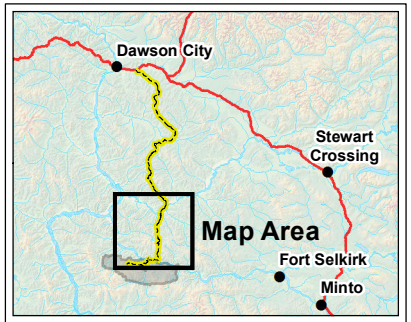

Legend

- Settlement/Community
- Proposed Route
- Coffee Property

Density of perennial sow-thistle (Sonchus arvensis ssp. arvensis)

- High
- Moderate
- Nil

FIGURE: 4 - 7

Density distribution of perennial sow-thistle, southern portion of the survey extent

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Map Reference Scale: 1:250,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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MS	MP/AM	1/4/2017

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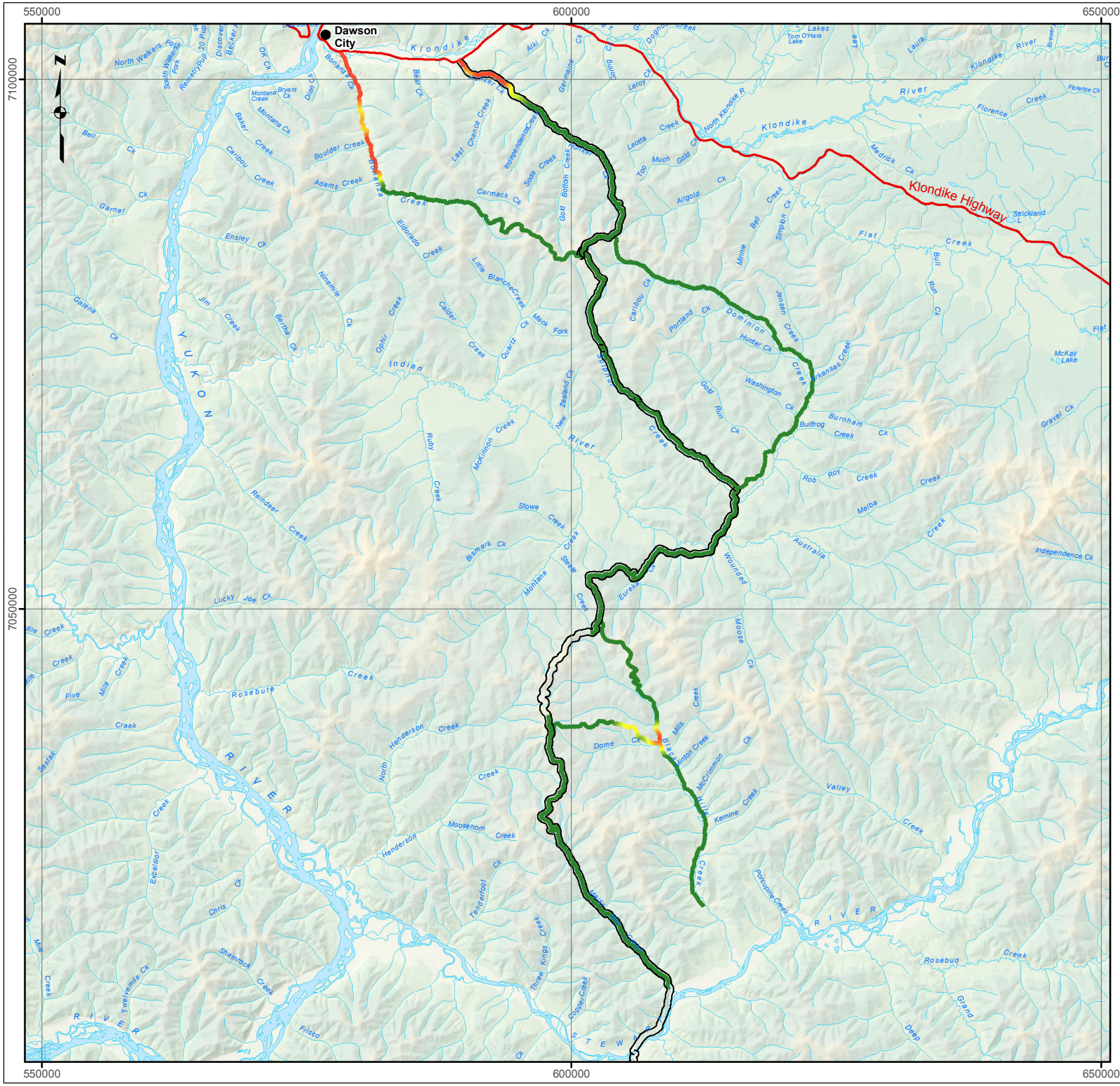

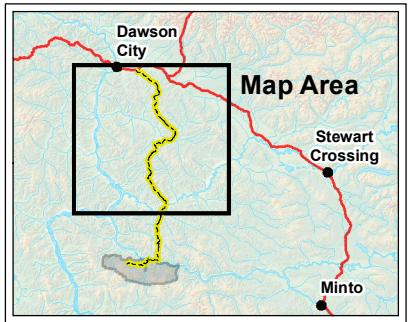

Legend

- Settlement/Community
- Highway
- Proposed Route
- Coffee Property

Density of white sweetclover (Melilotus albus)

- High
- Moderate
- Nil

FIGURE: 4 - 8

Density distribution of white sweetclover, northern portion of the survey extent

Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

0 5 10 15
KM

Map Reference Scale: 1:500,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MS	Checked: MP/AM	Date: 02/09/2016

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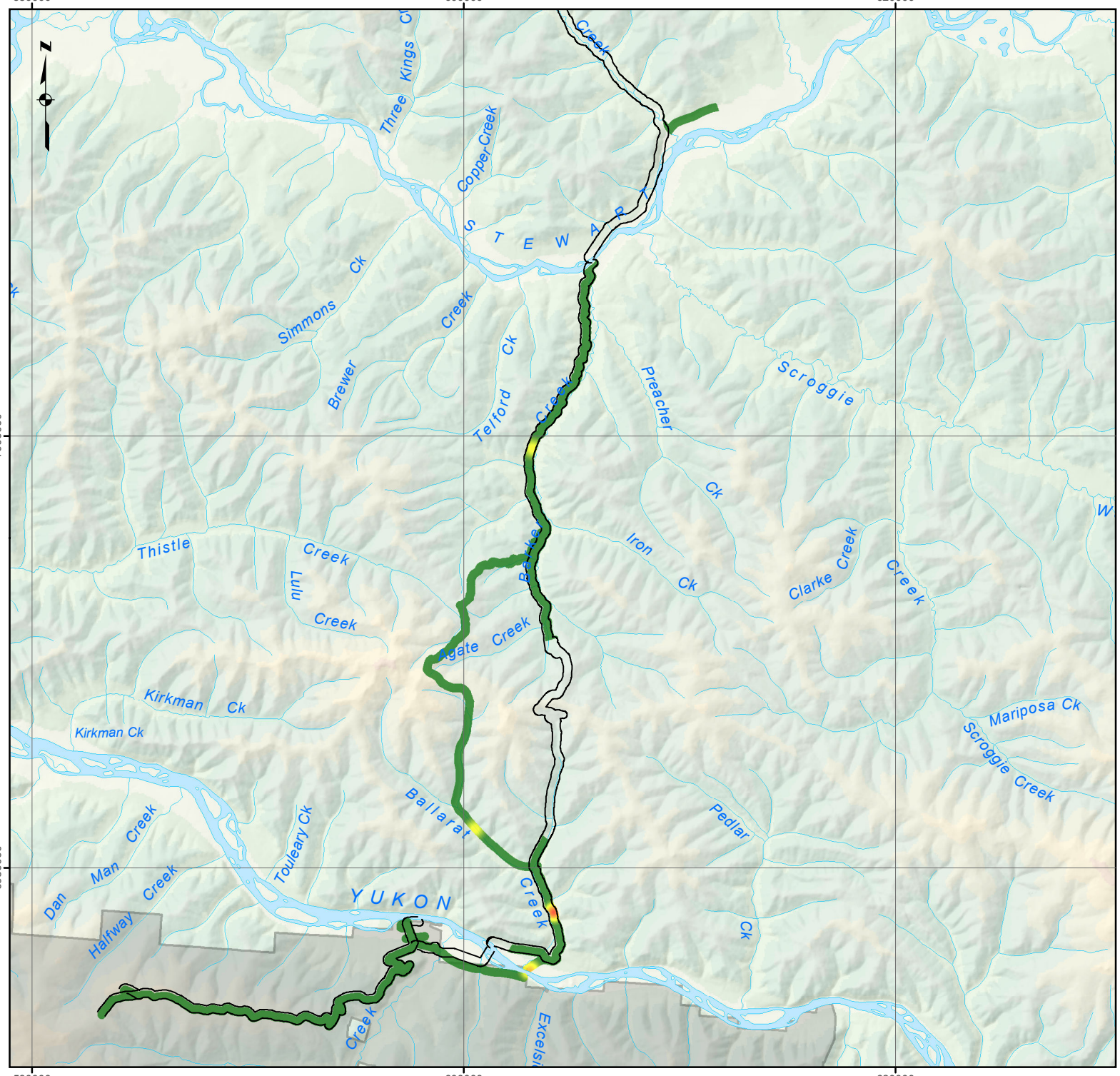

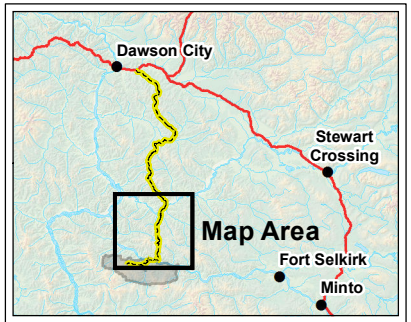

Legend

- Settlement/Community
- Proposed Route
- Coffee Property

Density of white sweetclover (Melilotus albus)

- High
- Moderate
- Nil

FIGURE: 4 - 9

Density distribution of white sweetclover, southern portion of the survey extent

Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

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Disclaimer
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0 5 10
KM

Map Reference Scale: 1:250,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MS	Checked: MP/AM	Date: 1/4/2017

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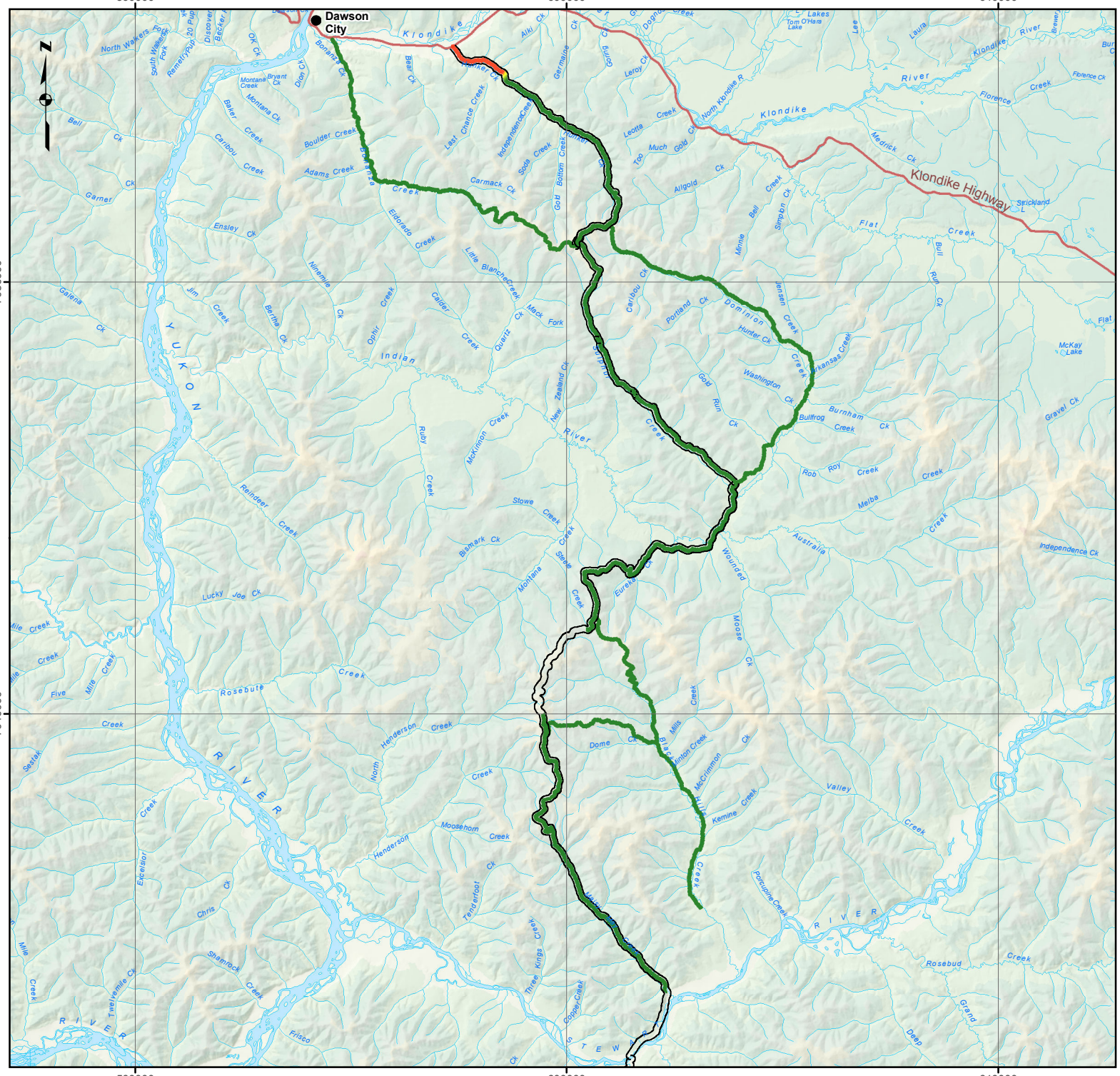

Legend

- Settlement/Community
- Highway
- Proposed Route

Density of yellow sweetclover (Melilotus officinale)

- High
- Moderate
- Nil

FIGURE: 4 - 10

Density distribution of yellow sweetclover, northern portion of the survey extent

Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

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0 5 10 15
KM

Map Reference Scale: 1:500,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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4.2.1 INVASIVE PLANT INFORMATION SHEETS

Species information sheets were developed for rank 1 invasive plants observed during field surveys. Information sheets include species name, Yukon invasiveness rank, geographic distribution, botanical description, typical habitat and the location where it was found within the survey extent. Descriptions were adapted from the FNA (2015 and 2016), Flora of the Yukon Territory (Cody 2000), the Illustrated Flora of British Columbia (Douglas *et al.* 1998–2002) and YISC (YISC 2015).

Bromus inermis (Smooth brome)

Family: Poaceae — Grass Family

Smooth brome has been widely introduced in North America for use in pastures and grass as hay. Its native origin is Germany, Hungary, France and northern Asia. Across Canada, smooth brome is known for its invasive properties. In Yukon, its invasiveness rank is 1 (top priority). It is found along most Yukon highways, as a result of roadside seeding and erosion control, as well as old settlements located far from roads or rivers, likely due to hay production. It is known from every community in Yukon except Old Crow.

Smooth brome is a cold hardy, persistent, creeping perennial grass. Once established, it grows creeping underground rhizomes. Stems are smooth to soft or stiff-hairy, up to 1.2 m in height. Leaf blades are flat, smooth to somewhat hairy, 3-10 mm wide. Commonly, there is a "W" shaped line on the upper leaf. It has ear-shaped lobes at the bases of the leaf that clasp the stem and a translucent tongue-like appendage called a ligule, 0.5-2.5 mm long. Seed heads are 7-20 cm long with spikelets that contain the grass flowers and seeds. Spikelets are purple tinged and the overall shape resembles a cigar with tapered ends.

Smooth brome was found scattered along the NAR and around Coffee Camp in 2015 (Table 4-1, Figure 4-3 and 4-4). The density distribution of smooth brome along the NAR was relatively low compared to other invasive plant species. It was recorded from 14 transects and the density distribution class ranged from 2 – "few sporadically occurring individuals" to 6 – "several well-spaced patches or clumps" (Luttmerding *et al.* 1990; Appendix E). At Coffee Camp, it was prevalent and found throughout most of the cleared areas surrounding buildings with a high density distribution class of 8 (continuous dense occurrence of a species). The site was revisited in 2016 to discuss mowing practices in areas of infestations with onsite Environmental Monitors.



Photo 4-1. *Bromus inermis* (Smooth brome)

Crepis tectorum (Narrow-leaved hawksbeard)

Family: Asteraceae — Aster Family

Narrow-leaved hawksbeard is native to Europe. Introduced as a contaminant in seed, it is now widespread across Canada and the northeastern United States. In Yukon, its invasiveness rank is 1 (top priority). It is found along roadsides, pull outs, pastures and disturbed, open areas. In Yukon, it occurs along all major highways.

Narrow-leaved hawksbeard is an annual forb from a short taproot. Stems are erect, smooth to hairy, solitary, branched, measuring 0.3-1.0 m tall. It has two different types of leaves. Basal leaves are lance to oblanceolate in shape, 2-15 cm long and 0.3-4 cm wide, smooth to short-hairy with variable margins. Stem leaves clasp the stem and are mostly linear. Flowers are yellow, numerous and concentrated at the ends of branches. Subtending the flower heads are bracts that are short woolly-hairy or stiff-hairy.

Narrow-leaved hawksbeard was found scattered along the NAR, at the existing Coffee Airstrip and adjacent existing road, and one site along the Java Road at Km 21 in the vicinity of the proposed mine site (Table 4-1, Figure 4-5 and 4-6).

The presence of narrow-leaved hawksbeard along the NAR and at previously disturbed, open areas was high compared to other invasive plant species. It was recorded from 68 transects and the density distribution class ranged from 2 – "few sporadically occurring individuals" to 7 – "continuous uniform occurrence of well-spaced individuals" (Luttmerding *et al.* 1990; Appendix E). In the southern portion of the survey extent, narrow-leaved hawksbeard was found at five sites along the Coffee airstrip. Two sites were associated with the fuel tank location along the Coffee airstrip and three sites were along the edges of the Coffee airstrip itself. The density distribution ranged from 1 – "rare individual, a single occurrence to 8 – "continuous dense occurrence of a species" (Luttmerding *et al.* 1990; Appendix E). All individuals were pulled, bagged, and incinerated onsite with the exception of the largest and most dense patch of narrow-leaved hawksbeard found along the Coffee airstrip adjacent the wind sock (225 m^2). This patch was not eradicated, due to time limitations.



Photo 4-2. *Crepis tectorum* (Narrow-leaved hawksbeard)

***Sonchus arvensis* ssp. *uliginosus* (Perennial sow-thistle):**

Family: Asteraceae — Aster Family

Perennial sow-thistle has been introduced to North America. It is native to Europe and the Caucasus region of Asia (Royer and Dickson 1999). Perennial sow-thistle is known to be invasive and in several states and provinces is legally listed as noxious. In Yukon, its invasiveness rank is 1 (top priority). It is known from primarily the Whitehorse area, as well as Carmacks, Destruction Bay, Johnson's Crossing, and the Kotaneelee gas plant. Recent reports signal a spread of this species along highway corridors in Yukon.

Perennial sow-thistle resembles a tall dandelion more than a true thistle plant. It is a perennial forb with persistent, aggressive underground rhizomes that spread horizontally, up to 10 feet from the flowering plant. Stems are erect, branched, smooth, growing up to 2 m tall and exude a milky juice when punctured.

Leaves are alternate on the stem, strongly clasping, and waxy with weakly prickly edges. Flowering heads are yellow, large 3–5 cm wide, subtended by smooth, green, waxy bracts. Fruit seeds are 2.5-3.5 mm long, ribbed and cross-wrinkled topped with a conspicuous pappus of white wispy bristles that can easily be dispersed by the wind.

Perennial sow-thistle was found at only one site along the current Coffee airstrip in 2015 (Table 4-1, Figure 4-7) where four individual plants were observed directly adjacent to the plane loading/unloading dock. All individuals were "dead-headed" meaning the top part of the plant containing the seeds was removed, bagged and burned in the incinerator on site. No individuals were found growing during 2016 surveys.



Photo 4-3. *Sonchus arvensis* spp. *uliginosus* (Perennial sow-thistle)

Melilotus albus (White sweetclover)

Family: Fabaceae — Pea Family

White sweetclover has been widely introduced in North America for agricultural purposes as a forage crop and honey plant. It is considered weedy or invasive across most countries where introduced. Its native origin is Europe and Asia. In Yukon, its invasiveness rank is 1 (top priority). It is found along most major Yukon highways and also spreads along rivers. Sites where white sweetclover is known on the Yukon River are Whitehorse, Carmacks and Dawson and it is considered a serious problem on Alaskan waterways, including tributaries of the Yukon River.

White sweetclover is an annual or biennial forb from a taproot that rapidly colonizes well-drained, gravelly soils such as roadsides, waste areas and river banks. Stems are erect, 0.5-2 m tall, freely branched, finely to short-hairy or glabrous. Leaves are alternate on the stem, pinnately compound in three's, oblong to elliptic in shape, 1-4 cm long, mostly smooth with fine-teeth on the margins. Flowers are sweet-scented, arranged in long spikes of 20-50 white, pea-like flowers. Fruit pods are egg-shaped, nodding, 3-6 mm long, smooth and net-veined. A single plant can produce up to 300,000 seeds which remain viable in the soil or in water for several years (80% survival after 30 years; YISC 2015).

White sweetclover was found in several locations along the NAR (Table 4-1, Figure 4-8 and 4-9) in 2015. The density distribution of white sweetclover along the NAR was moderate compared to other invasive plant species. It was recorded from 14 transects and the density distribution class ranged from 2 – "few sporadically occurring individuals" to 8 – "continuous dense occurrence of a species" (Luttmerding *et al.* 1990; Appendix E). One notable patch was found on the north side of the Yukon River in an open clearing, previously disturbed, directly adjacent the river. This patch was pulled, bagged, and incinerated onsite.



Photo 4-4. *Melilotus albus* (White sweetclover)

Melilotus officinalis (Yellow sweetclover)

Family: Fabaceae — Pea Family

Yellow sweetclover has been widely introduced in North America for agricultural purposes as a forage crop and honey plant. It is considered weedy or invasive across most countries where introduced. Its native origin is Europe and Asia. In Yukon, its invasiveness rank is 1 (top priority). It is found along several major Yukon highways, but is not as prevalent as white sweetclover.

Yellow sweetclover is very similar to white sweetclover. It is an annual or biennial forb from a taproot that colonizes well-drained, gravelly soils such as roadsides, waste areas and river banks. Stems are erect, 0.5-2 m tall, freely branched, finely to short-hairy or glabrous. Leaves are alternate on the stem, pinnately compound in three's, oblong to elliptic in shape, 1-4 cm long, mostly smooth with fine-teeth on the margins. Flowers are yellow, sweet-scented in drying, arranged in long spikes of 20-50 pea-like flowers. Fruit pods are egg-shaped, nodding, 3-5 mm long, smooth and cross-ribbed. A single plant can produce up to 300,000 seeds which remain viable in the soil or in water for several years (80% survival after 30 years; YISC 2015).

Yellow sweetclover was only found in 2015 along the NAR within approximately 6 km of the North Klondike highway (Table 4-1, Figure 4-10). The density distribution of yellow sweetclover was moderate where it was found (density distribution class ranged from 4 – "several sporadically occurring individuals" to 6 – "several well-spaced patches or clumps of a species"; Luttmerding *et al.* 1990; Appendix E).



Photo 4-5. *Melilotus officinalis* (Yellow sweetclover)

4.3 DISCUSSION

Invasive plants found during field surveys range in degree of invasiveness (i.e., concern) from high priority (1) to least concern (7). Yukon ranks are based on general abundance, persistence, invasiveness rank in neighbouring jurisdictions, climate projections, and expert opinion of the Yukon CDC (Environment Yukon 2012). High priority species are those that are of most concern to the economy, environment, and human health (YISC 2015). The IUCN states that "invasive species represent the second most significant cause of species extinction worldwide after habitat destruction. The spread of invasive species is facilitated by increasing trade, travel, and the transporting of goods, as these organisms may "hitchhike" on ships, containers, cars, soils, etc. This is, therefore, a global problem that requires international cooperation and action" (IUCN 2011). Across Canada, it is estimated that there are 1,229 non-native vascular plant species to Canada, 486 of which are considered weedy or invasive (CFIA 2008). Relative to other jurisdictions, Yukon has fewer invasive species with approximately 154 non-native plant species, 20 of which are considered invasive (YISC 2015).

Not all invasive plants included in this report require targeted management or attention, but are included because they have been found to be invasive in other jurisdictions. Pineapple weed is a non-native species in Yukon and is known to be invasive in other jurisdictions; however, it is of low invasive concern in the territory (Environment Yukon 2012; YISC 2015). Similarly, alsike clover and common dandelion are widespread, persistent, and aggressive, but may not replace native species or change ecosystem function (Environment Yukon 2012; YISC 2015). Although these definitions may change, due to factors such as climate change, the focus of invasive plant surveys for the Coffee Project on high priority species is supported by the findings. Rank 1 invasive plants are considered highly invasive in Yukon and may displace or replace native ecosystems (Environment Yukon 2012).

In general, concentrations of invasive plants were less frequent in the southern portion of the survey extent compared to the northern portion. Prior to mining exploration at Coffee Creek, human habitation (i.e., farming) has led to relatively few invasive plants introductions, such as smooth brome and other lower priority species. Narrow-leaved hawksbeard and perennial sow-thistle are high priority species found in the vicinity of Coffee Camp. Both of these species had relatively low abundance and distribution in the southern portion of the study area. Coffee Camp is a relatively isolated location with no road access and limited disturbance. This indicates there are few vectors of dispersal for exotic species to be introduced.

Disturbed areas accessed by UTV and on foot in the southern portions of the survey extent had fewer invasive plants than areas accessible by truck in the northern portions of the survey extent. This is likely due to less exposure from humans and fewer vectors of plant introduction and dispersal (i.e., seeds in mud on vehicle tires). The northern section has a longer history of traffic and disturbance than the southern portion of the survey extent. It is well known that the presence of invasive plants is related to disturbance with introduction and spread commonly from machinery and equipment (YISC 2015). The most common invasive plant species observed at previously disturbed sites, clearings, pullouts and road junctions was narrow-leaved hawksbeard, followed by common dandelion, white sweetclover, and Kentucky bluegrass.

A common observation made along existing roads in the northern portion of the survey extent was that in areas where the road ditch was absent or narrow and native vegetation (i.e., alders, willow) was found growing on the edge of the roadside, invasive plants were not found. Invasive plants were found in areas previously disturbed, where an open niche was present for seed establishment and there is a vector for seed dispersal. Along the edges of the road where only a narrow band of disturbance was present, there were fewer invasive plants than in wider ditches.

Once established, the ecological impacts of invasive plants can be wide ranging. Smooth brome, white and yellow sweetclover form dense sod mats that smothers and excludes native species, inhibit natural succession and reduce biodiversity (YISC 2015). Perennial sow-thistle is also an aggressive species that forms dense mats through a network of underground roots. It is known to reduce water resources when found growing at high densities and can invade lake shores, beaches and agricultural areas (YISC 2015). Narrow-leaved hawksbeard, the most common invasive plant found during field surveys, is a prolific seed producer that readily colonizes open, disturbed areas and chokes out native species. All rank 1 invasive plants found during field surveys can be seen along major Yukon highways (Line *et al.* 2008), displacing habitat where native plants once thrived.

5 VEGETATION AND SOIL TRACE METALS SAMPLING

Trace metals sampling for the Coffee Project characterizes baseline vegetation and soil trace metal concentrations within the trace metals RSA with the potential to be affected by Project development. Trace metals are defined as, "elements that occur in natural and perturbed environments in small amounts and when present in sufficient bioavailable concentrations are toxic to living organisms" (Adriano 2001). Trace metals in dust deposition as total suspended particulates (TSP) can pose a risk to vegetation through elevated metal concentrations in soil and vegetation tissues. Dust on the surface of a leaf may alter pH, increase the temperature of the plant, and/or reduce the plants ability to photosynthesize (Auerbach *et al.* 1997; Spatt and Miller 1981; Walker and Everett 1987). Baseline data on trace metals in vegetation and soil for the Coffee Project will provide a benchmark to assess potential Project effects to metal concentrations in soil and vegetation.

Natural sources of trace metals in vegetation and soil is largely dependent on parent material or underlying geological material (e.g., bedrock) and the amount of weathering that has occurred; the older and more established the soil, the less it is influenced by the parent material (Adriano 2001). Anthropogenic sources of trace metals such as atmospheric deposition (i.e., dust) may include mine tailings, sewage and waste water, fossil fuel combustion, landfills, metal scrap heaps, and mining and smelting (Adriano 2001; CACAR 2003).

The Canadian Council of Ministers of the Environment (CCME) have established Canadian soil quality guidelines for the protection of environmental and human health by developing standards for soil quality in Canada (CCME 2006). These guidelines outline the "numerical concentrations that are recommended as levels that should result in negligible risk to biota, their functions, or any interactions that are integral to sustaining the health of ecosystems" (CCME 2006). Currently, no standards exist to assess trace metal concentrations in vegetation.

5.1 SAMPLING METHODOLOGY

Baseline data on vegetation and soil metal concentrations for the Coffee Project were initially collected in 2014, 2015 and 2016. Sites around the proposed mine site and Coffee Camp were sampled in July 2014 and sites along the proposed NAR were sampled in July and August 2015. For the 2014 and 2015 data collection years, site selection generally coincided with the Ecosystem Mapping Program (Section 2.0). Sample sites were located within three distance categories based on the proposed Project Footprint: adjacent (0-25 m), near (75-250 m), and far (1.5-2.5 km)(Figure 5-1). The 2016 sampling program consisted of sample sites within the near sample zone, the far sample zone, and the Moose Mountain and Thistle samples zones (Figure 5-1).

Vegetation included in baseline sampling consisted of four focal species or species groups: willow (*Salix* spp.), fruticose lichen (*Cladina* spp.), horsetail (*Equisetum arvense, Equisetum pratense,* and *Equisetum sylvaticum*), and lowbush cranberry. These plant species were chosen based on value as wildlife forage, importance to First Nations, and comparability to other studies:

- Willow is an important forage species for moose and other wildlife that consume the leaves, twigs, branches, and catkins (high in vitamin C) for sustenance. As a medicinal plant, the inner bark can be used to relieve headaches, fever, cold, flu, or pain related to urinary tract, sciatic nerve pain, tendonitis, osteoarthritis, back pain, muscle aches, sprains, or menstrual cramping. (Gray 2011; Schofield 1998). Willow is also used for basket making, making snares, tanning hides, and is a source for natural dyes (Schofield 1998; Leary 2009).
- Lichen is an important food source for caribou, particularly during the winter. Lichen lacks an outer cuticle; therefore, it absorbs nutrients from the atmosphere and has been used in previous studies to monitor air quality.
- Horsetail is eaten by wildlife including moose and bears. Some species of horsetail have medicinal uses (Gray 2011, Schofield 1998); although it is unknown whether local First Nations used horsetail in the Coffee Creek area for this purpose.
- Lowbush cranberry is harvested by First Nations (Mishler and Simeone 2004; InterGroup Consultants Ltd. 2009; Bates and DeRoy 2014) and local First Nations have reported previously harvesting it in the Coffee Creek area (Tr'ondëk Hwëch'in 2012b). Berries reduce the development of kidney stones and urinary tract infections, lower blood sugar, benefit the cardiovascular and immune system, stimulate digestion, prevent bacteria build up in the mouth, and improve eyesight (Gray 2011; Schofield 1998). Many bird and wildlife species also forage on lowbush cranberry for sustenance.

Both soil and vegetation samples were collected at each site; however, the vegetation species sampled at each site were subject to availability (not every species was available at every site). Collections were made using the following procedures:

- A new pair of nitrile gloves were worn for each vegetation and soil sample.
- Stainless steel tablespoons used for soil sampling were cleaned with alcohol wipes before and after each sample.
- A minimum of 10 grams of each vegetation sample was collected at each site within a 10 m radius of plot centre. For each of the focal species or species groups the following plant parts were collected:
    - Willow —current year's growth from at least 3 different individuals
    - Lichen —entire specimen
    - Horsetail — above ground portions
    - Lowbush cranberry — above ground portions and berries where available
- A minimum of 100 grams of soil from the top soil layer was collected at each site to a depth of ≤10 cm and above permafrost where possible. This reflects the top layer of the rooting zone where the potential for metal uptake in plants is expected to be the greatest.
- Samples were placed in new zip-loc bags, refrigerated and sent to an accredited laboratory for metals analyses.

Vegetation and soil samples were analyzed for total metal concentrations using inductively coupled plasma mass spectrometry (ICP-MS) by an accredited laboratory. Vegetation samples were analyzed for 31 total metals including: aluminum, antimony, arsenic, barium, beryllium, bismuth, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, phosphorus, potassium, selenium, silver, sodium, strontium, thallium, tin, titanium, uranium, vanadium, and zinc. Excluding boron, soil analysis included the same suite of metals, with the addition of lithium, zirconium, and soil pH.

In 2016, the baseline vegetation and soil trace metals sampling study design was revised to incorporate available data from dust isopleth modelling and improve extent and coverage around the proposed mine site. The improved study design considered spatial distribution and sample size to include new sample sites at varying distances from the proposed Project footprint. Distance categories were revised to better represent dust fall isopleth modelling and prevailing winds (South, Northeast, and Northwest). Sample sites were situated along 10 transects radiating out from the proposed mine site. To prevent pseudo-replication and ensure independence between sites, all transects were spaced a minimum of 300 m apart. Along each transect, sample sites were located at one of four distance categories: adjacent (100 m), near (1000 m), far (5.5-7.5 km), and control (≥15 km); control sites represent locations unaffected by Project activities.

From 2014-2016, the total number of vegetation and soil trace metals sample sites visited was 89 (Figure 5-1). Seventy-seven soil sites where located in the Coffee Area including 68 willow, 61 lichen, 61 lowbush cranberry, and 22 horsetail sites. Twelve soil sites were located along the NAR including 10 willow, 5 lichen, 8 lowbush cranberry, and 9 horsetail sites. A table of all sites, locations, distance class, disturbance category, and species collected is provided in Appendix G.

5.1.1 ANALYTICAL METHODS

A suite of total metals were analyzed for baseline concentrations in soil and vegetation. A subset of these total metals, referred to as chemicals of potential concern (CoPC), were selected to facilitate closer analysis based on the following considerations:

- Site conditions determined by baseline metal concentrations in vegetation and soil (i.e., several metals were not present at detectable levels in vegetation and soil samples and were therefore not selected as CoPC);
- Potential as a source of contamination in soil and vegetation (e.g., arsenic is a minor constituent associated with gold ores; CCME 1997); and
- The level of risk associated with each element. Several sources were consulted including:
    - Canadian Environmental Quality Guidelines (provided by the CCME) including soil quality guidelines;
    - Relevant studies and literature on the presence, effects and other aspects of metals in northern terrestrial biota (e.g. Gamberg 2000 & 2008; CACAR 2003).

In the study, Contaminants in Arctic Moose and Caribou, cadmium, copper, lead, and zinc were identified as trace metals of potential concern in northern biota (Gamberg 2008). Similarly, Contaminants in Yukon Country Foods identified arsenic and mercury as trace metals of potential concern (Gamberg 2000). The baseline water quality report found several total metals in surface water samples at varying amounts above reportable detection limits with the most notable being uranium (Lorax 2016). Based on this review, nine CoPC were selected including:

- Arsenic;
- Cadmium;
- Chromium;
- Copper;
- Mercury;
- Lead;
- Selenium;
- Uranium; and
- Zinc.

To facilitate closer analysis of trace metals in soil and vegetation the LSA was divided into two sections: the Coffee Area and NAR. Soil samples were screened for trace metal concentrations against CCME soil quality guidelines for CoPC following industrial standards. The analysis focused on samples that align with the revised study design implemented in 2016. Samples with metal concentrations below the CoPC reportable detection limit (RDL) provided by the laboratory were not included in the analysis. Horsetail was excluded from the analysis, due to insufficient sample size.

Average metal concentrations (mg/kg dry weight) in soil, willow, lichen, and lowbush cranberry were plotted by distance category (adjacent (100 m), near (1000 m), far (5.5-7.5 km), and control (≥15 km)), using standard box and whisker plots in R version 3.3.1 (R Core Team 2016). Boxplots are a standard and convenient way to analyze distribution and variability. Descriptive statistics including the five number summary (median, mean, minimum, maximum, standard deviation, first quartile, third quartile, and interquartile range) are provided in Appendix H.

Analytical Methods for Power Analysis — A power analysis was conducted using simulations to determine if samples size and study design were sufficient to detect a change in metal concentrations in soil and vegetation relative to recommended threshold values. CCME soil quality guidelines for the Protection of Environmental and Human Health provide recommended thresholds for all CoPC; however, no CCME guidelines currently exist for trace metals in vegetation. Where no threshold exists, a Project specific threshold was defined based on the median plus two standard deviations from 2014 baseline samples.

The power analysis focused on changes in trace metal concentrations to soil and focal plants (willow, lichen, and lowbush cranberry) for nine CoPC using R version 3.3.1 (R Core Team 2016). Power simulations were not performed for metals and substrates where more than 50% of baseline samples were below the

detection limit. CoPC included in the power analysis were arsenic, cadmium, chromium, copper, lead, mercury, selenium, uranium, and zinc.

Simulations were used to determine the effect size for a sampling design with four distance categories (adjacent (100 m), near (1000 m), far (5.5-7.5 km), and control (≥15 km)) with a minimum eight samples per category (Bolker 2007). Metal concentrations in three groups were simulated from a normal distribution, based on the mean and standard deviation of 2014 baseline sampling data following a log-transformation. Data for the fourth group were simulated assuming an increase in median metal concentrations for that group. For every 10% increase in metal concentrations, 1000 data sets were simulated.

A one-way ANOVA was run on each simulated data set and power was calculated as the proportion of tests with a significant difference among groups (p-value of less than 0.1). The level at which increased metal concentrations could be detected with statistical power of 0.8 (i.e. at least 80% of simulations) was compared to proposed thresholds to determine if a statistically significant change could be detected before exceeding the threshold.

5.2 RESULTS

Trace metal concentrations in soil were low with the exception of arsenic and chromium. Arsenic and chromium concentrations were above CCME soil quality guidelines in 24 (27%) and 4 (4%) samples, respectively. Arsenic samples above CCME guidelines were generally found within close proximity to the proposed mine site including adjacent (100 m) and near (1000 m) distances from the proposed Project footprint. Chromium samples above CCME guidelines were found at near (1000 m) and control sites (≥15 km) relative to the proposed Project footprint. Relatively few soil samples reported mercury and selenium above the laboratory RDL. pH was below the recommended range in 71 (79%) samples at various distances from the proposed Project footprint. Both arsenic and chromium contain outlier data; therefore, average and median values for all CoPC and pH are provided in Table 5-1.

No CCME guidelines currently exist for trace metals in vegetation. Trace metal concentrations in vegetation found little to no selenium in any of the focal species where all samples were below the RDL in lichen and lowbush cranberry, and only three were above the RDL in willow. Selenium in willow did not translate to selenium in soil at the same sites. Arsenic and uranium were detected in relatively more lichen samples than lowbush cranberry and willow where only one and three samples were above the RDL, respectively. The results suggest low concentrations of arsenic and uranium in lichen with an average of 0.1 mg/kg and 0.01 mg/kg, respectively, and no influence of outlying data. Similarly, chromium was detected in relatively more lichen samples than lowbush cranberry and willow where only three and four samples were above the RDL, respectively. Average concentration of chromium in lichen was 0.4 mg/kg. In comparison to lichen and willow, few lowbush cranberry samples had detectable concentrations of cadmium. Mercury was detectable in lichen, lowbush cranberry, and willow at low concentrations averaging 0.02 mg/kg, 0.01 mg/kg, and 0.01 mg/kg respectively. All average metal concentrations for CoPC in willow, lichen, and lowbush cranberry are provided in Table 5-2.

To facilitate closer analysis of trace metals in soil and vegetation, the LSA was divided into the Coffee Area around the proposed mine site (including Coffee Creek, Java Road, and the no longer considered Casino Connector) and the proposed NAR (Figure 5-1).

Table 5-1. Baseline trace metal concentrations in soils, 2014-2016

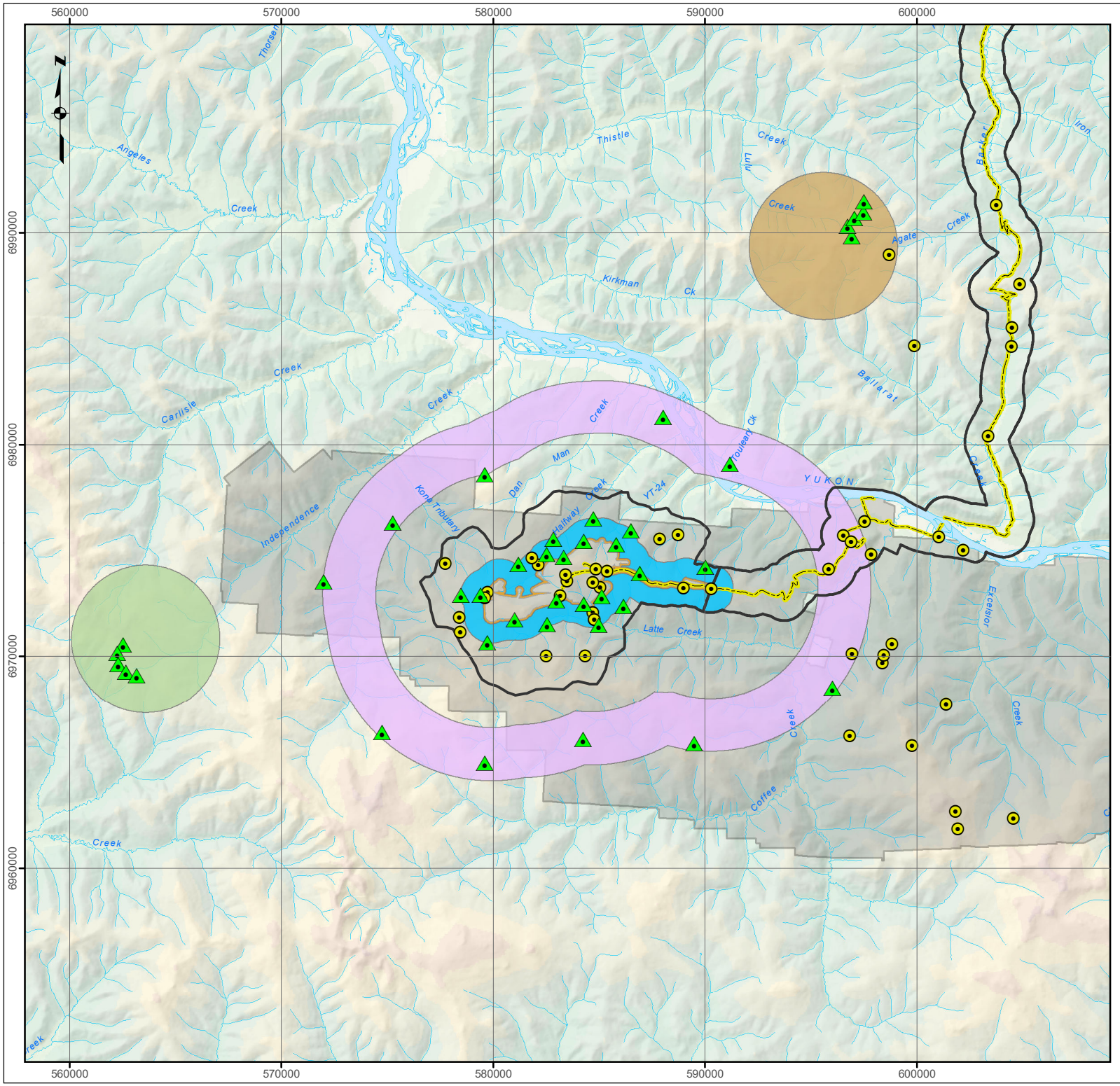
Parameter[1]	CCME Ind[2]	Average Concentration[3]	Median Concentration[3]	# Sites/(%) Above CCME Ind[4]
Arsenic	12	20.2 (n=89)	7.7 (n=89)	24 (27%)
Cadmium	22	0.3 (n=89)	0.2 (n=89)	0
Chromium	87	34.1 (n=89)	26.8 (n=89)	4 (4%)
Copper	91	20.1 (n=89)	16.8 (n=89)	0
Lead	600	9.2 (n=89)	7.8 (n=89)	0
Mercury	50	0.10 (n=34)	0.07 (n=34)	0
Selenium	2.9	0.8 (n=10)	0.6 (n=10)	0
Uranium	300	2.1 (n=52)	0.9 (n=52)	0
Zinc	360	46.8 (n=89)	41.4 (n=89)	0
pH	6-8	5.16 (n=89)	4.96 (n=89)	71 (79%)

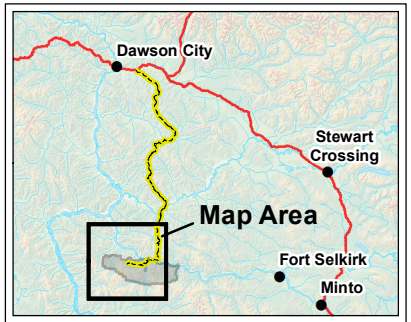
[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Industrial Soil Quality Guidelines provided by the CCME
[3] Samples above the RDL included in analysis; uranium was analyzed for in 2015 and 2016 only
[4] Values for pH are below CCME Industrial Soil Quality Guideline; none were above the recommended range

Table 5-2. Baseline trace metal concentrations in vegetation, 2014-2016

Parameter[1]	Willow Average Concentration	Lichen Average Concentrations	Lowbush Cranberry Average Concentration
Arsenic	n/a[2]	0.1 (n=44)	n/a[2]
Cadmium	1.8 (n=49)	0.03 (n=44)	0.03 (n=27)
Chromium	n/a[2]	0.4 (n=40)	n/a[2]
Copper	4.0 (n=49)	1.2 (n=39)	3.8 (n=5)
Lead	0.04 (n=48)	0.2 (n=39)	0.03 (n=50)
Mercury	0.01 (n=12)	0.02 (n=42)	0.01 (n=44)
Selenium	n/a[2]	n/a[2]	n/a[2]
Uranium	0.01 (n=10)	0.01 (n=44)	n/a[2]
Zinc	111.2 (n=49)	12.4 (n=44)	23.7 (n=50)

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Not enough samples above the RDL to conduct analysis





Legend

- Settlement/Community
- 2016 Trace Metals Sample Sites
- 2014 Trace Metals Sample Sites
- Proposed Route
- Coffee Property
- Local Study Area

Trace Metals Sampling Zones

- Adjacent Sample Zone
- Near Sample Zone
- Far Sample Zone
- Moose Mountain Sample Zone
- Thistle Mountain Sample Zone

FIGURE: 5-1

Trace metals sample sites within the Coffee Area

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Survey data was collected by EDI Environmental Dynamics Inc. (2014/2015).

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

0 1 2 3 4 5
KM

Map Reference Scale: 1:250,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MP	Checked: AM	Date: 1/6/2017

KAMINAK GOLD CORPORATION EDI

Path: O:\2014\14_Y_0306_Kaminak_CoffeeCk\Mapping\2016_Mapping\2016_Baseline\00.8_Vegetation\Veg_Baseline_mxd\Fig5_1_TraceMetals.mxd

5.2.1 COFFEE AREA

A total of 77 sample sites were surveyed in the Coffee Area in 2014 and 2016 (Figure 5-1). These included sites around the proposed mine site, along the existing Java Road, and along the previously considered Casino Connector route. Figures for all CoPC in soil, willow, lichen, and lowbush cranberry are provided where more than 50% of the samples were above the RDL. Large outlier data were removed from the figures to improve readability of the graphs and are indicated below.

Soil sampling in the Coffee Area had low concentrations of CoPC with the exception of arsenic and chromium. Eight soil samples were above the CCME recommended guideline for arsenic in soil, including one site with naturally high arsenic concentration (CCTMBS-603; 520 mg/kg; Figure 5-2). This site was located in the near distance category to the proposed mine site, which may be explained by the relationship of arsenic to ores that are commonly mined (CCME 1997). Three soil samples were above the CCME recommended guideline for chromium in soil, including one site with naturally high chromium concentrations (Figure 5-4; CCTMRS-635; 291 mg/kg). This site was a control site located ≥15 km from the proposed Project footprint; therefore, it is unknown why chromium concentrations were high other than a naturally high source or an error in sampling or analysis protocol. Site CCTMBS-603 contained higher than average concentration of uranium in the soil (26.8 mg/kg). The concentration at this site is well below CCME guidelines; however, it is an outlier in the dataset. More than half of the soil samples (79%) had a pH below CCME soil quality guidelines which recommend a range of 6–8. Of these samples all had a baseline pH between 4 and 6. Only four sites had a pH between 7 and 8.

In the absence of CCME guidelines for trace metals in vegetation, willow samples in the Coffee Area appeared to have low concentrations of CoPC. Few CoPC were detected in willow, including cadmium (Figure 5-9), copper (Figure 5-10), lead (Figure 5-11), and zinc (Figure 5-12). Outlier data were removed from the figures to improve readability, including cadmium (10.3 mg/kg) and zinc (293 mg/kg) at control site CCTMRW-614, cadmium at CCTMCW-610 (14.1 mg/kg) in the far distance category, zinc (298 mg/kg) at control site CCTMRW-636, and lead at CCTMRW-639 (0.224 mg/kg) also collected at a control site. Willow is a species of metal tolerance; therefore, metal concentrations were expected to be higher for some metals in willow than other plants collected in the same area.

All CoPC were detectable in lichen and appeared to be low with the exception of selenium which was non-detect across all lichen samples. Compared to willow, arsenic (Figure 5-13), chromium (Figure 5-14), mercury (Figure 5-18), and uranium (Figure 5-19) were detected in lichen at low concentrations; there was somewhat less cadmium (Figure 5-14), copper (Figure 5-16), and zinc (Figure 5-20) in lichen than willow. Lead was somewhat higher in lichen than willow at 0.15 mg/kg (Figure 5-17). Outlier data were removed from the figures to improve readability, including copper (3.06 mg/kg) and lead (0.45 mg/kg) at CCTMBL-602 in the near distance category and uranium (0.05 mg/kg) at CCTMA-601 in the adjacent distance category.

Few CoPC were detected in lowbush cranberry, including copper (Figure 5-21), lead (Figure 5-22), mercury (Figure 5-23) and zinc (Figure 5-24). Compared to the other focal plants, lowbush cranberry had

concentrations more similar to willow than lichen with the exception of mercury and zinc which were more similar to lichen. Average zinc was four times higher in willow (107 mg/kg) than both lowbush cranberry (24 mg/kg) and lichen (12 mg/kg). Outlier data was removed from Figure 5-23 to improve readability where mercury at CCTMBC-634 was 0.032 mg/kg.

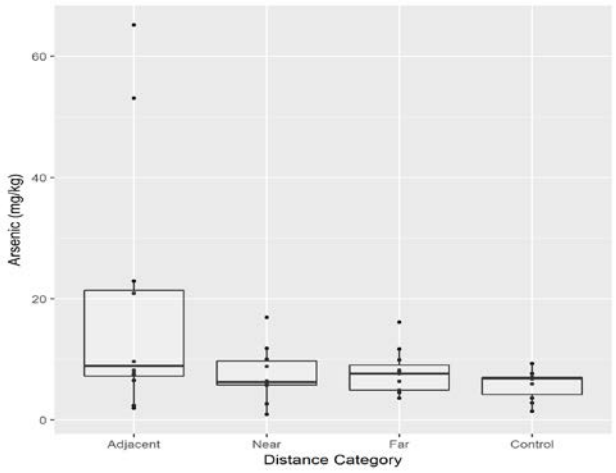


Figure 5-2. Arsenic concentrations in soil for the Coffee Area.

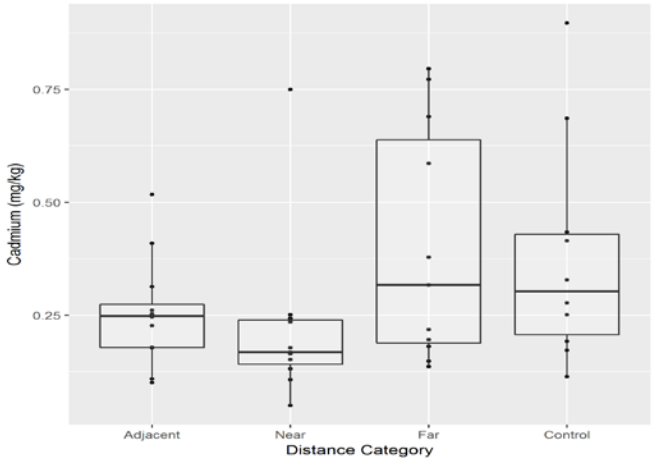


Figure 5-3. Cadmium concentrations in soil for the Coffee Area.

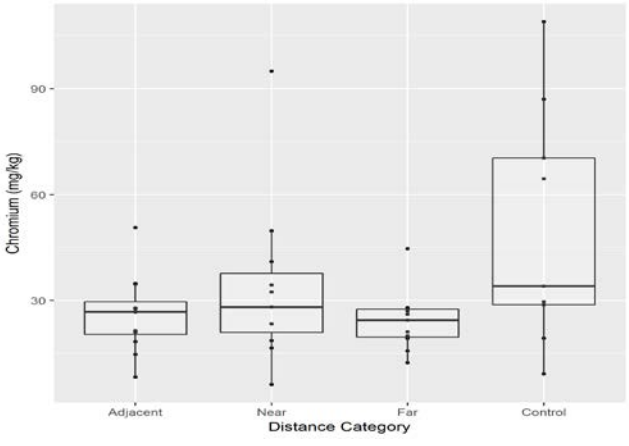


Figure 5-4. Chromium concentrations found in soil for the Coffee Area.

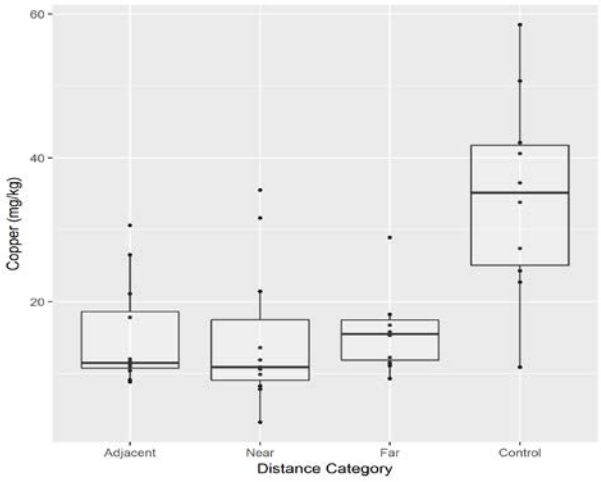


Figure 5-5. Copper concentrations in soil for the Coffee Area.

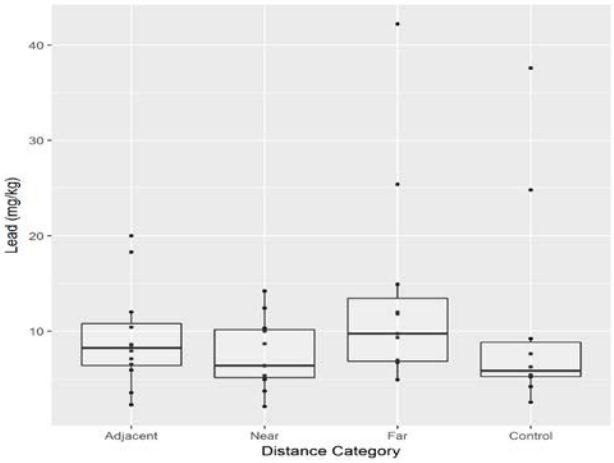


Figure 5-6. Lead concentrations in soil for the Coffee Area.

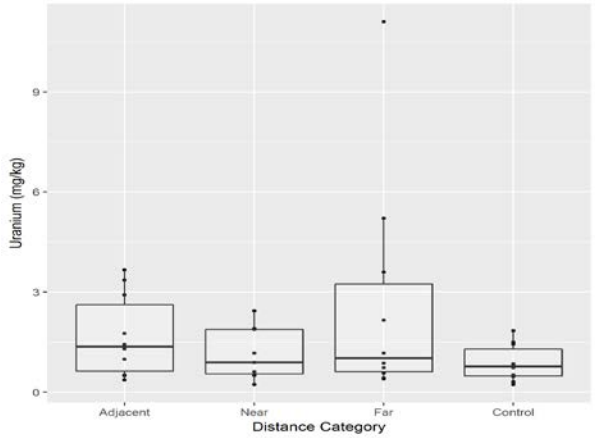


Figure 5-7. Uranium concentrations in soil for the Coffee Area.

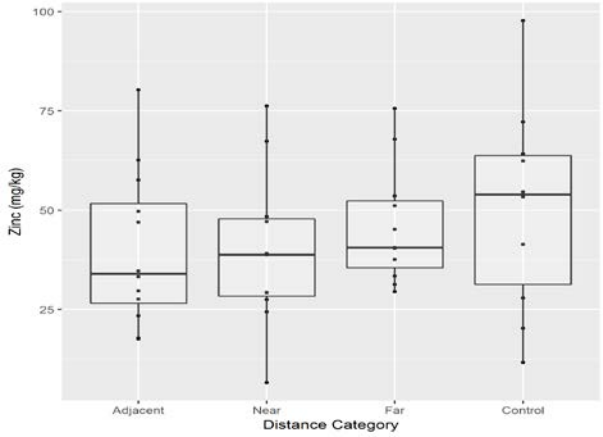


Figure 5-8. Zinc concentrations in soil for the Coffee Area.

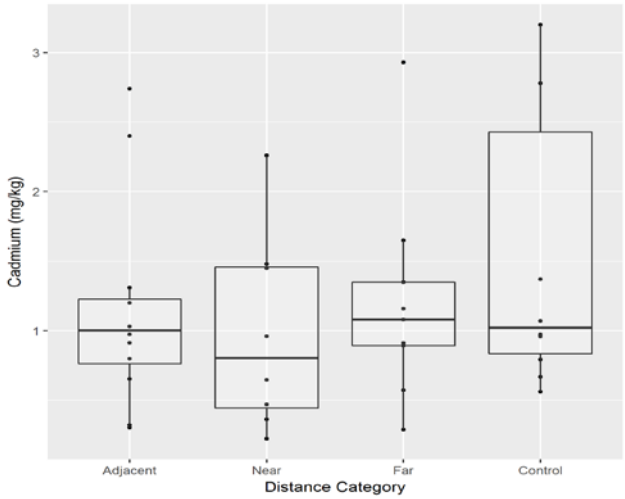


Figure 5-9. Cadmium concentrations in willow for the Coffee Area.

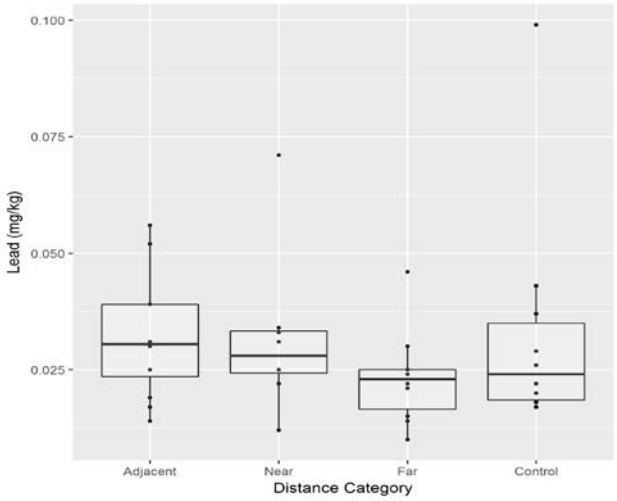


Figure 5-11. Lead concentrations in willow for the Coffee Area.

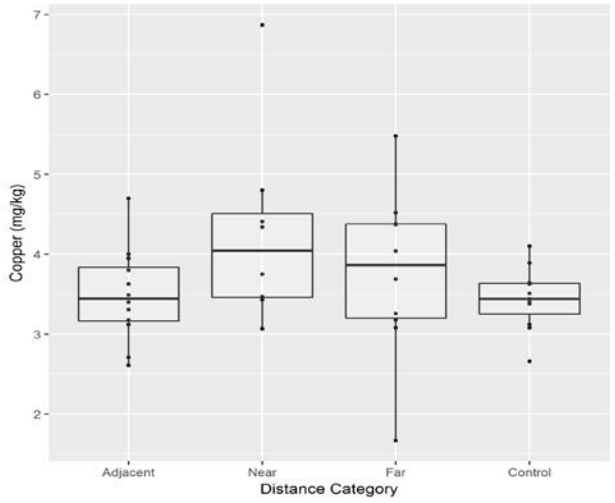


Figure 5-10. Copper concentrations in willow for the Coffee Area.

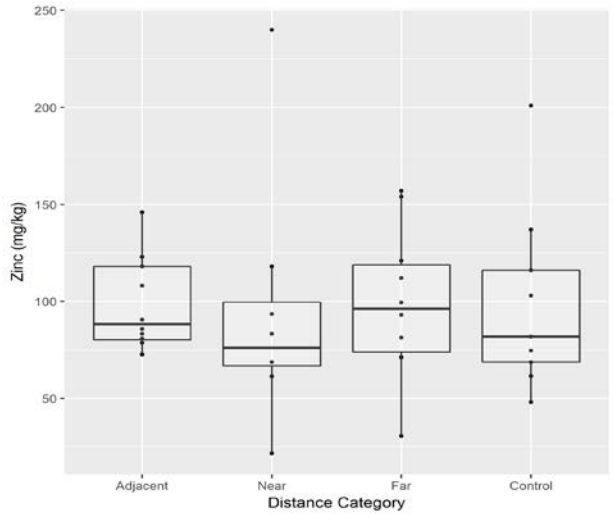


Figure 5-12. Zinc concentrations in willow for the Coffee Area.

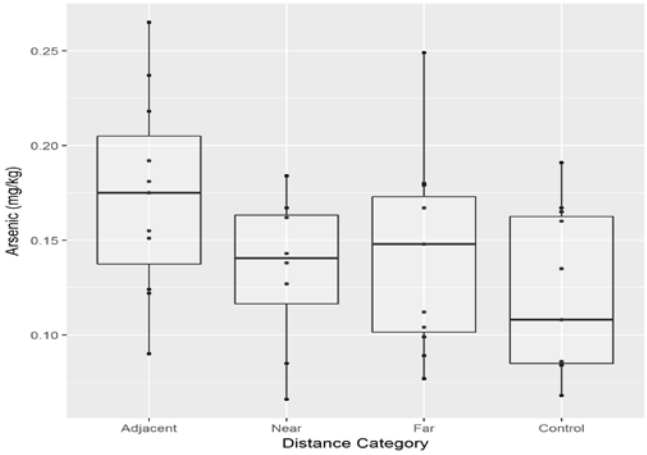


Figure 5-13. Arsenic concentrations in lichen for the Coffee Area.

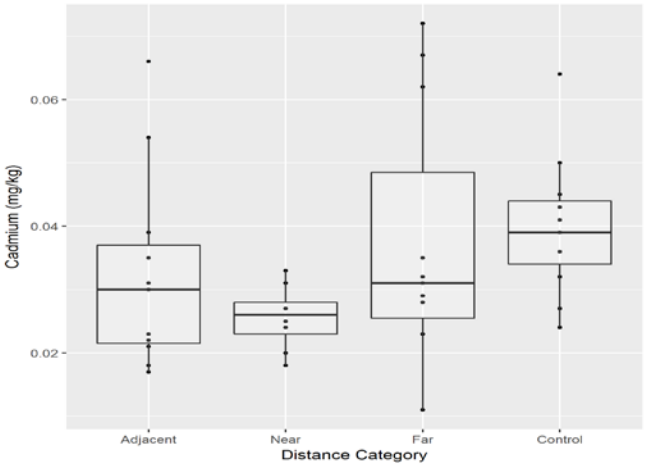


Figure 5-14. Cadmium concentrations in lichen for the Coffee Area.

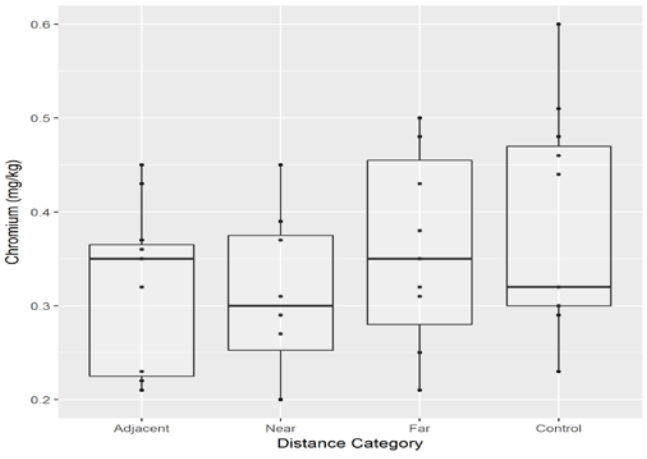


Figure 5-15. Chromium concentrations in lichen for the Coffee Area.

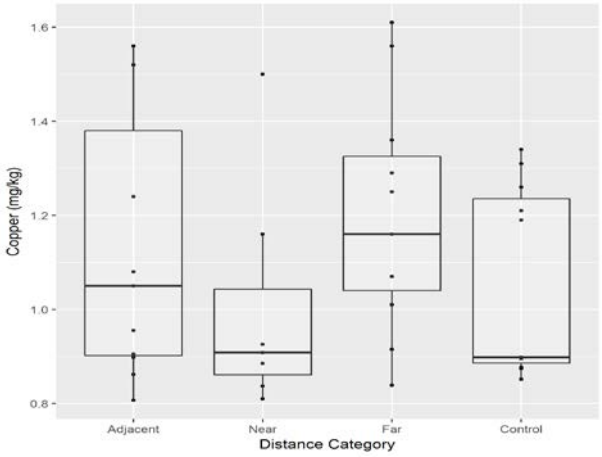


Figure 5-16. Copper concentrations in lichen for the Coffee Area.

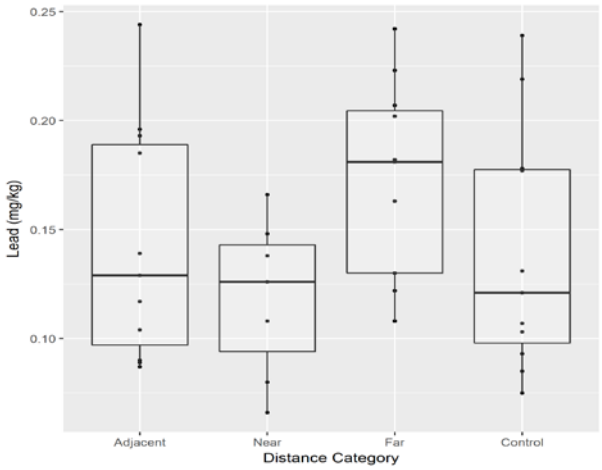


Figure 5-17. Lead concentrations in lichen for the Coffee Area.

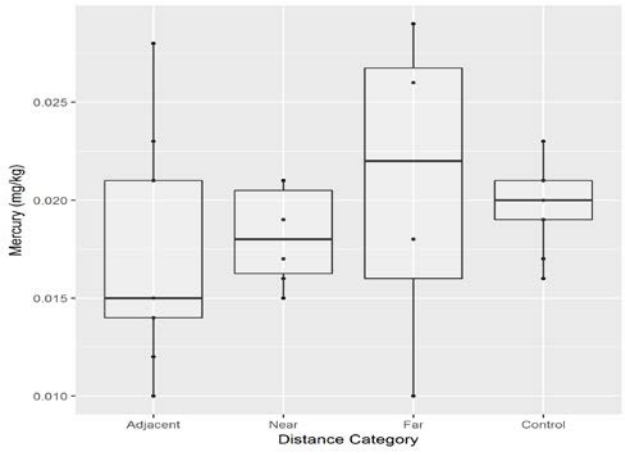


Figure 5-18. Mercury concentrations in lichen for the Coffee Area.

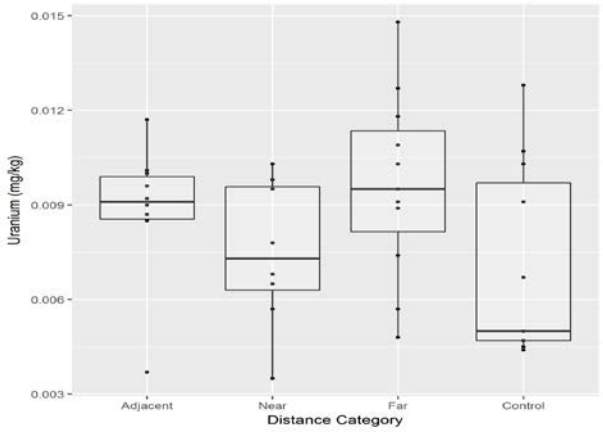


Figure 5-19. Uranium concentrations in lichen for the Coffee Area.

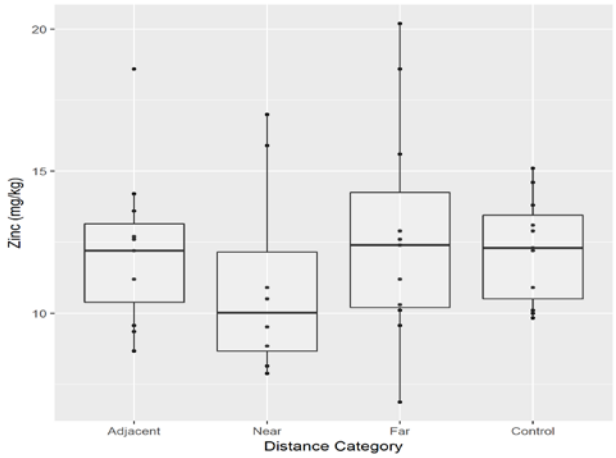


Figure 5-20. Zinc concentrations in lichen for the Coffee Area.

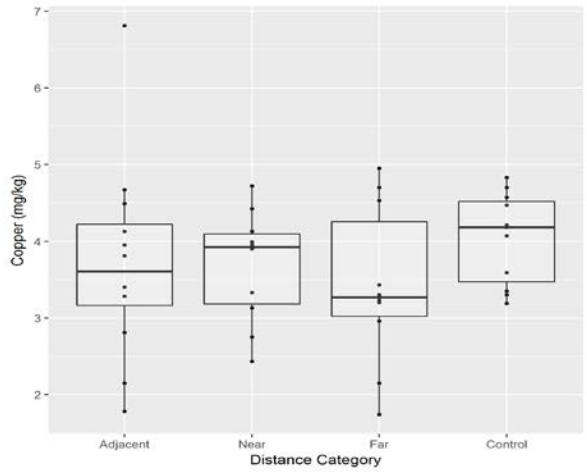


Figure 5-21. Copper concentrations in lowbush cranberry for the Coffee Area.

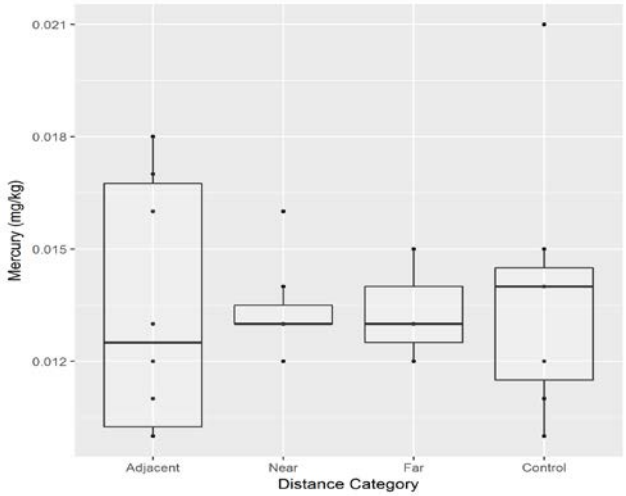


Figure 5-23. Mercury concentrations in lowbush cranberry for the Coffee Area.

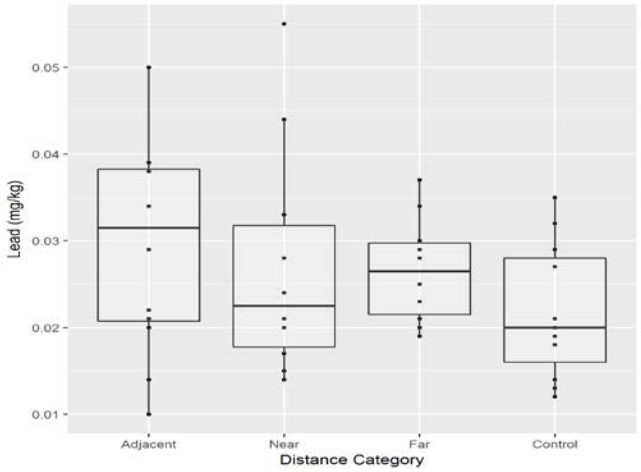


Figure 5-22. Lead concentrations in lowbush cranberry for the Coffee Area.

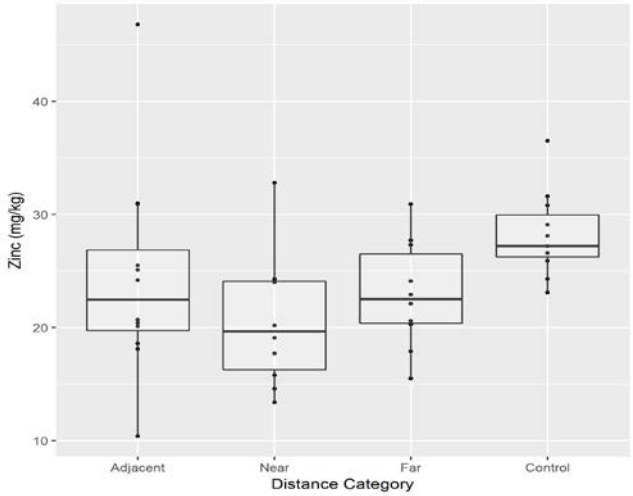


Figure 5-24. Zinc concentrations in lowbush cranberry for the Coffee Area.

5.2.1.1 Power Analysis

The results of the power analysis were used to revise the vegetation and soil trace metals study design in 2016 to improve statistical power to detect a change in median metal concentrations for CoPC in soil and vegetation. The power analysis determined that eight samples per distance category (adjacent (100 m), near (1000 m), far (5.5-7.5 km), and control (≥15 km)) would be sufficient to detect a change in median metal concentrations before exceeding the recommended threshold for most CoPC in soil and vegetation (Table 5-3).

Using the above sampling scheme, power to detect a change in median metal concentrations before exceeding the CCME Soil Quality guideline for industrial standards is possible for all CoPC, excluding arsenic in soil and zinc in willow. Based on 2014 sampling, there is no power to detect median metal concentrations of arsenic in soil before exceeding the threshold. Several samples were above the recommended threshold and it is unlikely that additional sampling will increase power to detect meaningful changes in metal concentrations. Similarly, 2014 sampling for zinc in willow presented an issue where power to detect a change in median metal concentration was low, due to 65% of the samples exceeding the baseline median zinc concentrations in willow (threshold for vegetation is 2014 baseline median plus two standard deviations).

Table 5-3. Results of the power analysis for trace metals in soil and vegetation

			Detectable Change			Threshold	
CoPC[1]	Substrate	Baseline Median[2]	Impacted Median[2]	Difference in Medians[2]	Percent Change (%)	CCME Ind[3]	Median +2 S.D.
Cu	Cranberry	2.670	5.073	2.403	190	25	5.19
Pb	Cranberry	0.027	0.075	0.048	280	20	0.09
Zn	Cranberry	15.678	28.221	12.542	180	100	28.95
As	Lichen	0.165	0.959	0.793	580	--	1.20
Cd	Lichen	0.031	0.062	0.031	200	30	0.07
Cr	Lichen	0.298	0.774	0.476	260	--	0.86
Cu	Lichen	1.463	2.926	1.463	200	15	3.00
Pb	Lichen	0.144	0.360	0.216	250	5	0.41
U	Lichen	0.007	0.029	0.021	390	--	0.03
Zn	Lichen	10.776	18.320	7.543	170	178	18.84
Cd	Willow	0.809	2.104	1.295	260	5	2.30
Cu	Willow	3.046	4.874	1.828	160	25	4.89
Pb	Willow	0.028	0.068	0.040	240	20	0.08
Zn	Willow	64.184	205.390	141.206	320	100	233.48
As	Soil	12.423	85.721	73.297	690	12	111.15
Cd	Soil	0.195	0.467	0.273	240	22	0.51
Cr	Soil	26.687	77.391	50.705	290	87	83.69
Cu	Soil	15.790	37.897	22.106	240	91	42.30
Pb	Soil	7.759	17.846	10.087	230	600	19.66
Zn	Soil	38.667	73.467	34.800	190	360	78.34

[1] CoPC with more than 50% of 2014 baseline samples above the RDL

[2] Total metals (units mg/kg dry weight) unless otherwise indicated

[3] Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

5.2.2 NORTHERN ACCESS ROUTE AREA

A total of 12 sample sites were surveyed along the NAR in 2015 (Figure 5-25). Trace metals sampling along the NAR indicate low concentrations of all CoPC in soil with the exception of arsenic and zinc. Arsenic concentrations were above CCME soil quality guidelines at two sites (Table 5-4). Both sites were within 1000 m of existing anthropogenic disturbances. Zinc concentrations were well below CCME soil quality guidelines; however, two sites had higher than average concentrations and some of the highest recorded concentrations of zinc in soil across all sample sites. These sites also correspond to above average concentrations of zinc in willow (Table 5-4). Only four sites detected mercury and selenium above the RDL. pH was below the recommended range in nine (75%) samples at 100 m (adjacent) and 1000 m (near) distances from the proposed Project footprint. All other CoPC were well below CCME guidelines.

No CCME guidelines currently exist for trace metals in vegetation. All focal vegetation samples were below the RDL for selenium. Excluding selenium, all CoPC were detected in lichen at or below the average

concentration across all sample sites. Similarly, all CoPC in lowbush cranberry were generally at or below the average concentration; a few lowbush cranberry samples were above the average concentration for copper, lead, zinc, and cadmium. In willow, zinc and cadmium were above the average concentration at two sites and were some of the highest concentrations for these metals across all sites. In contrast, zinc was average in lichen and just above average in lowbush cranberry. Cadmium was either below average or non-detect in lichen and lowbush cranberry. CoPC found at low concentrations or non-detect in willow and lowbush cranberry include arsenic, chromium, and uranium. Lichen samples had arsenic, chromium, and uranium; however, concentrations were at or below the average concentration across all sample sites. Mercury was low in all focal species of vegetation with average concentrations in lichen and lowbush cranberry and only one willow samples detect mercury above the RDL.

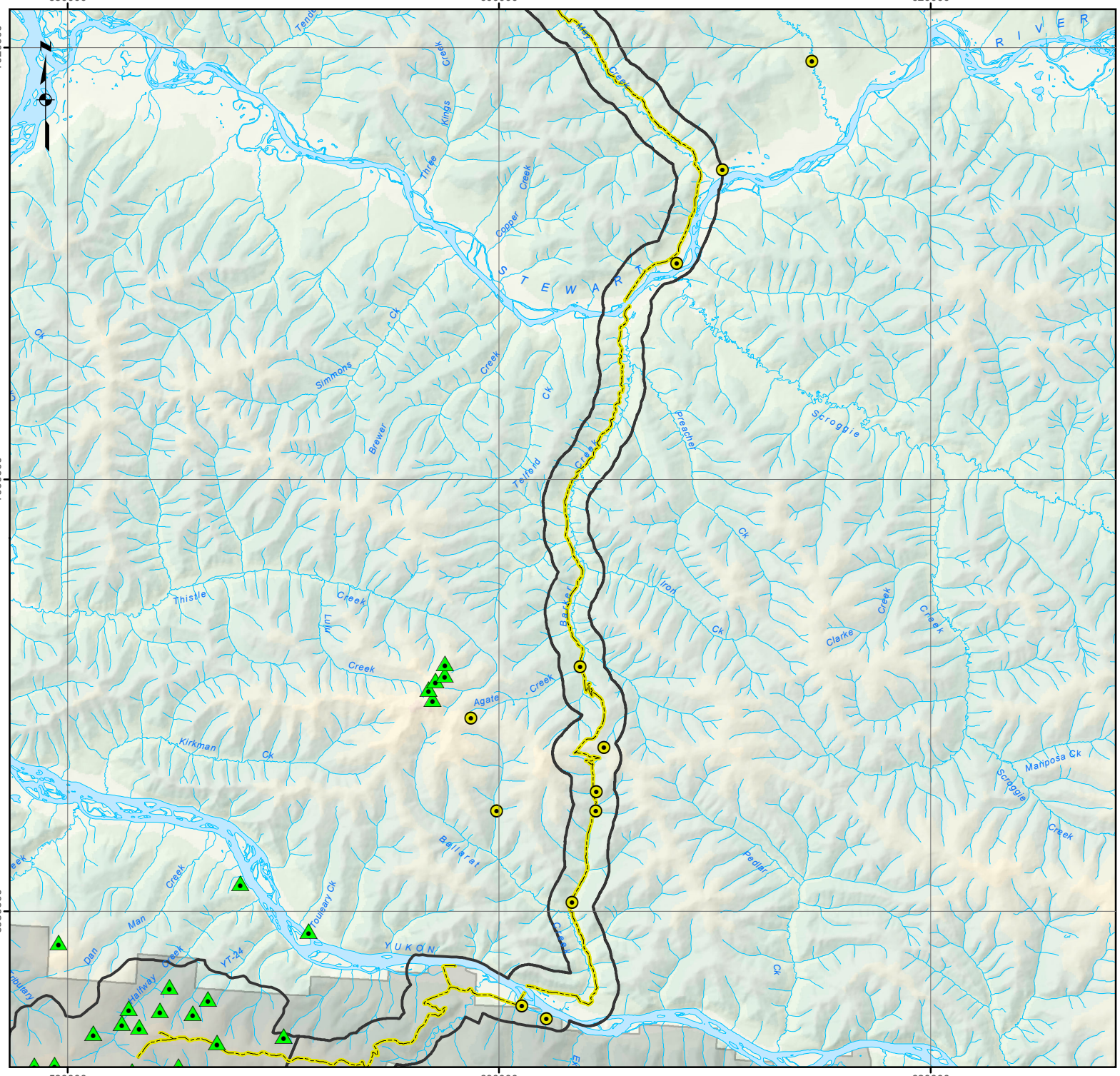
Further statistical analysis of trace metals along the NAR was not conducted due to insufficient sample size.

Table 5-4. Arsenic and zinc in soil and willow along the NAR, 2015

Parameter[1]	CCME Ind[2]	Site	Location	Metal Concentration (mg/kg dry weight)	
				Soil	Willow
Arsenic	12	CCTM500	North shore of the Stewart River, near Maisy May Creek	17.7	--
		CCTM511	On the road between Barker Creek and Maisy May Creek	14.3	--
Zinc	360	CCTM500	North shore of the Stewart River, near Maisy May Creek	167	209
		CCTM511	On the road between Barker Creek and Maisy May Creek	133	267

[1] Total metals (units mg/kg dry weight) unless otherwise indicated

[2] Industrial soil quality guidelines provided by CCME



Legend

- Settlement/Community
- 2016 Trace Metals Sample Sites
- Trace Metal Sample Sites
- Proposed Route
- Coffee Property
- Local Study Area

FIGURE: 5-25

Trace metals sample sites along the Northern Access Route

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Survey data was collected by EDI Environmental Dynamics Inc. (2014/2015).

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

0 1 2 3 4 5
KM

Map Reference Scale: 1:250,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MP	Checked: AM	Date: 1/6/2017

KAMINAK GOLD CORPORATION EDI

Path: O:\2014\14_Y_0306_Kaminak_CoffeeCk\Mapping\2016_Mapping\2016_Baseline\00.8_Vegetation\Veg_Baseline_mxd\Fig5_2_TraceMetals.mxd

5.3 DISCUSSION

Metals are common in the environment and can originate from both natural and anthropogenic sources (Spark 2005). Certain metals are essential for plant growth and development and can be safely consumed by wildlife and humans; however, at excessive concentrations these metals can become toxic to organisms. Other metals are non-essential for plant growth and development, which can affect vegetation health and survival (Sign *et al.* 2011). Plants play a significant role in the accumulation and transport of trace metals in the environment (Kabata-Pendias and Pendias 1984). Plants can uptake trace metals from soils, water, and air through fallout on the surface of leaves, shoots and/or root absorption. Native species have adaptations that allow them to survive in the environment where they are found; however, incremental additions of trace metals through anthropogenic sources such as dust emissions can pose a risk to vegetation through elevated metal concentrations in soil and vegetation tissues (Kabata-Pendias and Pendias 1984). Further, these plants have the potential to be ingested by wildlife and humans. Trace metals uptake in vegetation is largely dependent on factors such as plant species, soil type, soil texture, pH, reduction/oxidation potential, element solubility, and temperature which can affect the distribution, mobility, bioavailability, and speciation of certain metals (Sign *et al.* 2011).

Arsenic is a non-essential element for plants (Adriano 2001). Arsenic occurs as a component in complex ores that are commonly mined (CCME 1997). In Canada, gold ores are a known source of arsenic which explains the presence (27%) and above average concentration (20.2 mg/kg) of arsenic in baseline soil samples above CCME soil quality guidelines. These samples were mainly found within the adjacent (100 m) and near (1000 m) distance categories from the proposed Project footprint. Only soluble arsenic is available for plant uptake where solubility determines the amount of available arsenic (CCME 1997). The more soluble arsenic there is the more bioavailable it becomes for plant uptake. Speciation of arsenic determines the behaviour and the toxicity of arsenic. The amount of arsenic found in vegetation is rarely larger than the amount found in the associated soils (CCME 1997), and only some species of higher plants have recorded bioaccumulation of arsenic (Adriano 2001). During baseline sampling for the Coffee Project, lichen was the main focal plant with detectable concentrations of arsenic. Lowbush cranberry and willow had only one and three samples above the RDL. Arsenic transfer from plants and soil (mainly) to terrestrial mammals has been studied and found that direct ingestion was a major source of dietary arsenic in livestock (CCME 1997).

Cadmium is a non-essential element for plants (Adriano 2001). In Canada, background concentrations of cadmium in soil range from non-detectable (Whitby *et al.* 1978) to 8.1 mg/kg (Frank *et al.* 1986). Baseline cadmium concentrations in soil for the Coffee Project were low with an average of 0.28 mg/kg across all sites. For the Coffee Project, baseline samples detected low concentrations of cadmium in soil, lichen, and lowbush cranberry relative to willow. No soil samples were above CCME soil quality guidelines. The mobility of cadmium in soils is influenced by several processes, such as wind erosion, leaching, fluvial transport, and biotic uptake (CCME 1999a). Cadmium uptake by plants is not universal; instead it varies by species (CCME 1999a). Willow is a species of metal tolerance which can bioaccumulate in wildlife that

consume willow (Gamberg 2000). Wildlife exposed to cadmium would most likely be from ingestion of forage and soil (CCME 1999a).

Chromium exists naturally in plant tissues; however, the necessity of chromium to plants is still unknown (CCME 1999b). In contrast, it is well known that chromium (III) is essential to animal nutrition (CCME 1999b). Whole plant concentrations of ≥ 3 mg/kg may indicate possible contamination; however, there are cases of plants growing in serpentine soils where chromium concentrations were as high as 100 mg/kg (Williams 1988; Brookes 1987). For the Coffee Project, average baseline chromium concentration in soil across all sites was 33 mg/kg. Four sites had chromium concentrations above CCME soil quality guidelines, indicating naturally high concentrations of chromium in the soil. The highest concentration in soil was detected at site CCTMRS-635 with 291 mg/kg. At the same site chromium was below the RDL in willow and lowbush cranberry, and below average concentration in lichen. Studies show that translocation of chromium in soils to plants is low; therefore, the amount of available chromium in edible portions of the plant are low, despite growing in soil with elevated chromium concentrations (CCME 1999b). Although studies on animal exposure to chromium from the soil are not available, wildlife exposed to elevated concentrations of chromium is likely from soil ingestion or food ingestion of prey other than vegetation (CCME 1999b).

Copper is an essential nutrient for plants and is required in low concentrations as a constituent in several plant enzymes (Adriano 2001). Copper is a natural component in the environment and concentrations vary widely with soil type, distance from natural ore sources and anthropogenic sources, bedrock, and parent material type (CCME1999c). Copper concentrations in the Cordilleran Region are known to contain the highest concentrations of copper in Canada at 46 mg/kg, although, concentrations can be up to 100 mg/kg (British Columbia Ministry of Environment 1992). For the Coffee Project, average baseline copper concentration in soil across all sites was 19 mg/kg. No soil samples were above the CCME guideline. Unlike other trace metals, copper binds to soil particles resulting in limited mobility (CCME 1999c). Beyond soils capacity to hold copper ions, leaching can occur. Bioaccumulation of copper in plants can occur, but is often on a small scale (CCME 1999c). Availability of copper is influenced by many factors such as soil pH, cation exchange capacity, and organic matter content (Adriano 1986). For examples, copper is more mobile and absorptive in soil at low pH and high cations exchange capacity (CCME 1999c). For the Coffee Project, baseline samples detected low concentrations of cadmium in focal plants relative to soil and no soil samples were above CCME soil quality guidelines; therefore, natural concentration of copper in baseline samples appears to be low.

Lead is a non-essential element for plants (CCME 1999d). For the Coffee Project, average baseline lead concentration in soil across all sites was 9.35 mg/kg, well below the CCME soil quality guideline of 600 mg/kg for lead considering industrial conditions. The amount of lead in soils depends first on the parent material naturally occurring in an area then anthropogenic input. The mobility of lead and uptake by plants is largely influenced by pH (Adriano 2001). For examples, low pH leads to higher mobility and availability of lead for uptake by plants (CCME 1999d). Uptake and accumulation of lead varies by plant species (Adriano 2001). High concentrations of lead in plants cause physical deformities such as stunted growth, blackened roots, and discoloring leaves and toxic concentration reduce photosynthesis,

transpiration rates, and lower chlorophyll production to the point of necrosis (CCME 1999d). For the Coffee Project, baseline samples detected low concentrations of lead in focal plants relative to soil and soil lead concentrations were low compared to CCME guidelines. Lead toxicity in terrestrial organisms has been well studied and concludes that lead bioaccumulates in the food chain; exposure is mainly through ingestion, drinking water, or inhalation (CCME 1999d).

Mercury is a non-essential element for plants (Adriano 2001). Across Canada, the average concentration of mercury in the terrestrial environment is from 0.01 to 0.4 mg/kg except in areas of ore deposits, spills, landfills, and some metal-processing plants (Jonasson and Boyle 1972; Gracey and Stewart 1974; McKeague and Kloosterman 1974; Environment Canada 1979; OMEE 1994). Due to the presence of ore deposits at the Coffee Project, average baseline lead concentrations in soil were higher (0.09 mg/kg) than the Canadian average. The lowest soil concentrations where toxic effects of mercury in plants has been observed are 7 and 8 mg/kg, which resulted in a 50% reduction of turnip blooms (Sheppard et al. 1993). Major soil factors that influence the mobility and availability of mercury in soil include pH, organic matter, cation exchange capacity, redox potential, clay content, and soil texture (CCME 1999e). For example, mercury is more available for uptake at low pH and in high organic matter. For the Coffee Project, baseline samples detected low concentrations of mercury in focal plants and soil. No soil samples were above CCME soil quality guidelines; therefore, natural concentration of mercury in baseline samples appears to be low.

The role of selenium in plant growth and development is unknown (CCME 2009). A Canadian study representing all provinces and territories (except Manitoba) of 53 sites across a variety of soil types, found that background selenium concentrations ranged from 0.03 to 2 mg/kg with an average of 0.26 mg/kg (McKeague and Wolynetz 1980). A study from eastern Yukon found that vegetation grown on soils with underlying Paleozoic shales (seleniferous soils) contains selenium concentrations averaging 0.8 to 2.9 mg/kg (Fletcher *et al.* 1973). In contrast, vegetation grown on adjacent non-seleniferous soils was found to have selenium concentrations of less than 0.5 mg/kg. For the Coffee Project, average baseline selenium concentration in soil across all sites was 0.85 mg/kg indicating a higher average concentration, but this is still well below CCME soil quality guidelines and the upper range of selenium concentrations found in Canada. Similar to other metals, the mobility and availability of selenium is dependent on the form and concentration in the soil, as well as soil characteristics such as pH, organic matter, clay content, and soil type and texture (CCME 2009). Specifically, the oxidation state of selenium is dependent on these soil characteristics and under well-oxidized and high pH conditions selenium is more soluble and uptake by plants is possible. For the Coffee Project, baseline selenium concentrations were not detect in lichen, only one was above the RDL in lowbush cranberry, and three were above RDL in willow. Bioaccumulation of selenium appears to be possible in terrestrial organisms (CCME 2009). Although it is require by higher organisms in small doses, it can become toxic in greater quantities (Lemly 1997).

Uranium is not known to be essential for plants; however, there is some evidence that suggests plant growth is stimulated when exposed to uranium at low concentrations (Meyer *et al.* 1998; Gulati *et al.* 1980). These studies are limited to southern and mainly agronomic species. Uranium occurs naturally in the environment originating from mantle rocks and is released by weathering and erosion (CCME 2007). The average background concentration of uranium in surface soil across Canada is reported to be approximately

2 mg/kg (NCRP 1984). For the Coffee Project, baseline concentrations of uranium in soil averaged 1.99 mg/kg and concentrations in focal plants was very low (0.01 mg/kg) or below RDL, indicating normal concentrations. Uranium does not bioaccumulate in plants to a large degree (CCME 2007); therefore, uranium transfer to terrestrial mammals at present is low.

Zinc is an essential element for plants and is required in small amount to support biological processes in both plants and wildlife (CCME 1999f; Adriano 2001). Zinc concentrations in the Cordilleran Region average 73 mg/kg (McKeague and Wolynetz 1980). For the Coffee Project, baseline zinc concentrations in soil across all sites was 45.7 mg/kg; no soil samples were above the CCME guideline. In focal plants, the average zinc concentration was higher in willow (109.6 mg/kg) than lichen (12 mg/kg) and lowbush cranberry (23.8 mg/kg) and overall zinc was higher in willow than soil. Similar to cadmium in willow, this may be explained by species specific adaptions whereby willow can tolerate high concentrations of some metals. Zinc mobility and availability in soils is largely influenced by soil pH (Shuman 1975; Evans 1989; Duquette and Hendershot 1990; Davis-Carter and Shuman 1993). In low pH soils (below pH 5), zinc is more mobile and available for plant uptake (Duquette and Hendershot 1990). Although zinc can be toxic at high concentrations the required amount of zinc for wildlife growth and development depends on the site conditions in its natural environment (CCME 1999f).

CCME soil quality guidelines recommend a pH range of 6–8. More than half of the baseline samples (79%) were below this recommended range. Of these 71 samples all had a pH between 4 and 6. Four sites had a pH between 7 and 8. The normal pH range for highly productive soils is from 5.5 to 8, but can extend from 4 to 9 for all soils in the general environment (Langmuir *et al.* 2004). Soil with a pH outside of the identified range can affect the bioavailability of certain metals. Low pH can cause toxicity in soil and vegetation, due to greater bioavailability of certain metals (Chaney and Ryan 1993; Langmuir *et al.* 2004). It is known that acidic soils increase plant uptake of some metals such as zinc and cadmium and increase the potential for phytotoxicity (Chaney and Ryan 1993). Alternatively, alkaline soil pH increases the uptake of selenium.

In conclusion, trace metal concentrations in soils were low compared to CCME guidelines with the exception of arsenic and chromium. Arsenic samples above CCME guidelines were generally found within close proximity to the proposed mine site. Chromium samples above CCME guidelines were found close to the proposed mine site and at control sites ≥15 km relative to the proposed Project footprint. Few soil samples reported mercury and selenium above the RDL.

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APPENDIX A. LIST OF PLANT SPECIES OBSERVED DURING VEGETATION BASELINE SURVEYS

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List of plant species observed during baseline vegetation surveys in Coffee Project LSA, 2014-2016

Scientific name[1]	Common name[2]	Synonym[3]	Type
*Abies lasiocarpa (*Hook.) Nutt	subalpine fir		Tree
Abietinella abietina (Hedw.) Fleisch.	fir / prickly tamarisk-moss	*Thuidium abietinum* / *T. histricosum*	Moss
Achillea alpina L.	Siberian yarrow		Forb
Achillea millefolium L. s.l	common yarrow		Forb
Aconitum delphiniifolium DC.	northern monkhood		Forb
Aconogonon alaskanum (Small) Soják	Alaska wild-rhubarb	*Polygonum alaskanum* Wight ex Hulten	Forb
Actaea rubra (Aiton) Willd.	red baneberry		Shrub
Agrostis scabra Willd.	ticklegrass		Graminoid
Alectoria ochroleuca (Hoffm.) A. Massal.	two-toned witch's hair		Lichen
Alectoria sp.			Lichen
Alnus incana (Linnaeus) Moench	grey alder	*Alnus incana* (L.) Moench ssp. *tenuifolia* (Nutt.) Breitung	Shrub
Alnus viridis (Chaix) de Candolle	green alder	*Alnus crispa* (Drylander ex Ait.) Pursh ssp. *crispa*	Shrub
Amerorchis rotundifolia (Banks ex Pursh) Hulten	roundleaf orchid		Forb
Andromeda polifolia L.	bog-rosemary		Shrub
Androsace septentrionalis L.	pygmy-flower rock-jasmine		Forb
Anemone drummondii S. Wats. var. *lithophila* (Rydb.) C.L. Hitchc.	alpine anemone		Forb
Anemone multifida Poir.	cut-leaved anemone		Forb
Anemone parviflora Michx.	northern anemone		Forb
Anemone patens var. *multifida* Pritz.	pasqueflower	*Pulsatilla ludoviciana* (Nutt.) Heller	Forb
Anemone richardsonii Hook.	yellow anemone		Forb
Antennaria rosea Greene	rosy pussytoes		Forb
Anthoxanthum monticola (Bigelow) Veldkamp	alpine sweetgrass	*Hierochloe alpina* (Sw.) R. & S. ssp. *alpina*	Graminoid
Anticlea elegans var. *elegans* (Pursh) Rydb.	mountain death camas / elegant camas		Forb
Apocynum androsaemifolium L.	spreading dogbane		Forb
Aquilegia brevistyla Hook.	small-flower columbine		Forb
Arabidopsis lyrata ssp. *kamchatica* (Fisch. ex DC) O'Kane & Al-Shehbaz	Kamchatka rockcress	*Arabis kamchatica* (Fisch. ex DC.) Ledeb.	Forb

Scientific name[1]	Common name[2]	Synonym[3]	Type
Arctagrostis latifolia (R. Br.) Griseb.	polar grass		Graminoid
Arctostaphylos uva-ursi (L.) Spreng.	common bearberry/ kinnikinnick		Shrub
Arctous alpina (L.) Niedenzu	alpine bearberry		Shrub
Arctous rubra (Rehder & E.H. Wilson) Nakai	red bearberry	*Arctostaphylos rubra* (Linnaeus) Sprengel.	Shrub
Arnica griscomii ssp. *frigida* Fernald	snow arnica		Forb
Artemisia campestris L.	field sagewort		Forb
Artemisia frigida Willd.	fringed sage, prairie sagewort		Forb
Artemisia norvegica ssp. *saxatilis* Fries	mountain sagewort		Forb
Artemisia rupestris L.	Rock wormwood	*Absinthium viridifolium* var. *rupestre (Linnaeus) Besser*	Forb
Artemisia tilesii Ledeb.	alteutian mugwort		Forb
Aster sp.			Forb
Astragalus alpinus L.	alpine milk-vetch		Forb
Astragalus eucosmus B.L. Rob.	threadstalk milk-vetch	*Astragalus eucosmus* Robins. ssp. *eucosmus*	Forb
Astragalus laxmannii Jacq.	laxmann's milk-vetch	*Astragalus adsurgens* Pall. ssp. *viciifolius* (Hulten) Welsh	Forb
Astragalus williamsii Rydb.	Williams' milkvetch		Forb
Aulacomnium palustre (Hedw.) Schwaegr.	glow moss		Moss
Aulacomnium sp.			Moss
Aulacomnium turgidum (Wahlenb.) Schwaegr	swollen thread-moss		Moss
Barbarea orthoceras Ledeb.	winter cress		Forb
Barbilophozia sp.			Moss
Betula glandulosa Michx.	dwarf birch / scrub birch / shrub birch		Shrub
Betula neoalaskana Sarg.	alaska paper birch		Tree
Betula occidentalis Hook.	water birch		Shrub
Betula papyrifera Marshall	paper birch		Tree
Bistorta plumosa (Small) Greene	pink plumes / meadow bistort		Forb
Bistorta vivipara (L.) Delarbre	alpine bistort		Forb
Boechera retrofracta Graham	dangling suncress		Forb
Boechera spp.	boechera species		Forb
Boschniakia rossica (Chan. & Schlecht.) Fedtsch.	ground cone / broom rape		Forb

Scientific name[1]	Common name[2]	Synonym[3]	Type
Brachytheciastrum sp.			Moss
Brachythecium sp.	brachythecium moss		Moss
Bromus inermis Leyss.[5]	smooth brome		Graminoid
Bromus pumpellianus Scrib. var. *pumpellianus*	pumpelly brome		Graminoid
Bryocaulon divergens (Ach.) Karnef.			Lichen
Bryophyte sp.			Moss
*Bupleurum americanum*J.M. Coult. & Rose	american thorow wax		Forb
Calamagrostis canadensis (Michx.) P. Beauv.	bluejoint reedgrass		Graminoid
Calamagrostis purpurascens R. Br.	purple reed grass		Graminoid
Calla palustris L.	wild calla		Aquatic
Calliergon giganteum (Schimp.) Kindb.	giant water moss		Moss
Calliergon sp.			Moss
Callitriche palustris L.	vernal water-starwort	*Callitriche verna* L.	Aquatic
Calypso bulbosa (L.) Oakes	calypso / fairy-slipper		Forb
Campanula lasiocarpa Cham.	alpine harebell / bellflower		Forb
Campanula uniflora L.	Arctic harebell / one-flowered harebell		Forb
Capsella bursa-pastoris (L.) Medik.[5]	shepherd's-purse		Forb
Caragana arborescens Lam.[5]	Siberian peashrub		Shrub
Cardamine oligosperma Nutt.	few-seed bitter-cress		Forb
Cardamine pensylvanica Muhl. ex Willd.	Pennsylvania bitter-cress		Forb
Carex aquatilis Wahlenb.	water sedge		Graminoid
Carex atherodes Spreng.	awned sedge		Graminoid
Carex bigelowii ssp. *lugens* (T. Holm) T.V. Egorova	bigelow's sedge	*Carex lugens* Holm, *C. consimilis* Holm	Graminoid
Carex brunnescens (Pers.) Poir.	brownish sedge		Graminoid
Carex canescens L.	silvery sedge		Graminoid
Carex concinna R. Br.	Low northern sedge		Graminoid
Carex crawfordii Fern.	crawford sedge		Graminoid
Carex deflexa Hornem.	short-stemmed sedge		Graminoid
Carex diandra Schrank	lesser-paniocled sedge		Graminoid
Carex disperma Dewey	softleaf sedge		Graminoid
Carex franklinii Boott	rock dwelling sedge		Graminoid

Scientific name[1]	Common name[2]	Synonym[3]	Type
Carex lugens Holm	stiff sedge		Graminoid
Carex macloviana d'Urv.	Falkland Island sedge		Graminoid
Carex media R. Br.	Scandinavian sedge		Graminoid
Carex membranacea Hook.	shiner sedge		Graminoid
Carex pellita Willd.	wooly sedge		Graminoid
Carex podocarpa R.Br.	graceful mountain sedge		Graminoid
Carex praticola Rydb.	meadow sedge		Graminoid
Carex saxatilis L.	russet sedge		Graminoid
Carex scirpoidea Michx.	single-spike sedge		Graminoid
Carex siccata Dewey[4]	dry-spike sedge	*Carex foenea* Willd.	Graminoid
Carex sp.	sedge		Graminoid
Carex tenuiflora Wahlenb.	sparse-flowered sedge		Graminoid
Carex utriculata Boott	beaked sedge		Graminoid
Cassiope mertensiana (Bong.) D.Don	white mountain heather		Shrub
Cassiope tetragona (L.) D. Don	arctic white heather		Shrub
Castilleja raupii Pennell	raup's paintbrush		Forb
Cerastium beeringianum Cham. & Schlecht.	bering mouse-ear chickweed		Forb
Cerastium maximum L.	great mouse-ear chickweed		Forb
Ceratodon purpureus (Hedw.) Brid.	fire-moss		Moss
Cetraria ericetorum Opiz	hyphenated Iceland moss		Lichen
Cetraria islandica (L.) Ach.	true Iceland lichen		Lichen
Cetraria sp.			Lichen
Chamaedaphne calyculata (L.) Moench	leatherleaf		Shrub
Chamerion angustifolium ssp. *angustifolium* (L.) Holub	fireweed	*Epilobium angustifolium* L. s.I.	Forb
Chamerion latifolium (L.) Holub	river beauty	*Epilobium latifolium* L.	Forb
Chenopodium album L.[5]	lamb's quarters		Forb
Chenopodium capitatum L.	goosefoot		Forb
Cicuta virosa L.	European water-hemlock		Forb
Circaea alpina L.[4]	small enchanter's nightshade		Forb
Cladina mitis (Sandst.) Hustich	green reindeer lichen		Lichen
Cladina rangiferina (L.) Nyl.	gray reindeer lichen		Lichen

Scientific name[1]	Common name[2]	Synonym[3]	Type
Cladina sp.			Lichen
Cladina stellaris (Opiz) Brodo	star-tipped reindeer lichen		Lichen
Cladonia arbuscular ssp mitis (Sandst.) Ruoss			Lichen
Cladonia crispata (Ach.) Flotow	cup lichen		Lichen
Cladonia gracilis (L.) Willd.	pixie		Lichen
Cladonia multiformis G. Merr.	shape-shifting pixie		Lichen
Cladonia sp.			Lichen
Claytonia sarmentosa C.A.Mey.	spring beauty		Forb
Climacium dendroides (Hedw.) F. Weber & D. Mohr	tree climacium moss		Moss
Cnidium cnidiifolium (Turcz.) Schischk.	northern hemlock-parsley	*Conioselinum cnidiifolium* (Turcz.) A.E. Porsild	Forb
Comarum palustre L.	marsh cinquefoil	*Potentilla palustris* (L.) Scop.	Forb
Conocephalum conicum (L.) Lindb	snake liverwort		Liverwort
Coptidium lapponicum (L.) Gandog.	Lapland-crowfoot		Forb
Corallorhiza trifida Chatelain	northern coral root		Forb
*Cornus canadensis*L.	bunchberry		Forb
Cornus sericea ssp. *sericea* L.	red-osier dogwood	*Cornus stolonifera* Michx.	Shrub
Crepis tectorum L. [5]	narrow-leaf hawksbeard		Forb
Cypripedium guttatum Sw. [4]	spotted lady's slipper		Forb
Cypripedium sp.	hardy orchid species		Forb
Cystopteris fragilis (L.) Bernh.	fragile fern		Fern and Fern Allies
Cystopteris montana (Lam.) Bernh.	mountain bladder fern		Fern and Fern Allies
Dactylina arctica (Richardson) Nyl.	butterfingers		Lichen
Dasiphora fruticosa (L.) Rydb.	shrubby cinquefoil	Potentilla fruticosa ssp. *floribunda* (Pursh) Elkington	Shrub
Delphinium glaucum S. Wats.	mountain larkspur / tall delphinium		Forb
Deschampsia caespitosa (L.) P. Beauv.	tufted hairgrass		Graminoid
Descurainia sophioides (Fisch. ex Hook.) O.E. Schulz	northern tansy-mustard		Forb
Dicranum sp.	dicranum moss		Moss
Diphasiastrum alpinum (L.) Holub	alpine clubmoss	*Lycopodium alpinum* L.	Fern and Fern

Scientific name[1]	Common name[2]	Synonym[3]	Type
			Allies
Diphasiastrum complanatum (L.) Holub	northern running-pine		Fern and Fern Allies
Dodecatheon frigidum Cham. & Schltdl	western arctic shootingstar		Forb
Draba fladnizensis Wulfen	austrian draba, arctic draba		Forb
Dracocephalum parviflorum Nutt.	american dragonhead		Forb
Drepanocladus sp.	drepanocladus moss		Moss
Drosera rotundifolia L.	roundlfeaf sundew		Forb
Dryas ajanensis Juz.	white dryad		Shrub
Dryas alaskensis A.E. Porsild	alaskan mountain-avens	Dryas octopetala L. ssp. *alaskensis* (A.E. Porsild) Hulten	Shrub
Dryas hookeriana Juz.	white mountain-avens		Shrub
Dryas integrifolia Vahl	entire-leaved mountain-avens		Shrub
Dryas sp.			Shrub
Dryopteris fragrans (L.) Schott	fragrant wood fern		Fern and Fern Allies
Elymus repens (L.) Gould[5]	quackgrass		Graminoid
Elymus trachycaulus (Link) Gould ex Shinners	slender wheatgrass		Graminoid
Empetrum nigrum L. ssp. *hermaphroditum* (Lge.) Böcher	crowberry / mossberry		Shrub
Epilobium anagallidifolium Lam.	willowherb / fireweed		Forb
Epilobium ciliatum Raf.	fringed willowherb		Forb
Equisetum arvense L.	field horsetail		Fern and Fern Allies
Equisetum fluviatile L.	river horsetail		Fern and Fern Allies
Equisetum pratense Ehrh.	meadow horsetail		Fern and Fern Allies
Equisetum scirpoides Michx.	dwarf scouring rush		Fern and Fern Allies
Equisetum sylvaticum L.	wood horsetail		Fern and Fern Allies
Equisetum variegatum Schleicher	variegated scouring rush		Fern and Fern Allies

Scientific name[1]	Common name[2]	Synonym[3]	Type
Erigeron acris var. kamtschaticus (DC.) Herder	bitter fleabane	*Erigeron acris* ssp. *politus* (Fries) Schniz & Keller	Forb
Erigeron caespitosus Nutt.	tufted fleabane		Forb
Erigeron compositus Pursh	dwarf mountain fleabane		Forb
Erigeron glabellus Nutt. ssp. *pubescens* (Hook.) Cronq.	streamside fleabane		Forb
Eriophorum angustifolium Honck.	tall cottongrass		Graminoid
Eriophorum brachyantherum Trautv. & C.A. Mey.	northland cottonsedge		Graminoid
Eriophorum chamissonis C.A. Mey.	Chamisso's cottongrass		Graminoid
Eriophorum sp.			Graminoid
Eriophorum vaginatum L.	cotton grass		Graminoid
Erysimum cheiranthoides L.	wormseed mustard		Forb
Erysimum coarctatum Fernald	small-flower prairie wallflower		Forb
Euphrasia subarctica Raup	Arctic eyebright		Forb
Eurhynchiastrum pulchellum	elegant feathermoss	*Eurhynchium pulchellum* (Hedw.) Jenn.	Moss
Eurybia sibirica (L.) G. L. Nesom	arctic aster		Forb
Festuca altaica Trin.	northern rough fescue		Graminoid
Festuca saximontana var. *saximontana* Rydb.	northern rough fescue		Graminoid
Festuca sp.			Graminoid
Flavocetraria cucullata (Bellardi) Karnefelt & Thell	whirling dervish		Lichen
Flavocetraria nivalis (L.) Karnefelt & Thell	ballroom dervish		Lichen
Flavocetraria spp.			Lichen
Fragaria virginiana Duchesne	wild strawberry		Forb
*Galium boreale*L.	northern bedstraw		Forb
Galium trifidum L.	small bedstraw		Forb
Gentianella amarelle (L.) Borner	felwort		Forb
Gentianella propinqua (Richards.) J.M.Gillett	four petalled gentian		Forb
Gentianella propinqua ssp. *propinqua* (Richardson) J.M. Gillett	fourpart dwarf gentian		Forb
Geocaulon lividum (Richards.) Fern.	false toadflax		Forb
Geranium erianthum DC.	woolly geranium		Forb
Geum macrophyllum ssp. *perincisum* (Rydb.) Hult.	large-leaved avens		Forb

Scientific name[1]	Common name[2]	Synonym[3]	Type
Glyceria grandis S. Watson	tall mannagrass		Graminoid
Glyceria sp.			Graminoid
Goodyera repens (L.) R.Br.	northern rattlesnake plantain		Forb
Gymnocarpium jessoense (Koidzumi) Koidzumi	northern oak fern		Fern and Fern Allies
Hedysarum alpinum L.	liquorice root / bear root		Forb
Hedysarum boreale Nutt. ssp. *mackenzii* (Richards.) Welsh	northern hedysarum		Forb
Heracleum maximum Bartram	cow-parsnip		Forb
Hieracium umbellatum L.	umbellate hawkweed		Forb
Hordeum jubatum L.	foxtail		Graminoid
Huperzia haleakalae (B.) Holub	alpine fir-moss	*Lycopodium selago* L.	Fern and Fern Allies
Huperzia selago (L.) Bernh. ex Schrank & Mart.	fir clubmoss		Fern and Fern Allies
Hylocomium splendens (Hedw.) B.S.G.	step moss		Moss
Icmadophila ericetorum (L.) Zahlbr.	spraypaint lichen		Lichen
Juncus biglumis L.	two-flowered rush		Graminoid
Juncus castaneus Sm.	chestnut rush		Graminoid
Juncus drummondii E. Mey.	drummond rush		Graminoid
Juniperus communis L.	common juniper		Shrub
Linnaea borealis ssp. *americana*(Forbes) Hultén ex R.T. Clausen	twinberry	*Linnaea borealis* L. ssp. *americana* (Forbes) Hulten var. americana (Forbes) Rehd.	Shrub
Lupinus arcticus S. Watson	arctic lupin		Forb
Luzula arctica Blytt	arctic wood rush		Graminoid
Luzula confusa Lindeb.	northern wood rush		Graminoid
Luzula parviflora (Ehrh.) Desv.	small-flowered wood rush		Graminoid
Luzula rufescens Fisch. ex E. Mey.	hairy wood rush		Graminoid
Lycopodium annotinum L.	bristly club-moss		Fern and Fern Allies
Lycopodium clavatum L.	common club-moss		Fern and Fern Allies
Lycopodium sp.			Fern and Fern

Scientific name[1]	Common name[2]	Synonym[3]	Type
			Allies
Maianthemum sp.			Forb
Marchantia polymorpha L.	green-tongue lichen		Liverwort
Masonhalea richardsonii (Hook.) Karnefelt	arctic tumbleweed		Lichen
*Matricaria discoidea*DC. [5]	pineapple weed	*Matricaria matricariodes* (Less.) Porter	Forb
Melanelia sp.			Lichen
Melilotus albus Medik. [5]	white sweetclover		Forb
Melilotus officinalis (L.) Pall. [5]	yellow sweetclover		Forb
Menyanthes trifoliata L.	buckbean		Forb
Mertensia paniculata (Aiton) G. Don	tall bluebells		Forb
Micranthes nelsoniana var. *nelsoniana (D. Don) Small*	dotted saxifrage	*Saxifraga nelsoniana* D. Don ssp. *nelsoniana*	Forb
Micranthes nivalis (L.) Small	alpine saxifrage	*Saxifraga rufopilosa* (Hultén) A.E. Porsild	Forb
Micranthes reflexa (Hook.) Small	reflexed saxifrage	*Saxifraga reflexa* Hook.	Forb
Minuartia dawsonensis (Britt.) House	rock stitchwort		Forb
Minuartia obtusiloba (Rydb.) House	twin-flower sandwort		Forb
Mitella nuda L.	naked mitrewort		Forb
Mnium sp.			Moss
Moehringia lateriflora (L.) Fenzl	blunt-leaved sandwort		Forb
Moneses uniflora (L.) A. Gray	single delight		Forb
Myosotis asiatica (Vestergr.) Schischk. & Serg	mountain forget-me-not	*Myosotis alpestris* Schm. ssp. *asiatica* Vestergr.	Forb
Nephroma arcticum (L.) Torss.	arctic kidney lichen		Lichen
Nephroma sp.			Lichen
Orthilia secunda (L.) House	one-sided wintergreen		Forb
Oxytropis campestris (L.) DC	field locoweed		Forb
Oxytropis nigrescens (Pall.) Fisch.	blackish crazyweed		Forb
Oxytropis sp.			Forb
Paludella squarrosa (Hedw.) Brid.	angled paludella moss		Moss
Papaver lapponicum (Tolm.) Nordh.	Lapland poppy		Forb
Papaver radicatum Rottb.	arctic poppy		Forb
Parmelia spp.	shield lichens		Lichen

Scientific name[1]	Common name[2]	Synonym[3]	Type
Parmeliopsis sp.			Lichen
Parnassia palustris L.	northern grass-of-parnassus / bog star		Forb
Parrya nudicaulis L.	northern parrya		Forb
Pedicularis capitata M.F. Adams	capitate lousewort		Forb
Pedicularis labradorica Wirsing	labrador lousewort		Forb
Pedicularis lanata Cham. & Schltdl	woolly lousewort		Forb
Pedicularis langsdorffii Fisch.	Langsdorf's lousewort		Forb
Pedicularis lapponica L.	Lapland lousewort		Forb
Pedicularis sp.	lousewort		Forb
Peltigera aphthosa (L.) Willd.	common freckle pelt		Lichen
Peltigera canina (L.) Willd.	dog-lichen		Lichen
Peltigera neopolydactyla (Gyelnik) Gyelnik	frog pelt/finger felt lichen		Lichen
Peltigera sp.			Lichen
Penstemon gormanii Greene	gorman's beardtongue		Forb
Persicaria amphibia (L.) S.F. Gray	water smartweed / water knotweed		Forb
Petasites frigidus (L.) Fries s.l.	arctic sweet coltsfoot		Forb
Petasites saggitatus (Banks ex Pursh) Gray	arrowleaf		Forb
Phacelia mollis J.F. Macbr. [4]	Coffee Creek scorpionweed		Forb
Phleum pratense L.	timothy		Graminoid
Picea glauca (Moench) Voss	white spruce		Tree
Picea mariana (Mill.) Britton, Sterns & Poggenb.	black spruce		Tree
Pinguicula villosa L.	butterwort		Forb
Plantago major L. [5]	common plantain		Forb
Platanthera aquilonis Sheviak	northern green rein orchid		Forb
Platanthera dilatata (Pursh) Lindl.	tall white bog orchid		Forb
Platydictya jungermannioides (Brid.) H.A. Crum	Jungermann's platydictya moss		Moss
Pleurozium schreberi (Brid.) Mitt.	red-stem feathermoss		Moss
Poa alpina L.	alpine blue grass		Graminoid
Poa arctica ssp. *arctic* R. Br.	arctic bluegrass		Graminoid
Poa glauca Vahl	glaucous bluegrass		Graminoid
Poa interior Rydb.	Interior bluegrass, inland bluegrass		Graminoid

Scientific name[1]	Common name[2]	Synonym[3]	Type
Poa palustris L.	fowl bluegrass		Graminoid
Poa pratensis ssp. *pratensis* [5]	Kentucky bluegrass		Graminoid
Poa sp.	blue grass		Graminoid
Polemonium acutiflorum Willd. ex Roem. & Schult.	tall Jacob's-ladder		Forb
Polemonium boreale M.F. Adams	northern jacob's-ladder		Forb
Polemonium pulcherrimum Hook.	showy jacob's-ladder		Forb
*Polygonum achoreum*S.F. Blake	blake's knotweed		Forb
Polygonum aviculare L.	prostrate knotweed		Forb
Polygonum viviparum L.	alpine bistort		Forb
Polytrichum commune Hedw.	common haircap moss		Moss
Polytrichum juniperinum Hedw.	juniper haircap moss		Moss
Polytrichum piliferum Hedw.	awned haircap moss		Moss
Polytrichum sp.	Haircap moss		Moss
*Polytrichum strictum*Brid.	bog haircap moss		Moss
Populus balsamifera L.	balsam poplar		Tree
Populus tremuloides Michx.	trembling aspen		Tree
Potentilla anserina L.	common silverweed		Forb
Potentilla bimundorum Sojak	divided cinquefoil		Forb
Potentilla diversifolia Lehm.	diverse-leaved cinquefoil		Forb
Potentilla nivea L.	snow cinquefoil		Forb
Potentilla norvegica L.	Norwegian cinquefoil		Forb
Potentilla pensylvanica L.	pennsylvania cinquefoil		Forb
Potentilla sp.	cinquefoil		Forb
Potentilla uniflora Ledeb.	one-flowered cinquefoil		Forb
Ptilium crista-castrensis Hedw.	knight's plume moss		Moss
Puccinellia rupestris (With.) Fernald & Weath.	sandberg's bluegrass	*Poa secunda* Zea ex Roem. & Schult.	Graminoid
Pyrola asarifolia Michx.	liver-leaf, pink wintergreen		Forb
Pyrola chlorantha Sw.	greenish flowered wintergreen		Forb
Pyrola grandiflora Radius	arctic wintergreen		Forb
Pyrola sp.	wintergreen		Forb
Racomitrium lanuginosum (Hedw.) Brid.	Racomitrium moss		Moss

Scientific name[1]	Common name[2]	Synonym[3]	Type
Racomitrium spp.	racomitrium moss		Moss
Ranunculus eschscholtzii Schelecht.	subalpine buttercup / crowfoot		Forb
Ranunculus lapponicus	lapland buttercup		Forb
Ranunculus sp.	buttercup		Forb
Rhinanthus minor L.	little yellow rattle	*Rhinanthus crista-galli* L., *Rhinanthus minor* ssp. *borealis* (Sterneck) Á. Löve, *Rhinanthus borealis* (Sterneck) Chabert	Forb
Rhizocarpon geographicum (L.) DC.	green map lichen		Lichen
Rhododendron groenlandicum(Oeder) Kron & Judd	labrador-tea	*Ledum groenlandicum* Oeder	Shrub
Rhododendron tomentosum Harmaja	trappers tea	*Ledum decumbens* (Ait.) Lodd.	Shrub
Rhytidiadelphus triquetrus (Hedw.) Warnst.	electrified cat's tail moss		Moss
Rhytidium rugosum (Hedw.) Kindb.	crumpled-leaf moss		Moss
Ribes hudsonianum Richardson	northern black currant		Shrub
Ribes lacustre (Pers.) Poir.	black gooseberry, prickly currant		Shrub
Ribes triste Pallas	wild red currant		Shrub
Rorippa barbareifolia (DC.) Kitag.	hoary yellow cress		Forb
Rorippa palustris (L.) Bess.	marsh yellow cress		Forb
Rosa acicularis Lindl.	prickly rose		Shrub
Rosa woodsia Lindl.	wood rose		Shrub
Rubus arcticus L.	nagoonberry		Shrub
Rubus chamaemorus L.	cloudberry / baked apple		Shrub
Rubus ideaus L.	common red raspberry	*Rubus ideaus* L. s.l. (=R. strigosus Michx.)	Shrub
Rubus pubescens Raf.	dwarf red raspberry		Shrub
Rumex arcticus Trautv.	arctic dock		Forb
Rumex occidentalis S.Wats.	western dock		Forb
Rumex triangulivalvis (Danser) Rech. f.	triangular-valved dock		Forb
Salix alaxensis var. *alaxensis* (Andersson) Coville	felt-leaf willow		Shrub
Salix alaxensis var. *longistylis* (Rydb.) C.K. Schneid.	alaska willow		Shrub
Salix arbusculoides Andersson	northern bush willow		Shrub
Salix arctica Pall.	arctic willow		Shrub
Salix barclayi Anderss.	barclay's willow		Shrub

Scientific name[1]	Common name[2]	Synonym[3]	Type
*Salix barrattiana*Hook.	barratt's willow		Shrub
Salix bebbiana Sarg.	bebb's willow		Shrub
Salix exigua Nutt.	sandbar willow		Shrub
Salix glauca L.	gray-leaf willow		Shrub
Salix lasiandra Benth.	Pacific willow		Shrub
Salix monticola Bebb	serviceberry willow	*Salix pseudomonticola* Ball	Shrub
Salix myrtillifolia Anderss.	low blueberry willow		Shrub
Salix planifolia Pursh	tea-leaf willow		Shrub
Salix polaris Wahlenb.	polar willow		Shrub
Salix pulchra Cham.	diamond leaf willow		Shrub
Salix reticulata L.	net-leaf willow		Shrub
Salix scouleriana Barratt ex Hook.	scouler's willow		Shrub
Salix sp.	willow		Shrub
Sanguisorba sp.	burnett		Forb
Saxifraga tricuspidata Rottb.	prickly saxifrage / three toothed saxifrage		Forb
Senecio lugens Richardson	black-tipped groundsel		Forb
Shepherdia canadensis (L.) Nutt.	soopolallie / soapberry / buffalo berry		Shrub
Silene involucrata (Chamisso & Schlechtendal) ssp. *involucrata*	arctic campion		Forb
Silene repens Patrin ex Pers.	pink campion		Forb
Silene vulgaris (Moench) Garcke[5]	bladder campion		Forb
Sinapis alba L.[5]	white mustard		Forb
Solidago canadensis L.	Canada goldenrod		Forb
Solidago lepida DC.	western Canada goldenrod		Forb
Solidago multiradiata Ait.	alpine goldenrod		Forb
Solidago simplex Kunth	sticky goldenrod		Forb
Sonchus arvensis L.[5]	perennial sow-thistle		Forb
Sparganium angustifolium Michx.	narrow-leaved bur-reed		Graminoid
Sphagnum spp.	sphagnum moss		Moss
Spiraea beauverdiana Schneid.	Beauverd's spiraea		Shrub
Spiraea stevenii (C.K. Schneid.) Rydb.	steven's spirea	*Spirea beauverdiana* Schneid.	Shrub

Scientific name[1]	Common name[2]	Synonym[3]	Type
Spiranthes romanzoffiana Cham.	hooded ladies' tresses		Forb
Stellaria borealis Bigelow	boreal starwort		Forb
Stellaria calycantha (Ledeb.) Bong.	northern stitchwort		Forb
Stellaria *crassifolia* Ehrh.	fleshy stitchwort		Forb
Stellaria longifolia Muhl.	long-leaved starwort		Forb
Stellaria longipes ssp. *longipes* Goldie	doldie's starwort	*Stellaria laeta* Richards.	Forb
Stereocaulon alpinum Laurer ex Funck	Alpine snow lichen		Lichen
Stereocaulon sp.	foam lichens		Lichen
Symphyotrichum boreale (Torr. & Gray) A. & D. Löve	boreal aster	*Aster borealis* (Torr. & A. Gray) Prov.	Forb
Taraxacum ceratophorum (Ledeb.) DC.	horned dandelion		Forb
Taraxacum officinale G.H. Weber ex Wiggers[5]	common dandelion		Forb
Tephroseris lindstroemii (Ostenf.) A. Löve & D. Löve	northern groundsel	*Senecio tundricola* Tolm.	Forb
Thalictrum occidentale Gray	western meadowrue		Forb
Thalictrum sparsiflorum Turcz. ex Fisch. & Mey.	mountain meadow-rue		Forb
Thamnolia vermicularis (Sw.) Ach. Ex Schaerer	universal whiteworm		Lichen
Thlaspi arvense L.[5]	field penny-cress		Forb
Timmia sp.			Moss
Tofieldia pusilla (Michx.) Pers.	false asphodel / scotch asphodel		Forb
Tomenthypnum nitens (Hedw.) Loeske	tomenthypnum moss		Moss
Tomenthypnum sp.			Moss
Trifolium hybridum L.[5]	alsike clover		Forb
Trifolium pratense L.[5]	red clover		Forb
Trisetum spicatum (L.) Richt.	spike trisetum		Graminoid
Umbilicaria spp.	rock tripes		Lichen
Vaccinium caespitosum Michx.	dwarf blueberry / dwarf billberry		Shrub
Vaccinium oxycoccos L.	small cranberry	*Oxycoccus microcarpus* Turcz.	Shrub
Vaccinium uliginosum L.	bog blueberry / bog bilberry / blueberry		Shrub
Vaccinium vitis-idaea L.	lowbush cranberry / lingonberry / mountain cranberry		Shrub
Valeriana capitata Pall.	capitate valerian / mountain heliotrope		Forb
Veronica scutellata L.	skullcap speedwell		Forb

Scientific name[1]	Common name[2]	Synonym[3]	Type
Viburnum edule (Michx.) Raf.	highbush-cranberry		Shrub
Viola epipsela Ledeb. ssp. *repens* (Turcz.) Becker	northern marsh violet		Forb
Viola sp.	violet		Forb
Vulpicida tilesii (Ach.) J.-E. Mattsson & Lai	limestone sunshine lichen		Lichen
Wilhelmsia physodes (Fisch. ex Ser.) McNeill	merckia		Forb
Woodsia alpina (Bolton) S.F. Gray	alpine cliff fern		Fern and Fern Allies
Xanthoparmelia sp.	rock-shield lichens		Lichen
Zygadenus elegans Pursh	mountain death camas	*Anticlea elegans* var. *elegans* (Pursh) Rydb.	Forb

[1] Primary reference flora used was the online version of the Flora of North America (2014, 2015, 2016). Where species information was not available online, Integrated Taxonomic Information System (IT IS 2015) was used. Reference flora for Bryophyte species was the online version of Bryophyte Flora of North America (2014). Lichen species were referenced using Lichens of North America (Brodo *et al.* 2011).

[2] Common names not provided by 1) Flora of North America (2014, 2015. 2016), or 2) Flora of the Yukon Territory (Cody 2000) are from Klinkenberg (2015).

[3] Synonyms are provided for the Flora of the Yukon Territory (Cody 2000).

[4] Watch-list plant species found in the LSA (Yukon CDC 2016).

[5] Invasive plant species found in the LSA

APPENDIX B. ELC MAPPING AND BEM DESCRIPTIONS AND CODES

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Soil Moisture Regimes:

Lists the code, class and description of soil moisture regime classes, adapted from Table 1.1 in Field Manual for Describing Yukon Ecosystems (Draft).

Site soil moisture codes and descriptions

Code	Class	Description
1	Xeric	Water is removed very rapidly in relation to supply; soil is moist for brief periods following precipitation.
2	Subxeric	Water is removed rapidly in relation to supply; soil is moist for short periods following precipitation.
3	Submesic	Water is removed readily in relation to supply; water available for moderately short periods following precipitation.
4	Mesic	Water is removed somewhat slowly in relation to supply; soil may remain moist for a significant, but sometimes short period of the year.
5	Subhygric	Water is removed slowly enough to keep soil wet for a significant part of the growing season; some temporary seepage and possibly mottling below 20 cm.
6	Hygric	Water is removed slowly enough to keep soil wet for most of the growing season; permanent seepage and mottling; gleyed colours common.
7	Subhydric	Water is removed slowly enough to keep water table at or near the surface for most of the year; gleyed mineral or organic soils; permanent seepage < 30 cm below surface.
8	Hydric	Water is removed so slowly that water table is at or above soil surface all year; gleyed mineral or organic soils.

Site Modifiers:

The mapped site modifiers, adapted from Table 3.2 in the Standard for Terrestrial Ecosystem mapping in BC, are listed below.

Site modifiers codes and descriptions

Modifier[1]	Code	Criteria
Gentle slope	j	site occurs on gently sloping topography (less than 15%)
Cool	k	site sites occurs on cool, northerly aspects (315°-45°), on moderately steep slopes (15%-65%)
Warm	w	site series occurs on warm, southerly aspects (135°-270°), on moderately steep slopes (15-65%)
Steep cool	q	site series occurs on steep slopes (>65%) with cool, northerly aspects (315°-45°)
Steep warm	z	site series occurs on steep slopes (>65%) with warm, southerly aspects (135°-270°)
Shallow	s	site series occurs where soils are considered to be shallow to bedrock
Deep	d	site series occurs on soils are not considered to deep
Coarse-textured soils	c	site series occurs on soils with a coarse texture, including sand and loamy sand; and also sandy loam, loam and sandy clay loam with greater than 70% coarse fragment volume

[1] Slope and aspect class criteria defined by ecosystem mapper

Structural Stage:

The mapped structural stages, adapted from Field Manual for Describing Yukon Ecosystems (Environment Yukon 2014), are described below.

Structural stage codes and descriptions

Structural stage[1]	Code	Description
Non-vegetated	1	No vegetation or less than 5% established vegetation; often due to recent disturbance (e.g., placer mining) or unvegetated rock.
Sparse/cryptogram	2	Either the initial stages of primary and secondary succession or a cryptogram community maintained by environmental conditions; sparsely-vegetated or dominated by bryophytes and lichens; may be prolonged where there is little or no soil development (e.g., bedrock).
Sparse	2a	5 – 10% vegetation cover
Bryoid	2b	Bryophyte-dominated
Lichen	2c	Lichen-dominated
Herb	3	Early successional stage or herbaceous communities maintained by environmental conditions or disturbance (e.g., wetlands, post-fire forest succession); herb dominated, including forbs, graminoids and ferns; some invading or residual shrubs and trees may be present but are usually sparse or absent; many herbaceous communities are continually maintained in this stage.
Forb-dominated	3a	Herbaceous communities dominated (greater than 1/2 of the total herb cover) by non-graminoid herbs, including ferns.
Graminoid-dominated	3b	Herbaceous communities dominated (greater than 1/2 of the total herb cover) by grasses, sedges, reeds and rushes.
Aquatic	3c	Herbaceous communities dominated (greater than 1/2 of the total herb cover) by floating or submerged aquatic plants; does not include sedges growing in marshes with standing water.
Dwarf shrub	3d	Communities dominated (greater than 1/2 of the total herb cover) by dwarf woody species, such as kinnikinnick or dwarf willows.
Shrub[2]	4	Early successional stage or shrub communities maintained by environmental conditions or disturbance (e.g., wetlands, flooding, post-fire forest succession); dominated by shrubby vegetation; either dominated by shrubby vegetation, including tree seedlings/saplings, or if sparsely vegetated overall, the dominance of shrubs characterizes the community as a shrubland.
Tall shrub[2]	4a	Communities dominated by tall shrub layer vegetation - woody plants > 2m and ≤ 7 cm dbh; may be in this stage perpetually due to environmental conditions or disturbance.
Low shrub[2]	4b	Communities dominated by low shrub layer vegetation - woody plants < 2m; may be in this stage perpetually due to environmental conditions or disturbance.
Pole sapling[3]	5	Trees > 5m tall and > 7 cm dbh, typically densely stocked. Self-thinning and vertical structure are not yet evident in the canopy. Younger stands are vigorous (usually > 15–20 years old); older stagnated stands (up to 100 years old) are also included; time since disturbance usually < 40 years; up to 100+ years for dense (5000 – 15000+ stems per ha) stagnant stands.
Young forest[3]	6	Self-thinning has become evident and the forest canopy has begun to differentiate into distinct layers. A more open stand than the pole/sapling stage.
Mature forest[3]	7	Trees established after the last stand-replacing disturbance have matured; a second cycle of shade tolerant trees may have become established; shrub and herb understories become well developed as the canopy opens up.
Old forest[3]	8	Stands of old age with complex structure; patchy shrub and herb understories are typical; regeneration is usually of shade-tolerant species with composition similar to the overstory. Fire-maintained stands may have a 'single-storied' appearance. Very old stands having complex structure with abundant large-sized trees, snags and coarse woody debris (CWD); snags and CWD occurring in all stages of decomposition; stands are comprised entirely of shade-tolerant overstory species with well-established canopy gaps.

[1] In the assessment of structural stage, structural features and age criteria should be considered together. Broadleaf stands will generally be younger than coniferous stands belonging to the same structural stage.

[2] Substages 4a and 4b may, for example, include very old, low productivity stands (e.g., treed wetlands) less than 5m tall, respectively.

[3] Structural stages 4-7 will typically be estimated from a combination of attributes based on forest inventory maps and aerial photography.

Stand Modifiers:

The mapped stand composition modifiers, adapted from Table 3.5 in the Standard for Terrestrial Ecosystem Mapping in BC, and the mapped stand-influencing site disturbance modifiers, are listed below.

Stand composition modifiers[1, 2] and stand influencing site disturbance modifiers[3]

Stand modifier	Code	Description
Canopy Composition[1]		
Coniferous	C	Greater than 3/4 of total tree layer cover is coniferous[2]
Deciduous	D	Greater than 3/4 of total tree layer cover is broadleaf[2]
Mixed	M	Neither coniferous or broadleaf account for greater than 3/4 of total tree layer cover[2]
Site Disturbance[3]		
Fires	F	Areas influenced by wildfire

[1] Adapted from RIC, 1997

[2] Stand composition modifiers emphasize overstory and intermediate tree layers, since these are the most visible on aerial photographs.

[3] Site disturbance code from Field Manual for Describing Yukon Ecosystems (Draft)

Ecosystem units (including non-vegetated units):

All ecosystem units mapped within the Local Study Area are reported in the tables below, by Bioclimate Zone. Tables include assumed modifiers, site descriptions, mapped atypical modifiers and mapped structural stages.

Mapped ecosites within the Boreal Bioclimate Zones

Ecosite	Veg assoc	Name	Assumed modifiers	Description and typical situation	Moisture regime	Mapped modifiers	Mapped structural stage
20	Capu	Purple reedgrass - lichen	w	forb and graminoid dominated grassland; moderate to steep, south-facing slopes; medium to rich nutrient regime	xeric - subxeric	s, z	3, 3b, 4
20	Aruv	Kinnikinnick	w	ground shrub dominated 'grassland'; moderate to steep, south-facing slopes; tree cover <10%; medium to rich nutrient regime	xeric - subxeric	s, z	3, 3d
21		Aspen - kinnikinnick-purple reedgrass	d, w	dry aspen-dominated forest; mid to upper slope position, predominently southerly aspect; commonly medium nutrient regime	subxeric - submesic	c, s, z	4, 4a, 5, 6, 7
01	A	Aspen - soapberry - purple reedgrass	d, j	mesic aspen-dominated forest; lower to upper slopes across a range of aspects; low elevations only; medium regime regime	submesic - mesic	k, w	6, 7
01	W	Alaska birch - Labrador tea - tall bluebells - step moss	d, j	mesic alaska birch-dominated forest; lower to upper slopes across a range of aspects; medium nutrient regime	submesic - mesic	k, q, s, w, z	4a, 4b, 5, 6, 7
01	WSw	Alaska birch - white spruce - Labrador tea - lowbush cranberry - feathermoss	d, j	mesic mixedwood forest; lower to upper slopes across a range of aspects; medium in nutrient regime	submesic - mesic	k, q, s, w, z	4, 4a, 5, 6, 7, 8
01	Sw	White spruce - rose - bastard toadflax - feathermoss	d, j	mesic white spruce-dominated forest; lower to upper slopes across a range of aspects; low elevations only; medium regime regime	submesic - mesic	k, s, w	4, 4b, 5, 6, 7, 8
01	Sw(Sb)	Spruce - Labrador tea - lowbush cranberry - feathermoss	d, j	mesic coniferous forest, spruce (primarily white) dominated; lower to upper slopes across a range of aspects; medium nutrient regime	submesic - mesic	k, q, w, z	4, 4a, 4b, 5, 6, 7, 8

Ecosite	Veg assoc	Name	Assumed modifiers	Description and typical situation	Moisture regime	Mapped modifiers	Mapped structural stage
01		Spruce - feathermoss (Fire)	d, j	mesic forest; lower to upper slopes across a range of aspects; low elevations only; medium regime regime. (note: mapped in burned areas that are currently dominated by shrub, for which a canopy association cannot be determined)	submesic - mesic	k, q, s, w	3, 4, 4a, 4b
30		Black spruce - Labrador tea - reindeer lichen	d, k	black spruce-dominated forest; predominately on northerly lower to upper slopes; high lichen cover; poor nutrient regime.	submesic - mesic	q	4, 4a, 4b, 5, 6, 7, 8
31		Spruce - birch - lowbush cranberry - feathermoss	d, j	sparse coniferous forest near Subalpine Bioclimate boundary, spruce-dominated; high shrub cover; predominantly upper slope with variable aspect; medium nutrient regime	mesic	k, q, s, w, z	4, 4a, 4b, 5, 6, 7, 8
32	Sb1	Black spruce - scrub birch - labrador tea - cloudberry	d, k	moderate-to-steep northerly slopes underlain by permafrost; lower-to-mid slope; stunted black spruce canopy with scrub birch, Labrador tea and cloudberry in the understory; poor nutrient regime	subhygric - hygric	w	4, 4a, 4b, 7
32	Sb2	Black spruce - ladrador tea - cottongrass	d, k	moderate-to-steep northerly slopes underlain by permafrost; lower-to-mid slope; stunted black spruce canopy with Labrador tea, and cottongrass in the understory; poor nutrient regime	subhygric - hygric	q, w	4, 4a, 4b, 7
32		Black spruce - Labradror tea - cloudberry - sedge	d, k	moderate-to-steep northerly slopes underlain by permafrost; lower-to-mid slope; stunted black spruce canopy with Labrador tea and lowbush cranberry in the understory; poor nutrient regime (note: mapped in areas where vegetation association for ecosite is unknown)	subhygric - hygric	q, w	4, 4a, 4b, 5, 6, 7
33		Black spruce - Labrador tea - sedge - brownmoss - reindeer lichen	d, j	gentle-to-moderate, lower and toe slopes underlain by permafrost; black spruce dominated, spruce typically stunted; poor to medium nutrient regime	hygric	k, w	4, 4a, 4b, 6, 7, 8
40		White spruce - horsetail	d, j	spruce (predominately white) dominated riparian stands; floodplains and gullies; with horsetail and feathermoss	mesic to subhygric	c, k, w	4, 4a, 4b, 6, 7, 8
41		Balsam poplar - rose - horsetail	d, j	balsam poplar-dominated midbench floodplain; rose and horsetials common in the understory; located along the banks of rivers and larger creeks; rich nutrient regime	subhygric	c	4, 5, 6, 7

Ecosite	Veg assoc	Name	Assumed modifiers	Description and typical situation	Moisture regime	Mapped modifiers	Mapped structural stage
42		Alaska birch - alder - reedgrass	d, j	alaska birch-dominated riparian community; located along sideslope gullies and associated receiving areas; medium to rich nutrient regime	subhygric	k, w, q	4, 4a, 5, 6, 7
43		Tall shrub Balsam poplar - willow	d, j	balsam poplar and willow dominated low bench floodplain; located along the banks of the Yukon and Stewart Rivers; tall shrub structural stage	subhygric	c	4, 4a, 4b
F1		Spruce - willow - labrador tea - sedge	d, j	poor treed fen; open spruce canopy, spruce often stunted and in the shrub layer; located on level valley bottom terrain on fluvial parent materials; poor to medium nutrient regime; underlain by permafrost	subhydric	-	4, 4a, 4b, 5, 6, 7, 8
F2		Spruce - red bearberry - brownmoss	d, j	treed fen; open spruce canopy, spruce can be stunted; located on level valley bottom terrain on fluvial parent materials; medium nutrient regime; underlain by permafrost	subhydric	-	4, 4a, 6, 5, 8
F3		Birch - leatherleaf - sedge	d, j	shrubby birch dominated fen, with leathleaf, willows and labrador tea; level to depressionl sites; medium nutrient regime; underlain by permafrost	subhydric	-	4, 4a, 4b
S1		Willow - horsetail	d, j	willow-dominated shrubby riparian community; found along streams and sideslope creeks; medium to rich nutrient regime	hygric	k, w	4, 4a, 4b
S2		Willow - reedgrass	d, j	willow and reedgrass dominated swamp; level, typically surrounding marshes or ponds on old fluvial plains; medium to rich nutrient regime.	hygric - subhydric	-	4a, 4b
M1		Beaked sedge marsh	d, j	sedge-dominated marsh; fluctuating water table; rich nutrient regime	subhydric - hydric	-	3b
M2		Horsetail - sedge marsh	d, j	horsetail-dominated marsh; fluctuating water table; rich nutrient regime	subhydric - hydric	-	3a
M		Marsh	d, j	sedge and/or herb dominated marsh; fluctuating water table; rich nutrient regime (note: mapped when dominate marsh vegetation unknown)	subhydric - hydric	-	3
An		Anthropogenic	-	an area of athropogenic disturbance, including areas cleared for camps, homesteads and air-strips	-	-	1, 3, 4

Ecosite	Veg assoc	Name	Assumed modifiers	Description and typical situation	Moisture regime	Mapped modifiers	Mapped structural stage
Gb		Gravel bar	-	An elongated landform generated by waves and currents and usually running parallel to the shore. It is composed of unconsolidated small rounded cobbles, pebbles, stones and sand	-	-	1, 2
Mp		Placer mine	-	an area cleared and disturbed through placer mine activity, includes unvegetated areas and areas undergoing revegetation, primarly shrub-dominated	-	-	1, 2, 4
Pd		Pond	-	small body of water greater than 2 m deep, but not large enough to be classified as a lake	-	-	-
Rd		Road surface	-	an area cleared and compacted for the purpose of transporting goods and services by vehicles	-	-	1
Ri		River	-	watercourse formed when water flows between continuous, definable banks; the flow may be intermittent or perennial	-	-	-
Ro		Rock	-	gentle to steep, bedrock escarpment or outcropping, with little soil development and sparse vegetative cover	-	k, w, z	1, 2, 4, 7
Rt		Talus	-	active and inactive talus and scree; typically have a low herb layer cover because of mobile substrates or lack of soil.	-	k, q, z	1, 2

Mapped ecosites within the Subalpine and Alpine Bioclimate Zones

Ecosite	Name	Assumed modifiers	Description and typical situation	Moisture regime	Mapped modifiers	Mapped structural stage
10	Tors	c	protruding bedrock outcrops on mountain crests; vegetation growth is mainly restricted to fractures and crevices where soil has accumulated.	very xeric - xeric	-	1, 2
11	Felsenmeer	c	veneer of angular rock fragments/boulders fields over sloping ground, typically upper-slope to crest position; vegetative cover is typically <40% and includes dwarf shrubs, graminoids, mosses and lichens.	xeric - subxeric	k, q, w, z	2, 2a, 3, 3a
12	Scrub birch - mountain avens - lichen	j, s	plateaus and gentle crests at high elevations; vegetation community dominated by mountain avens, low-growing dwarf birch and lichens; poor to mediume nutrient regime	subxeric	k, w	3d, 4b, 2c
13	Scrub birch - crowberry - lowbush cranberry	k, s	moderatly sloping, northerly aspect, upper slope; low shrub and ground shrub dominated sites with exposed boulder channels; poor nutrient regime	subxeric - submesic	q, w	3d, 4b
14	Scrub birch - willow - mountain avens	j, s	low stature shrub-dominated sites with scrub birch, willows, labrador tea, and lowbush cranberry; commonly upper slope or crest; medium nutrient regime	subxeric - submesic	k, w, z	3d, 4b
01	Scrub birch - lowbush cranberry - feathermoss	d, j	shrub-dominated ecosystem with scrub birch, willows, labrador tea, lowbush cranberry, and bog blueberry; predominantly mid to upper slopes; typically poor to medium nutrient regime	submesic - mesic	k, q, s, w, z	4, 4b
31	Spruce - scrub birch - feathermoss	d, j	sparsely treed areas often near the boundary with the Boreal Bioclimate zone; conifers with ≤15% cover, high shrub cover; predominantly upper and mid slopes; medium nutrient regime	mesic	k, s, w, z	4, 4a, 4b, 5, 6, 7, 8

Ecosite	Name	Assumed modifiers	Description and typical situation	Moisture regime	Mapped modifiers	Mapped structural stage
30	Scrub birch - sedge - feathermoss	d, j	mid to lower slopes; predominantly cool and neutral aspects; scrub birch, willows, Labrador tea, sedge and feathermoss common; permafrost and seepage typically present; poor to medium nutrient regime	subhygric	k, w	4, 4b
32	Black spruce - Labrador tea - lowush cranberry - sedge	d, k	stunted black spruce (black spruce in shrub structural stage) and shrub dominated; predominantly on cool, moderate mid to lower slopes; permafrost and seepage present; poor nutrient regime	subhygric - hygric	w	4, 4a, 4b, 7
40	Willow - horsetail - peatmoss	d, j	willow-dominated riparian sites; located along sideslope creeks and drainage channels; shrub layer predominately medium stature; medium to rich nutrient regime	hygric - subhydric	k, w	4, 4a, 4b
An	Anthropogenic	-	areas of athropogenic disturbance, including areas cleared for camps, homesteads and air-strips	-	-	1
Rd	Road surface	-	an area cleared and compacted for the purpose of transporting goods and services by vehicles	-	-	1
Ro	Rock	-	gentle to steep, bedrock escarpment or outcropping, with little soil development and sparse vegetative cover	-	k, w	2

Broad Ecosystem Mapping (BEM):

ELC Ecosite descriptions and corresponding Broad Ecosystem Mapping (BEM) categories

Ecosite code	Veg assoc	Ecosite Name	Ecosite Description and typical situation	BEM code	BEM Category	BEM Canopy modifier
Boreal Bioclimate Zones						
20	**Capu**	Purple reedgrass - lichen	forb and graminoid dominated grassland; moderate to steep, south-facing slopes; medium to rich nutrient regime	**Gg**	Grassland	-
20	**Aruv**	Kinnikinnick	ground shrub dominated 'grassland'; moderate to steep, south-facing slopes; tree cover <10%; medium to rich nutrient regime	**Gg**	Grassland	-
21		Aspen - kinnikinnick- purple reedgrass	dry aspen-dominated forest; mid to upper slope position, predominently southerly aspect; commonly medium nutrient regime	**UpF**	Upland / Closed Canopy Forest	Deciduous
01	**A**	Aspen - soapberry - purple reedgrass	mesic aspen-dominated forest; lower to upper slopes across a range of aspects; low elevations only; medium regime regime	**UpF**	Upland / Closed Canopy Forest	Deciduous
01	**W**	Alaska birch - Labrador tea - tall bluebells - step moss	mesic alaska birch-dominated forest; lower to upper slopes across a range of aspects; medium nutrient regime	**UpF**	Upland / Closed Canopy Forest	Deciduous
01	**WSw**	Alaska birch - white spruce - Labrador tea - lowbush cranberry - feathermoss	mesic mixedwood forest; lower to upper slopes across a range of aspects; medium in nutrient regime	**UpF**	Upland / Closed Canopy Forest	Mixedwood
01	**Sw**	White spruce - rose - bastard toadflax - feathermoss	mesic white spruce-dominated forest; lower to upper slopes across a range of aspects; low elevations only; medium regime regime	**UpF**	Upland / Closed Canopy Forest	Coniferous
01	**Sw(Sb)**	Spruce - Labrador tea - lowbush cranberry - feathermoss	mesic coniferous forest, spruce (primarily white) dominated; lower to upper slopes across a range of aspects; medium nutrient regime	**UpF**	Upland / Closed Canopy Forest	Coniferous
01		Spruce - feathermoss (Fire)	mesic forest; lower to upper slopes across a range of aspects; low elevations only; medium regime regime. (note: mapped in burned areas that are currently dominated by shrub, for which a canopy association cannot be determined)	**UpF**	Upland / Closed Canopy Forest	-

Ecosite code	Veg assoc	Ecosite Name	Ecosite Description and typical situation	BEM code	BEM Category	BEM Canopy modifier
30		Black spruce - Labrador tea - reindeer lichen	black spruce-dominated forest; predominately on northerly lower to upper slopes; high lichen cover; poor nutrient regime.	**UpF**	Upland / Closed Canopy Forest	Coniferous
31		Spruce - birch - lowbush cranberry - feathermoss	sparse coniferous forest near Subalpine Bioclimate boundary, spruce-dominated; high shrub cover; predominantly upper slope with variable aspect; medium nutrient regime	**Fcs**	High Elevation Sparse Coniferous Forest	Coniferous
32	**Sb1**	Black spruce - scrub birch - labrador tea - cloudberry	moderate-to-steep northerly slopes underlain by permafrost; lower-to-mid slope; stunted black spruce canopy with scrub birch, Labrador tea and cloudberry in the understory; poor nutrient regime	**Stcs**	Stunted Coniferous Forest	Coniferous
32	**Sb2**	Black spruce - ladrador tea - cottongrass	moderate-to-steep northerly slopes underlain by permafrost; lower-to-mid slope; stunted black spruce canopy with Labrador tea, and cottongrass in the understory; poor nutrient regime	**Stcs**	Stunted Coniferous Forest	Coniferous
32		Black spruce - Labradror tea - cloudberry - sedge	moderate-to-steep northerly slopes underlain by permafrost; lower-to-mid slope; stunted black spruce canopy with Labrador tea and lowbush cranberry in the understory; poor nutrient regime (note: mapped in areas where vegetation association for ecosite is unknown)	**Stcs**	Stunted Coniferous Forest	Coniferous
33		Black spruce - Labrador tea - sedge - brownmoss - reindeer lichen	gentle-to-moderate, lower and toe slopes underlain by permafrost; black spruce dominated, spruce typically stunted; poor to medium nutrient regime	**Stcs**	Stunted Coniferous Forest	Coniferous
40		White spruce - horsetail	spruce (predominately white) dominated riparian stands; floodplains and gullies; with horsetail and feathermoss	**RF**	Riparian Forest	Coniferous, Mixedwood
41		Balsam poplar - rose - horsetail	balsam poplar-dominated midbench floodplain; rose and horsetials common in the understory; located along the banks of rivers and larger creeks; rich nutrient regime	**RF**	Riparian Forest	Deciduous, Mixedwood
42		Alaska birch - alder - reedgrass	alaska birch-dominated riparian community; located along sideslope gullies and associated receiving areas; medium to rich nutrient regime	**RF**	Riparian Forest	Deciduous

Ecosite code	Veg assoc	Ecosite Name	Ecosite Description and typical situation	BEM code	BEM Category	BEM Canopy modifier
43		Tall shrub Balsam poplar - willow	balsam poplar and willow dominated low bench floodplain; located along the banks of the Yukon and Stewart Rivers; tall shrub structural stage	**LSr**	Low Elevation Shrubby Riparian	-
F1		Spruce - willow - labrador tea - sedge	poor treed fen; open spruce canopy, spruce often stunted and in the shrub layer; located on level valley bottom terrain on fluvial parent materials; poor to medium nutrient regime; underlain by permafrost	**F**	Fen	Coniferous
F2		Spruce - red bearberry - brownmoss	treed fen; open spruce canopy, spruce can be stunted; located on level valley bottom terrain on fluvial parent materials; medium nutrient regime; underlain by permafrost	**F**	Fen	Coniferous
F3		Birch - leatherleaf - sedge	shrubby birch dominated fen, with leathleaf, willows and labrador tea; level to depressionl sites; medium nutrient regime; underlain by permafrost	**F**	Fen	-
S1		Willow - horsetail	willow-dominated shrubby riparian community; found along streams and sideslope creeks; medium to rich nutrient regime	**LSr**	Low Elevation Shrubby Riparian	-
S2		Willow - reedgrass	willow and reedgrass dominated swamp; level, typically surrounding marshes or ponds on old fluvial plains; medium to rich nutrient regime.	**S**	Swamp	-
M1		Beaked sedge marsh	sedge-dominated marsh; fluctuating water table; rich nutrient regime	**M**	Marsh	-
M2		Horsetail - sedge marsh	horsetail-dominated marsh; fluctuating water table; rich nutrient regime	**M**	Marsh	-
Subalpine and Alpine Bioclimate Zones						
10		Tors	protruding bedrock outcrops on mountain crests; vegetation growth is mainly restricted to fractures and crevices where soil has accumulated.	**-**	-	-
11		Felsenmeer	veneer of angular rock fragments/boulders fields over sloping ground, typically upper-slope to crest position; vegetative cover is typically <40% and includes dwarf shrubs, graminoids, mosses and lichens.	**Fe**	Felsenmeer	-

Ecosite code	Veg assoc	Ecosite Name	Ecosite Description and typical situation	BEM code	BEM Category	BEM Canopy modifier
12		Scrub birch - mountain avens - lichen	plateaus and gentle crests at high elevations; vegetation community dominated by mountain avens, low-growing dwarf birch and lichens; poor to mediume nutrient regime	**Ss**	Subalpine / Alpine Shrub	-
13		Scrub birch - crowberry - lowbush cranberry	moderatly sloping, northerly aspect, upper slope; low shrub and ground shrub dominated sites with exposed boulder channels; poor nutrient regime	**Ss**	Subalpine / Alpine Shrub	-
14		Scrub birch - willow - mountain avens	low stature shrub-dominated sites with scrub birch, willows, labrador tea, and lowbush cranberry; commonly upper slope or crest; medium nutrient regime	**Ss**	Subalpine / Alpine Shrub	-
01		Scrub birch - lowbush cranberry - feathermoss	shrub-dominated ecosystem with scrub birch, willows, labrador tea, lowbush cranberry, and bog blueberry; predominantly mid to upper slopes; typically poor to medium nutrient regime	**Ss**	Subalpine / Alpine Shrub	-
31		Spruce - scrub birch - feathermoss	sparsely treed areas often near the boundary with the Boreal Bioclimate zone; conifers with ≤15% cover, high shrub cover; predominantly upper and mid slopes; medium nutrient regime	**Fcs**	High Elevation Sparse Coniferous Forest	Coniferous
30		Scrub birch - sedge - feathermoss	mid to lower slopes; predominantly cool and neutral aspects; scrub birch, willows, Labrador tea, sedge and feathermoss common; permafrost and seepage typically present; poor to medium nutrient regime	**Ss**	Subalpine / Alpine Shrub	-
32		Black spruce - Labrador tea - lowush cranberry - sedge	stunted black spruce (black spruce in shrub structural stage) and shrub dominated; predominantly on cool, moderate mid to lower slopes; permafrost and seepage present; poor nutrient regime	**Stcs**	Stunted Coniferous Forest	Coniferous
40		Willow - horsetail - peatmoss	willow-dominated riparian sites; located along sideslope creeks and drainage channels; shrub layer predominately medium stature; medium to rich nutrient regime	**HSr**	High Elevation Shrubby Riparian	-

Field Data Collection:

The information collected at each plot type is listed below:

Full Plots

- Project ID, plot number, Polygon number, date, surveyors, UTM, GPS Accuracy
- Plot Representing – short description
- Ecosite/phase, Soil moisture and nutrient regime, Elevation, Slope, Aspect, Surface Shape, Mesoslope Position, Microtopography type and intensity, Exposure Type, Site Disturbance, Structural Stage, Flood regime
- Soils information, including soil drainage, soil texture and coarse fragment percentage, soil horizon information, root-restricting layers, rooting depth and humus form type.
- Vegetation information: the majority of species, **%** cover by species.
- Tree mensuration: trees measured from one quarter of the plot - describe species, diameter at breast height (DBH), approximate height and relevant tree health information. At least one age at DBH was determined.
- Site Diagram
- Photos – minimum of N, E, S, W, ground, and a soil pit photo

Ground Inspections

- Project ID, plot number, plot type, date, surveyors, UTM, GPS Accuracy
- Plot Representing – short description
- Ecosite/phase, Soil moisture and nutrient regime, Elevation, Slope, Aspect, Surface Shape, Mesoslope Position, Exposure Type, Site Disturbance, Structural Stage
- Soils information: drainage, soil texture and coarse fragment percentage, root-restricting layers, rooting depth, and humus form type.
- Vegetation: indicator species and everything over 1% cover, % cover by species and by layer (tree, shrub, herb and moss/lichen).
- Site Diagram if appropriate
- Photos – N, E, S, W, ground, and a soil photo

Visual Inspections

- Project ID, plot number, date, surveyors, UTM, GPS Accuracy
- Photos – N, E, S, W, ground
- Biogeoclimatic zone, Structural Stage, Soil Moisture Regime, Soil Nutrient Regime, Elevation, Slope, Aspect, Mesoslope Position, Canopy Composition, Structural Stage
- Minimal soils information: drainage, humus form, soil texture.
- Vegetation: top 10 species across the layers, % cover by species and by layer (tree, shrub, herb and moss/lichen).

APPENDIX C. COFFEE PROJECT ECOSYSTEM FACTSHEETS

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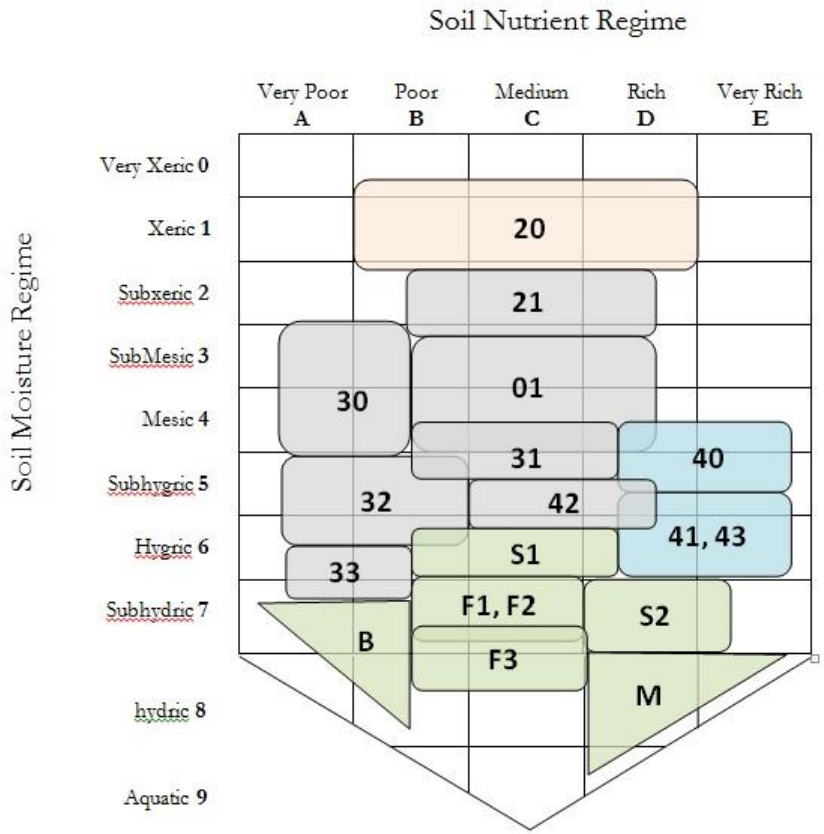
Ecosite Factsheet Overview

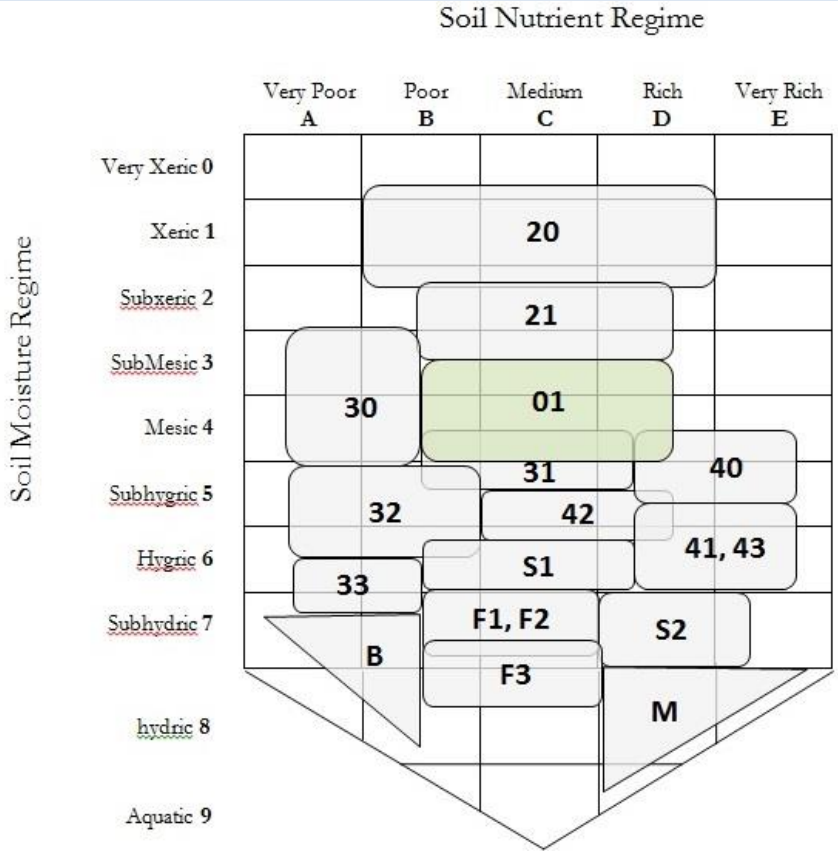
The ecosite and vegetation association names and codes are displayed at the top of each factsheet page. An edatopic grid is used to graphically depict the range of moisture and nutrient regimes typical of each ecosite (including associated vegetation associations). A description of the ecosite and the number of plots used to define the ecosite are listed below the edatopic grid. On the second page of each factsheet, the mean percent cover of plant species characteristic of the ecosite phase are presented for each layer (tree, shrub, herb and moss/lichen). Characteristic plant species are those that were either present in a minimum of 60% of the sample plots (Jennings *et al.* 2004) or had a prominence value of 20 or greater (prominence value $=\sqrt{\%\ frequncy\ x\ \%\ cover}$; Beckingham and Archibald 1996). Site and soil characteristics of the ecosite, including moisture regime, topographic position and rooting zone soil texture, are also presented. The superscript numbers attached to specific site and soil characteristics indicate the number of plots identified to have that characteristic. The presence or absence of permafrost in an ecosite refers to near-surface permafrost (within 75 cm of the ground surface). The entire survey extent occurred in the Extensive Discontinous Permafrost zone (which ranges between 50–90% permafrost presence; Burn 2004). Near-surface permafrost is common on north-facing slopes, toe-slopes and wet, poorly-drained valley bottoms throughout the Project area.

Boreal Bioclimate Zones



20-Capu Purple reedgrass – Lichen
20-Aruv Kinnikinnick
21 Aspen – Kinnikinnick – Purple reedgrass
01-A Aspen – soapberry – Purple reedgrass
01-W Alaska birch – Labrador – Tall bluebells – Step moss
01-WSw Alaska birch – White spruce – Labrador tea – Lowbush cranberry - Feathermoss
01-Sw White spruce – Rose – Bastard toadflax
01-Sw(Sb) Spruce – Labrador tea – Lowbush cranberry – Feathermoss
30 Black spruce – Labrador tea – Reindeer lichen
31 Spruce – Labrador tea – Lowbush cranberry – Feathermoss
32-Sb1 Black spruce – Scrub birch – Labrador tea – Cloudberry
32-Sb2 Black spruce – Labrador tea – Cottongrass
33 Blacks spruce – Labrador tea – sedge – brownmoss – Lichen
40 White spruce – Horsetail
41 Balsam poplar – Rose – Horsetail
42 Alaska birch – Alder – Reedgrass
43 Tall shrub Balsam poplar – Willow
F1 Spruce – Willow – Labrador tea – Sedge
F2 Spruce – Red bearberry – Brown moss
F3 Birch – Leatherleaf – Sedge
S1 Willow – Horsetail
S2 Willow – Reedgrass
M1 Beaked sedge
M2 Horsetail – Sedge

Aspen – Soapberry – Purple reedgrass (01-A)



Ecosite Association Description

The Aspen – Soapberry – Purple reedgrass association occurs on gentle-to-steep, middle-to-lower slopes, primarily in the Boreal Low Bioclimate zone. In the survey extent, this association was only found at low elevations along the proposed access road. The deciduous canopy is typically dominated by trembling aspen (*Populus tremuloides*); however a minor component of white spruce (*Picea glauca*) and balsam poplar (*Populus balsamifera*) can occur. The shrub layer is dominated by soapberry (*Shepherdia canadensis*) and prickly rose (*Rosa acicularis*), but a low ground shrub cover (*Linnaea borealis, Vaccinium vitis-idaea,* and *Arctostaphylos uva-ursi*) is also commonly present. The herb layer is dominated by a low cover of purple reedgrass (*Calamagrostis purpurascens*), with tall bluebells (*Mertensia paniculata*), and fireweed (*Chamerion angustifolium*) typically present in lesser amounts. The moss and lichen cover is sparse or absent.

The soil moisture regime of the Aspen – Soapberry – Purple reedgrass association ranges from submesic-to-mesic with a medium nutrient regime. Soils are well drained and parent material is typically colluvial.

Sample Plots: 3

Full	[0]
Ground	[2]
Visual	[1]





Characteristic Vegetation

Tree Layer:

[30] Trembling aspen (*Populus tremuloides*)

[6] White spruce (*Picea glauca*)

[4] Balsam poplar (*Populus balsamifera*)

Shrub Layer:

[6] Soapberry (*Shepherdia canadensis*)

[6] Prickly rose (*Rosa acicularis*)

[4] Trembling aspen (*Populus tremuloides*)

[3] Lowbush cranberry (*Vaccinium vitis-idaea*)

[3] Willow (*Salix* spp.)

[3] Twinflower (*Linnaea borealis*)

[2] Kinnikinnick (*Arctostaphylos uva-ursi*)

[2] White spruce (*Picea glauca*)

Herb Layer:

[7] Purple reedgrass (*Calamagrostis purpurascens*)

[2] Tall bluebells (*Mertensia paniculata*)

[2] Fireweed (*Chamerion angustifolium*)

[1] One-sided wintergreen (*Orthilia secunda*)

Moss/Lichen Layer:

[2] Step moss (*Hylocomium splendens*)

Site Characteristics

Moisture Regime: submesic[2], mesic[1]

Nutrient Regime: medium[3]

Slope Gradient: 10-50 %

Aspect: easterly[1], south-westerly[1], south-easterly[1]

Slope Position: midslope[3]

Soil Characteristics

Organic Thickness: 5-7 cm

Humus Form: moder[2], mor[1]

Drainage: well[3]

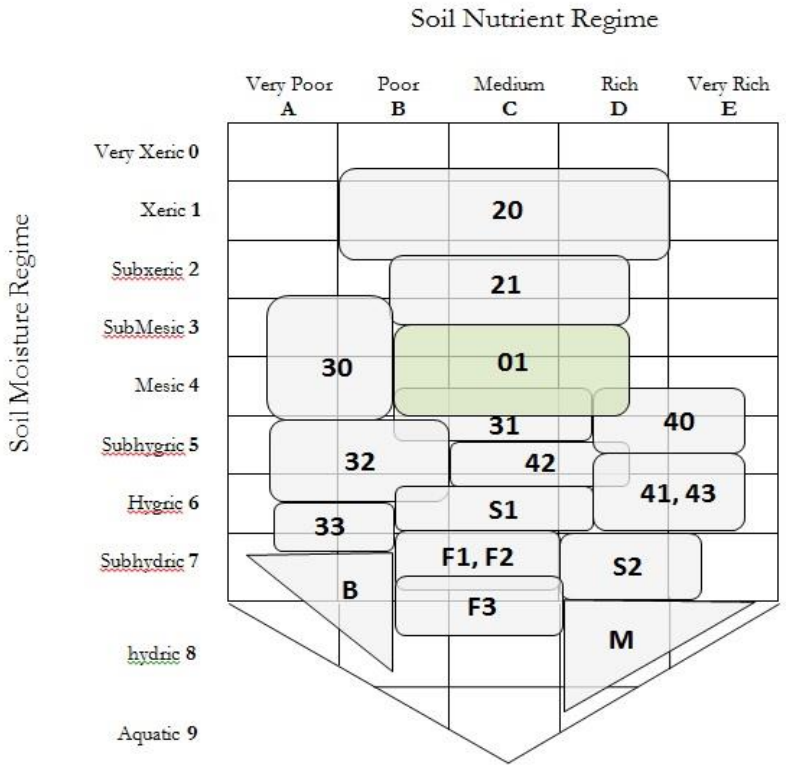
Seepage Water: absent

Permafrost: absent

Parent Material: C, D, F

Soil Texture: SiL[2], SiCL[1]

Alaska birch – Labrador tea – Tall bluebells – Step moss (01-W)



Ecosite Association Description

The Alaska birch – Labrador tea –Tall bluebells – Step moss association occurs on gentle-to-steep (predominantly moderate), middle-to-upper slopes, ranging in elevation from 450-1050 m. This association occurs across all aspects; however neutral aspects are common. The deciduous dominated canopy is typically dominated by Alaska birch (*Betula neoalaskana*). The shrub layer is often dominated by Labrador tea (*Rhododendron groenlandicum*) and lowbush cranberry (*Vaccinium vitis-idaea*), but prickly rose (*Rosa acicularis*) and green alder (*Alnus viridis*) are also commonly present. The herb layer is dominated by bluejoint reedgrass (*Calamagrostis canadensis*), tall bluebells (*Mertensia paniculata*), fireweed (*Chamerion angustifolium*) and clubmosses (*Lycopodium annotinum* and *Diphasiastrum complanatum*). Step moss dominates the moss layer, which is variable in extent due largely to the cover of deciduous leaf litter. Lichen cover is sparse or absent.

The soil moisture regime of the Alaska birch – Labrador tea –Tall bluebells – Step moss association ranges from submesic-to-mesic with a poor-to-medium nutrient regime. The dominant rooting zone texture is silty loam commonly overlaying colluvial parent material. Permafrost is absent in this ecosite and soils are well-drained.

Sample Plots: 20

Full	[1]
Ground	[8]
Visual	[11]





Characteristic Vegetation

Tree Layer:

[42] Alaska birch (*Betula neoalaskana*)

[4] White spruce (*Picea glauca*)

Shrub Layer:

[16] Labrador tea (*Rhododendron groenlandicum*)

[15] Lowbush cranberry (*Vaccinium vitis-idaea*)

[6] Willows (*Salix* spp.)

[6] Green alder (*Alnus viridis*)*

[5] Prickly rose (*Rosa acicularis*)

Herb Layer:

[6] Bluejoint reedgrass (*Calamagrostis canadensis*)

[3] Tall bluebells (*Mertensia paniculata*)

[2] Clubmoss (*Lycopodium annotinum*, *Diphasiastrum complanatum*)

[1] Fireweed (*Chamerion angustifolium*)

Moss/Lichen Layer:

[30] Step moss (*Hylocomium splendens*)

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Site Characteristics

Moisture Regime: mesic[13], submesic[7]

Nutrient Regime: medium[17], poor[3]

Slope Gradient: 8-60 %, generally >20 %

Aspect: easterly[12], westerly[4], southerly[3], northerly[1]

Slope Position: midslope[16], upper slope[3]

Soil Characteristics

Organic Thickness: 4-15 cm

Humus Form: mor[19], moder[1]

Drainage: well[20]

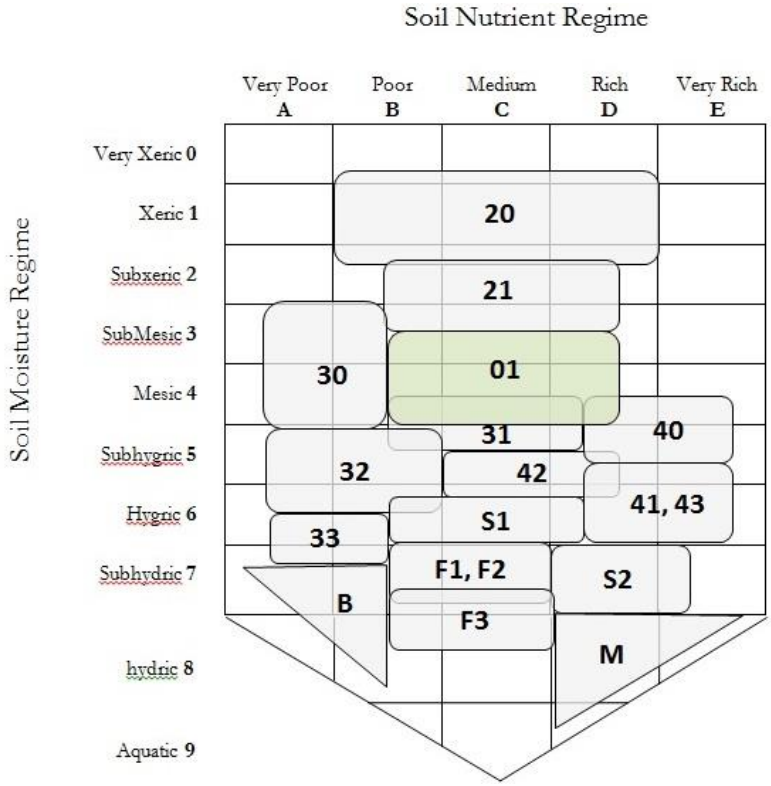
Seepage Water: absent

Permafrost: absent

Parent Material: C, D

Soil Texture: SiL[13], SL[2], L[4], LS[1]

Alaska birch–White spruce–Labrador tea–Lowbush cranberry–Feathermoss (01-Wsw)



Ecosite Association Description

The Alaska birch – White spruce – Labrador tea – Lowbush cranberry – Feathermoss association occurs on gentle-to-moderate, predominantly middle slopes; however it does occur across a range of slope positions. The association occurs on slopes across a range of aspects and ranges in elevation from approximately 400 to 1100 m. The canopy is co-dominated by white spruce (*Picea glauca*) and Alaska birch (*Betula neoalaskana*); however in some areas black spruce (*Picea mariana*) forms a minor component. The shrub layer is dominated by Labrador tea (*Rhododendron groenlandicum*), lowbush cranberry (*Vaccinium vitis-idaea*) and green alder (*Alnus viridis*), with a lesser component of willows (including *Salix alaxensis, S. glauca*, *S. planifolia* and *S. scouleriana*) and prickly rose (*Rosa acicularis*). The herb layer is variable and is typically sparse, with tall bluebells (*Mertensia paniculata*), bastard toadflax (*Geocaulon lividum*) and bluejoint reedgrass (*Calamagrostis canadensis*) most commonly present. The cover of the moss and lichen layer is variable and is dominated by feathermosses (*Hylocomium splendens* and *Pleurozium schreberi*), with a minor lichen component.

The soil moisture regime of the association ranges from submesic-to-subhygric (predominantly mesic), with typically a poor-to-medium nutrient regime. The dominant rooting zone textures are silty loam, loam and sandy loam overlaying predominantly colluvial parent material. Permafrost is absent in this ecosite and soils are well drained.

Sample Plots: 28

Full	[1]
Ground	[16]
Visual	[11]





Characteristic Vegetation

Tree Layer:

[23] Alaska Birch (*Betula neoalaskana*)

[15] White spruce (*Picea glauca*)

Shrub Layer:

[18] Labrador tea (*Rhododendron groenlandicum*)

[14] Lowbush cranberry (*Vaccinium vitis-idaea*)

[8] Green alder (*Alnus viridis*)

[4] Willows (*Salix* spp.)

[4] Alaska Birch (*Betula neoalaskana*)

[3] Prickly rose (*Rosa acicularis*)

Herb Layer:

[4] Bastard toadflax (*Geocaulon lividum*)

[2] Tall bluebells (*Mertensia paniculata*)

[2] Bluejoint reedgrass (*Calamagrostis canadensis*)*

Moss/Lichen Layer:

[48] Step moss (*Hylocomium splendens*)

[20] Red-stemmed feathermoss (*Pleurozium schreberi*)*

[5] Reindeer lichens (*Cladina* spp.)

[2] Pelt lichens (*Peltigera* spp.)

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Site Characteristics

Moisture Regime: mesic[20], submesic[7], subhygric[1]

Nutrient Regime: medium[16], poor[12]

Slope Gradient: 0-60 %, generally >12%

Aspect: variable

Slope Position: midslope[22], upper slope[1], lower slope[2], toe[1], level[1], crest[1]

Soil Characteristics

Organic Thickness: 8-30 cm

Humus Form: mor[23], moder[5]

Drainage: well[26], rapidly[1]

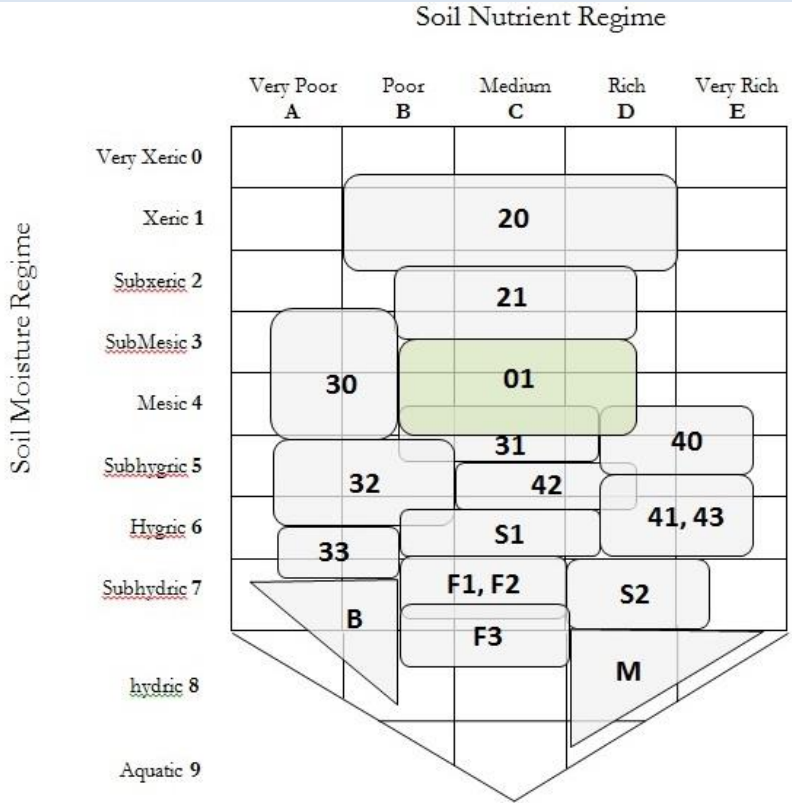
Seepage Water: absent

Permafrost: absent

Parent Material: C, D

Soil Texture: SiL[16], SL[7], L[4], FSL[2]

White spruce – Rose – Bastard toadflax – Feathermoss (01-Sw)



Ecosite Association Description

The White spruce – Rose – Bastard toadflax – Feathermoss association occurs on gentle-to-moderate, predominately middle-to-toe slopes. The association is occurs primarily in the Boreal Low Bioclimate zone on level areas or slopes with warm or neutral aspects below approximately 550 m in elevation. The canopy is dominated by white spruce (*Picea glauca*), which also typically forms a low to moderate shrub cover. The shrub layer typically consists of prickly rose (*Rosa acicularis*), willows (including *S. planifolia* and *S. scouleriana*) and lowbush cranberry (*Vaccinium vitis-idaea*), with lesser components of soapberry (*Shepherdia canadensis*) and twinflower (*Linnaea borealis*). The herb layer is variable, sparse and typically contains bastard toadflax (*Geocaulon lividum*) and tall bluebells (*Mertensia paniculata*). The moss and lichen layer is dominated by feathermosses, predominantly step moss (*Hylocomium splendens*), but also typically contains a low cover of freckle pelt (*Peltigera aphthosa*).

The soil moisture regime of the White spruce – Rose – Bastard toadflax – Feathermoss association ranges from submesic-to-mesic and the soil nutrient regime ranges from poor-to-medium. The rooting zone soil texture is variable but sandy and silt loams are common. The association lacks permafrost and is predominantly well-drained.

Sample Plots: 8

Full	[0]
Ground	[3]
Visual	[5]





Characteristic Vegetation

Tree Layer:

[32] White spruce (*Picea glauca*)

[5] Trembling aspen (*Populus tremuloides*)*

Shrub Layer:

[8] White spruce (*Picea glauca*)

[4] Willows (*Salix* spp.)

[3] Prickly rose (*Rosa acicularis*)

[3] Lowbush cranberry (*Vaccinium vitis-idaea*)

[1] Twinflower (*Linnaea borealis*)

[1] Soapberry (*Shepherdia canadensis*)

Herb Layer:

[3] Bastard toadflax (*Geocaulon lividum*)

[1] Tall bluebells (*Mertensia paniculata*)

Moss/Lichen Layer:

[60] Step moss (*Hylocomium splendens*)

[8] Red-stemmed feathermoss (*Pleurozium schreberi*)*

[2] Freckle pelt (*Peltigera aphthosa*)

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Site Characteristics

Moisture Regime: mesic[7], submesic[1]

Nutrient Regime: medium[4], poor[4]

Slope Gradient: 0-65 %, generally <20%

Aspect: southerly[2], easterly[2], westerly[1]

Slope Position: level[3], midslope[2], lower slope[2], toe[1]

Soil Characteristics

Organic Thickness: 8-15 cm

Humus Form: mor[5], moder[3]

Drainage: well[6], moderately well[2]

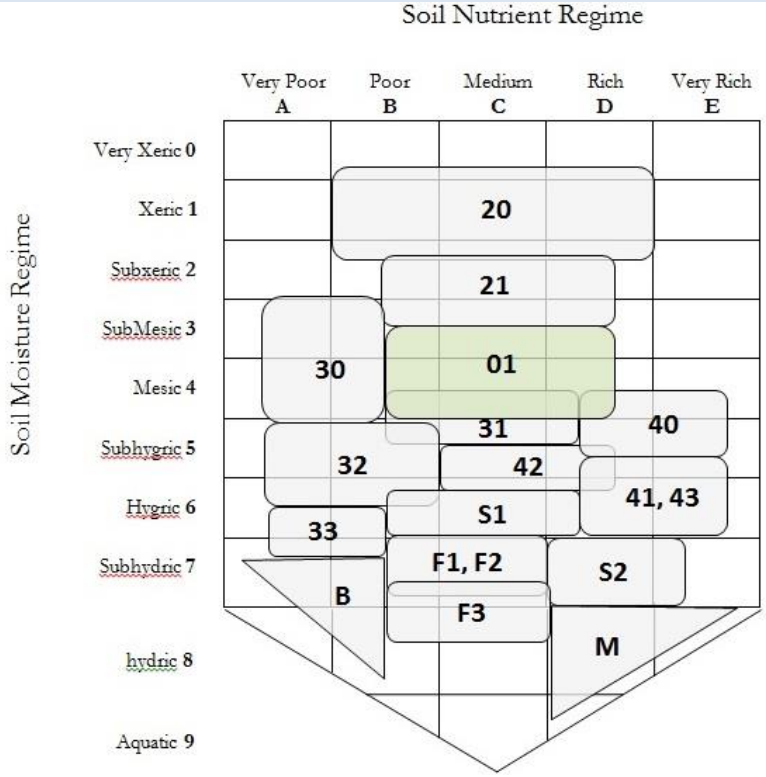
Seepage Water: absent

Permafrost: absent

Parent Material: C, D, F

Soil Texture: SiL[3], LS[2], FSL[1], SL[1], SiCL[1]

Spruce – Labrador tea – Lowbush cranberry – Feathermoss (01-Sw(Sb))



Ecosite Association Description

The Spruce – Labrador tea – Lowbush cranberry – Feathermoss association occurs on gentle-to-moderate, predominately middle-to-upper slopes; however slope position is variable. The association occurs primarily on slopes with warm or neutral aspects and ranges in elevation from approximately 450 to 1100 m. The canopy is typically dominated by white spruce (*Picea glauca*); however white and black spruce (*Picea mariana*) co-dominated canopies also occur. A minor Alaska birch (*Betula neoalaskana*) component in both the canopy and tree regeneration layer is common. The shrub layer is dominated by Labrador tea (*Rhododendron groenlandicum*), lowbush cranberry (*Vaccinium vitis-idaea*) and willows (including *Salix alaxensis, S. glauca*, *S. planifolia, S. reticulata* and *S. scouleriana*), with lesser components of crowberry (*Empetrum nigrum*) and bog blueberry (*Vaccinium uliginosum*). The herb layer is variable, sparse and typically contains tall bluebells (*Mertensia paniculata*) and bastard toadflax (*Geocaulon lividum*). The moss and lichen layer is dominated by step moss (*Hylocomium splendens*) and red-stemmed feathermoss (*Pleurozium schreberi*) with a lesser reindeer lichen (*Cladina mitis* and *C. rangiferina*) and pelt lichen (*Peltigera* spp.) component.

The soil moisture regime of the association ranges from submesic-to-subhygric and the soil nutrient regime ranges from poor-to-rich. The dominant rooting zone textures are sandy loam and silt loam, overlaying predominantly colluvial parent material. The association typically lacks permafrost and is predominantly well drained.

Sample Plots: 12

Full	[1]
Ground	[7]
Visual	[5]





Characteristic Vegetation

Tree Layer:

[25] White spruce (*Picea glauca*)

[5] Alaska birch (*Betula neoalaskana*)*

Shrub Layer:

[14] Labrador tea (*Rhododendron groenlandicum*)

[12] Lowbush cranberry (*Vaccinium vitis-idaea*)

[6] Willows (*Salix* spp.)

[5] Bog blueberry (*Vaccinium uliginosum*)

[4] Crowberry (*Empetrum nigrum*)

Herb Layer:

[2] Tall bluebells (*Mertensia paniculata*)

[2] Bastard toadflax (*Geocaulon lividum*)

Moss/Lichen Layer:

[56] Step moss (*Hylocomium splendens*)

[15] Red-stemmed feathermoss (*Pleurozium schreberi*)*

[6] Reindeer lichens (*Cladina* spp.)

[2] Pelt lichens (*Peltigera* spp.)

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Site Characteristics

Moisture Regime: mesic[6], submesic[3], subhygric[3]

Nutrient Regime: medium[9], rich[2], poor[1]

Slope Gradient: 2-50 %

Aspect: southerly[7], easterly[4], westerly[1]

Slope Position: midslope[6], upper slope[3], lower[1], toe[1], level[1]

Soil Characteristics

Organic Thickness: 3-30 cm

Humus Form: mor[7], moder[5]

Drainage: well[10], moderately[1]

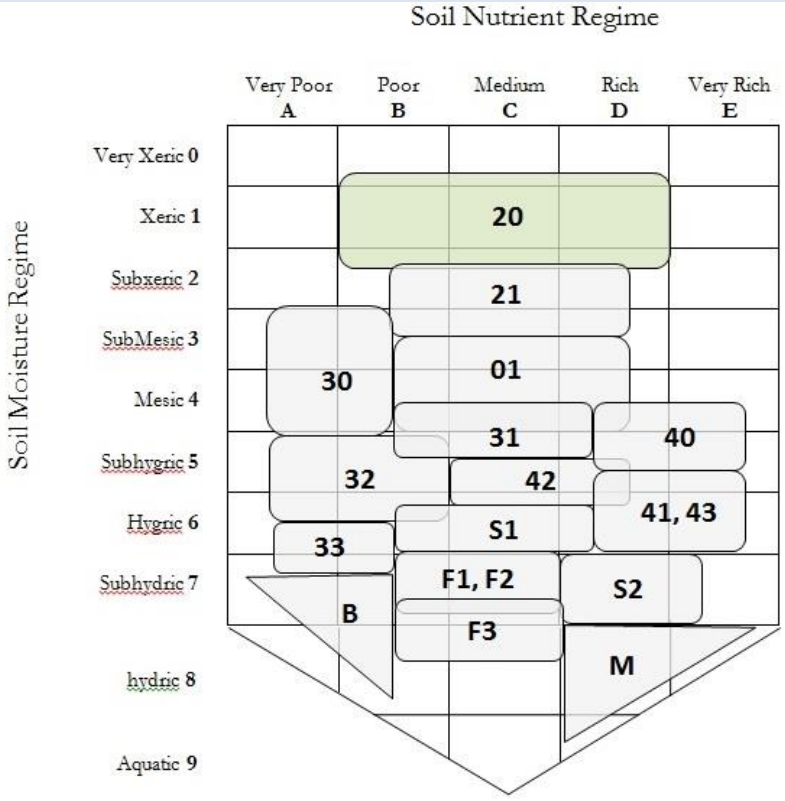
Seepage Water: absent

Permafrost: absent

Parent Material: C, D

Soil Texture: SiL[7], L[2], SL[1], FSL[1], SiCL[1]

Kinnikinnick (20-Aruv)



Ecosite Association Description

The Kinnikinnick association occurs on moderate-to-steep, primarily south-facing slopes at low to middle elevations (400-800 m). Within the ELC survey extent, this association has limited extent and is found on warm sideslopes near the Yukon and Stewart Rivers, Maisy May Creek and Barker Creek. Due to the topography, the dominant vegetation species found in this association are resilient to dry conditions and eroding soils. A high ground shrub cover of kinnikinnick (*Arctostaphylos uva-ursi*) is characteristic of this association. Other shrub species typically present in low cover are prickly rose (*Rosa acicularis*) and soapberry (*Shepherdia canadensis*). Trembling aspen (*Populus tremuloides*) is often present in the shrub layer as a regenerating tree species, but the cover is sporadic and commonly low. The herb, moss and lichen layers are sparse but can include purple reedgass (*Calamagrostis purpurascens*), northern bedstraw (*Galium boreale*), spikelike goldenrod (*Solidago simplex*) and *Cladonia* spp. This association is often closely associated with the Aspen – Kinnikinnick – Purple reedgrass ecosite.

The soil moisture regime of the Kinnikinnick ecosite is xeric to subxeric and the soil nutrient regime is typically medium. Rapidly drained, sandy soils typically overlay colluvial parent material. This association may be found on slightly cooler aspects or on site better protected from winter snow cover than other grassland associations.

Sample Plots: 4

Full	[0]
Ground	[1]
Visual	[0]





Characteristic Vegetation

Shrub Layer:

[65] Kinnikinnick (*Arctostaphylos uva-ursi*)

[8] Trembling aspen (*Populus tremuloides*)

[5] Rose (*Rosa acicularis, R. woodsii*)

[2] Soapberry (*Shepherdia canadensis*)

Herb Layer:

[5] Purple reedgrass (*Calamagrostis purpurascens*)

[1] Northern bedstraw (*Galium boreale*)

[1] Tall larkspur (*Aconitum delpiniifolium*)

[.5] Spikelike goldenrod (*Solidago simplex*)

Moss/Lichen Layer:

[2] Cladonia lichens (*Cladonia* spp.)

Site Characteristics

Moisture Regime: subxeric[1]

Nutrient Regime: medium[1]

Slope Gradient: 30-75%

Aspect: southerly[1]

Slope Position: midslope[1] to upper slope

Exposure: insolation

Soil Characteristics

Organic Thickness: 1 – 5 cm

Humus Form: mull[1]

Drainage: rapidly[1]

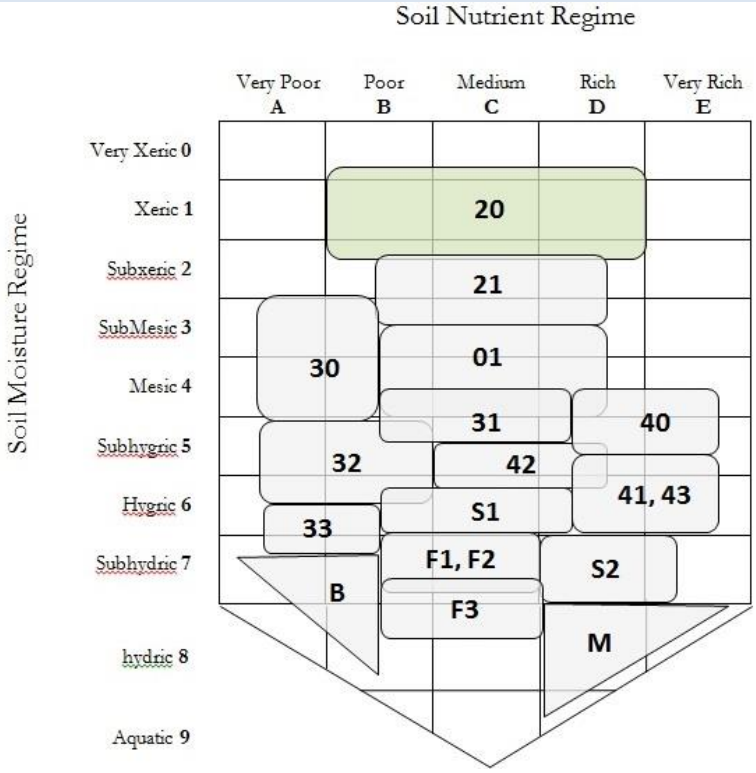
Seepage Water: absent

Permafrost: absent

Parent Material: C

Soil Texture: SL[1]

Purple reedgrass – Lichen (20-Capu)



Ecosite Description

The Purple reedgrass – Lichen ecosite occurs on moderate-to-steep, south-facing slopes at low to middle elevations (400-800 m). Within the survey extent, the ecosite is found along the steep, warm slopes above Coffee Creek, near the Yukon River, and near the Maisy May Creek and Stewart River junction. Due to the topography, the dominant vegetation species found in this ecosite are resilient to dry conditions and eroding soils. The sparse to moderate shrub layer is dominated by rose (*Rosa acicularis,* and *R. woodsii*), soapberry (*Shepherdia canadensis*) and kinnikinnick (*Arctostaphylos uva-ursi*). Trembling aspen (*Populus tremuloides*) is often present in the shrub layer as a regenerating tree species, but the cover is sporadic and typically low. The herb layer is dominated by purple reedgass (*Calamagrostis purpurascens*); however a number of other species are typically present, including pasture sage (*Artemisia frigida*), prickly saxifrage (*Saxifraga tricuspidata*), yarrow (*Achillea millefolium*), spikelike goldenrod (*Solidago simplex*), and cut leaf anemone (*Anemone multifida*). A lichen crust, of varying cover, is typical in this ecosite and is commonly dominated by *Cladonia* spp. Exposed mineral soil and decaying organic matter comprises much of the ground cover on these sites.

The soil moisture regime of the Purple reedgrass – Lichen ecosite is xeric to subxeric and the soil nutrient regime is typically medium. Rapidly drained, sandy soils overlay colluvial parent material. Due to the unstable conditions of these slopes (steep, dry, south facing) topsoil is susceptible to frost heave and wind and water erosion.

Sample Plots: 4

Full	[1]
Ground	[1]
Visual	[1]





Characteristic Vegetation

Shrub Layer:

[6] Rose (*Rosa acicularis, R. woodsii*)

[3] Soapberry (*Shepherdia canadensis*)

[2] Kinnikinnick (*Arctostaphylos uva-ursi*)

Herb Layer:

[17] Purple reedgrass (*Calamagrostis purpurascens*)

[4] Pasture sage (*Artemisia frigida*)

[2] Spikelike goldenrod (*Solidago simplex*)

[2] Prickly saxifrage (*Saxifraga tricuspidata*)

[1] Yarrow (*Achillea millefolium*)

[1] Northern bedstraw (*Galium boreale*)

[1] Sedges (*Carex* spp.)

[.5] Cut Leaf anemone (*Anemone multifida*)

[.5] Redhair saxifrage (*Saxifraga rufopilosa*)

Moss/Lichen Layer:

[10] Lichen crust (commonly *Cladonia* spp.)

Site Characteristics

Moisture Regime: subxeric[4]

Nutrient Regime: medium[3], poor[1]

Slope Gradient: 40-75%

Aspect: southerly[3], south-easterly[1]

Slope Position: upper slope[2], midslope[2]

Exposure: insolation

Soil Characteristics

Organic Thickness: 1 – 5 cm

Humus Form: mull[3], moder[1]

Drainage: rapidly[4]

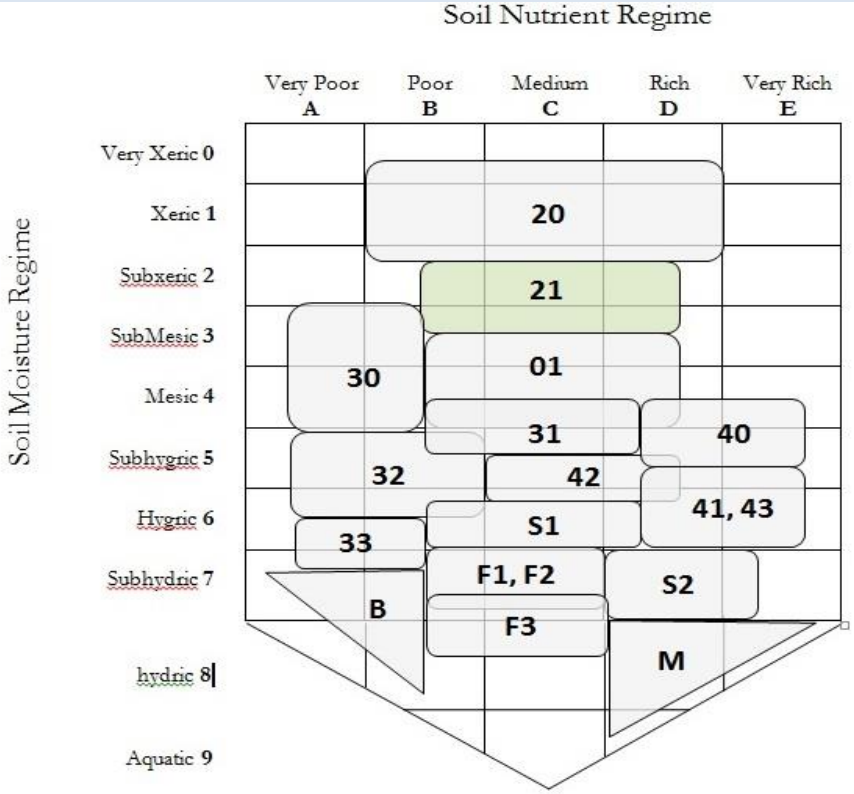
Seepage Water: absent

Permafrost: absent

Parent Material: C

Soil Texture: SL[2], FS[1], FSL[1]

Aspen – Kinnikinnick – Purple reedgrass (21)



Ecosite Description

The Aspen – Kinnikinnick – Purple reedgrass ecosite occurs on gentle-to-steep (predominately moderate) slopes with south- or west-facing aspects. The ecosite is found on middle-to-upper slopes, ranging in elevation from approximately 385-900 m. The canopy is generally dominated by trembling aspen (*Populus tremuloides*); however most stands have a minor white spruce (*Picea glauca*) component. Similarly, the regenerating tree layer is largely composed of aspen and white spruce. Ground shrubs, including kinnikinnick (*Arctostaphylos uva-ursi*) and lowbush cranberry (*Vaccinium vitis-idaea*), commonly dominate the shrub layer; however prickly rose (*Rosa acicularis*) and soapberry (*Shepherdia canadensis*) are also characteristic components. The herb layer is typically dominated by purple reedgrass (*Calamagrostis purpurascens*) and bastard toadflax (*Geocaulon lividum*), with tall bluebells (*Mertensia paniculata*), and fireweed (*Chamerion angustifolium*) commonly occurring in minor amounts. The moss and lichen layer is sparse, variable and sporadically distributed. Due to the slope and aspect position, this ecosite is prone to dry conditions, which increases the potential for fire.

The soil moisture regime of the Aspen – Kinnikinnick – Purple reedgrass ecosite ranges from subxeric-to-submesic and the soil nutrient regime ranges from poor-to-medium. The rooting zone soil texture is variable, though often sandy, and soils are rapidly-to-well drained. The parent material is primarily colluvial.

Sample Plots: 15

Full	[1]
Ground	[8]
Visual	[6]





Characteristic Vegetation

Tree Layer:

[27] Trembling aspen (*Populus tremuloides*)

[6] White spruce (*Picea glauca*)

Shrub Layer:

[37] Kinnikinnick (*Arctostaphylos uva-ursi*)

[7] Soapberry (*Shepherdia canadensis*)

[6] Trembling aspen (*Populus tremuloides*)

[5] Lowbush cranberry (*Vaccinium vitis-idaea*)

[4] Twinflower (*Linnaea borealis*)

[3] Prickly rose (*Rosa acicularis*)

Herb Layer:

[7] Purple reedgrass (*Calamagrostis purpurascens*)

[5] Bastard toadflax (*Geocaulon lividum*)

[2] Arctic lupine (*Lupinus arcticus*)*

[1] Tall bluebells (*Mertensia paniculata*)

[1] Fireweed (*Chamerion angustifolium*)

Moss/Lichen Layer:

[5] Step moss (*Hylocomium splendens*)

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Site Characteristics

Moisture Regime: submesic[11], subxeric[4]

Nutrient Regime: medium[9], poor[6]

Slope Gradient: 5-80 %, generally <20%

Aspect: southerly[3], westerly[1], north-westerly[1]

Slope Position: midslope[9], upper slope[3], lower slope[1]

Soil Characteristics

Organic Thickness: 1-9 cm

Humus Form: mor[9], moder[6]

Drainage: well[10], rapidly[5]

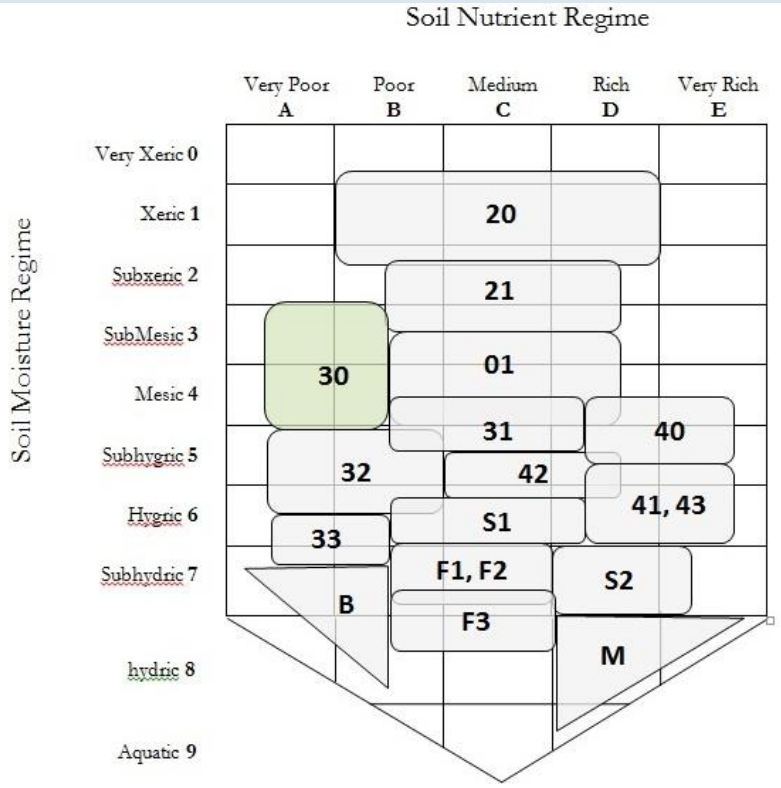
Seepage Water: absent

Permafrost: absent

Parent Material: C, D

Soil Texture: SL[5], SiCL[2], SiL[2], FSL[2], S[1]

Black spruce – Labrador tea – Reindeer lichen (30)



Ecosite Description

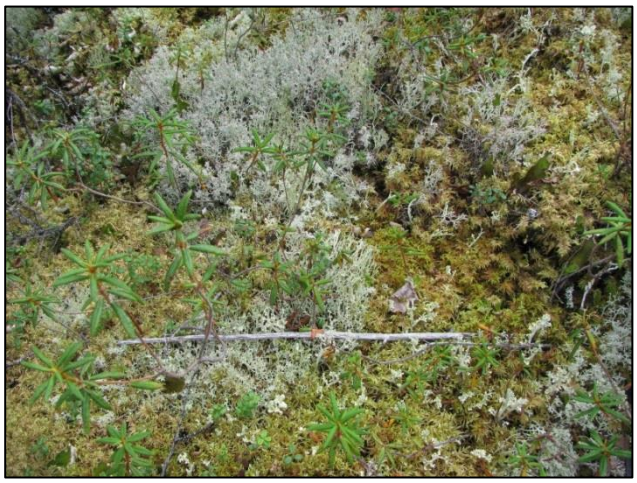
The Black spruce – Labrador tea – Reindeer lichen ecosite occurs on gentle-to-moderate, lower-to-upper slopes with a northerly aspect. Within the LSA, the ecosite ranges in elevation from approximately 400 to 1000 m. The canopy is dominated by black spruce (*Picea mariana*); however a minor Alaska birch (*Betula neoalaskana*) or white spruce (*Picea glauca*) component is common. The shrub layer is not as diverse as other forested ecosystems within the Boreal High Bioclimate zone and is dominated by Labrador tea (*Rhododendron groenlandicum*) and lowbush cranberry (*Vaccinium vitis-idaea*). The relatively sparse herb layer is typically dominated by bastard toadflax (*Geocaulon lividum*). The moss and lichen layer of this ecosite is well-developed, generally comprising over 85% cover, dominated by reindeer lichens (*Cladina mitis, C. rangiferina*, and *C. stellaris*), red-stemmed feathermoss (*Pleurozium schreberi)*, and step moss (*Hylocomium splendens*).

The soil moisture regime of the Black spruce – Labrador tea – Reindeer lichen ecosite ranges from submesic-to-mesic with a poor nutrient regime. The dominant rooting zone texture is silt loam overlaying colluvial or weathered bedrock parent material. Permafrost is absent in this ecosite and soils are rapidly-to-well drained.

Sample Plots: 7

Full	[0]
Ground	[3]
Visual	[4]





Characteristic Vegetation

Tree Layer:

[18] Black spruce (*Picea mariana*)

[4] Alaska Birch (*Betula neoalaskana*)

Shrub Layer:

[15] Black spruce (*Picea mariana*)

[3] Alaska birch (*Betula neoalaskana*)

[24] Labrador tea (*Rhododendron groenlandicum*)

[13] Lowbush cranberry (*Vaccinium vitis-idaea*)

[2] Willows (*Salix* spp.)

Herb Layer:

[5] Bastard toadflax (*Geocaulon lividum*)

[1] Common horsetail (*Equisetum arvense*)*

Moss/Lichen Layer:

[42] Reindeer lichen (*Cladina* spp.)

[31] Red-stemmed feathermoss (*Pleurozium schreberi*)

[18] Step moss (*Hylocomium splendens*)

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Site Characteristics

Moisture Regime: mesic[3], submesic[2], subhygric[2]

Nutrient Regime: poor[7]

Slope Gradient: 8-40%

Aspect: northerly[5], north-westerly[1], easterly[1]

Slope Position: midslope[2], upper slope[3], lower slope[1]

Soil Characteristics

Organic Thickness: 10-25 cm

Humus Form: mor[7]

Drainage: well[4], rapidly[1], moderately well[1]

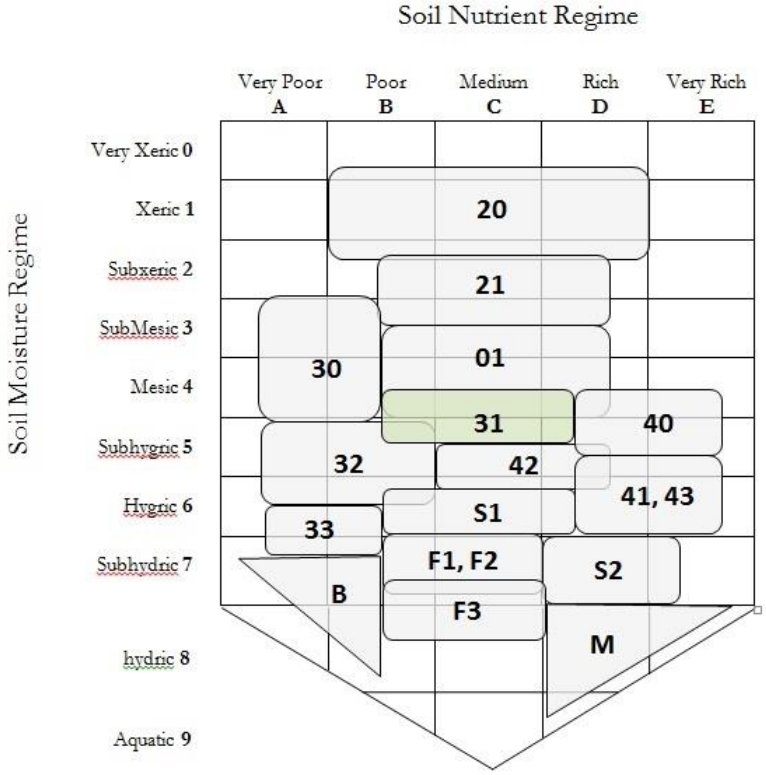
Seepage Water: absent

Permafrost: absent

Parent Material: C, D

Soil Texture: SiL[4], LS[1], S[1]

Spruce – Birch – Lowbush cranberry – Feathermoss (31)



Ecosite Description

The Spruce – Birch – Lowbush Cranberry – Feathermoss ecosite occurs on gentle-to-moderate, mid-to-upper slopes across a range of aspects. Within the ELC survey extent, the ecosite typically ranges from 900-1150 m. This ecosite is commonly found near the Subalpine Bioclimate zone boundary and is transitional between forested and shrub dominated ecosystems. A sparse conifer dominated canopy (~15% cover), composed of white and black spruce (*Picea glauca* and *P. mariana*) is characteristic. The shrub layer is well developed and is dominated by scrub birch (*Betula glandulosa*), water birch (*B. occidentalis*), Labrador tea (*Rhododendron groenlandicum*) and lowbush cranberry (*Vaccinium vitis-idaea*). Willows (including *Salix glauca* and *S. plainfolia*), Bog blueberry (*Vaccinium uliginosum*) and crowberry (*Empetrum nigrum*) are also common in the shrub layer. The herb layer is sparse and variable, but typically spruce muskeg sedge (*Carex lugens*) and grasses are present. The well-developed moss and lichen layer is dominated by red-stemmed feathermoss (*Pleurozium schreberi*), step moss (*Hylocomium splendens*) and reindeer lichens (*Cladina mitis, C. rangiferina*, and *C. stellaris*).

The soil moisture regime of the Spruce – Birch – Lowbush Cranberry – Feathermoss ecosite is typically mesic and the soil nutrient regime ranges from poor-to-medium. The dominant rooting zone textures are silt loam and sandy loam and soils are commonly well-drained. The parent material is weathered bedrock or colluvial.

Sample Plots: 24

Full	[1]
Ground	[11]
Visual	[12]





Characteristic Vegetation

Tree Layer:

[8] Black spruce (*Picea mariana*)

[8] White spruce (*Picea glauca*)

Shrub Layer:

[18] Scrub birch (*Betula glandulosa*)

[18] Labrador tea (*Rhododendron groenlandicum*)

[13] Lowbush cranberry (*Vaccinium vitis-idaea*)

[13] Water birch (*Betula occidentalis*)

[8] Willows (*Salix* spp.)

[6] Crowberry (*Empetrum nigrum*)

[5] Bog blueberry (*Vaccinium uliginosum*)

Herb Layer:

[2] Spruce muskeg sedge (*Carex lugens*)*

[2] Grasses (Poaceae spp.)*

Moss/Lichen Layer:

[36] Red-stemmed feathermoss (*Pleurozium schreberi*)

[20] Reindeer lichen (*Cladina* spp.)

[19] Step moss (*Hylocomium splendens*)

[5] Pelt lichens (*Peltigera* spp.)

[4] Haircap mosses (*Polytrichum* spp.)

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Site Characteristics

Moisture Regime: mesic[19], submesic[4], subhygric[1]

Nutrient Regime: medium[13], poor[10]

Slope Gradient: 2-40 %, generally >10%

Aspect: variable

Slope Position: midslope[12], upper slope[9], lower slope[1], level[1], crest[1]

Soil Characteristics

Organic Thickness: 5-29 cm

Humus Form: mor[15], moder[8], fibric[1]

Drainage: well[19], moderately well[2], rapidly[2], imperfectly[1]

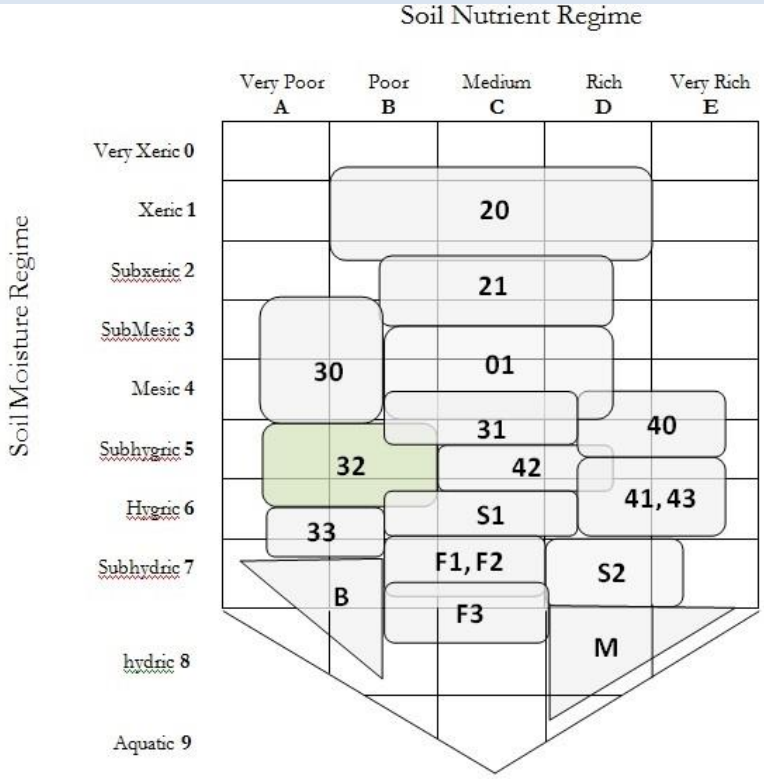
Seepage Water: absent

Permafrost: absent

Parent Material: D, C

Soil Texture: SiL[13], SL[7], L[2], FSL[1], SCL[1]

Black spruce – Scrub birch – Labrador tea – Cloudberry (32-Sb1)



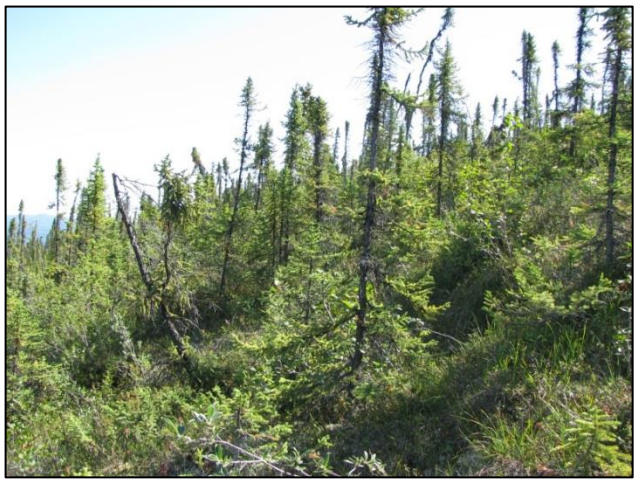
Ecosite Association Description

The Black spruce – Scrub birch – Labrador tea – Cloudberry association occurs on moderate-to-steep, lower-to-middle slopes on primarily cool aspects. Within the LSA, the association ranges in elevation from approximately 550 to 1100 m. Black spruce (*Picea mariana*) is the dominant tree species, but it tends to be stunted with a moderate-to-sparse canopy and is present in both the shrub and tree layers. The shrub layer is dominated by Labrador tea (*Rhododendron groenlandicum*) and/or Northern Labrador tea (*Rhododendron tomentosum*), lowbush cranberry (*Vaccinium vitis-idaea*) and scrub birch (*Betula glandulosa*). Bog blueberry (*Vaccinium uliginosum*) and crowberry (*Empetrum nigrum*) are also commonly present in lesser amounts. The herb layer commonly contains cloudberry (*Rubus chamaemorus*), sweet coltsfoot (*Petasites frigidus*) and spruce muskeg sedge (*Carex lugens*). The moss and lichen layer is an important constituent of this ecosite phase, often with greater than 80% cover. A combination of mosses and lichens is typical, including red-stemmed feathermoss (*Pleurozium schreberi*), step moss (*Hylocomium splendens*), peat moss (*Sphagnum* spp.), and reindeer lichen (*Cladina mitis, C. rangiferina*, and *C. stellaris*).

The soil moisture regime of the association ranges is subhygric-to-hygric and the nutrient regime is typically poor. The dominant rooting zone soil textures are silt loam and loam, overlaying predominantly colluvial parent material. Permafrost is often present within 50cm of the soil surface and soils are typically moderately well-to-poorly drained.

Sample Plots: 16

Full	[0]
Ground	[8]
Visual	[10]





Characteristic Vegetation

Tree Layer:

[6] Black spruce (*Picea mariana*)*

Shrub Layer:

[21] Black spruce (*Picea mariana*)

[28] Labrador tea (*Rhododendron groenlandicum* and *R. tomentosum*)

[11] lowbush cranberry (*Vaccinium vitis-idaea*)

[9] Scrub birch (*Betula glandulosa*)

[6] Bog blueberry (*Vaccinium uliginosum*)

[6] Willows (including *Salix glauca* and *S. planifolia)*

[5] Crowberry (*Empetrum nigrum*)

Herb Layer:

[6] Spruce muskeg sedge (*Carex lugens*)*

[4] Cloudberry (*Rubus chamaemorus*)

[1] Sweet coltsfoot (*Petasites frigidus*)

Moss/Lichen Layer:

[30] Step moss (*Hylocomium splendens*)

[26] Red-stemmed feathermoss (*Pleurozium schreberi*)

[25] Peat mosess (*Sphagnum* spp.)

[15] Reindeer lichens (*Cladina* spp.)

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Site Characteristics

Moisture Regime: subhygric[8], hygric[4], mesic[3]

Nutrient Regime: poor[11], medium[4]

Slope Gradient: 10-55 %

Aspect: northerly[7], north-westerly[3], esterly[2], westerly[2] north-easterly[1]

Slope Position: midslope[9], lower slope[3], upper slope[3]

Soil Characteristics

Organic Thickness: 10-40 cm

Humus Form: fibric[8], mor[6], moder[2]

Drainage: imperfectly[8], poorly[3], moderately well[3]

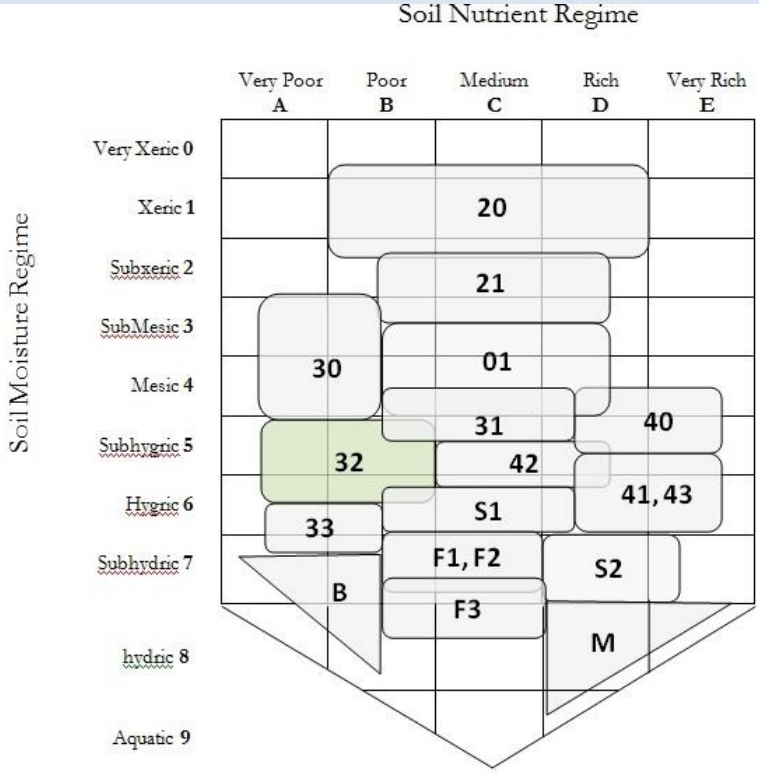
Seepage Water: sometimes present

Permafrost: typically present

Parent Material: C, D

Soil Texture: SiL[10], L[3], SiCL[1]

Black spruce – Labrador tea – Cottongrass (32-Sb2)



Ecosite Association Description

The Black spruce – Labrador tea – Cottongrass association occurs on moderate-to-steep, lower-to-middle slopes on primarily cool aspects. Within the LSA, the association ranges in elevation from approximately 450 to 1050 m. Black spruce (*Picea mariana*) is the dominant tree species, but it tends to be stunted with a moderate-to-sparse canopy and is present in both the shrub and tree layers. The shrub layer is dominated by Labrador tea (*Rhododendron groenlandicum*) and lowbush cranberry (*Vaccinium vitis-idaea*), with bog blueberry (*Vaccinium uliginosum*), green alder (*Alnus viridis*) and Northern Labrador tea (*Rhododendron tomentosum*) commonly present in lesser amounts. Sheathed cottongrass (*Eriophorum vaginatum*) characteristically dominates the herb layer; however cloudberry (*Rubus chamaemorus*) and bog cranberry (*Vaccinium oxycoccos*) are also typically present. The moss and lichen layer is an important constituent of this association, often with greater than 80% cover. A combination of mosses and lichens is typical, including red-stemmed feathermoss (*Pleurozium schreberi*), step moss (*Hylocomium splendens*), peat mosses (*Sphagnum* spp.), and reindeer lichens (*Cladina mitis, C. rangiferina*, and *C. stellaris*).

The soil moisture regime of the association ranges from subhygric-to-hygric and the nutrient regime ranges from poor-to-medium. The dominant rooting zone soil texture is silt loam, overlaying predominantly colluvial parent material. Permafrost is typically present within 50cm of the soil surface and soils are consequently imperfectly-to-poorly drained.

Sample Plots: 14

Full	[2]
Ground	[8]
Visual	[4]





Characteristic Vegetation

Tree Layer:

[3] Black spruce (*Picea mariana*)

Shrub Layer:

[23] Black spruce (*Picea mariana*)
[16] Labrador tea (*Rhododendron groenlandicum*)
[8] Lowbush cranberry (*Vaccinium vitis-idaea*)
[4] Bog blueberry (*Vaccinium uliginosum*)
[3] Green alder (*Alnus viridis*)
[2] Alaska birch (*Betula neoalaskana*)
[2] Northern Labrador tea (*Rhododendron tomentosum*)

Herb Layer:

[11] Sheathed cottongrass (*Eriophorum vaginatum*)
[3] Cloudberry (*Rubus chamaemorus*)
[1] Bog cranberry (*Vaccinium oxycoccos*)

Moss/Lichen Layer:

[25] Red-stemmed feathermoss (*Pleurozium schreberi*)
[20] Step moss (*Hylocomium splendens*)
[23] Peat mosses (*Sphagnum* spp.)
[12] Reindeer lichens (*Cladina* spp.)
[5] Cetraria lichens (*Cetraria* spp.)

Site Characteristics

Moisture Regime: hygric[8], subhygric[6]

Nutrient Regime: poor[11], medium[3]

Slope Gradient: 8-65 %

Aspect: northerly[11], north-westerly[1], north-easterly[1], westerly[1]

Slope Position: midslope[8], lower slope[5], toe[1]

Soil Characteristics

Organic Thickness: 20-45 cm

Humus Form: fibric[11], mor[2], moder[1]

Drainage: poorly[9], imperfectly[5]

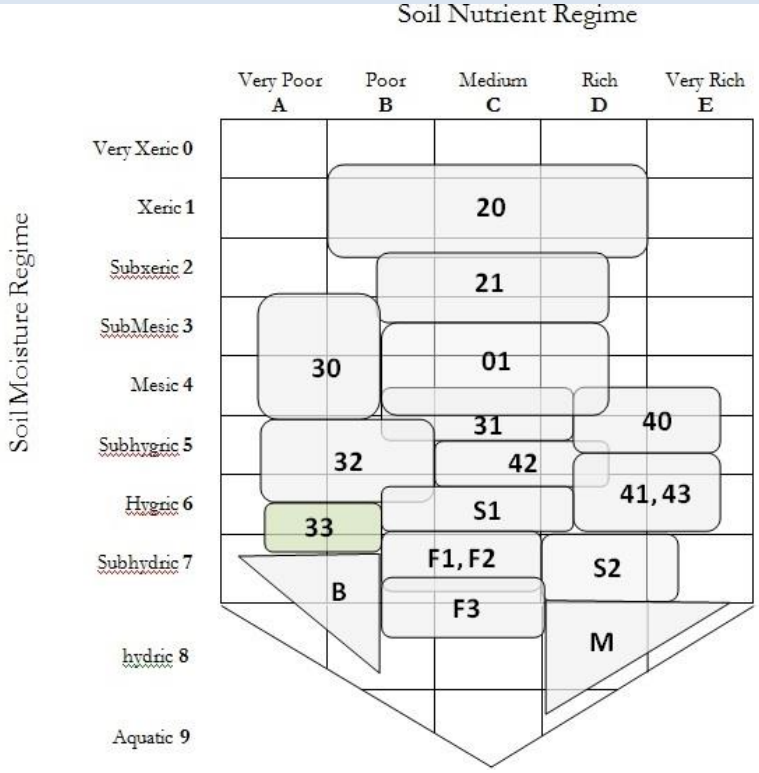
Seepage Water: sometimes present

Permafrost: present

Parent Material: C, D

Soil Texture: SiL[11], SL[1]

Black spruce – Labrador tea – Sedge – Brown moss – Reindeer lichen (33)



Ecosite Description

The Black spruce – Labrador tea – Sedge – Brown moss – Reindeer lichen association occurs on gentle-to-moderate, lower-to-toe slopes on primarily cool and neutral aspects. Within the survey extent, the association ranges in elevation from approximately 400 to 950 m and is often found in the lower-to-toe slope position leading to valley bottom drainages. Black spruce (*Picea mariana*) is the dominant tree species, but it tends to be stunted with a moderate-to-sparse canopy and is present in both the shrub and tree layers. The shrub layer is dominated by Labrador tea (*Rhododendron groenlandicum*) and lowbush cranberry (*Vaccinium vitis-idaea*), with willows (including *Salix glauca, S. planifolia, S. myrtillifolia,* and *S. scouleriana*) commonly present in lesser amounts. Spruce muskeg sedge (*Carex lugens*), red bearberry (*Arctous rubra*), and sweet coltsfoot (*Petasites frigidus*) are typically present in the herb layer. The moss and lichen layer is an important constituent of this association, often with greater than 80% cover. The combination of feather mosses, brown mosses and lichens is characteristic, and includes step moss (*Hylocomium splendens*), glow moss (*Aulacoumnium* spp.) and reindeer lichen (*Cladina mitis, C. rangiferina*, and *C. stellaris*).

The soil moisture regime of the association ranges from subhygric-to-hygric and the nutrient regime ranges from poor-to-medium. The rooting zone soil texture is variable, primarily sandy and silt loams, overlaying primarily colluvial and fluvial parent material. Permafrost is typically present within 50 cm of the soil surface and soils are consequently imperfectly-to-poorly drained.

Sample Plots: 11

Full	[0]
Ground	[5]
Visual	[6]





Characteristic Vegetation

Tree Layer:

[8] Black spruce (*Picea mariana*)

Shrub Layer:

[16] Black spruce (*Picea mariana*)

[11] Labrador tea (*Rhododendron groenlandicum*)

[7] Lowbush cranberry (*Vaccinium vitis-idaea*)

[2] Willows (*Salix* spp.)

Herb Layer:

[7] Spruce muskeg sedge (*Carex lugens*)

[6] Red bearberry (*Arctous rubra*)

[2] Sweet coltsfoot (*Petasites frigidus*)

[2] Dwarf scouring rush (*Equisetum scirpoides*)

Moss/Lichen Layer:

[45] Step moss (*Hylocomium splendens*)

[18] Reindeer lichens (*Cladina* spp.)

[13] Brown mosses (*Aulacomnium/Tomenthypnum*)

[1] Pelt lichens (*Peltigera* spp.)

Site Characteristics

Moisture Regime: hygric[7], subhygric[4]

Nutrient Regime: poor[7], medium[4]

Slope Gradient: 2-50 %, typically <20%.

Aspect: variable

Slope Position: lower slope[6], toe[4], level[1]

Soil Characteristics

Organic Thickness: 20-45 cm

Humus Form: fibric[6], mesic[2], moder[2]

Drainage: poorly[6], imperfectly[4], moderately well[1]

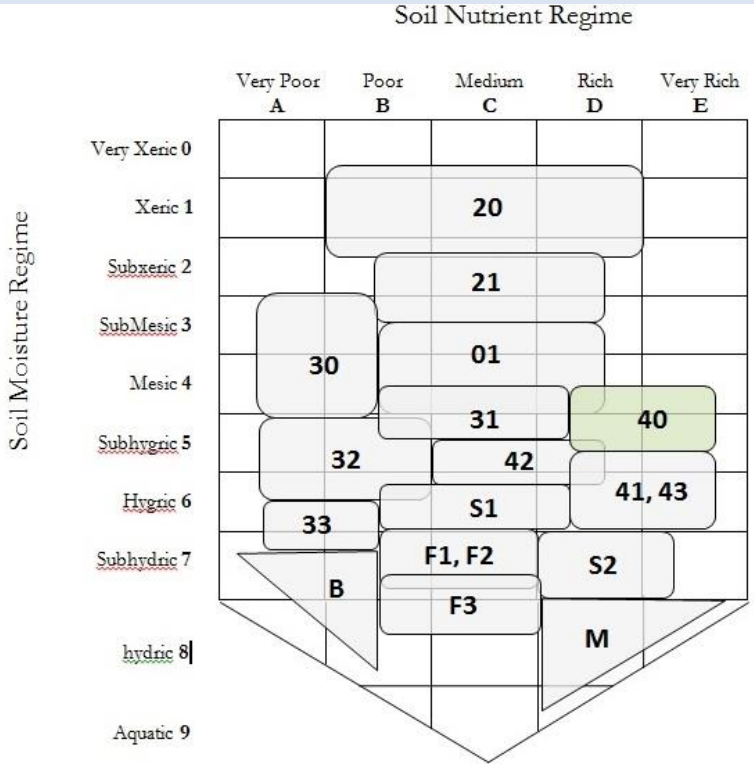
Seepage Water: typically present

Permafrost: present

Parent Material: C, F

Soil Texture: SiL[2], SL[2], L[2], LS[1]

White spruce – Horsetail (40)



Ecosite Description

The White spruce – Horsetail ecosite is a coniferous riparian ecosystem that occurs on broad, level floodplains and along the banks of streams and sideslope creeks. The ecosite occurs from approximately 380 to 1000 m, along the Yukon and Stewart Rivers, smaller creeks (e.g., Coffee Creek), and side slope drainages within the survey extent. The canopy is dominated by white spruce (*Picea glauca*); however a minor Alaska birch (*Betula neoalaskana*) or black spruce (*Picea mariana*) component can occur. Prickly rose (*Rosa acicularis*), green alder (*Alnus viridis*) and willow species (including *S. arbusculoides, S. barclayi, S. glauca, S. lasiandra,* and *S. scouleriana*) dominate the shrub layer, with highbush cranberry (*Viburnum edule*) and lowbush cranberry (*Vaccinium vitis-idaea*) often present in lesser amounts. The herb layer is dominated by common horsetail (*Equisetum arvense*) and bluejoint reedgrass (*Calamagrostis canadensis*). Other species often present in the herb layer include twinberry (*Linnaea borealis*) and tall bluebells (*Mertensia paniculata*). The moss layer is variable but step moss (*Hylocomium splendens*) is commonly the dominant species. Due to the increased moisture and nutrient regime of these riparian areas, the canopy is often more productive than other forested ecosites within the survey extent.

The soil moisture regime of the White spruce – Horsetail ecosite ranges from mesic-to-hygric and the nutrient regime is medium-to-rich. Soils are well-to-imperfectly drained with variable rooting zone soil texture. The parent material is typically fluvial.

Sample Plots: 9

Full	[1]
Ground	[6]
Visual	[2]





Characteristic Vegetation

Tree Layer:

[34] White spruce (*Picea glauca*)

[6] Alaska birch (*Betula neoalaskana*)

Shrub Layer:

[14] Prickly rose (*Rosa acicularis*)

[10] Green alder (*Alnus viridis*)

[8] Highbush cranberry (*Viburnum edule*)

[7] Willows (*Salix* spp.)

[3] Lowbush cranberry (*Vaccinium vitis-idaea*)

Herb Layer:

[10] Common horsetail (*Equisetum arvense*)

[5] Bluejoint reedgrass (*Calamagrostis canadensis*)

[3] Tall bluebells (*Mertensia paniculata*)

[2] Twinflower (*Linnaea borealis*)

Moss/Lichen Layer:

[50] Step moss (*Hylocomium splendens*)

Site Characteristics

Moisture Regime: subhygric[6], mesic[2], hygric[1]

Nutrient Regime: rich[5], medium[4]

Slope Gradient: 0-30 %

Aspect: variable

Slope Position: level[7], gully[2]

Soil Characteristics

Organic Thickness: 5-20 cm

Humus Form: moder[6], mor[3]

Drainage: well[6], moderately well[1], imperfect[2]

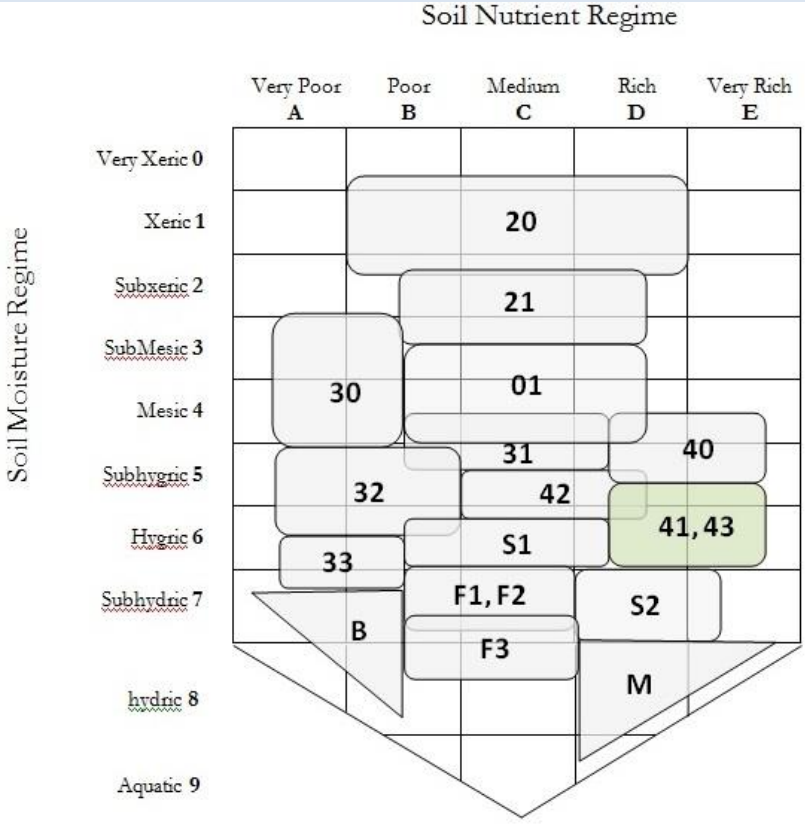
Seepage Water: typically absent

Permafrost: absent

Parent Material: F, C

Soil Texture: SiL[4], LS[2], FSL[1], cS[1]

Balsam poplar – Prickly rose – Horsetail (41)



Ecosite Description

The Balsam poplar – Prickly rose – Horsetail ecosite is a deciduous riparian ecosystem that occurs on broad, level floodplains and along the banks of rivers and creeks. The ecosite occurs at lower elevations within the survey extent, from approximately 350 to 450 m, along the Yukon and Stewart Rivers and along smaller streams and creeks (e.g., Coffee Creek). The canopy is often dominated by balsam poplar (*Populus balsamifera*), but mixed balsam poplar/Alaska birch (*Betula neoalaskana*) and Alaska birch dominated stands do occur. The well-developed shrub layer is dominated by prickly rose (*Rosa acicularis*), red-osier dogwood (*Cornus stolonifera*) and willows (including *Salix bebbiana*, *S. alaxensis*, and *S. planifolia*). Common horsetail (*Equisetum arvense*) dominates the herb layer; however tall bluebells (*Mertensia paniculata*) and northern bedstraw (*Galium boreale*) are also typically present. The moss layer is sparse due to a high cover of deciduous leaf litter and periodic flooding.

The soil moisture regime of Balsam poplar – Prickly rose – Horsetail ecosite is subhygric and the nutrient regime is rich-to-very rich. Soils are well drained with variable rooting zone soil texture. The parent material is fluvial.

Sample Plots: 4

Full	[1]
Ground	[3]
Visual	[0]





Characteristic Vegetation

Tree Layer:

[32] Balsam poplar (*Populus balsamifera*)

[15] Alaska birch (*Betula neoalaskana*)†

[3] White spruce (*Picea glauca*)

Shrub Layer:

[20] Prickly rose (*Rosa acicularis*)

[7] Red-osier dogwood (*Cornus stolonifera*)

[8] Highbush cranberry (*Viburnum edule*)*

[5] Willows (*Salix* spp.)

Herb Layer:

[15] Common horsetail (*Equisetum arvense*)

[8] Bluejoint reedgrass (*Calamagrostis canadensis*)*

[3] Tall bluebells (*Mertensia paniculata*)

[2] Northern bedstraw (*Galium boreale*)

Moss/Lichen Layer:

[3] Ragged mosses (*Brachythecium* spp.)

† Tree may be dominant in some plots

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Site Characteristics

Moisture Regime: subhygric[4]

Nutrient Regime: rich[3], very rich[1]

Slope Gradient: 0-2%

Aspect: N/A

Slope Position: level[4]

Soil Characteristics

Organic Thickness: 3-12 cm

Humus Form: mor[3], moder[1]

Drainage: well[3], moderately well[1]

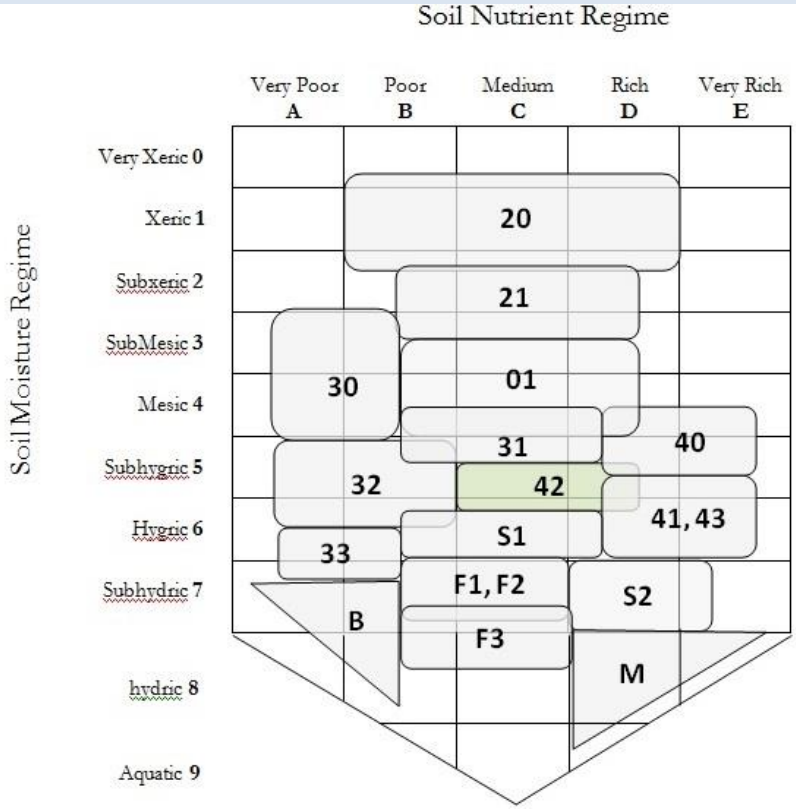
Seepage Water: absent

Permafrost: absent

Parent Material: F

Soil Texture: SiL[2], L[1], LS[1], S[1]

Alaska birch – Alder – Reedgrass (42)



Ecosite Description

The Alaska birch – Alder – Reedgrass ecosite is a deciduous dominated riparian ecosystem that occurs primarily along sideslope creeks and receiving areas. Within the survey extent, the ecosite occurs from approximately 450 to 1000 m. The canopy is dominated by Alaska birch (*Betula neoalaskana*), often with a minor spruce component. The well-developed shrub layer is dominated by tall shrub alder (*Alnus* spp.) and prickly rose (*Rosa acicularis*), with Labrador tea (*Rhododendron groenlandicum*) and lowbush cranberry (*Vaccinium vitis-idaea*) often present in lesser amounts. Common horsetail (*Equisetum arvense*) and Bluejoint reedgrass (*Calamagrostis canadensis*) dominate the herb layer; however tall bluebells (*Mertensia paniculata*) is also typically present. The sparse-to-moderate moss layer is dominated by step moss (*Hylocomium splendens*); however deciduous leaf litter cover is often high.

The soil moisture regime of Alaska birch – Alder – Reedgrass ecosite is subhygric-to-mesic and the nutrient regime is medium-to-rich. Soils are well-to-moderately well drained with variable rooting zone soil texture. The parent material is commonly colluvial or fluvial.

Sample Plots: 6

Full	[0]
Ground	[2]
Visual	[4]





Characteristic Vegetation

Tree Layer:

[27] Alaska birch (*Betula neoalaskana*)

[5] White spruce (*Picea glauca*)

Shrub Layer:

[26] Alder (*Alnus* spp.)

[16] Prickly rose (*Rosa acicularis*)

[4] Labrador tea (*Rhododendron groenlandicum*)

[4] Alaska birch (*Betula neoalaskana*)

[2] Mtn. cranberry (*Vaccinium vitis-idaea*)

Herb Layer:

[10] Common horsetail (*Equisetum arvense*)

[8] Bluejoint reedgrass (*Calamagrostis canadensis*)

[1] Tall bluebells (*Mertensia paniculata*)

Moss/Lichen Layer:

[20] Step moss (*Hylocomium splendens*)

[4] Peat mosses (*Sphagnum* sp.)

Site Characteristics

Moisture Regime: subhygric[5], mesic[1]

Nutrient Regime: medium[5], rich[1]

Slope Gradient: 2-30 %

Aspect: northerly[4], easterly[1], westerly[1]

Slope Position: gully[4], lower[1], level[1]

Soil Characteristics

Organic Thickness: 4-28 cm

Humus Form: mor[3], moder[3]

Drainage: moderately well[4], well[1], imperfectly[1]

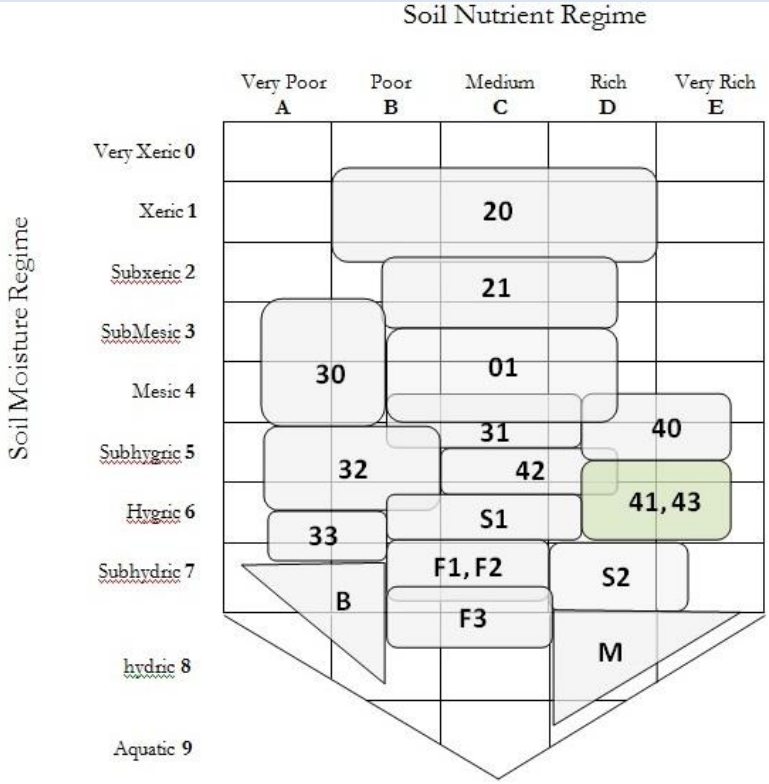
Seepage Water: absent

Permafrost: absent

Parent Material: C, F

Soil Texture: SiL[3], L[1], LS[1], S[1]

Tall shrub Balsam poplar – Willow (43)



Ecosite Description

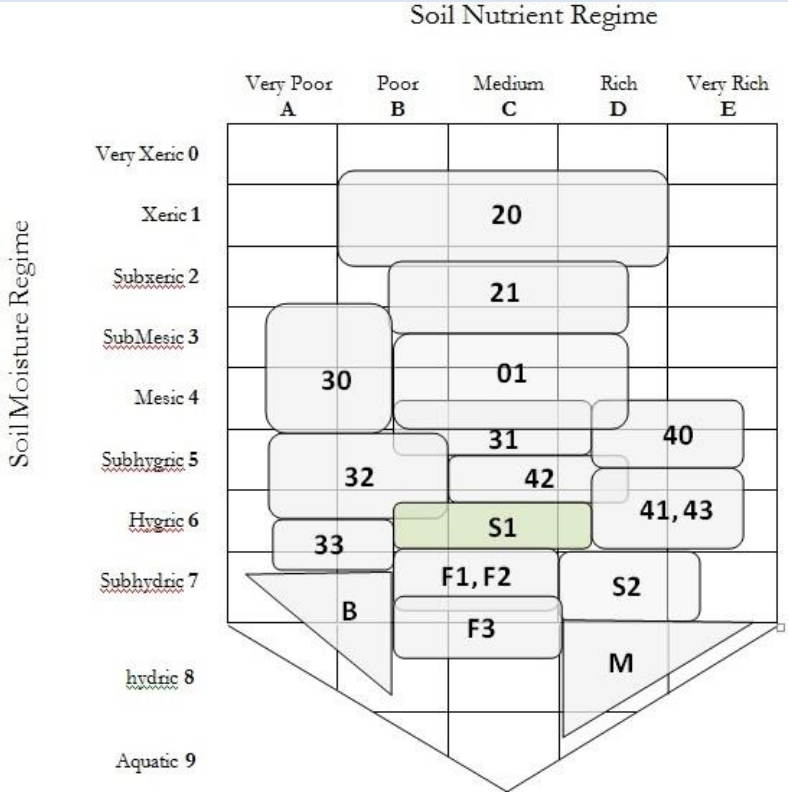
The Tall shrubs Balsam poplar - Willow ecosite is a low-bench floodplain community found on fluvial parent materials. The ecosite is dominated by young balsam poplar (*Populus balsamifera*) and willows and likely has limited understory due to frequent flooding. Within the ELC survey extent the ecosite only found along the edges of the Yukon and Stewart rivers.

The soil moisture regime of the Tall shrubs Balsam poplar - Willow ecosite is subhygric-to-hygric and the nutrient regime is rich-to-very rich. Soils are commonly coarse-texture fluvial deposits that are and rapidly-to-well drained.

Sample Plots: 0

Full	[0]
Ground	[0]
Visual	[0]

Willow – Horsetail (Swamp/S1)



Ecosite Description

The Willow – Horsetail ecosite occurs within the side channels of riverine habitats and side slope drainages where seasonal flooding is common. Within the survey extent, this association is found from approximately 550 to 1150 m. Willow species (including *Salix alaxensis, S. arbusculoides, S. glauca, S. planifolia, S. pulchra* and *S. reticulata*) are abundant and typically account for more than 60 % of the shrub cover within these ecosystems. A sparse conifer cover (<5%) is occasionally present. Other common shrub species include bog blueberry (*Vaccinium uliginosum*), and shrubby penstemon (*Dasiphora fruticosa*). The herb layer beneath the dense shrub layer is variable in composition, but bluejoint reedgrass (*Calamagrostis canadensis*) and horsetails (including *Equisetum arvense, E. pratense, E. scirpoides* and *E. variegatum*) commonly dominated by. The moss layer is also variable but is commonly dominated by peat moss (*Sphagnum* spp.), with hook mosses (*Drepanocladus* spp.) and leafy mosses (*Mnium* spp.) commonly present in lesser amounts.

The soil moisture regime of the Willow – Horsetail ecosite is subhygric-to-hygric and the soil nutrient regime is commonly medium or rich. Drainage ranges from moderately well-to-imperfectly with seepage often occurring within 60 cm of the soil surface. The parent material is fluvial and the rooting zone soil texture is variable.

Sample Plots: 11

Full	[1]
Ground	[1]
Visual	[9]





Characteristic Vegetation

Shrub Layer:

[58] Willows (*Salix* spp.)

[11] Bog blueberry (*Vaccinium uliginosum*)

[3] Shrubby penstemon (*Dasiphora fruticosa*)

Herb Layer:

[6] Bluejoint reedgrass (*Calamagrostis canadensis*)

[4] Common horsetail (*Equisetum arvense*)

[1] Dwarf scouring rush (*Equisetum scirpoides*)

[3] Sedges (*Carex* spp.)*

Moss/Lichen Layer:

[38] Peat mosses (*Sphagnum* spp.)

[18] Hook mosses (*Drepanocladus* spp.)

[5] Leafy mosses (*Mnium* spp.)

Site Characteristics

Moisture Regime: subhygric[7], hygric[4]

Nutrient Regime: medium[6], rich[4], poor[1]

Slope Gradient: 3-15 %

Aspect: variable

Slope Position: gully[11]

Soil Characteristics

Organic Thickness: 5-40 cm

Humus Form: moder[2], mor[2], fibric[2], mesic[1]

Drainage: moderately well[5], imperfectly[2], well[1]

Seepage Water: typically present

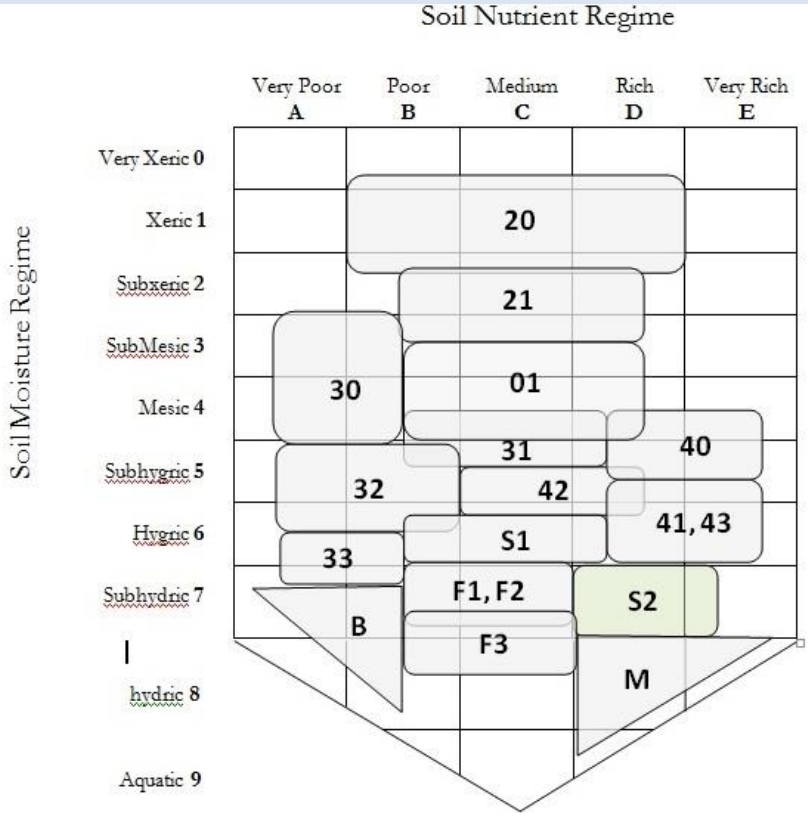
Permafrost: absent

Parent Material: F

Soil Texture: LS[2], SL[1], S[1], SiL[1], SiCL[1]

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Willow – Reedgrass (Swamp/S2)



Ecosite Description

The Willow / Reedgrass ecosite is a shrub-dominated swamp ecosystem that typically occurs along the edge of marsh and fen ecosystems and along moist riverine back channels. Within the survey extent, this association was infrequently sampled. Willows characteristically dominate the shrub layer; however other shrubs including prickly rose (*Rosa acicularis*) and northern black currant (*Ribes hudsonianum*) are also common. The herb layer beneath the dense shrub layer is variable in composition, but is dominated by a moderate-to-high cover of bluejoint reedgrass (*Calamagrostis canadensis*). The moss layer can be sparse to moderate.

The soil moisture regime of the Willow – Reedgrass swamp is subhygric-to-hygric and the soil nutrient regime is commonly medium. Drainage is typically imperfect with seepage commonly occurring within 60 cm of the soil surface. The parent material is fluvial and the rooting zone soil texture is variable.

Sample Plots: 2

Full	[0]
Ground	[1]
Visual	[1]





Characteristic Vegetation

Shrub Layer:

[45] Willows (*Salix* spp.)

[10] Prickly rose (*Rosa acicularis*)

[10] Northern black current (*Ribes hudsonianum*)

Herb Layer:

[20] Bluejoint reedgrass (*Calamagrostis canadensis*)

[5] Sedges (*Carex* spp.)

[2] Common horsetail (*Equisetum arvense*)

[2] Fireweed (*Chamerion angustifolium*)

Moss/Lichen Layer:

[30] Mosses

Site Characteristics

Moisture Regime: hygric[2]

Nutrient Regime: medium[2]

Slope Gradient: level

Aspect: N/A

Slope Position: depression[2]

Soil Characteristics

Organic Thickness:

Humus Form: moder[1]

Drainage: imperfectly[1]

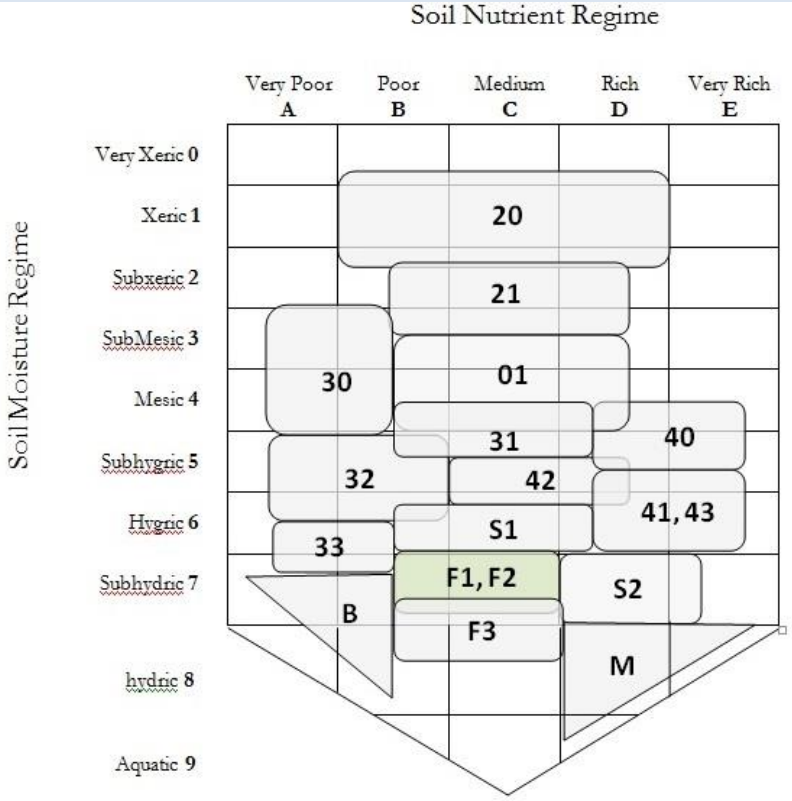
Seepage Water: typically present

Permafrost: absent

Parent Material: F

Soil Texture: SiL[1]

Spruce – Willow – Labrador tea – Sedge (Fen/F1)



Ecosite Description

The Spruce – Willow – Labrador tea – Sedge poor treed fen ecosite occurs on older, fluvial terraces below approximately 450 m elevation. White (*Picea glauca*) and/or black spruce (*Picea mariana*) comprise the open and stunted canopy (typically < 5m tall). In addition to spruce, Labrador tea (*Rhododendron groenlandicum*), willow (including *Salix glauca, S. myrtillifolia,* and *S. planifolia*) and lowbush cranberry (*Vaccinium vitis-idaea*) dominate the shrub layer, with bog blueberry (*Vaccinium uliginosum*) and shrubby cinquefoil (*Dasiphora fruticosa*) commonly present in lesser amounts. Sedge (primarily *Carex lugens*), sheathed cottongrass (*Eriophorum vaginatum*), red bearberry (*Arctous rubra*), and cloudberry (*Rubus chamaemorus*) are typically present in the herb layer. The moss and lichen layer is of moderate to high cover and is typically co-dominated by step moss (*Hylocomium splendens*), brown mosses (*Aulacoumnium* sp. and *Tomenthypnum nitens*) and peat moss (*Sphagnum* spp.).

The soil moisture regime of the ecosite ranges from hygric-to-subhydric and the nutrient regime ranges from poor-to-medium. The rooting zone soil texture is variable and parent material is typically fluvial. Permafrost is typically present within 50 cm of the soil surface and soils are poorly-to-very poorly drained.

Sample Plots: 7

Full	[1]
Ground	[6]
Visual	[0]





Characteristic Vegetation

Tree Layer:

[5] Spruce (*Picea glauca* and *P. mariana*)

Shrub Layer:

[20] Spruce (*Picea glauca* and *P. mariana*)
[12] Labrador tea (*Rhododendron groenlandicum*)
[8] Willows (*Salix* spp.)
[8] Lowbush cranberry (*Vaccinium vitis-idaea*)
[3] Bog blueberry (*Vaccinium uliginosum*)
[2] Shrubby cinquefoil (*Dasiphora fruticosa*)

Herb Layer:

[14] Sedges (*Carex* spp.)
[14] Sheathed cottongrass (*Eriophorum vaginatum*)
[5] Red bearberry (*Arctous rubra*)
[3] Cloudberry (*Rubus chamaemorus*)
[1] Sweet coltsfoot (*Petasites frigidus*)

Moss/Lichen Layer:

[20] Step moss (*Hylocomium splendens*)
[16] Brown mosses (*Aulacomnium* sp. and *Tomenthypnum nitens*)
[13] Peat mosses (*Sphagnum* spp.)
[6] Reindeer lichens (*Cladina* spp.)

Site Characteristics

Moisture Regime: subhydric[4], hygric[3]

Nutrient Regime: poor[5], medium[2]

Slope Gradient: 0-5 %

Aspect: N/A

Slope Position: toe[3], depression[3], level[1]

Soil Characteristics

Organic Thickness: 20+ cm

Humus Form: fibric[5], mesic[2]

Drainage: poorly[4], very poorly[3]

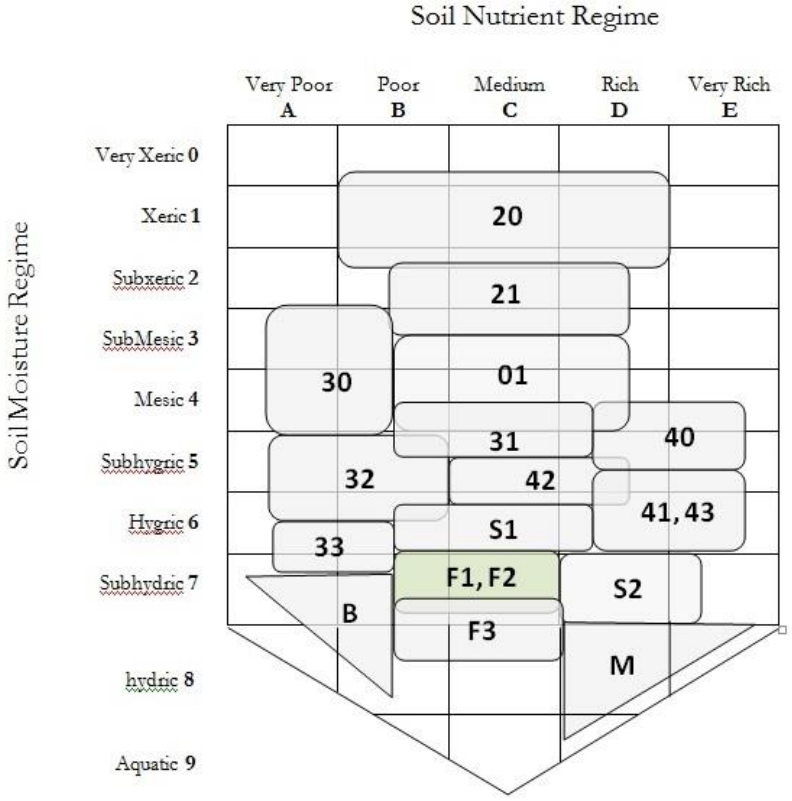
Seepage Water: present

Permafrost: present

Parent Material: F, O

Soil Texture: SiL[2], Of[2], L[1], FSL[1], Om[1]

Spruce – Red bearberry – Brown moss (Fen/F2)



Ecosite Description

The Spruce – Red bearberry – Brown moss treed fen ecosite occurs on older, level fluvial terraces below approximately 450 m elevation. White (*Picea glauca*) and/or black spruce (*Picea mariana*) comprise the open canopy, and are also a common component of the shrub layer. In addition to spruce, Labrador tea (*Rhododendron groenlandicum*) and lowbush cranberry (*Vaccinium vitis-idaea*) dominate the shrub layer, with willow (including *Salix glauca, S. myrtillifolia,* and *S. alaxensis*) commonly present in lesser amounts. Red bearberry (*Arctous rubra*), sedge (primarly *Carex lugens*), bluejoint reedgrass (*Calamagrostis canadensis*), sweet coltsfoot (*Petasites frigidus*) and dwarf-scouring rush (*Equisetum scirpoides*) are typically present in the herb layer. The moss and lichen layer is of moderate to high cover and is typically co-dominated by brown mosses (*Aulacoumnium* sp. and *Tomenthypnum nitens*) and step moss (*Hylocomium splendens*).

The soil moisture regime of the ecosite ranges from hygric-to-subhydric and the nutrient regime ranges from poor-to-medium. The rooting zone texture is primarily mesic organic, as mineral soil is often not reached before reaching the permafrost layer. Permafrost is typically present within 50 cm of the soil surface and soils are poorly drained. Parent material is typically fluvial.

Sample Plots: 3

Full	[0]
Ground	[1]
Visual	[2]





Characteristic Vegetation

Tree Layer:

[9] White spruce (*Picea glauca*)

[8] Black spruce (*Picea mariana*)

Shrub Layer:

[8] Labrador tea (*Rhododendron groenlandicum*)

[8] Lowbush cranberry (*Vaccinium vitis-idaea*)

[7] Spruce (*Picea glauca* and *P. mariana*)

[5] Willows (*Salix* spp.)

[2] Shrubby cinquefoil (*Dasiphora fruticosa*)

Herb Layer:

[6] Red bearberry (*Arctous rubra*)

[5] Sedges (*Carex* spp.)

[4] Bluejoint reedgrass (*Calamagrostis canadensis*)

[3] Sweet coltsfoot (*Petasites frigidus*)

[3] Dwarf scouring rush (*Equisetum scirpoides*)

Moss/Lichen Layer:

[33] Golden fuzzy fen moss (*Tomenthypnum nitens*)

[32] Step moss (*Hylocomium splendens*)

[10] Glow moss (*Aulacomnium* sp.)

[1] Pelt lichens (*Peltigera* spp.)

Site Characteristics

Moisture Regime: subhydric[2], hygric[1]

Nutrient Regime: medium[3]

Slope Gradient: level

Aspect: N/A

Slope Position: level[2], depression[1]

Soil Characteristics

Organic Thickness: > 45 cm

Humus Form: mesic[3]

Drainage: poorly[3]

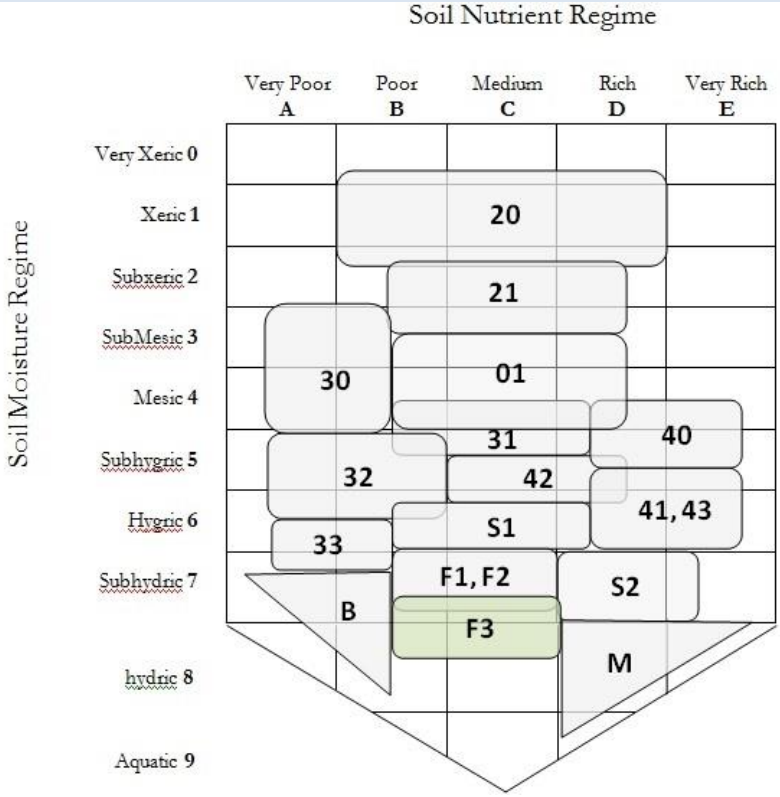
Seepage Water: present

Permafrost: present

Parent Material: F, O

Soil Texture: SiCL[1], Om[2]

Birch – Leatherleaf – Sedge (Fen/F3)



Ecosite Description

The Birch – Leatherleaf – Sedge ecosite is a shrubby poor fen ecosystem that occurs on level or gently sloping terrain with wet to saturated cryosolic soils. The ecosite occurs at relatively low elevations within the survey extent, ranging from 350-600 m. Alaska birch (*Betula neoalaskana*) is the dominant tree species; however they are restricted to the shrub layer (<5 m tall). Labrador tea (*Rhododendron groenlandicum*), leatherleaf (*Chamaedaphne calyculata*) and willows (including *Salix glauca* and *S. planifolia*) commonly dominate the shrub layer, with water birch (*Betula occidentalis*), lowbush cranberry (*Vaccinium vitis-idaea*) and bog blueberry (*Vaccinium uliginosum*) typically present in lesser amounts. The herb layer is commonly dominated by cottongrass, primarily the tussock-forming sheathed cottongrass (*Eriophorum vaginatum*), and sedges, primarily spruce muskeg sedge (*Carex lugens*). Moss cover is typically moderate and is composed of peat mosses (*Sphagnum* spp.), brown mosses (*Aulacomnium* sp. and *Tomenthypnum nitens*) and step moss (*Hylocomium splendens*).

The soil moisture regime of the Birch – Leatherleaf – Sedge ecosite is hygric-to-subhydric and the nutrient regime is poor-to-medium. Permafrost is present making cryosols the dominant soil group. Soils are poorly-to-very poorly drained.

Sample Plots: 6

Full	[1]
Ground	[4]
Visual	[1]





Characteristic Vegetation

Shrub Layer:

[14] Alaska Birch (*Betula neoalaskana*)
[10] Leatherleaf (*Chamaedaphne calyculata*)
[10] Labrador tea (*Rhododendron groenlandicum*)
[9] Lowbush cranberry (*Vaccinium vitis-idaea*)
[6] Blue-green willow (*Salix glauca*)
[6] Water birch (*Betula occidentalis*)
[4] Black Spruce (*Picea mariana*)
[4] Tea-leafed willow (*Salix planifolia*)
[3] Bog blueberry (*Vaccinium uliginosum*)

Herb Layer:

[20] Sedges (*Carex* spp.)
[19] Cottongrasses (*Eriophorum* spp.)
[3] Cloudberry (*Rubus chamaemorus*)

Moss/Lichen Layer:

[25] Peat mosses (*Sphagnum* spp.)
[22] Brown mosses (*Aulacomnium* sp. and *Tomenthypnum nitens*)
[15] Step moss (*Hylocomium splendens*)

Site Characteristics

Moisture Regime: subhydric[5], hygric[1]

Nutrient Regime: poor[5], medium[1]

Slope Gradient: 0-2 %

Aspect: N/A

Slope Position: level[3], depression[3]

Soil Characteristics

Organic Thickness: >30 cm

Humus Form: fibric[5], mesic[1]

Drainage: poorly[3], very poorly[3]

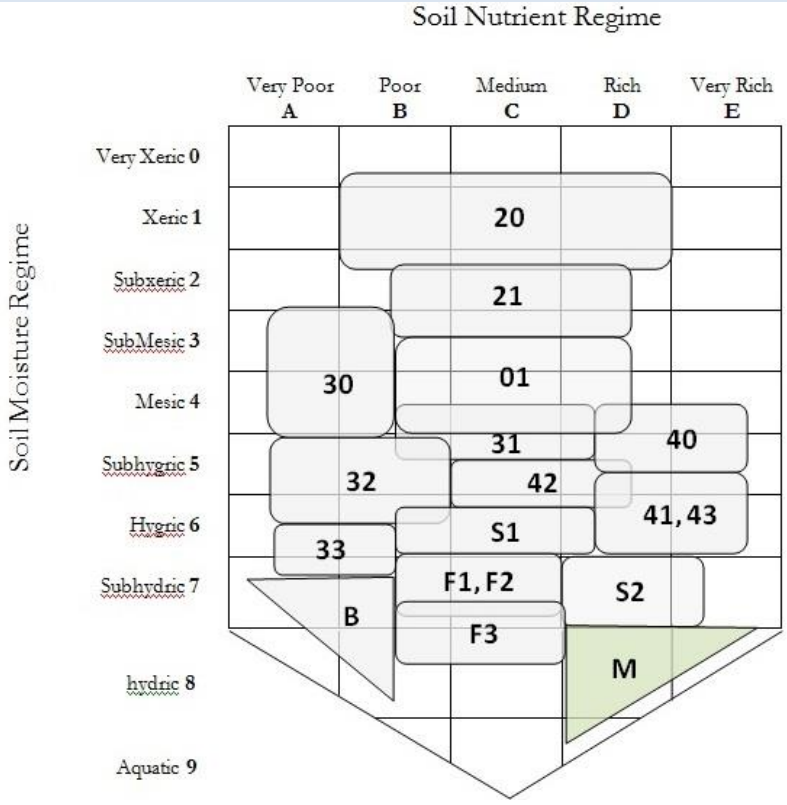
Seepage Water: present

Permafrost: present

Parent Material: C, F, O

Soil Texture: N/A

Beaked sedge (Marsh/M1)



Ecosite Description

The Beaked sedge ecosite is a graminoid-dominated riparian marsh that occurs with limited extent within the ELC survey extent. Beaked sedge marshes are only found at low elevations, primarily near the Yukon and Stewart Rivers. Species diversity is low and vegetation cover is strongly dominated by beaked sedge (*Carex utriculata*) with other forbs and aquatics scattered throughout. The water table of the ecosite fluctuates, with the early-season water tables dropping through the growing season and resulting in exposure of the substrate late in the season.

The soil moisture regime of the Beaked sedge association from subhydric-to-hydric and the nutrient regime is medium-to-rich. Nutrient availability is high due to water movement and aeration of the substrate.

Sample Plots: 6

Full	[1]
Ground	[4]
Visual	[2]





Characteristic Vegetation

Shrub Layer:

[1] Willows (*Salix* spp.)

Herb Layer:

[55] Beaked sedge (*Carex utriculata*)

[1] Marsh yellowcress (*Rorippa palustris*)

[1] Water horsetail (*Equisetum fluviatile*)*

[1] Blue-joint reedgrass (*Calamagrostis canadensis*)

Site Characteristics

Moisture Regime: subhydric[5], hydric[1]

Nutrient Regime: rich[3], medium[3]

Slope Gradient: level

Aspect: N/A

Slope Position: depression[6]

Soil Characteristics

Organic Thickness: 5 - 35 cm, typically <10 cm

Drainage: very poorly[3], poorly[2], imperfectly[1]

Seepage Water: present

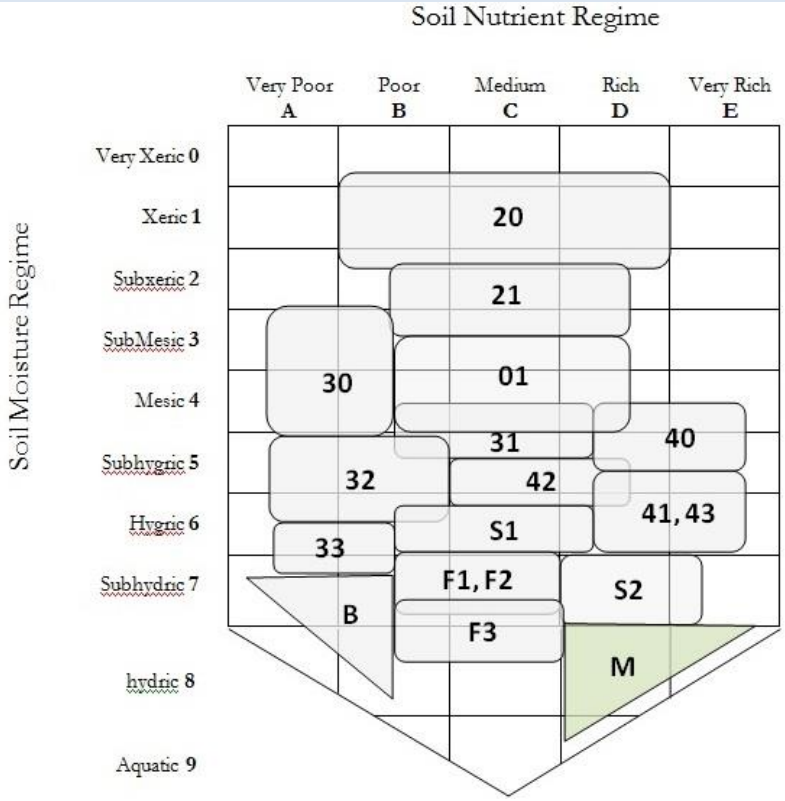
Permafrost: absent

Parent Material: F

Soil Texture: SiL[4], L[1], SiCL[1]

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Horsetail – Sedge (Marsh/M2)



Ecosite Description

The Horsetail - Sedge marsh ecosite occurs with limited extent in the survey extent and were only sampled at low elevations (below 400m), near the Stewart River. Species diversity is low and vegetation cover is dominated by water horsetail (*Equisetum fluviatile*), beaked sedge (*Carex utriculata*) and water sedge (*C. aquatilis*) with other forbs and aquatics scattered throughout. The water table of the ecosite fluctuates, with the early-season water tables dropping through the growing season and resulting in exposure of the substrate late in the season.

The soil moisture regime of the Horsetail - Sedge marsh ecosite ranges from subhydric-to-hydric and the nutrient regime is medium-to-rich. Nutrient availability is high due to water movement and aeration of the substrate.

Sample Plots: 2

Full	[0]
Ground	[2]
Visual	[0]





Characteristic Vegetation

Herb Layer:

[50] Water horsetail (*Equisetum fluviatile*)

[14] Beaked sedge (*Carex utriculata*)

[9] Water sedge (*Carex aquatilis*)

[5] Marsh cinquefoil (*Comarum palustre*)*

[1] Bluejoint reedgrass (*Calamagrostis Canadensis*)

Moss Layer:

[2] Jungermann's platydictya moss (*Platydictya jungermanniodies*)

*Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Site Characteristics

Moisture Regime: subhydric[1], hydric[1]

Nutrient Regime: rich[1], medium[1]

Slope Gradient: level

Aspect: N/A

Slope Position: depression[2]

Soil Characteristics

Organic Thickness: 2-35 cm

Humus Form: fibric[2]

Drainage: very poorly[2]

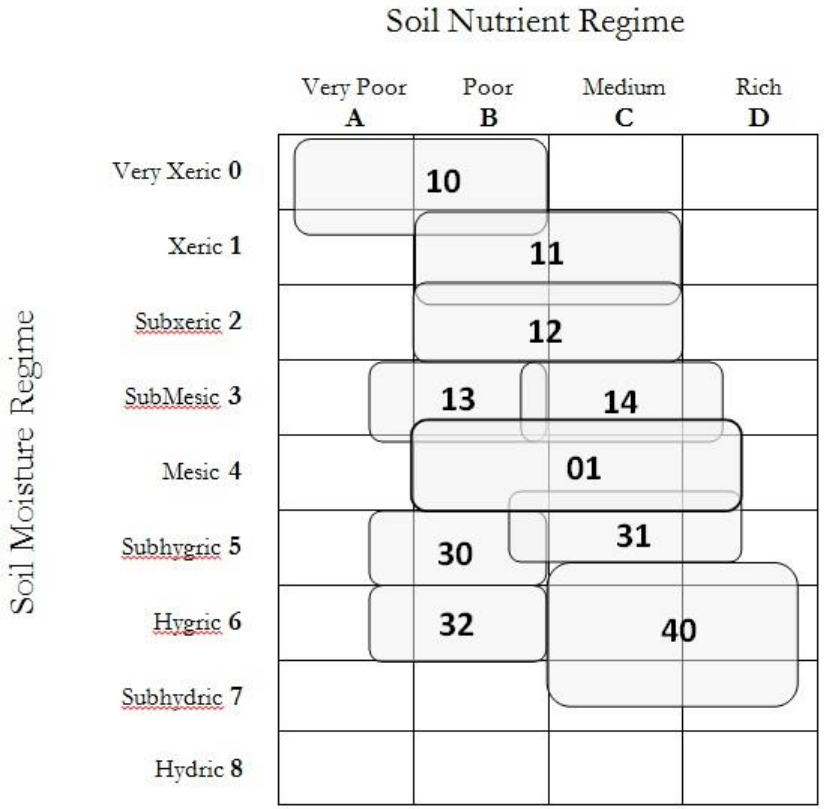
Seepage Water: present

Permafrost: absent

Parent Material: F, L

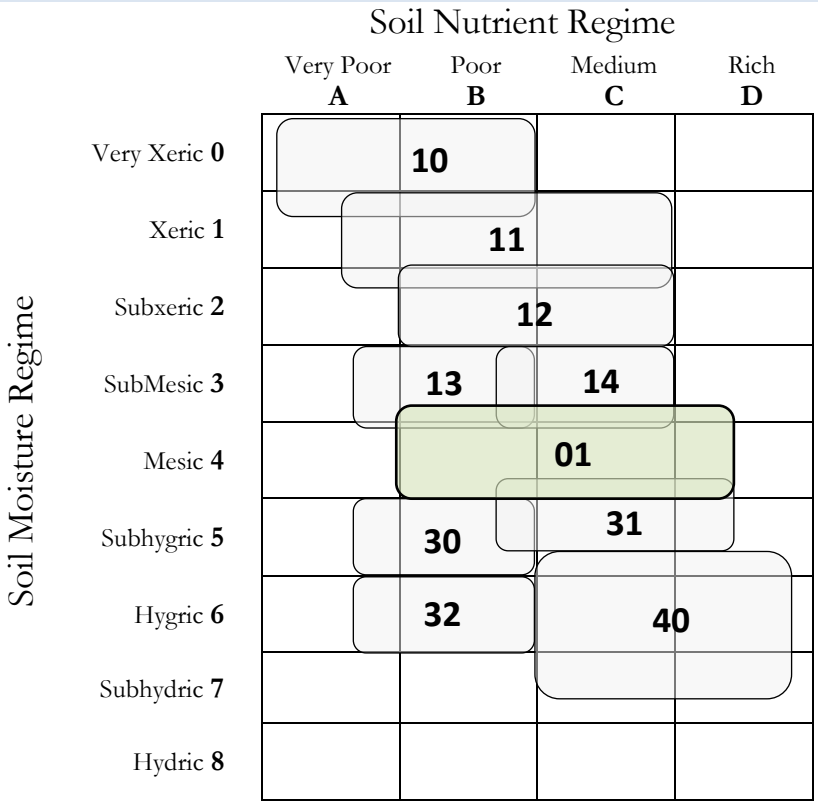
Soil Texture: SiS[1], Si[1]

Subalpine / Alpine Bioclimate Zones



10	Tors
11	Felsenmeer
12	Scrub birch – Mountain avens - Lichen
13	Scrub birch – Crowberry – Lowbush cranberry
14	Scrub birch – Willow – Mountain avens
01	Scrub birch – Lowbush cranberry – Feathermoss
31	Spruce – Scrub birch – Feathermoss
30	Scrub birch – Sedge – Feathermoss
32	Black Spruce – Labrador tea – Lowbush cranberry
40	Willow – Horsetail – Peatmoss

Scrub birch - Lowbush cranberry – Feathermoss (01)



Ecosite Description

The Scrub birch – Lowbush cranberry – Feathermoss ecosite is the zonal ecosystem of the subalpine zone and occurs on gentle-to-steep (primarily moderate), mid-to-upper slopes across a range of aspects. Within the LSA, the ecosite typically ranges from 1050-1450 m. The shrub layer is well developed and is dominated by scrub birch (*Betula glandulosa*). Also common in the shrub layer are Northern Labrador tea (*Rhododendron tomentosum*), Labrador tea (*Rhododendron groenlandicum*), lowbush cranberry (*Vaccinium vitis-idaea*) and willow species (including *Salix glauca* and *S. planifolia*). The herb layer is typically sparse with altai fescue (*Festuca altaica*) as the only characteristic species. The moss and lichen layer is well developed and contains a combination of feathermoss (*Pleurozium schreberi* and *Hylocomium splendens*) and reindeer lichen (*Cladina mitis, C. rangiferina*, and *C. stellaris*). Very low conifer tree cover (≤5%) is also common in the ecosite.

Areas disturbed by wildfire have a less diverse and abundant shrub layer, dominated by scrub birch, willow and bog blueberry (*Vaccinium uliginosum*). Altai fescue and fireweed (*Chamerion angustifolium*) dominate the more abundant herb layer, while the moss layer is dominated by fire moss (*Ceratodon purpureus*) and haircap mosses (*Polytrichum* spp.).

The soil moisture regime ranges from submesic-to-mesic and the soil nutrient regime ranges from poor-to-medium. The dominant rooting zone texture is silt loam and the drainage ranges from rapidly-to-moderately well. The parent material is weathered bedrock or colluvial.

Sample Plots: 28

Full	[1]
Ground	[8]
Visual	[19]





Characteristic Vegetation

Shrub layer:

[40] Scrub birch (*Betula glandulosa*)

[15] Labrador tea (*Rhododendron tomentosum, R. groenlandicum*)

[12] Lowbush cranberry (*Vaccinium vitis-idaea*)

[8] Willows (*Salix* spp.)

[7] Bog blueberry (*Vaccinium uliginosum*)

[7] Crowberry (*Empetrum nigrum*)

Herb layer:

[2] Altai fescue (*Festuca altaica*)

Moss/Lichen layer:

[28] Red-stemmed feathermoss (*Pleurozium schreberi*)

[23] Step moss (*Hylocomium splendens*)

[20] Reindeer lichens (*Cladina* spp.)

[7] Haircap mosses (*Polytrichum* spp.)

[3] Cetraria lichens (*Cetraria* spp.)

Site Characteristics

Moisture Regime: mesic[15], submesic[13]

Nutrient Regime: poor[17], medium[10]

Slope Gradient: 2-65 %, generally 20 %

Aspect: variable

Slope Position: upper slope[15], crest[7], midslope[5], lower slope[1]

Soil Characteristics

Organic Thickness: 2-20 cm

Humus Form: mor[16], moder[10]

Drainage: well[20], rapidly[6]

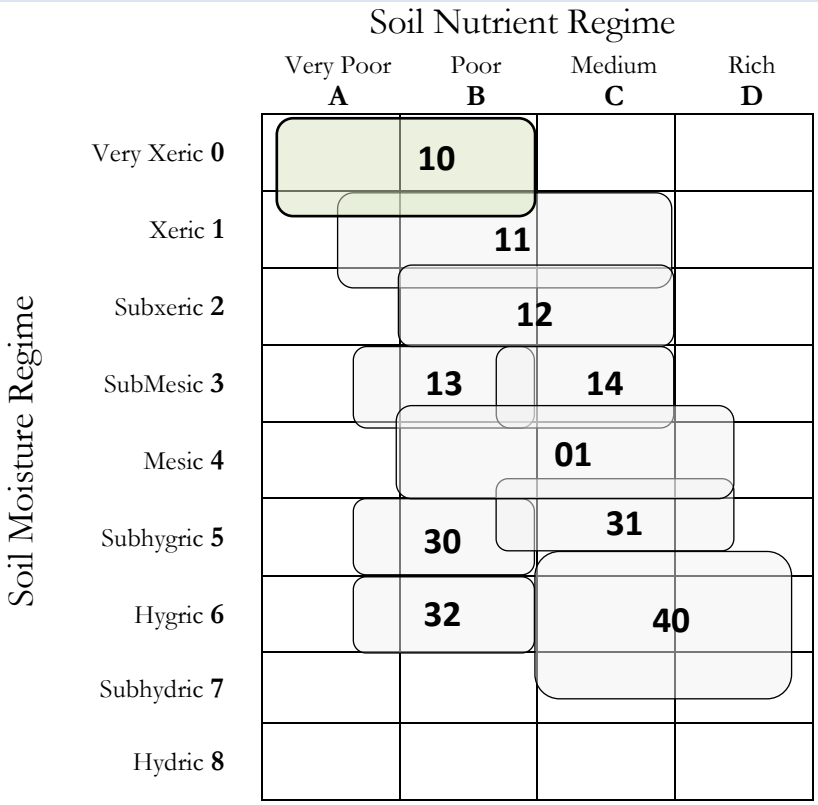
Seepage Water: absent

Permafrost: absent

Parent Material: D, C

Soil Texture: SiL[21], L[2], SL[1], FSL[1]

Tors (10)



Ecosite Description

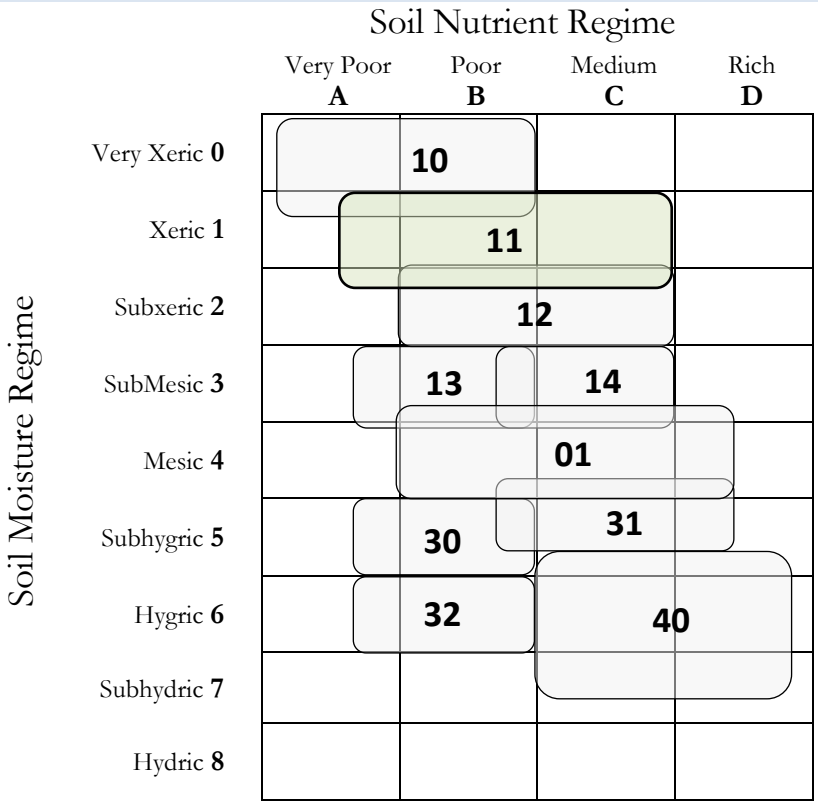
The Tors ecosite consists of protruding bedrock outcrops on summits and ridge crests. Vascular and non-vascular plants grow within the fractures and crevices of the rocks, and also form mats of vegetation perched on rock ledges. Within the ELC survey extent, the Tors ecosite has very limited extent and has not been sampled. Plant species found growing within Tors ecosystems in the adjacent Casino Project Study Area include prickly saxifrage (*Saxifraga tricuspidata*), alpine anemone (*Anemone drummondii*), arctic cinquefoil (*Potentilla nana*), sedges (*Carex* spp.), fragrant fern (*Dryopteris fragans*), step moss (*Hylocomium splendens*), rock-moss (*Racomitrium* spp.) and reindeer lichens (*Cladina* spp.; EDI 2013).

The soil moisture regime of the Tors ecosite is very xeric to xeric and the nutrient regime is very poor to poor. Soils are typically very rapidly drained, where present, and parent materials are commonly weather bedrock or blocky colluvium.

Sample Plots: 0

Full	[0]
Ground	[0]
Visual	[0]

Felsenmeer (11)



Ecosite Description

The Felsenmeer ecosite occurs on gentle-to-steep slopes across a range of aspects in crest and upper slope positions. Within the ELC survey extent, this ecosite is limited in extent and ranges between 1200-1600 m. Fifty to eighty percent of the substrate on these sites consists of boulders and cobbles, and vegetative cover is typically less than 40%. Consequently, vegetation establishment is limited to cracks, joints, and depressions between boulders where small amounts of organic matter, cobble and finer sediments have accumulated. Crustose lichens grow on rock faces, with fruiticose lichens, foliose lichens, mosses, and some rooted plants occupying pockets and depressions between boulders, or occurring as mats draped across boulders. Where soil accumulation is sufficient willow species (including *Salix arctica*, *S. glauca* and *S. pulchra*) are present. Dwarf shrubs including crowberry (*Empetrum nigrum*), lowbush cranberry (*Vaccinium vitis-idaea*) and mountain avens (*Dryas* spp.) often form mats over boulders. Herb species commonly present include alpine sweet grass (*Anthoxanthum monticola*), altai fescue (*Festuca altaica*), arctic lupine (*Lupinus arcticus*), and bistort (*Bistorta plumosa*). Rock-moss (*Racomitrium* spp.) is common.

The soil moisture regime of the Felsenmeer ecosite ranges from xeric to subxeric with a very poor to medium soil nutrient regime. Soil pockets are variable in size and extent, and the soil tends to be rapidly or very rapidly drained. Rooting zone soil texture is predominantly silt loam, overlaying weathered bedrock or colluvial parent materials that have undergone little transport from their source.

Sample Plots: 3

Full	[1]
Ground	[0]
Visual	[2]





Characteristic Vegetation

Shrub layer:

[8] Mountain avens (*Dryas* spp.)
[6] Willow (*Salix* spp.)
[1] Lowbush cranberry (*Vaccinium vitis-idaea*)
[2] Crowberry (*Empetrum nigrum*)

Herb layer:

[4] Alpine sweet grass (*Anthoxanthum monticola*)
[2] Altai fescue (*Festuca altaica*)
[2] Mountain sagewort (*Artemisia norvegica* ssp. *saxatilis*)
[1] Arctic lupine (*Lupinus arcticus*)
[.5] Arctic bluegrass (*Poa alpina*)
[.5] Bistort (*Bistorta plumosa*)
[.5] Alpine harebell (*Campanula lasiocarpa*)

Moss/Lichen layer:

[15] Rock mosses (*Racomitrium* spp.)
[8] Wiry fern moss (*Abietinella abietina*)
[8] Reindeer lichens (*Cladina* spp.)
[3] Cetraria lichens (*Cetraria* spp.)
[1] Haircap mosses (*Polytrichum* spp.)

Site Characteristics

Moisture Regime: subxeric[6], submesic[1]

Nutrient Regime: very poor[2], poor[1]

Slope Gradient: 2-65%

Aspect: variable

Slope Position: upper slope[2], crest[1]

Soil Characteristics

Organic Thickness: 0-26 cm

Humus Form: moder[1], mor[1]

Drainage: rapidly[2], very rapidly[1]

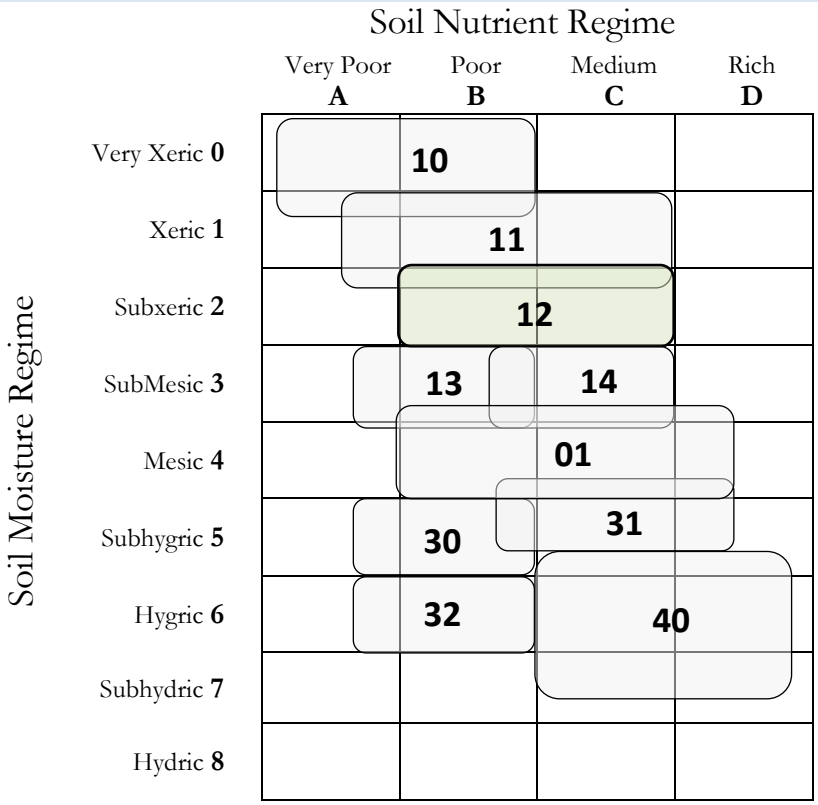
Seepage Water: absent

Permafrost: absent

Parent Material: D

Soil Texture: SiL[3]

Scrub birch – Mountain avens – Lichen (12)



Ecosite Description

The Scrub birch – Mountain avens – Lichen ecosite occurs on high elevation plateaus and gentle slopes on crest and upper slope positions, ranging from 1200-1450 m. The structural development of vegetation is limited by environmental conditions and communities are typically dominated by dwarf and low-growing shrubs and lichen. Mountain avens (*Dryas* spp.) dominate the dwarf shrub layer, with lesser components of lowbush cranberry (*Vaccinium vitis-idaea*), crowberry (*Empetrum nigrum*), and arctic willow (*Salix arctica*). Small patches of low-growing scrub birch (*Betula glandulosa*) and blue-green willow (*Salix glauca*) occur throughout the ecosite. The herb layer is very sparse and typically contains alpine sweet grass (*Anthoxanthum monticola*), sedges (*Carex* spp.) and prickly saxifrage (*Saxifraga tricuspidata*). The lichen layer is well developed and is dominated by reindeer lichens (*Cladina* spp.), Cetraria lichens (*Cetraria* spp.) and Alectoria lichens (*Alectoria* spp.).

The soil moisture regime is typically subxeric with a poor-to-medium soil nutrient regime. The dominant rooting zone soil textures are silt loam and sandy loam which are found over weathered bedrock and colluvial parent materials. The surface shape is typically convex, with rapidly- to-well drained soils.

Sample Plots: 7

Full	[1]
Ground	[3]
Visual	[3]





Characteristic Vegetation

Shrub layer:

[28] Mountain Avens (*Dryas* spp.)
[12] Scrub birch (*Betula glandulosa*)
[6] Lowbush cranberry (*Vaccinium vitis-idaea*)
[6] Artic willow (*Salix arctica*)
[5] Crowberry (*Empetrum nigrum*)
[2] Blue-green willow (*Salix glauca*)
[1] Alpine bearberry (*Arctous alpina*)*

Herb layer:

[1] Alpine sweet grass (*Anthoxanthum monticola*)
[.5] Sedges (*Carex* spp.)
[.5] Prickly saxifrage (*Saxifraga tricuspidata*) *
[.5] Alpine harebell (*Campanula lasiocarpa*)

Moss/Lichen layer:

[16] Cetraria lichens (*Cetraria* spp.)
[15] Alectoria lichens (*Alectoria* spp.)
[12] Reindeer lichens (*Cladina* spp.)

* Species characteristic of the phase but occurring in <60% of the sample plots with a prominence value <20

Site Characteristics

Moisture Regime: subxeric[7]

Nutrient Regime: poor[4], medium[3]

Slope Gradient: 3-15%

Aspect: variable

Slope Position: crest[5], upper slope[2]

Soil Characteristics

Organic Thickness: 3-5 cm

Humus Form: moder[4], mor[2]

Drainage: rapidly[4], well[2]

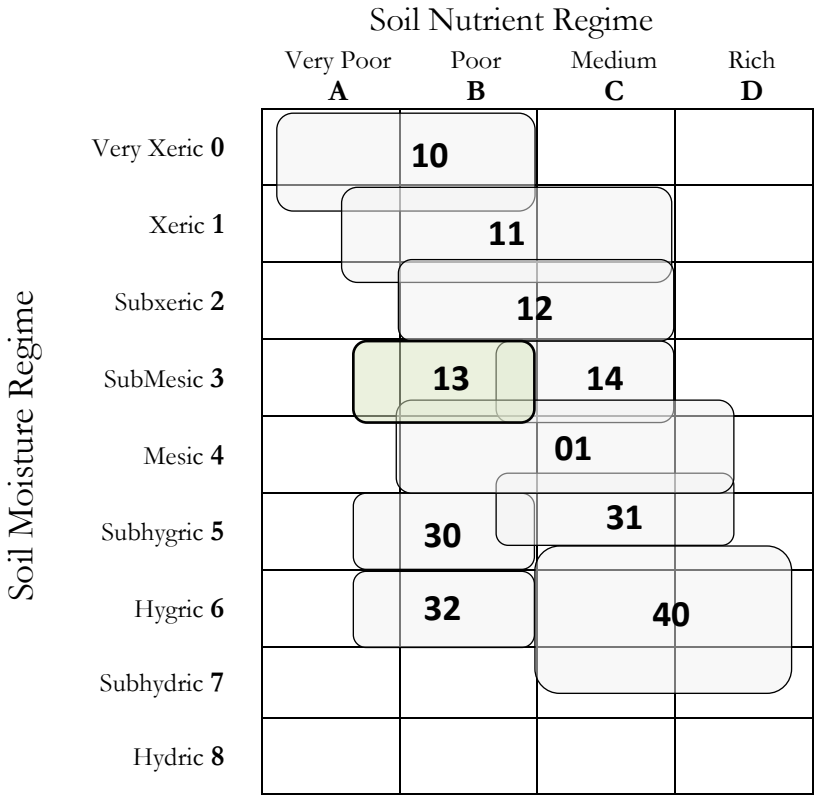
Seepage Water: absent

Permafrost: absent

Parent Material: D

Soil Texture: SiL[3], SL[3]

Scrub birch – Crowberry – Lowbush cranberry (13)



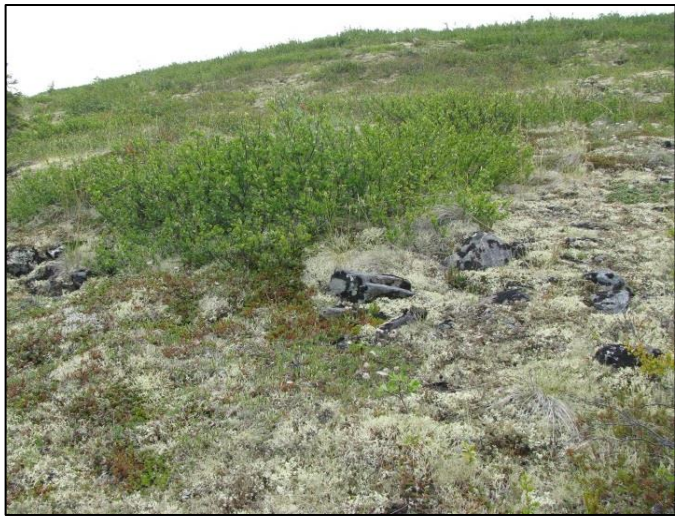
Ecosite Description

The Scrub birch – Crowberry – Lowbush Cranberry ecosite occurs primarily on cool, moderate, upper slopes, ranging from 1100-1450 m. The ecosite is shrub-dominated and characteristically contains exposed boulders and boulder channels. The shrub layer is composed of dwarf-to-medium growing shrubs and is typically dominated by scrub birch (*Betula glandulosa*) and crowberry (*Empetrum nigrum*) with lesser amounts of lowbush cranberry (*Vaccinium vitis-idaea*), Arctic white heather (*Cassiope tetragona*) and mountain avens (*Dryas* spp.). The herb layer is typically sparse and is dominated by alpine sweet grass (*Anthoxanthum monticola*) and altai fescue (*Festuca altaica*). Although low in percent cover, fragrant fern (*Dryopteris fragrans*) and prickly saxifrage (*Saxifraga tricuspidata*) are typically associated with the boulder channels within the ecosite. The moss and lichen layer is well developed and is dominated by reindeer lichens (*Cladina* spp.), Cetraria lichens (*Cetraria* spp.), red-stemmed feathermoss (*Pleurozium schreberi*) and haircap mosses (*Polytrichum* spp.).

The soil moisture regime of the Scrub birch – Crowberry – Lowbush Cranberry ecosite ranges from subxeric to mesic with a primarily poor soil nutrient regime. The dominant rooting zone soil textures are sandy loam and silt loam and the dominant parent materials are colluvial and weathered bedrock. Soils are rapidly-to-well drained.

Sample Plots: 13

Full	[1]
Ground	[7]
Visual	[5]





Characteristic Vegetation

Shrub layer:

[23] Scrub birch (*Betula glandulosa*)
[13] Crowberry (*Empetrum nigrum*)
[10] Lowbush cranberry (*Vaccinium vitis-idaea*)
[10] Arctic white heather (*Cassiope tetragona*)
[9] Blue-green willow (*Salix glauca*)
[8] Northern Labrador tea (*Rhododendron tomentosum*)
[5] Mountain Avens (*Dryas* spp.)

Herb layer:

[2] Alpine sweet grass (*Anthoxanthum monticola*)
[1] Altai fescue (*Festuca altaica*)
[.5] Fragrant fern (*Dryopteris fragrans*)
[.5] Prickly saxifrage (*Saxifraga tricuspidata*)

Moss/Lichen layer:

[22] Reindeer lichens (*Cladina* spp.)
[18] Cetraria lichens (*Cetraria* spp.)
[15] Red-stemmed feathermoss (*Pleurozium schreberi*)
[3] Haircap mosses (*Polytrichum* spp.)

Site Characteristics

Moisture Regime: submesic[9], subxeric[4], mesic[1]

Nutrient Regime: poor[10], medium[3]

Slope Gradient: 20-60 %, generally <45 %

Aspect: northerly[10], north-westerly[2], north-easterly[1]

Slope Position: upper slope[11], midslope[2]

Soil Characteristics

Organic thickness: 5-20 cm

Humus Form: mor[8], moder[4], fibric[1]

Drainage: rapidly[8], well[5]

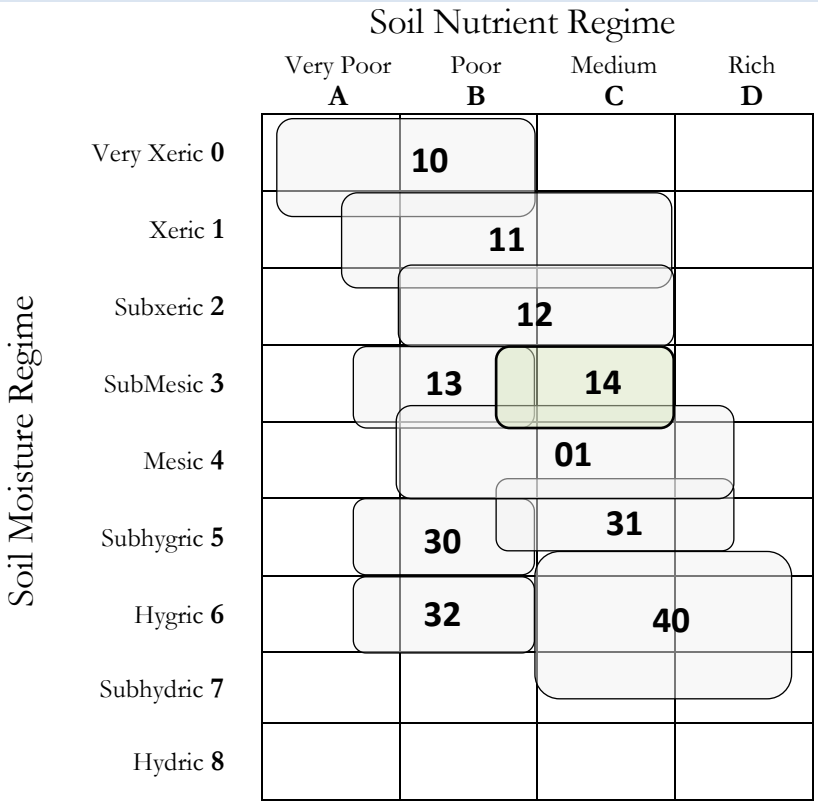
Seepage Water: absent

Permafrost: absent

Parent Material: C, D

Soil Texture: SL[5], SiL[4], FSL[2], L[1]

Scrub birch – Willow – Mountain avens (14)



Ecosite Description

The Scrub birch – Willow – Mountain avens ecosite occurs on gentle crests and upper slopes from approximately 1200 to 1500 m. The soils of this ecosite are typically shallow and exposed boulders and cobbles are common across the soil surface. The shrub layer is low in stature due to environmental limitations and is dominated by scrub birch (*Betula glandulosa*). Also common in the shrub layer are willows (including *Salix arctica* and *S. glauca*), mountain avens (*Dryas* spp.), lowbush cranberry (*Vaccinium vitis-idaea*) and crowberry (*Empetrum nigrum*). The herb layer is sparse, but commonly contains altai fescue (*Festuca altaica*) and arctic lupine (*Lupinus arcticus*). The lichen layer is well developed and contains a combination of reindeer lichens (*Cladina mitis, C. rangiferina*, and *C. stellaris*) and Cetraria lichens (*Cetraria* spp).

The soil moisture regime of the Scrub birch – Willow – Mountain avens ecosite ranges from subxeric-to-submesic and the soil nutrient regime ranges from poor-to-medium. The dominant rooting zone texture is silt loam and the drainage is typically rapid. The parent material is colluvial or weathered bedrock.

Sample Plots: 2

Full	[0]
Ground	[1]
Visual	[1]





Characteristic Vegetation

Shrub layer:

[59] Scrub birch (*Betula glandulosa*)

[15] Willow (*Salix* spp.)

[12] Mountain avens (*Dryas* spp.)

[10] Crowberry (*Empetrum nigrum*)

[8] Lowbush cranberry (*Vaccinium vitis-idaea*)

[3] White spruce (*Picea glauca*)

Herb layer:

[2] Altai fescue (*Festuca altaica*)

[1] Arctic lupine (*Lupinus arcticus*)

Moss/Lichen layer:

[26] Reindeer lichens (*Cladina* spp.)

[15] Cetraria lichens (*Cetraria* spp.)

Site Characteristics

Moisture Regime: subxeric[2]

Nutrient Regime: poor[1], medium[1]

Slope Gradient: typically <10 %

Aspect: variable

Slope Position: crest[2]

Soil Characteristics

Organic Thickness: 6-12 cm

Humus Form: mor[1], moder[1]

Drainage: rapidly[2]

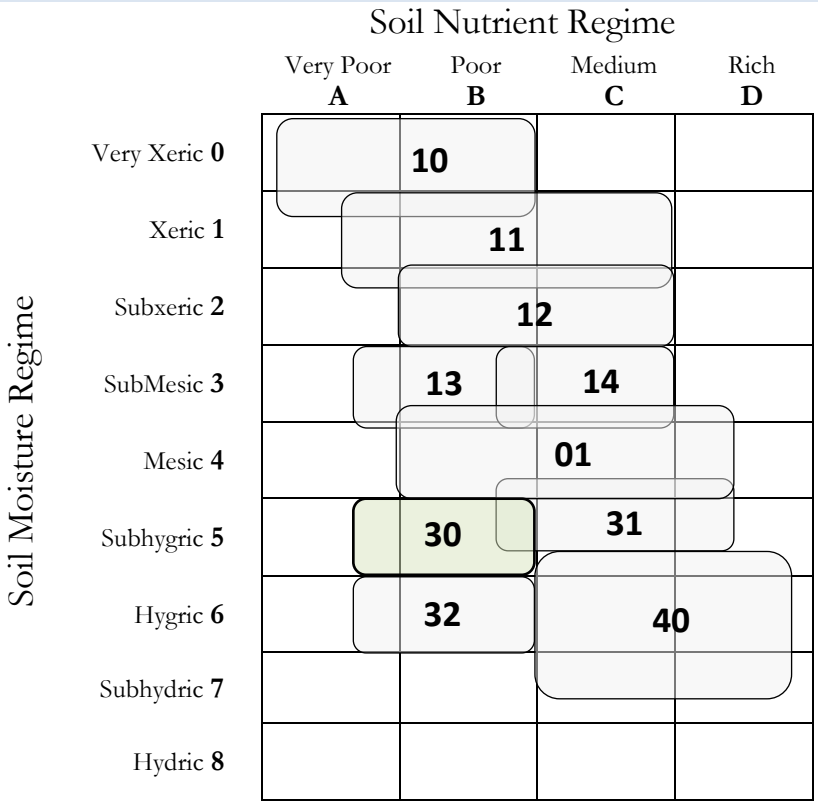
Seepage Water: absent

Permafrost: absent

Parent Material: D, C

Soil Texture: SiL[2]

Scrub birch – Sedge – Feathermoss (30)



Ecosite Description

The Scrub birch – Spruce muskeg sedge – Feathermoss ecosite occurs on gentle-to-moderate, lower-to-middle slopes with a neutral or northerly aspect. Within the LSA, the ecosite typically ranges from 1050-1450 m. The shrub layer is well developed and is dominated by scrub birch (*Betula glandulosa*) and willow species (including *Salix glauca*, *S. planifolia*, and *S. pulchra*). Also common in the shrub layer are lowbush cranberry (*Vaccinium vitis-idaea*), Northern Labrador tea (*Rhododendron tomentosum*), and crowberry (*Empetrum nigrum*). Spruce muskeg sedge (*Carex lugens*) is characteristic of the herb layer, although a low cover of sweet coltsfoot (*Petasites frigidus*) is also typically present. The moss and lichen layer is an important constituent of this ecosite, often having an 80% or greater cover. A combination of mosses and lichens are typically present, including red-stemmed feathermoss (*Pleurozium schreberi*), step moss (*Hylocomium splendens*), peat moss (*Sphagnum* spp.), reindeer lichen (*Cladina mitis, C. rangiferina*, and *C. stellaris*) and Cetraria lichens (*Cetraria* spp.)

The soil moisture regime of the Scrub birch / Spruce muskeg sedge / Feathermoss ecosite ranges from subhygric-to-hygric and has a poor-to-medium nutrient regime. The dominant rooting zone soil texture is silt loam overlaying colluvial or weathered bedrock parent material. Permafrost is almost always present within 50cm of the soil surface and soils are correspondingly imperfectly or poorly drained.

Sample Plots: 13

Full	[1]
Ground	[5]
Visual	[7]





Characteristic Vegetation

Shrub layer:

[25] Scrub birch (*Betula glandulosa*)

[13] Northern Labrador tea (*Rhododendron tomentosum*)

[12] Willows (*Salix* spp.)

[12] Lowbush cranberry (*Vaccinium vitis-idaea*)

[11] Labrador tea (*Rhododendron groenlandicum*)

[7] Crowberry (*Empetrum nigrum*)

[7] Bog blueberry (*Vaccinium uliginosum*)

Herb layer:

[8] Spruce muskeg sedge (*Carex lugens*)

[1] Sweet coltsfoot (*Petasites frigidus*)

Moss/Lichen layer:

[35] Step moss (*Hylocomium splendens*)

[24] Red-stemmed feathermoss (*Pleurozium schreberi*)

[14] Reindeer lichens (*Cladina* spp.)

[6] Cetraria lichens (*Cetraria* spp.)

[5] Peatmoss (*Sphagnum* spp.)

Site Characteristics

Moisture Regime: subhygric[8], hygric[3], mesic[2]

Nutrient Regime: poor[8], medium[5]

Slope Gradient: 2-25 %

Aspect: northerly[7], easterly[4], westerly[1]

Slope Position: midslope[8], upper slope[3], lower slope[1], level[1]

Soil Characteristics

Organic Thickness: 5-35 cm

Humus Form: fibric[8], mor[5]

Drainage: imperfectly[5], poorly[5], moderately well[2]

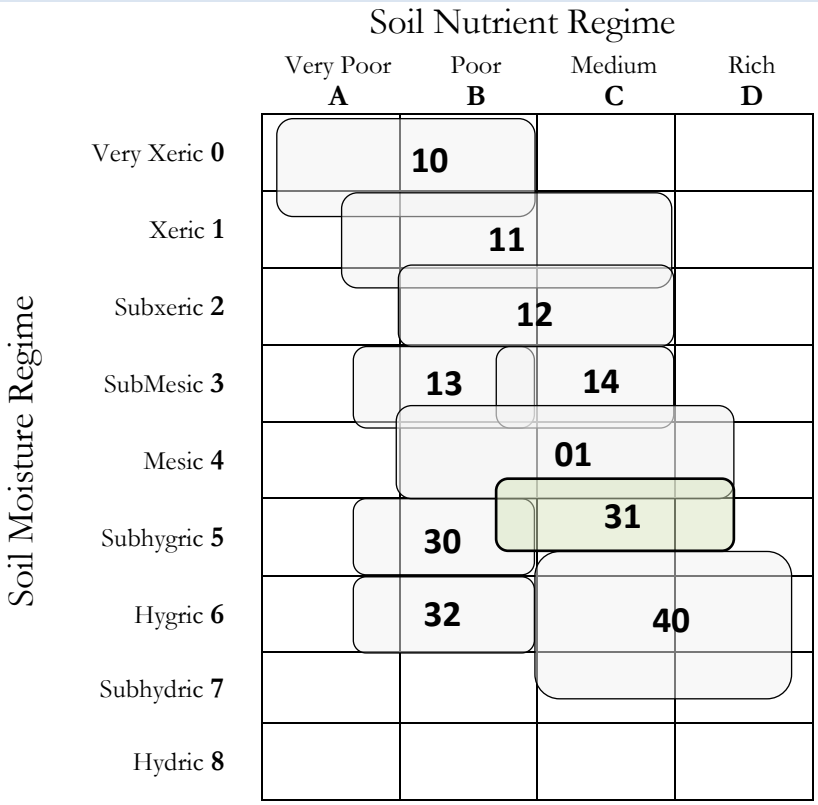
Seepage Water: present

Permafrost: present

Parent Material: D, C

Soil Texture: SiL[8], L[2], SiCL[1], SL[1]

Spruce – Scrub birch – Feathermoss (31)



Ecosite Description

The Spruce – Scrub birch – Feathermoss ecosite occurs on gentle-to-moderate, upper slopes across a range of aspects. Within the LSA, the ecosite typically ranges from 1050-1300 m. It is commonly found adjacent to the Boreal High Bioclimate zone boundary and is transitional between forested and shrub dominated ecosystems. A sparse conifer dominated canopy (~15% cover), composed of white and black spruce (*Picea glauca* and *P. mariana*) is characteristic of this ecosite. A minor component of subalpine fir (*Abies lasiocarpa*) can also occur. The shrub layer is well developed and is dominated by scrub birch (*Betula glandulosa*) and willow species (including *Salix glauca*, *S. planifolia* and *S. scouleriana*). Also common in the shrub layer are lowbush cranberry (*Vaccinium vitis-idaea*), Labrador tea (*Rhododendron groenlandicum*), and bog blueberry (*Vaccinium uliginosum*). The herb layer is variable with limited cover, but typically altai fescue (*Festuca altaica*) and tall bluebells (*Mertensia paniculata*) are present. The well-developed moss and lichen layer is dominated by step moss (*Hylocomium splendens*), red-stemmed feathermoss (*Pleurozium schreberi*), and reindeer lichens (*Cladina mitis, C. rangiferina*, and *C. stellaris*).

The soil moisture regime of the ecosite ranges from submesic-to-mesic and the soil nutrient regime ranges from poor-to-medium. The dominant rooting zone texture is silt loam and drainage ranges from well to moderately well. The parent material is weathered bedrock or colluvial.

Sample Plots: 6

Full	[1]
Ground	[4]
Visual	[1]





Characteristic Vegetation

Tree layer:

[10] White spruce (*Picea glauca*)

[5] Black spruce (*Picea mariana*)

Shrub layer:

[20] Scrub birch (*Betula glandulosa*)

[15] Willows (*Salix* spp.)

[6] Labrador tea (*Rhododendron groenlandicum, R. tomentosum*)

[8] Lowbush cranberry (*Vaccinium vitis-idaea*)

[8] Bog blueberry (*Vaccinium uliginosum*)

[6] Crowberry (*Empetrum nigrum*)

[3] Water birch (*Betula occidentalis*)

Herb layer:

[2] Altai fescue (*Festuca altaica*)

[1] Tall bluebells (*Mertensia paniculata*)

Moss/Lichen layer:

[27] Step moss (*Hylocomium splendens*)

[22] Red-stemmed feathermoss (*Pleurozium schreberi*)

[18] Reindeer lichens (*Cladina* spp.)

[4] Haircap mosses (*Polytrichum* spp.)

Site Characteristics

Moisture Regime: mesic[3], submesic[3]

Nutrient Regime: medium[5], poor[1]

Slope Gradient: 5-35 %

Aspect: variable

Slope Position: upper slope[6]

Soil Characteristics

Organic Thickness: 3-15 cm

Humus Form: moder[3], mor[3]

Drainage: rapidly[1], well[4], moderately well[1]

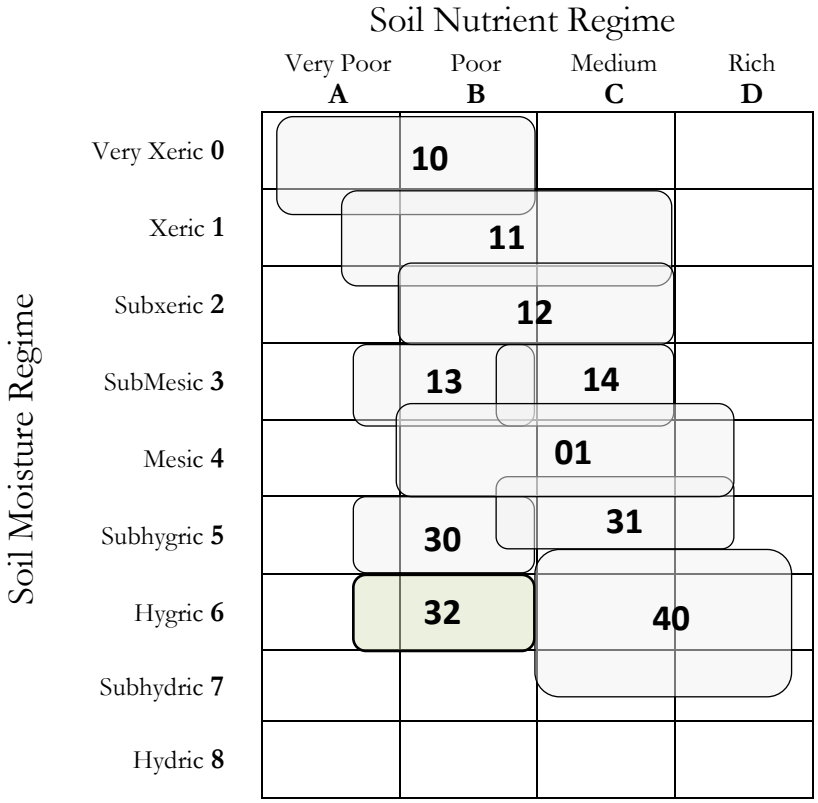
Seepage Water: absent

Permafrost: absent

Parent Material: C, D

Soil Texture: SiL[5], SL[1]

Black spruce – Labrador tea – Lowbush cranberry – Sedge (32)



Ecosite Description

The Black spruce – Labrador tea – Lowbush cranberry – Sedge ecosite occurs on gentle-to-moderate, lower-to-mid slopes, with a cool aspect. Within the LSA, the ecosite typically ranges from 1050-1250 m. Black spruce (*Picea mariana*) is the dominant tree species, but it tends to be stunted with a moderate-to-sparse canopy and is restricted to the shrub layer (i.e., <5m tall). The shrub layer is dominated by scrub birch (*Betula glandulosa*), Labrador tea (*Rhododendron groenlandicum*), lowbush cranberry (*Vaccinium vitis-idaea*) and willow species (including *Salix glauca*, *S. planifolia* and *S. lasiandra*). Spruce muskeg sedge (*Carex lugens*) dominates the herb layer; however cloudberry (*Rubus chamaemorus*) and sweet coltsfoot (*Petasites frigidus*) are also typically present. The moss and lichen layer is an important constituent of this ecosite, often with greater than 80% cover. A combination of mosses and lichens are typically present, including red-stemmed feathermoss (*Pleurozium schreberi*), step moss (*Hylocomium splendens*), peat mosses (*Sphagnum* spp.), reindeer lichens (*Cladina mitis, C. rangiferina*, and *C. stellaris*) and *Cetraria* spp.

The soil moisture regime ranges from subhygric-to-hygric and the nutrient regime is typically poor. The dominant rooting zone soil texture is silt loam overlaying colluvial parent material. Permafrost is almost always present within 50 cm of the soil surface and soils are correspondingly imperfectly or poorly drained.

Sample Plots: 7

Full	[1]
Ground	[1]
Visual	[4]





Characteristic Vegetation

Shrub layer:

[29] Black spruce (*Picea mariana*)

[12] Scrub birch (*Betula glandulosa*)

[11] Lowbush cranberry (*Vaccinium vitis-idaea*)

[8] Labrador tea (*Rhododendron groenlandicum*)

[8] Willows (*Salix* spp.)

[5] Crowberry (*Empetrum nigrum*)

[4] Bog blueberry (*Vaccinium uliginosum*)

Herb layer:

[6] Spruce muskeg sedge (*Carex lugens*)

[3] Cloudberry (*Rubus chamaemorus*)

[1] Sweet coltsfoot (*Petasites frigidus*)

Moss/Lichen layer:

[25] Step moss (*Hylocomium splendens*)

[21] Red-stemmed feathermoss (*Pleurozium schreberi*)

[20] Peat mosses (*Sphagnum* spp.)

[12] Reindeer lichens (*Cladina* spp.)

[2] Cetraria lichens (*Certraria* spp.)

[0.5] Arctic kidney lichen (*Nephroma arcticum*)

Site Characteristics

Moisture Regime: subhygric[4], hygric[3]

Nutrient Regime: poor[6], medium[1]

Slope Gradient: 2-55 %, typically >15%

Aspect: northerly[5], north-easterly[1], easterly[1]

Slope Position: lower slope[3], midslope[2], upper slope[2]

Soil Characteristics

Organic Thickness: 15-35 cm

Humus Form: fibric[2], moder[2], mesic[1]

Drainage: imperfectly[3], poorly[2], moderately well[2]

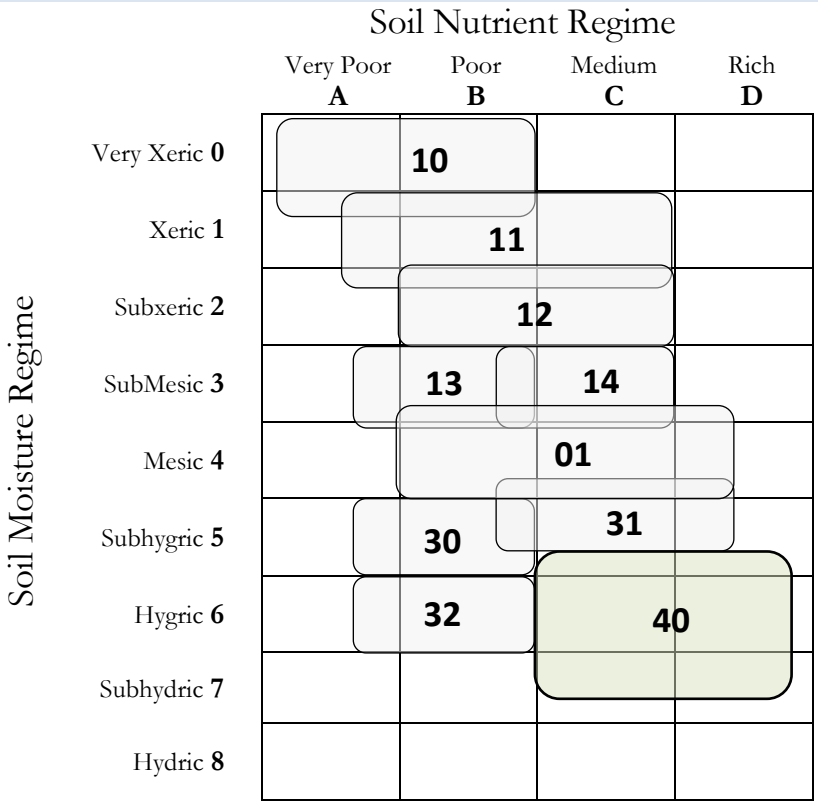
Seepage Water: present[3], absent[3]

Permafrost: present

Parent Material: C

Soil Texture: SiL[5], SL[1], L[1]

Willow – Horsetail – Peat moss (40)



Ecosite Description

The Willow – Horsetail – Peatmoss ecosite occurs along the channels of subalpine riverine habitats and side slope drainages where seasonal flooding is common (above 1150 m elevation). Willow species (including *Salix pulchra* and *S. planifolia*) are abundant and typically account for more than 60% of the shrub cover within these ecosystems. Other common shrub species include scrub birch (*Betula glandulosa*), bog blueberry (*Vaccinium uliginosum*), and Labrador tea (*Rhododendron groenlandicum*). The herb layer beneath the dense shrub layer is sparse and typically contains cloudberry (*Rubus chamaemorus*), sweet coltsfoot (*Petasites frigidus*), and horsetails (including *Equisetum pratense* and *E. sylvaticum*). The moss layer is dominated by peat moss (*Sphagnum* spp.); however Calligeron moss (*Calliergon* spp.) and leafy liverworts (*Barbilophozia* spp.) are also present.

The soil moisture regime of the Willow – Horsetail – Peatmoss ecosite is hygric and the soil nutrient regime ranges from medium-to-rich. Drainage is typically poor with seepage occurring within 30 cm of the soil surface. The parent material is typically fluvial and the rooting zone soil texture is silt loam or loam.

Sample Plots: 3

Full	[1]
Ground	[1]
Visual	[1]





Characteristic Vegetation

Shrub layer:

[53] Willows (*Salix* spp.)

[10] Scrub birch (*Betula glandulosa*)

[10] Bog blueberry (*Vaccinium uliginosum*)

[3] Black spruce (*Picea mariana*)

[4] Labrador tea (*Rhododendron groenlandicum, R. tomentosum*)

Herb layer:

[3] Horsetails (*Equisetum* spp.)

[2] Cloudberry (*Rubus chamaemorus*)

[2] Sweet coltsfoot (*Petasites frigidus*)

Moss/Lichen layer:

[45] Peat mosses (*Sphagnum* spp.)

[10] Calliergon mosses (*Calliergon* spp.)

[3] Leafy liverworts (*Barbilophozia* spp.)

Site Characteristics

Moisture Regime: hygric[3]

Nutrient Regime: medium[3]

Slope Gradient: 10-17 %

Aspect: north-easterly[2], northerly[1]

Slope Position: gully[2], midslope[1]

Soil Characteristics

Organic Thickness: 15-25 cm

Humus Form: fibric[2], moder[1]

Drainage: poorly[3]

Seepage Water: present

Permafrost: absent

Parent Material: F

Soil Texture: SiL[2], L[1]

APPENDIX D. LIST OF POTENTIAL RARE PLANT SPECIES FOR THE COFFEE LSA

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List of rare plant species with the potential to occur in the Coffee LSA

Type	Common name[2]	Scientific name[1]	Synonym[3]	YK Rank[4]
Aquatic	floating marsh-marigold	*Caltha natans* Pall.		Watch
Aquatic	pygmy waterlily	*Nymphaea tetragona* Georgi		Track
Aquatic	closed-leaved pondweed	*Potamogeton foliosus* ssp. *foliosus* Raf.		Watch
Aquatic	Yenisei river pondweed	*Potamogeton subsibiricus* Hagstr.		Track
Aquatic	northern arrowhead	*Sagittaria cuneata* E. Sheldon		Watch
Fern	northern beech fern	*Phegopteris connectilis* (Michx.) Watt		Track
Fern	holly fern	*Polystichum lonchitis* (L.) Roth		Watch
Forb	little leaf pussytoes	*Antennaria microphylla* Rydb.		Watch
Forb	Aleutian cress	*Aphragmus eschscholtzianus* Andrz. ex DC.		Track
Forb	Yukon woodworm	*Artemisia laciniata* ssp. *laciniata* Willd.		Track
Forb	green spleenwort	*Asplenium trichomanes-ramosum* L.		Track
Forb	Alaska moonwort	*Botrychium alaskense* W.H. Wagner & J.R. Grant		Track
Forb	linear-leaf moonwort	*Botrychium lineare* W.H. Wagner		Track
Forb	leatherleaf grapefern	*Botrychium multifidum* (S.G. Gmel.) Rupr.	*Botrychium multifidum* (Gmel.) Rupr. var. *multifidum*	Track
Forb	maple-leaf goosefoot	*Chenopodium simplex* (Torr.) Raf.		Watch
Forb	elk thistle	*Cirsium foliosum* (Hook.) DC.		Track
Forb	scamman's claytonia	*Claytonia scammaniana* Hultén		Watch
Forb	Alaska bugseed	*Corispermum ochotense* var. *alaskanum* Mosyakin		Track
Forb	spotted lady's slipper	*Cypripedium guttatum* Sw.		Watch
Forb	small yellow lady's-slipper	*Cypripedium parviflorum* Salisb.		Track
Forb	arctic larkspur	*Delphinium brachycentrum* Ledeb.		Track
Forb	kathul mountain draba	*Draba murrayi* G.A. Mulligan		Track
Forb	star-flowered draba	*Draba stenopetala* Trautv.		Track
Forb	Yukon whitlowgrass	*Draba yukonensis* A.E. Porsild		Track
Forb	creeping spike-rush	*Eleocharis uniglumis* (Link) Schult.		Watch
Forb	tundra fleabane	*Erigeron hyperboreus* Greene		Watch
Forb	Philadelphia fleabane	*Erigeron philadelphicus* var. *philadelphicus* L.		Watch
Forb	porsild's arctic fleabane	*Erigeron porsildii* G.L. Nesom & D.F. Murray	*E. grandiflorus* Hook. ssp. *arcticus* A.E. Porsild	Watch
Forb	alpine golden wild buckwheat	*Eriogonum flavum* var. *aquilinum* Reveal		Track
Forb	showy alpine forget-me-not	*Eritrichium splendens* Kearney		Track
Forb	pursh's wallflower	*Erysimum capitatum* var. *purshii* (Durand) Rollins	*Erysimum angustatum* Rydb.	Track
Forb	prairie smoke	*Geum triflorum* Pursh		Watch
Forb	beach-head iris	*Iris setosa* Pall. ex Link		Track
Forb	spiny-spored quillwort	*Isoetes echinospora* Durieu		Track

Type	Common name[2]	Scientific name[1]	Synonym[3]	YK Rank[4]
Forb	maritime quillwort	*Isoetes maritima* Underw.		Track
Forb	island koenigia	*Koenigia islandica* L.		Watch
Forb	spiked saxifrage	*Micranthes spicata* (D. Don) Small		Track
Forb	Yukon goldenweed	*Nestotus macleanii* (Brandegee) R.P. Roberts, Urbatsch & Neubig		Track
Forb	Mertens' oxytrope	*Oxytropis mertensiana* Turcz.		Track
Forb	scamman's oxytrope	*Oxytropis scammaniana* Hultén		Watch
Forb	coffee creek scorpionweed	*Phacelia mollis* J.F. Macbr.		Watch
Forb	macound's woodroot	*Podistera macounii* (J.M. Coult. & Rose) Mathias & Constance		Watch
Forb	Yukon podistera	*Podistera yukonensis* Mathias & Constance		Track
Forb	arctic primrose	*Primula pumila* (Ledeb.) Pax	*Primula eximia* Greene	Watch
Forb	mount sheldon butterweed	*Senecio sheldonensis* A.E. Porsild		Track
Forb	william's catchfly	*Silene williamsii* Britton		Track
Forb	blue eyed grass	*Sisyrinchium montanum* var. *montanum* Green		Watch
Forb	water-parsnip	*Sium suave* Walter		Watch
Forb	porsild's false candytuft	*Smelowskia porsildii* (W.H. Drury & Rollins) Jurtzev	*Smelowskia calycina* var. *integrifolia* (Seem.) Rollins	Track
Forb	Alaska starwort	*Stellaria alaskana* Hultén		Track
Forb	matted starwort	*Stellaria dicranoides* (Cham. & Schltdl.) Fenzl		Track
Forb	Yukon aster	*Symphyotrichum yukonense* (Cronquist) G.L. Nesom		Track
Forb	pink dandelion	*Taraxacum carneocoloratum* A. Nelson		Track
Forb	hooker's townsendia	*Townsendia hookeri* Beaman		Watch
Forb	arctic yellow violet	*Viola biflora* var. *biflora*		Track
Graminoid	Idaho bentgrass	*Agrostis clavata* Trin.	*Agrostis filiculmis* M.E. Jones	Track
Graminoid	spike-oat	*Avenula hookeri* (Scribn.) Holub	*Helictotrichon hookeri* (Scribn.) Henrard	Watch
Graminoid	Lapland sedge	*Carex lapponica* O. Lang		Watch
Graminoid	weak sedge	*Carex laxa* Wahlenb.		Track
Graminoid	peck's sedge	*Carex peckii* Howe		Watch
Graminoid	long-styled sedge	*Carex stylosa* C.A. Mey.		Watch
Graminoid	meadow barley	*Hordeum brachyantherum* ssp. *brachyantherum* Nevski		Watch
Graminoid	oriental June grass	*Koeleria asiatica* Domin		Track
Graminoid	hairy wood rush	*Luzula rufescens* Fisch. ex E. Mey.		Watch
Graminoid	reed canarygrass	*Phalaris arundinacea* L.		Watch
Graminoid	short bluegrass	*Poa abbreviata* ssp. *abbreviata* R. Br.		Track
Graminoid	Patterson bluegrass	*Poa abbreviata* ssp. *pattersonii* (Vasey) Á. Löve, D. Löve & B.M. Kapoor	*Poa jordalii* A.E. Porsild	Track

Type	Common name[2]	Scientific name[1]	Synonym[3]	YK Rank[4]
Graminoid	viviparous alpine bluegrass	*Poa alpina ssp. vivipara* (L.) Arcang.		Watch
Graminoid	Siberian false oats	*Trisetum sibiricum* ssp. *sibiricum* Rupr.		Track
Shrub	bog birch, dwarf birch	*Betula pumila* L.	*Betula pumila* var. *glandulifera* Regel	Watch

1 Primary reference flora used was the online version of the Flora of North America (2014, 2015, 2016). Where species information was not available online, Integrated Taxonomic Information System (ITIS; 2015) was used. Reference flora for Bryophyte species was the online version of Bryophyte Flora of North America (2015). Lichen species were referenced using Lichens of North America (Brodo *et al.* 2011).

2 Common names not provided by 1) Flora of North America (2014, 2015, 2016), or 2) Flora of the Yukon Territory (Cody 2000) are from Klinkenberg (2015).

3 Synonyms are provided for the Flora of the Yukon Territory (Cody 2000).

4 Yukon conservation status rank. Track = plants that are of conservation concern in Yukon. Watch = plants for which more information is needed before a conservation status can be determined, but which may be threatened or endangered in Yukon or throughout their range (Yukon CDC 2016).

5 This species was down-listed in 2014 and is no longer considered rare following field surveys within the Project area.

APPENDIX E. DENSITY DISTRIBUTION CLASSES FOR INVASIVE PLANT SURVEYS (ADAPTED FROM LUTTMERDING *ET AL.* 1990)

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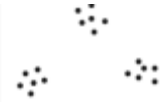
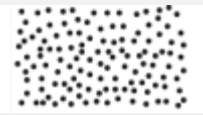
Density distribution classes for invasive plant surveys, 2015 and 2016 (Adapted from Luttmerding *et al.* 1990)

Class	Density Distribution	No. of plants in 20 m x 20 m area	No. of plants/ha 100 m x 100 m	Diagram	Approximate % Cover Range
1	rare individual, a single occurrence	1	≤5		1-5
2	a few sporadically occurring individuals	2-5	5-50		1-5
3	a single patch or clump of species	1 patch (occupying an area smaller than one quadrant of the plot)	variable (3 patches)		1-10
4	several sporadically occurring individuals	≥6	≥50		5-10
5	a few patches or clumps of species	2-5 patches (each occupying an area smaller than one quadrant of the plot)	variable (3-10 patches)		10-30
6	several well-spaced patches or clumps	≥6 patches (each occupying less than one quadrant of the plot)	variable (10-many disjunct patches)		10-30
7	continuous occurrence of a species with a few gaps in the distribution	many	many (some openings)		30-60
8	continuous dense occurrence of a species	many	many		>60

Notes: The density distribution class is determined over a sufficiently large area to account for normal variation in distribution pattern.

APPENDIX F. INVASIVE PLANT SPECIES LOCATIONS

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Invasive plant species found in the northern portion of survey extent, road survey 2015

Segment	KM[1]	Smooth Brome	Narrow-leaved Hawksbeard	White Sweetclover	Yellow Sweetclover	Common Dandelion	Alsike Clover	Kentucky Bluegrass	Other Spp.[2]	Notes
1	1-2	0	7	6	6	5	2	0	0	Start at North Klondike Highway and Hunker Creek Road, driving south
2	2-4	5	6	6	4	2	2	0	0	-
3	4-6	5	5	6	5	5	5	0	0	-
4	6-8	5	2	2	0	2	2	0	0	-
5	8-10	5	2	0	0	2	2	0	0	-
6	10-12	0	7	0	0	0	0	0	0	-
7	12-14	6	5	0	0	2	2	0	0	Continue along Hunker Creek Road to Sulphur Creek Road and Eureka Ridge
8	14-16	0	2	0	0	0	3	0	0	-
9	16-18	2	2	0	0	3	5	0	0	-
10	18-20	0	0	0	0	0	2	2	0	Pullout, clearing
11	20-22	0	0	0	0	0	0	0	0	-
12	22-24	0	0	0	0	0	0	0	0	-
13	24-26	2	0	0	0	2	2	2	3	*Silene vulgaris* and *Elymus repens*; *Silene* was hand-pulled and bagged.
14	26-28	0	0	0	0	3	0	0	0	-
15	28-30	0	0	0	0	0	0	2	0	-
16	30-32	0	0	0	0	3	0	2	0	-

Segment	KM[1]	Smooth Brome	Narrow-leaved Hawksbeard	White Sweetclover	Yellow Sweetclover	Common Dandelion	Alsike Clover	Kentucky Bluegrass	Other Spp.[2]	Notes
17	32-34	2	2	0	0	2	0	2	0	-
18	34-36	0	2	0	0	2	0	0	0	-
19	36-38	0	2	0	0	5	2	5	0	Pullout, clearing
20	38-40	0	7	0	0	5	0	2	0	-
21	40-42	0	7	0	0	5	3	2	0	-
22	42-44	4	5	0	0	5	0	0	0	-
23	44-46	0	7	0	0	3	2	2	0	-
24	46-48	0	0	0	0	0	0	5	0	-
25	48-50	0	0	0	0	3	0	5	0	-
26	50-52	0	2	0	0	0	0	5	0	-
27	52-54	2	0	0	0	2	0	5	0	-
28	54-56	3	2	0	0	2	0	0	0	-
29	56-58	5	5	0	0	3	5	0	0	-
30	58-60	0	2	0	0	0	3	0	0	-
31	60-62	0	2	0	0	2	0	0	0	-
32	62-64	0	2	0	0	3	3	0	0	-

Segment	KM[1]	Smooth Brome	Narrow-leaved Hawksbeard	White Sweetclover	Yellow Sweetclover	Common Dandelion	Alsike Clover	Kentucky Bluegrass	Other Spp.[2]	Notes
33	64-66	0	2	0	0	0	0	0	0	-
34	66-68	0	5	0	0	0	0	0	0	-
35	68-70	0	2	0	0	2	0	0	0	-
36	70-72	0	5	0	0	5	2	0	0	-
37	72-74	0	5	0	0	5	2	0	0	-
38	74-76	0	2	0	0	2	0	0	0	-
39	76-78	0	2	0	0	0	0	3	0	-
40	78-80	0	0	0	0	0	0	5	0	-
41	80-82	0	0	0	0	0	0	3	0	-
42	82-84	0	0	0	0	0	0	0	0	-
43	84-86	0	0	0	0	0	0	0	0	-
44	86-88	0	0	0	0	0	0	0	0	-
45	88-90	0	0	0	0	0	0	2	0	-
46	90-92	0	0	0	0	0	0	0	0	-
47	92-94	0	0	0	0	0	0	0	0	-
48	94-96	0	0	0	0	0	0	0	0	-

Segment	KM[1]	Smooth Brome	Narrow-leaved Hawksbeard	White Sweetclover	Yellow Sweetclover	Common Dandelion	Alsike Clover	Kentucky Bluegrass	Other Spp.[2]	Notes
49	96-98	0	2	0	0	0	2	2	0	-
50	98-100	0	2	0	0	3	3	0	0	-
51	100-102	0	2	0	0	2	0	0	0	Survey southern section of Black Hills Road, drive north and complete west and east arm of Black Hills
52	102-104	0	0	0	0	0	0	0	2	*Capsella bursa- pastoris*
53	104-106	0	0	0	0	0	0	0	0	-
54	106-108	0	2	0	0	2	0	0	0	-
55	108-110	0	0	0	0	0	0	0	0	-
56	110-112	0	0	0	0	0	0	0	0	-
57	112-114	0	0	0	0	2	0	0	0	-
58	114-116	0	0	0	0	0	0	5	0	-
59	116-118	0	0	0	0	3	0	0	0	-
60	118-120	0	0	0	0	0	0	5	0	-
61	120-122	0	0	0	0	0	0	5	0	-
62	122-124	0	0	0	0	0	0	2	0	-
63	124-126	0	0	0	0	0	0	5	0	-

Segment	KM[1]	Smooth Brome	Narrow-leaved Hawksbeard	White Sweetclover	Yellow Sweetclover	Common Dandelion	Alsike Clover	Kentucky Bluegrass	Other Spp.[2]	Notes
64	126-128	0	0	0	0	0	0	0	0	-
65	128-130	0	0	0	0	3	0	5	0	-
66	130-132	0	0	0	0	0	0	5	0	-
67	132-134	0	0	0	0	0	0	5	0	-
68	134-136	0	0	0	0	5	0	6	0	-
69	136-140	0	2	0	0	0	0	5	0	-
70	140-142	0	0	0	0	0	0	2	0	-
71	142-144	0	2	3	0	2	0	0	0	-
72	144-146	0	4	5	0	5	0	0	0	-
73	146-148	0	7	0	0	5	0	0	0	-
74	148-150	0	7	0	0	5	0	0	0	-
75	150-152	0	2	0	0	0	0	0	0	-
76	152-154	0	4	0	0	0	0	0	0	-
77	154-156	0	2	0	0	0	0	0	0	-
78	156-158	0	2	0	0	0	0	0	0	-
79	158-160	0	0	0	0	0	0	0	0	-

Segment	KM[1]	Smooth Brome	Narrow-leaved Hawksbeard	White Sweetclover	Yellow Sweetclover	Common Dandelion	Alsike Clover	Kentucky Bluegrass	Other Spp.[2]	Notes
80	160-162	0	0	8	0	0	0	0	0	Survey along Bonanza Creek Road & Dominion Road
81	162-164	0	2	7	0	1	0	0	0	-
82	164-166	0	0	5	0	0	0	0	0	-
83	166-168	0	2	5	0	2	3	0	3	*Trifolium pratense*
84	168-170	0	2	3	0	2	3	0	1	*Taraxaxum officinale*
85	170-172	0	2	3	0	2	2	0	1	*Caragana arborescens* at Dredge No. 4
86	172-174	0	2	5	0	2	0	0	0	-
87	174-176	3	0	0	0	2	2	3	0	-
88	176-178	0	4	5	0	2	3	2	0	-
89	178-180	0	0	0	0	0	3	6	0	-
90	180-182	0	0	0	0	0	0	5	0	-
91	182-184	0	5	0	0	2	3	5	0	-
92	184-186	0	0	0	0	0	0	5	0	-
93	186-188	0	0	0	0	3	0	5	0	-
94	188-190	0	0	0	0	3	0	5	0	-
95	190-192	0	0	0	0	0	0	5	0	-

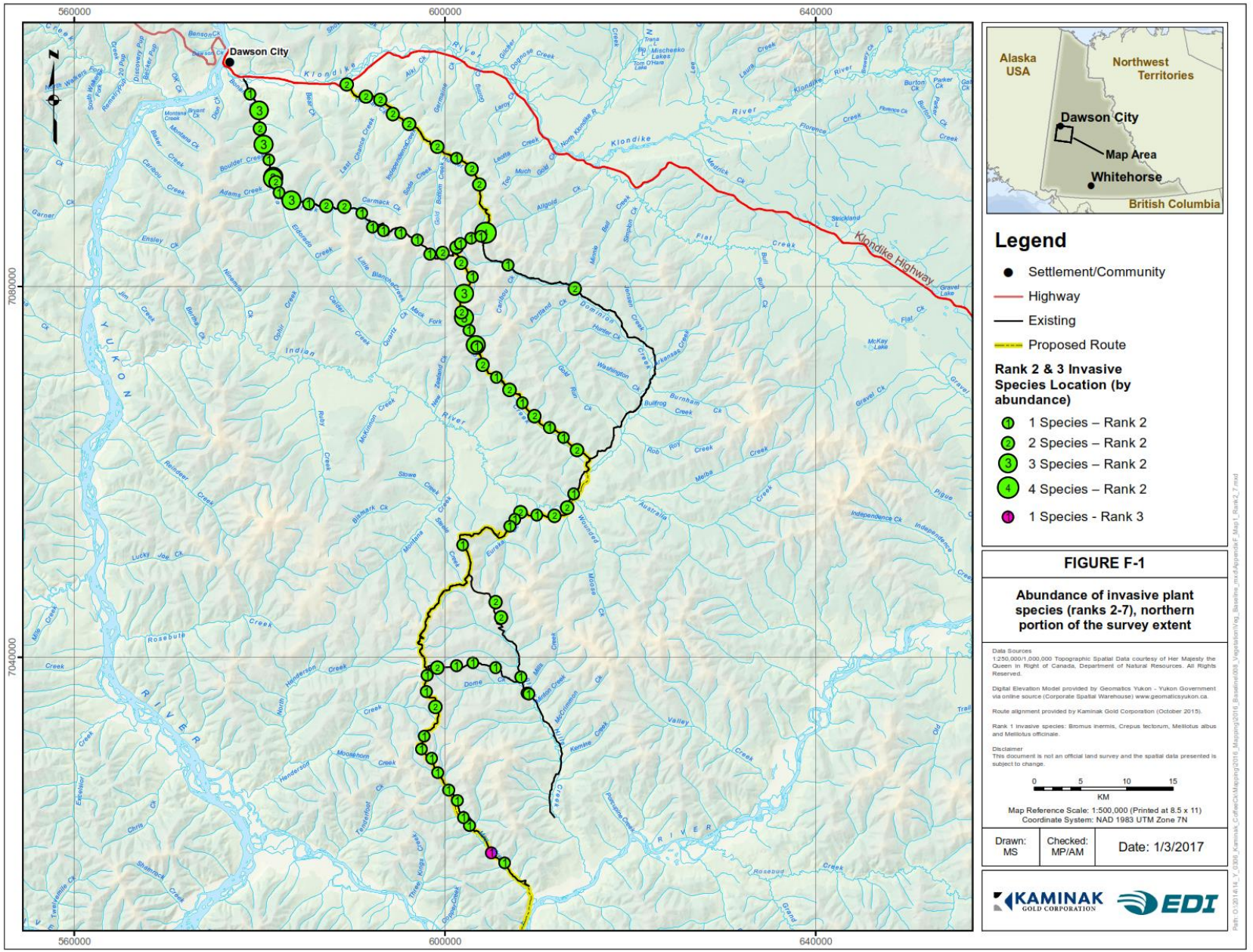
Segment	KM[1]	Smooth Brome	Narrow-leaved Hawksbeard	White Sweetclover	Yellow Sweetclover	Common Dandelion	Alsike Clover	Kentucky Bluegrass	Other Spp.[2]	Notes
96	192-194	0	0	0	0	0	0	2	0	-
97	194-196	0	2	0	0	0	0	5	0	-
98	196-198	0	0	0	0	0	0	5	0	-
99	198-200	0	0	0	0	0	0	5	0	Start of Dominion Road, drive south
100	200-202	0	2	0	0	0	0	2	0	-
101	202-204	0	4	0	0	2	0	2	0	-
102	204-206	0	5	0	0	0	0	2	0	-
103	206-208	0	5	0	0	0	0	0	0	-
104	208-210	0	2	0	0	0	0	2	0	-
105	210-212	2	2	0	0	0	0	0	0	-
106	212-214	0	2	0	0	0	0	0	0	-
107	214-216	0	0	0	0	0	0	0	0	-
108	216-218	0	6	0	0	2	0	2	0	-
109	218-220	0	7	0	0	0	0	0	0	-
110	220-222	0	7	0	0	0	0	0	0	-
111	222-224	0	7	0	0	0	0	0	0	-

Segment	KM[1]	Smooth Brome	Narrow-leaved Hawksbeard	White Sweetclover	Yellow Sweetclover	Common Dandelion	Alsike Clover	Kentucky Bluegrass	Other Spp.[2]	Notes
112	224-226	0	5	0	0	0	0	0	0	-
113	226-228	0	5	0	0	0	0	0	0	-
114	228-230	0	4	0	0	0	0	0	0	-
115	230-232	0	6	0	0	0	0	0	0	-
116	232-234	0	6	0	0	0	0	0	0	-
117	234-236	0	5	0	0	0	0	0	0	-
118	236-238	0	5	0	0	0	0	0	0	Most southern end of Dominion Road

Values represent density distribution classes (refer to Appendix E for definitions; sourced from Luttmerding *et al.* 1990).

[1] KM markers are approximate and based on 2 KM transects.

[2] Includes less common invasive plant species observed during the Northern Access Route survey.


560000
600000
640000
7080000
7040000
Dawson City
Klondike Highway
YUKON RIVER
Alaska USA
Northwest Territories
Dawson City
Map Area
Whitehorse
British Columbia
Legend
Settlement/Community
Highway
Existing
Proposed Route
Rank 2 & 3 Invasive Species Location (by abundance)
1 Species – Rank 2
2 Species – Rank 2
3 Species – Rank 2
4 Species – Rank 2
1 Species - Rank 3
FIGURE F-1
Abundance of invasive plant species (ranks 2-7), northern portion of the survey extent
Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen In Right of Canada, Department of Natural Resources. All Rights Reserved.
Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.
Route alignment provided by Kaminak Gold Corporation (October 2015).
Rank 1 invasive species: Bromus inermis, Crepus tectorum, Melilotus albus and Melilotus officinale.
Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.
0 5 10 15
KM
Map Reference Scale: 1:500,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N
Drawn: MS
Checked: MP/AM
Date: 1/3/2017
KAMINAK GOLD CORPORATION
EDI

Invasive plant species found in the southern portion of survey extent, road survey 2016

Segment	KM[1]	Smooth Brome	Narrow-leaved Hawksbeard	White Sweetclover	Yellow Sweetclover	Common Dandelion	Alsike Clover	Kentucky Bluegrass	Notes
1	1-3	0	**2**	0	0	0	0	0	-
2	3-5	0	0	0	0	0	0	0	-
3	5-7	0	0	0	0	0	0	0	-
4	7-9	0	0	0	0	0	0	0	-
5	9-11	0	0	0	0	0	0	0	-
6	11-13	0	0	0	0	0	0	0	-
7	13-15	0	0	0	0	0	0	0	-
8	15-17	0	0	0	0	0	0	0	-
9	17-19	0	0	0	0	0	0	0	-
10	19-21	0	**1**	0	0	0	0	0	One flowering individual; picked, bagged and incinerated onsite

Values represent density distribution classes (refer to Appendix E for definitions; sourced from Luttmerding *et al.* 1990).

[1] KM markers are approximate and based on 2 KM transects.

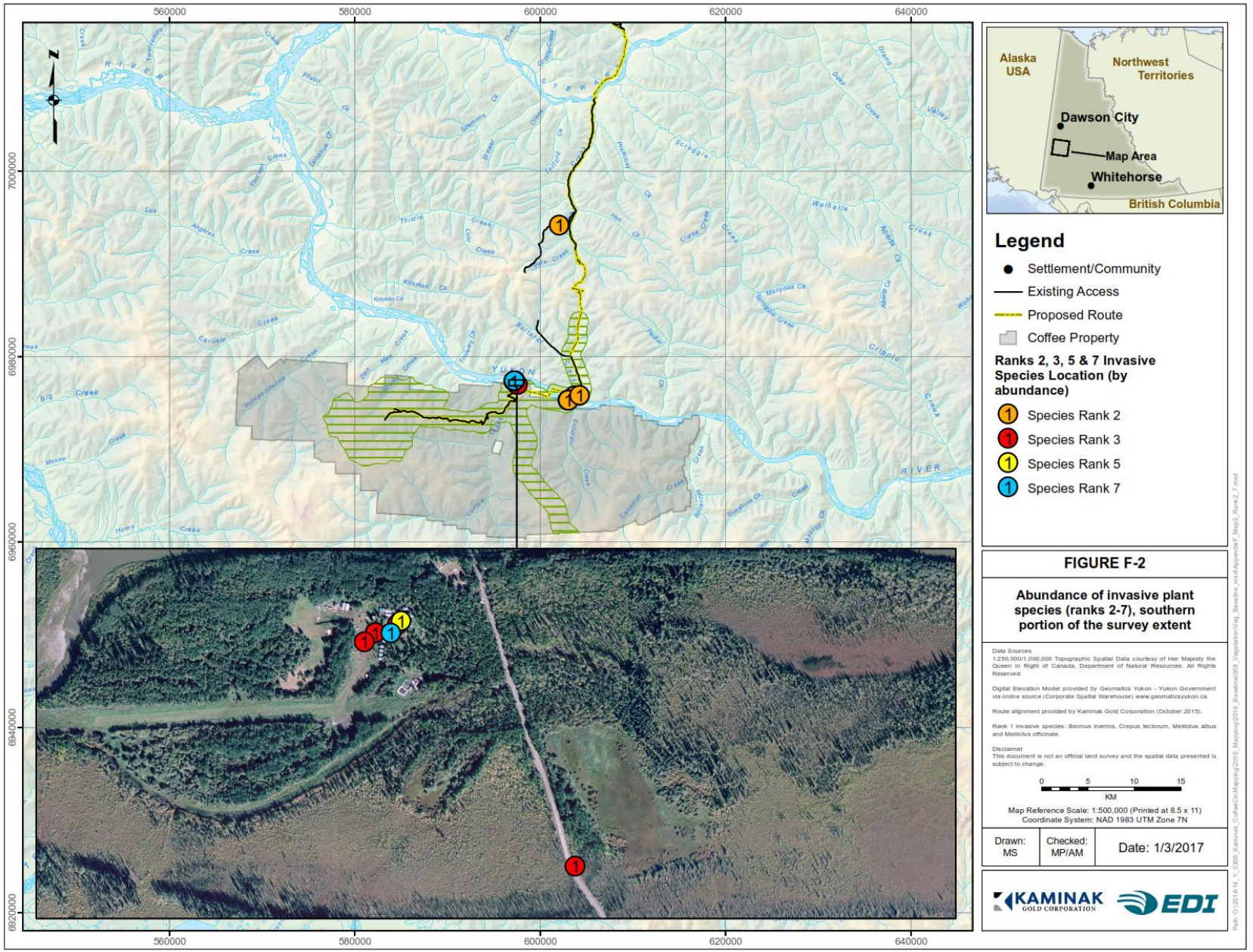
Invasive plant species found in the southern portion of survey extent, walking surveys 2015 and 2016

Species name	Common name	Latitude	Longitude	Habitat Type	Density Distribution[1]	Notes
Bromus inermis	Smooth brome	63.2432	-138.8107	Clearing; Coffee Camp	8	All around Coffee Camp
Bromus inermis	Smooth brome	62.91325	-139.0887	Clearing	7	*Old Maisey May farm, field of smooth brome and fireweed ~10,000 m²; site was accessed via helicopter
Capsella bursa-pastoris	Shepherd's purse	62.9095	-139.079679	Clearing; Coffee Camp	6	Scattered around Coffee Camp
Chenopodium album	Lamb's-quarters	62.9132	-139.0862	Clearing; Coffee Camp	4	Scattered around Coffee Camp
Crepis tectorum	Narrow-leaved hawksbeard	63.1093	-138.9549	Road	7	100 m transect
Crepis tectorum	Narrow-leaved hawksbeard	63.1093	-138.9549	Clearing	4	South of the junction for Barker route, 250 m² area, edge of burn on switchback in clearing/equipment storage
Crepis tectorum	Narrow-leaved hawksbeard	63.1093	-138.9549	Road	7	1 patch 30 m²
Crepis tectorum	Narrow-leaved hawksbeard	62.9545	-139.0223	Clearing	7	1 large patch ~5000 m², several trucks and old buildings, open area close to stream
Crepis tectorum	Narrow-leaved hawksbeard	62.9566	-139.0245	Road	5	1 patch ~30 m²
Crepis tectorum	Narrow-leaved hawksbeard	62.9081	-139.0789	Clearing; Coffee airstrip	6	Approximately 100 individuals removed
Crepis tectorum	Narrow-leaved hawksbeard	62.9076	-139.0760	Clearing; Coffee airstrip	6	Approximately 100 individuals removed
Crepis tectorum	Narrow-leaved hawksbeard	62.9082	-139.0704	Clearing; Coffee airstrip	8	Largest patch at airstrip 225 m² area, requires follow-up management
Crepis tectorum	Narrow-leaved hawksbeard	62.9075	-139.0788	Clearing; Coffee airstrip	6	Fuel tanks at Coffee airstrip; approximately 100x2 m patch
Crepis tectorum	Narrow-leaved hawksbeard	62.9076	-139.0788	Clearing; Coffee airstrip	1	Edge of fuel tanks at Coffee airstrip; one patch

Species name	Common name	Latitude	Longitude	Habitat Type	Density Distribution[1]	Notes
Crepis tectorum	Narrow-leaved hawksbeard	62.9075	-139.0846	Java Road	2	KM 1 on west side of Coffee airstrip near wind sock
Crepis tectorum	Narrow-leaved hawksbeard	62.9076	-139.0786	Java Road	2	KM 1 on north side of Coffee airstrip; approximately 300x1 m patch
Crepis tectorum	Narrow-leaved hawksbeard	62.8798	-139.3627	Java Road	1	KM 21; one flowering individual, picked, bagged and incinerated onsite
Matricaria discoidea	Pineapple weed	62.9133	-139.0854	Clearing; Camp	6	Scattered around Coffee Camp
Melilotus albus	White sweetclover	62.8928	-138.9723	Clearing	3	1 patch at Ballarat barge along north bank of Yukon River, plants were removed.
Melilotus albus	White sweetclover	63.1093	-138.9549	Clearing	3	South of the junction for Barker route, 250 m², edge of burn on switchback in clearing/ equipment storage; plants were removed.
Melilotus albus	White sweetclover	62.9520	-139.0183	Clearing	1	Few individuals, hand-pulled
Melilotus albus	White sweetclover	62.9520	-139.0183	Road	1	1 plant removed
Melilotus albus	White sweetclover	62.9165	-138.9491	Road	4	20 plants removed
Plantago major	Great plantain	62.9133	-139.0853	Clearing; Coffee Camp	6	Scattered around Coffee Camp
Sinapis alba	White mustard	62.9132	-139.0856	Other; garden box outside Camp kitchen	1	Planted in garden box
Sonchus arvensis ssp. *arvensis*	Perennial sow-thistle	62.9082	-139.0785	Clearing; Coffee airstrip near fuel drums	2	Found when waiting for plane to arrive, did not have access to GPS or camera; four individuals; flowering heads were picked, bagged and put in the incinerator; approx. location (Latitude 62.9082, Longitude -139.0785).
Taraxacum officinale	Common dandelion	62.8970	-138.9584	Clearing	2	Few scattered individuals at Ballarat barge along north bank of Yukon River, not hand-pulled
Taraxacum officinale	Common dandelion	62.8930	-138.9730	Road	1	1 plant
Taraxacum officinale	Common dandelion	62.8930	-138.9723	Clearing	7	Airstrip along Barker Creek, plants very large and healthy, other plants present were *Hordeum jubatum* and *Elymus trachycaulus*

Species name	Common name	Latitude	Longitude	Habitat Type	Density Distribution[1]	Notes
Taraxacum officinale	Common dandelion	62.8974	-138.9478	Road	2	few plants
Taraxacum officinale	Common dandelion	63.0626	-138.9796	Road	1	1 plant
Thlaspi arvense	Field pennycress	62.9130	-139.0866	Clearing; Coffee Camp	5	Scattered around Coffee Camp

[1] Values sourced from Luttmerding *et al.* 1990; refer to Appendix E for definitions.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Northwest Territories
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Map Area
Whitehorse
British Columbia
Legend
Settlement/Community
Existing Access
Proposed Route
Coffee Property
Ranks 2, 3, 5 & 7 Invasive Species Location (by abundance)
Species Rank 2
Species Rank 3
Species Rank 5
Species Rank 7
FIGURE F-2
Abundance of invasive plant species (ranks 2-7), southern portion of the survey extent
Data Sources
1:250,000/1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.
Digital Elevation Model provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.
Route alignment provided by Kaminak Gold Corporation (October 2015).
Rank 1 invasive species: Bromus inermis, Crepus tectorum, Melilotus albus and Melilotus officinale.
Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.
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KM
Map Reference Scale: 1:500,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N
Drawn: MS
Checked: MP/AM
Date: 1/3/2017
KAMINAK GOLD CORPORATION
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APPENDIX G. VEGETATION AND SOIL TRACE METALS SAMPLE SITE LOCATIONS

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Vegetation and soil trace metals sample sites, 2014-2016

Location	Distance Category[1]	Site	Location		UTM Zone (7N)	# of Samples	Species Collected[2]	Transect[3]	Year
			Easting	Northing					
Coffee Area	Adjacent	CCHMA-21	583487	6973572	4	S, W, L, C	-	2014	
Coffee Area	Adjacent	CCHMA-39	584710	6973498	5	S, W, H, L, C	-	2014	
Coffee Area	Adjacent	CCHMA-50	579744	6973002	4	S, W, L, C	-	2014	
Coffee Area	Adjacent	CCTMA-628	586941	6973925	4	S, W, L, C	Transect 1	2016	
Coffee Area	Adjacent	CCTMA-619	584298	6972457	5	S, W, H, L, C	Transect 11	2016	
Coffee Area	Adjacent	CCTMA-622	585146	6972820	4	S, W, L, C	Transect 12	2016	
Coffee Area	Adjacent	CCTMA-626	585820	6975288	4	S, W, L, C	Transect 2	2016	
Coffee Area	Adjacent	CCTMA-627	584290	6975416	5	S, W, H, L, C	Transect 3	2016	
Coffee Area	Adjacent	CCTMA-623	583327	6974659	4	S, W, L, C	Transect 4	2016	
Coffee Area	Adjacent	CCTMA-631	582532	6974820	4	S, W, L, C	Transect 5	2016	
Coffee Area	Adjacent	CCTMA-600	579395	6972911	4	S, W, L, C	Transect 7	2016	
Coffee Area	Adjacent	CCTMA-601	581016	6971713	4	S, W, L, C	Transect 8	2016	
Coffee Area	Adjacent	CCTMA-632	582999	6972624	4	S, W, L, C	Transect 9	2016	
Coffee Area	Near	CCHMA-98	599779	6965785	4	S, W, L, C	-	2014	
Coffee Area	Near	CCHMA-106	598384	6969684	4	S, W, L, C	-	2014	
Coffee Area	Near	CCHMA-299	598458	6970041	2	S, H	-	2014	
Coffee Area	Near	CCHMA-135	584702	6972062	3	S, H, C	-	2014	
Coffee Area	Near	CCHMB-76	597532	6976362	4	S, W, L, C	-	2014	
Coffee Area	Near	CCHMB-92	601841	6962653	2	S, H	-	2014	
Coffee Area	Near	CCHMB-410	601935	6961852	4	S, W, L, C	-	2014	
Coffee Area	Near	CCHMB-419	598578	6971398	2	S, H	-	2014	
Coffee Area	Near	CCHMB-422	598825	6970580	5	S, W, H, L, C	-	2014	
Coffee Area	Near	CCHMB-113	588990	6973231	2	S, W	-	2014	
Coffee Area	Near	CCHMB-120	590301	6973176	3	S, W, C	-	2014	
Coffee Area	Near	CCHMB-130	595839	6974105	4	S, W, H, C	-	2014	
Coffee Area	Near	CCTMA-629	590024	6974220	3	S, L, C	Transect 1	2016	
Coffee Area	Near	CCTMB-621	584987	6971458	3	S, L, C	Transect 11	2016	
Coffee Area	Near	CCTMB-634	586152	6972368	4	S, W, L, C	Transect 12	2016	
Coffee Area	Near	CCTMB-625	586521	6975931	4	S, W, L, C	Transect 2	2016	
Coffee Area	Near	CCTMB-624	584741	6976510	3	S, L, C	Transect 3	2016	
Coffee Area	Near	CCTMB-630	582848	6975526	4	S, W, L, C	Transect 4	2016	
Coffee Area	Near	CCTMB-633	581197	6974342	4	S, W, L, C	Transect 6	2016	
Coffee Area	Near	CCTMB-603	578466	6972880	4	S, W, L, C	Transect 7	2016	
Coffee Area	Near	CCTMB-602	579714	6970666	4	S, W, L, C	Transect 8	2016	
Coffee Area	Near	CCTMB-620	582546	6971515	4	S, W, L, C	Transect 9	2016	
Coffee Area	Far	CCHMB-164	583420	6973834	4	S, W, L, C	-	2014	
Coffee Area	Far	CCHMB-440	597868	6974816	4	S, W, H, C	-	2014	
Coffee Area	Far	CCHMB-843	585391	6974038	4	S, W, L, C	-	2014	
Coffee Area	Far	CCHMB-138	584781	6971753	5	S, W, H, L, C	-	2014	

Location	Distance Category[1]	Site	Location		UTM Zone (7N)	# of Samples	Species Collected[2]	Transect[3]	Year
			Easting	Northing					
Coffee Area	Far	CCHMC-55	578452	6971148	4	S, W, L, C	-	2014	
Coffee Area	Far	CCHMC-59	578394	6971848	3	S, W, H	-	2014	
Coffee Area	Far	CCHMC-62	584347	6970033	4	S, W, L, C	-	2014	
Coffee Area	Far	CCTMC-613	584253	6966085	4	S, W, L, C	Transect 10	2016	
Coffee Area	Far	CCTMC-612	589500	6965882	4	S, W, L, C	Transect 11	2016	
Coffee Area	Far	CCTMC-611	596022	6968511	3	S, L, C	Transect 12	2016	
Coffee Area	Far	CCTMC-606	591161	6979095	4	S, W, L, C	Transect 2	2016	
Coffee Area	Far	CCTMC-607	588011	6981306	4	S, W, L, C	Transect 3	2016	
Coffee Area	Far	CCTMC-608	579583	6978574	4	S, W, L, C	Transect 5	2016	
Coffee Area	Far	CCTMC-609	575259	6976307	5	S, W, H, L, C	Transect 6	2016	
Coffee Area	Far	CCTMC-604	571999	6973526	5	S, W, H, L, C	Transect 7	2016	
Coffee Area	Far	CCTMC-605	574742	6966413	4	S, W, L, C	Transect 8	2016	
Coffee Area	Far	CCTMC-610	579588	6964959	4	S, W, L, C	Transect 9	2016	
Coffee Area	Control	CCTMR-614	562527	6970562	4	S, W, L, C	Moose Mt	2016	
Coffee Area	Control	CCTMR-615	562244	6970134	4	S, W, L, C	Moose Mt	2016	
Coffee Area	Control	CCTMR-616	562302	6969616	4	S, W, L, C	Moose Mt	2016	
Coffee Area	Control	CCTMR-617	562664	6969244	4	S, W, L, C	Moose Mt	2016	
Coffee Area	Control	CCTMR-618	563152	6969075	4	S, W, L, C	Moose Mt	2016	
Coffee Area	Control	CCTMR-635	596932	6989830	4	S, W, L, C	Thistle Mt	2016	
Coffee Area	Control	CCTMR-636	596728	6990306	4	S, W, L, C	Thistle Mt	2016	
Coffee Area	Control	CCTMR-637	597050	6990697	4	S, W, L, C	Thistle Mt	2016	
Coffee Area	Control	CCTMR-638	597482	6990970	4	S, W, L, C	Thistle Mt	2016	
Coffee Area	Control	CCTMR-639	597498	6991481	4	S, W, L, C	Thistle Mt	2016	
Coffee Area	-	CCHMC-69	582515	6970004	4	S, W, H, C	-	2014	
Coffee Area	-	CCHMC-81	577747	6974381	4	S, W, L, C	-	2014	
Coffee Area	-	CCHMC-400	584781	6971753	4	S, W, L, C	-	2014	
Coffee Area	-	CCHMC-436	587857	6975551	4	S, W, H, C	-	2014	
Coffee Area	-	CCHMA-30A	582129	6974317	3	S, W, H	-	2014	
Coffee Area	-	CCHMA-851	584855	6974143	4	S, W,L, C	-	2014	
Coffee Area	-	CCHMA-38	585055	6973272	4	S, W, L, C	-	2014	
Coffee Area	-	CCTMA-BD5	596554	6975730	3	S, W, H	-	2014	
Coffee Area	-	CCHMB-20	583162	6972867	4	S, W, L, C	-	2014	
Coffee Area	-	CCHMB-28A	581838	6974643	4	S, W, L, C	-	2014	
Coffee Area	-	CCHMB-49	579615	6972752	4	S, W, L, C	-	2014	
Northern Access Route	-	CCTM502	598713	6988961	4	S, W, L, C	-	2015	
Northern Access Route	-	CCTM507	603767	6991322	4	S, W, H, L	-	2015	
Northern Access Route	-	CCTM510	604478	6984640	4	S, W, L, C	-	2015	
Northern Access Route	-	CCTM500	610349	7014338	3	S, W, H	-	2015	
Northern Access Route	-	CCTM501	601053	6975567	5	S, W, H, L, C	-	2015	
Northern Access Route	-	CCTM503	604863	6987586	3	S, H, C	-	2015	
Northern Access Route	-	CCTM504	602192	6975029	3	S, H, C	-	2015	

Location	Distance Category[1]	Site	Location		UTM Zone (7N)	# of Samples	Species Collected[2]	Transect[3]	Year
			Easting		Northing				
Northern Access Route	-	CCTM505	603378		6980401	4	S, W, L, C	-	2015
Northern Access Route	-	CCTM506	599896		6984660	4	S, W, H, C	-	2015
Northern Access Route	-	CCTM508	614504		7019383	3	S, W, H	-	2015
Northern Access Route	-	CCTM509	604505		6985536	4	S, W, H, C	-	2015
Northern Access Route	-	CCTM511	608229		7009997	4	S, W, L, C	-	2015
--	**Total Sites**	**89**	--		**Total Samples**	**327**	--	--	--

[1] 2014 distance categories were preliminary (adjacent 0-25 m; near 75-250 m; far 1.5-2.5 km); In 2016, dust isopleth modelling was available and distance categories were revised to better represent site conditions (adjacent 100 m; near 1000 m; far 5.5-7.5 km; control ≥15 km)

[2] S = soil; W = willow; H = horsetail; L = lichen; C = cranberry

[3] Transects were incorporated in 2016 as part of the revised study design

APPENDIX H. VEGETATION AND SOIL TRACE METALS SAMPLING LABORATORY RESULTS

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2014 Willow trace metal analysis (n=32), sample sites CCHMWB-20 to CCHMWC-62

Parameter[1]	CCHMWB-20	CCHMWA-21	CCHMWB-28A	CCHMWA-30A	CCHMWA-38	CCHMWA-39	CCHMWB-49	CCHMWA-50	CCHMWC-55	CCHMWC-59	CCHMWC-62	RDL[2]
Aluminum	11.8	13.0	18.0	6.2	27.0	9.4	24.1	16.8	36.3	9.3	41.4	1.0
Antimony	<0.0050	<0.0050	<0.0050	<0.0050	0.0052	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.063	0.124	<0.050	<0.050	<0.050	0.050
Barium	15.6	23.6	13.9	8.25	35.2	25.5	22.4	11.0	28.8	14.9	52.8	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	6.9	2.2	4.7	3.5	3.3	5.5	6.2	3.8	4.3	4.6	3.8	2.0
Cadmium	0.671	0.721	0.589	0.290	0.592	0.627	1.20	0.951	0.606	0.951	1.80	0.010
Calcium	8530	7430	4680	3860	7820	5670	5810	3310	7160	5880	12300	10
Chromium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	0.257	0.443	1.91	0.575	1.51	0.244	0.282	0.186	0.686	0.283	1.01	0.020
Copper	2.72	3.39	2.29	2.76	4.49	2.42	3.31	1.99	4.26	3.39	3.84	0.050
Iron	41	42	56	44	64	38	56	44	67	58	72	10
Lead	0.023	0.014	0.021	0.013	0.042	0.027	0.039	0.022	0.034	0.022	0.032	0.010
Magnesium	1240	2080	1270	805	3080	1310	1920	1030	2950	2140	3800	10
Manganese	136	247	517	328	164	200	276	503	166	241	298	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	0.160	0.087	0.093	0.109	0.323	0.086	0.053	0.082	0.059	0.070	0.094	0.050
Nickel	1.49	3.83	1.02	0.635	3.66	0.276	1.45	0.888	3.21	0.915	3.10	0.050
Phosphorus	749	1020	834	960	2310	657	928	736	1040	927	1880	10
Potassium	11400	7040	5990	7600	10900	8300	7350	5000	5370	4760	9230	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	11	17	<10	<10	<10	11	<10	<10	<10	10
Strontium	18.3	21.4	22.8	29.1	44.5	18.5	29.9	19.3	38.5	29.3	81.9	0.10
Thallium	<0.0020	0.0040	<0.0020	<0.0020	<0.0020	<0.0020	0.0037	<0.0020	0.0028	<0.0020	0.0025	0.002
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	1.4	<1.0	1.6	1.0
Uranium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0021	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	94.1	49.2	92.9	39.7	43.1	65.6	146	135	35.0	107	43.9	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2014 Willow trace metal analysis (n=32), sample sites CCHMWB-76 to CCHMWB-422

Parameter[1]	CCHMWB76	CCHMWC-81	CCHMWA-106	CCHMWB-113	CCHMWB-120	CCHMWB-130	CCHMWB-138	CCHMWB-164	CCHMWC-400	CCHMWB-410	CCHMWB-422	RDL[2]
Aluminum	26.8	33.7	27.1	19.8	94.7	52.0	11.2	36.7	32.1	28.5	28.2	1.0
Antimony	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0057	<0.0050	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.053	<0.050	0.050
Barium	12.5	39.2	76.7	31.2	84.3	133	24.7	49.9	57.1	19.8	51.6	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	7.9	3.5	2.2	10.4	11.1	16.6	7.7	3.9	3.3	4.7	3.6	2.0
Cadmium	0.804	0.669	0.912	0.973	0.911	2.74	2.70	0.702	1.24	0.558	0.523	0.010
Calcium	13500	8640	13600	9740	12100	10300	8330	14200	7450	5340	11800	10
Chromium	0.24	<0.20	<0.20	<0.20	0.35	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	0.180	2.05	1.98	0.570	1.31	1.27	0.218	1.98	0.944	0.263	1.34	0.020
Copper	2.17	3.03	3.22	2.81	2.99	3.12	4.20	2.99	2.52	4.07	3.95	0.050
Iron	58	118	49	50	97	57	55	64	60	66	78	10
Lead	0.031	0.030	0.059	0.020	0.057	0.025	0.015	0.032	0.044	0.042	0.019	0.010
Magnesium	3110	2580	2400	2640	4000	1910	2250	3040	3080	1840	2430	10
Manganese	195	331	451	141	214	376	434	315	250	92.6	349	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	0.514	0.070	0.081	0.180	0.109	0.614	0.196	0.059	0.056	0.101	0.144	0.050
Nickel	0.997	2.81	3.84	1.54	3.15	2.60	2.36	3.32	2.71	1.91	4.12	0.050
Phosphorus	664	1170	2300	2830	2730	3620	1510	1500	1810	1030	1880	10
Potassium	5060	7110	8550	7790	9730	9550	7480	8410	7290	6340	9910	10
Selenium	<0.050	<0.050	0.119	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	12	<10	<10	<10	<10	<10	244	<10	<10	10
Strontium	37.3	54.6	66.3	31.0	86.1	64.0	45.0	67.3	54.3	23.0	34.3	0.10
Thallium	0.0023	0.0040	0.0025	0.0025	0.0036	<0.0020	<0.0020	0.0075	0.0038	<0.0020	<0.0020	0.002
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	1.8	1.2	1.2	1.1	3.3	1.4	<1.0	1.3	1.2	1.4	1.3	1.0
Uranium	<0.0020	0.0048	0.0034	<0.0020	0.0040	0.0021	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	147	27.4	26.3	86.3	77.2	90.6	294	31.2	43.1	57.2	75.4	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2014 Willow trace metal analysis (n=32), sample sites CCHMWC-436 to CCTMWA

Parameter[1]	CCHMWC-436	CCHMWC-438	CCHMWB-843	CCHMWA-851	CCHMWA-851 r	CCTMWC-BD1	CCTMWC-BD3-r[2]	CCTMWC-BD4	CCTMWA-BD5	CCTMWC-	CCTMWA-	RDL[3]
Aluminum	6.1	9.6	53.7	136	295	42.8	17.3	20.9	104	19.6	100	1.0
Antimony	<0.0050	<0.0050	0.0139	0.0446	0.0982	<0.0050	<0.0050	<0.0050	0.0096	<0.0050	0.0091	0.005
Arsenic	<0.050	<0.050	0.126	0.679	1.48	<0.050	<0.050	<0.050	0.089	<0.050	0.078	0.050
Barium	33.4	13.0	40.2	42.6	54.6	36.3	26.6	12.8	48.0	15.9	47.1	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	2.7	7.5	4.3	<2.0	3.7	4.9	6.0	7.5	5.8	5.5	9.8	2.0
Cadmium	0.780	0.526	0.626	0.522	0.484	0.805	0.289	1.30	1.45	0.561	1.67	0.010
Calcium	10600	8120	7970	5720	6920	4820	8730	6880	21100	8110	19000	10
Chromium	<0.20	<0.20	0.25	1.18	1.71	<0.20	<0.20	<0.20	0.36	<0.20	0.41	0.20
Cobalt	0.535	1.00	1.49	1.04	1.61	0.616	0.328	0.619	0.440	0.296	0.548	0.020
Copper	2.86	3.27	2.86	3.10	3.35	2.59	1.67	3.20	4.34	2.26	4.72	0.050
Iron	30	50	104	234	490	80	55	75	253	58	230	10
Lead	0.012	0.027	0.036	0.078	0.154	0.037	0.014	0.023	0.071	0.030	0.068	0.010
Magnesium	1200	2170	2780	2090	3090	1230	1710	2620	2210	1350	2210	10
Manganese	33.0	308	589	171	266	557	217	690	44.9	369	45.9	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	0.140	0.106	0.139	0.063	0.139	0.108	0.278	0.351	1.60	0.246	1.37	0.050
Nickel	2.61	0.702	2.48	2.84	2.95	0.514	0.840	1.37	1.38	0.460	1.76	0.050
Phosphorus	1060	1330	1370	1440	1810	638	739	1050	1270	651	1440	10
Potassium	9100	9840	8360	6550	7390	4270	8760	6090	7200	7730	9370	10
Selenium	0.061	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.051	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	23	44	<10	13	<10	10
Strontium	36.7	28.6	41.5	41.5	44.1	26.5	20.9	35.9	71.9	18.6	67.3	0.10
Thallium	<0.0020	<0.0020	0.0032	0.0042	0.0070	0.0036	<0.0020	<0.0020	0.0064	<0.0020	0.0029	0.002
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	3.3	10.0	14.4	2.6	1.3	1.4	6.2	1.3	5.2	1.0
Uranium	<0.0020	<0.0020	0.0043	0.0096	0.0201	0.0028	<0.0020	<0.0020	0.0088	<0.0020	0.0069	0.002
Vanadium	<0.20	<0.20	<0.20	0.47	0.96	<0.20	<0.20	<0.20	0.27	<0.20	0.26	0.20
Zinc	16.2	38.1	69.7	28.6	79.5	105	71.1	155	68.8	71.9	79.1	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2014 Lichen trace metal analysis (n=23), sample sites CCHMLB-20 to CCHMLB-76

Parameter[1]	CCHMLB-20	CCHMLA-21	CCHMLB-28A	CCHMLA-38	CCHMLA-39	CCHMLA-49	CCHMLB-49	CCHMLC-55	CCHMLC-62	CCHMLB-76	RDL[2]
Aluminum	95.2	136	117	140	96.1	121	136	139	140	138	1.0
Antimony	0.0184	0.0117	0.0117	0.0128	0.0123	0.0447	0.0087	0.0083	0.0094	0.0111	0.005
Arsenic	0.291	0.223	0.131	0.175	0.166	3.11	0.155	0.109	0.137	0.127	0.050
Barium	13.6	6.65	4.31	7.03	5.58	5.03	5.48	5.11	6.41	5.93	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Cadmium	0.026	0.031	0.051	0.027	0.038	0.027	0.035	0.025	0.021	0.042	0.010
Calcium	1600	822	691	548	694	798	692	727	809	962	10
Chromium	0.24	0.32	0.29	0.35	0.21	0.26	0.22	0.24	0.31	1.48	0.20
Cobalt	0.072	0.109	0.120	0.117	0.077	0.096	0.123	0.101	0.117	0.134	0.020
Copper	1.51	0.928	3.38	1.27	1.04	1.30	1.24	1.04	1.33	1.43	0.050
Iron	145	201	203	206	135	185	175	180	217	207	10
Lead	0.125	0.169	0.205	0.153	0.118	0.172	0.185	0.155	0.153	0.187	0.010
Magnesium	260	227	269	235	205	316	284	300	392	250	10
Manganese	23.4	51.1	128	63.7	82.0	151	138	121	176	26.1	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	0.057	<0.050	<0.050	<0.050	<0.050	0.054	<0.050	<0.050	<0.050	0.057	0.050
Nickel	0.319	0.389	0.589	0.383	0.287	0.336	0.405	0.429	0.458	1.17	0.050
Phosphorus	404	272	260	274	258	454	361	367	454	267	10
Potassium	1150	663	741	621	831	1090	916	894	1160	978	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	12	11	<10	<10	11	<10	13	15	31	30	10
Strontium	4.33	2.58	1.86	2.08	1.79	2.05	2.28	2.22	2.19	2.86	0.10
Thallium	<0.0020	<0.0020	0.0026	<0.0020	<0.0020	0.0026	<0.0020	0.0026	0.0025	0.0021	0.002
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.30	0.10
Titanium	4.7	7.2	6.4	7.8	5.1	5.1	6.6	6.5	6.7	7.4	1.0
Uranium	0.0048	0.0067	0.0191	0.0087	0.0068	0.0208	0.0117	0.0065	0.0066	0.0084	0.002
Vanadium	0.24	0.36	0.35	0.35	0.23	0.32	0.33	0.36	0.38	0.44	0.20
Zinc	10.2	11.6	8.75	9.71	8.49	14.4	9.57	9.66	8.01	12.8	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2014 Lichen trace metal analysis (n=23), sample sites CCHMLC-81 to CCHMLA-851-r

Parameter[1]	CCHMLC-81	CCHMLA-98	CCHMLA-106	CCHMLB-164	CCHMLC-400	CCHMLB-410	CCHMLB-422	CCHMLB-843	CCHMLA-851 r[2]	RDL[3]
Aluminum	140	104	88.8	122	112	107	98.0	295	375	1.0
Antimony	0.0120	0.0095	<0.0050	0.0128	<0.0050	0.0125	0.0069	0.236	0.0991	0.005
Arsenic	0.148	0.136	0.074	0.199	<0.050	0.126	0.097	2.63	1.67	0.050
Barium	3.53	5.29	8.83	5.77	53.0	4.80	4.87	9.25	6.32	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	<2.0	<2.0	<2.0	<2.0	7.4	<2.0	<2.0	2.6	<2.0	2.0
Cadmium	0.038	0.040	0.049	0.057	0.040	0.030	0.024	0.051	0.048	0.010
Calcium	554	791	830	727	4220	653	708	1060	812	10
Chromium	0.28	0.35	<0.20	0.25	<0.20	0.24	0.24	1.43	1.07	0.20
Cobalt	0.111	0.129	0.091	0.105	0.042	0.081	0.081	0.245	0.276	0.020
Copper	1.35	1.61	1.24	1.39	2.56	1.52	0.989	2.11	2.21	0.050
Iron	198	189	111	183	57	165	156	514	525	10
Lead	0.195	0.155	0.118	0.167	0.030	0.159	0.126	0.339	0.290	0.010
Magnesium	271	235	410	313	1150	280	235	512	483	10
Manganese	72.6	113	134	95.5	1560	103	110	177	158	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	<0.050	0.072	<0.050	<0.050	0.160	<0.050	<0.050	0.208	0.062	0.050
Nickel	0.437	0.448	0.312	0.406	0.251	0.354	0.330	0.754	0.923	0.050
Phosphorus	295	323	561	418	795	361	339	532	630	10
Potassium	853	839	1360	1010	3350	951	933	1320	1390	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	14	<10	13	<10	<10	13	<10	15	23	10
Strontium	1.70	2.90	2.99	2.50	6.01	1.73	1.94	2.89	2.35	0.10
Thallium	<0.0020	<0.0020	<0.0020	0.0023	<0.0020	0.0022	0.0023	0.0104	0.0067	0.002
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.12	0.10
Titanium	7.5	6.2	4.1	6.1	1.8	5.9	4.9	17.9	24.1	1.0
Uranium	0.0076	0.0075	0.0041	0.0062	<0.0020	0.0065	0.0047	0.0898	0.0354	0.002
Vanadium	0.39	0.32	<0.20	0.35	<0.20	0.25	0.24	0.76	1.07	0.20
Zinc	8.31	9.66	12.3	8.90	16.7	10.4	10.8	15.6	19.3	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2014 Lichen trace metal analysis (n=23), sample sites CCTMLC-BD1 to CCTMLC

Parameter[1]	CCTMLC-BD1	CCTMLC-BD2	CCTMLC-BD3-r[2]	CCTMLC-BD4	CCTML-BD7	CCTMLC	RDL[3]
Aluminum	176	113	49.7	114	116	112	1.0
Antimony	0.0166	0.0118	<0.0050	0.0079	0.0075	0.0100	0.005
Arsenic	0.170	0.126	<0.050	0.102	0.128	0.122	0.050
Barium	7.11	5.84	44.3	4.92	5.92	10.4	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	<2.0	<2.0	8.6	<2.0	<2.0	<2.0	2.0
Cadmium	0.024	0.019	0.011	0.032	0.033	0.017	0.010
Calcium	980	926	5980	676	903	955	10
Chromium	0.35	0.26	<0.20	0.25	0.27	0.27	0.20
Cobalt	0.161	0.103	0.031	0.097	0.085	0.103	0.020
Copper	3.25	1.36	2.01	1.28	0.953	1.39	0.050
Iron	299	187	55	171	174	187	10
Lead	0.280	0.140	0.039	0.168	0.142	0.114	0.010
Magnesium	375	326	819	235	282	344	10
Manganese	222	286	1140	89.5	79.6	85.7	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	0.078	<0.050	0.056	<0.050	<0.050	<0.050	0.050
Nickel	0.491	0.348	0.153	0.446	0.327	0.316	0.050
Phosphorus	318	233	573	276	327	294	10
Potassium	1070	803	4160	823	949	896	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	23	11	<10	13	10	16	10
Strontium	2.67	1.88	5.80	2.22	3.86	3.28	0.10
Thallium	0.0026	<0.0020	<0.0020	0.0025	<0.0020	<0.0020	0.002
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	8.6	6.8	1.7	6.8	6.4	7.3	1.0
Uranium	0.0094	0.0062	<0.0020	0.0062	0.0225	0.0182	0.002
Vanadium	0.53	0.32	<0.20	0.33	0.30	0.36	0.20
Zinc	14.4	10.9	22.1	7.82	8.43	7.92	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2014 Horsetail trace metal analysis (n=16), sample sites CCHMHA-30A to CCHMHC-436

Parameter[1]	CCHMHA-30A	CCHMHC-59	CCHMHC-69	CCHMHB-92	CCHMHB-130	CCHMHA-135	CCHMHB-138	CCHMHA-299	CCHMHB-419	CCHMHB-422	CCHMHC-436	RDL[2]
Aluminum	35.1	12.6	17.0	47.6	90.4	5.8	16.2	35.0	11.9	43.7	73.0	1.0
Antimony	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0059	0.005
Arsenic	0.208	<0.050	<0.050	<0.050	<0.050	<0.050	0.062	<0.050	<0.050	<0.050	0.062	0.050
Barium	32.5	82.6	38.0	32.9	227	18.6	59.3	104	12.5	142	7.95	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	12.0	14.2	12.6	12.4	26.1	6.8	17.6	7.9	5.5	11.8	<2.0	2.0
Cadmium	0.045	0.083	0.133	0.131	0.077	0.081	0.079	0.024	1.98	0.097	0.045	0.010
Calcium	15500	21800	18900	17000	15900	14000	20700	14100	6720	21500	889	10
Chromium	<0.20	<0.20	<0.20	<0.20	0.46	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	0.160	0.552	0.419	0.098	0.605	0.067	0.052	0.084	0.204	0.326	0.077	0.020
Copper	5.51	4.30	2.84	3.59	2.85	1.94	4.00	2.04	3.04	2.98	1.20	0.050
Iron	80	140	65	30	34	19	40	22	40	28	118	10
Lead	0.064	0.029	0.020	<0.010	0.023	0.015	0.018	0.049	0.018	0.031	0.110	0.010
Magnesium	2040	3990	3120	2010	2090	1290	2960	1990	1960	3120	405	10
Manganese	96.2	247	228	45.4	47.6	32.1	50.8	84.4	632	153	129	0.10
Mercury	0.010	<0.010	<0.010	0.011	0.014	0.013	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	0.460	0.133	0.065	0.306	0.310	0.057	0.217	0.063	<0.050	0.186	<0.050	0.050
Nickel	0.206	0.621	0.576	0.378	2.83	0.168	0.262	0.576	0.905	1.18	0.325	0.050
Phosphorus	1100	1230	638	1370	1240	556	882	842	862	1040	544	10
Potassium	27000	29200	9500	28900	23000	13900	27300	12400	4560	15600	1310	10
Selenium	<0.050	<0.050	<0.050	<0.050	0.073	<0.050	<0.050	<0.050	<0.050	0.241	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	25	31	70	35	<10	<10	27	<10	12	<10	<10	10
Strontium	120	113	99.1	76.2	92.9	48.7	117	68.4	32.8	71.8	2.84	0.10
Thallium	0.0029	0.0048	0.0023	0.0058	0.0030	<0.0020	0.0035	<0.0020	0.0020	0.0021	0.0020	0.002
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	2.2	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3.4	1.0
Uranium	0.0105	0.0041	0.0056	0.0028	0.0030	<0.0020	0.0135	<0.0020	<0.0020	<0.0020	0.0031	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.24	0.20
Zinc	14.3	40.1	38.3	22.9	10.7	6.04	30.8	12.7	201	23.2	11.5	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2014 Horsetail trace metal analysis (n=16), sample sites CCHMHC-438 to CCTMHA

Parameter[1]	CCHMHC-438	CCHMHB-440	CCHMHB-455	CCTMHC-BD2	CCHMH-BD3-r[2]	CCTMHA-BD5	CCHMHC	CCTMHA	RDL[3]
Aluminum	8.4	6.7	12500	33.5	5.1	25.0	6.6	32.8	1.0
Antimony	<0.0050	0.0062	0.238	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.005
Arsenic	<0.050	<0.050	6.13	<0.050	<0.050	<0.050	<0.050	0.068	0.050
Barium	54.6	77.8	178	103	92.2	46.9	102	57.5	0.10
Beryllium	<0.10	<0.10	0.77	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	0.26	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	8.9	17.0	<2.0	12.5	7.9	9.9	7.6	8.0	2.0
Cadmium	0.118	0.119	0.071	0.034	0.032	0.073	0.052	0.067	0.010
Calcium	18800	18100	3920	16000	13800	16200	15900	21400	10
Chromium	<0.20	0.20	44.7	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	0.144	0.043	10.4	0.716	0.376	0.096	0.421	0.111	0.020
Copper	3.61	4.16	17.4	4.27	2.43	3.42	2.53	3.81	0.050
Iron	41	36	27400	59	51	73	82	92	10
Lead	0.042	0.018	11.0	0.019	0.012	0.025	0.014	0.045	0.010
Magnesium	3680	3460	4240	3270	2570	2230	3260	2240	10
Manganese	62.5	32.9	402	241	112	58.6	115	61.1	0.10
Mercury	0.010	0.014	0.032	<0.010	<0.010	0.012	<0.010	0.012	0.010
Molybdenum	0.188	0.157	0.725	0.218	0.667	1.86	0.639	2.32	0.050
Nickel	0.328	0.493	26.0	1.42	0.670	0.254	0.627	0.333	0.050
Phosphorus	837	871	713	774	583	1010	817	1040	10
Potassium	22500	21600	1540	15700	13100	21400	14300	17100	10
Selenium	<0.050	<0.050	0.332	<0.050	<0.050	0.079	<0.050	<0.050	0.050
Silver	<0.020	<0.020	0.067	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	84	<10	<10	37	<10	13	10
Strontium	88.4	73.8	27.6	45.9	43.2	51.4	56.0	67.2	0.10
Thallium	0.0070	0.0034	0.154	0.0031	0.0027	0.0032	0.0030	0.0047	0.002
Tin	<0.10	<0.10	0.44	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	349	<1.0	<1.0	1.6	<1.0	1.9	1.0
Uranium	<0.0020	<0.0020	2.17	<0.0020	<0.0020	0.0031	<0.0020	0.0081	0.002
Vanadium	<0.20	<0.20	36.5	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	9.30	12.1	52.3	59.7	28.1	14.0	26.5	13.3	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2014 Lowbush cranberry trace metal analysis (n=29), sample sites CCHMCB-20 to CCHMCB-76

Parameter[1]	CCHMCB-20	CCHMCA-21	CCHMCB-28A	CCHMCA-38	CCHMCA-39	CCHMCB-49	CCHMCA-50	CCHMCC-55	CCHMCC-62	CCHMCC-69	CCHMCB-76	RDL[2]
Aluminum	8.3	53.1	76.4	63.6	49.6	39.1	52.5	67.4	93.9	68.7	4.5	1.0
Antimony	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0053	<0.0050	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.058	<0.050	<0.050	<0.050	<0.050	0.050
Barium	46.8	41.5	49.2	56.5	54.0	22.1	36.0	34.3	71.9	66.7	77.6	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	5.7	3.3	4.9	3.2	6.8	3.4	6.1	3.3	5.2	7.3	4.3	2.0
Cadmium	<0.010	0.027	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.014	0.107	0.010
Calcium	2930	3560	4010	3960	4230	2140	3640	3050	5650	5940	16600	10
Chromium	<0.20	<0.20	<0.20	0.25	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	<0.020	0.027	0.029	0.028	<0.020	<0.020	<0.020	0.025	0.027	<0.020	0.057	0.020
Copper	1.47	2.88	2.07	2.57	2.20	1.78	2.78	2.52	2.88	9.12	3.11	0.050
Iron	15	40	31	41	37	13	27	24	41	63	27	10
Lead	<0.010	0.024	0.026	0.034	0.018	<0.010	0.019	0.019	0.024	0.151	<0.010	0.010
Magnesium	589	737	862	886	864	625	808	810	1320	1100	1450	10
Manganese	225	1230	1580	1260	1120	903	1710	1170	1890	2130	39.1	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	0.010
Molybdenum	<0.050	0.058	<0.050	0.101	<0.050	<0.050	0.055	0.059	0.128	0.053	0.130	0.050
Nickel	0.080	0.359	0.169	0.254	0.156	0.117	0.201	0.208	0.268	0.187	0.325	0.050
Phosphorus	512	682	480	748	546	471	482	641	947	677	643	10
Potassium	2850	3090	2420	3040	2740	2120	2600	2720	3390	3130	12900	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.199	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
Strontium	3.59	3.85	3.80	3.87	3.42	2.05	3.35	3.07	6.22	9.92	50.7	0.10
Thallium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0026	<0.0020	<0.0020	0.002
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.14	<0.10	0.10
Titanium	<1.0	1.3	<1.0	1.2	1.0	<1.0	<1.0	<1.0	1.1	<1.0	<1.0	1.0
Uranium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	11.9	16.8	11.2	13.6	13.9	10.4	14.5	13.6	12.9	20.6	7.21	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2014 Lowbush cranberry trace metal analysis (n=29), sample sites CCHMCC-81 to CCHMCB-422

Parameter[1]	CCHMCC-81	CCHMCA-98	CCHMCA-106	CCHMCB-120	CCHMCB-130	CCHMCA-135	CCHMCB-138	CCHMCB-164	CCHMCC-400	CCHMCB-410	CCHMCB-422	RDL[2]
Aluminum	96.5	58.0	59.8	37.2	177	40.6	70.5	98.9	117	78.7	73.1	1.0
Antimony	0.0055	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0131	<0.0050	<0.0050	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.051	<0.050	<0.050	<0.050	0.050
Barium	71.2	54.5	72.9	62.1	136	63.7	59.6	87.8	54.5	77.6	103	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	6.1	11.0	4.4	8.0	11.2	7.3	5.7	4.3	5.1	7.2	4.6	2.0
Cadmium	0.017	<0.010	<0.010	<0.010	0.118	<0.010	0.022	<0.010	0.011	0.010	<0.010	0.010
Calcium	5540	5120	3790	5890	6380	5030	4820	5920	4130	5520	6270	10
Chromium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	0.036	<0.020	0.038	0.022	0.103	0.044	<0.020	0.054	0.045	0.026	0.032	0.020
Copper	2.92	3.72	2.55	1.59	2.15	2.56	2.56	2.28	3.07	3.61	2.41	0.050
Iron	52	38	35	66	74	32	31	45	47	56	45	10
Lead	0.036	0.018	0.014	0.039	0.039	0.016	0.026	0.026	0.055	0.035	0.026	0.010
Magnesium	1310	1060	1070	761	1340	1100	968	1260	886	1370	1170	10
Manganese	2060	2010	986	898	2870	959	924	1800	1490	1540	1390	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	0.063	0.077	0.162	0.138	1.43	0.058	0.064	0.105	0.072	<0.050	0.162	0.050
Nickel	0.260	0.339	0.355	0.129	0.303	0.190	0.199	0.290	0.274	0.290	0.313	0.050
Phosphorus	822	1090	919	480	772	942	653	848	737	1170	711	10
Potassium	2950	5190	3880	2450	3770	4390	3100	3160	3130	4160	3270	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
Strontium	5.30	3.54	6.84	11.7	9.66	6.61	9.87	11.1	5.90	7.05	8.91	0.10
Thallium	<0.0020	<0.0020	<0.0020	<0.0020	0.0088	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	2.9	<1.0	<1.0	2.5	1.9	<1.0	1.0	1.3	1.2	1.2	1.6	1.0
Uranium	<0.0020	<0.0020	<0.0020	<0.0020	0.0030	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	21.0	20.6	15.7	16.0	18.1	13.0	22.4	22.2	16.4	28.7	14.9	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2014 Lowbush cranberry trace metal analysis (n=29), sample sites CCHMCC-436 to CCTMCC

Parameter[1]	CCHMCC-436	CCHMCC-438	CCHMCB-440	CCHMCB-843	CCHMCA-851	CCHMCA-851 r[2]	CCTMCC-BD1	CCTMCC-BD2	CCTMCC-	RDL[3]
Aluminum	34.1	69.5	52.3	76.9	100	123	135	82.1	54.0	1.0
Antimony	<0.0050	<0.0050	<0.0050	0.0289	0.0217	0.0221	0.0067	<0.0050	<0.0050	0.005
Arsenic	<0.050	<0.050	<0.050	0.205	0.320	0.396	<0.050	<0.050	<0.050	0.050
Barium	73.2	49.2	143	37.2	40.8	41.7	61.7	40.8	40.1	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	7.4	3.6	10.2	6.6	3.3	4.2	9.2	7.3	7.2	2.0
Cadmium	0.020	0.016	0.024	0.014	<0.010	<0.010	<0.010	<0.010	0.011	0.010
Calcium	3730	3230	7340	3790	3090	3020	6660	5710	5840	10
Chromium	<0.20	<0.20	<0.20	0.28	0.54	0.41	0.21	<0.20	<0.20	0.20
Cobalt	<0.020	0.068	0.036	0.040	0.054	0.055	0.034	0.023	0.034	0.020
Copper	2.16	3.49	3.39	2.55	1.96	2.41	2.84	3.37	1.73	0.050
Iron	25	32	60	98	113	111	71	44	68	10
Lead	0.027	0.018	0.038	0.047	0.048	0.049	0.050	0.032	0.045	0.010
Magnesium	939	719	1250	767	776	789	738	689	775	10
Manganese	691	1050	527	1490	1080	1090	2580	2740	946	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	0.109	<0.050	<0.050	0.062	<0.050	0.069	0.083	0.145	<0.050	0.050
Nickel	0.404	0.435	0.457	0.378	0.446	0.313	0.233	0.170	0.179	0.050
Phosphorus	903	746	1010	951	777	629	541	466	512	10
Potassium	4190	3210	3930	4000	3040	3110	3170	2840	3880	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
Strontium	3.29	7.03	20.1	4.56	2.77	3.50	4.13	2.72	5.91	0.10
Thallium	<0.0020	<0.0020	<0.0020	0.0050	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Tin	0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	1.7	3.1	5.2	4.9	2.1	1.4	2.4	1.0
Uranium	<0.0020	0.0065	0.0025	0.0079	0.0057	0.0053	0.0039	<0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	0.23	<0.20	<0.20	<0.20	0.20
Zinc	17.3	9.58	26.5	18.5	12.0	10.2	17.9	17.8	20.1	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2014 Soil trace metal analysis (n=37), sample sites CCHMSB-20 to CCHMSC-62

Parameter[1]	CCME Ind[2]	CCHMSB-20	CCHMSA-21	CCHMSB-28A	CCHMS-30A	CCHMSA-38	CCHMSA-39	CCHMSB-49	CCHMSA-50	CCHMSC-55	CCHMSC-59	CCHMSC-62	RDL[3]
Aluminum	NA	13200	20700	12000	11800	24600	17600	7290	8920	16900	20300	14800	100
Antimony	40	2.07	0.68	0.88	0.28	1.67	3.83	0.60	2.28	0.41	1.00	1.20	0.10
Arsenic	12	41.6	47.4	10.5	11.0	22.4	30.0	65.2	41.5	6.19	7.90	14.6	0.50
Barium	2000	388	128	114	85.2	175	223	55.9	114	100	174	103	0.10
Beryllium	8	0.47	0.63	0.44	<0.40	0.64	0.49	<0.40	<0.40	0.46	0.54	<0.40	0.40
Bismuth	NA	0.11	0.21	0.34	0.14	0.29	0.39	0.17	<0.10	0.10	0.12	0.16	0.10
Cadmium	22	0.224	0.123	0.136	0.069	0.300	0.135	0.109	0.120	0.214	0.344	0.190	0.050
Calcium	NA	24600	5590	2160	4370	3320	5380	1080	2210	3050	5030	1690	100
Chromium	87	46.0	115	34.6	49.1	45.5	55.5	14.7	12.6	24.2	27.4	22.1	1.0
Cobalt	300	9.92	19.6	8.43	6.92	12.9	15.2	3.27	2.10	7.88	6.59	5.20	0.30
Copper	91	18.3	48.5	12.0	10.7	22.1	12.4	8.85	10.8	17.2	16.1	11.5	0.50
Iron	NA	20900	28600	21800	15400	35500	25400	17000	10000	26600	19800	28700	100
Lead	600	7.39	3.39	5.25	4.44	10.8	5.54	7.09	3.52	8.52	12.2	12.4	0.10
Magnesium	NA	5650	16200	4130	6730	7830	11300	1750	1600	4670	4570	3750	100
Manganese	NA	538	491	293	222	341	520	281	185	404	212	221	0.20
Mercury	50	0.235	<0.050	<0.050	<0.050	<0.050	0.050	<0.050	0.054	0.071	0.144	<0.050	0.050
Molybdenum	40	0.53	0.39	1.00	0.30	1.06	0.74	1.35	0.51	0.78	0.71	2.19	0.10
Nickel	89	33.4	49.3	15.3	22.2	29.7	25.9	6.64	7.28	16.9	17.0	11.4	0.80
Phosphorus	NA	537	341	307	309	359	480	405	762	448	526	217	10
Potassium	NA	1050	3550	927	1510	831	3360	598	355	638	612	568	100
Selenium	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	40	0.102	0.051	0.053	<0.050	0.127	0.070	0.058	0.167	0.064	0.136	0.076	0.050
Sodium	NA	237	<100	101	326	135	148	133	223	144	188	<100	100
Strontium	NA	92.9	19.4	22.7	42.5	24.9	27.8	13.6	22.2	22.7	33.7	16.0	0.10
Thallium	1	0.419	0.310	0.106	0.117	0.154	0.227	0.116	0.113	0.121	0.173	0.139	0.050
Tin	300	0.37	0.98	0.58	0.55	0.59	0.96	0.57	0.25	0.49	0.57	0.57	0.10
Titanium	NA	588	727	721	626	1010	1070	649	188	947	761	967	1.0
Vanadium	130	38.8	64.3	42.2	28.2	68.1	46.1	54.3	17.2	60.0	45.0	82.1	2.0
Zinc	360	40.4	32.9	32.9	27.0	54.0	40.2	27.6	21.0	52.2	61.8	40.9	1.0
Zirconium	NA	2.98	3.43	1.41	0.72	8.69	1.87	0.79	<0.50	2.45	2.78	2.48	0.50
pH	6-8	6.51	6.12	5.44	6.13	6.08	5.88	4.13	5.41	5.19	5.77	4.87	NA

[1] Total metals (units mg/kg dry weight) unless otherwise indicated; Lithium and uranium were missed during laboratory analysis, therefore, are not included for 2014 soil samples

[2] Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[3] Reportable Detection Limit (RDL)

2014 Soil trace metal analysis (n=37), sample sites CCHMSC-69 to CCHMSB-138

Parameter[1]	CCME Ind[2]	CCHMSC-69	CCHMCSB-76	CCHMC-81	CCHMSB-92	CCHMSA-98	CCHMSA-106	CCHMSB-113	CCHMSB-120	CCHMSB-130	CCHMSA-135	CCHMSB-138	RDL[3]
Aluminum	NA	13100	4910	19400	17400	24700	20900	21100	11300	20400	16100	16300	100
Antimony	40	0.26	0.48	0.45	11.3	1.99	0.52	0.39	0.25	0.76	0.33	0.89	0.10
Arsenic	12	2.53	2.14	16.8	90.6	51.4	7.90	6.69	2.92	20.8	6.15	26.5	0.50
Barium	2000	112	215	121	206	260	150	190	66.7	277	164	148	0.10
Beryllium	8	<0.40	<0.40	0.42	<0.40	0.50	0.83	0.54	0.60	0.71	0.41	0.53	0.40
Bismuth	NA	<0.10	<0.10	0.15	0.21	0.14	0.25	0.13	0.14	0.43	0.18	0.17	0.10
Cadmium	22	0.164	0.314	0.242	0.343	0.343	0.241	0.121	0.121	0.409	0.277	0.285	0.050
Calcium	NA	2720	32000	2440	4360	5120	1460	5580	1270	4270	4300	4980	100
Chromium	87	17.5	10.4	26.8	22.8	59.6	30.8	56.5	11.5	50.6	18.8	33.2	1.0
Cobalt	300	5.43	2.91	7.65	12.4	14.9	8.21	14.0	4.90	13.8	8.13	10.9	0.30
Copper	91	8.33	23.9	13.1	27.1	46.8	17.6	19.3	6.13	30.6	13.0	16.1	0.50
Iron	NA	17000	7750	27900	30800	34600	33300	29800	17300	31300	21500	26400	100
Lead	600	7.94	2.02	9.22	5.58	10.3	14.2	7.11	6.66	10.4	10.8	14.5	0.10
Magnesium	NA	2730	2610	4640	6710	9030	3320	9400	3190	7390	6740	6740	100
Manganese	NA	399	225	367	733	500	248	591	316	391	707	1080	0.20
Mercury	50	0.061	0.053	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.062	0.050
Molybdenum	40	0.48	0.60	1.03	1.41	0.98	1.69	0.82	0.31	0.82	1.69	1.05	0.10
Nickel	89	9.05	13.8	14.7	17.1	42.0	16.6	32.5	7.03	28.3	11.0	17.7	0.80
Phosphorus	NA	367	907	299	705	583	468	589	249	404	450	447	10
Potassium	NA	396	192	661	944	1410	581	854	2210	1060	1900	1640	100
Selenium	2.9	<0.50	0.65	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	40	0.068	0.077	0.064	0.109	0.184	0.134	0.066	<0.050	0.094	0.374	0.086	0.050
Sodium	NA	130	129	114	315	254	<100	161	<100	179	261	237	100
Strontium	NA	18.3	124	21.8	27.0	32.0	13.5	30.3	11.1	31.2	92.3	41.2	0.10
Thallium	1	0.160	<0.050	0.189	0.227	0.162	0.123	0.155	0.341	0.207	0.251	0.243	0.050
Tin	300	0.51	0.10	0.96	0.45	0.56	0.96	0.68	0.45	0.70	0.61	0.70	0.10
Titanium	NA	618	137	1010	1290	1380	587	1010	685	1100	838	933	1.0
Vanadium	130	36.1	13.7	64.0	74.3	87.2	62.2	70.4	23.1	65.1	54.1	53.3	2.0
Zinc	360	37.3	16.2	47.6	54.5	82.0	38.9	44.1	31.9	49.7	45.7	61.9	1.0
Zirconium	NA	1.26	2.58	5.01	3.24	4.48	7.86	1.42	0.95	12.9	2.03	2.52	0.50
pH	6-8	5.72	6.32	5.69	5.86	6.20	5.54	5.95	5.15	5.78	4.48	6.21	NA

[1] Total metals (units mg/kg dry weight) unless otherwise indicated; Lithium and uranium were missed during laboratory analysis, therefore, are not included for 2014 soil samples

[2] Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[3] Reportable Detection Limit (RDL)

2014 Soil trace metal analysis (n=37), sample sites CCHMSA-164 to CCHMSB-440

Parameter[1]	CCME Ind[2]	CCHMSB-164	CCHMSA-299	CCHMSC-400	CCHMSB-410	CCHMSB-419	CCHMSB-422	CCHMBSC-436	CCHMSC-438	CCHMSB-440	RDL[3]
Aluminum	NA	15000	11000	22000	24100	16000	22800	15000	8060	15400	100
Antimony	40	0.33	0.48	1.51	49.2	0.22	0.55	1.14	0.68	0.69	0.10
Arsenic	12	4.71	4.71	7.47	50.6	2.83	7.94	8.52	7.21	13.4	0.50
Barium	2000	75.1	56.5	102	298	137	176	188	58.4	175	0.10
Beryllium	8	<0.40	<0.40	0.59	0.64	0.99	0.58	0.50	<0.40	0.47	0.40
Bismuth	NA	<0.10	0.35	0.13	0.17	0.36	0.20	0.20	0.12	0.19	0.10
Cadmium	22	0.098	0.117	0.180	0.436	0.198	0.142	0.210	0.122	0.230	0.050
Calcium	NA	1900	771	2770	7830	1910	1940	4150	2400	5040	100
Chromium	87	39.8	14.2	38.5	32.2	21.9	43.7	21.2	13.4	29.0	1.0
Cobalt	300	5.90	2.96	13.7	5.43	4.84	11.7	6.73	5.85	10.7	0.30
Copper	91	14.4	7.39	18.7	37.4	17.3	16.8	12.0	5.44	20.2	0.50
Iron	NA	19300	19200	32100	24000	17000	38900	22500	15500	26600	100
Lead	600	4.82	16.0	9.23	7.48	8.37	10.7	10.9	5.55	7.86	0.10
Magnesium	NA	4960	1710	7140	4360	3210	4820	4110	3570	6630	100
Manganese	NA	164	141	651	162	229	344	322	233	599	0.20
Mercury	50	<0.050	<0.050	0.052	0.123	0.060	<0.050	<0.050	<0.050	<0.050	0.050
Molybdenum	40	0.84	1.07	1.06	0.67	0.64	1.97	0.77	0.61	1.49	0.10
Nickel	89	18.9	6.18	18.8	15.2	12.2	27.0	12.8	8.35	19.5	0.80
Phosphorus	NA	181	189	517	907	516	249	262	273	545	10
Potassium	NA	446	389	1390	787	1060	775	799	838	1940	100
Selenium	2.9	<0.50	<0.50	<0.50	0.67	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	40	<0.050	0.057	0.072	0.282	0.136	0.065	0.161	<0.050	0.083	0.050
Sodium	NA	206	<100	104	124	<100	104	124	<100	257	100
Strontium	NA	18.1	9.62	23.1	50.1	20.6	16.6	25.3	16.7	32.0	0.10
Thallium	1	0.107	0.109	0.210	0.201	0.194	0.174	0.128	0.107	0.216	0.050
Tin	300	0.38	0.73	0.60	0.50	1.23	0.87	0.59	0.38	0.57	0.10
Titanium	NA	782	660	1100	649	418	840	704	498	987	1.0
Vanadium	130	44.4	55.1	76.1	44.1	30.7	77.6	44.2	31.3	57.6	2.0
Zinc	360	24.3	24.8	51.2	37.6	36.9	42.2	39.2	25.3	61.4	1.0
Zirconium	NA	1.04	1.72	2.99	3.61	0.81	2.64	4.52	2.17	2.52	0.50
pH	6-8	5.37	4.46	5.01	6.23	4.38	4.94	5.77	5.55	5.57	NA

[1] Total metals (units mg/kg dry weight) unless otherwise indicated; Lithium and uranium were missed during laboratory analysis, therefore, are not included for 2014 soil samples

[2] Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[3] Reportable Detection Limit (RDL)

2014 Soil trace metal analysis (n=37), sample sites CCHMSB-843 to CCTMSA-BD5

Parameter[1]	CCME Ind[2]	CCHMSB-843	CCHMSA-851	CCHMSA-851-r[3]	CCTMSC-BD1	CCTMSC-BD2	CCTMSC-BD3-r[3]	CCTMSC-BD4	CCTMSA-BD5	RDL[4]
Aluminum	NA	23100	13600	15900	11700	4290	14800	18200	9620	100
Antimony	40	8.41	8.31	13.2	0.23	0.61	0.31	0.85	0.38	0.10
Arsenic	12	78.8	93.1	204	4.33	4.36	3.59	10.2	5.87	0.50
Barium	2000	162	72.3	118	176	159	373	196	149	0.10
Beryllium	8	0.65	0.73	0.90	<0.40	0.62	0.66	0.61	<0.40	0.40
Bismuth	NA	0.19	0.16	0.12	0.11	0.28	0.21	0.21	<0.10	0.10
Cadmium	22	0.158	0.149	0.156	0.116	0.230	0.586	0.296	0.152	0.050
Calcium	NA	3470	2550	3720	3430	7420	11800	4130	7270	100
Chromium	87	39.1	21.1	24.6	10.3	12.9	15.7	29.1	18.6	1.0
Cobalt	300	9.29	9.67	10.3	7.17	44.5	6.32	8.79	5.86	0.30
Copper	91	20.8	16.2	17.5	8.95	17.1	18.2	21.7	13.6	0.50
Iron	NA	27800	24600	30500	21700	44600	21000	23900	18100	100
Lead	600	9.52	9.27	9.13	3.72	7.24	12.0	13.6	4.93	0.10
Magnesium	NA	5940	6740	7670	5490	1290	3340	3910	3510	100
Manganese	NA	367	279	395	282	3420	535	418	196	0.20
Mercury	50	0.103	0.079	0.204	<0.050	0.086	0.051	0.077	<0.050	0.050
Molybdenum	40	1.26	0.73	0.59	0.77	5.55	0.73	0.66	0.53	0.10
Nickel	89	21.2	12.0	14.5	6.68	6.83	11.6	16.7	14.4	0.80
Phosphorus	NA	408	666	734	441	1370	460	307	453	10
Potassium	NA	983	2980	2190	387	229	1110	421	562	100
Selenium	2.9	<0.50	<0.50	<0.50	<0.50	0.61	0.98	<0.50	<0.50	0.50
Silver	40	0.113	0.079	0.058	<0.050	0.298	0.193	0.127	0.060	0.050
Sodium	NA	132	124	111	226	<100	<100	143	179	100
Strontium	NA	28.5	19.8	27.7	24.5	33.6	41.6	31.7	40.1	0.10
Thallium	1	0.285	0.393	0.495	0.109	0.088	0.126	0.139	0.064	0.050
Tin	300	0.72	0.74	0.67	0.38	0.19	0.74	1.09	0.27	0.10
Titanium	NA	861	921	1050	1160	107	436	751	487	1.0
Vanadium	130	67.6	59.7	74.0	60.4	36.8	36.2	52.0	34.3	2.0
Zinc	360	44.9	36.7	46.5	38.0	19.0	31.3	48.2	38.8	1.0
Zirconium	NA	1.42	1.16	2.79	0.95	0.55	4.13	5.87	2.13	0.50
pH	6-8	5.32	4.36	4.86	4.79	5.36	6.62	5.83	6.93	NA

[1] Total metals (units mg/kg dry weight) unless otherwise indicated; Lithium and uranium were missed during laboratory analysis, therefore, are not included for 2014 soil samples

[2] Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[3] Replicate samples

[4] Reportable Detection Limit (RDL)

2015 Willow trace metal analysis (n=10), sample sites CCTM500-W to CCTM511-W

Parameter[1]	CCTM 500-W	CCTM 501-W	CCTM 502-W	CCTM 505-W	CCTM 506-W	CCTM 507-W	CCTM 508-W	CCTM 509-W	CCTM 510-W	CCTM 511-W	RDL[2]
Aluminum	13.4	9.3	11.2	7.5	6.8	10.3	10.1	12.3	5.9	10.6	1.0
Antimony	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Barium	36.3	32.5	45.3	26.9	11	11.1	24.2	231	15	28.2	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	24	6.9	3.5	19.9	12.2	9.4	12.6	6.5	10.5	30.7	2.0
Cadmium	7.27	0.747	1.33	0.339	0.175	0.234	1.26	1.01	0.433	6.48	0.010
Calcium	26200	12200	11100	16100	6670	14700	16200	15800	8660	16700	10
Chromium	<0.20	<0.20	<0.20	<0.20	<0.20	1.85	<0.20	<0.20	<0.20	3.09	0.20
Cobalt	0.254	0.608	0.366	0.543	0.505	0.45	0.539	1.16	0.403	0.463	0.020
Copper	7.61	5.71	3.55	3.03	2.87	3.18	6.19	5.35	4.88	5.87	0.050
Iron	72	59	46	39	46	44	74	42	34	63	10
Lead	0.081	0.035	0.019	0.022	0.097	0.065	0.087	0.041	0.113	0.039	0.010
Magnesium	6410	4430	2300	5180	3360	4870	3540	2980	2890	2860	10
Manganese	57.1	440	189	294	404	149	172	64.5	213	76.7	0.10
Mercury	0.015	0.01	0.01	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	0.011	0.010
Molybdenum	0.139	0.343	0.197	0.188	0.1	0.278	0.284	<0.050	0.186	0.13	0.050
Nickel	2.56	1.22	0.775	0.505	0.214	1.64	2.71	0.981	1.79	6.16	0.050
Phosphorus	2400	1500	862	980	989	809	2200	2470	1010	1420	10
Potassium	14800	10700	11800	8500	4510	7880	14900	9510	8000	8500	10
Selenium	0.566	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.084	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	13	<10	<10	36	<10	<10	<10	<10	<10	10
Strontium	68.2	43.7	28.3	53.7	57.1	103	51.3	77.7	25.8	37.8	0.10
Thallium	0.0027	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020
Tin	<0.10	<0.10	0.15	<0.10	0.12	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
Uranium	0.0055	<0.0020	<0.0020	<0.0020	0.0076	0.0218	0.0022	<0.0020	<0.0020	<0.0020	0.0020
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	209	82.4	112	84.8	78.3	120	118	58.6	53.8	267	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2015 Lichen trace metal analysis (n=5), sample sites CCTM501-L to CCTM510-L

Parameter[1]	CCTM501-L	CCTM502-L	CCTM505-L	CCTM507-L	CCTM510-L	RDL[2]
Aluminum	66.6	86.9	133	96.3	93.2	1.0
Antimony	<0.0050	0.0071	0.0112	0.012	0.0081	0.005
Arsenic	0.063	0.082	0.116	0.098	0.083	0.050
Barium	5.28	4.92	8.74	7.35	7.23	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	<2.0	<2.0	<2.0	<2.0	<2.0	2.0
Cadmium	0.02	0.047	0.018	0.014	0.04	0.010
Calcium	819	1020	893	1040	833	10
Chromium	<0.20	0.23	0.5	0.3	0.62	0.20
Cobalt	0.069	0.083	0.089	0.077	0.075	0.020
Copper	1.04	1.11	1.98	2.55	2.26	0.050
Iron	117	150	225	162	140	10
Lead	0.114	0.129	0.264	0.362	0.178	0.010
Magnesium	236	296	232	230	256	10
Manganese	105	94.2	41.5	31.8	61.1	0.10
Mercury	0.022	0.018	0.013	0.011	<0.010	0.010
Molybdenum	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Nickel	0.234	0.256	0.442	0.266	0.447	0.050
Phosphorus	332	284	288	245	278	10
Potassium	1130	877	628	795	829	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	12	<10	10
Strontium	1.97	1.83	2.86	6.63	2.07	0.10
Thallium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	3.6	5.5	7.6	5.5	5.8	1.0
Uranium	0.0038	0.0051	0.007	0.0107	0.0125	0.0020
Vanadium	<0.20	0.22	0.36	0.25	0.23	0.20
Zinc	11	11.8	10.9	12.3	9.19	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2015 Horsetail trace metal analysis (n=9), sample sites CCTM500-H to CCTM511-H

Parameter[1]	CCTM 500-H	CCTM 501-H	CCTM 503-H	CCTM 504-H	CCTM 506-H	CCTM 507-H	CCTM 508-H	CCTM 509-H	CCTM5 11-H	RDL[2]
Aluminum	4	12	90.1	6.8	63	4.2	7.1	16.1	7.2	1.0
Antimony	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.066	0.050
Barium	19.4	143	230	41.1	76.8	48.1	20.2	215	48.1	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	17.4	9	12.7	12.2	14.2	22.7	17.6	9.4	20.6	2.0
Cadmium	1.12	0.139	0.067	0.087	0.038	0.025	0.237	0.106	0.611	0.010
Calcium	26100	18700	12600	15500	16000	28500	20400	19600	21800	10
Chromium	<0.20	<0.20	<0.20	0.59	2.06	0.66	0.48	1.39	0.64	0.20
Cobalt	0.044	0.562	2.03	0.042	0.12	0.342	0.362	0.678	0.262	0.020
Copper	5.96	4.69	3.83	2.88	7.53	3.9	4.82	3.62	5.3	0.050
Iron	46	44	42	35	120	38	36	33	46	10
Lead	0.025	0.013	0.021	0.05	0.233	0.042	0.069	0.087	0.04	0.010
Magnesium	9880	4340	4310	3470	6070	6110	4530	3030	5230	10
Manganese	20.4	226	320	48.6	70.4	89.8	103	46.1	40.5	0.10
Mercury	0.018	0.015	0.012	0.012	<0.010	<0.010	<0.010	0.013	0.016	0.010
Molybdenum	0.555	0.257	0.138	0.31	0.273	0.559	0.286	<0.050	0.072	0.050
Nickel	1.08	0.932	1.64	0.386	1.28	0.424	1.37	0.992	1.4	0.050
Phosphorus	1320	1900	1280	716	763	1300	643	785	1290	10
Potassium	38600	28600	15900	14800	18400	18400	18500	10000	18200	10
Selenium	1.82	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.085	0.359	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	23	<10	<10	<10	42	56	119	<10	<10	10
Strontium	71.8	81	85.6	44	196	202	67.9	92.3	58.7	0.10
Thallium	0.0048	0.0036	0.0117	<0.0020	<0.0020	<0.0020	0.0051	<0.0020	0.0025	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	<1.0	<1.0	2.9	<1.0	<1.0	<1.0	<1.0	1.0
Uranium	0.0089	<0.0020	<0.0020	<0.0020	0.0433	0.0736	<0.0020	<0.0020	<0.0020	0.0020
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	30.2	23.7	35.6	13.2	17.5	23.1	25.8	7.67	31.6	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2015 Lowbush cranberry trace metal analysis (n=8), sample sites CCTM501-C to CCTM510-C

Parameter[1]	CCTM501-C	CCTM502-C	CCTM503-C	CCTM504-C	CCTM505-C	CCTM506-C	CCTM509-C	CCTM510-C	RDL[2]
Aluminum	96.5	50.9	97.4	32.5	34.5	87.3	29.8	84.7	1.0
Antimony	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Barium	87.4	70.6	67	72.1	81.5	75.6	120	86.2	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	5.3	10.3	6.9	8.1	12.3	8.5	5.9	9.4	2.0
Cadmium	0.019	<0.010	<0.010	0.045	0.01	<0.010	0.024	<0.010	0.010
Calcium	6940	6310	5990	4920	7940	6740	4360	8020	10
Chromium	<0.20	<0.20	<0.20	<0.20	<0.20	1.16	0.58	<0.20	0.20
Cobalt	0.031	<0.020	0.02	<0.020	0.028	0.03	0.037	0.024	0.020
Copper	3.04	4.34	3.82	3.38	3.48	5.39	3.66	4.98	0.050
Iron	43	31	34	30	49	46	34	42	10
Lead	0.027	0.029	0.027	0.034	0.09	0.154	0.057	0.143	0.010
Magnesium	1480	846	988	1160	926	1060	1090	918	10
Manganese	1450	1950	2860	739	1070	2080	964	1380	0.10
Mercury	0.017	0.012	0.017	0.014	0.012	0.013	0.01	0.012	0.010
Molybdenum	0.102	0.059	0.068	0.123	<0.050	<0.050	<0.050	<0.050	0.050
Nickel	0.228	0.119	0.188	0.186	0.167	0.525	0.721	0.177	0.050
Phosphorus	910	695	575	848	585	651	796	627	10
Potassium	3620	4000	3030	4060	2820	3030	2710	3060	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	11	<10	<10	10
Strontium	10.3	4.81	4.07	6.55	17.9	10.6	6.15	7.2	0.10
Thallium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	<1.0	<1.0	1.3	<1.0	<1.0	1.1	1.0
Uranium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	19.6	22	19.7	25.3	33.7	20.1	14	24.3	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2015 Soil trace metal analysis (n=12), sample sites CCTM500-S to CCTM511-S

Parameter[1]	CCME Ind[2]	CCTM 500-S	CCTM 501-S	CCTM 502-S	CCTM 503-S	CCTM 504-S	CCTM 505-S	CCTM 506-S	CCTM 507-S	CCTM 508-S	CCTM 509-S	CCTM 510-S	CCTM 511-S	RDL[3]
Aluminum	NA	10400	16800	12300	15800	12500	14000	17400	15500	7720	17200	9120	11900	100
Antimony	40	1.73	0.51	0.25	0.2	0.87	0.27	0.18	0.42	0.3	0.16	0.52	1.61	0.10
Arsenic	12	17.7	8.33	4.77	4.74	11.8	3.59	4.75	6.21	5.11	3.42	2.77	14.3	0.50
Barium	2000	585	181	336	182	514	281	187	175	148	262	467	545	0.10
Beryllium	8	0.55	0.4	<0.40	<0.40	0.83	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.66	0.40
Bismuth	NA	0.25	0.14	<0.10	<0.10	0.21	0.1	<0.10	0.11	<0.10	<0.10	<0.10	0.27	0.10
Cadmium	22	1.43	0.197	0.185	0.149	0.762	0.138	0.105	0.325	0.154	0.105	0.181	0.749	0.050
Calcium	NA	16700	5670	7740	2460	6940	8240	4830	14600	3410	3580	13000	5390	100
Chromium	87	21.1	34.7	18.4	22.2	30.7	27.8	26.6	22.9	18.1	17.7	16.5	22	1.0
Cobalt	300	13	9.69	13.3	6.67	12.8	10.2	10.9	10.6	5.93	10.6	13.6	13	0.30
Copper	91	37.5	18.5	22.3	15.8	56.6	37.1	20.4	25.5	9.98	23.3	33.1	41.4	0.50
Iron	NA	29100	25100	22800	25700	29900	27200	26900	22700	15200	27400	20400	27400	100
Lead	600	15.9	7.79	5.07	8.18	10.8	4.4	4.73	6.79	4.51	3.36	3.34	17.8	0.10
Lithium	NA	19.8	12.5	8.2	8	12.5	7.2	11.5	11.8	8.2	9.4	<5.0	22.3	5.0
Magnesium	NA	6470	6510	6640	4780	5800	6810	10000	5840	3960	12200	4630	5390	100
Manganese	NA	953	254	796	183	1130	361	334	478	209	296	573	453	0.20
Mercury	50	0.095	<0.050	<0.050	0.051	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.073	0.193	0.050
Molybdenum	40	3.34	0.67	0.84	0.56	3.31	1.03	0.72	0.38	0.45	0.37	0.56	2.08	0.10
Nickel	89	40.5	20.4	10.4	11.2	39.2	14.8	14.6	16.2	13.1	10.1	15.9	39.1	0.80
Phosphorus	NA	889	613	695	477	850	422	466	497	702	569	644	849	10
Potassium	NA	939	619	1400	1030	1960	1230	1130	694	1370	4630	677	927	100
Selenium	2.9	1.28	<0.50	<0.50	<0.50	1.52	<0.50	<0.50	<0.50	<0.50	<0.50	0.53	1.38	0.50
Silver	40	0.282	0.066	0.127	0.149	0.499	0.075	0.066	0.118	<0.050	0.063	0.104	0.3	0.050
Sodium	NA	101	240	162	138	125	235	219	312	152	191	137	<100	100
Strontium	NA	66	36.8	34.3	18.6	40.7	43.8	21.2	114	17.7	15.2	65.4	34.9	0.10
Thallium	1	0.117	0.123	0.12	0.102	0.159	0.072	0.071	<0.050	0.1	0.106	<0.050	0.126	0.050
Tin	300	0.31	0.52	0.27	0.42	0.43	0.35	0.33	0.31	0.23	0.29	0.18	0.26	0.10
Titanium	NA	120	1000	859	840	602	573	1090	709	529	1510	375	92.7	1.0
Uranium	300	1.18	1.36	0.774	0.614	1.51	1.04	0.511	10.9	0.803	0.305	0.518	1.31	0.050
Vanadium	130	40.1	62.7	58.7	50.6	56.8	58.7	72.3	50.9	28	74.3	31.2	39.1	2.0
Zinc	360	167	51.6	54	61.8	115	61.7	54.1	47.5	38.9	57.9	30.2	133	1.0
Zirconium	NA	2.6	4.28	1.21	1.14	0.66	2.89	1.04	7.79	1.83	0.91	3.13	2.12	0.50
pH	6-8	8.29	5.92	5.85	4.79	6.39	5.85	5.44	7.19	5.76	4.83	5.90	5.82	NA

[1] Total metals (units mg/kg dry weight) unless otherwise indicated

[2] Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[3] Reportable Detection Limit (RDL)

2016 Willow trace metal analysis (n=36), sample sites CCTMAW-600 to CCTMCW-610

Parameter[1]	CCTMAW-600	CCTMAW-601	CCTMBW-602	CCTMBW-603	CCTMCW-604	CCTMCW-605	CCTMCW-606	CCTMCW-607	CCTMCW-608	CCTMCW-609	CCTMCW-610	RDL[2]
Aluminum	28.6	19.5	20.3	25.6	16.6	22.7	16.1	9.9	13.5	13.5	32.7	1.0
Antimony	0.0193	0.0137	0.0102	0.0168	0.0086	0.0142	<0.0050	<0.0050	0.0055	<0.0050	0.0099	0.005
Arsenic	<0.050	<0.050	<0.050	0.126	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Barium	37.9	22.8	12.8	15.2	11.1	22.5	53.6	23.2	8.38	26.3	82.5	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	4.3	7	3.4	4.2	5.6	5.9	14.7	9.9	2.2	7.6	3.7	2.0
Cadmium	1.03	0.305	0.363	0.224	1.65	2.93	1.08	1.16	0.573	1.35	14.1	0.010
Calcium	7890	6450	4480	5540	2720	7540	12600	12400	4530	5830	10100	10
Chromium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	0.895	0.275	0.919	0.427	0.851	0.333	0.245	0.557	0.656	0.143	1.18	0.020
Copper	3.63	3.8	3.43	3.75	4.04	5.48	4.38	4.37	3.08	3.18	3.26	0.050
Iron	68	72	79	68	84	58	66	82	59	44	59	10
Lead	0.031	0.014	0.012	0.025	0.024	0.025	0.021	<0.010	0.015	0.022	0.025	0.010
Magnesium	2840	2720	1550	2820	1430	2540	3040	3510	1810	2250	3690	10
Manganese	586	317	1050	224	464	212	50.1	245	434	761	108	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	0.121	0.086	0.086	0.084	0.506	0.058	0.712	3.03	0.097	0.075	0.118	0.050
Nickel	3.58	3.73	1.35	2.17	2.05	2.75	1.26	1.17	0.519	1.3	4.99	0.050
Phosphorus	2380	2260	1830	1740	1710	1340	1980	2470	1240	1270	2400	10
Potassium	9880	9900	8360	10900	13000	10800	12800	9320	6850	9790	10700	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.342	<0.050	<0.050	<0.050	0.094	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	<10	<10	<10	15	<10	10
Strontium	46.4	38.6	30.8	30.2	15.9	19.8	46.5	39	19.5	37.1	50	0.10
Thallium	0.0023	<0.0020	<0.0020	0.0038	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0033	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	<1.0	1.1	<1.0	1.2	<1.0	<1.0	<1.0	<1.0	1.2	1.0
Uranium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	123	85.9	83.2	61.3	121	154	93	112	71.3	157	99.4	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2016 Willow trace metal analysis (n=36), sample sites CCTMCW-612 to CCTMAW-622

Parameter[1]	CCTMCW-612	CCTMCW-613	CCTMCW-613-R[2]	CCTMRW-614	CCTMRW-615	CCTMRW-616	CCTMRW-617	CCTMRW-618	CCTMAW-619	CCTMBW-620	CCTMAW-622	RDL[3]
Aluminum	71.7	232	118	25	19.7	55.1	47.6	38.6	12.8	68.2	22	1.0
Antimony	0.0223	0.026	0.0085	0.0053	0.011	0.0113	0.0275	0.0148	0.0308	0.015	0.0147	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Barium	43.4	65.6	59.2	19.2	43.9	99.2	102	62.5	22.3	11	136	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	5.8	3.4	3.3	6.7	5.4	4.9	2.5	2.9	6.9	8.8	3.6	2.0
Cadmium	0.91	0.894	0.783	10.3	2.78	0.669	0.793	2.78	0.323	0.47	0.799	0.010
Calcium	11100	12400	10100	4830	8290	12500	11400	10100	22000	4230	26700	10
Chromium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	1.21	3.28	1.49	1.69	0.329	1.25	3.07	3.03	0.351	2.54	0.862	0.020
Copper	4.52	3.69	3.81	3.63	4.1	3.12	3.44	3.4	4	3.47	4.7	0.050
Iron	53	74	180	45	52	113	66	74	69	97	64	10
Lead	0.03	0.046	0.027	0.018	0.029	0.022	0.02	0.037	0.03	0.022	0.019	0.010
Magnesium	4460	4880	5120	1280	2090	4450	4630	3390	2280	1790	2880	10
Manganese	281	242	277	1150	400	310	240	184	77.1	1040	198	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.011	<0.010	0.011	0.010
Molybdenum	0.082	0.107	0.168	0.089	0.127	0.355	0.242	0.265	0.303	0.094	0.096	0.050
Nickel	4.01	7.89	6.55	4.23	3.33	3.31	16.5	9.41	0.478	2.74	1.56	0.050
Phosphorus	2600	2110	2200	980	1190	1750	2020	1510	1090	1060	1850	10
Potassium	10900	9430	9340	7000	11500	9400	11200	10500	9180	7020	11200	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.123	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	<10	<10	<10	30	<10	10
Strontium	56.5	91.2	72.1	24.6	35.5	73.1	75.6	45.7	73	22.7	92.6	0.10
Thallium	0.0032	<0.0020	0.0036	<0.0020	0.0027	<0.0020	0.0066	0.0058	<0.0020	0.0024	0.0033	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	<1.0	<1.0	1.0
Uranium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	81.3	30.7	39.8	293	201	116	74.7	103	118	118	83.3	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2016 Willow trace metal analysis (n=36), sample sites CCTMAW-622-R to CCTMBW-633

Parameter[1]	CCTMAW-622-R[2]	CCTMAW-623	CCTMBW-625	CCTMBW-625-R[2]	CCTMAW-626	CCTMAW-627	CCTMAW-628	CCTMBW-629	CCTMAW-631	CCTMAW-632	CCTMBW-633	RDL[3]
Aluminum	20.9	35.5	44.1	45.2	46	38.9	73.7	26	26.3	20.4	15.3	1.0
Antimony	0.0639	0.0303	0.026	0.0263	0.0131	0.0523	0.0192	0.022	0.024	0.0194	0.0145	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	0.084	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Barium	104	45.8	103	106	16.4	67.1	79.8	64.5	209	47.9	30.1	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	3.3	3	21	17.4	6.6	7.3	2.8	20.2	5.3	3.4	9.1	2.0
Cadmium	0.644	1.03	1.48	1.48	0.654	0.973	0.914	2.26	1.31	2.4	0.962	0.010
Calcium	19500	11600	13000	11300	6070	12600	12800	14300	14200	13800	11500	10
Chromium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.3	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	1.55	1.31	2.03	2.25	4.09	0.698	1.32	1.08	0.68	0.987	0.156	0.020
Copper	4.55	3.18	4.8	5	2.61	2.71	3.95	4.41	3.49	3.4	3.07	0.050
Iron	56	71	44	43	96	90	112	43	43	44	53	10
Lead	0.027	0.025	0.031	0.038	0.017	0.039	0.052	0.033	0.056	0.031	0.025	0.010
Magnesium	3290	3750	2650	2390	2240	3620	5150	1760	2020	3470	2030	10
Manganese	242	260	851	817	1220	357	250	272	107	179	136	0.10
Mercury	<0.010	<0.010	0.011	0.011	<0.010	0.011	<0.010	0.012	0.012	<0.010	<0.010	0.010
Molybdenum	0.12	0.174	0.314	0.252	0.241	0.158	0.111	0.269	<0.050	0.086	0.53	0.050
Nickel	5.04	2.77	6.9	7.81	1.9	1.99	7.97	1.82	2.07	2.13	0.402	0.050
Phosphorus	2160	1510	3170	3180	902	1020	3170	2730	2110	2780	869	10
Potassium	16600	11100	15800	16700	6790	12300	11100	10500	14600	11700	10500	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	30	<10	<10	<10	<10	<10	<10	10
Strontium	76.7	59.5	94.4	93.5	22.6	46.3	73.4	72	87.1	71.3	63.4	0.10
Thallium	0.012	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.004	<0.0020	<0.0020	0.0042	<0.0020	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	<1.0	<1.0	<1.0	1.5	3.3	<1.0	<1.0	<1.0	<1.0	1.0
Uranium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0021	0.0036	<0.0020	0.0111	<0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	54.2	78.7	93.5	90.2	108	72.5	80.8	68.7	72.8	118	240	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2016 Willow trace metal analysis (n=36), sample sites CCTMBW-634 to CCTMRW-639-R

Parameter[1]	CCTMBW-634	CCTMRW-635	CCTMRW-636	CCTMRW-637	CCTMRW-638	CCTMRW-639	CCTMRW-639-R[2]	RDL[3]
Aluminum	11	10.2	9.1	17.4	52.5	57.4	70.4	1.0
Antimony	0.0267	0.0171	0.0395	0.0164	0.0519	0.0397	0.0469	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Barium	37.6	12.9	43.5	51.1	60.9	80.3	55	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	6.9	3.5	8.5	6.5	4.2	4.2	4.4	2.0
Cadmium	0.648	0.959	3.2	0.974	0.562	1.37	1.07	0.010
Calcium	17700	2680	9930	10900	8940	11600	8050	10
Chromium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	0.335	1.52	0.396	0.637	1.99	3.17	3.15	0.020
Copper	6.87	3.64	3.89	2.66	3.51	3.38	3.08	0.050
Iron	49	40	37	46	103	125	127	10
Lead	0.034	0.017	0.043	0.017	0.026	0.224	0.099	0.010
Magnesium	1310	2090	2230	2760	3010	3710	3930	10
Manganese	52.1	385	483	261	274	308	660	0.10
Mercury	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	0.277	0.093	0.055	0.158	0.207	0.061	0.058	0.050
Nickel	2.22	9.38	3.51	0.7	2.66	3.34	2.93	0.050
Phosphorus	935	1350	950	1120	1380	1510	1990	10
Potassium	8600	8410	7810	9330	11100	10900	10900	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	<10	10
Strontium	91.3	6.91	39.2	40.4	39.1	49.6	34	0.10
Thallium	<0.0020	<0.0020	0.0042	<0.0020	<0.0020	<0.0020	0.0025	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
Uranium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	21.7	61.6	298	137	48.1	81.9	68.7	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2016 Lichen trace metal analysis (n=38), sample sites CCTMAL-600 to CCTMCL-610

Parameter[1]	CCTMAL-600	CCTMAL-601	CCTMBL-602	CCTMBL-603	CCTMCL-604	CCTMCL-605	CCTMCL-606	CCTMCL-607	CCTMCL-608	CCTMCL-609	CCTMCL-610	RDL[2]
Aluminum	159	168	159	140	174	220	130	92.6	162	108	159	1.0
Antimony	0.0686	0.0461	0.0858	0.0357	0.0201	0.021	0.0149	0.0146	0.02	0.0163	0.0855	0.005
Arsenic	0.192	0.151	0.167	0.162	0.18	0.249	0.104	0.077	0.148	0.099	0.148	0.050
Barium	3.88	8.3	8.44	7.45	8.19	12.3	16.8	15	6.65	7.36	12.4	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	4.6	4	3.6	2.5	<2.0	2.2	2.1	2.5	2.6	<2.0	2.5	2.0
Cadmium	0.039	0.054	0.033	0.024	0.067	0.072	0.032	0.011	0.028	0.035	0.062	0.010
Calcium	715	1080	911	935	785	1370	2080	1940	888	956	1270	10
Chromium	0.35	0.32	0.37	0.39	0.35	0.5	0.32	0.25	0.43	0.25	0.38	0.20
Cobalt	0.098	0.105	0.12	0.106	0.147	0.172	0.114	0.078	0.142	0.09	0.156	0.020
Copper	1.52	1.52	3.06	1.5	1.25	1.56	1.16	0.839	1.36	1.07	1.61	0.050
Iron	215	231	246	228	290	360	232	155	265	172	246	10
Lead	0.193	0.196	0.45	0.148	0.223	0.242	0.163	0.108	0.182	0.13	0.202	0.010
Magnesium	293	356	331	326	298	435	291	202	272	286	505	10
Manganese	180	196	167	213	120	286	145	24.4	203	197	138	0.10
Mercury	0.017	0.021	0.026	0.02	0.013	0.028	0.026	0.016	0.018	0.017	0.035	0.010
Molybdenum	<0.050	<0.050	<0.050	<0.050	0.072	0.055	<0.050	0.199	<0.050	<0.050	<0.050	0.050
Nickel	0.607	0.862	0.546	0.479	0.545	0.586	0.416	0.278	0.475	0.332	0.695	0.050
Phosphorus	428	473	566	452	292	444	447	298	310	348	526	10
Potassium	954	1010	1120	920	694	920	1020	763	849	924	1060	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	18	15	13	17	<10	11	<10	<10	10	13	16	10
Strontium	1.69	3.58	1.93	1.67	2.24	2.19	4.92	5.49	2.22	2.5	4.5	0.10
Thallium	<0.0020	<0.0020	0.0032	0.0032	0.0026	0.0032	0.0041	<0.0020	0.0022	<0.0020	0.0034	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	7.1	7.4	8.7	7.2	8.8	11.4	6.9	4.8	9.3	6	8.2	1.0
Uranium	0.0087	0.0459	0.0103	0.0098	0.0103	0.0148	0.0074	0.0057	0.0091	0.0127	0.0095	0.002
Vanadium	0.32	0.39	0.43	0.36	0.44	0.66	0.33	<0.20	0.4	0.27	0.46	0.20
Zinc	12.7	14.2	17	15.9	9.57	15.6	20.2	11.2	10.1	12.6	18.6	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2016 Lichen trace metal analysis (n=38), sample sites CCTMCL-611 to CCTMBL-620

Parameter[1]	CCTMCL-611	CCTMCL-612	CCTMCL-613	CCTMCL-613R[2]	CCTMRL-614	CCTMRL-615	CCTMRL-616	CCTMRL-617	CCTMRL-618	CCTMBL-619	CCTMBL-620	RDL[3]
Aluminum	120	249	189	226	182	160	190	231	197	141	178	1.0
Antimony	0.0311	0.0207	0.0358	0.0263	0.0509	0.0299	0.0257	0.0301	0.0309	0.315	0.033	0.005
Arsenic	0.112	0.179	0.167	0.188	0.165	0.135	0.16	0.191	0.167	0.181	0.184	0.050
Barium	7.38	5.98	5.95	6.27	7.81	10.5	11.6	6.66	6.84	5	3.73	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.1	2.0
Cadmium	0.029	0.031	0.023	0.027	0.05	0.064	0.043	0.041	0.045	0.023	0.018	0.010
Calcium	791	857	665	737	973	1130	1120	752	829	1220	600	10
Chromium	0.31	0.5	0.48	0.64	0.46	0.48	0.44	0.6	0.51	0.37	0.45	0.20
Cobalt	0.087	0.165	0.148	0.186	0.146	0.124	0.15	0.181	0.16	0.099	0.151	0.020
Copper	1.01	1.16	1.29	1.2	1.21	1.19	1.31	1.26	1.34	1.56	1.16	0.050
Iron	199	275	298	348	287	248	294	361	301	227	279	10
Lead	0.122	0.181	0.207	0.199	0.177	0.131	0.178	0.239	0.219	0.244	0.166	0.010
Magnesium	258	352	326	357	339	365	361	294	282	233	273	10
Manganese	163	106	72.4	83.6	296	148	142	87.5	101	20.2	158	0.10
Mercury	0.018	0.029	0.026	0.021	0.023	0.023	0.021	0.02	0.021	0.021	0.017	0.010
Molybdenum	0.075	<0.050	<0.050	<0.050	<0.050	0.066	0.057	<0.050	<0.050	<0.050	<0.050	0.050
Nickel	0.37	0.547	0.591	0.67	0.575	0.553	0.579	0.634	0.625	0.389	0.491	0.050
Phosphorus	310	416	400	430	294	391	445	309	348	283	250	10
Potassium	870	1050	899	887	839	1010	879	828	884	865	880	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	13	11	12	15	11	14	10	13	14	10	12	10
Strontium	1.5	2.2	2.42	2.71	2.05	3.77	4.48	2.07	1.91	3.56	1.24	0.10
Thallium	0.002	0.0028	0.0025	0.003	0.0028	0.0023	<0.0020	0.0043	0.0037	0.0022	0.0026	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	6.9	8.9	10.7	12.6	11.4	8.7	9.5	13.4	12.3	8.7	11.5	1.0
Uranium	0.0089	0.0118	0.0109	0.0113	0.0091	0.0067	0.0103	0.0128	0.0107	0.009	0.0095	0.002
Vanadium	0.29	0.49	0.51	0.6	0.51	0.49	0.49	0.59	0.49	0.35	0.49	0.20
Zinc	10.3	12.9	12.4	13.1	12.2	13.8	15.1	9.83	10	12.2	9.52	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2016 Lichen trace metal analysis (n=38), sample sites CCTMBL-621 to CCTMAL-632

Parameter[1]	CCTMBL-621	CCTMAL-622	CCTMAL-622-R[2]	CCTMAL-623	CCTMBL-624	CCTMAL-626	CCTMAL-627	CCTMAL-628	CCTMBL-630	CCTMAL-631	CCTMAL-632	RDL[3]
Aluminum	127	107	93.7	125	116	151	137	166	53.9	88.6	85.5	1.0
Antimony	0.0266	0.0311	0.0438	0.0794	0.117	0.0728	0.0434	0.025	0.0958	0.0638	0.0922	0.005
Arsenic	0.138	0.122	0.092	0.218	0.127	0.175	0.265	0.237	0.066	0.124	0.09	0.050
Barium	4.34	7.43	7.72	8.79	3.9	5.36	4.77	4.51	5.14	6.52	5.36	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	2.3	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.3	2.0
Cadmium	0.02	0.03	0.027	0.022	0.027	0.021	0.017	0.018	0.031	0.031	0.066	0.010
Calcium	646	972	921	702	587	672	546	639	554	745	739	10
Chromium	0.29	0.23	0.21	0.36	0.31	0.43	0.36	0.45	<0.20	0.21	0.22	0.20
Cobalt	0.101	0.092	0.075	0.102	0.092	0.13	0.108	0.112	0.049	0.083	0.081	0.020
Copper	0.908	0.898	0.806	0.955	0.837	1.05	0.862	1.08	0.81	0.905	0.807	0.050
Iron	204	162	126	199	173	244	216	231	86	143	121	10
Lead	0.126	0.09	0.071	0.117	0.108	0.129	0.104	0.139	0.066	0.089	0.087	0.010
Magnesium	255	432	386	292	234	256	246	388	204	358	406	10
Manganese	186	171	164	136	203	120	113	91.8	86.7	229	132	0.10
Mercury	0.021	0.014	0.015	0.023	0.015	0.012	0.015	0.021	0.021	0.028	0.014	0.010
Molybdenum	<0.050	<0.050	<0.050	0.05	<0.050	0.06	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Nickel	0.345	0.306	0.259	0.366	0.337	0.372	0.378	0.408	0.213	0.334	0.301	0.050
Phosphorus	268	511	497	392	257	267	362	538	401	404	499	10
Potassium	954	1170	1190	956	986	892	896	1490	1130	1110	1100	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	11	11	12	12	<10	<10	<10	<10	10
Strontium	1.1	2.52	2.34	1.68	1.18	1.72	1.2	1.75	1.32	1.94	2.2	0.10
Thallium	0.0027	0.0021	0.0027	0.0049	0.002	0.0025	0.004	0.0023	0.0032	<0.0020	<0.0020	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	7.4	5.9	4.4	7.3	6.6	10.5	7.6	9.9	2.3	4.7	4	1.0
Uranium	0.0068	0.0085	0.0048	0.0101	0.0057	0.0092	0.01	0.0096	0.0078	0.0085	0.0037	0.002
Vanadium	0.34	0.23	<0.20	0.3	0.28	0.39	0.38	0.43	<0.20	0.22	<0.20	0.20
Zinc	7.88	12.6	11.6	9.35	8.84	8.67	11.2	12.2	8.14	18.6	13.6	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2016 Lichen trace metal analysis (n=38), sample sites CCTMBL-633 to CCTMRL-639-R

Parameter[1]	CCTMBL-633	CCTMBL-634	CCTMRL-635	CCTMRL-636	CCTMRL-637	CCTMRL-638	CCTMRL-639	CCTMRL-639-R[2]	RDL[3]
Aluminum	119	65	102	90.4	127	90.5	84.8	87.9	1.0
Antimony	0.0218	0.0281	0.0139	0.018	0.0146	0.0634	0.0218	0.0252	0.005
Arsenic	0.143	0.085	0.108	0.086	0.068	0.085	0.084	0.085	0.050
Barium	5.05	8.51	4.08	6.59	4.53	5.19	6.11	5.93	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	2.1	3.2	<2.0	<2.0	<2.0	2.1	<2.0	<2.0	2.0
Cadmium	0.025	0.027	0.024	0.039	0.027	0.039	0.036	0.032	0.010
Calcium	811	1290	665	979	693	764	909	814	10
Chromium	0.27	<0.20	0.32	0.32	0.23	0.29	0.3	0.3	0.20
Cobalt	0.096	0.072	0.091	0.078	0.082	0.112	0.092	0.1	0.020
Copper	0.885	0.926	0.897	0.852	0.877	0.898	0.874	0.895	0.050
Iron	186	121	156	141	110	150	136	134	10
Lead	0.138	0.08	0.121	0.103	0.075	0.107	0.085	0.093	0.010
Magnesium	219	424	486	305	427	305	368	351	10
Manganese	51.2	20.5	34.7	138	121	154	193	178	0.10
Mercury	0.016	0.019	0.02	0.019	0.017	0.016	0.02	0.019	0.010
Molybdenum	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Nickel	0.309	0.231	0.445	0.346	0.297	0.294	0.271	0.313	0.050
Phosphorus	237	429	336	391	571	399	482	490	10
Potassium	865	1610	1090	1160	1330	1120	1180	1180	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	<10	<10	10
Strontium	2.76	5.39	1.47	2.4	1.81	1.58	1.69	1.61	0.10
Thallium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0021	<0.0020	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	7.2	3.3	5.4	5	4.1	4.5	4.4	4.4	1.0
Uranium	0.0065	0.0035	0.005	0.0045	0.0044	0.0047	0.0047	0.0047	0.002
Vanadium	0.26	<0.20	0.27	0.25	<0.20	0.24	0.22	0.24	0.20
Zinc	10.5	10.9	10.1	12.3	14.6	10.9	13.1	12.9	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2016 Horsetail trace metal analysis (n=6), sample sites CCTMCH-604 to CCTMBH-630

Parameter[1]	CCTMCH-604	CCTMCH-609	CCTMAH-619	CCTMBH-625	CCTMBH-625-R[2]	CCTMAH-627	CCTMBH-630	RDL[3]
Aluminum	99.7	24.1	4.8	71.7	50.0	74.3	60.1	1.0
Antimony	0.0087	0.0179	0.0406	0.0155	0.0182	0.0166	0.124	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	0.063	0.108	<0.050	0.050
Barium	104	123	30.9	346	310	295	203	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	13.0	8.8	22.9	28.7	25.8	14.7	11.5	2.0
Cadmium	0.432	0.141	0.051	0.085	0.107	0.061	0.070	0.010
Calcium	7020	9700	35300	28400	27300	28000	16600	10
Chromium	<0.20	<0.20	<0.20	<0.20	0.28	<0.20	0.21	0.20
Cobalt	2.07	0.413	0.544	0.608	0.441	0.625	0.834	0.020
Copper	3.84	4.45	2.17	2.23	2.24	2.52	4.04	0.050
Iron	170	45	40	24	23	105	85	10
Lead	0.036	0.027	0.014	0.052	0.053	0.037	0.056	0.010
Magnesium	3050	3590	2280	1760	2040	1350	3840	10
Manganese	234	285	82.5	136	122	202	181	0.10
Mercury	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010
Molybdenum	0.705	0.182	0.127	0.117	0.198	0.304	0.383	0.050
Nickel	3.69	0.813	0.198	3.09	2.76	1.27	1.73	0.050
Phosphorus	1570	2210	945	899	959	748	1070	10
Potassium	26100	26800	28400	9150	10600	14000	26900	10
Selenium	<0.050	<0.050	<0.050	0.307	0.511	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	48	<10	<10	<10	<10	10
Strontium	48.8	72.3	99.4	163	153	113	106	0.10
Thallium	0.0258	<0.0020	<0.0020	0.0025	0.0021	0.0031	<0.0020	0.0020
Tin	<0.10	<0.10	<0.10	0.64	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
Uranium	<0.0020	0.0034	<0.0020	0.0061	0.0046	0.0023	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	70.7	39.8	27.9	34.0	41.8	22.1	46.9	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2016 Lowbush cranberry trace metal analysis (n=40), sample sites CCTMAC-600 to CCTMCC-610

Parameter[1]	CCTMAC-600	CCTMAC-601	CCTMBC-602	CCTMBC-603	CCTMCC-604	CCTMCC-605	CCTMCC-606	CCTMCC-607	CCTMCC-608	CCTMCC-609	CCTMCC-610	RDL[2]
Aluminum	161	119	162	146	144	157	34.1	40.5	95.2	101	93.3	1.0
Antimony	<0.0050	0.0069	0.0051	0.0069	0.0058	0.0055	0.0091	0.0066	0.0069	<0.0050	0.0079	0.005
Arsenic	<0.050	<0.050	<0.050	0.09	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Barium	76.4	96.3	62.5	71.3	54	71.1	121	116	73.5	75.2	86.9	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	7.5	8.1	4.2	6.9	7.2	8.8	10.1	8.8	4.4	6.9	7.3	2.0
Cadmium	<0.010	0.019	<0.010	<0.010	0.011	0.015	<0.010	0.014	<0.010	0.013	0.04	0.010
Calcium	6180	6450	5430	5750	8040	5530	6260	8030	5240	5390	5910	10
Chromium	<0.20	<0.20	0.21	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	0.035	0.039	0.037	0.029	0.044	0.021	0.024	0.024	0.03	0.029	0.031	0.020
Copper	6.81 (1)	4.49	3.9	3.95	3.3	4.53	2.15	1.74	3.2	2.96	3.23	0.050
Iron	60	59	82	58	61	42	41	35	36	46	48	10
Lead	0.034	0.05	0.055	0.044	0.034	0.023	0.019	0.021	0.028	0.029	0.025	0.010
Magnesium	1230	1100	1290	1300	1170	864	1010	911	1230	712	869	10
Manganese	3040	2620	1820	2650	2900	2500	1070	828	1920	2560	1970	0.10
Mercury	0.018	0.025	0.013	0.017	0.017	<0.010	0.014	0.012	<0.010	0.012	<0.010	0.010
Molybdenum	0.057	<0.050	0.088	<0.050	0.243	<0.050	0.12	1.89	0.096	0.4	<0.050	0.050
Nickel	0.303	0.349	0.436	0.254	0.321	0.404	0.134	0.137	0.317	0.184	0.187	0.050
Phosphorus	1040	1160	1110	997	635	811	930	728	649	611	1130	10
Potassium	3540	4200	3590	3580	2790	3840	4380	2730	2210	3400	4170	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
Strontium	6.82	10.7	5.91	6.98	6.07	4.36	10.8	12.7	5.52	9.08	5.02	0.10
Thallium	<0.0020	<0.0020	0.0023	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	1.4	1.4	1.8	1.5	1.7	<1.0	1	<1.0	<1.0	1.1	1.4	1.0
Uranium	<0.0020	0.0027	<0.0020	<0.0020	<0.0020	0.0076	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	24.2	25.5	24	24.1	22.1	22.9	27.7	15.5	20.6	17.9	24.1	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Reportable Detection Limit (RDL)

2016 Lowbush cranberry trace metal analysis (n=40), sample sites CCTMCC-611 to CCTMBC-620

Parameter[1]	CCTMCC-611	CCTMCC-612	CCTMCC-613	CCTMCC-613-R[2]	CCTMRC-614	CCTMRC-615	CCTMRC-616	CCTMRC-617	CCTMRC-618	CCTMAC-619	CCTMBC-620	RDL[3]
Aluminum	94.2	107	111	64.7	111	111	127	159	137	44.3	95.1	1.0
Antimony	0.0116	<0.0050	0.0081	0.0097	<0.0050	0.0198	0.0134	0.0178	0.0062	0.0249	0.0201	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Barium	61.1	93.7	76.1	95.1	77.4	91.5	116	117	74.8	89.4	50.1	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	8.1	5.1	5.8	5.1	8.9	8	8.2	6.1	8.4	9.5	8.9	2.0
Cadmium	<0.010	<0.010	<0.010	<0.010	0.025	0.013	0.017	0.011	0.033	<0.010	<0.010	0.010
Calcium	5970	6020	5870	5620	7440	7400	6710	6180	6650	9620	5100	10
Chromium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	0.028	0.039	0.037	0.052	0.02	0.025	0.035	0.05	0.043	0.026	0.029	0.020
Copper	4.7	4.95	3.43	3.77	4.57	3.3	4.18	3.19	4.07	3.81	3.33	0.050
Iron	43	46	44	41	44	46	60	68	54	44	26	10
Lead	0.03	0.037	0.02	0.029	0.021	0.027	0.029	0.035	0.032	0.029	0.021	0.010
Magnesium	993	1580	1480	1650	785	947	1130	1670	1220	909	875	10
Manganese	2530	1700	1720	1520	3260	3050	2910	2460	2690	864	2520	0.10
Mercury	0.015	0.012	0.013	<0.010	0.014	0.012	0.015	0.021	0.014	0.018	0.013	0.010
Molybdenum	0.124	0.059	0.051	<0.050	0.087	0.093	0.077	0.054	<0.050	<0.050	0.051	0.050
Nickel	0.253	0.387	0.352	0.39	0.266	0.421	0.331	0.432	0.358	0.574	0.173	0.050
Phosphorus	652	1230	1260	1170	729	947	1070	1090	1090	690	645	10
Potassium	2790	4620	3900	3920	4010	3840	3990	3900	4020	3960	2860	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
Strontium	5.14	5.87	7.4	10.5	5.97	6.03	8.08	10	4.32	16.1	3.43	0.10
Thallium	0.0024	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.43	<0.10	<0.10	0.10
Titanium	1	<1.0	1.1	<1.0	1.1	1.1	1.8	2	1.4	1.1	<1.0	1.0
Uranium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0021	<0.0020	<0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	20.3	30.9	27.3	24.7	27.2	28.1	23.1	25.9	36.5	46.8	17.7	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2016 Lowbush cranberry trace metal analysis (n=40), sample sites CCTMBC-621 to CCTMBC-629

Parameter[1]	CCTMBC-621	CCTMAC-622	CCTMAC-622-R[2]	CCTMAC-623	CCTMBC-624	CCTMBC-625	CCTMBC-625-R	CCTMAC-626	CCTMAC-627	CCTMAC-628	CCTMBC-629	RDL[3]
Aluminum	105	49.4	47.6	144	105	155	139	136	135	111	84.9	1.0
Antimony	0.0479	0.0206	0.0416	0.0167	0.0209	0.0145	0.0119	0.0202	0.0121	0.0096	0.0079	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Barium	74.8	68.6	72.8	79.7	81.2	103	116	87.5	96.8	94.8	86.9	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	8.9	5.3	5.6	7.6	6.3	13.7	12.8	7	9.4	3.5	10.1	2.0
Cadmium	<0.010	<0.010	<0.010	0.016	<0.010	0.133	0.174	<0.010	0.01	<0.010	0.055	0.010
Calcium	7790	5250	4860	7580	5900	7370	6760	7930	6380	4990	6380	10
Chromium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	0.024	0.029	0.027	0.036	<0.020	0.062	0.056	0.028	0.024	0.038	<0.020	0.020
Copper	3.99	3.4	3.68	4.67	2.75	4.13	4.65	2.81	3.95	3.28	2.43	0.050
Iron	38	30	30	46	36	39	52	41	41	44	39	10
Lead	0.024	0.021	0.028	0.038	0.02	0.015	0.068	0.039	0.02	0.022	0.017	0.010
Magnesium	918	936	851	1220	1310	896	958	1310	1120	1250	866	10
Manganese	3210	1830	1840	2680	2680	2690	2500	2830	2140	1540	1140	0.10
Mercury	0.016	<0.010	0.011	0.018	0.013	0.013	0.011	0.017	0.016	0.012	0.012	0.010
Molybdenum	<0.050	0.181	0.158	0.107	0.088	0.457	0.317	0.072	<0.050	0.109	0.238	0.050
Nickel	0.195	0.238	0.299	0.247	0.192	0.184	0.162	0.173	0.248	0.275	0.152	0.050
Phosphorus	640	1150	1150	993	689	1120	1010	649	768	1150	890	10
Potassium	2940	4150	4480	3660	2940	4790	3570	2780	3350	4750	3440	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
Strontium	4.07	5.1	5.94	6.05	4.46	13.9	12.4	6.63	6.15	5.76	9.71	0.10
Thallium	0.0029	<0.0020	<0.0020	0.003	<0.0020	0.0078	0.0124	<0.0020	0.0021	<0.0020	<0.0020	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	<1.0	1.1	<1.0	<1.0	<1.0	1.1	1	1.2	<1.0	1.0
Uranium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	19.1	18.6	17.5	30.9	13.4	24.3	24.4	20.7	25.1	20.1	20.2	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2016 Lowbush cranberry trace metal analysis (n=40), sample sites CCTMBC-630 to CCTMRC-639-R

Parameter[1]	CCTMBC-630	CCTMBC-630	CCTMAC-632	CCTMBC-633	CCTMBC-634	CCTMRC-635	CCTMRC-636	CCTMRC-637	CCTMRC-638	CCTMRC-639	CCTMRC-639-R[2]	RDL[3]
Aluminum	107	85.4	119	48.6	33.4	45.5	83.8	84.8	81.2	106	89.6	1.0
Antimony	0.125	0.0182	0.0111	0.0138	0.0115	0.0068	0.0239	0.0143	0.0223	0.0067	0.0075	0.005
Arsenic	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Barium	95.2	90	111	61.7	96.9	75	65.3	84.8	77.5	97.6	106	0.10
Beryllium	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Bismuth	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Boron	5.5	4.4	6.5	8.8	14.1	7.2	13.4	10	6.8	8.5	7	2.0
Cadmium	<0.010	0.012	0.022	0.021	0.027	<0.010	0.027	0.016	<0.010	0.015	<0.010	0.010
Calcium	6430	5380	6760	6990	8950	5350	6690	7000	6280	5810	6950	10
Chromium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Cobalt	0.06	0.029	0.021	<0.020	0.049	0.032	<0.020	<0.020	0.021	0.058	0.033	0.020
Copper	3.13	4.13	3.4	4.42	4.72	4.47	3.35	3.59	4.21	4.83	4.7	0.050
Iron	40	33	35	36	63	26	33	37	31	36	33	10
Lead	0.028	0.034	0.014	0.014	0.033	0.012	0.02	0.018	0.013	0.019	0.014	0.010
Magnesium	1260	1380	1150	895	979	916	861	971	921	910	939	10
Manganese	1600	1540	2310	2190	555	1630	2640	2190	2500	2140	2430	0.10
Mercury	0.013	0.011	0.013	0.014	0.032	0.01	0.012	0.015	0.01	0.011	0.014	0.010
Molybdenum	0.116	0.063	0.093	0.156	0.358	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Nickel	0.269	0.432	0.205	0.127	0.195	0.902	0.194	0.157	0.248	0.267	0.264	0.050
Phosphorus	869	884	1280	920	749	1180	904	1180	1110	1140	1200	10
Potassium	3530	3210	4950	4300	4110	5090	4190	4060	4140	4200	4430	10
Selenium	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050
Silver	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020
Sodium	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	10
Strontium	11.6	8.88	7.49	8.45	21.7	3.98	6.08	5.38	4.13	5.78	5.6	0.10
Thallium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020
Tin	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Titanium	<1.0	<1.0	<1.0	<1.0	1.3	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0
Uranium	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.002
Vanadium	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20
Zinc	14.6	20.4	31	32.8	15.8	24.3	26.6	29.1	26.6	31.6	30.8	0.20

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] R = replicate sample
[3] Reportable Detection Limit (RDL)

2016 Soil trace metal analysis (n=40), sample sites CCTMAS-600 to CCTMCS-610

Parameter[1]	CCME Ind[2]	CCTMAS-600	CCTMAS-601	CCTMBS-602	CCTMBS-603	CCTMCS-604	CCTMCS-605	CCTMCS-606	CCTMCS-607	CCTMCS-608	CCTMCS-609	CCTMCS-610	RDL[3]
Aluminum	NA	17500	18000	3180	41000	12200	24000	14800	11300	14900	10400	10900	100
Antimony	40	0.62	0.37	<0.10	1.73	1.87	0.44	0.45	0.3	0.4	0.57	0.58	0.10
Arsenic	12	53.1	8.18	0.9	520	16.1	7.65	8.22	4.91	4.51	9.9	6.35	0.50
Barium	2000	122	99.8	18.4	300	158	138	278	131	138	312	91.8	0.10
Beryllium	8	<0.40	<0.40	<0.40	1.08	<0.40	<0.40	<0.40	<0.40	<0.40	0.43	<0.40	0.40
Bismuth	NA	<0.10	0.31	<0.10	0.23	0.25	<0.10	0.12	<0.10	0.17	<0.10	0.21	0.10
Cadmium	22	0.227	0.253	<0.050	0.75	0.796	0.378	0.69	0.218	0.196	0.772	0.317	0.050
Calcium	NA	3000	2780	578	6240	2820	5120	4340	10400	3480	7620	1160	100
Chromium	87	27.7	26.7	6.2	49.7	26.1	44.7	28	21.1	28	12.4	20	1.0
Cobalt	300	6.98	6.52	0.7	9.18	5.59	16.7	9.16	6.39	8.1	21.5	4.3	0.30
Copper	91	17.8	12	3.23	31.6	18.2	28.9	15.5	12.2	11.5	15.8	15.3	0.50
Iron	NA	23400	24900	4890	38300	18000	36600	22300	18300	18400	11200	23500	100
Lead	600	8.54	12	2.1	14.2	42.2	6.95	6.72	4.88	11.8	4.91	9.32	0.10
Lithium	NA	10.9	14.6	<5.0	14.6	6.2	10.2	9.2	8.4	8.6	<5.0	5.9	5.0
Magnesium	NA	4300	3830	298	3850	3060	15400	4070	3410	4120	1670	2100	100
Manganese	NA	294	520	17.6	670	177	574	420	224	265	3150	153	0.20
Mercury	50	<0.050	<0.050	<0.050	0.261	0.071	<0.050	<0.050	<0.050	<0.050	0.157	<0.050	0.050
Molybdenum	40	0.47	0.73	0.31	2.17	1.86	0.68	1.45	0.37	0.84	0.93	1.56	0.10
Nickel	89	16.2	13.1	1.61	27.6	13.8	29.2	19	13.7	16.4	11.7	10.7	0.80
Phosphorus	NA	489	351	259	1240	642	644	375	584	530	1040	267	10
Potassium	NA	643	1020	222	1350	671	1430	358	733	663	517	354	100
Selenium	2.9	<0.50	<0.50	<0.50	0.55	0.53	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	40	0.066	0.089	<0.050	0.491	0.681	0.103	0.076	0.057	0.108	0.269	0.227	0.050
Sodium	NA	<100	108	194	107	168	127	192	196	209	<100	142	100
Strontium	NA	21.3	21.4	7.58	49.5	24.9	34.9	29.4	38.8	27	71	13.3	0.10
Thallium	1	0.167	0.262	<0.050	0.316	0.325	0.125	0.109	0.069	0.139	0.134	0.117	0.050
Tin	300	0.56	1.16	0.15	0.72	0.44	0.26	0.42	0.31	0.67	0.2	0.53	0.10
Titanium	NA	881	1030	84.2	451	657	1140	631	686	796	198	657	1.0
Uranium	300	1.76	3.66	0.234	26.8	5.21	0.419	0.569	0.867	1.17	11.1	0.397	0.050
Vanadium	130	53.7	53.2	11.1	60.3	40.2	80.8	61.2	42.1	53.5	19.1	68.3	2.0
Zinc	360	47	57.6	6.6	76.2	67.9	75.6	51.1	40.4	53.6	29.5	37.6	1.0
Zirconium	NA	4	2.83	<0.50	4.65	6	2.29	2.46	1.88	1.88	2.06	1.44	0.50
pH	6-8	5.8	4.98	4.19	7.10	4.69	6.12	4.98	5.04	4.77	5.30	4.82	NA

[1] Total metals (units mg/kg dry weight) unless otherwise indicated

[2] Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[3] Reportable Detection Limit (RDL)

2016 Soil trace metal analysis (n=40), sample sites CCTMCS-611 to CCTMBS-620

Parameter[1]	CCME Ind[2]	CCTMCS-611	CCTMCS-612	CCTMCS-613	CCTMCS-613-R[3]	CCTMRS-614	CCTMRS-615	CCTMRS-616	CCTMRS-617	CCTMRS-618	CCTMAS-619	CCTMBS-620	RDL[4]
Aluminum	NA	13000	12100	13500	14900	9790	25500	27700	10300	28600	12800	13100	100
Antimony	40	0.5	0.64	0.52	0.55	0.28	0.24	0.31	0.29	0.24	0.42	0.32	0.10
Arsenic	12	11.7	4.9	7.97	8.38	2.79	3.61	9.29	6.73	6.96	7.47	6.42	0.50
Barium	2000	80.6	54.1	74.4	56.9	193	401	260	65.7	341	165	96.3	0.10
Beryllium	8	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.40
Bismuth	NA	0.25	0.46	0.18	0.16	0.1	<0.10	0.15	0.12	0.13	0.12	0.14	0.10
Cadmium	22	0.181	0.136	0.148	0.15	0.897	0.277	0.251	0.114	0.328	0.313	0.168	0.050
Calcium	NA	2300	732	1210	1400	4300	5220	3880	1130	4420	27000	2780	100
Chromium	87	24.4	19.2	27	24.9	19.3	109	64.5	70.4	87	34.7	23.4	1.0
Cobalt	300	3.59	3.63	4.9	5.3	17.6	14.4	16.2	5.55	23.3	9.05	4.67	0.30
Copper	91	9.29	11.1	16.7	12.8	40.6	27.4	42.1	10.9	50.7	26.5	8.26	0.50
Iron	NA	21000	25900	27600	33200	14000	28600	36200	15000	41100	21300	18300	100
Lead	600	14.9	25.4	9.75	8.6	5.29	6.23	5.21	4.19	24.8	8.59	10	0.10
Lithium	NA	6.6	5.8	7.6	7.8	<5.0	10.6	22.5	<5.0	30.2	8.4	7.8	5.0
Magnesium	NA	3030	1470	2900	2970	1830	17300	10700	4550	13600	7200	3660	100
Manganese	NA	102	438	171	201	858	382	458	110	379	423	175	0.20
Mercury	50	<0.050	0.09	<0.050	<0.050	0.105	<0.050	<0.050	<0.050	<0.050	0.056	0.066	0.050
Molybdenum	40	0.58	2.32	1.55	1.11	1.4	0.64	0.7	0.84	0.98	0.53	0.63	0.10
Nickel	89	10.2	6.59	11.1	13.5	16	45	40.6	67.9	56.7	21.8	12.5	0.80
Phosphorus	NA	351	209	337	237	1220	493	688	284	560	500	560	10
Potassium	NA	464	790	362	427	410	6640	4670	518	3950	2190	514	100
Selenium	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	40	0.119	<0.050	<0.050	<0.050	0.79	0.158	0.067	0.057	0.243	0.1	0.101	0.050
Sodium	NA	140	<100	<100	<100	143	125	211	113	189	246	173	100
Strontium	NA	17.7	9.34	14.1	11.8	31.5	35.6	21.1	11	22.2	107	20.9	0.10
Thallium	1	0.105	0.299	0.153	0.138	0.109	0.238	0.279	0.058	0.374	0.197	0.131	0.050
Tin	300	0.38	1.51	0.62	0.66	0.14	0.33	0.59	0.36	0.45	0.38	0.48	0.10
Titanium	NA	682	973	670	962	157	1540	1910	705	2140	724	714	1.0
Uranium	300	3.6	2.16	0.735	0.691	1.84	0.518	0.823	0.309	0.728	2.91	2.44	0.050
Vanadium	130	56.9	59.7	75	72	26.5	77.1	99	46.9	112	41.9	43.6	2.0
Zinc	360	40.6	45.2	33.4	34.9	27.9	62.4	64.2	20.3	97.7	62.6	47.1	1.0
Zirconium	NA	3.47	2.76	1.2	1.51	0.54	2.83	3.44	0.64	3.27	3.65	1.68	0.50
pH	6-8	4.73	5.04	4.4	4.69	4.96	5.46	5.46	4.67	5.38	7.42	4.78	NA

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)
[3] R = replicate sample
[4] Reportable Detection Limit (RDL)

2016 Soil trace metal analysis (n=40), sample sites CCTMAS-621 to CCTMBS-629

Parameter[1]	CCME Ind[2]	CCTMBS-621	CCTMAS-622-	CCTMAS-622-R[3]	CCTMAS-623	CCTMBS-624	CCTMBS-625	CCTMBS-625-R[3]	CCTMAS-626	CCTMAS-627	CCTMAS-628	CCTMBS-629	RDL[4]
Aluminum	NA	11000	15600	17000	10200	13400	10900	9270	8130	3000	10900	25400	100
Antimony	40	0.13	0.29	0.28	1.2	11.2	0.66	0.41	0.22	0.23	0.34	0.41	0.10
Arsenic	12	2.65	7.75	9.71	20.9	16.9	11.8	5.85	1.92	2.36	6.53	8.8	0.50
Barium	2000	82.9	171	186	73	131	42.6	38.1	80.3	39.3	85.8	146	0.10
Beryllium	8	<0.40	<0.40	<0.40	<0.40	0.47	<0.40	<0.40	<0.40	<0.40	<0.40	0.4	0.40
Bismuth	NA	0.12	0.14	0.18	0.11	0.16	0.14	0.12	<0.10	<0.10	0.13	0.25	0.10
Cadmium	22	0.131	0.101	0.155	0.246	0.243	0.178	0.212	0.261	0.25	0.179	0.235	0.050
Calcium	NA	2760	2860	2740	1840	3590	1170	686	1930	958	1420	2670	100
Chromium	87	34.4	26.8	33.8	21	28.1	16.5	11.4	18.3	8.3	21.4	41	1.0
Cobalt	300	4.7	8.55	10.2	5.03	12	3.47	3.08	2.99	1.37	5.89	9.11	0.30
Copper	91	10.6	11.3	11.6	10.9	9.88	7.82	8.65	10.4	9.12	11.7	11.9	0.50
Iron	NA	14700	24300	25900	16600	28100	16200	13600	9770	6460	18700	33600	100
Lead	600	6.38	6.53	8.16	5.92	10.3	8.69	6.08	3.55	2.27	7.93	12.4	0.10
Lithium	NA	<5.0	8.9	10.3	<5.0	5.8	5.3	<5.0	<5.0	<5.0	<5.0	18.6	5.0
Magnesium	NA	4130	4420	5120	2380	6280	2050	812	2300	426	3570	6390	100
Manganese	NA	127	274	426	132	602	149	340	62.3	38.7	218	250	0.20
Mercury	50	0.061	<0.050	<0.050	0.086	<0.050	<0.050	<0.050	0.053	0.062	<0.050	<0.050	0.050
Molybdenum	40	0.56	0.85	1.36	1.2	0.9	0.82	0.83	0.64	0.64	0.74	1.34	0.10
Nickel	89	10.9	14.6	16.2	10.6	10.6	6.84	3.64	7.75	3.57	11	22.1	0.80
Phosphorus	NA	500	283	356	460	393	264	214	491	643	390	234	10
Potassium	NA	1090	610	736	559	2480	582	393	533	340	590	1170	100
Selenium	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.50
Silver	40	0.068	0.055	0.072	0.082	0.082	0.053	0.073	0.096	0.112	0.064	0.077	0.050
Sodium	NA	110	153	122	106	<100	128	137	152	144	103	<100	100
Strontium	NA	21.2	20.1	22.8	14.5	19.5	9.74	7.77	15.5	8.9	13.1	19.9	0.10
Thallium	1	0.11	0.125	0.189	0.101	0.161	0.106	0.08	0.116	<0.050	0.12	0.206	0.050
Tin	300	0.41	0.43	0.58	0.34	0.94	0.4	0.34	0.37	0.15	0.38	0.84	0.10
Titanium	NA	702	819	1110	581	656	592	480	434	125	636	854	1.0
Uranium	300	1.17	0.49	0.526	1.43	0.893	0.545	0.676	0.985	0.369	0.507	0.612	0.050
Vanadium	130	25.8	52.4	71.2	44.2	65.6	34.6	30.5	21.3	17.5	55.3	79.8	2.0
Zinc	360	29.2	29.7	34.3	23.4	48.4	24.4	15.7	17.8	17.6	34.7	67.3	1.0
Zirconium	NA	1.58	1.02	1.33	1	0.97	0.86	0.8	0.59	0.66	1.4	3.98	0.50
pH	6-8	4.32	5.09	4.71	4.39	4.64	4.46	4.73	4.48	4.06	4.17	4.92	NA

[1] Total metals (units mg/kg dry weight) unless otherwise indicated
[2] Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)
[3] R = replicate sample
[4] Reportable Detection Limit (RDL)

2016 Soil trace metal analysis (n=40), sample sites CCTMBS-630 to CCTMRS-639-R

Parameter[1]	CCME Ind[2]	CCTMBS-630	CCTMAS-631	CCTMAS-632	CCTMBS-633	CCTMBS-634	CCTMRS-635	CCTMRS-636	CCTMRS-637	CCTMRS-638	CCTMRS-639	CCTMRS-639-R[3]	RDL[4]
Aluminum	NA	15300	12100	21300	23100	11400	7670	17500	21800	6500	13000	7550	100
Antimony	40	0.28	3.31	0.36	0.22	0.56	0.28	0.51	0.38	0.13	0.35	0.23	0.10
Arsenic	12	6.06	22.9	9.61	5.71	10	5.93	7.04	7.63	1.42	6.94	4.2	0.50
Barium	2000	110	66.6	149	222	335	197	639	129	172	138	57	0.10
Beryllium	8	0.42	<0.40	1	<0.40	0.41	<0.40	0.62	0.48	<0.40	<0.40	<0.40	0.40
Bismuth	NA	0.14	0.32	0.27	0.15	0.14	<0.10	0.16	0.13	<0.10	0.33	0.82	0.10
Cadmium	22	0.164	0.178	0.517	0.107	0.251	0.415	0.686	0.172	0.434	0.192	0.55	0.050
Calcium	NA	2910	1250	4200	7090	22100	6870	6310	3090	2420	3300	1290	100
Chromium	87	23.4	27.9	34.8	95	32.4	291	29.6	34.1	9.2	28.8	20	1.0
Cobalt	300	7.64	6.36	9.15	14.8	10.7	26.5	30.5	12.1	2.9	10.4	5.7	0.30
Copper	91	10.9	11.2	21.1	35.5	21.4	58.5	33.8	24.3	36.5	22.7	21.6	0.50
Iron	NA	20200	21800	27200	20100	21600	18500	27300	31500	8230	25100	16400	100
Lead	600	5.34	20	18.3	3.72	6.37	2.54	9.22	7.62	5.42	37.6	26.5	0.10
Lithium	NA	6.2	5.3	11.3	11.7	8.5	<5.0	6.5	12.7	<5.0	9	<5.0	5.0
Magnesium	NA	4700	3330	7160	11300	6090	15300	2620	6700	654	6540	3030	100
Manganese	NA	143	392	444	214	420	999	11600	357	41.4	332	163	0.20
Mercury	50	<0.050	0.095	<0.050	<0.050	0.061	0.07	0.137	<0.050	0.065	<0.050	0.056	0.050
Molybdenum	40	0.53	1.19	1.57	0.19	0.57	0.56	2.66	0.94	0.79	0.93	0.74	0.10
Nickel	89	13.4	13.2	16.8	53.5	23.1	290	36.4	23.8	9.02	16.9	8.51	0.80
Phosphorus	NA	390	421	502	343	472	686	1310	417	629	537	613	10
Potassium	NA	1310	686	1500	915	2300	378	589	739	361	685	555	100
Selenium	2.9	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	0.56	<0.50	<0.50	<0.50	<0.50	0.50
Silver	40	0.101	0.111	0.37	<0.050	0.098	0.13	0.428	<0.050	0.203	0.144	0.229	0.050
Sodium	NA	<100	<100	209	345	178	<100	143	<100	143	123	119	100
Strontium	NA	19.2	10.7	34	67.1	173	25.1	38.9	20.1	20.5	22.3	12.4	0.10
Thallium	1	0.133	0.114	0.269	0.127	0.173	0.105	0.233	0.088	<0.050	0.093	<0.050	0.050
Tin	300	0.64	0.61	1.05	0.32	0.35	<0.10	0.3	0.51	0.11	0.32	0.22	0.10
Titanium	NA	808	672	1040	672	673	248	248	781	95.6	940	419	1.0
Uranium	300	1.88	1.3	3.36	0.505	1.9	0.23	1.43	0.852	1.5	0.473	0.403	0.050
Vanadium	130	41	50.6	65	36.2	37.8	22.5	45	65.8	13.2	58.9	40.8	2.0
Zinc	360	27.5	33.2	80.3	29.3	39.1	41.4	72.2	54.6	11.7	53.3	30	1.0
Zirconium	NA	1.54	0.88	3.31	1.15	4	0.61	0.61	1.19	<0.50	1.03	0.7	0.50
pH	6-8	4.76	4.31	5.14	6.2	6.85	6.72	5.57	5.18	4.54	4.73	4.02	NA

[1] Total metals (units mg/kg dry weight) unless otherwise indicated

[2] Industrial Soil Quality Guidelines provided by the Canadian Council of Ministers of the Environment (CCME)

[3] R = replicate sample

[4] Reportable Detection Limit (RDL)

APPENDIX I. VEGETATION AND SOIL TRACE METALS SAMPLING CERTIFICATE OF ANALYSIS, QUALITY ASSURANCE REPORT & RAW LABORATORY RESULTS

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Your Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

Attention:Anne MacLeod

EDI ENVIRONMENTAL DYNAMICS INC.
2195 2nd Avenue
WHITEHORSE, YT
CANADA Y1A 3T8

Your C.O.C. #: 08396125, 08396126, 08396127, 08396128, 08396129, 08396130, 08396131, 08396132, 08396133, 08396134, 08396135, 08396136, 08396122, 08396123, 08396124

Report Date: 2014/10/31
Report #: R1675669
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B473400
Received: 2014/08/21, 14:45

Sample Matrix: VEGETATION
Samples Received: 110

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by CRC ICPMS (total) - Plant	18	2014/10/03	2014/10/09	BBY7SOP-00002	EPA 6020A R1 m
Elements by CRC ICPMS (total) - Plant	18	2014/10/08	2014/10/11	BBY7SOP-00002	EPA 6020A R1 m
Elements by CRC ICPMS (total) - Plant	10	2014/10/16	2014/10/18	BBY7SOP-00002	EPA 6020A R1 m
Elements by CRC ICPMS (total) - Plant	24	2014/10/17	2014/10/24	BBY7SOP-00002	EPA 6020A R1 m
Elements by CRC ICPMS (total) - Plant	39	2014/10/17	2014/10/29	BBY7SOP-00002	EPA 6020A R1 m
Elements by CRC ICPMS (total) - Plant	1	2014/10/17	2014/10/31	BBY7SOP-00002	EPA 6020A R1 m

Sample Matrix: Soil
Samples Received: 42

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by ICPMS (total)	40	2014/08/24	2014/08/26	BBY7SOP-00001	EPA 6020a R1 m
Elements by ICPMS (total)	2	2014/08/25	2014/08/27	BBY7SOP-00001	EPA 6020a R1 m
pH (2:1 DI Water Extract)	40	2014/08/25	2014/08/25	BBY6SOP-00028	BCMOE BCLM Mar2005 m
pH (2:1 DI Water Extract)	2	2014/08/26	2014/08/26	BBY6SOP-00028	BCMOE BCLM Mar2005 m

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Your Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

Attention:Anne MacLeod

EDI ENVIRONMENTAL DYNAMICS INC.
2195 2nd Avenue
WHITEHORSE, YT
CANADA Y1A 3T8

Your C.O.C. #: 08396125, 08396126, 08396127, 08396128, 08396129, 08396130, 08396131, 08396132, 08396133, 08396134, 08396135, 08396136, 08396122, 08396123, 08396124

Report Date: 2014/10/31
Report #: R1675669
Version: 1 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B473400
Received: 2014/08/21, 14:45

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Graham Rudkin, Project Manager, Environmental
Email: GRudkin@maxxam.ca
Phone# (604)638-5926 Ext:5926

==========

This report has been generated and distributed using a secure automated process.
Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2326	KK2327	KK2328	KK2329	KK2330	KK2331		
Sampling Date		2014/08/04	2014/08/04	2014/08/04	2014/08/03	2014/08/03	2014/08/01		
COC Number		08396125	08396125	08396125	08396125	08396125	08396125		
	Units	CCHMWC-59	CCHMCA-50	CCHMLC-55	CCHMWA-851	CCHMWA-851 REP2	CCHMCA-21	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	9.3	52.5	139	136	295	53.1	1.0	7665088
Total Antimony (Sb)	mg/kg	<0.0050	<0.0050	0.0083	0.0446	0.0982	<0.0050	0.0050	7665088
Total Arsenic (As)	mg/kg	<0.050	0.058	0.109	0.679	1.48	<0.050	0.050	7665088
Total Barium (Ba)	mg/kg	14.9	36.0	5.11	42.6	54.6	41.5	0.10	7665088
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7665088
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7665088
Total Boron (B)	mg/kg	4.6	6.1	<2.0	<2.0	3.7	3.3	2.0	7665088
Total Cadmium (Cd)	mg/kg	0.951	<0.010	0.025	0.522	0.484	0.027	0.010	7665088
Total Calcium (Ca)	mg/kg	5880	3640	727	5720	6920	3560	10	7665088
Total Chromium (Cr)	mg/kg	<0.20	<0.20	0.24	1.18	1.71	<0.20	0.20	7665088
Total Cobalt (Co)	mg/kg	0.283	<0.020	0.101	1.04	1.61	0.027	0.020	7665088
Total Copper (Cu)	mg/kg	3.39	2.78	1.04	3.10	3.35	2.88	0.050	7665088
Total Iron (Fe)	mg/kg	58	27	180	234	490	40	10	7665088
Total Lead (Pb)	mg/kg	0.022	0.019	0.155	0.078	0.154	0.024	0.010	7665088
Total Magnesium (Mg)	mg/kg	2140	808	300	2090	3090	737	10	7665088
Total Manganese (Mn)	mg/kg	241	1710	121	171	266	1230	0.10	7665088
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7665088
Total Molybdenum (Mo)	mg/kg	0.070	0.055	<0.050	0.063	0.139	0.058	0.050	7665088
Total Nickel (Ni)	mg/kg	0.915	0.201	0.429	2.84	2.95	0.359	0.050	7665088
Total Phosphorus (P)	mg/kg	927	482	367	1440	1810	682	10	7665088
Total Potassium (K)	mg/kg	4760	2600	894	6550	7390	3090	10	7665088
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7665088
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7665088
Total Sodium (Na)	mg/kg	<10	<10	15	<10	<10	<10	10	7665088
Total Strontium (Sr)	mg/kg	29.3	3.35	2.22	41.5	44.1	3.85	0.10	7665088
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	0.0026	0.0042	0.0070	<0.0020	0.0020	7665088
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7665088
Total Titanium (Ti)	mg/kg	<1.0	<1.0	6.5	10.0	14.4	1.3	1.0	7665088
Total Uranium (U)	mg/kg	<0.0020	<0.0020	0.0065	0.0096	0.0201	<0.0020	0.0020	7665088
Total Vanadium (V)	mg/kg	<0.20	<0.20	0.36	0.47	0.96	<0.20	0.20	7665088
Total Zinc (Zn)	mg/kg	107	14.5	9.66	28.6	79.5	16.8	0.20	7665088

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2332	KK2333	KK2334	KK2335	KK2336	KK2337		
Sampling Date		2014/08/04	2014/08/03	2014/08/01	2014/08/04	2014/08/01	2014/08/04		
COC Number		08396125	08396125	08396125	08396125	08396125	08396125		
	Units	CCHMWA-50	CCHMCA-851 REP2	CCHMWB-20	CCHMLB-49	CCHMLB-20	CCHMCC-55	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	16.8	123	11.8	136	95.2	67.4	1.0	7665088
Total Antimony (Sb)	mg/kg	<0.0050	0.0221	<0.0050	0.0087	0.0184	<0.0050	0.0050	7665088
Total Arsenic (As)	mg/kg	0.124	0.396	<0.050	0.155	0.291	<0.050	0.050	7665088
Total Barium (Ba)	mg/kg	11.0	41.7	15.6	5.48	13.6	34.3	0.10	7665088
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7665088
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7665088
Total Boron (B)	mg/kg	3.8	4.2	6.9	<2.0	<2.0	3.3	2.0	7665088
Total Cadmium (Cd)	mg/kg	0.951	<0.010	0.671	0.035	0.026	<0.010	0.010	7665088
Total Calcium (Ca)	mg/kg	3310	3020	8530	692	1600	3050	10	7665088
Total Chromium (Cr)	mg/kg	<0.20	0.41	<0.20	0.22	0.24	<0.20	0.20	7665088
Total Cobalt (Co)	mg/kg	0.186	0.055	0.257	0.123	0.072	0.025	0.020	7665088
Total Copper (Cu)	mg/kg	1.99	2.41	2.72	1.24	1.51	2.52	0.050	7665088
Total Iron (Fe)	mg/kg	44	111	41	175	145	24	10	7665088
Total Lead (Pb)	mg/kg	0.022	0.049	0.023	0.185	0.125	0.019	0.010	7665088
Total Magnesium (Mg)	mg/kg	1030	789	1240	284	260	810	10	7665088
Total Manganese (Mn)	mg/kg	503	1090	136	138	23.4	1170	0.10	7665088
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7665088
Total Molybdenum (Mo)	mg/kg	0.082	0.069	0.160	<0.050	0.057	0.059	0.050	7665088
Total Nickel (Ni)	mg/kg	0.888	0.313	1.49	0.405	0.319	0.208	0.050	7665088
Total Phosphorus (P)	mg/kg	736	629	749	361	404	641	10	7665088
Total Potassium (K)	mg/kg	5000	3110	11400	916	1150	2720	10	7665088
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7665088
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7665088
Total Sodium (Na)	mg/kg	11	<10	<10	13	12	<10	10	7665088
Total Strontium (Sr)	mg/kg	19.3	3.50	18.3	2.28	4.33	3.07	0.10	7665088
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	7665088
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7665088
Total Titanium (Ti)	mg/kg	<1.0	4.9	<1.0	6.6	4.7	<1.0	1.0	7665088
Total Uranium (U)	mg/kg	<0.0020	0.0053	<0.0020	0.0117	0.0048	<0.0020	0.0020	7665088
Total Vanadium (V)	mg/kg	<0.20	0.23	<0.20	0.33	0.24	<0.20	0.20	7665088
Total Zinc (Zn)	mg/kg	135	10.2	94.1	9.57	10.2	13.6	0.20	7665088

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2359	KK2360	KK2361	KK2362	KK2363	KK2364		
Sampling Date		2014/08/04	2014/08/04	2014/08/02	2014/08/03	2014/08/02	2014/08/02		
COC Number		08396126	08396126	08396126	08396126	08396126	08396126		
	Units	CCHMLA-21	CCHMWC-55	CCHMWB-28A	CCHMLA-39	CCHMCB-28A	CCHMHA-30A	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	136	36.3	18.0	96.1	76.4	35.1	1.0	7665088
Total Antimony (Sb)	mg/kg	0.0117	<0.0050	<0.0050	0.0123	<0.0050	<0.0050	0.0050	7665088
Total Arsenic (As)	mg/kg	0.223	<0.050	<0.050	0.166	<0.050	0.208	0.050	7665088
Total Barium (Ba)	mg/kg	6.65	28.8	13.9	5.58	49.2	32.5	0.10	7665088
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7665088
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7665088
Total Boron (B)	mg/kg	<2.0	4.3	4.7	<2.0	4.9	12.0	2.0	7665088
Total Cadmium (Cd)	mg/kg	0.031	0.606	0.589	0.038	<0.010	0.045	0.010	7665088
Total Calcium (Ca)	mg/kg	822	7160	4680	694	4010	15500	10	7665088
Total Chromium (Cr)	mg/kg	0.32	<0.20	<0.20	0.21	<0.20	<0.20	0.20	7665088
Total Cobalt (Co)	mg/kg	0.109	0.686	1.91	0.077	0.029	0.160	0.020	7665088
Total Copper (Cu)	mg/kg	0.928	4.26	2.29	1.04	2.07	5.51	0.050	7665088
Total Iron (Fe)	mg/kg	201	67	56	135	31	80	10	7665088
Total Lead (Pb)	mg/kg	0.169	0.034	0.021	0.118	0.026	0.064	0.010	7665088
Total Magnesium (Mg)	mg/kg	227	2950	1270	205	862	2040	10	7665088
Total Manganese (Mn)	mg/kg	51.1	166	517	82.0	1580	96.2	0.10	7665088
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	0.010	7665088
Total Molybdenum (Mo)	mg/kg	<0.050	0.059	0.093	<0.050	<0.050	0.460	0.050	7665088
Total Nickel (Ni)	mg/kg	0.389	3.21	1.02	0.287	0.169	0.206	0.050	7665088
Total Phosphorus (P)	mg/kg	272	1040	834	258	480	1100	10	7665088
Total Potassium (K)	mg/kg	663	5370	5990	831	2420	27000	10	7665088
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7665088
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7665088
Total Sodium (Na)	mg/kg	11	<10	11	11	<10	25	10	7665088
Total Strontium (Sr)	mg/kg	2.58	38.5	22.8	1.79	3.80	120	0.10	7665088
Total Thallium (Tl)	mg/kg	<0.0020	0.0028	<0.0020	<0.0020	<0.0020	0.0029	0.0020	7665088
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7665088
Total Titanium (Ti)	mg/kg	7.2	1.4	<1.0	5.1	<1.0	2.2	1.0	7665088
Total Uranium (U)	mg/kg	0.0067	<0.0020	<0.0020	0.0068	<0.0020	0.0105	0.0020	7665088
Total Vanadium (V)	mg/kg	0.36	<0.20	<0.20	0.23	<0.20	<0.20	0.20	7665088
Total Zinc (Zn)	mg/kg	11.6	35.0	92.9	8.49	11.2	14.3	0.20	7665088

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2365	KK2366	KK2367	KK2368	KK2369	KK2370		
Sampling Date		2014/08/04	2014/08/02	2014/08/04	2014/08/04	2014/08/04	2014/08/03		
COC Number		08396126	08396126	08396126	08396126	08396126	08396126		
	Units	CCHMCB-49	CCHMLB-28A	CCHMHC-59	CCHMWB-49	CCHMLA-49	CCHMLA-38	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	39.1	117	12.6	24.1	121	140	1.0	7671661
Total Antimony (Sb)	mg/kg	<0.0050	0.0117	<0.0050	<0.0050	0.0447	0.0128	0.0050	7671661
Total Arsenic (As)	mg/kg	<0.050	0.131	<0.050	0.063	3.11	0.175	0.050	7671661
Total Barium (Ba)	mg/kg	22.1	4.31	82.6	22.4	5.03	7.03	0.10	7671661
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7671661
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7671661
Total Boron (B)	mg/kg	3.4	<2.0	14.2	6.2	<2.0	<2.0	2.0	7671661
Total Cadmium (Cd)	mg/kg	<0.010	0.051	0.083	1.20	0.027	0.027	0.010	7671661
Total Calcium (Ca)	mg/kg	2140	691	21800	5810	798	548	10	7671661
Total Chromium (Cr)	mg/kg	<0.20	0.29	<0.20	<0.20	0.26	0.35	0.20	7671661
Total Cobalt (Co)	mg/kg	<0.020	0.120	0.552	0.282	0.096	0.117	0.020	7671661
Total Copper (Cu)	mg/kg	1.78	3.38	4.30	3.31	1.30	1.27	0.050	7671661
Total Iron (Fe)	mg/kg	13	203	140	56	185	206	10	7671661
Total Lead (Pb)	mg/kg	<0.010	0.205	0.029	0.039	0.172	0.153	0.010	7671661
Total Magnesium (Mg)	mg/kg	625	269	3990	1920	316	235	10	7671661
Total Manganese (Mn)	mg/kg	903	128	247	276	151	63.7	0.10	7671661
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7671661
Total Molybdenum (Mo)	mg/kg	<0.050	<0.050	0.133	0.053	0.054	<0.050	0.050	7671661
Total Nickel (Ni)	mg/kg	0.117	0.589	0.621	1.45	0.336	0.383	0.050	7671661
Total Phosphorus (P)	mg/kg	471	260	1230	928	454	274	10	7671661
Total Potassium (K)	mg/kg	2120	741	29200	7350	1090	621	10	7671661
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7671661
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7671661
Total Sodium (Na)	mg/kg	<10	<10	31	<10	<10	<10	10	7671661
Total Strontium (Sr)	mg/kg	2.05	1.86	113	29.9	2.05	2.08	0.10	7671661
Total Thallium (Tl)	mg/kg	<0.0020	0.0026	0.0048	0.0037	0.0026	<0.0020	0.0020	7671661
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7671661
Total Titanium (Ti)	mg/kg	<1.0	6.4	<1.0	1.2	5.1	7.8	1.0	7671661
Total Uranium (U)	mg/kg	<0.0020	0.0191	0.0041	<0.0020	0.0208	0.0087	0.0020	7671661
Total Vanadium (V)	mg/kg	<0.20	0.35	<0.20	<0.20	0.32	0.35	0.20	7671661
Total Zinc (Zn)	mg/kg	10.4	8.75	40.1	146	14.4	9.71	0.20	7671661

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2384	KK2385	KK2387	KK2388	KK2390	KK2391		
Sampling Date		2014/08/01	2014/08/01	2014/08/03	2014/08/03	2014/08/03	2014/08/03		
COC Number		08396127	08396127	08396127	08396127	08396127	08396127		
	Units	CCHMCB-20	CCHMWA-21	CCHMCA-39	CCHMWA-39	CCHMCA-38	CCHMCA-851	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	8.3	13.0	49.6	9.4	63.6	100	1.0	7671661
Total Antimony (Sb)	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0217	0.0050	7671661
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	0.320	0.050	7671661
Total Barium (Ba)	mg/kg	46.8	23.6	54.0	25.5	56.5	40.8	0.10	7671661
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7671661
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7671661
Total Boron (B)	mg/kg	5.7	2.2	6.8	5.5	3.2	3.3	2.0	7671661
Total Cadmium (Cd)	mg/kg	<0.010	0.721	<0.010	0.627	<0.010	<0.010	0.010	7671661
Total Calcium (Ca)	mg/kg	2930	7430	4230	5670	3960	3090	10	7671661
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	0.25	0.54	0.20	7671661
Total Cobalt (Co)	mg/kg	<0.020	0.443	<0.020	0.244	0.028	0.054	0.020	7671661
Total Copper (Cu)	mg/kg	1.47	3.39	2.20	2.42	2.57	1.96	0.050	7671661
Total Iron (Fe)	mg/kg	15	42	37	38	41	113	10	7671661
Total Lead (Pb)	mg/kg	<0.010	0.014	0.018	0.027	0.034	0.048	0.010	7671661
Total Magnesium (Mg)	mg/kg	589	2080	864	1310	886	776	10	7671661
Total Manganese (Mn)	mg/kg	225	247	1120	200	1260	1080	0.10	7671661
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7671661
Total Molybdenum (Mo)	mg/kg	<0.050	0.087	<0.050	0.086	0.101	<0.050	0.050	7671661
Total Nickel (Ni)	mg/kg	0.080	3.83	0.156	0.276	0.254	0.446	0.050	7671661
Total Phosphorus (P)	mg/kg	512	1020	546	657	748	777	10	7671661
Total Potassium (K)	mg/kg	2850	7040	2740	8300	3040	3040	10	7671661
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7671661
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7671661
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	<10	10	7671661
Total Strontium (Sr)	mg/kg	3.59	21.4	3.42	18.5	3.87	2.77	0.10	7671661
Total Thallium (Tl)	mg/kg	<0.0020	0.0040	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	7671661
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7671661
Total Titanium (Ti)	mg/kg	<1.0	<1.0	1.0	<1.0	1.2	5.2	1.0	7671661
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0057	0.0020	7671661
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7671661
Total Zinc (Zn)	mg/kg	11.9	49.2	13.9	65.6	13.6	12.0	0.20	7671661

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2394	KK2416	KK2428	KK2430	KK2431	KK2432		
Sampling Date		2014/08/03	2014/08/02	2014/08/09	2014/08/08	2014/08/06	2014/08/10		
COC Number		08396127	08396128	08396129	08396129	08396129	08396129		
	Units	CCHMWA-38	CCHMWA-30A	CCHMHB-419	CCHMLA-98	CCHMWB-76	CCHMCC-438	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	27.0	6.2	11.9	104	26.8	69.5	1.0	7671661
Total Antimony (Sb)	mg/kg	0.0052	<0.0050	<0.0050	0.0095	<0.0050	<0.0050	0.0050	7671661
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	0.136	<0.050	<0.050	0.050	7671661
Total Barium (Ba)	mg/kg	35.2	8.25	12.5	5.29	12.5	49.2	0.10	7671661
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7671661
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7671661
Total Boron (B)	mg/kg	3.3	3.5	5.5	<2.0	7.9	3.6	2.0	7671661
Total Cadmium (Cd)	mg/kg	0.592	0.290	1.98	0.040	0.804	0.016	0.010	7671661
Total Calcium (Ca)	mg/kg	7820	3860	6720	791	13500	3230	10	7671661
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	0.35	0.24	<0.20	0.20	7671661
Total Cobalt (Co)	mg/kg	1.51	0.575	0.204	0.129	0.180	0.068	0.020	7671661
Total Copper (Cu)	mg/kg	4.49	2.76	3.04	1.61	2.17	3.49	0.050	7671661
Total Iron (Fe)	mg/kg	64	44	40	189	58	32	10	7671661
Total Lead (Pb)	mg/kg	0.042	0.013	0.018	0.155	0.031	0.018	0.010	7671661
Total Magnesium (Mg)	mg/kg	3080	805	1960	235	3110	719	10	7671661
Total Manganese (Mn)	mg/kg	164	328	632	113	195	1050	0.10	7671661
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7671661
Total Molybdenum (Mo)	mg/kg	0.323	0.109	<0.050	0.072	0.514	<0.050	0.050	7671661
Total Nickel (Ni)	mg/kg	3.66	0.635	0.905	0.448	0.997	0.435	0.050	7671661
Total Phosphorus (P)	mg/kg	2310	960	862	323	664	746	10	7671661
Total Potassium (K)	mg/kg	10900	7600	4560	839	5060	3210	10	7671661
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7671661
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7671661
Total Sodium (Na)	mg/kg	<10	17	12	<10	<10	<10	10	7671661
Total Strontium (Sr)	mg/kg	44.5	29.1	32.8	2.90	37.3	7.03	0.10	7671661
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	0.0020	<0.0020	0.0023	<0.0020	0.0020	7671661
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7671661
Total Titanium (Ti)	mg/kg	<1.0	<1.0	<1.0	6.2	1.8	<1.0	1.0	7671661
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	0.0075	<0.0020	0.0065	0.0020	7671661
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	0.32	<0.20	<0.20	0.20	7671661
Total Zinc (Zn)	mg/kg	43.1	39.7	201	9.66	147	9.58	0.20	7671661

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2433	KK2434	KK2435	KK2436	KK2437	KK2438		
Sampling Date		2014/08/10	2014/08/03	2014/08/08	2014/08/11	2014/08/12	2014/08/05		
COC Number		08396129	08396129	08396129	08396129	08396129	08396129		
	Units	CCHMWC-438	CCHMLA-851 REP1	CCHMWB-410	CCHMCB-440	CCHMHB-138	CCHMCC-69	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	9.6	375	28.5	52.3	16.2	68.7	1.0	7680437
Total Antimony (Sb)	mg/kg	<0.0050	0.0991	0.0057	<0.0050	<0.0050	0.0053	0.0050	7680437
Total Arsenic (As)	mg/kg	<0.050	1.67	0.053	<0.050	0.062	<0.050	0.050	7680437
Total Barium (Ba)	mg/kg	13.0	6.32	19.8	143	59.3	66.7	0.10	7680437
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7680437
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7680437
Total Boron (B)	mg/kg	7.5	<2.0	4.7	10.2	17.6	7.3	2.0	7680437
Total Cadmium (Cd)	mg/kg	0.526	0.048	0.558	0.024	0.079	0.014	0.010	7680437
Total Calcium (Ca)	mg/kg	8120	812	5340	7340	20700	5940	10	7680437
Total Chromium (Cr)	mg/kg	<0.20	1.07	<0.20	<0.20	<0.20	<0.20	0.20	7680437
Total Cobalt (Co)	mg/kg	1.00	0.276	0.263	0.036	0.052	<0.020	0.020	7680437
Total Copper (Cu)	mg/kg	3.27	2.21	4.07	3.39	4.00	9.12	0.050	7680437
Total Iron (Fe)	mg/kg	50	525	66	60	40	63	10	7680437
Total Lead (Pb)	mg/kg	0.027	0.290	0.042	0.038	0.018	0.151	0.010	7680437
Total Magnesium (Mg)	mg/kg	2170	483	1840	1250	2960	1100	10	7680437
Total Manganese (Mn)	mg/kg	308	158	92.6	527	50.8	2130	0.10	7680437
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7680437
Total Molybdenum (Mo)	mg/kg	0.106	0.062	0.101	<0.050	0.217	0.053	0.050	7680437
Total Nickel (Ni)	mg/kg	0.702	0.923	1.91	0.457	0.262	0.187	0.050	7680437
Total Phosphorus (P)	mg/kg	1330	630	1030	1010	882	677	10	7680437
Total Potassium (K)	mg/kg	9840	1390	6340	3930	27300	3130	10	7680437
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7680437
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7680437
Total Sodium (Na)	mg/kg	<10	23	<10	<10	27	<10	10	7680437
Total Strontium (Sr)	mg/kg	28.6	2.35	23.0	20.1	117	9.92	0.10	7680437
Total Thallium (Tl)	mg/kg	<0.0020	0.0067	<0.0020	<0.0020	0.0035	<0.0020	0.0020	7680437
Total Tin (Sn)	mg/kg	<0.10	0.12	<0.10	<0.10	<0.10	0.14	0.10	7680437
Total Titanium (Ti)	mg/kg	<1.0	24.1	1.4	1.7	<1.0	<1.0	1.0	7680437
Total Uranium (U)	mg/kg	<0.0020	0.0354	<0.0020	0.0025	0.0135	<0.0020	0.0020	7680437
Total Vanadium (V)	mg/kg	<0.20	1.07	<0.20	<0.20	<0.20	<0.20	0.20	7680437
Total Zinc (Zn)	mg/kg	38.1	19.3	57.2	26.5	30.8	20.6	0.20	7680437

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2439	KK2497	KK2498	KK2499		KK2500		
Sampling Date		2014/08/09	2014/08/09	2014/08/10	2014/08/10		2014/08/12		
COC Number		08396129	08396130	08396130	08396130		08396130		
	Units	CCHMHB-422	CCHMWA-106	CCHMWB-120	CCHMHC-438	QC Batch	CCHMCB-138	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	43.7	27.1	94.7	8.4	7680437	70.5	1.0	7682773
Total Antimony (Sb)	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	7680437	<0.0050	0.0050	7682773
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	7680437	<0.050	0.050	7682773
Total Barium (Ba)	mg/kg	142	76.7	84.3	54.6	7680437	59.6	0.10	7682773
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	7680437	<0.10	0.10	7682773
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	7680437	<0.10	0.10	7682773
Total Boron (B)	mg/kg	11.8	2.2	11.1	8.9	7680437	5.7	2.0	7682773
Total Cadmium (Cd)	mg/kg	0.097	0.912	0.911	0.118	7680437	0.022	0.010	7682773
Total Calcium (Ca)	mg/kg	21500	13600	12100	18800	7680437	4820	10	7682773
Total Chromium (Cr)	mg/kg	<0.20	<0.20	0.35	<0.20	7680437	<0.20	0.20	7682773
Total Cobalt (Co)	mg/kg	0.326	1.98	1.31	0.144	7680437	<0.020	0.020	7682773
Total Copper (Cu)	mg/kg	2.98	3.22	2.99	3.61	7680437	2.56	0.050	7682773
Total Iron (Fe)	mg/kg	28	49	97	41	7680437	31	10	7682773
Total Lead (Pb)	mg/kg	0.031	0.059	0.057	0.042	7680437	0.026	0.010	7682773
Total Magnesium (Mg)	mg/kg	3120	2400	4000	3680	7680437	968	10	7682773
Total Manganese (Mn)	mg/kg	153	451	214	62.5	7680437	924	0.10	7682773
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	0.010	7680437	<0.010	0.010	7682773
Total Molybdenum (Mo)	mg/kg	0.186	0.081	0.109	0.188	7680437	0.064	0.050	7682773
Total Nickel (Ni)	mg/kg	1.18	3.84	3.15	0.328	7680437	0.199	0.050	7682773
Total Phosphorus (P)	mg/kg	1040	2300	2730	837	7680437	653	10	7682773
Total Potassium (K)	mg/kg	15600	8550	9730	22500	7680437	3100	10	7682773
Total Selenium (Se)	mg/kg	0.241	0.119	<0.050	<0.050	7680437	<0.050	0.050	7682773
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	7680437	<0.020	0.020	7682773
Total Sodium (Na)	mg/kg	<10	12	<10	<10	7680437	<10	10	7682773
Total Strontium (Sr)	mg/kg	71.8	66.3	86.1	88.4	7680437	9.87	0.10	7682773
Total Thallium (Tl)	mg/kg	0.0021	0.0025	0.0036	0.0070	7680437	<0.0020	0.0020	7682773
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	7680437	<0.10	0.10	7682773
Total Titanium (Ti)	mg/kg	<1.0	1.2	3.3	<1.0	7680437	1.0	1.0	7682773
Total Uranium (U)	mg/kg	<0.0020	0.0034	0.0040	<0.0020	7680437	<0.0020	0.0020	7682773
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	7680437	<0.20	0.20	7682773
Total Zinc (Zn)	mg/kg	23.2	26.3	77.2	9.30	7680437	22.4	0.20	7682773

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2501	KK2502	KK2503		KK2504	KK2505		
Sampling Date		2014/08/12	2014/08/05	2014/08/10		2014/08/06	2014/08/10		
COC Number		08396130	08396130	08396130		08396130	08396130		
	Units	CCHMHA-135	CCHMHC-69	CCHMWC-436	QC Batch	CCHMLC-400	CCHMCB-120	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	5.8	17.0	6.1	7682773	112	37.2	1.0	7682966
Total Antimony (Sb)	mg/kg	<0.0050	<0.0050	<0.0050	7682773	<0.0050	<0.0050	0.0050	7682966
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	7682773	<0.050	<0.050	0.050	7682966
Total Barium (Ba)	mg/kg	18.6	38.0	33.4	7682773	53.0	62.1	0.10	7682966
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	7682773	<0.10	<0.10	0.10	7682966
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	7682773	<0.10	<0.10	0.10	7682966
Total Boron (B)	mg/kg	6.8	12.6	2.7	7682773	7.4	8.0	2.0	7682966
Total Cadmium (Cd)	mg/kg	0.081	0.133	0.780	7682773	0.040	<0.010	0.010	7682966
Total Calcium (Ca)	mg/kg	14000	18900	10600	7682773	4220	5890	10	7682966
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	7682773	<0.20	<0.20	0.20	7682966
Total Cobalt (Co)	mg/kg	0.067	0.419	0.535	7682773	0.042	0.022	0.020	7682966
Total Copper (Cu)	mg/kg	1.94	2.84	2.86	7682773	2.56	1.59	0.050	7682966
Total Iron (Fe)	mg/kg	19	65	30	7682773	57	66	10	7682966
Total Lead (Pb)	mg/kg	0.015	0.020	0.012	7682773	0.030	0.039	0.010	7682966
Total Magnesium (Mg)	mg/kg	1290	3120	1200	7682773	1150	761	10	7682966
Total Manganese (Mn)	mg/kg	32.1	228	33.0	7682773	1560	898	0.10	7682966
Total Mercury (Hg)	mg/kg	0.013	<0.010	<0.010	7682773	<0.010	<0.010	0.010	7682966
Total Molybdenum (Mo)	mg/kg	0.057	0.065	0.140	7682773	0.160	0.138	0.050	7682966
Total Nickel (Ni)	mg/kg	0.168	0.576	2.61	7682773	0.251	0.129	0.050	7682966
Total Phosphorus (P)	mg/kg	556	638	1060	7682773	795	480	10	7682966
Total Potassium (K)	mg/kg	13900	9500	9100	7682773	3350	2450	10	7682966
Total Selenium (Se)	mg/kg	<0.050	<0.050	0.061	7682773	<0.050	<0.050	0.050	7682966
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	7682773	<0.020	<0.020	0.020	7682966
Total Sodium (Na)	mg/kg	<10	70	<10	7682773	<10	<10	10	7682966
Total Strontium (Sr)	mg/kg	48.7	99.1	36.7	7682773	6.01	11.7	0.10	7682966
Total Thallium (Tl)	mg/kg	<0.0020	0.0023	<0.0020	7682773	<0.0020	<0.0020	0.0020	7682966
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	7682773	<0.10	<0.10	0.10	7682966
Total Titanium (Ti)	mg/kg	<1.0	<1.0	<1.0	7682773	1.8	2.5	1.0	7682966
Total Uranium (U)	mg/kg	<0.0020	0.0056	<0.0020	7682773	<0.0020	<0.0020	0.0020	7682966
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	7682773	<0.20	<0.20	0.20	7682966
Total Zinc (Zn)	mg/kg	6.04	38.3	16.2	7682773	16.7	16.0	0.20	7682966

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2506	KK2507	KK2508	KK2544	KK2545	KK2546		
Sampling Date		2014/08/06	2014/08/10	2014/08/09	2014/08/07	2014/08/10	2014/08/06		
COC Number		08396130	08396130	08396130	08396131	08396131	08396131		
	Units	CCHMCB-76	CCHMHC-436	CCHMLA-106	CCHMWC-81	CCHMWB-113	CCHMWC-400	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	4.5	73.0	88.8	33.7	19.8	32.1	1.0	7682966
Total Antimony (Sb)	mg/kg	<0.0050	0.0059	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	7682966
Total Arsenic (As)	mg/kg	<0.050	0.062	0.074	<0.050	<0.050	<0.050	0.050	7682966
Total Barium (Ba)	mg/kg	77.6	7.95	8.83	39.2	31.2	57.1	0.10	7682966
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682966
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682966
Total Boron (B)	mg/kg	4.3	<2.0	<2.0	3.5	10.4	3.3	2.0	7682966
Total Cadmium (Cd)	mg/kg	0.107	0.045	0.049	0.669	0.973	1.24	0.010	7682966
Total Calcium (Ca)	mg/kg	16600	889	830	8640	9740	7450	10	7682966
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7682966
Total Cobalt (Co)	mg/kg	0.057	0.077	0.091	2.05	0.570	0.944	0.020	7682966
Total Copper (Cu)	mg/kg	3.11	1.20	1.24	3.03	2.81	2.52	0.050	7682966
Total Iron (Fe)	mg/kg	27	118	111	118	50	60	10	7682966
Total Lead (Pb)	mg/kg	<0.010	0.110	0.118	0.030	0.020	0.044	0.010	7682966
Total Magnesium (Mg)	mg/kg	1450	405	410	2580	2640	3080	10	7682966
Total Manganese (Mn)	mg/kg	39.1	129	134	331	141	250	0.10	7682966
Total Mercury (Hg)	mg/kg	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7682966
Total Molybdenum (Mo)	mg/kg	0.130	<0.050	<0.050	0.070	0.180	0.056	0.050	7682966
Total Nickel (Ni)	mg/kg	0.325	0.325	0.312	2.81	1.54	2.71	0.050	7682966
Total Phosphorus (P)	mg/kg	643	544	561	1170	2830	1810	10	7682966
Total Potassium (K)	mg/kg	12900	1310	1360	7110	7790	7290	10	7682966
Total Selenium (Se)	mg/kg	0.199	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7682966
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7682966
Total Sodium (Na)	mg/kg	<10	<10	13	<10	<10	244	10	7682966
Total Strontium (Sr)	mg/kg	50.7	2.84	2.99	54.6	31.0	54.3	0.10	7682966
Total Thallium (Tl)	mg/kg	<0.0020	0.0020	<0.0020	0.0040	0.0025	0.0038	0.0020	7682966
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682966
Total Titanium (Ti)	mg/kg	<1.0	3.4	4.1	1.2	1.1	1.2	1.0	7682966
Total Uranium (U)	mg/kg	<0.0020	0.0031	0.0041	0.0048	<0.0020	<0.0020	0.0020	7682966
Total Vanadium (V)	mg/kg	<0.20	0.24	<0.20	<0.20	<0.20	<0.20	0.20	7682966
Total Zinc (Zn)	mg/kg	7.21	11.5	12.3	27.4	86.3	43.1	0.20	7682966

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2547	KK2548	KK2549	KK2551	KK2554	KK2571		
Sampling Date		2014/08/06	2014/08/10	2014/08/09	2014/08/08	2014/08/08	2014/08/09		
COC Number		08396131	08396131	08396131	08396131	08396131	08396132		
	Units	CCHMCC-400	CCHMCC-436	CCHMHA-299	CCHMCA-98	CCHMLB-410	CCHMCB-422	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	117	34.1	35.0	58.0	107	73.1	1.0	7682966
Total Antimony (Sb)	mg/kg	0.0131	<0.0050	<0.0050	<0.0050	0.0125	<0.0050	0.0050	7682966
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	0.126	<0.050	0.050	7682966
Total Barium (Ba)	mg/kg	54.5	73.2	104	54.5	4.80	103	0.10	7682966
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682966
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682966
Total Boron (B)	mg/kg	5.1	7.4	7.9	11.0	<2.0	4.6	2.0	7682966
Total Cadmium (Cd)	mg/kg	0.011	0.020	0.024	<0.010	0.030	<0.010	0.010	7682966
Total Calcium (Ca)	mg/kg	4130	3730	14100	5120	653	6270	10	7682966
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	0.24	<0.20	0.20	7682966
Total Cobalt (Co)	mg/kg	0.045	<0.020	0.084	<0.020	0.081	0.032	0.020	7682966
Total Copper (Cu)	mg/kg	3.07	2.16	2.04	3.72	1.52	2.41	0.050	7682966
Total Iron (Fe)	mg/kg	47	25	22	38	165	45	10	7682966
Total Lead (Pb)	mg/kg	0.055	0.027	0.049	0.018	0.159	0.026	0.010	7682966
Total Magnesium (Mg)	mg/kg	886	939	1990	1060	280	1170	10	7682966
Total Manganese (Mn)	mg/kg	1490	691	84.4	2010	103	1390	0.10	7682966
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7682966
Total Molybdenum (Mo)	mg/kg	0.072	0.109	0.063	0.077	<0.050	0.162	0.050	7682966
Total Nickel (Ni)	mg/kg	0.274	0.404	0.576	0.339	0.354	0.313	0.050	7682966
Total Phosphorus (P)	mg/kg	737	903	842	1090	361	711	10	7682966
Total Potassium (K)	mg/kg	3130	4190	12400	5190	951	3270	10	7682966
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7682966
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7682966
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	13	<10	10	7682966
Total Strontium (Sr)	mg/kg	5.90	3.29	68.4	3.54	1.73	8.91	0.10	7682966
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	0.0022	<0.0020	0.0020	7682966
Total Tin (Sn)	mg/kg	<0.10	0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682966
Total Titanium (Ti)	mg/kg	1.2	<1.0	<1.0	<1.0	5.9	1.6	1.0	7682966
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	0.0065	<0.0020	0.0020	7682966
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	0.25	<0.20	0.20	7682966
Total Zinc (Zn)	mg/kg	16.4	17.3	12.7	20.6	10.4	14.9	0.20	7682966

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2572	KK2600	KK2606	KK2608	KK2610	KK2611		
Sampling Date		2014/08/09	2014/08/09	2014/08/07	2014/08/05	2014/08/09	2014/08/05		
COC Number		08396132	08396133	08396133	08396133	08396133	08396133		
	Units	CCHMWB-422	CCHMLB-422	CCHMLC-81	CCHMLC-62	CCHMCA-106	CCHMWC-62	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	28.2	98.0	140	140	59.8	41.4	1.0	7682966
Total Antimony (Sb)	mg/kg	<0.0050	0.0069	0.0120	0.0094	<0.0050	<0.0050	0.0050	7682966
Total Arsenic (As)	mg/kg	<0.050	0.097	0.148	0.137	<0.050	<0.050	0.050	7682966
Total Barium (Ba)	mg/kg	51.6	4.87	3.53	6.41	72.9	52.8	0.10	7682966
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682966
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682966
Total Boron (B)	mg/kg	3.6	<2.0	<2.0	<2.0	4.4	3.8	2.0	7682966
Total Cadmium (Cd)	mg/kg	0.523	0.024	0.038	0.021	<0.010	1.80	0.010	7682966
Total Calcium (Ca)	mg/kg	11800	708	554	809	3790	12300	10	7682966
Total Chromium (Cr)	mg/kg	<0.20	0.24	0.28	0.31	<0.20	<0.20	0.20	7682966
Total Cobalt (Co)	mg/kg	1.34	0.081	0.111	0.117	0.038	1.01	0.020	7682966
Total Copper (Cu)	mg/kg	3.95	0.989	1.35	1.33	2.55	3.84	0.050	7682966
Total Iron (Fe)	mg/kg	78	156	198	217	35	72	10	7682966
Total Lead (Pb)	mg/kg	0.019	0.126	0.195	0.153	0.014	0.032	0.010	7682966
Total Magnesium (Mg)	mg/kg	2430	235	271	392	1070	3800	10	7682966
Total Manganese (Mn)	mg/kg	349	110	72.6	176	986	298	0.10	7682966
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7682966
Total Molybdenum (Mo)	mg/kg	0.144	<0.050	<0.050	<0.050	0.162	0.094	0.050	7682966
Total Nickel (Ni)	mg/kg	4.12	0.330	0.437	0.458	0.355	3.10	0.050	7682966
Total Phosphorus (P)	mg/kg	1880	339	295	454	919	1880	10	7682966
Total Potassium (K)	mg/kg	9910	933	853	1160	3880	9230	10	7682966
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7682966
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7682966
Total Sodium (Na)	mg/kg	<10	<10	14	31	<10	<10	10	7682966
Total Strontium (Sr)	mg/kg	34.3	1.94	1.70	2.19	6.84	81.9	0.10	7682966
Total Thallium (Tl)	mg/kg	<0.0020	0.0023	<0.0020	0.0025	<0.0020	0.0025	0.0020	7682966
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682966
Total Titanium (Ti)	mg/kg	1.3	4.9	7.5	6.7	<1.0	1.6	1.0	7682966
Total Uranium (U)	mg/kg	<0.0020	0.0047	0.0076	0.0066	<0.0020	0.0021	0.0020	7682966
Total Vanadium (V)	mg/kg	<0.20	0.24	0.39	0.38	<0.20	<0.20	0.20	7682966
Total Zinc (Zn)	mg/kg	75.4	10.8	8.31	8.01	15.7	43.9	0.20	7682966

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2617	KK2618	KK2619	KK2621	KK2625	KK2626		
Sampling Date		2014/08/08	2014/08/07	2014/08/06	2014/08/08	2014/08/05	2014/08/11		
COC Number		08396134	08396134	08396134	08396134	08396134	08396134		
	Units	CCHMHB-92	CCHMCC-81	CCHMLB-76	CCHMCB-410	CCHMCC-62	CCHMCB-164	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	47.6	96.5	138	78.7	93.9	98.9	1.0	7682971
Total Antimony (Sb)	mg/kg	<0.0050	0.0055	0.0111	<0.0050	<0.0050	<0.0050	0.0050	7682971
Total Arsenic (As)	mg/kg	<0.050	<0.050	0.127	<0.050	<0.050	0.051	0.050	7682971
Total Barium (Ba)	mg/kg	32.9	71.2	5.93	77.6	71.9	87.8	0.10	7682971
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682971
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682971
Total Boron (B)	mg/kg	12.4	6.1	<2.0	7.2	5.2	4.3	2.0	7682971
Total Cadmium (Cd)	mg/kg	0.131	0.017	0.042	0.010	<0.010	<0.010	0.010	7682971
Total Calcium (Ca)	mg/kg	17000	5540	962	5520	5650	5920	10	7682971
Total Chromium (Cr)	mg/kg	<0.20	<0.20	1.48	<0.20	<0.20	<0.20	0.20	7682971
Total Cobalt (Co)	mg/kg	0.098	0.036	0.134	0.026	0.027	0.054	0.020	7682971
Total Copper (Cu)	mg/kg	3.59	2.92	1.43	3.61	2.88	2.28	0.050	7682971
Total Iron (Fe)	mg/kg	30	52	207	56	41	45	10	7682971
Total Lead (Pb)	mg/kg	<0.010	0.036	0.187	0.035	0.024	0.026	0.010	7682971
Total Magnesium (Mg)	mg/kg	2010	1310	250	1370	1320	1260	10	7682971
Total Manganese (Mn)	mg/kg	45.4	2060	26.1	1540	1890	1800	0.10	7682971
Total Mercury (Hg)	mg/kg	0.011	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7682971
Total Molybdenum (Mo)	mg/kg	0.306	0.063	0.057	<0.050	0.128	0.105	0.050	7682971
Total Nickel (Ni)	mg/kg	0.378	0.260	1.17	0.290	0.268	0.290	0.050	7682971
Total Phosphorus (P)	mg/kg	1370	822	267	1170	947	848	10	7682971
Total Potassium (K)	mg/kg	28900	2950	978	4160	3390	3160	10	7682971
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7682971
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7682971
Total Sodium (Na)	mg/kg	35	<10	30	<10	<10	<10	10	7682971
Total Strontium (Sr)	mg/kg	76.2	5.30	2.86	7.05	6.22	11.1	0.10	7682971
Total Thallium (Tl)	mg/kg	0.0058	<0.0020	0.0021	<0.0020	0.0026	<0.0020	0.0020	7682971
Total Tin (Sn)	mg/kg	<0.10	<0.10	0.30	<0.10	<0.10	<0.10	0.10	7682971
Total Titanium (Ti)	mg/kg	<1.0	2.9	7.4	1.2	1.1	1.3	1.0	7682971
Total Uranium (U)	mg/kg	0.0028	<0.0020	0.0084	0.0020	<0.0020	<0.0020	0.0020	7682971
Total Vanadium (V)	mg/kg	<0.20	<0.20	0.44	<0.20	<0.20	<0.20	0.20	7682971
Total Zinc (Zn)	mg/kg	22.9	21.0	12.8	28.7	12.9	22.2	0.20	7682971

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2628	KK2629	KK2630	KK2631	KK2632	KK2633		
Sampling Date		2014/08/13	2014/08/12	2014/08/12	2014/08/11	2014/08/11	2014/08/11		
COC Number		08396134	08396135	08396135	08396135	08396135	08396135		
	Units	CCTMCC-BD1	CCHMWB-138	CCHMHB-455	CCHMCB-843	CCHMWB-164	CCHMCB-130	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	135	11.2	12500	76.9	36.7	177	1.0	7682971
Total Antimony (Sb)	mg/kg	0.0067	<0.0050	0.238	0.0289	<0.0050	<0.0050	0.0050	7682971
Total Arsenic (As)	mg/kg	<0.050	<0.050	6.13	0.205	<0.050	<0.050	0.050	7682971
Total Barium (Ba)	mg/kg	61.7	24.7	178	37.2	49.9	136	0.10	7682971
Total Beryllium (Be)	mg/kg	<0.10	<0.10	0.77	<0.10	<0.10	<0.10	0.10	7682971
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	0.26	<0.10	<0.10	<0.10	0.10	7682971
Total Boron (B)	mg/kg	9.2	7.7	<2.0	6.6	3.9	11.2	2.0	7682971
Total Cadmium (Cd)	mg/kg	<0.010	2.70	0.071	0.014	0.702	0.118	0.010	7682971
Total Calcium (Ca)	mg/kg	6660	8330	3920	3790	14200	6380	10	7682971
Total Chromium (Cr)	mg/kg	0.21	<0.20	44.7	0.28	<0.20	<0.20	0.20	7682971
Total Cobalt (Co)	mg/kg	0.034	0.218	10.4	0.040	1.98	0.103	0.020	7682971
Total Copper (Cu)	mg/kg	2.84	4.20	17.4	2.55	2.99	2.15	0.050	7682971
Total Iron (Fe)	mg/kg	71	55	27400	98	64	74	10	7682971
Total Lead (Pb)	mg/kg	0.050	0.015	11.0	0.047	0.032	0.039	0.010	7682971
Total Magnesium (Mg)	mg/kg	738	2250	4240	767	3040	1340	10	7682971
Total Manganese (Mn)	mg/kg	2580	434	402	1490	315	2870	0.10	7682971
Total Mercury (Hg)	mg/kg	<0.010	<0.010	0.032	<0.010	<0.010	<0.010	0.010	7682971
Total Molybdenum (Mo)	mg/kg	0.083	0.196	0.725	0.062	0.059	1.43	0.050	7682971
Total Nickel (Ni)	mg/kg	0.233	2.36	26.0	0.378	3.32	0.303	0.050	7682971
Total Phosphorus (P)	mg/kg	541	1510	713	951	1500	772	10	7682971
Total Potassium (K)	mg/kg	3170	7480	1540	4000	8410	3770	10	7682971
Total Selenium (Se)	mg/kg	<0.050	<0.050	0.332	<0.050	<0.050	<0.050	0.050	7682971
Total Silver (Ag)	mg/kg	<0.020	<0.020	0.067	<0.020	<0.020	<0.020	0.020	7682971
Total Sodium (Na)	mg/kg	<10	<10	84	<10	<10	<10	10	7682971
Total Strontium (Sr)	mg/kg	4.13	45.0	27.6	4.56	67.3	9.66	0.10	7682971
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	0.154	0.0050	0.0075	0.0088	0.0020	7682971
Total Tin (Sn)	mg/kg	<0.10	<0.10	0.44	<0.10	<0.10	<0.10	0.10	7682971
Total Titanium (Ti)	mg/kg	2.1	<1.0	349	3.1	1.3	1.9	1.0	7682971
Total Uranium (U)	mg/kg	0.0039	<0.0020	2.17	0.0079	<0.0020	0.0030	0.0020	7682971
Total Vanadium (V)	mg/kg	<0.20	<0.20	36.5	<0.20	<0.20	<0.20	0.20	7682971
Total Zinc (Zn)	mg/kg	17.9	294	52.3	18.5	31.2	18.1	0.20	7682971

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2634	KK2635	KK2636	KK2637	KK2638	KK2639		
Sampling Date		2014/08/11	2014/08/11	2014/08/13	2014/08/11	2014/08/11	2014/08/11		
COC Number		08396135	08396135	08396135	08396135	08396135	08396135		
	Units	CCHMWB-843	CCHMWB-130	CCTMWC-BD1	CCHMLB-843	CCHMLB-164	CCHMHB-440	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	53.7	52.0	42.8	295	122	6.7	1.0	7682971
Total Antimony (Sb)	mg/kg	0.0139	<0.0050	<0.0050	0.236	0.0128	0.0062	0.0050	7682971
Total Arsenic (As)	mg/kg	0.126	<0.050	<0.050	2.63	0.199	<0.050	0.050	7682971
Total Barium (Ba)	mg/kg	40.2	133	36.3	9.25	5.77	77.8	0.10	7682971
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682971
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682971
Total Boron (B)	mg/kg	4.3	16.6	4.9	2.6	<2.0	17.0	2.0	7682971
Total Cadmium (Cd)	mg/kg	0.626	2.74	0.805	0.051	0.057	0.119	0.010	7682971
Total Calcium (Ca)	mg/kg	7970	10300	4820	1060	727	18100	10	7682971
Total Chromium (Cr)	mg/kg	0.25	<0.20	<0.20	1.43	0.25	0.20	0.20	7682971
Total Cobalt (Co)	mg/kg	1.49	1.27	0.616	0.245	0.105	0.043	0.020	7682971
Total Copper (Cu)	mg/kg	2.86	3.12	2.59	2.11	1.39	4.16	0.050	7682971
Total Iron (Fe)	mg/kg	104	57	80	514	183	36	10	7682971
Total Lead (Pb)	mg/kg	0.036	0.025	0.037	0.339	0.167	0.018	0.010	7682971
Total Magnesium (Mg)	mg/kg	2780	1910	1230	512	313	3460	10	7682971
Total Manganese (Mn)	mg/kg	589	376	557	177	95.5	32.9	0.10	7682971
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	0.014	0.010	7682971
Total Molybdenum (Mo)	mg/kg	0.139	0.614	0.108	0.208	<0.050	0.157	0.050	7682971
Total Nickel (Ni)	mg/kg	2.48	2.60	0.514	0.754	0.406	0.493	0.050	7682971
Total Phosphorus (P)	mg/kg	1370	3620	638	532	418	871	10	7682971
Total Potassium (K)	mg/kg	8360	9550	4270	1320	1010	21600	10	7682971
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7682971
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7682971
Total Sodium (Na)	mg/kg	<10	<10	<10	15	<10	<10	10	7682971
Total Strontium (Sr)	mg/kg	41.5	64.0	26.5	2.89	2.50	73.8	0.10	7682971
Total Thallium (Tl)	mg/kg	0.0032	<0.0020	0.0036	0.0104	0.0023	0.0034	0.0020	7682971
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682971
Total Titanium (Ti)	mg/kg	3.3	1.4	2.6	17.9	6.1	<1.0	1.0	7682971
Total Uranium (U)	mg/kg	0.0043	0.0021	0.0028	0.0898	0.0062	<0.0020	0.0020	7682971
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	0.76	0.35	<0.20	0.20	7682971
Total Zinc (Zn)	mg/kg	69.7	90.6	105	15.6	8.90	12.1	0.20	7682971

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2640		KK2641		KK2642	KK2643	KK2658		
Sampling Date		2014/08/12		2014/08/11		2014/08/13	2014/08/12			
COC Number		08396135		08396136		08396136	08396136	08396122		
	Units	CCHMCA-135	QC Batch	CCHMHB-130	QC Batch	CCHMH-BD3	CCHMSB-455	CCTML-BD7	RDL	QC Batch
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	40.6	7682971	90.4	7696757	5.1	28.7	116	1.0	7682974
Total Antimony (Sb)	mg/kg	<0.0050	7682971	<0.0050	7696757	<0.0050	<0.0050	0.0075	0.0050	7682974
Total Arsenic (As)	mg/kg	<0.050	7682971	<0.050	7696757	<0.050	<0.050	0.128	0.050	7682974
Total Barium (Ba)	mg/kg	63.7	7682971	227	7696757	92.2	188	5.92	0.10	7682974
Total Beryllium (Be)	mg/kg	<0.10	7682971	<0.10	7696757	<0.10	<0.10	<0.10	0.10	7682974
Total Bismuth (Bi)	mg/kg	<0.10	7682971	<0.10	7696757	<0.10	<0.10	<0.10	0.10	7682974
Total Boron (B)	mg/kg	7.3	7682971	26.1	7696757	7.9	11.4	<2.0	2.0	7682974
Total Cadmium (Cd)	mg/kg	<0.010	7682971	0.077	7696757	0.032	0.119	0.033	0.010	7682974
Total Calcium (Ca)	mg/kg	5030	7682971	15900	7696757	13800	19800	903	10	7682974
Total Chromium (Cr)	mg/kg	<0.20	7682971	0.46	7696757	<0.20	<0.20	0.27	0.20	7682974
Total Cobalt (Co)	mg/kg	0.044	7682971	0.605	7696757	0.376	2.47	0.085	0.020	7682974
Total Copper (Cu)	mg/kg	2.56	7682971	2.85	7696757	2.43	3.71	0.953	0.050	7682974
Total Iron (Fe)	mg/kg	32	7682971	34	7696757	51	55	174	10	7682974
Total Lead (Pb)	mg/kg	0.016	7682971	0.023	7696757	0.012	0.013	0.142	0.010	7682974
Total Magnesium (Mg)	mg/kg	1100	7682971	2090	7696757	2570	4310	282	10	7682974
Total Manganese (Mn)	mg/kg	959	7682971	47.6	7696757	112	256	79.6	0.10	7682974
Total Mercury (Hg)	mg/kg	<0.010	7682971	0.014	7696757	<0.010	<0.010	<0.010	0.010	7682974
Total Molybdenum (Mo)	mg/kg	0.058	7682971	0.310	7696757	0.667	0.640	<0.050	0.050	7682974
Total Nickel (Ni)	mg/kg	0.190	7682971	2.83	7696757	0.670	5.67	0.327	0.050	7682974
Total Phosphorus (P)	mg/kg	942	7682971	1240	7696757	583	1310	327	10	7682974
Total Potassium (K)	mg/kg	4390	7682971	23000	7696757	13100	20400	949	10	7682974
Total Selenium (Se)	mg/kg	<0.050	7682971	0.073	7696757	<0.050	<0.050	<0.050	0.050	7682974
Total Silver (Ag)	mg/kg	<0.020	7682971	<0.020	7696757	<0.020	<0.020	<0.020	0.020	7682974
Total Sodium (Na)	mg/kg	<10	7682971	<10	7696757	<10	<10	10	10	7682974
Total Strontium (Sr)	mg/kg	6.61	7682971	92.9	7696757	43.2	132	3.86	0.10	7682974
Total Thallium (Tl)	mg/kg	<0.0020	7682971	0.0030	7696757	0.0027	0.0105	<0.0020	0.0020	7682974
Total Tin (Sn)	mg/kg	<0.10	7682971	<0.10	7696757	<0.10	<0.10	<0.10	0.10	7682974
Total Titanium (Ti)	mg/kg	<1.0	7682971	<1.0	7696757	<1.0	<1.0	6.4	1.0	7682974
Total Uranium (U)	mg/kg	<0.0020	7682971	0.0030	7696757	<0.0020	<0.0020	0.0225	0.0020	7682974
Total Vanadium (V)	mg/kg	<0.20	7682971	<0.20	7696757	<0.20	<0.20	0.30	0.20	7682974
Total Zinc (Zn)	mg/kg	13.0	7682971	10.7	7696757	28.1	44.0	8.43	0.20	7682974

RDL = Reportable Detection Limit

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2666	KK2667	KK2668	KK2669	KK2701	KK2703		
Sampling Date		2014/08/13	2014/08/13	2014/08/13	2014/08/13	2014/08/13	2014/08/13		
COC Number		08396122	08396122	08396122	08396122	08396123	08396123		
	Units	CCTMLC-BD1	CCTMLC-BD2	CCTMLC-BD3	CCHMHC-REP3	CCTMLC-BD4	CCTMHC-BD2	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	176	113	87.5	6.6	114	33.5	1.0	7682974
Total Antimony (Sb)	mg/kg	0.0166	0.0118	0.0086	<0.0050	0.0079	<0.0050	0.0050	7682974
Total Arsenic (As)	mg/kg	0.170	0.126	0.089	<0.050	0.102	<0.050	0.050	7682974
Total Barium (Ba)	mg/kg	7.11	5.84	4.79	102	4.92	103	0.10	7682974
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682974
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682974
Total Boron (B)	mg/kg	<2.0	<2.0	<2.0	7.6	<2.0	12.5	2.0	7682974
Total Cadmium (Cd)	mg/kg	0.024	0.019	0.023	0.052	0.032	0.034	0.010	7682974
Total Calcium (Ca)	mg/kg	980	926	572	15900	676	16000	10	7682974
Total Chromium (Cr)	mg/kg	0.35	0.26	0.21	<0.20	0.25	<0.20	0.20	7682974
Total Cobalt (Co)	mg/kg	0.161	0.103	0.086	0.421	0.097	0.716	0.020	7682974
Total Copper (Cu)	mg/kg	3.25	1.36	0.915	2.53	1.28	4.27	0.050	7682974
Total Iron (Fe)	mg/kg	299	187	143	82	171	59	10	7682974
Total Lead (Pb)	mg/kg	0.280	0.140	0.130	0.014	0.168	0.019	0.010	7682974
Total Magnesium (Mg)	mg/kg	375	326	229	3260	235	3270	10	7682974
Total Manganese (Mn)	mg/kg	222	286	85.0	115	89.5	241	0.10	7682974
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	7682974
Total Molybdenum (Mo)	mg/kg	0.078	<0.050	<0.050	0.639	<0.050	0.218	0.050	7682974
Total Nickel (Ni)	mg/kg	0.491	0.348	0.302	0.627	0.446	1.42	0.050	7682974
Total Phosphorus (P)	mg/kg	318	233	263	817	276	774	10	7682974
Total Potassium (K)	mg/kg	1070	803	860	14300	823	15700	10	7682974
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7682974
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7682974
Total Sodium (Na)	mg/kg	23	11	12	<10	13	<10	10	7682974
Total Strontium (Sr)	mg/kg	2.67	1.88	1.52	56.0	2.22	45.9	0.10	7682974
Total Thallium (Tl)	mg/kg	0.0026	<0.0020	0.0023	0.0030	0.0025	0.0031	0.0020	7682974
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682974
Total Titanium (Ti)	mg/kg	8.6	6.8	4.7	<1.0	6.8	<1.0	1.0	7682974
Total Uranium (U)	mg/kg	0.0094	0.0062	0.0048	<0.0020	0.0062	<0.0020	0.0020	7682974
Total Vanadium (V)	mg/kg	0.53	0.32	0.28	<0.20	0.33	<0.20	0.20	7682974
Total Zinc (Zn)	mg/kg	14.4	10.9	6.87	26.5	7.82	59.7	0.20	7682974

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2704	KK2705	KK2706	KK2707	KK2709	KK2710		
Sampling Date		2014/08/13	2014/08/13	2014/08/13	2014/08/13	2014/08/13	2014/08/13		
COC Number		08396123	08396123	08396123	08396123	08396123	08396123		
	Units	CCTMWC-REP3	CCTMLC-BD3	CCTMWC-BD4	CCTMHA-REP4	CCTMCC-REP3	CCTMWC-BD3	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	19.6	49.7	20.9	32.8	54.0	17.3	1.0	7682974
Total Antimony (Sb)	mg/kg	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	0.0050	7682974
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	0.068	<0.050	<0.050	0.050	7682974
Total Barium (Ba)	mg/kg	15.9	44.3	12.8	57.5	40.1	26.6	0.10	7682974
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682974
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682974
Total Boron (B)	mg/kg	5.5	8.6	7.5	8.0	7.2	6.0	2.0	7682974
Total Cadmium (Cd)	mg/kg	0.561	0.011	1.30	0.067	0.011	0.289	0.010	7682974
Total Calcium (Ca)	mg/kg	8110	5980	6880	21400	5840	8730	10	7682974
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7682974
Total Cobalt (Co)	mg/kg	0.296	0.031	0.619	0.111	0.034	0.328	0.020	7682974
Total Copper (Cu)	mg/kg	2.26	2.01	3.20	3.81	1.73	1.67	0.050	7682974
Total Iron (Fe)	mg/kg	58	55	75	92	68	55	10	7682974
Total Lead (Pb)	mg/kg	0.030	0.039	0.023	0.045	0.045	0.014	0.010	7682974
Total Magnesium (Mg)	mg/kg	1350	819	2620	2240	775	1710	10	7682974
Total Manganese (Mn)	mg/kg	369	1140	690	61.1	946	217	0.10	7682974
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	0.012	<0.010	<0.010	0.010	7682974
Total Molybdenum (Mo)	mg/kg	0.246	0.056	0.351	2.32	<0.050	0.278	0.050	7682974
Total Nickel (Ni)	mg/kg	0.460	0.153	1.37	0.333	0.179	0.840	0.050	7682974
Total Phosphorus (P)	mg/kg	651	573	1050	1040	512	739	10	7682974
Total Potassium (K)	mg/kg	7730	4160	6090	17100	3880	8760	10	7682974
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	7682974
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7682974
Total Sodium (Na)	mg/kg	13	<10	44	13	<10	23	10	7682974
Total Strontium (Sr)	mg/kg	18.6	5.80	35.9	67.2	5.91	20.9	0.10	7682974
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	<0.0020	0.0047	<0.0020	<0.0020	0.0020	7682974
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682974
Total Titanium (Ti)	mg/kg	1.3	1.7	1.4	1.9	2.4	1.3	1.0	7682974
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	0.0081	<0.0020	<0.0020	0.0020	7682974
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	7682974
Total Zinc (Zn)	mg/kg	71.9	22.1	155	13.3	20.1	71.1	0.20	7682974

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (VEGETATION)

Maxxam ID		KK2711	KK2713	KK2714	KK2715	KK2716		
Sampling Date		2014/08/13	2014/08/13	2014/08/13	2014/08/13	2014/08/13		
COC Number		08396123	08396124	08396124	08396124	08396124		
	Units	CCTMCC-BD2	CCTMLC-REP3	CCTMHA-BD5	CCTMWA-REP4	CCTMWA-BD5	RDL	QC Batch
Total Metals by ICPMS								
Total Aluminum (Al)	mg/kg	82.1	112	25.0	100	104	1.0	7682974
Total Antimony (Sb)	mg/kg	<0.0050	0.0100	<0.0050	0.0091	0.0096	0.0050	7682974
Total Arsenic (As)	mg/kg	<0.050	0.122	<0.050	0.078	0.089	0.050	7682974
Total Barium (Ba)	mg/kg	40.8	10.4	46.9	47.1	48.0	0.10	7682974
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682974
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682974
Total Boron (B)	mg/kg	7.3	<2.0	9.9	9.8	5.8	2.0	7682974
Total Cadmium (Cd)	mg/kg	<0.010	0.017	0.073	1.67	1.45	0.010	7682974
Total Calcium (Ca)	mg/kg	5710	955	16200	19000	21100	10	7682974
Total Chromium (Cr)	mg/kg	<0.20	0.27	<0.20	0.41	0.36	0.20	7682974
Total Cobalt (Co)	mg/kg	0.023	0.103	0.096	0.548	0.440	0.020	7682974
Total Copper (Cu)	mg/kg	3.37	1.39	3.42	4.72	4.34	0.050	7682974
Total Iron (Fe)	mg/kg	44	187	73	230	253	10	7682974
Total Lead (Pb)	mg/kg	0.032	0.114	0.025	0.068	0.071	0.010	7682974
Total Magnesium (Mg)	mg/kg	689	344	2230	2210	2210	10	7682974
Total Manganese (Mn)	mg/kg	2740	85.7	58.6	45.9	44.9	0.10	7682974
Total Mercury (Hg)	mg/kg	<0.010	<0.010	0.012	<0.010	<0.010	0.010	7682974
Total Molybdenum (Mo)	mg/kg	0.145	<0.050	1.86	1.37	1.60	0.050	7682974
Total Nickel (Ni)	mg/kg	0.170	0.316	0.254	1.76	1.38	0.050	7682974
Total Phosphorus (P)	mg/kg	466	294	1010	1440	1270	10	7682974
Total Potassium (K)	mg/kg	2840	896	21400	9370	7200	10	7682974
Total Selenium (Se)	mg/kg	<0.050	<0.050	0.079	0.051	<0.050	0.050	7682974
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	7682974
Total Sodium (Na)	mg/kg	<10	16	37	<10	<10	10	7682974
Total Strontium (Sr)	mg/kg	2.72	3.28	51.4	67.3	71.9	0.10	7682974
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	0.0032	0.0029	0.0064	0.0020	7682974
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	7682974
Total Titanium (Ti)	mg/kg	1.4	7.3	1.6	5.2	6.2	1.0	7682974
Total Uranium (U)	mg/kg	<0.0020	0.0182	0.0031	0.0069	0.0088	0.0020	7682974
Total Vanadium (V)	mg/kg	<0.20	0.36	<0.20	0.26	0.27	0.20	7682974
Total Zinc (Zn)	mg/kg	17.8	7.92	14.0	79.1	68.8	0.20	7682974

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		KK2389	KK2392	KK2393		KK2395	KK2414	KK2415	
Sampling Date		2014/08/03	2014/08/02	2014/08/01		2014/08/03	2014/08/01	2014/08/03	
COC Number		08396127	08396127	08396127		08396127	08396128	08396128	
	Units	CCHMSA-39	CCHMSB-28A	CCHMSBB-20	QC Batch	CCHMSA-851	CCHMSAB-20	CCHMSA-38	QC Batch
Physical Properties									
Soluble (2:1) pH	pH	5.88	5.44	7.09	7612689	4.36	6.51	6.08	7612694

Maxxam ID		KK2417	KK2418	KK2419	KK2420		KK2421	KK2422	
Sampling Date		2014/08/04	2014/08/03	2014/08/04	2014/08/02		2014/08/01	2014/08/04	
COC Number		08396128	08396128	08396128	08396128		08396128	08396128	
	Units	CCHMSA-50	CCHMSA-851 REP2	CCHMSB-49	CCHMSA-30A	QC Batch	CCHMSA-21	CCHMSC-55	QC Batch
Physical Properties									
Soluble (2:1) pH	pH	5.41	4.86	4.13	6.13	7612689	6.12	5.19	7612694

Maxxam ID		KK2423	KK2550	KK2552	KK2555		KK2568	KK2569	
Sampling Date		2014/08/04	2014/08/10	2014/08/11	2014/08/10		2014/08/10	2014/08/11	
COC Number		08396128	08396131	08396131	08396131		08396132	08396132	
	Units	CCHMSC-59	CCHMSC-438	CCHMSB-440	CCHMSC-436	QC Batch	CCHMSB-113	CCHMSB-130	QC Batch
Physical Properties									
Soluble (2:1) pH	pH	5.77	5.55	5.57	5.77	7612689	5.95	5.78	7612694

Maxxam ID		KK2570	KK2573		KK2601		KK2602		KK2603	
Sampling Date		2014/08/10	2014/08/06		2014/08/08		2014/08/06		2014/08/08	
COC Number		08396132	08396132		08396133		08396133		08396133	
	Units	CCHMSB-120	CCHMSC-400	QC Batch	CCHMSB-92	QC Batch	CCHMSB-76	QC Batch	CCHMSB-410	QC Batch
Physical Properties										
Soluble (2:1) pH	pH	5.15	5.01	7612694	5.86	7612689	6.32	7612989	6.23	7612694

Maxxam ID		KK2604	KK2605	KK2607	KK2609		KK2620	KK2622	
Sampling Date		2014/08/05	2014/08/05	2014/08/09	2014/08/09		2014/08/09	2014/08/07	
COC Number		08396133	08396133	08396133	08396133		08396134	08396134	
	Units	CCHMSC-69	CCHMSC-62	CCHMSA-299	CCHMSA-106	QC Batch	CCHMSB-422	CCHMSC-81	QC Batch
Physical Properties									
Soluble (2:1) pH	pH	5.72	4.87	4.46	5.54	7612694	4.94	5.69	7612689

Maxxam ID		KK2623	KK2624	KK2627		KK2659		KK2660	
Sampling Date		2014/08/09	2014/08/08	2014/08/12		2014/08/13		2014/08/13	
COC Number		08396134	08396134	08396134		08396122		08396122	
	Units	CCHMSB-419	CCHMSA-98	CCHMSB-138	QC Batch	CCTMSC-BD2	QC Batch	CCTMSC-BD1	QC Batch
Physical Properties									
Soluble (2:1) pH	pH	4.38	6.20	6.21	7612689	5.36	7612989	4.79	7612694

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

RESULTS OF CHEMICAL ANALYSES OF SOIL

Maxxam ID		KK2661	KK2662		KK2663		KK2664		KK2665	
Sampling Date		2014/08/13	2014/08/13		2014/08/11		2014/08/12		2014/08/11	
COC Number		08396122	08396122		08396122		08396122		08396122	
	Units	CCTMSC-BD3	CCTMSC-BD4	QC Batch	CCTMSB-843	QC Batch	CCHMSA-135	QC Batch	CCHMSB-164	QC Batch
Physical Properties										
Soluble (2:1) pH	pH	6.62	5.83	7612694	5.32	7612689	4.48	7612694	5.37	7612689

Maxxam ID		KK2702	KK2708		KK2712	
Sampling Date		2014/08/13	2014/08/13		2014/08/13	
COC Number		08396123	08396123		08396123	
	Units	CCTMSA-BD5	CCTMSA-REP4	QC Batch	CCTMSC-REP3	QC Batch
Physical Properties						
Soluble (2:1) pH	pH	6.93	6.94	7612694	6.82	7612689

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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KK2389	KK2392	KK2393		KK2395	KK2414	KK2415		
Sampling Date		2014/08/03	2014/08/02	2014/08/01		2014/08/03	2014/08/01	2014/08/03		
COC Number		08396127	08396127	08396127		08396127	08396128	08396128		
	Units	CCHMSA-39	CCHMSB-28A	CCHMSBB-20	QC Batch	CCHMSA-851	CCHMSAB-20	CCHMSA-38	RDL	QC Batch
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	17600	12000	18800	7612683	13600	13200	24600	100	7612691
Total Antimony (Sb)	mg/kg	3.83	0.88	2.44	7612683	8.31	2.07	1.67	0.10	7612691
Total Arsenic (As)	mg/kg	30.0	10.5	52.4	7612683	93.1	41.6	22.4	0.50	7612691
Total Barium (Ba)	mg/kg	223	114	320	7612683	72.3	388	175	0.10	7612691
Total Beryllium (Be)	mg/kg	0.49	0.44	0.67	7612683	0.73	0.47	0.64	0.40	7612691
Total Bismuth (Bi)	mg/kg	0.39	0.34	0.14	7612683	0.16	0.11	0.29	0.10	7612691
Total Cadmium (Cd)	mg/kg	0.135	0.136	0.263	7612683	0.149	0.224	0.300	0.050	7612691
Total Calcium (Ca)	mg/kg	5380	2160	14400	7612683	2550	24600	3320	100	7612691
Total Chromium (Cr)	mg/kg	55.5	34.6	54.8	7612683	21.1	46.0	45.5	1.0	7612691
Total Cobalt (Co)	mg/kg	15.2	8.43	14.2	7612683	9.67	9.92	12.9	0.30	7612691
Total Copper (Cu)	mg/kg	12.4	12.0	19.1	7612683	16.2	18.3	22.1	0.50	7612691
Total Iron (Fe)	mg/kg	25400	21800	31700	7612683	24600	20900	35500	100	7612691
Total Lead (Pb)	mg/kg	5.54	5.25	10.6	7612683	9.27	7.39	10.8	0.10	7612691
Total Magnesium (Mg)	mg/kg	11300	4130	8870	7612683	6740	5650	7830	100	7612691
Total Manganese (Mn)	mg/kg	520	293	565	7612683	279	538	341	0.20	7612691
Total Mercury (Hg)	mg/kg	0.050	<0.050	0.296	7612683	0.079	0.235	<0.050	0.050	7612691
Total Molybdenum (Mo)	mg/kg	0.74	1.00	0.55	7612683	0.73	0.53	1.06	0.10	7612691
Total Nickel (Ni)	mg/kg	25.9	15.3	39.8	7612683	12.0	33.4	29.7	0.80	7612691
Total Phosphorus (P)	mg/kg	480	307	605	7612683	666	537	359	10	7612691
Total Potassium (K)	mg/kg	3360	927	3000	7612683	2980	1050	831	100	7612691
Total Selenium (Se)	mg/kg	<0.50	<0.50	<0.50	7612683	<0.50	<0.50	<0.50	0.50	7612691
Total Silver (Ag)	mg/kg	0.070	0.053	0.097	7612683	0.079	0.102	0.127	0.050	7612691
Total Sodium (Na)	mg/kg	148	101	340	7612683	124	237	135	100	7612691
Total Strontium (Sr)	mg/kg	27.8	22.7	69.4	7612683	19.8	92.9	24.9	0.10	7612691
Total Thallium (Tl)	mg/kg	0.227	0.106	0.760	7612683	0.393	0.419	0.154	0.050	7612691
Total Tin (Sn)	mg/kg	0.96	0.58	0.60	7612683	0.74	0.37	0.59	0.10	7612691
Total Titanium (Ti)	mg/kg	1070	721	1080	7612683	921	588	1010	1.0	7612691
Total Vanadium (V)	mg/kg	46.1	42.2	69.0	7612683	59.7	38.8	68.1	2.0	7612691
Total Zinc (Zn)	mg/kg	40.2	32.9	56.7	7612683	36.7	40.4	54.0	1.0	7612691
Total Zirconium (Zr)	mg/kg	1.87	1.41	3.99	7612683	1.16	2.98	8.69	0.50	7612691

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KK2417	KK2418	KK2419	KK2420		KK2421		
Sampling Date		2014/08/04	2014/08/03	2014/08/04	2014/08/02		2014/08/01		
COC Number		08396128	08396128	08396128	08396128		08396128		
	Units	CCHMSA-50	CCHMSA-851 REP2	CCHMSB-49	CCHMSA-30A	QC Batch	CCHMSA-21	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	8920	15900	7290	11800	7612683	20700	100	7612691
Total Antimony (Sb)	mg/kg	2.28	13.2	0.60	0.28	7612683	0.68	0.10	7612691
Total Arsenic (As)	mg/kg	41.5	204	65.2	11.0	7612683	47.4	0.50	7612691
Total Barium (Ba)	mg/kg	114	118	55.9	85.2	7612683	128	0.10	7612691
Total Beryllium (Be)	mg/kg	<0.40	0.90	<0.40	<0.40	7612683	0.63	0.40	7612691
Total Bismuth (Bi)	mg/kg	<0.10	0.12	0.17	0.14	7612683	0.21	0.10	7612691
Total Cadmium (Cd)	mg/kg	0.120	0.156	0.109	0.069	7612683	0.123	0.050	7612691
Total Calcium (Ca)	mg/kg	2210	3720	1080	4370	7612683	5590	100	7612691
Total Chromium (Cr)	mg/kg	12.6	24.6	14.7	49.1	7612683	115	1.0	7612691
Total Cobalt (Co)	mg/kg	2.10	10.3	3.27	6.92	7612683	19.6	0.30	7612691
Total Copper (Cu)	mg/kg	10.8	17.5	8.85	10.7	7612683	48.5	0.50	7612691
Total Iron (Fe)	mg/kg	10000	30500	17000	15400	7612683	28600	100	7612691
Total Lead (Pb)	mg/kg	3.52	9.13	7.09	4.44	7612683	3.39	0.10	7612691
Total Magnesium (Mg)	mg/kg	1600	7670	1750	6730	7612683	16200	100	7612691
Total Manganese (Mn)	mg/kg	185	395	281	222	7612683	491	0.20	7612691
Total Mercury (Hg)	mg/kg	0.054	0.204	<0.050	<0.050	7612683	<0.050	0.050	7612691
Total Molybdenum (Mo)	mg/kg	0.51	0.59	1.35	0.30	7612683	0.39	0.10	7612691
Total Nickel (Ni)	mg/kg	7.28	14.5	6.64	22.2	7612683	49.3	0.80	7612691
Total Phosphorus (P)	mg/kg	762	734	405	309	7612683	341	10	7612691
Total Potassium (K)	mg/kg	355	2190	598	1510	7612683	3550	100	7612691
Total Selenium (Se)	mg/kg	<0.50	<0.50	<0.50	<0.50	7612683	<0.50	0.50	7612691
Total Silver (Ag)	mg/kg	0.167	0.058	0.058	<0.050	7612683	0.051	0.050	7612691
Total Sodium (Na)	mg/kg	223	111	133	326	7612683	<100	100	7612691
Total Strontium (Sr)	mg/kg	22.2	27.7	13.6	42.5	7612683	19.4	0.10	7612691
Total Thallium (Tl)	mg/kg	0.113	0.495	0.116	0.117	7612683	0.310	0.050	7612691
Total Tin (Sn)	mg/kg	0.25	0.67	0.57	0.55	7612683	0.98	0.10	7612691
Total Titanium (Ti)	mg/kg	188	1050	649	626	7612683	727	1.0	7612691
Total Vanadium (V)	mg/kg	17.2	74.0	54.3	28.2	7612683	64.3	2.0	7612691
Total Zinc (Zn)	mg/kg	21.0	46.5	27.6	27.0	7612683	32.9	1.0	7612691
Total Zirconium (Zr)	mg/kg	<0.50	2.79	0.79	0.72	7612683	3.43	0.50	7612691

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KK2422		KK2423	KK2550	KK2552	KK2555		
Sampling Date		2014/08/04		2014/08/04	2014/08/10	2014/08/11	2014/08/10		
COC Number		08396128		08396128	08396131	08396131	08396131		
	Units	CCHMSC-55	QC Batch	CCHMSC-59	CCHMSC-438	CCHMSB-440	CCHMSC-436	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	16900	7612691	20300	8060	15400	15000	100	7612683
Total Antimony (Sb)	mg/kg	0.41	7612691	1.00	0.68	0.69	1.14	0.10	7612683
Total Arsenic (As)	mg/kg	6.19	7612691	7.90	7.21	13.4	8.52	0.50	7612683
Total Barium (Ba)	mg/kg	100	7612691	174	58.4	175	188	0.10	7612683
Total Beryllium (Be)	mg/kg	0.46	7612691	0.54	<0.40	0.47	0.50	0.40	7612683
Total Bismuth (Bi)	mg/kg	0.10	7612691	0.12	0.12	0.19	0.20	0.10	7612683
Total Cadmium (Cd)	mg/kg	0.214	7612691	0.344	0.122	0.230	0.210	0.050	7612683
Total Calcium (Ca)	mg/kg	3050	7612691	5030	2400	5040	4150	100	7612683
Total Chromium (Cr)	mg/kg	24.2	7612691	27.4	13.4	29.0	21.2	1.0	7612683
Total Cobalt (Co)	mg/kg	7.88	7612691	6.59	5.85	10.7	6.73	0.30	7612683
Total Copper (Cu)	mg/kg	17.2	7612691	16.1	5.44	20.2	12.0	0.50	7612683
Total Iron (Fe)	mg/kg	26600	7612691	19800	15500	26600	22500	100	7612683
Total Lead (Pb)	mg/kg	8.52	7612691	12.2	5.55	7.86	10.9	0.10	7612683
Total Magnesium (Mg)	mg/kg	4670	7612691	4570	3570	6630	4110	100	7612683
Total Manganese (Mn)	mg/kg	404	7612691	212	233	599	322	0.20	7612683
Total Mercury (Hg)	mg/kg	0.071	7612691	0.144	<0.050	<0.050	<0.050	0.050	7612683
Total Molybdenum (Mo)	mg/kg	0.78	7612691	0.71	0.61	1.49	0.77	0.10	7612683
Total Nickel (Ni)	mg/kg	16.9	7612691	17.0	8.35	19.5	12.8	0.80	7612683
Total Phosphorus (P)	mg/kg	448	7612691	526	273	545	262	10	7612683
Total Potassium (K)	mg/kg	638	7612691	612	838	1940	799	100	7612683
Total Selenium (Se)	mg/kg	<0.50	7612691	<0.50	<0.50	<0.50	<0.50	0.50	7612683
Total Silver (Ag)	mg/kg	0.064	7612691	0.136	<0.050	0.083	0.161	0.050	7612683
Total Sodium (Na)	mg/kg	144	7612691	188	<100	257	124	100	7612683
Total Strontium (Sr)	mg/kg	22.7	7612691	33.7	16.7	32.0	25.3	0.10	7612683
Total Thallium (Tl)	mg/kg	0.121	7612691	0.173	0.107	0.216	0.128	0.050	7612683
Total Tin (Sn)	mg/kg	0.49	7612691	0.57	0.38	0.57	0.59	0.10	7612683
Total Titanium (Ti)	mg/kg	947	7612691	761	498	987	704	1.0	7612683
Total Vanadium (V)	mg/kg	60.0	7612691	45.0	31.3	57.6	44.2	2.0	7612683
Total Zinc (Zn)	mg/kg	52.2	7612691	61.8	25.3	61.4	39.2	1.0	7612683
Total Zirconium (Zr)	mg/kg	2.45	7612691	2.78	2.17	2.52	4.52	0.50	7612683

RDL = Reportable Detection Limit

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Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KK2568	KK2569	KK2570	KK2573		KK2601		
Sampling Date		2014/08/10	2014/08/11	2014/08/10	2014/08/06		2014/08/08		
COC Number		08396132	08396132	08396132	08396132		08396133		
	Units	CCHMSB-113	CCHMSB-130	CCHMSB-120	CCHMSC-400	QC Batch	CCHMSB-92	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	21100	20400	11300	22000	7612691	17400	100	7612683
Total Antimony (Sb)	mg/kg	0.39	0.76	0.25	1.51	7612691	11.3	0.10	7612683
Total Arsenic (As)	mg/kg	6.69	20.8	2.92	7.47	7612691	90.6	0.50	7612683
Total Barium (Ba)	mg/kg	190	277	66.7	102	7612691	206	0.10	7612683
Total Beryllium (Be)	mg/kg	0.54	0.71	0.60	0.59	7612691	<0.40	0.40	7612683
Total Bismuth (Bi)	mg/kg	0.13	0.43	0.14	0.13	7612691	0.21	0.10	7612683
Total Cadmium (Cd)	mg/kg	0.121	0.409	0.121	0.180	7612691	0.343	0.050	7612683
Total Calcium (Ca)	mg/kg	5580	4270	1270	2770	7612691	4360	100	7612683
Total Chromium (Cr)	mg/kg	56.5	50.6	11.5	38.5	7612691	22.8	1.0	7612683
Total Cobalt (Co)	mg/kg	14.0	13.8	4.90	13.7	7612691	12.4	0.30	7612683
Total Copper (Cu)	mg/kg	19.3	30.6	6.13	18.7	7612691	27.1	0.50	7612683
Total Iron (Fe)	mg/kg	29800	31300	17300	32100	7612691	30800	100	7612683
Total Lead (Pb)	mg/kg	7.11	10.4	6.66	9.23	7612691	5.58	0.10	7612683
Total Magnesium (Mg)	mg/kg	9400	7390	3190	7140	7612691	6710	100	7612683
Total Manganese (Mn)	mg/kg	591	391	316	651	7612691	733	0.20	7612683
Total Mercury (Hg)	mg/kg	<0.050	<0.050	<0.050	0.052	7612691	<0.050	0.050	7612683
Total Molybdenum (Mo)	mg/kg	0.82	0.82	0.31	1.06	7612691	1.41	0.10	7612683
Total Nickel (Ni)	mg/kg	32.5	28.3	7.03	18.8	7612691	17.1	0.80	7612683
Total Phosphorus (P)	mg/kg	589	404	249	517	7612691	705	10	7612683
Total Potassium (K)	mg/kg	854	1060	2210	1390	7612691	944	100	7612683
Total Selenium (Se)	mg/kg	<0.50	<0.50	<0.50	<0.50	7612691	<0.50	0.50	7612683
Total Silver (Ag)	mg/kg	0.066	0.094	<0.050	0.072	7612691	0.109	0.050	7612683
Total Sodium (Na)	mg/kg	161	179	<100	104	7612691	315	100	7612683
Total Strontium (Sr)	mg/kg	30.3	31.2	11.1	23.1	7612691	27.0	0.10	7612683
Total Thallium (Tl)	mg/kg	0.155	0.207	0.341	0.210	7612691	0.227	0.050	7612683
Total Tin (Sn)	mg/kg	0.68	0.70	0.45	0.60	7612691	0.45	0.10	7612683
Total Titanium (Ti)	mg/kg	1010	1100	685	1100	7612691	1290	1.0	7612683
Total Vanadium (V)	mg/kg	70.4	65.1	23.1	76.1	7612691	74.3	2.0	7612683
Total Zinc (Zn)	mg/kg	44.1	49.7	31.9	51.2	7612691	54.5	1.0	7612683
Total Zirconium (Zr)	mg/kg	1.42	12.9	0.95	2.99	7612691	3.24	0.50	7612683

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KK2602		KK2603	KK2604	KK2605	KK2607	KK2609		
Sampling Date		2014/08/06		2014/08/08	2014/08/05	2014/08/05	2014/08/09	2014/08/09		
COC Number		08396133		08396133	08396133	08396133	08396133	08396133		
	Units	CCHMSB-76	QC Batch	CCHMSB-410	CCHMSC-69	CCHMSC-62	CCHMSA-299	CCHMSA-106	RDL	QC Batch
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	4910	7612980	24100	13100	14800	11000	20900	100	7612691
Total Antimony (Sb)	mg/kg	0.48	7612980	49.2	0.26	1.20	0.48	0.52	0.10	7612691
Total Arsenic (As)	mg/kg	2.14	7612980	50.6	2.53	14.6	4.71	7.90	0.50	7612691
Total Barium (Ba)	mg/kg	215	7612980	298	112	103	56.5	150	0.10	7612691
Total Beryllium (Be)	mg/kg	<0.40	7612980	0.64	<0.40	<0.40	<0.40	0.83	0.40	7612691
Total Bismuth (Bi)	mg/kg	<0.10	7612980	0.17	<0.10	0.16	0.35	0.25	0.10	7612691
Total Cadmium (Cd)	mg/kg	0.314	7612980	0.436	0.164	0.190	0.117	0.241	0.050	7612691
Total Calcium (Ca)	mg/kg	32000	7612980	7830	2720	1690	771	1460	100	7612691
Total Chromium (Cr)	mg/kg	10.4	7612980	32.2	17.5	22.1	14.2	30.8	1.0	7612691
Total Cobalt (Co)	mg/kg	2.91	7612980	5.43	5.43	5.20	2.96	8.21	0.30	7612691
Total Copper (Cu)	mg/kg	23.9	7612980	37.4	8.33	11.5	7.39	17.6	0.50	7612691
Total Iron (Fe)	mg/kg	7750	7612980	24000	17000	28700	19200	33300	100	7612691
Total Lead (Pb)	mg/kg	2.02	7612980	7.48	7.94	12.4	16.0	14.2	0.10	7612691
Total Magnesium (Mg)	mg/kg	2610	7612980	4360	2730	3750	1710	3320	100	7612691
Total Manganese (Mn)	mg/kg	225	7612980	162	399	221	141	248	0.20	7612691
Total Mercury (Hg)	mg/kg	0.053	7612980	0.123	0.061	<0.050	<0.050	<0.050	0.050	7612691
Total Molybdenum (Mo)	mg/kg	0.60	7612980	0.67	0.48	2.19	1.07	1.69	0.10	7612691
Total Nickel (Ni)	mg/kg	13.8	7612980	15.2	9.05	11.4	6.18	16.6	0.80	7612691
Total Phosphorus (P)	mg/kg	907	7612980	907	367	217	189	468	10	7612691
Total Potassium (K)	mg/kg	192	7612980	787	396	568	389	581	100	7612691
Total Selenium (Se)	mg/kg	0.65	7612980	0.67	<0.50	<0.50	<0.50	<0.50	0.50	7612691
Total Silver (Ag)	mg/kg	0.077	7612980	0.282	0.068	0.076	0.057	0.134	0.050	7612691
Total Sodium (Na)	mg/kg	129	7612980	124	130	<100	<100	<100	100	7612691
Total Strontium (Sr)	mg/kg	124	7612980	50.1	18.3	16.0	9.62	13.5	0.10	7612691
Total Thallium (Tl)	mg/kg	<0.050	7612980	0.201	0.160	0.139	0.109	0.123	0.050	7612691
Total Tin (Sn)	mg/kg	0.10	7612980	0.50	0.51	0.57	0.73	0.96	0.10	7612691
Total Titanium (Ti)	mg/kg	137	7612980	649	618	967	660	587	1.0	7612691
Total Vanadium (V)	mg/kg	13.7	7612980	44.1	36.1	82.1	55.1	62.2	2.0	7612691
Total Zinc (Zn)	mg/kg	16.2	7612980	37.6	37.3	40.9	24.8	38.9	1.0	7612691
Total Zirconium (Zr)	mg/kg	2.58	7612980	3.61	1.26	2.48	1.72	7.86	0.50	7612691

RDL = Reportable Detection Limit

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KK2620	KK2622	KK2623	KK2624	KK2627		KK2659		
Sampling Date		2014/08/09	2014/08/07	2014/08/09	2014/08/08	2014/08/12		2014/08/13		
COC Number		08396134	08396134	08396134	08396134	08396134		08396122		
	Units	CCHMSB-422	CCHMSC-81	CCHMSB-419	CCHMSA-98	CCHMSB-138	QC Batch	CCTMSC-BD2	RDL	QC Batch
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	22800	19400	16000	24700	16300	7612683	4290	100	7612980
Total Antimony (Sb)	mg/kg	0.55	0.45	0.22	1.99	0.89	7612683	0.61	0.10	7612980
Total Arsenic (As)	mg/kg	7.94	16.8	2.83	51.4	26.5	7612683	4.36	0.50	7612980
Total Barium (Ba)	mg/kg	176	121	137	260	148	7612683	159	0.10	7612980
Total Beryllium (Be)	mg/kg	0.58	0.42	0.99	0.50	0.53	7612683	0.62	0.40	7612980
Total Bismuth (Bi)	mg/kg	0.20	0.15	0.36	0.14	0.17	7612683	0.28	0.10	7612980
Total Cadmium (Cd)	mg/kg	0.142	0.242	0.198	0.343	0.285	7612683	0.230	0.050	7612980
Total Calcium (Ca)	mg/kg	1940	2440	1910	5120	4980	7612683	7420	100	7612980
Total Chromium (Cr)	mg/kg	43.7	26.8	21.9	59.6	33.2	7612683	12.9	1.0	7612980
Total Cobalt (Co)	mg/kg	11.7	7.65	4.84	14.9	10.9	7612683	44.5	0.30	7612980
Total Copper (Cu)	mg/kg	16.8	13.1	17.3	46.8	16.1	7612683	17.1	0.50	7612980
Total Iron (Fe)	mg/kg	38900	27900	17000	34600	26400	7612683	44600	100	7612980
Total Lead (Pb)	mg/kg	10.7	9.22	8.37	10.3	14.5	7612683	7.24	0.10	7612980
Total Magnesium (Mg)	mg/kg	4820	4640	3210	9030	6740	7612683	1290	100	7612980
Total Manganese (Mn)	mg/kg	344	367	229	500	1080	7612683	3420	0.20	7612980
Total Mercury (Hg)	mg/kg	<0.050	<0.050	0.060	<0.050	0.062	7612683	0.086	0.050	7612980
Total Molybdenum (Mo)	mg/kg	1.97	1.03	0.64	0.98	1.05	7612683	5.55	0.10	7612980
Total Nickel (Ni)	mg/kg	27.0	14.7	12.2	42.0	17.7	7612683	6.83	0.80	7612980
Total Phosphorus (P)	mg/kg	249	299	516	583	447	7612683	1370	10	7612980
Total Potassium (K)	mg/kg	775	661	1060	1410	1640	7612683	229	100	7612980
Total Selenium (Se)	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	7612683	0.61	0.50	7612980
Total Silver (Ag)	mg/kg	0.065	0.064	0.136	0.184	0.086	7612683	0.298	0.050	7612980
Total Sodium (Na)	mg/kg	104	114	<100	254	237	7612683	<100	100	7612980
Total Strontium (Sr)	mg/kg	16.6	21.8	20.6	32.0	41.2	7612683	33.6	0.10	7612980
Total Thallium (Tl)	mg/kg	0.174	0.189	0.194	0.162	0.243	7612683	0.088	0.050	7612980
Total Tin (Sn)	mg/kg	0.87	0.96	1.23	0.56	0.70	7612683	0.19	0.10	7612980
Total Titanium (Ti)	mg/kg	840	1010	418	1380	933	7612683	107	1.0	7612980
Total Vanadium (V)	mg/kg	77.6	64.0	30.7	87.2	53.3	7612683	36.8	2.0	7612980
Total Zinc (Zn)	mg/kg	42.2	47.6	36.9	82.0	61.9	7612683	19.0	1.0	7612980
Total Zirconium (Zr)	mg/kg	2.64	5.01	0.81	4.48	2.52	7612683	0.55	0.50	7612980

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KK2660	KK2661	KK2662		KK2663		KK2664		
Sampling Date		2014/08/13	2014/08/13	2014/08/13		2014/08/11		2014/08/12		
COC Number		08396122	08396122	08396122		08396122		08396122		
	Units	CCTMSC-BD1	CCTMSC-BD3	CCTMSC-BD4	QC Batch	CCTMSB-843	QC Batch	CCHMSA-135	RDL	QC Batch
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	11700	14800	18200	7612691	23100	7612683	16100	100	7612691
Total Antimony (Sb)	mg/kg	0.23	0.31	0.85	7612691	8.41	7612683	0.33	0.10	7612691
Total Arsenic (As)	mg/kg	4.33	3.59	10.2	7612691	78.8	7612683	6.15	0.50	7612691
Total Barium (Ba)	mg/kg	176	373	196	7612691	162	7612683	164	0.10	7612691
Total Beryllium (Be)	mg/kg	<0.40	0.66	0.61	7612691	0.65	7612683	0.41	0.40	7612691
Total Bismuth (Bi)	mg/kg	0.11	0.21	0.21	7612691	0.19	7612683	0.18	0.10	7612691
Total Cadmium (Cd)	mg/kg	0.116	0.586	0.296	7612691	0.158	7612683	0.277	0.050	7612691
Total Calcium (Ca)	mg/kg	3430	11800	4130	7612691	3470	7612683	4300	100	7612691
Total Chromium (Cr)	mg/kg	10.3	15.7	29.1	7612691	39.1	7612683	18.8	1.0	7612691
Total Cobalt (Co)	mg/kg	7.17	6.32	8.79	7612691	9.29	7612683	8.13	0.30	7612691
Total Copper (Cu)	mg/kg	8.95	18.2	21.7	7612691	20.8	7612683	13.0	0.50	7612691
Total Iron (Fe)	mg/kg	21700	21000	23900	7612691	27800	7612683	21500	100	7612691
Total Lead (Pb)	mg/kg	3.72	12.0	13.6	7612691	9.52	7612683	10.8	0.10	7612691
Total Magnesium (Mg)	mg/kg	5490	3340	3910	7612691	5940	7612683	6740	100	7612691
Total Manganese (Mn)	mg/kg	282	535	418	7612691	367	7612683	707	0.20	7612691
Total Mercury (Hg)	mg/kg	<0.050	0.051	0.077	7612691	0.103	7612683	<0.050	0.050	7612691
Total Molybdenum (Mo)	mg/kg	0.77	0.73	0.66	7612691	1.26	7612683	1.69	0.10	7612691
Total Nickel (Ni)	mg/kg	6.68	11.6	16.7	7612691	21.2	7612683	11.0	0.80	7612691
Total Phosphorus (P)	mg/kg	441	460	307	7612691	408	7612683	450	10	7612691
Total Potassium (K)	mg/kg	387	1110	421	7612691	983	7612683	1900	100	7612691
Total Selenium (Se)	mg/kg	<0.50	0.98	<0.50	7612691	<0.50	7612683	<0.50	0.50	7612691
Total Silver (Ag)	mg/kg	<0.050	0.193	0.127	7612691	0.113	7612683	0.374	0.050	7612691
Total Sodium (Na)	mg/kg	226	<100	143	7612691	132	7612683	261	100	7612691
Total Strontium (Sr)	mg/kg	24.5	41.6	31.7	7612691	28.5	7612683	92.3	0.10	7612691
Total Thallium (Tl)	mg/kg	0.109	0.126	0.139	7612691	0.285	7612683	0.251	0.050	7612691
Total Tin (Sn)	mg/kg	0.38	0.74	1.09	7612691	0.72	7612683	0.61	0.10	7612691
Total Titanium (Ti)	mg/kg	1160	436	751	7612691	861	7612683	838	1.0	7612691
Total Vanadium (V)	mg/kg	60.4	36.2	52.0	7612691	67.6	7612683	54.1	2.0	7612691
Total Zinc (Zn)	mg/kg	38.0	31.3	48.2	7612691	44.9	7612683	45.7	1.0	7612691
Total Zirconium (Zr)	mg/kg	0.95	4.13	5.87	7612691	1.42	7612683	2.03	0.50	7612691

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		KK2665		KK2702	KK2708		KK2712		
Sampling Date		2014/08/11		2014/08/13	2014/08/13		2014/08/13		
COC Number		08396122		08396123	08396123		08396123		
	Units	CCHMSB-164	QC Batch	CCTMSA-BD5	CCTMSA-REP4	QC Batch	CCTMSC-REP3	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	15000	7612683	9620	10400	7612691	14900	100	7612683
Total Antimony (Sb)	mg/kg	0.33	7612683	0.38	0.38	7612691	0.27	0.10	7612683
Total Arsenic (As)	mg/kg	4.71	7612683	5.87	6.38	7612691	2.83	0.50	7612683
Total Barium (Ba)	mg/kg	75.1	7612683	149	164	7612691	349	0.10	7612683
Total Beryllium (Be)	mg/kg	<0.40	7612683	<0.40	<0.40	7612691	0.66	0.40	7612683
Total Bismuth (Bi)	mg/kg	<0.10	7612683	<0.10	<0.10	7612691	0.18	0.10	7612683
Total Cadmium (Cd)	mg/kg	0.098	7612683	0.152	0.136	7612691	0.562	0.050	7612683
Total Calcium (Ca)	mg/kg	1900	7612683	7270	8270	7612691	10300	100	7612683
Total Chromium (Cr)	mg/kg	39.8	7612683	18.6	19.4	7612691	14.2	1.0	7612683
Total Cobalt (Co)	mg/kg	5.90	7612683	5.86	6.17	7612691	5.81	0.30	7612683
Total Copper (Cu)	mg/kg	14.4	7612683	13.6	14.0	7612691	16.7	0.50	7612683
Total Iron (Fe)	mg/kg	19300	7612683	18100	18900	7612691	18400	100	7612683
Total Lead (Pb)	mg/kg	4.82	7612683	4.93	5.50	7612691	10.5	0.10	7612683
Total Magnesium (Mg)	mg/kg	4960	7612683	3510	3660	7612691	3500	100	7612683
Total Manganese (Mn)	mg/kg	164	7612683	196	204	7612691	472	0.20	7612683
Total Mercury (Hg)	mg/kg	<0.050	7612683	<0.050	<0.050	7612691	<0.050	0.050	7612683
Total Molybdenum (Mo)	mg/kg	0.84	7612683	0.53	0.58	7612691	0.61	0.10	7612683
Total Nickel (Ni)	mg/kg	18.9	7612683	14.4	14.7	7612691	10.7	0.80	7612683
Total Phosphorus (P)	mg/kg	181	7612683	453	501	7612691	372	10	7612683
Total Potassium (K)	mg/kg	446	7612683	562	517	7612691	1180	100	7612683
Total Selenium (Se)	mg/kg	<0.50	7612683	<0.50	<0.50	7612691	0.92	0.50	7612683
Total Silver (Ag)	mg/kg	<0.050	7612683	0.060	0.059	7612691	0.173	0.050	7612683
Total Sodium (Na)	mg/kg	206	7612683	179	223	7612691	<100	100	7612683
Total Strontium (Sr)	mg/kg	18.1	7612683	40.1	46.2	7612691	36.5	0.10	7612683
Total Thallium (Tl)	mg/kg	0.107	7612683	0.064	0.064	7612691	0.114	0.050	7612683
Total Tin (Sn)	mg/kg	0.38	7612683	0.27	0.31	7612691	0.72	0.10	7612683
Total Titanium (Ti)	mg/kg	782	7612683	487	557	7612691	452	1.0	7612683
Total Vanadium (V)	mg/kg	44.4	7612683	34.3	38.0	7612691	32.5	2.0	7612683
Total Zinc (Zn)	mg/kg	24.3	7612683	38.8	39.9	7612691	28.2	1.0	7612683
Total Zirconium (Zr)	mg/kg	1.04	7612683	2.13	2.14	7612691	3.56	0.50	7612683

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

GENERAL COMMENTS

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B473400
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QUALITY ASSURANCE REPORT

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7612683	Total Aluminum (Al)	2014/08/26					<100	mg/kg	3.6	35	99	70 - 130
7612683	Total Antimony (Sb)	2014/08/26	91	75 - 125	97	75 - 125	<0.10	mg/kg	NC	30	98	70 - 130
7612683	Total Arsenic (As)	2014/08/26	92	75 - 125	100	75 - 125	<0.50	mg/kg	0.46	30	91	70 - 130
7612683	Total Barium (Ba)	2014/08/26	NC	75 - 125	100	75 - 125	<0.10	mg/kg	0.13	35	97	70 - 130
7612683	Total Beryllium (Be)	2014/08/26	100	75 - 125	109	75 - 125	<0.40	mg/kg	NC	30		
7612683	Total Bismuth (Bi)	2014/08/26					<0.10	mg/kg	NC	30		
7612683	Total Cadmium (Cd)	2014/08/26	94	75 - 125	96	75 - 125	<0.050	mg/kg	NC	30	98	70 - 130
7612683	Total Calcium (Ca)	2014/08/26					<100	mg/kg	6.3	30	98	70 - 130
7612683	Total Chromium (Cr)	2014/08/26	NC	75 - 125	99	75 - 125	<1.0	mg/kg	4.1	30	97	70 - 130
7612683	Total Cobalt (Co)	2014/08/26	95	75 - 125	100	75 - 125	<0.30	mg/kg	0.76	30	89	70 - 130
7612683	Total Copper (Cu)	2014/08/26	98	75 - 125	105	75 - 125	<0.50	mg/kg	0.056	30	93	70 - 130
7612683	Total Iron (Fe)	2014/08/26					<100	mg/kg	0.85	30	97	70 - 130
7612683	Total Lead (Pb)	2014/08/26	97	75 - 125	102	75 - 125	<0.10	mg/kg	0.40	35	97	70 - 130
7612683	Total Magnesium (Mg)	2014/08/26					<100	mg/kg	2.8	30	90	70 - 130
7612683	Total Manganese (Mn)	2014/08/26	NC	75 - 125	102	75 - 125	<0.20	mg/kg	2.5	30	96	70 - 130
7612683	Total Mercury (Hg)	2014/08/26	88	75 - 125	89	75 - 125	<0.050	mg/kg	NC	35	86	70 - 130
7612683	Total Molybdenum (Mo)	2014/08/26	102	75 - 125	103	75 - 125	<0.10	mg/kg	2.9	35	109	70 - 130
7612683	Total Nickel (Ni)	2014/08/26	99	75 - 125	102	75 - 125	<0.80	mg/kg	2.9	30	91	70 - 130
7612683	Total Phosphorus (P)	2014/08/26					<10	mg/kg	0.21	30	77	70 - 130
7612683	Total Potassium (K)	2014/08/26					<100	mg/kg	4.5	35		
7612683	Total Selenium (Se)	2014/08/26	87	75 - 125	105	75 - 125	<0.50	mg/kg	NC	30		
7612683	Total Silver (Ag)	2014/08/26	81	75 - 125	84	75 - 125	<0.050	mg/kg	NC	35		
7612683	Total Sodium (Na)	2014/08/26					<100	mg/kg	NC	35		
7612683	Total Strontium (Sr)	2014/08/26	110	75 - 125	109	75 - 125	<0.10	mg/kg	0.93	35	104	70 - 130
7612683	Total Thallium (Tl)	2014/08/26	98	75 - 125	105	75 - 125	<0.050	mg/kg	NC	30	94	70 - 130
7612683	Total Tin (Sn)	2014/08/26	92	75 - 125	98	75 - 125	<0.10	mg/kg	7.5	35		
7612683	Total Titanium (Ti)	2014/08/26	NC	75 - 125	99	75 - 125	1.8, RDL=1.0	mg/kg	3.2	35	103	70 - 130
7612683	Total Vanadium (V)	2014/08/26	NC	75 - 125	93	75 - 125	<2.0	mg/kg	1.8	30	95	70 - 130
7612683	Total Zinc (Zn)	2014/08/26	NC	75 - 125	98	75 - 125	<1.0	mg/kg	0.30	30	87	70 - 130
7612683	Total Zirconium (Zr)	2014/08/26					<0.50	mg/kg	3.1	30		
7612689	Soluble (2:1) pH	2014/08/25			101	97 - 103			0.18	N/A		
7612691	Total Aluminum (Al)	2014/08/26					<100	mg/kg	1.3	35	96	70 - 130

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7612691	Total Antimony (Sb)	2014/08/26	95	75 - 125	98	75 - 125	<0.10	mg/kg	NC	30	98	70 - 130
7612691	Total Arsenic (As)	2014/08/26	95	75 - 125	93	75 - 125	<0.50	mg/kg	6.7	30	90	70 - 130
7612691	Total Barium (Ba)	2014/08/26	NC	75 - 125	97	75 - 125	<0.10	mg/kg	2.5	35	95	70 - 130
7612691	Total Beryllium (Be)	2014/08/26	104	75 - 125	105	75 - 125	<0.40	mg/kg	NC	30		
7612691	Total Bismuth (Bi)	2014/08/26					<0.10	mg/kg	NC	30		
7612691	Total Cadmium (Cd)	2014/08/26	98	75 - 125	97	75 - 125	<0.050	mg/kg	NC	30	95	70 - 130
7612691	Total Calcium (Ca)	2014/08/26					<100	mg/kg	1.4	30	93	70 - 130
7612691	Total Chromium (Cr)	2014/08/26	101	75 - 125	98	75 - 125	<1.0	mg/kg	2.4	30	97	70 - 130
7612691	Total Cobalt (Co)	2014/08/26	101	75 - 125	102	75 - 125	<0.30	mg/kg	2.1	30	86	70 - 130
7612691	Total Copper (Cu)	2014/08/26	103	75 - 125	105	75 - 125	<0.50	mg/kg	0.48	30	89	70 - 130
7612691	Total Iron (Fe)	2014/08/26					<100	mg/kg	1.4	30	99	70 - 130
7612691	Total Lead (Pb)	2014/08/26	104	75 - 125	99	75 - 125	<0.10	mg/kg	2.1	35	90	70 - 130
7612691	Total Magnesium (Mg)	2014/08/26					<100	mg/kg	2.2	30	88	70 - 130
7612691	Total Manganese (Mn)	2014/08/26	NC	75 - 125	102	75 - 125	<0.20	mg/kg	0.35	30	95	70 - 130
7612691	Total Mercury (Hg)	2014/08/26	95	75 - 125	88	75 - 125	<0.050	mg/kg	NC	35	70	70 - 130
7612691	Total Molybdenum (Mo)	2014/08/26	105	75 - 125	100	75 - 125	<0.10	mg/kg	NC	35	108	70 - 130
7612691	Total Nickel (Ni)	2014/08/26	102	75 - 125	101	75 - 125	<0.80	mg/kg	1.3	30	93	70 - 130
7612691	Total Phosphorus (P)	2014/08/26					<10	mg/kg	0.41	30	78	70 - 130
7612691	Total Potassium (K)	2014/08/26					<100	mg/kg	NC	35		
7612691	Total Selenium (Se)	2014/08/26	95	75 - 125	93	75 - 125	<0.50	mg/kg	NC	30		
7612691	Total Silver (Ag)	2014/08/26	85	75 - 125	87	75 - 125	<0.050	mg/kg	NC	35		
7612691	Total Sodium (Na)	2014/08/26					<100	mg/kg	NC	35		
7612691	Total Strontium (Sr)	2014/08/26	111	75 - 125	104	75 - 125	<0.10	mg/kg	1.8	35	100	70 - 130
7612691	Total Thallium (Tl)	2014/08/26	104	75 - 125	102	75 - 125	<0.050	mg/kg	NC	30	88	70 - 130
7612691	Total Tin (Sn)	2014/08/26	96	75 - 125	95	75 - 125	<0.10	mg/kg	NC	35		
7612691	Total Titanium (Ti)	2014/08/26	NC	75 - 125	96	75 - 125	1.2, RDL=1.0	mg/kg	4.0	35	105	70 - 130
7612691	Total Vanadium (V)	2014/08/26	NC	75 - 125	95	75 - 125	<2.0	mg/kg	2.1	30	97	70 - 130
7612691	Total Zinc (Zn)	2014/08/26	NC	75 - 125	98	75 - 125	<1.0	mg/kg	1.4	30	85	70 - 130
7612691	Total Zirconium (Zr)	2014/08/26					<0.50	mg/kg	NC	30		
7612694	Soluble (2:1) pH	2014/08/25			100	97 - 103			0.70	N/A		
7612980	Total Aluminum (Al)	2014/08/27					<100	mg/kg			91	70 - 130
7612980	Total Antimony (Sb)	2014/08/27	87	75 - 125	104	75 - 125	<0.10	mg/kg			100	70 - 130

QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7612980	Total Arsenic (As)	2014/08/27	96	75 - 125	97	75 - 125	<0.50	mg/kg	0.81	30	93	70 - 130
7612980	Total Barium (Ba)	2014/08/27	NC	75 - 125	107	75 - 125	<0.10	mg/kg	1.2	35	102	70 - 130
7612980	Total Beryllium (Be)	2014/08/27	110	75 - 125	108	75 - 125	<0.40	mg/kg				
7612980	Total Bismuth (Bi)	2014/08/27					<0.10	mg/kg				
7612980	Total Cadmium (Cd)	2014/08/27	100	75 - 125	100	75 - 125	<0.050	mg/kg			97	70 - 130
7612980	Total Calcium (Ca)	2014/08/27					<100	mg/kg			89	70 - 130
7612980	Total Chromium (Cr)	2014/08/27	101	75 - 125	100	75 - 125	<1.0	mg/kg	3.9	30	100	70 - 130
7612980	Total Cobalt (Co)	2014/08/27	100	75 - 125	103	75 - 125	<0.30	mg/kg			88	70 - 130
7612980	Total Copper (Cu)	2014/08/27	NC	75 - 125	100	75 - 125	<0.50	mg/kg	3.7	30	89	70 - 130
7612980	Total Iron (Fe)	2014/08/27					<100	mg/kg			95	70 - 130
7612980	Total Lead (Pb)	2014/08/27	98	75 - 125	104	75 - 125	<0.10	mg/kg	5.5	35	92	70 - 130
7612980	Total Magnesium (Mg)	2014/08/27					<100	mg/kg			92	70 - 130
7612980	Total Manganese (Mn)	2014/08/27	NC	75 - 125	104	75 - 125	<0.20	mg/kg			95	70 - 130
7612980	Total Mercury (Hg)	2014/08/27	87	75 - 125	100	75 - 125	<0.050	mg/kg			83	70 - 130
7612980	Total Molybdenum (Mo)	2014/08/27	93	75 - 125	105	75 - 125	<0.10	mg/kg			110	70 - 130
7612980	Total Nickel (Ni)	2014/08/27	98	75 - 125	100	75 - 125	<0.80	mg/kg			92	70 - 130
7612980	Total Phosphorus (P)	2014/08/27					<10	mg/kg			85	70 - 130
7612980	Total Potassium (K)	2014/08/27					<100	mg/kg				
7612980	Total Selenium (Se)	2014/08/27	101	75 - 125	102	75 - 125	<0.50	mg/kg				
7612980	Total Silver (Ag)	2014/08/27	82	75 - 125	82	75 - 125	<0.050	mg/kg				
7612980	Total Sodium (Na)	2014/08/27					<100	mg/kg				
7612980	Total Strontium (Sr)	2014/08/27	NC	75 - 125	99	75 - 125	<0.10	mg/kg			96	70 - 130
7612980	Total Thallium (Tl)	2014/08/27	101	75 - 125	105	75 - 125	<0.050	mg/kg			95	70 - 130
7612980	Total Tin (Sn)	2014/08/27	85	75 - 125	101	75 - 125	<0.10	mg/kg				
7612980	Total Titanium (Ti)	2014/08/27	NC	75 - 125	98	75 - 125	<1.0	mg/kg			105	70 - 130
7612980	Total Vanadium (V)	2014/08/27	NC	75 - 125	100	75 - 125	<2.0	mg/kg			98	70 - 130
7612980	Total Zinc (Zn)	2014/08/27	NC	75 - 125	106	75 - 125	<1.0	mg/kg	2.4	30	91	70 - 130
7612980	Total Zirconium (Zr)	2014/08/27					<0.50	mg/kg				
7612989	Soluble (2:1) pH	2014/08/26			101	97 - 103			0.32	N/A		
7665088	Total Aluminum (Al)	2014/10/09					1.7, RDL=1.0	mg/kg	6.8	35	36	20 - 93
7665088	Total Antimony (Sb)	2014/10/09	99	75 - 125	103	75 - 125	<0.0050	mg/kg	NC	35	83	75 - 125
7665088	Total Arsenic (As)	2014/10/09	104	75 - 125	103	75 - 125	<0.050	mg/kg	NC	35	91	75 - 125

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			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7665088	Total Barium (Ba)	2014/10/09	NC	75 - 125	99	75 - 125	<0.10	mg/kg	7.2	35	87	75 - 125
7665088	Total Beryllium (Be)	2014/10/09	99	75 - 125	99	75 - 125	<0.10	mg/kg	NC	35		
7665088	Total Bismuth (Bi)	2014/10/09					<0.10	mg/kg	NC	35		
7665088	Total Boron (B)	2014/10/09					<2.0	mg/kg	NC	35	92	75 - 125
7665088	Total Cadmium (Cd)	2014/10/09	98	75 - 125	101	75 - 125	<0.010	mg/kg	NC	35	93	75 - 125
7665088	Total Calcium (Ca)	2014/10/09					<10	mg/kg	8.2	35		
7665088	Total Chromium (Cr)	2014/10/09	101	75 - 125	102	75 - 125	<0.20	mg/kg	NC	35	45	28 - 97
7665088	Total Cobalt (Co)	2014/10/09	102	75 - 125	104	75 - 125	<0.020	mg/kg	8.1	35	89	75 - 125
7665088	Total Copper (Cu)	2014/10/09	108	75 - 125	106	75 - 125	<0.050	mg/kg	14	35	92	75 - 125
7665088	Total Iron (Fe)	2014/10/09					<10	mg/kg	8.5	35	85	75 - 125
7665088	Total Lead (Pb)	2014/10/09	100	75 - 125	102	75 - 125	<0.010	mg/kg	7.0	35		
7665088	Total Magnesium (Mg)	2014/10/09					<10	mg/kg	17	35	88	75 - 125
7665088	Total Manganese (Mn)	2014/10/09	NC	75 - 125	104	75 - 125	<0.10	mg/kg	11	35	94	75 - 125
7665088	Total Mercury (Hg)	2014/10/09	101	75 - 125	109	75 - 125	<0.010	mg/kg	NC	35	100	75 - 125
7665088	Total Molybdenum (Mo)	2014/10/09	97	75 - 125	102	75 - 125	<0.050	mg/kg	NC	35	85	75 - 125
7665088	Total Nickel (Ni)	2014/10/09	103	75 - 125	104	75 - 125	0.052, RDL=0.050	mg/kg	5.4	35	75	58 - 126
7665088	Total Phosphorus (P)	2014/10/09					<10	mg/kg	9.5	35		
7665088	Total Potassium (K)	2014/10/09					<10	mg/kg	8.0	35		
7665088	Total Selenium (Se)	2014/10/09	100	75 - 125	99	75 - 125	<0.050	mg/kg	NC	35	119	75 - 125
7665088	Total Silver (Ag)	2014/10/09	83	75 - 125	79	75 - 125	<0.020	mg/kg	NC	35		
7665088	Total Sodium (Na)	2014/10/09					<10	mg/kg	NC	35	80	75 - 125
7665088	Total Strontium (Sr)	2014/10/09	101	75 - 125	100	75 - 125	<0.10	mg/kg	7.3	35	100	75 - 125
7665088	Total Thallium (Tl)	2014/10/09	84	75 - 125	96	75 - 125	<0.0020	mg/kg	NC	35		
7665088	Total Tin (Sn)	2014/10/09					<0.10	mg/kg	NC	35		
7665088	Total Titanium (Ti)	2014/10/09					<1.0	mg/kg	18	35		
7665088	Total Uranium (U)	2014/10/09	96	75 - 125	99	75 - 125	<0.0020	mg/kg	NC	35		
7665088	Total Vanadium (V)	2014/10/09	102	75 - 125	103	75 - 125	<0.20	mg/kg	NC	35		
7665088	Total Zinc (Zn)	2014/10/09	NC	75 - 125	104	75 - 125	<0.20	mg/kg	12	35	90	75 - 125
7671661	Total Aluminum (Al)	2014/10/11					<1.0	mg/kg	6.6	35	35	20 - 93
7671661	Total Antimony (Sb)	2014/10/11	100	75 - 125	107	75 - 125	<0.0050	mg/kg	NC	35	84	75 - 125
7671661	Total Arsenic (As)	2014/10/11	95	75 - 125	103	75 - 125	<0.050	mg/kg	NC	35	83	75 - 125

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7671661	Total Barium (Ba)	2014/10/11	NC	75 - 125	104	75 - 125	<0.10	mg/kg	11	35	88	75 - 125
7671661	Total Beryllium (Be)	2014/10/11	98	75 - 125	101	75 - 125	<0.10	mg/kg	NC	35		
7671661	Total Bismuth (Bi)	2014/10/11					<0.10	mg/kg	NC	35		
7671661	Total Boron (B)	2014/10/11					<2.0	mg/kg	NC	35	89	75 - 125
7671661	Total Cadmium (Cd)	2014/10/11	101	75 - 125	103	75 - 125	<0.010	mg/kg	12	35	91	75 - 125
7671661	Total Calcium (Ca)	2014/10/11					<10	mg/kg	16	35		
7671661	Total Chromium (Cr)	2014/10/11	98	75 - 125	103	75 - 125	<0.20	mg/kg	NC	35	47	28 - 97
7671661	Total Cobalt (Co)	2014/10/11	96	75 - 125	106	75 - 125	<0.020	mg/kg	6.1	35	84	75 - 125
7671661	Total Copper (Cu)	2014/10/11	101	75 - 125	106	75 - 125	<0.050	mg/kg	14	35	87	75 - 125
7671661	Total Iron (Fe)	2014/10/11					<10	mg/kg	17	35	84	75 - 125
7671661	Total Lead (Pb)	2014/10/11	99	75 - 125	103	75 - 125	<0.010	mg/kg	NC	35		
7671661	Total Magnesium (Mg)	2014/10/11					<10	mg/kg	13	35	82	75 - 125
7671661	Total Manganese (Mn)	2014/10/11	NC	75 - 125	107	75 - 125	<0.10	mg/kg	14	35	90	75 - 125
7671661	Total Mercury (Hg)	2014/10/11	99	75 - 125	109	75 - 125	<0.010	mg/kg	NC	35	89	75 - 125
7671661	Total Molybdenum (Mo)	2014/10/11	110	75 - 125	107	75 - 125	<0.050	mg/kg	16	35	82	75 - 125
7671661	Total Nickel (Ni)	2014/10/11	106	75 - 125	106	75 - 125	<0.050	mg/kg	10	35	73	58 - 126
7671661	Total Phosphorus (P)	2014/10/11					<10	mg/kg	14	35		
7671661	Total Potassium (K)	2014/10/11					<10	mg/kg	14	35		
7671661	Total Selenium (Se)	2014/10/11	92	75 - 125	97	75 - 125	<0.050	mg/kg	NC	35	104	75 - 125
7671661	Total Silver (Ag)	2014/10/11	77	75 - 125	78	75 - 125	<0.020	mg/kg	NC	35		
7671661	Total Sodium (Na)	2014/10/11					<10	mg/kg	NC	35	89	75 - 125
7671661	Total Strontium (Sr)	2014/10/11	NC	75 - 125	104	75 - 125	<0.10	mg/kg	13	35	96	75 - 125
7671661	Total Thallium (Tl)	2014/10/11	95	75 - 125	87	75 - 125	<0.0020	mg/kg	NC	35		
7671661	Total Tin (Sn)	2014/10/11					<0.10	mg/kg	NC	35		
7671661	Total Titanium (Ti)	2014/10/11					<1.0	mg/kg	NC	35		
7671661	Total Uranium (U)	2014/10/11	100	75 - 125	101	75 - 125	<0.0020	mg/kg	NC	35		
7671661	Total Vanadium (V)	2014/10/11	99	75 - 125	103	75 - 125	<0.20	mg/kg	NC	35		
7671661	Total Zinc (Zn)	2014/10/11	NC	75 - 125	103	75 - 125	<0.20	mg/kg	14	35	84	75 - 125
7680437	Total Aluminum (Al)	2014/10/18					<1.0	mg/kg	5.2	35	29	20 - 93
7680437	Total Antimony (Sb)	2014/10/18	97	75 - 125	99	75 - 125	<0.0050	mg/kg	NC	35	77	75 - 125
7680437	Total Arsenic (As)	2014/10/18	96	75 - 125	96	75 - 125	<0.050	mg/kg	NC	35	85	75 - 125
7680437	Total Barium (Ba)	2014/10/18	NC	75 - 125	92	75 - 125	<0.10	mg/kg	1.9	35	90	75 - 125

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			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7680437	Total Beryllium (Be)	2014/10/18	94	75 - 125	92	75 - 125	<0.10	mg/kg	NC	35		
7680437	Total Bismuth (Bi)	2014/10/18					<0.10	mg/kg	NC	35		
7680437	Total Boron (B)	2014/10/18					<2.0	mg/kg	1.1	35	80	75 - 125
7680437	Total Cadmium (Cd)	2014/10/18	91	75 - 125	92	75 - 125	<0.010	mg/kg	6.9	35	79	75 - 125
7680437	Total Calcium (Ca)	2014/10/18					<10	mg/kg	5.5	35		
7680437	Total Chromium (Cr)	2014/10/18	87	75 - 125	92	75 - 125	<0.20	mg/kg	NC	35	33	28 - 97
7680437	Total Cobalt (Co)	2014/10/18	88	75 - 125	93	75 - 125	<0.020	mg/kg	5.8	35	76	75 - 125
7680437	Total Copper (Cu)	2014/10/18	NC	75 - 125	96	75 - 125	<0.050	mg/kg	1.2	35	79	75 - 125
7680437	Total Iron (Fe)	2014/10/18					<10	mg/kg	6.4	35	83	75 - 125
7680437	Total Lead (Pb)	2014/10/18	91	75 - 125	94	75 - 125	<0.010	mg/kg	9.4	35		
7680437	Total Magnesium (Mg)	2014/10/18					<10	mg/kg	5.3	35	91	75 - 125
7680437	Total Manganese (Mn)	2014/10/18	NC	75 - 125	95	75 - 125	<0.10	mg/kg	6.8	35	82	75 - 125
7680437	Total Mercury (Hg)	2014/10/18	97	75 - 125	104	75 - 125	<0.010	mg/kg	NC	35	85	75 - 125
7680437	Total Molybdenum (Mo)	2014/10/18	100	75 - 125	98	75 - 125	<0.050	mg/kg	7.7	35	76	75 - 125
7680437	Total Nickel (Ni)	2014/10/18	87	75 - 125	96	75 - 125	<0.050	mg/kg	9.8	35	59	58 - 126
7680437	Total Phosphorus (P)	2014/10/18					<10	mg/kg	5.4	35		
7680437	Total Potassium (K)	2014/10/18					<10	mg/kg	6.5	35		
7680437	Total Selenium (Se)	2014/10/18	91	75 - 125	102	75 - 125	<0.050	mg/kg	NC	35	97	75 - 125
7680437	Total Silver (Ag)	2014/10/18	79	75 - 125	81	75 - 125	<0.020	mg/kg	NC	35		
7680437	Total Sodium (Na)	2014/10/18					<10	mg/kg	NC	35	98	75 - 125
7680437	Total Strontium (Sr)	2014/10/18	NC	75 - 125	91	75 - 125	<0.10	mg/kg	3.4	35	83	75 - 125
7680437	Total Thallium (Tl)	2014/10/18	92	75 - 125	84	75 - 125	<0.0020	mg/kg	NC	35		
7680437	Total Tin (Sn)	2014/10/18					<0.10	mg/kg	NC	35		
7680437	Total Titanium (Ti)	2014/10/18					<1.0	mg/kg	NC	35		
7680437	Total Uranium (U)	2014/10/18	93	75 - 125	92	75 - 125	<0.0020	mg/kg	NC	35		
7680437	Total Vanadium (V)	2014/10/18	92	75 - 125	92	75 - 125	<0.20	mg/kg	NC	35		
7680437	Total Zinc (Zn)	2014/10/18	NC	75 - 125	96	75 - 125	<0.20	mg/kg	4.8	35	78	75 - 125
7682773	Total Aluminum (Al)	2014/10/24					1.2, RDL=1.0	mg/kg	NC	35	37	20 - 93
7682773	Total Antimony (Sb)	2014/10/24	80	75 - 125	102	75 - 125	<0.0050	mg/kg	NC	35	86	75 - 125
7682773	Total Arsenic (As)	2014/10/24	98	75 - 125	100	75 - 125	<0.050	mg/kg	NC	35	101	75 - 125
7682773	Total Barium (Ba)	2014/10/24	NC	75 - 125	99	75 - 125	<0.10	mg/kg	28	35	88	75 - 125
7682773	Total Beryllium (Be)	2014/10/24	95	75 - 125	104	75 - 125	<0.10	mg/kg	NC	35		

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			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7682773	Total Bismuth (Bi)	2014/10/24					<0.10	mg/kg	NC	35		
7682773	Total Boron (B)	2014/10/24					<2.0	mg/kg	NC	35	92	75 - 125
7682773	Total Cadmium (Cd)	2014/10/24	100	75 - 125	101	75 - 125	<0.010	mg/kg	23	35	93	75 - 125
7682773	Total Calcium (Ca)	2014/10/24					<10	mg/kg	26	35		
7682773	Total Chromium (Cr)	2014/10/24	96	75 - 125	101	75 - 125	<0.20	mg/kg	NC	35	50	28 - 97
7682773	Total Cobalt (Co)	2014/10/24	95	75 - 125	105	75 - 125	<0.020	mg/kg	NC	35	89	75 - 125
7682773	Total Copper (Cu)	2014/10/24	119	75 - 125	104	75 - 125	<0.050	mg/kg	25	35	89	75 - 125
7682773	Total Iron (Fe)	2014/10/24					<10	mg/kg	NC	35	81	75 - 125
7682773	Total Lead (Pb)	2014/10/24	92	75 - 125	100	75 - 125	<0.010	mg/kg	NC	35		
7682773	Total Magnesium (Mg)	2014/10/24					<10	mg/kg	25	35	83	75 - 125
7682773	Total Manganese (Mn)	2014/10/24	NC	75 - 125	103	75 - 125	<0.10	mg/kg	32	35	93	75 - 125
7682773	Total Mercury (Hg)	2014/10/24	91	75 - 125	117	75 - 125	<0.010	mg/kg	NC	35	124	75 - 125
7682773	Total Molybdenum (Mo)	2014/10/24	101	75 - 125	99	75 - 125	<0.050	mg/kg	NC	35	92	75 - 125
7682773	Total Nickel (Ni)	2014/10/24	94	75 - 125	101	75 - 125	<0.050	mg/kg	NC	35	76	58 - 126
7682773	Total Phosphorus (P)	2014/10/24					<10	mg/kg	24	35		
7682773	Total Potassium (K)	2014/10/24					<10	mg/kg	27	35		
7682773	Total Selenium (Se)	2014/10/24	93	75 - 125	96	75 - 125	<0.050	mg/kg	NC	35	118	75 - 125
7682773	Total Silver (Ag)	2014/10/24	93	75 - 125	91	75 - 125	<0.020	mg/kg	NC	35		
7682773	Total Sodium (Na)	2014/10/24					<10	mg/kg	NC	35	77	75 - 125
7682773	Total Strontium (Sr)	2014/10/24	NC	75 - 125	103	75 - 125	<0.10	mg/kg	29	35	97	75 - 125
7682773	Total Thallium (Tl)	2014/10/24	89	75 - 125	87	75 - 125	<0.0020	mg/kg	NC	35		
7682773	Total Tin (Sn)	2014/10/24					<0.10	mg/kg	NC	35		
7682773	Total Titanium (Ti)	2014/10/24					<1.0	mg/kg	NC	35		
7682773	Total Uranium (U)	2014/10/24	90	75 - 125	97	75 - 125	<0.0020	mg/kg	NC	35		
7682773	Total Vanadium (V)	2014/10/24	94	75 - 125	104	75 - 125	<0.20	mg/kg	NC	35		
7682773	Total Zinc (Zn)	2014/10/24	NC	75 - 125	103	75 - 125	<0.20	mg/kg	23	35	88	75 - 125
7682966	Total Aluminum (Al)	2014/10/24					<1.0	mg/kg	7.8	35	36	20 - 93
7682966	Total Antimony (Sb)	2014/10/24	102	75 - 125	94	75 - 125	<0.0050	mg/kg	NC	35	88	75 - 125
7682966	Total Arsenic (As)	2014/10/24	97	75 - 125	95	75 - 125	<0.050	mg/kg	NC	35	106	75 - 125
7682966	Total Barium (Ba)	2014/10/24	NC	75 - 125	93	75 - 125	<0.10	mg/kg	4.4	35	90	75 - 125
7682966	Total Beryllium (Be)	2014/10/24	100	75 - 125	95	75 - 125	<0.10	mg/kg	NC	35		
7682966	Total Bismuth (Bi)	2014/10/24			0.00000	N/A	<0.10	mg/kg	NC	35		

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QUALITY ASSURANCE REPORT(CONT'D)

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7682966	Total Boron (B)	2014/10/24			0.00000	N/A	<2.0	mg/kg	NC	35	89	75 - 125
7682966	Total Cadmium (Cd)	2014/10/24	102	75 - 125	94	75 - 125	<0.010	mg/kg	NC	35	96	75 - 125
7682966	Total Calcium (Ca)	2014/10/24			0.00000	N/A	<10	mg/kg	4.0	35		
7682966	Total Chromium (Cr)	2014/10/24	102	75 - 125	101	75 - 125	<0.20	mg/kg	NC	35	62	28 - 97
7682966	Total Cobalt (Co)	2014/10/24	103	75 - 125	102	75 - 125	<0.020	mg/kg	NC	35	91	75 - 125
7682966	Total Copper (Cu)	2014/10/24	106	75 - 125	104	75 - 125	<0.050	mg/kg	16	35	95	75 - 125
7682966	Total Iron (Fe)	2014/10/24			0.00000	N/A	<10	mg/kg	7.9	35	83	75 - 125
7682966	Total Lead (Pb)	2014/10/24	101	75 - 125	95	75 - 125	<0.010	mg/kg	4.6	35		
7682966	Total Magnesium (Mg)	2014/10/24			0.00000	N/A	<10	mg/kg	2.0	35	87	75 - 125
7682966	Total Manganese (Mn)	2014/10/24	NC	75 - 125	103	75 - 125	<0.10	mg/kg	1.9	35	97	75 - 125
7682966	Total Mercury (Hg)	2014/10/24	97	75 - 125	92	75 - 125	<0.010	mg/kg	NC	35	98	75 - 125
7682966	Total Molybdenum (Mo)	2014/10/24	101	75 - 125	93	75 - 125	<0.050	mg/kg	NC	35	92	75 - 125
7682966	Total Nickel (Ni)	2014/10/24	103	75 - 125	103	75 - 125	<0.050	mg/kg	12	35	111	58 - 126
7682966	Total Phosphorus (P)	2014/10/24			0.00000	N/A	<10	mg/kg	4.3	35		
7682966	Total Potassium (K)	2014/10/24			0.00000	N/A	<10	mg/kg	0.32	35		
7682966	Total Selenium (Se)	2014/10/24	94	75 - 125	97	75 - 125	<0.050	mg/kg	NC	35	106	75 - 125
7682966	Total Silver (Ag)	2014/10/24	94	75 - 125	92	75 - 125	<0.020	mg/kg	NC	35		
7682966	Total Sodium (Na)	2014/10/24			0.00000	N/A	<10	mg/kg	NC	35	86	75 - 125
7682966	Total Strontium (Sr)	2014/10/24	NC	75 - 125	96	75 - 125	<0.10	mg/kg	1.7	35	100	75 - 125
7682966	Total Thallium (Tl)	2014/10/24	96	75 - 125	85	75 - 125	<0.0020	mg/kg	NC	35		
7682966	Total Tin (Sn)	2014/10/24			0.00000	N/A	<0.10	mg/kg	NC	35		
7682966	Total Titanium (Ti)	2014/10/24			0.00000	N/A	<1.0	mg/kg	NC	35		
7682966	Total Uranium (U)	2014/10/24	98	75 - 125	92	75 - 125	<0.0020	mg/kg	NC	35		
7682966	Total Vanadium (V)	2014/10/24	104	75 - 125	105	75 - 125	<0.20	mg/kg	NC	35		
7682966	Total Zinc (Zn)	2014/10/24	NC	75 - 125	99	75 - 125	<0.20	mg/kg	2.5	35	90	75 - 125
7682971	Total Aluminum (Al)	2014/10/29					<1.0	mg/kg	5.7	35	38	20 - 93
7682971	Total Antimony (Sb)	2014/10/29	97	75 - 125	102	75 - 125	<0.0050	mg/kg	NC	35	89	75 - 125
7682971	Total Arsenic (As)	2014/10/29	104	75 - 125	100	75 - 125	<0.050	mg/kg	NC	35	101	75 - 125
7682971	Total Barium (Ba)	2014/10/29	NC	75 - 125	100	75 - 125	<0.10	mg/kg	1.3	35	88	75 - 125
7682971	Total Beryllium (Be)	2014/10/29	105	75 - 125	99	75 - 125	<0.10	mg/kg	NC	35		
7682971	Total Bismuth (Bi)	2014/10/29					<0.10	mg/kg	NC	35		
7682971	Total Boron (B)	2014/10/29					<2.0	mg/kg	NC	35	88	75 - 125

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			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7682971	Total Cadmium (Cd)	2014/10/29	104	75 - 125	103	75 - 125	<0.010	mg/kg	2.0	35	96	75 - 125
7682971	Total Calcium (Ca)	2014/10/29					<10	mg/kg	2.5	35		
7682971	Total Chromium (Cr)	2014/10/29	106	75 - 125	102	75 - 125	<0.20	mg/kg	NC	35	56	28 - 97
7682971	Total Cobalt (Co)	2014/10/29	108	75 - 125	103	75 - 125	<0.020	mg/kg	2.0	35	94	75 - 125
7682971	Total Copper (Cu)	2014/10/29	NC	75 - 125	107	75 - 125	<0.050	mg/kg	10	35	98	75 - 125
7682971	Total Iron (Fe)	2014/10/29					<10	mg/kg	0.32	35	86	75 - 125
7682971	Total Lead (Pb)	2014/10/29	102	75 - 125	100	75 - 125	<0.010	mg/kg	NC	35		
7682971	Total Magnesium (Mg)	2014/10/29					<10	mg/kg	3.0	35	94	75 - 125
7682971	Total Manganese (Mn)	2014/10/29	NC	75 - 125	106	75 - 125	<0.10	mg/kg	2.0	35	102	75 - 125
7682971	Total Mercury (Hg)	2014/10/29	87	75 - 125	102	75 - 125	<0.010	mg/kg	NC	35	107	75 - 125
7682971	Total Molybdenum (Mo)	2014/10/29	101	75 - 125	99	75 - 125	<0.050	mg/kg	NC	35	90	75 - 125
7682971	Total Nickel (Ni)	2014/10/29	NC	75 - 125	103	75 - 125	<0.050	mg/kg	3.7	35	83	58 - 126
7682971	Total Phosphorus (P)	2014/10/29					<10	mg/kg	0.94	35		
7682971	Total Potassium (K)	2014/10/29					<10	mg/kg	2.2	35		
7682971	Total Selenium (Se)	2014/10/29	99	75 - 125	101	75 - 125	<0.050	mg/kg	NC	35	119	75 - 125
7682971	Total Silver (Ag)	2014/10/29	92	75 - 125	95	75 - 125	<0.020	mg/kg	NC	35		
7682971	Total Sodium (Na)	2014/10/29					<10	mg/kg	NC	35	88	75 - 125
7682971	Total Strontium (Sr)	2014/10/29	NC	75 - 125	102	75 - 125	<0.10	mg/kg	0.56	35	100	75 - 125
7682971	Total Thallium (Tl)	2014/10/29	97	75 - 125	91	75 - 125	<0.0020	mg/kg	NC	35		
7682971	Total Tin (Sn)	2014/10/29					<0.10	mg/kg	NC	35		
7682971	Total Titanium (Ti)	2014/10/29					<1.0	mg/kg	NC	35		
7682971	Total Uranium (U)	2014/10/29	102	75 - 125	96	75 - 125	<0.0020	mg/kg	NC	35		
7682971	Total Vanadium (V)	2014/10/29	108	75 - 125	104	75 - 125	<0.20	mg/kg	NC	35		
7682971	Total Zinc (Zn)	2014/10/29	NC	75 - 125	104	75 - 125	<0.20	mg/kg	5.6	35	97	75 - 125
7682974	Total Aluminum (Al)	2014/10/29					<1.0	mg/kg	9.0	35	39	20 - 93
7682974	Total Antimony (Sb)	2014/10/29	97	75 - 125	104	75 - 125	<0.0050	mg/kg	NC	35	94	75 - 125
7682974	Total Arsenic (As)	2014/10/29	101	75 - 125	103	75 - 125	<0.050	mg/kg	NC	35	101	75 - 125
7682974	Total Barium (Ba)	2014/10/29	NC	75 - 125	101	75 - 125	<0.10	mg/kg	10	35	87	75 - 125
7682974	Total Beryllium (Be)	2014/10/29	101	75 - 125	98	75 - 125	<0.10	mg/kg	NC	35		
7682974	Total Bismuth (Bi)	2014/10/29					<0.10	mg/kg	NC	35		
7682974	Total Boron (B)	2014/10/29					<2.0	mg/kg	NC	35	87	75 - 125
7682974	Total Cadmium (Cd)	2014/10/29	98	75 - 125	100	75 - 125	<0.010	mg/kg	NC	35	93	75 - 125

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			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7682974	Total Calcium (Ca)	2014/10/29					<10	mg/kg	2.4	35		
7682974	Total Chromium (Cr)	2014/10/29	104	75 - 125	110	75 - 125	<0.20	mg/kg	NC	35	66	28 - 97
7682974	Total Cobalt (Co)	2014/10/29	103	75 - 125	113	75 - 125	<0.020	mg/kg	NC	35	94	75 - 125
7682974	Total Copper (Cu)	2014/10/29	100	75 - 125	111	75 - 125	<0.050	mg/kg	8.6	35	92	75 - 125
7682974	Total Iron (Fe)	2014/10/29					<10	mg/kg	3.3	35	88	75 - 125
7682974	Total Lead (Pb)	2014/10/29	98	75 - 125	100	75 - 125	<0.010	mg/kg	10	35		
7682974	Total Magnesium (Mg)	2014/10/29					<10	mg/kg	4.4	35	93	75 - 125
7682974	Total Manganese (Mn)	2014/10/29	NC	75 - 125	108	75 - 125	<0.10	mg/kg	7.5	35	95	75 - 125
7682974	Total Mercury (Hg)	2014/10/29	101	75 - 125	108	75 - 125	<0.010	mg/kg	NC	35	95	75 - 125
7682974	Total Molybdenum (Mo)	2014/10/29	92	75 - 125	100	75 - 125	<0.050	mg/kg	NC	35	85	75 - 125
7682974	Total Nickel (Ni)	2014/10/29	104	75 - 125	108	75 - 125	<0.050	mg/kg	11	35	88	58 - 126
7682974	Total Phosphorus (P)	2014/10/29					<10	mg/kg	4.4	35		
7682974	Total Potassium (K)	2014/10/29					<10	mg/kg	2.8	35		
7682974	Total Selenium (Se)	2014/10/29	103	75 - 125	97	75 - 125	<0.050	mg/kg	NC	35	123	75 - 125
7682974	Total Silver (Ag)	2014/10/29	93	75 - 125	94	75 - 125	<0.020	mg/kg	NC	35		
7682974	Total Sodium (Na)	2014/10/29					<10	mg/kg	NC	35	90	75 - 125
7682974	Total Strontium (Sr)	2014/10/29	98	75 - 125	96	75 - 125	<0.10	mg/kg	9.4	35	101	75 - 125
7682974	Total Thallium (Tl)	2014/10/29	96	75 - 125	97	75 - 125	<0.0020	mg/kg	NC	35		
7682974	Total Tin (Sn)	2014/10/29					<0.10	mg/kg	NC	35		
7682974	Total Titanium (Ti)	2014/10/29					<1.0	mg/kg	12	35		
7682974	Total Uranium (U)	2014/10/29	95	75 - 125	99	75 - 125	<0.0020	mg/kg	NC	35		
7682974	Total Vanadium (V)	2014/10/29	100	75 - 125	113	75 - 125	<0.20	mg/kg	NC	35		
7682974	Total Zinc (Zn)	2014/10/29	NC	75 - 125	114	75 - 125	<0.20	mg/kg	5.4	35	94	75 - 125
7696757	Total Aluminum (Al)	2014/10/31					<1.0	mg/kg	0.058	35	36	20 - 93
7696757	Total Antimony (Sb)	2014/10/31	81	75 - 125	95	75 - 125	<0.0050	mg/kg	NC	35	89	75 - 125
7696757	Total Arsenic (As)	2014/10/31	104	75 - 125	103	75 - 125	<0.050	mg/kg	NC	35	100	75 - 125
7696757	Total Barium (Ba)	2014/10/31	NC	75 - 125	98	75 - 125	<0.10	mg/kg	1.2	35	88	75 - 125
7696757	Total Beryllium (Be)	2014/10/31	96	75 - 125	94	75 - 125	<0.10	mg/kg	NC	35		
7696757	Total Bismuth (Bi)	2014/10/31					<0.10	mg/kg	NC	35		
7696757	Total Boron (B)	2014/10/31					<2.0	mg/kg	1.6	35	95	75 - 125
7696757	Total Cadmium (Cd)	2014/10/31	98	75 - 125	100	75 - 125	<0.010	mg/kg	0.90	35	92	75 - 125
7696757	Total Calcium (Ca)	2014/10/31					<10	mg/kg	2.4	35		

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			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7696757	Total Chromium (Cr)	2014/10/31	100	75 - 125	105	75 - 125	<0.20	mg/kg	NC	35	51	28 - 97
7696757	Total Cobalt (Co)	2014/10/31	96	75 - 125	104	75 - 125	<0.020	mg/kg	2.3	35	90	75 - 125
7696757	Total Copper (Cu)	2014/10/31	NC	75 - 125	104	75 - 125	<0.050	mg/kg	1.3	35	87	75 - 125
7696757	Total Iron (Fe)	2014/10/31					<10	mg/kg	NC	35	86	75 - 125
7696757	Total Lead (Pb)	2014/10/31	94	75 - 125	101	75 - 125	<0.010	mg/kg	NC	35		
7696757	Total Magnesium (Mg)	2014/10/31					<10	mg/kg	0.72	35	89	75 - 125
7696757	Total Manganese (Mn)	2014/10/31	NC	75 - 125	104	75 - 125	<0.10	mg/kg	1.6	35	95	75 - 125
7696757	Total Mercury (Hg)	2014/10/31	102	75 - 125	95	75 - 125	<0.010	mg/kg	NC	35	95	75 - 125
7696757	Total Molybdenum (Mo)	2014/10/31	103	75 - 125	89	75 - 125	<0.050	mg/kg	0.39	35	88	75 - 125
7696757	Total Nickel (Ni)	2014/10/31	NC	75 - 125	104	75 - 125	<0.050	mg/kg	3.0	35	76	58 - 126
7696757	Total Phosphorus (P)	2014/10/31					<10	mg/kg	0.92	35		
7696757	Total Potassium (K)	2014/10/31					<10	mg/kg	3.3	35		
7696757	Total Selenium (Se)	2014/10/31	98	75 - 125	97	75 - 125	<0.050	mg/kg	NC	35	108	75 - 125
7696757	Total Silver (Ag)	2014/10/31	88	75 - 125	92	75 - 125	<0.020	mg/kg	NC	35		
7696757	Total Sodium (Na)	2014/10/31					<10	mg/kg	NC	35	81	75 - 125
7696757	Total Strontium (Sr)	2014/10/31	NC	75 - 125	101	75 - 125	<0.10	mg/kg	1.4	35	100	75 - 125
7696757	Total Thallium (Tl)	2014/10/31	95	75 - 125	96	75 - 125	<0.0020	mg/kg	NC	35		
7696757	Total Tin (Sn)	2014/10/31					<0.10	mg/kg	NC	35		
7696757	Total Titanium (Ti)	2014/10/31					<1.0	mg/kg	NC	35		
7696757	Total Uranium (U)	2014/10/31	95	75 - 125	97	75 - 125	<0.0020	mg/kg	NC	35		
7696757	Total Vanadium (V)	2014/10/31	98	75 - 125	102	75 - 125	<0.20	mg/kg	NC	35		
7696757	Total Zinc (Zn)	2014/10/31	NC	75 - 125	102	75 - 125	<0.20	mg/kg	1.2	35	90	75 - 125

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

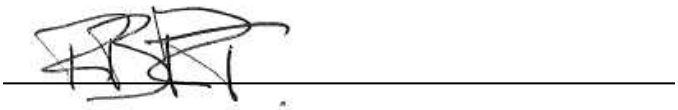
NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

Maxxam Job #: B473400
Report Date: 2014/10/31

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG. & SOIL
Site Location: KAMINAK-COFFEE CREEK

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Rob Reinert, Data Validation Coordinator

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Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your Project #: 14-Y-0306 KAMINAK VEG AND SOIL
Site Location: KAMINAK-COFFEE CREEK
Your C.O.C. #: 08412523, 08412524

Attention:Anne MacLeod

EDI ENVIRONMENTAL DYNAMICS INC.
2195 2nd Avenue
WHITEHORSE, YT
CANADA Y1A 3T8

Report Date: 2015/08/10
Report #: R2019466
Version: 1 - Partial

CERTIFICATE OF ANALYSIS – PARTIAL RESULTS

MAXXAM JOB #: B566854
Received: 2015/08/05, 10:25

Sample Matrix: Soil
Samples Received: 4

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by ICPMS (total)	4	2015/08/08	2015/08/10	BBY7SOP-00001	EPA 6020a R1 m
pH (2:1 DI Water Extract)	4	2015/08/08	2015/08/10	BBY6SOP-00028	BCMOE BCLM Mar2005 m

Reference Method suffix "m" indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Graham Rudkin, Project Manager, Environmental
Email: GRudkin@maxxam.ca
Phone# (604)638-5926 Ext:5926
==========
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Maxxam Job #: B566854
Report Date: 2015/08/10

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG AND SOIL
Site Location: KAMINAK-COFFEE CREEK
Sampler Initials: SE

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		MV1428	MV1441	MV1442	MV1443		
Sampling Date		2015/07/25	2015/07/25	2015/07/25	2015/07/25		
COC Number		08412523	08412524	08412524	08412524		
	Units	CCTM502-SOIL	CCTM500-SOIL	CCTM501-SOIL	CCTM503-SOIL	RDL	QC Batch
Physical Properties							
Soluble (2:1) pH	pH	5.85	8.29	5.92	4.79	N/A	7995170
Total Metals by ICPMS							
Total Aluminum (Al)	mg/kg	12300	10400	16800	15800	100	7995169
Total Antimony (Sb)	mg/kg	0.25	1.73	0.51	0.20	0.10	7995169
Total Arsenic (As)	mg/kg	4.77	17.7	8.33	4.74	0.50	7995169
Total Barium (Ba)	mg/kg	336	585	181	182	0.10	7995169
Total Beryllium (Be)	mg/kg	<0.40	0.55	0.40	<0.40	0.40	7995169
Total Bismuth (Bi)	mg/kg	<0.10	0.25	0.14	<0.10	0.10	7995169
Total Cadmium (Cd)	mg/kg	0.185	1.43	0.197	0.149	0.050	7995169
Total Calcium (Ca)	mg/kg	7740	16700	5670	2460	100	7995169
Total Chromium (Cr)	mg/kg	18.4	21.1	34.7	22.2	1.0	7995169
Total Cobalt (Co)	mg/kg	13.3	13.0	9.69	6.67	0.30	7995169
Total Copper (Cu)	mg/kg	22.3	37.5	18.5	15.8	0.50	7995169
Total Iron (Fe)	mg/kg	22800	29100	25100	25700	100	7995169
Total Lead (Pb)	mg/kg	5.07	15.9	7.79	8.18	0.10	7995169
Total Lithium (Li)	mg/kg	8.2	19.8	12.5	8.0	5.0	7995169
Total Magnesium (Mg)	mg/kg	6640	6470	6510	4780	100	7995169
Total Manganese (Mn)	mg/kg	796	953	254	183	0.20	7995169
Total Mercury (Hg)	mg/kg	<0.050	0.095	<0.050	0.051	0.050	7995169
Total Molybdenum (Mo)	mg/kg	0.84	3.34	0.67	0.56	0.10	7995169
Total Nickel (Ni)	mg/kg	10.4	40.5	20.4	11.2	0.80	7995169
Total Phosphorus (P)	mg/kg	695	889	613	477	10	7995169
Total Potassium (K)	mg/kg	1400	939	619	1030	100	7995169
Total Selenium (Se)	mg/kg	<0.50	1.28	<0.50	<0.50	0.50	7995169
Total Silver (Ag)	mg/kg	0.127	0.282	0.066	0.149	0.050	7995169
Total Sodium (Na)	mg/kg	162	101	240	138	100	7995169
Total Strontium (Sr)	mg/kg	34.3	66.0	36.8	18.6	0.10	7995169
Total Thallium (Tl)	mg/kg	0.120	0.117	0.123	0.102	0.050	7995169
Total Tin (Sn)	mg/kg	0.27	0.31	0.52	0.42	0.10	7995169
Total Titanium (Ti)	mg/kg	859	120	1000	840	1.0	7995169
Total Uranium (U)	mg/kg	0.774	1.18	1.36	0.614	0.050	7995169
Total Vanadium (V)	mg/kg	58.7	40.1	62.7	50.6	2.0	7995169
Total Zinc (Zn)	mg/kg	54.0	167	51.6	61.8	1.0	7995169
Total Zirconium (Zr)	mg/kg	1.21	2.60	4.28	1.14	0.50	7995169

RDL = Reportable Detection Limit
N/A = Not Applicable

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Maxxam Analytics International Corporation

Maxxam Job #: B566854
Report Date: 2015/08/10

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG AND SOIL
Site Location: KAMINAK-COFFEE CREEK
Sampler Initials: SE

GENERAL COMMENTS

Submission Integrity Note:
No sampling times indicated on the Chain of Custody.

Results relate only to the items tested.

Maxxam Analytics Partnership Limited

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B566854
Report Date: 2015/08/10

QUALITY ASSURANCE REPORT

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG AND SOIL
Site Location: KAMINAK-COFFEE CREEK
Sampler Initials: SE

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7995169	Total Aluminum (Al)	2015/08/10					<100	mg/kg			102	70 - 130
7995169	Total Antimony (Sb)	2015/08/10	100	75 - 125	101	75 - 125	<0.10	mg/kg			103	70 - 130
7995169	Total Arsenic (As)	2015/08/10	96	75 - 125	98	75 - 125	<0.50	mg/kg			98	70 - 130
7995169	Total Barium (Ba)	2015/08/10	98	75 - 125	105	75 - 125	0.19, RDL=0.10	mg/kg			103	70 - 130
7995169	Total Beryllium (Be)	2015/08/10	91	75 - 125	99	75 - 125	<0.40	mg/kg				
7995169	Total Bismuth (Bi)	2015/08/10					<0.10	mg/kg				
7995169	Total Cadmium (Cd)	2015/08/10	95	75 - 125	102	75 - 125	<0.050	mg/kg			102	70 - 130
7995169	Total Calcium (Ca)	2015/08/10					<100	mg/kg			100	70 - 130
7995169	Total Chromium (Cr)	2015/08/10	97	75 - 125	107	75 - 125	<1.0	mg/kg			109	70 - 130
7995169	Total Cobalt (Co)	2015/08/10	96	75 - 125	108	75 - 125	<0.30	mg/kg			95	70 - 130
7995169	Total Copper (Cu)	2015/08/10	96	75 - 125	107	75 - 125	<0.50	mg/kg			94	70 - 130
7995169	Total Iron (Fe)	2015/08/10					<100	mg/kg			99	70 - 130
7995169	Total Lead (Pb)	2015/08/10	93	75 - 125	103	75 - 125	<0.10	mg/kg	34	35	93	70 - 130
7995169	Total Lithium (Li)	2015/08/10	94	75 - 125	101	75 - 125	<5.0	mg/kg				
7995169	Total Magnesium (Mg)	2015/08/10					<100	mg/kg			94	70 - 130
7995169	Total Manganese (Mn)	2015/08/10	NC	75 - 125	106	75 - 125	<0.20	mg/kg			98	70 - 130
7995169	Total Mercury (Hg)	2015/08/10	91	75 - 125	98	75 - 125	<0.050	mg/kg			103	70 - 130
7995169	Total Molybdenum (Mo)	2015/08/10	111	75 - 125	104	75 - 125	<0.10	mg/kg			110	70 - 130
7995169	Total Nickel (Ni)	2015/08/10	96	75 - 125	103	75 - 125	<0.80	mg/kg			96	70 - 130
7995169	Total Phosphorus (P)	2015/08/10					<10	mg/kg			88	70 - 130
7995169	Total Potassium (K)	2015/08/10					<100	mg/kg				
7995169	Total Selenium (Se)	2015/08/10	97	75 - 125	98	75 - 125	<0.50	mg/kg				
7995169	Total Silver (Ag)	2015/08/10	98	75 - 125	104	75 - 125	<0.050	mg/kg			95	60 - 140
7995169	Total Sodium (Na)	2015/08/10					<100	mg/kg				
7995169	Total Strontium (Sr)	2015/08/10	NC	75 - 125	99	75 - 125	<0.10	mg/kg			100	70 - 130
7995169	Total Thallium (Tl)	2015/08/10	96	75 - 125	104	75 - 125	<0.050	mg/kg			91	70 - 130
7995169	Total Tin (Sn)	2015/08/10	96	75 - 125	99	75 - 125	<0.10	mg/kg				
7995169	Total Titanium (Ti)	2015/08/10	NC	75 - 125	99	75 - 125	<1.0	mg/kg			109	70 - 130
7995169	Total Uranium (U)	2015/08/10	99	75 - 125	101	75 - 125	<0.050	mg/kg			104	70 - 130
7995169	Total Vanadium (V)	2015/08/10	99	75 - 125	101	75 - 125	<2.0	mg/kg			105	70 - 130

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Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby

Maxxam Job #: B566854
Report Date: 2015/08/10

QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG AND SOIL
Site Location: KAMINAK-COFFEE CREEK
Sampler Initials: SE

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	Units	Value (%)	QC Limits	% Recovery	QC Limits
7995169	Total Zinc (Zn)	2015/08/10	91	75 - 125	99	75 - 125	<1.0	mg/kg			88	70 - 130
7995169	Total Zirconium (Zr)	2015/08/10					<0.50	mg/kg				
7995170	Soluble (2:1) pH	2015/08/10			99	97 - 103			0.24	N/A		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

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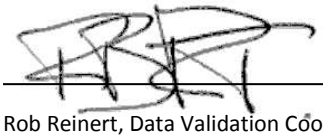
Maxxam Analytics International Corporation

Maxxam Job #: B566854
Report Date: 2015/08/10

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14-Y-0306 KAMINAK VEG AND SOIL
Site Location: KAMINAK-COFFEE CREEK
Sampler Initials: SE

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Rob Reinert, Data Validation Coordinator

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Your Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

Attention:Brodie Smith

EDI ENVIRONMENTAL DYNAMICS INC.
2195 2nd Avenue
WHITEHORSE, YT
CANADA Y1A 3T8

Your C.O.C. #: 08426712, 08426713, 08426714, 08426715, 08426716, 08426717, 08426718, 08426719, 08426720, 08426721, 08426722, 08426723, 08426724, 08426725, 08426726, 08426727, 08426728, 08426729, 08426730, 08426731

Report Date: 2016/09/29
Report #: R2271322
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B672722
Received: 2016/08/24, 09:15

Sample Matrix: Soil
Samples Received: 44

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements by ICPMS (total)	28	2016/08/30	2016/08/30	BBY7SOP-00017,	BC SALM,EPA 6020bR2m
Elements by ICPMS (total)	16	2016/08/30	2016/08/31	BBY7SOP-00017,	BC SALM,EPA 6020bR2m
Moisture	44	2016/08/27	2016/08/29	BBY8SOP-00017	BCMOE BCLM Dec2000 m
pH (2:1 DI Water Extract)	28	2016/08/30	2016/08/30	BBY6SOP-00028	BCMOE BCLM Mar2005 m
pH (2:1 DI Water Extract)	16	2016/08/30	2016/08/31	BBY6SOP-00028	BCMOE BCLM Mar2005 m

Sample Matrix: TISSUE
Samples Received: 132

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Elements in Tissue by CRC ICPMS - Dry Wt	10	2016/09/21	2016/09/23	BBY7SOP-00002	EPA 6020A R1 m
Elements in Tissue by CRC ICPMS - Dry Wt	20	2016/09/21	2016/09/25	BBY7SOP-00002	EPA 6020A R1 m
Elements in Tissue by CRC ICPMS - Dry Wt	40	2016/09/22	2016/09/25	BBY7SOP-00002	EPA 6020A R1 m
Elements in Tissue by CRC ICPMS - Dry Wt	18	2016/09/22	2016/09/27	BBY7SOP-00002	EPA 6020A R1 m
Elements in Tissue by CRC ICPMS - Dry Wt	24	2016/09/23	2016/09/27	BBY7SOP-00002	EPA 6020A R1 m
Elements in Tissue by CRC ICPMS - Dry Wt	20	2016/09/23	2016/09/28	BBY7SOP-00002	EPA 6020A R1 m
Moisture in Tissue	10	N/A	2016/09/23	BBY8SOP-00017	OMOE E3139 3.1 m
Moisture in Tissue	40	N/A	2016/09/24	BBY8SOP-00017	OMOE E3139 3.1 m
Moisture in Tissue	40	N/A	2016/09/27	BBY8SOP-00017	OMOE E3139 3.1 m
Moisture in Tissue	42	N/A	2016/09/28	BBY8SOP-00017	OMOE E3139 3.1 m

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

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Your Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

Attention:Brodie Smith

EDI ENVIRONMENTAL DYNAMICS INC.
2195 2nd Avenue
WHITEHORSE, YT
CANADA Y1A 3T8

Your C.O.C. #: 08426712, 08426713, 08426714, 08426715, 08426716, 08426717, 08426718, 08426719, 08426720, 08426721, 08426722, 08426723, 08426724, 08426725, 08426726, 08426727, 08426728, 08426729, 08426730, 08426731

Report Date: 2016/09/29
Report #: R2271322
Version: 2 - Final

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B672722
Received: 2016/08/24, 09:15

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Graham Rudkin, Project Manager, Environmental
Email: GRudkin@maxxam.ca
Phone# (604)638-5926 Ext:5926

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

PHYSICAL TESTING (SOIL)

Maxxam ID		PJ0116		PJ0117		PJ0118	PJ0119	PJ0120		
Sampling Date		2016/07/05		2016/07/05		2016/07/05	2016/07/05	2016/07/05		
COC Number		08426712		08426712		08426712	08426712	08426712		
	UNITS	CCTMAS-600	QC Batch	CCTMAS-601	QC Batch	CCTMBS-602	CCTMBS-603	CCTMCS-604	RDL	QC Batch
Physical Properties										
Moisture	%	12	8378807	25	8378803	44	67	70	0.30	8378807
RDL = Reportable Detection Limit										

Maxxam ID		PJ0121		PJ0123	PJ0124	PJ0125	PJ0148	PJ0149		
Sampling Date		2016/07/05		2016/07/06	2016/07/06	2016/07/06	2016/07/06	2016/08/18		
COC Number		08426712		08426712	08426712	08426712	08426713	08426713		
	UNITS	CCTMCS-605	QC Batch	CCTMCS-607	CCTMCS-608	CCTMCS-609	CCTMCS-610	CCTMCS-611	RDL	QC Batch
Physical Properties										
Moisture	%	25	8378807	43	53	88	37	37	0.30	8378803
RDL = Reportable Detection Limit										

Maxxam ID		PJ0150		PJ0151	PJ0152	PJ0153	PJ0154	PJ0155		
Sampling Date		2016/08/18		2016/08/18	2016/08/18	2016/08/18	2016/08/18	2016/08/18		
COC Number		08426713		08426713	08426713	08426713	08426713	08426713		
	UNITS	CCTMCS-612	QC Batch	CCTMCS-613	CCTMCS-613-R	CCTMRS-614	CCTMRS-615	CCTMRS-616	RDL	QC Batch
Physical Properties										
Moisture	%	17	8378803	38	26	72	53	17	0.30	8378807
RDL = Reportable Detection Limit										

Maxxam ID		PJ0156		PJ0157		PJ0186	PJ0187		
Sampling Date		2016/08/18		2016/08/19		2016/08/19	2016/08/19		
COC Number		08426713		08426713		08426714	08426714		
	UNITS	CCTMRS-617	QC Batch	CCTMRS-618	QC Batch	CCTMAS-619	CCTMBS-620	RDL	QC Batch
Physical Properties									
Moisture	%	44	8378807	22	8378819	64	52	0.30	8378803
RDL = Reportable Detection Limit									

Maxxam ID		PJ0188		PJ0189		PJ0190		PJ0191		
Sampling Date		2016/08/19		2016/08/19		2016/08/19		2016/08/19		
COC Number		08426714		08426714		08426714		08426714		
	UNITS	CCTMBS-621	QC Batch	CCTMAS-622	QC Batch	CCTMAS-622-R	QC Batch	CCTMAS-623	RDL	QC Batch
Physical Properties										
Moisture	%	54	8378807	34	8378803	29	8378819	40	0.30	8378803
RDL = Reportable Detection Limit										

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

PHYSICAL TESTING (SOIL)

Maxxam ID		PJ0192	PJ0193		PJ0194	PJ0195	PJ0216		
Sampling Date		2016/08/19	2016/08/19		2016/08/19	2016/08/19	2016/08/19		
COC Number		08426714	08426714		08426714	08426714	08426715		
	UNITS	CCTMBS-624	CCTMBS-625	QC Batch	CCTMBS-625-R	CCTMAS-626	CCTMAS-627	RDL	QC Batch
Physical Properties									
Moisture	%	74	33	8378807	37	61	73	0.30	8378803
RDL = Reportable Detection Limit									

Maxxam ID		PJ0217		PJ0218	PJ0219		PJ0220		
Sampling Date		2016/08/19		2016/08/19	2016/08/20		2016/08/20		
COC Number		08426715		08426715	08426715		08426715		
	UNITS	CCTMAS-628	QC Batch	CCTMBS-629	CCTMBS-630	QC Batch	CCTMAS-631	RDL	QC Batch
Physical Properties									
Moisture	%	29	8378807	31	35	8378803	47	0.30	8378819
RDL = Reportable Detection Limit									

Maxxam ID		PJ0221		PJ0222	PJ0223	PJ0224		PJ0225		
Sampling Date		2016/08/20		2016/08/20	2016/08/20	2016/08/21		2016/08/21		
COC Number		08426715		08426715	08426715	08426715		08426715		
	UNITS	CCTMAS-632	QC Batch	CCTMBS-633	CCTMBS-634	CCTMRS-635	QC Batch	CCTMRS-636	RDL	QC Batch
Physical Properties										
Moisture	%	40	8378807	23	33	56	8378803	68	0.30	8378807
RDL = Reportable Detection Limit										

Maxxam ID		PJ0238	PJ0239		PJ0240		PJ0241		
Sampling Date		2016/08/21	2016/08/21		2016/08/21		2016/08/21		
COC Number		08426716	08426716		08426716		08426716		
	UNITS	CCTMRS-637	CCTMRS-638	QC Batch	CCTMRS-639	QC Batch	CCTMRS-639-R	RDL	QC Batch
Physical Properties									
Moisture	%	22	55	8378807	21	8378819	47	0.30	8378807
RDL = Reportable Detection Limit									

Maxxam ID		PJ2887		
Sampling Date		2016/08/19		
COC Number		08426713		
	UNITS	CCTMCS-606	RDL	QC Batch
Physical Properties				
Moisture	%	22	0.30	8378803
RDL = Reportable Detection Limit				

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0261	PJ0262	PJ0263	PJ0264	PJ0265	PJ0266		
Sampling Date		2016/07/05	2016/07/05	2016/07/05	2016/07/05	2016/07/05	2016/07/05		
COC Number		08426717	08426717	08426717	08426717	08426717	08426717		
	UNITS	CCTMAL-600	CCTMAL-601	CCTMBL-602	CCTMBL-603	CCTMCL-604	CCTMCL-605	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	159	168	159	140	174	220	1.0	8405576
Total Antimony (Sb)	mg/kg	0.0686	0.0461	0.0858	0.0357	0.0201	0.0210	0.0050	8405576
Total Arsenic (As)	mg/kg	0.192	0.151	0.167	0.162	0.180	0.249	0.050	8405576
Total Barium (Ba)	mg/kg	3.88	8.30	8.44	7.45	8.19	12.3	0.10	8405576
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405576
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405576
Total Boron (B)	mg/kg	4.6	4.0	3.6	2.5	<2.0	2.2	2.0	8405576
Total Cadmium (Cd)	mg/kg	0.039	0.054	0.033	0.024	0.067	0.072	0.010	8405576
Total Calcium (Ca)	mg/kg	715	1080	911	935	785	1370	10	8405576
Total Chromium (Cr)	mg/kg	0.35	0.32	0.37	0.39	0.35	0.50	0.20	8405576
Total Cobalt (Co)	mg/kg	0.098	0.105	0.120	0.106	0.147	0.172	0.020	8405576
Total Copper (Cu)	mg/kg	1.52	1.52	3.06	1.50	1.25	1.56	0.050	8405576
Total Iron (Fe)	mg/kg	215	231	246	228	290	360	10	8405576
Total Lead (Pb)	mg/kg	0.193	0.196	0.450	0.148	0.223	0.242	0.010	8405576
Total Magnesium (Mg)	mg/kg	293	356	331	326	298	435	10	8405576
Total Manganese (Mn)	mg/kg	180	196	167	213	120	286	0.10	8405576
Total Mercury (Hg)	mg/kg	0.017	0.021	0.026	0.020	0.013	0.028	0.010	8405576
Total Molybdenum (Mo)	mg/kg	<0.050	<0.050	<0.050	<0.050	0.072	0.055	0.050	8405576
Total Nickel (Ni)	mg/kg	0.607	0.862	0.546	0.479	0.545	0.586	0.050	8405576
Total Phosphorus (P)	mg/kg	428	473	566	452	292	444	10	8405576
Total Potassium (K)	mg/kg	954	1010	1120	920	694	920	10	8405576
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8405576
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8405576
Total Sodium (Na)	mg/kg	18	15	13	17	<10	11	10	8405576
Total Strontium (Sr)	mg/kg	1.69	3.58	1.93	1.67	2.24	2.19	0.10	8405576
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	0.0032	0.0032	0.0026	0.0032	0.0020	8405576
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405576
Total Titanium (Ti)	mg/kg	7.1	7.4	8.7	7.2	8.8	11.4	1.0	8405576
Total Uranium (U)	mg/kg	0.0087	0.0459	0.0103	0.0098	0.0103	0.0148	0.0020	8405576
Total Vanadium (V)	mg/kg	0.32	0.39	0.43	0.36	0.44	0.66	0.20	8405576
Total Zinc (Zn)	mg/kg	12.7	14.2	17.0	15.9	9.57	15.6	0.20	8405576

RDL = Reportable Detection Limit

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0267	PJ0268	PJ0269	PJ0270		PJ0290	PJ0291		
Sampling Date		2016/07/06	2016/07/06	2016/07/06	2016/07/06		2016/07/06	2016/08/18		
COC Number		08426717	08426717	08426717	08426717		08426718	08426718		
	UNITS	CCTMCL-606	CCTMCL-607	CCTMCL-608	CCTMCL-609	QC Batch	CCTMCL-610	CCTMCL-611	RDL	QC Batch
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	130	92.6	162	108	8405576	159	120	1.0	8405594
Total Antimony (Sb)	mg/kg	0.0149	0.0146	0.0200	0.0163	8405576	0.0855	0.0311	0.0050	8405594
Total Arsenic (As)	mg/kg	0.104	0.077	0.148	0.099	8405576	0.148	0.112	0.050	8405594
Total Barium (Ba)	mg/kg	16.8	15.0	6.65	7.36	8405576	12.4	7.38	0.10	8405594
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	8405576	<0.10	<0.10	0.10	8405594
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	8405576	<0.10	<0.10	0.10	8405594
Total Boron (B)	mg/kg	2.1	2.5	2.6	<2.0	8405576	2.5	<2.0	2.0	8405594
Total Cadmium (Cd)	mg/kg	0.032	0.011	0.028	0.035	8405576	0.062	0.029	0.010	8405594
Total Calcium (Ca)	mg/kg	2080	1940	888	956	8405576	1270	791	10	8405594
Total Chromium (Cr)	mg/kg	0.32	0.25	0.43	0.25	8405576	0.38	0.31	0.20	8405594
Total Cobalt (Co)	mg/kg	0.114	0.078	0.142	0.090	8405576	0.156	0.087	0.020	8405594
Total Copper (Cu)	mg/kg	1.16	0.839	1.36	1.07	8405576	1.61	1.01	0.050	8405594
Total Iron (Fe)	mg/kg	232	155	265	172	8405576	246	199	10	8405594
Total Lead (Pb)	mg/kg	0.163	0.108	0.182	0.130	8405576	0.202	0.122	0.010	8405594
Total Magnesium (Mg)	mg/kg	291	202	272	286	8405576	505	258	10	8405594
Total Manganese (Mn)	mg/kg	145	24.4	203	197	8405576	138	163	0.10	8405594
Total Mercury (Hg)	mg/kg	0.026	0.016	0.018	0.017	8405576	0.035	0.018	0.010	8405594
Total Molybdenum (Mo)	mg/kg	<0.050	0.199	<0.050	<0.050	8405576	<0.050	0.075	0.050	8405594
Total Nickel (Ni)	mg/kg	0.416	0.278	0.475	0.332	8405576	0.695	0.370	0.050	8405594
Total Phosphorus (P)	mg/kg	447	298	310	348	8405576	526	310	10	8405594
Total Potassium (K)	mg/kg	1020	763	849	924	8405576	1060	870	10	8405594
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	8405576	<0.050	<0.050	0.050	8405594
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	8405576	<0.020	<0.020	0.020	8405594
Total Sodium (Na)	mg/kg	<10	<10	10	13	8405576	16	13	10	8405594
Total Strontium (Sr)	mg/kg	4.92	5.49	2.22	2.50	8405576	4.50	1.50	0.10	8405594
Total Thallium (Tl)	mg/kg	0.0041	<0.0020	0.0022	<0.0020	8405576	0.0034	0.0020	0.0020	8405594
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	8405576	<0.10	<0.10	0.10	8405594
Total Titanium (Ti)	mg/kg	6.9	4.8	9.3	6.0	8405576	8.2	6.9	1.0	8405594
Total Uranium (U)	mg/kg	0.0074	0.0057	0.0091	0.0127	8405576	0.0095	0.0089	0.0020	8405594
Total Vanadium (V)	mg/kg	0.33	<0.20	0.40	0.27	8405576	0.46	0.29	0.20	8405594
Total Zinc (Zn)	mg/kg	20.2	11.2	10.1	12.6	8405576	18.6	10.3	0.20	8405594

RDL = Reportable Detection Limit

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0292	PJ0293	PJ0294	PJ0295	PJ0296	PJ0297		
Sampling Date		2016/08/18	2016/08/18	2016/08/18	2016/08/18	2016/08/18	2016/08/18		
COC Number		08426718	08426718	08426718	08426718	08426718	08426718		
	UNITS	CCTMCL-612	CCTMCL-613	CCTMCL-613R	CCTMRL-614	CCTMRL-615	CCTMRL-616	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	249	189	226	182	160	190	1.0	8405594
Total Antimony (Sb)	mg/kg	0.0207	0.0358	0.0263	0.0509	0.0299	0.0257	0.0050	8405594
Total Arsenic (As)	mg/kg	0.179	0.167	0.188	0.165	0.135	0.160	0.050	8405594
Total Barium (Ba)	mg/kg	5.98	5.95	6.27	7.81	10.5	11.6	0.10	8405594
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405594
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405594
Total Boron (B)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	8405594
Total Cadmium (Cd)	mg/kg	0.031	0.023	0.027	0.050	0.064	0.043	0.010	8405594
Total Calcium (Ca)	mg/kg	857	665	737	973	1130	1120	10	8405594
Total Chromium (Cr)	mg/kg	0.50	0.48	0.64	0.46	0.48	0.44	0.20	8405594
Total Cobalt (Co)	mg/kg	0.165	0.148	0.186	0.146	0.124	0.150	0.020	8405594
Total Copper (Cu)	mg/kg	1.16	1.29	1.20	1.21	1.19	1.31	0.050	8405594
Total Iron (Fe)	mg/kg	275	298	348	287	248	294	10	8405594
Total Lead (Pb)	mg/kg	0.181	0.207	0.199	0.177	0.131	0.178	0.010	8405594
Total Magnesium (Mg)	mg/kg	352	326	357	339	365	361	10	8405594
Total Manganese (Mn)	mg/kg	106	72.4	83.6	296	148	142	0.10	8405594
Total Mercury (Hg)	mg/kg	0.029	0.026	0.021	0.023	0.023	0.021	0.010	8405594
Total Molybdenum (Mo)	mg/kg	<0.050	<0.050	<0.050	<0.050	0.066	0.057	0.050	8405594
Total Nickel (Ni)	mg/kg	0.547	0.591	0.670	0.575	0.553	0.579	0.050	8405594
Total Phosphorus (P)	mg/kg	416	400	430	294	391	445	10	8405594
Total Potassium (K)	mg/kg	1050	899	887	839	1010	879	10	8405594
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8405594
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8405594
Total Sodium (Na)	mg/kg	11	12	15	11	14	10	10	8405594
Total Strontium (Sr)	mg/kg	2.20	2.42	2.71	2.05	3.77	4.48	0.10	8405594
Total Thallium (Tl)	mg/kg	0.0028	0.0025	0.0030	0.0028	0.0023	<0.0020	0.0020	8405594
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405594
Total Titanium (Ti)	mg/kg	8.9	10.7	12.6	11.4	8.7	9.5	1.0	8405594
Total Uranium (U)	mg/kg	0.0118	0.0109	0.0113	0.0091	0.0067	0.0103	0.0020	8405594
Total Vanadium (V)	mg/kg	0.49	0.51	0.60	0.51	0.49	0.49	0.20	8405594
Total Zinc (Zn)	mg/kg	12.9	12.4	13.1	12.2	13.8	15.1	0.20	8405594
RDL = Reportable Detection Limit									

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0298	PJ0299	PJ0326	PJ0327	PJ0328	PJ0329		
Sampling Date		2016/08/18	2016/08/18	2016/08/19	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426718	08426718	08426719	08426719	08426719	08426719		
	UNITS	CCTMRL-617	CCTMRL-618	CCTMAL-619	CCTMBL-620	CCTMBL-621	CCTMAL-622	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	231	197	141	178	127	107	1.0	8405594
Total Antimony (Sb)	mg/kg	0.0301	0.0309	0.315	0.0330	0.0266	0.0311	0.0050	8405594
Total Arsenic (As)	mg/kg	0.191	0.167	0.181	0.184	0.138	0.122	0.050	8405594
Total Barium (Ba)	mg/kg	6.66	6.84	5.00	3.73	4.34	7.43	0.10	8405594
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405594
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405594
Total Boron (B)	mg/kg	<2.0	<2.0	<2.0	2.1	2.3	<2.0	2.0	8405594
Total Cadmium (Cd)	mg/kg	0.041	0.045	0.023	0.018	0.020	0.030	0.010	8405594
Total Calcium (Ca)	mg/kg	752	829	1220	600	646	972	10	8405594
Total Chromium (Cr)	mg/kg	0.60	0.51	0.37	0.45	0.29	0.23	0.20	8405594
Total Cobalt (Co)	mg/kg	0.181	0.160	0.099	0.151	0.101	0.092	0.020	8405594
Total Copper (Cu)	mg/kg	1.26	1.34	1.56	1.16	0.908	0.898	0.050	8405594
Total Iron (Fe)	mg/kg	361	301	227	279	204	162	10	8405594
Total Lead (Pb)	mg/kg	0.239	0.219	0.244	0.166	0.126	0.090	0.010	8405594
Total Magnesium (Mg)	mg/kg	294	282	233	273	255	432	10	8405594
Total Manganese (Mn)	mg/kg	87.5	101	20.2	158	186	171	0.10	8405594
Total Mercury (Hg)	mg/kg	0.020	0.021	0.021	0.017	0.021	0.014	0.010	8405594
Total Molybdenum (Mo)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8405594
Total Nickel (Ni)	mg/kg	0.634	0.625	0.389	0.491	0.345	0.306	0.050	8405594
Total Phosphorus (P)	mg/kg	309	348	283	250	268	511	10	8405594
Total Potassium (K)	mg/kg	828	884	865	880	954	1170	10	8405594
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8405594
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8405594
Total Sodium (Na)	mg/kg	13	14	10	12	<10	<10	10	8405594
Total Strontium (Sr)	mg/kg	2.07	1.91	3.56	1.24	1.10	2.52	0.10	8405594
Total Thallium (Tl)	mg/kg	0.0043	0.0037	0.0022	0.0026	0.0027	0.0021	0.0020	8405594
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405594
Total Titanium (Ti)	mg/kg	13.4	12.3	8.7	11.5	7.4	5.9	1.0	8405594
Total Uranium (U)	mg/kg	0.0128	0.0107	0.0090	0.0095	0.0068	0.0085	0.0020	8405594
Total Vanadium (V)	mg/kg	0.59	0.49	0.35	0.49	0.34	0.23	0.20	8405594
Total Zinc (Zn)	mg/kg	9.83	10.0	12.2	9.52	7.88	12.6	0.20	8405594

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0330	PJ0331	PJ0332	PJ0333	PJ0334	PJ0335		
Sampling Date		2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426719	08426719	08426719	08426719	08426719	08426719		
	UNITS	CCTMAL-622-R	CCTMAL-623	CCTMBL-624	CCTMAL-626	CCTMAL-627	CCTMAL-628	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	93.7	125	116	151	137	166	1.0	8405594
Total Antimony (Sb)	mg/kg	0.0438	0.0794	0.117	0.0728	0.0434	0.0250	0.0050	8405594
Total Arsenic (As)	mg/kg	0.092	0.218	0.127	0.175	0.265	0.237	0.050	8405594
Total Barium (Ba)	mg/kg	7.72	8.79	3.90	5.36	4.77	4.51	0.10	8405594
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405594
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405594
Total Boron (B)	mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	8405594
Total Cadmium (Cd)	mg/kg	0.027	0.022	0.027	0.021	0.017	0.018	0.010	8405594
Total Calcium (Ca)	mg/kg	921	702	587	672	546	639	10	8405594
Total Chromium (Cr)	mg/kg	0.21	0.36	0.31	0.43	0.36	0.45	0.20	8405594
Total Cobalt (Co)	mg/kg	0.075	0.102	0.092	0.130	0.108	0.112	0.020	8405594
Total Copper (Cu)	mg/kg	0.806	0.955	0.837	1.05	0.862	1.08	0.050	8405594
Total Iron (Fe)	mg/kg	126	199	173	244	216	231	10	8405594
Total Lead (Pb)	mg/kg	0.071	0.117	0.108	0.129	0.104	0.139	0.010	8405594
Total Magnesium (Mg)	mg/kg	386	292	234	256	246	388	10	8405594
Total Manganese (Mn)	mg/kg	164	136	203	120	113	91.8	0.10	8405594
Total Mercury (Hg)	mg/kg	0.015	0.023	0.015	0.012	0.015	0.021	0.010	8405594
Total Molybdenum (Mo)	mg/kg	<0.050	0.050	<0.050	0.060	<0.050	<0.050	0.050	8405594
Total Nickel (Ni)	mg/kg	0.259	0.366	0.337	0.372	0.378	0.408	0.050	8405594
Total Phosphorus (P)	mg/kg	497	392	257	267	362	538	10	8405594
Total Potassium (K)	mg/kg	1190	956	986	892	896	1490	10	8405594
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8405594
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8405594
Total Sodium (Na)	mg/kg	<10	11	11	12	12	<10	10	8405594
Total Strontium (Sr)	mg/kg	2.34	1.68	1.18	1.72	1.20	1.75	0.10	8405594
Total Thallium (Tl)	mg/kg	0.0027	0.0049	0.0020	0.0025	0.0040	0.0023	0.0020	8405594
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8405594
Total Titanium (Ti)	mg/kg	4.4	7.3	6.6	10.5	7.6	9.9	1.0	8405594
Total Uranium (U)	mg/kg	0.0048	0.0101	0.0057	0.0092	0.0100	0.0096	0.0020	8405594
Total Vanadium (V)	mg/kg	<0.20	0.30	0.28	0.39	0.38	0.43	0.20	8405594
Total Zinc (Zn)	mg/kg	11.6	9.35	8.84	8.67	11.2	12.2	0.20	8405594

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0369	PJ0370	PJ0371	PJ0372	PJ0373	PJ0374		
Sampling Date		2016/08/20	2016/08/20	2016/08/20	2016/08/20	2016/08/20	2016/08/21		
COC Number		08426720	08426720	08426720	08426720	08426720	08426720		
	UNITS	CCTMBL-630	CCTMAL-631	CCTMAL-632	CCTMBL-633	CCTMBL-634	CCTMRL-635	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	53.9	88.6	85.5	119	65.0	102	1.0	8407097
Total Antimony (Sb)	mg/kg	0.0958	0.0638	0.0922	0.0218	0.0281	0.0139	0.0050	8407097
Total Arsenic (As)	mg/kg	0.066	0.124	0.090	0.143	0.085	0.108	0.050	8407097
Total Barium (Ba)	mg/kg	5.14	6.52	5.36	5.05	8.51	4.08	0.10	8407097
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407097
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407097
Total Boron (B)	mg/kg	<2.0	<2.0	2.3	2.1	3.2	<2.0	2.0	8407097
Total Cadmium (Cd)	mg/kg	0.031	0.031	0.066	0.025	0.027	0.024	0.010	8407097
Total Calcium (Ca)	mg/kg	554	745	739	811	1290	665	10	8407097
Total Chromium (Cr)	mg/kg	<0.20	0.21	0.22	0.27	<0.20	0.32	0.20	8407097
Total Cobalt (Co)	mg/kg	0.049	0.083	0.081	0.096	0.072	0.091	0.020	8407097
Total Copper (Cu)	mg/kg	0.810	0.905	0.807	0.885	0.926	0.897	0.050	8407097
Total Iron (Fe)	mg/kg	86	143	121	186	121	156	10	8407097
Total Lead (Pb)	mg/kg	0.066	0.089	0.087	0.138	0.080	0.121	0.010	8407097
Total Magnesium (Mg)	mg/kg	204	358	406	219	424	486	10	8407097
Total Manganese (Mn)	mg/kg	86.7	229	132	51.2	20.5	34.7	0.10	8407097
Total Mercury (Hg)	mg/kg	0.021	0.028	0.014	0.016	0.019	0.020	0.010	8407097
Total Molybdenum (Mo)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407097
Total Nickel (Ni)	mg/kg	0.213	0.334	0.301	0.309	0.231	0.445	0.050	8407097
Total Phosphorus (P)	mg/kg	401	404	499	237	429	336	10	8407097
Total Potassium (K)	mg/kg	1130	1110	1100	865	1610	1090	10	8407097
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407097
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8407097
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	<10	10	8407097
Total Strontium (Sr)	mg/kg	1.32	1.94	2.20	2.76	5.39	1.47	0.10	8407097
Total Thallium (Tl)	mg/kg	0.0032	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8407097
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407097
Total Titanium (Ti)	mg/kg	2.3	4.7	4.0	7.2	3.3	5.4	1.0	8407097
Total Uranium (U)	mg/kg	0.0078	0.0085	0.0037	0.0065	0.0035	0.0050	0.0020	8407097
Total Vanadium (V)	mg/kg	<0.20	0.22	<0.20	0.26	<0.20	0.27	0.20	8407097
Total Zinc (Zn)	mg/kg	8.14	18.6	13.6	10.5	10.9	10.1	0.20	8407097

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0375	PJ0376	PJ0377	PJ0391	PJ0392		
Sampling Date		2016/08/21	2016/08/21	2016/08/21	2016/08/21	2016/08/21		
COC Number		08426720	08426720	08426720	08426721	08426721		
	UNITS	CCTMRL-636	CCTMRL-637	CCTMRL-638	CCTMRL-639	CCTMRL-639-R	RDL	QC Batch
Total Metals by ICPMS								
Total Aluminum (Al)	mg/kg	90.4	127	90.5	84.8	87.9	1.0	8407097
Total Antimony (Sb)	mg/kg	0.0180	0.0146	0.0634	0.0218	0.0252	0.0050	8407097
Total Arsenic (As)	mg/kg	0.086	0.068	0.085	0.084	0.085	0.050	8407097
Total Barium (Ba)	mg/kg	6.59	4.53	5.19	6.11	5.93	0.10	8407097
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407097
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407097
Total Boron (B)	mg/kg	<2.0	<2.0	2.1	<2.0	<2.0	2.0	8407097
Total Cadmium (Cd)	mg/kg	0.039	0.027	0.039	0.036	0.032	0.010	8407097
Total Calcium (Ca)	mg/kg	979	693	764	909	814	10	8407097
Total Chromium (Cr)	mg/kg	0.32	0.23	0.29	0.30	0.30	0.20	8407097
Total Cobalt (Co)	mg/kg	0.078	0.082	0.112	0.092	0.100	0.020	8407097
Total Copper (Cu)	mg/kg	0.852	0.877	0.898	0.874	0.895	0.050	8407097
Total Iron (Fe)	mg/kg	141	110	150	136	134	10	8407097
Total Lead (Pb)	mg/kg	0.103	0.075	0.107	0.085	0.093	0.010	8407097
Total Magnesium (Mg)	mg/kg	305	427	305	368	351	10	8407097
Total Manganese (Mn)	mg/kg	138	121	154	193	178	0.10	8407097
Total Mercury (Hg)	mg/kg	0.019	0.017	0.016	0.020	0.019	0.010	8407097
Total Molybdenum (Mo)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407097
Total Nickel (Ni)	mg/kg	0.346	0.297	0.294	0.271	0.313	0.050	8407097
Total Phosphorus (P)	mg/kg	391	571	399	482	490	10	8407097
Total Potassium (K)	mg/kg	1160	1330	1120	1180	1180	10	8407097
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407097
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8407097
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	10	8407097
Total Strontium (Sr)	mg/kg	2.40	1.81	1.58	1.69	1.61	0.10	8407097
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	<0.0020	0.0021	<0.0020	0.0020	8407097
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407097
Total Titanium (Ti)	mg/kg	5.0	4.1	4.5	4.4	4.4	1.0	8407097
Total Uranium (U)	mg/kg	0.0045	0.0044	0.0047	0.0047	0.0047	0.0020	8407097
Total Vanadium (V)	mg/kg	0.25	<0.20	0.24	0.22	0.24	0.20	8407097
Total Zinc (Zn)	mg/kg	12.3	14.6	10.9	13.1	12.9	0.20	8407097

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0411	PJ0412	PJ0413	PJ0414	PJ0415	PJ0416		
Sampling Date		2016/08/21	2016/07/05	2016/07/05	2016/07/05	2016/07/05	2016/07/05		
COC Number		08426722	08426722	08426722	08426722	08426722	08426722		
	UNITS	CCTMAC-600	CCTMAC-601	CCTMBC-602	CCTMBC-603	CCTMCC-604	CCTMCC-605	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	161	119	162	146	144	157	1.0	8408741
Total Antimony (Sb)	mg/kg	<0.0050	0.0069	0.0051	0.0069	0.0058	0.0055	0.0050	8408741
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	0.090	<0.050	<0.050	0.050	8408741
Total Barium (Ba)	mg/kg	76.4	96.3	62.5	71.3	54.0	71.1	0.10	8408741
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408741
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408741
Total Boron (B)	mg/kg	7.5	8.1	4.2	6.9	7.2	8.8	2.0	8408741
Total Cadmium (Cd)	mg/kg	<0.010	0.019	<0.010	<0.010	0.011	0.015	0.010	8408741
Total Calcium (Ca)	mg/kg	6180	6450	5430	5750	8040	5530	10	8408741
Total Chromium (Cr)	mg/kg	<0.20	<0.20	0.21	<0.20	<0.20	<0.20	0.20	8408741
Total Cobalt (Co)	mg/kg	0.035	0.039	0.037	0.029	0.044	0.021	0.020	8408741
Total Copper (Cu)	mg/kg	6.81 (1)	4.49	3.90	3.95	3.30	4.53	0.050	8408741
Total Iron (Fe)	mg/kg	60	59	82	58	61	42	10	8408741
Total Lead (Pb)	mg/kg	0.034	0.050	0.055	0.044	0.034	0.023	0.010	8408741
Total Magnesium (Mg)	mg/kg	1230	1100	1290	1300	1170	864	10	8408741
Total Manganese (Mn)	mg/kg	3040	2620	1820	2650	2900	2500	0.10	8408741
Total Mercury (Hg)	mg/kg	0.018	0.025	0.013	0.017	0.017	<0.010	0.010	8408741
Total Molybdenum (Mo)	mg/kg	0.057	<0.050	0.088	<0.050	0.243	<0.050	0.050	8408741
Total Nickel (Ni)	mg/kg	0.303	0.349	0.436	0.254	0.321	0.404	0.050	8408741
Total Phosphorus (P)	mg/kg	1040	1160	1110	997	635	811	10	8408741
Total Potassium (K)	mg/kg	3540	4200	3590	3580	2790	3840	10	8408741
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8408741
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8408741
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	<10	10	8408741
Total Strontium (Sr)	mg/kg	6.82	10.7	5.91	6.98	6.07	4.36	0.10	8408741
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	0.0023	<0.0020	<0.0020	<0.0020	0.0020	8408741
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408741
Total Titanium (Ti)	mg/kg	1.4	1.4	1.8	1.5	1.7	<1.0	1.0	8408741
Total Uranium (U)	mg/kg	<0.0020	0.0027	<0.0020	<0.0020	<0.0020	0.0076	0.0020	8408741
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8408741
Total Zinc (Zn)	mg/kg	24.2	25.5	24.0	24.1	22.1	22.9	0.20	8408741

RDL = Reportable Detection Limit
(1) Duplicate outside acceptance criteria - re-analysis yields similar results.

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0417	PJ0418	PJ0419	PJ0420	PJ0433	PJ0434		
Sampling Date		2016/07/06	2016/07/06	2016/07/06	2016/07/06	2016/07/06	2016/08/18		
COC Number		08426722	08426722	08426722	08426722	08426723	08426723		
	UNITS	CCTMCC-606	CCTMCC-607	CCTMCC-608	CCTMCC-609	CCTMCC-610	CCTMCC-611	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	34.1	40.5	95.2	101	93.3	94.2	1.0	8408741
Total Antimony (Sb)	mg/kg	0.0091	0.0066	0.0069	<0.0050	0.0079	0.0116	0.0050	8408741
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8408741
Total Barium (Ba)	mg/kg	121	116	73.5	75.2	86.9	61.1	0.10	8408741
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408741
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408741
Total Boron (B)	mg/kg	10.1	8.8	4.4	6.9	7.3	8.1	2.0	8408741
Total Cadmium (Cd)	mg/kg	<0.010	0.014	<0.010	0.013	0.040	<0.010	0.010	8408741
Total Calcium (Ca)	mg/kg	6260	8030	5240	5390	5910	5970	10	8408741
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8408741
Total Cobalt (Co)	mg/kg	0.024	0.024	0.030	0.029	0.031	0.028	0.020	8408741
Total Copper (Cu)	mg/kg	2.15	1.74	3.20	2.96	3.23	4.70	0.050	8408741
Total Iron (Fe)	mg/kg	41	35	36	46	48	43	10	8408741
Total Lead (Pb)	mg/kg	0.019	0.021	0.028	0.029	0.025	0.030	0.010	8408741
Total Magnesium (Mg)	mg/kg	1010	911	1230	712	869	993	10	8408741
Total Manganese (Mn)	mg/kg	1070	828	1920	2560	1970	2530	0.10	8408741
Total Mercury (Hg)	mg/kg	0.014	0.012	<0.010	0.012	<0.010	0.015	0.010	8408741
Total Molybdenum (Mo)	mg/kg	0.120	1.89	0.096	0.400	<0.050	0.124	0.050	8408741
Total Nickel (Ni)	mg/kg	0.134	0.137	0.317	0.184	0.187	0.253	0.050	8408741
Total Phosphorus (P)	mg/kg	930	728	649	611	1130	652	10	8408741
Total Potassium (K)	mg/kg	4380	2730	2210	3400	4170	2790	10	8408741
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8408741
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8408741
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	<10	10	8408741
Total Strontium (Sr)	mg/kg	10.8	12.7	5.52	9.08	5.02	5.14	0.10	8408741
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0024	0.0020	8408741
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408741
Total Titanium (Ti)	mg/kg	1.0	<1.0	<1.0	1.1	1.4	1.0	1.0	8408741
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8408741
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8408741
Total Zinc (Zn)	mg/kg	27.7	15.5	20.6	17.9	24.1	20.3	0.20	8408741

RDL = Reportable Detection Limit

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0435	PJ0436	PJ0437	PJ0438	PJ0439	PJ0440		
Sampling Date		2016/08/18	2016/08/18	2016/08/18	2016/08/18	2016/08/18	2016/08/18		
COC Number		08426723	08426723	08426723	08426723	08426723	08426723		
	UNITS	CCTMCC-612	CCTMCC-613	CCTMCC-613-R	CCTMRC-614	CCTMRC-615	CCTMRC-616	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	107	111	64.7	111	111	127	1.0	8408741
Total Antimony (Sb)	mg/kg	<0.0050	0.0081	0.0097	<0.0050	0.0198	0.0134	0.0050	8408741
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8408741
Total Barium (Ba)	mg/kg	93.7	76.1	95.1	77.4	91.5	116	0.10	8408741
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408741
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408741
Total Boron (B)	mg/kg	5.1	5.8	5.1	8.9	8.0	8.2	2.0	8408741
Total Cadmium (Cd)	mg/kg	<0.010	<0.010	<0.010	0.025	0.013	0.017	0.010	8408741
Total Calcium (Ca)	mg/kg	6020	5870	5620	7440	7400	6710	10	8408741
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8408741
Total Cobalt (Co)	mg/kg	0.039	0.037	0.052	0.020	0.025	0.035	0.020	8408741
Total Copper (Cu)	mg/kg	4.95	3.43	3.77	4.57	3.30	4.18	0.050	8408741
Total Iron (Fe)	mg/kg	46	44	41	44	46	60	10	8408741
Total Lead (Pb)	mg/kg	0.037	0.020	0.029	0.021	0.027	0.029	0.010	8408741
Total Magnesium (Mg)	mg/kg	1580	1480	1650	785	947	1130	10	8408741
Total Manganese (Mn)	mg/kg	1700	1720	1520	3260	3050	2910	0.10	8408741
Total Mercury (Hg)	mg/kg	0.012	0.013	<0.010	0.014	0.012	0.015	0.010	8408741
Total Molybdenum (Mo)	mg/kg	0.059	0.051	<0.050	0.087	0.093	0.077	0.050	8408741
Total Nickel (Ni)	mg/kg	0.387	0.352	0.390	0.266	0.421	0.331	0.050	8408741
Total Phosphorus (P)	mg/kg	1230	1260	1170	729	947	1070	10	8408741
Total Potassium (K)	mg/kg	4620	3900	3920	4010	3840	3990	10	8408741
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8408741
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8408741
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	<10	10	8408741
Total Strontium (Sr)	mg/kg	5.87	7.40	10.5	5.97	6.03	8.08	0.10	8408741
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8408741
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408741
Total Titanium (Ti)	mg/kg	<1.0	1.1	<1.0	1.1	1.1	1.8	1.0	8408741
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8408741
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8408741
Total Zinc (Zn)	mg/kg	30.9	27.3	24.7	27.2	28.1	23.1	0.20	8408741

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0441	PJ0442		PJ0454	PJ0455	PJ0456		
Sampling Date		2016/08/18	2016/08/18		2016/08/19	2016/08/19	2016/08/19		
COC Number		08426723	08426723		08426724	08426724	08426724		
	UNITS	CCTMRC-617	CCTMRC-618	QC Batch	CCTMAC-619	CCTMBC-620	CCTMBC-621	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	159	137	8408741	44.3	95.1	105	1.0	8408878
Total Antimony (Sb)	mg/kg	0.0178	0.0062	8408741	0.0249	0.0201	0.0479	0.0050	8408878
Total Arsenic (As)	mg/kg	<0.050	<0.050	8408741	<0.050	<0.050	<0.050	0.050	8408878
Total Barium (Ba)	mg/kg	117	74.8	8408741	89.4	50.1	74.8	0.10	8408878
Total Beryllium (Be)	mg/kg	<0.10	<0.10	8408741	<0.10	<0.10	<0.10	0.10	8408878
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	8408741	<0.10	<0.10	<0.10	0.10	8408878
Total Boron (B)	mg/kg	6.1	8.4	8408741	9.5	8.9	8.9	2.0	8408878
Total Cadmium (Cd)	mg/kg	0.011	0.033	8408741	<0.010	<0.010	<0.010	0.010	8408878
Total Calcium (Ca)	mg/kg	6180	6650	8408741	9620	5100	7790	10	8408878
Total Chromium (Cr)	mg/kg	<0.20	<0.20	8408741	<0.20	<0.20	<0.20	0.20	8408878
Total Cobalt (Co)	mg/kg	0.050	0.043	8408741	0.026	0.029	0.024	0.020	8408878
Total Copper (Cu)	mg/kg	3.19	4.07	8408741	3.81	3.33	3.99	0.050	8408878
Total Iron (Fe)	mg/kg	68	54	8408741	44	26	38	10	8408878
Total Lead (Pb)	mg/kg	0.035	0.032	8408741	0.029	0.021	0.024	0.010	8408878
Total Magnesium (Mg)	mg/kg	1670	1220	8408741	909	875	918	10	8408878
Total Manganese (Mn)	mg/kg	2460	2690	8408741	864	2520	3210	0.10	8408878
Total Mercury (Hg)	mg/kg	0.021	0.014	8408741	0.018 (1)	0.013	0.016	0.010	8408878
Total Molybdenum (Mo)	mg/kg	0.054	<0.050	8408741	<0.050	0.051	<0.050	0.050	8408878
Total Nickel (Ni)	mg/kg	0.432	0.358	8408741	0.574 (2)	0.173	0.195	0.050	8408878
Total Phosphorus (P)	mg/kg	1090	1090	8408741	690	645	640	10	8408878
Total Potassium (K)	mg/kg	3900	4020	8408741	3960	2860	2940	10	8408878
Total Selenium (Se)	mg/kg	<0.050	<0.050	8408741	<0.050	<0.050	<0.050	0.050	8408878
Total Silver (Ag)	mg/kg	<0.020	<0.020	8408741	<0.020	<0.020	<0.020	0.020	8408878
Total Sodium (Na)	mg/kg	<10	<10	8408741	<10	<10	<10	10	8408878
Total Strontium (Sr)	mg/kg	10.0	4.32	8408741	16.1	3.43	4.07	0.10	8408878
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	8408741	<0.0020	<0.0020	0.0029	0.0020	8408878
Total Tin (Sn)	mg/kg	<0.10	0.43	8408741	<0.10	<0.10	<0.10	0.10	8408878
Total Titanium (Ti)	mg/kg	2.0	1.4	8408741	1.1	<1.0	<1.0	1.0	8408878
Total Uranium (U)	mg/kg	0.0021	<0.0020	8408741	<0.0020	<0.0020	<0.0020	0.0020	8408878
Total Vanadium (V)	mg/kg	<0.20	<0.20	8408741	<0.20	<0.20	<0.20	0.20	8408878
Total Zinc (Zn)	mg/kg	25.9	36.5	8408741	46.8	17.7	19.1	0.20	8408878

RDL = Reportable Detection Limit
(1) Matrix Spike outside acceptance criteria (10% of analytes failure allowed).
(2) Duplicate outside acceptance criteria - re-analysis yields similar results.

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0457	PJ0458	PJ0459	PJ0460	PJ0461	PJ0462		
Sampling Date		2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426724	08426724	08426724	08426724	08426724	08426724		
	UNITS	CCTMAC-622	CCTMAC-622-R	CCTMAC-623	CCTMBC-624	CCTMBC-625	CCTMBC-625-R	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	49.4	47.6	144	105	155	139	1.0	8408878
Total Antimony (Sb)	mg/kg	0.0206	0.0416	0.0167	0.0209	0.0145	0.0119	0.0050	8408878
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8408878
Total Barium (Ba)	mg/kg	68.6	72.8	79.7	81.2	103	116	0.10	8408878
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408878
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408878
Total Boron (B)	mg/kg	5.3	5.6	7.6	6.3	13.7	12.8	2.0	8408878
Total Cadmium (Cd)	mg/kg	<0.010	<0.010	0.016	<0.010	0.133	0.174	0.010	8408878
Total Calcium (Ca)	mg/kg	5250	4860	7580	5900	7370	6760	10	8408878
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8408878
Total Cobalt (Co)	mg/kg	0.029	0.027	0.036	<0.020	0.062	0.056	0.020	8408878
Total Copper (Cu)	mg/kg	3.40	3.68	4.67	2.75	4.13	4.65	0.050	8408878
Total Iron (Fe)	mg/kg	30	30	46	36	39	52	10	8408878
Total Lead (Pb)	mg/kg	0.021	0.028	0.038	0.020	0.015	0.068	0.010	8408878
Total Magnesium (Mg)	mg/kg	936	851	1220	1310	896	958	10	8408878
Total Manganese (Mn)	mg/kg	1830	1840	2680	2680	2690	2500	0.10	8408878
Total Mercury (Hg)	mg/kg	<0.010	0.011	0.018	0.013	0.013	0.011	0.010	8408878
Total Molybdenum (Mo)	mg/kg	0.181	0.158	0.107	0.088	0.457	0.317	0.050	8408878
Total Nickel (Ni)	mg/kg	0.238	0.299	0.247	0.192	0.184	0.162	0.050	8408878
Total Phosphorus (P)	mg/kg	1150	1150	993	689	1120	1010	10	8408878
Total Potassium (K)	mg/kg	4150	4480	3660	2940	4790	3570	10	8408878
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8408878
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8408878
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	<10	10	8408878
Total Strontium (Sr)	mg/kg	5.10	5.94	6.05	4.46	13.9	12.4	0.10	8408878
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	0.0030	<0.0020	0.0078	0.0124	0.0020	8408878
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408878
Total Titanium (Ti)	mg/kg	<1.0	<1.0	1.1	<1.0	<1.0	<1.0	1.0	8408878
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8408878
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8408878
Total Zinc (Zn)	mg/kg	18.6	17.5	30.9	13.4	24.3	24.4	0.20	8408878

RDL = Reportable Detection Limit

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0463	PJ0475	PJ0476	PJ0477	PJ0478	PJ0479		
Sampling Date		2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/20	2016/08/20		
COC Number		08426724	08426725	08426725	08426725	08426725	08426725		
	UNITS	CCTMAC-626	CCTMAC-627	CCTMAC-628	CCTMBC-629	CCTMBC-630	CCTMAC-631	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	136	135	111	84.9	107	85.4	1.0	8408878
Total Antimony (Sb)	mg/kg	0.0202	0.0121	0.0096	0.0079	0.125	0.0182	0.0050	8408878
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8408878
Total Barium (Ba)	mg/kg	87.5	96.8	94.8	86.9	95.2	90.0	0.10	8408878
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408878
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408878
Total Boron (B)	mg/kg	7.0	9.4	3.5	10.1	5.5	4.4	2.0	8408878
Total Cadmium (Cd)	mg/kg	<0.010	0.010	<0.010	0.055	<0.010	0.012	0.010	8408878
Total Calcium (Ca)	mg/kg	7930	6380	4990	6380	6430	5380	10	8408878
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8408878
Total Cobalt (Co)	mg/kg	0.028	0.024	0.038	<0.020	0.060	0.029	0.020	8408878
Total Copper (Cu)	mg/kg	2.81	3.95	3.28	2.43	3.13	4.13	0.050	8408878
Total Iron (Fe)	mg/kg	41	41	44	39	40	33	10	8408878
Total Lead (Pb)	mg/kg	0.039	0.020	0.022	0.017	0.028	0.034	0.010	8408878
Total Magnesium (Mg)	mg/kg	1310	1120	1250	866	1260	1380	10	8408878
Total Manganese (Mn)	mg/kg	2830	2140	1540	1140	1600	1540	0.10	8408878
Total Mercury (Hg)	mg/kg	0.017	0.016	0.012	0.012	0.013	0.011	0.010	8408878
Total Molybdenum (Mo)	mg/kg	0.072	<0.050	0.109	0.238	0.116	0.063	0.050	8408878
Total Nickel (Ni)	mg/kg	0.173	0.248	0.275	0.152	0.269	0.432	0.050	8408878
Total Phosphorus (P)	mg/kg	649	768	1150	890	869	884	10	8408878
Total Potassium (K)	mg/kg	2780	3350	4750	3440	3530	3210	10	8408878
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8408878
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8408878
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	<10	10	8408878
Total Strontium (Sr)	mg/kg	6.63	6.15	5.76	9.71	11.6	8.88	0.10	8408878
Total Thallium (Tl)	mg/kg	<0.0020	0.0021	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8408878
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408878
Total Titanium (Ti)	mg/kg	1.1	1.0	1.2	<1.0	<1.0	<1.0	1.0	8408878
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8408878
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8408878
Total Zinc (Zn)	mg/kg	20.7	25.1	20.1	20.2	14.6	20.4	0.20	8408878

RDL = Reportable Detection Limit

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0480	PJ0481	PJ0482	PJ0483	PJ0484		
Sampling Date		2016/08/20	2016/08/20	2016/08/20	2016/08/21	2016/08/21		
COC Number		08426725	08426725	08426725	08426725	08426725		
	UNITS	CCTMAC-632	CCTMBC-633	CCTMBC-634	CCTMRC-635	CCTMRC-636	RDL	QC Batch
Total Metals by ICPMS								
Total Aluminum (Al)	mg/kg	119	48.6	33.4	45.5	83.8	1.0	8408878
Total Antimony (Sb)	mg/kg	0.0111	0.0138	0.0115	0.0068	0.0239	0.0050	8408878
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8408878
Total Barium (Ba)	mg/kg	111	61.7	96.9	75.0	65.3	0.10	8408878
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408878
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408878
Total Boron (B)	mg/kg	6.5	8.8	14.1	7.2	13.4	2.0	8408878
Total Cadmium (Cd)	mg/kg	0.022	0.021	0.027	<0.010	0.027	0.010	8408878
Total Calcium (Ca)	mg/kg	6760	6990	8950	5350	6690	10	8408878
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8408878
Total Cobalt (Co)	mg/kg	0.021	<0.020	0.049	0.032	<0.020	0.020	8408878
Total Copper (Cu)	mg/kg	3.40	4.42	4.72	4.47	3.35	0.050	8408878
Total Iron (Fe)	mg/kg	35	36	63	26	33	10	8408878
Total Lead (Pb)	mg/kg	0.014	0.014	0.033	0.012	0.020	0.010	8408878
Total Magnesium (Mg)	mg/kg	1150	895	979	916	861	10	8408878
Total Manganese (Mn)	mg/kg	2310	2190	555	1630	2640	0.10	8408878
Total Mercury (Hg)	mg/kg	0.013	0.014	0.032	0.010	0.012	0.010	8408878
Total Molybdenum (Mo)	mg/kg	0.093	0.156	0.358	<0.050	<0.050	0.050	8408878
Total Nickel (Ni)	mg/kg	0.205	0.127	0.195	0.902	0.194	0.050	8408878
Total Phosphorus (P)	mg/kg	1280	920	749	1180	904	10	8408878
Total Potassium (K)	mg/kg	4950	4300	4110	5090	4190	10	8408878
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8408878
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8408878
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	10	8408878
Total Strontium (Sr)	mg/kg	7.49	8.45	21.7	3.98	6.08	0.10	8408878
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8408878
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8408878
Total Titanium (Ti)	mg/kg	<1.0	<1.0	1.3	<1.0	<1.0	1.0	8408878
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8408878
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8408878
Total Zinc (Zn)	mg/kg	31.0	32.8	15.8	24.3	26.6	0.20	8408878

RDL = Reportable Detection Limit

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0491	PJ0492	PJ0493	PJ0494		PJ0518		
Sampling Date		2016/08/21	2016/08/21	2016/08/21	2016/08/21		2016/07/05		
COC Number		08426726	08426726	08426726	08426726		08426727		
	UNITS	CCTMRC-637	CCTMRC-638	CCTMRC-639	CCTMRC-639-R	QC Batch	CCTMAW-600	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	84.8	81.2	106	89.6	8408888	28.6	1.0	8407097
Total Antimony (Sb)	mg/kg	0.0143	0.0223	0.0067	0.0075	8408888	0.0193	0.0050	8407097
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	8408888	<0.050	0.050	8407097
Total Barium (Ba)	mg/kg	84.8	77.5	97.6	106	8408888	37.9	0.10	8407097
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	8408888	<0.10	0.10	8407097
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	8408888	<0.10	0.10	8407097
Total Boron (B)	mg/kg	10.0	6.8	8.5	7.0	8408888	4.3	2.0	8407097
Total Cadmium (Cd)	mg/kg	0.016	<0.010	0.015	<0.010	8408888	1.03	0.010	8407097
Total Calcium (Ca)	mg/kg	7000	6280	5810	6950	8408888	7890	10	8407097
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	8408888	<0.20	0.20	8407097
Total Cobalt (Co)	mg/kg	<0.020	0.021	0.058	0.033	8408888	0.895	0.020	8407097
Total Copper (Cu)	mg/kg	3.59	4.21	4.83	4.70	8408888	3.63	0.050	8407097
Total Iron (Fe)	mg/kg	37	31	36	33	8408888	68	10	8407097
Total Lead (Pb)	mg/kg	0.018	0.013	0.019	0.014	8408888	0.031	0.010	8407097
Total Magnesium (Mg)	mg/kg	971	921	910	939	8408888	2840	10	8407097
Total Manganese (Mn)	mg/kg	2190	2500	2140	2430	8408888	586	0.10	8407097
Total Mercury (Hg)	mg/kg	0.015	0.010	0.011	0.014	8408888	<0.010	0.010	8407097
Total Molybdenum (Mo)	mg/kg	<0.050	<0.050	<0.050	<0.050	8408888	0.121	0.050	8407097
Total Nickel (Ni)	mg/kg	0.157	0.248	0.267	0.264	8408888	3.58	0.050	8407097
Total Phosphorus (P)	mg/kg	1180	1110	1140	1200	8408888	2380	10	8407097
Total Potassium (K)	mg/kg	4060	4140	4200	4430	8408888	9880	10	8407097
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	8408888	<0.050	0.050	8407097
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	8408888	<0.020	0.020	8407097
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	8408888	<10	10	8407097
Total Strontium (Sr)	mg/kg	5.38	4.13	5.78	5.60	8408888	46.4	0.10	8407097
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	8408888	0.0023	0.0020	8407097
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	8408888	<0.10	0.10	8407097
Total Titanium (Ti)	mg/kg	<1.0	<1.0	<1.0	<1.0	8408888	<1.0	1.0	8407097
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	8408888	<0.0020	0.0020	8407097
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	8408888	<0.20	0.20	8407097
Total Zinc (Zn)	mg/kg	29.1	26.6	31.6	30.8	8408888	123	0.20	8407097

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0519	PJ0520	PJ0521	PJ0522	PJ0523	PJ0524		
Sampling Date		2016/07/05	2016/07/05	2016/07/05	2016/07/05	2016/07/05	2016/07/06		
COC Number		08426727	08426727	08426727	08426727	08426727	08426727		
	UNITS	CCTMAW-601	CCTMBW-602	CCTMBW-603	CCTMCW-604	CCTMCW-605	CCTMCW-606	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	19.5	20.3	25.6	16.6	22.7	16.1	1.0	8407097
Total Antimony (Sb)	mg/kg	0.0137	0.0102	0.0168	0.0086	0.0142	<0.0050	0.0050	8407097
Total Arsenic (As)	mg/kg	<0.050	<0.050	0.126	<0.050	<0.050	<0.050	0.050	8407097
Total Barium (Ba)	mg/kg	22.8	12.8	15.2	11.1	22.5	53.6	0.10	8407097
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407097
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407097
Total Boron (B)	mg/kg	7.0	3.4	4.2	5.6	5.9	14.7	2.0	8407097
Total Cadmium (Cd)	mg/kg	0.305	0.363	0.224	1.65	2.93	1.08	0.010	8407097
Total Calcium (Ca)	mg/kg	6450	4480	5540	2720	7540	12600	10	8407097
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407097
Total Cobalt (Co)	mg/kg	0.275	0.919	0.427	0.851	0.333	0.245	0.020	8407097
Total Copper (Cu)	mg/kg	3.80	3.43	3.75	4.04	5.48	4.38	0.050	8407097
Total Iron (Fe)	mg/kg	72	79	68	84	58	66	10	8407097
Total Lead (Pb)	mg/kg	0.014	0.012	0.025	0.024	0.025	0.021	0.010	8407097
Total Magnesium (Mg)	mg/kg	2720	1550	2820	1430	2540	3040	10	8407097
Total Manganese (Mn)	mg/kg	317	1050	224	464	212	50.1	0.10	8407097
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	8407097
Total Molybdenum (Mo)	mg/kg	0.086	0.086	0.084	0.506	0.058	0.712	0.050	8407097
Total Nickel (Ni)	mg/kg	3.73	1.35	2.17	2.05	2.75	1.26	0.050	8407097
Total Phosphorus (P)	mg/kg	2260	1830	1740	1710	1340	1980	10	8407097
Total Potassium (K)	mg/kg	9900	8360	10900	13000	10800	12800	10	8407097
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	0.342	0.050	8407097
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8407097
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	<10	10	8407097
Total Strontium (Sr)	mg/kg	38.6	30.8	30.2	15.9	19.8	46.5	0.10	8407097
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	0.0038	<0.0020	<0.0020	<0.0020	0.0020	8407097
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407097
Total Titanium (Ti)	mg/kg	<1.0	<1.0	1.1	<1.0	1.2	<1.0	1.0	8407097
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8407097
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407097
Total Zinc (Zn)	mg/kg	85.9	83.2	61.3	121	154	93.0	0.20	8407097

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0525	PJ0526		PJ0527	PJ0602	PJ0603		
Sampling Date		2016/07/06	2016/07/06		2016/07/06	2016/07/06	2016/08/18		
COC Number		08426727	08426727		08426727	08426728	08426728		
	UNITS	CCTMCW-607	CCTMCW-608	QC Batch	CCTMCW-609	CCTMCW-610	CCTMCW-612	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	9.9	13.5	8407097	13.5	32.7	71.7	1.0	8407099
Total Antimony (Sb)	mg/kg	<0.0050	0.0055	8407097	<0.0050	0.0099	0.0223	0.0050	8407099
Total Arsenic (As)	mg/kg	<0.050	<0.050	8407097	<0.050	<0.050	<0.050	0.050	8407099
Total Barium (Ba)	mg/kg	23.2	8.38	8407097	26.3	82.5	43.4	0.10	8407099
Total Beryllium (Be)	mg/kg	<0.10	<0.10	8407097	<0.10	<0.10	<0.10	0.10	8407099
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	8407097	<0.10	<0.10	<0.10	0.10	8407099
Total Boron (B)	mg/kg	9.9	2.2	8407097	7.6	3.7	5.8	2.0	8407099
Total Cadmium (Cd)	mg/kg	1.16	0.573	8407097	1.35	14.1	0.910	0.010	8407099
Total Calcium (Ca)	mg/kg	12400	4530	8407097	5830	10100	11100	10	8407099
Total Chromium (Cr)	mg/kg	<0.20	<0.20	8407097	<0.20	<0.20	<0.20	0.20	8407099
Total Cobalt (Co)	mg/kg	0.557	0.656	8407097	0.143	1.18	1.21	0.020	8407099
Total Copper (Cu)	mg/kg	4.37	3.08	8407097	3.18	3.26	4.52	0.050	8407099
Total Iron (Fe)	mg/kg	82	59	8407097	44	59	53	10	8407099
Total Lead (Pb)	mg/kg	<0.010	0.015	8407097	0.022	0.025	0.030	0.010	8407099
Total Magnesium (Mg)	mg/kg	3510	1810	8407097	2250	3690	4460	10	8407099
Total Manganese (Mn)	mg/kg	245	434	8407097	761	108	281	0.10	8407099
Total Mercury (Hg)	mg/kg	<0.010	<0.010	8407097	<0.010	<0.010	<0.010	0.010	8407099
Total Molybdenum (Mo)	mg/kg	3.03	0.097	8407097	0.075	0.118	0.082	0.050	8407099
Total Nickel (Ni)	mg/kg	1.17	0.519	8407097	1.30	4.99	4.01	0.050	8407099
Total Phosphorus (P)	mg/kg	2470	1240	8407097	1270	2400	2600	10	8407099
Total Potassium (K)	mg/kg	9320	6850	8407097	9790	10700	10900	10	8407099
Total Selenium (Se)	mg/kg	<0.050	<0.050	8407097	<0.050	0.094	<0.050	0.050	8407099
Total Silver (Ag)	mg/kg	<0.020	<0.020	8407097	<0.020	<0.020	<0.020	0.020	8407099
Total Sodium (Na)	mg/kg	<10	<10	8407097	15	<10	<10	10	8407099
Total Strontium (Sr)	mg/kg	39.0	19.5	8407097	37.1	50.0	56.5	0.10	8407099
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	8407097	<0.0020	0.0033	0.0032	0.0020	8407099
Total Tin (Sn)	mg/kg	<0.10	<0.10	8407097	<0.10	<0.10	<0.10	0.10	8407099
Total Titanium (Ti)	mg/kg	<1.0	<1.0	8407097	<1.0	1.2	1.1	1.0	8407099
Total Uranium (U)	mg/kg	<0.0020	<0.0020	8407097	<0.0020	<0.0020	<0.0020	0.0020	8407099
Total Vanadium (V)	mg/kg	<0.20	<0.20	8407097	<0.20	<0.20	<0.20	0.20	8407099
Total Zinc (Zn)	mg/kg	112	71.3	8407097	157	99.4	81.3	0.20	8407099

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0604	PJ0605	PJ0606	PJ0607	PJ0608	PJ0609		
Sampling Date		2016/08/18	2016/08/18	2016/08/18	2016/08/18	2016/08/18	2016/08/18		
COC Number		08426728	08426728	08426728	08426728	08426728	08426728		
	UNITS	CCTMCW-613	CCTMCW-613-R	CCTMRW-614	CCTMRW-615	CCTMRW-616	CCTMRW-617	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	232	118	25.0	19.7	55.1	47.6	1.0	8407099
Total Antimony (Sb)	mg/kg	0.0260	0.0085	0.0053	0.0110	0.0113	0.0275	0.0050	8407099
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407099
Total Barium (Ba)	mg/kg	65.6	59.2	19.2	43.9	99.2	102	0.10	8407099
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407099
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407099
Total Boron (B)	mg/kg	3.4	3.3	6.7	5.4	4.9	2.5	2.0	8407099
Total Cadmium (Cd)	mg/kg	0.894	0.783	10.3	2.78	0.669	0.793	0.010	8407099
Total Calcium (Ca)	mg/kg	12400	10100	4830	8290	12500	11400	10	8407099
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407099
Total Cobalt (Co)	mg/kg	3.28	1.49	1.69	0.329	1.25	3.07	0.020	8407099
Total Copper (Cu)	mg/kg	3.69	3.81	3.63	4.10	3.12	3.44	0.050	8407099
Total Iron (Fe)	mg/kg	74	180	45	52	113	66	10	8407099
Total Lead (Pb)	mg/kg	0.046	0.027	0.018	0.029	0.022	0.020	0.010	8407099
Total Magnesium (Mg)	mg/kg	4880	5120	1280	2090	4450	4630	10	8407099
Total Manganese (Mn)	mg/kg	242	277	1150	400	310	240	0.10	8407099
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	8407099
Total Molybdenum (Mo)	mg/kg	0.107	0.168	0.089	0.127	0.355	0.242	0.050	8407099
Total Nickel (Ni)	mg/kg	7.89	6.55	4.23	3.33	3.31	16.5	0.050	8407099
Total Phosphorus (P)	mg/kg	2110	2200	980	1190	1750	2020	10	8407099
Total Potassium (K)	mg/kg	9430	9340	7000	11500	9400	11200	10	8407099
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407099
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8407099
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	<10	10	8407099
Total Strontium (Sr)	mg/kg	91.2	72.1	24.6	35.5	73.1	75.6	0.10	8407099
Total Thallium (Tl)	mg/kg	<0.0020	0.0036	<0.0020	0.0027	<0.0020	0.0066	0.0020	8407099
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407099
Total Titanium (Ti)	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	8407099
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8407099
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407099
Total Zinc (Zn)	mg/kg	30.7	39.8	293	201	116	74.7	0.20	8407099

RDL = Reportable Detection Limit

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0610	PJ0611	PJ0632	PJ0633	PJ0634	PJ0635		
Sampling Date		2016/08/18	2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426728	08426728	08426729	08426729	08426729	08426729		
	UNITS	CCTMRW-618	CCTMAW-619	CCTMBW-620	CCTMAW-622	CCTMAW-622-R	CCTMAW-623	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	38.6	12.8	68.2	22.0	20.9	35.5	1.0	8407099
Total Antimony (Sb)	mg/kg	0.0148	0.0308	0.0150	0.0147	0.0639	0.0303	0.0050	8407099
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407099
Total Barium (Ba)	mg/kg	62.5	22.3	11.0	136	104	45.8	0.10	8407099
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407099
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407099
Total Boron (B)	mg/kg	2.9	6.9	8.8	3.6	3.3	3.0	2.0	8407099
Total Cadmium (Cd)	mg/kg	2.78	0.323	0.470	0.799	0.644	1.03	0.010	8407099
Total Calcium (Ca)	mg/kg	10100	22000	4230	26700	19500	11600	10	8407099
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407099
Total Cobalt (Co)	mg/kg	3.03	0.351	2.54	0.862	1.55	1.31	0.020	8407099
Total Copper (Cu)	mg/kg	3.40	4.00	3.47	4.70	4.55	3.18	0.050	8407099
Total Iron (Fe)	mg/kg	74	69	97	64	56	71	10	8407099
Total Lead (Pb)	mg/kg	0.037	0.030	0.022	0.019	0.027	0.025	0.010	8407099
Total Magnesium (Mg)	mg/kg	3390	2280	1790	2880	3290	3750	10	8407099
Total Manganese (Mn)	mg/kg	184	77.1	1040	198	242	260	0.10	8407099
Total Mercury (Hg)	mg/kg	<0.010	0.011	<0.010	0.011	<0.010	<0.010	0.010	8407099
Total Molybdenum (Mo)	mg/kg	0.265	0.303	0.094	0.096	0.120	0.174	0.050	8407099
Total Nickel (Ni)	mg/kg	9.41	0.478	2.74	1.56	5.04	2.77	0.050	8407099
Total Phosphorus (P)	mg/kg	1510	1090	1060	1850	2160	1510	10	8407099
Total Potassium (K)	mg/kg	10500	9180	7020	11200	16600	11100	10	8407099
Total Selenium (Se)	mg/kg	0.123	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407099
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8407099
Total Sodium (Na)	mg/kg	<10	<10	30	<10	<10	<10	10	8407099
Total Strontium (Sr)	mg/kg	45.7	73.0	22.7	92.6	76.7	59.5	0.10	8407099
Total Thallium (Tl)	mg/kg	0.0058	<0.0020	0.0024	0.0033	0.0120	<0.0020	0.0020	8407099
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407099
Total Titanium (Ti)	mg/kg	1.2	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	8407099
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8407099
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407099
Total Zinc (Zn)	mg/kg	103	118	118	83.3	54.2	78.7	0.20	8407099

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0636	PJ0637	PJ0638	PJ0639	PJ0640		
Sampling Date		2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426729	08426729	08426729	08426729	08426729		
	UNITS	CCTMBW-625	CCTMBW-625-R	CCTMAW-626	CCTMAW-627	CCTMAW-628	RDL	QC Batch
Total Metals by ICPMS								
Total Aluminum (Al)	mg/kg	44.1	45.2	46.0	38.9	73.7	1.0	8407099
Total Antimony (Sb)	mg/kg	0.0260	0.0263	0.0131	0.0523	0.0192	0.0050	8407099
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	0.084	<0.050	0.050	8407099
Total Barium (Ba)	mg/kg	103	106	16.4	67.1	79.8	0.10	8407099
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407099
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407099
Total Boron (B)	mg/kg	21.0	17.4	6.6	7.3	2.8	2.0	8407099
Total Cadmium (Cd)	mg/kg	1.48	1.48	0.654	0.973	0.914	0.010	8407099
Total Calcium (Ca)	mg/kg	13000	11300	6070	12600	12800	10	8407099
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	0.30	0.20	8407099
Total Cobalt (Co)	mg/kg	2.03	2.25	4.09	0.698	1.32	0.020	8407099
Total Copper (Cu)	mg/kg	4.80	5.00	2.61	2.71	3.95	0.050	8407099
Total Iron (Fe)	mg/kg	44	43	96	90	112	10	8407099
Total Lead (Pb)	mg/kg	0.031	0.038	0.017	0.039	0.052	0.010	8407099
Total Magnesium (Mg)	mg/kg	2650	2390	2240	3620	5150	10	8407099
Total Manganese (Mn)	mg/kg	851	817	1220	357	250	0.10	8407099
Total Mercury (Hg)	mg/kg	0.011	0.011	<0.010	0.011	<0.010	0.010	8407099
Total Molybdenum (Mo)	mg/kg	0.314	0.252	0.241	0.158	0.111	0.050	8407099
Total Nickel (Ni)	mg/kg	6.90	7.81	1.90	1.99	7.97	0.050	8407099
Total Phosphorus (P)	mg/kg	3170	3180	902	1020	3170	10	8407099
Total Potassium (K)	mg/kg	15800	16700	6790	12300	11100	10	8407099
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407099
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8407099
Total Sodium (Na)	mg/kg	<10	<10	30	<10	<10	10	8407099
Total Strontium (Sr)	mg/kg	94.4	93.5	22.6	46.3	73.4	0.10	8407099
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	0.0040	0.0020	8407099
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407099
Total Titanium (Ti)	mg/kg	<1.0	<1.0	<1.0	1.5	3.3	1.0	8407099
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	0.0021	0.0036	0.0020	8407099
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407099
Total Zinc (Zn)	mg/kg	93.5	90.2	108	72.5	80.8	0.20	8407099

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0641	PJ0643	PJ0644	PJ0645	PJ0646	PJ0647		
Sampling Date		2016/08/19	2016/08/20	2016/08/20	2016/08/20	2016/08/20	2016/08/21		
COC Number		08426729	08426730	08426730	08426730	08426730	08426730		
	UNITS	CCTMBW-629	CCTMAW-631	CCTMAW-632	CCTMBW-633	CCTMBW-634	CCTMRW-635	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	26.0	26.3	20.4	15.3	11.0	10.2	1.0	8407124
Total Antimony (Sb)	mg/kg	0.0220	0.0240	0.0194	0.0145	0.0267	0.0171	0.0050	8407124
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407124
Total Barium (Ba)	mg/kg	64.5	209	47.9	30.1	37.6	12.9	0.10	8407124
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407124
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407124
Total Boron (B)	mg/kg	20.2	5.3	3.4	9.1	6.9	3.5	2.0	8407124
Total Cadmium (Cd)	mg/kg	2.26	1.31	2.40	0.962	0.648	0.959	0.010	8407124
Total Calcium (Ca)	mg/kg	14300	14200	13800	11500	17700	2680	10	8407124
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407124
Total Cobalt (Co)	mg/kg	1.08	0.680	0.987	0.156	0.335	1.52	0.020	8407124
Total Copper (Cu)	mg/kg	4.41	3.49	3.40	3.07	6.87	3.64	0.050	8407124
Total Iron (Fe)	mg/kg	43	43	44	53	49	40	10	8407124
Total Lead (Pb)	mg/kg	0.033	0.056	0.031	0.025	0.034	0.017	0.010	8407124
Total Magnesium (Mg)	mg/kg	1760	2020	3470	2030	1310	2090	10	8407124
Total Manganese (Mn)	mg/kg	272	107	179	136	52.1	385	0.10	8407124
Total Mercury (Hg)	mg/kg	0.012	0.012	<0.010	<0.010	0.011	<0.010	0.010	8407124
Total Molybdenum (Mo)	mg/kg	0.269	<0.050	0.086	0.530	0.277	0.093	0.050	8407124
Total Nickel (Ni)	mg/kg	1.82	2.07	2.13	0.402	2.22	9.38	0.050	8407124
Total Phosphorus (P)	mg/kg	2730	2110	2780	869	935	1350	10	8407124
Total Potassium (K)	mg/kg	10500	14600	11700	10500	8600	8410	10	8407124
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407124
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8407124
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	<10	10	8407124
Total Strontium (Sr)	mg/kg	72.0	87.1	71.3	63.4	91.3	6.91	0.10	8407124
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	0.0042	<0.0020	<0.0020	<0.0020	0.0020	8407124
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407124
Total Titanium (Ti)	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	8407124
Total Uranium (U)	mg/kg	<0.0020	0.0111	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8407124
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407124
Total Zinc (Zn)	mg/kg	68.7	72.8	118	240	21.7	61.6	0.20	8407124

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0648	PJ0649	PJ0650	PJ0651	PJ0652	PJ0664		
Sampling Date		2016/08/21	2016/08/21	2016/08/21	2016/08/21	2016/08/21	2016/07/05		
COC Number		08426730	08426730	08426730	08426730	08426730	08426731		
	UNITS	CCTMRW-636	CCTMRW-637	CCTMRW-638	CCTMRW-639	CCTMRW-639-R	CCTMCH-604	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	9.1	17.4	52.5	57.4	70.4	99.7	1.0	8407124
Total Antimony (Sb)	mg/kg	0.0395	0.0164	0.0519	0.0397	0.0469	0.0087	0.0050	8407124
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407124
Total Barium (Ba)	mg/kg	43.5	51.1	60.9	80.3	55.0	104	0.10	8407124
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407124
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407124
Total Boron (B)	mg/kg	8.5	6.5	4.2	4.2	4.4	13.0	2.0	8407124
Total Cadmium (Cd)	mg/kg	3.20	0.974	0.562	1.37	1.07	0.432	0.010	8407124
Total Calcium (Ca)	mg/kg	9930	10900	8940	11600	8050	7020	10	8407124
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407124
Total Cobalt (Co)	mg/kg	0.396	0.637	1.99	3.17	3.15	2.07	0.020	8407124
Total Copper (Cu)	mg/kg	3.89	2.66	3.51	3.38	3.08	3.84	0.050	8407124
Total Iron (Fe)	mg/kg	37	46	103	125	127	170	10	8407124
Total Lead (Pb)	mg/kg	0.043	0.017	0.026	0.224	0.099	0.036	0.010	8407124
Total Magnesium (Mg)	mg/kg	2230	2760	3010	3710	3930	3050	10	8407124
Total Manganese (Mn)	mg/kg	483	261	274	308	660	234	0.10	8407124
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	8407124
Total Molybdenum (Mo)	mg/kg	0.055	0.158	0.207	0.061	0.058	0.705	0.050	8407124
Total Nickel (Ni)	mg/kg	3.51	0.700	2.66	3.34	2.93	3.69	0.050	8407124
Total Phosphorus (P)	mg/kg	950	1120	1380	1510	1990	1570	10	8407124
Total Potassium (K)	mg/kg	7810	9330	11100	10900	10900	26100	10	8407124
Total Selenium (Se)	mg/kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.050	8407124
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8407124
Total Sodium (Na)	mg/kg	<10	<10	<10	<10	<10	<10	10	8407124
Total Strontium (Sr)	mg/kg	39.2	40.4	39.1	49.6	34.0	48.8	0.10	8407124
Total Thallium (Tl)	mg/kg	0.0042	<0.0020	<0.0020	<0.0020	0.0025	0.0258	0.0020	8407124
Total Tin (Sn)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407124
Total Titanium (Ti)	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	8407124
Total Uranium (U)	mg/kg	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	<0.0020	0.0020	8407124
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407124
Total Zinc (Zn)	mg/kg	298	137	48.1	81.9	68.7	70.7	0.20	8407124

RDL = Reportable Detection Limit

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

ELEMENTS BY ATOMIC SPECTROSCOPY - DRY WT (TISSUE)

Maxxam ID		PJ0665	PJ0666	PJ0667	PJ0668	PJ0669	PJ0670		
Sampling Date		2016/07/06	2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/20		
COC Number		08426731	08426731	08426731	08426731	08426731	08426731		
	UNITS	CCTMCH-609	CCTMAH-619	CCTMBH-625	CCTMBH-625-R	CCTMAH-627	CCTMBH-630	RDL	QC Batch
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	24.1	4.8	71.7	50.0	74.3	60.1	1.0	8407124
Total Antimony (Sb)	mg/kg	0.0179	0.0406	0.0155	0.0182	0.0166	0.124	0.0050	8407124
Total Arsenic (As)	mg/kg	<0.050	<0.050	<0.050	0.063	0.108	<0.050	0.050	8407124
Total Barium (Ba)	mg/kg	123	30.9	346	310	295	203	0.10	8407124
Total Beryllium (Be)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407124
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	8407124
Total Boron (B)	mg/kg	8.8	22.9	28.7	25.8	14.7	11.5	2.0	8407124
Total Cadmium (Cd)	mg/kg	0.141	0.051	0.085	0.107	0.061	0.070	0.010	8407124
Total Calcium (Ca)	mg/kg	9700	35300	28400	27300	28000	16600	10	8407124
Total Chromium (Cr)	mg/kg	<0.20	<0.20	<0.20	0.28	<0.20	0.21	0.20	8407124
Total Cobalt (Co)	mg/kg	0.413	0.544	0.608	0.441	0.625	0.834	0.020	8407124
Total Copper (Cu)	mg/kg	4.45	2.17	2.23	2.24	2.52	4.04	0.050	8407124
Total Iron (Fe)	mg/kg	45	40	24	23	105	85	10	8407124
Total Lead (Pb)	mg/kg	0.027	0.014	0.052	0.053	0.037	0.056	0.010	8407124
Total Magnesium (Mg)	mg/kg	3590	2280	1760	2040	1350	3840	10	8407124
Total Manganese (Mn)	mg/kg	285	82.5	136	122	202	181	0.10	8407124
Total Mercury (Hg)	mg/kg	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0.010	8407124
Total Molybdenum (Mo)	mg/kg	0.182	0.127	0.117	0.198	0.304	0.383	0.050	8407124
Total Nickel (Ni)	mg/kg	0.813	0.198	3.09	2.76	1.27	1.73	0.050	8407124
Total Phosphorus (P)	mg/kg	2210	945	899	959	748	1070	10	8407124
Total Potassium (K)	mg/kg	26800	28400	9150	10600	14000	26900	10	8407124
Total Selenium (Se)	mg/kg	<0.050	<0.050	0.307	0.511	<0.050	<0.050	0.050	8407124
Total Silver (Ag)	mg/kg	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	8407124
Total Sodium (Na)	mg/kg	<10	48	<10	<10	<10	<10	10	8407124
Total Strontium (Sr)	mg/kg	72.3	99.4	163	153	113	106	0.10	8407124
Total Thallium (Tl)	mg/kg	<0.0020	<0.0020	0.0025	0.0021	0.0031	<0.0020	0.0020	8407124
Total Tin (Sn)	mg/kg	<0.10	<0.10	0.64	<0.10	<0.10	<0.10	0.10	8407124
Total Titanium (Ti)	mg/kg	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.0	8407124
Total Uranium (U)	mg/kg	0.0034	<0.0020	0.0061	0.0046	0.0023	<0.0020	0.0020	8407124
Total Vanadium (V)	mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	0.20	8407124
Total Zinc (Zn)	mg/kg	39.8	27.9	34.0	41.8	22.1	46.9	0.20	8407124

RDL = Reportable Detection Limit

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

PHYSICAL TESTING (TISSUE)

Maxxam ID		PJ0261	PJ0262	PJ0263	PJ0264	PJ0265	PJ0266		
Sampling Date		2016/07/05	2016/07/05	2016/07/05	2016/07/05	2016/07/05	2016/07/05		
COC Number		08426717	08426717	08426717	08426717	08426717	08426717		
	UNITS	CCTMAL-600	CCTMAL-601	CCTMBL-602	CCTMBL-603	CCTMCL-604	CCTMCL-605	RDL	QC Batch
Physical Properties									
Moisture	%	58	64	59	64	53	64	0.30	8408031
RDL = Reportable Detection Limit									

Maxxam ID		PJ0267	PJ0268	PJ0269	PJ0270		PJ0290		
Sampling Date		2016/07/06	2016/07/06	2016/07/06	2016/07/06		2016/07/06		
COC Number		08426717	08426717	08426717	08426717		08426718		
	UNITS	CCTMCL-606	CCTMCL-607	CCTMCL-608	CCTMCL-609	QC Batch	CCTMCL-610	RDL	QC Batch
Physical Properties									
Moisture	%	32	56	66	70	8408031	63	0.30	8409719
RDL = Reportable Detection Limit									

Maxxam ID		PJ0291		PJ0292	PJ0293	PJ0294	PJ0295	PJ0296		
Sampling Date		2016/08/18		2016/08/18	2016/08/18	2016/08/18	2016/08/18	2016/08/18		
COC Number		08426718		08426718	08426718	08426718	08426718	08426718		
	UNITS	CCTMCL-611	QC Batch	CCTMCL-612	CCTMCL-613	CCTMCL-613R	CCTMRL-614	CCTMRL-615	RDL	QC Batch
Physical Properties										
Moisture	%	32	8413052	50	26	21	22	29	0.30	8409719
RDL = Reportable Detection Limit										

Maxxam ID		PJ0297	PJ0298	PJ0299	PJ0326	PJ0327	PJ0328		
Sampling Date		2016/08/18	2016/08/18	2016/08/18	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426718	08426718	08426718	08426719	08426719	08426719		
	UNITS	CCTMRL-616	CCTMRL-617	CCTMRL-618	CCTMAL-619	CCTMBL-620	CCTMBL-621	RDL	QC Batch
Physical Properties									
Moisture	%	26	29	35	62	61	61	0.30	8409719
RDL = Reportable Detection Limit									

Maxxam ID		PJ0329	PJ0330	PJ0331	PJ0332	PJ0333	PJ0334		
Sampling Date		2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426719	08426719	08426719	08426719	08426719	08426719		
	UNITS	CCTMAL-622	CCTMAL-622-R	CCTMAL-623	CCTMBL-624	CCTMAL-626	CCTMAL-627	RDL	QC Batch
Physical Properties									
Moisture	%	61	61	59	68	59	52	0.30	8409719
RDL = Reportable Detection Limit									

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

PHYSICAL TESTING (TISSUE)

Maxxam ID		PJ0335	PJ0369		PJ0370	PJ0371	PJ0372	PJ0373		
Sampling Date		2016/08/19	2016/08/20		2016/08/20	2016/08/20	2016/08/20	2016/08/20		
COC Number		08426719	08426720		08426720	08426720	08426720	08426720		
	UNITS	CCTMAL-628	CCTMBL-630	QC Batch	CCTMAL-631	CCTMAL-632	CCTMBL-633	CCTMBL-634	RDL	QC Batch
Physical Properties										
Moisture	%	49	70	8409719	65	63	56	55	0.30	8409718
RDL = Reportable Detection Limit										

Maxxam ID		PJ0374	PJ0375	PJ0376	PJ0377	PJ0391	PJ0392		
Sampling Date		2016/08/21	2016/08/21	2016/08/21	2016/08/21	2016/08/21	2016/08/21		
COC Number		08426720	08426720	08426720	08426720	08426721	08426721		
	UNITS	CCTMRL-635	CCTMRL-636	CCTMRL-637	CCTMRL-638	CCTMRL-639	CCTMRL-639-R	RDL	QC Batch
Physical Properties									
Moisture	%	25	16	16	29	28	29	0.30	8409718
RDL = Reportable Detection Limit									

Maxxam ID		PJ0411	PJ0412	PJ0413	PJ0414	PJ0415	PJ0416		
Sampling Date		2016/08/21	2016/07/05	2016/07/05	2016/07/05	2016/07/05	2016/07/05		
COC Number		08426722	08426722	08426722	08426722	08426722	08426722		
	UNITS	CCTMAC-600	CCTMAC-601	CCTMBC-602	CCTMBC-603	CCTMCC-604	CCTMCC-605	RDL	QC Batch
Physical Properties									
Moisture	%	51	52	55	51	51	59	0.30	8409718
RDL = Reportable Detection Limit									

Maxxam ID		PJ0417	PJ0418	PJ0419	PJ0420		PJ0433	PJ0434		
Sampling Date		2016/07/06	2016/07/06	2016/07/06	2016/07/06		2016/07/06	2016/08/18		
COC Number		08426722	08426722	08426722	08426722		08426723	08426723		
	UNITS	CCTMCC-606	CCTMCC-607	CCTMCC-608	CCTMCC-609	QC Batch	CCTMCC-610	CCTMCC-611	RDL	QC Batch
Physical Properties										
Moisture	%	56	53	55	52	8409718	57	50	0.30	8411681
RDL = Reportable Detection Limit										

Maxxam ID		PJ0435	PJ0436	PJ0437	PJ0438	PJ0439	PJ0440		
Sampling Date		2016/08/18	2016/08/18	2016/08/18	2016/08/18	2016/08/18	2016/08/18		
COC Number		08426723	08426723	08426723	08426723	08426723	08426723		
	UNITS	CCTMCC-612	CCTMCC-613	CCTMCC-613-R	CCTMRC-614	CCTMRC-615	CCTMRC-616	RDL	QC Batch
Physical Properties									
Moisture	%	54	54	53	54	50	56	0.30	8411681
RDL = Reportable Detection Limit									

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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

PHYSICAL TESTING (TISSUE)

Maxxam ID		PJ0441	PJ0442	PJ0454	PJ0455	PJ0456	PJ0457		
Sampling Date		2016/08/18	2016/08/18	2016/08/19	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426723	08426723	08426724	08426724	08426724	08426724		
	UNITS	CCTMRC-617	CCTMRC-618	CCTMAC-619	CCTMBC-620	CCTMBC-621	CCTMAC-622	RDL	QC Batch
Physical Properties									
Moisture	%	55	55	61	54	51	62	0.30	8411681
RDL = Reportable Detection Limit									

Maxxam ID		PJ0458	PJ0459	PJ0460	PJ0461	PJ0462	PJ0463		
Sampling Date		2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426724	08426724	08426724	08426724	08426724	08426724		
	UNITS	CCTMAC-622-R	CCTMAC-623	CCTMBC-624	CCTMBC-625	CCTMBC-625-R	CCTMAC-626	RDL	QC Batch
Physical Properties									
Moisture	%	60	51	54	54	56	51	0.30	8411681
RDL = Reportable Detection Limit									

Maxxam ID		PJ0475	PJ0476	PJ0477	PJ0478	PJ0479	PJ0480		
Sampling Date		2016/08/19	2016/08/19	2016/08/19	2016/08/20	2016/08/20	2016/08/20		
COC Number		08426725	08426725	08426725	08426725	08426725	08426725		
	UNITS	CCTMAC-627	CCTMAC-628	CCTMBC-629	CCTMBC-630	CCTMAC-631	CCTMAC-632	RDL	QC Batch
Physical Properties									
Moisture	%	55	52	55	58	57	56	0.30	8411700
RDL = Reportable Detection Limit									

Maxxam ID		PJ0481	PJ0482	PJ0483	PJ0484	PJ0491	PJ0492		
Sampling Date		2016/08/20	2016/08/20	2016/08/21	2016/08/21	2016/08/21	2016/08/21		
COC Number		08426725	08426725	08426725	08426725	08426726	08426726		
	UNITS	CCTMBC-633	CCTMBC-634	CCTMRC-635	CCTMRC-636	CCTMRC-637	CCTMRC-638	RDL	QC Batch
Physical Properties									
Moisture	%	54	53	55	52	53	50	0.30	8411700
RDL = Reportable Detection Limit									

Maxxam ID		PJ0493	PJ0494	PJ0518	PJ0519	PJ0520	PJ0521		
Sampling Date		2016/08/21	2016/08/21	2016/07/05	2016/07/05	2016/07/05	2016/07/05		
COC Number		08426726	08426726	08426727	08426727	08426727	08426727		
	UNITS	CCTMRC-639	CCTMRC-639-R	CCTMAW-600	CCTMAW-601	CCTMBW-602	CCTMBW-603	RDL	QC Batch
Physical Properties									
Moisture	%	53	54	62	65	59	62	0.30	8411700
RDL = Reportable Detection Limit									

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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

PHYSICAL TESTING (TISSUE)

Maxxam ID		PJ0522	PJ0523		PJ0524		PJ0525	PJ0526		
Sampling Date		2016/07/05	2016/07/05		2016/07/06		2016/07/06	2016/07/06		
COC Number		08426727	08426727		08426727		08426727	08426727		
	UNITS	CCTMCW-604	CCTMCW-605	QC Batch	CCTMCW-606	QC Batch	CCTMCW-607	CCTMCW-608	RDL	QC Batch
Physical Properties										
Moisture	%	67	64	8411700	62	8413067	67	64	0.30	8413052
RDL = Reportable Detection Limit										

Maxxam ID		PJ0527	PJ0602	PJ0603	PJ0604	PJ0605	PJ0606		
Sampling Date		2016/07/06	2016/07/06	2016/08/18	2016/08/18	2016/08/18	2016/08/18		
COC Number		08426727	08426728	08426728	08426728	08426728	08426728		
	UNITS	CCTMCW-609	CCTMCW-610	CCTMCW-612	CCTMCW-613	CCTMCW-613-R	CCTMRW-614	RDL	QC Batch
Physical Properties									
Moisture	%	63	66	63	64	60	57	0.30	8413052
RDL = Reportable Detection Limit									

Maxxam ID		PJ0607	PJ0608	PJ0609	PJ0610	PJ0611	PJ0632		
Sampling Date		2016/08/18	2016/08/18	2016/08/18	2016/08/18	2016/08/19	2016/08/19		
COC Number		08426728	08426728	08426728	08426728	08426728	08426729		
	UNITS	CCTMRW-615	CCTMRW-616	CCTMRW-617	CCTMRW-618	CCTMAW-619	CCTMBW-620	RDL	QC Batch
Physical Properties									
Moisture	%	58	59	59	60	59	58	0.30	8413052
RDL = Reportable Detection Limit									

Maxxam ID		PJ0633	PJ0634	PJ0635	PJ0636	PJ0637		
Sampling Date		2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426729	08426729	08426729	08426729	08426729		
	UNITS	CCTMAW-622	CCTMAW-622-R	CCTMAW-623	CCTMBW-625	CCTMBW-625-R	RDL	QC Batch
Physical Properties								
Moisture	%	62	62	61	61	61	0.30	8413052
RDL = Reportable Detection Limit								

Maxxam ID		PJ0638	PJ0639	PJ0640	PJ0641	PJ0643	PJ0644		
Sampling Date		2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/20	2016/08/20		
COC Number		08426729	08426729	08426729	08426729	08426730	08426730		
	UNITS	CCTMAW-626	CCTMAW-627	CCTMAW-628	CCTMBW-629	CCTMAW-631	CCTMAW-632	RDL	QC Batch
Physical Properties									
Moisture	%	58	60	62	59	65	62	0.30	8413067
RDL = Reportable Detection Limit									

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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

PHYSICAL TESTING (TISSUE)

Maxxam ID		PJ0645	PJ0646	PJ0647	PJ0648	PJ0649	PJ0650		
Sampling Date		2016/08/20	2016/08/20	2016/08/21	2016/08/21	2016/08/21	2016/08/21		
COC Number		08426730	08426730	08426730	08426730	08426730	08426730		
	UNITS	CCTMBW-633	CCTMBW-634	CCTMRW-635	CCTMRW-636	CCTMRW-637	CCTMRW-638	RDL	QC Batch
Physical Properties									
Moisture	%	60	60	58	58	60	60	0.30	8413067
RDL = Reportable Detection Limit									

Maxxam ID		PJ0651	PJ0652	PJ0664	PJ0665	PJ0666	PJ0667		
Sampling Date		2016/08/21	2016/08/21	2016/07/05	2016/07/06	2016/08/19	2016/08/19		
COC Number		08426730	08426730	08426731	08426731	08426731	08426731		
	UNITS	CCTMRW-639	CCTMRW-639-R	CCTMCH-604	CCTMCH-609	CCTMAH-619	CCTMBH-625	RDL	QC Batch
Physical Properties									
Moisture	%	58	60	74	78	78	69	0.30	8413067
RDL = Reportable Detection Limit									

Maxxam ID		PJ0668	PJ0669		PJ0670		
Sampling Date		2016/08/19	2016/08/19		2016/08/20		
COC Number		08426731	08426731		08426731		
	UNITS	CCTMBH-625-R	CCTMAH-627	QC Batch	CCTMBH-630	RDL	QC Batch
Physical Properties							
Moisture	%	67	75	8413067	78	0.30	8413052
RDL = Reportable Detection Limit							

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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0116		PJ0117	PJ0118	PJ0119		PJ0120		
Sampling Date		2016/07/05		2016/07/05	2016/07/05	2016/07/05		2016/07/05		
COC Number		08426712		08426712	08426712	08426712		08426712		
	UNITS	CCTMAS-600	QC Batch	CCTMAS-601	CCTMBS-602	CCTMBS-603	QC Batch	CCTMCS-604	RDL	QC Batch
Physical Properties										
Soluble (2:1) pH	pH	5.80	8381592	4.98	4.19	7.10 (1)	8381597	4.69	N/A	8382278
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	17500	8381589	18000	3180	41000	8381594	12200	100	8382276
Total Antimony (Sb)	mg/kg	0.62	8381589	0.37	<0.10	1.73	8381594	1.87	0.10	8382276
Total Arsenic (As)	mg/kg	53.1	8381589	8.18	0.90	520	8381594	16.1	0.50	8382276
Total Barium (Ba)	mg/kg	122	8381589	99.8	18.4	300	8381594	158	0.10	8382276
Total Beryllium (Be)	mg/kg	<0.40	8381589	<0.40	<0.40	1.08	8381594	<0.40	0.40	8382276
Total Bismuth (Bi)	mg/kg	<0.10	8381589	0.31	<0.10	0.23	8381594	0.25	0.10	8382276
Total Cadmium (Cd)	mg/kg	0.227	8381589	0.253	<0.050	0.750	8381594	0.796	0.050	8382276
Total Calcium (Ca)	mg/kg	3000	8381589	2780	578	6240	8381594	2820	100	8382276
Total Chromium (Cr)	mg/kg	27.7	8381589	26.7	6.2	49.7	8381594	26.1	1.0	8382276
Total Cobalt (Co)	mg/kg	6.98	8381589	6.52	0.70	9.18	8381594	5.59	0.30	8382276
Total Copper (Cu)	mg/kg	17.8	8381589	12.0	3.23	31.6	8381594	18.2	0.50	8382276
Total Iron (Fe)	mg/kg	23400	8381589	24900	4890	38300	8381594	18000	100	8382276
Total Lead (Pb)	mg/kg	8.54	8381589	12.0	2.10	14.2	8381594	42.2	0.10	8382276
Total Lithium (Li)	mg/kg	10.9	8381589	14.6	<5.0	14.6	8381594	6.2	5.0	8382276
Total Magnesium (Mg)	mg/kg	4300	8381589	3830	298	3850	8381594	3060	100	8382276
Total Manganese (Mn)	mg/kg	294	8381589	520	17.6	670	8381594	177	0.20	8382276
Total Mercury (Hg)	mg/kg	<0.050	8381589	<0.050	<0.050	0.261	8381594	0.071	0.050	8382276
Total Molybdenum (Mo)	mg/kg	0.47	8381589	0.73	0.31	2.17	8381594	1.86	0.10	8382276
Total Nickel (Ni)	mg/kg	16.2	8381589	13.1	1.61	27.6	8381594	13.8	0.80	8382276
Total Phosphorus (P)	mg/kg	489	8381589	351	259	1240	8381594	642	10	8382276
Total Potassium (K)	mg/kg	643	8381589	1020	222	1350	8381594	671	100	8382276
Total Selenium (Se)	mg/kg	<0.50	8381589	<0.50	<0.50	0.55	8381594	0.53	0.50	8382276
Total Silver (Ag)	mg/kg	0.066	8381589	0.089	<0.050	0.491	8381594	0.681	0.050	8382276
Total Sodium (Na)	mg/kg	<100	8381589	108	194	107	8381594	168	100	8382276
Total Strontium (Sr)	mg/kg	21.3	8381589	21.4	7.58	49.5	8381594	24.9	0.10	8382276
Total Thallium (Tl)	mg/kg	0.167	8381589	0.262	<0.050	0.316	8381594	0.325	0.050	8382276
Total Tin (Sn)	mg/kg	0.56	8381589	1.16	0.15	0.72	8381594	0.44	0.10	8382276
Total Titanium (Ti)	mg/kg	881	8381589	1030	84.2	451	8381594	657	1.0	8382276
Total Uranium (U)	mg/kg	1.76	8381589	3.66	0.234	26.8	8381594	5.21	0.050	8382276
Total Vanadium (V)	mg/kg	53.7	8381589	53.2	11.1	60.3	8381594	40.2	2.0	8382276

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Due to high absorbtivity of the sample the water soil extraction ratio has changed from 2:1 to 3:1.

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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0116		PJ0117	PJ0118	PJ0119		PJ0120		
Sampling Date		2016/07/05		2016/07/05	2016/07/05	2016/07/05		2016/07/05		
COC Number		08426712		08426712	08426712	08426712		08426712		
	UNITS	CCTMAS-600	QC Batch	CCTMAS-601	CCTMBS-602	CCTMBS-603	QC Batch	CCTMCS-604	RDL	QC Batch
Total Zinc (Zn)	mg/kg	47.0	8381589	57.6	6.6	76.2	8381594	67.9	1.0	8382276
Total Zirconium (Zr)	mg/kg	4.00	8381589	2.83	<0.50	4.65	8381594	6.00	0.50	8382276
RDL = Reportable Detection Limit										

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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0121	PJ0123		PJ0124	PJ0125	PJ0148	PJ0149		
Sampling Date		2016/07/05	2016/07/06		2016/07/06	2016/07/06	2016/07/06	2016/08/18		
COC Number		08426712	08426712		08426712	08426712	08426713	08426713		
	UNITS	CCTMCS-605	CCTMCS-607	QC Batch	CCTMCS-608	CCTMCS-609	CCTMCS-610	CCTMCS-611	RDL	QC Batch
Physical Properties										
Soluble (2:1) pH	pH	6.12	5.04	8381597	4.77	5.30 (1)	4.82	4.73	N/A	8382278
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	24000	11300	8381594	14900	10400	10900	13000	100	8382276
Total Antimony (Sb)	mg/kg	0.44	0.30	8381594	0.40	0.57	0.58	0.50	0.10	8382276
Total Arsenic (As)	mg/kg	7.65	4.91	8381594	4.51	9.90	6.35	11.7	0.50	8382276
Total Barium (Ba)	mg/kg	138	131	8381594	138	312	91.8	80.6	0.10	8382276
Total Beryllium (Be)	mg/kg	<0.40	<0.40	8381594	<0.40	0.43	<0.40	<0.40	0.40	8382276
Total Bismuth (Bi)	mg/kg	<0.10	<0.10	8381594	0.17	<0.10	0.21	0.25	0.10	8382276
Total Cadmium (Cd)	mg/kg	0.378	0.218	8381594	0.196	0.772	0.317	0.181	0.050	8382276
Total Calcium (Ca)	mg/kg	5120	10400	8381594	3480	7620	1160	2300	100	8382276
Total Chromium (Cr)	mg/kg	44.7	21.1	8381594	28.0	12.4	20.0	24.4	1.0	8382276
Total Cobalt (Co)	mg/kg	16.7	6.39	8381594	8.10	21.5	4.30	3.59	0.30	8382276
Total Copper (Cu)	mg/kg	28.9	12.2	8381594	11.5	15.8	15.3	9.29	0.50	8382276
Total Iron (Fe)	mg/kg	36600	18300	8381594	18400	11200	23500	21000	100	8382276
Total Lead (Pb)	mg/kg	6.95	4.88	8381594	11.8	4.91	9.32	14.9	0.10	8382276
Total Lithium (Li)	mg/kg	10.2	8.4	8381594	8.6	<5.0	5.9	6.6	5.0	8382276
Total Magnesium (Mg)	mg/kg	15400	3410	8381594	4120	1670	2100	3030	100	8382276
Total Manganese (Mn)	mg/kg	574	224	8381594	265	3150	153	102	0.20	8382276
Total Mercury (Hg)	mg/kg	<0.050	<0.050	8381594	<0.050	0.157	<0.050	<0.050	0.050	8382276
Total Molybdenum (Mo)	mg/kg	0.68	0.37	8381594	0.84	0.93	1.56	0.58	0.10	8382276
Total Nickel (Ni)	mg/kg	29.2	13.7	8381594	16.4	11.7	10.7	10.2	0.80	8382276
Total Phosphorus (P)	mg/kg	644	584	8381594	530	1040	267	351	10	8382276
Total Potassium (K)	mg/kg	1430	733	8381594	663	517	354	464	100	8382276
Total Selenium (Se)	mg/kg	<0.50	<0.50	8381594	<0.50	<0.50	<0.50	<0.50	0.50	8382276
Total Silver (Ag)	mg/kg	0.103	0.057	8381594	0.108	0.269	0.227	0.119	0.050	8382276
Total Sodium (Na)	mg/kg	127	196	8381594	209	<100	142	140	100	8382276
Total Strontium (Sr)	mg/kg	34.9	38.8	8381594	27.0	71.0	13.3	17.7	0.10	8382276
Total Thallium (Tl)	mg/kg	0.125	0.069	8381594	0.139	0.134	0.117	0.105	0.050	8382276
Total Tin (Sn)	mg/kg	0.26	0.31	8381594	0.67	0.20	0.53	0.38	0.10	8382276
Total Titanium (Ti)	mg/kg	1140	686	8381594	796	198	657	682	1.0	8382276
Total Uranium (U)	mg/kg	0.419	0.867	8381594	1.17	11.1	0.397	3.60	0.050	8382276
Total Vanadium (V)	mg/kg	80.8	42.1	8381594	53.5	19.1	68.3	56.9	2.0	8382276

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Due to high absorbtivity of the sample the water soil extraction ratio has changed from 2:1 to 6:1.

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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0121	PJ0123		PJ0124	PJ0125	PJ0148	PJ0149		
Sampling Date		2016/07/05	2016/07/06		2016/07/06	2016/07/06	2016/07/06	2016/08/18		
COC Number		08426712	08426712		08426712	08426712	08426713	08426713		
	UNITS	**CCTMCS-605**	**CCTMCS-607**	**QC Batch**	**CCTMCS-608**	**CCTMCS-609**	**CCTMCS-610**	**CCTMCS-611**	**RDL**	**QC Batch**
Total Zinc (Zn)	mg/kg	75.6	40.4	8381594	53.6	29.5	37.6	40.6	1.0	8382276
Total Zirconium (Zr)	mg/kg	2.29	1.88	8381594	1.88	2.06	1.44	3.47	0.50	8382276
RDL = Reportable Detection Limit										

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Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0150		PJ0151		PJ0152	PJ0153		
Sampling Date		2016/08/18		2016/08/18		2016/08/18	2016/08/18		
COC Number		08426713		08426713		08426713	08426713		
	UNITS	CCTMCS-612	QC Batch	CCTMCS-613	QC Batch	CCTMCS-613-R	CCTMRS-614	RDL	QC Batch
Physical Properties									
Soluble (2:1) pH	pH	5.04	8381592	4.40	8382278	4.69	4.96 (1)	N/A	8381597
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	12100	8381589	13500	8382276	14900	9790	100	8381594
Total Antimony (Sb)	mg/kg	0.64	8381589	0.52	8382276	0.55	0.28	0.10	8381594
Total Arsenic (As)	mg/kg	4.90	8381589	7.97	8382276	8.38	2.79	0.50	8381594
Total Barium (Ba)	mg/kg	54.1	8381589	74.4	8382276	56.9	193	0.10	8381594
Total Beryllium (Be)	mg/kg	<0.40	8381589	<0.40	8382276	<0.40	<0.40	0.40	8381594
Total Bismuth (Bi)	mg/kg	0.46	8381589	0.18	8382276	0.16	0.10	0.10	8381594
Total Cadmium (Cd)	mg/kg	0.136	8381589	0.148	8382276	0.150	0.897	0.050	8381594
Total Calcium (Ca)	mg/kg	732	8381589	1210	8382276	1400	4300	100	8381594
Total Chromium (Cr)	mg/kg	19.2	8381589	27.0	8382276	24.9	19.3	1.0	8381594
Total Cobalt (Co)	mg/kg	3.63	8381589	4.90	8382276	5.30	17.6	0.30	8381594
Total Copper (Cu)	mg/kg	11.1	8381589	16.7	8382276	12.8	40.6	0.50	8381594
Total Iron (Fe)	mg/kg	25900	8381589	27600	8382276	33200	14000	100	8381594
Total Lead (Pb)	mg/kg	25.4	8381589	9.75	8382276	8.60	5.29	0.10	8381594
Total Lithium (Li)	mg/kg	5.8	8381589	7.6	8382276	7.8	<5.0	5.0	8381594
Total Magnesium (Mg)	mg/kg	1470	8381589	2900	8382276	2970	1830	100	8381594
Total Manganese (Mn)	mg/kg	438	8381589	171	8382276	201	858	0.20	8381594
Total Mercury (Hg)	mg/kg	0.090	8381589	<0.050	8382276	<0.050	0.105	0.050	8381594
Total Molybdenum (Mo)	mg/kg	2.32	8381589	1.55	8382276	1.11	1.40	0.10	8381594
Total Nickel (Ni)	mg/kg	6.59	8381589	11.1	8382276	13.5	16.0	0.80	8381594
Total Phosphorus (P)	mg/kg	209	8381589	337	8382276	237	1220	10	8381594
Total Potassium (K)	mg/kg	790	8381589	362	8382276	427	410	100	8381594
Total Selenium (Se)	mg/kg	<0.50	8381589	<0.50	8382276	<0.50	<0.50	0.50	8381594
Total Silver (Ag)	mg/kg	<0.050	8381589	<0.050	8382276	<0.050	0.790	0.050	8381594
Total Sodium (Na)	mg/kg	<100	8381589	<100	8382276	<100	143	100	8381594
Total Strontium (Sr)	mg/kg	9.34	8381589	14.1	8382276	11.8	31.5	0.10	8381594
Total Thallium (Tl)	mg/kg	0.299	8381589	0.153	8382276	0.138	0.109	0.050	8381594
Total Tin (Sn)	mg/kg	1.51	8381589	0.62	8382276	0.66	0.14	0.10	8381594
Total Titanium (Ti)	mg/kg	973	8381589	670	8382276	962	157	1.0	8381594
Total Uranium (U)	mg/kg	2.16	8381589	0.735	8382276	0.691	1.84	0.050	8381594
Total Vanadium (V)	mg/kg	59.7	8381589	75.0	8382276	72.0	26.5	2.0	8381594

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Due to high absorbtivity of the sample the water soil extraction ratio has changed from 2:1 to 4:1.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0150		PJ0151		PJ0152	PJ0153		
Sampling Date		2016/08/18		2016/08/18		2016/08/18	2016/08/18		
COC Number		08426713		08426713		08426713	08426713		
	UNITS	**CCTMCS-612**	**QC Batch**	**CCTMCS-613**	**QC Batch**	**CCTMCS-613-R**	**CCTMRS-614**	**RDL**	**QC Batch**
Total Zinc (Zn)	mg/kg	45.2	8381589	33.4	8382276	34.9	27.9	1.0	8381594
Total Zirconium (Zr)	mg/kg	2.76	8381589	1.20	8382276	1.51	0.54	0.50	8381594
RDL = Reportable Detection Limit									

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0154	PJ0155		PJ0156	PJ0157		PJ0186		
Sampling Date		2016/08/18	2016/08/18		2016/08/18	2016/08/19		2016/08/19		
COC Number		08426713	08426713		08426713	08426713		08426714		
	UNITS	CCTMRS-615	CCTMRS-616	QC Batch	CCTMRS-617	CCTMRS-618	QC Batch	CCTMAS-619	RDL	QC Batch
Physical Properties										
Soluble (2:1) pH	pH	5.46	5.46	8381592	4.67	5.38	8381597	7.42	N/A	8382278
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	25500	27700	8381589	10300	28600	8381594	12800	100	8382276
Total Antimony (Sb)	mg/kg	0.24	0.31	8381589	0.29	0.24	8381594	0.42	0.10	8382276
Total Arsenic (As)	mg/kg	3.61	9.29	8381589	6.73	6.96	8381594	7.47	0.50	8382276
Total Barium (Ba)	mg/kg	401	260	8381589	65.7	341	8381594	165	0.10	8382276
Total Beryllium (Be)	mg/kg	<0.40	<0.40	8381589	<0.40	<0.40	8381594	<0.40	0.40	8382276
Total Bismuth (Bi)	mg/kg	<0.10	0.15	8381589	0.12	0.13	8381594	0.12	0.10	8382276
Total Cadmium (Cd)	mg/kg	0.277	0.251	8381589	0.114	0.328	8381594	0.313	0.050	8382276
Total Calcium (Ca)	mg/kg	5220	3880	8381589	1130	4420	8381594	27000	100	8382276
Total Chromium (Cr)	mg/kg	109	64.5	8381589	70.4	87.0	8381594	34.7	1.0	8382276
Total Cobalt (Co)	mg/kg	14.4	16.2	8381589	5.55	23.3	8381594	9.05	0.30	8382276
Total Copper (Cu)	mg/kg	27.4	42.1	8381589	10.9	50.7	8381594	26.5	0.50	8382276
Total Iron (Fe)	mg/kg	28600	36200	8381589	15000	41100	8381594	21300	100	8382276
Total Lead (Pb)	mg/kg	6.23	5.21	8381589	4.19	24.8	8381594	8.59	0.10	8382276
Total Lithium (Li)	mg/kg	10.6	22.5	8381589	<5.0	30.2	8381594	8.4	5.0	8382276
Total Magnesium (Mg)	mg/kg	17300	10700	8381589	4550	13600	8381594	7200	100	8382276
Total Manganese (Mn)	mg/kg	382	458	8381589	110	379	8381594	423	0.20	8382276
Total Mercury (Hg)	mg/kg	<0.050	<0.050	8381589	<0.050	<0.050	8381594	0.056	0.050	8382276
Total Molybdenum (Mo)	mg/kg	0.64	0.70	8381589	0.84	0.98	8381594	0.53	0.10	8382276
Total Nickel (Ni)	mg/kg	45.0	40.6	8381589	67.9	56.7	8381594	21.8	0.80	8382276
Total Phosphorus (P)	mg/kg	493	688	8381589	284	560	8381594	500	10	8382276
Total Potassium (K)	mg/kg	6640	4670	8381589	518	3950	8381594	2190	100	8382276
Total Selenium (Se)	mg/kg	<0.50	<0.50	8381589	<0.50	<0.50	8381594	<0.50	0.50	8382276
Total Silver (Ag)	mg/kg	0.158	0.067	8381589	0.057	0.243	8381594	0.100	0.050	8382276
Total Sodium (Na)	mg/kg	125	211	8381589	113	189	8381594	246	100	8382276
Total Strontium (Sr)	mg/kg	35.6	21.1	8381589	11.0	22.2	8381594	107	0.10	8382276
Total Thallium (Tl)	mg/kg	0.238	0.279	8381589	0.058	0.374	8381594	0.197	0.050	8382276
Total Tin (Sn)	mg/kg	0.33	0.59	8381589	0.36	0.45	8381594	0.38	0.10	8382276
Total Titanium (Ti)	mg/kg	1540	1910	8381589	705	2140	8381594	724	1.0	8382276
Total Uranium (U)	mg/kg	0.518	0.823	8381589	0.309	0.728	8381594	2.91	0.050	8382276
Total Vanadium (V)	mg/kg	77.1	99.0	8381589	46.9	112	8381594	41.9	2.0	8382276

RDL = Reportable Detection Limit
N/A = Not Applicable

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0154	PJ0155		PJ0156	PJ0157		PJ0186		
Sampling Date		2016/08/18	2016/08/18		2016/08/18	2016/08/19		2016/08/19		
COC Number		08426713	08426713		08426713	08426713		08426714		
	UNITS	**CCTMRS-615**	**CCTMRS-616**	**QC Batch**	**CCTMRS-617**	**CCTMRS-618**	**QC Batch**	**CCTMAS-619**	**RDL**	**QC Batch**
Total Zinc (Zn)	mg/kg	62.4	64.2	8381589	20.3	97.7	8381594	62.6	1.0	8382276
Total Zirconium (Zr)	mg/kg	2.83	3.44	8381589	0.64	3.27	8381594	3.65	0.50	8382276
RDL = Reportable Detection Limit										

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0187		PJ0188	PJ0189		PJ0190		
Sampling Date		2016/08/19		2016/08/19	2016/08/19		2016/08/19		
COC Number		08426714		08426714	08426714		08426714		
	UNITS	CCTMBS-620	QC Batch	CCTMBS-621	CCTMAS-622	QC Batch	CCTMAS-622-R	RDL	QC Batch
Physical Properties									
Soluble (2:1) pH	pH	4.78	8382278	4.32 (1)	5.09	8381597	4.71	N/A	8381592
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	13100	8382276	11000	15600	8381594	17000	100	8381589
Total Antimony (Sb)	mg/kg	0.32	8382276	0.13	0.29	8381594	0.28	0.10	8381589
Total Arsenic (As)	mg/kg	6.42	8382276	2.65	7.75	8381594	9.71	0.50	8381589
Total Barium (Ba)	mg/kg	96.3	8382276	82.9	171	8381594	186	0.10	8381589
Total Beryllium (Be)	mg/kg	<0.40	8382276	<0.40	<0.40	8381594	<0.40	0.40	8381589
Total Bismuth (Bi)	mg/kg	0.14	8382276	0.12	0.14	8381594	0.18	0.10	8381589
Total Cadmium (Cd)	mg/kg	0.168	8382276	0.131	0.101	8381594	0.155	0.050	8381589
Total Calcium (Ca)	mg/kg	2780	8382276	2760	2860	8381594	2740	100	8381589
Total Chromium (Cr)	mg/kg	23.4	8382276	34.4	26.8	8381594	33.8	1.0	8381589
Total Cobalt (Co)	mg/kg	4.67	8382276	4.70	8.55	8381594	10.2	0.30	8381589
Total Copper (Cu)	mg/kg	8.26	8382276	10.6	11.3	8381594	11.6	0.50	8381589
Total Iron (Fe)	mg/kg	18300	8382276	14700	24300	8381594	25900	100	8381589
Total Lead (Pb)	mg/kg	10.0	8382276	6.38	6.53	8381594	8.16	0.10	8381589
Total Lithium (Li)	mg/kg	7.8	8382276	<5.0	8.9	8381594	10.3	5.0	8381589
Total Magnesium (Mg)	mg/kg	3660	8382276	4130	4420	8381594	5120	100	8381589
Total Manganese (Mn)	mg/kg	175	8382276	127	274	8381594	426	0.20	8381589
Total Mercury (Hg)	mg/kg	0.066	8382276	0.061	<0.050	8381594	<0.050	0.050	8381589
Total Molybdenum (Mo)	mg/kg	0.63	8382276	0.56	0.85	8381594	1.36	0.10	8381589
Total Nickel (Ni)	mg/kg	12.5	8382276	10.9	14.6	8381594	16.2	0.80	8381589
Total Phosphorus (P)	mg/kg	560	8382276	500	283	8381594	356	10	8381589
Total Potassium (K)	mg/kg	514	8382276	1090	610	8381594	736	100	8381589
Total Selenium (Se)	mg/kg	<0.50	8382276	<0.50	<0.50	8381594	<0.50	0.50	8381589
Total Silver (Ag)	mg/kg	0.101	8382276	0.068	0.055	8381594	0.072	0.050	8381589
Total Sodium (Na)	mg/kg	173	8382276	110	153	8381594	122	100	8381589
Total Strontium (Sr)	mg/kg	20.9	8382276	21.2	20.1	8381594	22.8	0.10	8381589
Total Thallium (Tl)	mg/kg	0.131	8382276	0.110	0.125	8381594	0.189	0.050	8381589
Total Tin (Sn)	mg/kg	0.48	8382276	0.41	0.43	8381594	0.58	0.10	8381589
Total Titanium (Ti)	mg/kg	714	8382276	702	819	8381594	1110	1.0	8381589
Total Uranium (U)	mg/kg	2.44	8382276	1.17	0.490	8381594	0.526	0.050	8381589
Total Vanadium (V)	mg/kg	43.6	8382276	25.8	52.4	8381594	71.2	2.0	8381589

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Due to high absorbtivity of the sample the water soil extraction ratio has changed from 2:1 to 4:1.

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0187		PJ0188	PJ0189		PJ0190		
Sampling Date		2016/08/19		2016/08/19	2016/08/19		2016/08/19		
COC Number		08426714		08426714	08426714		08426714		
	UNITS	**CCTMBS-620**	**QC Batch**	**CCTMBS-621**	**CCTMAS-622**	**QC Batch**	**CCTMAS-622-R**	**RDL**	**QC Batch**
Total Zinc (Zn)	mg/kg	47.1	8382276	29.2	29.7	8381594	34.3	1.0	8381589
Total Zirconium (Zr)	mg/kg	1.68	8382276	1.58	1.02	8381594	1.33	0.50	8381589
RDL = Reportable Detection Limit									

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0191	PJ0192	PJ0193	PJ0194	PJ0195		
Sampling Date		2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426714	08426714	08426714	08426714	08426714		
	UNITS	CCTMAS-623	CCTMBS-624	CCTMBS-625	CCTMBS-625-R	CCTMAS-626	RDL	QC Batch
Physical Properties								
Soluble (2:1) pH	pH	4.39	4.64	4.46	4.73	4.48 (1)	N/A	8381597
Total Metals by ICPMS								
Total Aluminum (Al)	mg/kg	10200	13400	10900	9270	8130	100	8381594
Total Antimony (Sb)	mg/kg	1.20	11.2	0.66	0.41	0.22	0.10	8381594
Total Arsenic (As)	mg/kg	20.9	16.9	11.8	5.85	1.92	0.50	8381594
Total Barium (Ba)	mg/kg	73.0	131	42.6	38.1	80.3	0.10	8381594
Total Beryllium (Be)	mg/kg	<0.40	0.47	<0.40	<0.40	<0.40	0.40	8381594
Total Bismuth (Bi)	mg/kg	0.11	0.16	0.14	0.12	<0.10	0.10	8381594
Total Cadmium (Cd)	mg/kg	0.246	0.243	0.178	0.212	0.261	0.050	8381594
Total Calcium (Ca)	mg/kg	1840	3590	1170	686	1930	100	8381594
Total Chromium (Cr)	mg/kg	21.0	28.1	16.5	11.4	18.3	1.0	8381594
Total Cobalt (Co)	mg/kg	5.03	12.0	3.47	3.08	2.99	0.30	8381594
Total Copper (Cu)	mg/kg	10.9	9.88	7.82	8.65	10.4	0.50	8381594
Total Iron (Fe)	mg/kg	16600	28100	16200	13600	9770	100	8381594
Total Lead (Pb)	mg/kg	5.92	10.3	8.69	6.08	3.55	0.10	8381594
Total Lithium (Li)	mg/kg	<5.0	5.8	5.3	<5.0	<5.0	5.0	8381594
Total Magnesium (Mg)	mg/kg	2380	6280	2050	812	2300	100	8381594
Total Manganese (Mn)	mg/kg	132	602	149	340	62.3	0.20	8381594
Total Mercury (Hg)	mg/kg	0.086	<0.050	<0.050	<0.050	0.053	0.050	8381594
Total Molybdenum (Mo)	mg/kg	1.20	0.90	0.82	0.83	0.64	0.10	8381594
Total Nickel (Ni)	mg/kg	10.6	10.6	6.84	3.64	7.75	0.80	8381594
Total Phosphorus (P)	mg/kg	460	393	264	214	491	10	8381594
Total Potassium (K)	mg/kg	559	2480	582	393	533	100	8381594
Total Selenium (Se)	mg/kg	<0.50	<0.50	<0.50	<0.50	<0.50	0.50	8381594
Total Silver (Ag)	mg/kg	0.082	0.082	0.053	0.073	0.096	0.050	8381594
Total Sodium (Na)	mg/kg	106	<100	128	137	152	100	8381594
Total Strontium (Sr)	mg/kg	14.5	19.5	9.74	7.77	15.5	0.10	8381594
Total Thallium (Tl)	mg/kg	0.101	0.161	0.106	0.080	0.116	0.050	8381594
Total Tin (Sn)	mg/kg	0.34	0.94	0.40	0.34	0.37	0.10	8381594
Total Titanium (Ti)	mg/kg	581	656	592	480	434	1.0	8381594
Total Uranium (U)	mg/kg	1.43	0.893	0.545	0.676	0.985	0.050	8381594
Total Vanadium (V)	mg/kg	44.2	65.6	34.6	30.5	21.3	2.0	8381594

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Due to high absorbtivity of the sample the water soil extraction ratio has changed from 2:1 to 3:1.

Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0191	PJ0192	PJ0193	PJ0194	PJ0195		
Sampling Date		2016/08/19	2016/08/19	2016/08/19	2016/08/19	2016/08/19		
COC Number		08426714	08426714	08426714	08426714	08426714		
	UNITS	CCTMAS-623	CCTMBS-624	CCTMBS-625	CCTMBS-625-R	CCTMAS-626	RDL	QC Batch
Total Zinc (Zn)	mg/kg	23.4	48.4	24.4	15.7	17.8	1.0	8381594
Total Zirconium (Zr)	mg/kg	1.00	0.97	0.86	0.80	0.59	0.50	8381594
RDL = Reportable Detection Limit								

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Maxxam Job #: B672722
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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0216	PJ0217	PJ0218		PJ0219	PJ0220		
Sampling Date		2016/08/19	2016/08/19	2016/08/19		2016/08/20	2016/08/20		
COC Number		08426715	08426715	08426715		08426715	08426715		
	UNITS	CCTMAS-627	CCTMAS-628	CCTMBS-629	QC Batch	CCTMBS-630	CCTMAS-631	RDL	QC Batch
Physical Properties									
Soluble (2:1) pH	pH	4.06 (1)	4.17	4.92	8382278	4.76	4.31	N/A	8381597
Total Metals by ICPMS									
Total Aluminum (Al)	mg/kg	3000	10900	25400	8382276	15300	12100	100	8381594
Total Antimony (Sb)	mg/kg	0.23	0.34	0.41	8382276	0.28	3.31	0.10	8381594
Total Arsenic (As)	mg/kg	2.36	6.53	8.80	8382276	6.06	22.9	0.50	8381594
Total Barium (Ba)	mg/kg	39.3	85.8	146	8382276	110	66.6	0.10	8381594
Total Beryllium (Be)	mg/kg	<0.40	<0.40	0.40	8382276	0.42	<0.40	0.40	8381594
Total Bismuth (Bi)	mg/kg	<0.10	0.13	0.25	8382276	0.14	0.32	0.10	8381594
Total Cadmium (Cd)	mg/kg	0.250	0.179	0.235	8382276	0.164	0.178	0.050	8381594
Total Calcium (Ca)	mg/kg	958	1420	2670	8382276	2910	1250	100	8381594
Total Chromium (Cr)	mg/kg	8.3	21.4	41.0	8382276	23.4	27.9	1.0	8381594
Total Cobalt (Co)	mg/kg	1.37	5.89	9.11	8382276	7.64	6.36	0.30	8381594
Total Copper (Cu)	mg/kg	9.12	11.7	11.9	8382276	10.9	11.2	0.50	8381594
Total Iron (Fe)	mg/kg	6460	18700	33600	8382276	20200	21800	100	8381594
Total Lead (Pb)	mg/kg	2.27	7.93	12.4	8382276	5.34	20.0	0.10	8381594
Total Lithium (Li)	mg/kg	<5.0	<5.0	18.6	8382276	6.2	5.3	5.0	8381594
Total Magnesium (Mg)	mg/kg	426	3570	6390	8382276	4700	3330	100	8381594
Total Manganese (Mn)	mg/kg	38.7	218	250	8382276	143	392	0.20	8381594
Total Mercury (Hg)	mg/kg	0.062	<0.050	<0.050	8382276	<0.050	0.095	0.050	8381594
Total Molybdenum (Mo)	mg/kg	0.64	0.74	1.34	8382276	0.53	1.19	0.10	8381594
Total Nickel (Ni)	mg/kg	3.57	11.0	22.1	8382276	13.4	13.2	0.80	8381594
Total Phosphorus (P)	mg/kg	643	390	234	8382276	390	421	10	8381594
Total Potassium (K)	mg/kg	340	590	1170	8382276	1310	686	100	8381594
Total Selenium (Se)	mg/kg	<0.50	<0.50	<0.50	8382276	<0.50	<0.50	0.50	8381594
Total Silver (Ag)	mg/kg	0.112	0.064	0.077	8382276	0.101	0.111	0.050	8381594
Total Sodium (Na)	mg/kg	144	103	<100	8382276	<100	<100	100	8381594
Total Strontium (Sr)	mg/kg	8.90	13.1	19.9	8382276	19.2	10.7	0.10	8381594
Total Thallium (Tl)	mg/kg	<0.050	0.120	0.206	8382276	0.133	0.114	0.050	8381594
Total Tin (Sn)	mg/kg	0.15	0.38	0.84	8382276	0.64	0.61	0.10	8381594
Total Titanium (Ti)	mg/kg	125	636	854	8382276	808	672	1.0	8381594
Total Uranium (U)	mg/kg	0.369	0.507	0.612	8382276	1.88	1.30	0.050	8381594
Total Vanadium (V)	mg/kg	17.5	55.3	79.8	8382276	41.0	50.6	2.0	8381594

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Due to high absorbtivity of the sample the water soil extraction ratio has changed from 2:1 to 3:1.

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0216	PJ0217	PJ0218		PJ0219	PJ0220		
Sampling Date		2016/08/19	2016/08/19	2016/08/19		2016/08/20	2016/08/20		
COC Number		08426715	08426715	08426715		08426715	08426715		
	UNITS	CCTMAS-627	CCTMAS-628	CCTMBS-629	QC Batch	CCTMBS-630	CCTMAS-631	RDL	QC Batch
Total Zinc (Zn)	mg/kg	17.6	34.7	67.3	8382276	27.5	33.2	1.0	8381594
Total Zirconium (Zr)	mg/kg	0.66	1.40	3.98	8382276	1.54	0.88	0.50	8381594
RDL = Reportable Detection Limit									

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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0221		PJ0222		PJ0223		PJ0224		
Sampling Date		2016/08/20		2016/08/20		2016/08/20		2016/08/21		
COC Number		08426715		08426715		08426715		08426715		
	UNITS	CCTMAS-632	QC Batch	CCTMBS-633	QC Batch	CCTMBS-634	QC Batch	CCTMRS-635	RDL	QC Batch
Physical Properties										
Soluble (2:1) pH	pH	5.14	8382278	6.20	8381597	6.85	8382278	6.72	N/A	8381592
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	21300	8382276	23100	8381594	11400	8382276	7670	100	8381589
Total Antimony (Sb)	mg/kg	0.36	8382276	0.22	8381594	0.56	8382276	0.28	0.10	8381589
Total Arsenic (As)	mg/kg	9.61	8382276	5.71	8381594	10.0	8382276	5.93	0.50	8381589
Total Barium (Ba)	mg/kg	149	8382276	222	8381594	335	8382276	197	0.10	8381589
Total Beryllium (Be)	mg/kg	1.00	8382276	<0.40	8381594	0.41	8382276	<0.40	0.40	8381589
Total Bismuth (Bi)	mg/kg	0.27	8382276	0.15	8381594	0.14	8382276	<0.10	0.10	8381589
Total Cadmium (Cd)	mg/kg	0.517	8382276	0.107	8381594	0.251	8382276	0.415	0.050	8381589
Total Calcium (Ca)	mg/kg	4200	8382276	7090	8381594	22100	8382276	6870	100	8381589
Total Chromium (Cr)	mg/kg	34.8	8382276	95.0	8381594	32.4	8382276	291	1.0	8381589
Total Cobalt (Co)	mg/kg	9.15	8382276	14.8	8381594	10.7	8382276	26.5	0.30	8381589
Total Copper (Cu)	mg/kg	21.1	8382276	35.5	8381594	21.4	8382276	58.5	0.50	8381589
Total Iron (Fe)	mg/kg	27200	8382276	20100	8381594	21600	8382276	18500	100	8381589
Total Lead (Pb)	mg/kg	18.3	8382276	3.72	8381594	6.37	8382276	2.54	0.10	8381589
Total Lithium (Li)	mg/kg	11.3	8382276	11.7	8381594	8.5	8382276	<5.0	5.0	8381589
Total Magnesium (Mg)	mg/kg	7160	8382276	11300	8381594	6090	8382276	15300	100	8381589
Total Manganese (Mn)	mg/kg	444	8382276	214	8381594	420	8382276	999	0.20	8381589
Total Mercury (Hg)	mg/kg	<0.050	8382276	<0.050	8381594	0.061	8382276	0.070	0.050	8381589
Total Molybdenum (Mo)	mg/kg	1.57	8382276	0.19	8381594	0.57	8382276	0.56	0.10	8381589
Total Nickel (Ni)	mg/kg	16.8	8382276	53.5	8381594	23.1	8382276	290	0.80	8381589
Total Phosphorus (P)	mg/kg	502	8382276	343	8381594	472	8382276	686	10	8381589
Total Potassium (K)	mg/kg	1500	8382276	915	8381594	2300	8382276	378	100	8381589
Total Selenium (Se)	mg/kg	<0.50	8382276	<0.50	8381594	<0.50	8382276	<0.50	0.50	8381589
Total Silver (Ag)	mg/kg	0.370	8382276	<0.050	8381594	0.098	8382276	0.130	0.050	8381589
Total Sodium (Na)	mg/kg	209	8382276	345	8381594	178	8382276	<100	100	8381589
Total Strontium (Sr)	mg/kg	34.0	8382276	67.1	8381594	173	8382276	25.1	0.10	8381589
Total Thallium (Tl)	mg/kg	0.269	8382276	0.127	8381594	0.173	8382276	0.105	0.050	8381589
Total Tin (Sn)	mg/kg	1.05	8382276	0.32	8381594	0.35	8382276	<0.10	0.10	8381589
Total Titanium (Ti)	mg/kg	1040	8382276	672	8381594	673	8382276	248	1.0	8381589
Total Uranium (U)	mg/kg	3.36	8382276	0.505	8381594	1.90	8382276	0.230	0.050	8381589
Total Vanadium (V)	mg/kg	65.0	8382276	36.2	8381594	37.8	8382276	22.5	2.0	8381589

RDL = Reportable Detection Limit
N/A = Not Applicable

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0221		PJ0222		PJ0223		PJ0224		
Sampling Date		2016/08/20		2016/08/20		2016/08/20		2016/08/21		
COC Number		08426715		08426715		08426715		08426715		
	UNITS	CCTMAS-632	QC Batch	CCTMBS-633	QC Batch	CCTMBS-634	QC Batch	CCTMRS-635	RDL	QC Batch
Total Zinc (Zn)	mg/kg	80.3	8382276	29.3	8381594	39.1	8382276	41.4	1.0	8381589
Total Zirconium (Zr)	mg/kg	3.31	8382276	1.15	8381594	4.00	8382276	0.61	0.50	8381589
RDL = Reportable Detection Limit										

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Maxxam Job #: B672722
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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0225		PJ0238		PJ0239		PJ0240		
Sampling Date		2016/08/21		2016/08/21		2016/08/21		2016/08/21		
COC Number		08426715		08426716		08426716		08426716		
	UNITS	CCTMRS-636	QC Batch	CCTMRS-637	QC Batch	CCTMRS-638	QC Batch	CCTMRS-639	RDL	QC Batch
Physical Properties										
Soluble (2:1) pH	pH	5.57	8381592	5.18	8381597	4.54	8381592	4.73	N/A	8382278
Total Metals by ICPMS										
Total Aluminum (Al)	mg/kg	17500	8381589	21800	8381594	6500	8381589	13000	100	8382276
Total Antimony (Sb)	mg/kg	0.51	8381589	0.38	8381594	0.13	8381589	0.35	0.10	8382276
Total Arsenic (As)	mg/kg	7.04	8381589	7.63	8381594	1.42	8381589	6.94	0.50	8382276
Total Barium (Ba)	mg/kg	639	8381589	129	8381594	172	8381589	138	0.10	8382276
Total Beryllium (Be)	mg/kg	0.62	8381589	0.48	8381594	<0.40	8381589	<0.40	0.40	8382276
Total Bismuth (Bi)	mg/kg	0.16	8381589	0.13	8381594	<0.10	8381589	0.33	0.10	8382276
Total Cadmium (Cd)	mg/kg	0.686	8381589	0.172	8381594	0.434	8381589	0.192	0.050	8382276
Total Calcium (Ca)	mg/kg	6310	8381589	3090	8381594	2420	8381589	3300	100	8382276
Total Chromium (Cr)	mg/kg	29.6	8381589	34.1	8381594	9.2	8381589	28.8	1.0	8382276
Total Cobalt (Co)	mg/kg	30.5	8381589	12.1	8381594	2.90	8381589	10.4	0.30	8382276
Total Copper (Cu)	mg/kg	33.8	8381589	24.3	8381594	36.5	8381589	22.7	0.50	8382276
Total Iron (Fe)	mg/kg	27300	8381589	31500	8381594	8230	8381589	25100	100	8382276
Total Lead (Pb)	mg/kg	9.22	8381589	7.62	8381594	5.42	8381589	37.6	0.10	8382276
Total Lithium (Li)	mg/kg	6.5	8381589	12.7	8381594	<5.0	8381589	9.0	5.0	8382276
Total Magnesium (Mg)	mg/kg	2620	8381589	6700	8381594	654	8381589	6540	100	8382276
Total Manganese (Mn)	mg/kg	11600	8381589	357	8381594	41.4	8381589	332	0.20	8382276
Total Mercury (Hg)	mg/kg	0.137	8381589	<0.050	8381594	0.065	8381589	<0.050	0.050	8382276
Total Molybdenum (Mo)	mg/kg	2.66	8381589	0.94	8381594	0.79	8381589	0.93	0.10	8382276
Total Nickel (Ni)	mg/kg	36.4	8381589	23.8	8381594	9.02	8381589	16.9	0.80	8382276
Total Phosphorus (P)	mg/kg	1310	8381589	417	8381594	629	8381589	537	10	8382276
Total Potassium (K)	mg/kg	589	8381589	739	8381594	361	8381589	685	100	8382276
Total Selenium (Se)	mg/kg	0.56	8381589	<0.50	8381594	<0.50	8381589	<0.50	0.50	8382276
Total Silver (Ag)	mg/kg	0.428	8381589	<0.050	8381594	0.203	8381589	0.144	0.050	8382276
Total Sodium (Na)	mg/kg	143	8381589	<100	8381594	143	8381589	123	100	8382276
Total Strontium (Sr)	mg/kg	38.9	8381589	20.1	8381594	20.5	8381589	22.3	0.10	8382276
Total Thallium (Tl)	mg/kg	0.233	8381589	0.088	8381594	<0.050	8381589	0.093	0.050	8382276
Total Tin (Sn)	mg/kg	0.30	8381589	0.51	8381594	0.11	8381589	0.32	0.10	8382276
Total Titanium (Ti)	mg/kg	248	8381589	781	8381594	95.6	8381589	940	1.0	8382276
Total Uranium (U)	mg/kg	1.43	8381589	0.852	8381594	1.50	8381589	0.473	0.050	8382276
Total Vanadium (V)	mg/kg	45.0	8381589	65.8	8381594	13.2	8381589	58.9	2.0	8382276

RDL = Reportable Detection Limit
N/A = Not Applicable

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0225		PJ0238		PJ0239		PJ0240		
Sampling Date		2016/08/21		2016/08/21		2016/08/21		2016/08/21		
COC Number		08426715		08426716		08426716		08426716		
	UNITS	**CCTMRS-636**	**QC Batch**	**CCTMRS-637**	**QC Batch**	**CCTMRS-638**	**QC Batch**	**CCTMRS-639**	**RDL**	**QC Batch**
Total Zinc (Zn)	mg/kg	72.2	8381589	54.6	8381594	11.7	8381589	53.3	1.0	8382276
Total Zirconium (Zr)	mg/kg	0.61	8381589	1.19	8381594	<0.50	8381589	1.03	0.50	8382276
RDL = Reportable Detection Limit										

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EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0241	PJ2887		
Sampling Date		2016/08/21	2016/08/19		
COC Number		08426716	08426713		
	UNITS	CCTMRS-639-R	CCTMCS-606	RDL	QC Batch
Physical Properties					
Soluble (2:1) pH	pH	4.02 (1)	4.98	N/A	8382278
Total Metals by ICPMS					
Total Aluminum (Al)	mg/kg	7550	14800	100	8382276
Total Antimony (Sb)	mg/kg	0.23	0.45	0.10	8382276
Total Arsenic (As)	mg/kg	4.20	8.22	0.50	8382276
Total Barium (Ba)	mg/kg	57.0	278	0.10	8382276
Total Beryllium (Be)	mg/kg	<0.40	<0.40	0.40	8382276
Total Bismuth (Bi)	mg/kg	0.82	0.12	0.10	8382276
Total Cadmium (Cd)	mg/kg	0.550	0.690	0.050	8382276
Total Calcium (Ca)	mg/kg	1290	4340	100	8382276
Total Chromium (Cr)	mg/kg	20.0	28.0	1.0	8382276
Total Cobalt (Co)	mg/kg	5.70	9.16	0.30	8382276
Total Copper (Cu)	mg/kg	21.6	15.5	0.50	8382276
Total Iron (Fe)	mg/kg	16400	22300	100	8382276
Total Lead (Pb)	mg/kg	26.5	6.72	0.10	8382276
Total Lithium (Li)	mg/kg	<5.0	9.2	5.0	8382276
Total Magnesium (Mg)	mg/kg	3030	4070	100	8382276
Total Manganese (Mn)	mg/kg	163	420	0.20	8382276
Total Mercury (Hg)	mg/kg	0.056	<0.050	0.050	8382276
Total Molybdenum (Mo)	mg/kg	0.74	1.45	0.10	8382276
Total Nickel (Ni)	mg/kg	8.51	19.0	0.80	8382276
Total Phosphorus (P)	mg/kg	613	375	10	8382276
Total Potassium (K)	mg/kg	555	358	100	8382276
Total Selenium (Se)	mg/kg	<0.50	<0.50	0.50	8382276
Total Silver (Ag)	mg/kg	0.229	0.076	0.050	8382276
Total Sodium (Na)	mg/kg	119	192	100	8382276
Total Strontium (Sr)	mg/kg	12.4	29.4	0.10	8382276
Total Thallium (Tl)	mg/kg	<0.050	0.109	0.050	8382276
Total Tin (Sn)	mg/kg	0.22	0.42	0.10	8382276
Total Titanium (Ti)	mg/kg	419	631	1.0	8382276
Total Uranium (U)	mg/kg	0.403	0.569	0.050	8382276

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Due to high absorbtivity of the sample the water soil extraction ratio has changed from 2:1 to 3:1.

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Maxxam Job #: B672722
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

CSR/CCME METALS IN SOIL (SOIL)

Maxxam ID		PJ0241	PJ2887		
Sampling Date		2016/08/21	2016/08/19		
COC Number		08426716	08426713		
	UNITS	**CCTMRS-639-R**	**CCTMCS-606**	**RDL**	**QC Batch**
Total Vanadium (V)	mg/kg	40.8	61.2	2.0	8382276
Total Zinc (Zn)	mg/kg	30.0	51.1	1.0	8382276
Total Zirconium (Zr)	mg/kg	0.70	2.46	0.50	8382276
RDL = Reportable Detection Limit					

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EDI ENVIRONMENTAL DYNAMICS INC.
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GENERAL COMMENTS

Samples from PJ0116 to PJ0148, PJ0261 to PJ0290, PJ0412 to PJ0433, PJ0519 to PJ0602, were received after holding time expired on mercury.

Sample PJ0116-01 : Sample received past method-specified hold time for Total Mercury in soil.

Sample PJ0117-01 : Sample received past method-specified hold time for Total Mercury in soil.

Sample PJ0118-01 : Sample received past method-specified hold time for Total Mercury in soil.

Sample PJ0119-01 : Sample received past method-specified hold time for Total Mercury in soil.

Sample PJ0120-01 : Sample received past method-specified hold time for Total Mercury in soil.

Sample PJ0121-01 : Sample received past method-specified hold time for Total Mercury in soil.

Sample PJ0123-01 : Sample received past method-specified hold time for Total Mercury in soil.

Sample PJ0124-01 : Sample received past method-specified hold time for Total Mercury in soil.

Sample PJ0125-01 : Sample received past method-specified hold time for Total Mercury in soil.

Sample PJ0148-01 : Sample received past method-specified hold time for Total Mercury in soil.

Results relate only to the items tested.

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Report Date: 2016/09/29

QUALITY ASSURANCE REPORT

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8378803	Moisture	2016/08/29					<0.30	%	4.0	20		
8378807	Moisture	2016/08/29					<0.30	%	5.0	20		
8378819	Moisture	2016/08/29					<0.30	%	1.5	20		
8381589	Total Aluminum (Al)	2016/08/30					<100	mg/kg	0.75	35	98	70 - 130
8381589	Total Antimony (Sb)	2016/08/30	91	75 - 125	92	75 - 125	<0.10	mg/kg	NC	30	106	70 - 130
8381589	Total Arsenic (As)	2016/08/30	87	75 - 125	90	75 - 125	<0.50	mg/kg	NC	30	84	70 - 130
8381589	Total Barium (Ba)	2016/08/30	NC	75 - 125	97	75 - 125	<0.10	mg/kg	2.7	35	95	70 - 130
8381589	Total Beryllium (Be)	2016/08/30	94	75 - 125	90	75 - 125	<0.40	mg/kg	NC	30	89	70 - 130
8381589	Total Bismuth (Bi)	2016/08/30					<0.10	mg/kg	NC	30		
8381589	Total Cadmium (Cd)	2016/08/30	97	75 - 125	99	75 - 125	<0.050	mg/kg	NC	30	116	70 - 130
8381589	Total Calcium (Ca)	2016/08/30					<100	mg/kg	2.1	30	94	70 - 130
8381589	Total Chromium (Cr)	2016/08/30	91	75 - 125	97	75 - 125	<1.0	mg/kg	0.069	30	101	70 - 130
8381589	Total Cobalt (Co)	2016/08/30	95	75 - 125	98	75 - 125	<0.30	mg/kg	0.39	30	93	70 - 130
8381589	Total Copper (Cu)	2016/08/30	NC	75 - 125	99	75 - 125	<0.50	mg/kg	4.8	30	102	70 - 130
8381589	Total Iron (Fe)	2016/08/30					<100	mg/kg	1.4	30	95	70 - 130
8381589	Total Lead (Pb)	2016/08/30	94	75 - 125	97	75 - 125	<0.10	mg/kg	4.1	35	100	70 - 130
8381589	Total Lithium (Li)	2016/08/30	100	75 - 125	95	75 - 125	<5.0	mg/kg	NC	30	96	70 - 130
8381589	Total Magnesium (Mg)	2016/08/30					<100	mg/kg	2.2	30	93	70 - 130
8381589	Total Manganese (Mn)	2016/08/30	NC	75 - 125	97	75 - 125	<0.20	mg/kg	0.44	30	96	70 - 130
8381589	Total Mercury (Hg)	2016/08/30	90	75 - 125	91	75 - 125	<0.050	mg/kg	NC	35	129	70 - 130
8381589	Total Molybdenum (Mo)	2016/08/30	97	75 - 125	97	75 - 125	<0.10	mg/kg	4.4	35	116	70 - 130
8381589	Total Nickel (Ni)	2016/08/30	95	75 - 125	95	75 - 125	<0.80	mg/kg	4.3	30	125	70 - 130
8381589	Total Phosphorus (P)	2016/08/30					<10	mg/kg	0.49	30	87	70 - 130
8381589	Total Potassium (K)	2016/08/30					<100	mg/kg	NC	35	91	70 - 130
8381589	Total Selenium (Se)	2016/08/30	86	75 - 125	88	75 - 125	<0.50	mg/kg	NC	30		
8381589	Total Silver (Ag)	2016/08/30	93	75 - 125	91	75 - 125	<0.050	mg/kg	NC	35	92	70 - 130
8381589	Total Sodium (Na)	2016/08/30					<100	mg/kg	NC	35	77	70 - 130
8381589	Total Strontium (Sr)	2016/08/30	96	75 - 125	96	75 - 125	<0.10	mg/kg	3.4	35	99	70 - 130
8381589	Total Thallium (Tl)	2016/08/30	92	75 - 125	93	75 - 125	<0.050	mg/kg	NC	30	86	70 - 130
8381589	Total Tin (Sn)	2016/08/30	90	75 - 125	90	75 - 125	<0.10	mg/kg	1.5	35	90	70 - 130
8381589	Total Titanium (Ti)	2016/08/30	NC	75 - 125	95	75 - 125	<1.0	mg/kg	0.90	35		

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8381589	Total Uranium (U)	2016/08/30	89	75 - 125	89	75 - 125	<0.050	mg/kg	NC	30	89	70 - 130
8381589	Total Vanadium (V)	2016/08/30	NC	75 - 125	95	75 - 125	<2.0	mg/kg	0.95	30	95	70 - 130
8381589	Total Zinc (Zn)	2016/08/30	NC	75 - 125	90	75 - 125	<1.0	mg/kg	3.4	30	93	70 - 130
8381589	Total Zirconium (Zr)	2016/08/30					<0.50	mg/kg	4.6	30		
8381592	Soluble (2:1) pH	2016/08/30			100	97 - 103			0.17	N/A		
8381594	Total Aluminum (Al)	2016/08/30					<100	mg/kg	12	35	106	70 - 130
8381594	Total Antimony (Sb)	2016/08/30	90	75 - 125	95	75 - 125	<0.10	mg/kg	NC	30	108	70 - 130
8381594	Total Arsenic (As)	2016/08/30	87	75 - 125	94	75 - 125	<0.50	mg/kg	NC	30	87	70 - 130
8381594	Total Barium (Ba)	2016/08/30	89	75 - 125	95	75 - 125	0.12, RDL=0.10	mg/kg	9.3	35	92	70 - 130
8381594	Total Beryllium (Be)	2016/08/30	88	75 - 125	93	75 - 125	<0.40	mg/kg	NC	30	85	70 - 130
8381594	Total Bismuth (Bi)	2016/08/30					<0.10	mg/kg	NC	30		
8381594	Total Cadmium (Cd)	2016/08/30	99	75 - 125	104	75 - 125	<0.050	mg/kg	NC	30	119	70 - 130
8381594	Total Calcium (Ca)	2016/08/30					<100	mg/kg	NC	30	101	70 - 130
8381594	Total Chromium (Cr)	2016/08/30	92	75 - 125	99	75 - 125	<1.0	mg/kg	5.1	30	105	70 - 130
8381594	Total Cobalt (Co)	2016/08/30	96	75 - 125	100	75 - 125	<0.30	mg/kg	NC	30	96	70 - 130
8381594	Total Copper (Cu)	2016/08/30	98	75 - 125	102	75 - 125	<0.50	mg/kg	0.84	30	99	70 - 130
8381594	Total Iron (Fe)	2016/08/30					<100	mg/kg	6.9	30	101	70 - 130
8381594	Total Lead (Pb)	2016/08/30	92	75 - 125	97	75 - 125	<0.10	mg/kg	6.9	35	99	70 - 130
8381594	Total Lithium (Li)	2016/08/30	91	75 - 125	94	75 - 125	<5.0	mg/kg	NC	30	97	70 - 130
8381594	Total Magnesium (Mg)	2016/08/30					<100	mg/kg	NC	30	94	70 - 130
8381594	Total Manganese (Mn)	2016/08/30	90	75 - 125	96	75 - 125	<0.20	mg/kg	6.3	30	98	70 - 130
8381594	Total Mercury (Hg)	2016/08/30	90	75 - 125	97	75 - 125	<0.050	mg/kg	NC	35	108	70 - 130
8381594	Total Molybdenum (Mo)	2016/08/30	93	75 - 125	94	75 - 125	<0.10	mg/kg	NC	35	104	70 - 130
8381594	Total Nickel (Ni)	2016/08/30	95	75 - 125	98	75 - 125	<0.80	mg/kg	NC	30	103	70 - 130
8381594	Total Phosphorus (P)	2016/08/30					<10	mg/kg	0.76	30	90	70 - 130
8381594	Total Potassium (K)	2016/08/30					<100	mg/kg	NC	35	102	70 - 130
8381594	Total Selenium (Se)	2016/08/30	87	75 - 125	96	75 - 125	<0.50	mg/kg	NC	30		
8381594	Total Silver (Ag)	2016/08/30	91	75 - 125	97	75 - 125	<0.050	mg/kg	NC	35	84	70 - 130
8381594	Total Sodium (Na)	2016/08/30					<100	mg/kg	NC	35	83	70 - 130
8381594	Total Strontium (Sr)	2016/08/30	96	75 - 125	96	75 - 125	<0.10	mg/kg	12	35	97	70 - 130

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8381594	Total Thallium (Tl)	2016/08/30	89	75 - 125	95	75 - 125	<0.050	mg/kg	NC	30	86	70 - 130
8381594	Total Tin (Sn)	2016/08/30	87	75 - 125	88	75 - 125	<0.10	mg/kg	NC	35	87	70 - 130
8381594	Total Titanium (Ti)	2016/08/30	NC	75 - 125	96	75 - 125	<1.0	mg/kg	35	35		
8381594	Total Uranium (U)	2016/08/30	85	75 - 125	91	75 - 125	<0.050	mg/kg	NC	30	98	70 - 130
8381594	Total Vanadium (V)	2016/08/30	91	75 - 125	98	75 - 125	<2.0	mg/kg	3.4	30	98	70 - 130
8381594	Total Zinc (Zn)	2016/08/30	89	75 - 125	101	75 - 125	<1.0	mg/kg	19	30	94	70 - 130
8381594	Total Zirconium (Zr)	2016/08/30					<0.50	mg/kg	NC	30		
8381597	Soluble (2:1) pH	2016/08/30			100	97 - 103			0.48	N/A		
8382276	Total Aluminum (Al)	2016/08/31					<100	mg/kg			97	70 - 130
8382276	Total Antimony (Sb)	2016/08/31	93	75 - 125	96	75 - 125	<0.10	mg/kg			101	70 - 130
8382276	Total Arsenic (As)	2016/08/31	92	75 - 125	95	75 - 125	<0.50	mg/kg			100	70 - 130
8382276	Total Barium (Ba)	2016/08/31	96	75 - 125	100	75 - 125	<0.10	mg/kg			96	70 - 130
8382276	Total Beryllium (Be)	2016/08/31	97	75 - 125	96	75 - 125	<0.40	mg/kg			94	70 - 130
8382276	Total Bismuth (Bi)	2016/08/31					<0.10	mg/kg				
8382276	Total Cadmium (Cd)	2016/08/31	100	75 - 125	107	75 - 125	<0.050	mg/kg			122	70 - 130
8382276	Total Calcium (Ca)	2016/08/31					<100	mg/kg			102	70 - 130
8382276	Total Chromium (Cr)	2016/08/31	NC	75 - 125	100	75 - 125	<1.0	mg/kg			109	70 - 130
8382276	Total Cobalt (Co)	2016/08/31	90	75 - 125	103	75 - 125	<0.30	mg/kg			99	70 - 130
8382276	Total Copper (Cu)	2016/08/31	NC	75 - 125	99	75 - 125	<0.50	mg/kg	5.0	30	99	70 - 130
8382276	Total Iron (Fe)	2016/08/31					<100	mg/kg			99	70 - 130
8382276	Total Lead (Pb)	2016/08/31	96	75 - 125	100	75 - 125	<0.10	mg/kg			100	70 - 130
8382276	Total Lithium (Li)	2016/08/31	95	75 - 125	94	75 - 125	<5.0	mg/kg			100	70 - 130
8382276	Total Magnesium (Mg)	2016/08/31					<100	mg/kg			104	70 - 130
8382276	Total Manganese (Mn)	2016/08/31	NC	75 - 125	101	75 - 125	<0.20	mg/kg			104	70 - 130
8382276	Total Mercury (Hg)	2016/08/31	93	75 - 125	99	75 - 125	<0.050	mg/kg			96	70 - 130
8382276	Total Molybdenum (Mo)	2016/08/31	97	75 - 125	94	75 - 125	<0.10	mg/kg			109	70 - 130
8382276	Total Nickel (Ni)	2016/08/31	NC	75 - 125	97	75 - 125	<0.80	mg/kg			103	70 - 130
8382276	Total Phosphorus (P)	2016/08/31					<10	mg/kg			94	70 - 130
8382276	Total Potassium (K)	2016/08/31					<100	mg/kg			95	70 - 130
8382276	Total Selenium (Se)	2016/08/31	95	75 - 125	100	75 - 125	<0.50	mg/kg				
8382276	Total Silver (Ag)	2016/08/31	92	75 - 125	95	75 - 125	<0.050	mg/kg			116	70 - 130

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8382276	Total Sodium (Na)	2016/08/31					<100	mg/kg			97	70 - 130
8382276	Total Strontium (Sr)	2016/08/31	NC	75 - 125	95	75 - 125	<0.10	mg/kg			100	70 - 130
8382276	Total Thallium (Tl)	2016/08/31	94	75 - 125	101	75 - 125	<0.050	mg/kg			90	70 - 130
8382276	Total Tin (Sn)	2016/08/31	89	75 - 125	90	75 - 125	<0.10	mg/kg			89	70 - 130
8382276	Total Titanium (Ti)	2016/08/31	NC	75 - 125	97	75 - 125	<1.0	mg/kg				
8382276	Total Uranium (U)	2016/08/31	96	75 - 125	97	75 - 125	<0.050	mg/kg			105	70 - 130
8382276	Total Vanadium (V)	2016/08/31	NC	75 - 125	100	75 - 125	<2.0	mg/kg			105	70 - 130
8382276	Total Zinc (Zn)	2016/08/31	NC	75 - 125	103	75 - 125	<1.0	mg/kg			103	70 - 130
8382276	Total Zirconium (Zr)	2016/08/31					<0.50	mg/kg				
8382278	Soluble (2:1) pH	2016/08/31			100	97 - 103			1.5	N/A		
8405576	Total Aluminum (Al)	2016/09/23					<1.0	mg/kg	NC	35	46	17 - 93
8405576	Total Antimony (Sb)	2016/09/23	105	75 - 125	107	75 - 125	<0.0050	mg/kg	NC	35		
8405576	Total Arsenic (As)	2016/09/23	110	75 - 125	103	75 - 125	<0.050	mg/kg	NC	35	104	42 - 199
8405576	Total Barium (Ba)	2016/09/23	NC	75 - 125	115	75 - 125	<0.10	mg/kg	0.22	35		
8405576	Total Beryllium (Be)	2016/09/23	115	75 - 125	106	75 - 125	<0.10	mg/kg	NC	35		
8405576	Total Bismuth (Bi)	2016/09/23					<0.10	mg/kg	NC	35		
8405576	Total Boron (B)	2016/09/23					<2.0	mg/kg	7.9	35	105	75 - 125
8405576	Total Cadmium (Cd)	2016/09/23	NC	75 - 125	106	75 - 125	<0.010	mg/kg	0.50	35	97	75 - 125
8405576	Total Calcium (Ca)	2016/09/23					<10	mg/kg	1.8	35	104	75 - 125
8405576	Total Chromium (Cr)	2016/09/23	110	75 - 125	103	75 - 125	<0.20	mg/kg	NC	35		
8405576	Total Cobalt (Co)	2016/09/23	107	75 - 125	104	75 - 125	<0.020	mg/kg	5.9	35	88	75 - 125
8405576	Total Copper (Cu)	2016/09/23	NC	75 - 125	103	75 - 125	<0.050	mg/kg	5.2	35	95	75 - 125
8405576	Total Iron (Fe)	2016/09/23					<10	mg/kg	3.9	35		
8405576	Total Lead (Pb)	2016/09/23	98	75 - 125	101	75 - 125	<0.010	mg/kg	10	35		
8405576	Total Magnesium (Mg)	2016/09/23					<10	mg/kg	0.88	35		
8405576	Total Manganese (Mn)	2016/09/23	NC	75 - 125	103	75 - 125	<0.10	mg/kg	4.5	35	95	75 - 125
8405576	Total Mercury (Hg)	2016/09/23	113	75 - 125	111	75 - 125	0.012, RDL=0.010	mg/kg	NC	35	108	75 - 125
8405576	Total Molybdenum (Mo)	2016/09/23	108	75 - 125	98	75 - 125	<0.050	mg/kg	0.85	35		
8405576	Total Nickel (Ni)	2016/09/23	108	75 - 125	105	75 - 125	<0.050	mg/kg	0.64	35	85	75 - 125
8405576	Total Phosphorus (P)	2016/09/23					<10	mg/kg	1.3	35	117	75 - 125

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8405576	Total Potassium (K)	2016/09/23					<10	mg/kg	3.3	35	101	75 - 125
8405576	Total Selenium (Se)	2016/09/23	110	75 - 125	106	75 - 125	<0.050	mg/kg	6.1	35	120	75 - 125
8405576	Total Silver (Ag)	2016/09/23	95	75 - 125	93	75 - 125	<0.020	mg/kg	NC	35		
8405576	Total Sodium (Na)	2016/09/23					<10	mg/kg	NC	35	101	75 - 125
8405576	Total Strontium (Sr)	2016/09/23	NC	75 - 125	101	75 - 125	<0.10	mg/kg	1.7	35	99	75 - 125
8405576	Total Thallium (Tl)	2016/09/23	106	75 - 125	106	75 - 125	<0.0020	mg/kg	NC	35		
8405576	Total Tin (Sn)	2016/09/23	77	75 - 125	102	75 - 125	<0.10	mg/kg	NC	35		
8405576	Total Titanium (Ti)	2016/09/23	71 (1)	75 - 125	101	75 - 125	<1.0	mg/kg	NC	35		
8405576	Total Uranium (U)	2016/09/23	101	75 - 125	100	75 - 125	<0.0020	mg/kg	4.2	35		
8405576	Total Vanadium (V)	2016/09/23	111	75 - 125	104	75 - 125	<0.20	mg/kg	NC	35		
8405576	Total Zinc (Zn)	2016/09/23	NC	75 - 125	106	75 - 125	<0.20	mg/kg	2.6	35	96	75 - 125
8405594	Total Aluminum (Al)	2016/09/25					<1.0	mg/kg	6.6	35	46	17 - 93
8405594	Total Antimony (Sb)	2016/09/25	106	75 - 125	114	75 - 125	<0.0050	mg/kg	2.5	35		
8405594	Total Arsenic (As)	2016/09/25	107	75 - 125	114	75 - 125	<0.050	mg/kg	NC	35	103	42 - 199
8405594	Total Barium (Ba)	2016/09/25	NC	75 - 125	118	75 - 125	<0.10	mg/kg	7.1	35		
8405594	Total Beryllium (Be)	2016/09/25	108	75 - 125	114	75 - 125	<0.10	mg/kg	NC	35		
8405594	Total Bismuth (Bi)	2016/09/25					<0.10	mg/kg	NC	35		
8405594	Total Boron (B)	2016/09/25					<2.0	mg/kg	NC	35	105	75 - 125
8405594	Total Cadmium (Cd)	2016/09/25	108	75 - 125	113	75 - 125	<0.010	mg/kg	5.5	35	102	75 - 125
8405594	Total Calcium (Ca)	2016/09/25					<10	mg/kg	2.3	35	99	75 - 125
8405594	Total Chromium (Cr)	2016/09/25	105	75 - 125	109	75 - 125	<0.20	mg/kg	NC	35		
8405594	Total Cobalt (Co)	2016/09/25	104	75 - 125	111	75 - 125	<0.020	mg/kg	1.1	35	92	75 - 125
8405594	Total Copper (Cu)	2016/09/25	104	75 - 125	111	75 - 125	<0.050	mg/kg	5.6	35	98	75 - 125
8405594	Total Iron (Fe)	2016/09/25					<10	mg/kg	6.0	35		
8405594	Total Lead (Pb)	2016/09/25	98	75 - 125	108	75 - 125	<0.010	mg/kg	10	35		
8405594	Total Magnesium (Mg)	2016/09/25					<10	mg/kg	0.012	35		
8405594	Total Manganese (Mn)	2016/09/25	NC	75 - 125	112	75 - 125	<0.10	mg/kg	3.8	35	102	75 - 125
8405594	Total Mercury (Hg)	2016/09/25	109	75 - 125	125	75 - 125	0.013, RDL=0.010	mg/kg	NC	35	125	75 - 125
8405594	Total Molybdenum (Mo)	2016/09/25	105	75 - 125	108	75 - 125	<0.050	mg/kg	NC	35		
8405594	Total Nickel (Ni)	2016/09/25	103	75 - 125	114	75 - 125	<0.050	mg/kg	0.66	35	88	75 - 125

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8405594	Total Phosphorus (P)	2016/09/25					<10	mg/kg	2.8	35	120	75 - 125
8405594	Total Potassium (K)	2016/09/25					<10	mg/kg	3.3	35	107	75 - 125
8405594	Total Selenium (Se)	2016/09/25	118	75 - 125	115	75 - 125	<0.050	mg/kg	NC	35	96	75 - 125
8405594	Total Silver (Ag)	2016/09/25	75	75 - 125	169 (2)	75 - 125	<0.020	mg/kg	NC	35		
8405594	Total Sodium (Na)	2016/09/25					<10	mg/kg	NC	35	113	75 - 125
8405594	Total Strontium (Sr)	2016/09/25	NC	75 - 125	107	75 - 125	<0.10	mg/kg	4.4	35	102	75 - 125
8405594	Total Thallium (Tl)	2016/09/25	101	75 - 125	113	75 - 125	<0.0020	mg/kg	NC	35		
8405594	Total Tin (Sn)	2016/09/25	99	75 - 125	106	75 - 125	<0.10	mg/kg	NC	35		
8405594	Total Titanium (Ti)	2016/09/25	NC	75 - 125	107	75 - 125	<1.0	mg/kg	8.3	35		
8405594	Total Uranium (U)	2016/09/25	99	75 - 125	108	75 - 125	<0.0020	mg/kg	NC	35		
8405594	Total Vanadium (V)	2016/09/25	105	75 - 125	110	75 - 125	<0.20	mg/kg	NC	35		
8405594	Total Zinc (Zn)	2016/09/25	NC	75 - 125	113	75 - 125	<0.20	mg/kg	3.6	35	105	75 - 125
8407097	Total Aluminum (Al)	2016/09/25					<1.0	mg/kg	0.60	35	48	17 - 93
8407097	Total Antimony (Sb)	2016/09/25	110	75 - 125	109	75 - 125	<0.0050	mg/kg	7.8	35		
8407097	Total Arsenic (As)	2016/09/25	104	75 - 125	108	75 - 125	<0.050	mg/kg	NC	35	79	42 - 199
8407097	Total Barium (Ba)	2016/09/25	NC	75 - 125	118	75 - 125	<0.10	mg/kg	5.1	35		
8407097	Total Beryllium (Be)	2016/09/25	114	75 - 125	111	75 - 125	<0.10	mg/kg	NC	35		
8407097	Total Bismuth (Bi)	2016/09/25					<0.10	mg/kg	NC	35		
8407097	Total Boron (B)	2016/09/25					<2.0	mg/kg	NC	35	108	75 - 125
8407097	Total Cadmium (Cd)	2016/09/25	109	75 - 125	109	75 - 125	<0.010	mg/kg	NC	35	98	75 - 125
8407097	Total Calcium (Ca)	2016/09/25					<10	mg/kg	2.9	35	99	75 - 125
8407097	Total Chromium (Cr)	2016/09/25	99	75 - 125	101	75 - 125	<0.20	mg/kg	NC	35		
8407097	Total Cobalt (Co)	2016/09/25	103	75 - 125	106	75 - 125	<0.020	mg/kg	NC	35	91	75 - 125
8407097	Total Copper (Cu)	2016/09/25	101	75 - 125	103	75 - 125	<0.050	mg/kg	1.4	35	99	75 - 125
8407097	Total Iron (Fe)	2016/09/25					<10	mg/kg	1.4	35		
8407097	Total Lead (Pb)	2016/09/25	101	75 - 125	103	75 - 125	<0.010	mg/kg	6.0	35		
8407097	Total Magnesium (Mg)	2016/09/25					<10	mg/kg	8.8	35		
8407097	Total Manganese (Mn)	2016/09/25	NC	75 - 125	107	75 - 125	<0.10	mg/kg	9.4	35	99	75 - 125
8407097	Total Mercury (Hg)	2016/09/25	115	75 - 125	112	75 - 125	<0.010	mg/kg	NC	35	104	75 - 125
8407097	Total Molybdenum (Mo)	2016/09/25	104	75 - 125	105	75 - 125	<0.050	mg/kg	NC	35		
8407097	Total Nickel (Ni)	2016/09/25	102	75 - 125	108	75 - 125	<0.050	mg/kg	NC	35	87	75 - 125

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8407097	Total Phosphorus (P)	2016/09/25					<10	mg/kg	8.6	35	117	75 - 125
8407097	Total Potassium (K)	2016/09/25					<10	mg/kg	9.5	35	107	75 - 125
8407097	Total Selenium (Se)	2016/09/25	118	75 - 125	113	75 - 125	<0.050	mg/kg	NC	35	84	75 - 125
8407097	Total Silver (Ag)	2016/09/25	76	75 - 125	101	75 - 125	<0.020	mg/kg	NC	35		
8407097	Total Sodium (Na)	2016/09/25					<10	mg/kg	NC	35	112	75 - 125
8407097	Total Strontium (Sr)	2016/09/25	100	75 - 125	102	75 - 125	<0.10	mg/kg	3.7	35	99	75 - 125
8407097	Total Thallium (Tl)	2016/09/25	105	75 - 125	109	75 - 125	<0.0020	mg/kg	NC	35		
8407097	Total Tin (Sn)	2016/09/25	103	75 - 125	104	75 - 125	<0.10	mg/kg	NC	35		
8407097	Total Titanium (Ti)	2016/09/25	104	75 - 125	96	75 - 125	<1.0	mg/kg	NC	35		
8407097	Total Uranium (U)	2016/09/25	103	75 - 125	103	75 - 125	<0.0020	mg/kg	NC	35		
8407097	Total Vanadium (V)	2016/09/25	105	75 - 125	103	75 - 125	<0.20	mg/kg	NC	35		
8407097	Total Zinc (Zn)	2016/09/25	NC	75 - 125	111	75 - 125	<0.20	mg/kg	4.7	35	101	75 - 125
8407099	Total Aluminum (Al)	2016/09/25					<1.0	mg/kg	6.3	35	46	17 - 93
8407099	Total Antimony (Sb)	2016/09/25	114	75 - 125	108	75 - 125	<0.0050	mg/kg	NC	35		
8407099	Total Arsenic (As)	2016/09/25	110	75 - 125	106	75 - 125	<0.050	mg/kg	NC	35	95	42 - 199
8407099	Total Barium (Ba)	2016/09/25	NC	75 - 125	118	75 - 125	<0.10	mg/kg	4.0	35		
8407099	Total Beryllium (Be)	2016/09/25	118	75 - 125	108	75 - 125	<0.10	mg/kg	NC	35		
8407099	Total Bismuth (Bi)	2016/09/25					<0.10	mg/kg	NC	35		
8407099	Total Boron (B)	2016/09/25					<2.0	mg/kg	NC	35	112	75 - 125
8407099	Total Cadmium (Cd)	2016/09/25	116	75 - 125	107	75 - 125	<0.010	mg/kg	2.2	35	103	75 - 125
8407099	Total Calcium (Ca)	2016/09/25					<10	mg/kg	2.5	35	103	75 - 125
8407099	Total Chromium (Cr)	2016/09/25	103	75 - 125	106	75 - 125	<0.20	mg/kg	NC	35		
8407099	Total Cobalt (Co)	2016/09/25	105	75 - 125	107	75 - 125	<0.020	mg/kg	0.91	35	96	75 - 125
8407099	Total Copper (Cu)	2016/09/25	NC	75 - 125	106	75 - 125	<0.050	mg/kg	0.83	35	102	75 - 125
8407099	Total Iron (Fe)	2016/09/25					<10	mg/kg	NC	35		
8407099	Total Lead (Pb)	2016/09/25	99	75 - 125	103	75 - 125	<0.010	mg/kg	NC	35		
8407099	Total Magnesium (Mg)	2016/09/25					<10	mg/kg	1.3	35		
8407099	Total Manganese (Mn)	2016/09/25	NC	75 - 125	108	75 - 125	<0.10	mg/kg	0.91	35	102	75 - 125
8407099	Total Mercury (Hg)	2016/09/25	111	75 - 125	110	75 - 125	<0.010	mg/kg	NC	35	99	75 - 125
8407099	Total Molybdenum (Mo)	2016/09/25	108	75 - 125	105	75 - 125	<0.050	mg/kg	NC	35		
8407099	Total Nickel (Ni)	2016/09/25	108	75 - 125	110	75 - 125	<0.050	mg/kg	0.66	35	92	75 - 125

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8407099	Total Phosphorus (P)	2016/09/25					<10	mg/kg	0.60	35	119	75 - 125
8407099	Total Potassium (K)	2016/09/25					<10	mg/kg	0.49	35	107	75 - 125
8407099	Total Selenium (Se)	2016/09/25	118	75 - 125	115	75 - 125	<0.050	mg/kg	NC	35	120	75 - 125
8407099	Total Silver (Ag)	2016/09/25	80	75 - 125	87	75 - 125	<0.020	mg/kg	NC	35		
8407099	Total Sodium (Na)	2016/09/25					<10	mg/kg	NC	35	111	75 - 125
8407099	Total Strontium (Sr)	2016/09/25	NC	75 - 125	104	75 - 125	<0.10	mg/kg	0.83	35	102	75 - 125
8407099	Total Thallium (Tl)	2016/09/25	108	75 - 125	107	75 - 125	<0.0020	mg/kg	NC	35		
8407099	Total Tin (Sn)	2016/09/25	104	75 - 125	100	75 - 125	<0.10	mg/kg	NC	35		
8407099	Total Titanium (Ti)	2016/09/25	102	75 - 125	96	75 - 125	<1.0	mg/kg	NC	35		
8407099	Total Uranium (U)	2016/09/25	101	75 - 125	103	75 - 125	<0.0020	mg/kg	NC	35		
8407099	Total Vanadium (V)	2016/09/25	107	75 - 125	104	75 - 125	<0.20	mg/kg	NC	35		
8407099	Total Zinc (Zn)	2016/09/25	NC	75 - 125	110	75 - 125	<0.20	mg/kg	3.6	35	105	75 - 125
8407124	Total Aluminum (Al)	2016/09/27					<1.0	mg/kg	2.6	35	35	17 - 93
8407124	Total Antimony (Sb)	2016/09/27	119	75 - 125	105	75 - 125	<0.0050	mg/kg	NC	35		
8407124	Total Arsenic (As)	2016/09/27	116	75 - 125	106	75 - 125	<0.050	mg/kg	NC	35	95	42 - 199
8407124	Total Barium (Ba)	2016/09/27	NC	75 - 125	126 (3)	75 - 125	<0.10	mg/kg	0.31	35		
8407124	Total Beryllium (Be)	2016/09/27	119	75 - 125	103	75 - 125	<0.10	mg/kg	NC	35		
8407124	Total Bismuth (Bi)	2016/09/27					<0.10	mg/kg	NC	35		
8407124	Total Boron (B)	2016/09/27					<2.0	mg/kg	0.36	35	105	75 - 125
8407124	Total Cadmium (Cd)	2016/09/27	119	75 - 125	103	75 - 125	<0.010	mg/kg	1.9	35	99	75 - 125
8407124	Total Calcium (Ca)	2016/09/27					<10	mg/kg	2.3	35	99	75 - 125
8407124	Total Chromium (Cr)	2016/09/27	111	75 - 125	104	75 - 125	<0.20	mg/kg	NC	35		
8407124	Total Cobalt (Co)	2016/09/27	111	75 - 125	106	75 - 125	<0.020	mg/kg	2.7	35	89	75 - 125
8407124	Total Copper (Cu)	2016/09/27	NC	75 - 125	103	75 - 125	<0.050	mg/kg	8.3	35	95	75 - 125
8407124	Total Iron (Fe)	2016/09/27					<10	mg/kg	NC	35		
8407124	Total Lead (Pb)	2016/09/27	100	75 - 125	96	75 - 125	<0.010	mg/kg	NC	35		
8407124	Total Magnesium (Mg)	2016/09/27					<10	mg/kg	1.1	35		
8407124	Total Manganese (Mn)	2016/09/27	NC	75 - 125	107	75 - 125	<0.10	mg/kg	2.9	35	98	75 - 125
8407124	Total Mercury (Hg)	2016/09/27	117	75 - 125	108	75 - 125	<0.010	mg/kg	NC	35	99	75 - 125
8407124	Total Molybdenum (Mo)	2016/09/27	117	75 - 125	100	75 - 125	<0.050	mg/kg	2.1	35		

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8407124	Total Nickel (Ni)	2016/09/27	116	75 - 125	107	75 - 125	0.055, RDL=0.050	mg/kg	7.6	35	80	75 - 125
8407124	Total Phosphorus (P)	2016/09/27					<10	mg/kg	5.2	35	116	75 - 125
8407124	Total Potassium (K)	2016/09/27					<10	mg/kg	4.3	35	105	75 - 125
8407124	Total Selenium (Se)	2016/09/27	121	75 - 125	110	75 - 125	<0.050	mg/kg	NC	35	121	75 - 125
8407124	Total Silver (Ag)	2016/09/27	87	75 - 125	83	75 - 125	<0.020	mg/kg	NC	35		
8407124	Total Sodium (Na)	2016/09/27					<10	mg/kg	NC	35	98	75 - 125
8407124	Total Strontium (Sr)	2016/09/27	NC	75 - 125	94	75 - 125	<0.10	mg/kg	0.64	35	99	75 - 125
8407124	Total Thallium (Tl)	2016/09/27	112	75 - 125	105	75 - 125	<0.0020	mg/kg	NC	35		
8407124	Total Tin (Sn)	2016/09/27	109	75 - 125	97	75 - 125	<0.10	mg/kg	NC	35		
8407124	Total Titanium (Ti)	2016/09/27	111	75 - 125	105	75 - 125	<1.0	mg/kg	NC	35		
8407124	Total Uranium (U)	2016/09/27	101	75 - 125	94	75 - 125	0.0030, RDL=0.0020	mg/kg	NC	35		
8407124	Total Vanadium (V)	2016/09/27	115	75 - 125	107	75 - 125	<0.20	mg/kg	NC	35		
8407124	Total Zinc (Zn)	2016/09/27	NC	75 - 125	111	75 - 125	<0.20	mg/kg	8.8	35	98	75 - 125
8408031	Moisture	2016/09/23					<0.30	%	0.15	20		
8408741	Total Aluminum (Al)	2016/09/27					<1.0	mg/kg	4.6	35	38	17 - 93
8408741	Total Antimony (Sb)	2016/09/27	112	75 - 125	110	75 - 125	<0.0050	mg/kg	NC	35		
8408741	Total Arsenic (As)	2016/09/27	116	75 - 125	109	75 - 125	<0.050	mg/kg	NC	35	100	42 - 199
8408741	Total Barium (Ba)	2016/09/27	NC	75 - 125	120	75 - 125	<0.10	mg/kg	13	35		
8408741	Total Beryllium (Be)	2016/09/27	122	75 - 125	105	75 - 125	<0.10	mg/kg	NC	35		
8408741	Total Bismuth (Bi)	2016/09/27					<0.10	mg/kg	NC	35		
8408741	Total Boron (B)	2016/09/27					<2.0	mg/kg	NC	35	96	75 - 125
8408741	Total Cadmium (Cd)	2016/09/27	115	75 - 125	108	75 - 125	<0.010	mg/kg	NC	35	102	75 - 125
8408741	Total Calcium (Ca)	2016/09/27					<10	mg/kg	13	35	104	75 - 125
8408741	Total Chromium (Cr)	2016/09/27	107	75 - 125	100	75 - 125	<0.20	mg/kg	NC	35		
8408741	Total Cobalt (Co)	2016/09/27	108	75 - 125	103	75 - 125	<0.020	mg/kg	NC	35	95	75 - 125
8408741	Total Copper (Cu)	2016/09/27	NC	75 - 125	101	75 - 125	<0.050	mg/kg	58 (1)	35	101	75 - 125
8408741	Total Iron (Fe)	2016/09/27					<10	mg/kg	4.2	35		
8408741	Total Lead (Pb)	2016/09/27	101	75 - 125	95	75 - 125	<0.010	mg/kg	NC	35		
8408741	Total Magnesium (Mg)	2016/09/27					<10	mg/kg	11	35		
8408741	Total Manganese (Mn)	2016/09/27	NC	75 - 125	104	75 - 125	<0.10	mg/kg	11	35	104	75 - 125

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8408741	Total Mercury (Hg)	2016/09/27	121	75 - 125	113	75 - 125	<0.010	mg/kg	NC	35	102	75 - 125
8408741	Total Molybdenum (Mo)	2016/09/27	114	75 - 125	103	75 - 125	<0.050	mg/kg	NC	35		
8408741	Total Nickel (Ni)	2016/09/27	109	75 - 125	103	75 - 125	<0.050	mg/kg	0.80	35	89	75 - 125
8408741	Total Phosphorus (P)	2016/09/27					<10	mg/kg	8.8	35	125	75 - 125
8408741	Total Potassium (K)	2016/09/27					<10	mg/kg	4.0	35	110	75 - 125
8408741	Total Selenium (Se)	2016/09/27	120	75 - 125	111	75 - 125	<0.050	mg/kg	NC	35	102	75 - 125
8408741	Total Silver (Ag)	2016/09/27	83	75 - 125	96	75 - 125	<0.020	mg/kg	NC	35		
8408741	Total Sodium (Na)	2016/09/27					<10	mg/kg	NC	35	109	75 - 125
8408741	Total Strontium (Sr)	2016/09/27	NC	75 - 125	101	75 - 125	<0.10	mg/kg	12	35	109	75 - 125
8408741	Total Thallium (Tl)	2016/09/27	113	75 - 125	106	75 - 125	<0.0020	mg/kg	NC	35		
8408741	Total Tin (Sn)	2016/09/27	106	75 - 125	106	75 - 125	<0.10	mg/kg	NC	35		
8408741	Total Titanium (Ti)	2016/09/27	115	75 - 125	106	75 - 125	<1.0	mg/kg	NC	35		
8408741	Total Uranium (U)	2016/09/27	102	75 - 125	92	75 - 125	<0.0020	mg/kg	NC	35		
8408741	Total Vanadium (V)	2016/09/27	111	75 - 125	106	75 - 125	<0.20	mg/kg	NC	35		
8408741	Total Zinc (Zn)	2016/09/27	NC	75 - 125	106	75 - 125	<0.20	mg/kg	8.8	35	102	75 - 125
8408878	Total Aluminum (Al)	2016/09/28					<1.0	mg/kg	6.9	35	44	17 - 93
8408878	Total Antimony (Sb)	2016/09/28	119	75 - 125	113	75 - 125	<0.0050	mg/kg	NC	35		
8408878	Total Arsenic (As)	2016/09/28	115	75 - 125	108	75 - 125	<0.050	mg/kg	NC	35	103	42 - 199
8408878	Total Barium (Ba)	2016/09/28	NC	75 - 125	118	75 - 125	<0.10	mg/kg	15	35		
8408878	Total Beryllium (Be)	2016/09/28	119	75 - 125	109	75 - 125	<0.10	mg/kg	NC	35		
8408878	Total Bismuth (Bi)	2016/09/28					<0.10	mg/kg	NC	35		
8408878	Total Boron (B)	2016/09/28					<2.0	mg/kg	NC	35	113	75 - 125
8408878	Total Cadmium (Cd)	2016/09/28	119	75 - 125	113	75 - 125	<0.010	mg/kg	NC	35	108	75 - 125
8408878	Total Calcium (Ca)	2016/09/28					<10	mg/kg	13	35	107	75 - 125
8408878	Total Chromium (Cr)	2016/09/28	110	75 - 125	110	75 - 125	<0.20	mg/kg	NC	35		
8408878	Total Cobalt (Co)	2016/09/28	111	75 - 125	107	75 - 125	<0.020	mg/kg	NC	35	92	75 - 125
8408878	Total Copper (Cu)	2016/09/28	NC	75 - 125	107	75 - 125	<0.050	mg/kg	19	35	102	75 - 125
8408878	Total Iron (Fe)	2016/09/28					<10	mg/kg	NC	35		
8408878	Total Lead (Pb)	2016/09/28	103	75 - 125	101	75 - 125	<0.010	mg/kg	NC	35		
8408878	Total Magnesium (Mg)	2016/09/28					<10	mg/kg	5.7	35		
8408878	Total Manganese (Mn)	2016/09/28	NC	75 - 125	110	75 - 125	<0.10	mg/kg	11	35	105	75 - 125

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8408878	Total Mercury (Hg)	2016/09/28	127 (1)	75 - 125	122	75 - 125	<0.010	mg/kg	NC	35	117	75 - 125
8408878	Total Molybdenum (Mo)	2016/09/28	116	75 - 125	111	75 - 125	<0.050	mg/kg	NC	35		
8408878	Total Nickel (Ni)	2016/09/28	104	75 - 125	109	75 - 125	<0.050	mg/kg	NC	35	89	75 - 125
8408878	Total Phosphorus (P)	2016/09/28					<10	mg/kg	9.0	35	123	75 - 125
8408878	Total Potassium (K)	2016/09/28					<10	mg/kg	8.7	35	109	75 - 125
8408878	Total Selenium (Se)	2016/09/28	119	75 - 125	113	75 - 125	<0.050	mg/kg	NC	35	106	75 - 125
8408878	Total Silver (Ag)	2016/09/28	84	75 - 125	89	75 - 125	<0.020	mg/kg	NC	35		
8408878	Total Sodium (Na)	2016/09/28					<10	mg/kg	NC	35	110	75 - 125
8408878	Total Strontium (Sr)	2016/09/28	NC	75 - 125	104	75 - 125	<0.10	mg/kg	11	35	110	75 - 125
8408878	Total Thallium (Tl)	2016/09/28	112	75 - 125	113	75 - 125	<0.0020	mg/kg	NC	35		
8408878	Total Tin (Sn)	2016/09/28	109	75 - 125	106	75 - 125	<0.10	mg/kg	NC	35		
8408878	Total Titanium (Ti)	2016/09/28	107	75 - 125	112	75 - 125	<1.0	mg/kg	NC	35		
8408878	Total Uranium (U)	2016/09/28	103	75 - 125	100	75 - 125	<0.0020	mg/kg	NC	35		
8408878	Total Vanadium (V)	2016/09/28	113	75 - 125	105	75 - 125	<0.20	mg/kg	NC	35		
8408878	Total Zinc (Zn)	2016/09/28	NC	75 - 125	110	75 - 125	<0.20	mg/kg	9.3	35	105	75 - 125
8408888	Total Aluminum (Al)	2016/09/27					<1.0	mg/kg	1.2	35	38	17 - 93
8408888	Total Antimony (Sb)	2016/09/27	105	75 - 125	116	75 - 125	<0.0050	mg/kg	NC	35		
8408888	Total Arsenic (As)	2016/09/27	107	75 - 125	112	75 - 125	<0.050	mg/kg	NC	35	106	42 - 199
8408888	Total Barium (Ba)	2016/09/27	NC	75 - 125	119	75 - 125	<0.10	mg/kg	4.3	35		
8408888	Total Beryllium (Be)	2016/09/27	107	75 - 125	120	75 - 125	<0.10	mg/kg	NC	35		
8408888	Total Bismuth (Bi)	2016/09/27					<0.10	mg/kg	NC	35		
8408888	Total Boron (B)	2016/09/27					<2.0	mg/kg	4.8	35	93	75 - 125
8408888	Total Cadmium (Cd)	2016/09/27	107	75 - 125	116	75 - 125	<0.010	mg/kg	NC	35	100	75 - 125
8408888	Total Calcium (Ca)	2016/09/27					<10	mg/kg	3.5	35	104	75 - 125
8408888	Total Chromium (Cr)	2016/09/27	95	75 - 125	115	75 - 125	<0.20	mg/kg	NC	35		
8408888	Total Cobalt (Co)	2016/09/27	98	75 - 125	118	75 - 125	<0.020	mg/kg	NC	35	93	75 - 125
8408888	Total Copper (Cu)	2016/09/27	NC	75 - 125	117	75 - 125	<0.050	mg/kg	8.6	35	102	75 - 125
8408888	Total Iron (Fe)	2016/09/27					<10	mg/kg	NC	35		
8408888	Total Lead (Pb)	2016/09/27	94	75 - 125	105	75 - 125	<0.010	mg/kg	NC	35		
8408888	Total Magnesium (Mg)	2016/09/27					<10	mg/kg	1.6	35		
8408888	Total Manganese (Mn)	2016/09/27	NC	75 - 125	121	75 - 125	<0.10	mg/kg	0.73	35	104	75 - 125

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8408888	Total Mercury (Hg)	2016/09/27	110	75 - 125	121	75 - 125	<0.010	mg/kg	NC	35	93	75 - 125
8408888	Total Molybdenum (Mo)	2016/09/27	106	75 - 125	116	75 - 125	<0.050	mg/kg	NC	35		
8408888	Total Nickel (Ni)	2016/09/27	99	75 - 125	121	75 - 125	<0.050	mg/kg	NC	35	88	75 - 125
8408888	Total Phosphorus (P)	2016/09/27					<10	mg/kg	0.83	35	122	75 - 125
8408888	Total Potassium (K)	2016/09/27					<10	mg/kg	1.5	35	108	75 - 125
8408888	Total Selenium (Se)	2016/09/27	107	75 - 125	119	75 - 125	<0.050	mg/kg	NC	35	109	75 - 125
8408888	Total Silver (Ag)	2016/09/27	79	75 - 125	101	75 - 125	<0.020	mg/kg	NC	35		
8408888	Total Sodium (Na)	2016/09/27					<10	mg/kg	NC	35	111	75 - 125
8408888	Total Strontium (Sr)	2016/09/27	NC	75 - 125	112	75 - 125	<0.10	mg/kg	5.4	35	106	75 - 125
8408888	Total Thallium (Tl)	2016/09/27	103	75 - 125	119	75 - 125	<0.0020	mg/kg	NC	35		
8408888	Total Tin (Sn)	2016/09/27	100	75 - 125	108	75 - 125	<0.10	mg/kg	NC	35		
8408888	Total Titanium (Ti)	2016/09/27	99	75 - 125	114	75 - 125	<1.0	mg/kg	NC	35		
8408888	Total Uranium (U)	2016/09/27	92	75 - 125	103	75 - 125	<0.0020	mg/kg	NC	35		
8408888	Total Vanadium (V)	2016/09/27	103	75 - 125	118	75 - 125	<0.20	mg/kg	NC	35		
8408888	Total Zinc (Zn)	2016/09/27	NC	75 - 125	117	75 - 125	<0.20	mg/kg	1.8	35	104	75 - 125
8409718	Moisture	2016/09/24					<0.30	%	4.0	20		
8409719	Moisture	2016/09/24					<0.30	%	2.6	20		
8411681	Moisture	2016/09/27					<0.30	%	2.3	20		
8411700	Moisture	2016/09/27					<0.30	%	1.9	20		
8413052	Moisture	2016/09/28					<0.30	%	0.61	20		

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QUALITY ASSURANCE REPORT(CONT'D)

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

			Matrix Spike		Spiked Blank		Method Blank		RPD		QC Standard	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits	% Recovery	QC Limits
8413067	Moisture	2016/09/28					<0.30	%	1.4	20		

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

(1) Recovery or RPD for this parameter is outside control limits. The overall quality control for this analysis meets acceptability criteria.

(2) Blank Spike outside acceptance criteria - re-analysis yields similar results.

(3) Blank Spike outside acceptance criteria (10% of analytes failure allowed).

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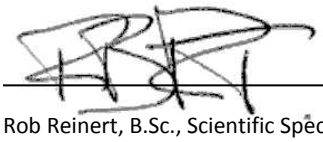
Report Date: 2016/09/29

EDI ENVIRONMENTAL DYNAMICS INC.
Client Project #: 14Y0306
Site Location: KAMINAK COFFEE CREEK

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Rob Reinert, B.Sc., Scientific Specialist

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APPENDIX H
Wildlife Baseline Reports

Coffee Gold Mine:
Wildlife Baseline Report
Version 1.2



Prepared For
Kaminak Gold Corporation
Suite 3400-666 Burrard Street
Vancouver, BC V6C 2X8

Prepared By
EDI Environmental Dynamics Inc.
2195-2nd Avenue
Whitehorse, YT Y1A 3T8

EDI Contact
Anne MacLeod, R.P.Bio.
867.393.4882

EDI Project
14Y0306
March 2017

ENVIRONMENTAL DYNAMICS INC.
Down to Earth Biology

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REVISION SUMMARY

Version No.	Date	Revision Notes	Revision Authors
1.0	July 8, 2016	Draft Version	L. Pigage and others
1.1	Sept 27, 2016	Final Version	K. Russell, A. MacLeod
1.2	Mar 14, 2017	Addition of 2016 field data and Fortymile caribou RSF model results	B. Smith, K. Beckmann, T. Mahon, A. MacLeod

EXECUTIVE SUMMARY

Kaminak Gold Corporation, a wholly owned subsidiary of Goldcorp Inc. (Kaminak; the Proponent) is proposing to develop the Coffee Gold Mine (Coffee Project; the Project) located 130 km south of Dawson, Yukon. The Project is located at a green field site that has not been previously mined, but has had ongoing exploration activities since discovery in 2010. Baseline environmental studies began in 2010 and were expanded in the following years in anticipation of future regulatory requirements. Kaminak retained Environmental Dynamics Inc. (EDI) to complete the terrestrial baseline studies.

To receive authorization for the Project to proceed, it must be evaluated under the *Yukon Environmental and Socio-economic Assessment Act* (YESAA), obtain a Quartz Mining License, a Type A Water Licence, and other associated authorizations. During the environmental assessment process, potential Project effects on valued environmental and socio-economic components are determined and mitigation is developed to reduce or eliminate potential adverse effects. In support of that assessment, this wildlife baseline report was developed to summarize information on current and historical wildlife presence, distribution, and habitat use in the Project area using the best available information including published and unpublished scientific data, Traditional Knowledge, local knowledge, and baseline survey data.

Species of potential conservation concern listed under the federal *Species at Risk Act* (SARA), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and/or the Canadian Endangered Species Conservation Council (CESCC) that occur, or have the potential to occur in the Project area include woodland caribou (northern mountain population), grizzly bear, wolverine, cougar, collared pika, and little brown myotis.

Three caribou herds have the potential to inhabit the area including the Fortymile, Klaza, and Nelchina caribou herds. The Fortymile and Nelchina herds are both barren-ground caribou, while the Klaza herd is part of the northern mountain population of woodland caribou.

Fortymile Caribou Herd

The Fortymile caribou herd is a migratory ecotype of caribou that occupies east-central Alaska and west-central Yukon. The core of the herd's range is centred on the Yukon-Tanana Upland (i.e., Tanana Hills) in Alaska. The herd has experienced large fluctuations in population size ranging from an estimated 260,000 to 500,000 animals in the 1920s to approximately 5,740 to 8,610 animals in 1974. Currently, the Fortymile caribou herd is estimated at approximately 52,000 individuals.

The Fortymile caribou herd displays long-distance movements between relatively distinct seasonal ranges. The herd calves and summers in the higher elevation habitat of the Yukon-Tanana Upland (the Tanana Hills) in east-central Alaska and has only recently been using its historic winter range in Yukon (since 2002) and the Project Regional Study Area (RSA; since 2013). Use of the RSA by Fortymile caribou is seasonal and occurs between October and April. Based on both satellite collar data and aerial survey data, large numbers of Fortymile caribou were observed in the RSA during the winters of 2013/2014 and 2015/2016, with very few caribou found in the RSA during the winter of 2014/2015.

Migratory caribou herds exhibit unpredictable use of their winter range, so accurately predicting annual distribution and movement in future years is not possible as there are too many variables that influence caribou behaviour. However, based on the current use of the RSA, and assuming a stable or increasing population, the Fortymile caribou herd has the potential to occur within the RSA seasonally during any year.

Klaza Caribou Herd

The Klaza caribou herd is part of the northern mountain population of woodland caribou. The herd's annual range includes part of the Dawson Range Mountains in central Yukon, with Klaza caribou often concentrating in higher elevation habitats, including Klaza, Apex, Prospector, and Nansen mountains (Hegel and O'Donoghue 2015). The most recent population estimate for the Klaza caribou (2012) estimated the herd at 1,179 animals (Hegel 2013).

The annual range of the Klaza caribou herd overlaps only the southern portions of the RSA, south of the Yukon River. However, the RSA does not overlap with the Klaza winter range (Hegel and O'Donoghue 2015). Consequently, the Project is only expected to interact with Klaza caribou during the spring, summer, and/or fall months. Caribou were observed incidentally within the RSA between May and September during baseline studies. Based on these observations and the location of the Project at the northern extent of the range, Klaza caribou are not expected to use the RSA in any considerable numbers.

Nelchina Caribou Herd

The Nelchina caribou herd is a relatively large barren-ground herd in the interior of Alaska. Similar to the Fortymile caribou herd, Nelchina caribou calve in the western portion of their range and disperse east toward the Alaska-Yukon border during winter. The herd occupies winter range on the periphery of the RSA. The winter range of the Nelchina caribou herd is primarily located in Alaska (Collins *et al.* 2011; Joly *et al.* 2003); however, a portion of the herd winters near the Yukon-Alaska border and some collared caribou have spent a part of the winter in Yukon, though not in significant numbers (Schwanke 2011). A small number of caribou from the Nelchina herd may enter the RSA during winter, but the number of caribou and time spent in the RSA is expected to be very low.

Moose

Moose occur throughout the entire Yukon and are considered to be Secure (CESCC 2011). Within the RSA, moose densities are close to the Yukon average (150 to 249 moose/1000 km^2; Yukon Fish and Wildlife Management Board 1996), with some of the northern sections possibly higher than average. In coordination with the 2015 Dawson Goldfields moose census, a population estimate was developed for the area within a 10 km buffer of the proposed Northern Access Route (NAR), an aerial extent of 3,298 km^2. An estimated 814 moose (90% CI of 723-917) are expected to occur within this area at a density of 247 moose/1,000 km^2.

Moose were observed many times throughout the year during wildlife baseline surveys and are widely distributed across the RSA (EDI 2017a). During the early winter season, moose congregate in subalpine shrub communities. Key areas where moose are abundant during the early winter include the King Solomon Dome area and the Henderson Dome area. In the late winter, moose are more restricted in their habitat use

than in other seasons, although regional surveys have indicated that snow depths may not be as restrictive here as in other parts of Yukon, and that during the late-winter season moose may be distributed over a wider range of elevations as compared to other areas (O'Donoghue *et al.* 2013b; EDI 2017a, 2016b). A Habitat Suitability Index (HSI) model developed for moose late winter habitat found that the RSA contains abundant and widespread high quality late winter moose habitat. During the late winter, higher concentrations of moose were observed in the southwestern sections of the RSA along the White river, the upper sections of the Henderson Creek and Black Hills Creek drainages, and just north of the Indian River.

Moose are the primary harvest species within the RSA and are a highly valued species for both First Nations people and licensed hunters. Between 2006 and 2015, 480 moose were harvested by licensed hunters within the RSA (Government of Yukon 2016a). With a total mean annual harvest of 48 moose, between 5 and 10% of the total Yukon annual moose harvest occurs within the RSA. The Dawson Goldfields Game Management Subzones (GMSs) in particular are some of the most intensely harvested areas of Yukon as a result of having above average moose density (Cooley *et al.* 2012) and above average access.

Thinhorn Sheep

Thinhorn sheep are distributed throughout Yukon. Most Yukon thinhorn sheep populations occur in alpine/subalpine habitat with available food sources that are in close proximity to escape terrain. Within the RSA, the only known thinhorn sheep populations occur along the Yukon River on the steep, south-facing bluffs. Three occurrence areas are known along the Yukon River: the Minto occurrence area to the east of the RSA, the White River occurrence area located at the confluence of the Yukon and White Rivers, and the Ballarat Creek occurrence area along the north bank of the Yukon River near Ballarat Creek. The proposed NAR passes through the Ballarat Creek occurrence area. Based on the low numbers of sheep at each of these three occurrence areas, it is thought that sheep migrate along the Yukon River. The maximum number of sheep documented within the Ballarat Creek occurrence area is eight sheep. Several wildlife surveys were completed to document sheep use of this area, and an HSI model was developed to better understand the distribution of suitable sheep habitat along the Yukon River cooridor.

Mule deer

Mule deer occur in the RSA, but at low numbers. Mule deer have been expanding their range into the Yukon since the 1940s. The current working estimate for the Yukon mule deer population is thought to be around 1,000 animals (S. Czetwertynski, pers. comm, 2016). Based on observations of mule deer during baseline studies, and by Project personnel, the mule deer population is likely limited to a small number of individuals concentrated along the south-facing slopes of the Yukon, Stewart, and potentially Indian River valleys, and along the Klondike Highway. According to trapping concession holders whose traplines overlap the RSA, mule deer have been present in the Coffee Creek/Yukon River area for at least 30 years and the population has been increasing (Interview 14, pers. comm., 2016).

Grizzly Bear

Yukon's grizzly bear population is estimated to be between 6,000 and 7,000 individuals, making up about 25% of the total grizzly bear population in Canada (COSEWIC 2012). There is limited available information

on grizzly bear abundance and distribution within the RSA but according to the Environment Yukon carnivore biologist, grizzly bear density in the area is considered to be low (R. Maraj, pers. comm., 2016). The working density estimate for the Klondike Plateau ecoregion is 11 bears/1,000 km^2 and the Yukon Plateau-Central ecoregion is 15 bears/1,000 km^2. Grizzly bear observations have been recorded throughout the RSA on wildlife cameras, during baseline studies, and by Project personnel. Based on observations and harvest records, it can be assumed that grizzly bears use the entire RSA but occur at relatively low densities. Given their large ranges and diverse habitat requirements grizzly bears have the potential to interact with all aspects of the proposed Project footprint.

To assess the availability and quality of grizzly bear habitat in the RSA, four GIS-based models were produced, which are described in the Coffee Gold Mine: Grizzly Bear Habitat Model Report (EDI 2016c). Each model aims to predict an aspect of grizzly bear habitat requirements, including habitat effectiveness, security zones, linkage zones, and denning habitat suitability.

Grizzly bear denning surveys were completed within a 2 km buffer of the proposed NAR alignment and within a 5 km buffer of the proposed mine site in spring 2016 (March 21–May 6). No grizzly bears or grizzly bear dens were located despite considerable survey effort by trained biologists (EDI 2017a). The first grizzly bears were noted on the paired site wildlife cameras on April 14 and April 26, indicating that den emergence occurred during the survey period.

Black Bear

Detailed information on black bear distribution and abundance within the RSA is not available; however, local knowledge indicates that there are 'lots of black bears in the area' (Interview 15, pers. comm. 2016), which is consistent with Project observations. Black bears have commonly been observed in the RSA during the non-denning period (October to May; Government of Yukon 2015b) and were recorded throughout baseline studies during wildlife surveys, as incidental observations recorded by Kaminak staff, on the remote wildlife cameras. During grizzly bear den surveys conducted in 2016, several black bears and suspected black bear den sites were located on south-facing slopes with fresh greenery (EDI 2017a). As a result of their diverse seasonal habitat needs, black bears have the potential to interact with the proposed Project across the entire extent of the Project footprint.

Wolverine

Wolverines occur in the RSA and have been observed on a number of occasions during wildlife baseline surveys. During the 2015 snow track survey of the Java Road (access road between the Yukon River and the deposit area) fresh tracks of one wolverine were incidentally recorded. The 2016 snow track survey of the NAR and Java Road detected 14 occurrences of fresh wolverine tracks and eight old tracks. Wolverines were generally detected at higher elevations along Sulphur Creek, Eureka Ridge, Maisy May Creek, Barker Creek, Thistle Mountain, and Java Road. Wildlife cameras have been installed since May 2015 within the LSA, with three observations of wolverine captured on the Sulphur and Eureka wildlife cameras thus far. One wolverine was observed during the 2016 late winter ungulate survey (EDI 2017a).

A denning habitat model was created for the RSA using remotely sensed snow cover estimates (EDI 2016d). Based on the model, less than one percent (%) of the RSA is classified as high quality denning habitat, with high value habitats occurring primarily along high elevation ridges.

Given the large size of wolverine home ranges there is potential for wolverines to interact with the Project at low densities across the entire extent of the Project footprint.

Wolves

The wolf population in the RSA is unknown; however, local knowledge indicates that wolf populations within the region are healthy and relatively abundant, with 'lots of wolves in the area' (Interview 14 & 15, pers. comm. 2016). During Project baseline surveys, wolves were observed throughout the RSA incidentally during aerial ungulate surveys, by remote trail cameras, during the snow track surveys conducted in 2015 and 2016, and by Project personnel (EDI 2017a). Wolf tracks were observed during both the 2015 snow tracking survey along the Java Road and the 2016 snow tracking survey along the proposed NAR. The majority of tracks were observed in low elevation areas.

A paired-site wildlife road use camera study was conducted and wolves were captured on at least one of two paired cameras at each of the six locations. During the winter of 2015/2016, wolves passed cameras on the NAR 76 times with pack size ranging from one to ten animals. A total of 199 wolves were counted passing the cameras. Wolves are assumed to occur throughout the RSA, wherever available prey exists.

Other furbearers

In addition to wolverine and wolf, several other high-value furbearing species are present in the RSA including Canada lynx, American marten, red fox, coyote, red squirrel, American mink, common muskrat, northern river otter, ermine, least weasel, and American beaver. Historical trapping records also indicated Arctic fox occurred in this area; however, it is believed this is an exceptional occurrence. Project baseline surveys documented many of these species throughout the RSA during snow track surveys and incidentally on various other surveys.

According to Yukon Conservation Services, the RSA overlaps a very active trapping area (K. Meister, pers. comm. 2016). Based on current trapping records, Canada lynx and American marten are key harvest species in the region; however, various other species are also important to local trappers including red fox, coyote, red squirrel, mink, otter, weasels and beaver. Based on Traditional Knowledge, many of the species currently harvested in the RSA have a long history of harvest in the region (e.g., Pearse and Weinstein 1988; Mishler and Simeone 2004; InterGroup Consultants Ltd 2009; Tr'ondëk Hwëch'in 2012a, 2012b; Bates and DeRoy 2014; Dobrowolsky 2014), and local First Nations specifically report having harvested beaver, muskrat, mink, marten, snowshoe hare, gopher, fox, lynx, and wolverine in the Coffee Creek area (Tr'ondëk Hwëch'in 2012a; Bates and DeRoy 2014; Dobrowolsky 2014).

Collared pika

Collared pika have been assessed by COSEWIC as a species of Special Concern and are known to occur in the Project region. Project baseline studies included targeted surveys for collared pika; however, no pika

were detected within close proximity to proposed Project infrastructure. Pika were observed in many of the talus patches located in the southeastern sections of the RSA.

Little brown myotis

In August 2014, acoustic bat surveys were conducted near the Coffee exploration camp in the Yukon River Valley and at the Latte deposit. Little brown myotis was detected at the Camp Location but not at the Latte Deposit. Based on the Project observations and previous documentation of little brown myotis near Dawson (Slough and Jung 2008), the species is expected to be present, in low numbers, in suitable, low-elevation (i.e., below 1,000 m) habitats throughout the RSA. A habitat model of potential roosting habitat for little brown myotis was developed to assess the availability of roosting habitat within the RSA.

Other small mammals

Other small mammals that have the potential to occur in the Project area include red squirrel, Arctic ground squirrel, northern flying squirrel, snowshoe hare, and several species of species of mice, voles and shrews. While none of these small mammal species are a conservation concern federally or territorially, they remain ecologically important as prey species of larger carnivores and furbearers.

Amphibians

Wood frog is the only species of amphibian expected to occur in the RSA. Wood frogs were observed incidentally by Project staff on several occasions in lowland habitats within the Yukon River valley. Observations included both adult and juvenile individuals. Wood frog is assumed to occur throughout the Project area in appropriate wetland habitats and will interact with Project infrastructure and activities in these areas.

Mineral licks

Mineral licks are important to ungulate species as they provide a means to obtain essential mineral nutrients which otherwise may be lacking in an ungulate diet (Rea *et al.* 2004). Several mineral licks were reported to EDI and the Company in the Coffee Creek area, Barker Creek area, and the Maisy May Creek area. These areas were investigated by qualified biologists. To date, no active mineral licks have been identified in the RSA; however, follow-up surveys are planned.

ACKNOWLEDGEMENTS

The information summarized in this Wildlife Baseline Report reflects the hard work of a number of people and organizations, without whom, this report would not have been possible.

The Government of Yukon, Department of Environment (Environment Yukon) funded and staffed many of the regional studies summarized in this report. The assistance of a number of Environment Yukon biologists who supplied background data on surveys, collared wildlife, wildlife mortalities and local knowledge, as well as valuable input and guidance for this baseline report is greatly appreciated. Thanks to Mike Suitor (North Yukon Regional Biologist), Martin Kienzler (Fish and Wildlife Technician), Mark O'Donoghue (Northern Regional Biologist), Ramona Maraj (Carnivore Biologist), Troy Hegel (Ungulate Biologist, Caribou/Sheep/Goat), Sophie Czetwertynski (Ungulate Biologist, Moose/Elk/Deer), Kyle Russell (Program Technician, Caribou/Sheep/Goat), Tom Jung (Senior Wildlife Biologist, Biodiversity), Bruce McLean (Senior Habitat Protection Biologist), Kirby Meister (Conservation Office Services, Manager, Field Operations North), Richard Cherepak (Environmental Assessment Analyst), and Julia Ahlgren (Environmental Assessment Analyst) among others.

As a component of the engagement and consultation process undertaken for the Coffee Gold Mine, various groups and individuals shared their knowledge of the Project area and the local wildlife. Several of these individuals asked to remain anonymous, but their contributions greatly increased our understanding of wildlife populations in this region. The time and input from all involved in the engagement and consultation process is much appreciated. Special thanks to the members of the Tr'ondëk Hwëch'in Technical Working Group for their advice on the environmental baseline program and the information that they shared about the Project area.

Wildlife baseline field surveys for the Coffee Gold Mine were conducted by Access Consulting Group (2011–2013) and EDI Environmental Dynamics Inc. (2014–2016). Thanks to the Kaminak Environmental Monitors (Robert Farr, Derek Scheffen, Andrew Taylor and Evan Warren), members of the Tr'ondëk Hwëch'in Natural Resources Department (George MacLeod and James Roberts) and other local residents (Geoff Ranson, Spencer Wallace, Becky Partridge, and David Curtis) who assisted in various wildlife surveys and baseline programs conducted for this Project.

AUTHORSHIP

This report was prepared by the following staff in EDI Environmental Dynamics Inc.'s Whitehorse office:

Lee Hawkings, B.Sc ..... Author

Graeme Pelchat, M.Sc., R.P.Bio. ..... Author

Brodie Smith, B.Sc ..... Author

Todd Mahon, M.Sc., R.P.Bio ..... Author

Lea Pigage, B.Sc., R.P.Bio, PMP ..... Wildlife discipline lead, author, editor

Matt Power, AScT ..... GIS analyses, management, and mapping

Anne MacLeod, B.Sc., R.P.Bio ..... Project manager, terrestrial lead and senior reviewer

Mike Setterington, M.Sc., R.P.Bio. C.W.B ..... Senior reviewer

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ACRONYMS AND ABBREVIATIONS

CESCC ..... Canadian Endangered Species Conservation Council

COSEWIC ..... Committee on the Status of Endangered Wildlife in Canada

Coffee Project, the Project ..... Coffee Gold Mine

EDI ..... Environmental Dynamics Inc.

FCSA ..... Fortymile Caribou Study Area

FNNND ..... First Nation of Na-cho Nyäk Dun

GIS ..... Geographic Information System

GMA ..... Game Management Area

GMS ..... Game Management Subzone

GMZ ..... Game Management Zone

HSI ..... Habitat Suitability Index

IUCN ..... International Union for the Conservation of Nature

Kaminak ..... Kaminak Gold Corporation

KCH ..... Klaza Caribou Herd

km ..... Kilometres

km^2 ..... Kilometres squared

LSA ..... Local Study Area

NAR ..... Northern Access Route

RSA ..... Regional Study Area

RTC ..... Registered Trapping Concession

SARA ..... *Species at Risk Act*

SFN ..... Selkirk First Nation

THFN ..... Tr'ondëk Hwëch'in First Nation

VCs ..... Valued Components

VHF ..... Very High Frequency

WKA ..... Wildlife Key Area

WRFN ..... White River First Nation

YESAA ..... *Yukon Environmental and Socio-economic Assessment Act*

YESAB ..... Yukon Environmental and Socio-economic Assessment Board

YFWMB ..... Yukon Fish and Wildlife Management Board

Yukon CDC ..... Yukon Conservation Data Centre

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1 INTRODUCTION

1.1 PROJECT DETAILS

Kaminak Gold Corporation, a wholly owned subsidiary of Goldcorp Inc. (Kaminak; the Proponent) is proposing to develop a gold mine, known as the Coffee Gold Mine (Coffee Project; the Project) in west-central Yukon, located approximately 130 kilometers south of Dawson (Figure 1-1). The Project (including the proposed access corridor) is located on Crown Land and overlaps the asserted area or established traditional territories of Tr'ondëk Hwëch'in (TH), Selkirk First Nation (SFN), First Nation of Na-cho Nyäk Dun (FNNND) and White River First Nation (WRFN).

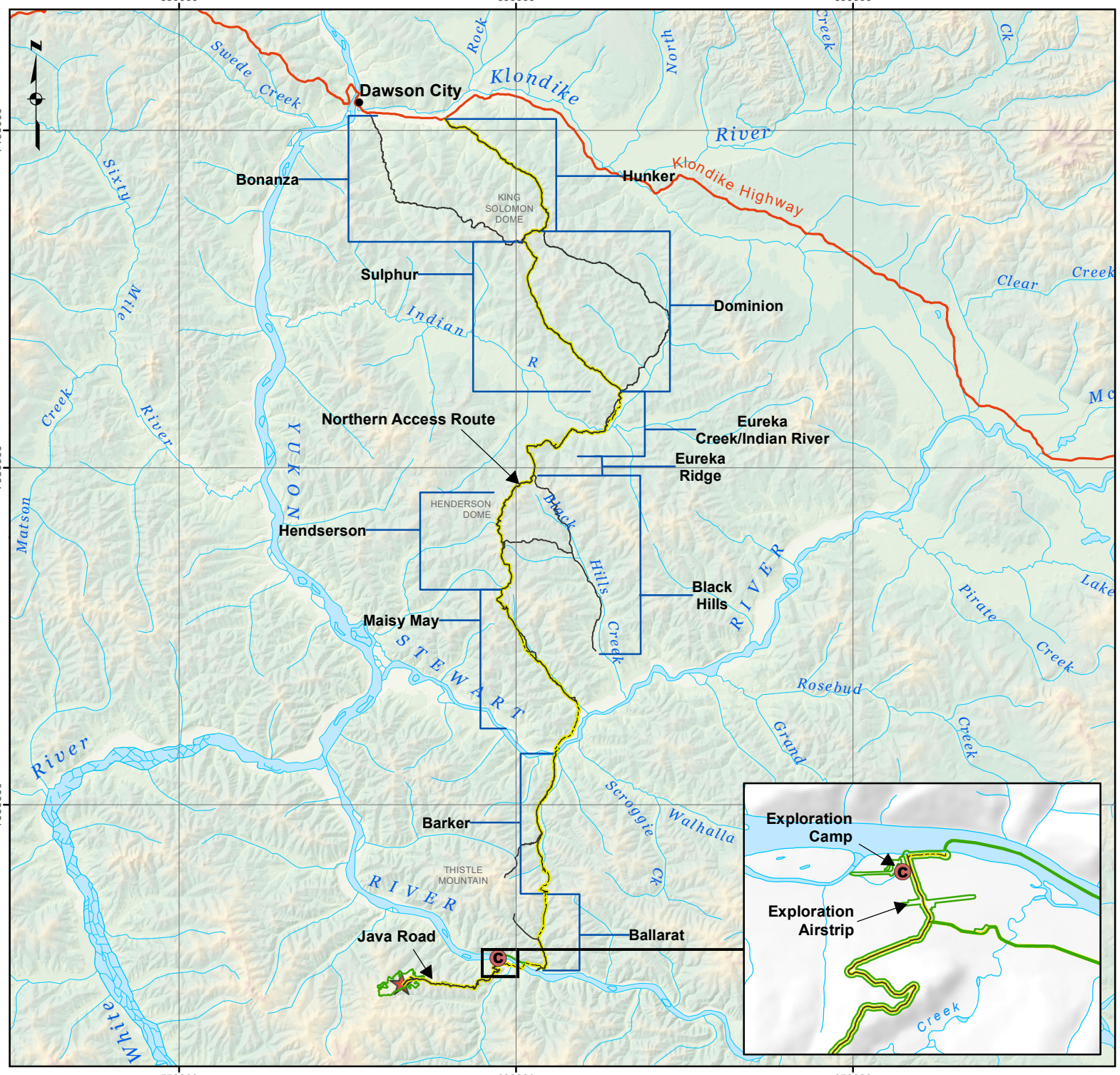
The proposed Project will consist of an open pit gold mine using a cyanide heap leach process to extract gold from the ore. The Project will include four open pits (Latte, Double Double, Supremo, and Kona) developed using standard drill and blast methods and mined using conventional shovel and truck methods. Other Project infrastructure will include waste rock storage facilities, a conventional heap leach facility, a processing plant, a camp site, an airstrip and other support infrastructure. A 214 km all-weather access road with river barge crossings, referred to as the Northern Access Route (NAR), will provide access between Dawson and the mine site. The majority of the NAR is located along existing roads through the Dawson Goldfields which will be upgraded; approximately 37 km of new road will be constructed, along with the construction or upgrade of barge landings at the river crossings. During the open water period barges will be utilized to cross the Stewart River and Yukon River, and during the winter months, ice crossings will be constructed to allow transport trucks to drive across the rivers.

Kaminak retained EDI Environmental Dynamics Inc. (EDI) to perform the terrestrial wildlife baseline investigation in support of the Project Proposal to be submitted to the Yukon Environment and Socio-economic Assessment Board (YESAB) Executive Committee for screening under the *Yukon Environment and Socio-economic Assessment Act* (YESAA), and applications to be submitted for a Quartz Mining License and a Type A Water License from the Yukon Water Board, among other permits and licenses.

Wildlife baseline surveys for the Coffee Project were completed for most of the focal species between 2011 and present and are described in detail in the Wildlife Field Programs Report (EDI 2017a). Habitat models were developed for moose (late winter; EDI 2016a), thinhorn sheep (EDI 2016b), grizzly bear (EDI 2016c) and wolverine (denning; EDI 2016d), to quantify available habitat in the Project area, which are described in their respective reports. This report summarizes the current knowledge and baseline conditions of terrestrial mammals and amphibians in the Project area, including results from the wildlife surveys and habitat modelling, and relies on a number of data sources described further in Section 1.4. This report, as well as the accompanying reports, is in support of the Project Proposal submission to YESAB, the Water License Application, and the Quartz Mining License Application, among other licenses and permits required. Reports accompanying this wildlife baseline report include:

- Coffee Gold Mine: Wildlife Field Program Report (EDI 2017a)

- A Resource Selection Function Model for the Fortymile Caribou Herd (Muhly 2017)
- Coffee Gold Mine: Moose Late Winter Habitat Suitability (EDI 2016a)
- Coffee Gold Mine: Thinhorn Sheep Habitat Suitability (EDI 2016b)
- Coffee Gold Mine: Grizzly Bear Habitat Model (EDI 2016c)
- Coffee Gold Mine: Wolverine Denning Habitat Model (EDI 2016d)
- Coffee Gold Mine: Bird Baseline Report (EDI 2017b).





Legend

- Exploration Camp
- Location of Coffee Gold Mine
- Existing
- Proposed Route
- Highway
- Project Footprint

FIGURE: 1-1

Overview of the Coffee Project

Data Sources
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Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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1.2 OBJECTIVES

To receive authorization for the Project to proceed, it must be evaluated under YESAA, as well as obtain a Quartz Mining License, and Type A Water License. During the environmental assessment process, potential Project effects on valued environmental and socio-economic components (VCs) are determined and mitigation is developed to reduce or eliminate potential adverse effects.

To assess potential Project effects on wildlife, an understanding of wildlife baseline conditions is required. Therefore, the overall objective of this wildlife baseline report is to summarize information on current and historical wildlife presence, distribution and habitat use in the Project area using the best available information including published and unpublished scientific data, Traditional Knowledge, local knowledge, and baseline survey data. The content of this report addresses the objectives identified in YESAB's *Proponents Guide to Information Requirements for Executive Committee Project Proposal Submissions* (2005):

- Describe abundance and distribution characteristics of major wildlife species within the project area and vicinity. Include information on mammals, amphibians, birds, and reptiles (including rare/endangered species);
- Describe the habitat classifications used in the Project area, and any implications concerning the distribution and abundance of habitat types that may influence the Project;
- Provide a map showing the spatial arrangement of habitats of special interest, if applicable;
- Identify and describe transportation corridors and critical, key, and sensitive habitats. Include periods of habitat use in the Project area and vicinity;
- Identify any species listed on the COSEWIC (Committee on the Status of Endangered Wildlife in Canada) and Species at Risk lists;
- Describe any special management requirements due to vulnerability, threatened, or endangered status; and
- Identify and describe any ongoing studies in the Project area.

The wildlife baseline report also includes information requirements, to the extent possible, discussed in the Government of Yukon, Department of Environment (Environment Yukon) document *Kaminak Gold Corporation at Coffee Creek – Dawson Goldfields Access Considerations, Wildlife Baseline Data Recommendations* (Suitor 2015). These recommendations were developed to provide general guidance to the proponent and its consultant, EDI, on information needed to assess potential effects of the development and use of the NAR.

1.3 SPATIAL BOUNDARIES

The **Regional Study Area** (RSA) was established to assess the abundance and distribution of most large wildlife species in the Project area, including caribou, moose, thinhorn sheep, mule deer, grizzly and black bears, wolf, wolverine, and other furbearers. Game Management Areas are legal boundaries used to manage Yukon wildlife species and are made up of Game Management Zones (GMZ or Zones) that are further divided into Game Management Subzones (GMS or Subzones). In Yukon, there are eleven Zones divided

into 443 Subzones. The RSA was delineated to include any GMS that intersects, or is in close proximity to the Project footprint, including the NAR (Figure 1-2). The size of the RSA is 13,661 km^2.

To assess the abundance and distribution of wildlife that have smaller, or more localized, habitat requirements, a **Local Study Area** (LSA) was established. The wildlife LSA is approximately 473 km^2 and includes the proposed mine site area, the road between the existing Coffee Camp and the deposit (i.e., the Java Road), the current airstrip, Coffee Camp, and the proposed NAR to the junction with the Klondike Highway. Around the mine site, the LSA is delineated based on the height of land while encompassing a minimum buffer of 1 km around the proposed development. Along the NAR, the LSA includes a 1 km buffer on either side of the road.

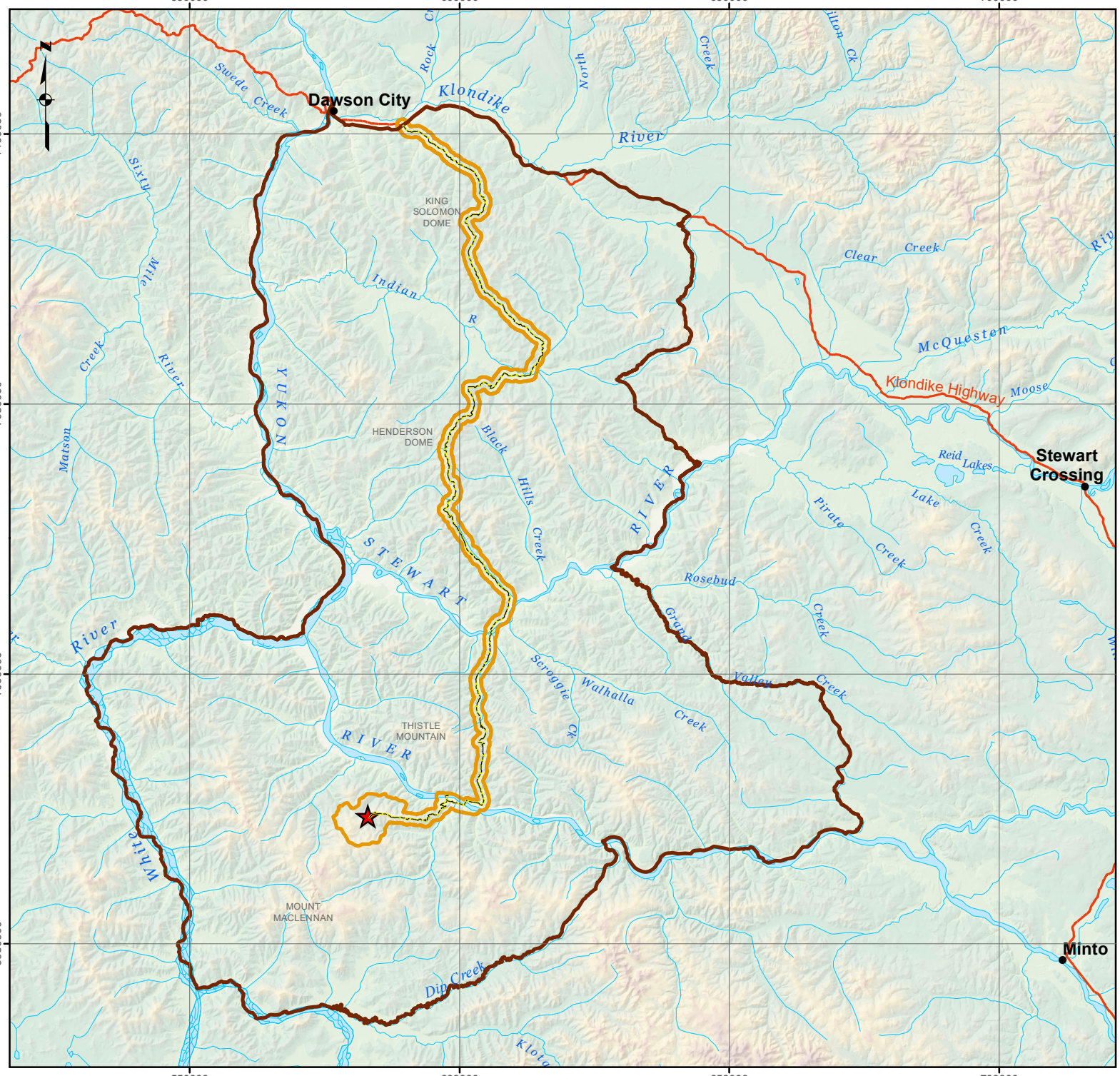
The **Project footprint** is the area that encompasses all Project infrastructure, including new and existing sections of the NAR. Figure 1-2 displays the boundaries of the RSA, LSA and Project footprint. Figure 1-3 and Figure 1-4 show the GMSs and trapping concessions, respectively, that interact with the Project.

The majority of the baseline field studies and analysis for the wildlife baseline were located within the RSA. However, field surveys did not always extend to the full boundaries of the RSA. For those surveys, discussion of survey results references the **survey extent**. In some cases, the survey extents have shifted several times since the initiation of wildlife surveys for the Coffee Project, to accommodate changes related to Project access. For more discussion on the specific survey extents for wildlife baseline studies, refer to the Coffee Gold Mine: Wildlife Field Program Report (EDI 2017a).

1.4 DATA SOURCES

This report summarizes the wildlife baseline conditions for the Project area, which were compiled from a number of sources that are referenced in the relevant sections. These sources include:

- Wildlife baseline surveys conducted for the Coffee Project (Access Consulting Group 2011, 2013a, 2013b, 2014; EDI 2017a);
- Wildlife habitat modelling completed for the Coffee Project (EDI 2016a, 2016b, 2016c, 2016d; Muhly 2017);
- Regional wildlife survey data, population estimates, and harvest data collected by Environment Yukon (various);
- Collar data for the Fortymile Caribou Herd collected by Environment Yukon, Alaska Department of Fish and Game, and Alaska Bureau of Land Management;
- Traditional Knowledge (various);
- Information collected during Project consultation; and
- Available scientific literature including both published and unpublished sources.





Legend

- Coffee Project
- Highway
- Proposed Route
- Local Study Area
- Regional Study Area

FIGURE: 1-2

Wildlife study areas for the Coffee Project

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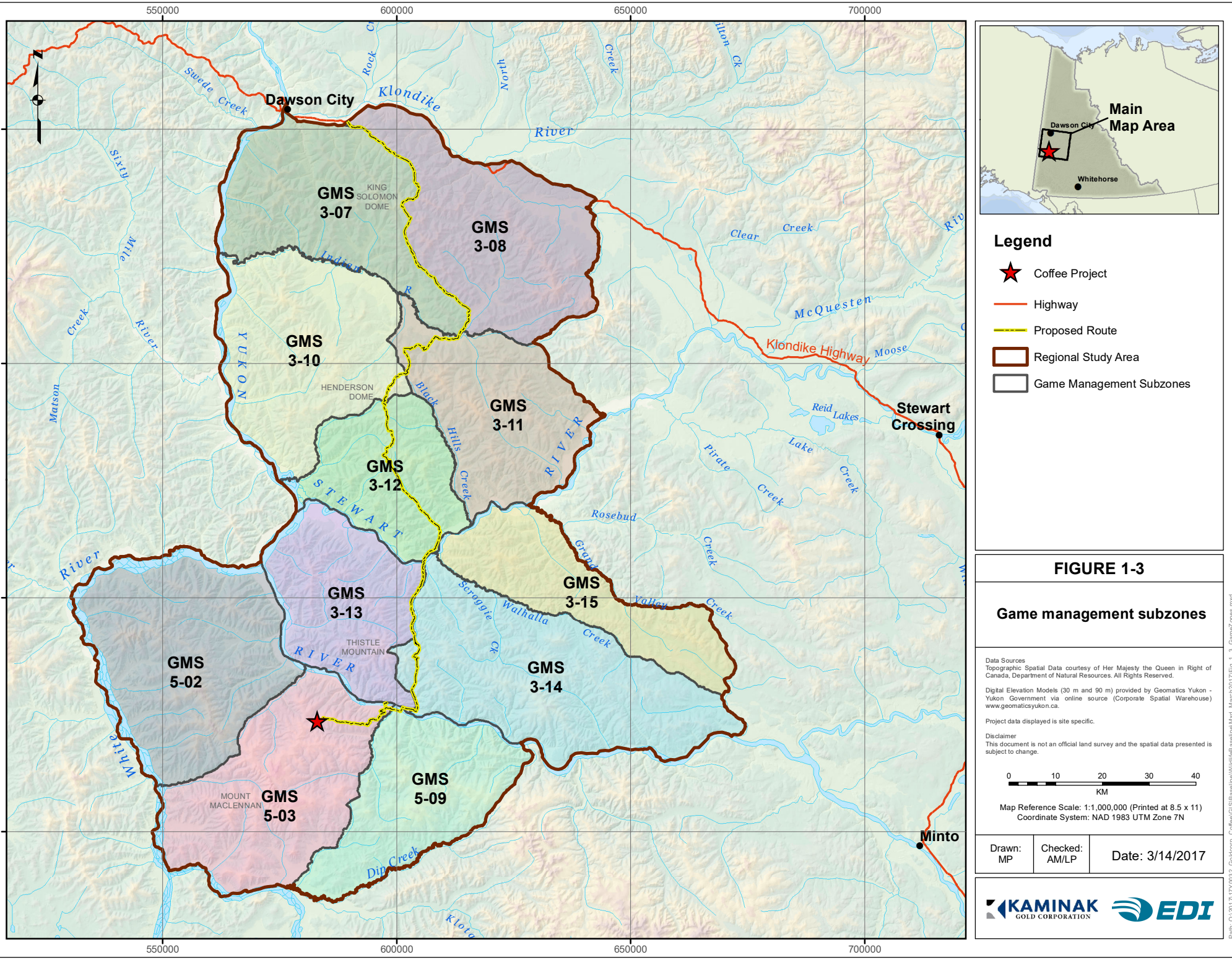

Legend

- Coffee Project
- Highway
- Proposed Route
- Regional Study Area
- Game Management Subzones

FIGURE 1-3

Game management subzones

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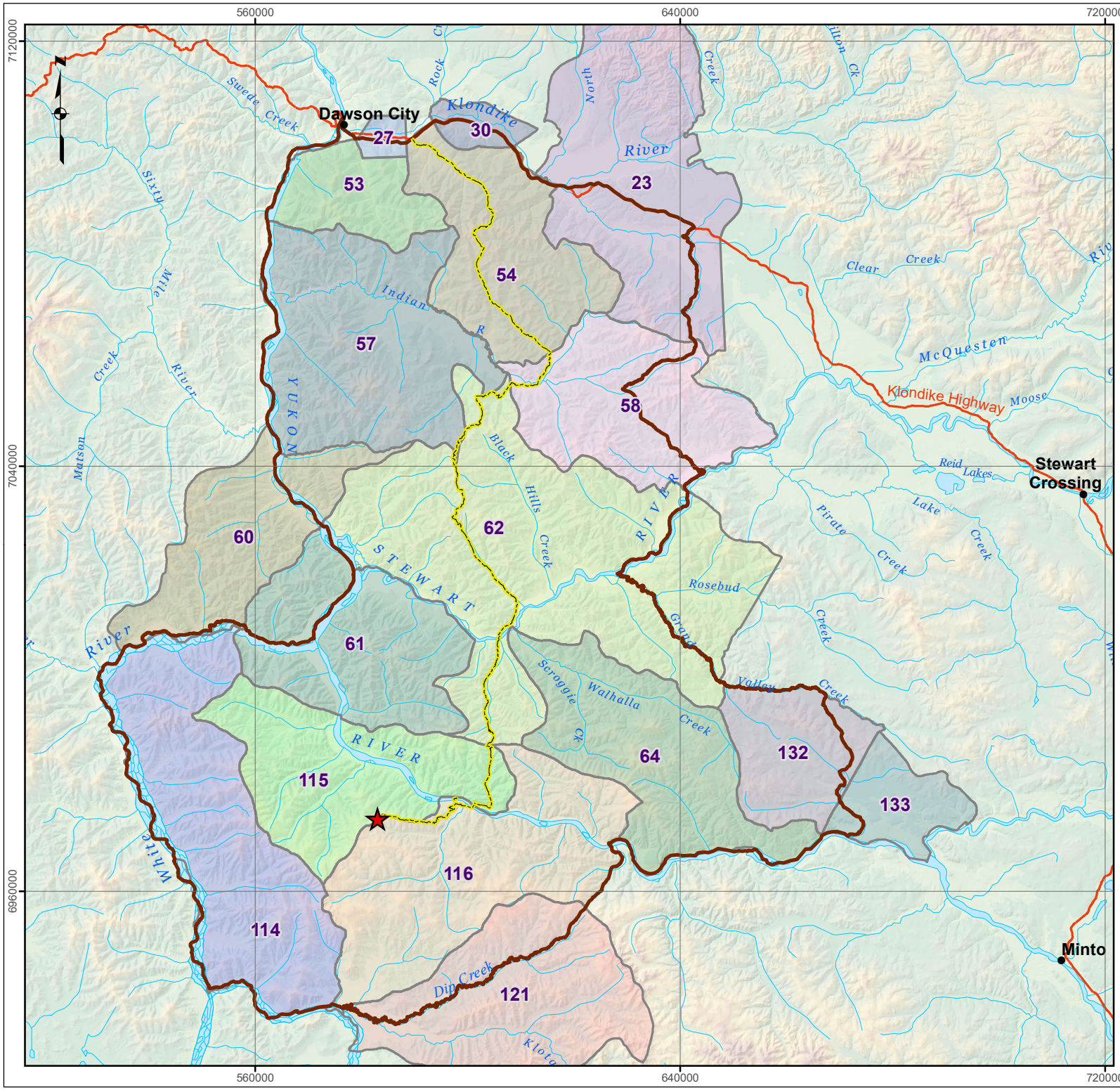



Legend

- Coffee Project
- Highway
- Proposed Route
- Regional Study Area
- Trapping Concessions

FIGURE: 1-4

Trapping concessions

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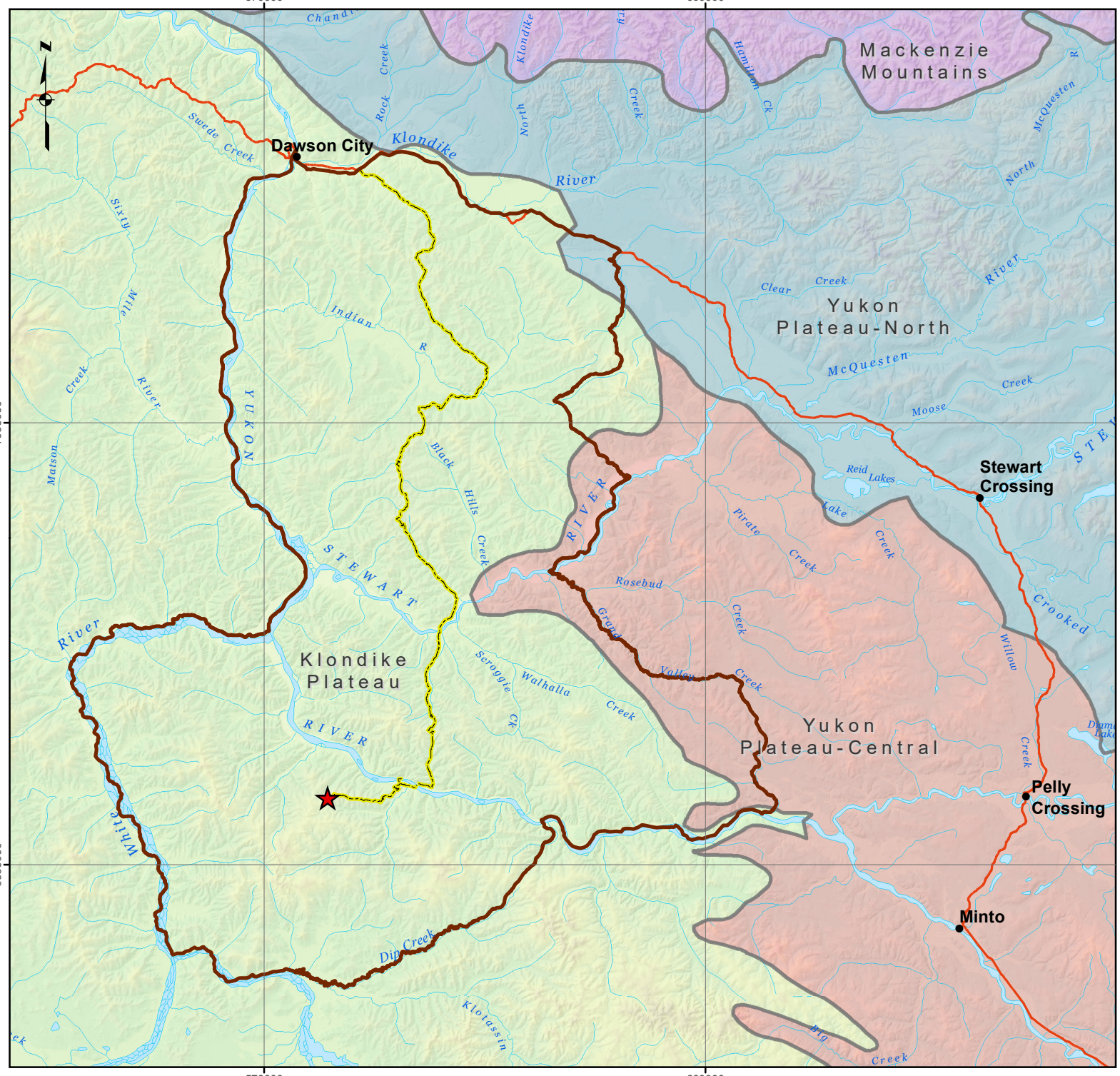
1.5 REGIONAL OVERVIEW

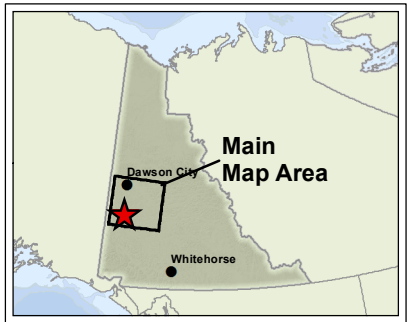
1.5.1 ECOLOGICAL DESCRIPTION

The Project is located in west-central Yukon, within the Boreal Cordillera Ecozone, and within that, the Klondike Plateau Ecoregion (Figure 1-5; Smith *et al.* 2004). The area is a part of easternmost Beringia, and as such, has been exposed to long periods of weathering. The colluvial surface deposits have been deeply incised, forming steep-sided V-shaped valleys containing small streams. These features are characteristic of the ecoregion and are defining features which distinguish the area from adjacent ecoregions (Smith *et al.* 2004). Alpine and subalpine ridges within the area also show characteristic rock outcroppings (tors) which are bedrock remnants that remain after long periods of weathering. One of the most notable physical features in the ecoregion is the Yukon River which flows in an east-west direction through the south portion of the Project area. Elevations in the RSA range from less than 400 m along the Yukon River to over 1,700 m. Lakes are absent from the study area and open-water wetlands and ponds are mainly limited to small bodies of water along the river floodplains and ponds resulting from placer mining activities in the Dawson Goldfields region. The southern portion of the Project area overlaps the northwestern extent of the Dawson Range.

The Project area includes predominantly boreal forest and subalpine habitats. Alpine habitat is also present but is limited in overall extent and is confined to small patches in the southwest and southeast portions of the RSA. Boreal forest habitats are generally dominated by white spruce (*Picea glauca*) and/or black spruce (*Picea mariana*) forests, with mixed forests and stands of aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), and/or birch (*Betula neoalaskana*) on warmer aspects, well-drained slopes, and valley bottoms. This region has an extensive fire history, therefore young, deciduous-dominated, and mixedwood stands are more common than mature conifer-dominated stands. The hillsides which flank the north side of Coffee Creek and the Yukon, Stewart, and Indian rivers are dominated by deciduous vegetation including aspen and birch. Understory vegetation varies across aspects and slope position with nutrient-rich sites supporting willows (*Salix* spp.), alders (*Alnus* spp.), and a variety of other shrubs, grasses, horsetails (*Equisetum* spp.), and forbs, while poorly drained depressions and upland sites include sphagnum mosses (*Sphagnum* spp.), tussock grass, sedges, shrubs, and lichens. Subalpine areas represent the transitional zone from boreal forest to alpine and are characterized by dense scrub birch (*Betula glandulosa*) and willow with dwarf shrubs becoming more common with an increase in elevation. Alpine habitats are characterised by primarily unvegetated areas and sparsely vegetated tundra; tors and felsenmeer are also found on the high elevation ridges.

The northern portion of the NAR passes through the Dawson Goldfields. This area has a long history of placer mining activity with a number of active mine sites and extensive areas of disturbed ground. This disturbance is limited primarily to the valley bottoms with relatively intact and unmined vegetated areas on the hillsides. The disturbed areas include a wide range of reclaimed sites ranging from those in a very early successional state, dominated by bare ground and grasses to areas in a more advanced successional state where dense stands of young aspen, balsam poplar, and willow dominate.





Legend

- Coffee Project
- Proposed Route
- Regional Study Area

Ecoregions overlapping the Project Area

- Klondike Plateau Ecoregion
- Mackenzie Mountains Ecoregion
- Yukon Plateau-Central Ecoregion
- Yukon Plateau-North Ecoregion

FIGURE: 1-5

Ecoregions in the Project area

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1.5.2 WILDLIFE OVERVIEW

The entire LSA and a large portion of the RSA fall within the Dawson Regional Planning area and numerous wildlife species have the potential to occur in the region, as listed in Table 1-1. Ungulates that are common throughout the area include caribou (*Rangifer tarandus*) and moose (*Alces alces*). Thinhorn sheep (*Ovis dallii*) and mule deer (*Odocoileus hemionus*) are present but have been observed in lesser numbers. Wood bison (*Bison bison athabascae*) and elk (*Cervus canadensis*) have not been documented in the area. Predators include grizzly (*Ursus arctos*) and black bear (*Ursus americanus*), wolf (*Canus lupus*), coyote (*Canus latrans*), and red fox (*Vulpes vulpes*). Other furbearers that have been documented in the Project area include North American beaver (*Castor canadensis*), Canada lynx (*Lynx canadensis*), wolverine (*Gulo gulo*), American marten (*Martes americana*), American mink (*Neovison vison*), North American river otter (*Lontra canadensis*), and a variety of weasels. A number of small mammal species can also be found in the RSA including snowshoe hare (*Lepus americanus*), collared pika (*Ochotona collaris*), common muskrat (*Ondatra zibethicus*), squirrels, mice, voles, shrews (*Sorex* sp.) and bats (*Myotis* sp.). The only amphibian expected to occur in the Project region is the wood frog (*Lithobates sylvaticus*).

Table 1-1. Mammal species that have the potential to occur in the Project area.

Common name	Latin name	Presence documented in the RSA[1]
UNGULATES		
Caribou	*Rangifer tarandus caribou and Rangifer tarandus granti*	Yes
Moose	*Alces alces*	Yes
Thinhorn sheep	*Ovis dalli*	Yes
Mule deer	*Odocoileus hemionus*	Yes
CARNIVORES		
Grizzly bear	*Ursus arctos*	Yes
Black bear	*Ursus americanus*	Yes
Wolverine	*Gulo gulo*	Yes
Grey wolf	*Canis lupus*	Yes
Coyote	*Canis latrans*	Yes
Red fox	*Vulpes vulpes*	Yes
Arctic fox	*Vulpes lagopus*	Yes[2]
Cougar	*Puma concolour*	Possible[3]
Canada lynx	*Lynx canadensis*	Yes
American marten	*Martes americana*	Yes
Least weasel	*Mustela nivalis*	Yes
Ermine	*Mustela ermine*	Yes
American mink	*Neovison vison*	Yes
Northern river otter	*Lontra canadensis*	Yes
HARE AND PIKAs		
Snowshoe hare	*Lepus americanus*	Yes
Collared pika	*Ochotona collaris*	Yes
RODENTS		
Red squirrel	*Tamiascurus hudsonicus*	Yes
Least chipmunk	*Tamias minimus*	No
Woodchuck	*Marmota monax*	No
Hoary marmot	*Marmota caligata*	Yes
Arctic ground squirrel	*Spermophilus parryii*	Yes
Northern flying squirrel	*Glaucomys sabrinus*	Yes
American beaver	*Castor canadensis*	Yes
Bushy-tailed woodrat	*Neotoma cinerea*	No
Deer mice	*Peromyscus maniculatus*	Yes
Northern red-backed vole	*Myodes rutilus*	Yes
Meadow vole	*Microtus pennsylvanicus*	No
Tundra vole	*Microtus oeconomus*	No
Singing vole	*Microtus miurus*	No

Table 1-1. Mammal species that have the potential to occur in the Project area.

Common name	Latin name	Presence documented in the RSA[1]
Common muskrat	*Ondatra zibethicus*	Yes
Northern bog lemming	*Synaptomys borealis*	Yes
Meadow jumping mouse	*Zapus hudsonius*	No
North American Porcupine	*Erethizon dorsatum*	Yes
BATS		
Little brown bat	*Myotis lucifugus*	Yes
Northern long-eared myotis	*Myotis septentrionalis*	No
SHREWS		
Dusky shrew	*Sorex monticolus*	No
American water shrew	*Sorex palustris*	No
Pygmy shrew	*Sorex hoyi*	No
Tundra shrew	*Sorex tundrensis*	No

[1] Species presence confirmed by observation made during environmental baseline studies, as incidental observations by mine staff, or through harvest records provided by Environment Yukon (Government of Yukon 2016a).

[2] Historical trapping records have documented Arctic fox in the RSA; however, it is believed this is an exceptional occurrence. Baseline studies have not observed the species and the RSA is south of the documented range for Arctic fox in Yukon (Government of Yukon 2016b).

[3] During the Project engagement and consultation process, anecdotal reports of cougar sightings in the region were received by the Project team. The Camp Wildlife Log also included a report of a cougar in the Project area in 2011; however, no photo or other documentation was available to provide confirmation of this reported sighting. The species was not detected during other baseline studies and, to our knowledge, there are no confirmed records of cougar in the RSA.

1.5.3 SPECIES AT RISK

A number of the wildlife species occurring in the RSA are considered to be of conservation concern — either federally or territorially in Yukon (Table 1-2). The list includes species assessed by COSEWIC and identified in SARA. It also includes species identified in the *Yukon Wildlife Act* and by the Yukon Conservation Data Centre (Yukon CDC).

Table 1-2. Mammals with conservation status that occur, or have the potential to occur, in the RSA.

Common Name	Latin Name	SARA[1]	COSEWIC[2]	Yukon	Observed in the RSA[5]
Woodland Caribou, Northern Mountain Population	*Rangifer tarandus caribou*	Special Concern (Schedule 1)	Special Concern (2014)	-	Yes
Mule deer	*Odocoileus hemionus*	No status	Not at Risk	Vulnerable[3]	Yes
Grizzly Bear	*Ursus arctos*	No Status	Special Concern (2012)	-	Yes
Wolverine	*Gulo gulo*	No Status	Special Concern (2014)	-	Yes
Cougar	*Puma concolour*	Not at Risk	Not at Risk	Specially Protected[4]	Possible
Collared Pika	*Ochonona collaris*	No Status	Special Concern (2011)	-	Yes
Little Brown Myotis	*Myotis lucifugus*	Endangered (Schedule 1)	Endangered (2013)	-	Yes

[1]*Species at Risk Act* (SARA) Designation.
[2]COSEWIC Designation with year last assessed.
[3]Yukon CDC status.
[4]*Yukon Wildlife Act* Designation.
[5]Observed in the RSA during wildlife baseline studies.

1.5.4 FOCAL SPECIES

The wildlife baseline program, including both the field surveys outlined in the Wildlife Field Programs Report (EDI 2017a), and the discussion of baseline conditions in this Wildlife Baseline Report includes a broad review of the species and habitats present, as well as more detailed focus on specific species. Focal species selected for field surveys and baseline reporting include both species of conservation concern and species with social, cultural, or economic value. They reflect recommendations received during Project consultation with Environment Canada, Environment Yukon, local First Nations, and other stakeholders, as well as a review of relevant Traditional Knowledge. Consideration for the selection of focal species or species groups included:

- Species of conservation concern including both federal (COSEWIC and SARA) and territorial listings (Table 1-2);
- Species harvested by First Nations or other local harvesters in the RSA;
- Species selected as focal species for previous environmental assessments in Yukon;
- Species raised as a concern during Project consultation;
- Species with the potential to interact with the proposed Project.

Discussion of focal species in this Wildlife Baseline Report includes both species that were a primary focus and species that were a secondary focus. Those species identified as a primary focus for the Wildlife Baseline

Report are generally discussed in greater detail; in most cases, targeted field surveys and habitat modelling were completed for these species. Those species identified as a secondary focus for the Wildlife Baseline Report are described in lesser detail; however, in some cases targeted field surveys were conducted for these species. Table 1-3 identifies the focal species for the Wildlife Baseline Report and the rationale for their selection.

Table 1-3. Focal species or species groups selected for the Wildlife Baseline Report

Species/Species Group	Primary or Secondary Focus	Rationale for Selection as a Focal Species
Caribou	Primary	Fortymile Caribou Herd raised as a key concern by Environment Yukon (Suitor 2015) and TH (N. Becker, pers. comm. 2016), during Project consultation effects to Fortymile caribou were one of the most commonly raised concerns regarding wildlife[1]. Klaza Caribou Herd listed on Schedule 1 of the SARA and assessed as Special Concern by COSEWIC.
Moose	Primary	Primary big game harvest species present in the RSA; raised as a concern by Environment Yukon (Suitor 2015); identified as a key concern by TH (N. Becker, pers. comm. 2016); during Project consultation effects to moose were one of the most commonly raised concerns regarding wildlife[1].
Thinhorn Sheep	Primary	Raised as a concern by Environment Yukon (Suitor 2015) due to low densities and sensitivity of sheep to disturbance.
Mule Deer	Secondary	Not raised as a particular concern in relation to Project effects; however, Environment Yukon requested that baseline observations be documented and reported (Suitor 2015).
Grizzly Bear	Primary	Raised as a concern by Environment Yukon (Suitor 2015; R. Maraj, pers. comm., 2016); assessed as Special Concern by COSEWIC.
Black Bear	Secondary	Raised as a concern by Environment Yukon (R. Maraj, pers. comm., 2016) due to potential mortality risks associated with the Project.
Wolverine	Primary	Raised as a concern by Environment Yukon (Suitor 2015; R. Maraj, pers. comm., 2016); assessed as Special Concern by COSEWIC.
Grey Wolf	Secondary	Raised as a concern, primarily in relation to the potential effects of facilitated predation on ungulate species (Suitor 2015; TH TWG, pers. comm., 2016).
Other Furbearers	Secondary	Raised as a concern by TH (TH TWG, pers. comm., 2016); Wildlife Baseline Report focusses on American marten and lynx, the two most frequently trapped species in the RSA.
Collared Pika	Secondary	Raised as a concern by Environment Canada (Environment Canada, pers. comm., 2015) and assessed as Special Concern by COSEWIC. Initially considered as a Primary focus; however, field surveys did not locate any pika within 10 km of the proposed Project footprint.
Bats	Primary	Listed on Schedule 1 of the SARA and assessed as Endangered by COSEWIC.

[1] During Project consultation, a wide range of concerns regarding wildlife and specific wildlife species were related to the Project team; however, concerns regards effects to the Fortymile Caribou Herd and moose were the most common and were raised by Project regulators, First Nations and other Yukon residents.

2 UNGULATES

Ungulates, particularly caribou, moose, and thinhorn sheep are important and highly valued species in Yukon. A number of surveys were completed as part of the Project's Wildlife Field Program that focused on assessing ungulate habitat use and distribution (Table 2-1). The methods and results of these surveys are described in the Wildlife Field Program Report (EDI 2017a). The spatial boundaries for the aerial ungulate surveys completed by EDI are shown in Figure 2-1.

Table 2-1. Summary of ungulate surveys conducted for the Coffee Project (2014–2016).

Survey Type	Target Species	Dates Conducted
Aerial Early Winter Moose Surveys [1]	Moose	November 13–16, 20–22, 2015
Aerial Late Winter Ungulate Surveys	Moose and Caribou	February 28–March 5, 2014 March 10–14, 2015 March 7–10, 2016
Aerial Thinhorn Sheep Surveys	Thinhorn sheep	November 22, 2015 (early winter) February 29, 2016 (late winter) May 25, 2016 (lambing) June 13, 2016 (summer) October 24, 2016 (early winter)
Ground-based Sheep Investigations	Thinhorn sheep	May 27–August 28, 2015 June 14–17, 2016 October 25–26, 2016
Snow Tracking Surveys	Caribou, Moose, Wolves, Wolverine, and other Furbearers	February 11–15, 2015 February 22–25, 2016
Remote Camera Studies	Caribou, Moose, Thinhorn sheep, and Wolves	May 2015-Ongoing
Mineral Lick Investigation	Ungulates	August 2–5, 2015 August 26–30, 2015 April 25 and 26, 2016 June 15, 2016
Pellet Removal Plots	Caribou	Summers of 2014, 2015, 2016
Caribou Pellet Collection and Dietary Analysis	Caribou	Summer of 2014

[1] Conducted in conjunction with Environment Yukon.

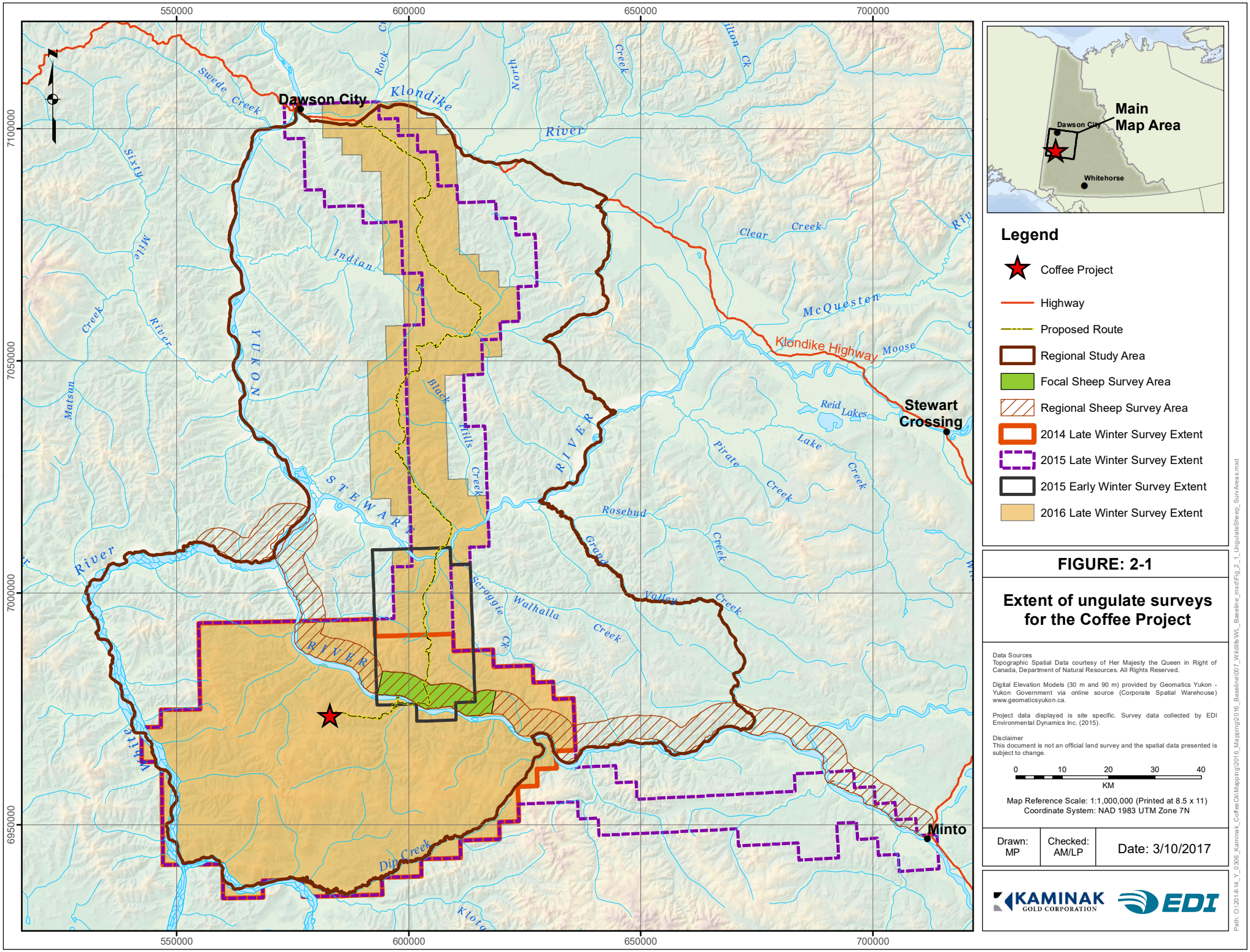

FIGURE: 2-1

Extent of ungulate surveys for the Coffee Project

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Survey data collected by EDI Environmental Dynamics Inc. (2015).

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

0 10 20 30 40
KM

Map Reference Scale: 1:1,000,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MP	Checked: AM/LP	Date: 3/10/2017

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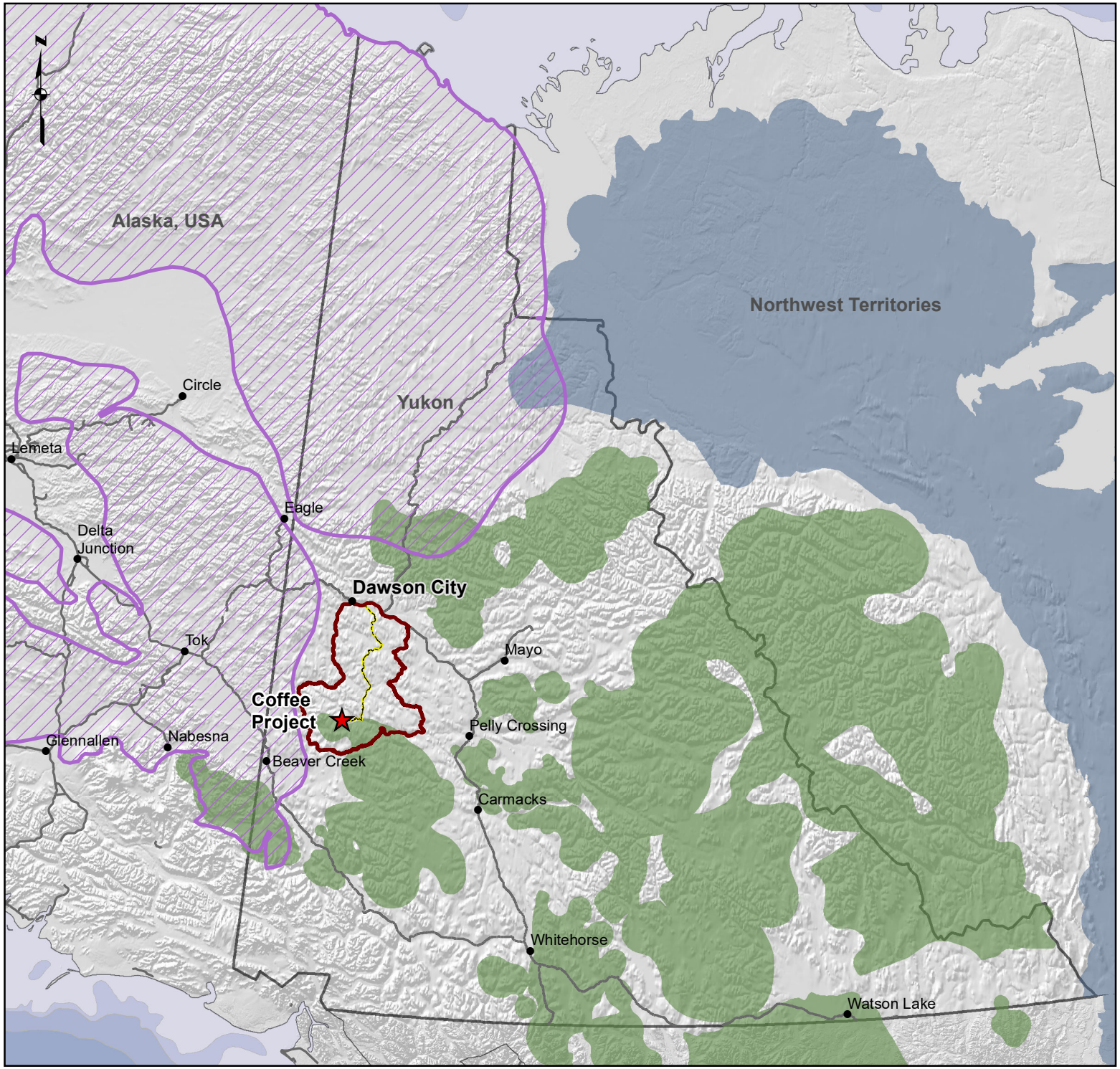
2.1 CARIBOU

Caribou occupy most of the northern hemisphere's higher latitude terrestrial environments (CARMA 2016), and are commonly the most abundant large mammal throughout their range. In North America, caribou are classified by subspecies or ecotype based on geographic distribution, physical attributes, behaviour, and management authority; however, there is currently no agreed taxonomic classification (Festa-Bianchet *et al.* 2011). In this report we have used COSEWIC's classification of caribou as 'designatable units' (COSEWIC 2011a).

Yukon is occupied by caribou that are part of the northern mountain, barren-ground, and boreal designatable units — of these, northern mountain and barren-ground caribou are found in the RSA (Figure 2-2). Northern mountain caribou are a sedentary ecotype of caribou that occur throughout most of Yukon and parts of northern British Columbia and western Northwest Territories. The total population of Northern Mountain caribou is approximately 45,000 individuals in 36 geographically distinct herds, though some herd ranges overlap (Environment Canada 2012). Northern Mountain caribou are listed as a species of Special Concern on Schedule 1 of the Canadian *Species at Risk Act* (SARA; Government of Canada 2016) and are considered Vulnerable within Yukon (Government of Yukon 2015a). The Yukon population of northern mountain caribou is estimated at 25,000 (Government of Yukon 2015a). Barren-ground caribou are a migratory ecotype of caribou that occupy most of northern Canada and Alaska. The total population of barren-ground caribou likely exceeds 2,000,000 (CARMA 2016; data from herds in central Alaska and much of Nunavut are missing). The Yukon population is estimated at approximately 220,000 animals (Government of Yukon 2015b).

Within the RSA, three herds of caribou may occur seasonally: the Klaza caribou herd (classified as northern mountain caribou), and the Fortymile and Nelchina caribou herds (barren-ground caribou). In Canada, the Fortymile and Nelchina caribou herds are recognized as part of the barren-ground caribou; however, in Alaska and much of the published literature, the herd's taxonomic classification is Grant's caribou, similar to the Porcupine caribou herd in northern Yukon. The distribution of Grant's caribou includes most of Alaska and parts of northern and western Yukon. The current annual range of the Fortymile and Klaza caribou herds overlaps with the RSA, while the Nelchina caribou herd range is on the periphery of the RSA.





Legend

- Coffee Project
- Proposed Route
- Regional Study Area

Migratory Caribou Range

- Barren-ground Caribou

Sedentary Caribou Range

- Boreal Caribou
- Northern Mountain Caribou

FIGURE: 2-2

Distribution of caribou in Yukon

Data Sources
Topographic Spatial Data courtesy of Esri. All Rights Reserved.

Barren Ground caribou herd range - Alaska Department of Fish and Game.

Northern mountain caribou ranges - Yukon Government Environment Yukon.

Boreal caribou range - Government of Northwest Territories, 2015.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

0 100 200
KM

Map Reference Scale: 1:6,000,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 CSRS Yukon Albers

Drawn: MP	Checked: AM/LP	Date: 3/14/2017

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2.1.1 FORTYMILE CARIBOU

The Fortymile caribou herd is a migratory ecotype of caribou and part of the barren-ground designatable unit. The Fortymile caribou herd occupies east-central Alaska and west-central Yukon. The core of the herd's range is centred on the Yukon-Tanana Upland (i.e., Tanana Hills) in Alaska. Historically, the Fortymile caribou herd was one of the largest caribou herds in North America and the herd ranged widely across both Yukon and Alaska, including the entire Project RSA. Following a population crash in the early to mid-1900s, the herd abandoned most of its Yukon range, including the RSA. The Fortymile caribou have only recently returned to the Project area with an eruptive movement in the fall of 2013, corresponding with the continued growth of the herd.

2.1.1.1 Population and Herd Recovery

The Fortymile caribou herd was once one of the largest caribou herds in North America. In the 1920s, the herd was estimated to have reached a population peak of between 260,000 and 569,000 animals (Murie 1935; Boertje et al. 2012). At the herd's peak, they ranged across large areas of Alaska and Yukon. The Yukon range included much of central Yukon and extended as far south and east as Whitehorse, with parts of Yukon used during all seasons (McDonald and Cooley 2004). During the early part of the 20th century, there were reports of large groups of caribou migrating throughout the central Yukon (McDonald and Cooley 2004); all are assumed to be Fortymile caribou. The 1995 Fortymile Caribou Herd Management Plan (Alaska Department of Fish and Game 1995) and McDonald and Cooley (2004) provide the estimated historical extent of their range, which approximately corresponds with Murie (1935; Figure 2-5).

The Fortymile caribou herd experienced a population decline during the 1930s (McDonald and Cooley 2004) followed by further declines until it reached its smallest recorded size in 1973 of between 5,740 and 8,610 caribou (Valkenburg et al. 1994). As the population decreased, the herd disappeared from large portions (>75%) of its historic range (Gronquist et al. 2006) including nearly all of its range in Yukon. The herd was not observed in Yukon during some winters starting in 1960, and not at all between 1976 and 1984 (McDonald and Cooley 2004).

The Fortymile caribou herd began increasing in size through the mid-1970s and 1980s as a result of reduced harvest, favorable environmental conditions, and low wolf numbers (Valkenburg et al. 1994), until population growth stagnated at approximately 22,000 caribou in the early 1990s (Gronquist et al. 2006). During this period, very few caribou crossed into Yukon, although starting in 1985, small numbers were infrequently found in Yukon (McDonald and Cooley 2004; M. Suitor, pers. comm. 2014-2016).

In 1993, concerned about the low numbers of Fortymile caribou returning to Yukon, the Tr'ondëk Hwëch'in (TH) initiated discussions with Alaskan Fish and Game Advisory Committees and expressed interest in recovering the herd to its former ranges. This led to the creation of an international recovery team with representatives from governments, First Nations, user groups, and committees/boards from both Alaska and Yukon. In 1995, the team produced a comprehensive five-year recovery plan for the herd aimed at promoting herd growth through reduced harvest, habitat management, predator management, and public outreach (Gronquist et al. 2006; M. Suitor, pers. comm. 2014-2016). Through the recovery efforts, the

Fortymile caribou herd increased by 78% over the life of the plan, and by 2001 the herd had increased to 40,204 animals (Gronquist et al. 2006). In the fall of 2002, the herd began its first major movement into Yukon since the 1960s with tens of thousands of caribou returning to Yukon and extending the herd's winter range into areas west of Dawson, in the vicinity of the Yukon, Forty Mile, Sixty Mile, and Ladue Rivers (Barker and Hegel 2012; Kienzler and Suitor 2015).

In 2010, the Alaska Department of Fish and Game estimated that the herd size had increased to 51,675 caribou (Alaska Department of Fish & Game 2014); however, the herd range in Yukon was still largely restricted to habitats along the north shore of the Yukon River downstream of Dawson and along the Top of the World Highway, Sixty Mile River, and Ladue River. In the fall of 2013, the Fortymile caribou herd made another eruptive movement east into Yukon, reoccupying large areas of their historic range (including parts of the Project RSA) last used during previous population peaks in the 1960s, and in some cases decades earlier (Kienzler and Suitor 2015). The Fortymile caribou herd is currently estimated at approximately 52,000 animals based on the 2010 population estimate. A population survey was attempted in Alaska in 2015 and 2016, the results of which are not yet available; however, the herd is believed to be stable or increasing in size (M. Suitor, pers. comm. 2014-2016). Table 2-2 provides a summary of the Fortymile caribou population estimates between 1920 and 2010.

Large caribou herds naturally cycle through periods of scarcity and abundance. In the case of the Fortymile caribou herd, the causes of the decline may have been a combination of weather (Post and Forchhammer 2004), overgrazing of winter forage (Collins et al. 2011), and predation (Valkenburg et al. 1994); however, early in the recovery effort, people believed that the near extirpation of the Fortymile herd was mostly due to harvest. Long-term monitoring of caribou populations and Traditional Knowledge suggest that large migratory caribou herds naturally cycle between periods of population highs and lows, with corresponding range expansions and contractions (Gunn et al. 2011). The decline of the Fortymile herd likely followed this pattern, but the additional adverse anthropogenic effects related to increased hunting pressure during Klondike gold rush may have exacerbated the decline and/or delayed their recovery (Valkenburg et al. 1994).

Table 2-2. Summary of the Fortymile caribou population estimates (1920–2010)

Year	Estimate	Reference
1920	200,000–568,000	Valkenburg *et al.* 1994; Murie 1935
1950	6,500	“”
1950	20,000	“”
1953	46,000	“”
1956	45,000	“”
1958	40,000	“”
1960	50,000	“”
1962	50,000	“”
1963	50,000	“”
1969	20,000	“”
1970	15,000	“”
1971	11,000	“”
1972	15,000	“”
1973	5,312	“”
1974	4,041	“”
1975	3,982	“”
1975	7,175	“”
1981	10,093	“”
1983	12,350	“”
1984	13,402	“”
1986	15,303	“”
1988	19,975	“”
1990	22,766	“”
2003	43,375	Harvest Management Coalition 2012
2010	51,675	“”

2.1.1.2 Distribution and Movement

The Fortymile caribou herd is a migratory ecotype that displays the characteristic long-distance movements between relatively distinct seasonal ranges and gregarious behaviour on calving grounds. Migratory behaviour provides access to seasonally available habitat and helps avoid predators. Winter range is generally the largest of the seasonal ranges and often overlaps with the winter range(s) of other migratory and non-migratory caribou herds. Winter range distribution and movement is somewhat unpredictable as caribou are inconsistent in their range use.

The Fortymile herd calves and summers in the higher elevation habitat of the Yukon-Tanana Upland (Tanana Hills) in east-central Alaska. This portion of the herd’s range has remained its core range during the population lows and caribou occupy this area during all seasons (Figure 2-5; Boertje *et al.* 2012). The herd has primarily occupied the Alaska portion of their range since the population low in the 1970s. As the herd

recovered, their range expanded, reoccupying parts of their historic range west of the Steese Highway and east into Yukon, often in eruptive movements (see section 2.1.1.1). The size of the herd's range shows a direct relationship with herd size (Boertje *et al.* 2012).

Currently, Fortymile caribou are present seasonally in Yukon. Although historically Fortymile caribou may have been found in Yukon year-round (McDonald and Cooley 2004), recent satellite collared caribou locations show they are generally using habitat in Yukon and the Project RSA only during the early and late winter seasons, and the corresponding migration periods, between October and April (Figure 2-6 and Figure 2-7). This is consistent with data from the various remote camera monitoring programs which, to date, have photographed caribou in the RSA from late October through late-April (EDI 2017a).

Since 2013, the winter range of the Fortymile herd has included large portions of the Project RSA; however, winter distribution has varied between years. Both the satellite collar data and Project survey data show that caribou heavily used the RSA during the winter of 2013/2014 and again in 2015/2016, while very few caribou were in the RSA during the winter of 2014/2015 (Figure 2-6, Figure 2-7, Figure 2-8). During the winters of 2013/2014 and 2015/2016 satellite collared caribou locations show that a considerable portion of the herd was in Yukon, including parts of the RSA. However during the winter of 2014/2015, the herd only used the very western edge of Yukon and no collared animals used the RSA. Collar data indicates that the caribou did not cross the White or Yukon rivers during the fall of 2014, and observations by survey crews indicated that the White River remained unfrozen, providing a possible hypothesis for the Fortymile herd not using the area. Collar data and survey data for the winter of 2016/2017 were not available at the time of reporting; however, according to Environment Yukon biologists the majority of the herd is wintering in Alaska and did not cross into the Yukon (M. Suitor, pers. comm., 2016).

Baseline ungulate surveys for the Coffee Project began in 2011 (Access Consulting Group 2011, 2013a, 2013b); however, Fortymile caribou were not detected in the Project area until the winter of 2013/2014 (consistent with satellite collar data). The late winter survey in March 2014 recorded 1,146 Fortymile caribou occupying areas within the southern portion of the RSA, south of the Yukon River (the 2014 survey did not yet include the northern portion of the RSA). During the winter of 2014/2015, very few caribou were observed, with only 21 caribou documented during the 2015 late winter survey (EDI 2017a). Caribou were again observed in large numbers in the 2015/2016 winter surveys — 4,752 caribou were observed incidentally during the 2015 early winter moose survey of the Dawson Goldfields in the northern portion of the RSA (north of the Stewart River; report pending, preliminary data provided by M. Suitor, pers. comm., 2016), with another 625 caribou documented in incidental sightings in an associated late winter survey along the NAR between the Yukon and Stewart Rivers (EDI 2017a). During the March 2016 late winter survey, 290 caribou were observed within the survey extent and surveyors noted an abundance of tracks (both old and new) in various locations through the area (EDI 2017a). The majority of caribou observed during the Project surveys were using alpine and subalpine areas within the survey extent, with concentrations on the alpine and subalpine ridges to the north of the Yukon River from Thistle Mountain east to Selwyn Dome. Caribou were observed in a range of habitat types from low elevation forests to alpine. Across the various surveys, caribou were observed in groups ranging in size from 1–130 animals (EDI 2017a).

Migratory caribou herds exhibit unpredictable use of their winter range, so accurately predicting annual distribution and movement in future years is not possible as there are too many variables that influence caribou behaviour. Future range use and movements of the Fortymile caribou herd in Yukon likely depends on stable or continued population growth; however, based on the herd's current distribution, Fortymile caribou have the potential to occur seasonally within the RSA during any year. Use of the RSA in any given year could range from no caribou, to small numbers of caribou in isolated areas of the RSA, to thousands of caribou spread across large portions of the RSA.

Residency in RSA

Fortymile caribou outfitted with satellite collars started occupying areas near the Project in September 2013. Two caribou location datasets were provided by Environment Yukon that document caribou distribution. The datasets were specific to the type of collar used to record caribou locations: Argos and Iridium. The Iridium collar dataset generally provided one location per caribou per day; however, some intervals between locations were longer because caribou left Yukon, collars may have temporarily malfunctioned, or collar data was screened out prior to distributing. The Argos collar dataset recorded multiple locations per day but did not include a time stamp in the dataset, therefore to make the data comparable to the Iridium dataset, locations were averaged for each day. Averaging location reduces precision and accuracy; however, the data is suitable at the scale of this analysis.

Both collar datasets were restricted to a polygon provided by Environment Yukon (M. Suitor, pers. comm., 2015; Figure 2-8) that outlines the area which the Fortymile herd can reasonably be expected to use within the coming decade. It is based on the historic distribution of the herd, the 2013–2014 distribution, and what Environment Yukon considers to be expansion habitat adjacent to those locations. This area, referred to as the Fortymile Caribou Study Area (FCSA) in this report, encompasses all areas that the herd has used since returning to Yukon (2002 to spring 2016), as well as additional habitats to the west which may be used should the herd continue to expand its range. Compared to the historic range (e.g., McDonald and Cooley 2004), this study area does not go as far south and east, but does include area to the north (Tombstone-Ogilvie) based on the 2013 Fortymile herd movement.

The collar data provided the opportunity to characterize residency time in the Project footprint, the wildlife RSA and the FCSA. Residency is based on the three season-years (October 1 to April 30; 2013/2014, 2014/2015, 2015/2016) of satellite collar data collected for the herd. Consecutive point locations were connected to create step segments and a polyline database. The lines were then split at each node to create individual step segments. Steps that intersect the FCSA, RSA or Project footprint were selected and split at the intersection. The proportion of each step that was within each study area multiplied by the number of days the step represented (usually one day) was used to estimate the residency time of each caribou. The method was repeated for each year. The average residency time was calculated using all three years of collar data and the maximum and minimum amount of time any one individual caribou spent in the FCSA, RSA or Project footprint from the three years of data were used as the maximum and minimum residency times.

The average residency time in the Project footprint for all collared caribou over the three years of data collection was only 0.01 days (range 0–0.19 days) whereas the average residency time in the RSA was 15.97

days (range 0–162.26 days) and the average residency time in the entire FCSA was 74.77 days (range 1.00–183.00 days; Table 2-3). These estimates assume that the collars are representative of the caribou that occurred in Yukon during this period and that step lengths accurately represent caribou movements. Based on this information, collared Fortymile caribou have spent a relatively small amount of time during the winter season in the Project footprint area relative to the time spent in the remainder of the RSA and FCSA, suggesting that while the area could be used, to date, use has been relatively brief.

Table 2-3. Residency estimates of collared Fortymile caribou within Fortymile Caribou Study Area, Regional Study Area and Project footprint

Study Area	Residency Measure (days)	2013/2014	2014/2015	2015/2016	Total
Fortymile Caribou Study Area (Area = 77,5532 km²)	*Total satellite collared caribou*	*28*	*20*	*55*	*103*
	Average residency	113.50	17.50	75.88	74.77
	Maximum residency	183.00	74.00	148.84	183.00
	Minimum residency	10.00	1.00	18.00	1.00
Wildlife RSA (Area = 13, 661 km²)	*Total satellite collared caribou*	*5*	*0*	*20*	*25*
	Average residency	11.93	0	23.83	15.97
	Maximum residency	162.26	0	115.76	162.26
	Minimum residency	0	0	0	0
Project footprint (Area = 33 km²)	*Total satellite collared caribou*	*0*	*0*	*9*	*9*
	Average residency	0	0	0.01	0.01
	Maximum residency	0.00	0.00	0.19	0.19
	Minimum residency	0.00	0.00	0.00	0.00

Long-distance movement patterns

The Fortymile caribou move extensively within their annual range. Long-distance directional movements consistent with migratory behaviour are exhibited in the satellite collar data. To identify areas of long-distance movement consistent with migratory behaviour, we calculated the distance between consecutive points within the FCSA. For the purposes of this baseline report, two time periods were used in the analysis which are based on when caribou are expected to occur in the RSA (caribou encounter period: October 1 to April 30), and when they are not expected to occur in the RSA (May 1 to September 31). The lines were sorted by length and the top 0.5 % of the longest lines was excluded from the dataset to account for errors in the location dataset. The 75th percentile was used as the criteria for identification of change in caribou movement behaviour (i.e., foraging vs. migratory movement).

Based on the collar data, long-distance movements tend to be more concentrated in specific areas, such as higher elevation terrain and adjacent to the Yukon River. Caribou crossed the major rivers most frequently on the White River upstream of the Yukon River confluence (winter 2013/2014), and on the Yukon River just north of the confluence of the White and Yukon rivers and north of the Yukon and Stewart River confluence (winter of 2015/2016; Figure 2-9). During the winter of 2013/2014, long-distance caribou movement within the RSA was most concentrated south of the Yukon River in the Dawson Range (Figure 2-9). In the winter of 2015/2016, caribou travel paths in the RSA were concentrated in the higher

elevation areas connecting Mt. Stewart, Thistle Mountain, Selwyn Dome, and the higher elevation areas connecting Ruby Mountain, Reindeer Mountain, and Henderson Dome (Figure 2-9).

The analysis of long-distance movement based on satellite collar data is generally consistent with other reports of Fortymile caribou migration through this region. Anecdotal reports received by Environment Yukon during the winter of 2013/2014 also support the premise that during migration, Fortymile caribou tend to use higher elevation terrain. Reports indicate that during the fall of 2013, caribou moved into the Dawson Goldfields using ridge systems in the area. Once on top of a ridge system, caribou travelled east in large numbers (i.e. hundreds) with small groups breaking off and travelling down different ridge systems to access new areas (Kienzler and Suitor 2015). The collar and survey data are also consistent with Traditional Knowledge that confirms Fortymile caribou historically used and moved through the RSA (Tr'ondëk Hwëch'in 2012b), although one local trapping concession holder reported that Fortymile caribou were moving through the area differently, using different migration routes, than they had observed when the Fortymile had last been seen in Yukon (Interview 14, pers. comm., 2016). In the past, Coffee Creek was known as one of many points where caribou crossed the Yukon River (Dobrowolsky 2014; Tr'ondëk Hwëch'in 2012a) and the subalpine and alpine ridges in the Coffee Creek area are known to provide winter habitat for the Fortymile herd (Tr'ondëk Hwëch'in 2012a).

2.1.1.3 Winter Habitat Use and Diet

An early winter season habitat model was developed to quantify habitat selection by Fortymile caribou within the Canadian portion of their range (Muhly 2017). This model and the accompanying report (Muhly 2017) provides the most current baseline information describing Fortymile caribou early winter habitat use. The early winter season, December 1 to February 26, was chosen because that was the period when the herd appeared to be relatively 'settled' on their winter range (i.e. not exhibiting long distance directional movement associated with migration; M. Suitor, pers. comm., 2015). The study area used in the modelling exercise was the FCSA, which encompasses all areas that the herd has used since returning to Yukon, as well as additional areas to the south and east which may be used should the herd continue to expand its range (M. Suitor, pers. comm., 2015).

The model followed a resource selection function (RSF) approach (Boyce and McDonald 1999; Manly et al. 2007), which indicates the relative probability of wildlife selection of habitat types (Johnson et al. 2006). An RSF is a data-driven model that quantifies and contrasts the statistical relationships between used animal locations and available habitat, and the results can be used to predict habitat quality across an area of inference. Data on caribou use was obtained from 60 caribou affixed with GPS telemetry collars that were monitored between 2012 and 2016 as part of a joint study by the Alaska Department of Fish and Game and Bureau of Land Management in the United States of America, and by Environment Yukon in Canada. The RSF used a second-order design that examined selection of home ranges within a population range (Johnson 1980). Habitat variables used in the analysis consisted of spatial data available in a GIS and included EOSD Land Cover Classes, normalized difference vegetation index (NDVI) values, slope, aspect, distance to water, and road density. The predictive performance of the top-selected RSF model, as determined using Akaike Information Criterion (AIC), was evaluated using a k-fold cross validation approach (Johnson et al. 2006).

Results of the RSF analysis indicated that:

- Caribou selected home ranges farther from large rivers.
- Caribou selected areas that were burned 41 to 60 years ago, but avoided areas burned 11 to 40 years and 61 to 70 years ago, or that were not burned, relative to recently burned areas (less than 10 years ago).
- Caribou selected all vegetation cover types relative to barren cover, except for dense conifer forest. Bryoids were the strongest selected vegetation cover type, followed by sparse mixedwood forest, water, shrubland, and dense broadleaf forest.
- Caribou selected east and west aspects relative to north aspects, and avoided flat aspects.
- Caribou avoided areas with high-use road densities greater than 0.05 km/km^2 and areas with low-use road densities greater than 0.10 km/km^2.
- Caribou selected areas with intermediate NDVI values.
- Caribou selected slopes between 20 to 30 degrees.

Model validation statistics calculated using k-fold cross validation on 28 caribou indicated that the RSF model had good predictive power of caribou locations (Muhly 2017). Based on the model results, habitat selection probabilities were predicted across the study area (Figure 2-10). Descriptive rating classes were applied to the RSF scores based on the frequency of actual caribou use (i.e., telemetry locations) relative to random locations across the range of RSF predictions. This was done by determining the RSF value at which point the ratio of used to random points switched from negative to positive (0.76) and defining Moderate and High categories to equal bins above 0.76 and Low and Very Low to equal bins below 0.76. The distribution of habitat availability and caribou telemetry locations within the FCSA are summarized in Table 2-4.

Table 2-4. Availability of early winter habitat within the Fortymile caribou herd study area.

Habitat class	RSF Values	Area (km^2)	Area (%)	Caribou Observations	Used:Random Ratio
High	0.88 - 1	5,148	6.6	182 (15.7%)	+0.93
Moderate	0.76 - 0.88	14,232	18.4	562 (45.1%)	+0.77
Low	0.38 - 0.76	45,049	58.1	452 (38.7%)	-0.35
Very Low	0 - 0.38	13,072	16.9	6 (0.5%)	-0.93

Although the early winter period was identified as the key season of interest for this project, there is also value in determining how well the model predicted caribou use in the rut (October 1 – November 30) and late winter (February 27 – March 31) periods. Performance of the early winter RSF for the rut and late winter periods was assessed by evaluating the distribution of predicted RSF scores associated with caribou locations from those two periods and comparing them to the pattern of RSF scores associated with used and available (i.e. random) locations during early winter (Figure 2-3). This shows that the distribution of predicted RSF scores for caribou locations is similar among seasons. Overall, for all three seasons, use was higher than random for RSF scores in the three highest bins and lower than random in the seven lowest bins. This provides support that the early winter model is also representative of selection during rut and late winter. However, smaller differences between used and random locations during rut and late winter, than

for early winter, suggests that the model does not perform as well for rut and late winter as it does for early winter.

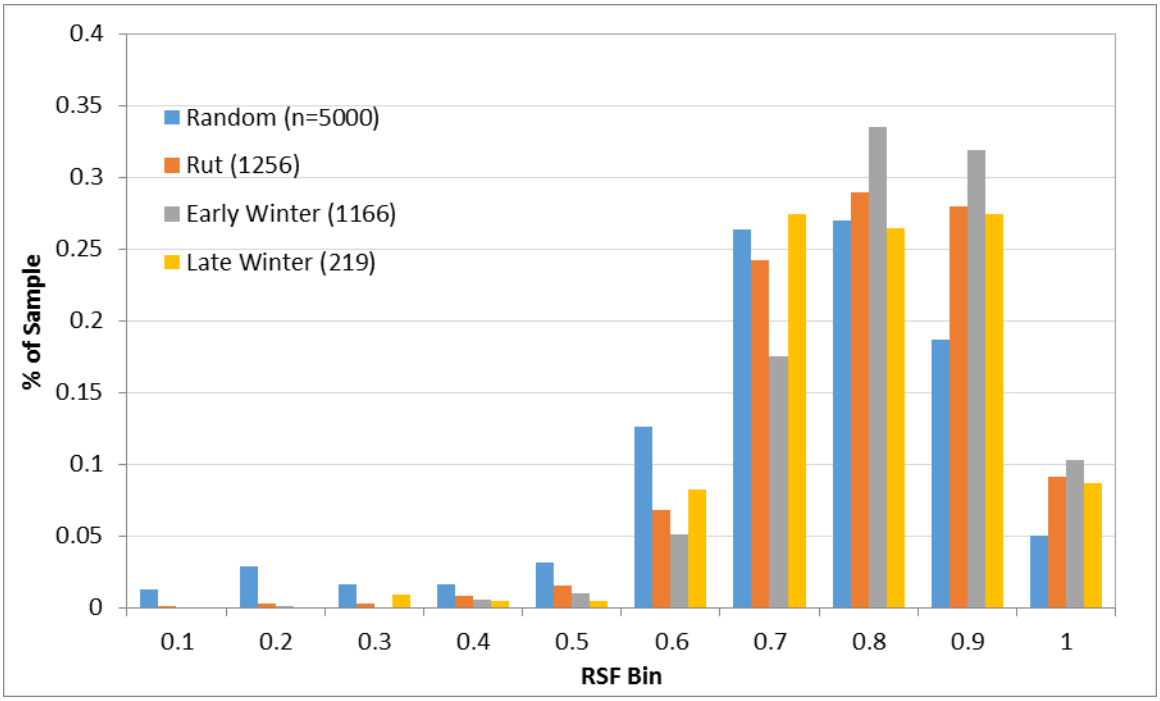


Figure 2-3. Comparison of predicted RSF scores for caribou locations across seasons.

Winter habitat selection by caribou herds in Yukon has previously been statistically modeled using a combination of fire history, vegetation cover, terrain, and human disturbance variables (Florkiewicz *et al.* 2004, 2007; Collins *et al.* 2011) including for the Fortymile caribou herd using aerial survey data from 2008–2010 (Barker and Hegel 2012). Although the significance of, and coefficient values for, covariates vary among studies, results tend to consistently support two primary mechanisms driving selection – avoidance of predation risk and selection of foraging habitat. In other studies, selection of mid-upper elevation habitats is likely a result of avoidance of predation and greater snow depth in valley bottoms, and poor forage availability and climatic conditions at high elevations (James *et al.* 2004; Gustine *et al.* 2006; Barker and Hegel 2012).

For the smaller study area examined by Barker and Hegel (2012) (in the northwestern portion of the FCSA), Fortymile caribou selected winter range that was mid-elevation (peak selection at 786 m), contained high lichen abundance, and was far from old burns. Although Muhly (2017) did not include elevation as a covariate in his model, concentrations of predicted high quality habitat occurred in subalpine and low alpine areas at 700–1000 m.

Lichens, the primary winter forage for caribou, appear to be a primary driver of Fortymile caribou habitat selection (Barker and Hegel 2012). During winter, caribou consume approximately 1.3–4.9 kg of lichen per day (Holleman *et al.* 1979), accounting for more than half of forage intake. In Yukon, lichen abundance is largely determined by wildfire history. Lichens are slow-growing and typically take between 40 and 60 years post-burn for enough suitable lichen biomass to accumulate before the area is considered good winter

foraging habitat (Klein 1982; Schaeffer and Pruitt 1991; Thomas *et al.* 1996; Joly *et al.* 2003, 2007, 2010; Collins *et al.* 2011); however, in Environment Canada's (2008) *Scientific review for the identification of critical habitat for woodland caribou (Rangifer tarandus caribou), boreal population, in Canada*, 50 years post-burn is considered to be 'recently disturbed'. The abundance of lichens is also often influenced by forest community type (e.g., dry, mature coniferous forests), soil characteristics, topography, grazing, and the time since disturbance (i.e., from land clearing or forest fire; Joly et al. 2010).

Within the Fortymile caribou herd range, wildland fires, followed by land clearing, are likely the greatest influence on lichen abundance; however, large caribou herds can also overgraze winter range causing reduced lichen availability (Collins *et al.* 2011; Joly *et al.* 2015). Snow depth may also be an important influence on winter habitat selection (Russell *et al.* 1993; Johnson *et al.* 2002; Tyler 2010), with deep snow restricting movement and hindering the accessibility and detection of lichen (Johnson *et al.* 2000).

Fortymile caribou diet analysis

Caribou fecal pellets were collected near the proposed mine site during summer 2014 and analyzed for winter diet composition (Figure 2-4). The pellets are most likely from the Fortymile caribou that were present in the RSA during the winter of 2013/14; however, given the time of the collection it is possible that some of the pellets were from outside of the winter season. Analysis of the diet composition from the pellets indicate that the Fortymile caribou in Yukon seem to be consuming less lichen and greater moss than was reported from other herds in Alaska (Table 2-5). Lower lichen content in caribou winter diets is hypothesized to be associated with reduced adult overwinter survival and potentially recruitment of young through reduced body condition at birth (Joly *et al.* 2015). The results are consistent with an area where the preferred winter forage is limited, as moss is only consumed incidentally when caribou consume lichens closer to the moss layer that has limited nutritional value (Ihl and Barboza 2007). The proportion of lichen in the diet is less informative because differences in content of lichens in caribou diets have been documented as a function of sex, reproductive status (pregnant vs. not pregnant), caribou herds, and seasonal differences (early vs. late winter) (Joly *et al.* 2015). The date of deposition, sex, and age of the caribou that dropped the pellets are unknown.

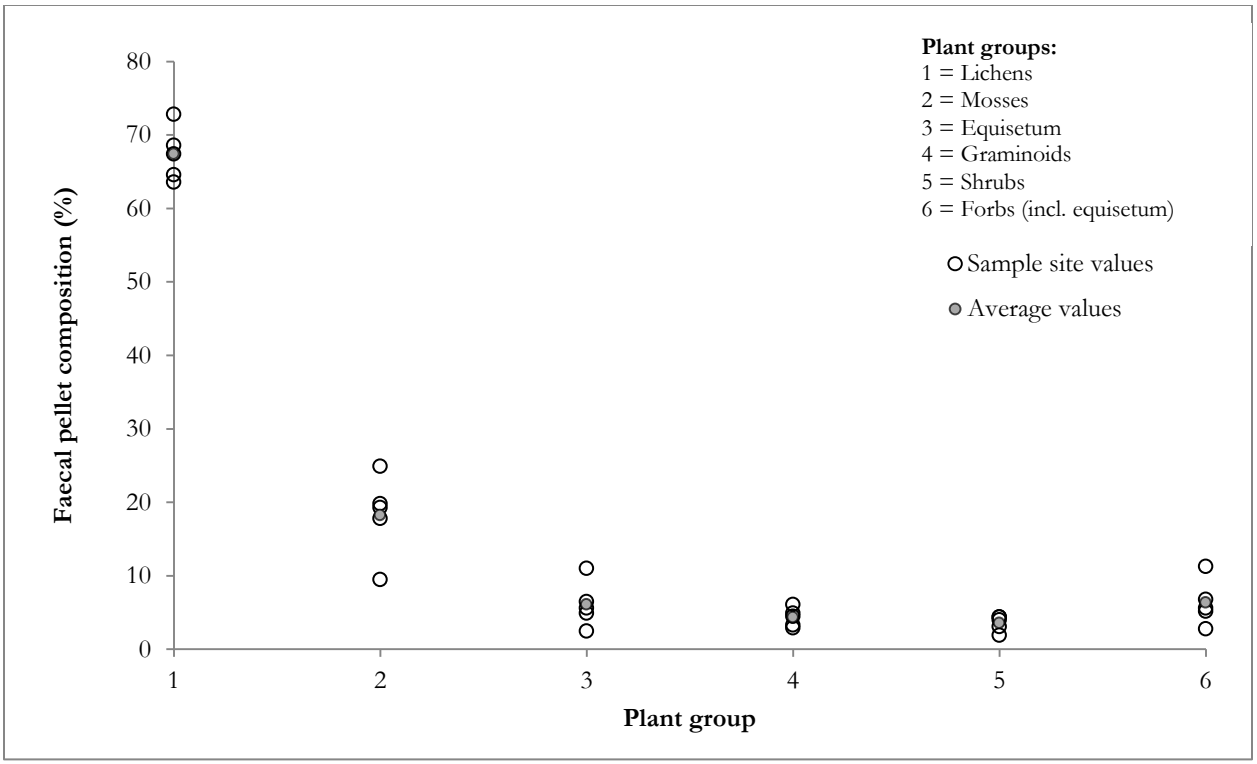


Figure 2-4. Faecal pellet composition (%) of caribou samples collected within the RSA. Averages are derived from the five sample sites.

Table 2-5. Faecal pellet composition (%) of caribou samples collected within the RSA compared to Fortymile caribou, Arctic caribou, and Galena Mountain caribou winter faecal samples.

	Arctic (2012)[1]	Galena (2012)[1]	Fortymile (1992)[2]	Fortymile (1993)[2]	Fortymile (1994)[2]	Fortymile (1995)[2]	Fortymile (1996)[2]	Fortymile (2014)
Lichens	72.8	88.8	72	81	80	84	86	67.4
Mosses	11.9	4.7	9	7	4	1	1	18.4
Equisetum	n/a	n/a	7	3	6	8	6	6.1
Graminoids	5.9	1.6	1	1	4	2	2	4.3
Shrubs	7.6	4.2	10	8	5	4	5	3.6
Forbs (incl. equisetum)	1.7	0.4	3	0	0	0	0	6.3
Sample size	**74**	**18**	**6**	**7**	**1**	**6**	**4**	**5**

[1] Data from Joly et al. 2015, [2]Data from Boertje and Gardner 1998.

2.1.1.4 Harvest and Mortality

First Nations people in Yukon and Alaska have relied on the Fortymile herd as a source of food and materials for centuries. According to information collected by McDonald and Cooley (2004), Han people have hunted Fortymile caribou since at least the mid-1850s, using the hides for clothing and freezing or drying the meat. The herd was commercially harvested during the Klondike gold rush until the 1930s

(Valkenburg *et al.* 1994) and was an important source of income for First Nations during that time (Tr'ondëk Hwëch'in. n.d.). Prior to and during the Klondike gold rush, most of the Fortymile caribou harvest likely occurred along the major rivers that bisect the herd's range because those were the primary transportation routes. The distribution of caribou harvest changed considerably with the construction of the Steese Highway in the 1920s and the Taylor and Top of the World highways in the 1950s. The majority of Fortymile harvest now occurs along these transportation routes.

Harvest management is complicated by the fact that the herd's range crosses the Alaska-Yukon border. In Alaska, the state Department of Fish and Game and the federal Bureau of Land Management and Eastern Interior Regional Subsistence Advisory Council work together with local advisory committees. In Yukon, Environment Yukon, TH, and the Yukon Fish and Wildlife Management Board (YFWMB) are responsible for aspects of harvest management (M. Suitor, pers. comm. 2014-2016). Transboundary harvest management for any species is difficult due to different users and priorities on each side of the border; however, Alaska and Yukon organizations cooperatively manage harvest through participation in the Fortymile Caribou Harvest Coalition.

Currently, by agreement of the Coalition parties and Yukon, Alaskan hunters are allocated 65% of the annual allowable harvest (AAH) and Yukon hunters 35%. The AAH varies by herd size: total AAH is set at 3% when the herd is below 70,000 caribou and increases to 4% when the herd exceeds 70,000 caribou (Harvest Management Coalition 2012). However, as a part of the Fortymile Caribou Herd Management Plan (1996–2001, see Section 2.1.1.1), the Yukon Government closed resident harvest of Fortymile caribou in Yukon and the TH began a voluntary no-harvest program. Since then, the Yukon Government and TH have chosen to maintain the closure so that the Yukon portion of the harvest allocation can be put towards population growth.

Harvest estimates for the Fortymile caribou herd are available from 1951, although the quality of harvest data has improved since then (Valkenburg *et al.* 1994). Annual harvest estimates of Fortymile caribou between 1951 and 2010 range from 30 to 2,325 caribou (Valkenburg *et al.* 1994, Harvest Management Coalition 2012), and the number approximately tracks the herd numbers. Harvest of the Fortymile herd is now more strictly regulated. Alaska hunters harvest approximately 1,000 caribou per year and the Yukon harvest is currently limited to a very small First Nations' harvest (Dawson Regional Planning Commission 2013; M. Suitor, pers. comm. 2014-2016; K. Meister, pers. comm. 2016; N. Ayoub, pers. comm. 2016).

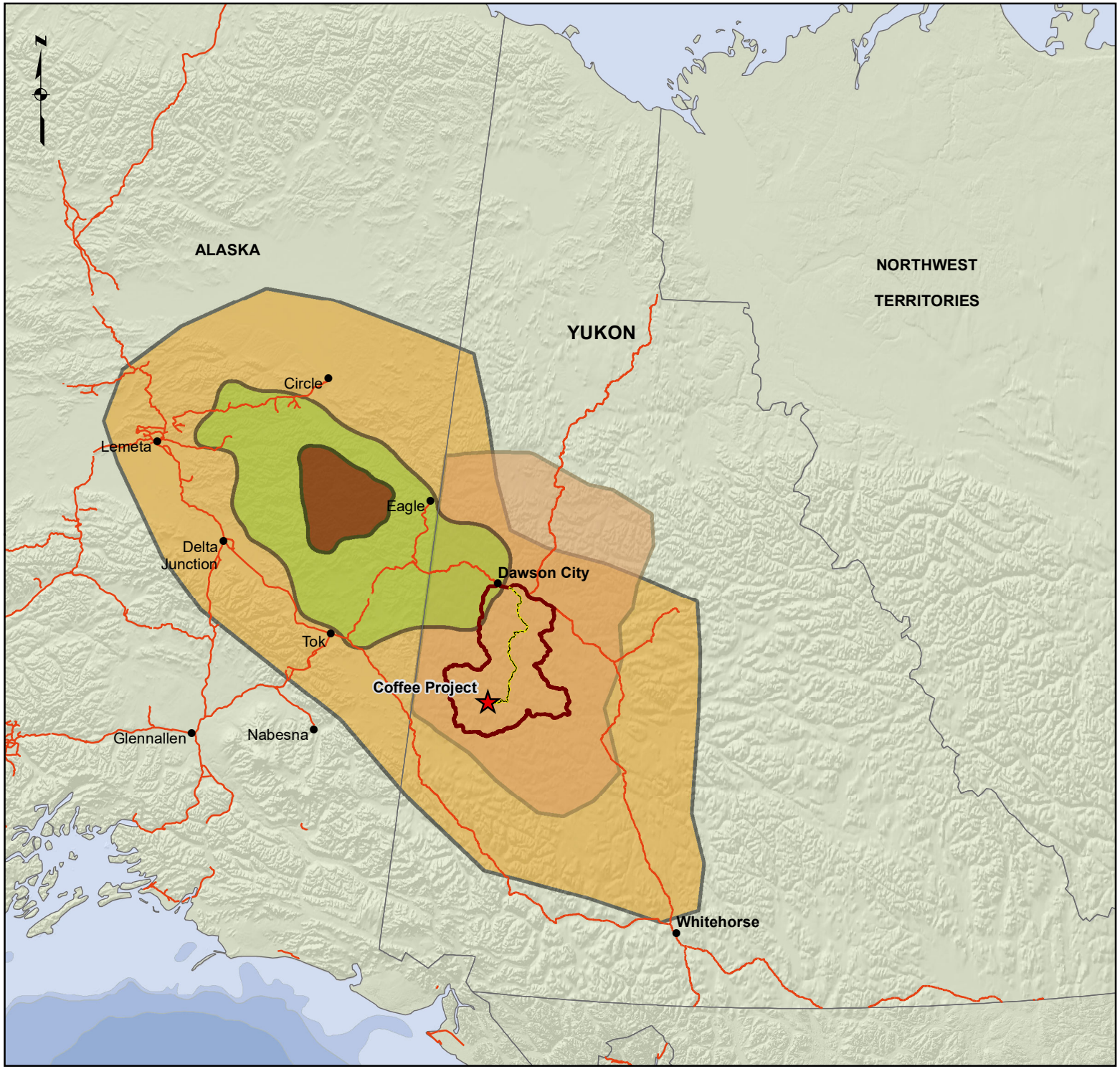
With the expanding herd range and increasing herd size, Yukon and TH governments are considering re-opening the Yukon harvest for Fortymile caribou in the near future (M. Suitor, pers. comm. 2014-2016; K. Meister, pers. comm. 2016). As detailed in the Fortymile Caribou Herd Harvest Plan 2012–2018, Yukon and TH governments negotiated an allocation of 35% of the AAH, corresponding to a harvest of more than 500 caribou per year in Yukon (Table 2-6).

Predator control has played an important role in the recovery of the Fortymile caribou herd (Harvest Management Coalition 2012). Active predator control within the Fortymile caribou range has been implemented to some degree in Alaska since about 1950 (Valkenburg *et al.* 1994). Wolf predation has been suggested as the dominant factor determining the herd's population growth (Boertje *et al.* 2012). Wolves

followed by grizzly bears are the greatest cause of Fortymile caribou mortality. Boertje and Gardner (1998) estimate that wolves consumed 2,000–3,000 calves and 1,200–1,900 adult caribou annually from 1992 to 1997.

Table 2-6. Fortymile caribou harvest targets (Harvest Management Coalition 2012)

Herd size	Harvest rate (%)	Yukon allocation (35%)	Alaska allocation (65%)
50,000	3%	525	975
55,000	3%	578	1,073
60,000	3%	630	1,170
65,000	3%	683	1,268
70,000	4%	980	1,820
75,000	4%	1,050	1,950
80,000	4%	1,120	2,080
85,000	4%	1,190	2,210
90,000	4%	1,260	2,340
100,000	4%	1,400	2,600





Legend

- Coffee Project
- Highway
- Proposed Route
- Regional Study Area
- Fortymile Caribou Herd Study Area
- Fortymile Caribou Herd Core Range
- Fortymile Caribou 2008 Range
- Fortymile Caribou Herd Historic Range

FIGURE: 2-5

Fortymile caribou herd range

Data Sources
Topographic Spatial Data courtesy of Esri. All Rights Reserved.

Fortymile caribou herd core range and 2008 range - Boertje et al., 2012.

Fortymile caribou herd historic range - McDonald and Cooley, 2004.

Disclaimer
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Map Reference Scale: 1:6,000,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 CSRS Yukon Albers

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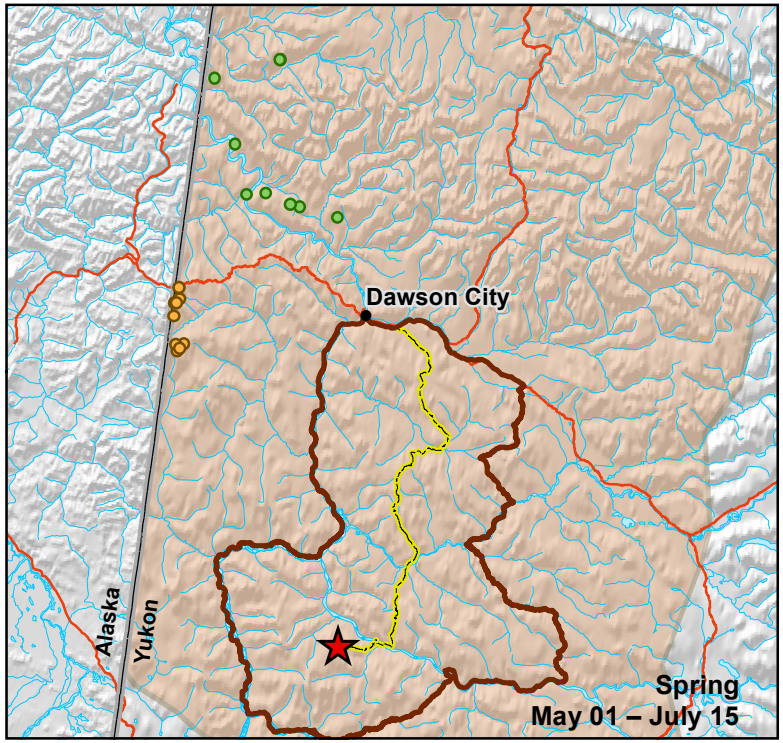

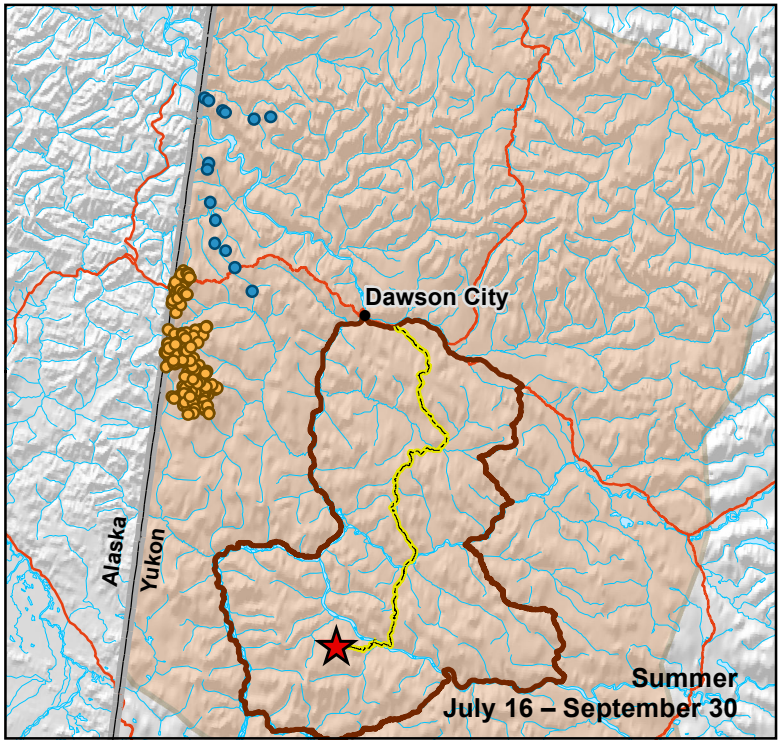

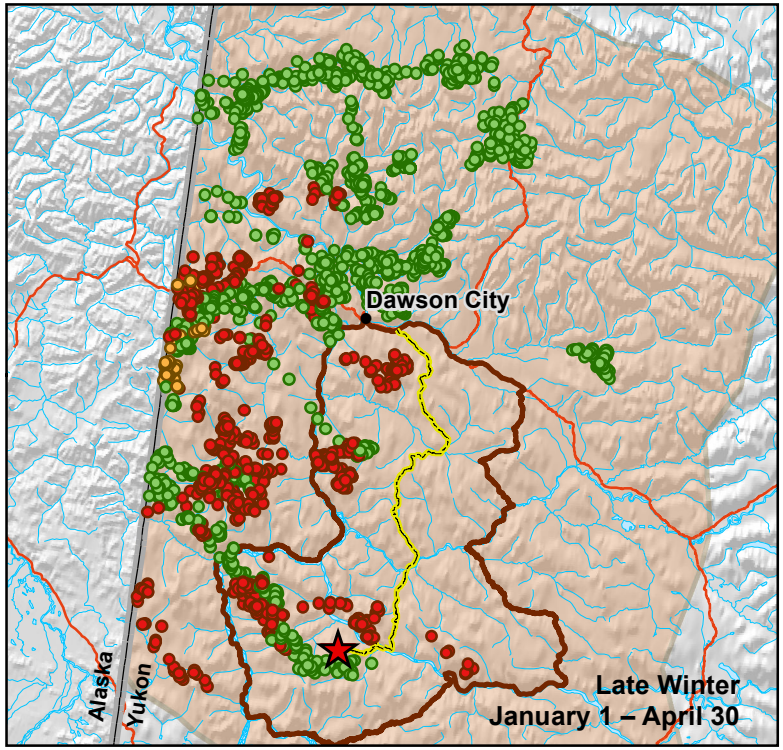

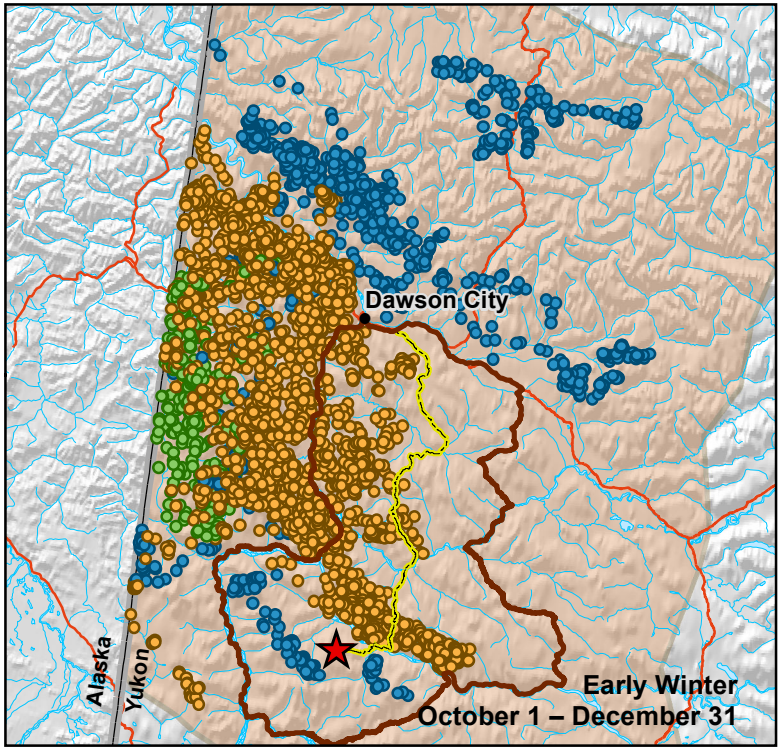



Legend

- Coffee Project
- Proposed Route
- Yukon/Alaska Border
- Fortymile Caribou Study Area
- Regional Study Area

Fortymile Caribou Herd Satellite Collar Locations (by year)

- 2013
- 2014
- 2015
- 2016

FIGURE: 2-6

Fortymile caribou satellite collar locations in Yukon (Sept. 2013 – Feb. 2016)

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Collar data provided by Environment Yukon - Yukon Government, Alaska Department of Fish and Game, and Alaska Bureau of Land Management.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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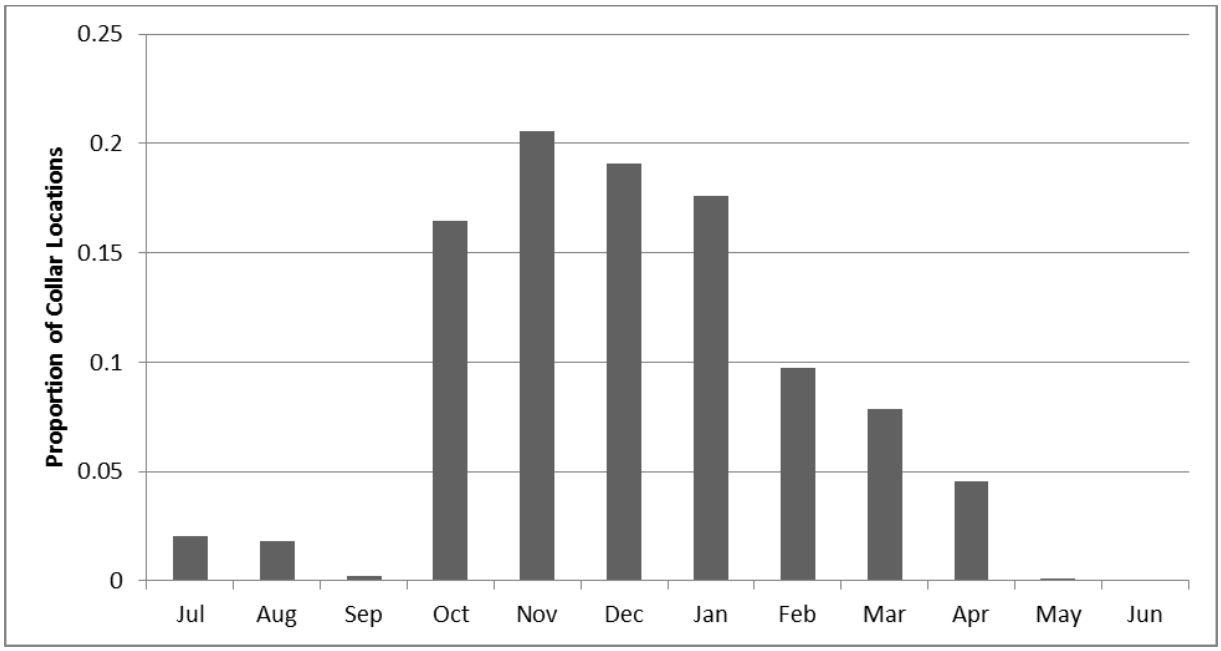
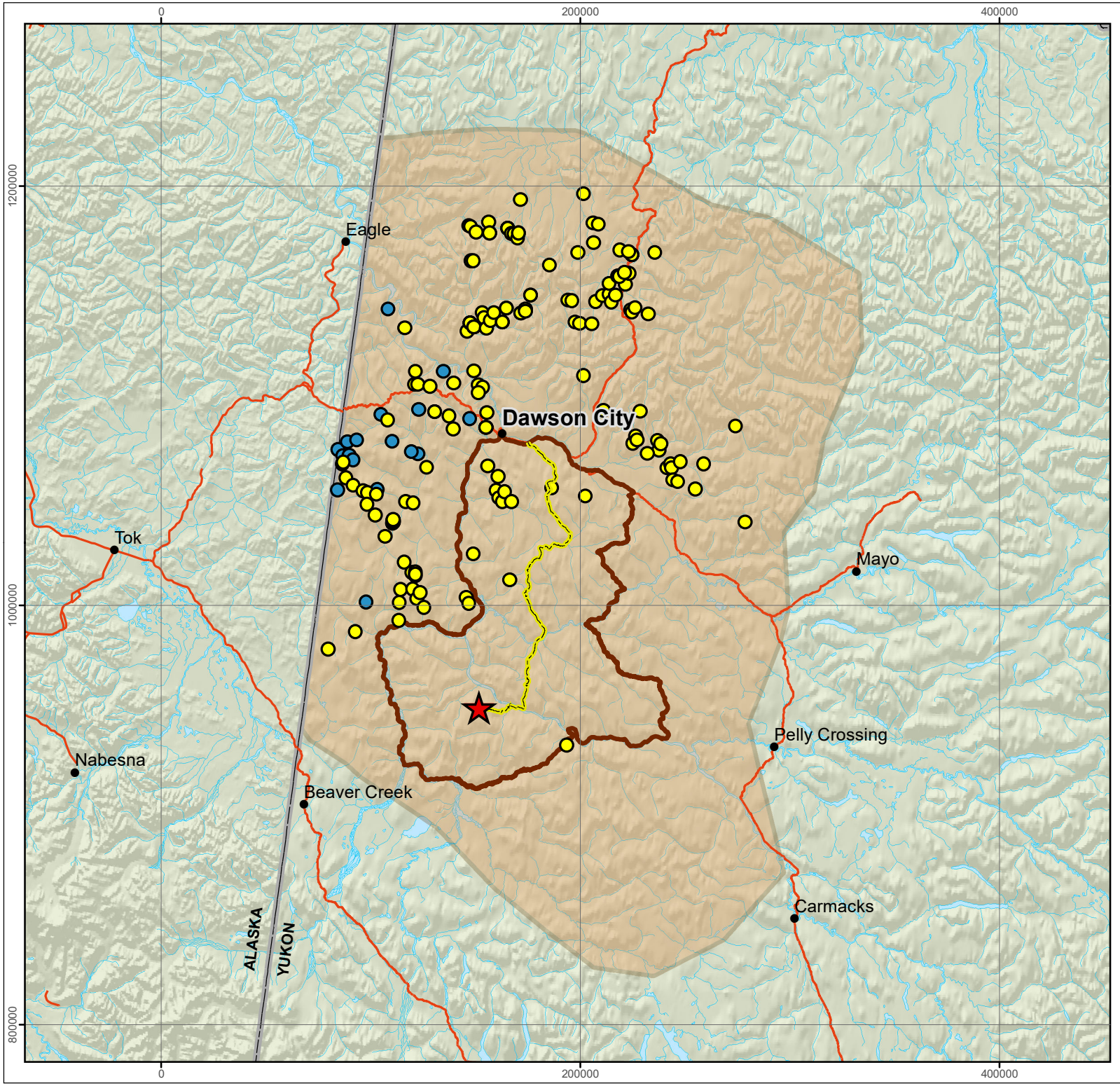
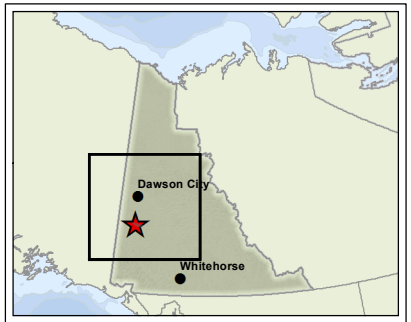


Figure 2-7. Proportion of available caribou satellite collar locations by month within Yukon between September 27, 2013 and February 2, 2016.





Legend

- Coffee Project
- Fortymile Caribou Locations (2003 - 2013)
- Fortymile Caribou Locations (2013 - 2015)
- Proposed Route
- Yukon/Alaska Border
- Regional Study Area
- Fortymile Caribou Study Area

FIGURE: 2-8

Fortymile VHF collared caribou locations (pre and post 2013)

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Collar data provided by Environment Yukon - Yukon Government, Alaska Department of Fish and Game, and Alaska Bureau of Land Management.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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Map Reference Scale: 1:3,000,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 CSRS Yukon Albers

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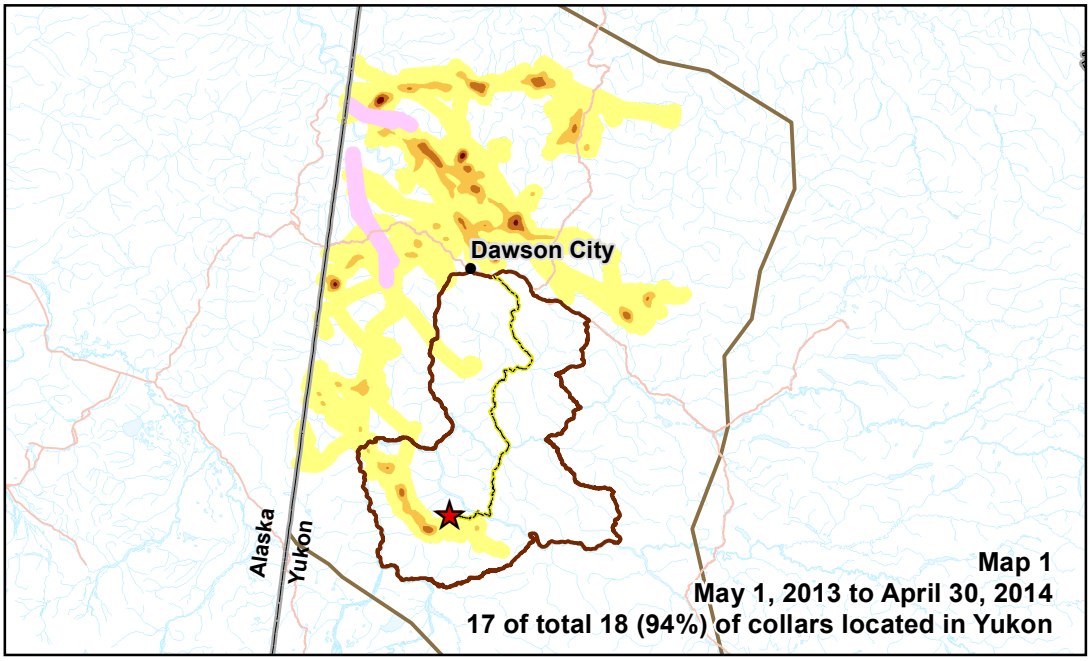

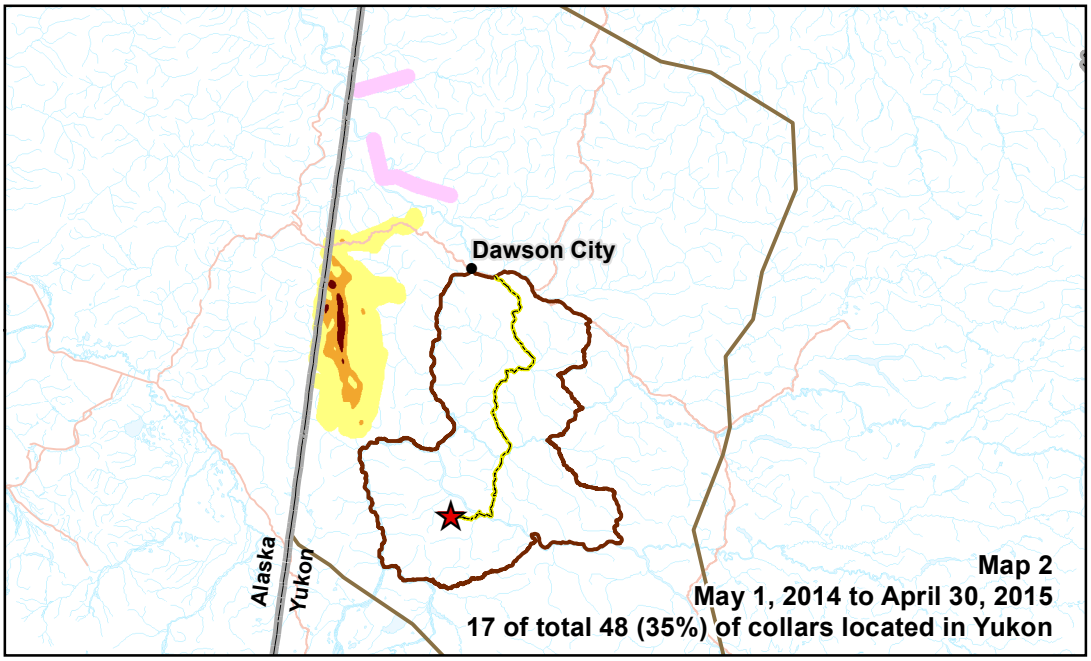

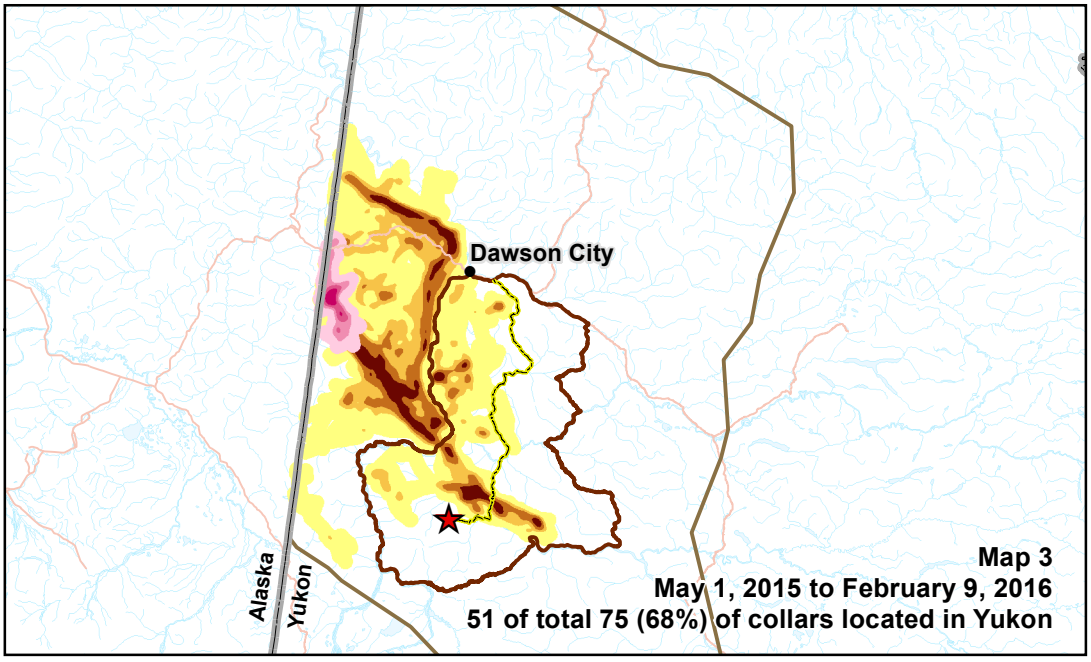



Legend

- Coffee Project
- Proposed Route
- Yukon/Alaska Border
- Fortymile Caribou Study Area
- Regional Study Area

Density of long-distance caribou movements (path segments/km^2)

May 1 – September 30	October 1 – April 30
<1	<1
1 - 2	1 - 2
2 - 3.5	2 - 3.5
>3.5	>3.5

FIGURE: 2-9

Long-distance movements of Fortymile caribou in Yukon

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Collar data provided by Environment Yukon - Yukon Government, Alaska Department of Fish and Game, and Alaska Bureau of Land Management.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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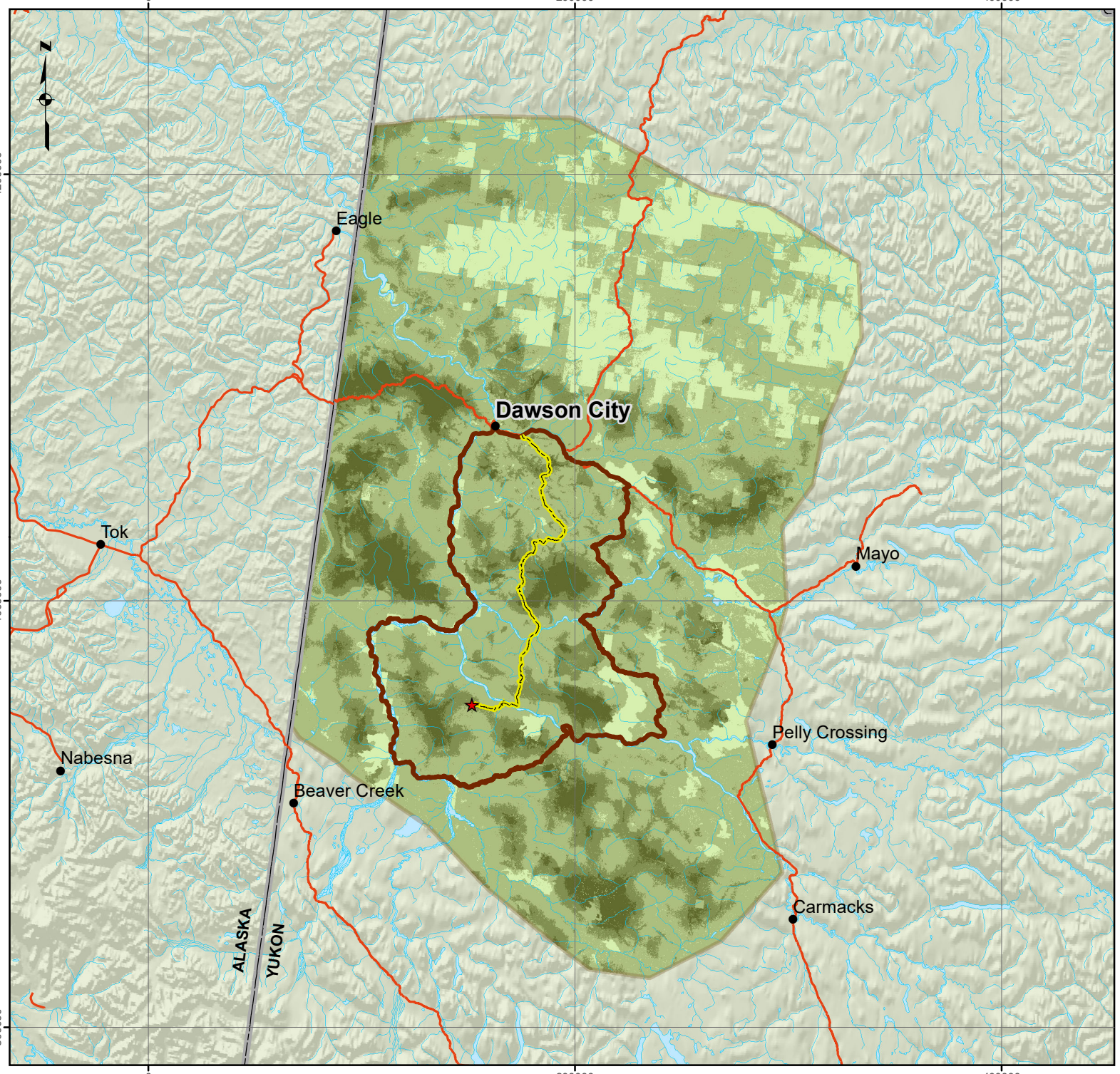

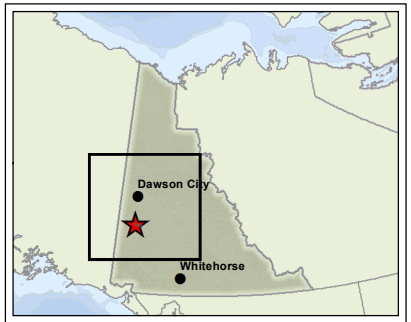

Legend

- Coffee Project
- Proposed Route
- Yukon/Alaska Border
- Regional Study Area
- Fortymile Caribou Study Area

Fortymile Caribou Herd Habitat Suitability (Early Winter)

- Very Low
- Low
- Moderate
- High

FIGURE: 2-10

Early winter habitat suitability for the Fortymile caribou herd

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Resource Selection Function Probability Model provided by Tyler Muhly in conjunction with EDI Environmental Dynamics Inc. (2016).

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Coordinate System: NAD 1983 CSRS Yukon Albers

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KAMINAK GOLD CORPORATION

EDI

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2.1.2 OTHER CARIBOU HERDS

2.1.2.1 Klaza Caribou Herd

The Klaza caribou herd (Klaza) is part of the northern mountain population of woodland caribou. The first documentation of the Klaza caribou herd was by Hoefs and Lortie (1975) who conducted a large mammal inventory within Game Management Zone 5. Increased interest in mineral exploration in the Dawson Range, and the start of construction of the Freegold Road in the mid-1980s precipitated the first detailed herd study from 1987 to 1991. Based on this work, the first inventory of the Klaza herd in 1989 estimated a total of 441 caribou (Farnell *et al.* 1991). In 2000, a fall composition survey documented 651 caribou (Hegel 2013). Following the mineral exploration "rush" in 2010, Yukon Government prioritized an update to the information available on herd demographics and completed a detailed habitat use study. The most recent population study for the Klaza herd was in 2012, resulting in an estimated 1,179 caribou (95% CI=952–1461; Hegel 2013).

The Klaza caribou herd annual range is located in the Dawson Range in central Yukon and overlaps the southern portion of the Project RSA, south of the Yukon River (Figure 2-11). Throughout their range, Klaza caribou are typically concentrated in higher elevation habitats including Klaza, Apex, Prospector, and Nansen mountains (Hegel and O'Donoghue 2015). The herd occupies primarily high elevation habitats near and above treeline within its range, making seasonal altitudinal changes in habitat use.

During the calving season, individuals are dispersed throughout their range. Cows usually give birth alone or in small groups to reduce predation risk as predators are less likely to detect isolated or small groups of caribou. In the summer, caribou typically use higher elevation habitat to escape insects and reduce predation risk (Farnell *et al.* 1991). Klaza caribou remain in higher elevation habitat through the fall until snow accumulation and condition reduces access to winter forage. Caribou move to lower elevations during winter where ground lichens are more abundant and available. Late winter is the most limiting seasonal habitat for woodland caribou (Environment Canada 2008). Given the importance of winter habitat, Hegel and O'Donoghue (2015) modeled late winter habitat selection by Klaza caribou. The Klaza winter range is located entirely outside the RSA and does not interact with the Project (Figure 2-11).

Klaza caribou have been occasionally observed within the RSA since the initiation of exploration activities on the Coffee Property in 2010 (Table 2-6). Project observations of suspected Klaza caribou were limited to the spring, summer, and early fall months and were typically single caribou or small groups of caribou, as would be expected on the periphery of the range. Based on observations to date, the Project is expected to interact with the Klaza caribou herd during the spring, summer, and/or fall months but caribou are not expected to be found near the Project in any considerable numbers.

Predation is the primary source of mortality for the Klaza caribou herd. Harvest is strictly managed through a lottery permit hunt. Fewer than ten caribou are harvested from the Klaza caribou herd annually (EDI 2014).

Table 2-7. Project observations of suspected Klaza caribou in the Project RSA

Date	Number of Caribou	Description	Location	Source[1]
8 Sept 2010	2	Female caribou with calf seen near the south Kona zone	Near Kona deposit	Camp wildlife log
20 Sept 2010	17	Group of 17 caribou near the "B52 Saddle"	Headwaters of Halfway Creek; between Latte and Kona deposits	Camp wildlife log
11 Sept 2011	5	Group of caribou resting on west side of Supremo hill — 3 adults, possibly 2 sub-adults.	Near Supremo deposit	Camp wildlife log
Late summer 2012	Unknown	Helicopter pilot reported that he saw caribou in small groups on the ridges during the later summer of 2012, when flying for exploration purposes.	Coffee Property	Access 2014
4 Aug 2013	1	Caribou at km 13 on Java Road. Possibly a yearling.	Km 13 on Java Road[2]	Camp wildlife log
18 May 2014	1	Caribou at km 9.5 on Java Road. Possibly a yearling.	Km 9.5 on Java Road[2]	Camp wildlife log
22-24 June 2014	12	Group of 4 bulls, 6 cows and 2 calves observed in alpine area along alternate road alignment between Coffee and Casino	In southeast section of Coffee Property (approximately 20 km southeast of proposed mine site)	Incidental observation: breeding bird surveys
28 July 2014	2	2 adult male caribou between km 9 and km 12 on Java Road.	Km 9 and km 12 on Java Road[2]	Camp wildlife log
7 July 2015	2	2 caribou crossed the road near exploration laydown area.	Laydown area near Supremo deposit	Camp wildlife log
8 July 2015	1	Caribou at km 17 on Java Road	Km 17 on Java Road[2]	Camp wildlife log
20 July 2015	1	Caribou along road between Latte and Supremo	Road between Latte and Supremo deposits	Camp wildlife log
11 Aug 2015	1	1 male caribou along Java Road at km 16.5.	Km 16.5 on Java Road[2]	Camp wildlife log
13 Aug 2015	1	1 male caribou along Java Road at km 17.4	Km 17.4 on Java Road[2]	Camp wildlife log
12 May 2016	1	Caribou observed along Java Road at km 16	Km 16 on Java Road[2]	Camp wildlife log
13 May 2016	1	Caribou observed along Java Road at km 17, possibly a yearling.	Km 17 on Java Road[2]	Camp wildlife log
8 June 2016	1	Caribou at Latte deposit	Near Latte deposit	Camp wildlife log
18 June 2016	3	Caribou observed along Java Road at km 17.9	Km 17.9 on Java Road[2]	Camp wildlife log
6 July 2016	1	Caribou observed along Java Road at km 13.5.	Km 13.5 on Java Road[2]	Camp wildlife log
19 July 2016	1	Caribou observed along Java Road at km 12.	Km 12 on Java Road[2]	Camp wildlife log
28 July 2016	1	Caribou at Supremo Hill	Near Supremo deposit	Camp wildlife log

Date	Number of Caribou	Description	Location	Source[1]
7 Aug 2016	2	Caribou observed near core farm gravel pit.	Coffee Property – near exploration airstrip	Camp wildlife log
28 Aug 2016	15	Caribou at Kona deposit.	Near Kona deposit.	Camp wildlife log
27 Sept 2016	2	Caribou seen at WB15-05	Headwaters of Latte Creek, south of proposed Heap Leach Facility	Camp wildlife log

[1] At the time of reporting, camp wildlife log for 2012 was not available.

[2] Java Road refers to the access road between the Yukon River barge landing and the Supremo and Latte deposit areas.

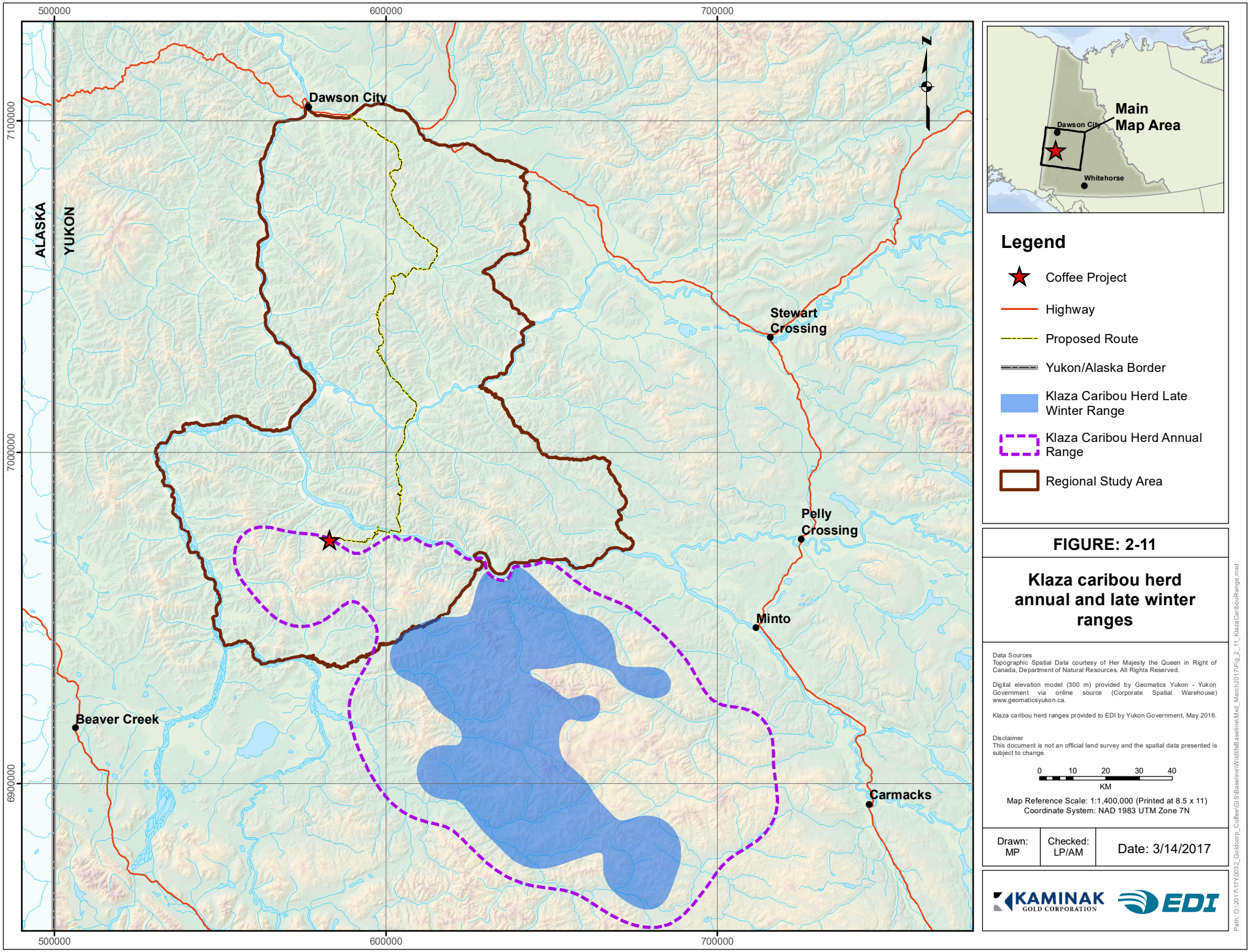

FIGURE: 2-11

Klaza caribou herd annual and late winter ranges

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital elevation model (300 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Klaza caribou herd ranges provided to EDI by Yukon Government, May 2016.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

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KM

Map Reference Scale: 1:1,400,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MP	Checked: LP/AM	Date: 3/14/2017

KAMINAK GOLD CORPORATION EDI

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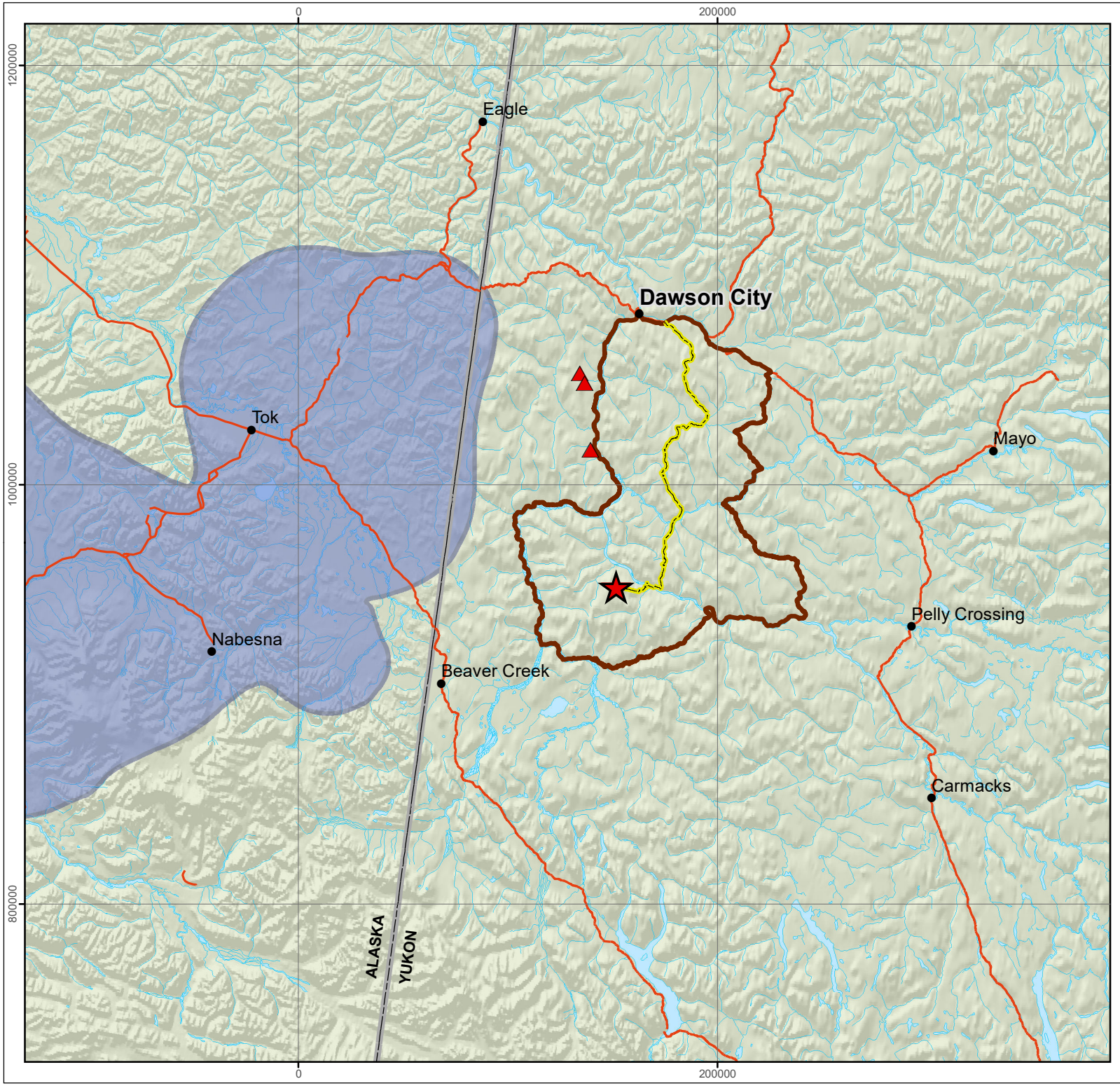
2.1.2.2 Nelchina Caribou Herd

The Nelchina caribou herd is a relatively large barren-ground herd in the interior of Alaska. Similar to the Fortymile caribou herd, Nelchina caribou calve in the western portion of their range and disperse east toward the Alaska-Yukon border during winter. Also similar to the Fortymile, the Nelchina caribou herd has undergone considerable changes in population size over the last decade. The last population low occurred in the early 1970s, when the herd dropped to <10,000 animals (Van Ballenberghe 1985 *in* Eberhardt and Pitcher 1992). Since then, the herd has increased and as of 2011, was estimated at 46,500 caribou (Alaska Department of Fish & Game 2016). During population lows, the area occupied by the Nelchina herd contracted towards their calving area (Hemming 1975). As the herd grew in the 1980s, it expanded its winter range to the Tanana Uplands near the Yukon-Alaska border (Roffler *et al.* 2012). The use of the winter range near the Alaska-Yukon border is a relatively new change in winter distribution. Prior to the early 1990s the Nelchina herd's winter range was the Nelchina River basin south of the Alaska Range of mountains and north of Valdez, Alaska. Recently, part of the Nelchina herd occupied winter range in an area northeast of Tok, Alaska and adjacent to the Taylor Highway and the Alaska-Yukon border. There is some evidence that the shift was due to a change in lichen biomass from overgrazing and forest fires within the historic winter range (Collins *et al.* 2011).

The Nelchina caribou herd occupies winter range in an area west of the RSA, primarily in Alaska (Collins *et al.* 2011, Joly *et al.* 2003). A portion of the herd winters near the Yukon-Alaska border and some collared caribou have spent a part of the winter in Yukon, though not in significant numbers (Schwanke 2011). Available collar data shows that three Nelchina very high frequency (VHF) collar locations were documented on the northwestern border of the RSA (Figure 2-12). The Fortymile and Nelchina herds can mix during the fall and winter (Roffler *et al.* 2012). Males tend to show greater overlap with other herds and do not exhibit as much range fidelity as females (Roffler *et al.* 2012); however, the sex of the Nelchina caribou near the RSA is unknown. Based on the collar data and discussions with Environment Yukon (M. Suitor, pers. comm., 2014-2016), a small number of caribou from the Nelchina herd may enter the RSA during winters, although the RSA is outside of the current mapped herd range and the number of caribou and time spent in the RSA is likely to be very low. Winter habitat use by Nelchina caribou is expected to be similar to habitat use by the Fortymile caribou herd (T. Hegel and M. Suitor, pers. comm., 2015) and driven by the selection for high lichen abundance and avoidance of recently burned areas (Joly *et al.* 2003; Collins *et al.* 2011).





Legend

- Coffee Project
- Nelchina Caribou Locations (2015)
- Proposed Route
- Yukon/Alaska Border
- Regional Study Area
- Nelchina Caribou Herd Range (partially shown)

FIGURE: 2-12

Nelchina caribou herd range and VHF collared caribou locations (2015)

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Collar data provided by Environment Yukon - Yukon Government, Alaska Department of Fish and Game, and Alaska Bureau of Land Management.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

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Map Reference Scale: 1:3,000,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 CSRS Yukon Albers

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2.2 MOOSE

Moose are a large herbivore and the largest member of the deer family. Moose are widespread across Canada, occurring in every province and territory with the exception of Prince Edward Island. Due to their large global range and population, and their apparent global population growth, moose have been assessed as Least Concern by the International Union for the Conservation of Nature (IUCN; Geist *et al.* 2008). Moose have not been assessed by COSEWIC but are widespread across Canada and are not a conservation concern in the broader Canadian context. Moose are considered Secure in Yukon (CESCC 2011).

Yukon is uniquely situated as a transition zone between two subspecies of moose: Alaska moose (*Alces alces gigas*) and western moose (*Alces alces andersoni*). These two subspecies formed as a result of geographical separation during the last glacial maximum. Alaska moose persisted in the Beringian refugia while western moose persisted south of the Laurentide and Cordilleran ice sheets. Currently, ranges of both subspecies have expanded, with a region of hybridization occurring in the central Yukon (Hundertmark *et al.* 2003).

2.2.1 POPULATION

The total Yukon moose population is approximately 70,000. This population estimate is based on ongoing aerial surveys conducted by Environment Yukon to support moose management in the territory (Government of Yukon 2016c). The moose population within the RSA, particularly the region north of the Stewart River in Game Management Zone 3, has been well studied. Recent early winter census surveys in 2012 and 2015 provide up to date population and density estimates for nearly all of the RSA. Overall, moose densities in the RSA are close to the Yukon average, which generally ranges between 150 to 249 moose/1000 km^2 (Yukon Fish and Wildlife Management Board 1996), with some of the northern regions possibly higher than average. According to the Dawson Planning Region Resource Assessment Report, the area "supports a stable moose population at relatively high densities" (Dawson Regional Planning Commission 2013).

In the southern half of the RSA, an early winter moose census was conducted in November 2012 for the Lower Stewart White Gold region. GMSs surveyed included the entirety of GMS 313, 314, 502, 503, and 509. The total survey area was about 6,751 km^2. Based on survey results an estimated 1,147 moose (90% CI of 960-1,333) are expected in the survey area, at a density of 170 moose per 1,000 km^2 (O'Donoghue *et al.* 2013a). The 2012 census data indicates that calf survival was fairly low, while yearling and bull ratios were healthy (Table 2-8).

The northern regions of the RSA were most recently surveyed in the 2015 Dawson Goldfields moose census. This survey included the entirety of GMS 307, 308, 310, 311 and 312. Based on survey results, an estimated 1,639 moose (90% CI of 1,501-1,801) are expected in the survey area, at a density of 277 moose/1000 km^2 (report pending, preliminary survey results provided by M. Suitor). Following the completion of the 2015 Dawson Goldfields survey, Kaminak, in collaboration with Environment Yukon, extended the survey to include the area along the proposed NAR between the Yukon and Stewart rivers (including portions of GMS 313 and 314). Based on the combined survey results, Environment Yukon

developed a population estimate for the NAR, including the area within a 10 km buffer of the proposed alignment from the junction with the Klondike Highway to the Yukon River, an aerial extent of 3,298 km². An estimated 814 moose (90% CI of 723-917) are expected to occur within this area at a density of 247 moose/1,000 km².

Table 2-8. Survey estimates from the 2012 early winter moose census (O'Donoghue *et al.* 2013a).

	Number of calves per 100 adult cows	Yearling and bull ratio per 100 adults	Yearling and bull ratio per 100 cows
Survey Results	21	12	64
YFWMB Recommendations (1996)	25	8-15	30

2.2.2 DISTRIBUTION

Moose are distributed across the territory in all boreal forest regions, but are more densely populated in southern Yukon (Government of Yukon 2016c). Moose tend to have a clumped distribution, selecting habitats based on the availability of forage, distance to cover, ease of travel, and avoidance of predators (Hamilton *et al.* 1980; Dussault *et al.* 2005). They prefer mosaic forest communities with some combination of mature forest for cover and shrub or wetland areas for forage (Geist *et al.* 2008). In Yukon, moose are often found in riparian areas, wetlands, regenerating burns, and near treeline in subalpine shrub habitat with abundant willows (Tr'ondëk Hwëch'in 2012b; Government of Yukon 2016c).

In west-central Yukon, moose often show seasonal elevation migration patterns, although some moose likely have small home-ranges that are inhabited year round (Hundertmark 1997; Dawson Regional Planning Commission 2013). In the spring and summer, moose can be found in a wide variety of habitats ranging from subalpine to valley bottom. Wetlands and aquatic habitats can be important feeding areas for moose at this time of year (Government of Yukon 2016c).

In the late fall and early winter months, moose tend to congregate in the extensive shrub communities of the subalpine. Early winter census surveys in the Lower Stewart White Gold area found that moose were widely distributed in a variety of habitats but were more likely to be seen in subalpine willow flats and creek draws compared to forested areas, burned areas, and lower elevation slopes (O'Donoghue *et al.* 2013a). Based on the results of the early winter moose surveys, high densities of moose can be expected in several higher elevation areas of the RSA during the early winter; those with the potential to interact with the proposed NAR include the King Solomon Dome area, and the Henderson Dome area. Figure 2-13 shows the early winter moose densities along the NAR based on the 2015 early winter surveys. Based on the 2012 early winter moose survey in the southern sections of the RSA (O'Donoghue *et al.* 2013a), high densities of moose are not expected in the mine site area during the early winter.

When snow loads are low, moose may stay in the high elevation early winter habitats year round; however with deeper snow, moose are forced down into lower elevation areas during the late winter (Government of Yukon 2016c). In parts of Yukon, late winter moose habitat is limited to low elevation areas along stream and river valleys; key winter ranges for moose are generally low elevation forested valleys where tree canopy

cover intercepts snow, resulting in shallower snow conditions, lower energy costs, greater forage availability, and cover from predators (Government of Yukon 2016c). However, within the RSA, late winter ungulate surveys have indicated that snow depths may not be as restrictive as in other parts of Yukon, and that during the late-winter season moose may be distributed over a wider range of elevations as compared to other areas (O'Donoghue *et al.* 2013b; EDI 2017a, 2016b). Late winter aerial surveys have documented moose throughout the RSA (O'Donoghue *et al.* 2013b; EDI 2017a). Based on the results of the Project late winter ungulate surveys (2014–2016), several parts of the survey extent show higher concentrations of moose during the late winter including the southwestern sections of the RSA along the White River, the upper sections of the Henderson Creek and Black Hills Creek drainages, and just north of the Indian River (Figure 2-14). Moose in the RSA were frequently observed on higher elevation slopes (i.e. upper boreal high and subalpine) than would be expected in regions with more snowfall.

2.2.3 HABITAT USE AND DIET

Moose use a wide range of habitats throughout the RSA, selecting for several habitat variables at varying spatial and temporal scales. Moose are herbivorous, feeding on a variety of woody shrubs, leaves, and aquatic plants (Government of Yukon 2016c). Mineral licks play an important role in moose diet as a source of sodium (Tankersley and Gasaway 1983). Throughout the snow-free portion of the year, habitat availability is likely not a limiting factor for moose in the RSA.

Moose habitat is most limited during the late winter periods when primary productivity is lowest, energetic demands are highest, and snow conditions reduce habitat availability by increasing the energetic costs of travel. Moose late winter habitat selection involves trade-offs between predator avoidance, snow depth, and forage availability (Dussault *et al.* 2005). While predation often occurs in the spring and summer, winter predation by wolves remains a source of mortality (Hayes *et al.* 2003) and moose avoid habitat types that increase the likelihood of detection by wolves (Dussault *et al.* 2005). Taller and denser vegetation types provide more shelter from predators and reduced snow cover, while more open areas have a greater abundance of willow shrub, the preferred winter food source of moose (Risenhoover 1989).

Moose were commonly observed browsing on willows during the late winter Coffee Project baseline surveys. Willow is an early successional species and is most abundant in open and disturbed areas such as subalpine treeline, stream riparian, placer mines, exploration camps, and burns between 10 and 30 years old (Maier *et al.* 2005). Moose are likely to use habitat characterized by a mosaic of forest and shrub areas as these areas provide both shelter and forage. With the exception of high elevation areas, snow depth is unlikely to limit moose movement during winter as much of the RSA often receives less than 70 cm of snow, recognized as a limiting depth for habitat use by moose (Peek 1997). The February 2016 snow tracking survey along the NAR found an average snow depth of 45 cm within the survey extent (range 14–96 cm; EDI 2017a).

Two important factors influencing the availability of moose habitat in the RSA are forest fires and human disturbance. Fire is the driving factor in central Yukon forest succession. Areas burned 10 to 30 years ago provide excellent moose habitat due to their early successional state with an abundance of woody shrubs for

browse (Maier *et al.* 2005). Recently burned areas and areas that have not been burned in over 40 years provide lower forage availability.

Other disturbed areas such as roads, trails, and placer disturbed creeks and valleys, can also provide high quality moose browse. Disturbances create an opening in the forest canopy and clear ground, leaving prime conditions for early successional species such as willow to establish. Willows thrive along the edges and within disturbed areas creating excellent foraging opportunities for moose. Roads and trails also provide movement corridors allowing for rapid and efficient movement between habitat areas.

To determine the availability and suitability of late winter habitat in the RSA, a Habitat Suitability Index (HSI) model was developed (EDI 2016a). The HSI model used land cover, fire history, and digital elevation model data to estimate habitat suitability based on knowledge of moose from studies in other areas. The HSI model was validated with late winter survey data from 2008 (Environment Yukon 2010), 2012 (O'Donoghue *et al.* 2013b), 2014, and 2015 (EDI 2017a), and showed good agreement in most of the RSA. The model indicates that the RSA contains abundant high quality late winter moose habitat (Table 2-9). High quality late winter habitat is also widely distributed within the RSA (Figure 2-15). A particularly large patch of late winter habitat occurs between the White and Yukon rivers in the southwest portion of the RSA. This modelled area repeatedly had high concentrations of moose during late winter aerial surveys. Another large patch of modelled suitable late-winter habitat occurs in the Indian River drainage; however, there were few observations of moose in this area. Few observations in the modelled high-value habitat is likely because the area was burned in 2004 and surveyed in late winter 2008, only three growing seasons later. Current conditions, 12 years since the burn, are expected to offer much higher suitability and use by moose due to forage development over the intervening period.

Table 2-9. Availability of late winter moose habitat within the RSA.

Habitat class	Area (km²)	% RSA	Moose Observations	Selection Index
High	3,585	26.2%	607 (55.1%)	+1.10
Moderate	2,245	17.4%	192 (17.4%)	+0.05
Low	1,964	14.4%	132 (12.0%)	-0.17
Very Low	5,867	42.9%	171 (15.5%)	-0.64

2.2.4 HARVEST AND MORTALITY

Moose are the primary harvest species within the RSA and are a highly valued species for both First Nations people and licensed hunters. The Coffee Creek area has been traditionally used by local First Nations and families would return to the area each fall to harvest moose (Tr'ondëk Hwëch'in 2012a).

Much of the RSA, particularly the Dawson Goldfields region, is very accessible to hunters due to an abundance of roads and trails. These areas experience relatively high levels of harvest pressure. Licensed harvest in Yukon is managed by Environment Yukon. Environment Yukon's moose management guidelines allow for Annual Allowable Harvest rates of 2 to 5%, with rates of 3 to 4% for relatively stable, average

density populations (Yukon Renewable Resources 1996). Harvest data from licenced hunter kill reports is collected and compared to GMS population estimates to ensure that harvest rates are sustainable.

All GMSs in the RSA are open to licenced hunters for bull moose with an annual bag limit of one. Harvest records were provided by Environment Yukon from the previous ten years of moose harvest data (2006–2015) and reported by GMS (Table 2-10; Government of Yukon 2016a). Between 2006 and 2015, 480 moose were harvested by licensed hunters within the RSA. Mean annual harvest rates vary by subzone, from 1.4 moose/year to 8.2 moose/year (Government of Yukon 2016a). In general, harvest numbers appear related to accessibility of areas with the higher harvest generally occurring closer to Dawson and in areas accessible from existing Dawson Goldfields access roads (GMS 307, 308, 310-312). Relatively high harvest also occurred in GMSs accessible from the Yukon River and remote placer access roads (GMS 502, 313 and 314). The remaining GMSs (315, 503 and 509) had relatively low harvest numbers, likely due to their relative inaccessibility to hunters. Subsistence harvest by First Nations is assumed to be at similar levels to licenced harvest (N. Ayoub pers. comm., 2016).

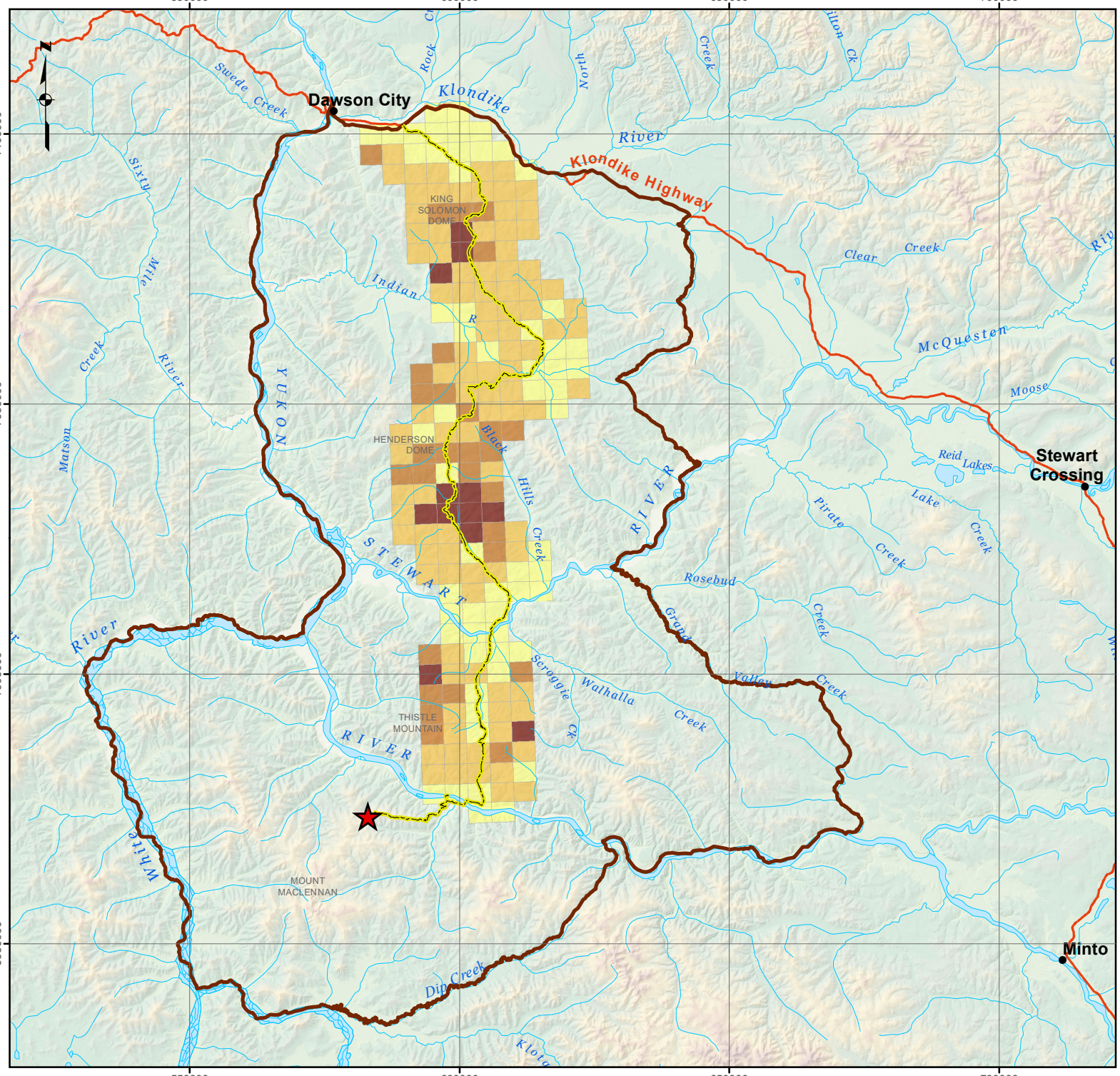
A cumulative effects assessment for wildlife in the White Gold area states that new access into previously inaccessible areas could result in increased moose harvest (EDI 2013). This assessment modelled total moose harvest, road/trail density, and length of major rivers within each GMS to look at the relationship between human access and harvest. The study found that the number of moose harvested in a GMS is independent of moose density and river access, but moose harvest increased by 3.12 moose for every additional 1 km of road/trail per 1 km^2, indicating that there is a positive correlation between density of roads/trails and number of moose harvested.

With a total mean annual harvest of 48 moose (Government of Yukon 2016a), between 5 and 10% of the total Yukon annual moose harvest occurs within the RSA. The Dawson Goldfield GMSs in particular are some of the most intensely harvested areas of Yukon as a result of having above average moose density (Cooley *et al.* 2012) and above average access. Non-harvest moose mortality also occurs occasionally within the RSA. Between 2006 and 2015 a total of 20 moose were killed as a result of non-harvest activities such as vehicle collisions (Government of Yukon 2016a). Non-harvest moose mortality occurs more frequently in regions with higher human activity levels. Out of 20 non-harvest mortalities reported, 18 occurred in GMSs 307 and 308; the two GMSs within the RSA that border the Klondike Highway.

Predation, particularly of moose calves, by grizzly bears, black bears, and wolves, is likely one of the leading causes of moose mortality (Larsen *et al.* 1989). Studies from southeast Yukon found that grizzly bears and wolves accounted for 50% and 26% of all moose mortalities, respectively (Larsen *et al.* 1989). Many cows give birth to calves in the subalpine zone in May and June to provide abundant browse at that time of year. Grizzly bears spend much of the spring in the subalpine zone and may kill as many as 50% of each year's moose calves (Government of Yukon 2016b). In eastern interior Alaska, Bertram and Vivion (2002a) found that predation was responsible for 92% of calf mortality, driving a very low overall calf survival rate of 20% and limiting population growth in the area. Predation levels in the RSA are unknown but it is likely that predation limits moose populations.

Table 2-10. Moose harvest statistics from 2006 to 2015 in the game management subzones that interact with the RSA (Government of Yukon 2016a).

GMS	Harvest Regulations (2015-2016 season)	Total Harvest	Mean Annual Harvest
307	Open; Bag limit 1	72	7.2
308	Open; Bag limit 1	51	5.1
310	Open; Bag limit 1	53	5.3
311	Open; Bag limit 1	44	4.4
312	Open; Bag limit 1	65	6.5
313	Open; Bag limit 1	82	8.2
314	Open; Bag limit 1	31	3.1
315	Open; Bag limit 1	16	1.6
502	Open; Bag limit 1	37	3.7
503	Open; Bag limit 1	15	1.5
509	Open; Bag limit 1	14	1.4
Total		**480**	**48**





Legend

- Coffee Project
- Highway
- Proposed Route
- Regional Study Area

Early Winter Moose Density

- Low
- Moderate
- Moderate/High
- High

FIGURE: 2-13

Early winter moose density estimate

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Survey data collected by EDI Environmental Dynamics Inc. (2014-2016).

Disclaimer
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Map Reference Scale: 1:1,000,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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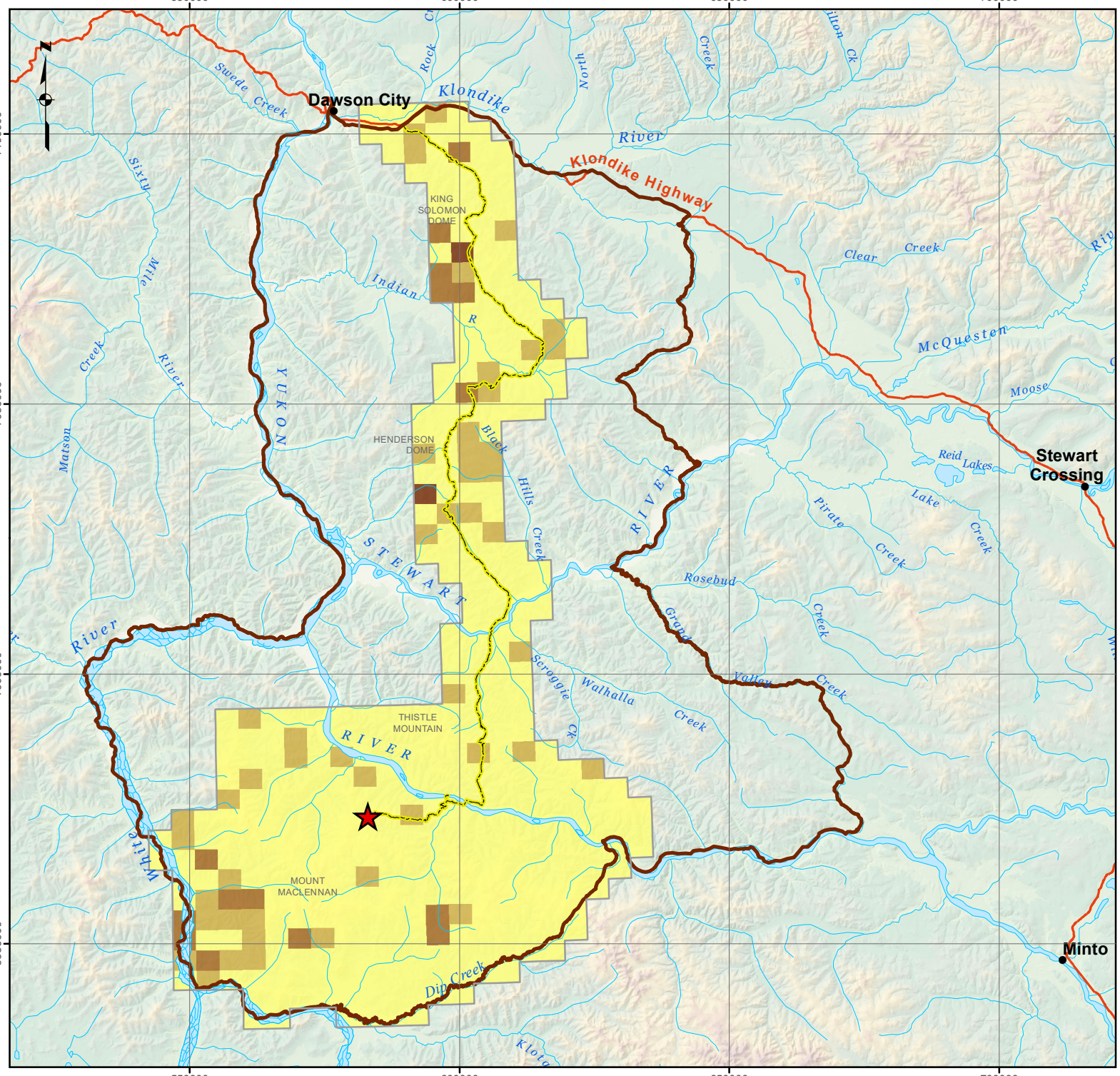

FIGURE: 2-11

Late winter moose density estimate

Data Sources
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Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Survey data collected by EDI Environmental Dynamics Inc. (2014-2016).

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

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KM

Map Reference Scale: 1:1,000,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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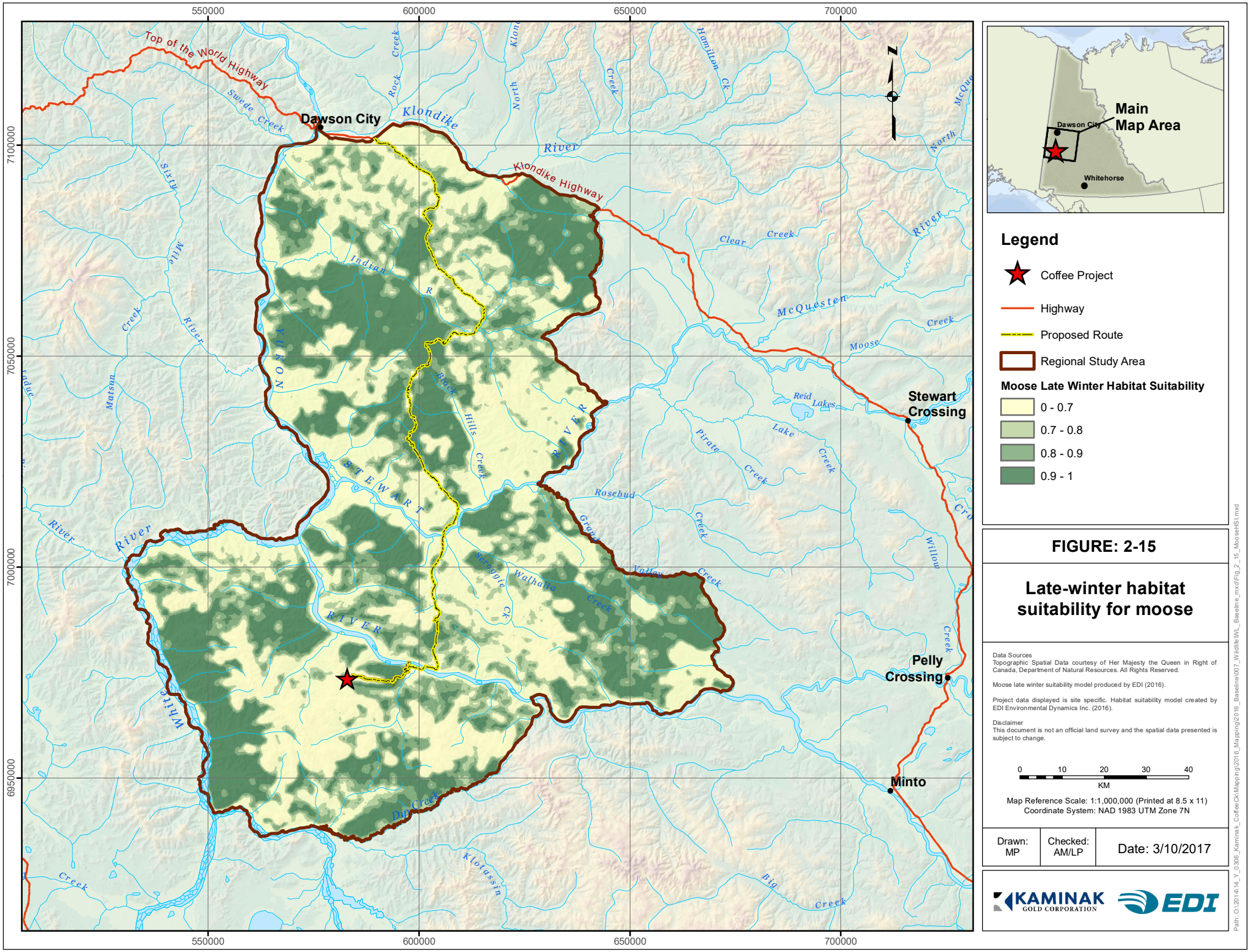

FIGURE: 2-15

Late-winter habitat suitability for moose

Data Sources
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Moose late winter suitability model produced by EDI (2016).

Project data displayed is site specific. Habitat suitability model created by EDI Environmental Dynamics Inc. (2016).

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Coordinate System: NAD 1983 UTM Zone 7N

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2.3 THINHORN SHEEP

Thinhorn sheep are native to northwestern North America, inhabiting portions of Yukon, British Columbia, Northwest Territories, and Alaska (Festa-Bianchet 2008). There are two subspecies, Dall's sheep (*Ovis dalli dalli*) and Stone's sheep (*Ovis dalli stonei*). A colour morph known as Fannin sheep also occurs and is thought to be the result of cross-breeding between Dall's and Stone's sheep (Worley *et al.* 2004; Government of Yukon 2015c). Dall's sheep are more abundant than Stone's sheep in Yukon and are the only subspecies that occur in the RSA. For the purposes of this baseline report, sheep using the area are referred to as thinhorn sheep.

Thinhorn sheep have not been assessed by COSEWIC but appear to have stable populations and ranges, and are designated Least Concern by the IUCN (Festa-Bianchet 2008) and Secure in Yukon (CESCC 2011).

2.3.1 POPULATION

An estimated 20,000 thinhorn sheep live in Yukon, ranging from the southern border to the North Slope (Barichello *et al.* 1989a; Government of Yukon 2015c). Within the RSA, there are records of thinhorn sheep from two general areas: Mount Maclennan, located approximately 14 km south of the proposed mine site, and the steep south-facing bluffs along the Yukon River (Figure 2-16).

The Yukon Wildlife Key Area (WKA) database has records of sheep on Mount Maclennan based on Traditional Knowledge. The area was noted as having a historic population of 12–15 sheep that 'may have been hunted out'; no sheep have been recorded there since 1990 (Government of Yukon 2016d). A survey of the Mount Maclennan area in July 2010 by Environment Yukon did not locate any sheep (Government of Yukon 2011a).

The other area of the RSA with known use by thinhorn sheep is the steep, south-facing hillslopes with rock bluff complexes, located along the north side of the Yukon River. The first official survey of this area for thinhorn sheep was in July 2010 (Government of Yukon 2011a); however there are anecdotal reports dating back to the Yukon gold rush of sheep using this area (Russell pers. comm. 2015). Local trapping concession holders also report seeing small numbers of thinhorn sheep on the cliffs above the Yukon River year-round, and observations have included both adult sheep and ewes with lambs (Interview 14, pers. comm., 2016). Several Project baseline surveys for sheep were conducted along the Yukon River corridor to augment existing data on thinhorn sheep in the RSA (EDI 2017a). A WKA for sheep has been delineated along the Yukon River bluffs west of Ballarat Creek (Government of Yukon 2016d); however, Project surveys observed sheep within a broader area both east and west of Ballarat Creek, referred to in this report as the Ballarat Creek occurrence area (Figure 2-17). A maximum of eight sheep have been observed at the Ballarat Creek occurrence area during any single survey; during Project baseline surveys, a maximum of four sheep were observed (Table 2-11).

Outside of the Project RSA, thinhorn sheep populations also occur on the steep slopes near the confluence of the White and Yukon rivers (referred to as White River occurrence area) and on the north slope of the

Yukon River between Minto and Fort Selkirk (referred to as the Minto occurrence area). Fifteen years of sheep surveys in the Minto occurrence area show a stable or slightly increasing sheep population of approximately 120 animals, and lamb to nursery sheep ratios suitable for maintaining a healthy population (Government of Yukon 2014a). Within the White River occurrence area, approximately 15–20 sheep have been present since 2003 (Government of Yukon 2011a). These populations may act as a source for immigrants into the Ballarat Creek area.

The distances between the three areas are farther than sheep normally move on an annual basis (45 km from the White River occurrence area to Ballarat and 85 km from Ballarat to the Minto occurrence area); however, individual animals or small groups have been observed making occasional dispersal movements over those distances (Geist 1971). In other parts of North America several sheep populations have been described as having metapopulation structures (Bleich et al. 1996; Epps et al. 2005; Akçakaya et al. 2007), that are characterized by isolated subpopulations, in discreet occurrence areas separated by unsuitable habitat, that exhibit a pattern of extirpation and recolonization of individual areas over a period of many years. If a metapopulation dynamic is occurring along the Yukon River, the Ballarat occurrence area might be considered a 'satellite' subpopulation (Hanski and Gyllenberg 1993) that is likely to experience more frequent extirpations, and longer vacancies, due to its small geographic size and small subpopulation number. The Minto occurrence area might be a 'core' subpopulation that is rarely extirpated and which is a regular source of emigrating animals to recolonize or supplement satellite areas like Ballarat. Without immigration to supplement or recolonize the Ballarat occurrence area, long term persistence of sheep is uncertain. Berger (1990) predicted that populations with less than 50 sheep will go extinct, on average, within 50 years. Empirical observations of small sheep populations have observed both extinctions and persistence over periods of several decades, and the factors that affected those outcomes varied widely among populations (Krausman 1997).

Table 2-11. Thinhorn Sheep observations within the Ballarat Creek occurrence area 2010-2016

Date	Survey	Thinhorn Sheep Observations[1]	Source
June 2010	Environment Yukon Sheep Survey	6 sheep (4 nursery, 1 lamb, 1 ram)	Government of Yukon 2011a
February 2011	Environment Yukon Sheep Survey	8 sheep (6 nursery, 2 rams)	Government of Yukon 2011a
June 2014	Cliff-nesting Raptor Survey	4 sheep (nursery – no lambs)	EDI 2017a
April 2015	Cliff-nesting Raptor Survey	0	EDI 2017a
June 2015	Cliff-nesting Raptor Survey	0	EDI 2017a
June 2015	Incidental Observation	3 sheep (unclassified)	EDI 2017a
August 2015	Incidental Observation	1 sheep (unclassified)	EDI 2017a
November 2015	Sheep Survey – Early Winter	4 sheep (3 ewes, 1 unclassified)	EDI 2017a
February 2016	Sheep Survey – Late Winter	0	EDI 2017a
May 2016	Sheep Survey – Lambing	4 sheep (unclassified – no lambs)	EDI 2017a
June 2016	Sheep/Raptor Survey – Summer	0	EDI 2017a
June 2016	Incidental Observation – Ground Based Sheep Surveys	4 sheep (3 ewes, 1 possible yearling)	EDI 2017a
October 2016	Sheep Survey – Early Winter	4 sheep (nursery – no lambs)	EDI 2017a

[1] Outside of the Ballarat Creek occurrence area, one additional observation of thinhorn sheep was made in the RSA during Project baseline studies. The Camp Wildlife Log includes a record of three sheep observed walking along the slopes near the Kona deposit in June 2016. There are no cliffs or other steep slopes that could provide escape terrain for thinhorn sheep in the vicinity of the Kona deposit, and subsequent searches for sheep in this area conducted by the Kaminak Environmental Monitors did not locate the animals.

2.3.2 DISTRIBUTION AND MOVEMENT

Thinhorn sheep generally have a clustered distribution, staying in relatively close proximity to essential habitat features including escape terrain, mineral licks, and foraging habitat. They are not migratory but may move to different seasonal ranges (Government of Yukon 2015c). In contrast to the vast majority of Yukon sheep, the population known in the RSA inhabits non-alpine, low elevation riparian areas.

The Ballarat Creek occurrence area consists of several steep, south-facing bluff complexes separated by forested valleys, including bluffs both east and west of Ballarat Creek. Survey observations and local knowledge (Interview 14, pers. comm., 2016) indicate that sheep may be found within the Ballarat Creek occurrence area year-round (Table 2-11). Although sample size is low, there is some indication of differences in seasonal distribution within the occurrence area to suggest that sheep may exhibit seasonal movements between areas of suitable habitat within the occurrence area, at least periodically crossing the Ballarat Creek valley (Figure 2-17).

To gain additional information on sheep distribution and movement through the Ballarat Creek area, remote cameras were installed in several locations along established wildlife trails within the Ballarat Creek valley and the lower valley slopes in 2015 (EDI 2017a). Sheep trail investigations were also conducted in 2015 and 2016, and in October 2016 remote cameras were deployed along ridgetop trails in the Ballarat area to gain a

better understanding of sheep use and movements. To date, no sheep have been captured on the remote cameras in the Ballarat Creek valley or lower valley slopes (EDI 2017a; data from the ridgetop cameras was not available at the time of reporting). The 2015 and 2016 trail investigations identified a number of wildlife trails with varying level of use. Well-used trails are located along the valley bottom; however, most of these parallel Ballarat Creek and based on camera results are mostly used by other species. Lightly used trails were located along the ridgelines on both the east and west side of the creek and evidence of sheep use was found along ridgeline trails. Areas showing evidence of concentrated use by sheep including numerous pellet groups, bed sites, and disturbed ground leading into escape terrain and forage habitat were also found during the sheep trail investigations; however, these were generally located along the mid- to upper-sections of the slopes. The proposed NAR alignment parallels then crosses Ballarat Creek and travels west below the Yukon River bluffs to where it crosses the Yukon River. The 2016 sheep trail investigations included a survey at the toe of the slope west of Ballarat Creek where the proposed NAR alignment intersects the currently delineated thinhorn sheep WKA. No evidence of use by thinhorn sheep was found in this area.

As discussed in Section 2.3.1, if there is a metapopulation dynamic occurring along the Yukon River, occasional movements between the three Yukon River occurrence areas may occur. If thinhorn sheep do travel among the three known occurrence areas, the most likely movement corridor is along a series of steep hillslopes and ridges that occur on the north side of the Yukon River. Based on survey observations, these hillslopes offer good foraging habitat but limited escape terrain. A more detailed review of sheep habitat availability and distribution can be found in the Thinhorn Sheep Habitat Suitability Report (EDI 2016b) which was developed to map the distribution and quantify sheep habitat along the Yukon River corridor (Figure 2-18).

2.3.3 HABITAT USE AND DIET

Within the RSA and along the Yukon River corridor, thinhorn sheep occur in low densities at sporadic, isolated locations. The primary limiting factor for sheep in this region appears to be the amount of suitable habitat, especially escape terrain (Hayes 2015).

Thinhorn sheep have very specific habitat requirements. Foremost is the need for steep, rugged rock cliffs that they use as 'escape terrain' to avoid predators (Geist 1971). They also require seasonal foraging areas and secluded lambing areas in association with escape terrain. Foraging areas are predominantly grass and forb dominated habitats (Seip and Bunnell 1985), such as alpine tundra, south aspect hillslopes, and, occasionally, low elevation meadows where sheep primarily feed on grasses, sedges and forbs although they will also browse on shrubs (Hoefs and Cowan 1979). Mineral licks can also be important habitat features for many sheep populations (Simmons 1982; Government of Yukon 2015c). Mineral licks are used during the spring and summer, but use is typically highest in June and July. Sheep may travel several kilometers away from escape terrain and through forested areas to access mineral licks (Simmons 1982).

Most sheep in the Yukon make annual movements or migrations among seasonal habitat types (Sheep Management Team 1996). Winter range is typically used from early September to May, and consists of foraging habitat, in association with escape terrain, with characteristics that reduce snow accumulation.

These characteristics can include lower elevation, south aspect, and wind prone slopes, often in combination. In May, sheep typically begin moving away from their winter range, following the progression of new plant growth to higher elevations. Pregnant ewes normally seek steep, secluded areas away from other sheep in May and June to birth and rear their lambs before regrouping with other sheep in the summer. Summer range tends to be the most widespread of seasonal sheep habitats and includes a variety of foraging types in association with escape terrain. Summer range often is at the highest elevations, but can include a range of elevations and can overlap with winter range. During the rut and pre-rut periods (October to December) rams may travel great distances in search of mating opportunities, often with a diminished regard for proximity to escape terrain.

Most sheep in Yukon occur in mountain alpine zones, where grass and forb dominated meadows, occur in association with mountain cliffs and ridges that provide escape terrain (Sheep Management Team 1996; Hayes 2015). Thinhorn sheep habitat use in the RSA is markedly different — pasture tends to be low elevation, south-facing parkland slopes rather than the more typical alpine meadow and subalpine shrub communities. Escape terrain is believed to be the rocky riparian outcrops that characterize much of the north bank of the Yukon River.

To determine the availability and distribution of thinhorn sheep habitat along the Yukon River corridor, an HSI model was developed (EDI 2016b). The HSI model used terrain steepness, aspect, distance from escape terrain, land cover, and distance from the Yukon River to estimate habitat suitability within and between the White River, Ballarat Creek, and Minto occurrence areas. Generally, the model results corresponded well with information about habitat use by thinhorn sheep in the area. The amount and distribution of modeled sheep habitat is quite limited with High and Moderate rated habitats accounting for only 1% of the total modelling area (Table 2-12). Suitable habitats were identified in relatively small extents, concentrated on steep, non-forested, south aspect hillslopes, with rocky bluff complexes, along the north side of the Yukon River. The model predictions corresponded well with the three known sheep occurrence areas in the region and identified several other potential habitat areas between them (Figure 2-18).

Table 2-12. Availability of thinhorn sheep habitat within the modelling extent.

Habitat class	Area (km²)	% Area
High	3,585	26.2%
Moderate	2,245	17.4%
Low	1,964	14.4%
Very Low	5,867	42.9%

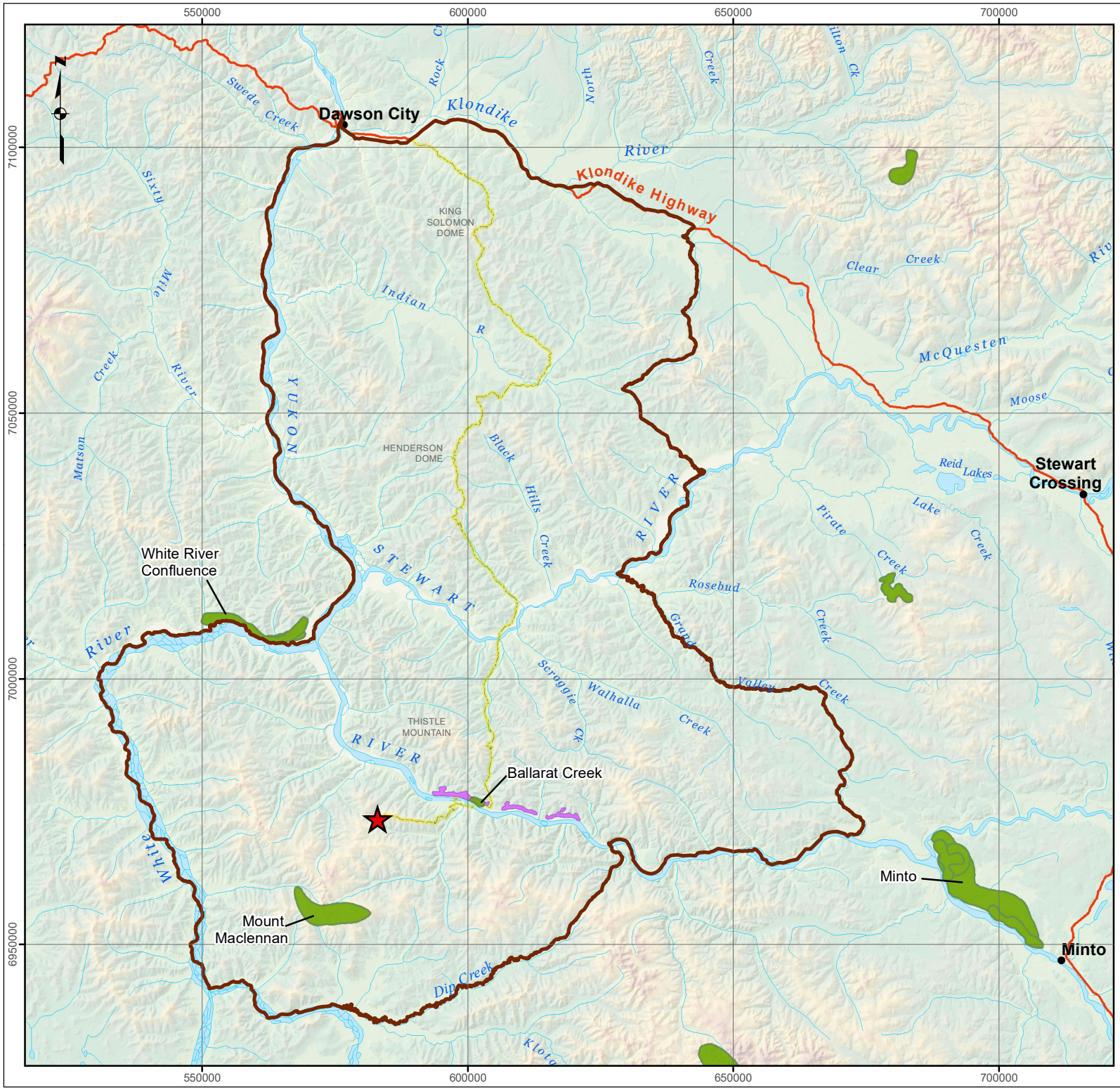
2.3.4 HARVEST AND MORTALITY

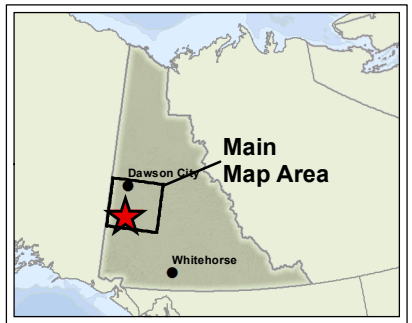
Thinhorn sheep are highly valued in Yukon, both for their appeal to sport-hunters and for their importance as a traditional harvest species for some Yukon First Nations. Licensed hunting of thinhorn sheep is managed by Environment Yukon while Yukon First Nations have subsistence harvest rights for sheep protected under the Umbrella Final Agreement, and Yukon First Nation Final Agreements.

Thinhorn sheep are known to be a traditional seasonal food source for all four First Nation groups with asserted or established traditional territories that overlap the Project (Bates and DeRoy 2014; InterGroup Consultants Ltd. 2009; Dawson Indian Band 1988; McClellan 1987; Mishler and Simeone 2004; Pearse and Weinstein 1988); however, the areas where sheep hunting traditionally occurs are well outside the RSA. There is no documented Traditional Knowledge of sheep being targeted where they occur along the Yukon River and sheep are not known to be harvested within the RSA at the current time. Sheep harvest is permitted by licensed hunters in GMS 502, 503, and 509 (Figure 1-3) but there have been no sheep harvested by licensed hunters in the last 10 years. All Zone 3 GMSs, which includes the Ballarat Creek occurrence area, are closed to sheep hunting. There is little information available on unlicensed or subsistence harvest; however, local trapline concession holders have indicated that they are not aware of any subsistence harvest of sheep in the area (Interview 14, pers. comm., 2016).

The main cause of natural mortality for thinhorn sheep within the RSA is likely predation, although mortality rates are unknown. Predators of sheep include wolves, wolverine, coyotes, golden eagles, lynx, and grizzly bear (Hoefs and Cowan 1979; Stephenson *et al.* 1991; Arthur 2003). No predators in the region are suspected to be sheep specialists as there is likely not enough sheep biomass available. Generally, wolves are not believed to have a strong effect on sheep populations (Barichello *et al.* 1989b); however, in the RSA there may be a risk of predation by wolves since the Ballarat Creek sheep live in sympatry with moose, caribou, and mule deer and the density of wolves is likely higher than in alpine sheep habitat which may increase opportunistic predation.

Severe weather during late winter and spring can limit sheep forage access, affecting already precarious energy balances in ewes and lambs and ultimately influencing recruitment (Geist 1971). Sheep are also known to be susceptible to diseases such as pneumonia and parasites (Jenkins *et al.* 2007). Due to their naturally fragmented range and isolated small group size, Yukon River sheep may be at a greater risk of extirpation from stochastic events such as extreme weather and disease.





Legend

- Coffee Project
- Highway
- Proposed Route
- Regional Study Area
- Ballarat Creek Occurrence Area
- Dall's Sheep Wildlife Key Areas

FIGURE: 2-16

Thinhorn sheep wildlife key areas in vicinity of the Coffee Project RSA

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Dawson Range Sheep Distribution and Wildlife Key Areas provided by Environment Yukon - Yukon Government.

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Map Reference Scale: 1:1,000,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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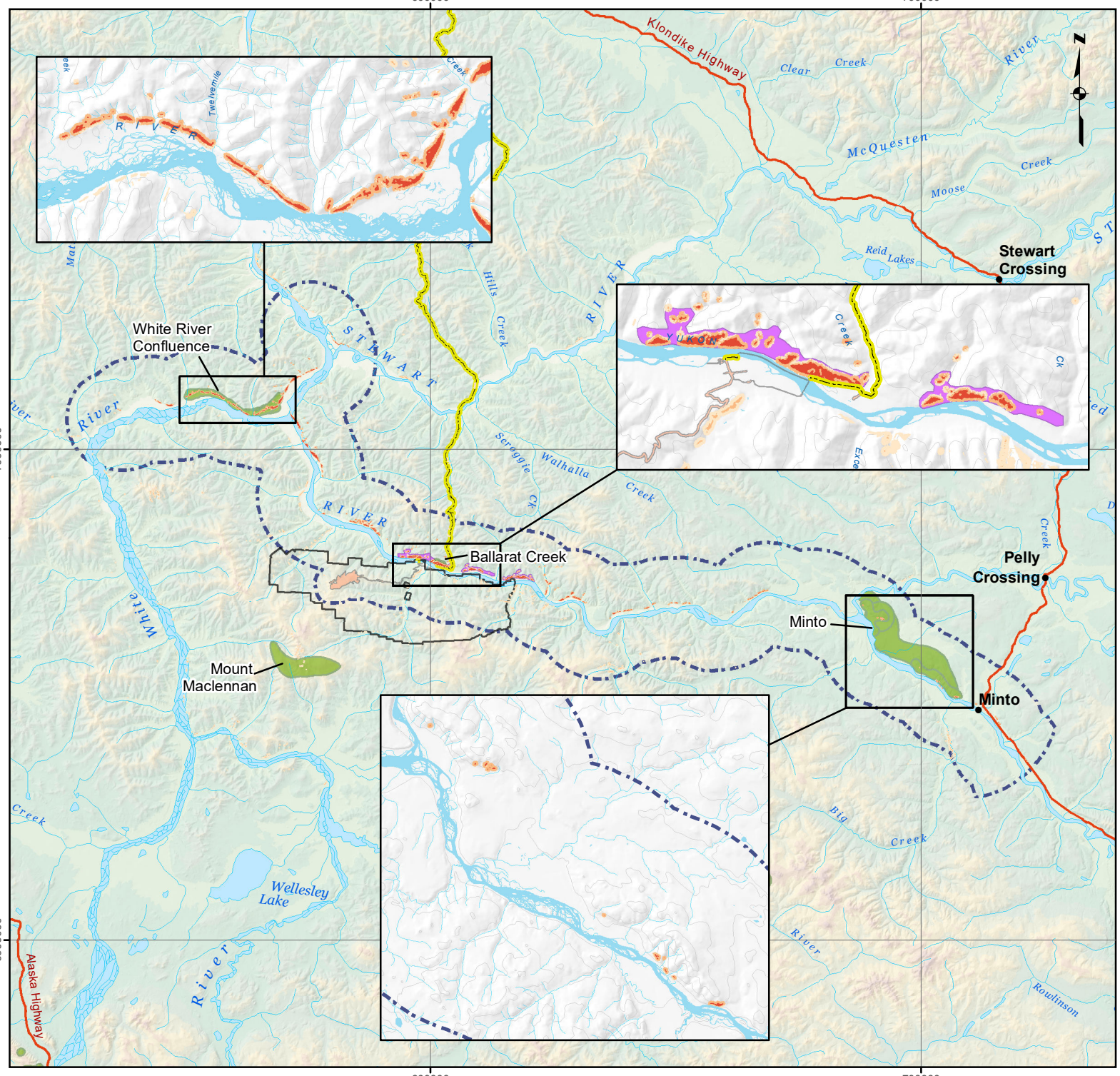
Figure 2-17. Thinhorn sheep observations within the Ballarat Creek occurrence area

Figure 2-17: Thinhorn Sheep Observations within the Ballarat Creek Occurrence Area is not provided in the publically available version of the Coffee Gold Mine: Wildlife Baseline Report due to the sensitive nature of the data.





Legend

- Highway
- Proposed Route
- Project Footprint
- Thinhorn Sheep Wildlife Key Areas
- Ballarat Creek Occurrence
- Thinhorn Sheep Habitat Modeling Extent

Habitat Suitability Index

- Nil
- Low
- Moderate
- High

FIGURE: 2-18

Thinhorn sheep habitat suitability

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Thinhorn sheep habitat suitability model produced by EDI (2016).

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2.4 MULE DEER

Mule deer are ubiquitous in western North America, inhabiting a wide variety of habitats from Alaska, Western Canada and United States, and into Northern Mexico. Due to their adaptability to a wide range of habitats and a large stable global population, mule deer are considered to be Least Concern by the IUCN (Sanchez Rojas and Gallina Tassaro 2008). Mule deer have not been assessed by COSEWIC.

Mule deer only reached Yukon in the last 70–80 years, with the first reported sightings from Southern Yukon in the 1940s (Hoefs 2001). Mule deer are now known to occupy much of Yukon, south of Dawson, particularly along the highway corridors which provide preferred early successional vegetation (Government of Yukon 2015d). Dawson appears to be the northern limit of mule deer range in Yukon with the exception of one sighting on the Dempster Highway (Hoefs 2001). In Yukon, mule deer are considered Vulnerable (CESCC 2011) due to their small population size and the location of the Yukon population on the margins of the Canadian range.

Northward range expansion into Yukon is likely a result of recolonization following the last glacial maximum (Hoefs 2001). Other factors such as climate change and the northward spread of agriculture may be accelerating this range expansion.

2.4.1 POPULATION

Mule deer population in Yukon is small and not well studied. In 2001, Hoefs estimated that there were likely between 500 and 800 individuals. This number now is likely higher as the population appears to have been increasing steadily in Yukon since record keeping began in the 1950s (Hoefs 2001). The current working estimate for the Yukon mule deer population is thought to be around 1,000 animals (S. Czetwertynski, pers. comm., 2016). The number of mule deer in the RSA is unknown; however, based on mule deer observations during wildlife surveys in the RSA, it is likely limited to a small number of individuals concentrated along the south-facing slopes of the Yukon, Stewart, and potentially Indian rivers valleys, and along the Klondike Highway. According to trapping concession holders whose traplines overlap the RSA, mule deer have been present in the Coffee Creek/Yukon River area for at least 30 years and the mule deer population has been increasing in the area (Interview 14, pers. comm., 2016).

2.4.2 DISTRIBUTION

Mule deer are known to inhabit the RSA, although their regional distribution is not well-understood. All mule deer and mule deer sign observed during Project baseline surveys were located along the Yukon River near Ballarat Creek and the slopes above Coffee Creek (EDI 2017a). According to the local Conservation Officer Services, small numbers of deer are also occasionally observed along the lower Stewart River and along the local highways (K. Meister, pers. comm., 2016).

In other northern forest regions, mule deer migrate seasonally, inhabiting high elevation areas during summer and fall and moving to lower elevation areas with lower snow accumulation in the winter and

spring (Hayden *et al.* 2008). Mule deer ranges can be variable in size and are dependent on seasonal migration and dispersal. Reports exist of migrations of more than 160 km (Wallmo 1981); however, some deer maintain the same home range during all seasons, making dispersal, movement, and population densities difficult to predict with sparse data. Open and semi-open grass dominated south-facing slopes throughout the RSA likely provide ideal year-round habitat for mule deer due to the availability of forage and low snow accumulation during winter as a result of wind and sun exposure.

Project baseline surveys documented mule deer or mule deer sign on several occasions. Remote wildlife cameras in the Ballarat Creek valley photographed mule deer during eight separate events in 2015 and 2016, including observations in both the summer and winter seasons (in April, May, August, November, and December). In November 2015, during an early winter ungulate survey, four deer were observed west of Ballarat Creek, mid-slope on a sparsely forested, south-facing slope above the Yukon River. The Camp Wildlife Log also documented mule deer south of the Yukon River, along the lower sections of the Java Road, on two occasions in August 2016. Other than the one observation of four deer during the early winter ungulate survey, mule deer were observed individually or in groups of two.

2.4.3 HABITAT USE AND DIET

Mule deer habitat in Yukon consists of grass-dominated areas, either semi-arid south facing slopes or early successional vegetation areas such as burns, agricultural fields, and road right-of-ways (Government of Yukon 2015d). Deer are not well adapted to deep snow and require winter range with limited snow cover. Winter habitat exists on south-facing slopes where wind and sun exposure reduce snow cover, providing forage throughout the winter. South-facing slopes are also the first free of snow in the spring and have the first green-up making them ideal for spring grazing. Mule deer diet throughout the year consists of grasses, forbs, foliage, and shrubs (Government of Yukon 2015d).

2.4.4 HARVEST AND MORTALITY

Mule deer harvest in Yukon is managed by Environment Yukon and controlled through the Permit Hunt Authorization lottery system. Only ten permits are issued each year and only male mule deer may be harvested. No mule deer have been harvested by licenced hunters within the RSA in the last 10 years.

Natural predators of mule deer include bears, wolves, cougars, and coyotes (Government of Yukon 2015d). Mortality rates of mule deer within the RSA remain unknown. Weather, human land use, and disease are other factors controlling mule deer population dynamics in Yukon. Cold winters may be particularly limiting in the RSA as this region represents the most northerly mule deer habitat in the world (Sanchez Rojas and Gallina Tassaro 2008).

3 CARNIVORES

Large carnivores including grizzly bear, black bear, grey wolf, wolverine, and smaller furbearing species such as American marten, lynx, and red fox are known to be present in the RSA. These species are economically, ecologically, and culturally valuable to First Nations people, licensed hunters, and the fur harvest industry. A number of surveys were completed as part of the Project's Wildlife Field Program that focused on assessing carnivore and furbearer habitat use and distribution (Table 3-1). The methods and results of these surveys are summarized in the Wildlife Field Program Report (EDI 2017a).

Table 3-1. Summary of carnivore and furbearer surveys conducted for the Coffee Project (2014–2016).

Survey Type	Target Species	Dates Conducted
Grizzly Bear Den Surveys	Grizzly Bear, Black Bear	March 21, 2016 March 31, 2016 April 22, 2016 May 6, 2016
Snow Track Surveys - Coffee Property	All wildlife species	February 11-15, 2015
Snow Track Surveys - NAR	All wildlife Species	February 22-26, 2016
Paired Site Wildlife Road Use Study	Wolf and others	November 2015-Ongoing
Remote Camera studies	All wildlife Species	May 2015-Ongoing

3.1 GRIZZLY BEAR

Grizzly bear are a large omnivore found across western and northern Canada (COSEWIC 2012) and are recognized for their social, cultural, and economic value. Grizzly bears were assessed by COSEWIC in 2012 and are listed as a species of Special Concern (COSEWIC 2012). COSEWIC has identified the largest threats to Canadian grizzly bear population as 1) human caused mortality (including illegal and legal hunting, defense of life or property, and accidental killings) and 2) habitat loss and fragmentation (COSEWIC 2012). In Yukon, grizzly bears are listed as Sensitive (CESCC 2011).

3.1.1 POPULATION

Yukon's grizzly bear population is estimated to be between 6,000 and 7,000 individuals, making up about 25% of the total grizzly bear population in Canada (COSEWIC 2012). There is limited available information on grizzly bear abundance and distribution within the RSA but according to the Environment Yukon carnivore biologist, grizzly bear density in the area is considered to be low (R. Maraj, pers. comm., 2016). The working density estimate for the Klondike Plateau ecoregion is 11 bears/1,000 km^2 and the Yukon Plateau-Central is 15 bears/1,000 km^2. Based on observations and harvest records, it can be assumed that grizzly bears use the entire RSA but occur at relatively low densities. Additionally, based on local knowledge, there is some indication that grizzly bear densities might be slightly higher in the southern portions of the RSA than the northern sections — reports from local biologists and trapline concession holders suggest that while present, grizzly bears are uncommon along the northern portions of the proposed NAR (M. Suitor,

pers. comm. 2014-2016; Interview 15, pers. comm. 2016), but may be present in slightly higher numbers to the south (Interview 14, pers. comm. 2016).

3.1.2 DISTRIBUTION

Grizzly bears occur throughout Yukon, ranging from the B.C./Yukon border to the Arctic coast. Grizzly bears have large home ranges that are determined by food availability, cover, and possibly competition avoidance (Rigg 2005). The average home range size in Canada is 700 km² for females and 1,800 km² for males (COSEWIC 2012). The weighted average multi-annual home range size for females in Kluane was 305 km² (Maraj 2007) while in the Mackenzie Mountains, the average home range size for six females was estimated at 265 km² (Miller *et al.* 1982).

Grizzly bear observations have been recorded throughout the RSA on wildlife cameras, during baseline studies in the area, and by Project personnel. Grizzly bears were documented on 13 separate occasions on remote cameras, and incidentally by EDI biologists during baseline surveys on 5 occasions. Grizzly bears were also reported on the Camp Wildlife Log on 15 occasions between 2010 and 2016 (EDI 2017a). Grizzly bear observations were made throughout the RSA including observations in the Dominion Creek valley, Eureka Ridge, Maisy May Creek valley, Barker Creek valley, Ballarat Creek valley, and along the Java Road (see Figure 1-1 for Project area references). Observations were recorded seasonally between April 13 and October 24. Most observations were of individual bears; however, observations of females accompanied by a cub or yearling were made on multiple occasions. Given their large ranges and diverse habitat requirements grizzly bears have the potential to interact with all aspects of the proposed Project footprint including the NAR and mine site.

3.1.3 HABITAT USE AND DIET

Yukon grizzly bears use a variety of habitats, including boreal forest, alpine and subalpine, and arctic tundra (Government of Yukon 2015e). Grizzly bears are opportunistic omnivores and vary their diets based on seasonal food availability. The primary food source for grizzly bears is vegetation, but they will also prey on animals opportunistically. The other main food sources in the spring include overwintered berries, roots and winter-killed carcasses (Popadynec 2009; Government of Yukon 2015e). Within Yukon, grizzly bears are the primary predator of moose calves in the spring (Larsen *et al.* 1989). Throughout the summer and fall, grizzly bears feed largely on grasses and horsetail, and berries when they become available (Government of Yukon 2015e). Traditional Knowledge of bear habitat and diet indicates that low-lying river valleys and floodplains (such as the White River) provide good grizzly bear habitat due to the seasonal abundance of high-bush cranberries (Campbell 2012).

To assess the availability and quality of grizzly bear habitat in the RSA, four geographical information systems (GIS) based models were produced, which are described in the Coffee Gold Mine: Grizzly Bear Habitat Model Report (EDI 2016c). Each model aims to predict an aspect of grizzly bear habitat requirements. The models include:

- Habitat effectiveness
- Security zones
- Linkage zones
- Denning habitat suitability

The habitat effectiveness model evaluates habitat quality as a relationship of topographic features, vegetative features, and proximity to human infrastructure and activities to estimate grizzly bear habitat effectiveness. At baseline, the habitat effectiveness model indicated that overall habitat in the RSA is 93.1% effective during green-up (peak greenness in July) and 92.7% effective during green down (senescence in September).

The security zones model estimates if available habitat is secure, where grizzly bears can forage for 24–48 hours without interacting with humans. The security areas model identified that at baseline 93.9% of the RSA is 'secure' for grizzly bears (Figure 3-1).

The linkage zones model identifies areas of potential movement for bears between habitat patches based on landscape factors and proximity to human infrastructure and activities. The linkage zone model identified that 92.5% of the RSA was modelled to be in the minimal danger category (Figure 3-2).

A denning habitat suitability model was created to identify and quantify areas suitable for grizzly bear denning. The grizzly bear denning habitat model estimates that 0.5% and 9.2% of areas within the RSA have high and moderately-high suitable habitat for denning, respectively (Figure 3-3). More information on the models is provided in EDI 2016c. Grizzly bear denning surveys were also completed within a 2 km buffer of the proposed NAR alignment and within a 5 km buffer of the proposed mine site in spring 2016 (March 21–May 6). No grizzly bears or grizzly bear dens were located despite considerable survey effort by trained biologists (EDI 2017a). The first grizzly bears were noted on wildlife cameras in the Ballarat Creek drainage on April 14, 2016 (adult bear) and on April 26, 2016 in the Barker Creek drainage (sow and cub), indicating that den emergence occurred during the survey period. During other Project baseline surveys in the RSA, two potential grizzly bear dens were observed on a steep south-facing slope above the Yukon River.

3.1.4 HARVEST AND MORTALITY

Grizzly bears are managed as a big game species in Yukon, and harvest of grizzly bears is restricted in some GMS. The bag limit is one bear every three years in open subzones (Government of Yukon 2015f). It is compulsory for all hunters to report all bear kills (Government of Yukon 2015f). From 2006–2015, grizzly bears were harvested in game management subzones 307, 308, 313, 314, and 509 within the RSA (Government of Yukon 2016a). Grizzly bears were not harvested in the other GMSs found in the RSA (310, 311, 312, 315, 502, and 503). According to conservation officer services, most of the grizzly bear harvest in this region occurs along the Yukon and Stewart rivers rather than local roads (K. Meister, pers. comm. 2016). One other mortality was recorded in GMS 311. Table 3-1 summarizes harvest data for the subzones where harvesting occurred.

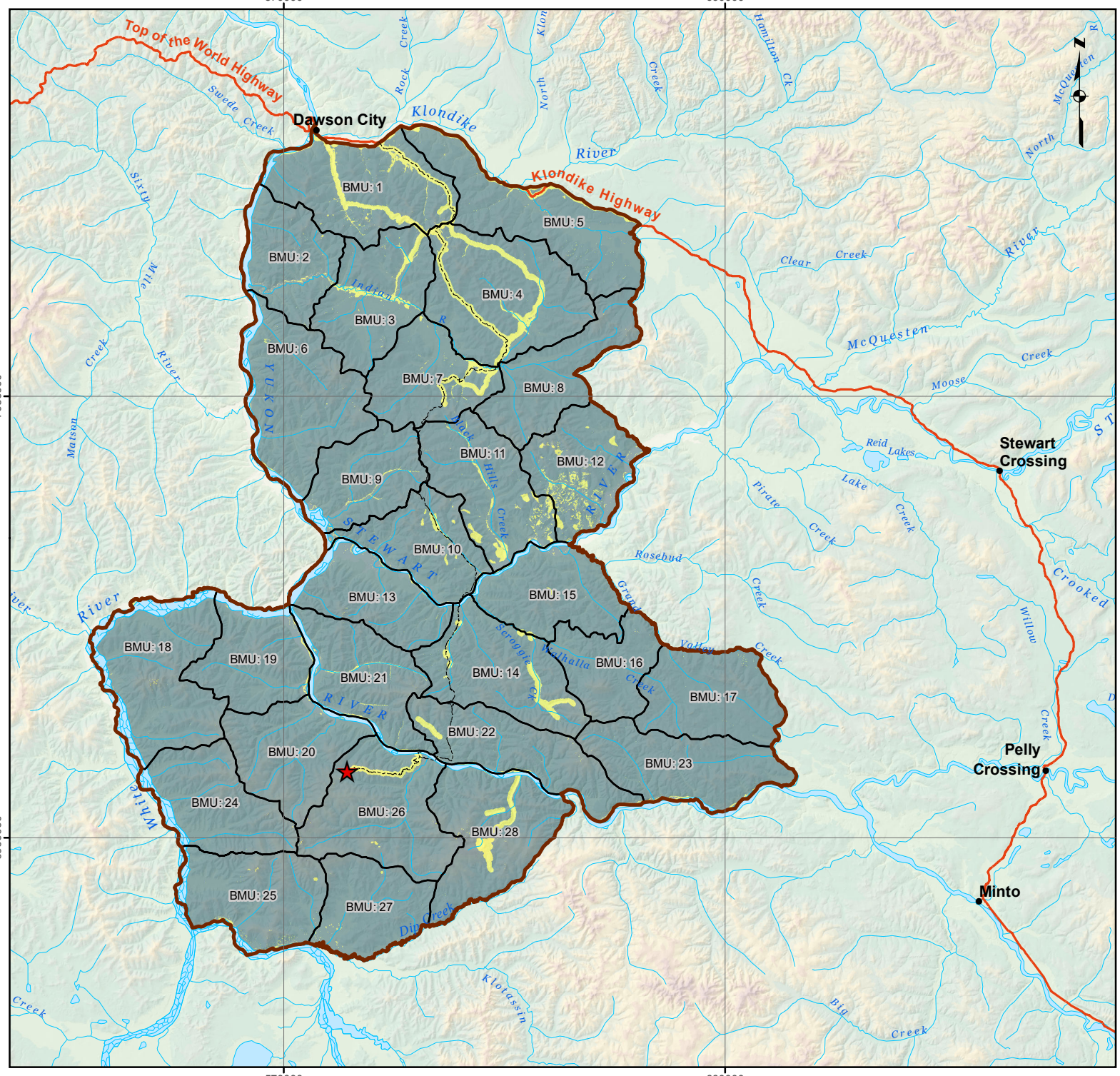
Table 3-1. Grizzly bear harvest statistics from 2006 to 2015 in the game management subzones that interact with the RSA (Government of Yukon 2016a).

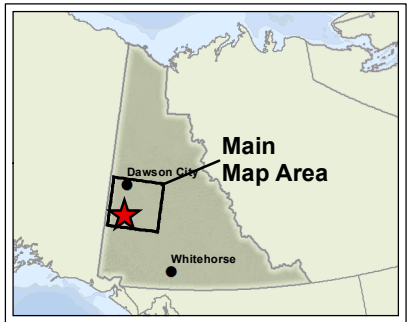
GMS	Harvest Regulations (2015-2016 season)	Total Harvest	Mean Annual Harvest
307	Open; Bag limit 1 every 3 years	1	0.1
308	Open; Bag limit 1 every 3 years	1	0.1
313	Open; Bag limit 1 every 3 years	1	0.1
314	Open; Bag limit 1 every 3 years	1	0.1
509	Open; Bag limit 1 every 3 years	2	0.2
Total		**6**	**0.6**

Other sources of mortality include conflict kills, collisions with vehicles, and predation from other bears or large carnivores, such as wolves. While conflict kills are required to be reported to Conservation Officer Services, it is suspected that not all incidents are accurately reported.

Collisions with vehicles that result in mortality do occur but these collisions in Yukon are rare. EDI (2015) reported that 15 grizzly bear mortalities resulted from collisions with vehicles between 2003 and 2014 on all Yukon Highways. The majority of these collisions occurred on the Alaska Highway (60%) where there is the majority of traffic volume travelling at high speeds. The most comparable road to the NAR is the Nahanni Range Road where only one grizzly bear was killed in the 12 year period. Although the Nahanni Range Road is comparable, traffic volumes and speed limits are higher and road conditions are better than the NAR will be.

Predation on grizzly bears, particularly predation on bear cubs by other bears does occur but predation rates for Yukon are unknown.





Legend

- Coffee Project
- Highway
- Proposed Route
- Regional Study Area
- Bear Management Unit

Grizzly Bear Security Areas

- Not Secure
- Secure

FIGURE: 3-1

Grizzly bear security areas

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Grizzly bear security areas created by EDI Environmental Dynamics Inc. (2016).

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KM

Map Reference Scale: 1:1,000,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn: MP	Checked: AM/LP	Date: 3/10/2017

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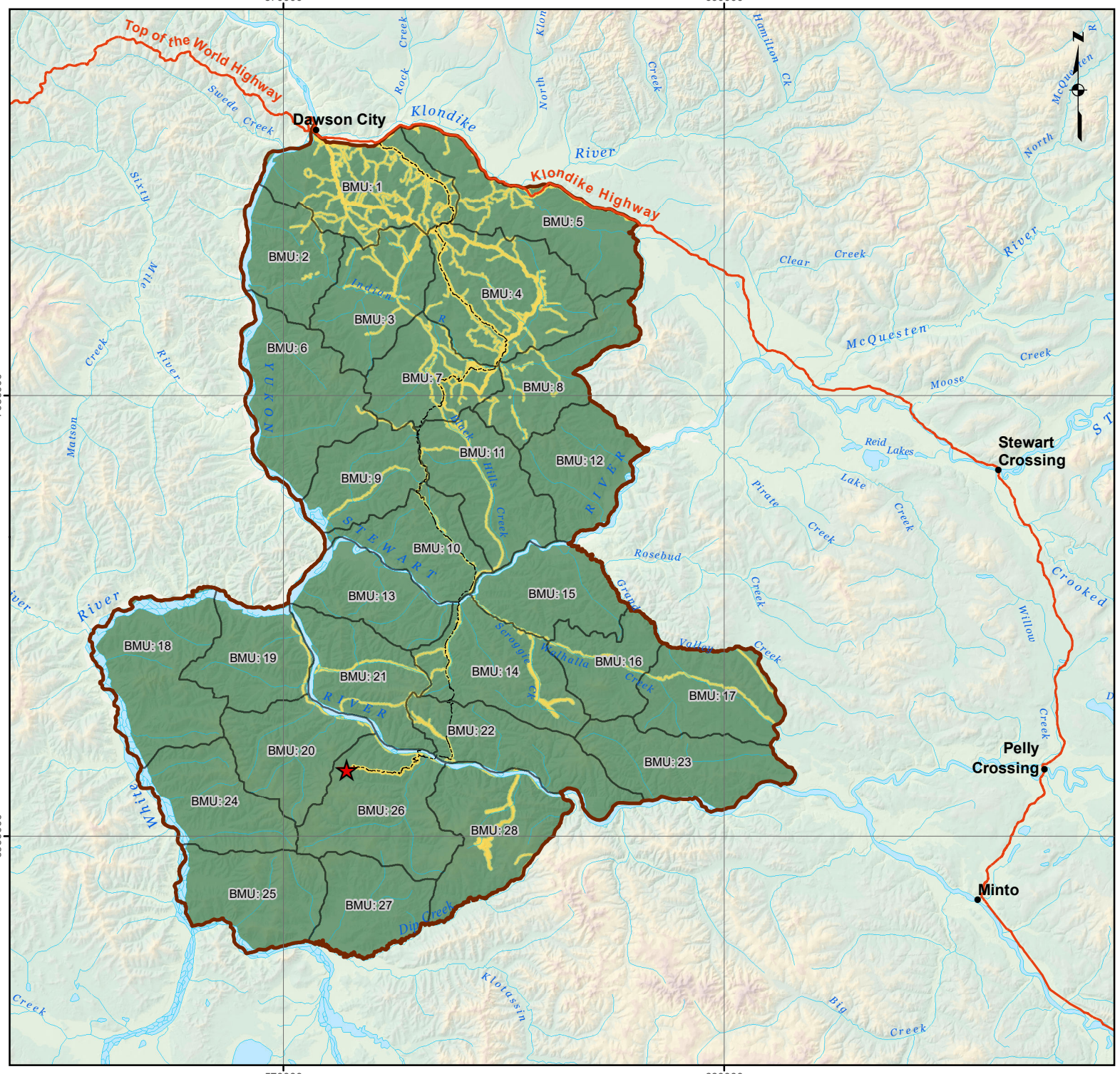

FIGURE: 3-2

Grizzly bear linkage zones

Data Sources
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Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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Map Reference Scale: 1:1,000,000 (Printed at 8.5 x 11)
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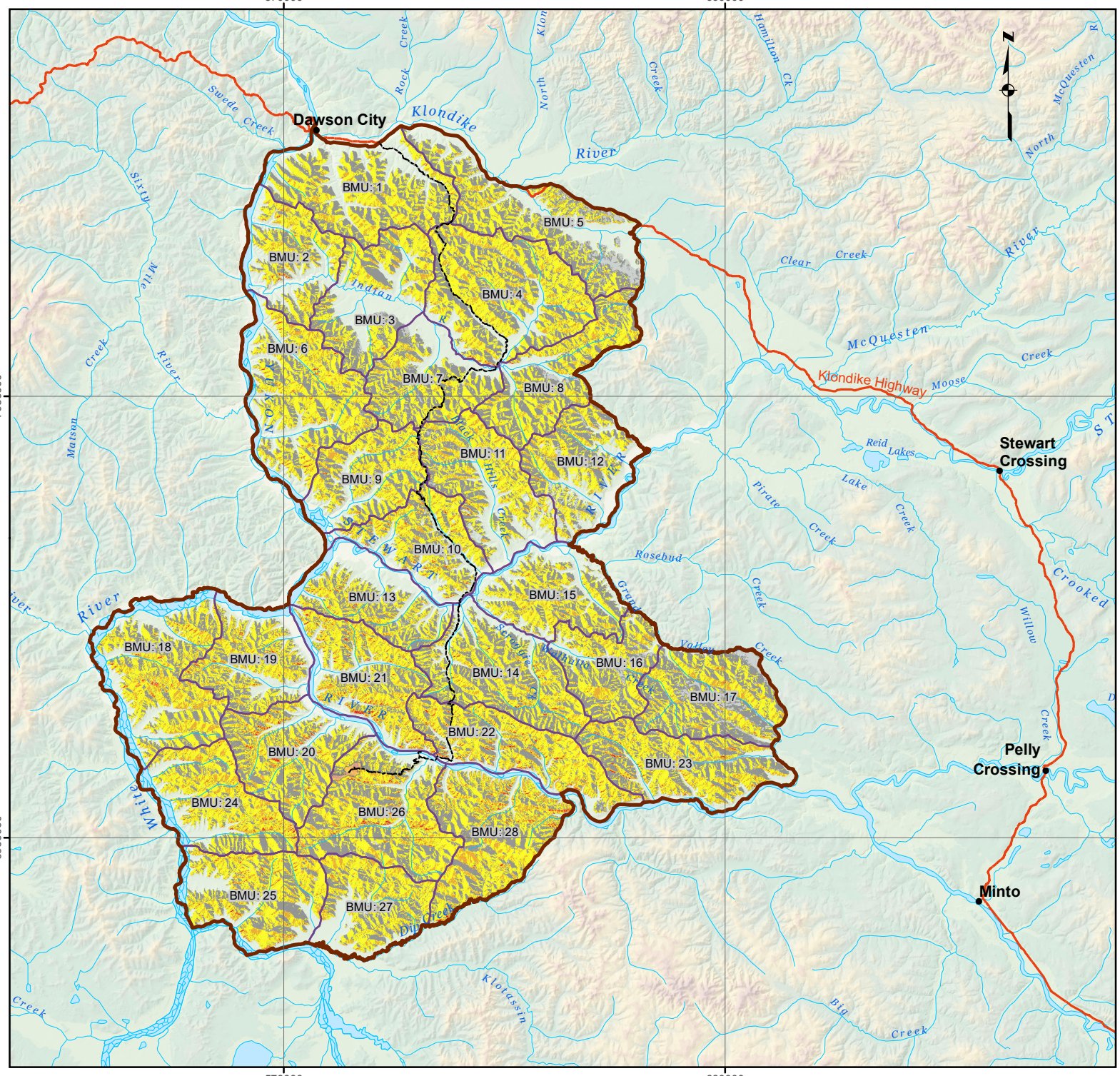

FIGURE: 3-3

Grizzly bear denning suitability

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Suitability model created by EDI Environmental Dynamics Inc. (2016).

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Map Reference Scale: 1:1,000,000 (Printed at 8.5 x 11)
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3.2 BLACK BEAR

There are an estimated 10,000 black bears in Yukon (Government of Yukon 2015g). They range from the British Columbia/Yukon border to northern Yukon near Old Crow, with the highest population densities in the southern portion of their range (Government of Yukon 2015g). Black bears are designated Not at Risk in Canada (COSEWIC 2002).

Black bears are omnivores, with a diet that varies widely depending on location and season (Government of Yukon 2015g). Plants and berries make up the majority of their diet, which is supplemented by insects and meat (MacHutchon 1989). Black bears use a wide variety of forested and non-forested habitats for foraging. Local knowledge (e.g. M. Suitor, pers. comm. 2014-2016; Interview 15, pers. comm. 2016) and incidental Project observations indicate that grassy, south-facing slopes within the RSA are heavily used by black bears, particularly in the spring. Other important foraging habitats include floodplains along rivers and creeks, and berry-rich habitats (Government of Yukon 2015g). Denning usually occurs in well-drained forested areas on level terrain under root clumps (Bertram and Vivion 2002b). Males are the first to emerge from their dens in early spring, while females and cubs remain in the den a month longer (Government of Yukon 2015g).

Detailed information on black bear distribution and abundance within the RSA is not available; however, local knowledge indicates that there are 'lots of black bears in the area' (Interview 15, pers. comm. 2016), which is consistent with Project observations. Black bears have commonly been observed in the RSA during the non-denning period (May to October; Government of Yukon 2015g). Although no specific surveys were conducted for black bears, they were recorded throughout baseline studies during wildlife surveys, as incidental observations, on the remote wildlife cameras, and in recorded harvest statistics. Black bears were the most commonly recorded species in the Camp Wildlife Log and were the most frequently observed species on remote cameras during the non-denning period — 196 black bears were recorded in the Camp Wildlife Log between 2010 and 2016, and 214 bears photographed on remote cameras, although in both cases some of these observations could have been of the same individual (EDI 2017a). Collectively baseline observations of black bear occurred from April 18–September 30 (with the exception of one observation in Feb 2015). Black bear sows with one or two cubs were observed in all years. During grizzly bear denning surveys in spring 2016, several black bears and suspected black bear den sites were located on south aspect slopes with fresh greenery (EDI 2017a). As a result of their diverse seasonal habitat needs, black bears have the potential to interact with the proposed Project across the entire extent of the Project footprint including the NAR, mine site, and camp infrastructure.

Black bears are managed as a big game species in Yukon and are harvested by First Nations and licensed hunters. The bag limit for licensed hunters is two black bears per year and harvest can occur from spring through fall in all Yukon game management subzones (Government of Yukon 2015f). It is compulsory for licensed hunters to report all black bear kills (Government of Yukon 2015f). Within the RSA, black bears have been harvested in game management subzones 307, 308, 310-314, 502, and 509 (Government of Yukon 2016a). Black bears were not harvested in GMS 315 and 503. Table 3-2 summarizes harvest data between 2006 and 2015 for these subzones.

Other sources of black bear mortality include conflict kills, collisions with vehicles, and predation from other bears or large carnivores. While conflict kills are required to be reported to Conservation Officer Services, it is suspected that not all incidents are accurately reported. Current levels of conflict kills within the RSA are believed to be relatively high, particularly in the northern sections of the RSA (K. Meister, pers. comm. 2016; R. Maraj, pers. comm. 2016).

Table 3-2. Black bear harvest statistics between 2006 and 2015 in the game management subzones that interact with the RSA (Government of Yukon 2016a).

GMS	Harvest Regulations (2015-2016 season)	Total Harvest	Mean Annual Harvest
307	Open; Bag limit 1	14	1.4
308	Open; Bag limit 1	5	0.5
310	Open; Bag limit 1	4	0.4
311	Open; Bag limit 1	4	0.4
312	Open; Bag limit 1	10	1.0
313	Open; Bag limit 1	6	0.6
314	Open; Bag limit 1	14	1.4
502	Open; Bag limit 1	1	0.1
509	Open; Bag limit 1	2	0.2
Total		**60**	**6.0**

3.3 WOLVERINE

Wolverine has a circumpolar distribution and is the largest mustelid in North America. The species is widely distributed across Canada and Alaska. Wolverines occur at low densities throughout their range because of their territorial behaviour and large home ranges. The conservation status of wolverines in Canada was assessed as Special Concern by COSEWIC in 2014. The assessment identifies the primary reasons for the designation as human caused effects on the southern portion of the species range, risks associated with climate changes, and a lack of available information (COSEWIC 2014).

3.3.1 POPULATION

Densities of wolverine are generally low compared to other terrestrial mammal species. The low density is thought to be linked to food availability. The estimated population of wolverine in Canada is unknown but assumed to be greater than 10,000 individuals (COSEWIC 2014). In Yukon, the wolverine population is estimated to be 3,500–4,000 animals (COSEWIC 2014). Wolverine densities in Yukon are some of the highest reported in North America, estimated at approximately ten wolverine per 1,000 km² (Banci and Harestad 1990, Golden *et al.* 2007).

3.3.2 DISTRIBUTION

Wolverines are widely distributed across North America and assumed to occupy all of Yukon. Wolverines are territorial and move extensively within their home ranges. Home ranges are generally discrete, though male and female home ranges overlap (Persson *et al.* 2010). Home ranges of wolverines have been documented exceeding 1,000 km² (Persson *et al.* 2010), but in Yukon are reported at 139–526 km² (Banci 1987). Wolverines are a polygynous species where male home ranges are larger and overlap multiple female home ranges to increase mating opportunities.

Wolverines were observed in the RSA on a number of occasions. The 2015 snow track survey of the Java Road did not detect wolverine on transects, but fresh tracks of one wolverine were incidentally recorded travelling the length of the airstrip during the survey (i.e. off transect). The 2016 snow track survey of the NAR and Java Road detected 14 occurrences of fresh wolverine tracks and eight old tracks (Table 3-3). Wolverine were generally detected at higher elevations along Sulphur Creek, Eureka Ridge, Maisy May, Barker Creek, Thistle Mountain, and Java Road (Figure 3-4). Wildlife cameras have been installed within the LSA since May 2015, with two observations of wolverine captured in the Sulphur Creek valley and one captured in the Eureka Ridge area. One wolverine was observed during the 2016 late winter ungulate survey (EDI 2017a).

Given the large size of wolverine home ranges there is potential for wolverines to interact with the Project at low densities across the entire extent of the Project footprint including the NAR, mine site, and camp infrastructure.

Table 3-3. Wolverine tracks (fresh and old) observed during the 2016 snow track surveys.

Road Segment[1]	Total Number of Track Observations	Number of Observed Old Tracks	Number of Observed New Tracks
Sulphur	2	1	1
Indian River	0	0	0
Eureka	2	1	1
Henderson Dome	0	0	0
Maisy May	4	2	2
Stewart River	0	0	0
Barker	4	0	4
Thistle	5	2	3
Thistle to NAR	1	1	0
Ballarat	0	0	0
Yukon River	0	0	0
Kona/Java	6	3	3
Total	26	8	14

[1] Road segments are shown on Figure 1-1

3.3.3 HABITAT USE AND DIET

Wolverine are generally not known to have specific habitat requirements and are assumed to occur where prey is available. Wolverine are thought to avoid areas where anthropogenic activity occurs. Although the wolverine collar data in Scrafford and Boyce's study (2015) shows that wolverine in Northwestern Alberta do use habitat in close proximity to industrial activity, human presence associated with this activity is relatively low.

Denning habitat is often thought to be a limiting habitat feature for wolverine since they require snow deep enough to dig dens into. Wolverines use two types of dens: natal and maternal (Magoun and Copeland 1998). Natal dens are used early February to mid-March for parturition (i.e., birthing) and immediately post-partum (Copeland *et al.* 2010). Female wolverines move kits to maternal dens when natal den conditions become unsuitable. Maternal dens can be several kilometres from natal dens and a female wolverine may use multiple maternal dens within a single year (Magoun and Copeland 1998). Snow cover through the wolverine denning period has been shown to predict wolverine den locations, and is described as a critical habitat component (Copeland *et al.* 2010).

A denning habitat model created for the RSA using remotely sensed snow cover estimates between 2006 and 2015 found that the area likely contains limited high quality denning habitats (Figure 3-5; EDI 2016d). The RSA contains few areas of regular late spring snow cover, assumed to be a proxy for deep snow and indicative of potential wolverine denning habitat. The number of years that an area was snow covered was binned into four classes that describe the relative quality of an area for wolverine denning. The habitat quality classes represent the top three, middle four, and bottom three years with late snow cover; in addition to a habitat class that represents potentially unsuitable habitat. The lowest habitat quality class, very low,

represents areas that were never snow covered through the entire 10 year study period and are likely unsuitable denning habitat. Low quality habitats are those that were irregularly snow covered; moderate quality habitat are areas that were commonly snow covered; and high quality habitat are areas that were regularly snow covered through the denning season.

Less than 1% of the RSA was classified as high quality denning habitat during the study period (Table 3-4). The denning habitat model suggests that there is little suitable denning habitat within the RSA; consequently, the wolverine population in the region may be limited by the availability of denning habitat. Areas where wolverines are most likely to den within the RSA are concentrated in higher elevation terrain such as the high elevation ridges south and west of the Yukon River (Figure 3-5).

Wolverines are carnivores that acquire food through predation and scavenging. Foraging strategy depends on the availability of prey and the presence of other predators. They are known to opportunistically prey on large and small animals, and consume carrion when available. Wolverines have been described as facultative scavengers (Van Dijk *et al.* 2008) and facultative predators (Andrén *et al.* 2011), as they scavenge when prey is unavailable and hunt for prey when carrion is unavailable. As predators they consume a broad number of species (e.g., mammals of various sizes and birds), but as a scavenger they consume the species targeted by the dominant predator in the region (Van Dijk *et al.* 2008). Prey species includes moose, beaver, snowshoe hare, other ungulates, black bear, marten, red squirrel, and grouse (Scrafford and Boyce 2015). The primary prey species in Yukon seems to be snowshoe hares (Jung and Kukka 2013, Van Dijk *et al.* 2008).

Wolverines in the RSA are unlikely to be limited by food availability given the abundance of ungulates and prey species in this region, particularly since they will have increasing access to food with the Fortymile caribou herd now reoccupying the area. Migratory caribou herds can be an important source of food for wolverine (Dalerum *et al.* 2009) and reductions in caribou numbers in Canada may be one of the causes for the reduced wolverine numbers (COSEWIC 2014). The seasonal presence of the Fortymile caribou herd in the RSA would provide abundant food for wolverine during the winter, potentially increasing the wolverine density in the region. During summers when Fortymile caribou migrate back to Alaska, wolverine may shift their diet to other species that are common in the region (Dalerum *et al.* 2009) such as moose or snowshoe hare.

Table 3-4. Availability of wolverine denning habitat classes within the RSA.

Habitat class	Years with late snow	Area (km²)	%
High	8 to 10	27	0.2
Moderate	4 to 7	1,451	9.1
Low	1 to 3	11,468	72.1
Very Low	0	2,959	18.6

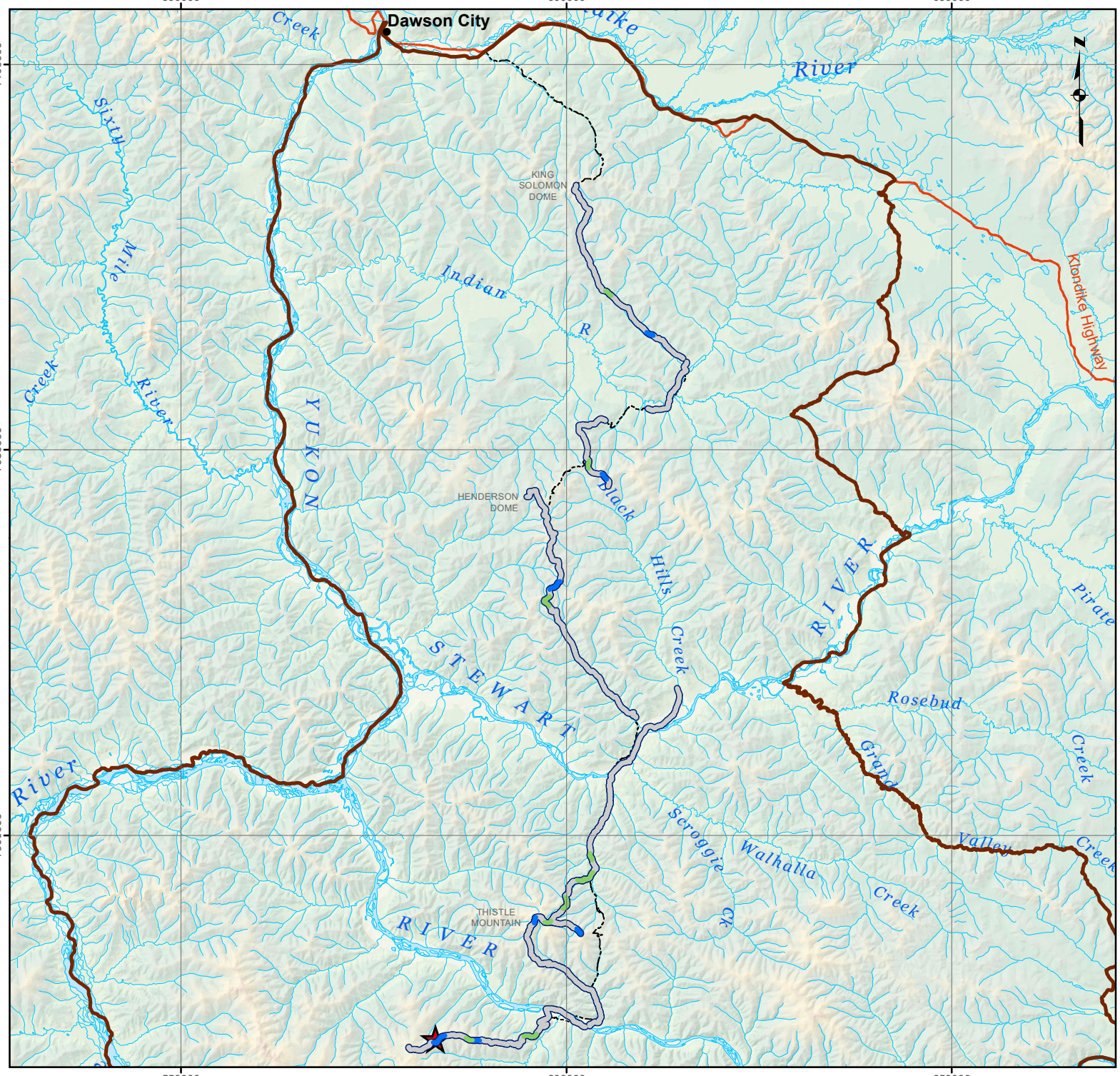
3.3.4 HARVEST AND MORTALITY

Wolverines are exposed to natural mortality risks from predation and starvation. The predators of wolverines are large carnivores, such as wolves, grizzly bear, cougars, and other wolverine, as well as golden eagles (Cardinal 2004). The extent of predation on wolverines is unknown.

Wolverines are a commonly trapped furbearer in Yukon and a valuable species for First Nations and non-First Nations trappers. One study found that human-caused mortality (trapping and road-kill) accounted for 46% of deaths in a review of 12 studies using radio-collared animals (Krebs *et al.* 2004). Yukon's trapping rules restrict the timing of harvest in order to target male wolverine and a study of harvested carcasses indicated that the rules are generally working to minimize female mortality (Jung and Kukka 2013). The number of wolverine trapped in Yukon varies among years. Average annual wolverine harvest in Yukon between 1990 and 2010 was approximately 120 wolverines (Jung and Kukka 2013). Within trapping concessions that intersect the RSA, between 2004 and 2013 the average wolverine harvest was 10 wolverine per year (Table 3-6). Trapping by licensed fur harvesters has been reported as the primary cause of adult wolverine mortality in Montana (Squires *et al.* 2007). The effect of trapping on Yukon's wolverine population is unknown.

Wolverines are also recognized as a big game species in Yukon's hunting regulations. Wolverines are harvestable by Yukon residents with a valid hunting license. Resident hunters are permitted to harvest one wolverine per year and are charged a nominal sealing fee when the pelt is submitted for inspection. Guided non-residents are permitted to harvest one wolverine per year and are charged the sealing fee in addition to the $75 non-resident harvest fee. No wolverine kills were reported in the RSA by hunters between 2006 and 2015 (Government of Yukon 2016a).

Other sources of wolverine mortality may include collisions with vehicles and predation by other carnivores. A recent study on large mammal-vehicle collisions on major roads and highways in Yukon did not report any wolverine kills as a result of a motor vehicle collision between 2003 and 2014 (EDI 2015). Natural predation rates on wolverine in Yukon are unknown.





Legend

- Coffee Project
- Highway
- Proposed Route
- Regional Study Area

Wolverine Tracks Observed

- No Tracks
- Few
- Some
- Many
- Very Many
- Old Tracks

FIGURE 3-4

2016 Late winter snow tracking survey: wolverine

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Data collected by EDI (2016) was obtained using Garmin GPS technology.

Disclaimer
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Map Reference Scale: 1:700,000 (Printed at 8.5 x 11)
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Drawn: LG	Checked: AM/LP	Date: 3/10/2017

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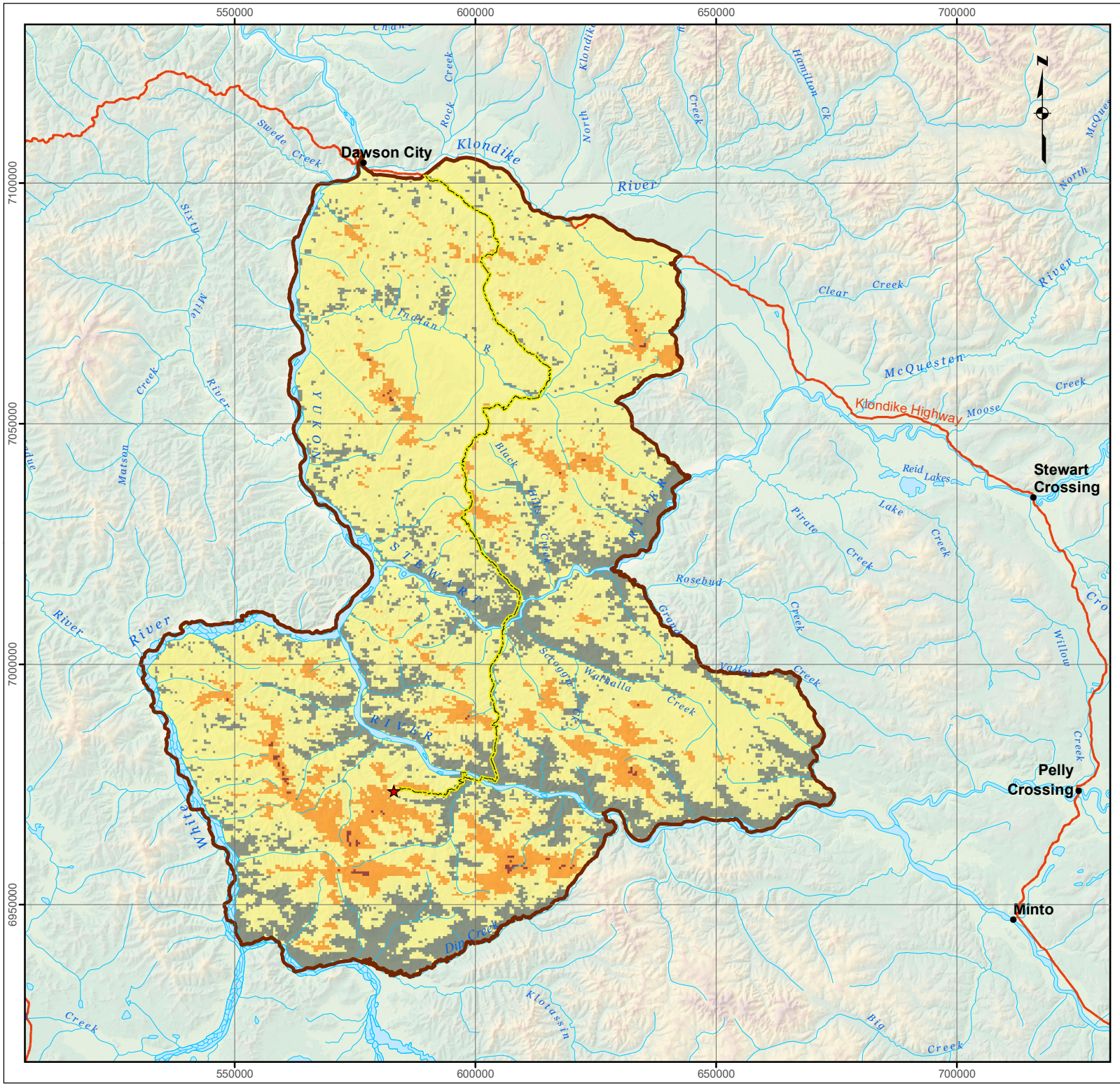

Legend

- Coffee Project
- Highway
- Proposed Route
- Regional Study Area

Wolverine Denning Habitat Suitability

- Very Low (0)
- Low (1-3)
- Moderate (4-7)
- High (8-10)

FIGURE: 3-5

Wolverine denning habitat suitability

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Denning habitat suitability created by EDI Environmental Dynamics Inc. (2016).

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Map Reference Scale: 1:1,000,000 (Printed at 8.5 x 11)
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3.4 GREY WOLF

Grey wolves are widely distributed around the globe although range contraction has occurred in many regions due to habitat loss and fragmentation (Mech and Boitani 2010). Wolves are abundant in Yukon and are not a conservation concern federally or territorially (Government of Yukon 2012). The wolf population in Yukon is believed to fluctuate but is considered relatively stable with a total population of approximately 4,500 to 5,000 (Government of Yukon 2012).

Wolf populations have been shown to be correlated to the abundance of their ungulate prey species, primarily moose and caribou (Messier 1994). Total wolf population and wolf densities are an important factor in determining population dynamics of ungulates (Messier 1994). Wolves hunt in packs of varying sizes, with differing rates of hunting success depending on pack size (Hayes *et al.* 2000).

Wolves are widely distributed across the landscape, moving over large ranges and inhabiting any areas where prey species are available. In the spring, females give birth to pups which are raised in a den. Litter size is typically five or six pups (Mech and Boitani 2010). Wolf dens may be multi-generational, being used and developed over many years. Dens are sensitive to human disturbance and may be abandoned if human activity occurs nearby (Frame *et al.* 2007). No wolf dens have been identified in the RSA to date.

The wolf population in the RSA is unknown; however, local knowledge indicates that wolf populations within the region are healthy and relatively abundant, with 'lots of wolves in the area' (Interview 14 & 15, pers. comm. 2016). During Project baseline surveys, wolves were observed throughout the RSA incidentally during aerial ungulate surveys (Table 3-5), during the snow track surveys conducted in 2015 and 2016 (Figure 3-6), by remote trail cameras, and by Project personnel (EDI 2017a).

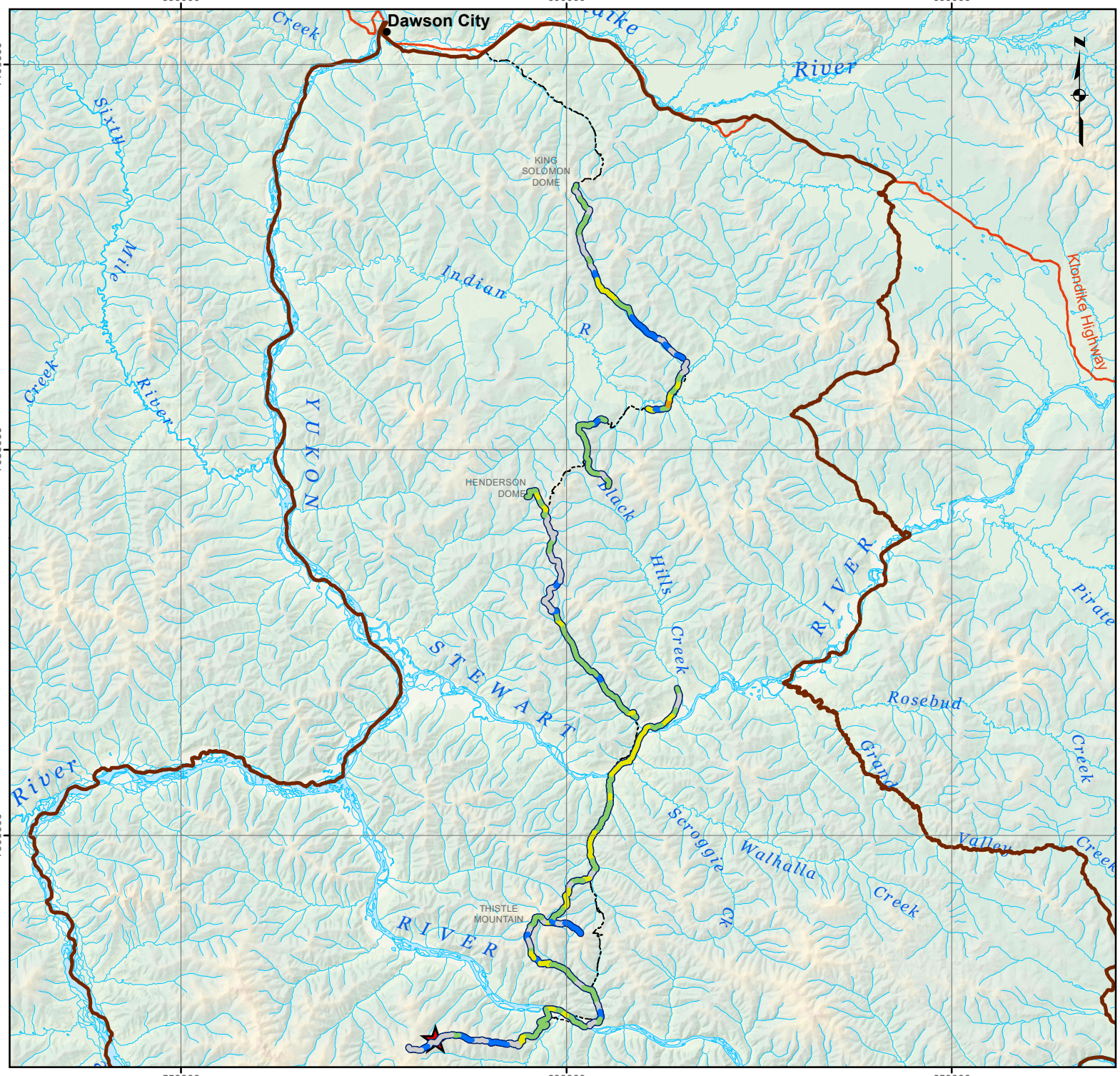
Table 3-5. Incidental observations of grey wolves during regional ungulate surveys in the RSA.

Survey	Location	Survey Area	Wolf Observations	Source
2012 Late Winter Moose Survey: Lower Stewart River — White Gold Area	Southern sections of Coffee RSA & surrounding areas	11,490 km^2	Four groups of wolves totalling 14 individuals	O'Donoghue *et al.* 2013b
2012 Early Winter Moose Survey: Lower Stewart River West — White Gold Area	Southern sections of Coffee RSA	6,751 km^2	One pack of 8 wolves and 3 individual wolves	O'Donoghue *et al.* 2013a
2014 Coffee Project Late Winter Survey	Southern sections of RSA	3,500 km^2	Two wolves	EDI 2017a
2015 Coffee Project Late Winter Survey	Southern sections of RSA & NAR corridor	7,300 km^2	Wolf tracks were noted in several locations but no wolves observed	EDI 2017a
2015 Early Winter Moose Survey: Dawson Goldfields	Northern sections of RSA	N/A	Three wolf packs with 12-13 wolves in each pack and 2 individual wolves	M. Suitor, pers. comm., 2016 (report pending)
2016 Coffee Project Late Winter Survey	Southern sections of RSA & NAR corridor	6,350 km^2	One pack of 4 wolves	EDI 2017a

Wolf tracks were observed during snow track surveys conducted in both February 2015 along the Java Road and February 2016 along the NAR. During the Java Road snow track surveys, wolf tracks were observed on six of the 31 transects, five of which were located in the boreal high and one in the subalpine bioclimate zone. Most of these observations were located on transects along Coffee Creek, the Yukon River, and the lower elevations of the Java Road (EDI 2017a). During the 2016 snow tracking surveys along the NAR, wolf tracks were observed in 132 of the 204 1-km segments and were more commonly observed in the lower elevation areas (average elevation of observations was 674 m), but were observed throughout the entire elevational range of the survey route (Figure 3-6). Wolf tracks were observed more in the following areas (from north to south): Sulphur Creek, Eureka Creek, Henderson Dome, along the Stewart River, Barker Creek, and near and along the Yukon River (refer to Figure 1-1 for road segments).

During Project consultation, concerns were raised regarding the potential for Project activities to result in increased wolf use along the NAR during the winter, thereby potentially leading to increased predation rates. In response to these concerns, a paired site remote camera study was initiated in November 2015 to document current use of roads in the RSA. During the winter of 2015/2016, wolves were captured on at least one of two paired cameras at each of the six locations. Wolves passed cameras on the NAR 76 times with pack size ranging from one to ten animals. A total of 199 wolves were counted passing paired cameras along the NAR; however, the same individuals may have been captured on multiple occasions. The majority of wolf observations along the proposed NAR were along the Indian River, Stewart River/lower Barker Creek, and Ballarat Creek valleys. With the exception of Ballarat Creek (Site A), it appears that wolves currently use the existing roads along the NAR alignment more than they use the off-route roads (EDI 2017a).

Wolves are managed as a big game species and as a furbearer, being both hunted and trapped across Yukon. Wolf pelts are an important source of revenue for First Nation and non-First Nation trappers within the RSA (InterGroup 2009). On average 155 wolves are trapped and 60 are harvested by hunters in Yukon every year (Government of Yukon 2012). In the GMSs and RTCs that overlap with the RSA, a mean annual harvest of 16 wolves per year was reported between 2004 and 2013 (Table 3-6; Government of Yukon 2016a). Due to their ability for rapid, widespread dispersal and rapid breeding, wolf populations are resilient to population decline from harvest mortality. There is currently no threat of unsustainable harvest or loss of genetic diversity in Yukon wolf populations (Government of Yukon 2012).





Legend

- Coffee Project
- Highway
- Proposed Route
- Regional Study Area

Wolf Tracks Observed

- No Tracks
- Few
- Some
- Many
- Old Tracks

FIGURE 3-6

2016 Late winter snow tracking survey: wolf

Data Sources
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Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific. Data collected by EDI (2016) was obtained using Garmin GPS technology.

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Map Reference Scale: 1:700,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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3.5 OTHER FURBEARERS

In addition to wolverine and wolf, several other high-value furbearing species are present in the RSA including Canada lynx, American marten, red fox, coyote, red squirrel, American mink, common muskrat, northern river otter, ermine, least weasel, and American beaver. Project baseline surveys documented many of these species throughout the RSA during snow track surveys and incidentally on various other surveys. American marten, Canada lynx, and red squirrel were the most common furbearers documented during snow track surveys. Coyote was documented in the RSA during baseline studies, but based on Project observations and local knowledge (Interview 15, pers. comm. 2016) appears to present in only small numbers. Likewise, while Arctic fox is reported as being harvested in the RSA, this is believed to be an extralimital occurrence; baseline studies did not detect this species and the RSA is well outside the documented range for Arctic fox in Yukon (Government of Yukon 2016b).

Management of furbearers and trapping is the responsibility of Environment Yukon. Trapping harvest statistics are recorded for each registered trapline concession (RTC). Harvest statistics for individual RTCs are considered private and therefore trapline data provided by Environment Yukon represents a coarse view of furbearer harvest in the RSA. Twenty RTCs intersect with the RSA and harvest statistics are reported from two blocks (Figure 3-7):

- North Block — North of the Stewart River (RTCs 23, 27, 30, 53, 54, 57, 58, 60, and 62)
- South Block — South of the Stewart River (RTCs 61, 64, 114, 115, 116, 121, 122, 132, and 133)

According to Yukon Conservation Services, the RSA, particularly the northern sections of the RSA overlapping game management zone 3, is a very active trapping area (K. Meister, pers. comm. 2016). Based on current trapping records (Table 3-6) and discussions with local trapping concession holders (e.g. Interview 14 & 15, pers. comm. 2016), Canada lynx and American marten are key harvest species in the region; however, various other species are also important to local trappers. Table 3-6 lists the mean annual, minimum annual, maximum annual and total harvest for each furbearing species harvested within the North and South Blocks from 2004 to 2013.

Table 3-6. Furbearer harvest statistics from registered trapline concessions that interact with the RSA north and south of the Stewart River.

Animal	Mean annual harvest (2004-2013)		Minimum annual harvest (2004–2013)		Maximum annual harvest (2004–2013)		Total Harvest (2004–2013)	
	North	South	North	South	North	South	North	South
Beaver	19.3	9.8	0	0	45	55	193	98
Coyote	0.5	2.3	0	0	2	7	5	23
Arctic fox	0.4	0	0	0	3	0	4	0
Red fox	9.3	2.8	0	0	23	5	93	28
Lynx	78.1	22.5	18	5	157	64	781	225
American marten	182.4	75.6	77	4	440	170	1,824	756
Mink	3.5	1.5	0	0	14	4	35	15
Otter	0.3	0.2	0	0	2	2	3	2
Red squirrel	14.1	10.6	0	0	52	86	141	106
Weasel	12.7	1.2	3	0	40	5	127	12
Wolf	10.1	5.7	1	3	24	8	101	57
Wolverine	6.3	3.9	2	0	12	8	63	39

According to Traditional Knowledge, many of the species currently harvested in the RSA have a long history of harvest in the region (e.g., Pearse and Weinstein 1988; Mishler and Simeone 2004; InterGroup Consultants Ltd 2009; Tr'ondëk Hwëch'in 2012a, 2012b; Bates and DeRoy 2014; Dobrowolsky 2014), and local First Nations specifically report having harvested beaver, muskrat, mink, marten, snowshoe hare, gopher, fox, lynx, and wolverine in the Coffee Creek area (Tr'ondëk Hwëch'in 2012a; Bates and DeRoy 2014; Dobrowolsky 2014). The trapping of furbearers for their furs and meat was, and continues to be, an important way of life for local First Nations (Pearse and Weinstein 1988; InterGroup Consultants Ltd. 2009; Calliou Group 2012; Tr'ondëk Hwëch'in 2012b; Bates and DeRoy 2014).

Due to the relative abundance of American marten and Canada lynx within the RSA, and their importance to First Nations and the fur harvest industry, these species are described further in the following sections.

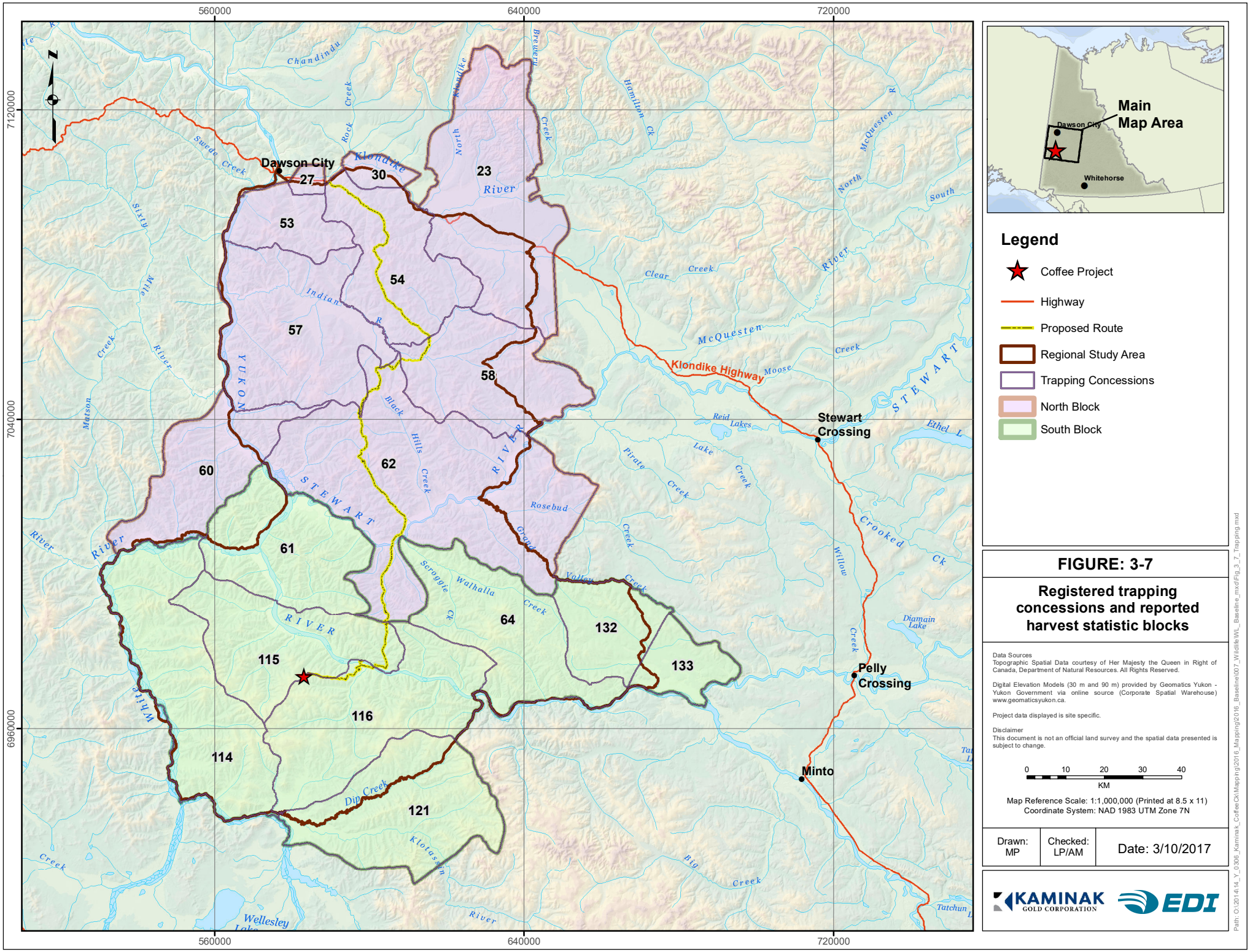

FIGURE: 3-7

Registered trapping concessions and reported harvest statistic blocks

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Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific.

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Map Reference Scale: 1:1,000,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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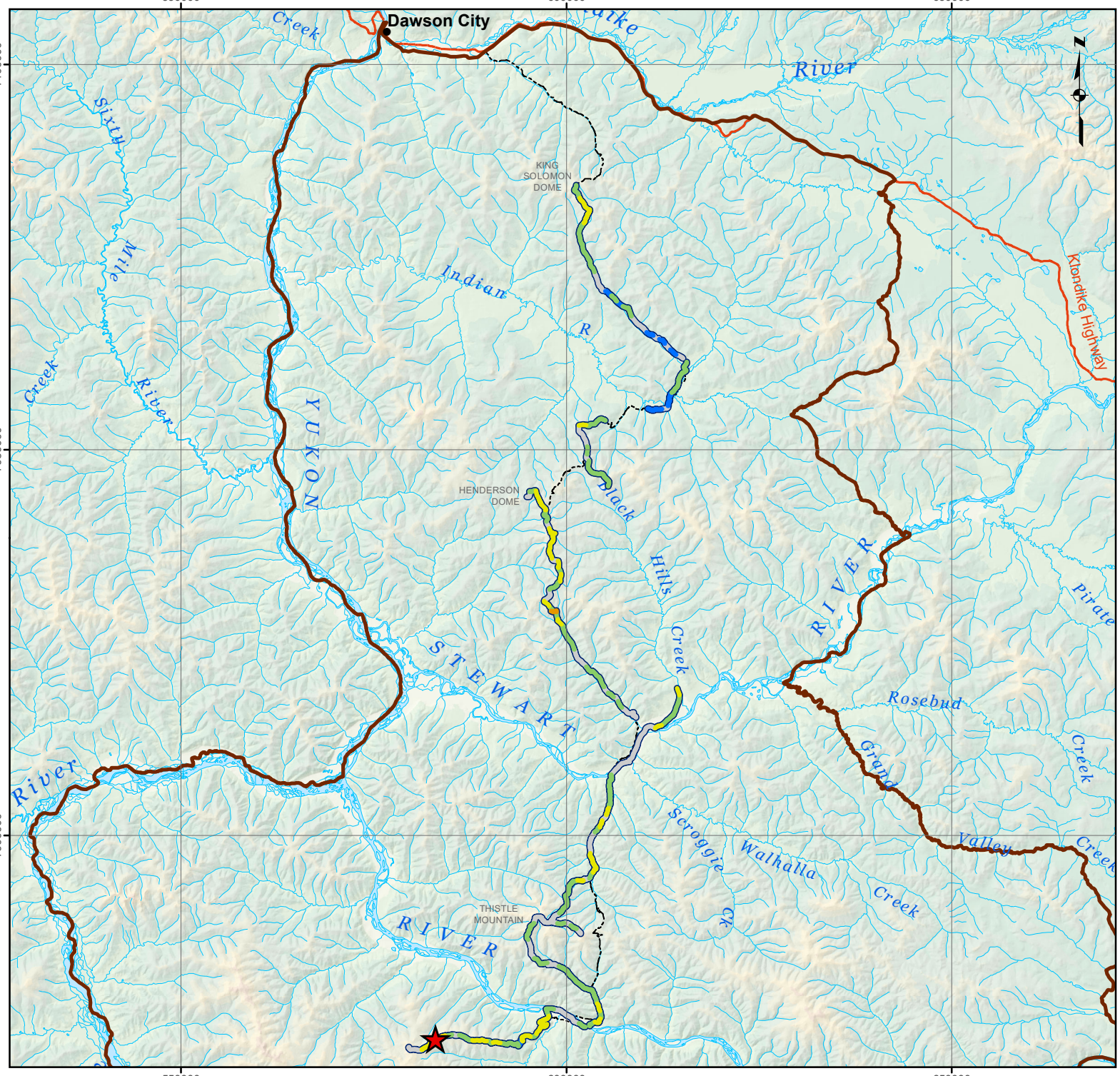
3.5.1 AMERICAN MARTEN

American marten are widely distributed across Canada and some of the northern United States (Reid and Helgen 2008). Marten occur in forested areas throughout Yukon. While no population estimates exist and trend data is primarily based on trapping harvest reports, marten are considered Secure in Yukon (CESCC 2011) and have not been assessed by COSEWIC with the exception of the Newfoundland sub-species (*Martes americana atrata*) which was assessed as Threatened (COSEWIC 2007).

Marten primarily inhabit mature coniferous forests with closed canopies and abundant standing and downed woody debris (Buskirk and Powell 1994). In Yukon, they have also been known to use early successional forest and disturbed forest areas although older coniferous forests are certainly their preferred habitat (Slough 1989). Dens are located in enclosed features such as downed trees, tree cavities, burrows, rock piles, or brush piles (Hatler *et al.* 2008). Marten primarily feed on small mammals such as voles and mice but have also been observed forging opportunistically on berries, birds, and snowshoe hare (Slough *et al.* 1989).

Marten are a commonly trapped species in Yukon. Marten were the most frequently harvested furbearer in the RSA between 2004 and 2013 with an annual average of 182 and 75 being harvested from North and South Blocks, respectively (Table 3-6). In the RSA, annual marten harvest ranged from ~80 (2009) to over 600 (2006) animals. Local trapline concession holders report that marten are abundant in the region and populations are generally healthy (Interview 14 & 15, pers. comm. 2016) although density and distribution can fluctuate, particularly in response to forest fires (Interview 15, pers. comm. 2016). Marten are widespread, but are particularly abundant in forested habitats and in the 'high country' (Interview 14 & 15, pers. comm. 2016). One of the interviewees reported that in the northern sections of the RSA, marten populations did not seem to be affected by the placer mines and associated roads (Interview 15, pers. comm. 2016).

Marten have been observed incidentally on multiple occasions within the LSA by Project personnel and on the wildlife cameras (EDI 2017a). Marten were also one of the most commonly documented species during snow track surveys where they were found in a wide range of habitat types including boreal forest, subalpine shrub, and burns throughout the survey area (Figure 3-8). The spatial distribution and frequency of marten observations throughout the LSA indicate that marten are likely to interact with the Project, wherever suitable habitat exists.





Legend

- Coffee Project
- Highway
- Proposed Route
- Regional Study Area

American Marten Tracks Observed

- No Tracks
- Few
- Some
- Many
- Very Many
- Old Tracks

FIGURE 3-8

2016 Late winter snow tracking survey: American marten

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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Map Reference Scale: 1:700,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

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LG	AM/LP	3/10/2017

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3.5.2 LYNX

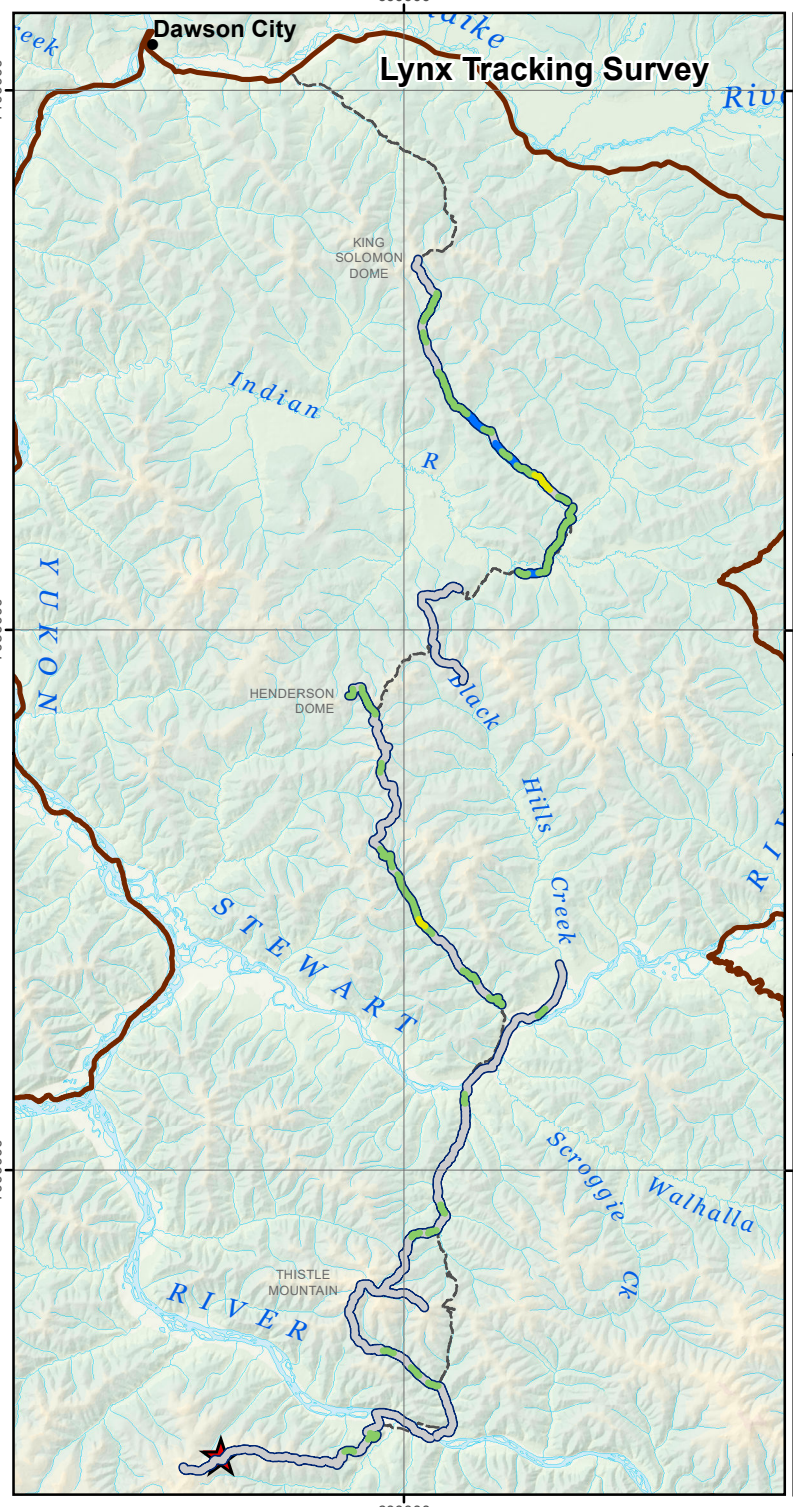
Canada lynx are distributed across the forested regions of Canada and parts of the northern United States. Their Yukon range includes the entire territory with the exception of the Arctic coastal plain which is not forested. Lynx populations fluctuate broadly every 9 to 11 years, depending on the cyclical abundance of snowshoe hare, their primary prey species (Stenseth *et al.* 1997). There are no estimates of Yukon lynx population size available.

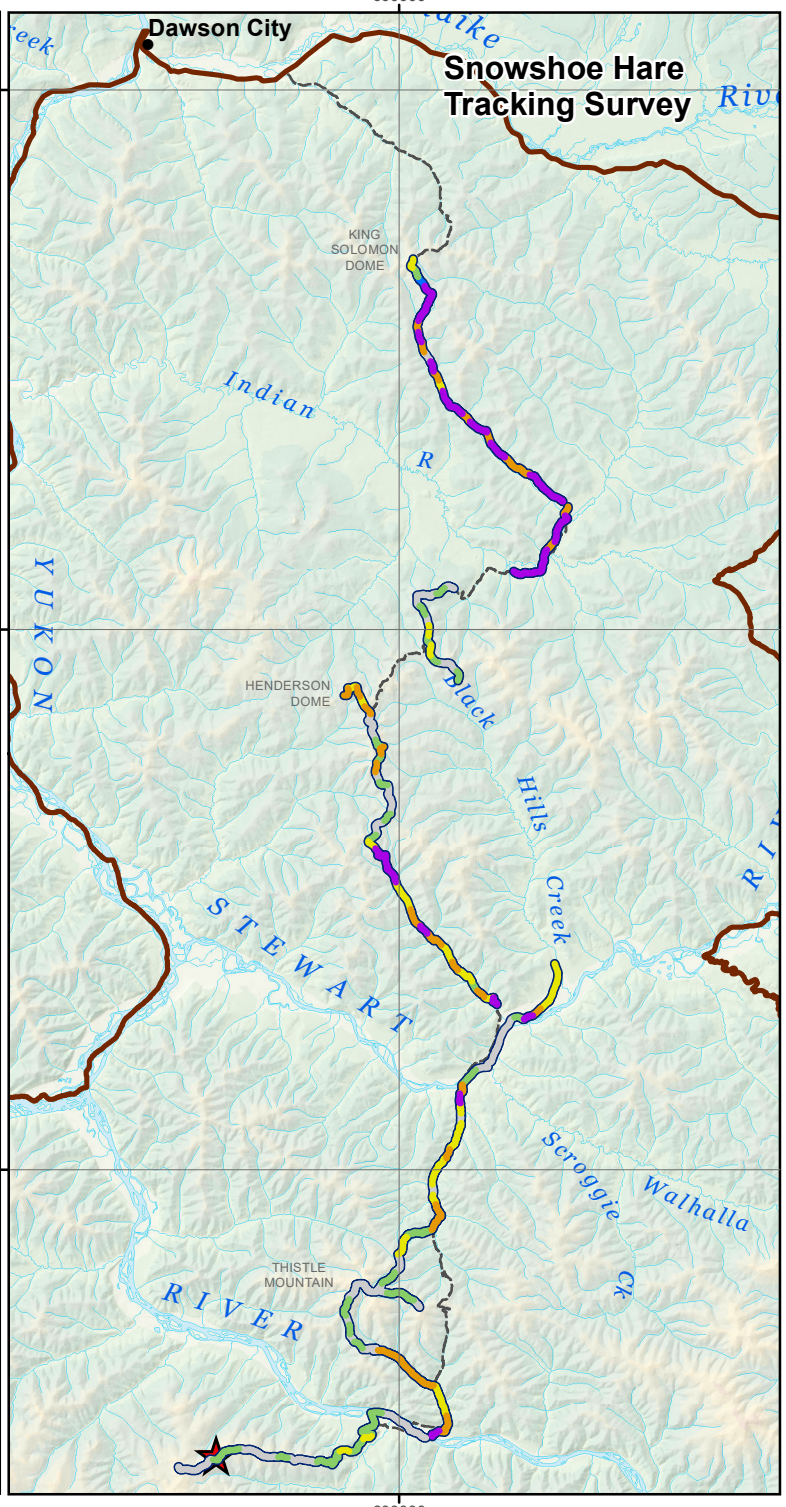
Lynx have high potential for population growth as demonstrated by their rapid increase in numbers during periods of high prey abundance. They also have been found to migrate vast distances during times of low prey abundance, increasing their resilience to local disturbances. No evidence has been found to suggest recent overall declines in lynx numbers or distribution. Lynx were assessed as Not at Risk by COSEWIC (Poole 2001) and are considered Stable territorially (CESCC 2011).

Lynx dens are often located in areas with thick vegetation growth or blowdown debris which offer some form of overhead protection (Slough 1999). Dens are not re-used year to year but they remain an important habitat feature for lynx recruitment. No lynx dens have been identified in the RSA to date, although targeted surveys for lynx dens were not conducted. Remote cameras did capture family groups of lynx on multiple occasions and lynx are assumed to den in the RSA.

Lynx are the second most frequently trapped animal in the RSA with an average of 78 and 22 lynx harvested annually in the North and South Blocks, respectively (based on 2004–2013 harvest data; Table 3-6). Trapping harvest of lynx typically follows lynx population cycles. Within the RSA lynx harvest increased between 2004 and 2007. A maximum of 157 and 64 lynx were harvested annually in the North and South Blocks, respectively. From 2008 to 2013 lynx harvest numbers generally decreased with the lowest reported harvest of lynx occurring in 2013, the last year of available trapping data.

Lynx have been observed incidentally within the LSA on many occasions by Project personnel, by remote cameras deployed for wildlife field programs and during the 2016 late winter ungulate survey (EDI 2017a). In particular, remote cameras photographed 270 lynx during 2015 and 2016 (although some of these observations were likely of the same individual). Lynx tracks were observed many times during 2015 and 2016 snow tracking surveys (Figure 3-9). Lynx presence generally occurred in lower elevation, unburned boreal forest areas. Lynx presence also correlated with the presence of snowshoe hare, their main prey (Figure 3-9). During snow tracking surveys, lynx were only observed in areas where snowshoe hare tracks were also observed. The proposed Project is most likely to interact with lynx and lynx habitat in the lower elevation boreal forest regions along the NAR.







Legend

- Settlement/Community
- Coffee Project
- Highway
- Proposed Route
- Regional Study Area

Lynx & Snowshoe Hare Tracks Observed

- No Tracks
- Few
- Some
- Many
- Very Many
- Old Tracks

FIGURE 3-9

2016 Late winter snow tracking survey: lynx and snowshoe hare

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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4 SMALL MAMMALS

Several species of small mammals were studied during the Coffee Project wildlife baseline program in 2014 and 2015 (EDI 2017a). Table 4-1 provides a summary of small mammal studies conducted for the Project.

Table 4-1. Summary of small mammal studies and surveys.

Date	Target Species	Objectives	Methods
August 1–11, 2014	Bats	Document species composition	Remote acoustic monitoring at Coffee camp and Latte deposit
August 25–27, 2014	Collared Pika	Document distribution	Point Count surveys on talus patches within 5 km of proposed Project infrastructure
August 3, 2015 August 28–30, 2015	Collared Pika	Document distribution	Point Count surveys on talus patches within 5 km of proposed Project infrastructure
August 26–31, 2015	Mice, Voles	Document species composition, collect samples for trace metal analysis	Snap trapping along 3 traplines set up in different habitat types

4.1 COLLARED PIKA

Collared pika are a species of small lagomorph (rabbit family) found in alpine regions throughout the Beringian areas of Yukon, British Columbia, Northwest Territories and Alaska. Collared pika were assessed as a species of Special Concern by COSEWIC in 2011 primarily due to their predicted sensitivity to climate change and poor dispersal abilities.

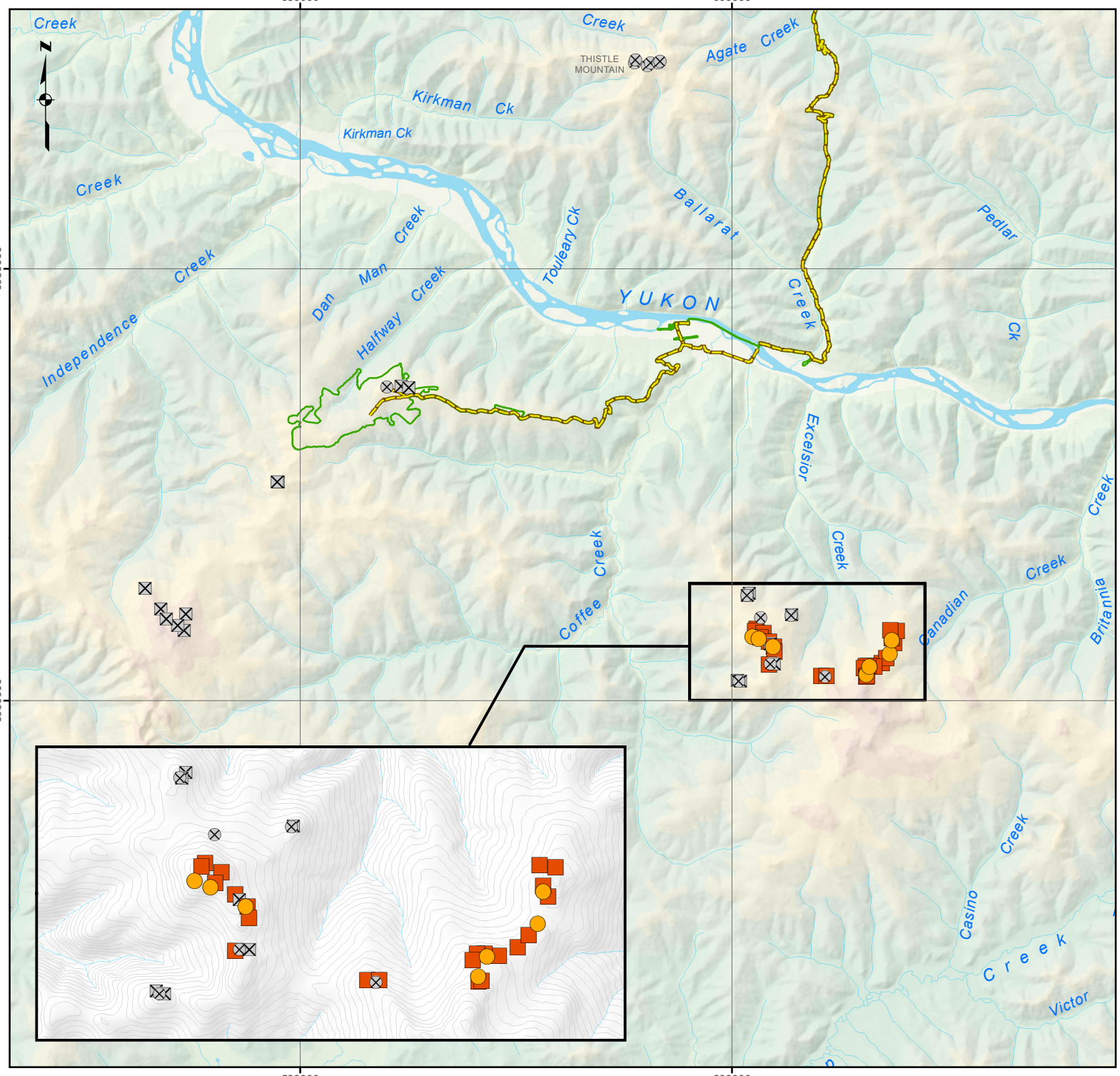
The habitat requirements for pika consist of alpine boulder fields (talus) in close proximity to alpine meadows. Pika rely on talus areas, using the interstitial spaces between boulders for shelter, predator avoidance, and food storage. They also rely on meadows close to these talus patches to provide forage opportunities. During summer, pika will collect and store forage materials, primarily graminoids, leafy shrubs, and forbs (Hudson *et al.* 2008) in food caches called haypiles which allow them to survive during the winter months. Pika are highly territorial and actively defend their haypiles and foraging grounds. Due to their specific habitat requirements, pika habitat is naturally fragmented across their range.

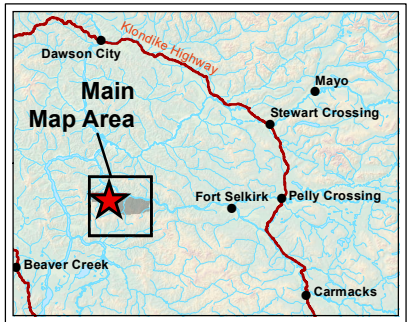
Little is known regarding the total population size or average colony size of collared pika as they are not well-studied and often inhabit remote alpine habitats. Almost all available information on collared pika comes from one location in the Ruby Ranges of southwestern Yukon where long-term studies have been conducted (Franken and Hik 2004; Morrison and Hik 2007; Hudson *et al.* 2008). Pika exhibit metapopulation characteristics with many distinct sub-populations interconnected by occasional dispersal and migration events (Franken and Hik 2004). Dispersal and migration are not well understood for pika. Franken and Hik (2004) found that post-weaning juveniles disperse typically less than 500 m from their birthplace. Long-distance dispersal between mountain ranges has not been documented and is thought to very rarely occur.

No studies have been conducted to date to determine the frequency and rates of collared pika mortality from different sources. Studies in the Ruby Ranges have found correlations between annual pika mortality and climate conditions suggesting that cold exposure in low snow years and starvation in late snowmelt years may be important factors in determining annual mortality rates (Morrison and Hik 2007). Little is known about pika predation but it is likely that predators include weasels, red fox, and raptors (COSEWIC 2011b).

In the western United States studies on American pika (*Ochotona princeps*), a closely related species, have found a link between climate warming and upslope retreat of populations (Beever *et al.* 2003; Rodhouse *et al.* 2010). As lower elevation habitats become less suitable due to changing temperature and moisture conditions, pika populations may become more fragmented and isolated, increasing the risk of local extirpations due to stochastic environmental conditions (Beever *et al.* 2003). Studies conducted on collared pika suggest that habitat fragmentation, which may be exacerbated by climate warming, is a concern for this species as well (Franken and Hik 2004). Climate change may also increase the variability of temperature, precipitation, and extreme weather events which can directly and indirectly affect pika survival (Morrison and Hik 2007; COSEWIC 2011b).

Baseline studies for the Coffee Project included two years of pika surveys in suitable habitats within 5 km of Project infrastructure. During these surveys, pika were only located in the southeastern corner of the Coffee Property (Figure 4-1; EDI 2017a). The two years of baseline surveys confirmed occupancy in many talus patches within this area; however, pika were not found to occupy any other talus patches within the survey extent. Pika were not found within the Project LSA and the surveys indicated that potential habitat within the LSA was extremely limited and marginal in quality. Pika are not likely to interact with the Project due to the large distance between proposed infrastructure and the documented pika colonies and their poor ability to disperse.





Legend

- Proposed Route
- Project Footprint

2014 Pika Survey Results

- Pika Detected/Observed
- No Pika Detected/Observed

2015 Pika Survey Results

- Pika Detected/Observed
- No Pika Detected/Observed

FIGURE: 4-1

Pika survey effort & observations for the Coffee Gold Project

Data Sources
1:250,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model and 1:250,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

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4.2 BATS

Information on bat distribution, seasonal activity patterns, and roosting habitats for Yukon is not well studied; however, five species of bats are known to occur in the territory. Little brown myotis (little brown bat) is the most wide-spread bat species within the territory and can be found from Dawson south to the British Colombia border (Slough and Jung 2008; Government of Yukon 2011b; Slough et al. 2014), typically below 1,000 m in elevation (Slough and Jung 2008). Other Yukon bat species include northern long-eared myotis, big brown bat (*Eptesicus fuscus*), hoary bat (*Lasiurus cinereus*) and long-legged myotis (*Myotis volans*) found in the south-eastern and south-central parts of Yukon (Slough and Jung 2008; Slough et al. 2014).

The northern long-eared myotis and the little brown myotis species have been emergency listed under the federal SARA as the result of drastic population declines from white-nose syndrome in eastern Canada. The little brown myotis and the northern long-eared myotis are both listed as endangered territorially (Government of Yukon 2014b). Little brown myotis is common across much of Canada and it is believed that the total population was likely greater than one million and relatively stable prior to the discovery of white-nose syndrome in 2006 (COSEWIC 2013). Ongoing studies of little brown myotis in Yukon aim to increase knowledge of this species and establish a long-term data set to assess population trends territorially (Jung and Kukka 2014). Several recent studies of bat colonies infected with white-nose syndrome in eastern Canada and the United States show a decline of greater than 90% population within three years of infection (Mainguy and Derosiers 2011; Turner et al. 2011; COSEWIC 2013). White-nose syndrome remains the primary concern for conservation of this species although white-nose syndrome is not believed to have expanded into Yukon bat populations yet (COSEWIC 2013).

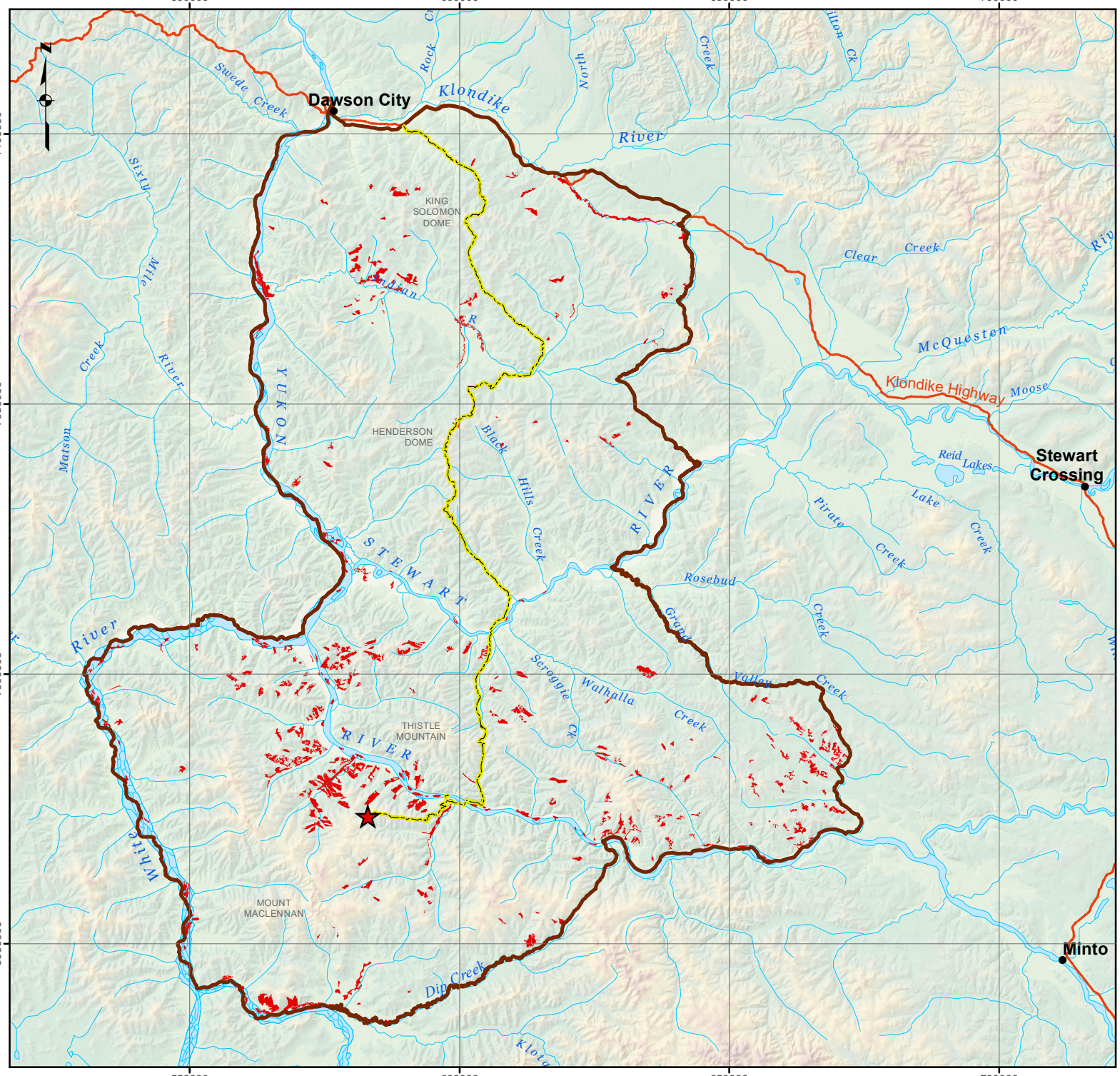
Acoustic surveys for bats within the Project LSA were conducted in August 2014 in two locations: the first at a wetland in the Yukon River floodplain near the current Coffee camp (430 m elevation), and the second near the proposed mine site in the Latte deposit area (1105 m elevation). Little brown myotis was detected on all four survey nights at the Coffee camp location, but was not detected in the Latte area, which was surveyed for six nights (EDI 2017a). Previous studies in Yukon have found that little brown myotis is generally found below 1,000 m in elevation (Slough and Jung 2008), which is consistent with the lack of detections in the Latte area. No other bat species were detected during the investigations and based on existing knowledge no other species are expected within the Project area.

Little brown myotis can usually be found in Yukon between mid- to late April and late September/early October. Females typically begin to occupy maternity colony roosts in Yukon during the last two weeks of April, with pups typically born from late June through mid-July. Maternity colonies began to disband in early August with only a few bats, mainly juveniles, remaining by September (Slough and Jung 2008) or early October (Government of Yukon 2011b). Nagorsen and Brigham (1993) reported no bat hibernacula north of 52°N in British Columbia. Hibernating bats have not been found in the Yukon and it is believed that bats likely migrate to winter hibernacula outside of Yukon (Slough and Jung 2008).

In the summer, little brown myotis forage for insects, typically over water, during the night (Jung et al. 1999). Foraging habitats are generally found within 500 m of water and include riparian, lacustrine, shoreline, and, to a lesser degree, forested habitats (Slough and Jung 2008). Studies in B.C. have also found

little brown myotis foraging over bluffs and forest openings (Nagorsen and Brogham 1993). During the day little brown myotis roost in tree cavities, on cliffs, and on artificial structures. Female bats also establish summer maternity roosts to give birth to and raise pups (Fenton and Barclay 1980). Most known maternity roosts in Yukon are located in buildings; however a few natural roosts are known in rock crevices and trees (Slough and Jung 2008). Bats typically emerge at sunset to forage and return to their day roost by sunrise. They may travel long distances in a night between their foraging and roosting areas. One-way commuting distances from roost to foraging areas can range from less than 1 km to as far as 20 km (Pierson 1998).

Based on the detection of little brown myotis at the Coffee camp survey location, and previous records of little brown myotis near Dawson (Slough and Jung 2008), the species is expected to be present, in low numbers, in suitable, low-elevation (i.e., below 1,000 m) habitats throughout the RSA. Little brown myotis are most likely to interact with Project infrastructure and activities during the summer months in areas with potential for roost sites or foraging habitat. Roosting habitat is expected to be the most limiting factor within the RSA; to characterise the availability of roosting habitat a basic habitat suitability model was conducted. Because specific roosting features such as tree cavities, rock crevices, caves and under the bark of trees, are difficult to identify at a broad-scale, old forest (i.e. > 130 years) below 1,000 m in elevation was used as a surrogate for potential roosting habitat (Figure 4-2). This habitat type often contains roosting features like tree cavities and thick tree bark that bats can climb under. The model identified a total of 307.9 km^2 of potential roosting habitat within the RSA; however, only a small fraction of this area is likely to contain the site-specific features required for roosting.





Legend

- Coffee Project
- Highway
- Proposed Route
- Regional Study Area
- Little Brown Myotis Roosting Habitat

FIGURE 4-2

Little brown myotis roosting habitat suitability mapping

Data Sources
Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Models (30 m and 90 m) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomaticsyukon.ca.

Project data displayed is site specific.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.

0 10 20 30 40
KM

Map Reference Scale: 1:1,000,000 (Printed at 8.5 x 11)
Coordinate System: NAD 1983 UTM Zone 7N

Drawn:	Checked:	Date:
MP	AM/LP	3/14/2017

KAMINAK GOLD CORPORATION EDI

Path: O:\2017\Y0032_Goldcorp_Coffee\GIS\Baseline\WildlifeBaseline\Mxd_March2017\Fig_4_2_MyotisHabitat.mxd

4.3 OTHER SMALL MAMMALS

Other small mammals that have the potential to occur in the LSA include red squirrel, Arctic ground squirrel, northern flying squirrel, snowshoe hare, and several species of species of mice, voles and shrews. While none of the small mammals known to the area are a conservation concern federally or territorially, they remain ecologically important as prey species of larger carnivores and furbearers. Additionally, some small mammal species, in particular Arctic ground squirrel and snowshoe hare, have been used by First Nations people in the area (Pearse and Weinstein 1988). All small mammals present within the LSA are likely to interact with some portion of the proposed Project footprint.

During wildlife baseline studies, northern red-backed voles and deer mice were captured during a small mammal trapping program conducted in August 2015. Red-backed voles were captured in both mature boreal low forest and subalpine shrub habitats. Deer mice were captured less frequently than red-backed voles and only in mature boreal low forest (EDI 2017a). It is expected that these species are both widespread in the Project RSA. It is likely that other species of vole, mouse, or shrew inhabit the LSA; however, none have been detected to date. Trace metals analysis on red-backed voles was also conducted to assess baseline concentrations of trace metals in small mammals (EDI 2017a).

Snowshoe hare were observed incidentally by Project staff and remote cameras on multiple occasions. Snowshoe hare tracks were present throughout the LSA and in many habitat types during snow tracking surveys (Figure 3-9; EDI 2017a). Hare tracks were typically found in lower elevation areas, but were also sometimes detected in subalpine areas. Lynx tracks were often detected in areas where hare tracks were abundant.

5 AMPHIBIANS

Four species of amphibians are known to occur in Yukon: wood frog, western toad (*Anaxyrus boreas*), Columbia spotted frog (*Rana luteiventris*), and boreal chorus frog (*Pseudacris maculate*). Wood frog is the only species expected to occur in the RSA as the other three species are only known to occur in south central and southeast Yukon, near the British Columbia border (Government of Yukon 2013a). The wood frog is common across Yukon and is not a conservation concern territorially, with its Yukon range extending from the British Columbia border north to the Old Crow Flats. It is estimated that there are more than 10,000 mature individuals in Yukon (Government of Yukon 2013b).

The wood frog inhabits a variety of habitats, but is typically found in or near wetlands. Breeding occurs from late April through June in clear shallow ponds (Government of Yukon 2013a). Wood frogs are distinctive for their ability to survive sub-zero winter temperatures. Where most amphibians would freeze and die, wood frogs produce a sugar which acts as antifreeze, preventing their cells from freezing. Their heart stops beating, intercellular liquid freezes and the sediment and water around them freezes but in the spring they thaw out and emerge (Government of Yukon 2013a).

No amphibian surveys were conducted as part of the Project's wildlife field program; however wood frogs were observed incidentally by Project staff on several occasions in lowland habitats within the Yukon River valley. Observations included both adult and juvenile individuals. Wood frog is assumed to occur throughout the Project area in appropriate wetland habitats and will interact with Project infrastructure and activities in these areas.

6 MINERAL LICKS

Mineral licks are important to ungulate species as they provide essential mineral nutrients which otherwise may be lacking in an ungulate diet (Rea *et al.* 2004). Mineral licks can be characterized as 'wet' or 'dry' depending on their location and characteristics. Wet licks are found in moist, muddy areas and are typically used by moose. They are often characterized by a concentration of trails and tracks leading to a wet, muddy spring (Rea *et al.* 2004). Sheep and goats more commonly use dry licks which can be areas of exposed mineral soils on a hillside or cut bank.

During the Project baseline data collection program, several known/suspected mineral licks were reported to the Project team by Environment Yukon and local First Nations. Several field surveys were conducted to locate the reported mineral licks; however, to date no mineral licks have been confirmed in the LSA despite substantial survey effort (EDI 2017a).

A mineral lick was reported in the Barker Creek valley as part of a WKA identified by Environment Yukon (EDI 2017a). EDI biologists conducted a thorough search of the location provided by Environment Yukon and walked the entire length of the proposed NAR that passes through the WKA in August 2015. No evidence of a mineral lick was found. Biologists also noted a lack of other wildlife sign that might indicate a mineral lick in the vicinity (e.g., wildlife trails, extensive ungulate sign).

Reports of a mineral lick in the Coffee Creek area were provided to EDI by both Environment Yukon and TH, although neither could provide a specific location (i.e., geographic coordinates) and descriptions of the site varied. During the summer of 2015, EDI biologists and Kaminak environmental monitors searched several areas within the Coffee Creek valley which matched the descriptions provided, but no mineral licks were located. However, biologists did note an abundance of moose sign throughout the Coffee Creek valley and the surveys did locate several wildlife trails.

During Project consultation for the Coffee Project in late 2015/early 2016, two additional mineral licks in the Maisy May valley and the Black Hills area were reported to the Project team by TH members. A description of each mineral lick and their location was provided by Tr'ondëk Hwëch'in Fish and Wildlife Branch (N. Ayoub, pers. comm. 2016). The reported location of the mineral lick in the Black Hills area is more than 3 km from the proposed NAR, therefore, no interaction with the proposed Project is expected and follow-up surveys will not be conducted in this area. The reported lick in the Maisy May valley is in closer proximity to the proposed NAR; however, a field verification survey and remote camera monitoring conducted in summer 2016 did not identify an active lick in this area. Follow-up discussion and/or field surveys with the TH to confirm the exact location and status of the reported lick are planned.

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APPENDIX I
Seismic Design Report

Coffee Gold Project Seismic Design Report

Prepared for:

Kaminak Gold
Vancouver, BC Canada

Prepared by:

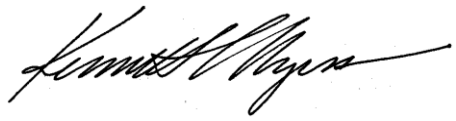
1325 Airmotive Way, Suite 175u
Reno, Nevada 89502
775-322-7622

Project No.157801
August 10, 2015

Coffee Gold Project Seismic Design Report

The following documents have been prepared by The MINES Group, Inc. under the professional supervision of the engineer whose seal and signature appear hereon.

The findings are presented within the limits described by the client, and prepared in accordance with generally accepted professional engineering principles and practices. No other warranties either express or implied are made.



Kenneth L. Myers, P.E.
Principal

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1 EXECUTIVE SUMMARY

The Coffee Gold Project is located in west central Yukon Territory, Canada approximately 330 kilometers (km) northwest of Whitehorse. The project will involve the design and construction of a number of facilities associated with the proposed gold mining operation at the site. Facilities may include an open pit, a heap leach pad, various ponds and water storage reservoirs, crushers, pipelines, roads, and various mine and administrative buildings. All planned facilities will need to be designed to resist expected seismic (earthquake) loading.

Western Canada, southeast Alaska, and the Aleutian volcanic arc are among the more seismically active areas in North America. Southwestern Yukon Territory is directly affected by this area of elevated seismicity. The Coffee Gold Project site is located in an area of moderate seismicity known as the Tintina Trench that also holds some of the region's major river systems including the Yukon, Pelly, and Stewart rivers. The northern boundary of the trench is the Tintina fault, a long right lateral strike slip fault responsible both for the formation of the trench and its name. The area to the north of the Tintina fault would seem to be associated with a higher level of historic seismicity than the area within the trench itself. The southern boundary of the trench is the highly active Denali fault, a long right lateral strike slip fault responsible for generating the largest of the earthquakes in close proximity to the site. The area to the southwest of the Denali fault holds some of the most seismically active features in North America, or for that matter, in the world. They include the Fairweather-Queen Charlotte fault and the Aleutian Megathrust zone. The Coffee Gold Project lies very near the geographic center of the trench being approximately 125 km from both the Tintina fault to the northeast and the Denali fault to the southwest.

Most practitioners would suggest that investigations extend for a minimum radius of 150 km from the site. For important projects, a radius of 150 km to 300 km might be more appropriate (the Nuclear Regulatory Commission or NRC requires 200 km). For this project the historic data set was collected for an area within a 1000 km radius. This was done not because damaging impacts are expected from earthquakes originating at a distance of 1000 km, but rather in order to understand more completely the nature of the very complex and highly active sources of seismic energy that begin a mere 125 km southwest of the Coffee Gold Project.

Regional seismic source zones were assigned to a map of historic earthquake events for the specific purpose of evaluating potential seismic loads for the Coffee Gold Project site. We have identified six (6) seismic source zones which (proceeding from northeast to southwest) are as follows:

1. Tintina North Zone
2. Inland Alaska Zone
3. Tintina Trench Zone
4. Denali Fault Zone
5. Aleutian Megathrust Zone
6. Fairweather-Queen Charlotte, Transition Fault Zone

The purpose of identifying discrete seismic source zones is to characterize and quantify the nature of the largest earthquake that is likely to occur within the zone. This information can be utilized in either a deterministic seismic hazard analysis (DSHA) or a probabilistic seismic hazard analysis (PSHA). Although different in approach, they probably have more in common than they have differences. Of interest is the largest earthquake that could reasonably be expected to occur

within the zone, the mean rate of occurrence or recurrence interval, and the location of the earthquake. Seismic source zones come in two (2) varieties:

1. An Aerial Seismic Source where earthquakes are uniformly distributed throughout the area and assumed to be equally likely to occur anywhere within the area.
2. A Linear Seismic Source where earthquakes occur along a narrow linear band (fault), but are again assumed to be equally likely to occur anywhere along the fault line.

For the DSHA approach, the largest earthquake event that could occur within the zone is estimated and then relocated to the position that most closely approaches the site (either along the fault in a narrow linear source zone or within the area boundaries in an aerial source zone). Site specific ground motion parameters are then estimated by attenuating ground motion between the earthquake location and the site. This seems like a very logical "worst case" type of approach, but can sometimes lead to unrealistically severe design criteria. To address this concern, in the PSHA approach the single input parameter of earthquake magnitude is replaced with a cumulative probability distribution relating earthquake magnitude to recurrence rate and an associated exceedance probability. The simple location parameter or distance to the site is replaced by another cumulative probability distribution that addresses the uncertainty associated with where the earthquake event might occur within the source zone (i.e., the variability in the distance to the site). Finally, there is also uncertainty associated with ground motion attenuation and a random component is applied to the ground motion.

The steps involved in a DSHA analysis are as follows:

1. Using information derived from geologic maps, fault maps, and plots of historic earthquake events, identify discrete seismic source zone polygons.
2. Extract "clipped" data sets lying within each seismic source zone that represent the nature of the seismicity within the zone.
3. Estimate the Maximum Credible Earthquake (MCE) associated with each seismic source.
4. Estimate the closest point of approach to the site of interest for each seismic source zone.
5. Estimate site specific ground motions by attenuating motions over the distance between the earthquake epicenter and the site.

Results of analyses for all seismic source zones are summarized in Table 1 and plotted in Figure 1. Most building codes (including the 2010 National Building Code of Canada (NBCC)) allow for either a site specific deterministic design approach or a probabilistic approach. For the site specific DSHA procedure the estimated spectral acceleration values at the various natural periods as shown in Table are used to develop a design spectral acceleration response spectrum. These design accelerations are then used to determine seismic loads for structural design, which will also vary as a function of occupancy and use.

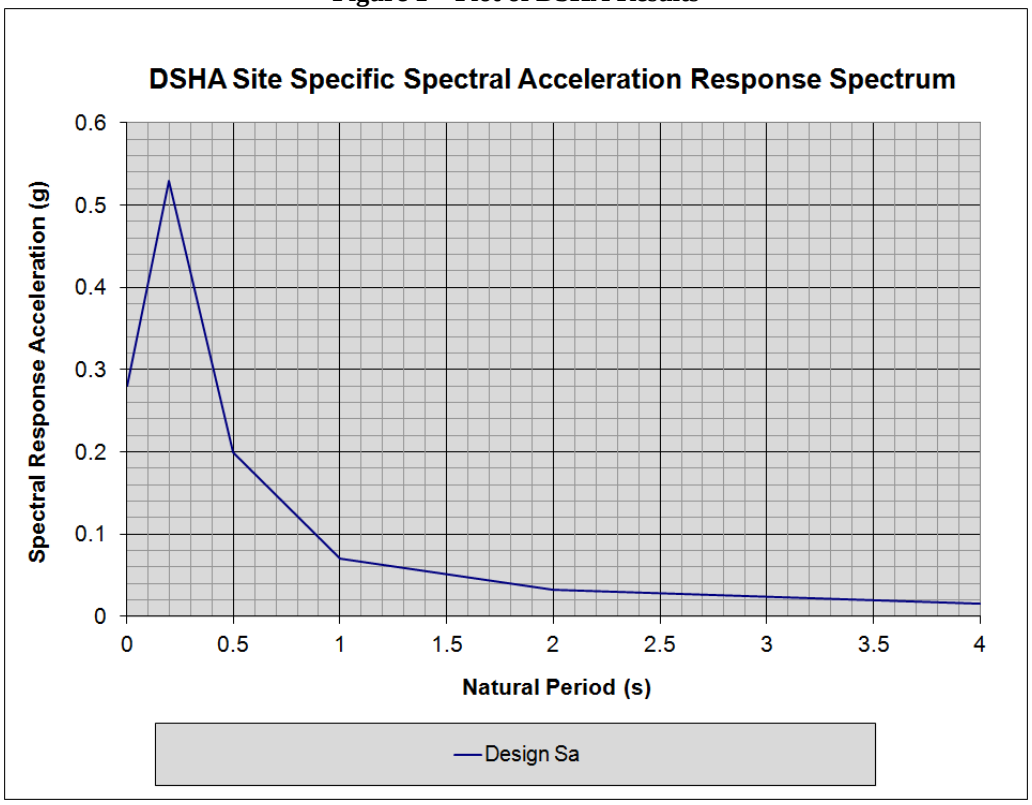
Table 1 – Summary of DSHA Results

Seismic Source Zone	Magnitude				Distance (km)			Pseudo-Spectral Acceleration (g)				
	Max Historic	Gutenberg-Richter	Surface Fault Rupture	MCE	Mean	Median	Closest	PGA	0.2 s	0.5 s	1.0 s	2.0 s
Tintina North	6.9	7.2	---	7.2	547	496	118	.026	0.047	0.038	0.022	0.011
Inland Alaska	7.1	7.1	---	7.1	656	633	420	---	---	---	---	---
Tintina Trench at 55 km	4.6	5.0	---	5.0	550	591	55	0.0085	0.0155	0.0065	0.0002	0.0001
Tintina Trench at 1 km	4.6	5.0	---	5.0	---	---	1	0.28	0.53	0.20	0.070	0.020
Denali Fault	7.9	7.3	8.0	8.0	360	350	105	0.06	0.11	0.085	0.050	0.0025
Aleutian Megathrust	9.2	8.3	---	9.2	662	623	364	0.07*	0.153*	---	---	0.092*
Fairweather-Queen Charlotte and Transition Fault	7.9	8.7	8.0	8.7	509	517	267	0.022**	0.036**	0.084**	0.056**	0.032**

Notes: * - Estimated from 2003 Atkinson and Boore equations for ground-motions in megathrust subduction zones

** - Estimated using M8.5 event at 267 km and the Abrahamson and Silva 2013 NGA West 2 attenuation relationship

Figure 1 – Plot of DSHA Results



The PSHA analysis can be performed using the same seismic source zones and by replacing the maximum credible earthquake with the probability distribution of earthquake events, the site distance with the probability distribution of site distances, and adding a random component to the attenuated spectral acceleration values, then using a Monte Carlo type sampling model to compile a new distribution of spectral accelerations associated with an exceedance probability. However, some developed countries, including the U.S. and Canada, have their own web-based PSHA programs that use regionally based maps of seismic source zones and compute site distances by asking you to enter a specific geographic site location using latitude and longitude.

The Canadian PSHA model is located on the Natural Resources of Canada website and was utilized to generate the PSHA results summarized in Table and plotted in Figure 2. The results assume a Site Class C (stiff soil and/or soft rock in the upper 30 m of the subsurface profile) and are consistent with the observed site conditions at the Coffee Gold Project site.

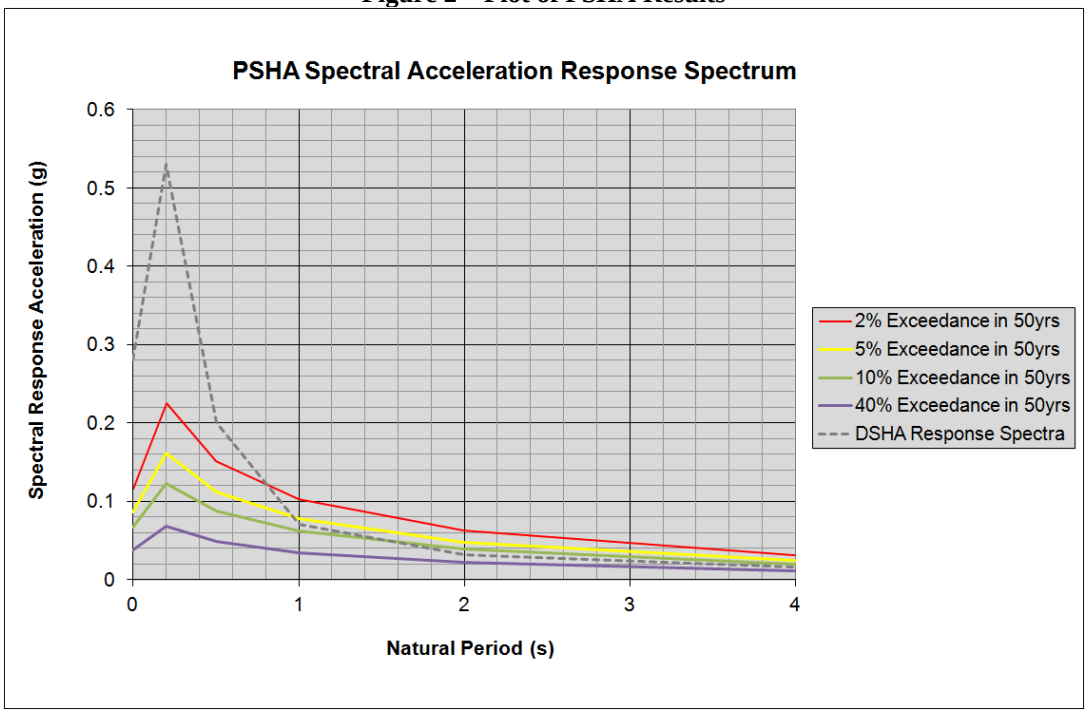
Figure 2 plots the DSHA spectral response spectra (shown as a dashed gray line) on the same plot as the PSHA spectral response spectra in order to permit a comparison of the two methods. As expected the design ground motions from the DSHA analysis are similar but more conservative, at least for natural periods less than 0.8 s. The reduced probability of larger earthquakes occurring in very close proximity to the site moderates the distribution of spectral accelerations resulting in reduced short period Sa values from the PSHA. Beyond the natural period of 0.8 s the design Sa is slightly less than both the 2% and 5% exceedance earthquakes (return periods of 2475 yrs and 1000 yrs respectively), implying that these rare, large earthquakes occurring at larger radial distances have a magnitude higher than the MCEs selected for the DSHA analysis.

Table 2 – Summary of PSHA Results

Annual Exceedance Probability	0.01	0.0021	0.001	0.000404
Recurrence Interval (yrs)	100	475	1000	2475
Probability of Exceedance in 50yrs	40%	10%	5%	2%
Period (s)	Sa (g)	Sa (g)	Sa (g)	Sa (g)
PGA	0.038	0.067	0.086	0.116
0.2	0.068	0.123	0.161	0.225
0.5	0.049	0.087	0.112	0.151
1	0.034	0.062	0.078	0.103
2	0.022	0.039	0.048	0.063
4*	0.011	0.0195	0.024	0.0315

Note: * - Per the 2010 NBCC the 4s Sa = (2s Sa)/2

Figure 2 – Plot of PSHA Results



For the design of buildings and other structures at the Coffee Gold Project site the PSHA results shown in Table and Figure 2 for the earthquake event having a 2% probability of exceedance in 50 yrs coupled with the criteria and design procedures for estimating seismic loads found in the 2010 NBCC should be applied for structural design.

Seismic design in connection with earthen geotechnical structures (earth dams, embankments, excavations, etc.) is usually associated with slope stability analysis. Current practice in slope design incorporates a hierarchy of slope analysis procedures that progress from simple and conservative, to more rigorous but less conservative. The first level in the hierarchy is the pseudostatic analysis. For the Coffee Gold Project site, the recommended pseudostatic acceleration coefficient for use in pseudostatic stability analysis is 0.06g. The second level in the hierarchy of seismic stability analysis is displacement analysis indicating acceptably small displacements. For critical structures,

the last level in the hierarchy of seismic stability analysis tools is a full dynamic analysis, again indicating acceptably small displacements.

2 Introduction and Project Description

The Coffee Gold Project is located in west central Yukon Territory, Canada approximately 330 kilometers (km) northwest of Whitehorse. The project will involve the design and construction of a number of facilities associated with the proposed gold mining operation at the site. Facilities may include an open pit, a heap leach pad, various ponds and water storage reservoirs, crushers, pipelines, roads, and various mine and administrative buildings. All planned facilities will need to be designed to resist expected seismic (earthquake) loading.

Seismic events or earthquakes have long been known to be associated strongly with tectonic movements of large masses of the earth's crust or *plates*. Earthquakes can and do occur virtually anywhere in the earth's crust, but tend to concentrate, both in space and time, near the boundaries of the major plates. They can be associated with magmatic movement and volcanism, with areas of crustal thinning or spreading centers (rift zones), or even from elastic crustal rebound and isostatic uplift following the removal of a great thickness of glacial ice. However, the largest earthquakes and the greatest frequency of earthquakes seem to be associated with movement along plate boundaries and *subduction* zones where edge of one plate is sinking beneath the edge of an adjacent plate that is overriding it. Most earthquakes are directly associated with the breaking or rupture of the crust along a fault line. The size or *magnitude* of the earthquake is a function of a number of factors including the type of rock present, the dip angle of the subduction zone, the depth of the rupture, the creep rate and magnitude of the stress drop during a rupture, the areal extent of the rupture, and so on. This report will describe the seismic environment surrounding the site, identify seismic source zones (the origins of earthquakes), characterize the nature of the seismic hazard, and propose appropriate seismic design criteria.

3 The Seismic Environment and Historic Data

Western Canada, southeast Alaska, and the Aleutian volcanic arc are among the more seismically active areas in North America as seen on Figure 3 through Figure 5. Southwestern Yukon Territory is directly affected by this area of elevated seismicity.

Figure 3 – Plot of Significant Earthquake Events in Canada

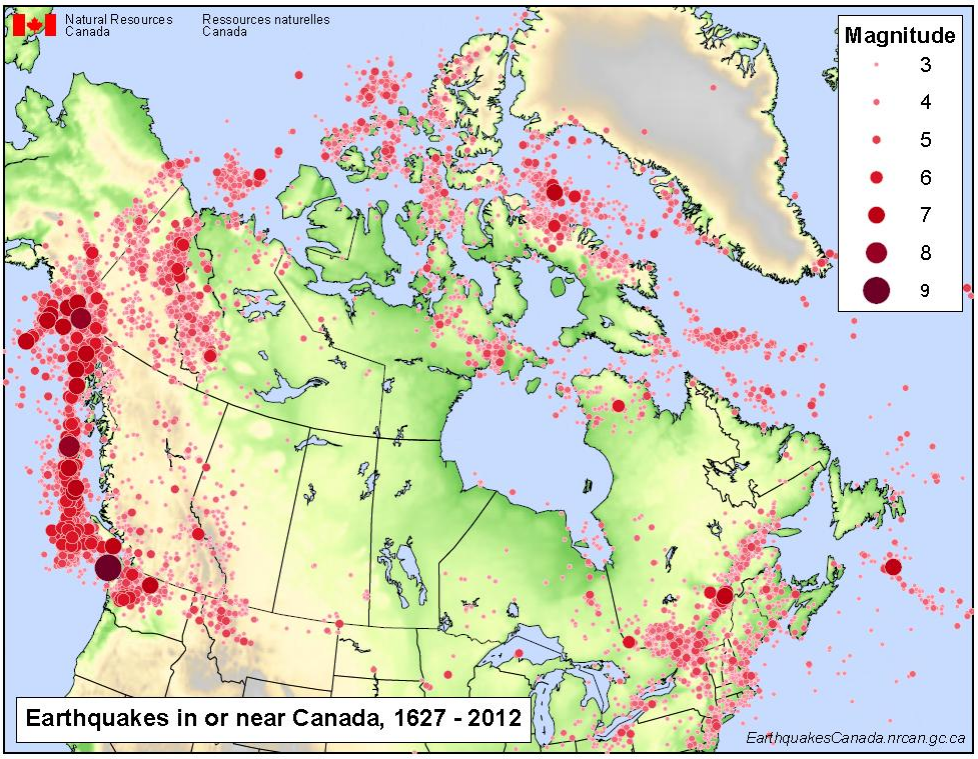


Figure 4 – Relative Seismic Hazard Map of Canada

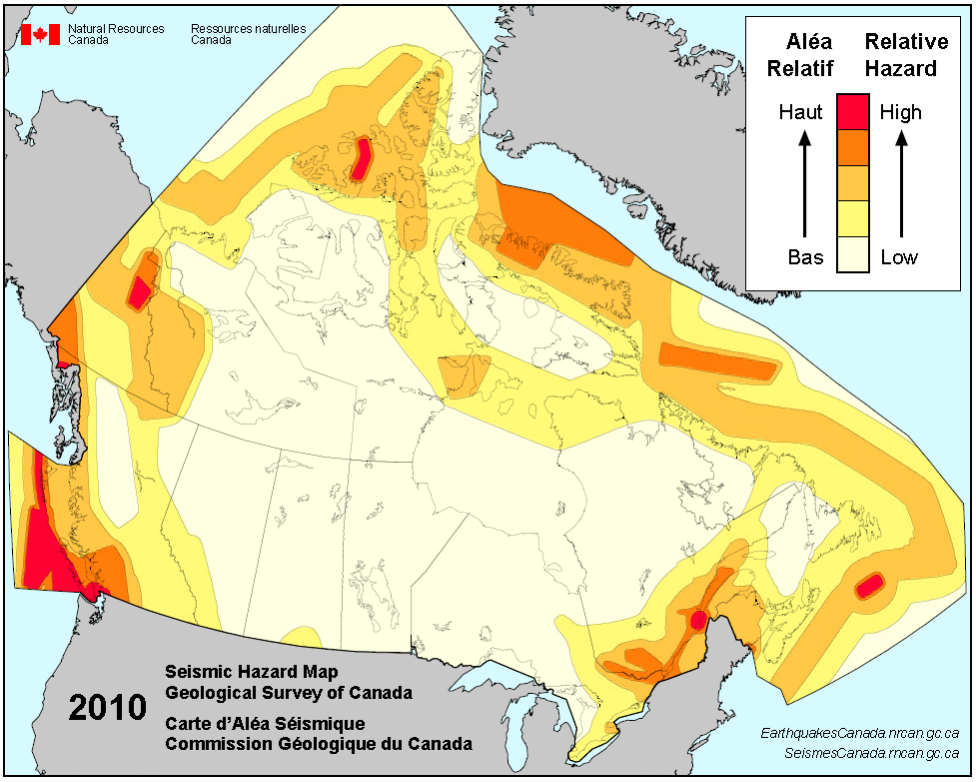
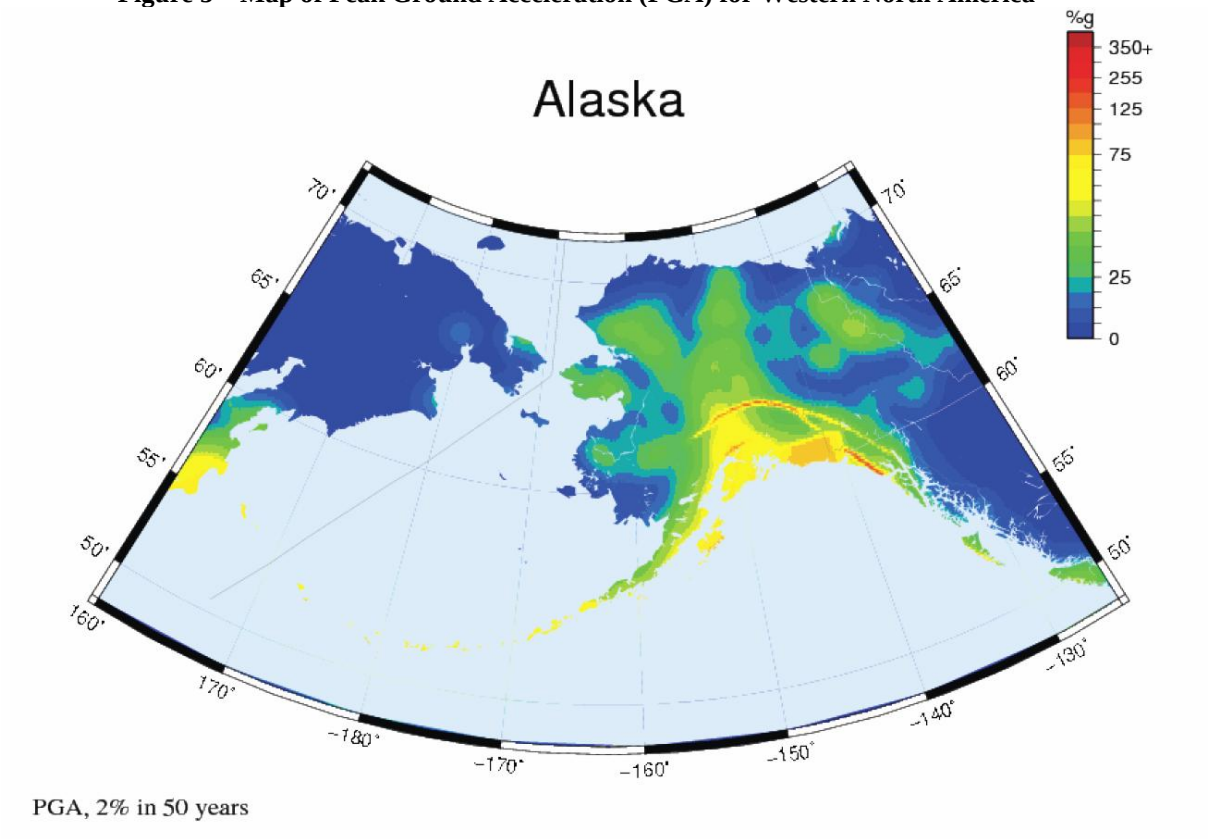


Figure 5 – Map of Peak Ground Acceleration (PGA) for Western North America



PGA, 2% in 50 years

The Coffee Gold Project site is located in an area of moderate seismicity known as the Tintina Trench that also holds some of the region's major river systems including the Yukon, Pelly, and Stewart rivers. The northern boundary of the trench is the Tintina fault, a long right lateral strike slip fault responsible both for the formation of the trench and its name. The area to the north of the Tintina fault would seem to be associated with a higher level of historic seismicity than the area within the trench itself. The southern boundary of the trench is the highly active Denali fault, a long right lateral strike slip fault responsible for generating the largest of the earthquakes in close proximity to the site. The area to the southwest of the Denali fault holds some of the most seismically active features in North America, or for that matter, in the world. They include the Fairweather-Queen Charlotte fault and the Aleutian Megathrust zone. The Coffee Gold Project lies very near the geographic center of the trench being approximately 125 km from both the Tintina fault to the northeast and the Denali fault to the southwest (see Figure 7).

When evaluating the potential impact of seismic activity at a specific site it is not necessary to investigate events at great distances from the site of interest, as the damaging effects of earthquake ground motion dissipate rapidly with distance. The response of structures to vibratory loading is a function of harmonics and the *natural period* of the structure. Short, stiff structures tend to respond more to high frequency vibrations while taller more flexible structures tend to respond more to low frequency vibrations. Earthquake events produce a mixture of both high and low frequency vibration. However, the high frequency end of the spectrum tends to attenuate rather quickly over short distances while the low frequencies persist longer over much larger distances. This means that a structure with a low frequency natural period may still experience damaging motion at a distance of 100 km from the earthquake while structures with a high natural period may exhibit little or no response.

Most practitioners would suggest that investigations extend for a minimum radius of 150 km from the site. For important projects, a radius of 150 km to 300 km might be more appropriate (the Nuclear Regulatory Commission or NRC requires 200 km). For this project the historic data set was collected for an area within a 1000 km radius. This was done not because damaging impacts are expected from earthquakes originating at a distance of 1000 km, but rather in order to understand more completely the nature of the very complex and highly active sources of seismic energy that begin a mere 125 km southwest of the Coffee Gold Project.

Figure 6 shows a plot of the historic recorded earthquake events within a 1000 km radius of the Coffee Gold Project site. This data set was created by downloading the events from the Natural Resources Canada (NRC) database and combining those events with another set of events from the United States Geological Survey (USGS) database. The combined dataset was then screened for duplicates and the resulting filtered dataset is the final dataset displayed in Figure 6. For purposes of this report, the Coffee Gold Project site is assumed to be located as follows:

Lat-Long:
62.8745° Latitude, -139.1819° Longitude

Universal Transverse Mercator (UTM) Projection, Zone 7N:
UTM Easting 592,477 m, UTM Northing 6,972,913 m

A more detailed plot of the location of historic earthquake events overlaid on a topographic map of the region surrounding the site is shown on Figure 7. The increase in both magnitude and frequency of earthquake events in the area to the southwest of the project is evident in this figure.

Using the full 1000 km radius dataset, the event specific information in Table 3 was extracted. Figure 8 shows the frequency distribution of earthquakes for the full data set.

Table 3 – Summary of Significant Historic Earthquake Events

	Magnitude	Epicenter Distance (km)	Year	Month	Day
Largest Earthquake:	9.3	481	1964	3	28
Closest Earthquake:	4.5	55	1993	12	7
Closest Earthquake with Magn >= 5:	5	154	2002	11	8
Closest Earthquake with Magn >= 6:	7.1	279	1979	2	28
Closest Earthquake with Magn >= 7:	7.1	279	1979	2	28
Closest Earthquake with Magn >= 8:	9.3	481	1964	3	28
Closest Earthquake with Magn >= 9:	9.3	481	1964	3	28

It should be noted that the combined NRC/USGS dataset contains a variety of different methods for the measurement of magnitude including surface wave, body wave, the so called Richter magnitude, and moment magnitude. The current standard is moment magnitude which requires a map of hypocenters of rupture locations (defining rupture length and width) along with an estimate of the average slip. This kind of information was simply not available in the early days of data collection on earthquakes. All of the early methods of magnitude measurement have limitations, i.e. they "saturate" at magnitudes somewhere around 8.0 to 8.5 (meaning they would record events larger than magnitude 8.5 as a magnitude 8.0 to 8.5 event). Most of the more recent events in the dataset would report a moment magnitude (Mo).

Figure 9 shows a plot of earthquake magnitude vs. distance for the full dataset and the number of events within each magnitude range. The envelope line (the yellow line at the left of the plot) shows a very rough estimate of the earthquake magnitude that could be expected to occur at the

location of the site (approximately magnitude 4). Figure 10 is a plot of the Gutenberg-Richter relationship for the full 1000 km radius dataset. The relationship predicts the maximum magnitude earthquake in the region to be approximately M8.8. The plot also reveals some of the problems and limitations of the Gutenberg-Richter relationship. The curve "tails off" at both the top or high magnitude end of the plot (the result of a limited record length that understates the number of large, infrequent events) and at the bottom (the result of widely spaced instrumentation, especially in remote regions, that cannot record the smaller magnitude events).

Ground motion response to earthquakes depends not just on the character of the earthquake, but also the character of the subsurface conditions at the site. Of concern is the nature of the soil/rock in the upper 30 m of soil/rock profile. Test pits and drilling at the site indicate that the soil cover is relatively thin and the underlying rock moderately to highly weathered. Therefore, for the purpose of this investigation, the site was assigned to Site Class C (stiff soil or soft rock) with an assumed representative shear velocity (Vs30) of 360 m/s to 760 m/s consistent with the recommendations in the 2010 National Building Code of Canada.

Although interesting and informative, evaluations that treat the entire regional dataset as a uniformly distributed source of earthquakes and seismic energy are inappropriate for the assignment of seismic design criteria to a specific site. In the next section we will examine the 1000 km radius dataset in more detail and attempt to identify specific, individual seismic sources.

Figure 6 – Plot of Historic Earthquake Events within a 1000 km Radius

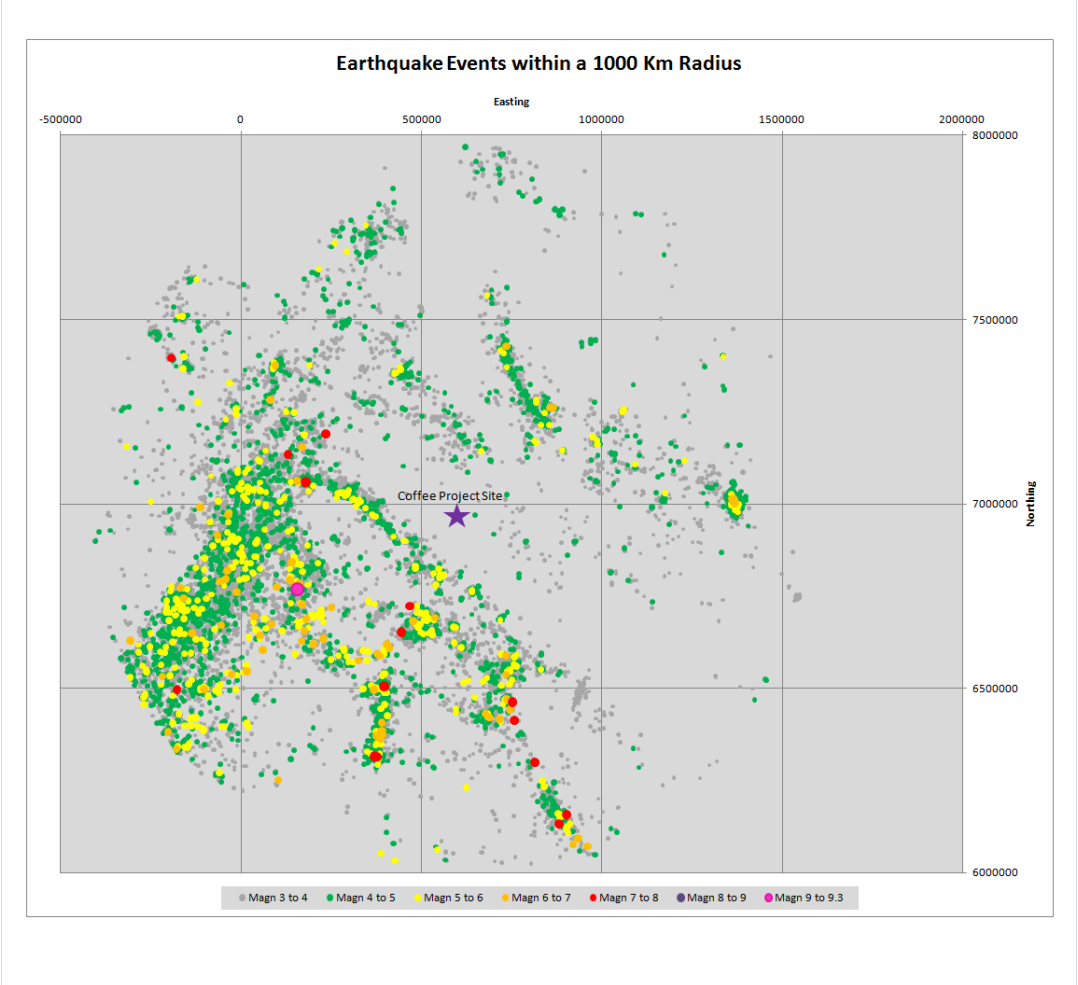


Figure 7 – Historic Earthquake Events Near the Project Site

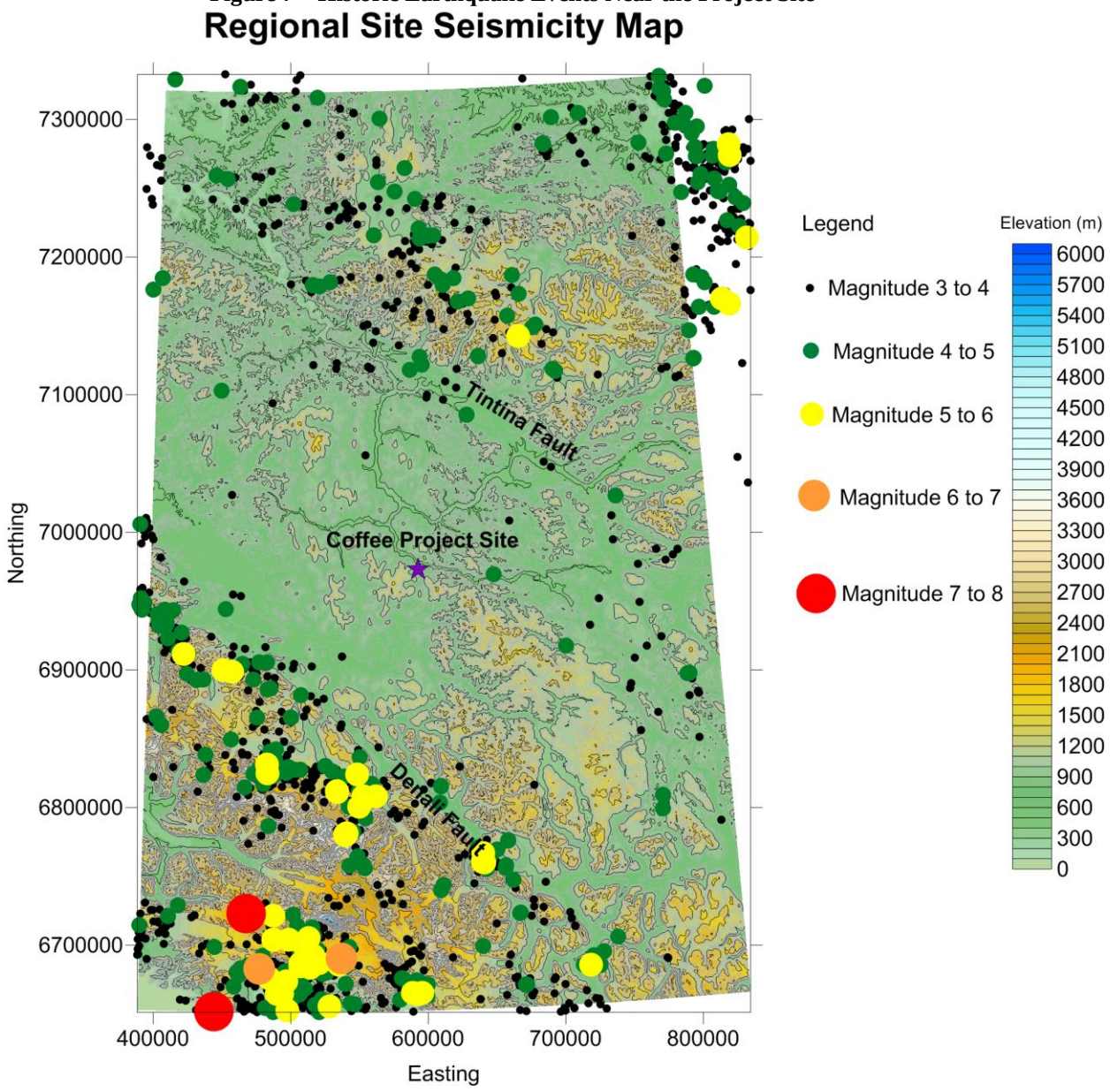


Figure 8 – Frequency Distribution for Historic Earthquakes within a 1000 km Radius

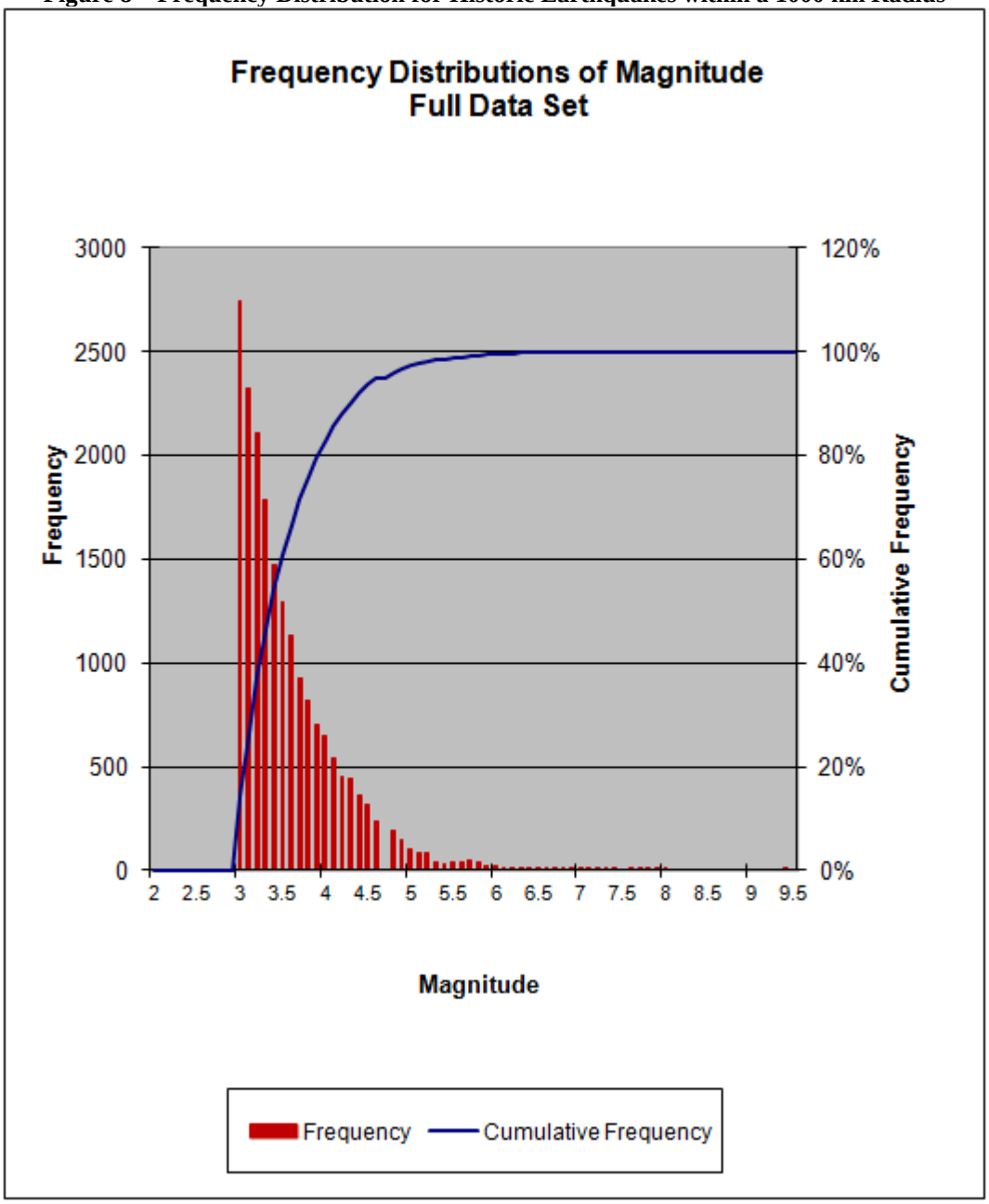


Figure 9 – Historic Earthquake Magnitude vs. Distance

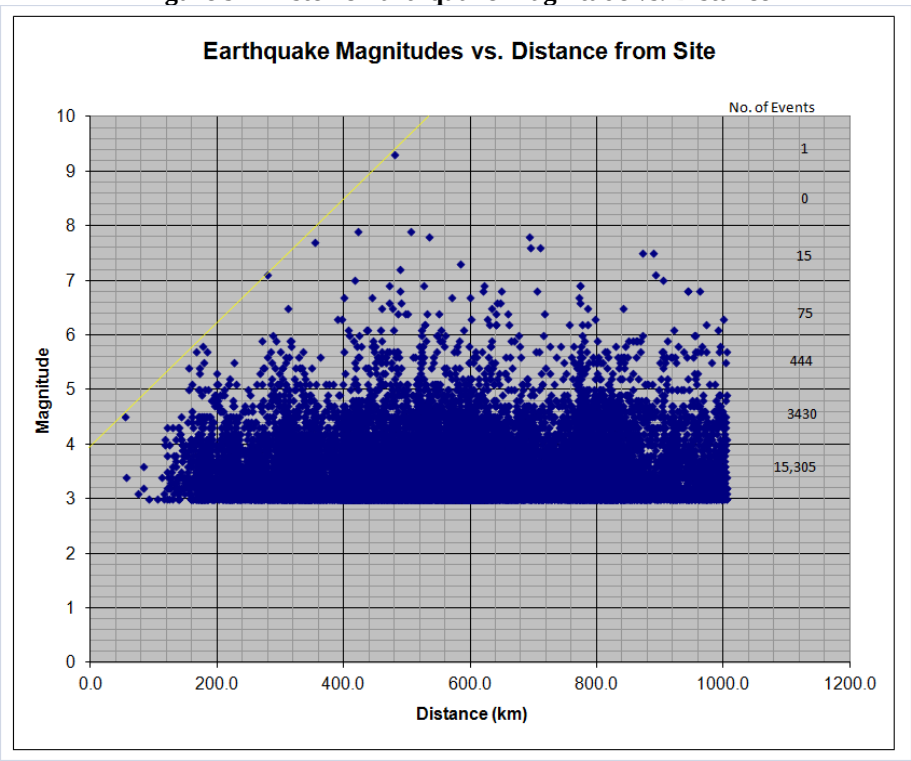
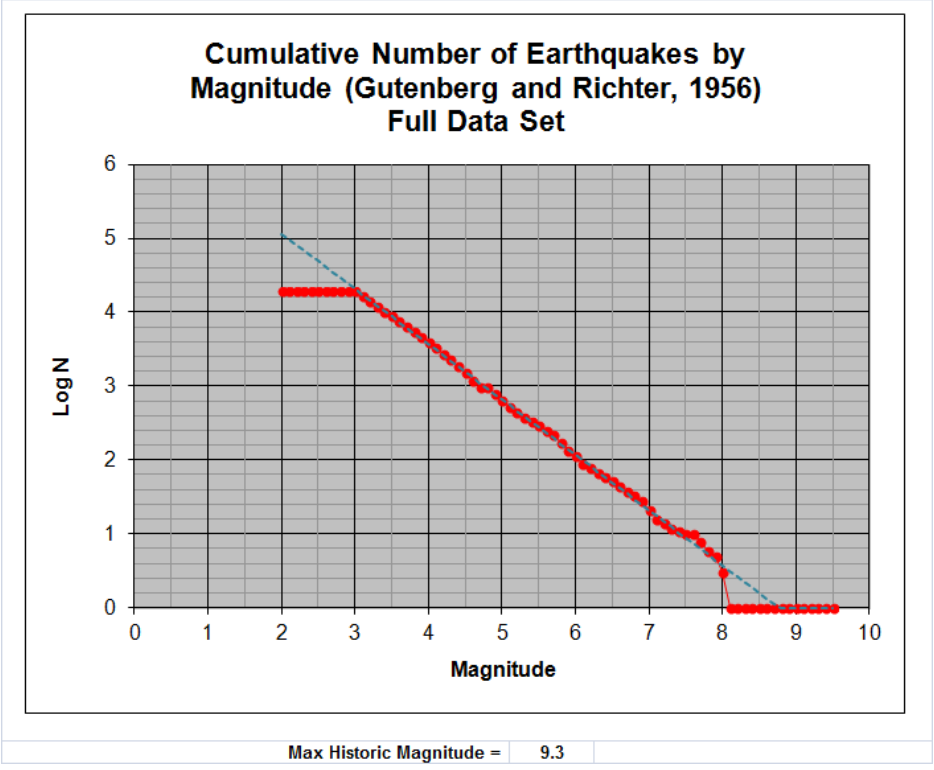


Figure 10 – Gutenberg-Richter Relationship for Historic Earthquakes within a 1000 km Radius



4 Seismic Source Zones

The maps that follow show, at progressively larger scale, the location of the major seismogenic fault systems in southwest Yukon Territory and southeast Alaska (see Figure 11 through Figure 13). Figure 14 shows the regional seismic source zones assigned to the map of historic earthquake events for the specific purpose of evaluating potential seismic loads for the Coffee Gold Project site. We have identified six (6) seismic source zones which (proceeding from northeast to southwest) are as follows:

1. Tintina North Zone
2. Inland Alaska Zone
3. Tintina Trench Zone
4. Denali Fault Zone
5. Aleutian Megathrust Zone
6. Fairweather-Queen Charlotte, Transition Fault Zone

The purpose of identifying discrete seismic source zones is to characterize and quantify the nature of the largest earthquake that is likely to occur within the zone. This information can be utilized in either a deterministic seismic hazard analysis (DSHA) or a probabilistic seismic hazard analysis (PSHA). Although different in approach, they probably have more in common than they have differences. Of interest is the largest earthquake that could reasonably be expected to occur within the zone, the mean rate of occurrence or recurrence interval, and the location of the earthquake. Seismic source zones come in two (2) varieties:

1. An Aerial Seismic Source where earthquakes are uniformly distributed throughout the area and assumed to be equally likely to occur anywhere within the area.
2. A Linear Seismic Source where earthquakes occur along a narrow linear band (fault), but are again assumed to be equally likely to occur anywhere along the fault line.

Figure 11 – Major Faults along the West Coast of North America

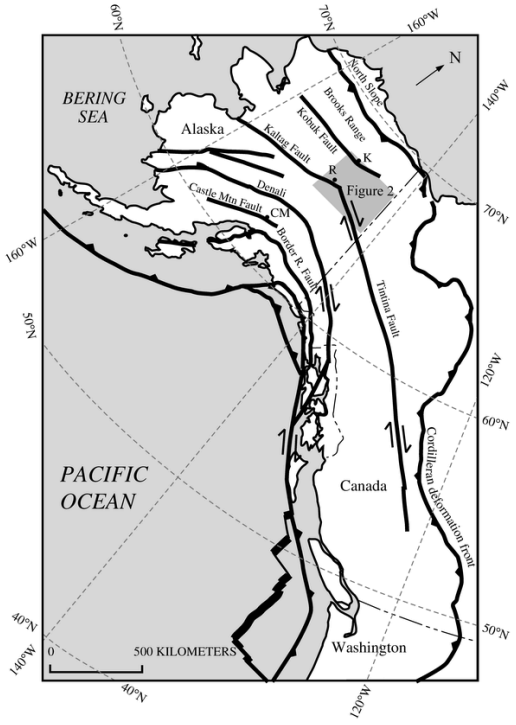


Figure 12 – Major Faults in Southwest Yukon and Southeast Alaska

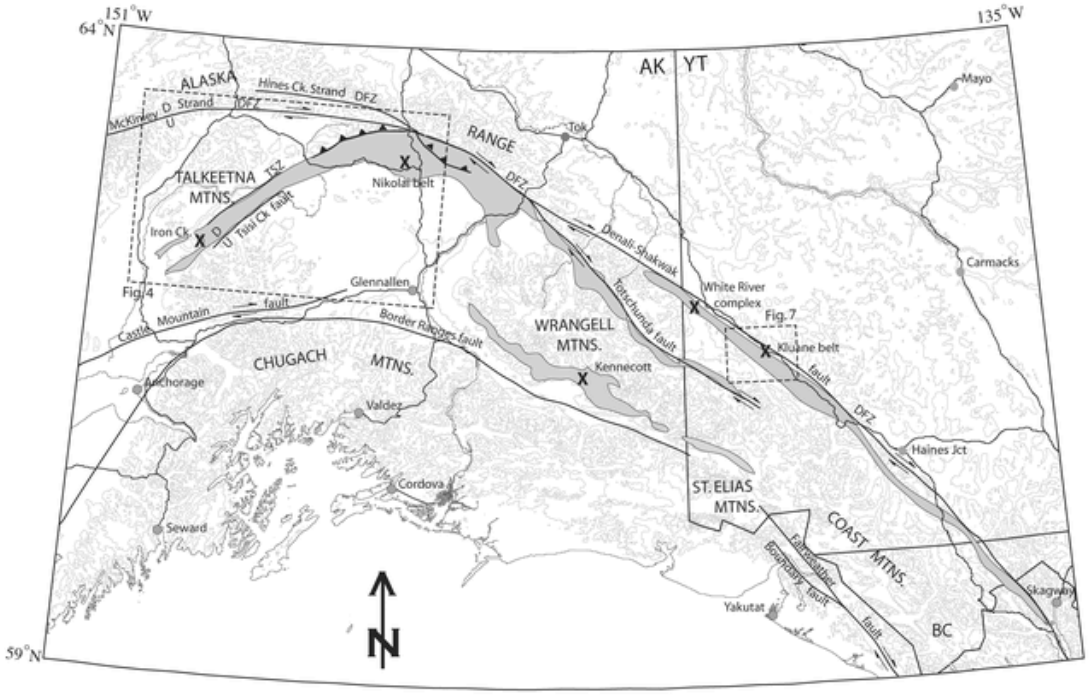


Figure 13 – Significant Seismic Features in Southwest Yukon and Southeast Alaska

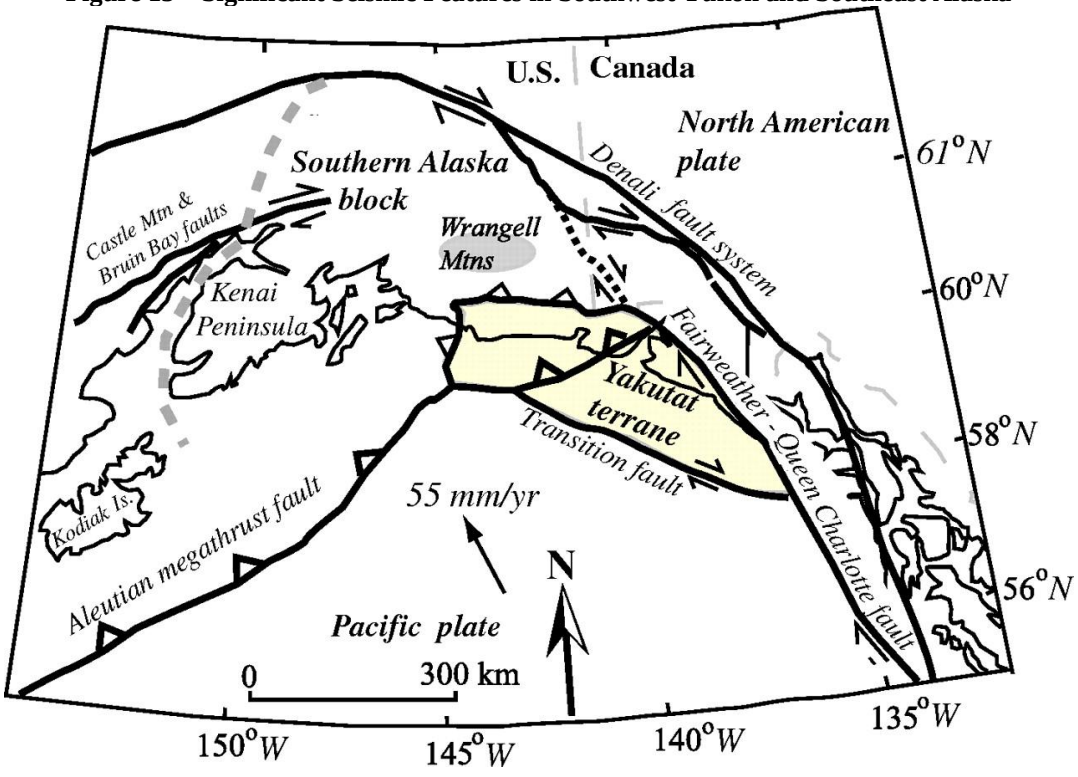
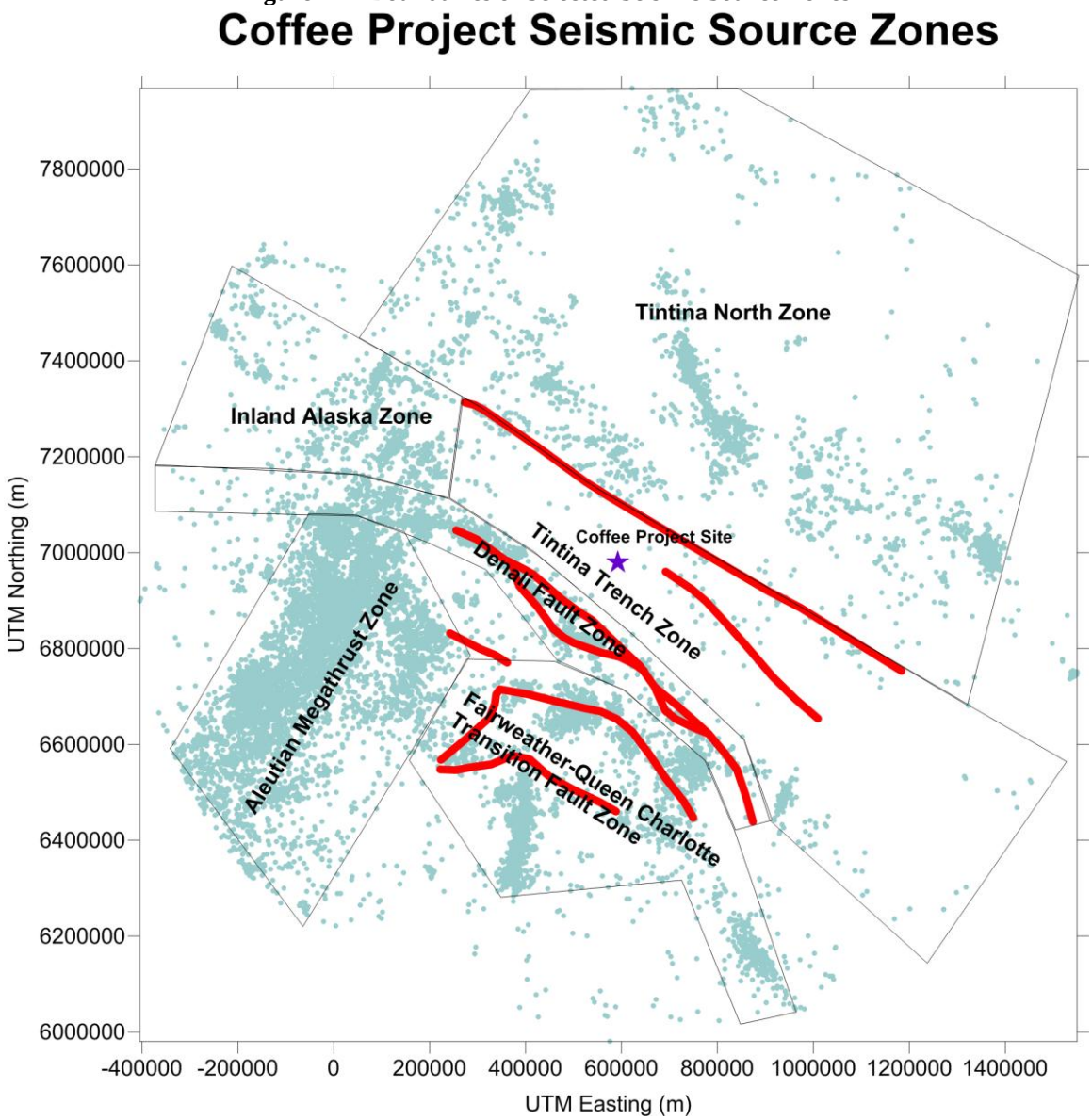


Figure 14 – Boundaries of Selected Seismic Source Zones



Note: The mapped fault locations (shown in red above) are based on the Regional Tectonics and Historical Seismicity map (Figure 1) in the Knight Piesold Consulting, Preliminary Seismic Hazard Assessment, dated December 9, 2014.

For the DSHA approach, the largest earthquake event that could occur within the zone is estimated and then relocated to the position that most closely approaches the site (either along the fault in a narrow linear source zone or within the area boundaries in an aerial source zone). Site specific ground motion parameters are then estimated by attenuating ground motion between the earthquake location and the site. This seems like a very logical "worst case" type of approach, but can sometimes lead to unrealistically severe design criteria. To address this concern, in the PSHA approach the single input parameter of earthquake magnitude is replaced with a cumulative probability distribution relating earthquake magnitude to recurrence rate and an associated exceedance probability. The simple location parameter or distance to the site is replaced by another cumulative probability distribution that addresses the uncertainty associated with where the earthquake event might occur within the source zone (i.e., the variability in the distance to the

site). Finally, there is also uncertainty associated with ground motion attenuation and a random component is applied to the ground motion.

5 Deterministic Seismic Hazard Analysis (DSHA)

The steps involved in a DSHA analysis are as follows:

1. Using information derived from geologic maps, fault maps, and plots of historic earthquake events, identify discrete seismic source zone polygons.
2. Extract "clipped" data sets lying within each seismic source zone that represent the nature of the seismicity within the zone.
3. Estimate the Maximum Credible Earthquake (MCE) associated with each seismic source.
4. Estimate the closest point of approach to the site of interest for each seismic source zone.
5. Estimate site specific ground motions by attenuating motions over the distance between the earthquake epicenter and the site.

The MCE is the larger of the magnitude predicted by the Gutenberg-Richter relationship for the clipped data set, the mapped fault characteristics (typically surface rupture length, subsurface rupture length, rupture area, or maximum displacement), or the maximum recorded historic earthquake within the seismic source zone. Sometimes in areas of low seismicity, from 0.5 to 1.0 units of magnitude will be added to the maximum recorded historic earthquake. That will not apply in this highly active seismic area. The most commonly used relationships between earthquake magnitude and fault geometry are those of Wells and Coppersmith, 1994 which were used in the completion of this evaluation.

The attenuation relationships used in this evaluation are the most current Next Generation Attenuation equations (NGA) from 2013 assuming 5% damping. Three (3) relationships were selected representing western North America and coastal plate boundary environments. They include:

- Abrahamson, Silva, and Kamai (2013) – NGA West 2
- Campbell and Bozorgnia (2013) – NGA West 2
- Chiou and Youngs (2013) – NGA West 2

A brief description of each seismic source zone will follow along with a summary of any pertinent assumptions made with respect to the zone.

5.1 Tintina North

The Tintina North Zone is treated as aerial seismic source zone despite the presence of the long right lateral strike slip Tintina fault along the full length of its southwestern border. Examination of the pattern of earthquake events in the historic record does not disclose a concentration of events along the alignment of the fault. A plot of the pattern of historic events is shown in Figure 15. Figure 16 shows the frequency distribution of earthquake magnitudes within the source zone which is then plotted in the Gutenberg-Richter relationship as shown in Figure 17 and shows an estimated maximum event magnitude of 7.2. This exceeds the maximum recorded historic event of magnitude 6.9. Figure 18 shows the distribution of the distances between event epicenters and the site. The statistics of this distribution are as follows:

- Mean = 547 km
- Median = 496 km
- Minimum (closest) = 118 km

Figure 15 – Historic Earthquake Locations in the Tintina North Seismic Source Zone

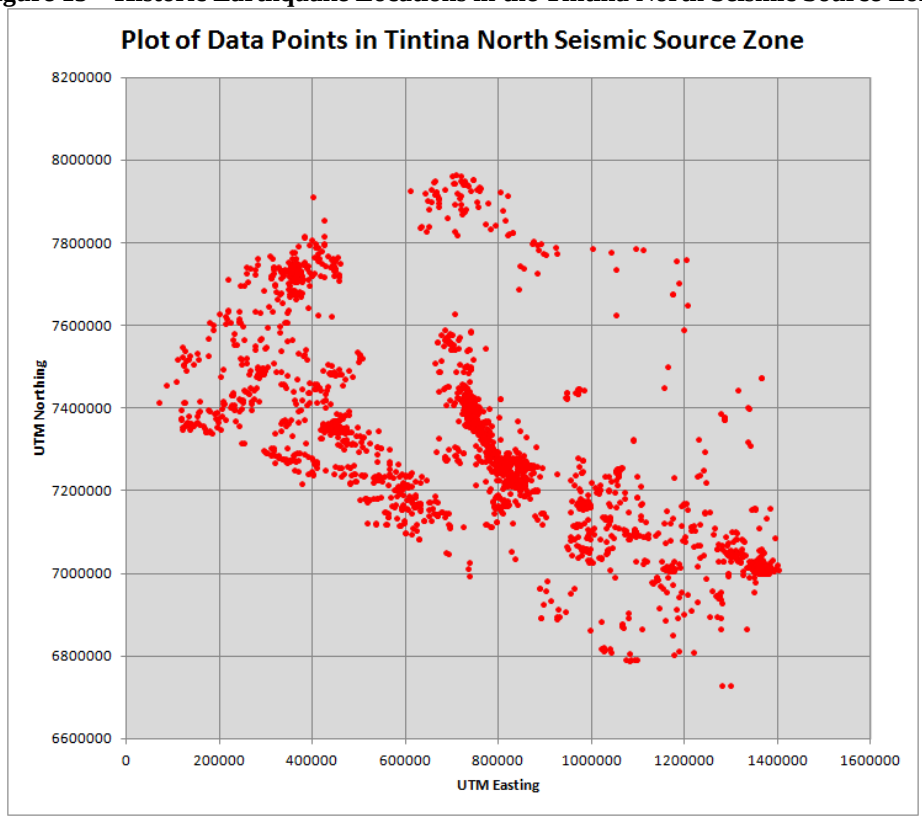


Figure 16 – Frequency Distribution of Magnitude for the Tintina North Seismic Source Zone

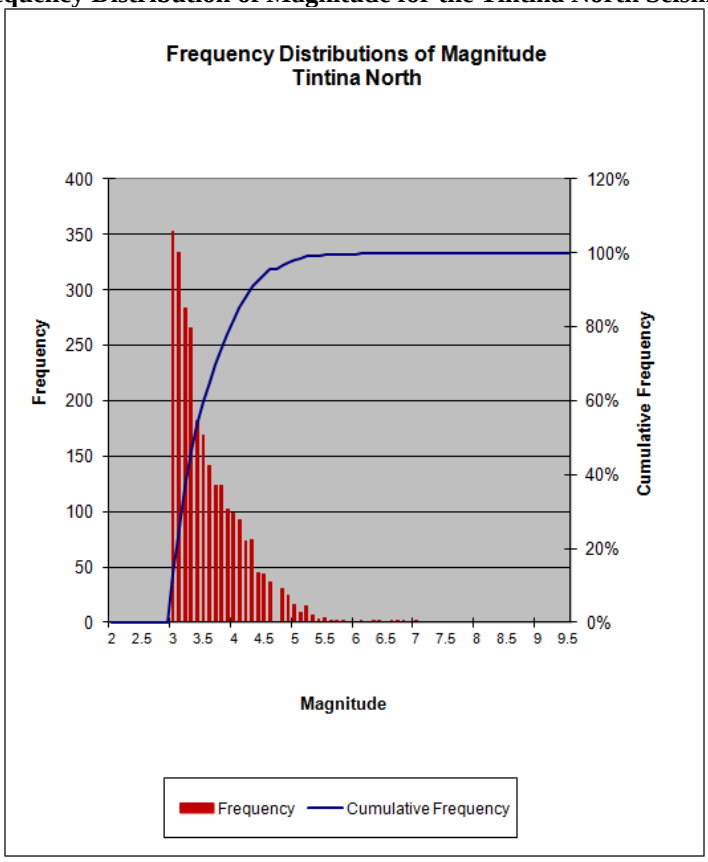


Figure 17 - Gutenberg-Richter Relationship for Tintina North Seismic Source Zone

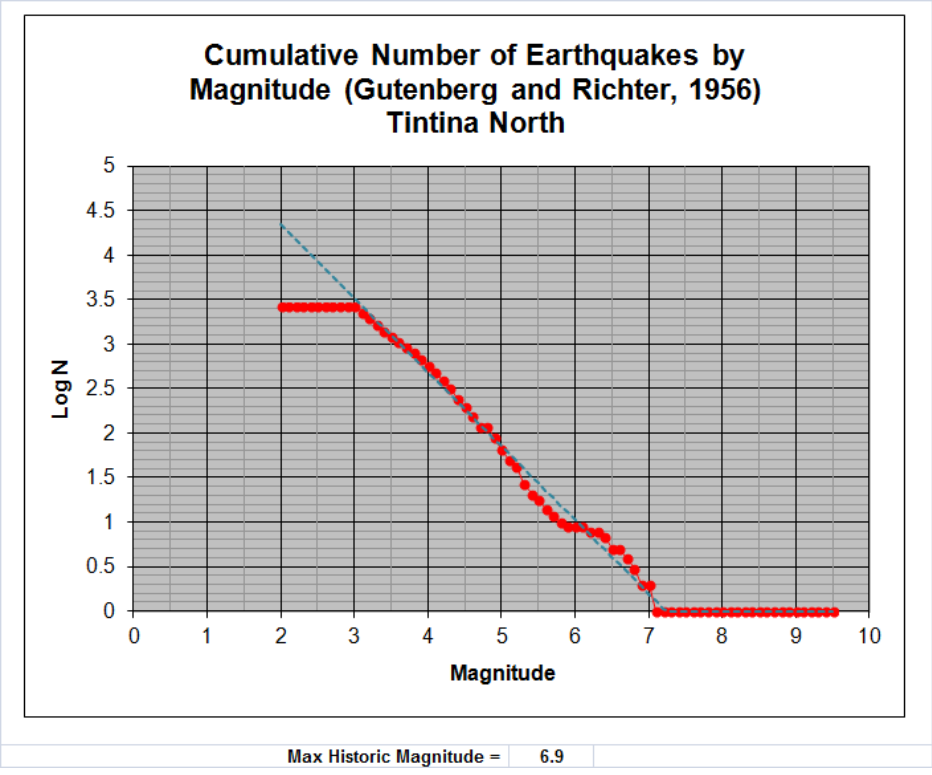
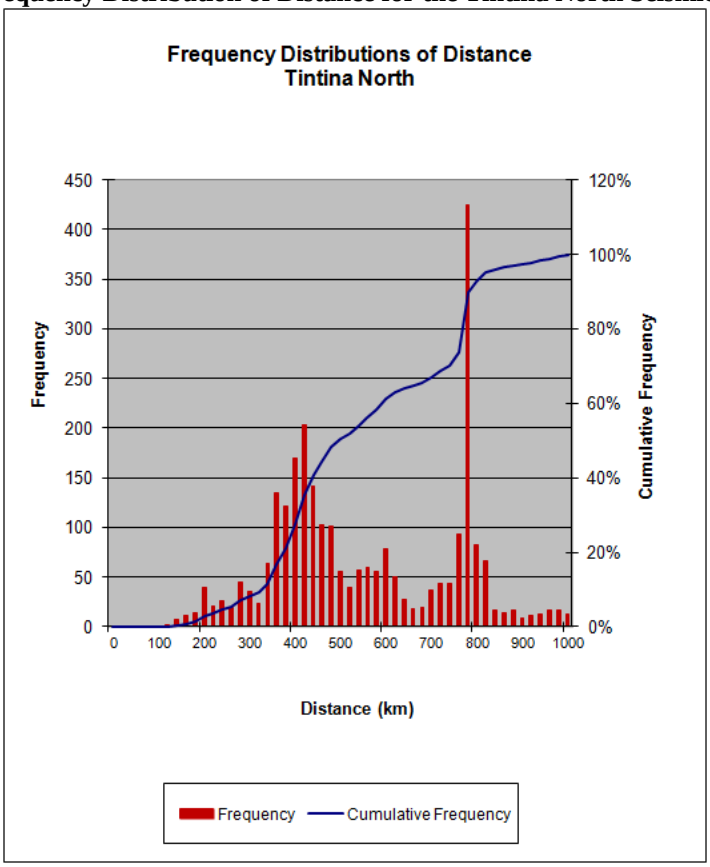


Figure 18 - Frequency Distribution of Distance for the Tintina North Seismic Source Zone

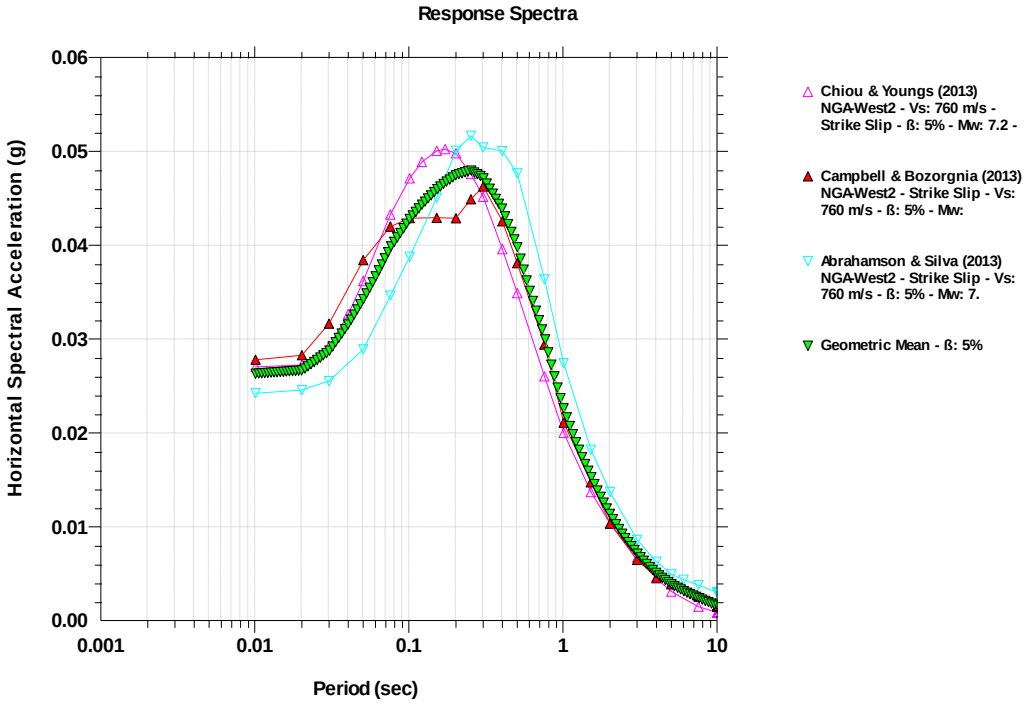


Using the maximum magnitude of 7.2 at the minimum distance of 118 km the attenuated ground motion response spectra shown in Figure 19 was generated. Mean values of pseudo-spectral acceleration were then extracted from this figure and are shown in Table 4.

Table 4 – Attenuated Sa vs. Natural Period for the Tintina North Seismic Source Zone

Natural Period (s)	Spectral Acceleration (g)
PGA (0 s)	.026
0.2	.047
0.5	.038
1.0	.022
2.0	.011

Figure 19 – Attenuated Sa Response Spectra for Tintina North Seismic Source Zone



5.2 Inland Alaska

The Inland Alaska seismic source zone is a westward extension of the Tintina Trench across the U.S.-Canadian border and into Alaska. It is modeled as an aerial seismic source zone (see Figure 20). Figure 21 shows the frequency distribution of earthquake magnitudes within the source zone which is then plotted in the Gutenberg-Richter relationship as shown in Figure 22 and shows an estimated maximum event magnitude of 7.1. This estimate is identical to the maximum recorded historic event of magnitude 7.1. Figure 23 shows the distribution of the distances between event epicenters and the site. The statistics of this distribution are as follows:

- Mean = 656 km
- Median = 633 km
- Minimum (closest) = 420 km

Figure 20 - Historic Earthquake Locations in the Inland Alaska Seismic Source Zone

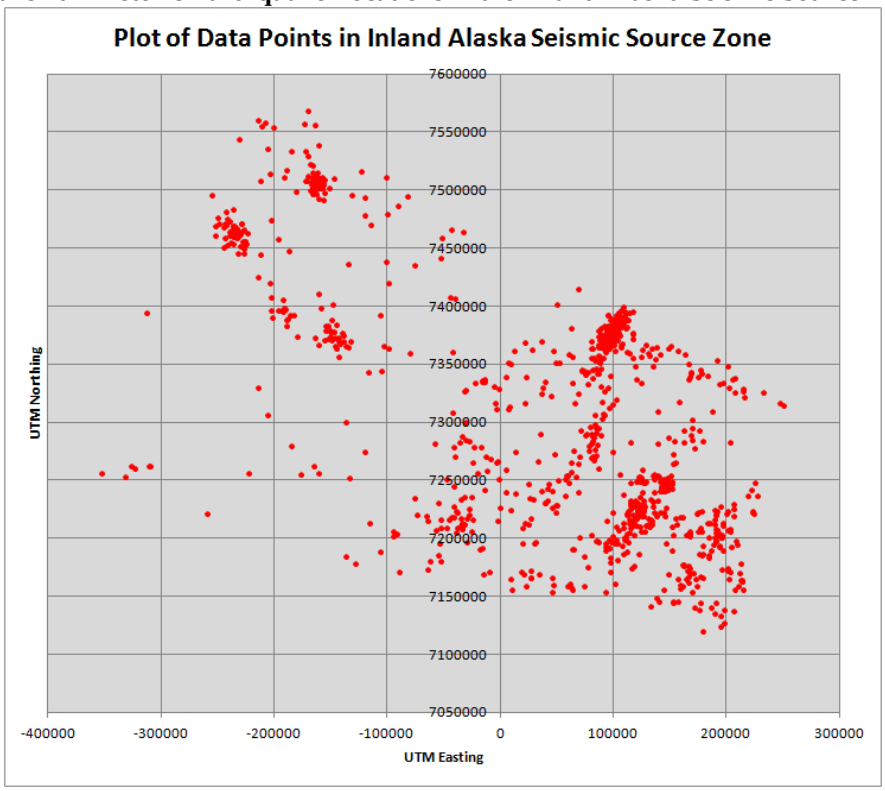


Figure 21 - Frequency Distribution of Magnitude for the Inland Alaska Seismic Source Zone

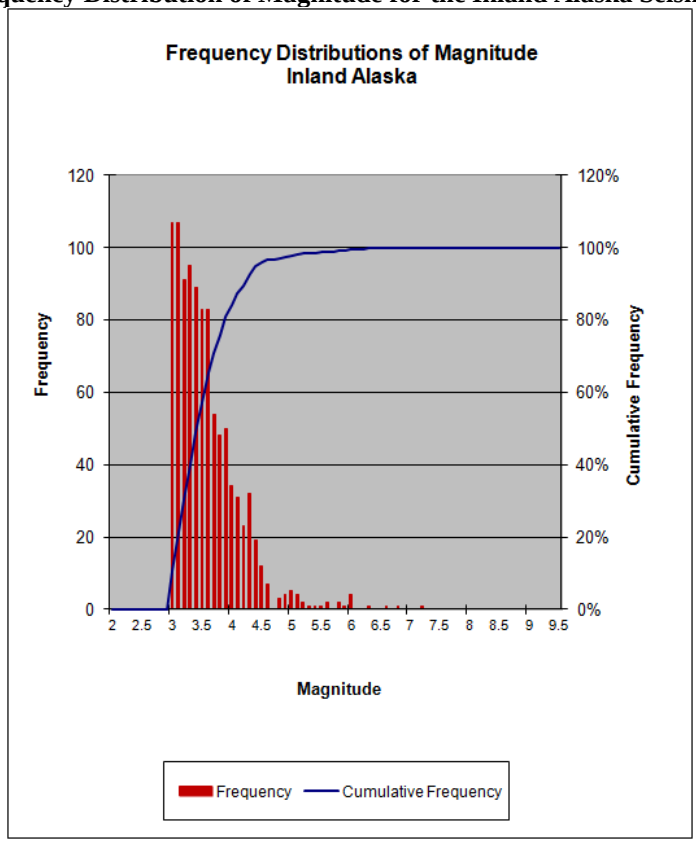


Figure 22 - Gutenberg-Richter Relationship for Inland Alaska Seismic Source Zone

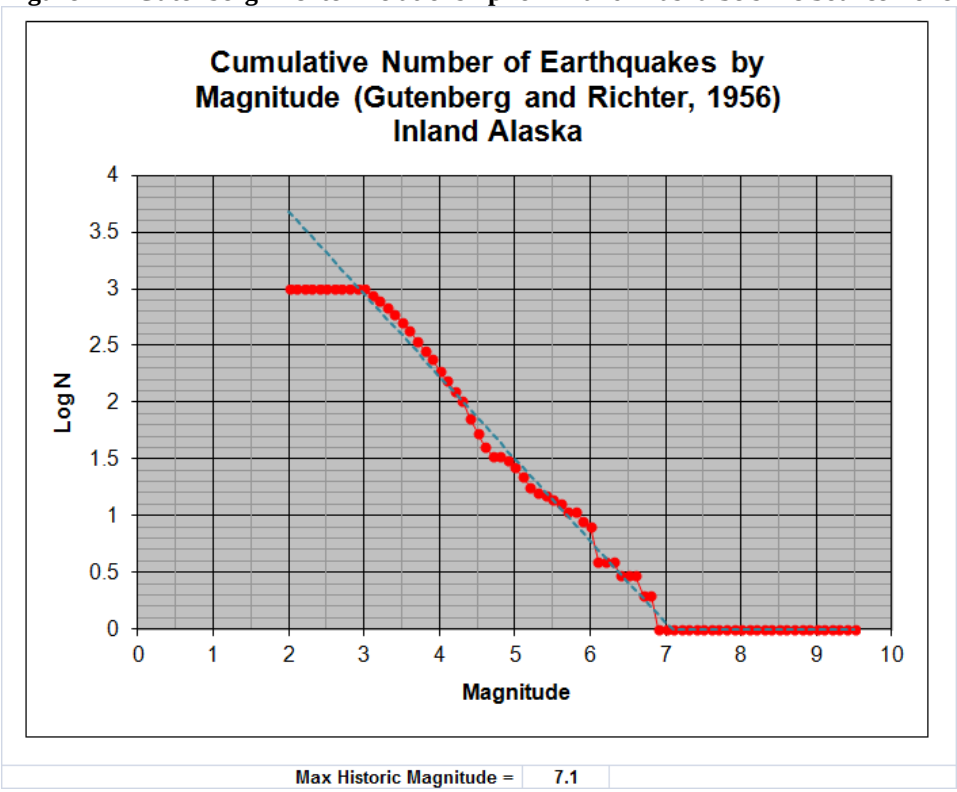
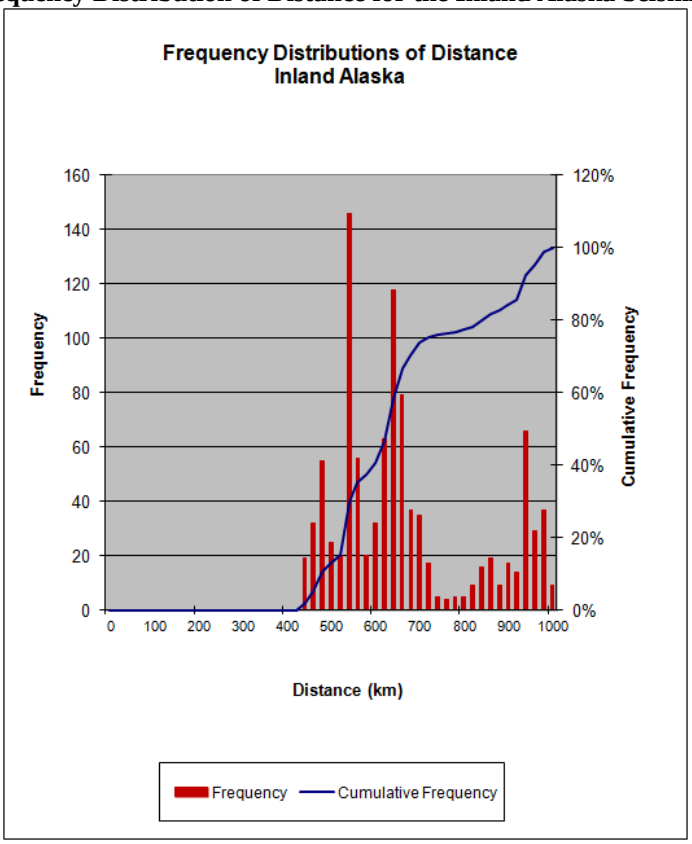


Figure 23 - Frequency Distribution of Distance for the Inland Alaska Seismic Source Zone



Application of the 2013 version of the NGA relationships are restricted to earthquake magnitudes of 5.0 to 8.5 and for distances not exceeding 300 km. Given the closest approach at 420 km, no attenuated ground motions can be estimated for this source zone using the NGA West 2 relationships. However, given the 7.1 magnitude and 420 km distance compared to the 7.2 magnitude and 118 km distance obtained for Tintina North, the expected ground motion would be less than that calculated for Tintina North and would not control design parameters.

5.3 Tintina Trench

The Tintina Trench seismic source zone is a broad valley lying between the Tintina Fault on its northeast boundary and the Denali Fault on its southwest boundary. It is modeled as an aerial seismic source zone (see Figure 24). Figure 25 shows the frequency distribution of earthquake magnitudes within the source zone which is then plotted in the Gutenberg-Richter relationship as shown in Figure 26 and shows an estimated maximum event magnitude of 5.0. This estimate exceeds the maximum recorded historic event of magnitude 4.6. Figure 27 shows the distribution of the distances between event epicenters and the site. The statistics of this distribution are as follows:

- Mean = 550 km
- Median = 591 km
- Minimum (closest) = 55 km

However, the project site itself lies roughly near the geographic center of this source zone. Therefore in theory, given that earthquakes are equally likely to occur anywhere within this seismic source zone, the maximum credible earthquake could occur directly below the project site (distance D = 0 km). Therefore, for this zone two (2) ground motion attenuation profiles were developed, one at the 55 km historic minimum and one for a distance of 1 km (1 instead of 0 to preclude any potential divide by zero issues).

Figure 24 - Historic Earthquake Locations in the Tintina Trench Seismic Source Zone

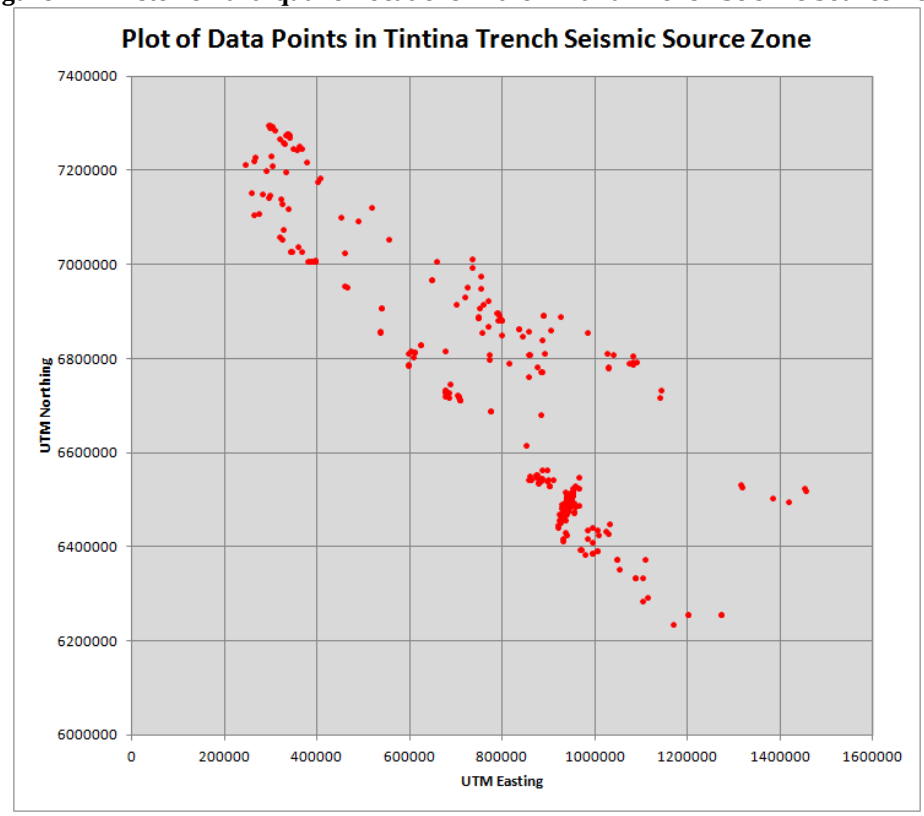


Figure 25 - Frequency Distribution of Magnitude for the Tintina Trench Seismic Source Zone

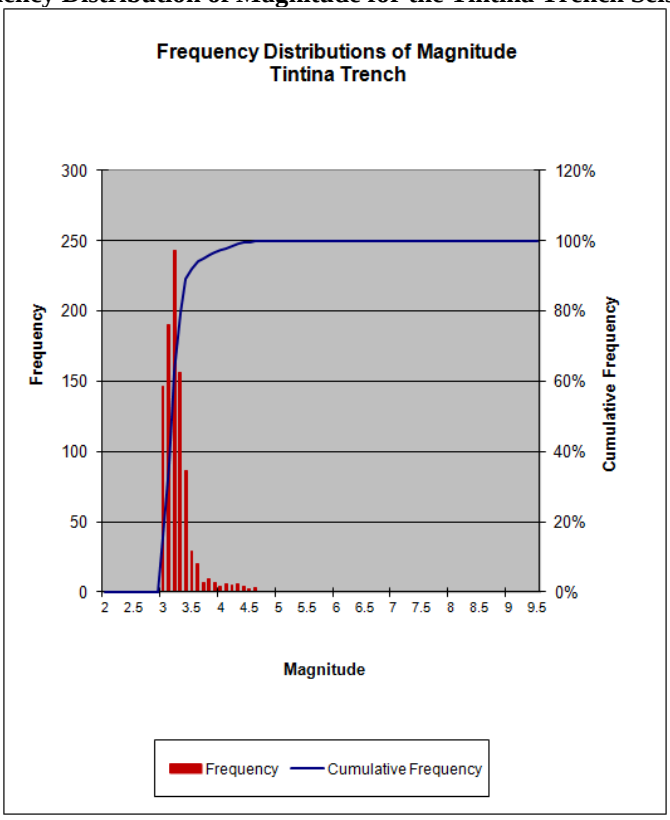


Figure 26 - Gutenberg-Richter Relationship for Tintina Trench Seismic Source Zone

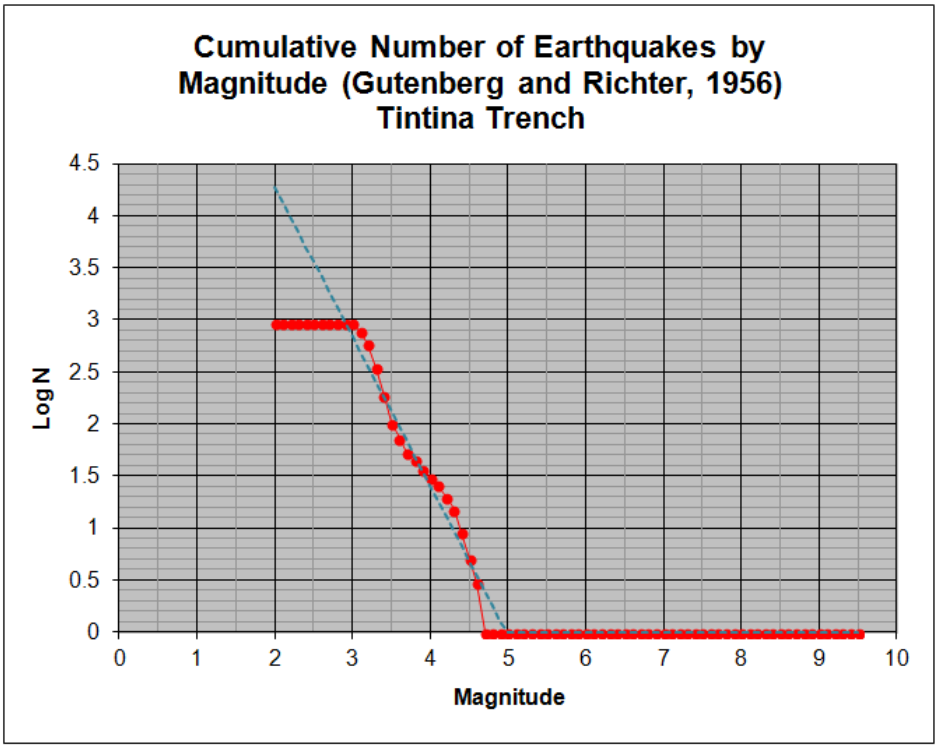
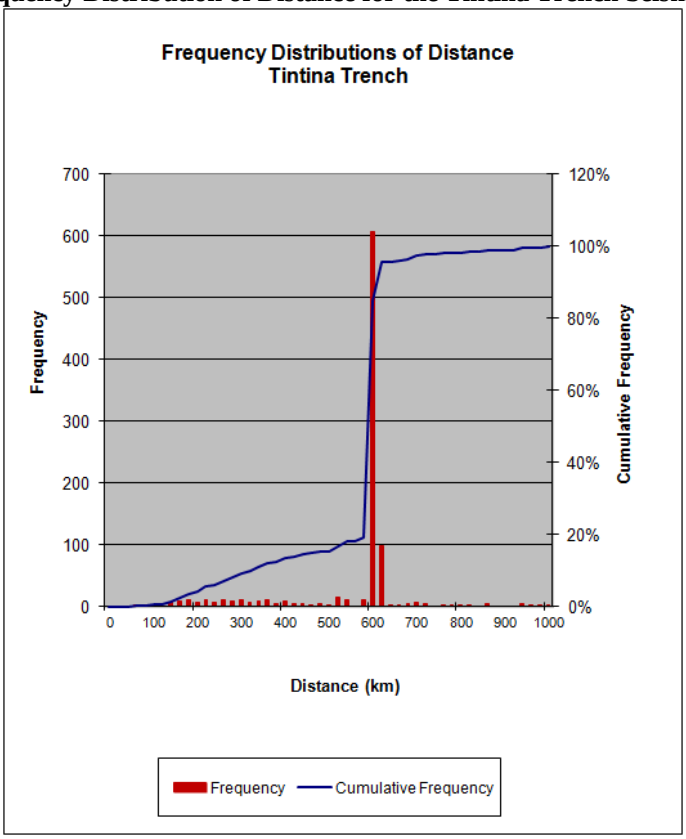


Figure 27 - Frequency Distribution of Distance for the Tintina Trench Seismic Source Zone



Using the maximum magnitude of 5.0 at the minimum distances of 55 km and 1 km the attenuated ground motion response spectra shown in Figure 28 and Figure 29 were generated. Mean values of pseudo-spectral acceleration were then extracted from these figures and are shown in Table 5.

Table 5 - Attenuated Sa vs. Natural Period for the Tintina Trench Seismic Source Zone

Natural Period (s)	Spectral Acceleration (g)	
	D = 55 km	D = 1 km
PGA (0 s)	.0085	.28
0.2	.0155	.53
0.5	.0065	.20
1.0	.0002	.07
2.0	.0001	.02

Figure 28 - Attenuated Sa Response Spectra for Tintina Trench 55 km Seismic Source Zone

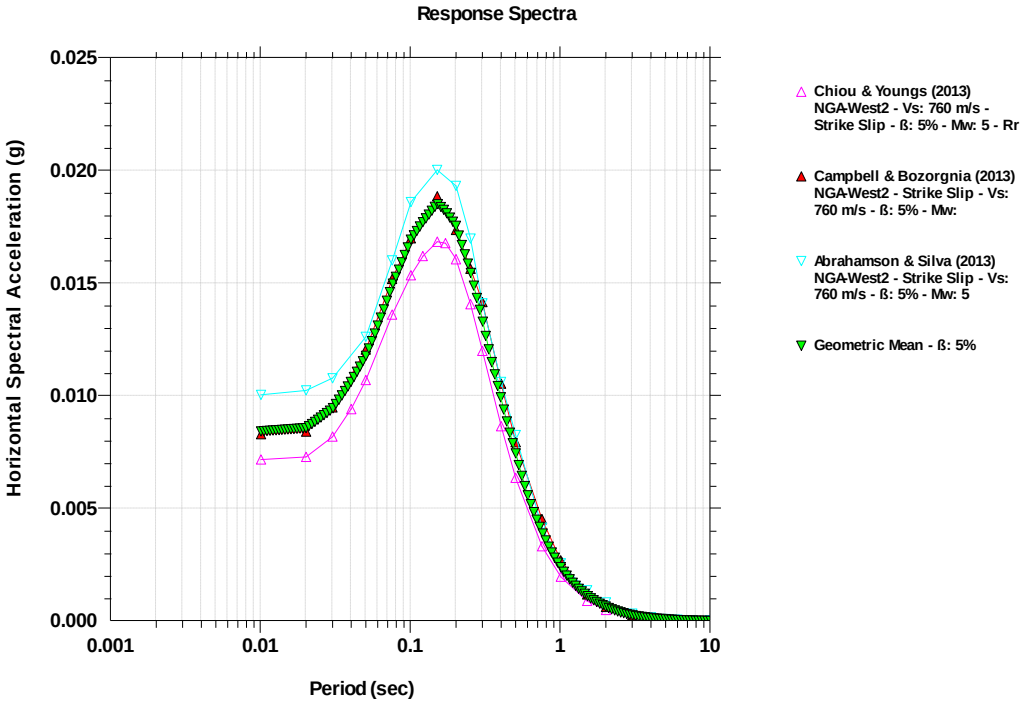
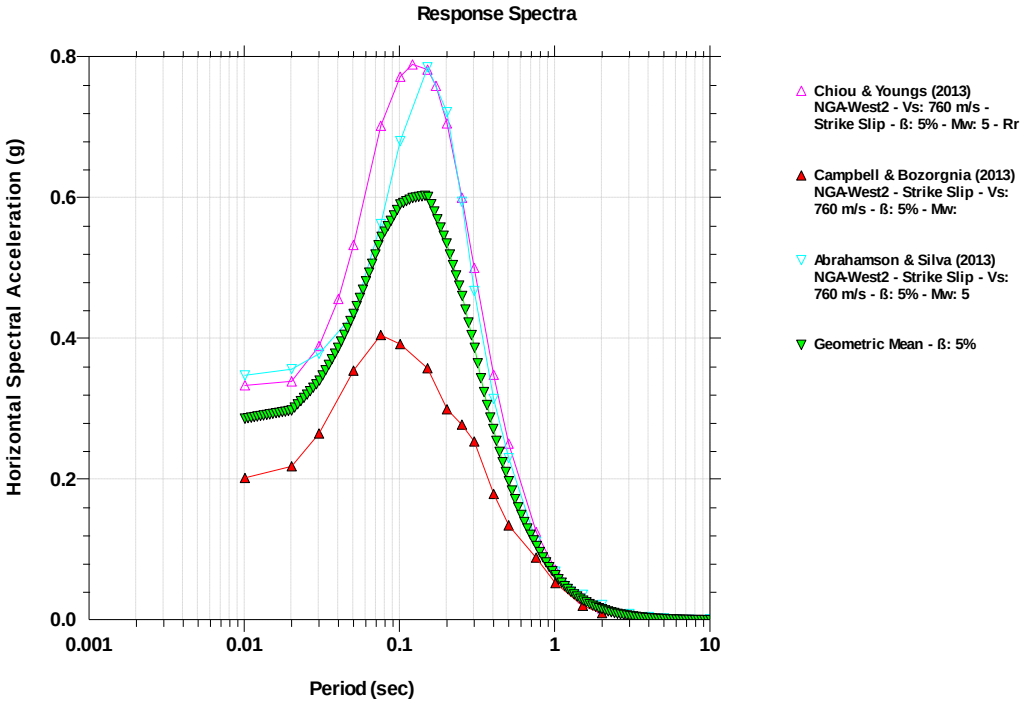


Figure 29 - Attenuated Sa Response Spectra for Tintina Trench 1 km Seismic Source Zone



5.4 Denali Fault

The Denali Fault seismic source zone is a long right lateral strike slip fault that extends from the southeast of the site to the northwest, curving westward as it moves across the U.S.-Canadian border and into Alaska. It is modeled as a linear seismic source zone (see Figure 30). Figure 31 shows the frequency distribution of earthquake magnitudes within the source zone which is then plotted in the Gutenberg-Richter relationship as shown in Figure 32 and shows an estimated maximum event magnitude of 7.3. This estimate is less than the maximum recorded historic event of magnitude 7.9. Figure 33 shows the distribution of the distances between event epicenters and the site. The statistics of this distribution are as follows:

- Mean = 360 km
- Median = 350 km
- Minimum (closest) = 105 km

The Denali fault is nearly 2000 km long extending from the east end of our seismic source zone to the southeast across all of Yukon Territory and into British Columbia, and from the west end of our seismic source zone southwest across all of southern Alaska. Estimation of the MCE as a function of surface fault rupture requires an estimate of the maximum expected rupture length for a single earthquake event. The long strike slip faults never rupture along their full length in a single event. Instead they are segmented. Segment lengths can often be observed from mapped fault traces as structural discontinuities (offsets normal to the fault trace or sudden "kinks" or changes in direction of the trace – Slemmons, 1977). However, major strike slip faults rarely exhibit any significant structural discontinuities. Various rules of thumb for maximum surface rupture length have been proposed in the literature over the years including one-half of the mapped total length (Wentworth et. al., 1969) or 17% to 38% of the mapped total length (Slemmons, 1977). A research study on the M7.9 November 3, 2002 event on the Denali fault documented a surface rupture length of 340 km (Eberhart-Phillips and Haeussler, 2003). Using a surface rupture length (SRL) of 340 km the Wells and Coppersmith equation generates a magnitude of 8.0.

Figure 30 - Historic Earthquake Locations in the Denali Fault Seismic Source Zone

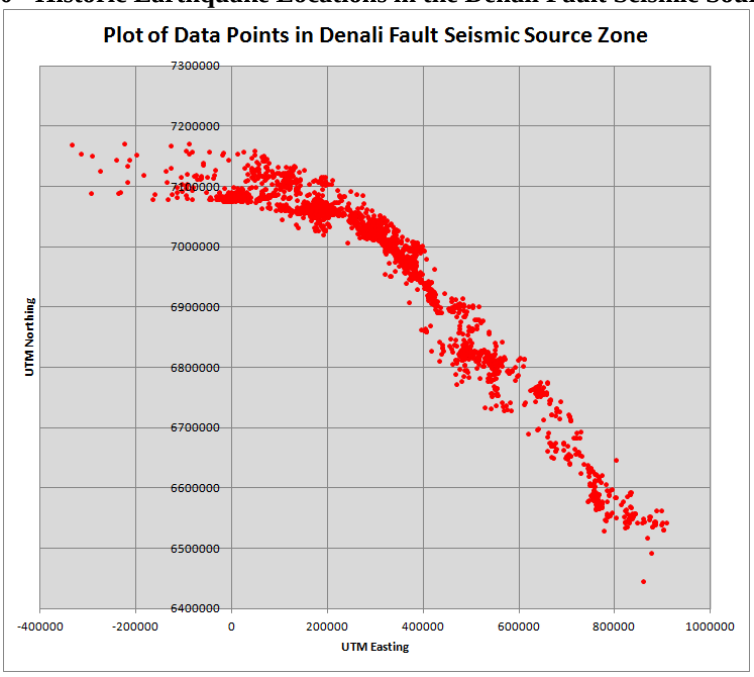


Figure 31 - Frequency Distribution of Magnitude for the Denali Fault Seismic Source Zone

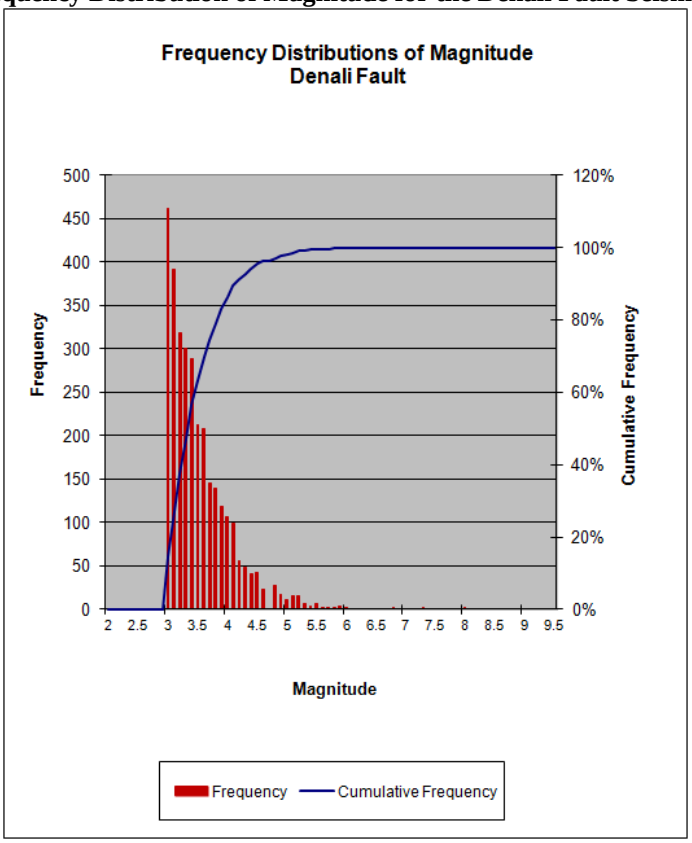
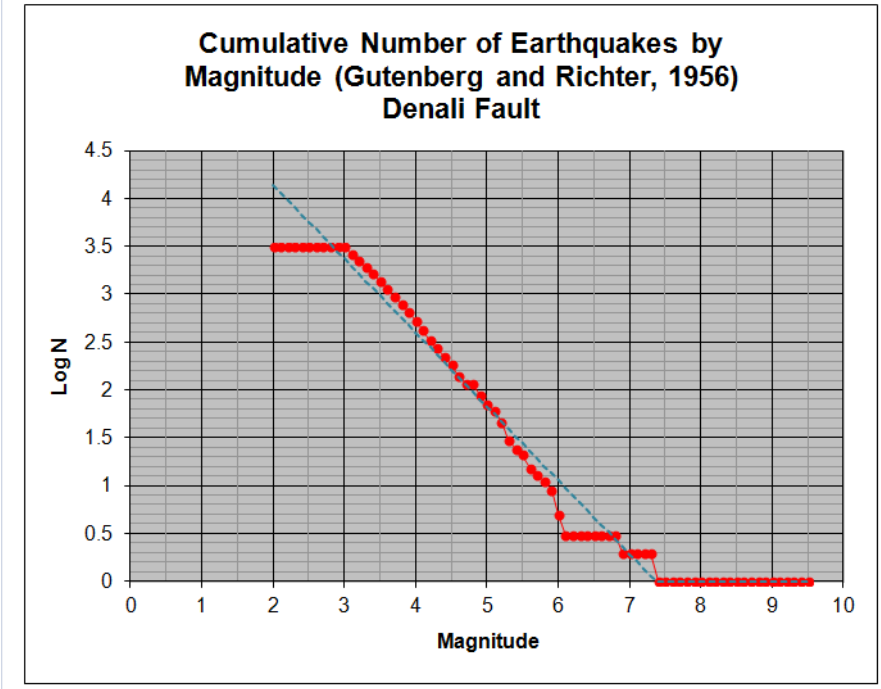
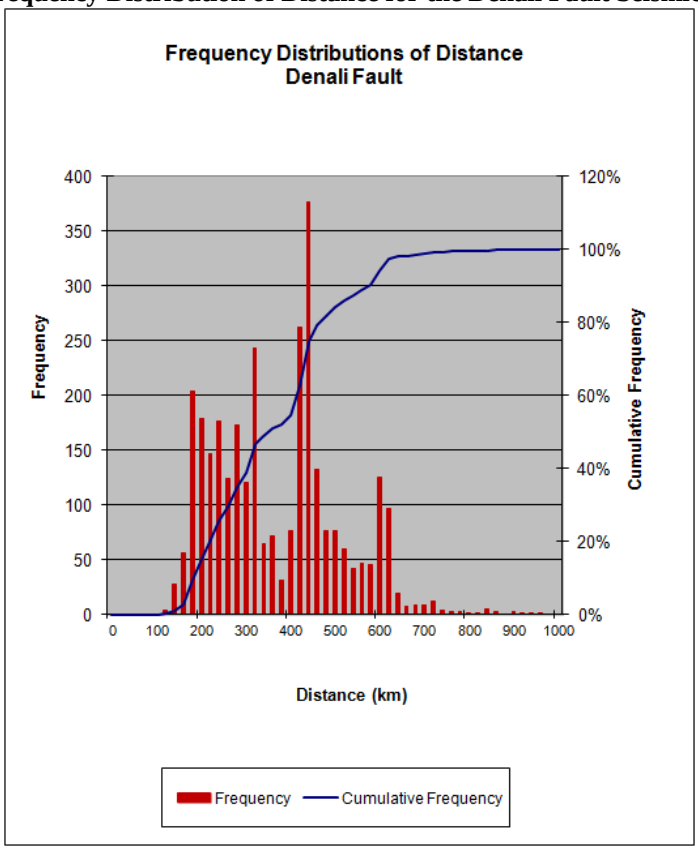


Figure 32 - Gutenberg-Richter Relationship for Denali Fault Seismic Source Zone



Max Historic Magnitude =	7.9

Figure 33 - Frequency Distribution of Distance for the Denali Fault Seismic Source Zone

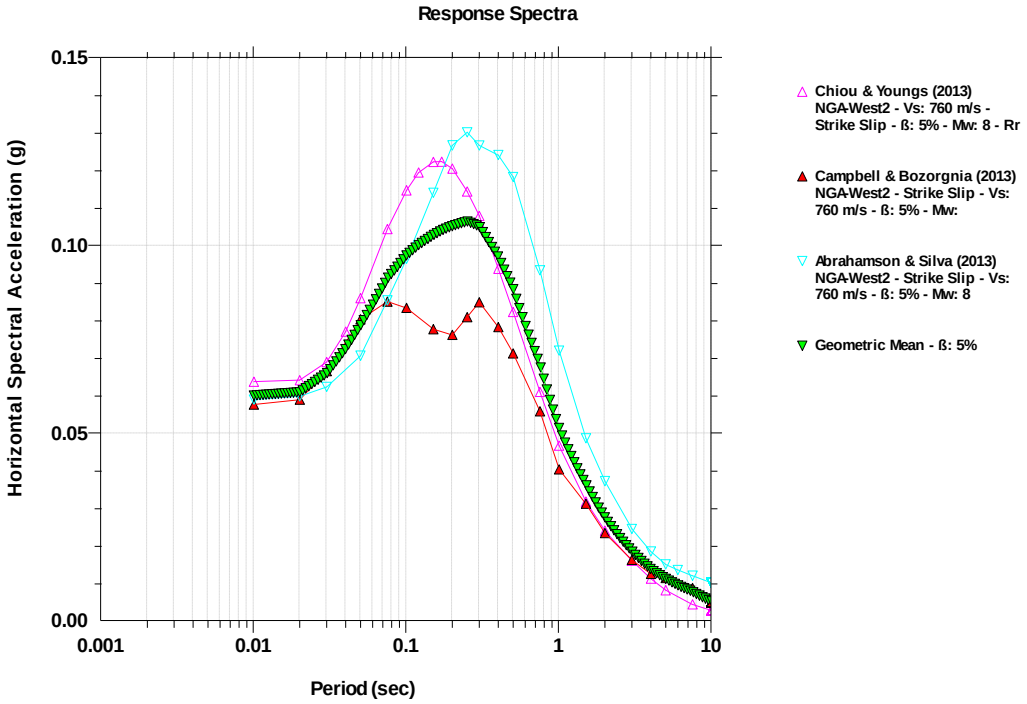


Using the maximum magnitude of 8.0 at the minimum distance of 105 km the attenuated ground motion response spectra shown in Figure 34 was generated. Mean values of pseudo-spectral acceleration were then extracted from this figure and are shown in Table 6.

Table 6 - Attenuated Sa vs. Natural Period for the Denali Fault Seismic Source Zone

Natural Period (s)	Spectral Acceleration (g)
PGA (0 s)	.06
0.2	.11
0.5	.085
1.0	.050
2.0	.0025

Figure 34 - Attenuated Sa Response Spectra for Denali Fault Seismic Source Zone



5.5 Aleutian Megathrust

The Aleutian Megathrust seismic source zone is a wide, rectangular shaped band oriented northwest to southeast and lying just south of the Denali fault. It is modeled as an aerial seismic source zone (see Figure 35). The earthquake pattern reflects a northwest dipping subduction zone/thrust fault where the Pacific Plate is diving below the North American Plate. Figure 36 shows the frequency distribution of earthquake magnitudes within the source zone which is then plotted in the Gutenberg-Richter relationship as shown in Figure 37 and shows an estimated maximum event magnitude of 8.3. This estimate is less than the maximum recorded historic event of magnitude 9.3. Figure 38 shows the distribution of the distances between event epicenters and the site. The statistics of this distribution are as follows:

- Mean = 662 km
- Median = 623 km
- Minimum (closest) = 364 km

Although this seismic source zone is technically a thrust fault, the low angle of the thrust causes the events to be spread out into very broad band that is better viewed as an aerial seismic source zone. The historic events in this zone capture the March 28, 1964 Prince William Sound earthquake which is described in most of the literature as a M9.2 event (although the USGS in its database assigns it M9.3). This event is the second largest earthquake event ever recorded in the world in the history of seismic data collection (second only to the May 22, 1960 M9.5 event in the coastal subduction zone of Chile).

Figure 35 - Historic Earthquake Locations in the Aleutian Megathrust Seismic Source Zone

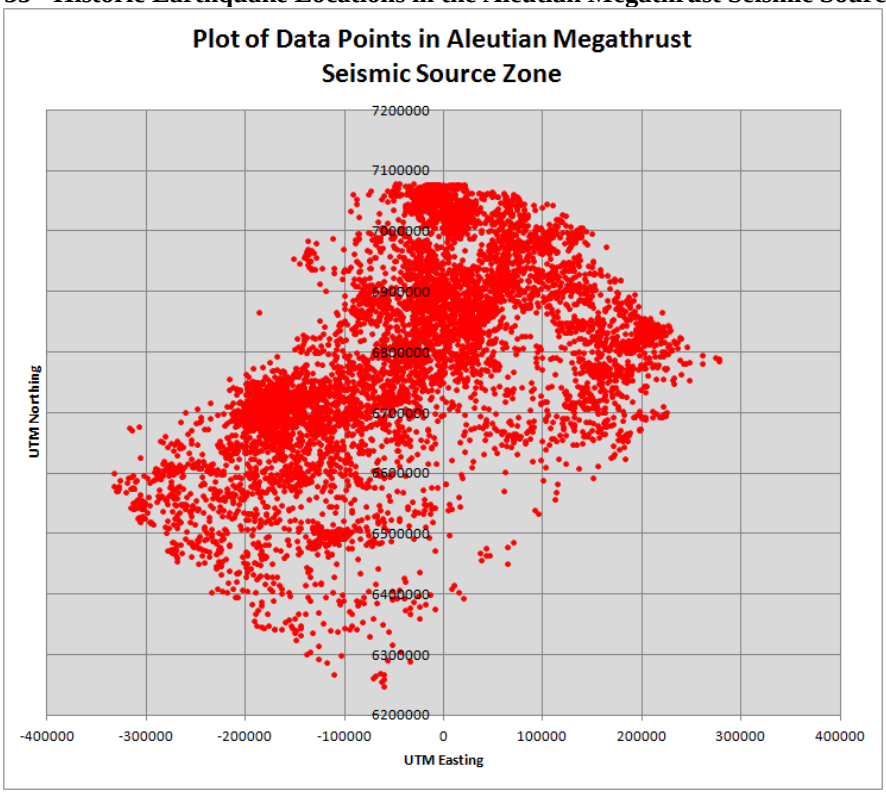


Figure 36 - Frequency Distribution of Magnitude for the Aleutian Megathrust Seismic Source Zone

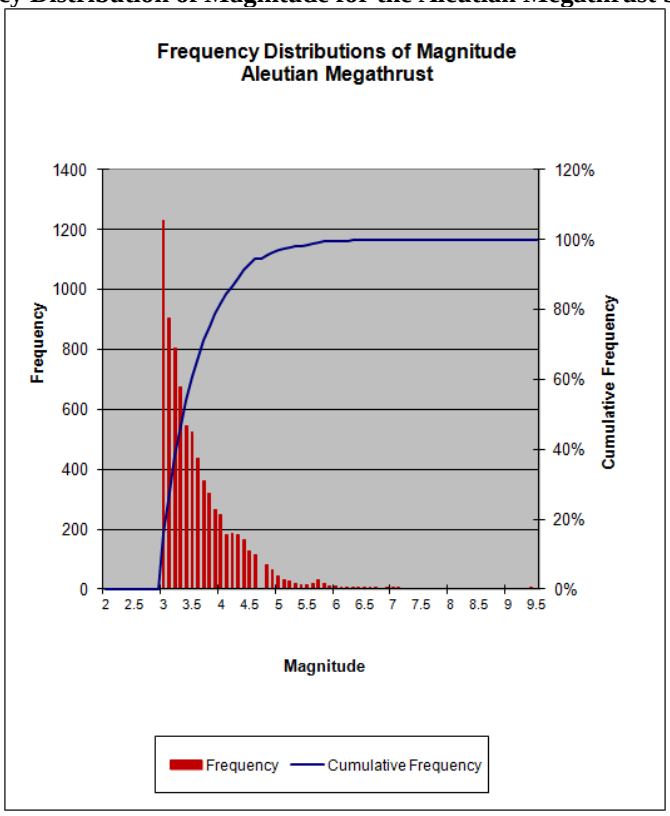
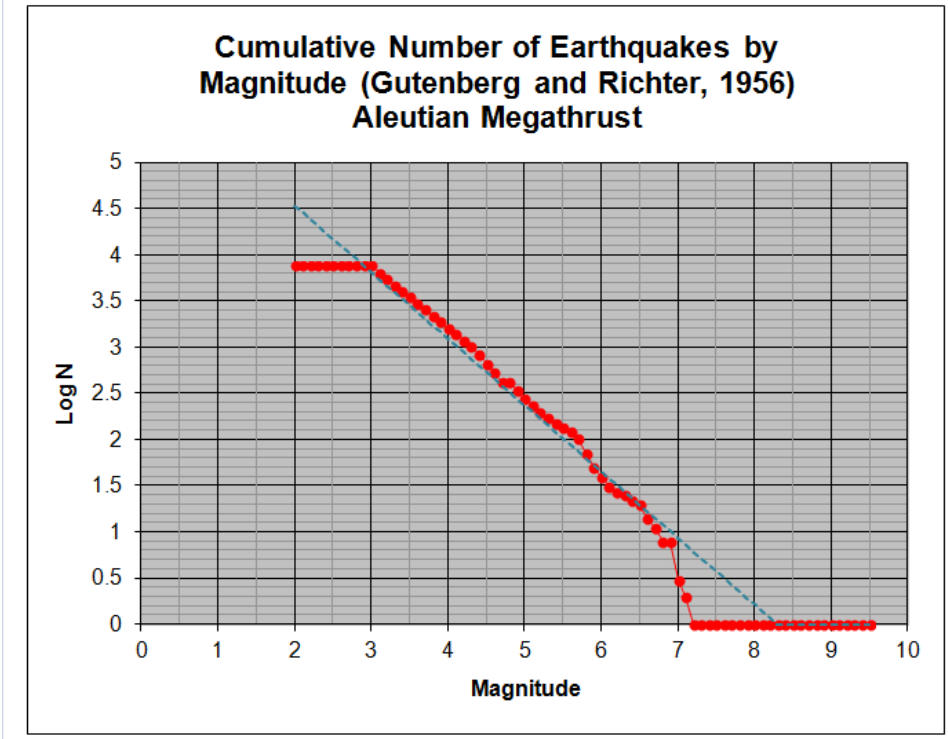
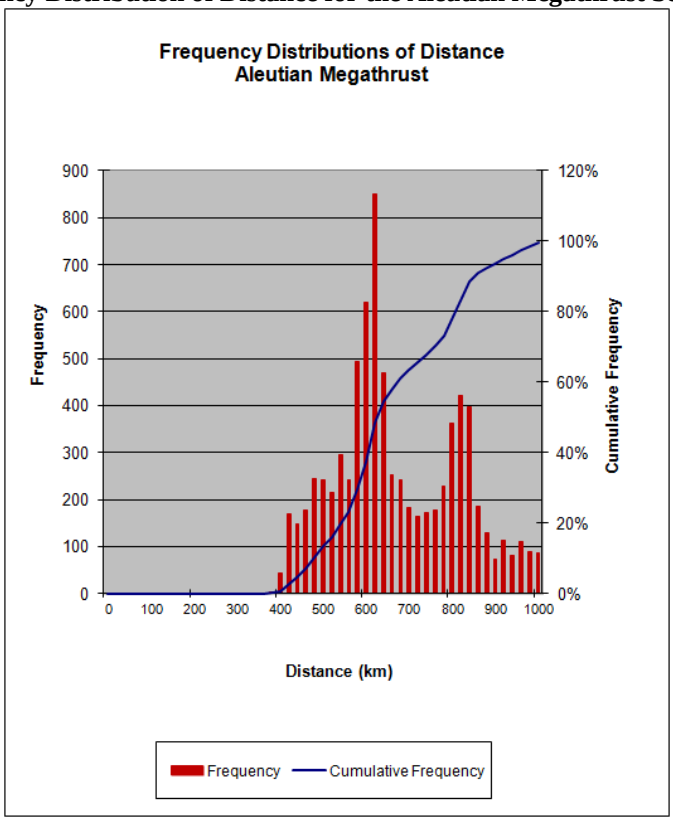


Figure 37 - Gutenberg-Richter Relationship for Aleutian Megathrust Seismic Source Zone



Max Historic Magnitude =	9.3

Figure 38 - Frequency Distribution of Distance for the Aleutian Megathrust Seismic Source Zone



The MCE maximum magnitude of 9.3 at the minimum distance of 364 km exceeds the NGA 2013 attenuated ground motion response spectra relationship limitations for both magnitude and distance. Therefore, it is not possible to use these relationships to estimate ground motion parameters at the site.

However, given the magnitude of the actual recorded event and the relatively close approach to the site for such a large event (well under 400 km), it is considered appropriate to explore potential impacts outside of the accepted 2013 NGA attenuation relationships. One of the most pertinent papers addressing ground motions for subduction zone earthquakes is a 2003 paper by Atkinson and Boore entitled "Empirical Ground-Motion Relations for Subduction-Zone Earthquakes and their Application to Cascadia and other Regions". Some of the principal observations and conclusions from that paper can be summarized as follows. For a megathrust interface earthquake of M8+ at a distance of 100 km from the causative fault the following ground motions could be expected:

- 110 cm/s2 at 0.5 Hertz (Hz) (0.112g at a period of 2 s)
- 660 cm/s2 at 2.5 Hz (0.673g at 0.4 s)
- 410 cm/s2 at 5 Hz (0.418g at 0.2 s)
- PGA of 180 cm/s@ (PGA of 0.183g)

These damaging ground motions would be experienced over a very large area approximately 300 km wide (presumed to be normal to the fault trace) by 500 km long (presumed to be along the fault trace). Near field ground motions appear to saturate above about magnitude 8 (i.e. ground motions above M8 are not significantly different from those at M8). Figure 39 is a figure from the paper that shows a plot of the predicted PGA vs. magnitude and distance for both rock sites (dashed line) and soil sites (solid line). Examination of this plot shows the saturation effect as the

curves for the M7.5 event and the M8.5 event converge on the left edge of the plot at a fault distance of about 20 km. It also shows the very flat nature of the M8.5 curve up to about 100 km distance from the fault (i.e. virtually no attenuation for the first 100 km). The magnitude range of the dataset used to generate these curves was M6.0 to M8.3. Therefore they still do not apply directly to a M9.2+ event. In Figure 40 a graphical extrapolation of the curves was subjectively applied to represent a potential M9+ event that preserves the saturation over the first 100 km of distance but allows for separation of the curves over larger distances (the red line added to the figure). This was done to provide a rough "ballpark" estimate of the kind of ground motion that might be experienced at the project site in response to another great megathrust earthquake event along the eastern edge of the Aleutian Megathrust seismic source zone. Similarly a graphical extrapolation of the ground motion curves for 5 Hz (0.2 s period) and 0.5 Hz (2 s period) is shown in Figure 41 and Figure 42 respectively.

Figure 39 – PGA vs. Distance for Interface Megathrust Earthquake Events

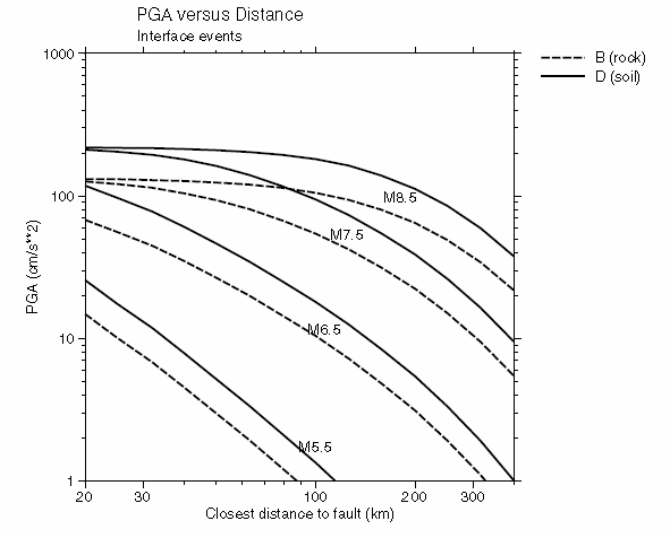


Figure 40 - PGA vs. Distance for Interface Megathrust Earthquake Events with Graphical Extrapolation

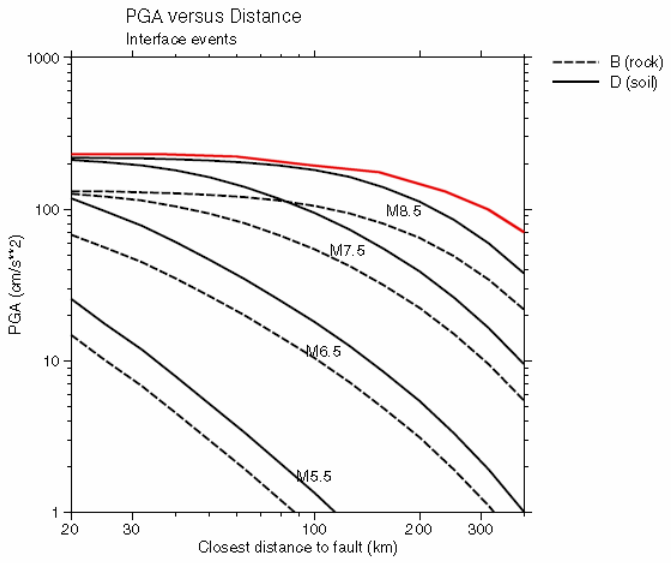


Figure 41 – Sa 0.2s vs. Distance for Interface Megathrust Earthquake Events with Graphical Extrapolation

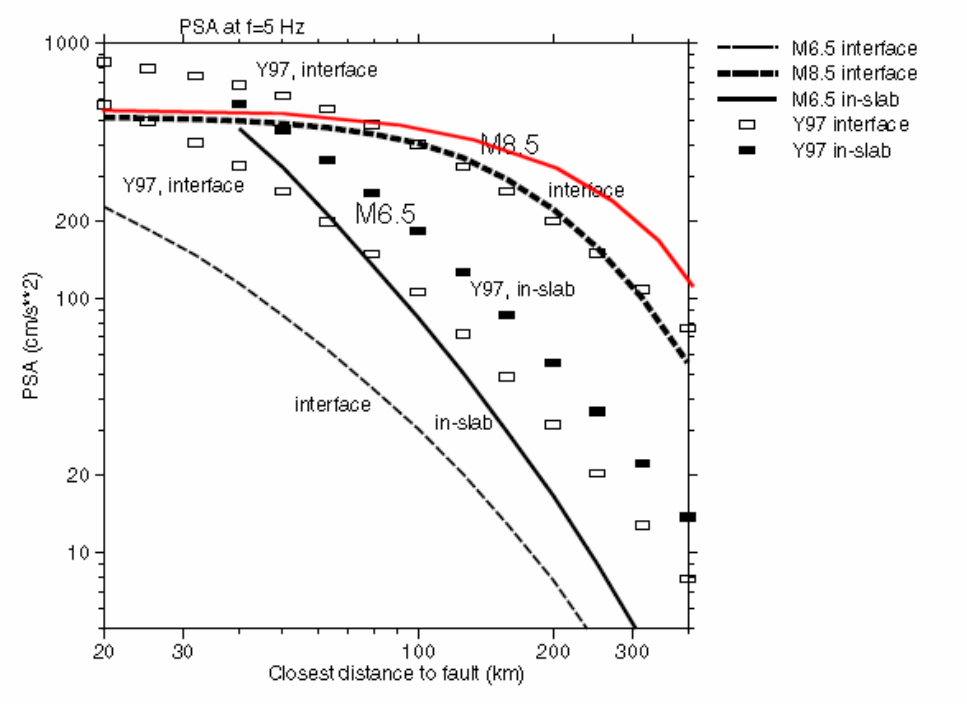
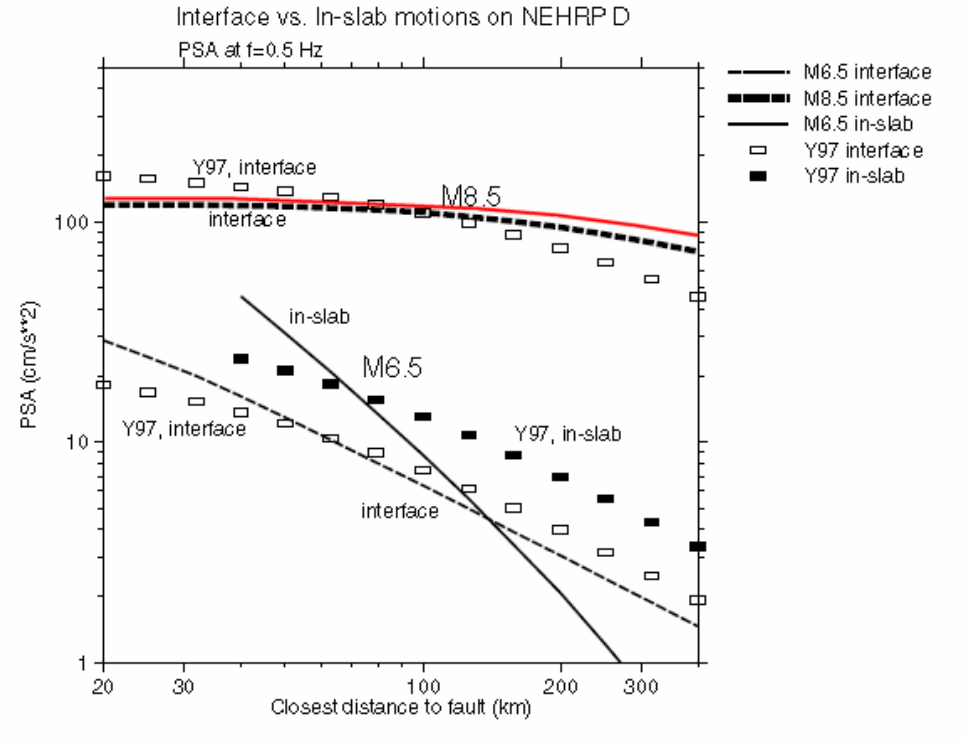


Figure 42 - Sa 2s vs. Distance for Interface Megathrust Earthquake Events with Graphical Extrapolation



Extrapolated values of pseudo-spectral acceleration are shown in Table 7.

Table 7 - Sa vs. Natural Period Extrapolated for the Aleutian Megathrust Seismic Source Zone

Natural Period (s)	Spectral Acceleration (g)
PGA (0 s)	0.07
0.2	0.153
2.0	0.092

5.6 Fairweather-Queen Charlotte and Transition Fault

The Fairweather-Queen Charlotte and Transition Fault seismic source zone contains multiple linear seismic sources including the long right lateral strike slip Fairweather-Queen Charlotte fault that extends from the coastal area immediately south of the site off to the southeast into British Columbia and southeast Alaska and the relatively short Transition fault that borders the Yakutat accretion terrane southeast of the St. Elias Mountains. The distribution of historic earthquakes is shown in Figure 43 Figure 44 shows the frequency distribution of earthquake magnitudes within the source zone which is then plotted in the Gutenberg-Richter relationship as shown in Figure 45 and shows an estimated maximum event magnitude of 8.7. This exceeds the maximum recorded historic event of magnitude 7.9. Figure 46 shows the distribution of the distances between event epicenters and the site. The statistics of this distribution are as follows:

- Mean = 509 km
- Median = 517 km
- Minimum (closest) = 267 km

There is relatively little evidence upon which to base an estimate of maximum SRL. However, the fault appears to have a total length of at least 800 km and using the 38% rule of thumb of Slemmons (1977), a SRL of 300 km would seem reasonable. This SRL results in an estimate of magnitude 8.0.

Figure 43 - Historic Earthquake Locations in the Fairweather-Queen Charlotte and Transition Fault Seismic Source Zone

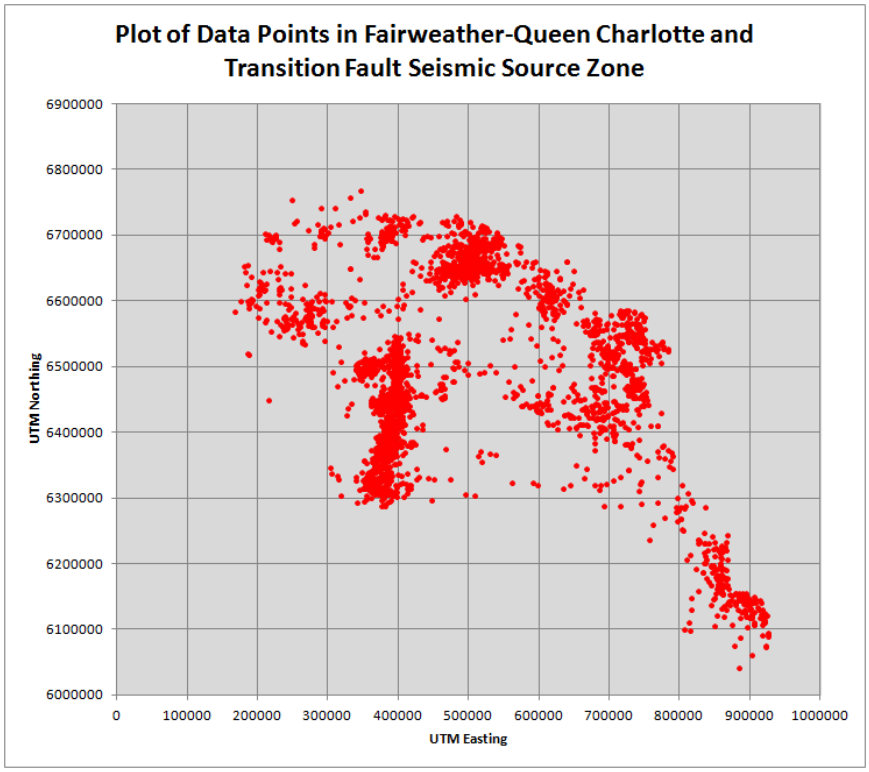


Figure 44 - Frequency Distribution of Magnitude for the Fairweather-Queen Charlotte and Transition Fault Seismic Source Zone

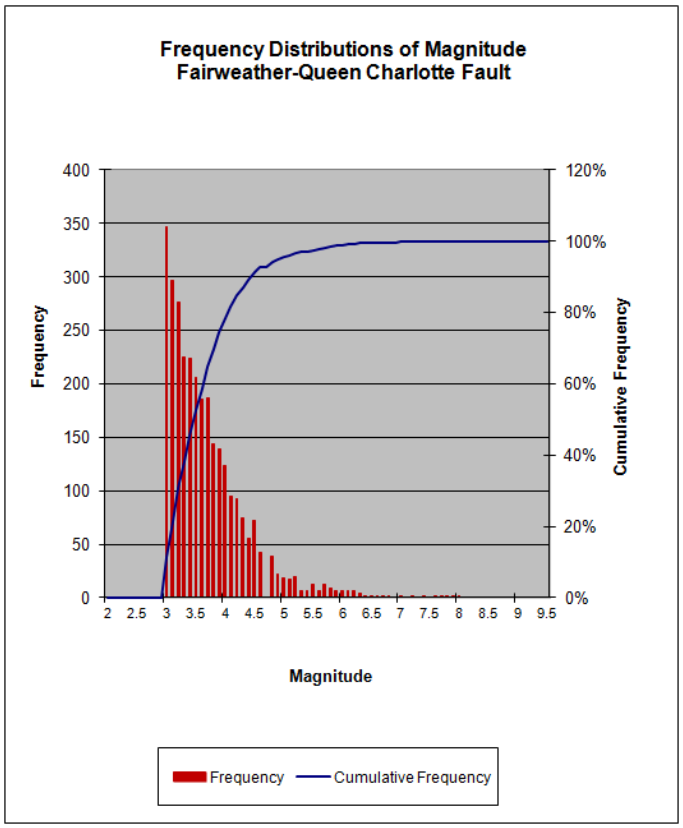


Figure 45 - Gutenberg-Richter Relationship for Fairweather-Queen Charlotte and Transition Fault Seismic Source Zone

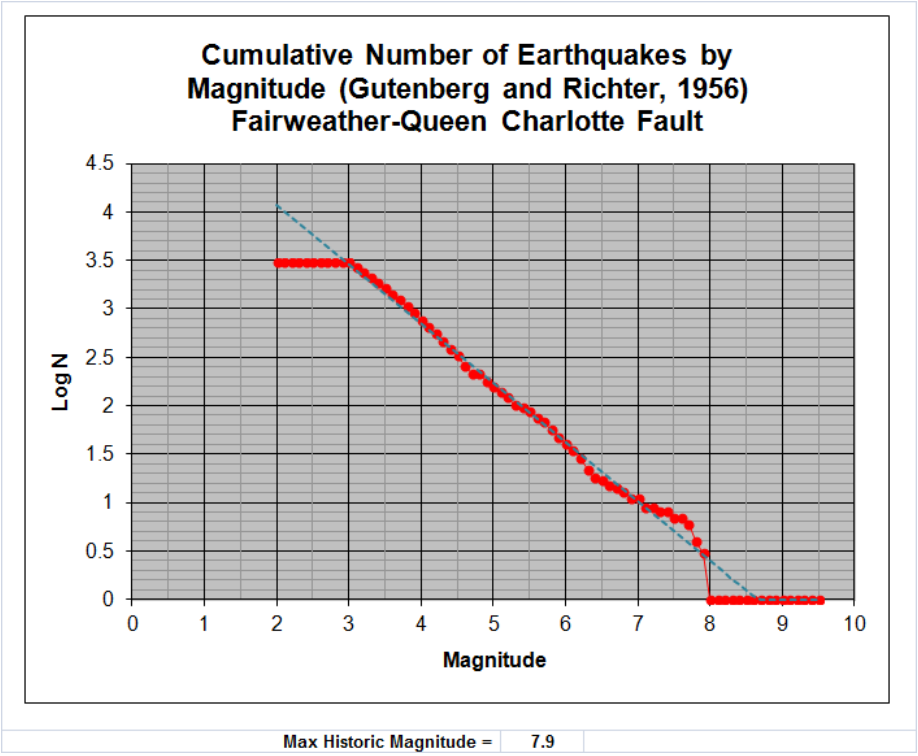
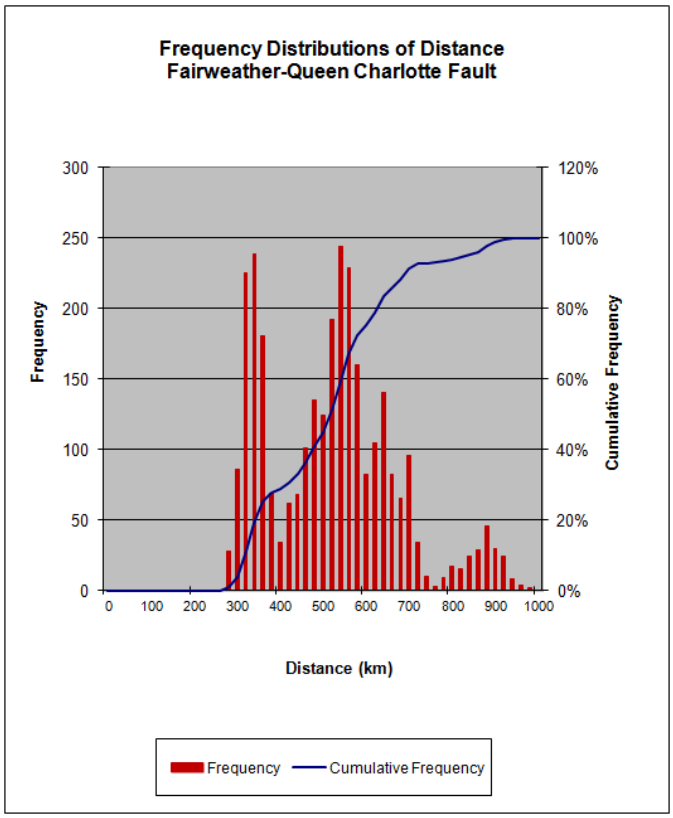


Figure 46 - Frequency Distribution of Distance for the Fairweather-Queen Charlotte and Transition Fault Seismic Source Zone



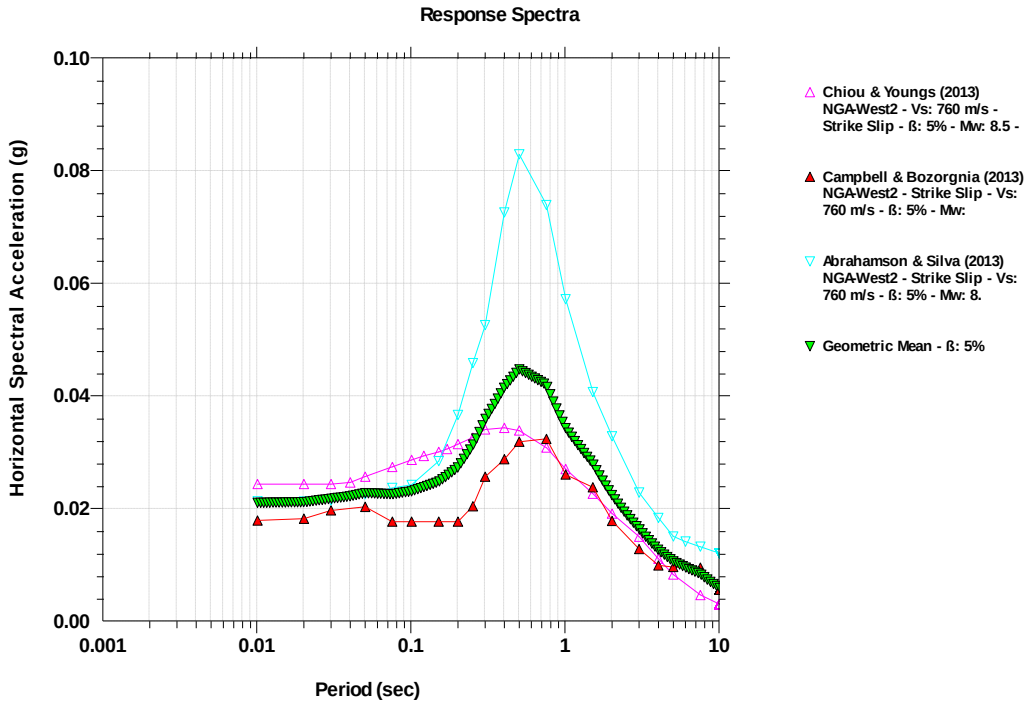
Although the distance falls within the valid range, the magnitude of 8.7 slightly exceeds the magnitude limitation of M8.5. In order to obtain an approximation of expected ground motions, a maximum magnitude of 8.5 was used in the evaluation but rather than the mean parameters, the more conservative estimates of the Abrahamson and Silva NGA West 2 relationship was used to account for the slightly larger MCE of M8.7. Using the maximum magnitude of 8.5 at the minimum distance of 267 km the attenuated ground motion response spectra shown in Figure 47 was generated. Values of pseudo-spectral acceleration were then extracted from this figure (using the Abrahamson and Silva relationship) and are shown in Table 8.

Table 8 - Attenuated Sa vs. Natural Period for the Fairweather-Queen Charlotte and Transition Fault Seismic Source Zone

Natural Period (s)	Spectral Acceleration (g)
PGA (0 s)	.022
0.2	.036
0.5	.084
1.0	.056
2.0	.032

The plot shown in Figure 47 clearly shows the effect of less attenuation of longer period (lower frequency) vibrations at longer site distances.

Figure 47 - Attenuated Sa Response Spectra for Fairweather-Queen Charlotte and Transition Fault Seismic Source Zone



5.7 DSHA Results Summary

Results of analyses for all seismic source zones are summarized in Table 9. Most building codes (including the 2010 National Building Code of Canada (NBCC)) allow for either a site specific deterministic design approach or a probabilistic approach. For the site specific DSHA procedure the estimated spectral acceleration values at the various natural periods as shown in Table 9 are used to develop a design spectral acceleration response spectrum. These design accelerations are then used to determine seismic loads for structural design which will also vary as a function of occupancy and use.

Figure 48 shows a plot of the grouping of spectral acceleration (Sa) vs. natural period (T) for all of the seismic source zones considered including the extrapolated estimates for the Aleutian Megathrust seismic source zone. A final design spectrum is obtained by taking the maximum spectral response acceleration at each natural period attributed to any one of the seismic source zones. However, some special circumstances warrant discussion in the development of the final design spectrum for the Coffee Gold Project site. The first is the Tintina Trench seismic source zone where the Coffee Gold Project site itself is located. The spectral acceleration curve for the minimum recorded site distance of 55 km is shown as the magenta curve on Figure 48. The spectral acceleration curve for an earthquake epicenter at the project site (distance of 1 km) is shown as the red curve on Figure 48. In the absence of any geologic constraints that could preclude earthquake events within the 55 km radius and the assumption that earthquakes are equally likely to occur at any location within seismic source zone it would seem reasonable that the closer (1 km) earthquake control the short period design accelerations. The second issue involves the extrapolated Sa values for the Aleutian Megathrust seismic source zone. As can be seen on Figure 48 the design Sa values are dominated by the Tintina Trench 1 km values until a natural period of approximately 0.75 s when the values for the Aleutian Megathrust zone (shown as a dashed purple line in Figure 48) begin to exceed those from any other seismic source zone. Although the probabilistic aspects of the seismic hazard will be addressed in a following section, it warrants mentioning that the great megathrust interface earthquake event is extremely rare having a high recurrence interval. It would be appropriate to consider this event for important permanent structures with a long expected design life (often 100 yrs +) such as a major dam, a major bridge, or a high rise structure. But the structures anticipated at the Coffee Gold Project are expected to be temporary (an expected mine life less than 20 yrs) and the only permanent structures are likely to be reclaimed earthworks with natural periods likely in the range of 0.1 s to 0.8 s. So the use of the Aleutian Megathrust Sa values would seem to be excessively conservative. The Fairweather-Queen Charlotte and Transition Fault zone begins to dominate spectral acceleration beyond a natural period of 1.6 s.

Seismic design procedures often differ from one code to the next and the NBCC does differ from the procedures of the International Building Code (IBC) commonly used at mining sites around the world. One significant difference is in the procedure for development of the design pseudo-acceleration spectrum. The NBCC for Site Class C assigns values of 1.0 to both the acceleration based site coefficient (Fa) and the velocity based site coefficient (Fv) then applies those coefficients directly to the short and long period values of Sa. The IBC for Site Class C assigns value of 1.2 to Fa and 1.7 to Fv, then applies those coefficients to the short and long period values of Sa and reduces them by 2/3. The different procedures result in significantly different design response spectrums as shown in Figure 48 vs. Figure 49 and for the final design spectrum Figure 50 vs. Figure 51. Both spectra have been provided here so that vendors with “standard” facility designs used at other sites can directly compare the differences in design criteria.

Table 9 – Summary of DSHA Results

Seismic Source Zone	Magnitude				Distance (km)			Pseudo-Spectral Acceleration (g)				
	Max Historic	Gutenberg-Richter	Surface Fault Rupture	MCE	Mean	Median	Closest	PGA	0.2 s	0.5 s	1.0 s	2.0 s
Tintina North	6.9	7.2	---	7.2	547	496	118	.026	0.047	0.038	0.022	0.011
Inland Alaska	7.1	7.1	---	7.1	656	633	420	---	---	---	---	---
Tintina Trench at 55 km	4.6	5.0	---	5.0	550	591	55	0.0085	0.0155	0.0065	0.0002	0.0001
Tintina Trench at 1 km	4.6	5.0	---	5.0	---	---	1	0.28	0.53	0.20	0.070	0.020
Denali Fault	7.9	7.3	8.0	8.0	360	350	105	0.06	0.11	0.085	0.050	0.0025
Aleutian Megathrust	9.2	8.3	---	9.2	662	623	364	0.07*	0.153*	---	---	0.092*
Fairweather-Queen Charlotte and Transition Fault	7.9	8.7	8.0	8.7	509	517	267	0.022**	0.036**	0.084**	0.056**	0.032**

Notes: * - Estimated from 2003 Atkinson and Boore equations for ground-motions in megathrust subduction zones

** - Estimated using M8.5 event at 267 km and the Abrahamson and Silva 2013 NGA West 2 attenuation relationship

Figure 48 – DSHA Site Specific Sa Response Spectra by Seismic Source Zone

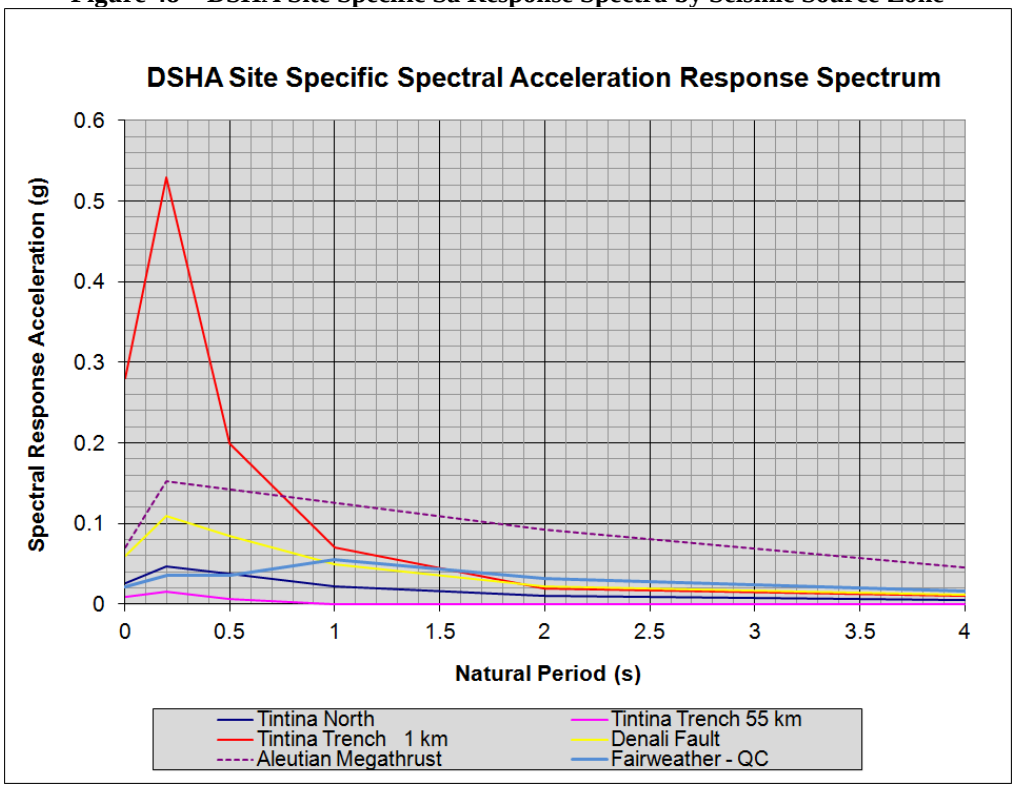


Figure 49 - DSHA IBC General Procedure Sa Response Spectra by Seismic Source Zone

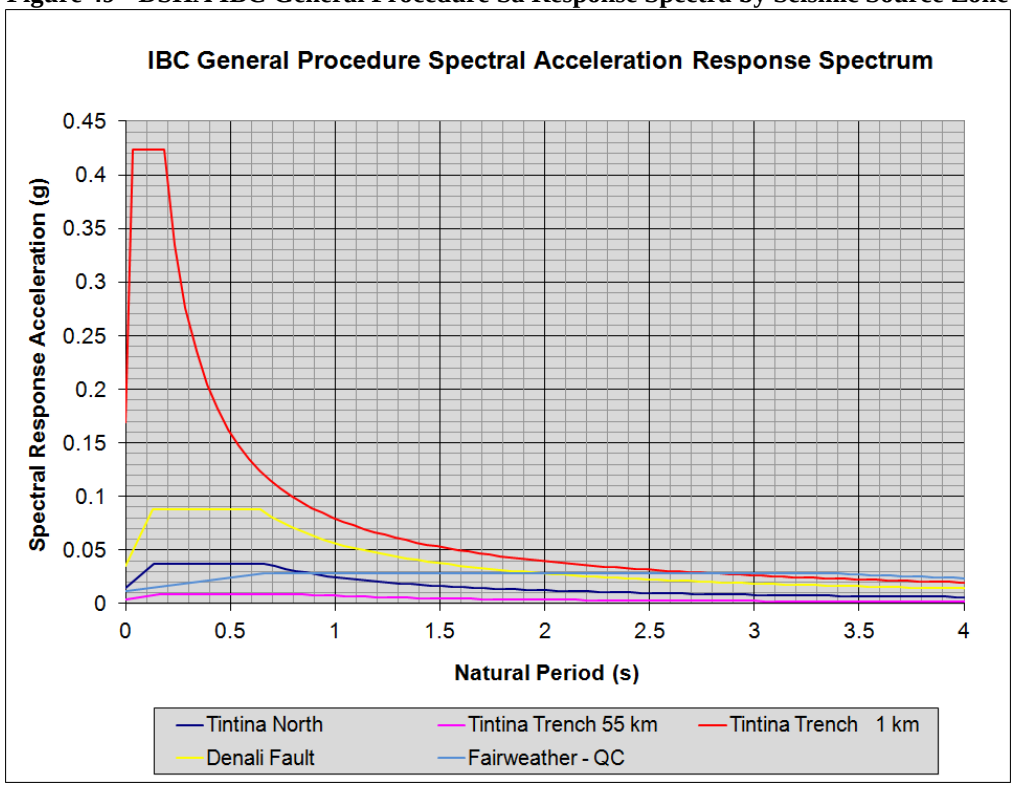


Figure 50 - DSHA Site Specific Sa Design Response Spectra

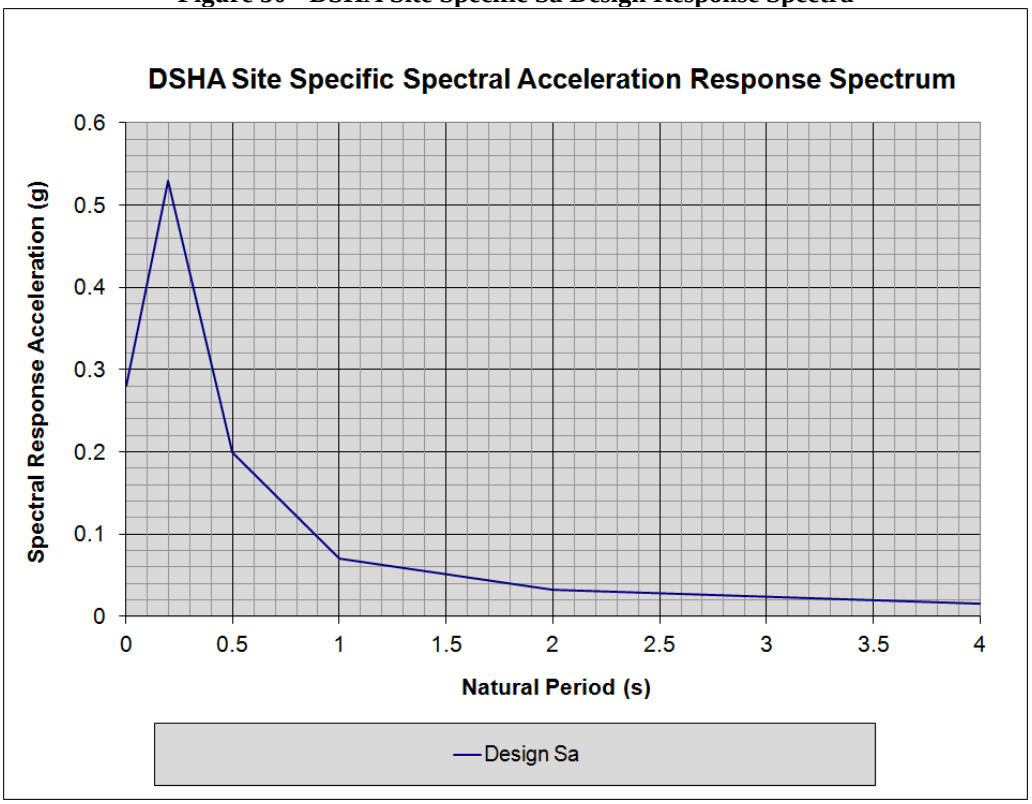
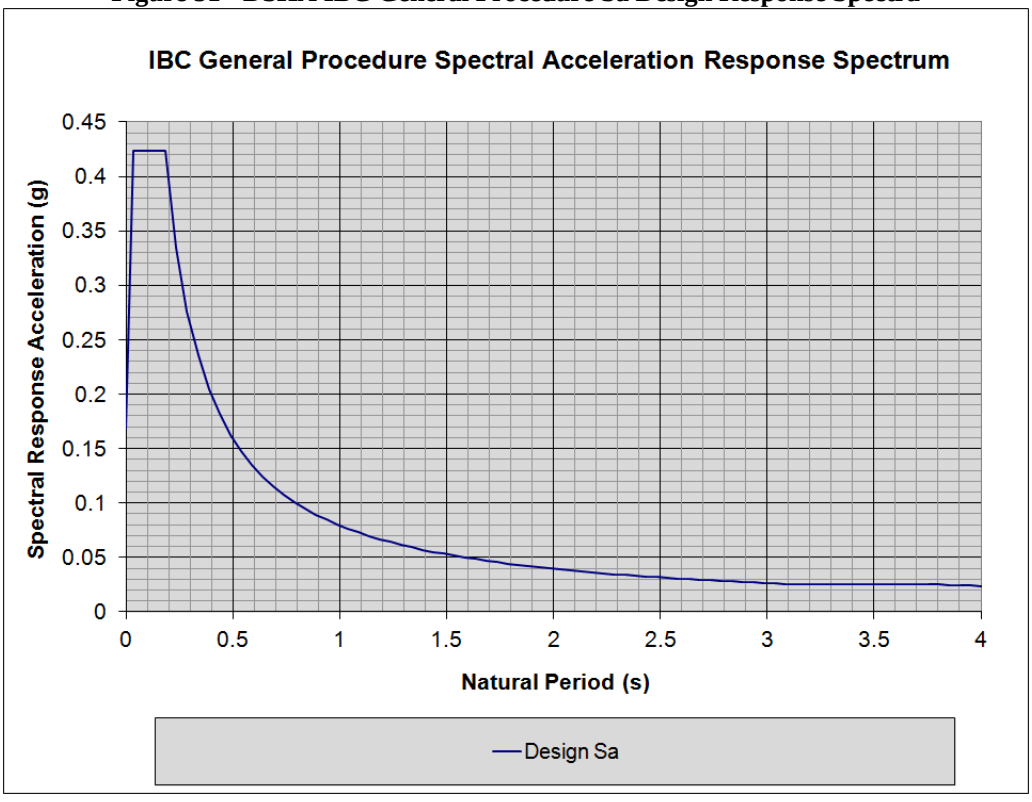


Figure 51 - DSHA IBC General Procedure Sa Design Response Spectra



6 Probabilistic Seismic Hazard Analysis (PSHA)

The PSHA analysis can be performed using the same seismic source zones and by replacing the maximum credible earthquake with the probability distribution of earthquake events, the site distance with the probability distribution of site distances, and adding a random component to the attenuated spectral acceleration values, then using a Monte Carlo type sampling model to compile a new distribution of spectral accelerations associated with an exceedance probability. However, some developed countries, including the U.S. and Canada, have their own web-based PSHA programs that use regionally based maps of seismic source zones and compute site distances by asking you to enter a specific geographic site location using latitude and longitude.

The Canadian PSHA model is located on the Natural Resources of Canada website and was utilized to generate the information found in Appendix A and summarized in Table 10. The results assume a Site Class C (stiff soil and/or soft rock in the upper 30 m of the subsurface profile) and are consistent with the observed site conditions at the Coffee Gold Project site.

In applying the PSHA results to design, there is no longer a single design earthquake event (in the case of DSHA the maximum credible earthquake or MCE). Now it is necessary to choose an appropriate design earthquake that has an associated annual exceedance probability, or its inverse, the recurrence interval. Selection of the appropriate design earthquake is commonly a function of the facilities purpose or function, its importance, and the consequences of failure. In that context, a description of some commonly used definitions would be appropriate.

Earthquake design levels and their definitions can vary with the nature of the facility and the regulatory agency in charge of overseeing their design and operation. Some common definitions will be described here as follows:

- Operating Basis Earthquake (OBE) – Sometimes also referred to as the operating level earthquake (OLE) it is the earthquake for which a structure is designed to remain operational with damage considered to be readily repairable following the event. In terms of probability, it is usually taken to be the earthquake having a 50% probability of exceedance in 50 yrs.
- Design Basis Earthquake (DBE) – Sometimes also referred to as the contingency level earthquake (CLE) it is the earthquake expected to produce significant damage (with the facility not necessarily remaining operational), but with damage that is ultimately repairable. In terms of probability, it is usually taken to be the earthquake having a 10% probability of exceedance in 50 yrs.
- Maximum Credible Earthquake (MCE) – This has already been described under DSHA procedures as the largest earthquake capable of occurring under the known tectonic framework for a specific seismic source. It can sometimes also be referred to as the controlling earthquake.
- Maximum Design Earthquake (MDE) – This is the earthquake that is expected to produce the strongest level of shaking and is often used interchangeably with the MCE event described above, however it is based on *ground motions* **not** earthquake magnitude. It can be determined from deterministic or probabilistic methods.

- Maximum Considered Earthquake (MCE) – Often confused with the other MCE (maximum credible earthquake) it is usually intended to be the probabilistic equivalent of the maximum credible earthquake and has meaning only in the context of a PSHA analysis so it is important to make it clear up front, which MCE is being used in any discussion. It is commonly used as the required design criteria in building codes. In terms of probability, it is usually taken to be the earthquake having a 2% probability of exceedance in 50 yrs.

  Note: The definition descriptions above have numerous sources, but much of the language was derived from a 2011 presentation by Oregon State University.

Figure 52 plots the DSHA spectral response spectra (shown as a dashed gray line) on the same plot as the PSHA spectral response spectra in order to permit a comparison of the two methods. As expected the design ground motions from the DSHA analysis are similar but more conservative, at least for natural periods less than 0.8 s. The reduced probability of larger earthquakes occurring in very close proximity to the site moderates the distribution of spectral accelerations resulting in reduced short period Sa values from the PSHA. Beyond the natural period of 0.8 s the design Sa is slightly less than both the 2% and 5% exceedance earthquakes (return periods of 2475 yrs and 1000 yrs respectively), implying that these rare, large earthquakes occurring at larger radial distances have a magnitude higher than the MCEs selected for the DSHA analysis.

Table 10 – Summary of PSHA Results

Annual Exceedance Probability	**0.01**	**0.0021**	**0.001**	**0.000404**
Recurrence Interval (yrs)	**100**	**475**	**1000**	**2475**
Probability of Exceedance in 50yrs	**40%**	**10%**	**5%**	**2%**
Period (s)	**Sa (g)**	**Sa (g)**	**Sa (g)**	**Sa (g)**
PGA	0.038	0.067	0.086	0.116
0.2	0.068	0.123	0.161	0.225
0.5	0.049	0.087	0.112	0.151
1	0.034	0.062	0.078	0.103
2	0.022	0.039	0.048	0.063
4*	0.011	0.0195	0.024	0.0315

Note: * - Per the 2010 NBCC the 4s Sa = (2s Sa)/2

Figure 52 – Plot of PSHA Results and Comparison with DSHA Results

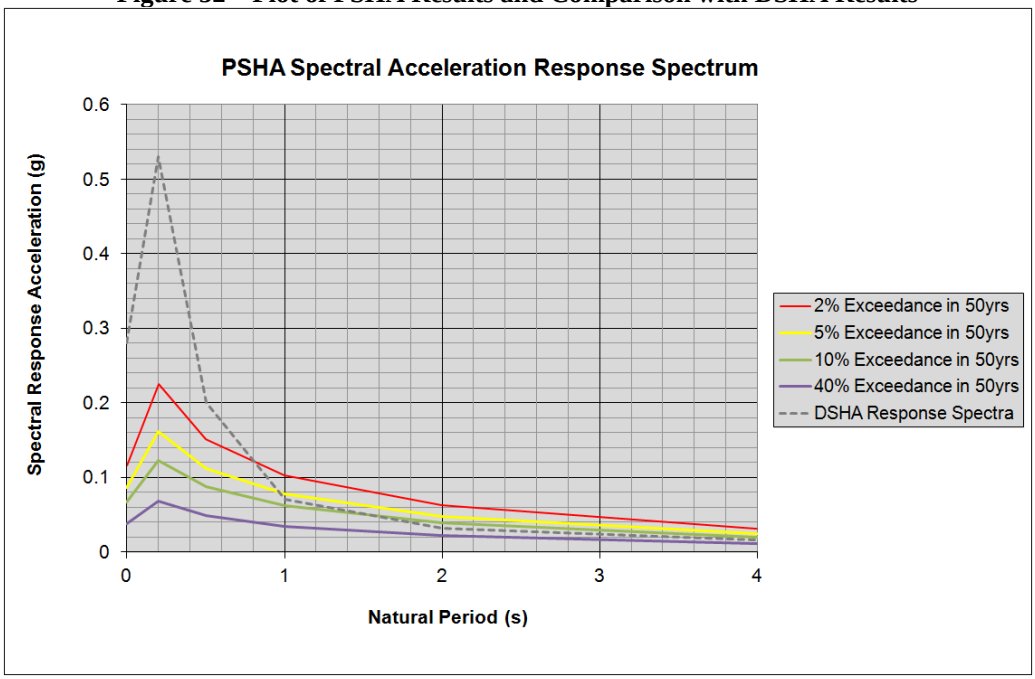
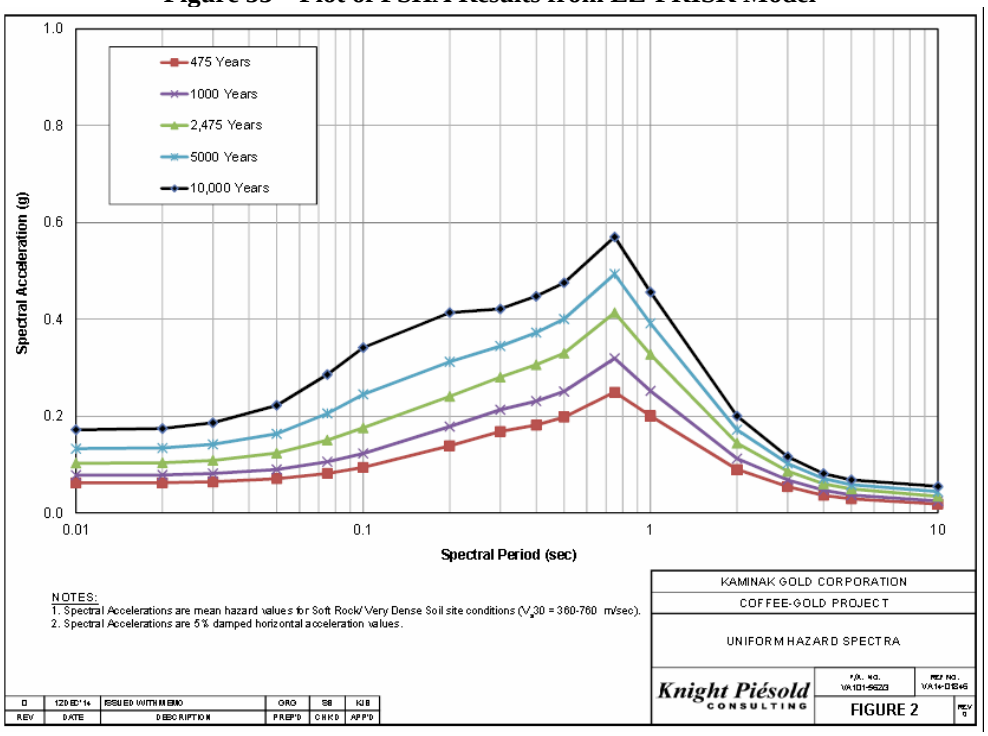


Figure 53 shows the PSHA results from the proprietary EZ-FRISK program taken from the Knight Piesold preliminary seismic study. The Sa values for the 2% exceedance in 50 yrs event are similar up to the 0.2 s natural period, but then go on to peak consistently at a natural period of 0.75 s at a Sa nearly double the 0.2s Sa for all earthquake levels. The reason for this behavior is unclear.

Figure 53 – Plot of PSHA Results from EZ-FRISK Model

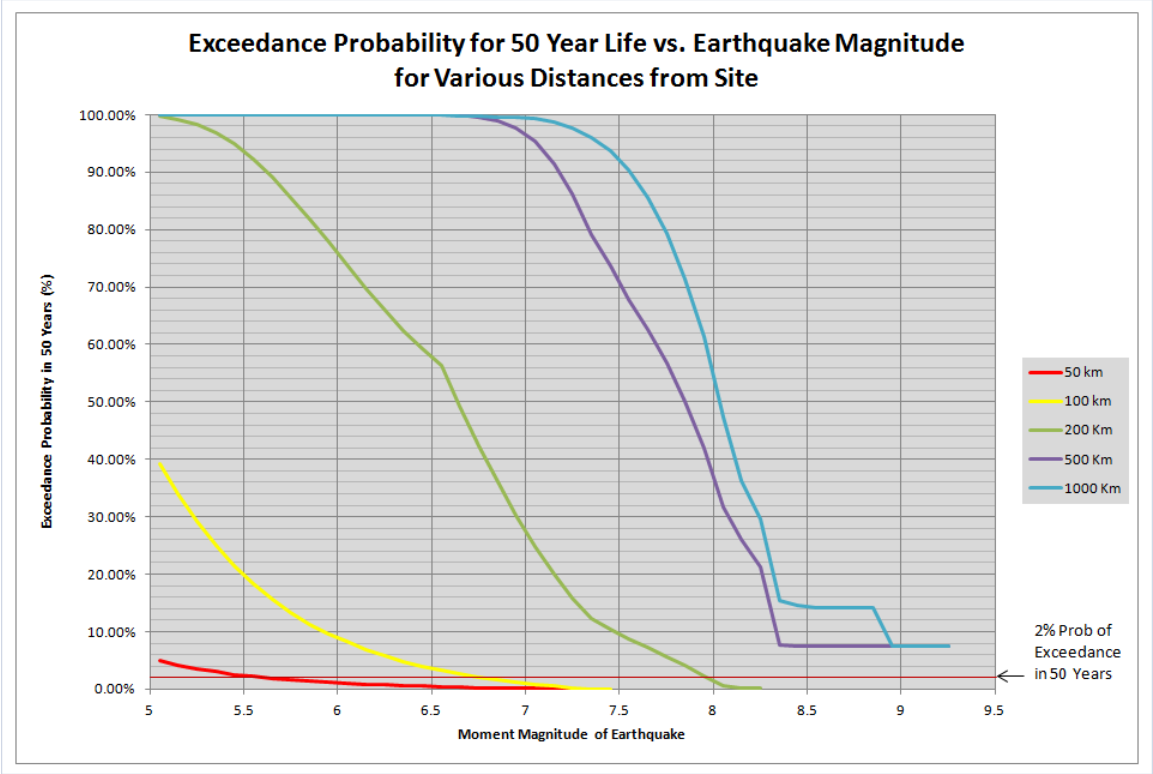


The USGS PSHA web based model functions only within the limits of the United States. However, they do provide custom hazard maps and estimates of earthquake magnitude vs. exceedance probability over a 50 year interval at most world locations based on latitude and longitude coordinates. Figure 54 is a plot of earthquake magnitude vs. Exceedance Probability in 50 years and Table 11 shows the estimated earthquake magnitude as a function of exceedance probability and radial distance from the Coffee Gold Project site.

Table 11 – Summary of Earthquake Probability Level vs. Radial Site Distance from USGS Model

RI (yrs)	Ex. Prob. in 50 yrs	Radial Distance from Site				
		50	100	200	500	1000
100	40%	< 5.0	< 5.0	6.8	7.95	8.1
475	10%	< 5.0	5.9	7.5	8.3	8.9
1000	5%	5.05	6.3	7.8	9.3+	9.3+
2475	2%	5.6	6.8	8.0	9.3+	9.3+
5000	1%	6.05	7.0	8.0	9.3+	9.3+
10,000	0.5%	6.45	7.25	8.1	9.3+	9.3+

Figure 54 - Plot of Earthquake Probability Level vs. Radial Site Distance from USGS Model



7 Seismic Design Criteria

For the design of buildings and other structures at the Coffee Gold Project site the PSHA results shown in Table 10 and Figure 52 for the earthquake event having a 2% probability of exceedance in 50 yrs coupled with the criteria and design procedures for estimating seismic loads found in the 2010 NBCC should be applied for structural design.

The kinds of structures anticipated at the Coffee Gold Project site should generally be associated with natural periods less than 0.8 s. Typical structures could include 1 to 5 story buildings (T = 0.1 s to 0.5 s), small concrete gravity structures (T = 0.3 s), or earthen structures (T = 0.1 s to 0.8 s). Most long natural periods are associated long bridges or tall high rise structures (the Golden Gate bridge with T = 18 s or a 70 story skyscraper with T = 8 s). A common rule of thumb for moment frame buildings is T = 0.1 x (No. of Stories). A common rule of thumb for earthen structures is T = 4H/Vs, where H is the average height of the potential sliding mass and Vs is the average shear velocity of the sliding mass. As long as the natural period of a structure is less than or equal to 0.8 s the designer can elect to use a site specific deterministic design procedure and remain conservative.

Seismic design in connection with earthen geotechnical structures (earth dams, embankments, excavations, etc.) is usually associated with slope stability analysis. Current practice in slope design incorporates a hierarchy of slope analysis procedures that progress from simple and conservative, to more rigorous but less conservative. The first level in the hierarchy is the pseudostatic analysis. This procedure has a long history apparently dating back to around 1920. It assumes that the impact of earthquake loading on slope stability can be modeled using a conventional limit equilibrium model with a static horizontal force F (equal to mass times acceleration acting **out** of the slope) applied to the centroid of the mass (or in the case of modern method of slices limit equilibrium models, to the centroid of each slice). Vertical acceleration is not considered in the typical pseudostatic analysis because it tends to be smaller than the horizontal component, can act in either an upward or downward direction, and seems to have a very minor impact on the results. Once a seismic acceleration coefficient is selected, a new FOS is computed and, if found to be greater than 1.0, the slope would be considered stable. Although believed to be very conservative, the degree of conservatism was unknown until researchers began investigating the method further in the 1960's and 1970's. The best known of these studies was published in 1979 by Dr. H. Bolton Seed (*Considerations in the Earthquake Resistant Design of Earth and Rockfill Dams*, Geotechnique, Vol. 23, No. 3, 1979). Dr. Seed's conclusions in that paper were that the pseudostatic analysis procedure was in fact very conservative and recommended that, for slopes composed of materials that showed no significant loss of strength as a result of cyclic loading (i.e., no liquefaction), use of the pseudostatic analysis procedure with an appropriate seismic acceleration coefficient and target FOS would assure acceptably small displacements. The seismic acceleration coefficient is not the same as the peak ground acceleration, but is a ratio of some selected design acceleration to the acceleration of gravity (i.e., it is expressed as a percentage of "g"). Dr. Seed tied his recommendations for the design seismic acceleration coefficient to earthquake magnitude recommending 0.05 g for earthquakes with a magnitude of less than 6.5, 0.10 g for earthquakes with magnitude between 6.5 and 7.5, and 0.15 g for earthquakes with magnitude greater than 7.5 and up to 8.25. His study focused on the design of earth and rockfill dams and he recommended obtaining a target factor of safety of 1.15 (allowing for a 15% reduction in strength as a result of shaking).

Beginning in the 1980's it became commonplace for many practitioners seeking a more technically based method for the selection of the seismic acceleration coefficient to select the value as a percentage of the estimated peak ground acceleration (PGA) at the site (Hynes-Griffin and Franklin, 1984), typically using 50% to 60% of the PGA. However, the basis for the 50% or 60% range was pretty arbitrary. One of the more interesting studies pertaining to selection of the seismic acceleration coefficient was done by California consultant Robert Pyke in 1999. Pyke revisited the original work of Seed whose recommendations were actually a simplified interpretation of the displacement analysis shown in Figure 55. Using Seed's threshold of acceptably small displacements, Pyke produced the curve shown in Figure 56 showing the reduction of the estimated PGA (for the purpose of obtaining a seismic acceleration coefficient

for pseudostatic analysis) to range from 20% (0.2) for a magnitude 6.5 earthquake to 50% (0.5) for a magnitude 8.25 earthquake, using intermediate values on the continuous curve for earthquake magnitudes lying between 6.5 and 8.25. Using the Tintina Trench MCE of 5.0 and the associated PGA of 0.28g from the DSHA, application of Pyke's criteria yields a pseudostatic acceleration coefficient of 0.2 x 0.28 = 0.06g. Similarly, using the expected PGA of 0.116g associated with the maximum considered earthquake having a 2% probability of exceedance in 50 yrs (expected to be an earthquake with magnitude greater than 8,25) Pyke's criteria yields a pseudostatic acceleration coefficient of 0.5 x 0.116 = 0.06g. Therefore, the recommended pseudostatic acceleration coefficient is 0.06g regardless of whether a deterministic or probabilistic approach is used.

Figure 55 - Displacement Analysis Results from Seed, 1979 after Pyke, 1999

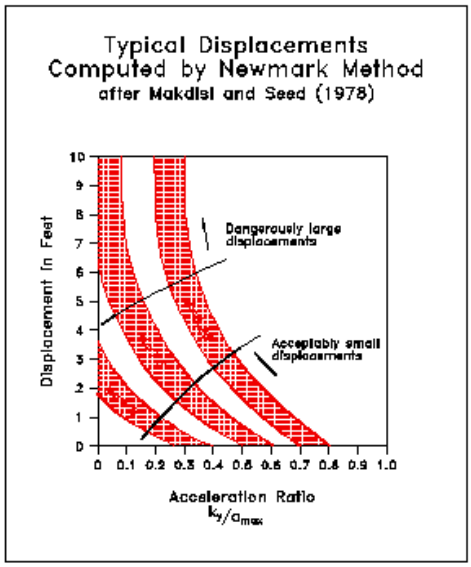
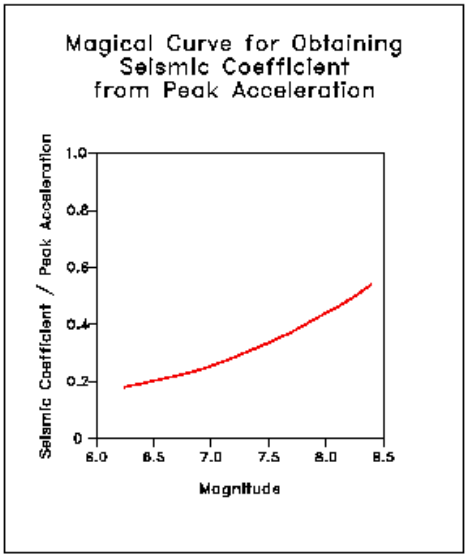


Figure 56 - Pyke's Recommended Reduction of the Peak Ground Acceleration for Selection of a Seismic Acceleration Coefficient as a Function of Earthquake Magnitude



In most cases, if a sufficiently high FOS is computed using the pseudostatic analysis (1.00 for the 1999 Pyke criteria or 1.15 for the 1979 Seed criteria), then it is presumed that displacements during the design earthquake will be acceptably small and no further evaluation of seismic stability impact is necessary. If the FOS is not found to meet the design criteria, then the stability under earthquake loading is considered to be in question, and the designer should proceed to the next level of analysis in the hierarchy to further evaluate seismic stability using a more rigorous analysis procedure.

The second level in the hierarchy of seismic stability analysis is displacement analysis. There are three (3) commonly used procedures for displacement analysis. The first was developed by Newmark and published in 1965 (*Effects of Earthquakes on Dams and Embankments*, Geotechnique, Vol. 15, No. 2, 1965). Although considered a more rigorous analysis method, the Newmark method is also based on a pseudostatic analysis procedure. A simple pseudostatic stability analysis is used to find the critical seismic acceleration coefficient K_c at which the FOS is exactly 1.00. The critical seismic acceleration coefficient is then converted into the yield acceleration a_y which is assumed to be the horizontal acceleration above which the mass will begin to move. An earthquake time history is then selected that is modified and scaled as necessary to represent the expected design earthquake event. An estimate of the cumulative displacement of the potential failure mass is then obtained by mapping the frequency and duration of the acceleration pulses that exceed the yield acceleration and double integrating that portion of the acceleration time history curve to obtain the displacement (i.e., the integral of the acceleration curve yields the velocity, and the integration of the velocity yields the displacement). The cumulative sum of all the increments of displacement represents an estimate of the total permanent displacement.

The second method is a simplified version of the Newmark procedure published by Makdisi and Seed in 1978 (*Simplified Procedure for Estimating Dam and Embankment Earthquake-Induced Deformations*, Journal of Geotechnical Engineering Division, ASCE Vol. 104, No GT7, 1978). It uses the same sliding block type model of Newmark's analysis but utilizes the average (rather than peak) acceleration computed with the procedure of Chopra and the shear beam method. It is very graphically oriented using a plot that relates the average maximum acceleration with the depth of the potential failure surface and another plot of normalized permanent displacement with yield acceleration for earthquakes of various magnitudes.

The third method is a relatively current updated version of a Newmark type of analysis (Bray and Travasarou, 2007) that makes use of the more comprehensive database of recorded ground motions since 1965. It continues to make use of the concept of a system's yield coefficient, but accounts for the characteristics of the earthquake event using spectral acceleration (Sa), fundamental (natural) period Ts, and earthquake magnitude M. The procedure can be used stochastically, quantitatively addressing uncertainty in the controlling parameters, or deterministically to evaluate seismic displacement potential for a discrete event.

The displacement methods have no simple pass/fail criteria, nor any stable/unstable threshold. They simply produce an estimate of the maximum permanent displacement and it is up to the designer, owner, and potentially a knowledgeable representative of the regulating agency to decide if that amount of displacement is acceptable or unacceptable. In the case of embankment dams there are often physical consequences to displacement (loss of freeboard, reduction of crest width, embankment cracking that could carry seepage and create a piping risk, etc.). With other non-impounding slope structures detrimental impacts from displacement are less clear. Could the displacement undermine a structure at the top of a slope, or impact a structure at the toe, or cross a critical property boundary? Will pipelines, power lines, or drainage facilities be disrupted?

Mine pit slopes and other non-impounding embankments and slopes often have few direct consequences from displacement. So what represents unacceptable displacement? One way to look at it in slopes of rock or stiff soil would be to limit displacements to something that would not exceed the yield strain (the strain at which peak stress is attained and beyond which the available stress drops quickly to lower residual levels leading to a sudden "brittle" failure and large unpredictable plastic strains). For many intact rock and stiff soil materials the yield strain might be in the range of 0.5% to 1.0%. Therefore, for a small failure plane of 30 m in length, the yield point could potentially be reached with a cumulative displacement of only 15 to 30 cm, or for a larger failure plane of 300 m in length, with a cumulative displacement of 1.5 to 3 m. This sort of approach is similar to the criteria used by Seed as shown in Pyke's graph (Figure 55) that shows dangerously large displacements beginning in a range of 4 to 6 ft (1.2 to 1.8 m) and becoming clearly unpredictable in the range of 8 to 10 ft (2.4 to 3 m) as displacements are increasing rapidly with little or no increase in acceleration ratio. Interpretations of what represents an acceptably small displacement threshold vary widely in the literature typically ranging from about 5 cm to about 100 cm (1 m). However for large pit slopes or high embankments where failure plane lengths can be as large as 500 to 1000 m long, displacements on the order of 5 m to 10 m can be acceptable. In weaker more ductile materials like soil and soft rock, there may not be any peak shear strain behavior, and therefore no specific limiting displacement. At the very least, the comparison of an estimated cumulative axial strain (using the calculated Newmark displacement divided by the failure plane length) to a threshold axial failure strain in intact rock should be conservative. A fractured rock mass is likely to have a much larger peak failure strain (commonly between 1% and 5%).

So what if a displacement analysis shows the expected displacements to be unacceptable? Must the slope then be considered seismically unstable? Not necessarily. The displacement analysis procedures still remain a pseudostatic type of analysis that estimate displacements using models based on the application of unidirectional static loads on rigid bodies and are an approximation of the expected behavior during earthquakes. For critical structures, the last level in the hierarchy of seismic stability analysis tools is a full dynamic analysis. This approach attempts to quantify the true dynamic shear strength and pore pressure response to earthquake shaking using a program such as the SHAKE program (1-D) at one extreme or something like the PEER OpenSees program (3-D) at the other extreme and an appropriately selected and scaled acceleration time history representing the design earthquake. Permanent deformations are estimated using some form of numerical continuum model (i.e., a finite element, finite difference, or discrete element model of the structure/slope). Dynamic modeling tends to be very slow and expensive due to the more extensive data requirements and the complexity of setting up the models. Dynamic modeling is rarely used in mine pit design or non-impounding embankment design. Although more precise in the manner in which earthquake motions and material shear strength behavior are treated, the final result of the modeling is still a displacement time history and has all the same limitations of subjective interpretation associated with the other displacement methods (i.e., what is an acceptable amount of displacement?).

Seismic risk must necessarily consider the potential consequences of the seismic hazard. The nature of the potential impacts vary depending on whether facilities are considered temporary, have a fixed life, or are considered permanent. Facilities can be impacted in a number of ways including surface ground rupture, strong shaking, liquefaction, and seismically induced instability. Other potential impacts not considered pertinent to this site, and therefore not considered, include seiches and tsunamis.

All fixed structures at the site will be impacted by strong ground motion independent of their position at the site. For most facilities, the magnitude threshold at which some level of damage

might be expected is about 5.0 with the severity of damage increasing with increasing magnitude. Probability of impact is simply the probability of the occurrence of the event.

Liquefaction, or the sudden loss of strength in the foundation soils supporting structures, typically begins at a magnitude threshold on the order of 6.0. However, the phenomenon requires not only strong ground motion, but also the presence of loose, saturated, non-cohesive soil. Although these conditions can exist locally where deeply weathered pockets in the bedrock have been filled with loose granular soil, the conditions would be rare and isolated. A detailed evaluation of site specific liquefaction risk is beyond the scope of this study.

Potential impacts from ground rupture during seismic events affect primarily permanent, fixed linear facilities such as roads, channels, pipelines, and so on. Surface ground rupture has been documented during events as small as magnitude 3.6 (Imperial, California, 1966), however, as a general rule, surface fault rupture requires events larger than magnitude 5.5. No known active faults exist on the site, and therefore the risk of impact from surface fault displacement is considered low.

Another potential consequence of a major seismic event is the occurrence of seismically induced instability. David Keefer of the USGS in Menlo Park, California has prepared most of the work on seismically induced slides. His initial study involved a review of 15 historic earthquakes (Keefer, Wiczorek, Harp, and Tuel, 1979) but was subsequently updated and expanded to include 40 historical earthquakes distributed worldwide (Keefer, 1984). His findings showed that the most common seismically induced events included rockfalls, disrupted soil slides, and rockslides. The minimum magnitude threshold required to induce events of this type was 4.0, however, the frequency of slides was not significant until magnitudes on the order of 5.5 were experienced. Magnitude 5.5 earthquakes caused a few tens of slides at most, while earthquakes with magnitudes exceeding 8 caused several thousands of slides at the very least. The area experiencing seismically induced slides varied from 200 km^2 at magnitude 5.5 to more than 100,000 km^2 at magnitude 8.0. The risk of seismically induced instability at the site is low due to the expected low probability/high recurrence interval of a magnitude 5.5+ earthquake. However, a magnitude 5.5+ earthquake near the site would likely cause increased rockfall and raveling on existing mine benches and other slopes of exposed rock.

8 Conclusions and Recommendations

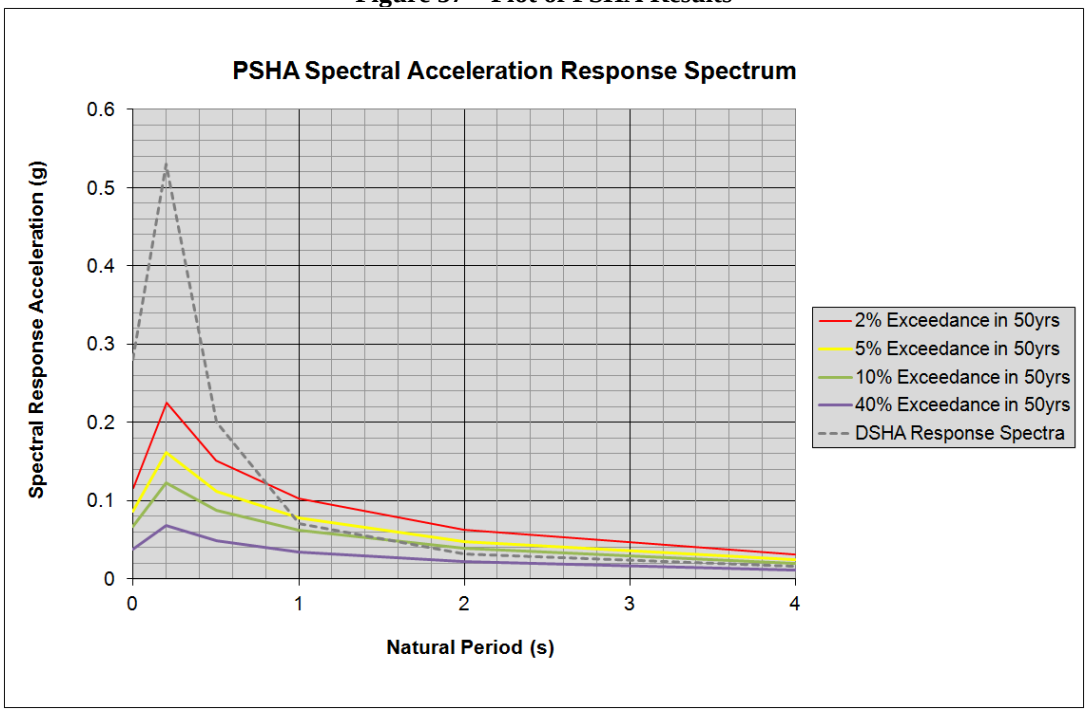
A deterministic approach to seismic hazard analysis or DSHA and a probabilistic approach or PSHA have produced similar design pseudo-acceleration response spectra. For short natural periods between 0.0 s and 0.8 s the deterministic curve is the more conservative (see Figure 57 and Table 12). Beyond a natural period of 0.8 s the PSHA results for a maximum considered earthquake having a 2% probability of exceedance in 50 yrs exceed the DSHA results. This is believed to be the result of changes in the 2010 edition of the NBCC code for PSHA resulting in a reduction in the PGA and short-period spectral values and an increase in the long-period values as well as the influence of larger high recurrence interval earthquakes at larger distances from the site. For most of the structures anticipated to be constructed at the site, use of the PSHA results for the maximum considered earthquake having a 2% probability of exceedance in 50 yrs is recommended.

Table 12 – Summary of PSHA Results

Annual Exceedance Probability	0.01	0.0021	0.001	0.000404
Recurrence Interval (yrs)	100	475	1000	2475
Probability of Exceedance in 50yrs	40%	10%	5%	2%
Period (s)	Sa (g)	Sa (g)	Sa (g)	Sa (g)
PGA	0.038	0.067	0.086	0.116
0.2	0.068	0.123	0.161	0.225
0.5	0.049	0.087	0.112	0.151
1	0.034	0.062	0.078	0.103
2	0.022	0.039	0.048	0.063
4*	0.011	0.0195	0.024	0.0315

Note: * - Per the 2010 NBCC the 4s Sa = (2s Sa)/2

Figure 57 – Plot of PSHA Results



For seismic slope stability analyses in soil and rock, a hierarchy of analysis methods should be implemented with progression to the next method in the hierarchy required only in the event of failure to satisfy the requirements of the previous method. Recommended methods in the order of their application are as follows:

- Pseudostatic stability analysis using a pseudostatic acceleration coefficient of 0.06 g (to be used only at sites with no liquefaction potential).
- Seismic displacement analysis using the procedures of Newmark, 1965, Makdisi and Seed, 1978, or Bray and Travasarou, 2007 showing acceptably small displacements.
- Full dynamic analysis of soil-structure interaction coupled with continuum modeling showing acceptably small displacements.

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Appendix A
Results of PSHA from National Resource of Canada Web Based Modeling Procedure

2010 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Requested by: ,

August 06, 2015

Site Coordinates: 62.8745 North 139.1819 West

User File Reference: Coffee Project Site

National Building Code ground motions:
2% probability of exceedance in 50 years (0.000404 per annum)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA (g)
0.225	0.151	0.103	0.063	0.116

Notes. Spectral and peak hazard values are determined for firm ground (NBCC 2010 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g. 5% damped spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are tabulated. Only 2 significant figures are to be used. ***These values have been interpolated from a 10 km spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the calculated values.***

Ground motions for other probabilities:

Probability of exceedance per annum	0.010	0.0021	0.001
Probability of exceedance in 50 years	40%	10%	5%
Sa(0.2)	0.068	0.123	0.161
Sa(0.5)	0.049	0.087	0.112
Sa(1.0)	0.034	0.062	0.078
Sa(2.0)	0.022	0.039	0.048
PGA	0.038	0.067	0.086

References

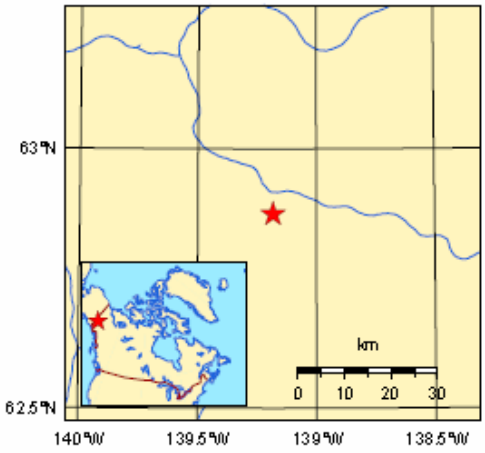
National Building Code of Canada 2010 NRCC no. 53301; sections 4.1.8, 9.20.1.2, 9.23.10.2, 9.31.6.2, and 6.2.1.3
Appendix C: Climatic Information for Building Design in Canada - table in Appendix C starting on page C-11 of Division B, volume 2

User's Guide - NBC 2010, Structural Commentaries NRCC no. 53543 (in preparation)
Commentary J: Design for Seismic Effects

Geological Survey of Canada Open File xxxx
Fourth generation seismic hazard maps of Canada: Maps and grid values to be used with the 2010 National Building Code of Canada (in preparation)

See the websites *www.EarthquakesCanada.ca* and *www.nationalcodes.ca* for more information

Aussi disponible en français



APPENDIX J
Geochemical Source Term Report

APPENDIX J
Geochemical Source Term Report

Coffee Mine Project
Geochemical Source Term Report

Prepared by:
Lorax Environmental Services Ltd.
2289 Burrard St.
Vancouver, BC, V6J 3H9

Prepared for:
Newmont Goldcorp
666 Burrard St #3400
Vancouver, BC V6C 2X8

1 January 2023

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1. Introduction

1.1 Overview

This report describes the geochemical source terms developed and used in the Coffee Mine project water quality model (WQM). Geochemical source terms are water quality predictions for water in contact with geologic material disturbed by mining activities. Individual source terms are developed on an annual basis for each year of mine life and for post-closure. Specifically, the report describes the approach and resultant source terms for:

- WRSFs
- Pit Wall Rock
- Haul Roads
- ROM Stockpiles and
- Heap Leach Solutions

All source term inputs used in the Water Balance Water Quality Model (WBWQM), are presented in Appendix A. For each mine component, a base case and upper case source term has been calculated. The base case source term is meant to reflect the expected condition, while the upper case is meant to reflect a reasonably conservative upper estimate. These predictions become inputs to the WBWQM that is used to predict water quality in the receiving environment as a result of Project activity during operations and following reclamation and closure.

Source terms presented herein reflect the proposed mine plan and associated mine waste management and water management practices. The mine facilities and the assumed lithologic composition are described in Section 2. The geochemical data used to estimate loading rates and solubility controls is described in Section 3. Section 4 presents the approach, methodology and resultant source term determinations for the mine components. The scaling of loading rates and application of solubility controls to develop the source terms are an important discussion within Section 4.

2. Mine Facilities

In this section the footprints, mass and composition of mine waste facilities are presented. These mine facility details used as inputs to source term calculations.

2.1 Waste Rock Storage Facilities

Approximately 330 Mt of waste rock will be excavated from the Supremo Pit, Double Double Pit, Latte Pit and Kona Pit over the life of the Project. The majority of waste rock excavated (~246 Mt) will be stored in one out of pit waste rock facilities (Alpha WRSF) and four in-pit WRSFs (In-Pit Supremo, In-Pit Latte, In-Pit Double Double and In-Pit Kona). The lithologic composition of each waste rock facility is estimated by assuming; no re-handling of waste rock takes place, and waste rock is deposited in the WRSF nearest the origin of excavation; and the proportion of different weathering states is the same as what was anticipated in the Project Proposal geochemical characterization report (Appendix B). This assumption results in waste rock from the Latte Pit (schist) and Kona Pit (granite) being stored in the Alpha WRSF, while waste rock from the Supremo Pit and Double Double pits (gneiss) are placed in the Alpha WRSF and all four In-pit dumps. This results in the Alpha WRSF being the only facility which contains a mixture of different lithologies. The other In-pit waste rock dumps will be composed of exclusively gneiss waste rock. The tonnage and geologic composition of the five WRSFs are shown in Figure 2-1 and Figure 2-2. The annualized footprints of WRSFs are provided in Table 2-1.

At the end of mine life, the mine pits will begin to flood. The ultimate pit lake volume will be controlled by the spillway elevation of each backfilled pit. The percentage of each backfill dump below the spillway elevation, and the percentage of the dump footprint occupied by saturated waste rock, is provided in Table 2-2.

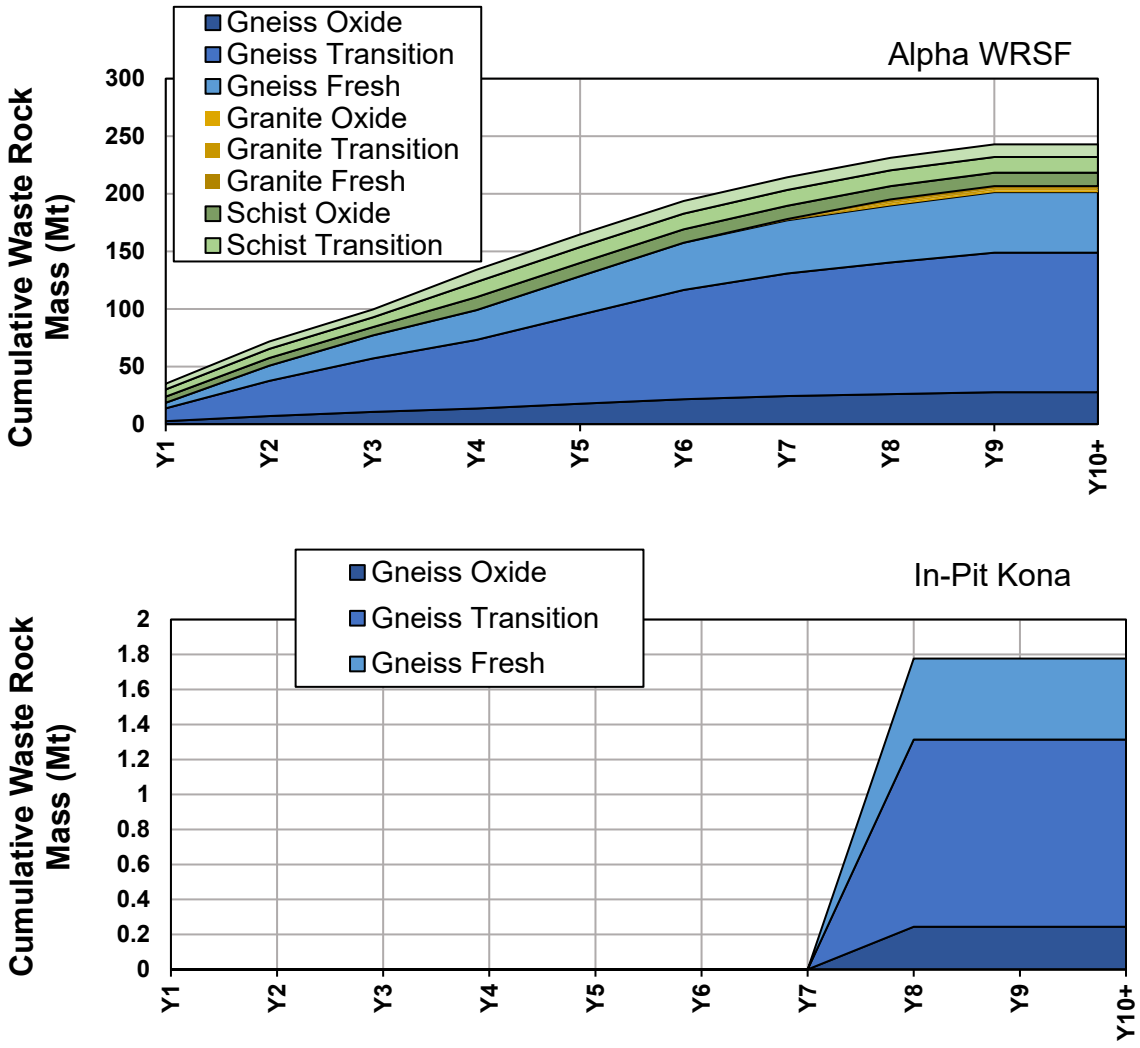

Figure 2-1: Mass and geologic composition of Alpha WRSF (top) and Backfilled Kona pit (bottom) over the LOM.

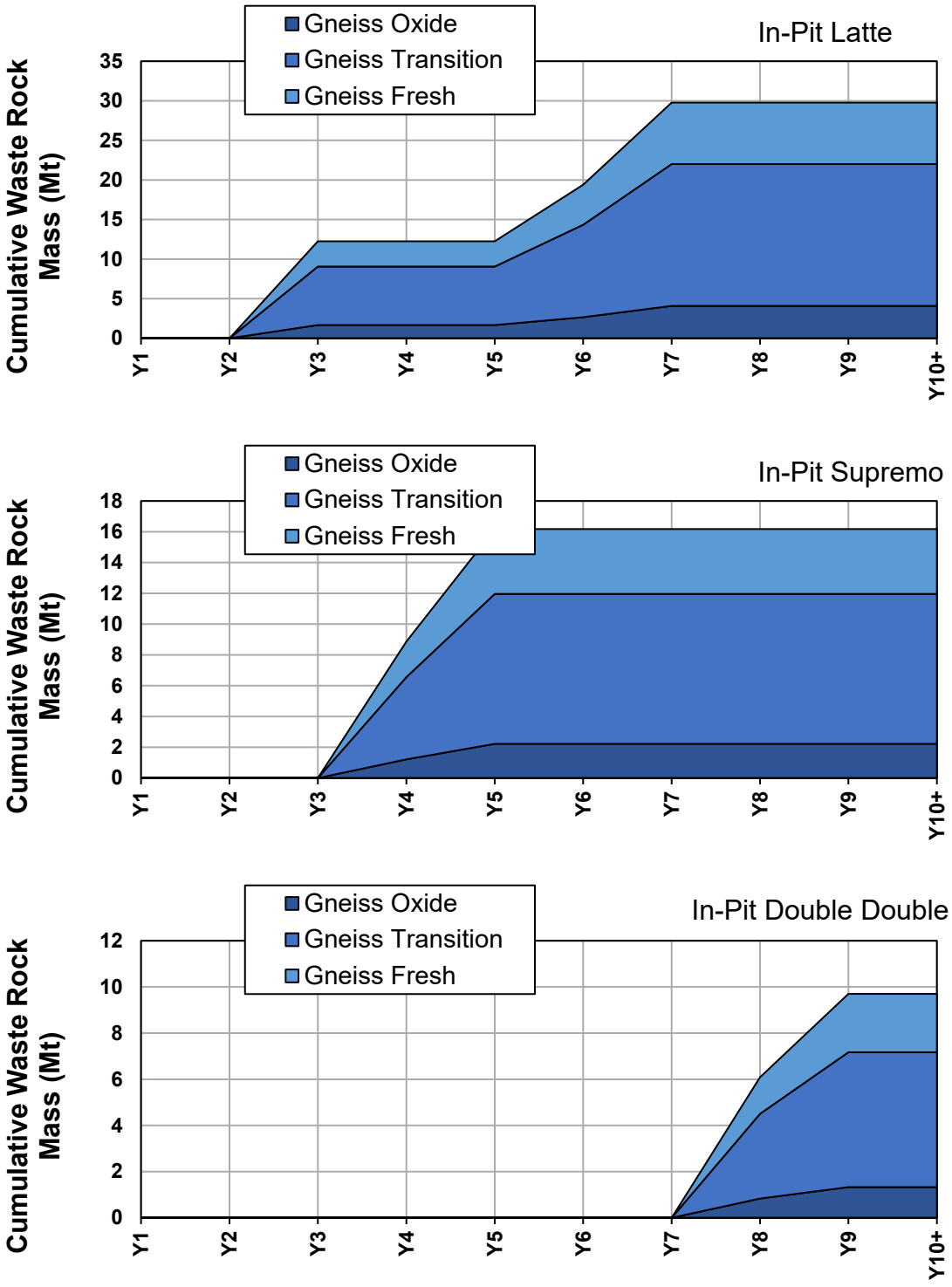

Figure 2-2: Mass and geologic composition of In-Pit Latte (top), In-pit Supremo (Middle) and In-Pit Double Double (bottom) WRSFs over the LOM.

Table 2-1:
Surface area (ha) of mine facilities in each year of mine life

Year	Alpha WRSF	In-Pit Kona	In-Pit Latte	In-Pit Supremo	In-Pit Double Double
Y1	57.4	-	-	-	-
Y2	96.8	-	-	-	-
Y3	109.7	-	10.1	-	-
Y4	145.4	-	10.1	10.1	-
Y5	161.4	-	10.1	19.7	-
Y6	170.8	-	17.3	19.7	-
Y7	179.0	-	25.6	19.7	-
Y8	179.8	3.2	25.6	19.7	8.4
Y9	187.9	3.2	25.6	19.7	11.9

Table 2-2:
Percentage of footprint and mass submerged once pits flood to spillway elevation

	Alpha WRSF	In-Pit Kona	Latte In-Pit	Supremo In-Pit	DD Backfill In-Pit
Footprint	0%	77%	37%	43%	45%
Mass	0%	39%	13%	17%	14%

2.1.1 Pit Wall Rock

Pit wall rock refers to rock exposures within the mining pit. This includes the pit floor, benches and blast damaged fractured rock. Fracturing and slope ravelling of the pit walls exposes a greater proportion of the wall rock to weathering. Assumptions regarding wall rock geochemical loading rates and solubility controls are described in detail in Section 5.2 of Appendix B.

During mine life, the composite loading from different mine pits will depend on the relative surface area of different wall rock geologies. The evolution of pit wall geology and surface area is incorporated into the Project Operations WQM. Annualized pit wall rock exposures are shown in Table 2-3 for the Supremo, Latte, Double Double and Kona pits. The runoff chemistry assigned to each of these wall rock units is provided in Appendix A.

Table 2-3:
Relative proportions of rock types exposed within mine pits upon completion of excavations

			Supremo Pit				Double Double Pit	Kona Pit	Latte Pit
			SU4-North	SU4-South	SU3-SU5	SU1-SU2			
Gneiss	Ore	Oxide	10%	15%	14%	7%	3%	0%	0%
		Transition	3%	1%	1%	3%	9%	0%	0%
	Waste Rock	Oxide	4%	12%	7%	4%	5%	0%	0%
		Transition	43%	37%	47%	54%	18%	0%	0%
		Fresh	41%	34%	30%	27%	66%	0%	0%
Schist	Ore	Oxide	0%	0%	0%	0%	0%	0%	4%
		Transition	0%	0%	0%	0%	0%	0%	21%
	Waste Rock	Oxide	0%	0%	0%	0%	0%	0%	12%
		Transition	0%	0%	0%	2%	0%	0%	21%
		Fresh	0%	0%	0%	0%	0%	0%	40%
Granite	Ore	Oxide	0%	0%	0%	0%	0%	10%	0%
		Transition	0%	0%	0%	0%	0%	11%	0%
	Waste Rock	Oxide	0%	0%	0%	0%	0%	16%	0%
		Transition	0%	0%	0%	0%	0%	21%	0%
		Fresh	0%	0%	0%	0%	0%	42%	0%

2.1.2 ROM Pad and Stockpile

Approximately 67 Mt of ore mined from the open pits will either be taken directly to the HLF or temporarily stockpiled on the ROM pad during the coldest winter months before stacking on the HLF. The maximum capacity of the ROM stockpile is 3 Mt, with the actual value fluctuating seasonally. The mass of ore on the ROM pad will fluctuate widely, with a mass ranging from 3.0 Mt to 0.33 Mt during Project Operations (Figure 2-3). Peak volumes occur during the winter months when ore is still being produced from the pits but no new material is stacked on the HLF, and minimum volumes occur during summer or fall months when ROM material is being removed to the HLF.

No granite ore from the Kona Pit will be placed in the ROM stockpile due to the elevated ML potential and mildly acidic pH associated with this ore type. The granite ore will be immediately directed to the HLF, where it will be mixed with lime and stored with other non-potentially acid generating ore types.

Stockpiled ore will be placed upon a pad constructed with waste rock. The pad will be constructed exclusively of schist waste rock to utilize the metal attenuating attributes of this rock type. The ability of schist waste rock to attenuate As and U is related to the

relatively high Fe content of this rock type and has been demonstrated in column experiments.

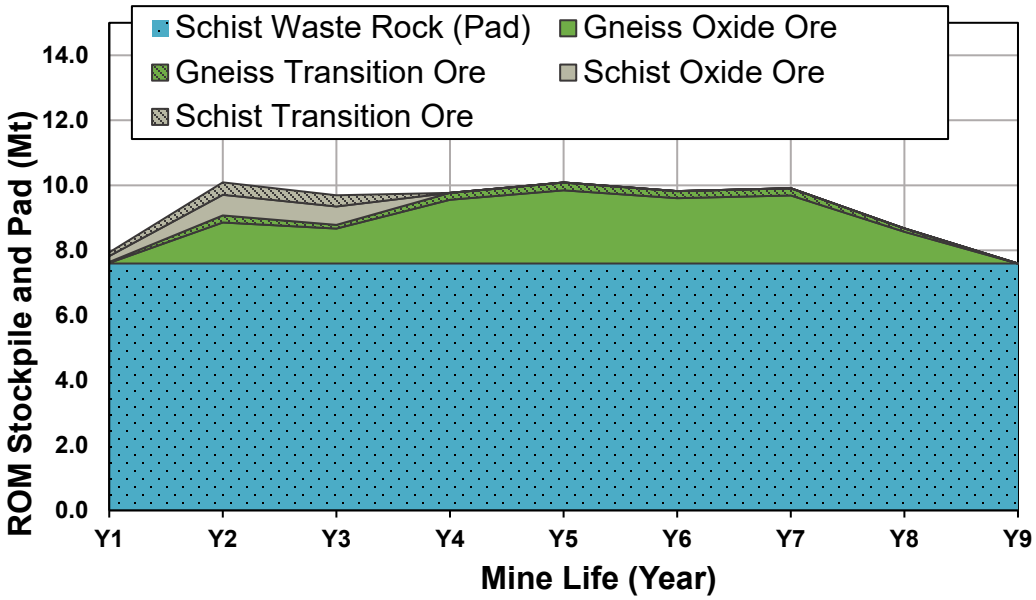

Figure 2-3: Mass and composition of ROM ore stockpile and waste rock used in pad construction.

2.1.3 Haul Roads

Haul roads will be constructed from ROM waste rock and represent a potential source of geochemical loading. The significance of the geochemical loading associated with haul roads will in large part depend on the ML/ARD screening criteria used to select construction material. For the purpose of source term calculation, it is assumed that no screening protocols are in place, and that the haul roads are constructed with gneiss waste rock, which represents the dominant waste rock type produced by the mine.

The length of out-of-pit haul roads connecting mine facilities is available for the end of mine life. The length of haul roads in the Halfway Creek, Latte Creek and YT24 catchments are shown in Table 2-4. It is assumed that the length and distribution of haul roads shown in Table 2-4 are present throughout the Project Operations. Haul roads are assumed to have an average fill thickness of 1.5 m and average width of 12 m.

Table 2-4:
Length of Haul Roads at end of operations by catchment

Scaling Factors	Haul Road Length (km)
Latte Catchment	0.89
Halfway Catchment	13.6
YT-24 Catchment	0.69

3. Data Sources

In this chapter geochemical and hydrological data sources used to develop source terms are presented. Kinetic test results are used to assign geochemical loading rates to different waste types that will be exposed by mining activity. The kinetic tests are also used to inform solubility constraints and upscaling behaviour of dissolved concentrations. Hydrology data is used to estimate the volume of runoff produced by a given mine waste facility. The flow volumes are required to convert geochemical loading rates into concentrations.

3.1 Hydrology

Surplus water produced from mine facilities is calculated by multiplying the mean annual precipitation (MAP) by estimated runoff coefficient. Precipitation amounts at the Coffee Gold site are influenced by orographic gradients that vary by season. The overall MAP orographic gradient is estimated to be 7% increase/100 m, based on analysis of long-term regional climate records and site climate data. The elevation dependent MAP developed for the Coffee site is presented in Figure 3-1. Using this elevation dependent estimate results in MAP range from 400 mm to 500 mm for mine facilities.

Runoff coefficients were developed for mine infrastructure (*i.e.*, pits and WRSFs) based on measured data from mine sites located in similar climatic zones, and professional experience (Table 3-1). The infiltration coefficient for the WRSFs averages 35% of MAP but varies from 21% in dry-years to roughly 50% in wet-years, consistent with published findings from comparable climates. A runoff coefficient of 0.7 is assigned to pit walls and haul roads, based on their low permeability and limited storage capacity.

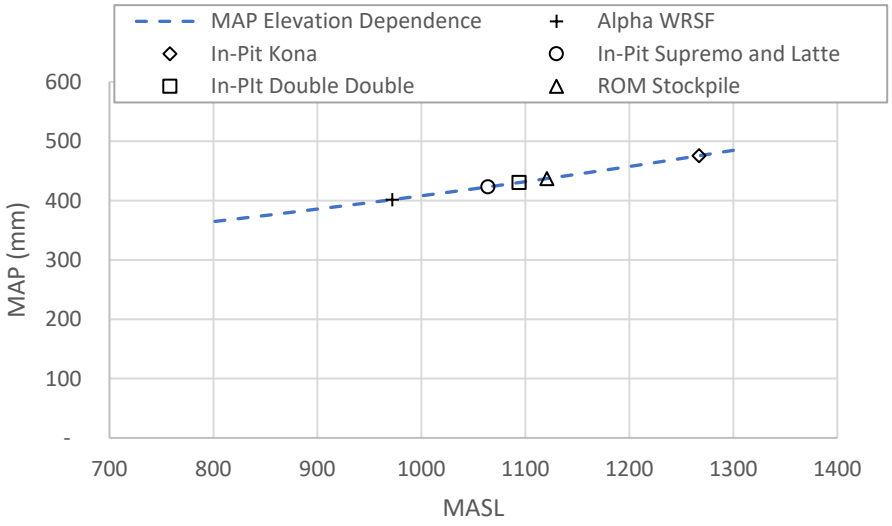

Figure 3-1: Mean annual precipitation as a function of MASL at the Coffee site.

Table 3-1:
Mine facility runoff coefficients

Facility	MAP (mm)	Runoff Coefficient
Alpha WRSF	402	0.35
In-Pit Kona	475	0.35
In-Pit Supremo	423	0.35
In-Pit Latte	423	0.35
In-Pit Double Double	430	0.35
ROM Stockpile	435	0.35
Haul Roads	485	0.70
Pit Wall	450	0.70

3.2 Kinetic Testing

Kinetic test data are used to assess long term drainage chemistry, develop source terms for water quality predictions and evaluate disposal strategies for waste rock that will be produced during the life of the Project. The kinetic tests developed for the Project include 8 humidity cells, 17 unsaturated columns, 11 field bins and 10 saturated columns. A summary of the kinetic tests developed for waste rock, ore and leach tailings for the Project is summarized in Table 3-2.

Table 3-2:
Summary of Kinetic Tests Initiated for the Coffee Gold Mine

Test ID	Duplicates	Material	Lithology	Weathering Facies	Start Date	Termination Date
Unsaturated Columns						
Col 1		Leach Tailings	Gneiss/Schist	Oxide/Transition	10-Apr-14	active
Col 2	Duplicate of Col 1	Leach Tailings	Gneiss/Schist	Oxide/Transition	10-Apr-14	active
Col 3		Waste Rock	Schist	Oxide	16-Jul-14	active
Col 4		Waste Rock	Schist	Transition	16-Jul-14	active
Col 5		Waste Rock	Gneiss	Oxide	16-Jul-14	active
Col 6		Waste Rock	Gneiss	Transition	30-Jul-14	active
Col 7		Ore	Granite	Oxide	22-Apr-15	19-Apr-17
Col 8		Ore	Granite	Transition	22-Apr-15	19-Apr-17
Col 9		Ore	Schist	Oxide	22-Apr-15	active
Col 10		Ore	Schist	Transition	22-Apr-15	active
Col 11		Ore	Gneiss	Oxide	22-Apr-15	active
Col 12		Ore	Gneiss	Transition	22-Apr-15	active
Col 13		Waste Rock	Granite	Transition	20-May-15	19-Apr-17
Col 14		Waste Rock	Granite	Fresh	20-May-15	19-Apr-17
Col 15		Leach Tailings	Schist	Oxide/Transition	3-Jun-15	active
Col 16		Leach Tailings	Gneiss	Oxide/Transition	3-Jun-15	active
Col 17		Leach Tailings	Gneiss/Granite	Oxide/Transition	3-Jun-15	active
Humidity Cells						
HC 1	Duplicate of Col 4	Waste Rock	Schist	Transition	25-Jun-14	24-Feb-16
HC 2		Waste Rock	Schist	Fresh	25-Jun-14	24-Feb-16
HC 3	Duplicate of Col 6	Waste Rock	Gneiss	Transition	25-Jun-14	24-Feb-16
HC 4		Waste Rock	Gneiss	Fresh	25-Jun-14	24-Feb-16
HC 5	Duplicate of Col 13	Waste Rock	Granite	Transition	6-May-15	24-Apr-17
HC 6	Duplicate of Col 14	Waste Rock	Granite	Fresh	6-May-15	24-Apr-17
HC 7		Waste Rock	Schist	Fresh	12-Aug-15	24-Apr-17
HC 8		Waste Rock	Gneiss	Fresh	12-Aug-15	24-Apr-17
Field Bins						
FB-GO	Duplicate of Col 5	Waste Rock	Gneiss	Oxide	17-Jun-14	active
FB-GT	Duplicate of Col 6 & HC 3	Waste Rock	Gneiss	Transition	17-Jun-14	active
FB-GS	Duplicate of HC 4	Waste Rock	Gneiss	Fresh	17-Jun-14	active
FB-SO	Duplicate of Col 3	Waste Rock	Schist	Oxide	17-Jun-14	active
FB-ST	Duplicate of Col 4 & HC 1	Waste Rock	Schist	Transition	17-Jun-14	active
FB-SS	Duplicate of HC 2	Waste Rock	Schist	Fresh	17-Jun-14	active
FB-GGT	Duplicate of Col 13 & HC 5	Waste Rock	Granite	Transition	17-Jun-15	active
FB-GGS	Duplicate of Col 14 & HC 6	Waste Rock	Granite	Fresh	17-Jun-15	active
FB-LT1	Duplicate of Col 1 & Col 2	Leach Tailings	Gneiss/Schist	Oxide/Transition	17-Jun-14	active
FB-LT2		Leach Tailings	Schist	Oxide	10-Aug-15	active
FB-LT3		Leach Tailings	Gneiss	Oxide	10-Aug-15	active
Saturated Columns						
Kona 1	Col 13,14 and 8 Residue	Waste rock/ore	Granite	Tran./Fresh	07-Jul-17	24-May-19
Kona 2	Col 13,14 and 7 Residue	Waste rock/ore	Granite	Oxide/Tran./Fresh	07-Jul-17	24-May-19
Kona 3	Col 13 Residue	Waste Rock	Granite	Transition	07-Jul-17	24-May-19
Kona 4	Col 14 Residue	Waste Rock	Granite	Fresh	07-Jul-17	24-May-19
Sat-GO	FB-GO Residue	Waste Rock	Gneiss	Oxide	29-Sept-17	24-May-19
Sat-GT	FB-GT Residue	Waste Rock	Gneiss	Transition	29-Sept-17	24-May-19
Sat-GS	FB-GS Residue	Waste Rock	Gneiss	Fresh	29-Sept-17	24-May-19
Sat-SO	FB-SO Residue	Waste Rock	Schist	Oxide	29-Sept-17	24-May-19
Sat-ST	FB-ST Residue	Waste Rock	Schist	Transition	29-Sept-17	24-May-19
Sat-SS	FB-SS Residue	Waste Rock	Schist	Fresh	29-Sept-17	24-May-19

Unsaturated kinetic tests (field bins, humidity cells, and columns) were initiated to evaluate the metal leaching potential of unsaturated mine waste at different scales and storage conditions. Geochemical loading rates used to estimate source terms for unsaturated mine waste are derived from field bins, humidity cells and unsaturated column experiments. Experimental setup, sample characteristics, and initial results of these experiments are presented in Appendix B. Most of these tests have continued since they were initiated in 2014 or 2015.

Saturated column tests provide a means to evaluate the metal leaching potential of saturated waste rock in backfilled pits. The saturated column results are used to inform metal leaching behaviour of backfilled waste rock which may become saturated upon mine closure. Experimental setup, sample characteristics and results of the saturated column testwork are provided in Appendix C.

3.2.1 Unsaturated Tests

Unsaturated kinetic tests (columns and field bins) generate information on long term metal leaching behaviour of mine waste. The loading rate statistics and kinetic test cycles used in source term development are provided in Appendix D.

3.2.2 Saturated Tests

Saturated column experiments were operated in several phases. In the first phase columns were operated independently and received an influent of DI water containing a low concentration of Na-Lactate to mimic DOC concentrations observed in the background groundwater at site (approx. 10 mg/L). In the second phase of the experiment saturated columns were operated in sequence, to investigate impact of mixed waste rock in a backfill facility.

Overall, results show that sulphide oxidation was curtailed and metal solubility and release was inhibited by saturated conditions. A significant exception to this general trend was for As. Leaching of As was enhanced by saturated columns, with granite columns producing the highest concentrations of this element. The second phase of the experiment, when columns were operated in sequence, demonstrated that As was not conservative under saturated conditions (Figure 3-2). Controls on As solubility under saturated conditions are more closely related to the availability of Fe-oxide mineral surfaces and concentration of Ca^{2+} and PO_4^{2-} which impact As sorption potential. The observation that saturated conditions enhance As mobility is consistent with groundwater monitoring at site, which often reveal elevated As concentrations, with the highest concentrations being associated with groundwater monitored screened in granite bedrock near the Kona Pit. The median and 90th percentile As values observed in Phase 1 of the saturated column experiments are shown in Table 3-3

Table 3-3:
Arsenic concentrations produced during Phase 1 of the saturated column experiments.

Column ID	Lithology	Weathering	As mg/L	
			P50	P90
GO	Gneiss	Oxide	0.0464	0.0518
GS	Gneiss	Fresh	0.0344	0.0506
GT	Gneiss	Transition	0.117	0.158
SO	Schist	Oxide	0.0218	0.0294
SS	Schist	Fresh	0.0121	0.0135
ST	Schist	Transition	0.0091	0.0125
GGT	Granite	Oxide	2.11	3.9515
GGS	Granite	Fresh	0.3765	0.48225

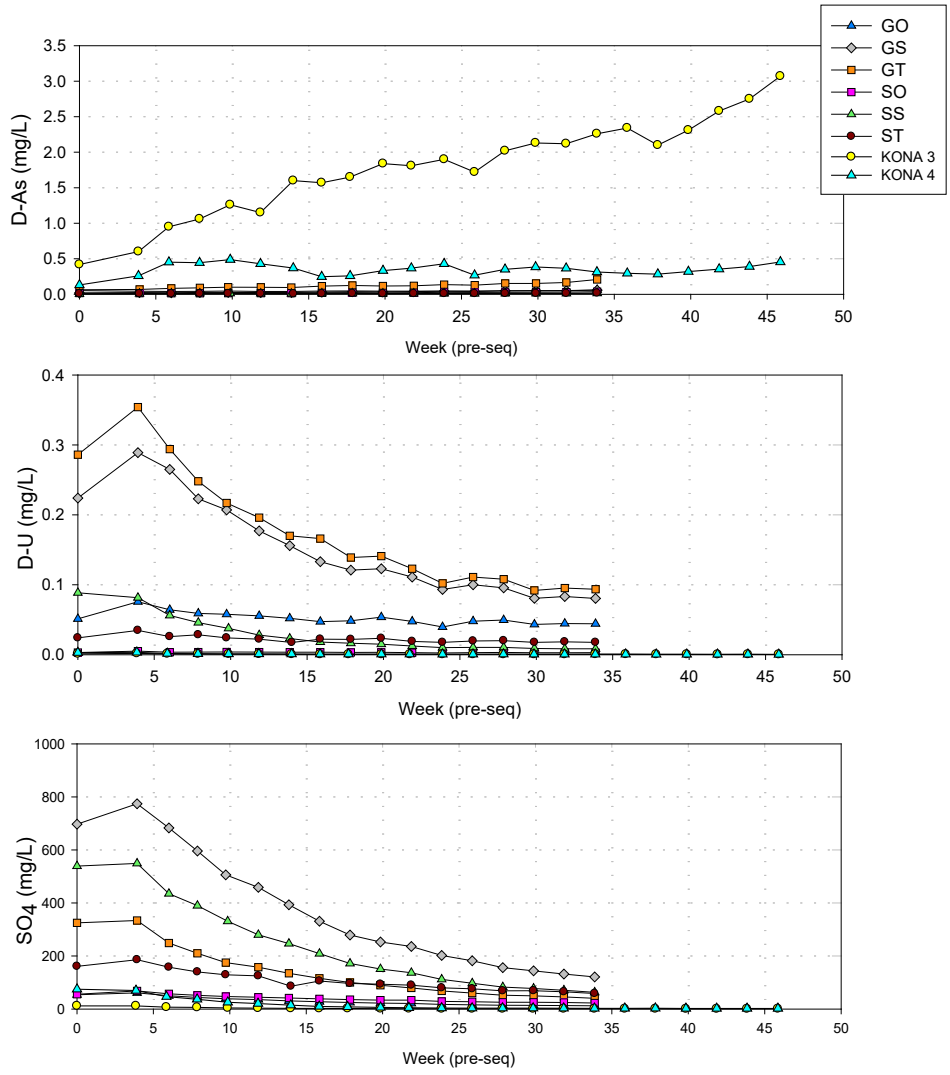

Figure 3-2: Time-series of As, U and SO_4 for Phase I Saturated Column Study

4. Source Term Calculations

4.1 Approach

Geochemical source terms are calculated by upscaling kinetic test geochemical loading rates to reflect site conditions. The scaled loading rates are then applied to incorporate the mass, footprint, hydrology and rock types present in a given mine facility. Solubility controls are then derived for certain parameters that are not expected to behave conservatively in the geochemical conditions of a given mine waste environment. These solubility controls are based on a combination of first principles, thermodynamic equilibrium, and experimental data or field monitoring data. Overall, the approach to source term calculation is consistent with what was completed for source term development in the Project Proposal for the Coffee Project as described in Appendix B.

A variety of updates have been made to source term model inputs in the current source term iteration relative to that presented in Appendix B. These updates include kinetic test results; solubility controls; and assumptions regarding release of a geochemical load from saturated waste rock and pit wall. Kinetic test results are used to calculate loading rates and estimate metal release from sub-aqueously stored mine rock. The updated kinetic test results are shown in Appendix D. Solubility calculations incorporate the geochemical modelling program PHREEQC to calculate solubility constraints for surface sorption of U to Fe-oxide mineral surfaces, and mineral solubility controls for certain major ions (Ca, Mg and P).

4.2 Waste Rock Storage Facility

Two types of loadings from waste rock are included in the WQM and described herein. During mine operations all waste rock will be stored in unsaturated conditions. The unsaturated waste rock source term represents the chemistry of water which infiltrates through unsaturated mine waste. Once a pit is completed mining and/or upon mine closure, meteoric water will accumulate in the mine pits, potentially submerging a portion of backfilled waste rock. Submergence of waste rock is modelled using a flushing source term. This source term reflects a one-time release of an accumulated load on waste rock surface solubilized by inundation by pit lake water.

4.2.1 Unsaturated Source Term

The unsaturated WRSF source terms are calculated by upscaling geochemical loading rates measured in waste rock field bin experiments. Field bins loading rates are applied to WRSF source term calculation using the same approach as that used in previous source term

iterations. The only update is the time period of data incorporated into the loading calculation. The date range and field bin data used in source term development is identified in Table 4-1. These loading rates are applied to the lithologic composition and mass of each WRSF shown in Figure 2-1 and Figure 2-2. Similar to previous source term iterations (Appendix B), the FB-GGT field bin is used to represent both granite oxide and granite transition waste rock. Field bin loading rates used in source term calculation are presented in Appendix D.

Table 4-1:
Overview of Kinetic Tests Used for WRSF Source Term Calculation

Kinetic Test ID	Mineralization	Lithology	Date Range
FB-GO	Oxide	Gneiss	June 2014-Oct 2018
FB-GT	Transition	Gneiss	June 2014-Oct 2018
FB-GS	Fresh	Gneiss	June 2014-Oct 2018
FB-SO	Oxide	Schist	June 2014-Oct 2018
FB-ST	Transition	Schist	June 2014-Oct 2018
FB-SS	Fresh	Schist	June 2014-Oct 2018
FB-GGT	Transition	Granite	June 2015-Oct 2018
FB-GGS	Fresh	Granite	June 2015-Oct 2018

Empirical scaling factors are developed based on a comparison between field bin data to a full-scale waste rock seepage data. Bulk scaling factors described in Section 5 of Appendix B are maintained herein.

The annual surplus water from WRSFs is used to convert loading rates to concentrations. The MAP and runoff coefficients used to calculate surplus water for WRSFs are shown in Section 3.1.

4.2.2 Saturated Source Term

Unsaturated waste rock will accumulate a geochemical load on mineral surfaces that are insufficiently flushed by infiltrating pore water. This load will become available when waste rock is inundated by a pit lake water. It is assumed that 50% of waste rock mineral surfaces are flushed by infiltrating meteoric water, leaving the other 50% of mineral surfaces to accumulate a geochemical load. The unflushed surfaces are assumed to accumulate an oxide load at the same weathering rate applied to the upscaled loading rate applied to the unsaturated source term described above. The rate at which a load accumulates on waste rock which is released upon pit lake inundation are shown in Appendix A. Note that Supremo Backfill, Latte Backfill and Double Double Backfill are all built from waste rock excavated from the Supremo Pit. As such, they are assumed to

have the same lithologic composition, hence, geochemical loading rate. No solubility controls are applied to this source term.

4.2.3 Solubility Controls

Upscaling kinetic test loading rates often results in concentrations that exceed solubility controls, particularly in neutral pH environments where a number of solubility limitations can exert an influence on drainage chemistry. Metal solubility can be affected by secondary mineral formation, sorption to mineral surfaces, and aqueous complexation reactions. The approach used to set solubility constraints is described in Appendix B and developed a method for calculating solubility of U, As and Ra, while concentration caps based on empirical data. For WRSFs, concentration caps based on empirical data were set for parameters which were frequently below detection limit (Hg and P) or parameters which are not expected to behave conservatively under aerobic, neutral pH conditions (Fe and Al).

In the current source term predictions, the model used to calculate U concentrations has been updated, and now incorporates the geochemical modelling program PHREEQC (Parkhurst and Apello, 1999). The PHREEQC model used to calculate U solubility also calculates solubility of P, Ca and alkalinity. Furthermore, enhancement of As solubility in backfilled waste rock dumps which have been partially flooded is also incorporated.

4.2.3.1 Uranium Solubility

Model Approach

A variety of factors influence U solubility in a mine waste environment. Solubility can be influenced by pH, redox conditions, availability of Fe-oxide mineral surfaces, and presence of ligands that can form aqueous complexes with U. Redox conditions can influence the oxidation state that U occurs in. Uranium(VI) and U(IV) are the two most common oxidations states of U; U(IV) being generally insoluble at pH > 3, while U(VI) forms the relatively soluble uranyl (UO_2^{2+}) aquocation (Cumberland *et al*., 2017). The oxidation state of U in Project mine rock has been directly measured using X-ray adsorption near edge spectroscopy (XANES) (Lorax, 2017). The analysis found that a significant portion of U (100% to 89% in oxide; 17% to 49% in transition; and, 27% to 67% in fresh). This shows that U can be mobilized to pore without post-depositional oxidation.

The uranyl aquocation (UO_2^{2+}) is generally insoluble in the presence of Fe-oxide minerals, and requires complexation with an anionic ligand before it can be released into pore water (Cumberland *et al.,* 2016). This effect is primarily because some UO_2^{2+} aqueous complexes can outcompete mineral surfaces for UO_2^{2+} binding, thus weakening U sorption (Stewart *et al.*, 2010). In most environmental settings, the most important complexes

which enhance UO_2^{2+} solubility are carbonate (CO_3^{2-}) and Ca (Stewart, 2008). The solubility of U(VI) in the presence of hydrous ferric oxide (HFO) and varying pH, Ca^{2+}, and CO_3^{2-} is illustrated in Figure 4-1 for reference. Overall, the figure illustrates that U mobility is strongly influenced by Ca and pCO_2 under a broad pH range (pH 3.5 to pH 10.5). The importance of Ca, alkalinity and pH on U mobility can also be observed in regional monitoring data.

A regional survey of over 3000 baseline water quality samples found that elevated U concentrations (>15 µg/L) were almost always associated with elevated pH, Ca, alkalinity (Figure 4-2) (Lorax, 2019). Overall, creeks with alkalinity >150 mg/L and Ca >80 mg/L have an 80 % probability of having U concentrations above 15 µg/L. Furthermore, the parabolic relationship of U and pH shows that U concentrations are maximal in circumneutral to alkaline pH and highly acidic surface waters, while U concentrations are lowest in the pH 4.5 to 6.5 range (Figure 4-2). This results show that the regional occurrence of U in Dawson Range creeks is consistent with what would be predicted with ligand-complexation surface-sorption model (Figure 4-1). This understanding, based on a first principles understanding and supported by baseline observations, forms the basis for U solubility modelling.

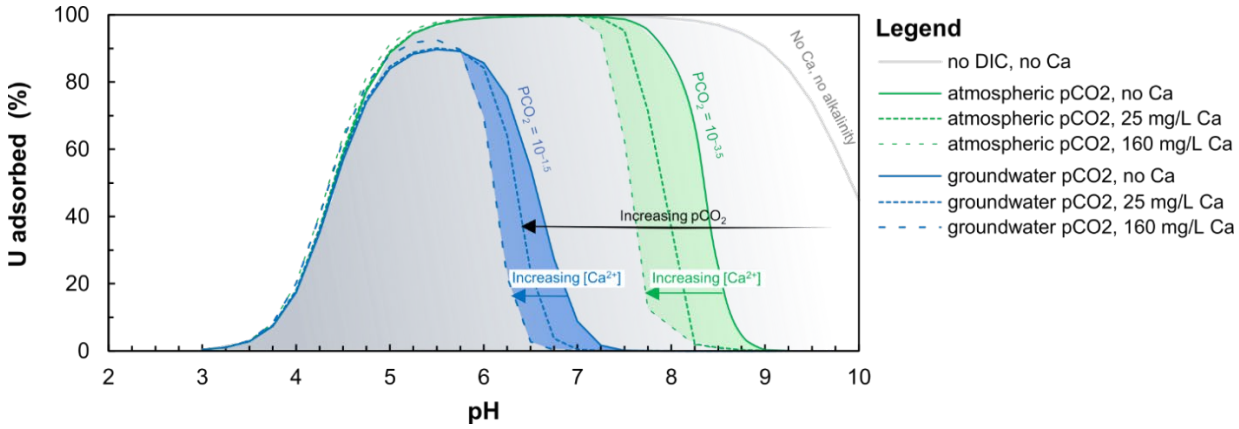

Figure 4-1: Generalized U(VI) sorption behavior on Fe-oxhydroxide as a function of pH, Ca, and alkalinity in a PHREEQC simulation. Alkalinity is fixed by pCO_2 representative of typical atmospheric ($10^{-3.5}$ atm) and groundwater ($10^{-3.5}$ atm) concentrations. The U sorption envelope decreases from pH ~6.5 to 9 as pCO_2 and [Ca] increase, indicating greater U(VI) solubility (Figure from Lorax, 2019).

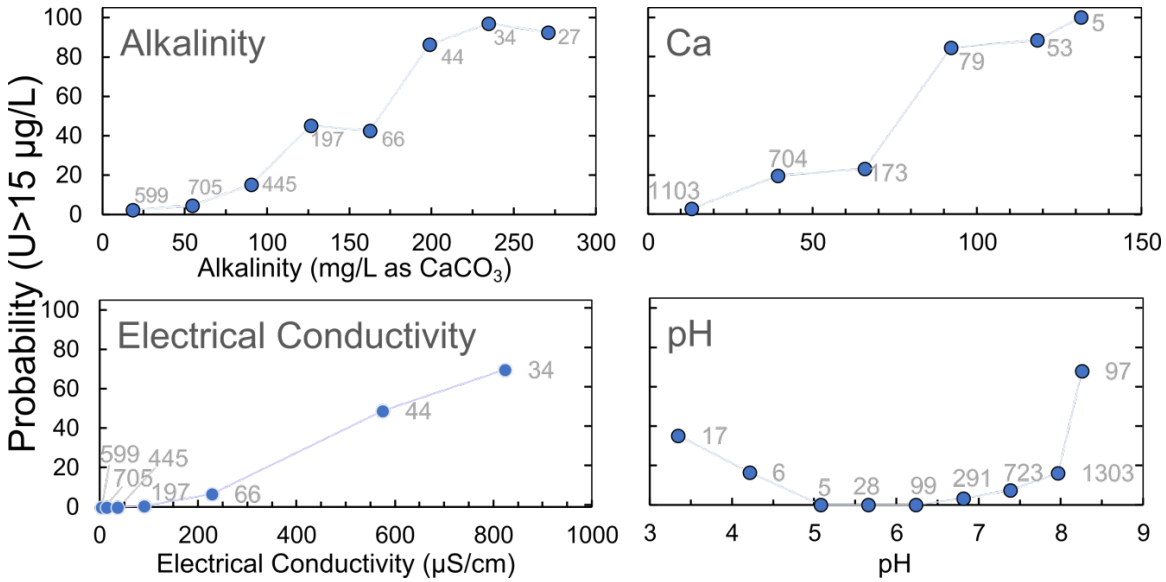

Figure 4-2: Probability of having U concentrations above the CCME guideline value (15 µg/L) calculated over different ranges in alkalinity, Ca, electrical conductivity, and pH in surface water samples in the Dawson Range. Data labels in grey font correspond to the number of water-sample analyses used to calculate each probability value

The first principles of uranium mobility and field observations illustrate the importance of alkalinity, Ca and pH on controlling U mobility. In order to translate this understanding into a geochemical source term prediction the surface sorption module in the geochemical modelling program PHREEQC is employed. This model uses the double layer surface model described by Dzombek and Morel (1990) with no explicit calculation of the diffuse-layer composition. The model is coupled to the llnl.dat database amended with thermodynamic data for Ca-UO_2 surface complexation from Bernhard *et al*., (2001) and $Ca_2UO_2(CO_3)_3$ and $Ca_2UO_2(CO_3)_2^{2-}$ phases from Payne, (1999).

Model Validation for Uranium Solubility

To validate the modelling approach, and calibrate poorly constrained inputs, the model is used to re-produce kinetic test U concentrations. Model inputs include solution chemistry (includes Ca, alkalinity and pH); water content; U(VI) availability; and, mineral surfaces available for sorption in the form of hydrous ferric oxide (HFO) (Table 4-2). The kinetic test leachate chemistry provides a direct measure of solution chemistry and is directly applied as a model input. The total U and Fe content is measured in each kinetic test sample prior to test setup. The proportion of total U present as U(VI) can be constrained with XANES data (Lorax, 2017). In the model it is assumed that 100% of U(VI) present in a sample is present on Fe-oxide mineral surfaces. This is a conservative assumption, in that most other potential reservoirs of U(VI) (uranophane, brannerite, *etc.*) would be less

available. The Fe-oxide content can be estimated based on mineralogical analysis; however, it is challenging to determine how a bulk measurement translates to reactive HFO surface area. Therefore, the availability of HFO mineral surfaces area is calibrated within the model. Note that this is the only calibrated model input.

The available HFO surface area is adjusted such that mean and maximum concentrations of kinetic tests are overpredicted in the model. This results an estimate of the % Fe as HFO ranging from 0.79% to 0.11% in most samples (Table 4-2). The amount of total Fe present as HFO correlates with weathering horizon, with greater %Fe as HFO in gneiss-oxide (0.62%) compared to gneiss-transition (0.30% to 0.34%) and gneiss-fresh (0.17%). This is consistent with the degree of weathering and expected Fe-oxide content of the different weathering facies.

Table 4-2:
Model inputs used to re-produce kinetic test U concentrations.

Test ID	Lithology	Weathering	Water Content (ml/kg)	Fe (g/kg)	% Fe as HFO	U ppm	% U as U(VI)	Solution Chemistry
Col 5	Gneiss	Oxide	125	15	0.62%	5.5	95%	Measured
HC3	Gneiss	Transition	100	12	0.30%	6.3	50%	Measured
Col 6	Gneiss	Transition	83	12	0.34%	6.3	50%	Measured
HC4	Gneiss	Fresh	165	18	0.17%	6.1	30%	Measured
Col 3	Schist	Oxide	106	29	0.79%	2.6	95%	Measured
HC1	Schist	Transition	165	26	0.15%	2.6	50%	Measured
Col 4	Schist	Transition	99	26	0.11%	2.7	50%	Measured
HC2	Schist	Fresh	170	29	0.07%	3.2	30%	Measured
Col 13	Granite	Transition	159	8.7	3.02%	7.6	50%	Measured
HC5	Granite	Transition	210	8.7	16.78%	7.6	50%	Measured
Col 14	Granite	Fresh	143	11	0.42%	6.2	30%	Measured
HC6	Granite	Fresh	180	11	0.78%	6.2	30%	Measured

The model significantly overestimates maximum concentrations of most kinetic tests, in some cases modeled maximums are over 500% of maximum measured values (Table 4-3). This provides some assurance that the modelled values will conservatively predict peak concentrations produced from mine waste facilities. The validation model results are plotted against measured results for two kinetic tests in Figure 4-3 to illustrate that the model also captures variations in U concentrations over time. The ability of the PHREEQC surface sorption model to re-produce U trends and conservatively predict U concentrations in kinetic test samples shows that this modelling approach can reasonably be applied to source term predictions.

Table 4-3:
Measured and modeled U concentrations from kinetic tests.

Test ID	Lithology	Weathering	Mean			Max		
			Measured (mg/L)	Model (mg/L)	% Diff	Measured (mg/L)	Model (mg/L)	% Diff
Col 5	Gneiss	Oxide	0.086	0.103	19%	0.168	1.074	539%
HC3	Gneiss	Transition	0.028	0.032	16%	0.065	0.089	36%
Col 6	Gneiss	Transition	0.211	0.242	15%	0.439	1.755	300%
HC4	Gneiss	Fresh	0.011	0.017	54%	0.060	0.061	0%
Col 3	Schist	Oxide	0.005	0.007	35%	0.025	0.167	570%
HC1	Schist	Transition	0.004	0.006	27%	0.018	0.020	14%
Col 4	Schist	Transition	0.036	0.048	33%	0.181	0.599	231%
HC2	Schist	Fresh	0.008	0.011	34%	0.024	0.036	52%
Col 13	Granite	Transition	0.001	0.002	34%	0.004	0.015	291%
HC5	Granite	Transition	0.001	0.001	84%	0.003	0.003	2%
Col 14	Granite	Fresh	0.093	0.094	0%	0.401	0.872	117%
HC6	Granite	Fresh	0.002	0.005	184%	0.026	0.032	26%

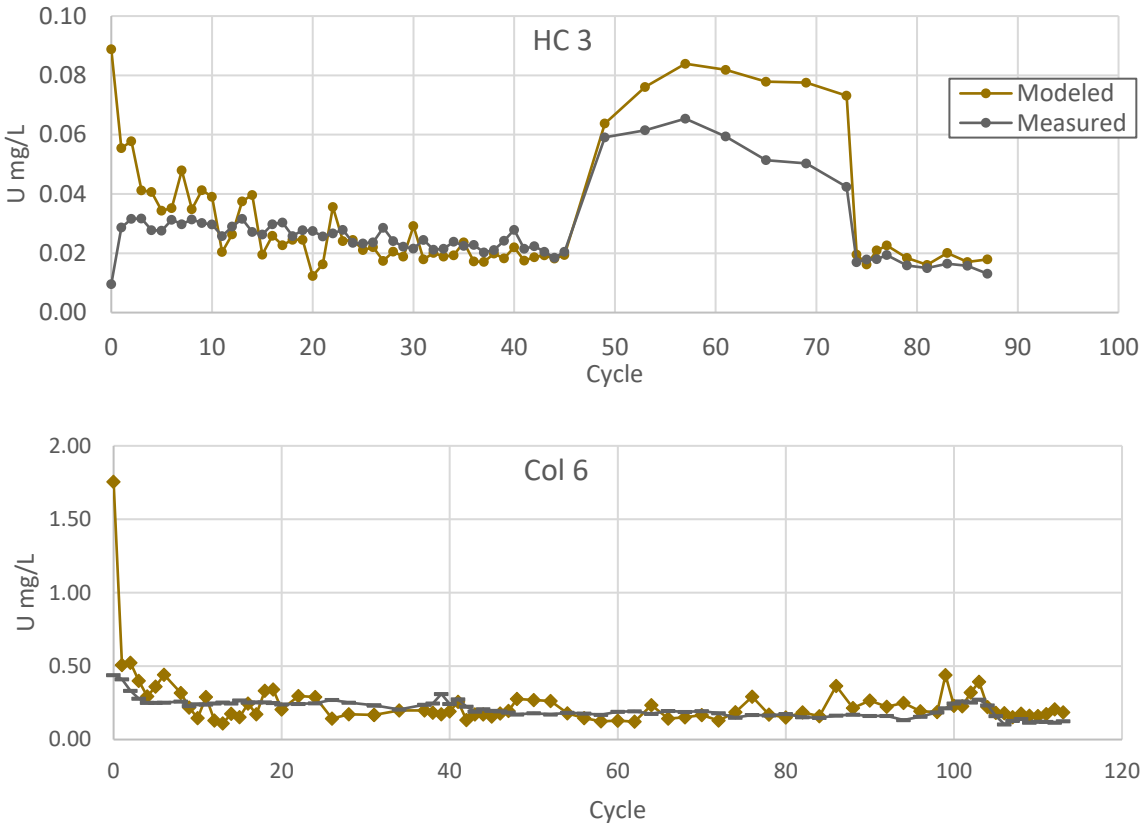

Figure 4-3: Model validation results compared to measured results for HC3 and Col 6.

Model Predictions for Uranium

Uranium source term concentrations are predicted using the PHREEQC surface sorption modelling approach described in the previous section. Model inputs are based on expected composition of various waste rock facilities, estimated pore water chemistry based on upscaled kinetic test data, and solubility constraints applied on certain mineral phases. The % of available U and Fe determined used in model validation are applied in the source term model (Table 4-3). The total Fe and U present in the waste facilities is calculated using the median Fe and U concentrations associated with each rock type (Table 4-4). An average water content of 11% is estimated based on the water content of other waste rock facilities in northern climates (Eriksson *et al.,* 1995; Nichol *et al*., 2005). The range of pH 8.0 to pH 8.3 is used for the base case and upper case scenarios, consistent with the pH assumptions used in previous source term iterations Lorax (2017).

Table 4-4:
Total Fe and U content of waste rock and U solubility model inputs.

Lithology	Weathering	Water content (ml/kg)	Fe (g/kg)	% Fe as HFO	U ppm[1]	% U as U(VI)	Solution Chemistry
Gneiss	Oxide	60	12.4	0.62%	7.0	95%	Source Term
Gneiss	Transition	60	12.8	0.32%	3.9	50%	Source Term
Gneiss	Fresh	60	17.5	0.17%	2.7	30%	Source Term
Granite	Oxide	60	12.2	0.60%	6.0	95%	Source Term
Granite	Transition	60	12.5	0.60%	6.3	50%	Source Term
Granite	Fresh	60	6.5	0.60%	6.7	30%	Source Term
Schist	Oxide	60	29.8	0.79%	2.1	95%	Source Term
Schist	Transition	60	29.4	0.13%	1.8	50%	Source Term
Schist	Fresh	60	29.8	0.07%	1.4	30%	Source Term

[1]Median values of mine waste assay data
[2]HFO and U(VI) availability assigned to each rock type in U solubility model.

The concentrations of P, Ca and alkalinity are predicted within the PHREEQC model. This is required as these parameters impact U mobility and have inter-related solubility constraints. That is, Ca solubility is generally controlled by calcite ($CaCO_3$), which CO_3^{2-} (alkalinity) is a constituent parameter. Similarly, P concentrations are generally controlled by apatite minerals [$Ca_5(PO_4)_3(Cl, F, OH)$], of which Ca is a constituent parameter. The concentration of PO_4^{3-} in pore water can influence surface sorption reactions and can compete with CO_3^{2-} for complexation with UO_2^{2+} ions. However, in neutral mine drainage P is generally limited by apatite mineral solubility. Therefore, the P concentration is predicted by assuming hydroxylapatite [$Ca_5(PO_4)_3OH$] SI of 0 (equilibrium) in both the upper case and base case model.

Calcite is often found to be supersaturated in mine drainage due to cation exchange processes and release of Ca from non-carbonate sources. Once calcite becomes supersaturated, precipitation can be kinetically inhibited by lack of free energy to create new surface areas, lack of nucleation sites, and the presence of competing species such as phosphate, Mg ions and organic ligands (Lorah and Herman, 1988; Lebron and Suarez, 1996). Consequently, supersaturation with respect to calcite can be maintained without calcite precipitation taking place. In fact, the precipitation of calcite directly from solution often requires water to be at least 5 times saturation with respect to calcite (log[SI] = 0.7) (Suarez, 1983; Chen *et al*., 2004). To account for this, the SI for calcite is set to 0.7 and 0.9 are used for the base case and upper case source terms, respectively. This is equivalent to Ca concentrations that are 5 to 8 times equilibrium values.

The alkalinity of mine drainage is controlled primarily by pH and the build-up of pore gas CO_2 within mine facilities. The gas permeability and flow through mine waste is difficult to predict; however, there is a significant volume of publicly available data on waste rock alkalinity. For instance, waste rock seeps at the Mt. Nansen mine are producing alkalinity values ranging from 16 mg$CaCO_3$/L to 48 mg$CaCO_3$/L. A much larger review of alkalinity values from 20 calcite buffered waste rock dumps at coal mines in the Elk Valley and Peace River region reported median and 90th percentile alkalinity values of 260 mg$CaCO_3$/L and 445 mg$CaCO_3$/L, respectively (MEND, 2015). For the purpose of source term prediction, a pCO_2 value is set to $10^{-2.7}$ is used both the upper case and base case scenarios. This is equivalent to pCO_2 concentrations that are 60 times atmospheric concentrations and results in mean alkalinity values of 266 mg$CaCO_3$/L in base case source terms and 579 mg$CaCO_3$/L in upper case predictions.

Using this approach and the model assumptions outlined herein, U solubility can be calculated for mine waste facilities. The final source terms are provided in Appendix A. An example of the U, Ca and alkalinity predicted for the base case Alpha WRSF over mine life is provided in Figure 4-4.

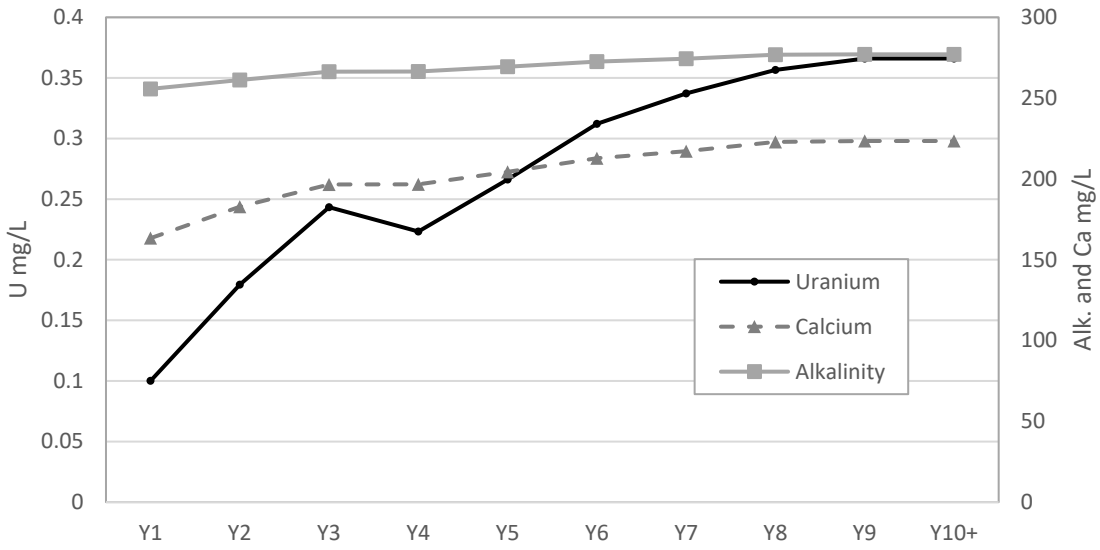

Figure 4-4: Model results for base case Alpha WRSF for U, Ca and Alkalinity.

4.2.3.2 Arsenic Solubility

Arsenic is released by a combination of sulphide mineral oxidation (*e.g.*, arsenopyrite, arsenianpyrite, and orpiment) and dissolution of oxide minerals (scorodite, yukonite, Fe-oxide mineral surfaces). Sorption is typically the most important control on As transport in natural waters, and occurs on the surface of various phases including organic matter, calcite, clays, and (oxyhydr)oxides of Al, Mn, and especially Fe (Smedley and Kinniburgh, 2002). The sorption potential of As is strongly related to oxidation state. In oxidizing aqueous environments, As forms the oxyanion arsenate [$As(V)O_4^{3-}$]. Under moderately reducing condition, As is found as arsenite [$As(III)O_3^{3-}$]. Arsenate sorption is generally stronger than that of arsenite (Goldberg, 2002; Grafe *et al.*, 2002; Dixit and Hering, 2003). The enhanced mobility of As under reducing environments can be observed in baseline monitoring data from the Dawson Range.

A survey of surface water in the Dawson Range found As concentrations to be consistently below 1 µg/L across the region (Lorax, 2019). The median and mean As concentrations of the 2,121 surface water samples that are available are both 0.5 µg/L. Only two As concentrations above the 5 µg/L were observed in surface water in the entire dataset (both were between 5 µg/L and 6 µg/L). Groundwater As concentrations are substantially higher than those of surface water. In 17 of the 46 groundwater wells at the Casino and Coffee project sites, median As concentrations exceed 5 µg/L. The most As-rich groundwater is found in the MW14-05A/B well cluster screened into granite bedrock below the Kona Pit; these wells have median As concentrations of 1,860 µg/L and 161 µg/L, respectively. They are also characterized by reducing conditions, as indicated by elevated Fe(II) and sulfide concentrations.

The solubility of As in unsaturated conditions can be related to pH, Fe-oxide content, and As concentration in host rock. These factors are considered in the existing As source term for unsaturated mine waste, as described in Appendix 31-D (Lorax 2017). No updates are made to the modelling approach for As solubility in unsaturated environments.

The solubility of As in saturated environments will be enhanced relative to unsaturated conditions due to occurrence of As predominantly as arsenite rather than arsenate. This is supported by both groundwater monitoring data and saturated column tests. In order to estimate the concentration of As produced from infiltration through saturated mine waste, the median and 90th percentile of concentrations observed in saturated column are applied to the base case and upper case source terms, respectively (Table 3-3). The saturated As source term is applied the proportion of each backfill WRSFs footprint which is flooded upon pit lake formation (Table 2-2).

Some management of waste rock to minimize As metal leaching is incorporated into development of this solubility control. It is assumed that material with high As leaching potential, based on As/Fe molar above 4.5 mmole/mole, will be excluded from portions of mine pits where waste rock will potentially become saturated. Therefore, the gneiss transition (GT) column is excluded from source term calculations, and this rock type is assigned As concentrations produced from the gneiss sulphide column (GS).

4.3 ROM Stockpile

4.3.1 Unsaturated Source Term

The ROM stockpile contains ore placed on a pad of schist waste rock. The ROM pad source terms are calculated by upscaling geochemical loading rates from ore unsaturated columns and waste rock field bins to estimate the loading generated from these two components of the facility. The loading rate from ore on the stockpile is calculated using the median and 75th percentile loading rates measured in unsaturated column work. The columns and cycles used to calculate these loading rates are presented in Table 4-5. Column loading rates are provided in Appendix D. These loading rates are applied to the lithologic composition of ore and waste rock which compose the ROM Pad, as shown in Figure 2-3. The ore column scaling approach is described in Appendix B. For the waste rock pad, the same scaled loading used for WRSF source terms are applied to ROM pad waste rock.

The annual surplus water of the ROM stockpile is used to convert loading rates to concentrations. The MAP and runoff coefficients used to calculate surplus water are shown in Section 3.1.

Table 4-5:
Kinetic Tests and Cycles Used for Ore Stockpile Term Calculation

Kinetic Test ID	Mineralization	Lithology	Material Type	Cycles/Weeks
Col 9	Oxide	Schist	Ore	2-78
Col 10	Transition	Schist	Ore	2-78
Col 11	Oxide	Gneiss	Ore	2-78
Col 12	Transition	Gneiss	Ore	2-50

4.3.2 Solubility Controls

The ROM stockpile source terms are calculated by upscaling kinetic test loading rates. A number of parameters are affected by thermodynamic solubility controls and scale-independent release mechanisms. Concentrations of As and ^{226}Ra are calculated using the same approach that was applied in Lorax (2018). The concentration prediction for U has been updated consistent with model updates described in section 4.2.3. The same assumptions regarding pH and pCO_2 and calcite SI values applied to waste rock are also applied to the ROM pad.

Table 4-6:
Total Fe and U content of ore lithologies and U solubility model inputs.

Lithology	Weathering	Water content (ml/kg)	Fe (g/kg)	% Fe as HFO	U ppm[1]	% U as U(VI)	Solution Chemistry
Gneiss	Oxide	60	16	0.62%	14	95%	Source Term
Gneiss	Transition	60	14	0.32%	11	50%	Source Term
Granite	Oxide	60	15	0.60%	14	95%	Source Term
Granite	Transition	60	12	0.60%	12	50%	Source Term
Schist	Oxide	60	31	0.79%	2.9	95%	Source Term
Schist	Transition	60	30	0.13%	2.6	50%	Source Term

Ore stockpiled on the ROM pad will be placed on a pad of schist waste rock. Infiltration of ore contact water through schist waste rock will attenuate a portion of the As and U load associated with the ore material. To quantify this effect, the solubility of As and U parameters is calculated assuming that ROM pad pore water is in contact with schist waste rock prior to discharge. That is, the inputs to the As and U solubility model assume that solid surfaces have the composition of schist waste rock. Some portion of water which contacts the ore stockpile may bypass the schist waste rock through preferential flow paths. To account for the potential for such behaviour, it is assumed that 10% to 20% of ore

contact water bypasses schist waste rock in the base case and upper case scenario. An example of calculated infiltration for the ore stockpile, waste rock pad, and Rom Pad which combines the two source terms is shown for two conservative parameters (SO_4 and Zn) and two non-conservative parameters (As and U) in Table 4-7 for Y2 of mine life.

Table 4-7:
Example of infiltration chemistry calculated for the ore stockpile, waste rock pad and combined source term for Y2 base case scenario

	SO_4	As	U	Zn
	mg/L	mg/L	mg/L	mg/L
Ore Stockpile Component	159	0.151	0.055	0.014
Waste Rock Component	146	0.002	0.021	0.015
Combined Source Term	305	0.018	0.024	0.029

4.4 Pit Wall Rock

Pit wall rock refers to rock exposures within the mining pit itself. This includes the pit floor, benches and blast damaged fractured rock. The WQM includes two types of geochemical loading released from pit wall rock: meteoric runoff from unsaturated pit wall rock exposures; and submergence of pit wall exposures. Pit wall runoff source term represents weathering from sub-aerially exposed pit wall. The second type of pit wall loading is from submergence of pit wall by pit lake formation. This source terms represents the flushing of oxidation products which may accumulate on mineral surfaces while the wall rock is unsaturated.

4.4.1 Unsaturated Source Term

Source terms for pit wall runoff are calculated by scaling laboratory columns representing waste rock and ore which will compose the wall exposures. The loading rates have been updated to incorporate recent column data. The column IDs and cycles used in source term development are shown in Table 4-8. The proportion of different rock types which make up pit walls at the end of mine life is shown in Table 2-3. It is assumed that the relative exposure of different lithologies shown in this figure is maintained throughout mine life. Pit wall upscaling is described in detail in Section 5.2 Appendix B.

The annual surplus water of pit wall rock is used to convert loading rates to concentrations. A constant pit wall elevation of 1170 masl is used to estimate MAP of all pit walls. The MAP and runoff coefficients used to calculate surplus water are shown in Section 3.1.

Table 4-8:
Kinetic Tests and Cycles Used for Pit Wall Source Term Calculation

Kinetic Test ID	Mineralization	Lithology	Material Type	Cycles/Weeks
Col 3	Oxide	Schist	Waste	2-98
Col 4	Transition	Schist	Waste	2-98
Col 5	Oxide	Gneiss	Waste	2-98
Col 6	Transition	Gneiss	Waste	2-98
Col 7	Oxide	Granite	Ore	2-52
Col 8	Transition	Granite	Ore	2-52
Col 9	Oxide	Schist	Ore	2-78
Col 10	Transition	Schist	Ore	2-78
Col 11	Oxide	Gneiss	Ore	2-78
Col 12	Transition	Gneiss	Ore	2-50
Col 13	Transition	Granite	Waste	2-50
HC6	Fresh	Granite	Waste	2-100
HC2	Fresh	Schist	Waste	2-87
HC4	Fresh	Gneiss	Waste	2-87

Note: Median loading rates used for base case, and 75th percentile loadings used for upper case source terms.

4.4.2 Saturated Source Term

The pit wall source term assumes that 75% of rock surfaces in the blast damaged zone and 50% of the blast fractured zone are flushed by meteoric water when subaerially exposed. When the pit wall becomes inundated by a pit lake, the blast-fractured and blast-influenced zone will be entirely flushed and the accumulated load will be released at that time. That is, 25% of the rock surface in the blast damaged zone and 50% of the surface in the blast fractured zone accumulates oxidation products, which are released once the pit wall is submerged. The unflushed surfaces are assumed to accumulate an oxide load at the same weathering rate applied to the unsaturated wall rock source terms. The accumulation rate is provided in Appendix A along with the other source terms. No solubility controls are applied to the saturated pit wall load.

4.4.3 Solubility Controls

Solubility controls for U are applied using the updated modelling approach described in Section 4.2.3 of this report. The one exception to this for mildly acidic granite transition ore exposures. The upscaled U concentration is directly applied to this rock type (*e.g.*, no solubility constraint). For all other rock types, the same pH assumptions applied to waste rock (base case pH 8.0; upper case pH 8.3) are applied. Alkalinity is determined by setting a pCO_2 value of $10^{-3.2}$. This is equivalent to 2x atmospheric pCO_2 concentration, and results in alkalinity values ranging from 70 mg/L to 180 mg/L. These alkalinity values are

similar or greater than background alkalinity concentrations observed in Halfway Creek at HC 2.5 (10th percentile 9.73 mg/L; median 72 mg/L; and, 90th percentile 132 mg/L).

Arsenic and ^{226}Ra solubility controls are calculated using the same approach described in Lorax (2017). Solubility caps for select other parameters not expected to upscale conservatively or present in detection limit values in kinetic tests are set to field bin results (Fe, Al, Cu, Hg, Se and Sb). The same parameters and solubility caps described in Lorax (2017) are applied to the current source term iteration.

4.5 Haul Roads

4.5.1 Unsaturated Source Term

Haul roads will be constructed primarily with waste rock. The lithology of waste rock that will be used in haul road construction is not yet defined. For the purpose of source term calculation, it is assumed that haul roads are constructed entirely of gneiss waste rock. This is the dominant rock type (~80%) of waste rock that will be produced over mine life. In the base case scenario, the loading rate assigned to haul road construction material is weighted based on the relative proportion of gneiss oxide, gneiss transition, and gneiss fresh waste rock that will be produced over mine life (13% oxide, 56% transition and 31% fresh). In the upper case scenario, the maximum loading rate for a given parameter from each of the three gneiss field bins is used for each parameter.

Geochemical loading rates are scaled to reflect differences in particle size surface area between field and kinetic test conditions. Roads will be constructed using gravel and sand particle size fraction of waste rock. Only the relatively fine grain size fraction will be used for road construction, with boulders and cobbles being excluded.

The annual surplus water of haul roads is used to convert loading rates to concentrations. A constant elevation of 1300 masl is used to estimate MAP of all haul roads. The MAP and runoff coefficients used to calculate surplus water are shown in Section 3.1.

4.5.2 Solubility Controls

Solubility controls are calculated for U, As and ^{226}Ra. Uranium solubility is calculated using the modelling approach described in section 4.1.3 of this report. The alkalinity is determined by setting a pCO_2 value of $10^{-3.2}$, which results in alkalinity values of 73 mg/L to 143mg/L for the base case and upper case scenario, respectively. The approach to calculating As and ^{226}Ra solubility controls is the same approach described WRSFs. Other model inputs (*e.g.*, pH and calcite SI) are consistent with what is described in section 4.1.3 for base case and upper case scenarios.

4.6 Heap Leach Solution Source Terms

A cyanide heap leaching facility is planned for extraction and recovery of Au from oxide and transition ore. Ore will be leached with lime buffered NaCN solution applied with drip emitters. The leach solution will drain into collection pipes that will direct the pregnant solution to the process plant where precious metals will be recovered. The resulting barren solution will be amended with additional lime and NaCN as required and then recirculated to the heap to continue the leaching cycle.

The HLF will be constructed in stages and gold recovery from certain areas of the pad will be completed while other areas are undergoing leaching. For those areas where leaching is completed, progressive reclamation will be able to commence. Upon completion of economic gold recovery of heap leach ore, progressive reclamation will be initiated which involves the following steps:

- Rinsing of leached ore with barren solution to export and volatilize cyanide and free cyanide;
- Capping of the HLF with geosynthetic clay liner (GCL) protected by 0.5 m of coarse waste rock for the flat surfaces, and 0.5 m of coarse waste rock over the slopes;
- If necessary, passive treatment of post-reclamation HLF seepage to serve as a final polishing step as contingency (*e.g.,* zero valent iron, coarse organic composted wood chips from tree clearing, suitable geologic material).

During operations and early closure, discharge of any excess HLF solution will undergo active treatment prior to release to the Alpha Pond and ultimately, Halfway Creek. Active treatment will include cyanide destruction, physico-chemical treatment and nitrate removal and final metal polishing using a biological system termed the Electrochemical Biological Reactor (EBR) system. Once active treatment is terminated and closure of the HLF is completed and stabilized, it may be necessary to direct residual HLF seepage waters through the events ponds converted to passive systems prior to discharge to Halfway Creek.

The development of a heap leach solution source term for use in the water quality model for parameters of interest involved a multi-step approach:

- Develop an estimate of early phase heap leach process barren solution coincident with water treatment requirements commencing in year 2
- Develop an estimate of heap leach recycled solution later in the mine life prior for parameters of concern as well as major ion concentrations that could accumulate over time. The concentrations of several major ions (*e.g.* SO_4, Na, Ca, Mg, K,

alkalinity) are anticipated to behave conservatively and accumulate in recycled heap rinse solutions.

- For parameters of interest that are targeted in the water treatment process, a back-calculation approach was used to develop estimates of effluent discharge concentrations for both active and passive treatment based on assimilative capacity in Halfway Creek. Calculated effluent discharge concentrations were used as the active or passive treated effluent concentration in the water quality model.

4.6.1 HLF Barren Solution Chemistry – Early Phase

During mine operations, HLF solutions will be dominantly pregnant/barren solution with some amount of meteoric water. Later in the mine life the HLF pore water will be a combination of pregnant solution and rinse water from areas where recirculation rinsing has been initiated. For the operations source term, it is assumed that all HLF pore water is barren solution during operations. The processing of heap leach ore for the Project will entail the use of cyanide solutions under pH conditions ranging between pH 10.0 and 11.0. While the dissolution of gold is the primary objective during cyanide leaching, other metals are liberated during the leaching process, both as a result of complexation reactions with cyanide (*e.g.* Cu-CN, Cd-CN, Zn-CN) and increased solubility under elevated pH conditions (*e.g.* As and U).

In Appendix B, the chemistry of Coffee barren solutions was estimated based on the final water quality measured in metallurgical cyanide leach columns (see Table 4-56 in Appendix B). This water quality estimate was updated to account for potentially higher concentrations of nitrate-nitrogen in the solutions as compared to measured in metallurgical columns and the inclusion of estimates for Cl, Ca and Na in the solutions based on measured concentrations in early phase Eagle Gold heap leach process solutions and charge balancing of solution chemistry. A summary of the early phase source term prediction is provided in Table 4-9.

Table 4-9:
Early Phase Heap Leach Solutions Source Term Estimate

Parameter	Units	Early Phase HLF Solution
pH	s.u.	9 to 10
$N\text{-}NH_3$	mg/L	72
$N\text{-}NO_3$	mg/L	50
$N\text{-}NO_2$	mg/L	1
Cl	mg/L	300
Sulphate	mg/L	1100
Total Alk	$mg/CaCO_3/L$	600
WAD-CN	mg/L	130
TDS	mg/L	2750
Al	mg/L	0.09
Ag	mg/L	0.00045
As	mg/L	5.0
Ca	mg/L	300
Cd	mg/L	0.0036
Cr	mg/L	0.008
Cu	mg/L	2
Co	mg/L	0.5
Fe	mg/L	2.3
Hg	mg/L	0.005
Mg	mg/L	2
Mn	mg/L	0.27
Mo	mg/L	0.125
Na	mg/L	580
K	mg/L	8
Ni	mg/L	0.019
Pb	mg/L	0.0002
Sb	mg/L	0.09
Se	mg/L	0.007
U	mg/L	0.1
Zn	mg/L	0.7

4.6.2 HLF Barren Solution Chemistry – Late Phase

The chemistry of the Coffee HLF solutions will evolve over the mine life as ore stacking and solution recycling progresses. A conceptual understanding of the chemical evolution of process solution can be informed by other HLF operations where Au has been recovered using sodium cyanide (NaCN) and lime (CaO) additives. In this section three analogue mine sites are described. The rinsed draindown chemistry of these sites is subsequently used to inform the behaviour of major ions and trace metals in HLF drainage for the Coffee Project for the later stages of heap leach operation.

4.6.2.1 Analogue Mines

Brewery Creek Mine

The Brewery Creek Mine is located 55 km east of Dawson City, Yukon and operated a gold heap leach facility from 1997 to 2001. The ore was primarily hosted in quartz monzonite sills and to a lesser extent in the Earn Group clastic sediments. A total of 9.5 Mt of ore was stacked in 7 cells encompassing an area of 31 ha. The heap was amended with cyanide, caustic and lime. The heap leach process recycled nearly all of the water used in processing. Thus, little or no water was released to the environment during operations. Mining ceased in September 2000, but processing and gold recovery continued uninterrupted until December 2001. Detoxification in the form of nutrient addition to promote in-situ biodegradation of cyanide species began in May 2002. Analytical results of solution chemistry from the Brewery Creek Mine is available from the end of operations (December, 2001), to May 2002 when detoxification using nutrient additives was initiated.

Daisy Mine

The Daisy Mine is located 8.9 km east of Beatty, Nevada and operated as a gold heap leach facility from 1996 to 2000. The ore consists of silicified and argillic altered limestone, with gold occurring in goethite and arseniosiderite minerals. During operations cyanide, lime and caustic were amended to the ore. By the end of operations, the HLF contained approximately 16 Mt of ore on a 17 ha pad. Owing to the arid climate, the site operated under a water deficit throughout mine life. No rinsing of the HLF occurred at the end of operations. Cover installation was complete in February 2002, at which point the HLF draindown commenced. Quarterly water quality monitoring is available from 2002 to 2008.

Marigold Mine

The Marigold Mine is located 4.8 km south of Valmy, Nevada. As of 2014, a total of 18 cells were operated, with cells 1, 2,7 and 8 inactive and in draindown. The ore is hosted in the Valmy Formation quartzite and argillites, with gold being hosted in iron oxide minerals contained in fractures. During operations cyanide, lime and caustic were amended to the ore, and process solution was circulated through all active cells. Cell 7, specifically, was operated from 1992 to 2001, and contained 2.4 Mt of ore at the end of operations. Owing to the arid climate, the site operated under a water deficit throughout mine life. No rinsing of the HLF occurred at the end of operations. Quarterly water quality monitoring is available for the first two years of draindown (2002 to 2003).

4.6.2.2 HLF Rinse Solution Estimate for Major Ions at Coffee

Recirculation of HLF process solution and progressive rinsing of the heap will lead to the accumulation of dissolved parameters in process solution. The rate and degree to which parameters will accumulate in solution depends on the source, release mechanism, and geochemical controls on mobility. Most trace elements are expected to stabilize in heap leach solutions relatively quickly, with the primary controls being related to the availability of cyanide and the highly alkaline pH produced by lime addition. Major ions are generally more soluble than trace metals in the HLF environment and may accumulate in process solution over time.

In order to accurately predict TDS, the accumulation of major ions in re-circulated process solution needs to be estimated. The eight major ions which mostly compose TDS at the three analogue mine sites are Na, Mg, Ca, SO_4, Cl, NO_3, K and HCO_3. Accurate prediction of the accumulation of TDS in the Coffee HLF requires a conceptual understanding of the sources and geochemical behavior of these elements in the Coffee HLF.

Major ion loadings in the Coffee HLF originate from reagents amended in support of Au extraction and weathering of primary minerals. Reagents which contribute to major ion loading include NaCN and lime (CaO). Irrigating NaCN solution into the heap leach contributes to Na and N loadings in the re-circulated process solution. A small portion of N is lost to CN off-gassing and denitrification, with the majority of residual N occurring as NO_3 in heap rinse solutions. Considering the non-conservative behaviour and lack of thermodynamic solubility constraints impacting N concentrations, the observed concentrations of N species at analogue mines are considered a reasonable approach to estimating N concentrations in the Coffee HLF.

The high Na concentrations observed in analogue HLF operations is primarily due to Na released from NaCN addition (Table 4-10). Sodium is highly soluble, and Na amended in the form of NaCN can be expected to eventually be rinsed from the heap. However, a portion of the Na amended in the form of NaCN will be trapped in dead-end pore space or retained on cation exchange sites within the heap. This Na retained in the heap will form a reservoir that will be gradually leached after draindown and closure. In order to calculate Na concentrations in the Coffee HLF, a loading model is used which incorporates the NaCN addition rate and an estimate of the mass of Na which will be retained within the HLF.

Calcium is present in lime and in carbonate minerals (calcite and dolomite) within the heap. The high pH produced by lime dissolution will limit dissolution of Ca bearing carbonates, and a portion of Ca from the lime additive will re-precipitation as secondary calcite. The concentration of Ca in re-circulated process solution will be controlled by thermodynamic

solubility constraints effecting Ca-carbonate formation and dissolution. Speciation of water quality data from the three analogue mines using the geochemical modelling program PHREEQC coupled to the Lawrence Livermore National Labs Database (llnl.dat) can be used to predict the degree of calcite saturation in these heaps (Parkhurst and Appelo, 1996). The results show that calcite is supersaturated at all three analogue mines (Figure 4-5), with similar median calcite SI values of 0.63 at Brewery Creek Mine, 0.53 at Daisy Mine, and 0.44 at Marigold Mine. These results show that Ca concentrations will be controlled by calcite precipitation with SI values ranging from 0.44 to 0.63.

Table 4-10:
Major Ion Concentrations Measured at Analogue Mines

		Analogue Sites								
		Brewery Creek Mine			**Daisy Mine**			**Marigold Mine**		
Parameter	*units*	*Min*	*P50*	*Max*	*Min*	*P50*	*Max*	*Min*	*P50*	*Max*
pH	mg/L	8.14	8.74	9.31	6.89	7.68	8.01	7.43	8.26	8.75
N-NO_3	mg/L	263	276	307	48	170	230	161	233	275
SO_4	mg/L	439	499	539	2160	2400	3100	560	650	726
Alkalinity	mg$CaCO_3$/L	13.9	41.1	82.5	95	130.5	160	21.4	47.5	77.2
Ca	mg/L	139	177	184	360	394	450	95.9	115	138
Mg	mg/L	7.8	9.31	10.3	93	110	140	28.2	32	37.8
Na	mg/L	338	434	455	720	780	940	754	840	946
Cl	mg/L	37	41.5	51.7	82	93.5	120	418	565	682
K	mg/L	3.7	5.4	51.5	9.9	15	27	7.8	8.25	10.8
TDS	mg/L	2290	2430	2624	3500	4485	5400	2810	3280	3620

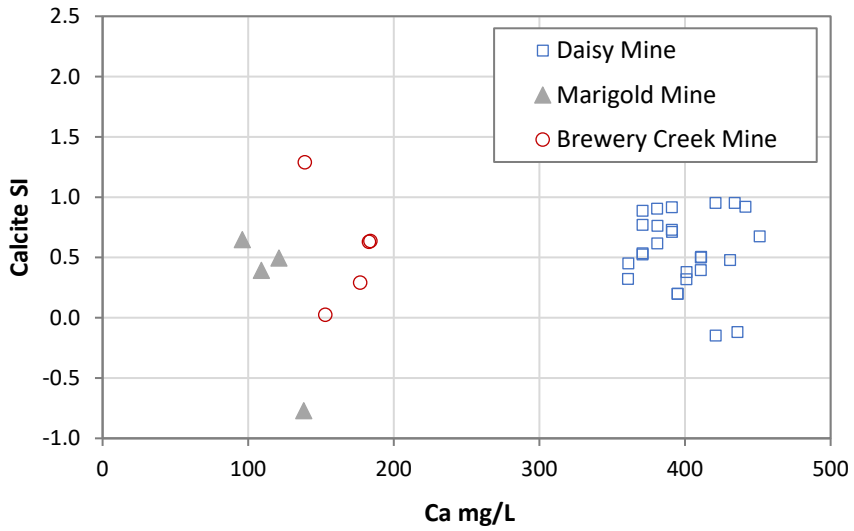

Figure 4-5: Calcium concentrations *versus* calcite saturation indices (SI) in HLF drainage at analogue mines.

The concentration of HCO_3 is determined by the interaction between carbonate dissolution/precipitation, biodegradation of CN, and ingress of atmospheric CO_2 into the heap. Assuming that calcite precipitates to achieve the range of SI values observed shown in Figure 4-5, the HCO_3 concentration can be predicted based on solution pH and pCO_2 concentrations. The relationship between these two parameters in the analogue dataset is shown in Figure 4-6.

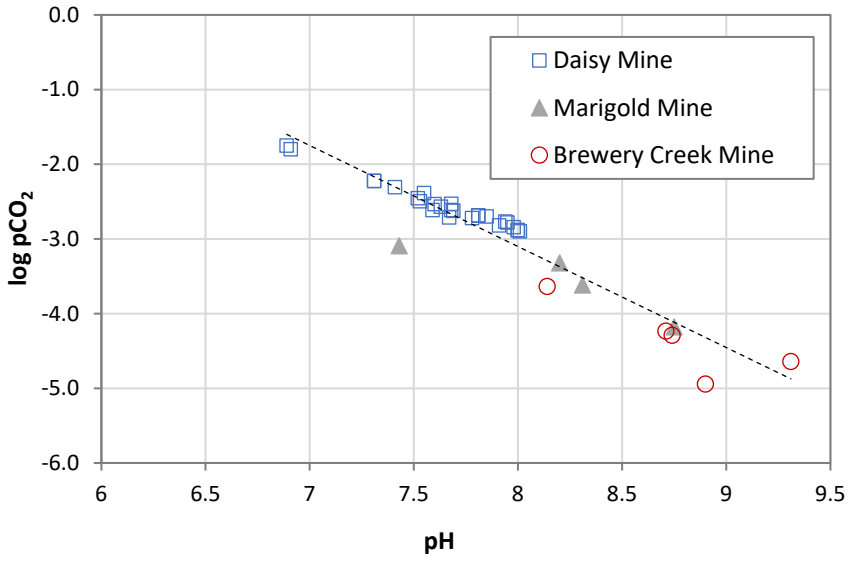

Figure 4-6: Log pCO_2 versus pH in HLF drainage at analogue mines. Dotted line indicates best fit linear regression.

The analogue mine data shows pCO_2 is undersaturated with respect to atmospheric concentrations when pH > 8.2 (atmospheric log pCO_2 = -3.4). This indicates that residual CaO remains in the HLF and is providing a source alkalinity that is not associated with carbonate mineral dissolution. As lime is rinsed or re-precipitated as calcite in the heap, the pH declines to <8.2 and pCO_2 becomes supersaturated with respect to atmospheric concentrations. Drainage from unsaturated mine rock facilities is typically elevated in pCO_2 relative to atmospheric values due to limitations on gas exchange between the interior of the facility and the atmosphere. Collectively, the analogue mines show a consistent relationship between pCO_2 and drainage pH. Once a pH estimate is established, the relationship between pCO_2 and pH shown in Figure 4-6 can be used to estimate HCO_3 concentrations at the Coffee HLF.

The primary source of Mg in the ore is dolomite and to a lesser extent silicate minerals (*e.g.,* phengite and biotite). Any Mg that enters process solution from weathering of silicates or dolomite is likely to be re-precipitated in the high pH environment of the active HLF facility as magnesite ($MgCO_3$). As lime is rinsed from the HLF and the pH declines, Mg concentrations will increase from increasing solubility of primary Mg minerals and dissolution of any secondary magnesite which may have formed in the heap. The SI of magnesite is plotted against Mg concentrations for the three analogue mines in Figure 4-7.

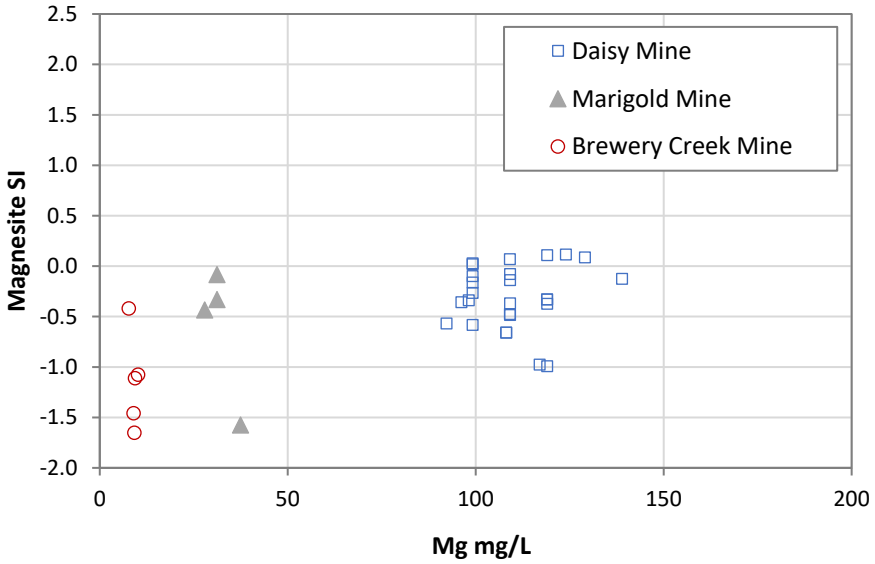

Figure 4-7: Magnesium concentrations versus magnesite saturation indices (SI) in HLF drainage at analogue mines.

The results show that Mg concentrations are often near equilibrium with magnesite at the Daisy Mine and Marigold Mine, which generally have higher Mg concentrations compared to Brewery Creek Mine. This shows that magnesite equilibrium (SI=0) is an effective

upper solubility limit on Mg concentrations and can be used to conservatively predict Mg concentrations in the Coffee HLF. Potassium is released from weathering of mica and K-feldspar minerals which are relatively abundant in Coffee ore. The solubility of potassium is controlled mainly by cation exchange in porous media, with clay minerals generally providing the most abundant exchange sites. The degree to which K concentrations will be controlled by cation exchange depends on solution chemistry, competing ion effects, and the availability and mineralogy of clay mineral surfaces. An empirical relationship can be observed between K and pH in the three analogue mines that is consistent with results from the Coffee Project leach tailings field bins (Figure 4-8). Given the relatively consistent relationship between K and pH from these data sources, it is assumed that K concentrations in the Coffee HLF can be reasonably predicted based on the empirical relationship shown in Figure 4-8.

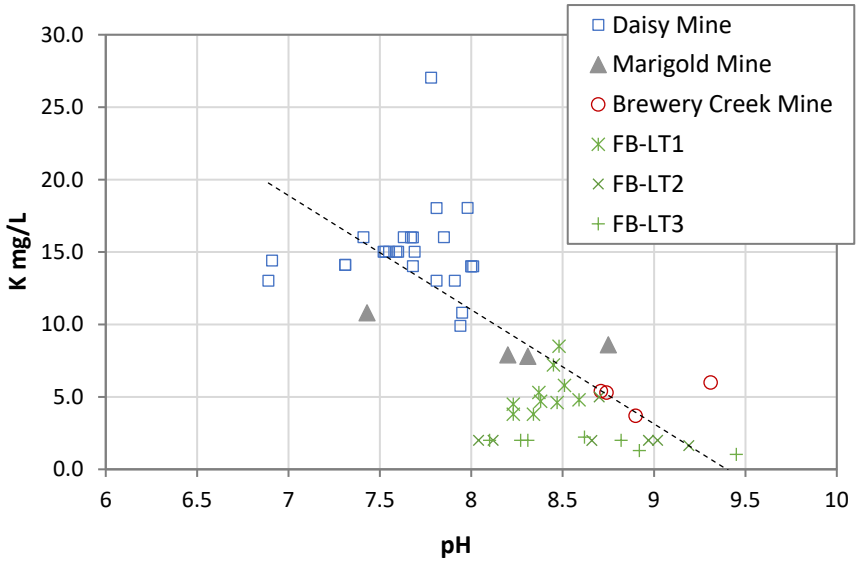

Figure 4-8: Potassium concentrations *versus* pH in HLF drainage at analogue mines. Dotted line indicates best fit linear regression.

Chloride is a major ion in HLF drainage that has not been identified in any distinct mineral phase. This element is often present as an impurity in apatite minerals and can be associated with clay minerals in mine rock. Chloride is highly soluble and any Cl released from mine rock is expected to be retained in the process solution. Considering the conservative behaviour of Cl, prediction of Cl will require a conservative loading model using site specific geochemical characterization data for the Coffee Project.

Sulphate will be released from dissolution of sulphate minerals and oxidation of residual sulphides present in the ore. The sulphur content varies considerably in different ore types, with schist generally having significantly higher sulphate and sulphide compared to gneiss

and granite. Sulphate is expected to remain relatively soluble during heap leach operations. This is due to elevated pH values generated by lime addition limiting Ca solubility. After irrigation of barren solution is complete, pH values will decline allowing for increased Ca solubility, which may potentially lead to gypsum precipitation. Sulphate concentrations can be predicted using a conservative loading model, similar to Cl, with the final concentrations potentially being limited by gypsum solubility.

Modeling Approach for Major Ions for Coffee

In addition to evaluating analogue sites, there are two general approaches used to predicting concentrations of major ions:

- Loading calculations for conservative parameters (Na, Cl and SO_4); and,
- assigned concentrations for non-conservative parameters based on the thermodynamics of mineral precipitation/dissolution or empirical observations (K, Ca, Mg, NO_3 and HCO_3).

Note that solubility constraints for SO_4 are considered in the final solution but are ultimately not applied as predicted concentrations remain below gypsum saturation. An upper case and base case prediction for major ions has been developed, consistent with previous source term development for the Coffee Project.

Major ion loading rates are predicted based on geochemical test results for metallurgical columns and leach tailings kinetic tests. Metallurgical column and leach tailings kinetic testing samples used in source term development are shown in Table 4-11. Data for solubility constraints are generated from empirical observations of analogue mines described above or using the geochemical modelling program PHREEQC coupled to the llnl.dat database.

Table 4-11:
Metallurgical Columns and Kinetic Test

Lithology	Weathering	Met Columns	Kinetic Tests
		Head ID (*Column IDs*)	**Column ID (*Composition*)**
Schist	Oxide	72133 (*73001*), 72136 (*72153, 72156*)	Column 15 (*100% Schist*)
Schist	Transition	72137 (*72759, 72162*), 72138 (*72165, 72168*)	
Granite	Oxide	72139 (*72717, 72174*)	Column 17 (*90% Gneiss, 10% Granite*)
Granite	Transition	72177 (*72177, 72180*)	
Gneiss	Oxide	72134 (*73004*), 72142 (*73010*, *73013*, *73007*), 72143 (*73019*, *73022, 73016*), 72144 (*73025*, *73028*), 72145 (*73031, 73034*)	
Gneiss	Transition	72146 (*73037, 73040*)	

The major ions SO_4, Na and Cl are modeled to behave conservatively and accumulate in the process solution during operations. Two types of loading are used to predict these concentrations; a water-soluble load that will be released shortly after ore is stacked on the heap and irrigated with process solution; and, a kinetic weathering rate representing gradual release of major ions from primary minerals in the spent leach tailings. The calculations of loading rates for conservative parameters are described below.

The water-soluble load for SO_4 and Cl is estimated using results from the metallurgical column tests. The columns were irrigated with NaCN solution which was recirculated over a 32-day period. The concentration of SO_4 and Cl in the column water at the end of the experiment can be used to calculate the water-soluble load of these parameters associated with different ore types. Details of columns used to calculate the water-soluble load from the metallurgical columns are shown in Table 4-12. The loading is calculated by multiplying the concentration by the total water added to the column during testing and divided by the column mass. When multiple columns are constructed from the same head sample, the columns are averaged to produce a loading associated with the head sample. The loading released each year of mine life is scaled based on the quantity and lithology of ore that will be stacked on the HLF in a given year.

Table 4-12:
Metallurgical column results for SO_4 and Cl concentrations

Lithology	Weathering	Head ID	Column ID	Mass (kg)	Water Added (L)	SO_4 (mg/L)	Cl (mg/L)
Schist	Oxide	72133 A	73001	48	18.4	43.1	19.4
		72136 A	72153	101	32.6	725	26.0
			72156	50	19.7	547	23.0
	Tran.	72137 A	72159	94	30.4	2980	27.0
			72162	50	16.5	2370	<25
		72138 A	72165	84	28.6	2570	<25
			72168	49	19.3	2670	<25
Granite	Oxide	72139 A	72171	104	33.0	57.4	27.0
			72174	50	20.3	37.9	20.6
	Tran.	72140 A	72177	98	29.9	666	23.0
			72180	50	18.5	424	22.0
Gneiss	Oxide	72134 A	73004	46	16.4	8.8	17.9
		72142 A	73010	83	29.8	9.6	21.0
			73013	43	19.6	11.8	21.8
			73007	718	143.7	6.9	15.0
		72143A	73019	86	28.5	10.6	22.0
			73022	44	22.4	12.3	19.2
			73016	741	147.8	8.1	16.0
		72144 A	73025	99	29.2	44.5	22.0
			73028	50	18.4	41.9	24.0
		72145 A	73031	95	28.2	58.2	25.0
			73034	49	17.3	62.8	24.7
	Tran.	72146 A	73037	94	25.8	444	27.0
			73040	50	22.5	744	30.0

The water-soluble load of Na is estimated based on the expected NaCN amendment rate and an estimate of Na that will retained within the HLF. Amending NaCN at a dossage of 0.2 kg/t would equate to a Na amendment of 93.8 mg/kg. It is assumed that 70% of the Na amendment will be available to process solution, resulting in 65.7 mg/kg Na being immediately water-soluble. The water-soluble load associated with each lithology and weathering zone is presented in Table 4-13. These rates are applied to the base case and upper case loading model.

Table 4-13:
Water-soluble load of SO_4, Cl and Na used in loading model

Lithology	Weathering	SO_4	Cl	Na
		kg/t	kg/t	kg/t
Schist	Oxide	121	8.1	65.7
Schist	Transition	918	5.5	65.7
Granite	Oxide	16.8	8.5	65.7
Granite	Transition	180	7.6	65.7
Gneiss	Oxide	8.9	7.1	65.7
Gneiss	Transition	228	10.5	65.7

After the initial water-soluble load is released to process water in the HLF, primary minerals in the ore will continue to weather. Weathering of the ore over time is measured using kinetic tests conducted on leach tailings samples built from metallurgical column residues (Table 4-11). Major ion weathering rates used in the model are presented in Table 4-14.

Table 4-14:
Weathering rate of SO_4, Cl and Na used in loading model

Lithology	Weathering	SO_4		Cl		Na	
		Upper Case	Base Case	Upper Case	Base Case	Upper Case	Base Case
		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
Schist	Oxide	0.107	0.0279	0.0024	0.000945	0.0124	0.00187
Schist	Transition	0.107	0.0279	0.0024	0.000945	0.0124	0.00187
Granite	Oxide	0.0118	0.0038	0.00235	0.00093	0.0642	0.00881
Granite	Transition	0.0118	0.0038	0.00235	0.00093	0.0642	0.00881
Gneiss	Oxide	0.0118	0.0038	0.00235	0.00093	0.0642	0.00881
Gneiss	Transition	0.0118	0.0038	0.00235	0.00093	0.0642	0.00881

The upscaled loadings are converted to a concentration using the HLF water balance. All loadings of Na, Cl and SO_4 are modeled to accumulate within HLF process water (pore water + barren/pregnant tanks) between Y-1 and Y6. Starting in Y6, a portion of the load in the HLF is exported to treatment with surplus water. Surplus water continues to be generated for the remainder of HLF operations and rinsing. After Y6 concentrations are predicted to decline in the heap leach solution. This is due to: export of TDS with discharge solution; and, the type of ore stacked is primarily gneiss oxide which produces relatively low quantities of SO_4 compared to other ore types.

Non-conservative parameters are estimated based on empirical relationships described above (Figure 4-5 to Figure 4-8) combined with thermodynamic solubility constraints imposed using the geochemical modelling program PHREEQC. In order to employ thermodynamic solubility constraints a prediction of pH is required. The pH of the drain HLF solution is set to the range of pH values observed in Coffee leach tailings field bins (min= pH 8.0; median = pH 8.4; max = pH 9.4). Lower pH estimates result in more conservative TDS estimates. Therefore, the upper case estimate uses the minimum pH observed in field bins of pH 8.0, and the base case source term uses the median pH observed in field bins of pH 8.4.

The concentration of Ca and Mg are predicted based on thermodynamic solubility constraints. Data from analogue mines show that magnesite equilibrium provides a conservative estimate of Mg concentrations (Figure 4-7). Therefore, Mg concentrations set to equilibrium with magnesite (SI=0) in both the upper case and base case scenarios. Calcium concentrations tend to be super saturated with respect to calcite, with median SI values of 0.44, 0.53 and 0.63 (Figure 4-5). For the base case and upper case scenario calcite is set to an SI of 0.53 and 0.63, respectively. Alkalinity is predicted based on the relationship observed between pCO_2 and pH in the analogue mines (Figure 4-6). Based on this relationship log pCO_2 is set at -3.78 in the base case scenario which assumes pH 8.0, and log pCO_2 is set at -3.10 in the upper case scenario which assumes a pH of 8.4.

Nitrate and K concentrations are assigned values based on analogue data. The K concentration is estimated based on the empirical relationship between K and pH shown in Figure 4-8. Nitrate concentrations are set to the maximum and median concentrations observed at the Brewery Creek Mine, which has the highest NO_3 concentrations of the three analogue sites (see Table 4-10).

4.6.2.3 HLF Late Phase and Rinse Solution Estimate for Trace Elements at Coffee

The water quality estimate for late phase rinsed HLF ore for trace elements is based on upscaling kinetic test results on leach tailings samples. The concentration prediction for U in HLF rinse solutions has been updated to be consistent with model updates described in section 4.2.3.1 of this report. Model inputs are modified to reflect the material composition, pore water chemistry, and water content of the HLF. The availability of U and Fe-oxides are updated using median total Fe and U content of the various ore lithologies (Table 4-6). The HLF water content will be elevated compared to waste rock owing to irrigation of detoxified rinse solution at the end of mine life, and a water content of 18% is applied (*i.e.*, 90 ml/kg). The concentration of As has been estimated using the same approach described in section 4.2.3.2. Residual CN in HLF drainage is taken from monitoring data from the Brewery Creek closed heap leach operation in Yukon.

Data Sources

Kinetic test loading rates for leach tailings are upscaled to produce the rinsed HLF chemistry estimate for trace elements. During the rinsing phase, it is expected that 4 pore volumes will be rinsed through the HLF. Therefore, loading rates were calculated from leach tailings kinetic tests after this volume of pore water has been rinsed. The kinetic test ID's and cycles used are presented in Table 4-15; note that the cycles vary with the size of the columns, with a greater number of cycles required to rinse the equivalent of 4 pore volumes in larger columns. Median loading rates are used for base case rinse chemistry estimates and 75th percentile loading rates are used for upper case rinse estimates calculations.

Table 4-15:
Kinetic Test Data used in HLF Post Closure Source Term

Kinetic Test ID	Metallurgic Sample ID	Mineralization	Lithology	Material Type	Cycles
Col 1	70340	90% Oxide 10% Transition	82% Gneiss 23% Schist	Leach Tailings	23-87
Col 2	70340	90% Oxide 10% Transition	82% Gneiss 23% Schist	Leach Tailings	51-87
Col 16	20%72162, 20% 72168, 30% 72150, 30% 72156	40% Oxide, 60% Transition	Schist	Leach Tailings	9-57
Col 17	35% 73028, 35% 73034, 18% 73040, 7% 72174, 3% 72180	80% Oxide 20% Transition	90% Gneiss, 10% Granite	Leach Tailings	8-57

The HLF rinse chemistry estimate is calculated by upscaling kinetic test loading rates and weighting the scaled results proportional to the different ore types contained in the HLF. Scaling factors used in HLF rinse chemistry calculation are summarized in Table 4-16.

Table 4-16:
Heap Leach Rinse Solution Estimate Scaling Factors

Scaling Factors	Unit	Base Case	Upper Case
Mean Annual Precipitation	mm	485	485
Runoff Coefficient	-	30%	30%
Grain size correction	-	20%	20%
% of material flushed	-	10%	25%
Bulk Scaling	-	2%	5%

Physical scaling factors considered in development of the HLF rinse estimate include grain size correction and flushing rate. Note that kinetic testing was carried out in a cold room which maintained a temperature of 4°C. The HLF will approach mean annual temperatures of ambient air, which is near 0°C, and may become partially frozen during winter months. No consideration is given to freezing of the HLF during winter months or re-establishment of permafrost. The geochemical loading rates measured at 4°C is expected to produce a conservative approximation of field loading rates, and no temperature scaling factor is applied.

There are differences in the grain size used in kinetic test samples, and the grain size specified in the design criteria of the HLF. Metallurgical leach columns were conducted on a variety of grain sizes to examine Au recovery. Laboratory kinetic test samples were collected from the smallest grain size samples of 80% -12.2 mm to ensure conservative results. The design criteria for the HLF is 80% - 50 mm. The grain size distribution on metallurgical leach column samples crushed to 80% - 50 mm found that on average 20% of the sample is -12.2 mm. Therefore, a grain size scaling factor of 0.2 is applied.

Unsaturated rock piles are known to develop preferential water pathways with variable moisture content. As a result, the entire mass of the reactive grain size fraction will not be equally rinsed by infiltrating water. Laboratory kinetic tests will experience a greater degree of flushing of mineral surfaces due to their small size and high flushing rate. In uncovered waster rock environments, an average contact water factor of 10% to 50% has been estimated (Elboushi, 1975; Kempton, 2012). Over 50% of the HLF will be covered with either raincoats during operations or a geosynthetic clay liner at the end of mine life. At closure, much of the infiltration will only occur through uncovered slopes, limiting the contact with reactive mineral surfaces. Therefore, a contact water factor of 10% to 25% was applied to the base case and upper case source term calculations. The physical scaling factors used in the upper case and base case source term predictions are presented in Table 4-16.

Kinetic tests representing various ore types are weighted to reflect the expected composition of the HLF at the end of mine life. The relative proportions of Col 1, Col 2, Col 15 and Col 17 is 0.35, 0.35, 0.10, and 0.20, respectively.

Solubility Controls

The HLF rinse estimate is calculated by upscaling kinetic test loading rates. This approach to source term calculation frequently results in predicted concentrations that exceed thermodynamic solubility controls, particularly in neutral pH environments where numerous controls on dissolved concentrations influence drainage chemistry. Solubility

controls for As, U and ^{226}Ra are calculated using the approach described in Section 4.2.3 of this report.

Nitrogen Species

As introduced above, elevated concentrations of nitrogen species are expected to be present in HLF drainage in post closure. Unlike other sources of nitrogen loading at the mine site, the primary source of nitrogen species in the HLF is from degradation of CN. Hence, nitrogen concentrations cannot be calculated based on an estimate of explosive use. Nitrogen loadings in the HLF will depend in large part on the rate of CN degradation during mine life and the effectiveness of rinsing closed sections of the heap during progressive reclamation. For the purposes of source term prediction, NO_3, NH_4, and WAD-CN concentrations produced at the closed heap leach facility at an analogue mine site, Brewery Creek are applied. The median and maximum concentrations observed 4 to 11 years after closure are used as the Base Case and Upper source term concentrations for nitrogen species.

For CN-WAD, the maximum and median concentrations measured at Brewery Creek were 0.196 mg/L and 0.086 mg/L. Nitrite was not regularly monitored in HLF drainage at the Brewery Creek site. Therefore, the ratio of NO_2/NO_3 in available Brewery Creek data was used to predict NO_2 concentrations based on the maximum and median NO_3 concentration.

4.6.2.4 HLF Late Phase Solution and Draindown Seepage Chemistry Estimate

The rinse and seepage water quality estimate for the HLF is presented in Table 4-17 for base case and upper case. This water quality estimate represents drainage chemistry from the HLF during late phase operations and rinsing.

The nature of loading calculations and source term calculations often results in solution chemistries that are not in charge balance. Charge balance refers to the fact that in all waters the valence concentration (eq/L) of positively charged cations must always equal the valence concentration of negatively charged anions. The charge balance of the predicted solutions has % error ranging from of -6.9% to +9.6%. Correcting this charge balance error would require manipulation of the solution chemistry. The predicted concentrations have been developed as reasonably conservative approximations of Coffee HLF chemistry. While they are not precisely charge balanced, the predictions are considered reasonable for the purpose of water quality modelling and guiding potential treatment testwork. Therefore, no further adjustments are made to correct the charge balance.

Table 4-17:
Late Phase Heap Water Chemistry Estimate prior to Treatment

		HLF Late Phase Chemistry	
		Upper Case	**Base Case**
pH	s.u.	8.4	8.0
N-NH_4	mg/L	0.06	0.025
N-NO_3	mg/L	307	275
N-NO_2	mg/L	1.9	1.6
Cl	mg/L	123	115
Sulphate	mg/L	2516	2300
Total Alk	mg/$CaCO_3$/L	87	47
WAD-CN	mg/L	0.2	0.09
TDS	mg/L	4100	3000
Al	mg/L	0.2	0.06
Ag	mg/L	0.00125	0.00009
As	mg/L	2.0	0.66
Ca	mg/L	350	204
Cd	mg/L	0.00013	0.00004
Cr	mg/L	0.014	0.004
Cu	mg/L	0.014	0.004
Fe	mg/L	0.5	0.15
Hg	mg/L	0.00026	0.0001
Mg	mg/L	155	117
Mn	mg/L	0.06	0.016
Mo	mg/L	0.105	0.0330
Na	mg/L	1168	890
K	mg/L	11	8
Ni	mg/L	0.006	0.002
Pb	mg/L	0.0013	0.00032
Sb	mg/L	0.5	0.17
Se	mg/L	0.005	0.0015
Tl	mg/L	0.004	0.0015
U	mg/L	0.685	0.300
Zn	mg/L	0.052	0.02
Ra-226	Bq/L	0.07	0.05

4.6.3 Summary of HLF Solution Source Term Estimate

Table 4-18 provides a summary of the source term estimate for the HLF solution during operations and later in the mine life and into closure (e.g., as draindown seepage chemistry).

Table 4-18:
Early and Late Phase Heap Water Chemistry Estimate Source Term

Parameter	Units	Early Phase HLF Solution	Later Phase HLF Solution
pH	s.u.	9 to 10	8.4
$N\text{-}NH_3$	mg/L	72	0.06
$N\text{-}NO_3$	mg/L	50	307
$N\text{-}NO_2$	mg/L	1	1.9
Cl	mg/L	300	123
Sulphate	mg/L	1100	2516
Total Alk	$mg/CaCO_3/L$	600	87
WAD-CN	mg/L	130	0.2
TDS	mg/L	2750	4100
Al	mg/L	0.09	0.2
Ag	mg/L	0.00045	0.00125
As	mg/L	5.0	2.0
Ca	mg/L	300	350
Cd	mg/L	0.0036	0.00013
Cr	mg/L	0.008	0.014
Cu	mg/L	2	0.014
Co	mg/L	0.5	0.25
Fe	mg/L	2.3	0.5
Hg	mg/L	0.005	0.00026
Mg	mg/L	2	155
Mn	mg/L	0.27	0.06
Mo	mg/L	0.125	0.105
Na	mg/L	580	1168
K	mg/L	8	11
Ni	mg/L	0.019	0.006
Pb	mg/L	0.0002	0.0013
Sb	mg/L	0.09	0.5
Se	mg/L	0.007	0.005
U	mg/L	0.1	0.685
Zn	mg/L	0.7	0.052

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Appendix A: Source Terms

Newmont™ COFFEE

			Alkalinity	Sulphate	P	Al	Ag	As	Ca	Cd	Cl	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Tl	U	Zn	Ra226
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Alpha WRSF																													
Base Case																													
Y1			2.56E+02	842.0794378	9.69E-04	0.008228957	1.95196E-05	0.004437896	1.63E+02	1.59452E-05	5.175228	0.000484378	0.001185598	0.001546028	0.025610154	5.41713E-06	25.09858	9.93E+01	0.011256683	0.041563093	63.00021	0.005100522	0.002429059	0.012724604	0.000915041	0.000175655	0.1001028	0.048571521	0.01030844
Y2			2.61E+02	1098.919711	8.12E-04	0.008228957	2.3628E-05	0.005403955	1.83E+02	2.1261E-05	6.441121	0.000568156	0.001451841	0.001968891	0.030979054	5.41713E-06	29.70646	1.12E+02	0.011323323	0.06034412	70.91733	0.005053573	0.002953354	0.014774196	0.001042446	0.00021649	0.1794877	0.051573505	0.009086412
Y3			2.66E+02	1381.298493	6.84E-04	0.008228957	2.890848E-05	0.005768261	1.97E+02	2.69181E-05	7.962226	0.00068673	0.001784019	0.002453946	0.037892378	5.41713E-06	36.03341	1.21E+02	0.012789631	0.07846698	97.95048	0.005665078	0.003619398	0.017785402	0.001245284	0.000266658	0.243355	0.059761683	0.008152935
Y4			2.68E+02	1383.742682	6.74E-04	0.008228957	2.938186E-05	0.005571746	1.97E+02	2.68622E-05	8.047844	0.000702581	0.001809	0.002469429	0.03851832	5.41713E-06	36.7945	1.21E+02	0.013582673	0.077209048	98.85569	0.006041836	0.003675364	0.018235977	0.001282198	0.000270045	0.2333444	0.062570533	0.008146106
Y5			2.69E+02	1556.034004	6.19E-04	0.008228957	3.249666E-05	0.005797182	2.04E+02	3.03401E-05	8.957808	0.000771219	0.002006146	0.002762558	0.042598801	5.41713E-06	40.47814	1.26E+02	0.014282095	0.088620543	110.2221	0.006322005	0.004069186	0.019967035	0.001397162	0.000299916	0.2662268	0.066881481	0.007705366
Y6			2.73E+02	1752.939006	5.67E-04	0.008228957	3.61396E-05	0.005975239	2.13E+02	3.42947E-05	10.01176	0.000852525	0.002235725	0.003099744	0.047362976	5.41713E-06	44.82442	1.31E+02	0.015232135	0.101389074	123.3556	0.006713935	0.004528964	0.022027372	0.001535339	0.000334624	0.3121846	0.072337704	0.007282237
Y7			2.74E+02	1860.928681	5.43E-04	0.008228957	3.86082E-05	0.006094669	2.17E+02	3.99781E-05	10.58701	0.001526558	0.002362429	0.003675025	0.050203119	5.41713E-06	47.44509	1.34E+02	0.408756918	0.107996874	130.7595	0.007143648	0.004761618	0.023127905	0.001604908	0.0003561	0.3371746	0.078605697	0.00707878
Y8			2.77E+02	2005.959855	5.09E-04	0.008228957	4.319444E-05	0.006236087	2.23E+02	5.53812E-05	11.39067	0.003840637	0.002545741	0.005322423	0.054809935	5.41713E-06	51.85586	1.37E+02	1.812541325	0.115263924	141.5322	0.008390037	0.005056492	0.024758903	0.001702605	0.000392077	0.3566192	0.095727926	0.006831397
Y9			2.77E+02	2021.510409	5.08E-04	0.008228957	4.329211E-05	0.006271858	2.23E+02	5.50216E-05	11.45808	0.003719137	0.002558719	0.005269248	0.05501403	5.41713E-06	51.99259	1.38E+02	1.734661644	0.116670172	142.3621	0.008294547	0.005085319	0.024831517	0.001706803	0.00039366	0.3660202	0.094891616	0.006806438
Closure			2.77E+02	2021.510409	5.08E-04	0.008228957	4.329211E-05	0.006271858	2.23E+02	5.50216E-05	11.45808	0.003719137	0.002558719	0.005269248	0.05501403	5.41713E-06	51.99259	1.38E+02	1.734661644	0.116670172	142.3621	0.008294547	0.005085319	0.024831517	0.001706803	0.00039366	0.3660202	0.094891616	0.006806438
Alpha WRSF																													
Upper Case																													
Y1			5.24E+02	1231.632708	3.30E-04	0.012513423	2.85495E-05	0.020813814	8.09E+01	2.33216E-05	7.569333	0.000708455	0.001734065	0.002261234	0.037457635	8.50822E-06	36.70939	3.12E+01	0.016464123	0.060790541	92.14465	0.007460068	0.003552762	0.018611116	0.001338346	0.000256914	0.14143626	0.071041129	0.017826755
Y2			5.38E+02	1607.289525	2.74E-04	0.012513423	3.455855E-05	0.024860363	8.79E+01	3.10965E-05	9.42084	0.00083099	0.002123475	0.002879717	0.045310233	8.50822E-06	43.44892	3.40E+01	0.016561591	0.088259834	115.5714	0.0073914	0.004319602	0.021608868	0.001524691	0.000316641	0.2443784	0.075431856	0.015713458
Y3			5.52E+02	2020.299187	2.30E-04	0.012513423	4.228176E-05	0.026386337	9.48E+01	3.93707E-05	11.64562	0.001004417	0.002609322	0.003589163	0.055421721	8.50822E-06	52.70278	3.67E+01	0.021706225	0.114756488	143.2632	0.008285792	0.005293763	0.026913084	0.001821363	0.000390016	0.332129	0.087407958	0.014099163
Y4			5.52E+02	2023.87408	2.26E-04	0.012513423	4.297411E-05	0.025563192	9.48E+01	3.9289E-05	11.77085	0.001027601	0.00264586	0.003611808	0.056337259	8.50822E-06	53.81596	3.67E+01	0.019866135	0.112926625	144.5872	0.008836842	0.005375619	0.026672099	0.001875355	0.000394497	0.303926	0.091516206	0.014087353
Y5			5.59E+02	2275.868864	2.07E-04	0.012513423	4.75298E-05	0.026507476	9.86E+01	4.43758E-05	13.10177	0.001127991	0.002934207	0.004004542	0.062299527	8.50822E-06	59.20367	3.82E+01	0.020889117	0.129617176	161.2119	0.009246619	0.005951627	0.029203959	0.002043502	0.000438659	0.3647112	0.097821436	0.013325165
Y6			5.68E+02	2563.863831	1.90E-04	0.012513423	5.285727E-05	0.027253305	1.03E+02	5.01597E-05	14.64329	0.00124691	0.003269991	0.004533712	0.0692735	8.50822E-06	65.56058	3.98E+01	0.022278654	0.148292541	180.4209	0.009819859	0.006624102	0.032217426	0.002245601	0.000489424	0.4320176	0.105800783	0.012593434
Y7			5.72E+02	2721.810471	1.81E-04	0.012513423	5.646874E-05	0.030818762	1.05E+02	5.84723E-05	15.48465	0.002232757	0.00345531	0.005375123	0.073427518	8.50822E-06	69.39361	4.07E+01	0.597851423	0.157957167	191.25	0.010448362	0.006964384	0.033827075	0.002347353	0.000520893	0.4686458	0.114969375	0.012241588
Y8			5.78E+02	2931.934327	1.68E-04	0.012513423	6.317666E-05	0.0413761	1.08E+02	8.1001E-05	16.66009	0.005617349	0.003723422	0.007784622	0.080165487	8.50822E-06	75.84483	4.17E+01	2.651038703	0.168586017	207.0063	0.012271341	0.007395669	0.036212587	0.002490245	0.000573456	0.4951114	0.140012497	0.011813781
Y9			5.79E+02	2956.678703	1.68E-04	0.012513423	6.33194E-05	0.040902143	1.08E+02	8.04751E-05	16.75869	0.005439642	0.003742405	0.007706848	0.080463999	8.50822E-06	76.04482	4.19E+01	2.537131205	0.170642808	208.2201	0.012131676	0.007437832	0.036318792	0.002496384	0.000575771	0.5092724	0.138789302	0.011770617
Closure			5.79E+02	2956.678703	1.68E-04	0.012513423	6.33194E-05	0.040902143	1.08E+02	8.04751E-05	16.75869	0.005439642	0.003742405	0.007706848	0.080463999	8.50822E-06	76.04482	4.19E+01	2.537131205	0.170642808	208.2201	0.012131676	0.007437832	0.036318792	0.002496384	0.000575771	0.5092724	0.138789302	0.011770617
In-Pit Kona																													
Base Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y4			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y5			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y6			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y7			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y8			2.54E+02	772.1407579	1.31E-03	0.022879125	1.483888E-05	0.006983296	1.53E+02	1.53709E-05	4.227084	0.000338092	0.000928986	0.001136894	0.019433283	0.000005	17.96104	8.80E+01	0.004739232	0.048232383	52.46434	0.00201948	0.001868185	0.008630865	0.000587521	0.00013994	0.3213	0.024950275	0.013416376
Y9			2.54E+02	772.1407579	1.31E-03	0.022879125	1.483888E-05	0.006983296	1.53E+02	1.53709E-05	4.227084	0.000338092	0.000928986	0.001136894	0.019433283	0.000005	17.96104	8.80E+01	0.004739232	0.048232383	52.46434	0.00201948	0.001868185	0.008630865	0.000587521	0.00013994	0.3213	0.024950275	0.013416376
Closure			2.29E+02	168.5872449	7.02E-03	0.022879125	3.239866E-06	0.029381213	3.27E+01	3.35605E-06	0.922931	7.38183E-05	0.000202832	0.000291894	0.004243014	0.000005	3.921568	1.68E+01	0.001034752	0.010530936	11.45493	0.000440928	0.000407895	0.001884441	0.000128278	3.05542E-05	0.09686362	0.005447579	0.027598687
In-Pit Kona																													
Upper Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y4			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y5			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y6			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y7			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y8			5.20E+02	1129.339787	4.58E-04	0.028135436	2.170333E-05	0.031475772	7.87E+01	2.24817E-05	6.182569	0.000494497	0.001358743	0.001955353	0.028423289	0.000005	26.26998	3.03E+01	0.006931642	0.070545103	76.7348	0.009253709	0.002732423	0.012623578	0.000859313	0.000204678	0.4715732	0.036492489	0.022888616
Y9			5.20E+02	1129.339787	4.58E-04	0.028135436	2.170333E-05	0.031475772	7.87E+01	2.24817E-05	6.182569	0.000494497	0.001358743	0.001955353	0.028423289	0.000005	26.26998	3.03E+01	0.006931642	0.070545103	76.7348	0.009253709	0.002732423	0.012623578	0.000859313	0.000204678	0.4715732	0.036492489	0.022888616
Closure			4.74E+02	246.5771703	1.95E-03	0.028135436	4.73865E-06	0.04633986	4.78E+01	4.90859E-06	1.349886	0.000107967	0.000296665	0.000426927	0.006205869	0.000005	5.73572	2.06E+01	0.001513437	0.015402638	16.75408	0.000644905	0.00059659	0.0027562	0.00018762	4.46888E-05	0.23584134	0.007967677	0.047083935
In-pit Latte WRSF																													
Base Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			2.75E+02	1914.082579	5.89E-04	0.008250873	3.67843E-05	0.006983296	2.19E+02	3.81035E-05	10.47864	0.000838107	0.002302891	0.003314066	0.048173741	5.44404E-06	44.52416	1.35E+02	0.011748222	0.119564681	130.0554	0.005006149	0.004631098	0.021395307	0.001456423	0.000346902	0.5640124	0.061849975	0.009380879
Y4			2.75E+02	1914.082579	5.89E-04	0.008250873	3.67843E-05	0.006983296	2.19E+02	3.81035E-05	10.47864	0.000838107	0.002302891	0.003314066	0.048173741	5.44404E-06	44.52416	1.35E+02	0.011748222	0.119564681	130.0554	0.005006149	0.004631098	0.021395307	0.001456423	0.000346902	0.5640124	0.061849975	0.009380879
Y5			2.75E+02	1914.082579	5.89E-04	0.008250873	3.67843E-05	0.006983296	2.19E+02	3.81035E-05	10.47864	0.000838107	0.002302891	0.003314066	0.048173741	5.44404E-06	44.52416	1.35E+02	0.011748222	0.119564681	130.0554	0.005006149	0.004631098	0.021395307	0.001456423	0.000346902	0.5640124	0.061849975	0.009380879
Y6			2.73E+02	1764.390016	6.32E-04	0.008250873	3.39075E-05	0.006983296	2.13E+02	3.51236E-05	9.659151	0.000772563	0.002122792	0.003054886	0.04440627	5.44404E-06	41.04211	1.31E+02	0.010829442	0.110214017	119.8843	0.004614639	0.004268919	0.019722067	0.001342522	0.000319772	0.5358332	0.057012942	0.009750055
Y7			2.74E+02	1825.398899	6.14E-04	0.008250873	3.508E-05	0.006983296	2.16E+02	3.63381E-05	9.993144	0.000799276	0.002196193	0.003160518	0.045941745	5.44404E-06	42.46126	1.33E+02	0.011203901	0.114024985	124.0297	0.004774203	0.004416529	0.020404015	0.001388944	0.000330829	0.5473762	0.058984329	0.009594212
Y8			2.74E+02	1825.398899	6.14E-04	0.008250873	3.508E-05	0.006983296	2.16E+02	3.63381E-05	9.993144	0.000799276	0.002196193	0.003160518	0.045941745	5.44404E-06	42.46126	1.33E+02	0.011203901	0.114024985	124.0297	0.004774203	0.004416529	0.020404015	0.001388944	0.000330829	0.5473762	0.058984329	0.009594212
Y9			2.74E+02	1825.398899	6.14E-04	0.008250873	3.508E-05	0.006983296	2.16E+02	3.63381E-05	9.993144	0.000799276	0.002196193	0.003160518	0.045941745	5.44404E-06	42.46126	1.33E+02	0.011203901	0.114024985	124.0297	0.004774203	0.004416529	0.020404015	0.001388944	0.000330829	0.5473762	0.058984329	0.009594212
Closure			2.66E+02	1351.879931	7.97E-04	0.008250873	2.598E-05	0.017861899	1.95E+02	2.69118E-05	7.440865	0.000591939	0.001626488	0.002340661	0.034024192	5.44404E-06	31.44656	1.20E+02	0.008297545	0.084446249	91.85565	0.003535748	0.003270856	0.015111096	0.001028644	0.00024501	0.4546752	0.043683455	0.011061862
In-pit Latte WRSF																													
Upper Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			5.74E+02	2799.553824	2.00E-04	0.012250909	5.3801E-05	0.031475772	1.06E+02	5.57305E-05	15.32615	0.001225823	0.003368229	0.004847181	0.070459333	7.99078E-06	65.12142	4.11E+01	0.017183052	0.174876343	190.2202	0.007322038	0.006773485	0.031292962	0.002130177	0.000507382	0.8017744	0.090462311	0.015942562
Y4			5.74E+02	2799.553824	2.00E-04	0.012250909	5.3801E-05	0.031475772	1.06E+02	5.57305E-05	15.32615	0.001225823	0.003368229	0.004847181	0.070459333	7.99078E-06	65.12142	4.11E+01	0.017183052	0.174876343	190.2202	0.007322038	0.006773485	0.031292962	0.002130177	0.000507382	0.8017744	0.090462311	0.015942562
Y5			5.74E+02	2799.553824	2.00E-04	0.012250909	5.3801E-05	0.031475772	1.06E+02	5.57305E-05	15.32615	0.001225823	0.003368229	0.004847181	0.070459333	7.99078E-06	65.12142	4.11E+01	0.017183052	0.174876343	190.2202	0.007322038	0.006773485	0.031292962	0.002130177	0.000507382	0.8017744	0.090462311	0.015942562
Y6			5.68E+02	2580.61218	2.15E-04	0.012250909	4.95935E-05	0.031475772	1.03E+02	5.13721E-05	14.12756	0.001129957	0.003104814	0.004468103	0.064948997	7.99078E-06	60.02854	3.99E+01	0.015839236	0.16119998	175.3438	0.006749411	0.006243758	0.028845667	0.001963585	0.000467702	0.7561498	0.083387624	0.015569967
Y7			5.71E+02	2669.844302	2.08E-04	0.012250909	5.130383E-05	0.031475772	1.04E+02	5.31484E-05	14.61606	0.001169028	0.003212171	0.004622601	0.067194796	7.99078E-06	62.1042	4.04E+01	0.016386923	0.166773935	181.4069	0.006982791	0.006459654	0.029843089	0.002031481	0.000483874	0.7746186	0.086270992	0.016305116
Y8			5.71E+02	2669.844302	2.08E-04	0.012250909	5.130383E-05	0.031475772	1.04E+02	5.31484E-05	14.61606	0.001169028	0.003212171	0.004622601	0.067194796	7.99078E-06	62.1042	4.04E+01	0.016386923	0.166773935	181.4069	0.006982791	0.006459654	0.029843089	0.002031481	0.000483874	0.7746186	0.086270992	0.016305116
Y9			5.71E+02	2669.844302	2.08E-04	0.012250909	5.130383E-05	0.031475772	1.04E+02	5.31484E-05	14.61606	0.001169028	0.003212171	0.004622601	0.067194796	7.99078E-06	62.1042	4.04E+01	0.016386923	0.166773935	181.4069	0.006982791	0.006459654	0.029843089	0.002031481	0.000483874	0.7746186	0.086270992	0.016305116
Closure			5.50E+02	1977.271343	2.73E-04	0.012250909	3.799866E-05	0.038695216	9.41E+01	3.93614E-05	10.82457	0.000865776	0.002378916	0.003423472	0.04976408	7.99078E-06	45.99402	3.64E+01	0.012136061	0.123511818	134.3489	0.005171415	0.004783983	0.02210162	0.001504503	0.000358354	0.6350316	0.063891801	0.018799349
In-pit Supremo WRSF																													
Base Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y4			2.66E+02	1375.774372	7.85E-04	0.008457944	2.64392E-05	0.006983296	1.96E+02	2.73874E-05	7.531675	0.000602402	0.001655236	0.002382032	0.034625569	5.48274E-06	32.00238	1.21E+02	0.008444204	0.085938834	93.4792	0.003598242	0.003328668	0.015378184	0.001046825	0.000249341	0.4595304	0.044455559	0.010556488
Y5			2.65E+02	1290.850182	8.30E-04	0.008457944	2.480725E-05	0.006983296	1.92E+02	2.56969E-05	7.066758	0.000565217	0.001553061	0.002234994	0.032488192	5.48274E-06	30.02693	1.18E+02	0.007922958	0.080633977	87.70888	0.003376129	0.003123195	0.014428915	0.000982206	0.00023349	0.442204	0.041711393	0.01088017
Y6			2.65E+02	1290.522741	8.30E-04	0.008457944	2.480095E-05	0.006983296	1.92E+02	2.56903E-05	7.064965	0.000565073	0.001552667	0.002234427	0.032479951	5.48274E-06	30.01931	1.18E+02	0.007920948	0.080613523	87.68664	0.003375272	0.003122403	0.014425255	0.000981957	0.00023389	0.4421326	0.041700813	0.010881478
Y7			2.65E+02	1287.254271	8.32E-04	0.008457944	2.473811E-05	0.006983296	1.92E+02	2.56253E-05	7.047072	0.000563642	0.001548735	0.002228768	0.03239769	5.48274E-06	29.94328	1.18E+02	0.007900887	0.080409356	87.46455	0.003366724	0.003114495	0.014388721	0.00097947	0.00023298	0.4414424	0.041595198	0.010894566
Y8			2.65E+02	1287.254271	8.32E-04	0.008457944	2.473811E-05	0.006983296	1.92E+02	2.56253E-05	7.047072	0.000563642	0.001548735	0.002228768	0.03239769	5.48274E-06	29.94328	1.18E+02	0.007900887	0.080409356	87.46455	0.003366724	0.003114495	0.014388721	0.00097947	0.00023298	0.4414424	0.041595198	0.010894566
Y9			2.65E+02	1287.254271	8.32E-04	0.008457944	2.473811E-05	0.006983296	1.92E+02	2.56253E-05	7.047072	0.000563642	0.001548735	0.002228768	0.03239769	5.48274E-06	29.94328	1.18E+02	0.007900887	0.080409356	87.46455	0.003366724	0.003114495	0.014388721	0.00097947	0.00023298	0.4414424	0.041595198	0.010894566
Closure			2.56E+02	857.2615126	1.20E-03	0.008457944	1.647466E-05	0.019558186	1.70E+02	1.70654E-05	4.693077	0.000375364	0.001031398	0.001484273	0.021575607	5.48274E-06	19.94107	9.80E+01	0.005261685	0.053549518	58.24801	0.002242108	0.002074133	0.009582331	0.000652289	0.00015367	0.3657822	0.027700792	0.013209765
In-pit Supremo WRSF																													
Upper Case																													
Y1			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y2			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y3			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y4			5.51E+02	2012.21956	2.69E-04	0.012675547	3.867036E-05	0.031475772	9.47E+01	4.00571E-05	11.01589	0.000881078	0.002420963	0.003483981	0.050643658	8.06761E-06	46.80696	3.66E+01	0.012350566	0.125694885	136.7235	0.00526282	0.004868539	0.022492266	0.001531095	0.000364688	0.641886	0.065021087	0.017976509
Y5			5.47E+02	1888.008701	2.85E-04	0.012675547	3.628326E-05	0.031475772	9.27E+01	3.75844E-05	10.3359	0.000826691	0.002271521	0.003268921	0.047517512	8.06761E-06	43.91765	3.58E+01	0.011588187	0.117935956	128.2838	0.004937955	0.004568013	0.021103857	0.001436583	0.000342176	0.6175624	0.061007447	0.018527704
Y6			5.47E+02	1887.529783	2.85E-04	0.012675547	3.627E-05	0.031475772	9.27E+01	3.7549E-05	10.33328	0.000826481	0.002270945	0.003268092	0.047505459	8.06761E-06	43.90651	3.58E+01	0.011585247	0.11790604	128.2512	0.004936702	0.004566854	0.021098504	0.001436219	0.00034209	0.617491	0.060991971	0.018529932
Y7			5.47E+02	1882.74929	2.85E-04	0.012675547	3.618216E-05	0.031475772	9.26E+01	3.74798E-05	10.30711	0.000824388	0.002265193	0.003259815	0.

Haul Road	Alkalinity	Sulphate	P	WADCN	Al	Ag	As	Ca	Cd	Cl	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Tl	U	Zn	Ra226
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Upper Case	145.305	247.3713	0.002264	0	0.013289	5.55E-06	0.029981	32.7968	5.6E-06	1.116154	0.00011	0.000757	0.00074	0.009311	2.55E-06	4.820933	30.29286	0.001252	0.034844	16.30951	0.000625	0.001281	0.002289	0.000178	4.62E-05	0.044506	0.008228	0.06057
Base Case	73.415	165.3674	0.003748	0	0.002452	3.25E-06	0.006673	48.556	3.39E-06	0.921176	7.37E-05	0.0002	0.000297	0.004258	1.31E-06	3.930555	19.56948	0.001022	0.010643	11.45291	0.000429	0.000394	0.001883	0.000126	3.11E-05	0.029698	0.005721	0.035641

	Years	Alkalinity	Sulphate	P	Al	Ag	As	Ca	Cd	Cl	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Tl	U	Zn	Ra226
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case																												
Schist Oxide Waste	All Years	68.73	6.245327	4.83E-03	0.002077	3E-06	0.003508	17.7884	3.14E-06	3.82	2.29E-05	0.001077	0.000603	0.007048	1.01E-05	3.476297	7.352424	0.000229	0.003973	0.259826	0.000184	2.84E-05	0.004521	0.000178	7.41E-05	0.001079	0.001951	0.000655
Schist Transition Waste	All Years	70.07	51.84251	4.92E-03	0.002504	4.78E-06	0.001078	24.9316	5.95E-06	4.4	2.82E-05	0.000952	0.000948	0.007598	1.07E-05	10.2286	12.64439	0.000212	0.013564	0.902071	0.000816	2.13E-05	0.001851	0.000248	1.09E-05	0.006639	0.002139	0.000147
Schist Sulphide Waste	All Years	70.66	62.92521	2.54E-03	0.005	6.23E-05	0.000854	36.1664	9.34E-05	6.9	0.001447	0.000934	0.00096	0.01	2.5E-06	6.794115	10.98076	0.367546	0.009033	0.445196	0.015102	0.000315	0.0433	0.001869	0.000218	0.005344	0.031148	0.000727
Schist Oxide Ore	All Years	70.105	40.64969	1.18E-02	0.004656	3.23E-05	0.163476	27.0948	8.35E-06	3.82	7.08E-05	0.000309	0.001038	0.016738	2.38E-05	2.660521	10.32519	0.003168	0.004857	0.218754	0.001608	4.72E-05	0.007268	0.000955	0.000102	0.001315	0.004719	0.000227
Schist Transition Ore	All Years	77.34	132.7093	1.74E-02	0.004719	1.72E-05	0.181843	58.236	7.08E-06	4.4	0.000482	0.000151	0.001001	0.016298	2.33E-05	4.720346	16.25796	0.043771	0.005239	0.368863	0.004134	7.55E-05	0.034219	0.001793	0.000208	0.004796	0.004594	0.000397
Gneiss Oxide Waste	All Years	68.79	8.176345	1.73E-02	0.002124	2.94E-06	0.054146	17.3968	8.56E-06	2.37	3.02E-05	0.000715	0.00078	0.006938	9.99E-06	5.12207	6.461816	0.000195	0.018472	0.802494	0.000201	1.89E-05	0.00251	6.38E-05	2.52E-05	0.081735	0.001982	0.034723
Gneiss Transition Waste	All Years	69.055	9.887124	8.77E-03	0.004153	2.41E-06	0.003489	19.8636	5.19E-06	5.4	2.16E-05	0.000139	0.000625	0.00691	9.91E-06	4.524299	7.916024	0.000134	0.011605	0.3776	0.000208	1.55E-05	0.009155	0.000129	0.000131	0.021884	0.001959	0.018126
Gneiss Sulphide Waste	All Years	70.635	62.29596	3.50E-03	0.0091	6.17E-05	0.000887	34.8476	9.25E-05	6.2	0.000493	0.000934	0.001354	0.012	5.5E-06	6.18252	11.42853	0.262156	0.023194	0.663514	0.003083	0.000311	0.01176	0.001573	0.000186	0.013575	0.030833	0.01252
Gneiss Oxide Ore	All Years	78.37	9.753408	1.20E-01	0.004483	1.82E-05	0.137143	21.9452	9.44E-06	2.37	6.49E-05	0.000454	0.000824	0.016738	2.39E-05	3.409384	6.376412	0.001133	0.015574	0.262681	0.000239	5.18E-05	0.011256	0.000133	0.000206	0.049355	0.004719	0.056763
Gneiss Transition Ore	All Years	91.04	66.01334	7.08E-02	0.00574	1.45E-05	0.15998	42.416	1.13E-05	5.4	9.88E-05	0.000172	0.001231	0.019837	2.83E-05	5.22453	12.17721	0.011325	0.02121	0.30284	0.000405	4.25E-05	0.112077	0.000635	0.000259	0.029234	0.005595	0.005088
Granite Transition Waste	All Years	68.65	22.02382	4.24E-02	0.003436	3.16E-06	0.001807	6.3448	3.34E-06	6	0.000665	5.19E-05	0.000441	0.005781	8.26E-06	14.36081	1.800652	0.353931	0.002319	26.63434	0.000227	4.72E-05	0.005978	5.73E-05	3.73E-05	0.000753	0.002548	0.001234
granite Sulphide Waste	All Years	70.905	62.29596	4.45E-03	0.006	9.34E-05	0.050305	36.7836	9.34E-05	5	0.0019	0.000934	0.006982	0.007	0.00001	12.59921	6.210239	2.399	0.010291	3.915268	0.003091	0.001828	0.01176	0.001246	0.000216	0.017025	0.060408	0.053334
Granite Oxide Ore	All Years	0	3.633931	7.54E-02	0.138042	4.85E-06	0.069928	20.8452	3.68E-06	6	4.18E-05	8.37E-05	0.000865	0.023912	1.2E-05	12.43643	6.01866	0.012878	0.001144	30.24792	0.000121	0.000103	0.019381	7.55E-05	3.26E-05	0.000512	0.002328	0.00373
Granite Transition Ore	All Years	0	63.3185	4.24E-02	0.196012	2.53E-06	8.8	68.376	8.54E-05	6	0.067673	8.89E-05	0.017582	0.119991	1.23E-05	18.14638	16.71032	2.867423	0.000167	1.247365	0.018022	8.95E-05	0.008168	0.000438	0.000294	0.001452	0.124081	0.00345
Granite Oxide Waste	All Years	68.78	22.02382	7.54E-02	0.003436	3.16E-06	0.001807	6.1984	3.34E-06	6	0.000665	5.19E-05	0.000441	0.005781	8.26E-06	14.36081	1.800652	0.353931	0.002319	26.63434	0.000227	4.72E-05	0.005978	5.73E-05	3.73E-05	0.000753	0.002548	0.002647
Upper Case																												
Schist Oxide Waste	All Years	142.625	9.537103	0.000998	0.003893	5.11E-05	0.012711	35.49661	5.72E-06	4.88	4.59E-05	0.001311	0.000975	0.007433	1.06E-05	6.885405	14.15619	0.000523	0.004224	1.369803	0.00031	5.55E-05	0.005093	0.000391	7.91E-05	0.003617	0.002077	0.003205
Schist Transition Waste	All Years	144.865	60.34921	0.007995	0.003973	5.29E-05	0.003843	42.98838	9.98E-06	4.95	7.53E-05	0.001196	0.001427	0.007887	1.12E-05	14.69314	17.94416	0.001758	0.020159	6.313286	0.001095	3.89E-05	0.002078	0.000569	1.53E-05	0.022084	0.002234	0.001036
Schist Sulphide Waste	All Years	149.97	153.3802	0.034439	0.0037	6.29E-05	0.001739	74.26649	0.000125	15.45	0.001925	0.001542	0.00096	0.01	0.000005	19.37227	28.33901	0.419491	0.013721	1.48616	0.018878	0.000934	0.0411	0.000935	0.000315	0.022266	0.031227	0.002654
Schist Oxide Ore	All Years	147.605	99.67354	0.00285	0.006255	0.00012	0.239028	60.26539	1.43E-05	4.88	0.000135	0.00059	0.001606	0.018736	2.42E-05	5.859479	23.23286	0.006216	0.006032	1.574947	0.002039	9.69E-05	0.007954	0.001296	0.000144	0.002738	0.004845	0.000301
Schist Transition Ore	All Years	161.28	248.0512	0.037088	0.008265	0.000116	0.310504	113.4551	9.06E-06	4.95	0.000716	0.000375	0.001392	0.016518	2.36E-05	8.051655	31.16966	0.063161	0.006592	1.335843	0.005588	0.000103	0.039643	0.002256	0.000261	0.009945	0.004719	0.011064
Gneiss Oxide Waste	All Years	142.665	12.74826	0.067875	0.003825	4.88E-05	0.018824	35.47367	1.36E-05	7.935	5.83E-05	0.000969	0.001167	0.007268	1.05E-05	10.08389	12.51258	0.000454	0.023001	6.224795	0.000326	3.09E-05	0.002709	0.000146	2.85E-05	0.085592	0.002092	0.073839
Gneiss Transition Waste	All Years	143.39	18.34663	0.01926	0.005541	4.96E-05	0.013158	38.04801	8.35E-06	9.1	4.86E-05	0.0003	0.000944	0.007268	1.04E-05	9.562216	15.63394	0.000308	0.017694	1.370976	0.000327	3.09E-05	0.01045	0.000209	0.000141	0.05141	0.002065	0.052797
Gneiss Sulphide Waste	All Years	147.32	92.972	0.05751	0.00541	6.23E-05	0.000944	57.55757	9.44E-05	11	0.000704	0.001096	0.001354	0.012	5.5E-06	12.9019	22.8093	0.296181	0.029584	2.027009	0.003146	0.000617	0.0123	0.001886	0.000315	0.038744	0.031148	0.066037
Gneiss Oxide Ore	All Years	177.48	14.34695	0.140929	0.006695	0.000118	0.245418	52.36821	1.57E-05	7.935	0.000102	0.000802	0.001251	0.017179	2.49E-05	7.658684	13.8359	0.002454	0.020851	2.470888	0.000245	9.34E-05	0.012598	0.000191	0.000235	0.064322	0.004782	0.103936
Gneiss Transition Ore	All Years	184.18	120.5461	0.062401	0.009017	0.000142	0.295255	82.08347	1.85E-05	9.1	0.000213	0.000616	0.00136	0.020472	2.87E-05	11.19631	24.15068	0.041962	0.03385	1.176725	0.000839	8.61E-05	0.129444	0.000775	0.000326	0.056226	0.005668	0.00718
Granite Transition Waste	All Years	140.735	32.37502	0.002422	0.005309	3.62E-05	0.01595	11.63002	5.73E-06	6	0.000933	0.000151	0.000689	0.006167	8.81E-06	23.84097	3.011491	0.437959	0.002787	50.98738	0.000315	6.54E-05	0.00689	8.48E-05	4.85E-05	0.000897	0.003461	0.005398
granite Sulphide Waste	All Years	147.09	67.01535	0.044827	0.008	0.00037	0.06048	57.63411	0.000154	5	0.002314	0.001598	0.009561	0.007	0.00003	20.05223	9.607	2.934706	0.026316	6.540321	0.003115	0.00309	0.02333	0.002171	0.000328	0.025681	0.061981	0.101351
Granite Oxide Ore	All Years	0	6.056552	1.25E-02	0.199512	1.58E-05	0.327112	36.49832	6.1E-06	6	0.000119	0.00013	0.001477	0.031868	1.93E-05	20.359	10.14677	0.022877	0.002656	80.47012	0.000253	0.000146	0.026746	0.000118	4.8E-05	0.000858	0.002655	0.010583
Granite Transition Ore	All Years	0	79.88749	2.42E-03	0.262268	9.51E-06	11.45	100.2225	9.81E-05	6	0.09579	0.000111	0.019355	0.191175	1.43E-05	25.50854	24.15362	3.306287	0.000504	3.612391	0.024619	0.000173	0.009081	0.000718	0.000485	0.001654	0.13337	0.045602
Granite Oxide Waste	All Years	140.79	32.37502	0.012532	0.005309	3.62E-05	0.082737	11.63002	5.73E-06	6	0.000933	0.000151	0.000689	0.006167	8.81E-06	23.84097	3.011491	0.437959	0.002787	50.98738	0.000315	6.54E-05	0.00689	8.48E-05	4.85E-05	0.000897	0.003461	0.010313
Wall Rock Submergence Loading (Accumulation Rate of Load Released Upon Inundation)																												
		mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	mg/m2/wk	Bq/m2/wk
Base Case																												
Schist Oxide Waste	All Years	21.37824	0.016538	0.007108	1.03E-05	0.012007	60.89106	1.07E-05	13.07615	7.84E-05	0.003686	0.002063	0.024125	3.45E-05	11.89963	25.16791	0.000784	0.013599	0.889404	0.00063	9.73E-05	0.015475	0.000609	0.000253	0.003695	0.006677	0.002241
Schist Transition Waste	All Years	177.4609	0.016839	0.00857	1.64E-05	0.003689	85.34278	2.04E-05	15.06154	9.65E-05	0.00326	0.003246	0.026009	3.66E-05	35.0133	43.28271	0.000726	0.046432	3.087859	0.002795	7.28E-05	0.006335	0.000849	3.74E-05	0.022727	0.007324	0.000503
Schist Sulphide Waste	All Years	215.3978	0.008705	0.017115	0.000213	0.002924	123.8004	0.00032	23.61923	0.004954	0.003199	0.003286	0.034231	8.56E-06	23.25678	37.58798	1.258139	0.03092	1.523941	0.051695	0.001077	0.148219	0.006397	0.000746	0.018294	0.106622	0.00249
Schist Oxide Ore	All Years	139.147	0.040533	0.015939	0.00011	0.559589	92.74758	2.86E-05	13.07615	0.000242	0.001058	0.003554	0.057296	8.13E-05	9.107168	35.34391	0.010843	0.016625	0.748812	0.005503	0.000162	0.024878	0.003268	0.000351	0.004502	0.016155	0.000778
Schist Transition Ore	All Years	454.2741	0.059707	0.016155	5.88E-05	0.622461	199.3463	2.42E-05	15.06154	0.00165	0.000518	0.003427	0.055788	7.97E-05	16.15811	55.65225	0.149831	0.017932	1.262647	0.014152	0.000258	0.117133	0.006139	0.000712	0.016418	0.015724	0.001359
Gneiss Oxide Waste	All Years	27.98826	0.059389	0.00727	1.01E-05	0.185346	59.55058	2.93E-05	8.112692	0.000103	0.002449	0.002669	0.023748	3.42E-05	17.53324	22.11929	0.000669	0.063233	2.746998	0.000689	6.46E-05	0.008592	0.000218	8.63E-05	0.279784	0.006785	0.118858
Gneiss Transition Waste	All Years	33.84439	0.03002	0.014216	8.24E-06	0.011943	67.99463	1.78E-05	18.48462	7.39E-05	0.000476	0.00214	0.023653	3.39E-05	15.48702	27.09716	0.000459	0.039723	1.292553	0.000711	5.32E-05	0.031338	0.000443	0.000447	0.074909	0.006704	0.062047
Gneiss Sulphide Waste	All Years	213.2439	0.011979	0.03115	0.000211	0.003036	119.286	0.000317	21.22308	0.001689	0.003199	0.004635	0.041077	1.88E-05	21.16324	39.12072	0.89738	0.079396	2.271259	0.010554	0.001066	0.040255	0.005385	0.000637	0.046468	0.105545	0.042858
Gneiss Oxide Ore	All Years	33.38667	0.410613	0.015347	6.25E-05	0.46945	75.12011	3.23E-05	8.112692	0.000222	0.001554	0.00282	0.057296	8.19E-05	11.67058	21.82695	0.003877	0.053311	0.899177	0.000819	0.000177	0.038529	0.000457	0.000707	0.168947	0.016155	0.194304
Gneiss Transition Ore	All Years	225.9688	0.242219	0.019649	4.97E-05	0.547625	145.1932	3.88E-05	18.48462	0.000338	0.000589	0.004214	0.067903	9.7E-05	17.88397	41.68353	0.038766	0.072605	1.036646	0.001387	0.000146	0.383649	0.002174	0.000888	0.100069	0.019152	0.017417
Granite Transition Waste	All Years	75.38925	0.145283	0.011761	1.08E-05	0.006185	21.71874	1.14E-05	20.53846	0.002278	0.000178	0.001511	0.01979	2.83E-05	49.15816	6.16377	1.211532	0.007937	91.1714	0.000775	0.000162	0.020463	0.000196	0.000128	0.002577	0.008724	0.004224
granite Sulphide Waste	All Years	213.2439	0.015239	0.020538	0.00032	0.172197	125.9131	0.00032	17.11538	0.006504	0.003199	0.023898	0.023962	3.42E-05	43.12807	21.25813	8.211962	0.035228	13.40226	0.010581	0.006257	0.040255	0.004265	0.000738	0.058279	0.206782	0.182567
Granite Oxide Ore	All Years	12.43923	0.258073	0.472529	1.66E-05	0.23937	71.35472	1.26E-05	20.53846	0.000143	0.000286	0.002962	0.081851	4.09E-05	42.57085	20.60234	0.044083	0.003918	103.541	0.000415	0.000354	0.066343	0.000258	0.000112	0.001753	0.00797	0.012769
Granite Transition Ore	All Years	216.7441	0.145283	0.670964	8.67E-06	30.12308	234.0563	0.000292	20.53846	0.23165	0.000304	0.060185	0.410737	4.21E-05	62.11647	57.20071	9.815411	0.000572	4.269825	0.06169	0.000306	0.027961	0.001499	0.001007	0.00497	0.424738	0.011811
Granite Oxide Waste	All Years	75.38925	0.258073	0.011761	1.08E-05	0.006185	21.2176	1.14E-05	20.53846	0.002278	0.000178	0.001511	0.01979	2.83E-05	49.15816	6.16377	1.211532	0.007937	91.1714	0.000775	0.000162	0.020463	0.000196	0.000128	0.002577	0.008724	0.00906
Upper Case																												
Schist Oxide Waste	All Years	32.64624	0.003415	0.013325	0.000175	0.04351	121.5076	1.96E-05	16.70462	0.000157	0.004488	0.003339	0.025444	3.61E-05	23.56927	48.45772	0.001791	0.014459	4.688941	0.001061	0.00019	0.017435	0.00134	0.000271	0.012381	0.007108	0.01097
Schist Transition Waste	All Years	206.58	0.027368	0.013601	0.000181	0.013155	147.1525	3.42E-05	16.94423	0.000258	0.004093	0.004884	0.026999	3.82E-05	50.29574	61.42425	0.006019	0.069005	21.61087	0.003748	0.000133	0.007112	0.001947	5.24E-05	0.075596	0.007647	0.003547
Schist Sulphide Waste	All Years	525.0323	0.117886	0.012665	0.000215	0.005951	254.2199	0.000426	52.88654	0.006589	0.005277	0.003286	0.034231	1.71E-05	66.31279	97.00662	1.43595	0.046968	5.087238	0.064619	0.003199	0.140688	0.003201	0.001077	0.076218	0.106891	0.009086
Schist Oxide Ore	All Years	341.1902	0.009755	0.021411	0.000409	0.81821	206.2931	4.88E-05	16.70462	0.000462	0.002019	0.005499	0.064135	8.29E-05	20.05745	79.52788	0.021279	0.020649	5.391163	0.006979	0.000332	0.027226	0.004437	0.000493	0.009371	0.016586	0.001031
Schist Transition Ore	All Years	849.0983	0.126954	0.028293	0.000398	1.062881	388.3657	3.1E-05	16.94423	0.00245	0.001285	0.004766	0.056542	8.08E-05	27.56143	106.6962	0.216206	0.022564	4.572693	0.019127	0.000352	0.135701	0.007723	0.000892	0.034043	0.016155	0.037874
Gneiss Oxide Waste	All Years	43.63826	0.232342	0.013094	0.000167	0.064437	121.4291	4.66E-05	27.16212	0.0002	0.003317	0.003995	0.024878	3.58E-05	34.51793	42.83152	0.001555	0.078733	21.30795	0.001115	0.000106	0.009273	0.000498	9.74E-05	0.292988	0.007162	0.252755
Gneiss Transition Waste	All Years	62.80193	0.06593	0.018968	0.00017	0.045039	130.2413	2.86E-05	31.15	0.000166	0.001026	0.003233	0.024878	3.55E-05	32.7322	53.51617	0.001054	0.060569	4.692957	0.001119	0.000106	0.035772	0.000717	0.000484	0.175982	0.007068	0.180729
Gneiss Sulphide Waste	All Years	318.2503	0.196862	0.018519	0.000213	0.00323	197.024	0.000323	37.65385	0.00241	0.003751	0.004635	0.041077	1.88E-05	44.1642	78.078	1.013851	0.101269	6.938609	0.01077	0.002111	0.042104	0.006456	0.001077	0.132624	0.106622	0.226049
Gneiss Oxide Ore	All Years	49.11071	0.482412	0.022918	0.000404	0.840086	179.2604	5.37E-05	27.16212	0.000349	0.002746	0.004281	0.058804	8.51E-05	26.21626	47.36137	0.008401	0.071374	8.45804	0.00084	0.00032	0.043123	0.000655	0.000804	0.22018	0.01637	0.35578
Gneiss Transition Ore	All Years	412.6386	0.213604	0.030867	0.000485	1.01068	280.978	6.32E-05	31.15	0.000728	0.002108	0.004656	0.070079	9.82E-05	38.32584	82.66965	0.14364	0.11587	4.028021	0.002873	0.000295	0.443095	0.002653	0.001116	0.192465	0.019401	0.024578
Granite Transition Waste	All Years	110.8222	0.008292	0.018174	0.000124	0.054598	39.81047	1.96E-05	20.53846	0.003193	0.000516	0.002359	0.021109	3.02E-05	81.60947	10.30857	1.499169	0.009542	174.5337	0.001077	0.000224	0.023586	0.00029	0.000166	0.003072	0.011847	0.018478
granite Sulphide Waste	All Years	229.3987	0.153447	0.027385	0.001267	0.207026	197.286	0.000526	17.11538	0.007922	0.005468	0.03273	0.023962	0.000103	68.64033	32.8855	10.04572	0.090082	22.38802	0.010662	0.010577	0.079859	0.007431	0.001122	0.087907	0.212167	0.346932
Granite Oxide Ore	All Years	20.73204	0.042899	0.682946	5.42E-05	1.119731	124.9366	2.09E-05	20.53846	0.000409	0.000444	0.005055	0.109086	6.62E-05	69.69041	34.73318	0.078311	0.00909	275.4554	0.000867	0.000501	0.091555	0.000402	0.000164	0.002938	0.009087	0.036226
Granite Transition Ore	All Years	273.461	0.008292	0.897765	3.26E-05	39.19423	343.0693	0.000336	20.53846	0.327897	0.00038	0.066255	0.654406	4.91E-05	87.31769	82.67969	11.31768	0.001726	12.36549	0.084272	0.000592	0.031086	0.002457	0.001659	0.005662	0.456536	0.156099
Granite Oxide Waste	All Years	110.8222	0.042899	0.018174	0.000124	0.283214	39.81047	1.96E-05	20.53846	0.003193	0.000516	0.002359	0.021109	3.02E-05	81.60947	10.30857	1.499169	0.009542	174.5337	0.001077	0.000224	0.023586	0.00029	0.000166	0.003072	0.011847	0.035301

Year	Alkalinity	Sulphate	P	Al	Ag	As	Ca	Cd	Cl	Co	Cr	Cu	Fe	Hg	K	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Tl	U	Zn	Ra226
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
ROM Stockpile (Ore+PAD)																											
Base Case Concentratoins																											
Y1	234.355	188.023	0.001395	0.004856	1.92E-05	0.020932	68.984	6.62E-06	1.141215	0.000271	0.000416	0.000877	0.015472	1.5855E-05	9.408768	31.987	0.015272	0.005417	11.13555	0.003956	0.000506	0.016508	0.000878	0.000124	0.011418	0.01761	0.024157
Y2	251.755	304.9187	0.000359	0.015866	7.27E-05	0.018318	140.436	2.71E-05	1.141215	0.00064	0.001179	0.003139	0.055174	7.2443E-05	27.17632	83.3923	0.042121	0.029075	12.51027	0.007588	0.000635	0.065163	0.002754	0.000534	0.023525	0.028804	0.032308
Y3	249.49	283.9906	0.000414	0.013908	6.39E-05	0.018386	137.952	2.34E-05	1.141215	0.00058	0.001055	0.002735	0.048156	6.2437E-05	23.94072	74.37932	0.037523	0.02437	12.27101	0.007026	0.000613	0.051895	0.002441	0.000458	0.023532	0.026825	0.03286
Y4	239.66	169.6422	0.000779	0.00944	3.26E-05	0.016017	110.916	1.72E-05	1.141215	0.000253	0.000947	0.001653	0.032862	4.075E-05	17.46985	40.45471	0.008326	0.027639	11.71531	0.002954	0.000554	0.037982	0.00046	0.000374	0.02674	0.022514	0.057888
Y5	241.45	173.1911	0.000692	0.010517	3.68E-05	0.016017	124.084	1.95E-05	1.141215	0.000269	0.001047	0.001855	0.036847	4.6444E-05	19.28643	43.96267	0.008821	0.031409	11.85069	0.003014	0.000565	0.042886	0.000502	0.000424	0.030347	0.023638	0.057323
Y6	239.96	170.2314	0.000763	0.009619	3.33E-05	0.016017	113.104	1.76E-05	1.141215	0.000256	0.000964	0.001686	0.033523	4.1696E-05	17.77146	41.03714	0.008408	0.028265	11.73778	0.002964	0.000556	0.038796	0.000467	0.000382	0.027338	0.0227	0.057793
Y7	240.465	171.2271	0.000737	0.009921	3.45E-05	0.016017	116.796	1.83E-05	1.141215	0.00026	0.000992	0.001743	0.034642	4.3293E-05	18.28113	42.02134	0.008547	0.029323	11.77577	0.002981	0.000559	0.040172	0.000479	0.000396	0.02835	0.023016	0.057634
Y8	233.225	157.5749	0.001401	0.005777	1.84E-05	0.016017	66.156	9.59E-06	1.141215	0.000199	0.000608	0.000966	0.019309	2.1389E-05	11.29296	28.52659	0.006645	0.014818	11.25497	0.002752	0.000513	0.021307	0.000315	0.000206	0.01463	0.018692	0.059949
Y9	226.2	145.5853	0.001401	0.002137	4.22E-06	0.001589	21.7056	1.99E-06	1.141215	0.000145	0.000271	0.000284	0.005843	2.1523E-06	5.155798	16.67521	0.004974	0.002079	10.79759	0.00255	0.000473	0.00474	0.000172	3.85E-05	0.004146	0.014896	0.06224
Upper Case Concentratoins																											
Y1	487.7	300.1846	0.000553	0.007208	7.49E-05	0.104265	87.644	1.02E-05	1.66915	0.000411	0.000695	0.001289	0.018916	1.7095E-05	12.42752	42.9025	0.023189	0.007366	16.88654	0.005588	0.000749	0.020394	0.001172	0.000168	0.02805	0.024572	0.008608
Y2	519.6	534.1037	0.000148	0.023743	0.000357	0.090015	103.244	4.31E-05	1.66915	0.000997	0.002178	0.004616	0.060847	7.5133E-05	32.54065	102.9959	0.067576	0.039205	21.94318	0.010358	0.000976	0.075924	0.003628	0.000673	0.035013	0.035998	0.016596
Y3	514.55	492.862	0.000169	0.020781	0.000307	0.090124	101.264	3.72E-05	1.66915	0.000899	0.001922	0.004045	0.053463	6.4889E-05	28.81229	92.48293	0.058728	0.03259	21.10807	0.009604	0.000937	0.0607	0.003221	0.00058	0.032871	0.03398	0.01666
Y4	492.125	251.9	0.000324	0.014099	0.000197	0.077467	89.448	2.82E-05	1.66915	0.000391	0.00164	0.002416	0.036293	4.3154E-05	21.19624	49.77056	0.017198	0.038093	19.75626	0.004209	0.000839	0.044749	0.000644	0.000443	0.043273	0.029506	0.036327
Y5	494.33	257.6482	0.000285	0.015718	0.000225	0.077467	90.072	3.19E-05	1.66915	0.000417	0.001823	0.002711	0.040386	4.9056E-05	23.21068	53.51481	0.018662	0.043264	20.34097	0.00428	0.00086	0.050328	0.000702	0.0005	0.045087	0.030645	0.03594
Y6	492.495	252.8544	0.000317	0.014368	0.000202	0.077467	89.552	2.88E-05	1.66915	0.000395	0.00167	0.002465	0.036973	4.4134E-05	21.5307	50.39222	0.017441	0.038952	19.85334	0.004221	0.000842	0.045675	0.000653	0.000452	0.043563	0.029695	0.036262
Y7	493.115	254.4671	0.000305	0.014822	0.000209	0.077467	89.728	2.99E-05	1.66915	0.000403	0.001722	0.002548	0.038121	4.579E-05	22.09587	51.44272	0.017852	0.040403	20.01739	0.004241	0.000848	0.047241	0.00067	0.000468	0.044062	0.030015	0.036153
Y8	483.17	232.3542	0.000589	0.008595	0.000101	0.077467	78.724	1.55E-05	1.66915	0.000301	0.001016	0.001412	0.022375	2.3087E-05	14.34654	37.03898	0.01222	0.020511	17.76806	0.003969	0.000765	0.02578	0.000447	0.000249	0.03398	0.025634	0.037745
Y9	468.22	212.9343	0.000589	0.003126	6.17E-06	0.003622	31.7736	2.91E-06	1.66915	0.000212	0.000396	0.000416	0.008546	3.148E-06	7.540915	24.38931	0.007275	0.003041	15.79265	0.003729	0.000692	0.006932	0.000251	5.63E-05	0.00936	0.021786	0.037745
ROM PAD (Slopes composed of waste rock only)																											
Base Case																											
All Years	226.2	145.5853	0.001401	0.002137	4.22E-06	0.001589	21.7056	1.99E-06	1.141215	0.000145	0.000271	0.000284	0.005843	2.1523E-06	5.155798	16.67521	0.004974	0.002079	10.79759	0.00255	0.000473	0.00474	0.000172	3.85E-05	0.004146	0.014896	0.06224
Upper Case																											
All Years	468.22	212.9343	0.000589	0.003126	6.17E-06	0.003622	31.7736	2.91E-06	1.66915	0.000212	0.000396	0.000416	0.008546	3.148E-06	7.540915	24.38931	0.007275	0.003041	15.79265	0.003729	0.000692	0.006932	0.000251	5.63E-05	0.00936	0.021786	0.037745

Appendix B: Coffee Gold Project Geochemical Characterization Report

Newmont™
COFFEE

GOLDCORP



Coffee Gold Project

Geochemical Characterization Report

Project No. A362-2
March 2017

LORAX ENVIRONMENTAL

2289 Burrard Street
Vancouver, BC, V6J 3H9
Canada
1-604-688-7173

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1. Introduction

1.1 Project Background

The proposed Coffee Gold Mine (the Project) is an advanced exploration gold project located in the White Gold District of west-central Yukon, approximately 130 km south of Dawson City. The Project contains several gold occurrences within an exploration concession covering an area of more than 600 km^2.

The Project will mine 60 MT of ore and 300 MT of waste rock from four open pits during an 11 ½ year mine life. The ore will be crushed and placed onto a heap leach facility by truck for nine months of the year. During the three coldest months of winter, run-of-mine (ROM) ore will be stockpiled. Gold will be extracted from pregnant leach solution by an adsorption, desorption, recovery (ADR) carbon plant with mercury retorting to produce a final gold doré product. Waste rock will either be stored in a waste rock storage facility (Alpha WRSF) adjacent to mine pits or backfilled into other completed mine pits.

1.2 Scope and Purpose

The purpose of the geochemical characterization program is to determine the metal leaching and acid rock drainage (ML/ARD) potential of geologic material that will be disturbed by mining activities. Techniques used to assess ML/ARD potential include static tests, which examine the intrinsic ML/ARD potential of a sample, and kinetic tests, which expose the material to various weathering conditions. These results are used to predict the geochemical evolution of drainage produced from mine waste facilities that will exist during mine operations and closure, and inform mine waste management, water quality predictions, aquatic resources effects assessments and mitigation/contingency measures.

1.3 Report Structure

The geochemical characterization program relates the ML/ARD characteristics of various rock units present at site. The site geology and rock units defined in the geologic block model are described in Chapter 2. Analytical methods of the various field and laboratory testwork are described in Chapter 3, and the results are presented and discussed in Chapter 4. In Chapter 4 the intrinsic ML/ARD potential from different rock units is described. This information is then combined with site specific information on climate, hydrology and the mine plan to produce geochemical source terms in Chapter 5.

2. Geology

This chapter provides a description of site geology and an overview of the volume of various geologic materials that will be excavated during mine life. The information presented in this section has largely been drawn from the Feasibility Study (JDS, 2016) for the Project. Geologic information most relevant to the geochemical characterization of materials to be disturbed as part of the Project is summarized below.

2.1 Regional Geology

The Project is located in the Yukon-Tanana Terrane (YTT), an accreted pericratonic rock sequence that extends from southeast Alaska into northern British Columbia. The YTT consists of schists and gneisses that were deformed and metamorphosed in the late Paleozoic era, and subjected to a number of intrusive events in the Mesozoic. The YTT hosts a number of gold deposits related to these Mesozoic intrusions. The Paleozoic rocks are pervasively foliated and contain at least two overprinting rock fabrics. During the Early Jurassic period, the rocks were tectonically stacked along foliation parallel thrust faults.

2.2 Local Geology

The Project area consists of felsic to mafic gneisses and schists of Paleozoic age which were intruded by a large granitic body in the late Cretaceous. A number of intermediate to felsic dikes have cut granitic and metamorphic country rock. Mineralization at the Project is divided into two main west-northwest trending, south to southwest dipping panels bordering a third intrusive rock panel to the south. From north to south, these are divided into an augen gneiss-mafic schist sequence overlain by a package of interbanded biotite-feldspar-quartz-muscovite schist, mafic metavolcanic rocks and metacarbonate rocks. To the south, the sequences are butted against a Cretaceous granite along a west-northwest trending contact. The Paleozoic metamorphic rocks and the Cretaceous granite rock sequence are cut by intermediate to felsic dykes. The major rock units present at the Project site are shown in Table 2-1. A vast majority of the rock that will be mined from mine pits are the felsic gneiss (Supremo and Double Double pits), biotite schist (Latte pit) and granite (Kona pit).

Gold mineralization at the site is hydrothermal in origin and structurally controlled. The gold mineralization is associated with brecciation, pyrite and silica sericite alteration, and minor quartz veins. Main groupings of rock types at the Project site are described below. Note that there is some variability within these main rock types, and multiple lithology codes have been used in drill core logging.

Table 2-1:
Rock Units in the Project Area

Rock Unit	Description
Felsic Gneiss	Variable quartz + feldspar augen + biotite +muscovite. Typical Mg# 2-28. Low in potassium. Host to gold mineralized zones at Supremo.
Biotite Schist	Biotite+/-feldspar+/-quartz+/-muscovite+/- amphibole. Commonly carbonate-rich. High in potassium. Typical Mg# 20 - 40. Locally mylonitic. Host to gold mineralized zones at Latte.
Muscovite Schist	Mainly quartz + muscovite. Typical Mg# 10 - 20. Locally mylonitic.
Biotite Amphibolite	Amphibole + feldspar + biotite. Typical Mg# 20 - 40. Biotite and amphibole both Fe-rich. Contains up to 20% biotite.
Amphibolite	Found within the lower mafic footwall. Amphibole + feldspar ± biotite. Typical Mg# 30-50, biotite and amphibole more Mg-rich than biotite amphibolite. Contains up to 15% biotite.
Metagabbro/Amphibolite	Interleaved metagabbro with coarse magnesiohornblende + feldspar, and fine-grained, massive amphibolite with >95% magnesiohornblende. Moderate to strong retrogression to actinolite. High Mg content of biotite, amphibole.
Ultramafics	Serpentinite, pyroxenite or listwaenite. Typical Mg# 50 - 73, higher than all amphibolites and metagabbro. Very high in chromium and nickel.
Granite	Coffee Creek granite and Dawson Range batholith. Both are phases of the Whitehorse Plutonic suite and are uranium-rich. Dawson Range batholith higher in Thorium. Both are identifiable using airborne radiometrics.
Dacite Dykes	Quartz + feldspar phenocryst porphyry. Generally strongly silicified and sericitized. Strong spatial association with mineralized gold zones.
Andesite Dykes	Feldspar phenocrystic. Aphanitic in gold-bearing structures where all original textures are destroyed by intense silicification and sericitization. Strong spatial association with mineralized gold zones.

Source: Kaminak 2016

2.3 Weathering Facies

Structural weaknesses associated with gold mineralization have led to extensive weathering and oxidation along structurally controlled corridors at the Project. The extent of oxidation is directly related to the amount of fracturing and the presence of sulphide mineralization and clay alteration. The surrounding country rock outside of these corridors is typically fresh (unoxidized) from surface. Weathering facies have been grouped according to the following nomenclature: oxide, upper transition, lower transition, fresh (unweathered). Brief summaries of these divisions are described in turn below.

Oxide

Oxide materials are defined as materials which show greater than 95% of rock surfaces being oxidized. The oxide facies is characterized by the presence of cubic vugs or limonite/hematite stains after pyrite. Rock surfaces show a pale orange-brown to dark red discoloration.

Upper Transition

The upper transition materials are defined by between 50% to 95% visible oxidation on rock faces. Outside of the ore zones, this material typically shows oxidized intervals or stronger limonite veining with associated limonite halos separated by fresh (unweathered) intervals. In mineralized zones, upper transition materials also typically show unoxidized windows. In support of the geologic block model used to develop the mine plan, the upper transition unit is further broken down into upper and middle transition units. For the purpose of the geochemical evaluation, the upper and middle transition materials are treated as a single weathering facies.

Lower Transition

The lower transition facies describes materials showing between 5% and 50% oxidation. Fresh (unweathered) materials are more pervasive. In mineralized zones, the lower transition facies show <50% oxidization of pyrite around veins/fractures.

Fresh (unweathered)

The fresh (unweathered) facies describes materials showing ≤5% oxidation. These materials are characterized by an absence of oxidation of brassy metamorphic pyrite and the presence of weak to absent fracture-controlled limonite-hematite. Very minor joint-controlled oxidation on unmineralized joint/fracture surfaces can also be present, although oxidation does not extend into adjacent country rock

3. Methodology

In this section, the rational for sample selection is discussed and a brief overview of analytical methods is provided.

3.1 Sample Selection

A key objective of the geochemical program was to produce a dataset that is representative of all types of materials to be disturbed or exposed during the Project. In this regard, appropriate sample selection is critical for adequately describing the variability in mine waste geochemical characteristics. The sampling program was specifically designed to characterize geochemical properties giving consideration to the following variables:

- Material type (*e.g.,* ore, waste rock, leach tailings, borrow material, overburden)
- Lithology (*e.g.,* gneiss, schist, granite, other)
- Weathering (*e.g*., oxide, transition, fresh)

The geochemical program included a variety of static testwork and kinetic testwork, in addition to detailed mineralogical analysis. A summary of the of number of samples and type of tests (by material type) is provided in Table 3-1. Test procedures are described below.

Table 3-1:
Summary of Geochemical Characterization Testwork for the Coffee Gold Mine as a Function of Material Type

Analytical Test	Ore	Waste Rock	Leach Tailings	Overburden and Borrow Material
Static Tests				
Acid base accounting (ABA)	38	348	16	105
Shake Flask Extraction (SFE)	18	102	*NS*	31
Aqua Regia (ICP-MS) Trace Metals	38	348	16	105
Aqua Regia (ICP-OES) Metals*	3,545	26,549	*NS*	*NS*
Kinetic Tests				
Humidity Cells	*NS*	8	*NS*	*NS*
Unsaturated Columns	6	6	7	*NS*
Field Bins	*NS*	8	3	*NS*
Cyanide column effluent	*NS*	*NS*	26	*NS*
Mineralogy				
XANES	6	5	*NS*	*NS*
XRD	7	41	8	*NS*
µXRF	6	7	*NS*	*NS*

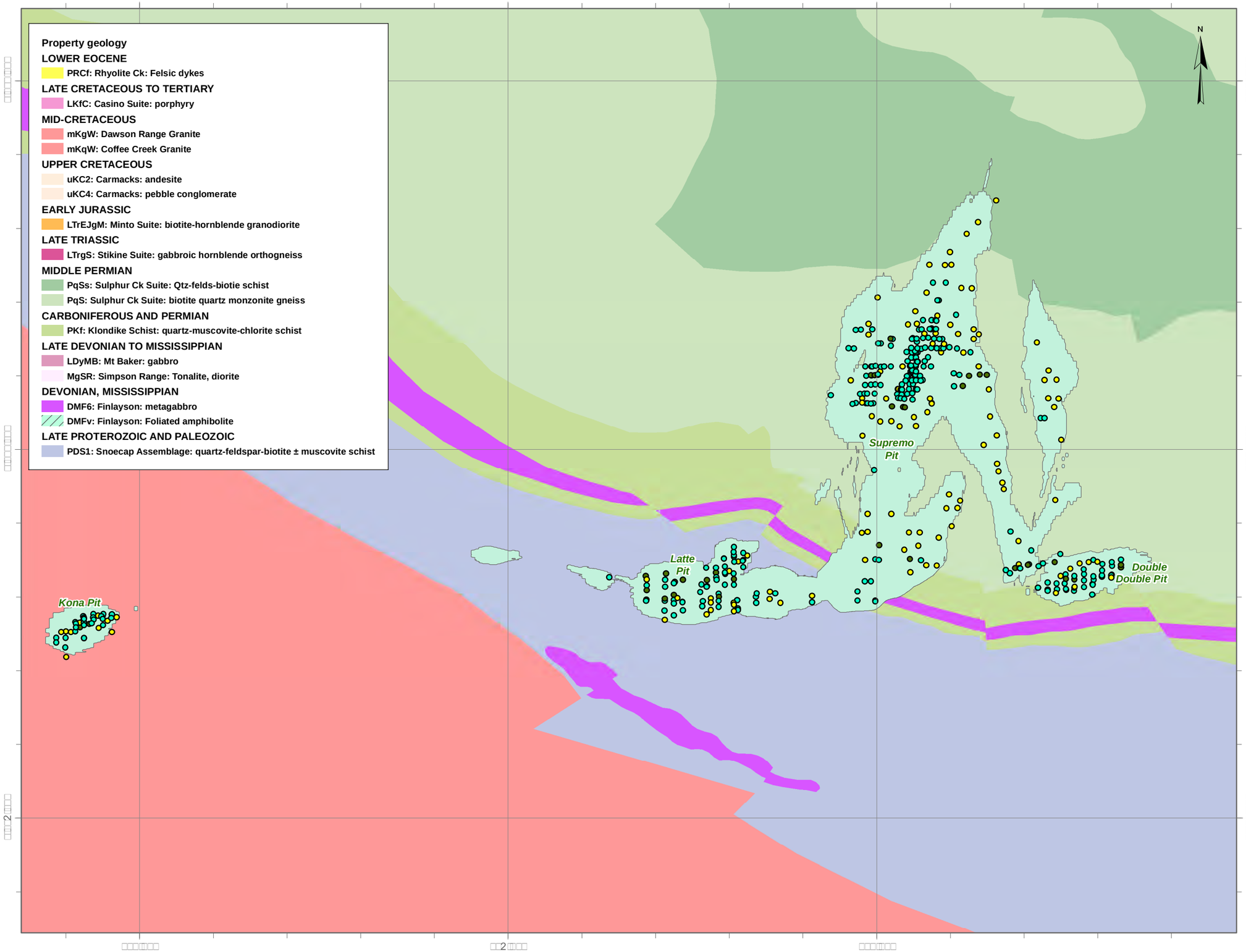
Notes:
NS = no sample
*Analyses completed in support of the exploration assay database
XANES = x-ray absorption near-edge spectroscopy
XRD = x-ray diffraction
µXRF = micro x-ray fluorescence

One of the primary objectives of static testing was to assign ML/ARD characteristics by rock type. As described in Chapter 2 (Geology), the Coffee Gold Mine deposit consists of several mineralized lithologies overprinted by an in-situ weathering profile; therefore, the geochemistry of site mine rock (waste rock and ore) was assessed by lithology (gneiss, granite, schist and other) and weathering facies (oxide, upper and lower transition and fresh). A summary of the sample distribution for waste rock and ore as a function of lithologic unit and weathering facies is provided in Table 3-2 along with the percentage of waste rock and ore to be disturbed during the life of the Project. Plan view maps showing sampling locations for surficial samples (overburden and borrow) are shown in Figure 3-1. Drill core collar locations for waste rock and ore sampled from drill core is shown in Figure 3-2. Cross sections show sample locations with respect to pit shells are provided in Appendix A.

Table 3-2:
Summary of Waste Rock and Ore Proportions for the Coffee Gold Mine and Number of Samples Submitted for Static Testwork

Lithologic Unit	Weathering Facies	Waste Rock		Ore	
		% of total	*n* of samples	% of total	*n of* samples
Gneiss	Oxide	85.8%	34	72.5%	5
	Upper Transition		26		5
	Lower Transition		79		
	Fresh		49	*NA*	*NA*
Schist	Oxide	11.3%	15	24.2%	6
	Upper Transition		14		5
	Lower Transition		19		
	Fresh		31	*NA*	*NA*
Granite	Oxide	1.8%	6	2.7%	6
	Upper Transition		17		8
	Lower Transition		14		
	Fresh		20	*NA*	*NA*
Other	Oxide	0.1%	4	0.4%	1
	Upper Transition		7		2
	Lower Transition		6		
	Fresh		7	*NA*	*NA*
Total		*100%*	*348*	*100%*	*38*

Notes:
NA = not applicable,
NS = no samples*other lithologies not included in ore block model



LEGEND

Drill Collars

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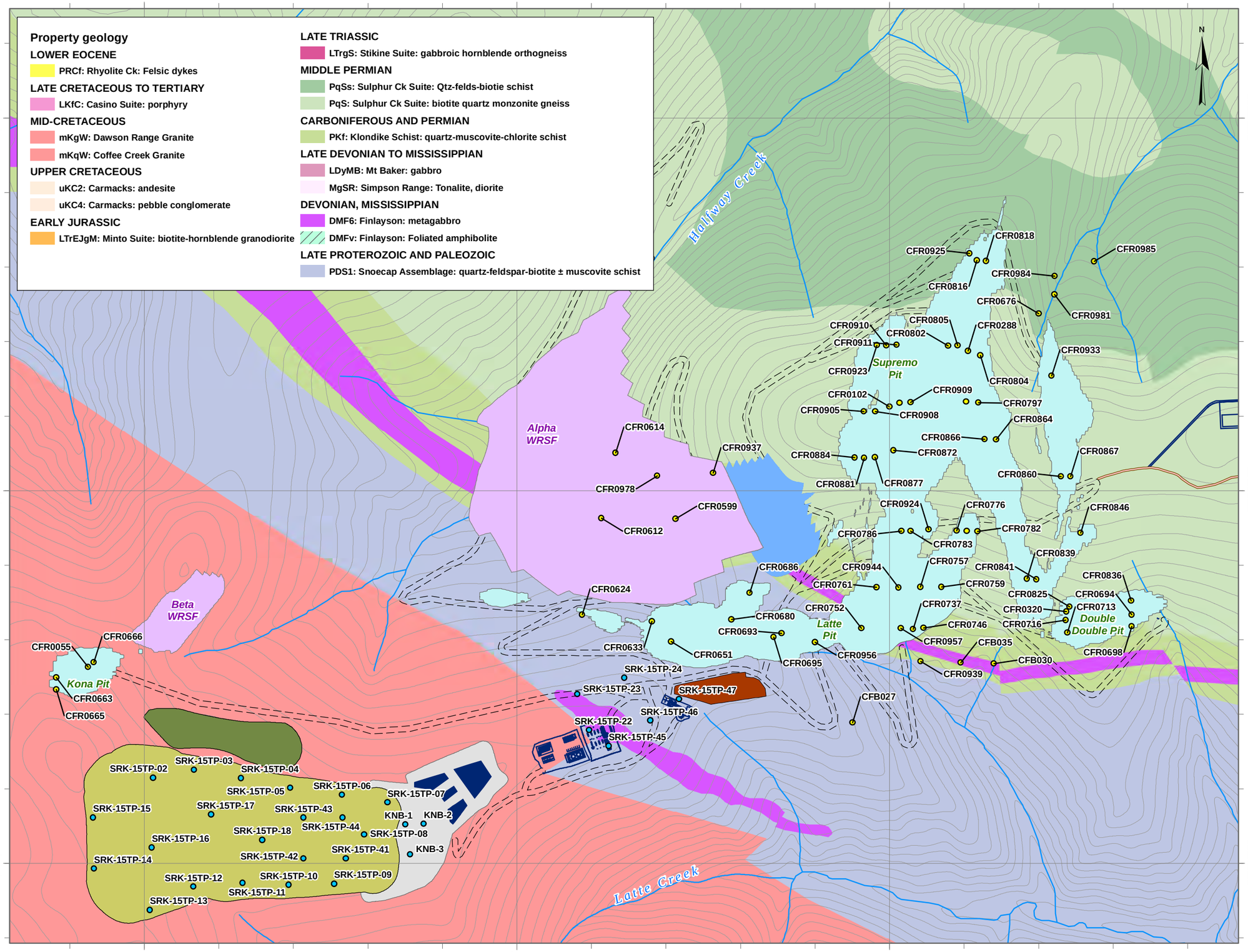

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3.2 Analytical Methods

3.2.1 Mineralogy

3.2.1.1 Quantitative X-ray Diffraction

X-ray diffraction (XRD) is a powerful tool used to characterize the crystal structures of materials. Each mineral possesses a characteristic X-ray diffraction pattern that can be matched against a database of recorded phases. XRD data are produced when a monochromatic beam is projected onto a sample at an angle; this produces diffraction pattern peaks, which can be used as "fingerprints" to identify the mineral phases present. XRD was conducted at SGS and the University of British Columbia (UBC) Earth & Ocean Sciences Department. Select samples were submitted to the Canadian Light Source (CLS) for x-ray absorption near-edge spectroscopy (XANES) analysis in order to achieve higher resolution and identify minerals present in trace quantities.

3.2.1.2 µ-X-ray Florescence (XRF) Mapping

Synchrotron X-ray florescence (XRF) is a powerful approach for probing and mapping the distribution of elements in a given sample, with the data output used to define phase associations for parameters of concern (*e.g.,* arsenic (As) and uranium (U)). The principle of XRF is based on the detection of X-ray photons emitted from elements irradiated with X-rays. The emitted X-ray photon energies are element specific providing a unique identification for each element. µ-XRF maps were collected on the Very Sensitive Elemental and Structural Probe Employing Radiation from a Synchrotron (VESPERS) beamline at the CLS using a pink beam (meaning the photon beam consists of a wide range of energies, at a maximum of 20 KeV).

3.2.1.3 X-ray Absorption Near-Edge Spectroscopy (XANES)

Each element has a characteristic energy at which it absorbs X-rays, termed the X-ray absorption edge. Features of this edge and the absorption features of the elements on either side of the edge can provide information about the oxidation state and coordination environment of the element of study. XANES is part of the x-ray absorption spectrum and generally ranges from -50 eV to +100 eV relative to the absorption edge. In this regard, XANES analysis (performed at the CLS) was conducted to acquire phase association information for As and U, both of which represent parameters of potential concern in mine waste materials.

3.2.2 Static Tests

3.2.3 Acid-Base Accounting

Acid-base accounting (ABA) consists of a suite of tests used to estimate the acid generating potential (AP) and acid neutralizing potential (NP) of a sample. An accounting technique is then used to compare the AP and NP with standard criteria thereby indicating the theoretical acid generation potential of a sample. ABA was conducted by ALS in North Vancouver, B.C. Neutralization potential was measured using the standard sobek method (sobek NP) (Sobek et al. 1978) and the siderite peroxide correction sobek method (siderite NP) (Skousen *et al*., 1997). Carbonate NP (CaNP) was quantified from the total inorganic carbon (TIC) content by treating the sample with $HClO_4$ to evolve inorganic carbon (C) as CO_2, which was then measured by coulometery. A surrogate NP is developed by correlating NP values measured in ABA testwork to elemental abundances measured in the ICP-OES database, as discussed in Chapter 4. Total sulphur (S) was determined using a Leco furnace analyzer. Sulphate-S was determined via HCl extraction and measured gravimetrically after precipitation of barium chloride ($BaCl_2$). Sulphide-S was determined by first leaching the sulphate-S with sodium carbonate ($NaCO_3$) and then measuring the remaining sulphide-S with a Leco furnace. The oxidized sulphide was then determined gravimetrically after precipitation with $BaCl_2$.

3.2.4 Metal Abundance

Metal abundance in mine rock was measured as part of the ML/ARD characterization program and as part of the exploration program. Metal analysis conducted in support of the exploration program used a two acid (aqua regia) digestion followed by a 35 element (including S) inductively coupled plasma optical emission spectrometry (ICP-OES) scan (exploration database). Metal analysis conducted as part of the geochemical characterization program also used a two acid (aqua regia) digestion; however, this was followed by a 51 element inductively coupled plasma mass spectrometry (ICP-MS) scan (ABA database). The exploration database is considerably larger than the ABA database, with approximately 80,000 exploration samples versus a few hundred ABA samples. Both data sets were used in the analysis of acid-generating potential. All metal assays were conducted at ALS in North Vancouver, B.C.

3.2.5 SFE

Shake flask extractions (SFE) were conducted as described by Price (1997) in *Draft Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia*, using a 24-hour NanoPure water leach

extraction test at a 3:1 liquid to solid ratio. The leachate was filtered and submitted for analysis including pH, conductivity, sulphate and dissolved metals.

3.2.6 Kinetic Tests

Kinetic test data are used to assess long term drainage chemistry, develop source terms for water quality predictions and evaluate disposal strategies for waste rock that will be produced during the life of the Project. The kinetic tests developed for the Project include eight humidity cells, 17 unsaturated columns and 11 field bins. A brief overview of these kinetic test programs is provided below. A summary of the kinetic tests developed for waste rock, ore and leach tailings for the Project is summarized in Table 3-3.

Most waste rock kinetic tests used composite samples each constructed from approximately 80 m of split drill core collected from three to six drill holes from across the site. Drill core samples were selected by comparing metal assay results to statistics on metal abundance in non-mineralized (Au < 0.3 ppm) material of the respective lithologies/weathering zones. Composite samples were produced for the three main weathering zones (oxide, transition and fresh) and the three dominant lithologies (gneiss, schist and granite). Note that a granite oxide composite was not constructed due to it's relatively low abundance in the deposit (approx. 0.5% of waste rock). In addition to these composite samples, humidity cells were initiated on two individual drill core samples (HC7 and HC8) to examine metal leaching from schist and gneiss fresh facies that has As and U concentrations in the upper 90th percentile of the respective material types. Laboratory and field kinetic test results are provided in Appendix D.

3.2.6.1 Humidity Cells

Humidity cell tests measure the weathering rates of geological materials that are exposed to air and water under controlled laboratory conditions. The tests are designed to mimic weathering conditions by exposing samples to alternating cycles of dry and moist air, with regular flushings of the samples. The leachate is collected and analyzed at regular intervals to assess primary reaction rates for acid generation, neutralization, and metal release under controlled laboratory conditions. The reaction rates can be used to estimate the time to NP depletion and onset of acid generation.

Humidity cells are composed of Plexiglas cylinders (10.2 cm inner diameter, 25.5 cm length) filled with 1 kg of sample crushed to approximately minus 6 mm. The sample material is placed on a perforated acrylic disk covered in a nylon mesh. The contents of the cell are subjected to three days of dry air permeation followed by three days of humid air permeation (<10% relative humidity). On the seventh day, at the end of each wet/dry cycle, the contents of the cell are leached with 500 mL of distilled de-ionized water (Price,

1997). The purpose of the leaching step is to recover any readily soluble reaction products that have formed due to mineral dissolution or sulphide oxidation. The leachate is then analyzed for pH, conductivity, hardness, anions and dissolved metals, including mercury (Hg).

Table 3-3:
Summary of Kinetic Tests Initiated for the Coffee Gold Mine

Test ID	Duplicates	Material	Lithology	Weathering Facies	Start Date	Test Status
Unsaturated Columns						
Col 1		Leach Tailings	Gneiss/Schist	Oxide/Transition	10-Apr-14	active
Col 2	Duplicate of Col 1	Leach Tailings	Gneiss/Schist	Oxide/Transition	10-Apr-14	active
Col 3		Waste Rock	Schist	Oxide	16-Jul-14	active
Col 4		Waste Rock	Schist	Transition	16-Jul-14	active
Col 5		Waste Rock	Gneiss	Oxide	16-Jul-14	active
Col 6		Waste Rock	Gneiss	Transition	30-Jul-14	active
Col 7		Ore	Granite	Oxide	22-Apr-15	active
Col 8		Ore	Granite	Transition	22-Apr-15	active
Col 9		Ore	Schist	Oxide	22-Apr-15	active
Col 10		Ore	Schist	Transition	22-Apr-15	active
Col 11		Ore	Gneiss	Oxide	22-Apr-15	active
Col 12		Ore	Gneiss	Transition	22-Apr-15	active
Col 13		Waste Rock	Granite	Transition	20-May-15	active
Col 14		Waste Rock	Granite	Fresh	20-May-15	active
Col 15		Leach Tailings	Schist	Oxide/Transition	3-Jun-15	active
Col 16		Leach Tailings	Gneiss	Oxide/Transition	3-Jun-15	active
Col 17		Leach Tailings	Gneiss/Granite	Oxide/Transition	3-Jun-15	active
Humidity Cells						
HC 1	Duplicate of Col 4	Waste Rock	Schist	Transition	25-Jun-14	terminated
HC 2		Waste Rock	Schist	Fresh	25-Jun-14	terminated
HC 3	Duplicate of Col 6	Waste Rock	Gneiss	Transition	25-Jun-14	terminated
HC 4		Waste Rock	Gneiss	Fresh	25-Jun-14	terminated
HC 5	Duplicate of Col 13	Waste Rock	Granite	Transition	6-May-15	active
HC 6	Duplicate of Col 14	Waste Rock	Granite	Fresh	6-May-15	active
HC 7		Waste Rock	Schist	Fresh	12-Aug-15	active
HC 8		Waste Rock	Gneiss	Fresh	12-Aug-15	active
Field Bins						
FB-GO	Duplicate of Col 5	Waste Rock	Gneiss	Oxide	17-Jun-14	active
FB-GT	Duplicate of Col 6 & HC 3	Waste Rock	Gneiss	Transition	17-Jun-14	active
FB-GS	Duplicate of HC 4	Waste Rock	Gneiss	Fresh	17-Jun-14	active
FB-SO	Duplicate of Col 3	Waste Rock	Schist	Oxide	17-Jun-14	active
FB-ST	Duplicate of Col 4 & HC 1	Waste Rock	Schist	Transition	17-Jun-14	active
FB-SS	Duplicate of HC 2	Waste Rock	Schist	Fresh	17-Jun-14	active
FB-GGT	Duplicate of Col 13 & HC 5	Waste Rock	Granite	Transition	17-Jun-15	active
FB-GGS	Duplicate of Col 14 & HC 6	Waste Rock	Granite	Fresh	17-Jun-15	active
FB-LT1	Duplicate of Col 1 & Col 2	Leach Tailings	Gneiss/Schist	Oxide/Transition	17-Jun-14	active
FB-LT2		Leach Tailings	Schist	Oxide	10-Aug-15	active
FB-LT3		Leach Tailings	Gneiss	Oxide	10-Aug-15	active

Notes:
All columns and humidity cells are constructed of Plexiglas with acrylic perforated disk & nylon mesh;
All unsaturated columns are operated as trickle leach and all humidity cells as flood leach according to the MEND method (Price, 1997);
No sample preparation was conducted prior to flushings;
All columns and humidity cells were operated in a cold room at SGS and maintained at 4°C.

The humidity cell experiments were operated in a 4°C cold room to mimic the subarctic environment of the Project site. Although seasonally warmer temperatures can be expected in the near-surface waste materials, the bulk of the waste rock mass can be expected to remain at near-freezing temperatures throughout the year. In this regard, cool (4°C) experiment conditions are more representative of conditions to be expected at site. A summary of the humidity cell tests for the Project are provided in Table 3-3.

Humidity cell tests were subjected to recirculation experiment that involved recirculating the weekly effluent as influent to the tests. Effluent was re-circulated for three consecutive cycles, and then on the fourth cycle the leachate chemistry was analyzed. The objective of the recirculation experiment was to simulate increased pore water residence time to allow for assessment of whether the leachate chemistry produced by the kinetic tests are controlled primarily by the kinetic loading rates or by pH related solubility influences.

3.2.6.2 Unsaturated Columns

The unsaturated column test work is used to determine the kinetic behaviour of waste rock and ore stored on the surface and exposed to atmospheric weathering (sub-aerial storage). Unsaturated columns permit more flexibility than humidity cells with respect to test scale, particle size and range, sample mass, water infiltration or flow rate, degree of oxygenation and monitoring (cycle length).

The unsaturated columns are composed of Plexiglas cylinders (21.0 cm inside diameter, 20.5 cm length) filled with 4.4 kg to 20 kg of sample. The sample material is placed on a perforated Plexiglas disk covered in a nylon mesh. Columns containing waste rock or ore have the sample crushed to approximately minus 6 mm while the grain size distribution of leach tailings samples were not modified. The unsaturated columns are subjected to a trickle leach, whereby 400 mL of distilled de-ionized water is sprinkled on a bi-weekly basis. This is equivalent to 4.35 mm of rainfall per week. As per the rationale described above for the humidity cells, the unsaturated columns were operated in a 4°C cold room to mimic the subarctic environment of the Project site. Leachate collected from the unsaturated columns is analyzed for the same parameters as the humidity cells (pH, conductivity, hardness, anions and dissolved metals, including Hg).

Column tests were subjected to recirculation experiment that involved recirculating the weekly effluent as influent to the tests. Initially, effluent was re-circulated for one cycle, and then on the second cycle the leachate chemistry was analyzed. After a period of 8 cycles little change in solution chemistry was observed. Therefore, the re-circulation period was extended to two cycles, with the leachate being analyzed on the third cycle. The objective of the recirculation experiment was to simulate a slower an increased residence time to allow for assessment of whether the leachate chemistry produced by the

kinetic tests are controlled primarily by the kinetic loading rates or by pH related solubility influences.

3.2.6.3 Field Bins

Field bins are utilized to characterize the weathering characteristics of larger-scale samples under ambient climate conditions. Loading measurements from field bins can be utilized to develop scaling factors for laboratory-based tests when developing water quality predictions. The field bin leachate results can also be used to estimate drainage quality and give an indication of the timescale over which acidic conditions may develop.

The field bins for the Project were erected in Small's Expediting yard adjacent to the Whitehorse airport. Six barrels were loaded with crushed drill core and one barrel was filled with cyanide column leach residue on May 7th, 2014 (Table 3-3). Five additional barrels were developed the following year on June 6th, 2015, including one empty rain test barrel which was established to assess the chemistry of infiltrating water.

The field bins consist of 119L HDPE colorless barrels (80 cm high x 45 cm diameter) mounted in wooden cribs that are supported on a slight incline to improve the flow of leachate towards the drainage tap and collection containers (Table 3-3). A hole is drilled and threaded in the bottom of each barrel. This is where the acid-washed tubing and fittings are securely fit to allow leachate to drain to the collection system attached to the base of the cribs below the field bins. Two pieces of nylon mesh are placed over the hole at the bottom of the bin to prevent fines from clogging the drain. As well, elbow taps (positioned with the opening facing down) are threaded into holes drilled along the sides of each of the barrels to ensure adequate air flow through the interior of the bin.

Prior to placing the test material in a barrel, the samples were weighed, mixed and split using the cone and quarter technique. The split sample, comprising roughly 12.5% of the original material, was sent to the analytical laboratory for physical sediment characteristics, geochemical static testwork and additional laboratory kinetic testing. The quartering process is performed in order to ensure that each sample is properly mixed and that a representative sample is obtained for further analyses and duplicate laboratory kinetic testwork.

The initial leachate sample was achieved by irrigating the field bins with approximately 8L of distilled-deionized water. Subsequent sampling is conducted when sufficient volumes of natural precipitation have collected in the leachate collection jugs. Precipitation percolates through, and reacts with, the mine rock stored in the field bins and then flows through tubing attached to the bottom of each bin into collection jugs located in Rubbermaid totes (Figure 3-3). Leachate is collected and analyzed for pH, conductivity,

anions and dissolved metals, including Hg. Leachate collected from the leach tailings field bins are also analyzed for cyanide forms and compounds, including total, weak acid dissociable (WAD), cyanate (CNO^z) and thiocyanate (SCN^-).



Figure 3-3: Picture of Field Kinetic Tests

3.2.7 Metallurgical Columns

Metallurgical testwork for the Project was carried out by Kappes, Cassiday & Associates (KCA) in Reno, Nevada in 2014 and 2015. Ore (head) sample preparation and cyanide column leach testwork procedures are detailed in the report *Coffee Project Report of Metallurgical Test Work* (KCA, 2015).

In total, 17 columns were established during this phase of metallurgical testing to account for variations in scale, grain size, lithology and weathering facies. Three different scales and particle size distributions were established for testwork:

- Large scale columns, which measured 45.7 cm in diameter and contained 730 kg of sample composed of 80% particles passing 150 mm;
- Intermediate scale columns, which measured 20.3 cm in diameter and contained approximately 90 kg of sample composed of 80% particles passing 80 mm; and
- Small scale columns, which measured 15 cm in diameter and contained approximately 50 kg of sample composed of 80% particles passing 12.5 mm.

Lime buffered cyanide solution (NaCN) was continuously distributed onto the material through Tygon tubing at a flow rate of 10 to 12 L/hr/m^2 of column surface area. The column tests were run as continuously drained drip leach tests to more accurately reflect the actual conditions of a full scale heap leach. Following the stripping of Au from the effluent, the

barren solution was recirculated through the column with makeup NaCN amended as required to maintain a target level of 0.6 g NaCN /L and hydrated lime ($Ca(OH)_2$) added as needed for pH control. At the end of the cyanide leach experiments, samples of spent ore (leach tailings) were collected from the metallurgical columns for geochemical characterization. The final leach solution from the columns were collected to provide an indication of heap leach process water chemistry during Operations. No steps were taken to rinse remaining pore water or detoxify cyanide in leach tailings samples before samples were collected for geochemical testwork.

3.2.8 Radioisotopes

Solid samples of waste rock, ore and overburden were analyzed for naturally occurring radioactive material (NORM) by the Saskatchewan Research Council (SRC) Environmental Analytical Laboratories. The samples were analyzed for the major components of NORM, namely, natural U (principally ^{238}U) and thorium (^{232}Th) and their major radioactive decay products, and ^{40}K, the naturally occurring radionuclide of potassium. The results for ^{238}U and ^{232}Th were based on the analysis by the ICP-MS method of U and Th concentrations on a mass basis. Conversion to radioactivity concentrations by SRC was done using standard conversion factors for natural U and Th (0.01235 Bq/g per ppm of U; 0.00406 Bq/g per ppm of Th). The concentrations of other radionuclides were determined by gamma radiation spectrometry.

The activity of ^{226}Ra was measured in kinetic test leachate and in process solution from metallurgical columns. Kinetic test leachate samples included leach tailings field bins, waste rock field bins and laboratory ore columns. Field bin samples were not filtered while ore columns and metallurgical column samples were filtered prior to analysis. The activity of ^{226}Ra was determined at ALS Environmental or SRC Environmental Analytical Laboratories by alpha radiation spectrometry.

3.3 Quality Assurance and Quality Control

3.3.1 Static Testwork

The quality assurance and quality control (QA/QC) program for the static test program involved the analysis of laboratory duplicates. Approximately one duplicate was measured for every 20 samples. The analytical laboratory adheres to a precision specification of $\pm$10% for internal geochemical laboratory duplicates. Precision can be expressed as a function of concentration:

$$P_c = ((Detection\ Limit / c) + P) \times 100\%$$

where *Pc* is the precision at concentration c; *c* is concentration of the element; and *P* is the "Precision Factor" of the element. This is the precision of the method at very high concentrations. Any laboratory duplicate result that does not adhere to the precision specifications would trigger a re-analysis.

3.3.2 Kinetic Program

QA/QC samples for the laboratory kinetic test programs (humidity cells and columns) include the collection of a blank sample during each sampling event to monitor any contamination that may occur during sample collection and handling. Each set of samples submitted for analyses is also subjected to a rigorous internal laboratory QC program.

A field QA/QC program was established to evaluate the quality of the field bin data set, including field duplicates and field blanks. The field duplicate sample is intended to monitor the variability in sub-sampling and analysis, while the field blank is used to quantify any contamination that may occur during sample collection, handling and transportation. Field QA/QC data for all the field bins are presented in Appendix D.1-6, and includes data for field duplicate and field blank samples collected in 2014 and 2015.

For the purpose of evaluating the field duplicate samples, acceptable precision and accuracy was defined to be within 20% relative percent difference (RPD) at concentrations greater than 10 times (10×) the detection limit (DL); where,

$$RPD = [(result - duplicate\ result) * 100] / [(result + duplicate\ result) / 2]$$

All field duplicates were within the data quality objectives, with nearly all (98%) of RPD values < 20% (for concentrations greater than 10 times the detection limit). Field blanks show all but one parameter to be at concentrations below their respective detection limits. Only the sulphate value for the field blank sample collected June 4, 2014 is at the detection limit (0.3 mg/L). Overall, results of the QA/QC program demonstrate very good quality control on limiting contamination during sampling activities.

4. Geochemical Characterization Results

The following sections provide data collected for the geochemical characterization of geologic waste materials for the Project. The chapter has been divided by waste material, including waste rock, ore, leach tailings and overburden/borrow materials. Within each section, data are provided with respect to mineralogy, ABA, SFE, solid phase elements and kinetic testwork. As well, variations in geochemical properties as a function of lithology and weathering facies within each waste type are discussed. The results from these components are ultimately used to define acid generating potential, metal leaching potential and drainage chemistry predictions (source terms) for mine waste facilities.

4.1 Waste Rock

4.1.1 Overview of Test Results

Geochemical testwork indicates that all lithologies and weathering facies of waste rock have little or no potential for acid generation. The low potential for acid generation is, in part, related to the lack of sulphur (S) mineralization, with median total S values in gneiss, granite and schist being 0.01, <0.01 and 0.03 wt.%, respectively. There is some variation in sulphur content between weathering facies within each lithology, with the fresh weathering facies typically showing greater S content then the transition and oxide facies. However, the S content remains relatively low even in unweathered (fresh) waste rock, with median values ranging from <0.01 to 0.11 wt.%. Due to the low S concentrations and the presence of carbonate minerals, all waste rock is classified as non-reactive or non-PAG.

Mineralogical investigations indicate that the most frequently detected sulphur mineral waste rock is pyrite (<1 wt.%). Calcite represents the dominant carbonate mineral (<29 wt.%), indicating that these materials are capable of buffering acid generating reactions. However, carbonate minerals that are less effective at neutralizing acid are also present in appreciable amounts in the gneiss and schist (<11 wt.%). The oxide gneiss and granite waste rock have limited buffering capacity, owing to the undetectable to very low abundance of carbonate minerals.

Solid phase metal analysis found that As, Sb, Bi and Se were enriched in all rock types, while U enrichment was limited to the granite and gneiss lithologies. Elemental enrichment is related to both lithology and weathering facies, with Sb and As concentrations being most enriched in the oxide weathering facies, and in the granite lithology. Schist waste rock is also elevated with respect to Se and Cr. Granite and gneiss waste rock show U enrichment.

Results of the SFE indicate that As and Sb are metals of potential concern from all waste rock lithologies, most notably granite. Elevated concentrations of Cr were also observed in the gneiss and schist lithologies. It is interesting to note that U was not found to be elevated in SFE testwork, which is in contrast to metal enrichment and metal leaching results from kinetic testwork. This result is attributed to the low alkalinity produced during SFE experiments.

Field and laboratory kinetic tests are consistent with static testwork results, with the highest As concentrations produced by granite waste rock, the highest Sb concentrations produced by schist fresh facies and the overall highest U concentrations produced by gneiss waste rock. Uranium was similarly enriched in the granite waste rock, however, the concentrations in granite leachate were highly variable, and can be related to the low alkalinity produced in some granite samples which inhibits U solubility. The gneiss and schist oxide facies produced the highest Cr concentrations and the lowest As and Sb concentrations. Note that this is contrary to elemental enrichment testing which showed that oxide facies generally had the greatest As and Sb. This result is attributed to the relative abundance of Fe in the oxide kinetic test samples.

4.1.2 Mineralogy

The following section provides an overview of the mineralogical results for waste rock samples. Mineralogical laboratory reports for XRD and assessments completed at the CLS are presented in Appendix B.1 and Appendix B.2, respectively.

4.1.2.1 Gneiss Waste Rock

Gneiss materials are typically characterized by quartz, plagioclase, K-feldspar, kaolinite, +/- illite/muscovite, +/- phlogopite, and, with exception of the oxide weathering facies, carbonate minerals including calcite +/- ankerite +/- dolomite (Table 4-1). Of these, quartz, plagioclase, and K-feldspar comprise the major rock forming minerals. Sheet silicates such as illite/muscovite, kaolinite, phlogopite, and bioite, also contribute significantly to the total mineral make up. Kaolinite, a secondary clay mineral that generally forms from the weathering of aluminium feldspars, is typically present in the greatest amounts in the oxide facies and, to a lesser extent, the upper transition facies. The fresh facies has the lowest occurrence of kaolinite. Illite/muscovite is variable within each facies and does not show any discernible trend.

Calcite represents the dominant carbonate mineral for each of the upper transition, lower transition and fresh facies. Dolomite is rare, present in only a single upper transition sample (KAM091516, Table 4-1), a single lower transition sample (KAM079117), and two fresh samples (KAM078808 and KAM092488) Ankerite is typically present in the upper

transition samples, is present in a single lower transition sample (KAM051451) and notably absent from samples associated with oxide and fresh weathering facies. The presence of carbonate minerals in gneiss samples from the upper transition, lower transition, and fresh materials in appreciable abundances, indicates that these weathering facies are capable of buffering acid generating reactions. In contrast, the oxide gneiss has limited buffering capacity, owing to the absence of carbonate minerals detectable by XRD. However, ABA results discussed in subsequent sections show that some carbonate content is associated with oxide weathering facies.

Sulphide minerals are present in each of the gneiss weathering facies (oxide, upper transition, lower transition, and fresh), although not all samples show detectable sulphide minerals irrespective of weathering facies. With respect to gneiss waste rock, the major sulphide species is pyrite, with pyrrhotite present in a single fresh sample (KAM145241, Table 4-1).

In addition to sulphide minerals, XRD identified the presence of sulphate minerals in the gneiss samples including gypsum (lower transition facies), hydronium-jarosite (oxide facies) and natroalunite (fresh facies). These minerals are present in very low abundances (Table 4-1). Since natroalunite is typically a secondary mineral formed through weathering processes, it is unexpected to see detectable quantities associated with the fresh (unweathered) material. In this regard, the presence of natroalunite in this sample should be viewed with some uncertainty. Similarly, the very low abundance of gypsum in a lower transition sample should also be viewed as being uncertain.

Table 4-1:
XRD Results for Gneiss Waste Rock Samples

		Oxide			Upper Transition						Lower Transition					Fresh				
Sample ID		KAM144308	KAM139298	KAM137583	KAM152499	KAM084288	KAM097065	KAM097065	KAM029087	KAM091516	KAM050812	KAM079117	KAM143923	KAM051451	N839989	KAM145241	KAM153051	N837976	KAM078808	KAM092488
Mineral	**Ideal Formula**	**wt. %**																		
Ankerite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2$				0.75	8.1	0.50			2.4				1.6						
Calcite	$CaCO_3$				0.63	2.7	2.9	2.4	5.1	6.7	7.3	0.22	7.8	7.3	0.64	9.6	0.68	10	0.50	
Dolomite	$(Ca,Mg)CO_3$									13		5.1							4.9	4.1
Siderite	$Fe^{2+}CO_3$																			
Dawsonite	$NaAlCO_3(OH)_2$												0.16							
Pyrite	FeS_2			0.35		0.38	0.20					0.69			0.59		0.31		0.70	0.46
Pyrrhotite	$Fe_{1-x}S$															0.33				
Gypsum	CaSO4 2H2O												0.29							
Goethite	$a\text{-}Fe^{3+}O(OH)$					0.90														
Hydroniumjarosite	$H_2Fe_6^{3+}(SO_4)_4(OH)_{12}$			0.54																
Natroalunite	$NaAl_3(SO4)_2(OH)_6$																	0.39		
Diaspore	AlO(OH)							0.7												
Biotite	$K(Mg,Fe)_3[AlSi_3O_{10}(OH,F)_2$													8.1						
Phlogopite	$KMg_3AlSi_3O_{10}(OH)_2$			1.9	2.5					14	9.5		1.6		3.5	6.3		16		
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	10						12			7.3		25	14					7.2	14
Illite/Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$/ $K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$		6.1	14	6.7	4.0	9.0		6.0			8.7			26		5.1			
Kaolinite	$Al_2Si_2O_5(OH)_4$	9.6	16	12	2.6	17	14	7.8	15	13		8.3	7.6		6.9		3.8		1.7	9.6
K-feldspar	$KAlSi_3O_8$	24	31	20	20	17	14	14	22	28	25	33	1.7	11	11	33	18	4.6		23
Plagioclase	$NaAlSi_3O_8 - CaAl_2Si_2O_8$			13	28	1.39	3.8	3.1		7.3	13	7.1	9.0	25	7.8	24	32	20	56	
Quartz	SiO_2	56	48	38	37	48	55	60	51	16	27	37	47	26	33	14	40	19	29	49
Anatase	TiO_2			0.41					0.50						0.49					
Clinozoisite	$Ca_2Al_3(SiO_4)_3(OH)$				1.8		0.46				9.8				6.0			11		
Grossular	$Ca_3Al_2(SiO_4)_3$													1.0				0.57		
Actinolite	$Ca_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$															1.6		15		
Augite	$(Ca,Na)(Mg,Fe,Al,Ti)(Si,Al)_2O_6$															11	1.0			
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$										1.2			6.1	4.3			3.5		
Barite	$BaSO_4$	0.20																		
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

4.1.2.2 Schist Waste Rock

The schist oxide, upper transition, lower transition, and fresh materials are composed of quartz, K-feldspar, +/- plagioclase, kaolinite, +/- illite/muscovite, +/- phlogopite, +/- biotite, carbonate minerals, including calcite +/- ankerite +/- dolomite, +/- siderite, and +/- dawsonite, and sulphide minerals, including +/- pyrite, +/- arsenopyrite, +/- galena, and +/- manganese sulphide (Table 4-2). Of these, quartz, plagioclase, K-feldspar, kaolinite and illite/muscovite represent the bulk of the mineral assemblage irrespective of weathering facies. The schist unit exhibits the greatest abundances of sheet silicates. As with the gneiss unit, kaolinite is typically present in the greatest abundance in the oxide facies, followed by the upper transition.

Calcite and dolomite comprise the major carbonate minerals for each of the oxide, upper transition, lower transition, and fresh materials. Ankerite is also present in appreciable amounts in each of the upper transition, lower transition, and fresh weathering facies. Siderite is present in two samples, from the upper transition (KAM022156, Table 4-2) and fresh (KAM036824) facies. Appreciable quantities of Fe/Mn-bearing carbonates in the upper transition, lower transition, and fresh weathering facies indicate that CaNP may overestimate the NP derived from carbonate minerals for the schist unit from these facies.

Pyrite is present in each of the upper transition, lower transition, and fresh weathering facies. In contrast, sulphide minerals (including pyrite) were not detected in the oxide schist facies. No sulphate minerals were detected in any of the schist samples.

4.1.2.3 Granite Waste Rock

The granite unit is generally characterized as being composed of quartz, +/- plagioclase, +/- K-feldspar, kaolinite, +/- illite/muscovite, +/- phlogopite, and +/- trace carbonate minerals (Table 4-3). Quartz, +/- plagioclase, an +/- K-feldspar comprise the major minerals for the granite material. The granite oxide facies is primarily quartz (55 to 66 wt.%) with trace amounts of K-feldspar (< 2 wt.%), while the upper transition, lower transition, and fresh facies granite material is comprised of quartz (31 to 62 wt.%), K-feldspar (0 to 31 wt.%), +/- plagioclase (0 to 35 wt.%). Sheet silicates such as kaolinite and illite/muscovite are generally most abundant in the oxide facies, with a combined contribution of 33% to 42 % of the granite composition. The lower transition facies exhibit slightly lower abundances of kaolinite and illite/muscovite (23 to 24 wt.%), with the exception of R305815 which shows much lower abundances.

The granite samples showed undetectable to very low abundances of carbonate minerals. Hydrocalumite was observed in a single oxide sample (R305826, Table 4-3) and a single

fresh sample (R305832). Calcite and dolomite were only observed in fresh granite samples (KAM025798 and R305825). Iron bearing carbonates were also observed in two samples at very low abundances, including upper transition (R305818) and fresh (KAM025798) weathering facies.

Pyrite was the only sulphide mineral observed for the granite, and only present in two samples. These included a single upper transition sample (KAM025898, Table 4-3) and a single fresh sample (R305825), both showing abundances of <1 wt.%.

In addition to sulphide minerals being present, XRD identified the presence of acidic sulphate minerals (hydronium-jarosite) in a single upper transition sample. This material is present in very low abundance and therefore there is some uncertainty as to the validity of this identification.

4.1.2.4 Other Waste Rock Lithologies

Mineral assemblages for other waste rock materials, including two dyke samples (KAM029393 and KAM03975) and a single breccia sample (KAM036549) (Table 4-4). For the oxide dyke, the major minerals include quartz, kaolinite, and illite/muscovite. Neither carbonate nor sulphide minerals were present in the XRD scans. With respect to lower transition dyke material, dominant minerals included quartz, K-feldspar, plagioclase, kaolinite, illite/muscovite, biotite, and carbonate minerals (calcite, ankerite, and siderite). Sulphide minerals were not detectable in XRD scans of the lower transition dyke sample. The fresh breccia material exhibits quartz, K-feldspar, kaolinite, muscovite, and carbonate minerals, such as dolomite, ankerite, and siderite. The only sulphide mineral present in these samples was pyrite (0.5 wt.%) in the fresh breccia sample.

Table 4-2:
XRD Results for Schist Waste Rock Samples

		Oxide		Upper Transition				Lower Transition				Fresh			
Sample ID		KAM029385	J957606	KAM147059	KAM037928	KAM079346	KAM022156	KAM043465	KAM081312	KAM047995	KAM039252	KAM149916	KAM151027	KAM036824	KAM149916
Mineral	**Ideal Formula**	**wt. %**													
Ankerite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2$			10		9.8	11	9.7	0.089	3.9	5.4	0.90		5.5	11
Calcite	$CaCO_3$		29		13			1.7	0.28	5.6	3.8	4.8			2.0
Dolomite	$(Ca, Mg)CO_3$			11		12							22	9.3	7.9
Siderite	$Fe^{2+}CO_3$						0.49							4.5	
Dawsonite	$NaAlCO_3(OH)_2$			0.19									0.21		
Hydrocalumite	$Ca_4Al_2(OH)_{12}(Cl,CO_3,OH)_2 \cdot 4H_2O$														
Galena	PbS			0.048											
Pyrite	FeS_2			1.0			0.52	0.94		0.50	0.70	1.4	0.91	1.3	0.60
Pyrite, arsenian	$Fe(As, S)_2$														0.80
Manganese sulfide	MnS_2														0.40
Hematite	$a\text{-}Fe_2O_3$		0.28		0.70										
Biotite	$K(Mg,Fe)_3[AlSi_3O_{10}(OH,F)2$				2.0					10	9.0				
Phlogopite	$KMg_3AlSi_3O_{10}(OH)_2$											12			
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	21				12		17	9.0	0.00	9.7	8.6		14	25
Illite/Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2/ K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$		12	9.6	11		22			6.3			20		
Kaolinite	$Al_2Si_2O_5(OH)_4$	20	13	21	13	21	21	10	0.93	4.2	9.7	4.1	4.9	15	11
K-feldspar	$KAlSi_3O_8$	6.5	10		15	10		3.2	15	12	16	6.1	1.8	1.6	
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$								35	20	8.6	10			
Quartz	SiO_2	50	35	46	43	35	44	57	40	34	36	42	41	49	41
Cristobalite	SiO_2														
Anatase	TiO_2		0.91		1.0		0.66	0.44		0.40	0.40	0.48	0.14		
Rutile	TiO_2			0.42									0.43		
Clinozoisite	$Ca_2Al_3(SiO_4)_3(OH)$											6.0			
Grossular	$Ca_3Al_2(SiO_4)_3$												8.0		
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$									2.1		3.8			
Analcime	$Na_2(Al_2Si_4O_{12}) \cdot 2H_2O$														
Diopside	$CaMgSi_2O_6$	2.2													
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

Table 4-3:
XRD Results for Granite Waste Rock Samples

		Oxide		Upper Transition					Lower Transition			Fresh		
Sample ID		R305826	R305808	R305824	KAM025898	KAM025898	R305818	R305821	R305817	R305803	R305815	R305832	KAM025798	R305825
Mineral	**Ideal Formula**	**wt. %**												
Ankerite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2$						0.20							
Calcite	$CaCO_3$												0.93	
Dolomite	$(Ca,Mg)CO_3$													0.10
Siderite	$Fe^{2+}CO_3$												0.50	
Hydrocalumite	$Ca_4Al_2(OH)_{12}(Cl,CO_3,OH)_2 \cdot 4H_2O$	0.10										0.40		
Pyrite	FeS_2					0.20								0.087
Gorceixite	$BaAl_3(PO_4)_2(OH)_5 \cdot H_2O$		0.11											
Iron-alpha	a-Fe				0.28								0.22	
Hematite	$a\text{-}Fe_2O_3$							0.20			0.2?	0.18	0.28	
Hydroniumjarosite	$H_2Fe_6^{3+}(SO_4)_4(OH)_{12}$							0.27						
Jarosite	$KFe_3^{+3}(SO_4)_2(OH)_6$						0.40							
Biotite	$K(Mg,Fe)_3[AlSi_3O_{10}(OH,F)_2$					1.0			1.4		2.0	2.6		
Phlogopite	$KMg_3AlSi_3O_{10}(OH)_2$				1.1								1.7	
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$												1.1	
Illite/Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$/ $K0.65Al2.0Al0.65Si3.35O_{10}(OH)_2$	35	1.8	0.55		1.7	12	4.8	3.1	1.4		2.7		
Kaolinite	$Al_2Si_2O_5(OH)_4$	7.6	32	37	10	8.4	8.5	4.1	21	22	0.61	7.1	0.87	19
K-feldspar	$KAlSi_3O_8$	1.6			30	30	21	31	30	31	28	29	28	31
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$				21	18		25			34	19	35	
Quartz	SiO_2	55	66	62	37	37	54	31	45	38	35	39	31	49
Cristobalite	SiO_2					2.9	4.1	2.5		7.4				
Anatase	TiO_2		0.18	0.28										
Rutile	TiO_2							0.70						
Clinochlore	$(Mg,Fe^{2+})5Al(Si_3Al)O_{10}(OH)_8$												0.81	
Analcime	$Na_2(Al_2Si_4O_{12}) \cdot 2H_2O$	0.24												
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

Table 4-4:
XRD Results for Dyke (KAM02939 and KAM037975) and Breccia (KAM036549) Waste Rock Samples

		Oxide	Lower Transition	Fresh
Sample ID		KAM029393	KAM037975	KAM036549
Mineral	**Ideal Formula**	**wt. %**		
Ankerite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2$		2.4	12
Calcite	$CaCO_3$		8.5	
Dolomite	$(Ca,Mg)CO_3$			6.5
Siderite	$Fe^{2+}CO_3$		0.80	0.60
Pyrite	FeS_2			0.50
Hematite	$a\text{-}Fe_2O_3$		1.1	
Diaspore	AlO(OH)			1.10
Biotite	$K(Mg,Fe)_3[AlSi_3O_{10}(OH,F)_2$		14	
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$			18
Illite/Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$/ $K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$	15	5.9	
Kaolinite	$Al_2Si_2O_5(OH)_4$	30	6.9	8.2
K-feldspar	$KAlSi_3O_8$		8.3	3.6
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$		25	
Quartz	SiO_2	54	26	49
Anatase	TiO_2	0.70	0.90	0.40
	Total	*100*	*100*	*100*

4.1.2.5 Summary of Sulphur and Carbonate Mineralogy

Regardless of the lithotype or weathering facies, pyrite is the primary sulphide mineral. In general, the schist unit shows the greatest sulphide mineral abundance (Table 4-2), followed by the gneiss and the granite units. Typically, the oxide samples are depleted with respect to sulphide minerals. Other sulphide minerals identified in trace abundances include pyrrhotite in both the gneiss and schist lithology; and arsenopyrite, galena, and manganese-sulphide in the schist lithology. However, due to the low abundances of these sulphide minerals, their presence cannot be stated with certainty based on the XRD data. Sulphate minerals were identified in gneiss and granite lithologies. These minerals were generally, but not always, found in the oxide and transition weathering facies. The two

sulphate minerals, hydroniumjarosite and K-jarosite, identified in the granite lithology (Table 4-3) are both acid generating, while sulphate minerals identified in the gneiss lithology were a combination of acid generating (hydroniumjarosite, Table 4-1) and non-acid generating (gypsum and barite). No sulphate minerals were identified by XRD in schist waste rock; however, ABA analysis shows that minor quantities of sulphate are present in this rock type (75th percentile of 0.01 wt.%) and barite was identified in schist ore.

Carbonate mineral phases identified by XRD include calcite, dolomite, ankerite, siderite, and in rare instances dawsonite. Of these, NP is strongly associated with more readily soluble carbonate minerals including calcite and dolomite. When available, these carbonates buffer acid generating reactions such that a neutral pH is maintained. Within a given lithology, carbonate abundance shows a general pattern of decreasing abundance with increased degree of weathering. In this regard, oxide facies samples show the lowest carbonate mineral abundance, with many samples exhibiting undetectable levels. Similarly, a number of upper transition samples exhibit carbonate-depleted characteristics. Highest carbonate abundances are exhibited by unweathered (fresh) schist materials (Table 4-2), followed by the gneiss and granite units. The Fe- and Mn-bearing carbonates, ankerite and siderite, were identified in approximately half the samples. Typically, the Fe-carbonates are in much lower concentrations than calcite and dolomite and are associated with the gneiss and schist samples (predominantly upper and lower transition samples).

4.1.2.6 Trace Element Occurrence

For the purposes of identifying mineral associations for trace elements of interest, mine waste rock and ore samples were analyzed at the CLS using high resolution microscopy methods. Specific trace elements examined were As and U owing to elevated concentrations observed in site water quality and in kinetic test results. The analysis included µXRF and XANES testing to determine elemental-phase associations and valence state. Note that µXRF could not detect elements with emission energies that fall below Ar, meaning that elements lighter than Ar are not detectable. The complete results of this analysis are provided in Appendix B.2.

Arsenic

The XANES results are presented in Table 4-6. A total of 10 samples were compared with As K-edge XANES spectra and five standards. The results show that arsenate (As(V)) is the only oxidation state identified within the oxide weathering facies and is the dominant speciation in most samples from the transition and fresh weathering facies. Reduced forms

of As (As(-I) and As(III)) were less abundant than As(V) in all but one unweathered (fresh) gneiss waste rock sample.

For all samples where As was detected, a co-association with Fe was observed. This is consistent with XRD results which have identified the presence of arsenopyrite (FeAsS), arsenian-pyrite[$Fe(As,S)_2$] and scorodite ($FeAsO_4*H_2O$), but may also be a result of As being present on Fe-oxide mineral surfaces. In one schist transition sample, As was associated with both Fe and Ca, indicating the presence of yukonite [$Ca_3Fe(AsO_4)_2(OH)_3*5H_2O$]. Although it was not identified by µXRD, XANES data indicated the presence of As(I) suggesting that the sulphide minerals realgar (As_4S_4) or orpiment (As_2S_3) may also be present.

Uranium

For quantifying U oxidation states, XANES spectra were collected for nine samples (Table 4-7). Analysis of the gneiss oxide composite sample was attempted (5.5 ppm U); however, the concentration was below the detection capabilities of the beamline. The oxidation state of U in most of the samples is a mixture of U(IV) and U(VI) with the only exception being a single gneiss oxide sample where U(VI) was the only oxidation state detected. In general, oxide samples are dominated by U(VI) while transition and fresh samples show a wide range of U(VI) and U(IV) proportions. It is interesting to note that in all samples, including fresh unweathered material, U(VI) is present. This has implications for U release to pore water as U(VI) is more soluble than in the reduced oxidation state.

Associations of U with other elements was examined with µXRF data collected from 18 samples. Results are summarized in Table 4-5. Despite the high resolution of the µXRF technique, U minerals were only identified in 8 of the samples analyzed due to its low abundance. Uranium minerals are chemically diverse, and a range of minerals may be present that incorporate elements which overlap with spots identified by µXRF. For the purpose of identifying the most likely U host phases, only relatively common minerals were considered.

Uranium minerals can be classified as reduced or oxidized species. Reduced uranium minerals incorporate U in the tetravalent oxidation state [U(IV)] while oxidized uranium minerals incorporate U in the hexavalent oxidation state [U(VI)]. XANES data, described below, indicates that U is present in both oxidation states in most samples. The most abundant U(IV) bearing minerals in decreasing prevalence are uraninite (UO_2), coffinite ($USiO_4 \cdot nH_2O$) and brannerite [$(U,Ca,Y,Ce)(Ti,Fe)_2O_6$] (Gilligan *et al.*, 2015). In gneiss waste rock samples, U was found to be associated with Fe, Ti, Ca, As, Cu and Th. The association of U with Ca, Fe and Ti in three out of six gneiss samples suggests that brannerite is present (Table 4-5), although the presence of the uraninite and coffinite cannot

be precluded. Note that in one gneiss sample (72146B) no elemental overlap was found with U. This indicates that U is occurring with elements lighter than Ar, which includes Si and O.

Minerals containing U(VI) can occur in a diverse group of minerals that can be broadly classified as hydrated uranyl oxides, phosphates, vanadates, silicates and carbonates. Uranyl carbonate minerals generally form in evaporate deposits, which is a class of minerals not expected to occur in the Project waste rock or ore. No association between U and V was identified, indicating that vanadates are not present. Silicon, P and O have emission energies below the range that was detectable by this analysis. Associations of U with Cu and/or As in gneiss waste rock and ore suggest the presence of uranyl phosphate minerals. That is, Cu occurs in tobernite ($Cu(UO_2)_2(PO_4)_8 \cdot 12H_2O$) and AsO_4 can commonly substitute for PO_4 in the autunite series minerals ($Ca(UO_2)_2(AsO_4,PO_4)_8 \cdot 8H_2O$. The association between U and Fe could be related to a variety of oxidized or reduced minerals, but may also reflect adsorption of the positively charged uranyl ion onto negatively charged surfaces of sulfides, clays and organic matter, as well as Fe, Mn and Al oxyhydroxide particles (Lottermoser, 2007).

In schist waste rock, U was found to be associated with Fe, Ca and As (Table 4-5). In a single sample, 72146B, no detectable elements (i.e., elements heavier than Ar) overlapped with a U spot, indicating the presence of a U oxide or silicate mineral. The association of U with As and Ca suggests the presence of an autunite series mineral, as described above.

Table 4-5:
Summary of As and U µ-XRF Results for Coffee Gold Mine Samples

Sample Description	Drill Core /Head ID	Lithology	Weathering	Ore/ Waste	Verified U Spots[1]	Verified As Spots	U Spatial Overlap						As Spatial Overlap	
							Fe	As	Ca	Cu	Ti	Th	Fe	Ca
Kinetic Test Sample (FB-GO, Col 5)	Composite	Gneiss	Oxide	Waste	X	X	✓	✓	✓	✓	✓	✓	✓	-
High U Drill Core	KAM144308	Gneiss	Oxide	Waste	X^2	X	✓	-	✓	✓	-	✓	✓	-
Kinetic Test Sample (FB-GT, HC3, Col 6)	Composite	Gneiss	Transition	Waste	-	X	-	-	-	-	-	-	✓	-
High U Drill Core	KAM091516	Gneiss	Transition	Waste	X^2	X	✓	-	✓	✓	✓	-	✓	-
Kinetic Test Sample (FB-GS, HC4)	Composite	Gneiss	Fresh	Waste	X	X	✓	-	-	✓	✓	-	✓	-
High U Drill Core	KAM078808	Gneiss	Fresh	Waste	X^2	X	✓	-	-	✓	-	-	✓	-
Kinetic Test Sample (FB-SO, Col 3)	Composite	Schist	Oxide	Waste	-	X	-	-	-	-	-	-	✓	-
High U Drill Core	KAM029385	Schist	Oxide	Waste	-	X	-	-	-	-	-	-	✓	-
Kinetic Test Sample (FB-ST, HC1, Col 4)	Composite	Schist	Transition	Waste	-	X	-	-	-	-	-	-	✓	-
High U Drill Core	KAM079346	Schist	Transition	Waste	X	X	✓	-	✓	-	-	-	✓	-
Kinetic Test Sample (FB-SS, HC2)	Composite	Schist	Fresh	Waste	-	X	-	-	-	-	-	-	✓	-
High U Drill Core	KAM047252	Schist	Fresh	Waste	X^2	X	✓	✓	✓	-	-	-	✓	-
Met Head Sample	72146B	Gneiss	Transition	Ore	X	X	-	-	-	-	-	-	✓	-
Met Head Sample	50% 72144B 50% 72145B	Gneiss	Oxide	Ore	-	X	-	-	-	-	-	-	✓	-
Met Head Sample	72139B	Granite	Oxide	Ore	-	X	-	-	-	-	-	-	✓	-
Met Head Sample	72140B	Granite	Transition	Ore	-	X	-	-	-	-	-	-	✓	-
Met Head Sample	50% 72138B 50% 72137B	Schist	Oxide	Ore	-	X	-	-	-	-	-	-	✓	-
Met Head Sample	50% 72135B 50% 72136B	Schist	Transition	Ore	-	X	-	-	-	-	-	-	✓	✓

Notes: [1] Single spot indicated by X, two spots indicated by X^2.

Table 4-6:
Relative Abundance of As Species Estimated from the Linear Combination Fits of XANES Data

Sample Description	Drill Core /Head ID	Lithology	Weathering Facies	Ore/ Waste	As(V)	As(-I)	As(III)
					%	%	%
Met Head Sample	72144B	Gneiss	Oxide	Ore	100	-	-
High U Drill Core Sample	KAM144308	Gneiss	Oxide	Waste	100	-	-
Kinetic Test Sample (GS)	Composite	Gneiss	Fresh	Waste	59	19	22
High U Drill Core Sample	KAM078808	Gneiss	Fresh	Waste	20	61	20
Met Head Sample	72139B*	Granite	Oxide	Ore	100	-	-
High U Drill Core Sample	KAM029385	Schist	Oxide	Waste	100	-	-
Met Head Sample	72135B	Schist	Oxide	Ore	100	-	-
Met Head Sample	72137B	Schist	Transition	Ore	91	9.3	-
Met Head Sample	72146B	Gneiss	Transition	Ore	95	5.7	-
Met Head Sample	72140B	Granite	Transition	Ore	100	-	-

Table 4-7:
Relative Abundance of U Species Estimated from the Linear Combination Fits of XANES Data

Sample Description	Sample ID	Lithology	Weathering Facies	Ore/ Waste	U(IV)	U(VI)
					%	%
High U Drill Core Sample	KAM144308	Gneiss	Oxide	Waste	0	100
High U Drill Core Sample	KAM091516	Gneiss	Transition	Waste	83	17
High U Drill Core Sample	KAM078808	Gneiss	Fresh	Waste	73	27
Kinetic Test Sample (GS)	Composite	Gneiss	Fresh	Waste	33	67
High U Drill Core Sample	KAM029385	Schist	Oxide	Waste	11	89
High U Drill Core Sample	KAM079346	Schist	Transition	Waste	53	47
SS Waste	KAM047252	Schist	Fresh	Waste	72	28
Met Head Sample	72146B	Gneiss	Transition	Ore	51	49

4.1.3 Acid Base Accounting

This section discusses the ABA results for the Project waste rock lithologies. Nearly 350 waste rock samples were submitted for ABA testwork. The statistical distributions for the major waste rock lithologies (gneiss, schist and granite) are presented by weathering facies in Table 4-8 and Table 4-9, respectively. The complete set of ABA results and data for the minor waste rock lithologies are provided in Appendix C.1-1.

4.1.3.1 Rinse and Paste pH

Paste and rinse pH values provide information on the pH of a rock type immediately after excavation. Paste pH is the standard test conducted as part of most ABA testwork, however, it often produces an unreliably high estimate of pH. This is because the sample is pulverized to 100 µm size or smaller to produce a paste, resulting in an extremely high number of new surfaces and the exposure (and abrasion) of minerals not previously subjected to weathering. Rinse pH provides a more representative indication of the present drainage pH of a sample as it is conducted on a sample that is crushed to <2 mm (i.e., grain size of sand). Figure 4-1 shows paste pH against rinse pH with a 1:1 line superimposed, illustrating lower rinse pH values compared to paste pH.

Rinse pH for the two dominant lithologies (gneiss and schist) are circum-neutral to alkaline ($6.6 \leq pH \leq 9.9$, weather facies medians ranging from 7.2 - 8.8) (Table 4-8 and Table 4-9). The granite samples show slightly lower pH values ($6.0 \leq pH \leq 9.2$) (Table 4-10). In general, rinse pH decreases with increased weathering, whereby the oxide facies samples show the lowest pH values and the fresh facies samples show the highest pH values. However, rinse pHs even for the most weathered samples (oxide) typically remain above pH 7. Overall, the rinse pH values demonstrate that the in-situ pH of the waste rock types at the Project site are circum-neutral to alkaline.

Table 4-8:
Statistical Distribution of ABA Results by Weathering Facies for Gneiss Waste Rock

Parameter	Rinse pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	T-C NP*	CaNP	Sobek NP	Siderite NP	T-C NNP*	Sobek NNP	NPR	NPR	NPR
Unit	s.u.	s.u.	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	T-C NP*/ T-AP	CaNP/ T-AP	SobekNP/ T-AP
Gneiss (Oxide)														
n	21	34	34	22	22	34	22	18	18	34	18	34	22	18
Min	6.6	6.4	*<0.01*	0.005	*<0.005*	*<0.8*	*<4.5*	3.0	4.0	0.5	2.7	2.5	7.2	8.0
25th PCTL	7.2	7.3	*<0.01*	*<0.01*	*<0.01*	1.6	*<4.5*	4.3	5.0	1.2	4.0	5.0	15	13
Median	7.3	7.7	0.01	0.01	0.01	3.9	4.5	6.5	7.5	3.6	6.2	9.1	15	20
75th PCTL	7.5	8.4	0.01	0.01	0.01	7.8	15	17	18	7.5	15	18	18	28
Max	8.7	9.3	0.10	0.10	0.02	40	36	25	25	38	25	78	76	83
Gneiss (Upper Transition)														
n	16	25	26	17	17	26	17	10	10	26	10	26	17	10
Min	7.1	6.6	*<0.01*	0.005	*<0.01*	0.8	2.3	2.0	3.0	-27.0	1.7	0.1	0.2	1.4
25th PCTL	7.3	7.2	*<0.01*	*<0.01*	*<0.01*	1.0	*<4.5*	10.0	5.3	0.5	6.9	2.6	14	11
Median	7.5	7.5	0.01	0.01	0.01	1.9	*<4.5*	28	25	1.2	23	5.1	15	24
75th PCTL	7.7	7.9	0.01	0.03	0.01	18	25	33	31	18	30	23	25	63
Max	9.2	9.4	0.94	0.90	0.02	50	48	52	53	49	52	159	153	166
Gneiss (Lower Transition)														
n	44	79	79	44	44	79	44	13	13	79	13	79	44	13
Min	6.8	6.8	*<0.01*	0.005	*<0.01*	*<0.8*	*<4.5*	4.0	5.0	-0.2	3.7	0.8	6.2	5.7
25th PCTL	7.9	8.1	*<0.01*	*<0.01*	*<0.01*	1.6	*<4.5*	13	15	1.2	13	5.0	15	20
Median	8.8	8.6	0.01	0.01	0.01	3.9	8.0	20	20	3.6	19	7.8	15	32
75th PCTL	9.2	9.1	0.02	0.01	0.01	19	35	48	50	17	40	23	39	61
Max	9.8	9.7	0.30	0.25	0.03	86	91	127	121	85	125	173	159	100
Gneiss (Fresh)														
n	34	49	49	34	34	49	34	10	10	49	10	49	34	10
Min	7.2	7.6	*<0.01*	*<0.01*	*<0.01*	0.8	*<4.5*	6.0	6.0	0.5	5.7	1.1	1.1	5.5
25th PCTL	8.6	8.7	*<0.01*	*<0.01*	*<0.01*	3.1	*<4.5*	9.0	10	1.3	8.7	5.2	15	21
Median	9.0	9.0	0.01	0.01	0.01	13	8.0	18	20	11	16	17	15	26
75th PCTL	9.5	9.3	0.04	0.04	0.01	32	35	38	39	31	34	35	27	41
Max	9.9	9.8	0.43	0.16	0.03	98	98	128	140	94	127	316	311	390
Gneiss (All Weathering Facies)														
n	115	187	188	117	117	188	117	51	51	188	51	188	117	51
Min	6.6	6.4	*<0.01*	*<0.01*	*<0.01*	*<0.8*	2.3	2.0	3.0	-27	1.7	0.08	0.15	1.4
25th PCTL	7.4	7.7	*<0.01*	*<0.01*	*<0.01*	1.6	*<4.5*	6.0	6.5	1.2	5.7	5.0	14	13
Median	8.4	8.5	0.01	0.01	0.01	4.7	4.5	15	15	4.4	13	10	15	27
75th PCTL	9.2	9.1	0.02	0.02	0.01	21	23	29	26	20	26	26	29	42
Max	9.9	9.8	0.94	0.90	0.03	98	98	128	140	94	127	303	298	390

Notes: Values in grey italics are below the analytical detection limit; *n* = number of analyses included in statistical distribution; * adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.2.3 for discussion); NNP = net neutralization potential, derived by subtracting AP from NP.

Table 4-9:
Statistical Distribution of ABA Results by Weathering Facies for Schist Waste Rock

Parameter	Rinse pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	T-C NP*	CaNP	Sobek NP	Siderite NP	T-C NNP*	Sobek NNP	NPR	NPR	NPR
Unit	s.u.	s.u.	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	T-C NP*/ T-AP	CaNP/ T-AP	SobekNP/ T-AP
Schist (Oxide)														
n	13	15	15	13	13	15	13	12	12	15	12	15	13	12
Min	6.8	6.6	*<0.01*	*<0.01*	*<0.01*	1.6	*<4.5*	4.0	4.0	1.3	3.7	4.6	4.0	3.4
25th PCTL	7.0	7.4	0.01	*<0.01*	*<0.01*	7.8	4.5	18	21	6.8	17	9.6	14	15
Median	7.2	7.6	0.01	0.01	*<0.01*	63	116	127	137	49	121	20	19	43
75th PCTL	7.3	8.0	0.07	0.05	0.01	155	157	161	167	144	161	155	236	258
Max	7.8	8.5	0.44	0.34	0.06	250	268	268	271	250	268	800	858	858
Schist (Upper Transition)														
n	11	14	14	11	11	14	11	6	6	14	6	14	11	6
Min	7.2	7.7	*<0.01*	*<0.01*	*<0.005*	2.3	*<4.5*	6.0	7.0	2.0	5.7	5.4	5.7	6.6
25th PCTL	7.7	8.1	0.02	0.01	*<0.01*	76	72	94	97	75	92	18	16	13
Median	8.2	8.2	0.04	0.02	*<0.01*	107	93	118	119	103	114	51	37	17
75th PCTL	8.3	8.4	0.08	0.14	0.01	168	155	188	182	160	167	137	127	115
Max	8.5	8.6	1.02	0.97	0.03	209	223	209	202	193	189	539	393	432
Schist (Lower Transition)														
n	15	19	19	15	15	19	15	7	7	19	7	19	15	7
Min	7.2	7.5	*<0.01*	*<0.01*	*<0.01*	0.8	*<4.5*	7.0	7.0	0.5	6.7	2.6	8.3	13
25th PCTL	7.3	8.1	0.01	*<0.01*	*<0.01*	34	30	53	74	31	49	11	15	18
Median	8.1	8.3	0.03	0.01	0.01	61	57	60	96	61	55	32	33	26
75th PCTL	8.7	8.5	0.11	0.06	0.01	84	78	105	110	77	104	194	131	50
Max	9.4	9.3	0.32	0.13	0.02	230	216	115	123	229	112	350	230	320
Schist (Fresh)														
n	19	31	31	19	19	31	19	8	8	31	8	31	19	8
Min	7.3	8.1	*<0.01*	*<0.01*	*<0.01*	*<0.8*	*<4.5*	11	12	0.5	11	2.3	2.2	3.3
25th PCTL	8.3	8.4	0.01	*<0.01*	*<0.01*	33	35	86	87	33	63	9.4	12	5.6
Median	8.6	8.6	0.06	0.03	0.01	57	59	108	107	51	89	23	24	42
75th PCTL	8.9	8.9	0.16	0.17	0.01	87	91	112	117	85	110	93	100	75
Max	9.3	9.3	0.97	0.80	0.03	376	141	147	149	375	147	345	356	470
Schist (All Weathering Facies)														
n	58	79	79	58	58	79	58	33	33	79	33	79	58	33
Min	6.8	6.6	*<0.01*	*<0.01*	*<0.01*	*<0.8*	*<4.5*	4.0	4.0	0.46	3.7	2.3	2.2	3.3
25th PCTL	7.3	8.1	*<0.01*	*<0.01*	*<0.01*	33	32	47	51	31	46	11	14	13
Median	8.2	8.3	0.03	0.01	*<0.01*	63	65	108	106	59.4	93	28	25	26
75th PCTL	8.6	8.6	0.14	0.10	0.01	110	121	135	144	108	126	131	131	147
Max	9.4	9.3	1.0	0.97	0.06	376	268	268	271	375	268	800	858	858

Notes: Values in grey italics are below the analytical detection limit; *n* = number of analyses included in statistical distribution; * adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.2.3 for discussion); NNP = net neutralization potential, derived by subtracting AP from NP.

Table 4-10:
Statistical Distribution of ABA Results by Weathering Facies for Granite Waste Rock

Parameter	Rinse pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	T-C NP*	CaNP	Sobek NP	SideriteNP	T-C NNP*	Sobek NNP	NPR	NPR	NPR
Unit	s.u.	s.u.	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	T-C NP* /T-AP	CaNP /T-AP	SobekNP /T-AP
Granite (oxide)														
n	6	6	6	6	6	6	6	6	3	6	6	6	6	6
Min	6.0	5.9	*<0.01*	*<0.01*	*<0.01*	0.8	*<4.5*	1.0	3.0	0.5	0.7	2.5	14	3.2
25th PCTL	6.2	6.0	*<0.01*	*<0.01*	0.01	1.0	*<4.5*	2.0	3.5	0.7	1.7	3.1	14	6.4
Median	6.4	6.4	0.01	0.01	0.01	1.9	*<4.5*	2.0	4.0	1.6	1.7	6.2	14	6.4
75th PCTL	6.6	6.8	0.01	0.01	0.02	2.9	*<4.5*	2.0	4.0	2.6	1.7	9.6	15	7
Max	7.5	7.8	0.01	0.01	0.02	3.1	*<4.5*	4.0	4.0	2.8	3.7	10	15	13
Granite (Upper Transition)														
n	11	17	17	17	17	11	11	17	7	17	17	11	11	17
Min	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	0.8	2.3	1.0	2.0	-3.8	-2.8	0.4	1.1	0.3
25th PCTL	6.9	6.5	*<0.01*	*<0.01*	*<0.01*	1.2	*<4.5*	1.0	3.0	-0.3	0.7	2.5	11	3.2
Median	7.0	6.9	0.01	*<0.01*	0.01	1.6	*<4.5*	2.0	4.0	0.5	1.7	5.2	14	6.7
75th PCTL	7.3	7.2	0.01	0.01	0.01	2.3	*<4.5*	3.0	4.5	1.3	2.7	7.4	15	9.6
Max	8.9	8.8	0.13	0.11	0.05	5.4	6.8	6.0	6.0	5.1	5.7	17	22	20
Granite (Lower Transition)														
n	12	14	14	14	14	12	12	14	7	14	14	12	12	14
Min	6.3	5.9	*<0.01*	*<0.01*	*<0.01*	0.8	*<4.5*	1.0	4.0	-0.3	0.4	1.5	2.9	1.3
25th PCTL	6.8	6.7	*<0.01*	*<0.01*	0.01	2.3	*<4.5*	2.3	5.0	0.9	1.9	4.9	14	7.4
Median	8.0	7.8	0.01	*<0.01*	0.01	2.7	*<4.5*	3.5	6.0	2.0	3.2	7.8	15	11
75th PCTL	8.7	8.6	0.01	0.01	0.01	4.5	5.1	5.0	6.5	3.4	4.7	15	17	17
Max	9.0	9.0	0.05	0.01	0.02	8.5	9.1	7.0	7.0	8.2	6.7	28	30	23
Granite (Fresh)														
n	13	20	20	20	20	13	13	20	6	20	20	13	13	20
Min	6.8	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.8*	*<4.5*	2.0	3.0	-4.4	1.6	0.5	2.9	1.4
25th PCTL	8.0	7.6	*<0.01*	*<0.01*	*<0.01*	0.8	*<4.5*	3.0	4.3	-0.7	2.1	2.5	14	4.0
Median	8.5	8.5	0.01	0.01	0.01	3.1	4.5	4.0	5.0	0.5	3.1	10	15	8.2
75th PCTL	9.0	8.8	0.03	0.01	0.01	5.4	4.5	5.3	5.8	3.0	4.7	18	15	17
Max	9.2	9.3	0.14	0.14	0.02	20	18	18	19	20	18	65	58	58
Granite (All Weathering Facies)														
n	42	57	57	38	57	42	42	57	23	42	57	42	42	57
Min	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	0.8	2.3	1.0	2.0	-2	-2.8	0.41	1.1	0.3
25th PCTL	6.8	6.7	*<0.01*	*<0.01*	*<0.01*	1.6	*<4.5*	2.0	4.0	0.5	1.7	2.5	14	3.2
Median	7.4	7.3	0.01	0.01	0.01	2.3	*<4.5*	3.0	5.0	2.0	2.7	7.4	14	6.7
75th PCTL	8.7	8.6	0.01	0.01	0.01	3.7	4.5	5.0	6.0	2.9	3.7	10	15	13
Max	9.2	9.3	0.14	0.14	0.05	20	18	18	19	20	18	65	58	58

Notes: Values in grey italics are below the analytical detection limit; *n* = number of analyses included in statistical distribution; * adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.2.3 for discussion); NNP = net neutralization potential, derived by subtracting AP from NP.

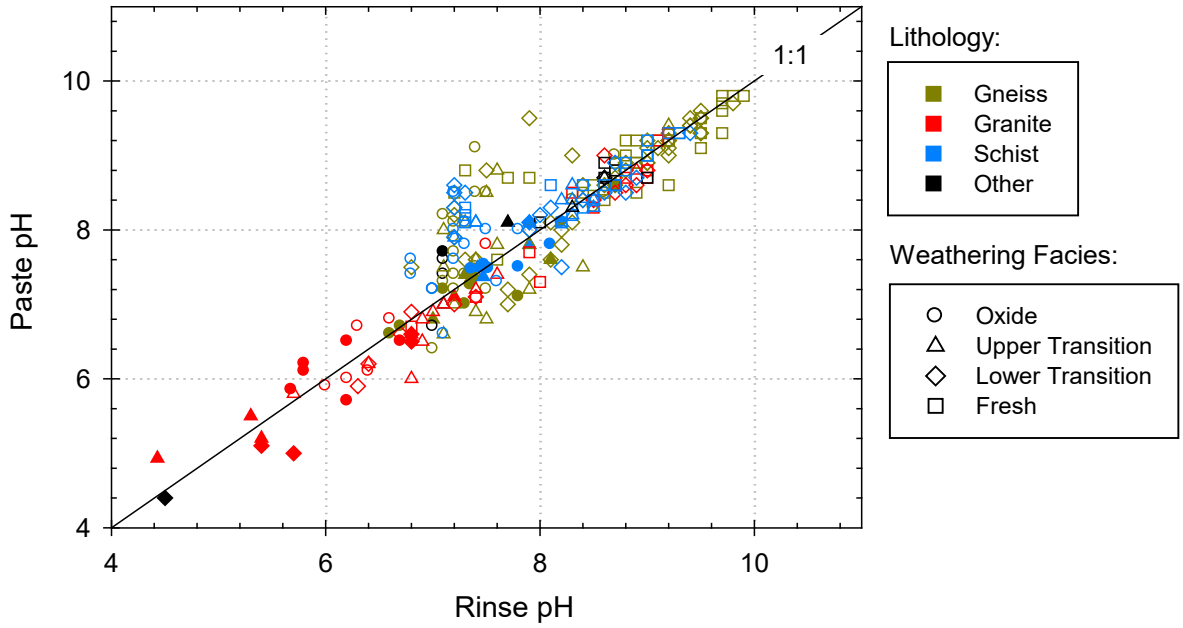

Figure 4-1: Rinse pH vs paste pH for Coffee Gold Mine waste rock and ore samples as presented by lithology and weathering facies. Waste rock samples are represented by hollow samples and ore samples are represented by filled symbols

4.1.3.2 Acid Potential

The acid generating potential (AP) of a rock sample is estimated from the sulphur (S) content. The amount of acidity generated per mass of S depends in large part on the mineralogy and solid phase speciation of sulphur. That is, different sulphide and sulphate minerals produce different amounts of acidity when oxidized. Mineralogical investigations (Section 4.1.2) identified pyrite as the dominant S-bearing mineral. The AP of pyrite is calculated based on the stoichiometry of pyrite oxidation and $Fe(OH)_3$ precipitation:

$$2FeS_2 + 7.5O_2 + 7H_2O = 4SO_4^{2-} + 2Fe(OH)_3 + 8H^+$$

Based on this equation, two moles of H^+ are produced per mole of S. Other S-bearing minerals identified by mineralogical determination include pyrrhotite, galena, natroalunite, gypsum and hydronium-jarosite. Of these minerals, pyrrhotite, natroalunite and hydronium-jarosite have the potential to generate acidity. With the exception of pyrrhotite, the acidity potential per mole of S is equal or less than that of pyrite. Due to the similar acidity potential and scarcity of other S bearing minerals, the above stoichiometry of pyrite oxidation is assumed to be appropriate for relating total-S to AP.

AP from ABA

Figure 4-2 shows the relationship between sulphide-S and total-S, with samples on the 1:1 line demonstrating perfect agreement. Overall, strong agreement is observed between the two measures of S, with total-S values being generally slightly higher than those for sulphide-S. This indicates that the majority of S in host lithology types is present in sulphide minerals, which is consistent with the mineralogical assessment which found the dominant sulphur mineral is pyrite. Given the above considerations, total-S was used to calculate AP. This assumption is considered to represent a conservative means to assess the acid generating potential of waste rock for the Project. Note that of the 252 waste rock samples measured for sulphide-S, 148 show total-S and sulphide-S concentrations at or below the detection limit of 0.01 wt.%; therefore, symbols for these data points overlap in Figure 4-2.

Sulphur species abundances are presented by weathering facies for gneiss, schist and granite waste rock in Table 4-8, Table 4-9 and Table 4-10. In general, total and sulphide-S concentrations decrease with increased weathering for each major lithologic unit, and relative concentrations of total and sulphide-S are highest in the schist samples and lowest in the granite samples. Specifically, total and sulphide-S concentrations are at or below the detection limit in a majority of the samples from the most weathered (oxide) facies, with the median value for the schist, 75th percentile value for the gneiss and all of the granite waste rock samples at or below 0.01 wt.% (Table 4-8, Table 4-9 and Table 4-10). In the schist samples, there is a distinct correlation between total-S content and weathering facies, with 75th percentile concentrations of 0.07, 0.08, 0.11, and 0.16 wt.% for the oxide, upper transition, lower transition and fresh facies, respectively. Sulphate-S concentrations are low in all samples (<0.06 wt.%), with the majority of samples at or near the detection limit (0.01 wt.%).

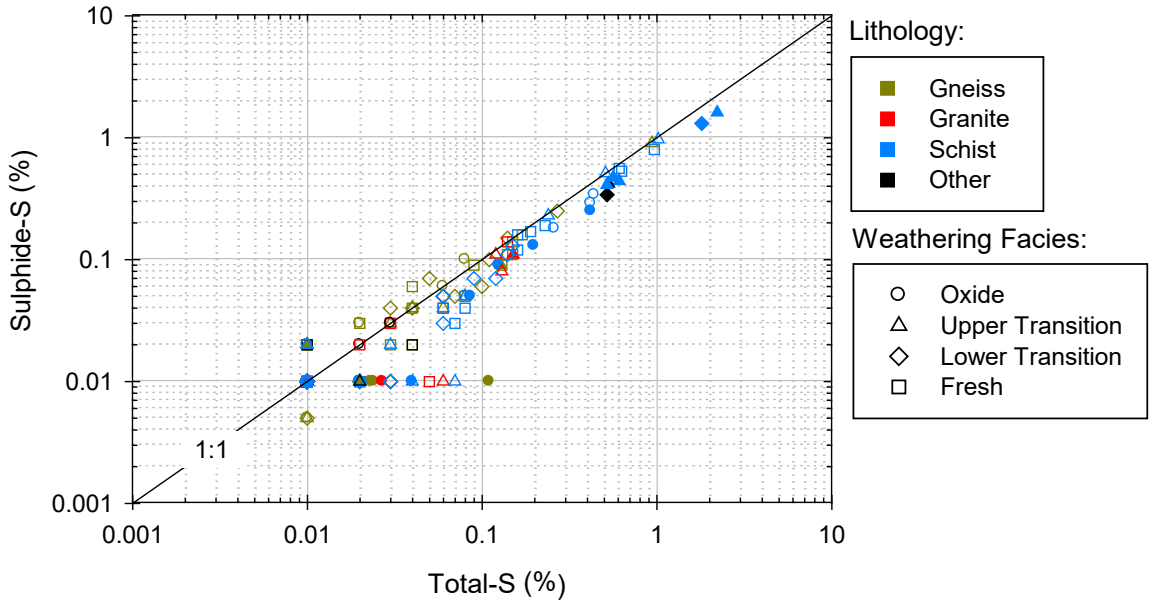

Figure 4-2: Total-S versus sulphide-S for waste rock and ore samples as presented by lithology and weathering facies. Ore samples are represented by filled symbols, waste rock samples are represented by hollow symbols.

AP Surrogates

A considerably larger sample population is available from the exploration assay database which comprises 26,549 analyses by aqua regia digestion and ICP-OES analysis (Section 3.2.4). This database included measurements of S, and has the potential to vastly expand statistics on sulphur distribution throughout the deposit. However, aqua regia often provide an incomplete digestion of sulphur minerals, with Leco furnace being the preferred method to obtain more reliable sulphur measurements. In order to determine the reliability of sulphur measured by an aqua regia digestion, results for the Leco furnace and aqua regia digestions conducted as part of the ABA sampling program are compared in Figure 4-3.

Comparison of total-S results from the ABA database shows that the majority of the samples plot along the 1:1 line (Figure 4-3), indicating near perfect agreement. Samples near or below the detection limit (0.01 wt.%) show greater variation, which in part can be attributed to the increased uncertainty near the limits of the analytical instrument. However, where there is deviation from the 1:1 line at higher concentrations, total-S measurements from aqua regia digestion are generally higher than those measured by LECO furnace. This exercise demonstrates that the application of total-S values from the exploration database as a surrogate to derive AP is a conservative means to evaluate ARD potential of mine rock. The statistical distribution of surrogate AP values (presented as total-S) are presented in Table 4-11.

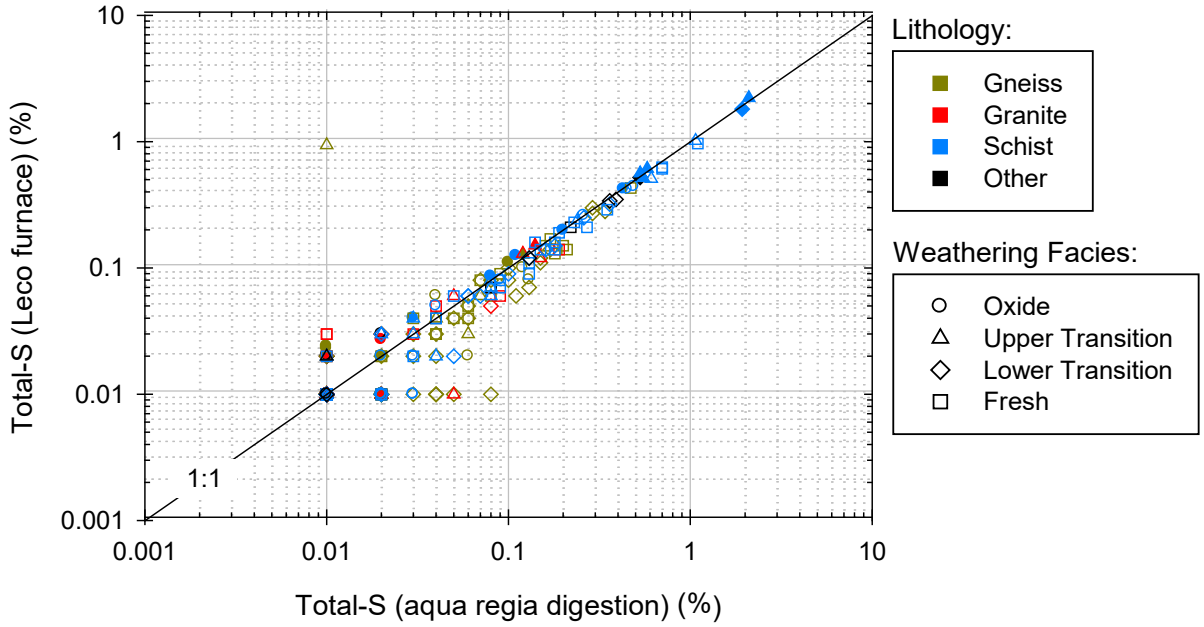

Figure 4-3: Total-S by LECO furnace vs total-S by aqua regia digestion for Coffee Gold Mine waste rock samples as presented by lithology and weathering facies. Ore samples are represented by filled symbols

Table 4-11:
Statistical Distribution of Sulphur (wt.%) Measured in Assay Database Used for Surrogate Acid Potential Values for Waste Rock Lithologies

Lithology	Statistic	Oxide	Upper Transition	Lower Transition	Fresh	All Weathering Facies
Gneiss	*n*	3218	4367	5647	1073	14305
	n <DL	1861	1951	1871	410	6093
	Max	1.3	0.67	2.2	1.0	2.2
	95th PCTL	0.07	0.12	0.17	0.19	0.14
	75th PCTL	0.01	0.02	0.05	0.05	0.03
	Median	*<0.01*	0.01	0.01	0.01	0.01
	25th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	5th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Schist	*n*	2355	2175	3330	861	8721
	n <DL	443	229	748	96	1516
	Max	1.2	2.6	2.3	3.4	3.4
	95th PCTL	0.22	0.64	0.4	0.6	0.45
	75th PCTL	0.05	0.15	0.11	0.31	0.12
	Median	0.02	0.04	0.02	0.11	0.03
	25th PCTL	0.01	0.02	0.01	0.02	0.01
	5th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Granite	*n*	578	140	235	24	977
	n <DL	406	120	144	13	683
	Max	0.46	0.31	0.22	0.43	0.46
	95th PCTL	0.022	0.021	0.02	0.15	0.03
	75th PCTL	0.01	*<0.01*	0.01	0.05	0.01
	Median	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	25th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	5th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Other	*n*	1411	585	710	241	2947
	n <DL	388	133	187	29	737
	Max	1.91	1.6	1.3	4.1	4.1
	95th PCTL	0.38	0.38	0.27	1.9	0.43
	75th PCTL	0.06	0.09	0.03	0.35	0.07
	Median	0.02	0.03	0.01	0.04	0.02
	25th PCTL	*<0.01*	0.01	*<0.01*	0.01	*<0.01*
	5th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*

Notes: Values in grey italics are below the analytical detection limit. *n* is the number of samples included in the statistical distribution, *n* < DL is the number of samples below the detection limit.

4.1.3.3 Neutralization Potential

A variety of analytical methods are available to measure NP, including bulk NP (Sobek NP and siderite NP methods) and carbonate mineral specific NP (NP derived from total carbon and inorganic carbon content) (Section 3.2.2). Each NP method contributes to the understanding of the NP of a material; however, no one method provides an accurate measurement of the effective 'field' neutralization capacity (i.e., the ability of a potential NP source to maintain a neutral drainage chemistry). It is therefore important to understand the mineralogy of the phases contributing to the overall NP of the sample. The solubility of fast dissolving carbonate allows for the rapid neutralization of acid generated via sulphide mineral oxidation. Conversely, non-carbonate minerals (*e.g.,* silicates) are a less reliable NP source since the rate of dissolution for these minerals is considerably slower and requires that the generation of acidity also be slow in order for these minerals to provide effective neutralization potential.

The Sobek NP procedure involves soaking the sample in strong acid (heated) to ensure effective dissolution, and then back titrating to determine the remaining un-neutralized acidity. This method is generally thought to underestimate the NP of slowly dissolving aluminosilicate minerals since it is carried out for a limited duration. Further, this method can overestimate NP from other minerals which would not be predicted to dissolve under neutral-pH weathering (i.e., due to the aggressive extraction technique) or would not contribute to the effective NP (*e.g.*, presence of Fe and/or Mn bearing carbonate minerals such as ankerite and siderite).

Siderite NP is similar to the Sobek method but attempts to correct for Fe and Mn bearing carbonate minerals that do not contribute to the overall effective NP of a sample by adding a chemical oxidant (H_2O_2) to ensure that any reduced species (Fe^{2+} and Mn^{2+}) are oxidized during the analysis. In contrast, Carbonate NP is based on the measurement of inorganic C in a sample and assumes that all carbonate minerals contributing to CaNP react like calcite. Therefore, similar to the Sobek NP method, the CaNP procedure can overestimate the effective NP of a material if significant Fe or Mn-carbonate minerals are present.

A comparison of the bulk NPs and CaNP can provide information about the NP sources and capacity of the carbonate minerals. If Sobek NP is higher than CaNP, for example, it can be inferred there is measurable neutralization available from non-carbonate minerals. Conversely, if CaNP and Sobek NP are higher than siderite NP, then a measurable portion of the inorganic C is not generating alkalinity or is unreactive and indicates either the presence of Fe or Mn-bearing carbonates (Price, 1997).

NP from ABA

Figure 4-4 plots siderite NP and CaNP as a function of Sobek NP for waste rock and ore samples from each weathering facies of each dominant lithologic unit. The results demonstrate that Sobek NP and siderite NP are generally very similar. The similarity between these NP measurements shows, that although Fe and Mn oxides are present (Section 4.1.1), they are not prevalent enough to significantly affect NP measurements. Furthermore, siderite NP is often slightly higher than Sobek NP. This is an artifact of the analytical technique, caused by an additional boiling step in the siderite procedure to breakdown any residual peroxide. Hydrochloric acid is volatile and is lost during the boiling step thereby leaving less acidity to back titrate, resulting in higher NP. This results in siderite NP overestimating Sobek NP when little or no Mn or Fe carbonates are present. Variance between the two bulk NP measurements in the lower range of NP concentrations (less than approximately 10 kg $CaCO_3$/t), can also in part be attributed to analytical limitations near the detection limits. The bulk NP methods generally produce higher NP estimates compared to CaNP, indicating that non-carbonate minerals are contributing to the overall Sobek and siderite NP measurements. Based on the NP data presented in Figure 4-4, CaNP provide a conservative estimate of NP compared to Sobek or siderite measurements for waste rock and ore.

Overall, the schist waste rock samples exhibit the highest CaNP (range: <4.5 to 268 kg $CaCO_3$/t; median of 65 kg $CaCO_3$/t; Table 4-8) while the granite waste rock samples have the lowest CaNP (range: 2.3 to 18 kg $CaCO_3$/t; median of <4.5 kg $CaCO_3$/t; Table 4-9). The gneiss samples are also characterized by low CaNP, with concentrations ranging from 2.3 to 98 kg $CaCO_3$/t (median of 4.5 kg $CaCO_3$/t) (Table 4-10). Waste rock CaNP is generally inversely related to the degree of weathering within a given lithologic unit, with oxide facies samples showing the overall lowest CaNP values and samples from the fresh facies having the highest CaNP. Median CaNP values for granite waste rock samples are below the detection limit (<4.5 kg $CaCO_3$/t) for all weathering facies. Median CaNP values for the gneiss samples are also below the detection limit for the oxide and upper transition facies but are slightly higher for the lower transition and fresh facies (8 kg $CaCO_3$/t for both facies). CaNP values for the gneiss waste rock weathering facies increase with decreasing degree of weathering, with 75th percentile values of 15, 25 and 35 kg $CaCO_3$/t CaNP for the oxide, upper transition and lower transition and fresh facies, respectively. The opposite is true for the schist waste rock samples where median values for the oxide and upper transition facies samples have higher CaNP (116 and 93 kg $CaCO_3$/t) compared to the lower transition and fresh facies (57 and 59 kg $CaCO_3$/t).

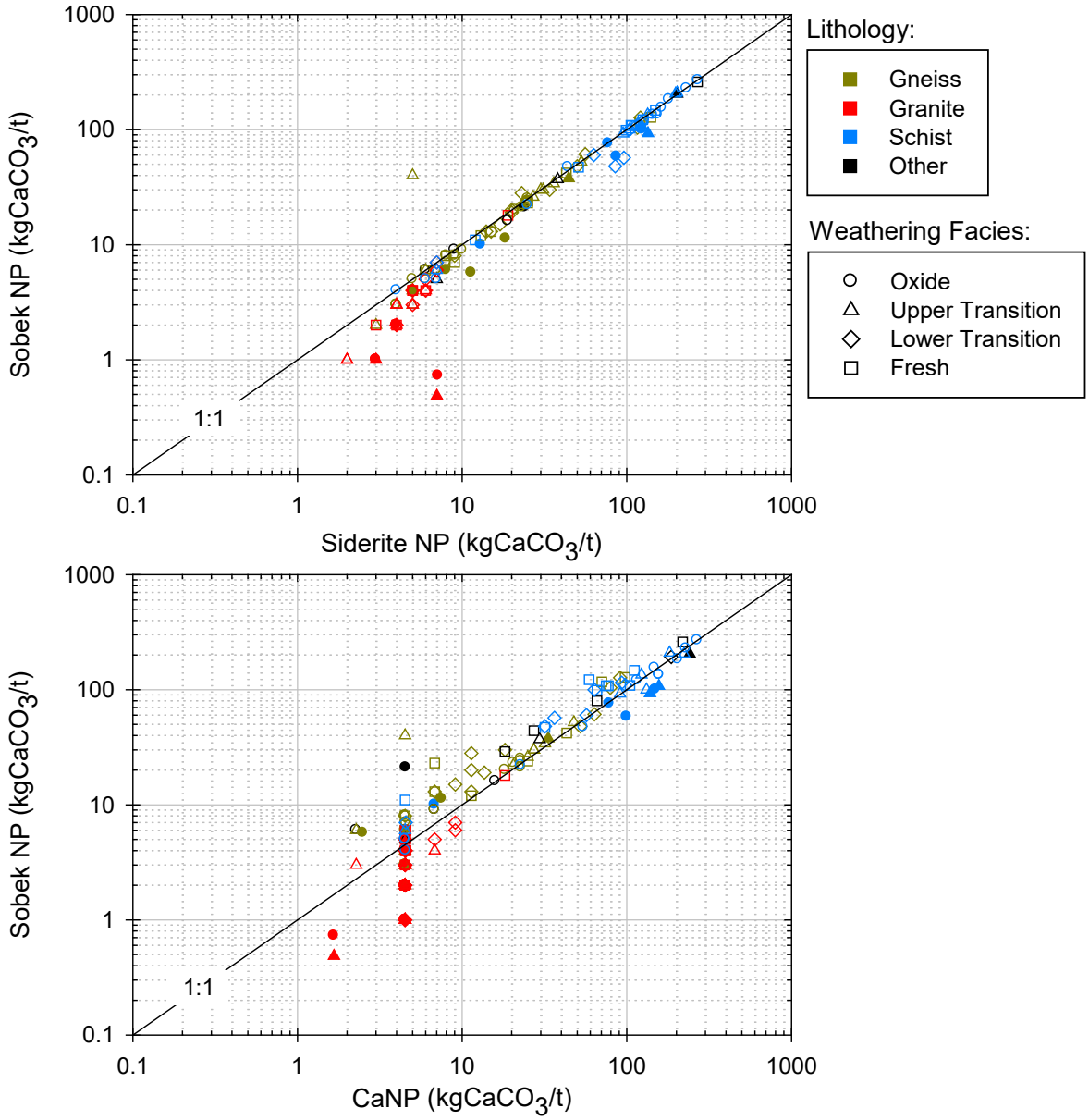

Figure 4-4: Relationship between Sobek NP and siderite NP (top) and Sobek NP and CaNP (bottom) waste rock samples as presented by lithology and weathering facies. Ore samples are represented by filled symbols.

The use of total-C to derive NP in place of CaNP (derived from TIC) was assessed given the considerably lower detection limit (0.01 wt.%) for total-C measurements and the more rapid and cost effective analytical method for total-C (LECO furnace). Total-C and CaNP show a strong correlation ($R^2 = 0.99$), illustrating a high degree of predictability for CaNP based on total-C measurements (Figure 4-5). This relationship can be expressed by the following equation:

$$\text{CaNP (kg } CaCO_3\text{/t)} = 77.6 \times \text{Total C (wt.\%)}$$

The minor variation between the CaNP and total-C values in Figure 4-5 is attributed to either a small amount of organic C present in the sample (present in situ or as a result of sample contamination) and/or from analytical differences between the total-C and TIC determinations.

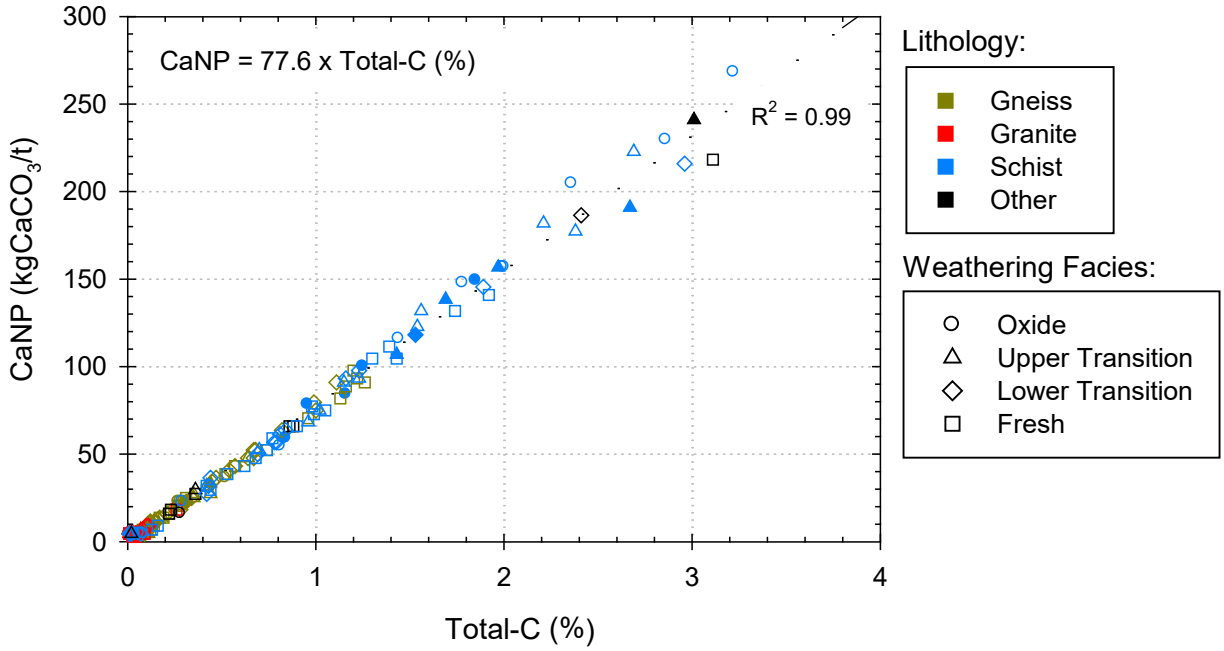

Figure 4-5: Total-C (Leco) plotted against CaNP for waste rock samples as presented by lithology and weathering facies. Ore samples are represented by filled symbols. Dotted line shows the linear regression as per the equation shown on the figure.

NP Surrogates

It is often the case that surrogates for NP measurements can be found in metal assay data. The potential for surrogate NPs were investigated in order to determine if the large exploration database can provide an indication of NP distribution throughout the deposit. This investigation found a relationship between Ca and Sobek NP. A comparison of Sobek NP (via ABA analysis) versus ICP Ca NP (as measured through solid phase Ca determination by aqua regia digestion) is presented in Figure 4-6. This estimate of surrogate NP assumes that all Ca is present in the form of $CaCO_3$. The majority of the samples plot just above the 1:1 line, indicating that Sobek NP is generally higher than NP derived from the Ca measurements. Accordingly, the application of Ca from aqua regia digestion as a surrogate to derive NP represents a conservative means to augment the ABA

data set for site rock NP determinations. Assuming that 100% of Ca resides in $CaCO_3$ results in the following forumla which relates Ca wt.% to NP.

$$NP = Ca \times 40.08^{-1} \times 1000$$

Where NP is in units of $kgCaCO_3/t$, Ca is in units of wt.% and 40.08 is the molar weight of Ca. As discussed in Section 3.2.4, a considerably larger sample population is available from the exploration assay database which comprises 26,549 calcium (Ca) analyses by aqua regia digestion. Utilization of this larger dataset allows for a more robust assessment of the ARD potential of waste rock and ore using Ca values to derive NP. The statistical distribution for surrogate NP values (calculated using Ca from the exploration database) are presented in Table 4-12.

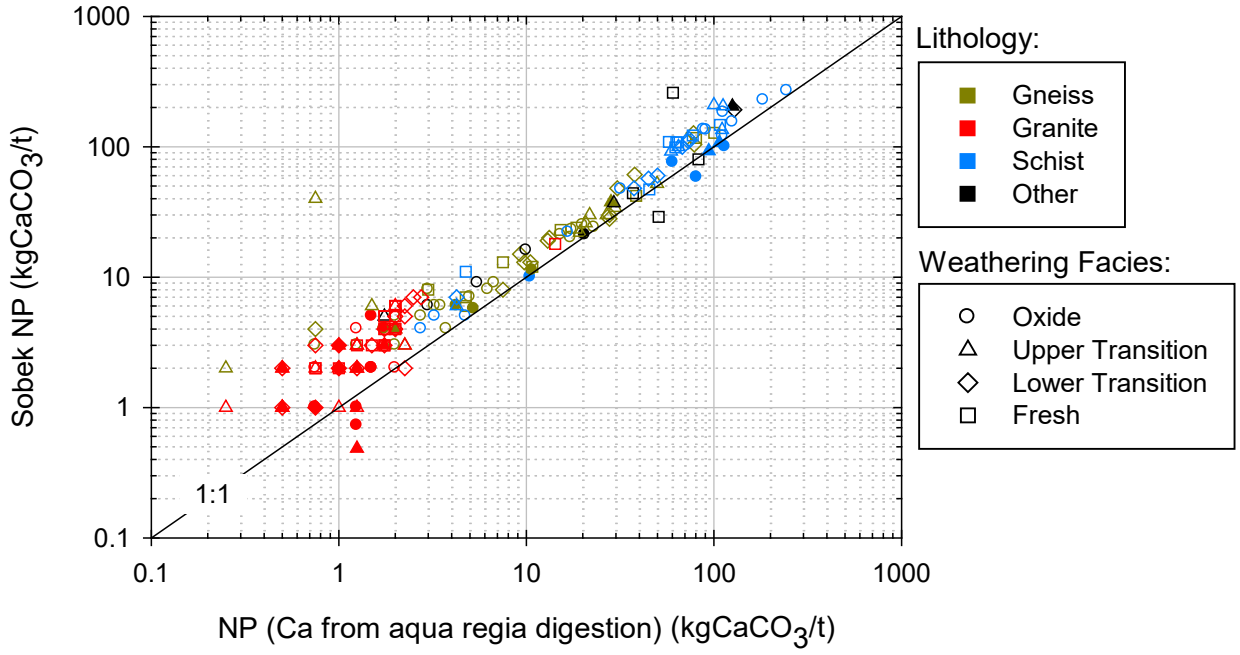

Figure 4-6: Sobek NP versus surrogate NP calculated using Ca from aqua regia digestion (ABA database) for static test samples. Waste rock samples are hollow symbols, ore samples are represented by filled symbols.

Table 4-12:
Statistical Distribution of Neutralization Potential (kg $CaCO_3$/t) Values Calculated from Ca Measured in Assay Database for Waste Rock Lithologies

Lithology	Statistic	Oxide	Upper Transition	Lower Transition	Fresh	All Weathering Facies
Gneiss	*n*	3218	4367	5647	1073	14305
	Max	195	245	280	167.8	280
	95th PCTL	57.3	60.8	75.8	78.1	70.5
	75th PCTL	7.5	19.3	34.5	35.3	25
	Median	1.8	6	17	18.3	9.5
	25th PCTL	1	1.8	6.5	9	2
	5th PCTL	0.5	0.8	1.5	3	0.5
	Min	*<0.3*	*<0.3*	0.3	0.8	*<0.3*
Schist	*n*	2355	2175	3330	861	8721
	Max	625	625	625	625	625
	95th PCTL	237.5	255	165	227.5	220
	75th PCTL	116	120.8	78.8	97	103
	Median	74.8	79.8	47	63	63.5
	25th PCTL	33.5	50.8	25.5	39.8	33.3
	5th PCTL	2.5	11.8	8.8	13.3	6.5
	Min	0.3	0.5	2	4.5	0.3
Granite	*n*	578	140	235	24	977
	Max	11.5	4.5	10.8	3	11.5
	95th PCTL	2.5	3	3	2.7	2.8
	75th PCTL	1.8	2.3	2.3	1.3	2
	Median	1.3	1.8	1.8	0.5	1.5
	25th PCTL	0.8	1.3	1.3	0.3	1
	5th PCTL	0.5	0.5	*<0.3*	*<0.3*	0.5
	Min	*<0.3*	*<0.3*	*<0.3*	*<0.3*	*<0.3*
Other	*n*	1411	585	710	241	2947
	Max	592.5	505	540	287.5	592.5
	95th PCTL	197.5	222.5	167.5	137.8	197.5
	75th PCTL	113.5	115.8	74.1	79	101.6
	Median	54.8	50.3	35.5	46.3	43.3
	25th PCTL	5.3	9	13	19.5	8.5
	5th PCTL	0.8	0.8	1.5	5	1
	Min	0.3	0.3	*<0.3*	*<0.3*	*<0.3*

Notes: Values in grey italics are below the analytical detection limit. *n* is the number of samples included in the statistical distribution, *n* < DL is the number of samples below the detection limit

4.1.3.4 Net Potential Ratio

The acid generating potential of mine rock will be defined by the ratio of NP to AP and a minimum sulphur content. The NP/AP ratio, or net potential ratio (NPR), used to define the acid generating potential of mine rock will vary depending on the type of NP estimate used in the calculation. Bulk NP measurements, such as the Sobek method, involve boiling a rock sample in acid and often releases NP that would not be effective at maintaining a neutral pH in a mine waste environment. Therefore, when Sobek NP is used to calculate NPR a criterion of 3 is used to define non-PAG rock. Conversely, carbonate minerals are generally effective at maintaining a neutral pH while present, and an NPR ratio of 2 is applied when carbonate mineral specific NP estimates are used to estimate NPR. For the purposes of PAG definition, AP will be defined by a total-S measurement for all material types.

In addition to this NPR criteria, samples require a minimum quantity of AP to be classified as acid generating. A total-S cutoff of 0.02 wt.% is used to define non-reactive samples. This is considered highly conservative given that this low concentration is below average continental abundance (0.04 wt.%) and much of the mine rock is at a highly weathered state. The classification criteria used to screen for ARD potential are as follows:

- Where the total-S content is <0.02 wt.% the sample is classified as non-reactive
- Where the total-S content is ≥0.02 wt.%, and the Sobek NP/AP ratio is greater than 3 or carbonate - NP/AP of greater than 2, the sample is classified as non-PAG.
- Where the total-S content is ≥0.02 wt.%, the Sobek NP/AP ratio between 1 and 3 or a carbonate-NP/AP of between 1 and 2, the sample is classified as having an uncertain acid generating potential.
- Where the total-S content is ≥0.02 wt.%, the Sobek NP/AP ratio or a carbonate-NP/AP is less than 1, the sample is classified as potentially acid generating.

For the purposes of this pre-mining geochemical assessment a variety of methods are used to estimate NP, AP and NPR. As such there is some variability in the classification scheme depending on the type of measurement being applied. During mine operations set of definitive criteria and set analyses will be used to classify mine waste as PAG or non-PAG. These criteria are described in the Mine Waste ML/ARD Management and Monitoring Plan.

Figure 4-7 presents Sobek NP, CaNP and T-C NP versus T-AP. The results show that all samples with total-S at or below the detection limit (T-AP ≤ 0.3 kg $CaCO_3$/t) are non-PAG. The plots also indicate that several granite waste rock and ore samples (generally from the upper transition facies) are either PAG or have an uncertain PAG potential when Sobek

NP is applied. When the most conservative NP is applied (T-C NP), a few granite and gneiss samples are indicated to be PAG or have an uncertain potential. With the exception of one upper transition ore sample, the schist waste rock and ore samples are indicated to be non-PAG.

The statistical distribution for NPR derived using the different NP values are presented by weathering facies for each lithology Table 4-8, Table 4-9 and Table 4-10. Consistent with the distribution of NP for the waste rock lithologies, the schist samples have the overall highest NPR (T-C NP*) values (median NPR = 28) and the granite samples have the lowest (median NPR = 7.5). Within a given lithology, the lowest NPR distribution is generally indicated for the oxide facies compared to relatively higher NPR values for fresh facies. The considerably higher NP of the schist waste rock samples is further supported by the high net neutralization potential (NNP) values, which is the amount of excess NP relative to AP (*i.e.,* NNP = NP – AP). To provide context, a NNP of 0 is equivalent to a NPR of 1. Median values for T-C NNP* for the schist, gneiss and granite waste rock samples are 59.4, 4.4 and 2.0 kg $CaCO_3$/t, respectively (Table 4-9).

The statistical distributions presented in Table 4-8, Table 4-9 and Table 4-10 do not take into account the samples with negligible AP. Table 4-13 provides a summary of the relative proportions of PAG, uncertain, neutral and non-PAG waste rock samples by lithologic units according to the different NP methods and criteria described above. Also presented in Table 4-13 are the relative proportions of PAG and non-PAG waste rock samples according to NPR values derived using surrogate NP and AP values calculated using Ca and S from the exploration database. The results demonstrate that the distribution of PAG and non-PAG waste rock is generally consistent, with all schist and other minor lithology samples indicated to be non-PAG and 1 to 4% of gneiss samples indicated to have some PAG potential. A higher proportion of the granite samples are classified as PAG or uncertain (10% using surrogate NP and AP), however, a majority of this rock unit is classified as being non-PAG or as neutral independent of NPR criteria applied. Overall, the results of the ABA analyses indicate that ARD is not expected to be an issue for the Coffee Creek waste rock.

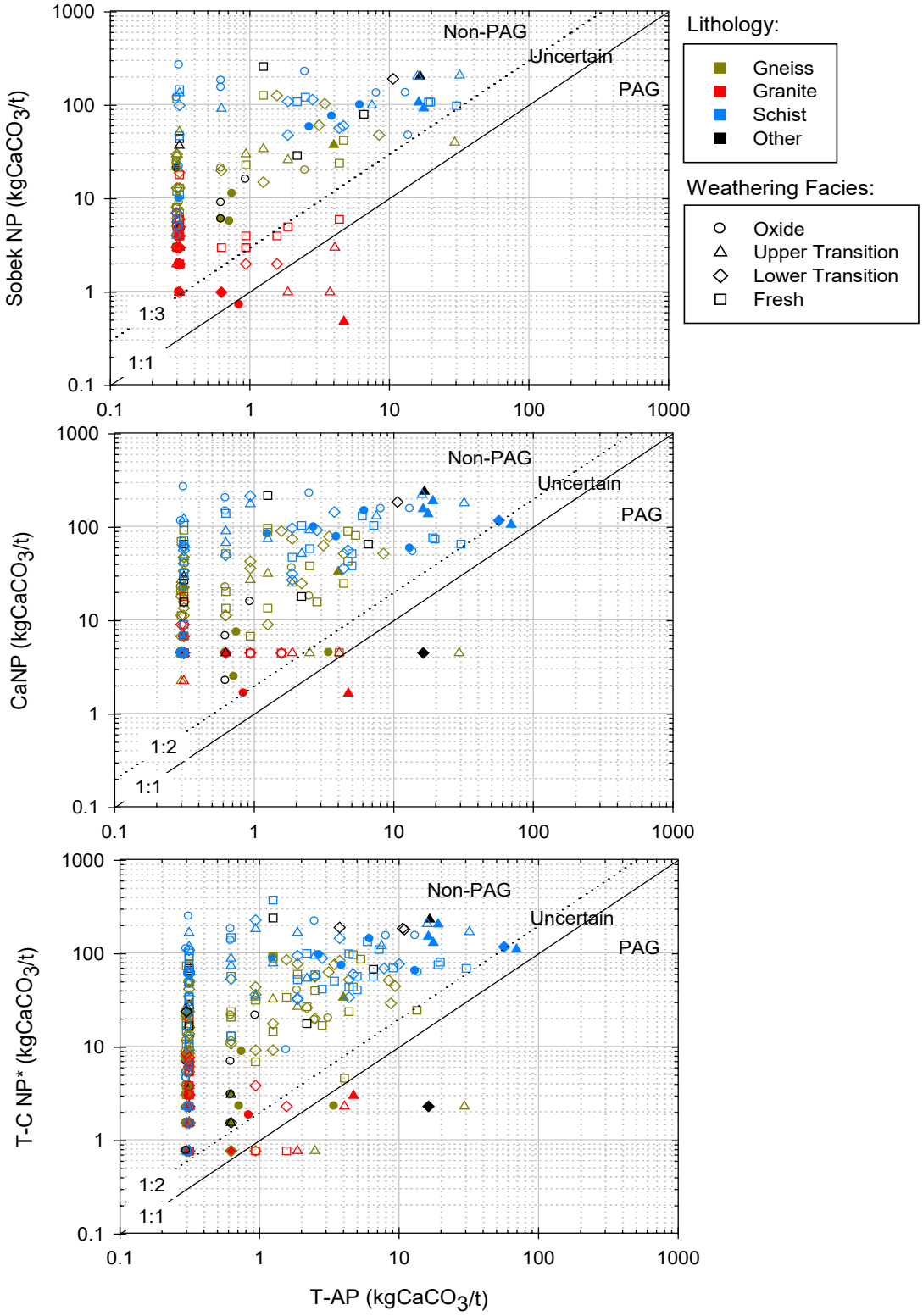

Figure 4-7: Sobek NP (top), CaNP (middle) and T-C NP* (bottom) *vs* T-AP for Coffee Gold Mine waste rock and ore as presented by lithology and weathering facies. Ore samples are represented by filled symbols while waste rock is shown as hollow symbols.

Table 4-13:
ARD Distributions for Coffee Gold Mine Waste Rock Lithologies based on Various Estimates of Neutralization Potential

Lithology	ARD Designation	NPR (T-C NP*/AP)		NPR (CaNP/T-AP)		NPR (Sobek NP/T-AP)		NPR (surrogate NP/AP)	
		n	%	*n*	%	*n*	%	*n*	%
GNEISS	*Total No. Samples*	*188*		*117*		*51*		*14305*	
	Non-reactive	135	72%	82	70%	35	69%	9303	65%
	Non-PAG	46	24%	32	27%	15	29%	4531	32%
	Uncertain	4	2%	2	2%	1	2%	347	2%
	PAG	3	2%	1	1%	0	0%	124	1%
SCHIST	*Total No. Samples*	*79*		*58*		*33*		*8721*	
	Non-reactive	31	39%	23	40%	13	39%	3099	36%
	Non-PAG	48	61%	35	60%	20	61%	5336	61%
	Uncertain	0	0%	0	0%	0	0%	263	3%
	PAG	0	0%	0	0%	0	0%	23	0%
GRANITE	*Total No. Samples*	*42*		*42*		*57*		*977*	
	Non-reactive	36	86%	36	86%	45	79%	865	89%
	Non-PAG	1	2%	5	12%	4	7%	11	1%
	Uncertain	1	2%	1	2%	5	9%	50	5%
	PAG	4	10%	0	0%	3	5%	51	5%
Other (including Metabasalt)	*Total No. Samples*	*24*		*15*		*11*		*2546*	
	Non-reactive	11	46%	6	40%	3	27%	1089	43%
	Non-PAG	13	54%	9	60%	8	73%	1284	50%
	Uncertain	0	0%	0	0%	0	0%	96	4%
	PAG	0	0%	0	0%	0	0%	77	3%

Notes:
n = number of analyses included in distribution.
* adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.3.3 for discussion).
NPR (surrogate NP/AP) is NP derived from Ca and AP derived from S from the aqua regia digestion exploration database.
All samples with total-S <0.02 wt.% are considered non-reactive.
Criteria for NPRs derived using sobek NP and ICP data are defined as NPR ≥3 (non-PAG), 1≤NPR<3 (uncertain), NPR<1 (PAG).
Criteria for NPRs derived using T-C NP* and CaNP are defined as NPR ≥2 (non-PAG), 1≤NPR<2 (uncertain), NPR<1 (PAG).

4.1.4 Shake Flask Extractions

Metal concentrations measured in SFE provide an indication of the readily soluble metals which will be immediately available for leaching upon exposure to infiltrating water. In order to highlight the significance of various SFE results, the results are compared to Metal Mining Effluent Regulations (MMER, 2002) and Canadian Council of Ministers of the Environment (CCME, 2007) water quality guidelines for the protection of aquatic life. A summary of the relevant guidelines is presented Table 4-14.

Table 4-14:
Summary of Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines for the Protection of Aquatic Life and Metal Mining Effluent Regulations (MMER) Water Quality Guidelines

Parameter	Units	CCME[1]		MMER[2]		
		30-day	Max	MMM	MCS	MGS
Total Cyanide	mg/L		0.005			
Sulphate	mg/L	218				
Al	mg/L	0.1				
Sb	mg/L		0.009			
As	mg/L	0.005		0.5	0.75	1
Cd	mg/L	0.0001	0.0011			
Co	mg/L	0.004	0.11			
Cr	mg/L		0.001			
Cu	mg/L	0.002		0.3	0.45	0.6
Fe	mg/L	0.3				
Pb	mg/L	0.001		0.2	0.3	0.4
Hg	mg/L	0.000026				
Mo	mg/L	0.073				
Ni	mg/L	0.025		0.5	0.75	1
Se	mg/L	0.001				
Ag	mg/L	0.00025				
Tl	mg/L	0.0008				
U	mg/L	0.015	0.033			
Zn	mg/L	0.03		0.5	0.75	1
^{226}Ra	Bq/L			0.37	0.74	1.11

Notes: All guidelines are for total metals unless otherwise indicated

1. Canadian Council of Ministers of the Environment (CCME, 2007) Freshwater Quality Guidelines for Protection of Aquatic Life; Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016); Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI); Underlined guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.
2. Metal Mines Effluent Regulations (MMER, 2002); maximum authorized monthly mean (MMM); maximum authorized concentration in a composite sample (MCS); and maximum authorized concentration in a grab sample (MGS).

A statistical distribution of SFE parameters that exceed water quality guidelines are presented by weathering facies for gneiss, schist and granite in Table 4-15, Table 4-16 and Table 4-17. Aluminium, Sb, As and Hg are indicated to exceed the CCME guidelines in SFE from almost all of the weathering facies of each dominant lithology. In particular, As exceeds the CCME guideline in median values for the schist unit and nearly every sample from the gneiss and granite units. Maximum values for each weathering facies of the granite unit also exceed the maximum MMER guideline (1 mg/L As). Concentrations of Cu, Fe, Pb and U exceed the CCME guidelines in SFE from one or more samples from each of the weathering facies for the granite and gneiss units, while Cr exceeds the CCME

guideline from several of the gneiss and schist samples. Two oxide schist samples contain sulphate in SFE at values that exceed the reference guideline. The elevated sulphate in SFE leachate from these samples is consistent with higher solid phase sulphur measured in the samples (0.42 and 0.26 wt.%S, Appendix C.1-2), and reflects the rinsing of surface oxidation products from the highly weathered material. It should be noted that a detection limit of 0.00005 mg/L for Hg was often applied during analysis, which is higher than the CCME guideline (0.000026 mg/L); therefore, it is difficult to provide an accurate assessment of the proportion of samples for each lithology with soluble Hg at levels that exceed the guideline. In general, Hg is not enriched in solid phase of the waste rock samples; however, median values for the oxide facies of schist and granite waste rock show enrichment (Section 4.1.4). Soluble metal concentrations in SFE from other minor lithologies are generally low, with one or more samples having Al, Sb, As or Hg at concentrations that exceed the respective CCME guidelines (Appendix C.1-2).

Overall, the highest median and maximum metal concentrations in SFE are from all weathering facies of the granite unit (Table 4-16), while the lowest are generally from the schist unit (in particular samples from the fresh facies). Leachate pH for the gneiss and schist samples are neutral to alkaline, ranging from 7.4 to 9.5 (median values >8), reflecting the higher NP of these units. Leachate pH values for the granite samples are slightly lower, ranging from 6.4 to 9.2, with consistently lower pH measured for the oxide samples (median of 6.7).

Aluminum and Fe are sparingly water soluble under neutral pH and aerobic conditions. Therefore, the high concentrations of these metals are expected to be due to fine suspended solids (colloidal size) that passed through the 0.45µm filter during the extraction experiment. The exceedances observed for other metals in SFEs may also be associated with suspended solids given that the samples comprising the highest concentrations of Al and Fe in SFEs tend to also comprise the most elevated concentrations of other metals (As, Co, Cu, Fe, Pb, Mn, Ni, U and/or Ag and Zn). This is particularly evident for samples from the more weathered facies of each lithology and for the granite samples (*e.g.*, samples ABA064, ABA096, ABA059, ABA067, ABA065, ABA054, ABA174, ABA152, ABA166; Appendix C.1-2). However, there are also several SFE samples that contain elevated As, Sb and Cr but low Al and Fe (*e.g.*, ABA146, ABA143, ABA148, oxide schist samples and ABA132; Appendix C.1-2). Overall, the results of the SFE indicate that Cr may be a concern in gneiss and schist lithologies, while As and Sb may be metals of potential concern from all waste rock lithologies. It is interesting to note that U concentrations are generally low in SFE data, with median values of all lithologies and weathering facies being below CCME guidelines. This is likely related to the low alkalinity produced during the SFE procedure inhibiting U solubility (median alkalinity of 21 mg$CaCO_3$/L, 30 mg$CaCO_3$/L and 4.3 mg$CaCO_3$/L for gneiss, schist and granite, respectively).

Table 4-15:
Shake Flask Extraction Results for Gneiss Waste Rock by Weathering Facies

Gneiss	pH	Sulfate	Al	Sb	As	Cr	Co	Cu	Fe	Pb	Hg	Se	Tl	U	Zn
	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide (*n* = 9)															
Min	7.2	*<0.5*	0.019	0.0014	0.0095	0.00025	0.00005	0.0005	0.015	0.00005	0.000025	0.00025	*<0.0001*	0.00007	0.005
25th PCTL	8.0	0.52	0.13	0.0049	0.035	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.00018	*<0.01*
Median	8.3	1.3	0.43	0.0069	0.12	0.0005	0.0001	*<0.001*	0.062	0.00013	*<0.00005*	*<0.0005*	0.00012	0.0018	*<0.01*
75th PCTL	8.8	1.9	3.0	0.021	0.18	0.0029	0.00071	0.0018	3.2	0.0068	0.000065	*<0.0005*	0.00013	0.0036	*<0.01*
Max	9.4	16	3.8	0.046	1.2	0.004	0.001	0.0044	5.7	0.01	0.00014	*<0.0005*	0.00063	0.019	*<0.01*
Upper Transition (*n* = 7)															
Min	7.3	*<0.5*	0.028	0.00045	0.0079	0.00025	0.00005	0.0005	0.015	0.00005	0.000025	0.00025	0.00005	0.000069	0.005
25th PCTL	7.8	0.62	0.078	0.0016	0.014	0.0005	0.000075	0.00075	0.031	0.000075	0.000025	0.00038	*<0.0001*	0.00016	0.0075
Median	8.1	0.89	0.28	0.0049	0.046	0.00069	0.00033	0.001	0.24	0.0001	0.00005	*<0.0005*	0.0001	0.00039	*<0.01*
75th PCTL	8.4	1.3	2.3	0.0097	0.087	0.0015	0.0011	0.0034	1.4	0.0028	0.00061	*<0.0005*	0.00018	0.0031	*<0.01*
Max	9.5	12	7.6	0.028	0.2	0.0029	0.0017	0.0053	4.7	0.023	0.0056	0.0005	0.00027	0.0074	0.01
Lower Transition (*n* = 19)															
Min	7.4	*<0.5*	0.016	0.00011	0.0045	0.00025	0.00005	0.0005	0.015	0.00005	0.000025	0.00025	*<0.0001*	0.000038	0.005
25th PCTL	8.4	0.52	0.22	0.00038	0.012	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.00023	*<0.01*
Median	9.2	1.1	0.34	0.00082	0.017	*<0.0005*	*<0.0001*	*<0.001*	0.051	0.0001	*<0.00005*	*<0.0005*	*<0.0001*	0.00058	*<0.01*
75th PCTL	9.3	2.2	0.65	0.0023	0.031	0.0005	0.0001	*<0.001*	0.14	0.00026	*<0.00005*	*<0.0005*	*<0.0001*	0.0015	*<0.01*
Max	9.8	15	4.1	0.0064	0.092	0.011	0.00086	0.0031	2.4	0.0035	0.0014	0.0021	0.00025	0.026	0.01
Fresh (*n* = 16)															
Min	8.1	*<0.5*	0.062	*<0.0001*	0.0022	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.000036	*<0.01*
25th PCTL	8.9	0.6	0.21	0.00027	0.006	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.00043	*<0.01*
Median	9.1	1.2	0.45	0.00052	0.014	*<0.0005*	*<0.0001*	*<0.001*	0.14	0.00011	*<0.00005*	*<0.0005*	*<0.0001*	0.0011	*<0.01*
75th PCTL	9.1	4.3	0.68	0.0014	0.033	*<0.0005*	0.00016	0.0011	0.32	0.00046	*<0.00005*	*<0.0005*	*<0.0001*	0.0018	*<0.01*
Max	9.4	10	5.5	0.028	0.16	0.0046	0.0016	0.0066	5.0	0.0044	0.000076	0.00082	*<0.0001*	0.059	*<0.01*

Notes:
Values in grey italics are below the analytical detection limit; All guidelines are for total metals unless otherwise indicated.
Values that exceed the Metal Mines Effluent Regulations (MMER, 2002) maximum (MMM) water quality guideline are shaded in dark grey.
Values that exceed the Canadian Council of Ministers of the Environment (CCME, 2007) Water Quality Guidelines are shaded in light blue (30-day) and dark blue (maximum);
Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016);
Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI);
Guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

Table 4-16:
Shake Flask Extraction Results for Schist Waste Rock by Weathering Facies

Schist	pH	Sulfate	Al	Sb	As	Cr	Co	Cu	Fe	Pb	Hg	Se	Tl	U	Zn
	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide (*n* = 7)															
Min	8	1.8	0.048	0.0012	*<0.001*	*<0.0005*	*<0.0001*	*<0.001*	0.015	*<0.0001*	0.000025	*<0.0005*	*<0.0001*	0.000019	*<0.01*
25th PCTL	8.3	3.2	0.065	0.0025	0.0035	0.0005	*<0.0001*	*<0.001*	0.022	*<0.0001*	0.000038	*<0.0005*	*<0.0001*	0.000063	*<0.01*
Median	8.5	4.5	0.088	0.0041	0.007	0.00077	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.000079	*<0.01*
75th PCTL	8.6	280	0.13	0.0098	0.052	0.0033	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	0.00006	0.0008	0.00038	0.0048	*<0.01*
Max	8.8	920	0.22	0.012	0.16	0.0044	0.0001	0.001	*<0.03*	0.0001	0.0017	0.0022	0.00092	0.012	0.01
Upper Transition (*n* = 2)															
Min	8.3	8.4	0.092	0.00011	0.0005	0.00025	0.00005	0.0005	0.015	0.00005	*<0.00005*	0.00025	0.00005	0.00016	0.005
Max	8.8	29	0.14	0.0028	*<0.001*	0.00061	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	0.00014	*<0.0005*	*<0.0001*	0.00035	*<0.01*
Lower Transition (*n* = 8)															
Min	7.8	*<0.5*	0.055	0.00053	0.0005	0.00025	0.00005	0.0005	0.015	0.00005	0.000025	0.00025	0.00005	0.000046	0.005
25th PCTL	8.4	4.0	0.16	0.0011	0.0048	*<0.0005*	0.000088	0.00088	0.026	0.000088	0.000025	*<0.0005*	*<0.0001*	0.0003	0.0088
Median	8.7	9.9	0.26	0.0018	0.0098	0.0007	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.00056	*<0.01*
75th PCTL	9	12	0.57	0.0057	0.019	0.0014	0.00029	*<0.001*	0.61	0.00036	0.000062	*<0.0005*	*<0.0001*	0.00081	*<0.01*
Max	9.3	130	7.3	0.022	0.36	0.0046	0.00099	0.0037	4.6	0.0036	0.00062	0.0011	0.00015	0.0041	0.01
Fresh (*n* = 7)															
Min	8.6	0.52	0.072	0.00017	*<0.001*	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.000022	*<0.01*
25th PCTL	8.9	0.54	0.11	0.00023	0.0036	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.000042	*<0.01*
Median	9.3	0.93	0.14	0.00026	0.0049	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.000078	*<0.01*
75th PCTL	9.3	11	0.16	0.00036	0.0063	*<0.0005*	0.00012	*<0.001*	*<0.03*	*<0.0001*	*<0.00005*	*<0.0005*	*<0.0001*	0.00018	*<0.01*
Max	9.4	97	0.22	0.011	0.0078	0.00087	0.00014	*<0.001*	0.09	*<0.0001*	*<0.00005*	0.00073	*<0.0001*	0.008	*<0.01*

Notes:
Values in grey italics are below the analytical detection limit; All guidelines are for total metals unless otherwise indicated.
Values that exceed the Metal Mines Effluent Regulations (MMER, 2002) maximum (MMM) water quality guideline are shaded in dark grey.
Values that exceed the Canadian Council of Ministers of the Environment (CCME, 2007) Water Quality Guidelines are shaded in light blue (30-day) and dark blue (maximum);
Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016);
Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI);
Guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

Table 4-17:
Shake Flask Extraction Results for Granite Waste Rock Weathering Facies

Granite	pH	Sulfate	Al	Sb	As	Cr	Co	Cu	Fe	Pb	Hg	Se	Tl	U	Zn
	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide (*n* = 3)															
Min	6.6	*<0.5*	0.005	0.017	0.096	*<0.0005*	*<0.0001*	*<0.001*	0.034	*<0.0001*	0.00017	*<0.0005*	0.0001	0.000046	*<0.01*
Median	6.7	0.5	0.11	0.018	0.25	*<0.0005*	*<0.0001*	*<0.001*	0.29	0.00022	0.00024	*<0.0005*	0.0001	0.00015	*<0.01*
Max	6.8	1.7	5.2	0.029	3.5	0.0005	0.0024	0.0032	8.5	0.017	0.00029	*<0.0005*	0.0013	0.0083	*<0.01*
Upper Transition (*n* = 7)															
Min	6.5	*<0.5*	*<0.005*	0.00034	0.018	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	0.000025	*<0.0005*	0.0001	0.000035	*<0.01*
25th PCTL	7.1	0.92	3.7	0.0039	0.021	*<0.0005*	0.00018	*<0.001*	1.8	0.0043	*<0.00005*	*<0.0005*	0.00012	0.0038	*<0.01*
Median	7.5	4.0	4.9	0.0055	0.059	*<0.0005*	0.00082	*<0.001*	4.1	0.0074	0.00005	*<0.0005*	0.00015	0.0073	0.011
75th PCTL	8	4.9	7.3	0.011	0.61	0.00058	0.001	0.002	5.8	0.019	0.00012	*<0.0005*	0.0002	0.012	0.034
Max	8.8	16	14	0.035	1.5	0.00066	0.0017	0.0091	13	0.027	0.00055	0.0005	0.00023	0.022	0.066
Lower Transition (*n* = 6)															
Min	6.4	*<0.5*	4.3	0.00058	0.018	*<0.0005*	0.00099	*<0.001*	4.2	0.002	*<0.00005*	*<0.0005*	*<0.0001*	0.0051	0.022
25th PCTL	7.8	0.51	4.6	0.001	0.036	0.00052	0.0012	*<0.001*	5.6	0.0051	*<0.00005*	*<0.0005*	0.00016	0.0071	0.023
Median	8.6	0.62	5.1	0.0015	0.082	0.00059	0.0013	0.0014	6.6	0.0077	*<0.00005*	*<0.0005*	0.00018	0.012	0.024
75th PCTL	8.8	0.9	5.5	0.032	0.3	0.00069	0.002	0.0026	7.1	0.0094	0.000083	*<0.0005*	0.00022	0.016	0.028
Max	8.9	1.2	6.5	0.16	2.5	0.001	0.0045	0.0048	18	0.015	0.0001	*<0.0005*	0.00032	0.017	0.035
Fresh (*n* = 8)															
Min	6.6	*<0.5*	0.0074	0.00039	0.0031	0.00025	0.00005	0.0005	0.015	0.00005	0.000025	0.00025	0.00005	0.00012	0.005
25th PCTL	7.4	*<0.5*	0.4	0.0006	0.024	*<0.0005*	0.00017	0.001	0.23	0.00038	*<0.00005*	*<0.0005*	*<0.0001*	0.0025	*<0.01*
Median	8.2	1.2	3.4	0.0024	0.061	0.0005	0.00099	0.0012	3.2	0.0021	*<0.00005*	*<0.0005*	0.00012	0.0068	*<0.01*
75th PCTL	8.8	3.8	5.0	0.016	0.31	0.00074	0.0021	0.0034	5.6	0.008	*<0.00005*	*<0.0005*	0.00019	0.013	0.03
Max	9.2	27	7.5	0.064	1.3	0.00088	0.0071	0.0059	5.8	0.013	*<0.00005*	*<0.0005*	0.00022	0.017	0.038

Notes:
Values in grey italics are below the analytical detection limit; All guidelines are for total metals unless otherwise indicated.
Values that exceed the Metal Mines Effluent Regulations (MMER, 2002) MGS water quality guideline are shaded in dark grey.
Values that exceed the Canadian Council of Ministers of the Environment (CCME, 2007) Water Quality Guidelines are shaded in light blue (30-day) and dark blue (maximum);
Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016);
Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI);
Guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg CaCO3/L.

4.1.5 Solid-Phase Elemental Abundance

Statistical summaries of solid phase element results are presented by weathering facies for by lithologic unit Table 4-18, Table 4-19 and Table 4-20 compared to average continental abundances (ACA; Price, 1997). The complete set of solid phase element results are presented in Appendix C.1-3. The results show that the waste rock samples are enriched in Sb, As, Bi, Hg, Se and U with respect to ACAs (shaded values in the tables). In order to compare relative metal enrichment between different lithologies, Table 4-21 presents the median values with a colour gradient superimposed to highlight relative concentrations. The data demonstrate that elemental enrichment is related to both lithology and weathering facies. In general, the highest Sb, As and Hg concentrations were measured in samples from the granite oxide facies (10 ppm, 2400 ppm, 0.46 ppm, respectively) as well as in samples from the oxide facies of the other lithologic units. The highest U content was measured in all weathering facies of the granite samples (median of 6.0 - 6.7 ppm). In contrast, the schist samples show the highest abundance of Se (median of 0.5 - 0.7 ppm) as well as other metals generally associated with sulphide mineralization (*i.e.,* Cr, Co, Cu, Zn) (Table 4-19). The enrichment of Sb, As, Hg and U in the waste rock are particularly relevant given that these elements also exceeded water quality guidelines in SFE (Section 4.1.3).

Also presented for comparison are Sb and As concentrations from the exploration ICP-OES database (Table 4-21). Data for other elements (*e.g*., U) could not be compared due to the high detection limits applied in support of the exploration program analyses. Further, some elements (*e.g.,* Se) were not analyzed as part of the assays for the exploration program. Table 4-22 presents the statistical distribution of Sb and As for each lithology as a whole, with light and dark grey shading representing three and ten times higher than the ACA values. Note that for the larger assay database, the 95th and 5th percentile values are shown in place of the maximum and minimum values to provide a more representative upper and lower limit for the lithologic and weathering facies and avoid highlighting outliers. Also provided in Table 4-22 are the distributions of Sb and As by weathering facies for each lithologic unit, with a colour gradient superimposed to highlight the relative concentrations. The data from the larger sample population of the assay database indicate that the highest concentrations of Sb and As (95th percentiles of 74 and 4240 ppm) are associated with the fresh facies of the granite unit, followed by the oxide facies. This contrasts with the results of the ICP-MS database which shows the highest values for the granite oxide; however, considerably fewer samples are available for this unit. With the exception of these samples, the data in Table 4-22 demonstrate that the highest Sb and As concentrations are generally associated with the oxide facies for each lithology. The overall lowest Sb and As concentrations are indicated for the gneiss and schist waste rock samples, particularly for the lower transition and fresh facies (median Sb = <2 ppm and median As = 6-12 ppm). For complete statistics of the exploration ICP-OES see Appendix C.1-4.

Table 4-18:
Solid Phase Elements by Aqua Regia Digestion for Gneiss Waste Rock by Weathering Facies

ACA	*8.23*	*0.2*	*1.8*	*0.0085*	*102*	*25*	*60*	*5.6*	*14*	*0.085*	*0.05*	*2.7*	*70*
Gneiss	**Al**	**Sb**	**As**	**Bi**	**Cr**	**Co**	**Cu**	**Fe**	**Pb**	**Hg**	**Se**	**U**	**Zn**
	%	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Oxide (*n* = 34)													
Min	0.33	0.47	2.7	0.05	3.0	0.60	0.60	0.48	2.1	*<0.01*	0.2	1.2	5.0
25th PCTL	0.55	1.5	41	0.092	5.0	1.4	2.3	0.79	5.9	0.032	0.4	3.7	8.2
Median	0.68	3.1	98	0.13	6.5	1.8	3.4	1.0	7.6	0.085	0.45	7.0	12
75th PCTL	0.86	13	220	0.18	11	3.0	8.0	1.3	11	0.2	0.6	9.7	18
Max	1.9	52	2100	2.1	110	21	17	4.0	33	0.91	1.2	29	45
Upper Transition (*n* = 26)													
Min	0.36	0.11	3.7	0.02	3.0	0.4	1.6	0.32	4.0	0.01	0.2	2.2	2.0
25th PCTL	0.61	3.7	85	0.1	5.0	1.6	3.8	0.88	7.2	0.06	0.3	3.7	9.2
Median	0.7	6.4	240	0.16	7.0	2.4	5.0	1.0	10	0.16	0.4	6.2	14
75th PCTL	0.86	15	480	0.38	13	5.0	7.7	1.5	13	0.76	0.5	13	23
Max	3.1	83	2100	2.1	60	31	27	4.6	32	5.2	1.0	22	70
Lower Transition (*n* = 79)													
Min	0.27	*<0.05*	2.6	0.03	2	0.6	0.8	0.43	1.2	*<0.01*	*<0.2*	0.29	2.0
25th PCTL	0.57	0.44	11	0.08	5	1.6	2.3	0.83	4.2	*<0.01*	0.4	2.5	9.0
Median	0.81	1.4	20	0.14	7	2.4	3.5	1.2	6.2	0.01	0.4	3.6	16
75th PCTL	1.3	3.2	56	0.25	22	7.8	6.8	2	8	0.06	0.5	5.9	26
Max	4.2	28	330	1.0	160	22	26	7.3	88	1.7	1	19	72
Fresh (*n* = 49)													
Min	0.22	*<0.05*	2.0	0.02	5.0	0.6	0.9	0.44	1.5	0.01	0.3	0.27	4.0
25th PCTL	0.52	0.22	4.7	0.09	6.0	1.5	2.8	0.99	3.3	0.01	0.4	1.9	11
Median	1.1	0.5	6.3	0.18	11	5.0	4.8	1.7	5.2	0.01	0.5	2.7	20
75th PCTL	1.6	1.1	18	0.51	55	13	9.3	2.5	7.6	0.01	0.6	3.5	32
Max	2.3	14	240	8.4	370	20	29	3.7	43	0.07	1.3	20	64

Notes:
Values in grey italics are below the analytical detection limit.
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA.

Table 4-19:
Solid Phase Elements by Aqua Regia Digestion for Schist Waste Rock by Weathering Facies

ACA	*8.23*	*0.2*	*1.8*	*0.0085*	*102*	*25*	*60*	*5.6*	*14*	*0.085*	*0.05*	*2.7*	*70*
Schist	**Al**	**Sb**	**As**	**Bi**	**Cr**	**Co**	**Cu**	**Fe**	**Pb**	**Hg**	**Se**	**U**	**Zn**
	%	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Oxide (*n* = 15)													
Min	0.5	3.0	25	0.09	4.0	1.1	1.0	0.68	2.4	0.08	0.3	0.63	5.0
25th PCTL	0.76	5.1	160	0.17	12	6.5	6.3	1.9	7.2	0.25	0.4	1.6	28
Median	0.9	9.1	190	0.26	30	9.6	14	2.7	9.7	0.33	0.7	2.1	44
75th PCTL	1.1	11	390	0.36	38	13	21	3.0	11	0.42	0.9	3.3	60
Max	1.4	44	1400	1.6	46	19	57	4.3	19	0.75	1.4	9.6	67
Upper Transition (*n* = 14)													
Min	0.81	0.95	6.4	0.09	8.0	5.0	5.2	1.8	4.7	0.01	0.4	1.0	16
25th PCTL	0.98	3.4	23	0.2	26	9.1	11	2.4	6.9	0.022	0.62	1.5	37
Median	1.2	4.1	47	0.28	32	11	17	2.6	8.4	0.12	0.7	2.1	48
75th PCTL	1.5	8.4	160	0.48	39	13	28	3.5	11	0.19	0.98	2.6	68
Max	2.4	66	310	3.9	130	29	110	4.7	37	0.32	1.1	4.3	140
Lower Transition (*n* = 19)													
Min	0.39	0.06	3.5	0.09	6.0	2.3	3.2	0.91	1.6	0.01	0.2	0.81	7.0
25th PCTL	1.6	0.74	9.6	0.27	38	12	6.6	2.5	6.4	0.01	0.4	1.3	47
Median	1.9	1.7	20	0.43	60	14	14	3.2	8.8	0.01	0.6	1.6	53
75th PCTL	2.3	3.0	31	0.68	78	17	25	3.4	12	0.025	0.8	1.9	63
Max	2.7	19	48	2.4	150	22	42	4.4	49	0.32	1.3	3.7	99
Fresh (*n* = 31)													
Min	0.81	0.11	1.4	0.04	10	4.2	4.1	1.4	2.2	0.01	*<0.2*	0.34	12
25th PCTL	1.6	0.3	10	0.14	41	13	8.4	2.6	4.2	0.01	0.25	0.7	39
Median	2.0	0.81	20	0.21	67	15	14	3.2	6.3	0.01	0.5	1.4	46
75th PCTL	2.2	1.7	30	0.34	130	19	22	3.4	8.6	0.01	0.8	2.2	58
Max	3.0	10	130	18	230	28	48	4.6	30	0.06	1.1	6.2	130

Notes:
Values in grey italics are below the analytical detection limit.
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA.

Table 4-20:
Solid Phase Elements by Aqua Regia Digestion for Granite Waste Rock by Weathering Facies

ACA	*8.23*	*0.2*	*1.8*	*0.0085*	*102*	*25*	*60*	*5.6*	*14*	*0.085*	*0.05*	*2.7*	*70*
Granite	**Al**	**Sb**	**As**	**Bi**	**Cr**	**Co**	**Cu**	**Fe**	**Pb**	**Hg**	**Se**	**U**	**Zn**
	%	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Oxide (*n* = 6)													
Min	0.43	0.82	81	0.06	2.0	0.7	1.7	1.0	7.7	0.01	*<0.2*	5.3	5.0
25th PCTL	0.49	7.8	1700	0.07	2.2	1.2	1.9	1.6	18	0.2	0.2	5.6	8.5
Median	0.57	10	2400	0.07	3.0	2.0	2.4	1.6	21	0.46	0.25	6.0	24
75th PCTL	0.69	29	2800	0.092	3.8	2.6	2.9	1.9	22	0.81	0.38	7.6	30
Max	0.73	38	3000	0.77	5.0	10	14	2.0	26	0.84	0.4	22	36
Upper Transition (*n* = 17)													
Min	0.33	0.11	2.7	0.07	2.0	0.1	1.1	0.36	6.8	*<0.01*	*<0.2*	4.6	5.0
25th PCTL	0.48	0.83	110	0.1	4.0	0.6	1.5	0.7	9.9	0.03	0.3	5.7	13
Median	0.61	1.2	200	0.12	4.0	0.9	2.3	0.93	13	0.13	0.4	6.7	19
75th PCTL	0.73	2.0	360	0.13	5.0	1.1	4.7	1.2	20	0.21	0.5	9.2	23
Max	1.1	28	3000	0.27	8.0	1.6	9.2	1.4	39	0.79	0.8	46	37
Lower Transition (*n* = 14)													
Min	0.41	0.08	2.1	0.06	2.0	0.5	1.2	0.48	5.4	*<0.01*	0.2	4.4	4.0
25th PCTL	0.49	0.31	13	0.06	3.0	1.3	1.6	0.97	5.6	0.01	0.3	5.1	24
Median	0.57	1.0	33	0.075	5.0	1.5	1.8	1.2	8.2	0.02	0.4	6.0	31
75th PCTL	0.87	3.5	410	0.088	7.0	2.4	2.4	1.6	12	0.22	0.4	8.9	36
Max	0.95	85	2300	1.0	12	5.0	13	2.8	25	1.7	0.5	26	88
Fresh (*n* = 20)													
Min	0.4	0.06	3.3	0.05	3.0	1.1	0.8	0.88	4.9	*<0.01*	0.2	4.4	19
25th PCTL	0.44	0.2	5.8	0.068	5.0	1.4	1.5	1.1	5.7	*<0.01*	0.38	6.3	26
Median	0.46	0.48	20	0.1	6.0	1.5	3.0	1.2	6.4	0.01	0.4	6.7	29
75th PCTL	0.53	2.0	80	0.32	7.0	2.0	3.9	1.4	8.6	0.022	0.5	7.4	37
Max	1.0	16	1400	1.3	10	3.4	7.2	1.7	15	0.22	0.7	29	72

Notes:
Values in grey italics are below the analytical detection limit.
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA.

Table 4-21:
Comparison of Median Solid Phase Values for Enriched Elements in Waste Rock by Weathering Facies and Lithologies

Lithologic Unit	Al	Sb	As	Bi	Cr	Co	Cu	Fe	Pb	Hg	Se	U	Zn
	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
Gneiss *(Medians)*													
Oxide (n = 34)	0.68	3.1	98	0.13	6.5	1.8	3.4	1.0	7.6	0.085	0.45	7.0	12
Upper Transition (n = 26)	0.7	6.4	240	0.16	7.0	2.4	5.0	1.0	10	0.16	0.4	6.2	14
Lower Transition (n = 79)	0.81	1.4	20	0.14	7.0	2.4	3.5	1.2	6.2	0.01	0.4	3.6	16
Fresh (n = 49)	1.1	0.5	6.3	0.18	11	5.0	4.8	1.7	5.2	0.01	0.5	2.7	20
Schist *(Medians)*													
Oxide (n = 15)	0.9	9.1	190	0.26	30	9.6	14	2.7	9.7	0.33	0.7	2.1	44
Upper Transition (n = 14)	1.2	4.1	47	0.28	32	11	17	2.6	8.4	0.12	0.7	2.1	48
Lower Transition (n = 19)	1.9	1.7	20	0.43	60	14	14	3.2	8.8	0.01	0.6	1.6	53
Fresh (n = 31)	2.0	0.81	20	0.21	67	15	14	3.2	6.3	0.01	0.5	1.4	46
Granite *(Medians)*													
Oxide (n = 6)	0.57	10	2400	0.07	3.0	2.0	2.4	1.6	21	0.46	0.25	6.0	24
Upper Transition (n = 17)	0.61	1.2	200	0.12	4.0	0.9	2.3	0.93	13	0.13	0.4	6.7	19
Lower Transition (n = 14)	0.57	1.0	33	0.075	5.0	1.5	1.8	1.2	8.2	0.02	0.4	6.0	31
Fresh (n = 20)	0.46	0.48	20	0.1	6.0	1.5	3.0	1.2	6.4	0.01	0.4	6.7	29
Other *(Median)*													
All (n = 24)	1.4	3.1	81	0.16	16	14	8.8	3.2	8.7	0.07	0.5	3.0	51

Notes:
Green gradient shading represents relative concentrations of elements for all weathering facies and lithologic units.

Table 4-22:
Solid Phase As and Sb Concentrations in Waste Rock from the Exploration Database

Lithology	**Gneiss**		**Schist**		**Granite**		**Other Lithologies**	
Parameter	**Sb**	**As**	**Sb**	**As**	**Sb**	**As**	**Sb**	**As**
Units	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Total for Lithologic Unit								
n	*14296*	*14296*	*8715*	*8715*	*975*	*975*	*2895*	*2895*
5th PCTL	*<2*	2	*<2*	2	*<2*	3	*<2*	4
25th PCTL	*<2*	7	*<2*	8	*<2*	23	*<2*	21
Median	2	26	2	24	2	118	4	85
75th PCTL	5	118	6	89	6	582	12	412
95th PCTL	26	578	25	737	36.3	2540	56	1540
Oxide facies								
n	*3218*	*3218*	*2355*	*2355*	*578*	*578*	*1411*	*1411*
5th PCTL	*<2*	15	*<2*	8	*<2*	10	*<2*	15
25th PCTL	3	66	3	36.5	*<2*	59.5	4	70
Median	7	179	7	116	3	288	8	284
75th PCTL	16	349	14	368	8	859	20	680
95th PCTL	52	1060	61	1360	36	2710	76	2000
Upper Transition Facies								
n	*4367*	*4367*	*2175*	*2175*	*140*	*140*	*585*	*585*
5th PCTL	*<2*	3	*<2*	4	*<2*	2	*<2*	5
25th PCTL	*<2*	13	*<2*	13	*<2*	10	2	23
Median	2	38	3	32	*<2*	27	4	65
75th PCTL	6	124	7	100	2	95	9	248
95th PCTL	25	583	18	633	13	1460	45	1760
Lower Transition Facies								
n	*5647*	*5647*	*3330*	*3330*	*235*	*235*	*710*	*710*
5th PCTL	*<2*	*<2*	*<2*	2	*<2*	2	*<2*	2
25th PCTL	*<2*	4	*<2*	5	*<2*	6	*<2*	8
Median	*<2*	10	*<2*	12	*<2*	32	*<2*	18
75th PCTL	2	29	2	28	3	108	4	56
95th PCTL	8	174	8	133	24	1620	25	460
Fresh Facies								
n	*1073*	*1073*	*861*	*861*	*24*	*24*	*241*	*241*
5th PCTL	*<2*	*<2*	*<2*	*<2*	*<1.4*	37.9	*<2*	*<2*
25th PCTL	*<2*	3	*<2*	5	6	685	*<2*	6
Median	*<2*	6	*<2*	10	33	1650	*<2*	23
75th PCTL	2	14	2	18	39.5	3160	5	457
95th PCTL	8	74.8	5	74	74	4240	19	4730

Notes:
Values in grey italics are below the analytical detection limit.
Values shaded in light grey are 3x's the Average Continental Abundance (ACA) for Sb (2 ppm) and As (1.8 ppm), according to Price (1997), values shaded in dark grey are 10x's the ACA values.
Red and green gradient shading represent relative concentrations of Sb and As, for all weathering facies and lithologic units.

4.1.6 Kinetic Test Samples

4.1.6.1 Sample Selection Criteria and Rationale

A total of six unsaturated columns, eight humidity cells and eight field bins have been initiated for the different weathering facies (oxide, transition and fresh) of the dominant waste rock lithologies (gneiss, schist and granite) to assess the ML/ARD potential of stockpiled waste rock. A summary of the waste rock kinetic test material, sample selection criteria and rationale for the testwork are presented in Table 4-23. With the exception of HC7 and HC8, which were initiated to evaluate the potential extreme-case of As-leaching from gneiss and schist waste rock, waste rock used for laboratory kinetic testwork (columns and humidity cells) are representative split samples from the waste rock field bins (*i.e.,* duplicates in Table 4-23).

The compositions of kinetic test samples are compared to the range of metal and sulphur concentrations observed in the greater static test database in Figure 4-8 and Figure 4-9. These figures are box plots showing the distribution of total-S and solid phase element concentrations (As, Sb and U) for the larger sample populations (exploration and ABA databases) by waste rock lithology and weathering facies (as presented in Section 4.1.4), with the results for the kinetic test sub-samples superimposed. Total-S concentrations for the kinetic test sub-samples indicate that the kinetic tests represent moderate to high total-S with respect to the larger sample population (i.e*.,* exploration database); therefore, leachate data compiled from the kinetic tests represent 'best-estimate' to 'worst-case' drainage quality with respect to potential acid generation from subaerially stockpiled gneiss, schist and granite waste rock for the Project (Figure 4-8 and Table 4-23).

Solid phase concentrations of As, Sb and U for the kinetic test sub-samples are generally in the moderate to very high concentration ranges with respect to the larger sample populations (*i.e.,* exploration database for As and Sb and ABA database for U); therefore, leachate data compiled from kinetic testwork represent 'best-estimate' to 'worst-case' drainage quality with respect to potential metals of concern. Only the granite fresh facies kinetic test sub-sample comprises low concentrations of As and Sb with respect to the exploration database distribution; therefore, As and Sb may be under-represented in leachate collected from the granite fresh kinetic tests.

Table 4-23:
Waste Rock Kinetic Test Summary

Lithology	Weathering Facies	Test ID	Kinetic Test	Sample Description	Dry Wt. of Sample (kg)	Test Duration (weeks)	Recirculation Cycles
Gneiss	Oxide	Col 5	Unsaturated Column	Moderate T-S (60th PCTL) and As, Sb, U.	10.0	86	45-77
		FB-GO	Field Bin (Dup of Col 5)		183	70	-
	Transition	Col 6	Unsaturated Column	High T-S (85th PCTL) and As, Sb, U (>75th PCTL).	10.0	84	43-75
		HC3	Humidity Cell (Dup of Col 6)		1.0	87	46-73
		FB-GT	Field Bin (Dup of Col 6 and HC 3)		229	70	-
	Fresh	HC4	Humidity Cell	Very high T- S, As, U (95th PCTL), low Sb.	1.0	87	46-73
		FB-GS	Field Bin (Dup of HC 4)		190	70	-
		HC8	Humidity Cell	Very high T-S and U (95th PCTL) and As (> 95th PCTL).	1.0	28	-
Schist	Oxide	Col 3	Unsaturated Column	Moderate T-S and U (65th PCTL), high As and Sb (>75th PCTL).	10.0	86	45-77
		FB-SO	Field Bin (Dup of Col 3)		171	70	-
	Transition	Col 4	Unsaturated Column	High T-S (70th PCTL), As and U (80th PCTL), low Sb.	10.0	86	45-77
		HC1	Humidity Cell (Dup of Col 4)		1.0	87	46-73
		FB-ST	Field Bin (Dup of Col 4 and HC 1)		165	70	-
	Fresh	HC2	Humidity Cell	Very high T-S (~90th PCTL), high As, Sb, U (~80th PCTL)	1.0	87	46-73
		FB-SS	Field Bin (Dup of HC 2)		202	70	-
		HC7	Humidity Cell	Very high T-S, As, Sb (>95th PCTL), U (90th PCTL)	1.0	28	-
Granite	Transition	Col 13	Unsaturated Column	Very high T-S (>95th PCTL), high As (85th PCTL), very low Sb (<5th PCTL), moderate U (60th PCTL)	10.0	41	-
		HC5	Humidity Cell (Dup of Col 13)		1.0	42	-
		FB-GGT	Field Bin (Dup of Col 13 and HC 5)		166	18	-
	Fresh	Col 14	Unsaturated Column	High T-S (70th PCTL), low to very low As, Sb and U (<25th PCTL)	10.0	41	-
		HC6	Humidity Cell (Dup of Col 14)		1.0	42	-
		FB-GGS	Field Bin (Dup of Col 14 and HC 6)		134	18	-

Notes: All columns and humidity cells are constructed of Plexiglas with acrylic perforated disk & nylon mesh; All tests operated at temperature of 4°C; Leachate is sampled bi-weekly from all columns and weekly from all humidity cells; All columns are operated as trickle leach and all humidity cells operated as flood leach according to the MEND method (discussed in more detail in Section 3.2.6) Test duration refers to data available prior to cutoff date of March, 2016.

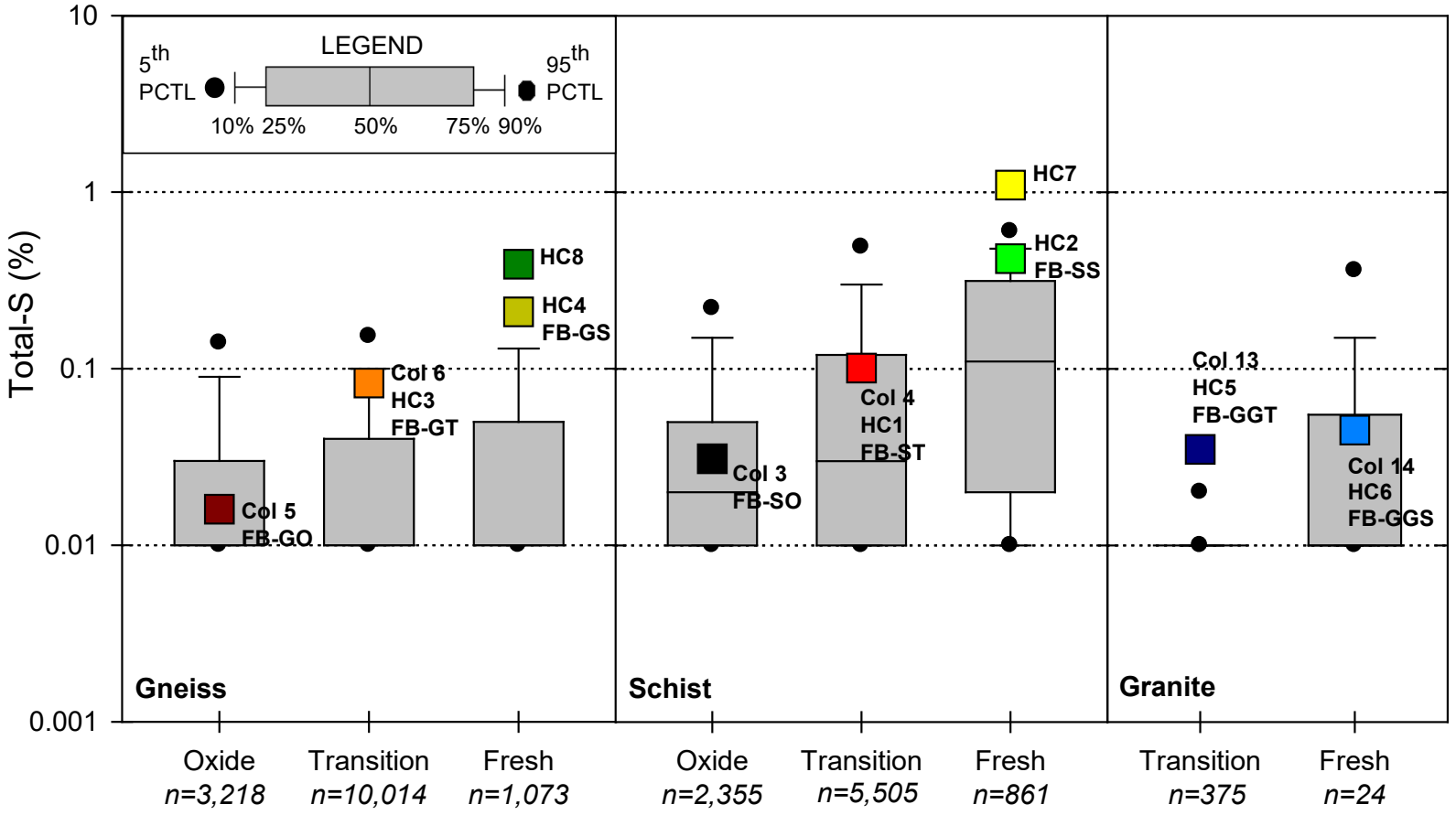

Figure 4-8: Box plots showing the ranges of total-S for the exploration database with total-S for the kinetic test sub-samples superimposed.

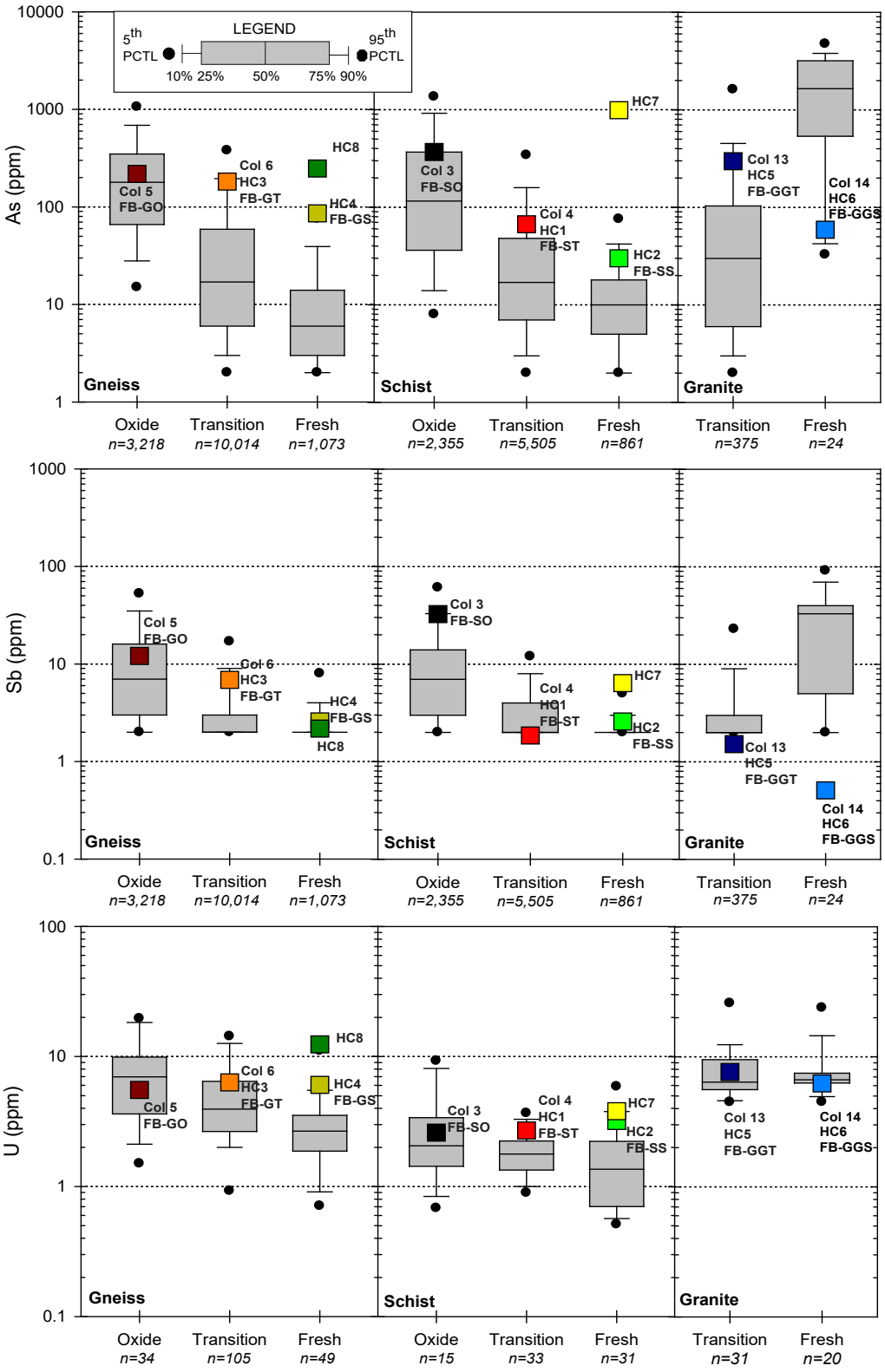

Figure 4-9: Box plots showing the ranges of As and Sb for the exploration database and U for the ABA database with concentrations for the kinetic test sub-samples superimposed

4.1.6.2 Static Tests

Mineralogy

A sub-sample from each of the waste rock kinetic tests was submitted for quantitative phase analysis using the Rietveld Method XRD. The minerals identified by XRD in the waste rock kinetic test sub-samples are provided in Table 4-24. The major rock forming minerals identified in each sample are quartz and feldspars, with lesser amounts of muscovite, biotite, chlorite and other silicates. Each sample also comprises measurable concentrations of kaolinite (1.4 – 15 wt.%), demonstrating the weathered state of the waste rock. Pyrite was only identified in the two sub-samples comprising high total-S (> 95th percentile, Figure 4-8), the gneiss fresh facies HC8 (0.5 wt.%) and schist fresh facies HC7 (1.3 wt.%).

Four carbonate minerals were identified in the schist and gneiss kinetic test sub-samples (Table 4-24). The highest proportion of carbonate minerals were identified in the schist sub-samples, with 8.2 wt.% measured in the oxide facies and approximately 20 wt.% measured in both fresh facies. The dominant carbonate mineral in the schist sub-samples is calcite, with concentrations ranging from 3.9 wt.% in the oxide facies up to 14.6 wt.% in the transition facies. High concentrations of ankerite (an Fe and Mn-bearing and therefore less effective neutralizing carbonate) were also identified in each schist sub-sample, with up to 9 wt.% identified in one of the fresh facies (HC2). Siderite (another Fe-bearing carbonate) was identified in appreciable amounts (4.5 wt.%) in the schist fresh facies sub-sample HC7. The distribution of carbonates in the schist kinetic test sub-samples is consistent with the wide range of carbonate concentrations (0.09 up to 29 wt.%) identified for the static test samples (Section 4.1.3).

The gneiss sub-samples comprise considerably less carbonates than the schist, with 3.0 wt.% measured in the oxide facies and up to 6.8 wt.% measured in one of the fresh facies (HC4). The dominant carbonate in the gneiss sub-samples is ankerite (1.3 – 4.5 wt.%), with lesser amounts of calcite (1 – 2.3 wt.%). Ankerite was also identified in appreciable amounts (up to 8.1 wt.%) in the transition static test samples (Section 4.1.1).

No carbonate minerals were detected in sub-samples from the granite kinetic tests, which is consistent with very low concentrations of carbonate minerals (<0.9 wt.%) identified in only a few of static test samples (Section 4.1.1).

Table 4-24:
X-Ray Diffraction Results for Waste Rock Kinetic Test Sub-Samples

		Lithology	Gneiss				Schist				Granite	
		Weathering Facies	Oxide	Transition	Fresh		Oxide	Transition	Fresh		Transition	Fresh
		Column	Col 5	Col 6	-	-	Col 3	Col 4	-	-	Col 13	-
Kinetic Test IDs		Humidity Cell	-	HC3	HC4	HC8	-	HC1	HC2	HC7	HC5	HC6
		Field Bin	FB-GO	FB-GT	FB-GS	-	FB-SO	FB-ST	FB-SS	-	FB-GGT	FB-GGS
Mineral	**Formula**		**wt. %**									
Quartz	SiO_2		47	46	39	49	55	31	33	49	35	29
Microcline	$KAlSi_3O_8$		19	16.3	12	23	0.7	7.8	11	1.6	27	29
Albite	$NaAlSi_3O_8$		7.5	9.7	17		1.2	20	8.7		18	22
Anorthite	$CaAl_2Si_2O_8$										6.7	9.8
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$		7.9	5.3	9.6	14	14	6.2	11	14	5.7	4.6
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$		1.0	1.2	3.0		1.3	7.0	4.4		0.7	1.4
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$		4.1	3.6	2.8		5.3	3.5	5			
Kaolinite	$Al_2Si_2O_5(OH)_4$		8.7	12	6.7	9.6	13	1.4	5.6	15	7.0	4.4
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$		0.3	0	0.4		0.4	2.3	0.3			
Diopside	$CaMgSi_2O_6$		1.7	1.3	2.1		0.6	3.9	1.8			
Calcite	$CaCO_3$		1.7	1.0	2.3		3.9	15	11			
Dolomite	$CaMg(CO_3)_2$					4.1				9.3		
Ankerite	$CaFe(CO_3)_2$		1.3	4.4	4.5		4.3	1.8	9.0	5.5		
Siderite	$FeCO_3$									4.5		
Pyrite	FeS_2					0.5				1.3		

Acid Base Accounting and Solid Phase Elements

Acid-base accounting and solid phase element result for the waste rock kinetic test sub-samples are presented in Table 4-25. All sub-samples have neutral to slightly alkaline rinse pH. The lowest pH (7.1) was measured in the granite transition sub-sample and reflects the low, but measurable, total-S (0.035 wt.%) and a lack of CaNP (0.8 kg $CaCO_3$/t), consistent with XRD results (Table 4-24).

For the gneiss and schist kinetic test sub-samples, concentrations of total-S and CaNP increase with decreasing degree of weathering within a lithology. The lowest total-S concentrations are indicated for the gneiss and schist oxide facies sub-samples (0.016 and 0.031 wt.%, respectively) and the highest total-S concentrations are indicated for the gneiss fresh facies (0.21 and 0.39 wt.%) and schist fresh facies (0.42 and 1.1 wt.%). The schist fresh facies sub-samples also comprise the highest CaNP values (174 kg$CaCO_3$/t and 151 kg $CaCO_3$/t). Of note, CaNP for the schist oxide facies (78 kg $CaCO_3$/t) is higher than the highest CaNP for the gneiss fresh facies (55 kg $CaCO_3$/t) (Table 4-2). The lowest CaNP values are indicated for the two granite kinetic test sub-samples (< 9.2 kg $CaCO_3$/t).

Sub-samples HC8 (gneiss) and HC7 (schist), which were selected for kinetic testwork to evaluate the potential for an ‘extreme-case’ of As leaching, comprise the highest total-S concentrations (0.39 and 1.1 wt.%, respectively) and As concentrations (248 and 989 ppm, Table 4-25). The highest metal concentrations were measured in the schist kinetic test sub-samples, with the overall highest values measured in the high total-S and As schist fresh facies sub-sample, HC7.

Table 4-25:
Acid-Base Accounting for Waste Rock Kinetic Test Sub-Samples

Lithology		Gneiss				Schist				Granite	
Weathering Facies		Oxide	Transition	Fresh		Oxide	Transition	Fresh		Transition	Fresh
Kinetic Test IDs	Column	Col 5	Col 6	-	-	Col 3	Col 4	-	-	Col 13	Col 14
	Humidity Cell	-	HC3	HC4	HC8	-	HC1	HC2	HC7	HC5	HC6
	Field Bin	FB-GO	FB-GT	FB-GS	-	FB-SO	FB-ST	FB-SS	-	FB-GGT	FB-GGS
Acid Base Accounting Parameters											
Rinse pH	s.u.	8.5	8.0	8.2	8.6	8.4	8.4	8.5	8.2	7.1	8.6
Total-S	wt.%	0.016	0.083	0.21	0.39	0.031	0.10	0.42	1.1	0.035	0.045
Sulphate-S	wt.%	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	0.01	*<0.01*	0.02	*<0.01*	*<0.01*
Sulphide-S	wt.%	0.01	0.07	0.18	0.38	0.01	0.05	0.35	1.1	*<0.01*	0.03
CaNP	kg $CaCO_3$/t	19	40	55	20	78	132	174	151	0.8	9.2
Sobek NP	kg $CaCO_3$/t	23	33	52	20	75	173	181	127	2.8	5.7
Siderite NP	kg $CaCO_3$/t	27	41	57	-	76	193	200	-	7.6	9.9
Solid Phase Elements by Aqua Regia											
Ag	ppm	0.17	0.03	0.03	0.06	0.17	0.05	0.11	0.05	0.04	0.03
Al	%	0.58	0.47	0.92	0.34	0.49	1.5	1.4	0.57	0.4	0.38
As	ppm	218	182	86	248	369	67	30	989	298	59
Cd	ppm	0.07	0.05	0.03	0.07	0.14	0.07	0.1	0.13	0.05	0.05
Co	ppm	6.2	4.1	8	1	13	15	14	17	1.6	1.6
Cr	ppm	142	122	112	100	125	190	145	111	132	125
Cu	ppm	9.8	5.9	6.7	2	24	16	18	27	7.6	5.6
Fe	%	1.5	1.2	1.8	0.6	2.9	2.6	2.9	3.7	0.87	1.1
Hg	ppm	0.15	0.24	0.07	0.11	0.44	0.03	0.12	0.51	0.14	0.08
Mn	ppm	339	280	373	102	530	589	660	733	384	678
Mo	ppm	5.0	4.9	4.5	5.4	3.8	5.5	3.3	3.6	6.7	6.2
Ni	ppm	9.7	5.7	13	5.7	27	50	54	43	6.4	5.8
Pb	ppm	11	7.4	6	6	17	9.3	15	43	16	8
Sb	ppm	12	6.9	2.6	2.2	32.6	1.9	2.6	6.4	1.5	0.51
Se	ppm	*<1*	*<1*	*<1*	2	*<1*	*<1*	*<1*	3	*<1*	*<1*
U	ppm	5.5	6.3	6.1	12.4	2.6	2.7	3.2	3.8	7.6	6.2
Zn	ppm	21	16	19	4	41	43	58	91	29	32

Notes: Values in grey italics are below the analytical detection limit; n = number of analyses included in statistical distribution; * adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.2.3.1 for discussion); NNP = net neutralization potential, derived by subtracting AP from NP.

Particle Size Distribution

The rate of dissolution increases as particle surface area increases; therefore, it is important to know the relative volume of fine particles when discussing the bulk samples as a whole (Jambor, 2002). Table 4-26 presents the distribution of grain sizes determined from sub-samples collected from the kinetic tests. These data indicate that the gneiss and schist waste rock kinetic tests are predominantly composed of particles measuring >0.425 mm (>70%), with the greatest proportion composed of particles measuring >0.425 and <6.3 mm. The HC8 and HC7 sub-samples, however, are dominantly composed of particles measuring >6.3 mm in diameter. The granite samples have a finer particle size range, with ~80% of each sub-sample composed of particles measuring <1.7 mm in diameter.

Table 4-26:
Particle Size Distribution for Waste Rock Kinetic Test Sub-Samples

Lithology		Gneiss				Schist				Granite	
Weathering Facies		Oxide	Transition	Fresh		Oxide	Transition	Fresh		Transition	Fresh
Kinetic Test IDs		Col 5	Col 6	-	-	Col 3	Col 4	-	-	Col 13	-
		-	HC3	HC4	HC8	-	HC1	HC2	HC7	HC5	HC6
		FB-GO	FB-GT	FB-GS	-	FB-SO	FB-ST	FB-SS	-	FB-GGT	FB-GGS
Sieve Designation	Aperture (mm)	Weight Retained (%)									
+ 3/8"	9.5	0.6	2.4	1.5	15	1.5	2.2	1.1	13	*ND*	*ND*
-3/8" + 1/4"	6.3	5.1	17	10	47	12	13	12	40	0.08	0
-1/4" + 5	4.0	17	26	22	17	23	19	20	17	1.9	2.4
5	1.7	19	18	21	11	20	15	17	14	18	20
25	0.425	27	18	22	7.7	23	24	23	12	35	35
65	0.15	13	7.3	9.0	1.6	9.0	11	11	3.1	18	17
170	0.053	9.5	5.6	7.5	1.0	5.9	8.5	7.6	1.3	13	12
-270	-0.053	8.9	5.7	7.0	0.10	5.8	7.4	7.6	1.1	15	13
	Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

4.1.6.3 Laboratory Kinetic Test Results

Results of the waste rock laboratory kinetic test program, including unsaturated columns and humidity cell tests, for gneiss, schist and granite weathering facies are presented and discussed in this section. A summary of the final and median loading rates from each kinetic test is presented in Table 4-27 (gneiss), Table 4-28 (schist) and Table 4-29 (granite). Note that the program for the granite waste rock was initiated after the gneiss and schist programs; therefore, there are fewer weeks of data for the granite tests (Table 4-23). Time series plots for weekly loading rates are presented in Figure 4-10 through Figure 4-14. The complete set of leachate concentrations, calculated loading rates and time series plots for unsaturated columns and humidity cell waste rock kinetic tests are provided in Appendix D.1.

Leachate pH and Sulphate Loading

Leachate pH for the gneiss, schist and granite waste rock laboratory kinetic tests are neutral to slightly alkaline, with weekly pH values for gneiss and schist kinetic tests generally ranging between 7.5 and 8.3 over the test period (Figure 4-10) and increasing over the recirculation experiment (between the dashed lines, Figure 4-10). Leachate pH values for the granite waste rock, particularly the fresh facies (Col 13 and HC6), are slightly lower, ranging from 6.7 to 8.2, and shows a slight decrease over the test period.

Weekly alkalinity loadings from the waste rock columns and humidity cells show a slight decrease over the test period. Alkalinity loading rates decrease from ~6 to ~2 mg $CaCO_3$/kg/wk from the columns and from ~25 to ~15 mg $CaCO_3$/kg/wk from the humidity cells, with a greater decrease observed during the recirculation experiment and from the high S fresh facies tests (HC8 and HC7). In general, alkalinity production rates are higher (by nearly an order of magnitude) from the transition and fresh facies humidity cell tests (particularly from the schist) compared to the columns. The slightly lower pH for the granite transition and fresh facies is consistent with a more prominent decrease in alkalinity production from the granite waste rock, particularly the fresh facies column (decreasing to <0.4 mg $CaCO_3$/kg/wk, Figure 4-11).

After the initial flush of the test material loading rates for sulphate decrease to <1 mg/kg/wk around week 20 from all waste rock kinetic tests (Figure 4-12). Weekly sulphate loadings from the humidity cells remain stable near or below the detection limit (equivalent to 2 mg/L) for the rest of the test period. Sulphate loadings from the columns continue to decrease over the test period, with lower rates (<0.1 mg/kg/wk) measured for the oxide facies of the gneiss and schist waste rock (Col 5 and Col 6). Loading rates are observed to decrease further during re-circulation experiment, as discussed below.

Table 4-27:
Loading Rates for Gneiss Waste Rock Laboratory Kinetic Tests

Parameter	Unit	Gneiss														
		Oxide (Col 5)			Transition (Col 6)			Transition (HC 3) (DUP of Col 6)			Fresh (HC 4)			Fresh (HC 8)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH	s.u.	8.2	8.2	8.2	8.3	8.2	8.3	7.5	7.7	7.8	7.8	7.8	7.8	7.3	7.4	7.5
Alkalinity	mg $CaCO_3$/kg/wk	1.7	2.4	2.7	2.0	2.2	2.2	8.7	11	13	16	16	18	5.3	5.2	5.4
Sulphate	mg/kg/wk	0.098	0.099	0.11	0.23	0.32	0.34	1.0	1.0	1.0	0.98	0.98	1.00	0.99	0.99	0.99
D-Al	mg/kg/wk	0.000069	0.000069	0.000088	0.000074	0.000095	0.00011	0.0072	0.0095	0.012	0.016	0.020	0.023	0.0054	0.0060	0.0067
D-Sb	mg/kg/wk	0.000039	0.000040	0.000041	0.00017	0.00014	0.00016	0.00025	0.00040	0.00045	0.00069	0.0014	0.0016	0.00064	0.00064	0.00067
D-As	mg/kg/wk	0.00025	0.00021	0.00024	0.00078	0.00079	0.00085	0.0016	0.0025	0.0040	0.0013	0.0024	0.0031	0.0076	0.0084	0.0091
D-Cd	mg/kg/wk	0.000000090	0.000000098	0.00000016	0.000000093	0.00000013	0.00000022	0.0000015	0.0000015	0.0000019	0.0000015	0.0000015	0.0000015	0.0000015	0.0000020	0.0000023
D-Ca	mg/kg/wk	0.43	0.43	0.45	0.50	0.49	0.50	2.3	2.4	2.6	4.0	3.8	4.3	1.1	1.1	1.1
D-Cr	mg/kg/wk	0.000010	0.0000067	0.0000094	0.0000011	0.0000011	0.0000014	0.000015	0.000015	0.000015	0.000015	0.000015	0.000015	0.000015	0.000015	0.000017
D-Co	mg/kg/wk	0.00000056	0.00000095	0.0000012	0.00000040	0.00000076	0.00000085	0.0000045	0.000010	0.000015	0.0000048	0.0000074	0.0000097	0.0000078	0.0000096	0.000011
D-Cu	mg/kg/wk	0.000014	0.000019	0.000021	0.0000060	0.000013	0.000015	0.00012	0.00014	0.00020	0.00011	0.00015	0.00024	0.00013	0.00025	0.00030
D-Fe	mg/kg/wk	0.00011	0.000100	0.00011	0.000100	0.000100	0.00011	0.0035	0.0035	0.0035	0.0034	0.0034	0.0035	0.0035	0.0035	0.0035
D-Pb	mg/kg/wk	0.00000049	0.00000049	0.00000084	0.00000047	0.00000019	0.00000051	0.0000051	0.0000051	0.000014	0.0000049	0.0000050	0.0000099	0.000010	0.000015	0.000025
D-Mg	mg/kg/wk	0.15	0.15	0.16	0.23	0.24	0.25	0.62	0.69	0.80	1.2	1.2	1.4	0.42	0.43	0.44
D-Mn	mg/kg/wk	0.0000029	0.0000088	0.000014	0.0000020	0.0000061	0.000010	0.0030	0.0034	0.0040	0.0033	0.0041	0.0047	0.0029	0.0026	0.0029
D-Hg	mg/kg/wk	0.00016	0.00014	0.00016	0.00014	0.00014	0.00015	0.0051	0.0050	0.0051	0.0049	0.0049	0.0050	0.0050	0.0050	0.0062
D-Mo	mg/kg/wk	0.00035	0.00032	0.00034	0.00023	0.00045	0.00051	0.00020	0.00041	0.00059	0.00018	0.00033	0.00041	0.000055	0.00012	0.00024
D-Ni	mg/kg/wk	0.0000033	0.0000058	0.0000070	0.0000034	0.0000067	0.0000075	0.000051	0.000050	0.000051	0.000049	0.000049	0.000050	0.000050	0.000051	0.000098
D-Se	mg/kg/wk	0.0000011	0.0000029	0.000013	0.0000012	0.0000026	0.000014	0.000020	0.000020	0.00040	0.000020	0.000025	0.00039	0.000020	0.000020	0.000040
D-Ag	mg/kg/wk	0.000000033	0.000000030	0.000000035	0.000000029	0.000000029	0.000000034	0.0000010	0.0000010	0.0000010	0.00000098	0.00000098	0.00000099	0.00000099	0.00000099	0.0000010
D-U	mg/kg/wk	0.0013	0.0013	0.0014	0.0038	0.0035	0.0038	0.0079	0.011	0.013	0.0034	0.0036	0.0042	0.0094	0.0099	0.010
D-Zn	mg/kg/wk	0.000016	0.000015	0.000017	0.000014	0.000014	0.000016	0.00051	0.00050	0.00051	0.00049	0.00049	0.00050	0.00050	0.00050	0.00050

Notes: All* excludes the first 10 cycles (which represent the flushing of surface oxidation products) and the recirculation cycles.

Table 4-28:
Loading Rates for Schist Waste Rock Laboratory Kinetic Tests

Parameter	Unit	Schist													
		Oxide (Col 3)			Transition (Col 4)			Transition (HC 1) (DUP of Col 4)			Fresh (HC 2)			Fresh (HC 7)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH	s.u.	8.2	8.1	8.2	8.2	8.2	8.2	7.8	7.8	7.9	7.9	7.9	7.9	7.5	7.6	7.6
Alkalinity	mg $CaCO_3$/kg/wk	2.0	2.1	2.3	1.9	2.2	2.3	16	17	18	18	18	20	11	11	11
Sulphate	mg/kg/wk	0.12	0.18	0.26	0.88	1.0	1.2	1.0	1.0	1.5	1.0	0.99	1.5	1.5	2.0	2.3
D-Al	mg/kg/wk	0.000070	0.000068	0.000078	0.000070	0.000076	0.000098	0.013	0.013	0.014	0.018	0.021	0.025	0.0068	0.0078	0.0091
D-Sb	mg/kg/wk	0.000063	0.000050	0.000052	0.000026	0.000031	0.000034	0.000099	0.00015	0.00019	0.0020	0.0040	0.0057	0.0030	0.0031	0.0035
D-As	mg/kg/wk	0.00018	0.00011	0.00016	0.000099	0.00010	0.00011	0.0010	0.0012	0.0015	0.0014	0.0028	0.0045	0.0075	0.0093	0.010
D-Cd	mg/kg/wk	0.000000052	0.000000041	0.000000062	0.00000014	0.00000014	0.00000020	0.0000015	0.0000015	0.0000017	0.0000015	0.0000015	0.0000023	0.0000015	0.0000015	0.0000016
D-Ca	mg/kg/wk	0.51	0.50	0.53	0.56	0.52	0.55	4.5	4.4	4.6	4.8	4.7	5.0	2.7	2.7	2.8
D-Cr	mg/kg/wk	0.000016	0.0000094	0.000012	0.000011	0.0000072	0.000011	0.000040	0.000030	0.000045	0.000015	0.000015	0.000023	0.000015	0.000015	0.000016
D-Co	mg/kg/wk	0.00000051	0.00000059	0.00000091	0.00000060	0.0000012	0.0000016	0.0000020	0.0000064	0.0000087	0.000020	0.000021	0.000026	0.00014	0.00015	0.00017
D-Cu	mg/kg/wk	0.0000090	0.000015	0.000020	0.000017	0.000022	0.000027	0.00011	0.00019	0.00028	0.000099	0.00015	0.00021	0.000078	0.00015	0.00020
D-Fe	mg/kg/wk	0.00012	0.000092	0.000098	0.00012	0.00011	0.00012	0.0035	0.0034	0.0035	0.0035	0.0035	0.0035	0.0034	0.0034	0.0035
D-Pb	mg/kg/wk	0.0000015	0.00000029	0.00000066	0.0000015	0.00000061	0.0000015	0.0000050	0.0000050	0.000015	0.0000050	0.0000050	0.000015	0.000015	0.000015	0.000023
D-Mg	mg/kg/wk	0.21	0.20	0.23	0.29	0.28	0.29	0.93	1.1	1.3	1.3	1.4	1.7	1.1	1.2	1.2
D-Mn	mg/kg/wk	0.0000044	0.0000075	0.000010	0.0000079	0.000029	0.000044	0.0017	0.0018	0.0021	0.0071	0.0060	0.0068	0.0057	0.0055	0.0061
D-Hg	mg/kg/wk	0.00017	0.00013	0.00014	0.00017	0.00016	0.00017	0.0050	0.0049	0.0050	0.0050	0.0050	0.0050	0.0049	0.0049	0.0050
D-Mo	mg/kg/wk	0.000063	0.000041	0.000053	0.00025	0.00037	0.00045	0.00031	0.00064	0.00093	0.000055	0.00013	0.00017	0.000044	0.00012	0.00029
D-Ni	mg/kg/wk	0.0000035	0.0000059	0.0000070	0.000015	0.000020	0.000026	0.000050	0.000050	0.000050	0.00020	0.00020	0.00025	0.00064	0.00077	0.00084
D-Se	mg/kg/wk	0.0000043	0.0000052	0.000013	0.0000087	0.0000096	0.000014	0.000045	0.000058	0.00041	0.000020	0.000031	0.00042	0.000020	0.000020	0.000042
D-Ag	mg/kg/wk	0.000000033	0.000000026	0.000000029	0.000000033	0.000000033	0.000000045	0.0000010	0.00000099	0.0000012	0.0000010	0.00000099	0.0000010	0.00000098	0.00000099	0.0000012
D-U	mg/kg/wk	0.000074	0.000069	0.000075	0.00057	0.00059	0.00061	0.0010	0.0015	0.0018	0.0020	0.0027	0.0034	0.0020	0.0023	0.0025
D-Zn	mg/kg/wk	0.000018	0.000014	0.000020	0.000017	0.000017	0.000019	0.00050	0.00049	0.00050	0.00050	0.00050	0.00050	0.00049	0.00049	0.00049

Notes: All* excludes the first 10 cycles (which represent the flushing of surface oxidation products) and the recirculation cycles.

Table 4-29:
Loading Rates for Granite Waste Rock Laboratory Kinetic Tests

Parameter	Unit	Granite											
		Transition (Col 13)			Fresh (Col 14)			Transition (HC 5) (DUP of Col 13)			Fresh (HC 6) (DUP of Col 14)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH	s.u.	7.5	7.5	7.5	8.2	8.2	8.2	6.7	7.1	7.3	7.0	7.3	7.3
Alkalinity	mg $CaCO_3$/kg/wk	0.31	0.29	0.32	1.4	1.6	1.6	1.6	2.0	2.2	4.8	5	6
Sulphate	mg/kg/wk	0.45	0.46	0.53	0.60	0.60	0.67	1.0	1.0	1.0	0.98	0.99	0.99
D-Al	mg/kg/wk	0.000045	0.000050	0.000077	0.000074	0.000077	0.000088	0.0072	0.017	0.029	0.0094	0.021	0.030
D-Sb	mg/kg/wk	0.00010	0.000090	0.00010	0.000094	0.000093	0.000094	0.00029	0.00054	0.00080	0.00025	0.00037	0.00044
D-As	mg/kg/wk	0.0016	0.0015	0.0016	0.00045	0.00045	0.00046	0.014	0.026	0.050	0.0047	0.0076	0.012
D-Cd	mg/kg/wk	0.000000077	0.000000073	0.000000084	0.00000015	0.00000013	0.00000017	0.0000015	0.0000019	0.0000052	0.0000015	0.0000015	0.0000022
D-Ca	mg/kg/wk	0.050	0.049	0.050	0.52	0.53	0.55	0.16	0.15	0.16	1.2	1.4	1.6
D-Cr	mg/kg/wk	0.00000045	0.00000045	0.00000078	0.00000044	0.00000051	0.00000073	0.000015	0.000017	0.000020	0.000015	0.000015	0.000015
D-Co	mg/kg/wk	0.000015	0.000014	0.000015	0.000012	0.000012	0.000014	0.000049	0.000050	0.000058	0.000032	0.000027	0.000033
D-Cu	mg/kg/wk	0.0000084	0.0000083	0.000013	0.0000068	0.0000072	0.0000084	0.00029	0.00022	0.00026	0.00013	0.00012	0.00018
D-Fe	mg/kg/wk	0.00011	0.000085	0.000098	0.000100	0.000100	0.00010	0.0035	0.0073	0.012	0.0034	0.0051	0.0093
D-Pb	mg/kg/wk	0.00000060	0.00000053	0.0000011	0.0000019	0.0000019	0.0000037	0.000025	0.000050	0.000081	0.0000099	0.000039	0.000053
D-Mg	mg/kg/wk	0.013	0.012	0.013	0.10	0.11	0.11	0.043	0.040	0.044	0.21	0.23	0.26
D-Mn	mg/kg/wk	0.0070	0.0060	0.0067	0.012	0.012	0.012	0.024	0.021	0.023	0.039	0.033	0.038
D-Hg	mg/kg/wk	0.00015	0.00012	0.00014	0.00014	0.00014	0.00015	0.0051	0.0050	0.0051	0.0049	0.0049	0.0050
D-Mo	mg/kg/wk	0.000032	0.000045	0.000048	0.00016	0.00016	0.00020	0.00013	0.00066	0.0011	0.00010	0.00032	0.00044
D-Ni	mg/kg/wk	0.0000045	0.0000046	0.0000051	0.0000029	0.0000030	0.0000044	0.000051	0.000050	0.000051	0.000049	0.000049	0.000050
D-Se	mg/kg/wk	0.00000060	0.00000065	0.00000087	0.00000058	0.00000064	0.0000010	0.000020	0.000020	0.000037	0.000020	0.000020	0.000022
D-Ag	mg/kg/wk	0.000000030	0.000000026	0.000000037	0.000000029	0.000000029	0.000000029	0.0000010	0.0000010	0.0000042	0.00000098	0.00000100	0.0000017
D-U	mg/kg/wk	0.000013	0.000013	0.000014	0.00081	0.00081	0.00088	0.00014	0.00023	0.00044	0.00031	0.00041	0.00048
D-Zn	mg/kg/wk	0.000	0.000036	0.000050	0.000015	0.000015	0.000028	0.00098	0.00051	0.00098	0.00049	0.00049	0.00050

Notes: All* excludes the first 10 cycles (which represent the flushing of surface oxidation products) and the recirculation cycles.

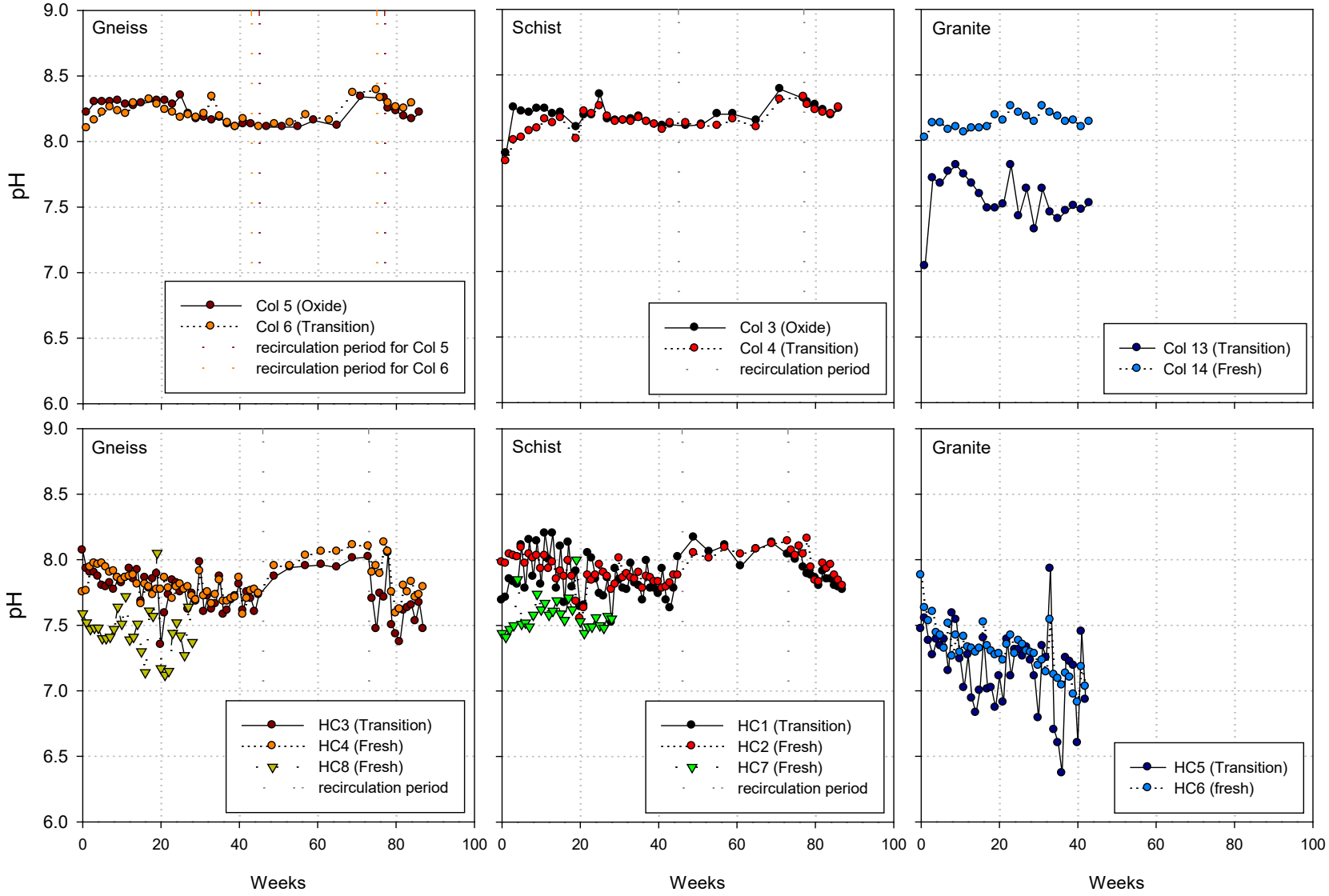

Figure 4-10: Leachate pH from gneiss, schist and granite waste rock unsaturated columns and humidity cells.

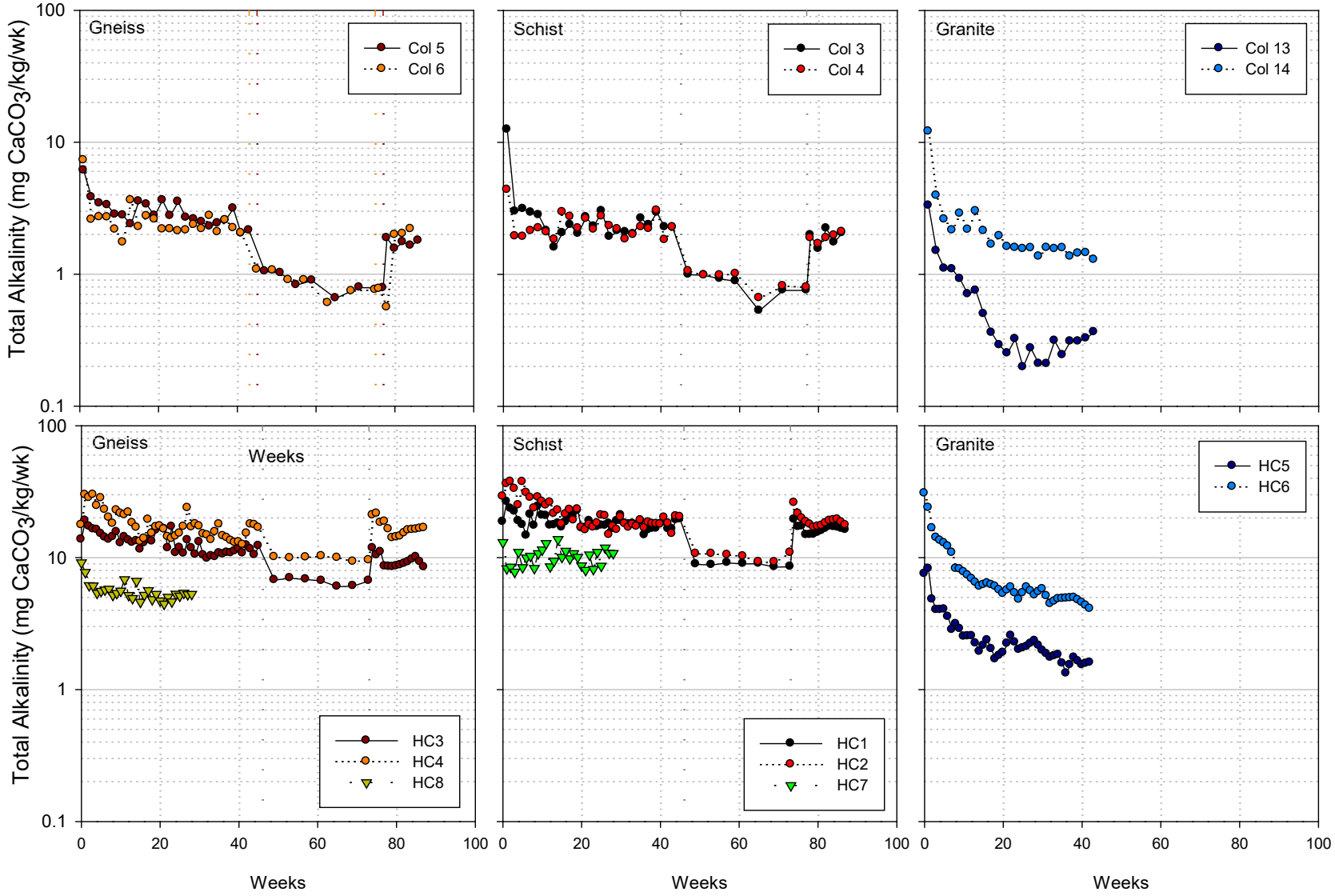

Figure 4-11: Alkalinity loading rates from gneiss, schist and granite waste rock unsaturated columns and humidity cells.

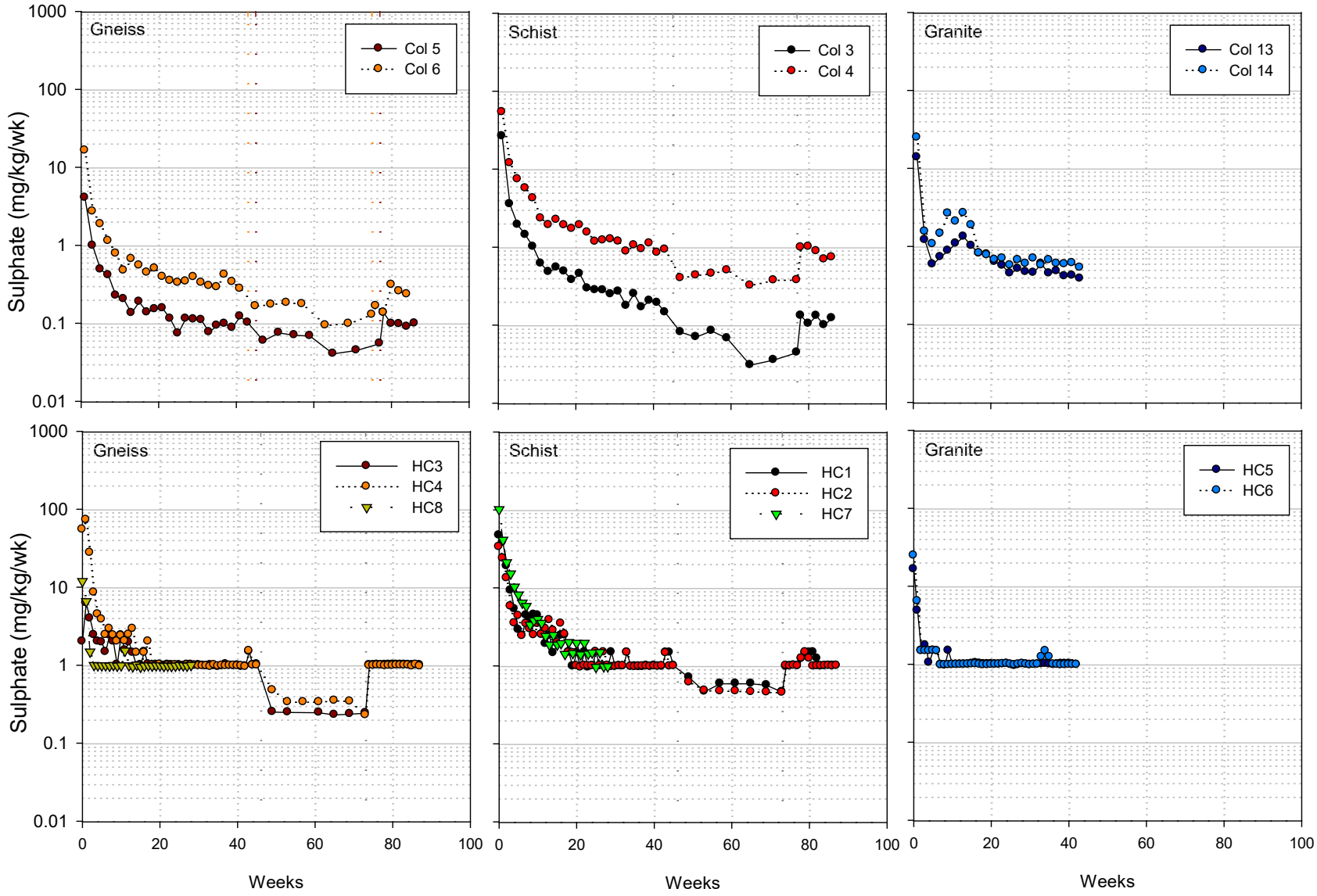

Figure 4-12: Sulphate loading rates from gneiss, schist and granite waste rock unsaturated columns and humidity cells

Metal Leaching Results

Potential metals of concern identified during static testwork include As, Sb, Cr, U and possibly Hg (Section 4.1.4 and 4.1.5). Loading rates for Hg decrease rapidly to below the analytical detection limit (0.01 µg/L; Appendix D.1) from all waste rock kinetic tests following the initial flushing of surface oxidation products. Time series profiles for the other parameters (As, Sb, Cr and U) from the waste rock kinetic tests are shown in Figure 4-13 (columns) and Figure 4-14 (humidity cells). Kinetic test results show that metal loading rates are affected by both rock type and the kinetic test procedure (i.e., humidity cell versus column).

The highest As loading rates are observed in the granite humidity cells and columns, which is consistent with SFE results but not necessarily solid phase metal abundance. Several kinetic test samples (Col 5, Col 3, and HC7) have higher As content than the granite samples but are producing lower As loading rates. This result can be related to differences in pH and Fe abundance, which will be discussed in more detail in Section 5.1.4.1.

Antimony loading rates vary widely between different kinetic tests. Column results Figure 4-14 generally show similar Sb loading rates for the three major lithologies. There is some indication that higher loading rates are associated with less weathered mine rock. This result is inconsistent with relative Sb enrichment in Sb test samples, as Sb content has a relationship with the degree of weathering.

Chromium loading rates are generally highest in the schist lithology, as indicated by column results. However, leachate concentrations are relatively low even in the schist columns, with the maximum concentration after the first flush being 0.00102 mg/L. Humidity cells generally produced Cr concentrations at or below the detection limit of 0.00003 mg/L, confounding any comparison between rock units.

The highest U loadings are generally observed in the gneiss lithology. The granite lithology, which contains similar solid phase U concentrations, produced a wide range of U loading rates. This variation in U loading rates can be related to alkalinity. That is, granite kinetic tests Col 13 and HC6 which are producing relatively high U loading rates, compared to Col 15 and HC5, are also producing relatively high alkalinity loading rates. This result is related to alkalinity supporting uranium solubility in neutral pH environments.

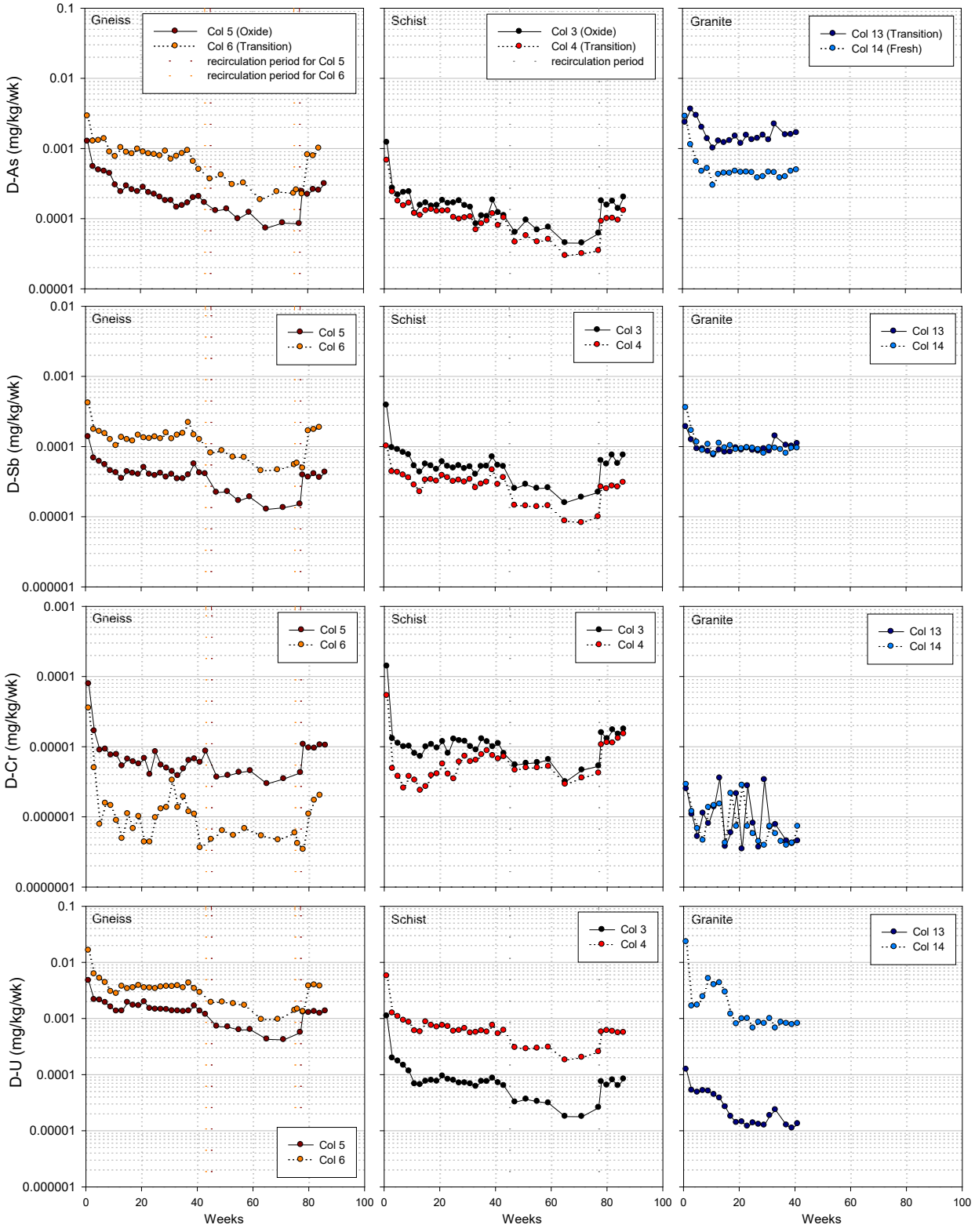

Figure 4-13: Metal (As, Sb, Cr and U) loading rates from gneiss, schist and granite waste rock unsaturated columns

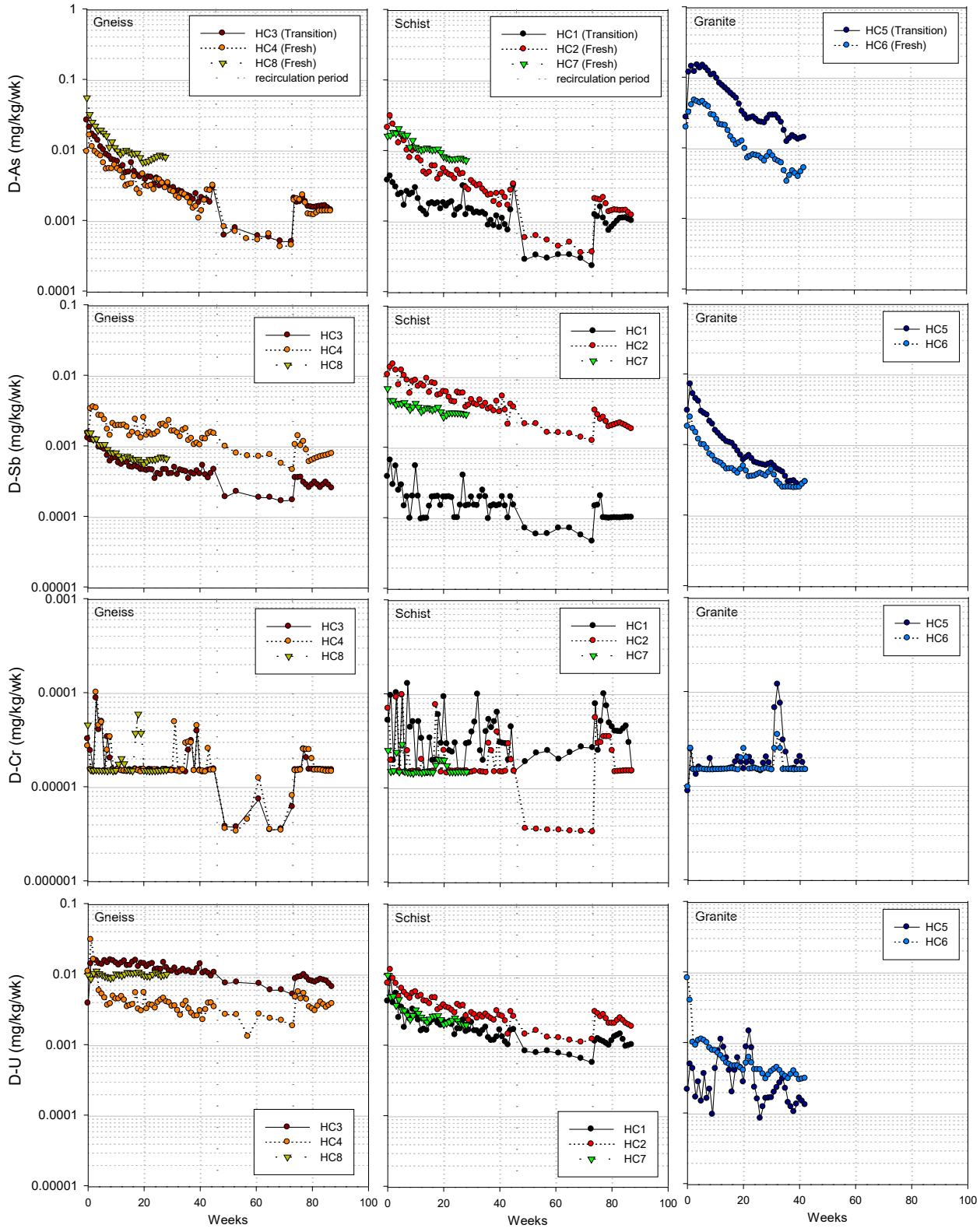

Figure 4-14: Metal (As, Sb, Cr and U) loading rates from gneiss, schist and granite waste rock humidity cells

In general, kinetic tests composed of the same test sub-samples are producing similar results with respect to leachate quality. In particular, preliminary data for the field kinetic tests (presented in Section 4.1.5.4), which are subjected to the actual site conditions and precipitation rates, support the results produced by the controlled (increased weathering) laboratory kinetic tests. Specifically, the highest As concentrations are leaching from field and laboratory kinetic tests composed of granite waste rock, in particular the transition facies and the highest Sb concentrations are produced by the schist fresh facies kinetic tests. The highest U concentrations are produced by the gneiss waste rock, transition and fresh facies, as well as the fresh facies for the schist and granite waste rock. The gneiss and schist oxide facies kinetic tests are producing the highest Cr concentrations and the lowest As and Sb concentrations (as well as the lowest U for the schist oxide).

Furthermore, the highest sulphate concentrations are produced by the gneiss and schist fresh facies kinetic tests and Mn tends to be elevated in all the granite transition and fresh facies kinetic tests compared to the gneiss and schist kinetic tests.

Recirculation Experiment

The gneiss and schist waste rock unsaturated columns and humidity cell tests were subjected to recirculation periods (Table 4-30) that involved recirculating the weekly (or biweekly) effluent (leachate) as influent to the tests. The objective of the recirculation experiment was to simulate a slower flowrate and therefore a longer residence time to allow for assessment of whether the leachate chemistry produced by the kinetic tests are controlled primarily by the kinetic loading rates or by pH related solubility influences.

Table 4-30 presents the final loading rate prior to the recirculation experiment (*i.e.,* reduction in flow rate), the final loading rate of the recirculation experiment and the median value for the recirculation period. The calculated differences between the final loading rate prior to the experiment and the final and median loading rates of the recirculation period are highlighted in yellow in Table 4-30. The recirculation periods are marked on the time series plots by dashed vertical lines (Figure 4-10 to Figure 4-14).

All kinetic tests show a slight increase in pH over the recirculation period. The increase in pH is particularly evident for the gneiss transition and fresh facies humidity cell tests, which increase by approximately half a pH unit. Loading rates for alkalinity, sulphate and nearly all metals decrease following the reduced flow conditions in the unsaturated waste rock laboratory kinetic tests (Table 4-30), with the majority of parameters from the waste rock columns and humidity cells decreasing by more than 50% (i.e., Diff of -50 or lower) by the final cycle of the recirculation period. For humidity cell tests comprising gneiss waste rock, many parameters decrease by more than 75%. Of note, are the increases in Cr from Col 6 (gneiss transition) and HC1 (schist transition) and the increase in Mo from HC2

(schist fresh). Other parameters such as Cd show increased, but fluctuating, loading rates over the recirculation period (Appendix D.1). The largest production decreases from the gneiss and schist waste rock columns are for Mn, Ni, Se, Ag and, to a lesser degree, Sb and Cu (as well as sulphate from schist oxide, Col 3). The largest decreases from the gneiss and schist humidity cells are for Al, As, Cd and Hg (>76%) as well as sulphate, Cu, Ni and Zn production rates from both gneiss waste rock humidity cells (HC3 and HC4).

Table 4-31 presents the concentrations prior to and during the recirculation experiment and the calculated percent differences (highlighted in yellow in Table 4-31). Time series profiles for leachate concentrations are presented in Appendix D.1. Concentrations for many parameters from the waste rock kinetic tests, particularly the columns, remain relatively unchanged (a percent difference of 0 indicates no change in concentration over the recirculation period), further supporting that metal release is primarily controlled by flushing rates and sample mass (i.e., solubility controls). Moreover, a pronounced increase in pH and alkalinity is observed for the humidity cells over the recirculation period, consistent with the increase in several metals over the same time frame, namely anion forming metals (i.e., Sb, As, Cr, Mo, U) (Table 4-31; Appendix D.1). In columns where pH and alkalinity remain relatively stable during the re-circulation time period, no such increase in anion forming metal concentrations is observed.

Table 4-30:
Loading Rate and Percent Differences for Recirculation Experiment for Gneiss and Schist Waste Rock Kinetic Tests

Kinetic Test	Loading Rates	pH	Cond.	Alkalinity (as $CaCO_3$)	Sulphate	Al	Sb	As	Cd	Cr	Cu	Fe	Mn	Hg	Mo	Ni	Se*	Ag	U	Zn
		s.u.	µS/cm	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	µg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
Unsaturated Columns																				
Gneiss Oxide (Col 5)	Cycle immediately before recirculation period (Cycle 43)	8.1	278	2.1	0.10	0.000074	0.000041	0.00017	0.000000044	0.0000086	0.000017	0.00010	0.0000088	0.00015	0.00030	0.0000058	0.0000012	0.000000058	0.0012	0.000015
	Final cycle of recirculation period (Cycle 77)	8.3	256	0.78	0.055	0.000040	0.000015	0.000084	0.000000021	0.0000042	0.0000077	0.000048	0.0000013	0.000068	0.00015	0.0000014	0.00000048	0.000000014	0.00056	0.0000068
	Median for recirculation period (cycles 45-77)	8.1	256	0.83	0.060	0.000043	0.000017	0.000099	0.000000084	0.0000039	0.0000071	0.000049	0.0000018	0.000084	0.00019	0.0000015	0.00000051	0.000000017	0.00063	0.0000070
	% Change of Final Recirculation Cycle		-8.2	-64	-46	-46	-63	-50	-53	-50	-56	-53	-85	-53	-51	-76	-61	-76	-52	-53
	% Change of Median for Recirculation Period		-8.2	-61	-41	-42	-59	-41	93	-55	-59	-52	-80	-42	-38	-74	-58	-71	-47	-52
Gneiss Transition (Col 6)	Cycle immediately before recirculation period (Cycle 41)	8.2	343	2.0	0.28	0.00010	0.00012	0.00050	0.000000036	0.00000036	0.000014	0.000084	0.0000088	0.00012	0.00027	0.0000060	0.0000023	0.000000036	0.0029	0.000012
	Final cycle of recirculation period (Cycle 75)	8.4	316	0.76	0.13	0.000044	0.000055	0.00023	0.000000018	0.00000058	0.0000041	0.000041	0.00000058	0.000058	0.000094	0.0000012	0.00000064	0.000000012	0.0014	0.0000058
	Median for recirculation period (cycles 43-75)	8.2	310	0.90	0.17	0.000059	0.000070	0.00030	0.000000042	0.00000058	0.0000047	0.000047	0.0000038	0.000068	0.00014	0.0000020	0.00000088	0.000000016	0.0017	0.0000068
	% Change of Final Recirculation Cycle		-7.8	-63	-54	-57	-56	-54	-51	62	-72	-51	-93	-51	-65	-81	-72	-68	-52	-51
	% Change of Median for Recirculation Period		-9.6	-56	-40	-42	-44	-39	13	50	-67	-44	-73	-44	-50	-66	-62	-56	-41	-44
Schist Oxide (Col 3)	Cycle immediately before recirculation period (Cycle 43)	8.1	318	2.3	0.15	0.000072	0.000052	0.00011	0.000000040	0.0000080	0.000020	0.000093	0.0000073	0.00013	0.000041	0.0000053	0.0000040	0.000000040	0.000063	0.000013
	Final cycle of recirculation period (Cycle 77)	8.3	263	0.76	0.044	0.000039	0.000022	0.000061	0.000000019	0.0000053	0.0000062	0.000044	0.0000011	0.000063	0.000025	0.0000013	0.00000082	0.000000013	0.000026	0.0000063
	Median for recirculation period (cycles 45-77)	8.2	269	0.89	0.068	0.000039	0.000025	0.000063	0.000000021	0.0000055	0.0000068	0.000047	0.0000018	0.000070	0.000025	0.0000014	0.0000011	0.000000014	0.000031	0.0000070
	% Change of Final Recirculation Cycle		-17	-67	-70	-46	-57	-44	-52	-34	-69	-52	-85	-52	-39	-76	-79	-68	-59	-52
	% Change of Median for Recirculation Period		-16	-61	-54	-46	-51	-42	-47	-31	-66	-49	-75	-47	-39	-75	-72	-65	-51	-47
Schist Transition (Col 4)	Cycle immediately before recirculation period (Cycle 43)	8.1	375	2.3	0.93	0.00010	0.000036	0.00010	0.000000049	0.0000072	0.000027	0.00011	0.000021	0.00016	0.00043	0.000021	0.0000060	0.00000013	0.00061	0.000016
	Final cycle of recirculation period (Cycle 77)	8.3	365	0.79	0.38	0.000036	0.0000099	0.000035	0.000000021	0.0000042	0.0000071	0.000050	0.0000015	0.000071	0.000092	0.0000057	0.0000023	0.000000014	0.00025	0.0000071
	Median for recirculation period (cycles 45-77)	8.1	365	0.98	0.40	0.000044	0.000014	0.000046	0.000000041	0.0000046	0.0000071	0.000055	0.0000041	0.000081	0.00015	0.0000075	0.0000030	0.000000024	0.00029	0.0000081
	% Change of Final Recirculation Cycle		-2.7	-65	-59	-65	-72	-66	-56	-42	-74	-56	-93	-56	-78	-73	-61	-89	-59	-56
	% Change of Median for Recirculation Period		-2.7	-57	-57	-58	-61	-55	-17	-36	-74	-52	-80	-50	-65	-64	-50	-81	-53	-50
Humidity Cells																				
Gneiss Transition (HC3)	Cycle immediately before recirculation period (Cycle 45)	7.7	38	12	1.0	0.0096	0.00046	0.0030	0.0000015	0.000015	0.00033	0.0036	0.0034	0.0051	0.00031	0.000051	0.0005*	0.0000010	0.010	0.0010
	Final cycle of recirculation period (Cycle 73)	8.0	98	6.7	0.24	0.0015	0.00017	0.00050	0.00000036	0.0000061	0.000047	0.0022	0.0015	0.0012	0.00024	0.000012	0.000017	0.00000036	0.0051	0.00012
	Median for recirculation period (cycles 46-73)	8.0	106	6.7	0.24	0.0015	0.00018	0.00059	0.00000036	0.0000037	0.000047	0.00086	0.0015	0.0012	0.00019	0.000012	0.0000050	0.00000025	0.0059	0.00012
	% Change of Final Recirculation Cycle		157	-46	-76	-84	-63	-83	-76	-60	-86	-39	-55	-76	-21	-76	*NA*	-64	-51	-88
	% Change of Median for Recirculation Period		181	-45	-76	-85	-60	-80	-76	-76	-86	-76	-55	-76	-39	-76	*NA*	-76	-43	-88
Gneiss Fresh (HC4)	Cycle immediately before recirculation period (Cycle 45)	7.7	62	17	0.99	0.021	0.0015	0.0031	0.0000015	0.000015	0.00020	0.0035	0.0047	0.0050	0.00032	0.000050	0.0005*	0.00000099	0.0034	0.00050
	Final cycle of recirculation period (Cycle 73)	8.1	145	9.5	0.23	0.0014	0.00046	0.00044	0.00000034	0.0000080	0.000043	0.0025	0.0018	0.0011	0.00025	0.000011	0.000020	0.00000023	0.0018	0.00011
	Median for recirculation period (cycles 46-73)	8.1	172	9.9	0.33	0.0015	0.00071	0.00055	0.00000035	0.0000036	0.000040	0.00080	0.0018	0.0011	0.00022	0.000022	0.0000089	0.00000024	0.0023	0.00011
	% Change of Final Recirculation Cycle		137	-43	-77	-93	-69	-86	-77	-46	-78	-28	-62	-77	-21	-77	*NA*	-77	-46	-77
	% Change of Median for Recirculation Period		179	-41	-66	-93	-52	-83	-77	-76	-80	-77	-62	-77	-29	-55	*NA*	-76	-32	-77
Schist Transition (HC1)	Cycle immediately before recirculation period (Cycle 45)	8.0	73	20	1.0	0.013	0.00015	0.0032	0.0000015	0.000015	0.00017	0.0035	0.0016	0.0050	0.00077	0.000050	0.0005*	0.0000010	0.0017	0.00050
	Final cycle of recirculation period (Cycle 73)	8.0	138	8.5	0.46	0.0022	0.000046	0.00023	0.00000035	0.000026	0.000071	0.00092	0.00058	0.0012	0.00035	0.000012	0.000028	0.0000015	0.00056	0.00023
	Median for recirculation period (cycles 46-73)	8.1	161	8.9	0.59	0.0012	0.000059	0.00029	0.00000035	0.000024	0.000041	0.00082	0.00046	0.0012	0.00029	0.000024	0.000018	0.00000024	0.00076	0.00012
	% Change of Final Recirculation Cycle		89	-56	-54	-83	-69	-93	-77	76	-57	-74	-63	-77	-55	-77	*NA*	50	-66	-54
	% Change of Median for Recirculation Period		121	-54	-41	-91	-61	-91	-77	57	-75	-77	-71	-77	-62	-53	*NA*	-77	-54	-77
Schist Fresh (HC2)	Cycle immediately before recirculation period (Cycle 45)	7.9	73	20	0.99	0.020	0.0037	0.0033	0.0000015	0.000015	0.00020	0.0035	0.0064	0.0050	0.000050	0.00020	0.0005*	0.00000099	0.0025	0.0015
	Final cycle of recirculation period (Cycle 73)	8.1	172	11	0.45	0.0012	0.0012	0.00036	0.00000034	0.0000034	0.00012	0.0045	0.0034	0.0011	0.00017	0.00017	0.000012	0.00000034	0.0012	0.00023
	Median for recirculation period (cycles 46-73)	8.1	172	10	0.47	0.0015	0.0016	0.00049	0.00000036	0.0000035	0.000052	0.00082	0.0037	0.0012	0.000052	0.00020	0.0000069	0.00000024	0.0013	0.00012
	% Change of Final Recirculation Cycle		134	-46	-55	-94	-67	-89	-77	-77	-40	30	-47	-77	243	-15	*NA*	-66	-52	-85
	% Change of Median for Recirculation Period		134	-48	-53	-93	-57	-85	-76	-76	-75	-76	-42	-76	4.4	0.88	*NA*	-76	-50	-92

Notes: Negative values represent a decrease in production rates; percent difference values are highlighted, * a high detection limit of 0.001 mg/L was often applied for Se analyses; as a result, for all columns, the second to last cycle prior to the recirculation period (which provided a measurable value) was applied for calculation of percent differences; however, for humidity cells, the 13 cycles prior to the recirculation period applied the high detection limit (*i.e.* 0.0005 mg/kg/wk) which is considered to be a disproportionately high value to use in the calculation of percent differences.

Table 4-31:
Concentrations and Percent Differences for Recirculation Experiment for Gneiss and Schist Waste Rock Kinetic Tests

Kinetic Test	Concentrations	pH	Cond.	Alkalinity (as $CaCO_3$)	Sulphate	Al	Sb	As	Cd	Cr	Cu	Fe	Mn	Hg	Mo	Ni	Se*	Ag	U	Zn
		s.u.	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Unsaturated Columns																				
Gneiss Oxide (Col 5)	Cycle immediately before recirculation period (Cycle 43)	8.1	278	148	7.0	0.0051	0.0028	0.012	0.0000030	0.00059	0.0012	0.0070	0.00061	0.010	0.021	0.00040	0.000090	0.0000040	0.081	0.0010
	Final cycle of recirculation period (Cycle 77)	8.3	256	114	8.0	0.0058	0.0022	0.012	0.0000030	0.00062	0.0011	0.0070	0.00019	0.010	0.022	0.00020	0.000070	0.0000020	0.082	0.0010
	Median for recirculation period (cycles 45-77)	8.1	256	122	8.0	0.0066	0.0025	0.015	0.000010	0.00059	0.0011	0.0070	0.00027	0.010	0.026	0.00020	0.000070	0.0000020	0.084	0.0010
	% Change of Final Recirculation Cycle		-8.2	-23	14	14	-21	6.0	0	5.1	-5.9	0	-69	0	3.4	-50	-22	-50	1.1	0
	% Change of Median for Recirculation Period		-8.2	-18	14	29	-11	31	233	0	-6.7	0	-56	0	24	-50	-22	-50	3.3	0
Gneiss Transition (Col 6)	Cycle immediately before recirculation period (Cycle 43)	8.2	343	170	23	0.0085	0.010	0.042	0.0000030	0.000030	0.0012	0.0070	0.00073	0.010	0.022	0.00050	0.00017	0.0000030	0.24	0.0010
	Final cycle of recirculation period (Cycle 77)	8.4	316	130	22	0.0075	0.0094	0.039	0.0000030	0.00010	0.00070	0.0070	0.00010	0.010	0.016	0.00020	0.00011	0.0000020	0.24	0.0010
	Median for recirculation period (cycles 45-77)	8.2	310	135	22	0.0086	0.010	0.046	0.0000060	0.00010	0.00070	0.0070	0.00030	0.010	0.020	0.00030	0.00013	0.0000020	0.24	0.0010
	% Change of Final Recirculation Cycle		-7.8	-24	-4.3	-12	-9.6	-6.3	0	233	-42	0	-86	0	-28	-60	-35	-33	-1.3	0
	% Change of Median for Recirculation Period		-9.6	-21	-4.3	1.2	-0.96	11	100	233	-42	0	-59	0	-10	-40	-24	-33	1.3	0
Schist Oxide (Col 3)	Cycle immediately before recirculation period (Cycle 43)	8.1	318	171	11	0.0054	0.0039	0.0083	0.0000030	0.00060	0.0015	0.0070	0.00055	0.010	0.0031	0.00040	0.00029	0.0000030	0.0048	0.0010
	Final cycle of recirculation period (Cycle 77)	8.3	263	119	7.0	0.0061	0.0035	0.0097	0.0000030	0.00083	0.00098	0.0070	0.00017	0.010	0.0040	0.00020	0.00013	0.0000020	0.0041	0.0010
	Median for recirculation period (cycles 45-77)	8.2	269	135	10	0.0065	0.0037	0.0098	0.0000030	0.00083	0.0010	0.0070	0.00025	0.010	0.0040	0.00020	0.00017	0.0000020	0.0046	0.0010
	% Change of Final Recirculation Cycle		-17	-30	-36	13	-10	17	0	38	-35	0	-69	0	28	-50	-55	-33	-15	0
	% Change of Median for Recirculation Period		-16	-21	-9.1	20	-5.1	18	0	38	-33	0	-55	0	28	-50	-41	-33	-3.6	0
Schist Transition (Col 4)	Cycle immediately before recirculation period (Cycle 43)	8.1	375	140	57	0.0064	0.0022	0.0063	0.0000030	0.00044	0.0017	0.0070	0.0013	0.010	0.026	0.0013	0.00046	0.0000080	0.038	0.0010
	Final cycle of recirculation period (Cycle 77)	8.3	365	112	53	0.0051	0.0014	0.0049	0.0000030	0.00059	0.0010	0.0070	0.00021	0.010	0.013	0.00080	0.00033	0.0000020	0.036	0.0010
	Median for recirculation period (cycles 45-77)	8.1	365	124	56	0.0064	0.0017	0.0057	0.0000050	0.00061	0.0011	0.0070	0.00050	0.010	0.018	0.0010	0.00036	0.0000030	0.036	0.0010
	% Change of Final Recirculation Cycle		-2.7	-20	-7.0	-20	-36	-22	0	34	-40	0	-84	0	-51	-38	-28	-75	-4.8	0
	% Change of Median for Recirculation Period		-2.7	-11	-1.8	0.00	-23	-9.5	67	39	-32	0	-61	0	-30	-23	-22	-63	-4.8	0
Humidity Cells																				
Gneiss Transition (HC3)	Cycle immediately before recirculation period (Cycle 45)	7.7	38	24	2.0	0.019	0.00090	0.0058	0.0000030	0.000030	0.00064	0.0070	0.0066	0.010	0.00060	0.00010	0.0010*	0.0000020	0.021	0.0020
	Final cycle of recirculation period (Cycle 73)	8.0	98	55	2.0	0.012	0.0014	0.0041	0.0000030	0.000050	0.00039	0.018	0.012	0.010	0.0020	0.00010	0.00014	0.0000030	0.042	0.0010
	Median for recirculation period (cycles 46-73)	8.0	106	54	2.0	0.012	0.0015	0.0049	0.0000030	0.000030	0.00045	0.0070	0.014	0.010	0.0016	0.00010	0.000045	0.0000020	0.055	0.0010
	% Change of Final Recirculation Cycle		157	129	0	-35	56	-29	0	67	-39	157	87	0	232	0	*NA*	50	107	-50
	% Change of Median for Recirculation Period		181	127	0	-35	67	-16	0	0	-30	0	105	0	167	0	*NA*	0	170	-50
Gneiss Fresh (HC4)	Cycle immediately before recirculation period (Cycle 45)	7.7	62	34	2.0	0.043	0.0030	0.0063	0.0000030	0.000030	0.00040	0.0070	0.0095	0.010	0.00064	0.00010	0.0010*	0.0000020	0.0069	0.0010
	Final cycle of recirculation period (Cycle 73)	8.1	145	84	2.0	0.012	0.0040	0.0039	0.0000030	0.000070	0.00038	0.022	0.016	0.010	0.0022	0.00010	0.00018	0.0000020	0.016	0.0010
	Median for recirculation period (cycles 46-73)	8.1	172	86	3.0	0.013	0.0064	0.0049	0.0000030	0.000030	0.00035	0.0070	0.016	0.010	0.0020	0.00020	0.000080	0.0000020	0.020	0.0010
	% Change of Final Recirculation Cycle		137	147	0	-71	33	-38	0	133	-5.0	214	64	0	244	0.00	*NA*	0	133	0
	% Change of Median for Recirculation Period		179	152	50	-69	113	-22	0	0	-13	0	64	0	214	100	*NA*	0	192	0
Schist Transition (HC1)	Cycle immediately before recirculation period (Cycle 45)	8.0	73	39	2.0	0.026	0.00030	0.0064	0.0000030	0.000030	0.00033	0.0070	0.0032	0.010	0.0015	0.00010	0.0010*	0.0000020	0.0033	0.0010
	Final cycle of recirculation period (Cycle 73)	8.0	138	74	4.0	0.019	0.00040	0.0020	0.0000030	0.00023	0.00062	0.0080	0.0050	0.010	0.0030	0.00010	0.00024	0.000013	0.0049	0.0020
	Median for recirculation period (cycles 46-73)	8.1	161	76	5.0	0.010	0.00050	0.0026	0.0000030	0.00020	0.00035	0.0070	0.0039	0.010	0.0025	0.00020	0.00015	0.0000020	0.0065	0.0010
	% Change of Final Recirculation Cycle		89	90	100	-26	33	-69	0	667	88	14	59	0	97	0	*NA*	550	48	100
	% Change of Median for Recirculation Period		121	94	150	-61	67	-59	0	567	6.1	0	23	0	61	100	*NA*	0	96	0
Schist Fresh (HC2)	Cycle immediately before recirculation period (Cycle 45)	7.9	73	41	2.0	0.040	0.0074	0.0067	0.0000030	0.000030	0.00041	0.0070	0.013	0.010	0.00010	0.00040	0.0010*	0.0000020	0.0051	0.0030
	Final cycle of recirculation period (Cycle 73)	8.1	172	97	4.0	0.011	0.011	0.0032	0.0000030	0.000030	0.0011	0.040	0.030	0.010	0.0015	0.0015	0.00011	0.0000030	0.011	0.0020
	Median for recirculation period (cycles 46-73)	8.1	172	87	4.0	0.013	0.014	0.0043	0.0000030	0.000030	0.00045	0.0070	0.031	0.010	0.00044	0.0017	0.000060	0.0000020	0.011	0.0010
	% Change of Final Recirculation Cycle		134	136	100	-72	47	-52	0	0	163	471	132	0	1410	275	*NA*	50	110	-33
	% Change of Median for Recirculation Period		134	112	100	-69	82	-36	0	0	9.8	0	141	0	340	325	*NA*	0	110	-67

Notes: Negative values represent a decrease in concentration; percent difference values are highlighted, * a high detection limit of 0.001 mg/L was often applied for Se analyses; as a result, for all columns, the second to last cycle prior to the recirculation period (which provided a measurable value) was applied for calculation of percent differences; however, for humidity cells, the 13 cycles prior to the recirculation period applied the high detection limit (*i.e.* 0.0005 mg/kg/wk) which is considered to be a disproportionately high value to use in the calculation of percent differences.

4.1.6.4 Field Kinetic Test Results

Leachate chemistry for the field kinetic tests are presented by lithology in Table 4-32 to Table 4-36. The results are compared to MMER (2002) and CCME (2007) water quality guidelines for the protection of aquatic life to highlight the significance of the preliminary field bin leachate data. A summary of the relevant guidelines is presented in Table 4-14.

A number of parameters exceed CCME guidelines in field bin drainage. Parameters which exceed 10x CCME guidelines in gneiss waste rock are As, SO_4 and U. Of these parameters U consistently exceeds 10x CCME in the FB-GT and FB-GS field bins, while As consistently exceeds 10x CCME in FB-GO. In schist field bins, Hg, As, Se and U were observed above 10x CCME. With the exception of U and Zn, these parameters was only observed above 10x CCME on one occasion which was generally the first field bin sample produced from the initial irrigation of the waste rock with DI water after it was packed in the field bin. Uranium consistently exceeded 10x CCME in FB-SS and Zn exceeded 10x CCME in FB-SO on two occasions. In granite field bins As, Mn and SO_4 were found above 10x CCME in multiple samples, and ^{226}Ra and As were found above MMER in the first flush of FB-GGT.

The only field bin to become mildly acidic during the test duration is FB-GGT. This field bin dropped from an initial pH of 7.9 to 5.1, which is near the pH of rainwater (approximately pH 5.6). Most metal concentrations remain relatively unchanged over this pH decline, which the exception of Mn which was relatively low in the first sample and then increased from 3.7 mg/L in the first sample to 25 - 20 mg/L in subsequent samples. Other metal cations, such as Zn, Cr, Cu, Cd and Pb show little, or no increase associated with the pH decline. The low pH produced by FB-GGT is not considered representative of broader granite transition material, as it has a sulphur content that is above the 95th percentile of typical granite transition waste rock (Figure 4-8). Therefore, the mildly acidic pH produced from this kinetic test is not considered representative of what will be produced from stockpiled granite waste rock at site.

Overall, the gneiss waste rock is leaching the highest concentrations of Mo and U, the schist waste rock is leaching the highest concentrations of Sb and Zn, and the granite waste rock is leaching the highest concentrations of As, Mn and ^{226}Ra.

The highest concentrations of parameters are often measured in the first sample from each of the field bins, which is in response to the dissolution of fine particles and secondary surface oxidation products and high TSS leading to a high potential for colloidal particles to pass through the 0.45 µm filter. This is particularly evident for the nitrogen species and dissolved Sb, As, Cu, Hg, Ni and Se which show a decrease in concentration following the initial leachate sample. Other parameters, namely sulphate and dissolved Cr, Mo, U and Zn, show fluctuating levels in leachate from the gneiss and schist field bins over the two field seasons.

Loading rates for gneiss and schist field bins are presented in Table 4-37. These loading rates are calculated excluding the first sample which was collected by irrigating the field bins with DI water immediately after they were built.

Table 4-32:
Leachate Concentrations for Oxide and Transition Gneiss Waste Rock Field Bins

Lithology		Gneiss											
Facies (Field Bin)		Oxide (FB-GO)						Transition (FB-GT)					
Date Sampled		17-Jun-14	25-Sep-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016	17-Jun-14	6-Oct-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016
Volume	L	4	0.55	8.2	5	8.8	11.9	4	1.5	3.8	4	4.2	3.1
pH	s.u.	7.8	8.2	8.3	8.2	8.2	8.0	7.7	8.1	8.0	7.9	8.0	7.7
Anions and Nutrients													
$Alkalinity_T$	$mgCaCO_3/L$	339	148	114	76	92.7	65.0	243	91	69	63	66.3	40.5
Cl	mg/L	44	14	2.3	2.4	3.74	1.79	20	13	5.3	5.4	3.5	1.16
F	mg/L	0.7	ND	0.58	0.87	0.865	0.855	0.51	ND	0.37	0.35	0.463	0.374
NH_3-N	mg/L	0.026	ND	0.01	<0.005	< 0.005	<0.0050	0.0086	0.025	0.0097	<0.005	< 0.005	<0.0050
NO_3-N	mg/L	3.6	0.084	0.0081	0.22	0.292	0.184	0.43	<0.05	<0.005	0.041	0.096	<0.0050
NO_2-N	mg/L	0.14	ND	<0.001	0.0011	ND	ND	0.023	ND	0.0012	<0.002	ND	ND
SO_4	mg/L	109	150	51.8	63.9	76.0	83.4	301	572	310	570	473	250
Dissolved Metals													
Al	mg/L	0.0078	0.0057	0.017	0.048	0.0455	0.0296	0.0091	0.0051	0.0034	0.0049	0.0071	0.0062
Sb	mg/L	0.0081	0.0043	0.0037	0.0041	0.00517	0.00411	0.018	0.01	0.01	0.0073	0.0117	0.00686
As	mg/L	0.047	0.032	0.041	0.066	0.0665	0.0879	0.088	0.045	0.043	0.035	0.0468	0.0440
Ba	mg/L	0.107	0.044	0.015	0.029	0.038	0.033	0.077	0.03	0.02	0.026	0.027	0.037
Cd	mg/L	<0.00002	<0.00001	<0.000005	<0.000005	< 0.000005	<0.0000050	<0.00002	0.000014	<0.000005	0.000019	0.0000109	0.0000184
Cr	mg/L	0.0012	0.0016	0.00028	0.0033	0.0025	0.0024	0.00011	<0.001	<0.0001	0.00022	< 0.001	<0.0010
Co	mg/L	0.0008	<0.0003	0.00012	0.00016	< 0.0003	<0.00030	0.0009	0.0006	0.00014	0.00029	< 0.0003	<0.00030
Cu	mg/L	0.0075	0.0025	0.001	0.0022	0.0023	0.0023	0.01	0.0024	0.0013	0.0018	0.0018	0.0015
Fe	mg/L	<0.01	<0.03	<0.01	0.044	< 0.03	<0.030	<0.01	<0.03	<0.01	<0.01	< 0.03	<0.030
Pb	mg/L	<0.00005	<0.0005	<0.00005	0.00016	< 0.0005	<0.00050	<0.00005	<0.0005	<0.00005	0.000085	< 0.0005	<0.00050
Mn	mg/L	0.027	0.007	0.00018	0.0058	0.00059	0.00082	0.065	0.016	0.0006	0.0075	0.00054	0.00025
Hg	mg/L	0.00023	0.000021	0.000008	0.000011	0.0000065	0.0000051	0.0002	<0.00001	<0.000005	0.000007	< 0.000005	<0.0000050
Mo	mg/L	0.036	0.056	0.058	0.16	0.118	0.129	0.044	0.049	0.046	0.049	0.0602	0.0526
Ni	mg/L	0.0039	0.0013	<0.0005	<0.0005	< 0.001	<0.0010	0.007	0.001	0.001	0.00071	< 0.001	<0.0010
Se	mg/L	0.0049	0.0022	0.00047	0.00033	0.000306	0.000108	0.004	0.002	0.001	0.00044	0.000276	0.000184
Ag	mg/L	<0.00001	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020	<0.00001	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020
U	mg/L	0.13	0.16	0.075	0.067	0.0880	0.0487	0.44	0.59	0.39	0.57	0.470	0.215
Zn	mg/L	0.0044	0.019	<0.001	0.0091	< 0.005	<0.0050	0.0053	0.01	0.0045	0.11	0.0435	0.0556
Radioisotopes													
Ra-226	Bq/L	ND	ND	0.026	0.026	0.019	< 0.01	ND	ND	0.026	0.026	0.033	0.033

Notes: Values in grey italics are below the analytical detection limit; *ND* = no data; all guidelines are for total metals except Al and Fe; values that exceed the MMER (2002) MGS water quality guideline are shaded in grey. Values that exceed the maximum or 30-day CCME (2007) water quality guidelines are shaded in light blue, and by 10 times are shaded in dark blue; guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016); guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI); guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

Table 4-33:
Leachate Concentrations for Fresh Gneiss Waste Rock Field Bins

Lithology		Gneiss					
Facies (Field Bin)		Fresh (FB-GS)					
Date Sampled		17-Jun-14	6-Oct-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016
Volume	L	4	1.5	8	4	3	1.1
pH	s.u.	7.6	7.7	7.9	8.0	8.0	8.0
Anions and Nutrients							
T-Alkalinity	$mgCaCO_3/L$	251	97	62	76	70.7	75.9
Cl	mg/L	17	17	5	2.8	4.9	<5.0
F	mg/L	<0.4	ND	0.43	0.19	0.24	<0.20
NH_3-N	mg/L	0.17	0.012	0.037	<0.005	< 0.005	<0.0050
NO_3-N	mg/L	2.4	1.5	0.72	1.1	1.80	<0.050
NO_2-N	mg/L	0.045	ND	<0.01	<0.005		
SO_4	mg/L	1060	2280	1120	1180	1180	937
Dissolved Metals							
Al	mg/L	0.009	0.005	0.0021	0.0091	< 0.005	<0.0050
Sb	mg/L	0.017	0.012	0.012	0.01	0.0126	0.00994
As	mg/L	0.066	0.015	0.013	0.012	0.0143	0.0103
Ba	mg/L	0.049	<0.02	0.013	0.029	< 0.02	< 0.02
Cd	mg/L	0.000012	<0.00002	<0.000005	0.0000073	0.0000122	0.0000132
Cr	mg/L	<0.0001	<0.001	0.00014	<0.0001	< 0.001	<0.0010
Co	mg/L	0.0017	0.0014	0.00042	0.00035	< 0.0003	<0.00030
Cu	mg/L	0.0072	0.0022	0.0009	0.0013	0.0011	0.0010
Fe	mg/L	<0.01	<0.03	<0.01	<0.01	< 0.03	<0.030
Pb	mg/L	<0.00005	<0.0005	<0.00005	<0.00005	< 0.0005	<0.00050
Mn	mg/L	0.14	0.044	0.006	0.013	0.00192	0.00030
Hg	mg/L	0.00002	<0.00001	<0.000005	<0.000005	< 0.000005	<0.0000050
Mo	mg/L	0.017	0.016	0.013	0.023	0.0302	0.0360
Ni	mg/L	0.011	0.0078	0.0037	0.0028	0.0029	0.0020
Se	mg/L	0.0052	0.0064	0.0014	0.000603	0.000608	0.000437
Ag	mg/L	<0.00001	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020
U	mg/L	0.4	0.75	0.43	0.49	0.443	0.375
Zn	mg/L	0.001	<0.005	0.0016	0.076	0.0461	0.0777
Radioisotopes							
Ra-226	Bq/L	ND	ND	0.06	0.057	0.053	0.033

Table 4-34:
Leachate Concentrations for Oxide and Transition Schist Waste Rock Field Bins

Lithology		Schist											
Facies (Field Bin)		Oxide (FB-SO)						Transition (FB-ST)					
Date Sampled		17-Jun-14	25-Sep-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016	17-Jun-14	25-Sep-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016
Volume	L	4	2	7.8	4	1.2	3.5	4	2	6.2	3	5	3.0
pH	s.u.	7.9	7.7	8.2	8.1	7.8	7.9	7.8	7.8	8.0	7.9	7.9	7.7
Anions and Nutrients													
T-Alkalinity	mg$CaCO_3$/L	499	41	89	85	55.3	47.7	118	46	70	51	65.9	47.3
Cl	mg/L	68	5.9	3.8	2.9	1.66	<0.5	15	5.5	1.7	4.4	2.5	<2.5
F	mg/L	0.69	ND	0.47	0.52	0.392	0.234	0.5	ND	0.41	0.22	0.431	0.29
NH_3-N	mg/L	0.17	<0.005	<0.005	<0.005	ND	<0.005	0.044	<0.005	<0.005	<0.005	<0.005	<0.005
NO_3-N	mg/L	3.2	<0.005	<0.005	<0.005	<0.005	<0.005	0.97	<0.05	<0.005	0.26	0.203	<0.025
NO_2-N	mg/L	0.22	ND	<0.001	<0.001	ND	ND	0.014	ND	<0.001	<0.002	ND	ND
SO_4	mg/L	732	133	158	109	62.2	21.9	516	633	416	575	512	366
Dissolved Metals													
Al	mg/L	0.0063	0.024	0.0033	0.003	0.0192	0.0246	0.011	0.014	0.0026	0.0023	0.0065	<0.0050
Sb	mg/L	0.009	0.0012	0.0032	0.003	0.00201	0.00181	0.0023	0.0015	0.0018	0.0013	0.00242	0.00106
As	mg/L	0.031	0.004	0.010	0.0092	0.00685	0.00702	0.013	0.0025	0.0033	0.0022	0.00371	0.00232
Ba	mg/L	0.089	0.03	0.013	0.054	0.034	0.040	0.052	0.029	0.023	0.034	0.041	0.044
Cd	mg/L	0.000013	0.000023	<0.000005	0.0000061	0.0000110	<0.0000050	<0.00001	0.000021	<0.000005	0.000013	<0.000005	0.0000119
Cr	mg/L	0.0015	<0.001	0.00089	0.0023	<0.001	<0.001	<0.0001	<0.001	0.00013	0.00052	<0.001	<0.001
Co	mg/L	0.0015	0.0008	<0.0001	0.00012	0.00033	<0.00030	0.001	0.00036	0.00012	0.00018	< 0.0003	<0.00030
Cu	mg/L	0.006	0.003	0.0006	0.00063	0.0016	<0.0010	0.0061	0.0016	0.00074	0.00087	0.0021	<0.0010
Fe	mg/L	<0.01	0.074	<0.01	<0.01	0.039	0.056	<0.01	0.032	<0.01	<0.01	<0.03	<0.030
Pb	mg/L	<0.00005	0.00084	<0.00005	0.00013	0.00079	<0.00050	<0.00005	0.00067	<0.00005	0.000053	0.00122	<0.00050
Mn	mg/L	0.036	0.096	0.0014	0.011	0.0528	0.0197	0.049	0.036	0.0021	0.02	0.00495	0.00307
Hg	mg/L	0.00031	0.000059	0.000009	0.0000052	< 0.000005	0.0000059	0.000019	<0.00001	<0.000005	<0.000005	<0.000005	<0.000005
Mo	mg/L	0.0037	0.0011	0.0052	0.0059	0.0032	0.0023	0.023	0.015	0.022	0.016	0.0277	0.0182
Ni	mg/L	0.005	<0.001	<0.0005	<0.0005	< 0.001	<0.0010	0.012	0.0024	0.0013	0.0013	0.0024	<0.0010
Se	mg/L	0.008	0.0011	0.00095	0.00031	0.000131	0.000058	0.013	0.0069	0.0015	0.0024	0.00108	0.000481
Ag	mg/L	<0.00001	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020	<0.00001	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020
U	mg/L	0.032	0.0036	0.0052	0.0062	0.00332	0.00199	0.047	0.064	0.044	0.045	0.0458	0.0230
Zn	mg/L	0.0026	0.56	0.024	0.15	0.325	0.0076	<0.001	0.21	0.030	0.11	0.0383	0.0449
Radioisotopes													
Ra-226	Bq/L	ND	ND	<0.01	0.011	0.013	< 0.01	ND	ND	0.025	0.023	0.016	0.021

Notes: Values in grey italics are below the analytical detection limit; *ND* = no data; all guidelines are for total metals except Al and Fe; values that exceed the MMER (2002) MGS water quality guideline are shaded in grey. Values that exceed the maximum or 30-day CCME (2007) water quality guidelines are shaded in light blue, and by 10 times are shaded in dark blue; guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016); guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI); guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

Table 4-35:
Leachate Concentrations for Fresh Schist Waste Rock Field Bins

Lithology		Schist					
Facies (Field Bin)		Fresh (FB-SS)					
Date Sampled		17-Jun-14	25-Sep-14	4-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016
Volume	L	4	2	7.8	3	3.9	2
pH	s.u.	7.7	7.8	8.1	8.1	8.1	7.9
Anions and Nutrients							
T-Alkalinity	$mgCaCO_3/L$	294	146	79	91	84.9	80.8
Cl	mg/L	24	24	3.8	6.9	5.4	2.6
F	mg/L	0.83	ND	0.36	0.25	0.30	0.23
NH_3-N	mg/L	0.29	ND	0.021	ND	<0.005	<0.005
NO_3-N	mg/L	0.95	<0.1	<0.025	<0.025	< 0.025	<0.025
NO_2-N	mg/L	0.013	ND	<0.005	<0.005	ND	ND
SO_4	mg/L	451	1660	679	882	916	686
Dissolved Metals							
Al	mg/L	0.013	<0.005	0.0017	0.0037	< 0.005	<0.0050
Sb	mg/L	0.059	0.043	0.041	0.025	0.0279	0.0180
As	mg/L	0.088	0.019	0.014	0.0092	0.0108	0.00623
Ba	mg/L	0.055	0.025	0.015	0.023	0.023	0.027
Cd	mg/L	0.000011	<0.00002	<0.000005	<0.000005	< 0.000005	0.0000059
Cr	mg/L	0.00024	<0.001	<0.0001	<0.0001	<0.001	<0.001
Co	mg/L	0.0018	0.0045	0.001	0.0011	< 0.0003	<0.00030
Cu	mg/L	0.011	0.0025	0.00079	0.00096	0.0011	<0.0010
Fe	mg/L	<0.01	<0.03	<0.01	<0.01	< 0.03	<0.030
Pb	mg/L	<0.00005	<0.0005	<0.00005	<0.00005	< 0.0005	<0.00050
Mn	mg/L	0.053	0.15	0.014	0.053	0.00377	0.00031
Hg	mg/L	<0.00001	<0.00001	<0.000005	<0.000005	< 0.000005	<0.0000050
Mo	mg/L	0.012	0.017	0.0081	0.0072	0.0062	0.0092
Ni	mg/L	0.063	0.058	0.021	0.015	0.0140	0.0090
Se	mg/L	0.0054	0.0056	0.00094	0.00049	0.000323	0.000244
Ag	mg/L	0.000013	<0.00002	<0.00001	<0.00001	< 0.00002	<0.000020
U	mg/L	0.13	0.57	0.22	0.25	0.239	0.151
Zn	mg/L	0.002	0.012	0.0013	0.088	0.0631	0.0677
Radioisotopes							
Ra-226	Bq/L	ND	ND	0.016	0.028	0.03	0.024

Table 4-36:
Leachate Concentrations for Granite Waste Rock Field Bins

Lithology		Granite							
Facies (Field Bin)		Fresh (FB-GGT)				Transition (FB-GGS)			
Date Sampled		17-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016	17-Jun-15	22-Oct-15	17-Jun-2016	7-Oct-2016
Volume		4.0.	6	4.5	3.6	1.5	5	3	7.8
pH	s.u.	7.9	6.4	5.32	5.13	8.3	7.7	8.10	7.44
Anions and Nutrients									
T-Alkalinity	mg$CaCO_3$/L	123	1.2	<1	<1	227	41	29.9	20.7
Cl	mg/L	26	6	2.0	<2.5	24	5	1.81	<2.5
F	mg/L	<0.2	0.1	0.082	<0.10	<0.8	0.86	0.803	0.77
NH_3-N	mg/L	1.6	0.73	0.233	<0.005	0.42	0.19	<0.005	<0.005
NO_3-N	mg/L	1.2	0.015	<0.01	<0.025	0.4	0.066	0.253	0.915
NO_2-N	mg/L	0.17	<0.002	ND	ND	0.03	0.07	ND	ND
SO_4	mg/L	317	708	554	424	597	497	225	380
Dissolved Metals									
Al	mg/L	0.012	0.028	0.0434	0.0614	0.0059	0.0037	0.0209	0.0120
Sb	mg/L	0.016	0.0089	0.0107	0.00662	0.0088	0.0073	0.00734	0.00537
As	mg/L	0.64	0.15	0.133	0.105	0.13	0.081	0.0473	0.0374
Ba	mg/L	0.083	0.03	0.039	0.028	0.049	0.027	< 0.02	0.028
Cd	mg/L	0.00011	0.0002	0.000198	0.000135	0.000091	0.000073	0.0000284	0.000105
Cr	mg/L	<0.0001	<0.0005	<0.001	<0.001	<0.0001	<0.0001	<0.001	<0.001
Co	mg/L	0.021	0.074	0.0661	0.0570	0.029	0.0054	0.00095	0.00518
Cu	mg/L	0.0015	0.0011	0.0014	0.0015	0.0025	0.00048	< 0.001	<0.0010
Fe	mg/L	<0.01	0.013	<0.03	0.033	<0.01	<0.01	<0.03	<0.03
Pb	mg/L	<0.00005	<0.00025	<0.0005	<0.0005	0.000053	<0.00005	<0.0005	<0.0005
Mn	mg/L	3.7	25	22.8	20.0	3.7	3.1	1.43	4.92
Hg	mg/L	0.000046	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005	<0.000005
Mo	mg/L	0.00073	0.00045	< 0.001	<0.0010	0.02	0.02	0.0110	0.0087
Ni	mg/L	0.0053	0.02	0.0183	0.0160	0.0031	0.00068	< 0.001	<0.0010
Se	mg/L	0.0011	0.00049	0.00029	<0.00025	0.00056	0.00019	< 0.00005	<0.000050
Ag	mg/L	<0.00001	<0.00005	<0.00005	<0.00005	<0.00001	<0.00001	<0.00002	<0.00002
U	mg/L	0.0058	0.0008	0.00134	0.00271	0.53	0.12	0.0308	0.0128
Zn	mg/L	0.14	0.25	0.227	0.212	0.0068	0.0075	< 0.005	0.0187
Radioisotopes									
Ra-226	Bq/L	0.39	0.099	0.019	0.017	ND	0.028	0.01	0.039

Notes: Values in grey italics are below the analytical detection limit; *ND* = no data; all guidelines are for total metals except Al and Fe; values that exceed the MMER (2002) MGS water quality guideline are shaded in grey. Values that exceed the maximum or 30-day CCME (2007) water quality guidelines are shaded in light blue, and by 10 times are shaded in dark blue; guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016); guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI); guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

Table 4-37:
Loading Rates for Waste Rock Field Kinetic Tests

Lithology		Gneiss			Schist			Granite	
Weathering Facies		Oxide	Transition	Fresh	Oxide	Transition	Fresh	Transition	Fresh
Field Test ID		FB-GO	FB-GT	FB-GS	FB-SO	FB-ST	FB-SS	FB-GGT	FB-GGS
Sulphate	mg/kg/wk	0.11	0.26	0.95	0.10	0.47	0.67	0.67	0.72
P	mg/kg/wk	0.000078	0.00003	0.000039	0.000045	0.000049	0.000039	0.00017	0.000092
Al	mg/kg/wk	0.000052	0.0000032	0.0000035	0.0000094	0.0000051	0.0000027	0.00005	0.00002
Ag	mg/kg/wk	0.000000025	9.2E-09	0.00000001	0.000000012	0.000000015	0.000000011	0.000000058	0.00000003
As	mg/kg/wk	0.00011	0.000026	0.00001	0.0000076	0.0000029	0.0000095	0.00015	0.0001
Ca	mg/kg/wk	0.019	0.05	0.17	0.017	0.093	0.11	0.13	0.2
Cd	mg/kg/wk	0.000000008	7.9E-09	6.6E-09	6.8E-09	8.8E-09	5.2E-09	0.00000021	0.00000015
Co	mg/kg/wk	0.00000041	0.00000027	0.00000042	0.00000023	0.00000031	0.00000087	0.000077	0.0000082
Cr	mg/kg/wk	0.0000041	0.00000037	0.00000046	0.0000012	0.00000075	0.00000037	0.00000094	0.0000012
Cu	mg/kg/wk	0.0000031	0.00000095	0.0000009	0.0000011	0.0000013	0.00000095	0.0000015	0.0000015
Fe	mg/kg/wk	0.000043	0.000012	0.000013	0.000024	0.00002	0.000014	0.000028	0.000042
Hg	mg/kg/wk	0.000000011	3.6E-09	4.2E-09	0.000000011	5.4E-09	4.3E-09	5.8E-09	9.2E-09
Mg	mg/kg/wk	0.007	0.024	0.12	0.0087	0.052	0.085	0.029	0.033
Mn	mg/kg/wk	0.0000022	0.0000022	0.0000076	0.000018	0.0000089	0.000024	0.026	0.0067
Mo	mg/kg/wk	0.00018	0.000031	0.000015	0.0000037	0.000021	0.0000066	0.00000092	0.000024
Ni	mg/kg/wk	0.0000013	0.00000056	0.0000029	0.00000061	0.0000015	0.000016	0.000021	0.0000016
Pb	mg/kg/wk	0.00000054	0.00000018	0.00000015	0.00000026	0.00000048	0.00000019	0.00000047	0.00000062
Sb	mg/kg/wk	0.0000068	0.0000055	0.0000089	0.0000022	0.0000017	0.000026	0.00001	0.000012
Se	mg/kg/wk	0.00000031	0.00000037	0.00000095	0.00000055	0.000002	0.00000095	0.00000041	0.00000018
Tl	mg/kg/wk	0.00000024	0.00000011	0.0000001	0.00000013	0.00000014	0.00000011	0.00000041	0.00000031
U	mg/kg/wk	0.00011	0.00026	0.00036	0.000004	0.000042	0.0002	0.0000018	0.0001
Zn	mg/kg/wk	0.0000076	0.000029	0.000024	0.000068	0.000044	0.000028	0.00027	0.000022

Note: Loading rates calculated excluding the first flush sample.

4.1.6.5 Comparison of Duplicate Kinetic Tests

To assess scale issues between the measured kinetic test rates and predictions of full scale waste rock storage conditions, duplicate samples of each lithology and weathering facies were submitted in multiple masses for kinetic testing under different operating conditions (i.e., unsaturated columns, humidity cells and field bins) (Table 4-36).

Loading rates measured from duplicate kinetic tests are compared in Table 4-36. This table shows median loading rates measured in laboratory kinetic tests and mean loading rates measured in field bins over the test duration. In general results for SO_4, As, Sb and U show that loading rates decline as kinetic tests become progressively larger. That is, humidity cells have the greatest loading rates, columns have intermediate loading rates and field bins have the lowest field bins. For example, the As loading rate in the gneiss transition humidity cell (HC3) is 2.3 and 17 times greater than that observed in a duplicate column (Col 6) and field bin (FB-GT), respectively. A similar result is observed for U, where HC3 is producing loading rates that are a factor of 3.1 and 38 times greater than Col 6 and FB-GT. The discrepancy between loading rates from duplicate kinetic tests at different scales and operating conditions suggests that loading rates are being affected by solubility constraints.

Arsenic solubility in neutral pH aerobic environments is pH sensitive, with sorption reactions often controlling dissolved concentrations (Pierce and Moore, 1982). Concentrations of As are plotted against pH in Figure 4-15. Note that in this figure and in Figure 4-16, the initial three cycles from laboratory kinetic tests and the first flush from field bins are excluded from the plots. These plots show that a similar concentration range of As is produced in kinetic test leachate where loading rates varied by over an order of magnitude. While there is some variability in the concentration produced by differing kinetic tests, the differences in concentration are smaller in magnitude than the differences in loading rates and can generally be related to pH.

In aerobic pH-neutral to alkaline environments uranium solubility has been shown to be sensitive to pH and alkalinity, with alkalinity general being the more influential (Davis and Curtis, 2003). The relationship between U and Alkalinity is presented in Figure 4-16 for duplicate kinetic tests below. In general, laboratory kinetic tests show a similar relationship between U concentrations and alkalinity, while field bin data deviates from this relationship in most cases. This variation in the relationship between U and alkalinity may be related to the relatively long storage time of field bin leachate. That is, drainage collected in collection jugs may be held for weeks to months in the field between water quality measurements, over this time temperature fluctuations, interaction with atmospheric CO_2 and potential precipitation reactions will affect alkalinity. Note that the first flush sample,

which was collected immediately after field bins were irrigated with DI water shows considerably higher alkalinity values than subsequent measurements (Table 4-32, Table 4-33 and Table 4-34).

Table 4-38:
Comparison of Loading Rates from Duplicate Samples Operated in Kinetic Tests with Different Masses and Operating Procedure

Sample Description	Kinetic Test ID	Mass	Time	Leachate	SO_4	As	Sb	U
		Kg	Week	L	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
Gneiss Oxide	Col 5	10	86	14	0.099	0.00021	0.000040	0.0013
	FB-GO	183	120	38	0.11	0.00011	0.0000068	0.00011
Gneiss Transition	HC3	1.0	87	43	1.0	0.0025	0.00040	0.011
	Col6	10	84	14	0.32	0.00079	0.00014	0.0035
	FB-GT	229	120	20.6	0.26	0.000026	0.0000055	0.00026
Gneiss Fresh	HC4	1.0	87	42	0.98	0.0024	0.0014	0.0036
	FB-GS	190	70	18	0.95	0.00001	0.0000089	0.00036
Schist Oxide	Col 3	10	86	14	0.18	0.00011	0.000050	0.000069
	FB-SO	171	120	22.5	0.10	0.0000076	0.0000022	0.000004
Schist Transition	HC1	1.0	87	43	1.0	0.0012	0.00015	0.0015
	Col 4	10	86	15	1.0	0.00010	0.000031	0.00059
	FB-ST	165	70	23.2	0.47	0.0000029	0.0000017	0.000042
Schist Fresh	HC2	1.0	87	43	0.99	0.0028	0.0040	0.0027
	FB-SS	202	120	22.7	0.67	0.0000095	0.000026	0.00020
Granite Transition	HC5	1.0	42	22	1.0	0.026	0.00054	0.00023
	Col13	10	41	6.2	0.46	0.0015	0.000090	0.000013
	FB-GGT	166	68	14.1	0.67	0.00015	0.00001	0.0000018
Granite Fresh	HC6	1.0	42	22	0.99	0.0076	0.00037	0.00041
	Col 14	10	41	6.6	0.60	0.00045	0.000093	0.00081
	FB-GGS	134	68	17.3	0.72	0.0001	0.000012	0.0001

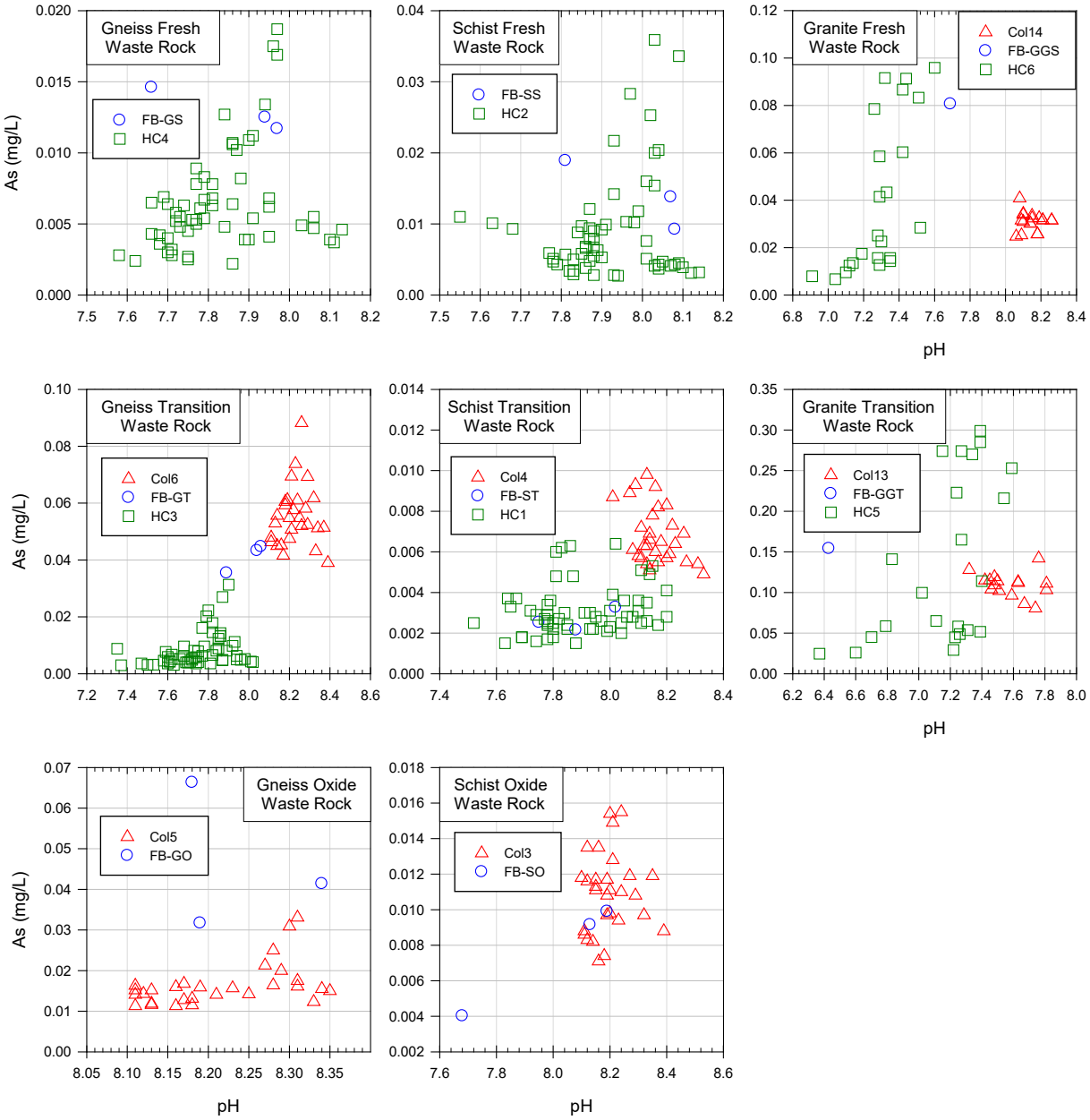

Figure 4-15: Arsenic versus pH measured in duplicate kinetic test samples containing different masses and operated under different procedures

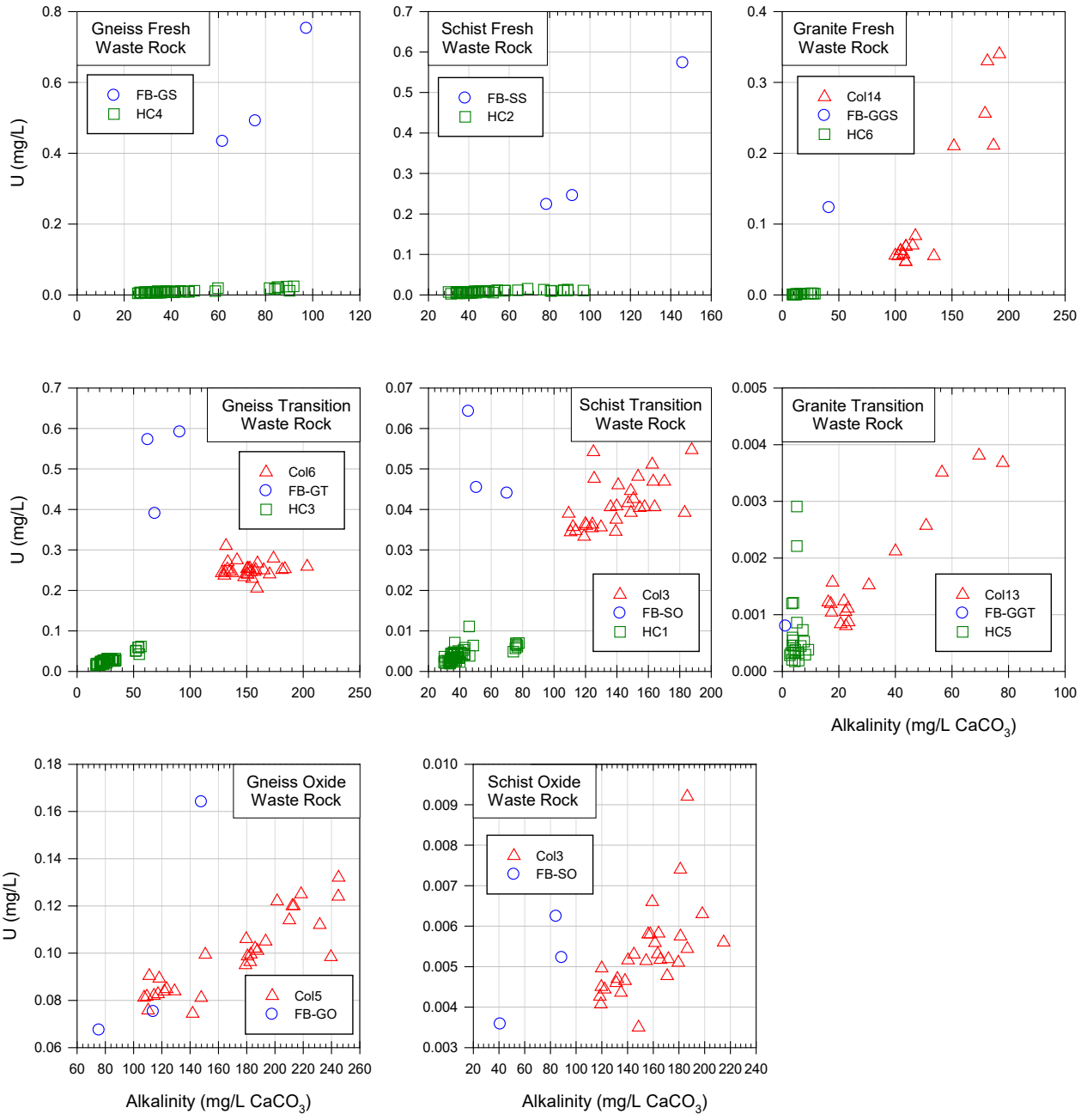

Figure 4-16: Uranium versus alkalinity measured in duplicate kinetic test samples containing different masses and operated under different procedures

4.1.7 Radioisotopes

4.1.7.1 Occurrence

Solid samples of waste rock, ore, and overburden were analyzed for NORM isotopes at SRC. The purpose of this analysis was to determine if geologic material at the Project site exceeds the Health Canada (2011) guidelines for Unconditional Derived Release Limits (UDRLs) of NORM.

The SRC NORM results, along with U and Th concentrations measured in the ICP-OES database, were reviewed by radioisotope specialists at Arcadis Canada Inc. (Arcadis). The elevated U detection limits in the ICP-OES database (10 ppm) did not pose a problem in this analysis, as U typically must be present in concentrations > 10ppm to exceed UDRLs.

The Arcadis review of SRC data and ICP-OES metal assays is provided in Appendix D.1-5. Overall, the data indicate secular equilibrium of the natural U and Th decay series, and there is high confidence that the materials that will be left on site can be considered as unrestricted according to the Canadian NORM Guidelines.

The Arcadis review also concluded that a state of secular equilibrium likely exists in the geologic samples, which has implications for the distribution of other radioisotopes, particularly ^{226}Ra which is regulated under MMER. Because secular equilibrium exists, the activity of ^{226}Ra in host rock can be determined by measurements of U concentration. Hence, the relative enrichment compared of ^{226}Ra and other daughter products of ^{238}U decay chain are directly proportional to the total U.

4.1.7.2 Kinetic Test Leachate

The activity of ^{226}Ra was measured in unfiltered field bin drainage. The relative activities are compared to solid phase U occurrence in the different rock samples (Table 4-25). That is, the schist waste rock field bins have the lowest range of activity (<0.01 Bq/L to 0.028 Bq/L), the gneiss has intermediate activity (0.026 to 0.06 Bq/L) and granite has the highest activity (0.028 Bq/L to 0.39 Bq/L) (Table 4-32, Table 4-33 and Table 4-34). Note that the peak activity of 0.39 Bq/L was observed in an unfiltered sample collected from the first flush of the granite field bin, and likely is an overestimate of dissolved activities.

There is generally a poor relationship between U concentration and ^{226}Ra activity in field bin leachate. For instance, FB-GGT is producing considerably higher ^{226}Ra then FB-GGS, while dissolved U is more than 100x greater in FB-GGS compared to FB-GGT (Table 4-34). In fact, FB-GGT is producing the lowest U concentrations of any of the waste rock field bins. This is related to the differences in chemistry between Ra and U. In aqueous

systems, Ra forms a bivalent cation [Ra(II)] and behaves similar to other alkaline earth metals such as Mg, Sr, Ca and particularly Ba. Conversely, U occurs in multiple oxidation states [U(IV) and U(VI)], and its solubility is dependent on redox potential, pH and complexation reactions with CO_3, PO_4 and SO_4. Hence, although these two parameters co-occur in the solid phase, different mechanisms control their release to pore water and subsequent mobility. Controls on Ra mobility are discussed further in Section 5.1.4.3.

4.2 Ore

4.2.1 Overview of Test Results

As a result of in-situ weathering, sulphide and carbonate minerals have largely been depleted from the ore. However, a few observations can be made, (1) transitional ore has slightly higher S and NP compared to oxide ore; (2) schist ore has the highest NP (51 $kgCaCO_3/t$) compared to gneiss (2.3 $kgCaCO_3/t$) and granite (median of 1.5 $kgCaCO_3/t$) ore; and (3) schist ore has the highest trace S mineralization (median of 0.07 wt.%) compared to gneiss and granite ore (median of 0.01 wt.%). As a result of the low S content, the low NP is sufficient to maintain a neutral drainage pH (rinse pH of 6.7 – 8.7) in gneiss and schist ore samples; therefore, the schist and gneiss ore are classified as non-PAG or non-reactive. Conversely, granite ore, which has the overall lowest NP values and a mildly acidic rinse pH (4.4 - 6.8), is classified as PAG.

Solid phase metal analysis shows the oxide and transition facies are enriched in Sb, As, Bi, Se, Ag and U with respect to ACA. Enrichment of As and Sb is significantly higher in ore compared to waste rock, being two orders of magnitude higher in the ore samples compared to waste rock samples.

Kinetic testing indicates that the mildly acidic conditions produced by granite ore will lead to a significant increase in metal leaching potential. Specifically, the granite transition facies produced acidic drainage (pH 4.5-5.5) over the test period, resulting in increased loads of metal cations (Al, Cd, Co, Cu, Fe, Mn, Ni and Zn) and As loads of up to two orders of magnitude higher than that produced by the schist and gneiss ore. Leachate pH produced by gneiss and schist ore kinetic tests remain slightly alkaline over the test period with metal loadings either gradually decreasing or producing relatively low and stable loading rates. Similar to the waste rock kinetic tests, loading rates from the ore kinetic tests are not proportional to the relative solid phase content of the kinetic test material but rather are influenced by pH conditions within the kinetic test.

4.2.2 Mineral Identification

The following section provides an overview of the mineralogical results of the Project ore lithologies. Mineralogical analysis of the Project ore was carried out on composite head samples developed for metallurgical testing. XRD results for Project ore samples are summarized in Table 4-37. Mineralogical laboratory reports for XRD and assessments completed at the CLS are presented in Appendix B.1 and Appendix B.2, respectively.

4.2.2.1 Gneiss Ore

The gneiss oxide ore sample is composed of quartz, microcline, kaolinite, muscovite and phengite, while the gneiss transition ore sample is composed of quartz, albite, microcline, kaolinite, muscovite, phengite, arsenopyrite, pyrite and carbonate minerals including calcite and dolomite (Table 4-37). The gneiss oxide ore sample is relatively deplete with respect to carbonate minerals.

The gneiss transition ore sample exhibits appreciable carbonate content, with near equal abundances of calcite and dolomite. Sulphide minerals were not detected by XRD in the gneiss oxide ore sample, highlighting limited AP for this material. In contrast, XRD found both pyrite and arsenopyrite in the gneiss transition sample.

4.2.2.2 Schist Ore

The schist oxide ore sample is composed of quartz, microcline, albite, phengite, kaolinite, dolomite, arsenopyrite, pyrite, orthoclase and barite, while the schist transition ore sample is composed of quartz, dolomite, muscovite, kaolinite, phengite, microcline, calcite, biotite, pyrite and barite. Carbonate minerals present in the schist ore include calcite and dolomite (Table 4-37). The carbonate assemblage of the schist oxide ore is composed solely of dolomite, while the schist transition ore exhibits both calcite and dolomite. Overall, the schist transition ore sample has approximately five times greater carbonate abundance relative to the schist oxide ore sample.

Sulphide minerals were detected in both schist ore sample. The schist oxide ore contains pyrite and arsenopyrite, while the schist transition ore contains only pyrite. Barite was detected in both schist oxide and transition ore samples.

4.2.2.3 Granite Ore

The granite oxide ore sample is composed of quartz, phengite, microcline, kaolinite and scorodite, while granite transition ore is characterized as having quartz; muscovite; kaolinite; microcline; orthoclase; and scorodite (Table 4-37). For each of the oxide and transition granite ore samples, carbonate minerals were not identified in XRD scans. Sulphides (as pyrite) were detected for the granite oxide ore material, while sulphides were not detected for the granite transition ore material.

Table 4-39:
XRD Results for Gneiss, Granite and Schist Ore Samples

Lithology		**Gneiss**		**Schist**		**Granite**	
Sample ID		**72144B**	**72146B**	**72135B**	**72137B**	**72139B**	**72140B**
Weathering		**Oxide**	**Transition**	**Oxide**	**Transition**	**Oxide**	**Transition**
Mineral		wt.%					
Calcite	$CaCO_3$		2.5		4		
Dolomite	$(Ca, Mg)CO_3$		3.4	3.5	15		
Pyrite	FeS_2		0.4	0.2	0.9	0.2	
Arsenopyrite	FeAsS		0.9	0.8			
Biotite	$K(Mg,Fe)_3[AlSi_3O_{10}(OH,F)_2$				1.8		
Phengite	$K(Al,Mg)_2(OH)_2(Si,Al)_4O_{10}$	18	7.7	9.2	7.3	22	
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	12	10		13		18
Kaolinite	$Al_2Si_2O_5(OH)_4$	7.2	6.3	10	7.9	12	9.3
Quartz	SiO_2	54	47	48	46	55	56
Orthoclase	$KAlSi_3O_8$			0.9			7.3
Microcline	$KAlSi_3O_8$	8.5	12	18	4.1	11	7.3
Albite	$NaAlSi_3O_8$		7.2	9.2			
Scorodite	$FeAsO_4 \cdot 2H_2O$					1.3	2.1
Magnesiohornblende	$Ca_2Mg_4Al(AlSi_7O_{22})(OH)_2$		1.7				
Barite	$BaSO_4$			0.2	0.5		
	Total	*100*	*100*	*100*	*100*	*100*	*100*

4.2.2.4 Trace Metal Occurrence

The occurrence of elements of interest (As and U) was investigated in ore samples using high-resolution microscopy examination at the CLS. The analysis included µXRF and XANES testing to determine elemental-phase associations and valence state. Results for µXRF are presented in Table 4-5 and the results for XANES are presented in Table 4-6 and Table 4-7. Elemental associations and oxidation states of As and U in ore samples are generally similar to waste rock, which is discussed in Section 4.1.1.6. The complete results of this analysis are provided in Appendix B.2.

4.2.3 Acid Base Accounting

This section discusses the ABA results for ore lithologies. A total of 38 samples were submitted for ABA testwork to characterize ore from the oxide and transition facies of the dominant lithologic units (gneiss, schist and granite). These samples were collected from 1-2 m drill core segments and from metallurgical head samples. This database is augmented

by an additional 3,579 ore samples that were submitted for metals assays as part of the exploration program. The statistical distributions for the ABA results are presented by weathering facies (oxide and transition) for gneiss, schist and granite ore in Table 4-38. The complete set of ABA results for the ore samples are provided in Appendix C.2-1.

4.2.3.1 Rinse pH

Rinse pH for the two dominant lithologies (gneiss and schist) are neutral to slightly alkaline (6.7≤pH≤8.7, median values of 7.3 and 7.7, respectively). By comparison, the granite samples show lower rinse pH values (4.4≤pH≤6.8, median values of 6.0 and 5.6 for oxide and transition, respectively). Unlike the waste rock sample set, the rinse pH values for the ore samples indicate that the in situ pH is largely controlled by lithology rather than the degree of weathering.

4.2.3.2 Acid Potential

The dominant sulphur species present in ore is generally similar between waste rock and ore, as such, acid potential is calculated based on the same assumptions as those employed for waste rock. Refer to Section 4.1.2.2 for a discussion of sulphur species and acid potential (AP).

AP from ABA

Figure 4-2 shows a strong relationship between total-S and sulphide-S, indicating that when S is detectable, it is primarily present in sulphide minerals. However, Total-S and S species abundances for ore lithologies are presented for oxide and transition facies in Table 4-38. Consistent with the results for the waste rock samples, total-S and sulphide-S are highest in the schist ore samples and lowest in the granite ore samples, with overall concentrations decreasing with increased weathering within each lithologic unit. Total-S and sulphide S for the schist ore samples, in particular, are higher than measured for the waste rock samples, with median values for the oxide and transition ore facies of 0.11 and 0.61 wt.% total-S, respectively. Median values for the gneiss and granite ore samples (0.02 and 0.01 wt.% total-S, respectively) are considerably lower and more consistent with values measured for waste rock samples.

Sulphate-S concentrations are low in the gneiss and granite ore samples, consistent with values measured for waste rock (0.01 wt.%). Notably higher sulphate-S values were measured for the schist ore samples, with median values of 0.02 and 0.15 wt.% for the oxide and transition facies, respectively.

Table 4-40:
Statistical Distribution of ABA Results by Weathering Facies for Ore Lithologies

Unit	Parameter	Rinse pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	T-C NP*	CaNP	Sobek NP	Siderite NP	T-C NNP*	Sobek NNP	NPR	NPR	NPR
	Unit	s.u.	s.u.	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	T-CNP*/ T-AP	CaNP/ T-AP	SobekNP/ T-AP
Gneiss	**Oxide facies**														
	n	*5*	*5*	*5*	*5*	*3*	*5*	*5*	*3*	*3*	*5*	*3*	*5*	*5*	*3*
	Min	6.7	6.7	0.01	*<0.01*	*<0.01*	2.3	2.5	5.7	8.0	-1.1	5.0	0.7	1.3	7.9
	Median	7.3	7.2	0.02	*<0.01*	0.01	3.1	*<4.5*	6.0	11	2.5	5.4	5.0	7.2	9.6
	Max	7.4	7.4	0.11	0.01	0.06	8.9	7.5	11	18	8.2	11	12	14	15
	Transition Facies														
	n	*5*	*5*	*5*	*5*	*4*	*5*	*5*	*2*	*2*	*5*	*2*	*5*	*5*	*2*
	Min	7.0	6.8	*<0.01*	0.01	*<0.01*	1.6	*<4.5*	4.0	5.0	1.3	3.7	5.2	8.3	9.4
	Median	7.3	7.5	0.01	0.02	0.01	7.8	*<4.5*	21	25	7.5	19	8.5	15	11
	Max	8.7	8.6	0.13	0.09	0.01	34	33	38	44	30	34	77	73	13
Schist	**Oxide facies**														
	n	*6*	*6*	*6*	*6*	*3*	*6*	*6*	*4*	*4*	*6*	*4*	*6*	*6*	*4*
	Min	7.4	7.5	0.01	*<0.01*	*<0.01*	7.0	6.8	10.0	13	6.7	9.7	5.0	4.5	16
	Median	7.7	7.5	0.11	0.07	0.02	82	81	67	82	80	64	23	23	20
	Max	8.2	8.1	0.42	0.25	0.05	144	149	100	124	137	94	72	67	32
	Transition Facies														
	n	*4*	*5*	*5*	*5*	*3*	*5*	*5*	*2*	*2*	*5*	*2*	*5*	*5*	*2*
	Min	7.4	7.4	0.52	0.41	0.02	111	107	93	123	42	75	1.6	1.5	5.3
	Median	7.7	7.8	0.61	0.47	0.15	131	138	100	129	114	83	7.4	7.8	5.9
	Max	7.9	8.1	2.2	1.6	0.19	207	191	107	134	188	91	11	10	6.6
Granite	**Oxide facies**														
	n	*6*	*6*	*6*	*6*	*5*	*6*	*6*	*6*	*3*	*6*	*6*	*6*	*6*	*6*
	Min	5.7	5.7	*<0.01*	*<0.01*	*<0.01*	*<0.8*	1.7	0.7	3.0	0.5	-0.1	2.2	2.0	0.9
	Median	6.0	6.2	0.01	0.01	0.01	2.3	*<4.5*	1.5	4.0	2.0	1.2	7.4	14	4.8
	Max	6.7	6.5	0.03	0.01	0.02	6.2	*<4.5*	5.0	7.1	5.9	4.7	21	15	17
	Transition Facies														
	n	*8*	*8*	*8*	*8*	*7*	*8*	*8*	*7*	*2*	*8*	*8*	*8*	*8*	*7*
	Min	4.4	4.9	*<0.01*	*<0.01*	0.01	0.8	1.7	0.5	3.0	-1.7	-4.2	0.6	0.4	0.1
	Median	5.6	5.4	0.01	*<0.01*	0.01	2.7	*<4.5*	2.0	5.0	1.6	1.2	6.3	15	6.4
	Max	6.8	6.6	0.15	0.11	0.02	3.9	*<4.5*	3.0	7.0	3.6	2.7	13	15	10

Notes:
Values in grey italics are below the analytical detection limit; *n* = number of analyses included in statistical distribution.
* adjusted T-C NP; calculated as Total C wt.% * 77.6.
NNP = net neutralization potential, derived by subtracting AP from NP.

AP Surrogates

The exploration ICP-OES database included S measurements, which can be used to accurately estimate total-S as measured by Leco furnace as described in Section 4.1.2.2 (Figure 4-3). The exercise demonstrates that the application of S values from the exploration database as a surrogate to derive AP is a conservative means to evaluate ARD potential of mine rock. The statistical distribution of S measured by ICP-OES used to calculate surrogate AP values for ore is presented in Table 4-39.

Table 4-41:
Statistical Distribution of Sulphur (wt.%) Measured in Assay Database Used for Surrogate Acid Potential Values for Ore Lithologies and Weathering Facies

Lithology	Statistic	Oxide	Upper Transition	Lower Transition	All Weathering Facies
Gneiss	*n*	804	307	140	1251
	n <DL	344	104	22	470
	Max	1.3	1.2	1.9	1.9
	95th PCTL	0.15	0.45	1.1	0.44
	75th PCTL	0.020	0.080	0.48	0.040
	Median	0.010	0.020	0.070	0.010
	25th PCTL	*<0.01*	*<0.01*	0.010	*<0.01*
	5th PCTL	*<0.01*	*<0.01*	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Schist	*n*	567	227	62	856
	n <DL	55	6.0	4.0	65
	Max	2.0	4.3	3.6	4.3
	95th PCTL	0.54	2.5	3.2	2.0
	75th PCTL	0.10	1.5	2.0	0.49
	Median	0.050	0.82	1.1	0.070
	25th PCTL	0.020	0.25	0.023	0.020
	5th PCTL	*<0.01*	0.030	*<0.01*	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*
Granite	*n*	141	20	7	168
	n <DL	58	2.0	0.00	60
	Max	0.81	0.91	0.36	0.91
	95th PCTL	0.070	0.70	0.33	0.25
	75th PCTL	0.020	0.31	0.23	0.030
	Median	0.010	0.15	0.19	0.010
	25th PCTL	*<0.01*	0.018	0.020	*<0.01*
	5th PCTL	*<0.01*	*<0.01*	0.010	*<0.01*
	Min	*<0.01*	*<0.01*	0.010	*<0.01*
Other	*n*	901	327	76	1304
	n <DL	236	58	2.0	296
	Max	4.0	4.2	4.0	4.2
	95th PCTL	0.63	1.6	2.2	1.5
	75th PCTL	0.080	0.55	1.5	0.17
	Median	0.020	0.030	1.1	0.020
	25th PCTL	*<0.01*	0.010	0.13	0.010
	5th PCTL	*<0.01*	*<0.01*	0.010	*<0.01*
	Min	*<0.01*	*<0.01*	*<0.01*	*<0.01*

4.2.3.3 Neutralization Potential

A variety of analytical methods were used to measure NP in waste rock and ore ABA samples. Refer to Section 4.1.2.3 for a discussion and interpretation of NP estimates produced form different methods.

NP from ABA

The relationship between sobek NP, siderite NP and CaNP for waste rock and ore samples are plotted in Figure 4-4. In general, the results for ore are similar to waste rock, in that siderite NP is greater than sobek NP, and sobek NP is greater than CaNP. Neutralization potential can also be estimated based on a total carbon measurement (Section 4.1.3.3). Using total carbon to estimate NP (T-C NP) and has the advantage of lower detection limits compared to CaNP.

Median NP values (CaNP, T-C NP* and sobek NP) for the ore samples are generally similar to median values for the waste rock samples, with the schist ore samples showing the overall highest NP concentrations (range: 7.0 to 207 kg $CaCO_3$/t T-C NP*; median = 110 kg $CaCO_3$/t, Appendix C.2-1) and the granite samples showing the lowest values (range: 0.8 to 6.2 kg $CaCO_3$/t T-C NP*; median = 2.3 kg $CaCO_3$/t). The gneiss samples also have overall low CaNP, with concentrations ranging from 1.6 up to 34 kg $CaCO_3$/t (median = 3.1 kg $CaCO_3$/t). The amount of NP in the ore samples is generally inversely related to the degree of weathering for a given lithologic unit, with samples from the oxide facies being characterized by lower NP values in comparison to transition facies.

NP Surrogates

The larger exploration database can be used to support interpretations of ARD potential given the strong correlation between sobek NP (as determined via ABA analysis) and CaNP (as measured through solid phase Ca determination by aqua regia digestion) (Figure 4-6). The results demonstrate that the application of aqua regia Ca from the exploration database may be used as a conservative surrogate to derive NP values. The statistical distribution of surrogate NP values (calculated using Ca from the exploration database) for ore are presented in Table 4-40.

Table 4-42:
Statistical Distribution of Neutralization Potential Values Calculated from Ca Measured in Assay Database for Ore Lithologies

Lithology	Statistic	Oxide	Upper Transition	Lower Transition	All Weathering Facies
Gneiss	*n*	804	307	140	1251
	Max	162.5	125.3	136.5	162.5
	95th PCTL	42	78.4	56.5	58
	75th PCTL	3.8	7.8	21.1	4.5
	Median	2	2.5	5.9	2.3
	25th PCTL	1.3	1.5	1.8	1.5
	5th PCTL	0.8	1	1	0.8
	Min	*<0.3*	0.3	0.8	*<0.3*
Granite	*n*	141	20	7	168
	Max	5.8	1.5	12.8	12.8
	95th PCTL	2.5	1.5	9.4	2.5
	75th PCTL	1.8	1.3	1.4	1.8
	Median	1.5	0.5	1	1.5
	25th PCTL	1	*<0.3*	*<0.3*	0.8
	5th PCTL	*<0.3*	*<0.3*	*<0.3*	*<0.3*
	Min	*<0.3*	*<0.3*	*<0.3*	*<0.3*
Schist	*n*	567	227	62	856
	Max	262.5	380	625	625
	95th PCTL	142.2	164.6	147	153.6
	75th PCTL	71.5	95	91.4	84.1
	Median	32.8	67.5	74.1	51.3
	25th PCTL	8.3	52.8	59.8	15
	5th PCTL	3.5	21.3	10.3	4.4
	Min	0.8	1.8	4.3	0.8
Other	*n*	901	327	76	1304
	Max	290	250	134	290
	95th PCTL	163.3	170.9	99.8	164.9
	75th PCTL	58.8	95.5	88.4	74.5
	Median	5	13	11.3	6.4
	25th PCTL	2	1.5	5.3	1.8
	5th PCTL	0.8	0.8	0.3	0.8
	Min	0.3	0.3	*<0.3*	*<0.3*

Notes: Values in grey italics are below the analytical detection limit. n is the number of samples included in the statistical distribution, n < DL is the number of samples below the detection limit.

4.2.3.4 Net Potential Ratio

The acid generating potential of mine rock will be defined by the ratio of NP to AP and a minimum sulphur content, as described in Section 4.1.2.4. NPR values for ore were calculated using NP derived from sobek NP, CaNP and T-C NP* and AP derived from total-S (*i.e.,* T-AP). As outlined for waste rock samples, ore samples with total-S < 0.02 wt.% is considered to have negligible AP and is non-PAG. The same criteria used to classify waste rock samples are applied to ore samples (as outlined in Section 4.1.2.4).

Figure 4-7 presents sobek NP, CaNP and T-C NP* versus T-AP for the waste rock and ore samples. The statistical distribution for NPR derived using the different NP values are presented by weathering facies for each lithology Table 4-41. Median NPR values for the ore samples are >5, indicating that the majority of the ore samples are non-PAG. Similar to NPR distribution for the waste rock samples, schist ore materials have the highest NPR(T-CNP*) values (median = 11) while granite samples show the lowest (median NPR = 7.4). Of note is the overall lower NPR values for the schist ore compared to that for of the schist waste rock (median of 28). As was noted for the schist waste rock, the schist ore samples also show appreciable NNP values, which is the amount of excess NP relative to AP, with median values of 80 and 114 kg $CaCO_3$/t T-C NNP* for the oxide and transition facies, respectively.

Table 4-41 provides a summary of the relative proportions of PAG and non-PAG ore samples by lithologic unit and weathering facies according to varying NP methods. Included in the table are the number and percentage of samples with total-S <0.02 wt.%, which are considered to have negligible AP and are therefore classified as non-PAG. Also presented in Table 4-41.are the relative proportions of PAG and non-PAG ore samples according to NPR values derived from NP and AP using Ca and S from the larger ICP-MS assay database. The exploration data are presented for reference to support the ABA database. The results demonstrate that the NPR distribution of PAG and non-PAG ore varies depending on the NP and AP methods used to calculated NPR. Given the considerably higher number of samples available from the exploration assay database, these values are considered to provide a more representative distribution for the ore lithologies. Based on these data, 5% of schist ore samples are indicated to be PAG (with another 21% indicated to have an uncertain potential), 12% of the gneiss and other minor lithology ore samples are indicated be PAG (15-17% uncertain) and 26% of the granite ore samples indicated to be PAG (13% uncertain).

Overall, the results of the ABA analyses indicate that there is a greater potential for ARD to be generated from the ore samples compared to waste rock, with up to approximately 27% of the gneiss, schist and other minor lithologic ore and up to 39% of granite ore indicated to have some PAG potential.

Table 4-43:
ARD Distributions for Coffee Gold Mine Ore Lithologies

Lithology	ARD Designation	NPR (T-CNP*/AP)		NPR (CaNP/T-AP)		NPR (Sobek NP/T-AP)		NPR (surrogate NP/AP)	
		n	%	n	%	n	%	n	%
GNEISS	*Total No. Samples*	*10*		*10*		*5*		*1251*	
	Non-Reactive	3	30%	3	30%	1	20%	711	57%
	Non-PAG	6	60%	6	60%	4	80%	201	16%
	Uncertain	0	0%	1	10%	0	0%	183	14.6%
	PAG	1	10%	0	0%	0	0%	155	12.4%
SCHIST	*Total No. Samples*	*11*		*11*		*6*		*858*	
	Non-Reactive	0	0%	0	0%	0	0%	147	17%
	Non-PAG	10	91%	10	91%	6	100%	489	57%
	Uncertain	1	9%	1	9%	0	0%	180	21.0%
	PAG	0	0%	0	0%	0	0%	42	4.9%
GRANITE	*Total No. Samples*	*14*		*14*		*13*		*168*	
	Non-Reactive	6	43%	6	43%	5	38%	98	58%
	Non-PAG	6	43%	6	43%	5	38%	4	2.0%
	Uncertain	1	7%	1	7%	1	8%	22	13.1%
	PAG	1	7%	1	7%	2	15%	44	26.2%
Other (including Metabasalt)	*Total No. Samples*	*3*		*3*		*1*		*1268*	
	Non-Reactive	2	*NA*	2	*NA*	1	*NA*	527	42%
	Non-PAG	0	*NA*	0	*NA*	0	*NA*	379	30%
	Uncertain	0	*NA*	0	*NA*	0	*NA*	213	16.8%
	PAG	1	*NA*	1	*NA*	0	*NA*	148	11.7%

Notes:
n = number of analyses included in distribution
* adjusted T-C NP; calculated as Total C wt.% * 77.6 (see Section 4.1.3.3).
NPR (surrogate NP/AP): NP derived using Ca and AP derived using S from aqua regia digestion of the exploration database.
All samples with total-S <0.02 wt.% are considered Neutral.
Criteria for NPRs derived using sobek NP and surrogate NP are defined as NPR ≥3 (non-PAG), 1≤NPR<3 (uncertain), NPR<1 (PAG)
Criteria for NPRs derived using T-C NP* and CaNP are defined as NPR ≥2 (non-PAG), 1≤NPR<2 (uncertain), NPR<1 (PAG)
NA: had too few samples from ABA analyses to provide representative percentages for the unit as a whole.

4.2.4 Shake Flask Extractions

A statistical distribution of parameters that exceed the CCME and MMER water quality guidelines in SFE are presented by ore lithology and weathering facies in Table 4-42. A summary of the CCME and MMER guidelines are presented guidelines are presented Table 4-14. The complete SFE results are presented in Appendix C.2-2. Consistent with exceedances for waste rock samples, Al, Sb, As and Hg are indicated to exceed the CCME guidelines in SFE from each of the dominant lithologies and other minor lithologies (two

samples submitted for SFE). In particular, As exceeds the CCME guideline in every sample for the gneiss, schist, granite and other minor lithologic unit samples. Additionally, one sample form the gneiss and three samples from the granite ore also exceed MMER guidelines. Concentrations of Co, Cu, Fe, Pb, Tl, U and Zn exceed CCME guidelines in SFE in one or more samples from the granite unit, while sulphate and Se exceed the respective guidelines in SFE from the schist unit. The elevated sulphate, for two schist ore samples in particular, is consistent with higher solid phase sulphur measured for the same two schist samples (0.2 and 0.56 wt.% total-S, Appendix C.2-1).

The highest metal concentrations in SFE are associated with oxide and transition granite facies, while the lowest values are generally associated with samples from the oxide schist ore. Exceptions to this include sulphate and Se, which are highest in the samples form the oxide and, in particular, transition facies of the schist ore. Leachate pH for the gneiss and schist samples are neutral to alkaline, ranging from 7.5 to 8.1 (slightly lower than the ranges for waste rock). Leachate pH values for the granite samples are lower, and marginally acidic in some cases, ranging from 5.6 to 7.4, with consistently low pH measured for the oxide granite samples (median pH = 5.6).

Some of the SFE metal exceedances (Al, Co, Cu, Fe, Pb, Mn, Zn) are likely associated with fine suspended solids carried through the 0.45 µm filter during the extraction experiment. However, there are SFE samples that contain elevated As and Sb (and Se in schist samples) which do not coincide with elevated concentrations of Al and Fe.

Overall, the results of the SFE for ore samples indicate that As, Sb and Hg may be metals of potential concern from ore lithologies and that Se may also pose a potential concern from schist ore. Unlike the schist waste rock, elevated Cr was not observed for the ore. It is interesting to note that U concentrations are generally low, with only a single granite-oxide sample producing U concentrations above CCME guidelines.

Table 4-44:
Shake Flask Extraction Results for Ore Samples by Lithology by Weathering Facies

Unit	Parameter	pH	SO_4	Al	Sb	As	Cr	Cu	Fe	Pb	Mn	Hg	Se	Tl	U	Zn
	Unit		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Gneiss	**Oxide facies (n = 2)**															
	Min	7.8	2.0	0.034	0.0052	0.096	0.000070	0.0011	*<0.007*	*<0.00001*	0.0047	0.00012	0.00004	0.000081	0.0022	*<0.001*
	Max	7.9	2.0	0.049	0.0069	0.13	*<0.00003*	0.0015	0.014	0.00004	0.0090	0.00044	0.00011	0.00020	0.0072	*<0.001*
	Transition Facies (n = 3)															
	Min	7.5	0.8	0.027	0.0083	0.14	*<0.00003*	0.0004	*<0.007*	*<0.00001*	*<0.0005*	0.00004	0.00037	*<0.0001*	0.00006	*<0.001*
	Median	7.8	7.9	0.086	0.042	0.18	*<0.00050*	*<0.001*	0.084	*<0.0001*	0.016	0.00046	*<0.0005*	0.00022	0.00096	*<0.01*
	Max	8.1	45	0.37	0.049	0.54	*<0.00050*	*<0.001*	0.16	0.00064	0.025	0.00051	*<0.0005*	0.00028	0.0089	*<0.01*
Schist	**Oxide facies (n = 3)**															
	Min	7.8	10	0.009	0.0037	0.086	*<0.00003*	0.00041	*<0.007*	*<0.00001*	0.0025	*<0.00001*	0.0003	0.000046	0.00094	*<0.001*
	Median	7.8	43	0.023	0.0046	0.12	*<0.00003*	0.001	*<0.007*	*<0.00001*	0.0042	*<0.00001*	0.00043	0.00011	0.0011	*<0.001*
	Max	8.0	225	0.026	0.0048	0.13	*<0.00003*	0.0014	*<0.007*	*<0.00001*	0.0245	0.00002	0.00094	0.00023	0.0015	*<0.001*
	Transition Facies (n = 2)															
	Min	7.7	208	0.012	0.011	0.074	*<0.00003*	0.0013	*<0.007*	*<0.00001*	0.047	*<0.00001*	0.0010	0.00024	0.0020	*<0.001*
	Max	7.8	328	0.022	0.014	0.15	*<0.00003*	0.0015	*<0.007*	*<0.00001*	0.057	*<0.00001*	0.0011	0.00033	0.0027	*<0.001*
Granite	**Oxide facies (n = 3)**															
	Min	6.1	1.7	0.092	0.020	0.51	*<0.00003*	*<0.001*	0.019	0.00013	0.0028	0.00003	0.00008	0.000051	0.00025	0.004
	Median	6.2	3.0	3.2	0.045	1.0	*<0.00005*	0.0042	0.92	0.00052	0.0031	0.0001	*<0.0005*	0.00065	0.0011	*<0.01*
	Max	7.4	9.6	18	0.17	1.8	0.00069	0.0058	25	0.029	0.48	0.0063	*<0.0005*	0.0023	0.033	0.042
	Transition Facies (n = 3)															
	Min	5.6	2.8	0.005	0.0040	0.13	*<0.0003*	*<0.001*	*<0.03*	*<0.0001*	0.0037	*<0.00001*	0.00043	0.00038	0.00025	*<0.01*
	Median	5.6	14	0.074	0.0062	0.22	*<0.0005*	*<0.001*	0.12	0.00014	0.0072	*<0.00005*	*<0.0005*	0.00086	0.00047	*<0.01*
	Max	5.7	40	1.4	0.023	1.5	*<0.0005*	0.017	0.94	0.00058	0.87	0.000073	*<0.0005*	0.00095	0.0026	0.033

Notes:
Values in grey italics are below the analytical detection limit; All guidelines are for total metals unless otherwise indicated.
Values that exceed the Metal Mines Effluent Regulations (MMER, 2002) MMM and MGS water quality guideline are shaded in light and dark grey, respectively.
Values that exceed the Canadian Council of Ministers of the Environment (CCME, 2007) Water Quality Guidelines are shaded in light blue (30-day) and dark blue (maximum);
Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016);
Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI);
Guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L.

4.2.5 Solid Phase Elemental Abundance

Statistical summaries of solid phase element results for ore are presented for oxide and transition facies by lithologic unit in Table 4-43 and compared to average continental abundances (ACA; Price, 1997). The complete set of solid phase element results are presented in Appendix C.2-3. The results show that the oxide and transition facies are enriched in Sb, As, Bi, Hg, Se and Ag and U with respect to ACAs (shaded values in the tables). With the exception of Ag, the observed metal enrichments for ore samples are consistent with those observed for waste rock samples, with concentrations in the ore samples generally higher than values measured for waste rock of same lithologic and weathering group. In particular, Sb and As are one to two orders of magnitude higher in the ore samples compared to waste rock samples of the same lithology and weathering group. The exception is the schist unit, for which metal concentrations (other than Sb and As) in ore samples are consistent with concentrations in waste rock. Overall, the highest metal concentrations are observed for the schist ore samples while the lowest are observed for granite ore materials (Table 4-43).

Also presented for comparison are Sb and As concentrations from the exploration ICP-OES database (Table 4-44). This table presents the statistical distribution of Sb and As for each lithology, with light and dark grey shading representing three and ten times higher than the ACA values. Note that for the larger assay database, the 95th and 5th percentile values are shown in place of the maximum and minimum values to provide more representative upper and lower limits for the lithologic and weathering facies groups and avoid highlighting outliers. Also provided in Table 4-44 are the distributions of Sb and As by weathering facies for each lithologic unit, with colour grading superimposed to highlight the relative concentrations.

These results show that concentrations of As are highest in schist (median of 2450 ppm). Similarly, high As concentrations are observed in the granite lithology and other minor lithologies (2040 and 1790 ppm), with the considerably lower AS values observed in the gneiss lithology (966 ppm). Antimony is generally present at much lower concentrations than As in all ore lithologies. The highest concentration is observed in the 'other' lithologies grouping with (median of 32 ppm), with intermediate Sb concentrations in the gneiss and schist lithologies (median of 21 ppm and 22 ppm, respectively) and the lowest concentrations are present in the granite lithology (15 ppm). For complete statistics of the exploration ICP-OES see Appendix C.2-4.

Table 4-45:
Solid Phase Elements by Aqua Regia Digestion for Ore Lithologies by Weathering Facies

	ACA	*8.23*	*0.2*	*1.8*	*0.009*	*25*	*60*	*5.6*	*14*	*0.085*	*0.05*	*0.075*	*0.85*	*2.7*	*70*
Unit	**Parameter**	**Al**	**Sb**	**As**	**Bi**	**Co**	**Cu**	**Fe**	**Pb**	**Hg**	**Se**	**Ag**	**Tl**	**U**	**Zn**
	Unit	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Gneiss	**Oxide facies (*n* = 5)**														
	Min	0.29	9.3	238	0.14	1.1	2.5	0.9	12	0.35	0.3	0.1	0.43	11	9.0
	Median	0.47	34	940	0.23	4.7	5.6	1.6	22	0.55	0.9	0.14	0.5	14	25
	Max	1.1	48	1095	0.91	6.5	58	2.3	52	1.8	*<1*	0.24	0.9	20	41
	Transition Facies (*n* = 5)														
	Min	0.36	11	333	0.06	1.1	1.8	0.88	10	0.27	0.2	0.05	0.28	5.7	10
	Median	0.5	50	1185	0.29	2.2	3.5	1.6	18	0.73	0.4	0.1	1.1	11	15
	Max	1.1	161	1700	0.3	6.6	15	1.9	25	1.4	*<1*	0.3	1.2	19	27
Schist	**Oxide facies (*n* = 6)**														
	Min	0.38	6.0	1100	0.23	9.4	12	2.6	12	0.41	0.6	0.08	0.3	2.4	41
	Median	0.535	17	1450	0.52	14	14	3.0	16	0.46	0.95	0.25	0.38	2.9	48
	Max	0.9	41	5910	1.3	16	20	4.1	20	1.6	*<1*	0.59	1.5	6.0	57
	Transition Facies (*n* = 5)														
	Min	0.43	7.3	712	0.16	8.8	10	2.6	6.8	0.17	0.5	0.13	0.22	1.8	43
	Median	0.6	22	1340	0.37	12	16	2.7	14	0.33	0.7	0.25	0.4	2.6	48
	Max	0.75	49	5130	0.74	14	26	2.9	29	0.6	*<1*	0.64	0.73	3.5	49
Granite	**Oxide facies (*n* = 6)**														
	Min	0.41	6.8	714	0.07	0.2	0.8	0.82	11	0.17	*<0.2*	0.08	0.56	1.8	3.0
	Median	0.475	25	2075	0.09	1.2	1.8	1.2	18	0.98	0.45	0.095	0.93	14	21
	Max	0.54	38	7940	0.19	6.8	2.6	1.6	42	8.5	1	0.12	2.7	52	42
	Transition Facies (*n* = 8)														
	Min	0.34	3.2	603	0.04	0.3	0.7	0.62	11	0.16	*<0.2*	0.03	0.24	5.1	4.0
	Median	0.77	23	2195	0.07	1.3	3.6	1.4	18	0.37	0.3	0.07	0.77	12	17
	Max	0.94	146	*>10000*	0.1	11	17	5.9	29	4.0	*<1*	0.1	1.21	53	20

Notes:
Values in grey italics are below the analytical detection limit.
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA.

Table 4-46:
Solid Phase As and Sb Concentrations in Ore from the Exploration Database

Lithology	**Gneiss**		**Schist**		**Granite**		**Other Lithologies**	
Parameter	**Sb**	**As**	**Sb**	**As**	**Sb**	**As**	**Sb**	**As**
Units	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Total for Lithologic Unit								
n	*1251*	*1251*	*856*	*856*	*168*	*168*	*1304*	*1304*
5th PCTL	4.0	235	5.0	516	5.0	707	6.0	255
25th PCTL	10	507	10	1320	10	1350	14	828
Median	21	966	22	2450	15	2040	32	1790
75th PCTL	47	1840	54	3800	36	3290	93	3320
95th PCTL	141	3840	391	8070	169	7190	433	6760
Oxide facies								
n	*804*	*804*	*567*	*567*	*141*	*141*	*901*	*901*
5th PCTL	5.0	263	5.0	584	5.0	711	6.0	312
25th PCTL	11	498	12	1340	10	1180	17	924
Median	24	919	27	2450	16	2030	41	1920
75th PCTL	52	1740	72	3610	34	3150	103	3310
95th PCTL	144	3770	514	8010	171	7410	390	6270
Upper Transition Facies								
n	*307*	*307*	*227*	*227*	*20*	*20*	*327*	*327*
5th PCTL	3.3	194	4.0	404	3.0	1470	5.0	218
25th PCTL	11	568	7.5	1430	8.5	1730	10	452
Median	21	1060	16	2530	11.5	2010	18	1460
75th PCTL	41	1930	33	4720	24	3320	45	2660
95th PCTL	124	3850	121	7690	160	6390	595	6370
Lower Transition Facies								
n	*140*	*140*	*62*	*62*	*7*	*7*	*76*	*76*
5th PCTL	2.0	143	2.2	25	3.6	632	4.8	111
25th PCTL	6.0	445	7.0	895	26	1050	11	1520
Median	10	1010	13	2100	62	3290	39	2720
75th PCTL	21	2230	35	3650	69	5020	109	6300
95th PCTL	71.6	4080	104	7910	103	5700	1280	10000

Notes:
Values in grey italics are below the analytical detection limit.
Values shaded in light grey are 3x's the Average Continental Abundance (ACA) for Sb (2 ppm) and As (1.8 ppm), according to Price (1997), values shaded in dark grey are 10x's the ACA values.
Red and green gradient shading represent relative concentrations of Sb and As, for all weathering facies and lithologic units.

4.2.6 Kinetic Tests

4.2.6.1 Sample Selection Criteria and Rationale

A total of six unsaturated columns composed of the different ore lithologies and weathering facies (oxide and transition) were initiated for kinetic testwork to obtain information on acid generation and metal leaching rates from ore that will be temporarily sub-aerially stored in the ROM stockpiles and exposed on the pit walls. The kinetic test ore samples were sourced from composite head samples used in metallurgical testwork. A summary of the ore columns, sample selection criteria and rationale for the testwork are provided in Table 4-45. Note that the ore samples were developed as composites to represent typical ore from the various mine pits. As such, other minor lithologies may also be included the composite samples, but for the purpose of discussion they will be referred to by the dominant ore lithology within each pit. Since Double Double is hosted in gneiss similar to Supremo pit, the composite ore sample from the much larger Supremo pit is used to represent ore from both Suremo and Double Double. Figure 4-17 and Figure 4-18 present box plots showing the distribution of total-S and solid phase As, Sb and U for each ore type, with the results for the kinetic test sub-samples superimposed. The data presented Figure 4-17 and Figure 4-18 indicate that the kinetic tests represent moderate to high total-S and low to very high concentrations of As, Sb and U with respect to the larger sample population (*i.e.*, exploration or ABA database); therefore, leachate from the column tests are considered to be representative of 'best-estimate' to 'worst-case' drainage quality from sub-aerially stockpiled gneiss, schist and granite ore (Table 4-45). All the unsaturated columns were operated as trickle leach columns operated on bi-weekly cycles. Additional detail pertaining to the operating procedures are provided in Section 3.2.6 and Appendix D.2.

Table 4-47:
Ore Kinetic Test Details

Lithology	Weathering Facies	Test ID	Head Sample/ Metallurgical Column	Sample Description	Dry Wt. of Sample (kg)	Cycles/ Weeks
Gneiss (Supremo)	Oxide	Col 11	50% 72144B 50% 72145B	Moderate to high T-S (75th PCTL) and moderate As, Sb, U	5.0	45
	Transition	Col 12	72146B	Moderate to high T-S (75th PCTL) and moderate As, Sb, U	4.3	45
Schist (Latte)	Oxide	Col 9	50% 72135B, 50% 72136B	High T-S (80th PCTL); moderate to low As, Sb, U < 50th PCTL)	5.0	45
	Transition	Col 10	50% 72137B, 50% 72138B	Moderate to low T-S (40th PCTL); low As, high Sb, moderate U	5.0	45
Granite (Kona)	Oxide	Col 7	72139B	High T-S (80th PCTL); high As, Sb (>75th PCTL), moderate U	4.4	45
	Transition	Col 8	72140B	Moderate T-S (50th PCTL); very high As, Sb (>90th PCTL), low U	4.4	45

Notes: All columns are constructed of Plexiglas with acrylic perforated disk & nylon mesh; All tests operated at temperature of 4°C; Leachate is sampled bi-weekly from all columns; All columns are operated as trickle leach (discussed in more detail in Section 3.2.6).

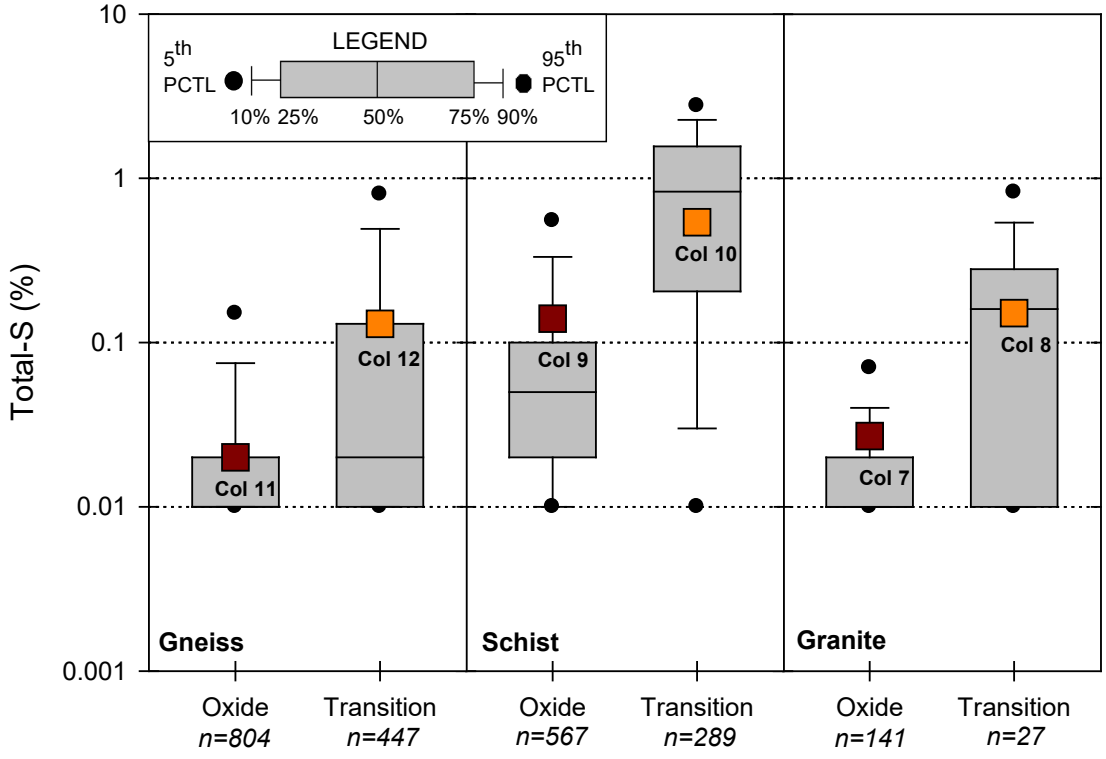

Figure 4-17: Box plots showing the concentration ranges for total-S for the exploration database ore samples with total-S for the kinetic test sub-samples superimposed

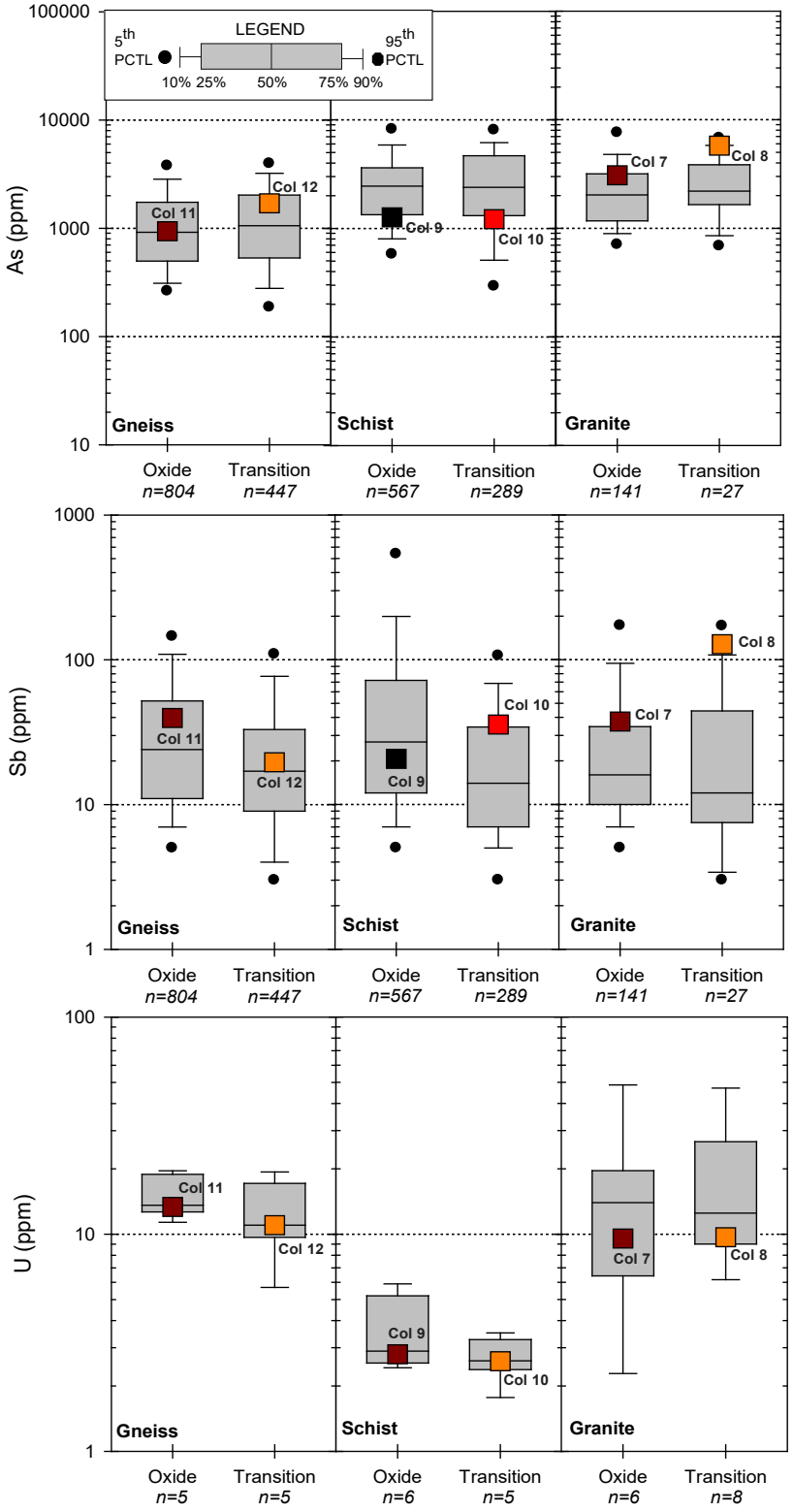

Figure 4-18: Box plots showing the concentration ranges for solid phase As and Sb for the exploration database ore samples and U for the ABA database ore samples with the kinetic test sub-samples superimposed.

4.2.6.2 Static Tests

Acid Base Accounting and Solid Phase Elements

Rinse pH for the gneiss and schist ore column sub-samples are pH-neutral (pH ~7.4, Table 4-46), owing to low total-S and presence of NP in the gneiss sub-samples and moderate total-S but higher NP in the schist sub-samples. Both granite ore sub-samples have acidic rinse pH values of pH 5.7 (oxide facies, Col 7) and 4.4 (transition facies, Col 8). Despite the low total-S content of these samples, they lack carbonate mineralization (CaNP) allowing even minor amounts of sulphur to produce a mildly acidic pH.

Consistent with the larger static test ore sample population, the highest total-S value was measured in the schist transition sub-sample (0.54 wt.%, Col 10) and the lowest total-S values were measured in the gneiss and granite oxide facies (0.02 and 0.03 wt.%, respectively). The schist oxide and transition sub-samples comprise the highest CaNP (125 and 148 kg $CaCO_3$/t) while the lowest CaNP values were measured in the granite oxide and transition sub-samples (1.7 kg $CaCO_3$/t for both) and the gneiss oxide facies sub-sample (5 kg $CaCO_3$/t).

The schist oxide facies and, in particular, transition facies sub-samples comprise the highest overall solid phase element concentrations (Ag, Al, Cd, Co, Cu, Fe, Mn, Ni, Pb, Zn; Table 4-46). However, the highest solid phase As and Sb concentrations were measured in the granite transition sub-sample (5770 and 128 ppm, respectively) and the highest U concentrations was measured in the gneiss oxide and transition sub-samples (13 and 11 ppm). Selenium concentrations are below the detection limit (<1 ppm) for each sub-sample.

Particle Size Distribution

Table 4-47 presents the distribution of grain sizes determined from representative sub-samples of the ore columns. These data indicate that the ore columns are predominantly composed of particles measuring > 0.425 and < 9.5 mm (81 – 91%), with the greatest proportion of test material composed of particles measuring >6.3 and < 9.5 mm.

Table 4-48:
Acid Base Accounting and Solid Phase Elements for Ore Column Sub-Samples

Lithology		Gneiss		Schist		Granite	
Weathering Facies		Oxide	Transition	Oxide	Transition	Oxide	Transition
Column ID		Col 11	Col 12	Col 9	Col 10	Col 7	Col 8
Acid Base Accounting Parameters							
Rinse pH	s.u.	7.4	7.3	7.4	7.4	5.7	4.4
Total-S	wt.%	0.02	0.13	0.14	0.54	0.03	0.15
Sulphate-S	wt.%	*<0.01*	0.02	0.04	0.05	*<0.01*	0.02
Sulphide-S	wt.%	*<0.01*	0.09	0.09	0.44	0.01	0.11
CaNP	kg $CaCO_3$/t	5	33	125	148	1.7	1.7
Sobek NP	kg $CaCO_3$/t	8	38	79	100	0.7	0.5
Siderite NP	kg $CaCO_3$/t	15	44	105	129	7.1	7.0
Solid Phase Elements by Aqua Regia							
Ag	ppm	0.11	0.16	0.25	0.29	0.080	0.090
Al	%	0.43	0.56	0.44	0.65	0.41	0.34
As	ppm	940	1700	1265	1215	3080	5770
Cd	ppm	0.060	0.040	0.10	0.090	0.060	0.040
Co	ppm	5.6	6.6	11	11	1.2	1.9
Cr	ppm	84	107	86	83	77	76
Cu	ppm	4.1	3.5	20	21	0.8	3.8
Fe	%	1.6	1.8	2.7	2.6	1.3	1.5
Hg	ppm	0.96	1.15	0.48	0.47	0.83	4.0
Mn	ppm	300	396	545	502	114	217
Mo	ppm	2.0	3.1	1.5	2.8	1.9	2.3
Ni	ppm	17	12	52	44	1.9	2.3
Pb	ppm	13	14	17	17	15	16
Sb	ppm	40	20	21	36	37	128
Se	ppm	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*
U	ppm	13	11	2.8	2.6	9.6	9.7
Zn	ppm	26	27	55	48	18	19

Notes: Values in grey italics are below the analytical detection limit.

Table 4-49:
Particle Size Distribution for Ore Column Sub-Samples

Sieve	Aperture	Col 7	Col 8	Col 9	Col 10	Col 11	Col 12
Designation	(mm)	Weight Retained (%)					
+ 3/8"	9.500	1.7	8.6	6.8	5.3	4.1	4.6
-3/8" + 1/4"	6.300	26.8	30.7	36.2	37	42.6	25.7
-1/4" + 5	4.000	22.2	26.2	23	22.9	23.7	18.3
-5 + 10	1.700	18.3	18.9	15.4	13	14	17.1
-10 + 35	0.425	19.8	11.8	11.9	14	10.6	19.7
-35 + 100	0.150	5.4	2.3	3.8	4.3	2.7	7.3
-100 + 270	0.053	2.8	0.9	2.0	2.1	1.3	4.5
-270	-0.053	3.0	0.6	0.9	1.4	1.0	2.8
	Total	*100*	*100*	*100*	*100*	*100*	*100*

4.2.6.3 Column Results

Results for unsaturated column testwork for ore samples are presented in this section. The complete set of leachate concentrations, calculated loading rates and time series plots for unsaturated ore columns are provided in Appendix D.2. A summary of the final and median loading rates from each kinetic test is presented in Table 4-48, Table 4-49 and Table 4-50. Time series profiles for weekly loading rates are presented in Figure 4-19 and Figure 4-20.

Leachate pH and Sulphate Loading

Leachate pH for the gneiss and schist oxide and transition ore columns remain slightly alkaline over the test period (median of 8.1; Table 4-48, Table 4-49, and Figure 4-19). Leachate pH for the granite oxide facies ore column remains neutral over the test period (median of 7.2, Table 4-50 and Figure 4-19) but an overall gradual decrease is evident from the initial pH of 7.6 to < 7.0 in the last few weeks of testing. Note that a subsample of this material produced a mildly acidic rinse pH during static testing (pH 5.7), indicating that the kinetic test sample is a heterogeneous mix of material, some of which lacks effective NP (Table 4-46). The granite transition facies ore column is acidic over the test period, fluctuating between pH 4.5 and 5.5. The low pH for Col 8 is consistent with low alkalinity production from the column (<0.03 mg $CaCO_3$/kg/wk). Sulphate loading rates from each of the ore columns shows a consistent decrease of one to two orders of magnitude over the test period to <5 mg/kg/wk. The initial sulphate load is generally proportional to the solid phase S content of the test material, with >100 mg/kg/wk leached from all transition facies columns (Col 12, Col 10 and Col 8) and the schist oxide facies column while <5 mg/kg/wk leached from the gneiss oxide facies column (Col 7).

Metal Leaching Trends

Metal loadings from the gneiss and schist oxide and transition ore columns are either gradually decreasing over the test period or are producing relatively low and stable loading rates (following the initial flush). A notable exception is Sb, which shows increased loadings in leachate from the gneiss transition column (Col 12). Uranium loadings from the gneiss oxide and transition ore columns (Col 11 and Col 12) are elevated with respect to the other ore columns and produced relatively stable loadings of >0.001 mg/kg/wk since week 25 of testing (Figure 4-20). The same is observed for Mo, with fairly stable loads of 0.0003 and 0.0005 mg/kg/wk produced by the gneiss oxide and transition ore columns, respectively.

The granite transition ore column (Col 8), which is producing acidic leachate, is producing the highest loads of metal cations, which include Al, Cd, Co, Cu, Fe, Mn, Ni and Zn (Appendix D.2) consistent with the lower pH environment for the column (Figure 4-19).

In particular, As loadings from the granite transition column (0.47 mg/kg/wk) are up to two orders of magnitude higher than that produced by the schist and gneiss columns (Figure 4-20). The sub-sample for Col 8 comprises the highest solid phase As concentrations of the ore kinetic tests (5770 ppm, Table 4-46); however, the schist ore columns generally comprise the highest solid phase concentrations of other metals. Similar to the waste rock kinetic tests, loading rates from the ore columns are not proportional to the relative solid phase content of the kinetic test material but rather are influenced by pH conditions within the kinetic test.

Table 4-50:
Loading Rates for Gneiss Ore Columns

Parameter	Unit	Gneiss					
		Oxide (Col 11)			Transition (Col 12)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH		8.1	8.1	8.1	8.1	8.1	8.1
Alkalinity	mg $CaCO_3$/kg	2.9	3.1	3.4	3.7	4.0	4.4
Sulphate	mg/kg/wk	0.27	0.29	0.31	1.9	2.0	2.3
D-Al	mg/kg/wk	0.00012	0.00014	0.00017	0.00016	0.00017	0.00029
D-Sb	mg/kg/wk	0.00021	0.00022	0.00025	0.0018	0.0013	0.0016
D-As	mg/kg/wk	0.0052	0.0053	0.0057	0.013	0.012	0.013
D-Cd	mg/kg/wk	0.00000013	0.00000013	0.00000018	0.00000013	0.00000016	0.00000025
D-Ca	mg/kg/wk	1.0	1.0	1.1	1.5	1.6	1.7
D-Cr	mg/kg/wk	0.0000080	0.0000072	0.0000079	0.0000013	0.0000014	0.0000028
D-Co	mg/kg/wk	0.0000019	0.0000022	0.0000022	0.0000042	0.0000041	0.0000055
D-Cu	mg/kg/wk	0.000015	0.000020	0.000024	0.000018	0.000021	0.000022
D-Fe	mg/kg/wk	0.00031	0.00031	0.00031	0.00031	0.00031	0.00032
D-Pb	mg/kg/wk	0.0000013	0.00000045	0.0000011	0.00000045	0.00000045	0.00000076
D-Mg	mg/kg/wk	0.28	0.27	0.29	0.45	0.47	0.50
D-Mn	mg/kg/wk	0.000056	0.000033	0.000054	0.00085	0.00081	0.00093
D-Hg	µg/kg/wk	0.00044	0.00044	0.00045	0.00044	0.00045	0.00045
D-Mo	mg/kg/wk	0.00038	0.00040	0.00044	0.00054	0.00060	0.00072
D-Ni	mg/kg/wk	0.0000044	0.0000044	0.0000086	0.000013	0.000015	0.000021
D-Se	mg/kg/wk	0.0000018	0.0000032	0.0000035	0.000011	0.000011	0.000015
D-Ag	mg/kg/wk	0.000000087	0.000000088	0.000000090	0.000000089	0.000000090	0.000000091
D-U	mg/kg/wk	0.0012	0.0013	0.0014	0.00097	0.0011	0.0012
D-Zn	mg/kg/wk	0.000044	0.000044	0.000045	0.000045	0.000045	0.000046

Notes: All* Excludes first 10 cycles (which represent the initial flushing of surface oxidation products).

Table 4-51:
Loading Rates for Schist Ore Columns

Parameter	Unit	Schist					
		Oxide (Col 9)			Transition (Col 10)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH		8.1	8.1	8.1	8.1	8.1	8.1
Alkalinity	mg $CaCO_3$/kg	3.6	3.9	4.1	2.8	2.9	3.1
Sulphate	mg/kg/wk	1.9	2.0	2.5	4.5	5.9	9.1
D-Al	mg/kg/wk	0.00013	0.00015	0.00023	0.00017	0.00017	0.00022
D-Sb	mg/kg/wk	0.00013	0.00014	0.00015	0.00069	0.00070	0.00073
D-As	mg/kg/wk	0.0039	0.0049	0.0053	0.0053	0.0052	0.0056
D-Cd	mg/kg/wk	0.00000017	0.00000021	0.00000032	0.00000013	0.00000013	0.00000016
D-Ca	mg/kg/wk	1.5	1.6	1.7	2.2	2.8	3.4
D-Cr	mg/kg/wk	0.0000050	0.0000043	0.0000049	0.0000013	0.0000014	0.0000020
D-Co	mg/kg/wk	0.0000024	0.0000025	0.0000033	0.000013	0.000015	0.000018
D-Cu	mg/kg/wk	0.000027	0.000029	0.000035	0.000019	0.000023	0.000031
D-Fe	mg/kg/wk	0.00030	0.00031	0.00031	0.00029	0.00029	0.00030
D-Pb	mg/kg/wk	0.0000020	0.00000095	0.0000026	0.0000029	0.00000087	0.0000026
D-Mg	mg/kg/wk	0.58	0.60	0.63	0.60	0.73	0.87
D-Mn	mg/kg/wk	0.00013	0.00013	0.00021	0.0012	0.0015	0.0017
D-Hg	µg/kg/wk	0.00044	0.00044	0.00044	0.00042	0.00042	0.00043
D-Mo	mg/kg/wk	0.00010	0.00011	0.00012	0.00012	0.00012	0.00014
D-Ni	mg/kg/wk	0.000037	0.000045	0.000053	0.000099	0.00012	0.00015
D-Se	mg/kg/wk	0.000022	0.000025	0.000028	0.000037	0.000043	0.000047
D-Ag	mg/kg/wk	0.000000089	0.00000011	0.00000017	0.000000084	0.000000084	0.000000086
D-U	mg/kg/wk	0.000050	0.000066	0.000087	0.00018	0.00023	0.00032
D-Zn	mg/kg/wk	0.000044	0.000044	0.000050	0.000042	0.000042	0.000050

Notes: All* Excludes first 10 cycles (which represent the initial flushing of surface oxidation products).

Table 4-52:
Loading Rates for Granite Ore Columns

Parameter	Unit	Granite					
		Oxide (Col 7)			Transition (Col 8)		
		Median (Final 5)	Median (All*)	75th PCTL (All*)	Median (Final 5)	Median (All*)	75th PCTL (All*)
pH		7.0	7.2	7.5	4.5	4.6	5.1
Alkalinity	mg $CaCO_3$/kg	0.40	0.49	0.56	0.0045	0.0045	0.0046
Sulphate	mg/kg/wk	0.16	0.17	0.22	2.6	2.6	2.9
D-Al	mg/kg/wk	0.0047	0.0037	0.0065	0.0078	0.0084	0.0094
D-Sb	mg/kg/wk	0.00067	0.00077	0.00094	0.00031	0.00031	0.00033
D-As	mg/kg/wk	0.016	0.018	0.020	0.47	0.48	0.53
D-Cd	mg/kg/wk	0.00000021	0.00000013	0.00000017	0.0000030	0.0000031	0.0000035
D-Ca	mg/kg/wk	0.11	0.099	0.11	0.65	0.70	0.74
D-Cr	mg/kg/wk	0.0000021	0.0000021	0.0000029	0.0000018	0.0000027	0.0000038
D-Co	mg/kg/wk	0.0000035	0.0000034	0.0000039	0.0028	0.0030	0.0033
D-Cu	mg/kg/wk	0.000035	0.000039	0.000062	0.00069	0.00069	0.00074
D-Fe	mg/kg/wk	0.00064	0.00052	0.0011	0.0050	0.0053	0.0068
D-Pb	mg/kg/wk	0.0000030	0.0000029	0.0000044	0.0000065	0.0000032	0.000012
D-Mg	mg/kg/wk	0.030	0.027	0.029	0.16	0.17	0.19
D-Mn	mg/kg/wk	0.00086	0.00069	0.00086	0.11	0.11	0.12
D-Hg	µg/kg/wk	0.00084	0.00045	0.00085	0.00046	0.00045	0.00047
D-Mo	mg/kg/wk	0.000049	0.000063	0.000099	0.000015	0.000015	0.000025
D-Ni	mg/kg/wk	0.0000084	0.0000045	0.0000085	0.00071	0.00075	0.00088
D-Se	mg/kg/wk	0.0000027	0.0000027	0.0000037	0.000019	0.000023	0.000026
D-Ag	mg/kg/wk	0.000000084	0.00000011	0.00000018	0.000000092	0.000000092	0.00000021
D-U	mg/kg/wk	0.000017	0.000015	0.000032	0.000054	0.000054	0.000058
D-Zn	mg/kg/wk	0.000046	0.000045	0.000084	0.0044	0.0045	0.0048

Notes: All* Excludes first 10 cycles (which represent the initial flushing of surface oxidation products).

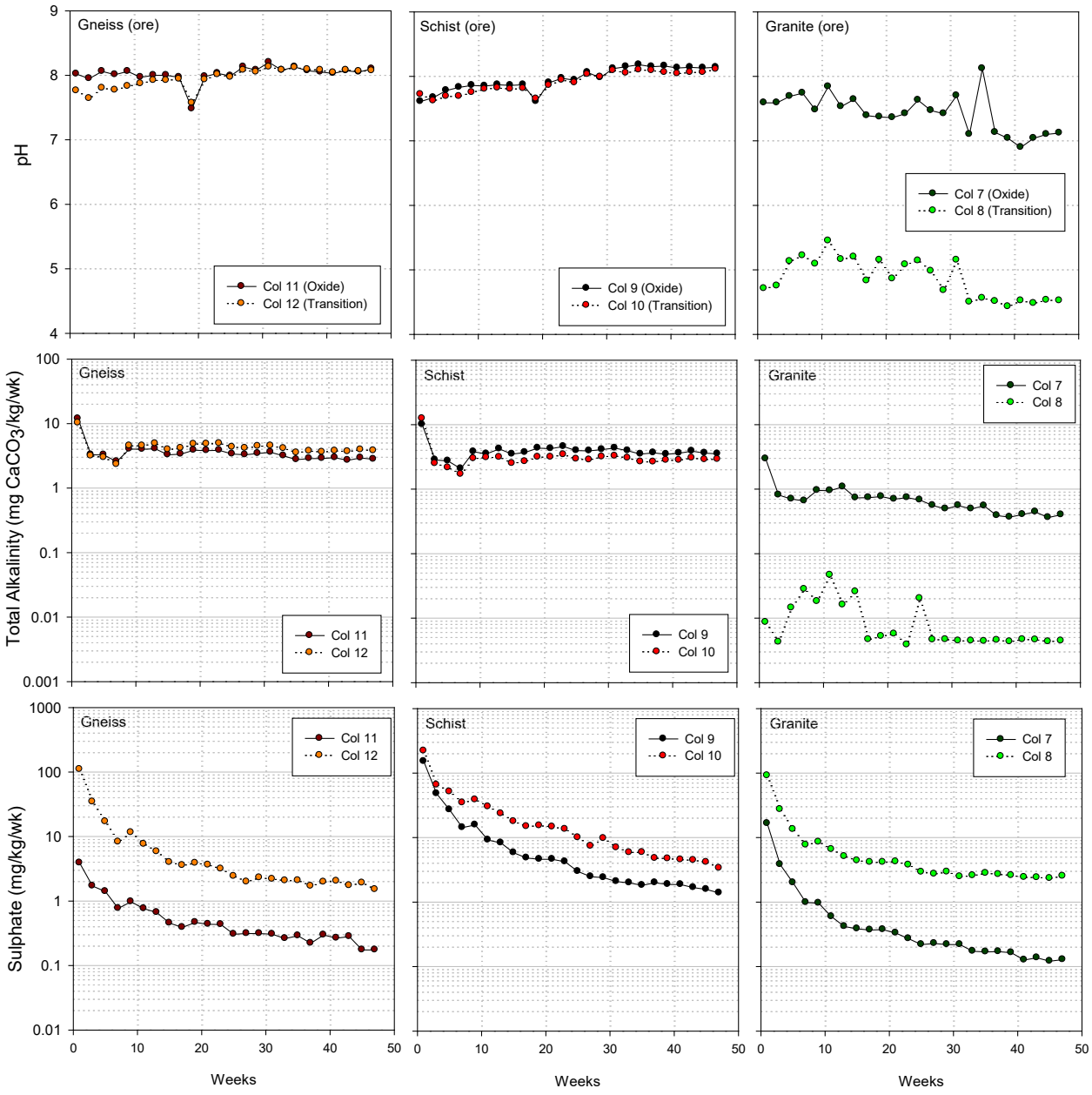

Figure 4-19: Time series plots for leachate pH, total alkalinity and weekly sulphate loadings for ore columns.

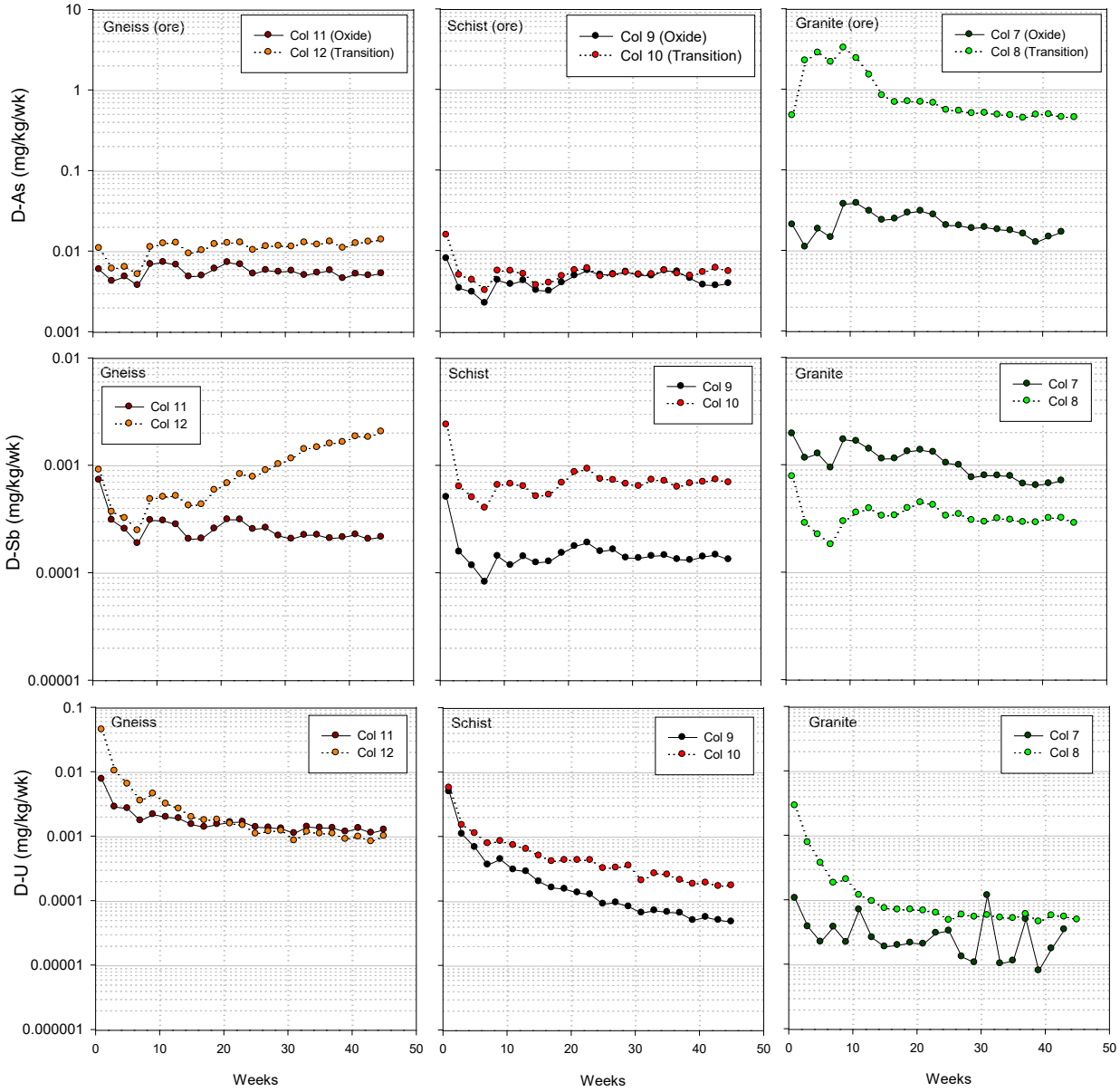

Figure 4-20: Weekly leaching rates for Sb, As and U in leachate from ore columns

4.2.7 Radioisotopes

4.2.7.1 Occurrence

The NORM results for ore samples are presented in Appendix D.1-5 and summarized in Section 4.1.6. Overall, the results show that ore can be considered as unrestricted according to the Canadian NORM Guidelines.

4.2.7.2 Kinetic Test Leachate

The activity of ^{226}Ra was measured in filtered leachate from the six laboratory ore columns on two occasions. Due to the large volume required for ^{226}Ra measurements (250 ml to 1000 ml), samples were collected over several cycles (Table 4-51). The first round of samples collected a volume of 250ml from each column, which gave an elevated detection limit of 0.03 Bq/L. Most samples produced activities below this detection limit, therefore, a second round of samples was submitted with a larger volume of water (1000 ml) to achieve a lower detection limit of 0.01 Bq/L.

Results of ^{226}Ra measurements in ore columns are presented alongside Ba and U concentrations averaged over the same cycles in Table 4-51. A majority of activity measurements are at or below the method detection limit. The relationship between ^{226}Ra activities, with ore type, Ba concentration or U occurrence is difficult to ascertain from this data due to the large number of detection limit values. In general, the results indicate that there is a low potential for ^{226}Ra leaching from ore as shown by ^{226}Ra concentrations generally at or below detection limits.

Table 4-53:
Activity of ^{226}Ra in Ore Column Kinetic Test Leachate

Column ID	Sample Description	Cycle/Week	Ba (mg/L)	U (mg/L)	^{226}Ra (Bq/L)
Col 12	Supremo Transition Ore	05-Jul	0.0041	0.047	*<0.03*
		10-Dec	0.0047	0.026	*<0.01*
Col 11	Supremo Oxide Ore	05-Jul	0.044	0.039	*<0.03*
		10-Dec	0.046	0.031	0.03
Col 10	Latte Transition Ore	05-Jul	0.0046	0.014	*<0.03*
		10-Dec	0.0063	0.0080	0.01
Col 9	Latte Oxide Ore	05-Jul	0.011	0.0063	0.04
		10-Dec	0.016	0.0023	*<0.01*
Col 8	Kona Transition Ore	05-Jul	0.00030	0.0018	*<0.03*
		10-Dec	0.00070	0.0011	0.01
Col 7	Kona Oxide Ore	05-Jul	0.00060	0.00050	0.03
		10-Dec	0.0010	0.00060	0.01

Notes: Values in grey italics are below the analytical detection limit.

4.3 Leach Tailings

This section presents the geochemical characterization results for leach tailings generated by the heap leach facility (HLF). Leach tailings will be generated when ore placed in the HLF is mixed with lime (CaO) and irrigated with NaCN solution which will change the character of metal leaching by raising pore water pH and by the formation of CN-metal

complexes. At the end of mine life, the HLF will be rinsed to remove residual CN from HLF pore water. Lime that remains in the HLF will eventually be rinsed or re-precipitate as calcite, resulting in a decline in pH from the alkaline values required to support CN stability to more neutral values. The goal of this geochemical characterization testwork is to describe HLF drainage at the end of mine life and in the long term after rinsing and detoxification is complete.

Leach tailings samples were collected from metallurgical cyanide leach columns operated at Kappes, Cassiday & Associates (KCA) in 2014 and 2015 and are considered to be representative of the leach tailings that will be generated by the HLF during Operation. Specifically, the leach tailings represent ore that has been mixed with lime and leached with NaCN to extract Au.

4.3.1 Overview of Test Results

Leach tailings have a lower ARD potential compared to ore due to the increased NP from lime that is added to maintain CN stability. Geochemical test work completed for tailings samples are consistent with results for ore (and waste rock), whereby tailings samples derived from granite ore have a lower NP content and, therefore, a greater potential to be PAG. Metal enrichment is expected to be similar between leach tailings and ore, as only a minor fraction of the total metal content will be removed during HLF operation.

Elements of potential concern from the HLF process water include Sb, As, Cr, Cu, Hg and possibly Cd and Zn from each of the ore units, sulphate and Se from the schist unit, and U from the granite and gneiss units. Metal solubility in process solution is supported by the high pH (>9.8) and presence of CN.

Kinetic testing on leach tailings sampled produced from metallurgical testing showed an immediate decline in pH from rinsing of residual lime, with pH values stabilizing at slightly alkaline values. Initial production rates for As, Sb and U are similar to the rates measured for ore of the same lithology and weathering facies; however, rates for the leach tailings columns show a continuous decrease following the initial flush. This is likely related to rinsing of water soluble metals during metallurgical testwork. The lowest U loading rates (by nearly an order of magnitude) are from the schist tailings, consistent with metallurgical column leach solution.

4.3.2 Mineralogy

The mineralogy of leach tailings is expected to be generally similar to that of ore. During the CN leaching process, some water soluble minerals, such as sulphates (*i.e.*, gypsum) or other secondary oxidation products (*i.e.*, oxides) may be rinsed from particle surfaces. The addition of lime may also result in the precipitation of secondary oxides and carbonates.

4.3.3 Acid Base Accounting

Select ABA results for 16 leach tailings samples are presented in Table 4-52. The full suite of ABA results for leach tailings samples are provided in Appendix C.3-1. The rinse pH of the leach tailings is alkaline (8.6≤pH≤9.7) reflecting the addition of lime during the metallurgical testing to support CN stability. Sobek NP measured in tailings show a large range in values (0.37 to 146 kg $CaCO_3$/t). Siderite NP values are uniformly greater than Sobek NP measurements. This difference in NP values was also observed in waste rock and ore, as described in Section 4.1.3.3. Note that NP estimated from carbon content will not accurately describe leach tailings due to the presence of lime, which contributes to NP but does not contain carbon. Both tailings samples derived from granite ore (oxide and transition facies) exhibit low sobek NP (≤ 1 kg $CaCO_3$/t).

Net potential ratio values for tailings samples were calculated using Sobek NP and AP derived from both total-S and sulphide-S. With the exception of granite, all leach tailings samples have NPR >4.7 when total-S is used to derive AP, and NPR>7.0 when sulphide-S is applied. The two tailings samples derived from granite ore have NPR values ranging from 0.1 to 0.6, and as such, are classified as PAG. The NPR results for tailings are consistent with results for ore (and waste rock), whereby tailings samples derived from granite ore have a greater potential to be PAG.

4.3.4 Trace Metal Enrichment

Solid phase element results for leach tailings are presented in Table 4-53 and are compared to ACA values (Price, 1997). The complete set of solid phase element results are presented in Appendix C.3-2. Antimony, As, Bi, Hg and U are indicated to be enriched in the leach tailings with respect to ACAs, with Sb, As and Bi enriched in all samples by 10x's the ACA. Solid phase elemental abundance in leach tailings are generally similar, or higher, than median values for ore of the same lithology and weathering facies.

Table 4-54:
Acid Base Accounting Results for Leach Tailings

Geologic Unit	Weathering Facies	Metallurgical ID (leach tailings)	Head Sample ID (ore)	Sample Description	Rinse	Total- S	Sulphide-S	Sulphate-S	Sobek NP	Siderite NP	NPR	NPR
					pH	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	NP/TAP	NP/SAP
Gneiss	Oxide	73004	72134	Supremo Mine Block (1")	9.7	0.007	*<0.01*	*<0.01*	3.5	12	16.2	11.3
		73013	72142	Supremo #1	9.6	0.014	*<0.01*	*<0.01*	6.2	13	14.2	19.9
		73022	72143	Supremo #2	9.7	0.015	*<0.01*	*<0.01*	2.2	8.7	4.7	7.0
		73028	72144	Supremo Oxide T1	9.6	0.033	0.01	*<0.01*	12	18	11.5	37.9
		73034	72145	Supremo Oxide T4	9.7	0.022	0.01	*<0.01*	30	36	43.3	95.2
	Transition	73040	72146	Supremo 80%	9.5	0.097	0.05	0.02	38	44	12.4	24.1
Gneiss/Schist	Oxide/Transition	70340	-	Supremo/Latte	8.4	0.08	0.04	0.02	48	-	19.2	38.4
Schist/Gneiss	Oxide	72186	72141	DD oxide	9.6	0.13	0.1	0.01	79	83	19.5	25.3
Schist	Oxide	72117	72101	Latte -583150 Trench (6")	9.6	0.035	*<0.01*	0.02	65	69	59.4	208.0
		72123	72102	Latte 583350 Trench (6")	9.7	0.048	0.02	0.02	96	119	63.9	153.3
		73001	72133	Latte mine block (1")	9.5	0.051	*<0.01*	0.04	5.6	15	3.5	18.0
		72150	72135	Latte Oxide West	8.6	0.11	0.07	0.02	124	154	36.1	56.7
		72156	72136	Latte Oxide East	9.6	0.087	0.06	0.02	79	85	29.2	42.3
	Transition	72162	72137	Latte 80%'	8.9	0.41	0.33	0.04	146	175	11.4	14.2
		72168	72138	Latte 60%	8.9	0.47	0.39	0.03	127	155	8.6	10.4
Granite	Oxide	72174	72139	Kona Oxide	9.7	0.033	0.02	*<0.01*	0.37	8.3	0.4	0.6
	Transition	72180	72140	Kona 80% CN	9.7	0.18	0.14	0.01	0.61	7.6	0.1	0.1

Notes:
Values in grey italics are below the analytical detection limit.
NNP: net neutralization potential calculated by subtracting TAP (acid potential derived from T-S) from Sobek NP.
NPR: net potential ratio

Table 4-55:
Solid Phase Element Results for Leach Tailings

		Average Continental Abundance		*8.23*	*0.2*	*1.8*	*0.01*	*0.15*	*102*	*25*	*60*	*5.6*	*14*	*0.09*	*1.2*	*84*	*0.08*	*2.7*	*70*
Geologic Unit	**Weathering Facies**	**Metallurgical ID (leach tailings)**	**Head Sample ID (ore)**	**Al**	**Sb**	**As**	**Bi**	**Cd**	**Cr**	**Co**	**Cu**	**Fe**	**Pb**	**Hg**	**Mo**	**Ni**	**Ag**	**U**	**Zn**
				%	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Schist	Oxide	72117	72101	0.76	138	1120	0.82	0.08	102	14.3	33.1	3.32	12.4	0.2	3.75	42.6	0.07	1.69	62
		72123	72102	0.53	52.7	1580	0.5	0.15	88	12.8	24.5	3.18	15.8	0.57	3.64	30	0.08	2.09	58
		73001	72133	0.44	243	9020	0.5	0.13	90	11	24.9	3.89	16.3	0.81	3.63	33.2	0.64	4.49	75
		72150	72135	0.4	25.5	1380	0.37	0.1	126	12.1	21.3	2.69	13.8	0.31	3.99	102	0.13	2.11	46
		72156	72136	0.52	27.4	1280	0.39	0.15	109	11.5	12.3	2.8	15.4	0.26	4.27	55.9	0.06	2.59	55
	Transition	72162	72137	0.65	20.8	1710	0.45	0.09	88	12.6	14.5	2.51	14.8	0.36	3.39	58.5	0.11	2.58	50
		72168	72138	0.83	55.5	932	0.46	0.1	103	10.6	19.5	2.75	12.5	0.28	4.28	40.8	0.08	2.42	49
Granite	Oxide	72174	72139	0.44	47.7	4170	0.08	0.05	93	1.4	2.2	1.48	15.6	0.55	4.84	5	0.03	8.8	17
	Transition	72180	72140	0.34	86.4	5880	0.11	0.04	103	1.4	1.6	1.23	19.5	2.99	5.47	5.4	0.06	7.35	12
Gneiss	Oxide	73004	72134	0.45	97.3	2660	0.45	0.2	122	14.8	19.9	4.35	9.3	1.39	6.52	57.8	0.25	22.6	40
		73013	72142	0.77	41.4	1060	0.23	0.12	137	13.3	8.5	2.91	14.3	0.56	4.65	70.4	0.12	20.1	42
		73022	72143	0.48	40.4	588	0.49	0.07	93	6.3	11.1	1.8	11	0.13	4.96	11.9	0.06	6.89	21
		73028	72144	0.49	54.5	969	0.32	0.09	98	8.5	7.7	2.25	14	0.6	4.82	13.5	0.09	17.7	41
		73034	72145	0.46	31.1	1040	0.18	0.06	110	4.4	6.6	1.45	12.8	1.09	5.35	15.7	0.15	12.4	21
	Transition	73040	72146	0.7	22	1760	0.57	0.08	126	6.8	2.3	1.98	13.2	1.06	6.39	22.6	0.06	12	29
Schist/Gneiss	Oxide	72186	72141	0.76	42.8	1410	0.8	0.11	120	13.1	10.1	3.15	13.7	0.41	4.09	34.2	0.06	4.91	42

Notes:
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA. Values shaded in blue are at the ACA.

4.3.5 Metallurgical Column Leach Solution

The final leach solution from CN leach columns operated at KCA was collected to provide an indication of heap leach water chemistry during operations. In the column experiments, ore samples were mixed with lime and irrigated with a NaCN solution, leading to elevated pH, cyanide species and concentrations of metals that form CN complexes (*e.g.*, Cu, Cd, Hg, Fe, Ni and Zn). Following the stripping of Au from the effluent, the barren solution was re-circulated through the column with makeup NaCN amended as required. In total, 16 columns were established to account for variations in scale, grain size, lithology and weathering facies.

Select parameters for the final leachate chemistry from the 16 metallurgical columns are provided in Table 4-56. The complete set of results are provided in Appendix C.3-3. The water chemistry of the final leachate is presented in Table 4-56 with MDMER and CCME (10x's) guidelines to provide an indication of the relative pore water quality that can be expected from the different ore types during Operation. In this manner parameters of potential concern (that may require treatment) can be identified. Key observations are as follows:

- The highest sulphate concentrations were measured in leachate from the schist ore, in particular the transition facies, which is consistent with higher total-S and sulphide-S measured for schist ore samples.
- The highest As and Sb concentrations were measured in leachate from the granite ore, in particular the transition facies, with values ranging from 40 to 85 mg/L As and 0.17 to 0.93 mg/L Sb.
- The highest Se concentrations were leached from the schist ore transition facies (0.010 to 0.019 mg/L), with all columns leaching Se at concentrations that exceed the 10x CCME value.
- The schist ore columns showed little to no potential for U leaching (<0.0059 mg/L), with all values well below 10x CCME guidelines and several orders of magnitude lower than those observed in leachate from the granite and gneiss (oxide in particular) ore columns.
- In general, higher concentrations of sulphate, As, Sb and Se are measured in leachate from the transition facies ore as compared to oxide facies ore of the equivalent lithology (with notable exception of As and Sb in schist columns).

Table 4-56:
Final Leach Solution from Metallurgical Cyanide Columns

Lithology	Weathering Zone	Head ID (ore)	Column ID (leach tailings)	Particle Size	Column mass	pH	T-Alk	T-CN	SO_4	D-Al	D-Sb	D-As	D-Ba	D-Cd	D-Cr	D-Cu	D-Hg	D-P	D-Se	D-U	D-Zn	Ra-226
				mm	kg	s.u.	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
CCME	**short-term**	-	-	-	-	-	-	-	-	-	-	-	-	0.001	-	-	-	-	-	0.033	0.055	-
	long-term	-	-	-	-	6.5 - 9.0	-	0.005	218	0.1	0.009	0.005	-	0.00009	0.001	0.002	0.000026	-	0.001	0.015	0.0059	-
MDMER	**Max in a grab sample**	-	-	-	-	-	-	2	-	-	-	1	-	-	-	0.6	-	-	-	-	1	1.11
Schist	Oxide	72133	73001	12.5	48	10	458	101	43	0.035	0.082	16	0.012	0.00011	0.012	0.21	0.0012	0.24	0.00059	0.033	0.061	-
		72136	72156	12.5	50	9.9	366	144	547	0.064	0.036	2.4	0.015	0.00057	0.0078	0.75	0.0055	0.075	0.0039	0.0015	0.16	-
			72153	80	101	9.8	590	119	725	0.045	0.085	6	0.014	0.0075	0.006	2.8	0.0069	0.19	0.0044	0.0059	1.6	-
	Transition	72137	72162	12.5	50	9.8	301	168	2370	0.028	0.042	0.87	0.011	0.00009	0.0014	1.5	0.00069	<0.1	0.014	0.00012	0.096	-
			72159	80	94	9.5	322	125	2980	0.074	0.15	3	0.02	0.0032	0.0023	4.9	0.0047	<0.1	0.018	0.00026	1.4	-
		72138	72168	12.5	49	9.6	223	134	2670	0.019	0.049	0.5	0.009	0.0001	0.0014	2.1	0.0004	<0.1	0.01	0.00008	0.12	-
			72165	80	84	9.5	229	99	2570	0.086	0.21	1.8	0.025	0.0022	0.0019	4.6	0.0024	<0.1	0.019	0.00008	1	-
Granite	Oxide	72139	72174	12.5	50	10.1	580	164	38	0.39	0.17	40	0.007	0.0002	0.012	0.28	0.0017	0.32	0.0012	0.58	0.1	-
			72171	80	104	9.8	738	139	57	0.33	0.26	55	0.013	0.0059	0.0044	1.8	0.0054	0.37	0.0025	1.1	1.9	-
	Transition	72140	72180	12.5	50	10	570	168	424	1.21	0.93	85	0.004	<0.0001	<0.002	0.54	0.0048	0.26	0.0043	0.45	0.12	-
			72177	80	98	9.7	661	179	666	0.53	0.78	75	0.018	0.0026	0.0017	2.3	0.022	0.4	0.0076	0.83	1.4	-
Gneiss	Oxide	72142	73013	12.5	43	10	491	172	12	0.056	0.015	0.71	0.03	0.00017	0.013	0.16	0.00078	0.52	0.00087	0.47	0.036	-
			73010	80	83	9.8	517	100	10	0.18	0.028	0.81	0.089	0.0046	0.013	0.55	0.0015	0.16	0.0015	0.14	0.41	-
			73007	150	718	9.9	468	168	6.9	0.19	0.01	0.17	0.35	0.0374	0.037	1.9	0.06	<0.05	0.0016	0.0045	1.1	0.1
		72143	73022	12.5	44	10	473	134	12	0.18	0.02	0.67	0.024	0.00004	0.013	0.09	0.00011	0.25	0.0019	0.17	0.021	-
			73019	80	86	9.9	883	90	11	0.34	0.047	2	0.047	0.0033	0.024	0.57	0.00065	1	0.004	0.74	0.41	-
			73016	150	741	9.9	678	124	8.1	0.37	0.028	1	0.037	0.0255	0.051	1.5	0.015	0.33	0.005	0.15	1.1	0.018
		72144	73028	12.5	50	10	492	126	42	0.11	0.036	3.6	0.033	0.0003	0.021	0.32	0.0023	0.39	0.0011	0.41	0.064	-
			73025	80	99	9.9	738	124	45	0.16	0.13	5.1	0.038	0.0029	0.022	1.1	0.0027	0.51	0.00083	0.41	0.64	-
		72145	73034	12.5	49	10	418	161	63	0.04	0.033	2.8	0.015	0.00027	0.013	0.21	0.004	0.18	0.00083	0.27	0.027	-
			73031	80	95	9.8	644	170	58	0.052	0.073	2.8	0.067	0.0019	0.012	1.1	0.0045	0.19	0.00079	0.15	0.66	-
		72134	73004	12.5	46	10	676	113	8.8	0.054	0.026	1.4	0.005	0.00053	0.0091	0.29	0.0055	0.97	0.0012	1.9	0.056	-
	Transition	72146	73040	12.5	50	10	374	156	744	0.061	0.18	7.5	0.003	0.00006	0.0015	0.32	0.0024	0.12	0.0063	0.058	0.039	-
			73037	80	94	9.8	1180	136	444	0.087	0.27	13	0.007	0.001	0.012	1	0.0032	1	0.0071	0.46	0.59	-
Gneiss/Schist	Oxide	72141	72186	12.5	50	10.1	439	142	177	0.058	0.035	1.9	0.004	0.00008	0.013	0.39	0.00012	0.11	0.0057	0.00032	0.068	-
			72183	80	95	9.8	564	134	220	0.028	0.089	2.6	0.018	0.0033	0.0042	3.2	0.0027	0.089	0.0098	0.004	1.1	-

Notes:
Values in grey italics are below the analytical detection limit;
Values that exceed the Metal and Diamond Mines Effluent Regulations (MDMER, 2018) maximum authorized concentration in a grab sample are shaded in dark grey.
Values that exceed the Canadian Council of Ministers of the Environment (CCME, 2019) Water Quality Guidelines for the Protection of Freshwater Aquatic Life by 10x's are shaded in light grey;
All guidelines are for total metal, except for Al, Mn, and Zn.
Guideline for Cu and Cd are based on a hardness of 50 mg $CaCO_3$/L; Guideline for Zn is based on a hardness of 50 mg/L CaCO3/L, a pH of 8.5, and a DOC of 2.5 mg/L
Guideline for Cr is for hexavalent (VI); Guidelines for sulphate and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 50 mg CaCO3/L

Total CN concentrations range from 90 to 179 mg/L in final effluent samples from the metallurgical CN columns. The presence of CN supports the solubility of a variety of metals that would otherwise be insoluble at neutral pH (*e.g.,* Cu, Cd, Zn, Hg, *etc*.). Other metals such as As, Sb and U, which are not directly associated with CN complexation, may also be present in elevated concentrations due to the increased solubility of oxyanions at high pH and alkalinity. Detoxification of the HLF will destroy CN and reduce the solubility of metals which form CN-complexes. Furthermore, pH can be expected to decline with time as lime is either rinsed from the system or re-precipitated as calcite. This will reduce the solubility of As, Sb and U; however, they will likely remain in effluent at concentrations of concern.

Based on the results of the final leach from the CN columns, elements of potential concern from the HLF include Sb, As, Cr, Cu, Hg and possibly Cd and Zn from each of the ore units, as well as sulphate and Se from the schist unit, and U from the granite and gneiss units. Of these, Sb, As, Hg and U are indicated to be enriched in solid phase analyses (Section 4.3.3).

4.3.6 Kinetic Tests

4.3.6.1 Sample Selection and Rationale

Five unsaturated columns and three field bins were constructed with leach tailings to obtain information on metal leaching rates from spent ore in the HLF after mine closure. The leach tailings used for kinetic testwork were sub-sampled from the final residue available upon completion of the metallurgical column testwork. Ore composites used for metallurgical testing were composed of lithologies and weathering facies in proportions representative of the proportions that will be placed in the HLF during the mine life. A summary of the leach tailings, sample selection criteria and rationale for the testwork are provided in Table 4-57. All the unsaturated columns were operated as trickle leach columns at 4°C. Additional detail pertaining to the operating procedures are provided in Section 3.2.6 and Appendix D.3. An overview of the metallurgical column testwork that produced the leach tailings is presented in Section 3.2.7.

Figure 4-21 and Figure 4-22 present box plots showing the distribution of total-S and solid phase As, Sb and U for each ore type, with the results for the kinetic test sub-samples superimposed. Note that several of the kinetic test samples contain a combination of lithologies (Col 1, Col 3, FB-LT1 and Col 17). These samples are compared against the the dominant rock type that composes the kinetic tests. The comparison indicates that the kinetic tests represent moderate too high total-S, with all samples except FB-LT3 plotting at or above medium values of the respective rock units. Antimony concentrations were uniformly above medium concentrations of the respective rock units. Most kinetic tests

samples plotted near or above median values of As and U, with the exception of FB-LT3 which plotted near the 25th percentile and 10th percentile for As and U, respectively.

Table 4-57:
Leach Tailings Kinetic Test Details, Sample Selection Criteria and Rationale

Lithology	Weathering Facies	Kinetic Test ID	Type of Test	Mass (kg)	Metallurg. Column ID	Weeks	Recirc. Cycles
Gneiss (82%) Schist (18%)	Oxide (90%) Transition (10%)	Col 1	Unsaturated Column	10.0	70340	98	57-89
		Col 2		20.0		98	57-89
		FB-LT1	Field Bin	76.3		70	-
Gneiss	Oxide (80%) Transition (20%)	Col 16	Unsaturated Column	5.0	40% 73028, 40% 73034, 20% 73040	39	-
Gneiss	Oxide	FB-LT2	Field Bin	200	50% 73007 50% 73016	10	-
Schist	Oxide	FB-LT3	Field Bin	200	50% 72108 50% 72111	10	-
Schist	Oxide (40%) Transition (60%)	Col 15	Unsaturated Column	5.0	20%72162, 20% 72168, 30% 72150, 30% 72156	39	-
Gneiss (90%) Granite (10%)	Oxide (80%) Transition (20%)	Col 17	Unsaturated Column	5.0	35% 73028, 35% 73034, 18% 73040, 7% 72174, 3% 72180	39	-

Notes: All columns are constructed of Plexiglas with acrylic perforated disk & nylon mesh; All tests operated at temperature of 4°C; Leachate is sampled bi-weekly from all columns; All columns are operated as trickle leach (discussed in more detail in Section 3.2.6).

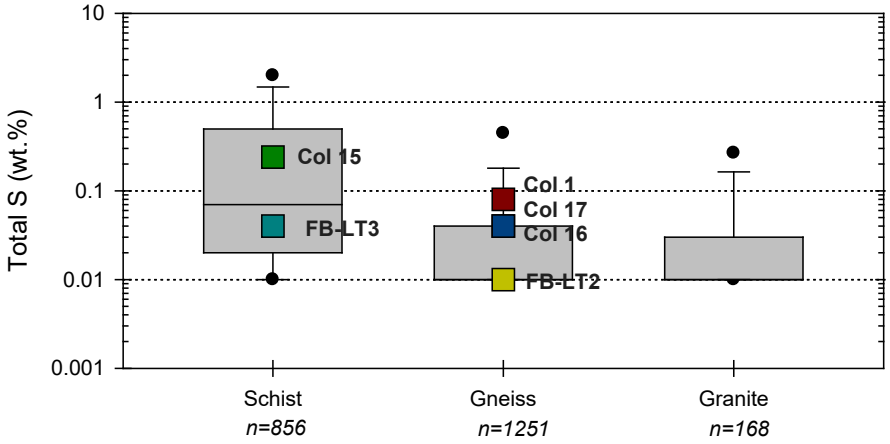

Figure 4-21: Box plots showing the concentration ranges for total-S from the exploration database ore samples with total-S for leach tailings kinetic test sub-samples superimposed

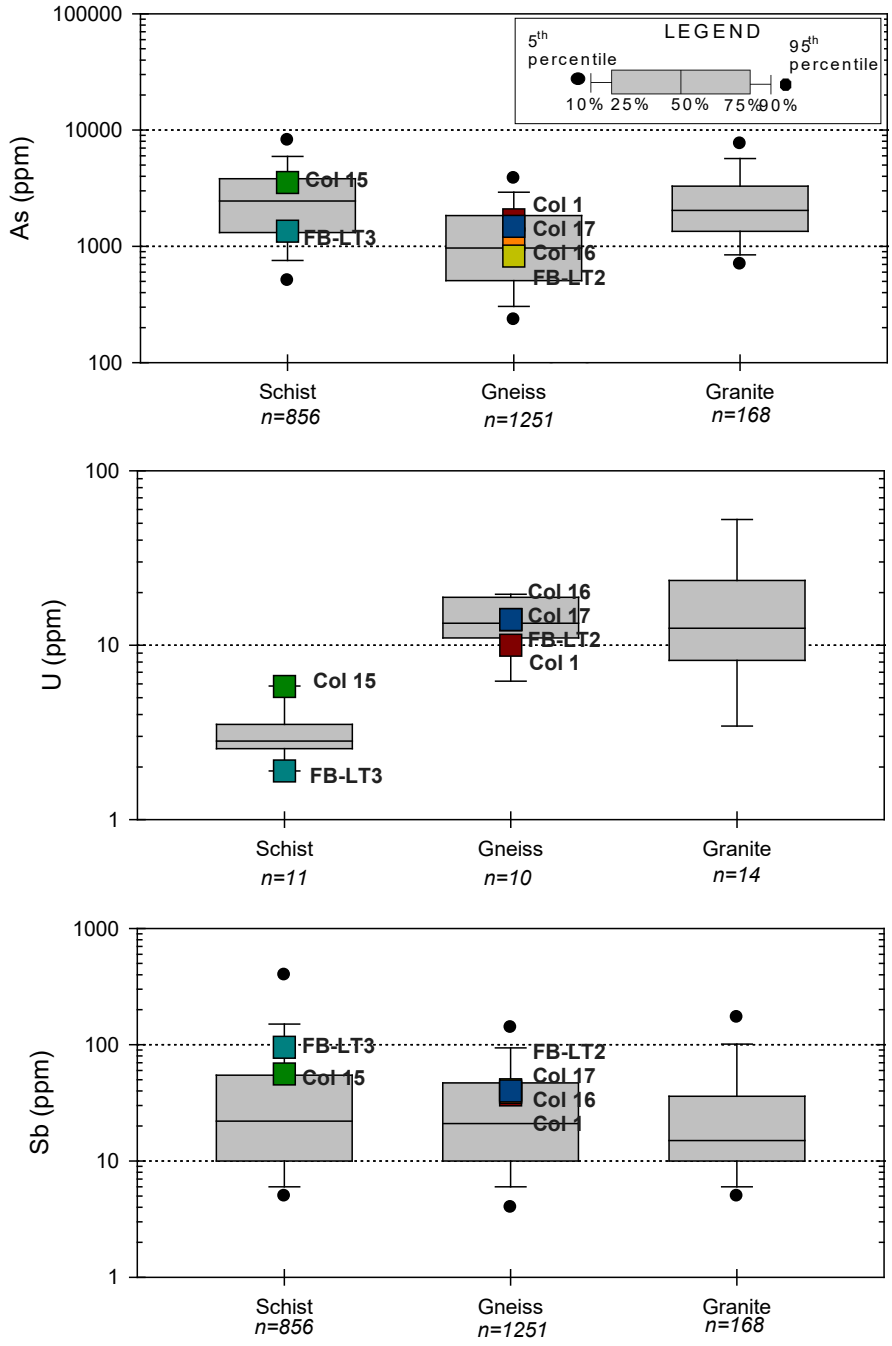

Figure 4-22: Box plots showing the concentration ranges for solid phase As and Sb from the exploration database ore samples and U from the ABA database ore samples with the leach tailings kinetic test sub-samples superimposed.

4.3.6.2 Static Tests

Mineralogy

A sub-sample of the leach tailings composite sample LT1 (derived from 82% gneiss, 18% schist and 90% oxide 10% transition ore) used for laboratory and field kinetic testwork in Col 1, Col 2 (20 kg duplicate of Col 1) and FB-LT1 was submitted for quantitative phase analysis using the Rietveld Method XRD. The minerals identified by XRD in the waste rock kinetic test sub-sample are provided in Table 4-58. The major rock forming minerals identified in each sample are quartz and feldspars (microcline and albite), with lesser amounts of muscovite, biotite, chlorite and phlogopite. The sample also comprises measurable concentrations of kaolinite (6.8 wt.%), demonstrating the weathered state of the test material. No sulphide minerals were identified in the leach tailings sample. However, two carbonate minerals, calcite (1.4 wt.%) and dolomite (4.6 wt.%), were identified.

Table 4-58:
XRD Results for Leach Tailings Kinetic Test Sub-samples

	Lithology	**Gneiss/Schist**
	Weathering Facies	**Oxide/Transition**
	Kinetic Test IDs	**Col 1/Col 2 & FB-LT1**
Mineral	**Formula**	**wt. %**
Quartz	SiO_2	56.3
Microcline	$KAlSi_3O_8$	1.6
Albite	$NaAlSi_3O_8$	4.6
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$	14.8
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$	0.5
Phlogopite	$KMg_3(AlSi_3O_{10})(OH)$	3.1
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$	6.4
Kaolinite	$Al_2Si_2O_5(OH)_4$	6.8
Calcite	$CaCO_3$	1.4
Dolomite	$CaMg(CO_3)_2$	4.6

Acid Base Accounting and Solid Phase Elements

Rinse pH for the leach tailings kinetic test sub-samples are alkaline (8.4 – 9.6), owing in part, to the addition of lime to the ore prior to leaching (Table 4-59). Total-S values range from 0.01 wt.% in the gneiss oxide field bin sub-sample (FB-LT2) up to 0.24 wt.% in the schist oxide/transition column sub-sample (Col 15). Consistent with observations made for

the waste rock and ore, leach tailings comprising schist contain the highest amounts of Sobek NP (55 – 80 kg $CaCO_3$/t) compared to leach tailings comprising only gneiss and/or granite (NP ≤ 23 kg $CaCO_3$/t).

The overall highest solid phase metal concentrations (Al, Cd, Co, Cu, Fe, Mn, Ni, Sb and Zn) were measured in the schist oxide field bin sub-sample (FB-LT3, Table 4-59) and the highest As concentration (3,543 ppm) was measured in the schist oxide/transition sample (Col 15).

Table 4-59:
Acid-Base Accounting Results and Solid Phase Elements in Leach Tailings Kinetic Test Sub-samples

Lithology		**Gneiss/ Schist**	**Gneiss**	**Gneiss**	**Schist**	**Schist**	**Gneiss/ Granite**
Weathering Facies		**Oxide/ Transition**	**Oxide/ Transition**	**Oxide**	**Oxide/ Transition**	**Oxide**	**Oxide/ Transition**
Kinetic Test IDs	**Column**	**Col 1**	**Col 16**	**-**	**Col 15**	**-**	**Col 17**
	Field Bin	**FB-LT1**	**-**	**FB-LT2**	**-**	**FB-LT3**	**-**
Acid Base Accounting Parameters							
Rinse pH	s.u.	8.4	9.6	9.6	9.4	9.6	9.4
Total-S	wt.%	0.08	0.04	0.01	0.24	0.04	0.04
Sulphate-S	wt.%	0.02	0.012	*<0.01*	0.02	0.02	0.012
Sulphide-S	wt.%	0.04	0.02	*<0.01*	0.19	0.02	0.02
CaNP	kg $CaCO_3$/t	47	23	1.7	59	81	20
Sobek NP	kg $CaCO_3$/t	48	24	4.2	55	80	21
Siderite NP	kg $CaCO_3$/t	-	30	11	71	94	28
Solid Phase Elements by Aqua Regia							
Ag	ppm	0.13	0.11	0.09	0.065	0.075	0.0987
Al	%	0.33	0.52	0.63	0.53	0.65	0.50
As	ppm	1690	1156	824	3543	1350	1488
Cd	ppm	0.09	0.076	0.095	0.065	0.12	0.072
Co	ppm	8.2	6.5	9.8	5.5	14	5.9
Cr	ppm	123	108	115	97	95	105
Cu	ppm	15	6.2	9.8	7.9	29	5.6
Fe	%	2.3	1.9	2.4	1.9	3.3	1.8
Hg	ppm	0.57	0.89	0.35	1.2	0.39	0.91
Mn	ppm	402	412	537	284	638	376
Mo	ppm	4.5	5.4	4.8	4.6	3.7	5.2
Ni	ppm	14	16	41	23	36	15
Pb	ppm	15	13	13	16	14	13
Sb	ppm	37	39	41	56	95	40
Se	ppm	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*
U	ppm	10	14	14	5.8	1.9	14
Zn	ppm	33	31	32	29	60	29

Notes: Values in grey italics are below the analytical detection limit. Green gradient shading represents relative concentrations for each parameter.

Particle Size Distribution

Table 4-60 presents the particle size distribution for individual leach tailings samples that compose the composite samples used for kinetic testwork. The proportion of each leach tailings sample used to construct the ML/ARD columns and field bins are provided in Table 4-57. Also provided in Table 4-61, are the particle size distribution of crushed ore used in the metallurgical columns. Field kinetic tests FB-LT2 and FB-LT3 comprise notably larger particles than the samples that make up the other field test and columns. Specifically, 45% of particles that compose FB-LT2 and FB-LT3 are between 37.5 and 75 mm in diameter, owing to the larger particles of crushed ore (82 – 115 mm) used in the metallurgical columns that produced the leach tailings. The leach tailings that compose kinetic tests Col 15, Col 16 and Col 17 also comprise a well sorted distribution of particles measuring < 16 mm in diameter, with the greatest proportion of particles (61-66%) comprising the 1.7 to 12.5 mm diameter fraction. Sample 70340 (Col 1 and FB-LT1) is predominantly composed of particles measuring between 6.3 mm and 37.5 mm in diameter (67%), with the greatest proportion of the test material comprising the 6.3 to 12.5 mm fraction (30%).

4.3.6.3 Unsaturated Column Results

At mine closure, it is anticipated that the heap leach tailings will be "rinsed" with barren recycle solution. As discussed in Section 3.2.7, the leach tailings were not rinsed following metallurgical testwork or prior to placing the material in the columns and field bins for ML/ARD kinetic testwork. In order to accurately account for leaching conditions at closure following the rinse of the HLF, loading rates were calculated (median and 75th percentile values) for the 10 weeks after rinsing with approximately 5 pore volumes through the leach tailings columns (Table 4-61). Time series profiles for the leach columns are presented in Figure 4-23 through Figure 4-25 and in Appendix D.3.

Leachate pH and Sulphate Loading

Leachate pH for all tailings columns remain slightly alkaline over the test period (7.9 - 8.9, Table 4-61). A gradual decline in pH reflecting rinsing of lime is evident in all leach tailings columns except Col 15 (schist) (Figure 4-23). The pH values from Col 15 were initially relatively low compared to other columns (pH 8.0) and have remained relatively constant over the test period. A decrease in leachate pH is expected from the leach tailings in response to the rinsing and/or re-precipitation of residual lime from metallurgical testing. Lime is unstable in the presence of water and atmospheric CO_2 and will re-precipitate as calcium carbonate minerals with time. The lower pH values associated with Col 15 is likely due to a smaller lime addition during metallurgical testing, which was 1 g/kg compared to 1.5 g/kg in gneiss samples (KCA, 2015).

Table 4-60:
Particle Size Distribution for Leach Tailings Kinetic Sample

ML/ARD Kinetic Test ID	Col 1/Col 2 FB-LT1	Col 17					FB-LT3		Col 15				FB-LT2	
		Col 16			*NA*	*NA*								
Metallurgical Column ID	**70340***	**73028**	**73034**	**73040**	**72174**	**72180**	**72108**	**72111**	**72162**	**72168**	**721504**	**72156**	**73007**	**73016**
	NA	12.1	12.9	12.2	11.4	12.2	82.3	115	12.2	12.4	11.5	12.4	93.8	110.3
Sieve (mm)	Weight Retained (%)													
175	0	0	0	0	0	0	0	0	0	0	0	0	0	0
150	0	0	0	0	0	0	0	8.8	0	0	0	0	5.4	5.4
100	0	0	0	0	0	0	13.6	13.3	0	0	0	0	9.4	16.1
75	0	0	0	0	0	0	6.1	14.9	0	0	0	0	11.5	15.4
62.5	0	0	0	0	0	0	8.9	8.8	0	0	0	0	4.7	6
50	0	0	0	0	0	0	6	6.9	0	0	0	0	7.6	8.5
37.5	0	0	0	0	0	0	6.4	6	0	0	0	0	7.4	4.1
25	15	0	0	0	0	0	9.1	6.6	0	0	0	0	6.9	6.1
16	22	0	0	0	0	0	9.6	6	0	0	0	0	6.4	5.9
12.5		16.4	21.6	18.1	16.3	17.1	4.8	3	17.3	18.2	15.8	17.8	3.5	3.6
9.5	30.1	23.4	22	23.3	29	37.1	9.8	6.5	37.6	38.8	34.2	38.2	7.1	7.6
6.3		20.4	19.1	18.3										
1.7	18.7	22.1	22	22.9	33.3	26.7	11.8	7.9	26.8	25.3	27.1	25.5	11.1	8
<1.7	14.4	17.8	15.3	17.4	21.4	19.2	14	11.2	18.3	17.7	22.9	18.6	19.1	13.4
Total	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*	*100*

Notes:
PSD for leach tailings samples were conducted as part of the metallurgical testwork (KCA, 2015)
* PSD completed at SGS; 14.4% <1.7 mm was further subdivided into 7.7% retained on 0.425 mm sieve, 3.8% on 0.15 mm, 2.1% on 0.053 mm and 0.8% < 0.053 mm.

Table 4-61:
Loading rates for leach tailings unsaturated columns for 10 cycles after rinsing.

Parameter	Unit	Gneiss/Schist (Oxide/Transition)				Schist (Oxide/Transition)		Gneiss (Oxide/Transition)		Gneiss/Granite (Oxide/Transition)	
		Col 1 (10 kg)		Col 2 (20 kg)		Col 15 (5 kg)		Col 16 (5 kg)		Col 17 (5 kg)	
		weeks 19-37		weeks 35-53		weeks 9-27		weeks 7-25		weeks 7-25	
		Median	75th PCTL	Median	75th PCTL	Median	75th PCTL	Median	75th PCTL	Median	75th PCTL
pH		8.4	8.4	8.5	8.5	8.1	8.2	8.5	8.6	8.5	8.6
Alkalinity	$mgCaCO_3/kg/wk$	4.5	4.9	2.8	2.9	6.2	6.8	12	15	208	271
Sulphate	mg/kg/wk	0.53	0.58	0.26	0.28	5.5	8.2	0.42	0.57	0.54	0.72
Total CN	mg/kg/wk	0.0023	0.0032	0.0011	0.0013	0.013	0.021	0.014	0.022	0.014	0.023
WAD CN	mg/kg/wk	0.00017	0.00018	0.000088	0.00015	0.0012	0.0016	0.0017	0.0029	0.0016	0.0019
Ammonia-N	mg/kg/wk	0.0067	0.0092	0.0035	0.0042	0.0098	0.015	0.0051	0.0056	0.0054	0.0077
Nitrate-N	mg/kg/wk	0.00098	0.00100	0.00051	0.00053	0.0029	0.0033	0.0029	0.0033	0.0029	0.0033
Nitrite-N	mg/kg/wk	0.00050	0.00065	0.0010	0.0015	0.0015	0.0016	0.0015	0.0017	0.0015	0.0016
Al	mg/kg/wk	0.00027	0.00032	0.000074	0.000098	0.00031	0.00034	0.0015	0.0024	0.0032	0.0065
Sb	mg/kg/wk	0.00062	0.00066	0.00036	0.00039	0.0018	0.0022	0.0018	0.0020	0.0024	0.0026
As	mg/kg/wk	0.034	0.036	0.019	0.020	0.027	0.038	0.11	0.14	0.17	0.20
Cd	mg/kg/wk	0.00000011	0.00000019	0.00000011	0.00000012	0.00000022	0.00000029	0.00000016	0.00000030	0.00000018	0.00000019
Ca	mg/kg/wk	0.089	0.091	0.050	0.053	1.8	1.9	0.24	0.25	0.24	0.25
Cr	mg/kg/wk	0.000034	0.000042	0.000021	0.000023	0.0000081	0.0000097	0.000025	0.000031	0.000016	0.000022
Co	mg/kg/wk	0.000094	0.00012	0.000051	0.000060	0.00023	0.00038	0.00023	0.00035	0.00025	0.00049
Cu	mg/kg/wk	0.000019	0.000022	0.0000096	0.000010	0.000045	0.000050	0.000036	0.000045	0.000044	0.000054
Fe	mg/kg/wk	0.00070	0.00092	0.00048	0.00058	0.0043	0.0062	0.0043	0.0076	0.0051	0.0089
Pb	mg/kg/wk	0.00000033	0.00000097	0.00000017	0.00000024	0.00000057	0.0000016	0.00000096	0.00000134	0.0000014	0.0000019
Mn	mg/kg/wk	0.0000096	0.000012	0.0000046	0.0000052	0.00041	0.00049	0.000035	0.000037	0.000034	0.000046
Hg	µg/kg/wk	0.00016	0.00017	0.000088	0.000092	0.00049	0.00054	0.00056	0.00108	0.00057	0.0013
Mo	mg/kg/wk	0.00046	0.00060	0.00029	0.00035	0.00029	0.00070	0.00071	0.00091	0.00059	0.00085
Ni	mg/kg/wk	0.0000044	0.0000050	0.0000018	0.0000023	0.000064	0.000084	0.0000056	0.0000091	0.0000057	0.0000094
Se	mg/kg/wk	0.0000053	0.0000067	0.0000083	0.0000088	0.000028	0.000042	0.000014	0.000017	0.000014	0.000015
Ag	mg/kg/wk	0.000000033	0.000000036	0.000000018	0.000000023	0.00000059	0.0000022	0.00000067	0.00000130	0.00000067	0.00000088
U	mg/kg/wk	0.0032	0.0038	0.0017	0.0019	0.00059	0.00067	0.018	0.025	0.020	0.026
Zn	mg/kg/wk	0.000016	0.000017	0.0000084	0.0000088	0.000049	0.000057	0.000049	0.000055	0.000049	0.000055

Notes: All concentrations below the analytical detection limit were set at the limit for calculation of loading rates and statistics;
Weeks used in derivation of median and 75th percentile values are based on five pore volumes having passed through the leach tailings of the kinetic test column.
Green gradient shading represents relative concentrations of median values for each parameter

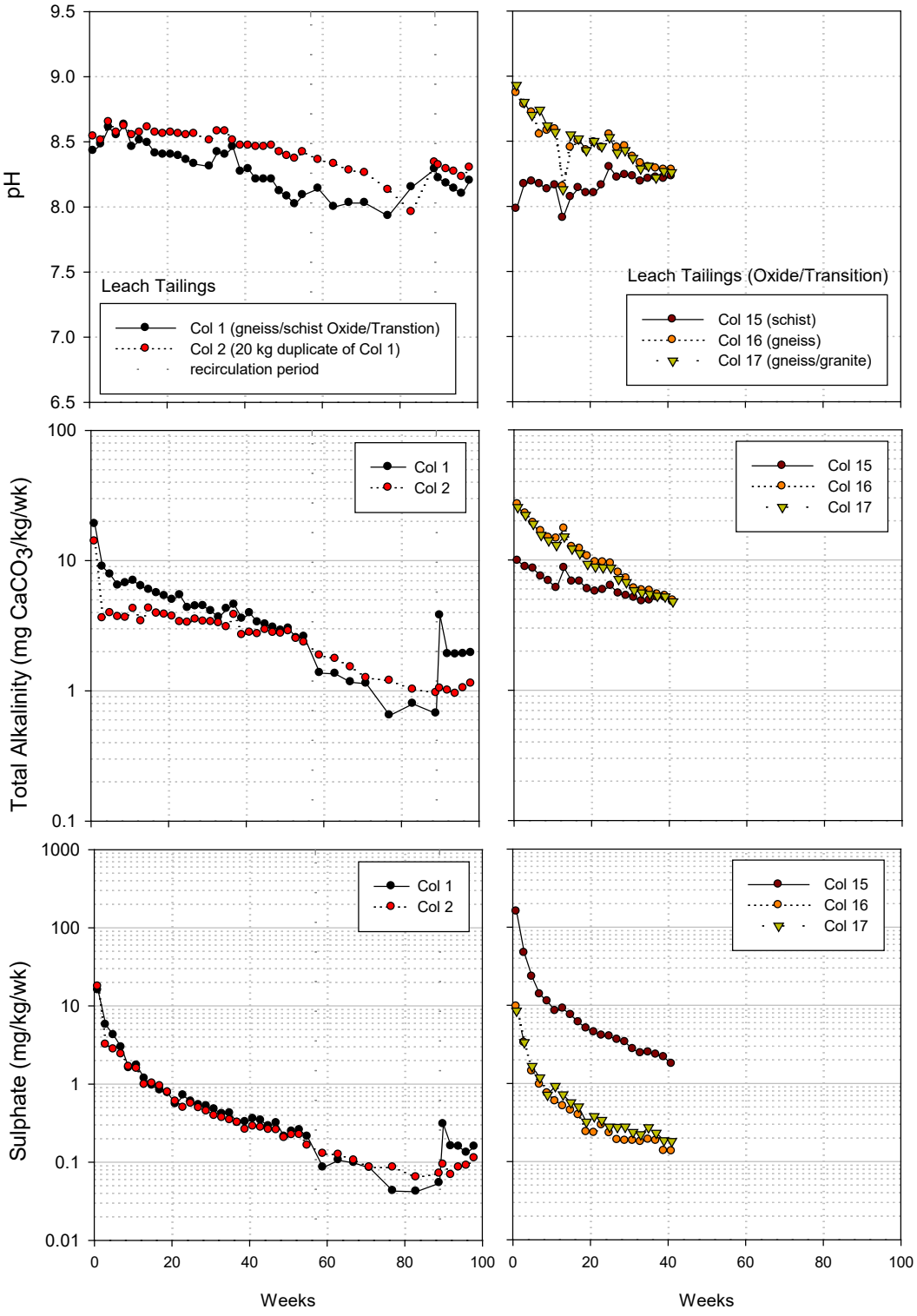

Figure 4-23: Leachate pH and weekly loading rates for total alkalinity and sulphate from leach tailings columns

Sulphate loading rates from each of the tailings columns shows a consistent decrease of one to two orders of magnitude over the test period, with Col 1, Col 2, Col 16 and Col 17 decreasing from ~10 mg/kg/wk to <0.2 mg/kg/wk. The initial sulphate load for the schist tailings (Col 15) is higher (158 mg/kg/wk), consistent with higher solid phase total and sulphide-S measured in the sub-sample (0.24 and 0.19 %, respectively; Table 4-61) and decreases to <2 mg/kg/wk over the 39 weeks of testing.

Residual Cyanide

Total and weak acid dissociable (WAD) cyanide loading rates from the leach tailings columns are initially low (< 1 mg/kg/wk) and decrease two to three orders of magnitude over the test period. The WAD cyanide analysis includes free CN and weak complexes with Zn, Cd, Ag, Cu, and Ni. Total cyanide analysis measures all of the cyanide present in any form, including in strong CN complexes with Fe, Co and Au.

Slightly higher total cyanide production rates are measured in leachate from Col 16, Col 17 and, in particular, Col 15 Table 4-61, Figure 4-24). WAD cyanide production rates decrease to near detection levels (0.01 mg/L) by approximately week 25 of testwork. Time series profiles indicate that cyanide (and WAD cyanide) production rates from Col 1 and Col 2 may be increasing following the recirculation period (Figure 4-24).

Thiocyanate (SCN) and cyanate (CNO) complexes were also evaluated in leachate samples from the tailings columns; however, with the exception of the initial flush for Col 15, 16 and 17, all values were below the detection limits (<2 and <1 mg/L, respectively)

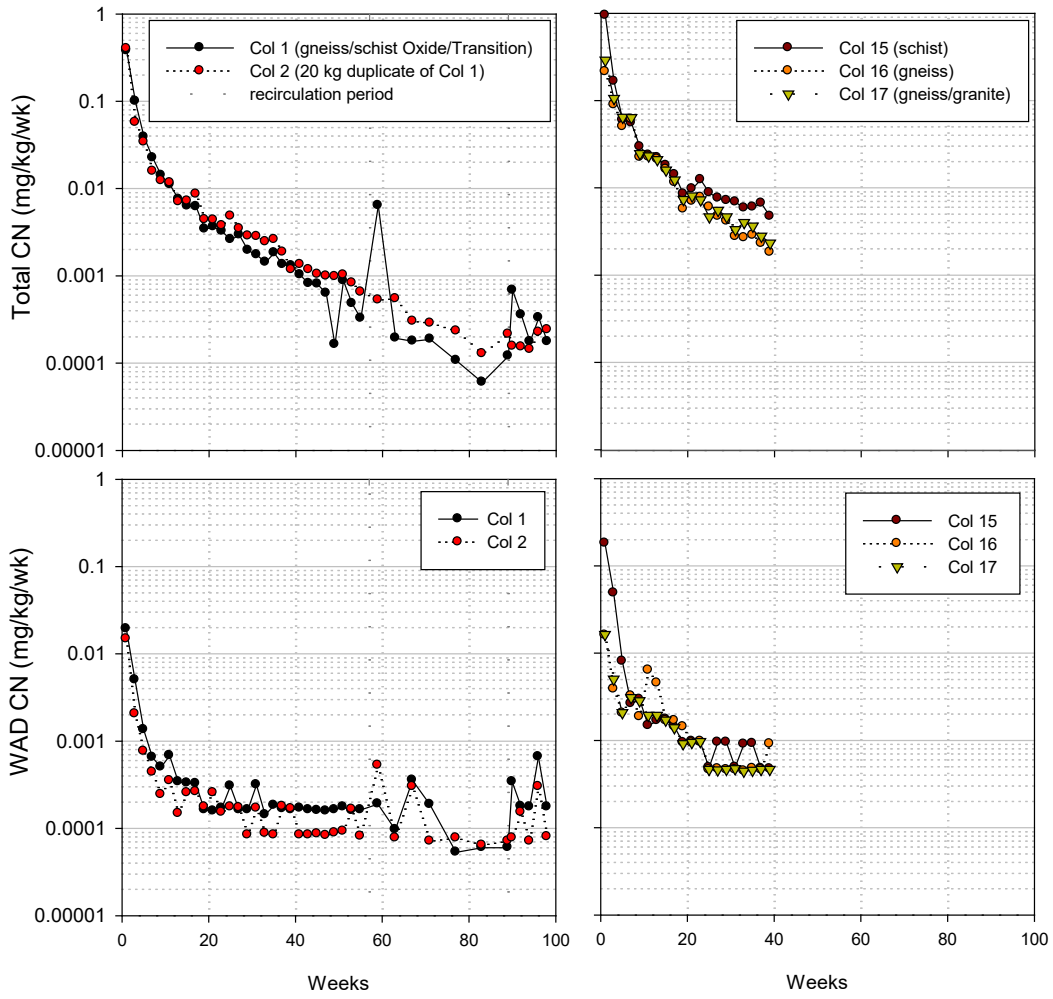

Figure 4-24: Loading rates for cyanide from leach tailings columns

Metal Leaching Trends

Time series profiles of As, Sb and U production rates are presented in Figure 4-25. Time series profiles for all other metals are provided in Appendix D.3. Loading rates for the leach tailings are generally relatively consistent (within the same order of magnitude), with slightly higher loadings observed for Col 15, Col 16 and Col 17 for most metals (Table 4-61, Figure 4-25, Appendix D.3). Loading rates for Col 16 and Col 17 are generally similar, with only slightly higher loadings of As and Al produced by the gneiss/granite tailings (Col 17) compared to the gneiss tailings (Col 16). The lowest U loading rates (by nearly an order of magnitude) are from the schist tailings (Col 15). Loading rates for the schist tailings (Col 15) are generally consistent with or slightly lower than the gneiss tailings (Col 16 and Col 17), with the exception of Mn, Ni and Se (Col 15, Appendix D.3), which are slightly higher compared to the gneiss tailings. This result is consistent with

metallurgical column leach solution, which found that schist leach columns contained significantly lower U concentrations than gneiss or granite leach columns (Table 4-57).

In general, metal production rates from each of the leach tailings columns decrease or remain relatively stable at or below the respective detection limit (Cd, Pb, Hg, Ni, Zn) over the test period (Figure 4-25; Appendix D.3). The only exception is Mn from the gneiss and gneiss/granite columns (Col 16 and Col 17), which increases an order of magnitude (0.00013 and 0.00004 mg/kg/wk, respectively) after reaching a low at approximately week 20 of testwork.

Initial production rates for As, Sb and U are similar to the rates measured for ore of similar lithology and weathering facies (Figure 4-25). However, unlike the production rates from the ore columns, rates for the leach tailings columns show a continuous decrease following the initial flush.

Recirculation Experiment

Col 1 and Col 2 were subjected to a recirculation experiment that involved recirculating leachate as influent to the columns. Table 4-62 presents the final production loading rate prior to the recirculation experiment (*i.e.*, reduction in flow rate), the final production rate of the recirculation experiment and the median value for the recirculation period. The calculated differences between the final production rate prior to the experiment and the final and median loading rates of the recirculation period are highlighted in yellow in Table 4-63. The recirculation periods are marked on the time series profiles by dashed vertical lines (Figure 4-23 through Figure 4-25).

Loading rates for nearly all parameters either decrease (by less than an order of magnitude) or remain at the detection limit following the reduced flow conditions in the leach tailings columns (Figure 4-23 through Figure 4-25). Parameters generally decrease by more than 60% (*i.e.*, Diff of -60 or lower) by the final cycle of the recirculation period (Table 4-62). The most notable exceptions are nitrate-N for both columns and, in particular, nitrite-N for Col 1, which show increases over the recirculation period.

Table 4-63 presents the concentrations prior to and during the recirculation experiment and the calculated percent differences (highlighted in yellow). Time series profiles for leachate concentrations are presented in Appendix D.3. Similar to the results of the waste rock recirculation experiment, concentrations for many parameters from the leach tailings columns remain relatively unchanged, generally decreasing by less than 50% (Diff of -50 or higher), indicating that metal release is primarily solubility controlled. A slight overall increase in Mn for Col 1 and Col 2 and a more pronounced increase in nitrate-N for both columns and nitrate-N for Col 1 is evident (Table 4-63, Appendix D.3). The increase in nitrate-N is consistent with the oxidation (and decrease) in ammonia-N for unsaturated (sub-aerial) columns.

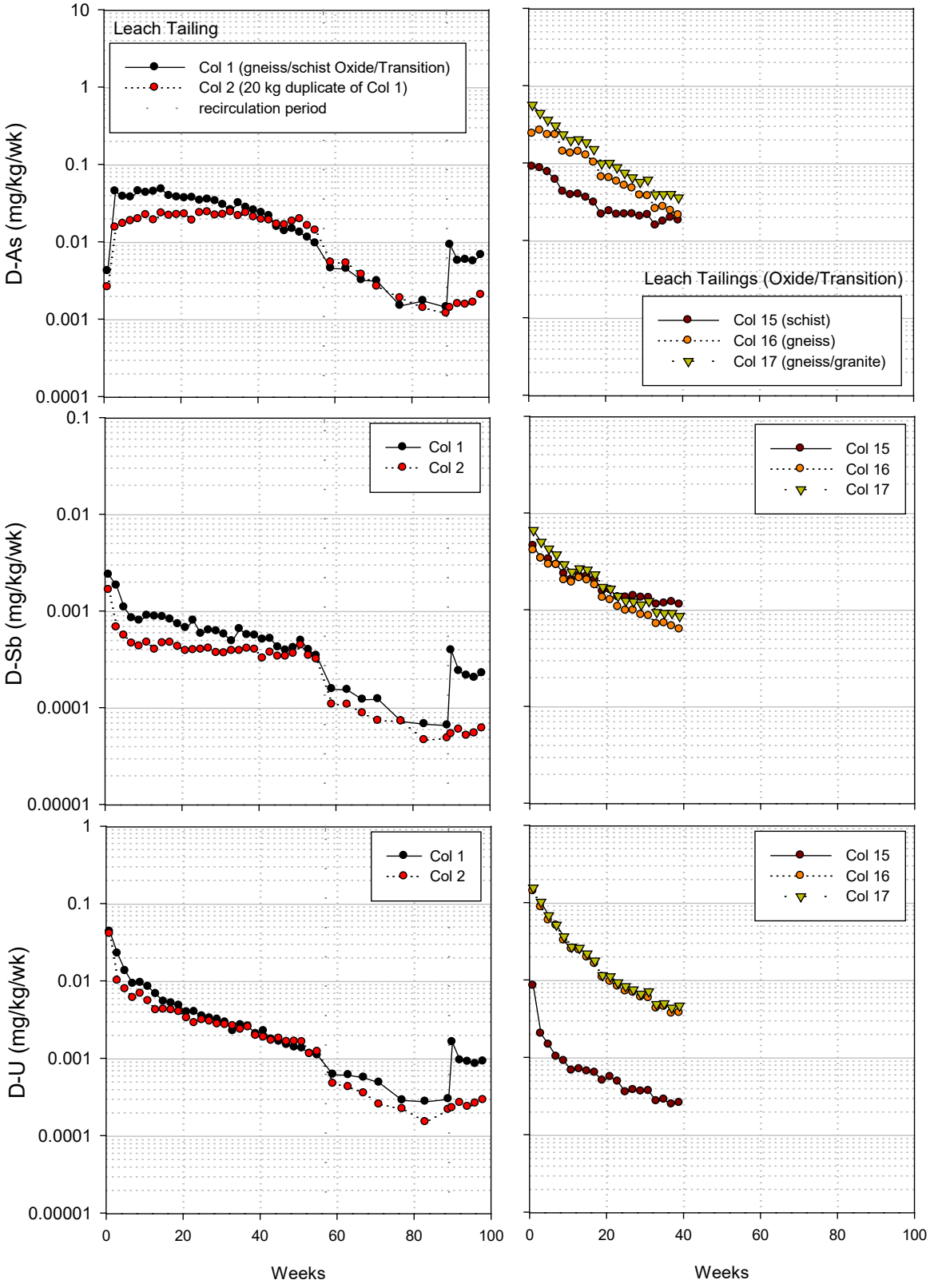

Figure 4-25: Loading rates for As, Sb and U from leach tailings columns

Table 4-62:
Loading Rates and Percent Difference of Recirculation Experiment for Gneiss/Schist Oxide/Transition Facies Leach Tailings Columns

Parameter	Unit	Col 1					Col 2				
		Loading Rates for Recirculation			*Percent Change*		Loading Rates for Recirculation			*Percent Change*	
		Cycle immediately before (Cycle 56)	Median (Cycles 57-89)	Final cycle (Cycle 89)	*Median for Recirc. Period*	*Final Recirc. Cycle*	Cycle immediately before (Cycle 56)	Median (Cycles 57-89)	Final cycle (Cycle 89)	*Median for Recirc. Period*	*Final Recirc. Cycle*
pH	s.u.	8.1	8.0	8.3	*NA*	*NA*	8.4	8.3	8.3	*NA*	*NA*
Alkalinity	mg/kg/wk	2.6	1.1	0.67	*-56*	*-74*	2.3	1.3	0.96	*-47*	*-59*
Sulphate	mg/kg/wk	0.21	0.084	0.054	*-60*	*-74*	0.16	0.086	0.071	*-47*	*-56*
Total CN	mg/kg/wk	0.00033	0.00018	0.00012	*-45*	*-63*	0.00065	0.00029	0.00021	*-56*	*-67*
WAD CN	mg/kg/wk	0.00016	0.00010	0.00006	*-41*	*-63*	0.00008	0.00008	0.00007	*-5*	*-12*
Ammonia-N	mg/kg/wk	0.0065	0.0057	0.00060	*-12*	*-91*	0.0016	0.0015	0.00036	*-8*	*-78*
Nitrate-N	mg/kg/wk	0.0010	0.0015	0.0018	*53*	*85*	0.0092	0.079	0.079	*761*	*761*
Nitrite-N	mg/kg/wk	0.0041	0.0768	0.0768	*1790*	*1790*	0.00049	0.00012	0.00011	*-76*	*-78*
Al	mg/kg/wk	0.00011	0.000047	0.000021	*-56*	*-80*	0.000076	0.000021	0.000017	*-72*	*-77*
Sb	mg/kg/wk	0.00034	0.00012	0.000065	*-65*	*-81*	0.00031	0.000073	0.000048	*-77*	*-85*
As	mg/kg/wk	0.0095	0.0031	0.0014	*-68*	*-85*	0.014	0.0026	0.0012	*-81*	*-92*
Cd	mg/kg/wk	0.00000005	0.00000003	0.00000002	*-45*	*-63*	0.00000002	0.00000002	0.00000001	*-5*	*-42*
Cr	mg/kg/wk	0.000013	0.0000061	0.0000032	*-51*	*-75*	0.000014	0.0000043	0.0000034	*-70*	*-76*
Co	mg/kg/wk	0.000028	0.000013	0.0000073	*-55*	*-74*	0.000033	0.0000078	0.0000061	*-76*	*-81*
Cu	mg/kg/wk	0.000015	0.0000048	0.0000028	*-69*	*-82*	0.000012	0.0000045	0.0000022	*-62*	*-81*
Fe	mg/kg/wk	0.00021	0.00010	0.00010	*-54*	*-52*	0.00026	0.000060	0.000046	*-77*	*-82*
Pb	mg/kg/wk	0.00000049	0.00000011	0.00000012	*-78*	*-75*	0.00000016	0.00000008	0.00000007	*-52*	*-56*
Mn	mg/kg/wk	0.000015	0.0000080	0.0000025	*-46*	*-83*	0.0000057	0.0000036	0.0000061	*-37*	*8*
Hg	µg/kg/wk	0.00033	0.000089	0.000060	*-73*	*-82*	0.000081	0.000038	0.000036	*-54*	*-56*
Mo	mg/kg/wk	0.00015	0.000059	0.000034	*-60*	*-77*	0.00020	0.000052	0.000024	*-73*	*-88*
Ni	mg/kg/wk	0.0000016	0.00000094	0.00000060	*-41*	*-63*	0.0000017	0.00000038	0.00000036	*-77*	*-78*
Se*	mg/kg/wk	0.000003	0.0000013	0.00000090	*-54*	*-67*	0.0000026	0.00000086	0.00000068	*-67*	*-74*
Ag	mg/kg/wk	0.00000094	0.00000008	0.00000005	*-92*	*-94*	0.00000042	0.00000004	0.00000002	*-90*	*-94*
U	mg/kg/wk	0.0011	0.00048	0.00029	*-56*	*-73*	0.0012	0.00025	0.00021	*-79*	*-82*
Zn	mg/kg/wk	0.000016	0.0000089	0.0000060	*-45*	*-63*	0.0000081	0.0000038	0.0000036	*-54*	*-56*

Notes: Alkalinity is presented as mg $CaCO_3$/kg/wk; Hg is presented as ug/kg/wk; negative values represent a decrease in production rates; percent difference values are highlighted; * a high detection limit of 0.001 mg/L was often applied for Se analyses; as a result, the second to last cycle prior to the recirculation period (which provided a measurable value) was applied for calculation of percent differences.

Table 4-63:
Concentrations and Percent Differences for Recirculation Experiment for Leach Tailings Columns

Parameter	Unit	Col 1					Col 2				
		Loading Rates for Recirculation			*Percent Change*		Loading Rates for Recirculation			*Percent Change*	
		Cycle immediately before (Cycle 56)	Median (Cycles 57-89)	Final cycle (Cycle 89)	*Median for Recirc. Period*	*Final Recirc. Cycle*	Cycle immediately before (Cycle 56)	Median (Cycles 57-89)	Final cycle (Cycle 89)	*Median for Recirc. Period*	*Final Recirc. Cycle*
pH	s.u.	8.1	8.0	8.3	*NA*	*NA*	8.4	8.3	8.3	*NA*	*NA*
Alkalinity	mg/L	160	131	111	-18	-30	289	176	135	-39	-53
Sulphate	mg/L	13	9.0	9.0	-31	-31	20	12	10	-40	-50
Total CN	mg/L	0.020	0.020	0.020	0	0	0.080	0.040	0.030	-50	-63
WAD CN	mg/L	*<0.01*	0.010	*<0.01*	0	0	*<0.01*	0.010	*<0.01*	0	0
Ammonia-N	mg/L	0.40	0.60	0.10	50	-75	0.20	0.40	*<0.1*	100	-50
Nitrate-N	mg/L	*<0.06*	0.17	0.30	183	400	1.1	22	22	1865	1865
Nitrite-N	mg/L	0.25	13	13	5020	5020	0.060	0.030	*<0.03*	-50	-50
Al	mg/L	0.0065	0.0051	0.0035	-22	-46	0.0093	0.0057	0.0048	-39	-48
Sb	mg/L	0.021	0.014	0.011	-36	-48	0.039	0.020	0.014	-47	-65
As	mg/L	0.59	0.33	0.24	-44	-59	1.7	0.74	0.33	-57	-81
Cd	mg/L	*<0.000003*	0.0000030	*<0.000003*	0	0	0.0000030	0.0000060	0.0000040	100	33
Cr	mg/L	0.00077	0.00065	0.00053	-16	-31	0.0018	0.0012	0.00096	-33	-46
Co	mg/L	0.0018	0.0014	0.0012	-18	-30	0.0040	0.0022	0.0017	-46	-57
Cu	mg/L	0.00095	0.00070	0.00046	-26	-52	0.0015	0.0013	0.00062	-14	-58
Fe	mg/L	0.013	0.011	0.017	-15	31	0.032	0.016	0.013	-50	-59
Pb	mg/L	0.000030	0.000020	0.000020	-33	-33	0.000020	0.000020	0.000020	0	0
Mn	mg/L	0.00091	0.00091	0.00042	0	-54	0.00070	0.0010	0.0017	44	146
Hg	µg/L	0.020	0.010	*<0.01*	-50	-50	0.010	0.010	*<0.01*	0	0
Mo	mg/L	0.0091	0.0066	0.0057	-27	-38	0.024	0.014	0.0067	-42	-72
Ni	mg/L	0.00010	0.00010	0.00010	0	0	0.00020	0.00010	0.00010	-50	-50
Se*	mg/L	0.00017	0.00016	0.00015	-6	-12	0.00032	0.00025	0.00019	-22	-41
Ag	mg/L	0.000058	0.0000090	0.0000090	-84	-84	0.000052	0.000011	0.0000070	-79	-87
U	mg/L	0.067	0.053	0.049	-20	-26	0.15	0.070	0.060	-52	-59
Zn	mg/L	*<0.001*	0.0010	*<0.001*	0	0	*<0.001*	0.0010	*<0.001*	0	0

Notes: Alkalinity is presented as mg $CaCO_3$/L; negative values represent a decrease in production rates; percent difference values are highlighted; * a high detection limit of 0.001 mg/L was often applied for Se analyses; as a result, the second to last cycle prior to the recirculation period (which provided a measurable value) was applied for calculation of percent differences.

4.3.6.4 Field Kinetic Tests

Leachate chemistry for the leach tailings field kinetic tests (FB-LT1, FB-LT2 and FB-LT3) are presented in Table 4-64. It is important to note that the leach tailings placed into the field bins were not subjected to a rinse prior to initiation of the kinetic testwork. For discussion of the preliminary results, leachate results for the field bins are compared to MMER and 10 times the CCME water quality guidelines (presented in Table 4-56) to highlight which parameters may be elevated in drainage from the HLF following rinse down. A summary of the water quality guidelines are provided in Table 4-14.

Total and WAD cyanide, ammonia-N, nitrite-N, dissolved Al, Sb, As, Cr, Cu, Fe, Hg, Ni and U, and radioisotope ^{226}Ra are indicated to exceed the MMER or 10x's the CCME guideline in at least one leachate sample from the field kinetic tests. In particular, As exceeds the MMER maximum authorized concentration in a grab sample (MGS) of 1 mg/L in every leachate sample collected to date from the field bins. Elevated concentrations of total and WAD cyanide are expected given that the contents of the kinetic tests were not subjected to a rinse down period prior to being placed in the field bins, Elevated concentrations of nitrogen species are anticipated from the natural degradation of cyanide compounds.

Leachate pH for the leach tailings field kinetic tests are slightly neutral, with slightly higher pH values measured in leachate from FB-LT2 and FB-LT3 (8.6-9.2). Concentrations are generally highest in the first sample from each field test. The exception is Zn, which reaches a maximum (0.047 mg/L) in FB-LT1 after 60 weeks of testwork. The overall highest concentrations of Al, Sb, Cr, Co, Fe, Pb, Mn, Hg, Mo and U were measured in leachate from the gneiss oxide (FB-LT2) and the overall highest concentrations of As, Cu, Ni, Se and Ag were measured in leachate from the schist oxide (FB-LT3). On-going monitoring of the field bins will provide an indication of which parameters may be of concern in drainage from the HLF after closure.

Table 4-64:
Leachate Results from Leach Tailings Field Kinetic Tests

	Lithology	Gneiss (82%) Schist (18%)					Gneiss		Schist	
	Weathering Facies	Oxide (90%) Transition (10%)					Oxide		Oxide	
	Field Bin	FBLT1					FBLT2		FBLT3	
	Date Sampled	17-Jun-14	25-Sep-14	4-Jun-15	10-Aug-15	22-Oct-15	10-Aug-15	22-Oct-15	10-Aug-15	22-Oct-15
pH	s.u.	8.5	8.5	8.6	8.4	8.5	8.7	9.2	8.9	8.6
Conductivity	uS/cm	716	991	709	529	692	595	490	780	734
T-Alkalinity	mg $CaCO_3$/L	227	15	193	*ND*	197	*ND*	254	*ND*	235
Cl	mg/L	20	18	8.4	2.1	3.7	8.3	6.2	15	16
F	mg/L	0.43	*ND*	0.31	0.36	0.35	0.35	0.27	0.54	0.60
SO_4	mg/L	119	243	135	88	118	9.89	6.2	18	24
DOC	mg/L	9	11	*ND*	*ND*	6.0	*ND*	26	*ND*	48
NH_3-N	mg/L	0.71	0.29	0.036	*ND*	*<0.005*	*ND*	5.0	*ND*	1.9
NO_3-N	mg/L	0.94	4.2	3.9	3.6	5.2	0.14	0.16	*<0.005*	0.85
NO_2-N	mg/L	2.0	*ND*	0.95	0.34	0.0046	0.18	0.080	*<0.001*	25
WAD CN	mg/L	0.18	0.019	0.34	0.010	0.017	0.047	0.052	*ND*	0.17
Total-CN	mg/L	1.6	0.34	0.83	0.27	0.38	1.5	2.6	*ND*	2.2
Dissolved Metals										
Al	mg/L	0.49	0.0084	0.0077	0.0084	0.012	10	0.85	0.30	1.7
Sb	mg/L	0.046	0.035	0.027	0.030	0.024	0.11	0.021	0.070	0.057
As	mg/L	1.2	1.8	1.6	1.3	1.4	1.2	1.1	2.3	3.2
Cd	mg/L	0.000020	*<0.00001*	*<0.000005*	*<0.000005*	*<0.000005*	*<0.00005*	0.0000089	*<0.000005*	0.0000057
Cr	mg/L	0.020	0.010	0.0015	0.003	0.0044	0.031	0.015	0.0018	0.0050
Co	mg/L	0.077	0.10	0.043	0.021	0.024	0.57	0.46	0.12	0.20
Cu	mg/L	0.0064	0.0023	0.0024	0.0020	0.0014	0.016	0.010	0.063	0.042
Fe	mg/L	1.0	0.81	0.24	0.12	0.19	15	2.2	0.32	2.9
Pb	mg/L	0.00053	*<0.0005*	*<0.00005*	0.00010	0.00007	0.0073	0.00049	0.000073	0.00088
Mn	mg/L	0.033	0.0094	0.010	0.013	0.0042	0.30	0.022	0.008	0.085
Hg	mg/L	0.00042	0.000052	0.000039	0.000019	0.000018	*ND*	0.00064	*ND*	0.00038
Mo	mg/L	0.054	0.089	0.043	0.058	0.061	0.22	0.17	0.034	0.048
Ni	mg/L	0.042	*<0.001*	0.00054	*<0.0005*	*<0.0005*	0.061	0.016	0.26	0.085
Se	mg/L	0.0019	0.0020	0.0010	0.00075	0.00082	0.0017	0.0017	0.0029	0.0024
Ag	mg/L	0.00020	*<0.00002*	0.000025	*<0.00001*	*<0.00001*	0.000043	0.000033	0.000075	0.00030
U	mg/L	0.21	0.36	0.23	0.16	0.21	0.46	0.67	0.036	0.027
Zn	mg/L	0.0016	0.019	0.0065	0.047	0.021	0.019	0.0019	*<0.001*	0.0066
Radioisotopes										
Ra226	Bq/L	*ND*	*ND*	0.012	0.020	0.012	*ND*	0.42	*ND*	0.03

Notes: ND = no date; values in blue italics are below the analytical detection limit. Values that exceed the MMER (2002) MGS water quality guideline are shaded in dark grey and the MMM guideline are shaded in light grey. Values that exceed 10 times the CCME (2007) water quality guidelines are shaded in blue; guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg $CaCO_3$/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016); guideline for Cd are calculated using the 25th percentile hardness of ~55 mg $CaCO_3$/L; guideline for Cr is for hexavalent (VI); guidelines for sulphate, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg CaC.

4.3.6.5 Comparison of Duplicates Kinetic Tests

Duplicate samples of leach tailings sample LT1 were submitted in multiple masses for kinetic testing under different operating conditions to assess scaling effects on metal leaching rates. This sample was submitted for a 10 kg column (Col 1) a 20 kg column (Col 2) and a 76 kg field bin (FB-LT1). A comparison of Col 1 (10 kg) and Col 2 (20 kg) indicates that these columns initially produce similar concentrations, but after the first few cycles Col 2 begins to produce lower loading rates, but greater concentrations of alkalinity, sulphate, total cyanide and dissolved As, Sb, Cr, Co, Fe, Mo, Se and U (Appendix D.3). Conversely, peak concentrations of alkalinity, sulphate, total cyanide, U and As are greater in Col 1 and Col 2 compared to the field bin (FB-LT1, 76.3 kg). In general, the differences between these duplicate samples can be related to variations in pH and alkalinity produced under different test conditions.

The relationship between As and pH, and U and alkalinity are shown in Figure 4-26 below. The results are generally similar to that of waste rock described in Section 4.1.5.5. Arsenic concentrations appear to be primarily related to pH in kinetic tests of different masses, consistent with As sorption to mineral surfaces which decreases with increasing pH (Pierce and Moore, 1982). The relationship between U and alkalinity is consistent for the different scale kinetic tests, while the field bin produces U concentrations within the concentration range observed from the column samples but shows little relation to alkalinity. This variation in the relationship between U and alkalinity in the field bin experiment may be related to the relatively long storage time of field bin leachate in collection jugs before sample collection. That is, field bin drainage in collection jugs may be held for weeks to months in the collection jug between sampling events, over this time temperature fluctuations (including freezing conditions), and interaction with atmospheric CO_2 will affect alkalinity.

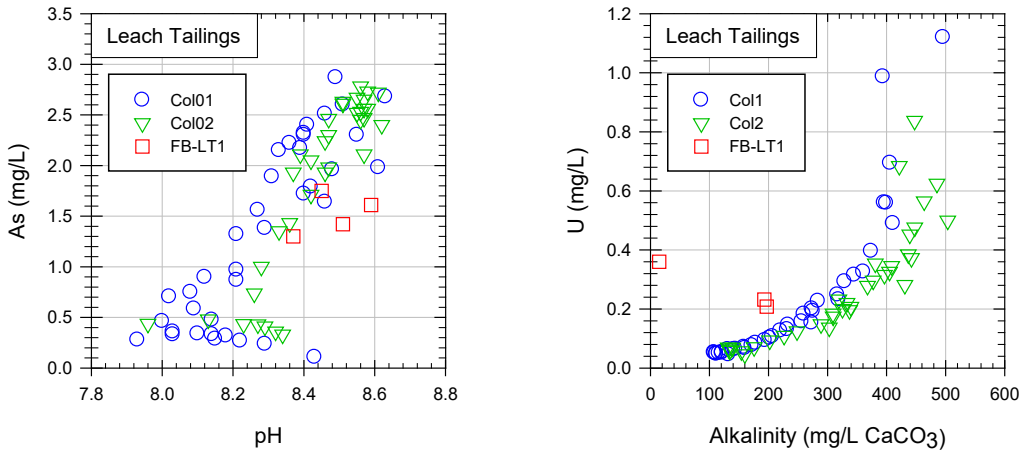

Figure 4-26: Comparison of As versus pH (left) and U versus alkalinity (right) in duplicate leach tailings kinetic test samples.

4.3.7 Radioisotopes

4.3.7.1 Occurrence

The NORM isotope results for leach tailings are expected to be analogous to that of ore because no solid separation will occur during ore processing (*e.g.*, sulphide flotation). That is, there is no potential for radioisotope enrichment in the leach tailings because the mass of ore on the leach pad is essentially unchanged by CN irrigation and Au recovery. The NORM results for ore samples are presented in Appendix D.1-5, and summarized in Section 4.1.5.

4.3.7.2 Kinetic Test Leachate

The activity of ^{226}Ra in leach tailings drainage was investigated by monitoring ^{226}Ra concentrations in metallurgical colums and field bin experiments (Table 4-56 and Table Table 4-64). The CN leach columns represent process water during mine life, while leach tailings field bins provide an indication of drainage chemistry at mine closure.

Field bins were monitored for ^{226}Ra starting in June 2015, however, not all samples subsequent to this time point had sufficient volume (1L) for ^{226}Ra analysis. Activities in FB-LT1 and FB-LT3 were an order of magnitude below the lowest MMER criteria (0.37 Bq/L), ranging from 0.012 to 0.03 Bq/L. The only exceedance of this MMER criteria was found in the single ^{226}Ra measurement in the gneiss oxide field bin (FB-LT2) of 0.42 Bq/L. Note that field bin samples of ^{226}Ra were not filtered, potentially leading to overestimate of dissolved activities due to incorporation of colloidal particles.

Dissolved ^{226}Ra was measured from the two large scale (718 to 741 kg) leach columns containing gneiss oxide ore samples during the metallurgical test program. These samples produced ^{226}Ra concentrations ranging from 0.1 Bq/L to 0.018 Bq/L in column 73022 and 73016, respectively (Table 4-56). It is interesting to note that the dissolved Ra concentrations follow dissolved Ba more closely than U in CN leach column samples. That is, column 73016 has a lower ^{226}Ra activity and Ba concentration, but considerably higher U concentrations than column 73022. Radium occurs as a radioactive decay product of ^{238}U, hence, the ^{226}Ra is expected to be elevated in the solid phase in samples with elevated U. However, in an aqueous system, ^{226}Ra forms a bivalent cation [Ra(II)] and behaves similar to other alkaline earth metals such as Mg, Sr, Ca and particularly Ba. The relationship between Ba and ^{226}Ra release from geologic material are described in more detail in Section 5.1.4.3.

4.4 Overburden and Borrow Material

Topsoil and overburden will be stripped from mine facilities and either stockpiled or used as fill depending on the source, ice content and material type. According to the JDS (2016) mine plan, approximately 1.5 Mm^3 of topsoil and 3.5 Mm^3 of inorganic overburden is planned to be excavated. Organic topsoil has an average depth of 0.3 m and will be stripped from the footprints of mine facilities and stored in the soil stockpile for later use as cover material at the end of mine life. Inorganic overburden has a depth ranging from 1.3 to 4.1 m and will either be used as fill within the mine facility footprint area that the material is sourced from or stored in the frozen soil stockpile. Note that overburden from pit shell areas is sent to WRSFs and are therefore not differentiated from waste rock.

Thirty samples of overburden were collected from test pits on the HLF and mine facility area footprints, while 75 samples were collected from drill cores from the pits and WRSF areas. The depth of overburden at the site is approximately 1.5 m in thickness. At each test pit and drill core site, a composite of the entire overburden profile was sampled for analyses. Locations of overburden samples in respect to mine facility footprints and surface geology is shown in Figure 3-2.

4.4.1 Overview of Test Results

Geochemical test results indicate that the mine site overburden has little or no potential for acid generation, owing to the low S content (median of 0.01%). The static test results demonstrate that the mine site overburden is at a highly weathered state, as indicated by the lack of carbonate or sulphide mineralization and the circumneutral to mildly acidic rinse-pH (5.2-8.9; median of 7.2) similar to that of rain water (~pH 5.6). Due to the lack of acid generating minerals, the mine site overburden is classified as non-PAG or unreactive.

The metal leaching potential from overburden is also considered to be low, with test samples indicated to be relatively deplete compared to ACA in a number of metals (Al, Cd, Co, Cr, Cu, Mn, Ni and Zn). Some samples showed enrichment in As, Bi, Hg, Sb and Se with respect to ACAs, consistent with solid phase element results for waste rock and ore. The most frequently elevated elements are Bi and Se; however, metal leaching results show concentrations of these metals are generally below the respective detection limits showing that these elements are not readily water.

4.4.2 Acid Base Accounting

Statistical summaries of select ABA results for overburden samples are presented by underlying geologic unit in Table 4-65. The complete set of ABA results are presented in

Appendix C.4-1. In general, ABA results indicate that the mine site overburden has little to no potential for acid generation, regardless of the location or underlying geology. This is primarily due to the overall low total-S and sulphide-S values for the overburden samples (<0.01-0.14 wt.% total-S; median = 0.01 wt.%) and the parent material. Total inorganic C is also low and generally below the detection limit (<0.05 wt.%C; <4.2 kg $CaCO_3$/t CaNP), particularly for the granite and gneiss (90th an 75th percentiles, respectively, below detection limit). Sobek NP values are also generally low, with median values of 3, 6, and 11 kg $CaCO_3$/t measured for overburden samples overlying granite, gneiss and schist bedrock, respectively (Table 4-65). NPR values were evaluated using sobek NP and AP calculated from total-S or sulphide-S, whichever was higher, and follow the same criteria as was applied to waste rock and ore for NPR values using sobek NP, as described in Section 4.1.2.4.

More than 95% of the overburden samples are classified as non-PAG (NPR>3) or neutral (total-S <0.02 wt.%), while none of the overburden samples are indicated to be PAG (NPR<1) when the most conservative S value is used to calculate AP. One sample from overburden overlying the meta-gabbro and two samples each from overburden overlying the schist and gneiss bedrock have NPRs between 1 and 3, indicating that they have an uncertain potential. The few samples with NPR values between 1 and 3 have measurable total-S >0.04 wt.%.

Of note is the general correlation between the ABA results for overburden with the ABA results for the respective underlying geologic unit, whereby overburden overlying granite bedrock has the overall lowest total-S and NP, while overburden overlying schist bedrock has slightly higher total-S and sulphide-S values and NP.

The ABA results demonstrate that the mine site overburden is highly weathered. This is shown by the relative absence of carbonate or sulphide mineralization, and the circum-neutral to mildly acidic rinse-pH values ($5.2 \leq pH \leq 8.9$; median = 7.2), which is higher than the pH of rain water (~pH 5.6). Due to the overall general lack of neutralizing or acid generating minerals in the samples, as well as high NPR values, the mine site overburden can be classified as non-PAG. Drainage from stockpiled overburden and from site pads comprising overburden can be expected to be similar to in-situ rinse pH measurements, as presented in Table 4-65.

Table 4-65:
Statistical Distribution of Acid Base Accounting Results for Mine Site Overburden

Underlying Geologic Unit	Rinse pH	Paste pH	Total S	Sulphide S	Sulphate S	TIC	Sobek NP	Sobek NNP	NPR
	s.u.	s.u.	wt.%	wt.%	wt.%	wt.%	kg $CaCO_3$/t	kg $CaCO_3$/t	obek NP/AP
Overburden overlying Granite (n = 28)									
Min	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	*<0.05*	1	0.7	3.2
10th PCTL	6.1	6.0	0.01	*<0.01*	*<0.01*	*<0.05*	2	1.4	3.2
25th PCTL	6.3	6.3	0.01	*<0.01*	0.01	*<0.05*	2	1.7	4.7
Median	6.6	6.6	0.01	0.01	0.01	*<0.05*	3	2.4	6.4
75th PCTL	7.0	6.9	0.02	0.02	0.01	*<0.05*	4	3.7	12.8
90th PCTL	7.3	7.5	0.02	0.02	0.02	*<0.05*	4.6	4.3	14.7
Max	8.9	8.7	0.02	0.03	0.02	0.05	8	7.7	25.6
Overburden overlying Gneiss (n = 41)									
Min	5.5	5.3	*<0.01*	*<0.01*	*<0.01*	*<0.05*	1	0.7	2.4
10th PCTL	6.7	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.05*	3	2.7	9.6
25th PCTL	7.0	6.9	*<0.01*	*<0.01*	0.01	*<0.05*	5	4.7	10.0
Median	7.5	7.5	0.01	*<0.01*	0.01	*<0.05*	6	5.7	16.7
75th PCTL	7.9	7.9	0.01	*<0.01*	0.02	*<0.05*	8	7.3	23.3
90th PCTL	8.1	8.1	0.01	0.01	0.02	0.07	11	10.7	35.2
Max	8.4	8.4	0.12	0.02	0.11	0.14	18	17.7	60.0
Overburden overlying Schist (n = 33)									
Min	6.0	5.9	*<0.01*	*<0.01*	*<0.01*	*<0.05*	3	1.8	2.4
10th PCTL	6.6	6.6	*<0.01*	*<0.01*	0.01	*<0.05*	5	4.4	8.6
25th PCTL	7.3	7.3	*<0.01*	*<0.01*	0.01	*<0.05*	7	6.7	13.3
Median	7.6	7.5	0.02	*<0.01*	0.02	0.05	11	10.1	22.4
75th PCTL	8.0	8.1	0.02	0.01	0.02	0.1	15	14.7	48.0
90th PCTL	8.3	8.3	0.038	0.02	0.02	0.89	90	89.4	141.0
Max	8.8	8.8	0.14	0.07	0.04	2.89	253	248.6	275.2
Overburden overlying Meta-gabbro (n = 3)									
17555	5.2	5.1	0.06	0.03	0.01	*<0.05*	3	1.1	1.6
R553404	9.2	9.2	*<0.01*	*<0.01*	0.02	1.3	138	137.7	460.0
R553602	7.4	7.4	0.01	*<0.01*	0.03	*<0.05*	8	7.7	25.6

Notes: Values in grey italics are below he analytical detection limit;
NP is neutralization potential;
NPR is sobek NP over acid potential (AP) calculated from total or sulphide-S, whichever was higher; and
NNP is net neutralization potential, calculated by subtracting AP from sobek NP

4.4.3 Shake Flask Extractions

Statistical summaries of shake flask extraction experiments for mine site overburden are presented by underlying geologic unit in Table 4-66 and compared to CCME freshwater quality guidelines for the protection of aquatic life (CCME, 2007). No water-soluble parameters exceed the MMER guidelines. Concentrations of Al, As, Cr, Cu, Fe, Pb and

Hg exceed the 30-day or maximum CCME guideline in at least one sample from overburden overlying the granite, gneiss and schist bedrock. The largest exceedances are associated with As, Al, Cu, Cr and Fe from overburden overlying gneiss and schist bedrock (25th percentile exceed CCME guidelines). Overall, the highest median concentrations for metals (Al, As, Sb, Cr, Co, Cu, Fe, Mn, Ni) in SFEs are observed for overburden samples overlying schist bedrock. The overall lowest metal concentrations in SFEs are observed for overburden overlying meta-gabbro and granite bedrock; however, the overburden overlying the granite has the highest median and maximum Pb and U concentrations in SFEs.

Iron and Al are sparingly water soluble under neutral pH and aerobic conditions. Accordingly, the high Al and Fe values are likely caused by fine suspended solids carried through the 0.45µm filter during the extraction experiment. The exceedances observed for other metals (*e.g.,* As, Cr, Cu, Pb) in SFEs may also be associated with suspended solids given that the samples (i.e*.,* CFR0864, SRK-15TP-41, -22 and -24, CFR0937 and CFR0984, Appendix C.4-2) which exhibit the highest concentrations of Al and Fe in SFEs also show elevated concentrations of As, Cr, Cu, Pb as well as other metals (*e.g*., Sb, Co, Mn, Mo, Ni, Ag).

4.4.4 Trace Metal Enrichment

Statistical summaries of solid phase element results for mine site overburden are presented by underlying geologic unit in Table 4-67 and compared to average continental abundances (ACA; Price, 1997). The complete set of solid phase element results are presented in Appendix C.4-3. The results presented show that overburden is relatively deplete in a number of metals, with 90th percentile values for Al, Cd, Co, Cr, Cu, Mn, Ni and Zn falling below ACAs. Consistent with solid phase element results for waste rock and ore, the overburden samples are enriched in As, Bi, Hg, Sb and Se with respect to 10 times the ACAs (dark shading in Table 4-67). In general, median concentrations of enriched metals are lowest in the overburden overlying granite bedrock and highest in the overburden overlying schist bedrock. This is consistent with the observed relative enrichment for waste rock samples, with the exception of Sb and As which are considerably higher in the oxide granite waste rock samples (Section 4.1.4). The most frequently elevated elements are Bi and Se; however, SFE concentrations (Table 4-66) were generally below the respective detection limits, indicating that this element is not in a readily water-soluble form. Overall, the data suggest that elements of potential concern for stockpiled overburden are As and possibly Hg. These elements are indicated to be enriched in the solid phase and exceed CCME limits in extraction experiments.

Table 4-66:
Statistical Summary of Shake Flask Extraction Results for Mine Site Overburden

	Unit	CCME		Overburden overlying Granite (n = 11)					Overburden overlying Gneiss (n = 12)					Overburden overlying Schist (n = 7)					Meta-gabbro
		Max	30-day	Min	25th PCTL	Median	75th PCTL	Max	Min	25th PCTL	Median	75th PCTL	Max	Min	25th PCTL	Median	75th PCTL	Max	CFB030
T-Alk.	mg CaCO3/L	-	-	*<2*	3.0	4.9	5.0	5.8	4.8	8.3	12.9	22.3	47.8	5.3	7.0	8.0	25.4	45.2	35.0
F	mg/L	-	-	*<0.02*	0.03	0.08	0.10	0.17	0.05	0.13	0.15	0.18	0.23	0.06	0.11	0.19	0.24	0.28	0.17
pH	pH	-	6.5-9.0	5.9	6.1	6.3	6.5	6.5	6.1	6.6	7.2	7.7	8.4	6.2	6.8	7.1	7.5	7.7	9.3
SO_4	mg/L	-	**218**	*<0.5*	*<0.5*	*<0.5*	0.53	1.36	*<0.5*	0.5875	0.67	0.735	1.78	0.54	0.84	1	1.95	3.09	2.89
Al	mg/L	-	0.1	0.0808	0.423	0.899	1.35	1.94	0.16	0.547	0.845	1.0425	2.11	0.71	1.14	1.43	1.55	1.89	0.22
Sb	mg/L	**0.009**	-	0.00013	0.00016	0.00021	0.00026	0.00069	0.00035	0.00086	0.00106	0.00195	0.00841	0.00023	0.00054	0.0016	0.0029	0.0075	*<0.0001*
As	mg/L	-	0.005	*<0.001*	0.0011	0.0016	0.0024	0.0263	0.0041	0.006375	0.01255	0.017025	0.0962	0.002	0.0062	0.0131	0.01495	0.0414	0.0021
Bi	mg/L	-	-	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*
Cd	mg/L	0.0011	0.0001	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
Cr	mg/L	0.001	-	*<0.0005*	0.0010	0.0018	0.0028	0.0037	*<0.0005*	0.0016	0.0022	0.0030	0.0048	0.0012	0.0029	0.0031	0.0040	0.0043	*<0.0005*
Co	mg/L	**0.11**	**0.004**	*<0.0001*	0.00015	0.00043	0.00054	0.00096	*<0.0001*	0.00028	0.00055	0.0010	0.0029	0.00028	0.00078	0.00086	0.0009	0.001	*<0.0001*
Cu	mg/L	-	0.002	*<0.001*	0.0021	0.0040	0.0050	0.0077	0.0021	0.0046	0.0056	0.0071	0.0091	0.0044	0.0069	0.0078	0.0122	0.0187	*<0.001*
Fe	mg/L	-	0.3	*<0.03*	0.24	0.75	1.14	1.93	0.05	0.55	0.81	1.05	2.06	0.74	0.94	1.13	1.39	2.01	*<0.03*
Pb	mg/L	-	0.001	0.0001	0.0003	0.0007	0.0007	0.0016	*<0.0001*	0.0002	0.0004	0.0006	0.0010	0.0004	0.0005	0.0005	0.0011	0.0014	*<0.0001*
Mn	mg/L	**1.15**	**0.85**	0.002	0.023	0.052	0.078	0.153	0.015	0.026	0.037	0.065	0.198	0.038	0.040	0.049	0.089	0.318	*<0.0005*
Hg	mg/L	-	3E-05	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.000065	0.00005	*<0.00005*	*<0.00005*	*<0.00005*	0.00026	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	0.00012	*<0.00005*
Mo	mg/L	-	0.73	0.0001	0.0005	0.0011	0.0013	0.0027	0.0007	0.0017	0.0020	0.0024	0.0042	0.0008	0.0016	0.0017	0.0033	0.012	0.0057
Ni	mg/L	-	0.025	*<0.0005*	0.0010	0.0015	0.0022	0.0036	*<0.0005*	0.0014	0.0025	0.0053	0.0071	0.0014	0.0022	0.0051	0.0056	0.0056	*<0.0005*
Se	mg/L	-	0.001	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	*<0.0005*	0.00064	*<0.0005*
Ag	mg/L	-	0.0003	*<0.00005*	*<0.00005*	*<0.00005*	0.00006	0.00014	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*	*<0.00005*
U	mg/L	0.033	0.015	0.0011	0.0015	0.0023	0.0024	0.0041	0.0002	0.0002	0.0004	0.0006	0.0015	0.0001	0.0004	0.0007	0.0009	0.0011	0.00001
Zn	mg/L	-	0.03	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*

Notes:
Values in grey italics are below the analytical detection limit; ND = no data.
Canadian Council of Ministers of the Environment (CCME, 2007); Water Quality Guidelines for the Protection of Freshwater Aquatic Life, sourced at st-ts.ccme.ca/en/index.html, March 2016.
Values that exceed the 30-day guideline are shaded in light grey, values that exceed the Max guideline are shaded in dark grey.
All guidelines are for total metals unless otherwise indicated.
Guidelines for Cu, Ni and Pb are based on the default value for when hardness is not known (which corresponds to the 25th percentile hardness value of ~55 mg CaCO3/L calculated using available SW data (n=754, Jun-27-2014 - Jan-26-2016).
Guideline for Cd are calculated using the 25th percentile hardness of ~55 mg CaCO3/L.
Guideline for Cr is for hexavalent (VI), which is the principal species found in surface waters.
Underlined guidelines for sulphate, Bi, Co and Sb are derived from BC MOE water quality guidelines for protection of freshwater aquatic life for reference. Sulphate is hardness dependent and is based on a hardness of 55 mg $CaCO_3$/L

Table 4-67:
Statistical Distribution of Solid Phase Element Results for Mine Site Overburden Samples

ACA	*0.075*	*8.2*	*1.8*	*0.0085*	*0.15*	*25*	*102*	*60*	*5.6*	*0.085*	*950*	*1.2*	*84.0*	*14*	*0.2*	*0.05*	*9.6*	*2.7*	*70*
Underlying Geologic Unit	**Ag**	**Al**	**As**	**Bi**	**Cd**	**Co**	**Cr**	**Cu**	**Fe**	**Hg**	**Mn**	**Mo**	**Ni**	**Pb**	**Sb**	**Se**	**Th**	**U**	**Zn**
	ppm	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**%**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**	**ppm**
Overburden overlying Granite (n = 28)																			
Min	0.01	0.2	1.1	0.04	0.01	0.2	2	0.4	0.5	0.01	39	0.2	0.3	4.4	0.07	0.2	5.5	2.4	4
10th PCTL	0.02	0.4	4.1	0.06	0.01	0.51	4.1	1.4	0.6	0.01	126	0.6	1.8	6.8	0.16	0.34	14	2.8	10
25th PCTL	0.02	0.6	5.6	0.08	0.04	2.6	8.8	4.1	1.2	0.01	428	0.7	3.6	7.2	0.21	0.4	17	3.5	24
Median	0.03	0.8	10	0.11	0.06	4.0	13	6.8	1.5	0.04	567	0.8	5.6	8.5	0.28	0.5	21	3.8	31
75th PCTL	0.04	0.9	26	0.15	0.07	4.8	15	9.4	1.7	0.10	669	1.0	7.9	9.8	0.51	0.7	25	5.0	35
90th PCTL	0.05	1.2	547	0.22	0.09	5.8	19	13	2	0.39	803	1.4	11	16	4.6	0.8	37	6.2	38
Max	0.07	1.4	>10000	0.4	0.33	6.5	25	15	3	1.3	1240	3.2	12	27	86	1.1	44	15	51
Overburden overlying Gneiss (n = 41)																			
Min	0.01	0.3	15	0.07	0.01	1.5	8	5.4	0.9	0.01	179	0.6	4.1	4.2	0.57	0.3	5.4	0.69	11
10th PCTL	0.02	0.6	27	0.1	0.03	3.6	12	6.7	1.4	0.02	233	0.8	7.8	4.7	1.3	0.4	11	1.1	17
25th PCTL	0.02	0.7	44	0.12	0.04	5.1	17	8	1.5	0.03	294	1.1	9.2	6.0	2.2	0.4	15	1.3	20
Median	0.04	1.0	83	0.16	0.06	7.0	25	12	2	0.05	358	1.4	13	7.4	3.4	0.5	20	2.1	25
75th PCTL	0.05	1.5	117	0.25	0.08	9.6	34	14	2	0.09	409	1.7	19	9.3	6.3	0.6	24	2.6	35
90th PCTL	0.07	1.9	372	0.38	0.09	15	78	19	3	0.39	502	2.4	37	11	17	0.7	27	4.4	41
Max	0.18	2.2	894	0.63	0.17	19	345	89	3	1.4	666	3.9	266	18	42	0.9	31	12	47
Overburden overlying Schist (n = 33)																			
Min	0.01	0.5	7.2	0.04	0.01	3.9	13	7.2	1.4	*<0.01*	210	0.5	8.3	1.3	0.19	0.3	0.8	0.25	12
10th PCTL	0.03	0.8	23	0.09	0.03	4.6	18	8.8	1.7	*<0.01*	275	0.6	10	3.4	0.4	0.4	5.9	0.8	20
25th PCTL	0.03	1.0	39	0.13	0.05	6.6	23	14	2	0.02	319	0.7	13	5.4	1.0	0.6	8.6	1.1	27
Median	0.04	1.4	90	0.19	0.07	11	37	22	2	0.05	437	1.0	25	7.2	3.0	0.7	11	1.6	46
75th PCTL	0.07	1.9	190	0.26	0.1	14	59	26	3	0.18	525	1.4	34	13	8.4	0.8	17	2.3	57
90th PCTL	0.14	2.4	667	0.38	0.14	18	72	34	4	0.44	728	1.9	39	16	19	0.98	20	3.0	60
Max	0.25	3.1	2370	0.53	0.31	21	94	39	5	1.1	879	3.9	62	25	30	1.4	30	6.2	71
Overburden overlying Meta-gabbro (n = 3)																			
17555	0.1	2.2	9	0.22	0.1	6.9	49	19	2.3	0.03	270	0.9	21	8.9	1.3	0.6	3.8	1.6	51
R553404	0.01	2.3	3.8	0.09	0.01	14	29	14	3	*<0.01*	635	0.8	18	1.3	0.14	0.3	3	0.49	50
R553602	0.03	1.7	66	0.5	0.07	13	36	17	3	0.04	477	0.8	26	11	1.2	0.9	13	1.3	49

Notes:
Values in grey italics are below the analytical detection limit.
Average Continental Abundance (ACA) according to Price (1997).
Values shaded in light grey are 3x's the ACA, values shaded in dark grey are 10x's the ACA. Values shaded in blue are at the ACA

4.4.5 Radioisotopes

The NORM results for overburden samples are presented in Appendix D.1-5 and summarized in Section 4.1.5. Overall, the results show that overburden can be considered as unrestricted according to the Canadian NORM Guidelines.

5. Source Term Predictions

In this chapter, the geochemical test results described in the previous sections are combined with site specific information, such as waste facility design, composition, climate and hydrology, to produce geochemical source term predictions. The geochemical characterization results used to develop source terms are described in Chapter 4. Nitrogen loadings from mine waste facilities consider proposed explosive use as well as operating mine data and are described in Appendix E-1. The site climate and hydrology of mine facilities is presented in Appendix 12-C, and mine facility design and composition are provided in the JDS (2016).

Geochemical source terms are water quality predictions for water in contact with geologic material disturbed by mining activities. Individual source terms are developed for each mine component at end of mine life and considering the full mine footprint. These source terms therefore include: one out of pit waste rock storage facility (Alpa WRSF), four in-pit backfill WRSFs, pit wall rock exposures, the heap leach facility (HLF) and the mine facilities area. Geochemical source terms are not developed for facilities which only exist during mine life, such as run-of mine (ROM) stockpile, frozen materials stockpile, HLF pore water during operations, and Beta WRSF which is backfilled into the Kona Pit before mine closure. The Coffee Gold Mine site layout at the end of mine life is shown in Figure 5-1. This figure shows the location of the various mine facilities and pits. The soil stockpile is not assigned a geochemical source term as this facility will contain organic topsoil that will be used for reclamation at the end of mine life. While runoff from this facility may be elevated in total suspended solids (TSS), the runoff chemistry is expected to be similar to background water quality.

For each mine component, an upper case and a base case source term has been calculated. The base case source term is meant to reflect a best estimate, while the upper case is meant to reflect a reasonably conservative upper estimate. These predictions become inputs to the site wide water quality model used to assess potential effects of the Project on the receiving environment at the end of mine life and throughout all closure phases.

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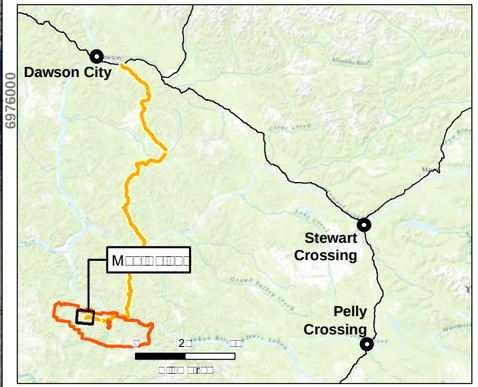
Project Layout at End of Mine Life



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5.1 Waste Rock Storage Facilities

Approximately 299 Mt of waste rock will be excavated from the Supremo, Double Double, Latte and Kona pits over the life of the Project. Waste rock produced from mine pits will be stored primarily in the Alpha WRSF. Waste rock will also be placed as backfill in the In-pit Kona, In-pit Latte, In-pit Supremo and In-pit Double Double WRSFs. Each of the WRSFs are described below.

The mass, lithology and oxidation state of waste rock to be excavated from the four mine pits is tabulated in Table 5-1 below. The composition of individual waste rock WRSFs is inferred from the year-by-year mine sequence. The general sequencing shows that the Latte pit which is geologically distinct, being the primary host of schist waste, is excavated in Year -1 to Year 3 of mine life, during which time the Alpha WRSF is the only waste rock storage area. Therefore, it is assumed that all of the waste rock from Latte pit is stored in the Alpha WRSF, while waste rock from Double Double and Supremo pits is equally distributed between the Alpha WRSF, and the Supremo, Double Double, and Latte In-pit WRSFs. The size and assumed composition of the WRSFs at the end of mine life is tabulated in Table 5-2. The surface area of each WRSF is provided in Table 5-4. Note that a minor amounts metabasalt waste rock be produced from the Supremo pit, Latte, and Double Double Pit. This waste type constitutes approximately 1.1 % of waste rock and is therefore not explicitly considered in source term calculations. The mass associated with this minor lithology is assigned the same geochemical signature as gneiss, which is the dominant rock type in each of the WRSFs containing metabasalt.

Table 5-1:
Mass, lithology and oxidation of waste rock produced from the four mine pits.

Lithology	Facies	Mine Pit				
		Latte	Double Double	Kona	Supremo	Total
Gneiss	Oxide (Mt)	1.95	0.81	0.00	33.60	**36.36**
	Trans (Mt)	1.05	3.65	0.00	137.18	**141.87**
	Fresh (Mt)	0.22	10.72	0.00	67.38	**78.31**
	Total	**3.23**	**15.17**	**0.00**	**238.15**	**256.55**
Metabasalt	Oxide (Mt)	0.13	0.26	0.00	0.24	**0.64**
	Trans (Mt)	0.09	0.36	0.00	1.68	**2.14**
	Fresh (Mt)	0.00	0.11	0.00	0.25	**0.37**
	Total	**0.23**	**0.74**	**0.00**	**2.17**	**3.14**
Schist	Oxide (Mt)	10.64	0.00	0.00	0.14	**10.78**
	Trans (Mt)	15.71	0.00	0.00	0.66	**16.37**
	Fresh (Mt)	10.20	0.02	0.00	0.00	**10.21**
	Total	**32.76**	**0.03**	**0.00**	**1.09**	**33.88**
Granite	Oxide (Mt)	0.00	0.00	1.40	0.00	**1.40**
	Trans (Mt)	0.00	0.00	1.55	0.00	**1.55**
	Fresh (Mt)	0.00	0.00	2.34	0.00	**2.34**
	Total	**0.00**	**0.00**	**5.30**	**0.00**	**5.30**
All	**Total**	**36.21**	**15.94**	**5.30**	**241.41**	**298.86**

Table 5-2:
Mass, lithology and oxidation of waste rock stored waste rock storage areas.

Lithology	Facies	Waste Rock Storage Facilities				
		Alpha WRSF	In-Pit Kona	In-Pit Latte	In-Pit Supremo	In-Pit Double Double
Gneiss	Oxide (Mt)	29.84	-	0.98	4.22	1.23
	Trans (Mt)	116.43	-	3.82	16.48	4.79
	Fresh (Mt)	64.27	-	2.11	9.09	2.64
	Total	**210.55**	**-**	**6.91**	**29.79**	**8.66**
Meta	Oxide (Mt)	0.52	-	0.02	0.07	0.02
	Trans (Mt)	1.75	-	0.06	0.25	0.07
	Fresh (Mt)	0.30	-	0.01	0.04	0.01
	Total	**2.58**	**-**	**0.08**	**0.36**	**0.11**
Schist	Oxide (Mt)	10.78	-	-	-	-
	Trans (Mt)	12.89	-	-	-	-
	Fresh (Mt)	10.21	-	-	-	-
	Total	**33.88**	**-**	**-**	**-**	**-**
Granite	Oxide (Mt)	-	1.40	-	-	-
	Trans (Mt)	-	1.55	-	-	-
	Fresh (Mt)	-	2.34	-	-	-
	Total	**-**	**5.30**	**-**	**-**	**-**
All	Total	247.00	5.30	6.99	30.16	8.77

Table 5-3:
Surface area of mine facilities in each year of mine life

In-Pit Kona Backfill	Alpha WRSF	In-pit Double Double Backfill	In-pit Latte Backfill	In-Pit Supremo Backfill
(ha)	(ha)	(ha)	(ha)	(ha)
8.27	151	10.5	8.20	32.2

5.1.1 Approach

Source terms for WRSFs are calculated by upscaling geochemical loading rates observed in field bin experiments and applying empirical scaling factors from an analogue mine site. Empirical scaling factors are developed based on a comparison between field bin data to a full-scale waste rock seepage data. The scaled loading rates are then applied to the mass, footprint, hydrology and rock types stored in the various WRSFs. Solubility controls are then derived for a number of parameters that are not expected to behave conservatively.

These solubility controls are based on a combination of first principles (thermodynamic equilibria and aqueous speciation), experimental data and field monitoring data.

5.1.2 Data Sources

Geochemical loading rates for different lithologies and waste rock oxidation types are calculated from field bin data (Table 4-37). These loading rates are calculated from field bin data gathered between June 2014 to October 2016. The loading rates are scaled based on data from an analogue mine site provided in Altura (2009) and Lorax (2011). Hydrology of WRSFs is obtained from Appendix 12-C. The WRSFs composition, mass and surface area are provided in the Project Description.

5.1.3 Data Scaling

5.1.3.1 Waste Rock

Loading rates are scaled based on empirical observations from the Mount Nansen Mine (Mt. Nansen) site. This mine site is considered an appropriate analogue due to similarities in geology and climate. The Mt. Nansen is a former Au and Ag mine located in Central Yukon, approximately 60 km west of Carmacks. Both Mt. Nansen and the Coffee Project are located in the Dawson Range within Yukon-Tanana Terrane. The mineralization and geology at Mt. Nansen is generally similar to that of the Project. Gold is hosted in epithermal quartz/sulphide veins which have been weathered by infiltrating meteoric water to a depth of 70 m. As such, the waste rock is a mixture of oxide and sulphide weathering zones. The waste rock also has similar geology, with the primary lithologies being augen gneiss, quartz-feldspar-chlorite gneiss, amphibolite, quartz-chlorite schist and granodiorite. The waste rock at Mt. Nansen was placed in a single waste rock facility. The exact proportions of the oxidation types are unknown, but it is assumed that a majority of the waste facility consists of oxide material (Strathcona, 2001).

Geochemical characterization of the waste rock shows that it has a median total-S content of 0.3 wt.%, with most sulphur occuring as sulphide. Sulphide minerals identified in ore (in decreasing abundance) are pyrite, arsenopyrite, galena, sphalerite, chalcopyrite, stibnite and tetrehedrite. No description of sulphide mineralogy specific to waste rock is available. Waste rock contains the carbonate mineral calcite, with median a TIC content of 0.4 wt.% (Lorax, 2011).

Mt. Nansen was active from 1996 to 1999, over which time approximately 1.85 Mt of waste rock was produced from the Brown and McDade pits. A portion of this waste rock was used as fill or for road construction, and it is estimated that approximately 1 Mt remains in the waste rock facility adjacent to the mine pit with a surface area of approximately

9.02 ha (Altura, 2009). Drainage chemistry of the waste rock facility has been monitored from naturally occurring seeps from at least May 2009 to July 2010. Seepage pH over this time period has remained circumneutral to alkaline, with pH ranging from 8.1 to 6.5 (median of 7.5).

A waste rock field bin was constructed at Mt Nansen using a similar design as those constructed for the Project. The field bin consisted of HDPE barrels of the same dimensions (76 cm high, 56 cm diameter) containing a similar mass of waste rock (166 kg) which was collected from the existing waste rock pile. The waste rock field bin was constructed in July, 2009 and operated until August, 2010; over which time period, a total of 23.5 L of leachate was produced and seven samples were collected for chemical analysis (Lorax, 2011).

Scaling factors are developed by comparing loading rates measured in the field bin with loading rates estimated for the full scale WRSF. Loading rates for the full scale WRSF are estimated by assuming that the same runoff coefficient as used for WRSFs at the Project (runoff coefficient of 0.35) and using the 90th percentile and median concentrations measured in seeps at Mt. Nansen. Select loading rates from the field bin and the full scale WRSF for Mt. Nansen are shown in Table 5-4. The major ions, SO_4, Ca, Mg and K, are generally soluble and in high enough concentrations so that detection limit values do not affect estimated loading rates. In order to check what solubility controls might be affecting these parameters, waste rock seepage and field bin chemistry was speciated using the geochemical modeling program PHREEQC coupled to the Lawrence Livermore National Laboratories database (Parkhurst and Apello, 1999).

The saturation indices (SI) calculated for calcite and gypsum are presented in Figure 5-2 and Figure 5-3, respectively. An SI of 0 indicates that a mineral is in equilibrium with the solution, a mineral may be dissolving or precipitating to achieve equilibrium. A positive SI denotes that a mineral is oversaturated and therefore may be precipitated from solution. A negative SI denotes that a mineral is unsaturated; if the solid phase is present it will dissolve until equilibrium is reached. However, it should be noted that saturation indices are based on the thermodynamics of mineral formation/dissolution and do not account for kinetic limitations that affect mineral formation. These data show that calcite was saturated in one of the waste rock seeps (NW Seep-01), while gypsum remained below saturation. The PHREEQC input files used to develop Figure 5-2 and Figure 5-3 are provided in Appendix E.2.

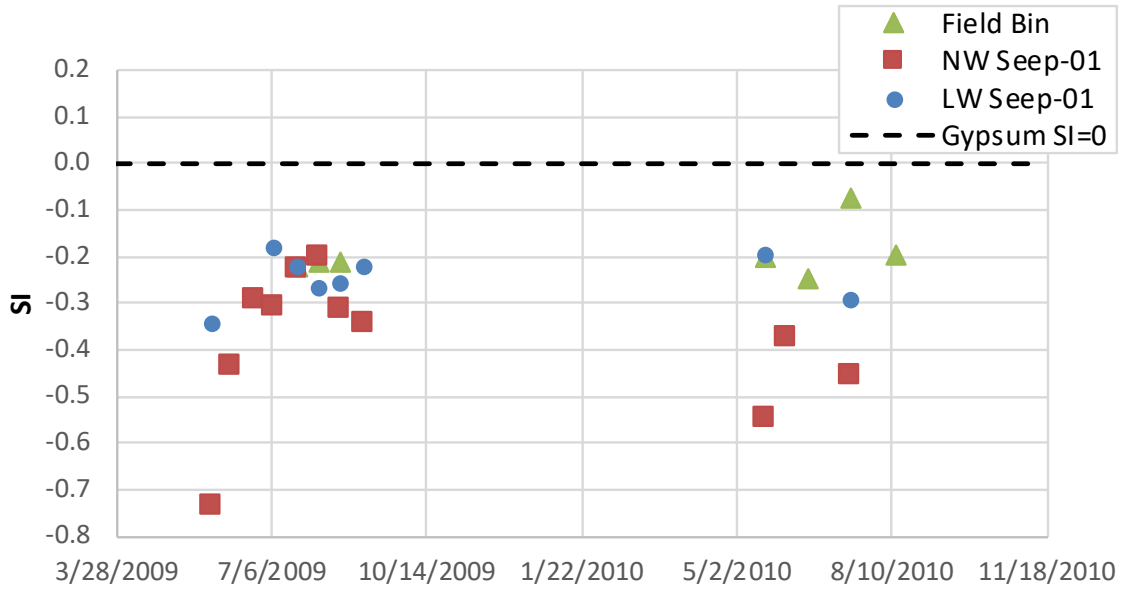


Figure 5-2: Gypsum Saturation indices (SI) calculated for analogue site

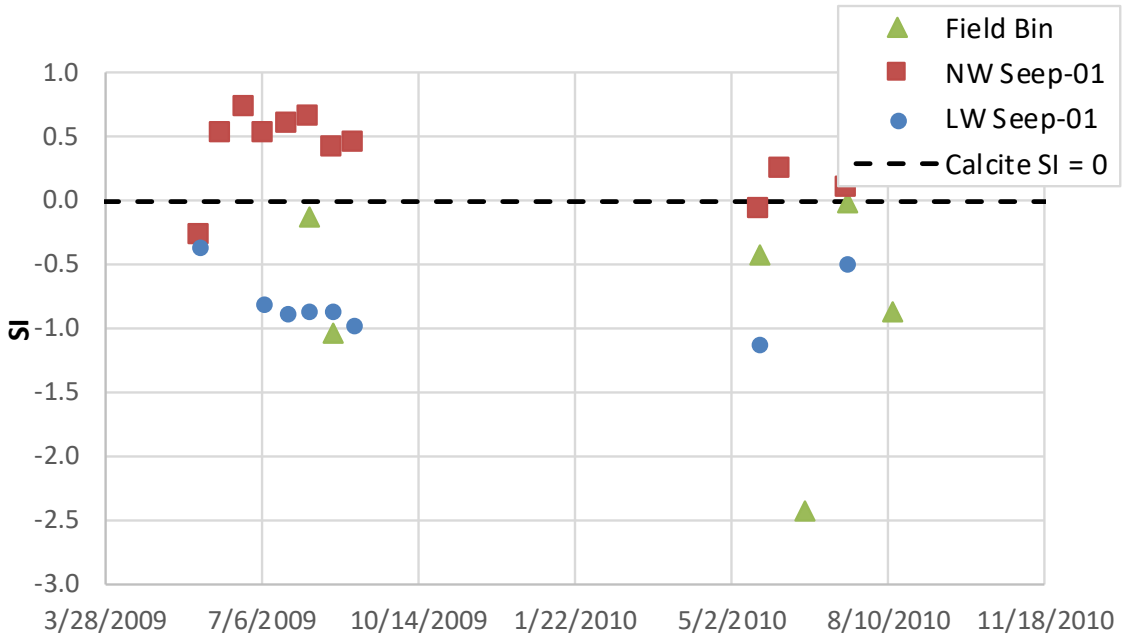


Figure 5-3: Calcite saturation indices (SI) calculated for analogue site

The ratio of the WRSF to field bin loading rates ranges from 0.052 to 0.089 when WRSF loading rates are calculated using median observed concentrations and range from 0.083 to 0.11 when 90th percentile concentrations are used to calculate WRSF loading rates.

Table 5-4:
Loading Rates from Field Bin and Full Scale WRSF at Analogue Mine Site

	units	SO_4	Ca	Mg	K
Field Bin	mg/kg/wk	4.38	1.01	0.435	0.0111
WRSF (Base)[1]	mg/kg/wk	0.28	0.09	0.023	0.00049
WRSF (Upper)[1]	mg/kg/wk	0.41	0.10	0.049	0.00093
WRSF (Base) / Field Bin	Ratio	0.065	0.089	0.052	0.044
WRSF (Upper) / Field Bin	Ratio	0.094	0.099	0.11	0.083

[1]Loading rates of analogue WRSF calculated assuming 90th percentile and median concentrations observed in seeps for base case and upper case estimates, respectively.

The ratio of field bin loading rates to full scale WRSFs loading rates provide an empirical scaling factor by which Project field bin results, presented in Table 5-4, can be related to full scale WRSFs. For the purpose of source term calculation, the empirical scaling factor observed for sulphate is applied. That is, a scaling factor of 0.065 is applied in the base case scenario and a scaling factor of 0.094 is applied in the upper case scenario. This scaling factor is applied to loading rates presented in Table 4-35 to estimate full scale WRSF source terms.

It is interesting to note that the scaling factors developed for SO_4 based on the analogue mine data are similar to what would be calculated based on differences in grain size between the field bin experiments and the full-scale waste rock facility. The Project field bins contain relatively fine-grained particles (< 0.25”), hence, material used in field bins have greater surface area to mass ratio than material in full scale WRSFs. The grain size distribution of granitic waste rock at Sudbury, found that 12% of the waste is <0.78”, while only 3% is < 0.24” (Fines *et al*., 2003). This would produce a scaling factor of 0.12 to 0.03 which is similar to scaling factors derived at the analogue minesite (0.11 to 0.044 for major ions in Table 5-4).

To convert the loading rate into a concentration, the scaled loading rate is multiplied by the mass of the WRSF in each year of mine life and divided by the surplus water available for each facility. Surplus water is estimated by multiplying the mean annual precipitation (MAP) (485 mm) by the runoff coefficient for WRSFs (0.35) and the surface area in each year of mine life (Table 5-1).

5.1.3.2 Underdrain

An underdrain will be constructed beneath the Alpha WRSF to convey upgradient runoff under the WRSF. The underdrain will be constructed of waste rock, and will impart a geochemical load on water moving through the drain. The underdrain consists of waste rock >0.3 m in diameter and will be 5 to 10 m in height and 30 to 50 m in width. For the purposes of source term calculation, it is assumed that the underdrain is at the maximum width and height throughout the underdrain (50 m and 10 m, respectively). A density of 2.6 t/m^3 and porosity of 0.3 are assumed. These assumptions produce an estimated mass of 910 tonnes of rock per m of underdrain.

In order to calculate underdrain loading rates, field bin loading rates presented in Table 4-37, are scaled based on particle surface area. In order to weight field bin loading rates from different lithologies, the underdrain is assumed to have the same geologic composition as the Alpha WRSF itself. The differences in grain size distribution is calculated by assuming that material in the field bins has a particle size of 6.35 mm, and the underdrain consists of material that has a particle size of 0.3 m. By assuming spherical particles, the surface area per kg of the field bin material and underdrain material is 0.36 m^2/kg and 0.0078 m^2/kg, respectively. The ratio of these two values produces a scaling factor of 0.021. This is the only scaling factor that is applied to the underdrain source term.

Note that this is an underestimate of the surface area of field bin material, as most field bin material is at a finer grain size. This is done as a conservative approximation, in that an underestimate of particle surface area in field bins produces a more conservative scaling factor. This scaling approach is used for both the base case and upper case source term calculation.

5.1.4 Solubility Controls

Upscaling kinetic test loading rates often results in concentrations that exceed solubility controls, particularly in neutral pH environments where a number of solubility limitations can exert an influence on drainage chemistry. Metal solubility can be controlled by thermodynamic mineral solubility, sorption to mineral surfaces, and aqueous complexation reactions. In the following sections the solubility controls applied to source term predictions for WRSFs are discussed.

5.1.4.1 Arsenic

Arsenic is released by a combination of sulphide mineral oxidation (*e.g.*, arsenopyrite, arsenianpyrite, and orpiment) and dissolution of oxide minerals (scorodite, yukonite, Fe-oxide mineral surfaces). In pH-neutral aerobic environments the solubility of this metalloid

is generally controlled by sorption to mineral surfaces. Unlike mineral saturation controls on solubility, sorption controls are determined by the availability and mineralogy of particle surfaces and solution chemistry. Given these complexities, solubility controls based on surface sorption are typically developed from site specific observations rather than thermodynamic data available in geochemical databases.

In aerobic neutral pH environments, arsenic speciates as the oxyanion arsenate ($HAsO4^{2-}$). Sorption of this aqueous species to mineral surfaces is controlled by a combination of pH and availability of Fe-oxide surfaces (Goldberg, 2002; Sharma and Sohn, 2009). Significant sorption of arsenate can take place on clays (Mn-oxides and Al-oxides), however, these minerals generally only become significant in Fe deficient systems (O'day, 2006). The degree of As sorption to Fe-oxides is highly pH sensitive, with maximum arsenate adsorption increasing as pH declines from 9 to 6 (Pierce and Moore, 1982).

Solubility controls for As are developed based on a scientific understanding of As behavior in mine waste environments which is supported by site specific geochemical characterization data. Data from kinetic testwork demonstrate two principles of As behaviour: As concentrations increase with increasing pH; and, the difference in As concentrations between different kinetic tests producing similar pH leachate can be related to the solid phase Fe content. The relationship between As concentrations and pH can be seen in geochemical kinetic testwork, as shown in Figure 4-15 and Figure 4-24. While the relationship between pH and arsenic is consistent between different scale kinetic tests using the same sample, the relationship varies considerably between different samples even within the same rock unit. For example, humidity cell tests using different samples of fresh gneiss waste rock (HC4 and HC8) and fresh schist waste rock (HC2 and HC7) show distinctly different relationships between pH and As (Figure 5-4). The difference can be related to the differences in solid phase As content, and more specifically, differences in As:Fe molar ratios. Specifically, the humidity cells with higher As:Fe ratios [HC7 and HC8 have As:Fe of 0.021 (mol/mol) and 0.032 (mol/mol), respectively] produce higher As compared to humidity cells of the same lithology and weathering with lower As:Fe ratios [HC2 and HC4 have As:Fe of 0.00080 (mol/mol) and 0.0037 (mol/mol)].

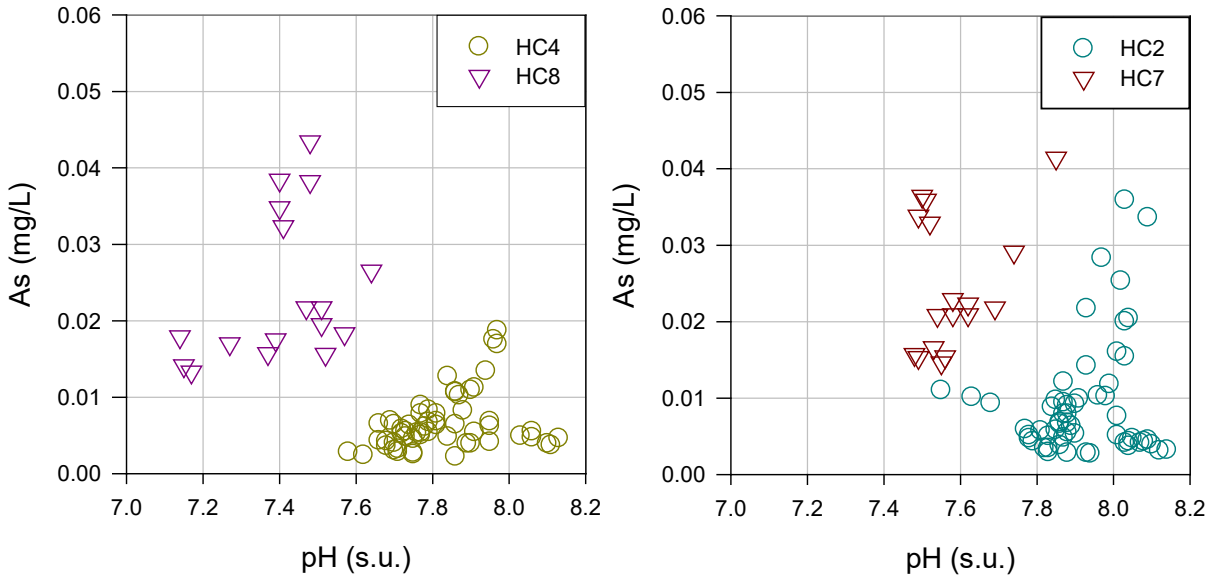


Figure 5-4: Comparison of the relationship between As and pH in two humidity cells containing different samples of the same lithology and weathering facies. Fresh gneiss waste rock humidity cells are shown on the left and fresh schist waste rock shown on the right

The relative abundance of available As and Fe-oxide mineral surfaces can be approximated based on the As:Fe molar ratios in kinetic test samples. The relationship between As concentrations produced at pH 8, and solid phase As:Fe molar ratios is shown in Figure 5-5. This result is consistent with results presented by Langmuir *et al.,* (1999), where it was shown that As concentrations in tailings pore water could be predicted based on As:Fe molar ratios. Figure 5-5. shows that a linear relationship exists over the range of As concentrations and As:Fe molar ratios in different ore and waste rock kinetic tests, with As concentrations increasing as the As:Fe molar ratio increases.

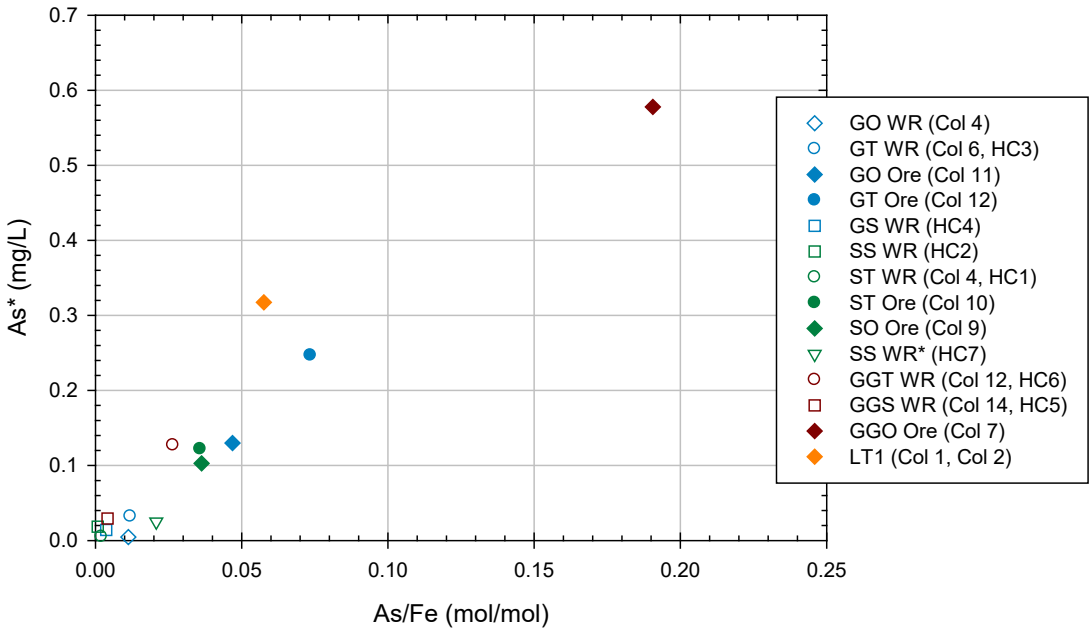


Figure 5-5: Observed arsenic concentrations at pH 8 plotted against As/Fe molar ratios measured by aqua regia analysis of kinetic test solids. Each data point represents an individual kinetic test sample.

This observed linear relationship only describe As solubility for a specific pH (8.0). In order to predict As concentrations at pHs other than 8, a relationship between As solubility and pH must be estimated. The increase in solubility of As(V) with increasing pH can be related to the shift in speciation from $H_2AsO_4^-$ to $HAsO_4^{2-}$ (Giménez *et al.*, 2007), with the ratio of these two species being directly related to the concentration of H^+ ions ($H^+ = 10^{-pH}$). Consequently, changes in As solubility can be inversely related to changes in H^+ concentrations, that is, a decline in H^+ by an order of magnitude (*i.e.,* increase of 1 pH unit) will result in an order of magnitude increase in As concentrations. Arsenic solubility in gneiss, schist and granite waste rock and ore is represented by the following equations:

$$As_{(aq)} = m \times As_{(sl)}/Fe_{(Sl)} \times 10^{-8}/H^+ \qquad (1)$$

Where $As_{(aq)}$ is the concentration of As in mg/L, As(sl) and Fe(sl) are moles of As and Fe in the solid sample, H^+ is the molar concentration of H^+ in solution (equal to 10^{-pH}) and m is the slope from the linear regressions developed from data shown in Figure 5-5 above (m equals 3.14, 2.85 and 3.06 for gneiss, schist and granite, respectively). This equation is used to define dissolved As concentrations based on As:Fe molar ratios and pH. The range of As:Fe ratios for each rock lithology broken down by weathering zone is presented in

Table 5-5 for ore and waste rock. The base case As source terms assume median As:Fe ratios, while the upper case source term calculations assumes 75th percentile As:Fe ratios.

Table 5-5:
Arsenic to Fe molar ratios in waste rock and ore lithologies and weathering zones

Statistic	Oxide	Transition	Fresh	Oxide	Transition
Gneiss	**Waste Rock**			**Ore**	
95th PCTL	3.77E-02	2.20E-02	3.10E-03	1.08E-01	1.94E-01
75th PCTL	1.92E-02	3.65E-03	7.37E-04	5.80E-02	7.60E-02
Median	1.11E-02	1.01E-03	3.22E-04	3.99E-02	4.81E-02
25th PCTL	4.24E-03	3.16E-04	1.49E-04	2.96E-02	3.13E-02
5th PCTL	9.29E-04	9.26E-05	6.33E-05	1.88E-02	1.22E-02
Schist	Waste Rock			Ore	
95th PCTL	2.02E-02	9.43E-03	1.85E-03	1.72E-01	1.98E-01
75th PCTL	2.88E-03	1.29E-03	5.08E-04	8.58E-02	1.01E-01
Median	9.13E-04	4.99E-04	2.55E-04	6.08E-02	6.92E-02
25th PCTL	3.26E-04	1.96E-04	1.37E-04	4.16E-02	3.70E-02
5th PCTL	9.95E-05	6.93E-05	5.95E-05	2.11E-02	1.00E-02
Granite	Waste Rock			Ore	
95th PCTL	1.42E-01	5.60E-02	4.92E-01	3.38E-01	4.24E-01
75th PCTL	4.53E-02	8.73E-03	1.87E-01	1.90E-01	2.68E-01
Median	2.23E-02	1.84E-03	1.19E-02	8.67E-02	1.69E-01
25th PCTL	3.98E-03	3.78E-04	1.35E-03	5.04E-02	7.42E-02
5th PCTL	6.20E-04	1.19E-04	2.87E-04	3.59E-02	3.69E-02

Note: Molar ratios calculated from ICP-OES database with the exception of the fresh granite unit, which combines both ICP-OES and ICP-MS databases due to limited number of samples

The relationship defined in equation 1 above is pH dependent, and the prediction of pH requires consideration of a variety of physical and geochemical conditions, as discussed below. Dissolution of carbonate minerals (primarily calcite and dolomite) are expected to control the pH and alkalinity WRSF pore water. Carbonate mineral equilibrium pH is determined by the partial pressure of carbon dioxide (pCO_2), temperature, and solution chemistry (*e.g.*, salinity and concentration of Ca and Mg). Waste rock field bins produced pH values from 7.7 to 8.2 in schist, and 7.7 to 8.3 in gneiss (Table 4-32 and Table 4-33). This is similar to the pH range reported for calcite and dolomite buffered full scale waste rock facilities in British Columbia. The combined dataset from Copper Mountain, Highland Valley Copper and Mount Polley waste rock facilities having 5th percentile, median and 95th percentile pHs of 7.6, 8.1 and 8.4 (SRK, 2015). For the purpose of calculating As solubility in WRSF source terms, a pH of 8.0 and 8.3 is assumed for the base case and upper case, respectively. This pH range is applied to all WRSFs.

The As solubility control is applied to WRSF source terms by calculating a concentration associated with each of the rock types within a WRSF and taking a weighted average. The same assumption regarding pore water pH is made for all rock types.

5.1.4.2 Uranium

Uranium solubility is dependent on redox potential, pH and availability of complexing ions such as CO_3, PO_4 or SO_4. Uranium primarily occurs in two oxidation states [U(IV) and U(VI)]. Uranium in the tetravalent form [U(IV)] is relatively insoluble and will typically precipitate as uraninite (UO_2). For U(IV) to be released into pore water, it must first be oxidized by atmospheric oxygen or another oxidizing agent such as Fe(III). Once oxidized to U(VI), U will speciate as a positively charged uranyl oxycation (UO_2^{2+}). In neutral pH environments the positively charged uranyl ion may be adsorbed onto negatively charged surfaces of sulfides, clays and organic matter as well as Fe, Mn and Al oxyhydroxide particles (Lottermoser, 2007). Uranyl ion solubility is enhanced by complexation with carbonate, which primarily occur with dissolved carbonate in neutral pH environments (Porcelli and Swarzenski, 2003).

Elemental associations observed with μXRF indicate that a portion of U(IV) occurs as brannerite minerals in gneiss waste rock, these minerals are generally considered relatively recalcitrant compared to other common U(IV) minerals such as uraninite and coffinite (Gilligan *et al*., 2015). X-ray adsorption near edge spectroscopy (XANES) analysis found that a portion of U is present in the oxidized U(VI) form, even in fresh (unweathered) waste rock samples (Table 4-7). This indicates that U can be mobilized to pore water by complexation with dissolved carbonate immediately, without requiring an intermediate oxidation step (*e.g.,* brannerite oxidation by oxygen) which would pose a kinetic limitation on U release.

In aerobic pH-neutral to alkaline environments U(VI) solubility is sensitive to pH and alkalinity (Dittrich and Reimus, 2015; Davis and Curtis, 2003; Waite *et al.,* 1994). Furthermore, Davis and Curtis (2003) found that alkalinity was the more influential of the two parameters controlling U(VI) solubility. This association between alkalinity and U(VI) solubility can be seen in laboratory kinetic test results (Figure 4-16 and Figure 4-24) and in site ground water and surface water quality data. The relationship between U and alkalinity in gneiss, schist and granite laboratory kinetic tests excluding the initial flushing period and ground water wells screened within the respective lithologies is shown in Figure 5-6. Note that field bin data is excluded from these plots due to uncertainties in the reliability of alkalinity measurements, as discussed in section 4.1.5.5. These plots show that there is some consistency between the relationship between alkalinity and U concentrations in both field and laboratory data. The fact that similar relationships are

observed between alkalinity and U concentrations in both site water quality and field kinetic test data supports the use of alkalinity as a proxy for U concentrations in planned mine waste facilities.

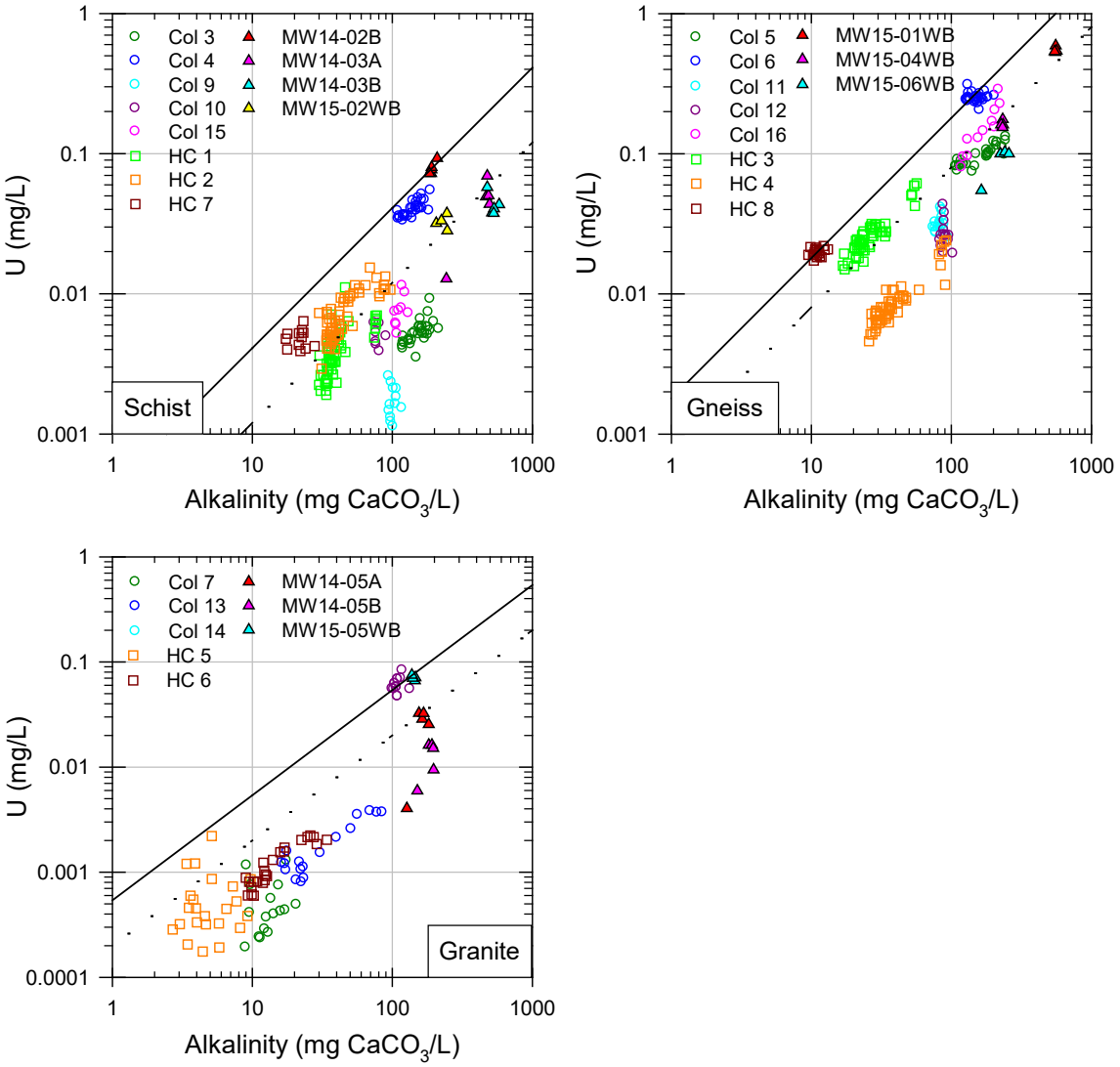


Figure 5-6: Relationship between U and alkalinity in groundwater monitoring wells and laboratory kinetic tests containing waste rock and ore. Data shown for kinetic tests containing, and groundwater wells screened in schist (upper left), gneiss (upper right) and granite (bottom left). Lines show relationship between alkalinity and U used to define base case solubility (dotted) and upper case (solid)

Source term predictions for U are based on the ratio of alkalinity to U observed in kinetic testwork and site water quality. Unlike As, variations in the relationship between U and alkalinity do not appear to be related to differences in solid phase U content. Considering that kinetic tests generally had elevated U compared to what was typical of site waste rock

(Figure 4-9), the relationship between alkalinity and U is expected to provide a conservative approximation of what can be expected from waste rock WRSFs. For source term prediction, the average and maximum U:Alk mass ratio observed in each kinetic test and groundwater sampling are presented in Table 5-6. The median ratio is used for the base case estimate and the maximum ratio is used for the upper case estimate. Note that these U:Alk ratios used to define the base case and upper case solubility are also illustrated in Figure 5-6 above.

Table 5-6:
Uranium to alkalinity ratio used to predict upper case and base case U solubility

	Base Case (mg/mg)	Upper Case (mg/mg)
Gneiss	8.0E-04	1.8E-03
Granite	2.8E-04	5.4E-04
Schist	1.2E-04	4.1E-04

In order to relate the U:Alk ratios presented in Table 5-6 to U concentration predictions requires an estimate of pore water alkalinity. The primary source of alkalinity in mine waste environments is from carbonate mineral dissolution. When present, carbonate minerals will dissolve until equilibrium is reached. The alkalinity produced by carbonate mineral equilibrium will depend primarily on the partial pressure of carbon dioxide (pCO_2), but will also be effected by temperature and solution chemistry. The interior of WRSFs generally have elevated pore gas pCO_2 compared to atmospheric concentrations due CO_2 generation from organic and inorganic processes. For the purposes of estimating alkalinity values produced from WRSFs, a range of conditions is considered. The relationship between alkalinity and pCO_2 at temperatures ranging from 10°C and 0.1°C, and TDS values ranging from 840 to 3400 mg/L are plotted in Figure 5-7. This figure was generated using the USGS geochemical modelling program PHREEQC, coupled to the Lawrence Livermore National Laboratories database (Parkhurst and Appelo, 1999). The PHREEQC input file is provided in Appendix E.2. In general, the modeled relationship shows that alkalinity is greater at lower temperatures and TDS values and increases with pCO2 from 50 $mgCaCO_3$ (atmospheric CO_2) to 470 $mgCaCO_3$/L (5% CO_2). This range of CO_2 values is similar to what has been observed at other low sulphur carbonate buffered WRSFs (MacGrergor *et al.,* 2012; Birkham *et al.,* 2003). For the purpose of source term calculation, a pore gas pCO_2 of 5% is assumed, using calcite equilibrium calculated at low TDS and 0.1°C shown in Figure 5-7. This produces an estimated alkalinity of 470 $mgCaCO_3$/L and is used the base case and upper case source term predictions for U.

The U solubility control is applied to WRSF source terms by calculating a concentration associated with each of the rock types within a WRSF and taking a weighted average. The same assumptions regarding alkalinity are made for all rock types.

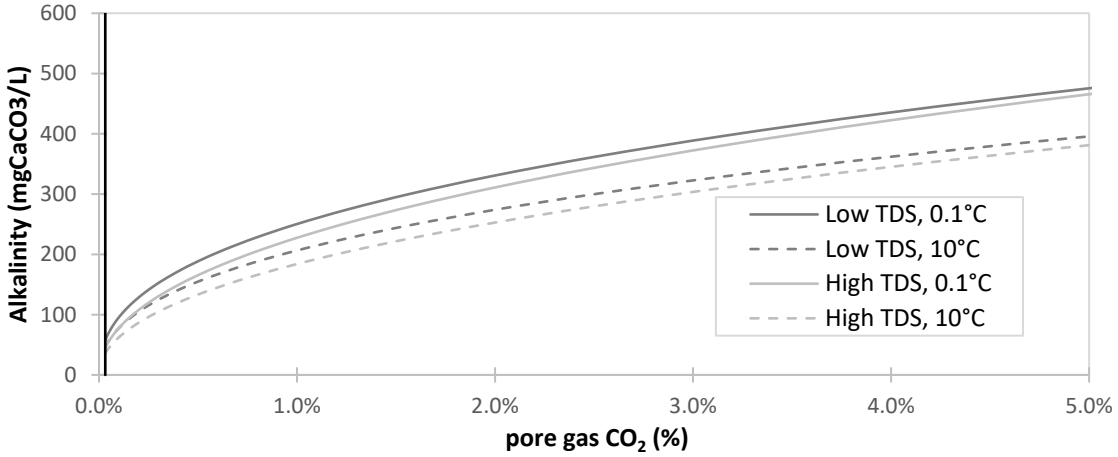


Figure 5-7: Relationship between pH and pore gas CO_2 at calcite equilibrium and varying temperatures and TDS.

5.1.4.3 Radium-226

Radium 226 is one of the main contributors to radiological doses in naturally occurring radioactive materials (NORM) and is the only radio-isotope regulated under MMER. This radio isotope is the fifth isotope of the ^{228}U decay chain and in most geologic material, the activity of ^{226}Ra in rock samples can be estimated directly from measurements of U concentrations. That is, daughter products of the ^{238}U series achieve equilibrium after about 1 million years. Secular equilibrium is a state in which the decay rate of all radioisotopes of a decay chain are equal. Analysis of naturally occurring radioactive materials (NORM) measured by gamma spectroscopy in ore, waste rock and overburden found that radioisotopes were in secular equilibrium, as is generally the case in geologic systems. This means that the activity of ^{226}Ra in host rock can be estimated based on the concentration of U. A concentration of 1 ppm of natural uranium (99.3% as ^{238}U) corresponds to 0.01235 Bq of ^{226}Ra per gram. Based on this relationship, the solid phase ^{226}Ra activity can be determined from the mass concentration of U.

In aqueous systems, Ra forms a bivalent cation [Ra(II)] and behaves similar to other alkaline earth metals such as Mg, Sr, Ca and Ba. There is abundant information from environmental radiochemical research which shows that the solubility of Ra(II) is mainly controlled by $BaSO_4$ solubility (Martin and Akber, 1999; Grandia *et al.,* 2008). The affinity of Ra to the barite crystal lattice is related to the similar ionic radius of Ra(II) and Ba(II) (1.36 Å and 1.43 Å, respectively), with $(Ba,Ra)SO_4$ behaving as a near ideal solid solution (Kulik *et al.,* 2003). The relationship between ^{226}Ra measured by alpha

spectroscopy and dissolved Ba measured by ICP-MS is shown Table 5-11 below. There is some evidence that elevated ^{226}Ra values are associated with elevated Ba, however, the relationship is confounded by the low concentration of ^{226}Ra. That is, most Ra measurements are within 10x the analytical detection limit (0.01 Bq/L). Activities within this range have a relatively large uncertainty, having a precision of +/- 50% to 100%, making these measurements semi-quantitative in nature.

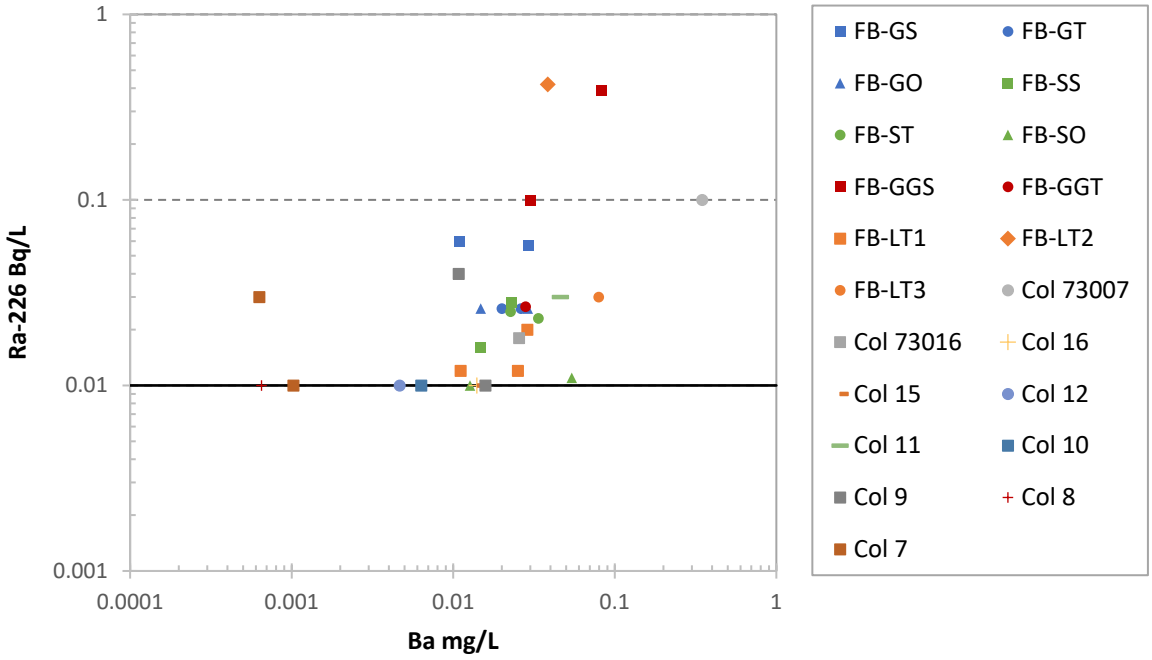


Figure 5-8: Barium concentration versus ^{226}Ra activity measured in field bins, laboratory kinetic test columns, and metallurgical cyanide leach columns. Black line shows detection limit, dotted line shows 10x detection limits for ^{226}Ra, data below this line can be considered semi-quantitative as the analytical precision is +/- 50 to 100%

Due to the large uncertainty in the relationship between Ba and ^{226}Ra in kinetic test leachate, the ratio of ^{226}Ra:Ba released into solution is assumed to be equivalent to the ratio which occurs in the solid phase. The median and 75th percentile ratios of ^{226}Ra:Ba ratios (Bq/ppm) for each of the respective rock types is presented in Table 5-7. In this table, the concentration of ^{226}Ra is calculated by assuming secular equilibrium with ^{238}U as described in section 4.1.7.

Table 5-7:
Ratio of Ra-226 to Ba measured in ICP-MS database for various lithologies, weathering types and ore/waste types.

Lithology	Weathering	Ore/Waste	Ra-226 / Ba (Bq/ppm)	
			P50	P75
Schist	Oxide	Waste	0.14	0.28
Schist	Transition	Waste	0.08	0.19
Schist	Fresh	Waste	0.07	0.12
Schist	Oxide	Ore	0.08	0.08
Schist	Transition	Ore	0.16	0.79
Gneiss	Oxide	Waste	0.84	1.16
Gneiss	Transition	Waste	0.69	1.16
Gneiss	Fresh	Waste	0.27	0.61
Gneiss	Oxide	Ore	0.73	0.97
Gneiss	Transition	Ore	0.71	0.82
Granite	Oxide	Waste	1.85	2.21
Granite	Transition	Waste	1.26	2.49
Granite	Fresh	Waste	1.01	1.34
Granite	Oxide	Ore	1.91	2.51
Granite	Transition	Ore	2.41	5.37

Thermodynamic calculations of barite saturation often underestimate barium concentrations observed in the natural environment (Martin et al., 2003). Barite solubility is graphed in Figure 5-9 and compared to metallurgical leach column data and field bin data (data presented in Table 4-32, Table 4-34, Table 4-36, Table 4-56 and Table 4-64). Note that first flush samples form field bins are excluded in this table. In this figure, barite solubility is calculated by assuming barite equilibrium (SI=0) and for barite under supersaturated conditions (SI=0.55). An SI of 0.55 is equivalent to the ion activity product (IAP) being 3.5 times the solubility product (Ksp). In other words, Ba concentrations are 3.5 times greater than what would be predicted by assuming barite equilibrium. Solubility calculations are done using the USGS geochemical modelling program PHREEQC coupled to the Lawerence Livermore National Laboratory database (Parkhusrt and Apello, 1999). The input file is provided in Appendix E.2. Most field bin data plots between the barite SI=0 and barite SI=0.55 solubility curves. This result is similar to results from Martin et al. (2003), who found that while barium generally conformed with expected behavior predicted by barite solubility (decreasing Ba with increasing SO4 concentrations), however, calculated SI values were generally greater than 0 (*i.e.*, greater than equilibrium). In order to predict Ba solubility for the purposes of source term calculations, a barite SI of 0.55 is assumed for both base case and upper case scenarios. This assumed barite SI

conservatively predicts Ba concentrations in 23 of 26 field bin samples and 24 of the 26 met column samples (Figure 5-9).

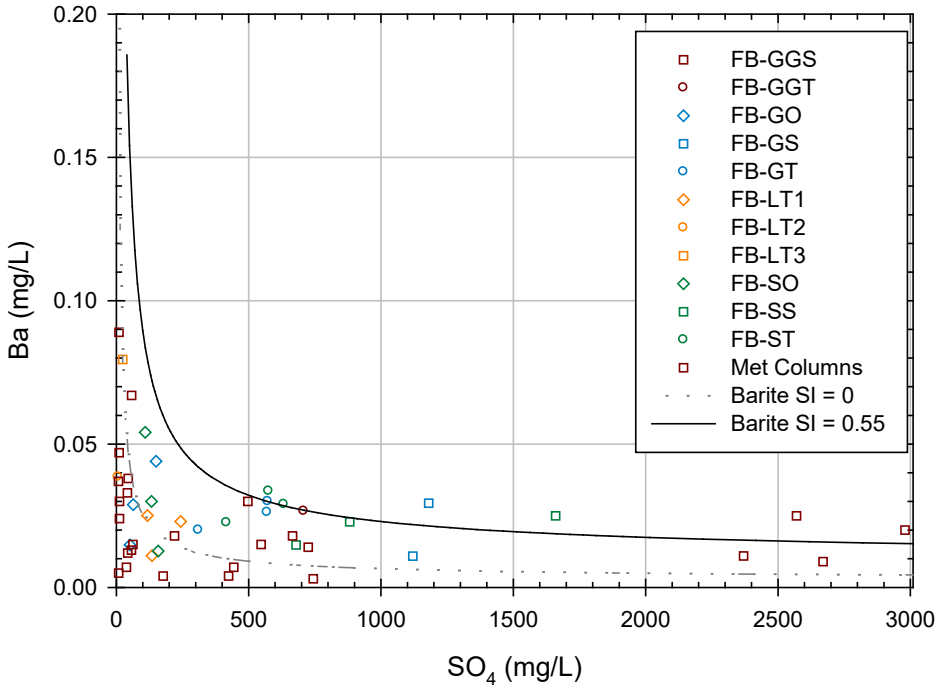


Figure 5-9: Relationship between barium and SO_4 in field bin and metallurgical leach column (met column) samples. The grey line indicates barite solubility at equilibrium (SI=0). The black line indicates barite at supersaturation (SI=0.55).

Source term predictions for ^{226}Ra are calculated by multiplying the ratio of ^{226}Ra to Ba in the solid phase by the predicted concentration of Ba assuming barite SI of 0.55. The ratio of ^{226}Ra to Ba is used as the sensitivity to differentiate the base case from the upper case. That is, the median ratio is used as the base case source term and the 75th percentile value is used in the upper case source term. Activities of ^{226}Ra, predicted by these assumptions, are plotted as a function of SO_4 concentrations for base case and upper case scenarios in Figure 5-10 and Figure 5-11, respectively. Due to the inverse relationship between Ra activities and SO_4, the base case source terms of SO_4 are used to calculate Ba solubility in both base case and upper case ^{226}Ra predictions to ensure conservative predictions. The ^{226}Ra solubility control is applied to WRSF source terms by calculating the ^{226}Ra:Ba ratio for each of the rock types within a WRSF and taking a weighted average.

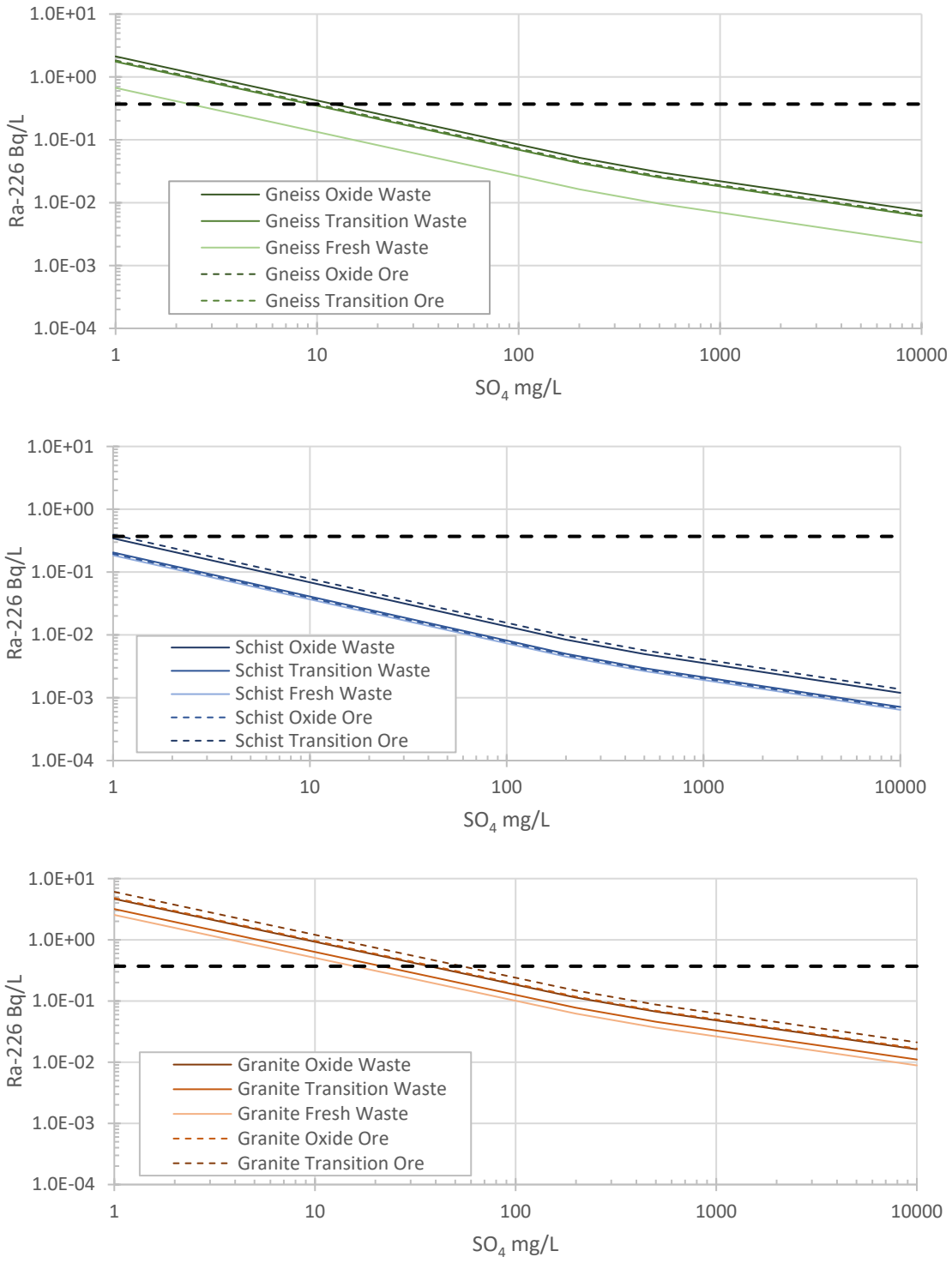


Figure 5-10: Base case solubility control of Ra-226 as a function of SO_4 concentrations. Plots show Ra-226 solubility for various gneiss (top), schist (middle), and granite (bottom) ore and waste rock units

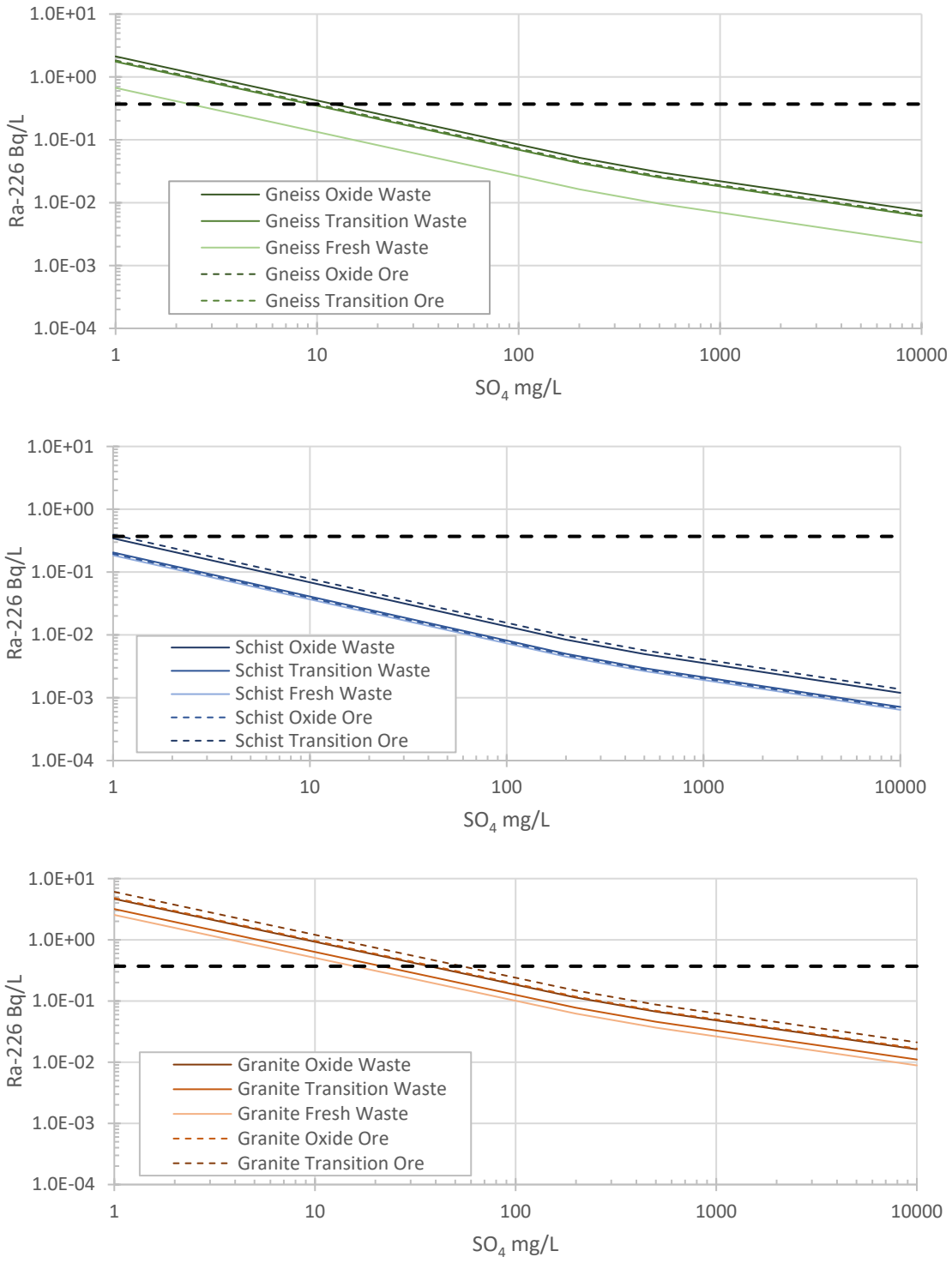


Figure 5-11: Upper case source term solubility of Ra-226 as a function of SO_4 concentrations. Plots show Ra-226 solubility for various gneiss (top), schist (middle), and granite (bottom) ore and waste rock units.

5.1.4.4 Other Parameters

Upscaling kinetic test loading rates often produces unrealistic concentrations due to detection limit values in kinetic test, or pH related solubility controls. The concentration of Hg and P were frequently at or below detection limits in kinetic testwork, and concentrations of Al and Fe are not expected to conservatively as they will precipitate as hydroxide or oxyhydroxide phases under neutral pH, aerobic conditions. Therefore, Hg, Fe and Al were set to median and 75th percentile concentrations observed in waste rock field bins for base case and upper case source term predictions, respectively. In the case of P, where all field bin values were below the relatively high detection limit value of 0.05 mg/L, the detection limit value is used in the upper case source term and the base case scenario is set at half the detection limit.

5.1.5 Source Term

Source terms for WRSFs are calculated for the maximum WRSF footprints and mass at end of mine life. Base case and upper case source term concentrations applied at end of mine life are presented in Table 5-8 and Table 5-9, respectively. The source term applied to the underdrain of the Alpha WRSF is provided in Table 5-10. The complete set of source terms is provided in Appendix E.3.

Table 5-8:
Base case source terms for WRSF for the final year of mine life,
Table 5-8closure and post-closure

Facility		Alpha WRSF	Kona Backfill	in Pit Latte	in Pit Supremo	in Pit Double Double
Sulfate	mg/L	1430	274	755	829	739
P	mg/L	0.0251	0.0267	0.025	0.025	0.025
Al	mg/L	0.00793	0.0143	0.00793	0.00793	0.00793
Ag	mg/L	0.0000387	0.0000181	0.0000199	0.0000218	0.0000195
As	mg/L	0.00631	0.0114	0.00702	0.00702	0.00702
Ca	mg/L	267	63.3	142	156	139
Cd	mg/L	0.0000241	0.0000722	0.0000126	0.0000139	0.0000124
Cr	mg/L	0.00292	0.000425	0.00155	0.00171	0.00152
Cu	mg/L	0.00397	0.000598	0.00209	0.00229	0.00204
Fe	mg/L	0.0215	0.0136	0.0214	0.0214	0.0214
Hg	mg/L	0.00000616	0.00000289	0.00000619	0.00000619	0.00000619
Mg	mg/L	162	12.1	85	93.3	83.2
Mn	mg/L	0.018	7.01	0.00647	0.00711	0.00634
Mo	mg/L	0.136	0.00437	0.0789	0.0866	0.0772
Ni	mg/L	0.00637	0.00497	0.00232	0.00255	0.00227
Pb	mg/L	0.000759	0.000213	0.000372	0.000408	0.000364
Sb	mg/L	0.0229	0.00433	0.0114	0.0125	0.0111
Se	mg/L	0.00206	0.000123	0.000911	0.001	0.000892
Tl	mg/L	0.000405	0.000145	0.00021	0.000231	0.000206
U	mg/L	0.332	0.132	0.376	0.376	0.376
Zn	mg/L	0.0898	0.063	0.0416	0.0457	0.0408
Ra-226	Bq/L	0.0114	0.0629	0.0174	0.0167	0.0176

Table 5-9:
Upper case source terms for WRSF in final year of mine life and closure

Facility		Alpha WRSF	Kona Backfill	in Pit Latte	in Pit Supremo	in Pit Double Double
Sulfate	mg/L	2090	401	1100	1210	1080
P	mg/L	0.0501	0.0782	0.05	0.05	0.05
Al	mg/L	0.015	0.021	0.0145	0.0145	0.0145
Ag	mg/L	0.0000566	0.0000264	0.0000291	0.0000319	0.0000285
As	mg/L	0.0282	0.595	0.0311	0.0311	0.0311
Ca	mg/L	391	92.6	207	227	203
Cd	mg/L	0.0000353	0.000106	0.0000185	0.0000203	0.0000181
Cr	mg/L	0.00428	0.000622	0.00227	0.0025	0.00222
Cu	mg/L	0.00581	0.000874	0.00305	0.00335	0.00299
Fe	mg/L	0.0336	0.0199	0.032	0.032	0.032
Hg	mg/L	0.0000245	4.22E-06	0.000012	0.0000132	0.0000117
Mg	mg/L	236	17.7	124	136	122
Mn	mg/L	0.0263	10.2	0.00946	0.0104	0.00927
Mo	mg/L	0.199	0.00639	0.115	0.127	0.113
Ni	mg/L	0.00931	0.00728	0.00339	0.00372	0.00332
Pb	mg/L	0.00111	0.000311	0.000544	0.000597	0.000532
Sb	mg/L	0.0335	0.00634	0.0166	0.0183	0.0163
Se	mg/L	0.00301	0.000179	0.00133	0.00146	0.0013
Tl	mg/L	0.000593	0.000211	0.000307	0.000337	0.000301
U	mg/L	0.769	0.254	0.86	0.86	0.86
Zn	mg/L	0.131	0.0921	0.0609	0.0669	0.0596
Ra-226	Bq/L	0.0195	0.0919	0.0295	0.0282	0.0298

Table 5-10:
Source term for Alpha WRSF underdrain applied in both base case and upper case.

Sulfate	mg/m/yr	439000
P	mg/m/yr	40.1
Al	mg/m/yr	9.55
Ag	mg/m/yr	0.0119
As	mg/m/yr	28.6
Ca	mg/m/yr	82200
Cd	mg/m/yr	0.00741
Cr	mg/m/yr	0.899
Cu	mg/m/yr	1.22
Fe	mg/m/yr	17.1
Hg	mg/m/yr	0.00514
Mg	mg/m/yr	49700
Mn	mg/m/yr	5.53
Mo	mg/m/yr	41.9
Ni	mg/m/yr	1.96
Pb	mg/m/yr	0.233
Sb	mg/m/yr	7.04
Se	mg/m/yr	0.632
Tl	mg/m/yr	0.125
U	mg/m/yr	245
Zn	mg/m/yr	27.6
Ra-226	Bq/m/yr	18.2

5.2 Pit Walls

Pit wall rock refers to rock exposures within the mining pit itself. This includes the pit floor, benches and blast damaged fractured rock. Pit walls are expected to be fractured as a result of blasting operations. Fracturing and slope ravelling of the pit walls exposes a greater proportion of the wall rock to weathering. Wall rock drainage chemistry will vary depending on the rock type exposed rock type. Pit wall rock will be composed of a combination of waste rock and ore, with the same associations between lithology and pit as described for waste rock and ore. A summary of the estimated percentages of different pit wall types that compose the pit walls at full exposure is provided in Table 5-11 below.

Table 5-11:
Plan view surface areas of wall rock exposed in mine pit. Maximum values show peak wall rock surface areas exposed during mine life, final values are wall rock exposures at the end of mine life

Pits	Primary	Ore		Waste		
	Lithology	Oxide	Transition	Oxide	Transition	Fresh
Supremo	Gneiss	12%	2%	6%	49%	32%
Double Double[1]	Gneiss	4%	8%	4%	21%	62%
Kona[1]	Granite	10%	11%	16%	21%	42%
Latte	Schist	4%	21%	12%	21%	41%

Notes: **1**. Double Double and Kona pits are entirely backfilled with waste rock by the end of mine life

5.2.1 Data Sources

Pit wall source terms are calculated by scaling laboratory kinetic test work. A list of the kinetic tests and cycles used in development of pit wall source terms is presented in Table 5-12 below. The loading rates used are the median and 75th percentile measured after the first 10 cycles of testing for the base case and upper case source terms, respectively. Kinetic test loading rates are presented in Section 4.1.5.3 and 4.2.5.3 for waste rock and ore, respectively. The volume of runoff from pit wall is estimated based on an MAP of 485 mm, and a runoff coefficient of 0.65 (Appendix 12-C).

Table 5-12:
Overview of Kinetic Tests Used for Pit Wall Source Term Calculation

Kinetic Test ID	Mineralization	Lithology	Material Type	Cycles/Weeks
Col 3	Oxide	Schist	Waste	10-44
Col 4	Transition	Schist	Waste	10-44
Col 5	Oxide	Gneiss	Waste	10-44
Col 6	Transition	Gneiss	Waste	10-44
Col 7	Oxide	Granite	Ore	10-22
Col 8	Transition	Granite	Ore	10-22
Col 9	Oxide	Schist	Ore	10-23
Col 10	Transition	Schist	Ore	10-23
Col 11	Oxide	Gneiss	Ore	10-23
Col 12	Transition	Gneiss	Ore	10-23
Col 13	Transition	Granite	Waste	10-21
HC6	Fresh	Granite	Waste	10-42
HC2	Fresh	Schist	Waste	10-87
HC4	Fresh	Gneiss	Waste	10-87

Note: Median loading rates used for base case, and 75th percentile loadings used for upper case source terms.

5.2.2 Data Scaling

The loading rates measured in the laboratory kinetic tests were scaled to address the differences between laboratory and field conditions. Laboratory rates were adjusted to account for the expected flushing rate, fractures associated with blasting, and grain size distribution. A summary of scaling factors used to develop the source terms is provided below in Table 5-13. The assumptions used in developing these scaling factors are described below.

Table 5-13:
Pit Wall Physical Scaling Factors

Scaling Factors	Unit	Blast Damaged	Blast Fractured
Thickness (m)	m	0.9	2.9
Average Wall Slope	degree	45	45
Mass	t/m^2	3.2	10.3
Grain Size Correction	-	20%	5%
% of Material Flushed	-	75%	50%
% of Year Frozen	-	42%	42%

Geochemical loading from the pit wall is influenced by the fracture intensity of the walls induced by blasting. The blast effects in the pit wall can be subdivided into two zones; a blast influenced zone and a blast damaged zone. The blast damaged zone consists of highly fractured pit wall rock exposed on the pit wall face or ravel collected on benches. The blast influenced zone consists of more widely spaced fractures in to the pit wall behind the blast damaged zone that will become progressively more fractured over time. The blast damaged zone is estimated to extend 0.9 m into the final pit wall, and the blast influenced zone is estimated to extend another 2.9 m into the pit wall. The effective volume of material in a planar unit area of 1 m^2 is increased by a factor 1.41 to account for the average pit wall slope of 45 degrees. Finally, the mass of rock in each unit area is determined by multiplying the effective volume by density of 2.6 $tonne/m^3$. Based on these estimates, the blast damaged zone contains 3.2 tonnes and the blast fractured zone contains 10.3 tonnes of rock per m^2 (Table 5-13). The surface area associated with these masses of wall rock is described below.

Humidity cells and unsaturated columns contain relatively fine grained particles (<10 mm), hence, material used in humidity cells have a greater surface area to mass ratio than material in the blast damaged zone and blast influenced zone of the pit wall. Estimated grain size correction factors are 20% for the blast damaged zone and 5% for the blast influenced zone.

Laboratory kinetic tests are conducted at a relatively high flushing rate compared to field conditions. The high flushing rate ensures that mineral surfaces are in contact with the leachate solution, which prevents oxide weathering products from accumulating

(armoring) mineral surfaces. Furthermore, preferential flow paths will develop in the heterogeneous pit wall rock and fracture zones, circumventing a portion of the exposed surface area. To account for these changes, a flushing factor is included in the source term calculation. It is assumed that 75% of rock surfaces on the blast damaged zone are flushed, and 50% of surfaces in the blast influenced zone are flushed (Table 5-13).

It is assumed that no metal loading or acid generation takes place on any of the pit wall units for the 5 months of the year with average temperatures below freezing. No additional temperature correction was incorporated into kinetic test loading rates.

5.2.3 Solubility Controls

The pit wall source terms are calculated by upscaling kinetic test loading rates. This approach to source term calculation frequently results in predicted concentrations that exceed thermodynamic solubility controls, particularly in neutral pH environments where numerous controls on dissolved concentrations influence drainage chemistry. Solubility controls for As, U and ^{226}Ra are calculated using the same approach as that described in Section 5.1.4. Concentrations of other parameters that are based on upscaling detection limit data or for parameters that have limited solubility in neutral-alkaline pH environments are also adjusted.

The As and U solubility control is partially based on an estimate of pH and alkalinity. For pit wall source terms, these values are estimated from kinetic tests representing the different respective rock types, with the median and 75th percentile used for base case and upper case source term predictions, respectively. The estimated pH and alkalinity values are presented in Other solubility controls applied to wall rock runoff source terms are restricted to unweathered (fresh) waste rock lithologies. This is largely due to the large number of detection limit concentrations produced by the relatively small humidity cell experiments. Loading rates for Fe, Hg, P and Se incorporate detection limit concentrations. Therefore, these parameters were set to median and 75th percentile concentrations observed in field bins (schist fresh and gneiss fresh) or in unsaturated laboratory columns (granite fresh) for base case and upper case source terms, respectively. Other parameters which were adjusted include Al in all three fresh waste rock lithologies, and Cu and Sb in the schist fresh and gneiss fresh lithologies. The upscaled concentration of these parameters exceeded field bin values, which incorporate a greater mass and infiltration rate than predicted for pit wall rock exposures, hence, field bin data represents an upper limit of what can reasonably be expected from wall rock runoff. Therefore, these concentrations were adjusted to median and 75th percentile concentrations observed in field bins.

Table 5-14. Solubility controls for As and U are not applied to the granite transition ore, due to the mildly acidic pH (medium pH 4.5) expected from this unit.

Other solubility controls applied to wall rock runoff source terms are restricted to unweathered (fresh) waste rock lithologies. This is largely due to the large number of detection limit concentrations produced by the relatively small humidity cell experiments. Loading rates for Fe, Hg, P and Se incorporate detection limit concentrations. Therefore, these parameters were set to median and 75th percentile concentrations observed in field bins (schist fresh and gneiss fresh) or in unsaturated laboratory columns (granite fresh) for base case and upper case source terms, respectively. Other parameters which were adjusted include Al in all three fresh waste rock lithologies, and Cu and Sb in the schist fresh and gneiss fresh lithologies. The upscaled concentration of these parameters exceeded field bin values, which incorporate a greater mass and infiltration rate than predicted for pit wall rock exposures, hence, field bin data represents an upper limit of what can reasonably be expected from wall rock runoff. Therefore, these concentrations were adjusted to median and 75th percentile concentrations observed in field bins.

Table 5-14:
Estimates of Wall Rock Runoff pH and Alkalinity Used to Calculate Arsenic and Uranium Solubility

Ore/Waste	Lithology	Weathering	Base Case		Upper Case	
			pH	Alkalinity	pH	Alkalinity
Waste	Gneiss	Oxide	8.2	148	8.3	114
		Transition	8	97	8.1	76
		Fresh	7.9	91	8	69
	Schist	Oxide	8.1	89	8.2	85
		Transition	7.9	70	8	51
		Fresh	8.1	146	8.1	91
	Granite	Oxide	7.5	22	7.8	21
		Transition	7.5	22	7.8	21
		Fresh	8.1	109	8.2	107
Ore	Gneiss	Oxide	8	148	8.1	114
		Transition	8	97	8.1	76
	Schist	Oxide	8	89	8.2	85
		Transition	8	70	8.1	51
	Granite	Oxide	7.4	22	7.8	21
		Transition	-	-	-	-

Note: No pH or alkalinity related solubility controls applied for granite transition ore.

5.2.4 Source Term

Wall rock source terms are calculated for each waste rock and ore unit that will be exposed on the pit wall during mine life and at closure. Base case and upper case source term predictions are provided in Table 5-15 and Table 5-16 respectively. The surface area of exposures of the different rock units on pit walls is presented in Table 5-11. Source terms for composite pit wall runoff from each of the mine pits are provided in Appendix E.3.

Table 5-15:
Base Case Estimates for Pit Wall Rock Source Terms

Lithology		**Gneiss**					**Schist**					**Granite**				
Material		**Waste Rock**			**Ore**		**Waste Rock**			**Ore**		**Waste Rock**			**Ore**	
Weathering Facies		**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**	**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**	**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**
Sulphate	mg/L	6.2	20	62	18	129	12	63	62	125	369	29	29	62	11	166
Al	mg/L	0.0043	0.0060	0.0091	0.0090	0.011	0.0043	0.0048	0.0050	0.010	0.011	0.0031	0.0031	0.009	0.23	0.53
Sb	mg/L	0.0025	0.0088	0.012	0.014	0.080	0.0031	0.0019	0.034	0.0089	0.044	0.0057	0.0057	0.012	0.048	0.020
As	mg/L	0.054	0.0030	0.00089	0.14	0.16	0.0040	0.0011	0.00090	0.16	0.18	0.0020	0.0020	0.050	0.070	12
Ba	mg/L	0.070	0.054	0.14	0.15	0.014	0.050	0.032	0.14	0.054	0.023	0.0011	0.0011	0.074	0.0015	0.00080
Be	mg/L	0.0000063	0.0000063	0.00022	0.000019	0.000020	0.0000058	0.0000068	0.00022	0.000019	0.000018	0.0000053	0.0000053	0.00022	0.000019	0.0013
Bi	mg/L	0.0000063	0.0000063	0.00022	0.000019	0.000020	0.0000058	0.0000068	0.00022	0.000019	0.000018	0.0000053	0.0000053	0.00022	0.000019	0.000020
B	mg/L	0.032	0.020	0.063	0.017	0.020	0.015	0.024	0.080	0.021	0.012	0.050	0.050	0.061	0.027	0.024
Cd	mg/L	0.0000060	0.0000080	0.000093	0.0000080	0.000010	0.0000026	0.0000090	0.000090	0.000013	0.0000080	0.0000046	0.0000046	0.000090	0.0000080	0.00019
Ca	mg/L	27	31	237	63	98	31	33	293	100	178	3.1	3.1	86	6.2	44
Cr	mg/L	0.00042	0.000071	0.00093	0.00045	0.000090	0.00059	0.00045	0.00090	0.00027	0.000090	0.000028	0.000028	0.00093	0.00013	0.00017
Co	mg/L	0.000060	0.000048	0.00046	0.00014	0.00026	0.000037	0.000080	0.0013	0.00016	0.0010	0.00088	0.00088	0.0017	0.00022	0.19
Cu	mg/L	0.0012	0.00081	0.0012	0.0013	0.0013	0.00090	0.0011	0.00096	0.0019	0.0014	0.00052	0.00052	0.0080	0.0025	0.043
Fe	mg/L	0.0063	0.0063	0.020	0.019	0.020	0.0058	0.020	0.010	0.019	0.018	0.0053	0.0053	0.0070	0.032	0.33
Pb	mg/L	0.000031	0.000012	0.00031	0.000028	0.000028	0.000018	0.000038	0.00031	0.000060	0.000050	0.000033	0.000033	0.0025	0.00018	0.00020
Li	mg/L	0.0037	0.0035	0.017	0.0065	0.0069	0.0051	0.010	0.024	0.0074	0.0068	0.0041	0.0041	0.021	0.00088	0.0078
Mg	mg/L	10	15	78	17	30	13	17	90	38	46	0.76	0.76	14	1.7	11
Mn	mg/L	0.00056	0.00039	0.26	0.0021	0.051	0.00047	0.0018	0.37	0.0080	0.090	0.38	0.38	2.1	0.044	7.2
Hg	mg/L	0.0000090	0.0000090	0.0000055	0.000027	0.000028	0.0000083	0.000010	0.0000025	0.000027	0.000026	0.0000076	0.0000076	0.0000025	0.000028	0.000029
Mo	mg/L	0.020	0.028	0.021	0.025	0.038	0.0026	0.023	0.0080	0.0067	0.0078	0.0028	0.0028	0.020	0.0039	0.0010
Ni	mg/L	0.00036	0.00042	0.0031	0.00028	0.00090	0.00037	0.0013	0.013	0.0028	0.0078	0.00029	0.00029	0.0031	0.00028	0.047
P	mg/L	0.0033	0.0049	0.025	0.094	0.013	0.0025	0.0029	0.025	0.0081	0.0079	0.0023	0.0023	0.025	0.028	0.056
K	mg/L	7.0	9.5	43	9.3	13	5.7	12	51	9.6	11	5.6	5.6	30	3.6	12
Se	mg/L	0.00018	0.00016	0.0016	0.00020	0.00072	0.00033	0.00060	0.0020	0.0016	0.0027	0.000041	0.000041	0.0012	0.00017	0.0015
Si	mg/L	5.5	4.1	21	11	11	4.2	5.0	15	9.0	6.1	11	11	74	5.8	16
Ag	mg/L	0.0000019	0.0000018	0.000062	0.0000055	0.0000056	0.0000017	0.0000021	0.000062	0.0000070	0.0000053	0.0000016	0.0000016	0.000060	0.0000070	0.0000060
Na	mg/L	12	2.4	3.9	4.5	2.0	2.1	14	3.4	3.8	2.4	13	13	10	13	1.3
Sr	mg/L	0.16	0.23	1.4	0.28	0.44	0.21	3.8	18	0.65	0.90	0.014	0.014	0.21	0.040	0.22
S	mg/L	2.7	7.2	25	7.7	47	4.2	23	32	49	151	11	11	19	4.9	60
Tl	mg/L	0.000028	0.00014	0.00018	0.00031	0.00036	0.000066	0.000010	0.00019	0.00017	0.00031	0.000041	0.000041	0.00025	0.000080	0.00090
Sn	mg/L	0.00013	0.000060	0.012	0.00014	0.00016	0.000046	0.00045	0.0025	0.00016	0.00010	0.000080	0.000080	0.0019	0.00017	0.00012
Ti	mg/L	0.000070	0.000058	0.0026	0.00014	0.00014	0.000042	0.000066	0.0028	0.00014	0.00013	0.000041	0.000041	0.010	0.00060	0.00014
U	mg/L	0.085	0.060	0.060	0.083	0.061	0.0043	0.0060	0.011	0.0041	0.0060	0.00080	0.00080	0.026	0.0010	0.0034
V	mg/L	0.00016	0.00014	0.0075	0.00022	0.00021	0.00011	0.00034	0.010	0.00016	0.00030	0.00010	0.00010	0.011	0.00042	0.00029
Zn	mg/L	0.00090	0.00090	0.031	0.0027	0.0028	0.00080	0.0010	0.031	0.0027	0.0026	0.0023	0.0023	0.031	0.0028	0.28
Ra-226	Bq/L	0.035	0.018	0.013	0.060	0.0051	0.00070	0.00010	0.00070	0.00023	0.00	0.0012	0.0012	0.050	0.0040	0.0030

Table 5-16:
Upper Case Estimates for Pit Wall Rock Source Terms

Lithology		**Gneiss**					**Schist**					**Granite**				
Material		**Waste Rock**			**Ore**		**Waste Rock**			**Ore**		**Waste Rock**			**Ore**	
Weathering Facies		**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**	**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**	**Oxide**	**Transition**	**Fresh**	**Oxide**	**Transition**
Sulphate	mg/L	7.2	22	63	20	143	17	74	92	155	574	33	33	62	14	181
Al	mg/L	0.0055	0.0067	0.0091	0.011	0.018	0.0049	0.0062	0.013	0.014	0.014	0.0049	0.0049	0.021	0.41	0.59
Sb	mg/L	0.0026	0.010	0.017	0.016	0.10	0.0033	0.0021	0.059	0.0097	0.046	0.0064	0.0064	0.028	0.059	0.021
As	mg/L	0.015	0.013	0.00094	0.25	0.30	0.013	0.0038	0.0017	0.33	0.35	0.016	0.016	0.060	0.33	21
Ba	mg/L	0.078	0.056	0.14	0.16	0.015	0.058	0.041	0.11	0.061	0.025	0.0012	0.0012	0.080	0.0024	0.0023
Be	mg/L	0.0000072	0.0000066	0.00022	0.000020	0.000020	0.0000061	0.0000073	0.00022	0.000019	0.000019	0.0000062	0.0000062	0.00022	0.000034	0.0014
Bi	mg/L	0.0000072	0.0000066	0.00022	0.000020	0.000020	0.0000062	0.0000073	0.00022	0.000019	0.000019	0.0000062	0.0000062	0.00022	0.000020	0.000020
B	mg/L	0.041	0.025	0.077	0.020	0.022	0.018	0.028	0.11	0.024	0.015	0.061	0.061	0.065	0.037	0.027
Cd	mg/L	0.000010	0.000014	0.000094	0.000011	0.000016	0.0000039	0.000012	0.00014	0.000020	0.000010	0.0000053	0.0000053	0.00014	0.000011	0.00022
Ca	mg/L	28	32	268	66	106	34	35	315	106	211	3.1	3.1	102	6.7	47
Cr	mg/L	0.00059	0.000091	0.00094	0.00050	0.00018	0.00074	0.00066	0.0015	0.00031	0.00012	0.000049	0.000049	0.00094	0.00018	0.00024
Cu	mg/L	0.0013	0.00096	0.007	0.0015	0.0014	0.0012	0.0017	0.011	0.0022	0.0019	0.00079	0.00079	0.011	0.0039	0.046
Fe	mg/L	0.0072	0.0066	0.012	0.020	0.020	0.0061	0.0073	0.030	0.019	0.019	0.0062	0.0062	0.030	0.071	0.43
Pb	mg/L	0.000053	0.000032	0.00062	0.000070	0.000048	0.000042	0.000096	0.00094	0.00016	0.00017	0.000069	0.000069	0.0033	0.00027	0.00077
Li	mg/L	0.0041	0.0039	0.020	0.0073	0.0075	0.0060	0.011	0.030	0.0083	0.0076	0.0044	0.0044	0.030	0.00093	0.0096
Mg	mg/L	10	16	86	19	31	14	18	108	40	55	0.81	0.81	16	1.8	12
Mn	mg/L	0.00090	0.00065	0.29	0.0034	0.059	0.00065	0.0028	0.43	0.013	0.11	0.42	0.42	2.4	0.054	7.5
Hg	mg/L	0.000010	0.0000094	0.0000055	0.000028	0.000028	0.0000088	0.000010	0.0000050	0.000028	0.000027	0.0000088	0.0000088	0.000030	0.000054	0.000029
Mo	mg/L	0.022	0.032	0.026	0.028	0.045	0.0033	0.029	0.011	0.0076	0.0088	0.0030	0.0030	0.027	0.0062	0.0016
Ni	mg/L	0.00044	0.00047	0.0031	0.00054	0.0013	0.00044	0.0016	0.016	0.0033	0.0096	0.00032	0.00032	0.0031	0.00054	0.055
P	mg/L	0.0040	0.0077	0.050	0.097	0.021	0.0026	0.0031	0.050	0.0084	0.0081	0.0045	0.0045	0.05	0.036	0.063
K	mg/L	7.6	9.7	51	9.6	14	6.2	13	64	9.9	12	6.3	6.3	40	3.8	12
Se	mg/L	0.00083	0.00087	0.0060	0.00022	0.00094	0.00079	0.00088	0.0060	0.0018	0.0030	0.000055	0.000055	0.0014	0.00024	0.0016
Si	mg/L	6.2	4.2	23	11	11	4.6	5.2	18	9.2	6.5	14	14	84	6.2	19
Ag	mg/L	0.0000022	0.0000021	0.000062	0.0000056	0.0000057	0.0000018	0.0000028	0.000063	0.000010	0.0000054	0.0000023	0.0000023	0.00011	0.000011	0.000013
Na	mg/L	29	3.7	5.5	6.2	2.7	3.8	30	4.7	5.3	3.3	14	14	12	15	1.7
Sr	mg/L	0.17	0.24	1.5	0.29	0.46	0.25	4.6	20	0.67	1.1	0.014	0.014	0.24	0.042	0.23
S	mg/L	3.0	7.8	34	8.7	53	5.6	25	47	61	199	12	12	22	6.1	62
Tl	mg/L	0.000032	0.00014	0.00028	0.00035	0.00042	0.000075	0.000015	0.00030	0.00022	0.00040	0.000050	0.000050	0.00031	0.00012	0.0011
Sn	mg/L	0.00032	0.00011	0.015	0.00019	0.00026	0.000094	0.00057	0.0044	0.00024	0.00011	0.00012	0.00012	0.0024	0.00040	0.00016
Ti	mg/L	0.00011	0.000082	0.0040	0.00016	0.00017	0.000069	0.000082	0.0053	0.00017	0.00014	0.000058	0.000058	0.019	0.0019	0.00016
U	mg/L	0.091	0.18	0.17	0.086	0.074	0.0047	0.029	0.060	0.0055	0.020	0.00087	0.00087	0.030	0.0020	0.0036
V	mg/L	0.00017	0.00016	0.0082	0.00025	0.00023	0.00011	0.00036	0.013	0.00022	0.00035	0.00012	0.00012	0.014	0.00052	0.00036
Zn	mg/L	0.0011	0.0010	0.031	0.0028	0.0029	0.0013	0.0012	0.031	0.0031	0.0031	0.0031	0.0031	0.031	0.0053	0.30
Ra-226	Bq/L	0.074	0.053	0.066	0.10	0.0072	0.0032	0.0010	0.0027	0.00030	0.011	0.0054	0.0054	0.10	0.011	0.046

5.3 Heap Leach Facility

A cyanide heap leaching facility is planned for extraction and recovery of Au from oxide and transition ore. The ore will be crushed to 80% - 50 mm and stacked on the lined HLF pad using haul trucks in nominal 10 m lifts. The facility will reach a maximum mass (60 Mt) in year 11 of mine life and occupy a footprint of 109 ha. Ore will be leached with lime buffered NaCN solution applied with drip emitters. The leach solution will drain into collection pipes that will direct the pregnant solution to the process plant where precious metals will be recovered. The resulting barren solution will be amended with additional lime and NaCN as required and then recirculated to the heap to continue the leaching cycle. The mass and geologic composition of ore on the HLF at the end of operations is provided in Table 5-17.

Table 5-17:
Lithology, oxidation and source of ore stockpiled in the Heap Leach Facility.

Lithology	Facies	Deposit				
		Latte	Double Double	Kona	Supremo	Total
Gneiss	Oxide (Mt)	0.39	0.53	0.00	37.36	**38.29**
	Transition (Mt)	0.01	0.87	0.00	4.46	**5.34**
	Total	**0.41**	**1.40**	**0.00**	**41.82**	**43.63**
Metabasalt	Oxide (Mt)	0.08	0.03	0.00	0.09	**0.20**
	Transition (Mt)	0.00	0.07	0.00	0.02	**0.09**
	Total	**0.08**	**0.10**	**0.00**	**0.11**	**0.29**
Schist	Oxide (Mt)	8.87	0.00	0.00	0.07	**8.93**
	Transition (Mt)	5.67	0.00	0.00	0.00	**5.68**
	Total	**14.54**	**0.00**	**0.00**	**0.07**	**14.61**
Granite	Oxide (Mt)	0.00	0.00	1.24	0.00	**1.24**
	Transition (Mt)	0.00	0.00	0.38	0.00	**0.38**
	Total	**0.00**	**0.00**	**1.63**	**0.00**	**1.63**
All	**Total**	**15.03**	**1.50**	**1.63**	**42.00**	**60.15**

Following final leaching for gold recovery, heap closure will be initiated which involves the following steps:

- Recirculation rinsing leached ore with barren solution to facilitate CN volatilization and export in drainage;

- Capping of the HLF with geosynthetic clay liner (GCL) and a store-and-release component overlying the GCL for the flat surfaces of the heap and a store-and-release cover for the slopes;
- Passive treatment of drainage to serve as a final polishing step of HLF drainage as contingency (*e.g.,* zero valent iron, coarse organic composted wood chips from tree clearing, suitable geologic material).

During operations and early closure, discharge of any excess HLF solution will undergo active treatment prior to release to the Alpha Pond and ultimately, Halfway Creek. Active treatment will include cyanide destruction, physico-chemical treatment and nitrate removal and final metal polishing using a biological system termed the Electrochemical Biological Reactor (EBR) system. Once active treatment is terminated and closure of the HLF is completed and stabilized, it may be necessary to direct residual HLF seepage waters through the events ponds converted to passive systems prior to discharge to Halfway Creek.

The chemistry of HLF pore water and drainage will vary depending on the stage of mine life. To reflect this, geochemical source terms have been developed over the life of operations.

5.3.1 Process Water

5.3.1.1 Approach

During mine operations, HLF solution will be dominantly pregnant/barren solution with some amount of meteoric water. Later in the mine life the HLF pore water will be a combination of pregnant solution and rinse water from areas where recirculation rinsing has been initiated. For the purpose of predicting an operations source term, it is assumed that all HLF pore water is barren solution during operations. The processing of heap leach ore for the Project will entail the use of cyanide solutions under pH conditions ranging between pH 10.0 and 11.0. While the dissolution of gold is the primary objective during cyanide leaching, other metals are liberated during the leaching process, both as a result of complexation reactions with cyanide (*e.g.* Cu-CN, Cd-CN, Zn-CN) and increased solubility under elevated pH conditions (*e.g.* As and U). The chemistry of barren solutions is estimated based on the final water quality measured in metallurgical cyanide leach columns (Table 4-56). The HLF solution chemistry representing different ore types is weighted proportional to the mass of the different ore types that will be in the HLF in the final year of mine life (Table 5-17).

5.3.1.2 Data Sources

The composition of process water is estimated based on water quality samples collected from 26 metallurgical columns. These tests are described in Section 3.2.7 and water quality results are provided in section Table 4-56.

5.3.1.3 Data Scaling

The chemistry observed in metallurgical columns are weighted based on the proportion of ore types in the HLF in a given year (Figure 5-12). For instance, in transition material from the Supremo pit constitutes approximately 7.5% of the ore in the HLF, hence, the chemistry observed in CN leach columns (columns 73040 and 73037). In this way, the operations source term for the HLF evolves as the composition of ore on the pad changes with time. For the purpose of water quality predictions, the maximum concentration observed for a given lithology or weathering type is used in the upper source term and the mean concentration is used for the base case source term.

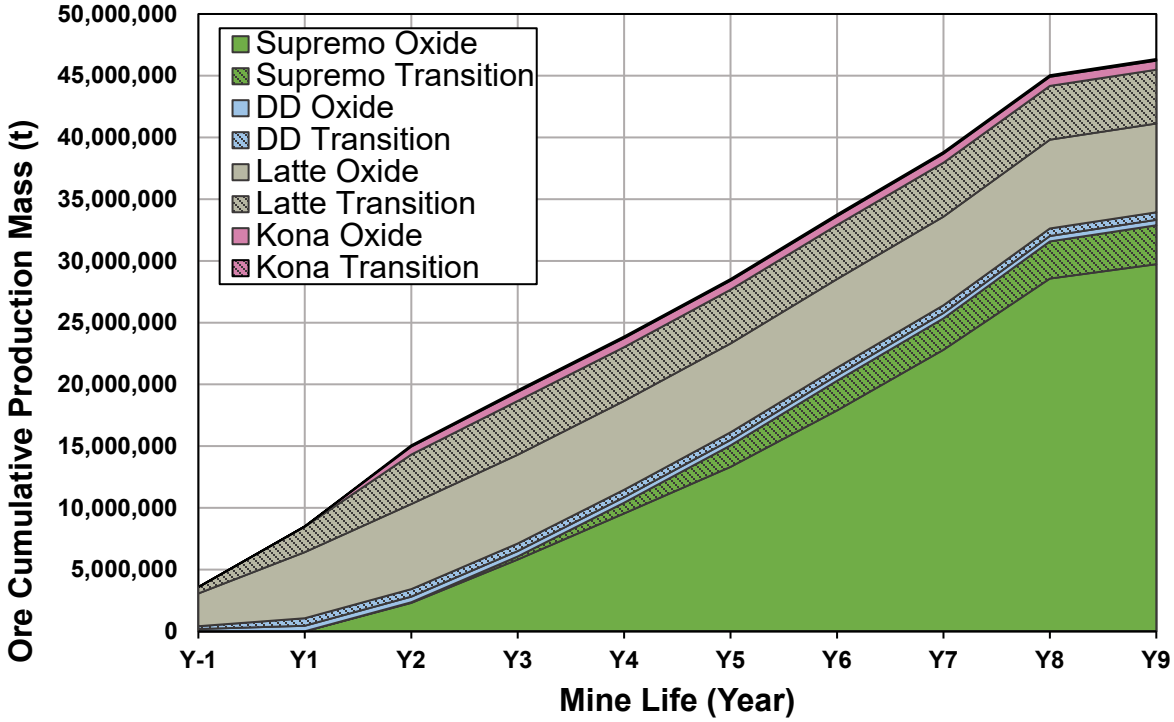


Figure 5-12: Mass and geologic composition of HLF over mine life

5.3.1.4 Solubility Controls

The operations source term is based on concentrations measured in metallurgical leach column tests. Since this source term is based on averaging measured concentrations rather than upscaling kinetic test loading rates, concentrations generally do not exceed

thermodynamic solubility constraints. The only parameter predicted based on a solubility calculation is ^{226}Ra as it was only measured in 2 of the 26 metallurgical columns (See Table 4-56). Therefore, the concentration of ^{226}Ra is calculated using the same approach described in Section 5.1.4.3.

5.3.2 Source Term

The operations source term representing process water that will be present in the HLF for years 1 through 9 are shown in Table 5-18 and Table 5-19 for the upper case and base case scenarios. This source term is based on water quality data collected in metallurgical column tests.

Table 5-18:
Base Case Source Term Predictions for HLF During Operations

	Year	1	2	3	4	5	6	7	8	9
T-CN	mg/L	132	134	134	135	136	136	136	136	136
Sulphate	mg/L	1245	1121	933	783	677	587	516	455	444
P	mg/L	0.12	0.17	0.21	0.24	0.27	0.28	0.29	0.31	0.31
WAD-CN	mg/L	127	128	129	130	131	131	132	132	132
Al	mg/L	0.054	0.089	0.10	0.11	0.12	0.13	0.13	0.13	0.14
Ag	mg/L	0.00056	0.00045	0.00041	0.00038	0.00035	0.00033	0.00032	0.00031	0.00031
As	mg/L	3.4	5.4	5.0	4.7	4.5	4.3	4.0	3.8	3.8
Ca	mg/L	77	75	64	54	46	40	36	32	31
Cd	mg/L	0.0031	0.0036	0.0043	0.0047	0.0050	0.0052	0.0055	0.0057	0.0058
Co	mg/L	0.59	0.58	0.57	0.56	0.55	0.55	0.54	0.53	0.53
Cr	mg/L	0.0053	0.0077	0.010	0.012	0.013	0.014	0.015	0.016	0.016
Cu	mg/L	2.2	2.0	1.8	1.6	1.5	1.3	1.3	1.2	1.2
Fe	mg/L	2.0	2.3	2.1	1.8	1.7	1.6	1.5	1.4	1.4
Hg	mg/L	0.0046	0.0051	0.0058	0.0063	0.0065	0.0068	0.0071	0.0073	0.0073
Mg	mg/L	2.2	2.1	1.8	1.6	1.4	1.2	1.1	1.0	1.0
Mn	mg/L	0.30	0.27	0.24	0.22	0.21	0.19	0.18	0.17	0.17
Mo	mg/L	0.11	0.12	0.15	0.17	0.18	0.19	0.20	0.21	0.21
Ni	mg/L	0.019	0.019	0.019	0.020	0.020	0.020	0.020	0.021	0.021
Pb	mg/L	0.00022	0.00022	0.00021	0.00020	0.00019	0.00018	0.00017	0.00017	0.00017
Sb	mg/L	0.078	0.086	0.081	0.079	0.078	0.076	0.072	0.070	0.070
Se	mg/L	0.0078	0.0072	0.0063	0.0056	0.0052	0.0047	0.0044	0.0041	0.0040
Tl	mg/L	0.000046	0.000048	0.000047	0.000045	0.000044	0.000043	0.000043	0.000042	0.000042
U	mg/L	0.0050	0.088	0.13	0.16	0.18	0.19	0.21	0.22	0.22
Zn	mg/L	0.80	0.74	0.69	0.64	0.60	0.58	0.56	0.54	0.54
Ra-226	Bq/L	0.0043	0.0084	0.011	0.014	0.016	0.018	0.020	0.022	0.023

Table 5-19:
Upper Case Source Term Predictions for HLF During Operations

	Year	1	2	3	4	5	6	7	8	9
T-CN	mg/L	152	157	160	161	163	164	165	166	166
Ammonia-N	mg/L	86	86	85	84	83	82	82	82	82
Nitrate-N	mg/L	0.60	0.76	0.90	0.98	1.0	1.1	1.2	1.2	1.2
Nitrite-N	mg/L	1.2	1.1	1.0	0.99	0.95	0.93	0.90	0.89	0.88
Sulphate	mg/L	1407	1272	1065	900	784	686	607	539	528
P	mg/L	0.16	0.30	0.43	0.53	0.61	0.67	0.72	0.76	0.77
WAD-CN	mg/L	149	153	156	158	159	161	162	163	163
Al	mg/L	0.072	0.14	0.18	0.21	0.23	0.24	0.26	0.27	0.27
Ag	mg/L	0.00090	0.00085	0.00089	0.00092	0.00093	0.00095	0.00097	0.00099	0.00099
As	mg/L	5.1	7.5	7.3	7.2	7.1	6.9	6.7	6.6	6.6
Ca	mg/L	100	105	96	87	80	75	72	69	68
Cd	mg/L	0.0059	0.010	0.015	0.018	0.020	0.022	0.024	0.025	0.026
Co	mg/L	0.76	0.83	0.89	0.92	0.95	0.97	0.99	1.0	1.0
Cr	mg/L	0.0063	0.013	0.019	0.024	0.027	0.030	0.033	0.035	0.035
Cu	mg/L	3.4	3.2	3.0	2.7	2.6	2.4	2.4	2.3	2.3
Fe	mg/L	2.4	2.9	2.7	2.5	2.3	2.2	2.1	2.0	2.0
Hg	mg/L	0.0060	0.014	0.022	0.027	0.031	0.034	0.037	0.040	0.040
Mg	mg/L	3.3	3.3	2.8	2.5	2.2	2.0	1.8	1.7	1.7
Mn	mg/L	0.67	0.64	0.59	0.55	0.52	0.49	0.47	0.45	0.45
Mo	mg/L	0.13	0.17	0.21	0.25	0.27	0.29	0.31	0.32	0.32
Ni	mg/L	0.025	0.044	0.063	0.075	0.084	0.092	0.099	0.11	0.11
Pb	mg/L	0.00033	0.00034	0.00033	0.00031	0.00030	0.00030	0.00029	0.00028	0.00028
Sb	mg/L	0.13	0.14	0.14	0.14	0.15	0.15	0.14	0.14	0.14
Se	mg/L	0.0093	0.0091	0.0084	0.0078	0.0074	0.0071	0.0068	0.0066	0.0065
Tl	mg/L	0.000066	0.000077	0.000083	0.000086	0.000089	0.000091	0.000093	0.000095	0.000095
U	mg/L	0.0074	0.17	0.28	0.36	0.41	0.46	0.49	0.52	0.53
Zn	mg/L	1.5	1.4	1.4	1.3	1.3	1.2	1.2	1.2	1.2
Ra-226	Bq/L	0.0086	0.015	0.018	0.021	0.024	0.027	0.029	0.032	0.032

5.4 Mine Facilities Area

The mine facilities area will be constructed using inorganic overburden excavated from within or near the mine facilities area footprint. This pad has a footprint of approximately 7 ha, and will host the plant site area, mine camp and other mine infrastructure. The mine facilities area will be reclaimed at the end of active closure, hence, the source term only exists during operations and active closure time periods.

5.4.1 Approach

Overburden from the mine facilities areas has been characterized by ABA, SFE and total metals analysis, as described in Section 4.4. The ABA results demonstrate that the mine site overburden is highly weathered. This is shown by the relative absence of carbonate or sulphide mineralization, and the circumneutral to mildly acidic rinse-pH values ($5.2 \leq$ pH ≤ 8.9; median = 7.2), which is slightly higher than the pH of rainwater (~pH 5.6). Due to the overall general lack of neutralizing or acid generating minerals in the samples, mine site overburden can be classified as non-PAG. The absence of sulphide mineralization shows that oxidation of the overburden material will not lead to release of metals or acidity, however, exposure of previously buried mineral surfaces may lead to rinsing of soluble metals by infiltrating meteoric waters.

5.4.2 Data Sources

The potential for metal leaching from rinsing of freshly exposed surfaces is measured by SFE testwork. Specifically, SFE tests conducted on 11 overburden samples collected from test pits on the plantsite and HLF area, as show in Figure 3-1. These samples include (test pit IDs) SRK-15TP-03, SRK-15TP-05, SRK-15TP-11, SRK-15TP-14, SRK-15TP-15, SRK-15TP-17, SRK-15TP-22, SRK-15TP-24, SRK-15TP-41, SRK-15TP-43 and SRK-15TP-46.

5.4.3 Solubility Controls

The minesite area source term is based on measured concentrations and not upscaled form kinetic test data, hence, thermodynamic solubility controls are generally not exceeded, and few solubility controls are required. The solubility of ^{226}Ra was calculated for the mine facilities area using the approach described in Section 5.1.4.3. The only other parameters which were set to solubility controls are Al and Fe. Iron and Al are sparingly water soluble under neutral pH and aerobic conditions but were observed in relatively high values in SFE tests (median of 0.505 mg/L and 0.715 mg/L, respectively). Accordingly, the high Al and Fe values are likely caused by fine suspended solids carried through the 0.45µm filter during the extraction experiment. The concentration of these elements was set to the

median and 75th percentile observed in gneiss oxide field bin for the base case and upper case source terms.

5.4.4 Source Term

The upper case and base case source terms for the mine facilities is presented in Table 5-20 below. The mine facilities area source term is constant throughout life of mine (LOM).

Table 5-20:
Base Case and Upper Case Source Term Predictions for Mine Facilities Area

Parameter	Units	Base Case	Upper Case
Sulphate	mg/L	0.25	0.86
P	mg/L	0.025	0.025
Al	mg/L	0.017	0.048
Ag	mg/L	0.000025	0.000061
As	mg/L	0.0023	0.0034
Ca	mg/L	0.94	1.4
Cd	mg/L	0.000025	0.000050
Cr	mg/L	0.0029	0.0035
Cu	mg/L	0.0052	0.0074
Fe	mg/L	0.030	0.044
Hg	mg/L	0.000025	0.000050
Mg	mg/L	0.35	0.51
Mn	mg/L	0.054	0.081
Mo	mg/L	0.0011	0.0015
Ni	mg/L	0.0022	0.0031
Pb	mg/L	0.00070	0.0011
Sb	mg/L	0.00025	0.00027
Se	mg/L	0.00025	0.00050
Tl	mg/L	0.000050	0.00010
U	mg/L	0.0016	0.0024
Zn	mg/L	0.0050	0.010
Ra-226	Bq/L	0.012	0.018

6. Closure

We trust that this Report meets your present requirements. Please let us know if you have any questions or comments.

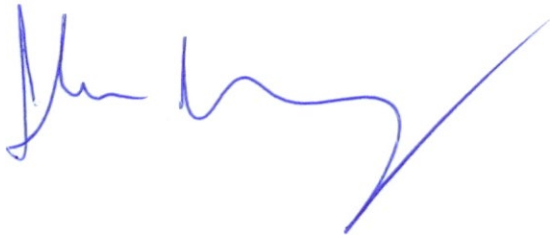
Respectfully submitted,
Lorax Environmental Services Ltd.

Authored By:



Stephanie Simpson, M.Sc.
Environmental Geoscientist

Authored and Reviewed By:



John Dockrey, M.Sc., P.Geo.
Environmental Geochemist

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Appendix A: Geological Cross Sections

GOLDCORP

582,000
583,000
584,000
585,000
6,975,000
6,974,000
6,973,000

N

18
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14
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11
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6
5
4
3
2
1

North WRSF
West WRSF
Supremo Pit
Latte Pit
Double Double Pit
South WRSF

LEGEND

- Drill Collars
- Section Lines

Proposed Mine Infrastructure

- Pits
- WRSF
- Watercourses
- Waterbodies
- Surface Contours (20m)

Coordinate System: *NAD 1983 UTM Zone 7N*
Projection: *Transverse Mercator*
Datum: *North American 1983*
Units: *Meter*

1:12,500

0 200 400 Meters

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE:

Plan View

PROJECT #: A362-4

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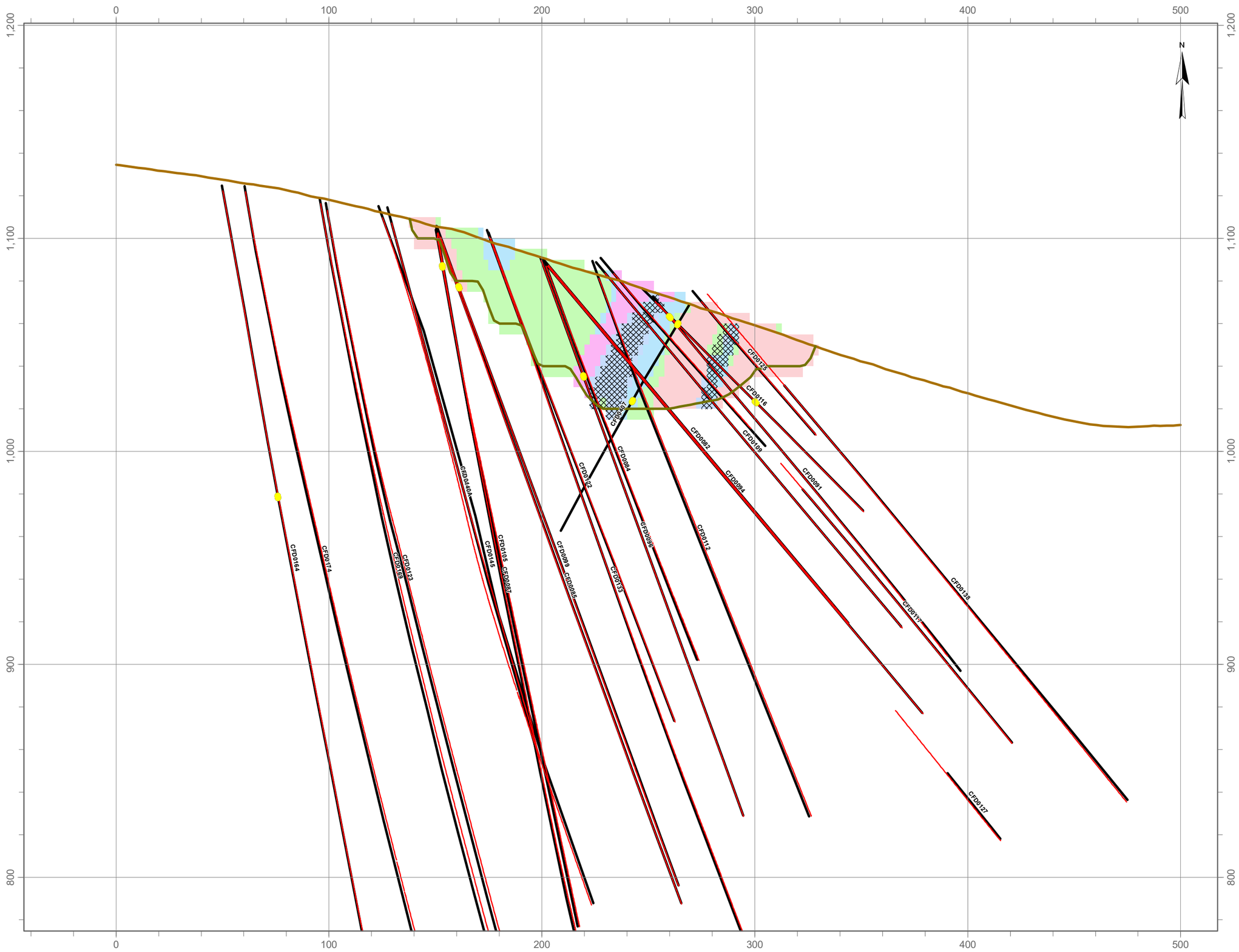

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	Feb 18, 2016
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KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE:

Section 1

PROJECT #: A362-4

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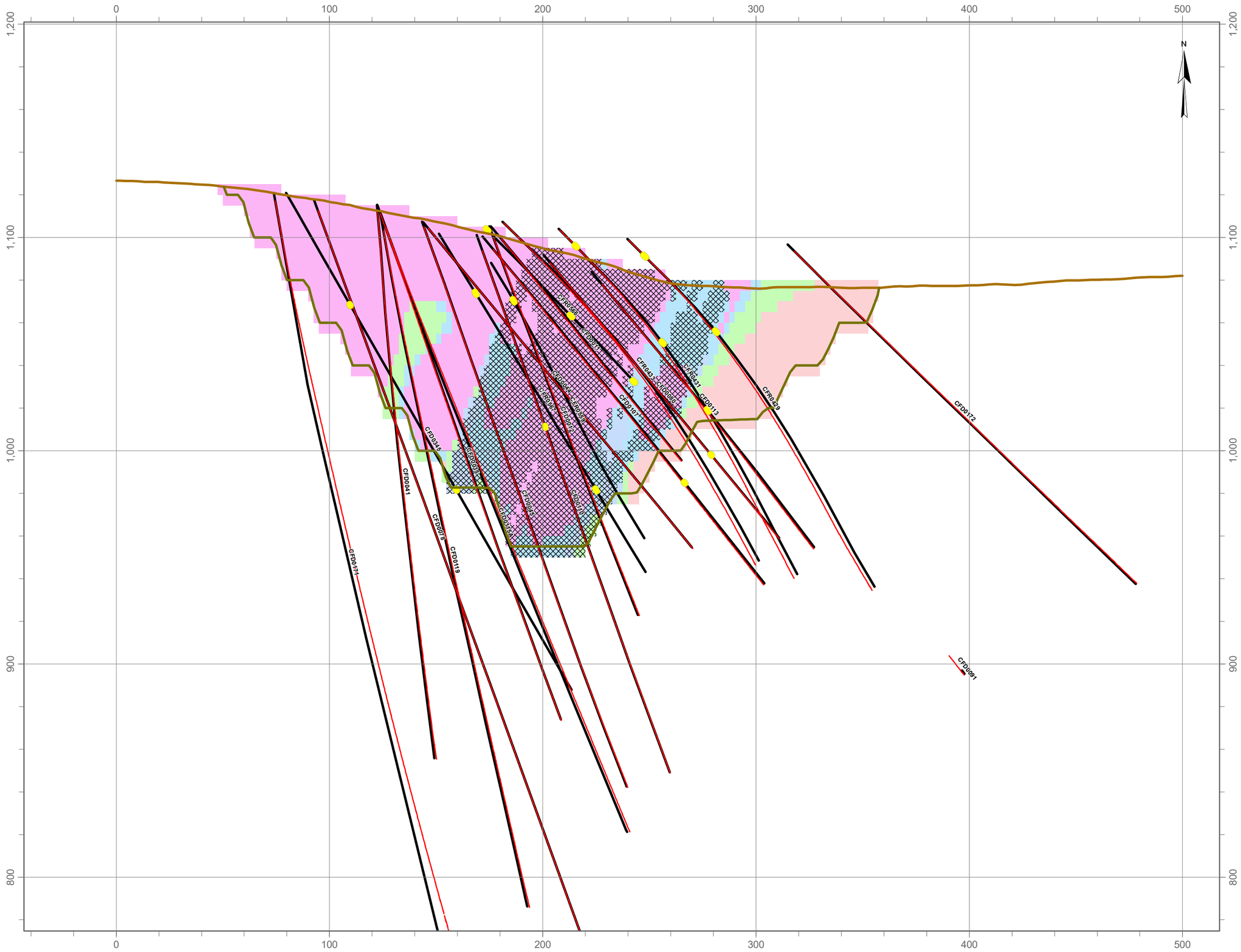

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	Feb 18, 2016
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PROJECT:

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TITLE:

Section 2

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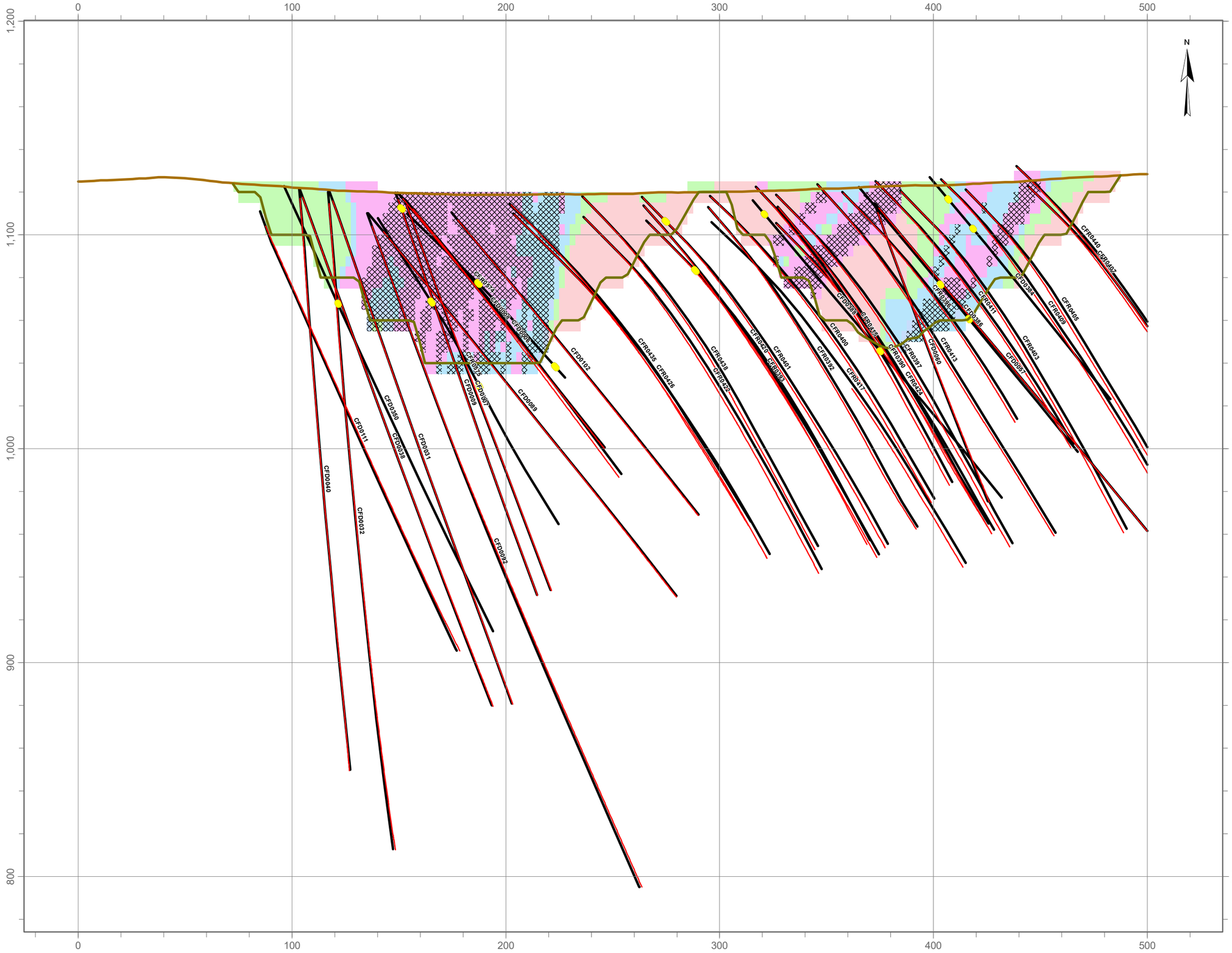

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	Feb 18, 2016
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CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE:

Section 3

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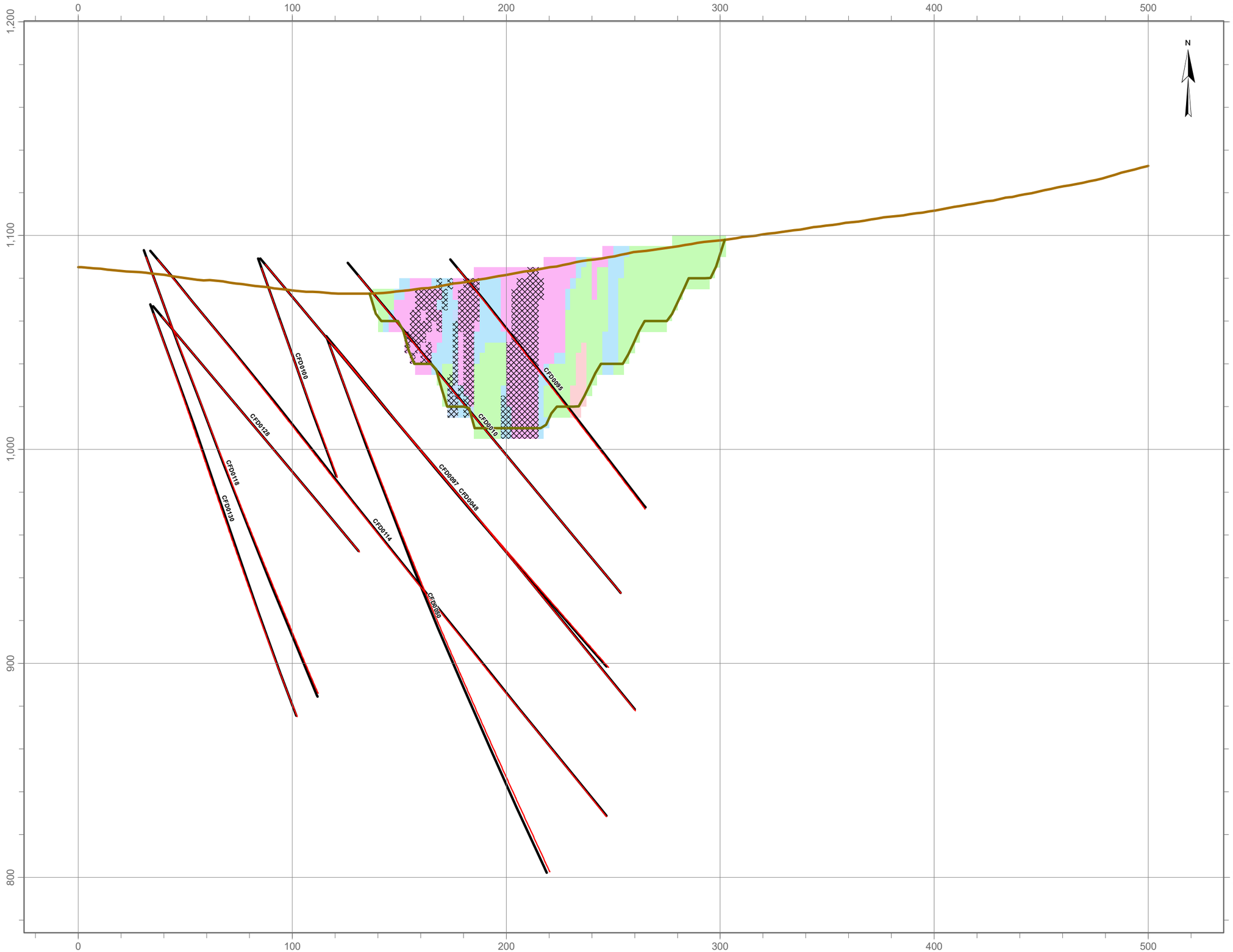

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

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PROJECT:

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TITLE:

Section 4

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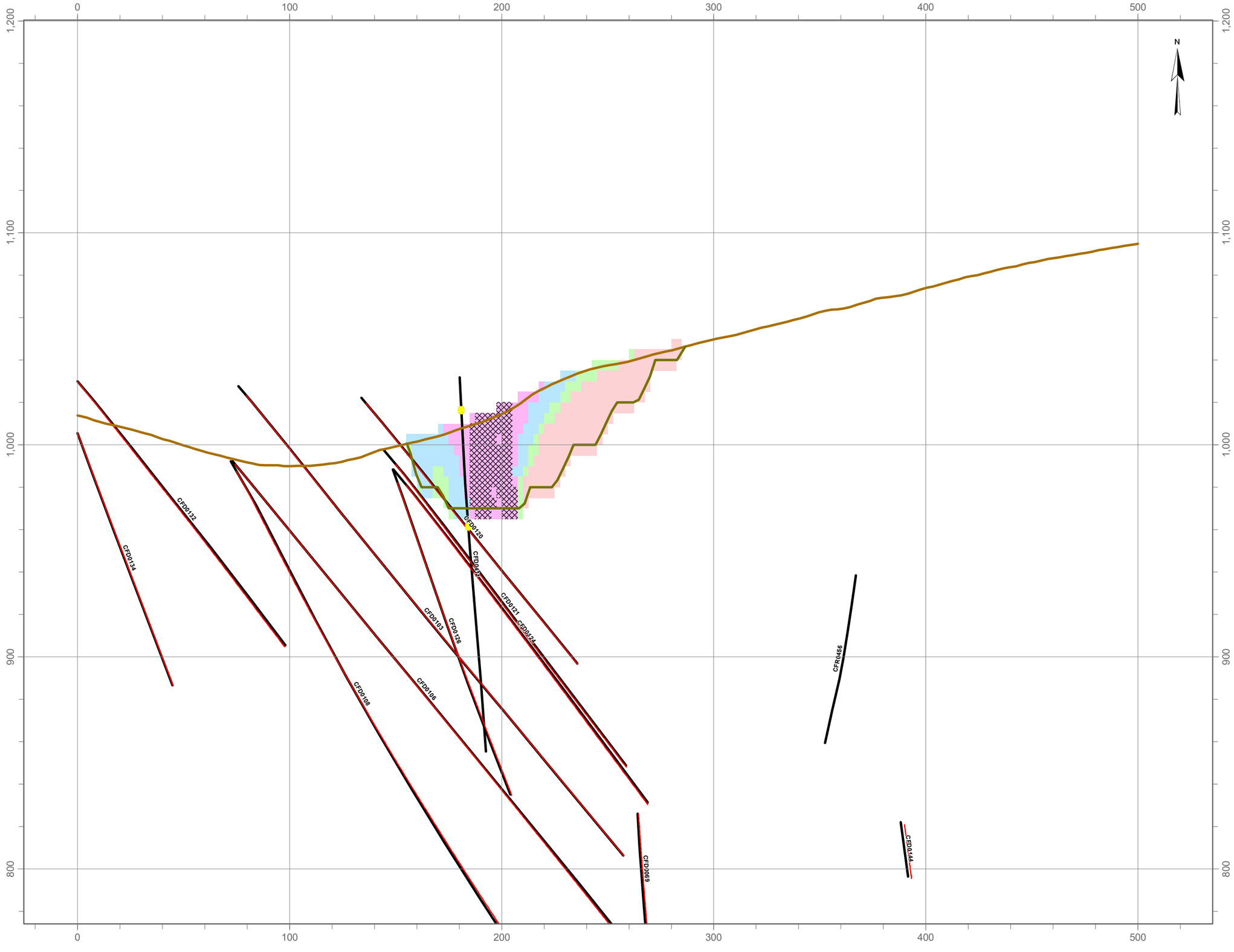

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	Feb 18, 2016
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KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

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TITLE:

Section 5

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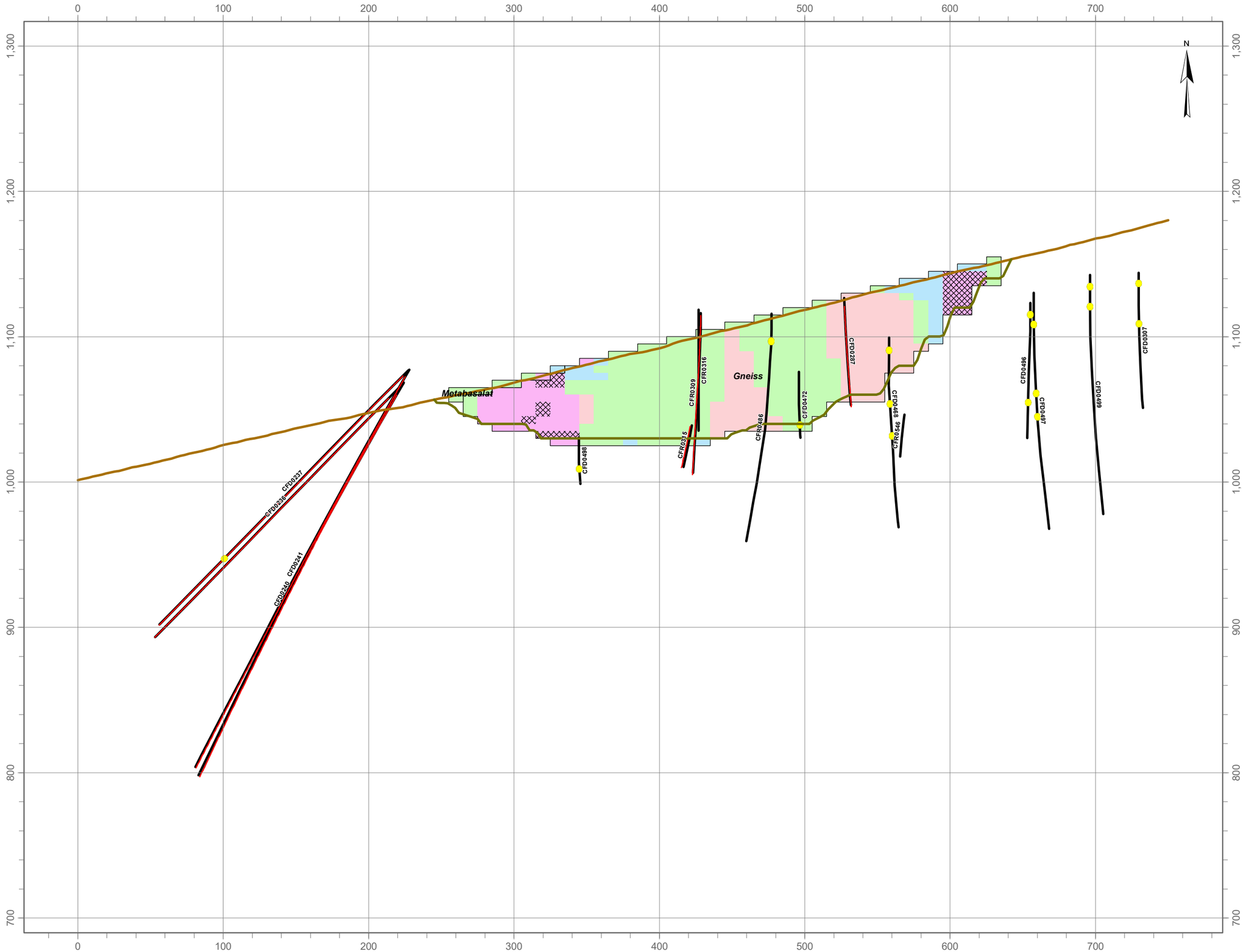

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone
- Lithology Boundary

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:2,500

0 20 40 Meters

DATE SAVED:	Feb 18, 2016
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CLIENT:

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LORAX ENVIRONMENTAL

PROJECT:

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TITLE:

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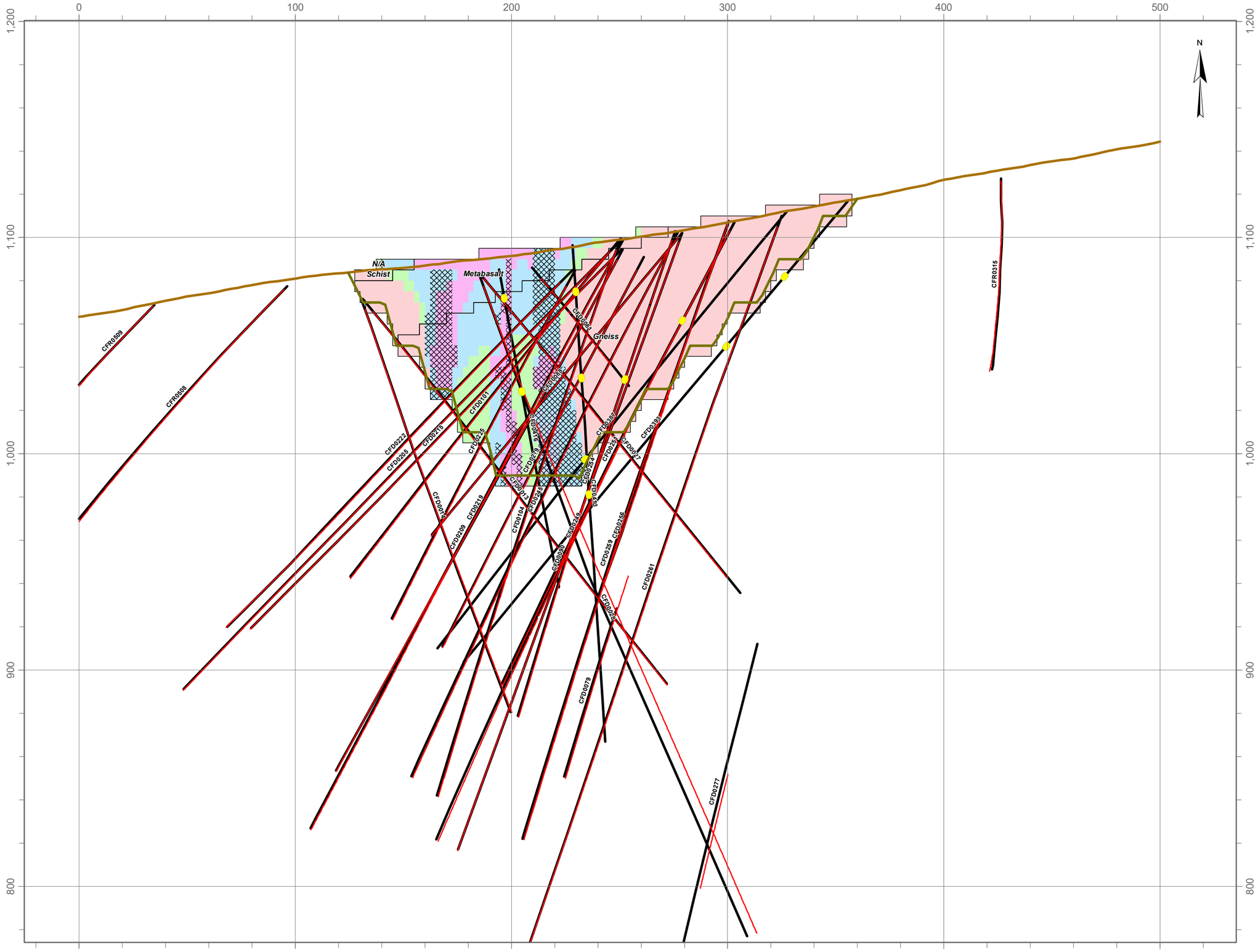

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone
- Geology Boundary

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	May 10, 2016
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CLIENT:

KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT:

Coffee Gold Project

TITLE:

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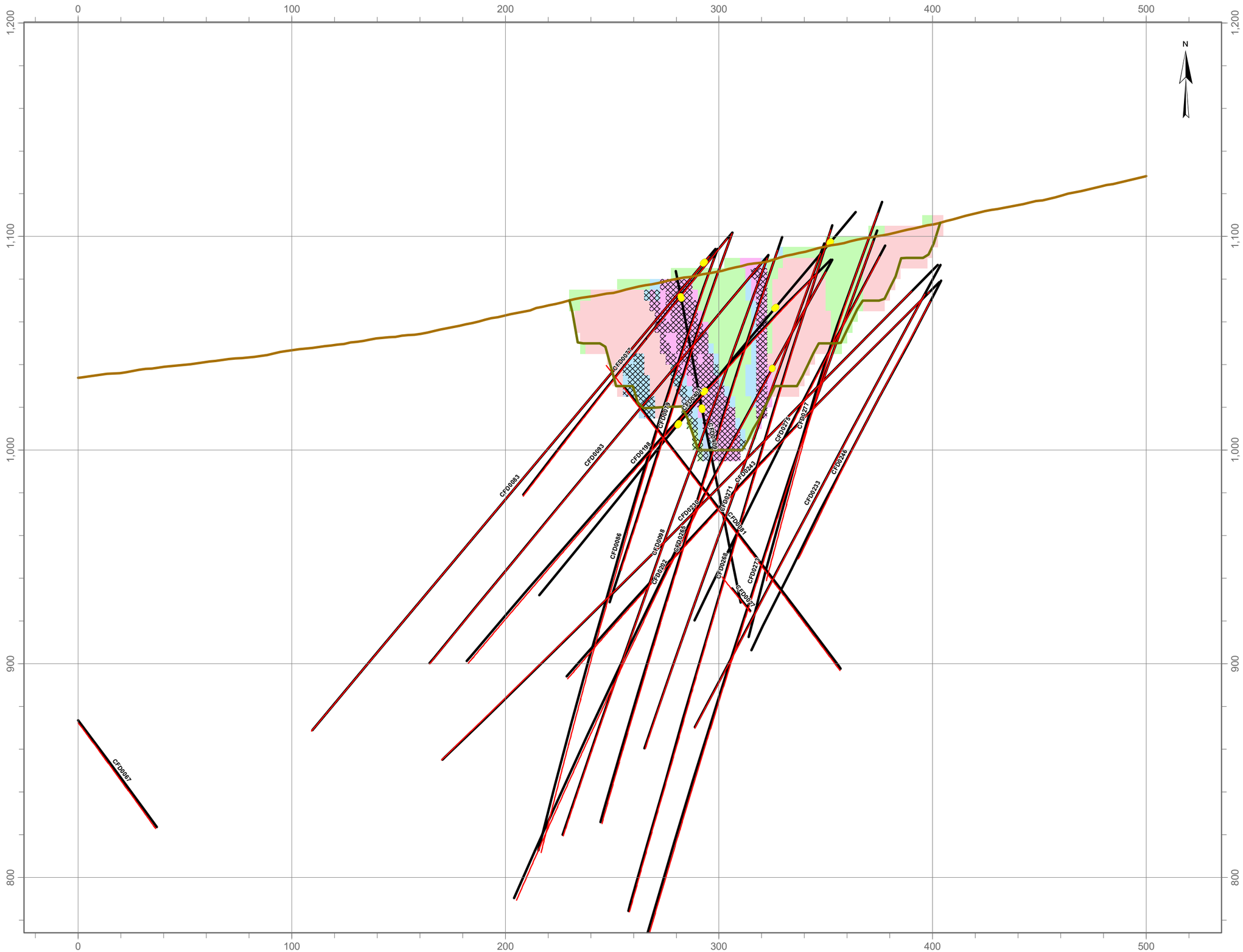

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

1:1,700

0 20 40 Meters

DATE SAVED:	May 10, 2016
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KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

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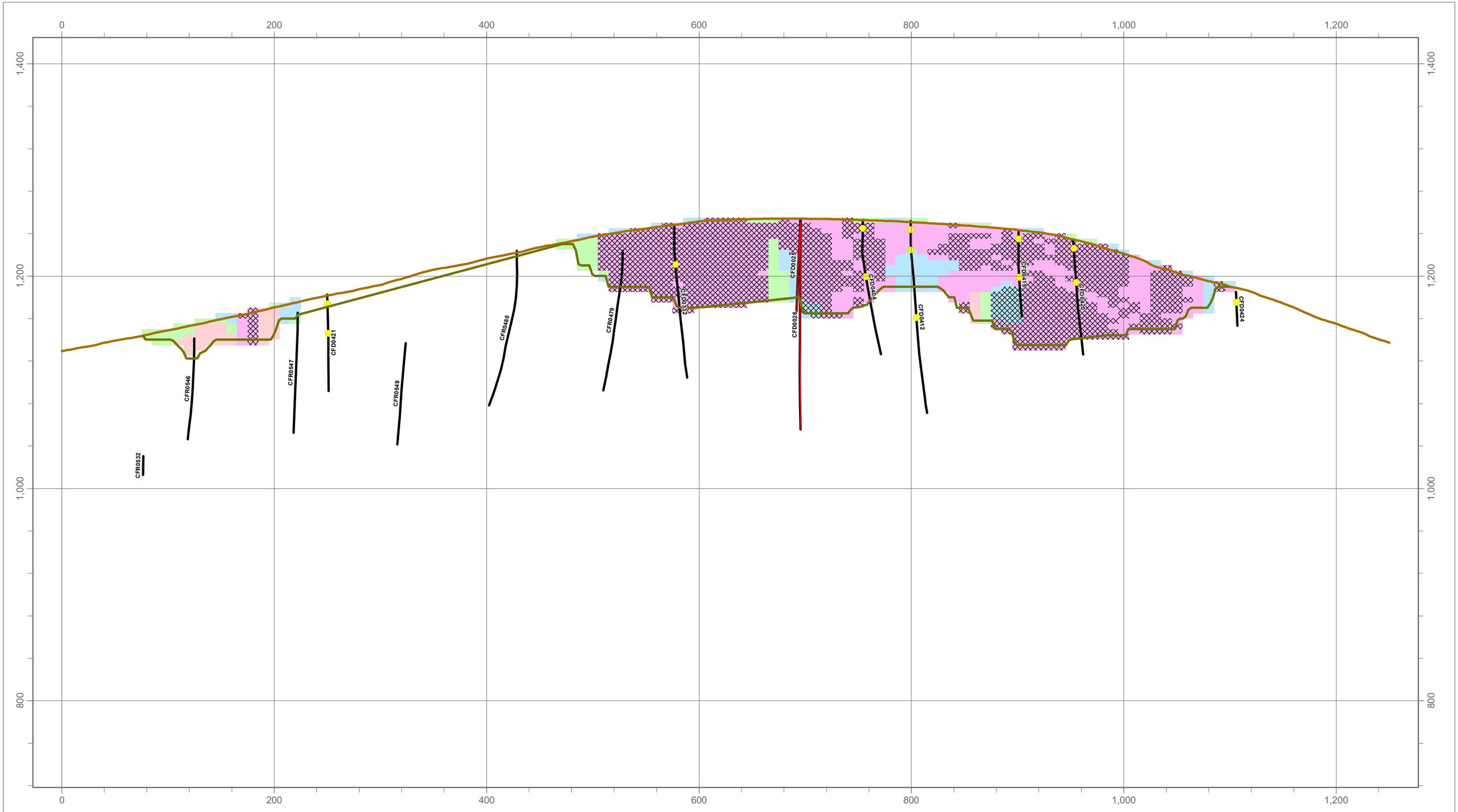

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
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1:3,250

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 09

PROJECT #: A362-1

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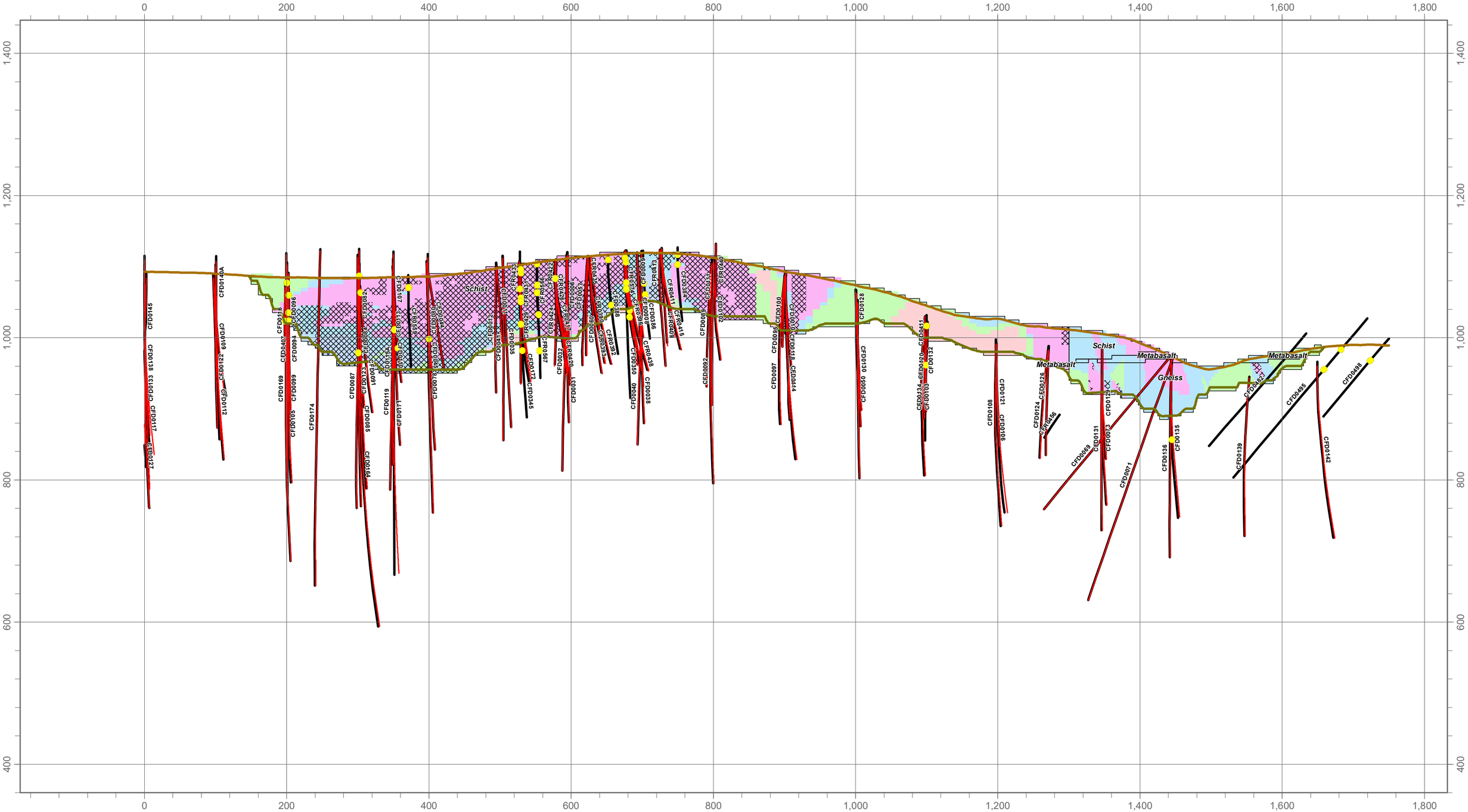

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Lithology Boundary
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
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1:5,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 10

PROJECT #: A362-1

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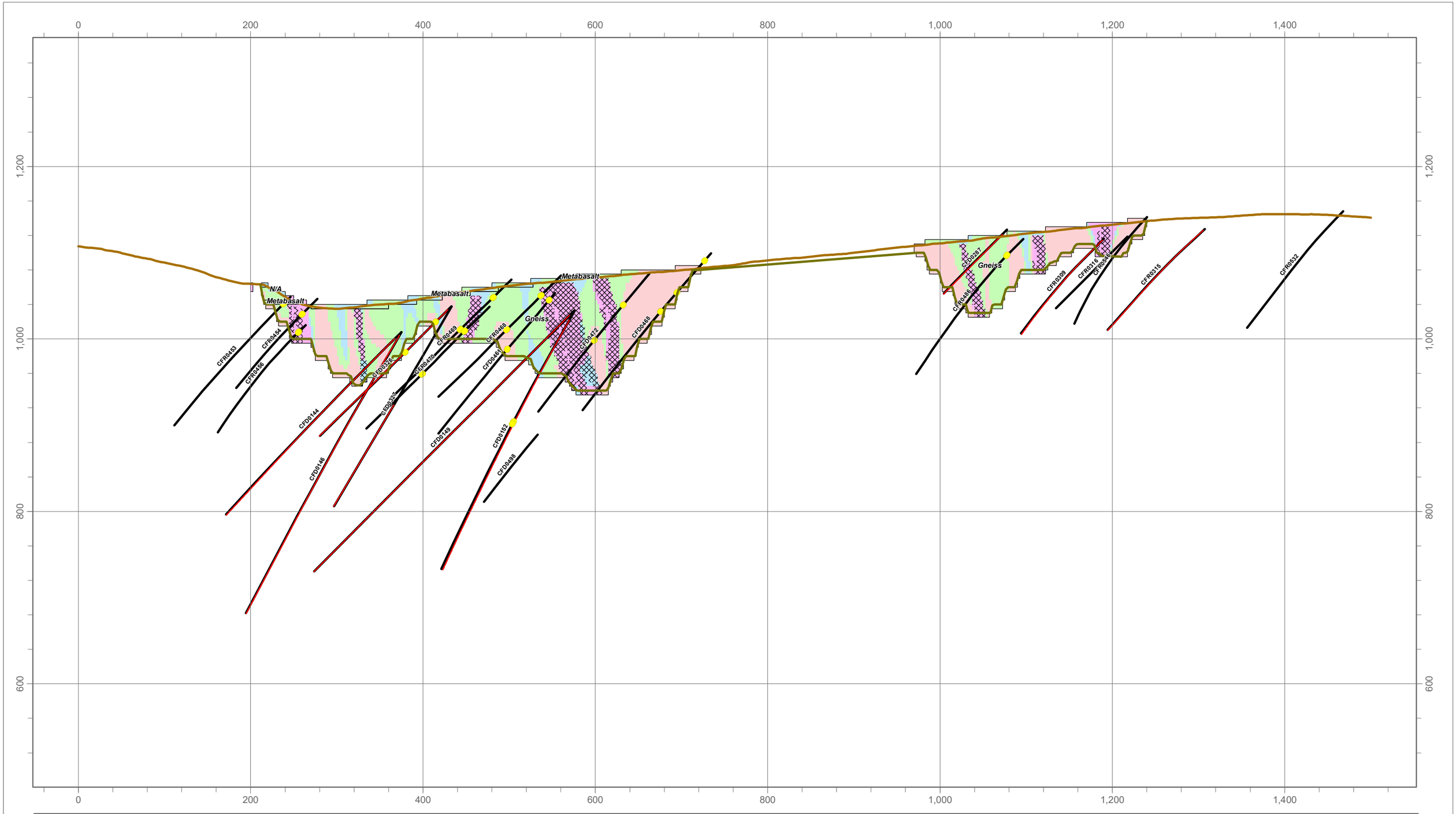

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone
- Geology Boundary

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 11

PROJECT #: A362-1

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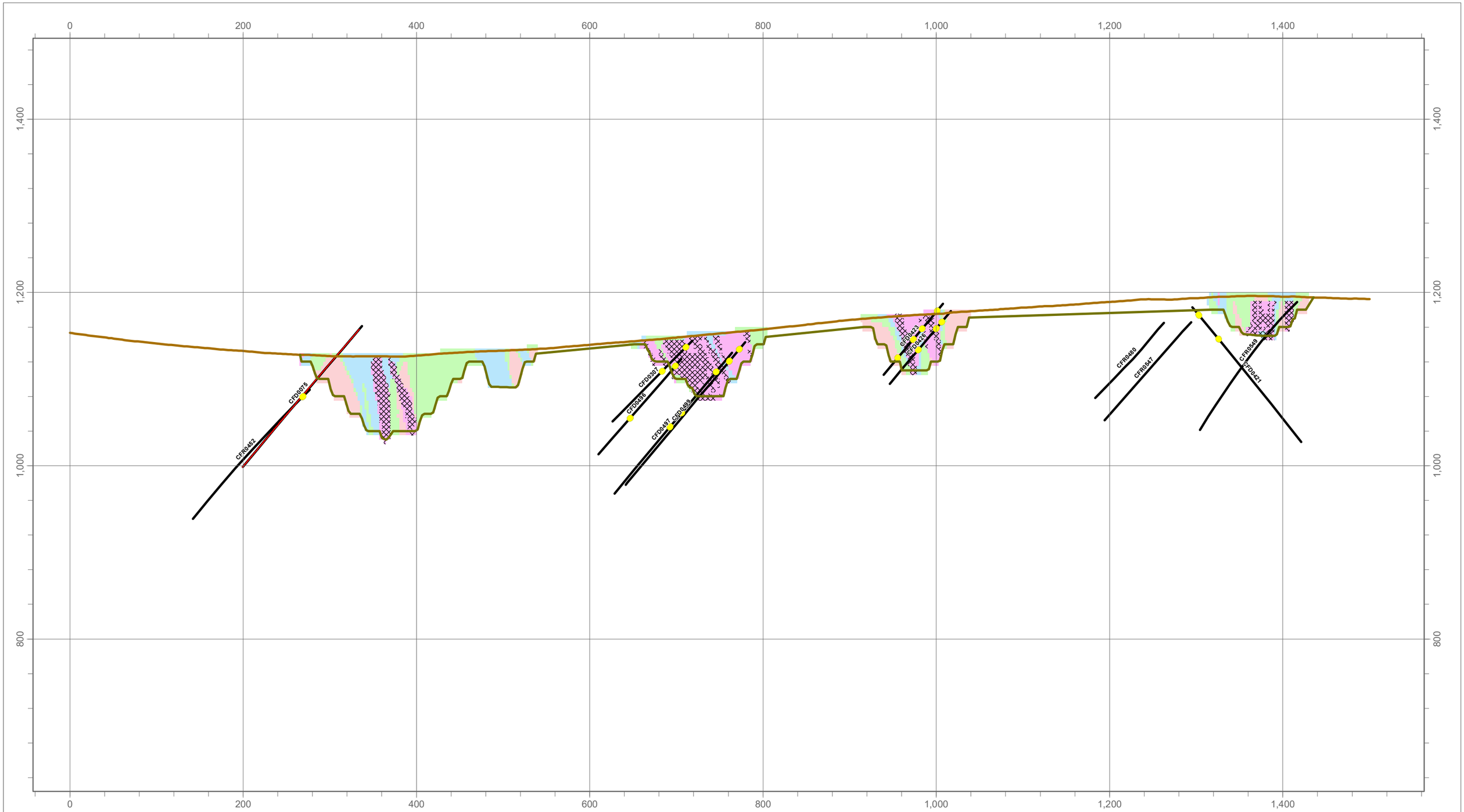

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 12

PROJECT #: A362-1

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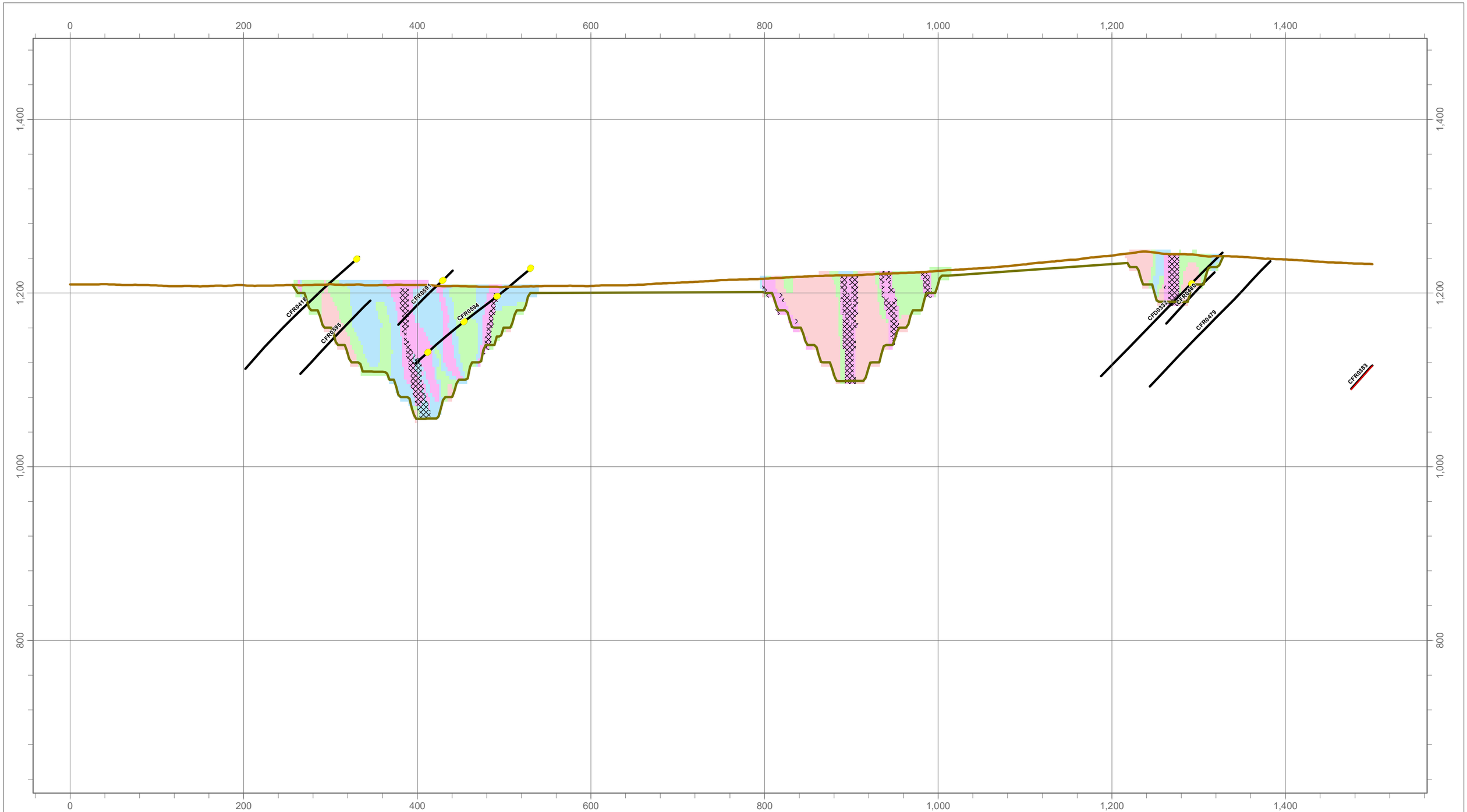

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

0 50 100

Meters

CLIENT: KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 13

PROJECT #: A362-1

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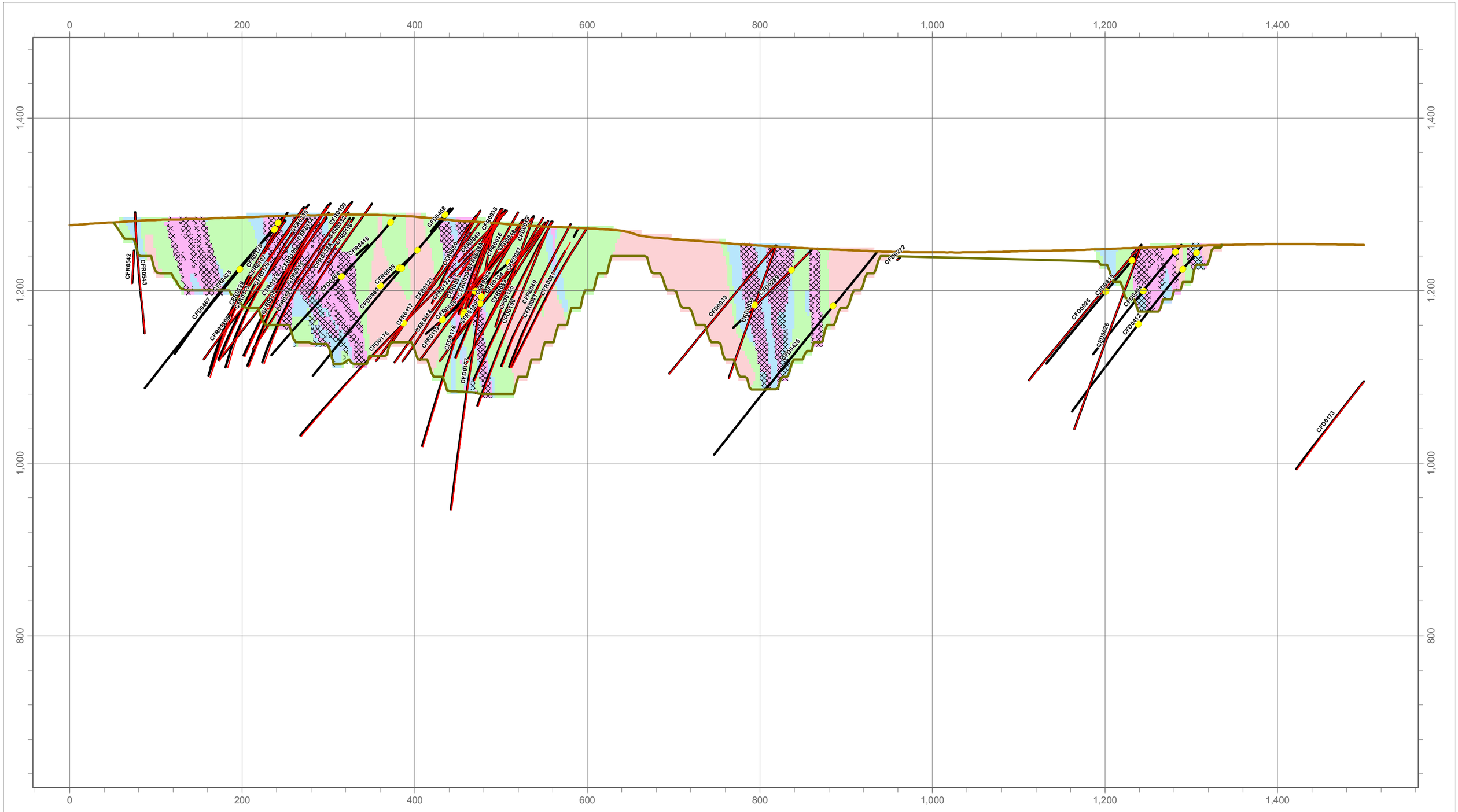

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

1:4,000

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Meters

CLIENT: KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 14

PROJECT #: A362-1

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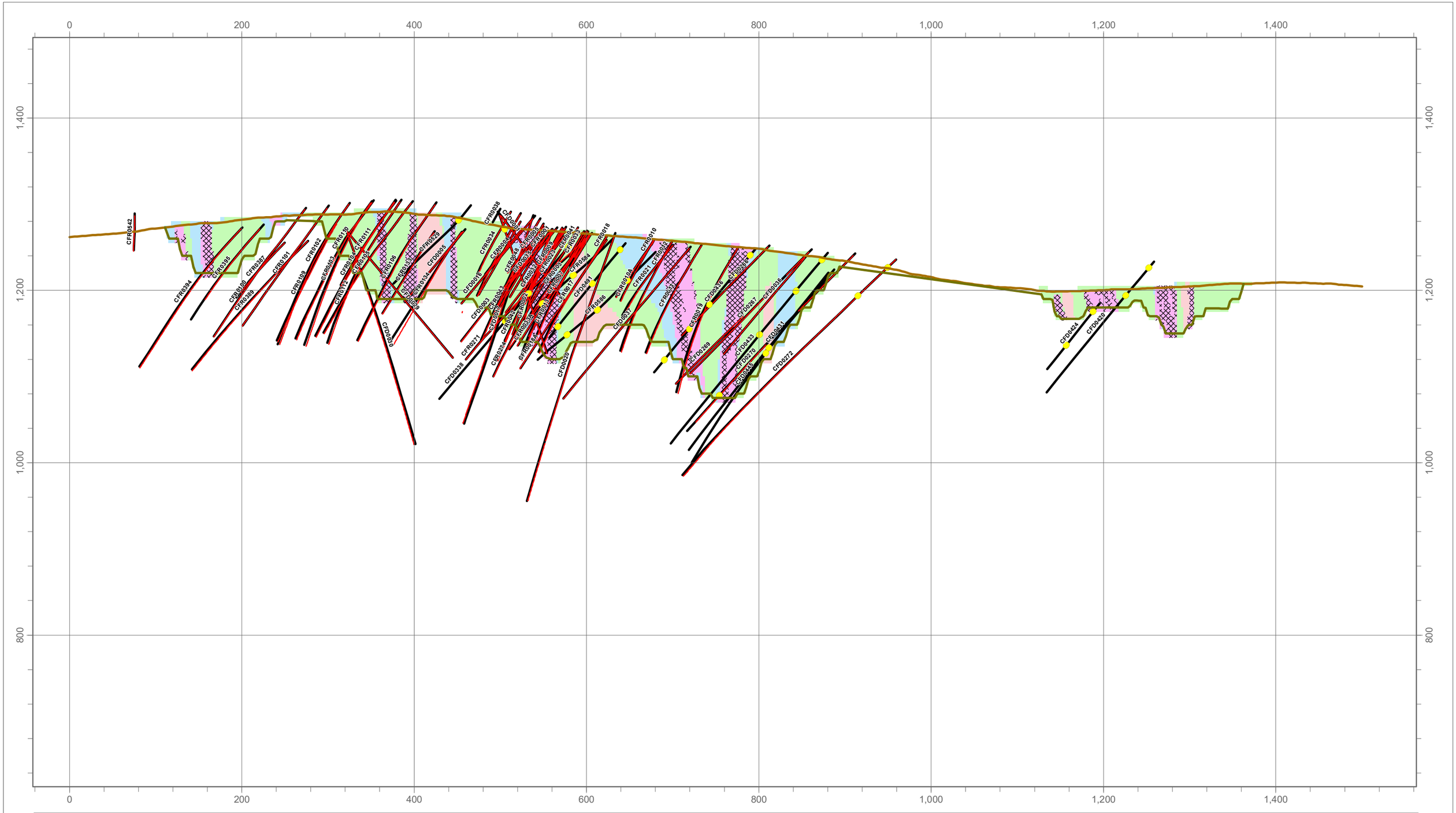
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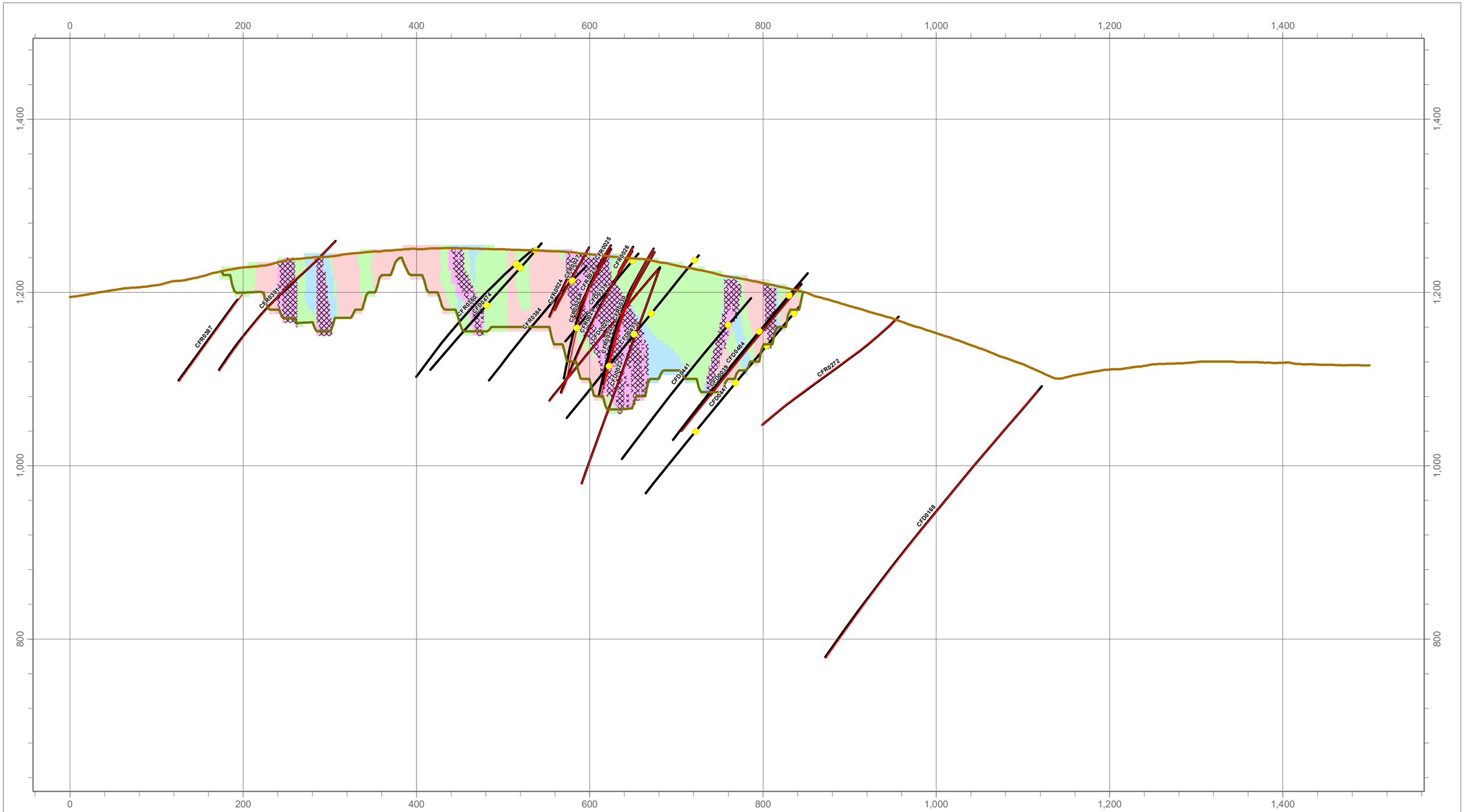

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

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Meters

CLIENT: KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 16

PROJECT #: A362-1

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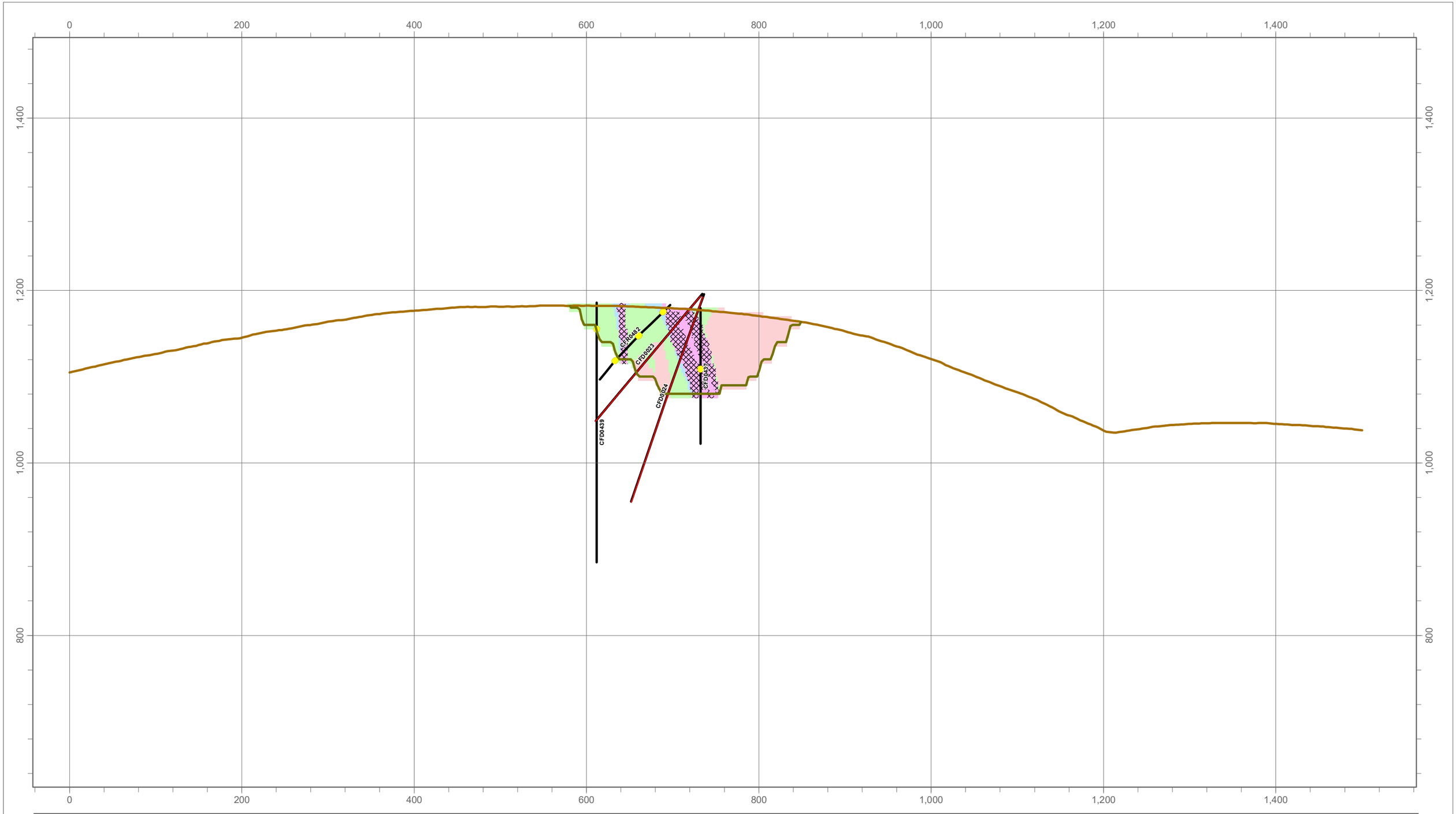

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

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CLIENT: KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 17

PROJECT #: A362-1

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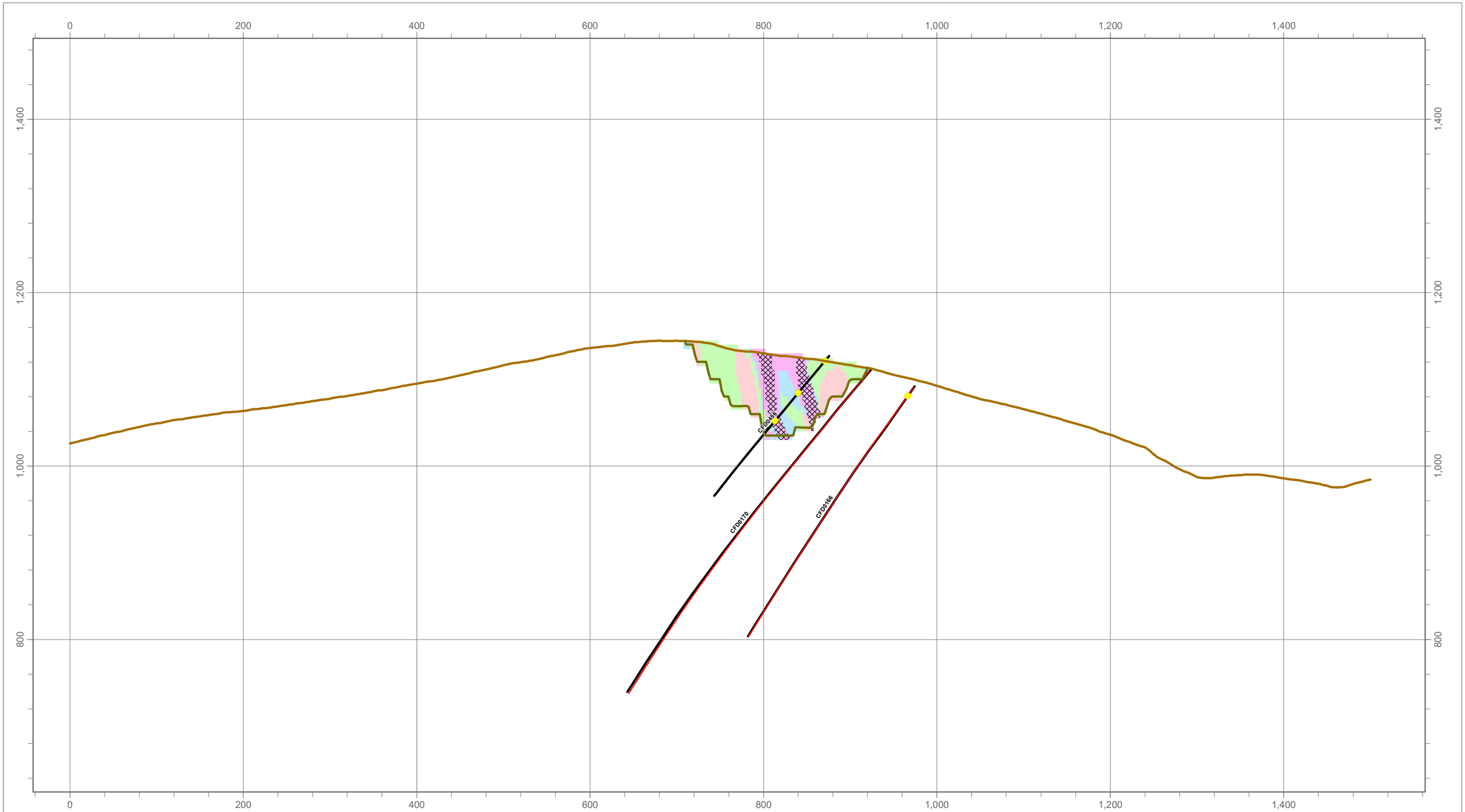

LEGEND

- Original Ground
- Pit
- ABA Samples
- ICP Samples
- Drillholes
- Ore Zone

Weathering

- Oxide
- Upper Transition Zone
- Middle Transition Zone
- Lower Transition Zone
- Sulphide

DATE SAVED:	Feb 18, 2016
DRAWN BY:	GM
REVIEWED:	JD
VERSION:	1

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CLIENT: KAMINAK GOLD CORPORATION

LORAX ENVIRONMENTAL

PROJECT: **Coffee Gold Project**

TITLE: Section 18

PROJECT #: A362-1

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Appendix B: Mineralogy Reports

GOLDCORP

APPENDIX B.1: X-RAY DIFFRACTION ANALYSES

QUANTITATIVE PHASE ANALYSIS OF TEN POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

Project: Kaminak #A362-1

John Dockrey, M.Sc.
Lorax Environmental Services Ltd.
2289 Burrard Street
Vancouver, BC V6J 3H9

Mati Raudsepp, Ph.D.
Elisabetta Pani, Ph.D.
Edith Czech, M.Sc.
Jenny Lai, B.Sc.
Lan Kato, B.A.

Dept. of Earth & Ocean Sciences
The University of British Columbia
6339 Stores Road
Vancouver, BC V6T 1Z4

January 14, 2015

EXPERIMENTAL METHOD

The ten samples of **Project Kaminak #A362-1** were reduced into fine powder to the optimum grain-size range for X-ray analysis (<10µm) by grinding under ethanol in a vibratory McCrone Micronising Mill for 10 minutes. Step-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKα radiation on a Bruker D8 Advance Bragg-Brentano diffractometer equipped with an Fe monochromator foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Soller slits and a LynxEye-XE detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 and Search-Match software by Bruker. X-ray powder-diffraction data of the samples were refined with Rietveld program Topas 4.2 (Bruker AXS). The results of quantitative phase analysis by Rietveld refinements are given in Table 1 (separate file, ***Lorax Environmental Results Jan 14 2015 – Proj Kaminak A362-1.xlsx***). These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots are shown in Figures 1 to 10. The ideal formulae of phases present are given in Table 2.

In samples 1, 2, 4, 7, 8 and 9 the kaolinite is highly disordered and its contribution to the diffraction pattern was estimated with a model structure. Consider the results approximate.

Table 2. List and ideal formulae of present phases.

Mineral	**Ideal Formula**
Analcime	$Na[AlSi_2O_6]\cdot H_2O$
Anatase	TiO_2
Ankerite/Dolomite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2/CaMg(CO_3)_2$
Biotite	$K(Mg,Fe^{2+})_3AlSi_3O_{10}(OH)_2$
Cristobalite	SiO_2
Gorceixite	$BaAl_3(PO_4)(PO_3OH)(OH)_6$
Hematite	α-Fe_2O_3
Hydrocalumite	$Ca_4Al_2(OH)_{12}(Cl,CO_3,OH)_{2-x}\cdot 4H_2O$
Jarosite	$K_2Fe_6^{3+}(SO_4)_4(OH)_{12}$
Kaolinite	$Al_2Si_2O_5(OH)_4$
K-feldspar	$KAlSi_3O_8$
Muscovite/Illite	$KAl_2(AlSi_3O_{10})(OH)_2/ K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$
Phlogopite	$KMg_3AlSi_3O_{10}(OH)_2$
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$
Pyrite	FeS_2
Quartz	SiO_2
Rutile	TiO_2
Siderite	$Fe^{2+}CO_3$

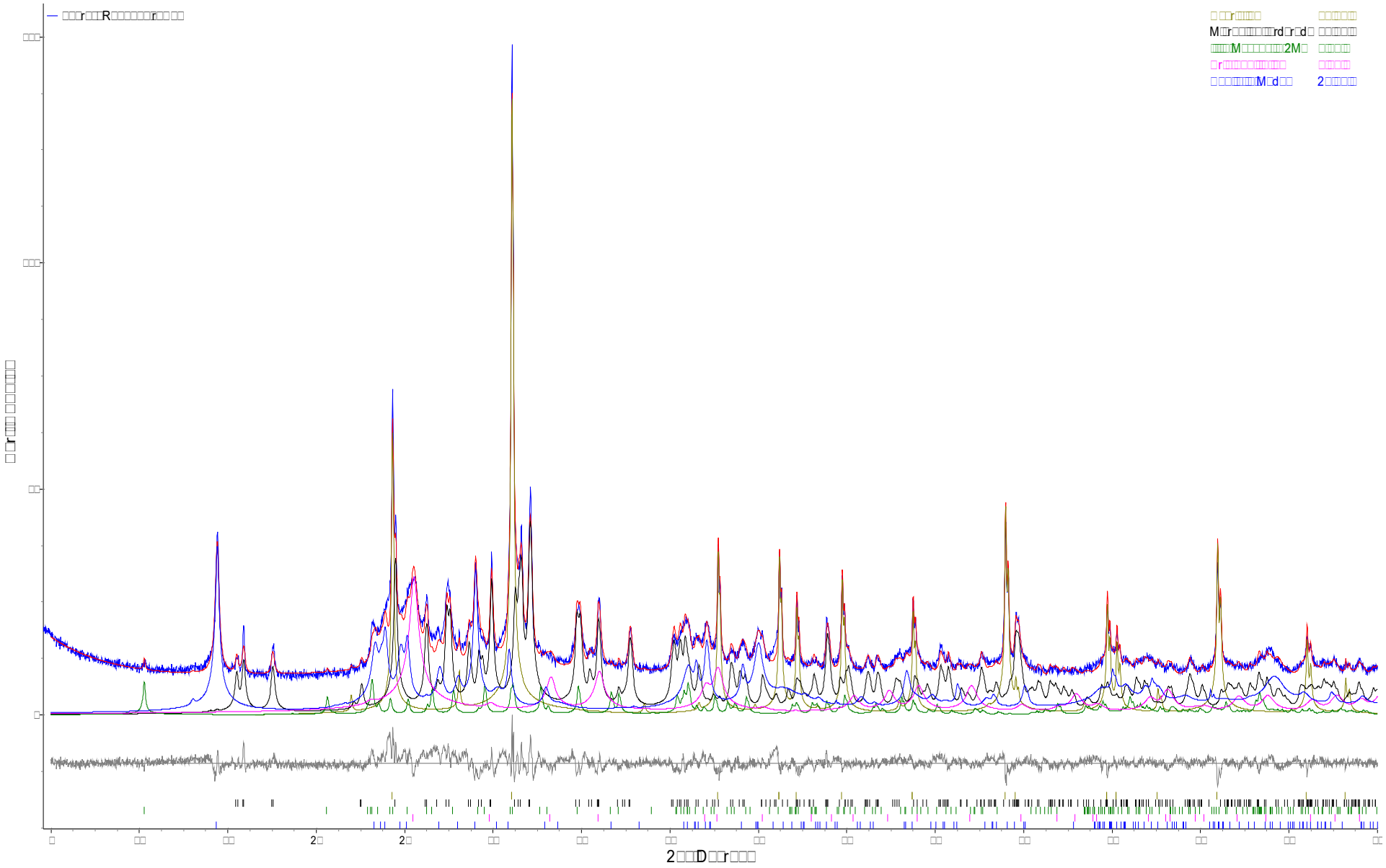

Figure 1. Rietveld refinement plot of sample **Lorax Environmental "R305803"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

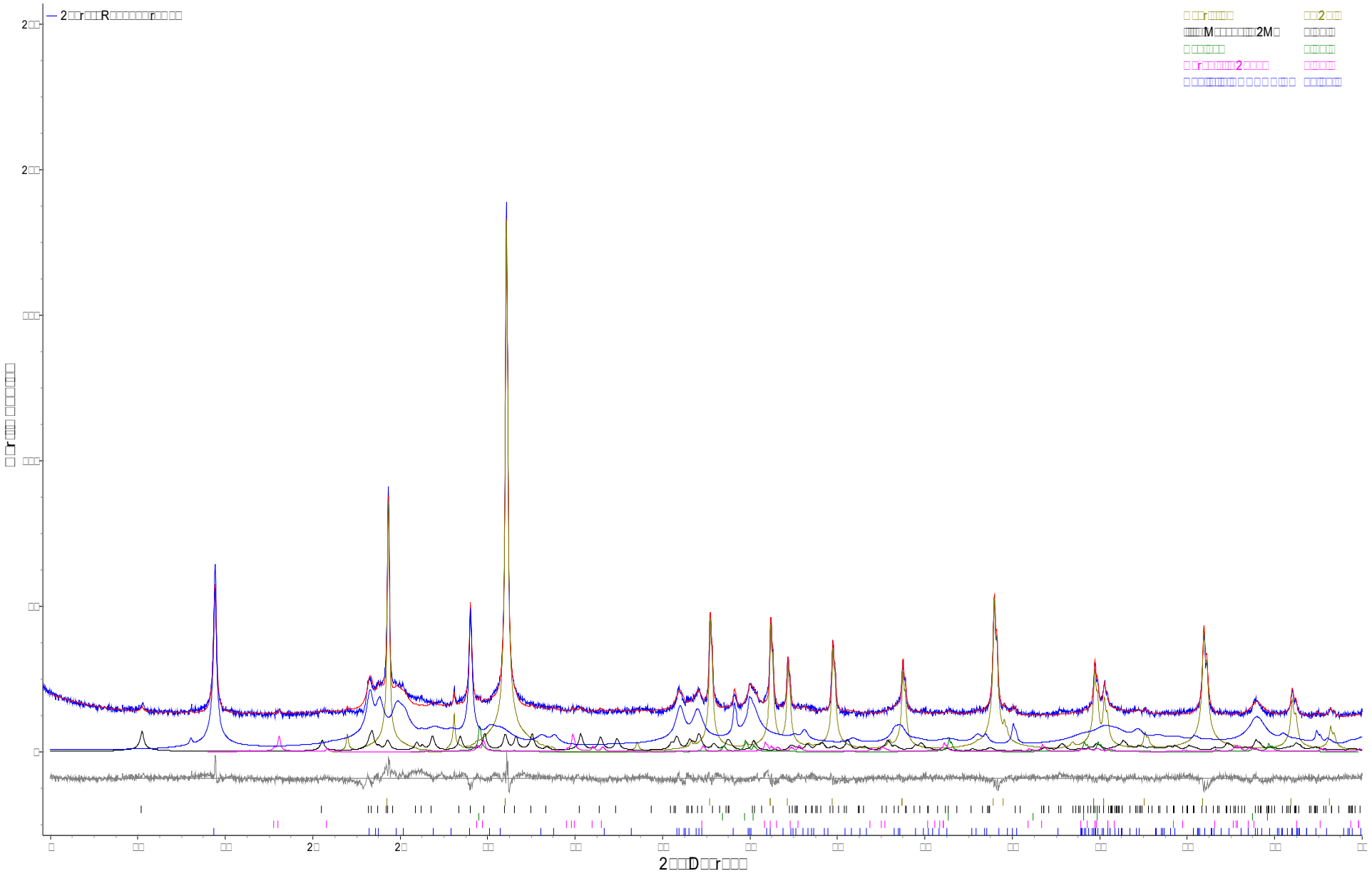

Figure 2. Rietveld refinement plot of sample **Lorax Environmental "R305808"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

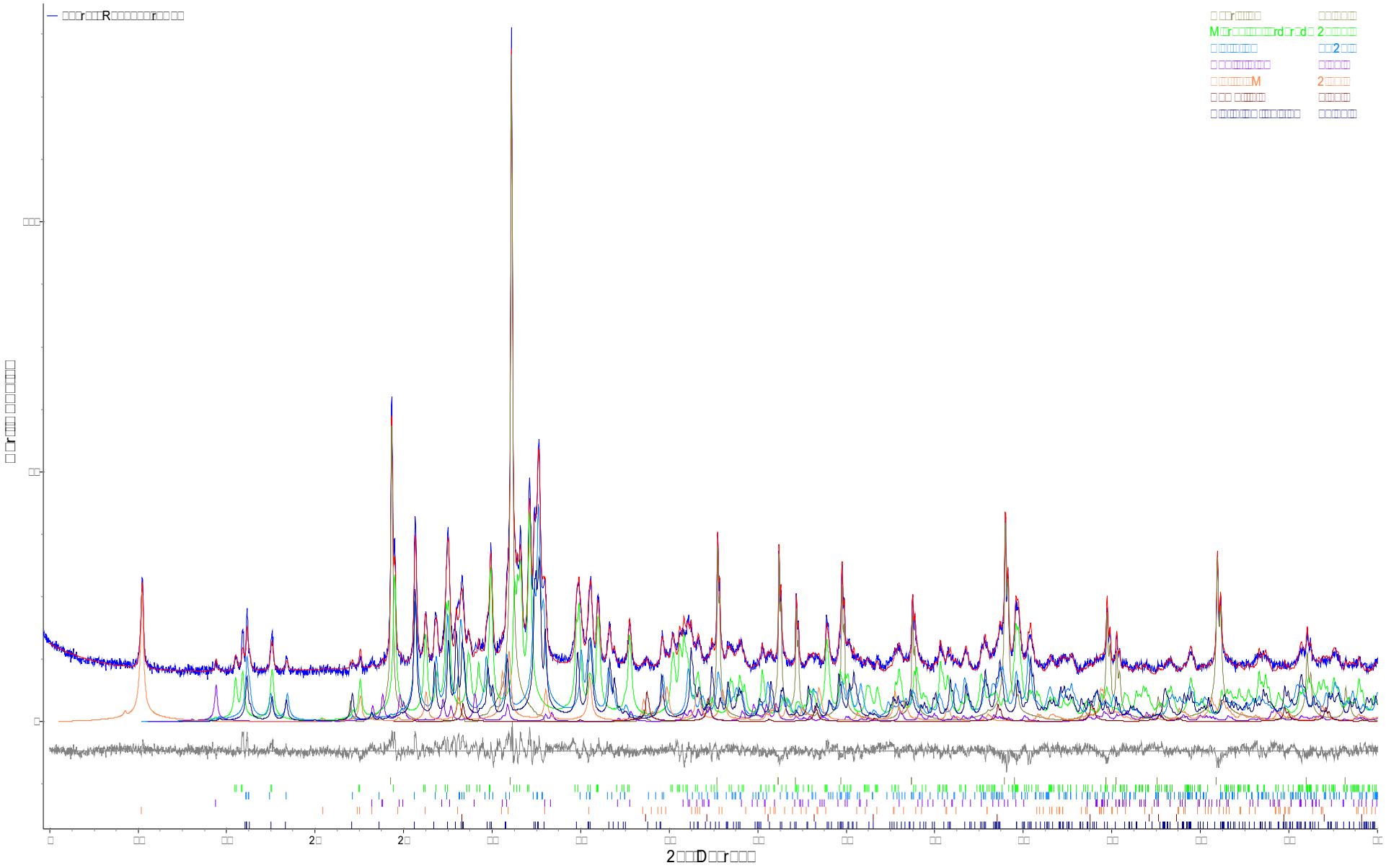

Figure 3. Rietveld refinement plot of sample **Lorax Environmental "R305815"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

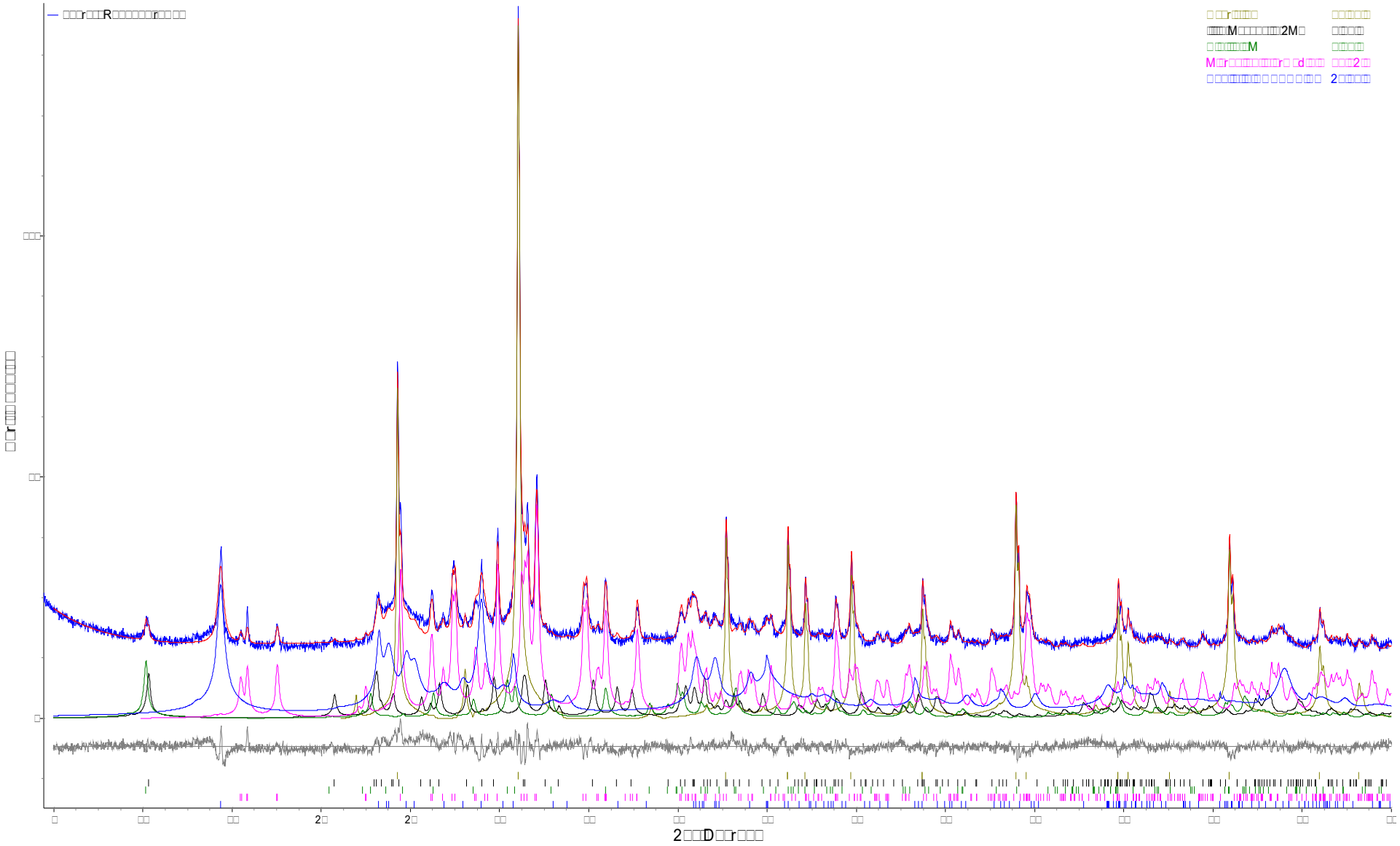

Figure 4. Rietveld refinement plot of sample **Lorax Environmental "R305817"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

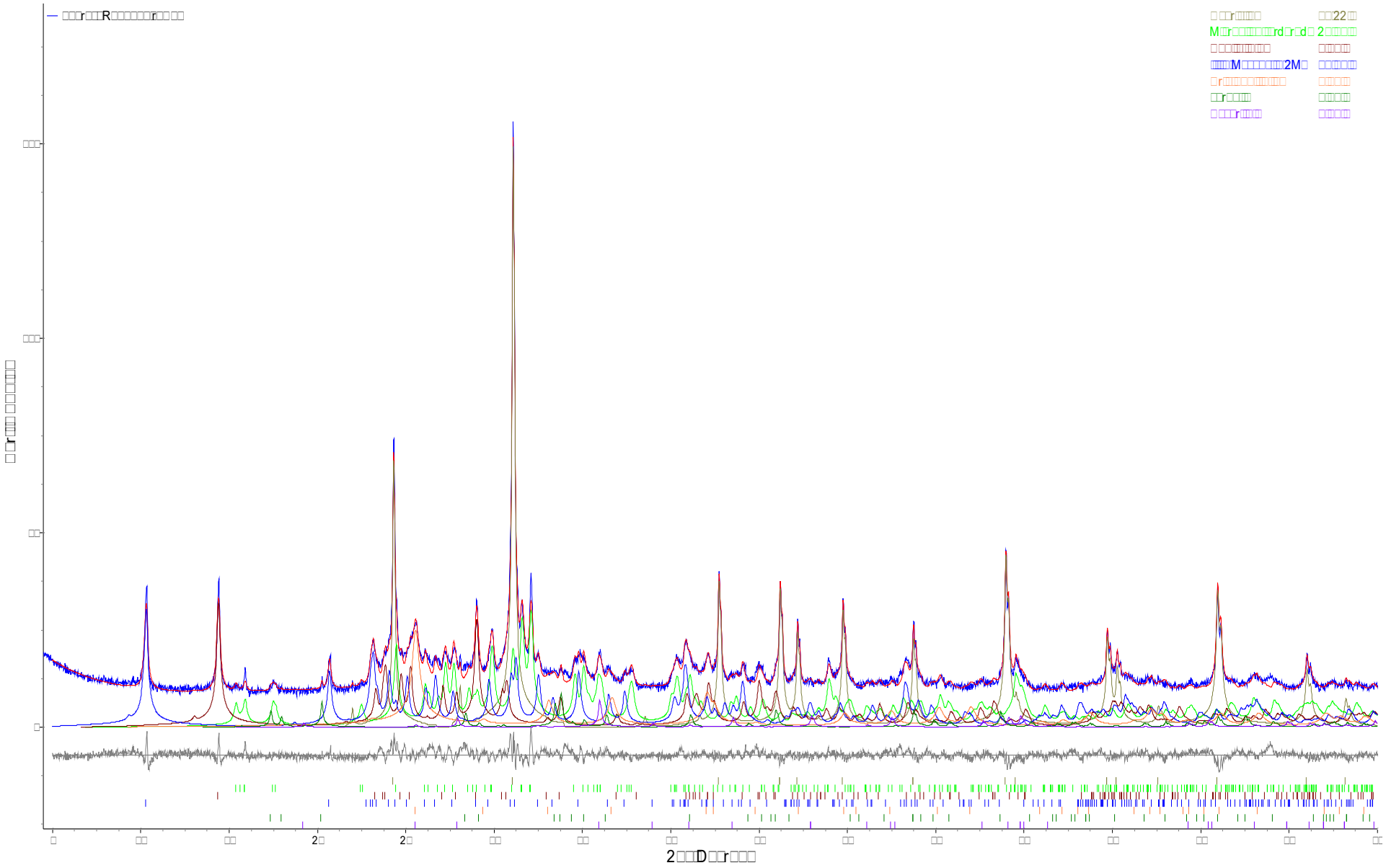

Figure 5. Rietveld refinement plot of sample **Lorax Environmental "R305818"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.



Figure 6. Rietveld refinement plot of sample **Lorax Environmental "R305821"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

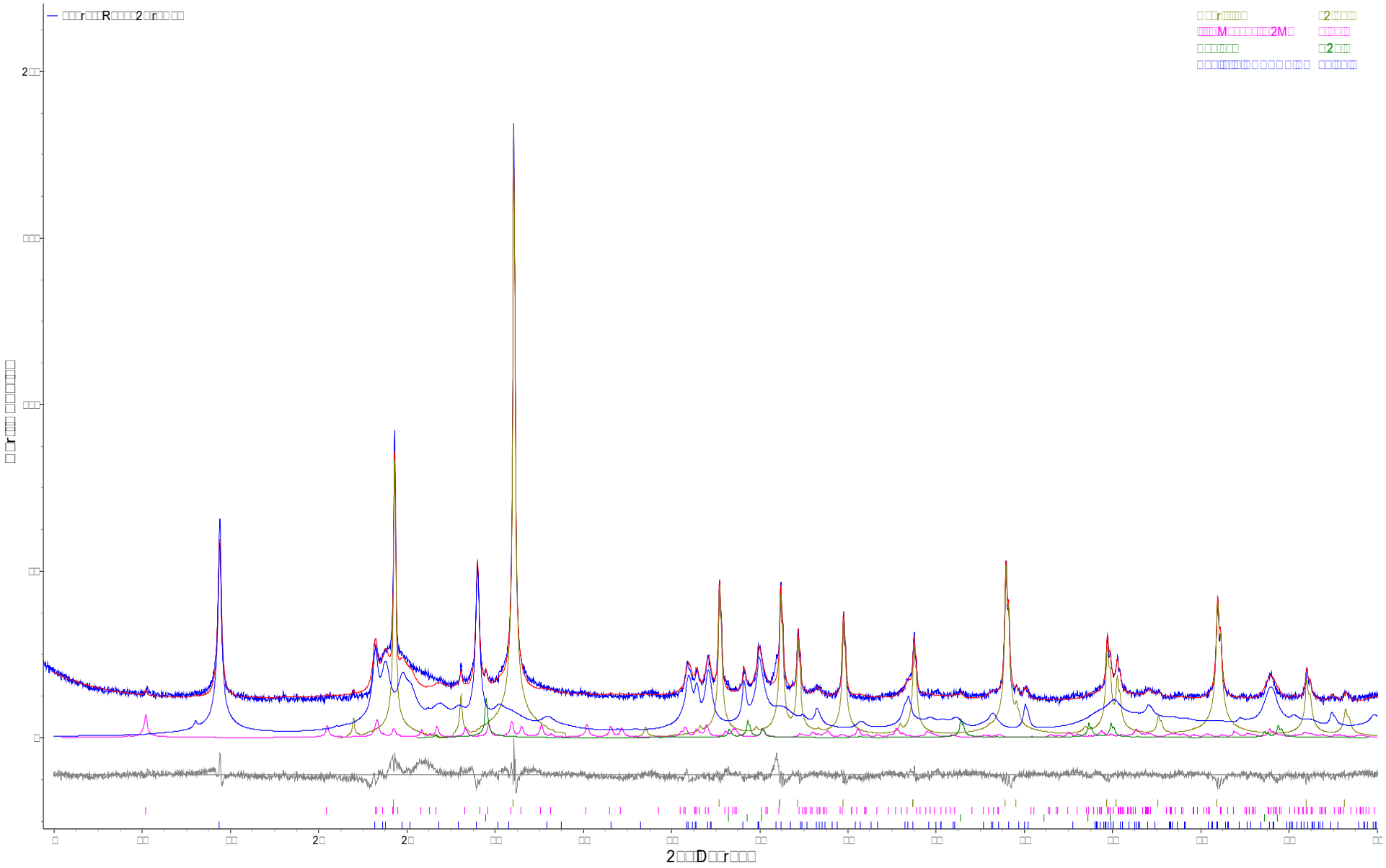

Figure 7. Rietveld refinement plot of sample **Lorax Environmental "R305824"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

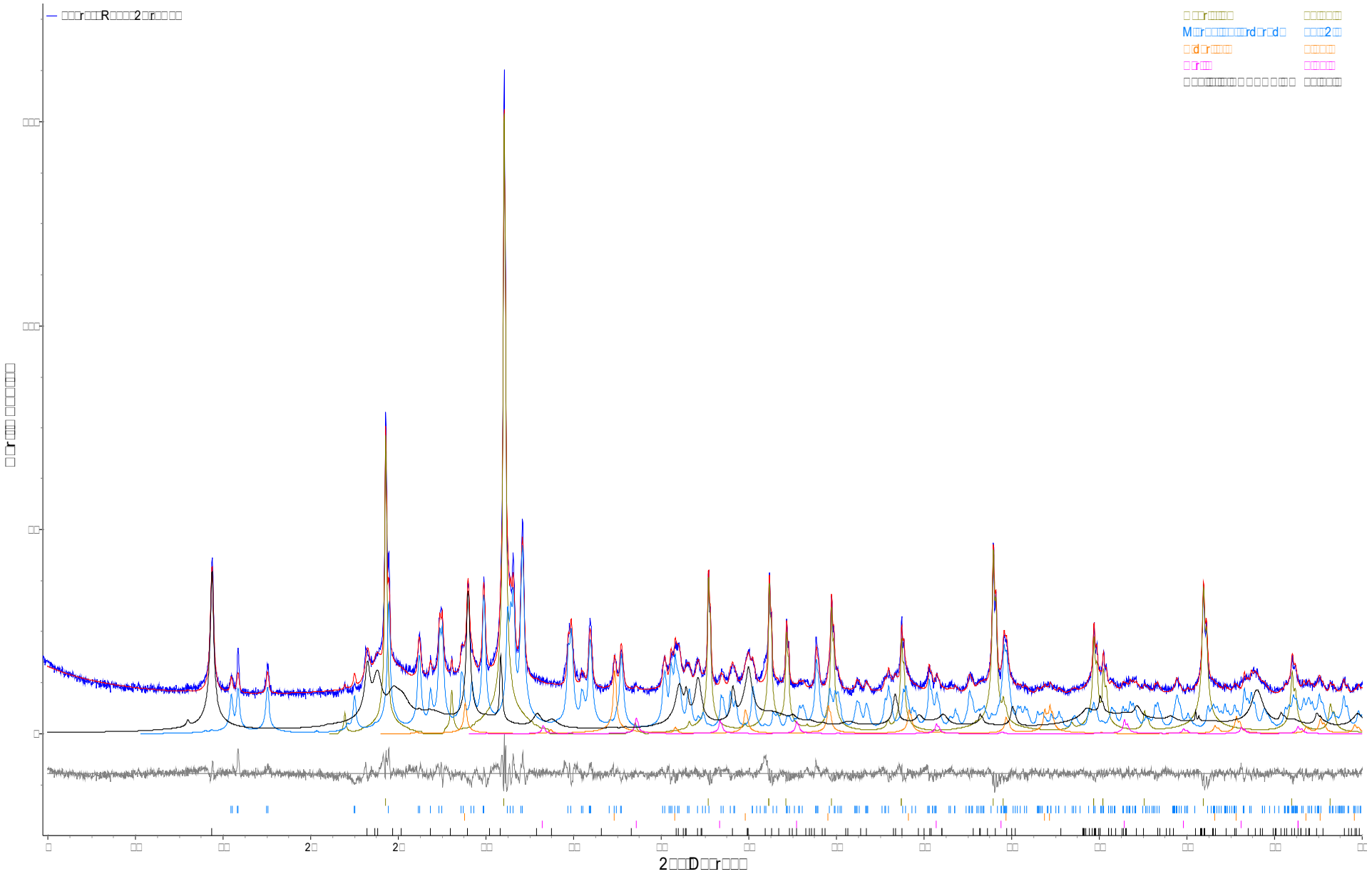

Figure 8. Rietveld refinement plot of sample **Lorax Environmental "R305825"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

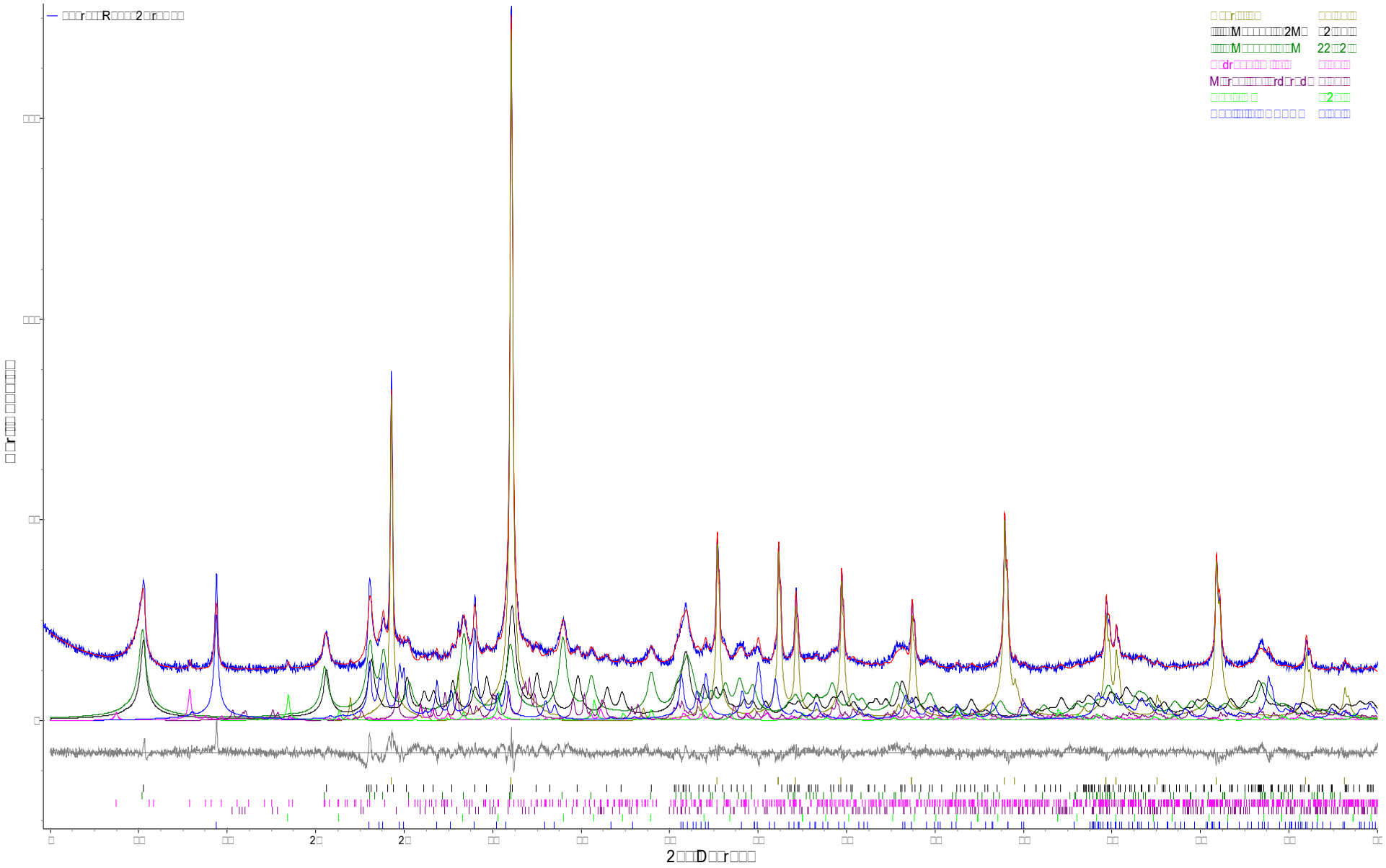

Figure 9. Rietveld refinement plot of sample **Lorax Environmental "R305826"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

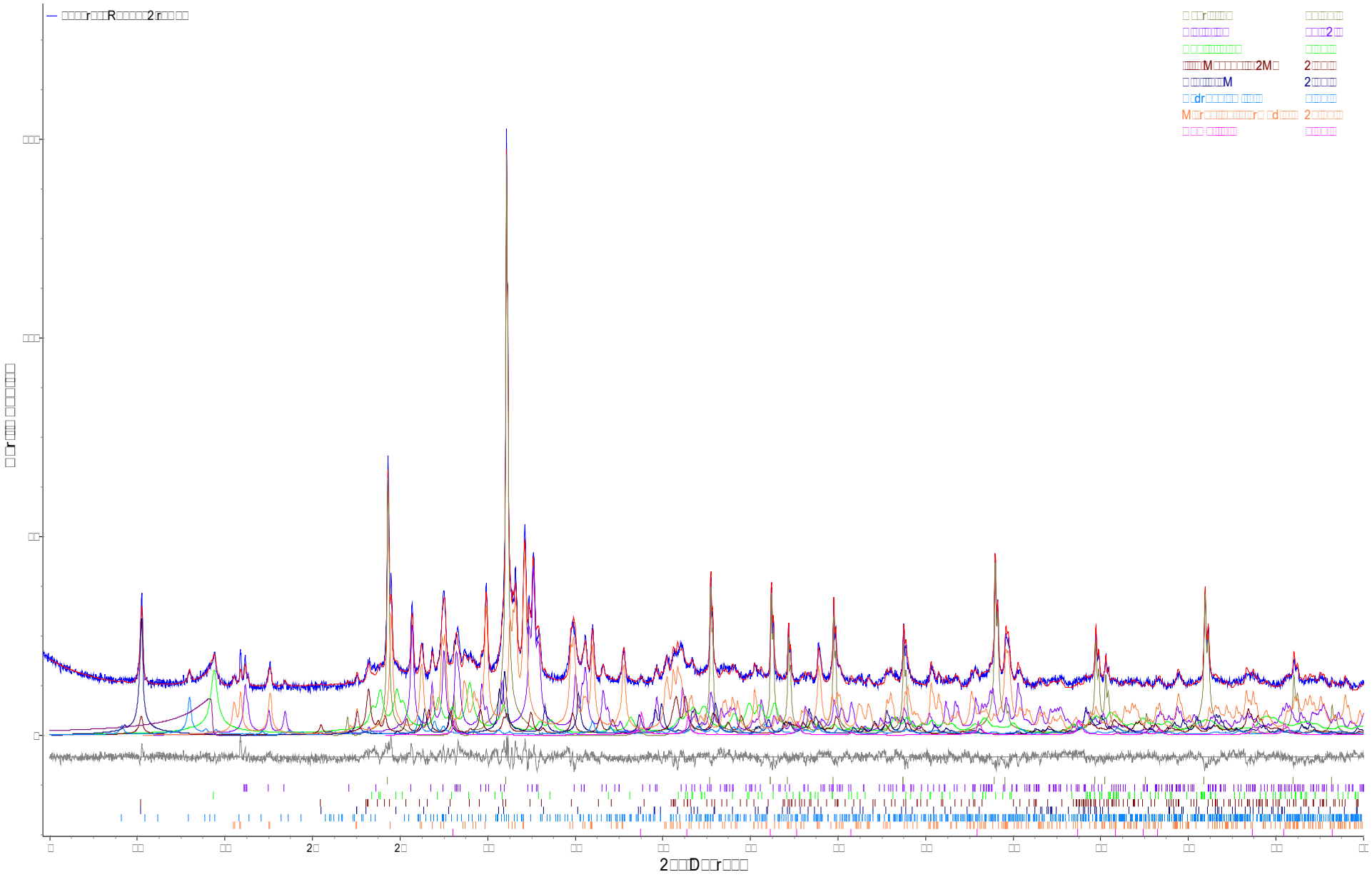

Figure 10. Rietveld refinement plot of sample **Lorax Environmental "R305832"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

QUANTITATIVE PHASE ANALYSIS OF TWENTY TWO POWDER SAMPLES USING THE RIETVELD METHOD AND X-RAY POWDER DIFFRACTION DATA.

Project: Coffee Gold A362-1

John Dockrey, M.Sc.
Lorax Environmental Services Ltd.
2289 Burrard Street
Vancouver, BC V6J 3H9

Mati Raudsepp, Ph.D.
Elisabetta Pani, Ph.D.
Edith Czech, M.Sc.
Lan Kato, B.A.

Dept. of Earth & Ocean Sciences
The University of British Columbia
6339 Stores Road
Vancouver, BC V6T 1Z4

May 1, 2014

EXPERIMENTAL METHOD

The twenty two samples of **Project Coffee Gold A362-1** were reduced into fine powder to the optimum grain-size range for X-ray analysis (<10µm) by grinding under ethanol in a vibratory McCrone Micronising Mill for 7 minutes. Step-scan X-ray powder-diffraction data were collected over a range 3-80°2θ with CoKα radiation on a Bruker D8 Advance Bragg-Brentano diffractometer equipped with an Fe monochromator foil, 0.6 mm (0.3°) divergence slit, incident- and diffracted-beam Soller slits and a LynxEye-XE detector. The long fine-focus Co X-ray tube was operated at 35 kV and 40 mA, using a take-off angle of 6°.

RESULTS

The X-ray diffractograms were analyzed using the International Centre for Diffraction Database PDF-4 and Search-Match software by Bruker. X-ray powder-diffraction data of the samples were refined with Rietveld program Topas 4.2 (Bruker AXS). The results of quantitative phase analysis by Rietveld refinements are given in Table 1 (separate file, ***Lorax Environmental Results May 1 2014 - proj Coffee Gold A362-1.xlsx***). These amounts represent the relative amounts of crystalline phases normalized to 100%. The Rietveld refinement plots are shown in Figures 1 to 22. The ideal formulae of phases present are given in Table 2.

In samples 5, 9, 10, 13, 21 and 22 the kaolinite is disordered and its contribution to the diffraction pattern was estimated with a model structure made from a 50:50 weighed standard mixture of kaolinite and quartz. Consider the results semi-quantitative.

Table 2. List and ideal formulae of present phases.

Mineral	**Ideal Formula**
Actinolite	$Ca_2(Mg,Fe^{2+})_5Si_8O_{22}(OH)_2$
Alunite	$K_2Al_6(SO_4)_4(OH)_{12}$
Anatase	TiO_2
Ankerite/Dolomite	$Ca(Fe^{2+},Mg,Mn)(CO_3)_2/CaMg(CO_3)_2$
Augite	$(Ca,Na)(Mg,Fe,Al,Ti)(Si,Al)_2O_6$
Calcite	$CaCO_3$
Clinochlore	$(Mg,Fe^{2+})_5Al(Si_3Al)O_{10}(OH)_8$
Clinozoisite	$Ca_2Al_3(SiO_4)_3(OH)$
Dawsonite	$NaAlCO_3(OH)_2$
Goethite	α-$Fe^{3+}O(OH)$
Grossular	$Ca_3Al_2(SiO_4)_3$
Hematite	α-Fe_2O_3
Iron	α-Fe
Jarosite	$K_2Fe_6^{3+}(SO_4)_4(OH)_{12}$
Kaolinite	$Al_2Si_2O_5(OH)_4$
K-feldspar	$KAlSi_3O_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Muscovite/Illite	$KAl_2(AlSi_3O_{10})(OH)_2$/ $K_{0.65}Al_{2.0}Al_{0.65}Si_{3.35}O_{10}(OH)_2$
Phlogopite	$KMg_3AlSi_3O_{10}(OH)_2$
Plagioclase	$NaAlSi_3O_8 – CaAl_2Si_2O_8$
Pyrite	FeS_2
Pyrrhotite	$Fe_{1-x}S$
Quartz	SiO_2
Rutile	TiO_2
Siderite	$Fe^{2+}CO_3$

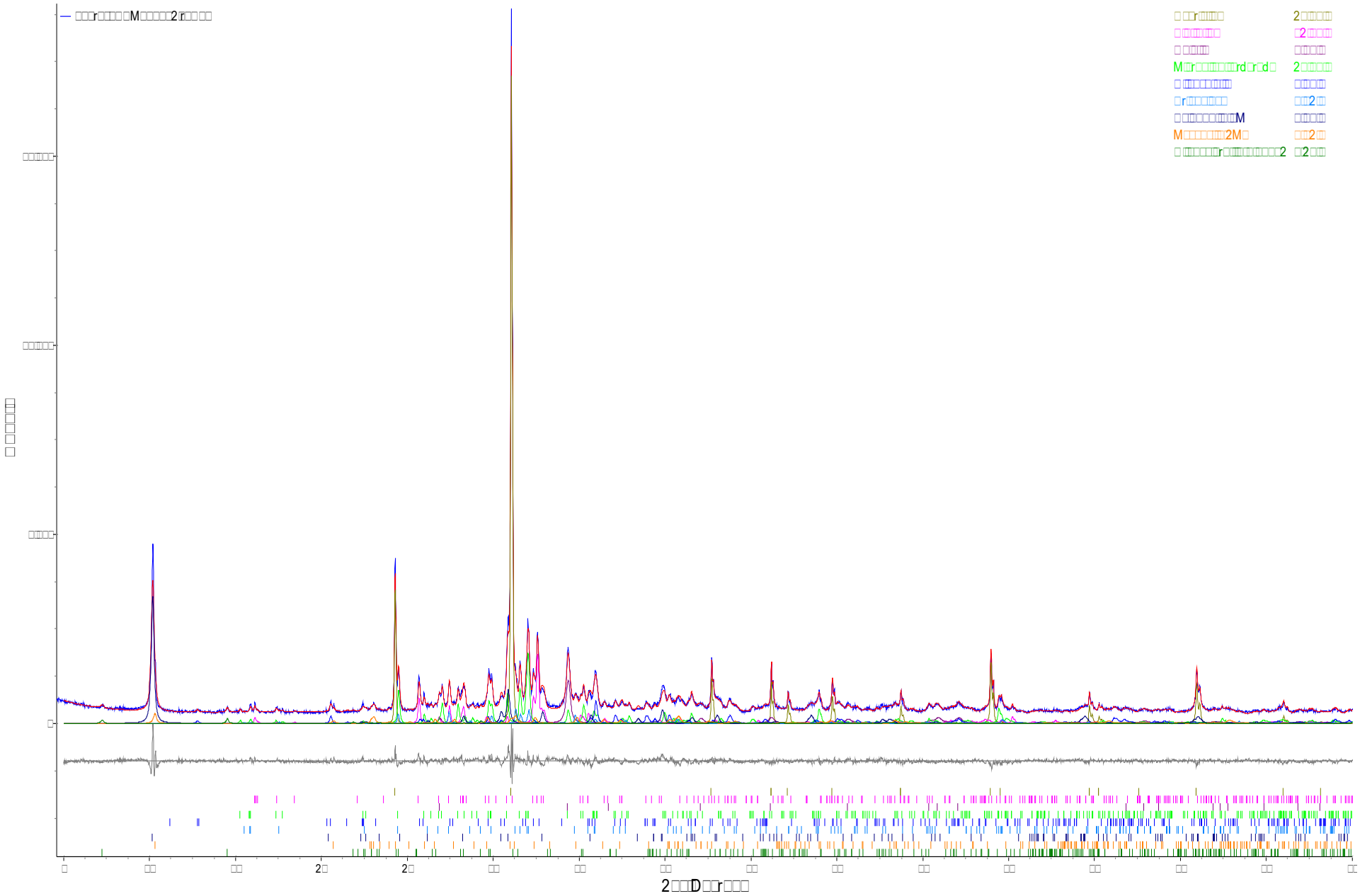

Figure 1. Rietveld refinement plot of sample **Lorax Environmental "KAM050812"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

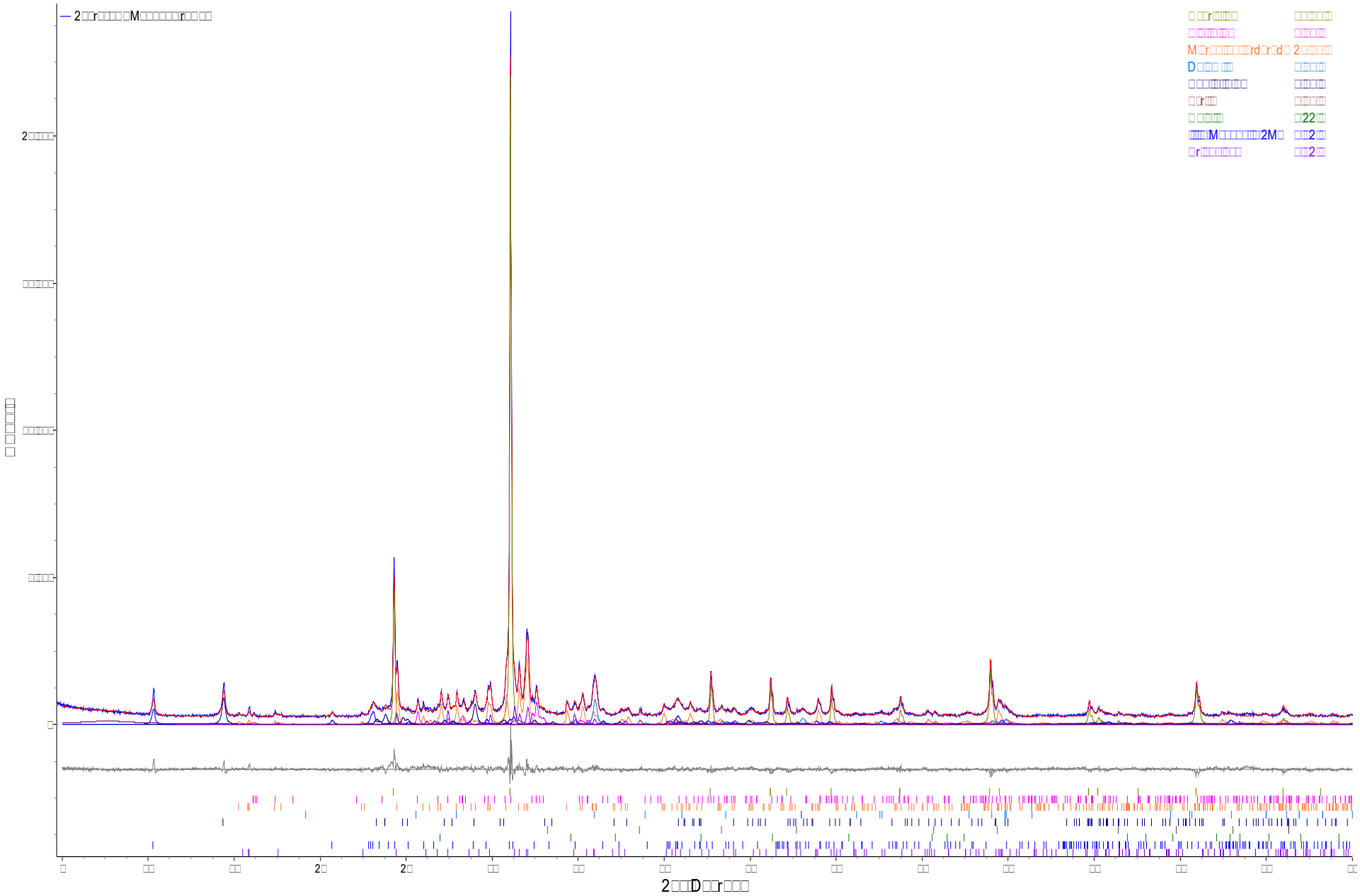

Figure 2. Rietveld refinement plot of sample **Lorax Environmental "KAM079117"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

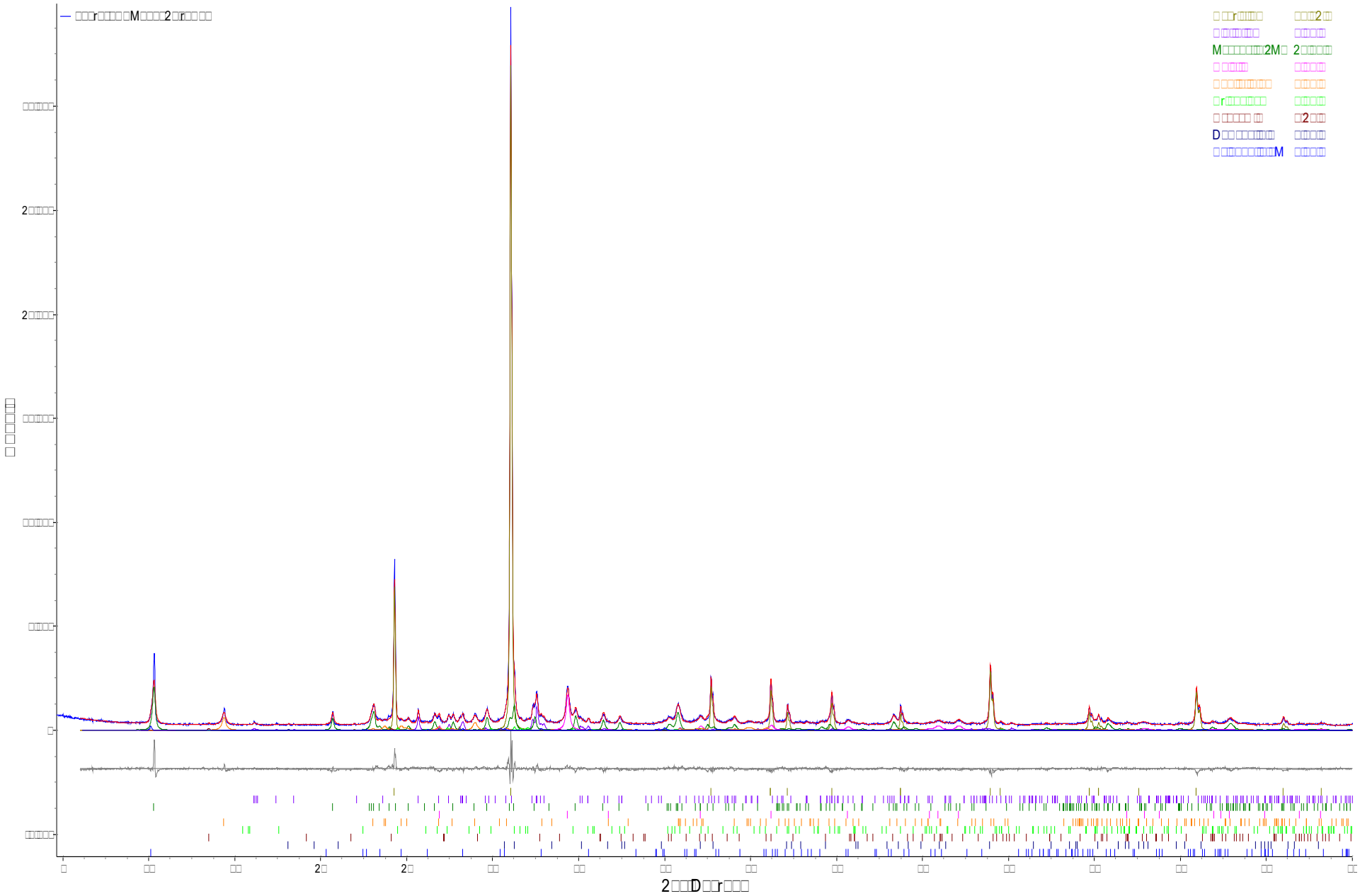

Figure 3. Rietveld refinement plot of sample **Lorax Environmental "KAM143923"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

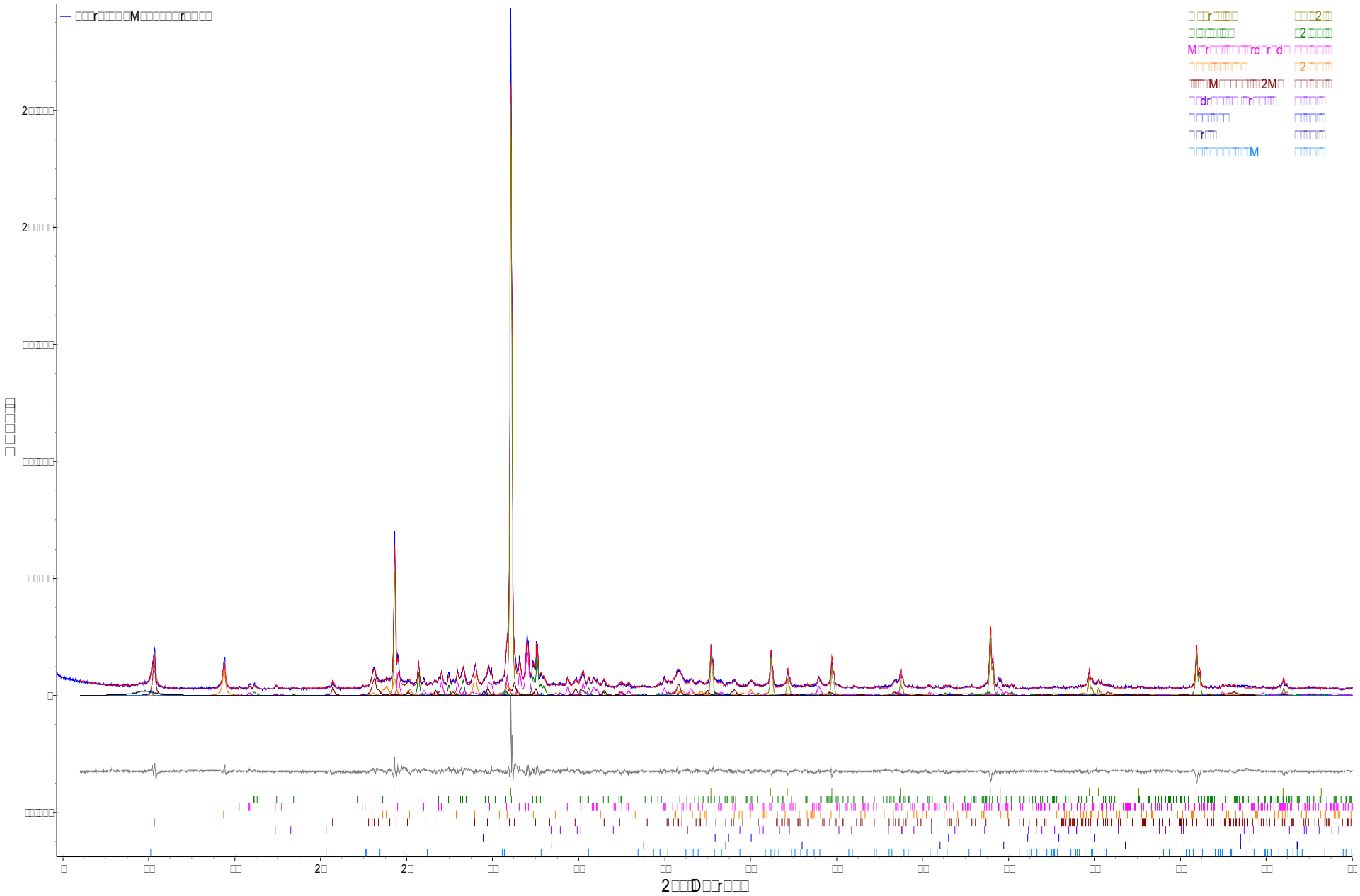

Figure 4. Rietveld refinement plot of sample **Lorax Environmental "KAM137583"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

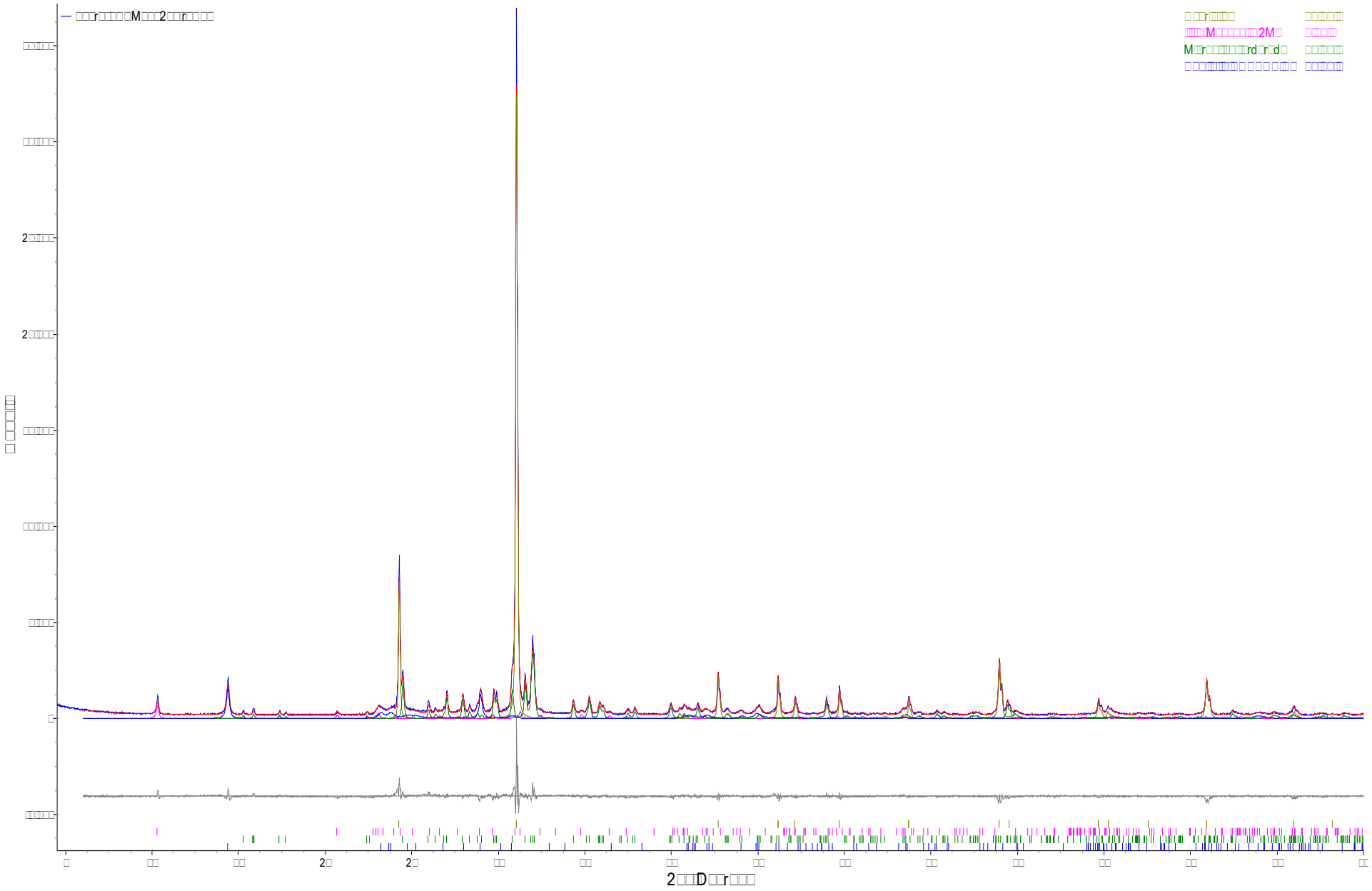

Figure 5. Rietveld refinement plot of sample **Lorax Environmental "KAM139298"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

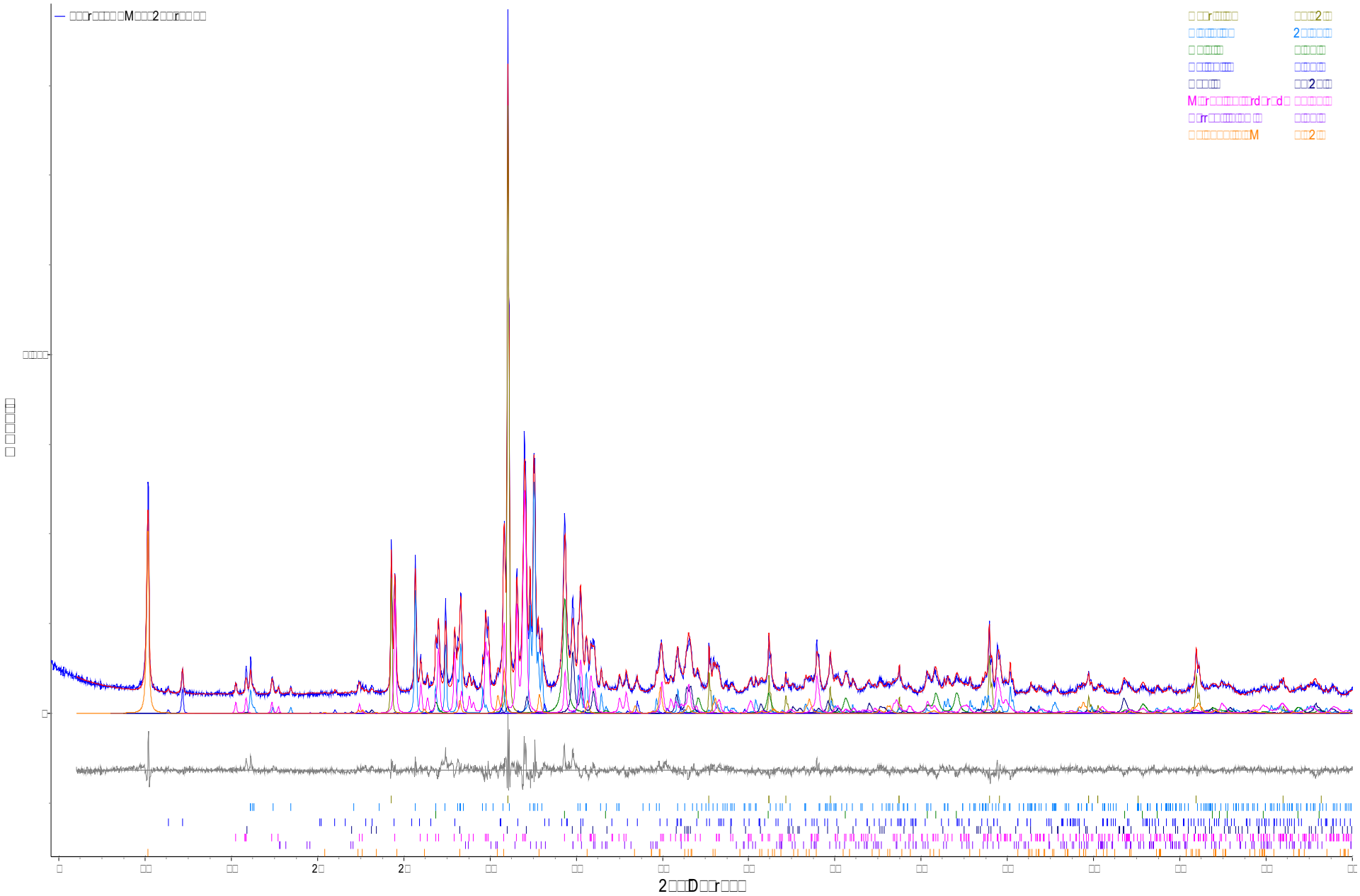

Figure 6. Rietveld refinement plot of sample **Lorax Environmental "KAM145241"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

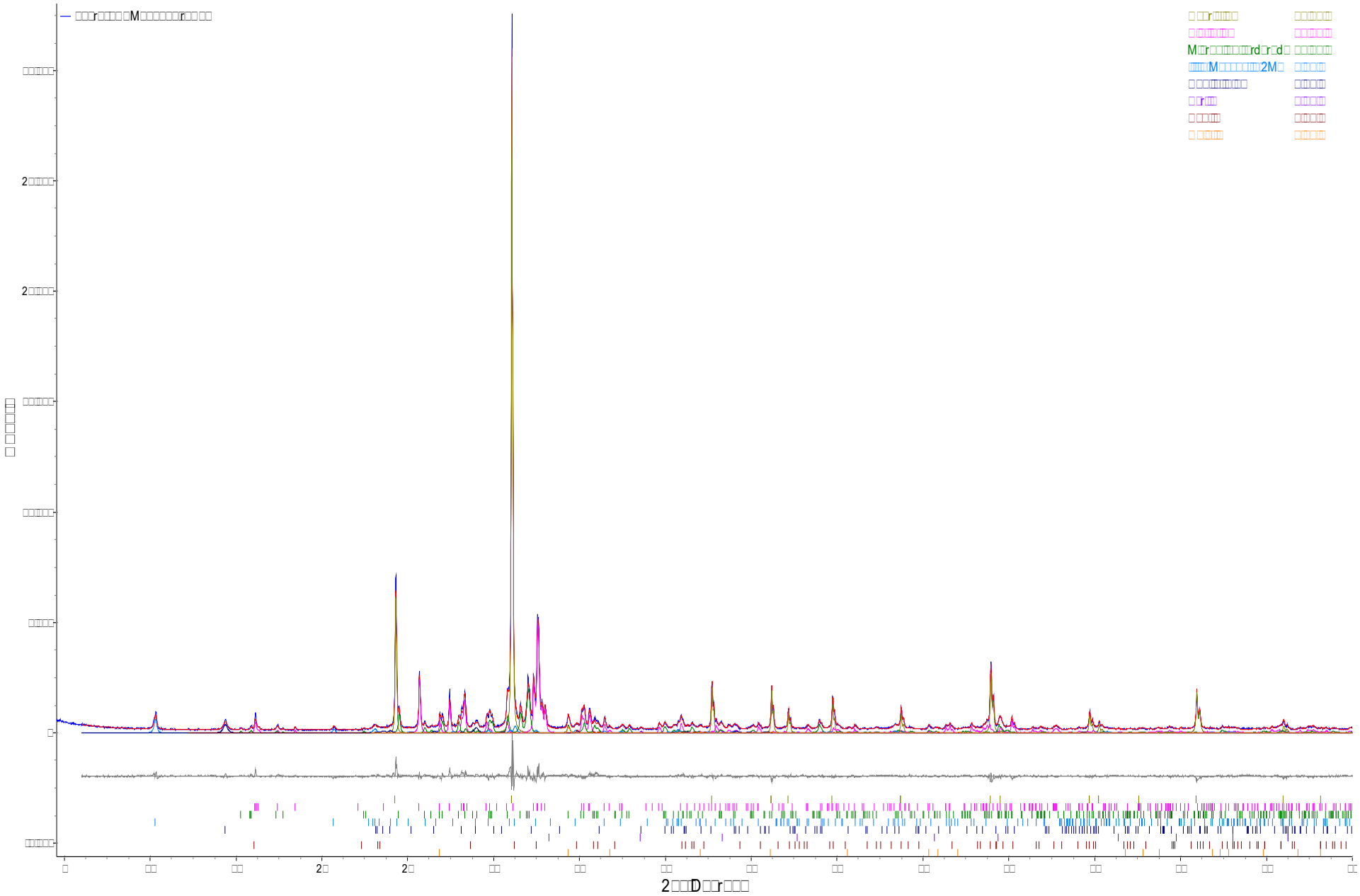

Figure 7. Rietveld refinement plot of sample **Lorax Environmental "KAM153051"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

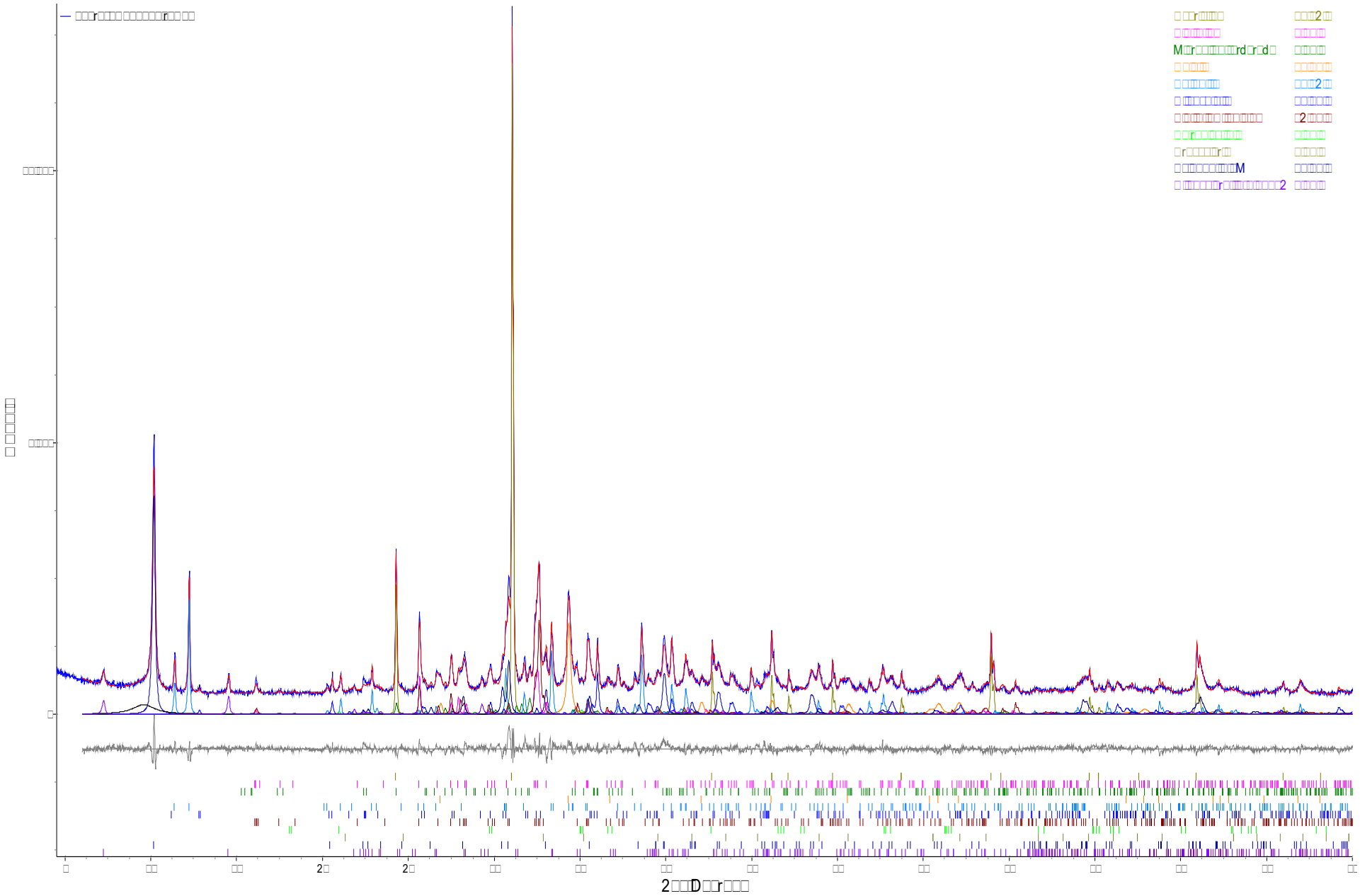

Figure 8. Rietveld refinement plot of sample **Lorax Environmental "N837976"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

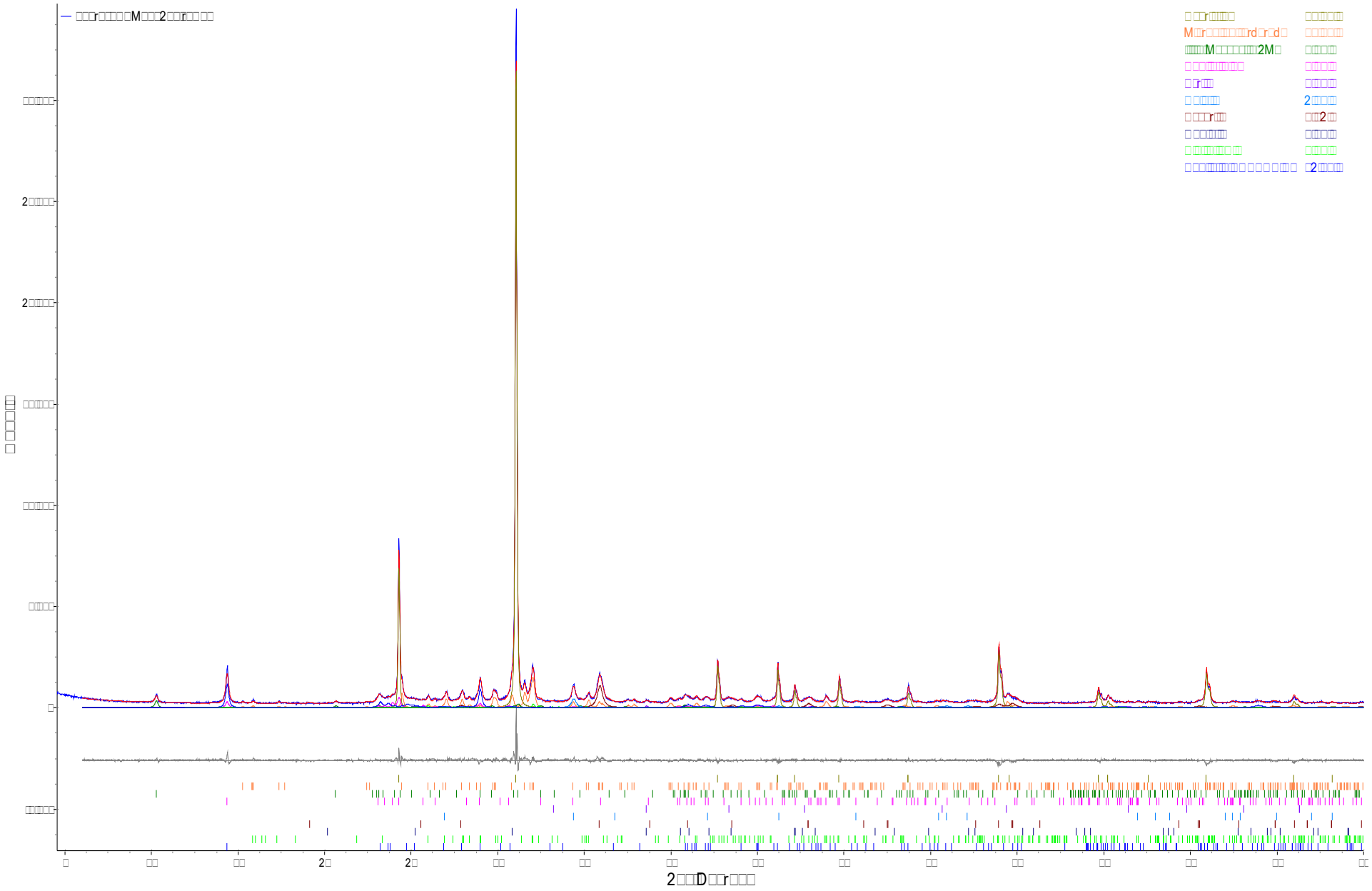

Figure 9. Rietveld refinement plot of sample **Lorax Environmental "KAM084288"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

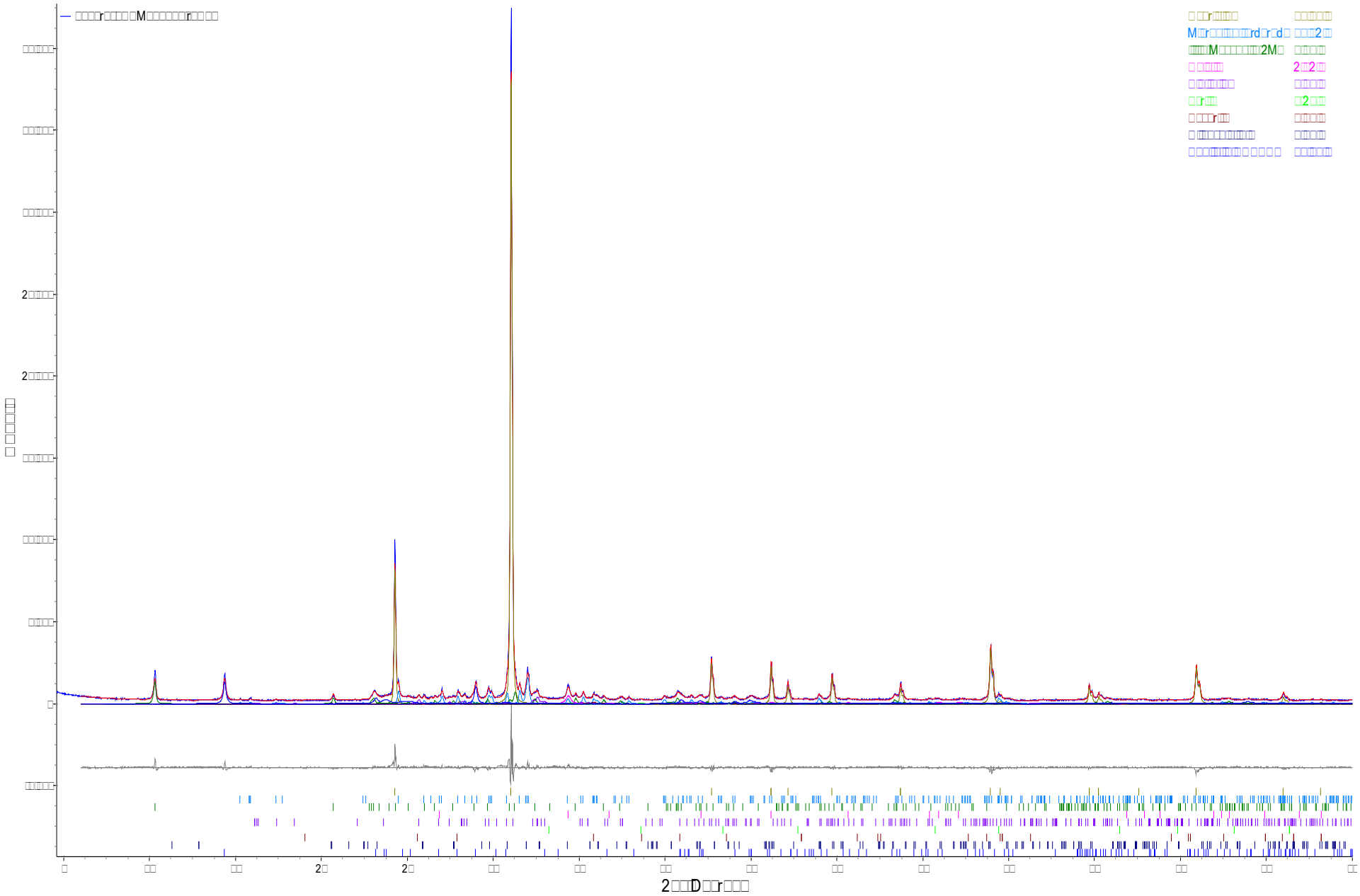

Figure 10. Rietveld refinement plot of sample **Lorax Environmental "KAM097065"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

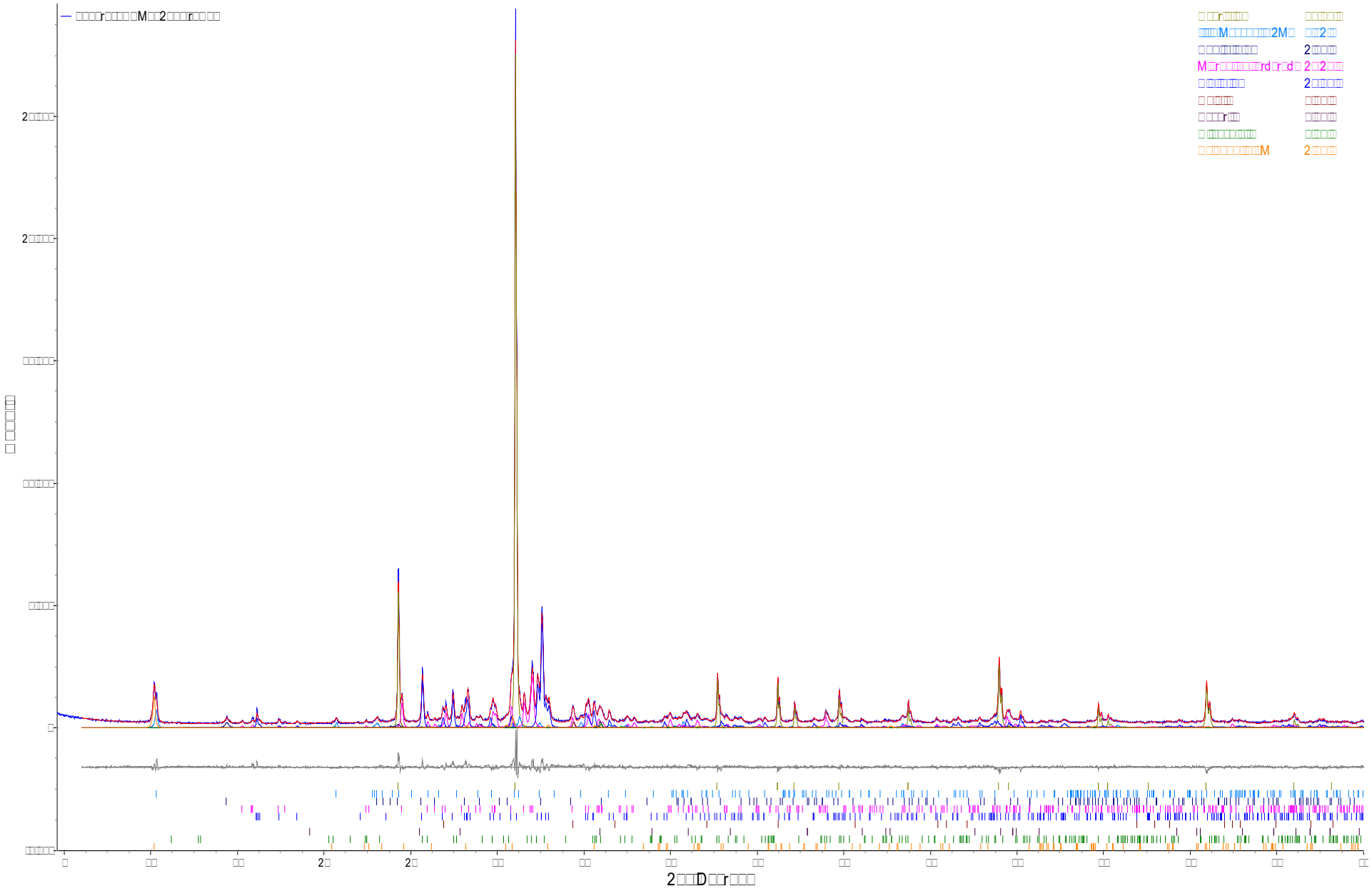

Figure 11. Rietveld refinement plot of sample **Lorax Environmental "KAM152499"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

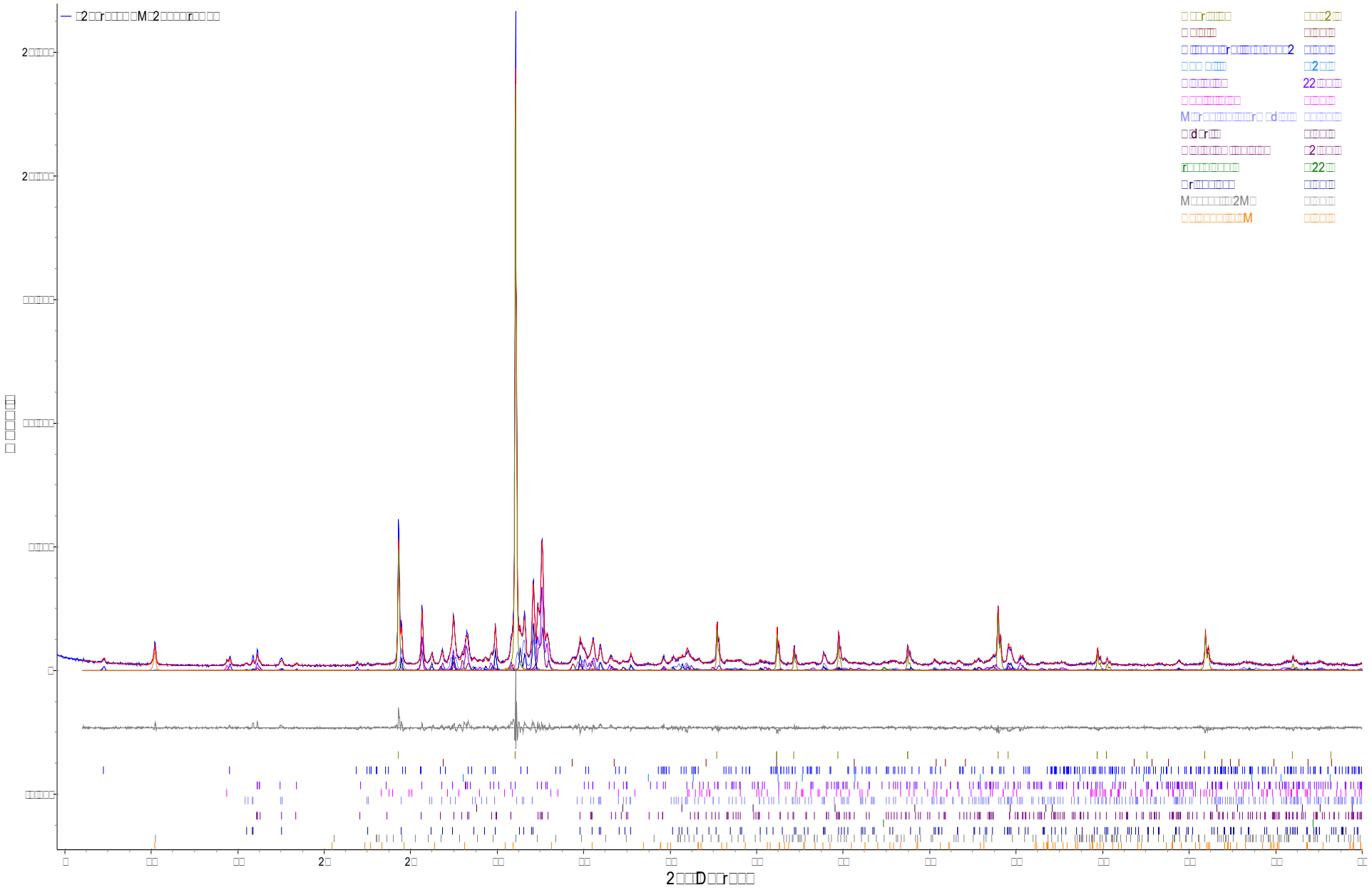

Figure 12. Rietveld refinement plot of sample **Lorax Environmental "KAM025798"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

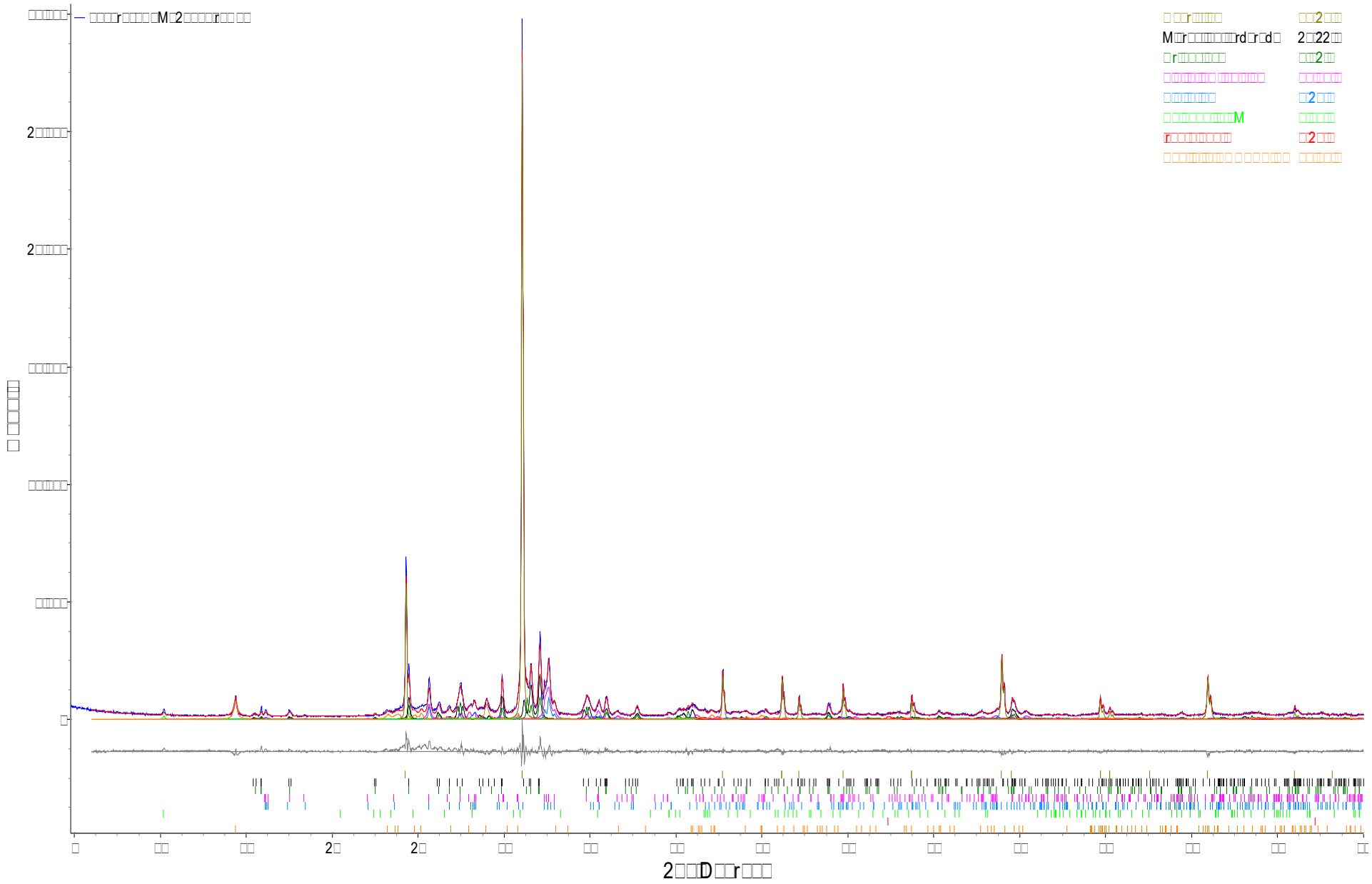

Figure 13. Rietveld refinement plot of sample **Lorax Environmental "KAM025898"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

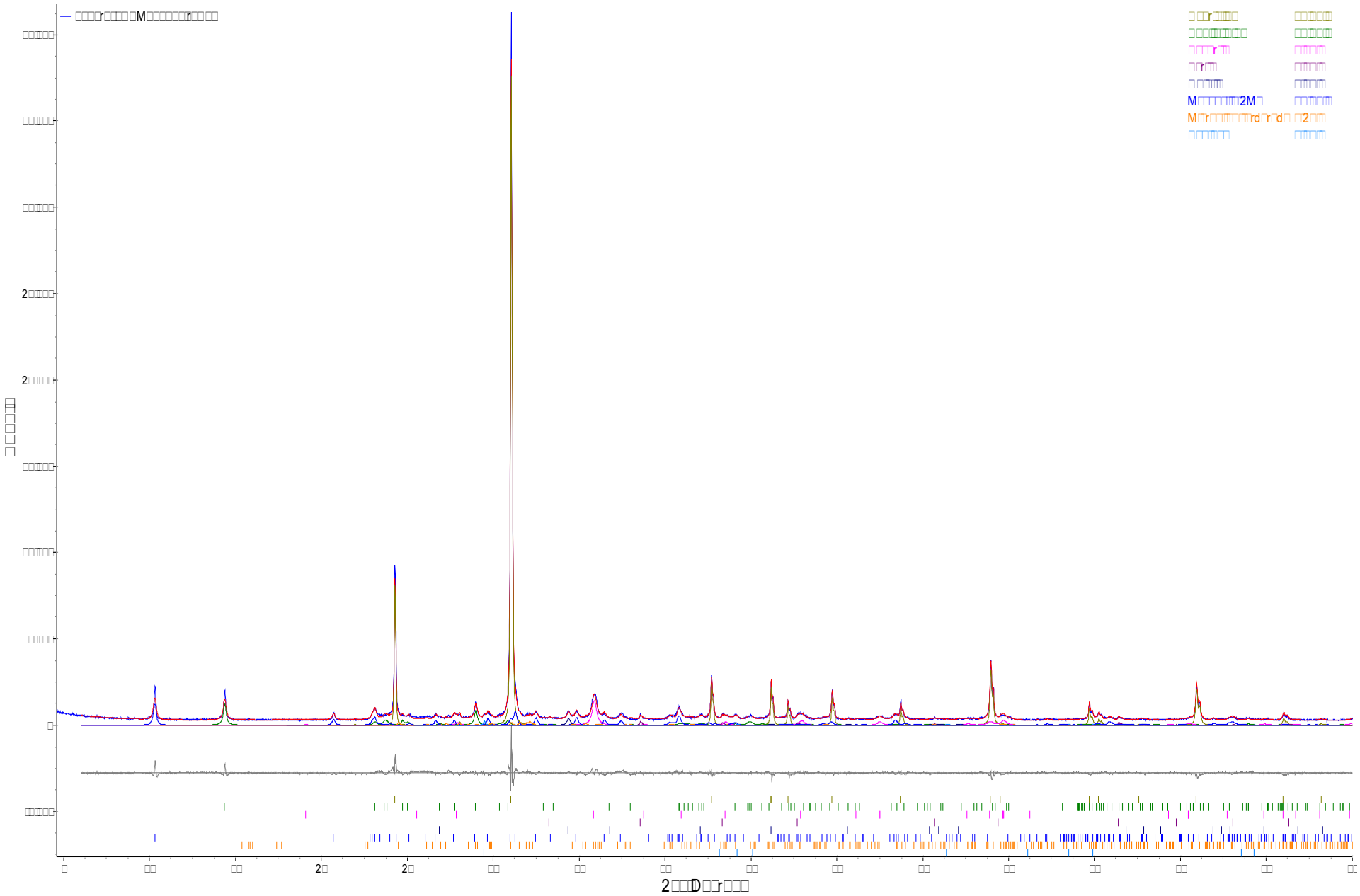

Figure 14. Rietveld refinement plot of sample **Lorax Environmental "KAM043465"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

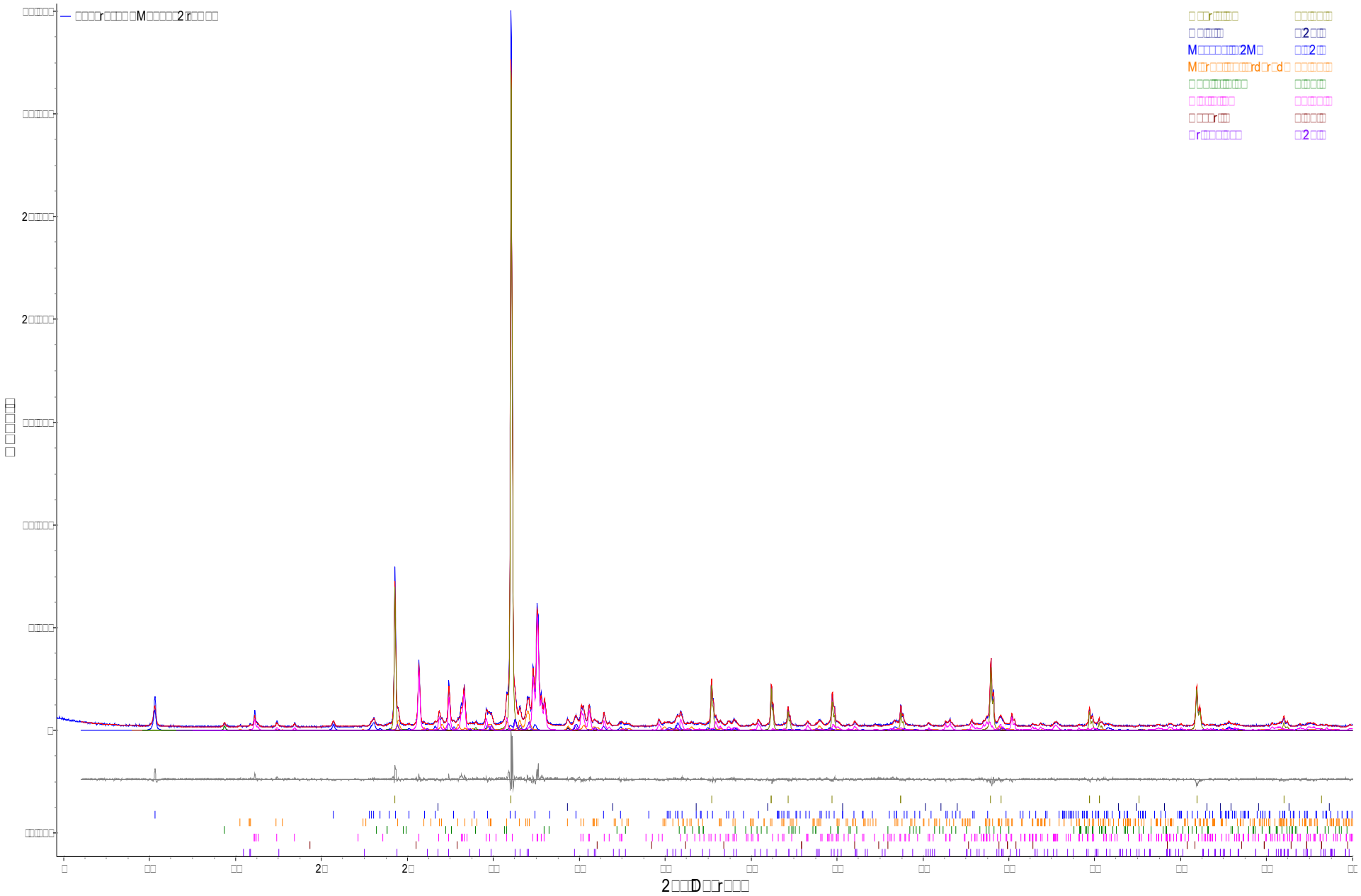

Figure 15. Rietveld refinement plot of sample **Lorax Environmental "KAM081312"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

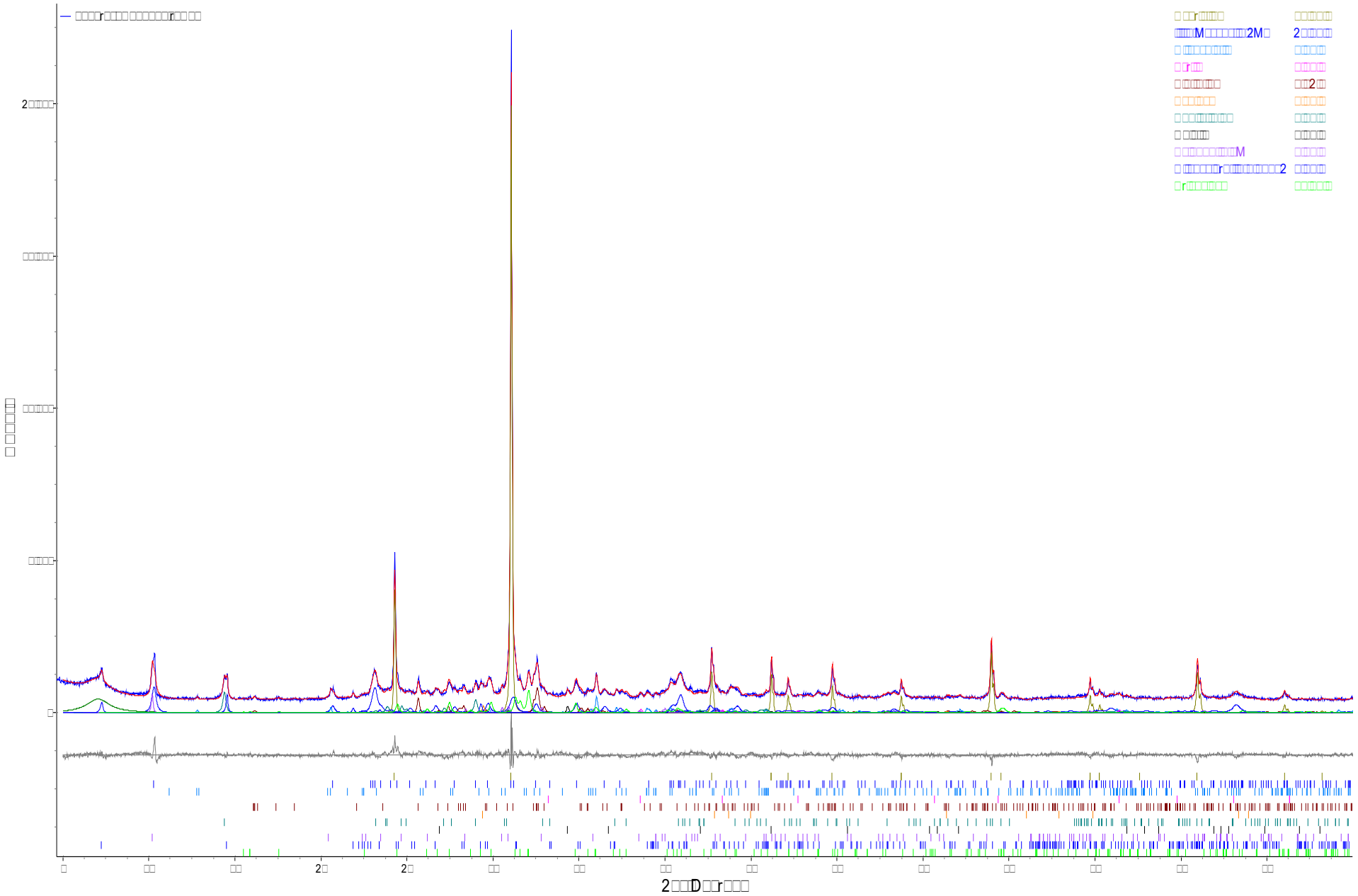

Figure 16. Rietveld refinement plot of sample **Lorax Environmental "N839989"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

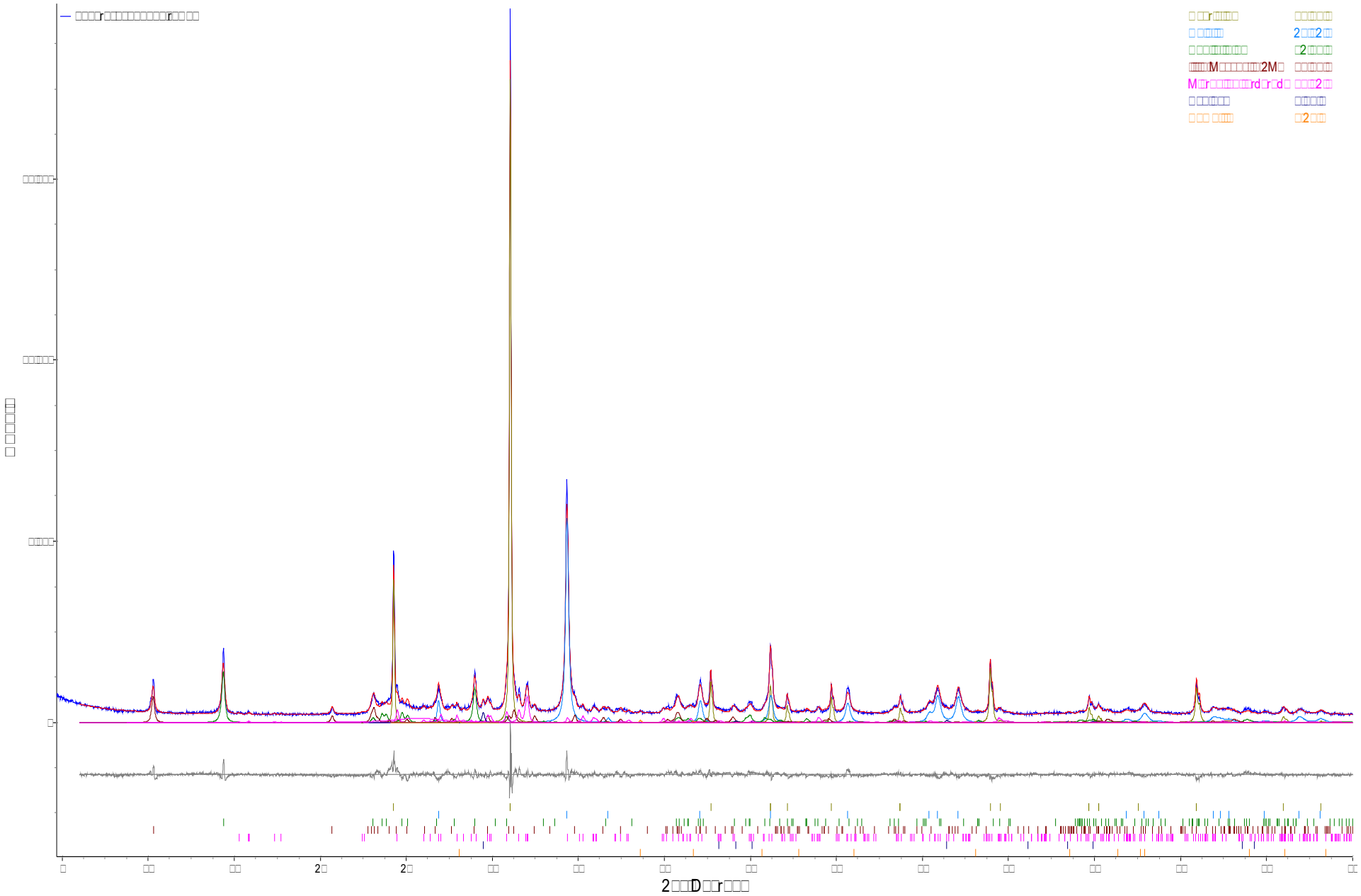

Figure 17. Rietveld refinement plot of sample **Lorax Environmental "J957606"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

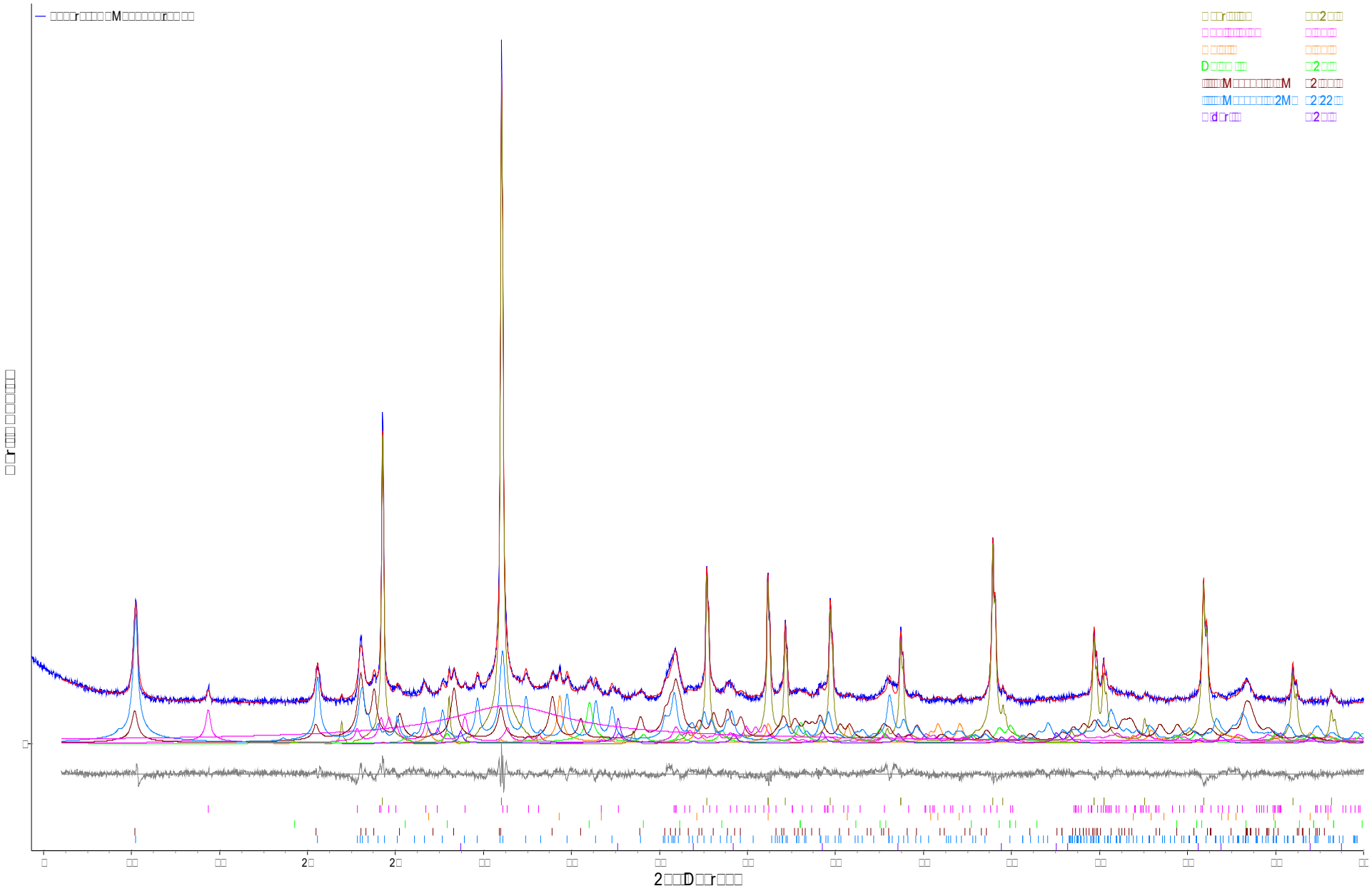

Figure 18. Rietveld refinement plot (y in sqrt) of sample **Lorax Environmental "KAM150859"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

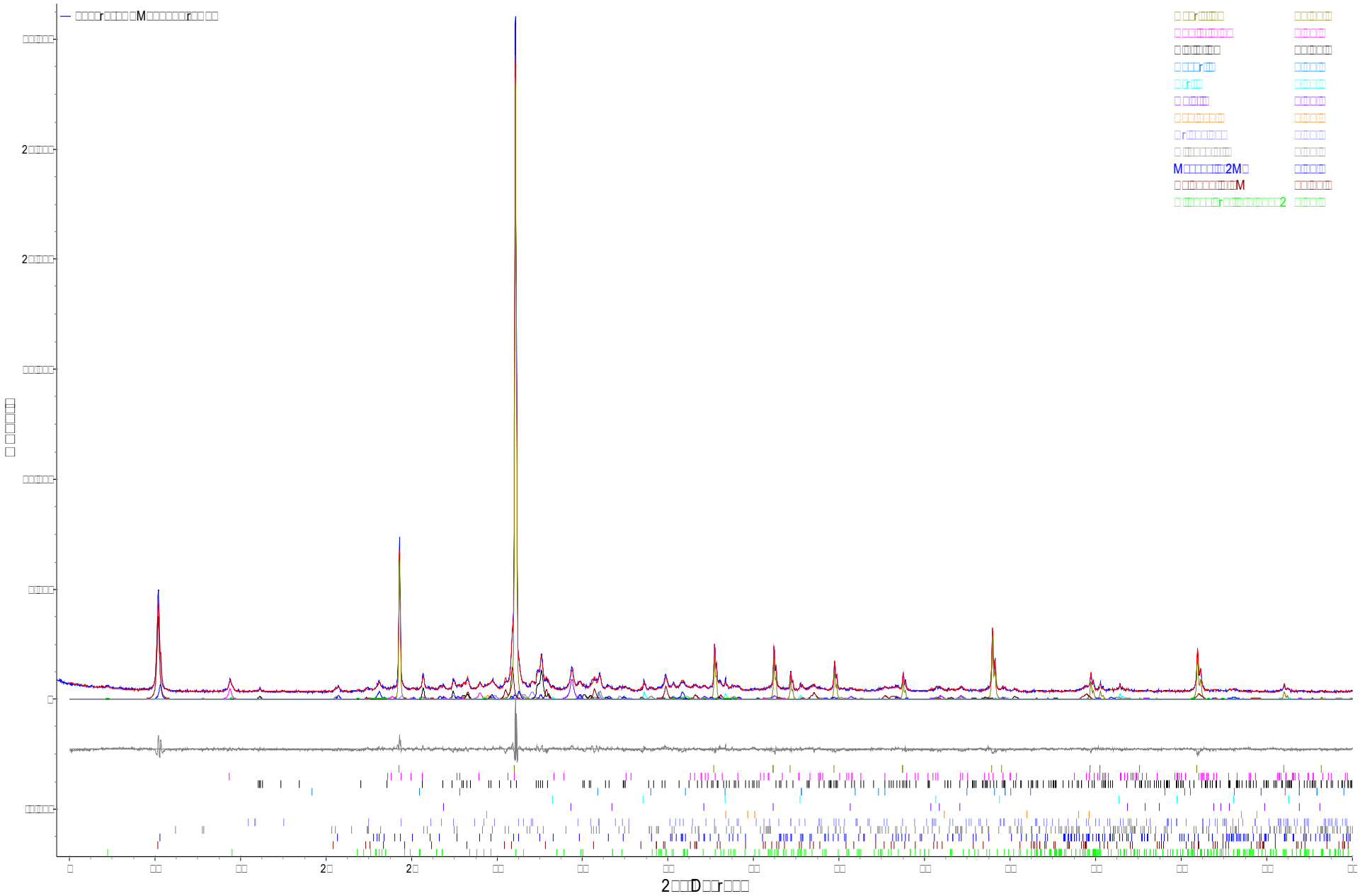

Figure 19. Rietveld refinement plot of sample **Lorax Environmental "KAM149916"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

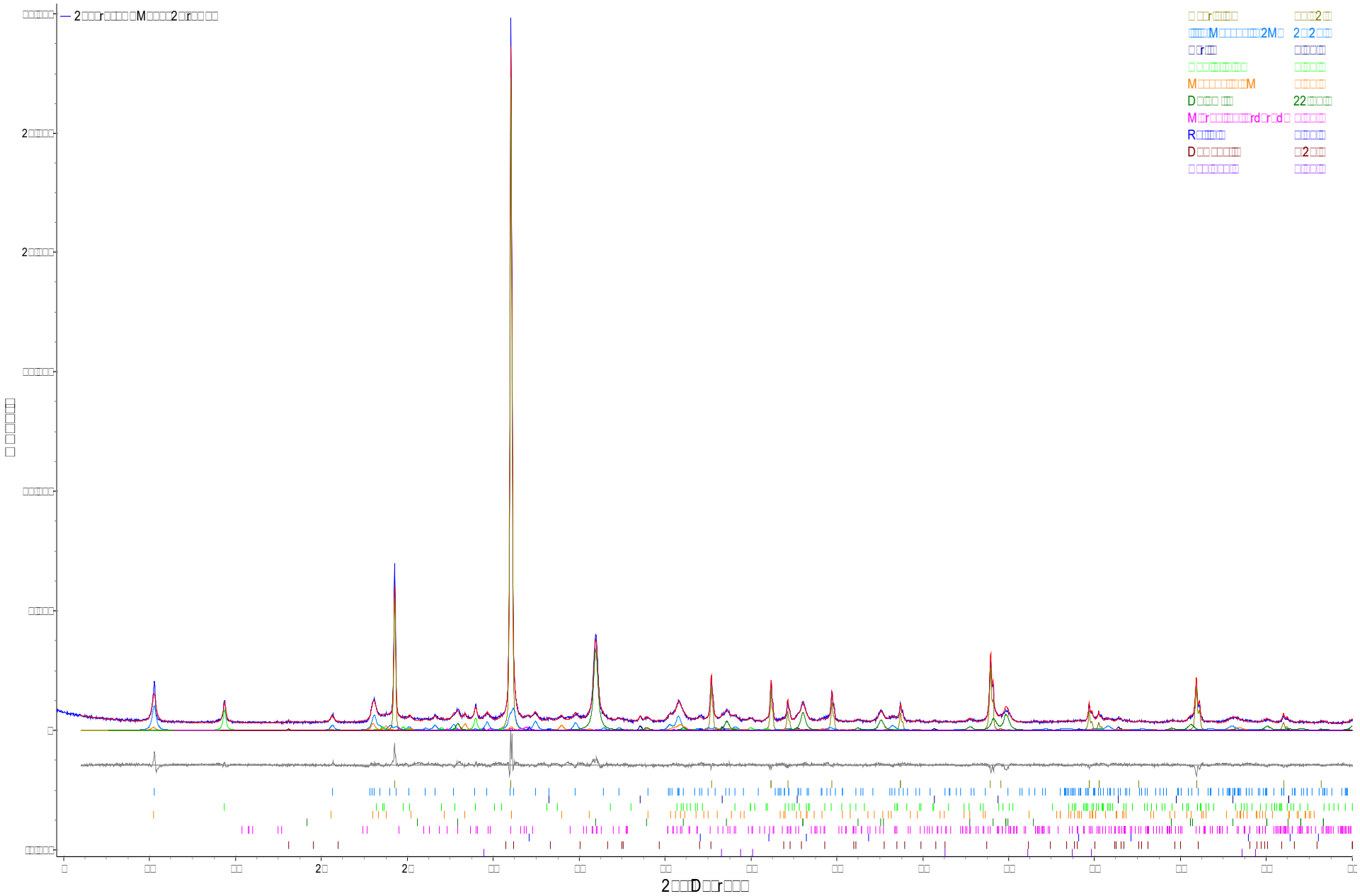

Figure 20. Rietveld refinement plot of sample **Lorax Environmental "KAM151027"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

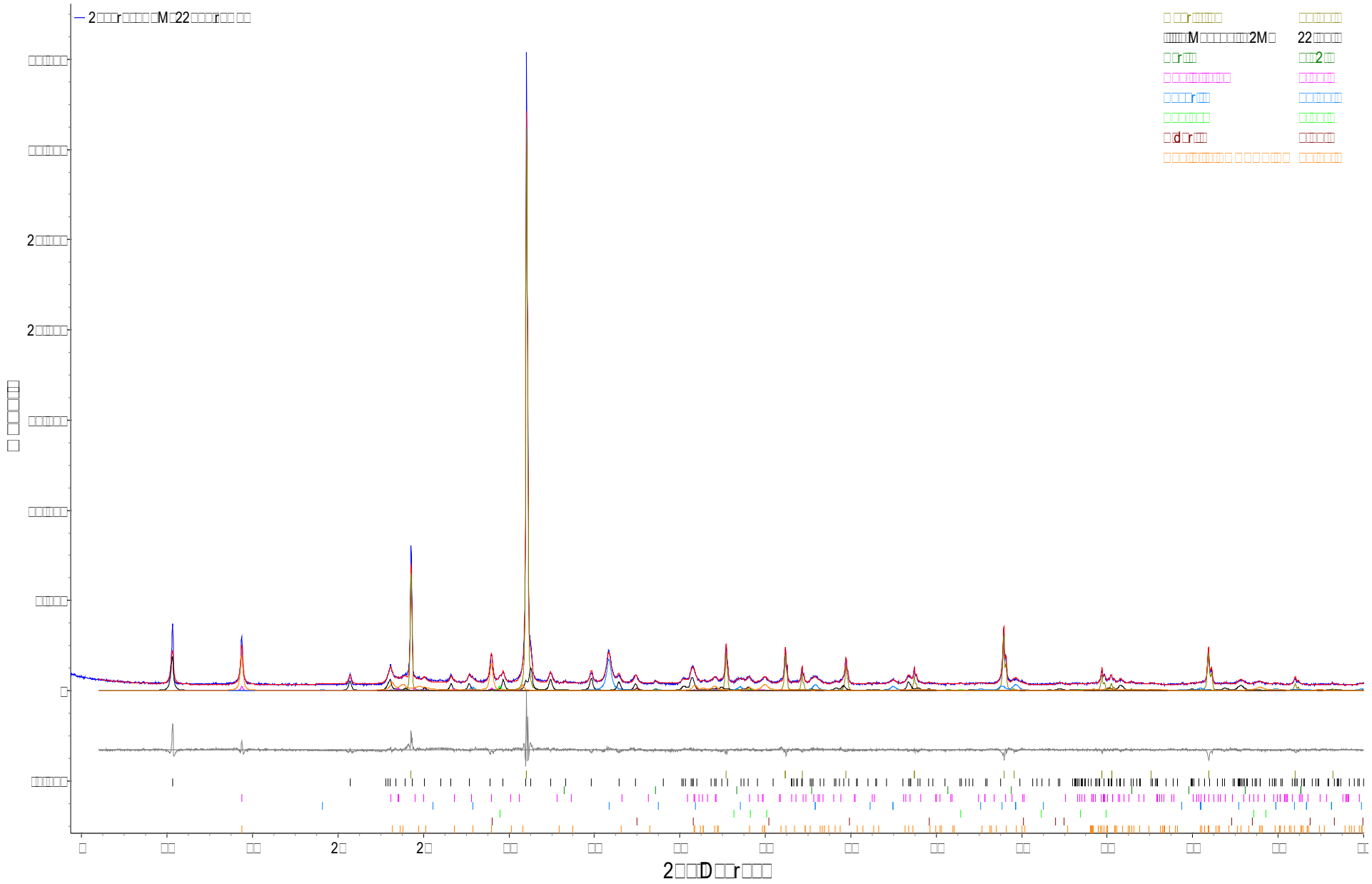

Figure 21. Rietveld refinement plot of sample **Lorax Environmental "KAM022156"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

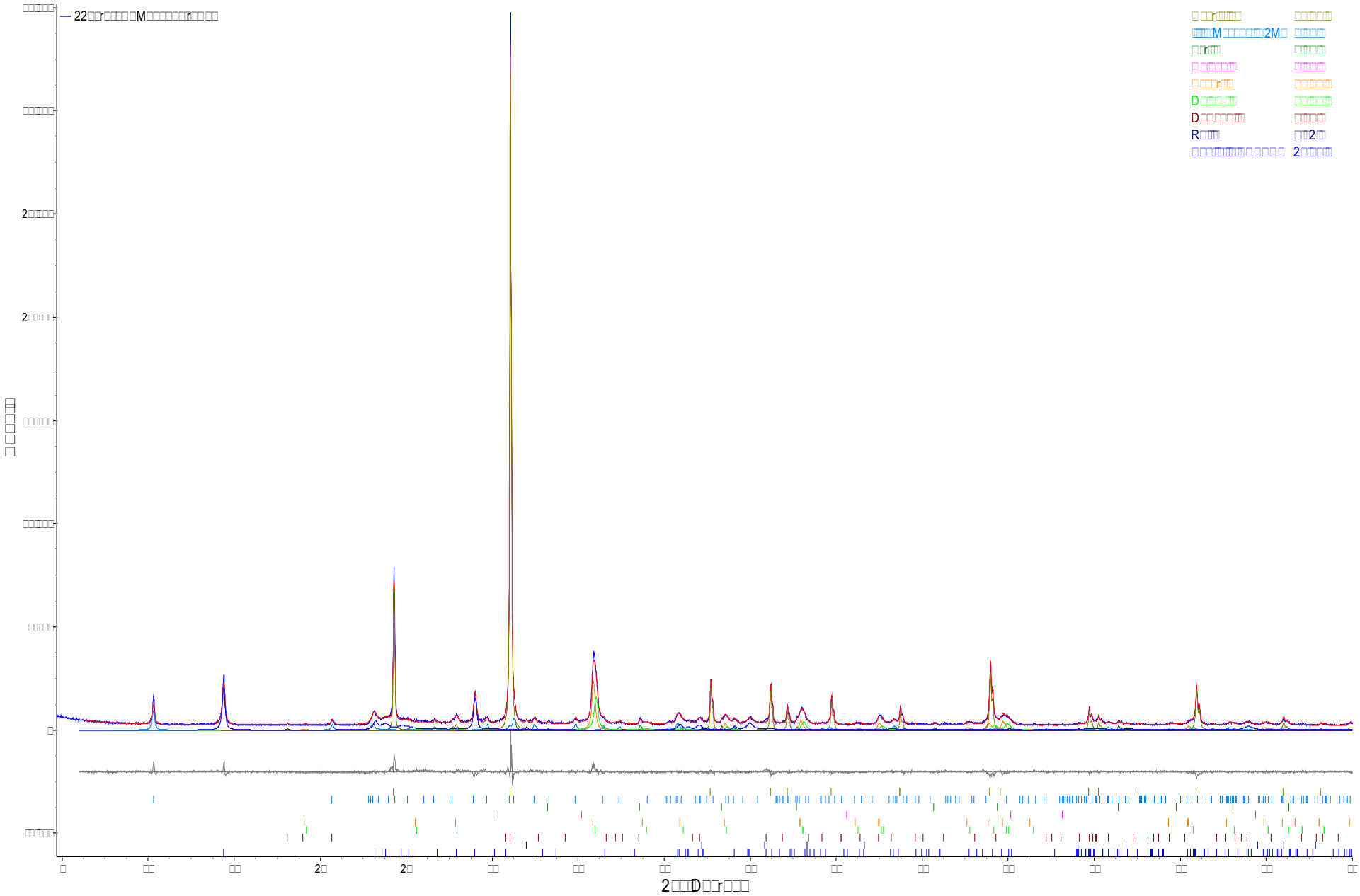

Figure 22. Rietveld refinement plot of sample **Lorax Environmental "KAM147059"** (blue line - observed intensity at each step; red line - calculated pattern; solid grey line below – difference between observed and calculated intensities; vertical bars - positions of all Bragg reflections). Coloured lines are individual diffraction patterns of all phases.

Appendix B.2: Mineralogical Assessments Completed at the Canadian Light Source

Report: Kaminak sample analyses at the Canadian Light Source

Prepared by: Viorica (Ibi) Bondici, Peter Blanchard, Samira Sumaila, and Joyce McBeth

Contact emails: joyce.mcbeth@usask.ca, vfb326@mail.usask.ca

Contact phone: 306-966-5764 (J. McBeth)

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2 PROJECT OBJECTIVES

The main objective of this project was to evaluate uranium (U), arsenic (As) and antimony (Sb) in Yukon gold mine ore using synchrotron-based techniques.

To achieve these objectives, the following analyses have been conducted:

1. Crystalline phase identification with powder X-ray diffraction (PXRD) for 18 Yukon gold mine waste rock and ore samples.
2. Oxidation state analysis with X-ray absorption near-edge structure (XANES) spectroscopy of U and As in the waste rock and ore samples.
3. Micro X-ray fluorescence (μ-XRF) mapping of various elements of interest.

3 BACKGROUND AND METHODS

Table 3.1 Sample ID and description

Sample ID	Lithology	Oxidation	Waste rock/Ore	[U] (ppm)*	[As] (ppm)*
SO waste	Schist	Oxide	Waste Rock	2.55	369
ST waste	Schist	Transition	Waste Rock	2.7	67
SS waste	Schist	Sulfide	Waste Rock	3.2	30
GO waste	Gneiss	Oxide	Waste Rock	5.5	218
GT waste	Gneiss	Transition	Waste Rock	6.3	182
GS waste	Gneiss	Sulfide	Waste Rock	6.1	86
72139B GRO ore	Granite	Oxide	Ore	9.6	3080
72140B GRT ore	Granite	Transition	Ore	9.7	5770
72135B	Schist	Oxide	Ore	2.6	1430
72137B	Schist	Transition	Ore	2.6	1340
72144B	Gneiss	Oxide	Ore	13.1	789
72146B GT ore	Gneiss	Transition	Ore	11	1700
KAM029385	Schist	Oxide	High U Waste Rock	25.4	1150
KAM079346	Schist	Transition	High U Waste Rock	22.2	130
KAM047252	Schist	Sulfide	High U Waste Rock	40.3	288
KAM091516	Gneiss	Transition	High U Waste Rock	41	62
KAM078808	Gneiss	Sulfide	High U Waste Rock	15.1	98
KAM144308	Gneiss	Oxide	High U Waste Rock	30	469

* Uranium and arsenic measured by aqua regia digestion and ICP-MS data provided by Lorax

3.1 Powder X-ray Diffraction (PXRD)

PXRD is a powerful tool used to characterize the crystal structures of materials. Each mineral possesses a characteristic X-ray diffraction pattern that can be matched against a database of recorded phases. PXRD data is produced when a monochromatic beam is projected onto a sample at an angle; this produces diffraction pattern peaks, which can be used as "fingerprints" to identify the mineral phases present. In this work synchrotron powder diffraction was performed using Debye-Scherrer transmission geometry and an area detector (Figure 3.1).

High-energy synchrotron powder diffraction measurements were conducted using the Macromolecular Crystallography beamline (CMCF2) at the Canadian Light Source. CMCF2 is a bending magnet beamline with a Si (111) double crystal monochromator. The samples were ground and loaded into 1.5 cm long 0.032 inch polyimide capillary tubes and sealed at both ends with Loctite 454 gel epoxy. The samples and a lanthanum hexaboride (LaB_6) standard were analysed on CMCF2 at a wavelength of 0.68878Å (energy: 18 KeV). 2D diffraction patterns were collected on a Rayonix MX300HE detector at a distance of 200 mm. The 2D X-ray diffraction patterns were calibrated and integrated using GSASII software (Toby and Von Dreele, 2013). The LaB_6 was used to calibrate the sample-detector distance, detector centering, and detector tilt. The calibration parameters obtained were applied to the entire pattern before integration. Mineral phases were identified by matching the diffraction patterns of the samples to the patterns of reference single-phase mineral. The Inorganic Crystal Structure Database was used in combination with X'Pert HighScore Plus (PW3212) software. Elemental abundance ICP-MS data (provided by Lorax) were taken into consideration for the identification of the main phases present in the samples. Quantitative Reitveld refinement calculations were conducted on the data to provide quantitative estimates of identified mineral abundances in the samples. The synchrotron-based PXRD detection limit can be as low as 0.1% of total mineral phases; however, proportions of minor phases (1 % or

less) are generally interpreted to be semi-quantitative, due to the influence of factors such as differing amorphous content between samples and sample inhomogeneity.

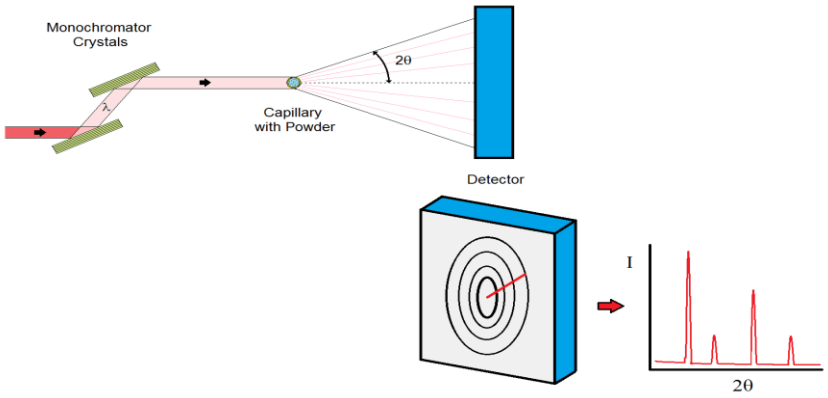


Figure 3.1 Schematic diagram of PXRD using Debye-Scherrer geometry

3.2 µ-X-ray fluorescence mapping (µXRF) mapping

Synchrotron X-ray fluorescence is a powerful approach for probing and mapping the distribution of a range of elements in a given sample. The principle of XRF is based on the detection of X-ray photons emitted from elements irradiated with X-rays. The emitted X-ray photon energies are element specific, providing a unique identification pattern for each element.

µ-XRF maps were collected on the Very Sensitive Elemental and Structural Probe Employing Radiation from a Synchrotron (VESPERS) beamline at the Canadian Light Source. Maps were collected using a pink beam (meaning the photon beam consists of a wide range of energies, max 20 keV) and several maps were collected monochromated for uranium (17199 eV). Maps were generally 300 x 300 µm in size (some smaller maps as well), collected with 5 x 5 um steps and a 1 s dwell time at each point. The beam spot size was on the order of 3 µm. µXRF spectra were collected for the following element regions of interest (ROIs), Ca K_α, Ti K_α, V K_α, Cr K_α, Mn K_α, Fe K_α – K_β, Ni K_α, Cu K_α, Zn K_α, Ga K_α, Ge K_α, As K_α-K_β, Se K_α, Rb K_α-K_β, Sr K_α-K_β, Pb L_α-L_β, Th L_α, and U L_α-L_β.It is important to note that elements with emission spectra that fall below

the Ar emission energy (2950.7 eV), such P (2013.7 eV) cannot be detected on this beamline. The complete μ-XRF spectra were also collected for each map pixel and any additional peaks were identified in the integrated map spectrum. Antimony peaks were specifically searched manually in the integrated spectra. MicroAnalysis Toolkit (SMAK) was used for the XRF image analyses.

3.3 X-ray absorption near-edge spectroscopy (XANES)

Each element has a characteristic energy at which it absorbs X-rays, termed the X-ray absorption edge; features of this edge and the absorption features of the element on either side of the edge can provide us with information about the oxidation state and coordination environment of the element of study. X-ray absorption near-edge structure (XANES) is part of the X-ray absorption spectrum in general ranging from -50 eV and +100 eV relative to the absorption edge, and XANES provides information about the oxidation state of the element of interest.

Arsenic and uranium μXANES spectra were collected at the CLS VESPERS beamline. For arsenic, the beamline was calibrated to an arsenic foil at the arsenic K-edge (binding energy of the K-shell electrons of arsenic) (11871.7 eV). The XANES spectra were collected by scanning through the As Kα absorption edge over 3 energy regions: -100 eV to -30eV in 10 eV steps; -30 eV to +40 eV in 0.5 eV steps; and +40 eV to +5K in 0.05 K steps. The dwell time for each step was 5 s and four spectra were collected for each sample to improve the signal to noise ratio and check for beam damage of the sample (the position and morphology of the edge in consecutive scans may change if the beam damages the sample). For uranium, the beam was calibrated to a yttrium foil (17038 eV) and a small μXRF map was collected for each sample at an energy of 17166 eV to search for U hotspots. For samples where a U hotspot was identified, U L_3 data was collected over the following energy regions: -100 eV to -30eV in 10 eV steps; -30 eV to +40 eV in 0.5 eV steps; and +40 eV to +5K in 0.05 K steps. The dwell time varied between 5-30 s depending upon the intensity of the U signal in each sample. Between 3 and 5 spectra were collected for each sample.

The Hard X-ray Micro-Analysis (HXMA) beamline was also used to obtain U XANES spectra. HXMA has both a higher photon flux hitting the sample and a more sensitive detector, which generally allows detection of much lower concentrations of U and transition

elements. However HXMA is used for bulk analyses, so for very localized spots of U VESPERS may sometimes be a more sensitive tool, because the beam can be focussed on a very small region on the sample. The HXMA beamline was calibrated to a yttrium foil at the first inflection point of the K absorption edge (17038 eV) and the uranium spectra were collected at the L_3 edge (17166 eV) over 5 energy regions: -200 eV to -160 eV, 10 eV steps; 160 eV to -100 eV, 0.5 eV steps (covering the yttrium foil calibration standard); -100 eV to -30 eV, 10 eV steps; -30 eV to +40 eV, 0.5 eV steps (uranium edge); and +40 eV to 14.2K, 0.05K steps. The dwell time for each step was 1 s.

XANES data analyses were performed using the ATHENA software suite (Demeter v. 0.9.22). In general, XANES spectra analyses provide information about the oxidation state of a given element and linear combination fitting (LCF) allow us to quantify relative abundance of species in a multi-species sample; however, the mineral phase of the element cannot be determined conclusively with this method alone. The oxidation state of each spectrum was extrapolated by comparing the absorption spectra of the samples to those of standards.

4 RESULTS AND INTERPRETATION

4.1 PXRD data

Detailed Reitveld analytical data diagrams are presented in the Appendix.

Table 4.1 Identified mineral phase in the ore samples

Sample ID	**72144B**	**72146B**	**72137B**	**72139B**	**72135B**	**72140B**
Lithology	**Gneiss**	**Gneiss**	**Schist**	**Granite**	**Schist**	**Granite**
Weathering	**Oxide**	**Transition**	**Transition**	**Oxide**	**Oxide**	**Transition**
Mineral	**Quant (wt. %)**					
Quartz	54.1	47.1	45.9	54.5	48.1	55.8
Microcline	8.5	12.3	4.1	10.5	17.7	7.3
Muscovite	11.9	10.4	13.1			18.1
Kaolinite	7.2	6.3	7.9	11.7	10.3	9.3
Phengite	18.2	7.7	7.3	21.8	9.2	
Albite		7.2			9.2	

Arsenopyrite		0.9			0.8	
Dolomite		3.4	15		3.5	
Scorodite				1.3		2.1
Barite*			0.5		0.2	
Calcite		2.5	4			
Orthoclase					0.9	7.3
Biotite			1.8			
Pyrite*		0.4	0.9	0.2	0.2	
Magnesiohornblende		1.7				

*Note: The synchrotron-based PXRD detection limit can be as low as 0.1% of total mineral phases; however, proportions of minor phases (1 % or less) are generally interpreted to be semi-quantitative, due to the influence of factors such as differing amorphous content between samples and sample inhomogeneity.

Table 4.2 Identified mineral phases in the waste samples

Sample ID	**SS**	**GS**	**GT**	**GO**	**SO**	**ST**
Lithology	**Schist**	**Gneiss**	**Gneiss**	**Gneiss**	**Schist**	**Schist**
Weathering	**Fresh**	**Fresh**	**Transition**	**Oxide**	**Oxide**	**Transition**
Mineral	**Quant (wt. %)**					
Pyrite*	1.3	0.2	0.2		0.4	0.2
Dolomite	14.4		3.6		3.5	
Quartz	29.8	38.5	49.9	46.2	53.2	28.2
Microcline	11.8	14.1	16.2	22	5.1	
Barite	0.3					
Calcite	5.1	2.3				10.6
Phengite	7.2		1.9		7.3	
Magnesium calcite	4.9	0.7	0.7		3.9	
Albite	12.8	22.3	8.4	11.3		18.5
Biotite	5.7					9.1
Muscovite		12.5	9	10.4	10.9	
Kaolinite	6.8	9.3	9.6	10.2	13.3	5.1
Arsenopyrite*			0.5			
Ankerite					2.3	
Orthoclase						11.1
Magnesiohornblende						3.3
Grossular						7.8
Diopside						6.2

*Note: The synchrotron-based PXRD detection limit can be as low as 0.1% of total mineral phases; however, proportions of minor phases (1 % or less) are generally interpreted to be semi-quantitative, due to the influence of factors such as differing amorphous content between samples and sample inhomogeneity.

Table 4.3 Identified mineral phases in the high uranium waste rock (KAM) samples

Sample ID	**078808**	**091516**	**144308**	**047252**	**079346**	**029385**
Lithology	**Gneiss**	**Gneiss**	**Gneiss**	**Schist**	**Schist**	**Schist**
Weathering	**Fresh**	**Transition**	**Oxide**	**Fresh**	**Transition**	**Oxide**
Mineral	**Quant (wt. %)**					
Albite	55.9	7.3				
Quartz	29.1	15.5	55.6	41	34.9	50.2
Phengite			10.1	3.1	12.2	21
Kaolinite	1.7	12.7	9.6	10.9	21.2	20
Dolomite	4.9	6.3		7.9	11.5	
Pyrite*	0.7			0.6		
Microcline		27.9	24.4		10.4	6.5
Magnesium calcite		7.1				
Calcite	0.5	6.7		2		
Phlogopite		14.1				
Ankerite		2.4		11	9.8	
Barite*			0.2			
Muscovite	7.2			22.3		
Pyrite, arsenian				0.8		

Manganese sulfide*				0.4		
Diopside						2.2

*Note: The synchrotron-based PXRD detection limit can be as low as 0.1% of total mineral phases; however, proportions of minor phases (1 % or less) are generally interpreted to be semi-quantitative, due to the influence of factors such as differing amorphous content between samples and sample inhomogeneity.

4.1 µXRF maps

4.1.1 Uranium in µXRF maps

µXRF maps were collected using a pink beam (broad energy spectrum) for 18 samples and the distribution of 6 elements (U L_α, Zn K_α, Fe K_α, Ca K_α, As K_β, Sr K_α) is shown for each sample in Figure 4.1-4.3 and Figure 7.8- 7.23. Monochromated uranium µXRF maps were also collected prior to the µXANES analyses performed on the VESPERS beamline. It is important to note that the emission peaks of Rb L_α and U L_α partially overlap; therefore, U can be either masked or appear as a false positive when Rb is present in the sample. Potential presence of Rb is also indicated on the U XRF maps labeled as U L_α / Rb L_α. In addition, U and Rb often occur together, so each putative uranium hotspot region was inspected manually to ensure that the true uranium hotspots are correctly identified in the data. All the samples were examined, and true U hotspots were detected only in 5 KAM samples, 1 ore and 2 waste samples (Figure 4.4, 4.5, 7.1, U hotspot regions are highlighted in the U/Rb XRF maps). Though the concentration of U in the GO and GS waste samples was relatively low (5.5 and 6.1 ppm, respectively; ICP-MS data), we still observed verified U hotspots in these samples. This indicates that even though U concentrations were low, U occurred as highly concentrated particles. These particles are likely evenly dispersed in these ground samples since they were observed in duplicate XRF maps for the GS waste sample.

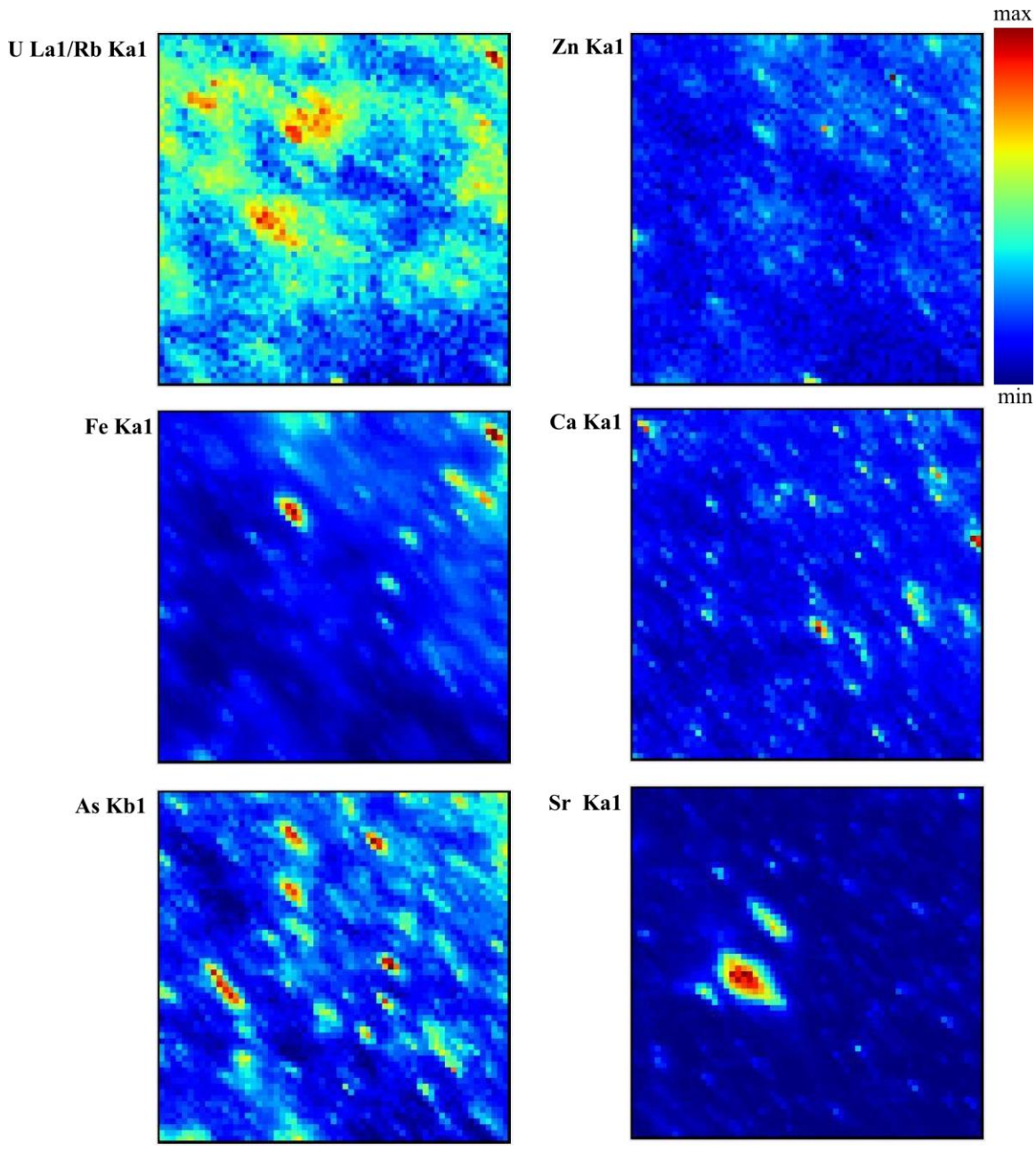


Figure 4.1 XRF elemental distribution maps of 72144B sample
X-ray fluorescence intensities of the elements are scaled between red (maximum) and blue (minimum).

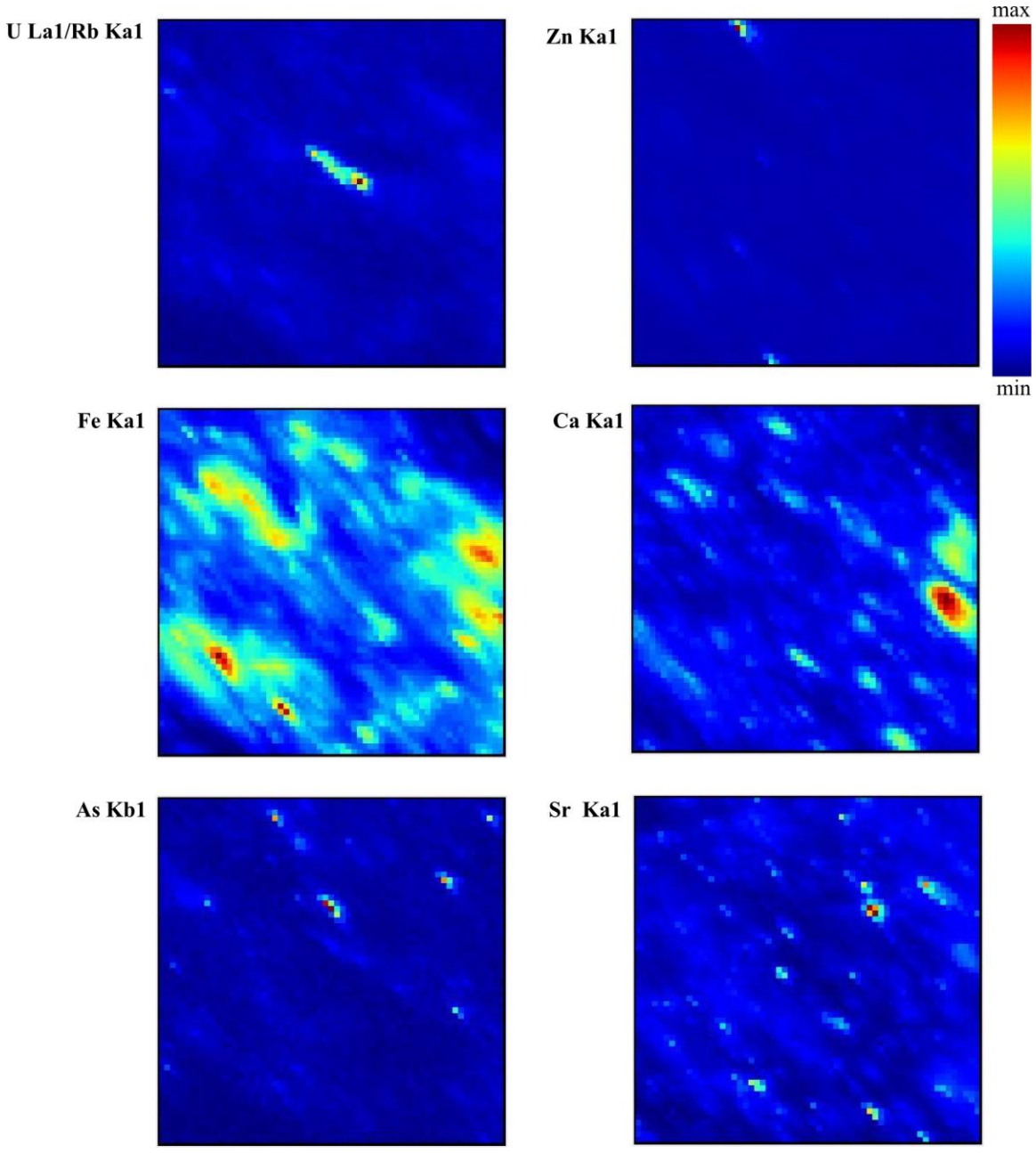

U La1/Rb Ka1
Zn Ka1
max
min
Fe Ka1
Ca Ka1
As Kb1
Sr Ka1

Figure 4.2 XRF elemental distribution maps of GS waste
X-ray fluorescence intensities of the elements are scaled between red (maximum) and blue (minimum).

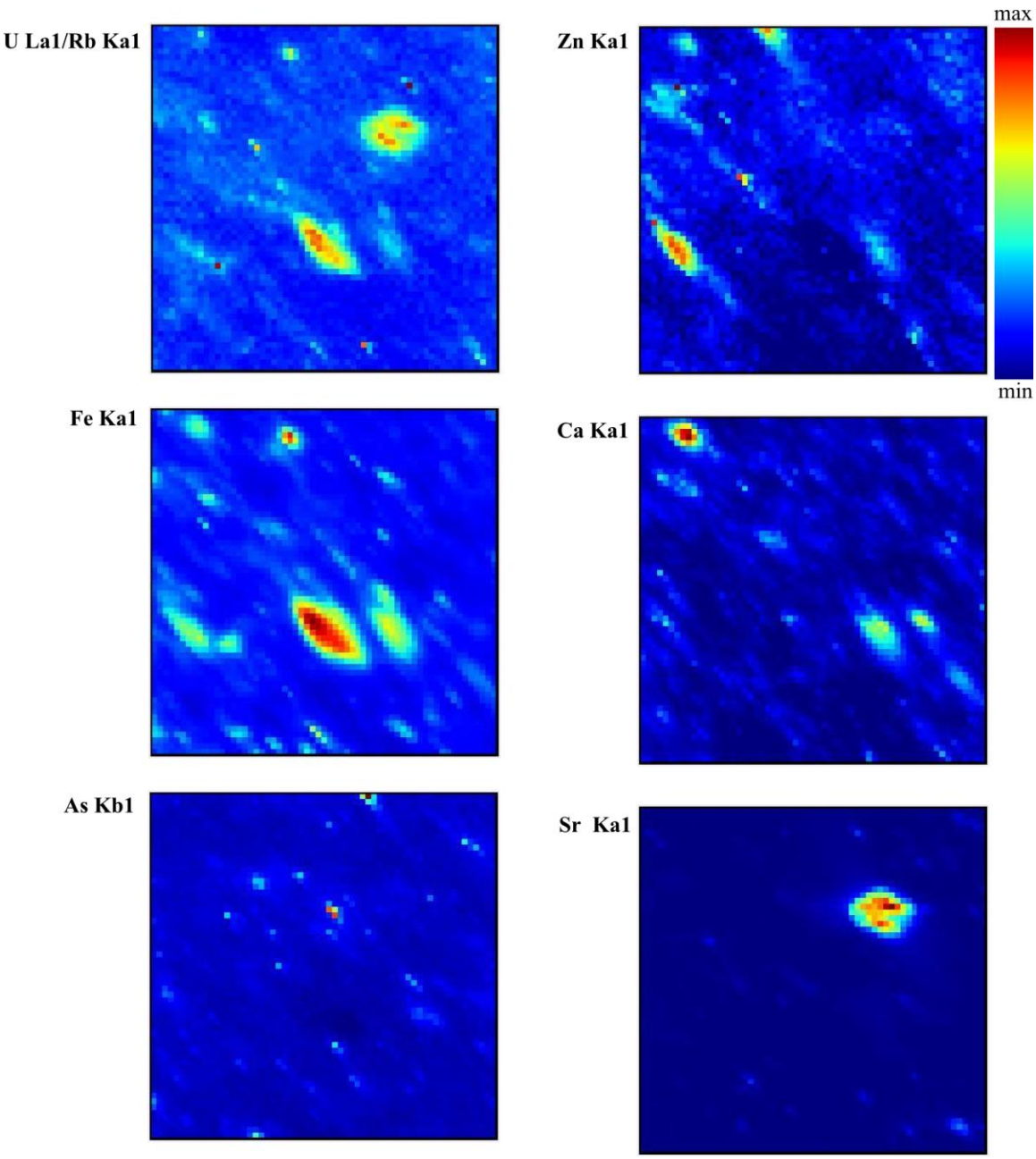
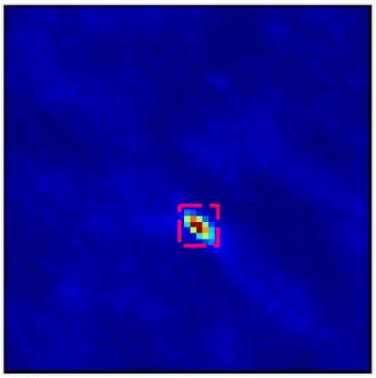
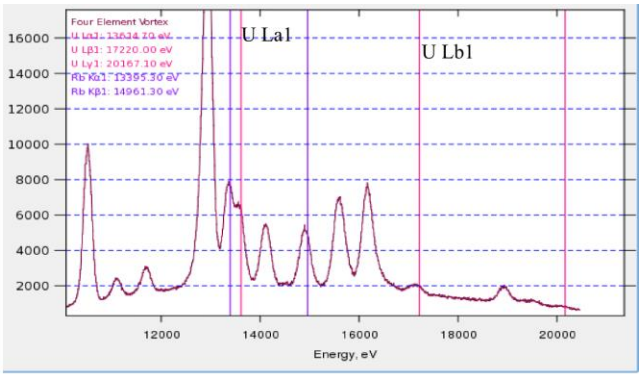
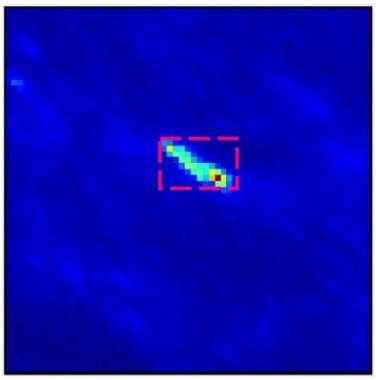


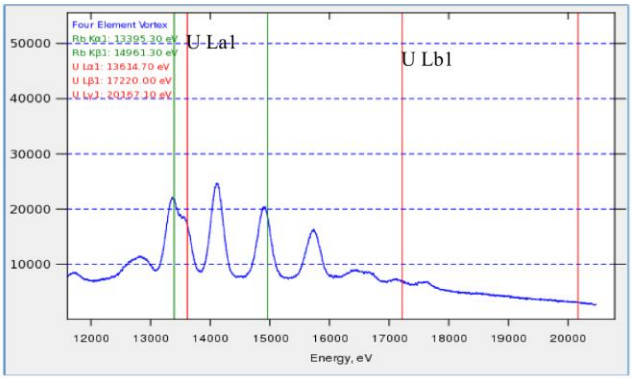
Figure 4.3 XRF elemental distribution maps of KAM078808 sample
X-ray fluorescence intensities of the elements are scaled between red (maximum) and blue (minimum).



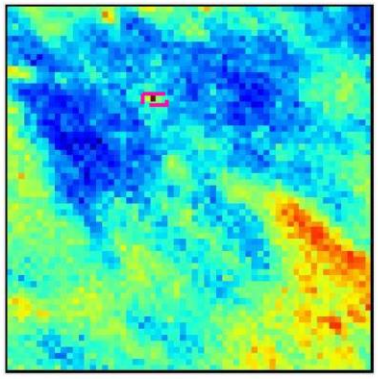


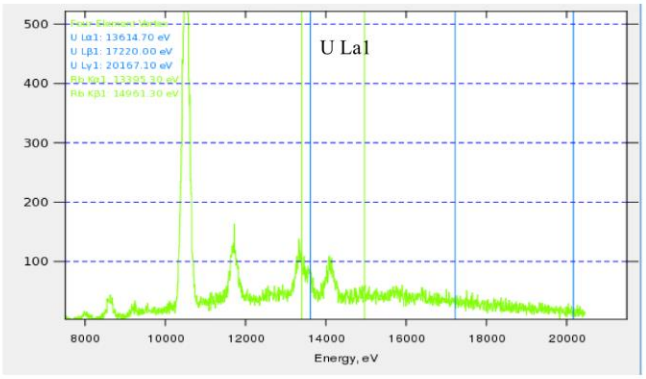
GO waste





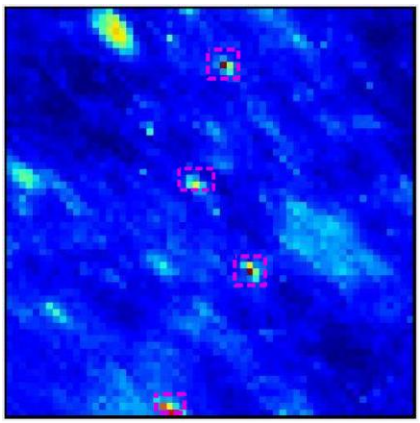
GS waste

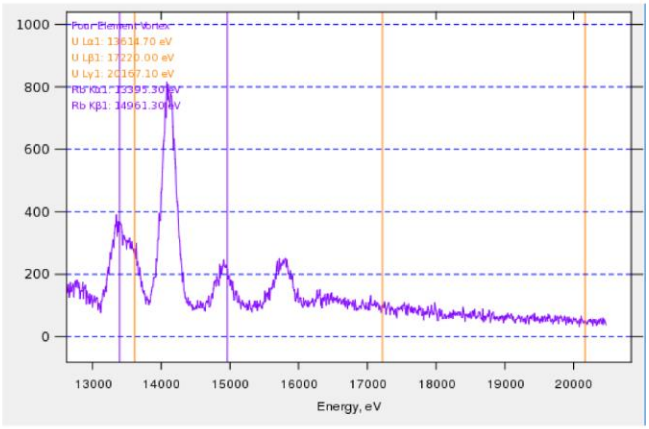




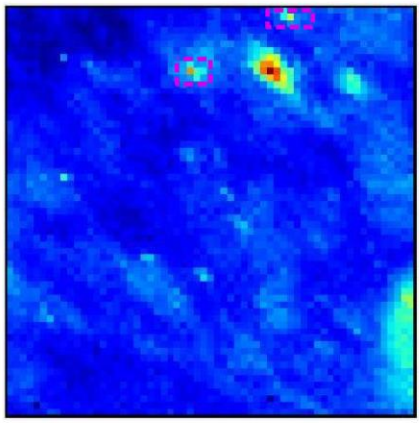
GT ore

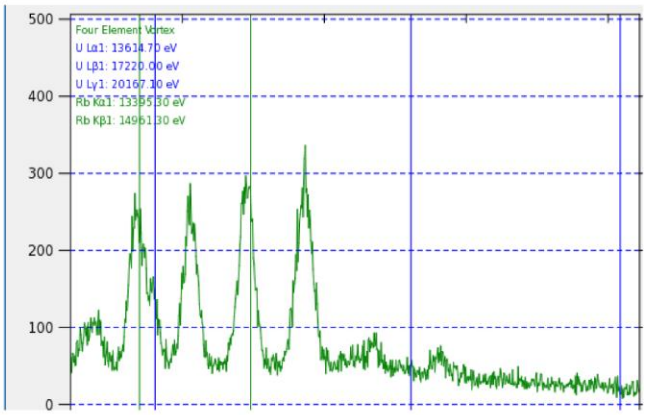
Figure 4.4 Verified U hotspots and corresponding spectra identified on the U/Rb XRF maps. These regions are marked with purple boxes**.**



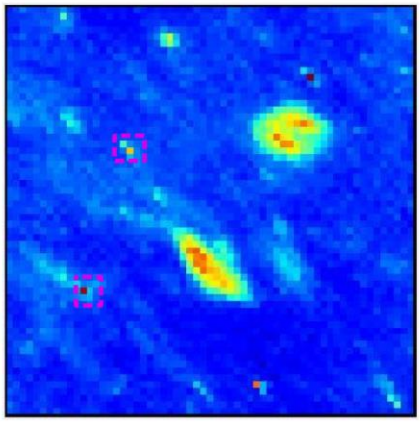


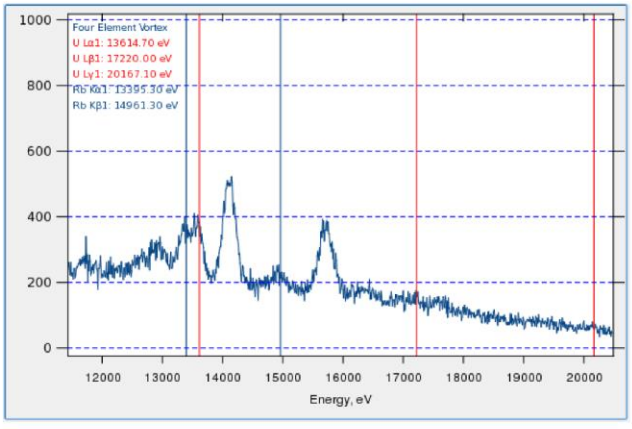
KAM047252





KAM091516





KAM078808

Figure 4.5 Verified U hotspot regions and corresponding spectra identified on the U/Rb XRF maps. These regions are marked with purple boxes.

4.1.2 Tri-colour µXRF maps

In order to investigate the presence of different types of primary (e.g. brannerite, thorite) and secondary (e.g. autunite, carnotite, torbernite, uranophane) uranium minerals in the samples, the co-occurrence of U with a range of elements (Ti, Th, V, Ca, Cu, As) was checked. Various As-bearing minerals were also checked by looking at potential association of As with Fe and Ca. Colour maps were prepared to illustrate the following co-localization patterns for elements that showed association with U and As: U/Fe/As, Ca/Fe/As, U/Th, and U/Ti.

Tri-colour plots illustrating co-localization of U with Fe and As are shown in Figure 4.6. From these images it is evident that U tends to co-occur with Fe, as indicated by purple coloured regions. Spatial overlapping of As with U and Fe is also visible (indicated with greenish/yellowish coloured regions) in GO waste and KAM047242 samples (Figure 4.6). The arsenic-bearing iron mineral phase arsenian pyrite has been identified in the KAM047242 using PXRD analysis (Table 4.3). Co-localization of U with Th and Ti is illustrated in Figure 4.7. Spatial overlap of U with Th is visible in KAM144308 and GO waste samples and of U with Ti in KAM091516 and GS waste samples.

To investigate the presence of Ca-Fe arsenate phases (such as yukonite) in the samples tri-colour plots were constructed for As, Ca and Fe (Figure 4.8; Figure 7.3). Distinct purple regions are visible in each sample, indicating that As tend to co-occur with Fe; however, distinct red regions in KAM091516, KAM078808, KAM047252, 72144B, 72135B, GS waste and GT waste samples indicate As is present at far higher concentrations than Fe in those regions (Figure 7.3). Only one whitish region was observed that indicates the co-occurrence of As, Ca, and Fe; this was in the 72137B sample (Figure 4.8). To test this apparently relationship, we sub-selected scatter-plotted data points from this map that had the following relationships: high As/high Fe, high As/high Ca, and high Fe/low Ca (Figure 4.10). This analysis confirmed that the whitish region was relatively high in Ca/Fe/As, and distinct from the surrounding region that was high in Fe but low in Ca (Figure 4.10, high Ca/Fe/As region outlined in red). For most of the samples, As was correlated with Fe.. An example of this Fe and As relationship is

presented for the GRT ore sample (Figure 4.9). This is in agreement with the PXRD analysis where scorodite was identified in the sample (Table 4.2). Overall, these findings suggest that yukonite or other Ca/Fe/As phases could be present, however they are certainly not as prevalent in the samples as Fe/As phases, such as scorodite. A summary table of μXRF map data and spatial overlap of U and As with various elements are summarized in Table 4.4.

Table 4.4 Summary table of As and U microXRF analyses

Sample ID	micro XRF map	Verified Uranium spots	SPATIAL OVERLAP**							
			U/Fe	As/U/Fe	Ca/U	Cu/U	Ti/U	Th/U	Fe/As	As/Ca/Fe
SO waste	✓	**ND**							✓	
ST waste	✓	**ND**							✓	
SS waste	✓	**ND**							✓	
GO waste	✓	✓	✓	✓	✓	✓		✓	✓	
GT waste	✓	**ND**							✓	
GS waste	✓	✓	✓			✓	✓		✓	
GRO ore	✓	**ND**							✓	
GRT ore	✓	**ND**							✓	
72135B	✓	**ND**							✓	
72137B	✓	**ND**							✓	✓
72144B	✓	**ND**							✓	
GT ore	✓	✓							✓	
KAM029385	✓	**ND**							✓	
KAM079346	✓	✓	✓		✓				✓	
KAM047252	✓	☑	✓	✓	✓				✓	
KAM091516	✓	☑	✓		✓	✓	✓		✓	
KAM078808	✓	☑	✓			✓			✓	
KAM144308	✓	☑	✓		✓	✓		✓	✓	

*pink beam – broad energy spectrum
**spatial overlap- is not necessarily correlation
blank boxes indicate a lack of co-occurrence, all possible combinations in the table have been checked
☑- indicate multiple U spots were detected

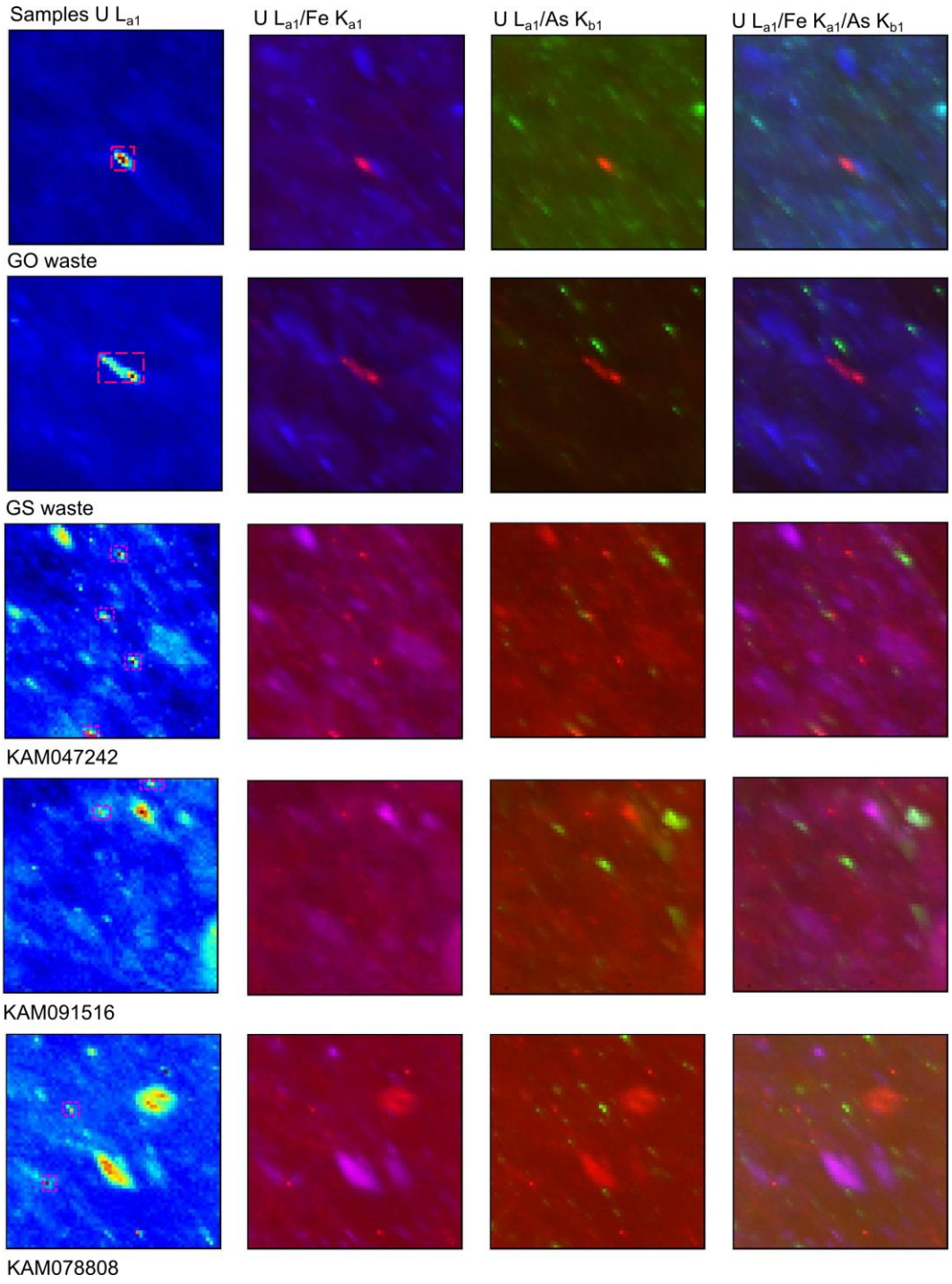

Samples U L_{a1}
U L_{a1}/Fe K_{a1}
U L_{a1}/As K_{b1}
U L_{a1}/Fe K_{a1}/As K_{b1}
GO waste
GS waste
KAM047242
KAM091516
KAM078808

Figure 4.6 Tri-colour mapping plot of U, As and Fe
(Red=U, Green=As, Blue=Fe)

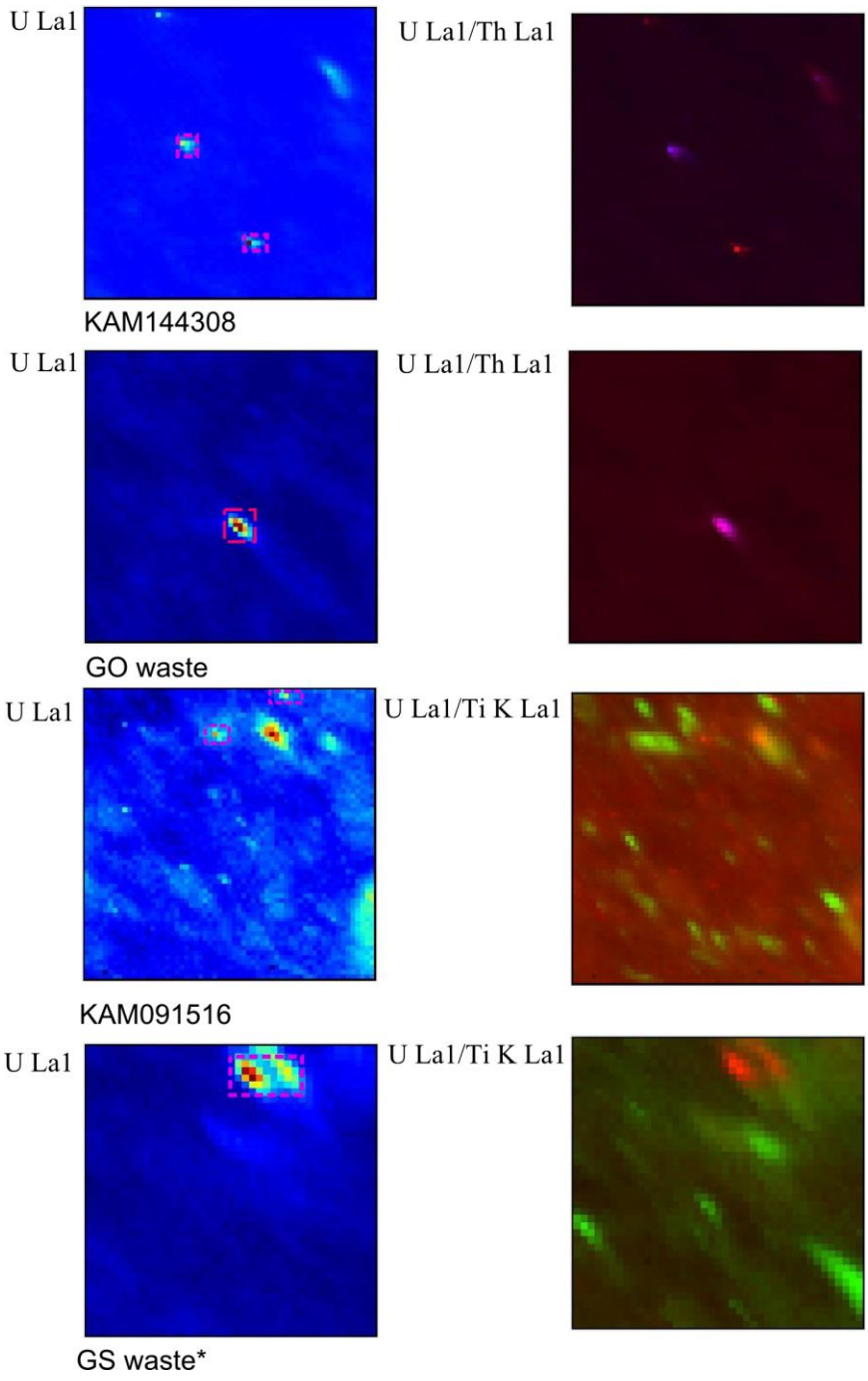
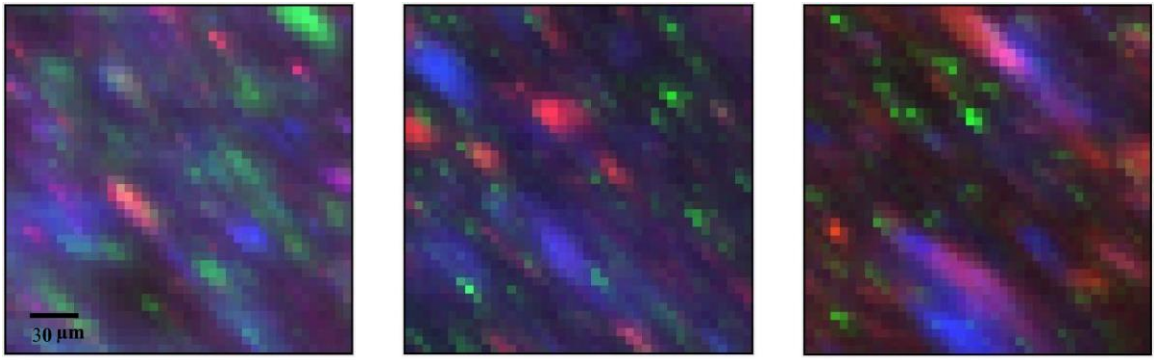


Figure 4.7 Colour map of U-Th and U-Ti

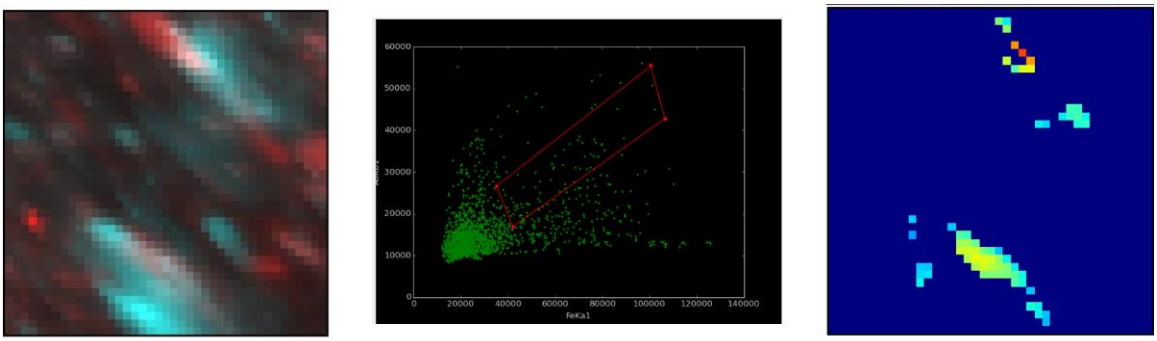
(Red=U, Blue=Th; Red=U, Green=Ti)



72137B GRO ore GRT ore

Figure 4.8 Tri-colour mapping plot of As, Fe and Ca

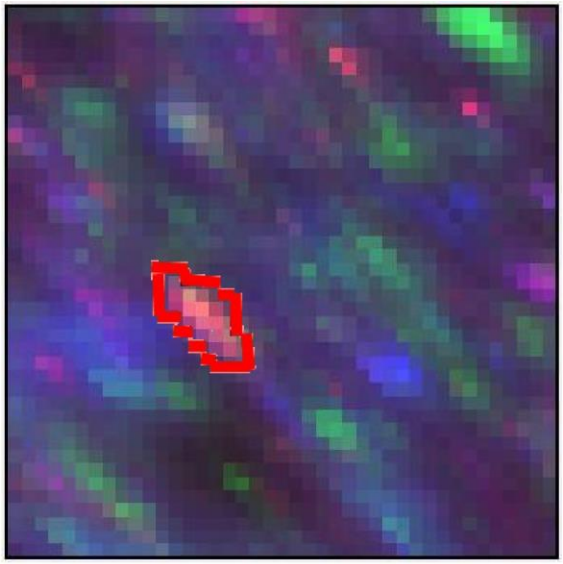
(Red=As, Green=Ca, Blue=Fe)



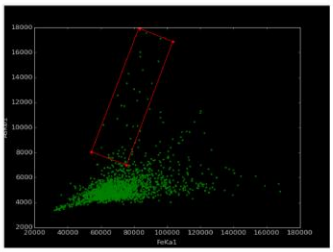
GRT ore Fe Ka1-As Kb1 scatter plot Fe Ka1-As Kb1 selected plot corresponding As region

Figure 4.9 Colour map and scatter plot of As and Fe

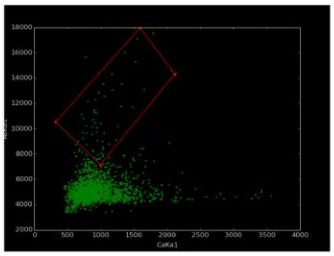
(Red=As, Cyan=Fe)



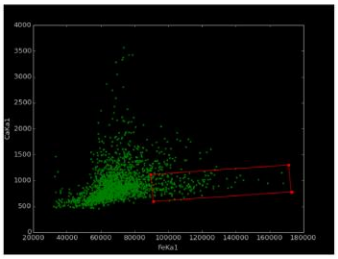
72137B



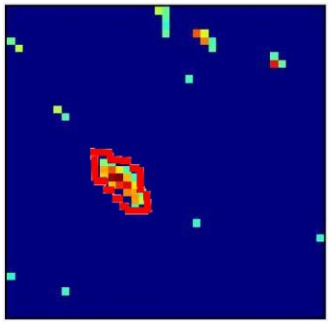
Fe Ka1-As Kb1 scatter plot



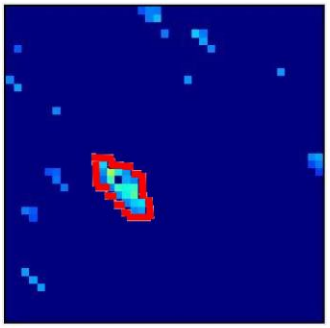
Ca Ka1-As Kb1 scatter plot



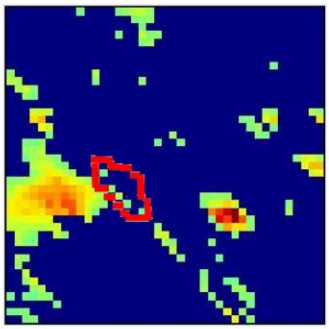
Fe Ka1-Ca Ka1 scatter plot



Fe Ka1-As Kb1 marked plot
corresponding As region



Ca Ka1-As Kb1 marked plot
corresponding Ca region



Fe Ka1-Ca Ka1 marked plot
corresponding Fe region

Figure 4.10 Tri-color and scatter plot of As, Ca and Fe

(Red=As, Green=Ca, Blue=Fe)

4.2 Arsenic µXANES data

Figure 4.11 compares the As K-edge XANES spectra of 10 samples to 5 standards with known oxidation state. To extrapolate oxidation state of As the following standards were used: scorodite ($FeAsO_4 \cdot 2H_2O$; As^{+5}), Ca-arsenate ($Ca_3(AsO4)_2$; As^{+5}), and yukonite ($Ca_3Fe(AsO_4)_2(OH)_3 \cdot 5H_2O$; As^{+5}), orpiment (As_2S_3; As^{+3}), and arsenopyrite (FeAsS; As^{-1}). Comparison of these spectra indicates that As is in oxidized form (As^{+5}) in 6 samples, (KAM144308, KAM029385; 72139B, 72144B, 72135B, 72140B, Figure 4.11A). Four samples contain both oxidized and reduced As species (72137B, 72146B, KAM078808, GS waste, figure 4.11B).

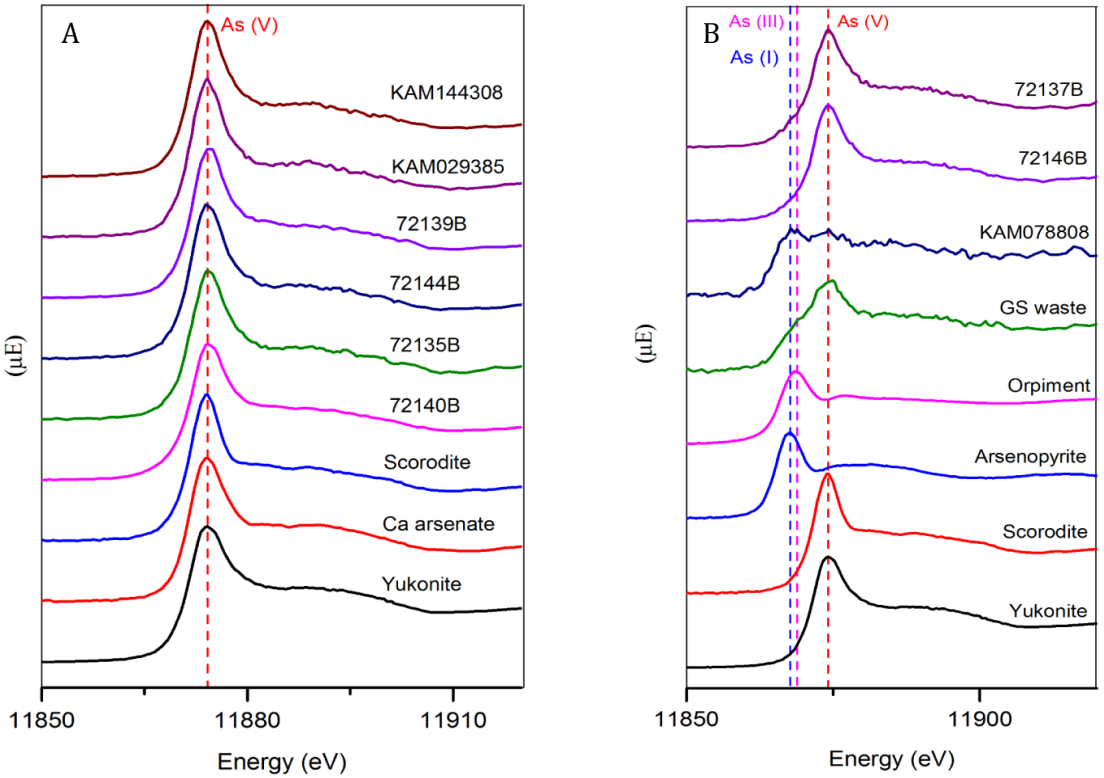


Figure 4.11 Arsenic K-edge µXANES spectra

The As K-edge spectra of the samples were further analyzed using the linear combination fitting (LCF) method. Since scorodite and arsenopyrite were identified in some of the samples using PXRD, we used these standards for the LCF analyses; orpiment was selected as the As^{3+} standard because it is a common As^{3+} mineral with a unique absorption edge energy that is different from other arsenic (III) oxides, therefore it is relatively easy to identify this oxidation state (examples of LCF results are shown in Figure 4.12). The relative abundance of As^{+5}, As^{+3}, and As^{-1} containing compounds represented by scorodite, orpiment, and arsenopyrite, respectively, are summarized in Table 4.5.

It is important to note that the XANES spectra analyses provide information about the oxidation state of As and allows quantification of relative abundance of the identified oxidation species; however, mineral phases cannot be determined unless additional complementary methods are used and there is detectable mineral phase present. Therefore, relative abundance of scorodite and arsenopyrite can be determined using XANES analyses in those samples in which these mineral phases were identified using PXRD (Table 4.5). Since orpiment was not identified by PXRD in any of the samples, and no other As^{+3} minerals were identified, orpiment was selected to represent the As^{+3} oxidation state and relative abundance of As^{+3} mineral phase.

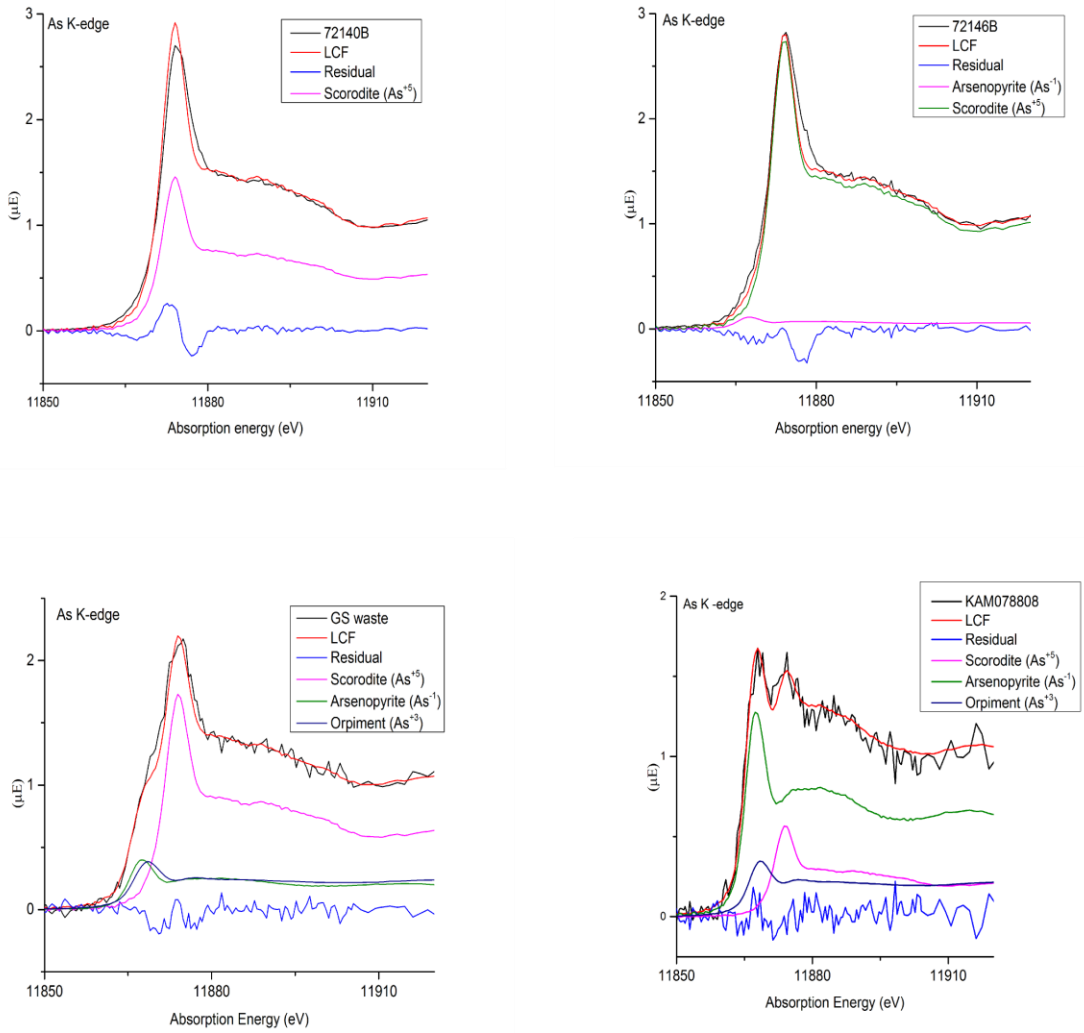


Figure 4.12 Arsenic spectra of samples compared to spectra calculated from linear combination fitting of the standards

Table 4.5 Relative abundance of As species estimated from the linear combination fits

Sample	Scorodite (As^{+5})	Arsenopyrite (As^{-1})	Orpiment (As^{+3})	R factor
GS waste	59.4	19.1	21.6	0.0087566
KAM078808	19.5	61	19.5	0.0197784
72140B*	100	-	-	0.0124062
72146B**	94.7	5.3	-	0.0133656
72137B	90.7	9.3	-	0.0188721
72135B	100	-	-	0.0147336
72144B	100	-	-	0.0170556
72139B*	100	-	-	0.0143326
KAM144308	100	-	-	0.0153481
KAM029385	100	-	-	0.0172278

* scorodite identified by PXRD

** arsenopyrite identified by PXRD

4.3 Uranium XANES data

Uranium L_3-edge XANES spectra were collected on the HXMA beamline for 8 samples (6 high uranium waste rock, 1 ore, and 1 waste rock sample). In general, all these samples are on the low end of bulk U concentrations that can be detected using the HXMA beamline (concentrations based on ICP-MS analyses provided by Lorax). To maximize the chances of obtaining U XANES spectra the high uranium waste rock samples were run first (U concentration ranging between 30 to 60 ppm). Then other samples were selected where verified U hotspots were detected with µXRF mapping; the U concentrations in these samples were between 6 and 10 ppm. U spectra were obtained for GS waste (6.1 ppm) and GT ore (11 ppm). Analyses of the GO waste sample were also attempted (5.5 ppm) however the concentration was below the detection capabilities of the beamline. Additional µXANES spectra were also collected for two of these high uranium waste rock samples (KAM091516, KAM078808) on the VESPERS beamline.

A limited number of U standards were run due to radiation regulation limitations placed on our analyses and standard acquisition. We selected a single standard for each of the two most common oxidation states observed in environmental samples: uraninite (UO_2; U^{+4}) and uranium nitrate ($UO_2(NO_3)_2$; U^{+6}). It is important to note that these standards were used to obtain spectra for the relevant oxidation states of U and it does not indicate that these phases would occur in these geological samples (the $UO_2(NO_3)_2$ is not expected to occur in a natural environment).

Note that the difference between uranium phases of similar oxidation states is minimal due to the broadness in line-shape of the U L3-edge. There is a distinct shift in the U L3-edge absorption edge energy between U^{4+} and U^{6+}, as illustrated in Figures 4.13 and 7.4. Therefore, LCF analysis can provide information on the relative amount of $U^{+4}$and U^{+6} species in each sample. For the LCF analysis, spectra were fitted to uraninite and uranyl nitrate as representatives of the U^{+4} and U^{+6} species, respectively, present in the samples. The U XANES spectra were fitted to the standards (Figure 4.14, 7.5) and the relative abundance of U^{+4} and U^{+6} species is summarized in Table 4.6.

Based on the absorption edge energy of the standards, the oxidation state of U in most of the samples analysed is between +4 and +6 (Figure 4.14). In one high uranium waste rock sample (KAM144308), uranium appears as +6 only. The predominant oxidation state of U (>50%) is +4 in most of the samples except for KAM029385 and GS waste rock samples (Table 4.6). Uranium µXANES spectra were also collected for two high uranium waste rock samples (KAM091516, KAM078808) using the VESPERS beamline, and the results were consistent with the other data (mixture of +4 and +6 oxidation states) Figure 7.7).

Visible verified U hotspots as well as U XANES data are available for a total of 6 samples: five high U waste rock and one gneiss waste rock. The fact that these samples contain U^{+6} and the spatial overlap of verified U regions with Fe (Figure 4.13) suggest that this form of U is associated with iron oxides in these samples. Distribution of P was not examined in these samples due to beamline energy limitations; however, spatial

overlap of verified U regions with Ca and/or Cu, Ti, Th as well as presence of U^{+4} suggest that other U mineral phases are also possible.

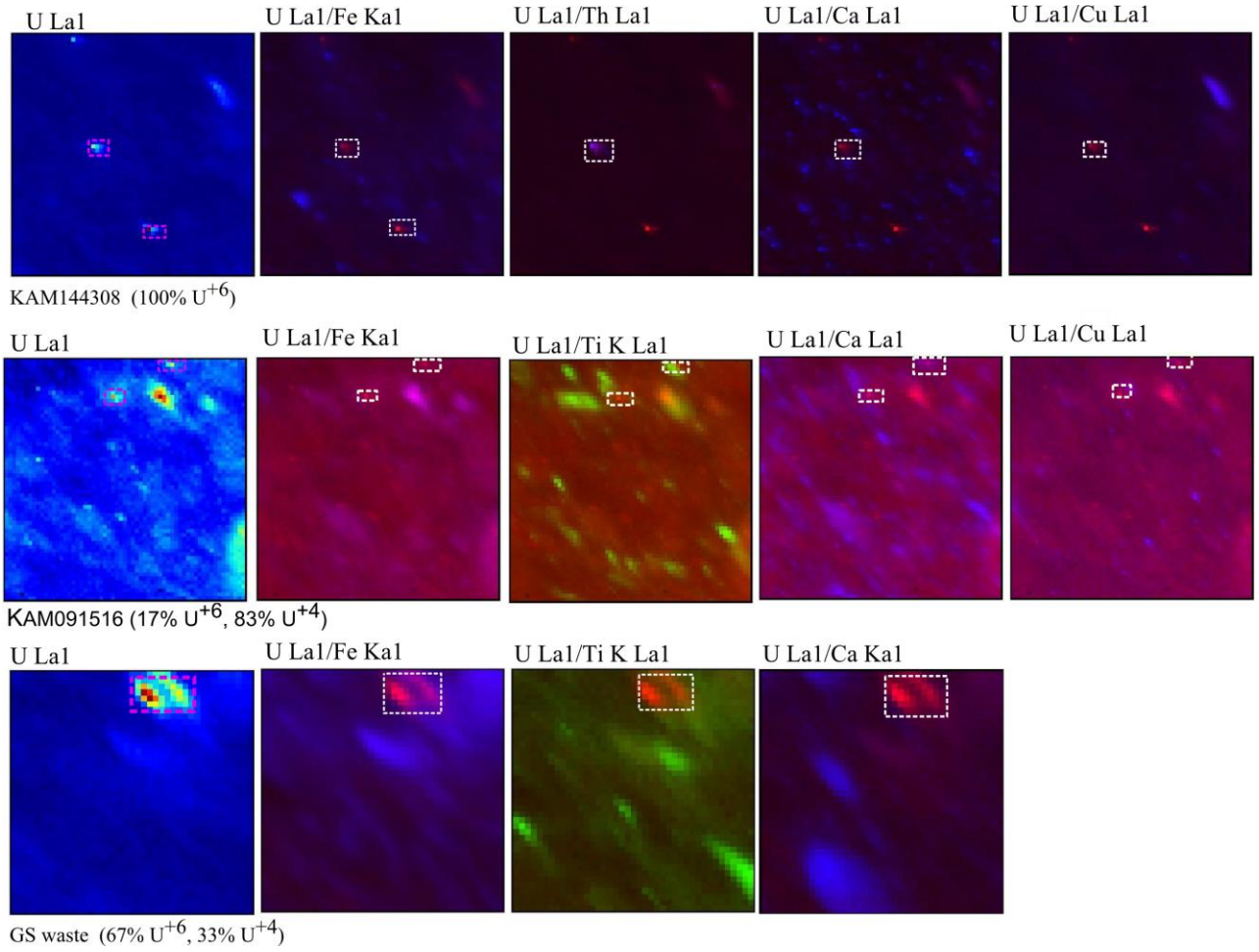


Figure 4.13 Spatial overlap of verified U spots with a range of elements that can be found in various U-bearing mineral phases (Red=U, Ti=green, Fe, Ca, Cu=green). This figure is divided in two panels for presentation purposes and it is continued on the next page.

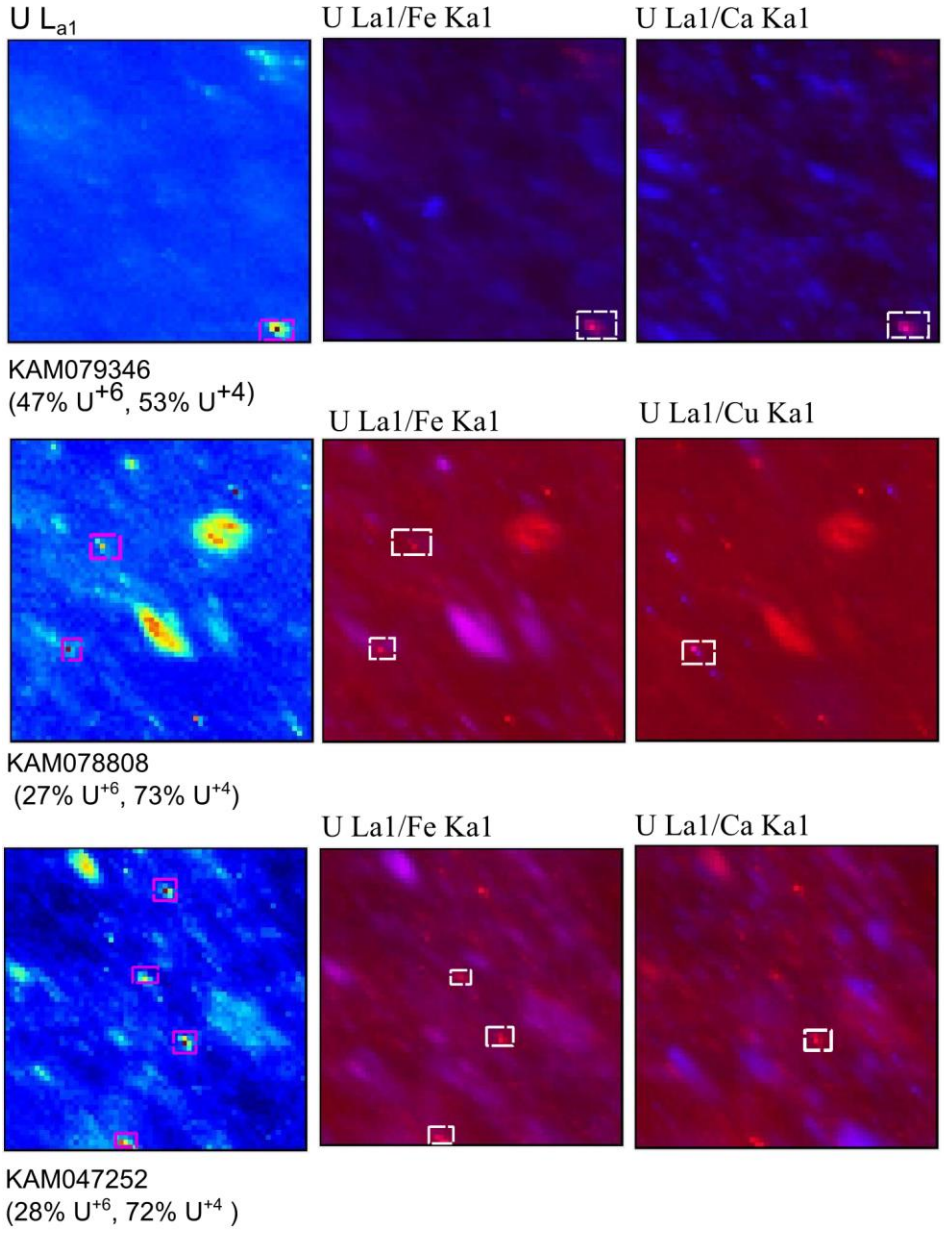


Figure 4.14 Spatial overlap of verified U spots with a range of elements that are that can be found in various U-bearing mineral phases (Red=U, Ti=green, Fe, Ca, Cu=green). This figure is divided in two panels for presentation purposes.

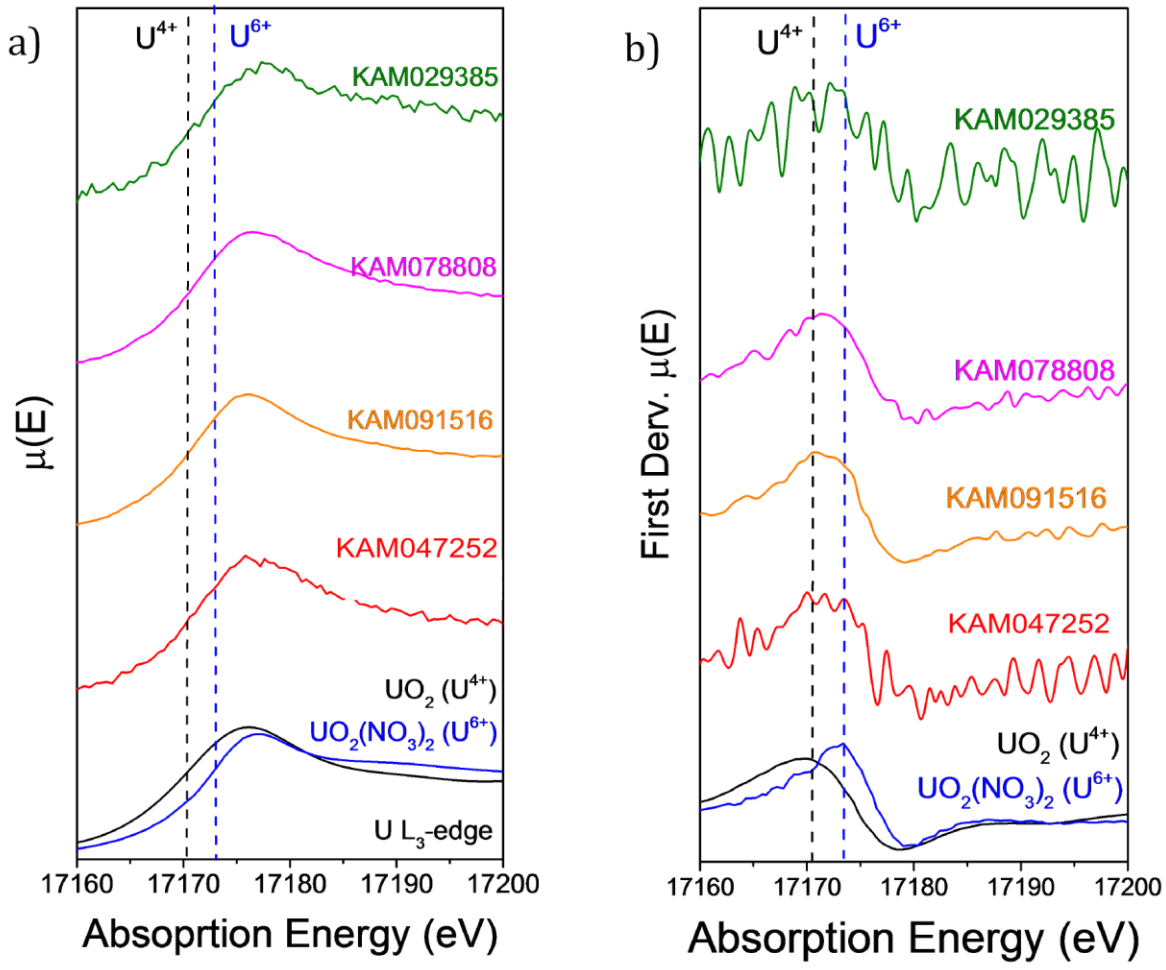


Figure 4.15 Uranium L_3-edge XANES spectra

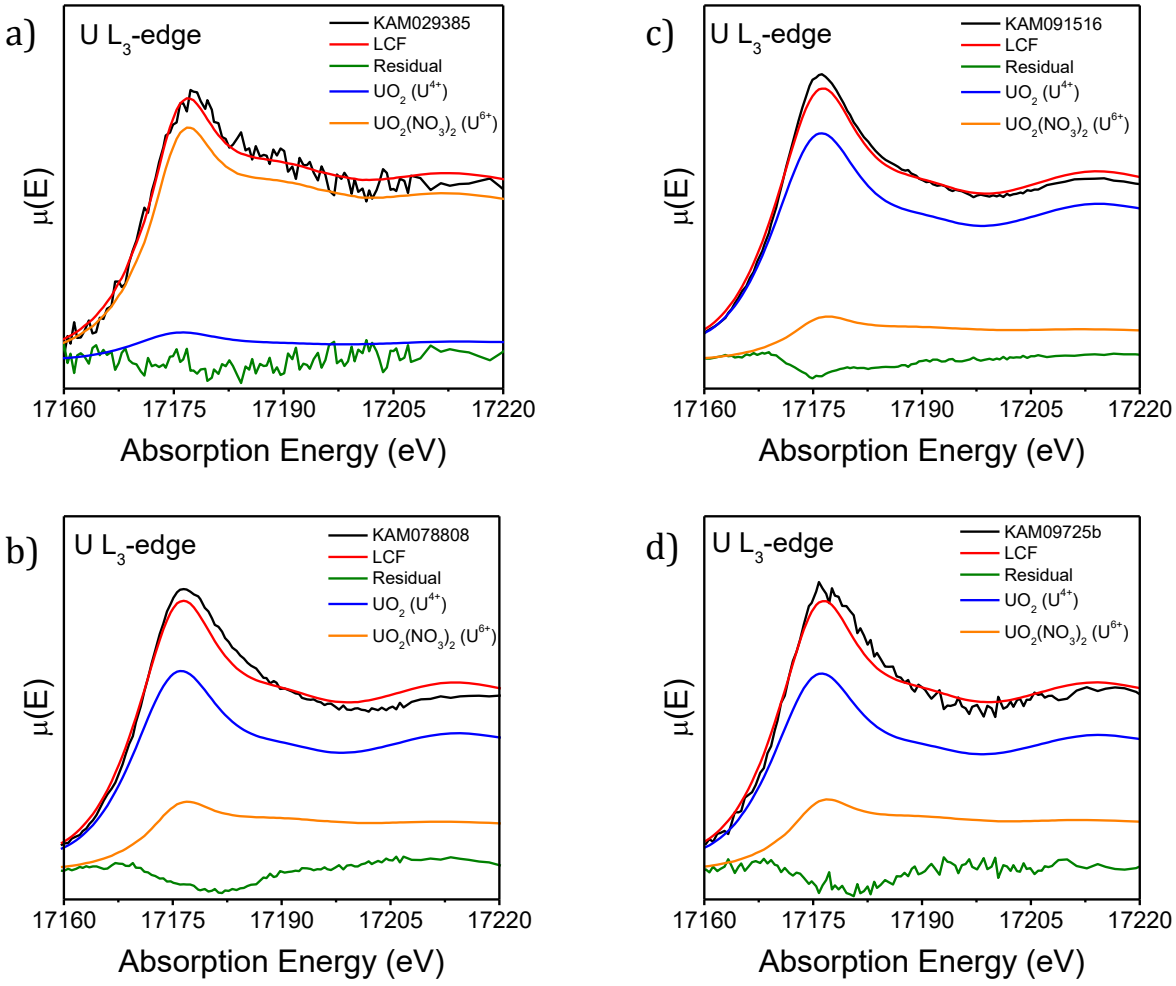


Figure 4.16 Linear combination fitting of Uranium

Table 4.6 Relative abundance of U species estimated from the linear combinations fits.

Sample	UO_2 (U^{4+}) at %	$UO+(NO_3)_2$ (U^{6+}) at %	R factor
KAM029385	11	89	0.0142021
KAM078808	73	27	0.0137348
KAM091516	83	17	0.0058184
KAM047252	72	28	0.0133641
KAM079346	53	47	0.0059290
KAM144308	0	100	0.0038118
GS waste	33	67	0.0250210
GT ore	51	49	0.0630183

5 Findings

Synchrotron-based analyses of the Yukon gold mine ore and waste rock samples revealed that the oxidation state and mineralogical phase of As vary among samples. A total of 3 oxidation states (As^{+5}, As^{+3}, As^{-1}) and 3 mineralogical phases (scorodite, arsenopyrite and arsenian pyrite) were identified in the samples using μXANES and PXRD methods, respectively. These complementary analyses further indicate that in both schist and one of the gneiss ore samples, As is a mix of the valence states As^{+5} and As^{-1}, and potentially in two mineral phases. The mineral phase containing As^{-1} is most likely arsenopyrite, since this phase was identified in one of the schist ore sample (72135B) using PXRD. All three oxidation states were found in two of the analysed waste rock samples of gneiss, however, the corresponding arsenic mineral phases cannot be extrapolated from the XANES data alone. Arsenic appeared in a single oxidation state (+5) in the granite ore samples, which was in agreement with the single mineral phase, scorodite, identified using PXRD analyses. μXRF analyses also revealed potential presence of yukonite in one of the schist ore sample (72137B). PXRD analyses cannot exclude the possibility that arsenic is present in an amorphous form in any of these samples, or in a mineral form that is below the detection limit for the method (on the order of 0.1 %).

Based on XANES analyses, the oxidation state of U in most of the samples analysed (8 in total) was between +4 and +6. The predominant oxidation state of U was +4 in all the analysed samples, except for two of the gneiss and one of the schist waste rock samples. Since no U phases were identified using PXRD, U mineral phases that could potentially be present in these samples remain highly speculative. μXRF analyses revealed that U tends to co-occur with Fe, this may indicate U^{+6} association with Fe oxides. Spatial overlap of U with Ca and/or Cu detected in the waste rock samples indicate that other U-bearing mineral phases, such as autunite, tobernite or uranophane could potentially be present. Association of U with Ti and Th was only visible in the gneiss waste rock samples; this may indicate the presence of thorite and brannerite U mineral phases, respectively. It is important to note, XANES data and spatial overlap detected by microXRF analyses are not sufficient to determine the U-bearing mineral phases with certainty.

6 Considerations for future analyses

Elucidation of the U mineral phases present in these materials is a challenge because of the low U concentrations in the samples. The detection limits of the analytical techniques such PXRD, XANES, μXRD could be improved if whole rock (unground) samples were used; unground samples could potentially be subsampled selectively to target more concentrated regions of the materials. Sequential chemical extraction of U should be also considered as an approach to investigate the U-bearing minerals present in these ore and waste rock samples.

Acknowledgments

The authors thank Drs. Renfei Feng, Ning Chen, and Weifeng Chen for assistance at the VESPER and HXMA beamlines, respectively. Industrial research scientists, Drs. Jeff Cutler and Joel Reid are also thanked for their constructive feedback on this report.

Table 6.1 Summary table of the completed sample analyses

Sample ID	PXRD	µXRF maps (pink beam – broad energy spectrum)	Arsenic-µXANES	Uranium-XANES
SO waste	✓	✓		
ST waste	✓	✓		
SS waste	✓	✓		
GO waste	✓	✓		
GT waste	✓	✓		
GS waste	✓	✓	✓	✓
GRO ore	✓	✓	✓	
GRT ore	✓	✓	✓	
72135B	✓	✓	✓	
72137B	✓	✓	✓	
72144B	✓	✓	✓	
GT ore	✓	✓	✓	✓
KAM029385	✓	✓	✓	✓
KAM079346	✓	✓		✓
KAM047252	✓	✓		✓
KAM091516	✓	✓		✓
KAM078808	✓	✓	✓	✓
KAM144308	✓	✓	✓	✓

7 Appendix

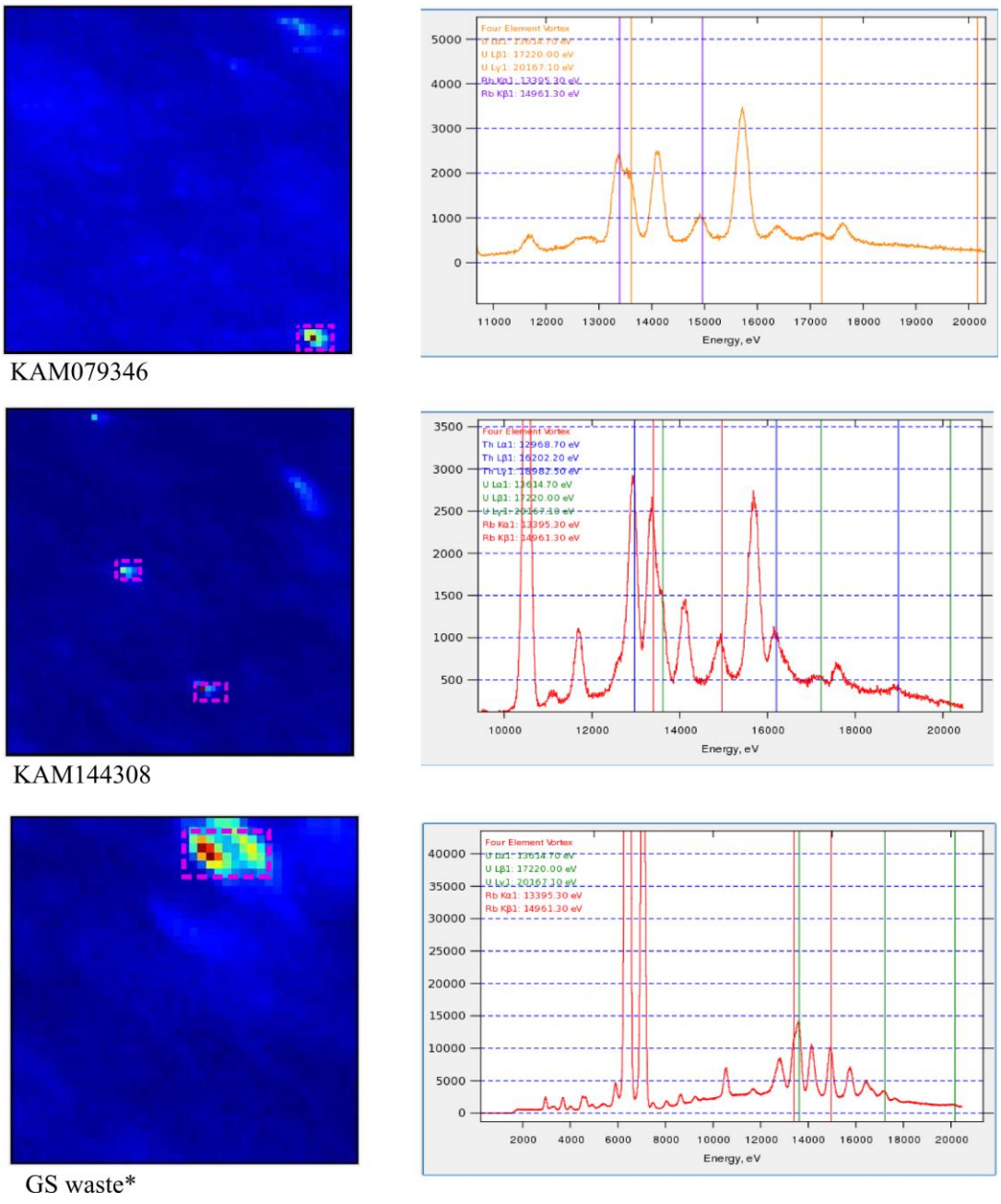


Figure 7.1 Verified U hotspot regions and corresponding spectra identified on the U/Rb XRF maps

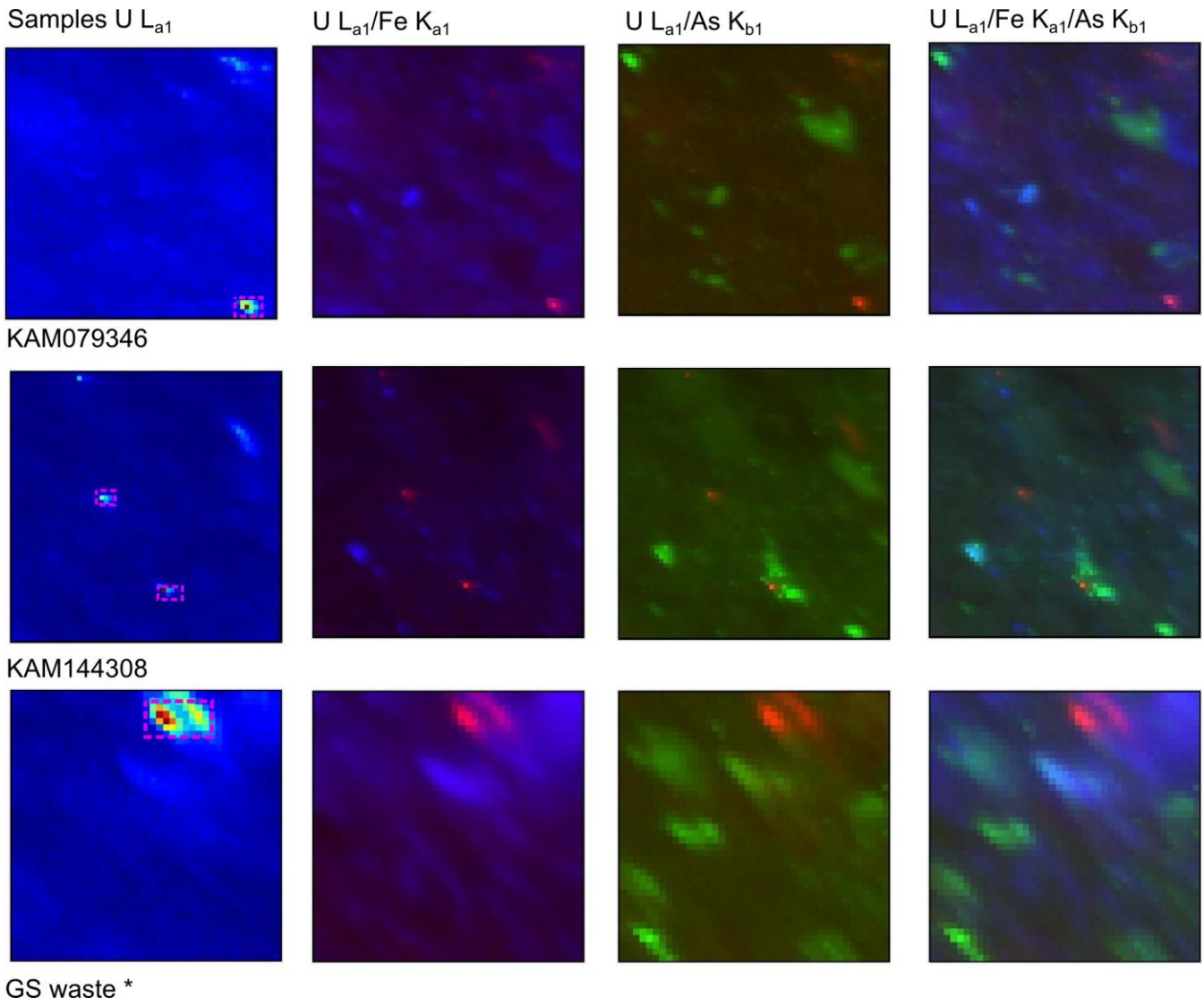
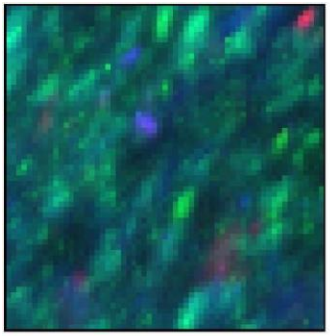


Figure 7.2 Tri-color mapping plot of U, As and Fe (Red=U, Green=As, Blue=Fe)



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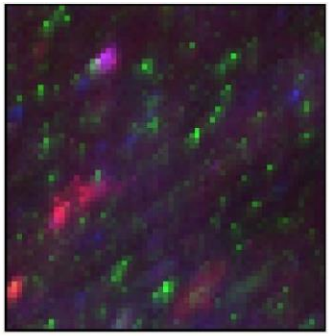

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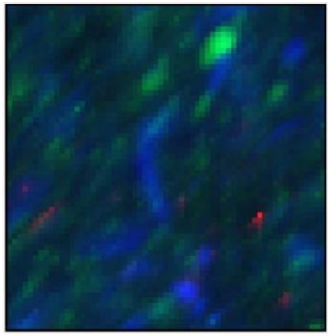

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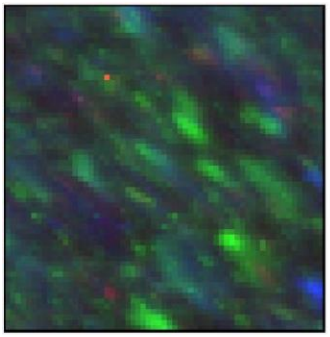
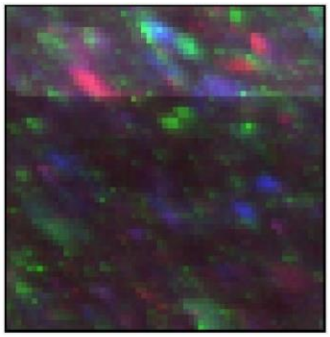
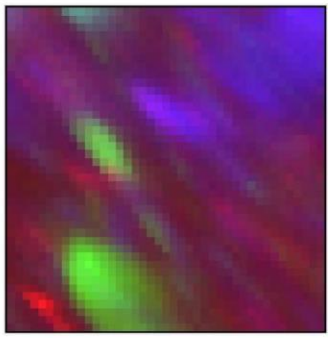


ST waste



SO waste



GS waste*

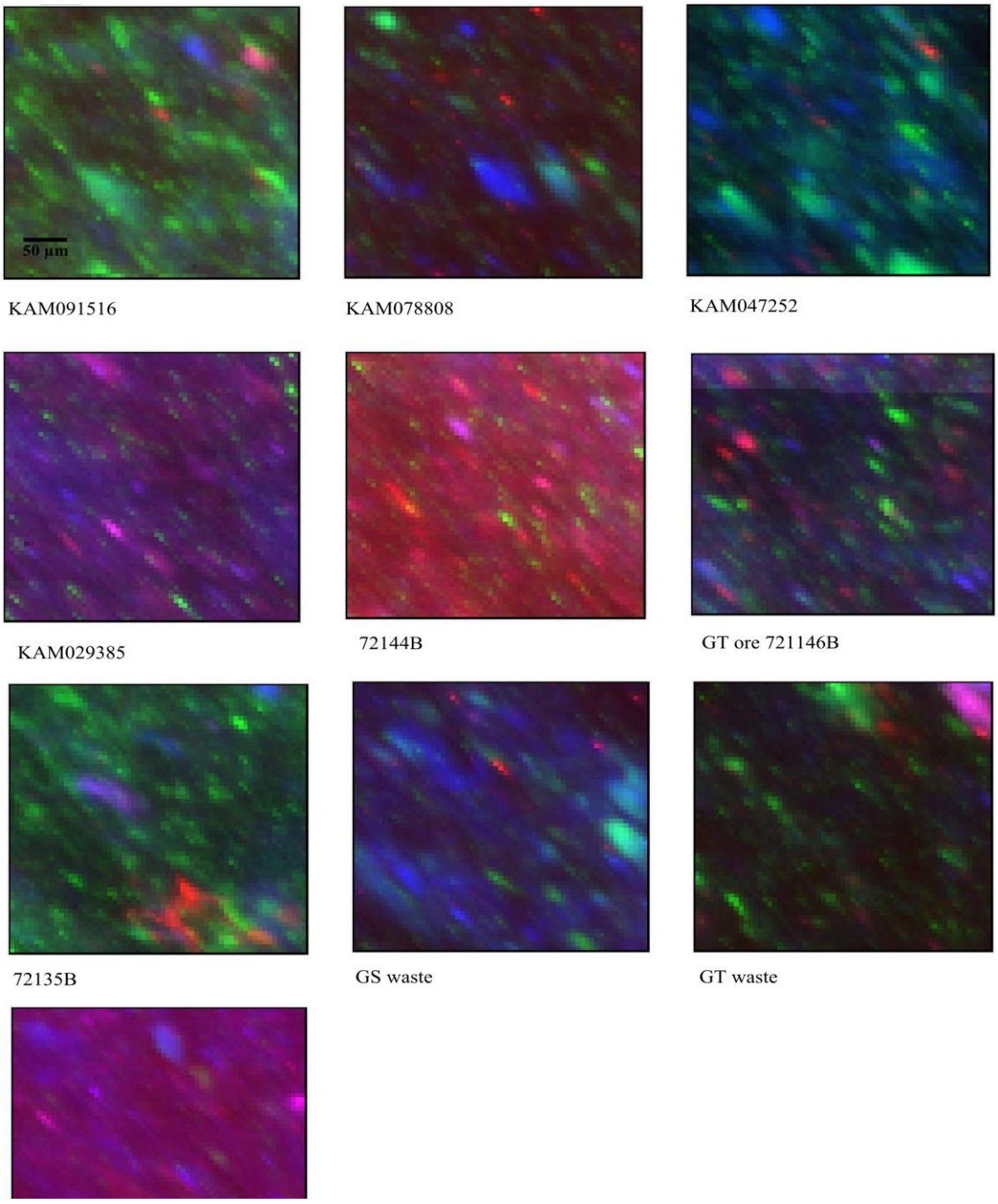
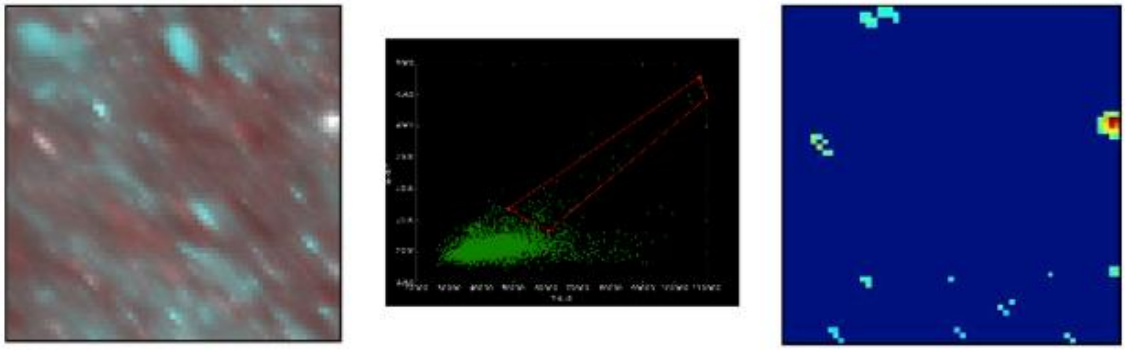


Figure 7.3 Tri-color mapping plot of As, Fe and Ca
(Red=As, Green=Ca, Blue=Fe)



GO waste

Fe Ka1-As Kb1 scatter plot

Fe Ka1-As Kb1 selected plot corresponding As region

Figure 7.4 Colour map and scatter plot of As and Fe

(Red=As, Cyan=Fe)

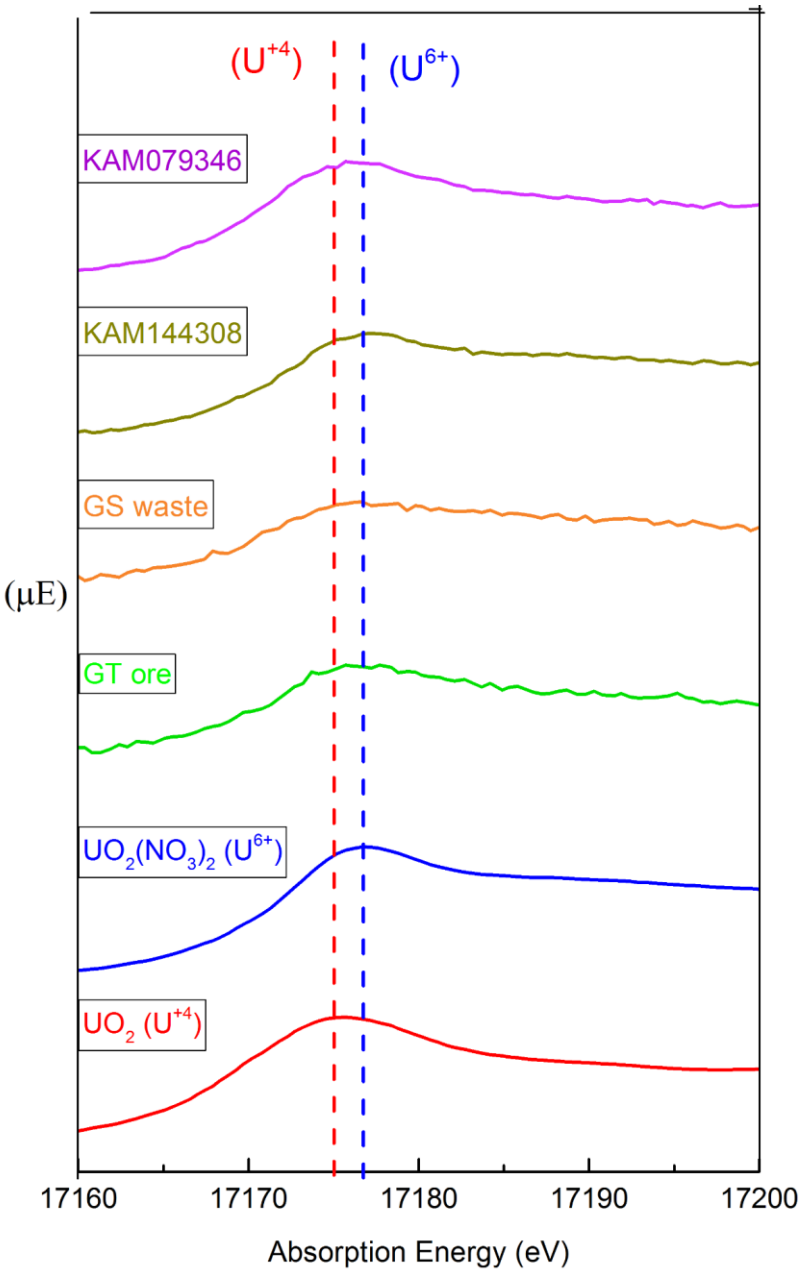


Figure 7.5 Uranium L_3-edge XANES spectra

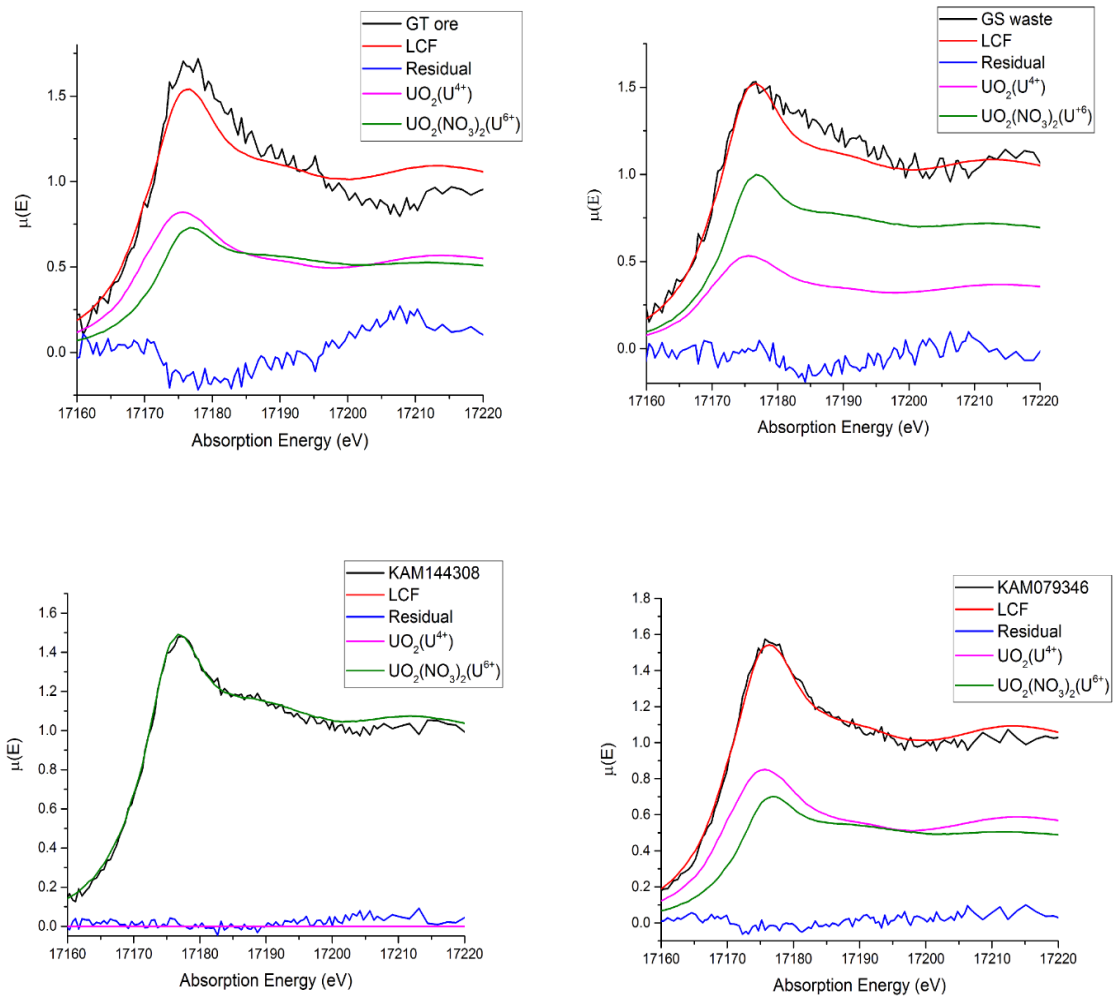


Figure 7.6 Linear combination fitting of Uranium

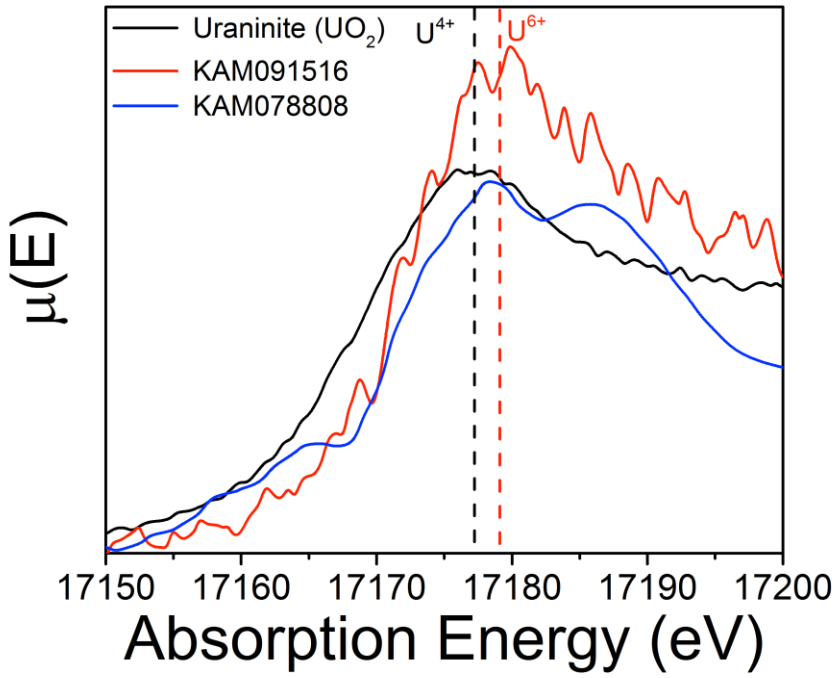


Figure 7.7 Uranium microXANES spectra

7 APPENDIX

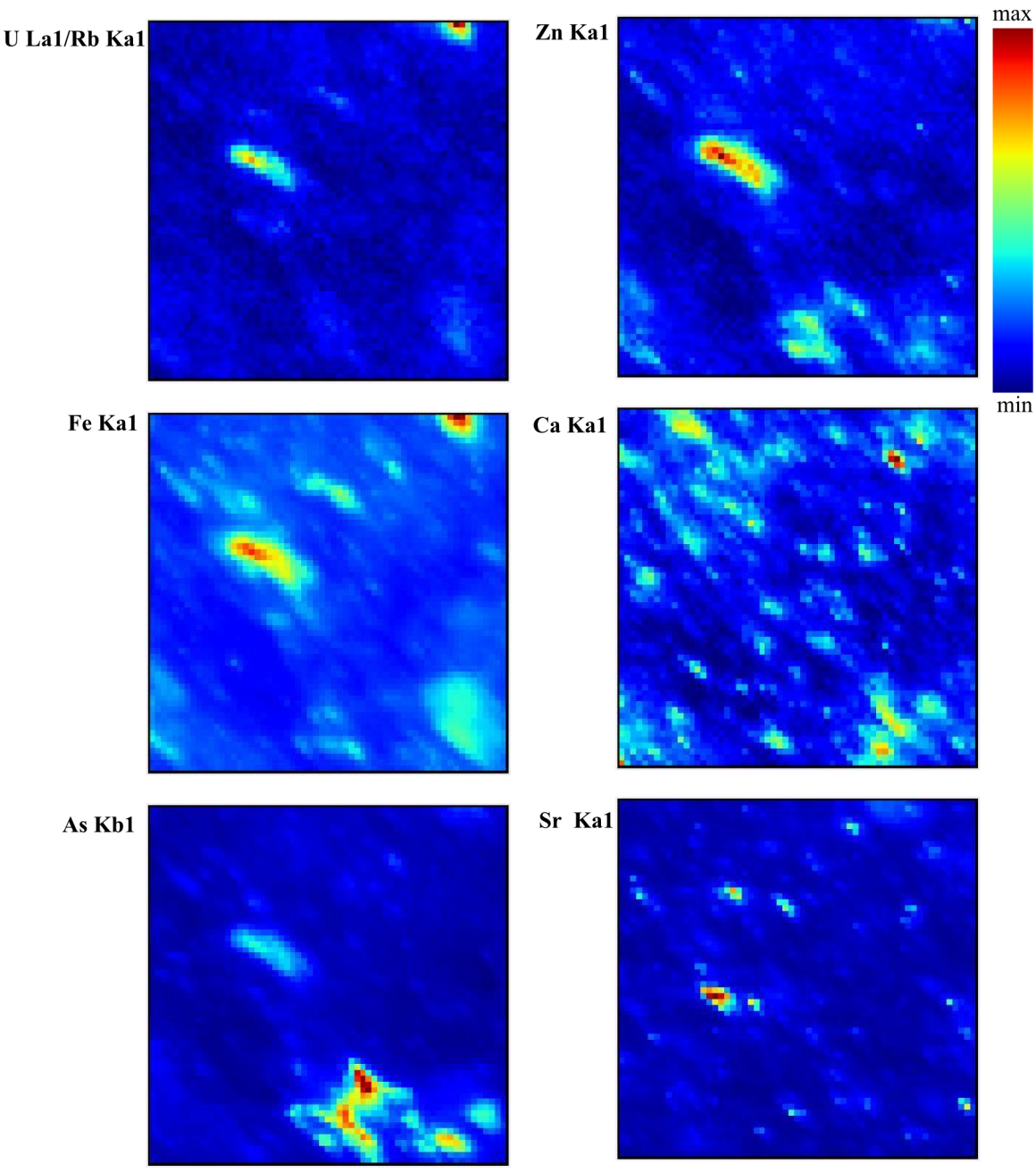


Figure 7.8 XRF elemental distribution maps of 72135B

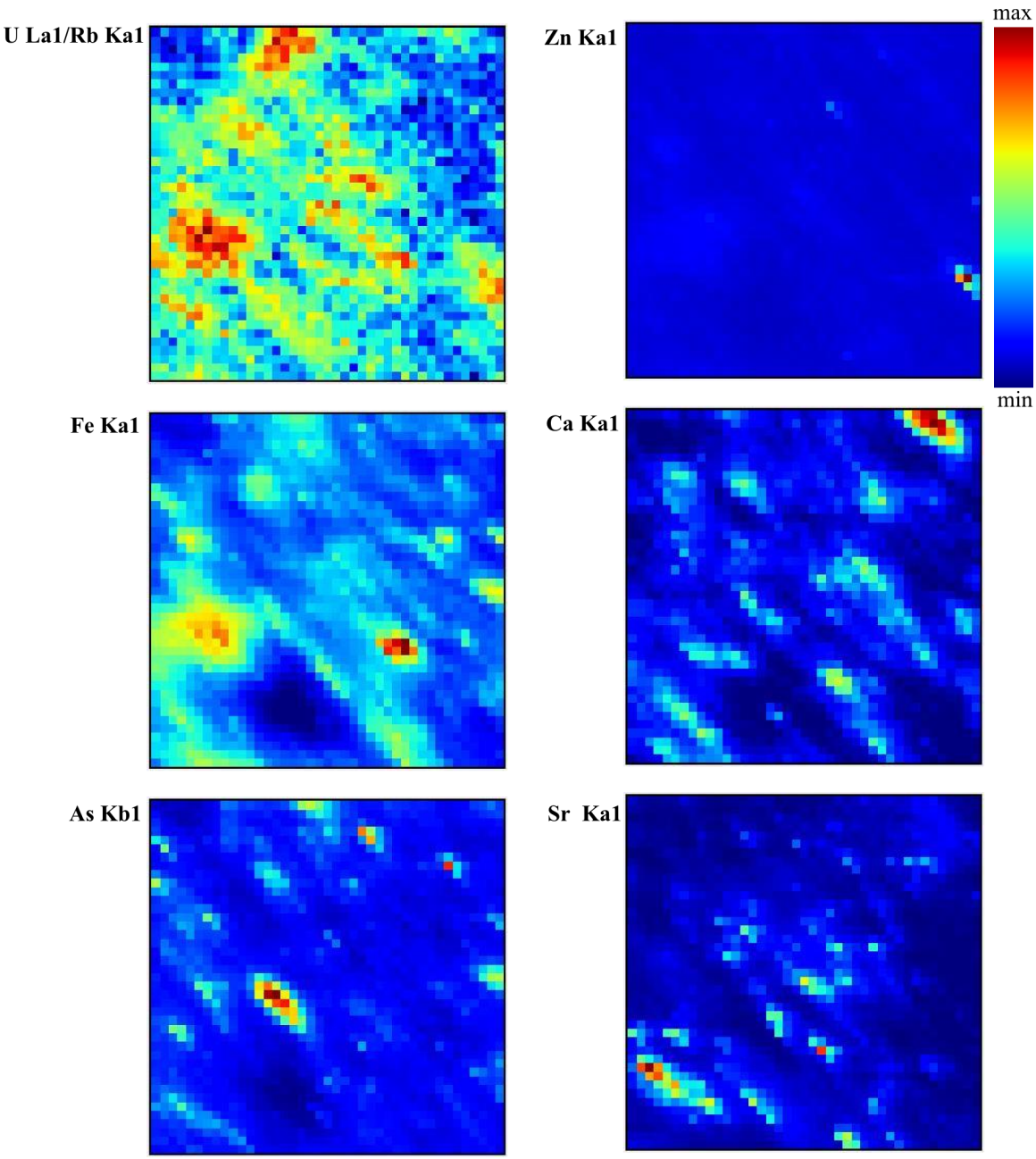


Figure 7.9 XRF elemental distribution maps of 72137B

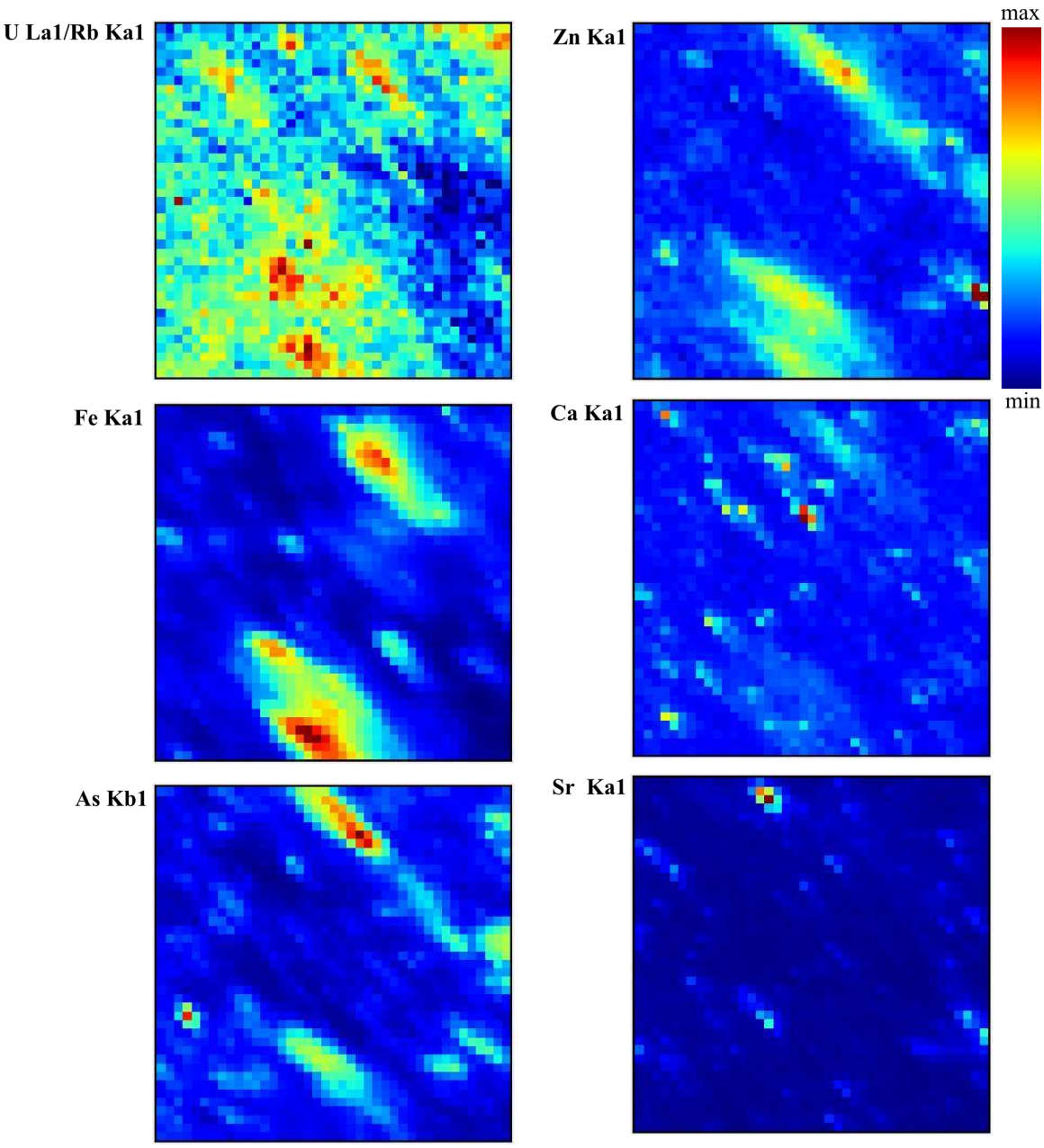


Figure 7.10 XRF elemental distribution maps of GRT

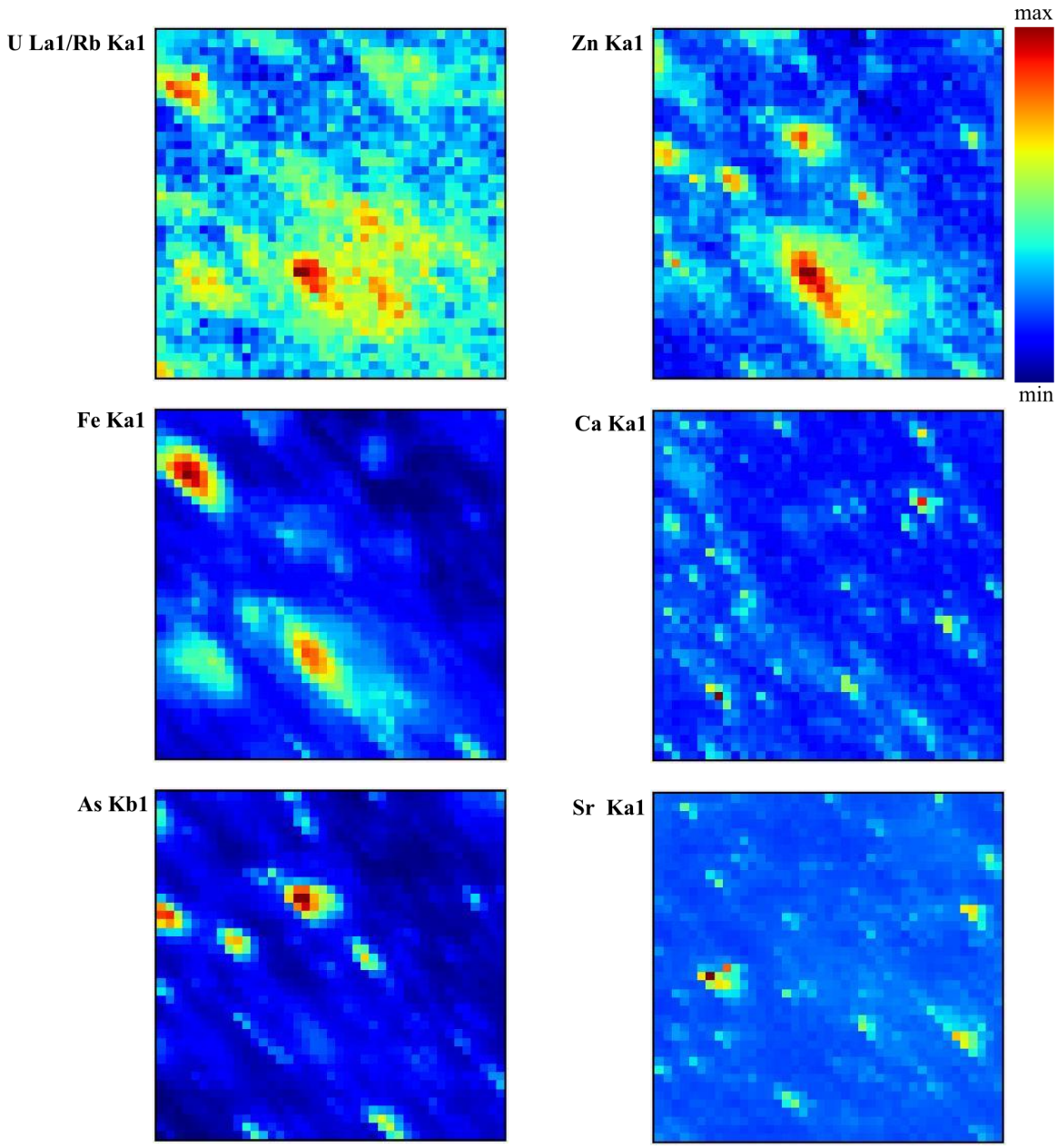


Figure 7.11 XRF elemental distribution maps of GRO ore

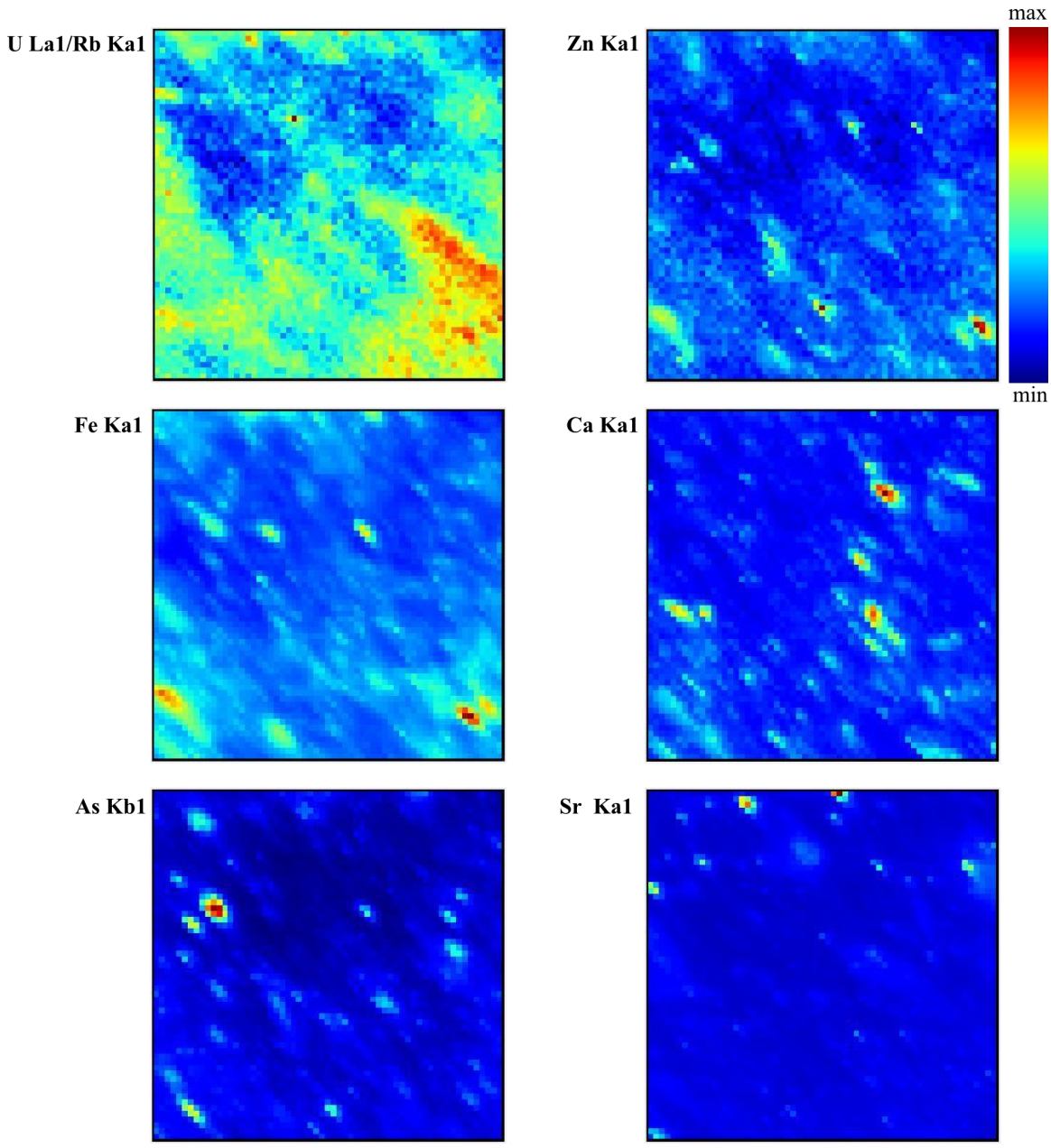


Figure 7.12 XRF elemental distribution maps of GT ore

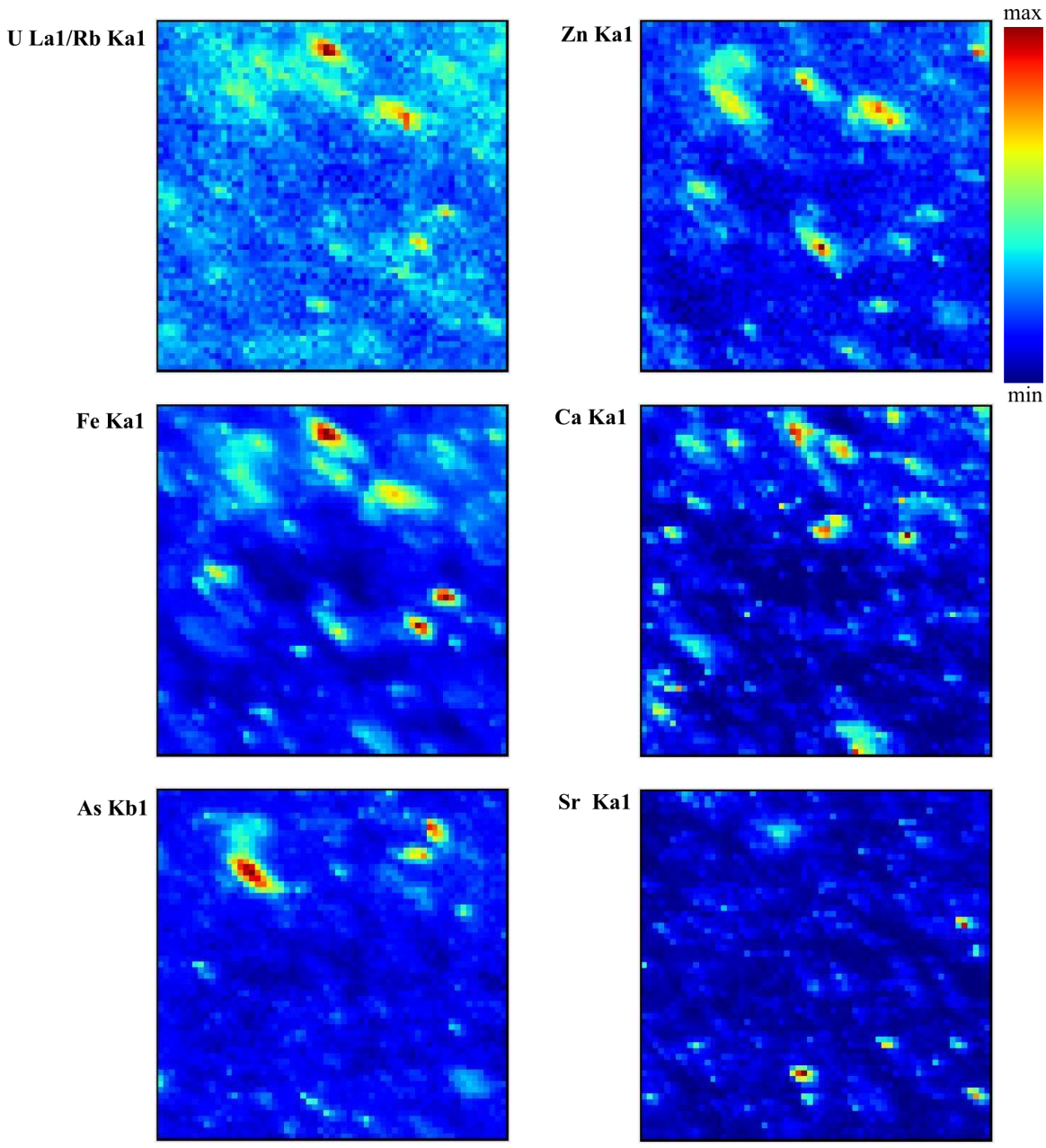


Figure 7.13 XRF elemental distribution maps of SO waste

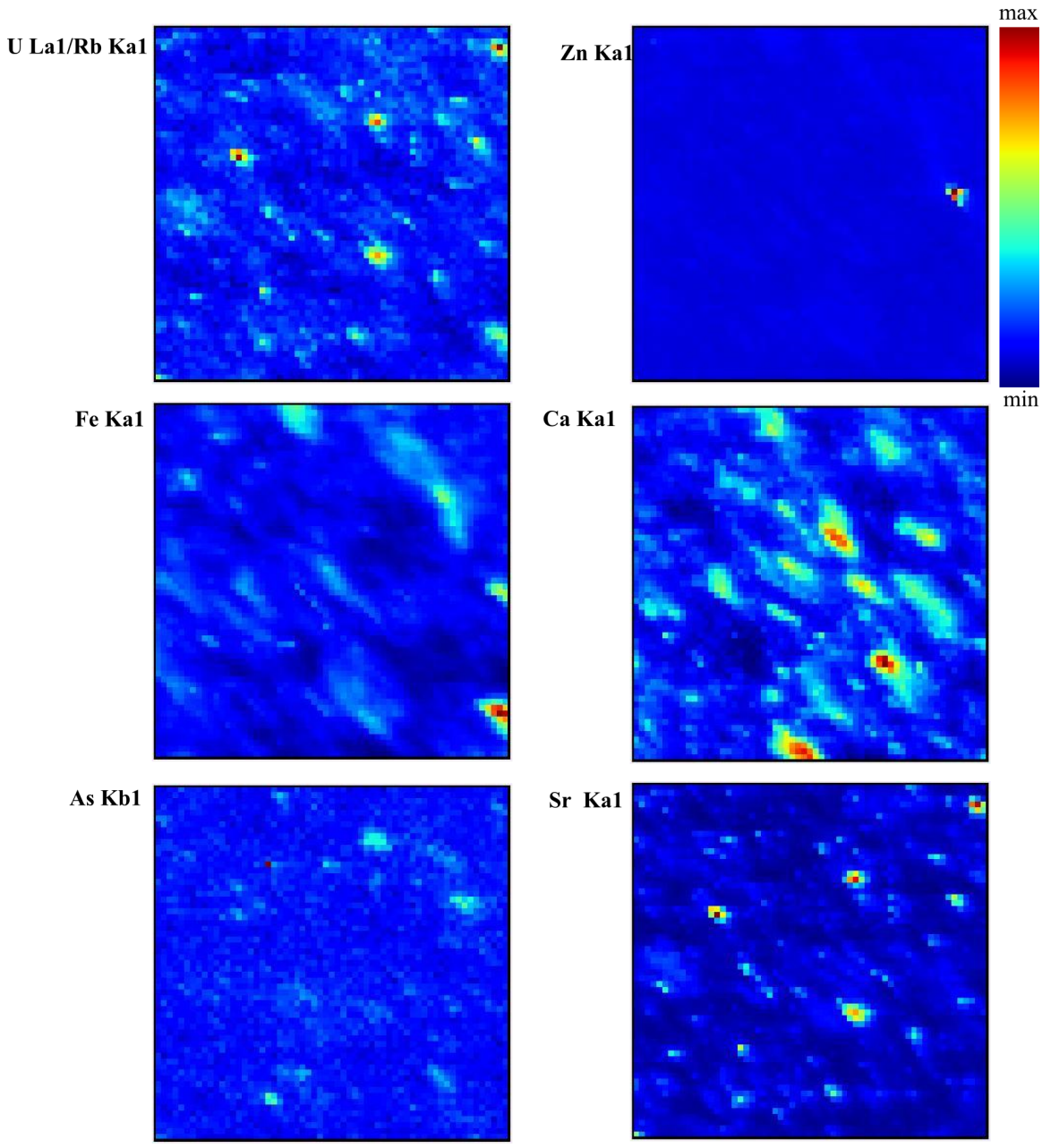


Figure 7.14 XRF elemental distribution maps of ST waste

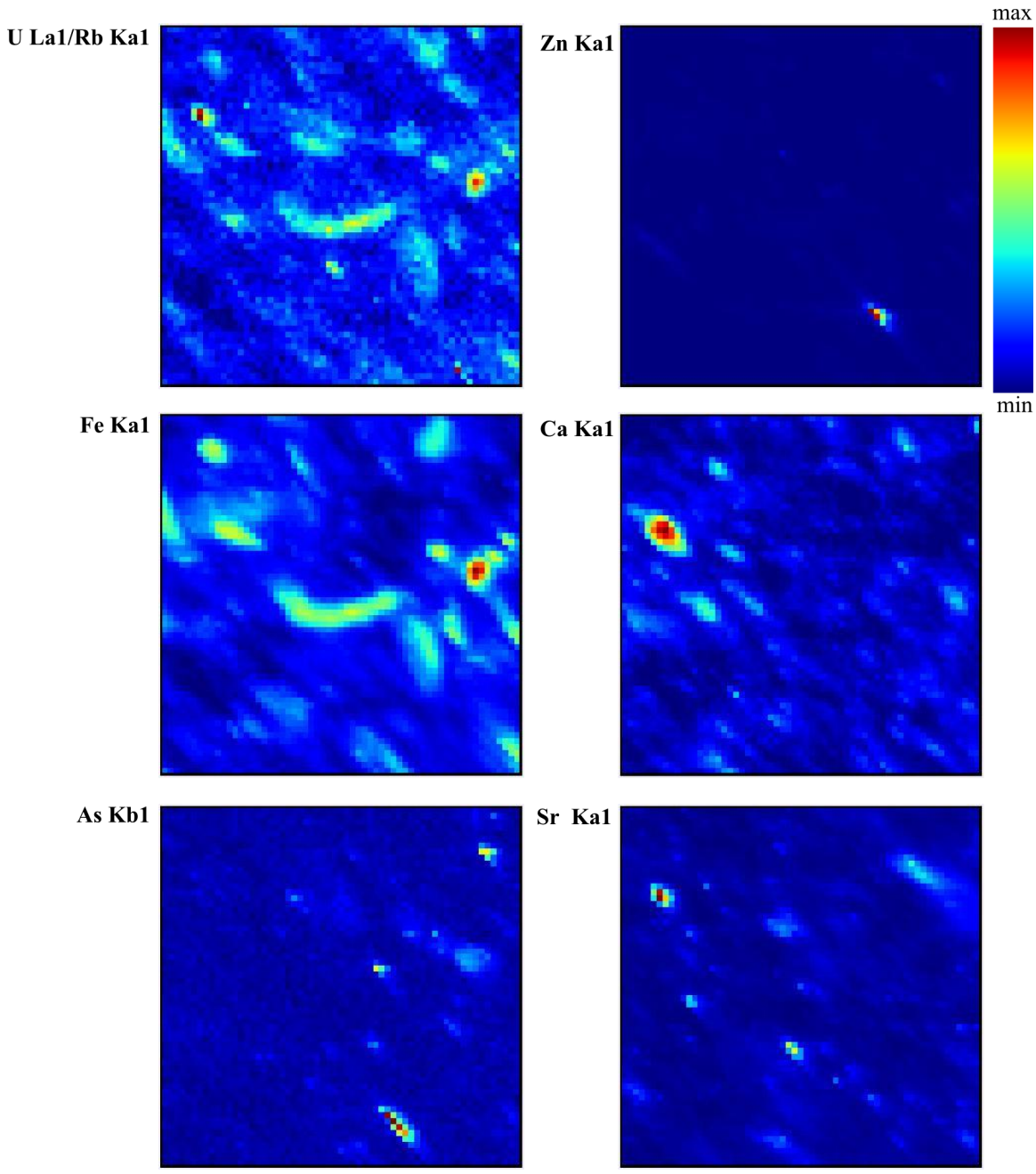


Figure 7.15 XRF elemental distribution maps of SS waste

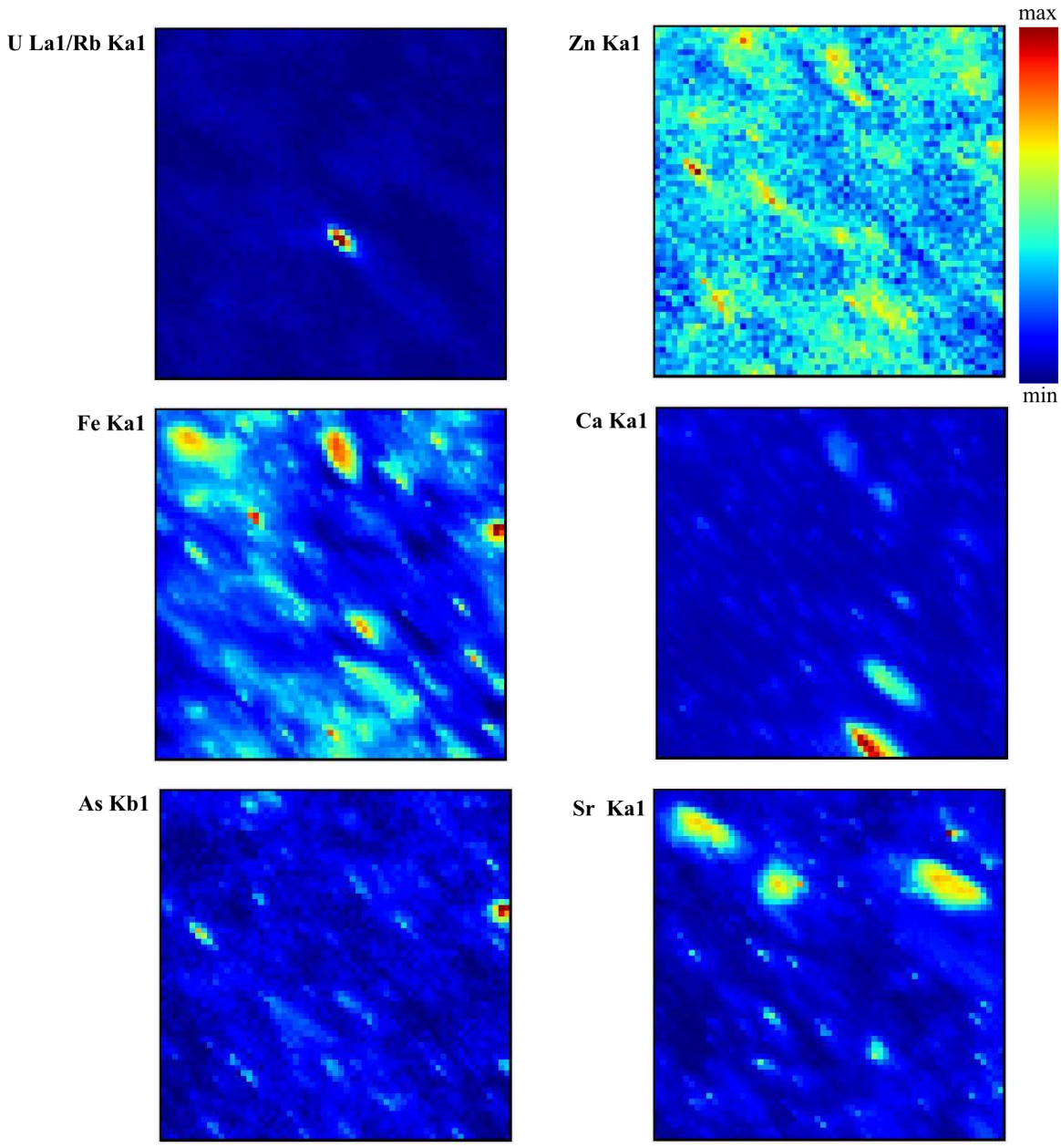


Figure 7.16 XRF elemental distribution maps of GO waste

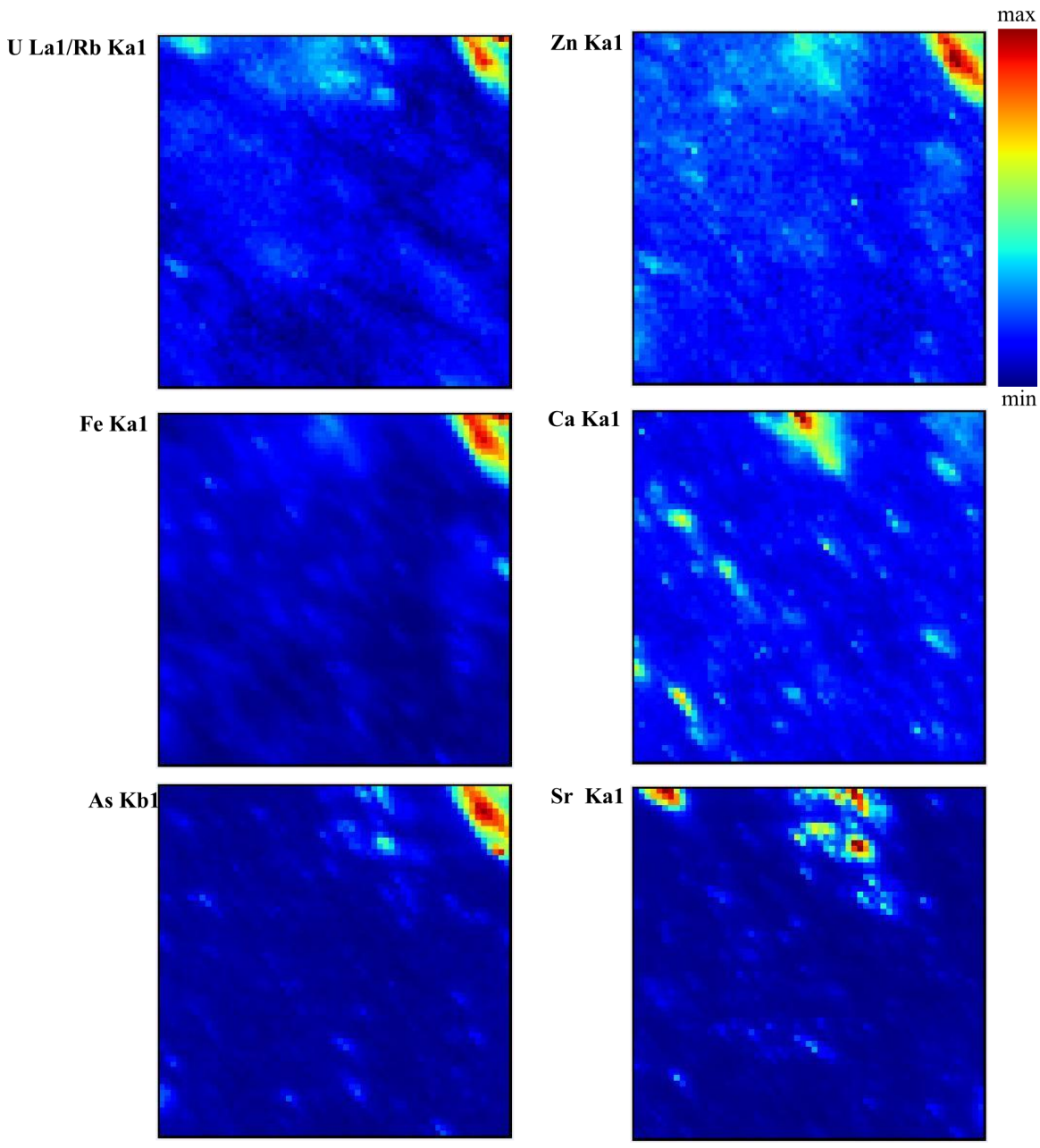


Figure 7.17 XRF elemental distribution maps of GT waste

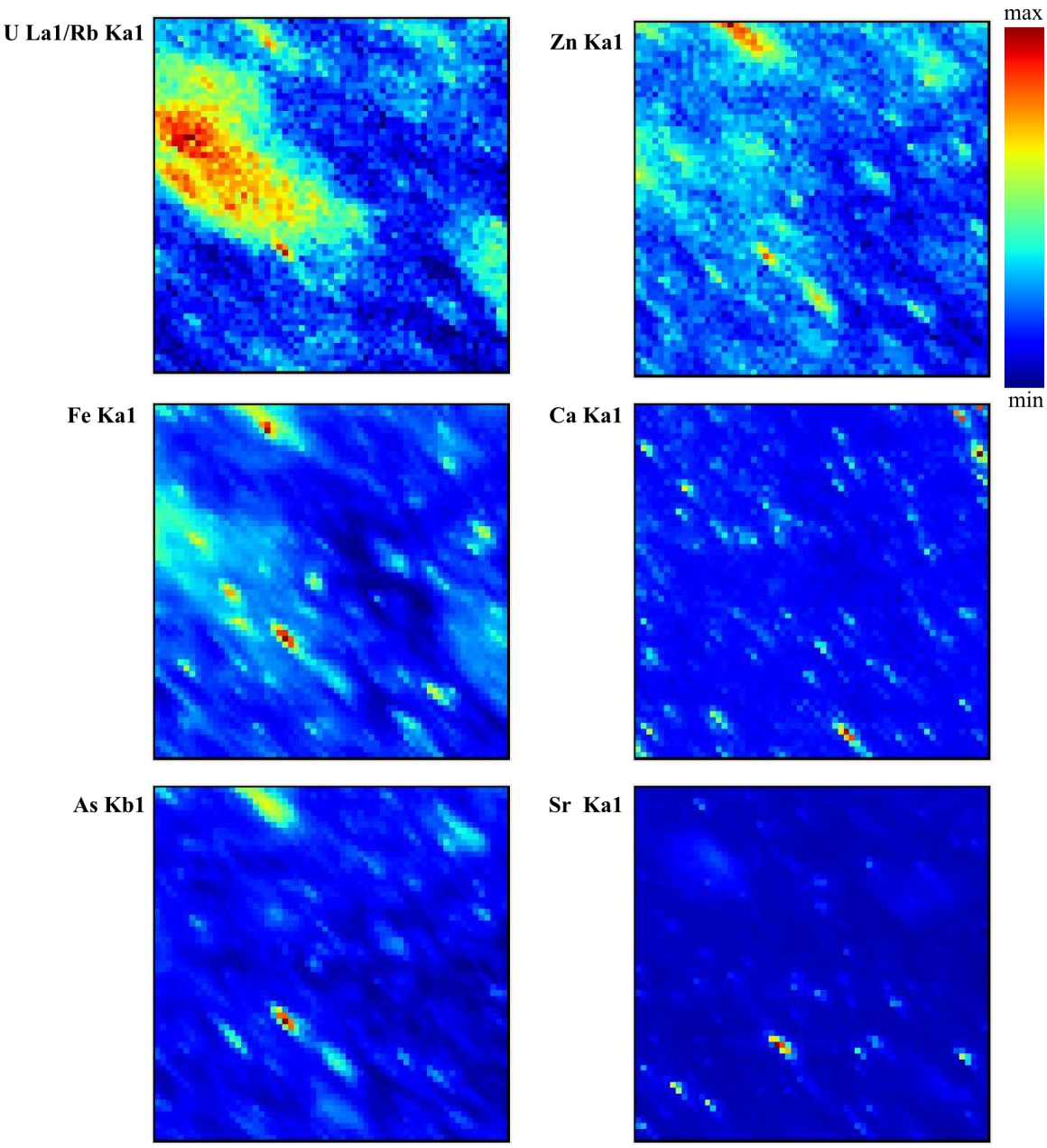
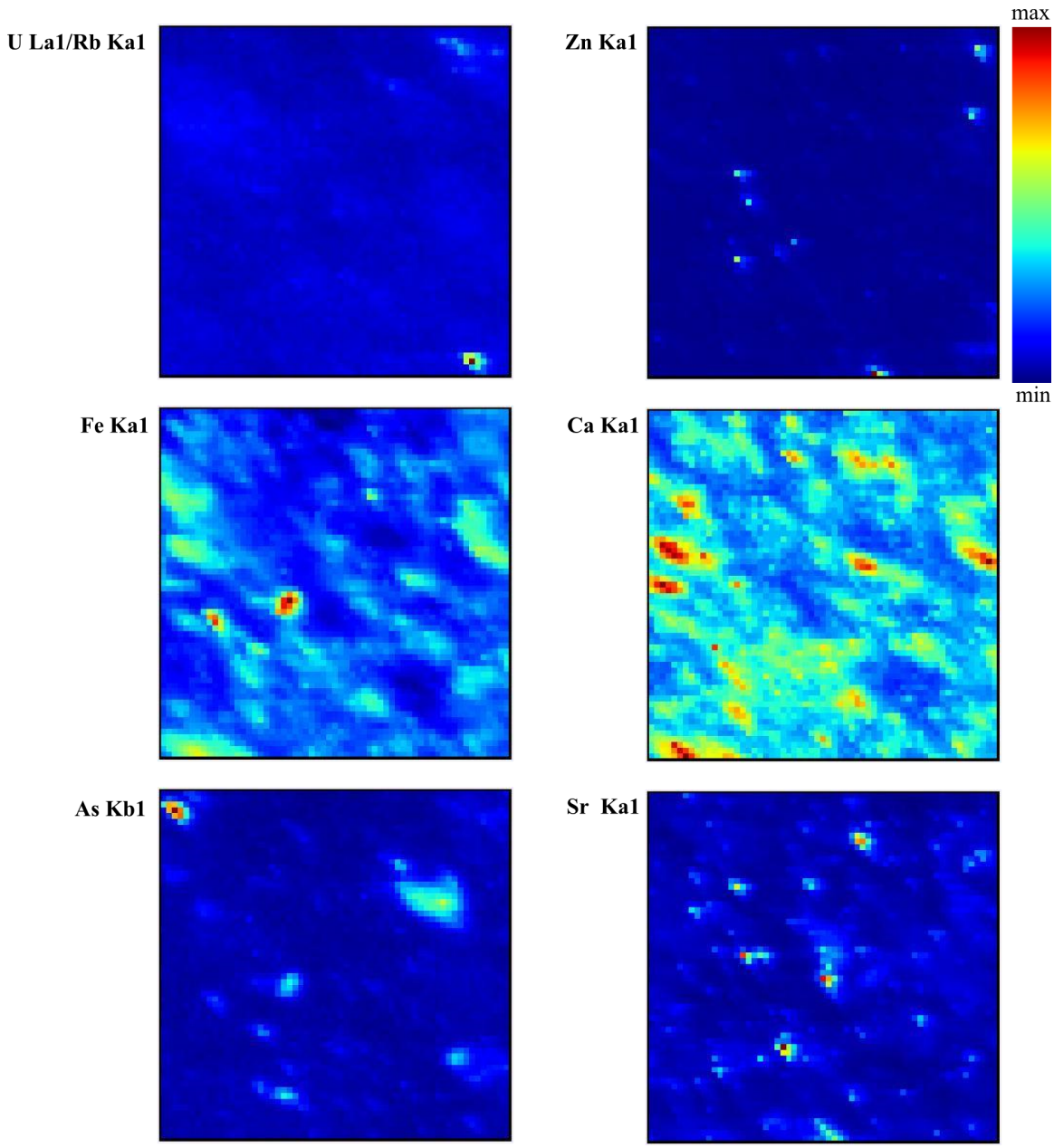


Figure 7.18 XRF elemental distribution maps of KAM029385



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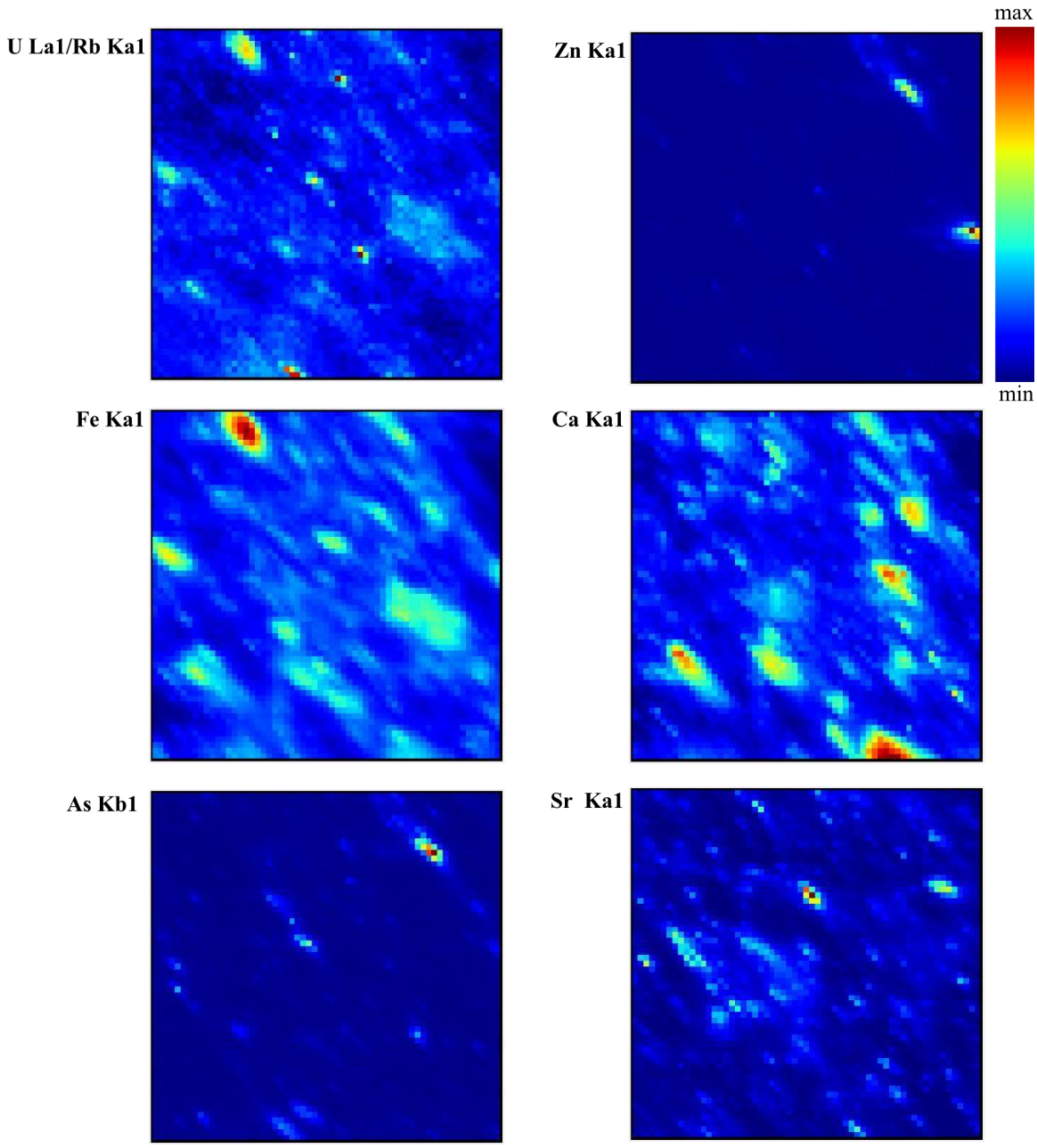

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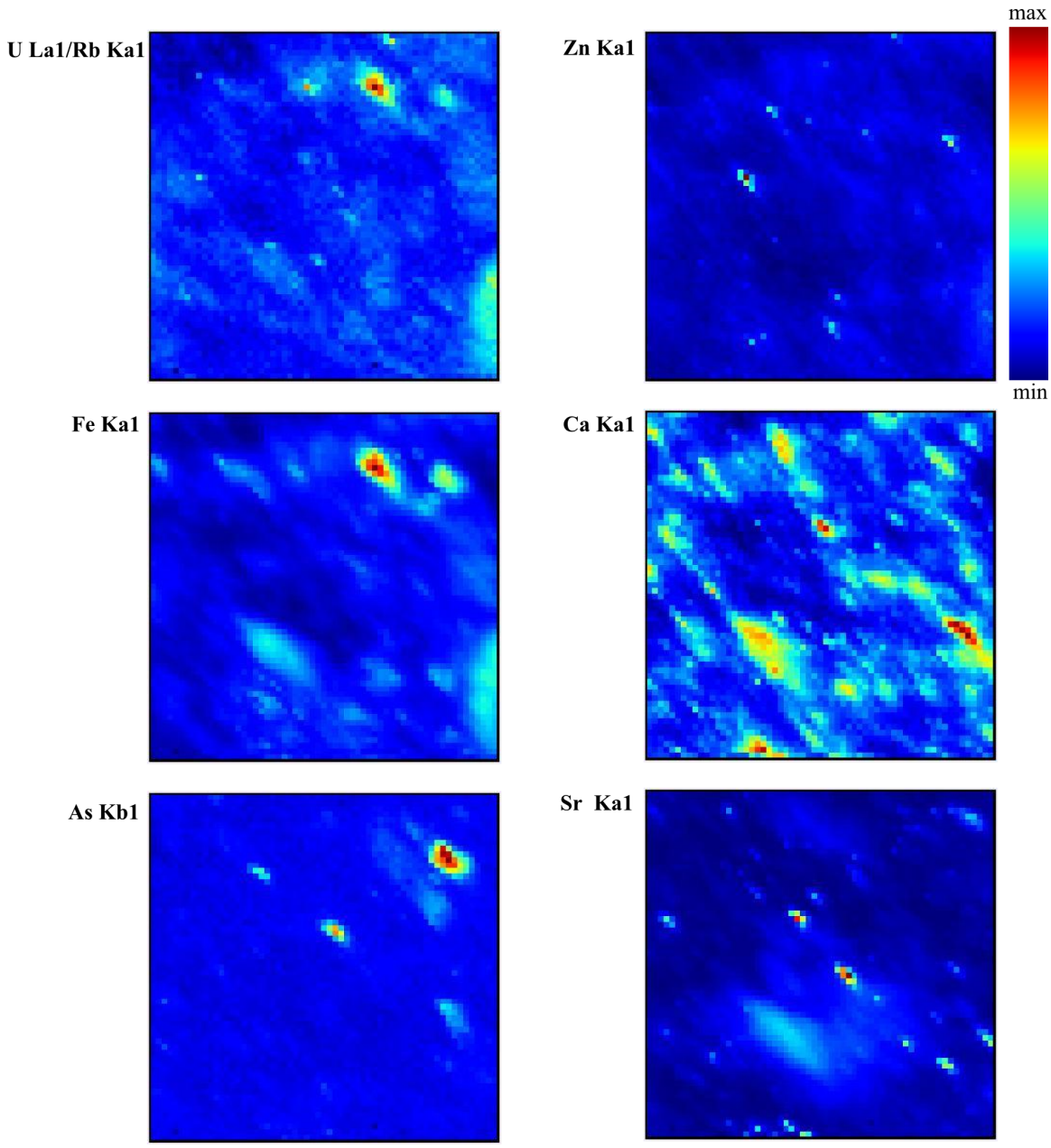

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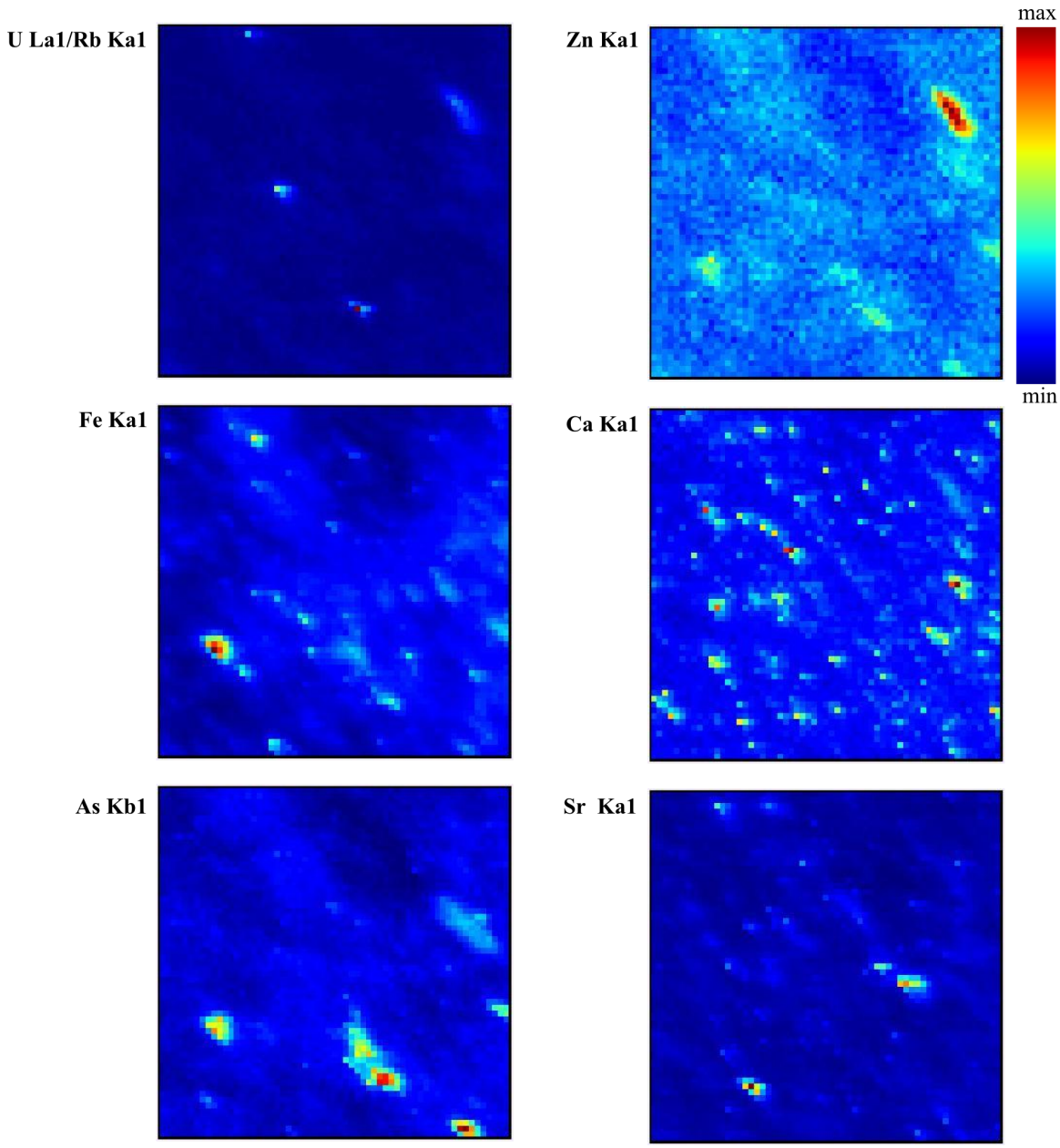

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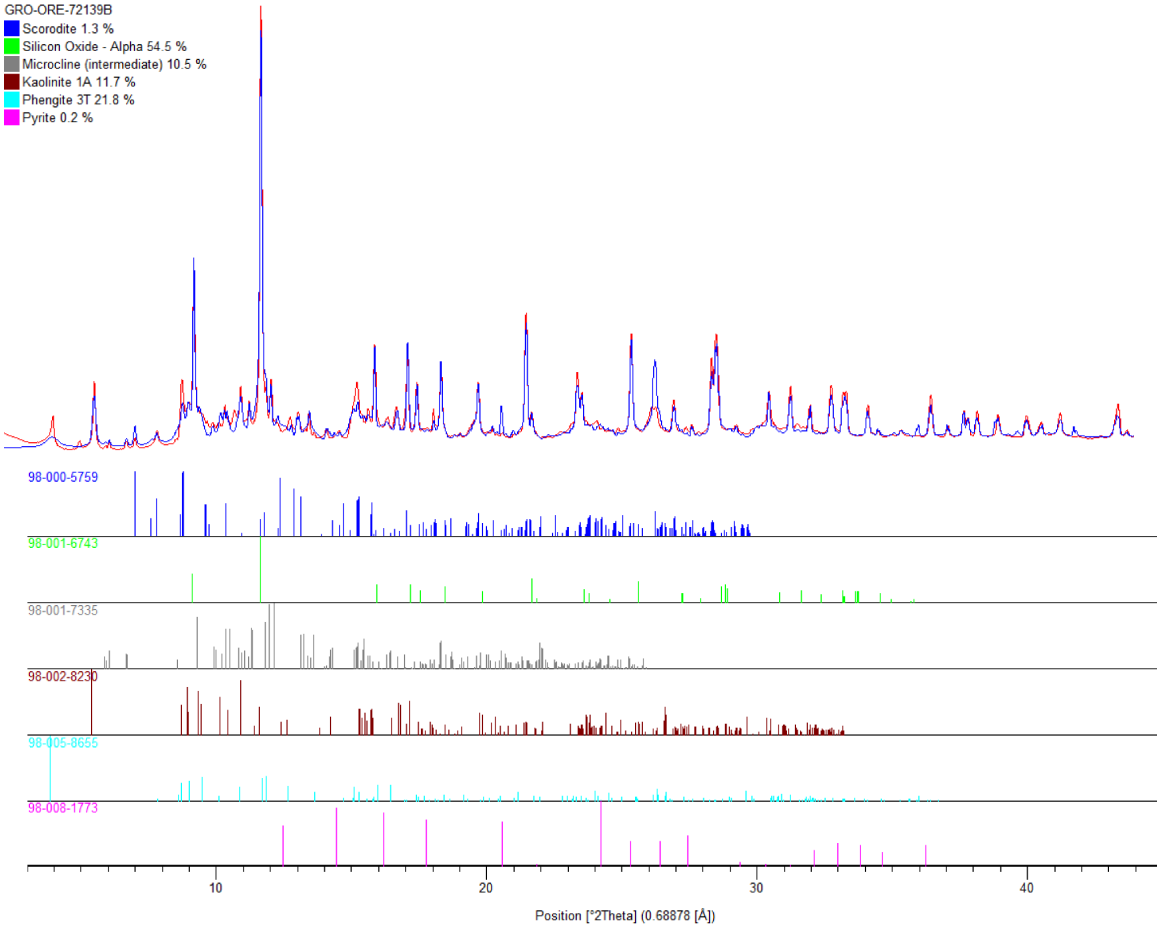


Figure 7.23 Diffraction pattern of GRO ore

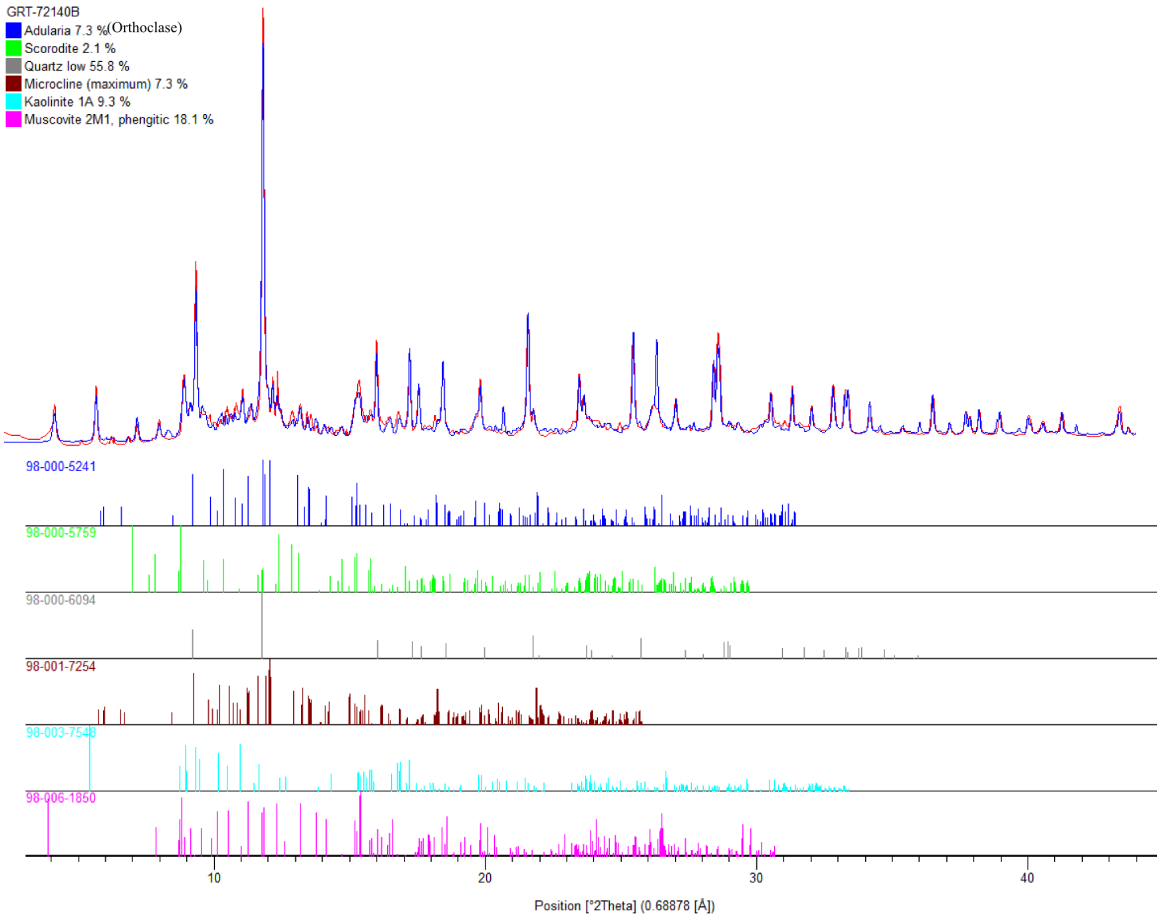


Figure 7.24 Diffraction pattern of GRT ore

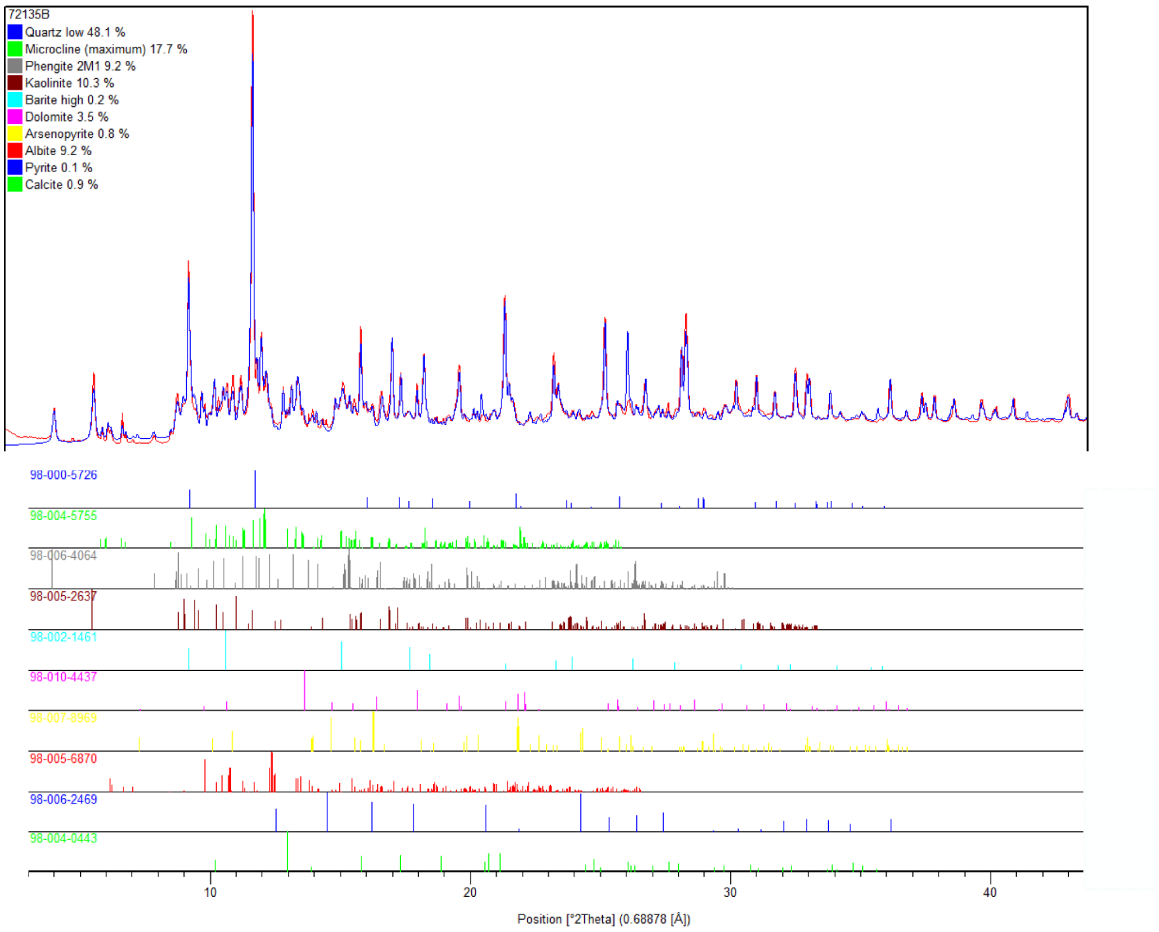


Figure 7.25 Diffraction pattern of 72135B

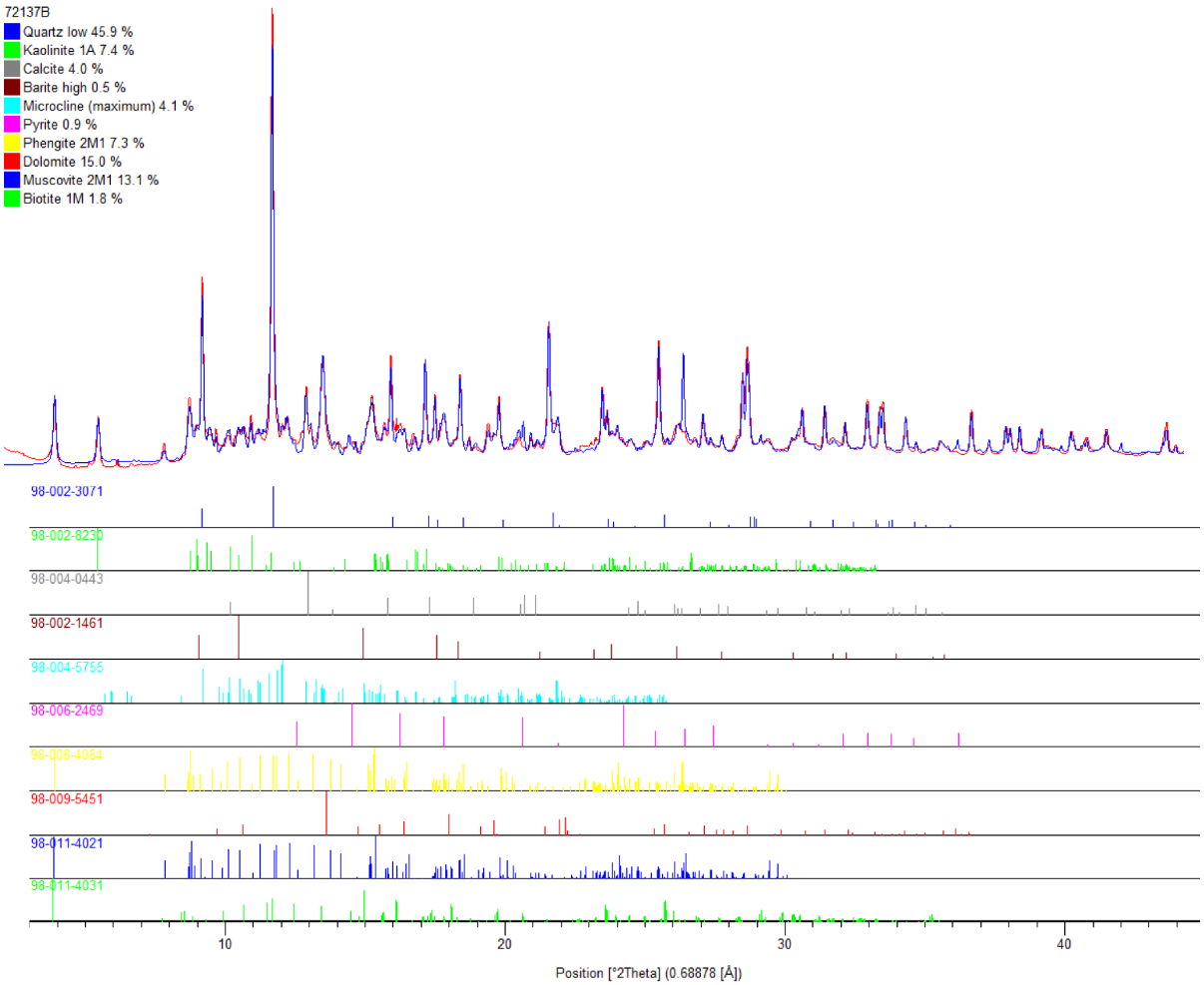


Figure 7.26 Diffraction pattern of 72137B

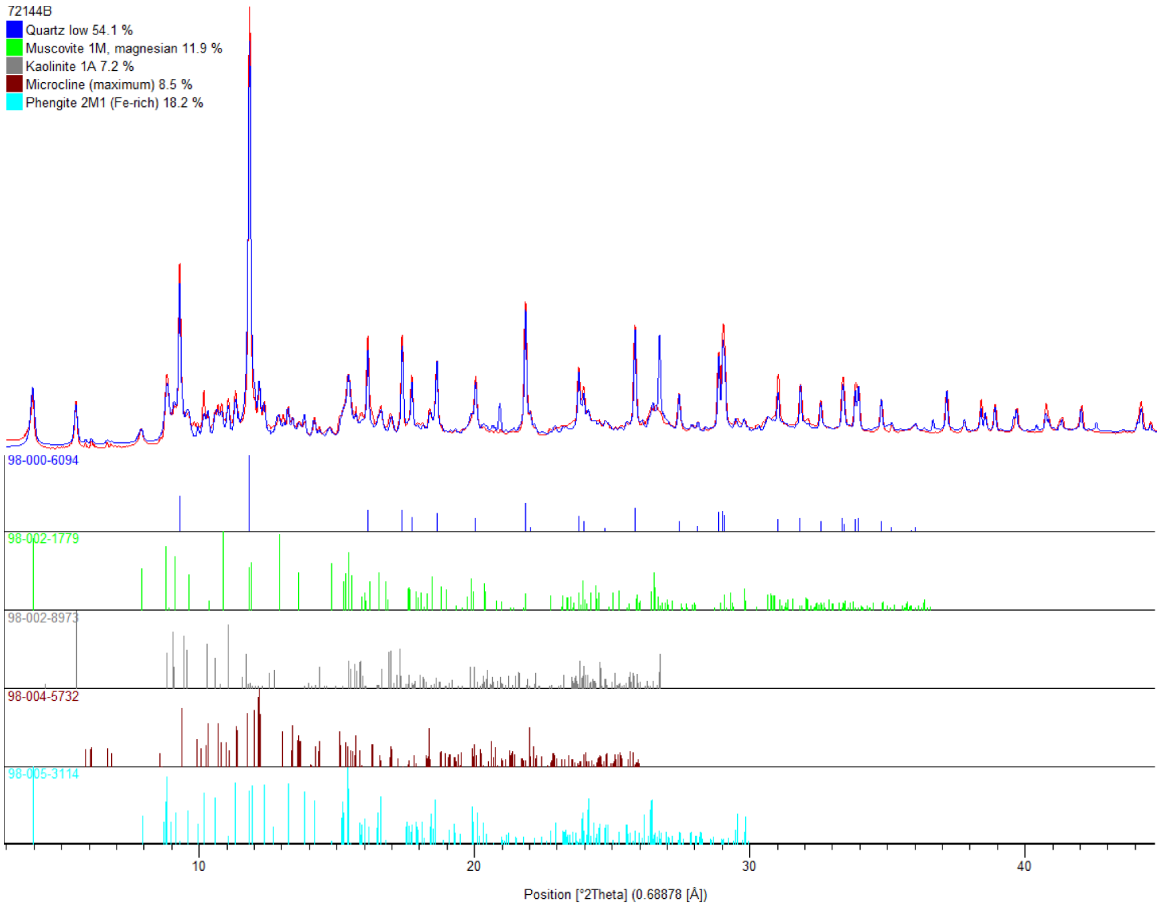


Figure 7.27 Diffraction pattern of 72144B

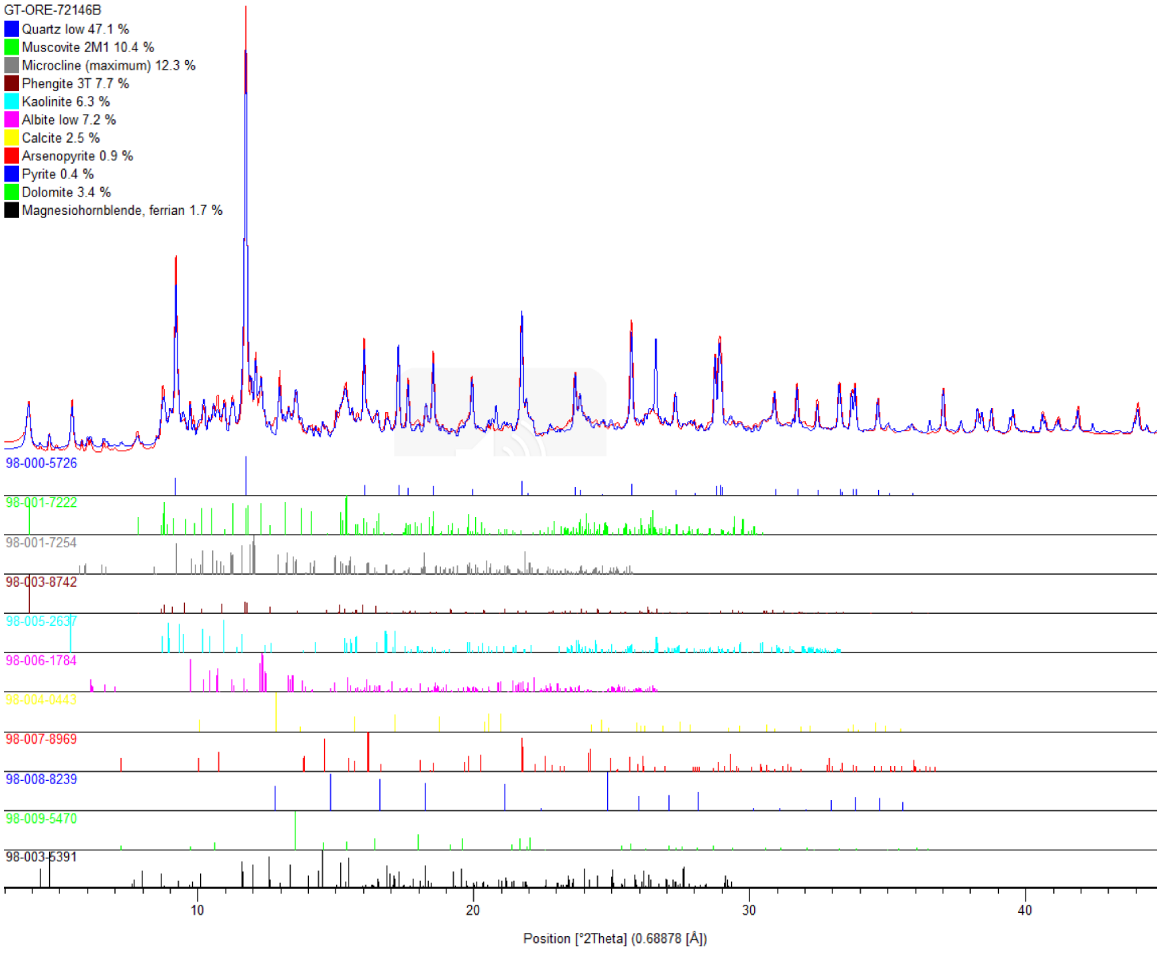


Figure 7.28 Diffraction pattern of GT ore

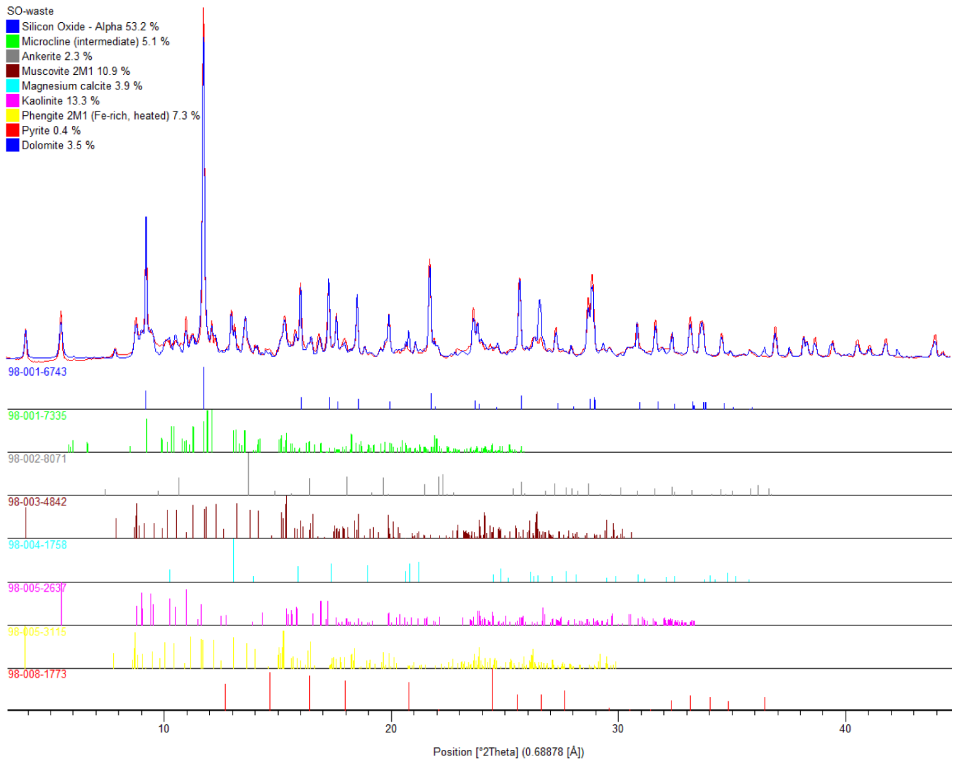


Figure 7.29 Diffraction pattern of SO waste

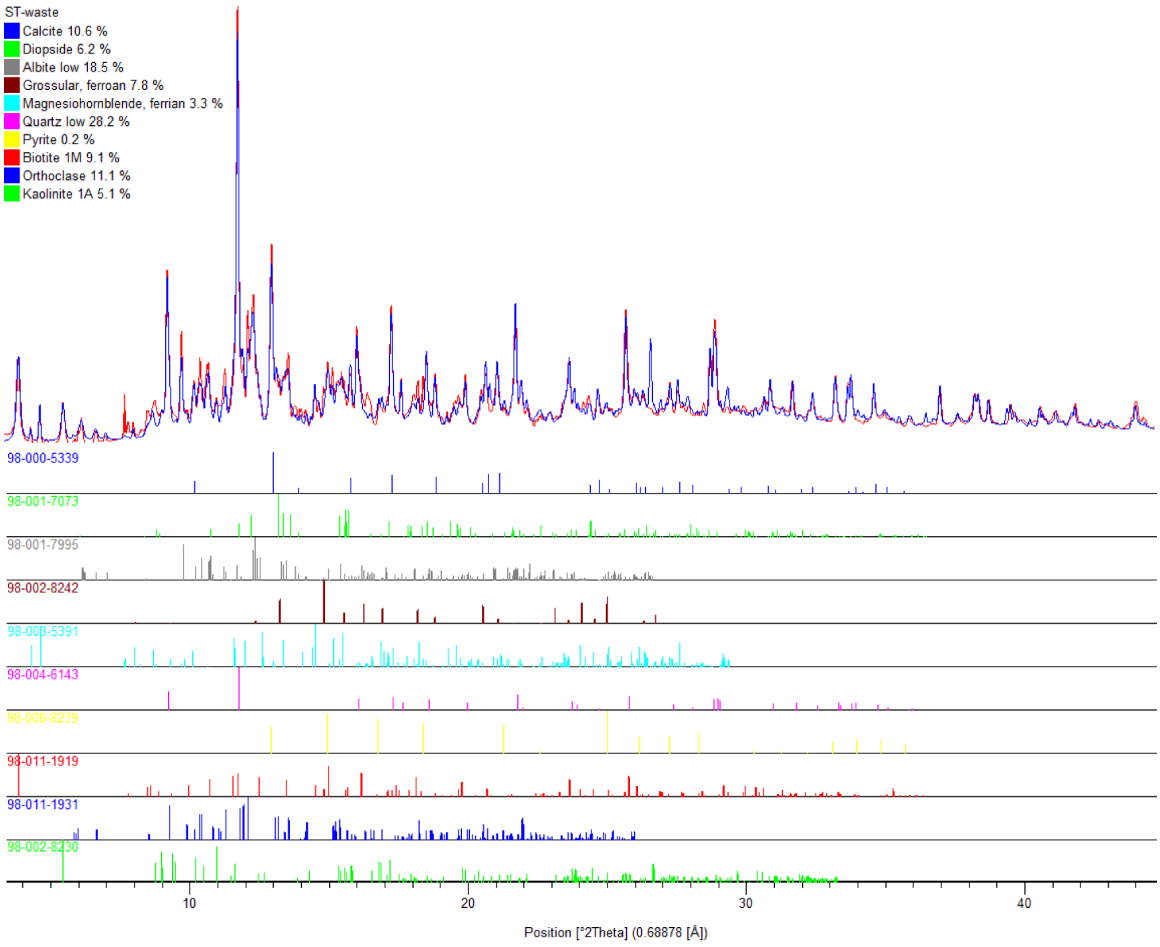


Figure 7.30 Diffraction pattern of ST waste

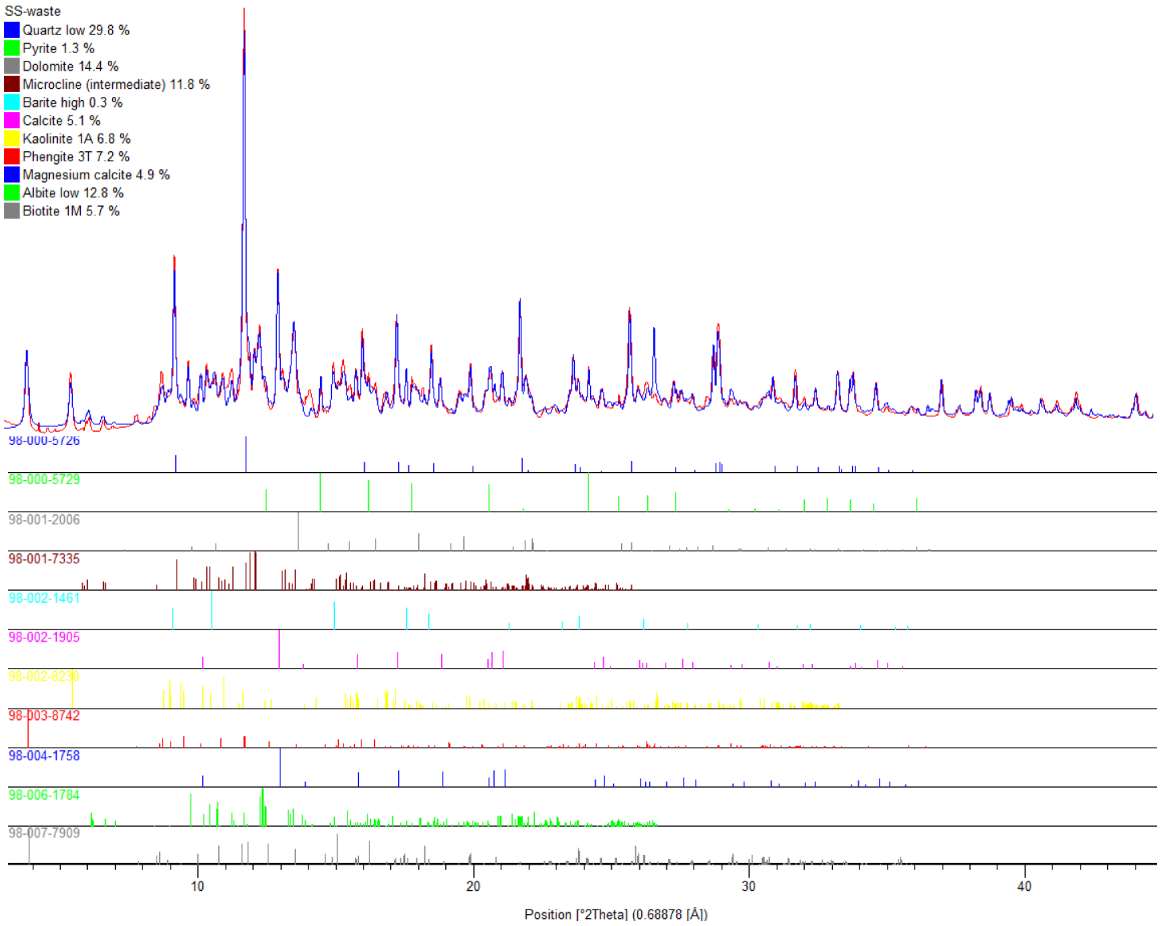


Figure 7.31 Diffraction pattern of SS waste

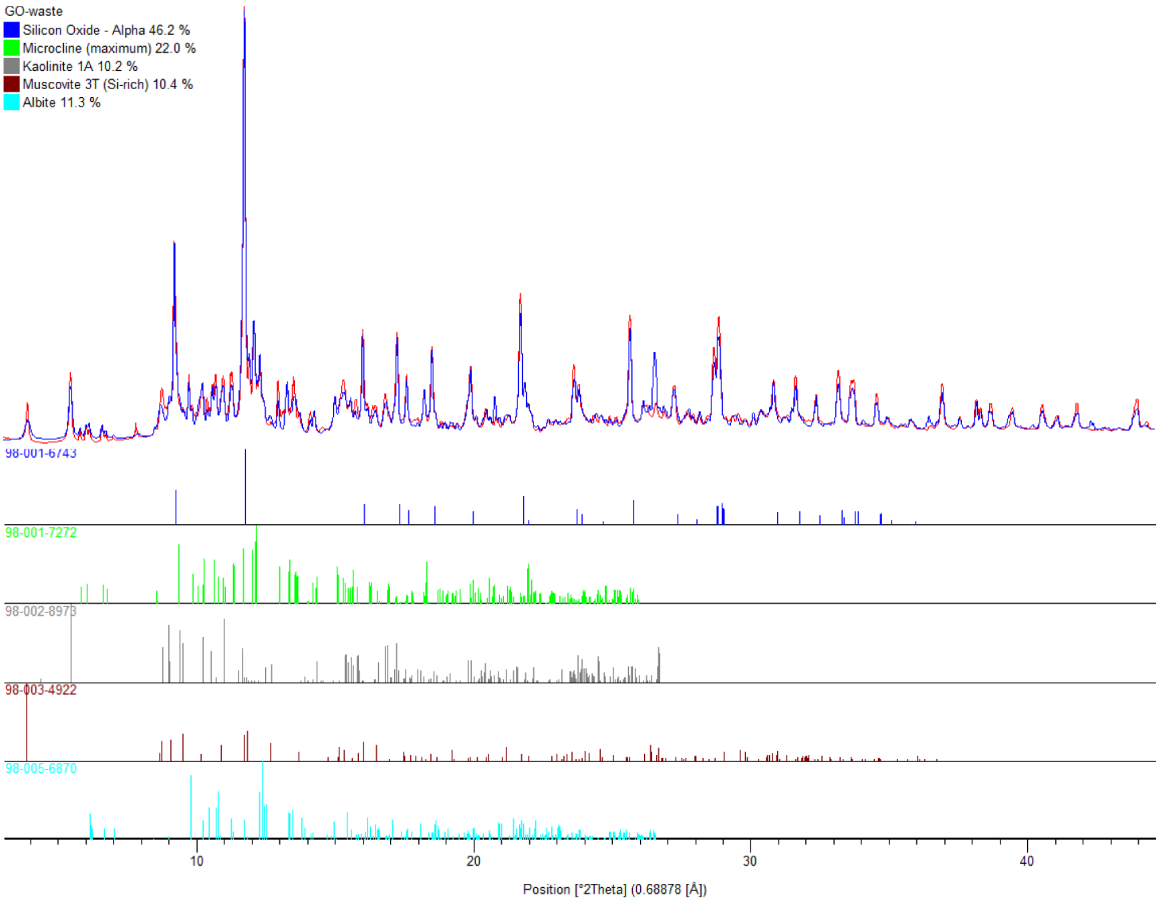


Figure 7.32 Diffraction pattern of GO waste

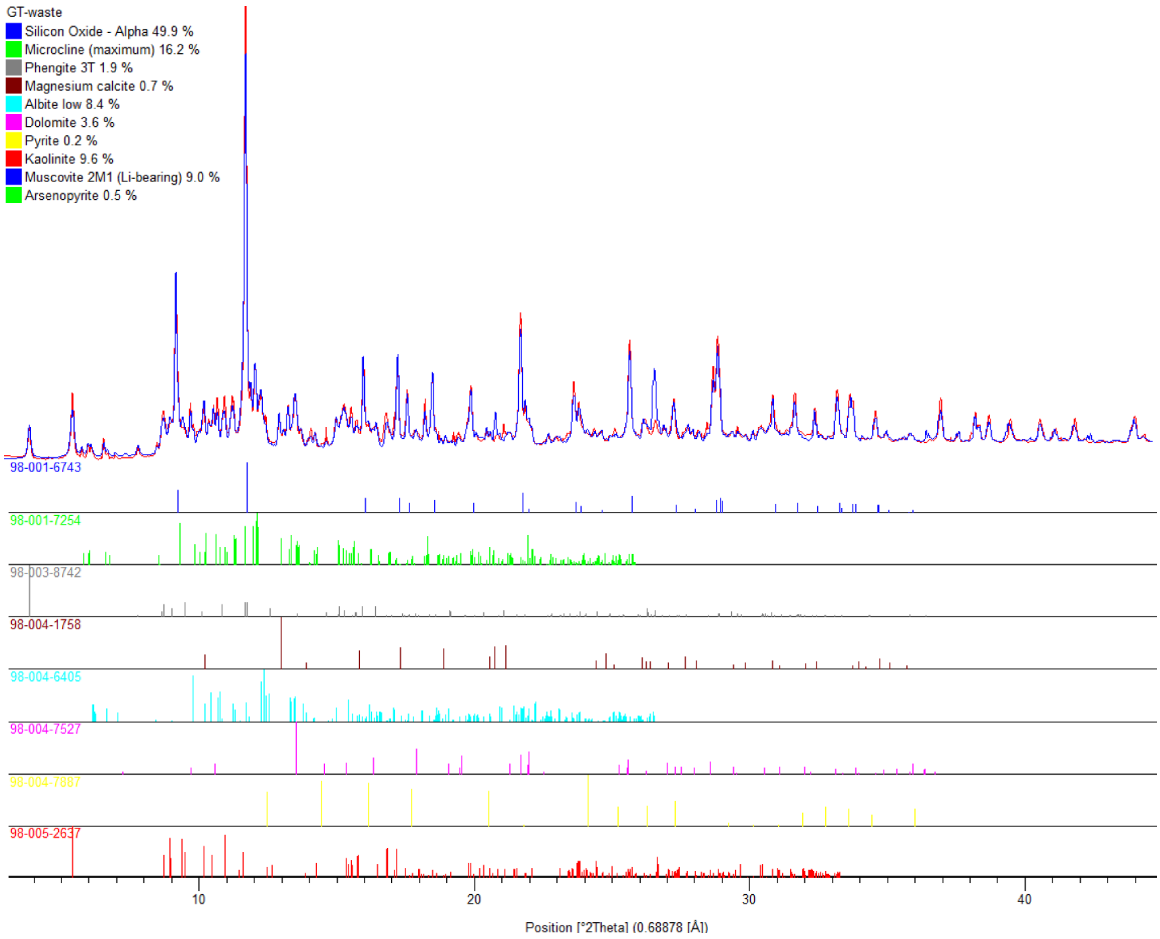


Figure 7.33 Diffraction pattern of GT waste

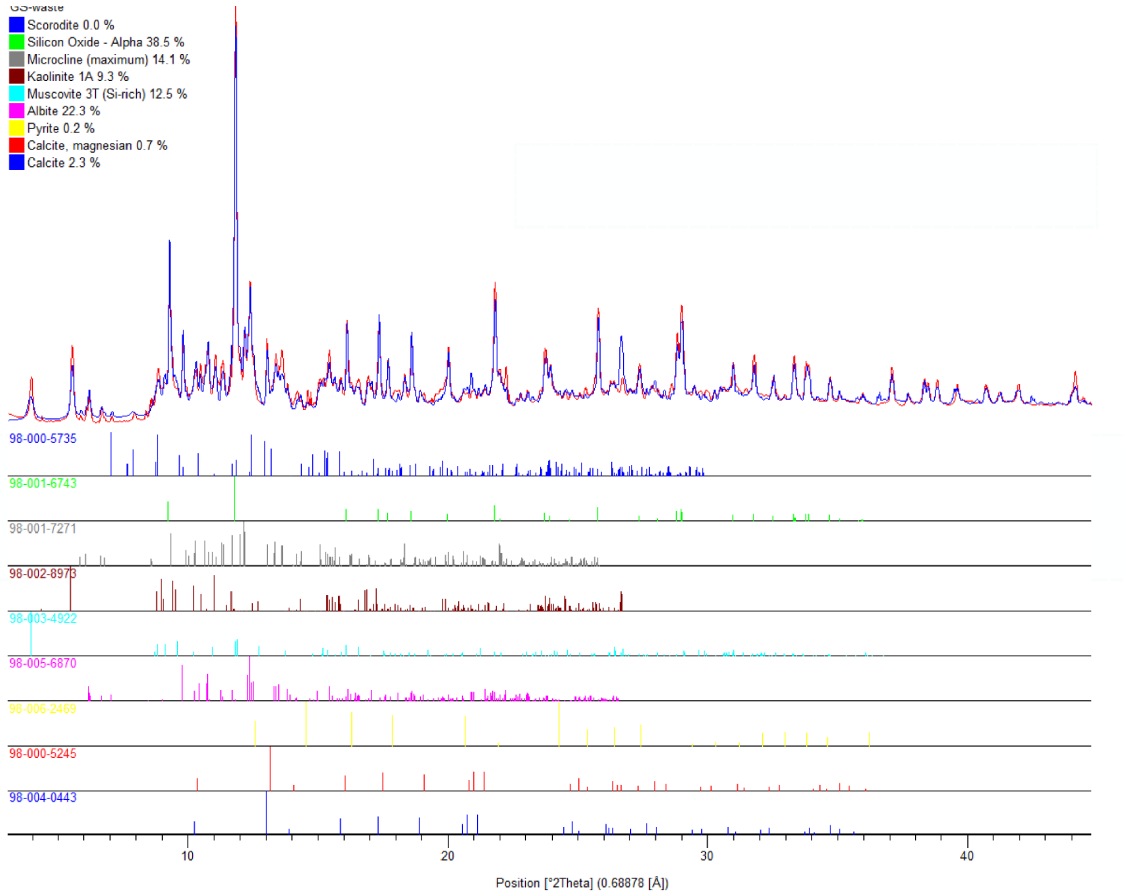


Figure 7.34 Diffraction pattern of GS waste

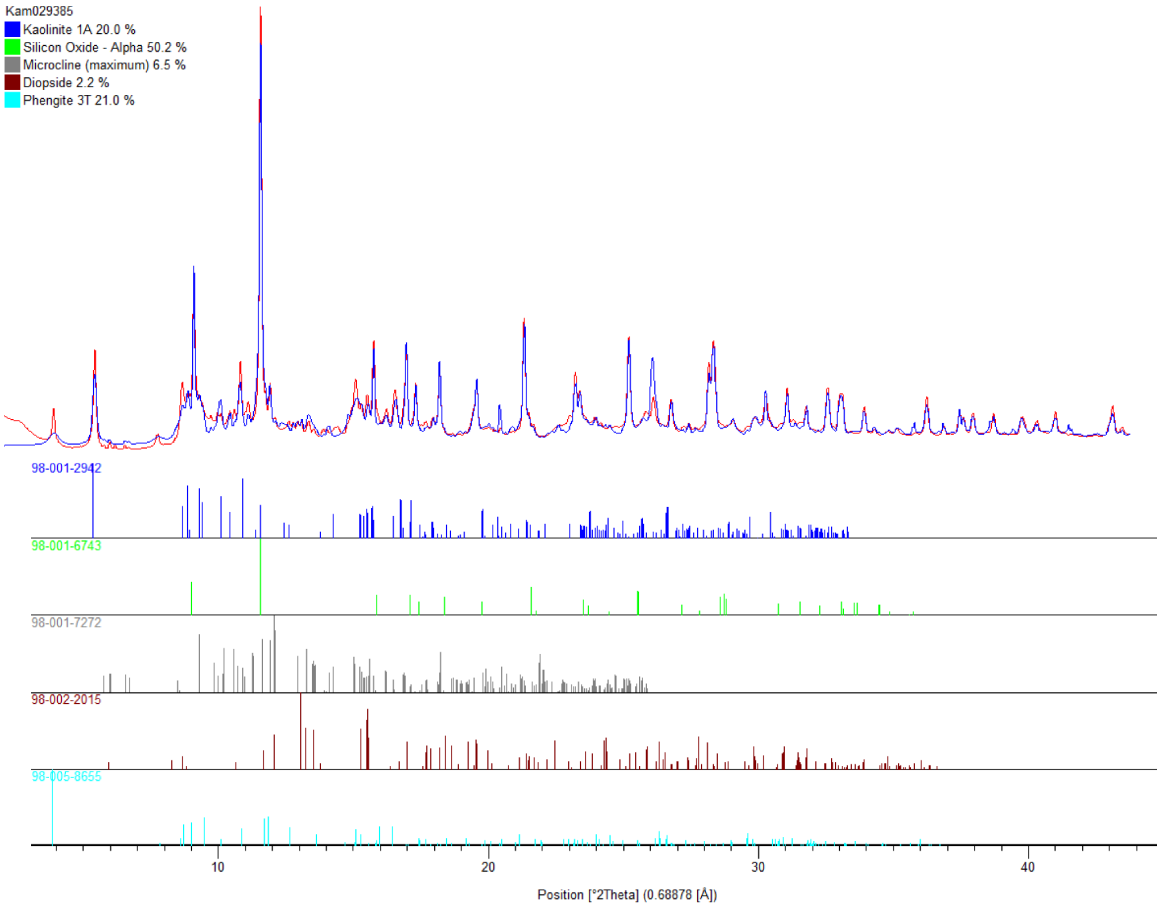


Figure 7.35 Diffraction pattern of KAM029385

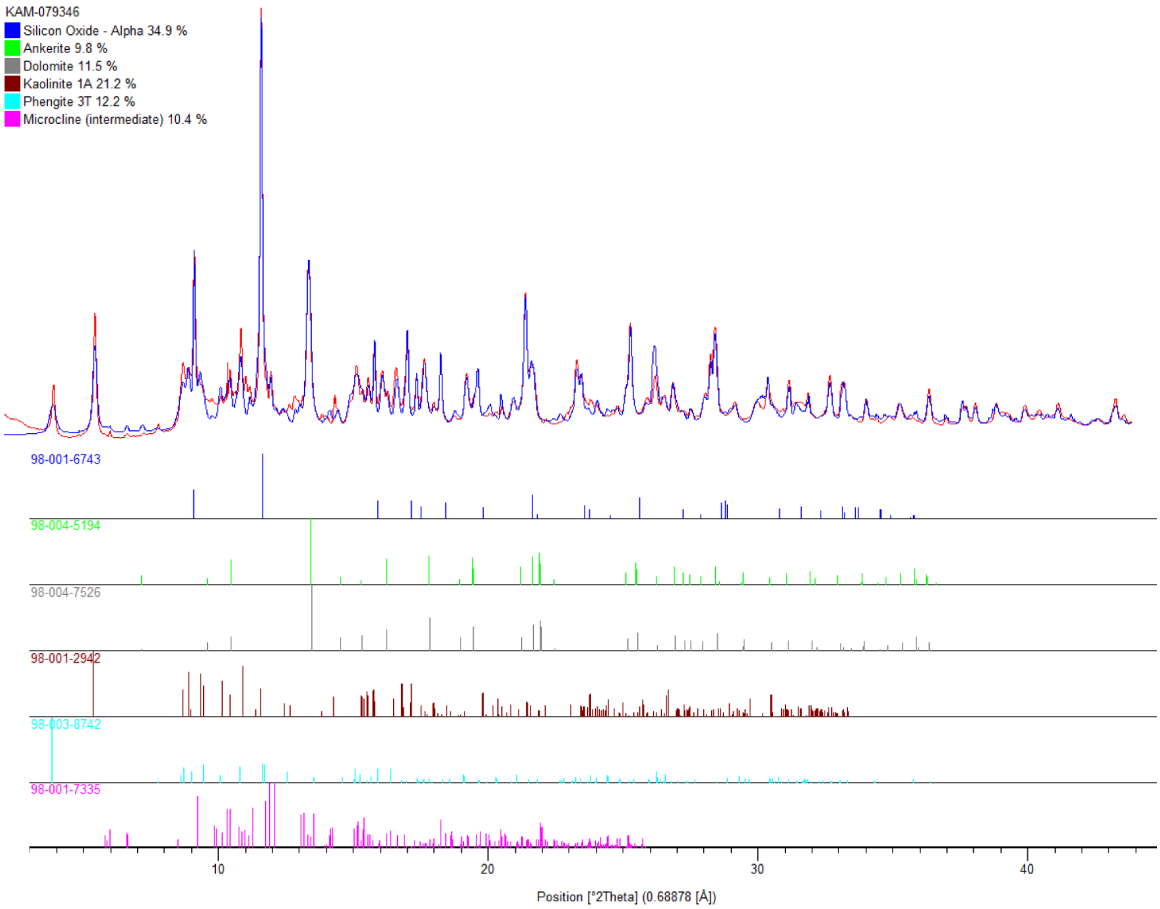


Figure 7.36 Diffraction pattern of KAM079346

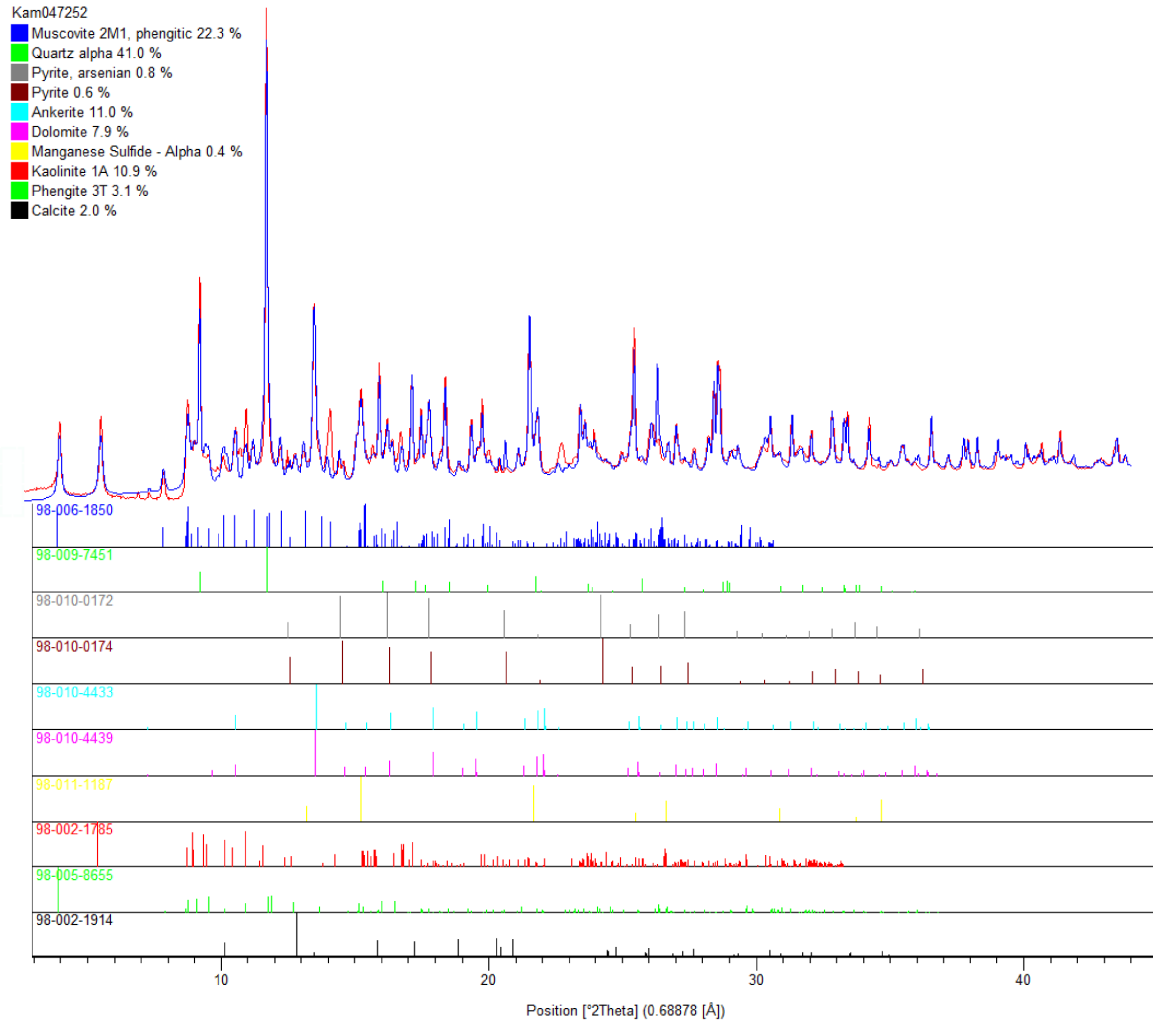


Figure 7.37 Diffraction pattern of KAM047252

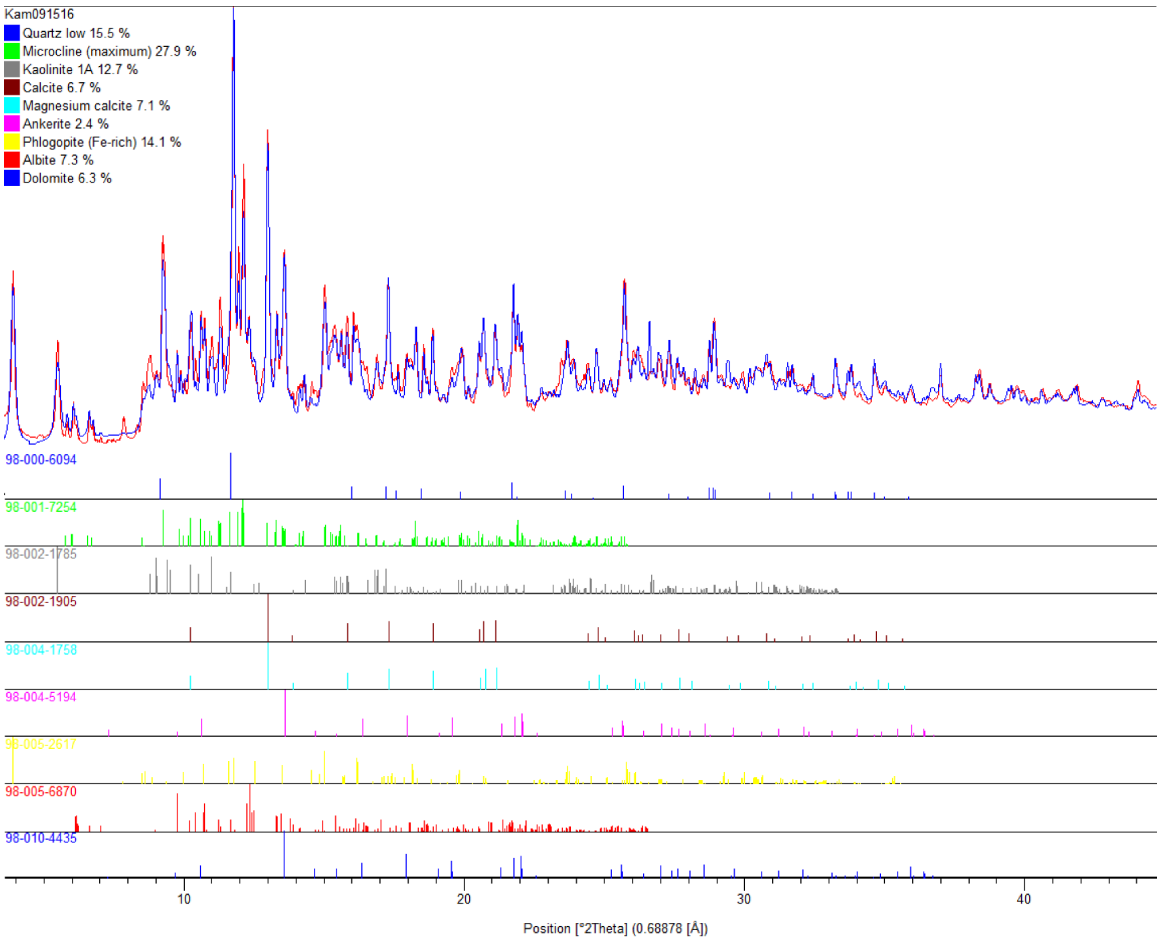


Figure 7.38 Diffraction pattern of KAM091516

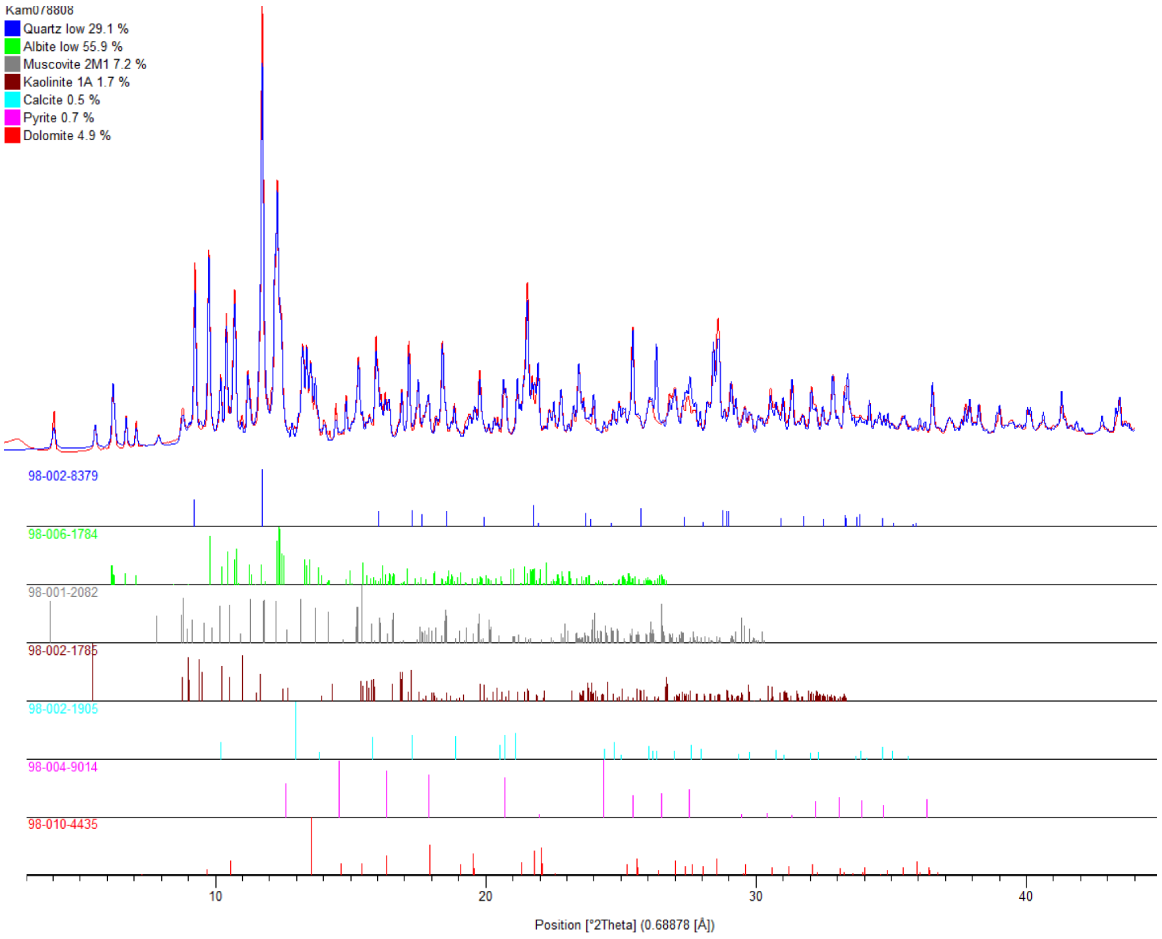


Figure 7.39 Diffraction pattern of KAM078808

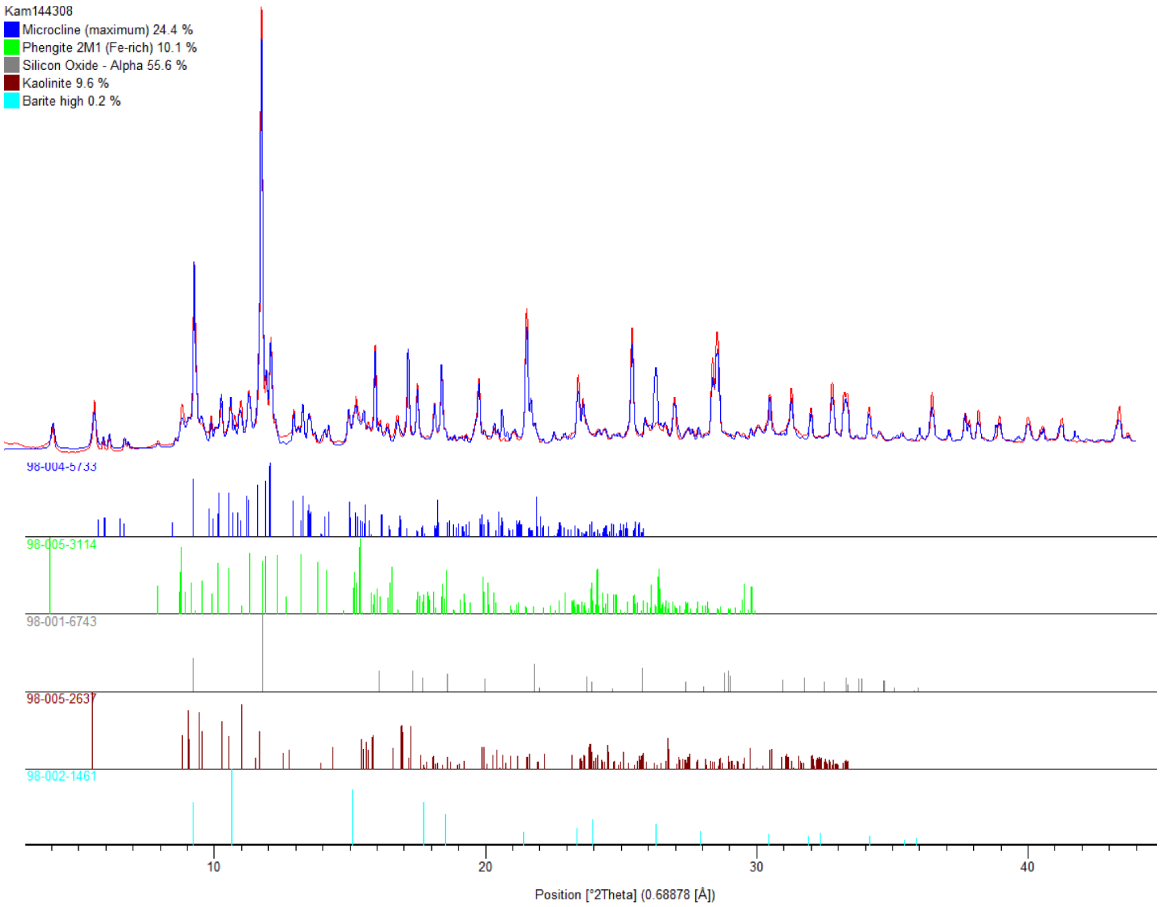


Figure 7.40 Diffraction pattern of KAM155308

Appendix C: Static Test Results

Appendix C.1: Static Test Results for Waste Rock

Appendix C.2: Static Test Results for Ore

Appendix C.3: Static Test Results for Leach Tailings

Appendix C.4: Static Test Results for Overburden

GOLDCORP

Appendix C.1: Static Test Results for Waste Rock

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	kg$CaCO_3$/t	%	%	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Oxide Facies for Gneiss Waste Rock																											
ABA001	KAM000219	CFD0002	21	22	Waste	Oxide	Gneiss	FG	7.1	7.3	*<0.01*	0.01	0.02	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	3.0	4.0	2.8	3.0	3.7	10	15	10	13
ABA043	KAM050495	CFD0152	149	150	Waste	Oxide	Gneiss	MxF	7.1	8.2	*<0.01*	*<0.01*	0.01	*<0.3*	0.28	0.90	22	21	23	25	21	23	25	72	68	77	83
ABA052	KAM079466	CFD0254	72	73	Waste	Oxide	Gneiss	MxF	7.4	9.1	*<0.01*	0.01	0.01	*<0.3*	0.27	1.0	21	23	25	25	21	25	25	70	76	83	83
ABA063	KAM125214	CFD0307	10	11	Waste	Oxide	Gneiss	MxF	8.3	8.4	*<0.01*	*<0.01*	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	8.0	8.0	1.3	8.0	7.7	5.2	15	27	27
ABA064	KAM125257	CFD0307	49	50	Waste	Oxide	Gneiss	MxF	7.4	7.5	0.01	*<0.01*	*<0.01*	0.30	0.020	*<0.2*	1.6	*<4.5*	4.0	5.0	1.2	4.0	4.7	5.0	14	13	16
ABA080	KAM115505	CFR0360	25.91	27.43	Waste	Oxide	Gneiss	MxF	7.5	7.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.10	0.20	7.8	4.5	4.0	5.0	7.5	4.0	4.7	26	15	13	17
ABA081	KAM117096	CFR0384	22.86	24.38	Waste	Oxide	Gneiss	MxF	7.3	7.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.060	0.20	4.7	4.5	5.0	5.0	4.4	5.0	4.7	16	15	17	17
ABA083	KAM119516	CFR0418	19.81	21.34	Waste	Oxide	Gneiss	MxF	8.6	8.5	0.01	*<0.01*	*<0.01*	0.30	0.050	0.20	3.9	4.5	6.0	7.0	3.6	6.0	6.7	12	15	19	22
ABA085	KAM120107	CFR0425	15.24	16.76	Waste	Oxide	Gneiss	MxM	7.2	7.9	*<0.01*	0.01	*<0.01*	*<0.3*	0.060	0.20	4.7	4.5	5.0	6.0	4.4	5.0	5.7	16	15	17	20
ABA096	KAM137284	CFR0468	32	33.53	Waste	Oxide	Gneiss	MxF	8.5	8.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	8.0	9.0	3.6	8.0	8.7	13	15	27	30
ABA104	KAM139298	CFR0482	10.67	12.19	Waste	Oxide	Gneiss	MxF	7.2	7.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.070	*<0.2*	5.4	*<4.5*	3.0	4.0	5.1	3.0	3.7	18	15	10	13
ABA136	KAM151967	CFR0584	109.73	111.25	Waste	Oxide	Gneiss	MxF	7.2	7.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.070	0.20	5.4	4.5	3.0	4.0	5.1	3.0	3.7	18	15	10	13
ABA137	KAM151932	CFR0584	60.96	62.48	Waste	Oxide	Gneiss	MxF	7.5	8.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.060	0.20	4.7	4.5	7.0	8.0	4.4	7.0	7.7	16	15	23	27
ABA138	KAM152219	CFR0586	155.45	156.97	Waste	Oxide	Gneiss	MxF	7.2	8.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.060	0.20	4.7	4.5	6.0	7.0	4.4	6.0	6.7	16	15	20	23
ABA144	KAM152716	CFR0591	30.48	32	Waste	Oxide	Gneiss	MxF	7.2	7.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.30	1.0	23	23	24	25	23	24	25	78	76	80	83
ABA145	KAM153015	CFR0594	60.96	62.48	Waste	Oxide	Gneiss	MxF	7.4	8.5	0.08	0.01	0.10	2.5	0.25	0.80	19	18	20	21	17	18	19	7.8	7.3	8.0	8.4
ABA146	KAM153091	CFR0594	164.59	166.12	Waste	Oxide	Gneiss	MxF	7.0	7.2	0.01	0.02	*<0.01*	0.30	0.10	0.30	7.8	6.8	9.0	10	7.5	9.0	9.7	25	22	29	32
ABA149	KAM153152	CFR0595	60.96	62.48	Waste	Oxide	Gneiss	MxF	8.7	9.0	0.02	*<0.01*	0.03	0.60	0.28	1.0	22	23	21	23	21	20	22	35	36	34	37
ABA224	R277421	CFD0423	53	54	Waste	Oxide	Gneiss	MxM	-	6.8	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA225	R272412	CFD0436	9	10	Waste	Oxide	Gneiss	FG	-	7.7	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA226	R272445	CFD0436	38	39	Waste	Oxide	Gneiss	FG	-	7.8	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA227	R272537	CFD0436	120	121	Waste	Oxide	Gneiss	MxF	-	8.4	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA228	R271769	CFD0425	80	81	Waste	Oxide	Gneiss	MxF	-	9.3	*<0.01*	-	-	*<0.3*	0.15	-	12	-	-	-	11	-	-	39	-	-	-
ABA229	R272589	CFD0436	166	167	Waste	Oxide	Gneiss	MxF	-	7.5	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA230	R280455	CFD0497	90	91	Waste	Oxide	Gneiss	MxM	-	8.6	0.10	-	-	3.1	0.26	-	20	-	-	-	17	-	-	6.5	-	-	-
ABA231	R277177	CFD0421	47	48	Waste	Oxide	Gneiss	MxM	-	7.5	0.01	-	-	0.30	0.030	-	2.3	-	-	-	2.0	-	-	7.5	-	-	-
ABA232	R277505	CFD0426	58	59	Waste	Oxide	Gneiss	MxM	-	7.2	*<0.01*	-	-	*<0.3*	*<0.01*	-	*<0.8*	-	-	-	0.48	-	-	2.6	-	-	-
ABA233	R277739	CFD0431	118	119	Waste	Oxide	Gneiss	MxF	-	7.6	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA234	R277403	CFD0423	37	38	Waste	Oxide	Gneiss	MxM	-	8.4	*<0.01*	-	-	*<0.3*	0.020	-	1.6	-	-	-	1.3	-	-	5.2	-	-	-
ABA235	R277137	CFD0421	11	12	Waste	Oxide	Gneiss	MxM	-	7.7	0.01	-	-	0.30	0.030	-	2.3	-	-	-	2.0	-	-	7.5	-	-	-
ABA380	KAM075906	CFD0216	90	91	Waste	Oxide	Gneiss	MxF	7.8	7.1	0.01	0.01	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	-	-	1.2	-	-	5.0	14	-	-
ABA382	KAM067845	CFD0221	211	212	Waste	Oxide	Gneiss	FG	-	8.6	0.06	*<0.01*	0.06	1.9	0.52	1.6	40	36	-	-	38	-	-	22	19	-	-
ABA384	KAM068794	CFD0238	227	228	Waste	Oxide	Gneiss	FG	7.0	6.4	0.01	0.02	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	-	-	1.2	-	-	5.0	14	-	-
ABA393	KAM030104	CFR0109	50.9	52.43	Waste	Oxide	Gneiss	FG	6.6	6.6	0.02	0.01	0.01	0.60	0.020	*<0.2*	1.6	*<4.5*	-	-	0.93	-	-	2.5	7.2	-	-
Statistical Summary						**Oxide**	**Gneiss**	**n**	21	34	34	22	22	34	34	22	34	22	18	18	34	18	18	34	22	18	18
								Max	8.7	9.3	0.10	0.02	0.10	3.1	0.50	1.6	40	36	25	25	39	25	25	78	76	83	83
								90th PCTL	8.5	8.6	0.02	0.01	0.03	0.60	0.30	1.0	22	23	23	25	21	23	25	38	65	78	83
								75th PCTL	7.5	8.4	0.01	0.01	0.01	0.30	0.10	0.70	7.8	15	17	18	7.5	15	16	18	18	28	32
								Median	7.3	7.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.10	0.20	3.9	4.5	6.5	7.5	3.6	6.2	7.2	9.1	15	20	23
								25th PCTL	7.2	7.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	4.3	5.0	1.2	4.0	4.7	5.0	15	13	16
								10th PCTL	7.0	7.1	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	3.0	4.0	0.50	2.7	3.7	2.5	14	10	13
								Min	6.6	6.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	*<0.2*	*<0.8*	*<4.5*	3.0	4.0	0.50	2.7	3.7	2.5	7.2	8.0	8.4
Upper Transition Facies for Gneiss Waste Rock																											
ABA016	KAM029087	CFD0175	145	146	Waste	Upper transition	Gneiss	MxF	7.1	7.5	0.01	0.01	*<0.01*	0.30	0.64	2.1	50	48	52	53	49	52	53	159	153	166	170
ABA042	KAM050492	CFD0152	146	147	Waste	Upper transition	Gneiss	MxF	7.3	8.1	*<0.01*	0.01	0.01	*<0.3*	0.35	1.2	27	27	30	30	27	30	30	91	91	100	100
ABA057	KAM096548	CFD0269	33	34	Waste	Upper transition	Gneiss	FG	7.5	8.5	0.94	*<0.01*	0.90	29	0.030	*<0.2*	2.3	*<4.5*	40	5.0	-27	11	-24	0.080	0.15	1.4	0.17
ABA059	KAM097012	CFD0272	17	18	Waste	Upper transition	Gneiss	FG	7.4	7.6	*<0.01*	0.01	0.01	*<0.3*	0.030	0.10	2.3	2.3	6.0	6.0	2.0	6.0	5.7	7.8	7.6	20	20
ABA060	KAM097065	CFD0272	65	66	Waste	Upper transition	Gneiss	FG	7.1	8	0.04	*<0.01*	0.04	1.3	0.42	1.4	33	32	34	36	31	33	35	26	25	27	29
ABA069	KAM145287	CFD0338	123	124	Waste	Upper transition	Gneiss	FG	7.4	7.4	0.01	*<0.01*	*<0.01*	0.30	0.020	*<0.2*	1.6	*<4.5*	3.0	5.0	1.2	3.0	4.7	5.0	14	9.6	16
ABA101	KAM137634	CFR0470	109.73	111.25	Waste	Upper transition	Gneiss	MxF	7.6	7.8	0.06	*<0.01*	0.04	1.9	0.35	1.1	27	25	26	27	25	24	25	14	13	14	14
ABA105	KAM139327	CFR0482	50.29	51.82	Waste	Upper transition	Gneiss	MxF	7.2	7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.11	*<0.2*	8.5	*<4.5*	2.0	3.0	8.2	2.0	2.7	28	15	6.7	10
ABA141	KAM152499	CFR0589	77.72	79.25	Waste	Upper transition	Gneiss	MxF	7.6	8.8	0.03	0.02	0.03	0.90	0.44	1.2	34	27	30	31	33	29	30	36	29	32	33
ABA147	KAM152978	CFR0594	10.67	12.19	Waste	Upper transition	Gneiss	MxF	9.2	9.4	*<0.01*	0.01	*<0.01*	*<0.3*	0.27	0.90	21	21	22	23	21	22	23	70	68	73	77
ABA237	R270907	CFD0412	10	11	Waste	Upper transition	Gneiss	MxF	-	8.2	0.01	-	-	0.30	0.63	-	49	-	-	-	49	-	-	156	-	-	-
ABA238	R280433	CFD0497	28	29	Waste	Upper transition	Gneiss	MxM	-	7.7	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA239	Q034712	CFD0473	7	8	Waste	Upper transition	Gneiss	FG	-	7.9	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA240	Q034807	CFD0473	117	118	Waste	Upper transition	Gneiss	FG	-	7.6	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA241	R272496	CFD0436	83	84	Waste	Upper transition	Gneiss	MxF	-	7.5	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA242	R270718	CFD0404	69	70	Waste	Upper transition	Gneiss	MxF	-	7.5	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA243	R271483	CFD0420	51	52	Waste	Upper transition	Gneiss	MxF	-	7.5	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA244	R272865	CFD0441	40	41	Waste	Upper transition	Gneiss	MxF	-	7.1	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA245	R278947	CFD0461	10	11	Waste	Upper transition	Gneiss	MxM	-	7	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA353	R304081	CFD0525	10	11	Waste	Upper Transition	Gneiss	MxF	8.4	7.5	*<0.01*	0.01	0.01	0.30	0.010	*<0.2*	0.80	*<4.5*	-	-	0.46	-	-	2.5	14	-	-
ABA367	R545582	CFD0524	56	57	Waste	Upper Transition	Gneiss	MxF	7.9	7.2	0.01	*<0.01*	0.02	0.30	0.020	*<0.2*	1.6	*<4.5*	-	-	1.2	-	-	5.0	14	-	-
ABA373	R271332	CFD0417	58	59	Waste	Upper Transition	Gneiss	MxF	7.5	6.8	0.08	0.01	0.05	2.5	0.010	*<0.2*	0.80	*<4.5*	-	-	-1.7	-	-	0.31	1.8	-	-
ABA385	KAM068709	CFD0238	151	152	Waste	Upper Transition	Gneiss	MxF	-	-	*<0.01*	0.01	0.01	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	-	-	3.6	-	-	13	15	-	-
ABA386	KAM069164	CFD0242	220.45	221	Waste	Upper Transition	Gneiss	FG	7.1	6.6	*<0.01*	0.01	0.02	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA407	R272624	CFD0438	17	18	Waste	Upper Transition	Gneiss	MxF	7.9	7.8	*<0.01*	0.02	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.8	15	-	-
ABA411	R544193	CFD0502	40	41	Waste	Upper Transition	Gneiss	MxF	7.4	6.9	*<0.01*	0.01	0.02	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.8	15	-	-
Statistical Summary						**Upper Transition**	**Gneiss**	**n**	16	25	26	17	17	26	26	17	26	17	10	10	26	10	10	26	17	10	10
								Max	9.2	9.4	0.94	0.02	0.90	29	0.64	2.1	50	48	52	53	49	52	53	159	153	166	170
								90th PCTL	8.2	8.4	0.05	0.01	0.04	1.6	0.43	1.3	33	29	41	38	32	35	37	80	77	107	107
								75th PCTL	7.7	7.9	0.01	0.01	0.03	0.31	0.23	1.1	18	25	33	31	18	30	30	23	26	63	66
								Median	7.5	7.5	0.01	0.01	0.01	0.31	0.030	*<0.2*	1.9	*<4.5*	28	25	1.2	23	24	5.1	15	24	24
								25th PCTL	7.3	7.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	1.0	*<4.5*	10	5.3	0.50	6.9	4.9	2.6	14	11	15
								10th PCTL	7.1	6.9	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	2.9	4.8	0.50	2.6	0	2.5	5.3	6.1	9.0
								Min	7.1	6.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	0.10	0.80	2.3	2.0	3.0	-27	1.7	-24	0.10	0.20	1.4	0.20

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Lower Transition Facies for Gneiss Waste Rock																											
ABA019	KAM029649	CFD0177	73	74	Waste	Lower transition	Gneiss	MxM	9.5	9.3	0.02	0.02	0.01	0.60	0.14	0.50	11	11	20	20	10	19	19	17	18	32	32
ABA020	KAM029658	CFD0177	81	82	Waste	Lower transition	Gneiss	MxM	7.9	9.5	0.05	*<0.01*	0.07	1.6	1.1	4.0	86	91	127	121	85	125	119	55	58	81	77
ABA047	KAM051446	CFD0166	13	14	Waste	Lower transition	Gneiss	MxM	9.5	9.3	*<0.01*	*<0.01*	0.01	*<0.3*	0.12	0.50	9.3	11	28	23	9.0	28	23	31	38	93	77
ABA051	KAM079117	CFD0251	51	52	Waste	Lower transition	Gneiss	MxF	7.2	7.9	0.27	0.02	0.25	8.4	0.67	2.3	52	52	48	50	44	40	42	6.2	6.2	5.7	5.9
ABA058	KAM096948	CFD0270	230	231	Waste	Lower transition	Gneiss	MxF	7.2	8.2	0.10	*<0.01*	0.06	3.1	0.82	2.8	64	64	61	56	61	58	53	20	20	20	18
ABA067	KAM129499	CFD0332	50	51	Waste	Lower Transition	Gneiss	MxM	9.5	9.5	0.04	*<0.01*	0.04	1.3	0.12	0.40	9.3	9.1	15	17	8.1	14	16	7.5	7.3	12	14
ABA070	KAM099512	CFD0338	10	11	Waste	Lower transition	Gneiss	MxF	7.9	8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	4.0	5.0	1.3	4.0	4.7	5.2	15	13	17
ABA073	KAM145537	CFD0339	111	112	Waste	Lower transition	Gneiss	MxF	9	9.1	0.01	*<0.01*	*<0.01*	0.30	0.12	0.50	9.3	11	13	15	9.0	13	15	30	36	42	48
ABA098	KAM137429	CFR0469	28.96	30.48	Waste	Lower transition	Gneiss	MxF	8.7	8.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	8.0	9.0	2.8	8.0	8.7	10	15	27	30
ABA106	KAM139356	CFR0482	89.92	91.44	Waste	Lower transition	Gneiss	MxF	7.2	8.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.28	0.80	22	18	30	34	21	30	34	72	61	100	113
ABA117	KAM122524	CFR0529	21.34	22.86	Waste	Lower transition	Gneiss	FG	9.5	9.6	*<0.01*	0.01	*<0.01*	*<0.3*	0.11	0.30	8.5	6.8	13	14	8.2	13	14	28	23	43	47
ABA142	KAM152462	CFR0589	25.91	27.43	Waste	Lower transition	Gneiss	MxF	8.3	9	0.01	0.02	0.01	0.30	0.17	0.60	13	14	19	20	13	19	20	42	44	61	64
ABA150	KAM153129	CFR0595	30.48	32	Waste	Lower transition	Gneiss	MxM	7.5	8.8	0.11	0.01	0.10	3.4	0.99	3.5	77	80	104	116	73	101	113	22	23	30	34
ABA246	R273797	CFD0458	9	10	Waste	Lower transition	Gneiss	FG	-	8.3	0.01	-	-	0.30	0.18	-	14	-	-	-	14	-	-	45	-	-	-
ABA247	R283019	CFD0484	33	34	Waste	Lower transition	Gneiss	FG	-	7.9	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA249	R273398	CFD0447	188	189	Waste	Lower transition	Gneiss	MxF	-	8.5	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA250	R279032	CFD0461	85	86	Waste	Lower transition	Gneiss	MxM	-	9	0.28	-	-	8.8	0.38	-	30	-	-	-	21	-	-	3.4	-	-	-
ABA251	R274019	CFD0464	10	11	Waste	Lower transition	Gneiss	FG	-	8.1	*<0.01*	-	-	*<0.3*	0.030	-	2.3	-	-	-	2.0	-	-	7.8	-	-	-
ABA252	R274341	CFD0467	80	81	Waste	Lower transition	Gneiss	MxF	-	8.9	*<0.01*	-	-	*<0.3*	0.020	-	1.6	-	-	-	1.3	-	-	5.2	-	-	-
ABA253	R282397	CFD0474	95	96	Waste	Lower transition	Gneiss	MxF	-	7.3	*<0.01*	-	-	*<0.3*	*<0.01*	-	*<0.8*	-	-	-	0.48	-	-	2.6	-	-	-
ABA254	R270666	CFD0404	10	11	Waste	Lower transition	Gneiss	MxF	-	8.9	*<0.01*	-	-	*<0.3*	0.050	-	3.9	-	-	-	3.6	-	-	13	-	-	-
ABA255	R271756	CFD0424	62	63	Waste	Lower transition	Gneiss	MxM	-	8.2	0.01	-	-	0.30	0.040	-	3.1	-	-	-	2.8	-	-	9.9	-	-	-
ABA256	R271112	CFD0415	8	9	Waste	Lower transition	Gneiss	MxM	-	8.9	0.08	-	-	2.5	0.26	-	20	-	-	-	18	-	-	8.1	-	-	-
ABA257	R273315	CFD0447	115	116	Waste	Lower transition	Gneiss	FG	-	8.5	0.01	-	-	0.30	0.090	-	7.0	-	-	-	6.7	-	-	22	-	-	-
ABA258	R276507	CFD0409	12	13	Waste	Lower transition	Gneiss	MxM	-	8	*<0.01*	-	-	*<0.3*	0.030	-	2.3	-	-	-	2.0	-	-	7.8	-	-	-
ABA259	R280545	CFD0499	10	11	Waste	Lower transition	Gneiss	MxM	-	8.4	0.02	-	-	0.60	0.010	-	0.80	-	-	-	0.15	-	-	1.2	-	-	-
ABA260	R280565	CFD0499	28	29	Waste	Lower transition	Gneiss	MxM	-	8.7	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA261	R274115	CFD0464	95	96	Waste	Lower transition	Gneiss	MxF	-	8.6	0.12	-	-	3.8	1.1	-	85	-	-	-	81	-	-	23	-	-	-
ABA262	R274262	CFD0467	10	11	Waste	Lower transition	Gneiss	MxF	-	9.1	*<0.01*	-	-	*<0.3*	0.10	-	7.8	-	-	-	7.5	-	-	26	-	-	-
ABA263	R282302	CFD0474	10	11	Waste	Lower transition	Gneiss	FG	-	7.2	*<0.01*	-	-	*<0.3*	0.030	-	2.3	-	-	-	2.0	-	-	7.8	-	-	-
ABA264	R271435	CFD0420	9	10	Waste	Lower transition	Gneiss	MxF	-	8.6	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA265	R271165	CFD0415	55	56	Waste	Lower transition	Gneiss	MxF	-	9.3	0.03	-	-	0.90	0.12	-	9.3	-	-	-	8.4	-	-	9.9	-	-	-
ABA267	R273694	CFD0456	97	98	Waste	Lower transition	Gneiss	MxM	-	8.2	0.30	-	-	9.4	0.58	-	45	-	-	-	36	-	-	4.8	-	-	-
ABA269	R279507	CFD0468	60	61	Waste	Lower transition	Gneiss	MxF	-	8.5	0.02	-	-	0.60	0.010	-	0.80	-	-	-	0.15	-	-	1.2	-	-	-
ABA270	R272186	CFD0433	10	11	Waste	Lower transition	Gneiss	MxF	-	7.6	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA271	R283079	CFD0484	87	88	Waste	Lower transition	Gneiss	FG	-	8.6	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA272	Q034772	CFD0473	86	87	Waste	Lower transition	Gneiss	MxF	-	8.5	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA273	R282171	CFD0439	30	31	Waste	Lower transition	Gneiss	MxF	-	7.6	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA274	R277372	CFD0423	10	11	Waste	Lower transition	Gneiss	MxM	-	9.3	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA275	R283492	CFD0496	10	11	Waste	Lower transition	Gneiss	MxF	-	8.6	0.03	-	-	0.90	0.010	-	0.80	-	-	-	-0.16	-	-	0.83	-	-	-
ABA276	R273866	CFD0460	63	64	Waste	Lower transition	Gneiss	FG	-	9	0.04	-	-	1.3	0.23	-	18	-	-	-	17	-	-	14	-	-	-
ABA277	R273898	CFD0460	91	92	Waste	Lower transition	Gneiss	MxF	-	9.3	0.08	-	-	2.5	0.73	-	57	-	-	-	54	-	-	23	-	-	-
ABA278	Q035773	CFD0491	9	10	Waste	Lower transition	Gneiss	MxF	-	8.2	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA279	Q035789	CFD0491	60	61	Waste	Lower transition	Gneiss	MxF	-	6.8	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA280	R271699	CFD0424	12	13	Waste	Lower transition	Gneiss	MxF	-	9.2	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA282	R282102	CFD0437	70	71	Waste	Lower transition	Gneiss	MxF	-	7.3	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA283	R273302	CFD0447	59	60	Waste	Lower transition	Gneiss	FG	-	8.8	0.08	-	-	2.5	0.74	-	57	-	-	-	55	-	-	23	-	-	-
ABA284	R273593	CFD0456	7	8	Waste	Lower transition	Gneiss	MxF	-	8	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	0.48	-	-	2.6	-	-	-
ABA338	R270835	CFD0406	32	33	Waste	Lower Transition	Gneiss	MxF	9.2	9.3	0.01	0.02	0.01	0.30	0.64	2.1	50	48	-	-	49	-	-	159	153	-	-
ABA339	R270848	CFD0406	58	58.309	Waste	Lower Transition	Gneiss	MxF	9.4	9.4	*<0.01*	0.01	*<0.01*	*<0.3*	0.21	0.70	16	16	-	-	16	-	-	54	53	-	-
ABA340	R270686	CFD0404	27	28	Waste	Lower Transition	Gneiss	MxM	9	8.9	0.07	*<0.01*	0.05	2.2	0.34	1.1	26	25	-	-	24	-	-	12	11	-	-
ABA341	R270737	CFD0404	85	86	Waste	Lower Transition	Gneiss	FG	9.2	9.2	0.01	*<0.01*	*<0.01*	0.30	0.45	1.5	35	34	-	-	35	-	-	112	109	-	-
ABA342	R551085	CFD0563	10	11	Waste	Lower Transition	Gneiss	MxM	9.4	9.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.21	0.70	16	16	-	-	16	-	-	54	53	-	-
ABA343	R551107	CFD0563	30	31	Waste	Lower Transition	Gneiss	MxM	8.8	8.8	0.06	0.01	0.05	1.9	1.0	3.3	78	75	-	-	76	-	-	41	40	-	-
ABA344	R551131	CFD0563	50	51	Waste	Lower Transition	Gneiss	MxM	9.2	9.2	0.01	*<0.01*	*<0.01*	0.30	0.54	1.8	42	41	-	-	42	-	-	134	131	-	-
ABA348	R304313	CFD0541	56	57	Waste	Lower Transition	Gneiss	MxM	8.3	8.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA360	R623829	CFD0555	10	11	Waste	Lower Transition	Gneiss	MxF	9.2	9.2	0.01	*<0.01*	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	-	-	1.2	-	-	5.0	14	-	-
ABA361	R623933	CFD0555	102	103	Waste	Lower Transition	Gneiss	MxF	8.4	8.6	0.03	0.01	0.01	0.90	0.47	1.6	37	36	-	-	36	-	-	39	39	-	-
ABA362	R507027	CFD0555	185	186	Waste	Lower Transition	Gneiss	FG	9	8.9	0.03	0.01	0.04	0.90	0.57	1.9	44	43	-	-	43	-	-	47	46	-	-
ABA363	R545397	CFD0520	20	21	Waste	Lower Transition	Gneiss	FG	7.7	7	*<0.01*	*<0.01*	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA364	R545422	CFD0520	41	42	Waste	Lower Transition	Gneiss	FG	7.7	7.2	*<0.01*	0.01	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA366	R545552	CFD0524	30	31	Waste	Lower Transition	Gneiss	MxF	8.4	8.4	0.02	0.03	0.01	0.60	0.15	0.50	12	11	-	-	11	-	-	19	18	-	-
ABA369	R545644	CFD0526	81	82	Waste	Lower Transition	Gneiss	MxF	8.6	8.6	*<0.01*	*<0.01*	0.01	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	-	-	3.6	-	-	13	15	-	-
ABA370	R545697	CFD0528	42	43	Waste	Lower Transition	Gneiss	MxF	8.2	7.8	*<0.01*	0.01	0.01	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA371	R271272	CFD0417	5	6	Waste	Lower Transition	Gneiss	MxF	9.8	9.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	-	-	3.6	-	-	13	15	-	-
ABA372	R271299	CFD0417	30	30.7	Waste	Lower Transition	Gneiss	MxF	7.9	7.4	*<0.01*	*<0.01*	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA376	R279575	CFD0468	120	121	Waste	Lower Transition	Gneiss	MxF	9.2	9.1	0.01	0.01	*<0.01*	0.30	0.070	0.20	5.4	4.5	-	-	5.1	-	-	17	15	-	-
ABA390	R278608	CFD0450	10	11	Waste	Lower Transition	Gneiss	MxF	6.8	7.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA391	R278677	CFD0450	71	72	Waste	Lower Transition	Gneiss	MxF	7.4	7.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA392	R278725	CFD0450	114	114.287	Waste	Lower Transition	Gneiss	MxF	7.3	7.6	0.01	0.01	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.5	14	-	-
ABA395	R545811	CFD0529	58	59	Waste	Lower Transition	Gneiss	FG	9.5	9.5	*<0.01*	0.01	0.01	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.8	15	-	-
ABA399	R543714	CFD0549	30	31	Waste	Lower Transition	Gneiss	MxF	9.4	9.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.090	0.20	7.0	4.5	-	-	6.7	-	-	23	15	-	-
ABA400	R543741	CFD0549	53	54	Waste	Lower Transition	Gneiss	MxF	8.1	8.1	*<0.01*	0.02	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.8	15	-	-
ABA402	R544003	CFD0553	80	81	Waste	Lower Transition	Gneiss	MxF	8.8	8.9	0.01	0.02	0.01	0.30	0.10	0.30	7.8	6.8	-	-	7.5	-	-	25	22	-	-
ABA405	R554003	CFD0501	10	11	Waste	Lower Transition	Gneiss	MxF	8.1	7.6	*<0.01*	0.02	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA406	R554039	CFD0501	42	43	Waste	Lower Transition	Gneiss	MxF	9.2	9	*<0.01*	0.02	0.01	*<0.3*	0.11	0.30	8.5	6.8	-	-	8.2	-	-	28	23	-	-
ABA409	R272762	CFD0438	184	185	Waste	Lower Transition	Gneiss	FG	9	9.2	0.14	0.02	0.15	4.4	0.68	2.3	53	52	-	-	48	-	-	12	12	-	-
ABA410	R544159	CFD0502	10	11	Waste	Lower Transition	Gneiss	MxF	8.2	8	*<0.01*	0.01	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA412	R544228	CFD0502	70	71	Waste	Lower Transition	Gneiss	MxF	9.1	9.1	*<0.01*	*<0.01*	0.01	*<0.3*	0.67	2.1	52	48	-	-	52	-	-	173	159	-	-
Statistical Summary							**Lower Transition**	**Gneiss**	**n**	44	79	79	44	44	79	79	44	79	44	13	13	79	13	13	79	44	13	13
									Max	9.8	9.7	0.30	0.03	0.25	9.4	1.1	4.0	86	91	127	121	85	125	119	173	159	100	113
									90th PCTL	9.5	9.3	0.08	0.02	0.06	2.5	0.70	2.3	52	52	95	104	50	92	101	49	60	91	77
									75th PCTL	9.2	9.1	0.02	0.01	0.01	0.60	0.20	1.5	19	35	48	50	17	40	42	23	39	61	64
									Median	8.8	8.6	0.01	0.01	0.01	0.30	0.10	0.40	3.9	8.0	20	20	3.6	19	20	7.8	15	32	34
									25th PCTL	7.9	8.1	*<0.01*	*<0.01*	0.01	*<0.3*	0.00	*<0.2*	1.6	*<4.5*	13	15	1.2	13	15	5.0	15	20	18
									10th PCTL	7.3	7.6	*<0.01*	*<0.01*	0.01	*<0.3*	0.00	*<0.2*	0.80	*<4.5*	9.0	10	0.50	8.7	9.7	2.6	14	12	14
									Min	6.8	6.8	*<0.01*	*<0.01*	0.01	*<0.3*	*<0.01*	*<0.2*	*<0.8*	*<4.5*	4.0	5.0	-0.20	3.7	4.7	0.80	6.2	5.7	5.9

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	kgCaCO$_3$/t	%	%	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Fresh Facies for Gneiss Waste Rock																											
ABA065	KAM128393	CFD0326	25	26	Waste	Fresh	Gneiss	MxM	7.6	7.6	0.01	0.01	0.01	0.30	0.040	0.20	3.1	4.5	7.0	9.0	2.8	7.0	8.7	9.9	15	22	29
ABA066	KAM128504	CFD0326	75	76	Waste	Fresh	Gneiss	MxM	8.6	8.5	0.01	0.01	0.01	0.30	0.080	0.30	6.2	6.8	13	15	5.9	13	15	20	22	42	48
ABA071	KAM145241	CFD0338	81	82	Waste	Fresh	Gneiss	MxM	9.0	9.0	0.04	*<0.01*	0.02	1.3	1.2	4.3	93	98	128	140	92	127	139	75	78	102	112
ABA097	KAM137325	CFR0468	88.39	89.92	Waste	Fresh	Gneiss	MxM	8.7	8.8	0.03	*<0.01*	0.02	0.90	0.090	0.30	7.0	6.8	23	25	6.1	22	24	7.5	7.3	25	27
ABA099	KAM137468	CFR0469	82.3	83.82	Waste	Fresh	Gneiss	MxM	7.7	8.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.96	3.1	75	71	117	120	74	117	120	248	235	390	400
ABA108	KAM139795	CFR0486	25.91	27.43	Waste	Fresh	Gneiss	MxM	8.4	8.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	8.0	8.0	3.6	8.0	7.7	13	15	27	27
ABA139	KAM152151	CFR0586	60.96	62.48	Waste	Fresh	Gneiss	MxF	7.9	8.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	6.0	6.0	2.8	6.0	5.7	10	15	20	20
ABA140	KAM152186	CFR0586	109.73	111.25	Waste	Fresh	Gneiss	MxF	8.9	9.2	*<0.01*	0.01	*<0.01*	*<0.3*	0.14	0.50	11	11	12	13	11	12	13	36	38	40	43
ABA143	KAM152536	CFR0589	128.02	129.54	Waste	Fresh	Gneiss	FG	7.3	8.8	0.15	0.01	0.11	4.7	0.57	1.9	44	43	42	43	40	37	38	9.4	9.2	9.0	9.2
ABA148	KAM153051	CFR0594	109.73	111.25	Waste	Fresh	Gneiss	MxF	7.2	8.5	0.14	0.01	0.11	4.4	0.31	1.1	24	25	24	25	20	20	21	5.5	5.7	5.5	5.7
ABA285	R277457	CFD0426	16	17	Waste	Fresh	Gneiss	MxM	-	8.8	*<0.01*	-	-	*<0.3*	0.23	-	18	-	-	-	18	-	-	59	-	-	-
ABA286	R279452	CFD0468	11	12	Waste	Fresh	Gneiss	MxF	-	9.0	*<0.01*	-	-	*<0.3*	0.020	-	1.6	-	-	-	1.3	-	-	5.2	-	-	-
ABA287	R274861	CFD0472	100	101	Waste	Fresh	Gneiss	MxM	-	9.1	0.43	-	-	13	0.32	-	25	-	-	-	11	-	-	1.9	-	-	-
ABA288	R283657	CFD0498	82	83	Waste	Fresh	Gneiss	MxM	-	8.8	0.01	-	-	0.30	0.010	-	0.80	-	-	-	0.46	-	-	2.5	-	-	-
ABA289	Q035925	CFD0495	94	95	Waste	Fresh	Gneiss	MxM	-	8.5	0.01	-	-	0.30	0.21	-	16	-	-	-	16	-	-	52	-	-	-
ABA290	R272262	CFD0433	123	124	Waste	Fresh	Gneiss	MxF	-	8.6	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA293	R276133	CFD0393	45	46	Waste	Fresh	Gneiss	MxM	-	9.0	0.06	-	-	1.9	0.78	-	61	-	-	-	59	-	-	32	-	-	-
ABA294	R276236	CFD0401	18	19	Waste	Fresh	Gneiss	MxM	-	8.6	0.01	-	-	0.30	0.45	-	35	-	-	-	35	-	-	112	-	-	-
ABA295	R271028	CFD0412	117	118	Waste	Fresh	Gneiss	MxF	-	8.8	*<0.01*	-	-	*<0.3*	0.19	-	15	-	-	-	14	-	-	49	-	-	-
ABA297	R279539	CFD0468	89	90	Waste	Fresh	Gneiss	MxF	-	9.4	0.03	-	-	0.90	0.41	-	32	-	-	-	31	-	-	34	-	-	-
ABA298	R275689	CFD0495	57	58	Waste	Fresh	Gneiss	MxM	-	9.1	0.05	-	-	1.6	0.44	-	34	-	-	-	33	-	-	22	-	-	-
ABA299	R272239	CFD0433	57	58	Waste	Fresh	Gneiss	MxF	-	8.9	0.07	-	-	2.2	0.35	-	27	-	-	-	25	-	-	12	-	-	-
ABA300	R278428	CFD0445	118	119	Waste	Fresh	Gneiss	MxF	-	9.3	*<0.01*	-	-	*<0.3*	0.10	-	7.8	-	-	-	7.5	-	-	26	-	-	-
ABA301	R273296	CFD0447	10	11	Waste	Fresh	Gneiss	FG	-	9.3	*<0.01*	-	-	*<0.3*	0.10	-	7.8	-	-	-	7.5	-	-	26	-	-	-
ABA302	R270935	CFD0412	35	36	Waste	Fresh	Gneiss	MxF	-	9.2	0.02	-	-	0.60	0.31	-	24	-	-	-	23	-	-	38	-	-	-
ABA346	R277538	CFD0426	87	88	Waste	Fresh	Gneiss	MxM	9.3	9.3	0.13	0.01	0.09	4.1	0.060	0.20	4.7	4.5	-	-	0.59	-	-	1.2	1.1	-	-
ABA347	R304284	CFD0541	30	31	Waste	Fresh	Gneiss	FG	9.0	9.0	*<0.01*	0.01	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA350	R304041	CFD0539	10	11	Waste	Fresh	Gneiss	FG	9.5	9.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA351	R304231	CFD0539	45	46	Waste	Fresh	Gneiss	MxM	8.6	8.4	*<0.01*	0.01	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA354	R304119	CFD0525	45	46	Waste	Fresh	Gneiss	MxM	8.8	9.2	0.02	*<0.01*	0.03	0.60	0.17	0.60	13	14	-	-	13	-	-	21	22	-	-
ABA355	R304173	CFD0525	91	92	Waste	Fresh	Gneiss	FG	9.7	9.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.070	0.20	5.4	4.5	-	-	5.1	-	-	18	15	-	-
ABA356	R623617	CFD0548	10	11	Waste	Fresh	Gneiss	MxF	9.2	9.2	*<0.01*	0.01	0.02	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA357	R623685	CFD0548	70	71	Waste	Fresh	Gneiss	MxF	9.2	9.2	*<0.01*	0.01	*<0.01*	*<0.3*	0.27	0.90	21	21	-	-	21	-	-	70	68	-	-
ABA358	R623742	CFD0548	120	121	Waste	Fresh	Gneiss	MxF	9.2	9.3	0.02	0.01	*<0.01*	0.60	0.27	0.90	21	21	-	-	20	-	-	34	33	-	-
ABA365	R545443	CFD0520	60	61	Waste	Fresh	Gneiss	FG	9.5	9.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA374	R271368	CFD0417	91	92	Waste	Fresh	Gneiss	FG	9.7	9.6	0.01	0.01	0.02	0.30	0.12	0.30	9.3	6.8	-	-	9.0	-	-	30	22	-	-
ABA378	R279593	CFD0468	135	136	Waste	Fresh	Gneiss	MxF	9.8	9.8	0.08	*<0.01*	0.05	2.5	0.52	1.7	40	39	-	-	38	-	-	16	15	-	-
ABA379	R279615	CFD0468	155	155.692	Waste	Fresh	Gneiss	MxF	9.9	9.8	0.09	0.03	0.09	2.8	0.22	0.70	17	16	-	-	14	-	-	6.1	5.7	-	-
ABA381	R511981	CFR0700	48.77	49.42	Waste	Fresh	Gneiss	MxM	8.5	8.6	0.17	0.01	0.16	5.3	1.1	3.6	88	82	-	-	82	-	-	17	15	-	-
ABA387	Q034442	CFD0469	19	20	Waste	Fresh	Gneiss	MxF	9.2	8.6	*<0.01*	0.01	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA388	Q034516	CFD0469	102	103	Waste	Fresh	Gneiss	MxF	9.7	9.3	0.04	0.01	0.04	1.3	0.19	0.60	15	14	-	-	13	-	-	12	11	-	-
ABA389	Q034537	CFD0469	121	121.9	Waste	Fresh	Gneiss	MxF	8.9	8.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA396	R545818	CFD0529	65	66	Waste	Fresh	Gneiss	MxF	9.7	9.7	*<0.01*	*<0.01*	0.01	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA398	R543692	CFD0549	10	11	Waste	Fresh	Gneiss	FG	9.1	9.2	*<0.01*	0.02	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA401	R543957	CFD0553	40	41	Waste	Fresh	Gneiss	MxF	8.7	8.9	0.15	0.02	0.14	4.7	1.3	4.0	98	91	-	-	93	-	-	21	19	-	-
ABA404	R550544	CFD0553	160	161	Waste	Fresh	Gneiss	MxF	8.9	8.9	0.02	0.01	*<0.01*	0.60	0.74	2.3	57	52	-	-	57	-	-	92	84	-	-
ABA408	R272713	CFD0438	96	97	Waste	Fresh	Gneiss	MxF	9.5	9.5	0.01	0.02	0.01	0.30	0.14	0.40	11	9.1	-	-	11	-	-	35	29	-	-
ABA413	R276141	CFD0393	127	128	Waste	Fresh	Gneiss	MxM	8.9	8.9	*<0.01*	0.02	0.01	*<0.3*	1.2	4.1	95	93	-	-	94	-	-	316	311	-	-
ABA414	R276153	CFD0393	170	171	Waste	Fresh	Gneiss	MxM	8.8	9.0	0.04	*<0.01*	0.06	1.3	1.2	3.9	90	89	-	-	89	-	-	72	71	-	-
Statistical Summary						**Fresh**	**Gneiss**	**n**	34	49	49	34	34	49	49	34	49	34	10	10	49	10	10	49	34	10	10
								Max	9.9	9.8	0.43	0.03	0.16	13	1.3	4.3	98	98	128	140	94	127	139	316	311	390	400
								90th PCTL	9.7	9.5	0.13	0.02	0.10	4.1	1.0	3.8	77	87	118	122	76	118	122	73	76	131	141
								75th PCTL	9.5	9.3	0.04	0.01	0.04	1.3	0.40	1.6	32	35	38	39	31	34	35	35	27	41	47
								Median	9.0	9.0	0.01	0.01	0.01	0.31	0.20	0.40	13	8.0	18	20	11	16	18	17	15	26	28
								25th PCTL	8.6	8.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.00	*<0.2*	3.1	*<4.5*	9.0	10	1.3	8.7	9.7	5.2	15	21	22
								10th PCTL	7.8	8.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.00	*<0.2*	0.80	*<4.5*	6.9	7.8	0.50	6.6	7.5	2.6	7.9	8.6	8.8
								Min	7.2	7.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.00	*<0.2*	0.80	*<4.5*	6.0	6.0	0.50	5.7	5.7	1.1	1.1	5.5	5.7
Statistical Summary for Gneiss Waste Rock								**n**	115	187	188.00	117.00	117.00	188	188	117	188	117	51	51	188	51	51	188	117	51	51
								n < DL	-	-	88.00	44.00	48.00	88	2	46	2	46	0	0	0	0	0	0	0	0	0
								Max	9.9	9.8	0.94	0.03	0.90	29	1.3	4.3	98	98	128	140	94	127	139	303	298	390	400
								90th PCTL	9.5	9.3	0.08	0.02	0.06	2.5	0.64	2.3	50	52	52	53	48	52	53	62	73	93	83
								75th PCTL	9.2	9.1	0.02	0.01	0.02	0.60	0.27	1.0	21	23	29	26	20	26	25	26	29	43	48
								Median	8.4	8.5	0.01	0.01	0.01	0.30	0.060	0.20	4.7	4.5	15	15	4.4	13	15	9.9	15	27	27
								25th PCTL	7.4	7.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	6.0	6.5	1.2	5.7	6.2	5.0	14	13	16
								10th PCTL	7.2	7.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	4.0	5.0	0.50	3.7	4.7	2.5	10	9.0	10
								Min	6.6	6.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	0.10	*<0.8*	2.3	2.0	3.0	-27	1.7	-24	0.10	0.20	1.4	0.20

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Oxide Facies for Schist Waste Rock																											
ABA005	KAM022322	CFD0110	95	96	Waste	Oxide	Schist	RQM	6.8	7.6	0.42	0.06	0.29	13	2.0	6.9	155	157	135	154	142	122	141	12	12	10	12
ABA026	KAM037656	CFD0096	59	60	Waste	Oxide	Schist	BtS	6.8	7.4	0.26	0.01	0.18	8.1	2.0	6.9	154	157	134	144	146	126	136	19	19	16	18
ABA074	KAM146948	CFD0345	60	61	Waste	Oxide	Schist	BtS_carb	7.8	8	0.02	0.01	0.01	0.60	1.8	6.5	138	148	154	163	138	153	162	221	236	246	261
ABA077	J957606	CFD0350	60	61	Waste	Oxide	Schist	BtS_carb	7.3	7.8	0.01	*<0.01*	0.01	0.30	3.2	12	250	268	268	271	250	268	271	800	858	858	867
ABA090	KAM133632	CFR0431	71.63	73.15	Waste	Oxide	Schist	BtS	7	7.2	0.44	*<0.01*	0.34	14	0.81	2.4	63	55	47	44	49	33	30	4.6	4.0	3.4	3.2
ABA094	KAM135457	CFR0454	24.38	25.91	Waste	Oxide	Schist	BtS	7.6	7.3	0.01	*<0.01*	0.01	0.30	0.080	*<0.2*	6.2	*<4.5*	5.0	6.0	5.9	5.0	5.7	20	14	16	19
ABA125	KAM149844	CFR0566	10.67	12.19	Waste	Oxide	Schist	BtS	7.2	7.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.060	0.20	4.7	4.5	4.0	4.0	4.4	4.0	3.7	16	15	13	13
ABA128	KAM149954	CFR0567	47.24	48.77	Waste	Oxide	Schist	BtS	7.3	8.1	0.02	*<0.01*	*<0.01*	0.60	2.4	9.0	183	205	183	180	183	182	179	293	327	293	288
ABA129	KAM150033	CFR0567	155.45	156.97	Waste	Oxide	Schist	BtS	7	7.2	0.01	*<0.01*	*<0.01*	0.30	0.030	*<0.2*	2.3	*<4.5*	5.0	7.0	2.0	5.0	6.7	7.5	14	16	22
ABA130	KAM150823	CFR0574	10.67	12.19	Waste	Oxide	Schist	BtS	7.2	8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	1.4	5.1	112	116	120	129	111	120	129	372	386	400	430
ABA131	KAM150859	CFR0574	60.96	62.48	Waste	Oxide	Schist	BtS	7.2	8.5	0.01	0.01	0.01	0.30	0.29	1.0	23	23	22	25	22	22	25	72	73	70	80
ABA133	KAM150951	CFR0575	60.96	62.48	Waste	Oxide	Schist	BtS	7.5	8	0.08	0.03	0.05	2.5	2.9	10	222	230	227	231	219	225	229	89	92	91	92
ABA201	R276929	CFD0416	13	14	Waste	Oxide	Schist	BtS	-	8.2	0.01	-	-	0.30	0.29	-	23	-	-	-	22	-	-	72	-	-	-
ABA202	R270012	CFD0384	13	14	Waste	Oxide	Schist	BtS_carb	-	7.5	0.05	-	-	1.6	0.12	-	9.3	-	-	-	7.8	-	-	6.0	-	-	-
ABA383	KAM068572	CFD0234	225.1	226	Waste	Oxide	Schist	MsS	7.1	6.6	*<0.01*	*<0.01*	0.02	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
Statistical Summary						**Oxide**	**Schist**	**n**	13	15	15	13	13	15	15	13	15	13	12	12	15	12	12	15	13	12	12
								Max	7.8	8.5	0.44	0.06	0.34	14	3.2	12	250	268	268	271	250	268	271	800	858	858	867
								90th PCTL	7.6	8.2	0.36	0.03	0.27	11	2.7	9.9	206	225	223	226	205	220	224	341	375	389	416
								75th PCTL	7.3	8	0.07	0.01	0.05	2.0	2.0	6.9	155	157	161	167	144	161	167	155	236	258	268
								Median	7.2	7.6	0.01	*<0.01*	0.01	0.31	0.81	5.1	63	116	127	137	49	121	132	20	19	43	51
								25th PCTL	7	7.4	0.01	*<0.01*	0.01	0.31	0.10	0.20	7.8	4.5	18	21	6.8	17	20	9.6	14	15	17
								10th PCTL	6.8	7.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.042	*<0.2*	3.3	*<4.5*	5.0	6.1	3.0	4.7	5.8	5.5	12	11	12
								Min	6.8	6.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	4.0	4.0	1.3	3.7	3.7	4.6	4.0	3.4	3.2
Upper Transition Facies for Schist Waste Rock																											
ABA004	KAM022156	CFD0107	149	150	Waste	Upper transition	Schist	RQM	7.4	8.1	0.24	0.01	0.23	7.5	1.6	5.8	121	132	100	104	114	93	97	16	18	13	14
ABA027	KAM037928	CFD0099	30	31	Waste	Upper transition	Schist	BtS_carb	7.2	7.9	0.01	*<0.01*	0.02	0.30	1.5	5.4	120	123	135	134	119	135	134	382	393	432	429
ABA062	KAM081561	CFD0202	58	58.5	Waste	Upper transition	Schist	BtS	8.3	8.6	1.02	*<0.01*	0.97	32	2.2	8.0	172	182	209	202	140	177	170	5.4	5.7	6.6	6.3
ABA076	KAM147059	CFD0345	160	161	Waste	Upper transition	Schist	BtS	7.9	8.1	0.51	*<0.01*	0.51	16	2.7	9.8	209	223	205	198	193	189	182	13	14	13	12
ABA092	KAM135149	CFR0452	10.67	12.19	Waste	Upper Transition	Schist	BtS	8.3	8.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	6.0	7.0	2.0	6.0	6.7	7.8	15	20	23
ABA124	KAM149042	CFR0559	35.05	36.58	Waste	Upper transition	Schist	BtS	7.4	8.1	0.02	*<0.01*	*<0.01*	0.60	1.2	4.0	89	91	92	95	89	91	94	143	145	147	152
ABA204	R270174	CFD0388	8	9	Waste	Upper transition	Schist	MsS	-	7.7	0.03	-	-	0.90	0.46	-	36	-	-	-	35	-	-	38	-	-	-
ABA205	R276797	CFD0413	115	116	Waste	Upper transition	Schist	BtS	-	8.1	0.01	-	-	0.30	2.2	-	168	-	-	-	168	-	-	539	-	-	-
ABA206	Q033613	CFD0407	52	53	Waste	Upper transition	Schist	BtS	-	8.4	0.06	-	-	1.9	2.2	-	168	-	-	-	167	-	-	90	-	-	-
ABA316	R270207	CFD0390	5	6	Waste	Upper Transition	Schist	MsS	8.3	8.2	0.08	0.01	0.05	2.5	1.2	4.1	95	93	-	-	93	-	-	38	37	-	-
ABA317	R270258	CFD0390	50	51	Waste	Upper Transition	Schist	BtS_carb	8.5	8.3	0.07	0.03	0.01	2.2	0.70	2.3	54	52	-	-	52	-	-	25	24	-	-
ABA320	R270432	CFD0392	44	45	Waste	Upper Transition	Schist	BtS_carb	8.2	8.4	0.02	0.01	*<0.01*	0.60	0.96	3.0	75	68	-	-	74	-	-	119	109	-	-
ABA323	Q033713	CFD0411	24	25	Waste	Upper Transition	Schist	BtS_Carb	8.2	8.1	0.03	*<0.01*	0.02	0.90	2.4	7.8	185	177	-	-	184	-	-	197	189	-	-
ABA332	Q033589	CFD0407	32	33	Waste	Upper Transition	schist	BtS	8.5	8.4	0.04	0.01	0.01	1.3	1.0	3.3	79	75	-	-	78	-	-	63	60	-	-
Statistical Summary						**Upper Transition**	**Schist**	**n**	11	14	14	11	11	14	14	11	14	11	6	6	14	6	6	14	11	6	6
								Max	8.5	8.6	1.02	0.03	0.97	32	2.7	9.8	209	223	209	202	193	189	182	539	393	432	429
								90th PCTL	8.5	8.4	0.43	0.01	0.51	13	2.3	8.0	181	182	207	200	179	183	176	327	189	290	290
								75th PCTL	8.3	8.4	0.08	0.01	0.14	2.4	2.2	6.8	168	155	188	182	160	167	161	137	127	115	120
								Median	8.2	8.2	0.04	*<0.01*	0.02	1.1	1.4	4.1	108	93	118	119	103	114	115	51	37	17	19
								25th PCTL	7.7	8.1	0.02	*<0.01*	*<0.01*	0.63	0.98	3.2	76	72	94	97	75	92	95	18	16	13	13
								10th PCTL	7.4	8	0.01	*<0.01*	*<0.01*	0.31	0.53	2.3	41	52	49	51	40	49	51	9.4	14	9.7	9.4
								Min	7.2	7.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	6.0	7.0	2.0	5.7	6.7	5.4	5.7	6.6	6.3
Lower Transition Facies for Schist Waste Rock																											
ABA021	KAM033153	CFD0164	148	149	Waste	Lower transition	Schist	BtS	9.4	9.3	0.14	0.02	0.11	4.4	0.44	1.6	34	36	57	96	30	53	92	7.8	8.3	13	22
ABA024	KAM036666	CFD0087	17	18	Waste	Lower transition	Schist	BtS_carb	7.2	8.5	0.06	*<0.01*	0.05	1.9	0.43	1.4	33	32	48	85	31	46	83	18	17	26	45
ABA025	KAM037046	CFD0091	12	13	Waste	Lower transition	Schist	BtS	7.2	7.9	0.01	0.01	*<0.01*	0.30	0.84	2.8	65	64	100	104	65	100	104	209	204	320	333
ABA031	KAM039252	CFD0116	75	76	Waste	Lower transition	Schist	RQM	7.2	8.3	0.06	0.01	0.03	1.9	1.2	4.3	95	98	110	116	94	108	114	51	52	59	62
ABA038	KAM047995	CFD0135	153	154	Waste	Lower transition	Schist	BtS	7.3	8.5	0.09	0.02	0.07	2.8	1.2	4.1	90	93	115	123	87	112	120	32	33	41	44
ABA054	KAM081312	CFD0198	85	86	Waste	Lower transition	Schist	BtS	8.9	8.7	*<0.01*	*<0.01*	0.01	*<0.3*	0.070	0.20	5.4	4.5	7.0	7.0	5.1	7.0	6.7	18	15	23	23
ABA086	KAM133474	CFR0429	59.44	60.96	Waste	Lower transition	Schist	BtS	8.4	8.4	0.15	*<0.01*	0.13	4.7	0.78	2.5	61	57	60	63	56	55	58	13	12	13	13
ABA208	R276736	CFD0413	61	62	Waste	Lower transition	Schist	BtS	-	8.2	0.32	-	-	10	1.0	-	78	-	-	-	68	-	-	7.8	-	-	-
ABA209	R270032	CFD0384	31	32	Waste	Lower transition	Schist	BtS_carb	-	8.2	0.25	-	-	7.8	0.90	-	70	-	-	-	62	-	-	8.9	-	-	-
ABA210	R276281	CFD0401	58	59	Waste	Lower transition	Schist	BtS	-	8	0.01	-	-	0.30	1.4	-	109	-	-	-	109	-	-	350	-	-	-
ABA211	R276567	CFD0409	65	66	Waste	Lower transition	Schist	BtS	-	8	0.01	-	-	0.30	0.77	-	60	-	-	-	59	-	-	191	-	-	-
ABA318	R270302	CFD0390	88	89	Waste	Lower Transition	Schist	BtS_carb	7.2	8.6	0.03	0.01	0.01	0.90	3.0	9.5	230	216	-	-	229	-	-	245	230	-	-
ABA319	R270394	CFD0392	10	11	Waste	Lower Transition	Schist	BtS_carb	8	8.2	0.01	0.01	*<0.01*	0.30	0.79	2.5	61	57	-	-	61	-	-	196	182	-	-
ABA325	R512767	CFR0724	39.62	41.15	Waste	Lower Transition	schist	BtS	8.7	8.9	0.06	0.01	0.05	1.9	0.42	1.2	33	27	-	-	31	-	-	17	15	-	-
ABA333	R277487	CFD0426	43	44	Waste	Lower Transition	schist	BtS	8.2	7.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	-	-	0.48	-	-	2.6	15	-	-
ABA335	R550437	CFD0518	25	26	Waste	Lower Transition	schist	BtS	8.1	8.3	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA336	R550471	CFD0518	55	56	Waste	Lower Transition	Schist	BtS_carb	7.9	8	0.12	0.01	0.07	3.8	1.9	6.4	147	146	-	-	143	-	-	39	39	-	-
ABA337	R550494	CFD0518	75	75.032	Waste	Lower Transition	schist	BtS	8.6	8.5	0.01	0.01	*<0.01*	0.30	0.81	2.7	63	61	-	-	63	-	-	201	196	-	-
ABA345	R551151	CFD0563	68	69	Waste	Lower Transition	schist	BtS	8.8	8.5	0.02	*<0.01*	0.01	0.60	0.69	2.2	54	50	-	-	53	-	-	86	80	-	-
Statistical Summary						**Lower Transition**	**Schist**	**n**	15	19	19	15	15	19	19	15	19	15	7	7	19	7	7	19	15	7	7
								Max	9.4	9.3	0.32	0.02	0.13	10	3.0	9.5	230	216	115	123	229	112	120	350	230	320	333
								90th PCTL	8.9	8.7	0.17	0.02	0.09	5.3	1.5	5.6	117	126	112	119	116	110	117	216	201	163	170
								75th PCTL	8.7	8.5	0.11	0.01	0.06	3.3	1.1	3.5	84	78	105	110	77	104	109	194	131	50	54
								Median	8.1	8.3	0.03	0.01	0.01	0.94	0.79	2.5	61	57	60	96	61	55	92	32	33	26	44
								25th PCTL	7.3	8.1	0.01	*<0.01*	*<0.01*	0.31	0.44	1.3	34	30	53	74	31	49	71	11	15	18	23
								10th PCTL	7.2	8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.060	*<0.2*	4.7	*<4.5*	32	41	4.4	30	38	7.2	13	13	19
								Min	7.2	7.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	7.0	7.0	0.48	6.7	6.7	2.6	8.3	13	13

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Fresh Facies for Schist Waste Rock																											
ABA082	KAM131674	CFR0401	15.24	16.76	Waste	Fresh	Schist	BtS	8.2	8.1	0.01	*<0.01*	*<0.01*	0.30	0.42	1.4	33	32	47	51	32	47	51	104	102	150	163
ABA084	KAM132888	CFR0420	32	33.53	Waste	Fresh	Schist	BtS	8.1	8.6	0.01	*<0.01*	0.01	0.30	1.4	4.9	108	111	147	149	108	147	149	345	356	470	477
ABA091	KAM133659	CFR0431	109.73	111.25	Waste	Fresh	Schist	BtS	8.8	8.8	0.97	0.03	0.80	30	0.90	2.9	70	66	99	99	40	69	69	2.3	2.2	3.3	3.3
ABA093	KAM135298	CFR0453	10.67	12.19	Waste	Fresh	Schist	BtS	8.4	8.3	0.08	*<0.01*	0.04	2.5	0.77	2.6	60	59	122	125	57	120	123	24	24	49	50
ABA095	KAM135693	CFR0456	10.67	12.19	Waste	Fresh	Schist	BtS	8.7	8.6	0.01	*<0.01*	*<0.01*	0.30	0.030	*<0.2*	2.3	*<4.5*	11	12	2.0	11	12	7.5	14	35	38
ABA127	KAM149916	CFR0566	109.73	111.25	Waste	Fresh	Schist	BtS_carb	7.3	8.1	0.63	*<0.01*	0.53	20	1.1	3.3	82	75	108	107	62	88	87	4.1	3.8	5.5	5.4
ABA132	KAM150898	CFR0574	114.3	115.82	Waste	Fresh	Schist	BtS	7.3	8.2	0.61	*<0.01*	0.56	19	0.98	3.4	76	77	108	114	57	89	95	4.0	4.1	5.7	6.0
ABA134	KAM150984	CFR0575	106.68	108.2	Waste	Fresh	Schist	BtS	7.3	8.3	0.07	0.01	0.03	2.2	1.3	4.6	101	105	109	106	99	107	104	46	48	50	48
ABA212	Q033565	CFD0407	10	11	Waste	Fresh	Schist	BtS	-	8.8	0.09	-	-	2.8	0.54	-	42	-	-	-	39	-	-	15	-	-	-
ABA213	R280479	CFD0497	111	112	Waste	Fresh	Schist	BtS	-	8.9	0.02	-	-	0.60	0.17	-	13	-	-	-	13	-	-	21	-	-	-
ABA214	R274802	CFD0472	47	48	Waste	Fresh	Schist	BtS	-	8.5	*<0.01*	-	-	*<0.3*	*<0.01*	-	*<0.8*	-	-	-	0.48	-	-	2.6	-	-	-
ABA215	R275143	CFD0482	40	41	Waste	Fresh	Schist	BtS	-	8.1	0.01	-	-	0.30	1.2	-	93	-	-	-	93	-	-	298	-	-	-
ABA216	R276122	CFD0393	87	88	Waste	Fresh	Schist	BtS	-	8.7	*<0.01*	-	-	*<0.3*	0.22	-	17	-	-	-	17	-	-	57	-	-	-
ABA217	R270181	CFD0388	92	93	Waste	Fresh	Schist	BtS_carb	-	8.5	0.29	-	-	9.1	0.91	-	71	-	-	-	62	-	-	7.8	-	-	-
ABA218	R283622	CFD0498	28	29	Waste	Fresh	Schist	BtS	-	9	0.01	-	-	0.30	0.33	-	26	-	-	-	25	-	-	82	-	-	-
ABA219	R276979	CFD0416	57	58	Waste	Fresh	Schist	BtS	-	8.4	0.04	-	-	1.3	4.9	-	376	-	-	-	375	-	-	301	-	-	-
ABA220	R276002	CFD0387	148	149	Waste	Fresh	Schist	BtS	-	9.2	0.14	-	-	4.4	0.57	-	44	-	-	-	40	-	-	10	-	-	-
ABA221	R276317	CFD0401	129	130	Waste	Fresh	Schist	BtS	-	8.4	0.11	-	-	3.4	0.66	-	51	-	-	-	48	-	-	15	-	-	-
ABA222	R270104	CFD0386	59	60	Waste	Fresh	Schist	BtS_carb	-	8.5	0.21	-	-	6.6	0.74	-	57	-	-	-	51	-	-	8.8	-	-	-
ABA223	R270127	CFD0386	80	81	Waste	Fresh	Schist	MsS	-	8.6	0.14	-	-	4.4	1.3	-	100	-	-	-	96	-	-	23	-	-	-
ABA321	R270466	CFD0392	74	75	Waste	Fresh	Schist	BtS_carb	8.4	8.6	0.16	*<0.01*	0.12	5.0	0.74	2.3	57	52	-	-	52	-	-	11	10	-	-
ABA322	R270482	CFD0392	88	89	Waste	Fresh	Schist	BtS_carb	8.3	8.2	0.02	0.01	*<0.01*	0.60	1.9	6.2	149	141	-	-	148	-	-	238	225	-	-
ABA326	R512983	CFR0731	32	32.395	Waste	Fresh	schist	BtS	8.6	8.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.13	0.30	10	6.8	-	-	9.8	-	-	34	23	-	-
ABA329	R270202	CFD0388	110	110.2	Waste	Fresh	Schist	BtS_carb	9.2	9.3	0.19	0.01	0.17	5.9	1.7	5.8	135	132	-	-	129	-	-	23	22	-	-
ABA330	R276299	CFD0401	74	75	Waste	Fresh	schist	BtS	8.7	8.6	0.06	*<0.01*	0.04	1.9	0.68	2.1	53	48	-	-	51	-	-	28	25	-	-
ABA331	R276331	CFD0401	141	142	Waste	Fresh	schist	BtS	8.5	8.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.99	3.2	77	73	-	-	77	-	-	256	242	-	-
ABA377	R279587	CFD0468	131	132	Waste	Fresh	Schist	AmBtS	9	9	0.23	0.01	0.19	7.2	1.4	4.6	111	105	-	-	104	-	-	15	15	-	-
ABA415	R277001	CFD0398	49	50	Waste	Fresh	schist	BtS	8.8	8.9	*<0.01*	*<0.01*	0.01	*<0.3*	0.16	0.40	12	9.1	-	-	12	-	-	41	30	-	-
ABA416	R277017	CFD0398	64	65	Waste	Fresh	schist	BtS	9	9	*<0.01*	0.01	*<0.01*	*<0.3*	0.44	1.3	34	30	-	-	34	-	-	114	98	-	-
ABA417	R277021	CFD0398	124	125	Waste	Fresh	schist	BtS	9	9.2	*<0.01*	0.02	0.01	*<0.3*	0.62	1.9	48	43	-	-	48	-	-	160	144	-	-
ABA418	R277041	CFD0398	160	161	Waste	Fresh	schist	BtS	9.3	9.3	0.16	0.02	0.16	5.0	0.53	1.7	41	39	-	-	36	-	-	8.2	7.7	-	-
Statistical Summary						**Fresh**	**Schist**	**n**	19	31	31	19	19	31	31	19	31	19	8	8	31	8	8	31	19	8	8
								Max	9.3	9.3	1.00	0.00	0.80	30	4.9	6.2	376	141	147	149	375	147	149	345	356	470	477
								90th PCTL	9	9.2	0.30	0.00	0.50	9.1	1.4	5.1	111	116	130	132	108	128	130	256	229	246	257
								75th PCTL	8.9	8.9	0.20	0.00	0.20	5.0	1.1	4.0	87	91	112	117	85	110	109	93	100	75	78
								Median	8.6	8.6	0.10	*<0.01*	0.00	1.9	0.70	2.6	57	59	108	107	51	89	91	23	24	42	43
								25th PCTL	8.3	8.4	0.00	*<0.01*	*<0.01*	0.30	0.40	1.6	33	35	86	87	33	63	64	9.4	12	5.6	5.8
								10th PCTL	7.3	8.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.20	0.40	12	8.6	36	39	12	36	39	4.1	4.0	4.8	4.8
								Min	7.3	8.1	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	*<0.2*	*<0.8*	*<4.5*	11	12	0.50	11	12	2.3	2.2	3.3	3.3
Statistical Summary for Schist Waste Rock								**n**	58	79	79	58	58	79	79	58	79	58	33	33	79	33	33	79	58	33	33
								n < DL	-	-	14	30	18	14	1	7	1	7	0	0	0	0	0	0	0	0	0
								Max	9.4	9.3	1.00	0.10	1.00	32	4.9	12	376	268	268	271	375	268	271	800	858	858	867
								90th PCTL	8.9	8.9	0.30	0.00	0.30	9.3	2.2	7.9	169	179	201	194	167	181	178	294	234	384	410
								75th PCTL	8.6	8.6	0.10	0.00	0.10	4.4	1.4	5.3	110	121	135	144	108	126	136	131	131	147	152
								Median	8.2	8.3	0.00	*<0.01*	0.00	0.90	0.80	2.9	63	65	108	106	59	93	97	28	25	26	38
								25th PCTL	7.3	8.1	0.00	*<0.01*	*<0.01*	0.30	0.40	1.4	33	32	47	51	31	46	51	11	14	13	13
								10th PCTL	7.2	7.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.10	*<0.2*	5.3	*<4.5*	6.2	7.0	5.0	5.9	6.7	5.3	8.1	5.8	6.1
								Min	6.8	6.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	*<0.2*	*<0.8*	*<4.5*	4.0	4.0	0.50	3.7	3.7	2.3	2.2	3.3	3.2
Oxide Facies for Granite Waste Rock																											
ABA157	R305807	CFD0382	76	77	Waste	Oxide	Granite	GG	6.2	6	0.01	0.01	0.01	0.30	0.010	*<0.2*	0.80	*<4.5*	2.0	4.0	0.46	2.0	3.7	2.5	14	6.4	13
ABA158	R305808	CFD0382	79	80	Waste	Oxide	Granite	GG	6	5.9	0.01	0.01	0.01	0.30	0.010	*<0.2*	0.80	*<4.5*	1.0	3.0	0.46	1.0	2.7	2.5	14	3.2	9.6
ABA174	R305826	CFD0403	7	8	Waste	Oxide	Granite	GG	6.4	6.1	0.01	*<0.01*	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	2.0	4.0	1.2	2.0	3.7	5.0	14	6.4	13
ABA421	I354544	CFD0053	50.29	51	Waste	Oxide	Granite	GG	6.3	6.7	0.01	0.02	*<0.01*	0.30	0.030	*<0.2*	2.3	*<4.5*	2.0	-	2.0	2.0	-	7.5	14	6.4	-
ABA423	Q033319	CFD0403	7	7.8	Waste	Oxide	Granite	GG	6.6	6.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	2.0	-	2.8	2.0	-	10	15	6.7	-
ABA429	Q032778	CFD0394	39.7	40	Waste	Oxide	Granite	GG	7.5	7.8	*<0.01*	0.02	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	4.0	-	2.8	4.0	-	10	15	13	-
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	6	6	6	6	6	6	6	3	6	6	3	6	6	6	3
								Max	7.5	7.8	0.01	0.02	0.01	0.31	0.040	*<0.2*	3.1	*<4.5*	4.0	4.0	2.8	3.7	3.7	10	15	13	13
								90th PCTL	7.1	7.3	0.01	0.02	0.01	0.31	0.040	*<0.2*	3.1	*<4.5*	3.0	4.0	2.8	2.7	3.7	10	15	10	13
								75th PCTL	6.6	6.8	0.01	0.02	0.01	0.31	0.038	*<0.2*	2.9	*<4.5*	2.0	4.0	2.6	1.7	3.7	9.6	15	6.6	13
								Median	6.4	6.4	0.01	0.01	*<0.01*	0.31	0.025	*<0.2*	1.9	*<4.5*	2.0	4.0	1.6	1.7	3.7	6.2	14	6.4	13
								25th PCTL	6.2	6	*<0.01*	0.01	*<0.01*	*<0.3*	0.013	*<0.2*	0.97	*<4.5*	2.0	3.5	0.66	1.7	3.2	3.1	14	6.4	11
								10th PCTL	6.1	6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.78	*<4.5*	1.5	3.2	0.46	1.2	2.9	2.5	14	4.8	10
								Min	6	5.9	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.78	*<4.5*	1.0	3.0	0.46	0.69	2.7	2.5	14	3.2	9.6

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	kg$CaCO_3$/t	%	%	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	kg$CaCO_3$/t	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Upper Transition Facies for Granite Waste Rock																											
ABA013	KAM025898	CFD0150	81	82	Waste	Upper transition	Granite	GG	6.9	6.5	0.01	*<0.01*	*<0.01*	0.30	0.030	0.10	2.3	2.3	3.0	4.0	2.0	3.0	3.7	7.5	7.3	9.6	13
ABA151	R305801	CFD0381	13	14	Waste	Upper transition	Granite	GG	8.9	8.8	0.01	0.02	0.01	0.30	0.070	0.30	5.4	6.8	4.0	6.0	5.1	4.0	5.7	17	22	13	19
ABA152	R305802	CFD0381	35	36	Waste	Upper transition	Granite	GG	7	6.9	0.01	0.01	*<0.01*	0.30	0.030	*<0.2*	2.3	4.5	3.0	5.0	2.0	3.0	4.7	7.5	15	9.6	16
ABA167	R305818	CFD0394	30	31	Waste	Upper transition	Granite	GG	6.4	6.2	0.06	0.05	0.01	1.9	0.010	*<0.2*	0.80	*<4.5*	1.0	2.0	-1.1	-1.0	0.13	0.41	2.4	0.53	1.1
ABA169	R305821	CFD0399	20	21	Waste	Upper transition	Granite	GG	7.4	7.2	0.13	0.04	0.08	4.1	0.030	*<0.2*	2.3	*<4.5*	3.0	4.0	-1.7	-1.0	-0.060	0.57	1.1	0.74	0.98
ABA172	R305824	CFD0396	29	30	Waste	Upper transition	Granite	GG	5.7	5.8	0.01	*<0.01*	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	1.0	2.0	1.2	1.0	1.7	5.0	14	3.2	6.4
ABA178	R305831	CFD0400	11	12	Waste	Upper transition	Granite	GG	7.1	7	0.01	*<0.01*	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	2.0	4.0	2.0	2.0	3.7	7.5	14	6.4	13
ABA189	CFD0399_10_20	CFD0399	10	20	Waste	Upper transition	Granite	GG	-	6	0.12	0.01	0.11	3.8	-	-	-	-	1.0	-	-3.8	-3.0	-	-	-	0.27	-
ABA190	CFD0396_50_60	CFD0396	50	60	Waste	Upper transition	Granite	GG	-	7	*<0.01*	0.01	*<0.01*	*<0.3*	-	-	-	-	2.0	-	-0.30	2.0	-	-	-	6.7	-
ABA191	CFD0394_31_41	CFD0394	31	41	Waste	Upper transition	Granite	GG	-	6.9	0.01	*<0.01*	0.01	0.30	-	-	-	-	2.0	-	-0.31	2.0	-	-	-	6.4	-
ABA192	CFD0394_55_66	CFD0394	55	66	Waste	Upper transition	Granite	GG	-	7.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	-	-	-	-	3.0	-	-0.30	3.0	-	-	-	10	-
ABA195	CFD0381_4_13	CFD0381	4	13	Waste	Upper transition	Granite	GG	-	8.8	*<0.01*	0.02	*<0.01*	*<0.3*	-	-	-	-	6.0	-	-0.30	6.0	-	-	-	20	-
ABA196	CFD0380_36_50	CFD0380	36	50	Waste	Upper transition	Granite	GG	-	6.8	*<0.01*	0.01	*<0.01*	*<0.3*	-	-	-	-	2.0	-	-0.30	2.0	-	-	-	6.7	-
ABA431	Q041083	CFD0380	30	30.18	Waste	Upper Transition	Granite	GG	7.6	7.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	2.0	-	1.3	2.0	-	5.2	15	6.7	-
ABA434	Q032756	CFD0394	19.5	19.6	Waste	Upper Transition	Granite	GG	7.2	7.1	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	3.0	-	1.3	3.0	-	5.2	15	10	-
ABA435	Q032826	CFD0394	81.1	81.7	Waste	Upper Transition	Granite	GG	6.9	6.8	0.01	0.01	*<0.01*	0.30	0.010	*<0.2*	0.80	*<4.5*	1.0	-	0.46	1.0	-	2.5	14	3.2	-
ABA436	Q032927	CFD0396	65	65.528	Waste	Upper Transition	Granite	GG	6.8	6	0.01	0.01	*<0.01*	0.30	0.010	*<0.2*	0.80	*<4.5*	1.0	-	0.46	1.0	-	2.5	14	3.2	-
Statistical Summary						**Upper Tranistion**	**Granite**	**n**	11	17	17	17	17	17	11	11	11	11	17	7	17	17	7	11	11	17	7
								Max	8.9	8.8	0.13	0.05	0.11	4.1	0.070	0.30	5.4	6.8	6.0	6.0	5.1	5.7	5.7	17	22	20	19
								90th PCTL	7.6	8	0.08	0.03	0.04	2.6	0.030	0.20	2.3	4.5	3.4	5.4	2.0	3.1	5.1	7.4	15	11	17
								75th PCTL	7.3	7.2	0.01	0.01	0.01	0.31	0.030	0.20	2.3	4.5	3.0	4.5	1.3	2.7	4.2	7.4	15	9.6	14
								Median	7	6.9	0.01	0.01	*<0.01*	0.31	0.020	*<0.2*	1.6	*<4.5*	2.0	4.0	0.46	1.7	3.7	5.2	14	6.7	13
								25th PCTL	6.9	6.5	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.015	*<0.2*	1.2	*<4.5*	1.0	3.0	-0.30	0.69	0.91	2.5	11	3.2	3.7
								10th PCTL	6.4	6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	1.0	2.0	-1.4	-0.95	0.050	0.57	2.4	0.66	1.0
								Min	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	1.0	2.0	-3.8	-2.8	-0.063	0.41	1.1	0.27	0.98
Lower Transition Facies for Granite Waste Rock																											
ABA010	KAM024598	CFD0137	49	50	Waste	Lower transition	Granite	GG	9	8.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.11	0.40	8.5	9.1	7.0	7.0	8.2	7.0	6.7	28	30	23	23
ABA154	R305804	CFD0382	10	11	Waste	Lower transition	Granite	GG	8.5	8.4	0.01	0.02	0.01	0.30	0.080	0.30	6.2	6.8	5.0	6.0	5.9	5.0	5.7	20	22	16	19
ABA155	R305805	CFD0382	50	51	Waste	Lower transition	Granite	GG	7.2	7	0.01	0.01	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	3.0	5.0	2.0	3.0	4.7	7.5	14	9.6	16
ABA159	R305809	CFD0383	10	11	Waste	Lower transition	Granite	GG	8.7	8.5	0.01	0.01	*<0.01*	0.30	0.040	0.20	3.1	4.5	4.0	6.0	2.8	4.0	5.7	9.9	15	13	19
ABA160	R305811	CFD0383	48	49	Waste	Lower transition	Granite	GG	8.8	8.6	0.01	0.01	0.01	0.30	0.10	0.40	7.8	9.1	6.0	7.0	7.5	6.0	6.7	25	29	19	22
ABA164	R305815	CFD0389	10	11	Waste	Lower transition	Granite	GG	8.9	8.6	0.01	*<0.01*	*<0.01*	0.30	0.010	*<0.2*	0.80	*<4.5*	4.0	5.0	0.46	4.0	4.7	2.5	14	13	16
ABA166	R305817	CFD0389	45	46	Waste	Lower transition	Granite	GG	6.4	6.2	0.03	0.01	0.01	0.90	0.050	*<0.2*	3.9	*<4.5*	2.0	4.0	2.9	1.0	3.1	4.1	4.8	2.1	4.3
ABA193	CFD383_115_125	CFD0383	115	125	Waste	Lower transition	Granite	GG	-	8.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	-	-	-	-	7.0	-	-0.30	7.0	-	-	-	23	-
ABA194	CFD0382_84_94	CFD0382	84	94	Waste	Lower transition	Granite	GG	-	6.6	*<0.01*	0.02	*<0.01*	*<0.3*	-	-	-	-	3.0	-	-0.30	3.0	-	-	-	10	-
ABA424	Q041284	CFD0382	4	5	Waste	Lower Transition	Granite	GG	8.6	9	*<0.01*	0.01	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	5.0	-	3.6	5.0	-	13	15	17	-
ABA425	Q041377	CFD0382	87	88	Waste	Lower Transition	Granite	GG	7.4	7.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	2.0	-	2.0	2.0	-	7.8	15	6.7	-
ABA426	Q041396	CFD0382	103	104	Waste	Lower Transition	Granite	GG	6.7	6.6	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	1.0	-	1.3	1.0	-	5.2	15	3.3	-
ABA427	Q041404	CFD0382	110	111	Waste	Lower Transition	Granite	GG	6.8	6.9	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	3.0	-	2.0	3.0	-	7.8	15	10	-
ABA430	Q041069	CFD0380	18	18.1	Waste	Lower Transition	Granite	GG	6.3	5.9	0.05	0.02	0.01	1.6	0.030	*<0.2*	2.3	*<4.5*	2.0	-	0.77	0.00	-	1.5	2.9	1.3	-
Statistical Summary						**Lower Tranistion**	**Granite**	**n**	12	14	14	14	14	14	12	12	12	12	14	7	14	14	7	12	12	14	7
								Max	9	9	0.05	0.02	0.01	1.6	0.11	0.40	8.5	9.1	7.0	7.0	8.2	6.7	6.7	28	30	23	23
								90th PCTL	8.9	8.7	0.02	0.02	0.01	0.75	0.098	0.39	7.6	8.9	6.7	7.0	7.0	6.4	6.7	24	28	22	23
								75th PCTL	8.7	8.6	0.01	0.01	0.01	0.31	0.058	0.23	4.5	5.1	5.0	6.5	3.4	4.7	6.2	15	17	17	21
								Median	8	7.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.035	*<0.2*	2.7	*<4.5*	3.5	6.0	2.0	3.2	5.7	7.8	15	11	19
								25th PCTL	6.8	6.7	*<0.01*	0.01	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	2.3	5.0	0.89	1.9	4.7	4.9	14	7.4	16
								10th PCTL	6.4	6.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.021	*<0.2*	1.6	*<4.5*	2.0	4.6	-0.071	0.81	4.0	2.6	5.8	2.5	11
								Min	6.3	5.9	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	1.0	4.0	-0.30	0.44	3.1	1.5	2.9	1.3	4.3
Fresh Facies for Granite Waste Rock																											
ABA012	KAM025798	CFD0147	260	261	Waste	Fresh	Granite	GG	8.8	8.7	0.01	*<0.01*	0.01	0.30	0.26	0.80	20	18	18	19	20	18	19	65	58	58	61
ABA162	R305813	CFD0385	10	11	Waste	Fresh	Granite	GG	9	8.7	0.01	0.01	0.01	0.30	0.040	0.20	3.1	4.5	4.0	5.0	2.8	4.0	4.7	9.9	15	13	16
ABA163	R305814	CFD0385	59	60	Waste	Fresh	Granite	GG	7.4	7.1	0.01	0.01	0.01	0.30	*<0.01*	*<0.2*	*<0.8*	*<4.5*	2.0	4.0	0.46	2.0	3.7	2.5	14	6.4	13
ABA165	R305816	CFD0389	30	31	Waste	Fresh	Granite	GG	8.5	8.4	0.05	*<0.01*	0.01	1.6	0.010	*<0.2*	0.80	*<4.5*	4.0	5.0	-0.79	2.0	3.4	0.50	2.9	2.6	3.2
ABA168	R305819	CFD0394	88	89	Waste	Fresh	Granite	GG	8.5	8.3	0.01	0.01	0.01	0.30	0.050	0.20	3.9	4.5	4.0	6.0	3.6	4.0	5.7	12	15	13	19
ABA179	R305832	CFD0400	60	61	Waste	Fresh	Granite	GG	6.8	6.7	0.01	0.01	0.01	0.30	0.020	*<0.2*	1.6	*<4.5*	2.0	3.0	1.2	2.0	2.7	5.0	14	6.4	9.6
ABA180	CFD0396_72_81	CFD0396	72	81	Waste	Fresh	Granite	GG	-	6.7	0.06	0.02	0.04	1.9	-	-	-	-	5.0	-	-1.9	3.0	-	-	-	2.7	-
ABA182	CFD0394_94_104	CFD0394	94	104	Waste	Fresh	Granite	GG	-	7.3	0.14	*<0.01*	0.14	4.4	-	-	-	-	6.0	-	-4.4	2.0	-	-	-	1.4	-
ABA186	CFD0380_2_17	CFD0380	2	17	Waste	Fresh	Granite	GG	-	8.8	*<0.01*	0.01	*<0.01*	*<0.3*	-	-	-	-	5.0	-	-0.30	5.0	-	-	-	17	-
ABA187	CFD0380_22_30	CFD0380	22	30	Waste	Fresh	Granite	GG	-	8.3	*<0.01*	0.01	*<0.01*	*<0.3*	-	-	-	-	3.0	-	-0.30	3.0	-	-	-	10	-
ABA198	CFD0385_28_38	CFD0385	28	38	Waste	Fresh	Granite	GG	-	9	0.03	*<0.01*	0.03	0.90	-	-	-	-	4.0	-	-0.94	3.0	-	-	-	4.3	-
ABA199	CFD0385_38_48	CFD0385	38	48	Waste	Fresh	Granite	GG	-	8.6	0.02	*<0.01*	0.02	0.60	-	-	-	-	3.0	-	-0.63	2.0	-	-	-	4.8	-
ABA200	CFD0385_48_58	CFD0385	48	58	Waste	Fresh	Granite	GG	-	8.3	0.03	*<0.01*	0.03	0.90	-	-	-	-	3.0	-	-0.94	2.0	-	-	-	3.2	-
ABA437	Q041055	CFD0380	5	6	Waste	Fresh	Granite	GG	9.2	9.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.090	0.20	7.0	4.5	6.0	-	6.7	6.0	-	23	15	20	-
ABA438	Q041063	CFD0380	12	13	Waste	Fresh	Granite	GG	9.1	9.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.070	0.20	5.4	4.5	6.0	-	5.1	6.0	-	18	15	20	-
ABA439	Q041678	CFD0385	8	9	Waste	Fresh	Granite	GG	9.2	9.3	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	6.0	-	2.8	6.0	-	10	15	20	-
ABA440	Q041699	CFD0385	27	28	Waste	Fresh	Granite	GG	9	8.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.040	0.20	3.1	4.5	5.0	-	2.8	5.0	-	10	15	17	-
ABA441	Q032423	CFD0385	92	92.58	Waste	Fresh	Granite	GG	7.9	7.7	0.03	0.02	0.01	0.90	0.010	*<0.2*	0.80	*<4.5*	3.0	-	-0.16	2.0	-	0.83	4.8	3.2	-
ABA442	Q032601	CFD0391	3.35	3.879	Waste	Fresh	Granite	GG	8.3	8.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.090	*<0.2*	7.0	*<4.5*	5.0	-	6.7	5.0	-	23	15	17	-
ABA443	Q033167	CFD0400	60	60.963	Waste	Fresh	Granite	GG	8	7.3	0.01	*<0.01*	*<0.01*	0.30	0.010	*<0.2*	0.80	*<4.5*	2.0	-	0.46	2.0	-	2.5	14	6.4	-
Statistical Summary						**Fresh**	**Granite**	**n**	13	20	20	20	20	20	13	13	13	13	20	6	20	20	6	13	13	20	6
								Max	9.2	9.3	0.14	0.02	0.14	4.4	0.26	0.80	20	18	18	19	20	18	19	65	58	58	61
								90th PCTL	9.2	9.2	0.05	0.01	0.03	1.6	0.090	0.20	7.0	4.5	6.0	13	6.7	5.7	12	23	15	20	40
								75th PCTL	9	8.8	0.03	0.01	0.01	0.94	0.070	0.20	5.4	4.5	5.3	5.8	3.0	4.7	5.4	18	15	17	18
								Median	8.5	8.5	0.01	*<0.01*	0.01	0.31	0.040	*<0.2*	3.1	*<4.5*	4.0	5.0	0.46	3.1	4.2	10	15	8.2	14
								25th PCTL	8	7.6	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	3.0	4.3	-0.67	2.1	3.5	2.5	14	4.0	10
								10th PCTL	7.5	7.1	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	2.0	3.5	-1.0	1.7	3.1	1.2	6.7	2.7	6.4
								Min	6.8	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.80	*<4.5*	2.0	3.0	-4.4	1.6	2.7	0.50	2.9	1.4	3.2

Appendix C.1-1: Acid-Base Accounting Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide-S	T-AP	Total-C	Inorg. C (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Statistical Summary for Granite Waste Rock								**n**	42	57	57	57	38	57	42	42	42	42	57	23	42	57	23	42	42	57	3
								n < DL	-	-	22	21	13	22	1	30	1	30	0	0	0	0	0	0	0	0	0
								Max	9.2	9.3	0.14	0.05	0.14	4.4	0.26	0.80	20	18	18	19	20	18	19	65	58	58	61
								90th PCTL	9	8.8	0.05	0.02	0.03	1.6	0.089	0.29	6.9	6.6	6.0	6.8	6.6	5.7	6.5	22	21	19	53
								75th PCTL	8.7	8.6	0.01	0.01	0.01	0.31	0.048	0.20	3.7	4.5	5.0	6.0	2.9	3.7	5.7	9.9	15	13	42
								Median	7.4	7.3	0.01	0.01	0.01	0.31	0.030	*<0.2*	2.3	*<4.5*	3.0	5.0	2.0	2.7	3.7	7.4	14	6.7	23
								25th PCTL	6.8	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	2.0	4.0	0.54	1.7	3.3	2.5	14	3.2	18
								10th PCTL	6.3	6.06	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	*<0.2*	0.78	*<4.5*	1.0	3.0	0.46	0.69	1.9	1.6	4.8	2.4	15
								Min	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	0.10	0.78	2.3	1.0	2.0	-1.7	-2.8	-0.063	0.41	1.1	0.27	13
Oxide Facies for Other Lithologies Waste Rock																											
ABA017	KAM029389	CFD0176	96	97	Waste	Oxide	Dykes	FC	7.1	7.4	0.02	0.01	0.02	0.60	0.090	0.30	7.0	6.8	9.0	9.0	6.4	8.0	8.4	11	11	14	14
ABA018	KAM029393	CFD0176	99	100	Waste	Oxide	Dykes	FC	7	6.7	0.02	*<0.01*	0.01	0.60	0.040	0.10	3.1	2.3	6.0	6.0	2.5	5.0	5.4	5.0	3.6	9.6	9.6
ABA056	KAM084551	CFD0237	181	181.5	Waste	Oxide	HU	HU	7.1	7.6	0.03	*<0.01*	0.03	0.90	0.28	0.70	22	16	16	19	21	15	18	23	17	17	20
ABA306	R277468	CFD0426	26	27	Waste	Oxide	SZ	SZ	-	8	*<0.01*	-	-	*<0.3*	0.010	-	0.80	-	-	-	-	-	-	2.6	0.00	-	-
Statistical Summary						**Oxide**	**Other Lithologies**	**n**	3	4	4	3	3	4	4	3	4	3	3	3	3	3	3	4	4	3	3
								Max	7.1	8	0.03	0.01	0.03	0.94	0.28	0.70	22	16	16	19	21	15	18	23	17	17	20
								90th PCTL	7.1	7.9	0.03	0.01	0.03	0.84	0.22	0.62	17	14	15	17	18	14	16	20	15	17	19
								75th PCTL	7.1	7.7	0.02	0.01	0.03	0.70	0.14	0.50	11	11	13	14	14	12	13	14	12	16	17
								Median	7.1	7.5	0.02	*<0.01*	0.02	0.63	0.065	0.30	5.0	6.8	9.0	9.0	6.4	8.4	8.4	8.1	7.3	14	14
								25th PCTL	7.1	7.2	0.02	*<0.01*	0.02	0.54	0.033	0.20	2.5	4.5	7.5	7.5	4.4	6.9	6.9	4.4	2.7	12	12
								10th PCTL	7	6.9	*<0.01*	*<0.01*	0.01	*<0.3*	0.019	0.14	1.5	3.2	6.6	6.6	3.3	6.0	6.0	3.3	1.1	11	11
								Min	7	6.7	*<0.01*	*<0.01*	0.01	*<0.3*	0.010	0.10	0.80	2.3	6.0	6.0	2.5	5.4	5.4	2.6	0.00	9.6	9.6
Upper Transition Facies for Other Lithologies Waste Rock																											
ABA061	KAM019714	CFD0083	8	9	Waste	Upper transition	Metabasalt/	Amph	8.6	8.7	0.01	*<0.01*	*<0.01*	0.30	0.36	1.3	28	30	37	38	28	37	38	89	95	118	122
ABA303	Q033703	CFD0411	15	16	Waste	Upper transition	dykes	DIOR	-	7.5	0.01	-	-	0.30	0.020	-	1.6	-	-	-	1.2	-	-	5.0	-	-	-
ABA072	KAM145425	CFD0339	10	11	Waste	Upper transition	Dykes	FC	7.1	7	0.01	*<0.01*	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	5.0	7.0	2.0	5.0	6.7	7.5	14	16	22
ABA311	Q034859	CFD0473	164	165	Waste	Upper transition	dykes	FC	-	7.4	0.02	-	-	0.60	0.040	-	3.1	-	-	-	2.5	-	-	5.0	-	-	-
ABA305	R273647	CFD0456	55	56	Waste	Upper transition	Fault	FLT	-	7.3	*<0.01*	-	-	*<0.3*	0.030	-	2.3	-	-	-	2.0	-	-	7.8	-	-	-
ABA022	KAM035755	CFD0080	122	123	Waste	Upper transition	YO	YO	7.7	8.1	0.53	0.01	0.42	17	3.0	11	234	241	204	202	217	187	185	14	15	12	12
ABA368	R545623	CFD0524	92	92.6	Waste	Upper Transition	Yx	Yx	8.3	8.3	0.02	*<0.01*	*<0.01*	0.60	0.020	*<0.2*	1.6	*<4.5*	-	-	-	-	-	2.5	7.2	-	-
Statistical Summary						**Upper Transition**	**Other Lithologies**	**n**	4	7	7	4	4	7	7	4	7	4	3	3	6	3	3	7	4	3	3
								Max	8.6	8.7	0.53	0.01	0.42	17	3.0	11	234	241	204	202	217	187	185	89	95	118	122
								90th PCTL	8.5	8.5	0.22	0.01	0.30	7.0	1.4	7.8	110	178	171	169	122	157	156	44	71	98	102
								75th PCTL	8.4	8.2	0.02	*<0.01*	0.11	0.63	0.20	3.6	16	82	121	120	21	112	112	11	35	67	72
								Median	8	7.5	0.01	*<0.01*	*<0.01*	0.31	0.030	0.75	2.3	17	37	38	2.3	37	38	7.4	14	16	22
								25th PCTL	7.6	7.4	0.01	*<0.01*	*<0.01*	0.31	0.025	*<0.2*	1.9	*<4.5*	21	23	2.0	21	22	5.0	13	14	17
								10th PCTL	7.3	7.2	0.01	*<0.01*	*<0.01*	0.31	0.020	*<0.2*	1.6	*<4.5*	11	13	1.6	11	13	4.0	9.4	13	14
								Min	7.1	7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	5.0	7.0	1.2	4.7	6.7	2.5	7.2	12	12
Lower Transition Facies for Other Lithologies Waste Rock																											
ABA449	R283583	CFD0496	90	91	Waste	Lower Transition	Metabasalt	MBSLT	8.6	8.7	0.34	0.01	-	11	2.4	8.2	187	186	192	-	176	181	-	18	18	18	-
ABA304	R283583	CFD0496	90	91	Waste	Lower transition	Metabasalt/	MBSLT	-	8.4	0.35	-	-	11	2.4	-	182	-	-	-	171	-	-	17	-	-	-
ABA312	R282332	CFD0474	37	38	Waste	Lower transition	dykes	IV	-	8.7	*<0.01*	-	-	*<0.3*	0.31	-	24	-	-	-	24	-	-	80	-	-	-
ABA313	Q035862	CFD0491	124	125	Waste	Lower transition	dykes	IV	-	6.9	0.02	-	-	0.60	0.020	-	1.6	-	-	-	0.93	-	-	2.5	-	-	-
ABA308	Q033764	CFD0411	70	71	Waste	Lower transition	YC	YC	-	8	0.12	-	-	3.8	2.5	-	192	-	-	-	188	-	-	51	-	-	-
ABA310	R276691	CFD0413	21	22	Waste	Lower transition	Ylim	Ylim	-	8.1	*<0.01*	-	-	*<0.3*	0.31	-	24	-	-	-	24	-	-	80	-	-	-
Statistical Summary						**Lower Transition**	**Other Lithologies**	**n**	1	6	6	1	0	6	6	1	6	1	1	0	6	1	0	6	1	1	0
								Max	-	8.7	0.35	-	-	11	2.5	8.2	192	-	-	-	188	-	-	80	-	-	-
								90th PCTL	-	8.7	0.35	-	-	11	2.4	8.2	189	-	-	-	182	-	-	80	-	-	-
								75th PCTL	-	8.6	0.29	-	-	8.9	2.4	8.2	186	-	-	-	175	-	-	73	-	-	-
								Median	-	8.3	0.07	-	-	2.2	1.3	8.2	103	-	-	-	98	-	-	34	-	-	-
								25th PCTL	-	8	0.01	-	-	0.38	0.31	8.2	24	-	-	-	24	-	-	17	-	-	-
								10th PCTL	-	7.5	*<0.01*	-	-	*<0.3*	0.17	8.2	13	-	-	-	12	-	-	9.6	-	-	-
								Min	-	6.9	*<0.01*	-	-	*<0.3*	0.020	8.2	1.6	-	-	-	0.93	-	-	2.5	-	-	-
Fresh Facies for Other Lithologies Waste Rock																											
ABA447	R274909	CFD0472	143.2	144	Waste	Fresh	Metabasalt	MBSLT	8	8.1	*<0.01*	0.02	-	*<0.3*	0.36	1.2	28	27	44	-	28	44	-	93	91	147	-
ABA448	R274918	CFD0472	150	151	Waste	Fresh	Metabasalt	MBSLT	8.6	8.9	0.07	*<0.01*	-	2.2	0.23	0.80	18	18	29	-	16	27	-	8.2	8.3	13	-
ABA450	R293475	CFR0730	91.44	92.96	Waste	Fresh	Metabasalt	MBSLT	8.6	8.7	0.21	0.03	-	6.6	0.88	2.9	68	66	80	-	62	73	-	10	10	12	-
ABA087	KAM133438	CFR0429	10.67	12.19	Waste	Fresh	Mafic/	RU	9	8.7	0.04	0.01	0.02	1.3	3.1	9.6	241	218	260	269	240	259	268	193	175	208	215
ABA307	R277453	CFD0423	81	82	Waste	Fresh	Mafic/	RU	-	8.2	0.01	-	-	0.30	0.90	-	70	-	-	-	70	-	-	223	-	-	-
ABA349	R304353	CFD0541	90	91	Waste	Fresh	IV	IV	8.7	8.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.22	0.70	17	16	-	-	17	-	-	57	53	-	-
ABA352	R304282	CFD0539	90	91	Waste	Fresh	IV	IV	8.7	8.6	*<0.01*	*<0.01*	0.02	*<0.3*	0.86	2.9	67	66	-	-	66	-	-	222	220	-	-
Statistical Summary						**Fresh**	**Other Lithologies**	**n**	6	7	7	6	3	7	7	6	7	6	4	1	7	4	1	7	6	4	1
								Max	9	8.9	0.21	0.03	0.02	6.6	3.1	9.6	241	218	260	-	240	259	-	223	220	208	-
								90th PCTL	8.9	8.8	0.13	0.03	0.02	3.9	1.8	6.3	138	142	206	-	138	203	-	223	197	190	-
								75th PCTL	8.7	8.8	0.06	0.02	0.02	1.7	0.89	2.9	69	66	125	-	68	120	-	208	154	162	-
								Median	8.7	8.7	0.01	0.01	0.02	0.31	0.86	2.1	67	47	62	-	62	59	-	93	72	80	-
								25th PCTL	8.6	8.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.30	0.90	23	21	40	-	22	39	-	34	21	13	-
								10th PCTL	8.3	8.2	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.23	0.75	18	17	34	-	16	32	-	9.5	9.2	13	-
								Min	8	8.1	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.22	0.70	17	16	29	-	16	27	-	8.2	8.3	12	-
Statistical Summary for Other Lithologies Waste Rock								**n**	14	24	24	14	10	24	24	14	24	14	11	7	24	11	7	24	15	11	7
								n < DL	-	-	7	7	3	7	0	2	0	2	0	0	0	0	0	0	0	0	0
								Max	9	8.9	0.53	0.03	0.42	17	3.1	11	241	241	260	269	240	259	268	223	211	208	215
								90th PCTL	8.7	8.7	0.30	0.02	0.07	9.4	2.5	9.2	190	209	204	229	184	187	218	162	143	141	159
								75th PCTL	8.6	8.7	0.05	0.01	0.02	1.5	0.89	2.9	69	66	136	120	67	127	112	80	69	68	72
								Median	8.5	8.1	0.02	*<0.01*	0.02	0.63	0.30	1.0	23	23	37	19	22	37	18	15	15	16	20
								25th PCTL	7.3	7.475	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.038	0.40	2.9	9.1	13	8.0	2.4	12	7.5	6.8	9.2	13	13
								10th PCTL	7.1	7.09	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	6.0	6.6	1.0	5.4	6.2	3.3	5.1	12	11
								Min	7	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.010	0.10	0.80	2.3	5.0	6.0	0.48	4.7	5.4	2.5	0.00	9.6	9.6

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit
Sulphate Sulphur determined by 25% HCL with Gravimetric Finish.
Sulphide Sulphur determined by Sobek 1:7 Nitric Acid with S by ICP-MS Finish.
T-AP = Acid potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material, derived from Total S * 31.25.
NP = Neutralization potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material.
Carbonate NP (CaNP) is calculated from total inorganic carbon (TIC); T-C NP* calculated from Total-C * 77.6.
Net NP (NNP) = NP - AP; Neutralization potential ratio (NPR).

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	pH	T-Alkalnity	Br	Cl	F	NO_3-N	NO_2-N	SO_4	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
										mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Gneiss Waste Rock																											
ABA043	KAM050495	CFD0152	149.0	150.0	Waste	Oxide	Gneiss	MxF	8.4	-	-	-	-	-	-	1.3	0.47	0.020	0.035	0.0073	0.00025	0.00025	0.13	0.000025	18	0.00025	0.000050
ABA064	KAM125257	CFD0307	49.0	50.0	Waste	Oxide	Gneiss	MxF	8.0	-	-	-	-	-	-	*<0.5*	3.6	0.041	0.19	0.069	*<0.0005*	*<0.0005*	0.014	*<0.00005*	0.84	0.0040	0.00073
ABA080	KAM115505	CFR0360	25.9	27.4	Waste	Oxide	Gneiss	MxF	7.2	-	-	-	-	-	-	*<0.5*	0.019	0.0028	0.0095	0.017	*<0.0005*	*<0.0005*	0.034	*<0.00005*	2.4	*<0.0005*	0.00020
ABA096	KAM137284	CFR0468	32.0	33.5	Waste	Oxide	Gneiss	MxF	8.3	-	-	-	-	-	-	0.52	3.8	0.0053	0.12	0.055	*<0.0005*	0.00063	*0.010*	*<0.00005*	0.57	0.0039	0.0010
ABA104	KAM139298	CFR0482	10.7	12.2	Waste	Oxide	Gneiss	MxF	7.4	-	-	-	-	-	-	0.80	3.0	0.021	0.18	0.085	*<0.0005*	*<0.0005*	0.022	*<0.00005*	0.67	0.0028	0.00071
ABA138	KAM152219	CFR0586	155.5	157.0	Waste	Oxide	Gneiss	MxF	8.8	-	-	-	-	-	-	3.5	0.26	0.0014	0.015	0.021	*<0.0005*	*<0.0005*	0.013	*<0.00005*	8.8	*<0.0005*	*<0.0001*
ABA144	KAM152716	CFR0591	30.5	32.0	Waste	Oxide	Gneiss	MxF	8.9	-	-	-	-	-	-	1.9	0.13	0.0069	0.17	0.025	*<0.0005*	*<0.0005*	0.017	*<0.00005*	12	*<0.0005*	*<0.0001*
ABA146	KAM153091	CFR0594	164.6	166.1	Waste	Oxide	Gneiss	MxF	8.3	-	-	-	-	-	-	16	0.036	0.047	1.2	0.0019	*<0.0005*	*<0.0005*	0.036	*<0.00005*	20	0.0029	*<0.0001*
ABA149	KAM153152	CFR0595	61.0	62.5	Waste	Oxide	Gneiss	MxF	9.4	-	-	-	-	-	-	1.4	0.43	0.0049	0.076	0.0052	*<0.0005*	*<0.0005*	0.016	*<0.00005*	6.6	*<0.0005*	*<0.0001*
Statistical Summary						**Oxide**	**Gneiss**	**n**	9	-	-	-	-	-	-	9	9	9	9	9	9	9	9	9	9	9	9
								Max	9.4	-	-	-	-	-	-	16	3.8	0.047	1.2	0.085	0.00050	0.00063	0.13	0.000050	20	0.0040	0.0010
								90th PCTL	9.0	-	-	-	-	-	-	6.0	3.7	0.042	0.39	0.072	0.00050	0.00053	0.054	0.000050	18	0.0039	0.00079
								75th PCTL	8.8	-	-	-	-	-	-	1.9	3.0	0.021	0.18	0.055	*<0.0005*	*<0.0005*	0.034	*<0.00005*	12	0.0029	0.00071
								Median	8.3	-	-	-	-	-	-	1.3	0.43	0.0069	0.12	0.021	*<0.0005*	*<0.0005*	0.017	*<0.00005*	6.6	0.00050	0.00010
								25th PCTL	8.0	-	-	-	-	-	-	0.52	0.13	0.0049	0.035	0.0073	*<0.0005*	*<0.0005*	0.014	*<0.00005*	0.84	*<0.0005*	*<0.0001*
								10th PCTL	7.4	-	-	-	-	-	-	*<0.5*	0.032	0.0025	0.014	0.0045	*<0.0005*	*<0.0005*	0.012	*<0.00005*	0.65	*<0.0005*	*<0.0001*
								Min	7.2	-	-	-	-	-	-	*<0.5*	0.019	0.0014	0.0095	0.0019	*<0.0005*	*<0.0005*	0.010	*<0.00005*	0.57	*<0.0005*	*<0.0001*
Upper Transition Facies for Gneiss Waste Rock																											
ABA016	KAM029087	CFD0175	145.0	146.0	Waste	Upper transition	Gneiss	MxF	8.1	-	-	-	-	-	-	1.7	0.11	0.0071	0.014	0.011	0.00025	0.00025	0.042	0.000025	28	0.0016	0.000050
ABA059	KAM097012	CFD0272	17.0	18.0	Waste	Upper transition	Gneiss	FG	8.6	-	-	-	-	-	-	0.55	7.6	0.028	0.20	0.11	0.00050	0.00050	0.043	0.000050	0.52	0.0029	0.0016
ABA060	KAM097065	CFD0272	65.0	66.0	Waste	Upper transition	Gneiss	FG	8.3	-	-	-	-	-	-	12	0.28	0.012	0.094	0.13	0.00025	0.00025	0.14	0.000025	23	0.00025	0.000050
ABA147	KAM152978	CFR0594	10.7	12.2	Waste	Upper transition	Gneiss	MxF	9.5	-	-	-	-	-	-	0.89	4.1	0.00045	0.015	0.048	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.6	0.00069	0.00066
ABA353	R304081	CFD0525	10.0	11.0	Waste	Upper Transition	Gneiss	MxF	7.7	4.2	*<0.05*	*<0.5*	0.17	0.0098	0.0027	0.90	0.51	0.0019	0.046	0.031	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.99	0.0013	0.00033
ABA367	R545582	CFD0524	56.0	57.0	Waste	Upper Transition	Gneiss	MxF	7.9	3.9	*<0.05*	*<0.5*	0.096	0.013	0.011	0.70	0.044	0.0049	0.079	0.0021	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.37	*<0.0005*	*<0.0001*
ABA411	R544193	CFD0502	40.0	41.0	Waste	Upper Transition	Gneiss	MxF	7.3	3.3	*<0.05*	*<0.5*	0.069	0.021	0.011	*<0.5*	0.028	0.0013	0.0079	0.0027	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.55	*<0.0005*	0.0017
Statistical Summary						**Upper Transition**	**Gneiss**	**n**	7	-	-	-	-	-	-	7	7	7	7	7	7	7	7	7	7	7	7
								Max	9.5	-	-	-	-	-	-	12	7.6	0.028	0.20	0.13	*<0.0005*	*<0.0005*	0.14	*<0.00005*	28	0.0029	0.0017
								90th PCTL	8.9	-	-	-	-	-	-	6.0	5.5	0.019	0.14	0.12	*<0.0005*	*<0.0005*	0.081	*<0.00005*	25	0.0021	0.0016
								75th PCTL	8.4	-	-	-	-	-	-	1.3	2.3	0.0097	0.087	0.078	*<0.0005*	*<0.0005*	0.043	*<0.00005*	14	0.0015	0.0011
								Median	8.1	-	-	-	-	-	-	0.89	0.28	0.0049	0.046	0.031	*<0.0005*	*<0.0005*	0.010	*<0.00005*	0.99	0.00069	0.00033
								25th PCTL	7.8	-	-	-	-	-	-	0.63	0.079	0.0016	0.014	0.0067	0.00038	0.00038	*<0.01*	0.000038	0.54	*<0.0005*	0.000075
								10th PCTL	7.5	-	-	-	-	-	-	0.53	0.038	0.00094	0.012	0.0025	0.00025	0.00025	*<0.01*	0.000025	0.46	0.00040	0.000050
								Min	7.3	-	-	-	-	-	-	*<0.5*	0.028	0.00045	0.0079	0.0021	0.00025	0.00025	*<0.01*	0.000025	0.37	0.00025	0.000050
Lower Transition Facies for Gneiss Waste Rock																											
ABA019	KAM029649	CFD0177	73.0	74.0	Waste	Lower transition	Gneiss	MxM	9.8	-	-	-	-	-	-	0.55	2.6	0.0026	0.015	0.011	0.00050	0.00050	0.026	0.000050	2.2	0.00050	0.00010
ABA058	KAM096948	CFD0270	230.0	231.0	Waste	Lower transition	Gneiss	MxF	8.6	-	-	-	-	-	-	15	0.64	0.0039	0.016	0.020	0.00025	0.00025	0.047	0.000025	25	0.00025	0.000050
ABA067	KAM129499	CFD0332	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	9.7	-	-	-	-	-	-	1.1	4.1	0.0018	0.012	0.031	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	3.8	*<0.0005*	0.00035
ABA070	KAM099512	CFD0338	10.0	11.0	Waste	Lower transition	Gneiss	MxF	9.2	33	*<0.05*	*<0.5*	0.16	0.0093	0.010	4.1	0.19	0.00020	0.0066	0.27	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.1	*<0.0005*	*<0.0001*
ABA073	KAM145537	CFD0339	111.0	112.0	Waste	Lower transition	Gneiss	MxF	9.2	28	*<0.05*	*<0.5*	0.12	0.0073	0.0089	7.3	0.20	0.0037	0.029	0.30	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.7	*<0.0005*	*<0.0001*
ABA098	KAM137429	CFR0469	29.0	30.5	Waste	Lower transition	Gneiss	MxF	9.4	26	*<0.05*	*<0.5*	0.13	*<0.005*	0.0041	*<0.5*	0.65	0.00017	0.019	0.0075	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.6	*<0.0005*	*<0.0001*
ABA106	KAM139356	CFR0482	89.9	91.4	Waste	Lower transition	Gneiss	MxF	9.3	32	*<0.05*	*<0.5*	0.21	*<0.005*	0.0062	2.7	0.26	0.00011	0.0045	0.0048	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	*<0.0001*
ABA117	KAM122524	CFR0529	21.3	22.9	Waste	Lower transition	Gneiss	FG	8.1	7.5	*<0.05*	*<0.5*	0.35	0.0081	0.0060	*<0.5*	2.0	0.0021	0.028	0.054	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.85	0.011	0.00086
ABA142	KAM152462	CFR0589	25.9	27.4	Waste	Lower transition	Gneiss	MxF	9.3	27	*<0.05*	*<0.5*	0.098	*<0.005*	0.0045	8.8	0.17	0.00049	0.014	0.23	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.6	*<0.0005*	*<0.0001*
ABA150	KAM153129	CFR0595	30.5	32.0	Waste	Lower transition	Gneiss	MxM	9.4	38	*<0.05*	*<0.5*	0.21	*<0.005*	0.0084	1.6	0.42	0.00082	0.056	0.0080	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.6	*<0.0005*	*<0.0001*
ABA246	R273797	CFD0458	9.0	10.0	Waste	Lower transition	Gneiss	FG	7.7	4.5	*<0.05*	*<0.5*	0.098	*<0.005*	0.024	*<0.5*	0.027	0.0017	0.017	0.0036	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.28	*<0.0005*	*<0.0001*
ABA247	R283019	CFD0484	33.0	34.0	Waste	Lower transition	Gneiss	FG	9.2	26	*<0.05*	*<0.5*	0.15	*<0.005*	0.011	0.72	0.24	0.00056	0.033	0.0079	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.2	*<0.0005*	*<0.0001*
ABA249	R273398	CFD0447	188.0	189.0	Waste	Lower transition	Gneiss	MxF	9.3	20	*<0.05*	*<0.5*	0.095	*<0.005*	*<0.001*	*<0.5*	0.42	0.00084	0.043	0.0067	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	3.2	*<0.0005*	*<0.0001*
ABA250	R279032	CFD0461	85.0	86.0	Waste	Lower transition	Gneiss	MxM	9.3	22	*<0.05*	*<0.5*	0.065	*<0.005*	0.0032	1.7	0.39	0.00027	0.021	0.0040	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	*<0.0001*
ABA251	R274019	CFD0464	10.0	11.0	Waste	Lower transition	Gneiss	FG	7.6	4.0	*<0.05*	*<0.5*	0.091	*<0.005*	*<0.001*	0.66	0.25	0.0033	0.092	0.0016	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.15	*<0.0005*	*<0.0001*
ABA252	R274341	CFD0467	80.0	81.0	Waste	Lower transition	Gneiss	MxF	9.2	24	*<0.05*	*<0.5*	0.11	*<0.005*	0.0027	0.97	0.24	0.00078	0.013	0.0026	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.6	*<0.0005*	*<0.0001*
ABA253	R282397	CFD0474	95.0	96.0	Waste	Lower transition	Gneiss	MxF	7.4	3.8	*<0.05*	*<0.5*	0.054	0.0074	0.0067	*<0.5*	0.016	0.00063	0.0080	0.0033	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.45	*<0.0005*	*<0.0001*
ABA254	R270666	CFD0404	10.0	11.0	Waste	Lower transition	Gneiss	MxF	7.5	3.3	*<0.05*	*<0.5*	0.11	*<0.005*	0.0037	1.1	1.2	0.0064	0.033	0.019	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.77	0.00055	0.00039
ABA255	R271756	CFD0424	62.0	63.0	Waste	Lower transition	Gneiss	MxM	9.4	28	*<0.05*	*<0.5*	0.17	0.0054	0.011	1.2	0.34	0.00013	0.0071	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.8	*<0.0005*	*<0.0001*
ABA256	R271112	CFD0415	8.0	9.0	Waste	Lower transition	Gneiss	MxM	19	16	16	16	16	16	16	19	19	19	19	19	19	19	19	19	19	19	19
ABA257	R273315	CFD0447	115.0	116.0	Waste	Lower transition	Gneiss	FG	9.8	38	*<0.05*	*<0.5*	0.30	0.0090	0.024	15	4.1	0.0064	0.092	0.30	0.00050	0.00050	0.047	0.000050	25	0.011	0.00086
ABA258	R276507	CFD0409	12.0	13.0	Waste	Lower transition	Gneiss	MxM	9.4	33	*<0.05*	*<0.5*	0.20	0.0080	0.011	7.6	2.1	0.0038	0.046	0.24	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.2	0.00051	0.00036
ABA259	R280545	CFD0499	10.0	11.0	Waste	Lower transition	Gneiss	MxM	9.3	28	*<0.05*	*<0.5*	0.20	0.0060	0.0090	2.2	0.65	0.0023	0.031	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	0.00010
ABA260	R280565	CFD0499	28.0	29.0	Waste	Lower transition	Gneiss	MxM	9.2	25	*<0.05*	*<0.5*	0.10	*<0.005*	0.0060	1.1	0.34	0.00082	0.017	0.0079	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	*<0.0001*
ABA261	R274115	CFD0464	95.0	96.0	Waste	Lower transition	Gneiss	MxF	8.4	6.8	*<0.05*	*<0.5*	0.10	*<0.005*	0.0040	*<0.5*	0.22	0.00038	0.013	0.0038	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.5	*<0.0005*	*<0.0001*
ABA262	R274262	CFD0467	10.0	11.0	Waste	Lower transition	Gneiss	MxF	7.6	3.9	*<0.05*	*<0.5*	0.10	*<0.005*	0.0020	*<0.5*	0.14	0.00016	0.0070	0.0024	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.42	*<0.0005*	*<0.0001*
ABA263	R282302	CFD0474	10.0	11.0	Waste	Lower transition	Gneiss	FG	7.4	3.3	*<0.05*	*<0.5*	0.10	*<0.005*	*<0.001*	*<0.5*	0.016	0.00011	0.0045	*<0.001*	0.00025	0.00025	0.010	0.000025	0.15	0.00025	0.000050
ABA264	R271435	CFD0420	9.0	10.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA265	R271165	CFD0415	55.0	56.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA267	R273694	CFD0456	97.0	98.0	Waste	Lower transition	Gneiss	MxM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA269	R279507	CFD0468	60.0	61.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA270	R272186	CFD0433	10.0	11.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA271	R283079	CFD0484	87.0	88.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA272	Q034772	CFD0473	86.0	87.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA273	R282171	CFD0439	30.0	31.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA274	R277372	CFD0423	10.0	11.0	Waste	Lower transition	Gneiss	MxM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	pH	T-Alkalnity	Br	Cl	F	NO_3-N	NO_2-N	SO_4	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
										mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ABA275	R283492	CFD0496	10.0	11.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA276	R273866	CFD0460	63.0	64.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA277	R273898	CFD0460	91.0	92.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA278	Q035773	CFD0491	9.0	10.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA279	Q035789	CFD0491	60.0	61.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA280	R271699	CFD0424	12.0	13.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA282	R282102	CFD0437	70.0	71.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA283	R273302	CFD0447	59.0	60.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA284	R273593	CFD0456	7.0	8.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA338	R270835	CFD0406	32.0	33.0	Waste	Lower Transition	Gneiss	MxF	9.2	33	*<0.05*	*<0.5*	0.16	0.0093	0.010	4.1	0.19	0.00020	0.0066	0.27	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.1	*<0.0005*	*<0.0001*
ABA340	R270686	CFD0404	27.0	28.0	Waste	Lower Transition	Gneiss	MxM	9.2	28	*<0.05*	*<0.5*	0.12	0.0073	0.0089	7.3	0.20	0.0037	0.029	0.30	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.7	*<0.0005*	*<0.0001*
ABA342	R551085	CFD0563	10.0	11.0	Waste	Lower Transition	Gneiss	MxM	9.4	26	*<0.05*	*<0.5*	0.13	*<0.005*	0.0041	*<0.5*	0.65	0.00017	0.019	0.0075	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.6	*<0.0005*	*<0.0001*
ABA344	R551131	CFD0563	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	9.3	32	*<0.05*	*<0.5*	0.21	*<0.005*	0.0062	2.7	0.26	0.00011	0.0045	0.0048	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	*<0.0001*
ABA348	R304313	CFD0541	56.0	57.0	Waste	Lower Transition	Gneiss	MxM	8.1	7.5	*<0.05*	*<0.5*	0.35	0.0081	0.0060	*<0.5*	2.0	0.0021	0.028	0.054	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.85	0.011	0.00086
ABA361	R623933	CFD0555	102.0	103.0	Waste	Lower Transition	Gneiss	MxF	9.3	27	*<0.05*	*<0.5*	0.098	*<0.005*	0.0045	8.8	0.17	0.00049	0.014	0.23	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.6	*<0.0005*	*<0.0001*
ABA362	R507027	CFD0555	185.0	186.0	Waste	Lower Transition	Gneiss	FG	9.4	38	*<0.05*	*<0.5*	0.21	*<0.005*	0.0084	1.6	0.42	0.00082	0.056	0.0080	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.6	*<0.0005*	*<0.0001*
ABA363	R545397	CFD0520	20.0	21.0	Waste	Lower Transition	Gneiss	FG	7.7	4.5	*<0.05*	*<0.5*	0.098	*<0.005*	0.024	*<0.5*	0.027	0.0017	0.017	0.0036	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.28	*<0.0005*	*<0.0001*
ABA369	R545644	CFD0526	81.0	82.0	Waste	Lower Transition	Gneiss	MxF	9.2	26	*<0.05*	*<0.5*	0.15	*<0.005*	0.011	0.72	0.24	0.00056	0.033	0.0079	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.2	*<0.0005*	*<0.0001*
ABA395	R545811	CFD0529	58.0	59.0	Waste	Lower Transition	Gneiss	FG	9.3	20	*<0.05*	*<0.5*	0.095	*<0.005*	*<0.001*	*<0.5*	0.42	0.00084	0.043	0.0067	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	3.2	*<0.0005*	*<0.0001*
ABA399	R543714	CFD0549	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	9.3	22	*<0.05*	*<0.5*	0.065	*<0.005*	0.0032	1.7	0.39	0.00027	0.021	0.0040	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	*<0.0001*
ABA400	R543741	CFD0549	53.0	54.0	Waste	Lower Transition	Gneiss	MxF	7.6	4.0	*<0.05*	*<0.5*	0.091	*<0.005*	*<0.001*	0.66	0.25	0.0033	0.092	0.0016	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.15	*<0.0005*	*<0.0001*
ABA402	R544003	CFD0553	80.0	81.0	Waste	Lower Transition	Gneiss	MxF	9.2	24	*<0.05*	*<0.5*	0.11	*<0.005*	0.0027	0.97	0.24	0.00078	0.013	0.0026	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.6	*<0.0005*	*<0.0001*
ABA405	R554003	CFD0501	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	7.4	3.8	*<0.05*	*<0.5*	0.054	0.0074	0.0067	*<0.5*	0.016	0.00063	0.0080	0.0033	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.45	*<0.0005*	*<0.0001*
ABA410	R544159	CFD0502	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	7.5	3.3	*<0.05*	*<0.5*	0.11	*<0.005*	0.0037	1.1	1.2	0.0064	0.033	0.019	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.77	0.00055	0.00039
ABA412	R544228	CFD0502	70.0	71.0	Waste	Lower Transition	Gneiss	MxF	9.4	28	*<0.05*	*<0.5*	0.17	0.0054	0.011	1.2	0.34	0.00013	0.0071	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.8	*<0.0005*	*<0.0001*
Statistical Summary						**Lower Transition**	**Gneiss**	**n**	19	16	16	16	16	16	16	19	19	19	19	19	19	19	19	19	19	19	19
								Max	9.8	38	*<0.05*	*<0.5*	0.30	0.0090	0.024	15	4.1	0.0064	0.092	0.30	0.00050	0.00050	0.047	0.000050	25	0.011	0.00086
								90th PCTL	9.4	33	*<0.05*	*<0.5*	0.20	0.0080	0.011	7.6	2.1	0.0038	0.046	0.24	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.2	0.00051	0.00036
								75th PCTL	9.3	28	*<0.05*	*<0.5*	0.20	0.0060	0.0090	2.2	0.65	0.0023	0.031	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	0.00010
								Median	9.2	25	*<0.05*	*<0.5*	0.10	*<0.005*	0.0060	1.1	0.34	0.00082	0.017	0.0079	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	*<0.0001*
								25th PCTL	8.4	6.8	*<0.05*	*<0.5*	0.10	*<0.005*	0.0040	*<0.5*	0.22	0.00038	0.013	0.0038	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.5	*<0.0005*	*<0.0001*
								10th PCTL	7.6	3.9	*<0.05*	*<0.5*	0.10	*<0.005*	0.0020	*<0.5*	0.14	0.00016	0.0070	0.0024	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.42	*<0.0005*	*<0.0001*
								Min	7.4	3.3	*<0.05*	*<0.5*	0.10	*<0.005*	*<0.001*	*<0.5*	0.016	0.00011	0.0045	*<0.001*	0.00025	0.00025	0.010	0.000025	0.15	0.00025	0.000050
Fresh Facies for Gneiss Waste Rock																											
ABA065	KAM128393	CFD0326	25.0	26.0	Waste	Fresh	Gneiss	MxM	8.1	-	-	-	-	-	-	0.92	5.5	0.028	0.14	0.13	*<0.0005*	*<0.0005*	0.011	*<0.00005*	1.9	0.0046	0.0015
ABA097	KAM137325	CFR0468	88.4	89.9	Waste	Fresh	Gneiss	MxM	9.1	-	-	-	-	-	-	8.8	0.43	0.00093	0.024	0.029	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.0	*<0.0005*	*<0.0001*
ABA139	KAM152151	CFR0586	61.0	62.5	Waste	Fresh	Gneiss	MxF	9.1	-	-	-	-	-	-	*<0.5*	3.2	0.0021	0.060	0.042	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.2	0.0014	0.00073
ABA143	KAM152536	CFR0589	128.0	129.5	Waste	Fresh	Gneiss	FG	9.0	-	-	-	-	-	-	10	0.24	0.0087	0.064	0.095	*<0.0005*	*<0.0005*	0.023	*<0.00005*	9.5	*<0.0005*	*<0.0001*
ABA148	KAM153051	CFR0594	109.7	111.3	Waste	Fresh	Gneiss	MxF	8.9	-	-	-	-	-	-	7.3	0.15	0.015	0.16	0.021	*<0.0005*	*<0.0005*	0.017	*<0.00005*	11	*<0.0005*	*<0.0001*
ABA347	R304284	CFD0541	30.0	31.0	Waste	Fresh	Gneiss	FG	8.7	11	*<0.05*	*<0.5*	0.12	*<0.005*	0.0064	0.95	0.99	0.0012	0.016	0.0084	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.1	*<0.0005*	0.0016
ABA350	R304041	CFD0539	10.0	11.0	Waste	Fresh	Gneiss	FG	8.8	9.8	*<0.05*	1.1	0.16	*<0.005*	*<0.001*	0.56	1.0	0.00053	0.012	0.013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.30	*<0.0005*	*<0.0001*
ABA354	R304119	CFD0525	45.0	46.0	Waste	Fresh	Gneiss	MxM	9.3	33	*<0.05*	*<0.5*	0.33	*<0.005*	0.0074	1.8	0.43	0.00021	0.0063	0.0014	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.2	*<0.0005*	*<0.0001*
ABA356	R623617	CFD0548	10.0	11.0	Waste	Fresh	Gneiss	MxF	8.5	8.5	*<0.05*	*<0.5*	0.17	*<0.005*	0.0040	*<0.5*	0.57	0.00066	0.014	0.012	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.70	*<0.0005*	0.00029
ABA358	R623742	CFD0548	120.0	121.0	Waste	Fresh	Gneiss	MxF	9.4	27	*<0.05*	*<0.5*	0.081	*<0.005*	0.0097	6.8	0.22	0.00037	0.0063	0.33	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.0	*<0.0005*	*<0.0001*
ABA365	R545443	CFD0520	60.0	61.0	Waste	Fresh	Gneiss	FG	8.9	12	*<0.05*	0.51	0.20	*<0.005*	0.0025	1.1	0.46	0.00016	0.0041	0.012	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.2	*<0.0005*	0.00011
ABA396	R545818	CFD0529	65.0	66.0	Waste	Fresh	Gneiss	MxF	9.3	16	*<0.05*	0.57	0.17	*<0.005*	0.0043	0.55	0.54	0.00036	0.013	0.011	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.7	*<0.0005*	*<0.0001*
ABA398	R543692	CFD0549	10.0	11.0	Waste	Fresh	Gneiss	FG	8.9	11	*<0.05*	*<0.5*	0.12	*<0.005*	*<0.001*	0.62	0.50	0.00029	0.019	0.0051	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.76	*<0.0005*	*<0.0001*
ABA401	R543957	CFD0553	40.0	41.0	Waste	Fresh	Gneiss	MxF	9.1	41	*<0.05*	*<0.5*	0.16	*<0.005*	0.0010	3.5	0.16	*<0.0001*	0.0053	0.0062	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.3	*<0.0005*	*<0.0001*
ABA413	R276141	CFD0393	127.0	128.0	Waste	Fresh	Gneiss	MxM	9.1	36	*<0.05*	*<0.5*	0.28	0.0059	0.018	1.3	0.062	0.00012	0.0022	0.0013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.3	*<0.0005*	*<0.0001*
ABA414	R276153	CFD0393	170.0	171.0	Waste	Fresh	Gneiss	MxM	9.2	31	*<0.05*	1.6	0.17	0.0060	0.011	2.9	0.071	0.00052	0.0024	0.018	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.8	*<0.0005*	*<0.0001*
Statistical Summary						**Fresh**	**Gneiss**	**n**	16	11	11	11	11	11	11	16	16	16	16	16	16	16	16	16	16	16	16
								Max	9.4	41	*<0.05*	1.6	0.33	0.0060	0.018	10	5.5	0.028	0.16	0.33	*<0.0005*	*<0.0005*	0.023	*<0.00005*	11	0.0046	0.0016
								90th PCTL	9.3	36	*<0.05*	1.1	0.28	0.0059	0.011	8.0	2.1	0.012	0.10	0.11	*<0.0005*	*<0.0005*	0.014	*<0.00005*	8.2	0.00093	0.0011
								75th PCTL	9.1	32	*<0.05*	0.54	0.19	*<0.005*	0.0086	4.3	0.68	0.0014	0.033	0.032	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	0.00016
								Median	9.1	16	*<0.05*	*<0.5*	0.17	*<0.005*	0.0043	1.2	0.45	0.00053	0.014	0.012	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	3.7	*<0.0005*	*<0.0001*
								25th PCTL	8.9	11	*<0.05*	*<0.5*	0.14	*<0.005*	0.0018	0.61	0.21	0.00027	0.0061	0.0079	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.2	*<0.0005*	*<0.0001*
								10th PCTL	8.6	9.8	*<0.05*	*<0.5*	0.12	*<0.005*	0.0010	0.53	0.11	0.00014	0.0033	0.0033	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.73	*<0.0005*	*<0.0001*
								Min	8.1	8.5	*<0.05*	*<0.5*	0.081	*<0.005*	*<0.001*	*<0.5*	0.062	*<0.0001*	0.0022	0.0013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.30	*<0.0005*	*<0.0001*
Statistical Summary for Gneiss Waste Rock								**n**	51	30	30	30	30	30	30	51	51	51	51	51	51	51	51	51	51	51	51
								n < DL	0	0	30	26	0	20	4	10	0	1	0	1	45	44	35	45	0	35	30
								Max	9.8	41	*<0.05*	1.6	0.35	0.021	0.024	16	7.6	0.047	1.2	0.33	0.00050	0.00063	0.14	0.000050	28	0.011	0.0017
								90th PCTL	9.4	33	*<0.05*	0.50	0.22	0.0094	0.011	8.8	3.6	0.020	0.16	0.13	0.00050	0.00050	0.036	0.000050	12	0.0029	0.00086
								75th PCTL	9.3	28	*<0.05*	*<0.5*	0.17	0.0060	0.010	2.8	0.82	0.0051	0.062	0.045	*<0.0005*	*<0.0005*	0.015	*<0.00005*	6.7	0.00050	0.00031
								Median	8.9	21	*<0.05*	*<0.5*	0.14	0.0050	0.0061	1.1	0.42	0.0014	0.019	0.012	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	*<0.0001*
								25th PCTL	8.2	7.8	*<0.05*	*<0.5*	0.098	*<0.005*	0.0028	0.55	0.18	0.00047	0.012	0.0052	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.85	*<0.0005*	*<0.0001*
								10th PCTL	7.6	3.9	*<0.05*	*<0.5*	0.080	*<0.005*	0.0010	*<0.5*	0.044	0.00017	0.0063	0.0021	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.52	*<0.0005*	*<0.0001*
								Min	7.2	3.3	*<0.05*	*<0.5*	0.054	*<0.005*	*<0.001*	*<0.5*	0.016	*<0.0001*	0.0022	*<0.001*	0.00025	0.00025	*<0.01*	0.000025	0.15	0.00025	0.000050

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	pH	T-Alkalnity	Br	Cl	F	NO_3-N	NO_2-N	SO_4	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
										mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Schist Waste Rock																											
ABA005	KAM022322	CFD0110	95.0	96.0	Waste	Oxide	Schist	RQM	8.0	-	-	-	-	-	-	925	0.17	0.0092	0.048	0.040	0.00050	0.00050	0.16	0.000050	222	0.00050	0.00010
ABA026	KAM037656	CFD0096	59.0	60.0	Waste	Oxide	Schist	BtS	8.3	-	-	-	-	-	-	546	0.22	0.0023	0.0010	0.036	0.00050	0.00050	0.058	0.000050	120	0.00050	0.00010
ABA074	KAM146948	CFD0345	60.0	61.0	Waste	Oxide	Schist	BtS_carb	8.5	-	-	-	-	-	-	4.5	0.088	0.0012	*<0.001*	0.030	*<0.0005*	*<0.0005*	0.012	*<0.00005*	16	0.0044	*<0.0001*
ABA077	J957606	CFD0350	60.0	61.0	Waste	Oxide	Schist	BtS_carb	8.4	-	-	-	-	-	-	1.8	0.048	0.0041	0.0060	0.021	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	20	0.0022	*<0.0001*
ABA125	KAM149844	CFR0566	10.7	12.2	Waste	Oxide	Schist	BtS	8.6	-	-	-	-	-	-	4.3	0.069	0.012	0.056	0.070	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	15	0.00077	*<0.0001*
ABA130	KAM150823	CFR0574	10.7	12.2	Waste	Oxide	Schist	BtS	8.5	-	-	-	-	-	-	2.2	0.061	0.0027	0.0070	0.036	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	20	0.0044	*<0.0001*
ABA131	KAM150859	CFR0574	61.0	62.5	Waste	Oxide	Schist	BtS	8.8	-	-	-	-	-	-	20	0.090	0.010	0.16	0.059	*<0.0005*	*<0.0005*	0.036	*<0.00005*	12	*<0.0005*	*<0.0001*
Statistical Summary						**Oxide**	**Schist**	**n**	7	-	-	-	-	-	-	7	7	7	7	7	7	7	7	7	7	7	7
								Max	8.8	-	-	-	-	-	-	925	0.22	0.012	0.16	0.070	0.00050	0.00050	0.16	0.000050	222	0.0044	0.00010
								90th PCTL	8.7	-	-	-	-	-	-	698	0.19	0.011	0.098	0.063	0.00050	0.00050	0.10	0.000050	161	0.0044	0.00010
								75th PCTL	8.6	-	-	-	-	-	-	283	0.13	0.0098	0.052	0.049	0.00050	0.00050	0.047	0.000050	70	0.0033	0.00010
								Median	8.5	-	-	-	-	-	-	4.5	0.088	0.0041	0.0070	0.036	*<0.0005*	*<0.0005*	0.012	*<0.00005*	20	0.00077	*<0.0001*
								25th PCTL	8.3	-	-	-	-	-	-	3.2	0.065	0.0025	0.0035	0.033	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	16	0.00050	*<0.0001*
								10th PCTL	8.2	-	-	-	-	-	-	2.0	0.056	0.0018	*<0.001*	0.027	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	14	0.00050	*<0.0001*
								Min	8.0	-	-	-	-	-	-	1.8	0.048	0.0012	*<0.001*	0.021	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	12	*<0.0005*	*<0.0001*
Upper Transition Facies for Schist Waste Rock																											
ABA027	KAM037928	CFD0099	30	31	Waste	Upper transition	Schist	BtS_carb	8.3	-	-	-	-	-	-	8.4	0.15	0.0028	0.00050	0.20	0.00025	0.00025	0.047	0.000025	22	0.00025	0.000050
ABA332	Q033589	CFD0407	32	33	Waste	Upper Transition	schist	BtS	8.8	46	*<0.05*	*<0.5*	0.51	0.0062	0.029	29	0.092	0.00011	*<0.001*	0.022	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	10	0.00061	*<0.0001*
Lower Transition Facies for Schist Waste Rock																											
ABA031	KAM039252	CFD0116	75	76	Waste	Lower transition	Schist	RQM	8.6	-	-	-	-	-	-	12	0.40	0.00053	0.00050	0.25	0.00025	0.00025	0.055	0.000025	19	0.00061	0.000050
ABA038	KAM047995	CFD0135	153	154	Waste	Lower transition	Schist	BtS	8.7	-	-	-	-	-	-	8.6	0.23	0.016	0.011	0.059	0.00025	0.00025	0.048	0.000025	11	0.00025	0.000050
ABA054	KAM081312	CFD0198	85	86	Waste	Lower transition	Schist	BtS	9.3	-	-	-	-	-	-	*<0.5*	7.3	0.022	0.36	0.070	0.00050	0.00050	0.025	0.000050	2.5	0.0046	0.00099
ABA333	R277487	CFD0426	43	44	Waste	Lower Transition	schist	BtS	7.8	4.8	*<0.05*	*<0.5*	0.29	0.011	0.0018	1.1	1.1	0.0022	0.029	0.019	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.65	0.0022	0.00049
ABA335	R550437	CFD0518	25	26	Waste	Lower Transition	schist	BtS	8.3	20	*<0.05*	*<0.5*	0.17	*<0.005*	0.0043	5.0	0.29	0.0012	0.0084	0.032	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.0	0.0012	0.00022
ABA336	R550471	CFD0518	55	56	Waste	Lower Transition	Schist	BtS_carb	8.5	32	*<0.05*	*<0.5*	0.26	*<0.005*	0.012	130	0.055	0.0022	0.0031	0.045	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	44	*<0.0005*	*<0.0001*
ABA337	R550494	CFD0518	75	75	Waste	Lower Transition	schist	BtS	9.0	33	*<0.05*	*<0.5*	0.21	0.0084	0.013	12	0.17	0.00076	0.0054	0.20	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	*<0.0005*	*<0.0001*
ABA345	R551151	CFD0563	68	69	Waste	Lower Transition	schist	BtS	9.0	35	*<0.05*	*<0.5*	0.41	0.0051	0.0086	11	0.13	0.0014	0.015	0.27	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	0.00079	*<0.0001*
Statistical Summary						**Lower Transition**	**Schist**	**n**	8	5	5	5	5	5	5	8	8	8	8	8	8	8	8	8	8	8
								Max	9.3	35	*<0.05*	*<0.5*	0.41	0.011	0.013	130	7.3	0.022	0.36	0.27	*<0.0005*	*<0.0005*	0.055	*<0.00005*	44	0.0046	0.00099
								90th PCTL	9.1	34	*<0.05*	*<0.5*	0.36	0.0098	0.012	48	3.0	0.018	0.13	0.26	*<0.0005*	*<0.0005*	0.050	*<0.00005*	27	0.0029	0.00064
								75th PCTL	9.0	33	*<0.05*	*<0.5*	0.29	0.0084	0.012	12	0.57	0.0057	0.019	0.22	*<0.0005*	*<0.0005*	0.031	*<0.00005*	13	0.0014	0.00029
								Median	8.7	32	*<0.05*	*<0.5*	0.26	0.0051	0.0086	9.9	0.26	0.0018	0.0098	0.065	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	0.00070	*<0.0001*
								25th PCTL	8.4	20	*<0.05*	*<0.5*	0.21	*<0.005*	0.0043	4.0	0.16	0.0011	0.0048	0.041	0.00044	0.00044	*<0.01*	0.000044	5.9	*<0.0005*	*<0.0001*
								10th PCTL	8.2	11	*<0.05*	*<0.5*	0.19	*<0.005*	0.0028	0.92	0.11	0.00069	0.0023	0.028	0.00025	0.00025	*<0.01*	0.000025	1.9	0.00043	0.000050
								Min	7.8	4.8	*<0.05*	*<0.5*	0.17	*<0.005*	0.0018	*<0.5*	0.055	0.00053	0.00050	0.019	0.00025	0.00025	*<0.01*	0.000025	0.65	0.00025	0.000050
Fresh Facies for Schist Waste Rock																											
ABA132	KAM150898	CFR0574	114.3	115.8	Waste	Fresh	Schist	BtS	8.6	-	-	-	-	-	-	97	0.072	0.011	0.0060	0.045	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	27	*<0.0005*	*<0.0001*
ABA330	R276299	CFD0401	74.0	75.0	Waste	Fresh	schist	BtS	8.9	25	*<0.05*	*<0.5*	0.090	0.0065	0.013	21	0.14	0.00017	0.0049	0.0020	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	12	*<0.0005*	0.00013
ABA331	R276331	CFD0401	141.0	142.0	Waste	Fresh	schist	BtS	9.0	43	*<0.05*	*<0.5*	0.35	0.0056	0.016	0.93	0.090	0.00034	0.0078	0.0027	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.5	*<0.0005*	*<0.0001*
ABA415	R277001	CFD0398	49.0	50.0	Waste	Fresh	schist	BtS	9.3	24	*<0.05*	*<0.5*	0.11	0.0087	0.0082	0.52	0.22	0.00038	0.0045	0.0018	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	0.00087	0.00014
ABA416	R277017	CFD0398	64.0	65.0	Waste	Fresh	schist	BtS	9.3	27	*<0.05*	*<0.5*	0.14	0.0075	0.0069	0.54	0.16	0.00026	0.0066	0.0016	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.8	*<0.0005*	*<0.0001*
ABA417	R277021	CFD0398	124.0	125.0	Waste	Fresh	schist	BtS	9.3	31	*<0.05*	*<0.5*	0.16	*<0.005*	0.0087	0.53	0.12	0.00026	0.0028	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.1	*<0.0005*	*<0.0001*
ABA418	R277041	CFD0398	160.0	161.0	Waste	Fresh	schist	BtS	9.4	29	*<0.05*	*<0.5*	0.21	0.0077	0.0077	2.3	0.17	0.00020	*<0.001*	0.0036	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.2	*<0.0005*	*<0.0001*
Statistical Summary						**Fresh**	**Schist**	**n**	7	6	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	7
								Max	9.4	43	*<0.05*	*<0.5*	0.35	0.0087	0.016	97	0.20	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	27	0.00087	0.00014
								90th PCTL	9.3	37	*<0.05*	*<0.5*	0.28	0.0082	0.014	51	0.20	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	18	0.00065	0.00013
								75th PCTL	9.3	31	*<0.05*	*<0.5*	0.20	0.0077	0.012	11	0.20	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	9.7	*<0.0005*	0.00012
								Median	9.3	28	*<0.05*	*<0.5*	0.15	0.0070	0.0085	0.90	0.10	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.5	*<0.0005*	*<0.0001*
								25th PCTL	8.9	25	*<0.05*	*<0.5*	0.11	0.0058	0.0078	0.50	0.10	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.0	*<0.0005*	*<0.0001*
								10th PCTL	8.8	25	*<0.05*	*<0.5*	0.098	0.0053	0.0073	0.50	0.10	0.00	0.00	0.00	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.6	*<0.0005*	*<0.0001*
								Min	8.6	24	*<0.05*	*<0.5*	0.090	*<0.005*	0.0069	0.50	0.10	0.00	*<0.001*	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.2	*<0.0005*	*<0.0001*
Statistical Summary for Schist Waste Rock								**n**	24	12	12	12	12	12	12	24	24	24	24	24	24	24	24	24	24	24
								n < DL	0	0	12	12	0	3	0	1	0	0	3	1	18	18	16	18	0	9	14
								Max	9.4	46	*<0.05*	*<0.5*	0.51	0.011	0.029	925	7.3	0.022	0.36	0.27	0.00050	0.00050	0.16	0.000050	222	0.0046	0.00099
								90th PCTL	9.3	42	*<0.05*	*<0.5*	0.41	0.0087	0.015	120	0.36	0.012	0.054	0.20	0.00050	0.00050	0.053	0.000050	39	0.0037	0.00020
								75th PCTL	9.0	34	*<0.05*	*<0.5*	0.30	0.0079	0.013	20	0.22	0.0053	0.012	0.062	*<0.0005*	*<0.0005*	0.028	*<0.00005*	20	0.00094	0.00010
								Median	8.7	30	*<0.05*	*<0.5*	0.21	0.0064	0.0087	6.7	0.14	0.0018	0.0060	0.036	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	0.00050	*<0.0001*
								25th PCTL	8.4	25	*<0.05*	*<0.5*	0.16	0.0051	0.0075	1.6	0.089	0.00037	0.0024	0.015	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.9	*<0.0005*	*<0.0001*
								10th PCTL	8.3	20	*<0.05*	*<0.5*	0.11	*<0.005*	0.0046	0.53	0.063	0.00022	*<0.001*	0.0019	0.00033	0.00033	0.010	0.000033	5.4	*<0.0005*	0.000065
								Min	7.8	4.8	*<0.05*	*<0.5*	0.090	*<0.005*	0.0018	*<0.5*	0.048	0.00011	0.00050	*<0.001*	0.00025	0.00025	0.010	0.000025	0.65	0.00025	0.000050

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	pH	T-Alkalnity	Br	Cl	F	NO_3-N	NO_2-N	SO_4	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
										mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Granite Waste Rock																											
ABA157	R305807	CFD0382	76	77	Waste	Oxide	Granite	GG	6.8	-	-	-	-	-	-	*<0.5*	0.11	0.029	0.25	*<0.001*	*<0.0005*	*<0.0005*	0.052	*<0.00005*	0.17	*<0.0005*	*<0.0001*
ABA158	R305808	CFD0382	79	80	Waste	Oxide	Granite	GG	6.6	-	-	-	-	-	-	*<0.5*	*<0.005*	0.017	0.096	*<0.001*	*<0.0005*	*<0.0005*	0.026	*<0.00005*	0.24	*<0.0005*	*<0.0001*
ABA174	R305826	CFD0403	7.0	8.0	Waste	Oxide	Granite	GG	6.7	-	-	-	-	-	-	1.7	5.2	0.018	3.5	0.013	*<0.0005*	*<0.0005*	0.10	*<0.00005*	0.94	*<0.0005*	0.0024
Upper Transition Facies for Granite Waste Rock																											
ABA013	KAM025898	CFD0150	81	82	Waste	Upper transition	Granite	GG	7.5	-	-	-	-	-	-	4.0	9.7	0.011	0.023	0.047	0.00050	0.00050	0.048	0.000050	0.43	0.00050	0.00027
ABA151	R305801	CFD0381	13	14	Waste	Upper transition	Granite	GG	8.8	-	-	-	-	-	-	*<0.5*	4.9	0.00034	0.020	0.054	*<0.0005*	*<0.0005*	0.041	*<0.00005*	1.5	0.00066	0.00082
ABA152	R305802	CFD0381	35	36	Waste	Upper transition	Granite	GG	8.4	-	-	-	-	-	-	4.6	15	0.0052	1.5	0.069	0.00070	*<0.0005*	0.038	*<0.00005*	2.9	0.00065	0.0012
ABA167	R305818	CFD0394	30	31	Waste	Upper transition	Granite	GG	6.8	-	-	-	-	-	-	5.2	3.3	0.035	0.46	0.029	*<0.0005*	*<0.0005*	0.052	*<0.00005*	0.52	*<0.0005*	*<0.0001*
ABA169	R305821	CFD0399	20	21	Waste	Upper transition	Granite	GG	7.4	-	-	-	-	-	-	16	4.2	0.0026	0.059	0.034	*<0.0005*	*<0.0005*	0.036	*<0.00005*	1.6	*<0.0005*	0.00092
ABA172	R305824	CFD0396	29	30	Waste	Upper transition	Granite	GG	6.5	-	-	-	-	-	-	*<0.5*	*<0.005*	0.010	0.018	*<0.001*	*<0.0005*	*<0.0005*	0.013	*<0.00005*	0.31	*<0.0005*	*<0.0001*
ABA178	R305831	CFD0400	11	12	Waste	Upper transition	Granite	GG	7.6	-	-	-	-	-	-	1.3	5.0	0.0055	0.76	0.048	0.0012	*<0.0005*	0.018	0.000050	1.2	*<0.0005*	0.0017
Statistical Summary						**Upper Transition**	**Granite**	**n**	7	-	-	-	-	-	-	7	7	7	7	7	7	7	7	7	7	7	7
								Max	8.8	-	-	-	-	-	-	16	15	0.035	1.5	0.069	0.0012	0.00050	0.052	0.000050	2.9	0.00066	0.0017
								90th PCTL	8.5	-	-	-	-	-	-	9.4	12	0.021	1.1	0.060	0.00090	0.00050	0.050	0.000050	2.1	0.00065	0.0014
								75th PCTL	8.0	-	-	-	-	-	-	4.9	7.3	0.011	0.61	0.051	0.00060	*<0.0005*	0.045	*<0.00005*	1.6	0.00058	0.0010
								Median	7.5	-	-	-	-	-	-	4.0	4.9	0.0055	0.059	0.047	*<0.0005*	*<0.0005*	0.038	*<0.00005*	1.2	*<0.0005*	0.00082
								25th PCTL	7.1	-	-	-	-	-	-	0.92	3.7	0.0039	0.021	0.031	*<0.0005*	*<0.0005*	0.027	*<0.00005*	0.48	*<0.0005*	0.00019
								10th PCTL	6.7	-	-	-	-	-	-	*<0.5*	2.0	0.0017	0.019	0.018	*<0.0005*	*<0.0005*	0.016	*<0.00005*	0.38	*<0.0005*	*<0.0001*
								Min	6.5	-	-	-	-	-	-	*<0.5*	*<0.005*	0.00034	0.018	*<0.001*	*<0.0005*	*<0.0005*	0.013	*<0.00005*	0.31	*<0.0005*	*<0.0001*
Lower Transition Facies for Granite Waste Rock																											
ABA154	R305804	CFD0382	10	11	Waste	Lower transition	Granite	GG	8.5	-	-	-	-	-	-	*<0.5*	4.5	0.0014	0.038	0.047	*<0.0005*	*<0.0005*	0.075	*<0.00005*	1.4	0.00056	0.0013
ABA155	R305805	CFD0382	50	51	Waste	Lower transition	Granite	GG	7.6	-	-	-	-	-	-	1.2	5.1	0.042	0.36	0.053	*<0.0005*	*<0.0005*	0.016	*<0.00005*	1.6	*<0.0005*	0.0045
ABA159	R305809	CFD0383	10	11	Waste	Lower transition	Granite	GG	8.8	-	-	-	-	-	-	0.55	5.2	0.00058	0.035	0.059	*<0.0005*	*<0.0005*	0.026	*<0.00005*	1.2	0.00071	0.00099
ABA160	R305811	CFD0383	48	49	Waste	Lower transition	Granite	GG	8.8	-	-	-	-	-	-	0.70	4.3	0.0017	0.018	0.050	*<0.0005*	*<0.0005*	0.031	*<0.00005*	1.6	0.00062	0.0012
ABA164	R305815	CFD0389	10	11	Waste	Lower transition	Granite	GG	8.9	-	-	-	-	-	-	*<0.5*	5.6	0.00093	0.13	0.065	*<0.0005*	*<0.0005*	0.030	*<0.00005*	1.1	0.0011	0.0022
ABA166	R305817	CFD0389	45	46	Waste	Lower transition	Granite	GG	6.4	-	-	-	-	-	-	0.97	6.5	0.16	2.5	0.0087	0.00066	*<0.0005*	0.012	*<0.00005*	0.98	*<0.0005*	0.0014
Statistical Summary						**Lower Transition**	**Granite**	**n**	6	-	-	-	-	-	-	6	6	6	6	6	6	6	6	6	6	6	6
								Max	8.9	-	-	-	-	-	-	1.2	6.5	0.16	2.5	0.065	0.00066	*<0.0005*	0.075	*<0.00005*	1.6	0.0011	0.0045
								90th PCTL	8.9	-	-	-	-	-	-	1.1	6.0	0.10	1.4	0.062	0.00058	*<0.0005*	0.053	*<0.00005*	1.6	0.00088	0.0034
								75th PCTL	8.8	-	-	-	-	-	-	0.90	5.5	0.032	0.30	0.058	*<0.0005*	*<0.0005*	0.031	*<0.00005*	1.6	0.00069	0.0020
								Median	8.6	-	-	-	-	-	-	0.63	5.1	0.0015	0.082	0.052	*<0.0005*	*<0.0005*	0.028	*<0.00005*	1.3	0.00059	0.0013
								25th PCTL	7.8	-	-	-	-	-	-	0.51	4.6	0.0010	0.036	0.048	*<0.0005*	*<0.0005*	0.019	*<0.00005*	1.1	0.00052	0.0012
								10th PCTL	7.0	-	-	-	-	-	-	*<0.5*	4.4	0.00076	0.026	0.028	*<0.0005*	*<0.0005*	0.014	*<0.00005*	1.0	*<0.0005*	0.0011
								Min	6.4	-	-	-	-	-	-	*<0.5*	4.3	0.00058	0.018	0.0087	*<0.0005*	*<0.0005*	0.012	*<0.00005*	0.98	*<0.0005*	0.00099
Fresh Facies for Granite Waste Rock																											
ABA012	KAM025798	CFD0147	260	261	Waste	Fresh	Granite	GG	9.2	-	-	-	-	-	-	4.4	0.42	0.00062	0.030	0.022	0.00025	0.00025	0.060	0.000025	3.5	0.00025	0.000050
ABA162	R305813	CFD0385	10	11	Waste	Fresh	Granite	GG	8.9	-	-	-	-	-	-	*<0.5*	5.2	0.00093	0.083	0.056	*<0.0005*	*<0.0005*	0.19	*<0.00005*	1.1	0.00073	0.0010
ABA163	R305814	CFD0385	59	60	Waste	Fresh	Granite	GG	7.6	-	-	-	-	-	-	*<0.5*	3.9	0.043	0.28	0.018	*<0.0005*	*<0.0005*	0.027	*<0.00005*	0.61	*<0.0005*	0.0050
ABA165	R305816	CFD0389	30	31	Waste	Fresh	Granite	GG	8.8	-	-	-	-	-	-	*<0.5*	5.0	0.0039	0.42	0.045	*<0.0005*	*<0.0005*	0.038	*<0.00005*	1.0	0.00088	0.00098
ABA168	R305819	CFD0394	88	89	Waste	Fresh	Granite	GG	8.5	-	-	-	-	-	-	3.7	7.5	0.0069	0.039	0.058	*<0.0005*	*<0.0005*	0.031	*<0.00005*	1.1	0.00075	0.0011
ABA179	R305832	CFD0400	60	61	Waste	Fresh	Granite	GG	7.0	-	-	-	-	-	-	1.9	2.9	0.064	1.3	0.013	*<0.0005*	*<0.0005*	0.019	*<0.00005*	0.32	*<0.0005*	0.00019
ABA439	Q041678	CFD0385	8.0	9.0	Waste	Fresh	Granite	GG	8.0	6.1	*<0.05*	*<0.5*	0.21	0.0088	0.0025	*<0.5*	0.35	0.00039	0.0031	0.0028	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.41	*<0.0005*	*<0.0001*
ABA441	Q032423	CFD0385	92	93	Waste	Fresh	Granite	GG	6.6	2.5	*<0.05*	*<0.5*	0.20	0.0078	0.0043	27	0.0074	0.00053	0.0051	0.016	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.7	*<0.0005*	0.0071
Statistical Summary						**Fresh**	**Granite**	**n**	8	-	-	-	-	-	-	8	8	8	8	8	8	8	8	8	8	8	8
								Max	9.2	-	-	-	-	-	-	27	7.5	0.064	1.3	0.058	*<0.0005*	*<0.0005*	0.19	*<0.00005*	4.7	0.00088	0.0071
								90th PCTL	9.0	-	-	-	-	-	-	11	5.8	0.049	0.68	0.057	*<0.0005*	*<0.0005*	0.099	*<0.00005*	3.8	0.00079	0.0056
								75th PCTL	8.8	-	-	-	-	-	-	3.9	5.0	0.016	0.31	0.048	*<0.0005*	*<0.0005*	0.044	*<0.00005*	1.7	0.00074	0.0021
								Median	8.2	-	-	-	-	-	-	1.2	3.4	0.0024	0.061	0.020	*<0.0005*	*<0.0005*	0.029	*<0.00005*	1.1	*<0.0005*	0.00099
								25th PCTL	7.4	-	-	-	-	-	-	*<0.5*	0.40	0.00060	0.024	0.016	*<0.0005*	*<0.0005*	0.017	*<0.00005*	0.56	*<0.0005*	0.00017
								10th PCTL	6.9	-	-	-	-	-	-	*<0.5*	0.24	0.00049	0.0045	0.010	0.00043	0.00043	*<0.01*	0.000043	0.38	0.00043	0.000085
								Min	6.6	-	-	-	-	-	-	*<0.5*	0.0074	0.00039	0.0031	0.0028	0.00025	0.00025	*<0.01*	0.000025	0.32	0.00025	0.000050
Statistical Summary for Granite Waste Rock								**n**	24	2	2	2	2	2	2	24	24	24	24	24	24	24	24	24	24	24	24
								n < DL	0	0	2	2	0	0	0	10	2	0	0	3	19	22	2	21	0	13	5
								Max	9.2	6.1	*<0.05*	*<0.5*	0.21	0.0090	0.0040	27	15	0.16	3.5	0.069	0.0012	0.00050	0.19	0.000050	4.7	0.0011	0.0071
								90th PCTL	8.9	5.7	*<0.05*	*<0.5*	0.21	0.0090	0.0040	5.0	7.2	0.042	1.5	0.059	0.00061	*<0.0005*	0.071	0.000050	2.5	0.00074	0.0039
								75th PCTL	8.8	5.2	*<0.05*	*<0.5*	0.21	0.0090	0.0040	3.8	5.2	0.021	0.43	0.053	*<0.0005*	*<0.0005*	0.049	*<0.00005*	1.6	0.00065	0.0015
								Median	7.6	4.3	*<0.05*	*<0.5*	0.21	0.0080	0.0030	0.84	4.7	0.0054	0.089	0.039	*<0.0005*	*<0.0005*	0.031	*<0.00005*	1.1	*<0.0005*	0.00100
								25th PCTL	6.8	3.4	*<0.05*	*<0.5*	0.20	0.0080	0.0030	*<0.5*	2.3	0.00093	0.028	0.013	*<0.0005*	*<0.0005*	0.019	*<0.00005*	0.50	*<0.0005*	0.00017
								10th PCTL	6.6	2.9	*<0.05*	*<0.5*	0.20	0.0080	0.0030	*<0.5*	*<0.005*	0.00055	0.018	0.0020	*<0.0005*	*<0.0005*	0.012	*<0.00005*	0.31	*<0.0005*	*<0.0001*
								Min	6.4	2.5	*<0.05*	*<0.5*	0.20	0.0080	0.0030	*<0.5*	*<0.005*	0.00034	0.0031	*<0.001*	0.00025	0.00025	0.010	0.000025	0.17	0.00025	0.000050
Oxide and Fresh Facies for Other Lithologies Waste Rock																											
ABA018	KAM029393	CFD0176	99	100	Waste	Oxide	Dykes	FC	7.5	-	-	-	-	-	-	1.5	0.032	0.0079	0.0065	0.026	0.00025	0.00025	0.091	0.000025	3.5	0.00025	0.000050
ABA056	KAM084551	CFD0237	181	182	Waste	Oxide	HU	HU	8.2	-	-	-	-	-	-	-	0.12	0.0096	0.55	0.0097	0.00025	0.00025	0.21	0.000025	13	0.00059	0.000050
ABA352	R304282	CFD0539	90	91	Waste	Fresh	IV	IV	9.2	32	*<0.05*	*<0.5*	0.14	*<0.005*	0.011	0.62	0.31	0.00063	0.0034	0.0048	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.0	*<0.0005*	*<0.0001*

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
									mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Gneiss Waste Rock																														
ABA043	KAM050495	CFD0152	149.0	150.0	Waste	Oxide	Gneiss	MxF	0.00050	0.015	0.000050	0.0072	3.4	0.0046	0.000025	0.0091	0.00025	0.15	54	0.00025	3.0	0.000025	1.5	0.066	0.00012	0.00025	0.0050	0.000070	0.00050	0.0050
ABA064	KAM125257	CFD0307	49.0	50.0	Waste	Oxide	Gneiss	MxF	0.0018	5.7	0.0068	*<0.005*	0.47	0.13	0.00014	0.0028	0.0013	*<0.3*	3.0	*<0.0005*	17	0.00010	2.6	0.0055	0.00013	*<0.0005*	0.085	0.0018	0.0090	*<0.01*
ABA080	KAM115505	CFR0360	25.9	27.4	Waste	Oxide	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.38	0.096	*<0.00005*	0.0014	*<0.0005*	*<0.3*	7.1	*<0.0005*	7.7	*<0.00005*	0.69	0.011	0.00021	*<0.0005*	*<0.01*	0.00018	*<0.001*	*<0.01*
ABA096	KAM137284	CFR0468	32.0	33.5	Waste	Oxide	Gneiss	MxF	0.0030	3.2	0.0097	*<0.005*	0.50	0.080	*<0.00005*	0.012	0.0016	*<0.3*	2.0	*<0.0005*	13	0.000092	5.4	0.0057	*<0.0001*	*<0.0005*	0.12	0.0036	0.0047	*<0.01*
ABA104	KAM139298	CFR0482	10.7	12.2	Waste	Oxide	Gneiss	MxF	0.0044	3.8	0.010	*<0.005*	0.27	0.15	0.00014	0.0074	0.0013	*<0.3*	12	*<0.0005*	12	*<0.00005*	0.87	0.0069	0.00063	*<0.0005*	0.033	0.0043	0.0032	*<0.01*
ABA138	KAM152219	CFR0586	155.5	157.0	Waste	Oxide	Gneiss	MxF	*<0.001*	0.33	0.00046	*<0.005*	1.8	0.011	*<0.00005*	0.0091	*<0.0005*	*<0.3*	7.4	*<0.0005*	6.5	*<0.00005*	4.6	0.046	*<0.0001*	*<0.0005*	*<0.01*	0.00051	*<0.001*	*<0.01*
ABA144	KAM152716	CFR0591	30.5	32.0	Waste	Oxide	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.56	0.00062	*<0.00005*	0.0097	*<0.0005*	*<0.3*	9.3	*<0.0005*	4.3	*<0.00005*	0.56	0.042	*<0.0001*	*<0.0005*	*<0.01*	0.00011	*<0.001*	*<0.01*
ABA146	KAM153091	CFR0594	164.6	166.1	Waste	Oxide	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	0.011	4.7	0.00082	0.000065	0.064	*<0.0005*	*<0.3*	6.4	*<0.0005*	5.2	*<0.00005*	0.50	0.11	0.00013	*<0.0005*	*<0.01*	0.0034	*<0.001*	*<0.01*
ABA149	KAM153152	CFR0595	61.0	62.5	Waste	Oxide	Gneiss	MxF	*<0.001*	0.062	0.00013	*<0.005*	1.8	0.0023	*<0.00005*	0.0077	*<0.0005*	*<0.3*	5.3	*<0.0005*	5.3	*<0.00005*	12	0.049	*<0.0001*	*<0.0005*	*<0.01*	0.019	0.0023	*<0.01*
Statistical Summary						**Oxide**	**Gneiss**	**n**	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9
								Max	0.0044	5.7	0.010	0.011	4.7	0.15	0.00014	0.064	0.0016	*<0.3*	54	*<0.0005*	17	0.00010	12	0.11	0.00063	0.00050	0.12	0.019	0.0090	*<0.01*
								90th PCTL	0.0033	4.2	0.0098	0.0079	3.6	0.13	0.00014	0.022	0.0014	*<0.3*	21	*<0.0005*	13	0.000094	6.7	0.074	0.00029	*<0.0005*	0.092	0.0072	0.0056	*<0.01*
								75th PCTL	0.0018	3.2	0.0068	*<0.005*	1.8	0.096	0.000065	0.0097	0.0013	*<0.3*	9.3	*<0.0005*	12	*<0.00005*	4.6	0.049	0.00013	*<0.0005*	0.033	0.0036	0.0032	*<0.01*
								Median	*<0.001*	0.062	0.00013	*<0.005*	0.56	0.011	*<0.00005*	0.0091	*<0.0005*	*<0.3*	7.1	*<0.0005*	6.5	*<0.00005*	1.5	0.042	0.00012	*<0.0005*	*<0.01*	0.0018	0.0010	*<0.01*
								25th PCTL	*<0.001*	0.030	0.00010	*<0.005*	0.47	0.0023	*<0.00005*	0.0074	*<0.0005*	*<0.3*	5.3	*<0.0005*	5.2	*<0.00005*	0.69	0.0069	*<0.0001*	*<0.0005*	*<0.01*	0.00018	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.36	0.00078	*<0.00005*	0.0025	*<0.0005*	*<0.3*	2.8	*<0.0005*	4.1	*<0.00005*	0.55	0.0057	*<0.0001*	*<0.0005*	*<0.01*	0.00010	*<0.001*	*<0.01*
								Min	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.27	0.00062	*<0.00005*	0.0014	*<0.0005*	0.15	2.0	0.00025	3.0	0.000025	0.50	0.0055	*<0.0001*	0.00025	0.0050	0.000070	0.00050	0.0050
Upper Transition Facies for Gneiss Waste Rock																														
ABA016	KAM029087	CFD0175	145.0	146.0	Waste	Upper transition	Gneiss	MxF	0.00050	0.015	0.000050	0.0025	4.0	0.0054	0.000025	0.0058	0.00025	0.15	19	0.00025	5.2	0.000025	2.3	0.11	0.000050	0.00025	0.0050	0.000069	0.0046	0.0050
ABA059	KAM097012	CFD0272	17.0	18.0	Waste	Upper transition	Gneiss	FG	0.0053	4.7	0.023	0.0050	0.49	0.28	0.000025	0.015	0.0025	0.15	16	0.00050	18	0.000050	14	0.010	0.00027	0.0011	0.11	0.0032	0.015	0.010
ABA060	KAM097065	CFD0272	65.0	66.0	Waste	Upper transition	Gneiss	FG	0.00050	0.015	0.000050	0.0096	3.6	0.0087	0.000025	0.018	0.00025	0.15	51	0.00025	2.8	0.000025	2.6	0.14	0.00014	0.00025	0.0050	0.0030	0.00050	0.0050
ABA147	KAM152978	CFR0594	10.7	12.2	Waste	Upper transition	Gneiss	MxF	0.0052	1.6	0.0053	*<0.005*	0.38	0.039	*<0.00005*	0.0029	*<0.0005*	*<0.3*	10	*<0.0005*	14	*<0.00005*	8.6	0.018	*<0.0001*	0.00060	0.058	0.0074	0.0041	*<0.01*
ABA353	R304081	CFD0525	10.0	11.0	Waste	Upper Transition	Gneiss	MxF	0.0016	1.2	0.00028	*<0.005*	0.20	0.031	*<0.00005*	0.0011	0.0023	*<0.3*	1.5	*<0.0005*	5.2	*<0.00005*	0.62	0.0033	*<0.0001*	*<0.0005*	*<0.01*	0.00013	0.0017	*<0.01*
ABA367	R545582	CFD0524	56.0	57.0	Waste	Upper Transition	Gneiss	MxF	*<0.001*	0.047	*<0.0001*	*<0.005*	0.055	0.0020	0.0056	0.00093	*<0.0005*	*<0.3*	3.0	*<0.0005*	2.4	*<0.00005*	0.43	0.0031	0.00021	*<0.0005*	*<0.01*	0.00039	*<0.001*	*<0.01*
ABA411	R544193	CFD0502	40.0	41.0	Waste	Upper Transition	Gneiss	MxF	*<0.001*	0.24	*<0.0001*	*<0.005*	0.23	0.0086	0.0012	0.00015	*<0.0005*	*<0.3*	0.99	*<0.0005*	2.9	*<0.00005*	0.48	0.0043	*<0.0001*	*<0.0005*	*<0.01*	0.00018	*<0.001*	*<0.01*
Statistical Summary						**Upper Transition**	**Gneiss**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	0.0053	4.7	0.023	0.0096	4.0	0.28	0.0056	0.018	0.0025	*<0.3*	51	*<0.0005*	18	*<0.00005*	14	0.14	0.00027	0.0011	0.11	0.0074	0.015	*<0.01*
								90th PCTL	0.0052	2.8	0.012	0.0068	3.8	0.13	0.0029	0.017	0.0024	*<0.3*	32	*<0.0005*	16	*<0.00005*	11	0.12	0.00023	0.00080	0.079	0.0049	0.0089	*<0.01*
								75th PCTL	0.0034	1.4	0.0028	0.0050	2.0	0.035	0.00061	0.011	0.0014	*<0.3*	18	*<0.0005*	9.5	*<0.00005*	5.6	0.066	0.00018	0.00055	0.034	0.0031	0.0044	*<0.01*
								Median	*<0.001*	0.24	*<0.0001*	*<0.005*	0.38	0.0087	*<0.00005*	0.0029	*<0.0005*	0.30	10	*<0.0005*	5.2	*<0.00005*	2.3	0.010	*<0.0001*	*<0.0005*	*<0.01*	0.00039	0.0017	*<0.01*
								25th PCTL	0.00075	0.031	0.000075	*<0.005*	0.21	0.0070	0.000025	0.0010	*<0.0005*	0.15	2.2	0.00038	2.8	0.000038	0.55	0.0038	*<0.0001*	*<0.0005*	*<0.01*	0.00016	*<0.001*	0.0075
								10th PCTL	0.00050	0.015	0.000050	0.0040	0.14	0.0040	0.000025	0.00062	0.00025	0.15	1.3	0.00025	2.6	0.000025	0.46	0.0032	0.000080	0.00025	0.0050	0.00010	0.00080	0.0050
								Min	0.00050	0.015	0.000050	0.0025	0.055	0.0020	0.000025	0.00015	0.00025	0.15	0.99	0.00025	2.4	0.000025	0.43	0.0031	0.000050	0.00025	0.0050	0.000069	0.00050	0.0050
Lower Transition Facies for Gneiss Waste Rock																														
ABA019	KAM029649	CFD0177	73.0	74.0	Waste	Lower transition	Gneiss	MxM	0.0010	0.43	0.00049	0.0050	0.78	0.0061	0.000025	0.011	0.00050	0.15	42	0.00050	5.9	0.000050	47	0.0086	0.00010	0.00050	0.027	0.026	0.041	0.010
ABA058	KAM096948	CFD0270	230.0	231.0	Waste	Lower transition	Gneiss	MxF	0.00050	0.015	0.000050	0.0050	12	0.018	0.000025	0.012	0.00025	0.15	54	0.00025	1.7	0.000025	3.6	0.100	0.00014	0.00025	0.0050	0.0032	0.00050	0.0050
ABA067	KAM129499	CFD0332	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	*<0.001*	2.1	0.0035	*<0.005*	0.96	0.035	*<0.00005*	0.026	*<0.0005*	*<0.3*	13	0.0012	14	*<0.00005*	7.7	0.014	*<0.0001*	0.00099	0.092	0.0094	0.0071	*<0.01*
ABA070	KAM099512	CFD0338	10.0	11.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.4	0.00054	*<0.00005*	0.0049	*<0.0005*	*<0.3*	4.4	*<0.0005*	2.9	*<0.00005*	2.0	0.072	*<0.0001*	*<0.0005*	*<0.01*	0.0017	*<0.001*	*<0.01*
ABA073	KAM145537	CFD0339	111.0	112.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.95	0.00051	*<0.00005*	0.011	*<0.0005*	*<0.3*	6.2	0.0021	3.5	*<0.00005*	1.6	0.051	*<0.0001*	*<0.0005*	*<0.01*	0.011	0.0066	*<0.01*
ABA098	KAM137429	CFR0469	29.0	30.5	Waste	Lower transition	Gneiss	MxF	*<0.001*	0.16	0.00010	*<0.005*	0.31	0.0037	*<0.00005*	0.0012	*<0.0005*	*<0.3*	3.0	*<0.0005*	3.8	*<0.00005*	2.4	0.013	*<0.0001*	*<0.0005*	*<0.01*	0.00037	0.0019	*<0.01*
ABA106	KAM139356	CFR0482	89.9	91.4	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.1	*<0.0005*	*<0.00005*	0.0050	*<0.0005*	*<0.3*	6.1	*<0.0005*	3.6	*<0.00005*	2.5	0.020	*<0.0001*	*<0.0005*	*<0.01*	0.000038	0.0054	*<0.01*
ABA117	KAM122524	CFR0529	21.3	22.9	Waste	Lower transition	Gneiss	FG	*<0.001*	2.4	0.00020	*<0.005*	0.65	0.031	*<0.00005*	0.00090	0.0025	*<0.3*	1.1	*<0.0005*	12	*<0.00005*	1.9	0.0060	*<0.0001*	0.00067	0.043	0.00027	0.0063	*<0.01*
ABA142	KAM152462	CFR0589	25.9	27.4	Waste	Lower transition	Gneiss	MxF	*<0.001*	0.046	*<0.0001*	*<0.005*	1.7	0.0013	*<0.00005*	0.016	*<0.0005*	*<0.3*	7.2	*<0.0005*	3.6	*<0.00005*	1.1	0.11	*<0.0001*	*<0.0005*	*<0.01*	0.00082	0.0087	*<0.01*
ABA150	KAM153129	CFR0595	30.5	32.0	Waste	Lower transition	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.3	0.0014	*<0.00005*	0.0055	*<0.0005*	*<0.3*	6.4	*<0.0005*	3.3	*<0.00005*	2.1	0.038	*<0.0001*	*<0.0005*	*<0.01*	0.00012	0.0014	*<0.01*
ABA246	R273797	CFD0458	9.0	10.0	Waste	Lower transition	Gneiss	FG	*<0.001*	0.084	0.00011	*<0.005*	0.065	0.0072	0.0014	0.00061	*<0.0005*	*<0.3*	2.8	*<0.0005*	2.7	*<0.00005*	0.32	0.0034	0.00025	*<0.0005*	*<0.01*	0.00021	*<0.001*	*<0.01*
ABA247	R283019	CFD0484	33.0	34.0	Waste	Lower transition	Gneiss	FG	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.88	*<0.0005*	0.000065	0.0019	*<0.0005*	*<0.3*	3.7	*<0.0005*	4.6	*<0.00005*	2.4	0.019	*<0.0001*	*<0.0005*	*<0.01*	0.000046	*<0.001*	*<0.01*
ABA249	R273398	CFD0447	188.0	189.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	0.13	0.00011	*<0.005*	0.16	0.0036	*<0.00005*	0.0033	*<0.0005*	*<0.3*	0.73	*<0.0005*	4.0	*<0.00005*	4.8	0.013	*<0.0001*	*<0.0005*	*<0.01*	0.0013	*<0.001*	*<0.01*
ABA250	R279032	CFD0461	85.0	86.0	Waste	Lower transition	Gneiss	MxM	*<0.001*	0.071	0.00016	*<0.005*	0.25	0.0017	*<0.00005*	0.0044	*<0.0005*	*<0.3*	1.5	*<0.0005*	3.5	*<0.00005*	4.0	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.00052	*<0.001*	*<0.01*
ABA251	R274019	CFD0464	10.0	11.0	Waste	Lower transition	Gneiss	FG	*<0.001*	0.051	0.00045	*<0.005*	0.061	0.00055	*<0.00005*	0.0031	*<0.0005*	*<0.3*	2.9	*<0.0005*	2.0	*<0.00005*	0.39	0.0012	*<0.0001*	*<0.0005*	*<0.01*	0.00058	*<0.001*	*<0.01*
ABA252	R274341	CFD0467	80.0	81.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	0.058	0.00032	*<0.005*	1.7	0.0019	*<0.00005*	0.026	*<0.0005*	*<0.3*	2.1	*<0.0005*	2.6	*<0.00005*	1.6	0.027	*<0.0001*	*<0.0005*	*<0.01*	0.00078	*<0.001*	*<0.01*
ABA253	R282397	CFD0474	95.0	96.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.10	0.0069	*<0.00005*	0.00021	*<0.0005*	*<0.3*	1.7	*<0.0005*	1.4	*<0.00005*	0.44	0.0028	*<0.0001*	*<0.0005*	*<0.01*	0.00025	*<0.001*	*<0.01*
ABA254	R270666	CFD0404	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.0031	1.1	0.00087	*<0.005*	0.31	0.083	*<0.00005*	0.0030	*<0.0005*	*<0.3*	0.99	*<0.0005*	3.6	*<0.00005*	0.86	0.0060	*<0.0001*	*<0.0005*	0.015	0.0012	0.0020	*<0.01*
ABA255	R271756	CFD0424	62.0	63.0	Waste	Lower transition	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.0	*<0.0005*	*<0.00005*	0.0089	*<0.0005*	*<0.3*	4.7	*<0.0005*	2.9	*<0.00005*	1.6	0.024	*<0.0001*	*<0.0005*	*<0.01*	0.00021	0.0027	*<0.01*
ABA256	R271112	CFD0415	8.0	9.0	Waste	Lower transition	Gneiss	MxM	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
ABA257	R273315	CFD0447	115.0	116.0	Waste	Lower transition	Gneiss	FG	0.0031	2.4	0.0035	0.0050	12	0.083	0.0014	0.026	0.0025	*<0.3*	54	0.0021	14	0.000050	47	0.11	0.00025	0.00099	0.092	0.026	0.041	0.010
ABA258	R276507	CFD0409	12.0	13.0	Waste	Lower transition	Gneiss	MxM	0.0010	1.3	0.00057	0.0050	2.3	0.032	0.000053	0.018	0.00050	*<0.3*	18	0.00063	7.2	*<0.00005*	5.4	0.078	0.00011	0.00053	0.030	0.0097	0.0074	*<0.01*
ABA259	R280545	CFD0499	10.0	11.0	Waste	Lower transition	Gneiss	MxM	*<0.001*	0.14	0.00026	*<0.005*	1.4	0.0070	*<0.00005*	0.011	*<0.0005*	*<0.3*	6.3	*<0.0005*	3.9	*<0.00005*	3.0	0.032	*<0.0001*	*<0.0005*	0.010	0.0015	0.0059	*<0.01*
ABA260	R280565	CFD0499	28.0	29.0	Waste	Lower transition	Gneiss	MxM	*<0.001*	0.051	0.00010	*<0.005*	0.88	0.0019	*<0.00005*	0.0049	*<0.0005*	*<0.3*	3.7	*<0.0005*	3.5	*<0.00005*	2.0	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.00058	0.0014	*<0.01*
ABA261	R274115	CFD0464	95.0	96.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.28	0.00055	*<0.00005*	0.0025	*<0.0005*	*<0.3*	1.9	*<0.0005*	2.8	*<0.00005*	1.3	0.0073	*<0.0001*	*<0.0005*	*<0.01*	0.00023	*<0.001*	*<0.01*
ABA262	R274262	CFD0467	10.0	11.0	Waste	Lower transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.095	*<0.0005*	0.000045	0.00084	*<0.0005*	0.27	1.1	*<0.0005*	2.0	*<0.00005*	0.43	0.0032	*<0.0001*	*<0.0005*	*<0.01*	0.00011	*<0.001*	*<0.01*
ABA263	R282302	CFD0474	10.0	11.0	Waste	Lower transition	Gneiss	FG	0.00050	0.015	0.000050	*<0.005*	0.061	*<0.0005*	0.000025	0.00021	0.00025	0.15	0.73	0.00025	1.4	0.000025	0.32	0.0012	0.00010	0.00025	0.0050	0.000038	0.00050	0.0050
ABA264	R271435	CFD0420	9.0	10.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA265	R271165	CFD0415	55.0	56.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA267	R273694	CFD0456	97.0	98.0	Waste	Lower transition	Gneiss	MxM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA269	R279507	CFD0468	60.0	61.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA270	R272186	CFD0433	10.0	11.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA271	R283079	CFD0484	87.0	88.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA272	Q034772	CFD0473	86.0	87.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA273	R282171	CFD0439	30.0	31.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA274	R277372	CFD0423	10.0	11.0	Waste	Lower transition	Gneiss	MxM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
									mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ABA275	R283492	CFD0496	10.0	11.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA276	R273866	CFD0460	63.0	64.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA277	R273898	CFD0460	91.0	92.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA278	Q035773	CFD0491	9.0	10.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA279	Q035789	CFD0491	60.0	61.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA280	R271699	CFD0424	12.0	13.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA282	R282102	CFD0437	70.0	71.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA283	R273302	CFD0447	59.0	60.0	Waste	Lower transition	Gneiss	FG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA284	R273593	CFD0456	7.0	8.0	Waste	Lower transition	Gneiss	MxF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ABA338	R270835	CFD0406	32.0	33.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.4	0.00054	*<0.00005*	0.0049	*<0.0005*	*<0.3*	4.4	*<0.0005*	2.9	*<0.00005*	2.0	0.072	*<0.0001*	*<0.0005*	*<0.01*	0.0017	*<0.001*	*<0.01*
ABA340	R270686	CFD0404	27.0	28.0	Waste	Lower Transition	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.95	0.00051	*<0.00005*	0.011	*<0.0005*	*<0.3*	6.2	0.0021	3.5	*<0.00005*	1.6	0.051	*<0.0001*	*<0.0005*	*<0.01*	0.011	0.0066	*<0.01*
ABA342	R551085	CFD0563	10.0	11.0	Waste	Lower Transition	Gneiss	MxM	*<0.001*	0.16	0.00010	*<0.005*	0.31	0.0037	*<0.00005*	0.0012	*<0.0005*	*<0.3*	3.0	*<0.0005*	3.8	*<0.00005*	2.4	0.013	*<0.0001*	*<0.0005*	*<0.01*	0.00037	0.0019	*<0.01*
ABA344	R551131	CFD0563	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.1	*<0.0005*	*<0.00005*	0.0050	*<0.0005*	*<0.3*	6.1	*<0.0005*	3.6	*<0.00005*	2.5	0.020	*<0.0001*	*<0.0005*	*<0.01*	0.000038	0.0054	*<0.01*
ABA348	R304313	CFD0541	56.0	57.0	Waste	Lower Transition	Gneiss	MxM	*<0.001*	2.4	0.00020	*<0.005*	0.65	0.031	*<0.00005*	0.00090	0.0025	*<0.3*	1.1	*<0.0005*	12	*<0.00005*	1.9	0.0060	*<0.0001*	0.00067	0.043	0.00027	0.0063	*<0.01*
ABA361	R623933	CFD0555	102.0	103.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	0.046	*<0.0001*	*<0.005*	1.7	0.0013	*<0.00005*	0.016	*<0.0005*	*<0.3*	7.2	*<0.0005*	3.6	*<0.00005*	1.1	0.11	*<0.0001*	*<0.0005*	*<0.01*	0.00082	0.0087	*<0.01*
ABA362	R507027	CFD0555	185.0	186.0	Waste	Lower Transition	Gneiss	FG	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.3	0.0014	*<0.00005*	0.0055	*<0.0005*	*<0.3*	6.4	*<0.0005*	3.3	*<0.00005*	2.1	0.038	*<0.0001*	*<0.0005*	*<0.01*	0.00012	0.0014	*<0.01*
ABA363	R545397	CFD0520	20.0	21.0	Waste	Lower Transition	Gneiss	FG	*<0.001*	0.084	0.00011	*<0.005*	0.065	0.0072	0.0014	0.00061	*<0.0005*	*<0.3*	2.8	*<0.0005*	2.7	*<0.00005*	0.32	0.0034	0.00025	*<0.0005*	*<0.01*	0.00021	*<0.001*	*<0.01*
ABA369	R545644	CFD0526	81.0	82.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.88	*<0.0005*	0.000065	0.0019	*<0.0005*	*<0.3*	3.7	*<0.0005*	4.6	*<0.00005*	2.4	0.019	*<0.0001*	*<0.0005*	*<0.01*	0.000046	*<0.001*	*<0.01*
ABA395	R545811	CFD0529	58.0	59.0	Waste	Lower Transition	Gneiss	FG	*<0.001*	0.13	0.00011	*<0.005*	0.16	0.0036	*<0.00005*	0.0033	*<0.0005*	*<0.3*	0.73	*<0.0005*	4.0	*<0.00005*	4.8	0.013	*<0.0001*	*<0.0005*	*<0.01*	0.0013	*<0.001*	*<0.01*
ABA399	R543714	CFD0549	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	0.071	0.00016	*<0.005*	0.25	0.0017	*<0.00005*	0.0044	*<0.0005*	*<0.3*	1.5	*<0.0005*	3.5	*<0.00005*	4.0	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.00052	*<0.001*	*<0.01*
ABA400	R543741	CFD0549	53.0	54.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	0.051	0.00045	*<0.005*	0.061	0.00055	*<0.00005*	0.0031	*<0.0005*	*<0.3*	2.9	*<0.0005*	2.0	*<0.00005*	0.39	0.0012	*<0.0001*	*<0.0005*	*<0.01*	0.00058	*<0.001*	*<0.01*
ABA402	R544003	CFD0553	80.0	81.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	0.058	0.00032	*<0.005*	1.7	0.0019	*<0.00005*	0.026	*<0.0005*	*<0.3*	2.1	*<0.0005*	2.6	*<0.00005*	1.6	0.027	*<0.0001*	*<0.0005*	*<0.01*	0.00078	*<0.001*	*<0.01*
ABA405	R554003	CFD0501	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.10	0.0069	*<0.00005*	0.00021	*<0.0005*	*<0.3*	1.7	*<0.0005*	1.4	*<0.00005*	0.44	0.0028	*<0.0001*	*<0.0005*	*<0.01*	0.00025	*<0.001*	*<0.01*
ABA410	R544159	CFD0502	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	0.0031	1.1	0.00087	*<0.005*	0.31	0.083	*<0.00005*	0.0030	*<0.0005*	*<0.3*	0.99	*<0.0005*	3.6	*<0.00005*	0.86	0.0060	*<0.0001*	*<0.0005*	0.015	0.0012	0.0020	*<0.01*
ABA412	R544228	CFD0502	70.0	71.0	Waste	Lower Transition	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.0	*<0.0005*	*<0.00005*	0.0089	*<0.0005*	*<0.3*	4.7	*<0.0005*	2.9	*<0.00005*	1.6	0.024	*<0.0001*	*<0.0005*	*<0.01*	0.00021	0.0027	*<0.01*
Statistical Summary						**Lower Transition**	**Gneiss**	**n**	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
								Max	0.0031	2.4	0.0035	0.0050	12	0.083	0.0014	0.026	0.0025	*<0.3*	54	0.0021	14	0.000050	47	0.11	0.00025	0.00099	0.092	0.026	0.041	0.010
								90th PCTL	0.0010	1.3	0.00057	0.0050	2.3	0.032	0.000053	0.018	0.00050	*<0.3*	18	0.00063	7.2	*<0.00005*	5.4	0.078	0.00011	0.00053	0.030	0.0097	0.0074	*<0.01*
								75th PCTL	*<0.001*	0.14	0.00026	*<0.005*	1.4	0.0070	*<0.00005*	0.011	*<0.0005*	*<0.3*	6.3	*<0.0005*	3.9	*<0.00005*	3.0	0.032	*<0.0001*	*<0.0005*	0.010	0.0015	0.0059	*<0.01*
								Median	*<0.001*	0.051	0.00010	*<0.005*	0.88	0.0019	*<0.00005*	0.0049	*<0.0005*	*<0.3*	3.7	*<0.0005*	3.5	*<0.00005*	2.0	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.00058	0.0014	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.28	0.00055	*<0.00005*	0.0025	*<0.0005*	*<0.3*	1.9	*<0.0005*	2.8	*<0.00005*	1.3	0.0073	*<0.0001*	*<0.0005*	*<0.01*	0.00023	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.095	*<0.0005*	0.000045	0.00084	*<0.0005*	0.27	1.1	*<0.0005*	2.0	*<0.00005*	0.43	0.0032	*<0.0001*	*<0.0005*	*<0.01*	0.00011	*<0.001*	*<0.01*
								Min	0.00050	0.015	0.000050	*<0.005*	0.061	*<0.0005*	0.000025	0.00021	0.00025	0.15	0.73	0.00025	1.4	0.000025	0.32	0.0012	0.00010	0.00025	0.0050	0.000038	0.00050	0.0050
Fresh Facies for Gneiss Waste Rock																														
ABA065	KAM128393	CFD0326	25.0	26.0	Waste	Fresh	Gneiss	MxM	0.0066	3.1	0.0044	*<0.005*	1.2	0.15	0.000053	0.0086	0.0017	*<0.3*	3.8	*<0.0005*	14	*<0.00005*	3.2	0.014	*<0.0001*	0.00074	0.069	0.0026	0.0069	*<0.01*
ABA097	KAM137325	CFR0468	88.4	89.9	Waste	Fresh	Gneiss	MxM	*<0.001*	0.24	*<0.0001*	0.0068	1.6	0.0066	*<0.00005*	0.024	*<0.0005*	*<0.3*	6.2	0.00082	6.0	*<0.00005*	7.2	0.030	*<0.0001*	*<0.0005*	0.012	0.0015	0.0055	*<0.01*
ABA139	KAM152151	CFR0586	61.0	62.5	Waste	Fresh	Gneiss	MxF	0.0016	5.0	0.0039	*<0.005*	0.82	0.11	*<0.00005*	0.0047	*<0.0005*	*<0.3*	3.5	*<0.0005*	15	0.000052	8.0	0.014	*<0.0001*	0.0026	0.083	0.0036	0.0079	*<0.01*
ABA143	KAM152536	CFR0589	128.0	129.5	Waste	Fresh	Gneiss	FG	*<0.001*	*<0.03*	*<0.0001*	0.0056	2.1	0.0020	*<0.00005*	0.040	*<0.0005*	*<0.3*	7.0	*<0.0005*	3.0	*<0.00005*	12	0.11	*<0.0001*	*<0.0005*	*<0.01*	0.0053	*<0.001*	*<0.01*
ABA148	KAM153051	CFR0594	109.7	111.3	Waste	Fresh	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	0.0059	3.4	0.0030	*<0.00005*	0.045	*<0.0005*	*<0.3*	8.0	*<0.0005*	3.3	*<0.00005*	8.4	0.065	*<0.0001*	*<0.0005*	*<0.01*	0.059	*<0.001*	*<0.01*
ABA347	R304284	CFD0541	30.0	31.0	Waste	Fresh	Gneiss	FG	0.0027	0.63	0.0012	*<0.005*	0.30	0.015	*<0.00005*	0.0017	*<0.0005*	*<0.3*	2.9	*<0.0005*	6.5	*<0.00005*	2.4	0.0044	*<0.0001*	*<0.0005*	*<0.01*	0.00078	0.0016	*<0.01*
ABA350	R304041	CFD0539	10.0	11.0	Waste	Fresh	Gneiss	FG	0.0015	0.45	0.00051	*<0.005*	0.15	0.014	*<0.00005*	0.0010	*<0.0005*	*<0.3*	0.58	*<0.0005*	4.6	*<0.00005*	4.7	0.0018	*<0.0001*	*<0.0005*	*<0.01*	0.00097	0.0017	*<0.01*
ABA354	R304119	CFD0525	45.0	46.0	Waste	Fresh	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.93	0.00098	*<0.00005*	0.0058	*<0.0005*	*<0.3*	6.6	*<0.0005*	3.2	*<0.00005*	4.0	0.027	*<0.0001*	*<0.0005*	*<0.01*	0.00044	0.0035	*<0.01*
ABA356	R623617	CFD0548	10.0	11.0	Waste	Fresh	Gneiss	MxF	*<0.001*	0.28	0.00020	*<0.005*	0.23	0.021	0.000076	0.0026	*<0.0005*	*<0.3*	1.8	*<0.0005*	3.5	*<0.00005*	2.6	0.0024	*<0.0001*	*<0.0005*	0.012	0.000097	0.0031	*<0.01*
ABA358	R623742	CFD0548	120.0	121.0	Waste	Fresh	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.0	*<0.0005*	*<0.00005*	0.0031	*<0.0005*	*<0.3*	3.1	*<0.0005*	3.9	*<0.00005*	4.4	0.044	*<0.0001*	*<0.0005*	*<0.01*	0.0014	*<0.001*	*<0.01*
ABA365	R545443	CFD0520	60.0	61.0	Waste	Fresh	Gneiss	FG	*<0.001*	0.18	0.00039	*<0.005*	0.19	0.010	*<0.00005*	0.0060	*<0.0005*	*<0.3*	2.0	*<0.0005*	3.7	*<0.00005*	3.6	0.0055	*<0.0001*	*<0.0005*	*<0.01*	0.0012	*<0.001*	*<0.01*
ABA396	R545818	CFD0529	65.0	66.0	Waste	Fresh	Gneiss	MxF	*<0.001*	0.11	0.00012	*<0.005*	0.18	0.011	*<0.00005*	0.0055	*<0.0005*	*<0.3*	0.69	*<0.0005*	4.1	*<0.00005*	5.6	0.0082	*<0.0001*	*<0.0005*	*<0.01*	0.00041	0.0016	*<0.01*
ABA398	R543692	CFD0549	10.0	11.0	Waste	Fresh	Gneiss	FG	*<0.001*	0.17	0.00044	*<0.005*	0.14	0.0067	*<0.00005*	0.0028	*<0.0005*	*<0.3*	1.9	*<0.0005*	2.7	*<0.00005*	3.2	0.0033	*<0.0001*	*<0.0005*	*<0.01*	0.00077	*<0.001*	*<0.01*
ABA401	R543957	CFD0553	40.0	41.0	Waste	Fresh	Gneiss	MxF	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	3.0	0.0015	*<0.00005*	0.012	*<0.0005*	*<0.3*	6.9	*<0.0005*	2.6	*<0.00005*	2.8	0.034	*<0.0001*	*<0.0005*	*<0.01*	0.0016	0.0052	*<0.01*
ABA413	R276141	CFD0393	127.0	128.0	Waste	Fresh	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.7	0.00053	*<0.00005*	0.0059	*<0.0005*	*<0.3*	4.2	*<0.0005*	2.9	*<0.00005*	1.9	0.023	*<0.0001*	*<0.0005*	*<0.01*	0.000036	0.0022	*<0.01*
ABA414	R276153	CFD0393	170.0	171.0	Waste	Fresh	Gneiss	MxM	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.7	0.00055	*<0.00005*	0.0015	*<0.0005*	*<0.3*	2.6	*<0.0005*	3.2	*<0.00005*	2.4	0.031	*<0.0001*	*<0.0005*	*<0.01*	0.000036	0.0053	*<0.01*
Statistical Summary						**Fresh**	**Gneiss**	**n**	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16	16
								Max	0.0066	5.0	0.0044	0.0068	3.4	0.15	0.000076	0.045	0.0017	*<0.3*	8.0	0.00082	15	0.000052	12	0.11	*<0.0001*	0.0026	0.083	0.059	0.0079	*<0.01*
								90th PCTL	0.0022	1.9	0.0026	0.0058	2.8	0.066	0.000052	0.032	*<0.0005*	*<0.3*	6.9	*<0.0005*	10	*<0.00005*	8.2	0.054	*<0.0001*	0.00062	0.041	0.0045	0.0062	*<0.01*
								75th PCTL	0.0011	0.32	0.00046	*<0.005*	2.2	0.014	*<0.00005*	0.0095	*<0.0005*	*<0.3*	6.3	*<0.0005*	5.0	*<0.00005*	6.0	0.032	*<0.0001*	*<0.0005*	0.011	0.0018	0.0052	*<0.01*
								Median	*<0.001*	0.14	0.00011	*<0.005*	0.98	0.0066	*<0.00005*	0.0056	*<0.0005*	*<0.3*	3.3	*<0.0005*	3.6	*<0.00005*	3.8	0.018	*<0.0001*	*<0.0005*	*<0.01*	0.0011	0.0020	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.22	0.0013	*<0.00005*	0.0027	*<0.0005*	*<0.3*	1.9	*<0.0005*	3.1	*<0.00005*	2.7	0.0052	*<0.0001*	*<0.0005*	*<0.01*	0.00043	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.16	0.00054	*<0.00005*	0.0016	*<0.0005*	*<0.3*	1.2	*<0.0005*	2.8	*<0.00005*	2.4	0.0029	*<0.0001*	*<0.0005*	*<0.01*	0.000067	*<0.001*	*<0.01*
								Min	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.14	*<0.0005*	*<0.00005*	0.0010	*<0.0005*	*<0.3*	0.58	*<0.0005*	2.6	*<0.00005*	1.9	0.0018	*<0.0001*	*<0.0005*	*<0.01*	0.000036	*<0.001*	*<0.01*
Statistical Summary for Gneiss Waste Rock								**n**	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51	51
								n < DL	35	17	21	41	0	4	36	0	39	45	0	42	0	42	0	0	39	40	34	0	19	45
								Max	0.0066	5.7	0.023	0.011	12	0.28	0.0056	0.064	0.0025	0.30	54	0.0021	18	0.00010	47	0.14	0.00063	0.0026	0.12	0.059	0.041	0.010
								90th PCTL	0.0030	3.1	0.0044	0.0056	3.4	0.096	0.000076	0.024	0.0013	0.30	16	0.00050	14	0.000050	8.4	0.100	0.00014	0.00060	0.069	0.0074	0.0071	0.010
								75th PCTL	0.0010	0.44	0.00046	*<0.005*	1.8	0.020	0.000050	0.011	*<0.0005*	*<0.3*	7.1	*<0.0005*	5.9	*<0.00005*	4.7	0.043	*<0.0001*	*<0.0005*	0.011	0.0031	0.0050	*<0.01*
								Median	*<0.001*	0.062	0.00010	*<0.005*	0.82	0.0061	*<0.00005*	0.0055	*<0.0005*	*<0.3*	4.2	*<0.0005*	3.7	*<0.00005*	2.5	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.00078	0.0017	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.26	0.0014	*<0.00005*	0.0027	*<0.0005*	*<0.3*	2.1	*<0.0005*	2.9	*<0.00005*	1.5	0.0059	*<0.0001*	*<0.0005*	*<0.01*	0.00021	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.15	0.00053	0.000025	0.0010	0.00050	0.15	1.1	*<0.0005*	2.6	*<0.00005*	0.50	0.0033	*<0.0001*	*<0.0005*	*<0.01*	0.000070	*<0.001*	*<0.01*
								Min	0.00050	0.015	0.000050	0.0025	0.055	*<0.0005*	0.000025	0.00015	0.00025	0.15	0.58	0.00025	1.4	0.000025	0.32	0.0012	0.000050	0.00025	0.0050	0.000036	0.00050	0.0050

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
									mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Schist Waste Rock																														
ABA005	KAM022322	CFD0110	95.0	96.0	Waste	Oxide	Schist	RQM	0.0010	0.015	0.00010	0.047	79	0.065	0.000025	0.0073	0.00050	0.15	106	0.0022	2.8	0.000050	5.4	0.79	0.00092	0.00050	0.025	0.012	0.0010	0.010
ABA026	KAM037656	CFD0096	59.0	60.0	Waste	Oxide	Schist	BtS	0.0010	0.015	0.00010	0.025	56	0.044	0.000025	0.0096	0.00050	0.15	57	0.0011	2.6	0.000050	2.0	0.63	0.00021	0.00050	0.017	0.0092	0.0010	0.010
ABA074	KAM146948	CFD0345	60.0	61.0	Waste	Oxide	Schist	BtS_carb	*<0.001*	*<0.03*	*<0.0001*	0.0050	6.3	0.00075	*<0.00005*	0.0036	*<0.0005*	*<0.3*	17	*<0.0005*	3.6	*<0.00005*	1.2	0.087	*<0.0001*	*<0.0005*	*<0.01*	0.000054	*<0.001*	*<0.01*
ABA077	J957606	CFD0350	60.0	61.0	Waste	Oxide	Schist	BtS_carb	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.5	0.0017	0.0017	0.0063	*<0.0005*	*<0.3*	10	*<0.0005*	4.7	*<0.00005*	0.60	0.22	*<0.0001*	*<0.0005*	*<0.01*	0.000019	*<0.001*	*<0.01*
ABA125	KAM149844	CFR0566	10.7	12.2	Waste	Oxide	Schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.54	0.0021	*<0.00005*	0.0060	*<0.0005*	*<0.3*	6.2	*<0.0005*	5.6	*<0.00005*	0.52	0.047	*<0.0001*	*<0.0005*	*<0.01*	0.000079	*<0.001*	*<0.01*
ABA130	KAM150823	CFR0574	10.7	12.2	Waste	Oxide	Schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.76	0.00087	*<0.00005*	0.0064	*<0.0005*	*<0.3*	9.7	*<0.0005*	4.6	*<0.00005*	0.50	0.040	0.00054	*<0.0005*	*<0.01*	0.000072	*<0.001*	*<0.01*
ABA131	KAM150859	CFR0574	61.0	62.5	Waste	Oxide	Schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	4.3	0.0017	0.000071	0.014	*<0.0005*	*<0.3*	18	*<0.0005*	3.7	*<0.00005*	0.58	0.12	*<0.0001*	*<0.0005*	*<0.01*	0.00030	*<0.001*	*<0.01*
Statistical Summary						**Oxide**	**Schist**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	0.0010	*<0.03*	0.00010	0.047	79	0.065	0.0017	0.014	0.00050	*<0.3*	106	0.0022	5.6	0.000050	5.4	0.79	0.00092	0.00050	0.025	0.012	0.0010	0.010
								90th PCTL	0.0010	*<0.03*	0.00010	0.034	65	0.052	0.00071	0.011	0.00050	*<0.3*	77	0.0015	5.1	0.000050	3.3	0.69	0.00069	0.00050	0.020	0.010	0.0010	0.010
								75th PCTL	0.0010	*<0.03*	0.00010	0.015	31	0.023	0.000061	0.0084	0.00050	*<0.3*	38	0.00080	4.7	0.000050	1.6	0.42	0.00038	0.00050	0.014	0.0048	0.0010	0.010
								Median	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	4.3	0.0017	*<0.00005*	0.0064	*<0.0005*	*<0.3*	17	*<0.0005*	3.7	*<0.00005*	0.60	0.12	*<0.0001*	*<0.0005*	*<0.01*	0.000079	*<0.001*	*<0.01*
								25th PCTL	*<0.001*	0.023	*<0.0001*	*<0.005*	1.6	0.0013	*<0.00005*	0.0061	*<0.0005*	0.23	9.9	*<0.0005*	3.2	*<0.00005*	0.55	0.067	*<0.0001*	*<0.0005*	*<0.01*	0.000063	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	0.015	*<0.0001*	*<0.005*	0.67	0.00082	0.000025	0.0050	*<0.0005*	0.15	8.3	*<0.0005*	2.7	*<0.00005*	0.51	0.044	*<0.0001*	*<0.0005*	*<0.01*	0.000040	*<0.001*	*<0.01*
								Min	*<0.001*	0.015	*<0.0001*	*<0.005*	0.54	0.00075	0.000025	0.0036	*<0.0005*	0.15	6.2	*<0.0005*	2.6	*<0.00005*	0.50	0.040	*<0.0001*	*<0.0005*	*<0.01*	0.000019	*<0.001*	*<0.01*
Upper Transition Facies for Schist Waste Rock																														
ABA027	KAM037928	CFD0099	30	31	Waste	Upper transition	Schist	BtS_carb	0.00050	0.015	0.000050	0.0066	5.0	0.0042	0.00014	0.014	0.00025	0.15	38	0.00025	3.6	0.000025	2.6	0.14	0.000050	0.00025	0.0050	0.00016	0.0015	0.0050
ABA332	Q033589	CFD0407	32	33	Waste	Upper Transition	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	5.5	0.00080	*<0.00005*	0.0025	*<0.0005*	*<0.3*	3.2	*<0.0005*	2.5	*<0.00005*	9.9	0.079	*<0.0001*	*<0.0005*	*<0.01*	0.00035	*<0.001*	*<0.01*
Lower Transition Facies for Schist Waste Rock																														
ABA031	KAM039252	CFD0116	75	76	Waste	Lower transition	Schist	RQM	0.00050	0.015	0.000050	0.019	15	0.0076	0.000025	0.0096	0.00025	0.15	76	0.00025	2.6	0.000025	6.7	0.20	0.00015	0.00025	0.0050	0.00053	0.0044	0.0050
ABA038	KAM047995	CFD0135	153	154	Waste	Lower transition	Schist	BtS	0.00050	0.015	0.000050	0.021	8.9	0.0039	0.000025	0.017	0.00025	0.15	63	0.0011	3.7	0.000025	23	0.11	0.000050	0.00025	0.0050	0.0012	0.012	0.0050
ABA054	KAM081312	CFD0198	85	86	Waste	Lower transition	Schist	BtS	0.0037	4.6	0.0036	0.0050	0.60	0.072	0.000025	0.0094	0.0019	0.15	16	0.00050	25	0.000050	36	0.016	0.00010	0.00050	0.13	0.0041	0.021	0.010
ABA333	R277487	CFD0426	43	44	Waste	Lower Transition	schist	BtS	*<0.001*	1.5	0.00081	*<0.005*	0.41	0.038	0.00062	0.0075	0.00092	*<0.3*	1.6	*<0.0005*	6.6	*<0.00005*	1.3	0.0039	*<0.0001*	*<0.0005*	0.010	0.00059	0.0038	*<0.01*
ABA335	R550437	CFD0518	25	26	Waste	Lower Transition	schist	BtS	*<0.001*	0.33	0.00021	*<0.005*	0.74	0.013	0.000099	0.0064	0.00055	*<0.3*	2.1	*<0.0005*	4.6	*<0.00005*	2.0	0.029	*<0.0001*	*<0.0005*	0.013	0.000046	0.0011	*<0.01*
ABA336	R550471	CFD0518	55	56	Waste	Lower Transition	Schist	BtS_carb	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	8.8	0.0047	*<0.00005*	0.0043	*<0.0005*	*<0.3*	8.9	*<0.0005*	3.7	*<0.00005*	2.2	0.37	*<0.0001*	*<0.0005*	*<0.01*	0.00069	*<0.001*	*<0.01*
ABA337	R550494	CFD0518	75	75	Waste	Lower Transition	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.8	0.0011	*<0.00005*	0.0021	*<0.0005*	*<0.3*	4.4	*<0.0005*	3.7	*<0.00005*	2.4	0.81	*<0.0001*	*<0.0005*	*<0.01*	0.00020	0.0025	*<0.01*
ABA345	R551151	CFD0563	68	69	Waste	Lower Transition	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.1	0.00081	*<0.00005*	0.021	*<0.0005*	*<0.3*	4.3	*<0.0005*	4.4	*<0.00005*	2.5	0.061	*<0.0001*	*<0.0005*	*<0.01*	0.00033	0.0045	*<0.01*
Statistical Summary						**Lower Transition**	**Schist**	**n**	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
								Max	0.0037	4.6	0.0036	0.021	15	0.072	0.00062	0.021	0.0019	*<0.3*	76	0.0011	25	0.000050	36	0.81	0.00015	0.00050	0.13	0.0041	0.021	0.010
								90th PCTL	0.0018	2.4	0.0017	0.019	11	0.048	0.00025	0.018	0.0012	*<0.3*	67	0.00068	12	*<0.00005*	27	0.50	0.00012	*<0.0005*	0.048	0.0020	0.014	*<0.01*
								75th PCTL	0.0010	0.61	0.00036	0.0085	8.8	0.019	0.000062	0.011	0.00064	*<0.3*	27	0.00050	5.1	*<0.00005*	11	0.24	0.00010	*<0.0005*	0.011	0.00081	0.0063	*<0.01*
								Median	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.9	0.0061	*<0.00005*	0.0085	*<0.0005*	*<0.3*	6.6	*<0.0005*	4.1	*<0.00005*	2.4	0.085	*<0.0001*	*<0.0005*	*<0.01*	0.00056	0.0041	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.70	0.0032	0.000025	0.0058	0.00044	0.15	3.7	*<0.0005*	3.7	0.000044	2.1	0.025	*<0.0001*	0.00044	0.0088	0.00030	0.0022	0.0088
								10th PCTL	0.00050	0.015	0.000050	*<0.005*	0.54	0.0010	0.000025	0.0036	0.00025	0.15	1.9	0.00043	3.3	0.000025	1.8	0.012	0.000085	0.00025	0.0050	0.00015	0.0011	0.0050
								Min	0.00050	0.015	0.000050	*<0.005*	0.41	0.00081	0.000025	0.0021	0.00025	0.15	1.6	0.00025	2.6	0.000025	1.3	0.0039	0.000050	0.00025	0.0050	0.000046	*<0.001*	0.0050
Fresh Facies for Schist Waste Rock																														
ABA132	KAM150898	CFR0574	114.3	115.8	Waste	Fresh	Schist	BtS	*<0.001*	*<0.03*	*<0.0001*	0.0098	12	0.0074	*<0.00005*	0.065	*<0.0005*	*<0.3*	28	0.00073	2.7	*<0.00005*	4.6	0.22	*<0.0001*	*<0.0005*	*<0.01*	0.0080	*<0.001*	*<0.01*
ABA330	R276299	CFD0401	74.0	75.0	Waste	Fresh	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.4	0.0016	*<0.00005*	0.024	*<0.0005*	*<0.3*	3.7	*<0.0005*	3.1	*<0.00005*	1.7	0.025	*<0.0001*	*<0.0005*	*<0.01*	0.00027	*<0.001*	*<0.01*
ABA331	R276331	CFD0401	141.0	142.0	Waste	Fresh	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	3.3	0.00073	*<0.00005*	0.0056	*<0.0005*	*<0.3*	5.5	*<0.0005*	3.8	*<0.00005*	1.6	0.031	*<0.0001*	*<0.0005*	*<0.01*	0.000097	0.0046	*<0.01*
ABA415	R277001	CFD0398	49.0	50.0	Waste	Fresh	schist	BtS	*<0.001*	0.090	*<0.0001*	*<0.005*	0.75	0.0020	*<0.00005*	0.0030	*<0.0005*	*<0.3*	3.1	*<0.0005*	3.0	*<0.00005*	1.8	0.015	*<0.0001*	*<0.0005*	*<0.01*	0.000052	0.0033	*<0.01*
ABA416	R277017	CFD0398	64.0	65.0	Waste	Fresh	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.1	0.00073	*<0.00005*	0.0028	*<0.0005*	*<0.3*	3.1	*<0.0005*	2.2	*<0.00005*	2.0	0.017	*<0.0001*	*<0.0005*	*<0.01*	0.000078	0.0025	*<0.01*
ABA417	R277021	CFD0398	124.0	125.0	Waste	Fresh	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.5	*<0.0005*	*<0.00005*	0.0013	*<0.0005*	*<0.3*	3.7	*<0.0005*	2.9	*<0.00005*	2.2	0.020	*<0.0001*	*<0.0005*	*<0.01*	0.000032	0.0029	*<0.01*
ABA418	R277041	CFD0398	160.0	161.0	Waste	Fresh	schist	BtS	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.6	*<0.0005*	*<0.00005*	0.0040	*<0.0005*	*<0.3*	5.7	*<0.0005*	2.4	*<0.00005*	1.9	0.018	*<0.0001*	*<0.0005*	*<0.01*	0.000022	0.0038	*<0.01*
Statistical Summary						**Fresh**	**Schist**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	*<0.001*	0.090	*<0.0001*	0.0098	12	0.0074	*<0.00005*	0.065	*<0.0005*	*<0.3*	28	0.00073	3.8	*<0.00005*	4.6	0.22	*<0.0001*	*<0.0005*	*<0.01*	0.0080	0.0046	*<0.01*
								90th PCTL	*<0.001*	0.054	*<0.0001*	0.0069	6.6	0.0042	*<0.00005*	0.041	*<0.0005*	*<0.3*	15	0.00059	3.4	*<0.00005*	3.1	0.11	*<0.0001*	*<0.0005*	*<0.01*	0.0034	0.0041	*<0.01*
								75th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.4	0.0018	*<0.00005*	0.015	*<0.0005*	*<0.3*	5.6	*<0.0005*	3.0	*<0.00005*	2.1	0.028	*<0.0001*	*<0.0005*	*<0.01*	0.00018	0.0036	*<0.01*
								Median	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.5	0.00073	*<0.00005*	0.0040	*<0.0005*	*<0.3*	3.7	*<0.0005*	2.9	*<0.00005*	1.9	0.020	*<0.0001*	*<0.0005*	*<0.01*	0.000078	0.0029	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.3	0.00062	*<0.00005*	0.0029	*<0.0005*	*<0.3*	3.4	*<0.0005*	2.5	*<0.00005*	1.7	0.017	*<0.0001*	*<0.0005*	*<0.01*	0.000042	0.0018	*<0.01*
								10th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.97	*<0.0005*	*<0.00005*	0.0022	*<0.0005*	*<0.3*	3.1	*<0.0005*	2.3	*<0.00005*	1.6	0.016	*<0.0001*	*<0.0005*	*<0.01*	0.000028	*<0.001*	*<0.01*
								Min	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.75	*<0.0005*	*<0.00005*	0.0013	*<0.0005*	*<0.3*	3.1	*<0.0005*	2.2	*<0.00005*	1.6	0.015	*<0.0001*	*<0.0005*	*<0.01*	0.000022	*<0.001*	*<0.01*
Statistical Summary for Schist Waste Rock								**n**	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
								n < DL	18	15	16	16	0	2	14	0	16	18	0	17	0	18	0	0	17	18	16	0	9	18
								Max	0.0037	4.6	0.0036	0.047	79	0.072	0.0017	0.065	0.0019	0.30	106	0.0022	25	0.000050	36	0.81	0.00092	0.00050	0.13	0.012	0.021	0.010
								90th PCTL	0.0010	0.26	0.00018	0.020	14	0.042	0.00013	0.020	0.00054	0.30	61	0.00099	5.3	0.000050	8.9	0.55	0.00019	0.00050	0.016	0.0068	0.0046	0.010
								75th PCTL	*<0.001*	0.030	0.00010	0.0054	6.9	0.0074	0.000050	0.011	0.00050	*<0.3*	21	0.00050	4.4	*<0.00005*	3.1	0.20	0.00010	*<0.0005*	0.010	0.00061	0.0038	*<0.01*
								Median	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	2.3	0.0019	*<0.00005*	0.0064	*<0.0005*	*<0.3*	7.5	*<0.0005*	3.6	*<0.00005*	2.0	0.070	*<0.0001*	*<0.0005*	*<0.01*	0.00024	0.0013	*<0.01*
								25th PCTL	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.0	0.00081	*<0.00005*	0.0039	*<0.0005*	*<0.3*	3.7	*<0.0005*	2.8	*<0.00005*	1.5	0.024	*<0.0001*	*<0.0005*	*<0.01*	0.000068	*<0.001*	*<0.01*
								10th PCTL	0.00065	0.015	0.000065	*<0.005*	0.64	0.00073	0.000025	0.0026	0.00033	0.15	3.1	*<0.0005*	2.5	0.000033	0.59	0.016	*<0.0001*	0.00033	0.0065	0.000036	*<0.001*	0.0065
								Min	0.00050	0.015	0.000050	*<0.005*	0.41	*<0.0005*	0.000025	0.0013	0.00025	0.15	1.6	0.00025	2.2	0.000025	0.50	0.0039	0.000050	0.00025	0.0050	0.000019	*<0.001*	0.0050

Appendix C.1-2: Shake Flask Extraction Results for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
									mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Granite Waste Rock																														
ABA157	R305807	CFD0382	76	77	Waste	Oxide	Granite	GG	*<0.001*	0.29	0.00022	*<0.005*	*<0.05*	0.016	0.00024	0.00013	*<0.0005*	*<0.3*	2.9	*<0.0005*	12	*<0.00005*	0.93	0.0014	*<0.0001*	*<0.0005*	*<0.01*	0.00015	*<0.001*	*<0.01*
ABA158	R305808	CFD0382	79	80	Waste	Oxide	Granite	GG	*<0.001*	0.034	*<0.0001*	*<0.005*	0.056	0.0022	0.00017	*<0.0001*	*<0.0005*	*<0.3*	1.4	*<0.0005*	9.4	*<0.00005*	1.1	0.0023	*<0.0001*	*<0.0005*	*<0.01*	0.000046	*<0.001*	*<0.01*
ABA174	R305826	CFD0403	7.0	8.0	Waste	Oxide	Granite	GG	0.0032	8.5	0.017	*<0.005*	0.23	0.015	*0.00029*	0.00033	0.00060	*<0.3*	4.4	*<0.0005*	22	0.000080	2.1	0.015	0.0013	*<0.0005*	*<0.01*	0.0083	*<0.001*	*<0.01*
Upper Transition Facies for Granite Waste Rock																														
ABA013	KAM025898	CFD0150	81	82	Waste	Upper transition	Granite	GG	0.0010	2.3	0.0075	0.0050	0.28	0.044	0.000025	0.011	0.00050	0.15	7.7	0.00050	37	0.000050	9.1	0.0072	0.00023	0.00050	0.11	0.0073	0.0076	0.010
ABA151	R305801	CFD0381	13	14	Waste	Upper transition	Granite	GG	*<0.001*	6.1	0.013	0.027	0.71	0.48	*<0.00005*	0.0083	*<0.0005*	*<0.3*	9.6	*<0.0005*	24	0.000058	10	0.012	0.00021	*<0.0005*	0.24	0.012	0.010	0.024
ABA152	R305802	CFD0381	35	36	Waste	Upper transition	Granite	GG	0.0091	13	0.026	*<0.005*	1.2	0.36	0.000096	0.0048	0.00053	0.50	1.8	*<0.0005*	40	0.000065	12	0.030	0.00015	*<0.0005*	0.13	0.022	0.0061	0.066
ABA167	R305818	CFD0394	30	31	Waste	Upper transition	Granite	GG	*<0.001*	1.3	0.0022	*<0.005*	0.24	0.0086	0.00055	0.0038	*<0.0005*	*<0.3*	6.8	*<0.0005*	26	0.000082	1.4	0.0049	0.00018	*<0.0005*	*<0.01*	0.0044	*<0.001*	*<0.01*
ABA169	R305821	CFD0399	20	21	Waste	Upper transition	Granite	GG	*<0.001*	5.4	0.0065	*<0.005*	0.54	0.46	*<0.00005*	0.0030	0.00057	*<0.3*	10	*<0.0005*	24	0.000053	9.7	0.012	0.00011	*<0.0005*	0.024	0.0031	0.0030	0.011
ABA172	R305824	CFD0396	29	30	Waste	Upper transition	Granite	GG	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.064	0.0073	*<0.00005*	*<0.0001*	*<0.0005*	*<0.3*	0.89	*<0.0005*	8.7	*<0.00005*	1.2	0.0023	*<0.0001*	*<0.0005*	*<0.01*	0.000035	*<0.001*	*<0.01*
ABA178	R305831	CFD0400	11	12	Waste	Upper transition	Granite	GG	0.0029	4.1	0.027	*<0.005*	0.44	0.47	0.00015	0.0034	0.0015	*<0.3*	2.6	*<0.0005*	18	0.000067	6.5	0.0096	0.00012	*<0.0005*	0.097	0.013	0.0061	0.044
Statistical Summary						**Upper Transition**	**Granite**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	0.0091	13	0.027	0.027	1.2	0.48	0.00055	0.011	0.0015	0.50	10	0.00050	40	0.000082	12	0.030	0.00023	0.00050	0.24	0.022	0.010	0.066
								90th PCTL	0.0054	8.9	0.026	0.014	0.90	0.47	0.00031	0.0094	0.00094	0.38	9.9	0.00050	38	0.000073	11	0.019	0.00022	0.00050	0.17	0.016	0.0086	0.053
								75th PCTL	0.0020	5.8	0.019	0.0050	0.62	0.46	0.00012	0.0065	0.00055	*<0.3*	8.6	*<0.0005*	31	0.000066	9.8	0.012	0.00020	*<0.0005*	0.12	0.012	0.0069	0.034
								Median	*<0.001*	4.1	0.0075	*<0.005*	0.44	0.36	*<0.00005*	0.0038	0.00050	*<0.3*	6.8	*<0.0005*	24	0.000058	9.1	0.0096	0.00015	*<0.0005*	0.097	0.0073	0.0061	0.011
								25th PCTL	*<0.001*	1.8	0.0043	*<0.005*	0.26	0.026	*<0.00005*	0.0032	*<0.0005*	*<0.3*	2.2	*<0.0005*	21	0.000052	3.9	0.0060	0.00012	*<0.0005*	0.017	0.0038	0.0020	0.010
								10th PCTL	*<0.001*	0.79	0.0013	*<0.005*	0.17	0.0081	0.000040	0.0019	*<0.0005*	0.24	1.4	*<0.0005*	14	*<0.00005*	1.3	0.0038	0.00011	*<0.0005*	*<0.01*	0.0019	*<0.001*	*<0.01*
								Min	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.064	0.0073	0.000025	*<0.0001*	*<0.0005*	0.15	0.89	*<0.0005*	8.7	*<0.00005*	1.2	0.0023	*<0.0001*	*<0.0005*	*<0.01*	0.000035	*<0.001*	*<0.01*
Lower Transition Facies for Granite Waste Rock																														
ABA154	R305804	CFD0382	10	11	Waste	Lower transition	Granite	GG	*<0.001*	7.2	0.0075	0.023	0.70	0.32	*<0.00005*	0.0030	*<0.0005*	*<0.3*	8.8	*<0.0005*	24	0.000051	9.7	0.0098	0.00016	*<0.0005*	0.21	0.0062	0.0086	0.035
ABA155	R305805	CFD0382	50	51	Waste	Lower transition	Granite	GG	0.0029	4.3	0.0043	0.0089	0.75	0.20	0.00010	0.0067	0.00071	*<0.3*	4.3	*<0.0005*	29	0.00016	6.7	0.0080	0.00032	*<0.0005*	0.15	0.0051	0.0034	0.029
ABA159	R305809	CFD0383	10	11	Waste	Lower transition	Granite	GG	*<0.001*	6.6	0.0099	0.029	0.81	0.34	*<0.00005*	0.0023	*<0.0005*	*<0.3*	7.9	*<0.0005*	23	0.000065	8.9	0.011	0.00022	0.00052	0.32	0.016	0.017	0.022
ABA160	R305811	CFD0383	48	49	Waste	Lower transition	Granite	GG	*<0.001*	5.3	0.0078	0.030	0.89	0.35	*<0.00005*	0.00094	*<0.0005*	*<0.3*	10	*<0.0005*	22	0.000052	10	0.0098	0.00020	*<0.0005*	0.22	0.0100	0.0082	0.025
ABA164	R305815	CFD0389	10	11	Waste	Lower transition	Granite	GG	0.0018	6.7	0.015	0.011	0.65	0.34	*<0.00005*	0.012	*<0.0005*	*<0.3*	5.0	*<0.0005*	21	0.00011	7.8	0.012	0.00017	*<0.0005*	0.26	0.015	0.010	0.023
ABA166	R305817	CFD0389	45	46	Waste	Lower transition	Granite	GG	0.0048	18	0.0020	*<0.005*	0.42	0.13	0.000094	0.0012	0.00097	*<0.3*	2.7	*<0.0005*	17	0.000058	3.5	0.0087	*<0.0001*	*<0.0005*	0.022	0.017	0.0047	0.023
Statistical Summary						**Lower Transition**	**Granite**	**n**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	0.0048	18	0.015	0.030	0.89	0.35	0.00010	0.012	0.00097	*<0.3*	10	*<0.0005*	29	0.00016	10	0.012	0.00032	0.00052	0.32	0.017	0.017	0.035
								90th PCTL	0.0039	13	0.012	0.029	0.85	0.35	0.000097	0.0093	0.00084	*<0.3*	9.6	*<0.0005*	26	0.00013	10.0	0.011	0.00027	0.00051	0.29	0.016	0.014	0.032
								75th PCTL	0.0026	7.1	0.0094	0.027	0.80	0.34	0.000083	0.0058	0.00066	*<0.3*	8.6	*<0.0005*	24	0.00010	9.5	0.011	0.00022	*<0.0005*	0.25	0.016	0.0098	0.028
								Median	0.0014	6.6	0.0077	0.017	0.72	0.33	*<0.00005*	0.0027	*<0.0005*	*<0.3*	6.5	*<0.0005*	22	0.000062	8.3	0.0098	0.00019	*<0.0005*	0.21	0.012	0.0084	0.024
								25th PCTL	*<0.001*	5.6	0.0051	0.0093	0.66	0.23	*<0.00005*	0.0015	*<0.0005*	*<0.3*	4.5	*<0.0005*	21	0.000054	7.0	0.0090	0.00016	*<0.0005*	0.16	0.0071	0.0056	0.023
								10th PCTL	*<0.001*	4.8	0.0031	0.0070	0.53	0.16	*<0.00005*	0.0011	*<0.0005*	*<0.3*	3.5	*<0.0005*	19	0.000052	5.1	0.0083	0.00013	*<0.0005*	0.084	0.0057	0.0041	0.023
								Min	*<0.001*	4.3	0.0020	*<0.005*	0.42	0.13	*<0.00005*	0.00094	*<0.0005*	*<0.3*	2.7	*<0.0005*	17	0.000051	3.5	0.0080	*<0.0001*	*<0.0005*	0.022	0.0051	0.0034	0.022
Fresh Facies for Granite Waste Rock																														
ABA012	KAM025798	CFD0147	260	261	Waste	Fresh	Granite	GG	0.00050	0.015	0.000050	0.015	0.45	0.0059	0.000025	0.0014	0.00025	0.15	26	0.00025	6.1	0.000025	40	0.018	0.000050	0.00025	0.0050	0.0099	0.019	0.0050
ABA162	R305813	CFD0385	10	11	Waste	Fresh	Granite	GG	0.0059	5.6	0.013	0.022	0.68	0.46	*<0.00005*	0.0093	*<0.0005*	*<0.3*	7.7	*<0.0005*	18	0.000077	9.1	0.0095	0.00021	0.00071	0.25	0.017	0.015	0.030
ABA163	R305814	CFD0385	59	60	Waste	Fresh	Granite	GG	0.0035	2.9	0.0025	*<0.005*	0.35	0.074	*<0.00005*	0.00038	*<0.0005*	*<0.3*	3.0	*<0.0005*	23	*<0.00005*	4.3	0.0056	0.00018	0.00057	0.11	0.0030	0.0029	*<0.01*
ABA165	R305816	CFD0389	30	31	Waste	Fresh	Granite	GG	0.0013	5.8	0.010	0.0081	0.65	0.47	*<0.00005*	0.011	0.00052	*<0.3*	4.2	*<0.0005*	19	0.000056	7.5	0.010	0.00014	*<0.0005*	0.23	0.012	0.0096	0.038
ABA168	R305819	CFD0394	88	89	Waste	Fresh	Granite	GG	0.0011	3.6	0.0072	0.024	0.82	0.35	*<0.00005*	0.00073	*<0.0005*	*<0.3*	9.0	*<0.0005*	16	0.000058	9.0	0.0079	0.00022	0.00059	0.20	0.0036	0.014	0.030
ABA179	R305832	CFD0400	60	61	Waste	Fresh	Granite	GG	0.0034	5.8	0.0017	*<0.005*	0.16	0.031	*<0.00005*	0.0011	*<0.0005*	*<0.3*	3.4	*<0.0005*	19	*<0.00005*	5.5	0.0044	*<0.0001*	*<0.0005*	0.066	0.015	0.0023	*<0.01*
ABA439	Q041678	CFD0385	8.0	9.0	Waste	Fresh	Granite	GG	*<0.001*	0.29	0.00047	*<0.005*	0.13	0.026	*<0.00005*	0.0039	*<0.0005*	*<0.3*	1.5	*<0.0005*	2.8	*<0.00005*	2.0	0.0019	*<0.0001*	*<0.0005*	*<0.01*	0.0011	*<0.001*	*<0.01*
ABA441	Q032423	CFD0385	92	93	Waste	Fresh	Granite	GG	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.8	0.58	*<0.00005*	0.00014	0.0014	*<0.3*	2.6	*<0.0005*	3.6	*<0.00005*	1.8	0.017	*<0.0001*	*<0.0005*	*<0.01*	0.00013	*<0.001*	*<0.01*
Statistical Summary						**Fresh**	**Granite**	**n**	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
								Max	0.0059	5.8	0.013	0.024	1.8	0.58	*<0.00005*	0.011	0.0014	*<0.3*	26	*<0.0005*	23	0.000077	40	0.018	0.00022	0.00071	0.25	0.017	0.019	0.038
								90th PCTL	0.0042	5.8	0.011	0.023	1.1	0.51	*<0.00005*	0.0099	0.00077	*<0.3*	14	*<0.0005*	20	0.000064	18	0.018	0.00021	0.00063	0.24	0.015	0.016	0.032
								75th PCTL	0.0034	5.6	0.0080	0.017	0.71	0.46	*<0.00005*	0.0052	0.00051	*<0.3*	8.0	*<0.0005*	19	0.000057	9.0	0.012	0.00019	0.00058	0.21	0.013	0.014	0.030
								Median	0.0012	3.3	0.0021	0.0066	0.55	0.21	*<0.00005*	0.0013	*<0.0005*	*<0.3*	3.8	*<0.0005*	17	*<0.00005*	6.5	0.0087	0.00012	*<0.0005*	0.087	0.0068	0.0063	*<0.01*
								25th PCTL	*<0.001*	0.23	0.00038	*<0.005*	0.30	0.030	*<0.00005*	0.00064	*<0.0005*	*<0.3*	2.9	*<0.0005*	5.5	*<0.00005*	3.7	0.0053	*<0.0001*	*<0.0005*	*<0.01*	0.0025	0.0020	*<0.01*
								10th PCTL	0.00085	0.026	0.000085	*<0.005*	0.15	0.020	0.000043	0.00031	0.00043	0.26	2.3	0.00043	3.4	0.000043	2.0	0.0037	0.000085	0.00043	0.0085	0.00079	*<0.001*	0.0085
								Min	0.00050	0.015	0.000050	*<0.005*	0.13	0.0059	0.000025	0.00014	0.00025	0.15	1.5	0.00025	2.8	0.000025	1.8	0.0019	0.000050	0.00025	0.0050	0.00013	*<0.001*	0.0050
Statistical Summary for Granite Waste Rock								**n**	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
								n < DL	11	2	3	13	1	0	14	2	14	21	0	22	0	7	0	0	7	18	7	0	7	9
								Max	0.0091	18	0.027	0.030	1.8	0.58	0.00055	0.012	0.0015	0.50	26	0.00050	40	0.00016	40	0.030	0.0013	0.00071	0.32	0.022	0.019	0.066
								90th PCTL	0.0044	8.1	0.016	0.026	0.87	0.47	0.00022	0.010	0.00089	0.30	10	*<0.0005*	28	0.000081	10	0.017	0.00023	0.00056	0.25	0.017	0.015	0.037
								75th PCTL	0.0030	6.2	0.011	0.017	0.72	0.39	0.000097	0.0052	0.00054	*<0.3*	8.1	*<0.0005*	24	0.000066	9.3	0.012	0.00021	*<0.0005*	0.21	0.013	0.0098	0.029
								Median	0.0010	4.8	0.0068	*<0.005*	0.50	0.26	*<0.00005*	0.0027	*<0.0005*	*<0.3*	4.3	*<0.0005*	20	0.000055	7.1	0.0095	0.00016	*<0.0005*	0.10	0.0078	0.0054	0.017
								25th PCTL	*<0.001*	1.0	0.0014	*<0.005*	0.23	0.024	*<0.00005*	0.00064	*<0.0005*	*<0.3*	2.7	*<0.0005*	15	*<0.00005*	2.0	0.0054	*<0.0001*	*<0.0005*	*<0.01*	0.0031	*<0.001*	*<0.01*
								10th PCTL	*<0.001*	0.031	*<0.0001*	*<0.005*	0.084	0.0077	*<0.00005*	0.00013	*<0.0005*	*<0.3*	1.6	*<0.0005*	6.9	*<0.00005*	1.3	0.0023	*<0.0001*	*<0.0005*	*<0.01*	0.00013	*<0.001*	*<0.01*
								Min	0.00050	0.015	0.000050	*<0.005*	0.050	0.0022	0.000025	*<0.0001*	0.00025	0.15	0.89	0.00025	2.8	0.000025	0.93	0.0014	0.000050	0.00025	0.0050	0.000035	*<0.001*	0.0050
Oxide and Fresh Facies for Other Lithologies Waste Rock																														
ABA018	KAM029393	CFD0176	99	100	Waste	Oxide	Dykes	FC	0.00050	0.015	0.000050	0.0025	1.0	0.031	0.000025	0.0031	0.00025	0.15	21	0.00025	8.3	0.000025	1.2	0.035	0.00011	0.00025	0.0050	0.0000050	0.0035	0.0050
ABA056	KAM084551	CFD0237	181	182	Waste	Oxide	HU	HU	0.00050	0.015	0.000050	0.018	5.3	0.0051	0.000025	0.017	0.00079	0.15	60	0.00061	4.6	0.000025	10	0.15	0.00045	0.00025	0.0050	0.0017	0.0011	0.0050
ABA352	R304282	CFD0539	90	91	Waste	Fresh	IV	IV	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	1.0	0.0012	*<0.00005*	0.0040	*<0.0005*	*<0.3*	3.3	*<0.0005*	2.8	*<0.00005*	3.0	0.042	*<0.0001*	*<0.0005*	*<0.01*	0.000065	0.0040	*<0.01*

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Oxide Facies for Gneiss Waste Rock																															
ABA001	KAM000219	CFD0002	21.0	22.0	Waste	Oxide	Gneiss	FG	0.060	0.82	578	*<0.2*	*<10*	160	0.87	0.13	0.050	0.060	67	9.5	11	0.77	8.2	1.6	2.1	0.080	0.12	0.27	0.0070	0.23	37
ABA043	KAM050495	CFD0152	149.0	150.0	Waste	Oxide	Gneiss	MxF	0.010	1.0	48	*<0.2*	*<10*	30	0.51	0.070	0.70	*<0.01*	28	0.60	4.0	0.48	1.9	0.48	2.4	0.050	0.31	0.080	*<0.005*	0.27	15
ABA052	KAM079466	CFD0254	72.0	73.0	Waste	Oxide	Gneiss	MxF	0.010	0.56	11	*<0.2*	*<10*	50	0.39	0.26	0.80	0.010	78	2.0	5.0	0.20	0.60	1.0	2.5	0.090	0.23	*<0.01*	0.0080	0.17	40
ABA063	KAM125214	CFD0307	10.0	11.0	Waste	Oxide	Gneiss	MxF	0.030	0.85	175	*<0.2*	*<10*	120	0.40	0.68	0.12	0.010	97	5.8	8.0	1.3	4.5	1.8	4.5	0.11	0.24	0.010	0.014	0.53	54
ABA064	KAM125257	CFD0307	49.0	50.0	Waste	Oxide	Gneiss	MxF	0.17	0.60	114	*<0.2*	*<10*	70	0.53	0.16	0.070	0.010	56	1.4	5.0	0.58	1.9	0.63	1.9	0.060	0.41	0.080	*<0.005*	0.20	31
ABA080	KAM115505	CFR0360	25.9	27.4	Waste	Oxide	Gneiss	MxF	0.010	0.81	100	*<0.2*	*<10*	50	0.49	0.11	0.15	0.010	60	2.0	11	0.32	2.7	0.73	2.3	0.060	0.19	0.080	0.021	0.10	34
ABA081	KAM117096	CFR0384	22.9	24.4	Waste	Oxide	Gneiss	MxF	0.020	0.72	138	*<0.2*	*<10*	180	0.69	0.13	0.080	0.020	89	1.6	5.0	0.91	2.4	1.3	2.6	0.080	0.070	0.090	0.011	0.16	51
ABA083	KAM119516	CFR0418	19.8	21.3	Waste	Oxide	Gneiss	MxF	*<0.01*	0.44	14	*<0.2*	*<10*	40	0.41	0.060	0.13	*<0.01*	43	0.90	7.0	1.1	2.7	0.79	2.3	0.060	0.45	0.010	0.011	0.19	23
ABA085	KAM120107	CFR0425	15.2	16.8	Waste	Oxide	Gneiss	MxM	0.020	0.64	43	*<0.2*	*<10*	110	0.71	0.080	0.11	0.050	44	2.6	5.0	0.60	3.9	0.97	1.9	0.060	0.21	0.020	*<0.005*	0.26	24
ABA096	KAM137284	CFR0468	32.0	33.5	Waste	Oxide	Gneiss	MxF	0.24	1.1	44	*<0.2*	*<10*	150	0.55	2.1	0.25	0.020	106	4.2	14	1.4	9.5	1.8	5.5	0.080	0.21	0.040	0.015	0.62	49
ABA104	KAM139298	CFR0482	10.7	12.2	Waste	Oxide	Gneiss	MxF	0.020	0.77	256	*<0.2*	*<10*	120	1.1	0.15	0.030	0.020	88	1.8	8.0	0.38	12	1.1	2.5	0.070	0.080	0.33	0.0090	0.23	49
ABA136	KAM151967	CFR0584	109.7	111.3	Waste	Oxide	Gneiss	MxF	0.020	0.81	307	*<0.2*	*<10*	100	0.71	0.18	0.080	0.030	82	2.1	12	0.36	2.7	1.4	2.4	0.070	0.14	0.25	0.017	0.14	49
ABA137	KAM151932	CFR0584	61.0	62.5	Waste	Oxide	Gneiss	MxF	0.040	0.70	12	*<0.2*	*<10*	80	0.46	0.080	0.20	0.010	60	3.0	20	2.7	17	1.2	3.1	0.060	0.22	0.030	0.0080	0.32	34
ABA138	KAM152219	CFR0586	155.5	157.0	Waste	Oxide	Gneiss	MxF	0.030	0.55	48	*<0.2*	*<10*	90	0.55	0.10	0.14	0.030	88	1.6	14	0.45	4.9	1.2	1.8	0.070	0.18	0.040	0.0070	0.22	54
ABA144	KAM152716	CFR0591	30.5	32.0	Waste	Oxide	Gneiss	MxF	0.030	0.86	201	*<0.2*	*<10*	60	0.69	0.13	0.92	0.020	49	0.70	5.0	0.50	1.9	0.49	1.9	0.050	0.27	0.090	0.012	0.19	28
ABA145	KAM153015	CFR0594	61.0	62.5	Waste	Oxide	Gneiss	MxF	0.040	0.59	72	*<0.2*	*<10*	90	0.57	0.27	0.69	0.020	38	1.1	10	0.50	3.1	0.95	2.0	*<0.05*	0.30	0.14	0.031	0.17	22
ABA146	KAM153091	CFR0594	164.6	166.1	Waste	Oxide	Gneiss	MxF	0.030	1.1	2100	*<0.2*	*<10*	110	1.5	0.12	0.27	0.050	54	9.2	39	0.69	8.0	1.3	2.8	0.060	0.16	0.18	0.024	0.14	30
ABA149	KAM153152	CFR0595	61.0	62.5	Waste	Oxide	Gneiss	MxF	0.020	0.45	22	*<0.2*	*<10*	20	0.51	0.13	0.61	0.010	55	0.90	10	0.63	2.3	0.53	1.7	0.050	0.24	0.010	0.011	0.17	32
ABA224	R277421	CFD0423	53.0	54.0	Waste	Oxide	Gneiss	MxM	0.020	1.3	823	*<0.2*	*<10*	240	1.7	1.2	0.26	0.020	80	21	52	9.4	9.4	4.0	4.4	0.12	0.060	0.91	0.097	0.36	38
ABA225	R272412	CFD0436	9.0	10.0	Waste	Oxide	Gneiss	FG	0.040	1.1	35	*<0.2*	*<10*	90	1.2	0.070	0.050	*<0.01*	70	2.4	5.0	4.7	2.3	1.2	3.6	0.12	0.21	0.050	0.014	0.30	46
ABA226	R272445	CFD0436	38.0	39.0	Waste	Oxide	Gneiss	FG	0.030	1.9	103	*<0.2*	*<10*	160	1.8	0.10	0.18	0.030	67	13	114	5.6	13	2.5	5.0	0.14	0.24	0.060	0.022	0.84	39
ABA227	R272537	CFD0436	120.0	121.0	Waste	Oxide	Gneiss	MxF	0.040	0.57	53	*<0.2*	*<10*	70	0.69	0.36	0.060	0.030	86	1.4	5.0	1.0	2.0	1.2	2.3	0.11	0.16	0.040	0.018	0.25	44
ABA228	R271769	CFD0425	80.0	81.0	Waste	Oxide	Gneiss	MxF	0.010	0.46	2.7	*<0.2*	*<10*	40	0.34	0.060	0.61	0.010	68	1.7	8.0	1.0	2.4	0.87	2.7	0.080	0.38	*<0.01*	0.015	0.24	43
ABA229	R272589	CFD0436	166.0	167.0	Waste	Oxide	Gneiss	MxF	0.020	0.63	411	*<0.2*	*<10*	150	0.51	0.11	0.040	0.030	67	1.8	4.0	0.66	1.9	1.0	1.7	0.090	0.090	0.51	0.0070	0.21	39
ABA230	R280455	CFD0497	90.0	91.0	Waste	Oxide	Gneiss	MxM	0.020	0.33	23	*<0.2*	*<10*	220	0.57	0.10	0.72	0.010	37	1.0	8.0	0.58	4.2	0.92	1.6	0.10	0.47	0.020	*<0.005*	0.22	21
ABA231	R277177	CFD0421	47.0	48.0	Waste	Oxide	Gneiss	MxM	0.020	0.90	54	*<0.2*	*<10*	90	0.64	0.14	0.10	0.010	84	2.8	7.0	0.23	5.2	1.2	2.2	0.10	0.22	0.13	0.0080	0.22	46
ABA232	R277505	CFD0426	58.0	59.0	Waste	Oxide	Gneiss	MxM	0.010	0.38	40	*<0.2*	*<10*	70	0.37	0.10	0.020	0.010	35	1.6	4.0	0.090	5.3	0.51	1.1	*<0.05*	0.20	0.11	*<0.005*	0.10	20
ABA233	R277739	CFD0431	118.0	119.0	Waste	Oxide	Gneiss	MxF	0.050	0.82	154	*<0.2*	*<10*	130	0.91	0.14	0.020	0.030	95	1.8	6.0	0.29	2.0	1.2	2.2	0.10	0.17	0.21	*<0.005*	0.30	58
ABA234	R277403	CFD0423	37.0	38.0	Waste	Oxide	Gneiss	MxM	0.020	0.34	14	*<0.2*	*<10*	50	0.45	0.13	0.050	0.010	53	1.5	5.0	0.59	10	0.80	1.6	*<0.05*	0.30	0.010	*<0.005*	0.18	24
ABA235	R277137	CFD0421	11.0	12.0	Waste	Oxide	Gneiss	MxM	0.050	1.3	166	*<0.2*	*<10*	120	0.82	1.3	0.25	0.020	131	8.0	4.0	2.7	7.9	1.8	4.0	0.15	0.18	0.25	0.023	0.36	72
ABA380	KAM075906	CFD0216	90.0	91.0	Waste	Oxide	Gneiss	MxF	0.090	0.39	434	0.30	10	30	0.53	0.090	0.050	0.030	40	1.4	3.0	1.7	3.8	0.55	0.99	0.080	0.11	0.15	*<0.005*	0.19	22
ABA382	KAM067845	CFD0221	211.0	212.0	Waste	Oxide	Gneiss	FG	0.010	0.56	96	*<0.2*	*<10*	20	0.57	0.060	1.0	0.010	52	1.1	3.0	0.59	1.7	0.78	1.8	0.080	0.53	0.21	*<0.005*	0.17	30
ABA384	KAM068794	CFD0238	227.0	228.0	Waste	Oxide	Gneiss	FG	0.010	0.65	233	*<0.2*	*<10*	70	0.48	0.050	0.040	0.010	53	3.5	4.0	0.23	12	1.0	2.0	0.080	0.52	0.14	0.014	0.070	31
ABA393	KAM030104	CFR0109	50.9	52.4	Waste	Oxide	Gneiss	FG	0.070	0.48	1240	0.40	10	1280	0.58	0.23	0.060	0.030	68	1.4	5.0	0.74	3.1	1.1	1.7	0.080	0.12	0.61	0.016	0.16	42
Statistical Summary						**Oxide**	**Gneiss**	**n**	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
								Max	0.24	1.9	2100	0.40	10	1280	1.8	2.1	1.0	0.060	131	21	114	9.4	17	4.0	5.5	0.15	0.53	0.91	0.097	0.84	72
								90th PCTL	0.067	1.1	535	*0.20*	*10*	174	1.1	0.58	0.71	0.030	93	8.8	18	2.7	12	1.8	4.3	0.12	0.44	0.31	0.023	0.36	53
								75th PCTL	0.040	0.86	225	*0.20*	*10*	128	0.71	0.18	0.27	0.030	84	3.0	11	1.1	8.0	1.3	2.7	0.098	0.29	0.20	0.016	0.27	46
								Median	0.020	0.68	98	*0.20*	*10*	90	0.57	0.13	0.13	0.020	67	1.8	6.5	0.62	3.5	1.0	2.3	0.080	0.21	0.085	0.011	0.22	37
								25th PCTL	0.020	0.55	41	*0.20*	*10*	53	0.50	0.093	0.053	0.010	52	1.4	5.0	0.46	2.3	0.79	1.8	0.060	0.16	0.033	*0.0050*	0.17	29
								10th PCTL	0.010	0.41	14	*0.20*	*10*	33	0.40	0.063	0.040	0.010	38	0.93	4.0	0.25	1.9	0.54	1.6	0.050	0.096	0.010	*0.0050*	0.14	22
								Min	*0.010*	0.33	2.7	*0.20*	*10*	20	0.34	0.050	0.020	*0.010*	28	0.60	3.0	0.090	0.60	0.48	0.99	*0.050*	0.060	*0.010*	*0.0050*	0.070	15
Upper Transition Facies for Gneiss Waste Rock																															
ABA016	KAM029087	CFD0175	145.0	146.0	Waste	Upper transition	Gneiss	MxF	0.070	1.0	65	*<0.2*	*<10*	70	0.75	0.17	2.0	0.050	73	5.6	37	0.81	14	1.5	3.4	0.080	0.52	0.13	0.030	0.16	42
ABA042	KAM050492	CFD0152	146.0	147.0	Waste	Upper transition	Gneiss	MxF	0.010	0.73	40	*<0.2*	*<10*	50	0.48	0.020	1.1	0.020	40	0.40	3.0	0.38	1.6	0.43	1.5	0.050	0.23	0.050	*<0.005*	0.29	22
ABA057	KAM096548	CFD0269	33.0	34.0	Waste	Upper transition	Gneiss	FG	0.12	0.81	177	*<0.2*	*<10*	220	0.60	0.13	0.030	0.030	62	1.3	9.0	0.43	4.2	0.91	2.5	0.060	0.16	0.060	*<0.005*	0.36	38
ABA059	KAM097012	CFD0272	17.0	18.0	Waste	Upper transition	Gneiss	FG	0.040	0.87	56	*<0.2*	*<10*	140	0.95	0.040	0.060	0.030	76	2.6	6.0	1.1	5.9	1.0	3.1	0.060	0.24	0.040	0.0070	0.35	34
ABA060	KAM097065	CFD0272	65.0	66.0	Waste	Upper transition	Gneiss	FG	0.080	1.1	368	*<0.2*	10	130	0.79	0.33	1.2	0.040	62	1.7	4.0	0.74	4.8	1.0	2.7	0.070	0.22	0.58	0.011	0.29	38
ABA069	KAM145287	CFD0338	123.0	124.0	Waste	Upper transition	Gneiss	FG	0.070	0.53	1150	0.20	10	140	1.1	0.66	0.090	0.020	86	2.0	5.0	1.2	3.6	1.0	1.5	0.070	0.10	0.50	0.013	0.30	52
ABA101	KAM137634	CFR0470	109.7	111.3	Waste	Upper transition	Gneiss	MxF	0.070	0.73	100	*<0.2*	*<10*	110	0.66	0.55	0.83	0.050	105	4.5	13	2.0	4.8	2.0	3.9	0.090	0.30	0.10	0.030	0.19	57
ABA105	KAM139327	CFR0482	50.3	51.8	Waste	Upper transition	Gneiss	MxF	0.030	0.63	230	*<0.2*	*<10*	150	0.84	0.10	0.010	0.020	76	1.6	7.0	0.26	6.6	1.0	2.1	0.060	0.080	0.67	0.011	0.21	40
ABA141	KAM152499	CFR0589	77.7	79.3	Waste	Upper transition	Gneiss	MxF	0.010	0.85	18	*<0.2*	*<10*	80	0.67	0.070	0.87	0.010	67	4.2	13	1.6	3.1	1.3	3.2	0.060	0.40	0.010	0.0060	0.49	40
ABA147	KAM152978	CFR0594	10.7	12.2	Waste	Upper transition	Gneiss	MxF	0.050	0.36	3.7	*<0.2*	*<10*	40	0.35	0.16	0.77	0.020	42	0.60	8.0	0.16	5.4	0.32	1.2	*<0.05*	0.32	0.010	0.0050	0.25	24
ABA237	R270907	CFD0412	10.0	11.0	Waste	Upper transition	Gneiss	MxF	0.090	0.63	202	*<0.2*	*<10*	60	0.78	0.40	2.2	0.030	71	3.8	22	0.73	3.7	1.5	1.7	0.10	0.20	0.060	0.0060	0.25	42
ABA238	R280433	CFD0497	28.0	29.0	Waste	Upper transition	Gneiss	MxM	0.030	0.57	81	*<0.2*	*<10*	70	0.54	2.1	0.040	0.020	48	1.7	5.0	0.30	4.1	0.85	2.0	0.090	0.32	0.020	0.0050	0.21	22
ABA239	Q034712	CFD0473	7.0	8.0	Waste	Upper transition	Gneiss	FG	0.030	0.80	13	*<0.2*	*<10*	50	0.62	0.30	0.040	*<0.01*	46	1.2	7.0	0.17	3.7	0.50	2.2	0.10	0.40	0.020	0.021	0.19	26
ABA240	Q034807	CFD0473	117.0	118.0	Waste	Upper transition	Gneiss	FG	0.020	0.67	383	*<0.2*	*<10*	130	0.55	0.16	0.050	0.020	76	2.7	7.0	0.88	5.1	1.3	2.1	0.10	0.080	0.52	0.0080	0.21	46
ABA241	R272496	CFD0436	83.0	84.0	Waste	Upper transition	Gneiss	MxF	0.020	0.62	118	*<0.2*	*<10*	40	0.53	0.10	0.080	0.010	66	2.1	5.0	0.88	3.7	0.87	1.9	0.090	0.24	0.11	0.0090	0.17	39
ABA242	R270718	CFD0404	69.0	70.0	Waste	Upper transition	Gneiss	MxF	0.030	0.39	518	*<0.2*	*<10*	20	0.70	0.13	0.070	0.050	59	2.1	5.0	0.50	7.5	1.3	1.3	0.060	0.23	0.19	0.0090	0.10	36
ABA243	R271483	CFD0420	51.0	52.0	Waste	Upper transition	Gneiss	MxF	0.010	0.61	345	*<0.2*	*<10*	40	0.65	0.080	0.13	*<0.01*	52	12	3.0	2.9	13	0.87	2.2	0.070	0.14	0.79	0.0080	0.19	54
ABA244	R272865	CFD0441	40.0	41.0	Waste	Upper transition	Gneiss	MxF	0.090	1.1	1235	*<0.2*	*<10*	160	1.8	0.070	0.11	0.090	85	5.1	41	1.6	11	2.1	3.4	0.12	0.070	0.92	0.014	0.34	54
ABA245	R278947	CFD0461	10.0	11.0	Waste	Upper transition	Gneiss	MxM	0.060	0.79	1140	0.20	*<10*	110	0.78	0.46	0.10	0.070	124	4.6	13	0.92	7.8	1.9	2.9	0.12	0.15	2.1	0.030	0.19	63
ABA353	R304081	CFD0525	10.0	11.0	Waste	Upper Transition	Gneiss	MxF	0.15	2.4	252	*<0.2*	10	510	1.9	0.49	0.39	0.030	60	16	59	3.3	9.4	3.9	7.6	0.090	0.040	0.14	0.020	1.0	21
ABA367	R545582	CFD0524	56.0	57.0	Waste	Upper Transition	Gneiss	MxF	0.070	0.67	663	*<0.2*	*<10*	60	0.56	0.17	0.040	0.020	42	1.2	8.0	0.24	4.2	0.99	1.8	*<0.05*	0.13	2.1	0.0090	0.14	22
ABA373	R271332	CFD0417	58.0	59.0	Waste	Upper Transition	Gneiss	MxF	0.050	0.66	2110	*<0.2*	*<10*	170	0.55	0.040	0.040	0.020	72	1.6	5.0	0.79	2.8	1.1	2.1	0.060	0.050	5.2	0.012	0.17	40
ABA385	KAM068709	CFD0238	151.0	152.0	Waste	Upper Transition	Gneiss	MxF	0.090	0.57	217	*<0.2*	*<10*	40	0.56	0.10	0.040	0.030	41	0.80	6.0	0.31	4.5	0.72	1.4	0.070	0.39	1.9	*<0.005*	0.20	23
ABA386	KAM069164	CFD0242	220.5	221.0	Waste	Upper Transition	Gneiss	FG	0.020	0.55	720	0.20	*<10*	60	0.73	0.12	0.050	0.030	37	5.7	3.0	1.9	5.4	1.4	1.6	0.070	0.25	0.20	0.021	0.16	21
ABA407	R272624	CFD0438	17.0	18.0	Waste	Upper Transition	Gneiss	MxF	0.050	3.1	294	*<0.2*	*<10*	340	2.1	0.22	0.46	0.12	75	31	60	5.1	27	4.6	8.2	0.16	0.11	0.10	0.041	1.4	36
ABA411	R544193	CFD0502	40.0	41.0	Waste	Upper Transition	Gneiss	MxF	0.020	1.2	277	*<0.2*	*<10*	80	1.9	0.60	0.020	0.010	33	20	28	0.46	12	3.4	4.0	0.10	0.090	1.3	0.10	0.090	14
Statistical Summary						**Upper Transition**	**Gneiss**	**n**	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
								Max	0.15	3.1	2110	0.20	10	510	2.1	2.1	2.2	0.12	124	31	60	5.1	27	4.6	8.2	0.16	0.52	5.2	0.10	1.4	63
								90th PCTL	0.090	1.2	1145	0.20	10	195	1.8	0.58	1.1	0.060	85	14	39	2.4	12	2.7	3.9	0.11	0.40	2.0	0.030	0.43	54
								75th PCTL	0.070	0.87	484	*<0.2*	*<10*	140	0.83	0.38	0.69	0.038	75	5.0	13	1.5	7.7	1.5	3.2	0.098	0.29	0.76	0.021	0.30	42
								Median	0.050	0.70	241	*<0.2*	*<10*	80	0.69	0.16	0.085	0.025	64	2.4	7.0	0.80	5.0	1.0	2.1	0.070	0.21	0.17	0.010	0.21	38
								25th PCTL	0.023	0.61	85	*<0.2*	*<10*	53	0.56	0.10	0.040	0.020	47	1.6	5.0	0.39	3.8	0.88	1.7	0.060	0.10	0.060	0.0063	0.18	23
								10th PCTL	0.015	0.54	29	*<0.2*	*<10*	40	0.54	0.055	0.035	0.010	40	1.0	3.5	0.25	3.4	0.61	1.4	0.055	0.075	0.020	*<0.005*	0.15	21
								Min	0.010	0.36	3.7	*<0.2*	*<10*	20	0.35	0.020	0.010	*<0.01*	33	0.40	3.0	0.16	1.6	0.32	1.2	0.050	*<0.05*	0.010	*<0.005*	0.090	14

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Lower Transition Facies for Gneiss Waste Rock																															
ABA019	KAM029649	CFD0177	73.0	74.0	Waste	Lower transition	Gneiss	MxM	0.030	0.72	3.6	*<0.2*	*<10*	50	0.38	0.080	0.53	0.010	80	1.9	6.0	0.57	2.9	1.1	3.8	0.080	0.38	*<0.01*	0.0050	0.38	51
ABA020	KAM029658	CFD0177	81.0	82.0	Waste	Lower transition	Gneiss	MxM	0.040	2.0	2.6	*<0.2*	*<10*	140	0.80	0.090	3.1	0.030	53	14	77	1.8	12	2.8	7.0	0.090	0.26	*<0.01*	0.018	1.1	30
ABA047	KAM051446	CFD0166	13.0	14.0	Waste	Lower transition	Gneiss	MxM	0.010	1.8	2.7	*<0.2*	*<10*	170	0.40	0.050	1.1	0.010	18	12	43	0.63	2.8	2.4	6.6	0.12	0.090	*<0.01*	0.016	0.59	9.9
ABA051	KAM079117	CFD0251	51.0	52.0	Waste	Lower transition	Gneiss	MxF	0.030	1.3	13	*<0.2*	*<10*	60	0.69	0.48	1.2	0.020	95	4.0	6.0	0.73	2.6	2.0	4.3	0.10	0.26	0.020	0.013	0.27	54
ABA058	KAM096948	CFD0270	230.0	231.0	Waste	Lower transition	Gneiss	MxF	0.070	1.1	42	*<0.2*	*<10*	70	0.69	0.41	1.5	0.020	81	1.4	3.0	0.37	1.1	1.1	2.9	0.080	0.20	0.12	*<0.005*	0.31	50
ABA067	KAM129499	CFD0332	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	0.030	0.61	4.7	*<0.2*	*<10*	30	0.33	0.22	0.37	*<0.01*	66	1.7	6.0	0.54	3.0	0.91	3.5	0.060	0.24	0.010	*<0.005*	0.39	40
ABA070	KAM099512	CFD0338	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.010	0.58	14	*<0.2*	*<10*	60	0.70	0.20	0.030	*<0.01*	60	1.8	3.0	0.83	1.7	0.62	2.1	0.050	0.24	0.010	0.015	0.29	22
ABA073	KAM145537	CFD0339	111.0	112.0	Waste	Lower transition	Gneiss	MxF	0.020	0.54	8.8	*<0.2*	*<10*	280	0.42	0.14	0.42	*<0.01*	92	1.1	6.0	1.4	1.4	0.86	2.5	0.080	0.20	0.010	0.0070	0.36	54
ABA098	KAM137429	CFR0469	29.0	30.5	Waste	Lower transition	Gneiss	MxF	0.010	0.98	11	*<0.2*	*<10*	190	0.59	0.35	0.30	0.010	120	4.6	11	1.0	6.3	1.8	6.1	0.15	0.22	0.010	0.012	0.67	88
ABA106	KAM139356	CFR0482	89.9	91.4	Waste	Lower transition	Gneiss	MxF	0.030	1.6	37	*<0.2*	*<10*	360	1.2	0.22	1.1	0.010	62	14	46	3.8	17	2.3	4.4	0.070	0.18	0.050	0.013	0.98	34
ABA117	KAM122524	CFR0529	21.3	22.9	Waste	Lower transition	Gneiss	FG	*<0.01*	0.47	2.6	*<0.2*	*<10*	20	0.24	0.070	0.39	*<0.01*	55	0.90	9.0	0.35	2.0	0.55	2.4	0.070	0.26	*<0.01*	0.022	0.18	34
ABA142	KAM152462	CFR0589	25.9	27.4	Waste	Lower transition	Gneiss	MxF	0.020	0.67	6.5	*<0.2*	*<10*	30	0.59	0.090	0.52	*<0.01*	48	2.5	18	1.4	6.8	1.2	3.3	0.060	0.45	0.010	0.011	0.46	28
ABA150	KAM153129	CFR0595	30.5	32.0	Waste	Lower transition	Gneiss	MxM	0.040	1.8	13	*<0.2*	*<10*	130	0.74	0.40	3.1	0.020	39	11	67	5.7	4.9	2.8	6.1	0.11	0.080	0.010	0.028	1.1	19
ABA246	R273797	CFD0458	9.0	10.0	Waste	Lower transition	Gneiss	FG	0.010	0.81	35	*<0.2*	*<10*	80	0.66	0.060	0.65	0.030	67	2.2	5.0	0.70	1.8	1.3	2.8	0.11	0.53	0.070	0.016	0.26	40
ABA247	R283019	CFD0484	33.0	34.0	Waste	Lower transition	Gneiss	FG	0.040	1.2	69	*<0.2*	*<10*	130	1.2	0.22	0.36	0.030	55	11	56	4.7	19	2.2	3.4	0.060	0.13	0.040	0.028	0.51	24
ABA249	R273398	CFD0447	188.0	189.0	Waste	Lower transition	Gneiss	MxF	0.030	2.1	20	*<0.2*	*<10*	180	0.54	0.16	0.28	0.010	23	13	22	5.9	6.0	3.1	6.9	0.15	0.080	0.010	0.016	1.3	8.4
ABA250	R279032	CFD0461	85.0	86.0	Waste	Lower transition	Gneiss	MxM	0.030	1.3	152	*<0.2*	*<10*	110	0.64	1.0	1.4	0.060	61	11	22	2.0	9.2	2.5	4.4	0.14	0.34	0.010	0.0080	0.87	35
ABA251	R274019	CFD0464	10.0	11.0	Waste	Lower transition	Gneiss	FG	0.020	0.67	29	*<0.2*	*<10*	100	0.74	0.090	0.080	0.030	56	2.4	6.0	0.42	3.5	1.0	2.2	0.10	0.40	0.030	0.015	0.22	29
ABA252	R274341	CFD0467	80.0	81.0	Waste	Lower transition	Gneiss	MxF	0.010	0.35	9.9	*<0.2*	*<10*	80	0.43	0.31	0.030	0.010	51	1.3	7.0	0.48	3.0	0.76	1.5	0.090	0.49	*<0.01*	0.0090	0.18	23
ABA253	R282397	CFD0474	95.0	96.0	Waste	Lower transition	Gneiss	MxF	0.030	0.60	46	*<0.2*	*<10*	40	0.66	0.28	0.060	0.010	76	1.8	2.0	0.60	11	1.0	2.0	*<0.05*	0.29	0.060	0.062	0.13	20
ABA254	R270666	CFD0404	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.010	0.63	68	*<0.2*	*<10*	30	0.64	0.080	0.32	*<0.01*	41	4.4	22	2.1	5.1	1.4	3.5	0.080	0.39	0.020	*<0.005*	0.41	25
ABA255	R271756	CFD0424	62.0	63.0	Waste	Lower transition	Gneiss	MxM	0.010	0.67	20	*<0.2*	*<10*	70	0.51	0.060	0.15	0.030	87	2.1	5.0	0.30	3.0	1.3	2.1	0.11	0.24	0.010	0.010	0.17	51
ABA256	R271112	CFD0415	8.0	9.0	Waste	Lower transition	Gneiss	MxM	0.060	0.99	170	*<0.2*	*<10*	160	0.64	0.26	0.78	0.020	70	3.3	5.0	0.90	5.3	1.4	2.9	0.11	0.30	0.42	0.0090	0.49	43
ABA257	R273315	CFD0447	115.0	116.0	Waste	Lower transition	Gneiss	FG	0.020	0.67	25	*<0.2*	*<10*	180	0.66	0.070	0.28	*<0.01*	42	0.70	5.0	0.15	0.80	0.43	1.7	0.080	0.36	0.040	*<0.005*	0.23	23
ABA258	R276507	CFD0409	12.0	13.0	Waste	Lower transition	Gneiss	MxM	0.030	0.59	145	*<0.2*	*<10*	190	0.97	0.20	0.14	0.010	55	3.3	4.0	0.60	2.5	0.82	1.5	0.060	0.19	0.060	0.0060	0.34	30
ABA259	R280545	CFD0499	10.0	11.0	Waste	Lower transition	Gneiss	MxM	0.020	0.95	16	*<0.2*	*<10*	440	0.35	0.35	0.26	0.020	95	3.7	11	1.0	3.9	2.0	5.2	0.14	0.19	*<0.01*	0.017	0.65	47
ABA260	R280565	CFD0499	28.0	29.0	Waste	Lower transition	Gneiss	MxM	0.010	0.50	22	*<0.2*	*<10*	60	0.43	0.25	0.070	0.020	50	2.0	6.0	0.59	2.3	1.1	2.7	0.10	0.41	0.010	0.0080	0.29	24
ABA261	R274115	CFD0464	95.0	96.0	Waste	Lower transition	Gneiss	MxF	0.020	1.0	70	*<0.2*	*<10*	620	1.1	0.090	2.6	0.030	53	7.4	34	3.1	13	1.8	3.0	0.12	0.31	0.060	0.0090	0.61	31
ABA262	R274262	CFD0467	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.010	0.37	16	*<0.2*	*<10*	60	0.42	0.18	0.28	0.010	43	0.90	7.0	0.49	1.3	0.65	1.6	0.090	0.40	0.010	0.0070	0.25	24
ABA263	R282302	CFD0474	10.0	11.0	Waste	Lower transition	Gneiss	FG	0.050	1.3	90	*<0.2*	*<10*	70	0.81	0.070	0.020	0.020	61	1.1	5.0	0.24	2.0	0.82	3.1	0.050	0.14	0.11	0.0070	0.31	40
ABA264	R271435	CFD0420	9.0	10.0	Waste	Lower transition	Gneiss	MxF	0.020	0.51	166	*<0.2*	*<10*	60	0.83	0.070	0.11	0.010	79	4.4	13	2.9	4.8	1.2	2.3	0.070	0.27	0.060	*<0.005*	0.28	51
ABA265	R271165	CFD0415	55.0	56.0	Waste	Lower transition	Gneiss	MxF	0.020	0.57	4.8	*<0.2*	*<10*	60	0.36	0.21	0.45	0.010	93	1.6	6.0	1.6	1.3	1.7	3.4	0.11	0.21	0.010	0.018	0.32	57
ABA267	R273694	CFD0456	97.0	98.0	Waste	Lower transition	Gneiss	MxM	0.030	4.2	2.7	*<0.2*	*<10*	270	0.52	0.16	2.1	0.010	4.3	20	155	8.8	21	7.3	12	0.23	0.040	*<0.01*	0.030	2.2	2.1
ABA269	R279507	CFD0468	60.0	61.0	Waste	Lower transition	Gneiss	MxF	0.020	0.98	41	*<0.2*	*<10*	300	0.34	0.56	0.20	0.010	111	5.0	8.0	0.77	8.5	1.9	4.5	0.15	0.24	0.010	0.0070	0.62	59
ABA270	R272186	CFD0433	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.040	0.77	6.8	*<0.2*	*<10*	40	0.58	0.10	0.010	0.020	50	1.2	5.0	0.25	1.3	0.59	2.0	0.10	0.17	0.010	*<0.005*	0.28	31
ABA271	R283079	CFD0484	87.0	88.0	Waste	Lower transition	Gneiss	FG	0.010	0.86	13	*<0.2*	*<10*	90	0.64	0.060	0.23	0.020	84	6.1	18	3.0	7.4	1.6	2.7	0.070	0.19	0.010	0.014	0.49	49
ABA272	Q034772	CFD0473	86.0	87.0	Waste	Lower transition	Gneiss	MxF	0.020	1.3	42	*<0.2*	*<10*	160	0.87	0.10	0.53	0.030	76	14	23	4.2	17	2.5	4.4	0.13	0.14	*<0.01*	0.011	0.61	44
ABA273	R282171	CFD0439	30.0	31.0	Waste	Lower transition	Gneiss	MxF	0.020	0.97	56	*<0.2*	*<10*	100	0.95	0.070	0.030	0.020	95	2.1	4.0	2.1	2.6	1.2	2.9	0.12	0.11	0.070	0.0060	0.26	55
ABA274	R277372	CFD0423	10.0	11.0	Waste	Lower transition	Gneiss	MxM	0.010	0.43	4.2	*<0.2*	*<10*	50	0.26	0.25	0.13	0.030	54	4.1	6.0	0.83	5.3	0.79	2.3	0.050	0.18	0.010	0.0070	0.20	25
ABA275	R283492	CFD0496	10.0	11.0	Waste	Lower transition	Gneiss	MxF	0.020	0.93	27	*<0.2*	*<10*	200	0.34	0.47	0.21	*<0.01*	105	3.7	7.0	0.92	3.5	1.8	4.4	0.15	0.20	*<0.01*	0.012	0.59	62
ABA276	R273866	CFD0460	63.0	64.0	Waste	Lower transition	Gneiss	FG	0.010	0.81	17	*<0.2*	*<10*	40	0.65	0.19	0.76	0.010	58	4.4	18	1.6	4.2	1.7	3.4	0.11	0.53	*<0.01*	0.018	0.50	35
ABA277	R273898	CFD0460	91.0	92.0	Waste	Lower transition	Gneiss	MxF	0.020	1.2	16	*<0.2*	*<10*	200	0.60	0.15	2.6	0.020	98	8.1	5.0	0.66	14	2.5	4.5	0.15	0.45	*<0.01*	0.011	1.0	55
ABA278	Q035773	CFD0491	9.0	10.0	Waste	Lower transition	Gneiss	MxF	0.010	0.84	67	*<0.2*	*<10*	60	0.72	0.070	0.080	0.010	69	2.7	4.0	2.4	2.8	1.0	2.8	0.10	0.30	0.050	0.0050	0.32	43
ABA279	Q035789	CFD0491	60.0	61.0	Waste	Lower transition	Gneiss	MxF	0.080	1.5	190	*<0.2*	*<10*	70	0.71	0.52	0.060	0.090	74	1.7	3.0	0.78	22	0.97	3.9	0.10	0.21	0.13	0.074	0.14	41
ABA280	R271699	CFD0424	12.0	13.0	Waste	Lower transition	Gneiss	MxF	0.010	0.42	13	*<0.2*	*<10*	70	0.47	0.10	0.060	0.050	86	1.8	7.0	0.67	1.8	1.3	2.0	0.11	0.16	0.020	0.0090	0.26	50
ABA282	R282102	CFD0437	70.0	71.0	Waste	Lower transition	Gneiss	MxF	0.020	0.92	55	*<0.2*	*<10*	60	0.71	0.060	0.020	*<0.01*	44	1.2	4.0	0.19	4.1	0.49	2.0	0.10	0.26	0.070	*<0.005*	0.21	29
ABA283	R273302	CFD0447	59.0	60.0	Waste	Lower transition	Gneiss	FG	0.020	1.7	19	*<0.2*	*<10*	470	0.96	0.060	2.4	0.020	85	12	42	3.7	14	2.5	4.3	0.17	0.15	0.010	0.017	1.3	50
ABA284	R273593	CFD0456	7.0	8.0	Waste	Lower transition	Gneiss	MxF	0.010	1.8	17	*<0.2*	*<10*	300	0.62	0.080	0.21	0.010	46	11	50	2.7	4.0	2.5	5.3	0.13	0.17	0.040	0.017	1.1	20
ABA338	R270835	CFD0406	32.0	33.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.42	17	*<0.2*	*<10*	180	0.84	0.10	1.9	0.050	63	4.2	13	1.7	6.2	1.3	2.7	0.070	0.53	*<0.01*	0.015	0.27	38
ABA339	R270848	CFD0406	58.0	58.3	Waste	Lower Transition	Gneiss	MxF	0.010	0.57	8.3	*<0.2*	*<10*	30	0.42	0.25	0.97	*<0.01*	80	1.8	4.0	1.8	5.6	0.93	3.1	0.10	0.37	*<0.01*	0.052	0.19	49
ABA340	R270686	CFD0404	27.0	28.0	Waste	Lower Transition	Gneiss	MxM	0.020	1.9	16	*<0.2*	*<10*	230	1.2	0.030	1.4	0.020	21	21	97	2.8	26	2.6	4.6	0.10	0.14	0.010	0.0060	1.5	12
ABA341	R270737	CFD0404	85.0	86.0	Waste	Lower Transition	Gneiss	FG	0.050	0.58	8.5	*<0.2*	*<10*	90	0.84	0.16	1.3	0.040	63	6.9	37	1.3	6.8	1.5	2.3	0.070	0.44	*<0.01*	0.0070	0.35	39
ABA342	R551085	CFD0563	10.0	11.0	Waste	Lower Transition	Gneiss	MxM	0.010	0.73	11	*<0.2*	*<10*	70	0.36	0.36	0.78	*<0.01*	52	3.9	11	1.9	3.0	1.3	3.0	0.070	0.27	*<0.01*	0.010	0.48	27
ABA343	R551107	CFD0563	30.0	31.0	Waste	Lower Transition	Gneiss	MxM	0.020	1.9	5.3	*<0.2*	*<10*	250	0.70	0.21	3.6	0.040	15	22	122	1.9	5.3	2.6	6.1	0.14	0.080	*<0.01*	0.010	1.1	7.6
ABA344	R551131	CFD0563	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	0.010	2.2	2.6	*<0.2*	*<10*	430	0.81	0.050	2.3	0.020	12	17	96	2.6	6.7	3.1	6.0	0.12	0.080	*<0.01*	0.010	1.3	5.8
ABA348	R304313	CFD0541	56.0	57.0	Waste	Lower Transition	Gneiss	MxM	0.010	2.5	39	*<0.2*	*<10*	480	1.2	0.56	0.63	0.020	86	18	165	6.4	2.3	4.1	9.7	0.19	0.13	0.030	0.036	1.0	45
ABA360	R623829	CFD0555	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	0.010	0.40	13	*<0.2*	*<10*	120	0.32	0.15	0.060	0.010	47	1.6	8.0	0.38	1.3	1.1	1.8	0.050	0.42	*<0.01*	*<0.005*	0.25	26
ABA361	R623933	CFD0555	102.0	103.0	Waste	Lower Transition	Gneiss	MxF	0.020	1.6	16	*<0.2*	*<10*	1320	2.2	0.050	1.9	0.050	29	16	62	2.4	13	3.4	7.3	0.14	0.18	*<0.01*	0.018	1.4	15
ABA362	R507027	CFD0555	185.0	186.0	Waste	Lower Transition	Gneiss	FG	0.010	0.63	12	*<0.2*	*<10*	40	0.96	0.070	1.2	0.010	72	1.5	10	1.3	2.5	0.94	2.3	0.070	0.25	0.010	0.0090	0.27	43
ABA363	R545397	CFD0520	20.0	21.0	Waste	Lower Transition	Gneiss	FG	0.010	0.60	141	*<0.2*	*<10*	60	0.50	0.15	0.040	0.010	58	1.4	5.0	0.17	1.7	0.94	1.9	0.050	0.12	1.7	0.031	0.10	33
ABA364	R545422	CFD0520	41.0	42.0	Waste	Lower Transition	Gneiss	FG	0.020	0.60	51	*<0.2*	*<10*	60	0.56	0.30	0.020	0.010	54	1.4	4.0	0.12	3.5	0.67	1.6	0.050	0.11	0.68	0.014	0.15	29
ABA366	R545552	CFD0524	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	0.010	0.50	238	*<0.2*	*<10*	70	0.48	0.37	0.47	0.020	50	1.5	5.0	0.27	6.7	0.84	1.6	0.050	0.32	1.3	0.0060	0.13	29
ABA369	R545644	CFD0526	81.0	82.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.54	50	*<0.2*	*<10*	50	0.70	0.29	0.18	*<0.01*	45	1.2	5.0	0.73	3.6	0.78	1.9	0.050	0.38	0.52	0.011	0.17	24
ABA370	R545697	CFD0528	42.0	43.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.84	70	*<0.2*	*<10*	70	1.2	0.070	0.040	0.030	69	2.2	6.0	0.27	2.8	0.71	2.3	0.060	0.23	0.040	0.0070	0.20	42
ABA371	R271272	CFD0417	5.0	6.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.57	3.8	*<0.2*	*<10*	70	0.43	0.16	0.20	0.010	91	1.5	5.0	0.84	2.6	1.0	3.0	0.080	0.33	*<0.01*	0.010	0.37	53
ABA372	R271299	CFD0417	30.0	30.7	Waste	Lower Transition	Gneiss	MxF	0.060	0.88	332	*<0.2*	*<10*	100	0.81	0.50	0.060	0.020	87	1.6	3.0	1.2	1.3	0.92	2.7	0.070	0.060	0.84	0.0080	0.24	50
ABA376	R279575	CFD0468	120.0	121.0	Waste	Lower Transition	Gneiss	MxF	0.020	1.1	29	*<0.2*	*<10*	40	1.1	0.050	0.42	0.010	47	6.6	47	2.3	9.2	1.7	4.8	0.12	0.48	0.010	0.0060	0.72	28
ABA390	R278608	CFD0450	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	0.040	1.7	88	*<0.2*	*<10*	160	1.9	0.080	0.23	0.030	78	13	138	4.9	17	2.2	4.8	0.11	0.20	0.11	0.019	0.44	48
ABA391	R278677	CFD0450	71.0	72.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.65	128	*<0.2*	*<10*	70	0.60	0.090	0.020	0.020	50	1.8	4.0	0.21	3.1	0.72	2.0	0.070	0.12	0.090	*<0.005*	0.18	29
ABA392	R278725	CFD0450	114.0	114.3	Waste	Lower Transition	Gneiss	MxF	0.040	0.91	98	*<0.2*	*<10*	80	0.61	0.32	0.040	0.020	65	1.3	7.0	0.25	1.9	0.76	2.5	0.080	0.16	0.21	0.012	0.27	37
ABA395	R545811	CFD0529	58.0	59.0	Waste	Lower Transition	Gneiss	FG	0.020	0.34	21	*<0.2*	*<10*	40	0.48	0.14	0.10	*<0.01*	75	0.60	5.0	0.45	1.6	0.58	1.5	0.080	0.31	0.010	0.013	0.12	43
ABA399	R543714	CFD0549	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	0.010	0.27	11	*<0.2*	*<10*	30	0.45	0.090	0.28	*<0.01*	48	0.80	5.0	0.53	1.5	0.50	1.3	0.070	0.38	*<0.01*	0.0060	0.14	27
ABA400	R543741	CFD0549	53.0	54.0	Waste	Lower Transition	Gneiss	MxF	0.060	0.57	163	*<0.2*	*<10*	30	0.41	0.10	0.030	0.32	41	1.6	5.0	0.34	3.1	0.55	1.6	0.070	0.26	0.36	0.0050	0.21	23
ABA402	R544003	CFD0553	80.0	81.0	Waste	Lower Transition	Gneiss	MxF	0.040	0.37	27	*<0.2*	*<10*	40	0.64	0.10	0.25	0.040	64	1.4	6.0	0.76	3.7	1.0	1.7	0.090	0.46	0.020	*<0.005*	0.19	43
ABA405	R554003	CFD0501	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	0.020	0.70	56	*<0.2*	*<10*	50	0.68	0.060	0.020	0.010	53	1.0	3.0	0.41	2.7	0.61	1.6	0.070	0.13	0.10	0.0050	0.15	28
ABA406	R554039	CFD0501	42.0	43.0	Waste	Lower Transition	Gneiss	MxF	0.030	0.36	7.6	*<0.2*	*<10*	390	0.39	0.14	0.37	0.14	84	2.0	4.0	0.66	2.1	0.57	1.5	0.10	0.27	0.010	*<0.005*	0.25	47
ABA409	R272762	CFD0438	184.0	185.0	Waste	Lower Transition	Gneiss	FG	0.020	0.41	26	*<0.2*	*<10*	140	0.58	0.14	1.5	0.040	84	1.7	6.0	0.46	1.1	1.4	1.9	0.090	0.29	0.010	0.013	0.23	51
ABA410	R544159	CFD0502	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	0.060	1.5	214	*<0.2*	*<10*	150	1.3	0.14	0.16	0.030	73	10	8.0	2.4	19	2.1	4.3	0.13	0.15	0.050	0.022	0.76	40
ABA412	R544228	CFD0502	70.0	71.0	Waste	Lower Transition	Gneiss	MxF	0.030	1.4	19	*<0.2*	*<10*	70	1.8	0.21	2.2	0.040	76	11	44	2.7	14	2.1	4.6	0.13	0.39	0.010	0.026	1.0	41
Statistical Summary						**Lower Transition**	**Gneiss**	**n**	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
								Max	0.080	4.2	332	*<0.2*	*<10*	1320	2.2	1.0	3.6	0.32	120	22	165	8.8	26	7.3	12	0.23	0.53	1.7	0.074	2.2	88
								90th PCTL	0.042	1.8	146	*<0.2*	*<10*	312	1.2	0.40	2.1	0.040	92	14	63	3.8	15	2.6	6.1	0.14	0.44	0.15	0.026	1.1	53
								75th PCTL	0.030	1.3	56	*<0.2*	*<10*	180	0.81	0.25	1.0	0.030	80	7.8	22	2.2	6.8	2.1	4.4	0.12	0.35	0.060	0.016	0.62	48
								Median	0.020	0.81	20	*<0.2*	*<10*	80	0.64	0.14	0.28	0.020	62	2.4	7.0	0.84	3.5	1.2	2.9	0.090	0.24	0.010	0.010	0.32	35
								25th PCTL	0.010	0.57	11	*<0.2*	*<10*	60	0.46	0.080	0.080	0.010	50	1.6	5.0	0.49	2.3	0.83	2.0	0.070	0.16	*<0.01*	0.0060	0.23	26
								10th PCTL	0.010	0.42	4.6	*<0.2*	*<10*	40	0.36	0.060	0.030	*<0.01*	40	1.2	4.0	0.27	1.4	0.61	1.6	0.050	0.11	*<0.01*	*<0.005*	0.17	19
								Min	*<0.01*	0.27	2.6	*<0.2*	*<10*	20	0.24	0.030	0.010	*<0.01*	4.3	0.60	2.0	0.12	0.80	0.43	1.3

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag ppm	Al %	As ppm	Au ppm	B ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Ce ppm	Co ppm	Cr ppm	Cs ppm	Cu ppm	Fe %	Ga ppm	Ge ppm	Hf ppm	Hg ppm	In ppm	K %	La ppm
Fresh Facies for Gneiss Waste Rock																															
ABA065	KAM128393	CFD0326	25.0	26.0	Waste	Fresh	Gneiss	MxM	0.030	1.1	125	<0.2	<10	190	0.73	0.68	0.19	0.030	133	5.8	9.0	1.2	12	1.9	5.0	0.12	0.18	0.070	0.022	0.49	78
ABA066	KAM128504	CFD0326	75.0	76.0	Waste	Fresh	Gneiss	MxM	0.020	0.98	16	<0.2	<10	80	0.45	1.5	0.30	0.010	104	4.2	7.0	2.4	2.3	2.0	5.2	0.090	0.31	0.020	0.012	0.66	58
ABA071	KAM145241	CFD0338	81.0	82.0	Waste	Fresh	Gneiss	MxM	0.010	1.1	5.1	<0.2	<10	190	1.4	0.040	4.0	0.050	68	9.7	183	3.6	3.9	2.0	6.3	0.11	0.24	0.020	0.031	1.0	35
ABA097	KAM137325	CFR0468	88.4	89.9	Waste	Fresh	Gneiss	MxM	0.020	1.6	22	<0.2	<10	220	0.73	0.20	0.61	0.020	63	13	31	1.7	8.9	2.6	5.9	0.090	0.21	0.010	0.0070	1.2	38
ABA099	KAM137468	CFR0469	82.3	83.8	Waste	Fresh	Gneiss	MxM	0.030	1.9	30	<0.2	<10	290	0.50	1.1	3.2	0.030	29	18	366	1.5	9.5	2.5	6.8	0.10	0.13	0.010	0.019	1.2	16
ABA108	KAM139795	CFR0486	25.9	27.4	Waste	Fresh	Gneiss	MxM	0.010	0.97	19	<0.2	<10	160	0.48	1.1	0.12	0.010	96	6.0	10	1.4	4.1	1.5	4.5	0.10	0.26	0.040	0.020	0.57	55
ABA139	KAM152151	CFR0586	61.0	62.5	Waste	Fresh	Gneiss	MxF	0.010	0.59	20	<0.2	<10	40	0.53	0.090	0.19	0.010	72	1.4	13	1.8	2.8	0.88	3.2	0.080	0.35	0.020	0.020	0.26	43
ABA140	KAM152186	CFR0586	109.7	111.3	Waste	Fresh	Gneiss	MxF	0.020	0.40	3.8	<0.2	<10	30	0.40	0.23	0.43	<0.01	48	0.60	13	0.47	2.9	0.58	1.8	0.050	0.37	0.010	0.021	0.25	27
ABA143	KAM152536	CFR0589	128.0	129.5	Waste	Fresh	Gneiss	FG	0.030	0.55	99	<0.2	<10	110	0.61	0.42	1.5	0.010	62	0.80	11	0.68	2.6	0.81	2.2	0.060	0.14	0.020	0.046	0.18	37
ABA148	KAM153051	CFR0594	109.7	111.3	Waste	Fresh	Gneiss	MxF	0.010	0.66	245	<0.2	<10	40	0.79	0.17	0.74	0.020	63	1.7	11	1.2	2.7	0.85	2.5	0.060	0.36	0.050	0.014	0.23	38
ABA285	R277457	CFD0426	16.0	17.0	Waste	Fresh	Gneiss	MxM	0.040	1.3	4.7	<0.2	<10	170	0.32	0.18	1.2	0.030	28	17	93	0.87	20	2.3	4.5	0.090	0.15	<0.01	0.0070	0.68	16
ABA286	R279452	CFD0468	11.0	12.0	Waste	Fresh	Gneiss	MxF	0.020	1.1	16	<0.2	<10	230	0.50	0.98	0.15	0.010	112	5.0	6.0	0.72	9.3	1.8	4.2	0.15	0.23	<0.01	0.015	0.73	54
ABA287	R274861	CFD0472	100.0	101.0	Waste	Fresh	Gneiss	MxM	0.030	1.1	7.4	<0.2	<10	120	0.37	0.24	1.3	0.010	42	11	33	0.86	19	2.0	3.1	0.060	0.17	<0.01	0.012	0.77	26
ABA288	R283657	CFD0498	82.0	83.0	Waste	Fresh	Gneiss	MxM	0.11	0.97	6.1	<0.2	<10	110	0.36	1.5	0.10	0.010	67	4.2	5.0	0.95	4.3	1.7	3.6	0.13	0.29	<0.01	0.011	0.68	34
ABA289	Q035925	CFD0495	94.0	95.0	Waste	Fresh	Gneiss	MxM	0.090	1.4	2.6	<0.2	<10	100	0.65	1.1	0.76	0.060	108	6.4	6.0	0.96	16	1.9	5.9	0.15	0.31	<0.01	0.013	0.79	65
ABA290	R272262	CFD0433	123.0	124.0	Waste	Fresh	Gneiss	MxF	0.020	0.56	23	<0.2	<10	90	0.57	0.13	0.080	0.020	89	1.8	6.0	0.80	2.2	1.3	2.4	0.11	0.24	0.020	0.0070	0.31	51
ABA293	R276133	CFD0393	45.0	46.0	Waste	Fresh	Gneiss	MxM	0.030	2.3	2.0	<0.2	<10	560	0.62	1.6	3.0	0.020	17	20	147	2.4	4.4	3.0	7.2	0.12	0.080	<0.01	0.012	1.2	8.2
ABA294	R276236	CFD0401	18.0	19.0	Waste	Fresh	Gneiss	MxM	0.080	1.9	2.3	<0.2	<10	470	0.48	8.4	2.2	0.050	9.8	19	86	1.8	8.3	2.6	4.7	0.090	0.060	0.010	0.011	0.97	5.1
ABA295	R271028	CFD0412	117.0	118.0	Waste	Fresh	Gneiss	MxF	0.010	0.48	26	<0.2	<10	140	0.51	0.070	0.54	0.030	86	1.4	5.0	0.65	2.2	1.3	2.3	0.12	0.30	<0.01	0.0080	0.30	52
ABA297	R279539	CFD0468	89.0	90.0	Waste	Fresh	Gneiss	MxF	0.010	1.4	8.9	<0.2	<10	120	0.47	0.21	1.5	0.010	58	5.0	35	1.6	3.3	1.9	4.5	0.11	0.37	<0.01	0.010	0.94	34
ABA298	R275689	CFD0495	57.0	58.0	Waste	Fresh	Gneiss	MxM	0.020	2.1	5.5	<0.2	<10	380	0.44	0.36	2.4	0.010	15	18	114	1.4	4.8	2.6	6.0	0.21	0.11	<0.01	0.016	1.1	7.3
ABA299	R272239	CFD0433	57.0	58.0	Waste	Fresh	Gneiss	MxF	0.020	0.41	14	<0.2	<10	60	0.49	0.070	0.80	0.030	56	1.5	5.0	0.53	4.5	0.97	1.9	0.10	0.28	0.010	0.0060	0.29	34
ABA300	R278428	CFD0445	118.0	119.0	Waste	Fresh	Gneiss	MxF	0.010	0.66	2.1	<0.2	<10	70	0.42	0.10	0.40	0.010	94	1.4	7.0	1.3	1.8	1.1	3.1	0.13	0.20	<0.01	0.012	0.40	55
ABA301	R273296	CFD0447	10.0	11.0	Waste	Fresh	Gneiss	FG	0.020	0.54	2.0	<0.2	<10	60	0.36	0.040	0.38	0.010	92	1.5	8.0	0.52	2.9	1.1	2.8	0.12	0.21	<0.01	0.0050	0.32	56
ABA302	R270935	CFD0412	35.0	36.0	Waste	Fresh	Gneiss	MxF	0.010	2.1	18	<0.2	<10	180	0.63	0.020	1.4	0.020	39	15	61	2.4	16	2.9	5.3	0.16	0.23	<0.01	0.0090	1.6	23
ABA346	R277538	CFD0426	87.0	88.0	Waste	Fresh	Gneiss	MxM	0.020	1.5	25	<0.2	<10	310	0.40	0.060	0.64	<0.01	20	16	63	1.9	29	2.5	5.1	0.10	0.080	<0.01	0.0080	0.83	10
ABA347	R304284	CFD0541	30.0	31.0	Waste	Fresh	Gneiss	FG	0.010	0.22	4.7	<0.2	<10	30	0.37	0.060	0.050	<0.01	48	2.2	7.0	0.24	5.6	0.44	0.88	0.050	0.25	<0.01	<0.005	0.13	28
ABA350	R304041	CFD0539	10.0	11.0	Waste	Fresh	Gneiss	FG	0.010	0.35	4.5	<0.2	<10	40	0.42	0.080	0.050	<0.01	51	1.1	6.0	0.18	4.1	0.68	1.7	0.050	0.22	<0.01	0.0060	0.17	26
ABA351	R304231	CFD0539	45.0	46.0	Waste	Fresh	Gneiss	MxM	0.030	2.3	8.5	<0.2	<10	330	0.47	0.12	0.34	0.010	52	15	66	1.9	7.8	3.3	6.8	0.10	0.030	<0.01	0.013	0.99	26
ABA354	R304119	CFD0525	45.0	46.0	Waste	Fresh	Gneiss	MxM	0.010	2.0	5.3	<0.2	<10	170	0.38	0.11	0.69	0.010	56	14	51	1.7	13	3.2	6.4	0.10	0.040	<0.01	0.013	0.87	29
ABA355	R304173	CFD0525	91.0	92.0	Waste	Fresh	Gneiss	FG	0.010	0.34	3.6	<0.2	<10	10	0.30	0.14	0.29	<0.01	43	1.2	9.0	0.30	2.6	0.61	1.8	0.060	0.29	<0.01	0.011	0.090	24
ABA356	R623617	CFD0548	10.0	11.0	Waste	Fresh	Gneiss	MxF	0.010	1.2	6.1	<0.2	<10	250	0.52	0.18	0.26	0.010	35	8.1	12	1.2	5.8	1.7	4.1	0.060	0.060	0.010	0.0070	0.82	18
ABA357	R623685	CFD0548	70.0	71.0	Waste	Fresh	Gneiss	MxF	0.010	1.2	6.1	<0.2	<10	60	0.80	0.030	0.99	0.010	57	8.2	48	1.4	8.5	1.8	4.5	0.090	0.37	<0.01	0.0080	0.80	33
ABA358	R623742	CFD0548	120.0	121.0	Waste	Fresh	Gneiss	MxF	0.030	0.40	6.2	<0.2	<10	670	0.40	0.090	0.87	0.010	40	1.3	7.0	0.20	3.5	0.99	1.6	<0.05	0.48	<0.01	<0.005	0.20	23
ABA365	R545443	CFD0520	60.0	61.0	Waste	Fresh	Gneiss	FG	0.020	0.47	2.4	<0.2	<10	80	0.35	0.69	0.12	<0.01	91	1.5	5.0	1.1	2.5	1.0	3.0	0.090	0.26	<0.01	0.0090	0.28	59
ABA374	R271368	CFD0417	91.0	92.0	Waste	Fresh	Gneiss	FG	0.020	0.52	4.2	<0.2	<10	60	0.45	0.050	0.42	0.010	93	2.4	6.0	2.4	5.6	1.3	4.0	0.12	0.39	<0.01	0.011	0.35	57
ABA378	R279593	CFD0468	135.0	136.0	Waste	Fresh	Gneiss	MxF	0.010	1.9	5.5	<0.2	<10	240	0.47	0.040	1.9	0.010	62	9.3	10	1.9	1.9	2.7	6.1	0.12	0.14	<0.01	0.012	1.3	36
ABA379	R279615	CFD0468	155.0	155.7	Waste	Fresh	Gneiss	MxF	0.040	2.2	7.9	<0.2	<10	390	0.48	0.51	1.1	0.010	49	15	45	2.0	16	3.2	7.1	0.18	0.090	<0.01	0.014	1.2	27
ABA381	R511981	CFR0700	48.8	49.4	Waste	Fresh	Gneiss	MxM	0.020	1.7	10	<0.2	<10	180	0.85	0.48	4.4	0.020	32	13	55	5.1	9.8	2.7	5.4	0.17	0.40	0.040	0.028	0.35	15
ABA387	Q034442	CFD0469	19.0	20.0	Waste	Fresh	Gneiss	MxF	0.050	1.1	6.1	<0.2	<10	90	1.2	0.23	0.20	0.020	88	6.7	56	2.0	6.8	1.7	4.3	0.13	0.43	0.020	0.017	0.67	51
ABA388	Q034516	CFD0469	102.0	103.0	Waste	Fresh	Gneiss	MxF	0.12	0.56	4.2	<0.2	<10	80	0.44	6.5	0.65	0.030	101	1.8	6.0	0.96	6.3	1.1	2.9	0.11	0.29	<0.01	0.0090	0.36	63
ABA389	Q034537	CFD0469	121.0	121.9	Waste	Fresh	Gneiss	MxF	0.010	0.54	44	<0.2	<10	70	0.67	0.11	0.080	<0.01	86	1.7	6.0	3.2	9.4	1.2	2.6	0.10	0.23	0.050	0.011	0.25	49
ABA396	R545818	CFD0529	65.0	66.0	Waste	Fresh	Gneiss	MxF	0.010	0.50	5.1	<0.2	<10	40	0.38	0.16	0.17	<0.01	65	1.3	8.0	0.32	5.2	0.80	3.2	0.090	0.30	0.010	0.028	0.11	36
ABA398	R543692	CFD0549	10.0	11.0	Waste	Fresh	Gneiss	FG	0.020	0.37	13	<0.2	<10	30	0.43	0.30	0.060	0.010	31	0.60	5.0	0.83	2.7	0.73	2.2	0.070	0.36	<0.01	<0.005	0.19	16
ABA401	R543957	CFD0553	40.0	41.0	Waste	Fresh	Gneiss	MxF	0.020	2.2	8.8	<0.2	<10	300	0.79	0.11	3.3	0.010	61	16	17	5.4	3.7	3.7	7.7	0.13	0.13	0.010	0.029	1.4	33
ABA404	R550544	CFD0553	160.0	161.0	Waste	Fresh	Gneiss	MxF	0.030	0.25	37	<0.2	<10	840	0.42	0.16	2.3	0.030	58	1.3	8.0	0.64	2.8	0.90	1.2	0.080	0.42	0.010	0.0070	0.12	39
ABA408	R272713	CFD0438	96.0	97.0	Waste	Fresh	Gneiss	MxF	0.010	0.45	5.1	<0.2	<10	70	0.56	0.060	0.44	0.020	74	1.4	6.0	0.57	0.90	0.80	2.3	0.090	0.33	<0.01	0.012	0.24	44
ABA413	R276141	CFD0393	127.0	128.0	Waste	Fresh	Gneiss	MxM	0.58	2.3	9.5	<0.2	<10	220	0.59	2.1	4.1	0.060	26	18	178	1.7	7.6	3.0	8.7	0.17	0.13	<0.01	0.029	0.64	14
ABA414	R276153	CFD0393	170.0	171.0	Waste	Fresh	Gneiss	MxM	0.030	1.4	6.3	<0.2	<10	80	0.70	0.31	4.2	0.060	25	13	63	0.99	11	2.2	6.1	0.20	0.21	<0.01	0.027	0.18	14
Statistical Summary						**Fresh**	**Gneiss**	**n**	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
								Max	0.58	2.3	245	<0.2	<10	840	1.4	8.4	4.4	0.060	133	20	366	5.4	29	3.7	8.7	0.21	0.48	0.070	0.046	1.6	78
								90th PCTL	0.056	2.2	31	<0.2	<10	382	0.79	1.5	3.2	0.034	97	17	97	2.4	16	3.0	6.8	0.16	0.37	0.024	0.028	1.2	57
								75th PCTL	0.030	1.6	18	<0.2	<10	230	0.62	0.51	1.5	0.020	86	13	55	1.9	9.3	2.5	5.9	0.12	0.31	0.010	0.017	0.87	51
								Median	0.020	1.1	6.3	<0.2	<10	120	0.48	0.18	0.64	0.010	58	5.0	11	1.2	4.8	1.7	4.2	0.10	0.24	<0.01	0.012	0.57	34
								25th PCTL	0.010	0.52	4.7	<0.2	<10	70	0.42	0.090	0.20	0.010	40	1.5	6.0	0.72	2.8	0.99	2.5	0.090	0.14	<0.01	0.0080	0.25	23
								10th PCTL	0.010	0.39	2.6	<0.2	<10	40	0.37	0.048	0.096	<0.01	26	1.3	5.8	0.44	2.3	0.79	1.8	0.060	0.080	<0.01	0.0060	0.18	14
								Min	0.010	0.22	2.0	<0.2	<10	10	0.30	0.020	0.050	<0.01	9.8	0.60	5.0	0.18	0.90	0.44	0.88	<0.05	0.030	<0.01	<0.005	0.090	5.1
Statistical Summary for Gneiss Waste Rock								**n**	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188
								n < DL	1	0	0	117	117	0	0	0	0	19	0	0	0	0	0	0	0	6	0	30	20	0	0
								Max	0.58	4.2	2110	0.40	10	1320	2.2	8.4	4.4	0.32	133	31	366	9.4	29	7.3	12	0.23	0.53	5.2	0.10	2.2	88
								90th PCTL	0.070	1.9	282	<0.2	<10	303	1.1	0.62	2.1	0.050	94	15	62	3.1	14	2.7	6.1	0.14	0.41	0.44	0.028	1.0	54
								75th PCTL	0.040	1.2	101	<0.2	<10	173	0.76	0.30	0.84	0.030	81	8.1	22	1.9	8.2	2.0	4.4	0.11	0.31	0.090	0.017	0.62	48
								Median	0.020	0.77	25	<0.2	<10	90	0.59	0.14	0.28	0.020	62	2.3	7.5	0.88	4.2	1.2	2.8	0.090	0.23	0.020	0.011	0.29	36
								25th PCTL	0.010	0.56	8.8	<0.2	<10	60	0.46	0.080	0.080	0.010	48	1.5	5.0	0.50	2.6	0.87	2.0	0.070	0.14	0.010	0.0070	0.19	24
								10th PCTL	0.010	0.40	4.2	<0.2	<10	40	0.38	0.060	0.040	<0.01	34	1.1	4.0	0.27	1.8	0.61	1.6	0.050	0.080	<0.01	<0.005	0.15	17
								Min	<0.01	0.22	2.0	<0.2	<10	10	0.24	0.020	0.010	<0.01	4.3	0.40	2.0	0.090	0.60	0.32	0.88	<0.05	0.030	<0.01	<0.005	0.070	2.1

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Oxide Facies for Schist Waste Rock																															
ABA005	KAM022322	CFD0110	95.0	96.0	Waste	Oxide	Schist	RQM	0.040	1.3	1025	*<0.2*	10	370	1.1	0.29	3.5	0.030	48	13	32	1.3	18	2.9	3.9	0.080	0.030	0.22	0.029	0.32	24
ABA026	KAM037656	CFD0096	59.0	60.0	Waste	Oxide	Schist	BtS	0.15	1.4	38	*<0.2*	*<10*	100	1.1	1.7	3.6	0.080	68	13	32	2.4	15	3.0	5.8	0.10	0.12	0.12	0.029	0.34	35
ABA074	KAM146948	CFD0345	60.0	61.0	Waste	Oxide	Schist	BtS_carb	0.030	1.4	25	*<0.2*	*<10*	150	0.86	0.32	5.0	0.040	73	13	46	3.1	11	3.0	5.1	0.080	0.050	0.14	0.030	0.53	39
ABA077	J957606	CFD0350	60.0	61.0	Waste	Oxide	Schist	BtS_carb	0.020	0.91	222	*<0.2*	*<10*	80	0.55	0.19	9.8	0.030	81	9.6	18	2.0	12	2.1	3.4	0.11	0.060	0.44	0.029	0.23	45
ABA090	KAM133632	CFR0431	71.6	73.2	Waste	Oxide	Schist	BtS	0.040	0.90	182	*<0.2*	*<10*	310	0.71	0.29	1.3	0.030	69	19	42	0.18	30	4.3	3.2	0.080	0.060	0.75	0.074	0.10	34
ABA094	KAM135457	CFR0454	24.4	25.9	Waste	Oxide	Schist	BtS	0.090	0.80	537	0.20	*<10*	350	0.72	0.80	0.13	0.020	114	5.2	9.0	0.54	4.8	1.7	2.7	0.090	0.14	0.40	0.016	0.33	64
ABA125	KAM149844	CFR0566	10.7	12.2	Waste	Oxide	Schist	BtS	0.020	0.73	153	*<0.2*	*<10*	100	0.47	0.12	0.11	*<0.01*	49	2.9	14	0.27	6.7	1.1	2.2	0.060	0.31	0.47	0.010	0.15	22
ABA128	KAM149954	CFR0567	47.2	48.8	Waste	Oxide	Schist	BtS	0.050	0.88	230	*<0.2*	*<10*	80	0.88	0.39	4.5	0.030	44	8.1	22	0.66	14	2.2	2.5	0.050	0.14	0.38	0.024	0.12	24
ABA129	KAM150033	CFR0567	155.5	157.0	Waste	Oxide	Schist	BtS	0.11	1.1	1405	*<0.2*	*<10*	550	0.85	0.26	0.19	0.10	110	15	30	1.2	15	3.3	3.0	0.11	0.030	0.30	0.022	0.30	54
ABA130	KAM150823	CFR0574	10.7	12.2	Waste	Oxide	Schist	BtS	0.010	0.72	163	*<0.2*	*<10*	220	0.68	0.23	4.5	0.030	54	9.4	40	0.37	4.8	2.7	2.1	0.060	0.080	0.28	0.024	0.18	30
ABA131	KAM150859	CFR0574	61.0	62.5	Waste	Oxide	Schist	BtS	0.38	0.50	543	0.20	10	150	0.44	0.15	0.67	0.040	64	3.4	8.0	0.96	33	1.2	1.3	0.070	0.26	0.70	0.0080	0.31	30
ABA133	KAM150951	CFR0575	61.0	62.5	Waste	Oxide	Schist	BtS	0.060	0.91	238	*<0.2*	*<10*	690	0.96	0.42	7.4	0.080	55	14	41	0.94	57	2.7	2.6	0.080	0.030	0.32	0.031	0.28	27
ABA201	R276929	CFD0416	13.0	14.0	Waste	Oxide	Schist	BtS	0.060	0.81	165	*<0.2*	*<10*	100	1.1	0.20	1.0	0.060	47	19	35	1.2	24	4.3	2.6	0.090	0.020	0.080	0.015	0.18	23
ABA202	R270012	CFD0384	13.0	14.0	Waste	Oxide	Schist	BtS_carb	0.050	1.1	136	*<0.2*	*<10*	1730	0.60	0.15	0.54	0.050	95	7.8	8.0	0.68	5.9	2.5	3.0	0.070	0.25	0.34	0.026	0.16	47
ABA383	KAM068572	CFD0234	225.1	226.0	Waste	Oxide	Schist	MsS	0.020	0.61	191	*<0.2*	*<10*	60	0.43	0.090	0.040	0.010	36	1.1	4.0	0.38	1.0	0.68	1.6	0.070	0.33	0.33	0.012	0.11	21
-						**Oxide**	**Schist**	**n**	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
								Max	0.38	1.4	1405	0.20	10	1730	1.1	1.7	9.8	0.10	114	19	46	3.1	57	4.3	5.8	0.11	0.33	0.75	0.074	0.53	64
								90th PCTL	0.13	1.3	832	0.20	10	634	1.1	0.65	6.4	0.080	104	17	42	2.2	32	3.9	4.6	0.11	0.29	0.61	0.031	0.34	51
								75th PCTL	0.075	1.1	388	*<0.2*	*<10*	360	0.92	0.36	4.5	0.055	77	13	38	1.3	21	3.0	3.3	0.090	0.20	0.42	0.029	0.32	42
								Median	0.050	0.90	191	*<0.2*	*<10*	150	0.72	0.26	1.3	0.030	64	9.6	30	0.94	14	2.7	2.7	0.080	0.080	0.33	0.024	0.23	30
								25th PCTL	0.025	0.77	158	*<0.2*	*<10*	100	0.58	0.17	0.37	0.030	49	6.5	12	0.46	6.3	1.9	2.4	0.070	0.040	0.25	0.016	0.16	24
								10th PCTL	0.020	0.65	77	*<0.2*	*<10*	80	0.45	0.13	0.12	0.014	45	3.1	8.0	0.31	4.8	1.1	1.8	0.060	0.030	0.13	0.011	0.11	23
								Min	0.010	0.50	25	*<0.2*	*<10*	60	0.43	0.090	0.040	*<0.01*	36	1.1	4.0	0.18	1.0	0.68	1.3	0.050	0.020	0.080	0.0080	0.10	21
Upper Transition Facies for Schist Waste Rock																															
ABA004	KAM022156	CFD0107	149.0	150.0	Waste	Upper transition	Schist	RQM	0.030	1.1	144	*<0.2*	*<10*	110	0.66	0.090	2.6	0.040	70	8.2	17	0.33	11	2.6	3.0	0.10	0.090	0.16	0.022	0.28	36
ABA027	KAM037928	CFD0099	30.0	31.0	Waste	Upper transition	Schist	BtS_carb	0.50	1.6	14	*<0.2*	*<10*	450	1.4	0.15	4.4	0.040	75	10	27	3.1	8.9	3.1	6.8	0.10	0.060	0.26	0.033	0.44	39
ABA062	KAM081561	CFD0202	58.0	58.5	Waste	Upper transition	Schist	BtS	0.10	2.4	6.4	*<0.2*	*<10*	280	1.4	3.9	4.0	0.12	55	29	134	4.0	15	4.7	8.0	0.16	0.060	0.010	0.044	1.8	26
ABA076	KAM147059	CFD0345	160.0	161.0	Waste	Upper transition	Schist	BtS	0.070	0.94	160	*<0.2*	*<10*	190	0.75	0.27	4.5	0.070	26	12	37	0.51	17	2.3	2.3	0.050	0.050	0.32	0.022	0.17	12
ABA092	KAM135149	CFR0452	10.7	12.2	Waste	Upper Transition	Schist	BtS	0.040	0.85	50	*<0.2*	*<10*	120	0.43	2.2	0.17	0.020	115	5.0	8.0	0.54	18	1.8	4.7	0.10	0.17	0.020	0.016	0.50	68
ABA124	KAM149042	CFR0559	35.1	36.6	Waste	Upper transition	Schist	BtS	0.11	1.2	9.9	*<0.2*	*<10*	680	0.45	0.23	2.4	0.030	77	9.4	35	1.4	106	2.6	4.4	0.090	0.25	0.030	0.031	0.39	39
ABA204	R270174	CFD0388	8.0	9.0	Waste	Upper transition	Schist	MsS	0.050	1.5	223	*<0.2*	*<10*	610	1.4	0.15	1.7	0.090	72	13	40	3.1	29	4.0	4.6	0.13	0.050	0.19	0.035	0.45	36
ABA205	R276797	CFD0413	115.0	116.0	Waste	Upper transition	Schist	BtS	0.020	0.81	272	*<0.2*	*<10*	60	1.0	0.24	5.1	0.030	29	11	48	1.2	5.2	2.4	2.2	0.090	0.080	0.070	0.023	0.18	16
ABA206	Q033613	CFD0407	52.0	53.0	Waste	Upper transition	Schist	BtS	0.030	2.0	44	*<0.2*	*<10*	290	1.1	0.19	3.9	0.020	62	11	27	0.58	25	2.4	5.2	0.080	0.070	0.23	0.033	0.24	32
ABA316	R270207	CFD0390	5.0	6.0	Waste	Upper Transition	Schist	MsS	0.090	1.3	22	*<0.2*	*<10*	100	0.80	0.85	3.7	0.16	58	17	28	0.75	37	3.9	3.7	0.080	0.040	0.12	0.036	0.32	29
ABA317	R270258	CFD0390	50.0	51.0	Waste	Upper Transition	Schist	BtS_carb	0.020	1.2	24	*<0.2*	*<10*	2410	1.1	0.46	2.4	0.020	109	8.2	25	4.8	8.6	2.4	5.1	0.12	0.33	0.010	0.021	0.48	63
ABA320	R270432	CFD0392	44.0	45.0	Waste	Upper Transition	Schist	BtS_carb	0.030	0.97	312	*<0.2*	10	560	0.88	0.31	3.1	0.030	105	9.0	10	1.6	11	2.5	4.2	0.11	0.25	0.18	0.020	0.32	61
ABA323	Q033713	CFD0411	24.0	25.0	Waste	Upper Transition	Schist	BtS_Carb	0.030	1.0	131	*<0.2*	10	50	1.3	0.48	6.8	0.22	56	12	51	1.7	21	3.3	3.6	0.090	0.12	0.11	0.067	0.17	27
ABA332	Q033589	CFD0407	32.0	33.0	Waste	Upper Transition	schist	BtS	0.060	1.4	25	*<0.2*	*<10*	170	1.2	0.29	2.1	0.030	73	19	35	0.91	48	3.6	4.6	0.10	0.050	0.010	0.026	0.30	36
Statistical Summary						**Upper Transition**	**Schist**	**n**	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								Max	0.50	2.4	312	*<0.2*	10	2410	1.4	3.9	6.8	0.22	115	29	134	4.8	106	4.7	8.0	0.16	0.33	0.32	0.067	1.8	68
								90th PCTL	0.11	1.9	257	*<0.2*	10	659	1.4	1.8	4.9	0.15	107	18	50	3.7	45	4.0	6.3	0.13	0.25	0.25	0.042	0.49	62
								75th PCTL	0.085	1.5	156	*<0.2*	*<10*	533	1.3	0.48	4.3	0.085	77	13	39	2.7	28	3.5	5.0	0.11	0.16	0.19	0.035	0.45	39
								Median	0.045	1.2	47	*<0.2*	*<10*	235	1.0	0.28	3.4	0.035	71	11	32	1.3	17	2.6	4.5	0.10	0.075	0.12	0.029	0.32	36
								25th PCTL	0.030	0.98	23	*<0.2*	*<10*	113	0.76	0.20	2.4	0.030	57	9.1	26	0.62	11	2.4	3.6	0.090	0.053	0.023	0.022	0.25	27
								10th PCTL	0.023	0.88	11	*<0.2*	*<10*	72	0.51	0.15	1.8	0.020	36	8.2	12	0.52	8.7	2.3	2.5	0.080	0.050	0.010	0.020	0.17	19
								Min	0.020	0.81	6.4	*<0.2*	*<10*	50	0.43	0.090	0.17	0.020	26	5.0	8.0	0.33	5.2	1.8	2.2	0.050	0.040	0.010	0.016	0.17	12
Lower Transition Facies for Schist Waste Rock																															
ABA021	KAM033153	CFD0164	148.0	149.0	Waste	Lower transition	Schist	BtS	0.020	2.7	4.1	*<0.2*	*<10*	460	0.29	0.090	1.8	0.010	18	17	103	1.4	7.6	3.4	8.7	0.12	0.050	*<0.01*	0.015	1.8	9.0
ABA024	KAM036666	CFD0087	17.0	18.0	Waste	Lower transition	Schist	BtS_carb	0.060	2.7	11	*<0.2*	*<10*	750	0.80	0.27	1.5	0.070	71	14	32	3.4	28	4.2	13	0.16	0.070	*<0.01*	0.037	1.6	38
ABA025	KAM037046	CFD0091	12.0	13.0	Waste	Lower transition	Schist	BtS	0.10	2.7	20	*<0.2*	*<10*	190	1.2	0.80	2.7	0.10	63	14	60	3.3	15	3.3	9.7	0.14	0.070	0.010	0.024	1.0	34
ABA031	KAM039252	CFD0116	75.0	76.0	Waste	Lower transition	Schist	RQM	0.020	2.3	8.3	*<0.2*	*<10*	1430	1.3	0.30	2.9	0.020	88	12	78	7.3	14	3.2	9.0	0.13	0.15	0.040	0.068	1.1	47
ABA038	KAM047995	CFD0135	153.0	154.0	Waste	Lower transition	Schist	BtS	0.040	2.2	20	*<0.2*	*<10*	270	1.1	1.5	2.9	0.090	67	14	78	4.2	9.2	2.8	8.1	0.14	0.090	0.020	0.026	1.2	36
ABA054	KAM081312	CFD0198	85.0	86.0	Waste	Lower transition	Schist	BtS	0.080	0.39	41	*<0.2*	*<10*	50	0.29	0.19	0.17	0.020	49	2.3	6.0	0.30	4.3	0.91	1.4	0.060	0.37	0.020	*<0.005*	0.21	26
ABA086	KAM133474	CFR0429	59.4	61.0	Waste	Lower transition	Schist	BtS	0.060	1.6	27	*<0.2*	*<10*	230	0.66	0.11	2.0	0.080	90	13	47	2.7	17	2.6	5.8	0.10	0.090	0.030	0.022	1.1	48
ABA208	R276736	CFD0413	61.0	62.0	Waste	Lower transition	Schist	BtS	0.050	2.3	5.3	*<0.2*	*<10*	260	1.1	0.91	2.3	0.070	78	22	41	3.8	43	4.4	7.5	0.15	0.060	0.010	0.035	1.1	40
ABA209	R270032	CFD0384	31.0	32.0	Waste	Lower transition	Schist	BtS_carb	0.060	1.2	8.6	*<0.2*	*<10*	450	0.72	2.4	2.4	0.080	83	7.3	32	3.3	6.1	2.6	4.8	0.080	0.10	0.020	0.030	0.74	44
ABA210	R276281	CFD0401	58.0	59.0	Waste	Lower transition	Schist	BtS	0.050	1.9	35	*<0.2*	*<10*	120	1.0	0.43	4.6	0.090	68	13	122	2.0	3.7	3.2	7.6	0.10	0.090	0.010	0.030	0.58	38
ABA211	R276567	CFD0409	65.0	66.0	Waste	Lower transition	Schist	BtS	0.050	2.3	24	*<0.2*	*<10*	210	0.74	0.44	2.7	0.050	45	20	87	2.6	3.2	3.5	8.9	0.11	0.050	0.010	0.026	0.35	25
ABA318	R270302	CFD0390	88.0	89.0	Waste	Lower Transition	Schist	BtS_carb	0.070	1.5	3.5	*<0.2*	*<10*	10	0.55	0.86	10	0.060	25	9.4	36	1.0	24	1.9	4.5	0.10	0.16	*<0.01*	0.023	0.060	13
ABA319	R270394	CFD0392	10.0	11.0	Waste	Lower Transition	Schist	BtS_carb	0.030	2.1	13	*<0.2*	*<10*	430	0.81	0.33	2.8	0.030	73	18	79	3.9	26	3.6	8.0	0.11	0.040	0.070	0.028	0.60	39
ABA325	R512767	CFR0724	39.6	41.2	Waste	Lower Transition	schist	BtS	0.12	1.6	15	*<0.2*	*<10*	150	0.67	0.55	1.8	0.080	56	13	63	2.5	7.3	2.4	6.2	0.12	0.23	*<0.01*	0.019	0.62	30
ABA333	R277487	CFD0426	43.0	44.0	Waste	Lower Transition	schist	BtS	0.050	1.6	39	*<0.2*	*<10*	180	1.1	0.46	0.16	*<0.01*	82	8.3	41	2.5	3.9	1.7	4.1	0.10	0.12	0.32	0.027	0.62	45
ABA335	R550437	CFD0518	25.0	26.0	Waste	Lower Transition	schist	BtS	0.050	1.7	48	*<0.2*	*<10*	160	0.95	0.27	1.4	0.080	30	15	42	2.9	22	2.5	7.7	0.16	0.31	0.070	0.023	0.090	14
ABA336	R550471	CFD0518	55.0	56.0	Waste	Lower Transition	Schist	BtS_carb	0.090	1.8	38	*<0.2*	*<10*	810	0.61	0.46	6.4	0.16	69	17	35	6.2	34	3.7	6.9	0.12	0.070	*<0.01*	0.050	0.68	36
ABA337	R550494	CFD0518	75.0	75.0	Waste	Lower Transition	schist	BtS	0.070	1.9	15	*<0.2*	*<10*	550	0.66	0.20	2.9	0.050	75	15	65	2.7	38	3.3	7.7	0.12	0.070	*<0.01*	0.019	1.1	38
ABA345	R551151	CFD0563	68.0	69.0	Waste	Lower Transition	schist	BtS	0.070	1.8	22	*<0.2*	*<10*	1050	0.72	0.30	2.8	0.15	14	17	149	4.0	7.2	2.5	5.9	0.14	0.11	*<0.01*	0.029	0.55	6.8
Statistical Summary						**Lower Transition**	**Schist**	**n**	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
								Max	0.12	2.7	48	*<0.2*	*<10*	1430	1.3	2.4	10	0.16	90	22	149	7.3	43	4.4	13	0.16	0.37	0.32	0.068	1.8	48
								90th PCTL	0.092	2.7	40	*<0.2*	*<10*	858	1.1	1.0	5.0	0.11	84	18	107	4.6	35	3.8	9.2	0.15	0.25	0.070	0.040	1.3	45
								75th PCTL	0.070	2.3	31	*<0.2*	*<10*	505	1.1	0.68	2.9	0.085	77	17	79	3.8	25	3.4	8.4	0.14	0.14	0.025	0.030	1.1	39
								Median	0.060	1.9	20	*<0.2*	*<10*	260	0.74	0.43	2.7	0.070	68	14	60	2.9	14	3.2	7.6	0.12	0.090	0.010	0.026	0.68	36
								25th PCTL	0.050	1.6	9.6	*<0.2*	*<10*	170	0.66	0.27	1.8	0.040	47	12	39	2.5	6.7	2.5	5.8	0.10	0.070	*<0.01*	0.023	0.57	25
								10th PCTL	0.028	1.4	5.1	*<0.2*	*<10*	106	0.50	0.17	1.1	0.018	23	8.1	32	1.3	3.9	1.9	4.4	0.096	0.050	*<0.01*	0.018	0.19	12
								Min	0.020	0.39	3.5	*<0.2*	*<10*	10	0.29	0.090	0.16	*<0.01*	14	2.3	6.0	0.30	3.2	0.91	1.4	0.060	0.040	*<0.01*	*<0.005*	0.060	6.8

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Fresh Facies for Schist Waste Rock																															
ABA082	KAM131674	CFR0401	15.2	16.8	Waste	Fresh	Schist	BtS	0.030	2.3	21	<0.2	<10	1060	0.75	0.10	1.8	0.040	35	22	34	3.2	33	4.0	7.9	0.10	0.050	0.010	0.016	1.3	17
ABA084	KAM132888	CFR0420	32.0	33.5	Waste	Fresh	Schist	BtS	0.060	1.7	6.8	<0.2	<10	160	0.62	0.26	4.3	0.050	74	10	22	1.6	13	2.5	6.3	0.080	0.18	0.010	0.015	1.3	40
ABA091	KAM133659	CFR0431	109.7	111.3	Waste	Fresh	Schist	BtS	0.38	1.5	22	<0.2	<10	200	0.54	0.89	2.5	0.19	60	14	27	1.2	23	2.9	6.6	0.060	0.040	0.010	0.015	1.1	31
ABA093	KAM135298	CFR0453	10.7	12.2	Waste	Fresh	Schist	BtS	0.030	2.9	41	<0.2	<10	1900	0.71	0.040	3.1	0.040	28	23	231	6.8	48	3.2	7.0	0.10	0.50	0.030	0.011	1.4	14
ABA095	KAM135693	CFR0456	10.7	12.2	Waste	Fresh	Schist	BtS	0.020	2.3	28	<0.2	<10	530	0.55	0.10	0.19	0.27	51	17	68	3.0	24	3.7	8.3	0.080	0.040	0.010	0.041	1.6	26
ABA127	KAM149916	CFR0566	109.7	111.3	Waste	Fresh	Schist	BtS_carb	0.050	2.0	19	<0.2	<10	260	0.85	0.21	2.5	0.020	65	18	67	3.5	39	3.7	6.7	0.10	0.070	0.020	0.027	1.3	31
ABA132	KAM150898	CFR0574	114.3	115.8	Waste	Fresh	Schist	BtS	0.040	2.0	40	<0.2	<10	310	0.80	0.14	2.6	0.030	52	19	91	4.6	22	3.5	7.5	0.10	0.060	0.030	0.026	1.3	25
ABA134	KAM150984	CFR0575	106.7	108.2	Waste	Fresh	Schist	BtS	0.010	1.5	25	<0.2	<10	1670	0.75	0.26	2.3	0.010	98	10	25	6.5	9.2	3.0	6.2	0.10	0.060	0.010	0.027	0.40	54
ABA212	Q033565	CFD0407	10.0	11.0	Waste	Fresh	Schist	BtS	0.040	2.9	10	<0.2	<10	360	0.70	0.35	2.0	0.090	68	20	61	2.8	21	4.6	11	0.13	0.050	<0.01	0.054	1.6	36
ABA213	R280479	CFD0497	111.0	112.0	Waste	Fresh	Schist	BtS	0.020	2.1	20	<0.2	<10	430	0.72	0.33	1.1	0.010	33	13	28	2.2	5.1	2.8	6.3	0.14	0.080	<0.01	0.0070	1.1	19
ABA214	R274802	CFD0472	47.0	48.0	Waste	Fresh	Schist	BtS	0.050	0.81	72	<0.2	<10	90	0.39	0.96	0.18	0.010	94	4.2	10	0.65	4.5	1.9	3.6	0.080	0.22	<0.01	0.014	0.48	44
ABA215	R275143	CFD0482	40.0	41.0	Waste	Fresh	Schist	BtS	0.050	2.0	133	<0.2	<10	390	1.7	0.41	4.1	0.060	53	19	170	7.2	36	3.2	4.8	0.090	0.22	0.060	0.044	1.3	28
ABA216	R276122	CFD0393	87.0	88.0	Waste	Fresh	Schist	BtS	0.020	2.7	9.8	<0.2	<10	200	1.0	0.14	1.3	0.020	14	21	153	3.1	4.6	3.2	8.7	0.12	0.080	<0.01	0.011	1.0	7.2
ABA217	R270181	CFD0388	92.0	93.0	Waste	Fresh	Schist	BtS_carb	0.020	2.2	12	<0.2	<10	540	0.68	0.15	2.7	0.040	98	14	42	2.8	18	3.7	7.2	0.18	0.050	<0.01	0.028	1.6	51
ABA218	R283622	CFD0498	28.0	29.0	Waste	Fresh	Schist	BtS	0.060	1.6	11	<0.2	<10	240	0.30	18	2.0	0.020	16	14	84	1.1	10	2.1	5.2	0.15	0.12	<0.01	0.0080	0.71	7.4
ABA219	R276979	CFD0416	57.0	58.0	Waste	Fresh	Schist	BtS	0.010	1.2	15	<0.2	<10	130	2.3	0.090	9.1	0.090	19	28	143	12	4.1	3.8	3.2	0.070	0.090	<0.01	0.020	0.40	9.9
ABA220	R276002	CFD0387	148.0	149.0	Waste	Fresh	Schist	BtS	0.040	2.1	1.4	<0.2	<10	250	0.37	0.15	2.4	0.050	14	19	166	3.1	12	2.5	5.9	0.18	0.090	<0.01	0.012	0.71	6.4
ABA221	R276317	CFD0401	129.0	130.0	Waste	Fresh	Schist	BtS	0.020	0.94	1.7	<0.2	<10	40	0.33	0.16	2.6	0.020	11	8.3	63	1.1	8.0	1.4	4.0	0.13	0.12	0.010	0.010	0.49	4.4
ABA222	R270104	CFD0386	59.0	60.0	Waste	Fresh	Schist	BtS_carb	0.030	1.9	22	<0.2	<10	290	0.57	0.24	2.4	0.040	77	13	40	2.3	17	3.4	6.3	0.12	0.060	0.010	0.031	1.4	42
ABA223	R270127	CFD0386	80.0	81.0	Waste	Fresh	Schist	MsS	0.050	1.6	64	<0.2	<10	310	0.90	0.22	3.4	0.070	75	13	42	2.1	20	3.3	5.8	0.11	0.070	0.020	0.031	0.93	40
ABA321	R270466	CFD0392	74.0	75.0	Waste	Fresh	Schist	BtS_carb	0.060	2.2	48	<0.2	<10	250	0.95	0.52	1.9	0.040	90	13	44	4.3	15	3.4	7.9	0.13	0.050	<0.01	0.030	1.4	48
ABA322	R270482	CFD0392	88.0	89.0	Waste	Fresh	Schist	BtS_carb	0.040	2.2	62	<0.2	<10	460	0.80	0.75	6.0	0.050	51	14	72	3.6	27	3.4	7.5	0.11	0.050	<0.01	0.025	1.3	28
ABA326	R512983	CFR0731	32.0	32.4	Waste	Fresh	schist	BtS	0.030	2.4	30	<0.2	<10	90	0.63	0.21	1.3	0.040	20	25	199	4.5	25	3.3	7.1	0.12	0.14	<0.01	0.022	0.44	10
ABA329	R270202	CFD0388	110.0	110.2	Waste	Fresh	Schist	BtS_carb	0.020	1.7	28	<0.2	<10	200	0.59	0.34	5.9	0.030	42	13	66	1.9	10	2.5	6.3	0.13	0.17	<0.01	0.026	1.0	21
ABA330	R276299	CFD0401	74.0	75.0	Waste	Fresh	schist	BtS	0.090	1.2	21	<0.2	<10	140	0.48	0.45	3.1	0.010	21	16	45	0.71	5.8	3.0	4.5	0.26	0.28	<0.01	0.031	0.45	11
ABA331	R276331	CFD0401	141.0	142.0	Waste	Fresh	schist	BtS	0.030	3.0	30	<0.2	<10	460	1.1	0.16	3.5	0.090	33	23	180	5.8	17	4.4	11	0.17	0.080	<0.01	0.030	1.8	18
ABA377	R279587	CFD0468	131.0	132.0	Waste	Fresh	Schist	AmBtS	0.020	0.81	1.9	<0.2	<10	110	0.49	0.16	4.8	0.010	25	9.0	19	1.8	8.4	2.6	3.0	0.18	0.090	<0.01	0.045	0.35	14
ABA415	R277001	CFD0398	49.0	50.0	Waste	Fresh	schist	BtS	0.040	1.6	9.9	<0.2	<10	80	0.39	0.050	1.2	0.010	10	19	157	3.7	14	2.2	4.5	0.13	0.080	0.010	0.0090	0.57	5.3
ABA416	R277017	CFD0398	64.0	65.0	Waste	Fresh	schist	BtS	0.020	2.0	15	<0.2	<10	300	0.56	0.13	1.9	0.020	26	14	96	2.1	8.3	3.1	7.4	0.15	0.080	<0.01	0.013	1.2	14
ABA417	R277021	CFD0398	124.0	125.0	Waste	Fresh	schist	BtS	0.020	1.6	7.4	<0.2	<10	50	0.53	0.080	2.5	0.35	17	15	99	1.4	8.5	2.2	5.8	0.17	0.13	<0.01	0.016	0.59	8.7
ABA418	R277041	CFD0398	160.0	161.0	Waste	Fresh	schist	BtS	0.030	2.2	1.7	<0.2	<10	320	0.47	0.090	2.1	0.040	10	18	120	2.2	9.4	2.7	6.4	0.14	0.080	<0.01	0.0090	1.3	5.6
Statistical Summary						**Fresh**	**Schist**	**n**	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
								Max	0.38	3.0	133	<0.2	<10	1900	2.3	18	9.1	0.35	98	28	231	12	48	4.6	11	0.26	0.50	0.060	0.054	1.8	54
								90th PCTL	0.060	2.7	62	<0.2	<10	540	1.0	0.75	4.8	0.090	90	23	170	6.5	33	3.8	8.3	0.18	0.22	0.020	0.041	1.6	44
								75th PCTL	0.050	2.2	30	<0.2	<10	410	0.80	0.35	3.2	0.055	66	19	132	4.0	22	3.4	7.4	0.15	0.13	0.010	0.030	1.3	33
								Median	0.030	2.0	21	<0.2	<10	260	0.63	0.21	2.5	0.040	35	15	67	2.8	14	3.2	6.3	0.12	0.080	<0.01	0.022	1.1	19
								25th PCTL	0.020	1.6	10.0	<0.2	<10	150	0.51	0.14	1.9	0.020	20	13	41	1.8	8.5	2.6	5.5	0.10	0.060	<0.01	0.013	0.58	10
								10th PCTL	0.020	1.2	1.9	<0.2	<10	90	0.39	0.090	1.2	0.010	14	10	25	1.1	5.1	2.2	4.0	0.080	0.050	<0.01	0.0090	0.44	6.4
								Min	0.010	0.81	1.4	<0.2	<10	40	0.30	0.040	0.18	0.010	10	4.2	10	0.65	4.1	1.4	3.0	0.060	0.040	<0.01	0.0070	0.35	4.4
Statistical Summary for Schist Waste Rock								**n**	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
								Max	0.50	3.0	1405	0.20	10	2410	2.3	18	10	0.35	115	29	231	12	106	4.7	13	0.26	0.50	0.75	0.074	1.8	68
								90th PCTL	0.10	2.4	224	0.20	10	762	1.2	0.89	5.3	0.10	94	20	144	4.6	36	4.0	8.4	0.16	0.25	0.32	0.042	1.4	48
								75th PCTL	0.060	2.1	102	<0.2	<10	455	1.0	0.46	3.8	0.080	75	18	78	3.4	24	3.4	7.4	0.13	0.14	0.13	0.031	1.1	39
								Median	0.040	1.6	25	<0.2	<10	250	0.72	0.27	2.5	0.040	58	13	42	2.2	15	3.0	5.8	0.10	0.080	0.010	0.026	0.55	30
								25th PCTL	0.030	1.1	14	<0.2	<10	125	0.56	0.15	1.7	0.020	33	9.9	28	1.1	8.2	2.5	3.7	0.085	0.060	0.010	0.016	0.32	17
								10th PCTL	0.020	0.81	6.7	<0.2	<10	80	0.43	0.098	0.19	0.010	18	7.7	13	0.54	4.8	1.9	2.6	0.070	0.048	<0.01	0.011	0.17	8.9
								Min	0.010	0.39	1.4	<0.2	<10	10	0.29	0.040	0.040	<0.01	10	1.1	4.0	0.18	1.0	0.68	1.3	0.050	0.020	<0.01	<0.005	0.060	4.4
Oxide Facies for Granite Waste Rock																															
ABA157	R305807	CFD0382	76.0	77.0	Waste	Oxide	Granite	GG	0.020	0.73	1900	<0.2	<10	100	0.54	0.070	0.030	0.020	27	1.5	4.0	0.45	3.0	2.0	1.8	0.090	0.23	0.84	0.012	0.10	15
ABA158	R305808	CFD0382	79.0	80.0	Waste	Oxide	Granite	GG	0.020	0.72	1600	<0.2	<10	50	0.52	0.060	0.030	0.030	21	2.4	3.0	0.24	2.2	2.0	1.7	0.10	0.30	0.71	0.015	0.040	11
ABA174	R305826	CFD0403	7.0	8.0	Waste	Oxide	Granite	GG	0.050	0.47	2960	<0.2	<10	30	0.35	0.070	0.060	0.040	31	1.1	3.0	1.1	1.7	1.6	1.6	0.090	0.28	0.20	0.0080	0.18	17
ABA421	I354544	CFD0053	50.3	51.0	Waste	Oxide	Granite	GG	0.060	0.43	2840	0.20	10	30	0.36	0.77	0.080	0.060	44	0.70	2.0	2.1	1.8	1.0	1.5	0.080	0.11	0.84	0.010	0.21	25
ABA423	Q033319	CFD0403	7.0	7.8	Waste	Oxide	Granite	GG	0.050	0.60	2830	<0.2	10	40	0.43	0.070	0.060	0.030	31	11	2.0	1.3	14	1.6	1.9	0.070	0.23	0.21	0.0080	0.23	18
ABA429	Q032778	CFD0394	39.7	40.0	Waste	Oxide	Granite	GG	0.030	0.54	81	<0.2	<10	100	0.63	0.10	0.050	0.010	82	2.6	5.0	3.2	2.7	1.6	2.8	0.12	0.41	0.010	0.013	0.25	45
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	0.060	0.73	2960	0.20	10	100	0.63	0.77	0.080	0.060	82	11	5.0	3.2	14	2.0	2.8	0.12	0.41	0.84	0.015	0.25	45
								90th PCTL	0.055	0.73	2900	0.20	10	100	0.59	0.44	0.070	0.050	63	6.6	4.5	2.7	8.7	2.0	2.4	0.11	0.36	0.84	0.014	0.24	35
								75th PCTL	0.050	0.69	2838	<0.2	<10	88	0.54	0.093	0.060	0.038	41	2.6	3.8	1.9	2.9	1.9	1.9	0.098	0.30	0.81	0.013	0.23	24
								Median	0.040	0.57	2365	<0.2	<10	45	0.48	0.070	0.055	0.030	31	2.0	3.0	1.2	2.5	1.6	1.7	0.090	0.26	0.46	0.011	0.20	17
								25th PCTL	0.023	0.49	1675	<0.2	<10	33	0.38	0.070	0.035	0.023	28	1.2	2.3	0.61	1.9	1.6	1.6	0.083	0.23	0.20	0.0085	0.12	15
								10th PCTL	0.020	0.45	841	<0.2	<10	30	0.36	0.065	0.030	0.015	24	0.90	2.0	0.35	1.8	1.3	1.5	0.075	0.17	0.11	0.0080	0.070	13
								Min	0.020	0.43	81	<0.2	<10	30	0.35	0.060	0.030	0.010	21	0.70	2.0	0.24	1.7	1.0	1.5	0.070	0.11	0.010	0.0080	0.040	11

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Upper Transition Facies for Granite Waste Rock																															
ABA013	KAM025898	CFD0150	81.0	82.0	Waste	Upper transition	Granite	GG	0.020	0.78	17	*<0.2*	*<10*	30	0.44	0.10	0.040	*<0.01*	73	0.60	5.0	1.2	1.1	0.70	2.7	0.15	0.38	0.020	0.013	0.16	36
ABA151	R305801	CFD0381	13.0	14.0	Waste	Upper transition	Granite	GG	0.030	0.46	2.7	*<0.2*	*<10*	90	0.13	0.090	0.080	0.010	55	1.1	8.0	2.6	3.8	1.2	2.5	0.13	0.66	*<0.01*	0.016	0.32	31
ABA152	R305802	CFD0381	35.0	36.0	Waste	Upper transition	Granite	GG	0.030	1.1	132	*<0.2*	*<10*	100	0.57	0.13	0.090	0.010	49	0.90	3.0	14	5.2	0.96	3.7	0.13	0.35	0.030	0.014	0.19	25
ABA167	R305818	CFD0394	30.0	31.0	Waste	Upper transition	Granite	GG	0.080	0.41	196	*<0.2*	*<10*	50	0.27	0.18	0.020	0.020	29	0.10	4.0	0.47	1.5	0.36	0.96	0.090	0.31	0.29	0.011	0.19	16
ABA169	R305821	CFD0399	20.0	21.0	Waste	Upper transition	Granite	GG	0.060	0.33	90	*<0.2*	*<10*	30	0.71	0.17	0.050	0.020	50	1.6	5.0	0.62	1.6	1.2	1.2	0.12	0.55	0.050	0.011	0.13	28
ABA172	R305824	CFD0396	29.0	30.0	Waste	Upper transition	Granite	GG	0.020	0.82	365	*<0.2*	*<10*	60	0.45	0.13	0.020	0.020	34	0.50	4.0	0.23	1.5	1.3	2.1	0.10	0.36	0.18	0.016	0.020	17
ABA178	R305831	CFD0400	11.0	12.0	Waste	Upper transition	Granite	GG	0.020	0.54	108	*<0.2*	*<10*	50	0.56	0.070	0.050	0.020	37	1.0	5.0	1.5	1.5	0.67	2.2	0.13	0.52	0.030	0.012	0.13	20
ABA189	CFD0399_10_20	CFD0399	10.0	20.0	Waste	Upper transition	Granite	GG	0.080	0.73	1005	*<0.2*	*<10*	50	0.80	0.13	0.050	0.050	48	1.3	2.0	0.68	2.3	1.4	2.1	0.090	0.59	0.28	0.014	0.17	27
ABA190	CFD0396_50_60	CFD0396	50.0	60.0	Waste	Upper transition	Granite	GG	0.030	0.44	156	*<0.2*	*<10*	40	0.50	0.10	0.040	0.010	36	0.80	4.0	2.0	2.3	0.93	1.7	0.090	0.33	0.070	0.0080	0.16	21
ABA191	CFD0394_31_41	CFD0394	31.0	41.0	Waste	Upper transition	Granite	GG	0.050	0.61	408	*<0.2*	*<10*	60	0.55	0.15	0.030	0.020	46	0.90	4.0	1.6	2.5	1.2	1.9	0.080	0.30	0.15	0.011	0.23	25
ABA192	CFD0394_55_66	CFD0394	55.0	66.0	Waste	Upper transition	Granite	GG	0.030	0.48	201	*<0.2*	*<10*	50	0.53	0.090	0.050	0.020	53	0.90	5.0	2.2	1.7	0.88	1.8	0.090	0.35	0.21	0.010	0.16	31
ABA195	CFD0381_4_13	CFD0381	4.0	13.0	Waste	Upper transition	Granite	GG	0.020	0.49	8.6	*<0.2*	*<10*	90	0.17	0.11	0.080	0.010	49	1.3	7.0	3.0	1.4	1.4	2.8	0.10	0.61	0.020	0.016	0.34	27
ABA196	CFD0380_36_50	CFD0380	36.0	50.0	Waste	Upper transition	Granite	GG	0.040	0.70	457	*<0.2*	*<10*	30	0.44	0.13	0.020	0.020	46	0.50	5.0	0.47	4.2	0.83	1.8	0.080	0.30	0.21	0.0070	0.16	25
ABA431	Q041083	CFD0380	30.0	30.2	Waste	Upper Transition	Granite	GG	0.010	0.66	213	*<0.2*	*<10*	30	0.42	0.27	0.050	*<0.01*	34	1.1	4.0	1.3	8.7	0.80	2.4	0.080	0.35	0.020	0.012	0.11	17
ABA434	Q032756	CFD0394	19.5	19.6	Waste	Upper Transition	Granite	GG	0.080	0.76	3020	0.30	10	120	0.61	0.12	0.070	0.030	58	1.4	3.0	1.3	9.2	1.3	2.4	0.090	0.17	0.79	0.0090	0.26	32
ABA435	Q032826	CFD0394	81.1	81.7	Waste	Upper Transition	Granite	GG	0.020	0.54	138	*<0.2*	*<10*	30	0.40	0.080	0.040	*<0.01*	41	0.80	4.0	1.3	7.8	0.67	2.1	0.090	0.30	0.13	0.0090	0.13	22
ABA436	Q032927	CFD0396	65.0	65.5	Waste	Upper Transition	Granite	GG	0.040	0.66	215	*<0.2*	*<10*	40	0.37	0.11	0.010	0.010	44	0.40	4.0	0.55	4.7	0.49	2.0	0.090	0.32	0.20	0.0090	0.13	24
Statistical Summary						**Upper Transition**	**Granite**	**n**	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
								Max	0.080	1.1	3020	0.30	10	120	0.80	0.27	0.090	0.050	73	1.6	8.0	14	9.2	1.4	3.7	0.15	0.66	0.79	0.016	0.34	36
								90th PCTL	0.080	0.80	676	*<0.2*	*<10*	94	0.65	0.17	0.080	0.024	56	1.3	5.8	2.8	8.2	1.4	2.7	0.13	0.60	0.28	0.016	0.28	31
								75th PCTL	0.050	0.73	365	*<0.2*	*<10*	60	0.56	0.13	0.050	0.020	50	1.1	5.0	2.0	4.7	1.2	2.4	0.12	0.52	0.21	0.014	0.19	28
								Median	0.030	0.61	196	*<0.2*	*<10*	50	0.45	0.12	0.050	0.020	46	0.90	4.0	1.3	2.3	0.93	2.1	0.090	0.35	0.13	0.011	0.16	25
								25th PCTL	0.020	0.48	108	*<0.2*	*<10*	30	0.40	0.10	0.030	0.010	37	0.60	4.0	0.62	1.5	0.70	1.8	0.090	0.31	0.030	0.0090	0.13	21
								10th PCTL	0.020	0.43	13	*<0.2*	*<10*	30	0.23	0.086	0.020	*<0.01*	34	0.46	3.0	0.47	1.5	0.60	1.5	0.080	0.30	0.020	0.0086	0.12	17
								Min	0.010	0.33	2.7	*<0.2*	*<10*	30	0.13	0.070	0.010	*<0.01*	29	0.10	2.0	0.23	1.1	0.36	0.96	0.080	0.17	*<0.01*	0.0070	0.020	16
Lower Transition Facies for Granite Waste Rock																															
ABA010	KAM024598	CFD0137	49.0	50.0	Waste	Lower transition	Granite	GG	0.030	0.55	2.1	*<0.2*	*<10*	90	0.16	0.080	0.11	0.010	59	1.5	7.0	3.9	1.6	1.5	3.1	0.13	0.63	*<0.01*	0.017	0.39	33
ABA154	R305804	CFD0382	10.0	11.0	Waste	Lower transition	Granite	GG	0.020	0.45	9.5	*<0.2*	*<10*	90	0.31	0.090	0.080	0.010	54	1.3	8.0	3.7	1.7	1.2	2.5	0.12	0.61	0.010	0.015	0.30	29
ABA155	R305805	CFD0382	50.0	51.0	Waste	Lower transition	Granite	GG	0.14	0.82	41	*<0.2*	*<10*	110	0.35	0.070	0.060	0.010	66	4.6	3.0	4.0	2.5	0.95	3.3	0.14	0.44	0.020	0.013	0.27	32
ABA159	R305809	CFD0383	10.0	11.0	Waste	Lower transition	Granite	GG	0.020	0.53	26	*<0.2*	*<10*	100	0.15	0.070	0.080	0.010	52	1.2	7.0	3.8	1.5	1.2	2.9	0.12	0.70	0.010	0.018	0.35	29
ABA160	R305811	CFD0383	48.0	49.0	Waste	Lower transition	Granite	GG	0.020	0.49	8.2	*<0.2*	*<10*	90	0.25	0.060	0.090	0.010	51	1.5	8.0	3.5	1.2	1.3	2.7	0.14	0.63	0.010	0.015	0.34	28
ABA164	R305815	CFD0389	10.0	11.0	Waste	Lower transition	Granite	GG	0.020	0.43	11	*<0.2*	*<10*	70	0.15	0.060	0.070	0.010	53	1.1	12	1.8	1.3	1.0	2.4	0.13	0.78	0.020	0.013	0.28	29
ABA166	R305817	CFD0389	45.0	46.0	Waste	Lower transition	Granite	GG	0.11	0.95	2320	*<0.2*	*<10*	70	1.4	1.0	0.090	0.46	41	2.4	4.0	4.8	13	2.8	3.3	0.13	0.47	0.050	0.11	0.12	22
ABA193	CFD383_115_125	CFD0383	115.0	125.0	Waste	Lower transition	Granite	GG	0.030	0.49	22	*<0.2*	*<10*	80	0.25	0.080	0.10	0.040	50	2.1	5.0	1.9	2.0	1.6	3.1	0.11	0.36	0.020	0.017	0.24	28
ABA194	CFD0382_84_94	CFD0382	84.0	94.0	Waste	Lower transition	Granite	GG	0.050	0.86	1060	*<0.2*	*<10*	140	1.2	0.060	0.030	0.030	42	3.8	3.0	2.6	1.8	2.5	2.8	0.080	0.27	0.39	0.012	0.15	20
ABA424	Q041284	CFD0382	4.0	5.0	Waste	Lower Transition	Granite	GG	0.030	0.59	22	*<0.2*	*<10*	110	0.20	0.090	0.090	0.020	52	2.3	6.0	3.5	2.5	1.4	3.0	0.10	0.60	*<0.01*	0.014	0.36	27
ABA425	Q041377	CFD0382	87.0	88.0	Waste	Lower Transition	Granite	GG	0.020	0.87	140	*<0.2*	*<10*	30	0.28	0.060	0.020	*<0.01*	35	1.3	3.0	0.35	1.9	0.48	2.5	0.090	0.32	0.11	0.011	0.12	17
ABA426	Q041396	CFD0382	103.0	104.0	Waste	Lower Transition	Granite	GG	0.020	0.94	240	*<0.2*	*<10*	30	0.38	0.080	0.020	0.020	41	1.3	3.0	0.37	1.8	0.52	2.5	0.090	0.30	0.62	0.011	0.080	21
ABA427	Q041404	CFD0382	110.0	111.0	Waste	Lower Transition	Granite	GG	0.050	0.94	461	*<0.2*	*<10*	150	0.63	0.060	0.070	0.010	29	5.0	2.0	4.8	6.2	1.8	3.7	0.070	0.25	0.25	0.012	0.14	11
ABA430	Q041069	CFD0380	18.0	18.1	Waste	Lower Transition	Granite	GG	0.12	0.41	2110	0.20	10	50	0.42	0.38	0.050	0.050	44	0.50	5.0	2.6	2.1	0.84	1.3	0.080	0.15	1.7	0.0070	0.22	24
Statistical Summary						**Lower Transition**	**Granite**	**n**	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								Max	0.14	0.95	2320	0.20	10	150	1.4	1.0	0.11	0.46	66	5.0	12	4.8	13	2.8	3.7	0.14	0.78	1.7	0.11	0.39	33
								90th PCTL	0.12	0.94	1795	*<0.2*	*<10*	131	1.0	0.29	0.097	0.047	57	4.4	8.0	4.5	5.1	2.3	3.3	0.14	0.68	0.55	0.018	0.36	31
								75th PCTL	0.050	0.87	406	*<0.2*	*<10*	108	0.41	0.088	0.090	0.028	53	2.4	7.0	3.8	2.4	1.6	3.1	0.13	0.63	0.22	0.017	0.33	29
								Median	0.030	0.57	33	*<0.2*	*<10*	90	0.30	0.075	0.075	0.010	50	1.5	5.0	3.5	1.9	1.2	2.9	0.12	0.46	0.020	0.014	0.26	27
								25th PCTL	0.020	0.49	13	*<0.2*	*<10*	70	0.21	0.060	0.053	0.010	*<0.01*	1.3	3.0	2.1	1.6	0.97	2.5	0.090	0.31	0.010	0.012	0.14	21
								10th PCTL	0.020	0.44	8.6	*<0.2*	*<10*	36	0.15	0.060	0.023	0.010	36	1.1	3.0	0.79	1.4	0.62	2.4	0.080	0.26	*<0.01*	0.011	0.12	18
								Min	0.020	0.41	2.1	*<0.2*	*<10*	30	0.15	0.060	0.020	*<0.01*	29	0.50	2.0	0.35	1.2	0.48	1.3	0.070	0.15	*<0.01*	0.0070	0.080	11
Fresh Facies for Granite Waste Rock																															
ABA012	KAM025798	CFD0147	260.0	261.0	Waste	Fresh	Granite	GG	0.030	0.58	3.3	*<0.2*	*<10*	120	0.21	0.070	0.57	0.070	63	1.9	6.0	2.6	1.5	1.7	3.7	0.12	0.30	*<0.01*	0.026	0.27	37
ABA162	R305813	CFD0385	10.0	11.0	Waste	Fresh	Granite	GG	0.020	0.42	6.8	*<0.2*	*<10*	90	0.14	0.10	0.070	0.010	42	1.2	6.0	2.9	1.5	1.0	2.5	0.12	0.70	0.020	0.015	0.31	23
ABA163	R305814	CFD0385	59.0	60.0	Waste	Fresh	Granite	GG	0.020	0.77	80	*<0.2*	*<10*	70	0.32	0.10	0.040	*<0.01*	37	2.9	5.0	2.7	3.4	0.88	2.8	0.12	0.45	0.030	0.012	0.24	19
ABA165	R305816	CFD0389	30.0	31.0	Waste	Fresh	Granite	GG	0.030	0.43	27	*<0.2*	*<10*	70	0.22	1.3	0.080	0.35	54	1.2	7.0	1.9	7.2	0.96	2.4	0.13	0.61	0.020	0.097	0.26	30
ABA168	R305819	CFD0394	88.0	89.0	Waste	Fresh	Granite	GG	0.020	0.46	29	*<0.2*	*<10*	90	0.35	0.34	0.080	0.13	81	1.4	7.0	4.1	2.7	1.1	2.9	0.16	0.48	0.010	0.045	0.31	42
ABA179	R305832	CFD0400	60.0	61.0	Waste	Fresh	Granite	GG	0.010	0.98	1355	*<0.2*	*<10*	80	1.6	0.060	0.030	0.030	60	1.4	3.0	2.6	4.6	1.7	3.4	0.13	0.39	0.030	0.014	0.22	32
ABA180	CFD0396_72_81	CFD0396	72.0	81.0	Waste	Fresh	Granite	GG	0.040	0.54	42	*<0.2*	*<10*	20	0.46	0.060	0.080	*<0.01*	57	1.6	4.0	0.45	4.2	1.0	1.8	0.10	0.33	0.22	0.014	0.080	30
ABA182	CFD0394_94_104	CFD0394	94.0	104.0	Waste	Fresh	Granite	GG	0.040	0.53	652	*<0.2*	*<10*	40	0.58	0.060	0.080	0.030	40	1.4	4.0	1.4	2.1	1.4	1.7	0.080	0.28	0.13	0.012	0.19	21
ABA186	CFD0380_2_17	CFD0380	2.0	17.0	Waste	Fresh	Granite	GG	0.020	0.42	7.5	*<0.2*	*<10*	80	0.34	0.37	0.070	0.010	44	1.4	6.0	7.4	1.3	1.2	2.5	0.10	0.56	0.010	0.016	0.29	23
ABA187	CFD0380_22_30	CFD0380	22.0	30.0	Waste	Fresh	Granite	GG	0.020	0.44	14	*<0.2*	*<10*	70	0.35	0.38	0.060	*<0.01*	42	1.1	6.0	4.8	1.2	1.1	2.4	0.11	0.46	0.010	0.015	0.26	21
ABA198	CFD0385_28_38	CFD0385	28.0	38.0	Waste	Fresh	Granite	GG	0.030	0.50	5.4	*<0.2*	*<10*	100	0.14	0.080	0.070	0.010	51	1.5	8.0	2.8	4.0	1.2	2.9	0.12	0.68	*<0.01*	0.015	0.35	27
ABA199	CFD0385_38_48	CFD0385	38.0	48.0	Waste	Fresh	Granite	GG	0.020	0.40	48	*<0.2*	*<10*	80	0.29	0.080	0.070	0.010	49	2.2	7.0	2.8	2.3	1.3	2.4	0.060	0.57	0.010	0.017	0.26	26
ABA200	CFD0385_48_58	CFD0385	48.0	58.0	Waste	Fresh	Granite	GG	0.020	0.49	81	*<0.2*	*<10*	80	0.40	0.080	0.050	0.020	49	3.4	6.0	2.6	3.9	1.2	2.5	0.060	0.50	0.020	0.015	0.25	24
ABA437	Q041055	CFD0380	5.0	6.0	Waste	Fresh	Granite	GG	0.030	0.44	5.0	*<0.2*	*<10*	90	0.35	0.31	0.080	0.020	59	1.4	7.0	8.8	1.0	1.4	3.0	0.12	0.61	*<0.01*	0.016	0.32	34
ABA438	Q041063	CFD0380	12.0	13.0	Waste	Fresh	Granite	GG	0.030	0.47	5.9	*<0.2*	*<10*	90	0.33	0.35	0.080	0.020	49	2.5	6.0	8.8	1.7	1.4	3.1	0.11	0.65	0.010	0.019	0.33	27
ABA439	Q041678	CFD0385	8.0	9.0	Waste	Fresh	Granite	GG	0.020	0.53	3.4	*<0.2*	*<10*	90	0.23	0.11	0.080	0.030	43	1.6	10	2.6	3.2	1.3	2.7	0.090	0.65	*<0.01*	0.013	0.32	23
ABA440	Q041699	CFD0385	27.0	28.0	Waste	Fresh	Granite	GG	0.020	0.44	4.6	*<0.2*	*<10*	80	0.18	0.10	0.070	0.010	56	1.4	6.0	2.5	0.80	1.2	2.8	0.10	0.85	*<0.01*	0.012	0.29	32
ABA441	Q032423	CFD0385	92.0	92.6	Waste	Fresh	Granite	GG	0.010	0.44	82	*<0.2*	*<10*	100	0.35	0.050	0.070	0.010	64	2.6	5.0	2.1	3.5	1.3	2.6	0.12	0.36	0.030	0.011	0.25	33
ABA442	Q032601	CFD0391	3.4	3.9	Waste	Fresh	Granite	GG	0.060	0.46	7.7	*<0.2*	*<10*	120	0.24	0.17	0.070	0.080	48	1.6	9.0	2.2	3.6	1.4	2.6	0.10	0.55	*<0.01*	0.016	0.29	26
ABA443	Q033167	CFD0400	60.0	61.0	Waste	Fresh	Granite	GG	0.010	1.0	1040	*<0.2*	*<10*	90	1.5	0.060	0.030	0.010	71	1.5	4.0	2.4	4.6	1.4	3.8	0.13	0.37	0.020	0.0090	0.25	40
Statistical Summary						**Fresh**	**Granite**	**n**	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
								Max	0.10	1.0	1355	*<0.2*	*<10*	120	1.6	1.3	0.57	0.35	81	3.4	10	8.8	7.2	1.7	3.8	0.16	0.85	0.22	0.097	0.35	42
								90th PCTL	0.040	0.79	691	*<0.2*	*<10*	102	0.68	0.37	0.080	0.085	65	2.6	8.1	7.5	4.6	1.5	3.4	0.13	0.68	0.040	0.028	0.32	37
								75th PCTL	0.030	0.53	80	*<0.2*	*<10*	90	0.36	0.32	0.080	0.030	59	2.0	7.0	3.2	3.9	1.4	3.0	0.12	0.62	0.023	0.016	0.31	32
								Median	0.020	0.47	20	*<0.2*	*<10*	85	0.34	0.10	0.070	0.015	50	1.5	6.0	2.6	3.0	1.2	2.7	0.12	0.53	0.010	0.015	0.27	27
								25th PCTL	0.020	0.44	5.8	*<0.2*	*<10*	78	0.23	0.068	0.068	0.010	44	1.4	5.0	2.3	1.5	1.1	2.4	0.10	0.39	*<0.01*	0.013	0.25	23
								10th PCTL	0.010	0.42	4.5	*<0.2*	*<10*	67	0.18	0.060	0.039	*<0.01*	42	1.2	4.0	1.8	1.2	1.0	2.3	0.078	0.33	*<0.01*	0.012	0.22	21
								Min	0.010	0.40	3.3	*<0.2*	*<10*	20	0.14	0.050	0.030	*<0.01*	37	1.1	3.0	0.45	0.80	0.88	1.7	0.060	0.28	*<0.01*	0.0090	0.080	19

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Statistical Summary for Granite Waste Rock								**n**	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
								n < DL	0	0	0	54	53	0	0	0	0	7	0	0	0	0	0	0	0	0	9	0	0	0
								Max	0.14	1.1	3020	0.30	10	150	1.6	1.3	0.57	0.46	82	11	12	14	14	2.8	3.8	0.16	0.85	1.7	0.11	0.39	45
								90th PCTL	0.068	0.90	1984	*<0.2*	*<10*	110	0.66	0.36	0.090	0.054	64	2.7	8.0	4.8	6.6	1.7	3.3	0.13	0.65	0.48	0.017	0.33	33
								75th PCTL	0.040	0.73	457	*<0.2*	*<10*	90	0.53	0.13	0.080	0.030	54	1.9	6.0	3.2	3.9	1.4	2.9	0.12	0.60	0.20	0.016	0.29	30
								Median	0.030	0.53	82	*<0.2*	*<10*	80	0.36	0.090	0.070	0.020	49	1.4	5.0	2.4	2.3	1.2	2.5	0.10	0.39	0.030	0.013	0.24	26
								25th PCTL	0.020	0.45	11	*<0.2*	*<10*	50	0.25	0.070	0.040	0.010	41	1.1	4.0	1.3	1.6	0.96	2.0	0.090	0.30	0.010	0.011	0.16	21
								10th PCTL	0.020	0.43	5.2	*<0.2*	*<10*	30	0.17	0.060	0.026	*<0.01*	33	0.66	3.0	0.46	1.3	0.69	1.7	0.080	0.26	*<0.01*	0.0090	0.12	17
								Min	0.010	0.33	2.1	*<0.2*	*<10*	20	0.13	0.050	0.010	*<0.01*	21	0.10	2.0	0.23	0.80	0.36	0.96	0.060	0.11	*<0.01*	0.0070	0.020	11
Oxide Facies for Other Lithologies Waste Rock																															
KAM029389	ABA017	CFD0176	96.0	97.0	Waste	Oxide	Dykes	FC	*>100*	1.3	18	*<0.2*	*<10*	230	1.2	0.13	0.22	0.070	9.3	13	2.0	0.88	1065	2.4	2.6	*<0.05*	0.26	0.070	0.036	0.26	3.6
KAM029393	ABA018	CFD0176	99.0	100.0	Waste	Oxide	Dykes	FC	0.050	1.5	110	*<0.2*	*<10*	200	1.3	0.12	0.12	0.070	7.9	9.8	1.0	1.2	2.9	2.1	3.3	*<0.05*	0.16	0.13	0.040	0.25	3.3
KAM084551	ABA056	CFD0237	181.0	181.5	Waste	Oxide	HU	HU	0.090	1.1	1890	*<0.2*	10	50	0.99	0.47	0.40	0.090	15	16	21	2.0	25	3.3	2.9	0.050	0.030	2.0	0.025	0.33	6.7
R277468	ABA306	CFD0426	26.0	27.0	Waste	Oxide	SZ	SZ	0.050	0.79	20	*<0.2*	*<10*	110	0.63	0.37	0.21	0.020	66	6.5	22	1.1	7.9	1.4	2.5	0.070	0.23	0.050	*<0.005*	0.28	38
Statistical Summary						**Oxide**	**Other Lithologies**	**n**	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
								Max	100	1.5	1890	*<0.2*	10	230	1.3	0.47	0.40	0.090	66	16	22	2.0	1065	3.3	3.3	0.070	0.26	2.0	0.040	0.33	38
								90th PCTL	70	1.4	1356	*<0.2*	10	221	1.2	0.44	0.35	0.084	50	15	22	1.7	753	3.0	3.2	0.064	0.25	1.4	0.039	0.32	29
								75th PCTL	25	1.3	555	*<0.2*	*<10*	208	1.2	0.40	0.27	0.075	27	14	21	1.4	285	2.6	3.0	0.055	0.24	0.60	0.037	0.29	15
								Median	0.070	1.2	65	*<0.2*	*<10*	155	1.1	0.25	0.22	0.070	12	11	12	1.1	17	2.3	2.8	*<0.05*	0.20	0.10	0.031	0.27	5.2
								25th PCTL	0.050	0.99	19	*<0.2*	*<10*	95	0.90	0.13	0.19	0.058	9.0	9.0	1.8	1.0	6.7	2.0	2.6	*<0.05*	0.13	0.065	0.020	0.26	3.5
								10th PCTL	0.050	0.87	19	*<0.2*	*<10*	68	0.74	0.12	0.15	0.035	8.3	7.5	1.3	0.94	4.4	1.6	2.5	*<0.05*	0.069	0.056	0.011	0.25	3.4
								Min	0.050	0.79	18	*<0.2*	*<10*	50	0.63	0.12	0.12	0.020	7.9	6.5	1.0	0.88	2.9	1.4	2.5	*<0.05*	0.030	0.050	*<0.005*	0.25	3.3
Upper Transition Facies for Other Lithologies Waste Rock																															
KAM145425	ABA072	CFD0339	10.0	11.0	Waste	Upper transition	Dykes	FC	0.070	1.6	1165	*<0.2*	10	430	2.5	0.30	0.070	0.13	47	15	8.0	6.4	4.5	4.2	5.4	0.070	0.15	0.94	0.035	0.66	22
Q033703	ABA303	CFD0411	15.0	16.0	Waste	Upper transition	dykes	DIOR	0.15	0.80	194	*<0.2*	*<10*	280	0.59	0.44	0.10	0.31	63	0.80	2.0	1.9	6.3	1.6	3.4	0.11	1.2	0.070	0.020	0.22	34
Q034859	ABA311	CFD0473	164.0	165.0	Waste	Upper transition	dykes	FC	0.080	4.0	196	*<0.2*	*<10*	780	1.9	0.050	0.95	0.10	26	35	9.0	15	31	6.3	11	0.20	0.34	0.090	0.046	0.63	12
R273647	ABA305	CFD0456	55.0	56.0	Waste	Upper transition	Fault	FLT	0.060	2.7	450	*<0.2*	*<10*	200	1.5	0.13	0.28	0.020	17	17	66	12	13	3.2	6.0	0.14	0.040	0.12	0.033	0.81	6.5
KAM019714	ABA061	CFD0083	8.0	9.0	Waste	Upper transition	Metabasalt/ Amphibolite	Amph	0.030	1.3	8.1	*<0.2*	*<10*	190	0.54	0.13	1.2	0.060	76	9.2	25	1.1	7.9	2.1	4.3	0.10	0.15	*<0.01*	0.010	0.72	42
KAM035755	ABA022	CFD0080	122.0	123.0	Waste	Upper transition	YO	YO	0.10	1.3	1200	0.40	10	400	1.1	0.34	5.0	0.070	43	16	41	1.2	21	3.0	4.0	0.080	0.040	0.33	0.046	0.29	22
R545623	ABA368	CFD0524	92.0	92.6	Waste	Upper Transition	Yx	Yx	0.020	1.1	87	*<0.2*	*<10*	110	1.2	0.10	0.10	0.020	49	6.6	32	3.1	2.6	1.6	4.3	0.080	0.29	0.20	0.013	0.56	26
Statistical Summary						**Upper Transition**	**Other Lithologies**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	0.15	4.0	1200	0.40	10	780	2.5	0.44	5.0	0.31	76	35	66	15	31	6.3	11	0.20	1.2	0.94	0.046	0.81	42
								90th PCTL	0.12	3.2	1179	0.28	10	570	2.1	0.38	2.7	0.20	68	24	51	13	25	5.0	8.1	0.16	0.70	0.57	0.046	0.76	37
								75th PCTL	0.090	2.1	808	*<0.2*	10	415	1.7	0.32	1.1	0.12	56	16	37	9.1	17	3.7	5.7	0.13	0.32	0.27	0.041	0.69	30
								Median	0.070	1.3	196	*<0.2*	*<10*	280	1.2	0.13	0.28	0.070	47	15	25	3.1	7.9	3.0	4.3	0.10	0.15	0.12	0.033	0.63	22
								25th PCTL	0.045	1.2	140	*<0.2*	*<10*	195	0.83	0.12	0.10	0.040	35	7.9	8.5	1.5	5.4	1.9	4.1	0.080	0.095	0.080	0.017	0.43	17
								10th PCTL	0.026	0.97	55	*<0.2*	*<10*	158	0.57	0.080	0.088	0.020	23	4.3	5.6	1.1	3.7	1.6	3.8	0.076	0.040	0.046	0.012	0.26	9.7
								Min	0.020	0.80	8.1	*<0.2*	*<10*	110	0.54	0.050	0.070	0.020	17	0.80	2.0	1.1	2.6	1.6	3.4	0.070	0.040	*0.010*	0.010	0.22	6.5
Lower Transition Facies for Other Lithologies Waste Rock																															
R282332	ABA312	CFD0474	37.0	38.0	Waste	Lower transition	dykes	IV	0.050	2.9	5.0	*<0.2*	*<10*	450	0.34	0.050	1.8	0.080	29	14	17	3.8	12	3.6	8.0	0.090	0.63	*<0.01*	0.021	0.47	16
Q035862	ABA313	CFD0491	124.0	125.0	Waste	Lower transition	dykes	IV	0.040	1.9	140	*<0.2*	*<10*	320	1.5	0.060	0.15	0.12	39	15	14	3.2	14	3.4	5.1	0.12	0.36	0.26	0.029	0.46	22
R283583	ABA449	CFD0496	90.0	91.0	Waste	Lower Transition	Metabasalt	MBSLT	0.43	0.76	78	*<0.2*	10	60	1.6	0.39	5.1	0.45	37	18	12	1.6	7.4	4.1	2.5	0.10	0.040	0.050	0.021	0.45	18
R283583	ABA304	CFD0496	90.0	91.0	Waste	Lower transition	Metabasalt/ Amphibolite	MBSLT	0.40	0.79	78	*<0.2*	*<10*	60	1.4	0.37	5.4	0.45	36	18	13	1.5	7.2	4.2	2.4	0.10	0.040	0.070	0.019	0.47	17
Q033764	ABA308	CFD0411	70.0	71.0	Waste	Lower transition	YC	YC	0.030	1.1	128	*<0.2*	*<10*	110	1.5	0.66	5.1	0.10	55	14	32	4.9	9.6	3.9	3.3	0.11	0.030	0.050	0.026	0.27	26
R276691	ABA310	CFD0413	21.0	22.0	Waste	Lower transition	Ylim	Ylim	0.010	0.72	84	*<0.2*	*<10*	160	0.87	0.18	1.1	0.060	82	6.5	6.0	0.59	4.0	1.7	1.7	0.11	0.15	0.12	0.0090	0.25	45
Statistical Summary						**Lower Transition**	**Other Lithologies**	**n**	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
								Max	0.43	2.9	140	*<0.2*	10	450	1.6	0.66	5.4	0.45	82	18	32	4.9	14	4.2	8.0	0.12	0.63	0.26	0.029	0.47	45
								90th PCTL	0.42	2.4	134	*<0.2*	10	385	1.6	0.53	5.2	0.45	68	18	25	4.3	13	4.1	6.5	0.12	0.50	0.19	0.028	0.47	35
								75th PCTL	0.31	1.7	117	*<0.2*	*<10*	280	1.5	0.39	5.1	0.37	51	17	16	3.7	12	4.0	4.6	0.11	0.31	0.11	0.025	0.47	25
								Median	0.045	0.93	81	*<0.2*	*<10*	135	1.4	0.28	3.5	0.11	38	14	14	2.4	8.5	3.8	2.9	0.11	0.095	0.060	0.021	0.46	20
								25th PCTL	0.033	0.77	78	*<0.2*	*<10*	73	0.99	0.090	1.2	0.085	36	14	12	1.5	7.3	3.5	2.4	0.10	0.040	0.050	0.020	0.32	17
								10th PCTL	0.020	0.74	42	*<0.2*	*<10*	60	0.61	0.055	0.60	0.070	32	10	9.0	1.0	5.6	2.6	2.0	0.095	0.035	0.030	0.014	0.26	16
								Min	0.010	0.72	5.0	*<0.2*	*<10*	60	0.34	0.050	0.15	0.060	29	6.5	6.0	0.59	4.0	1.7	1.7	0.090	0.030	*<0.01*	0.0090	0.25	16
Fresh Facies for Other Lithologies Waste Rock																															
R304353	ABA349	CFD0541	90.0	91.0	Waste	Fresh	IV	IV	0.020	1.6	28	*<0.2*	*<10*	120	0.41	0.040	0.83	0.040	33	12	2.0	0.71	3.4	2.9	4.8	0.060	0.47	*<0.01*	0.016	0.22	16
R304282	ABA352	CFD0539	90.0	91.0	Waste	Fresh	IV	IV	0.040	2.1	5.0	*<0.2*	*<10*	170	0.23	0.13	2.9	0.10	40	13	16	0.94	13	3.4	6.4	0.070	0.48	*<0.01*	0.028	0.35	21
KAM133438	ABA087	CFR0429	10.7	12.2	Waste	Fresh	Mafic/ Ultramafic	RU	0.030	1.5	9.0	*<0.2*	*<10*	600	0.76	0.26	2.4	0.020	43	33	324	8.4	14	3.2	6.3	0.080	0.030	0.010	0.023	1.1	24
R277453	ABA307	CFD0423	81.0	82.0	Waste	Fresh	Mafic/ Ultramafic	RU	0.030	3.0	29	*<0.2*	*<10*	690	1.2	0.13	3.1	0.030	46	30	413	11	11	3.7	9.2	0.13	0.060	0.010	0.021	1.5	26
R274909	ABA447	CFD0472	143.2	144.0	Waste	Fresh	Metabasalt	MBSLT	0.020	2.6	142	*<0.2*	*<10*	150	1.9	0.070	1.5	*<0.01*	23	20	340	6.2	5.7	3.3	7.6	0.11	0.13	0.070	0.018	1.0	13
R274918	ABA448	CFD0472	150.0	151.0	Waste	Fresh	Metabasalt	MBSLT	0.010	0.91	3.6	*<0.2*	*<10*	30	0.22	0.29	2.0	*<0.01*	14	2.4	15	0.75	6.0	1.2	2.6	0.23	0.22	*<0.01*	0.049	0.070	7.0
R293475	ABA450	CFR0730	91.4	93.0	Waste	Fresh	Metabasalt	MBSLT	0.040	3.1	3.6	*<0.2*	*<10*	300	0.52	0.20	3.3	0.060	30	16	23	5.9	13	4.4	9.4	0.13	0.28	*<0.01*	0.026	0.80	14
Statistical Summary						**Lower Transition**	**Other Lithologies**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	0.040	3.1	142	*<0.2*	*<10*	690	1.9	0.29	3.3	0.10	46	33	413	11	14	4.4	9.4	0.23	0.48	0.070	0.049	1.5	26
								90th PCTL	0.040	3.0	74	*<0.2*	*<10*	636	1.5	0.27	3.2	0.076	44	31	369	9.3	13	4.0	9.3	0.17	0.47	0.034	0.036	1.3	24
								75th PCTL	0.035	2.8	29	*<0.2*	*<10*	450	0.98	0.23	3.0	0.050	42	25	332	7.3	13	3.6	8.4	0.13	0.38	0.010	0.027	1.0	22
								Median	0.030	2.1	9.0	*<0.2*	*<10*	170	0.52	0.13	2.4	0.030	33	16	23	5.9	11	3.3	6.4	0.11	0.22	*<0.01*	0.023	0.80	16
								25th PCTL	0.020	1.5	4.3	*<0.2*	*<10*	135	0.32	0.10	1.8	0.015	27	12	16	0.85	5.9	3.0	5.6	0.075	0.095	*<0.01*	0.020	0.29	13
								10th PCTL	0.016	1.3	3.6	*<0.2*	*<10*	84	0.23	0.058	1.2	*<0.01*	19	7.9	9.8	0.73	4.8	2.2	3.9	0.066	0.048	*<0.01*	0.017	0.16	10
								Min	0.010	0.91	3.6	*<0.2*	*<10*	30	0.22	0.040	0.83	*<0.01*	14	2.4	2.0	0.71	3.4	1.2	2.6	0.060	0.030	*<0.01*	0.016	0.070	7.0
Statistical Summary for Other Lithologies Waste Rock								**n**	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
								n < DL	0	0	0	23	20	0	0	0	0	2	0	0	0	0	0	0	0	2	0	6	1	0	0
								Max	100	4.0	1890	0.40	10	780	2.5	0.66	5.4	0.45	82	35	413	15	1065	6.3	11	0.23	1.2	2.0	0.049	1.5	45
								90th PCTL	0.33	2.9	951	*<0.2*	*<10*	555	1.8	0.43	5.1	0.26	65	27	247	9.9	24	4.2	8.8	0.14	0.48	0.31	0.044	0.96	37
								75th PCTL	0.083	2.2	155	*<0.2*	*<10*	340	1.5	0.35	3.0	0.10	47	17	32	6.0	13	3.8	6.4	0.11	0.30	0.12	0.034	0.68	26
								Median	0.045	1.4	81	*<0.2*	*<10*	195	1.1	0.16	1.1	0.070	38	14	17	1.9	8.8	3.2	4.3	0.10	0.16	0.070	0.024	0.46	20
								25th PCTL	0.030	1.0	16	*<0.2*	*<10*	110	0.58	0.12	0.22	0.028	25	9.7	8.8	1.1	5.9	2.1	2.8	0.070	0.040	*<0.01*	0.019	0.27	12
								10th PCTL	0.020	0.79	5.0	*<0.2*	*<10*	60	0.36	0.053	0.11	0.020	14	6.5	2.0	0.79	3.6	1.6	2.5	0.053	0.033	*<0.01*	0.011	0.23	6.6
								Min	0.010	0.72	3.6	*<0.2*	*<10*	30	0.22	0.040	0.070	*<0.01*	7.9	0.80	1.0	0.59	2.6	1.2	1.7	*<0.05*	0.030	*<0.01*	*<0.005*	0.070	3.3

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Oxide Facies for Gneiss Waste Rock																																				
ABA001	KAM000219	CFD0002	21.0	22.0	Waste	Oxide	Gneiss	FG	2.4	0.030	544	1.1	0.010	0.050	7.9	170	13	11	*<0.001*	*<0.01*	16	1.5	0.70	0.70	17	*<0.01*	0.010	30	*<0.005*	0.81	29	10	0.23	12	31	5.0
ABA043	KAM050495	CFD0152	149.0	150.0	Waste	Oxide	Gneiss	MxF	3.0	0.10	133	0.64	0.010	0.13	0.60	30	7.7	17	*<0.001*	*<0.01*	2.9	0.30	0.40	0.30	20	*<0.01*	*<0.01*	38	*<0.005*	0.11	2.4	1.0	0.33	11	5.0	10
ABA052	KAM079466	CFD0254	72.0	73.0	Waste	Oxide	Gneiss	MxF	1.3	0.060	136	0.45	0.11	0.10	1.9	80	3.2	9.5	*<0.001*	*<0.01*	0.63	1.3	0.70	0.30	12	*<0.01*	0.020	26	*<0.005*	0.060	1.8	4.0	0.090	14	8.0	7.2
ABA063	KAM125214	CFD0307	10.0	11.0	Waste	Oxide	Gneiss	MxF	3.9	0.31	380	1.6	0.080	0.34	2.6	390	2.1	47	0.0010	*<0.01*	1.1	2.0	0.80	1.4	8.9	*<0.01*	0.17	32	0.059	0.57	7.3	9.0	0.20	19	19	8.4
ABA064	KAM125257	CFD0307	49.0	50.0	Waste	Oxide	Gneiss	MxF	1.7	0.050	204	0.22	0.020	0.16	1.6	140	8.1	15	*<0.001*	*<0.01*	22	0.40	0.50	0.20	6.0	*<0.01*	0.060	38	*<0.005*	0.16	3.8	6.0	0.60	14	10	15
ABA080	KAM115505	CFR0360	25.9	27.4	Waste	Oxide	Gneiss	MxF	1.1	0.020	183	0.90	*<0.01*	*<0.05*	6.3	210	7.6	6.4	*<0.001*	*<0.01*	3.2	1.3	0.50	1.3	11	*<0.01*	*<0.01*	35	*<0.005*	0.16	11	8.0	0.58	13	8.0	7.1
ABA081	KAM117096	CFR0384	22.9	24.4	Waste	Oxide	Gneiss	MxF	2.2	0.040	489	1.9	0.010	0.060	1.9	220	13	12	*<0.001*	*<0.01*	2.0	1.3	0.40	0.40	9.9	*<0.01*	*<0.01*	33	0.0060	0.12	13	6.0	0.45	15	23	2.4
ABA083	KAM119516	CFR0418	19.8	21.3	Waste	Oxide	Gneiss	MxF	2.3	0.090	138	1.2	0.060	0.33	1.7	60	4.9	21	*<0.001*	*<0.01*	1.4	0.80	0.60	0.90	12	*<0.01*	*<0.01*	41	0.010	0.14	1.4	4.0	1.1	14	12	14
ABA085	KAM120107	CFR0425	15.2	16.8	Waste	Oxide	Gneiss	MxM	1.8	0.070	309	2.9	0.010	0.10	4.7	170	6.4	16	*<0.001*	*<0.01*	2.4	0.70	0.40	0.20	11	*<0.01*	0.010	35	0.0070	0.15	4.5	5.0	0.50	14	18	7.8
ABA096	KAM137284	CFR0468	32.0	33.5	Waste	Oxide	Gneiss	MxF	5.3	0.37	292	1.3	0.050	0.62	6.5	380	33	55	*<0.001*	0.010	3.1	2.1	0.60	1.4	22	*<0.01*	0.23	26	0.095	0.40	6.2	13	0.52	14	18	6.5
ABA104	KAM139298	CFR0482	10.7	12.2	Waste	Oxide	Gneiss	MxF	1.7	0.020	317	1.3	*<0.01*	0.10	3.6	120	22	14	*<0.001*	*<0.01*	14	1.0	0.50	0.40	9.0	*<0.01*	0.010	36	*<0.005*	0.28	12	5.0	0.69	13	21	2.9
ABA136	KAM151967	CFR0584	109.7	111.3	Waste	Oxide	Gneiss	MxF	1.5	0.020	363	1.5	*<0.01*	*<0.05*	6.0	160	11	8.7	*<0.001*	0.010	30	1.3	0.50	0.80	11	*<0.01*	0.010	37	*<0.005*	0.39	8.5	7.0	0.58	15	17	5.7
ABA137	KAM151932	CFR0584	61.0	62.5	Waste	Oxide	Gneiss	MxF	2.6	0.25	228	2.5	0.060	0.15	6.3	180	3.8	31	*<0.001*	0.010	1.3	1.6	0.20	1.5	17	*<0.01*	0.030	32	0.020	0.29	4.6	11	0.94	12	11	8.1
ABA138	KAM152219	CFR0586	155.5	157.0	Waste	Oxide	Gneiss	MxF	1.5	0.040	290	2.1	0.030	0.050	7.4	150	9.5	10	*<0.001*	0.020	1.7	0.60	0.40	0.30	14	*<0.01*	0.010	33	*<0.005*	0.10	2.4	3.0	0.69	7.7	17	5.8
ABA144	KAM152716	CFR0591	30.5	32.0	Waste	Oxide	Gneiss	MxF	1.4	0.020	129	1.4	*<0.01*	0.070	2.1	60	6.5	11	0.0010	0.020	3.3	0.30	0.40	0.90	23	*<0.01*	0.020	36	*<0.005*	0.10	3.6	1.0	0.39	12	5.0	10
ABA145	KAM153015	CFR0594	61.0	62.5	Waste	Oxide	Gneiss	MxF	2.0	0.090	190	2.0	0.060	0.20	2.0	70	3.8	12	*<0.001*	0.13	1.4	0.40	0.40	2.3	41	*<0.01*	0.060	35	0.0050	0.12	7.4	3.0	2.5	14	6.0	11
ABA146	KAM153091	CFR0594	164.6	166.1	Waste	Oxide	Gneiss	MxF	5.9	0.070	1160	2.9	*<0.01*	*<0.05*	19	180	5.8	9.5	*<0.001*	0.020	25	4.2	0.70	0.90	28	*<0.01*	0.010	33	*<0.005*	0.43	20	18	0.43	18	12	6.4
ABA149	KAM153152	CFR0595	61.0	62.5	Waste	Oxide	Gneiss	MxF	1.5	0.13	110	2.0	0.090	0.17	2.6	60	6.0	12	*<0.001*	0.060	0.70	0.40	0.30	0.70	37	*<0.01*	0.020	38	0.0050	0.060	7.7	2.0	2.1	13	5.0	9.1
ABA224	R277421	CFD0423	53.0	54.0	Waste	Oxide	Gneiss	MxM	5.2	0.31	605	1.5	*<0.01*	*<0.05*	34	680	11	39	0.0010	0.010	42	8.8	1.2	3.1	11	*<0.01*	0.10	15	0.029	2.3	19	47	0.39	28	45	2.0
ABA225	R272412	CFD0436	9.0	10.0	Waste	Oxide	Gneiss	FG	2.9	0.15	178	0.15	0.040	0.17	2.6	80	5.8	63	*<0.001*	0.010	4.1	1.2	0.60	1.7	9.5	*<0.01*	0.030	41	0.024	0.39	4.6	6.0	0.24	13	15	7.2
ABA226	R272445	CFD0436	38.0	39.0	Waste	Oxide	Gneiss	FG	6.0	1.2	475	0.47	0.030	*<0.05*	48	300	5.9	87	*<0.001*	0.010	2.4	6.3	0.50	2.2	15	*<0.01*	0.010	26	0.071	0.66	3.6	37	1.0	16	32	8.3
ABA227	R272537	CFD0436	120.0	121.0	Waste	Oxide	Gneiss	MxF	2.3	0.070	226	0.24	0.050	0.080	0.80	170	7.1	20	*<0.001*	0.010	2.6	0.80	0.40	1.2	8.9	*<0.01*	0.020	38	0.0070	0.16	6.7	3.0	0.19	11	16	4.7
ABA228	R271769	CFD0425	80.0	81.0	Waste	Oxide	Gneiss	MxF	3.3	0.21	171	0.24	0.050	0.89	1.7	180	6.4	26	*<0.001*	0.010	0.72	1.1	0.40	3.8	98	*<0.01*	*<0.01*	30	0.033	0.17	2.9	7.0	0.42	9.9	13	12
ABA229	R272589	CFD0436	166.0	167.0	Waste	Oxide	Gneiss	MxF	2.1	0.020	277	0.88	0.010	0.050	1.2	110	10	10	*<0.001*	0.010	5.6	0.70	0.20	0.40	31	*<0.01*	0.030	32	*<0.005*	0.13	9.9	3.0	0.17	8.6	7.0	2.6
ABA230	R280455	CFD0497	90.0	91.0	Waste	Oxide	Gneiss	MxM	1.2	0.10	164	4.2	0.040	0.38	2.1	50	6.8	14	*<0.001*	0.12	0.47	0.50	0.40	0.40	28	*<0.01*	0.030	36	0.0050	0.090	7.9	6.0	0.19	14	9.0	12
ABA231	R277177	CFD0421	47.0	48.0	Waste	Oxide	Gneiss	MxM	2.0	0.040	203	0.25	0.010	0.050	4.7	300	8.4	8.9	*<0.001*	*<0.01*	9.6	1.7	0.40	0.40	7.3	*<0.01*	0.030	32	*<0.005*	0.20	1.3	6.0	0.15	13	12	9.0
ABA232	R277505	CFD0426	58.0	59.0	Waste	Oxide	Gneiss	MxM	1.0	0.010	120	0.45	*<0.01*	0.10	1.4	70	7.1	5.5	*<0.001*	0.010	8.7	0.70	0.50	0.40	11	*<0.01*	0.020	40	*<0.005*	0.11	3.9	5.0	0.15	15	5.0	6.6
ABA233	R277739	CFD0431	118.0	119.0	Waste	Oxide	Gneiss	MxF	1.3	0.030	337	0.61	0.010	0.050	2.5	80	13	17	*<0.001*	0.010	14	0.50	0.30	0.30	6.8	*<0.01*	0.020	36	*<0.005*	0.26	9.1	5.0	0.50	9.6	12	5.1
ABA234	R277403	CFD0423	37.0	38.0	Waste	Oxide	Gneiss	MxM	1.5	0.060	153	0.83	0.030	0.28	1.0	100	7.7	18	*<0.001*	0.010	1.5	0.60	0.40	0.40	5.0	*<0.01*	0.020	41	0.0060	0.11	4.5	3.0	0.080	13	11	11
ABA235	R277137	CFD0421	11.0	12.0	Waste	Oxide	Gneiss	MxM	3.3	0.21	230	0.38	0.020	0.090	5.6	470	5.2	26	*<0.001*	*<0.01*	15	1.9	0.70	2.0	9.8	*<0.01*	0.31	34	0.016	0.36	2.2	8.0	0.22	19	19	5.8
ABA380	KAM075906	CFD0216	90.0	91.0	Waste	Oxide	Gneiss	MxF	0.90	0.020	35	3.9	0.010	0.080	0.50	40	20	11	*<0.001*	*<0.01*	52	0.20	0.30	0.20	11	*<0.01*	0.020	40	*<0.005*	0.29	8.7	*<1*	0.18	7.4	6.0	3.6
ABA382	KAM067845	CFD0221	211.0	212.0	Waste	Oxide	Gneiss	FG	1.6	0.29	196	1.7	0.010	0.090	0.40	80	18	14	*<0.001*	0.040	2.3	0.50	0.60	0.40	34	*<0.01*	0.010	40	*<0.005*	0.090	7.4	1.0	0.16	16	10	17
ABA384	KAM068794	CFD0238	227.0	228.0	Waste	Oxide	Gneiss	FG	1.5	0.010	224	0.43	0.010	*<0.05*	1.4	190	7.8	4.0	*<0.001*	*<0.01*	8.7	1.4	0.50	1.5	20	*<0.01*	*<0.01*	43	*<0.005*	0.29	14	8.0	0.19	14	13	17
ABA393	KAM030104	CFR0109	50.9	52.4	Waste	Oxide	Gneiss	FG	1.4	0.020	156	1.2	*<0.01*	*<0.05*	2.2	120	17	8.4	*<0.001*	0.010	6.6	0.90	0.40	0.80	22	*<0.01*	0.060	34	*<0.005*	0.24	18	4.0	0.71	11	9.0	5.0
Statistical Summary						**Oxide**	**Gneiss**	**n**	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
								Max	6.0	1.2	1160	4.2	0.11	0.89	48	680	33	87	0.0010	0.13	52	8.8	1.2	3.8	98	*0.010*	0.31	43	0.095	2.3	29	47	2.5	28	45	17
								90th PCTL	4.8	0.30	485	2.8	0.060	0.34	7.8	356	17	45	*0.0010*	0.034	24	2.1	0.70	2.1	33	*0.010*	0.088	41	0.032	0.53	17	12	1.00	17	22	13
								75th PCTL	2.8	0.15	315	1.8	0.048	0.17	5.9	188	11	21	*0.0010*	0.010	13	1.5	0.60	1.4	22	*0.010*	0.030	38	0.0093	0.34	9.7	8.0	0.60	15	18	10
								Median	1.9	0.065	214	1.2	0.010	0.090	2.4	145	7.7	14	*0.0010*	0.010	3.1	0.95	0.45	0.75	12	*0.010*	0.020	35	*0.0050*	0.17	7.0	5.5	0.41	13	12	7.2
								25th PCTL	1.5	0.023	158	0.46	0.010	0.050	1.6	80	5.9	10	*0.0010*	*0.010*	1.5	0.53	0.40	0.40	9.8	*0.010*	0.010	32	*0.0050*	0.11	3.7	3.0	0.19	12	8.3	5.3
								10th PCTL	1.2	0.020	130	0.24	*0.010*	*0.050*	0.86	60	4.1	8.5	*0.0010*	*0.010*	0.82	0.40	0.30	0.30	7.8	*0.010*	*0.010*	27	*0.0050*	0.093	2.2	1.3	0.15	9.7	5.3	3.1
								Min	0.90	0.010	35	0.15	*0.010*	*0.050*	0.40	30	2.1	4.0	*0.0010*	*0.010*	0.47	0.20	0.20	0.20	5.0	*0.010*	*0.010*	15	*0.0050*	0.060	1.3	*1.0*	0.080	7.4	5.0	2.0
Upper Transition Facies for Gneiss Waste Rock																																				
ABA016	KAM029087	CFD0175	145.0	146.0	Waste	Upper transition	Gneiss	MxF	2.2	0.080	365	0.45	0.010	*<0.05*	4.2	370	19	10	*<0.001*	*<0.01*	4.1	4.6	0.70	0.90	29	*<0.01*	0.030	31	*<0.005*	0.13	4.3	25	0.15	12	28	23
ABA042	KAM050492	CFD0152	146.0	147.0	Waste	Upper transition	Gneiss	MxF	1.4	0.030	137	0.16	0.010	0.15	0.60	40	5.2	17	*<0.001*	*<0.01*	1.8	0.20	0.30	0.20	27	*<0.01*	*<0.01*	38	*<0.005*	0.090	3.5	1.0	0.21	9.0	3.0	7.3
ABA057	KAM096548	CFD0269	33.0	34.0	Waste	Upper transition	Gneiss	FG	1.1	0.020	579	0.50	0.010	0.050	1.6	150	8.5	18	*<0.001*	*<0.01*	32	0.50	0.20	0.70	19	*<0.01*	0.010	32	*<0.005*	0.18	7.3	8.0	0.72	6.8	9.0	6.4
ABA059	KAM097012	CFD0272	17.0	18.0	Waste	Upper transition	Gneiss	FG	2.7	0.070	445	0.72	0.070	0.18	3.7	190	32	25	*<0.001*	*<0.01*	7.7	1.3	0.50	1.0	11	*<0.01*	*<0.01*	34	0.0080	0.34	6.0	7.0	0.50	14	14	9.9
ABA060	KAM097065	CFD0272	65.0	66.0	Waste	Upper transition	Gneiss	FG	4.6	0.090	257	2.0	0.010	0.060	0.90	170	12	18	*<0.001*	0.040	4.9	0.60	0.30	1.1	27	*<0.01*	0.010	29	*<0.005*	0.15	7.3	2.0	0.62	7.4	11	9.5
ABA069	KAM145287	CFD0338	123.0	124.0	Waste	Upper transition	Gneiss	FG	0.60	0.020	286	1.1	*<0.01*	*<0.05*	0.80	130	19	13	*<0.001*	0.020	5.4	0.50	0.50	0.60	11	*<0.01*	0.040	35	*<0.005*	0.24	22	2.0	0.21	15	22	4.0
ABA101	KAM137634	CFR0470	109.7	111.3	Waste	Upper transition	Gneiss	MxF	2.0	0.16	421	1.8	*<0.01*	0.080	6.4	460	21	11	*<0.001*	0.070	3.9	4.2	0.70	1.6	48	*<0.01*	0.080	22	0.0080	0.25	3.2	30	0.69	21	26	10
ABA105	KAM139327	CFR0482	50.3	51.8	Waste	Upper transition	Gneiss	MxF	1.7	0.020	295	1.5	*<0.01*	0.080	3.5	120	9.8	11	*<0.001*	*<0.01*	4.5	0.80	0.40	0.40	7.6	*<0.01*	0.010	34	*<0.005*	0.29	13	4.0	0.63	13	16	2.9
ABA141	KAM152499	CFR0589	77.7	79.3	Waste	Upper transition	Gneiss	MxF	3.2	0.43	236	2.2	0.050	0.26	7.9	280	4.1	43	*<0.001*	0.060	1.1	1.5	0.30	1.0	34	*<0.01*	0.020	32	0.052	0.24	4.4	14	1.2	13	18	16
ABA147	KAM152978	CFR0594	10.7	12.2	Waste	Upper transition	Gneiss	MxF	0.60	0.030	134	2.5	0.060	0.37	7.1	60	7.1	15	*<0.001*	0.020	0.11	0.20	0.40	0.60	20	*<0.01*	0.14	37	*<0.005*	0.080	2.9	1.0	1.1	10	2.0	12
ABA237	R270907	CFD0412	10.0	11.0	Waste	Upper transition	Gneiss	MxF	1.4	0.12	279	4.4	0.020	0.060	6.6	160	6.0	15	*<0.001*	0.010	1.8	2.2	0.30	0.30	17	*<0.01*	0.17	33	*<0.005*	0.10	2.7	15	0.070	11	14	6.2
ABA238	R280433	CFD0497	28.0	29.0	Waste	Upper transition	Gneiss	MxM	1.2	0.030	146	0.62	0.030	0.19	1.2	80	4.8	10	*<0.001*	0.010	1.4	0.50	0.30	0.50	11	*<0.01*	1.2	40	*<0.005*	0.15	4.8	3.0	0.090	11	7.0	8.8
ABA239	Q034712	CFD0473	7.0	8.0	Waste	Upper transition	Gneiss	FG	1.6	0.020	153	0.52	0.040	0.10	3.1	80	4.0	9.5	*<0.001*	*<0.01*	1.4	0.40	0.40	1.9	4.6	*<0.01*	0.020	41	*<0.005*	0.070	2.5	2.0	0.10	14	3.0	11
ABA240	Q034807	CFD0473	117.0	118.0	Waste	Upper transition	Gneiss	FG	2.1	0.020	331	0.61	0.010	*<0.05*	3.0	200	8.8	10	*<0.001*	0.010	3.6	1.4	0.30	0.60	27	*<0.01*	0.030	33	*<0.005*	0.16	6.4	5.0	0.13	13	10	2.5
ABA241	R272496	CFD0436	83.0	84.0	Waste	Upper transition	Gneiss	MxF	1.4	0.040	140	0.33	0.010	0.090	1.2	240	7.4	11	*<0.001*	0.010	8.3	0.90	0.20	1.3	6.2	*<0.01*	0.020	34	*<0.005*	0.23	5.3	3.0	0.36	11	12	8.4
ABA242	R270718	CFD0404	69.0	70.0	Waste	Upper transition	Gneiss	MxF	0.70	0.030	282	0.42	*<0.01*	*<0.05*	3.0	180	12	6.7	*<0.001*	0.010	83	0.70	0.30	0.70	9.0	*<0.01*	0.010	38	*<0.005*	0.32	2.2	5.0	0.44	12	15	8.2
ABA243	R271483	CFD0420	51.0	52.0	Waste	Upper transition	Gneiss	MxF	2.7	0.070	99	0.95	0.010	0.19	1.5	160	12	23	*<0.001*	*<0.01*	7.4	0.90	0.80	3.9	7.4	*<0.01*	*<0.01*	39	0.011	0.25	11	2.0	0.28	17	13	4.5
ABA244	R272865	CFD0441	40.0	41.0	Waste	Upper transition	Gneiss	MxF	2.4	0.19	72	1.4	0.010	*<0.05*	8.0	170	18	22	*<0.001*	*<0.01*	12	6.4	0.40	0.50	16	*<0.01*	0.020	26	0.0080	0.34	14	37	0.12	16	27	2.3
ABA245	R278947	CFD0461	10.0	11.0	Waste	Upper transition	Gneiss	MxM	2.5	0.050	226	1.1	*<0.01*	*<0.05*	4.4	250	10	9.8	*<0.001*	0.020	39	3.1	0.80	0.80	24	*<0.01*	0.070	27	*<0.005*	0.29	20	13	0.45	24	24	5.3
ABA353	R304081	CFD0525	10.0	11.0	Waste	Upper Transition	Gneiss	MxF	9.1	0.76	823	0.96	0.030	0.11	55	1120	5.2	64	*<0.001*	*<0.01*	16	6.4	0.50	2.7	15	*<0.01*	0.89	12	0.088	0.97	3.3	61	0.22	12	43	1.3
ABA367	R545582	CFD0524	56.0	57.0	Waste	Upper Transition	Gneiss	MxF	2.4	0.010	144	0.39	0.010	0.060	5.1	170	12	11	*<0.001*	*<0.01*	18	0.80	0.50	1.3	74	*<0.01*	0.010	31	*<0.005*	0.67	14	6.0	0.32	11	8.0	4.7
ABA373	R271332	CFD0417	58.0	59.0	Waste	Upper Transition	Gneiss	MxF	2.4	0.010	38	1.0	0.010	*<0.05*	1.0	80	16	10	0.0020	0.080	20	1.0	0.40	1.0	19	*<0.01*	*<0.01*	34	*<0.005*	3.2	12	2.0	0.17	8.0	13	1.4
ABA385	KAM068709	CFD0238	151.0	152.0	Waste	Upper Transition	Gneiss	MxF	1.3	0.020	127	0.18	0.010	0.080	1.2	70	13	11	*<0.001*	*<0.01*	3.9	0.40	0.40	0.30	15	*<0.01*	*<0.01*	41	*<0.005*	0.17	5.7	8.0	0.13	11	5.0	12
ABA386	KAM069164	CFD0242	220.5	221.0	Waste	Upper Transition	Gneiss	FG	1.4	0.020	67	0.90	0.010	*<0.05*	2.3	120	13	10	*<0.001*	*<0.01*	18	3.5	0.40	0.70	48	*<0.01*	0.010	34	*<0.005*	0.20	20	15	0.16	8.5	20	8.9
ABA407	R272624	CFD0438	17.0	18.0	Waste	Upper Transition	Gneiss	MxF	12	1.6	936	0.33	0.030	*<0.05*	25	1290	7.7	107	*<0.001*	*<0.01*	9.7	12	0.90	2.6	28	*<0.01*	0.11	17	0.14	1.9	14	96	0.67	18	70	3.5
ABA411	R544193	CFD0502	40.0	41.0	Waste	Upper Transition	Gneiss	MxF	6.4	0.040	431	0.71	0.010	*<0.05*	26	230	10	7.5	*<0.001*	*<0.01*	10	12	1.0	5.2	14	*<0.01*	0.010	25	*<0.005*	0.56	15	48	0.22	28	23	2.4
Statistical Summary						**Upper Transition**	**Gneiss**	**n**	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
								Max	12	1.6	936	4.4	0.070	0.37	55	1290	32	107	0.0020	0.080	83	12	1.0	5.2	74	*<0.01*	1.2	41	0.14	3.2	22	96	1.2	28	70	23
								90th PCTL	5.5	0.31	512	2.1	0.045	0.19	16	415	19	34	*<0.001*	0.050	26	6.4	0.80	2.7	41	*<0.01*	0.16	39	0.032	0.82	17	43	0.71	19	28	12
								75th PCTL	2.7	0.088	357	1.3	0.028	0.11	6.6	238	13	18	*<0.001*	0.018	15	3.4	0.50	1.3	27	*<0.01*	0.063	36	0.0073	0.34	13	15	0.59	14	23	9.8
								Median	2.1	0.035	247	0.81	0.010	0.060	3.3	170	10	11	*<0.001*	*<0.01*	6.4	0.95	0.40	0.85	18	*<0.01*	0.020	33	*<0.005*	0.24	6.2	6.5	0.25	12	14	6.9
								25th PCTL	1.4	0.020	138	0.46	0.010	*<0.05*	1.3	120	7.2	10	*<0.001*	*<0.01*	3.7	0.53	0.30	0.60	11	*<0.01*	0.010	29	*<0.005*	0.15	3.7	2.3	0.15	11	9.3	3.6
								10th PCTL	0.90	0.020	86	0.33	*<0.01*	*<0.05*	0.95	75	5.0	9.7	*<0.001*	*<0.01*	1.4	0.40	0.30	0.35	7.5	*<0.01*	*<0.01*	23	*<0.005*	0.095	2.8	2.0	0.11	8.3	4.0	2.4
								Min	0.60	0.010	38	0.16	*<0.01*	*<0.05*	0.60	40	4.0	6.7	*<0.001*	*<0.01*	0.11	0.20	0.20	0.20	4.6	*<0.01*	*<0.01*	12	*<0.005*	0.070	2.2	1.0	0.070	6.8	2.0	1.3

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Lower Transition Facies for Gneiss Waste Rock																																				
ABA019	KAM029649	CFD0177	73.0	74.0	Waste	Lower transition	Gneiss	MxM	4.6	0.26	175	0.74	0.10	0.60	1.0	240	7.0	36	*<0.001*	0.020	0.46	1.1	0.50	2.2	22	*<0.01*	0.010	33	0.047	0.19	3.0	8.0	0.17	12	13	14
ABA020	KAM029658	CFD0177	81.0	82.0	Waste	Lower transition	Gneiss	MxM	15	1.7	577	0.58	0.040	0.070	22	500	6.8	78	*<0.001*	0.060	0.15	7.9	0.70	0.60	69	*<0.01*	0.010	19	0.11	0.42	5.1	55	0.16	13	40	9.8
ABA047	KAM051446	CFD0166	13.0	14.0	Waste	Lower transition	Gneiss	MxM	8.4	1.3	287	0.75	0.18	0.22	16	580	1.3	37	*<0.001*	*<0.01*	0.53	5.7	0.30	2.6	41	*<0.01*	0.010	4.1	0.18	0.20	0.91	54	0.26	6.4	20	2.7
ABA051	KAM079117	CFD0251	51.0	52.0	Waste	Lower transition	Gneiss	MxF	4.5	0.45	228	1.3	0.020	*<0.05*	4.6	290	5.0	14	0.0010	0.29	1.2	2.0	0.80	0.40	41	*<0.01*	0.13	25	*<0.005*	0.090	4.9	10	0.14	16	23	9.3
ABA058	KAM096948	CFD0270	230.0	231.0	Waste	Lower transition	Gneiss	MxF	1.8	0.41	364	1.7	0.020	0.10	1.1	120	8.4	18	*<0.001*	0.10	0.66	0.60	0.40	0.50	31	*<0.01*	0.010	34	*<0.005*	0.26	5.9	2.0	0.26	9.9	14	5.9
ABA067	KAM129499	CFD0332	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	4.9	0.27	163	6.9	0.060	0.73	0.80	150	7.2	40	0.0010	0.050	0.51	0.60	0.50	1.1	12	*<0.01*	0.010	33	0.036	0.24	5.2	5.0	0.12	13	14	8.2
ABA070	KAM099512	CFD0338	10.0	11.0	Waste	Lower transition	Gneiss	MxF	2.3	0.13	190	0.24	0.040	0.28	0.70	100	7.2	30	*<0.001*	*<0.01*	0.40	0.40	0.40	1.3	4.5	*<0.01*	*<0.01*	35	0.014	0.21	3.9	2.0	0.10	11	9.0	8.5
ABA073	KAM145537	CFD0339	111.0	112.0	Waste	Lower transition	Gneiss	MxF	3.2	0.14	311	0.97	0.060	0.44	0.60	130	7.2	34	*<0.001*	0.020	0.45	0.70	0.50	0.60	20	*<0.01*	0.010	36	0.024	0.21	2.6	2.0	0.14	14	20	6.6
ABA098	KAM137429	CFR0469	29.0	30.5	Waste	Lower transition	Gneiss	MxF	6.6	0.40	407	1.7	0.060	0.99	5.6	390	4.9	62	*<0.001*	*<0.01*	0.39	1.9	0.70	1.1	117	*<0.01*	0.13	25	0.12	0.38	4.1	15	0.66	16	19	6.6
ABA106	KAM139356	CFR0482	89.9	91.4	Waste	Lower transition	Gneiss	MxF	8.8	1.2	468	0.88	0.030	0.060	23	730	9.0	74	*<0.001*	0.010	3.1	5.1	0.50	0.30	27	*<0.01*	*<0.01*	17	0.14	0.51	2.7	39	0.38	13	41	6.1
ABA117	KAM122524	CFR0529	21.3	22.9	Waste	Lower transition	Gneiss	FG	2.7	0.20	94	1.6	0.11	1.7	2.9	150	1.3	16	*<0.001*	0.010	0.090	0.80	0.40	3.9	26	*<0.01*	*<0.01*	31	0.047	0.10	3.0	5.0	2.9	9.1	7.0	8.8
ABA142	KAM152462	CFR0589	25.9	27.4	Waste	Lower transition	Gneiss	MxF	4.2	0.32	233	1.9	0.070	0.40	3.3	140	7.0	51	*<0.001*	0.040	0.29	1.5	0.50	1.0	14	*<0.01*	0.010	39	0.038	0.29	6.0	11	2.1	14	16	15
ABA150	KAM153129	CFR0595	30.5	32.0	Waste	Lower transition	Gneiss	MxM	9.1	1.4	721	2.6	0.050	0.20	42	490	5.9	68	0.0010	0.15	0.51	5.0	0.50	2.3	118	*<0.01*	0.060	9.1	0.15	0.35	0.93	39	0.46	10	34	2.3
ABA246	R273797	CFD0458	9.0	10.0	Waste	Lower transition	Gneiss	FG	1.5	0.060	266	0.85	0.010	0.10	1.1	350	6.4	14	*<0.001*	0.020	1.5	1.5	0.30	1.1	28	*<0.01*	0.020	34	0.0080	0.13	2.9	20	0.13	14	16	20
ABA247	R283019	CFD0484	33.0	34.0	Waste	Lower transition	Gneiss	FG	3.4	0.60	343	0.53	0.040	0.070	28	400	5.3	56	*<0.001*	0.010	2.9	5.1	0.40	1.0	17	*<0.01*	*<0.01*	28	0.056	0.48	11	25	0.19	12	27	4.4
ABA249	R273398	CFD0447	188.0	189.0	Waste	Lower transition	Gneiss	MxF	13	1.6	465	0.30	0.060	0.050	14	460	1.9	117	*<0.001*	*<0.01*	1.6	8.1	0.50	3.6	18	*<0.01*	0.020	7.5	0.17	0.50	1.4	49	0.18	19	27	1.8
ABA250	R279032	CFD0461	85.0	86.0	Waste	Lower transition	Gneiss	MxM	5.8	0.94	381	2.6	0.060	0.13	47	430	3.3	57	0.0020	0.34	1.6	2.7	0.90	0.70	64	*<0.01*	0.51	27	0.086	0.42	3.9	26	0.22	12	27	9.9
ABA251	R274019	CFD0464	10.0	11.0	Waste	Lower transition	Gneiss	FG	1.7	0.040	286	0.31	0.080	0.070	3.0	170	9.2	12	*<0.001*	0.010	0.99	0.70	0.40	1.4	13	*<0.01*	0.050	38	*<0.005*	0.13	3.5	5.0	0.090	11	11	13
ABA252	R274341	CFD0467	80.0	81.0	Waste	Lower transition	Gneiss	MxF	1.2	0.050	151	0.61	0.10	0.28	0.90	60	4.3	17	*<0.001*	0.020	0.29	0.40	0.20	1.5	6.2	0.010	0.030	43	0.0050	0.070	2.1	2.0	0.11	11	8.0	14
ABA253	R282397	CFD0474	95.0	96.0	Waste	Lower transition	Gneiss	MxF	1.6	0.030	134	0.71	0.010	0.050	1.4	190	14	9.9	*<0.001*	0.010	3.4	1.3	0.40	2.3	5.6	*<0.01*	*<0.01*	38	*<0.005*	0.25	6.9	5.0	0.22	9.1	11	11
ABA254	R270666	CFD0404	10.0	11.0	Waste	Lower transition	Gneiss	MxF	4.6	0.39	229	0.97	0.020	0.47	5.4	180	6.8	55	*<0.001*	0.010	1.6	2.1	0.50	1.2	13	*<0.01*	*<0.01*	33	0.057	0.34	2.5	15	0.20	14	16	12
ABA255	R271756	CFD0424	62.0	63.0	Waste	Lower transition	Gneiss	MxM	1.6	0.040	239	0.47	0.030	0.050	1.6	150	4.3	8.7	*<0.001*	*<0.01*	1.5	0.80	0.60	1.0	8.7	*<0.01*	0.010	34	*<0.005*	0.18	2.5	4.0	0.23	7.6	9.0	6.7
ABA256	R271112	CFD0415	8.0	9.0	Waste	Lower transition	Gneiss	MxM	3.8	0.15	442	1.3	0.050	0.15	2.1	300	11	37	*<0.001*	0.070	3.6	1.3	0.50	0.70	23	*<0.01*	0.030	23	0.025	0.40	3.4	7.0	0.45	12	35	12
ABA257	R273315	CFD0447	115.0	116.0	Waste	Lower transition	Gneiss	FG	1.4	0.030	117	0.24	0.040	0.14	0.70	60	3.8	13	*<0.001*	0.010	0.93	0.30	0.20	0.40	10	*<0.01*	0.020	41	*<0.005*	0.080	2.6	1.0	0.32	17	3.0	9.4
ABA258	R276507	CFD0409	12.0	13.0	Waste	Lower transition	Gneiss	MxM	1.2	0.050	625	0.16	0.010	0.090	2.5	130	6.0	15	*<0.001*	*<0.01*	9.9	0.80	0.20	1.5	9.4	*<0.01*	0.040	24	*<0.005*	0.16	1.6	3.0	4.7	9.0	5.0	5.5
ABA259	R280545	CFD0499	10.0	11.0	Waste	Lower transition	Gneiss	MxM	5.1	0.35	315	0.99	0.060	0.85	3.2	370	4.2	66	*<0.001*	0.040	0.15	1.7	0.50	1.3	44	0.010	0.18	26	0.12	0.47	3.9	13	0.19	12	26	4.6
ABA260	R280565	CFD0499	28.0	29.0	Waste	Lower transition	Gneiss	MxM	2.7	0.16	206	0.55	0.070	0.61	1.5	110	2.4	25	*<0.001*	0.020	1.4	0.80	0.40	1.1	12	*<0.01*	0.070	39	0.017	0.16	3.7	4.0	0.12	14	9.0	10
ABA261	R274115	CFD0464	95.0	96.0	Waste	Lower transition	Gneiss	MxF	3.8	0.87	397	0.59	0.040	0.050	16	270	5.3	40	*<0.001*	0.15	0.86	4.7	0.20	0.60	124	*<0.01*	0.030	27	0.039	0.31	5.3	24	0.16	11	19	9.5
ABA262	R274262	CFD0467	10.0	11.0	Waste	Lower transition	Gneiss	MxF	1.0	0.040	118	0.53	0.070	0.32	0.70	70	5.4	14	*<0.001*	0.020	0.44	0.50	0.50	0.50	17	*<0.01*	0.030	40	0.0050	0.080	2.2	4.0	0.56	13	6.0	11
ABA263	R282302	CFD0474	10.0	11.0	Waste	Lower transition	Gneiss	FG	1.9	0.030	143	0.30	0.010	0.050	2.1	100	7.4	18	*<0.001*	0.010	3.8	0.80	0.20	1.0	10	*<0.01*	0.010	34	*<0.005*	0.22	9.6	5.0	0.40	9.7	8.0	5.4
ABA264	R271435	CFD0420	9.0	10.0	Waste	Lower transition	Gneiss	MxF	2.7	0.13	307	0.34	0.040	0.17	7.6	150	7.5	33	*<0.001*	0.010	28	1.2	0.60	0.80	9.3	*<0.01*	*<0.01*	35	0.017	0.36	3.3	4.0	0.14	15	23	8.6
ABA265	R271165	CFD0415	55.0	56.0	Waste	Lower transition	Gneiss	MxF	4.3	0.15	356	1.9	0.060	0.70	1.2	140	7.8	39	*<0.001*	0.030	0.090	1.1	0.40	1.5	29	*<0.01*	0.010	33	0.032	0.25	3.8	4.0	0.14	11	24	5.2
ABA267	R273694	CFD0456	97.0	98.0	Waste	Lower transition	Gneiss	MxM	31	3.6	662	1.1	0.080	*<0.05*	43	370	1.2	138	*<0.001*	0.29	0.89	20	0.50	2.0	24	*<0.01*	0.030	0.20	0.24	0.86	0.81	177	0.080	11	72	0.50
ABA269	R279507	CFD0468	60.0	61.0	Waste	Lower transition	Gneiss	MxF	5.3	0.38	263	1.4	0.070	0.46	3.4	430	2.9	52	*<0.001*	0.030	1.6	1.6	0.80	1.9	24	*<0.01*	0.24	30	0.088	0.37	4.4	10	0.65	18	13	6.8
ABA270	R272186	CFD0433	10.0	11.0	Waste	Lower transition	Gneiss	MxF	1.1	0.020	116	0.39	0.020	0.070	1.3	80	3.1	14	*<0.001*	0.010	0.63	0.40	*<0.2*	0.80	6.0	*<0.01*	0.020	35	*<0.005*	0.12	2.4	1.0	0.36	3.6	4.0	5.6
ABA271	R283079	CFD0484	87.0	88.0	Waste	Lower transition	Gneiss	FG	4.4	0.57	310	0.16	0.040	0.080	11	310	7.2	46	*<0.001*	0.010	2.3	2.5	0.40	0.40	15	*<0.01*	*<0.01*	35	0.061	0.31	2.0	17	0.20	12	27	6.0
ABA272	Q034772	CFD0473	86.0	87.0	Waste	Lower transition	Gneiss	MxF	4.8	0.81	438	0.33	0.060	0.11	12	660	7.8	62	*<0.001*	*<0.01*	1.9	4.3	0.40	1.1	47	*<0.01*	0.020	26	0.15	0.40	3.8	38	0.71	15	38	3.5
ABA273	R282171	CFD0439	30.0	31.0	Waste	Lower transition	Gneiss	MxF	3.3	0.10	195	0.44	0.020	0.13	2.9	90	6.2	33	*<0.001*	*<0.01*	3.5	0.80	0.40	0.60	6.4	*<0.01*	0.020	39	0.016	0.24	6.4	3.0	0.18	16	22	3.3
ABA274	R277372	CFD0423	10.0	11.0	Waste	Lower transition	Gneiss	MxM	3.0	0.19	86	0.91	0.070	0.16	1.9	260	2.1	17	0.0010	0.010	0.28	1.4	0.50	1.5	15	*<0.01*	0.020	37	0.015	0.12	2.3	4.0	*<0.05*	12	7.0	5.8
ABA275	R283492	CFD0496	10.0	11.0	Waste	Lower transition	Gneiss	MxF	4.5	0.29	202	3.5	0.080	0.58	3.6	390	3.8	55	*<0.001*	0.040	0.24	1.8	0.60	1.2	20	*<0.01*	0.19	28	0.083	0.40	6.1	10	0.16	15	16	6.2
ABA276	R273866	CFD0460	63.0	64.0	Waste	Lower transition	Gneiss	FG	4.3	0.37	236	1.0	0.090	0.26	5.3	190	3.2	52	*<0.001*	0.060	0.50	1.7	0.40	1.4	25	*<0.01*	0.020	33	0.043	0.31	4.3	12	0.11	13	14	14
ABA277	R273898	CFD0460	91.0	92.0	Waste	Lower transition	Gneiss	MxF	7.4	0.47	461	1.5	0.050	0.38	2.7	1010	9.2	68	*<0.001*	0.10	*<0.05*	2.5	0.90	0.50	92	*<0.01*	0.020	28	0.17	0.43	3.4	45	0.22	19	34	13
ABA278	Q035773	CFD0491	9.0	10.0	Waste	Lower transition	Gneiss	MxF	2.7	0.12	119	0.20	0.040	0.17	2.6	200	5.3	37	*<0.001*	*<0.01*	7.0	0.70	0.50	1.7	6.6	*<0.01*	0.010	38	0.016	0.38	4.5	4.0	0.24	15	11	9.8
ABA279	Q035789	CFD0491	60.0	61.0	Waste	Lower transition	Gneiss	MxF	2.2	0.030	204	0.42	0.010	*<0.05*	1.4	250	88	7.8	*<0.001*	*<0.01*	16	1.5	0.40	3.2	7.8	*<0.01*	0.10	37	*<0.005*	0.29	10	10	0.41	16	22	6.9
ABA280	R271699	CFD0424	12.0	13.0	Waste	Lower transition	Gneiss	MxF	1.2	0.050	292	1.5	0.080	0.16	1.5	170	5.9	18	*<0.001*	*<0.01*	1.3	0.80	*<0.2*	0.60	9.0	*<0.01*	0.020	34	0.010	0.10	3.1	4.0	0.46	12	13	5.0
ABA282	R282102	CFD0437	70.0	71.0	Waste	Lower transition	Gneiss	MxF	2.0	0.020	140	0.34	0.010	0.10	1.2	60	13	11	*<0.001*	*<0.01*	2.9	0.40	0.30	0.60	7.1	*<0.01*	0.020	40	*<0.005*	0.080	6.5	1.0	0.17	18	2.0	7.7
ABA283	R273302	CFD0447	59.0	60.0	Waste	Lower transition	Gneiss	FG	7.1	1.4	491	0.89	0.040	*<0.05*	21	520	7.3	79	0.0010	0.080	0.49	6.9	0.60	0.50	69	*<0.01*	0.010	21	0.084	0.48	7.8	38	0.10	17	35	4.6
ABA284	R273593	CFD0456	7.0	8.0	Waste	Lower transition	Gneiss	MxF	11	1.4	448	0.38	0.050	0.060	23	390	2.2	84	*<0.001*	0.010	1.6	7.5	0.30	2.0	11	*<0.01*	0.020	11	0.13	0.49	0.73	42	0.13	15	21	4.9
ABA338	R270835	CFD0406	32.0	33.0	Waste	Lower Transition	Gneiss	MxF	1.5	0.33	389	1.5	0.040	0.090	10	260	5.1	25	0.0010	0.040	0.37	2.3	0.30	1.5	62	*<0.01*	0.010	32	0.019	0.18	3.0	12	3.7	9.7	18	17
ABA339	R270848	CFD0406	58.0	58.3	Waste	Lower Transition	Gneiss	MxF	3.5	0.19	294	0.59	0.050	0.70	1.2	190	2.8	29	*<0.001*	0.040	3.8	0.90	0.30	15	85	*<0.01*	*<0.01*	35	0.029	0.19	2.9	4.0	0.24	9.6	13	13
ABA340	R270686	CFD0404	27.0	28.0	Waste	Lower Transition	Gneiss	MxM	12	1.9	490	3.4	0.020	*<0.05*	37	510	1.9	142	0.0010	0.13	1.1	3.0	0.30	0.40	22	*<0.01*	*<0.01*	13	0.19	0.95	3.7	53	0.25	8.5	38	4.2
ABA341	R270737	CFD0404	85.0	86.0	Waste	Lower Transition	Gneiss	FG	2.4	0.43	324	1.2	0.030	0.070	16	230	9.7	28	*<0.001*	0.080	1.6	2.1	0.40	0.90	45	*<0.01*	0.010	29	0.023	0.19	3.3	12	0.11	9.7	24	16
ABA342	R551085	CFD0563	10.0	11.0	Waste	Lower Transition	Gneiss	MxM	4.8	0.42	233	0.83	0.050	0.27	3.9	280	2.4	41	*<0.001*	0.050	0.17	2.2	0.50	1.0	19	*<0.01*	0.020	24	0.045	0.29	1.7	12	0.30	14	14	7.8
ABA343	R551107	CFD0563	30.0	31.0	Waste	Lower Transition	Gneiss	MxM	13	1.9	589	0.66	0.050	0.16	49	690	8.5	57	*<0.001*	0.11	0.20	3.1	0.20	1.0	143	*<0.01*	0.060	5.9	0.19	0.35	0.73	44	0.61	5.6	51	2.1
ABA344	R551131	CFD0563	50.0	51.0	Waste	Lower Transition	Gneiss	MxM	16	1.9	578	0.53	0.040	0.13	28	950	3.3	63	*<0.001*	0.030	0.11	3.1	0.30	0.80	76	*<0.01*	0.040	2.1	0.24	0.38	0.29	57	0.37	5.2	54	1.8
ABA348	R304313	CFD0541	56.0	57.0	Waste	Lower Transition	Gneiss	MxM	10	1.3	641	0.26	0.070	0.080	44	680	2.5	58	*<0.001*	*<0.01*	3.2	7.3	0.80	4.9	49	*<0.01*	0.060	17	0.12	0.99	2.9	48	0.11	16	53	4.4
ABA360	R623829	CFD0555	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	2.9	0.12	123	3.8	0.050	0.25	1.4	140	5.7	23	*<0.001*	*<0.01*	0.80	0.60	0.30	0.70	6.7	*<0.01*	0.010	37	0.013	0.15	6.1	3.0	0.080	9.0	9.0	14
ABA361	R623933	CFD0555	102.0	103.0	Waste	Lower Transition	Gneiss	MxF	17	1.5	622	0.49	0.020	0.15	32	980	6.8	124	*<0.001*	0.020	1.6	6.9	0.40	2.1	195	*<0.01*	0.010	13	0.20	0.79	3.4	85	0.19	11	49	5.7
ABA362	R507027	CFD0555	185.0	186.0	Waste	Lower Transition	Gneiss	FG	3.4	0.32	221	1.4	0.030	0.14	1.2	140	4.1	26	*<0.001*	0.020	0.17	0.70	0.40	1.2	54	*<0.01*	0.010	33	0.012	0.17	2.3	3.0	0.29	11	10	8.9
ABA363	R545397	CFD0520	20.0	21.0	Waste	Lower Transition	Gneiss	FG	1.9	0.010	203	0.37	0.010	*<0.05*	1.9	210	11	5.1	*<0.001*	*<0.01*	5.7	1.4	0.40	1.1	24	*<0.01*	*<0.01*	32	*<0.005*	0.47	13	8.0	0.21	12	9.0	4.4
ABA364	R545422	CFD0520	41.0	42.0	Waste	Lower Transition	Gneiss	FG	1.9	0.010	176	0.29	0.010	0.050	1.5	110	14	9.0	*<0.001*	*<0.01*	2.0	0.70	0.60	0.90	10	*<0.01*	*<0.01*	35	*<0.005*	0.26	6.0	2.0	0.19	13	6.0	4.1
ABA366	R545552	CFD0524	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	1.5	0.030	215	1.2	0.010	0.050	0.80	70	13	10	*<0.001*	0.010	4.1	0.80	0.50	0.60	20	*<0.01*	0.010	37	*<0.005*	0.21	4.5	2.0	0.18	14	9.0	11
ABA369	R545644	CFD0526	81.0	82.0	Waste	Lower Transition	Gneiss	MxF	2.1	0.070	167	0.48	0.030	0.14	0.90	90	14	15	*<0.001*	*<0.01*	1.7	0.60	0.50	0.60	11	*<0.01*	*<0.01*	38	0.0070	0.11	3.6	3.0	0.26	15	8.0	12
ABA370	R545697	CFD0528	42.0	43.0	Waste	Lower Transition	Gneiss	MxF	3.0	0.030	120	0.38	0.040	0.050	2.2	110	6.0	14	*<0.001*	*<0.01*	4.6	0.50	0.40	1.0	9.5	*<0.01*	0.010	38	*<0.005*	0.20	8.2	3.0	0.25	11	5.0	8.6
ABA371	R271272	CFD0417	5.0	6.0	Waste	Lower Transition	Gneiss	MxF	3.7	0.12	263	1.2	0.070	0.50	1.0	130	7.8	36	*<0.001*	*<0.01*	0.97	0.60	0.50	1.2	15	*<0.01*	*<0.01*	35	0.027	0.29	2.0	2.0	0.23	12	19	10
ABA372	R271299	CFD0417	30.0	30.7	Waste	Lower Transition	Gneiss	MxF	2.3	0.030	320	0.36	0.010	*<0.05*	1.6	180	8.3	15	*<0.001*	*<0.01*	17	0.90	0.50	0.50	9.7	*<0.01*	*<0.01*	37	*<0.005*	1.1	9.2	3.0	0.20	13	16	2.1
ABA376	R279575	CFD0468	120.0	121.0	Waste	Lower Transition	Gneiss	MxF	10	0.83	333	0.86	0.060	0.41	11	240	5.3	85	*<0.001*	*<0.01*	0.20	1.9	0.50	0.90	31	0.010	0.020	34	0.077	0.45	3.8	22	0.22	15	24	16
ABA390	R278608	CFD0450	10.0	11.0	Waste	Lower Transition	Gneiss	MxF	6.9	0.62	469	0.46	0.040	*<0.05*	52	390	8.9	42	*<0.001*	*<0.01*	5.2	6.8	0.70	1.3	12	*<0.01*	0.020	38	0.034	0.65	6.4	29	0.41	18	25	6.6
ABA391	R278677	CFD0450	71.0	72.0	Waste	Lower Transition	Gneiss	MxF	1.7	0.010	189	0.28	0.010	0.050	2.4	120	7.2	12	*<0.001*	*<0.01*	11	0.60	0.40	0.50	8.0	*<0.01*	*<0.01*	40	*<0.005*	0.19	8.7	3.0	0.33	12	7.0	3.9
ABA392	R278725	CFD0450	114.0	114.3	Waste	Lower Transition	Gneiss	MxF	1.3	0.020	170	0.79	0.010	0.070	1.0	170	7.7	16	*<0.001*	*<0.01*	8.6	0.60	0.50	1.0	12	*<0.01*	0.010	35	*<0.005*	0.25	5.0	3.0	0.35	9.1	9.0	6.0
ABA395	R545811	CFD0529	58.0	59.0	Waste	Lower Transition	Gneiss	FG	1.0	0.030	138	0.15	0.11	0.060	0.70	210	2.0	8.1	*<0.001*	*<0.01*	1.8	0.60	0.50	1.4	12	*<0.01*	*<0.01*	38	*<0.005*	0.030	2.3	2.0	0.36	12	4.0	11
ABA399	R543714	CFD0549	30.0	31.0	Waste	Lower Transition	Gneiss	MxF	1.4	0.070	129	0.24	0.060	0.27	0.60	90	5.7	13	*<0.001*	*<0.01*	0.39	0.40	0.50	0.50	10	*<0.01*	0.010	39	0.0050	0.080	2.0	1.0	0.15	17	3.0	12
ABA400	R543741	CFD0549	53.0	54.0	Waste	Lower Transition	Gneiss	MxF	1.4	0.020	36	1.5	0.010	0.090	2.9	80	21	12	*<0.001*	*<0.01*	4.2	0.50	0.40	0.20	12	*<0.01*	0.050	41	*<0.005*	0.19	7.0	2.0	0.16	9.3	6.0	9.6
ABA402	R544003	CFD0553	80.0	81.0	Waste	Lower Transition	Gneiss	MxF	2.0	0.060	275	3.7	0.040	0.17	1.0	120	35	16	0.0010	*<0.01*	3.9	0.40	0.40	0.50	12	*<0.01*	0.050	37	0.0050	0.13	4.4	2.0	0.23	17	10	15
ABA405	R554003	CFD0501	10.0	11.0	Waste	Lower Transition	Gnei

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Fresh Facies for Gneiss Waste Rock																																				
ABA065	KAM128393	CFD0326	25.0	26.0	Waste	Fresh	Gneiss	MxM	4.5	0.35	329	0.71	0.020	0.12	4.2	440	7.5	39	*<0.001*	*<0.01*	14	2.7	0.90	1.0	18	*<0.01*	0.20	25	0.037	0.30	5.4	14	0.30	21	23	6.2
ABA066	KAM128504	CFD0326	75.0	76.0	Waste	Fresh	Gneiss	MxM	6.3	0.36	221	1.4	0.040	0.27	4.5	340	3.7	56	*<0.001*	0.010	1.8	2.2	1.0	0.80	18	*<0.01*	0.74	25	0.060	0.37	2.9	9.0	0.090	19	14	9.9
ABA071	KAM145241	CFD0338	81.0	82.0	Waste	Fresh	Gneiss	MxM	11	1.2	632	0.26	0.060	0.66	53	650	6.0	83	*<0.001*	0.050	0.53	4.8	0.80	6.3	763	0.010	*<0.01*	24	0.15	0.46	5.4	45	0.12	26	34	7.5
ABA097	KAM137325	CFR0468	88.4	89.9	Waste	Fresh	Gneiss	MxM	13	1.2	486	1.5	0.050	0.29	14	720	2.1	74	*<0.001*	0.040	0.77	2.2	0.60	1.1	34	*<0.01*	0.050	21	0.19	0.41	2.4	46	0.92	12	34	7.1
ABA099	KAM137468	CFR0469	82.3	83.8	Waste	Fresh	Gneiss	MxM	17	2.0	587	1.4	0.070	0.10	134	360	5.5	61	*<0.001*	*<0.01*	4.3	5.4	0.40	2.5	47	*<0.01*	0.40	11	0.15	0.36	1.8	50	0.43	9.5	37	4.0
ABA108	KAM139795	CFR0486	25.9	27.4	Waste	Fresh	Gneiss	MxM	5.5	0.48	341	1.3	0.070	0.22	3.8	360	2.7	35	*<0.001*	*<0.01*	1.4	2.1	0.80	1.5	9.9	*<0.01*	0.34	26	0.053	0.22	2.2	11	0.58	22	20	8.7
ABA139	KAM152151	CFR0586	61.0	62.5	Waste	Fresh	Gneiss	MxF	2.5	0.17	180	2.0	0.070	0.58	3.0	180	4.0	27	*<0.001*	0.010	1.4	1.1	0.50	3.8	30	*<0.01*	0.010	35	0.026	0.17	3.8	7.0	0.90	12	11	12
ABA140	KAM152186	CFR0586	109.7	111.3	Waste	Fresh	Gneiss	MxF	1.8	0.060	116	2.1	0.080	0.46	2.0	80	3.7	17	*<0.001*	0.010	0.22	0.60	0.40	3.4	13	*<0.01*	0.050	35	0.0080	0.090	2.8	2.0	0.82	16	6.0	13
ABA143	KAM152536	CFR0589	128.0	129.5	Waste	Fresh	Gneiss	FG	2.0	0.13	135	2.2	0.080	0.13	2.2	140	4.1	12	*<0.001*	0.20	1.0	0.70	0.40	3.5	111	*<0.01*	0.030	34	*<0.005*	0.060	6.8	3.0	1.9	12	4.0	5.3
ABA148	KAM153051	CFR0594	109.7	111.3	Waste	Fresh	Gneiss	MxF	2.3	0.15	151	3.6	0.060	0.14	2.3	160	4.9	18	*<0.001*	0.21	1.7	1.0	0.70	1.2	40	*<0.01*	0.010	37	0.0070	0.12	17	4.0	2.4	12	9.0	14
ABA285	R277457	CFD0426	16.0	17.0	Waste	Fresh	Gneiss	MxM	10	1.2	318	0.76	0.060	0.24	71	590	4.3	45	0.0010	0.010	0.34	2.4	0.90	2.1	26	*<0.01*	0.070	14	0.17	0.31	1.4	31	0.41	8.3	22	4.4
ABA286	R279452	CFD0468	11.0	12.0	Waste	Fresh	Gneiss	MxF	5.7	0.48	335	0.36	0.090	0.27	3.0	400	3.3	47	*<0.001*	0.020	0.91	1.9	0.60	1.1	14	*<0.01*	0.23	30	0.068	0.33	2.3	8.0	6.7	14	24	7.1
ABA287	R274861	CFD0472	100.0	101.0	Waste	Fresh	Gneiss	MxM	7.4	0.81	263	2.6	0.050	0.24	18	360	2.8	36	0.0010	0.47	0.19	1.7	1.3	1.1	35	*<0.01*	0.070	21	0.11	0.23	2.7	21	0.22	9.6	14	5.6
ABA288	R283657	CFD0498	82.0	83.0	Waste	Fresh	Gneiss	MxM	5.2	0.57	193	2.1	0.060	0.18	2.4	350	16	48	*<0.001*	0.020	0.47	1.7	0.50	0.70	9.9	*<0.01*	0.41	26	0.061	0.32	3.5	6.0	0.15	12	19	8.5
ABA289	Q035925	CFD0495	94.0	95.0	Waste	Fresh	Gneiss	MxM	8.7	0.84	218	4.4	0.060	0.16	2.9	390	5.8	52	*<0.001*	0.020	0.42	2.1	0.80	1.2	21	*<0.01*	0.38	27	0.061	0.32	2.2	10	0.26	22	22	9.5
ABA290	R272262	CFD0433	123.0	124.0	Waste	Fresh	Gneiss	MxF	2.5	0.080	288	0.43	0.050	0.17	1.2	190	5.8	25	*<0.001*	0.010	2.2	0.80	0.40	0.80	10	*<0.01*	0.020	36	0.013	0.17	3.4	5.0	0.28	11	17	7.1
ABA293	R276133	CFD0393	45.0	46.0	Waste	Fresh	Gneiss	MxM	15	2.4	672	0.69	0.040	0.14	47	680	3.1	61	0.0010	0.080	0.22	6.5	0.50	1.7	65	*<0.01*	0.92	5.8	0.22	0.38	0.72	55	0.21	8.7	53	1.6
ABA294	R276236	CFD0401	18.0	19.0	Waste	Fresh	Gneiss	MxM	12	1.7	524	1.0	0.060	0.18	56	810	18	47	*<0.001*	0.020	0.080	3.5	0.30	0.80	54	*<0.01*	6.1	2.6	0.23	0.28	0.27	46	0.22	4.2	56	1.2
ABA295	R271028	CFD0412	117.0	118.0	Waste	Fresh	Gneiss	MxF	1.4	0.060	216	0.63	0.050	0.14	1.1	140	4.9	17	*<0.001*	0.010	1.5	0.80	0.30	0.60	22	*<0.01*	0.010	34	0.0060	0.10	2.4	4.0	0.17	11	14	7.8
ABA297	R279539	CFD0468	89.0	90.0	Waste	Fresh	Gneiss	MxF	7.7	0.89	368	4.1	0.080	0.42	8.6	250	4.2	71	0.0060	0.040	0.11	1.7	0.50	1.0	43	0.010	0.10	31	0.088	0.42	11	18	0.47	14	18	12
ABA298	R275689	CFD0495	57.0	58.0	Waste	Fresh	Gneiss	MxM	12	1.8	550	1.4	0.090	0.29	61	780	5.2	49	*<0.001*	0.060	0.42	3.2	0.30	1.4	62	0.010	0.17	3.5	0.26	0.25	0.71	40	0.31	5.0	47	2.7
ABA299	R272239	CFD0433	57.0	58.0	Waste	Fresh	Gneiss	MxF	1.3	0.12	187	2.1	0.050	0.18	1.0	150	7.6	18	0.0030	0.080	0.18	0.70	0.40	1.6	47	*<0.01*	0.020	35	0.0050	0.10	20	4.0	0.34	11	11	8.3
ABA300	R278428	CFD0445	118.0	119.0	Waste	Fresh	Gneiss	MxF	4.2	0.17	278	0.35	0.10	0.53	1.1	150	5.9	42	*<0.001*	0.010	0.33	1.0	0.50	1.8	18	*<0.01*	0.020	35	0.032	0.21	2.0	3.0	0.17	12	18	5.6
ABA301	R273296	CFD0447	10.0	11.0	Waste	Fresh	Gneiss	FG	2.6	0.12	288	1.4	0.070	0.54	1.2	150	8.6	30	0.0010	0.010	0.050	0.60	0.40	0.70	20	*<0.01*	0.020	36	0.023	0.19	2.4	3.0	0.11	13	20	5.4
ABA302	R270935	CFD0412	35.0	36.0	Waste	Fresh	Gneiss	MxF	13	1.8	532	0.74	0.060	0.12	26	600	3.7	100	*<0.001*	0.020	0.42	3.0	0.50	0.50	33	*<0.01*	0.020	19	0.22	0.56	2.1	51	0.51	11	43	6.4
ABA346	R277538	CFD0426	87.0	88.0	Waste	Fresh	Gneiss	MxM	9.7	1.2	261	1.2	0.060	0.28	42	450	1.7	47	0.0010	0.18	0.30	3.0	0.40	1.1	25	*<0.01*	0.090	6.0	0.19	0.34	0.67	38	0.18	6.0	28	2.0
ABA347	R304284	CFD0541	30.0	31.0	Waste	Fresh	Gneiss	FG	0.90	0.040	126	0.61	0.030	0.18	1.0	100	6.0	11	*<0.001*	0.020	0.74	0.30	0.50	0.50	3.0	*<0.01*	*<0.01*	38	*<0.005*	0.070	3.1	1.0	1.3	13	5.0	7.7
ABA350	R304041	CFD0539	10.0	11.0	Waste	Fresh	Gneiss	FG	1.4	0.070	142	0.18	0.070	0.19	0.80	110	3.8	12	*<0.001*	*<0.01*	0.60	0.30	0.50	0.40	4.9	*<0.01*	0.020	40	*<0.005*	0.070	2.8	2.0	0.10	15	6.0	7.1
ABA351	R304231	CFD0539	45.0	46.0	Waste	Fresh	Gneiss	MxM	14	1.3	392	0.32	0.060	0.080	48	550	2.2	49	*<0.001*	*<0.01*	0.73	5.4	0.50	1.2	42	*<0.01*	0.040	12	0.12	0.30	0.89	47	0.13	13	32	0.80
ABA354	R304119	CFD0525	45.0	46.0	Waste	Fresh	Gneiss	MxM	10	1.1	436	0.75	0.050	0.10	45	480	3.3	55	*<0.001*	0.020	0.19	4.4	0.60	0.70	32	*<0.01*	0.020	13	0.091	0.33	1.6	33	0.11	14	36	1.4
ABA355	R304173	CFD0525	91.0	92.0	Waste	Fresh	Gneiss	FG	2.3	0.13	113	0.31	0.11	0.72	1.3	60	1.5	6.2	*<0.001*	*<0.01*	0.48	0.60	0.50	1.5	17	*<0.01*	*<0.01*	44	0.011	0.040	3.3	3.0	0.080	15	4.0	8.3
ABA356	R623617	CFD0548	10.0	11.0	Waste	Fresh	Gneiss	MxF	9.0	0.69	468	0.18	0.050	0.17	8.4	550	3.3	51	*<0.001*	*<0.01*	0.31	2.1	0.30	1.0	22	*<0.01*	0.020	6.7	0.11	0.32	1.1	17	0.16	5.3	27	1.8
ABA357	R623685	CFD0548	70.0	71.0	Waste	Fresh	Gneiss	MxF	11	0.93	391	0.21	0.070	0.16	17	270	6.3	69	*<0.001*	*<0.01*	0.19	2.4	0.40	1.9	29	*<0.01*	*<0.01*	29	0.10	0.42	1.9	24	0.11	13	26	12
ABA358	R623742	CFD0548	120.0	121.0	Waste	Fresh	Gneiss	MxF	1.2	0.080	210	0.28	0.080	0.16	1.7	70	9.8	14	*<0.001*	0.010	1.1	0.60	0.30	0.40	17	*<0.01*	*<0.01*	38	0.0050	0.090	4.7	3.0	0.18	9.8	7.0	15
ABA365	R545443	CFD0520	60.0	61.0	Waste	Fresh	Gneiss	FG	3.9	0.18	250	0.33	0.050	0.53	1.1	150	6.1	34	*<0.001*	*<0.01*	0.13	0.80	0.50	1.1	17	0.010	*<0.01*	34	0.029	0.29	2.6	4.0	0.25	13	19	8.1
ABA374	R271368	CFD0417	91.0	92.0	Waste	Fresh	Gneiss	FG	4.5	0.15	298	1.0	0.060	0.72	1.2	130	10	41	*<0.001*	*<0.01*	0.26	1.1	0.50	1.5	32	*<0.01*	*<0.01*	40	0.031	0.27	3.4	6.0	0.20	15	21	9.2
ABA378	R279593	CFD0468	135.0	136.0	Waste	Fresh	Gneiss	MxF	12	1.1	554	1.2	0.070	0.29	2.7	550	2.8	88	*<0.001*	0.070	*<0.05*	2.5	0.40	0.70	81	*<0.01*	0.010	19	0.16	0.59	4.0	29	0.24	11	36	5.5
ABA379	R279615	CFD0468	155.0	155.7	Waste	Fresh	Gneiss	MxF	13	1.5	649	3.2	0.10	0.20	19	610	2.5	62	*<0.001*	0.090	0.070	4.7	0.50	1.5	47	*<0.01*	0.19	16	0.16	0.34	2.9	48	0.48	11	48	2.5
ABA381	R511981	CFR0700	48.8	49.4	Waste	Fresh	Gneiss	MxM	7.0	0.86	553	1.4	0.040	0.52	42	650	8.6	22	*<0.001*	0.17	3.6	4.6	0.40	1.3	130	0.010	0.070	5.8	0.17	0.13	1.2	33	0.93	11	26	13
ABA387	Q034442	CFD0469	19.0	20.0	Waste	Fresh	Gneiss	MxF	6.6	0.69	332	0.67	0.080	0.19	24	330	8.8	71	*<0.001*	*<0.01*	0.66	2.2	0.50	3.0	14	*<0.01*	*<0.01*	33	0.076	0.48	4.1	18	0.29	14	23	16
ABA388	Q034516	CFD0469	102.0	103.0	Waste	Fresh	Gneiss	MxF	3.2	0.12	309	1.2	0.070	0.35	0.90	150	16	33	*<0.001*	0.030	0.55	0.80	0.70	0.60	23	*<0.01*	0.040	40	0.019	0.22	5.6	2.0	0.16	16	20	8.9
ABA389	Q034537	CFD0469	121.0	121.9	Waste	Fresh	Gneiss	MxF	2.7	0.10	142	0.30	0.060	0.22	1.4	170	7.0	25	*<0.001*	*<0.01*	3.5	1.2	0.40	1.3	8.4	*<0.01*	*<0.01*	40	0.015	0.16	3.5	5.0	0.18	14	13	6.6
ABA396	R545818	CFD0529	65.0	66.0	Waste	Fresh	Gneiss	MxF	3.5	0.24	172	0.28	0.11	0.73	1.7	210	1.5	9.0	*<0.001*	*<0.01*	0.56	1.0	0.50	5.7	22	*<0.01*	*<0.01*	34	0.030	0.040	2.5	7.0	0.16	13	7.0	9.9
ABA398	R543692	CFD0549	10.0	11.0	Waste	Fresh	Gneiss	FG	2.6	0.18	154	0.24	0.050	0.78	0.40	50	7.9	25	*<0.001*	*<0.01*	0.66	0.40	0.50	0.60	7.9	*<0.01*	0.010	43	0.0080	0.15	3.6	1.0	0.22	16	10	11
ABA401	R543957	CFD0553	40.0	41.0	Waste	Fresh	Gneiss	MxF	15	1.7	738	1.3	0.050	0.070	3.6	630	5.4	84	*<0.001*	0.16	0.15	8.9	0.60	0.90	49	*<0.01*	0.010	15	0.16	0.45	2.8	55	0.12	16	45	4.3
ABA404	R550544	CFD0553	160.0	161.0	Waste	Fresh	Gneiss	MxF	0.80	0.050	205	0.72	0.040	0.12	1.3	80	11	7.9	*<0.001*	0.010	1.7	0.60	0.50	0.60	374	*<0.01*	0.040	34	*<0.005*	0.050	2.0	7.0	0.15	18	6.0	14
ABA408	R272713	CFD0438	96.0	97.0	Waste	Fresh	Gneiss	MxF	2.3	0.12	208	0.19	0.090	0.14	0.80	190	4.5	18	*<0.001*	*<0.01*	0.50	0.60	0.30	1.4	17	*<0.01*	0.010	37	0.0090	0.11	3.4	3.0	0.44	9.1	6.0	12
ABA413	R276141	CFD0393	127.0	128.0	Waste	Fresh	Gneiss	MxM	16	2.5	781	0.81	0.030	0.11	56	670	43	35	*<0.001*	*<0.01*	0.37	8.2	0.40	1.7	71	*<0.01*	0.15	6.7	0.17	0.24	1.2	64	0.22	11	64	3.1
ABA414	R276153	CFD0393	170.0	171.0	Waste	Fresh	Gneiss	MxM	11	1.4	475	0.21	0.040	0.25	22	750	8.5	15	*<0.001*	0.060	3.5	4.2	0.40	1.6	111	*<0.01*	0.030	4.7	0.15	0.11	0.94	41	0.23	8.9	25	5.0
Statistical Summary						**Fresh**	**Gneiss**	**n**	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49	49
								Max	17	2.5	781	4.4	0.11	0.78	134	810	43	100	0.0060	0.47	14	8.9	1.3	6.3	763	0.010	6.1	44	0.26	0.59	20	64	6.7	26	64	16
								90th PCTL	13	1.7	596	2.2	0.090	0.60	54	672	10	72	0.0010	0.16	2.5	4.9	0.80	3.1	87	0.010	0.38	40	0.19	0.43	5.4	48	0.92	18	45	13
								75th PCTL	11	1.2	475	1.4	0.070	0.35	24	550	7.6	55	*<0.001*	0.050	1.1	3.0	0.60	1.6	47	*<0.01*	0.10	35	0.15	0.34	3.5	38	0.44	15	32	9.9
								Median	5.7	0.48	298	0.76	0.060	0.20	3.0	340	5.2	39	*<0.001*	0.010	0.50	1.9	0.50	1.2	26	*<0.01*	0.020	29	0.061	0.25	2.7	10	0.22	12	20	7.1
								25th PCTL	2.5	0.13	205	0.33	0.050	0.14	1.3	150	3.3	18	*<0.001*	*<0.01*	0.22	0.80	0.40	0.80	17	*<0.01*	0.010	15	0.013	0.12	1.9	4.0	0.16	11	11	5.0
								10th PCTL	1.4	0.078	142	0.23	0.040	0.12	1.0	96	2.4	12	*<0.001*	*<0.01*	0.13	0.60	0.30	0.60	9.9	*<0.01*	*<0.01*	6.0	0.0050	0.070	0.93	2.8	0.11	8.6	6.0	2.0
								Min	0.80	0.040	113	0.18	0.020	0.070	0.40	50	1.5	6.2	*<0.001*	*<0.01*	*<0.05*	0.30	0.30	0.40	3.0	*<0.01*	*<0.01*	2.6	*<0.005*	0.040	0.27	1.0	0.080	4.2	4.0	0.80
Statistical Summary for Gneiss Waste Rock								**n**	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188	188
								n < DL	0	0	0	0	13	20	0	0	0	0	110	59	0	0	0	0	0	120	30	0	51	0	0	2	0	0	0	0
								Max	31	3.6	1160	6.9	0.18	1.7	134	1290	88	142	0.0060	0.47	83	20	1.3	15	763	0.010	6.1	44	0.26	3.2	29	177	6.7	28	72	23
								90th PCTL	11	1.4	563	2.3	0.080	0.53	38	616	14	71	0.0010	0.083	14	5.5	0.73	2.4	66	0.010	0.17	40	0.16	0.53	12	46	0.84	18	37	14
								75th PCTL	5.9	0.58	398	1.5	0.060	0.26	9.8	383	9.3	49	0.0010	0.030	3.9	2.5	0.50	1.5	34	0.010	0.043	37	0.072	0.37	6.6	21	0.45	15	24	10
								Median	2.7	0.15	265	0.83	0.040	0.13	2.8	180	6.7	23	*<0.001*	0.010	1.5	1.3	0.50	1.0	19	*<0.01*	0.020	34	0.014	0.24	3.7	6.5	0.23	13	16	7.3
								25th PCTL	1.6	0.040	169	0.39	0.010	0.060	1.2	120	4.3	12	*<0.001*	*<0.01*	0.48	0.60	0.40	0.60	11	*<0.01*	0.010	26	*<0.005*	0.13	2.4	3.0	0.16	11	9.0	5.0
								10th PCTL	1.3	0.020	126	0.24	0.010	*<0.05*	0.90	70	2.8	9.7	*<0.001*	*<0.01*	0.19	0.40	0.30	0.40	7.9	*<0.01*	*<0.01*	13	*<0.005*	0.090	1.5	2.0	0.11	8.7	5.7	2.5
								Min	0.60	0.010	35	0.15	*<0.01*	*<0.05*	0.40	30	1.2	4.0	*<0.001*	*<0.01*	0.050	0.20	0.20	0.20	3.0	*<0.01*	*<0.01*	0.20	*<0.005*	0.030	0.27	1.0	0.050	3.6	2.0	0.50

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Oxide Facies for Schist Waste Rock																																				
ABA005	KAM022322	CFD0110	95.0	96.0	Waste	Oxide	Schist	RQM	4.8	1.3	486	0.57	0.010	*<0.05*	44	370	13	15	*<0.001*	0.45	10	4.9	0.80	0.40	114	*<0.01*	0.020	11	*<0.005*	0.30	3.3	24	0.25	15	50	1.1
ABA026	KAM037656	CFD0096	59.0	60.0	Waste	Oxide	Schist	BtS	6.3	1.3	570	0.63	0.010	*<0.05*	22	420	11	24	*<0.001*	0.26	3.1	7.1	1.2	0.80	80	*<0.01*	0.030	18	0.011	0.19	2.2	38	0.31	20	66	4.8
ABA074	KAM146948	CFD0345	60.0	61.0	Waste	Oxide	Schist	BtS_carb	4.6	0.51	635	0.50	*<0.01*	*<0.05*	19	490	6.7	28	*<0.001*	0.030	3.0	9.5	0.70	0.60	43	*<0.01*	0.030	15	0.041	0.26	2.1	51	0.14	19	44	1.9
ABA077	J957606	CFD0350	60.0	61.0	Waste	Oxide	Schist	BtS_carb	3.4	0.17	648	0.63	0.010	0.050	12	760	6.5	13	*<0.001*	*<0.01*	11	7.2	1.0	0.80	286	*<0.01*	0.010	17	0.014	0.25	1.3	28	0.30	21	33	2.1
ABA090	KAM133632	CFR0431	71.6	73.2	Waste	Oxide	Schist	BtS	3.6	0.37	583	1.3	*<0.01*	*<0.05*	54	850	10	3.8	0.0020	0.49	13	13	1.4	0.70	31	*<0.01*	0.020	9.6	*<0.005*	1.4	3.4	49	1.2	26	63	1.9
ABA094	KAM135457	CFR0454	24.4	25.9	Waste	Oxide	Schist	BtS	1.9	0.070	494	1.9	*<0.01*	0.090	5.8	360	8.7	15	*<0.001*	0.010	44	1.7	0.70	0.40	18	*<0.01*	0.22	27	0.0050	0.28	8.1	9.0	0.64	18	26	6.3
ABA125	KAM149844	CFR0566	10.7	12.2	Waste	Oxide	Schist	BtS	2.2	0.040	159	0.77	*<0.01*	0.090	6.6	90	2.4	5.9	*<0.001*	0.020	8.5	2.3	0.50	0.20	9.1	0.010	*<0.01*	24	*<0.005*	0.15	0.63	10	0.66	13	12	9.1
ABA128	KAM149954	CFR0567	47.2	48.8	Waste	Oxide	Schist	BtS	4.5	1.4	434	1.0	*<0.01*	*<0.05*	21	140	8.8	6.3	*<0.001*	0.020	7.0	3.9	0.40	0.40	93	*<0.01*	0.020	13	*<0.005*	0.15	1.9	22	0.16	12	40	5.6
ABA129	KAM150033	CFR0567	155.5	157.0	Waste	Oxide	Schist	BtS	3.7	0.090	308	0.61	*<0.01*	*<0.05*	67	600	9.7	12	*<0.001*	0.030	28	5.0	1.0	0.40	49	*<0.01*	0.020	20	*<0.005*	0.53	4.3	24	2.2	25	67	1.2
ABA130	KAM150823	CFR0574	10.7	12.2	Waste	Oxide	Schist	BtS	2.0	0.12	738	0.94	*<0.01*	*<0.05*	22	380	4.3	5.5	*<0.001*	0.020	4.6	5.0	0.40	0.30	39	*<0.01*	0.010	15	*<0.005*	0.78	1.1	30	0.32	16	30	3.5
ABA131	KAM150859	CFR0574	61.0	62.5	Waste	Oxide	Schist	BtS	0.60	0.15	272	1.3	*<0.01*	0.050	7.1	120	7.7	12	*<0.001*	0.030	11	1.1	0.30	*<0.2*	50	*<0.01*	0.020	22	*<0.005*	0.21	0.84	3.0	0.38	5.8	19	7.5
ABA133	KAM150951	CFR0575	61.0	62.5	Waste	Oxide	Schist	BtS	3.7	0.93	659	1.2	*<0.01*	*<0.05*	57	390	11	15	*<0.001*	0.090	11	4.7	0.80	0.20	109	*<0.01*	0.030	12	*<0.005*	0.36	2.0	23	0.27	19	61	1.3
ABA201	R276929	CFD0416	13.0	14.0	Waste	Oxide	Schist	BtS	3.1	0.090	411	0.51	0.010	*<0.05*	52	430	12	12	*<0.001*	0.010	5.6	5.4	0.80	0.30	23	*<0.01*	0.010	11	*<0.005*	0.14	2.7	34	0.35	15	59	0.90
ABA202	R270012	CFD0384	13.0	14.0	Waste	Oxide	Schist	BtS_carb	2.9	0.050	364	0.34	*<0.01*	*<0.05*	7.7	650	19	7.5	*<0.001*	0.040	3.9	4.4	0.30	0.40	54	*<0.01*	*<0.01*	24	0.0050	0.61	2.0	23	0.59	17	56	9.8
ABA383	KAM068572	CFD0234	225.1	226.0	Waste	Oxide	Schist	MsS	1.3	0.010	166	0.26	0.010	0.050	1.0	120	10	7.9	*<0.01*	*<0.01*	9.1	0.70	0.30	0.70	19	*<0.01*	*<0.01*	38	*<0.005*	0.15	9.6	6.0	0.28	9.8	5.0	11
-						**Oxide**	**Schist**	**n**	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15
								Max	6.3	1.4	738	1.9	0.010	0.090	67	850	19	28	0.0020	0.49	44	13	1.4	0.80	286	0.010	0.22	38	0.041	1.4	9.6	51	2.2	26	67	11
								90th PCTL	4.7	1.3	655	1.3	0.010	0.074	56	716	12	21	*<0.01*	0.37	22	8.6	1.1	0.76	112	*<0.01*	0.030	26	0.013	0.71	6.6	45	0.97	23	65	9.5
								75th PCTL	4.1	0.72	609	1.1	0.010	0.050	48	545	11	15	*<0.01*	0.065	11	6.3	0.90	0.65	86	*<0.01*	0.025	23	0.0050	0.45	3.3	32	0.62	20	60	6.9
								Median	3.4	0.15	486	0.63	*<0.01*	*<0.05*	21	390	9.7	12	*<0.01*	0.030	9.1	4.9	0.70	0.40	49	*<0.01*	0.020	17	*<0.005*	0.26	2.1	24	0.32	17	44	3.5
								25th PCTL	2.1	0.080	336	0.54	*<0.01*	*<0.05*	7.4	250	7.2	6.9	*<0.01*	0.015	5.1	3.1	0.40	0.30	27	*<0.01*	0.010	13	*<0.005*	0.17	1.6	16	0.28	14	28	1.6
								10th PCTL	1.5	0.044	208	0.40	*<0.01*	*<0.05*	6.1	120	5.2	5.7	*<0.01*	0.010	3.4	1.3	0.30	0.20	19	*<0.01*	*<0.01*	11	*<0.005*	0.15	0.93	7.2	0.20	11	15	1.1
								Min	0.60	0.010	159	0.26	*<0.01*	*<0.05*	1.0	90	2.4	3.8	*<0.01*	*0.010*	3.0	0.70	0.30	0.20	9.1	*<0.01*	*<0.01*	9.6	*<0.005*	0.14	0.63	3.0	0.14	5.8	5.0	0.90
Upper Transition Facies for Schist Waste Rock																																				
ABA004	KAM022156	CFD0107	149.0	150.0	Waste	Upper transition	Schist	RQM	3.3	0.80	463	0.90	0.020	0.060	23	360	8.6	11	*<0.001*	0.24	3.3	5.1	1.0	0.40	59	*<0.01*	0.020	18	0.0060	0.18	1.2	22	0.21	18	51	3.7
ABA027	KAM037928	CFD0099	30.0	31.0	Waste	Upper transition	Schist	BtS_carb	6.5	0.32	611	1.2	0.010	0.050	15	560	10	32	*<0.001*	0.010	2.1	6.8	0.90	0.80	89	*<0.01*	*<0.01*	17	0.026	0.20	2.4	35	1.4	22	54	1.7
ABA062	KAM081561	CFD0202	58.0	58.5	Waste	Upper transition	Schist	BtS	9.8	3.5	909	3.1	0.030	*<0.05*	35	1270	37	76	0.0060	1.1	4.1	22	1.1	1.9	60	*<0.01*	2.6	7.0	0.14	0.47	1.2	165	0.15	18	141	1.8
ABA076	KAM147059	CFD0345	160.0	161.0	Waste	Upper transition	Schist	BtS	4.3	1.9	533	0.45	0.010	*<0.05*	20	150	26	7.2	*<0.001*	0.61	8.9	4.6	0.70	0.30	108	*<0.01*	0.020	9.0	*<0.005*	0.070	2.2	28	0.24	13	52	2.9
ABA092	KAM135149	CFR0452	10.7	12.2	Waste	Upper Transition	Schist	BtS	5.2	0.32	232	2.0	0.060	0.38	4.8	370	7.3	39	*<0.001*	*<0.01*	0.95	1.8	1.0	0.70	16	*<0.01*	0.41	26	0.059	0.24	4.3	8.0	0.55	19	16	5.6
ABA124	KAM149042	CFR0559	35.1	36.6	Waste	Upper transition	Schist	BtS	4.5	0.78	435	1.4	*<0.01*	0.090	20	340	7.1	21	*<0.001*	0.040	3.6	5.3	0.70	0.80	45	*<0.01*	0.030	21	0.033	0.12	1.0	36	0.43	17	41	7.9
ABA204	R270174	CFD0388	8.0	9.0	Waste	Upper transition	Schist	MsS	5.0	0.38	426	0.53	0.010	*<0.05*	37	450	11	27	*<0.001*	0.030	4.1	9.0	0.60	0.70	35	*<0.01*	0.040	13	0.034	0.57	1.4	43	0.19	22	72	1.5
ABA205	R276797	CFD0413	115.0	116.0	Waste	Upper transition	Schist	BtS	2.9	1.0	481	0.49	0.010	*<0.05*	32	100	4.9	9.3	*<0.001*	0.010	66	5.5	0.40	0.50	87	*<0.01*	0.020	12	*<0.005*	0.11	3.5	29	0.81	11	28	2.5
ABA206	Q033613	CFD0407	52.0	53.0	Waste	Upper transition	Schist	BtS	8.7	1.6	377	0.73	0.010	*<0.05*	25	310	6.8	12	0.0010	0.080	6.8	7.0	0.70	0.70	89	*<0.01*	*<0.01*	20	0.0050	0.19	2.1	31	0.11	20	40	2.0
ABA316	R270207	CFD0390	5.0	6.0	Waste	Upper Transition	Schist	MsS	3.0	0.29	618	0.53	0.020	*<0.05*	36	450	12	15	*<0.001*	0.080	5.8	7.2	0.90	0.40	34	*<0.01*	0.030	11	0.0070	0.12	2.0	39	0.64	20	83	1.3
ABA317	R270258	CFD0390	50.0	51.0	Waste	Upper Transition	Schist	BtS_carb	4.4	0.42	286	1.2	0.050	0.060	9.8	570	4.7	41	*<0.001*	0.080	1.9	5.6	0.70	1.0	99	*<0.01*	0.020	31	0.032	0.23	1.8	32	0.080	15	36	13
ABA320	R270432	CFD0392	44.0	45.0	Waste	Upper Transition	Schist	BtS_carb	2.8	0.11	420	1.2	0.010	*<0.05*	7.0	450	8.1	16	*<0.001*	0.010	14	4.8	0.50	0.80	73	*<0.01*	*<0.01*	28	0.0070	0.15	2.6	29	0.64	16	36	9.7
ABA323	Q033713	CFD0411	24.0	25.0	Waste	Upper Transition	Schist	BtS_Carb	6.3	0.37	590	0.49	0.020	*<0.05*	31	520	11	12	*<0.001*	0.020	17	10	1.0	2.8	105	*<0.01*	0.010	11	0.0090	0.15	1.9	54	0.42	25	81	3.3
ABA332	Q033589	CFD0407	32.0	33.0	Waste	Upper Transition	schist	BtS	5.1	0.80	470	0.84	0.060	*<0.05*	35	420	5.9	17	*<0.001*	0.030	3.9	6.2	0.60	1.6	48	*<0.01*	0.010	15	0.0090	0.090	2.6	40	0.12	18	45	2.9
Statistical Summary						**Upper Transition**	**Schist**	**n**	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								Max	9.8	3.5	909	3.1	0.060	0.38	37	1270	37	76	0.0060	1.1	66	22	1.1	2.8	108	*<0.01*	2.6	31	0.14	0.57	4.3	165	1.4	25	141	13
								90th PCTL	8.0	1.8	616	1.9	0.057	0.081	36	567	21	40	0.0010	0.50	16	9.7	1.0	1.8	103	*<0.01*	0.30	27	0.052	0.40	3.3	51	0.76	22	82	9.2
								75th PCTL	6.0	0.96	576	1.2	0.028	0.058	34	503	11	30	*<0.001*	0.080	8.4	7.2	0.98	0.95	89	*<0.01*	0.030	21	0.033	0.22	2.6	40	0.62	20	68	5.1
								Median	4.8	0.60	467	0.87	0.015	*<0.05*	24	435	8.4	16	*<0.001*	0.035	4.1	5.9	0.70	0.75	67	*<0.01*	0.020	16	0.0090	0.17	2.1	34	0.33	18	48	2.9
								25th PCTL	3.6	0.33	422	0.53	0.010	*<0.05*	16	345	6.9	12	*<0.001*	0.013	3.4	5.2	0.63	0.55	46	*<0.01*	0.010	12	0.0063	0.12	1.5	29	0.16	16	37	1.9
								10th PCTL	2.9	0.30	313	0.49	0.010	*<0.05*	7.8	198	5.2	9.7	*<0.001*	0.010	2.0	4.7	0.53	0.40	35	*<0.01*	*<0.01*	9.5	*<0.005*	0.096	1.2	24	0.11	14	30	1.6
								Min	2.8	0.11	232	0.45	*<0.01*	*<0.05*	4.8	100	4.7	7.2	*<0.001*	*<0.01*	0.95	1.8	0.40	0.30	16	*<0.01*	*<0.01*	7.0	*<0.005*	0.070	1.0	8.0	0.080	11	16	1.3
Lower Transition Facies for Schist Waste Rock																																				
ABA021	KAM033153	CFD0164	148.0	149.0	Waste	Lower transition	Schist	BtS	14	2.2	584	0.42	0.11	0.090	39	630	1.6	89	*<0.001*	0.16	0.17	6.7	0.40	1.0	54	*<0.01*	0.010	4.7	0.23	0.48	1.4	72	0.27	7.2	60	1.6
ABA024	KAM036666	CFD0087	17.0	18.0	Waste	Lower transition	Schist	BtS_carb	17	1.4	551	0.61	0.10	0.17	17	990	4.9	97	*<0.001*	0.060	0.66	9.7	1.1	1.7	103	0.010	0.030	12	0.21	0.54	1.7	84	0.14	19	72	2.1
ABA025	KAM037046	CFD0091	12.0	13.0	Waste	Lower transition	Schist	BtS	15	1.3	510	0.70	0.030	0.070	26	610	8.8	73	*<0.001*	*<0.01*	0.81	8.4	0.80	0.80	154	*<0.01*	0.040	14	0.099	0.37	1.1	62	0.77	18	58	2.1
ABA031	KAM039252	CFD0116	75.0	76.0	Waste	Lower transition	Schist	RQM	16	1.3	582	0.53	0.020	0.12	30	660	7.4	78	*<0.001*	0.070	0.24	8.7	1.0	1.8	92	*<0.01*	0.020	21	0.11	0.50	1.8	49	0.14	22	49	5.0
ABA038	KAM047995	CFD0135	153.0	154.0	Waste	Lower transition	Schist	BtS	13	1.8	484	0.98	0.040	0.050	32	570	14	58	*<0.001*	0.10	2.2	6.9	0.70	1.2	65	*<0.01*	0.14	14	0.098	0.35	1.8	56	0.26	15	46	2.8
ABA054	KAM081312	CFD0198	85.0	86.0	Waste	Lower transition	Schist	BtS	0.70	0.030	127	0.32	0.080	0.25	3.6	100	4.3	10	*<0.001*	*<0.01*	4.9	0.70	0.50	0.30	8.7	*<0.01*	0.040	33	*<0.005*	0.060	2.3	4.0	0.35	12	7.0	11
ABA086	KAM133474	CFR0429	59.4	61.0	Waste	Lower transition	Schist	BtS	8.5	0.98	428	1.4	0.030	0.11	27	510	9.3	58	*<0.001*	0.18	1.4	5.3	0.60	0.60	61	*<0.01*	0.020	19	0.10	0.35	1.6	33	0.33	19	49	2.7
ABA208	R276736	CFD0413	61.0	62.0	Waste	Lower transition	Schist	BtS	16	1.2	620	0.74	0.020	0.090	33	650	8.9	67	0.0010	0.36	2.5	8.5	0.90	1.3	52	*<0.01*	0.070	13	0.12	0.41	1.7	56	0.14	20	57	1.5
ABA209	R270032	CFD0384	31.0	32.0	Waste	Lower transition	Schist	BtS_carb	8.3	0.69	523	10	0.040	0.14	18	580	7.2	43	0.0030	0.26	0.060	4.9	0.40	1.1	78	*<0.01*	0.16	16	0.090	0.28	2.2	24	0.12	19	41	3.2
ABA210	R276281	CFD0401	58.0	59.0	Waste	Lower transition	Schist	BtS	8.1	1.5	832	0.28	0.030	0.070	40	580	8.2	37	*<0.001*	*<0.01*	3.5	8.7	0.30	0.90	79	*<0.01*	0.17	17	0.037	0.31	3.2	50	0.46	21	49	2.6
ABA211	R276567	CFD0409	65.0	66.0	Waste	Lower transition	Schist	BtS	10	2.1	610	0.34	0.040	0.080	58	620	12	19	*<0.001*	0.020	1.2	11	0.20	0.50	58	*<0.01*	0.080	7.6	0.034	0.14	1.4	63	*<0.05*	9.9	53	1.4
ABA318	R270302	CFD0390	88.0	89.0	Waste	Lower Transition	Schist	BtS_carb	7.8	0.91	602	0.26	0.020	0.41	25	410	7.6	8.1	*<0.001*	0.020	0.14	3.1	0.30	2.0	355	0.010	0.030	5.0	0.11	0.050	1.2	21	0.32	7.9	48	3.9
ABA319	R270394	CFD0392	10.0	11.0	Waste	Lower Transition	Schist	BtS_carb	15	1.3	540	0.33	0.030	0.18	52	470	5.3	37	*<0.001*	*<0.01*	2.0	7.2	0.80	1.1	59	*<0.01*	0.010	13	0.060	0.22	0.93	46	0.080	19	58	1.2
ABA325	R512767	CFR0724	39.6	41.2	Waste	Lower Transition	schist	BtS	12	1.2	391	1.9	0.080	0.23	15	540	33	43	*<0.001*	0.060	1.7	5.4	0.60	1.2	53	*<0.01*	0.040	23	0.13	0.27	1.9	45	0.67	13	42	6.9
ABA333	R277487	CFD0426	43.0	44.0	Waste	Lower Transition	schist	BtS	8.1	0.71	393	0.49	0.030	0.10	19	380	5.7	54	*<0.001*	*<0.01*	3.3	3.0	0.70	3.3	14	*<0.01*	0.21	35	0.054	0.41	3.7	19	0.47	17	19	4.4
ABA335	R550437	CFD0518	25.0	26.0	Waste	Lower Transition	schist	BtS	9.8	0.88	591	0.31	0.030	0.35	40	860	12	9.1	*<0.001*	*<0.01*	2.9	6.0	0.40	1.7	273	*<0.01*	0.020	5.2	0.15	0.080	1.5	45	1.8	11	66	11
ABA336	R550471	CFD0518	55.0	56.0	Waste	Lower Transition	Schist	BtS_carb	11	0.92	681	0.30	0.030	0.11	35	1150	16	46	*<0.001*	0.13	19	7.2	1.3	2.0	231	*<0.01*	0.020	9.6	0.075	0.25	1.6	41	0.17	26	88	2.1
ABA337	R550494	CFD0518	75.0	75.0	Waste	Lower Transition	schist	BtS	16	1.1	526	0.12	0.040	0.13	46	660	12	80	*<0.001*	*<0.01*	0.94	4.9	0.70	1.2	1630	*<0.01*	0.030	12	0.13	0.52	0.89	48	0.34	16	67	2.2
ABA345	R551151	CFD0563	68.0	69.0	Waste	Lower Transition	schist	BtS	8.4	1.7	711	0.91	0.070	0.14	57	780	49	38	*<0.001*	0.050	3.0	6.2	0.30	2.0	54	*<0.01*	0.050	2.6	0.16	0.52	0.81	44	0.23	7.4	99	2.1
Statistical Summary						**Lower Transition**	**Schist**	**n**	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19
								Max	17	2.2	832	10	0.11	0.41	58	1150	49	97	0.0030	0.36	19	11	1.3	3.3	1630	0.010	0.21	35	0.23	0.54	3.7	84	1.8	26	99	11
								90th PCTL	16	1.8	687	1.5	0.084	0.27	53	886	19	82	0.0010	0.20	3.8	8.9	1.0	2.0	289	0.010	0.16	25	0.17	0.52	2.4	65	0.69	21	75	7.6
								75th PCTL	15	1.5	606	0.83	0.055	0.18	40	660	12	70	*<0.001*	0.12	3.0	8.5	0.80	1.8	129	*<0.01*	0.075	18	0.13	0.45	1.9	56	0.41	19	63	4.2
								Median	11	1.2	551	0.49	0.030	0.12	32	610	8.8	46	*<0.001*	0.050	1.7	6.7	0.60	1.2	65	*<0.01*	0.040	13	0.10	0.35	1.6	46	0.27	17	53	2.6
								25th PCTL	8.4	0.92	497	0.32	0.030	0.090	22	525	6.5	37	*<0.001*	*<0.01*	0.74	5.1	0.40	0.95	54	*<0.01*	0.020	8.6	0.068	0.24	1.3	37	0.14	11	47	2.1
								10th PCTL	8.0	0.71	393	0.28	0.020	0.070	17	404	4.8	9.8	*<0.001*	*<0.01*	0.16	3.1	0.30	0.58	44	*<0.01*	0.018	4.9	0.036	0.076	0.92	21	0.11	7.8	37	1.5
								Min	0.70	0.030	127	0.12	0.020	0.050	3.6	100	1.6	8.1	*<0.001*	*<0.01*	0.060	0.70	0.20	0.30	8.7	*<0.01*	0.010	2.6	*<0.005*	0.050	0.81	4.0	*<0.05*	7.2	7.0	1.2

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Fresh Facies for Schist Waste Rock																																				
ABA082	KAM131674	CFR0401	15.2	16.8	Waste	Fresh	Schist	BtS	16	1.7	548	0.73	0.040	*<0.05*	27	1570	4.2	62	*<0.001*	0.010	1.4	7.5	0.50	0.50	51	*<0.01*	0.020	6.4	0.21	0.35	0.55	75	0.22	12	60	1.5
ABA084	KAM132888	CFR0420	32.0	33.5	Waste	Fresh	Schist	BtS	11	1.4	539	1.2	0.020	0.12	20	630	6.8	75	*<0.001*	0.010	0.22	3.8	0.80	0.80	94	*<0.01*	0.020	16	0.13	0.43	1.4	27	0.28	16	40	6.6
ABA091	KAM133659	CFR0431	109.7	111.3	Waste	Fresh	Schist	BtS	10	1.1	423	1.8	0.050	0.13	19	750	30	56	*<0.001*	1.1	0.36	3.7	0.70	1.2	136	*<0.01*	0.070	13	0.099	0.30	2.0	36	0.59	12	45	1.0
ABA093	KAM135298	CFR0453	10.7	12.2	Waste	Fresh	Schist	BtS	16	2.3	586	0.76	0.10	0.060	102	1760	2.8	95	0.0010	0.090	3.7	8.7	0.60	0.50	169	*<0.01*	0.010	8.6	0.21	0.79	2.1	101	0.27	12	41	22
ABA095	KAM135693	CFR0456	10.7	12.2	Waste	Fresh	Schist	BtS	17	1.5	452	0.88	0.030	0.10	53	450	2.2	77	*<0.001*	0.010	1.6	5.0	0.70	0.50	22	*<0.01*	0.040	11	0.18	0.45	0.70	48	0.40	12	77	1.2
ABA127	KAM149916	CFR0566	109.7	111.3	Waste	Fresh	Schist	BtS_carb	17	1.3	434	1.3	0.020	0.080	54	440	4.6	68	0.0010	0.70	3.2	7.0	1.1	0.60	125	*<0.01*	0.020	11	0.13	0.37	1.4	56	0.54	20	64	2.4
ABA132	KAM150898	CFR0574	114.3	115.8	Waste	Fresh	Schist	BtS	17	1.6	434	1.1	0.030	*<0.05*	60	520	4.9	72	0.0010	0.70	4.0	9.3	0.90	1.0	104	0.010	0.020	9.3	0.10	0.42	2.2	59	0.36	18	56	1.7
ABA134	KAM150984	CFR0575	106.7	108.2	Waste	Fresh	Schist	BtS	9.4	1.4	536	2.3	0.020	0.050	11	750	6.3	25	*<0.001*	0.090	0.69	6.1	0.80	0.80	126	*<0.01*	*<0.01*	22	0.021	0.12	2.8	42	0.27	19	46	1.8
ABA212	Q033565	CFD0407	10.0	11.0	Waste	Fresh	Schist	BtS	22	2.1	702	0.28	0.050	0.050	45	890	16	88	0.0010	0.13	0.23	10	1.0	2.1	59	*<0.01*	0.010	12	0.16	0.54	1.5	73	0.16	21	86	1.6
ABA213	R280479	CFD0497	111.0	112.0	Waste	Fresh	Schist	BtS	15	1.4	724	0.98	0.070	0.13	15	860	3.0	54	*<0.001*	0.030	0.39	2.6	0.20	0.70	51	*<0.01*	0.080	7.9	0.16	0.28	1.1	36	0.14	5.9	40	2.5
ABA214	R274802	CFD0472	47.0	48.0	Waste	Fresh	Schist	BtS	5.5	0.32	243	1.8	0.040	0.42	5.7	370	6.0	38	0.0010	0.010	1.4	1.4	0.50	0.80	15	*<0.01*	0.12	27	0.053	0.30	6.2	7.0	0.22	14	12	6.8
ABA215	R275143	CFD0482	40.0	41.0	Waste	Fresh	Schist	BtS	6.7	1.5	550	0.83	0.010	*<0.05*	76	1040	13	98	0.0010	0.020	10	17	0.70	0.80	53	*<0.01*	0.050	21	0.076	0.99	4.2	102	0.38	18	32	6.7
ABA216	R276122	CFD0393	87.0	88.0	Waste	Fresh	Schist	BtS	19	3.3	691	0.13	0.040	0.17	35	640	6.1	88	*<0.001*	*<0.01*	0.98	5.6	0.20	1.6	51	*<0.01*	0.010	3.2	0.26	0.54	0.65	67	0.25	7.0	63	1.8
ABA217	R270181	CFD0388	92.0	93.0	Waste	Fresh	Schist	BtS_carb	17	1.5	603	1.6	0.040	0.11	24	860	8.7	84	0.0010	0.35	0.11	8.6	0.90	1.0	75	*<0.01*	0.020	19	0.18	0.42	3.1	57	0.12	23	54	1.6
ABA218	R283622	CFD0498	28.0	29.0	Waste	Fresh	Schist	BtS	9.1	1.3	362	0.25	0.070	0.44	32	720	7.9	46	*<0.001*	0.020	0.32	2.9	0.40	0.70	89	0.010	11	8.1	0.25	0.26	0.71	45	0.57	5.3	31	2.3
ABA219	R276979	CFD0416	57.0	58.0	Waste	Fresh	Schist	BtS	4.7	4.1	914	0.41	0.020	*<0.05*	56	320	11	32	0.0010	0.040	4.2	12	0.40	0.60	164	*<0.01*	0.010	4.3	0.034	0.29	1.3	51	*<0.05*	12	58	1.6
ABA220	R276002	CFD0387	148.0	149.0	Waste	Fresh	Schist	BtS	15	2.1	438	0.70	0.070	0.21	78	530	11	41	*<0.001*	0.15	0.17	4.4	0.20	0.70	69	0.010	0.050	4.2	0.25	0.22	0.58	50	0.23	6.2	43	1.5
ABA221	R276317	CFD0401	129.0	130.0	Waste	Fresh	Schist	BtS	4.4	0.99	304	0.42	0.030	0.46	32	520	4.6	38	*<0.001*	0.13	0.24	2.0	*<0.2*	1.8	175	*<0.01*	0.050	9.9	0.15	0.26	1.6	26	0.26	6.1	20	2.1
ABA222	R270104	CFD0386	59.0	60.0	Waste	Fresh	Schist	BtS_carb	15	1.1	521	0.72	0.030	0.10	33	610	8.0	72	0.0010	0.27	0.27	7.0	0.90	0.90	62	*<0.01*	0.010	15	0.16	0.41	1.7	38	0.11	22	59	1.8
ABA223	R270127	CFD0386	80.0	81.0	Waste	Fresh	Schist	MsS	6.4	0.87	468	0.65	0.030	0.090	39	370	15	54	*<0.001*	0.18	0.53	6.4	0.90	1.0	201	*<0.01*	*<0.01*	17	0.082	0.38	3.5	33	0.070	21	58	2.5
ABA321	R270466	CFD0392	74.0	75.0	Waste	Fresh	Schist	BtS_carb	18	1.3	489	0.68	0.040	0.12	27	670	7.5	88	0.0010	0.14	1.6	8.4	1.0	1.2	83	*<0.01*	0.020	17	0.16	0.50	6.0	46	0.090	21	54	1.8
ABA322	R270482	CFD0392	88.0	89.0	Waste	Fresh	Schist	BtS_carb	17	1.3	516	0.49	0.030	0.11	39	550	8.0	79	*<0.001*	*<0.01*	2.8	5.9	0.70	1.5	298	*<0.01*	0.020	11	0.14	0.48	1.1	44	0.12	15	58	1.7
ABA326	R512983	CFR0731	32.0	32.4	Waste	Fresh	schist	BtS	15	2.2	528	0.68	0.040	0.15	103	630	3.7	40	*<0.001*	*<0.01*	4.8	7.7	0.40	1.1	66	*<0.01*	0.080	5.1	0.22	0.32	0.62	56	0.27	9.0	43	3.5
ABA329	R270202	CFD0388	110.0	110.2	Waste	Fresh	Schist	BtS_carb	11	1.4	551	1.3	0.070	0.73	54	1440	4.5	62	0.0010	0.19	0.83	4.0	0.50	3.5	202	0.010	0.020	8.3	0.29	0.33	2.3	53	0.32	13	38	4.5
ABA330	R276299	CFD0401	74.0	75.0	Waste	Fresh	schist	BtS	4.5	0.78	744	3.1	0.060	0.90	39	640	2.2	30	*<0.001*	0.050	0.45	2.4	0.40	2.5	94	0.010	0.13	5.4	0.18	0.18	0.98	30	0.76	6.9	38	7.9
ABA331	R276331	CFD0401	141.0	142.0	Waste	Fresh	schist	BtS	30	3.0	928	0.38	0.030	0.060	41	780	13	104	*<0.001*	*<0.01*	1.7	9.5	0.50	1.5	138	*<0.01*	0.020	6.6	0.17	0.59	3.4	109	0.11	13	134	2.0
ABA377	R279587	CFD0468	131.0	132.0	Waste	Fresh	Schist	AmBtS	4.0	0.60	741	2.6	0.050	0.62	24	340	3.1	23	*<0.001*	0.23	0.12	1.2	0.20	3.9	380	0.010	0.040	7.2	0.079	0.13	0.93	16	0.98	5.8	18	2.0
ABA415	R277001	CFD0398	49.0	50.0	Waste	Fresh	schist	BtS	11	1.6	429	0.27	0.040	0.21	62	730	2.9	46	*<0.001*	*<0.01*	1.0	2.9	0.20	0.40	46	*<0.01*	0.070	3.6	0.22	0.32	0.34	35	0.30	4.1	34	1.7
ABA416	R277017	CFD0398	64.0	65.0	Waste	Fresh	schist	BtS	16	1.8	622	0.29	0.050	0.16	29	1000	4.1	70	*<0.001*	*<0.01*	0.81	3.9	0.20	1.2	63	*<0.01*	0.030	7.4	0.21	0.45	1.1	63	0.33	7.0	57	2.5
ABA417	R277021	CFD0398	124.0	125.0	Waste	Fresh	schist	BtS	9.8	1.7	396	0.16	0.040	0.23	27	870	7.0	43	*<0.001*	*<0.01*	0.66	4.2	0.30	1.2	87	*<0.01*	0.030	6.2	0.21	0.29	0.70	41	0.30	7.1	41	2.8
ABA418	R277041	CFD0398	160.0	161.0	Waste	Fresh	schist	BtS	18	2.1	574	1.2	0.040	0.13	48	560	8.6	65	*<0.001*	0.18	0.17	3.4	0.20	0.90	40	*<0.01*	0.040	3.7	0.20	0.40	0.51	49	0.23	3.9	53	2.3
Statistical Summary						**Fresh**	**Schist**	**n**	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
								Max	30	4.1	928	3.1	0.10	0.90	103	1760	30	104	0.0010	1.1	10	17	1.1	3.9	380	0.010	11	27	0.29	0.99	6.2	109	0.98	23	134	22
								90th PCTL	18	2.3	741	1.8	0.070	0.46	76	1040	13	88	0.0010	0.35	4.0	9.5	0.90	2.1	201	0.010	0.080	19	0.25	0.54	3.5	75	0.57	21	64	6.7
								75th PCTL	17	2.0	613	1.3	0.050	0.21	54	860	8.7	78	*<0.001*	0.18	1.7	8.1	0.80	1.4	137	*<0.01*	0.050	14	0.21	0.45	2.2	58	0.35	18	58	2.7
								Median	15	1.5	536	0.73	0.040	0.12	39	640	6.3	62	*<0.001*	0.050	0.81	5.6	0.50	1.0	87	*<0.01*	0.020	8.6	0.16	0.37	1.4	48	0.27	12	46	2.0
								25th PCTL	9.3	1.3	436	0.42	0.030	0.070	27	525	4.2	42	*<0.001*	0.010	0.30	3.6	0.25	0.70	56	*<0.01*	0.020	6.3	0.12	0.29	0.71	36	0.15	7.0	39	1.7
								10th PCTL	4.7	0.87	396	0.27	0.020	*<0.05*	19	370	2.9	32	*<0.001*	*<0.01*	0.17	2.4	0.20	0.50	46	*<0.01*	0.010	4.2	0.076	0.22	0.58	27	0.11	5.8	31	1.5
								Min	4.0	0.32	243	0.13	0.010	*<0.05*	5.7	320	2.2	23	*<0.001*	*<0.01*	0.11	1.2	*<0.2*	0.40	15	*<0.01*	0.010	3.2	0.021	0.12	0.34	7.0	*<0.05*	3.9	12	1.0
Statistical Summary for Schist Waste Rock								**n**	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
								Max	30	4.1	928	10	0.11	0.90	103	1760	49	104	0.0060	1.1	66	22	1.4	3.9	1630	0.010	11	38	0.29	1.4	9.6	165	2.2	26	141	22
								90th PCTL	17	2.1	714	1.8	0.070	0.36	57	910	15	84	0.0010	0.35	11	9.5	1.0	2.0	201	0.010	0.13	25	0.21	0.54	3.6	68	0.69	22	73	8.1
								75th PCTL	15	1.6	607	1.2	0.040	0.14	44	725	11	67	0.0010	0.15	4.8	7.6	0.90	1.2	106	0.010	0.045	19	0.16	0.44	2.4	52	0.45	19	60	4.7
								Median	8.4	1.2	526	0.70	0.030	0.090	32	560	8.0	39	*<0.001*	0.030	2.5	5.6	0.70	0.80	69	*<0.01*	0.020	13	0.082	0.30	1.7	41	0.28	16	49	2.3
								25th PCTL	4.5	0.56	429	0.44	0.010	*<0.05*	19	400	5.1	15	*<0.001*	0.010	0.75	4.0	0.40	0.55	50	*<0.01*	0.015	8.2	0.0090	0.19	1.1	28	0.16	12	39	1.7
								10th PCTL	2.9	0.12	307	0.28	*<0.01*	*<0.05*	7.6	318	3.6	8.9	*<0.001*	*<0.01*	0.23	2.2	0.20	0.40	23	*<0.01*	0.010	5.1	*<0.005*	0.12	0.70	18	0.11	6.8	20	1.4
								Min	0.60	0.010	127	0.12	*<0.01*	*<0.05*	1.0	90	1.6	3.8	*<0.001*	*<0.01*	0.060	0.70	0.20	*0.20*	8.7	*<0.01*	*<0.01*	2.6	*<0.005*	0.050	0.34	3.0	*<0.05*	3.9	5.0	0.90
Oxide Facies for Granite Waste Rock																																				
ABA157	R305807	CFD0382	76.0	77.0	Waste	Oxide	Granite	GG	2.8	0.010	2360	1.2	*<0.01*	0.090	1.0	180	17	6.1	*<0.001*	*<0.01*	35	1.3	0.30	0.30	72	*<0.01*	0.020	23	*<0.005*	2.1	6.5	3.0	2.4	6.6	36	6.3
ABA158	R305808	CFD0382	79.0	80.0	Waste	Oxide	Granite	GG	2.5	*<0.01*	1150	1.2	*<0.01*	0.090	1.0	190	22	3.0	*<0.001*	*<0.01*	38	1.0	0.20	0.40	112	*<0.01*	*<0.01*	23	*<0.005*	0.94	8.0	3.0	3.3	6.7	31	6.9
ABA174	R305826	CFD0403	7.0	8.0	Waste	Oxide	Granite	GG	0.80	0.010	21	0.61	*<0.01*	0.25	0.70	70	21	10	*<0.001*	*<0.01*	12	0.50	0.20	0.20	14	*<0.01*	*<0.01*	31	*<0.005*	1.2	5.6	1.0	0.080	2.9	5.0	6.8
ABA421	I354544	CFD0053	50.3	51.0	Waste	Oxide	Granite	GG	0.70	0.020	135	0.58	0.010	0.18	1.0	80	27	12	*<0.001*	0.010	7.5	0.60	0.40	0.30	56	*<0.01*	0.010	16	*<0.005*	0.35	22	2.0	0.090	13	19	3.3
ABA423	Q033319	CFD0403	7.0	7.8	Waste	Oxide	Granite	GG	1.3	0.020	34	0.72	0.010	0.20	1.6	60	21	15	*<0.001*	*<0.01*	8.8	0.60	*<0.2*	3.3	17	*<0.01*	0.010	35	*<0.005*	2.0	5.6	1.0	0.070	3.1	5.0	7.0
ABA429	Q032778	CFD0394	39.7	40.0	Waste	Oxide	Granite	GG	6.5	0.080	982	0.97	0.050	0.82	0.90	220	7.7	31	*<0.001*	*<0.01*	0.82	1.8	0.40	1.0	7.3	*<0.01*	*<0.01*	32	0.039	0.50	5.3	6.0	0.060	10	28	10
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	6.5	0.080	2360	1.2	0.050	0.82	1.6	220	27	31	*<0.001*	0.010	38	1.8	0.40	3.3	112	*<0.01*	0.020	35	0.039	2.1	22	6.0	3.3	13	36	10
								90th PCTL	4.7	0.050	1755	1.2	0.030	0.54	1.3	205	24	23	*<0.001*	0.010	36	1.6	0.40	2.2	92	*<0.01*	0.015	33	0.022	2.1	15	4.5	2.8	12	34	8.6
								75th PCTL	2.7	0.020	1108	1.1	0.010	0.24	1.0	188	22	14	*<0.001*	*<0.01*	29	1.2	0.38	0.85	68	*<0.01*	0.010	32	*<0.005*	1.8	7.6	3.0	1.8	9.3	30	7.0
								Median	1.9	0.015	559	0.85	*<0.01*	0.19	1.0	130	21	11	*<0.001*	*<0.01*	10	0.80	0.25	0.35	36	*<0.01*	*<0.01*	27	*<0.005*	1.1	6.0	2.5	0.085	6.6	24	6.9
								25th PCTL	0.93	0.010	59	0.64	*<0.01*	0.11	0.93	73	18	7.2	*<0.001*	*<0.01*	7.8	0.60	0.20	0.30	15	*<0.01*	*<0.01*	23	*<0.005*	0.61	5.6	1.3	0.073	4.0	8.5	6.4
								10th PCTL	0.75	0.010	28	0.60	*<0.01*	0.090	0.80	65	13	4.6	*<0.001*	*<0.01*	4.1	0.55	0.20	0.25	11	*<0.01*	*<0.01*	19	*<0.005*	0.43	5.4	1.0	0.065	3.0	5.0	4.8
								Min	0.70	*<0.01*	21	0.58	*<0.01*	0.090	0.70	60	7.7	3.0	*<0.001*	*<0.01*	0.82	0.50	*0.20*	0.20	7.3	*<0.01*	*<0.01*	16	*<0.005*	0.35	5.3	1.0	0.060	2.9	5.0	3.3

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Upper Transition Facies for Granite Waste Rock																																				
ABA013	KAM025898	CFD0150	81.0	82.0	Waste	Upper transition	Granite	GG	4.4	0.040	136	0.80	0.040	0.27	1.1	150	9.9	12	<0.001	<0.01	0.53	1.6	0.80	0.80	6.7	<0.01	<0.01	34	0.0080	0.18	11	5.0	0.060	19	13	7.9
ABA151	R305801	CFD0381	13.0	14.0	Waste	Upper transition	Granite	GG	12	0.11	869	1.2	0.070	1.3	0.80	150	6.8	35	<0.001	<0.01	0.11	2.1	0.50	1.1	5.5	<0.01	0.010	33	0.054	0.38	6.4	7.0	1.7	13	30	14
ABA152	R305802	CFD0381	35.0	36.0	Waste	Upper transition	Granite	GG	6.0	0.090	506	0.45	0.020	0.48	0.70	70	14	49	<0.001	<0.01	1.0	2.0	0.50	1.1	11	<0.01	0.010	35	0.034	0.43	9.7	5.0	16	11	37	7.4
ABA167	R305818	CFD0394	30.0	31.0	Waste	Upper transition	Granite	GG	0.60	0.010	16	0.92	<0.01	0.060	0.60	70	11	11	<0.001	0.050	2.8	0.40	0.20	<0.2	8.7	<0.01	<0.01	28	<0.005	0.12	4.6	1.0	0.19	9.2	5.0	7.5
ABA169	R305821	CFD0399	20.0	21.0	Waste	Upper transition	Granite	GG	0.60	0.010	456	0.60	0.030	0.13	1.1	220	20	8.0	<0.001	0.12	0.83	0.70	0.40	0.20	9.0	<0.01	<0.01	34	<0.005	0.080	5.7	3.0	0.17	10	23	13
ABA172	R305824	CFD0396	29.0	30.0	Waste	Upper transition	Granite	GG	1.6	<0.01	56	1.5	<0.01	0.080	0.50	150	22	2.3	<0.001	<0.01	11	1.9	<0.2	0.40	18	<0.01	<0.01	31	<0.005	0.11	8.6	4.0	0.13	9.3	16	8.7
ABA178	R305831	CFD0400	11.0	12.0	Waste	Upper transition	Granite	GG	3.0	0.050	294	0.38	0.020	0.71	1.1	80	9.6	19	<0.001	<0.01	0.76	1.3	0.50	0.70	5.0	<0.01	<0.01	32	0.023	0.23	5.3	4.0	0.14	28	28	12
ABA189	CFD0399_10_20	CFD0399	10.0	20.0	Waste	Upper transition	Granite	GG	1.2	0.020	154	0.71	0.030	0.12	0.90	200	31	9.1	<0.001	0.15	3.8	1.0	0.40	0.40	17	<0.01	0.010	52	<0.005	0.18	46	3.0	0.12	12	22	17
ABA190	CFD0396_50_60	CFD0396	50.0	60.0	Waste	Upper transition	Granite	GG	2.5	0.030	319	0.74	0.040	0.48	0.50	130	15	16	<0.001	<0.01	1.2	0.90	0.40	0.60	4.1	<0.01	0.010	31	0.012	0.18	9.2	4.0	0.070	9.0	19	7.6
ABA191	CFD0394_31_41	CFD0394	31.0	41.0	Waste	Upper transition	Granite	GG	2.7	0.030	230	0.68	0.030	0.34	0.90	170	16	19	<0.001	0.050	1.9	1.2	0.30	0.60	6.6	<0.01	0.010	31	0.010	0.22	6.1	4.0	0.10	9.3	23	8.0
ABA192	CFD0394_55_66	CFD0394	55.0	66.0	Waste	Upper transition	Granite	GG	1.5	0.020	460	0.71	0.040	0.27	0.90	110	24	13	<0.001	0.010	2.0	1.0	0.40	0.50	15	<0.01	0.010	31	0.0070	0.29	7.8	4.0	0.050	12	15	7.9
ABA195	CFD0381_4_13	CFD0381	4.0	13.0	Waste	Upper transition	Granite	GG	12	0.11	853	0.94	0.080	1.4	1.4	170	7.2	39	<0.001	<0.01	0.13	2.2	0.50	1.2	6.0	<0.01	0.010	33	0.055	0.37	6.7	7.0	0.080	13	33	14
ABA196	CFD0380_36_50	CFD0380	36.0	50.0	Waste	Upper transition	Granite	GG	1.0	0.010	63	0.76	0.010	0.10	1.1	80	13	9.1	<0.001	0.010	1.3	0.90	0.30	0.70	8.1	<0.01	0.010	28	<0.005	0.10	6.4	2.0	0.10	8.2	7.0	7.8
ABA431	Q041083	CFD0380	30.0	30.2	Waste	Upper Transition	Granite	GG	1.4	0.020	114	0.74	0.040	0.18	0.70	70	11	8.3	<0.001	<0.01	1.2	1.5	0.20	1.6	5.6	<0.01	<0.01	34	<0.005	0.23	5.2	4.0	0.050	7.5	13	8.3
ABA434	Q032756	CFD0394	19.5	19.6	Waste	Upper Transition	Granite	GG	1.2	0.020	73	1.1	0.010	0.12	1.3	100	39	15	<0.001	<0.01	28	0.90	0.40	1.1	25	<0.01	<0.01	32	<0.005	1.4	11	3.0	0.17	8.1	20	4.7
ABA435	Q032826	CFD0394	81.1	81.7	Waste	Upper Transition	Granite	GG	1.7	0.030	133	0.73	0.030	0.23	0.70	110	6.9	11	<0.001	0.020	1.0	1.2	0.30	1.3	4.9	<0.01	0.010	36	0.0090	0.12	7.8	3.0	0.050	8.6	10	7.8
ABA436	Q032927	CFD0396	65.0	65.5	Waste	Upper Transition	Granite	GG	1.3	0.010	97	0.64	0.010	0.070	0.50	70	13	8.1	<0.001	0.010	1.0	1.0	0.40	0.80	4.6	<0.01	<0.01	36	<0.005	0.25	5.6	3.0	0.090	10	7.0	8.4
Statistical Summary						**Upper Transition**	**Granite**	**n**	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
								Max	12	0.11	869	1.5	0.080	1.4	1.4	220	39	49	<0.001	0.15	28	2.2	0.80	1.6	25	<0.01	0.010	52	0.055	1.4	46	7.0	16	28	37	17
								90th PCTL	8.2	0.098	645	1.1	0.052	0.96	1.2	182	27	37	<0.001	0.078	6.7	2.0	0.50	1.2	17	<0.01	0.010	36	0.042	0.40	11	5.8	0.80	15	31	14
								75th PCTL	3.0	0.040	456	0.92	0.040	0.48	1.1	150	20	19	<0.001	0.020	2.0	1.6	0.50	1.1	11	<0.01	0.010	34	0.012	0.29	9.2	4.0	0.17	12	23	12
								Median	1.6	0.020	154	0.74	0.030	0.23	0.90	110	13	12	<0.001	<0.01	1.2	1.2	0.40	0.70	6.7	<0.01	<0.01	33	<0.005	0.22	6.7	4.0	0.10	10	19	8.0
								25th PCTL	1.2	0.010	97	0.68	0.010	0.12	0.70	80	9.9	9.1	<0.001	<0.01	0.83	0.90	0.30	0.50	5.5	<0.01	<0.01	31	<0.005	0.12	5.7	3.0	0.070	9.0	13	7.8
								10th PCTL	0.84	0.010	60	0.54	0.010	0.076	0.50	70	7.1	8.1	<0.001	<0.01	0.37	0.82	0.20	0.32	4.8	<0.01	<0.01	30	<0.005	0.11	5.3	2.6	0.050	8.1	7.0	7.5
								Min	0.60	<0.01	16	0.38	<0.01	0.060	0.50	70	6.8	2.3	<0.001	<0.01	0.11	0.40	0.20	0.20	4.1	<0.01	<0.01	28	<0.005	0.080	4.6	1.0	0.050	7.5	5.0	4.7
Lower Transition Facies for Granite Waste Rock																																				
ABA010	KAM024598	CFD0137	49.0	50.0	Waste	Lower transition	Granite	GG	14	0.13	701	0.68	0.11	1.0	2.4	160	5.4	42	<0.001	<0.01	0.080	1.7	0.50	1.2	7.2	<0.01	0.010	35	0.057	0.37	6.0	8.0	0.12	16	30	14
ABA154	R305804	CFD0382	10.0	11.0	Waste	Lower transition	Granite	GG	11	0.11	668	0.97	0.060	1.5	0.90	190	5.7	34	<0.001	<0.01	0.31	1.9	0.40	1.0	4.9	<0.01	<0.01	32	0.052	0.33	6.5	7.0	19	13	37	13
ABA155	R305805	CFD0382	50.0	51.0	Waste	Lower transition	Granite	GG	11	0.11	465	0.49	0.030	0.90	1.1	70	8.8	41	<0.001	<0.01	1.8	1.6	0.20	1.1	4.9	<0.01	<0.01	33	0.052	0.94	4.4	6.0	1.1	9.4	34	9.8
ABA159	R305809	CFD0383	10.0	11.0	Waste	Lower transition	Granite	GG	14	0.13	577	0.80	0.070	1.5	0.80	190	5.4	41	<0.001	<0.01	0.69	2.1	0.50	1.1	6.6	<0.01	0.010	35	0.064	0.42	6.0	8.0	0.55	12	31	16
ABA160	R305811	CFD0383	48.0	49.0	Waste	Lower transition	Granite	GG	13	0.13	775	0.78	0.070	1.4	1.0	180	5.6	36	<0.001	<0.01	0.34	1.6	0.40	1.0	5.7	<0.01	<0.01	30	0.058	0.34	5.9	7.0	7.4	13	35	13
ABA164	R305815	CFD0389	10.0	11.0	Waste	Lower transition	Granite	GG	5.7	0.090	332	0.65	0.070	1.2	1.0	160	6.4	28	<0.001	<0.01	0.24	1.5	0.20	0.70	5.4	<0.01	<0.01	33	0.045	0.25	4.8	7.0	7.0	11	22	18
ABA166	R305817	CFD0389	45.0	46.0	Waste	Lower transition	Granite	GG	1.4	0.040	225	1.5	<0.01	0.38	4.6	220	12	36	0.0010	0.020	85	1.2	0.30	1.0	16	<0.01	0.030	34	0.014	0.34	26	6.0	1.9	12	88	10
ABA193	CFD383_115_125	CFD0383	115.0	125.0	Waste	Lower transition	Granite	GG	6.5	0.14	1000	1.0	0.070	0.72	1.7	260	9.2	24	<0.001	<0.01	0.30	1.8	0.40	0.70	6.1	<0.01	0.010	30	0.039	0.22	6.4	9.0	0.050	14	39	8.4
ABA194	CFD0382_84_94	CFD0382	84.0	94.0	Waste	Lower transition	Granite	GG	1.9	0.020	1720	1.1	0.010	0.14	1.8	240	15	20	<0.001	<0.01	6.1	1.2	0.40	0.60	17	<0.01	0.010	31	0.0050	0.84	10	5.0	0.080	13	39	7.1
ABA424	Q041284	CFD0382	4.0	5.0	Waste	Lower Transition	Granite	GG	13	0.12	612	0.91	0.10	1.2	2.2	170	5.6	40	<0.001	<0.01	0.31	2.2	0.40	1.3	7.8	<0.01	<0.01	33	0.059	0.39	4.5	8.0	0.18	12	31	16
ABA425	Q041377	CFD0382	87.0	88.0	Waste	Lower Transition	Granite	GG	1.1	0.010	55	0.69	0.010	0.060	1.7	50	7.6	6.3	<0.001	<0.01	1.4	1.2	0.40	0.60	8.6	<0.01	<0.01	34	<0.005	0.070	4.6	2.0	<0.05	9.6	4.0	8.5
ABA426	Q041396	CFD0382	103.0	104.0	Waste	Lower Transition	Granite	GG	2.3	<0.01	56	0.93	0.010	0.060	1.0	90	25	4.9	<0.001	<0.01	5.1	1.3	0.50	0.50	42	<0.01	0.010	34	<0.005	0.24	9.7	6.0	<0.05	11	7.0	8.7
ABA427	Q041404	CFD0382	110.0	111.0	Waste	Lower Transition	Granite	GG	2.8	0.040	1020	1.1	0.010	0.13	1.4	120	13	21	<0.01	<0.01	2.0	1.4	0.30	1.1	8.2	<0.01	<0.01	36	0.0080	1.5	6.1	5.0	0.050	10	29	6.1
ABA430	Q041069	CFD0380	18.0	18.1	Waste	Lower Transition	Granite	GG	0.60	0.020	86	0.76	0.010	0.11	0.70	70	19	13	<0.001	0.080	4.0	0.50	0.30	0.30	21	<0.01	0.010	27	<0.005	1.9	14	1.0	0.15	9.3	7.0	4.2
Statistical Summary						**Lower Transition**	**Granite**	**n**	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								Max	14	0.14	1720	1.5	0.11	1.5	4.6	260	25	42	0.0010	0.080	85	2.2	0.50	1.3	42	<0.01	0.030	36	0.064	1.9	26	9.0	19	16	88	18
								90th PCTL	13	0.13	1014	1.1	0.091	1.4	2.3	234	18	41	0.0010	0.017	5.8	2.0	0.50	1.2	20	<0.01	0.010	35	0.059	1.3	13	8.0	7.3	14	39	16
								75th PCTL	12	0.13	757	0.99	0.070	1.2	1.8	190	13	39	<0.01	<0.01	3.5	1.8	0.40	1.1	14	<0.01	0.010	34	0.056	0.74	8.9	7.8	1.7	13	37	13
								Median	6.1	0.10	595	0.86	0.045	0.81	1.3	165	8.2	31	<0.01	<0.01	1.1	1.6	0.40	1.0	7.5	<0.01	<0.01	33	0.042	0.36	6.0	6.5	0.17	12	31	10
								25th PCTL	2.0	0.025	252	0.71	0.010	0.13	1.0	98	5.6	20	<0.01	<0.01	0.31	1.2	0.30	0.63	5.8	<0.01	<0.01	31	0.0058	0.27	5.1	5.3	0.058	10	24	8.4
								10th PCTL	1.2	0.013	65	0.66	0.010	0.075	0.83	70	5.5	8.2	<0.01	<0.01	0.26	1.2	0.23	0.53	5.1	<0.01	<0.01	30	<0.005	0.23	4.5	2.9	<0.05	9.5	7.0	6.4
								Min	0.60	0.010	55	0.49	<0.01	0.060	0.70	50	5.4	4.9	<0.01	<0.01	0.080	0.50	0.20	0.30	4.9	<0.01	<0.01	27	<0.005	0.070	4.4	1.0	<0.05	9.3	4.0	4.2
Fresh Facies for Granite Waste Rock																																				
ABA012	KAM025798	CFD0147	260.0	261.0	Waste	Fresh	Granite	GG	9.2	0.18	792	0.82	0.090	0.77	1.3	270	9.3	26	<0.001	<0.01	0.060	2.4	0.60	0.80	17	<0.01	0.010	26	0.030	0.21	6.3	11	0.070	17	39	6.2
ABA162	R305813	CFD0385	10.0	11.0	Waste	Fresh	Granite	GG	12	0.11	552	0.78	0.060	1.2	0.80	160	5.2	34	<0.001	<0.01	0.24	1.9	0.40	1.1	4.4	<0.01	<0.01	31	0.056	0.36	6.3	7.0	8.8	10	32	15
ABA163	R305814	CFD0385	59.0	60.0	Waste	Fresh	Granite	GG	5.8	0.090	278	0.21	0.030	0.60	1.5	50	7.9	29	<0.001	<0.01	3.0	1.5	0.20	1.5	6.1	<0.01	<0.01	33	0.043	0.68	4.4	6.0	0.26	8.1	19	9.7
ABA165	R305816	CFD0389	30.0	31.0	Waste	Fresh	Granite	GG	6.1	0.090	574	0.81	0.060	1.4	0.90	150	5.4	29	<0.001	0.040	0.63	1.4	0.50	0.90	5.7	<0.01	<0.01	32	0.046	0.26	6.6	7.0	3.8	18	72	14
ABA168	R305819	CFD0394	88.0	89.0	Waste	Fresh	Granite	GG	13	0.12	546	0.88	0.050	1.4	1.3	210	6.1	37	<0.001	0.010	1.8	1.7	0.40	1.1	4.3	<0.01	0.010	33	0.061	0.37	5.3	7.0	0.75	16	44	11
ABA179	R305832	CFD0400	60.0	61.0	Waste	Fresh	Granite	GG	3.2	0.080	201	0.80	0.020	0.57	1.0	150	8.4	38	<0.001	<0.01	16	1.3	0.40	1.1	7.0	<0.01	<0.01	36	0.041	0.46	29	9.0	0.13	12	30	8.4
ABA180	CFD0396_72_81	CFD0396	72.0	81.0	Waste	Fresh	Granite	GG	1.2	0.030	686	0.72	0.010	0.10	0.70	190	15	4.7	<0.001	0.090	0.73	1.4	0.30	0.70	3.2	<0.01	0.010	37	<0.005	0.50	5.4	5.0	0.19	14	26	8.5
ABA182	CFD0394_94_104	CFD0394	94.0	104.0	Waste	Fresh	Granite	GG	1.8	0.050	1140	0.76	0.030	0.22	1.0	160	13	13	<0.001	0.19	2.7	1.0	0.30	0.40	4.4	<0.01	0.010	29	0.0050	0.24	6.6	4.0	0.070	9.6	24	7.1
ABA186	CFD0380_2_17	CFD0380	2.0	17.0	Waste	Fresh	Granite	GG	18	0.10	753	0.78	0.060	1.6	1.0	150	6.6	37	<0.001	<0.01	0.20	2.1	0.40	1.4	4.4	<0.01	0.020	31	0.049	0.35	6.5	6.0	0.090	16	37	13
ABA187	CFD0380_22_30	CFD0380	22.0	30.0	Waste	Fresh	Granite	GG	12	0.080	345	0.75	0.060	1.6	1.0	170	14	33	<0.001	<0.01	0.52	1.8	0.40	1.3	4.5	<0.01	0.010	33	0.042	0.33	7.0	6.0	0.090	13	24	10
ABA198	CFD0385_28_38	CFD0385	28.0	38.0	Waste	Fresh	Granite	GG	16	0.12	509	1.4	0.080	1.3	1.1	170	6.1	38	<0.001	0.010	0.27	1.8	0.30	1.1	5.9	<0.01	<0.01	34	0.060	0.39	7.3	8.0	0.080	12	29	16
ABA199	CFD0385_38_48	CFD0385	38.0	48.0	Waste	Fresh	Granite	GG	12	0.11	553	1.1	0.040	1.9	1.4	160	4.9	33	0.0010	<0.01	1.1	1.7	0.40	1.3	4.1	<0.01	<0.01	33	0.055	0.31	7.6	7.0	0.090	13	29	14
ABA200	CFD0385_48_58	CFD0385	48.0	58.0	Waste	Fresh	Granite	GG	11	0.10	513	0.95	0.040	1.4	1.8	130	5.5	31	<0.001	<0.01	2.7	1.6	0.30	1.7	5.2	<0.01	<0.01	32	0.050	0.30	9.1	6.0	0.080	16	25	12
ABA437	Q041055	CFD0380	5.0	6.0	Waste	Fresh	Granite	GG	20	0.12	1080	0.78	0.070	1.4	1.2	160	5.9	43	<0.001	<0.01	0.10	2.4	0.60	1.6	4.9	<0.01	<0.01	33	0.057	0.43	7.4	7.0	0.080	17	37	14
ABA438	Q041063	CFD0380	12.0	13.0	Waste	Fresh	Granite	GG	21	0.13	1080	0.78	0.070	1.5	1.2	170	5.7	45	<0.001	<0.01	0.19	2.6	0.60	1.6	5.0	<0.01	<0.01	32	0.060	0.49	6.9	7.0	0.080	17	49	16
ABA439	Q041678	CFD0385	8.0	9.0	Waste	Fresh	Granite	GG	9.5	0.080	723	1.3	0.10	0.90	1.4	160	6.1	31	<0.001	<0.01	0.28	2.0	0.40	1.2	7.2	<0.01	<0.01	32	0.040	0.31	6.7	6.0	0.070	12	33	16
ABA440	Q041699	CFD0385	27.0	28.0	Waste	Fresh	Granite	GG	13	0.10	597	1.1	0.080	1.1	0.90	170	6.8	32	<0.001	<0.01	0.090	1.8	0.50	0.90	6.2	<0.01	<0.01	32	0.046	0.31	6.6	7.0	0.15	14	29	21
ABA441	Q032423	CFD0385	92.0	92.6	Waste	Fresh	Granite	GG	8.6	0.11	352	5.0	0.040	1.3	1.6	220	5.7	29	0.0010	0.030	0.44	1.6	0.70	1.3	8.0	<0.01	<0.01	39	0.050	0.29	10	7.0	0.070	16	27	9.1
ABA442	Q032601	CFD0391	3.4	3.9	Waste	Fresh	Granite	GG	12	0.11	581	0.91	0.080	1.5	1.9	170	9.7	33	<0.001	<0.01	0.12	1.8	0.40	1.1	6.1	<0.01	<0.01	34	0.052	0.35	4.6	8.0	0.69	13	29	15
ABA443	Q033167	CFD0400	60.0	61.0	Waste	Fresh	Granite	GG	4.6	0.080	227	0.55	0.040	0.45	1.1	110	7.6	40	<0.001	<0.01	6.8	1.5	0.40	1.1	8.1	<0.01	<0.01	38	0.044	0.49	19	8.0	0.060	12	24	9.5
Statistical Summary						**Fresh**	**Granite**	**n**	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
								Max	21	0.18	1140	5.0	0.10	1.9	1.9	270	15	45	0.0010	0.19	16	2.6	0.70	1.7	17	<0.01	0.020	39	0.061	0.68	29	11	8.8	18	72	21
								90th PCTL	18	0.12	1080	1.3	0.081	1.6	1.6	211	13	40	0.0010	0.045	3.4	2.4	0.60	1.6	8.0	<0.01	0.010	37	0.060	0.49	11	8.1	1.1	17	45	16
								75th PCTL	13	0.11	731	0.98	0.073	1.4	1.4	170	8.6	37	<0.01	0.010	2.0	1.9	0.50	1.3	6.4	<0.01	0.010	34	0.055	0.44	7.4	7.3	0.21	16	37	15
								Median	11	0.10	564	0.81	0.060	1.3	1.2	160	6.4	33	<0.01	<0.01	0.48	1.8	0.40	1.1	5.5	<0.01	<0.01	33	0.048	0.35	6.7	7.0	0.090	13	29	12
								25th PCTL	6.0	0.080	470	0.78	0.040	0.73	1.0	150	5.7	29	<0.01	<0.01	0.20	1.5	0.38	1.1	4.4	<0.01	<0.01	32	0.042	0.31	6.3	6.0	0.078	12	26	9.4
								10th PCTL	3.1	0.077	273	0.70	0.029	0.43	0.89	128	5.4	24	<0.01	<0.01	0.099	1.4	0.30	0.79	4.3	<0.01	<0.01	31	0.028	0.26	5.3	5.9	0.070	10	24	8.3
								Min	1.2	0.030	201	0.21	0.010	0.10	0.70	50	4.9	4.7	<0.01	<0.01	0.060	1.0	0.20	0.40	3.2	<0.01	<0.01	26	0.0050	0.21	4.4	4.0	0.060	8.1	19	6.2

Appendix C.1-3: Solid Phase Element by Aqua Regia Digestion for Waste Rock

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Statistical Summary for Granite Waste Rock								**n**	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
								n < DL	0	3	0	0	6	0	0	0	0	0	54	40	0	0	2	1	0	57	32	0	17	0	0	0	2	0	0	0
								Max	21	0.18	2360	5.0	0.11	1.9	4.6	270	39	49	0.0010	0.19	85	2.6	0.80	3.3	112	*<0.01*	0.030	52	0.064	2.1	46	11	19	28	88	21
								90th PCTL	13	0.12	1044	1.2	0.080	1.5	1.7	220	22	40	*<0.01*	0.050	11	2.1	0.50	1.4	19	*<0.01*	0.010	36	0.057	1.1	12	8.0	3.5	16	39	16
								75th PCTL	12	0.11	723	0.97	0.070	1.3	1.4	180	15	36	*<0.01*	*<0.01*	3.0	1.8	0.40	1.2	11	*<0.01*	*<0.01*	34	0.052	0.46	8.6	7.0	0.26	13	33	14
								Median	4.6	0.080	506	0.78	0.040	0.57	1.0	160	9.3	28	*<0.01*	*<0.01*	1.0	1.5	0.40	1.0	6.6	*<0.01*	*<0.01*	33	0.034	0.34	6.5	6.0	0.10	12	28	9.5
								25th PCTL	1.5	0.020	154	0.71	0.010	0.14	0.90	100	6.1	12	*<0.01*	*<0.01*	0.31	1.2	0.30	0.60	5.0	*<0.01*	*<0.01*	31	*<0.005*	0.24	5.6	4.0	0.070	9.4	19	7.8
								10th PCTL	1.1	0.010	60	0.59	*<0.01*	0.090	0.70	70	5.6	7.3	*<0.01*	*<0.01*	0.13	0.82	0.20	0.36	4.4	*<0.01*	*<0.01*	28	*<0.005*	0.16	4.7	2.0	0.050	8.1	7.0	6.6
								Min	0.60	*<0.01*	16	0.21	*<0.01*	0.060	0.50	50	4.9	2.3	*<0.01*	*<0.01*	0.060	0.40	0.20	0.20	3.2	*<0.01*	*<0.01*	16	*<0.005*	0.070	4.4	1.0	*<0.05*	2.9	4.0	3.3
Oxide Facies for Other Lithologies Waste Rock																																				
KAM029389	ABA017	CFD0176	96.0	97.0	Waste	Oxide	Dykes	FC	9.4	0.040	727	0.62	0.010	*<0.05*	98	110	11	14	0.0050	*<0.01*	1.9	7.7	0.70	0.20	43	*<0.01*	0.050	3.8	*<0.005*	0.14	6.3	34	500	12	55	12
KAM029393	ABA018	CFD0176	99.0	100.0	Waste	Oxide	Dykes	FC	7.2	0.050	655	0.47	0.010	*<0.05*	1.0	360	12	14	*<0.001*	*<0.01*	3.5	8.9	0.70	0.30	23	*<0.01*	0.030	4.5	*<0.005*	0.19	6.4	39	0.24	12	52	6.6
KAM084551	ABA056	CFD0237	181.0	181.5	Waste	Oxide	HU	HU	3.2	0.20	287	1.3	0.010	*<0.05*	42	50	11	16	*<0.001*	0.020	7.6	7.1	0.50	0.40	143	*<0.01*	0.050	6.0	*<0.005*	0.47	6.2	18	0.54	8.7	31	1.1
R277468	ABA306	CFD0426	26.0	27.0	Waste	Oxide	SZ	SZ	3.2	0.34	150	0.35	0.030	0.050	13	340	5.3	15	*<0.001*	0.010	2.1	1.4	0.80	0.90	13	*<0.01*	0.030	33	0.019	0.19	3.3	11	0.24	16	11	8.1
Statistical Summary						**Oxide**	**Other Lithologies**	**n**	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
								Max	9.4	0.34	727	1.3	0.030	0.050	98	360	12	16	0.0050	0.020	7.6	8.9	0.80	0.90	143	*<0.01*	0.050	33	0.019	0.47	6.4	39	500	16	55	12
								90th PCTL	8.7	0.30	705	1.1	0.024	0.050	81	354	11	15	0.0038	0.017	6.3	8.5	0.77	0.75	113	*<0.01*	0.050	25	0.015	0.39	6.4	38	350	15	54	11
								75th PCTL	7.8	0.24	673	0.80	0.015	*<0.05*	56	345	11	15	*<0.001*	0.013	4.5	8.0	0.73	0.53	68	*<0.01*	0.050	13	*<0.005*	0.26	6.3	35	125	13	53	9.1
								Median	5.2	0.13	471	0.55	0.010	*<0.05*	27	225	11	14	*<0.001*	*<0.01*	2.8	7.4	0.70	0.35	33	*<0.01*	0.040	5.3	*<0.005*	0.19	6.2	26	0.39	12	42	7.4
								25th PCTL	3.2	0.048	253	0.44	0.010	*<0.05*	9.9	95	9.4	14	*<0.001*	*<0.01*	2.0	5.7	0.65	0.28	21	*<0.01*	0.030	4.3	*<0.005*	0.18	5.5	16	0.24	11	26	5.2
								10th PCTL	3.2	0.043	191	0.39	0.010	*<0.05*	4.5	68	6.9	14	*<0.001*	*<0.01*	1.9	3.1	0.56	0.23	16	*<0.01*	0.030	4.0	*<0.005*	0.16	4.1	13	0.24	9.7	17	2.8
								Min	3.2	0.040	150	0.35	0.010	*<0.05*	1.0	50	5.3	14	*<0.001*	*<0.01*	1.9	1.4	0.50	0.20	13	*<0.01*	0.030	3.8	*<0.005*	0.14	3.3	11	0.24	8.7	11	1.1
Upper Transition Facies for Other Lithologies Waste Rock																																				
KAM145425	ABA072	CFD0339	10.0	11.0	Waste	Upper transition	Dykes	FC	3.6	0.30	1200	1.1	*<0.01*	*<0.05*	6.5	360	16	68	*<0.001*	0.020	77	11	0.60	0.80	138	*<0.01*	0.060	11	0.022	2.1	28	64	2.0	14	63	7.5
Q033703	ABA303	CFD0411	15.0	16.0	Waste	Upper transition	dykes	DIOR	2.7	0.040	480	0.63	*<0.01*	0.14	3.1	160	17	18	*<0.001*	0.010	17	3.0	0.70	0.40	14	*<0.01*	0.050	14	0.012	0.17	1.2	4.0	0.55	13	41	53
Q034859	ABA311	CFD0473	164.0	165.0	Waste	Upper transition	dykes	FC	21	1.3	941	0.29	0.050	*<0.05*	16	1640	6.6	58	*<0.001*	*<0.01*	9.0	21	0.50	0.70	77	*<0.01*	0.020	3.0	0.14	0.41	8.6	171	0.080	18	80	12
R273647	ABA305	CFD0456	55.0	56.0	Waste	Upper transition	Fault	FLT	15	1.0	555	0.51	0.020	*<0.05*	27	550	3.3	78	*<0.001*	0.010	68	14	0.40	1.2	16	*<0.01*	0.020	1.4	0.069	0.70	14	56	1.0	15	34	1.1
KAM019714	ABA061	CFD0083	8.0	9.0	Waste	Upper transition	Metabasalt/ Amphibolite	Amph	6.8	0.65	447	0.34	0.030	0.090	22	450	4.5	46	*<0.001*	*<0.01*	1.2	2.7	0.60	0.40	18	*<0.01*	0.020	19	0.072	0.32	1.3	28	0.20	10	43	6.8
KAM035755	ABA022	CFD0080	122.0	123.0	Waste	Upper transition	YO	YO	4.6	2.1	570	0.83	0.020	*<0.05*	146	280	11	19	*<0.001*	0.54	8.6	7.6	0.90	0.80	195	*<0.01*	0.020	9.8	0.0070	0.33	3.0	35	0.39	15	50	1.5
R545623	ABA368	CFD0524	92.0	92.6	Waste	Upper Transition	Yx	Yx	6.2	0.48	423	0.39	0.040	0.050	24	290	6.0	72	*<0.001*	*<0.01*	6.0	2.9	0.50	1.2	13	*<0.01*	*<0.01*	34	0.025	0.82	17	17	0.50	12	23	9.6
Statistical Summary						**Upper Transition**	**Other Lithologies**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	21	2.1	1200	1.1	0.050	0.14	146	1640	17	78	*<0.001*	0.54	77	21	0.90	1.2	195	*<0.01*	0.060	34	0.14	2.1	28	171	2.0	18	80	53
								90th PCTL	17	1.6	1045	0.95	0.044	0.11	75	986	16	74	*<0.001*	0.23	72	16	0.78	1.2	160	*<0.01*	0.054	25	0.10	1.3	21	107	1.4	16	70	28
								75th PCTL	11	1.1	756	0.73	0.035	0.070	26	500	13	70	*<0.001*	0.015	43	12	0.65	1.0	107	*<0.01*	0.035	17	0.071	0.76	15	60	0.79	15	57	11
								Median	6.2	0.65	555	0.51	0.020	*<0.05*	22	360	6.6	58	*<0.001*	0.010	9.0	7.6	0.60	0.80	18	*<0.01*	0.020	11	0.025	0.41	8.6	35	0.50	14	43	7.5
								25th PCTL	4.1	0.39	464	0.37	0.015	*<0.05*	11	285	5.3	32	*<0.001*	*<0.01*	7.3	3.0	0.50	0.55	15	*<0.01*	0.020	6.4	0.017	0.33	2.1	23	0.30	13	38	4.2
								10th PCTL	3.2	0.20	437	0.32	*<0.01*	*<0.05*	5.1	232	4.0	18	*<0.001*	*<0.01*	4.1	2.8	0.46	0.40	14	*<0.01*	0.016	2.4	0.010	0.26	1.3	12	0.15	11	30	1.3
								Min	2.7	0.040	423	0.29	*<0.01*	*<0.05*	3.1	160	3.3	18	*<0.001*	*<0.01*	1.2	2.7	0.40	0.40	13	*<0.01*	*<0.01*	1.4	0.0070	0.17	1.2	4.0	0.080	10	23	1.1
Lower Transition Facies for Other Lithologies Waste Rock																																				
R282332	ABA312	CFD0474	37.0	38.0	Waste	Lower transition	dykes	IV	13	1.4	657	0.66	0.24	0.11	3.8	670	9.3	40	*<0.001*	0.020	0.50	11	0.50	0.50	116	*<0.01*	*<0.01*	9.3	0.097	0.35	2.0	97	0.18	13	60	26
Q035862	ABA313	CFD0491	124.0	125.0	Waste	Lower transition	dykes	IV	9.0	0.30	820	0.80	0.010	*<0.05*	4.5	660	15	41	*<0.001*	*<0.01*	7.1	15	0.40	0.80	11	*<0.01*	0.010	8.3	0.027	0.48	4.4	90	0.26	13	62	14
R283583	ABA449	CFD0496	90.0	91.0	Waste	Lower Transition	Metabasalt	MBSLT	2.5	0.97	982	3.8	0.010	*<0.05*	22	740	24	23	0.0030	0.36	2.6	4.4	0.30	1.0	188	*<0.01*	0.49	4.0	0.0060	0.24	5.4	17	1.0	9.2	70	1.2
R283583	ABA304	CFD0496	90.0	91.0	Waste	Lower transition	Metabasalt/ Amphibolite	MBSLT	2.3	1.0	981	3.8	0.010	*<0.05*	21	780	23	23	0.0020	0.39	3.0	4.4	0.50	1.0	193	*<0.01*	0.49	3.7	0.0060	0.21	4.9	17	1.1	8.1	72	1.1
Q033764	ABA308	CFD0411	70.0	71.0	Waste	Lower transition	YC	YC	5.0	1.5	558	0.31	0.020	*<0.05*	24	430	13	15	*<0.001*	0.13	3.1	6.7	0.90	0.90	163	*<0.01*	0.050	12	*<0.005*	0.12	2.7	38	0.23	21	68	1.1
R276691	ABA310	CFD0413	21.0	22.0	Waste	Lower transition	Ylim	Ylim	1.7	0.040	488	0.48	0.010	*<0.05*	5.7	310	6.6	12	*<0.001*	0.010	7.0	1.9	0.40	0.90	15	*<0.01*	0.020	21	*<0.005*	0.16	2.2	6.0	0.19	11	20	6.2
Statistical Summary						**Lower Transition**	**Other Lithologies**	**n**	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
								Max	13	1.5	982	3.8	0.24	0.11	24	780	24	41	0.0030	0.39	7.1	15	0.90	1.0	193	*<0.01*	0.49	21	0.097	0.48	5.4	97	1.1	21	72	26
								90th PCTL	11	1.4	982	3.8	0.13	0.080	23	760	24	41	0.0025	0.38	7.0	13	0.70	1.0	191	*<0.01*	0.49	17	0.062	0.42	5.1	94	1.1	17	71	20
								75th PCTL	8.0	1.3	941	3.1	0.018	0.050	21	723	21	36	0.0018	0.30	6.1	10	0.50	0.98	182	*<0.01*	0.38	11	0.022	0.32	4.8	77	0.82	13	70	12
								Median	3.8	0.99	739	0.73	0.010	0.050	13	665	14	23	*<0.001*	0.075	3.1	5.6	0.45	0.90	140	*<0.01*	0.035	8.8	0.0060	0.23	3.5	28	0.25	12	65	3.7
								25th PCTL	2.4	0.47	583	0.53	0.010	0.050	4.8	488	10	17	*<0.001*	0.013	2.7	4.4	0.40	0.83	40	*<0.01*	0.013	5.1	0.0053	0.17	2.3	17	0.20	9.8	61	1.1
								10th PCTL	2.0	0.17	523	0.40	0.010	0.050	4.2	370	8.0	13	*<0.001*	*<0.01*	1.6	3.2	0.35	0.65	13	*<0.01*	*<0.01*	3.9	0.0050	0.14	2.1	12	0.19	8.7	40	1.1
								Min	1.7	0.040	488	0.31	0.010	*<0.05*	3.8	310	6.6	12	*<0.001*	*<0.01*	0.50	1.9	0.30	0.50	11	*<0.01*	*<0.01*	3.7	0.0050	0.12	2.0	6.0	0.18	8.1	20	1.1
Fresh Facies for Other Lithologies Waste Rock																																				
R304353	ABA349	CFD0541	90.0	91.0	Waste	Fresh	IV	IV	10	0.99	788	0.24	0.060	*<0.05*	1.1	450	10	11	*<0.001*	*<0.01*	0.96	3.1	0.50	0.30	22	*<0.01*	0.010	4.4	0.0050	0.080	1.3	30	*<0.05*	12	57	22
R304282	ABA352	CFD0539	90.0	91.0	Waste	Fresh	IV	IV	9.5	1.3	675	0.22	0.080	*<0.05*	3.8	660	7.6	23	*<0.001*	*<0.01*	0.72	11	0.40	0.50	80	*<0.01*	0.010	9.7	0.027	0.23	1.4	94	0.060	13	55	23
KAM133438	ABA087	CFR0429	10.7	12.2	Waste	Fresh	Mafic/ Ultramafic	RU	16	6.8	430	0.25	0.010	*<0.05*	603	430	3.3	82	*<0.001*	0.040	0.090	6.3	0.20	0.60	111	*<0.01*	0.010	6.1	0.089	0.52	0.39	32	0.11	4.6	37	0.80
R277453	ABA307	CFD0423	81.0	82.0	Waste	Fresh	Mafic/ Ultramafic	RU	18	3.7	477	1.2	0.020	*<0.05*	373	400	5.0	112	0.0010	0.020	0.61	8.8	0.70	1.5	41	*<0.01*	0.090	11	0.17	0.76	1.3	58	0.21	12	44	2.0
R274909	ABA447	CFD0472	143.2	144.0	Waste	Fresh	Metabasalt	MBSLT	20	3.2	564	0.48	0.020	0.070	283	170	2.4	107	*<0.001*	*<0.01*	4.9	5.5	0.30	1.7	41	*<0.01*	0.010	16	0.13	0.91	3.0	44	0.31	12	29	4.2
R274918	ABA448	CFD0472	150.0	151.0	Waste	Fresh	Metabasalt	MBSLT	1.1	0.29	227	3.0	0.020	1.2	5.6	450	1.3	7.9	*<0.001*	0.080	0.71	1.6	*<0.2*	5.1	92	0.010	0.050	2.1	0.14	0.060	0.56	11	0.39	3.2	7.0	7.0
R293475	ABA450	CFR0730	91.4	93.0	Waste	Fresh	Metabasalt	MBSLT	24	2.0	776	1.1	0.13	*<0.05*	5.2	1290	8.1	54	*<0.001*	0.22	0.32	9.4	0.50	0.80	119	*<0.01*	0.020	3.7	0.11	0.48	0.91	121	0.19	15	63	12
Statistical Summary						**Lower Transition**	**Other Lithologies**	**n**	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
								Max	24	6.8	788	3.0	0.13	1.2	603	1290	10	112	0.0010	0.22	4.9	11	0.70	5.1	119	0.010	0.090	16	0.17	0.91	3.0	121	0.39	15	63	23
								90th PCTL	21	4.9	781	1.9	0.10	0.53	465	912	9.0	109	0.0010	0.14	2.5	10	0.58	3.1	114	0.010	0.066	13	0.15	0.82	2.1	105	0.34	14	59	22
								75th PCTL	19	3.5	726	1.2	0.070	0.060	328	555	7.9	94	*<0.001*	0.060	0.84	9.1	0.50	1.6	101	*<0.01*	0.035	10	0.13	0.64	1.4	76	0.26	13	56	17
								Median	16	2.0	564	0.48	0.020	*<0.05*	5.6	450	5.0	54	*<0.001*	0.020	0.71	6.3	0.40	0.80	80	*<0.01*	0.010	6.1	0.11	0.48	1.3	44	0.19	12	44	7.0
								25th PCTL	9.8	1.1	454	0.25	0.020	*<0.05*	4.5	415	2.9	17	*<0.001*	*<0.01*	0.47	4.3	0.25	0.55	41	*<0.01*	0.010	4.1	0.058	0.16	0.74	31	0.085	8.3	33	3.1
								10th PCTL	6.1	0.71	349	0.23	0.016	*<0.05*	2.7	308	2.0	9.6	*<0.001*	*<0.01*	0.23	2.5	0.20	0.42	33	*<0.01*	0.010	3.1	0.018	0.072	0.49	22	0.056	4.1	20	1.5
								Min	1.1	0.29	227	0.22	0.010	*<0.05*	1.1	170	1.3	7.9	*<0.001*	*<0.01*	0.090	1.6	*0.20*	0.30	22	*<0.01*	0.010	2.1	0.0050	0.060	0.39	11	*<0.05*	3.2	7.0	0.80
Statistical Summary for Other Lithologies Waste Rock								**n**	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
								n < DL	0	0	0	0	2	17	0	0	0	0	20	9	0	0	1	0	0	23	2	0	5	0	0	0	1	0	0	0
								Max	24	6.8	1200	3.8	0.24	1.2	603	1640	24	112	0.0050	0.54	77	21	0.90	5.1	195	0.010	0.49	34	0.17	2.1	28	171	500	21	80	53
								90th PCTL	19	2.9	969	2.5	0.074	0.10	242	768	17	81	0.0017	0.32	15	13	0.77	1.4	181	*<0.01*	0.081	21	0.13	0.80	12	96	1.1	16	69	23
								75th PCTL	13	1.4	779	1.1	0.033	0.050	31	660	12	60	*<0.001*	0.050	7.2	9.8	0.70	1.0	124	*<0.01*	0.050	12	0.091	0.49	6.2	60	0.54	14	62	12
								Median	7.0	0.98	567	0.57	0.020	*<0.05*	18	430	8.7	23	*<0.001*	0.010	3.1	6.9	0.50	0.80	60	*<0.01*	0.020	8.8	0.024	0.33	3.0	35	0.25	12	51	6.9
								25th PCTL	3.2	0.30	470	0.35	0.010	*<0.05*	5.0	305	5.2	15	*<0.001*	*<0.01*	0.90	3.1	0.40	0.48	18	*<0.01*	0.010	4.0	0.0058	0.19	1.3	17	0.19	11	33	1.4
								10th PCTL	2.4	0.043	328	0.26	0.010	*<0.05*	3.3	163	3.3	12	*<0.001*	*<0.01*	0.53	2.1	0.30	0.33	13	*<0.01*	0.010	3.2	*<0.005*	0.13	0.99	11	0.089	8.3	21	1.1
								Min	1.1	0.040	150	0.22	*<0.01*	*<0.05*	1.0	50	1.3	7.9	*<0.001*	*<0.01*	0.090	1.4	0.20	0.20	11	*<0.01*	*<0.01*	1.4	*<0.005*	0.060	0.39	4.0	*<0.05*	3.2	7.0	0.80

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.1-4: Statistical Summary of Exploration Assay Database (Au < 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t
Gneiss Waste Rock																																											
Gneiss	Oxide	**n**	3218	3218	3218	10661	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218	3218
		n <DL	2732	0	1	487	3210	8	252	2860	30	3161	60	0	89	0	3062	2364	0	3	5	5	0	1242	1039	337	0	24	1861	495	450	0	250	2084	3214	2070	18	3179	24	-	-	-	-	-
		Max	100	4.7	4240	0.30	10	3040	3.6	21	7.8	3.5	78	377	236	11	10	6.0	2.2	1700	46	3.1	5860	9.0	0.28	392	2980	1425	1.3	531	36	1415	630	0.35	10	110	272	450	157	1851	195	39	195	*Non-reactive*
		95th PCTL	0.20	1.8	1057	0.17	*<10*	430	1.9	2.0	2.3	*<0.5*	22	78	25	4.2	*<10*	1.0	0.74	50	27	1.0	955	3.0	0.060	37	760	23	0.070	52	13	59	40	0.090	*<10*	20	79	*<10*	62	487	57	2.2	56	*Non-reactive*
		90th PCTL	0.20	1.3	687	0.10	*<10*	280	1.5	2.0	1.3	*<0.5*	16	51	19	3.3	*<10*	1.0	0.46	50	21	0.57	732	2.0	0.040	26	570	17	0.030	35	9.0	41	40	0.040	*<10*	10	57	*<10*	49	379	33	0.94	31	*Non-reactive*
		75th PCTL	*<0.2*	0.88	349	0.035	*<10*	150	1.0	*<2*	0.30	*<0.5*	8.0	20	11	2.1	*<10*	1.0	0.24	40	9.0	0.14	446	1.0	0.020	12	330	12	0.010	16	4.0	22	40	0.010	*<10*	10	25	*<10*	29	248	7.5	0.31	6.9	*Non-reactive*
		Median	*<0.2*	0.64	179	0.010	*<10*	90	0.70	*<2*	0.070	*<0.5*	3.0	9.0	5.0	1.2	*<10*	*<1*	0.17	30	3.0	0.040	279	1.0	0.010	3.0	180	9.0	*<0.01*	7.0	1.0	13	30	*<0.01*	*<10*	*<10*	8.0	*<10*	16	144	1.8	0.31	1.4	*Non-reactive*
		25th PCTL	*<0.2*	0.49	66	0.0030	*<10*	60	0.60	*<2*	0.040	*<0.5*	1.0	6.0	3.0	0.92	*<10*	*<1*	0.13	30	2.0	0.020	187	*<1*	*<0.01*	1.0	120	6.0	*<0.01*	3.0	1.0	9.0	30	*<0.01*	*<10*	*<10*	4.0	*<10*	10	55	1.0	0.31	0.44	*Non-reactive*
		10th PCTL	*<0.2*	0.38	28	0.0010	*<10*	40	0.50	*<2*	0.020	*<0.5*	1.0	4.0	1.0	0.71	*<10*	*<1*	0.10	20	1.0	0.010	121	*<1*	*<0.01*	*<1*	90	4.0	*<0.01*	*<2*	*<1*	6.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	6.0	21	0.50	0.31	0.19	1.3
		5th PCTL	*<0.2*	0.34	15	0.0010	*<10*	30	*<0.5*	*<2*	0.020	*<0.5*	1.0	3.0	1.0	0.61	*<10*	*<1*	0.080	20	1.0	0.010	78	*<1*	*<0.01*	*<1*	70	3.0	*<0.01*	*<2*	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	12	0.50	0.31	-0.063	0.63
		Min	*<0.2*	0.11	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.24	*<10*	*<1*	0.030	*<10*	*<1*	*<0.01*	9.0	*<1*	*<0.01*	*<1*	20	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.54	0.25	0.31	-11	0.63
Gneiss	Upper Transition	**n**	4367	4367	4367	16503	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367	4367
		n <DL	3846	0	109	1982	4359	19	614	3868	8	4312	113	0	137	0	4014	3570	0	10	2	2	0	1714	536	638	0	167	1951	1831	640	0	215	1560	4364	3727	28	4283	14	-	-	-	-	-
		Max	44	5.4	4240	0.30	10	4080	4.1	11	9.8	1.0	62	577	180	7.7	10	6.0	3.5	100	47	4.0	2060	46	0.18	150	2250	1005	0.67	107	31	633	1080	0.48	10	50	227	180	131	3521	245	21	244	*Non-reactive*
		95th PCTL	0.20	2.0	583	0.11	*<10*	410	1.6	2.0	2.4	*<0.5*	17	79	23	3.4	10	1.0	1.2	50	36	1.6	741	3.0	0.090	32	830	22	0.12	25	7.0	76	40	0.16	*<10*	10	66	*<10*	52	435	61	3.8	58	*Non-reactive*
		90th PCTL	0.20	1.6	337	0.053	*<10*	270	1.3	2.0	1.7	*<0.5*	13	53	16	2.8	*<10*	1.0	0.78	50	32	1.1	594	2.0	0.080	22	610	15	0.070	16	5.0	54	40	0.10	*<10*	10	47	*<10*	40	261	42	2.2	40	*Non-reactive*
		75th PCTL	*<0.2*	0.90	125	0.016	*<10*	140	0.90	*<2*	0.77	*<0.5*	7.0	20	9.0	1.8	*<10*	*<1*	0.40	40	21	0.43	390	2.0	0.060	9.0	350	11	0.020	6.0	3.0	32	40	0.040	*<10*	*<10*	21	*<10*	25	108	19	0.63	18	*Non-reactive*
		Median	*<0.2*	0.60	38	0.0040	*<10*	80	0.70	*<2*	0.24	*<0.5*	2.0	9.0	4.0	1.1	*<10*	*<1*	0.23	30	11	0.13	253	1.0	0.030	3.0	200	7.0	0.010	2.0	1.0	17	30	0.010	*<10*	*<10*	6.0	*<10*	15	33	6.0	0.31	5.4	*Non-reactive*
		25th PCTL	*<0.2*	0.45	13	0.0010	*<10*	50	0.50		0.070	*<0.5*	1.0	6.0	2.0	0.87	*<10*	*<1*	0.16	30	5.0	0.050	175	*<1*	0.010	1.0	130	5.0	*<0.01*	*<2*	1.0	10	30	*<0.01*	*<10*	*<10*	3.0	*<10*	10	10	1.8	0.31	1.2	3.1
		10th PCTL	*<0.2*	0.35	5.0	*<0.001*	*<10*	30	*<0.5*	*<2*	0.040	*<0.5*	1.0	4.0	1.0	0.67	*<10*	*<1*	0.12	20	2.0	0.020	127	*<1*	*<0.01*	*<1*	100	3.0	*<0.01*	*<2*	*<1*	7.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	6.0	3.6	1.0	0.31	0.44	0.94
		5th PCTL	*<0.2*	0.31	3.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.030	*<0.5*	1.0	3.0	1.0	0.57	*<10*	*<1*	0.10	20	2.0	0.020	101	*<1*	*<0.01*	*<1*	80	2.0	*<0.01*	*<2*	*<1*	6.0	20	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	2.1	0.75	0.31	0.19	0.63
		Min	*<0.2*	0.040	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.19	*<10*	*<1*	0.020	*<10*	*<2*	*<0.01*	14	*<1*	*<0.01*	*<1*	10	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.32	0.25	0.31	-19	0.63
Gneiss	Lower Transition	**n**	5647	5647	5647	23440	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647	5647
		n <DL	5227	0	390	5701	5646	16	1422	4978	0	5581	92	0	137	0	4489	5035	0	60	1	1	0	2658	170	897	0	379	1871	3879	452	0	777	617	5643	5178	21	5415	17	-	-	-	-	-
		Max	2.2	4.4	3160	0.30	10	2440	3.3	25	11	2.6	50	589	3960	7.3	10	17	3.5	110	58	4.8	1500	131	0.23	446	2340	288	2.2	109	29	667	70	0.41	10	50	212	190	540	2150	280	69	280	*Non-reactive*
		95th PCTL	0.20	2.5	174	0.040	*<10*	430	1.4	2.0	3.0	*<0.5*	20	121	26	3.6	10	1.0	1.5	50	41	2.2	750	4.0	0.10	44	920	15	0.17	8.0	7.0	95	40	0.24	*<10*	10	74	*<10*	58	128	76	5.3	73	*Non-reactive*
		90th PCTL	*<0.2*	2.1	81	0.019	*<10*	310	1.2	2.0	2.4	*<0.5*	17	86	20	3.2	10	1.0	1.2	50	39	1.8	635	3.0	0.080	34	730	12	0.12	5.0	6.0	73	40	0.20	*<10*	*<10*	60	*<10*	49	60	59	3.8	56	*Non-reactive*
		75th PCTL	*<0.2*	1.5	29	0.0050	*<10*	170	0.80	*<2*	1.4	*<0.5*	12	48	13	2.4	*<10*	*<1*	0.82	40	33	1.2	469	1.0	0.070	19	500	8.0	0.050	2.0	3.0	47	30	0.12	*<10*	*<10*	40	*<10*	35	21	35	1.6	32	*Non-reactive*
		Median	*<0.2*	0.85	10	0.0020	*<10*	80	0.60	*<2*	0.68	*<0.5*	5.0	15	6.0	1.5	*<10*	*<1*	0.40	30	24	0.45	311	1.0	0.050	5.0	280	6.0	0.010	*<2*	2.0	28	30	0.040	*<10*	*<10*	16	*<10*	21	6.8	17	0.31	16	*Non-reactive*
		25th PCTL	*<0.2*	0.50	4.0	0.0010	*<10*	50	*<0.5*	*<2*	0.26	*<0.5*	2.0	7.0	3.0	0.95	*<10*	*<1*	0.22	20	14	0.15	206	*<1*	0.040	1.0	165	3.0	*<0.01*	*<2*	1.0	17	20	0.010	*<10*	*<10*	4.0	*<10*	12	2.8	6.5	0.31	5.9	2.2
		10th PCTL	*<0.2*	0.38	2.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.090	*<0.5*	1.0	5.0	2.0	0.73	*<10*	*<1*	0.16	20	8.0	0.080	146	*<1*	0.020	*<1*	116	2.0	*<0.01*	*<2*	1.0	10	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	7.0	1.4	2.3	0.31	1.7	0.94
		5th PCTL	*<0.2*	0.33	*<2*	*<0.001*	*<10*	20	*<0.5*	*<2*	0.060	*<0.5*	1.0	4.0	1.0	0.62	*<10*	*<1*	0.13	10	5.0	0.040	116	*<1*	0.010	*<1*	90	*<2*	*<0.01*	*<2*	*<1*	8.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	5.0	0.94	1.5	0.31	0.94	0.63
		Min	*<0.2*	0.12	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	0.010	*<0.5*	*<1*	1.0	*<1*	0.22	*<10*	*<1*	0.010	*<10*	*<1*	*<0.01*	16	*<1*	*<0.01*	*<1*	20	*<2*	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.37	0.25	0.31	-60	0.63
Gneiss	Transition	**n**	10014	10014	10014	39943	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014	10014
		n <DL	9073	0	499	7683	10005	35	2036	8846	8	9893	205	0	274	0	8503	8605	0	70	3	3	0	4372	706	1535	0	546	3822	5710	1092	0	992	2177	10007	8905	49	9698	31	-	-	-	-	-
		Max	44	5.4	4240	0.30	10	4080	4.1	25	11	2.6	62	589	3960	7.7	10	17	3.5	110	58	4.8	2060	131	0.23	446	2340	1005	2.2	109	31	667	1080	0.48	10	50	227	190	540	3521	280	69	280	*Non-reactive*
		95th PCTL	0.20	2.3	378	0.069	*<10*	420	1.4	2.0	2.8	*<0.5*	19	105	25	3.6	10	1.0	1.4	50	40	2.0	746	3.0	0.090	40	890	18	0.15	17	7.0	90	40	0.22	*<10*	10	71	*<10*	56	284	71	4.7	68	*Non-reactive*
		90th PCTL	*<0.2*	2.0	195	0.032	*<10*	290	1.2	2.0	2.1	*<0.5*	16	74	19	3.0	10	1.0	1.1	50	37	1.6	625	3.0	0.080	29	690	13	0.10	9.0	5.0	67	40	0.17	*<10*	10	56	*<10*	46	156	53	3.1	50	*Non-reactive*
		75th PCTL	*<0.2*	1.3	59	0.0090	*<10*	150	0.90	*<2*	1.1	*<0.5*	10	37	11	2.2	*<10*	*<1*	0.65	40	30	0.89	439	2.0	0.060	15	440	9.0	0.040	3.0	3.0	41	40	0.090	*<10*	*<10*	33	*<10*	31	47	28	1.3	26	*Non-reactive*
		Median	*<0.2*	0.68	17	0.0020	*<10*	80	0.60	*<2*	0.51	*<0.5*	4.0	11	5.0	1.3	*<10*	*<1*	0.30	30	17	0.24	282	1.0	0.050	4.0	230	6.0	0.010	*<2*	1.0	23	30	0.020	*<10*	*<10*	9.0	*<10*	18	13	13	0.31	12	*Non-reactive*
		25th PCTL	*<0.2*	0.47	6.0	0.0010	*<10*	50	0.50	*<2*	0.12	*<0.5*	2.0	6.0	3.0	0.91	*<10*	*<1*	0.19	20	9.0	0.090	190	*<1*	0.030	1.0	150	4.0	*<0.01*	*<2*	1.0	13	20	0.010	*<10*	*<10*	4.0	*<10*	11	4.1	3.0	0.31	2.4	2.2
		10th PCTL	*<0.2*	0.36	3.0	*<0.001*	*<10*	30	*<0.5*	*<2*	0.050	*<0.5*	1.0	5.0	1.0	0.71	*<10*	*<1*	0.14	20	4.0	0.030	137	*<1*	0.010	*<1*	100	2.0	*<0.01*	*<2*	*<1*	8.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	7.0	1.8	1.3	0.31	0.94	0.94
		5th PCTL	*<0.2*	0.31	2.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.030	*<0.5*	1.0	4.0	1.0	0.59	*<10*	*<1*	0.11	10	2.0	0.020	109	*<1*	*<0.01*	*<1*	80	*<2*	*<0.01*	*<2*	*<1*	7.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	5.0	1.2	0.75	0.31	0.44	0.63
		Min	*<0.2*	0.040	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.19	*<10*	*<1*	0.010	*<10*	*<2*	*<0.01*	14	*<1*	*<0.01*	*<1*	10	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.32	0.25	0.31	-60	0.63
Gneiss	Fresh	**n**	1073	1073	1073	7533	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073	1073
		n <DL	997	0	120	2608	1070	8	342	977	0	1073	15	0	38	0	741	992	0	11	0	0	0	632	12	132	0	54	410	787	57	0	234	19	1071	1014	0	1042	0	-	-	-	-	-
		Max	26	4.2	1580	40	10	2250	2.5	27	6.7	*<0.5*	56	636	49	7.8	10	1.0	3.2	70	60	4.2	4950	64	0.21	416	1640	69	1.0	111	22	670	60	0.38	10	20	203	100	175	665	168	33	166	*Non-reactive*
		95th PCTL	0.20	2.6	75	0.027	*<10*	400	1.3	2.0	3.1	*<0.5*	21	145	24	3.6	10	1.0	1.6	60	44	2.5	742	4.0	0.10	53	940	14	0.19	8.0	7.0	109	40	0.26	*<10*	10	74	*<10*	61	40	78	5.9	75	*Non-reactive*
		90th PCTL	*<0.2*	2.3	39	0.010	*<10*	290	1.1	*<2*	2.6	*<0.5*	18	109	19	3.1	10	*<1*	1.3	50	42	2.1	651	2.8	0.090	41	788	11	0.13	4.0	5.0	86	40	0.23	*<10*	*<10*	62	*<10*	52	23	64	4.1	61	*Non-reactive*
		75th PCTL	*<0.2*	1.7	14	0.0030	*<10*	190	0.80	*<2*	1.4	*<0.5*	13	57	12	2.5	10	*<1*	0.91	40	36	1.4	504	1.0	0.070	22	580	7.0	0.050	2.0	3.0	55	30	0.15	*<10*	*<10*	45	*<10*	39	9.5	35	1.6	33	*Non-reactive*
		Median	*<0.2*	1.1	6.0	0.0010	*<10*	90	0.60	*<2*	0.73	*<0.5*	6.0	18	6.0	1.8	*<10*	*<1*	0.55	30	27	0.64	342	*<1*	0.050	7.0	360	5.0	0.010	*<2*	2.0	33	30	0.070	*<10*	*<10*	21	*<10*	25	4.2	18	0.31	17	*Non-reactive*
		25th PCTL	*<0.2*	0.55	3.0	*<0.001*	*<10*	40	*<0.5*	*<2*	0.36	*<0.5*	2.0	8.0	3.0	1.1	*<10*	*<1*	0.27	20	17	0.22	231	*<1*	0.040	2.0	190	3.0	*<0.01*	*<2*	1.0	21	20	0.030	*<10*	*<10*	6.0	*<10*	15	1.9	9.0	0.31	8.2	2.2
		10th PCTL	*<0.2*	0.42	*<2*	*<0.001*	*<10*	20	*<0.5*	*<2*	0.17	*<0.5*	1.0	6.0	1.0	0.80	*<10*	*<1*	0.20	10	12	0.13	170	*<1*	0.030	*<1*	130	2.0	*<0.01*	*<2*	1.0	15	*<20*	0.010	*<10*	*<10*	3.0	*<10*	9.0	1.1	4.3	0.31	3.5	0.94
		5th PCTL	*<0.2*	0.37	*<2*	*<0.001*	*<10*	20	*<0.5*	*<2*	0.12	*<0.5*	1.0	5.0	1.0	0.69	*<10*	*<1*	0.16	10	10	0.090	137	*<1*	0.020	*<1*	110	0.40	*<0.01*	*<2*	*<1*	12	*<20*	0.010	*<10*	*<10*	2.0	*<10*	7.0	0.82	3.0	0.31	2.4	0.63
		Min	*<0.2*	0.25	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	0.030	*<0.5*	*<1*	3.0	*<1*	0.26	*<10*	*<1*	0.090	*<10*	1.0	0.020	67	*<1*	*<0.01*	*<1*	60	*<2*	*<0.01*	*<2*	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	2.0	0.40	0.75	0.31	-5.2	0.63
Gneiss	All	**n**	14305	14305	14305	58137	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305	14305
		n <DL	12802	0	620	10778	14285	51	2630	12683	38	14127	280	0	401	0	12306	11961	0	84	8	8	0	6246	1757	2004	0	624	6093	6992	1599	0	1476	4280	14292	11989	67	13919	55	-	-	-	-	-
		Max	100	5.4	4240	40	10	4080	4.1	27	11	3.5	78	636	3960	11	10	17	3.5	1700	60	4.8	5860	131	0.28	446	2980	1425	2.2	531	36	1415	1080	0.48	10	110	272	450	540	3521	280	69	280	*Non-reactive*
		95th PCTL	0.20	2.3	578	0.090	*<10*	420	1.6	2.0	2.8	*<0.5*	20	104	25	3.7	10	1.0	1.3	50	40	1.9	786	3.0	0.090	41	870	19	0.14	26	8.0	87	40	0.21	*<10*	10	73	*<10*	58	373	71	4.4	67	*Non-reactive*
		90th PCTL	0.20	1.9	337	0.041	*<10*	290	1.3	2.0	2.0	*<0.5*	16	72	19	3.1	10	1.0	1.1	50	37	1.5	644	3.0	0.080	30	680	14	0.090	16	6.0	64	40	0.16	*<10*	10	57	*<10*	47	245	51	2.8	49	*Non-reactive*
		75th PCTL	*<0.2*	1.2	118	0.011	*<10*	160	0.90	*<2*	1.0	*<0.5*	10	34	11	2.2	*<10*	*<1*	0.58	40	28	0.77	446	1.0	0.060	15	430	10	0.030	5.0	3.0	38	40	0.070	*<10*	*<10*	32	*<10*	31	94	25	0.94	24	*Non-reactive*
		Median	*<0.2*	0.68	26	0.0030	*<10*	80	0.60	*<2*	0.38	*<0.5*	4.0	11	5.0	1.3	*<10*	*<1*	0.26	30	15	0.18	284	1.0	0.040	4.0	220	7.0	0.010	2.0	1.0	21	30	0.020	*<10*	*<10*	9.0	*<10*	18	20	9.5	0.31	8.8	*Non-reactive*
		25th PCTL	*<0.2*	0.48	7.0	0.0010	*<10*	50	0.50	*<2*	0.080	*<0.5*	2.0	6.0	3.0	0.92	*<10*	*<1*	0.17	20	5.0	0.060	193	*<1*	0.010	1.0	140	4.0	*<0.01*	*<2*	1.0	12	20	*<0.01*	*<10*	*<10*	4.0	*<10*	11	4.9	2.0	0.31	1.7	24
		10th PCTL	*<0.2*	0.37	3.0	*<0.001*	*<10*	30	*<0.5*	*<2*	0.040	*<0.5*	1.0	4.0	1.0	0.71	*<10*	*<1*	0.13	20	2.0	0.020	135	*<1*	*<0.01*	*<1*	100	2.0	*<0.01*	*<2*	*<1*	8.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	7.0	2.0	1.0	0.31	0.44	7.8
		5th PCTL	*<0.2*	0.32	2.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.020	*<0.5*	1.0	4.0	1.0	0.60	*<10*	*<1*	0.10	10	1.0	0.020	104	*<1*	*<0.01*	*<1*	80	2.0	*<0.01*	*<2*	*<1*	6.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	5.0	1.3	0.50	0.31	0.19	4.4
		Min	*<0.2*	0.040	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.19	*<10*	*<1*	0.010	*<10*	*<2*	*<0.01*	9.0	*<1*	*<0.01*	*<1*	10	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.32	0.25	0.31	-60	0.042

Appendix C.1-4: Statistical Summary of Exploration Assay Database (Au < 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t
Schist Waste Rock																																												
Schist	Oxide	**n**	2355	2355	2355	4431	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355	2355
		n <DL	2020	0	3	338	2347	0	92	1957	0	2320	1	2	10	0	2066	1430	0	11	1	1	1	0	1592	471	29	0	13	443	246	37	0	1131	1247	2347	2251	0	2352	0	-	-	-	-	-
		Max	9.2	4.6	6950	0.30	10	3490	4.3	17	25	3.6	108	1105	535	8.8	10	8.0	3.2	80	72	8.2	5460	8.0	0.090	1930	2000	215	1.2	634	33	1225	170	0.33	10	30	238	10	781	1702	625	38	625	*Non-reactive*
		95th PCTL	0.30	1.9	1360	0.14	*<10*	1200	1.6	2.0	9.5	*<0.5*	23	102	57	4.5	10	2.0	0.80	50	39	2.1	975	2.0	0.040	59	910	20	0.22	61	15	272	33	0.080	*<10*	*<10*	84	*<10*	81	464	238	6.9	234	*Non-reactive*
		90th PCTL	0.20	1.6	920	0.070	*<10*	836	1.4	2.0	6.8	*<0.5*	19	67	42	4.1	10	1.0	0.59	40	34	1.6	820	1.0	0.030	46	770	16	0.15	33	12	177	30	0.056	*<10*	*<10*	68	*<10*	69	312	170	4.7	169	*Non-reactive*
		75th PCTL	*<0.2*	1.2	368	0.018	*<10*	460	1.1	*<2*	4.6	*<0.5*	15	45	28	3.5	*<10*	1.0	0.33	40	26	1.1	659	1.0	0.020	33	620	12	0.050	14	9.0	97	20	0.020	*<10*	*<10*	50	*<10*	55	147	116	1.6	114	*Non-reactive*
		Median	*<0.2*	0.91	116	0.0050	*<10*	210	0.90	*<2*	3.0	*<0.5*	12	28	18	3.0	*<10*	*<1*	0.22	30	14	0.46	527	*<1*	0.010	23	470	9.0	0.020	7.0	6.0	55	20	*<0.01*	*<10*	*<10*	35	*<10*	44	43	75	0.63	73	5.9
		25th PCTL	*<0.2*	0.71	37	0.0020	*<10*	90	0.70	*<2*	1.3	*<0.5*	8.0	15	10	2.4	*<10*	*<1*	0.15	20	4.0	0.12	392	*<1*	0.010	13	350	7.0	0.010	3.0	4.0	29	*<20*	*<0.01*	*<10*	*<10*	19	*<10*	33	13	34	0.31	31	1.3
		10th PCTL	*<0.2*	0.54	14	0.0010	*<10*	50	0.50	*<2*	0.22	*<0.5*	5.0	7.4	5.0	1.7	*<10*	*<1*	0.10	20	2.0	0.060	257	*<1*	*<0.01*	6.0	220	5.0	*<0.01*	*<2*	2.0	17	*<20*	*<0.01*	*<10*	*<10*	10	*<10*	22	4.6	5.5	0.31	4.9	0.63
		5th PCTL	*<0.2*	0.48	8.0	*<0.001*	*<10*	40	0.50	*<2*	0.10	*<0.5*	3.0	5.0	3.0	1.2	*<10*	*<1*	0.070	10	2.0	0.040	212	*<1*	*<0.01*	3.0	140	4.0	*<0.01*	*<2*	1.0	13	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	14	2.8	2.5	0.31	2.2	0.63
		Min	*<0.2*	0.080	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.42	*<10*	*<1*	0.010	*<10*	*<1*	*<0.01*	27	*<1*	*<0.01*	*<1*	20	*<2*	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	3.0	0.59	0.25	0.31	-2.0	0.63
Schist	Upper Transition	**n**	2175	2175	2175	3456	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175	2175
		n <DL	1833	0	19	479	2162	0	108	1869	0	2136	0	0	11	0	1296	1687	3	4	0	0	0	1405	237	17	0	36	229	582	23	1	985	301	2170	2148	1	2163	1	-	-	-	-	-
		Max	4.3	6.0	4000	0.30	10	3450	3.2	14	25	2.5	83	1340	2770	6.4	10	16	2.1	160	76	9.6	6280	18	0.35	1015	5350	323	2.6	130	32	10000	270	0.35	10	10	220	1140	217	1146	625	81	625	*Non-reactive*
		95th PCTL	0.30	2.5	633	0.096	*<10*	1249	1.5	2.0	10	*<0.5*	21	140	57	4.4	10	1.0	1.4	50	41	2.3	885	1.0	0.050	69	1000	22	0.64	18	13	428	30	0.16	*<10*	*<10*	84	*<10*	80	262	255	20	251	*Non-reactive*
		90th PCTL	0.20	2.2	326	0.050	*<10*	760	1.3	2.0	7.0	*<0.5*	18	95	43	4.0	10	1.0	1.2	50	37	1.8	778	1.0	0.040	50	820	15	0.38	11	10	297	20	0.14	*<10*	*<10*	73	*<10*	69	123	175	12	172	*Non-reactive*
		75th PCTL	*<0.2*	1.8	100	0.014	*<10*	400	1.0	*<2*	4.8	*<0.5*	15	59	28	3.5	10	*<1*	0.87	40	31	1.4	646	1.0	0.030	36	650	11	0.15	7.0	8.0	142	20	0.090	*<10*	*<10*	58	*<10*	57	37	121	4.7	117	46
		Median	*<0.2*	1.4	32	0.0040	*<10*	210	0.80	*<2*	3.2	*<0.5*	12	38	19	3.0	*<10*	*<1*	0.53	30	25	1.0	518	*<1*	0.020	25	520	8.0	0.040	3.0	6.0	81	20	0.050	*<10*	*<10*	42	*<10*	48	12	80	1.3	75	4.4
		25th PCTL	*<0.2*	0.96	13	0.0010	*<10*	120	0.70	*<2*	2.0	*<0.5*	9.0	23	11	2.5	*<10*	*<1*	0.28	30	18	0.63	405	*<1*	0.010	16	410	6.0	0.020	*<2*	4.0	49	*<20*	0.010	*<10*	*<10*	29	*<10*	38	4.2	51	0.63	47	1.3
		10th PCTL	*<0.2*	0.68	6.0	*<0.001*	*<10*	70	0.50	*<2*	1.1	*<0.5*	7.0	11	6.0	1.9	*<10*	*<1*	0.19	20	11	0.33	309	*<1*	*<0.01*	8.0	310	4.0	*<0.01*	*<2*	3.0	29	*<20*	*<0.01*	*<10*	*<10*	17	*<10*	27	1.9	27	0.31	23	0.63
		5th PCTL	*<0.2*	0.57	4.0	*<0.001*	*<10*	40	0.50	*<2*	0.47	*<0.5*	5.0	6.0	3.0	1.4	*<10*	*<1*	0.13	10	8.0	0.16	248	*<1*	*<0.01*	4.0	230	3.0	*<0.01*	*<2*	2.0	18	*<20*	*<0.01*	*<10*	*<10*	9.0	*<10*	21	1.3	12	0.31	11	0.63
		Min	*<0.2*	0.21	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	0.020	*<0.5*	1.0	2.0	*<1*	0.36	*<10*	*<1*	*<0.01*	*<10*	1.0	0.010	40	*<1*	*<0.01*	*<1*	20	*<2*	*<0.01*	*<2*	*<1*	*<1*	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.33	0.50	0.31	-46	0.63
Schist	Lower Transition	**n**	3330	3330	3330	6365	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330	3330
		n <DL	2968	0	152	932	3330	0	918	2818	0	3289	2	0	12	0	1379	2750	2	219	0	0	0	2329	45	30	3	248	748	1941	16	0	2219	75	3325	3306	3	3302	0	-	-	-	-	-
		Max	6.4	5.7	2320	0.29	*<10*	3470	2.7	197	25	2.6	81	1420	279	7.1	10	2.0	2.8	120	80	14	1700	29	0.34	1620	3300	288	2.3	166	24	10000	210	0.59	10	50	212	30	540	761	625	73	625	*Non-reactive*
		95th PCTL	0.20	2.8	133	0.050	*<10*	710	1.2	2.0	6.6	*<0.5*	22	174	37	4.1	10	1.0	1.6	40	46	2.6	847	2.0	0.080	73	1060	19	0.40	8.0	10	304	30	0.26	*<10*	*<10*	87	*<10*	75	45	165	13	162	*Non-reactive*
		90th PCTL	0.20	2.6	70	0.025	*<10*	510	1.1	2.0	5.2	*<0.5*	20	139	30	3.8	10	1.0	1.5	40	44	2.3	737	1.0	0.070	55	890	13	0.27	5.0	9.0	186	20	0.23	*<10*	*<10*	74	*<10*	67	24	129	8.4	124	*Non-reactive*
		75th PCTL	*<0.2*	2.2	28	0.0090	*<10*	320	0.80	*<2*	3.2	*<0.5*	17	97	21	3.4	10	*<1*	1.2	30	39	1.8	593	1.0	0.050	41	710	8.0	0.11	2.0	6.0	102	20	0.18	*<10*	*<10*	58	*<10*	55	11	79	3.4	75	*Non-reactive*
		Median	*<0.2*	1.9	12	0.0030	*<10*	210	0.60	*<2*	1.9	*<0.5*	14	56	13	2.9	10	*<1*	0.87	20	32	1.3	467	*<1*	0.040	30	540	5.0	0.020	*<2*	4.0	58	*<20*	0.13	*<10*	*<10*	44	*<10*	44	4.6	47	0.63	44	8.8
		25th PCTL	*<0.2*	1.4	5.0	0.0010	*<10*	130	*<0.5*	*<2*	1.0	*<0.5*	10	34	7.0	2.2	*<10*	*<1*	0.56	10	27	0.99	370	*<1*	0.030	18	420	3.0	0.010	*<2*	3.0	35	*<20*	0.080	*<10*	*<10*	31	*<10*	32	2.1	26	0.31	23	1.9
		10th PCTL	*<0.2*	0.99	3.0	*<0.001*	*<10*	70	*<0.5*	*<2*	0.52	*<0.5*	7.0	16	4.0	1.6	*<10*	*<1*	0.34	10	23	0.62	296	*<1*	0.020	8.0	320	2.0	*<0.01*	*<2*	2.0	22	*<20*	0.040	*<10*	*<10*	18	*<10*	22	1.1	13	0.31	11	0.94
		5th PCTL	*<0.2*	0.80	2.0	*<0.001*	*<10*	50	*<0.5*	*<2*	0.35	*<0.5*	5.0	9.0	2.0	1.3	*<10*	*<1*	0.24	*<10*	19	0.44	250	*<1*	0.010	4.0	255	*<2*	*<0.01*	*<2*	2.0	17	*<20*	0.020	*<10*	*<10*	12	*<10*	17	0.80	8.8	0.31	7.2	0.63
		Min	*<0.2*	0.14	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	0.080	*<0.5*	*<1*	2.0	*<1*	0.31	*<10*	*<1*	*<0.01*	*<10*	2.0	0.020	92	*<1*	*<0.01*	*<1*	*<10*	*<2*	*<0.01*	*<2*	*<1*	6.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	3.0	0.45	2.0	0.31	-25	0.63
Schist	Transition	**n**	5505	5505	5505	9821	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505	5505
		n <DL	4801	0	171	1411	5492	0	1026	4687	0	5425	2	0	23	0	2675	4437	5	223	0	0	0	3734	282	47	3	284	977	2523	39	1	3204	376	5495	5454	4	5465	1	-	-	-	-	-
		Max	6.4	6.0	4000	0.30	10	3470	3.2	197	25	2.6	83	1420	2770	7.1	10	16	2.8	160	80	14	6280	29	0.35	1620	5350	323	2.6	166	32	10000	270	0.59	10	50	220	1140	540	1146	625	81	625	*Non-reactive*
		95th PCTL	0.30	2.7	342	0.070	*<10*	918	1.4	2.0	8.3	*<0.5*	22	163	46	4.2	10	1.0	1.6	50	45	2.5	865	2.0	0.070	72	1030	20	0.49	12	11	361	30	0.24	*<10*	*<10*	86	*<10*	76	122	207	15	205	*Non-reactive*
		90th PCTL	0.20	2.5	159	0.032	*<10*	600	1.2	2.0	6.0	*<0.5*	20	131	35	3.9	10	1.0	1.4	40	42	2.2	759	1.0	0.060	53	870	14	0.30	8.0	10	228	20	0.21	*<10*	*<10*	73	*<10*	68	52	151	9.4	148	*Non-reactive*
		75th PCTL	*<0.2*	2.1	48	0.010	*<10*	350	0.90	*<2*	3.9	*<0.5*	16	79	24	3.4	10	*<1*	1.1	30	36	1.7	615	1.0	0.050	39	690	9.0	0.12	4.0	7.0	117	20	0.15	*<10*	*<10*	58	*<10*	56	17	98	3.8	93	*Non-reactive*
		Median	*<0.2*	1.7	17	0.0030	*<10*	210	0.70	*<2*	2.4	*<0.5*	13	48	15	2.9	10	*<1*	0.74	30	29	1.2	485	*<1*	0.030	28	530	6.0	0.030	2.0	5.0	67	*<20*	0.10	*<10*	*<10*	44	*<10*	46	6.5	60	0.94	55	6.6
		25th PCTL	*<0.2*	1.2	7.0	0.0010	*<10*	120	0.50	*<2*	1.3	*<0.5*	10	28	9.0	2.4	*<10*	*<1*	0.44	20	24	0.80	383	*<1*	0.020	17	420	4.0	0.010	*<2*	3.0	39	*<20*	0.040	*<10*	*<10*	30	*<10*	34	2.5	32	0.31	30	1.6
		10th PCTL	*<0.2*	0.81	3.0	*<0.001*	*<10*	70	*<0.5*	*<2*	0.61	*<0.5*	7.0	13	4.0	1.7	*<10*	*<1*	0.24	10	17	0.47	300	*<1*	0.010	8.0	320	2.0	*<0.01*	*<2*	2.0	23	*<20*	0.010	*<10*	*<10*	18	*<10*	24	1.3	15	0.31	13	0.63
		5th PCTL	*<0.2*	0.64	2.0	*<0.001*	*<10*	50	*<0.5*	*<2*	0.38	*<0.5*	5.0	8.0	3.0	1.3	*<10*	*<1*	0.18	10	12	0.28	249	*<1*	*<0.01*	4.0	250	*<2*	*<0.01*	*<2*	2.0	17	*<20*	*<0.01*	*<10*	*<10*	10	*<10*	18	0.90	9.5	0.31	7.7	0.63
		Min	*<0.2*	0.14	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	0.020	*<0.5*	*<1*	2.0	*<1*	0.31	*<10*	*<1*	*<0.01*	*<10*	1.0	0.010	40	*<1*	*<0.01*	*<1*	*<10*	*<2*	*<0.01*	*<2*	*<1*	*<1*	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.33	0.50	0.31	-46	0.63
Schist	Fresh	**n**	862	861	861	2514	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861	861
		n <DL	791	0	46	474	860	1	236	701	0	856	0	0	3	0	257	739	0	73	0	0	0	513	10	0	1	66	96	640	0	0	641	13	861	852	0	859	0	-	-	-	-	-
		Max	2.6	3.9	5750	17	10	3220	2.2	38	25	4.6	60	967	84	7.0	20	3.0	2.7	80	80	11	2290	11	0.17	933	3420	396	3.4	10000	23	10000	50	0.39	*<10*	10	298	10	157	1837	625	106	620	*Non-reactive*
		95th PCTL	0.20	2.9	74	0.044	*<10*	830	1.2	2.0	9.1	*<0.5*	24	216	40	4.2	10	1.0	1.8	40	49	3.0	858	2.0	0.080	96	950	17	0.60	5.0	10	404	20	0.25	*<10*	*<10*	83	*<10*	75	24	228	19	220	*Non-reactive*
		90th PCTL	*<0.2*	2.6	42	0.017	*<10*	580	1.0	2.0	5.4	*<0.5*	20	163	34	3.8	10	1.0	1.6	40	46	2.6	744	1.0	0.070	56	850	13	0.48	3.0	8.0	253	20	0.24	*<10*	*<10*	70	*<10*	67	13	135	15	124	*Non-reactive*
		75th PCTL	*<0.2*	2.3	18	0.0060	*<10*	370	0.80	*<2*	3.9	*<0.5*	17	99	24	3.4	10	*<1*	1.3	30	40	1.8	587	1.0	0.050	40	680	9.0	0.31	2.0	7.0	126	20	0.19	*<10*	*<10*	58	*<10*	57	6.6	97	9.7	90	28
		Median	*<0.2*	1.9	10	0.0020	*<10*	260	0.60	*<2*	2.5	*<0.5*	14	56	17	3.0	10	*<1*	1.0	20	32	1.4	475	*<1*	0.040	31	560	6.0	0.11	*<2*	5.0	78	*<20*	0.13	*<10*	*<10*	45	*<10*	49	3.3	63	3.4	58	9.4
		25th PCTL	*<0.2*	1.6	5.0	0.0010	*<10*	170	*<0.5*	*<2*	1.6	*<0.5*	11	39	11	2.5	*<10*	*<1*	0.73	10	28	1.1	399	*<1*	0.030	22	450	3.0	0.020	*<2*	3.0	52	*<20*	0.10	*<10*	*<10*	34	*<10*	37	1.8	40	0.63	33	3.1
		10th PCTL	*<0.2*	1.2	2.0	*<0.001*	*<10*	90	*<0.5*	*<2*	0.87	*<0.5*	8.0	25	6.0	1.9	*<10*	*<1*	0.45	10	24	0.80	330	*<1*	0.020	13	380	2.0	*<0.01*	*<2*	2.0	33	*<20*	0.060	*<10*	*<10*	25	*<10*	27	0.99	22	0.31	16	0.94
		5th PCTL	*<0.2*	0.98	*<2*	*<0.001*	*<10*	60	*<0.5*	*<2*	0.53	*<0.5*	7.0	18	4.0	1.6	*<10*	*<1*	0.29	*<10*	22	0.65	289	*<1*	0.010	9.0	330	*<2*	*<0.01*	*<2*	2.0	25	*<20*	0.040	*<10*	*<10*	19	*<10*	22	0.77	13	0.31	9.9	0.63
		Min	*<0.2*	0.25	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	0.18	*<0.5*	3.0	4.0	*<1*	0.71	*<10*	*<1*	0.010	*<10*	2.0	0.060	119	*<1*	*<0.01*	2.0	*<10*	*<2*	*<0.01*	*<2*	1.0	9.0	*<20*	*<0.01*	*<10*	*<10*	5.0	*<10*	8.0	0.49	4.5	0.31	-30	0.63
Schist	All	**n**	8722	8721	8721	16766	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721	8721
		n <DL	7612	0	220	2223	8699	1	1354	7345	0	8601	3	2	36	0	4998	6606	5	307	1	1	0	5839	763	76	4	363	1516	3409	76	1	4976	1636	8703	8557	4	8676	1	-	-	-	-	-
		Max	9.2	6.0	6950	17	10	3490	4.3	197	25	4.6	108	1420	2770	8.8	20	16	3.2	160	80	14	6280	29	0.35	1930	5350	396	3.4	10000	33	10000	270	0.59	10	50	298	1140	781	1837	625	106	625	*Non-reactive*
		95th PCTL	0.20	2.6	742	0.087	*<10*	980	1.4	2.0	8.8	*<0.5*	22	157	48	4.3	10	1.0	1.5	50	45	2.5	880	2.0	0.070	69	1010	20	0.45	25	12	335	30	0.23	*<10*	*<10*	85	*<10*	77	275	220	14	219	*Non-reactive*
		90th PCTL	0.20	2.4	361	0.038	*<10*	680	1.2	2.0	6.2	*<0.5*	19	124	37	3.9	10	1.0	1.3	40	42	2.1	773	1.0	0.060	52	840	15	0.29	13	10	213	20	0.20	*<10*	*<10*	72	*<10*	68	136	155	9.1	152	*Non-reactive*
		75th PCTL	*<0.2*	2.0	90	0.011	*<10*	380	1.0	*<2*	4.1	*<0.5*	16	70	25	3.5	10	*<1*	1.0	30	35	1.6	624	1.0	0.040	38	670	10	0.12	6.0	8.0	113	20	0.14	*<10*	*<10*	56	*<10*	56	33	103	3.8	99	*Non-reactive*
		Median	*<0.2*	1.5	24	0.0030	*<10*	210	0.70	*<2*	2.5	*<0.5*	13	43	16	3.0	*<10*	*<1*	0.59	30	28	1.1	496	*<1*	0.030	27	520	7.0	0.030	2.0	5.0	65	*<20*	0.070	*<10*	*<10*	42	*<10*	46	8.7	64	0.94	59	82
		25th PCTL	*<0.2*	0.96	8.0	0.0010	*<10*	120	0.50	*<2*	1.3	*<0.5*	9.0	24	9.0	2.4	*<10*	*<1*	0.26	20	19	0.60	385	*<1*	0.010	16	400	4.0	0.010	*<2*	3.0	38	*<20*	0.010	*<10*	*<10*	27	*<10*	34	3.1	33	0.31	30	17
		10th PCTL	*<0.2*	0.69	4.0	*<0.001*	*<10*	60	*<0.5*	*<2*	0.51	*<0.5*	6.0	11	5.0	1.7	*<10*	*<1*	0.16	10	7.0	0.16	292	*<1*	0.010	8.0	290	3.0	*<0.01*	*<2*	2.0	22	*<20*	*<0.01*	*<10*	*<10*	15	*<10*	23	1.5	13	0.31	11	6.8
		5th PCTL	*<0.2*	0.55	2.0	*<0.001*	*<10*	40	*<0.5*	*<2*	0.26	*<0.5*	4.0	7.0	3.0	1.3	*<10*	*<1*	0.11	10	3.0	0.080	237	*<1*	*<0.01*	4.0	210	2.0	*<0.01*	*<2*	2.0	16	*<20*	*<0.01*	*<10*	*<10*	9.0	*<10*	17	1.00	6.5	0.31	5.4	4.0
		Min	*<0.2*	0.080	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.31	*<10*	*<1*	*<0.01*	*<10*	*<1*	*<0.01*	27	*<1*	*<0.01*	*<1*	*<10*	*<2*	*<0.01*	*<2*	*<1*	*<1*	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.33	0.25	0.31	-46	0.30

Appendix C.1-4: Statistical Summary of Exploration Assay Database (Au < 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t
Granite Waste Rock																																												
Granite	Oxide	**n**	578	578	578	583	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578	578
		n <DL	528	0	3	100	578	2	262	442	2	576	68	0	9	0	577	422	0	1	29	40	0	100	198	142	0	0	406	196	14	0	29	313	575	342	1	576	3	-	-	-	-	-
		Max	0.70	2.1	6330	0.30	*<10*	370	2.9	4.0	0.46	0.50	18	21	42	10	10	3.0	0.48	60	19	0.91	16600	5.0	0.090	12	790	38	0.46	330	9.0	138	50	0.11	10	50	70	10	128	5990	12	14	11	*Non-reactive*
		95th PCTL	0.20	0.92	2715	0.19	*<10*	200	1.2	3.0	0.10	*<0.5*	5.0	13	8.0	2.9	*<10*	1.0	0.30	40	9.0	0.12	1855	3.0	0.060	3.0	310	24	0.021	36	4.0	51	40	0.060	*<10*	20	16	*<10*	52	1840	2.5	0.67	2.1	*Non-reactive*
		90th PCTL	*<0.2*	0.82	1980	0.11	*<10*	130	0.90	2.0	0.080	*<0.5*	3.0	10	6.0	2.3	*<10*	1.0	0.27	30	8.0	0.11	1148	2.0	0.050	3.0	240	21	0.020	17	2.0	34	40	0.060	*<10*	10	9.0	*<10*	43	1151	2.0	0.63	1.7	*Non-reactive*
		75th PCTL	*<0.2*	0.66	859	0.035	*<10*	90	0.70	*<2*	0.070	*<0.5*	2.0	8.0	3.0	1.5	*<10*	1.0	0.21	30	7.0	0.080	619	2.0	0.030	2.0	180	16	0.010	8.0	2.0	17	30	0.040	*<10*	10	7.0	*<10*	34	586	1.8	0.31	1.4	*Non-reactive*
		Median	*<0.2*	0.53	288	0.010	*<10*	70	0.50	*<2*	0.050	*<0.5*	1.0	6.0	2.0	1.2	*<10*	*<1*	0.14	20	2.0	0.020	371	2.0	0.010	1.0	140	10	*<0.01*	3.0	1.0	9.0	30	*<0.01*	*<10*	*<10*	5.0	*<10*	26	289	1.3	0.31	0.94	*Non-reactive*
		25th PCTL	*<0.2*	0.43	60	0.0010	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	1.0	4.0	1.0	0.92	*<10*	*<1*	0.090	20	1.0	0.010	97	1.0	*<0.01*	1.0	90	7.0	*<0.01*	*<2*	1.0	7.0	30	*<0.01*	*<10*	*<10*	3.0	*<10*	13	51	0.75	0.31	0.44	*Non-reactive*
		10th PCTL	*<0.2*	0.38	18	*<0.001*	*<10*	30	*<0.5*	*<2*	0.020	*<0.5*	*<1*	2.0	1.0	0.68	*<10*	*<1*	0.070	10	0.00	0.010	37	*<1*	*<0.01*	*<1*	70	5.0	*<0.01*	*<2*	1.0	5.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	6.7	15	0.50	0.31	0.19	1.6
		5th PCTL	*<0.2*	0.35	10	*<0.001*	*<10*	20	*<0.5*	*<2*	0.020	*<0.5*	*<1*	2.0	1.0	0.56	*<10*	*<1*	0.060	10	*<0.15*	*<0.01*	23	*<1*	*<0.01*	*<1*	60	4.0	*<0.01*	*<2*	1.0	4.0	14	*<0.01*	*<10*	*<10*	1.0	*<10*	4.0	8.0	0.50	0.31	-0.063	0.63
		Min	*<0.2*	0.25	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.29	*<10*	*<1*	0.020	*<10*	*<3*	*<0.01*	10	*<1*	*<0.01*	*<1*	50	2.0	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	1.5	0.25	0.31	-13	0.63
Granite	Upper Transition	**n**	140	140	140	341	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
		n <DL	136	0	6	66	140	0	108	140	1	140	16	0	19	0	140	132	0	0	3	4	0	27	6	51	0	0	120	101	0	0	1	30	140	126	0	140	1	-	-	-	-	-
		Max	0.40	1.8	6150	0.29	*<10*	250	2.8	*<2*	0.18	*<0.5*	5.0	15	19	6.1	*<10*	2.0	0.40	70	11	0.18	1340	5.0	0.11	5.0	930	30	0.31	50	5.0	123	40	0.090	*<10*	30	26	*<10*	53	8200	4.5	9.7	4.2	*Non-reactive*
		95th PCTL	*<0.2*	0.82	1460	0.094	*<10*	130	0.70	*<2*	0.12	*<0.5*	2.0	13	5.0	1.6	*<10*	1.0	0.34	40	10	0.14	865	3.0	0.080	3.0	241	16	0.020	13	2.0	20	40	0.070	*<10*	10	10	*<10*	42	623	3.0	0.64	2.7	*Non-reactive*
		90th PCTL	*<0.2*	0.70	256	0.036	*<10*	110	0.70	*<2*	0.12	*<0.5*	2.0	12	4.0	1.5	*<10*	*<1*	0.33	30	10	0.13	774	3.0	0.080	3.0	221	14	0.010	6.0	2.0	12	40	0.070	*<10*	*<10*	8.1	*<10*	39	394	3.0	0.31	2.2	*Non-reactive*
		75th PCTL	*<0.2*	0.55	95	0.0080	*<10*	90	*<0.5*	*<2*	0.090	*<0.5*	2.0	10	3.0	1.4	*<10*	*<1*	0.31	30	9.0	0.12	677	2.0	0.070	2.0	190	9.3	*<0.01*	2.0	2.0	8.0	30	0.060	*<10*	*<10*	8.0	*<10*	35	100	2.3	0.31	1.9	*Non-reactive*
		Median	*<0.2*	0.48	27	0.0020	*<10*	80	*<0.5*	*<2*	0.070	*<0.5*	1.0	7.0	2.0	1.2	*<10*	*<1*	0.28	30	8.0	0.11	545	2.0	0.050	1.0	170	6.0	*<0.01*	*<2*	2.0	7.0	30	0.050	*<10*	*<10*	7.0	*<10*	31	23	1.8	0.31	1.4	*Non-reactive*
		25th PCTL	*<0.2*	0.45	9.8	0.0010	*<10*	50	*<0.5*	*<2*	0.050	*<0.5*	1.0	5.0	1.0	0.98	*<10*	*<1*	0.13	20	5.0	0.048	290	1.0	0.020	*<1*	138	5.0	*<0.01*	*<2*	1.0	6.0	30	0.018	*<10*	*<10*	5.8	*<10*	22	7.3	1.3	0.31	0.94	*Non-reactive*
		10th PCTL	*<0.2*	0.40	4.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.030	*<0.5*	*<1*	4.0	*<1*	0.59	*<10*	*<1*	0.070	20	1.0	0.010	53	*<1*	0.010	*<1*	80	5.0	*<0.01*	*<2*	1.0	5.0	30	*<0.01*	*<10*	*<10*	4.0	*<10*	6.9	2.9	0.75	0.31	0.41	*Non-reactive*
		5th PCTL	*<0.2*	0.39	2.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.020	*<0.5*	*<1*	4.0	*<1*	0.41	*<10*	*<1*	0.060	10	1.0	0.010	31	*<1*	0.010	*<1*	70	5.0	*<0.01*	*<2*	1.0	5.0	30	*<0.01*	*<10*	*<10*	3.0	*<10*	4.0	1.7	0.50	0.31	-0.063	1.3
		Min	*<0.2*	0.32	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	3.0	*<1*	0.27	*<10*	*<1*	0.040	10	*<4*	*<0.01*	15	*<1*	*<0.01*	*<1*	60	4.0	*<0.01*	*<2*	1.0	3.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	*<2*	1.4	0.25	0.31	-8.9	0.63
Granite	Lower Transition	**n**	235	235	235	379	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235	235
		n <DL	224	0	11	90	234	0	169	194	13	235	8	0	9	0	233	212	0	0	17	19	0	72	4	47	0	0	144	130	2	0	2	53	235	177	0	235	0	-	-	-	-	-
		Max	0.20	2.4	10000	0.25	10	600	2.6	3.0	0.43	*<0.5*	72	16	16	6.8	10	4.0	0.51	60	11	0.19	7720	4.0	0.15	9.0	560	31	0.22	169	9.0	78	50	0.090	*<10*	30	27	*<10*	80	8264	11	6.9	8.3	*Non-reactive*
		95th PCTL	*<0.2*	1.0	1617	0.028	*<10*	143	0.80	2.0	0.12	*<0.5*	5.0	9.0	5.0	2.0	*<10*	1.0	0.40	30	10	0.14	1742	2.0	0.11	3.0	236	21	0.020	24	2.0	20	40	0.070	*<10*	10	9.0	*<10*	46	829	3.0	0.63	2.7	*Non-reactive*
		90th PCTL	*<0.2*	0.95	493	0.014	*<10*	116	0.70	2.0	0.10	*<0.5*	4.0	8.0	4.0	1.7	*<10*	*<1*	0.37	30	10	0.14	935	2.0	0.10	2.0	200	13	0.020	12	2.0	12	40	0.070	*<10*	10	8.0	*<10*	40	395	2.5	0.63	2.2	*Non-reactive*
		75th PCTL	*<0.2*	0.74	109	0.0040	*<10*	100	0.50	*<2*	0.090	*<0.5*	2.0	7.0	2.5	1.5	*<10*	*<1*	0.34	30	8.0	0.12	733	1.0	0.080	2.0	180	9.0	0.010	3.0	2.0	8.5	30	0.060	*<10*	*<10*	7.0	*<10*	35	116	2.3	0.31	1.9	*Non-reactive*
		Median	*<0.2*	0.56	32	0.0010	*<10*	90	*<0.5*	*<2*	0.070	*<0.5*	2.0	6.0	1.0	1.3	*<10*	*<1*	0.28	30	7.0	0.10	542	1.0	0.050	1.0	160	7.0	*<0.01*	*<2*	2.0	8.0	30	0.050	*<10*	*<10*	7.0	*<10*	30	28	1.8	0.31	1.4	*Non-reactive*
		25th PCTL	*<0.2*	0.48	6.0	0.0010	*<10*	60	*<0.5*	*<2*	0.050	*<0.5*	1.0	5.0	1.0	1.1	*<10*	*<1*	0.15	20	4.0	0.040	339	*<1*	0.030	1.0	130	5.0	*<0.01*	*<2*	1.0	6.0	30	0.010	*<10*	*<10*	5.0	*<10*	23	3.9	1.3	0.31	0.94	*Non-reactive*
		10th PCTL	*<0.2*	0.42	2.0	*<0.001*	*<10*	40	*<0.5*	*<2*	0.020	*<0.5*	1.0	3.0	1.0	0.75	*<10*	*<1*	0.10	10	0.00	0.010	93	*<1*	0.010	*<1*	70	5.0	*<0.01*	*<2*	1.0	6.0	30	*<0.01*	*<10*	*<10*	3.0	*<10*	8.8	1.7	0.50	0.31	0.19	4.3
		5th PCTL	*<0.2*	0.39	2.0	*<0.001*	*<10*	30	*<0.5*	*<2*	*<0.01*	*<0.5*	1.0	3.0	1.0	0.54	*<10*	*<1*	0.080	10	*<1*	*<0.01*	45	*<1*	0.010	*<1*	60	5.0	*<0.01*	*<2*	1.0	5.0	30	*<0.01*	*<10*	*<10*	3.0	*<10*	5.7	1.4	0.25	0.31	-0.38	0.63
		Min	*<0.2*	0.26	*<2*	*<0.001*	*<10*	20	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	2.0	*<1*	0.30	*<10*	*<1*	0.040	10	*<3*	*<0.01*	7.0	*<1*	*<0.01*	*<1*	40	4.0	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	2.0	1.3	0.25	0.31	-5.1	0.63
Granite	Transition	**n**	375	375	375	720	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375	375
		n <DL	360	0	17	156	374	0	277	334	14	375	24	0	28	0	373	344	0	0	20	23	0	99	10	98	0	0	264	231	2	0	3	83	375	303	0	375	1	-	-	-	-	-
		Max	0.4	2.36	10000	0.29	10	600	2.8	3	0.43	*<0.5*	72	16	19	6.84	10	4	0.51	70	11	0.19	7720	5	0.15	9	930	31	0.31	169	9	123	50	0.09	*<10*	30	27	-10	80	8264	10.75	9.6875	8.25	*Non-reactive*
		95th PCTL	*<0.2*	1.01	1616.5	0.06605	*<10*	130	0.8	2	0.12	*<0.5*	5	12	5	1.953	*<10*	1	0.39	40	10	0.14	1240	3	0.11	3	243	18.3	0.02	23	2	20.6	40	0.07	*<10*	10	9	-10	43.9	724	3	0.625	2.6875	*Non-reactive*
		90th PCTL	*<0.2*	0.896	453	0.02	*<10*	110	0.7	2	0.11	*<0.5*	3	10	4	1.6	*<10*	*<1*	0.37	30	10	0.136	885.2	2	0.09	3	210	14	0.01	8.6	2	12	40	0.07	*<10*	10	8	-10	39	397	2.75	0.3125	2.1875	*Non-reactive*
		75th PCTL	*<0.2*	0.665	103	0.005	*<10*	100	0.5	*<2*	0.09	*<0.5*	2	7	3	1.435	*<10*	*<1*	0.33	30	8	0.12	704.5	2	0.07	2	180	9	0.01	3	2	8	30	0.06	*<10*	-10	8	-10	35	113	2.25	0.3125	1.9375	*Non-reactive*
		Median	*<0.2*	0.52	30	0.002	*<10*	80	*<0.5*	*<2*	0.07	*<0.5*	1	6	1	1.25	*<10*	*<1*	0.28	30	7	0.1	542	1	0.05	1	160	7	*<0.01*	*<2*	2	7	30	0.05	*<10*	-10	7	-10	30	24	1.75	0.3125	1.4375	*Non-reactive*
		25th PCTL	*<0.2*	0.46	6	0.001	*<10*	60	*<0.5*	*<2*	0.05	*<0.5*	1	5	1	1.02	*<10*	*<1*	0.14	20	4	0.04	325.5	*<1*	0.025	*<1*	130	5	*<0.01*	*<2*	1	6	30	0.01	*<10*	-10	5	-10	22	4.9	1.25	0.3125	0.9375	*Non-reactive*
		10th PCTL	*<0.2*	0.414	3	*<0.001*	*<10*	30	*<0.5*	*<2*	0.02	*<0.5*	1	3	1	0.64	*<10*	*<1*	0.09	20	1	0.01	64.8	*<1*	0.01	*<1*	70	5	*<0.01*	*<2*	1	6	30	-0.01	*<10*	-10	3	-10	8	1.9	0.5	0.3125	0.1875	*Non-reactive*
		5th PCTL	*<0.2*	0.39	2	*<0.001*	*<10*	20	*<0.5*	*<2*	0.02	*<0.5*	*<1*	3	*<1*	0.5	*<10*	*<1*	0.067	10	*<1*	*<0.01*	34.4	*<1*	0.01	*<1*	60	5	*<0.01*	*<2*	1	5	30	-0.01	*<10*	-10	3	-10	4.7	1.5	0.5	0.3125	-0.375	0.84
		Min	*<0.2*	0.26	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	2	*<1*	0.27	*<10*	*<1*	0.04	10	*<4*	*<0.01*	7	*<1*	*<0.01*	*<1*	40	4	*<0.01*	*<2*	*<1*	3	-20	-0.01	*<10*	-10	2	-10	-2	1.3	0.25	0.3125	-8.9375	0.63
Granite	Fresh	**n**	24	24	24	143	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
		n <DL	24	0	0	55	20	0	17	22	3	24	8	0	0	0	24	15	0	0	2	2	0	8	1	2	0	0	13	2	1	0	0	18	24	21	0	24	12	-	-	-	-	-
		Max	*<0.2*	1.0	5690	7.0	10	90	0.90	2.0	0.12	*<0.5*	3.0	8.0	8.0	1.6	*<10*	1.0	0.24	40	6.0	0.10	1505	3.0	0.030	3.0	230	27	0.43	129	2.0	19	40	0.020	*<10*	20	6.0	*<10*	51	9483	3.0	13	1.8	*Non-reactive*
		95th PCTL	*<0.2*	0.94	4242	0.20	10	70	0.80	1.4	0.11	*<0.5*	2.0	8.0	4.0	1.5	*<10*	1.0	0.20	30	5.0	0.079	1317	2.0	0.029	2.9	219	25	0.15	74	1.0	17	40	0.019	*<10*	10	5.9	*<10*	45	7229	2.7	4.7	1.0	*Non-reactive*
		90th PCTL	*<0.2*	0.91	3662	0.037	10	70	0.80	*<2*	0.097	*<0.5*	2.0	8.0	4.0	1.4	*<10*	1.0	0.20	30	5.0	0.064	1175	2.0	0.020	2.0	207	22	0.14	66	1.0	14	40	0.010	*<10*	4.0	5.0	*<10*	43	6587	2.4	4.5	0.92	*Non-reactive*
		75th PCTL	*<0.2*	0.82	3163	0.0040	*<10*	50	0.63	*<2*	0.050	*<0.5*	2.0	7.0	3.0	0.93	*<10*	1.0	0.18	23	3.0	0.025	151	2.0	0.010	2.0	155	19	0.045	40	1.0	8.0	30	*<0.005*	*<10*	*<10*	4.0	*<10*	12	5303	1.3	1.4	0.25	*Non-reactive*
		Median	*<0.2*	0.74	1648	0.0010	*<10*	40	*<0.5*	*<2*	0.020	*<0.5*	1.0	4.0	1.5	0.65	*<10*	*<1*	0.15	20	2.0	0.010	35	1.0	0.010	1.0	70	14	*<0.01*	33	1.0	5.5	30	*<0.01*	*<10*	*<10*	4.0	*<10*	0.00	2258	0.50	0.31	0.063	*Non-reactive*
		25th PCTL	*<0.2*	0.49	685	*<0.001*	*<10*	30	*<0.5*	*<2*	0.010	*<0.5*	*<1*	4.0	1.0	0.51	*<10*	*<1*	0.12	20	1.0	0.010	30	*<1*	0.010	1.0	58	13	*<0.01*	6.0	1.0	4.8	30	*<0.01*	*<10*	*<10*	3.0	*<10*	*<2*	1058	0.25	0.31	-0.14	4.5
		10th PCTL	*<0.2*	0.38	76	*<0.001*	*<10*	20	*<0.5*	*<2*	0.0040	*<0.5*	*<1*	3.0	1.0	0.46	*<10*	*<1*	0.11	10	1.0	0.010	27	*<1*	0.010	1.0	50	10	*<0.01*	2.0	1.0	4.0	30	*<0.01*	*<10*	*<10*	3.0	*<10*	*<2*	73	0.25	0.31	-2.9	1.4
		5th PCTL	*<0.2*	0.37	38	*<0.001*	*<10*	20	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	3.0	1.0	0.46	*<10*	*<1*	0.093	10	1.55	0.0070	24	*<1*	0.010	0.70	50	8.3	*<0.01*	1.4	1.0	4.0	30	*<0.01*	*<10*	*<10*	2.2	*<10*	*<2*	30	0.25	0.31	-3.4	0.98
		Min	*<0.2*	0.29	23	*<0.001*	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	3.0	1.0	0.38	*<10*	*<1*	0.060	10	*<2*	*<0.01*	21	*<1*	*<0.01*	*<1*	50	7.0	*<0.01*	*<2*	*<1*	4.0	30	*<0.01*	*<10*	*<10*	2.0	*<10*	*<2*	15	0.25	0.31	-13	0.63
Granite	All	**n**	977	977	977	1446	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977	977
		n <DL	912	0	20	311	972	2	556	798	19	975	100	0	37	0	974	781	0	1	51	65	0	207	209	242	0	0	683	429	17	0	32	414	974	666	1	975	16	-	-	-	-	-
		Max	0.70	2.4	10000	7.0	10	600	2.9	4.0	0.46	0.50	72	21	42	10	10	4.0	0.51	70	19	0.91	16600	5.0	0.15	12	930	38	0.46	330	9.0	138	50	0.11	10	50	70	10	128	9483	12	14	11	*Non-reactive*
		95th PCTL	0.20	0.95	2616	0.14	*<10*	160	1.1	2.0	0.11	*<0.5*	5.0	12	7.0	2.5	*<10*	1.0	0.36	40	10	0.13	1684	3.0	0.090	3.0	270	23	0.030	37	2.0	38	40	0.070	*<10*	20	12	*<10*	48	2150	2.8	0.94	2.4	*Non-reactive*
		90th PCTL	*<0.2*	0.86	1659	0.067	*<10*	120	0.80	2.0	0.090	*<0.5*	3.0	10	5.0	2.0	*<10*	1.0	0.33	30	9.0	0.13	1029	2.0	0.074	3.0	230	19	0.020	18	2.0	25	40	0.060	*<10*	10	8.0	*<10*	41	1090	2.3	0.63	1.9	*Non-reactive*
		75th PCTL	*<0.2*	0.67	591	0.014	*<10*	90	0.60	*<2*	0.080	*<0.5*	2.0	8.0	3.0	1.5	*<10*	*<1*	0.28	30	8.0	0.11	670	2.0	0.050	2.0	180	14	0.010	6.0	2.0	13	30	0.050	*<10*	10	7.0	*<10*	34	486	2.0	0.31	1.7	*Non-reactive*
		Median	*<0.2*	0.53	119	0.0030	*<10*	70	*<0.5*	*<2*	0.060	*<0.5*	1.0	6.0	2.0	1.2	*<10*	*<1*	0.17	20	5.0	0.050	443	1.0	0.020	1.0	150	8.0	*<0.01*	2.0	2.0	8.0	30	0.020	*<10*	*<10*	6.0	*<10*	28	117	1.5	0.31	1.2	*Non-reactive*
		25th PCTL	*<0.2*	0.44	23	0.0010	*<10*	40	*<0.5*	*<2*	0.040	*<0.5*	1.0	4.0	1.0	0.92	*<10*	*<1*	0.11	20	1.0	0.010	138	1.0	0.010	1.0	100	6.0	*<0.01*	*<2*	1.0	6.0	30	*<0.01*	*<10*	*<10*	4.0	*<10*	15	19	1.0	0.31	0.44	*Non-reactive*
		10th PCTL	*<0.2*	0.39	6.0	*<0.001*	*<10*	30	*<0.5*	*<2*	0.020	*<0.5*	*<1*	3.0	1.0	0.64	*<10*	*<1*	0.070	10	0.00	0.010	38	*<1*	*<0.01*	*<1*	70	5.0	*<0.01*	*<2*	1.0	5.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	6.0	4.1	0.50	0.31	0.19	2.8
		5th PCTL	*<0.2*	0.36	3.0	*<0.001*	*<10*	20	*<0.5*	*<2*	0.020	*<0.5*	*<1*	2.0	1.0	0.52	*<10*	*<1*	0.060	10	*<1*	*<0.01*	27	*<1*	*<0.01*	*<1*	60	4.0	*<0.01*	*<2*	1.0	5.0	20	*<0.01*	*<10*	*<10*	2.0	*<10*	4.0	2.3	0.50	0.31	-0.14	0.80
		Min	*<0.2*	0.25	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.27	*<10*	*<1*	0.020	*<10*	*<4*	*<0.01*	7.0	*<1*	*<0.01*	*<1*	40	2.0	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	1.3	0.25	0.31	-13	0.053

Appendix C.1-4: Statistical Summary of Exploration Assay Database (Au < 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t	kgCaCO$_3$/t
Other Lithologies																																												
Other	Oxide	**n**	1411	1411	1411	3165	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411	1411
		n <DL	1122	0	0	134	1406	0	84	1169	0	1390	15	8	6	0	1249	824	0	29	1	2	0	762	285	81	0	6	388	131	29	0	958	879	1406	1099	10	1387	1	-	-	-	-	-
		Max	20	4.9	5860	0.30	10	3350	4.2	18	24	2.5	87	618	314	14	10	14	1.8	1700	72	7.7	18250	9.0	0.27	643	2350	369	1.9	708	46	931	40	0.26	10	100	287	960	580	4614	593	60	592	*Non-reactive*
		95th PCTL	0.40	2.1	1995	0.22	*<10*	1220	2.3	3.0	7.9	*<0.5*	35	97	55	6.7	10	1.0	0.62	40	42	2.2	1483	2.0	0.040	63	1485	21	0.38	76	26	193	30	0.080	*<10*	30	180	*<10*	98	604	198	12	197	*Non-reactive*
		90th PCTL	0.20	1.6	1250	0.15	*<10*	890	1.9	2.0	6.4	*<0.5*	27	64	40	5.5	10	1.0	0.42	40	38	1.9	1070	2.0	0.040	47	1020	18	0.21	50	18	143	30	0.040	*<10*	20	128	*<10*	85	433	160	6.6	155	*Non-reactive*
		75th PCTL	*<0.2*	1.2	680	0.067	*<10*	460	1.3	*<2*	4.5	*<0.5*	16	39	29	3.8	*<10*	1.0	0.26	30	30	1.4	751	1.0	0.020	32	590	14	0.060	20	10	99	20	0.010	*<10*	*<10*	57	*<10*	66	252	114	1.9	111	*Non-reactive*
		Median	*<0.2*	0.85	284	0.019	*<10*	210	1.0	*<2*	2.2	*<0.5*	12	20	18	3.0	*<10*	*<1*	0.18	20	11	0.36	576	*<1*	0.010	19	370	10	0.020	8.0	7.0	51	*<20*	*<0.01*	*<10*	*<10*	37	*<10*	50	103	55	0.63	51	15
		25th PCTL	*<0.2*	0.61	70	0.0050	*<10*	90	0.70	*<2*	0.21	*<0.5*	6.0	8.0	8.0	2.1	*<10*	*<1*	0.13	10	2.0	0.060	400	*<1*	0.010	6.0	190	8.0	*<0.01*	4.0	4.0	25	*<20*	*<0.01*	*<10*	*<10*	18	*<10*	32	27	5.3	0.31	4.9	1.6
		10th PCTL	*<0.2*	0.49	26	0.0020	*<10*	50	0.50	*<2*	0.060	*<0.5*	2.0	3.0	3.0	1.3	*<10*	*<1*	0.090	10	1.0	0.030	217	*<1*	*<0.01*	1.0	110	6.0	*<0.01*	2.0	2.0	14	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	17	8.5	1.5	0.31	0.94	0.63
		5th PCTL	*<0.2*	0.43	15	0.0010	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	1.0	1.0	2.0	0.95	*<10*	*<1*	0.070	10	1.0	0.020	127	*<1*	*<0.01*	*<1*	70	5.0	*<0.01*	*<2*	1.0	11	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	10	4.8	0.75	0.31	0.44	0.63
		Min	*<0.2*	0.20	3.0	*<0.001*	*<10*	10	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.37	*<10*	*<1*	0.020	*<10*	*<1*	*<0.01*	8.0	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.94	0.25	0.31	-6.6	0.63
Other	Upper Transition	**n**	585	585	585	2943	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585	585
		n <DL	467	0	4	275	579	0	60	522	0	567	29	8	14	0	432	426	0	5	5	5	1	322	109	73	0	5	133	121	27	0	316	196	582	532	11	562	1	-	-	-	-	-
		Max	18	4.1	10000	0.30	10	3450	3.4	5.0	20	1.2	40	532	151	7.5	10	6.0	2.2	80	58	4.5	4440	6.0	0.22	912	2450	187	1.6	156	28	2940	50	0.46	10	30	203	110	171	7653	505	49	500	*Non-reactive*
		95th PCTL	0.40	2.5	1755	0.18	*<10*	1634	2.1	2.0	8.9	*<0.5*	25	151	37	4.8	10	1.0	1.2	50	41	2.4	1030	2.0	0.070	75	1580	28	0.38	45	17	239	40	0.16	*<10*	10	120	*<10*	88	727	223	12	219	*Non-reactive*
		90th PCTL	0.20	2.1	1157	0.12	*<10*	1176	1.7	2.0	7.6	*<0.5*	20	98	29	4.4	10	1.0	0.95	40	36	1.9	949	1.0	0.060	44	1020	20	0.26	24	13	196	30	0.11	*<10*	*<10*	97	*<10*	78	462	190	8.1	188	*Non-reactive*
		75th PCTL	*<0.2*	1.6	248	0.042	*<10*	400	1.2	*<2*	4.6	*<0.5*	15	47	19	3.5	10	1.0	0.57	30	28	1.3	743	1.0	0.040	26	700	14	0.090	9.0	10	103	20	0.070	*<10*	*<10*	66	*<10*	60	140	116	2.8	110	*Non-reactive*
		Median	*<0.2*	1.0	65	0.011	*<10*	180	0.80	*<2*	2.0	*<0.5*	10	19	11	2.7	*<10*	*<1*	0.28	30	20	0.63	548	*<1*	0.020	13	430	10	0.030	4.0	5.0	55	*<20*	0.020	*<10*	*<10*	37	*<10*	44	28	50	0.94	48	8.1
		25th PCTL	*<0.2*	0.68	23	0.0030	*<10*	90	0.60	*<2*	0.36	*<0.5*	5.0	7.0	6.0	1.7	*<10*	*<1*	0.18	20	9.0	0.18	354	*<1*	0.010	3.0	220	7.0	0.010	2.0	3.0	28	*<20*	*<0.01*	*<10*	*<10*	13	*<10*	28	9.6	9.0	0.31	7.4	1.9
		10th PCTL	*<0.2*	0.51	8.0	0.0010	*<10*	50	*<0.5*	*<2*	0.080	*<0.5*	1.0	3.0	2.0	1.1	*<10*	*<1*	0.12	10	3.0	0.040	193	*<1*	*<0.01*	*<1*	110	5.0	*<0.01*	*<2*	1.0	13	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	12	2.7	2.0	0.31	1.2	0.94
		5th PCTL	*<0.2*	0.45	5.0	*<0.001*	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	1.0	1.2	1.0	0.75	*<10*	*<1*	0.080	10	2.0	0.020	101	*<1*	*<0.01*	*<1*	82	4.0	*<0.01*	*<2*	1.0	9.0	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	8.0	1.5	0.75	0.31	0.19	0.63
		Min	*<0.2*	0.16	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.39	*<10*	*<1*	0.010	*<10*	*<1*	*<0.01*	*<5*	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	4.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.59	0.25	0.31	-19	0.63
Other	Lower Transition	**n**	710	710	710	2387	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710	710
		n <DL	573	0	26	284	703	0	234	598	2	698	28	5	4	0	392	548	0	63	1	1	0	421	18	75	0	60	187	370	14	0	459	102	709	670	0	679	8	-	-	-	-	-
		Max	1930	6.4	7110	0.30	10	2460	2.9	9.0	22	1.5	81	521	7700	7.0	10	7.0	2.3	130	61	4.6	1370	11	0.39	653	2440	82	1.3	123	34	1410	50	0.33	10	20	250	2990	1980	7146	540	40	538	*Non-reactive*
		95th PCTL	0.50	3.1	460	0.12	*<10*	780	1.6	3.0	6.7	*<0.5*	24	207	45	4.6	10	1.0	1.5	40	50	2.8	942	2.0	0.13	88	1556	21	0.27	25	13	174	30	0.25	*<10*	10	125	*<10*	79	223	168	8.4	160	*Non-reactive*
		90th PCTL	0.20	2.9	160	0.060	*<10*	561	1.2	2.0	4.4	*<0.5*	21	151	36	3.9	10	1.0	1.4	40	46	2.5	840	1.0	0.10	65	1390	15	0.13	10	11	142	30	0.22	*<10*	*<10*	102	*<10*	69	85	111	4.1	106	*Non-reactive*
		75th PCTL	*<0.2*	2.4	56	0.019	*<10*	340	0.90	*<2*	3.0	*<0.5*	16	85	24	3.4	10	*<1*	1.0	30	38	1.9	676	1.0	0.070	39	830	10	0.030	4.0	8.0	95	20	0.15	*<10*	*<10*	78	*<10*	57	24	74	0.94	69	*Non-reactive*
		Median	*<0.2*	1.8	18	0.0050	*<10*	230	0.60	*<2*	1.4	*<0.5*	12	30	14	2.8	*<10*	*<1*	0.57	20	29	1.2	522	*<1*	0.040	14	560	6.0	0.010	*<2*	5.0	55	*<20*	0.080	*<10*	*<10*	49	*<10*	45	7.5	36	0.31	34	*Non-reactive*
		25th PCTL	*<0.2*	1.0	8.0	0.0020	*<10*	120	*<0.5*	*<2*	0.52	*<0.5*	8.0	9.0	8.0	1.9	*<10*	*<1*	0.30	10	21	0.62	356	*<1*	0.030	4.0	310	4.0	*<0.01*	*<2*	3.0	28	*<20*	0.030	*<10*	*<10*	26	*<10*	27	2.8	13	0.31	13	1.3
		10th PCTL	*<0.2*	0.62	3.0	*<0.001*	*<10*	70	*<0.5*	*<2*	0.20	*<0.5*	3.0	5.0	4.0	1.3	*<10*	*<1*	0.17	10	11	0.16	240	*<1*	0.010	*<1*	150	2.0	*<0.01*	*<2*	1.0	16	*<20*	*<0.01*	*<10*	*<10*	11	*<10*	15	1.3	5.0	0.31	4.7	0.63
		5th PCTL	*<0.2*	0.48	2.0	*<0.001*	*<10*	50	*<0.5*	*<2*	0.060	*<0.5*	1.0	3.0	2.0	0.97	*<10*	*<1*	0.14	*<10*	3.9	0.045	161	*<1*	0.010	*<1*	80	*<2*	*<0.01*	*<2*	1.0	13	*<20*	*<0.01*	*<10*	*<10*	4.0	*<10*	7.5	0.90	1.5	0.31	1.2	0.63
		Min	*<0.2*	0.24	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	*<1*	*<1*	0.30	*<10*	*<1*	0.030	*<10*	*<3*	*<0.01*	7.0	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	4.0	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	*<2*	0.35	0.25	0.31	-7.9	0.63
Other	Transition	**n**	1295	1295	1295	5330	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295	1295
		n <DL	1040	0	30	559	1282	0	294	1120	2	1265	57	13	18	0	824	974	0	68	6	6	1	743	127	148	0	65	320	491	41	0	775	298	1291	1202	11	1241	9	-	-	-	-	-
		Max	1930	6.4	10000	0.30	10	3450	3.4	9.0	22	1.5	81	532	7700	7.5	10	7.0	2.3	130	61	4.6	4440	11	0.39	912	2450	187	1.6	156	34	2940	50	0.46	10	30	250	2990	1980	7653	540	49	538	*Non-reactive*
		95th PCTL	0.40	3.0	1330	0.16	*<10*	1273	1.9	2.0	8.2	*<0.5*	24	184	42	4.8	10	1.0	1.4	40	48	2.7	1010	2.0	0.11	87	1570	24	0.32	29	15	217	30	0.23	*<10*	10	122	*<10*	83	554	205	10	199	*Non-reactive*
		90th PCTL	0.20	2.7	535	0.092	*<10*	690	1.5	2.0	6.2	*<0.5*	20	133	33	4.2	10	1.0	1.2	40	44	2.3	888	1.0	0.080	61	1320	18	0.19	17	12	156	30	0.19	*<10*	*<10*	100	*<10*	72	268	155	5.8	149	*Non-reactive*
		75th PCTL	*<0.2*	2.2	121	0.031	*<10*	370	1.0	*<2*	3.4	*<0.5*	16	62	21	3.4	10	*<1*	0.85	30	33	1.6	716	1.0	0.060	33	750	12	0.060	7.0	8.0	97	20	0.11	*<10*	*<10*	73	*<10*	58	56	85	1.9	83	*Non-reactive*
		Median	*<0.2*	1.4	33	0.0080	*<10*	210	0.70	*<2*	1.6	*<0.5*	11	24	12	2.8	*<10*	*<1*	0.43	20	26	0.98	530	*<1*	0.030	14	480	8.0	0.020	2.0	5.0	55	*<20*	0.050	*<10*	*<10*	44	*<10*	45	12	40	0.63	38	18
		25th PCTL	*<0.2*	0.79	11	0.0020	*<10*	100	0.50	*<2*	0.45	*<0.5*	7.0	8.0	7.0	1.8	*<10*	*<1*	0.22	10	15	0.38	356	*<1*	0.010	3.0	260	5.0	0.010	*<2*	3.0	28	*<20*	0.010	*<10*	*<10*	20	*<10*	28	4.2	11	0.31	11	1.6
		10th PCTL	*<0.2*	0.54	5.0	*<0.001*	*<10*	60	*<0.5*	*<2*	0.14	*<0.5*	2.0	4.0	3.0	1.1	*<10*	*<1*	0.14	10	5.0	0.070	210	*<1*	0.010	*<1*	120	3.0	*<0.01*	*<2*	1.0	15	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	14	1.6	3.5	0.31	2.7	0.63
		5th PCTL	*<0.2*	0.46	3.0	*<0.001*	*<10*	50	*<0.5*	*<2*	0.040	*<0.5*	1.0	2.0	2.0	0.83	*<10*	*<1*	0.11	*<10*	2.0	0.020	112	*<1*	*<0.01*	*<1*	80	0.80	*<0.01*	*<2*	1.0	11	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	8.0	1.1	1.0	0.31	0.44	0.63
		Min	*<0.2*	0.16	*<2*	*<0.001*	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	*<1*	*<1*	0.30	*<10*	*<1*	0.010	*<10*	*<3*	*<0.01*	*<5*	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	4.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.35	0.25	0.31	-19	0.63
Other	Fresh	**n**	247	241	241	796	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241	241
		n <DL	175	0	16	91	238	1	85	206	2	236	22	0	4	0	137	179	0	26	1	1	0	171	22	36	1	18	29	130	6	0	185	79	241	234	1	238	4	-	-	-	-	-
		Max	1.4	6.4	10000	9.3	10	1970	3.4	4.0	12	1.9	78	1475	61	5.9	10	2.0	2.3	50	81	15	7720	6.0	0.40	1505	1720	271	4.1	129	20	448	40	0.34	*<10*	10	196	10	237	9483	288	129	234	*Non-reactive*
		95th PCTL	0.60	3.9	4730	2.0	*<10*	1070	1.6	2.0	5.5	*<0.5*	63	1110	32	5.0	10	1.0	1.5	40	76	9.8	1020	2.0	0.27	991	1470	25	1.9	19	12	282	20	0.23	*<10*	*<10*	164	*<10*	76	2472	138	59	125	*Non-reactive*
		90th PCTL	0.50	3.2	3110	1.1	*<10*	700	1.3	2.0	5.0	*<0.5*	28	152	26	4.2	10	1.0	1.1	30	48	2.7	912	1.0	0.22	45	1320	16	1.5	11	11	230	20	0.19	*<10*	*<10*	123	*<10*	71	1493	125	48	110	*Non-reactive*
		75th PCTL	0.20	2.6	457	0.044	*<10*	410	1.0	*<2*	3.2	*<0.5*	16	36	17	3.6	10	1.0	0.81	20	35	1.8	683	1.0	0.12	24	690	12	0.35	5.0	8.0	133	*<20*	0.14	*<10*	*<10*	91	*<10*	58	408	79	11	57	*Non-reactive*
		Median	*<0.2*	1.4	23	0.0060	*<10*	260	0.60	*<2*	1.9	*<0.5*	12	18	11	2.8	*<10*	*<1*	0.38	20	29	1.4	537	*<1*	0.040	11	410	8.0	0.040	*<2*	5.0	82	*<20*	0.050	*<10*	*<10*	33	*<10*	40	8.5	46	1.3	39	42
		25th PCTL	*<0.2*	0.78	6.0	0.0020	*<10*	140	*<0.5*	*<2*	0.78	*<0.5*	6.0	9.0	5.0	2.2	*<10*	*<1*	0.25	10	22	0.68	371	*<1*	0.020	2.0	120	4.0	0.010	*<2*	3.0	36	*<20*	*<0.01*	*<10*	*<10*	15	*<10*	30	1.7	20	0.31	13	3.8
		10th PCTL	*<0.2*	0.56	3.0	*<0.001*	*<10*	60	*<0.5*	*<2*	0.27	*<0.5*	1.0	4.0	2.0	0.81	*<10*	*<1*	0.16	*<10*	12	0.15	242	*<1*	0.010	*<1*	50	2.0	*<0.01*	*<2*	1.0	20	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	19	0.93	6.8	0.31	3.1	0.63
		5th PCTL	*<0.2*	0.48	*<2*	*<0.001*	*<10*	40	*<0.5*	*<2*	0.20	*<0.5*	*<1*	1.0	1.0	0.67	*<10*	*<1*	0.070	*<10*	9.0	0.10	133	*<1*	*<0.01*	*<1*	40	*<2*	*<0.01*	*<2*	1.0	17	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	15	0.66	5.0	0.31	-7.2	0.63
		Min	*<0.2*	0.050	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.49	*<10*	*<1*	0.010	*<10*	*<2*	*<0.01*	21	*<1*	*<0.01*	*<1*	*<10*	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.53	0.25	0.31	-67	0.63
Other	All	**n**	2953	2947	2947	9291	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947	2947
		n <DL	2337	0	46	784	2926	1	463	2495	4	2891	94	21	28	0	2210	1977	0	123	8	9	1	1676	434	265	1	89	737	752	76	0	1918	1256	2938	2535	22	2866	14	-	-	-	-	-
		Max	1930	6.4	10000	9.3	10	3450	4.2	18	24	2.5	87	1475	7700	14	10	14	2.3	1700	81	15	18250	11	0.40	1505	2450	369	4.1	708	46	2940	50	0.46	10	100	287	2990	1980	9483	593	129	592	*Non-reactive*
		95th PCTL	0.40	2.9	1914	0.21	*<10*	1230	2.1	2.0	7.9	*<0.5*	29	150	47	5.7	10	1.0	1.3	40	46	2.6	1154	2.0	0.11	74	1527	23	0.43	56	20	216	30	0.19	*<10*	20	151	*<10*	89	703	198	13	195	*Non-reactive*
		90th PCTL	0.20	2.5	1145	0.13	*<10*	810	1.7	2.0	6.1	*<0.5*	23	104	37	4.7	10	1.0	0.98	40	41	2.1	959	2.0	0.070	51	1230	18	0.26	31	14	156	30	0.15	*<10*	10	110	*<10*	79	430	153	8.1	147	*Non-reactive*
		75th PCTL	*<0.2*	1.6	446	0.043	*<10*	400	1.2	*<2*	4.1	*<0.5*	16	45	25	3.6	0.00	1.0	0.52	30	32	1.5	724	1.0	0.040	32	690	13	0.070	12	9.0	100	20	0.070	*<10*	*<10*	67	*<10*	62	176	102	2.2	97	*Non-reactive*
		Median	*<0.2*	1.0	90	0.010	*<10*	210	0.80	*<2*	1.7	*<0.5*	11	21	14	2.9	*<10*	*<1*	0.25	20	22	0.80	556	*<1*	0.020	16	420	9.0	0.020	5.0	6.0	55	*<20*	0.010	*<10*	*<10*	39	*<10*	47	36	43	0.63	40	153
		25th PCTL	*<0.2*	0.68	21	0.0020	*<10*	100	0.60	*<2*	0.34	*<0.5*	7.0	8.0	7.0	2.0	*<10*	*<1*	0.16	10	6.0	0.13	377	*<1*	0.010	4.0	215	6.0	0.00	*<2*	3.0	27	*<20*	*<0.01*	*<10*	*<10*	19	*<10*	30	7.8	8.5	0.31	7.7	25
		10th PCTL	*<0.2*	0.51	7.0	0.0010	*<10*	60	*<0.5*	*<2*	0.080	*<0.5*	2.0	3.0	3.0	1.2	*<10*	*<1*	0.10	10	2.0	0.040	217	*<1*	*<0.01*	1.0	100	4.0	*<0.01*	*<2*	1.0	15	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	16	2.3	2.0	0.31	1.2	6.7
		5th PCTL	*<0.2*	0.45	4.0	*<0.001*	*<10*	40	*<0.5*	*<2*	0.040	*<0.5*	1.0	2.0	2.0	0.86	*<10*	*<1*	0.080	10	1.0	0.020	113	*<1*	*<0.01*	*<1*	70	2.0	*<0.01*	*<2*	1.0	11	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	9.0	1.4	1.0	0.31	0.44	2.4
		Min	*<0.2*	0.050	*<2*	*<0.001*	*<10*	*<10*	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	*<1*	*<1*	0.30	*<10*	*<1*	0.010	*<10*	*<3*	*<0.01*	*<5*	*<1*	*<0.01*	*<1*	*<10*	*<2*	*<0.01*	*<2*	*<1*	2.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	0.35	0.25	0.31	-67	0.030

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.2: Static Test Results for Ore

Appendix C.2-1: Acid-Base Accounting Results for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide- S	T-AP	Total-C	TIC (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Oxide Facies for Gneiss Ore																											
ABA100	KAM137583	CFR0470	39.62	41.15	Ore	Oxide	Gneiss	MxM	7.1	7.2	0.02	0.01	*<0.01*	0.60	0.040	*<0.2*	3.1	*<4.5*	6.0	8.0	2.5	5.0	7.4	5.0	7.2	9.6	13
Supremo Oxide T1	72144	Head	composite	-	Ore	Oxide	Gneiss		7.4	7.3	0.02	-	*<0.01*	0.70	0.030	0.11	2.3	2.5	5.7	11	1.6	5.0	11	3.2	3.5	7.9	16
Supremo Oxide T4	72145	Head	composite	-	Ore	Oxide	Gneiss		7.4	7.4	0.02	-	*<0.01*	0.80	0.12	0.33	8.9	7.5	11	18	8.2	11	18	12	10	15	25
ABA394	KAM030261	CFR0110	81.08	82.6	Ore	Oxide	Gneiss	MxF	6.7	6.7	0.11	0.06	0.01	3.4	0.030	*<0.2*	2.3	*<4.5*	-	-	-1.1	-	-	0.68	1.3	-	-
ABA397	L861523	CFR0134	105.16	105.187	Ore	Oxide	Gneiss	FG	7.3	7.0	0.01	*<0.01*	0.01	0.30	0.040	*<0.2*	3.1	*<4.5*	-	-	2.8	-	-	9.9	14	-	-
Statistical Summary						**Oxide**	**Gneiss**	**n**	5	5	5.00	3.00	5.00	5	5	5	5	5	3	3	5	3	3	5	5	3	3
								Max	7.4	7.4	0.11	0.06	0.01	3.4	0.12	0.30	8.9	7.5	11	18	8.2	11	18	12	14	15	25
								90th PCTL	7.4	7.3	0.08	0.05	0.01	2.4	0.090	0.30	6.6	6.3	10	17	6.0	9.0	16	11	13	14	23
								75th PCTL	7.4	7.3	0.02	0.04	0.01	0.80	0.040	*<0.2*	3.1	*<4.5*	8.6	15	2.8	7.9	14	10	10	12	20
								Median	7.3	7.2	0.02	0.01	*<0.01*	0.70	0.040	*<0.2*	3.1	*<4.5*	6.0	11	2.5	5.4	11	5.0	7.2	10	16
								25th PCTL	7.1	7.0	0.02	*<0.01*	*<0.01*	0.60	0.030	*<0.2*	2.3	*<4.5*	5.8	9.7	1.6	5.2	9.0	3.2	3.5	8.8	14
								10th PCTL	6.9	6.8	0.01	*<0.01*	*<0.01*	0.40	0.030	0.10	2.3	3.3	5.8	8.7	0.00	5.1	8.0	1.7	2.2	8.3	13
								Min	6.7	6.7	0.01	*<0.01*	*<0.01*	0.30	0.030	0.10	2.3	2.5	5.7	8.0	-1.1	5.0	7.4	0.70	1.3	7.9	13
Upper and Lower Transition Facies for Gneiss Ore																											
Supremo 80%	72146	Head	composite	-	Ore	Transition	Gneiss		7.3	7.5	0.13	-	0.09	4.0	0.44	1.5	34	33	38	44	30	34	40	8.5	8.3	9.4	11
ABA375	R271389	CFD0417	109.3	109.775	Ore	Lower Transition	Gneiss	MxF	8.7	8.6	0.01	0.01	0.01	0.30	0.31	1.0	24	23	-	-	24	-	-	77	73	-	-
ABA002	KAM004886	CFD0034	73	74	Ore	Upper transition	Gneiss	FG	7.0	6.8	*<0.01*	0.01	0.02	*<0.3*	0.10	*<0.2*	7.8	*<4.5*	4.0	5.0	7.5	4.0	4.7	26	15	13	17
ABA359	R623803	CFD0548	174	174.935	Ore	Upper Transition	Gneiss	MxF	7.3	7.4	*<0.01*	0.01	0.02	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	-	-	1.3	-	-	5.2	15	-	-
ABA403	R544048	CFD0553	120	121	Ore	Upper Transition	Gneiss	MxF	8.1	7.6	*<0.01*	*<0.01*	0.01	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	-	-	2.0	-	-	7.8	15	-	-
Statistical Summary						**Transition**	**Gneiss**	**n**	5	5	5	4	5	5	5	5	5	5	2	2	5	2	2	5	5	2	2
								Max	8.7	8.6	0.13	0.01	0.09	4.0	0.44	1.5	34	33	38	44	30	34	40	77	73	13	17
								90th PCTL	8.5	8.2	0.08	0.01	0.06	2.5	0.39	1.3	30	29	34	41	28	31	37	57	50	13	16
								75th PCTL	8.1	7.6	0.01	0.01	0.02	0.31	0.31	1.0	24	23	29	35	24	26	31	26	15	12	15
								Median	7.3	7.5	*<0.01*	0.01	0.02	*<0.3*	0.10	*<0.2*	7.8	*<4.5*	21	25	7.5	19	23	8.5	15	11	14
								25th PCTL	7.3	7.4	*<0.01*	0.01	0.01	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	12	15	2.0	11	14	7.8	15	10	12
								10th PCTL	7.1	7.0	*<0.01*	*<0.01*	0.01	*<0.3*	0.020	*<0.2*	1.9	*<4.5*	7.4	8.9	1.6	6.7	8.3	6.2	11	9.8	12
								Min	7.0	6.8	*<0.01*	*<0.01*	0.01	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	4.0	5.0	1.3	3.7	4.7	5.2	8.3	9.4	11
Statistical Summary for Gneiss Ore								**n**	10	10	10	7	10	10	10	10	10	10	5	5	10	5	5	10	10	5	5
								n < DL	-	-	3	2	3	3	0	6	0	6	0	0	0	0	0	0	0	0	0
								Max	8.7	8.6	0.13	0.06	0.09	4.0	0.44	1.5	34	33	38	44	30	34	40	77	73	15	25
								90th PCTL	8.2	7.7	0.11	0.03	0.03	3.5	0.32	1.1	25	24	27	34	24	24	31	31	21	14	21
								75th PCTL	7.4	7.5	0.02	0.01	0.02	0.74	0.11	0.30	8.6	6.8	11	18	8.0	11	18	11	15	13	17
								Median	7.3	7.3	0.02	0.01	0.01	0.47	0.040	*<0.2*	3.1	*<4.5*	6.0	11	2.6	5.4	11	8.1	12	9.6	16
								25th PCTL	7.2	7.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.030	*<0.2*	2.3	*<4.5*	5.7	8.0	1.7	5.0	7.4	5.0	7.5	9.4	13
								10th PCTL	7.0	6.8	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.030	0.19	2.3	4.3	4.7	6.2	1.0	4.2	5.8	3.0	3.3	8.5	12
								Min	6.7	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.020	0.11	1.6	2.5	4.0	5.0	-1.1	3.7	4.7	0.68	1.3	7.9	11
Oxide Facies for Schist Ore																											
DD oxide	72141	Head	composite	-	-	Oxide	Gneiss/schist		7.5	7.5	0.13	-	0.09	3.9	0.96	3.5	74	78	76	77	70	72	73	19	20	19	20
ABA089	KAM133587	CFR0431	10.67	12.19	3	Oxide	Schist	BtS	7.8	7.5	0.01	*<0.01*	*<0.01*	0.30	0.090	0.30	7.0	6.8	10	13	6.7	10	13	22	22	32	42
Latte Oxide East	72136	Head	composite	-	-	Oxide	Schist		7.5	7.5	0.09	-	0.05	2.7	1.3	4.4	97	100	58	87	94	55	84	36	37	22	32
Latte Oxide West	72135	Head	composite	-	Ore	Oxide	Schist		7.4	7.5	0.20	-	0.13	6.2	1.9	6.6	144	149	100	124	137	94	118	23	24	16	20
ABA324	Q033726	CFD0411	36	37	Ore	Oxide	schist	BtS	8.1	7.8	0.42	0.05	0.25	13	0.84	2.6	65	59	-	-	52	-	-	5.0	4.5	-	-
ABA328	KAM001234	CFD0008	52	53	Ore	Oxide	schist	BtS	8.2	8.1	0.04	0.02	*<0.01*	1.3	1.2	3.7	90	84	-	-	89	-	-	72	67	-	-
Statistical Summary						**Oxide**	**Schist**	**n**	6	6	6	3	6	6	6	6	6	6	4	4	6	4	4	6	6	4	4
								Max	8.2	8.1	0.42	0.05	0.25	13	1.9	6.6	144	149	100	124	137	94	118	72	67	32	42
								90th PCTL	8.2	8.0	0.31	0.04	0.19	10	1.6	5.5	120	125	93	113	116	87	107	54	52	29	39
								75th PCTL	8.0	7.7	0.18	0.04	0.12	5.6	1.2	4.2	95	96	82	96	93	77	92	33	34	24	35
								Median	7.7	7.5	0.11	0.02	0.07	3.3	1.1	3.6	82	81	67	82	80	64	79	23	23	20	26
								25th PCTL	7.5	7.5	0.05	0.02	0.02	1.6	0.87	2.8	68	64	46	61	57	44	58	20	20	19	20
								10th PCTL	7.4	7.5	0.03	0.01	*<0.01*	0.78	0.47	1.5	36	33	24	32	29	23	31	12	12	17	20
								Min	7.4	7.5	0.01	*<0.01*	*<0.01*	0.31	0.090	0.30	7.0	6.8	10	13	7.0	9.7	13	5.0	4.5	16	20
Upper and Lower Transition Facies for Schist Ore																											
Latte 60%	72138	Head	composite	-	Ore	Transition	Schist		7.5	7.4	0.56	-	0.47	18	1.7	6.1	131	138	93	134	114	75	117	7.4	7.8	5.3	7.6
Latte 80%'	72137	Head	composite	-	Ore	Transition	Schist		7.4	7.5	0.52	-	0.41	16	2.0	6.9	153	157	107	123	137	91	107	9.4	9.7	6.6	7.6
ABA327	KAM001014	CFD0007	50.15	50.9	Ore	Lower Transition	schist	BtS	7.9	8.1	1.81	0.19	1.31	57	1.5	5.2	119	118	-	-	62	-	-	2.1	2.1	-	-
ABA314	KAM147294	CFD0346	107	107.5	Ore	Upper Transition	Schist	BtS_carb	-	7.9	0.61	0.02	0.44	19	2.7	8.4	207	191	-	-	188	-	-	11	10	-	-
ABA315	KAM147319	CFD0346	130.2	130.3	Ore	Upper Transition	Schist	BtS_carb	7.9	7.8	2.22	0.15	1.61	69	1.4	4.7	111	107	-	-	42	-	-	1.6	1.5	-	-
Statistical Summary						**Transition**	**Schist**	**n**	4	5	5	3	5	5	5	5	5	5	2	2	5	2	2	5	5	2	2
								Max	7.9	8.1	2.22	0.19	1.61	69	2.7	8.4	207	191	107	134	188	91	117	11	10	6.6	7.6
								90th PCTL	7.9	8.0	2.06	0.18	1.49	64	2.4	7.8	186	177	106	133	168	90	116	10	10	6.5	7.6
								75th PCTL	7.9	7.9	1.81	0.17	1.31	57	2.0	6.9	153	157	104	132	137	87	114	9.4	10	6.3	7.6
								Median	7.7	7.8	0.61	0.15	0.47	19	1.7	6.1	131	138	100	129	114	83	112	7.4	7.8	5.9	7.6
								25th PCTL	7.5	7.5	0.56	0.09	0.44	18	1.5	5.2	119	118	96	126	62	79	109	2.1	2.1	5.6	7.6
								10th PCTL	7.4	7.4	0.54	0.05	0.42	17	1.5	4.9	114	111	94	124	50	77	108	1.8	1.8	5.4	7.6
								Min	7.4	7.4	0.52	0.02	0.41	16	1.4	4.7	111	107	93	123	42	75	107	1.6	1.5	5.3	7.6
Statistical Summary for Schist Ore								**n**	10	11	11	6	11	11	11	11	11	11	6	6	11	6	6	11	11	6	6
								n < DL	-	-	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
								Max	8.2	8.1	2.22	0.19	1.61	69	2.7	8.4	207	191	107	134	188	94	118	72	67	32	42
								90th PCTL	8.1	8.1	1.81	0.17	1.31	57	2.0	6.9	153	157	104	129	137	92	117	36	37	27	37
								75th PCTL	7.9	7.9	0.59	0.13	0.46	18	1.8	6.3	137	144	98	124	125	87	114	23	23	21	29
								Median	7.7	7.5	0.42	0.04	0.25	13	1.4	4.7	111	107	84	105	89	74	95	11	10	18	20
								25th PCTL	7.5	7.5	0.11	0.02	0.07	3.3	1.1	3.6	82	81	63	79	57	60	76	6.2	6.2	9.0	11
								10th PCTL	7.4	7.5	0.04	0.02	*<0.01*	1.3	0.84	2.6	65	59	34	45	42	33	43	2.1	2.1	5.9	7.6
								Min	7.4	7.4	0.01	*<0.01*	*<0.01*	0.31	0.090	0.30	7.0	6.8	10	13	6.7	9.7	13	1.6	1.5	5.3	7.6

Appendix C.2-1: Acid-Base Accounting Results for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Rinse pH (1:1)	Paste pH	Total-S	Sulphate-S	Sulphide- S	T-AP	Total-C	TIC (as CO_2)	T-C NP*	CaNP	Sobek-NP	Siderite-NP	T-C NNP*	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
									s.u.	s.u.	%	%	%	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	T-CNP*/T-AP	CaNP/T-AP	SobekNP/T-AP	SideriteNP/T-AP
Oxide Facies for Granite Ore																											
ABA156	R305806	CFD0382	59	60	Ore	Oxide	Granite	GG	6.2	5.7	0.01	0.02	*<0.01*	0.30	*<0.01*	*<0.2*	*<0.8*	*<4.5*	1.0	3.0	0.46	1.0	2.7	2.5	14	3.2	9.6
ABA171	R305823	CFD0396	13	14	Ore	Oxide	Granite	GG	6.7	6.5	0.01	*<0.01*	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	2.0	4.0	2.0	2.0	3.7	7.5	14	6.4	13
Kona Oxide	72139	Head	composite	-	Ore	Oxide	Granite		5.7	5.9	0.03	-	0.01	0.80	0.020	0.070	1.9	1.7	0.70	7.1	1.0	0.00	6.3	2.2	2.0	0.86	8.5
ABA419	I308596	CFD0053	7	8	Ore	Oxide	Granite	GG	5.8	6.1	0.01	0.01	*<0.01*	0.30	0.030	*<0.2*	2.3	*<4.5*	1.0	-	2.0	1.0	-	7.5	14	3.2	-
ABA420	I354541	CFD0053	47	47.24	Ore	Oxide	Granite	GG	5.8	6.2	*<0.01*	0.01	*<0.01*	*<0.3*	0.080	*<0.2*	6.2	*<4.5*	5.0	-	5.9	5.0	-	21	15	17	-
ABA422	I354552	CFD0053	57.8	58	Ore	Oxide	Granite	GG	6.2	6.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	4.0	-	2.8	4.0	-	10	15	13	-
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	5	6	6	6	6	6	6	6	3	6	6	3	6	6	6	3
								Max	6.7	6.5	0.03	0.02	0.01	0.84	0.080	*<0.2*	6.2	*<4.5*	5.0	7.1	5.9	4.7	6.3	21	15	17	13
								90th PCTL	6.5	6.5	0.02	0.02	0.01	0.58	0.060	*<0.2*	4.7	*<4.5*	4.5	6.5	4.4	4.2	5.8	16	15	15	12
								75th PCTL	6.2	6.4	0.01	0.01	*<0.01*	0.31	0.040	*<0.2*	2.9	*<4.5*	3.5	5.6	2.6	3.2	5.0	9.6	15	12	11
								Median	6.0	6.2	0.01	0.01	*<0.01*	0.31	0.030	*<0.2*	2.3	*<4.5*	1.5	4.0	2.0	1.2	3.7	7.4	14	4.8	9.6
								25th PCTL	5.8	5.9	*<0.01*	0.01	*<0.01*	*<0.3*	0.030	*<0.2*	2.0	*<4.5*	1.0	3.5	1.3	0.70	3.2	3.7	14	3.2	9.0
								10th PCTL	5.7	5.8	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	0.14	1.3	3.1	0.90	3.2	0.70	0.30	2.9	2.3	8.2	2.0	8.7
								Min	5.7	5.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	0.070	*<0.8*	1.7	0.70	3.0	0.50	-0.10	2.7	2.2	2.0	0.90	8.5
Upper and Lower Transition Facies for Granite Ore																											
Kona 80% CN	72140	Head	composite	-	Ore	Transition	Granite		4.4	4.9	0.15	-	0.11	4.7	0.040	0.070	3.0	1.7	0.50	7.0	-1.7	-4.0	2.3	0.64	0.35	0.10	1.5
ABA161	R305812	CFD0383	84	85	Ore	Upper transition	Granite	GG	5.4	5.2	0.01	0.01	0.01	0.30	0.030	*<0.2*	2.3	*<4.5*	1.0	3.0	2.0	1.0	2.7	7.5	14	3.2	9.6
ABA428	Q041388	CFD0382	97	98	Ore	Lower Transition	Granite	GG	6.8	6.6	*<0.01*	0.02	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	3.0	-	1.3	3.0	-	5.2	15	10	-
ABA444	Q032413	CFD0385	83	83.75	Ore	Lower Transition	Granite	GG	5.4	5.1	0.02	0.01	*<0.01*	0.60	0.010	*<0.2*	0.80	*<4.5*	1.0	-	0.15	0.00	-	1.2	7.2	1.6	-
ABA445	Q032988	CFD0399	8.85	9	Ore	Lower Transition	Granite	GG	6.8	6.5	0.01	0.01	*<0.01*	0.30	0.040	*<0.2*	3.1	*<4.5*	2.0	-	2.8	2.0	-	9.9	14	6.4	-
ABA446	Q033347	CFD0403	32	33	Ore	Lower Transition	Granite	GG	5.7	5.0	*<0.01*	0.01	*<0.01*	*<0.3*	0.040	*<0.2*	3.1	*<4.5*	-	-	2.8	0.00	-	10	15	-	-
ABA432	Q041581	CFD0383	83.47	84	Ore	Upper Transition	Granite	GG	5.3	5.5	*<0.01*	0.01	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	2.0	-	3.6	2.0	-	13	15	6.7	-
ABA433	Q041589	CFD0383	91.9	92	Ore	Upper Transition	Granite	GG	6.8	6.6	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	2.0	-	1.3	2.0	-	5.2	15	6.7	-
Statistical Summary						**Transition**	**Granite**	**n**	8	8	8	7	8	8	8	8	8	8	7	2	8	8	2	8	8	7	2
								Max	6.8	6.6	0.15	0.02	0.11	4.7	0.050	*<0.2*	3.9	*<4.5*	3.0	7.0	3.6	2.7	2.7	13	15	10	9.6
								90th PCTL	6.8	6.6	0.06	0.01	0.04	1.9	0.043	*<0.2*	3.3	*<4.5*	2.4	6.6	3.0	2.0	2.6	11	15	8.0	8.8
								75th PCTL	6.8	6.5	0.01	0.01	*<0.01*	0.40	0.040	*<0.2*	3.1	*<4.5*	2.0	6.0	2.8	1.7	2.6	10	15	6.7	7.6
								Median	5.6	5.4	*<0.01*	0.01	*<0.01*	*<0.3*	0.035	*<0.2*	2.7	*<4.5*	2.0	5.0	1.6	1.2	2.5	6.3	15	6.4	5.5
								25th PCTL	5.4	5.1	*<0.01*	0.01	*<0.01*	*<0.3*	0.020	*<0.2*	1.6	*<4.5*	1.0	4.0	1.0	0.20	2.4	4.2	13	2.4	3.5
								10th PCTL	5.0	5.0	*<0.01*	0.01	*<0.01*	*<0.3*	0.017	0.16	1.3	3.7	0.79	3.4	-0.40	-1.5	2.3	1.1	5.1	1.0	2.3
								Min	4.4	4.9	*<0.01*	0.01	*<0.01*	*<0.3*	0.010	0.070	0.80	1.7	0.48	3.0	-1.7	-4.2	2.3	0.60	0.40	0.10	1.5
Statistical Summary for Granite Ore								**n**	14	14	14	12	14	14	14	14	14	14	13	5	14	14	5	14	14	13	5
								n < DL	-	-	6	1	10	6	1	12	1	12	0	0	0	0	0	0	0	0	0
								Max	6.8	6.6	0.15	0.02	0.11	4.7	0.080	0.20	6.2	4.5	5.0	7.1	5.9	4.7	6.3	21	15	17	13
								90th PCTL	6.8	6.6	0.02	0.02	0.01	0.80	0.047	0.20	3.6	4.5	3.8	7.1	3.3	3.4	5.3	12	15	13	12
								75th PCTL	6.6	6.5	0.01	0.01	0.01	0.30	0.040	*<0.2*	3.1	*<4.5*	2.0	7.0	2.8	1.7	3.7	10	15	6.7	9.6
								Median	5.8	6.0	0.01	0.01	*<0.01*	0.30	0.030	*<0.2*	2.3	*<4.5*	2.0	4.0	2.0	1.2	2.7	7.4	14	6.4	9.6
								25th PCTL	5.5	5.3	*<0.01*	0.01	*<0.01*	*<0.3*	0.021	*<0.2*	1.6	*<4.5*	1.0	3.0	1.1	0.50	2.7	3.2	14	3.2	8.5
								10th PCTL	5.3	5.0	*<0.01*	0.01	*<0.01*	*<0.3*	0.013	0.10	1.0	2.5	0.80	3.0	0.20	-0.20	2.5	1.5	3.5	1.0	4.3
								Min	4.4	4.9	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.01*	0.10	*<0.8*	1.7	0.50	3.0	-1.7	-4.2	2.3	0.60	0.40	0.10	1.5
Oxide and Transition Facies for Other Lithologies Ore																											
ABA126	KAM149885	CFR0566	67.06	68.58	Ore	Oxide	Dykes	IV	7.1	7.7	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.090	0.20	7.0	4.5	21	24	6.7	21	24	23	15	70	80
ABA334	R550421	CFD0518	10	11	Ore	Upper Transition	HU	HU	-	7.4	*<0.01*	*<0.01*	*<0.01*	*<0.3*	0.050	*<0.2*	3.9	*<4.5*	-	-	3.6	-	-	13	15	-	-
ABA175	R305827	CFD0403	70	71	Ore	Lower transition	Dykes	DIOR	4.5	4.4	0.52	0.02	0.34	16	0.030	*<0.2*	2.3	*<4.5*	0.00	2.0	-14	-16	-14	0.14	0.28	0.00	-

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in the statistical summary
n < DL = number of samples with values below the analytical detection limit
Sulphate Sulphur determined by 25% HCL with Gravimetric Finish.
Sulphide Sulphur determined by Sobek 1:7 Nitric Acid with S by ICP-MS Finish.
T-AP = Acid potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material, derived from Total S * 31.25.
NP = Neutralization potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material.
Carbonate NP (CaNP) is calculated from total inorganic carbon (TIC); T-C NP* calculated from Total-C * 77.6.
Net NP (NNP) = NP - AP; Neutralization potential ratio (NPR).

Appendix C.2-2: Shake Flask Extraction Results for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	pH	T-Alkalnity	Br	Cl	F	NO_3-N	NO_2-N	SO_4	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
										mg $CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Oxide Facies for Gneiss Ore																																																	
Supremo Oxide T1	72144	Head	composite		Ore	Oxide	Gneiss		7.9	-	-	-	-	-	-	2.0	0.049	0.0069	0.096	0.034	*<0.000007*	*<0.000007*	0.0077	0.0000030	4.9	0.000070	0.00022	0.0015	0.014	0.000040	0.0016	1.3	0.0047	0.00012	0.0083	0.00020	0.033	2.1	0.00011	2.1	0.0000030	3.9	0.026	0.000081	0.000070	0.00027	0.0022	0.00020	*<0.001*
Supremo Oxide T4	72145	Head	composite		Ore	Oxide	Gneiss		7.8	-	-	-	-	-	-	2.0	0.034	0.0052	0.13	0.058	*<0.000007*	*<0.000007*	0.0096	*<0.000003*	9.5	*<0.00003*	0.00022	0.0011	*<0.007*	*<0.00001*	0.0035	2.5	0.0090	0.00044	0.0051	0.00040	0.022	2.8	0.000040	2.1	0.0000030	3.1	0.042	0.00022	0.000040	0.00010	0.0072	0.00015	*<0.001*
Transition Facies for Gneiss Ore																																																
Supremo 80%	72146	Head	composite		Ore	Transition	Gneiss		7.8	-	-	-	-	-	-	45	0.027	0.0083	0.18	0.011	*<0.000007*	*<0.000007*	0.0076	*<0.000003*	20	*<0.00003*	0.00035	0.00040	*<0.007*	*<0.00001*	0.0016	5.5	0.016	0.000040	0.0066	0.00070	0.010	3.4	0.00037	1.6	*<0.000002*	2.8	0.076	0.00022	0.000020	0.000080	0.0089	0.00012	*<0.001*
ABA359	R623803	CFD0548	174	174.935	Ore	Upper Transition	Gneiss	MxF	8.1	5.9	*<0.050*	*<0.50*	0.13	0.0062	0.021	7.9	0.086	0.049	0.54	0.075	*<0.00050*	*<0.00050*	0.016	*<0.000050*	2.2	*<0.00050*	*<0.00010*	*<0.0010*	*<0.030*	*<0.00010*	*<0.0050*	0.57	*<0.00050*	0.00046	0.0014	*<0.00050*	*<0.30*	3.8	*<0.00050*	4.2	*<0.000050*	0.67	0.012	0.00028	*<0.00050*	*<0.010*	0.000060	*<0.0010*	*<0.010*
ABA403	R544048	CFD0553	120	121	Ore	Upper Transition	Gneiss	MxF	7.5	4.8	*<0.050*	*<0.50*	0.13	0.0073	0.0035	0.80	0.37	0.042	0.14	0.0082	*<0.00050*	*<0.00050*	0.014	*<0.000050*	0.44	*<0.00050*	*<0.00010*	*<0.0010*	0.16	0.00064	*<0.0050*	0.26	0.025	0.00051	0.020	*<0.00050*	*<0.30*	2.6	*<0.00050*	2.8	*<0.000050*	0.38	0.0025	*<0.00010*	*<0.00050*	*<0.010*	0.00096	*<0.0010*	*<0.010*
Oxide Facies for Schist Ore																																																
DD oxide	72141	Head	composite		Ore	Oxide	Gneiss/schist		7.8	-	-	-	-	-	-	10	0.026	0.0046	0.13	0.016	*<0.000007*	*<0.000007*	0.0081	0.0000050	10	*<0.00003*	0.00014	0.00041	*<0.007*	*<0.00001*	0.0011	4.2	0.0025	*<0.00001*	0.0045	0.00050	0.0030	2.7	0.00030	1.9	0.0000020	3.3	0.045	0.000046	0.000050	*<0.00005*	0.0011	0.00019	*<0.001*
Latte Oxide East	72136	Head	composite		Ore	Oxide	Schist		8.0	-	-	-	-	-	-	43	0.023	0.0048	0.12	0.044	*<0.000007*	*<0.000007*	0.0087	0.0000030	16	*<0.00003*	0.00016	0.0010	*<0.007*	*<0.00001*	0.0015	5.8	0.0042	*<0.00001*	0.0027	0.0018	0.010	2.9	0.00043	2.0	*<0.000002*	6.3	0.11	0.00011	0.000070	0.000060	0.00094	0.00013	*<0.001*
Latte Oxide West	72135	Head	composite		Ore	Oxide	Schist		7.8	-	-	-	-	-	-	225	0.0093	0.0037	0.086	0.017	*<0.000007*	*<0.000007*	0.0082	*<0.000003*	66	*<0.00003*	0.00035	0.0014	*<0.007*	*<0.00001*	0.0021	18	0.025	0.000020	0.0014	0.0055	*<0.003*	4.0	0.00094	1.6	0.0000020	7.6	0.33	0.00023	0.00011	*<0.00005*	0.0015	0.000050	*<0.001*
Transition Facies for Schist Ore																																																
Latte 60%	72138	Head	composite		Ore	Transition	Schist		7.8	-	-	-	-	-	-	328	0.012	0.014	0.074	0.015	*<0.000007*	*<0.000007*	0.0074	*<0.000003*	106	*<0.00003*	0.00059	0.0015	*<0.007*	*<0.00001*	0.0022	21	0.057	*<0.00001*	0.0017	0.0033	*<0.003*	4.6	0.0010	1.5	0.0000060	5.2	0.46	0.00024	0.000070	*<0.00005*	0.0027	0.00015	*<0.001*
Latte 80%'	72137	Head	composite		Ore	Transition	Schist		7.7	-	-	-	-	-	-	208	0.022	0.011	0.15	0.018	*<0.000007*	*<0.000007*	0.0075	*<0.000003*	68	*<0.00003*	0.00046	0.0013	*<0.007*	*<0.00001*	0.0015	14	0.047	*<0.00001*	0.0011	0.0047	*<0.003*	3.6	0.0011	1.3	0.0000040	2.5	0.28	0.00033	0.000090	*<0.00005*	0.0020	0.00016	*<0.001*
Oxide Facies for Granite Ore																																																
ABA156	R305806	CFD0382	59	60	Ore	Oxide	Granite	GG	6.2	-	-	-	-	-	-	9.6	3.2	0.045	1.00	0.0079	*<0.0005*	*<0.0005*	0.18	*<0.00005*	0.42	*<0.0005*	0.00024	*<0.001*	0.92	0.00052	0.0058	0.16	0.0031	0.00010	0.00058	*<0.0005*	*<0.3*	7	*<0.0005*	29	*<0.00005*	1.0	0.0038	0.00065	*<0.0005*	*<0.01*	0.0011	*<0.001*	*<0.01*
ABA171	R305823	CFD0396	13	14	Ore	Oxide	Granite	GG	7.4	-	-	-	-	-	-	1.7	18	0.17	1.8	0.077	0.00088	*<0.0005*	0.12	0.000085	0.75	0.00069	0.0017	0.0058	25	0.029	*<0.005*	0.37	0.48	0.0063	0.0084	0.0020	*<0.3*	7	*<0.0005*	34	0.00012	4.6	0.012	0.0023	0.00057	0.055	0.033	0.0041	0.042
Kona Oxide	72139	Head	composite		Ore	Oxide	Granite	-	6.1	-	-	-	-	-	-	3.0	0.092	0.020	0.51	0.00042	0.0000090	*<0.000007*	0.0099	0.0000060	0.060	*<0.00003*	0.000096	0.0042	0.019	0.00013	0.00056	0.026	0.0028	0.000030	0.00049	0.00030	0.022	0.6	0.000080	1.7	0.0000030	3.3	0.00071	0.000051	0.00010	0.00024	0.00025	0.00023	0.0040
Transition Facies for Granite Ore																																																
Kona 80% CN	72140	Head	composite			Transition	Granite		5.7	-	-	-	-	-	-	40	0.074	0.0062	1.5	0.00037	0.00027	*<0.000007*	0.014	0.000053	6.8	*<0.00003*	0.034	0.017	0.94	0.00014	0.0029	1.9	0.87	*<0.00001*	0.000080	0.0089	*<0.003*	3.2	0.00043	1.1	*<0.000002*	2.9	0.025	0.00086	0.000030	*<0.00005*	0.0026	0.000040	0.033
ABA161	R305812	CFD0383	84	85	40	Upper transition	Granite	GG	5.6	-	-	-	-	-	-	14	0.0051	0.0040	0.13	*<0.001*	*<0.0005*	*<0.0005*	0.13	*<0.00005*	0.31	*<0.0005*	0.00083	*<0.001*	*<0.03*	*<0.0001*	*<0.005*	0.078	0.0037	*<0.00005*	*<0.0001*	*<0.0005*	*<0.3*	10	*<0.0005*	16	*<0.00005*	2.6	0.0016	0.00095	*<0.0005*	*<0.01*	0.00047	*<0.001*	*<0.01*
ABA444	Q032413	CFD0385	83	83.75	80	Lower Transition	Granite	GG	5.6	*<2*	*<0.050*	*<0.50*	0.031	0.018	*<0.0010*	2.8	1.4	0.023	0.22	0.0030	*<0.0005*	*<0.0005*	0.028	*<0.000050*	*<0.10*	*<0.00050*	0.00016	*<0.0010*	0.12	0.00058	*<0.0050*	*<0.050*	0.0072	0.000073	0.00053	*<0.00050*	*<0.30*	2.1	*<0.00050*	5.0	*<0.000050*	0.68	0.00081	0.00038	*<0.00050*	*<0.010*	0.00025	*<0.0010*	*<0.010*
Oxide and Transition Facies for Other Lithologies Ore																																																
ABA126	KAM149885	CFR0566	67.06	68.58	Ore	Oxide	Dykes	IV	8.2	-	-	-	-	-	-	12	*<0.005*	0.088	0.073	0.12	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	23	0.038	*<0.0001*	*<0.001*	*<0.03*	*<0.0001*	0.0067	9.9	0.0017	0.010	0.0067	0.0073	*<0.3*	5	*<0.0005*	11	*<0.00005*	0.68	0.17	0.00056	*<0.0005*	*<0.01*	0.00094	*<0.001*	*<0.01*
ABA175	R305827	CFD0403	70	71	Ore	Lower transition	Dykes	DIOR	4.2	-	-	-	-	-	-	138	2.3	0.054	25	0.072	*<0.0025*	*<0.0025*	0.18	*<0.00025*	5.7	*<0.0025*	0.52	*<0.005*	15	*<0.0005*	*<0.025*	2.1	0.11	*<0.00005*	*<0.0005*	0.083	*<0.3*	55	*<0.0025*	22	*<0.00025*	2.0	0.071	0.019	*<0.0025*	*<0.01*	0.0035	*<0.005*	*<0.05*

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in the statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.2-3: Solid Phase Element Results by Aqua Regia Digestion for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Oxide Facies for Gneiss Ore																															
ABA100	KAM137583	CFR0470	39.62	41.15	Ore	Oxide	Gneiss	MxM	0.24	1.1	940	0.40	*<10*	590	1.2	0.91	0.17	0.040	134	6.2	12	1.7	21	2.3	4.5	0.12	0.28	0.48	0.031	0.46	77
Supremo Oxide T1	72144	Head	composite		Ore	Oxide	Gneiss		0.12	0.39	789	-	*<10*	223	1.0	0.28	0.21	0.070	53	6.5	79	1.8	5.6	1.6	1.2	*<0.1*	0.17	0.55	*<0.02*	0.19	32
Supremo Oxide T4	72145	Head	composite		Ore	Oxide	Gneiss		0.10	0.47	1090	-	*<10*	173	0.90	0.14	0.43	0.050	54	4.7	88	2.1	2.5	1.5	1.4	*<0.1*	0.16	1.4	*<0.02*	0.20	33
ABA394	KAM030261	CFR0110	81.08	82.6	Ore	Oxide	Gneiss	MxF	0.22	0.49	1095	4.9	10	240	0.74	0.23	0.090	0.10	69	3.1	6.0	1.5	58	1.9	1.7	0.10	0.11	1.8	0.011	0.29	39
ABA397	L861523	CFR0134	105.16	105.187	Ore	Oxide	Gneiss	FG	0.14	0.29	238	0.90	10	480	0.53	0.17	0.030	0.060	38	1.1	7.0	0.83	2.7	0.90	0.87	0.070	0.10	0.35	*<0.005*	0.18	21
Statistical Summary						**Oxide**	**Gneiss**	**n**	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	0.20	1.1	1095	4.9	10	590	1.2	0.90	0.40	0.10	134	6.5	88	2.1	58	2.3	4.5	0.10	0.30	1.8	0.00	0.50	77
								90th PCTL	0.20	0.90	1093	4.1	10	546	1.1	0.70	0.30	0.10	108	6.4	84	2.0	43	2.1	3.4	0.10	0.20	1.6	0.00	0.40	62
								75th PCTL	0.20	0.50	1090	2.9	10	480	1.0	0.30	0.20	0.10	69	6.2	79	1.8	21	1.9	1.7	0.10	0.20	1.4	0.00	0.30	39
								Median	0.10	0.50	940	0.90	*<10*	240	0.90	0.20	0.20	0.10	54	4.7	12	1.7	5.6	1.6	1.4	0.10	0.20	0.60	*<0.02*	0.20	33
								25th PCTL	0.10	0.40	789	0.70	*<10*	223	0.70	0.20	0.10	0.10	53	3.1	7.0	1.5	2.7	1.5	1.2	*<0.1*	0.10	0.50	*<0.02*	0.20	32
								10th PCTL	0.10	0.30	458	0.50	*<10*	193	0.60	0.20	0.10	0.00	44	1.9	6.4	1.1	2.6	1.1	1.0	*<0.1*	0.10	0.40	*<0.02*	0.20	25
								Min	0.10	0.30	238	0.40	*<10*	173	0.50	0.10	0.00	0.00	38	1.1	6.0	0.80	2.5	0.90	0.90	*<0.1*	0.10	0.40	*<0.02*	0.20	21
Transition Facies for Gneiss Ore																															
Supremo 80%	72146	Head	composite		Ore	Transition	Gneiss		0.16	0.56	1700	-	*<10*	191	0.90	0.30	1.1	0.040	57	6.6	107	2.4	3.5	1.8	1.9	*<0.1*	0.17	1.2	*<0.02*	0.26	34
ABA002	KAM004886	CFD0034	73	74	Ore	Upper transition	Gneiss	FG	0.050	1.1	882	0.50	10	290	0.81	0.16	0.080	0.030	55	1.1	6.0	0.54	1.8	1.1	2.8	0.060	0.16	1.4	0.014	0.18	33
ABA375	R271389	CFD0417	109.3	109.775	Ore	Lower Transition	Gneiss	MxF	0.070	0.50	1185	0.90	10	80	0.97	0.060	0.87	0.030	78	2.2	5.0	1.6	2.5	1.6	1.9	0.10	0.25	0.61	0.011	0.24	47
ABA359	R623803	CFD0548	174	174.935	Ore	Upper Transition	Gneiss	MxF	0.10	0.37	1570	1.6	10	320	1.3	0.29	0.13	0.020	42	2.1	6.0	2.8	15	1.9	1.0	*<0.05*	0.18	0.73	*<0.005*	0.17	23
ABA403	R544048	CFD0553	120	121	Ore	Upper Transition	Gneiss	MxF	0.30	0.36	333	8.9	10	430	0.56	0.29	0.040	0.050	47	2.7	6.0	1.4	7.2	0.88	1.1	0.070	0.11	0.27	*<0.005*	0.21	28
Statistical Summary						**Transition**	**Gneiss**	**n**	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	0.30	1.1	1700	8.9	10	430	1.3	0.30	1.1	0.10	78	6.6	107	2.8	15	1.9	2.8	0.10	0.30	1.4	*<0.02*	0.30	47
								90th PCTL	0.20	0.90	1648	6.7	10	386	1.2	0.30	1.0	0.00	70	5.0	67	2.6	12	1.9	2.4	*<0.1*	0.20	1.3	*<0.02*	0.30	42
								75th PCTL	0.20	0.60	1570	3.4	10	320	1.0	0.30	0.90	0.00	57	2.7	6.0	2.4	7.2	1.8	1.9	*<0.1*	0.20	1.2	0.010	0.20	34
								Median	0.10	0.50	1185	1.3	10	290	0.90	0.30	0.10	0.00	55	2.2	6.0	1.6	3.5	1.6	1.9	0.070	0.20	0.70	0.011	0.20	33
								25th PCTL	0.10	0.40	882	0.80	10	191	0.80	0.20	0.10	0.00	47	2.1	6.0	1.4	2.5	1.1	1.1	0.060	0.20	0.60	*<0.005*	0.20	28
								10th PCTL	0.10	0.40	553	0.60	*<10*	124	0.70	0.10	0.10	0.00	44	1.5	5.4	0.90	2.1	1.0	1.0	*<0.05*	0.10	0.40	*<0.005*	0.20	25
								Min	0.10	0.40	333	0.50	*<10*	80	0.60	0.10	0.00	0.00	42	1.1	5.0	0.50	1.8	0.90	1.0	*<0.05*	0.10	0.30	*<0.005*	0.20	23
Statistical Summary for Gneiss Ore								**n**	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	10	10
								n < DL	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	4	0	0	6	0	0
								Max	0.30	1.1	1700	8.9	10	590	1.3	0.91	1.1	0.10	134	6.6	107	2.8	58	2.3	4.5	0.12	0.28	1.8	0.031	0.46	77
								90th PCTL	0.25	1.1	1583	6.5	10	491	1.2	0.36	0.90	0.073	84	6.5	90	2.4	24	1.9	2.9	0.10	0.25	1.4	0.022	0.31	50
								75th PCTL	0.21	0.55	1163	3.3	10	403	0.99	0.29	0.38	0.058	66	5.8	62	2.0	13	1.8	1.9	0.10	0.18	1.3	*<0.02*	0.26	38
								Median	0.13	0.48	1015	0.90	10	265	0.90	0.26	0.15	0.045	55	2.9	6.5	1.7	4.6	1.6	1.6	*<0.1*	0.17	0.67	0.014	0.21	33
								25th PCTL	0.10	0.38	812	0.70	*<10*	199	0.76	0.16	0.083	0.033	49	2.1	6.0	1.4	2.6	1.2	1.1	0.070	0.12	0.50	0.011	0.18	29
								10th PCTL	0.068	0.35	324	0.46	*<10*	164	0.56	0.13	0.039	0.029	41	1.1	5.9	0.80	2.4	0.90	1.00	0.059	0.11	0.34	*<0.005*	0.18	23
								Min	0.050	0.29	238	0.40	*<10*	80	0.53	0.060	0.030	0.020	38	1.1	5.0	0.54	1.8	0.88	0.87	0.050	0.10	0.27	*<0.005*	0.17	21
Oxide Facies for Schist Ore																															
ABA089	KAM133587	CFR0431	10.67	12.19	Ore	Oxide	Schist	BtS	0.080	0.83	1470	0.30	*<10*	450	0.93	1.3	0.42	0.060	66	16	25	1.6	14	3.4	2.6	0.080	0.060	0.41	0.018	0.25	32
DD oxide	72141	Head	composite		Ore	Oxide	Gneiss/schist		0.18	0.60	1430	-	*<10*	322	1.1	0.77	2.4	0.10	47	12	85	2.8	12	2.7	1.8	*<0.1*	0.11	0.45	0.030	0.24	26
Latte Oxide East	72136	Head	composite		Ore	Oxide	Schist		0.22	0.47	1100	-	*<10*	438	1.0	0.44	3.2	0.11	54	9.4	79	2.4	19	2.6	1.7	*<0.1*	0.13	0.49	0.020	0.23	30
Latte Oxide West	72135	Head	composite		Ore	Oxide	Schist		0.28	0.40	1430	-	*<10*	658	1.1	0.59	4.6	0.090	49	12	93	1.8	20	2.8	1.3	*<0.1*	0.12	0.46	0.020	0.19	27
ABA324	Q033726	CFD0411	36	37	Ore	Oxide	schist	BtS	0.27	0.90	5910	2.1	10	440	1.2	0.26	2.2	0.040	89	16	19	5.1	15	4.1	3.5	0.11	0.030	1.6	0.035	0.52	47
ABA328	KAM001234	CFD0008	52	53	Ore	Oxide	schist	BtS	0.59	0.38	2920	2.6	10	1270	0.67	0.23	3.2	0.080	67	15	14	1.9	14	3.3	1.2	0.080	0.080	0.45	0.021	0.24	34
Statistical Summary						**Oxide**	**Schist**	**n**	6	6	6	3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	0.60	0.90	5910	2.6	10	1270	1.2	1.3	4.6	0.11	89	16	93	5.1	20	4.1	3.5	0.11	0.13	1.6	0.035	0.52	47
								90th PCTL	0.40	0.87	4415	2.5	10	964	1.2	1.1	3.9	0.11	78	16	89	3.9	20	3.7	3.1	0.11	0.13	1.1	0.033	0.39	41
								75th PCTL	0.30	0.77	2558	2.4	10	606	1.1	0.73	3.2	0.098	66	15	84	2.7	18	3.4	2.4	*<0.1*	0.12	0.48	0.028	0.25	34
								Median	0.20	0.54	1450	2.1	*<10*	445	1.1	0.52	2.8	0.085	60	14	52	2.1	14	3.0	1.8	*<0.1*	0.095	0.46	0.021	0.24	31
								25th PCTL	0.20	0.42	1430	1.2	*<10*	439	0.95	0.31	2.2	0.065	51	12	21	1.8	14	2.7	1.4	*<0.1*	0.065	0.45	0.020	0.23	28
								10th PCTL	0.10	0.39	1265	0.66	*<10*	380	0.80	0.25	1.3	0.050	48	11	17	1.7	13	2.7	1.2	0.080	0.045	0.43	0.019	0.21	27
								Min	0.10	0.38	1100	0.30	*<10*	322	0.67	0.23	0.42	0.040	47	9.4	14	1.6	12	2.6	1.2	0.080	0.030	0.41	0.018	0.19	26
Transition Facies for Schist Ore																															
Latte 60%	72138	Head	composite		Ore	Transition	Schist		0.19	0.75	1090	-	*<10*	272	0.90	0.37	3.8	0.090	54	11	75	3.0	16	2.7	2.7	*<0.1*	0.12	0.33	0.020	0.30	30
Latte 80%'	72137	Head	composite		Ore	Transition	Schist		0.39	0.55	1340	-	*<10*	353	0.80	0.58	4.3	0.090	49	12	90	2.1	26	2.6	1.7	*<0.1*	0.090	0.60	0.020	0.24	27
ABA327	KAM001014	CFD0007	50.15	50.9	Ore	Lower Transition	schist	BtS	0.25	0.60	3150	1.0	10	140	0.46	0.16	3.0	0.070	42	12	12	0.77	13	2.9	1.7	0.060	0.030	0.20	0.017	0.41	21
ABA314	KAM147294	CFD0346	107	107.5	Ore	Upper Transition	Schist	BtS_carb	0.13	0.67	712	0.30	*<10*	30	1.2	0.74	4.9	0.080	30	14	30	1.0	21	2.7	2.5	0.050	0.11	0.17	0.032	0.16	15
ABA315	KAM147319	CFD0346	130.2	130.3	Ore	Upper Transition	Schist	BtS_carb	0.64	0.43	5130	4.0	10	50	0.84	0.24	2.8	0.070	54	8.8	7.0	3.9	10	2.6	1.4	0.070	0.26	0.50	0.027	0.23	27
Statistical Summary						**Transition**	**Schist**	**n**	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	0.60	0.75	5130	4.0	10	353	1.2	0.74	4.9	0.090	54	14	90	3.9	26	2.9	2.7	*<0.1*	0.26	0.60	0.032	0.41	30
								90th PCTL	0.50	0.72	4338	3.4	10	321	1.1	0.68	4.7	0.090	54	13	84	3.5	24	2.8	2.6	*<0.1*	0.20	0.56	0.030	0.37	29
								75th PCTL	0.40	0.67	3150	2.5	*<10*	272	0.90	0.58	4.3	0.090	54	12	75	3.0	21	2.7	2.5	*<0.1*	0.12	0.50	0.027	0.30	27
								Median	0.30	0.60	1340	1.0	*<10*	140	0.84	0.37	3.8	0.080	49	12	30	2.1	16	2.7	1.7	0.070	0.11	0.33	0.020	0.24	27
								25th PCTL	0.20	0.55	1090	0.65	*<10*	50	0.80	0.24	3.0	0.070	42	11	12	1.0	13	2.6	1.7	0.060	0.090	0.20	0.020	0.23	21
								10th PCTL	0.20	0.48	863	0.44	*<10*	38	0.60	0.19	2.9	0.070	35	9.5	9.0	0.88	11	2.6	1.5	0.054	0.054	0.18	0.018	0.19	17
								Min	0.10	0.43	712	0.30	*<10*	30	0.46	0.16	2.8	0.070	30	8.8	7.0	0.77	10	2.6	1.4	0.050	0.030	0.17	0.017	0.16	15
Statistical Summary for Schist Ore								**n**	11	11	11	6	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
								n < DL	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0
								Max	0.64	0.90	5910	4.0	10	1270	1.2	1.3	4.9	0.11	89	16	93	5.1	26	4.1	3.5	0.11	0.26	1.6	0.035	0.52	47
								90th PCTL	0.59	0.83	5130	3.3	10	658	1.2	0.77	4.6	0.10	67	16	90	3.9	21	3.4	2.7	*<0.1*	0.13	0.60	0.032	0.41	34
								75th PCTL	0.34	0.71	3035	2.5	10	445	1.1	0.67	4.0	0.090	60	14	82	2.9	20	3.1	2.6	*<0.1*	0.12	0.50	0.029	0.28	31
								Median	0.25	0.60	1430	1.6	*<10*	353	0.93	0.44	3.2	0.080	54	12	30	2.1	15	2.7	1.7	*<0.1*	0.11	0.45	0.020	0.24	27
								25th PCTL	0.19	0.45	1220	0.48	*<10*	206	0.82	0.25	2.6	0.070	48	11	17	1.7	14	2.6	1.5	0.075	0.070	0.37	0.020	0.23	27
								10th PCTL	0.13	0.40	1090	0.30	*<10*	50	0.67	0.23	2.2	0.060	42	9.4	12	1.0	12	2.6	1.3	0.060	0.030	0.20	0.018	0.19	21
								Min	0.080	0.38	712	0.30	*<10*	30	0.46	0.16	0.42	0.040	30	8.8	7.0	0.77	10	2.6	1.2	0.050	0.030	0.17	0.017	0.16	15

Appendix C.2-3: Solid Phase Element Results by Aqua Regia Digestion for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La
									ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm
Oxide Facies for Granite Ore																															
ABA156	R305806	CFD0382	59	60	Ore	Oxide	Granite	GG	0.12	0.46	3330	1.3	*<10*	40	0.24	0.16	0.050	0.020	31	0.50	5.0	1.2	1.8	0.82	1.3	0.10	0.22	0.34	0.010	0.19	18
ABA171	R305823	CFD0396	13	14	Ore	Oxide	Granite	GG	0.10	0.49	803	0.70	*<10*	90	0.51	0.19	0.060	0.060	38	1.1	4.0	1.3	2.6	1.3	1.4	0.10	0.24	8.5	0.0090	0.14	20
Kona Oxide	72139	Head	composite		Ore	Oxide	Granite		0.080	0.41	3080	-	*<10*	64	0.50	0.080	0.050	0.060	26	1.2	77	1.5	0.80	1.3	1.4	*<0.1*	0.32	0.83	*<0.02*	0.13	15
ABA419	I308596	CFD0053	7	8	Ore	Oxide	Granite	GG	0.12	0.44	7940	4.8	10	30	0.29	0.090	0.030	0.010	29	0.20	3.0	1.4	1.0	1.1	1.2	0.070	0.21	0.17	*<0.005*	0.23	17
ABA420	I354541	CFD0053	47	47.24	Ore	Oxide	Granite	GG	0.090	0.54	1070	0.90	10	70	0.71	0.090	0.060	0.090	41	6.8	2.0	1.1	2.1	1.6	1.5	0.080	0.17	1.1	0.0070	0.17	23
ABA422	I354552	CFD0053	57.8	58	Ore	Oxide	Granite	GG	0.080	0.54	714	0.90	10	80	0.67	0.070	0.070	0.040	33	5.5	2.0	1.5	1.8	1.0	1.6	0.080	0.15	1.4	0.0050	0.18	18
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	0.10	0.50	7940	4.8	*<10*	90	0.70	0.20	0.10	0.10	41	6.8	77	1.5	2.6	1.6	1.6	0.10	0.30	8.5	*<0.02*	0.20	23
								90th PCTL	0.10	0.50	5635	3.4	*<10*	85	0.70	0.20	0.10	0.10	40	6.2	41	1.5	2.4	1.5	1.6	0.10	0.30	5.0	*<0.02*	0.20	22
								75th PCTL	0.10	0.50	3268	1.3	*<10*	78	0.60	0.10	0.10	0.10	37	4.4	4.8	1.5	2.0	1.3	1.5	*<0.1*	0.20	1.3	0.010	0.20	20
								Median	0.10	0.50	2075	0.90	*<10*	67	0.50	0.10	0.10	0.10	32	1.2	3.5	1.4	1.8	1.2	1.4	0.090	0.20	1.0	0.010	0.20	18
								25th PCTL	0.10	0.40	870	0.90	*<10*	46	0.30	0.10	0.10	0.00	30	0.70	2.3	1.2	1.2	1.0	1.3	0.080	0.20	0.50	0.010	0.10	17
								10th PCTL	0.10	0.40	759	0.80	*<10*	35	0.30	0.10	0.00	0.00	28	0.40	2.0	1.1	0.90	0.90	1.2	0.080	0.20	0.30	*<0.005*	0.10	16
								Min	0.10	0.40	714	0.70	*<10*	30	0.20	0.10	0.00	0.00	26	0.20	2.0	1.1	0.80	0.80	1.2	0.070	0.20	0.20	*<0.005*	0.10	15
Transition Facies for Granite Ore																															
Kona 80% CN	72140	Head	composite		Ore	Transition	Granite		0.090	0.34	5770	-	*<10*	44	0.40	0.10	0.050	0.040	24	1.9	76	1.4	3.8	1.5	1.2	*<0.1*	0.27	4.0	*<0.02*	0.12	14
ABA161	R305812	CFD0383	84	85	Ore	Upper transition	Granite	GG	0.060	0.57	2040	4.8	*<10*	20	0.50	0.050	0.020	0.15	31	1.2	4.0	1.4	3.5	3.9	1.4	0.11	0.18	0.29	0.0080	0.22	17
ABA432	Q041581	CFD0383	83.47	84	Ore	Upper Transition	Granite	GG	0.080	0.87	5690	4.6	*<10*	50	0.63	0.060	0.020	0.31	31	2.0	5.0	2.4	5.1	5.9	2.6	0.090	0.21	1.6	0.020	0.30	16
ABA428	Q041388	CFD0382	97	98	Ore	Lower Transition	Granite	GG	0.030	0.94	603	0.50	10	90	0.45	0.080	0.040	0.020	38	0.30	3.0	0.78	0.70	0.62	2.4	0.070	0.21	0.28	0.011	0.13	20
ABA444	Q032413	CFD0385	83	83.75	Ore	Lower Transition	Granite	GG	0.060	0.46	2350	1.8	10	70	0.37	0.040	0.030	0.010	49	0.80	5.0	1.7	1.5	1.0	1.5	0.090	0.19	0.42	0.0070	0.18	28
ABA445	Q032988	CFD0399	8.85	9	Ore	Lower Transition	Granite	GG	0.10	0.87	740	0.80	*<10*	90	0.76	0.090	0.040	0.050	34	1.1	7.0	0.67	3.6	1.4	2.5	0.080	0.29	0.16	0.012	0.15	19
ABA446	Q033347	CFD0403	32	33	Ore	Lower Transition	Granite	GG	0.090	0.67	*>10000*	3.5	10	40	0.20	0.080	0.010	0.020	43	11	6.0	1.3	17	1.1	2.9	0.080	0.31	0.91	0.013	0.18	25
ABA433	Q041589	CFD0383	91.9	92	Ore	Upper Transition	Granite	GG	0.040	0.93	1470	0.90	10	80	1.0	0.050	0.050	0.030	49	1.3	3.0	1.4	2.9	2.4	2.6	0.090	0.18	0.32	0.011	0.19	27
Statistical Summary						**Transition**	**Granite**	**n**	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
								Max	0.10	0.94	10000	4.8	10	90	1.0	0.10	0.050	0.31	49	11	76	2.4	17	5.9	2.9	0.11	0.31	4.0	0.020	0.30	28
								90th PCTL	0.10	0.93	7039	4.7	10	90	0.83	0.093	0.050	0.20	49	4.6	28	1.9	8.7	4.5	2.7	0.10	0.30	2.3	*<0.02*	0.24	27
								75th PCTL	0.10	0.89	5710	4.1	10	83	0.66	0.083	0.043	0.075	45	1.9	6.3	1.5	4.1	2.8	2.6	0.093	0.28	1.1	0.015	0.20	25
								Median	0.10	0.77	2195	1.8	*<10*	60	0.48	0.070	0.035	0.035	36	1.3	5.0	1.4	3.6	1.4	2.4	0.090	0.21	0.37	0.012	0.18	20
								25th PCTL	0.10	0.54	1288	0.85	*<10*	43	0.39	0.050	0.020	0.020	31	1.0	3.8	1.1	2.6	1.1	1.4	0.080	0.19	0.29	0.010	0.15	17
								10th PCTL	0.00	0.42	699	0.68	*<10*	34	0.32	0.047	0.017	0.017	29	0.70	3.0	0.75	1.3	0.91	1.3	0.077	0.18	0.24	0.0077	0.13	15
								Min	0.00	0.34	603	0.50	*<10*	20	0.20	0.040	0.010	0.010	24	0.30	3.0	0.67	0.70	0.62	1.2	0.070	0.18	0.16	0.0070	0.12	14
Statistical Summary for Granite Ore								**n**	14	14	14	12	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								n < DL	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3	0	0
								Max	0.12	0.94	10000	4.8	10	90	1.0	0.19	0.070	0.31	49	11	77	2.4	17	5.9	2.9	0.11	0.32	8.5	0.020	0.30	28
								90th PCTL	0.11	0.91	7289	4.8	10	90	0.75	0.14	0.060	0.13	47	6.4	55	1.6	4.7	3.4	2.6	0.10	0.30	3.2	0.020	0.23	26
								75th PCTL	0.098	0.82	5100	3.8	10	80	0.66	0.090	0.050	0.060	41	2.0	5.8	1.5	3.6	1.6	2.5	0.10	0.26	1.3	0.013	0.19	22
								Median	0.085	0.54	2195	1.1	*<10*	67	0.50	0.080	0.045	0.040	34	1.2	4.5	1.4	2.4	1.3	1.5	0.090	0.21	0.63	0.011	0.18	19
								25th PCTL	0.065	0.46	870	0.88	*<10*	41	0.38	0.063	0.030	0.020	31	0.88	3.0	1.2	1.6	1.0	1.4	0.080	0.18	0.30	0.0073	0.14	17
								10th PCTL	0.046	0.42	722	0.71	*<10*	33	0.26	0.050	0.020	0.013	27	0.36	2.3	0.88	0.86	0.87	1.2	0.073	0.17	0.20	0.0056	0.13	15
								Min	0.030	0.34	603	0.50	*<10*	20	0.20	0.040	0.010	0.010	24	0.20	2.0	0.67	0.70	0.62	1.2	0.070	0.15	0.16	*<0.005*	0.12	14
Oxide and Transition Facies for Other Lithologies Ore																															
ABA126	KAM149885	CFR0566	67.06	68.58	Ore	Oxide	Dykes	IV	0.19	0.58	1595	0.30	*<10*	350	2.3	0.14	0.82	0.060	16	124	512	2.6	6.9	6.0	3.7	0.060	0.020	1.4	0.010	0.050	8.2
ABA334	R550421	CFD0518	10	11	Ore	Upper Transition	HU	HU	0.95	0.44	2620	11	10	380	1.6	0.33	0.23	0.51	72	51	205	0.46	13	5.2	1.9	0.080	0.12	1.5	0.044	0.21	39
ABA175	R305827	CFD0403	70	71	Ore	Lower transition	Dykes	DIOR	0.090	0.58	*>10000*	1.1	*<10*	70	0.29	0.060	0.010	0.020	18	7.2	4.0	1.2	4.8	1.5	1.9	0.080	0.17	3.6	0.026	0.26	10

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in the statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.2-3: Solid Phase Element Results by Aqua Regia Digestion for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Oxide Facies for Gneiss Ore																																				
ABA100	KAM137583	CFR0470	39.62	41.15	Ore	Oxide	Gneiss	MxM	5.1	0.29	435	1.6	0.010	0.12	6.4	440	22	35	<0.001	0.020	48	3.6	0.90	0.80	26	<0.01	0.15	32	0.019	0.51	11	15	1.1	25	41	11
Supremo Oxide T1	72144	Head	composite		Ore	Oxide	Gneiss		<1	0.070	333	2.0	0.010	<0.05	23	300	12	11	-	0.010	46	3.4	<1	0.40	26	<0.05	<0.05	24	<0.01	0.46	13	17	0.60	11	25	6.3
Supremo Oxide T4	72145	Head	composite		Ore	Oxide	Gneiss		1.0	0.13	267	2.1	0.010	<0.05	11	210	15	14	-	0.010	34	2.3	<1	0.70	23	<0.05	<0.05	26	<0.01	0.90	14	12	0.30	11	26	5.1
ABA394	KAM030261	CFR0110	81.08	82.6	Ore	Oxide	Gneiss	MxF	0.60	0.020	213	1.5	0.010	<0.05	2.4	240	29	10	<0.001	0.10	9.3	1.6	0.40	0.50	92	<0.01	0.11	27	<0.005	0.50	20	8.0	0.92	7.1	9.0	4.8
ABA397	L861523	CFR0134	105.16	105.187	Ore	Oxide	Gneiss	FG	0.40	0.010	144	1.8	0.010	0.080	2.5	70	52	10	<0.001	<0.01	19	0.30	0.30	0.50	21	<0.01	0.030	35	<0.005	0.43	19	2.0	0.80	6.0	11	3.3
Statistical Summary						**Oxide**	**Gneiss**	**n**	5	5	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	5.1	0.30	435	2.1	0.010	0.12	23	440	52	35	<0.001	0.10	48	3.6	<1	0.80	92	<0.05	0.20	35	0.019	0.90	20	17	1.1	25	41	11
								90th PCTL	3.5	0.20	394	2.1	0.010	0.10	18	384	43	26	<0.001	0.10	47	3.5	<1	0.80	66	<0.05	0.10	34	<0.01	0.70	19	16	1.0	19	35	9.0
								75th PCTL	1.0	0.10	333	2.0	0.010	0.080	11	300	29	14	<0.001	0.00	46	3.4	<1	0.70	26	<0.05	0.10	32	<0.01	0.50	19	15	0.90	11	26	6.3
								Median	1.0	0.10	267	1.8	0.010	<0.05	6.4	240	22	11	<0.001	0.00	34	2.3	0.90	0.50	26	<0.01	0.10	27	<0.01	0.50	14	12	0.80	11	25	5.1
								25th PCTL	0.60	0.00	213	1.6	0.010	<0.05	2.5	210	15	10	<0.001	0.00	19	1.6	0.40	0.50	23	<0.01	0.10	26	<0.005	0.50	13	8.0	0.60	7.1	11	4.8
								10th PCTL	0.50	0.00	172	1.5	0.010	<0.05	2.4	126	13	10	<0.001	<0.01	13	0.80	0.30	0.40	22	<0.01	<0.05	25	<0.005	0.40	12	4.4	0.40	6.4	9.8	3.9
								Min	0.40	0.00	144	1.5	0.010	<0.05	2.4	70	12	10	<0.001	<0.01	9.3	0.30	0.30	0.40	21	<0.01	<0.05	24	<0.005	0.40	11	2.0	0.30	6.0	9.0	3.3
Transition Facies for Gneiss Ore																																				
Supremo 80%	72146	Head	composite		Ore	Transition	Gneiss		2.0	0.42	396	3.1	0.010	0.070	12	300	14	17	-	0.12	20	2.8	<1	0.30	49	<0.05	0.060	25	<0.01	1.2	11	14	0.20	11	27	6.1
ABA002	KAM004886	CFD0034	73	74	Ore	Upper transition	Gneiss	FG	3.8	0.030	186	0.84	0.010	0.050	1.7	160	10	11	<0.001	<0.01	50	0.80	0.40	1.7	19	<0.01	0.010	35	<0.005	0.78	19	4.0	0.29	10	10	6.8
ABA375	R271389	CFD0417	109.3	109.775	Ore	Lower Transition	Gneiss	MxF	1.7	0.090	387	2.0	0.010	0.060	1.2	110	18	16	<0.001	<0.01	11	0.90	0.40	0.50	29	<0.01	0.010	37	<0.005	0.28	16	2.0	0.42	15	24	9.4
ABA359	R623803	CFD0548	174	174.935	Ore	Upper Transition	Gneiss	MxF	0.50	0.030	112	0.55	<0.01	<0.05	5.0	70	25	9.1	<0.001	<0.01	161	0.70	0.40	0.30	14	<0.01	0.070	36	<0.005	1.1	5.7	3.0	0.32	9.6	12	5.6
ABA403	R544048	CFD0553	120	121	Ore	Upper Transition	Gneiss	MxF	0.30	0.020	1490	1.6	0.010	<0.05	2.9	80	23	11	<0.001	<0.01	108	0.30	0.20	0.50	8.3	<0.01	0.090	32	<0.005	1.1	11	3.0	2.0	6.8	15	4.0
Statistical Summary						**Transition**	**Gneiss**	**n**	5	5	5	5	5	5	5	5	5	5	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	3.8	0.40	1490	3.1	0.010	0.070	12	300	25	17	<0.001	0.12	161	2.8	<1	1.7	49	<0.05	0.10	37	<0.01	1.2	19	14	2.0	15	27	9.4
								90th PCTL	3.1	0.30	1052	2.7	0.010	0.066	9.4	244	24	17	<0.001	<0.01	139	2.0	0.80	1.2	41	<0.05	0.10	36	<0.01	1.2	18	10	1.4	13	26	8.4
								75th PCTL	2.0	0.10	396	2.0	0.010	0.060	5.0	160	23	16	<0.001	<0.01	108	0.90	0.40	0.50	29	<0.01	0.10	36	<0.005	1.1	16	4.0	0.40	11	24	6.8
								Median	1.7	0.00	387	1.6	0.010	0.050	2.9	110	18	11	<0.001	<0.01	50	0.80	0.40	0.50	19	<0.01	0.10	35	<0.005	1.1	11	3.0	0.30	10	15	6.1
								25th PCTL	0.50	0.00	186	0.80	0.010	<0.05	1.7	80	14	11	<0.001	<0.01	20	0.70	0.40	0.30	14	<0.01	0.00	32	<0.005	0.80	11	3.0	0.30	9.6	12	5.6
								10th PCTL	0.40	0.00	142	0.70	<0.01	<0.05	1.4	74	12	9.7	<0.001	<0.01	14	0.50	0.30	0.30	11	<0.01	0.00	27	<0.005	0.50	7.8	2.4	0.20	7.9	11	4.6
								Min	0.30	0.00	112	0.60	<0.01	<0.05	1.2	70	10	9.1	<0.001	<0.01	11	0.30	0.20	0.30	8.3	<0.01	0.00	25	<0.005	0.30	5.7	2.0	0.20	6.8	10	4.0
Statistical Summary for Gneiss Ore								**n**	10	10	10	10	10	10	10	10	10	10	7	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
								n < DL	1	0	0	0	1	5	0	0	0	0	7	5	0	0	3	0	0	10	2	0	9	0	0	0	0	0	0	0
								Max	5.1	0.42	1490	3.1	0.010	0.12	23	440	52	35	<0.001	0.12	161	3.6	<1	1.7	92	<0.05	0.15	37	0.019	1.2	20	17	2.0	25	41	11
								90th PCTL	3.9	0.30	541	2.2	0.010	0.084	13	314	31	19	<0.001	0.10	113	3.4	<1	0.89	53	<0.05	0.11	36	0.011	1.1	19	15	1.2	16	28	9.5
								75th PCTL	1.9	0.12	394	2.0	0.010	0.068	9.9	285	25	15	<0.001	0.018	50	2.7	0.98	0.65	28	<0.05	0.085	35	<0.01	1.1	18	14	0.89	11	26	6.7
								Median	1.0	0.050	300	1.7	0.010	0.050	4.0	185	20	11	<0.001	0.010	40	1.3	0.40	0.50	24	<0.01	0.055	32	<0.005	0.65	13	6.0	0.51	11	20	5.9
								25th PCTL	0.53	0.023	193	1.5	0.010	<0.05	2.4	88	14	10	<0.001	0.010	19	0.73	0.40	0.43	20	<0.01	0.035	26	<0.005	0.47	11	3.0	0.31	7.7	11	4.9
								10th PCTL	0.39	0.019	141	0.81	0.010	<0.05	1.7	70	12	10	<0.001	0.010	11	0.30	0.29	0.30	13	<0.01	0.010	24	<0.005	0.42	10	2.0	0.28	6.7	9.9	3.9
								Min	0.30	0.010	112	0.55	<0.01	<0.05	1.2	70	10	9.1	<0.001	0.010	9.3	0.30	0.20	0.30	8.3	<0.01	0.010	24	<0.005	0.28	5.7	2.0	0.20	6.0	9.0	3.3
Oxide Facies for Schist Ore																																				
ABA089	KAM133587	CFR0431	10.67	12.19	Ore	Oxide	Schist	BtS	2.9	0.12	844	0.62	<0.01	<0.05	34	530	12	11	<0.001	0.010	15	5.2	0.80	0.30	22	<0.01	0.040	13	<0.005	0.61	2.8	34	0.80	18	43	2.3
DD oxide	72141	Head	composite		Ore	Oxide	Gneiss/schist		2.0	0.59	551	1.4	0.010	<0.05	30	320	16	14	-	0.11	41	5.9	<1	0.40	57	<0.05	0.13	13	<0.01	0.30	5.2	22	1.0	10	41	3.6
Latte Oxide East	72136	Head	composite		Ore	Oxide	Schist		1.0	0.54	467	1.4	0.010	<0.05	38	420	16	13	-	0.080	22	4.8	<1	<0.3	130	<0.05	<0.05	13	<0.01	0.33	3.0	19	0.90	14	52	4.6
Latte Oxide West	72135	Head	composite		Ore	Oxide	Schist		<1	0.92	622	1.5	0.010	<0.05	66	430	17	11	-	0.20	19	4.8	<1	0.40	139	<0.05	0.060	11	<0.01	0.33	2.6	17	0.50	14	57	4.1
ABA324	Q033726	CFD0411	36	37	Ore	Oxide	schist	BtS	1.6	0.58	616	1.0	0.010	<0.05	23	620	15	30	<0.001	0.43	15	4.9	0.90	0.90	93	<0.01	0.020	16	0.0070	1.5	6.0	14	0.46	16	43	1.8
ABA328	KAM001234	CFD0008	52	53	Ore	Oxide	schist	BtS	0.40	0.48	718	0.91	<0.01	<0.05	27	410	20	10	<0.001	0.030	6.0	4.3	0.60	0.30	150	<0.01	0.080	17	<0.005	0.42	2.4	6.0	0.33	13	53	3.4
Statistical Summary						**Oxide**	**Schist**	**n**	6	6	6	6	6	6	6	6	6	6	3	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	2.9	0.92	844	1.5	0.010	<0.05	66	620	20	30	<0.001	0.43	41	5.9	<1	0.90	150	<0.05	0.13	17	<0.01	1.5	6.0	34	1.0	18	57	4.6
								90th PCTL	2.5	0.76	781	1.5	0.010	<0.05	52	575	19	22	<0.001	0.32	31	5.6	<1	0.65	145	<0.05	0.11	16	<0.01	1.1	5.6	28	0.95	17	55	4.4
								75th PCTL	1.9	0.59	694	1.4	0.010	<0.05	37	505	17	14	<0.001	0.18	21	5.1	<1	0.40	137	<0.05	0.075	15	<0.01	0.56	4.6	21	0.88	16	53	4.0
								Median	1.3	0.56	619	1.2	0.010	<0.05	32	425	16	12	<0.001	0.095	17	4.9	0.95	0.35	111	<0.01	0.055	13	0.0085	0.38	2.9	18	0.65	14	48	3.5
								25th PCTL	<1	0.50	567	0.94	<0.01	<0.05	28	413	15	11	<0.001	0.043	15	4.8	0.83	0.30	66	<0.01	0.043	13	<0.005	0.33	2.6	15	0.47	13	43	2.6
								10th PCTL	0.70	0.30	509	0.77	<0.01	<0.05	25	365	14	10	<0.001	0.020	10	4.6	0.70	0.30	40	<0.01	0.030	12	<0.005	0.32	2.5	10	0.40	12	42	2.1
								Min	0.40	0.12	467	0.62	<0.01	<0.05	23	320	12	10	<0.001	0.010	6.0	4.3	0.60	0.30	22	<0.01	0.020	11	<0.005	0.30	2.4	6.0	0.33	10	41	1.8
Transition Facies for Schist Ore																																				
Latte 60%	72138	Head	composite		Ore	Transition	Schist		3.0	1.1	506	2.3	0.020	0.070	32	450	14	18	-	0.53	49	5.4	<1	0.50	165	<0.05	<0.05	13	0.010	0.40	2.6	26	0.30	15	49	4.0
Latte 80%'	72137	Head	composite		Ore	Transition	Schist		2.0	1.4	497	3.3	0.010	<0.05	56	410	20	13	-	0.55	22	4.9	<1	0.40	164	<0.05	0.070	11	<0.01	0.73	2.6	19	0.20	13	46	2.8
ABA327	KAM001014	CFD0007	50.15	50.9	Ore	Lower Transition	schist	BtS	0.60	1.2	705	0.84	0.020	<0.05	29	380	6.8	18	0.0010	1.9	24	2.5	0.50	0.30	402	<0.01	0.060	11	<0.005	0.22	1.8	7.0	0.20	9.9	49	2.6
ABA314	KAM147294	CFD0346	107	107.5	Ore	Upper Transition	Schist	BtS_carb	4.1	1.6	469	0.69	0.020	0.050	34	270	29	9.6	0.0010	0.58	7.3	7.1	0.70	0.70	199	<0.01	0.050	9.4	<0.005	0.23	3.5	30	0.35	14	48	4.7
ABA315	KAM147319	CFD0346	130.2	130.3	Ore	Upper Transition	Schist	BtS_carb	0.30	1.2	567	1.1	0.010	<0.05	12	320	14	10	<0.001	2.1	8.7	3.6	0.50	0.30	209	<0.01	0.10	20	<0.005	0.64	3.2	6.0	0.46	14	43	11
Statistical Summary						**Transition**	**Schist**	**n**	5	5	5	5	5	5	5	5	5	5	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
								Max	4.1	1.6	705	3.3	0.020	0.070	56	450	29	18	0.0010	2.1	49	7.1	<1	0.70	402	<0.05	0.10	20	0.010	0.73	3.5	30	0.46	15	49	11
								90th PCTL	3.7	1.5	650	2.9	0.020	0.062	47	434	25	18	0.0010	2.0	39	6.4	<1	0.62	325	<0.05	0.088	17	<0.01	0.69	3.4	28	0.42	14	49	8.7
								75th PCTL	3.0	1.4	567	2.3	0.020	0.050	34	410	20	18	0.0010	1.9	24	5.4	<1	0.50	209	<0.05	0.070	13	<0.01	0.64	3.2	26	0.35	14	49	4.7
								Median	2.0	1.2	506	1.1	0.020	<0.05	32	380	14	13	0.0010	0.58	22	4.9	0.70	0.40	199	<0.01	0.060	11	<0.005	0.40	2.6	19	0.30	14	48	4.0
								25th PCTL	0.60	1.2	497	0.84	0.010	<0.05	29	320	14	10	<0.001	0.55	8.7	3.6	0.50	0.30	165	<0.01	0.050	11	<0.005	0.23	2.6	7.0	0.20	13	46	2.8
								10th PCTL	0.42	1.1	480	0.75	0.010	<0.05	19	290	9.7	9.9	<0.001	0.54	7.8	2.9	0.50	0.30	164	<0.01	0.050	9.9	<0.005	0.22	2.1	6.4	0.20	11	44	2.7
								Min	0.30	1.1	469	0.69	0.010	<0.05	12	270	6.8	9.6	<0.001	0.53	7.3	2.5	0.50	0.30	164	<0.01	0.050	9.4	<0.005	0.22	1.8	6.0	0.20	9.9	43	2.6
Statistical Summary for Schist Ore								**n**	11	11	11	11	11	11	11	11	11	11	6	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
								n < DL	1	0	0	0	2	9	0	0	0	0	4	0	0	0	5	1	0	11	2	0	9	0	0	0	0	0	0	0
								Max	4.1	1.6	844	3.3	0.020	0.070	66	620	29	30	0.0010	2.1	49	7.1	<1	0.90	402	<0.05	0.13	20	0.010	1.5	6.0	34	1.0	18	57	11
								90th PCTL	3.0	1.4	718	2.3	0.020	0.050	56	530	20	18	0.0010	1.9	41	5.9	<1	0.70	209	<0.05	0.10	17	<0.01	0.73	5.2	30	0.90	16	53	4.7
								75th PCTL	2.5	1.2	664	1.5	0.015	<0.05	36	440	18	16	<0.001	0.57	23	5.3	<1	0.45	182	<0.05	0.075	15	<0.01	0.63	3.4	24	0.65	14	51	4.4
								Median	1.6	0.92	567	1.1	0.010	<0.05	32	410	16	13	<0.001	0.43	19	4.9	0.90	0.40	150	<0.01	0.060	13	0.0070	0.40	2.8	19	0.46	14	48	3.6
								25th PCTL	0.80	0.56	502	0.88	0.010	<0.05	28	350	14	10	<0.001	0.095	12	4.6	0.65	0.30	111	<0.01	<0.05	11	<0.005	0.32	2.6	11	0.32	13	43	2.7
								10th PCTL	0.40	0.48	469	0.69	<0.01	<0.05	23	320	12	10	<0.001	0.030	7.3	3.6	0.50	0.30	57	<0.01	0.040	11	<0.005	0.23	2.4	6.0	0.20	10	43	2.3
								Min	0.30	0.12	467	0.62	<0.01	<0.05	12	270	6.8	9.6	<0.001	0.010	6.0	2.5	0.50	0.30	22	<0.01	0.020	9.4	<0.005	0.22	1.8	6.0	0.20	9.9	41	1.8

Appendix C.2-3: Solid Phase Element Results by Aqua Regia Digestion for Ore

ABA ID	Assay ID	Hole ID	From (m)	To (m)	Type	OxidationFacies	Lithology	Lith Code	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
									ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Oxide Facies for Granite Ore																																				
ABA156	R305806	CFD0382	59	60	Ore	Oxide	Granite	GG	1.0	0.010	20	1.2	*<0.01*	0.21	0.60	50	21	9.4	*<0.001*	0.010	26	0.40	*<0.2*	0.20	23	*<0.01*	0.010	26	*<0.005*	0.61	6.4	2.0	9.4	2.8	4.0	6.1
ABA171	R305823	CFD0396	13	14	Ore	Oxide	Granite	GG	0.90	0.010	404	1.3	*<0.01*	0.24	0.90	130	24	7.5	*<0.001*	*<0.01*	38	0.70	0.40	0.30	19	*<0.01*	0.020	26	*<0.005*	2.7	20	2.0	0.40	10	24	6.7
Kona Oxide	72139	Head	composite		Ore	Oxide	Granite		*<1*	0.020	114	1.9	*<0.01*	0.41	1.9	130	15	11	-	0.020	37	2.5	*<1*	*<0.3*	18	*<0.01*	*<0.05*	18	*<0.01*	0.56	9.6	10	0.20	7.2	18	12
ABA419	I308596	CFD0053	7	8	Ore	Oxide	Granite	GG	0.50	0.010	31	0.52	0.010	0.10	0.30	90	11	14	*<0.001*	0.010	24	0.90	*<0.2*	*<0.2*	15	*<0.01*	0.010	26	*<0.005*	0.69	1.8	6.0	0.14	1.5	3.0	7.1
ABA420	I354541	CFD0053	47	47.24	Ore	Oxide	Granite	GG	2.1	0.010	1740	0.90	0.010	0.17	3.7	160	42	8.8	*<0.001*	*<0.01*	9.0	1.2	0.50	0.20	50	*<0.01*	*<0.01*	28	*<0.005*	2.3	52	2.0	0.090	15	42	5.3
ABA422	I354552	CFD0053	57.8	58	Ore	Oxide	Granite	GG	1.2	0.020	1600	1.0	0.010	0.25	2.1	110	14	10	*<0.001*	*<0.01*	6.8	1.0	0.50	0.20	61	*<0.01*	0.020	19	*<0.005*	1.2	18	2.0	0.12	15	32	4.8
Statistical Summary						**Oxide**	**Granite**	**n**	6	6	6	6	6	6	6	6	6	6	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
								Max	2.1	0.00	1740	1.9	0.010	0.40	3.7	160	42	14	*<0.001*	0.020	38	2.5	*<1*	0.30	61	*<0.01*	*<0.05*	28	*<0.005*	2.7	52	10	9.4	15	42	12
								90th PCTL	1.7	0.00	1670	1.6	0.010	0.30	2.9	145	33	13	*<0.001*	0.020	38	1.9	0.80	0.30	56	*<0.01*	0.040	27	*<0.005*	2.5	36	8.0	4.9	15	37	9.4
								75th PCTL	1.2	0.00	1301	1.3	0.010	0.20	2.1	130	23	11	*<0.001*	0.010	35	1.2	0.50	*<0.3*	43	*<0.01*	0.020	26	*<0.005*	2.0	19	5.0	0.40	14	30	7.0
								Median	*<1*	0.00	259	1.1	*<0.01*	0.20	1.4	120	18	9.7	*<0.001*	*<0.01*	25	1.0	0.50	0.20	21	*<0.01*	0.020	26	*<0.005*	0.90	14	2.0	0.20	8.8	21	6.4
								25th PCTL	0.90	0.00	52	0.90	*<0.01*	0.20	0.70	95	14	9.0	*<0.001*	*<0.01*	13	0.80	0.30	0.20	18	*<0.01*	0.010	21	*<0.005*	0.60	7.2	2.0	0.10	3.9	7.5	5.5
								10th PCTL	0.70	0.00	26	0.70	*<0.01*	0.10	0.50	70	13	8.2	*<0.001*	*<0.01*	7.9	0.60	*<0.2*	*<0.2*	16	*<0.01*	0.010	19	*<0.005*	0.60	4.1	2.0	0.10	2.2	3.5	5.1
								Min	0.50	0.00	20	0.50	*<0.01*	0.10	0.30	50	11	7.5	*<0.001*	*<0.01*	6.8	0.40	*<0.2*	*<0.2*	15	*<0.01*	*<0.01*	18	*<0.005*	0.60	1.8	2.0	0.10	1.5	3.0	4.8
Transition Facies for Granite Ore																																				
Kona 80% CN	72140	Head	composite		Ore	Transition	Granite		*<1*	0.010	217	2.3	*<0.01*	0.34	2.3	140	16	8.8	-	0.14	128	2.3	*<1*	0.30	21	*<0.05*	*<0.05*	17	*<0.01*	1.2	9.7	8.0	0.10	6.3	19	11
ABA161	R305812	CFD0383	84	85	Ore	Upper transition	Granite	GG	0.50	0.010	54	1.7	*<0.01*	0.21	1.6	280	16	11	*<0.001*	*<0.01*	26	0.60	0.30	0.30	6.7	*<0.01*	0.030	26	*<0.005*	0.70	33	7.0	0.35	5.9	17	4.3
ABA432	Q041581	CFD0383	83.47	84	Ore	Upper Transition	Granite	GG	0.70	0.020	69	4.2	*<0.01*	0.21	2.6	460	24	18	*<0.001*	0.020	146	1.6	0.50	0.60	22	*<0.01*	0.050	13	*<0.005*	1.1	53	12	0.20	7.3	20	9.7
ABA428	Q041388	CFD0382	97	98	Ore	Lower Transition	Granite	GG	3.9	0.010	54	0.90	*<0.01*	0.080	0.80	70	26	7.4	*<0.001*	*<0.01*	4.1	0.90	0.30	0.20	20	*<0.01*	*<0.01*	31	*<0.005*	0.26	15	3.0	0.060	8.8	12	5.8
ABA444	Q032413	CFD0385	83	83.75	Ore	Lower Transition	Granite	GG	0.90	0.010	66	1.2	0.010	0.12	0.70	90	14	13	*<0.001*	0.010	20	0.40	*<0.2*	0.30	36	*<0.01*	0.010	36	*<0.005*	0.85	9.2	3.0	0.060	4.0	4.0	6.0
ABA445	Q032988	CFD0399	8.85	9	Ore	Lower Transition	Granite	GG	1.9	0.020	199	1.0	0.010	0.11	1.7	150	11	11	*<0.001*	0.010	3.2	1.9	0.30	0.40	30	*<0.01*	*<0.01*	23	*<0.005*	0.24	20	8.0	0.37	7.7	16	11
ABA446	Q033347	CFD0403	32	33	Ore	Lower Transition	Granite	GG	0.30	0.010	45	0.69	0.010	0.21	1.4	140	20	9.1	*<0.001*	*<0.01*	33	0.70	0.30	3.2	29	*<0.01*	0.040	27	*<0.005*	0.71	5.1	3.0	0.35	4.2	6.0	8.6
ABA433	Q041589	CFD0383	91.9	92	Ore	Upper Transition	Granite	GG	1.8	0.020	77	1.1	0.010	0.060	2.7	310	29	11	*<0.001*	*<0.01*	5.5	1.1	0.40	0.40	19	*<0.01*	0.010	34	*<0.005*	0.83	8.8	6.0	0.060	11	18	5.3
Statistical Summary						**Transition**	**Granite**	**n**	8	8	8	8	8	8	8	8	8	8	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
								Max	3.9	0.020	217	4.2	0.010	0.34	2.7	460	29	18	*<0.001*	0.14	146	2.3	*<1*	3.2	36	*<0.05*	0.050	36	*<0.01*	1.2	53	12	0.37	11	20	11
								90th PCTL	2.5	0.020	204	2.9	0.010	0.25	2.6	355	27	14	*<0.001*	0.056	133	2.0	0.65	1.4	31	*<0.01*	0.050	35	*<0.01*	1.1	39	9.2	0.36	9.3	19	11
								75th PCTL	1.8	0.020	108	1.9	0.010	0.21	2.4	288	24	12	*<0.001*	0.013	57	1.7	0.43	0.45	29	*<0.01*	0.043	32	*<0.005*	0.91	23	8.0	0.35	8.0	18	9.9
								Median	0.95	0.010	68	1.1	*<0.01*	0.17	1.7	145	18	11	*<0.001*	*<0.01*	23	1.0	0.30	0.35	22	*<0.01*	0.020	27	*<0.005*	0.77	12	6.5	0.15	6.8	17	7.3
								25th PCTL	0.65	0.010	54	0.99	*<0.01*	0.10	1.3	128	15	9.0	*<0.001*	*<0.01*	5.1	0.68	0.30	0.30	19	*<0.01*	0.010	21	*<0.005*	0.59	9.1	3.0	0.060	5.5	11	5.7
								10th PCTL	0.44	0.010	51	0.84	*<0.01*	0.074	0.77	84	13	8.4	*<0.001*	*<0.01*	3.8	0.54	0.27	0.27	15	*<0.01*	0.010	16	*<0.005*	0.25	7.7	3.0	0.060	4.1	5.4	5.0
								Min	0.30	0.010	45	0.69	*<0.01*	0.060	0.70	70	11	7.4	*<0.001*	*<0.01*	3.2	0.40	*<0.2*	0.20	6.7	*<0.01*	0.010	13	*<0.005*	0.24	5.1	3.0	0.060	4.0	4.0	4.3
Statistical Summary for Granite Ore								**n**	14	14	14	14	14	14	14	14	14	14	12	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14
								n < DL	2	0	0	0	7	0	0	0	0	0	12	7	0	0	5	2	0	14	5	0	14	0	0	0	0	0	0	0
								Max	3.9	0.020	1740	4.2	0.010	0.41	3.7	460	42	18	*<0.001*	0.14	146	2.5	1.0	3.2	61	*<0.05*	0.050	36	*<0.01*	2.7	53	12	9.4	15	42	12
								90th PCTL	2.0	0.020	1241	2.2	0.010	0.31	2.7	301	28	14	*<0.001*	0.020	101	2.2	0.85	0.54	46	*<0.01*	0.050	33	*<0.01*	1.9	46	9.4	0.39	13	30	11
								75th PCTL	1.7	0.020	213	1.6	0.010	0.23	2.3	158	24	11	*<0.001*	0.010	36	1.5	0.50	0.38	29	*<0.01*	0.038	28	*<0.005*	1.2	20	7.8	0.35	10	20	9.4
								Median	1.0	0.010	73	1.1	*<0.01*	0.21	1.7	135	18	10	*<0.001*	*<0.01*	25	0.95	0.35	0.30	22	*<0.01*	0.015	26	*<0.005*	0.77	12	4.5	0.17	7.3	18	6.4
								25th PCTL	0.75	0.010	54	0.93	*<0.01*	0.11	0.83	95	15	8.9	*<0.001*	*<0.01*	7.3	0.70	0.30	0.20	19	*<0.01*	*<0.01*	20	*<0.005*	0.63	8.9	2.3	0.093	4.6	7.5	5.4
								10th PCTL	0.50	0.010	35	0.75	*<0.01*	0.086	0.63	76	12	7.9	*<0.001*	*<0.01*	4.5	0.46	*<0.2*	0.20	16	*<0.01*	*<0.01*	17	*<0.005*	0.35	5.5	2.0	0.060	3.2	4.0	5.0
								Min	0.30	0.010	20	0.52	*<0.01*	0.060	0.30	50	11	7.4	*<0.001*	*<0.01*	3.2	0.40	*<0.2*	0.20	6.7	*<0.01*	*<0.01*	13	*<0.005*	0.24	1.8	2.0	0.060	1.5	3.0	4.3
Oxide and Transition Facies for Other Lithologies Ore																																				
ABA126	KAM149885	CFR0566	67.06	68.58	Ore	Oxide	Dykes	IV	2.5	0.46	2400	2.0	*<0.01*	*<0.05*	2740	2570	3.3	4.1	*<0.001*	0.020	363	7.2	0.30	0.70	54	0.010	0.090	4.6	*<0.005*	2.7	3.6	29	2.9	12	25	0.60
ABA334	R550421	CFD0518	10	11	Ore	Upper Transition	HU	HU	0.80	0.11	1830	0.21	0.010	*<0.05*	727	560	22	8.9	*<0.001*	*<0.01*	47	8.1	0.60	0.30	56	*<0.01*	1.4	12	*<0.005*	0.67	3.0	56	25	17	149	6.2
ABA175	R305827	CFD0403	70	71	Ore	Lower transition	Dykes	DIOR	0.50	0.010	12	0.52	*<0.01*	0.080	2.5	150	14	15	*<0.001*	0.53	281	4.3	0.30	0.30	21	*<0.01*	0.030	3.2	*<0.005*	3.1	2.6	10	0.060	3.1	5.0	8.3

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in the statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.2-4: Statistical Summary of Exploration Assay Database (Au > 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t
Gneiss Ore																																													
Gneiss	Oxide	**n**	804	804	804	2864	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804	804
		n <DL	401	0	0	0	761	0	73	704	1	789	40	0	6	0	799	318	0	4	2	2	0	195	388	66	0	1	344	2	188	0	150	760	801	255	4	800	8	-	-	-	-	-	-
		Max	8.5	2.5	10000	87	10	3210	3.3	13	6.5	0.60	55	240	105	9.6	10	8.0	1.1	90	38	2.0	5630	30	0.070	158	1620	1190	1.3	1325	31	286	60	0.11	10	130	179	20	181	3300	163	42	161	325	*Non-reactive*
		95th PCTL	0.60	0.96	3766	8.3	10	858	1.9	2.0	1.7	*<0.5*	28	42	30	5.7	*<10*	3.0	0.37	50	14	0.37	1246	5.0	0.020	30	710	40	0.15	144	14	106	40	0.010	*<10*	40	66	*<10*	74	1401	42	4.6	35	33	*Non-reactive*
		90th PCTL	0.50	0.77	2834	5.5	*<10*	570	1.6	2.0	0.44	*<0.5*	17	32	21	4.4	*<10*	2.0	0.32	40	6.0	0.13	845	4.0	0.020	21	567	26	0.070	108	9.0	81	40	*<0.01*	*<10*	30	42	*<10*	59	1137	11	2.2	9.8	17	*Non-reactive*
		75th PCTL	0.30	0.60	1740	2.8	*<10*	280	1.1	*<2*	0.15	*<0.5*	9.0	16	12	2.8	*<10*	1.0	0.27	40	3.0	0.050	495	3.0	0.010	11	310	19	0.020	52	4.0	45	30	*<0.01*	*<10*	20	18	*<10*	34	750	3.8	0.63	2.9	8.0	*Non-reactive*
		Median	0.20	0.48	919	1.3	*<10*	150	0.80	*<2*	0.080	*<0.5*	4.0	9.0	6.0	1.6	*<10*	1.0	0.23	30	2.0	0.030	249	1.0	0.010	4.0	180	14	0.010	24	1.0	25	30	*<0.01*	*<10*	10	7.0	*<10*	18	515	2.0	0.31	1.4	4.8	*Non-reactive*
		25th PCTL	*<0.2*	0.40	498	0.63	*<10*	90	0.60	*<2*	0.050	*<0.5*	2.0	6.0	3.0	1.0	*<10*	*<1*	0.19	20	1.0	0.020	124	1.0	*<0.01*	2.0	110	10	*<0.01*	11	1.0	17	20	*<0.01*	*<10*	*<10*	3.0	*<10*	11	383	1.3	0.31	0.69	2.4	2.2
		10th PCTL	*<0.2*	0.34	312	0.40	*<10*	60	0.50	*<2*	0.030	*<0.5*	1.0	4.0	2.0	0.82	*<10*	*<1*	0.16	10	1.0	0.020	48	*<1*	*<0.01*	1.0	80	8.0	*<0.01*	7.0	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.3	*<10*	7.0	284	0.75	0.31	0.063	1.1	0.63
		5th PCTL	*<0.2*	0.30	263	0.35	*<10*	50	*<0.5*	*<2*	0.030	*<0.5*	1.0	3.0	2.0	0.71	*<10*	*<1*	0.14	10	1.0	0.010	30	*<1*	*<0.01*	*<1*	70	6.0	*<0.01*	5.0	*<1*	10	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	4.0	242	0.75	0.31	-0.87	0.67	0.63
		Min	*<0.2*	0.23	39	0.30	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	2.0	*<1*	0.46	*<10*	*<1*	0.090	*<10*	*<1*	*<0.01*	11	*<1*	*<0.01*	*<1*	40	*<2*	*<0.01*	*<2*	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	22	0.25	0.31	-13	0.10	0.63
Gneiss	Upper Transition	**n**	310	307	307	1983	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307	307
		n <DL	150	0	0	0	298	0	13	266	0	306	6	0	1	0	306	94	0	0	1	1	0	66	182	42	0	0	104	4	72	0	40	277	302	94	5	305	0	-	-	-	-	-	-
		Max	2.3	2.0	10000	42	10	2650	3.5	4.0	5.0	2.2	42	144	94	9.4	10	12	1.1	60	45	2.4	2300	27	0.070	74	1830	169	1.2	3190	22	233	70	0.15	10	70	132	30	107	4033	125	38	116	164	*Non-reactive*
		95th PCTL	0.70	0.88	3847	6.7	*<10*	877	1.9	2.0	3.1	*<0.5*	19	48	33	4.0	*<10*	4.0	0.37	50	21	0.76	802	4.7	0.020	32	721	29	0.45	124	9.7	116	40	0.010	*<10*	30	53	*<10*	60	2267	78	14	61	43	*Non-reactive*
		90th PCTL	0.50	0.74	3076	4.8	*<10*	514	1.6	2.0	1.7	*<0.5*	13	35	20	3.7	*<10*	3.0	0.31	50	13	0.28	686	3.4	0.020	19	496	24	0.24	84	7.0	81	40	*<0.01*	*<10*	20	33	*<10*	48	1871	41	7.6	38	24	*Non-reactive*
		75th PCTL	0.30	0.61	1930	2.6	*<10*	280	1.1	*<2*	0.31	*<0.5*	7.0	15	11	2.3	*<10*	2.0	0.26	40	5.5	0.070	444	2.0	0.010	8.0	290	20	0.080	41	3.0	44	30	*<0.01*	*<10*	10	15	*<10*	30	872	7.8	2.5	5.4	8.6	*Non-reactive*
		Median	0.20	0.46	1065	1.2	*<10*	160	0.90	*<2*	0.10	*<0.5*	3.0	8.0	6.0	1.4	*<10*	1.0	0.22	30	2.0	0.040	248	1.0	*<0.01*	3.0	170	16	0.020	21	1.0	26	30	*<0.01*	*<10*	10	5.0	*<10*	18	612	2.5	0.63	1.7	5.2	38
		25th PCTL	*<0.2*	0.39	568	0.60	*<10*	90	0.70	*<2*	0.060	*<0.5*	2.0	5.0	3.0	1.1	*<10*	*<1*	0.18	30	2.0	0.020	158	1.0	*<0.01*	1.0	120	12	*<0.01*	11	1.0	17	20	*<0.01*	*<10*	*<10*	3.0	*<10*	11	437	1.5	0.31	0.69	2.2	2.2
		10th PCTL	*<0.2*	0.33	301	0.38	*<10*	60	0.60	*<2*	0.040	*<0.5*	1.0	4.0	2.0	0.89	*<10*	*<1*	0.16	20	1.0	0.020	77	*<1*	*<0.01*	*<1*	90	10	*<0.01*	5.0	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	262	1.0	0.31	-1.4	0.66	0.94
		5th PCTL	*<0.2*	0.30	194	0.34	*<10*	43	0.50	*<2*	0.040	*<0.5*	1.0	3.0	1.0	0.73	*<10*	*<1*	0.14	20	1.0	0.010	46	*<1*	*<0.01*	*<1*	80	8.0	*<0.01*	3.3	*<1*	10	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	4.0	232	1.0	0.31	-4.9	0.30	0.63
		Min	*<0.2*	0.22	15	0.30	*<10*	20	*<0.5*	*<2*	0.010	*<0.5*	*<1*	1.0	*<1*	0.45	*<10*	*<1*	0.10	10	*<1*	*<0.01*	20	*<1*	*<0.01*	*<1*	30	4.0	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	2.0	6.0	0.25	0.31	-21	0.068	0.63
Gneiss	Lower Transition	**n**	140	140	140	917	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140	140
		n <DL	71	0	0	0	139	0	3	114	0	138	2	0	1	0	138	58	0	0	0	0	0	35	58	15	0	0	22	1	52	0	5	114	138	50	6	128	0	-	-	-	-	-	-
		Max	9.6	2.9	7530	50	10	2140	3.9	4.0	5.5	0.50	111	164	143	5.1	10	8.0	1.5	60	45	2.4	4920	11	0.060	85	1010	728	1.9	1690	20	244	50	0.12	10	60	95	10	125	3758	137	59	114	174	*Non-reactive*
		95th PCTL	1.8	1.1	4076	6.0	*<10*	1444	1.7	2.0	2.3	*<0.5*	17	62	30	3.2	*<10*	2.0	0.65	50	29	1.2	1017	3.0	0.050	30	530	29	1.1	72	6.0	104	40	0.051	*<10*	30	41	10	52	2680	57	34	51	36	*Non-reactive*
		90th PCTL	0.80	0.80	3225	4.3	*<10*	801	1.4	2.0	1.7	*<0.5*	13	21	18	3.0	*<10*	2.0	0.44	50	27	0.83	766	3.0	0.030	24	473	23	0.87	50	4.0	74	40	0.020	*<10*	20	28	*<10*	38	2410	44	27	33	23	*Non-reactive*
		75th PCTL	0.30	0.62	2230	2.3	*<10*	310	1.1	*<2*	0.84	*<0.5*	6.3	13	10	2.2	*<10*	1.0	0.29	40	19	0.29	451	2.0	0.020	8.0	290	18	0.48	21	3.0	49	30	*<0.01*	*<10*	10	10	*<10*	27	1361	21	15	16	6.9	*Non-reactive*
		Median	*<0.2*	0.50	1010	1.1	*<10*	120	0.85	*<2*	0.24	*<0.5*	2.0	6.0	4.0	1.3	*<10*	1.0	0.25	40	5.0	0.060	276	1.0	0.010	2.0	160	13	0.070	10	1.0	31	30	*<0.01*	*<10*	10	3.0	*<10*	16	640	5.9	2.2	1.0	2.6	18
		25th PCTL	*<0.2*	0.41	445	0.58	*<10*	60	0.70	*<2*	0.070	*<0.5*	1.0	4.0	3.0	1.0	*<10*	*<1*	0.21	30	2.0	0.030	157	0.50	*<0.01*	1.0	110	10	0.010	6.0	*<1*	22	30	*<0.01*	*<10*	*<10*	1.0	*<10*	10	325	1.8	0.31	-1.1	0.80	3.1
		10th PCTL	*<0.2*	0.31	268	0.38	*<10*	40	0.60	*<2*	0.050	*<0.5*	1.0	3.0	2.0	0.80	*<10*	*<1*	0.17	20	1.9	0.020	43	*<1*	*<0.01*	*<1*	90	7.0	*<0.01*	3.0	*<1*	15	20	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	153	1.3	0.31	-10	0.28	0.94
		5th PCTL	*<0.2*	0.27	143	0.34	*<10*	30	0.50	*<2*	0.040	*<0.5*	1.0	3.0	1.0	0.75	*<10*	*<1*	0.16	20	1.0	0.020	25	*<1*	*<0.01*	*<1*	80	6.0	*<0.01*	2.0	*<1*	12	20	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	101	1.0	0.31	-27	0.16	0.63
		Min	*<0.2*	0.25	24	0.30	*<10*	20	*<0.5*	*<2*	0.030	*<0.5*	*<1*	2.0	*<1*	0.56	*<10*	*<1*	0.12	10	1.0	0.010	20	*<1*	*<0.01*	*<1*	30	4.0	*<0.01*	*<2*	*<1*	7.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	3.0	33	0.75	0.31	-44	0.082	0.63
Gneiss	Transition	**n**	**450**	447	447	2900	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447	447
		n <DL	**221**	0	0	0	437	0	16	380	0	444	8	0	2	0	444	152	0	0	1	1	0	101	240	57	0	0	126	5	124	0	45	391	440	144	11	433	0	-	-	-	-	-	-
		Max	**9.6**	2.9	10000	50	10	2650	3.9	4.0	5.5	2.2	111	164	143	9.4	10	12	1.5	60	45	2.4	4920	27	0.070	85	1830	728	1.9	3190	22	244	70	0.15	10	70	132	30	125	4033	137	59	116	174	*Non-reactive*
		95th PCTL	**0.96**	1.1	3927	6.6	*<10*	927	1.9	2.0	3.1	*<0.5*	18	50	32	3.9	*<10*	4.0	0.43	50	27	0.93	886	4.0	0.030	32	617	29	0.78	107	8.0	116	40	0.020	*<10*	30	47	*<10*	59	2502	76	24	60	43	*Non-reactive*
		90th PCTL	0.50	0.75	3220	4.7	*<10*	622	1.5	2.0	1.7	*<0.5*	13	33	19	3.3	*<10*	3.0	0.34	50	21	0.47	698	3.0	0.020	20	488	23	0.48	77	6.0	78	40	0.010	*<10*	20	31	*<10*	45	2139	43	15	36	24	*Non-reactive*
		75th PCTL	0.30	0.62	2030	2.5	*<10*	280	1.1	*<2*	0.57	*<0.5*	7.0	15	11	2.3	*<10*	2.0	0.27	40	8.0	0.12	448	2.0	0.010	8.0	290	20	0.13	33	3.0	45	30	*<0.01*	*<10*	10	13	*<10*	30	982	14	4.1	7.1	8.0	*Non-reactive*
		Median	0.20	0.47	1055	1.1	*<10*	150	0.90	*<2*	0.11	*<0.5*	3.0	7.0	6.0	1.4	*<10*	1.0	0.23	30	3.0	0.040	253	1.0	*<0.01*	3.0	170	15	0.020	17	1.0	28	30	*<0.01*	*<10*	10	4.0	*<10*	17	622	2.8	0.63	1.4	4.0	22
		25th PCTL	*<0.2*	0.40	534	0.59	*<10*	80	0.70	*<2*	0.070	*<0.5*	1.0	5.0	3.0	1.1	*<10*	*<1*	0.19	30	2.0	0.030	157	1.0	*<0.01*	1.0	115	12	*<0.01*	9.0	*<1*	19	30	*<0.01*	*<10*	*<10*	2.0	*<10*	10	404	1.8	0.31	0.44	1.4	2.5
		10th PCTL	*<0.2*	0.33	280	0.38	*<10*	50	0.60	*<2*	0.040	*<0.5*	1.0	3.0	2.0	0.88	*<10*	*<1*	0.16	20	1.0	0.020	69	*<1*	*<0.01*	*<1*	90	9.0	*<0.01*	4.0	*<1*	12	4.0	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	251	1.0	0.31	-4.9	0.51	0.94
		5th PCTL	*<0.2*	0.28	188	0.34	*<10*	40	0.50	*<2*	0.040	*<0.5*	1.0	3.0	1.0	0.74	*<10*	*<1*	0.15	20	1.0	0.020	33	*<1*	*<0.01*	*<1*	80	7.0	*<0.01*	3.0	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	158	1.0	0.31	-9.4	0.23	0.63
		Min	*<0.2*	0.22	15	0.30	*<10*	20	*<0.5*	*<2*	0.010	*<0.5*	*<1*	1.0	*<1*	0.45	*<10*	*<1*	0.10	10	*<1*	*<0.01*	20	*<1*	*<0.01*	*<1*	30	4.0	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	2.0	6.0	0.25	0.31	-44	0.068	0.63
Gneiss	All	**n**	1254	1251	1251	5764	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251	1251
		n <DL	622	0	0	0	1198	0	89	1084	1	1233	48	0	8	0	1243	470	0	4	3	3	0	296	628	123	0	1	470	7	312	0	195	1151	1241	399	15	1233	8	-	-	-	-	-	-
		Max	9.6	2.9	10000	87	10	3210	3.9	13	6.5	2.2	111	240	143	9.6	10	12	1.5	90	45	2.4	5630	30	0.070	158	1830	1190	1.9	3190	31	286	70	0.15	10	130	179	30	181	4033	163	59	161	325	*Non-reactive*
		95th PCTL	0.70	0.98	3840	7.3	*<10*	880	1.9	2.0	2.3	*<0.5*	22	48	30	5.2	*<10*	3.0	0.39	50	22	0.57	1093	5.0	0.020	32	700	33	0.44	141	12	112	40	0.010	*<10*	40	58	*<10*	71	1993	58	14	46	36	*Non-reactive*
		90th PCTL	0.50	0.76	2910	5.1	*<10*	580	1.6	2.0	1.1	*<0.5*	15	32	20	3.9	*<10*	2.0	0.32	40	13	0.25	795	4.0	0.020	21	530	25	0.18	94	8.0	80	40	*<0.01*	*<10*	30	39	*<10*	53	1358	27	5.6	22	18	*Non-reactive*
		75th PCTL	0.30	0.61	1840	2.6	*<10*	280	1.1	*<2*	0.18	*<0.5*	9.0	16	11	2.6	*<10*	1.0	0.27	40	4.0	0.060	462	2.0	0.010	10	300	19	0.040	47	4.0	45	30	*<0.01*	*<10*	15	16	*<10*	33	811	4.5	1.3	3.4	8.0	*Non-reactive*
		Median	0.20	0.48	966	1.2	*<10*	150	0.80	*<2*	0.090	*<0.5*	3.0	8.0	6.0	1.5	*<10*	1.0	0.23	30	2.0	0.030	250	1.0	*<0.01*	3.0	170	14	0.010	21	1.0	26	30	*<0.01*	*<10*	10	6.0	*<10*	18	545	2.3	0.31	1.4	4.8	*Non-reactive*
		25th PCTL	*<0.2*	0.40	507	0.61	*<10*	80	0.70	*<2*	0.060	*<0.5*	2.0	5.0	3.0	1.0	*<10*	*<1*	0.19	20	1.0	0.020	130	1.0	*<0.01*	1.0	110	11	*<0.01*	10	1.0	17	20	*<0.01*	*<10*	*<10*	3.0	*<10*	10	393	1.5	0.31	0.69	2.2	2.6
		10th PCTL	*<0.2*	0.34	306	0.39	*<10*	50	0.50	*<2*	0.040	*<0.5*	1.0	4.0	2.0	0.83	*<10*	*<1*	0.16	20	1.0	0.020	51	*<1*	*<0.01*	1.0	80	8.0	*<0.01*	6.0	*<1*	12	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	275	1.0	0.31	-0.50	0.80	0.80
		5th PCTL	*<0.2*	0.30	235	0.34	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	1.0	3.0	1.0	0.73	*<10*	*<1*	0.14	10	1.0	0.010	31	*<1*	*<0.01*	*<1*	70	6.0	*<0.01*	4.0	*<1*	10	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	4.0	228	0.75	0.31	-4.4	0.40	0.40
		Min	*<0.2*	0.22	15	0.30	*<10*	10	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	*<1*	0.45	*<10*	*<1*	0.090	*<10*	*<1*	*<0.01*	11	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	3.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	6.0	0.25	0.31	-44	0.068	0.068

Appendix C.2-4: Statistical Summary of Exploration Assay Database (Au > 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t
Schist Ore																																													
Schist	Oxide	**n**	567	567	567	1201	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567	567
		n <DL	166	0	0	0	541	0	12	442	0	561	0	0	2	0	565	169	0	0	0	0	0	301	150	1	0	0	55	0	4	0	370	527	557	517	0	557	0	-	-	-	-	-	-
		Max	3.7	2.0	10000	63	10	3730	2.8	6.0	11	4.5	103	194	686	12	10	12	0.95	70	60	4.5	2810	7.0	0.070	501	2390	253	2.0	10000	14	676	40	0.090	10	40	108	20	253	3802	263	62	261	632	*Non-reactive*
		95th PCTL	1.4	1.0	8006	12	*<10*	2080	1.6	3.0	5.7	*<0.5*	21	52	55	4.7	*<10*	3.0	0.41	60	38	1.7	1020	2.0	0.030	60	840	37	0.54	514	9.0	293	30	0.010	*<10*	10	40	*<10*	78	2229	142	17	137	206	*Non-reactive*
		90th PCTL	0.80	0.89	5832	6.5	*<10*	1754	1.5	2.0	4.6	*<0.5*	18	38	42	4.2	*<10*	2.0	0.37	50	30	1.3	879	1.0	0.020	49	720	27	0.33	196	7.0	222	20	*<0.01*	*<10*	*<10*	34	*<10*	70	1752	116	10	109	121	*Non-reactive*
		75th PCTL	0.50	0.74	3610	3.0	*<10*	800	1.2	*<2*	2.9	*<0.5*	15	22	29	3.6	*<10*	1.0	0.33	40	18	0.62	663	1.0	0.010	35	560	18	0.10	72	5.0	129	20	*<0.01*	*<10*	*<10*	19	*<10*	57	1110	72	3.1	68	47	24
		Median	0.30	0.60	2450	1.5	*<10*	350	0.90	*<2*	1.3	*<0.5*	12	15	19	3.1	*<10*	1.0	0.28	30	5.0	0.14	506	*<1*	0.010	24	440	13	0.050	27	4.0	72	*<20*	*<0.01*	*<10*	*<10*	12	*<10*	47	786	33	1.6	26	17	2.8
		25th PCTL	*<0.2*	0.47	1340	0.69	*<10*	160	0.80	*<2*	0.33	*<0.5*	8.0	9.0	11	2.5	*<10*	*<1*	0.24	30	2.0	0.070	361	*<1*	*<0.01*	14	330	10	0.020	12	3.0	42	*<20*	*<0.01*	*<10*	*<10*	8.0	*<10*	35	538	8.3	0.63	6.4	5.6	1.3
		10th PCTL	*<0.2*	0.38	802	0.44	*<10*	98	0.60	*<2*	0.20	*<0.5*	5.0	6.0	6.8	1.7	*<10*	*<1*	0.21	20	2.0	0.050	252	*<1*	*<0.01*	5.0	198	8.0	0.010	7.0	2.0	29	*<20*	*<0.01*	*<10*	*<10*	5.0	*<10*	22	348	5.0	0.31	3.4	2.9	0.63
		5th PCTL	*<0.2*	0.34	584	0.38	*<10*	70	0.50	*<2*	0.14	*<0.5*	4.0	4.0	4.0	1.4	*<10*	*<1*	0.18	20	1.0	0.040	201	*<1*	*<0.01*	3.0	150	7.0	*<0.01*	5.0	1.0	21	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	16	273	3.5	0.31	2.1	1.6	0.63
		Min	*<0.2*	0.23	184	0.30	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	1.0	2.0	*<1*	0.66	*<10*	*<1*	0.12	10	0.00	0.020	43	*<1*	*<0.01*	*<1*	40	4.0	*<0.01*	2.0	*<1*	12	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	154	0.75	0.31	-16	0.48	0.63
Schist	Upper Transition	**n**	227	227	227	506	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227	227
		n <DL	69	0	0	0	209	0	11	201	0	225	0	0	0	0	222	108	0	0	0	0	0	113	60	4	0	0	6	5	3	0	141	183	227	220	0	217	0	-	-	-	-	-	-
		Max	206	3.7	10000	79	10	2030	2.1	7.0	15	1.8	37	324	1180	5.7	10	15	1.4	60	59	3.1	1575	10	0.040	274	1150	63	4.3	537	19	723	30	0.13	*<10*	10	120	1350	379	4831	380	135	364	176	*Non-reactive*
		95th PCTL	1.8	1.4	7693	11	10	1070	1.4	2.0	6.6	*<0.5*	24	87	86	4.4	*<10*	2.0	0.54	40	40	2.3	1055	2.0	0.030	71	774	33	2.5	121	10	443	20	0.047	*<10*	*<10*	45	*<10*	88	2582	165	77	142	64	118
		90th PCTL	1.3	1.1	6294	7.4	*<10*	686	1.3	2.0	5.4	*<0.5*	19	50	53	4.0	*<10*	2.0	0.41	40	38	2.1	873	2.0	0.020	52	704	26	2.3	64	8.0	324	20	0.010	*<10*	*<10*	38	*<10*	74	1970	136	70	107	36	74
		75th PCTL	0.60	0.81	4720	3.3	*<10*	340	1.1	*<2*	3.8	*<0.5*	15	25	26	3.6	*<10*	1.0	0.35	30	32	1.4	630	1.0	0.020	36	550	17	1.5	33	6.0	224	20	*<0.01*	*<10*	*<10*	27	*<10*	61	1331	95	46	66	8.8	49
		Median	0.30	0.60	2530	1.3	*<10*	200	0.90	*<2*	2.7	*<0.5*	11	15	17	3.0	*<10*	1.0	0.29	30	27	0.99	515	1.0	0.010	22	430	12	0.82	16	4.0	149	*<20*	*<0.01*	*<10*	*<10*	13	*<10*	45	916	68	26	39	2.5	28
		25th PCTL	*<0.2*	0.47	1433	0.61	*<10*	100	0.70	*<2*	2.1	*<0.5*	8.0	8.5	10	2.4	*<10*	*<1*	0.25	20	19	0.67	393	*<1*	*<0.01*	14	330	10	0.25	7.5	2.0	105	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	34	547	53	7.7	18	1.6	8.8
		10th PCTL	*<0.2*	0.38	752	0.39	*<10*	70	0.50	*<2*	1.2	*<0.5*	6.0	6.0	6.0	1.9	*<10*	*<1*	0.23	10	12	0.36	300	*<1*	*<0.01*	6.2	210	7.0	0.050	5.0	1.6	65	*<20*	*<0.01*	*<10*	*<10*	4.0	*<10*	23	303	31	1.6	2.6	1.1	2.7
		5th PCTL	*<0.2*	0.33	404	0.35	*<10*	43	0.50	*<2*	0.85	*<0.5*	4.0	4.0	5.0	1.3	*<10*	*<1*	0.20	10	7.0	0.19	229	*<1*	*<0.01*	4.0	170	6.0	0.030	4.0	1.0	42	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	18	231	21	0.94	-9.3	0.88	0.94
		Min	*<0.2*	0.26	116	0.31	*<10*	30	*<0.5*	*<2*	0.070	*<0.5*	1.0	2.0	2.0	0.67	*<10*	*<1*	0.080	10	2.0	0.030	93	*<1*	*<0.01*	*<1*	30	2.0	*<0.01*	*<2*	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	6.0	29	1.8	0.31	-36	0.51	0.63
Schist	Lower Transition	**n**	62	62	62	215	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62	62
		n <DL	25	0	0	0	59	0	4	52	0	61	0	0	0	0	51	31	0	0	0	0	0	35	22	0	0	0	4	2	0	0	52	35	62	59	0	61	0	-	-	-	-	-	-
		Max	1.7	3.1	10000	66	10	1010	2.5	3.0	25	0.60	41	178	58	7.7	10	3.0	2.1	40	90	4.8	1135	20	0.080	133	1190	67	3.6	887	22	2680	20	0.20	*<10*	10	94	30	141	2618	625	111	623	429	*Non-reactive*
		95th PCTL	0.90	2.7	7908	11	*<10*	662	2.1	3.0	5.9	*<0.5*	23	102	48	4.5	10	2.0	1.7	40	46	2.8	1125	9.6	0.040	48	868	43	3.2	104	12	482	20	0.17	*<10*	*<10*	81	*<10*	102	2387	147	101	134	302	*Non-reactive*
		90th PCTL	0.80	2.5	5573	5.8	*<10*	416	1.5	2.0	5.3	*<0.5*	20	88	35	4.2	10	1.0	1.4	30	40	2.4	1119	1.0	0.030	47	697	38	3.0	68	11	385	20	0.14	*<10*	*<10*	77	*<10*	94	1897	132	95	102	249	*Non-reactive*
		75th PCTL	0.38	1.1	3650	2.6	*<10*	250	1.2	*<2*	3.7	*<0.5*	18	56	25	3.8	*<10*	1.0	0.47	30	34	1.7	754	1.0	0.030	35	560	19	2.0	35	8.0	291	*<20*	0.038	*<10*	*<10*	54	*<10*	62	1181	91	61	76	41	101
		Median	0.20	0.72	2100	0.94	*<10*	140	0.90	*<2*	3.0	*<0.5*	14	19	16	3.1	*<10*	0.00	0.36	20	28	1.2	615	*<1*	0.015	26	410	11	1.1	13	5.0	160	*<20*	*<0.01*	*<10*	*<10*	22	*<10*	48	624	74	35	38	2.6	52
		25th PCTL	*<0.2*	0.57	895	0.46	*<10*	90	0.80	*<2*	2.4	*<0.5*	10	11	9.0	2.7	*<10*	*<1*	0.28	20	24	0.95	487	*<1*	*<0.01*	19	333	8.0	0.023	7.0	3.0	108	*<20*	*<0.01*	*<10*	*<10*	12	*<10*	36	285	60	0.70	9.6	1.2	28
		10th PCTL	*<0.2*	0.50	293	0.36	*<10*	60	0.50	*<2*	1.4	*<0.5*	5.1	10	7.0	2.0	*<10*	*<1*	0.20	10	19	0.55	354	*<1*	*<0.01*	12	251	6.0	0.010	5.0	2.0	43	*<20*	*<0.01*	*<10*	*<10*	7.1	*<10*	26	73	34	0.31	-15	0.83	2.5
		5th PCTL	*<0.2*	0.43	25	0.33	*<10*	50	*<0.5*	*<2*	0.41	*<0.5*	4.0	6.0	6.0	1.5	*<10*	*<1*	0.17	10	3.5	0.27	294	*<1*	*<0.01*	7.2	230	3.1	*<0.01*	2.2	2.0	32	*<20*	*<0.01*	*<10*	*<10*	7.0	*<10*	21	6.0	10	0.31	-18	0.78	0.64
		Min	*<0.2*	0.15	7.0	0.30	*<10*	40	*<0.5*	*<2*	0.17	*<0.5*	1.0	4.0	1.0	0.51	*<10*	*<1*	0.080	10	2.0	0.050	212	*<1*	*<0.01*	3.0	110	3.0	*<0.01*	*<2*	1.0	13	*<20*	*<0.01*	*<10*	*<10*	4.0	*<10*	10	2.4	4.3	0.31	-67	0.31	0.63
Schist	Transition	**n**	289	289	289	721	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289	289
		n <DL	94	0	0	0	268	0	15	253	0	286	0	0	0	0	273	139	0	0	0	0	0	148	82	4	0	0	10	7	3	0	193	218	289	279	0	278	0	-	-	-	-	-	-
		Max	206	3.7	10000	79	10	2030	2.5	7.0	25	1.8	41	324	1180	7.7	10	15	2.1	60	90	4.8	1575	20	0.080	274	1190	67	4.3	887	22	2680	30	0.20	*<10*	10	120	1350	379	4831	625	135	623	429	*Non-reactive*
		95th PCTL	1.5	2.0	7990	11	10	1034	1.5	2.0	6.6	*<0.5*	24	90	77	4.5	10	2.0	0.84	40	41	2.5	1110	2.0	0.030	68	800	39	2.7	106	11	470	20	0.060	*<10*	*<10*	70	*<10*	97	2563	164	85	143	93	*Non-reactive*
		90th PCTL	1.0	1.3	6162	7.1	*<10*	650	1.3	2.0	5.4	*<0.5*	20	63	48	4.1	*<10*	2.0	0.50	40	38	2.2	965	2.0	0.030	48	700	26	2.3	68	9.0	342	20	0.032	*<10*	*<10*	51	*<10*	74	1953	134	70	107	62	101
		75th PCTL	0.60	0.88	4670	3.0	*<10*	320	1.1	*<2*	3.8	*<0.5*	15	26	26	3.6	*<10*	1.0	0.36	30	33	1.4	666	1.0	0.020	35	550	18	1.6	34	6.0	237	20	*<0.01*	*<10*	*<10*	29	*<10*	61	1306	95	49	67	11	56
		Median	0.20	0.63	2390	1.2	*<10*	180	0.90	*<2*	2.9	*<0.5*	11	15	17	3.0	*<10*	1.0	0.29	20	27	1.1	525	*<1*	0.010	24	430	12	0.83	14	4.0	156	*<20*	*<0.01*	*<10*	*<10*	14	*<10*	46	895	73	26	38	2.6	31
		25th PCTL	*<0.2*	0.49	1310	0.56	*<10*	100	0.70	*<2*	2.1	*<0.5*	8.0	9.0	10	2.4	*<10*	*<1*	0.25	20	20	0.67	412	*<1*	*<0.01*	15	330	9.0	0.21	7.0	2.0	107	*<20*	*<0.01*	*<10*	*<10*	7.0	*<10*	34	478	53	6.6	15	1.5	10
		10th PCTL	*<0.2*	0.41	521	0.38	*<10*	68	0.50	*<2*	1.3	*<0.5*	6.0	6.0	6.0	1.9	*<10*	*<1*	0.22	10	13	0.37	314	*<1*	*<0.01*	7.0	220	7.0	0.030	5.0	2.0	60	*<20*	*<0.01*	*<10*	*<10*	4.0	*<10*	23	246	32	0.94	1.0	1.0	2.5
		5th PCTL	*<0.2*	0.33	293	0.34	*<10*	44	*<0.5*	*<2*	0.60	*<0.5*	4.0	4.0	5.0	1.4	*<10*	*<1*	0.19	10	7.0	0.20	240	*<1*	*<0.01*	4.0	170	6.0	0.010	3.4	1.0	38	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	18	130	15	0.31	-16	0.80	0.94
		Min	*<0.2*	0.15	7.0	0.30	*<10*	30	*<0.5*	*<2*	0.070	*<0.5*	1.0	2.0	1.0	0.51	*<10*	*<1*	0.080	10	2.0	0.030	93	*<1*	*<0.01*	*<1*	30	2.0	*<0.01*	*<2*	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	6.0	2.4	1.8	0.31	-67	0.31	0.63
Schist	All	**n**	856	856	856	1922	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856	856
		n <DL	260	0	0	0	809	0	27	695	0	847	0	0	2	0	838	308	0	0	0	0	0	449	232	5	0	0	65	7	7	0	563	745	846	796	0	835	0	-	-	-	-	-	-
		Max	206	3.7	10000	79	10	3730	2.8	7.0	25	4.5	103	324	1180	12	10	15	2.1	70	90	4.8	2810	20	0.080	501	2390	253	4.3	10000	22	2680	40	0.20	10	40	120	1350	379	4831	625	135	623	632	*Non-reactive*
		95th PCTL	1.4	1.2	8070	12	10	1903	1.6	3.0	6.1	*<0.5*	23	66	59	4.7	*<10*	3.0	0.47	50	40	2.2	1065	2.0	0.030	65	840	37	2.0	391	10	338	30	0.020	*<10*	10	47	*<10*	80	2351	154	62	139	174	*Non-reactive*
		90th PCTL	0.90	0.99	5900	6.7	*<10*	1380	1.4	2.0	5.1	*<0.5*	19	45	43	4.1	*<10*	2.0	0.40	40	35	1.6	888	2.0	0.020	48	710	27	1.5	150	8.0	266	20	0.010	*<10*	*<10*	38	*<10*	73	1768	126	46	107	100	*Non-reactive*
		75th PCTL	0.50	0.78	3805	3.0	*<10*	610	1.2	*<2*	3.4	*<0.5*	15	24	28	3.6	*<10*	1.0	0.34	40	27	1.1	665	1.0	0.010	35	560	18	0.49	54	6.0	170	20	*<0.01*	*<10*	*<10*	23	*<10*	59	1181	84	15	67	35	65
		Median	0.30	0.60	2450	1.3	*<10*	270	0.90	*<2*	2.1	*<0.5*	12	15	18	3.1	*<10*	1.0	0.29	30	14	0.48	515	*<1*	0.010	24	435	13	0.070	22	4.0	101	*<20*	*<0.01*	*<10*	*<10*	12	*<10*	46	808	51	2.2	33	9.9	11
		25th PCTL	*<0.2*	0.48	1315	0.64	*<10*	130	0.80	*<2*	0.60	*<0.5*	8.0	9.0	10	2.5	*<10*	*<1*	0.25	20	3.0	0.080	372	*<1*	*<0.01*	14	330	10	0.020	10	3.0	50	*<20*	*<0.01*	*<10*	*<10*	8.0	*<10*	34	522	15	0.63	7.4	2.9	2.9
		10th PCTL	*<0.2*	0.38	756	0.41	*<10*	80	0.60	*<2*	0.22	*<0.5*	5.0	6.0	6.0	1.8	*<10*	*<1*	0.21	20	2.0	0.050	267	*<1*	*<0.01*	5.0	210	8.0	0.010	6.0	2.0	32	*<20*	*<0.01*	*<10*	*<10*	4.0	*<10*	22	317	5.5	0.31	2.9	1.4	1.4
		5th PCTL	*<0.2*	0.33	516	0.36	*<10*	60	0.50	*<2*	0.18	*<0.5*	4.0	4.0	4.0	1.4	*<10*	*<1*	0.19	10	1.0	0.040	204	*<1*	*<0.01*	3.0	160	6.0	*<0.01*	5.0	1.0	24	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	16	238	4.4	0.31	0.56	1.0	1.0
		Min	*<0.2*	0.15	7.0	0.30	*<10*	30	*<0.5*	*<2*	0.030	*<0.5*	1.0	2.0	*<1*	0.51	*<10*	*<1*	0.080	10	0.00	0.020	43	*<1*	*<0.01*	*<1*	30	2.0	*<0.01*	*<2*	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	5.0	2.4	0.75	0.31	-67	0.31	0.31

Appendix C.2-4: Statistical Summary of Exploration Assay Database (Au > 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t
Granite Ore																																													
Granite	Oxide	**n**	144	141	141	150	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141	141
		n <DL	99	0	0	0	131	1	59	114	8	141	27	0	3	0	140	47	0	0	5	5	0	25	97	29	0	0	58	0	35	0	22	141	140	44	1	141	7	-	-	-	-	-	-
		Max	9.4	1.2	10000	20	10	430	2.1	4.0	0.23	<0.5	11	10	21	11	10	5.0	0.33	30	4.0	0.060	23700	8.0	0.020	6.0	940	59	0.81	468	7.0	124	40	<0.01	10	160	24	<10	165	8543	5.8	25	3.4	11	*Non-reactive*
		95th PCTL	0.30	0.77	7410	8.3	10	190	1.1	2.0	0.10	<0.5	7.0	7.0	9.0	4.3	<10	3.0	0.25	30	2.0	0.020	2730	3.0	0.010	4.0	280	36	0.070	171	4.0	60	30	<0.01	<10	60	15	<10	58	4367	2.5	2.2	2.2	8.0	*Non-reactive*
		90th PCTL	0.20	0.68	4770	4.5	<10	150	0.90	2.0	0.090	<0.5	6.0	7.0	5.0	3.6	<10	2.0	0.23	30	2.0	0.020	1785	3.0	0.010	2.0	220	29	0.040	90	3.0	48	30	<0.01	<10	40	11	<10	48	3493	2.3	1.3	1.7	6.4	*Non-reactive*
		75th PCTL	0.20	0.55	3150	2.4	<10	100	0.70	<2	0.070	<0.5	3.0	6.0	3.0	2.2	<10	1.0	0.21	20	1.0	0.020	603	2.0	0.010	2.0	170	24	0.020	34	1.0	36	30	<0.01	<10	20	4.0	<10	33	2452	1.8	0.63	1.4	5.6	*Non-reactive*
		Median	<0.2	0.48	2030	1.2	<10	60	0.50	<2	0.060	<0.5	2.0	4.0	2.0	1.5	<10	1.0	0.17	20	1.0	0.010	138	1.0	<0.01	1.0	120	19	0.010	16	1.0	21	20	<0.01	<10	10	2.0	<10	20	1121	1.5	0.31	0.94	4.0	*Non-reactive*
		25th PCTL	<0.2	0.39	1185	0.64	<10	40	<0.5	<2	0.040	<0.5	1.0	3.0	2.0	1.1	<10	<1	0.14	20	1.0	0.010	45	1.0	<0.01	1.0	80	16	<0.01	10	1.0	14	20	<0.01	<10	<10	2.0	<10	8.0	651	1.0	0.31	0.31	1.6	1.3
		10th PCTL	<0.2	0.34	925	0.44	<10	30	<0.5	<2	0.010	<0.5	<1	2.0	1.0	0.85	<10	<1	0.12	10	0.00	0.010	24	<1	<0.01	<1	60	14	<0.01	7.0	<1	11	<20	<0.01	<10	<10	1.0	<10	3.0	511	0.25	0.31	-0.38	0.40	0.63
		5th PCTL	<0.2	0.32	711	0.34	<10	20	<0.5	<2	<0.01	<0.5	<1	1.0	1.0	0.78	<10	<1	0.10	10	0.00	0.010	19	<1	<0.01	<1	60	13	<0.01	5.0	<1	10	<20	<0.01	<10	<10	1.0	<10	2.0	464	0.25	0.31	-1.9	0.16	0.63
		Min	<0.2	0.17	581	0.30	<10	<10	<0.5	<2	<0.01	<0.5	<1	1.0	<1	0.38	<10	<1	0.060	10	<1	<0.01	11	<1	<0.01	<1	40	10	<0.01	2.0	<1	5.0	<20	<0.01	<10	<10	<1	<10	<2	341	0.25	0.31	-20	0.035	0.63
Granite	Upper Transition	**n**	28	20	20	60	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
		n <DL	13	0	0	0	11	0	8	18	7	20	4	0	3	0	20	7	0	0	0	0	0	9	13	8	0	0	2	0	11	3	1	20	20	6	2	20	1	-	-	-	-	-	-
		Max	6.9	1.1	10000	17	10	90	1.9	2.0	0.060	<0.5	4.0	8.0	8.0	5.8	<10	10	0.31	30	2.0	0.030	234	3.0	0.010	2.0	590	32	0.91	268	2.0	29	40	<0.01	<10	50	12	<10	60	8850	1.5	28	1.2	4.8	*Non-reactive*
		95th PCTL	4.2	0.97	6390	8.6	10	90	1.1	2.0	0.060	<0.5	3.1	8.0	4.2	4.5	<10	2.4	0.29	21	2.0	0.021	224	3.0	0.010	2.0	476	30	0.70	160	2.0	22	31	<0.01	<10	31	9.2	<10	37	4825	1.5	22	1.2	4.8	*Non-reactive*
		90th PCTL	2.2	0.96	5777	5.3	10	72	1.1	<2	0.060	<0.5	3.0	8.0	4.0	3.9	<10	1.1	0.29	20	2.0	0.020	201	3.0	0.010	2.0	344	30	0.52	48	1.1	21	30	<0.01	<10	21	7.2	<10	34	3949	1.5	16	0.96	4.1	*Non-reactive*
		75th PCTL	0.72	0.60	3325	2.7	10	50	0.83	<2	0.050	<0.5	2.3	6.3	2.0	1.8	<10	1.0	0.24	20	1.3	0.020	124	2.0	0.010	2.0	225	27	0.31	24	1.0	16	30	<0.01	<10	10	6.3	<10	20	3037	1.3	9.8	-0.047	1.0	2521
		Median	0.20	0.48	2008	1.3	<10	40	0.50	<2	0.020	<0.5	2.0	5.0	2.0	1.3	<10	1.0	0.22	20	1.0	0.010	69	1.0	<0.01	1.0	130	20	0.15	12	<1	9.5	30	<0.01	<10	10	2.0	<10	15	2148	0.50	4.7	-3.9	0.11	11
		25th PCTL	<0.2	0.43	1733	0.80	<10	30	<0.5	<2	<0.01	<0.5	1.0	3.8	1.8	0.99	<10	<1	0.20	18	1.0	0.010	31	<1	<0.01	<1	70	14	0.018	8.5	<1	5.8	28	<0.01	<10	<10	1.0	<10	4.5	1132	0.25	0.55	-9.5	0.034	4.8
		10th PCTL	<0.2	0.38	1510	0.43	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.54	<10	<1	0.17	10	0.00	0.010	20	<1	<0.01	<1	60	12	0.0080	4.8	<1	<1	20	<0.01	<10	<10	0.80	<10	2.0	582	0.25	0.31	-16	0.028	1.8
		5th PCTL	<0.2	0.34	1470	0.40	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.53	<10	<1	0.16	10	0.00	0.010	20	<1	<0.01	<1	59	12	<0.01	3.0	<1	<1	18	<0.01	<10	<10	<1	<10	1.8	470	0.25	0.31	-21	0.019	1.2
		Min	<0.2	0.32	719	0.35	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.42	<10	<1	0.12	10	0.00	0.010	19	<1	<0.01	<1	40	9.0	<0.01	3.0	<1	<1	<20	<0.01	<10	<10	<1	<10	<2	396	0.25	0.31	-27	0.016	0.63
Granite	Lower Transition	**n**	17	7.0	7.0	33	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
		n <DL	5	0	0	0	5	0	4	7	3	7	1	0	1	0	7	3	0	0	3	3	0	1	1	0	0	0	0	0	0	0	2	7	7	4	0	7	0	-	-	-	-	-	-
		Max	8.9	0.94	5820	11	10	90	0.80	<2	0.51	<0.5	2.0	15	9.0	2.1	<10	5.0	0.19	30	8.0	0.13	719	3.0	0.030	2.0	220	34	0.36	117	8.0	30	30	<0.01	<10	70	13	<10	48	5578	13	11	6.5	5.6	*Non-reactive*
		95th PCTL	8.9	0.84	5697	10.0	10	84	0.74	<2	0.38	<0.5	2.0	13	8.4	1.9	<10	3.8	0.18	27	6.5	0.100	539	2.7	0.027	2.0	202	31	0.33	103	7.4	29	30	<0.01	<10	52	13	<10	41	5481	9.4	10	5.0	4.9	*Non-reactive*
		90th PCTL	8.9	0.75	5574	9.4	10	78	0.68	<2	0.25	<0.5	2.0	11	7.8	1.7	<10	2.6	0.18	24	5.0	0.070	359	2.4	0.024	2.0	184	27	0.29	89	6.8	27	30	<0.01	<10	34	13	<10	35	5383	6.2	9.2	3.5	4.2	*Non-reactive*
		75th PCTL	3.9	0.56	5020	4.6	0.00	70	0.55	<2	0.055	<0.5	1.5	8.5	5.5	1.3	<10	1.0	0.16	20	2.5	0.025	94	1.5	0.015	2.0	150	21	0.23	69	3.5	24	30	<0.01	<10	10	9.5	<10	19	5113	1.4	7.0	1.1	2.6	5006
		Median	1.2	0.48	3290	1.8	<10	50	<0.5	<2	0.040	<0.5	1.0	7.0	2.0	1.0	<10	1.0	0.13	20	1.0	0.010	54	1.0	0.010	2.0	110	18	0.19	62	1.0	21	20	<0.01	<10	<10	4.0	<10	11	4062	1.0	5.9	-0.69	0.27	7.8
		25th PCTL	<0.2	0.43	1048	0.67	<10	40	<0.5	<2	<0.01	<0.5	1.0	4.0	2.0	0.82	<10	<1	0.11	10	<1	<0.01	14	1.0	0.010	1.0	75	16	0.020	26	1.0	19	0.00	<0.01	<10	<10	3.0	<10	3.0	802	0.25	0.63	-6.6	0.065	6.1
		10th PCTL	<0.2	0.32	662	0.47	<10	36	<0.5	<2	<0.01	<0.5	0.20	2.6	0.80	0.75	<10	<1	0.096	10	<1	<0.01	11	0.20	0.0020	1.0	66	15	0.010	4.2	1.0	13	<20	<0.01	<10	<10	2.6	<10	3.0	600	0.25	0.31	-8.6	0.038	3.9
		5th PCTL	<0.2	0.28	632	0.43	<10	33	<0.5	<2	<0.01	<0.5	<0.4	2.3	<1	0.70	<10	<1	0.093	10	<1	<0.01	10	<0.4	<0.01	1.0	63	15	0.010	3.6	1.0	8.9	<20	<0.01	<10	<10	2.3	<10	3.0	542	0.25	0.31	-9.4	0.035	2.4
		Min	<0.2	0.23	603	0.30	<10	30	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.65	<10	<1	0.090	10	<1	<0.01	10	<1	<0.01	1.0	60	14	0.010	3.0	1.0	5.0	<20	<0.01	<10	<10	2.0	<10	3.0	483	0.25	0.31	-10	0.032	0.94
Granite	Transition	**n**	45	27	27	93	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
		n <DL	18	0	0	0	16	0	12	25	10	27	5	0	4	0	27	10	0	0	3	3	0	10	14	8	0	0	2	0	11	3	3	27	27	10	2	27	1	-	-	-	-	-	-
		Max	8.9	1.1	10000	17	10	90	1.9	2.0	0.51	<0.5	4.0	15	9.0	5.8	<10	10	0.31	30	8.0	0.13	719	3.0	0.030	2.0	590	34	0.91	268	8.0	30	40	<0.01	<10	70	13	<10	60	8850	13	28	6.5	5.6	*Non-reactive*
		95th PCTL	8.5	0.96	6086	10.0	10	90	1.1	0.80	0.067	<0.5	3.0	8.7	7.7	4.3	<10	4.1	0.29	27	2.7	0.030	231	3.0	0.017	2.0	428	31	0.63	143	4.8	28	30	<0.01	<10	44	13	<10	44	5481	1.7	20	1.4	4.8	*Non-reactive*
		90th PCTL	4.9	0.95	5766	6.9	10	78	0.98	<2	0.060	<0.5	3.0	8.0	5.2	3.0	<10	1.4	0.28	20	2.0	0.024	208	3.0	0.010	2.0	330	30	0.49	89	2.0	23	30	<0.01	<10	24	10	<10	35	5086	1.5	15	1.2	4.3	*Non-reactive*
		75th PCTL	2.1	0.61	3715	3.3	10	55	0.75	<2	0.050	<0.5	2.0	7.0	2.5	1.6	<10	1.0	0.23	20	2.0	0.020	119	2.0	0.010	2.0	205	27	0.27	42	1.0	21	30	<0.01	<10	10	6.5	<10	20	3465	1.3	8.3	0.19	1.6	5014
		Median	0.20	0.48	2200	1.5	<10	40	0.50	<2	0.020	<0.5	1.0	5.0	2.0	1.2	<10	1.0	0.21	20	1.0	0.010	67	1.0	<0.01	1.0	110	19	0.16	12	1.0	12	30	<0.01	<10	10	3.0	<10	12	2181	0.50	5.0	-3.4	0.12	8.8
		25th PCTL	<0.2	0.42	1650	0.72	<10	30	<0.5	<2	<0.01	<0.5	1.0	3.5	2.0	0.83	<10	<1	0.17	10	1.0	0.010	26	<1	<0.01	<1	70	15	0.015	8.0	<1	6.5	20	<0.01	<10	<10	1.0	<10	3.0	960	0.25	0.47	-8.0	0.038	5.5
		10th PCTL	<0.2	0.36	1125	0.44	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.61	<10	<1	0.12	10	<1	0.0020	18	<1	<0.01	<1	60	12	0.010	4.2	<1	0.20	4.0	<0.01	<10	<10	1.0	<10	2.0	550	0.25	0.31	-15	0.031	1.6
		5th PCTL	<0.2	0.33	706	0.40	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.54	<10	<1	0.11	10	<1	<0.01	13	<1	<0.01	<1	60	12	<0.01	3.0	<1	<1	<20	<0.01	<10	<10	<0.4	<10	2.0	477	0.25	0.31	-19	0.022	1.0
		Min	<0.2	0.23	603	0.30	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	<1	0.42	<10	<1	0.090	10	<1	<0.01	10	<1	<0.01	<1	40	9.0	<0.01	3.0	<1	<1	<20	<0.01	<10	<10	<1	<10	<2	396	0.25	0.31	-27	0.016	0.63
Granite	All	**n**	189	168	168	243	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168	168
		n <DL	117	0	0	0	147	1	71	139	18	168	32	0	7	0	167	57	0	0	8	8	0	35	111	37	0	0	60	0	46	3	25	168	167	54	3	168	8	-	-	-	-	-	-
		Max	9.4	1.2	10000	20	10	430	2.1	4.0	0.51	<0.5	11	15	21	11	10	10	0.33	30	8.0	0.13	23700	8.0	0.030	6.0	940	59	0.91	468	8.0	124	40	<0.01	10	160	24	<10	165	8850	13	28	6.5	11	*Non-reactive*
		95th PCTL	3.4	0.91	7190	8.9	10	177	1.1	2.0	0.10	<0.5	7.0	8.0	8.7	4.3	<10	3.0	0.27	30	2.7	0.030	2619	3.0	0.010	3.0	330	35	0.25	169	4.7	59	30	<0.01	<10	60	15	<10	57	4687	2.5	7.8	2.2	6.9	*Non-reactive*
		90th PCTL	0.94	0.69	5494	5.5	10	143	0.90	2.0	0.083	<0.5	5.0	7.0	5.0	3.7	<10	2.0	0.24	23	2.0	0.020	1551	3.0	0.010	2.0	233	30	0.15	93	3.0	48	30	<0.01	<10	40	11	<10	48	3867	2.1	4.8	1.7	6.4	*Non-reactive*
		75th PCTL	0.20	0.55	3293	2.7	<10	90	0.70	<2	0.070	<0.5	3.0	6.0	3.0	2.1	<10	1.0	0.21	20	1.0	0.020	485	2.0	0.010	2.0	170	24	0.030	36	1.0	32	30	<0.01	<10	20	4.0	<10	32	2606	1.8	0.94	1.4	5.6	*Non-reactive*
		Median	<0.2	0.48	2035	1.3	<10	55	0.50	<2	0.060	<0.5	2.0	4.5	2.0	1.5	<10	1.0	0.18	20	1.0	0.010	117	1.0	<0.01	1.0	120	19	0.010	15	1.0	20	30	<0.01	<10	10	2.0	<10	19	1201	1.5	0.31	0.94	3.2	*Non-reactive*
		25th PCTL	<0.2	0.39	1353	0.67	<10	40	<0.5	<2	0.030	<0.5	1.0	3.0	2.0	1.0	<10	<1	0.14	20	1.0	0.010	37	1.0	<0.01	1.0	80	16	<0.01	10	<1	13	20	<0.01	<10	<10	1.0	<10	5.8	674	0.75	0.31	-0.13	0.80	0.80
		10th PCTL	<0.2	0.34	901	0.44	<10	30	<0.5	<2	<0.01	<0.5	<1	2.0	1.0	0.80	<10	<1	0.12	10	0.00	0.010	21	<1	<0.01	<1	60	14	<0.01	6.7	<1	9.0	<20	<0.01	<10	<10	1.0	<10	3.0	509	0.25	0.31	-3.7	0.12	0.12
		5th PCTL	<0.2	0.32	707	0.38	<10	20	<0.5	<2	<0.01	<0.5	<1	2.0	1.0	0.74	<10	<1	0.10	10	0.00	0.010	18	<1	<0.01	<1	60	12	<0.01	5.0	<1	7.4	<20	<0.01	<10	<10	1.0	<10	2.0	464	0.25	0.31	-7.6	0.046	0.046
		Min	<0.2	0.17	581	0.30	<10	<10	<0.5	<2	<0.01	<0.5	<1	1.0	<1	0.38	<10	<1	0.060	10	<1	<0.01	10	<1	<0.01	<1	40	9.0	<0.01	2.0	<1	<1	<20	<0.01	<10	<10	<1	<10	<2	341	0.25	0.31	-27	0.016	0.016

Appendix C.2-4: Statistical Summary of Exploration Assay Database (Au > 0.3 ppm)

Lithology	Oxide Facies	Statistics	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ga	Hg	K	La	Mg	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sr	Th	Ti	Tl	U	V	W	Zn	As/Fe	Surrogate Ca-NP (ICP-Ca)	Surrogate AP (ICP-S)	Surrogate NNP	Surrogate NPR	Surrogate NPR
			ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	Num	%	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	Ratio	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t	kgCaCO3/t
Other Lithologies																																													
Other	Oxide	**n**	902	901	901	2153	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901	901
		n <DL	288	0	0	0	859	0	76	760	0	879	27	2	5	0	894	321	0	16	0	0	0	319	288	76	0	2	236	1	63	0	630	840	896	503	5	875	3	-	-	-	-	-	-
		Max	4.3	2.9	10000	106	10	3480	5.3	5.0	12	1.1	111	193	148	11	10	8.0	1.5	60	68	5.1	28100	12	0.070	251	1890	194	4.0	10000	33	713	50	0.12	10	160	272	20	221	9178	290	125	289	712	*Non-reactive*
		95th PCTL	1.0	1.0	6270	21	*<10*	1190	2.1	2.0	6.5	*<0.5*	33	53	44	6.9	*<10*	3.0	0.38	40	42	2.1	1475	5.0	0.030	44	950	30	0.63	390	17	278	30	0.010	*<10*	50	89	*<10*	98	2027	163	20	154	218	*Non-reactive*
		90th PCTL	0.80	0.86	4700	12	*<10*	660	1.8	2.0	4.9	*<0.5*	27	41	35	5.9	*<10*	2.0	0.34	30	34	1.5	1135	4.0	0.020	36	740	24	0.32	232	14	205	30	*<0.01*	*<10*	30	67	*<10*	85	1357	121	10	117	136	*Non-reactive*
		75th PCTL	0.50	0.66	3310	4.5	*<10*	370	1.4	*<2*	2.4	*<0.5*	16	20	23	4.1	*<10*	1.0	0.29	30	14	0.47	760	2.0	0.010	22	540	17	0.080	103	7.0	124	20	*<0.01*	*<10*	20	32	*<10*	64	853	59	2.5	48	26	*Non-reactive*
		Median	0.20	0.52	1925	1.8	*<10*	200	1.0	*<2*	0.20	*<0.5*	10	12	12	2.8	*<10*	1.0	0.25	20	2.0	0.060	523	1.0	0.010	11	280	13	0.020	41	4.0	63	*<20*	*<0.01*	*<10*	*<10*	15	*<10*	39	588	5.0	0.63	3.7	7.0	23
		25th PCTL	*<0.2*	0.41	924	0.85	*<10*	110	0.60	*<2*	0.080	*<0.5*	4.0	6.0	6.0	1.9	*<10*	*<1*	0.20	10	1.0	0.030	243	*<1*	*<0.01*	3.0	160	10	*<0.01*	17	2.0	33	*<20*	*<0.01*	*<10*	*<10*	7.0	*<10*	21	421	2.0	0.31	1.2	2.7	1.9
		10th PCTL	*<0.2*	0.34	440	0.48	*<10*	60	0.50	*<2*	0.040	*<0.5*	2.0	4.0	3.0	1.1	*<10*	*<1*	0.16	10	1.0	0.020	63	*<1*	*<0.01*	1.0	90	7.0	*<0.01*	9.0	1.0	21	*<20*	*<0.01*	*<10*	*<10*	3.0	*<10*	11	306	1.0	0.31	0.063	1.1	0.63
		5th PCTL	*<0.2*	0.30	312	0.38	*<10*	50	*<0.5*	*<2*	0.030	*<0.5*	1.0	3.0	2.0	0.89	*<10*	*<1*	0.15	10	0.00	0.010	40	*<1*	*<0.01*	*<1*	70	6.0	*<0.01*	6.0	*<1*	16	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	8.0	239	0.75	0.31	-1.8	0.48	0.63
		Min	*<0.2*	0.17	117	0.30	*<10*	20	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.42	*<10*	*<1*	0.080	*<10*	0.00	0.010	8.0	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	4.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	129	0.25	0.31	-52	0.0048	0.63
Other	Upper Transition	**n**	350	327	327	1204	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327	327
		n <DL	76	0	0	0	308	0	81	264	0	314	76	1	1	0	327	198	0	3	0	0	1	152	126	98	0	1	58	0	79	0	256	318	325	274	8	323	0	-	-	-	-	-	-
		Max	206	2.0	10000	109	10	1430	2.2	4.0	10	2.1	37	197	1180	5.8	*<10*	33	1.1	60	59	4.0	4130	34	0.040	342	1150	122	4.2	5020	18	509	40	0.10	10	110	64	1350	379	8772	250	132	250	800	*Non-reactive*
		95th PCTL	1.2	0.86	6367	9.5	10	570	1.6	3.0	6.8	*<0.5*	20	44	34	4.4	*<10*	2.0	0.40	40	46	2.8	912	3.0	0.030	53	771	53	1.6	595	8.7	340	20	*<0.01*	*<10*	20	32	*<10*	77	2189	171	48	149	168	*Non-reactive*
		90th PCTL	1.0	0.73	5418	6.9	*<10*	406	1.4	2.0	5.5	*<0.5*	17	33	28	3.9	*<10*	1.0	0.37	30	42	2.2	832	2.0	0.020	36	564	32	1.2	208	8.0	278	20	*<0.01*	*<10*	10	28	*<10*	63	1488	138	37	120	70	*Non-reactive*
		75th PCTL	0.60	0.61	2655	3.5	*<10*	255	1.0	*<2*	3.8	*<0.5*	11	16	17	2.9	*<10*	1.0	0.32	30	32	1.3	714	1.0	0.010	20	400	23	0.55	45	4.0	164	*<20*	*<0.01*	*<10*	*<10*	15	*<10*	48	928	96	17	70	14	*Non-reactive*
		Median	0.38	0.50	1465	1.5	*<10*	160	0.70	*<2*	0.52	*<0.5*	7.0	8.0	9.0	2.3	*<10*	*<1*	0.28	30	6.0	0.11	424	1.0	0.010	6.0	170	16	0.030	18	2.0	55	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	35	669	13	0.94	11	4.0	34
		25th PCTL	0.20	0.45	452	0.79	*<10*	90	0.50	*<2*	0.060	*<0.5*	1.0	3.0	4.0	0.88	*<10*	*<1*	0.24	20	2.0	0.020	83	*<1*	*<0.01*	*<1*	80	12	0.010	10	1.0	21	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	15	521	1.5	0.31	0.94	2.4	6.1
		10th PCTL	*<0.2*	0.35	259	0.47	*<10*	56	*<0.5*	*<2*	0.040	*<0.5*	*<1*	2.0	3.0	0.54	*<10*	*<1*	0.19	10	1.0	0.010	40	*<1*	*<0.01*	*<1*	70	8.0	*<0.01*	6.0	*<1*	14	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	8.0	377	1.0	0.31	0.13	1.1	0.63
		5th PCTL	*<0.2*	0.30	218	0.38	*<10*	40	*<0.5*	*<2*	0.030	*<0.5*	*<1*	2.0	2.0	0.46	*<10*	*<1*	0.17	10	1.0	0.010	26	*<1*	*<0.01*	*<1*	60	7.0	*<0.01*	5.0	*<1*	11	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	310	0.75	0.31	-1.7	0.44	0.63
		Min	*<0.2*	0.24	117	0.30	*<10*	20	*<0.5*	*<2*	0.010	*<0.5*	*<1*	*<1*	*<1*	0.37	*<10*	*<1*	0.080	*<10*	0.00	0.010	*<5*	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	2.0	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	2.0	66	0.25	0.31	-47	0.0053	0.63
Other	Lower Transition	**n**	111	76	76	368	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76	76
		n <DL	24	0	0	0	66	0	9	67	2	76	2	0	0	0	74	26	0	1	0	0	0	33	24	21	0	0	2	1	4	0	68	62	73	56	4	75	0	-	-	-	-	-	-
		Max	19	2.9	10000	121	10	1450	2.7	3.0	5.4	*<0.5*	111	178	73	7.7	10	33	1.5	50	46	2.5	4920	4.0	0.080	71	1600	66	4.0	2180	22	449	40	0.19	10	140	95	10	125	5874	134	125	134	429	*Non-reactive*
		95th PCTL	10	1.5	10000	13	10	425	1.8	2.0	4.0	*<0.5*	28	56	58	5.0	*<10*	20	0.57	30	36	1.9	944	3.0	0.033	39	753	30	2.2	1275	17	233	23	0.090	*<10*	23	70	*<10*	63	5525	100	69	62	40	*Non-reactive*
		90th PCTL	4.5	1.2	9460	8.2	10	315	1.2	2.0	3.8	*<0.5*	16	30	46	3.9	*<10*	2.0	0.50	30	36	1.5	828	2.0	0.030	26	640	30	1.8	439	9.0	179	0.00	0.030	*<10*	20	52	*<10*	60	5318	96	57	55	31	*Non-reactive*
		75th PCTL	1.1	0.93	6300	3.8	*<10*	203	1.0	*<2*	3.5	*<0.5*	11	20	28	2.8	*<10*	1.0	0.40	20	31	1.3	702	1.0	0.020	15	563	20	1.5	109	6.3	129	*<20*	*<0.01*	*<10*	10	20	*<10*	48	3103	88	46	32	2.7	57
		Median	0.40	0.67	2720	1.7	*<10*	150	0.80	*<2*	0.45	*<0.5*	7.5	6.0	13	2.4	*<10*	1.0	0.31	20	12	0.28	380	1.0	0.010	2.0	250	14	1.1	39	4.0	59	*<20*	*<0.01*	*<10*	*<10*	12	*<10*	38	1049	11	35	6.9	1.3	43
		25th PCTL	0.20	0.55	1518	0.81	*<10*	98	0.50	*<2*	0.21	*<0.5*	2.0	2.0	6.8	1.9	*<10*	*<1*	0.24	10	3.0	0.10	70	*<1*	*<0.01*	*<1*	160	11	0.13	11	2.0	29	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	24	541	5.3	3.9	-21	0.19	29
		10th PCTL	*<0.2*	0.45	208	0.42	*<10*	60	*<0.5*	*<2*	0.010	*<0.5*	1.0	1.0	4.5	1.5	*<10*	*<1*	0.18	10	1.0	0.010	22	*<1*	*<0.01*	*<1*	115	8.0	0.010	6.5	1.0	23	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	5.5	151	0.25	0.31	-33	0.036	3.4
		5th PCTL	*<0.2*	0.44	111	0.36	*<10*	50	*<0.5*	*<2*	0.010	*<0.5*	1.0	1.0	2.0	1.1	*<10*	*<1*	0.16	10	1.0	0.010	17	*<1*	*<0.01*	*<1*	78	6.0	0.010	4.8	0.50	19	*<20*	*<0.01*	*<10*	*<10*	0.50	*<10*	3.8	47	0.25	0.31	-41	0.019	0.94
		Min	*<0.2*	0.40	7.0	0.31	*<10*	30	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	1.0	2.0	0.67	*<10*	*<1*	0.10	*<10*	0.00	0.010	10	*<1*	*<0.01*	*<1*	40	3.0	*<0.01*	*<2*	*<1*	13	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	3.0	2.4	0.25	0.31	-43	0.0058	0.63
Other	Transition	**n**	461	403	403	1572	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403	403
		n <DL	100	0	0	0	374	0	90	331	2	390	78	1	1	0	401	224	0	4	0	0	1	185	150	119	0	1	60	1	83	0	324	380	398	330	12	398	0	-	-	-	-	-	-
		Max	206	2.9	10000	121	10	1450	2.7	4.0	10	2.1	111	197	1180	7.7	10	33	1.5	60	59	4.0	4920	34	0.080	342	1600	122	4.2	5020	22	509	40	0.19	10	140	95	1350	379	8772	250	132	250	800	*Non-reactive*
		95th PCTL	3.2	1.0	9249	11	10	570	1.6	2.0	6.7	*<0.5*	20	48	38	4.4	*<10*	3.0	0.47	40	45	2.7	933	3.0	0.030	51	777	47	1.8	715	9.0	312	20	0.010	*<10*	20	43	*<10*	76	4479	168	55	142	128	*Non-reactive*
		90th PCTL	1.2	0.84	6270	7.0	*<10*	390	1.4	2.0	5.2	*<0.5*	17	32	32	3.9	*<10*	2.0	0.40	30	39	2.2	835	2.0	0.020	36	600	31	1.5	254	8.0	267	20	*<0.01*	*<10*	10	31	*<10*	62	2464	131	46	113	57	*Non-reactive*
		75th PCTL	0.70	0.68	3275	3.6	*<10*	240	1.0	*<2*	3.7	*<0.5*	11	16	19	2.9	*<10*	1.0	0.33	30	32	1.3	710	1.0	0.020	20	415	22	0.84	54	5.0	158	*<20*	*<0.01*	*<10*	*<10*	15	*<10*	48	1107	93	26	59	11	*Non-reactive*
		Median	0.40	0.53	1570	1.5	*<10*	160	0.70	*<2*	0.46	*<0.5*	7.0	8.0	9.0	2.3	*<10*	*<1*	0.29	20	6.0	0.13	417	1.0	0.010	4.0	200	16	0.080	18	3.0	56	*<20*	*<0.01*	*<10*	*<10*	7.0	*<10*	36	675	12	2.5	9.2	3.9	39
		25th PCTL	0.20	0.46	512	0.79	*<10*	90	0.50	*<2*	0.060	*<0.5*	1.0	3.0	4.0	1.2	*<10*	*<1*	0.24	20	2.0	0.020	80	*<1*	*<0.01*	*<1*	80	12	0.010	10	1.0	26	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	15	527	1.5	0.31	0.69	1.6	7.7
		10th PCTL	*<0.2*	0.37	254	0.47	*<10*	60	*<0.5*	*<2*	0.040	*<0.5*	*<1*	2.0	3.0	0.55	*<10*	*<1*	0.19	10	1.0	0.010	39	*<1*	*<0.01*	*<1*	70	8.0	*<0.01*	6.0	*<1*	15	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	8.0	361	1.0	0.31	-3.6	0.33	0.94
		5th PCTL	*<0.2*	0.31	207	0.37	*<10*	40	*<0.5*	*<2*	0.010	*<0.5*	*<1*	1.0	2.0	0.47	*<10*	*<1*	0.17	10	1.0	0.010	23	*<1*	*<0.01*	*<1*	60	7.0	*<0.01*	5.0	*<1*	12	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	6.1	246	0.25	0.31	-24	0.12	0.63
		Min	*<0.2*	0.24	7.0	0.30	*<10*	20	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	*<1*	*<1*	0.37	*<10*	*<1*	0.080	*<10*	0.00	0.010	*<5*	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	5.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	2.0	2.4	0.25	0.31	-47	0.0053	0.63
Other	All	**n**	1363	1304	1304	3725	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304	1304
		n <DL	388	0	0	0	1233	0	166	1091	2	1269	105	3	6	0	1295	545	0	20	0	0	1	504	438	195	0	3	296	2	146	0	954	1220	1294	833	17	1273	3	-	-	-	-	-	-
		Max	206	2.9	10000	121	10	3480	5.3	5.0	12	2.1	111	197	1180	11	10	33	1.5	60	68	5.1	28100	34	0.080	342	1890	194	4.2	10000	33	713	50	0.19	10	160	272	1350	379	9178	290	132	289	800	*Non-reactive*
		95th PCTL	1.2	1.0	6762	17	10	920	2.0	2.0	6.6	*<0.5*	31	53	41	6.4	*<10*	3.0	0.40	40	43	2.3	1347	5.0	0.030	46	878	35	1.4	433	16	289	30	0.010	*<10*	50	78	*<10*	94	2747	165	45	152	214	*Non-reactive*
		90th PCTL	0.90	0.85	5190	9.6	*<10*	570	1.7	2.0	5.0	*<0.5*	23	39	34	5.3	*<10*	2.0	0.36	30	37	1.6	1035	3.0	0.020	36	710	26	0.87	242	11	221	20	*<0.01*	*<10*	30	53	*<10*	82	1518	125	27	117	111	*Non-reactive*
		75th PCTL	0.50	0.66	3315	4.1	*<10*	330	1.3	*<2*	3.0	*<0.5*	14	20	22	3.7	*<10*	1.0	0.30	30	23	0.85	745	2.0	0.010	22	500	19	0.17	93	7.0	132	20	*<0.01*	*<10*	10	27	*<10*	57	919	75	5.3	54	22	*Non-reactive*
		Median	0.30	0.52	1793	1.7	*<10*	180	0.90	*<2*	0.26	*<0.5*	9.0	10	11	2.6	*<10*	1.0	0.26	20	3.0	0.070	500	1.0	0.010	10	260	14	0.020	32	3.0	60	*<20*	*<0.01*	*<10*	*<10*	12	*<10*	37	620	6.4	0.63	4.3	6.0	59
		25th PCTL	*<0.2*	0.43	828	0.82	*<10*	110	0.60	*<2*	0.070	*<0.5*	3.0	6.0	5.0	1.7	*<10*	*<1*	0.21	10	1.0	0.030	172	*<1*	*<0.01*	2.0	130	11	0.010	14	2.0	29	*<20*	*<0.01*	*<10*	*<10*	6.0	*<10*	20	446	1.8	0.31	0.94	2.4	2.6
		10th PCTL	*<0.2*	0.34	340	0.47	*<10*	60	*<0.5*	*<2*	0.040	*<0.5*	1.0	3.0	3.0	0.89	*<10*	*<1*	0.17	10	1.0	0.020	50	*<1*	*<0.01*	*<1*	80	8.0	*<0.01*	8.0	*<1*	18	*<20*	*<0.01*	*<10*	*<10*	2.0	*<10*	9.3	318	1.0	0.31	-0.42	0.89	0.89
		5th PCTL	*<0.2*	0.31	255	0.38	*<10*	50	*<0.5*	*<2*	0.030	*<0.5*	*<1*	2.0	2.0	0.57	*<10*	*<1*	0.15	10	1.0	0.010	32	*<1*	*<0.01*	*<1*	60	6.0	*<0.01*	6.0	*<1*	14	*<20*	*<0.01*	*<10*	*<10*	1.0	*<10*	7.0	239	0.75	0.31	-4.1	0.28	0.28
		Min	*<0.2*	0.17	7.0	0.30	*<10*	20	*<0.5*	*<2*	*<0.01*	*<0.5*	*<1*	*<1*	*<1*	0.37	*<10*	*<1*	0.080	*<10*	0.00	0.010	*<5*	*<1*	*<0.01*	*<1*	30	*<2*	*<0.01*	*<2*	*<1*	4.0	*<20*	*<0.01*	*<10*	*<10*	*<1*	*<10*	*<2*	2.4	0.25	0.31	-52	0.0048	0.0048

Notes: all values in grey italics are below the analytical detection limit
n = number of samples included in statistical summary
n < DL = number of samples with values below the analytical detection limit

Appendix C.3: Static Test Results for Leach Tailings

Appendix C.3-1: Acid-Base Accounting Results for Leach Tailings Solids

Metallurgical ID (leach tailings)	Head Sample ID (ore)	Oxidation Facies	Lithology	Sample Description	Rinse pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	Insoluble-S	T-AP	S-AP	Total-C	TIC	CaNP	Sobek NP	Siderite NP	CaNNP	Sobek NNP	Siderite NNP	NPR	NPR	NPR	NPR
					s.u.	s.u.	%	%	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	CaNP/T-AP	CaNP/S-AP	Sobek/T-AP	Siderite/T-AP
Tailings derived from Gneiss Oxide Ore																								
73004	72134	Oxide	Gneiss	Supremo Mine Block (1")	9.7	9.2	0.01	*<0.01*	*<0.01*	0.01	0.22	*<0.3*	0.042	0.020	1.7	3.5	12	1.4	3.5	12	7.6	5.6	16	55
73013	72142	Oxide	Gneiss	Supremo #1	9.6	9.3	0.01	*<0.01*	*<0.01*	0.01	0.44	*<0.3*	0.041	0.020	1.7	6.2	13	1.2	6.2	13	3.8	5.6	14	29
73022	72143	Oxide	Gneiss	Supremo #2	9.7	9.3	0.02	*<0.01*	*<0.01*	0.02	0.47	*<0.3*	0.041	0.020	1.7	2.2	8.7	1.2	2.2	8.7	3.6	5.6	4.7	19
73028	72144	Oxide	Gneiss	Supremo Oxide T1	9.6	9.3	0.03	0.01	*<0.01*	0.02	1.0	0.31	0.12	0.11	9.2	12	18	8.1	12	17	8.9	29	11	17
73034	72145	Oxide	Gneiss	Supremo Oxide T4	9.7	9.2	0.02	0.01	*<0.01*	0.01	0.69	0.31	0.37	0.36	30	30	36	29	29	36	44	96	43	53
Tailings derived from GneissTransition Ore																								
73040	72146	Transition	Gneiss	Supremo 80%	9.5	9.2	0.10	0.05	0.02	0.03	3.0	1.6	0.43	0.42	35	38	44	32	36	42	12	22	12	14
Tailings derived from Schist/Gneiss Oxide Ore																								
72186	72141	Oxide	Schist/Gneiss	DD oxide	9.6	9.3	0.13	0.1	0.01	0.02	4.0	3.1	1.0	1.0	84	79	83	80	76	80	21	27	20	21
Tailings derived from Schist Oxide Ore																								
72117	72101	Oxide	Schist	Latte -583150 Trench (6")	9.6	9.1	0.04	*<0.01*	0.02	0.02	1.1	*<0.3*	0.81	0.78	65	65	69	64	65	69	59	217	59	63
72123	72102	Oxide	Schist	Latte 583350 Trench (6")	9.7	9.2	0.05	0.02	0.02	0.01	1.5	0.63	1.2	1.2	97	96	119	95	95	118	64	155	64	79
73001	72133	Oxide	Schist	Latte mine block (1")	9.5	8.9	0.05	*<0.01*	0.04	0.01	1.6	*<0.3*	0.039	0.020	1.7	5.6	15	0.073	5.6	15	1.0	5.6	3.5	9.3
72150	72135	Oxide	Schist	Latte Oxide West	8.6	8.6	0.11	0.07	0.02	0.02	3.4	2.2	1.7	1.6	137	124	154	133	122	151	40	62	36	45
72156	72136	Oxide	Schist	Latte Oxide East	9.6	9.1	0.09	0.06	0.02	0.01	2.7	1.9	1.1	1.0	83	79	85	81	78	83	31	44	29	31
Tailings derived from Schist Transition Ore																								
72162	72137	Transition	Schist	Latte 80%'	8.9	8.4	0.41	0.33	0.04	0.04	13	10	2.1	1.9	158	146	175	146	136	165	12	15	11	14
72168	72138	Transition	Schist	Latte 60%	8.9	8.6	0.47	0.39	0.03	0.05	15	12	1.6	1.6	130	127	155	115	114	143	8.9	11	8.7	11
Tailings derived from Granite Oxide Ore																								
72174	72139	Oxide	Granite	Kona Oxide	9.7	9.2	0.03	0.02	*<0.01*	0.01	1.0	0.63	0.034	0.020	1.7	0.37	8.3	0.64	-0.26	7.7	1.6	2.7	0.35	8.1
Tailings derived from Granite Transition Ore																								
72180	72140	Transition	Granite	Kona 80% CN	9.7	8.9	0.18	0.14	0.01	0.03	5.5	4.4	0.045	0.030	2.5	0.61	7.6	-3.0	-3.8	3.2	0.45	0.57	0.11	1.4

Notes: all values in grey italics are below the analytical detection limit.
All samples are composed of the 12.5 mm particle size fraction of leach tailings
Sulphate Sulphur determined by 25% HCL with Gravimetric Finish.
Sulphide Sulphur determined by Sobek 1:7 Nitric Acid with S by ICP-MS Finish.
AP = Acid potential in tonnes CaCO3 equivalent per 1000 tonnes of material, T-AP is derived from Total-S*31.25 and S-AP is derived from Sulphide-S*31.25.
NP = Neutralization potential in tonnes CaCO3 equivalent per 1000 tonnes of material.
Carbonate NP (CaNP) is calculated from total inorganic carbon (TIC); T-C NP* calculated from Total-C * 77.6.
Net NP (NNP) = NP - AP; Neutralization potential ratio (NPR).

Appendix C.3-2: Solid Phase Element Results by Aqua Regia Digestion for Leach Tailings Solids

Metallurgical ID (leach tailings)	Head Sample ID (ore)	Oxidation Facies	Lithology	Sample Description	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Lu	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	S	Sb	Sc	Se	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	U	V	W	Y	Yb	Zn	Zr
					ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Tailings derived from Gnaiess Oxide Ore																																																												
73004	72101	Oxide	Gneiss	Supremo Mine Block (1")	0.25	0.45	2660	*<10*	318	1.0	0.45	0.21	0.20	74	15	122	1.7	20	4.4	1.6	*<0.1*	0.070	1.4	0.030	0.29	38	*<1*	0.17	0.070	682	6.5	0.060	*<0.1*	58	0.040	9.3	14	*<0*	97	4.7	*<1*	0.50	17	*<0.1*	0.51	0.22	13	*<0*	3.3	23	26	0.60	11	1.1	40	2.5
73013	72102	Oxide	Gneiss	Supremo #1	0.12	0.77	1060	*<10*	337	0.90	0.23	0.22	0.12	47	13	137	1.9	8.5	2.9	2.4	*<0.1*	0.15	0.56	0.030	0.29	25	3.0	0.16	0.27	793	4.7	0.050	0.070	70	0.041	14	16	0.010	41	8.9	*<1*	0.50	19	*<0.1*	0.37	0.10	17	0.010	1.6	20	36	0.40	10	1.1	42	6.7
73022	72133	Oxide	Gneiss	Supremo #2	0.060	0.48	588	*<10*	147	0.80	0.49	0.12	0.070	49	6.3	93	0.82	11	1.8	1.6	*<0.1*	0.20	0.13	*<0.02*	0.17	27	2.0	0.14	0.10	281	5.0	0.030	0.080	12	0.026	11	10	*<0*	40	3.5	*<1*	0.40	20	*<0.1*	0.33	0.17	24	*<0*	0.28	6.9	25	0.40	9.7	1.0	21	7.5
73028	72135	Oxide	Gneiss	Supremo Oxide T1	0.090	0.49	969	*<10*	196	1.2	0.32	0.38	0.090	63	8.5	98	1.6	7.7	2.3	1.6	*<0.1*	0.18	0.60	*<0.02*	0.26	34	2.0	0.19	0.16	472	4.8	0.030	0.070	14	0.036	14	14	0.030	55	4.4	*<1*	0.50	42	*<0.1*	0.43	0.090	25	*<0*	0.56	18	24	0.80	12	1.3	41	6.5
73034	72136	Oxide	Gneiss	Supremo Oxide T4	0.15	0.46	1040	*<10*	187	1.0	0.18	1.3	0.060	58	4.4	110	2.0	6.6	1.5	1.5	*<0.1*	0.13	1.1	*<0.02*	0.22	34	1.0	0.16	0.14	315	5.4	0.040	0.060	16	0.020	13	13	0.020	31	2.3	*<1*	1.4	30	*<0.1*	0.34	*<0.1*	27	*<0*	1.0	12	11	0.40	11	1.1	21	4.5
Tailings derived from Gneiss Transition Ore																																																											
73040	72137	Transition	Gneiss	Supremo 80%	0.060	0.70	1760	*<10*	302	0.90	0.57	1.2	0.080	64	6.8	126	2.6	2.3	2.0	2.3	*<0.1*	0.16	1.1	0.020	0.37	36	4.0	0.17	0.52	488	6.4	0.040	0.12	23	0.029	13	22	0.090	22	2.8	*<1*	0.80	46	*<0.1*	0.39	0.23	25	0.020	2.0	12	18	0.40	11	1.1	29	5.7
Tailings derived from Schist/Gneiss Oxide Ore																																																											
72186	72138	Oxide	Schist/Gneiss	DD oxide	0.060	0.76	1410	*<10*	291	1.2	0.80	2.7	0.11	53	13	120	2.9	10	3.2	2.5	*<0.1*	0.12	0.41	0.030	0.29	29	3.0	0.16	0.81	569	4.1	0.050	0.050	34	0.032	14	17	0.12	43	5.9	*<1*	0.60	63	*<0.1*	0.41	0.16	16	*<0*	0.29	4.9	27	1.6	11	1.1	42	4.0
Tailings derived from Schist Oxide Ore																																																											
72117	72139	Oxide	Schist	Latte -583150 Trench (6")	0.070	0.76	1120	*<10*	822	0.90	0.82	2.3	0.080	70	14	102	2.2	33	3.3	2.5	*<0.1*	0.12	0.20	0.020	0.30	35	4.0	0.24	0.54	552	3.8	0.050	0.060	43	0.057	12	15	0.030	138	5.5	*<1*	0.30	62	*<0.1*	0.64	0.070	12	0.010	0.47	1.7	30	0.30	18	1.6	62	5.0
72123	72140	Oxide	Schist	Latte 583350 Trench (6")	0.080	0.53	1580	*<10*	926	0.60	0.50	3.7	0.15	66	13	88	1.7	25	3.2	2.0	*<0.1*	0.13	0.57	0.030	0.27	35	2.0	0.20	0.44	723	3.6	0.040	0.080	30	0.070	16	13	0.050	53	4.9	*<1*	*<0.3*	90	*<0.1*	0.51	0.080	13	*<0*	0.75	2.1	24	1.0	14	1.3	58	4.8
73001	72134	Oxide	Schist	Latte mine block (1")	0.64	0.44	9020	*<10*	636	0.90	0.50	0.50	0.13	85	11	90	2.4	25	3.9	1.2	*<0.1*	0.060	0.81	0.040	0.23	46	1.0	0.23	0.050	627	3.6	0.050	*<0.1*	33	0.058	16	10	0.040	243	5.3	*<1*	*<0.3*	103	*<0.1*	0.62	0.33	10	*<0*	1.4	4.5	13	0.50	16	1.5	75	1.7
72150	72142	Oxide	Schist	Latte Oxide West	0.13	0.40	1380	*<10*	310	1.1	0.37	4.1	0.10	54	12	126	1.6	21	2.7	1.3	*<0.1*	0.12	0.31	*<0.02*	0.21	29	1.0	0.16	1.0	488	4.0	0.030	*<0.1*	102	0.033	14	9.9	0.11	26	3.9	*<1*	*<0.3*	115	*<0.1*	0.40	0.070	12	*<0*	0.24	2.1	16	1.3	12	1.1	46	3.7
72156	72143	Oxide	Schist	Latte Oxide East	0.060	0.52	1280	*<10*	387	1.1	0.39	2.9	0.15	59	12	109	2.5	12	2.8	2.0	*<0.1*	0.12	0.26	0.020	0.26	31	2.0	0.20	0.56	501	4.3	0.040	*<0.1*	56	0.039	15	13	0.090	27	4.5	*<1*	0.50	92	*<0.1*	0.52	0.060	12	*<0*	0.31	2.6	21	1.2	16	1.4	55	4.0
Tailings derived from Schist Transition Ore																																																											
72162	72144	Transition	Schist	Latte 80%'	0.11	0.65	1710	*<10*	329	0.80	0.45	5.0	0.090	57	13	88	2.0	15	2.5	2.2	*<0.1*	0.080	0.36	0.020	0.27	29	3.0	0.19	1.0	466	3.4	0.030	0.070	59	0.045	15	13	0.43	21	4.3	*<1*	0.40	133	*<0.1*	0.50	0.060	12	*<0*	0.61	2.6	20	0.40	14	1.3	50	2.5
72168	72145	Transition	Schist	Latte 60%	0.080	0.83	932	*<10*	344	0.90	0.46	4.0	0.10	57	11	103	3.1	20	2.8	3.1	*<0.1*	0.16	0.28	0.030	0.35	30	5.0	0.19	1.1	518	4.3	0.040	0.14	41	0.044	13	18	0.48	56	5.4	*<1*	0.60	144	*<0.1*	0.48	0.060	15	0.020	0.35	2.4	28	0.40	13	1.3	49	5.0
Tailings derived from Granite Oxide Ore																																																											
72174	72146	Oxide	Granite	Kona Oxide	0.030	0.44	4170	*<10*	91	0.60	0.080	0.12	0.050	28	1.4	93	1.2	2.2	1.5	1.5	*<0.1*	0.34	0.55	0.020	0.13	14	1.0	0.12	0.020	97	4.8	0.040	0.31	5.0	0.015	16	9.4	0.030	48	3.4	*<1*	0.40	23	*<0.1*	0.22	*<0.1*	24	*<0*	0.65	8.8	14	0.20	6.4	0.70	17	12
Tailings derived from Granite Transition Ore																																																											
72180	72141	Transition	Granite	Kona 80% CN	0.060	0.34	5880	*<10*	44	0.30	0.11	0.090	0.040	25	1.4	103	1.2	1.6	1.2	1.1	*<0.1*	0.26	3.0	*<0.02*	0.14	13	1.0	0.090	0.010	194	5.5	0.040	0.29	5.4	0.013	20	8.0	0.17	86	2.1	*<1*	0.30	20	*<0.1*	0.19	*<0.1*	18	*<0*	1.2	7.4	8.0	0.20	5.3	0.60	12	9.7

Notes: all values in grey italics are below the analytical detection limit.
All samples are composed of the 12.5 mm particle size fraction of leach tailings

Appendix C.3-3: Total and Dissolved Elements in Final Leachate from Cyanide Leach Tailings Columns

Lithology	Pit/Weathering Facies	Column ID	Head Sample ID	Column Particle size (p80)	Column mass	Conductivity	Hardness (as $CaCO_3$)	pH	TSS	TDS	T-Alk.	NH_3-N	Br	Cl	F	NO_3-N	NO_2-N	T-N	SO_4	WAD-CN	Total CN	Cyanate	SCN	T-Al	T-Sb	T-As	T-Ba	T-Be	T-Bi	T-Bo	T-Cd	T-Ca	T-Cs
				mm	kg	uS/cm	mg/L	s.u.	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Gneiss	Supremo #1	73010	72142	80	83	2570	8.8	9.8	275	1710	517	68	*<1*	21	*<0.4*	0.55	0.77	125	9.6	98	100	159	2.4	0.19	0.030	0.90	0.089	*<0.0002*	*<0.0001*	*<0.02*	0.0047	17	0.00020
Gneiss	Supremo #1	73013	72142	12.5	43	1530	11	10	277	869	491	43	*<0.5*	22	0.89	0.50	0.28	127	12	166	172	150	1.1	0.080	0.020	0.70	0.030	*<0.0002*	*<0.0001*	*<0.02*	0.00020	19	0.00020
Gneiss	Supremo #1	73007	72142	150	718	2340	132	9.9	328	1540	468	50	*<1*	15	*<0.4*	0.66	0.32	140	6.9	171	168	80	1.4	0.27	0.010	0.20	0.35	*<0.0002*	*<0.0001*	*<0.02*	0.038	98	0.00010
Gneiss	Supremo #2	73019	72143	80	86	2910	13	9.9	498	1950	883	79	*<1*	22	0.52	0.93	0.66	139	11	86	90	131	2.5	0.40	0.050	2.0	0.047	*<0.0005*	*<0.00025*	*<0.05*	0.0035	50	0.00010
Gneiss	Supremo #2	73022	72143	12.5	44	2010	8.0	10	286	1120	473	56	*<1*	192	0.65	0.58	0.28	124	12	129	134	200	1.4	0.30	0.020	0.70	0.024	*<0.0002*	*<0.0001*	0.037	0.00	22	0.00010
Gneiss	Supremo #2	73016	72143	150	741	2360	15	9.9	76	1570	678	74	*<1*	16	0.41	1.6	0.40	143	8.1	119	124	84	1.8	0.43	0.030	1.1	0.037	*<0.0002*	*<0.0001*	*<0.02*	0.027	18	0.00
Gneiss	Supremo Oxide T1	73025	72144	80	99	2600	3.8	9.9	701	1640	738	68	*<1*	22	*<0.4*	0.27	0.65	140	45	123	124	127	2.1	0.21	0.13	5.2	0.038	*<0.0002*	*<0.0001*	0.028	0.0029	57	0.0024
Gneiss	Supremo Oxide T1	73028	72144	12.5	50	1540	3.9	10	270	894	492	43	*<0.5*	24	0.76	0.32	0.35	109	42	123	126	168	1.3	0.13	0.040	3.6	0.033	*<0.0002*	*<0.0001*	0.023	0.00030	67	0.00010
Gneiss	Supremo Oxide T4	73031	72145	80	95	3130	7.8	9.8	595	2040	644	75	*<1*	25	*<0.4*	0.28	0.65	175	58	167	170	138	3.1	0.070	0.070	2.9	0.067	*<0.0005*	*<0.00025*	*<0.05*	0.0019	38	0.0011
Gneiss	Supremo Oxide T4	73034	72145	12.5	49	1540	7.7	10	310	911	418	56	*<0.5*	25	0.50	0.20	0.66	142	63	157	161	192	1.3	0.050	0.030	2.9	0.015	*<0.0002*	*<0.0001*	*<0.02*	0.00030	11	0.00010
Gneiss	Supremo Mine Block (1")	73004	72134	12.5	46	1770	9.2	10	58	992	676	40	*<0.5*	18	0.95	0.20	0.23	105	8.8	109	113	132	1.5	0.060	0.030	1.5	0.0050	*<0.0002*	*<0.0001*	*<0.02*	0.00060	2.7	0.00010
Gneiss	Supremo 80%	73037	72146	80	94	4250	6.5	9.8	690	2810	1180	80	*<1*	27	0.67	0.31	0.75	158	444	128	136	96	13	0.090	0.27	14	0.0070	*<0.0005*	*<0.00025*	*<0.05*	0.00090	1.6	0.0061
Gneiss	Supremo 80%	73040	72146	12.5	50	2780	17	10	305	1760	374	53	*<1*	30	0.94	0.20	0.72	136	744	150	156	188	7.8	0.080	0.18	7.4	0.0030	*<0.0002*	*<0.0001*	*<0.02*	0.00010	5.6	0.0010
Gneiss/Schist	DD oxide	72183	72141	80	95	3250	9.6	9.8	541	2230	564	89	*<1*	41	0.47	0.37	0.91	175	220	132	134	222	6.1	0.030	0.090	2.6	0.018	*<0.0005*	*<0.00025*	*<0.05*	0.0034	4.7	0.0033
Gneiss/Schist	DD oxide	72186	72141	12.5	50	1810	4.5	10	337	1060	439	60	*<1*	30	0.53	0.22	0.48	133	177	141	142	204	1.8	0.060	0.030	1.9	0.0040	*<0.0002*	*<0.0001*	*<0.02*	0.00010	1.8	0.00010
Schist	Latte mine block (1")	73001	72133	12.5	48	1450	9.6	10	50	820	458	40	*<0.5*	19	0.69	0.25	0.35	98	43	105	101	166	1.1	0.060	0.080	16	0.012	*<0.0002*	*<0.0001*	*<0.02*	0.00010	11	0.00020
Schist	Latte Oxide East	72153	72136	80	101	4300	8.2	9.8	18	3040	590	77	*<1*	26	0.71	0.65	1.3	156	725	117	119	149	6.4	0.050	0.090	6.2	0.014	*<0.0005*	*<0.00025*	*<0.05*	0.0076	6.5	0.0024
Schist	Latte Oxide East	72156	72136	12.5	50	2410	11	9.9	279	1520	366	60	*<1*	23	0.76	0.45	0.43	143	547	145	144	214	3.3	0.090	0.030	2.5	0.015	*<0.0002*	*<0.0001*	*<0.02*	0.00060	73	0.00040
Schist	Latte 80%'	72159	72137	80	94	7380	295	9.5	317	5630	322	103	*<2.5*	27	*<1*	0.26	1.0	198	2980	112	125	114	15	0.14	0.16	3.8	0.020	*<0.001*	*<0.0005*	*<0.1*	0.0037	209	0.010
Schist	Latte 80%'	72162	72137	12.5	50	5420	814	9.8	264	4040	301	61	*<2.5*	*<25*	*<1*	*0.25*	0.35	146	2370	157	168	215	6.5	0.080	0.040	1.1	0.011	*<0.0005*	*<0.00025*	*<0.05*	0.00010	381	0.0010
Schist	Latte 60%	72165	72138	80	84	6730	609	9.5	348	5280	229	87	*<2.5*	*<25*	*<1*	0.55	0.82	172	2570	86	99	204	34	0.13	0.22	2.6	0.025	*<0.0005*	*<0.00025*	*<0.05*	0.0023	361	0.0027
Schist	Latte 60%	72168	72138	12.5	49	5760	745	9.6	155	4510	223	83	*<2.5*	*<25*	*<1*	*0.25*	0.37	167	2670	119	134	262	7.4	0.040	0.050	0.60	0.0090	*<0.0005*	*<0.00025*	*<0.05*	0.00010	337	0.00090
Granite	Kona Oxide	72171	72139	80	104	3380	7.1	9.8	147	2340	738	83	*<1*	27	3.4	1.0	0.85	173	57	114	139	139	6.8	0.38	0.27	56	0.013	*<0.001*	*<0.0005*	*<0.1*	0.0061	50	0.0038
Granite	Kona Oxide	72174	72139	12.5	50	1790	5.4	10	246	1130	580	42	*<0.5*	21	3.4	0.55	0.30	129	38	149	164	163	2.0	0.43	0.17	41	0.0070	*<0.0005*	*<0.00025*	*<0.05*	0.00020	87	0.00010
Granite	Kona 80% CN	72177	72140	80	98	4050	9.2	9.7	286	2960	661	69	*<1*	23	1.8	0.23	0.74	194	666	125	179	140	48	0.59	0.78	75	0.018	*<0.001*	*<0.0005*	*<0.1*	0.0028	87	0.0054
Granite	Kona 80% CN	72180	72140	12.5	50	2670	15	10	193	1890	570	47	*<1*	22	2.4	0.33	0.47	144	424	123	168	172	15	1.5	1.1	98	0.0040	*<0.002*	*<0.001*	*<0.2*	*<0.0001*	56	0.00030

Notes: all values in grey italics are below the analytical detection limit

Appendix C.3-3: Total and Dissolved Elements in Final Leachate from Cyanide Leach Tailings Columns

Lithology	Pit/Weathering Facies	Column ID	T-Cr	T-Co	T-Cu	T-Fe	T-Pb	T-Li	T-Mg	T-Mn	T-Hg	T-Mo	T-Ni	T-P	T-K	T-Rb	T-Se	T-Si	T-Ag	T-Na	T-Sr	T-S	T-Te	T-Tl	T-Sn	T-Ti	T-W	T-U	T-V	T-Zn	T-Zr	D-Al	D-Sb	D-As	D-Ba	D-Be	D-Bi	D-Bo
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Gneiss	Supremo #1	73010	0.014	0.35	0.60	1.0	0.00062	*<0.002*	0.34	0.0030	0.0015	0.22	0.0045	0.19	6.2	0.0016	0.0016	4.2	0.000050	582	0.071	5.9	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.010	0.16	0.0023	0.43	*<0.0006*	0.18	0.028	0.81	0.064	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo #1	73013	0.014	0.080	0.17	1.2	0.00045	*<0.002*	0.79	0.71	0.00080	0.17	0.0053	0.55	14	0.026	0.00090	3.7	0.000040	315	0.049	5.4	*<0.0004*	*<0.00002*	*<0.0002*	0.00079	0.010	0.46	0.0023	0.038	*<0.0006*	0.056	0.015	0.71	0.0067	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo #1	73007	0.037	0.67	1.8	0.54	0.0043	*<0.002*	0.26	0.010	0.060	0.19	0.16	0.10	6.9	0.0011	0.0016	3.7	0.0013	454	0.24	4.1	*<0.0004*	0.00013	0.00021	0.0016	0.010	0.0050	0.0013	1.1	*<0.0006*	0.19	0.0097	0.17	0.29	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo #2	73019	0.025	0.56	0.61	1.2	0.0015	*<0.005*	0.29	0.010	0.00070	0.27	0.0028	1.1	11	0.0023	0.0040	5.5	0.000060	675	0.070	6.4	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.040	0.75	0.012	0.43	*<0.0015*	0.34	0.047	2.0	0.014	*<0.0005*	*<0.00025*	*<0.05*
Gneiss	Supremo #2	73022	0.014	0.19	0.090	1.3	0.0013	0.0086	0.51	0.38	0.00010	0.15	*<0.001*	0.27	11	0.0034	0.0018	4.6	0.000040	387	0.042	5.8	*<0.0004*	*<0.00002*	*<0.0002*	0.0024	0.020	0.17	0.0072	0.022	*<0.0006*	0.18	0.020	0.67	0.0029	*<0.0002*	*<0.0001*	0.036
Gneiss	Supremo #2	73016	0.053	1.2	1.8	1.7	0.0051	*<0.002*	0.16	0.010	0.015	0.44	0.068	0.36	5.5	0.0013	0.0053	5.7	0.00064	498	0.040	5.0	*<0.0004*	0.000031	0.00026	0.0014	0.030	0.16	0.011	1.2	*<0.0006*	0.37	0.028	1.0	0.026	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo Oxide T1	73025	0.023	0.53	1.1	0.42	0.0018	*<0.002*	0.33	0.030	0.0029	0.42	0.0029	0.59	13	0.013	0.00090	7.4	0.00024	551	0.071	19	*<0.0004*	0.000037	*<0.0002*	0.0011	0.12	0.42	0.0049	0.64	*<0.0006*	0.16	0.13	5.1	0.0097	*<0.0002*	*<0.0001*	0.026
Gneiss	Supremo Oxide T1	73028	0.021	0.31	0.32	0.32	0.00096	*<0.002*	0.32	0.080	0.0024	0.36	0.0027	0.46	9.2	0.0058	0.0010	6.2	0.00024	307	0.12	16	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.11	0.40	0.0049	0.062	*<0.0006*	0.11	0.036	3.6	0.0062	*<0.0002*	*<0.0001*	0.023
Gneiss	Supremo Oxide T4	73031	0.013	0.81	1.1	0.35	0.0011	*<0.005*	0.68	0.21	0.0043	0.24	*<0.0025*	0.23	15	0.0063	0.00090	6.3	0.000050	677	0.11	22	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.080	0.16	*<0.0025*	0.69	*<0.0015*	0.052	0.073	2.8	0.038	*<0.0005*	*<0.00025*	*<0.05*
Gneiss	Supremo Oxide T4	73034	0.014	0.44	0.22	0.28	0.00072	0.0029	0.87	0.37	0.0038	0.19	*<0.001*	0.21	9.5	0.0061	0.00090	5.0	0.000050	317	0.056	23	*<0.0004*	0.000039	*<0.0002*	*<0.0006*	0.060	0.28	0.0015	0.028	*<0.0006*	0.040	0.033	2.8	0.0066	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo Mine Block (1")	73004	0.010	0.080	0.28	1.9	*<0.0001*	*<0.002*	0.70	0.15	0.0044	0.13	0.0030	0.99	5.4	0.0068	0.0011	2.8	0.00014	375	0.016	4.5	*<0.0004*	0.000044	*<0.0002*	*<0.0006*	0.010	2.0	0.0011	0.054	*<0.0006*	0.054	0.026	1.4	0.0026	*<0.0002*	*<0.0001*	*<0.02*
Gneiss	Supremo 80%	73037	0.012	0.62	1.0	2.2	*<0.00025*	*<0.005*	1.0	0.020	0.0031	0.25	0.0040	1.0	31	0.034	0.0072	9.9	0.00046	909	0.025	157	*<0.001*	0.00012	*<0.0005*	*<0.0015*	0.040	0.46	0.0053	0.60	*<0.0015*	0.087	0.27	13	0.0068	*<0.0005*	*<0.00025*	*<0.05*
Gneiss	Supremo 80%	73040	0.0020	0.51	0.32	2.0	*<0.0001*	0.0027	1.1	0.62	0.0021	0.27	0.0018	0.11	19	0.012	0.0060	5.3	0.00022	551	0.080	240	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.030	0.059	0.0018	0.037	*<0.0006*	0.061	0.18	7.5	0.0025	*<0.0002*	*<0.0001*	*<0.02*
Gneiss/Schist	DD oxide	72183	0.0040	0.99	3.3	0.44	*<0.00025*	*<0.005*	0.63	0.020	0.0028	0.32	0.016	0.10	18	0.012	0.0096	5.3	0.00036	753	0.088	82	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.82	0.0040	*<0.0025*	1.1	*<0.0015*	0.028	0.089	2.6	0.017	*<0.0005*	*<0.00025*	*<0.05*
Gneiss/Schist	DD oxide	72186	0.013	0.41	0.40	0.11	*<0.0001*	*<0.002*	0.20	0.020	0.00010	0.17	*<0.001*	0.12	9.2	0.0025	0.0061	5.4	0.000040	372	0.048	63	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.34	0.00	0.0021	0.068	*<0.0006*	0.058	0.035	1.9	0.0037	*<0.0002*	*<0.0001*	*<0.02*
Schist	Latte mine block (1")	73001	0.013	0.040	0.21	0.56	0.00047	*<0.002*	1.0	0.14	0.00080	0.030	0.0018	0.27	3.7	0.0054	0.00060	3.6	0.00038	291	0.038	17	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.00	0.032	*<0.001*	0.063	*<0.0006*	0.035	0.082	16	0.0044	*<0.0002*	*<0.0001*	*<0.02*
Schist	Latte Oxide East	72153	0.0060	0.65	2.8	0.89	*<0.00025*	*<0.005*	0.48	0.040	0.0057	0.15	0.021	0.21	17	0.011	0.0051	8.1	0.00041	978	0.11	233	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.38	0.0060	0.0027	1.7	*<0.0015*	0.045	0.085	6.0	0.012	*<0.0005*	*<0.00025*	*<0.05*
Schist	Latte Oxide East	72156	0.0080	0.36	0.73	0.57	0.00071	*<0.002*	0.86	0.51	0.0050	0.090	0.025	0.16	14	0.0048	0.0038	3.5	0.0013	489	0.22	185	*<0.0004*	0.000044	*<0.0002*	*<0.0006*	0.17	0.0020	0.0017	0.16	*<0.0006*	0.064	0.036	2.4	0.0064	*<0.0002*	*<0.0001*	*<0.02*
Schist	Latte 80%'	72159	0.0030	1.1	5.2	4.4	0.0020	*<0.01*	2.9	0.030	0.0046	0.080	0.030	0.22	44	0.059	0.019	4.8	0.00034	1680	1.1	916	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.090	0.00	*<0.005*	1.5	*<0.003*	0.074	0.15	3.0	0.0069	*<0.001*	*<0.0005*	*<0.1*
Schist	Latte 80%'	72162	0.0020	0.68	1.6	3.5	0.00063	*<0.005*	9.1	1.5	0.00060	0.060	0.0029	0.13	50	0.021	0.014	2.7	*<0.00005*	981	1.4	782	*<0.001*	*<0.00005*	*<0.0005*	0.0020	0.020	0.00	*<0.0025*	0.097	*<0.0015*	0.028	0.042	0.87	0.0055	*<0.0005*	*<0.00025*	*<0.05*
Schist	Latte 60%	72165	0.0020	0.86	5.1	6.3	0.0018	0.0060	2.5	0.020	0.0022	0.080	0.024	0.16	48	0.033	0.018	3.9	0.00020	1340	1.7	868	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.070	0.00	0.0032	1.1	*<0.0015*	0.086	0.21	1.8	0.010	*<0.0005*	*<0.00025*	*<0.05*
Schist	Latte 60%	72168	0.0020	0.61	2.2	6.0	0.00034	*<0.005*	9.0	0.81	0.00030	0.070	0.0026	*<0.1*	44	0.016	0.0099	2.1	*<0.00005*	1090	1.5	828	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.020	0.00	*<0.0025*	0.12	*<0.0015*	0.019	0.049	0.53	0.0049	*<0.0005*	*<0.00025*	*<0.05*
Granite	Kona Oxide	72171	0.0050	0.58	1.7	8.3	0.0019	*<0.01*	0.28	0.040	0.0049	0.080	*<0.005*	0.45	19	0.043	0.0023	4.2	*<0.0001*	704	0.077	23	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.19	1.2	*<0.005*	1.9	*<0.003*	0.33	0.26	55	0.0035	*<0.001*	*<0.0005*	*<0.1*
Granite	Kona Oxide	72174	0.012	0.22	0.28	4.6	0.0013	*<0.005*	0.26	1.0	0.0014	0.040	*<0.0025*	0.42	11	0.011	0.0011	2.8	*<0.00005*	347	0.072	13	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.10	0.57	0.0047	0.10	*<0.0015*	0.39	0.17	40	*<0.00025*	*<0.0005*	*<0.00025*	*<0.05*
Granite	Kona 80% CN	72177	0.0020	1.5	2.2	18	0.0026	*<0.01*	0.46	0.14	0.021	0.060	*<0.005*	0.56	25	0.050	0.0082	3.6	*<0.0001*	857	0.065	216	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.18	0.83	0.0084	1.4	*<0.003*	0.53	0.78	75	0.0044	*<0.001*	*<0.0005*	*<0.1*
Granite	Kona 80% CN	72180	*<0.002*	1.1	0.64	15	*<0.001*	*<0.02*	0.25	1.9	0.0038	0.050	*<0.01*	0.31	16	0.015	0.0047	1.6	*<0.0002*	517	0.038	137	*<0.004*	*<0.0002*	*<0.002*	*<0.006*	0.15	0.52	0.015	0.14	*<0.006*	1.2	0.93	85	*<0.001*	*<0.002*	*<0.001*	*<0.2*

Notes: all values in grey italics are below the analytical detection limit

Appendix C.3-3: Total and Dissolved Elements in Final Leachate from Cyanide Leach Tailings Columns

Lithology	Pit/Weathering Facies	Column ID	D-Cd	D-Ca	D-Cs	D-Cr	D-Co	D-Cu	D-Fe	D-Pb	D-Li	D-Mg	D-Mn	D-Hg	D-Mo	D-Ni	D-P	D-K	D-Rb	D-Se	D-Si	D-Ag	D-Na	D-Sr	D-S	D-Te	D-Tl	D-Sn	D-Ti	D-W	D-U	D-V	D-Zn	D-Zr
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Gneiss	Supremo #1	73010	0.0046	3.0	0.00018	0.013	0.33	0.55	0.97	*<0.0001*	*<0.002*	0.31	0.0023	0.0015	0.21	0.0043	0.16	5.9	0.0015	0.0015	4.1	0.000038	561	0.048	5.6	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.012	0.14	0.0021	0.41	*<0.0006*
Gneiss	Supremo #1	73013	0.00017	3.1	0.00014	0.013	0.081	0.16	1.1	*<0.0001*	*<0.002*	0.73	0.32	0.00078	0.16	0.0049	0.52	14	0.027	0.00087	3.7	0.000036	311	0.030	5.4	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.012	0.47	0.0020	0.036	*<0.0006*
Gneiss	Supremo #1	73007	0.037	53	0.00012	0.037	0.67	1.9	0.40	*<0.0001*	*<0.002*	0.19	0.0082	0.060	0.18	0.15	*<0.05*	6.6	0.0011	0.0016	3.5	0.0011	447	0.19	3.9	*<0.0004*	0.00011	0.00023	*<0.0006*	0.0055	0.0045	*<0.001*	1.1	*<0.0006*
Gneiss	Supremo #2	73019	0.0033	4.9	0.000069	0.024	0.55	0.57	1.1	*<0.00025*	*<0.005*	0.25	0.0052	0.00065	0.27	0.0027	1.0	11	0.0020	0.0040	5.4	*<0.00005*	662	0.022	6.3	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.037	0.74	0.012	0.41	*<0.0015*
Gneiss	Supremo #2	73022	0.000043	2.6	0.000035	0.013	0.20	0.090	1.1	*<0.0001*	0.0089	0.39	0.055	0.00011	0.15	*<0.001*	0.25	11	0.0032	0.0019	4.4	0.000022	396	0.023	5.8	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.019	0.17	0.0069	0.021	*<0.0006*
Gneiss	Supremo #2	73016	0.026	5.7	*<0.00002*	0.051	1.2	1.5	1.5	0.00011	*<0.002*	0.10	0.0087	0.015	0.40	0.065	0.33	5.3	0.0012	0.0050	5.4	0.00045	484	0.027	4.9	*<0.0004*	*<0.00002*	0.00024	*<0.0006*	0.024	0.15	0.0099	1.1	*<0.0006*
Gneiss	Supremo Oxide T1	73025	0.0029	1.2	0.0024	0.022	0.52	1.1	0.36	*<0.0001*	*<0.002*	0.22	0.026	0.0027	0.42	0.0028	0.51	13	0.012	0.00083	7.1	0.00022	546	0.020	18	*<0.0004*	0.000032	*<0.0002*	*<0.0006*	0.12	0.41	0.0045	0.64	*<0.0006*
Gneiss	Supremo Oxide T1	73028	0.00030	1.1	0.00011	0.021	0.31	0.32	0.29	*<0.0001*	*<0.002*	0.26	0.071	0.0023	0.36	0.0028	0.39	9.0	0.0056	0.0011	6.1	0.00019	312	0.022	16	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.11	0.41	0.0046	0.064	*<0.0006*
Gneiss	Supremo Oxide T4	73031	0.0019	2.1	0.0010	0.012	0.78	1.1	0.33	*<0.00025*	*<0.005*	0.63	0.19	0.0045	0.24	*<0.0025*	0.19	15	0.0059	0.00079	6.3	*<0.00005*	649	0.062	22	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.076	0.15	*<0.0025*	0.66	*<0.0015*
Gneiss	Supremo Oxide T4	73034	0.00027	1.8	0.00012	0.013	0.42	0.21	0.25	*<0.0001*	0.0028	0.81	0.26	0.0040	0.18	*<0.001*	0.18	9.2	0.0056	0.00083	4.8	0.000044	305	0.037	22	*<0.0004*	0.000030	*<0.0002*	*<0.0006*	0.054	0.27	0.0014	0.027	*<0.0006*
Gneiss	Supremo Mine Block (1")	73004	0.00053	2.6	0.00012	0.0091	0.072	0.29	1.9	*<0.0001*	*<0.002*	0.66	0.019	0.0055	0.13	0.0031	0.97	5.2	0.0068	0.0012	2.7	0.00015	360	0.015	4.4	*<0.0004*	0.000040	*<0.0002*	*<0.0006*	0.0074	1.9	0.0011	0.056	*<0.0006*
Gneiss	Supremo 80%	73037	0.00096	1.2	0.0061	0.012	0.61	1.0	2.2	*<0.00025*	*<0.005*	0.88	0.019	0.0032	0.25	0.0041	1.0	30	0.034	0.0071	9.5	0.00041	898	0.025	153	*<0.001*	0.000084	*<0.0005*	*<0.0015*	0.045	0.46	0.0050	0.59	*<0.0015*
Gneiss	Supremo 80%	73040	0.000064	5.2	0.00099	0.0015	0.51	0.32	1.9	*<0.0001*	0.0028	1.1	0.57	0.0024	0.26	0.0019	0.12	19	0.011	0.0063	5.3	0.00021	553	0.078	220	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.027	0.058	0.0017	0.039	*<0.0006*
Gneiss/Schist	DD oxide	72183	0.0033	2.8	0.0030	0.0042	0.97	3.2	0.44	*<0.00025*	*<0.005*	0.61	0.017	0.0027	0.31	0.015	0.089	18	0.011	0.0098	5.2	0.00038	731	0.084	77	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.81	0.0040	*<0.0025*	1.1	*<0.0015*
Gneiss/Schist	DD oxide	72186	0.000076	1.5	0.00014	0.013	0.39	0.39	0.098	*<0.0001*	*<0.002*	0.20	0.019	0.00012	0.17	*<0.001*	0.11	9.0	0.0024	0.0057	5.4	0.000041	365	0.049	61	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.35	0.00032	0.0020	0.068	*<0.0006*
Schist	Latte mine block (1")	73001	0.00011	2.3	0.00023	0.012	0.040	0.21	0.50	*<0.0001*	*<0.002*	0.97	0.020	0.0012	0.035	0.0016	0.24	3.5	0.0054	0.00059	3.5	0.00037	283	0.028	16	*<0.0004*	*<0.00002*	*<0.0002*	*<0.0006*	0.0051	0.033	*<0.001*	0.061	*<0.0006*
Schist	Latte Oxide East	72153	0.0075	2.5	0.0022	0.0060	0.63	2.8	0.84	*<0.00025*	*<0.005*	0.44	0.032	0.0069	0.14	0.020	0.19	16	0.011	0.0044	7.7	0.00034	941	0.095	223	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.37	0.0059	*<0.0025*	1.6	*<0.0015*
Schist	Latte Oxide East	72156	0.00057	3.0	0.00042	0.0078	0.35	0.75	0.50	*<0.0001*	*<0.002*	0.75	0.48	0.0055	0.092	0.024	0.075	13	0.0047	0.0039	3.3	0.0013	476	0.11	175	*<0.0004*	0.000028	*<0.0002*	*<0.0006*	0.17	0.0015	0.0014	0.16	*<0.0006*
Schist	Latte 80%'	72159	0.0032	114	0.0093	0.0023	0.99	4.9	4.3	*<0.0005*	*<0.01*	2.8	0.014	0.0047	0.076	0.028	*<0.1*	43	0.056	0.018	4.7	0.00027	1590	0.95	909	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.085	0.00026	*<0.005*	1.4	*<0.003*
Schist	Latte 80%'	72162	0.000089	311	0.00089	0.0014	0.67	1.5	3.3	*<0.00025*	*<0.005*	9.0	1.2	0.00069	0.055	0.0028	*<0.1*	49	0.021	0.014	2.6	*<0.00005*	965	1.3	768	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.022	0.00012	*<0.0025*	0.096	*<0.0015*
Schist	Latte 60%	72165	0.0022	240	0.0026	0.0019	0.84	4.6	5.6	*<0.00025*	0.0054	2.2	0.0088	0.0024	0.079	0.022	*<0.1*	43	0.031	0.019	3.4	0.00016	1330	1.5	850	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.067	0.000081	0.0027	1.0	*<0.0015*
Schist	Latte 60%	72168	0.00010	284	0.00083	0.0014	0.60	2.1	5.7	*<0.00025*	*<0.005*	8.7	0.52	0.00036	0.068	*<0.0025*	*<0.1*	42	0.016	0.010	2.1	*<0.00005*	1080	1.4	810	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.017	0.000076	*<0.0025*	0.12	*<0.0015*
Granite	Kona Oxide	72171	0.0059	2.5	0.0036	0.0044	0.57	1.8	7.9	*<0.0005*	*<0.01*	0.20	0.019	0.0054	0.078	*<0.005*	0.37	18	0.041	0.0025	3.9	*<0.0001*	703	0.030	22	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.18	1.1	*<0.005*	1.9	*<0.003*
Granite	Kona Oxide	72174	0.00020	1.9	0.000056	0.012	0.22	0.28	4.6	*<0.00025*	*<0.005*	0.17	0.20	0.0017	0.037	*<0.0025*	0.32	11	0.011	0.0012	2.8	*<0.00005*	349	0.0090	13	*<0.001*	*<0.00005*	*<0.0005*	*<0.0015*	0.096	0.58	0.0046	0.10	*<0.0015*
Granite	Kona 80% CN	72177	0.0026	3.1	0.0053	0.0017	1.5	2.3	19	*<0.0005*	*<0.01*	0.34	0.064	0.022	0.061	*<0.005*	0.40	24	0.050	0.0076	3.4	*<0.0001*	877	0.024	214	*<0.002*	*<0.0001*	*<0.001*	*<0.003*	0.18	0.83	0.0091	1.4	*<0.003*
Granite	Kona 80% CN	72180	*<0.0001*	5.8	*<0.0002*	*<0.002*	0.94	0.54	15	*<0.001*	*<0.02*	0.21	0.79	0.0048	0.039	*<0.01*	0.26	15	0.012	0.0043	1.4	*<0.0002*	456	0.014	135	*<0.004*	*<0.0002*	*<0.002*	*<0.006*	0.13	0.45	0.013	0.12	*<0.006*

Notes: all values in grey italics are below the analytical detection limit

Appendix C.4: Static Test Results for Overburden

Appendix C.4-1: Acid-Base Accounting Results for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Fizz rating	Rinse-pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	Insoluble-S	T-AP	S-AP	TIC	Inorg. CO_2	CaNP	Sobek NP	Sobek NNP	NPR	NPR
				Unity	s.u.	s.u.	%	%	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	Sobek/T-AP	Sobek/S-AP
Overburden Overlying Gneiss Bedrock																			
KAM106801	CFR0320	DD Pit	gneiss	1	8	8	0.12	0.01	0.11	0.01	3.8	0.30	0.070	0.30	5.8	11	7.0	2.9	35
R281758	CFR0836	DD Pit	gneiss	1	6.5	6.5	0.01	*<0.01*	*<0.01*	0.01	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26
R283938	CFR0825	DD Pit	gneiss	1	7.7	7.7	0.01	0.01	0.02	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	10	10	33	32
R288218	CFR0694	DD Pit	gneiss	1	6.8	6.7	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R298598	CFR0716	DD Pit	gneiss	1	7.5	7.5	*<0.01*	0.01	0.02	*<0.01*	*<0.3*	0.30	*<0.05*	*<0.2*	*<4.2*	12	12	40	38
KAM018321	CFR0102	Supremo Pit	gneiss	1	7	7	0.04	0.01	0.02	0.02	1.3	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	2.3	9.6
KAM104165	CFR0288	Supremo Pit	gneiss	1	7.2	7.2	*<0.01*	0.01	*<0.01*	*<0.01*	*<0.3*	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R280751	CFR0805	Supremo Pit	gneiss	1	7.6	7.7	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R281909	CFR0839	Supremo Pit	gneiss	1	8.4	8.4	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	13	13	43	42
R281971	CFR0841	Supremo Pit	gneiss	1	6.7	6.8	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R284001	CFR0804	Supremo Pit	gneiss	1	7.4	7.4	*<0.01*	0.02	*<0.01*	*<0.01*	*<0.3*	0.60	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	11
R285461	CFR0757	Supremo Pit	gneiss	1	8.1	8	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
R285552	CFR0759	Supremo Pit	gneiss	1	7.5	7.5	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	0.10	0.40	8.3	7.0	7.0	23	22
R286151	CFR0776	Supremo Pit	gneiss	1	7.9	7.8	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
R286219	CFR0779	Supremo Pit	gneiss	1	8.1	8.1	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
R286345	CFR0782	Supremo Pit	gneiss	1	8.4	8.3	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R287156	CFR0802	Supremo Pit	gneiss	1	6.9	6.9	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
R513919	CFR0872	Supremo Pit	gneiss	1	7	6.9	*<0.01*	*<0.01*	0.03	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R514753	CFR0783	Supremo Pit	gneiss	1	7	6.8	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R514902	CFR0786	Supremo Pit	gneiss	1	8.3	8	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	11	11	37	35
R515335	CFR0797	Supremo Pit	gneiss	1	7.1	7.1	0.01	*<0.01*	*<0.01*	0.01	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R515458	CFR0799	Supremo Pit	gneiss	1	7.1	7	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R540708	CFR0864	Supremo Pit	gneiss	1	8.1	8	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26
R540846	CFR0866	Supremo Pit	gneiss	1	7.6	7.5	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R541274	CFR0877	Supremo Pit	gneiss	1	6.7	6.7	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R541396	CFR0881	Supremo Pit	gneiss	1	6.9	6.8	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R541524	CFR0884	Supremo Pit	gneiss	1	7.1	6.9	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R542611	CFR0909	Supremo Pit	gneiss	1	7.7	7.6	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
R542736	CFR0912	Supremo Pit	gneiss	1	8.1	8	*<0.01*	0.02	0.02	*<0.01*	*<0.3*	0.60	*<0.05*	*<0.2*	*<4.2*	10	10	33	16
R543125	CFR0924	Supremo Pit	gneiss	1	7.7	7.6	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R543393	CFR0933	Supremo Pit	gneiss	1	7.6	7.7	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	0.14	0.50	12	3.0	3.0	10	9.6
R546991	CFR0905	Supremo Pit	gneiss	1	6.8	6.7	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R547067	CFR0908	Supremo Pit	gneiss	1	8.3	8.2	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	0.070	0.30	5.8	11	11	37	35
R548052	CFR0944	Supremo Pit	gneiss	1	6.2	6.1	0.02	*<0.01*	0.01	0.01	0.60	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	5.0	10	19
R618573	CFR0846	Supremo Pit	gneiss	1	7.1	7.1	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	11	11	37	35
R618876	CFR0860	Supremo Pit	gneiss	1	8.1	8.1	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	0.10	0.40	8.3	18	18	60	58
R619123	CFR0867	Supremo Pit	gneiss	1	7.1	7	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R620371	CFR0910	Supremo Pit	gneiss	1	7.9	7.9	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R620448	CFR0911	Supremo Pit	gneiss	1	5.5	5.3	0.01	*<0.01*	*<0.01*	0.01	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	1.0	1.0	3.3	3.2
R620797	CFR0923	Supremo Pit	gneiss	1	5.9	5.9	0.02	0.02	*<0.01*	0.02	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	6.0	5.0	10	9.6
R290225	CFR0614	West WRSF	gneiss	1	7.7	7.7	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
Statistical Summary for Overburden overlying Gneiss Bedrock (n = 41)			**Max**	-	8.4	8.4	0.12	0.02	0.11	0.02	3.8	0.60	0.14	0.50	12	18	18	60	58
			90th PCTL	-	8.1	8.1	0.01	0.01	0.02	0.01	0.30	0.30	0.070	0.30	5.8	11	11	37	35
			75th PCTL	-	7.9	7.9	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	7.0	23	22
			Median	-	7.5	7.5	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
			25th PCTL	-	7	6.9	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	10	11
			10th PCTL	-	6.7	6.7	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
			Min	-	5.5	5.3	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	1.0	1.0	2.3	3.2

Appendix C.4-1: Acid-Base Accounting Results for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Fizz rating	Rinse-pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	Insoluble-S	T-AP	S-AP	TIC	Inorg. CO_2	CaNP	Sobek NP	Sobek NNP	NPR	NPR
				Unity	s.u.	s.u.	%	%	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	Sobek/T-AP	Sobek/S-AP
Overburden Overlying Schist Bedrock																			
R288438	CFR0698	DD Pit	schist	1	7.3	7.3	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26
R298516	CFR0713	DD Pit	schist	1	7.7	7.6	*<0.01*	0.01	0.02	*<0.01*	*<0.3*	0.30	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R294148	CFR0624	Latte Pit	schist	2	8.3	8.3	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	0.91	3.3	76	86	86	287	275
R297797	CFR0676	North WRSF	schist	2	8.4	8.4	0.02	0.01	0.01	0.01	0.60	0.30	0.20	0.80	17	31	30	52	99
R549926	CFR0981	North WRSF	schist	1	7.5	7.5	0.01	*<0.01*	0.02	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	11	11	37	35
R550015	CFR0984	North WRSF	schist	1	7.3	7.3	0.02	*<0.01*	*<0.01*	0.02	0.60	*<0.3*	*<0.05*	0.20	4.2	11	10	18	35
R550083	CFR0985	North WRSF	schist	1	8.2	8.2	0.02	0.01	0.02	*<0.01*	0.60	*<0.3*	*<0.05*	*<0.2*	*<4.2*	13	12	22	42
17551	SRK-15TP-47	ROM/Plant	schist	1	6.4	6.4	0.02	0.02	0.02	*<0.01*	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	7.0	6.0	12	11
17552	SRK-15TP-46	ROM/Plant	schist	1	6.3	6.2	0.02	0.01	0.02	*<0.01*	0.60	0.30	*<0.05*	*<0.2*	*<4.2*	5.0	4.0	8.3	16
17553	SRK-15TP-45	ROM/Plant	schist	1	6	5.9	0.04	0.02	0.02	0.02	1.3	0.60	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	2.3	4.8
17554	SRK-15TP-22	ROM/Plant	schist	1	6.8	6.9	0.02	0.02	0.01	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	10	9.0	17	16
17556	SRK-15TP-24	ROM/Plant	schist	1	7.4	7.5	0.02	*<0.01*	0.01	0.01	0.60	*<0.3*	*<0.05*	*<0.2*	*<4.2*	11	10	18	35
R547969	CFR0939	South WRSF	schist	1	8.4	8.4	0.03	0.01	0.02	0.01	0.90	0.30	*<0.05*	*<0.2*	*<4.2*	11	10	12	35
R553319	CFB027	South WRSF	schist	3	7.4	7.4	0.03	0.02	0.03	*<0.01*	0.90	0.60	0.90	3.3	75	115	114	128	184
R281332	CFR0816	Supremo Pit	schist	1	7.6	7.6	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	5.0	17	16
R281383	CFR0818	Supremo Pit	schist	1	6.7	6.7	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
R294487	CFR0633	Supremo Pit	schist	1	7.4	7.3	0.07	0.05	0.02	0.05	2.2	1.6	0.050	0.20	4.2	14	12	6.4	9.0
R296213	CFR0651	Supremo Pit	schist	3	8.1	8.1	0.02	*<0.01*	0.02	*<0.01*	0.60	*<0.3*	1.1	3.9	88	134	133	223	429
R299233	CFR0737	Supremo Pit	schist	1	7.9	7.9	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
R299489	CFR0746	Supremo Pit	schist	1	7.6	7.5	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	11	11	37	35
R510641	CFR0752	Supremo Pit	schist	2	8.8	8.8	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	0.15	0.60	13	75	75	250	240
R510976	CFR0761	Supremo Pit	schist	1	7.9	7.6	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	15	15	50	48
R511133	CFR0680	Supremo Pit	schist	3	8.2	8.1	0.02	*<0.01*	0.01	0.01	0.60	*<0.3*	0.85	3.1	71	91	90	152	291
R511474	CFR0686	Supremo Pit	schist	3	8.3	8.3	0.14	0.03	0.04	0.10	4.4	0.90	2.9	11	241	253	249	58	270
R511702	CFR0693	Supremo Pit	schist	1	8	7.9	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26
R511762	CFR0695	Supremo Pit	schist	1	8	7.9	0.01	0.01	0.02	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	9.0	9.0	30	29
R620878	CFR0925	Supremo Pit	schist	2	-	8.2	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	0.16	0.60	13	24	24	80	77
R622028	CFR0956	Supremo Pit	schist	1	7.2	7.1	0.02	0.02	0.02	*<0.01*	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	11	10	18	18
R622095	CFR0957	Supremo Pit	schist	1	6.6	6.6	0.02	*<0.01*	0.01	0.01	0.60	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	7.0	13	26
R289071	CFR0599	West WRSF	schist	1	7.4	7.4	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
R290074	CFR0612	West WRSF	schist	1	7.4	7.3	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	0.10	0.40	8.3	10	10	33	32
R549729	CFR0978	West WRSF	schist	1	6.6	6.6	0.09	0.07	0.01	0.08	2.8	2.2	0.10	0.40	8.3	8.0	5.0	2.9	3.7
R621156	CFR0937	West WRSF	schist	1	7.9	7.9	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	23	22
Statistical Summary for Overburden overlying Schist Bedrock (n = 33)			**Max**	-	8.8	8.8	0.14	0.07	0.04	0.10	4.4	2.2	2.9	11	241	253	249	287	429
			90th PCTL	-	8.3	8.3	0.04	0.02	0.02	0.02	1.2	0.60	0.89	3.3	74	90	89	147	264
			75th PCTL	-	8.0	8.1	0.02	0.01	0.02	0.01	0.60	0.30	0.10	0.40	8.3	15	15	50	48
			Median	-	7.6	7.5	0.02	*<0.01*	0.02	*<0.01*	0.60	*<0.3*	0.050	0.20	4.2	11	10	23	29
			25th PCTL	-	7.3	7.3	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	7.0	7.0	13	16
			10th PCTL	-	6.6	6.6	*<0.01*	*<0.01*	0.01	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	5.0	4.2	9.0	12
			Min	-	6.0	5.9	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	2.3	3.7

Appendix C.4-1: Acid-Base Accounting Results for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Fizz rating	Rinse-pH	Paste pH	Total-S	Sulphide-S	Sulphate-S	Insoluble-S	T-AP	S-AP	TIC	Inorg. CO_2	CaNP	Sobek NP	Sobek NNP	NPR	NPR
				Unity	s.u.	s.u.	%	%	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	%	%	$kgCaCO_3/t$	$kgCaCO_3/t$	$kgCaCO_3/t$	Sobek/T-AP	Sobek/S-AP
Overburden Overlying Granite Bedrock																			
17557	SRK-15TP-07	Event Pond	granite	1	5.8	5.8	0.02	0.02	0.01	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	5.0	4.8
KNB-1	KNB-1	Event Pond	granite	1	7.4	7.8	0.01	0.01	0.02	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	6.7	6.4
KNB-2	KNB-2	Event Pond	granite	1	6.9	7.4	0.01	0.02	0.01	*<0.01*	0.30	0.60	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	6.7	3.2
KNB-3	KNB-3	Event Pond	granite	1	7.8	7.7	0.01	0.02	0.01	*<0.01*	0.30	0.60	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	6.7	3.2
KAM013553	CFR0055	Kona Pit	granite	1	7.1	6.8	0.01	*<0.01*	*<0.01*	0.01	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
R297165	CFR0663	Kona Pit	granite	1	6.5	6.3	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	1.0	1.0	3.3	3.2
R297232	CFR0665	Kona Pit	granite	1	8.9	8.7	*<0.01*	0.01	*<0.01*	*<0.01*	*<0.3*	0.30	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
R297375	CFR0666	Kona Pit	granite	1	7	6.9	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26
17558	SRK-15TP-44	Leach Pad	granite	1	6.4	6.2	0.01	0.01	0.02	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	6.7	6.4
17559	SRK-15TP-06	Leach Pad	granite	1	6.8	6.8	0.02	0.03	*<0.01*	0.02	0.60	0.90	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	5.0	3.2
17560	SRK-15TP-43	Leach Pad	granite	1	6.4	6.5	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
17561	SRK-15TP-05	Leach Pad	granite	1	6.6	6.6	0.01	0.02	*<0.01*	0.01	0.30	0.60	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	4.8
17562	SRK-15TP-04	Leach Pad	granite	1	6.8	6.8	0.02	0.01	0.01	0.01	0.60	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	5.0	9.6
17565	SRK-15TP-03	Leach Pad	granite	1	6.2	6.1	0.02	0.01	0.01	0.01	0.60	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	5.0	9.6
17566	SRK-15TP-17	Leach Pad	granite	1	6.6	6.6	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
17567	SRK-15TP-02	Leach Pad	granite	1	6.3	6.3	0.02	0.03	0.01	0.01	0.60	0.90	*<0.05*	*<0.2*	*<4.2*	4.0	3.0	6.7	4.3
17570	SRK-15TP-16	Leach Pad	granite	1	6.5	6.7	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
17571	SRK-15TP-15	Leach Pad	granite	1	6.2	6.4	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	9.6
17572	SRK-15TP-14	Leach Pad	granite	1	5.7	5.9	0.02	0.01	0.01	0.01	0.60	0.30	0.050	0.20	4.2	2.0	1.0	3.3	6.4
17573	SRK-15TP-13	Leach Pad	granite	1	6.2	6.6	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	6.7	6.4
17574	SRK-15TP-12	Leach Pad	granite	1	6.2	6	0.02	0.02	0.01	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	2.0	1.0	3.3	3.2
17575	SRK-15TP-11	Leach Pad	granite	1	7.3	7.2	0.02	*<0.01*	0.02	*<0.01*	0.60	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	3.0	6.7	13
17576	SRK-15TP-18	Leach Pad	granite	1	6	6	0.01	*<0.01*	*<0.01*	0.01	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
17577	SRK-15TP-42	Leach Pad	granite	1	7	6.9	0.01	0.02	0.01	*<0.01*	0.30	0.60	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	10	4.8
17578	SRK-15TP-10	Leach Pad	granite	1	6.6	6.5	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
17579	SRK-15TP-09	Leach Pad	granite	1	6.5	6.4	0.01	0.02	*<0.01*	0.01	0.30	0.60	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	6.4
17580	SRK-15TP-41	Leach Pad	granite	1	7	6.9	0.01	*<0.01*	0.02	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	6.0	6.0	20	19
17581	SRK-15TP-08	Leach Pad	granite	1	6.5	6.5	0.02	0.02	0.01	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	3.0	2.0	5.0	4.8
Statistical Summary for Overburden overlying Granite Bedrock (n = 28)			**Max**	-	8.9	8.7	0.02	0.03	0.02	0.02	0.60	0.90	0.050	0.20	4.2	8.0	8.0	27	26
			90th PCTL	-	7.3	7.5	0.02	0.02	0.02	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	4.6	4.6	15	15
			75th PCTL	-	7.0	6.9	0.02	0.02	0.01	0.01	0.60	0.60	*<0.05*	*<0.2*	*<4.2*	4.0	4.0	13	13
			Median	-	6.6	6.6	0.01	0.01	0.01	*<0.01*	0.30	0.30	*<0.05*	*<0.2*	*<4.2*	3.0	3.0	6.7	6.4
			25th PCTL	-	6.3	6.3	0.01	*<0.01*	0.01	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	2.0	2.0	5.0	4.8
			10th PCTL	-	6.1	6.0	0.01	*<0.01*	*<0.01*	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	2.0	1.7	4.5	3.2
			Min	-	5.7	5.8	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.3*	*<0.3*	*<0.05*	*<0.2*	*<4.2*	1.0	1.0	3.3	3.2
Overburden Overlying Meta-Gabbro Bedrock (n = 3)																			
17555	SRK-15TP-23	ROM/Plant	meta-gabbro	1	5.2	5.1	0.06	0.03	0.01	0.05	1.9	0.90	*<0.05*	*<0.2*	*<4.2*	3.0	1.0	1.6	3.2
R553404	CFB030	South WRSF	meta-gabbro	3	9.2	9.2	*<0.01*	*<0.01*	0.02	*<0.01*	*<0.3*	*<0.3*	1.3	4.8	108	138	138	460	442
R553602	CFB035	South WRSF	meta-gabbro	1	7.4	7.4	0.01	*<0.01*	0.03	*<0.01*	0.30	*<0.3*	*<0.05*	*<0.2*	*<4.2*	8.0	8.0	27	26

Notes: all values in grey italics are below the analytical detection limit.
n = number of samples included in the statistical summary
Sulphate Sulphur determined by 25% HCL with Gravimetric Finish.
Sulphide Sulphur determined by Sobek 1:7 Nitric Acid with S by ICP-MS Finish.
AP = Acid potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material, T-AP derived from Total S * 31.25; S-AP derived from Sulphide-S *31.25.
NP = Neutralization potential in tonnes $CaCO_3$ equivalent per 1000 tonnes of material; carbonate NP (CaNP) is calculated from inorganic CO2.
Net NP (NNP) = NP - AP; Neutralization potential ratio (NPR)

Appendix C.4-2: Shake Flask Extraction Results for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Moisture	T-Alkalinity	Br	Cl	F	Nitrate-N	Nitrite-N	pH	Sulfate	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	Tl	Sn	Ti	U	V	Zn
				%	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	pH	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Overburden overlying Gneiss Bedrock																																													
R281758	CFR0836	DD Pit	gneiss	*<0.25*	14	*<0.05*	*<0.5*	0.18	0.92	0.033	6.1	1.8	0.88	0.0012	0.013	0.053	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.2	0.0034	0.0029	0.0058	0.81	0.00034	*<0.005*	1.4	0.20	*<0.00005*	0.0012	0.0053	*<0.3*	2.0	*<0.0005*	4.5	*<0.00005*	1.9	0.026	*<0.0001*	*<0.0005*	0.021	0.00018	0.0020	*<0.01*
R283938	CFR0825	DD Pit	gneiss	*<0.25*	17	*<0.05*	*<0.5*	0.23	0.027	0.0054	7.3	0.75	1.2	0.0025	0.0054	0.040	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	5.6	0.0026	0.00070	0.0047	1.0	0.00054	*<0.005*	0.67	0.032	*<0.00005*	0.0018	0.0030	*<0.3*	1.6	*<0.0005*	4.7	*<0.00005*	2.1	0.014	*<0.0001*	*<0.0005*	0.031	0.00019	0.0031	*<0.01*
R280751	CFR0805	Supremo Pit	gneiss	*<0.25*	11	*<0.05*	*<0.5*	0.15	0.060	0.0030	7.8	1.0	0.56	0.0024	0.026	0.026	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.6	0.00074	0.00022	0.0075	0.58	0.00046	*<0.005*	0.65	0.028	*<0.00005*	0.0028	0.00086	*<0.3*	1.9	*<0.0005*	3.1	*<0.00005*	1.7	0.013	*<0.0001*	*<0.0005*	*<0.01*	0.00045	0.0015	*<0.01*
R281971	CFR0841	Supremo Pit	gneiss	*<0.25*	15	*<0.05*	*<0.5*	0.048	0.19	0.0059	6.1	0.69	1.0	0.0015	0.013	0.078	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	6.4	0.0029	0.0025	0.0069	0.91	0.00023	*<0.005*	1.1	0.18	*<0.00005*	0.0015	0.0055	*<0.3*	2.1	*<0.0005*	5.2	*<0.00005*	2.1	0.027	*<0.0001*	*<0.0005*	0.024	0.00042	0.0021	*<0.01*
R513919	CFR0872	Supremo Pit	gneiss	*<0.25*	6.6	*<0.05*	*<0.5*	0.061	0.083	0.0051	6.3	0.55	0.66	0.00035	0.0046	0.024	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.4	0.0017	0.00051	0.0058	0.42	0.00027	*<0.005*	0.32	0.088	*<0.00005*	0.0018	0.0019	*<0.3*	0.96	*<0.0005*	3.9	*<0.00005*	2.8	0.0095	*<0.0001*	*<0.0005*	0.013	0.00031	0.0013	*<0.01*
R540708	CFR0864	Supremo Pit	gneiss	*<0.25*	6.0	*<0.05*	*<0.5*	0.16	0.018	0.0029	7.0	0.66	2.1	0.00085	0.010	0.045	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.0	0.0048	0.0010	0.0091	2.1	0.0010	*<0.005*	0.65	0.050	*<0.00005*	0.0036	0.0058	*<0.3*	1.1	*<0.0005*	6.6	*<0.00005*	2.7	0.0068	*<0.0001*	*<0.0005*	0.065	0.00059	0.0067	*<0.01*
R540846	CFR0866	Supremo Pit	gneiss	*<0.25*	39	*<0.05*	*<0.5*	0.14	0.035	0.0052	7.3	0.60	0.51	0.00095	0.012	0.044	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	0.0012	0.00030	0.0040	0.81	0.00045	*<0.005*	1.8	0.041	*<0.00005*	0.0020	0.0020	*<0.3*	1.7	*<0.0005*	4.0	*<0.00005*	2.1	0.054	*<0.0001*	*<0.0005*	0.016	0.00027	0.0023	*<0.01*
R542611	CFR0909	Supremo Pit	gneiss	*<0.25*	8.9	*<0.05*	*<0.5*	0.14	0.031	0.013	8.1	0.68	0.94	0.0084	0.096	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.5	0.0018	0.00038	0.0021	1.1	0.00094	*<0.005*	0.32	0.021	0.000066	0.0023	0.0010	*<0.3*	2.0	*<0.0005*	5.3	*<0.00005*	0.62	0.0090	*<0.0001*	*<0.0005*	0.020	0.0014	0.0020	*<0.01*
R543125	CFR0924	Supremo Pit	gneiss	*<0.25*	11	*<0.05*	*<0.5*	0.20	0.019	0.0025	7.2	0.64	1.1	0.00035	0.0041	0.024	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.6	0.0024	0.0010	0.0081	1.2	0.00072	*<0.005*	0.62	0.057	*<0.00005*	0.0023	0.0029	*<0.3*	0.96	*<0.0005*	5.0	*<0.00005*	3.5	0.011	*<0.0001*	*<0.0005*	0.036	0.00080	0.0036	*<0.01*
R547067	CFR0908	Supremo Pit	gneiss	*<0.25*	41	*<0.05*	*<0.5*	0.18	1.0	0.010	8.4	0.73	0.16	0.00090	0.014	0.045	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	13	*<0.0005*	*<0.0001*	0.0044	0.049	*<0.0001*	*<0.005*	1.3	0.028	*<0.00005*	0.0042	*<0.0005*	*<0.3*	2.0	*<0.0005*	2.8	*<0.00005*	4.0	0.056	*<0.0001*	*<0.0005*	*<0.01*	0.0015	0.0032	*<0.01*
R618876	CFR0860	Supremo Pit	gneiss	*<0.25*	48	*<0.05*	*<0.5*	0.14	0.013	0.0039	7.7	*<0.5*	0.26	0.00086	0.0067	0.037	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	9.5	0.0045	0.00016	0.0053	0.46	0.00019	*<0.005*	2.9	0.019	*<0.00005*	0.0021	0.0071	*<0.3*	7.3	*<0.0005*	3.1	*<0.00005*	2.4	0.021	*<0.0001*	*<0.0005*	*<0.01*	0.00016	0.0013	*<0.01*
R619123	CFR0867	Supremo Pit	gneiss	*<0.25*	4.8	*<0.05*	*<0.5*	0.097	0.020	0.0028	6.6	0.53	0.81	0.0018	0.053	0.013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.87	0.0021	0.00059	0.0050	0.60	0.00024	*<0.005*	0.30	0.015	0.00026	0.00069	0.0015	*<0.3*	1.9	*<0.0005*	5.2	*<0.00005*	1.5	0.0065	*<0.0001*	*<0.0005*	0.011	0.00046	0.0016	*<0.01*
Statistical Summary forOverburden overlying Gneiss bedrock (n = 11)			**Max**	-	48	*<0.05*	*<0.5*	0.23	1.0	0.033	8.4	1.8	2.1	0.0084	0.096	0.078	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	13	0.0048	0.0029	0.0091	2.1	0.0010	*<0.005*	2.9	0.20	0.00026	0.0042	0.0071	*<0.3*	7.3	*<0.0005*	6.6	*<0.00005*	4.0	0.056	*<0.0001*	*<0.0005*	0.065	0.0015	0.0067	*<0.01*
			90th PCTL	-	40	*<0.05*	*<0.5*	0.20	0.84	0.013	8.1	1.0	1.1	0.0025	0.050	0.052	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	11	0.0044	0.0023	0.0080	1.1	0.00092	*<0.005*	1.8	0.17	0.000064	0.0036	0.0058	*<0.3*	2.1	*<0.0005*	5.3	*<0.00005*	3.4	0.051	*<0.0001*	*<0.0005*	0.036	0.0013	0.0036	*<0.01*
			75th PCTL	-	22	*<0.05*	*<0.5*	0.18	0.11	0.0070	7.7	0.74	1.0	0.0019	0.017	0.045	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	7.2	0.0030	0.0010	0.0071	1.1	0.00059	*<0.005*	1.3	0.065	*<0.00005*	0.0024	0.0053	*<0.3*	2.0	*<0.0005*	5.2	*<0.00005*	2.7	0.026	*<0.0001*	*<0.0005*	0.026	0.00064	0.0031	*<0.01*
			Median	-	13	*<0.05*	*<0.5*	0.15	0.033	0.0052	7.2	0.67	0.85	0.0011	0.013	0.039	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	4.1	0.0022	0.00055	0.0056	0.81	0.00040	*<0.005*	0.66	0.037	*<0.00005*	0.0020	0.0025	*<0.3*	1.9	*<0.0005*	4.6	*<0.00005*	2.1	0.014	*<0.0001*	*<0.0005*	0.018	0.00044	0.0021	*<0.01*
			25th PCTL	-	8.3	*<0.05*	*<0.5*	0.13	0.020	0.0030	6.6	0.59	0.55	0.00086	0.0064	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.3	0.0016	0.00028	0.0046	0.55	0.00024	*<0.005*	0.55	0.026	*<0.00005*	0.0017	0.0014	*<0.3*	1.5	*<0.0005*	3.7	*<0.00005*	1.9	0.0094	*<0.0001*	*<0.0005*	0.011	0.00025	0.0016	*<0.01*
			10th PCTL	-	6.1	*<0.05*	*<0.5*	0.065	0.018	0.0028	6.1	0.53	0.29	0.00040	0.0047	0.024	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.1	0.00079	0.00017	0.0040	0.43	0.00019	*<0.005*	0.32	0.019	*<0.00005*	0.0012	0.00088	*<0.3*	0.97	*<0.0005*	3.1	*<0.00005*	1.5	0.0070	*<0.0001*	*<0.0005*	*<0.01*	0.00018	0.0013	*<0.01*
			Min	-	4.8	*<0.05*	*<0.5*	0.048	0.013	0.0025	6.1	*<0.5*	0.16	0.00035	0.0041	0.013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.87	*<0.0005*	*<0.0001*	0.0021	0.049	*<0.0001*	*<0.005*	0.30	0.015	0.000050	0.00069	*<0.0005*	*<0.3*	0.96	*<0.0005*	2.8	*<0.00005*	0.62	0.0065	*<0.0001*	*<0.0005*	*<0.01*	0.00016	0.0013	*<0.01*
Overburden overlying Schist Bedrock																																												
17552	SRK-15TP-46	ROM/Plant	schist	*<0.25*	7.6	*<0.05*	*<0.5*	0.064	0.016	0.0018	6.2	0.84	1.5	0.00025	0.0039	0.030	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	2.3	0.0031	0.00096	0.0070	0.98	0.00050	*<0.005*	0.59	0.079	*<0.00005*	0.00077	0.0021	*<0.3*	2.1	*<0.0005*	12	*<0.00005*	1.9	0.015	*<0.0001*	*<0.0005*	0.036	0.0011	0.0026	*<0.01*
17554	SRK-15TP-22	ROM/Plant	schist	*<0.25*	5.3	*<0.05*	*<0.5*	0.11	*<0.005*	0.0013	6.5	2.7	1.9	0.00023	0.0020	0.032	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.5	0.0043	0.0010	0.0089	1.4	0.0011	*<0.005*	0.64	0.038	*<0.00005*	0.0015	0.0051	*<0.3*	2.2	*<0.0005*	13	*<0.00005*	1.7	0.011	*<0.0001*	*<0.0005*	0.054	0.00078	0.0034	*<0.01*
17556	SRK-15TP-24	ROM/Plant	schist	*<0.25*	27	*<0.05*	*<0.5*	0.28	*<0.005*	*<0.001*	7.7	3.1	1.6	0.0016	0.0085	0.052	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	10	0.0043	0.00087	0.0078	2.0	0.0012	*<0.005*	0.75	0.042	0.00012	0.0016	0.0056	*<0.3*	2.6	0.00064	9.6	*<0.00005*	1.3	0.026	*<0.0001*	*<0.0005*	0.041	0.00014	0.0053	*<0.01*
R622028	CFR0956	Supremo Pit	schist	*<0.25*	23	*<0.05*	*<0.5*	0.19	0.033	0.0063	7.1	1.0	1.1	0.0026	0.015	0.10	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	12	0.0028	0.00086	0.0067	1.1	0.00042	*<0.005*	0.68	0.10	*<0.00005*	0.0045	0.0056	*<0.3*	1.1	*<0.0005*	5.5	*<0.00005*	1.2	0.039	*<0.0001*	*<0.0005*	0.032	0.00011	0.0031	*<0.01*
R281332	CFR0816	Supremo Pit	schist	*<0.25*	6.3	*<0.05*	*<0.5*	0.11	0.030	0.0028	7.0	0.54	1.2	0.0031	0.015	0.023	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.68	0.0012	0.00028	0.0044	0.74	0.00049	*<0.005*	0.23	0.039	*<0.00005*	0.0021	0.0014	*<0.3*	1.2	*<0.0005*	4.5	*<0.00005*	2.9	0.0038	*<0.0001*	*<0.0005*	0.018	0.0011	0.0021	*<0.01*
R621156	CFR0937	West WRSF	schist	*<0.25*	8.0	*<0.05*	*<0.5*	0.22	0.049	0.0013	7.4	0.84	1.4	0.00083	0.013	0.037	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.7	0.0030	0.00078	0.019	1.4	0.0014	*<0.005*	0.57	0.049	*<0.00005*	0.0017	0.0023	*<0.3*	1.1	*<0.0005*	5.9	*<0.00005*	3.2	0.0085	*<0.0001*	*<0.0005*	0.050	0.00068	0.0043	*<0.01*
R550015	CFR0984	North WRSF	schist	*<0.25*	45	*<0.05*	*<0.5*	0.25	0.028	0.0047	7.6	1.2	0.71	0.0075	0.041	0.061	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	14	0.0038	0.00078	0.016	0.90	0.00035	*<0.005*	2.2	0.32	*<0.00005*	0.012	0.0056	*<0.3*	3.1	*<0.0005*	4.6	*<0.00005*	4.6	0.042	*<0.0001*	*<0.0005*	0.026	0.00063	0.0091	*<0.01*
Statistical Summary forOverburden overlying Schist bedrock (n = 11)			**Max**	-	*45*	*<0.05*	*<0.5*	*0.28*	*0.049*	*0.0063*	*7.7*	*3.1*	*1.9*	*0.0075*	*0.041*	*0.10*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*14*	*0.0043*	*0.0010*	*0.019*	*2.0*	*0.0014*	*<0.005*	*2.2*	*0.32*	*0.00012*	*0.012*	*0.0056*	*<0.3*	*3.1*	*0.00064*	*13*	*<0.00005*	*4.6*	*0.042*	*<0.0001*	*<0.0005*	*0.054*	*0.0011*	*0.0091*	*<0.01*
			90th PCTL	-	*35*	*<0.05*	*<0.5*	*0.26*	*0.039*	*0.0053*	*7.6*	*2.9*	*1.7*	*0.0048*	*0.026*	*0.078*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*13*	*0.0043*	*0.00098*	*0.017*	*1.7*	*0.0013*	*<0.005*	*1.3*	*0.19*	*0.000077*	*0.0073*	*0.0056*	*<0.3*	*2.8*	*0.00056*	*12*	*<0.00005*	*3.7*	*0.040*	*<0.0001*	*<0.0005*	*0.052*	*0.0011*	*0.0068*	*<0.01*
			75th PCTL	-	*25*	*<0.05*	*<0.5*	*0.24*	*0.031*	*0.0038*	*7.5*	*2.0*	*1.6*	*0.0029*	*0.015*	*0.057*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*11*	*0.0040*	*0.00092*	*0.012*	*1.4*	*0.0011*	*<0.005*	*0.72*	*0.089*	*<0.00005*	*0.0033*	*0.0056*	*<0.3*	*2.4*	*<0.0005*	*11*	*<0.00005*	*3.0*	*0.033*	*<0.0001*	*<0.0005*	*0.046*	*0.00092*	*0.0048*	*<0.01*
			Median	-	*8.0*	*<0.05*	*<0.5*	*0.19*	*0.028*	*0.0018*	*7.1*	*1.0*	*1.4*	*0.0016*	*0.013*	*0.037*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*2.3*	*0.0031*	*0.00086*	*0.0078*	*1.1*	*0.00050*	*<0.005*	*0.64*	*0.049*	*<0.00005*	*0.0017*	*0.0051*	*<0.3*	*2.1*	*<0.0005*	*5.9*	*<0.00005*	*1.9*	*0.015*	*<0.0001*	*<0.0005*	*0.036*	*0.00068*	*0.0034*	*<0.01*
			25th PCTL	-	*7.0*	*<0.05*	*<0.5*	*0.11*	*0.011*	*0.0013*	*6.8*	*0.84*	*1.1*	*0.00054*	*0.0062*	*0.031*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*1.6*	*0.0029*	*0.00078*	*0.0069*	*0.94*	*0.00046*	*<0.005*	*0.58*	*0.040*	*<0.00005*	*0.0016*	*0.0022*	*<0.3*	*1.2*	*<0.0005*	*5.0*	*<0.00005*	*1.5*	*0.0097*	*<0.0001*	*<0.0005*	*0.029*	*0.00038*	*0.0029*	*<0.01*
			10th PCTL	-	*5.9*	*<0.05*	*<0.5*	*0.090*	*<0.005*	*0.0012*	*6.4*	*0.72*	*0.95*	*0.00024*	*0.0031*	*0.027*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*1.2*	*0.0022*	*0.00058*	*0.0058*	*0.84*	*0.00039*	*<0.005*	*0.44*	*0.038*	*<0.00005*	*0.0012*	*0.0018*	*<0.3*	*1.1*	*<0.0005*	*4.5*	*<0.00005*	*1.2*	*0.0066*	*<0.0001*	*<0.0005*	*0.023*	*0.00013*	*0.0024*	*<0.01*
			Min	-	*5.3*	*<0.05*	*<0.5*	*0.064*	*<0.005*	*<0.001*	*6.2*	*0.54*	*0.71*	*0.00023*	*0.0020*	*0.023*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*0.68*	*0.0012*	*0.00028*	*0.0044*	*0.74*	*0.00035*	*<0.005*	*0.23*	*0.038*	*<0.00005*	*0.00077*	*0.0014*	*<0.3*	*1.1*	*<0.0005*	*4.5*	*<0.00005*	*1.2*	*0.0038*	*<0.0001*	*<0.0005*	*0.018*	*0.00011*	*0.0021*	*<0.01*
Overburden overlying Granite Bedrock																																												
17560	SRK-15TP-43	Leach Pad	granite	*<0.25*	5.2	*<0.05*	*<0.5*	0.17	*<0.005*	*<0.001*	6.1	*<0.5*	1.4	0.00025	0.0011	0.019	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.0	0.0033	0.00046	0.0068	1.3	0.00075	*<0.005*	0.36	0.045	*<0.00005*	0.0011	0.0026	*<0.3*	0.79	*<0.0005*	11	*<0.00005*	2.2	0.0077	*<0.0001*	*<0.0005*	0.072	0.0016	0.0038	*<0.01*
17561	SRK-15TP-05	Leach Pad	granite	*<0.25*	4.1	*<0.05*	*<0.5*	0.079	*<0.005*	*<0.001*	6.2	0.56	0.98	0.00015	0.0011	0.014	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.59	0.0019	0.00049	0.0031	0.74	0.00062	*<0.005*	0.16	0.072	*<0.00005*	0.0011	0.0015	*<0.3*	0.90	*<0.0005*	7.5	0.000071	2.5	0.0051	*<0.0001*	*<0.0005*	0.029	0.0023	0.0018	*<0.01*
17565	SRK-15TP-03	Leach Pad	granite	*<0.25*	4.9	*<0.05*	*<0.5*	0.084	0.0098	0.0017	5.9	0.87	1.7	0.00021	0.0028	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.3	0.0029	0.00096	0.0052	1.6	0.0011	*<0.005*	0.35	0.15	*<0.00005*	0.00052	0.0022	*<0.3*	0.98	*<0.0005*	10	0.000079	2.3	0.011	*<0.0001*	*<0.0005*	0.054	0.0035	0.0034	*<0.01*
17566	SRK-15TP-17	Leach Pad	granite	*<0.25*	4.9	*<0.05*	*<0.5*	0.083	*<0.005*	*<0.001*	6.4	*<0.5*	0.90	0.00023	0.0016	0.013	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.86	0.0018	0.00029	0.0045	0.99	0.00070	*<0.005*	0.25	0.052	0.000065	0.0011	0.0022	*<0.3*	1.1	*<0.0005*	9.3	*<0.00005*	1.9	0.0077	*<0.0001*	*<0.0005*	0.033	0.0024	0.0022	*<0.01*
17571	SRK-15TP-15	Leach Pad	granite	*<0.25*	5.0	*<0.05*	*<0.5*	0.066	0.0080	0.0010	6.1	*<0.5*	1.3	0.00019	0.0023	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.94	0.0027	0.00079	0.0048	1.0	0.00070	*<0.005*	0.27	0.15	*<0.00005*	0.00054	0.0020	*<0.3*	0.94	*<0.0005*	10	*<0.00005*	2.1	0.0087	*<0.0001*	*<0.0005*	0.049	0.0015	0.0028	*<0.01*
17572	SRK-15TP-14	Leach Pad	granite	*<0.25*	3.9	*<0.05*	*<0.5*	0.047	0.058	0.0022	5.9	*<0.5*	0.74	0.00069	0.026	0.014	*<0.0005*	*<0.0005*	0.024	*<0.00005*	0.64	0.0015	0.00043	0.0040	0.44	0.00032	*<0.005*	0.17	0.054	*<0.00005*	0.00040	0.0015	*<0.3*	1.8	*<0.0005*	7.4	*<0.00005*	1.1	0.0059	*<0.0001*	*<0.0005*	0.011	0.0025	0.0010	*<0.01*
17575	SRK-15TP-11	Leach Pad	granite	*<0.25*	5.0	*<0.05*	*<0.5*	0.11	*<0.005*	0.0017	6.5	*<0.5*	0.79	0.00027	0.0025	0.012	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.38	0.0017	0.00020	0.0035	0.75	0.00069	*<0.005*	0.11	0.042	*<0.00005*	0.0015	0.0014	*<0.3*	0.91	*<0.0005*	7.4	*<0.00005*	2.2	0.0032	*<0.0001*	*<0.0005*	0.026	0.0041	0.0020	*<0.01*
17580	SRK-15TP-41	Leach Pad	granite	*<0.25*	5.8	*<0.05*	*<0.5*	0.13	*<0.005*	*<0.001*	6.5	*<0.5*	1.9	0.00027	0.0016	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.84	0.0037	0.00059	0.0077	1.9	0.0016	*<0.005*	0.44	0.084	*<0.00005*	0.0025	0.0036	*<0.3*	0.89	*<0.0005*	13	0.00014	2.3	0.0069	*<0.0001*	*<0.0005*	0.077	0.0015	0.0059	*<0.01*
KNB-1	KNB-1	Event Pond	granite	*<0.25*	*<2*	*<0.05*	*<0.5*	*<0.02*	0.13	*<0.001*	6.5	*<0.5*	0.11	0.00016	*<0.001*	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*<0.1*	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	0.00010	*<0.005*	*<0.05*	0.0016	*<0.00005*	0.0027	*<0.0005*	*<0.3*	0.53	*<0.0005*	2.0	*<0.00005*	0.55	*<0.0005*	*<0.0001*	*<0.0005*	*<0.01*	0.0023	*<0.001*	*<0.01*
KNB-2	KNB-2	Event Pond	granite	*<0.25*	*<2*	*<0.05*	*<0.5*	0.022	0.029	*<0.001*	6.4	*<0.5*	0.11	0.00015	*<0.001*	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*<0.1*	*<0.0005*	*<0.0001*	*<0.001*	0.046	0.00023	*<0.005*	*<0.05*	0.0025	*<0.00005*	0.00084	*<0.0005*	*<0.3*	0.48	*<0.0005*	2.2	*<0.00005*	0.61	*<0.0005*	*<0.0001*	*<0.0005*	*<0.01*	0.0017	*<0.001*	*<0.01*
KNB-3	KNB-3	Event Pond	granite	*<0.25*	*<2*	*<0.05*	*<0.5*	*<0.02*	0.41	*<0.001*	6.3	1.4	0.081	0.00013	0.0011	0.0029	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*<0.1*	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	0.00031	*<0.005*	*<0.05*	0.0034	*<0.00005*	0.00012	*<0.0005*	*<0.3*	0.98	*<0.0005*	2.5	*<0.00005*	0.75	*<0.0005*	*<0.0001*	*<0.0005*	*<0.01*	0.0011	*<0.001*	*<0.01*
Statistical Summary forOverburden overlying Granite bedrock (n = 11)			**Max**	-	5.8	*<0.05*	*<0.5*	0.17	0.41	0.0022	6.5	1.4	1.9	0.00069	0.026	0.025	*<0.0005*	*<0.0005*	0.024	*<0.00005*	1.3	0.0037	0.00096	0.0077	1.9	0.0016	*<0.005*	0.44	0.15	0.000065	0.0027	0.0036	*<0.3*	1.8	*<0.0005*	13	0.00014	2.5	0.011	*<0.0001*	*<0.0005*	0.077	0.0041	0.0059	*<0.01*
			90th PCTL	-	5.2	*<0.05*	*<0.5*	0.13	0.13	0.0017	6.5	0.87	1.7	0.00027	0.0028	0.025	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	1.0	0.0033	0.00079	0.0068	1.6	0.0011	*<0.005*	0.36	0.15	*<0.00005*	0.0025	0.0026	*<0.3*	1.1	*<0.0005*	11	0.000079	2.3	0.0087	*<0.0001*	*<0.0005*	0.072	0.0035	0.0038	*<0.01*
			75th PCTL	-	5.0	*<0.05*	*<0.5*	0.098	0.043	0.0014	6.5	0.53	1.4	0.00026	0.0024	0.022	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.90	0.0028	0.00054	0.0050	1.1	0.00073	*<0.005*	0.31	0.078	*<0.00005*	0.0013	0.0022	*<0.3*	0.98	*<0.0005*	10	0.000061	2.2	0.0077	*<0.0001*	*<0.0005*	0.052	0.0024	0.0031	*<0.01*
			Median	-	4.9	*<0.05*	*<0.5*	0.079	*<0.008*	*<0.001*	6.3	*<0.5*	0.90	0.00021	0.0016	0.014	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.64	0.0018	0.00043	0.0040	0.75	0.00069	*<0.005*	0.17	0.052	*<0.00005*	0.0011	0.0015	*<0.3*	0.91	*<0.0005*	7.5	*<0.00005*	2.1	0.0059	*<0.0001*	*<0.0005*	0.029	0.0023	0.0020	*<0.01*
			25th PCTL	-	3.0	*<0.05*	*<0.5*	0.035	*<0.005*	*<0.001*	6.1	*<0.5*	0.42	0.00016	0.0011	0.0073	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	0.24	0.0010	0.00015	0.0021	0.24	0.00032	*<0.005*	0.081	0.023	*<0.00005*	0.00053	0.00096	*<0.3*	0.84	*<0.0005*	4.9	*<0.00005*	0.93	0.0019	*<0.0001*	*<0.0005*	0.011	0.0015	0.0010	*<0.01*
			10th PCTL	-	*<2*	*<0.05*	*<0.5*	0.020	*<0.005*	*<0.001*	5.9	*<0.5*	0.11	0.00015	*<0.001*	*<0.001*	*<0.0005*	*<0.0005*	*<0.01*	*<0.00005*	*<0.1*	*<0.0005*	*<0.0001*	*<0.001*	*<0.03*	0.00023	*<0.005*	*<0.05*	0

Appendix C.4-3: Solid Phase Element Results by Aqua Regia Digestion for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
				ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Overburden Overlying Gneiss Bedrock																																																									
KAM106801	CFR0320	DD Pit	gneiss	0.18	0.58	481	2.8	<10	3100	0.99	0.22	0.52	0.020	56	5.8	9.0	1.7	5.4	1.5	1.4	0.060	0.060	0.48	0.011	0.26	32	0.90	0.090	352	0.63	0.010	<0.05	11	310	11	12	<0.001	0.080	5.9	2.2	0.40	0.30	54	<0.01	0.12	20	<0.005	0.29	1.2	7.0	0.71	8.5	11	2.6
R281758	CFR0836	DD Pit	gneiss	0.070	1.5	106	<0.2	<10	210	0.43	0.25	0.49	0.080	27	14	69	1.1	16	2.6	4.9	0.090	0.020	0.090	0.018	0.26	14	9.1	0.84	530	1.7	0.040	1.2	27	520	10	22	<0.001	0.010	6.1	3.9	0.30	1.1	34	<0.01	0.090	5.4	0.092	0.21	0.94	48	2.2	6.4	39	0.90
R283938	CFR0825	DD Pit	gneiss	0.050	1.6	39	<0.2	<10	190	0.54	0.25	0.53	0.050	36	12	53	1.1	12	2.4	5.3	0.090	0.060	0.030	0.017	0.33	19	9.0	0.82	442	1.2	0.060	1.2	22	470	8.2	30	<0.001	0.010	5.8	4.0	0.60	1.0	38	<0.01	0.050	11	0.11	0.20	1.2	43	2.0	8.5	35	2.8
R288218	CFR0694	DD Pit	gneiss	0.040	1.5	47	<0.2	<10	150	0.40	0.63	0.51	0.030	25	13	79	1.4	14	2.5	4.1	0.060	0.020	0.030	0.015	0.24	13	7.7	0.84	500	0.69	0.040	0.89	37	510	6.0	22	<0.001	0.010	2.6	3.1	0.60	0.80	29	<0.01	0.28	6.1	0.095	0.17	0.69	37	0.52	6.0	33	0.70
R298598	CFR0716	DD Pit	gneiss	0.030	1.8	44	<0.2	<10	220	0.76	0.31	0.34	0.050	62	10	33	2.1	10	2.7	6.3	0.12	0.13	0.020	0.019	0.61	32	10	0.81	502	1.2	0.050	0.94	20	610	9.3	43	<0.001	0.010	3.4	4.3	0.60	0.80	21	0.010	0.040	15	0.075	0.31	0.85	36	0.84	11	44	5.0
KAM018321	CFR0102	Supremo Pit	gneiss	0.18	0.81	894	1.2	<10	180	0.68	0.14	0.18	0.12	49	6.0	17	1.3	14	2.0	2.7	0.070	0.070	0.86	0.019	0.22	27	3.8	0.12	379	1.3	0.020	0.22	9.2	300	14	14	<0.001	0.040	17	3.4	0.50	0.80	33	<0.01	0.050	25	0.012	0.96	8.3	21	1.2	8.5	30	4.4
KAM104165	CFR0288	Supremo Pit	gneiss	0.060	0.45	372	1.3	<10	130	0.89	0.10	0.090	0.080	79	2.0	8.0	0.67	5.4	1.1	2.2	0.090	0.070	0.57	0.016	0.20	45	1.5	0.050	363	1.2	0.010	0.30	4.1	140	15	17	<0.001	<0.01	25	1.1	0.40	0.50	11	<0.01	0.040	27	<0.005	0.55	8.7	7.0	1.3	7.0	16	3.6
R280751	CFR0805	Supremo Pit	gneiss	0.030	0.55	145	<0.2	<10	100	0.52	0.17	0.080	0.080	67	3.6	18	1.1	22	1.4	2.2	0.080	0.17	0.050	0.011	0.17	38	2.4	0.10	336	3.2	0.020	0.39	11	180	8.8	17	0.0010	0.010	8.9	1.4	0.40	0.80	9.7	<0.01	0.010	25	0.018	0.19	4.3	13	3.3	8.5	36	3.6
R281909	CFR0839	Supremo Pit	gneiss	0.020	2.2	33	<0.2	<10	350	0.55	0.38	0.79	0.050	35	18	94	1.5	12	2.7	7.4	0.10	0.070	0.020	0.016	0.81	18	11	1.9	404	0.90	0.080	0.36	44	690	7.4	43	<0.001	0.010	3.2	3.7	0.40	1.8	34	<0.01	0.14	8.2	0.17	0.32	1.0	48	1.6	6.8	47	2.7
R281971	CFR0841	Supremo Pit	gneiss	0.050	1.2	83	<0.2	<10	170	0.40	0.36	0.34	0.040	44	8.4	28	0.88	13	2.1	4.2	0.070	0.030	0.13	0.017	0.23	24	7.0	0.39	358	1.3	0.050	1.1	15	340	6.0	23	<0.001	0.010	5.6	2.6	0.60	1.3	25	<0.01	0.14	14	0.061	0.18	1.5	30	2.3	9.3	25	1.1
R284001	CFR0804	Supremo Pit	gneiss	0.050	0.97	87	0.20	<10	130	0.70	0.11	0.24	0.080	62	5.6	25	1.0	23	1.8	3.6	0.10	0.070	0.080	0.016	0.24	41	4.8	0.21	403	3.1	0.060	1.2	12	310	9.4	23	<0.001	0.010	8.1	2.5	0.60	1.2	23	0.020	0.010	20	0.051	0.20	4.4	27	1.7	11	38	3.1
R285461	CFR0757	Supremo Pit	gneiss	0.070	0.94	15	<0.2	<10	100	0.33	0.20	0.34	0.090	28	6.6	30	0.49	7.2	1.7	3.0	0.060	0.14	0.010	0.012	0.27	16	4.0	0.38	294	1.1	0.060	0.50	15	360	7.9	20	<0.001	<0.01	0.58	1.8	0.60	1.1	28	<0.01	0.050	15	0.080	0.14	1.3	25	0.34	6.1	25	6.7
R285552	CFR0759	Supremo Pit	gneiss	0.020	2.0	104	<0.2	<10	230	0.84	0.47	0.36	0.040	89	12	55	2.5	11	2.9	7.0	0.18	0.13	0.050	0.016	1.1	49	11	1.3	453	0.79	0.040	0.86	13	590	6.4	84	<0.001	<0.01	2.2	3.7	0.80	1.6	27	0.010	0.12	20	0.14	0.61	2.6	43	0.71	16	41	6.2
R286151	CFR0776	Supremo Pit	gneiss	0.020	1.0	27	<0.2	<10	110	0.38	0.14	0.27	0.050	32	7.4	34	0.59	19	1.9	3.6	0.070	0.050	0.010	0.011	0.28	15	5.7	0.43	326	2.4	0.060	0.74	19	310	8.3	25	0.0010	<0.01	0.73	2.6	0.40	0.90	29	<0.01	0.030	16	0.071	0.14	1.3	30	1.3	7.0	23	3.2
R286219	CFR0779	Supremo Pit	gneiss	0.030	0.87	228	<0.2	<10	110	0.48	0.34	0.23	0.10	44	7.2	23	0.83	11	1.7	3.3	0.080	0.23	0.040	0.013	0.22	25	4.0	0.27	262	1.4	0.050	0.55	13	340	5.2	18	<0.001	<0.01	4.4	2.6	0.70	1.0	23	0.030	0.14	22	0.046	0.16	2.0	24	1.2	8.7	20	10
R286345	CFR0782	Supremo Pit	gneiss	0.020	0.88	38	<0.2	<10	100	0.34	0.24	0.27	0.030	85	5.1	12	0.87	9.5	1.8	4.5	0.10	0.19	0.020	0.011	0.45	43	4.8	0.31	267	1.4	0.050	0.75	6.6	400	4.4	46	<0.001	<0.01	1.4	1.9	0.70	0.90	22	<0.01	0.13	23	0.094	0.34	4.3	17	0.79	11	21	7.6
R287156	CFR0802	Supremo Pit	gneiss	0.040	0.94	121	<0.2	<10	110	0.61	0.19	0.18	0.070	55	6.5	19	1.1	8.9	1.9	2.9	0.080	0.12	0.040	0.015	0.21	34	4.4	0.21	409	0.81	0.040	0.45	9.9	350	7.5	19	<0.001	<0.01	4.6	2.6	0.40	0.70	18	<0.01	0.010	21	0.041	0.19	2.3	29	0.69	9.0	27	3.2
R513919	CFR0872	Supremo Pit	gneiss	0.030	1.1	91	<0.2	<10	120	0.49	0.090	0.18	0.070	38	8.1	27	1.0	12	1.8	3.1	0.060	0.12	0.060	0.013	0.19	20	5.3	0.30	372	1.5	0.040	0.24	17	240	8.8	15	<0.001	<0.01	3.3	2.6	0.50	0.80	16	<0.01	0.020	22	0.047	0.14	1.8	28	1.9	8.2	24	6.7
R514753	CFR0783	Supremo Pit	gneiss	0.040	0.89	117	<0.2	<10	160	0.42	0.12	0.25	0.10	36	7.4	21	0.54	12	1.9	2.8	0.060	0.20	0.030	0.015	0.15	19	4.7	0.23	414	1.2	0.030	0.48	13	290	6.7	12	<0.001	0.010	4.4	2.5	0.60	0.90	20	<0.01	0.030	17	0.044	0.090	1.9	31	1.5	7.3	23	2.2
R514902	CFR0786	Supremo Pit	gneiss	0.020	1.9	43	<0.2	<10	220	0.52	0.14	0.65	0.040	17	15	84	0.94	8.0	2.6	4.7	0.090	0.22	0.020	0.011	0.68	9.1	11	1.4	537	0.82	0.060	0.24	25	540	4.2	43	<0.001	<0.01	7.6	3.0	0.40	1.1	30	<0.01	0.050	11	0.15	0.30	1.1	42	0.78	5.6	30	5.2
R515335	CFR0797	Supremo Pit	gneiss	0.040	1.0	71	<0.2	<10	120	0.49	0.12	0.24	0.070	46	6.9	20	0.78	13	1.8	3.2	0.060	0.080	0.060	0.015	0.17	25	5.2	0.27	343	0.76	0.050	0.41	12	360	5.6	14	<0.001	<0.01	4.5	3.0	0.50	1.1	20	<0.01	0.030	21	0.054	0.11	2.4	31	0.87	9.4	24	4.3
R515458	CFR0799	Supremo Pit	gneiss	0.040	1.4	45	<0.2	<10	150	0.50	0.10	0.32	0.060	46	8.4	33	0.84	14	2.0	4.3	0.060	0.030	0.030	0.014	0.26	26	8.6	0.54	315	0.68	0.060	0.80	17	410	5.3	20	<0.001	0.010	3.1	3.2	0.60	1.0	24	<0.01	0.030	16	0.089	0.16	1.8	40	2.1	8.9	28	1.7
R540708	CFR0864	Supremo Pit	gneiss	0.040	1.5	44	<0.2	<10	150	0.62	0.090	0.42	0.030	41	9.6	42	1.2	18	2.4	4.3	0.090	0.14	0.050	0.013	0.35	23	8.4	0.63	408	3.9	0.060	0.57	19	390	6.5	32	0.0010	0.010	3.4	3.9	0.50	0.90	27	0.010	0.020	20	0.11	0.23	2.2	42	1.1	14	31	5.8
R540846	CFR0866	Supremo Pit	gneiss	0.050	1.2	108	<0.2	<10	110	1.0	0.38	0.31	0.050	53	7.0	26	1.6	13	1.9	5.1	0.15	0.17	0.12	0.016	0.20	28	5.9	0.30	381	1.6	0.040	0.79	15	280	8.5	27	<0.001	<0.01	3.4	4.2	0.70	1.4	21	0.060	0.020	31	0.045	0.28	2.4	29	0.93	13	25	8.8
R541274	CFR0877	Supremo Pit	gneiss	0.030	0.70	83	<0.2	<10	80	0.39	0.10	0.11	0.070	39	5.2	16	0.64	7.8	1.4	2.2	0.050	0.030	0.040	0.0090	0.16	20	3.4	0.18	326	1.7	0.030	0.44	9.8	190	11	13	<0.001	<0.01	3.9	1.4	0.60	0.60	12	<0.01	0.020	20	0.032	0.11	2.1	20	1.9	6.7	19	1.8
R541396	CFR0881	Supremo Pit	gneiss	0.020	0.50	99	<0.2	<10	60	0.40	0.11	0.070	0.090	31	2.8	15	0.38	5.4	0.85	1.6	0.050	0.040	0.030	0.0060	0.15	18	1.9	0.060	221	1.8	0.020	0.34	8.2	150	6.6	12	0.0010	<0.01	6.3	0.90	0.40	0.40	9.4	<0.01	0.010	27	0.011	0.090	2.9	10	0.59	8.0	13	3.1
R541524	CFR0884	Supremo Pit	gneiss	0.030	0.58	53	<0.2	<10	70	0.36	0.10	0.12	0.080	32	3.8	15	0.45	7.6	1.2	2.0	0.050	0.080	0.090	0.010	0.13	17	3.1	0.15	233	1.2	0.030	0.41	8.6	160	5.5	12	<0.001	<0.01	3.4	1.3	0.40	0.50	12	<0.01	0.020	25	0.033	0.10	2.1	18	1.1	8.8	17	4.1
R542611	CFR0909	Supremo Pit	gneiss	0.040	0.88	562	<0.2	<10	110	0.69	0.11	0.15	0.050	61	4.2	18	0.77	6.7	1.5	2.4	0.070	0.17	0.39	0.010	0.19	38	3.8	0.13	246	1.3	0.010	0.11	8.6	270	10	17	<0.001	<0.01	42	1.7	0.60	0.70	16	<0.01	0.020	29	0.021	0.57	12	16	2.0	12	19	9.3
R542736	CFR0912	Supremo Pit	gneiss	0.020	1.1	27	<0.2	<10	200	0.80	0.19	0.45	0.020	69	8.7	28	2.0	9.8	1.8	3.5	0.090	0.20	0.030	0.016	0.31	41	6.2	0.47	366	1.0	0.050	0.36	15	340	4.4	32	<0.001	0.010	1.9	2.9	0.60	1.3	27	<0.01	0.020	24	0.079	0.26	1.5	27	1.4	13	25	11
R543125	CFR0924	Supremo Pit	gneiss	0.020	0.85	16	<0.2	<10	90	0.31	0.16	0.23	0.050	31	6.6	24	0.49	8.0	1.5	2.7	0.050	0.090	0.010	0.011	0.22	15	4.6	0.34	305	1.1	0.050	0.52	13	280	4.6	18	<0.001	<0.01	0.57	1.9	0.40	0.80	15	<0.01	0.060	20	0.052	0.11	2.0	25	3.0	7.4	20	4.6
R543393	CFR0933	Supremo Pit	gneiss	0.020	0.44	150	<0.2	<10	50	0.35	0.14	0.11	0.090	35	3.5	12	0.74	6.0	1.4	1.7	0.050	0.090	0.10	0.0080	0.13	21	2.0	0.090	203	1.5	0.030	0.42	5.8	220	6.7	12	<0.001	<0.01	6.9	1.1	0.30	0.80	9.6	<0.01	0.020	25	0.017	0.12	2.1	11	2.9	6.7	17	4.3
R546991	CFR0905	Supremo Pit	gneiss	0.050	1.3	165	<0.2	<10	150	0.68	0.12	0.26	0.17	53	7.0	25	0.83	16	1.9	3.8	0.080	0.11	0.18	0.015	0.18	31	7.0	0.30	380	1.2	0.040	0.63	14	340	18	15	<0.001	0.010	3.2	3.5	0.70	0.60	35	<0.01	0.040	20	0.062	0.26	4.4	38	3.5	12	34	6.2
R547067	CFR0908	Supremo Pit	gneiss	0.040	0.67	32	<0.2	<10	90	0.44	0.14	0.44	0.040	57	4.2	17	0.75	11	1.4	2.7	0.060	0.28	0.030	0.012	0.19	35	4.7	0.25	289	1.6	0.050	0.42	8.1	270	10	18	<0.001	0.010	1.6	2.0	0.50	1.3	24	<0.01	0.030	27	0.043	0.14	2.3	20	2.8	13	22	14
R548052	CFR0944	Supremo Pit	gneiss	0.070	1.4	50	<0.2	<10	170	0.82	0.39	0.31	0.080	59	7.2	22	2.6	13	2.2	4.6	0.10	0.080	0.070	0.019	0.18	33	7.9	0.28	666	1.7	0.040	1.8	12	360	9.2	26	<0.001	0.010	2.2	3.3	0.90	1.5	23	0.030	0.040	16	0.057	0.24	10	33	3.2	15	45	2.9
R618573	CFR0846	Supremo Pit	gneiss	0.040	2.2	94	<0.2	<10	220	0.81	0.22	0.57	0.040	45	16	78	2.3	19	3.2	7.1	0.14	0.20	0.070	0.024	0.49	22	12	1.3	630	2.5	0.070	1.2	41	530	5.2	41	<0.001	0.010	20	5.2	0.60	2.0	40	0.030	0.060	13	0.16	0.34	1.1	54	2.0	9.9	41	5.0
R618876	CFR0860	Supremo Pit	gneiss	0.020	1.9	72	<0.2	<10	150	0.56	0.16	0.46	0.030	46	19	345	3.7	22	2.2	5.2	0.11	0.12	0.030	0.014	0.70	24	12	2.2	427	2.0	0.040	0.55	266	210	6.5	51	0.0010	<0.01	1.6	6.4	0.60	2.2	17	0.030	0.020	21	0.063	0.42	1.7	33	1.1	11	26	5.8
R619123	CFR0867	Supremo Pit	gneiss	0.040	1.5	880	0.20	<10	150	0.96	0.35	0.15	0.020	54	17	50	4.7	17	3.0	5.7	0.13	0.070	1.4	0.027	0.55	26	6.1	0.51	319	1.9	0.030	0.37	38	280	4.7	36	<0.001	0.020	20	5.7	0.80	2.1	31	0.010	0.060	9.9	0.050	0.75	2.9	34	0.80	11	40	2.5
R620371	CFR0910	Supremo Pit	gneiss	0.010	0.34	20	<0.2	<10	40	0.24	0.070	0.23	0.010	51	1.5	10	0.78	7.7	0.97	2.0	0.060	0.12	0.030	0.0060	0.17	29	2.4	0.10	194	1.7	0.030	1.2	5.3	130	7.4	19	<0.001	<0.01	1.1	0.60	0.30	1.3	12	<0.01	0.010	31	0.018	0.16	2.2	5.0	2.5	8.6	12	5.4
R620448	CFR0911	Supremo Pit	gneiss	0.030	0.69	64	<0.2	<10	50	0.32	0.16	0.090	0.080	26	4.5	15	0.65	9.3	1.6	2.7	0.060	0.020	0.050	0.013	0.12	15	3.7	0.13	251	1.4	0.030	0.75	7.8	280	7.6	11	<0.001	0.010	2.9	1.4	0.30	1.0	18	<0.01	0.020	14	0.030	0.10	2.1	23	1.1	6.5	19	0.90
R620797	CFR0923	Supremo Pit	gneiss	0.070	0.94	64	<0.2	<10	100	0.38	0.16	0.20	0.060	30	5.9	30	0.59	89	2.1	3.1	0.060	0.040	0.060	0.014	0.13	18	12	0.23	357	1.8	0.040	0.94	12	430	13	12	<0.001	0.010	9.8	2.1	0.40	7.5	16	0.030	0.020	12	0.046	0.12	2.0	32	1.0	6.5	37	1.4
R290225	CFR0614	West WRSF	gneiss	0.040	0.71	84	<0.2	<10	140	0.43	0.57	0.19	0.080	45	3.7	14	0.80	12	1.6	3.1	0.060	0.030	0.040	0.016	0.21	25	3.4	0.19	179	1.9	0.020	0.75	8.7	280	6.3	19	0.0010	0.010	1.3	2.0	0.40	0.80	27	<0.01	0.14	16	0.032	0.14	1.3	17	1.3	8.2	24	1.8
Statistical Summary for Overburden overlying Gneiss Bedrock (n = 41)			**Max**	0.18	2.2	894	2.8	<10	3100	1.0	0.63	0.79	0.17	89	19	345	4.7	89	3.2	7.4	0.18	0.28	1.4	0.027	1.1	49	12	2.2	666	3.9	0.080	1.8	266	690	18	84	0.0010	0.080	42	6.4	0.90	7.5	54	0.060	0.28	31	0.17	0.96	12	54	3.5	16	47	14
			90th PCTL	0.070	1.9	372	0.20	<10	220	0.84	0.38	0.52	0.090	67	15	78	2.3	19	2.7	5.7	0.12	0.20	0.39	0.019	0.61	41	11	1.3	502	2.4	0.060	1.2	37	530	11	43	0.0010	0.010	17	4.2	0.70	1.8	34	0.030	0.14	27	0.11	0.55	4.4	43	2.9	13	41	8.8
			75th PCTL	0.050	1.5	117	<0.2	<10	170	0.69	0.25	0.42	0.080	56	9.6	34	1.4	14	2.2	4.6	0.090	0.14	0.090	0.016	0.31	32	8.4	0.54	409	1.7	0.050	0.86	19	400	9.3	30	<0.001	0.010	6.3	3.5	0.60	1.3	29	<0.01	0.060	24	0.080	0.30	2.6	36	2.0	11	35	5.8
			Median	0.040	0.97	83	<0.2	<10	130	0.50	0.16	0.26	0.060	45	7.0	25	0.88	12	1.9	3.3	0.070	0.090	0.050	0.014	0.22	25	5.2	0.30	358	1.4	0.040	0.55	13	310	7.4	19	<0.001	0.010	3.4	2.6	0.50	1.0	23	<0.01	0.030	20	0.051	0.19	2.1	29	1.3	8.6	25	4.1
			25th PCTL	0.020	0.71	44	<0.2	<10	100	0.40	0.12	0.18	0.040	35	5.1	17	0.74	8.0	1.5	2.7	0.060	0.060	0.030	0.011	0.18	18	3.8	0.18	294	1.1	0.030	0.39	9.2	270	6.0	15	<0.001	<0.01	2.2	1.9	0.40	0.80	16	<0.01	0.020	15	0.032	0.14	1.3	20	0.87	7.0	20	2.6
			10th PCTL	0.020	0.55	27	<0.2	<10	70	0.34	0.10	0.11	0.030	28	3.6	12	0.54	6.7	1.4	2.0	0.050	0.030	0.020	0.010	0.15	15	2.4	0.10	233	0.79	0.020	0.24	7.8	180	4.7	12	<0.001	<0.01	1.3	1.3	0.40	0.60	12	<0.01	0.010	11	0.017	0.11	1.1	11	0.71	6.5	17	1.4
			Min	0.010	0.34	15	<0.2	<10	40	0.24	0.070	0.070	0.010	17	1.5	8.0	0.38	5.4	0.85	1.4	0.050	0.020	0.010	0.0060	0.12	9.1	0.90	0.050	179	0.63	0.010	<0.05	4.1	130	4.2	11	<0.001	<0.01	0.57	0.60	0.30	0.30	9.4	<0.01	0.010	5.4	<0.005	0.090	0.69	5.0	0.34	5.6	11	0.70

Appendix C.4-3: Solid Phase Element Results by Aqua Regia Digestion for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
				ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Overburden Overlying Schist Bedrock																																																									
R288438	CFR0698	DD Pit	schist	0.050	1.8	160	0.20	<10	180	0.58	0.22	0.45	0.080	57	12	69	1.8	15	2.5	4.8	0.070	0.040	0.050	0.016	0.51	26	11	1.1	591	0.85	0.030	0.36	33	460	9.9	34	0.0010	0.010	9.8	3.7	0.70	0.70	18	<0.01	0.030	10	0.063	0.31	1.0	30	7.5	8.4	58	1.9
R298516	CFR0713	DD Pit	schist	0.040	0.54	1440	<0.2	<10	190	0.67	0.13	0.25	0.060	93	4.3	14	1.3	7.2	1.8	2.3	0.11	0.11	0.26	0.010	0.22	59	1.9	0.14	308	1.5	0.010	0.28	9.8	240	13	16	0.0010	0.010	11	2.1	0.90	0.30	19	<0.01	0.030	27	0.0060	0.23	3.1	11	2.5	12	20	5.3
R294148	CFR0624	Latte Pit	schist	0.030	1.7	130	<0.2	<10	210	0.51	0.16	3.7	0.080	45	13	53	1.2	21	2.8	6.7	0.13	0.15	0.030	0.020	0.65	28	10	0.85	469	0.69	0.040	1.1	31	640	4.9	51	<0.001	0.010	1.9	5.8	1.0	0.90	130	0.020	0.020	9.4	0.13	0.31	0.76	46	0.86	13	46	4.5
R297797	CFR0676	North WRSF	schist	0.010	1.0	7.2	<0.2	<10	170	0.33	0.050	0.99	0.010	35	5.8	13	1.0	14	1.7	3.9	0.060	0.080	<0.01	0.0080	0.69	19	5.9	0.63	210	1.8	0.070	0.27	8.3	380	1.3	41	<0.001	0.020	0.61	2.2	0.40	1.2	23	<0.01	<0.01	9.1	0.098	0.23	1.5	21	3.0	8.1	12	2.6
R549926	CFR0981	North WRSF	schist	0.030	0.90	69	<0.2	<10	110	0.43	0.17	0.28	0.070	38	4.7	15	0.60	7.7	1.7	3.2	0.060	0.020	0.070	0.012	0.24	24	4.3	0.26	253	1.0	0.050	0.77	8.3	270	4.3	18	<0.001	<0.01	5.3	2.0	0.60	1.0	19	<0.01	0.010	18	0.040	0.13	2.3	21	2.5	9.1	20	1.0
R550015	CFR0984	North WRSF	schist	0.030	1.3	85	<0.2	<10	190	0.69	0.25	0.42	0.11	33	9.6	38	1.6	13	2.3	4.3	0.070	0.030	0.070	0.018	0.39	18	6.5	0.55	328	1.1	0.040	0.55	19	520	4.5	28	<0.001	0.010	9.6	5.2	0.60	1.6	19	<0.01	0.040	12	0.067	0.23	1.6	45	4.1	9.4	30	1.3
R550083	CFR0985	North WRSF	schist	0.040	2.5	34	<0.2	<10	470	0.89	0.14	0.72	0.050	16	21	86	1.1	27	3.8	8.4	0.15	0.090	0.010	0.026	1.2	7.6	18	2.0	663	1.2	0.080	0.41	40	830	2.5	74	<0.001	<0.01	1.2	7.4	0.70	5.2	29	<0.01	0.020	3.6	0.21	0.42	1.3	94	1.2	9.4	51	3.7
17551	SRK-15TP-47	ROM/Plant	schist	0.050	1.5	300	<0.2	<10	180	0.62	0.33	0.37	0.10	43	14	36	1.3	24	2.3	4.8	0.13	0.040	0.59	0.031	0.10	22	8.0	0.38	525	0.61	0.030	0.79	30	410	15	9.9	<0.001	0.010	8.4	4.8	0.70	0.60	22	<0.01	0.030	5.7	0.057	0.48	1.0	47	0.72	12	58	1.5
17552	SRK-15TP-46	ROM/Plant	schist	0.040	1.9	22	<0.2	<10	110	0.87	0.15	0.33	0.080	55	8.3	29	1.3	14	2.3	7.2	0.15	0.060	0.010	0.027	0.39	30	14	0.87	415	0.83	0.040	2.0	14	430	7.3	40	<0.001	0.010	0.25	4.5	0.70	1.2	28	<0.01	0.020	13	0.11	0.30	1.7	43	0.40	13	48	2.5
17553	SRK-15TP-45	ROM/Plant	schist	0.14	1.5	48	<0.2	<10	110	0.97	0.24	0.11	0.090	42	6.8	29	1.5	14	1.8	4.5	0.11	0.16	0.020	0.017	0.22	24	11	0.44	300	2.2	0.020	0.83	13	170	15	26	<0.001	0.040	0.44	2.4	0.40	0.70	14	<0.01	0.010	17	0.042	0.35	2.5	24	0.17	4.8	52	7.2
17554	SRK-15TP-22	ROM/Plant	schist	0.040	2.4	9.3	<0.2	<10	150	1.6	0.22	0.71	0.070	71	9.6	82	2.6	19	2.0	8.3	0.16	0.090	<0.01	0.022	0.58	37	19	1.2	392	0.46	0.13	1.1	36	540	17	65	<0.001	0.020	0.19	4.5	0.70	1.6	58	<0.01	0.010	18	0.14	0.47	1.9	38	0.26	10	61	3.6
17556	SRK-15TP-24	ROM/Plant	schist	0.070	2.4	63	<0.2	<10	230	1.3	0.23	0.84	0.14	60	18	73	3.3	34	3.3	8.4	0.16	0.090	0.29	0.039	0.41	27	12	0.79	508	0.55	0.090	0.80	61	570	13	43	<0.001	0.010	1.7	10	0.80	1.1	47	<0.01	0.020	11	0.12	0.68	1.2	58	0.27	14	71	3.6
R547969	CFR0939	South WRSF	schist	0.16	1.8	29	0.20	<10	290	0.50	0.26	0.34	0.070	34	13	59	2.8	25	2.9	6.5	0.090	0.070	<0.01	0.018	1.1	16	14	1.2	397	1.3	0.020	0.16	39	620	5.8	72	<0.001	0.020	1.0	3.9	0.70	0.90	19	<0.01	0.020	6.2	0.13	0.41	1.1	40	0.93	11	57	2.1
R553319	CFB027	South WRSF	schist	0.070	2.0	28	<0.2	<10	300	0.53	0.090	4.6	0.14	42	14	59	1.5	24	2.6	6.5	0.10	0.050	0.040	0.017	0.45	23	12	1.0	407	0.67	0.040	2.3	34	650	8.5	42	<0.001	0.030	0.92	4.4	0.70	0.70	159	<0.01	0.030	6.1	0.12	0.25	1.3	47	3.2	9.3	52	2.0
R281332	CFR0816	Supremo Pit	schist	0.030	1.0	48	<0.2	<10	130	0.76	0.090	0.14	0.030	69	4.3	18	0.86	8.0	1.4	3.2	0.080	0.14	0.050	0.0090	0.35	37	5.2	0.25	294	0.85	0.050	0.43	12	270	5.1	28	<0.001	<0.01	5.4	1.7	0.60	1.5	12	<0.01	0.010	30	0.038	0.19	3.5	16	1.3	14	18	7.0
R281383	CFR0818	Supremo Pit	schist	0.060	1.0	264	0.20	<10	150	0.83	0.12	0.14	0.11	38	6.6	20	0.78	11	2.1	3.0	0.060	0.030	0.16	0.016	0.22	24	4.2	0.17	347	1.3	0.030	0.54	12	300	6.4	16	<0.001	0.010	24	3.2	0.60	1.1	19	<0.01	0.020	18	0.031	0.17	6.2	32	1.7	11	27	1.4
R294487	CFR0633	Supremo Pit	schist	0.030	1.5	110	<0.2	<10	230	0.34	0.13	0.59	0.070	40	8.8	52	1.1	17	2.9	6.0	0.090	0.080	0.060	0.018	0.53	20	11	0.88	441	1.3	0.050	1.3	24	570	5.4	29	<0.001	0.060	3.7	4.2	0.60	1.1	29	<0.01	0.020	10	0.094	0.23	0.99	50	0.49	9.2	41	3.4
R296213	CFR0651	Supremo Pit	schist	0.040	1.8	39	<0.2	<10	350	0.81	0.21	3.1	0.060	69	11	46	4.0	25	3.3	7.4	0.16	0.080	0.13	0.034	0.77	40	10	1.1	502	1.9	0.020	0.47	24	590	9.8	44	<0.001	<0.01	4.3	7.9	0.90	1.1	72	<0.01	0.010	13	0.082	0.29	1.3	44	1.9	18	59	3.6
R299233	CFR0737	Supremo Pit	schist	0.040	0.87	123	<0.2	<10	120	0.39	0.38	0.27	0.060	38	5.9	22	0.84	8.3	1.9	3.0	0.070	0.17	0.050	0.013	0.26	23	4.0	0.27	270	1.6	0.040	0.69	9.7	320	7.4	20	<0.001	<0.01	3.5	1.9	0.50	1.1	20	<0.01	0.11	17	0.050	0.18	1.7	22	0.71	7.3	22	5.8
R299489	CFR0746	Supremo Pit	schist	0.020	2.4	190	<0.2	<10	370	0.54	0.14	0.49	0.030	38	18	47	2.9	26	3.7	6.2	0.090	0.070	0.020	0.011	1.1	20	15	1.6	750	1.4	0.030	0.14	27	610	3.2	64	<0.001	<0.01	3.0	4.5	0.70	0.50	20	<0.01	0.040	7.7	0.14	0.40	2.3	58	0.49	10	58	2.5
R510641	CFR0752	Supremo Pit	schist	0.020	2.2	99	<0.2	<10	250	0.30	0.040	1.2	0.020	2.5	20	66	2.2	35	3.2	4.3	0.070	0.040	0.010	0.010	0.95	1.2	10	1.7	542	0.59	0.080	<0.05	36	180	1.5	37	<0.001	<0.01	1.0	7.2	0.30	0.60	28	<0.01	0.010	0.80	0.095	0.29	0.25	68	0.16	2.8	35	1.0
R510976	CFR0761	Supremo Pit	schist	0.090	3.1	348	<0.2	<10	530	0.93	0.30	0.64	0.020	60	20	94	12	28	5.3	10	0.18	0.28	0.18	0.041	0.94	33	20	1.8	879	0.46	0.040	0.34	62	1560	7.1	55	<0.001	<0.01	30	15	1.2	0.90	34	<0.01	0.050	8.6	0.090	1.5	2.2	116	0.29	18	60	17
R511133	CFR0680	Supremo Pit	schist	0.030	1.4	747	<0.2	<10	340	1.1	0.15	3.0	0.040	63	11	41	1.3	15	2.8	5.4	0.18	0.060	0.45	0.027	0.31	33	7.1	0.34	499	0.71	0.020	0.88	24	450	10	21	<0.001	0.010	7.0	6.3	1.1	0.80	49	0.040	0.020	13	0.031	0.37	2.0	39	0.83	19	41	3.2
R511474	CFR0686	Supremo Pit	schist	0.060	0.83	90	<0.2	<10	2220	1.1	0.19	6.0	0.13	59	15	64	0.67	29	3.8	3.8	0.16	0.040	0.44	0.050	0.13	30	3.6	1.4	801	0.67	0.020	0.36	29	790	25	7.1	0.0010	0.11	5.2	17	1.4	0.80	187	<0.01	0.030	8.7	0.0090	0.17	0.75	122	3.0	23	65	1.6
R511702	CFR0693	Supremo Pit	schist	0.14	0.91	274	<0.2	<10	360	0.72	0.38	0.40	0.18	68	13	24	0.95	39	3.0	3.2	0.12	0.10	0.42	0.022	0.30	38	4.6	0.28	602	0.69	0.020	0.28	29	790	16	21	<0.001	<0.01	18	4.5	0.80	0.50	59	<0.01	0.040	10	0.031	0.28	1.5	32	5.3	13	46	2.9
R511762	CFR0695	Supremo Pit	schist	0.25	0.79	2370	0.60	<10	350	0.79	0.27	0.32	0.15	62	17	27	1.7	25	3.8	3.1	0.12	0.13	0.36	0.023	0.39	32	2.0	0.10	744	0.98	0.010	0.18	39	630	13	23	<0.001	<0.01	20	4.3	0.70	0.40	45	0.020	0.060	11	0.0060	0.44	2.6	17	1.0	12	51	1.8
R620878	CFR0925	Supremo Pit	schist	0.050	1.4	64	<0.2	<10	320	0.78	0.11	0.72	0.040	53	3.9	18	0.64	34	1.6	3.8	0.070	0.12	0.080	0.012	0.45	32	5.4	0.13	319	3.9	0.070	0.54	14	210	6.5	27	<0.001	0.010	3.0	1.5	0.70	3.2	23	<0.01	0.010	26	0.024	0.20	3.3	14	5.1	15	16	5.9
R622028	CFR0956	Supremo Pit	schist	0.060	1.3	132	<0.2	<10	350	0.54	0.21	0.63	0.080	44	12	37	1.6	22	2.8	4.7	0.080	0.050	0.070	0.021	0.27	25	8.1	0.43	503	1.0	0.030	0.85	26	420	8.5	23	<0.001	0.010	2.9	3.7	0.70	1.0	47	<0.01	0.030	6.7	0.060	0.18	1.0	37	2.3	14	40	2.1
R622095	CFR0957	Supremo Pit	schist	0.040	1.0	13	<0.2	<10	80	0.39	0.14	0.20	0.060	27	4.6	26	0.57	11	2.0	3.6	0.090	0.070	0.020	0.011	0.18	10	5.0	0.27	227	1.4	0.050	1.3	11	260	6.5	20	<0.001	0.010	0.43	2.1	0.50	0.70	17	0.010	0.030	16	0.051	0.12	1.5	25	1.7	5.0	22	2.6
R289071	CFR0599	West WRSF	schist	0.15	0.76	1630	0.20	<10	150	0.91	0.41	0.19	0.31	62	10	23	0.46	23	2.3	2.4	0.090	0.070	1.1	0.021	0.28	33	1.9	0.15	497	1.1	0.010	0.060	25	280	25	15	0.0010	<0.01	26	5.4	0.80	0.50	25	<0.01	0.020	14	<0.005	0.35	2.7	28	1.4	12	42	3.9
R290074	CFR0612	West WRSF	schist	0.030	2.6	36	<0.2	<10	420	0.44	0.080	0.36	0.040	17	18	51	1.8	39	3.0	6.9	0.070	0.040	<0.01	0.010	1.0	11	16	1.6	437	0.84	0.050	0.18	35	210	6.0	68	<0.001	<0.01	0.42	4.3	0.30	0.50	72	<0.01	0.020	5.8	0.11	0.43	0.45	47	0.86	2.6	46	1.5
R549729	CFR0978	West WRSF	schist	0.13	0.95	122	<0.2	<10	100	0.48	0.36	0.28	0.050	34	5.8	22	0.60	14	2.1	3.4	0.070	0.020	<0.01	0.015	0.15	20	4.6	0.25	317	2.8	0.030	0.88	13	330	6.9	13	0.0020	0.080	1.2	2.9	0.60	0.70	21	<0.01	0.26	11	0.037	0.16	1.7	27	220	8.0	24	0.60
R621156	CFR0937	West WRSF	schist	0.030	1.1	59	<0.2	<10	130	0.58	0.53	0.31	0.050	75	7.2	27	1.2	23	1.9	4.6	0.12	0.14	0.030	0.015	0.37	44	6.5	0.51	326	1.0	0.040	0.76	11	430	7.2	35	<0.001	<0.01	1.7	3.2	0.90	1.7	30	0.020	0.20	21	0.075	0.24	2.2	27	1.7	14	29	7.1
Statistical Summary for Overburden overlying Schist Bedrock (n = 33)			**Max**	0.25	3.1	2370	0.60	<10	2220	1.6	0.53	6.0	0.31	93	21	94	12	39	5.3	10	0.18	0.28	1.1	0.050	1.2	59	20	2.0	879	3.9	0.13	2.3	62	1560	25	74	0.0020	0.11	30	17	1.4	5.2	187	0.040	0.26	30	0.21	1.5	6.2	122	220	23	71	17
			90th PCTL	0.14	2.4	667	0.20	<10	410	1.1	0.38	3.1	0.14	69	18	72	2.9	34	3.7	8.1	0.16	0.15	0.44	0.033	1.0	38	16	1.6	728	1.9	0.078	1.2	39	762	16	65	0.0010	0.038	19	7.8	0.98	1.6	72	0.018	0.058	20	0.13	0.46	3.0	66	4.9	17	60	6.8
			75th PCTL	0.070	1.9	190	<0.2	<10	350	0.87	0.26	0.72	0.10	62	14	59	1.8	26	3.0	6.5	0.13	0.11	0.18	0.023	0.65	33	12	1.1	525	1.4	0.050	0.85	34	610	13	43	<0.001	0.010	8.4	5.4	0.80	1.1	47	<0.01	0.030	17	0.11	0.40	2.3	47	2.5	14	57	3.9
			Median	0.040	1.4	90	<0.2	<10	210	0.67	0.19	0.42	0.070	44	11	37	1.3	22	2.5	4.6	0.090	0.070	0.050	0.018	0.39	25	8.0	0.55	437	1.0	0.040	0.54	25	430	7.2	28	<0.001	0.010	3.0	4.3	0.70	0.90	28	<0.01	0.020	11	0.063	0.29	1.6	38	1.3	11	46	2.6
			25th PCTL	0.030	1.0	39	<0.2	<10	150	0.50	0.13	0.28	0.050	38	6.6	23	0.86	14	2.0	3.4	0.070	0.040	0.020	0.012	0.26	20	4.6	0.27	319	0.69	0.020	0.28	13	280	5.4	20	<0.001	<0.01	1.0	2.9	0.60	0.70	19	<0.01	0.020	8.6	0.037	0.20	1.1	25	0.71	9.1	27	1.8
			10th PCTL	0.030	0.84	23	<0.2	<10	110	0.39	0.090	0.19	0.030	28	4.6	18	0.61	8.8	1.7	3.0	0.070	0.032	<0.01	0.010	0.19	12	3.7	0.15	275	0.59	0.020	0.16	10.0	216	3.4	15	<0.001	<0.01	0.43	2.0	0.42	0.50	18	<0.01	0.010	5.9	0.012	0.17	0.81	18	0.27	5.5	20	1.3
			Min	0.010	0.54	7.2	<0.2	<10	80	0.30	0.040	0.11	0.010	2.5	3.9	13	0.46	7.2	1.4	2.3	0.060	0.020	<0.01	0.0080	0.10	1.2	1.9	0.10	210	0.46	0.010	<0.05	8.3	170	1.3	7.1	<0.001	<0.01	0.19	1.5	0.30	0.30	12	<0.01	<0.01	0.80	<0.005	0.12	0.25	11	0.16	2.6	12	0.60

Appendix C.4-3: Solid Phase Element Results by Aqua Regia Digestion for Overburden

Sample ID	Location Reference	Site Location	Underlying Geologic Unit	Ag	Al	As	Au	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Rb	Re	S	Sb	Sc	Se	Sn	Sr	Ta	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
				ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Overburden Overlying Granite Bedrock																																																									
17557	SRK-15TP-07	Event Pond	granite	0.050	1.4	12	*<0.2*	*<10*	110	0.43	0.15	0.22	0.060	37	6.4	25	0.98	13	1.8	4.3	0.12	0.060	0.12	0.023	0.070	19	8.2	0.30	450	1.0	0.030	1.5	12	320	8.5	7.7	*<0.001*	0.010	0.33	4.4	0.60	0.60	18	*<0.01*	0.010	17	0.074	0.16	4.0	42	0.17	10	39	2.3
KNB-1	KNB-1	Event Pond	granite	0.010	0.30	1.6	*<0.2*	*<10*	10	0.12	0.050	0.010	0.010	21	0.30	2.0	1.4	0.50	0.50	1.5	0.090	0.92	0.010	0.013	0.14	11	2.2	0.020	182	1.1	0.060	3.3	0.50	30	4.4	18	*<0.001*	*<0.01*	0.070	1.4	0.20	0.90	1.0	*<0.01*	*<0.01*	40	0.015	0.16	5.8	1.0	0.12	3.8	11	22
KNB-2	KNB-2	Event Pond	granite	0.010	0.23	1.1	*<0.2*	*<10*	10	0.090	0.040	0.010	0.010	21	0.20	2.0	0.73	0.40	0.46	1.1	0.090	0.53	0.010	0.0070	0.10	12	1.1	0.010	79	0.32	0.050	2.0	0.30	20	5.0	6.8	*<0.001*	*<0.01*	0.070	1.2	0.20	0.50	0.80	*<0.01*	*<0.01*	37	0.0050	0.060	2.6	1.0	0.16	4.7	6.0	14
KNB-3	KNB-3	Event Pond	granite	0.020	0.31	2.8	*<0.2*	*<10*	10	0.32	0.060	0.010	0.010	44	0.20	2.0	0.43	0.60	0.51	1.0	0.11	0.52	0.010	0.017	0.10	22	0.40	*<0.01*	39	0.18	0.070	0.82	0.80	60	8.5	5.4	*<0.001*	*<0.01*	0.16	1.4	0.40	0.80	1.1	*<0.01*	*<0.01*	44	*<0.005*	0.060	4.9	1.0	0.12	8.2	8.0	13
KAM013553	CFR0055	Kona Pit	granite	0.070	0.54	*>10000*	3.1	*<10*	110	0.37	0.090	0.14	0.070	19	2.1	9.0	0.85	7.4	2.2	2.9	0.080	0.25	1.3	0.033	0.13	11	3.3	0.080	146	1.6	0.010	0.26	2.8	250	12	14	*<0.001*	*<0.01*	86	7.0	0.40	0.30	50	*<0.01*	0.030	5.5	0.0060	0.74	3.5	28	0.83	4.7	16	12
R297165	CFR0663	Kona Pit	granite	0.020	1.2	1665	*<0.2*	*<10*	90	0.37	0.080	0.030	0.010	25	0.60	6.0	0.21	1.8	0.65	2.8	0.070	0.40	0.86	0.016	0.030	13	5.0	0.010	50	1.4	0.010	0.11	2.4	140	25	2.3	*<0.001*	*<0.01*	7.7	1.5	0.20	0.40	59	*<0.01*	*<0.01*	25	*<0.005*	0.17	3.6	4.0	1.3	4.1	4.0	11
R297232	CFR0665	Kona Pit	granite	0.030	0.49	11	*<0.2*	*<10*	110	0.26	0.060	0.080	0.020	51	1.8	5.0	2.7	14	1.5	3.3	0.14	0.59	*<0.01*	0.017	0.31	28	17	0.12	1200	1.4	0.060	1.9	2.2	160	7.0	45	*<0.001*	*<0.01*	0.21	2.6	0.50	1.3	14	0.070	*<0.01*	30	0.055	0.39	4.3	8.0	2.0	12	36	17
R297375	CFR0666	Kona Pit	granite	0.060	1.0	923	0.40	10	180	0.93	0.11	0.070	0.080	38	5.7	14	0.99	15	2.6	2.9	0.090	0.18	0.59	0.011	0.33	18	2.9	0.040	1240	3.2	0.010	0.25	5.3	230	17	22	*<0.001*	*<0.01*	8.7	2.3	0.40	0.50	24	0.010	*<0.01*	21	*<0.005*	0.81	15	9.0	1.5	7.7	28	9.2
17558	SRK-15TP-44	Leach Pad	granite	0.020	0.77	5.3	*<0.2*	*<10*	60	0.33	0.14	0.13	0.060	28	4.3	14	1.1	6.6	1.3	2.9	0.11	0.030	0.010	0.016	0.080	15	4.6	0.16	453	0.68	0.040	2.1	6.9	220	8.6	8.7	*<0.001*	*<0.01*	0.20	2.3	0.60	0.70	11	*<0.01*	0.010	17	0.046	0.10	3.0	23	0.14	10	28	1.0
17559	SRK-15TP-06	Leach Pad	granite	0.030	0.52	6.5	*<0.2*	*<10*	70	0.31	0.12	0.090	0.080	31	3.0	10	0.89	4.1	0.99	2.1	0.11	0.080	0.010	0.011	0.080	16	3.2	0.10	563	0.60	0.040	1.6	4.4	150	8.4	8.7	*<0.001*	*<0.01*	0.18	1.7	0.50	0.60	7.8	*<0.01*	0.010	23	0.030	0.11	3.8	14	0.14	12	22	3.1
17560	SRK-15TP-43	Leach Pad	granite	0.030	0.99	4.6	*<0.2*	*<10*	110	0.45	0.23	0.21	0.060	38	5.8	17	3.3	8.3	1.7	4.1	0.13	0.070	0.010	0.025	0.15	22	14	0.26	705	0.76	0.040	3.2	9.0	330	6.7	31	*<0.001*	0.010	0.24	3.8	0.70	1.6	16	*<0.01*	*<0.01*	17	0.083	0.34	3.5	30	0.19	14	37	3.1
17561	SRK-15TP-05	Leach Pad	granite	0.030	0.56	4.8	*<0.2*	*<10*	70	0.34	0.13	0.10	0.030	32	3.8	10	1.7	3.9	1.2	2.5	0.090	0.040	0.25	0.017	0.11	13	7.2	0.12	667	0.70	0.040	2.2	3.8	200	7.2	16	*<0.001*	*<0.01*	0.16	1.9	0.40	0.80	8.1	*<0.01*	*<0.01*	16	0.040	0.21	3.6	16	0.15	9.4	25	1.3
17562	SRK-15TP-04	Leach Pad	granite	0.020	0.65	6.0	*<0.2*	*<10*	70	0.35	0.21	0.12	0.030	27	3.2	11	1.4	4.0	1.2	2.6	0.10	0.10	0.050	0.016	0.11	16	7.1	0.14	363	0.72	0.040	1.6	4.4	220	7.3	15	0.0010	*<0.01*	0.19	2.2	0.40	0.80	11	*<0.01*	0.010	22	0.044	0.16	4.9	18	0.14	9.6	24	4.1
17565	SRK-15TP-03	Leach Pad	granite	0.050	0.77	9.3	*<0.2*	*<10*	70	0.32	0.13	0.13	0.050	31	4.3	13	1.3	6.2	1.5	3.2	0.10	0.030	0.050	0.017	0.10	20	6.0	0.15	516	0.85	0.040	2.3	5.3	300	7.7	13	*<0.001*	0.010	0.24	2.7	0.50	0.70	12	*<0.01*	0.010	14	0.042	0.16	4.2	21	0.14	11	29	1.2
17566	SRK-15TP-17	Leach Pad	granite	0.030	0.68	9.2	*<0.2*	*<10*	70	0.57	0.090	0.15	0.060	48	3.2	12	1.3	6.5	1.5	2.7	0.11	0.15	0.090	0.020	0.10	24	4.5	0.13	673	0.82	0.030	0.85	6.0	260	9.3	13	*<0.001*	*<0.01*	0.26	2.9	0.60	0.60	12	*<0.01*	*<0.01*	23	0.042	0.27	3.9	19	0.090	14	35	6.2
17567	SRK-15TP-02	Leach Pad	granite	0.040	1.1	26	*<0.2*	*<10*	130	0.42	0.11	0.22	0.090	44	6.5	19	1.2	13	1.9	4.0	0.13	0.070	0.020	0.020	0.10	23	7.0	0.27	647	0.74	0.030	1.3	12	400	7.7	12	*<0.001*	0.010	0.42	4.3	0.70	0.60	18	*<0.01*	0.010	17	0.071	0.21	3.1	35	0.13	12	37	2.8
17570	SRK-15TP-16	Leach Pad	granite	0.030	0.76	28	*<0.2*	*<10*	90	0.48	0.060	0.17	0.080	47	4.2	13	1.3	9.2	1.5	3.2	0.11	0.10	0.050	0.020	0.11	24	6.6	0.18	588	1.1	0.040	1.3	9.1	290	9.6	17	*<0.001*	*<0.01*	0.53	3.1	0.80	0.70	15	*<0.01*	*<0.01*	22	0.058	0.25	3.7	24	0.13	13	35	4.0
17571	SRK-15TP-15	Leach Pad	granite	0.020	0.90	8.9	*<0.2*	*<10*	90	0.35	0.080	0.14	0.070	41	4.4	15	1.2	7.3	1.5	3.5	0.11	0.080	0.040	0.017	0.11	21	8.2	0.19	542	0.83	0.040	2.2	7.4	240	7.1	17	*<0.001*	*<0.01*	0.23	2.8	0.60	0.60	12	*<0.01*	*<0.01*	19	0.065	0.20	2.4	26	0.12	12	31	3.1
17572	SRK-15TP-14	Leach Pad	granite	0.050	0.70	386	0.30	*<10*	130	0.52	0.090	0.090	0.33	40	4.5	12	0.67	6.1	1.3	2.2	0.10	0.030	0.19	0.014	0.13	21	2.9	0.10	763	1.0	0.020	1.1	5.5	190	15	7.9	*<0.001*	0.010	3.3	1.6	0.40	0.30	13	*<0.01*	*<0.01*	20	0.015	0.22	6.1	16	0.13	7.9	32	1.1
17573	SRK-15TP-13	Leach Pad	granite	0.030	0.52	19	*<0.2*	*<10*	80	0.79	0.060	0.040	0.040	53	1.4	6.0	1.3	2.1	0.82	1.8	0.11	0.22	0.30	0.010	0.12	31	1.3	0.020	551	0.93	0.010	0.20	2.2	120	27	8.7	*<0.001*	*<0.01*	0.56	1.3	0.50	0.30	9.1	*<0.01*	*<0.01*	37	*<0.005*	0.14	6.5	4.0	0.060	12	19	7.4
17574	SRK-15TP-12	Leach Pad	granite	0.030	0.83	43	*<0.2*	*<10*	90	0.51	0.080	0.11	0.10	37	4.7	13	1.0	6.9	1.5	3.3	0.11	0.020	0.090	0.016	0.090	20	5.2	0.16	642	0.72	0.030	1.5	7.2	260	9.0	11	*<0.001*	0.010	1.0	2.1	0.40	0.50	11	*<0.01*	0.010	12	0.046	0.22	3.5	25	0.15	9.7	33	0.60
17575	SRK-15TP-11	Leach Pad	granite	0.020	0.59	15	*<0.2*	*<10*	110	0.57	0.20	0.10	0.050	65	2.7	8.0	2.4	4.4	1.4	2.9	0.12	0.34	0.010	0.015	0.15	37	4.3	0.11	895	0.86	0.050	0.96	4.0	200	9.7	20	*<0.001*	*<0.01*	0.50	2.0	0.70	0.70	10	*<0.01*	0.010	30	0.037	0.24	5.8	13	0.15	16	34	10
17576	SRK-15TP-18	Leach Pad	granite	0.030	1.4	6.1	*<0.2*	*<10*	140	0.53	0.15	0.20	0.050	47	5.8	21	2.6	12	1.9	4.3	0.13	0.080	0.030	0.023	0.12	27	11	0.31	546	0.79	0.030	2.0	11	340	7.1	21	*<0.001*	0.010	0.28	4.7	0.90	0.90	17	*<0.01*	0.010	18	0.078	0.24	3.4	37	0.16	15	37	2.8
17577	SRK-15TP-42	Leach Pad	granite	0.030	0.71	15	*<0.2*	*<10*	90	0.75	0.21	0.13	0.050	53	3.1	11	4.2	5.6	1.3	3.6	0.15	0.17	0.020	0.049	0.15	27	9.2	0.14	616	0.64	0.050	3.6	5.6	190	9.2	45	*<0.001*	*<0.01*	0.38	4.6	1.1	2.2	13	*<0.01*	*<0.01*	23	0.044	0.46	5.1	17	0.20	26	51	5.6
17578	SRK-15TP-10	Leach Pad	granite	0.030	0.86	15	*<0.2*	*<10*	100	0.58	0.40	0.16	0.040	44	4.1	13	4.1	7.3	1.5	3.4	0.11	0.15	0.040	0.022	0.13	22	11	0.20	570	0.81	0.040	1.9	6.9	240	6.8	22	*<0.001*	*<0.01*	0.34	3.3	0.50	1.5	13	*<0.01*	*<0.01*	20	0.061	0.30	2.6	25	0.17	12	31	5.6
17579	SRK-15TP-09	Leach Pad	granite	0.040	1.0	5.4	*<0.2*	*<10*	100	0.59	0.25	0.17	0.050	41	5.7	17	2.1	9.9	1.7	4.0	0.13	0.040	0.020	0.020	0.10	22	9.4	0.25	575	0.58	0.040	2.1	9.5	260	8.1	15	*<0.001*	0.010	0.28	3.6	0.70	1.0	15	*<0.01*	0.010	15	0.068	0.18	3.5	32	0.18	16	33	1.5
17580	SRK-15TP-41	Leach Pad	granite	0.040	0.90	5.6	*<0.2*	*<10*	90	0.45	0.10	0.26	0.12	45	5.2	19	1.1	11	1.7	3.4	0.14	0.15	0.030	0.020	0.11	25	5.5	0.24	727	1.2	0.050	1.5	11	330	10	13	*<0.001*	*<0.01*	0.25	4.0	0.80	0.60	20	*<0.01*	0.010	25	0.071	0.14	3.9	32	0.15	15	39	6.2
17581	SRK-15TP-08	Leach Pad	granite	0.050	0.87	110	*<0.2*	*<10*	80	0.50	0.14	0.17	0.070	36	3.9	16	1.3	8.4	1.4	3.2	0.11	0.090	0.070	0.019	0.11	21	7.1	0.18	334	0.58	0.030	1.5	7.5	230	15	14	*<0.001*	0.010	0.36	3.3	0.60	0.70	15	*<0.01*	*<0.01*	23	0.052	0.18	8.5	24	0.14	14	31	3.7
Statistical Summary for Overburden overlying Granite Bedrock (n = 28)			**Max**	0.070	1.4	10000	3.1	10	180	0.93	0.40	0.26	0.33	65	6.5	25	4.2	15	2.6	4.3	0.15	0.92	1.3	0.049	0.33	37	17	0.31	1240	3.2	0.070	3.6	12	400	27	45	0.0010	0.010	86	7.0	1.1	2.2	59	0.070	0.030	44	0.083	0.81	15	42	2.0	26	51	22
			90th PCTL	0.050	1.2	547	0.23	*<10*	130	0.64	0.22	0.21	0.093	51	5.8	19	2.9	13	1.9	4.1	0.13	0.52	0.39	0.024	0.15	27	11	0.26	803	1.4	0.053	2.6	11	330	16	25	*<0.001*	0.010	4.6	4.5	0.80	1.4	21	*<0.01*	0.010	37	0.072	0.41	6.2	33	0.96	15	38	13
			75th PCTL	0.040	0.92	26	*<0.2*	*<10*	110	0.54	0.15	0.17	0.073	46	4.8	15	1.8	9.4	1.7	3.4	0.12	0.23	0.098	0.020	0.13	24	8.2	0.19	669	1.0	0.043	2.1	7.9	268	9.8	18	*<0.001*	0.010	0.51	3.7	0.70	0.83	16	*<0.01*	0.010	25	0.062	0.26	5.0	27	0.17	14	35	9.4
			Median	0.030	0.77	10	*<0.2*	*<10*	90	0.44	0.11	0.13	0.055	39	4.0	13	1.3	6.8	1.5	3.1	0.11	0.10	0.040	0.017	0.11	21	5.8	0.14	567	0.82	0.040	1.5	5.6	230	8.5	14	*<0.001*	*<0.01*	0.28	2.7	0.50	0.70	13	*<0.01*	*<0.01*	21	0.044	0.21	3.8	20	0.15	12	31	4.1
			25th PCTL	0.020	0.56	5.6	*<0.2*	*<10*	70	0.34	0.080	0.088	0.038	31	2.6	8.8	0.99	4.1	1.2	2.6	0.10	0.068	0.010	0.016	0.10	16	3.3	0.095	428	0.70	0.030	1.0	3.6	183	7.2	8.7	*<0.001*	*<0.01*	0.21	1.9	0.40	0.58	11	*<0.01*	*<0.01*	17	0.015	0.16	3.5	12	0.13	9.1	24	2.7
			10th PCTL	0.020	0.44	4.1	*<0.2*	*<10*	45	0.30	0.060	0.024	0.010	24	0.51	4.1	0.71	1.4	0.61	1.7	0.090	0.030	0.010	0.011	0.080	12	1.9	0.017	126	0.58	0.010	0.26	1.8	102	6.8	7.4	*<0.001*	*<0.01*	0.16	1.4	0.34	0.37	5.8	*<0.01*	*<0.01*	14	*<0.005*	0.11	2.8	3.1	0.12	4.7	10	1.2
			Min	0.010	0.23	1.1	*<0.2*	*<10*	10	0.090	0.040	0.010	0.010	19	0.20	2.0	0.21	0.40	0.46	1.0	0.070	0.020	0.010	0.0070	0.030	11	0.40	*<0.01*	39	0.18	0.010	0.11	0.30	20	4.4	2.3	*<0.001*	*<0.01*	0.070	1.2	0.20	0.30	0.80	*<0.01*	*<0.01*	5.5	*<0.005*	0.060	2.4	1.0	0.060	3.8	4.0	0.60
Overburden Overlying Meta-Gabbro Bedrock (n = 3)																																																								
17555	SRK-15TP-23	ROM/Plant	meta-gabbro	0.10	2.2	9.0	*<0.2*	*<10*	130	0.60	0.22	0.49	0.10	33	6.9	49	1.6	19	2.3	7.4	0.13	0.020	0.030	0.023	0.24	19	11	0.70	270	0.89	0.080	1.9	21	550	8.9	29	*<0.001*	0.050	1.3	5.0	0.60	1.0	33	*<0.01*	0.030	3.8	0.11	0.24	1.6	53	0.36	7.7	51	0.50
R553404	CFB030	South WRSF	meta-gabbro	0.010	2.3	3.8	*<0.2*	*<10*	590	0.30	0.090	4.0	0.010	16	14	29	2.3	14	3.5	6.4	0.080	0.030	*<0.01*	0.0060	1.6	7.6	17	1.5	635	0.76	0.020	0.12	18	970	1.3	75	*<0.001*	*<0.01*	0.14	2.5	0.30	0.50	125	*<0.01*	0.020	3.0	0.22	0.40	0.49	66	0.29	4.2	50	0.70
R553602	CFB035	South WRSF	meta-gabbro	0.030	1.7	66	*<0.2*	*<10*	220	0.85	0.50	0.29	0.070	47	13	36	3.3	17	2.9	5.6	0.070	0.040	0.040	0.023	0.57	18	8.8	0.59	477	0.83	0.020	0.59	26	540	11	44	*<0.001*	*<0.01*	1.2	5.7	0.90	0.90	19	*<0.01*	0.040	13	0.086	0.30	1.3	40	1.3	11	49	2.1

Notes: all values in grey italics are below the analytical detection limit.
n = number of samples included in the statistical summary

Appendix D: Kinetic Test Results

Appendix D.1: Kinetic Test Results for Waste Rock

Appendix D.2: Kinetic Test Results for Ore

Appendix D.3: Kinetic Test Results for Leach Tailings

GOLDCORP

APPENDIX D.1: KINETIC TEST RESULTS FOR WASTE ROCK

Appendix D.1-1: Overview of Operating Procedures for the Coffee Gold Mine Waste Rock Kinetic Tests

Test ID	Test Sample Description	Duplicate Tests	Type of Test	Lithology	Weathering Facies	Column Dimensions			Dry Wt. of Sample (kg)	Temp (°C)	Operation Procedure	Sampling Frequency	Total Volume of Initial Flushings (mL)	Flushing Rate/ Weekly Input* (mL)	Start Date	Test Status	Cycles/ Weeks	Recirculation Cycles
						Inner Diameter (cm)	Length (cm)	Height (cm)										
Col 3	SO	-	Unsaturated Column	Schist	Oxide	21.0	20.5		10	4°	Trickle Leach	Biweekly	1500	variable	16-Jul-14	active	86	45-77
Col 4	ST	-	Unsaturated Column	Schist	Transition	21.0	20.5		10	4°	Trickle Leach	Biweekly	1300	variable	16-Jul-14	active	86	45-77
Col 5	GO	-	Unsaturated Column	Gneiss	Oxide	21.0	20.5		10	4°	Trickle Leach	Biweekly	1500	variable	16-Jul-14	active	86	45-77
Col 6	GT	-	Unsaturated Column	Gneiss	Transition	21.0	20.5		10	4°	Trickle Leach	Biweekly	1200	variable	30-Jul-14	active	84	43-75
Col 13	OKY Master	-	Unsaturated Column	Granite	Transition	21.0	20.5		10	4°	Trickle Leach	Biweekly	2000	variable	20-May-15	active	41	-
Col 14	OKY Master (Fresh)	-	Unsaturated Column	Granite	Fresh	21.0	20.5		10	4°	Trickle Leach	Biweekly	2000	variable	20-May-15	active	41	-
HC 1	ST	Col 4	Humidity Cell	Schist	Transition		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	25-Jun-14	terminated	87	46-73
HC 2	SS	-	Humidity Cell	Schist	Fresh		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	25-Jun-14	terminated	87	46-73
HC 3	GT	Col 6	Humidity Cell	Gneiss	Transition		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	25-Jun-14	terminated	87	46-73
HC 4	GS	-	Humidity Cell	Gneiss	Fresh		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	25-Jun-14	terminated	87	46-73
HC 5	OKY Master	Col 13	Humidity Cell	Granite	Transition		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	6-May-15	active	42	-
HC 6	OKY Master (Fresh)	Col 14	Humidity Cell	Granite	Fresh		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	6-May-15	active	42	-
HC 7	KAM036824	-	Humidity Cell	Schist	Fresh		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	12-Aug-15	active	28	-
HC 8	KAM092488	-	Humidity Cell	Gneiss	Fresh		10.2	25.5	1	4°	Flood Leach	Weekly	500	500	12-Aug-15	active	28	-
FB-GO	Gneiss Oxide composite	Col 5	Field Bin	Gneiss	Oxide	45.0		80	183.1	site conditions	natural precipitation	3x's / field season	28	natural precipitation	17-Jun-14	active	70	-
FB-GT	Gneiss Transition composite	Col 6 & HC3	Field Bin	Gneiss	Transition	45.0		80	229.4				28		17-Jun-14	active	70	-
FB-GS	Gneiss Fresh composite	HC4	Field Bin	Gneiss	Fresh	45.0		80	190.1				28		17-Jun-14	active	70	-
FB-SO	Schist Oxide composite	Col 3	Field Bin	Schist	Oxide	45.0		80	171.3				28		17-Jun-14	active	70	-
FB-ST	Schist Transition composite	Col 4 & HC1	Field Bin	Schist	Transition	45.0		80	164.8				27.6		17-Jun-14	active	70	-
FB-SS	Schist Fresh composite	HC2	Field Bin	Schist	Fresh	45.0		80	201.5				28		17-Jun-14	active	70	-
FB-GGT	Granite Transition composite	Col 13 & HC5	Field Bin	Granite	Transition	45.0		80	165.5				26		17-Jun-15	active	18	-
FB-GGS	Granite Fresh composite	Col 14 & HC6	Field Bin	Granite	Fresh	45.0		80	134.4				22		17-Jun-15	active	18	-

Notes:
Columns and humidity cells are composed of Plexiglas with an acrylic perforated disk & nylon mesh
No sample preparation was conducted prior to leachate sampling for any tests
* generally 400-500 mL for columns, see individual leachate results in Appendix D.1-3 for specific input volumes

Appendix D.1-1: Overview of Operating Procedures for the Coffee Gold Mine Waste Rock Kinetic Tests

Construction of Field Bins

Field Bin ID	Bag #	Hole ID	Length (m)	Lithology	% Fresh	Weight (Kg)
FB-GO	20	CFD0152	48-52, 92-95, 96-100	65% MG, 35% FG	0	32
	25	CFD0149	170-175, 211-213	76% MG, 24% MxM	0	23
	34	CFD0175	126-130, 193-196	100% FG	0	24
	35	CFD0175	205-211,230-233	100% FG	0	28
	46	CFD0004	20.86-26.86	100% FG	0	21
	47	CFD0004	43-49	100% FG	0	19
	48	CFD0004	76-83	100% FG	0	23
	49	CFD0003	163-167	100% FG	0	13
	62	CFD0209	66-72, 15-19	100% MxM	2.3	20
	63	CFD0209	52.5-58	100% MxM	0	14
	64	CFD0176	12-18, 149-152	100% MxF	0	23
	79	CFD0267	109-122	100% MxF	0	20
	83	CFD0176	164-170	100% MxF	0	17
	84	CFD0176	170-175	100% MxF	0	22
FB-GT	16	CFD0142	134-139	100% MG	30	17
	17	CFD0142	139-144	100% MG	30	17
	26	CFD0175	47-54	100% FG	70	21
	27	CFD0175	54-61	100% FG	70	23
	28	CFD0175	61-68	100% FG	47	23
	29	CFD0175	68-75	100% FG	30	23
	30	CFD0175	75-82	100% FG	30	25
	31	CFD0175	82-89	100% FG	53	26
	32	CFD0175	89-93	100% FG	70	16
	33	CFD0175	44-46	100% FG	70	7
	65	CFD0270	252-258	100% MxF	70	25
	66	CFD0270	258-264	100% MxF	43	24
	67	CFD0270	264-271	100% MxF	36	19
	68	CFD0270	237-240, 241-243	40% FG, 60% MxF	30	16
	91	CFD0272	89-92, 93-95, 96-97, 98-99	100% FG	30	20
	92	CFD0272	76-80, 224-225, 239-245	46% FG, 54% MxF	30	24
	93	CFD0272	228-238	100% MxF	30	27
FB-GS	56	CFD0020	263-270	100% FG	100	23
	57	CFD0020	270-277	100% FG	100	22
	58	CFD0020	277-283	100% FG	100	18
	59	CFD0071	187-195	100% FG	100	27
	60	CFD0071	202-210	100% FG	100	33
	61	CFD0071	210-217	100% FG	100	27
	69	CFD0249	234.5-239	100% MxM	99.3	27
	70	CFD0249	262-269	100% MxM	98.4	18
	71	CFD0249	271-280.5	46% MxM, 54% MxF	99.4	20
	72	CFD0249	286-290	100% MxM	100	18
	73	CFD0249	271-280.5	46% MxM, 54% MxF	99.4	21
	74	CFD0249	292-298	100% MxF	100	35
	75	CFD0249	298-304	17% FG, 83% MxF	100	27
	76	CFD0273	245-254	100% MxM	70	28
	77	CFD0273	240-243	100% MxM	70	8
	78	CFD0170	391-399	100% MxM	100	30
FB-SO	1	CFD0131	57-63	100% MsS	0	19
	2	CFD0131	63-69	31% MsS, 69% RQM	0	21
	3	CFD0131	69-74	100% RQM	0	17
	4	CFD0131	77-81	100% RQM	0	13
	5	CFD0131	87-93	50% MsS, 50% RQM	0	20
	6	CFD0131	93-99	100% MsS	0	20
	7	CFD0131	99-105	41% MsS, 59% RQM	0	21
	36	CFD0084	43-49	100% RQM	0	19
	37	CFD0084	49-55	100% RQM	0	19
	38	CFD0084	55-61	100% RQM	0	22
	39	CFD0008	2.13-9	100% BtS	0	13
	40	CFD0008	42248	100% BtS	0	19
	41	CFD0008	15-21	100% BtS	0	21
	42	CFD0007	2.13-10	100% BtS	0	27
	43	CFD0007	42644	100% BtS	0	21
	44	CFD0007	16-21	100% BtS	0	18
	45	CFD0007	31-36	100% BtS	0	16

Appendix D.1-1: Overview of Operating Procedures for the Coffee Gold Mine Waste Rock Kinetic Tests

Construction of Field Bins

Field Bin ID	Bag #	Hole ID	Length (m)	Lithology	% Fresh	Weight (Kg)
FB-ST	18	CFD0146	57-62	100% BtS	70	17
	19	CFD0146	65-72	100% BtS	70	21
	21	CFD0145	70-80	100% BtS_Carb	30	37
	22	CFD0145	43009	100% BtS_Carb	70	25
	23	CFD0145	17-25	80% BtS_Carb, 20% YO	44	28
	24	CFD0145	25-32	15% BtS_Carb, 85% YO	4.3	23
	80	CFD0172	123-129	100% BtS	50	23
	81	CFD0172	129-135	100% BtS	50	21
	82	CFD0172	160-166	100% BtS	50	20
	85	CFD0142	16-22	100% BtS	70	25
	86	CFD0142	22-28	100% BtS	70	20
	87	CFD0142	28-34	100% BtS	70	18
	88	CFD0142	34-39	100% BtS	70	19
	89	CFD0265	246-256	100% BtS	54	30
	90	CFD0265	212-215, 220-228	100% BtS	70	30
FB-SS	8	CFD0096	167-173, 203-205	74% RQM, 26% BtS	100	16
	9	CFD0096	220-233	100% RQM	100	25
	10	CFD0096	233-239	100% RQM	100	13
	11	CFD0127	276-283	100% BtS	100	21
	12	CFD0127	283-290	100% BtS	100	23
	13	CFD0127	290-297	100% BtS	100	22
	14	CFD0127	297-304	100% BtS	100	18
	15	CFD0127	304-309	100% BtS	100	15
	50	CFD0040	230-237.4	100% BtS	100	24
	51	CFD0040	237.4-244	100% BtS	100	22
	52	CFD0040	244-250	100% BtS	100	24
	53	CFD0040	256-262	100% BtS	100	21
	54	CFD0040	262-268	100% BtS	100	21
	55	CFD0040	268-273	100% BtS	100	16
FB-GGT	1	CFD0380_36-50 (Bag 1 + 2)	*NA*	granite	10	13.59
	2	CFD0380_36-50 (Bag 3 +4)	*NA*	granite	10	16.761
	3	CFD0383_115-125 (Bag 1)	*NA*	granite	76	12.231
	4	CFD0383_115-125 (Bag 2)	*NA*	granite	76	14.496
	5	CFD0381_4-13 (Bag 1)	*NA*	granite	37	9.06
	6	CFD0381_4-13 (Bag 2)	*NA*	granite	37	12.684
	7	CFD0403_204-217 (Bag 1)	*NA*	granite	80	9.966
	8	CFD0403_204-217 (Bag 2)	*NA*	granite	80	13.137
	9	CFD0403_204-217 (Bag 3)	*NA*	granite	80	10.419
	10	CFD0396_50-60 (Bag 1)	*NA*	granite	40	13.59
	11	CFD0396_50-60 (Bag 2)	*NA*	granite	40	9.513
	12	CFD0394_31-41 (Bag 1)	*NA*	granite	38	13.137
	13	CFD0394_31-41 (Bag 2)	*NA*	granite	38	13.137
	14	CFD0394_55-66 (Bag 1)	*NA*	granite	50	12.231
	15	CFD0394_55-66 (Bag 2)	*NA*	granite	50	14.043
		CFD0389_34_38	*NA*	granite	100	6.3
		CFD0396_81_87	*NA*	granite	100	14.9
FB-GGS	1	CFD0380_22-30 (Bag 1 +2)	*NA*	granite	100	17.214
	2	CFD0383_182-194 (Bag 1)	*NA*	granite	99	10.872
	3	CFD0383_182-194 (Bag 2)	*NA*	granite	99	10.872
	4	CFD0383_182-194 (Bag 3)	*NA*	granite	99	12.231
	5	CFD0381_69-79 (Bag 1)	*NA*	granite	95	15.855
	6	CFD0381_69-79 (Bag 2)	*NA*	granite	95	11.325
	7	CFD0385_28-38 (Bag 1)	*NA*	granite	95	12.684
	8	CFD0385_28-38 (Bag 2)	*NA*	granite	95	14.043
	9	CFD0385_38-48 (Bag 1)	*NA*	granite	95	13.137
	13	CFD0394_99-104 (Bag 1)	*NA*	granite	95	11.325
	14	CFD0396_91-101 (Bag 1)	*NA*	granite	100	9.513
	15	CFD0396_91-101 (Bag 2)	*NA*	granite	100	11.778
	16	CFD0396_72-81 (Bag 1)	*NA*	granite	100	6.795
	17	CFD0396_72-81 (Bag 2)	*NA*	granite	100	10.872

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*SGS Canada Inc*
Project Number/ LIMS No.	*14094-101A/MI4521-JUN14*
ARD Number	*1416 Kaminak Coffee Proj*
Reporting Date:	*June 30, 2014*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Asemblages
3) Semi-Quantitative XRD Results
4) XRD Pattern(s)

Bernie C. Yeung, B.Sc.
Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

Method Summary

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

SGS Minerals
a division of SGS Canada Inc.
P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

Mineral/Compound	ST JUN4521-01 (wt %)	GO JUN4521-02 (wt %)	SO JUN4521-03 (wt %)	GS JUN4521-04 (wt %)	GT JUN4521-05 (wt %)	SS JUN4521-06 (wt %)
Quartz	31.1	46.8	55.2	39.4	45.7	32.9
Microcline	7.8	19.0	0.7	12.2	16.3	11.1
Albite	20.3	7.5	1.2	17.2	9.7	8.7
Biotite	7.0	1.0	1.3	3.0	1.2	4.4
Muscovite	6.2	7.9	13.9	9.6	5.3	10.6
Chlorite	3.5	4.1	5.3	2.8	3.6	5.0
Actinolite	2.3	0.3	0.4	0.4	0.0	0.3
Diopside	3.9	1.7	0.6	2.1	1.3	1.8
Calcite	14.6	1.7	3.9	2.3	1.0	10.6
Ankerite	1.8	1.3	4.3	4.5	4.4	9.0
Kaolinite	1.4	8.7	13.1	6.7	11.6	5.6
TOTAL	100	100	100	100	100	100

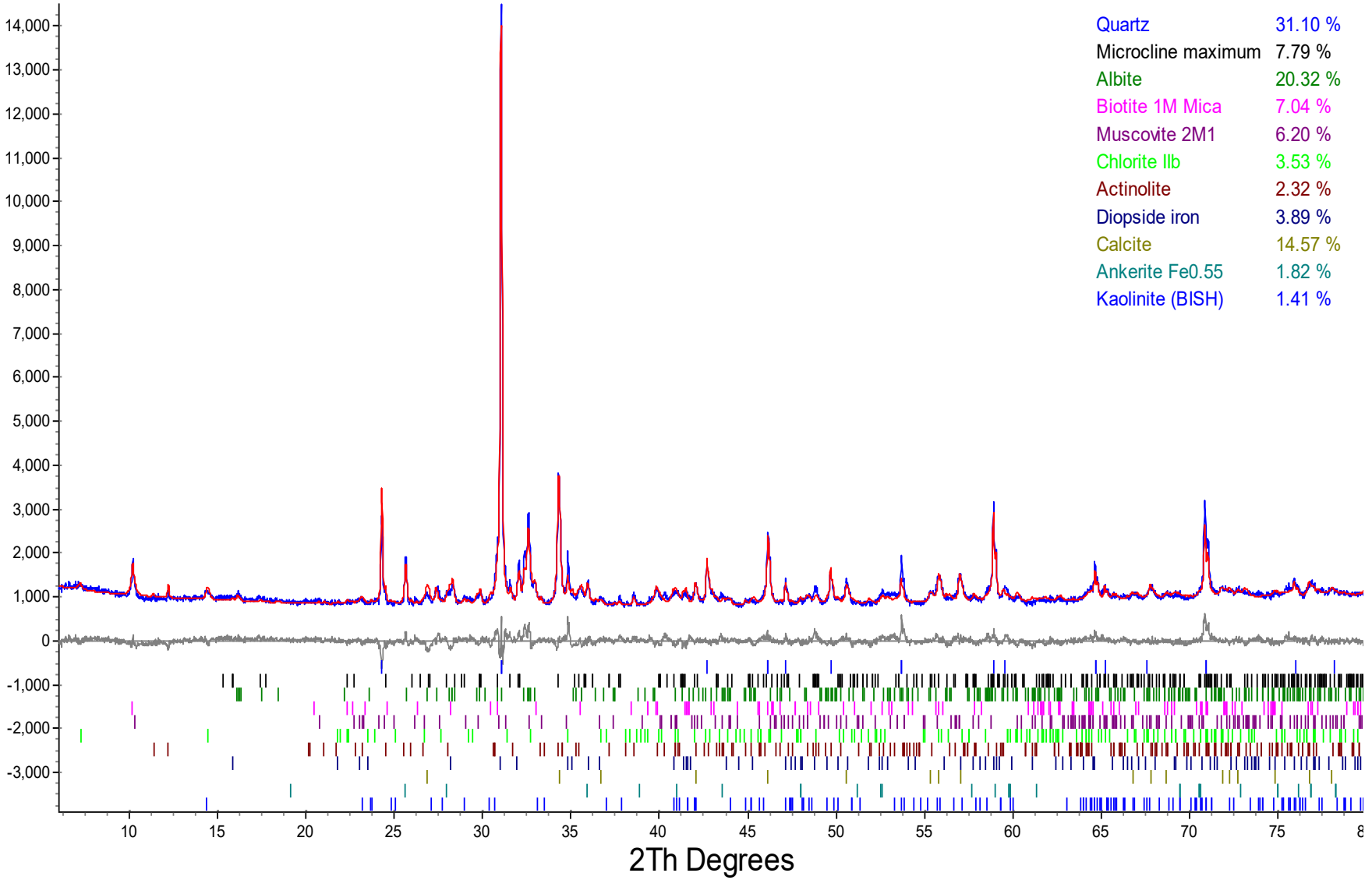
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identifed by the analyst and not included in the refinement calculation for the sample.

Mineral/Compound	Formula
Quartz	SiO_2
Microcline	$KAlSi_3O_8$
Albite	$NaAlSi_3O_8$
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$
Diopside	$CaMgSi_2O_6$
Calcite	$CaCO_3$
Ankerite	$CaFe(CO_3)_2$
Kaolinite	$Al_2Si_2O_5(OH)_4$

SGS Canada Inc
14094-101A/MI4521-JUN14
06/30/2014

Jun4521-1 riet.raw_1



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

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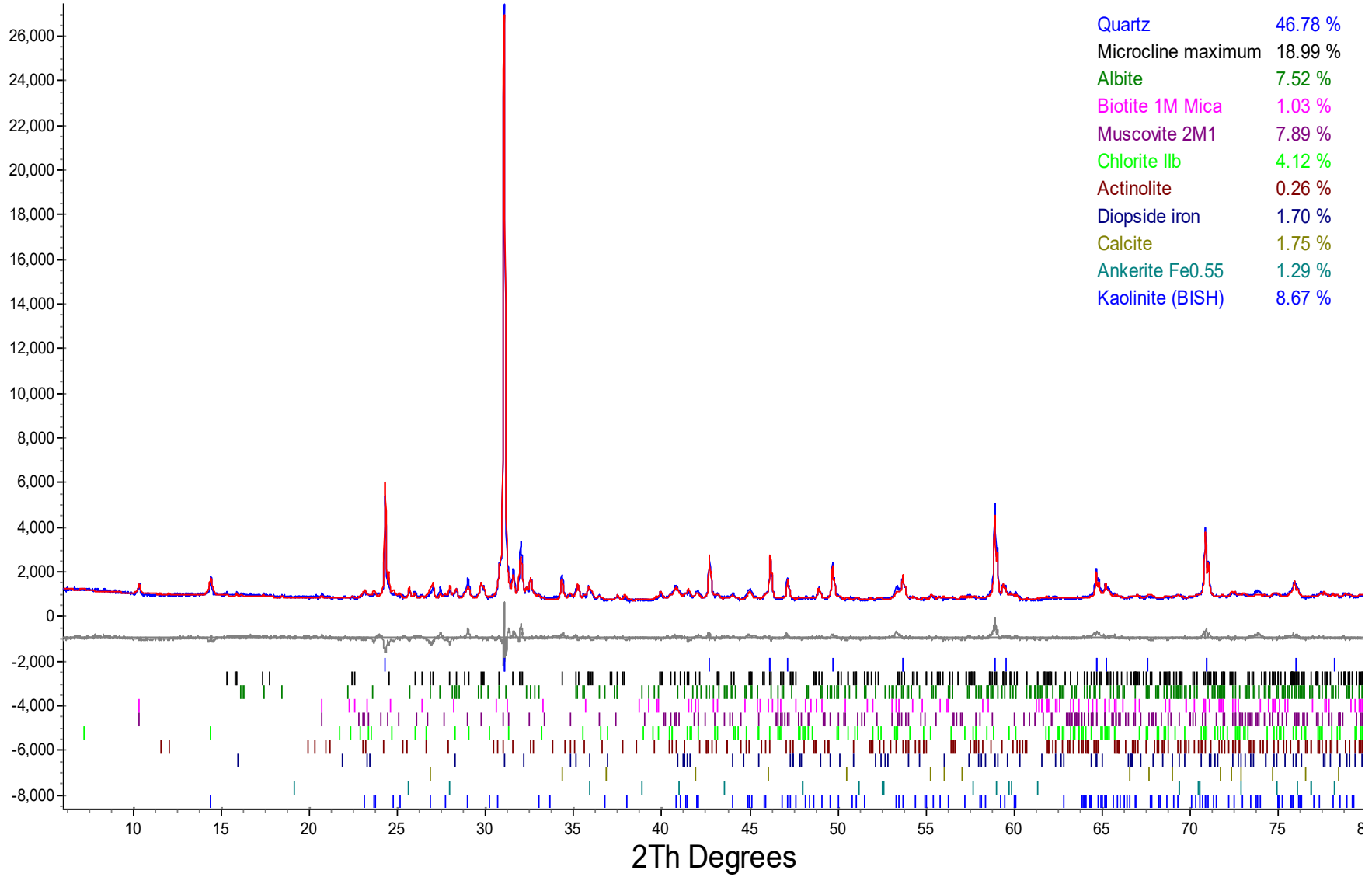
14094-101A/MI4521-JUN14
06/30/2014

Jun4521-2 riet.raw_1



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06/30/2014

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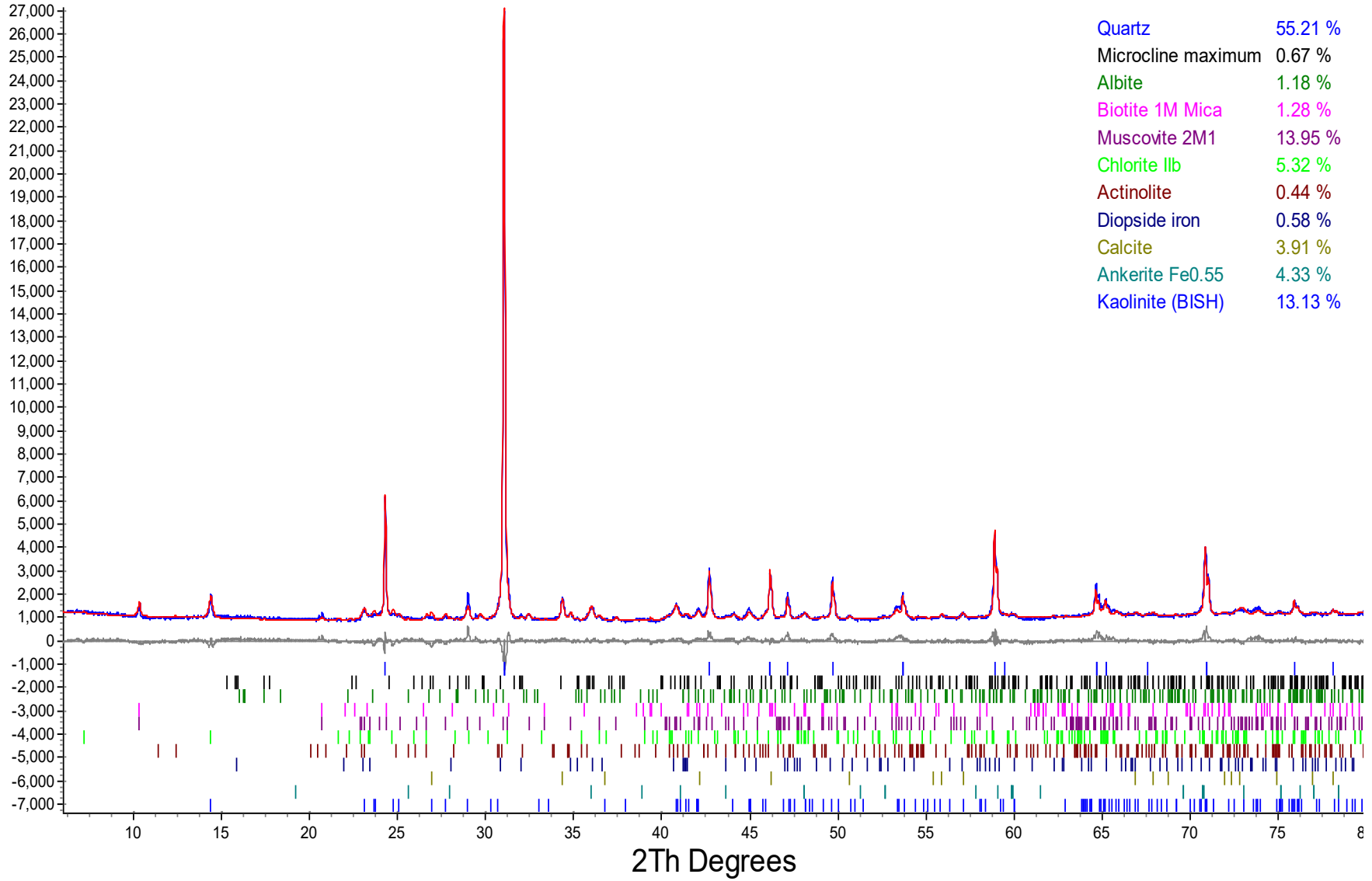

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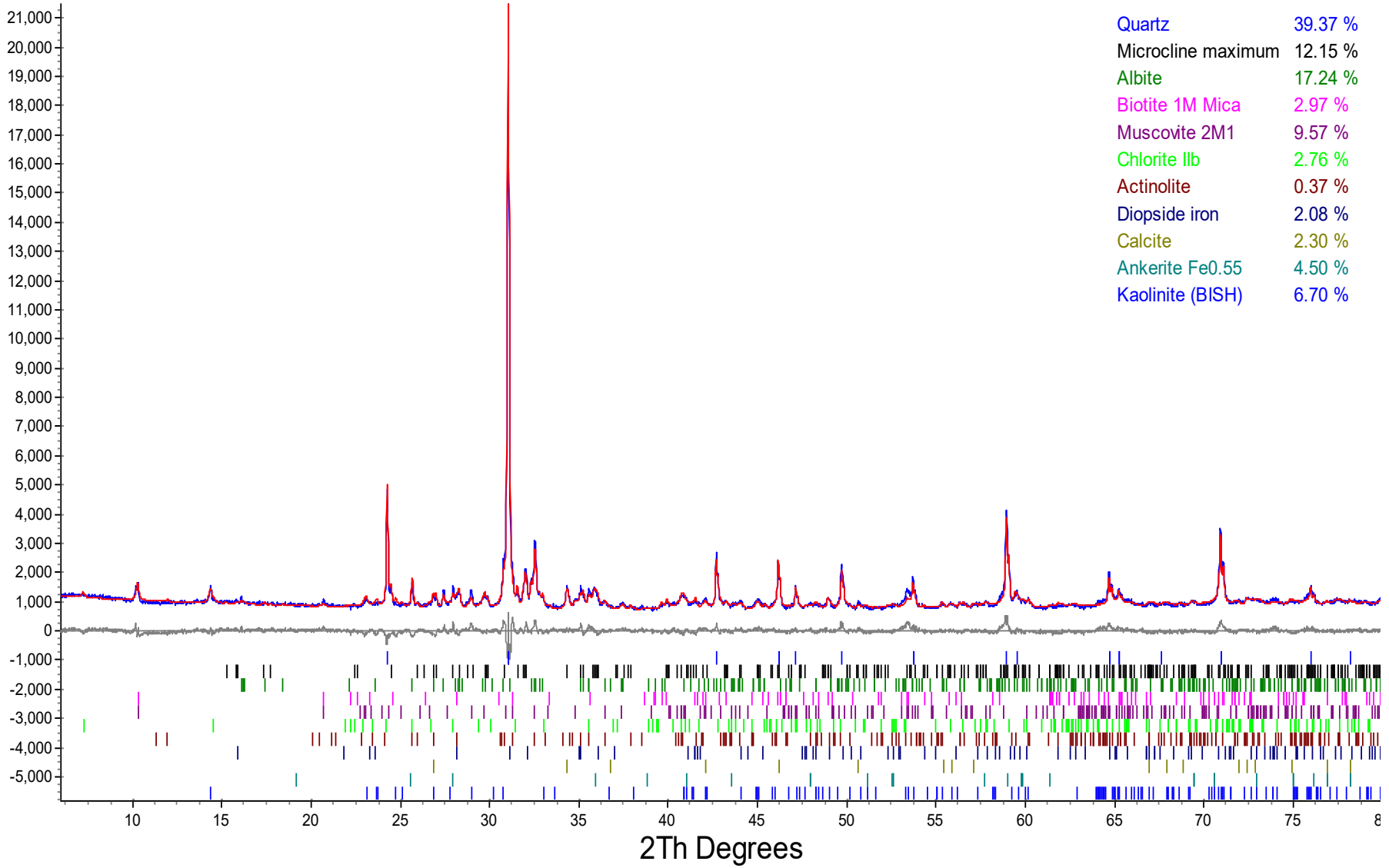
06/30/2014

Jun4521-4 riet.raw_1



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06/30/2014

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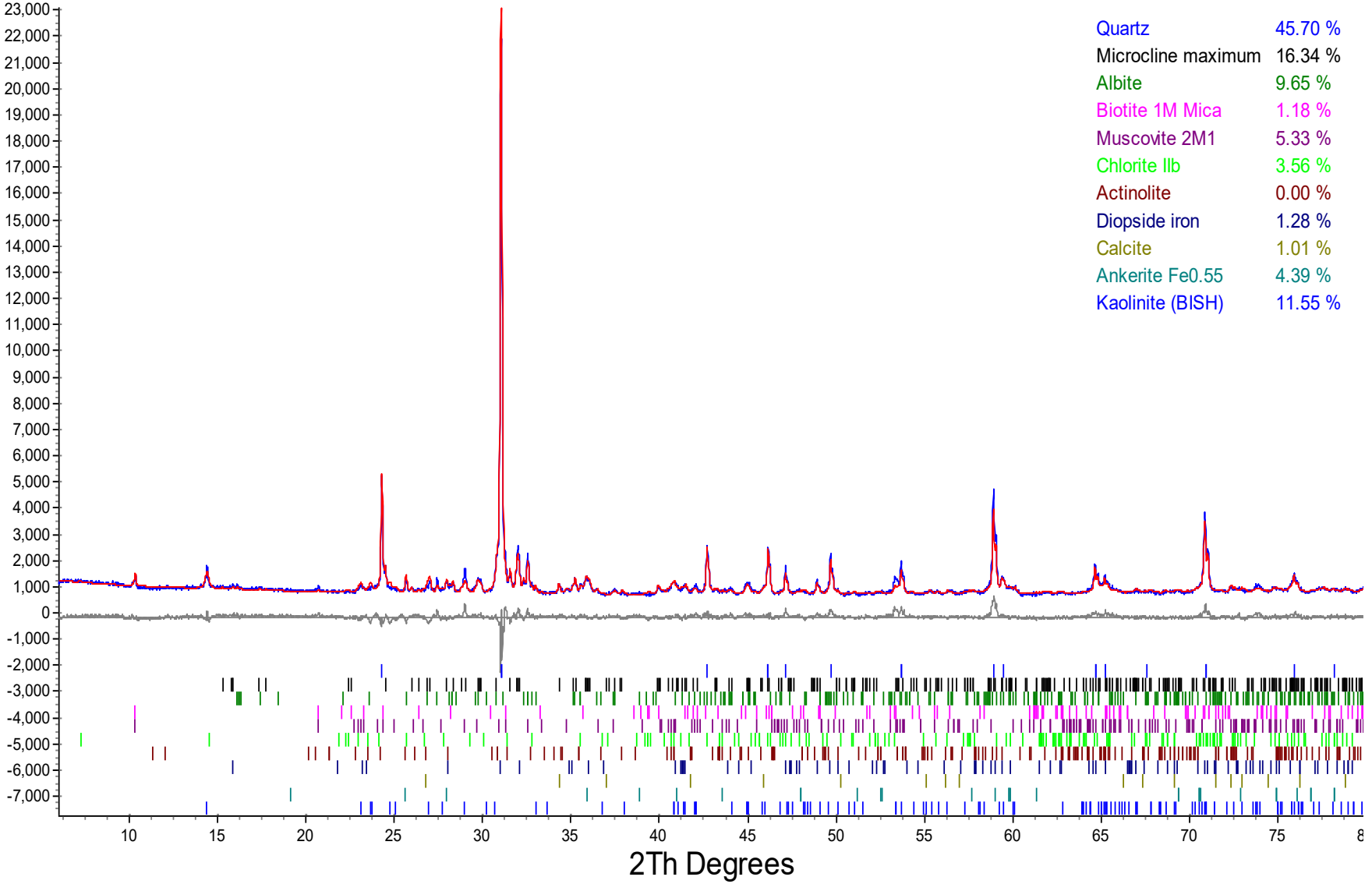

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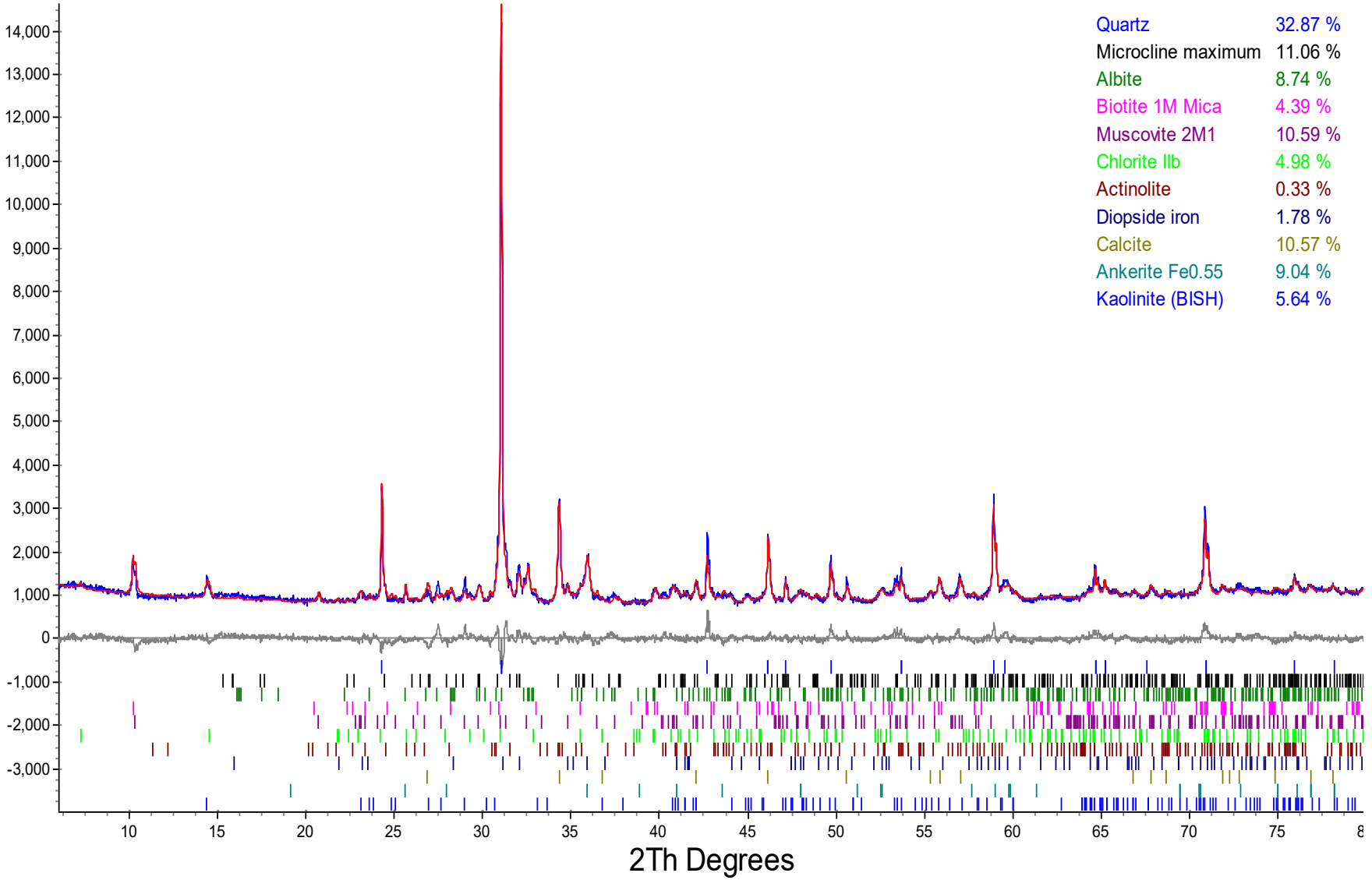
Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

SGS Canada Inc
14094-101A/MI4521-JUN14
06/30/2014

Jun4521-6 riet.raw_1



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Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*SGS Canada Inc*
Project Number/ LIMS No.	*14094-101B/MI4511-AUG15*
Batch No.	*1416 Kaminak*
Sample Receipt:	*August 14, 2015*
Sample Analysis:	*August 17, 2015*
Reporting Date:	*September 10, 2015*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations:	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit:	0.5-2%. Strongly dependent on crystallinity.

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Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

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Method Summary

The Rietveld Method of Mineral Identification by XRD (ME-LR-MIN-MET-MN-D05) method used by SGS Minerals Services is accredited to the requirements of ISO/IEC 17025.

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

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SGS Minerals
a division of SGS Canada Inc.
P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

Mineral/Compound	KAM036824 AUG4511-01 (wt %)	KAM092488 AUG4511-02 (wt %)
Quartz	49.1	48.9
Microcline	1.6	22.5
Muscovite	14.1	14.5
Kaolinite	14.7	9.6
Dolomite	9.3	4.1
Ankerite	5.5	0.0
Pyrite	1.3	0.5
Siderite	4.5	-
TOTAL	100	100

Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.
Dashes indicate that the mineral was not identifed by the analyst and not included in the refinement calculation for the sample.

Mineral/Compound	Formula
Quartz	SiO_2
Microcline	$KAlSi_3O_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Dolomite	$CaMg(CO_3)_2$
Ankerite	$CaFe(CO_3)_2$
Pyrite	FeS_2
Siderite	$FeCO_3$

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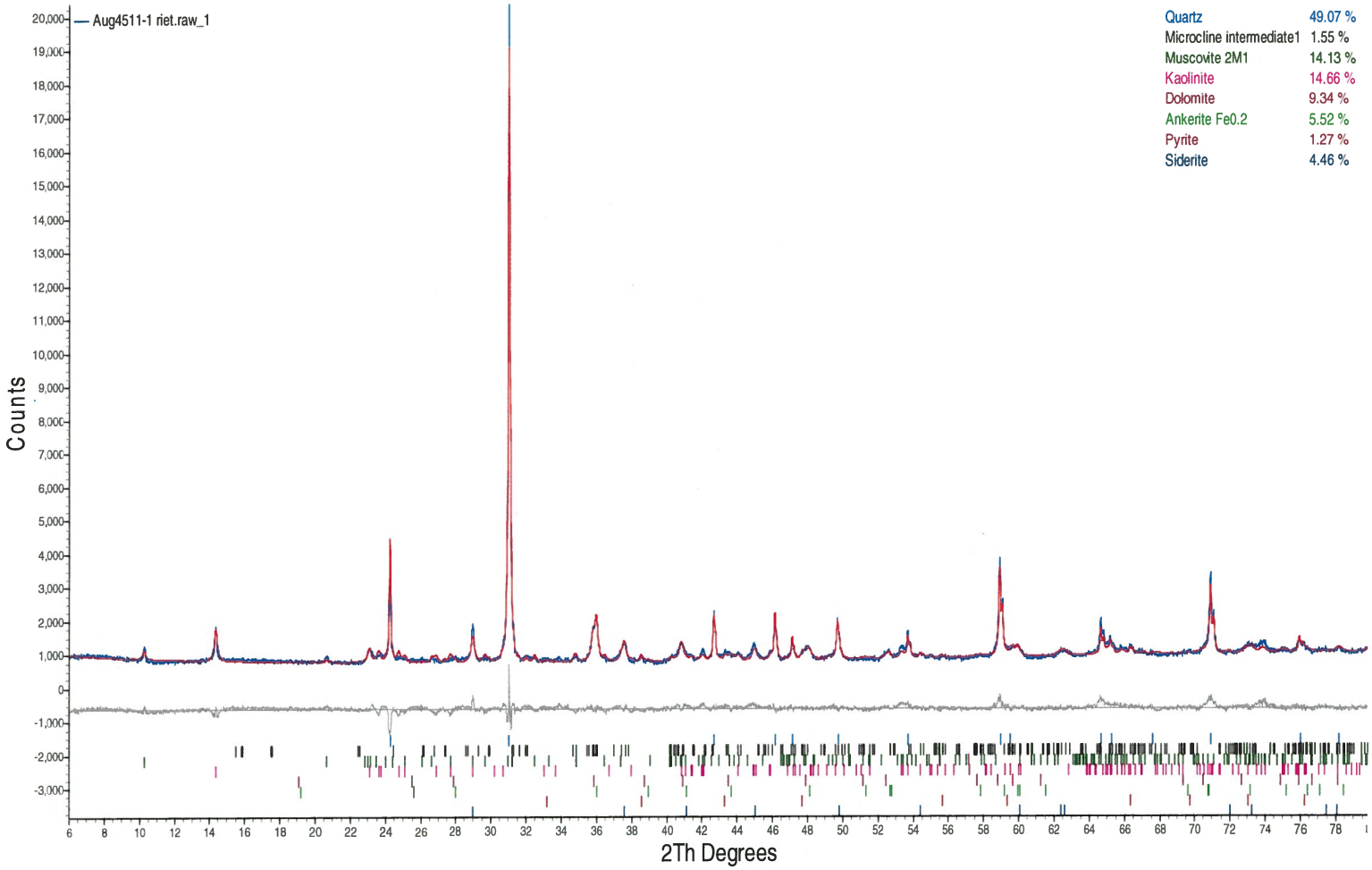
14094-101B/MI4511-AUG15
10-Sep-15

KAM036824



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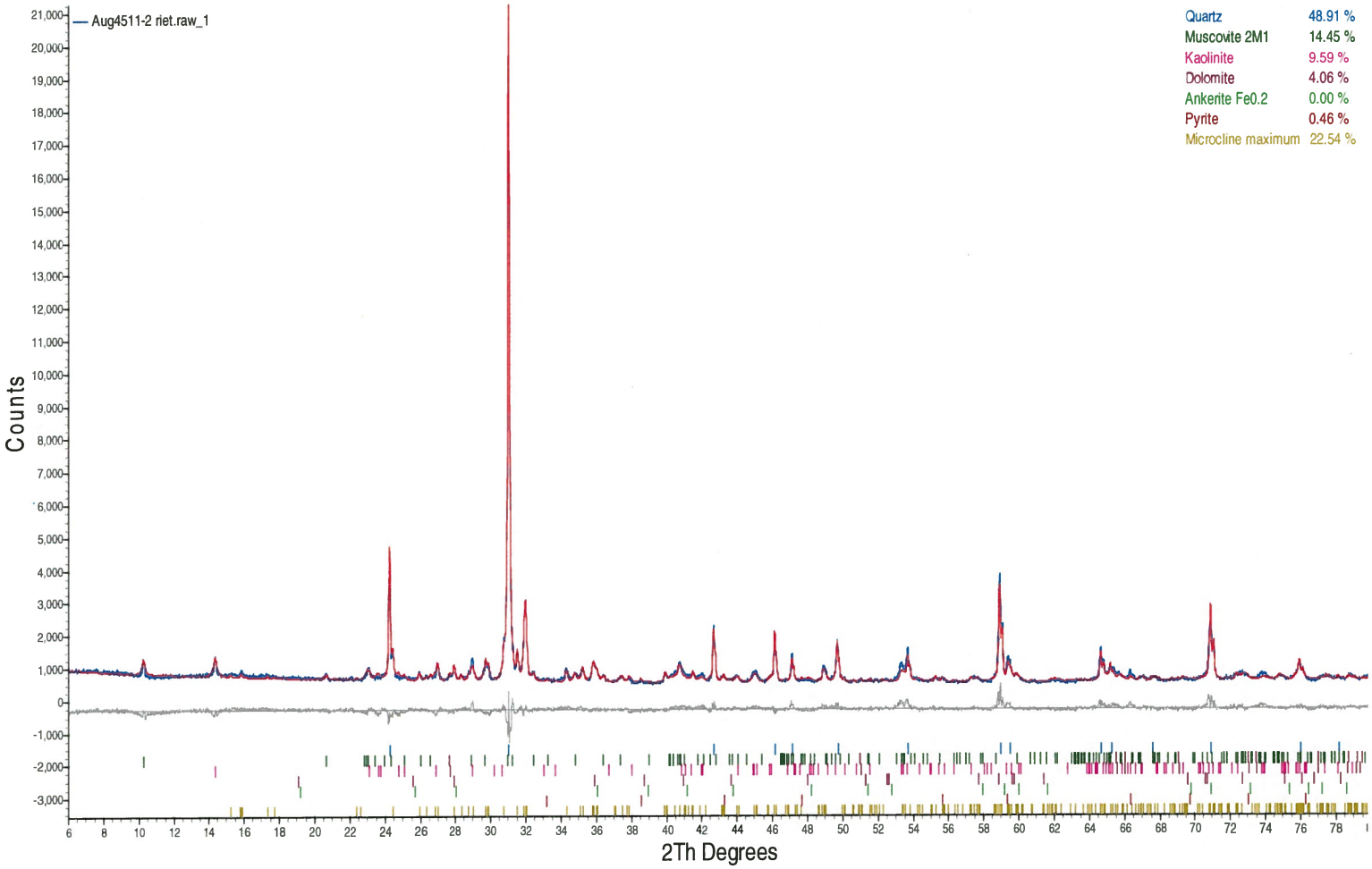
Aug4511-2 riet.raw_1
Quartz 48.91 %
Muscovite 2M1 14.45 %
Kaolinite 9.59 %
Dolomite 4.06 %
Ankerite Fe0.2 0.00 %
Pyrite 0.46 %
Microcline maximum 22.54 %
Counts
2Th Degrees

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*SGS Canada Inc*
Project Number/ LIMS No.	*14094-101B/MI4522-APR15*
Batch No.	*1416 Kaminak Coffee*
Sample Receipt:	*April 24, 2015*
Sample Analysis:	*April 29, 2015*
Reporting Date:	*May 1, 2015*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations:	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit:	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Asemblages
3) Quantitative XRD Results
4) XRD Pattern(s)

Kim Gibbs, H.B.Sc., P.Geo.
Senior Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

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Quantitative Rietveld Analysis:

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Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

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Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
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Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

Mineral/Compound	OKY Master APR4522-01 (wt %)	OKY Master (Sulphide) APR4522-02 (wt %)
Quartz	35.2	28.7
Microcline	26.9	29.0
Albite	17.7	22.2
Anorthite	6.7	9.8
Muscovite	5.7	4.6
Biotite	0.7	1.4
Kaolinite	7.0	4.4
TOTAL	100	100

Mineral/Compound	Formula
Quartz	SiO_2
Microcline	$KAlSi_3O_8$
Albite	$NaAlSi_3O_8$
Anorthite	$CaAl_2Si_2O_8$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Kaolinite	$Al_2Si_2O_5(OH)_4$

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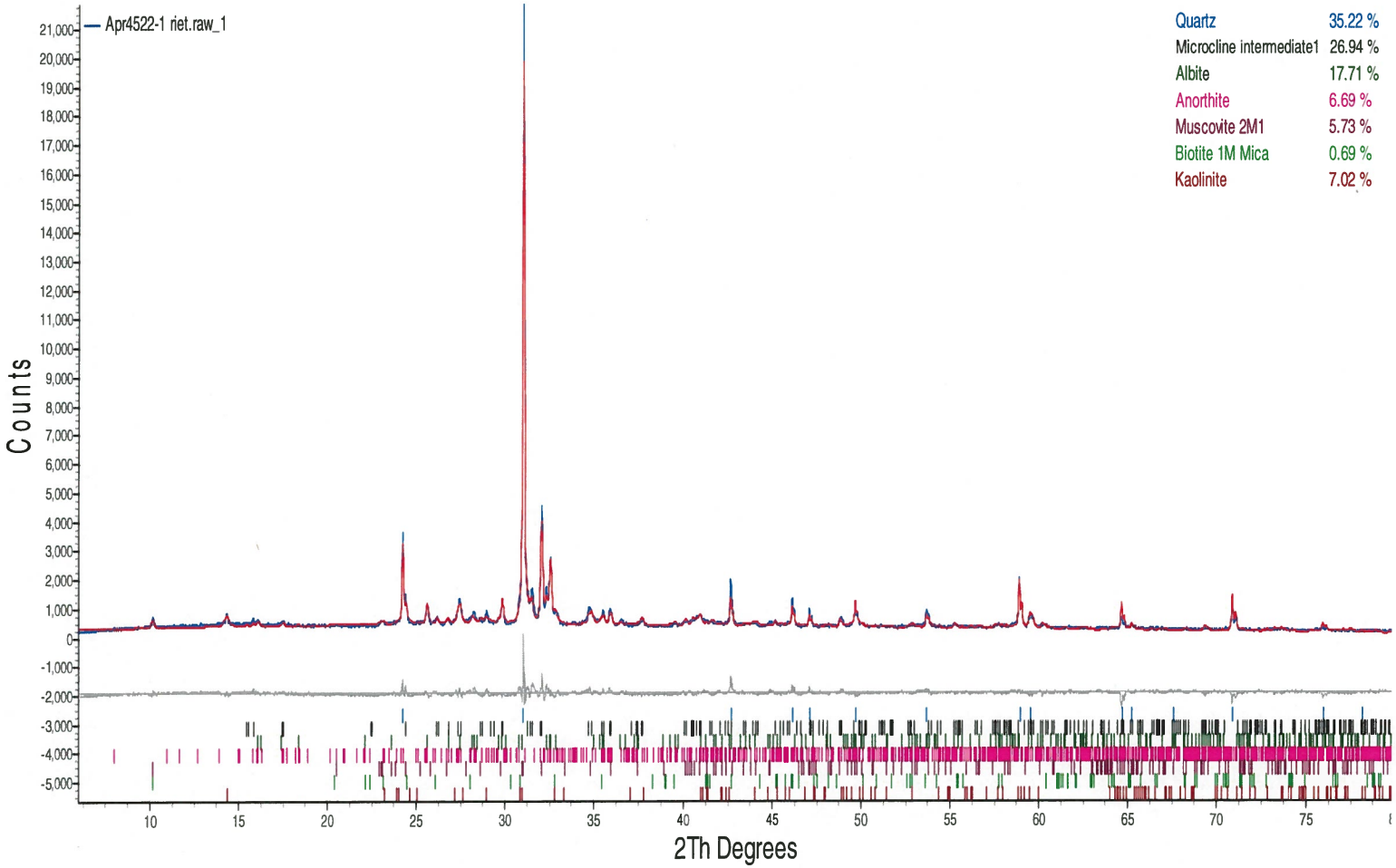
05/01/2015

OKY Master



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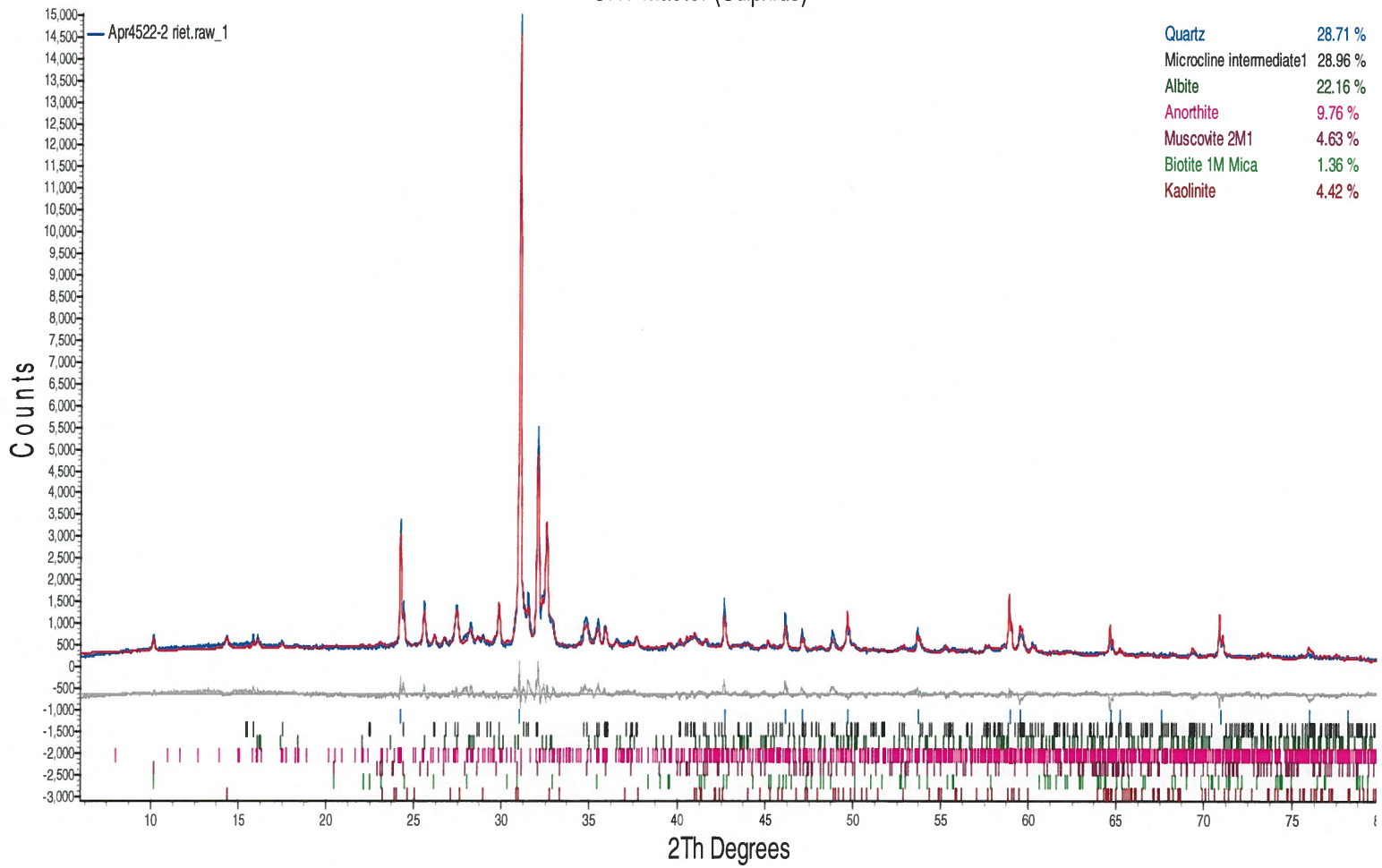
14094-101B/MI4522-APR15
05/01/2015

OKY Master (Sulphide)



Appendix D.1-2 Static Test Results for Waste Rock Kinetic Test Samples

Acid-Base Accounting Results

Kinetic Tests	Description	Lithology	Weathering Facies	Rinse pH	Paste pH	TIC	CaNP	Total C	Total S	S(SO4)	S(S-2)	Insoluble S	AP	Sobek NP	Siderite NP	Sobek NNP	Siderite NNP	Fizz Test
				s.u.	s.u.	%	kg $CaCO_3$/t	%	%	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	
			Method Code	*Sobek*	*Sobek*	*CSB02V*	*Calc.*	*CSA06V*	*CSA06V*	*CSA07V*	*CSA08D*	*Calc.*	*Calc.*	*Sobek*	*Siderite Corr.*	*Calc.*	*Calc.*	*Sobek*
			Limit of Detection	*0.20*	*0.20*	*0.01*	*#N/A*	*0.005*	*0.005*	*0.01*	*0.01*	*#N/A*	*#N/A*	*0.5*	*0.5*	*#N/A*	*#N/A*	*#N/A*
Col 5, FB-GO	GO	Gneiss	Oxide	8.46	8.43	0.23	19.2	0.258	0.016	*<0.01*	0.01	0.006	0.3	22.7	26.5	22.4	26.2	Slight
Col 6, HC3, FB-GT	GT	Gneiss	Transition	8.00	8.59	0.48	40.0	0.488	0.083	*<0.01*	0.07	0.013	2.2	32.9	40.8	30.7	38.6	Slight
HC4, FB-GS	GS	Gneiss	Fresh	8.22	8.28	0.66	55.0	0.672	0.21	*<0.01*	0.18	0.03	5.6	51.7	56.9	46.1	51.3	Slight
HC8	KAM092488	Gneiss	Fresh		8.58	0.24	20.0	0.24	0.386	*<0.01*	0.38	<0.01	11.9	20.2		8.3		Slight
Col 3, FB-SO	SO	Schist	Oxide	8.35	8.25	0.93	77.5	0.958	0.031	*<0.01*	0.01	0.021	0.3	74.9	75.9	74.6	75.6	Slight
Col 4, HC1, FB-ST	ST	Schist	Transition	8.41	8.28	1.58	131.7	1.62	0.101	0.01	0.05	0.041	1.6	172.9	192.6	171.3	191.0	Moderate
HC2, FB-SS	SS	Schist	Fresh	8.49	8.40	2.09	174.2	2.13	0.421	*<0.01*	0.35	0.071	10.9	180.5	200.1	169.6	189.2	Moderate
HC7	KAM036824	Schist	Fresh		8.18	1.81	150.8	1.83	1.1	0.02	1.06	0.02	33.1	127.2		94.1		Moderate
Col 13, HC5, FB-GGT	OKY Master	Granite	Transition	7.12	7.49	0.01	0.8	0.02	0.035	*<0.01*	<0.01	0.035	<0.3	2.8	7.6	2.8	7.6	None
Col 14, HC6, FB-GGS	OKY Master (Fresh)	Granite	Fresh	8.59	8.48	0.11	9.2	0.122	0.045	*<0.01*	0.03	0.015	0.9	5.7	9.9	4.8	9.0	None

Notes:
Values in grey italics are below the analytical detection limit
CaNP = carbonate NP calculated from total inorganic carbon (TIC)
NNP = net neutralization potential, derived by subtracting AP from NP

Appendix D.1-2 Static Test Results for Waste Rock Kinetic Test Samples

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Description	Lithology	Weathering Facies	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Lu	Mg	Mn	Mo
				ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm	ppm
			Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
			Limit of Detection	*0.01*	*0.01*	*1*	*10*	*5*	*0.1*	*0.02*	*0.01*	*0.01*	*0.05*	*0.1*	*1*	*0.05*	*0.5*	*0.01*	*0.1*	*0.1*	*0.05*	*0.01*	*0.02*	*0.01*	*0.1*	*1*	*0.01*	*0.01*	*2*	*0.05*
Col 5, FB-GO	GO	Gneiss	Oxide	0.17	0.58	218	30	106	0.8	0.35	0.68	0.07	62.7	6.2	142	1.57	9.8	1.5	2.3	*<0.1*	0.32	0.15	*<0.02*	0.21	33.3	2	0.23	0.21	339	4.98
Col 6, HC3, FB-GT	GT	Gneiss	Transition	0.03	0.47	182	30	162	0.7	0.2	0.96	0.05	58.8	4.1	122	1.21	5.9	1.18	1.9	*<0.1*	0.28	0.24	*<0.02*	0.19	32.1	2	0.19	0.35	280	4.89
HC4, FB-GS	GS	Gneiss	Fresh	0.03	0.92	86	20	120	0.7	0.47	1.57	0.03	65.4	8	112	2.07	6.7	1.81	3.6	*<0.1*	0.22	0.07	*<0.02*	0.41	33.4	5	0.22	0.6	373	4.49
HC8	KAM092488	Gneiss	Fresh	0.06	0.34	248	50	63	0.5	0.06	0.47	0.07	36.3	1	100	0.36	2	0.6	0.9	*<0.1*	0.23	0.11	*<0.02*	0.18	22.5	2	0.11	0.19	102	5.42
Col 3, FB-SO	SO	Schist	Oxide	0.17	0.49	369	20	336	0.8	0.48	2.33	0.14	55.6	12.6	125	1.21	24.1	2.89	1.9	*<0.1*	0.14	0.44	0.03	0.16	27.3	2	0.24	0.48	530	3.84
Col 4, HC1, FB-ST	ST	Schist	Transition	0.05	1.52	67	30	542	0.7	0.25	4.86	0.07	38.7	15.1	190	3.7	16.1	2.57	5.8	*<0.1*	0.17	0.03	0.02	0.83	22.7	13	0.19	1.21	589	5.49
HC2, FB-SS	SS	Schist	Fresh	0.11	1.37	30	20	327	0.9	0.45	5.03	0.1	57.5	14.2	145	3.62	18	2.87	5.9	*<0.1*	0.08	0.12	0.04	0.68	28	10	0.23	1.44	660	3.25
HC7	KAM036824	Schist	Fresh	0.05	0.57	989	50	182	1.1	0.21	2.65	0.13	47.1	17	111	1.87	26.9	3.68	2.7	*<0.1*	*<0.05*	0.51	0.04	0.21	24.2	2	0.24	1.11	733	3.64
Col 13, HC5, FB-GGT	OKY Master	Granite	Transition	0.04	0.4	298	*<10*	54	0.4	0.21	0.05	0.05	46.7	1.6	132	3.25	7.6	0.87	1.9	*<0.1*	0.38	0.14	*<0.02*	0.16	25.1	6	0.2	0.06	384	6.68
Col 14, HC6, FB-GGS	OKY Master (Sulphide)	Granite	Fresh	0.03	0.38	59	*<10*	63	0.4	0.15	0.1	0.05	48	1.6	125	3	5.6	1.1	2.2	*<0.1*	0.43	0.08	*<0.02*	0.2	25.7	8	0.23	0.12	678	6.21

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.1-2 Static Test Results for Waste Rock Kinetic Test Samples

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Description	Lithology	Weathering Facies	Na	Nb	Ni	P	Pb	Rb	S	Sb	Sc	Se	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	U	V	W	Y	Yb	Zn	Zr
				%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
			Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
			Limit of Detection	*0.01*	*0.05*	*0.5*	*0.005*	*0.2*	*0.2*	*0.01*	*0.05*	*0.1*	*1*	*0.3*	*0.5*	*0.05*	*0.02*	*0.05*	*0.1*	*0.01*	*0.02*	*0.05*	*1*	*0.1*	*0.05*	*0.1*	*1*	*0.5*
Col 5, FB-GO	GO	Gneiss	Oxide	0.02	0.1	9.7	0.03	10.8	18	0.01	12.1	3	*<1*	0.6	25	*<0.05*	0.49	0.1	35.2	*<0.01*	0.32	5.53	17	1.3	13	1.5	21	11.2
Col 6, HC3, FB-GT	GT	Gneiss	Transition	0.02	0.11	5.7	0.022	7.4	15.7	0.07	6.89	2	*<1*	0.6	38.1	*<0.05*	0.41	*<0.05*	30.6	*<0.01*	0.26	6.32	9	0.2	11	1.3	16	8.9
HC4, FB-GS	GS	Gneiss	Fresh	0.02	0.27	12.8	0.034	6	29.9	0.2	2.58	3.7	*<1*	0.7	55.3	*<0.05*	0.55	0.13	21.5	0.03	0.27	6.05	18	0.2	14.3	1.5	19	6.7
HC8	KAM092488	Gneiss	Fresh	0.01	0.09	5.7	0.006	6	12.5	0.35	2.18	0.4	2	*<0.3*	24.9	*<0.05*	0.19	0.09	36.1	*<0.01*	0.08	12.4	1	0.2	3.94	0.6	4	6.5
Col 3, FB-SO	SO	Schist	Oxide	0.01	*<0.05*	27.4	0.048	17	8.4	0.01	32.6	7	*<1*	0.4	56.9	*<0.05*	0.63	0.06	11.8	*<0.01*	0.44	2.55	32	0.4	15	1.6	41	4.5
Col 4, HC1, FB-ST	ST	Schist	Transition	0.04	0.73	49.6	0.048	9.3	52.2	0.09	1.86	5.7	*<1*	1.1	778	*<0.05*	0.41	0.07	15.1	0.11	0.48	2.71	42	1.4	11.9	1.3	43	4.8
HC2, FB-SS	SS	Schist	Fresh	0.03	0.29	53.9	0.063	15	43.1	0.43	2.59	6.8	*<1*	1.1	243	*<0.05*	0.61	*<0.05*	12.3	0.06	0.37	3.24	43	0.6	16.2	1.6	58	3
HC7	KAM036824	Schist	Fresh	0.02	0.07	43.1	0.048	42.5	13.3	1.09	6.4	8.6	3	0.4	70.9	*<0.05*	0.6	*<0.05*	11.7	*<0.01*	0.3	3.77	34	0.2	15.3	1.6	91	1.5
Col 13, HC5, FB-GGT	OKY Master	Granite	Transition	0.03	1.56	6.4	0.017	16.3	16.5	0.02	1.52	1.7	*<1*	0.7	7.6	*<0.05*	0.39	*<0.05*	30.3	0.02	0.24	7.64	6	0.1	11	1.3	29	8.3
Col 14, HC6, FB-GGS	OKY Master (Sulphide)	Granite	Fresh	0.04	2.38	5.8	0.019	8	22	0.04	0.51	2.1	*<1*	0.9	4	*<0.05*	0.41	*<0.05*	33.7	0.04	0.33	6.24	7	0.1	12.1	1.5	32	8.7

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 3 (SO)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1500	440	7.9	2529	#N/A	8.6	284	600	49	0.26	1.0	748	0.11	0.0088	0.028	0.050	0.000014	*< 0.000007*	0.032	0.000025	188	0.0032	0.0076
30-Jul-14	2	3	400	295	8.3	938	#N/A	2.5	203	240	7.5	0.36	*< 0.3*	209	0.0090	0.0065	0.018	0.019	*< 0.000007*	*< 0.000007*	0.023	*< 0.000003*	50	0.00088	0.00091
13-Aug-14	3	5	400	300	8.2	720	#N/A	3.4	208	129	2.6	0.32	*< 0.3*	164	0.0022	0.0060	0.014	0.024	*< 0.000007*	*< 0.000007*	0.024	*< 0.000003*	39	0.00074	0.00038
27-Aug-14	4	7	400	315	8.2	551	#N/A	8.0	187	91	*< 2*	0.40	*< 0.3*	133	0.0065	0.0052	0.015	0.022	*< 0.000007*	*< 0.000007*	0.028	*< 0.000003*	32	0.00063	0.00021
10-Sep-14	5	9	400	310	8.2	497	#N/A	3.8	181	65	0.50	0.43	*< 0.3*	118	0.0048	0.0049	0.016	0.024	*< 0.000007*	*< 0.000007*	0.023	*< 0.000003*	29	0.00065	0.00015
24-Sep-14	6	11	400	215	8.2	476	#N/A	4.7	198	57	0.30	0.36	*< 0.3*	133	0.0023	0.0049	0.011	0.032	*< 0.000007*	*< 0.000007*	0.021	*< 0.000003*	32	0.00074	0.00020
8-Oct-14	7	13	300	200	8.2	426	#N/A	4.2	159	48	*< 1*	0.42	*< 0.3*	129	0.0066	0.0043	0.015	0.031	*< 0.000007*	*< 0.000007*	0.019	*< 0.000003*	32	0.00072	0.00011
22-Oct-14	8	15	400	260	8.2	385	#N/A	6.1	158	42	*< 1*	0.44	*< 0.3*	126	0.0077	0.0043	0.013	0.034	*< 0.000007*	*< 0.000007*	0.021	0.000014	30	0.00076	0.000086
5-Nov-14	9	17	400	270	-	378	#N/A	#N/A	175	36	*< 1*	0.39	*< 0.3*	141	0.0050	0.0039	0.011	0.040	*< 0.000007*	*< 0.000007*	0.022	*< 0.000003*	33	0.00079	0.00011
19-Nov-14	10	19	400	260	8.1	351	#N/A	6.8	156	29	*< 0.2*	0.39	*< 0.3*	148	0.0049	0.0036	0.012	0.048	*< 0.000007*	*< 0.000007*	0.021	0.0000030	34	0.00073	0.000088
3-Dec-14	11	21	400	335	8.2	342	#N/A	2.7	161	27	*< 1*	0.35	*< 0.3*	161	0.0048	0.0036	0.011	0.051	*< 0.000007*	*< 0.000007*	0.020	0.0000040	39	0.00070	0.000074
17-Dec-14	12	23	400	280	8.2	362	#N/A	3.0	164	21	*< 0.2*	0.38	*< 0.3*	161	0.0052	0.0037	0.012	0.058	*< 0.000007*	*< 0.000007*	0.022	*< 0.000003*	37	0.00057	0.000067
31-Dec-14	13	25	400	280	8.4	353	#N/A	#N/A	215	20	*< 1*	0.37	*< 0.3*	154	0.0082	0.0035	0.012	0.057	*< 0.000007*	*< 0.000007*	0.020	*< 0.000003*	37	0.00091	0.00011
14-Jan-15	14	27	400	265	8.2	311	#N/A	3.4	145	21	*< 1*	0.44	*< 0.3*	145	0.0061	0.0040	0.014	0.051	*< 0.000007*	*< 0.000007*	0.020	0.0000050	34	0.00091	0.000073
28-Jan-15	15	29	400	275	8.2	334	#N/A	3.3	154	18	*< 1*	0.38	*< 0.3*	156	0.0087	0.0035	0.011	0.060	*< 0.000007*	0.0000090	0.017	0.000030	36	0.00086	0.000052
11-Feb-15	16	31	400	255	8.2	357	#N/A	3.2	164	21	*< 1*	0.41	*< 0.3*	163	0.0061	0.0040	0.011	0.062	*< 0.000007*	*< 0.000007*	0.022	0.0000080	39	0.00078	0.000066
25-Feb-15	17	33	400	235	8.2	343	#N/A	4.2	172	15	*< 1*	0.34	*< 0.3*	165	0.0024	0.0034	0.0071	0.066	*< 0.000007*	*< 0.000007*	0.020	*< 0.000003*	41	0.00076	0.000049
11-Mar-15	18	35	400	295	8.2	349	#N/A	2.9	180	17	*< 1*	0.39	*< 0.3*	169	0.0053	0.0035	0.0074	0.067	*< 0.000007*	*< 0.000007*	0.019	*< 0.000003*	42	0.00087	0.000074
25-Mar-15	19	37	400	260	8.1	366	#N/A	5.1	181	13	*< 1*	0.37	*< 0.3*	180	0.0051	0.0040	0.0082	0.077	*< 0.000007*	*< 0.000007*	0.018	*< 0.000003*	42	0.00090	0.000047
8-Apr-15	20	39	400	315	8.1	354	#N/A	5.0	187	13	*< 1*	0.37	*< 0.3*	172	0.0038	0.0045	0.012	0.077	*< 0.000007*	*< 0.000007*	0.019	*< 0.000003*	43	0.00063	0.000049
22-Apr-15	21	41	400	275	8.1	324	#N/A	5.4	166	14	*< 1*	0.42	*< 0.3*	161	0.0051	0.0039	0.0088	0.068	*< 0.000007*	*< 0.000007*	0.021	0.000028	39	0.00080	0.000032
6-May-15	22	43	400	265	8.1	318	#N/A	3.9	171	11	*< 1*	0.37	*< 0.3*	161	0.0054	0.0039	0.0083	0.075	*< 0.000007*	*< 0.000007*	0.019	*< 0.000003*	39	0.00060	0.000030
20-May-15	23	45	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	420	295	8.1	283	#N/A	4.7	135	11	*< 1*	0.46	*< 0.3*	135	0.0082	0.0034	0.0086	0.065	*< 0.000007*	*< 0.000007*	0.017	*< 0.000003*	33	0.00074	0.000026
17-Jun-15	25	49	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	420	280	8.1	304	#N/A	5.6	140	10	*< 1*	0.46	*< 0.3*	136	0.0044	0.0041	0.014	0.077	*< 0.000007*	*< 0.000007*	0.019	0.0000040	32	0.00082	0.000042
15-Jul-15	27	53	500	360	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	360	280	8.2	269	#N/A	2.1	132	12	*< 1*	0.50	*< 0.3*	125	0.0065	0.0036	0.0098	0.070	*< 0.000007*	*< 0.000007*	0.018	*< 0.000003*	30	0.00084	0.000035
12-Aug-15	29	57	500	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	400	270	8.2	259	#N/A	2.0	131	10	*< 1*	0.46	*< 0.3*	125	0.0079	0.0038	0.011	0.079	*< 0.000007*	*< 0.000007*	0.017	0.0000060	30	0.00096	0.000038
9-Sep-15	31	61	500	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	400	340	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	340	230	8.2	273	#N/A	3.3	138	8.0		0.48		123	0.0083	0.0041	0.012	0.077	*< 0.000007*	*< 0.000007*	0.015	0.0000030	29	0.00082	0.000026
21-Oct-15	34	67	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	450	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	420	305	8.4	264	#N/A	#N/A	149	7.0		0.52		125	0.0040	0.0037	0.0088	0.079	*< 0.000007*	*< 0.000007*	0.011	*< 0.000003*	30	0.00091	0.000023
2-Dec-15	37	73	500	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	460	405	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	405	380	8.3	263	#N/A	#N/A	119	7.0	-	0.48	-	123	0.0061	0.0035	0.0097	0.083	*< 0.000007*	*< 0.000007*	0.014	*< 0.000003*	29	0.00083	0.000051
6-Jan-16	40	78	400	330	8.3	255	#N/A	0.90	120	8.0	-	0.54	-	134	0.0057	0.0038	0.011	0.085	*< 0.000007*	*< 0.000007*	0.015	*< 0.000003*	32	0.00095	0.000031
20-Jan-16	41	80	400	260	8.3	255	#N/A	1.7	120	8.0	-	0.53	-	132	0.0054	0.0043	0.012	0.093	*< 0.000007*	*< 0.000007*	0.014	0.0000040	32	0.00099	0.00012
3-Feb-16	42	82	400	375	8.2	245	#N/A	2.0	119	7.0	-	0.37	-	122	0.0041	0.0040	0.0094	0.091	*< 0.000007*	*< 0.000007*	0.012	*< 0.000003*	30	0.00092	0.000023
17-Feb-16	43	84	400	285	8.2	262	#N/A	4.0	122	7.0	-	0.59	-	134	0.0018	0.0040	0.0097	0.096	*< 0.000007*	*< 0.000007*	0.012	*< 0.000003*	33	0.0011	0.000021
2-Mar-16	44	86	400	350	8.2	251	#N/A	1.3	117	7.0	-	0.56	-	126	0.0022	0.0043	0.012	0.094	*< 0.000007*	*< 0.000007*	0.011	*< 0.000003*	29	0.0010	0.000040

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 3 (SO)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1500	440	7.9	0.043	0.015	0.000090	0.020	68	0.052	0.34	0.0039	0.016	0.050	21	0.0081	5.0	0.000021	229	0.93	215	0.00019	0.00085	0.00054	0.025	0.0074	0.016	< 0.002
30-Jul-14	2	3	400	295	8.3	0.0079	2.7	0.000010	0.011	21	0.029	0.060	0.0046	0.0042	< 0.009	9.5	0.0034	4.8	< 0.000002	103	0.29	92	0.000096	0.000050	0.00039	0.013	0.00098	0.0030	< 0.002
13-Aug-14	3	5	400	300	8.2	0.0025	< 0.002	< 0.00001	0.011	16	0.011	0.020	0.0050	0.0021	< 0.009	7.9	0.0020	5.0	< 0.000002	46	0.23	49	0.000083	0.000020	0.00020	0.012	0.000020	0.0010	< 0.002
27-Aug-14	4	7	400	315	8.2	0.0014	< 0.002	0.000020	0.0089	13	0.0040	< 0.01	0.0049	0.0012	0.013	7.3	0.0013	4.9	< 0.000002	50	0.19	33	0.000082	0.00024	0.000070	0.0092	0.00019	< 0.001	< 0.002
10-Sep-14	5	9	400	310	8.2	0.0012	< 0.007	< 0.00001	0.0082	11	0.0021	< 0.01	0.0050	0.0010	< 0.003	6.5	0.0011	5.8	< 0.000002	56	0.20	27	0.000073	0.00017	< 0.00005	0.0074	0.00015	< 0.001	< 0.002
24-Sep-14	6	11	400	215	8.2	0.0015	< 0.002	0.000040	0.0091	13	0.0023	0.010	0.0034	0.0014	0.013	7.2	0.00045	5.0	0.000039	45	0.19	18	0.000080	0.000050	0.00033	0.0063	0.00011	0.0020	< 0.002
8-Oct-14	7	13	300	200	8.2	0.00098	< 0.007	0.00012	0.0090	12	0.0011	< 0.01	0.0046	0.00070	< 0.003	6.5	0.00080	5.1	< 0.000002	40	0.21	16	0.000077	0.000060	0.000090	0.0066	0.00014	< 0.001	< 0.002
22-Oct-14	8	15	400	260	8.2	0.0010	< 0.007	0.000030	0.0078	13	0.0017	< 0.01	0.0043	0.00070	< 0.003	7.4	0.00064	5.4	< 0.000002	30	0.19	15	0.000077	0.000060	0.00012	0.0058	0.00018	0.0010	< 0.002
5-Nov-14	9	17	400	270	-	0.00085	0.026	0.000060	0.0080	14	0.0016	< 0.01	0.0041	0.00060	< 0.003	6.3	0.00057	5.0	< 0.000002	24	0.24	12	0.000083	0.000030	0.00010	0.0058	0.000090	< 0.001	< 0.002
19-Nov-14	10	19	400	260	8.1	0.00096	< 0.007	< 0.00001	0.0082	15	0.00025	< 0.01	0.0037	0.00050	0.0060	6.6	0.00050	5.3	< 0.000002	17	0.26	9.4	0.00010	0.000070	0.00011	0.0058	0.00011	< 0.001	< 0.002
3-Dec-14	11	21	400	335	8.2	0.0011	< 0.007	0.000010	0.0074	15	0.0013	< 0.01	0.0032	0.00060	< 0.003	6.5	0.00043	5.0	< 0.000002	12	0.28	8.8	0.000089	0.000020	0.000070	0.0056	0.00010	< 0.001	< 0.002
17-Dec-14	12	23	400	280	8.2	0.00083	< 0.007	< 0.00001	0.0078	16	0.00018	< 0.01	0.0037	0.00050	< 0.003	7.3	0.00039	5.2	< 0.000002	9.2	0.29	7.7	0.000085	< 0.00001	0.000060	0.0058	0.00016	< 0.001	< 0.002
31-Dec-14	13	25	400	280	8.4	0.00082	< 0.007	0.00047	0.0071	15	0.0014	< 0.01	0.0042	0.00050	< 0.003	6.7	0.00035	5.1	0.0000020	6.3	0.28	7.2	0.000093	0.000070	0.000090	0.0056	0.00012	0.0020	< 0.002
14-Jan-15	14	27	400	265	8.2	0.0015	< 0.007	0.000050	0.0064	14	0.0012	< 0.01	0.0047	0.00050	< 0.003	6.7	0.00033	5.2	0.0000020	5.3	0.25	6.9	0.000078	0.000070	0.000090	0.0053	0.00014	0.0020	< 0.002
28-Jan-15	15	29	400	275	8.2	0.00071	< 0.007	0.000080	0.0057	16	0.00075	< 0.01	0.0041	0.00050	< 0.003	6.9	0.00043	4.7	< 0.000002	4.7	0.22	6.7	0.000083	0.00010	0.00012	0.0051	0.00022	0.0020	< 0.002
11-Feb-15	16	31	400	255	8.2	0.00067	< 0.007	0.000090	0.0067	16	0.00065	< 0.01	0.0036	0.00050	< 0.003	6.6	< 0.001	5.0	< 0.000002	3.6	0.27	6.4	0.000084	0.00039	< 0.00005	0.0053	0.00012	< 0.001	< 0.002
25-Feb-15	17	33	400	235	8.2	0.0013	< 0.007	0.000020	0.0068	16	0.00062	< 0.01	0.0026	0.00040	< 0.003	7.1	< 0.001	5.0	< 0.000002	3.0	0.27	5.4	0.000087	0.00013	< 0.00005	0.0052	0.000090	< 0.001	< 0.002
11-Mar-15	18	35	400	295	8.2	0.0016	< 0.007	0.000030	0.0068	16	0.00080	< 0.01	0.0028	0.00060	< 0.003	6.6	< 0.001	4.6	< 0.000002	2.6	0.29	5.3	0.000080	0.000020	< 0.00005	0.0051	0.00012	0.0020	< 0.002
25-Mar-15	19	37	400	260	8.1	0.0021	< 0.007	0.000010	0.0067	18	0.00060	< 0.01	0.0031	0.00060	< 0.003	7.7	< 0.001	5.7	0.0000020	2.7	0.31	5.5	0.000092	0.00068	0.000050	0.0058	0.00014	0.0010	< 0.002
8-Apr-15	20	39	400	315	8.1	0.0012	< 0.007	< 0.00001	0.0065	16	0.00039	< 0.01	0.0034	0.00040	< 0.003	7.2	< 0.001	5.8	< 0.000002	1.9	0.31	4.4	0.000080	0.00013	< 0.00005	0.0054	0.00011	< 0.001	< 0.002
22-Apr-15	21	41	400	275	8.1	0.0011	< 0.007	0.00027	0.0059	16	0.00075	< 0.01	0.0034	0.00040	< 0.003	7.1	0.00029	5.3	0.0000040	1.8	0.28	4.7	0.000086	0.00010	< 0.00005	0.0052	0.00013	0.0010	< 0.002
6-May-15	22	43	400	265	8.1	0.0015	< 0.007	< 0.00001	0.0060	15	0.00055	< 0.01	0.0031	0.00040	< 0.003	7.1	< 0.001	5.3	0.0000030	1.5	0.27	4.4	0.000071	0.000040	0.00012	0.0048	0.00018	0.0010	< 0.002
20-May-15	23	45	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	420	295	8.1	0.0020	< 0.007	0.000090	0.0048	13	0.00025	< 0.01	0.0034	0.00030	< 0.003	6.5	0.00015	4.9	0.0000020	1.1	0.24	4.5	0.000065	< 0.00001	< 0.00005	0.0044	0.00015	< 0.001	< 0.002
17-Jun-15	25	49	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	420	280	8.1	0.0044	< 0.007	0.000050	0.0052	14	0.0014	0.010	0.0041	0.00030	< 0.003	6.4	0.00029	5.2	< 0.000002	0.98	0.24	4.1	0.000074	0.00076	0.000080	0.0052	0.00012	0.0030	< 0.002
15-Jul-15	27	53	500	360	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	360	280	8.2	0.00046	< 0.007	0.000060	0.0048	12	0.00022	< 0.01	0.0043	0.00020	< 0.003	5.9	0.00012	4.4	< 0.000002	0.83	0.22	3.8	0.000063	0.000050	< 0.00005	0.0047	0.00013	0.0010	< 0.002
12-Aug-15	29	57	500	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	400	270	8.2	0.0010	< 0.007	0.00010	0.0043	12	0.0012	< 0.01	0.012	0.00020	< 0.003	5.9	0.00018	4.7	0.000087	0.87	0.23	3.9	0.000081	0.000090	< 0.00005	0.0046	0.00016	0.0020	< 0.002
9-Sep-15	31	61	500	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	400	340	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	340	230	8.2	0.0062	< 0.007	0.00066	0.0038	12	0.00053	0.020	0.0037	0.00030	< 0.003	5.8	0.00017	4.2	< 0.000002	0.66	0.20	3.5	0.000060	0.00030	< 0.00005	0.0047	0.00016	0.0010	< 0.002
21-Oct-15	34	67	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	450	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	420	305	8.4	0.00055	< 0.007	0.000060	0.0037	12	0.00024	< 0.01	0.0032	< 0.0001	< 0.003	6.0	0.00025	4.3	< 0.000002	0.59	0.20	3.1	0.000061	0.000030	0.000050	0.0035	0.000080	< 0.001	< 0.002
2-Dec-15	37	73	500	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	460	405	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	405	380	8.3	0.00098	< 0.007	0.00042	0.0033	12	0.00017	< 0.01	0.0040	0.00020	< 0.003	5.9	0.00013	4.2	< 0.000002	0.60	0.17	2.9	0.000043	0.00013	0.000060	0.0041	0.00013	< 0.001	< 0.002
6-Jan-16	40	78	400	330	8.3	0.0012	< 0.007	0.00048	0.0036	13	0.00057	< 0.01	0.0038	0.00020	< 0.003	6.6	0.00071	4.6	0.0000020	0.61	0.19	3.1	0.000023	0.00030	< 0.00005	0.0045	0.00010	< 0.001	< 0.002
20-Jan-16	41	80	400	260	8.3	0.00069	< 0.007	0.00019	0.0037	12	0.0062	< 0.01	0.0044	0.00030	< 0.003	6.2	0.00033	4.8	< 0.000002	0.57	0.22	3.1	0.00011	0.00010	< 0.00005	0.0050	0.00011	0.0020	< 0.002
3-Feb-16	42	82	400	375	8.2	0.00085	< 0.007	0.000080	0.0036	11	0.000040	< 0.01	0.0039	0.00020	< 0.003	6.0	0.00036	4.4	0.000011	0.56	0.22	3.0	0.000070	0.000040	< 0.00005	0.0043	0.00010	< 0.001	< 0.002
17-Feb-16	43	84	400	285	8.2	0.00045	< 0.007	0.000050	0.0036	13	0.00023	< 0.01	0.0040	0.00020	0.0050	6.3	0.000080	4.5	< 0.000002	0.61	0.21	3.0	0.000069	< 0.00001	< 0.00005	0.0044	0.000070	< 0.001	< 0.002
2-Mar-16	44	86	400	350	8.2	0.00024	< 0.007	0.000070	0.0036	13	0.00025	< 0.01	0.0041	0.00020	< 0.003	6.1	0.000080	4.5	< 0.000002	0.59	0.21	3.3	0.000076	0.000010	< 0.00005	0.0047	0.000070	< 0.001	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 3 (SO)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1500	440	7.9	2529	#N/A	0.38	12	26	2.2	0.011	0.044	33	0.0050	0.00039	0.0012	0.0022	0.00000062	0.00000031	0.0014	0.0000011	8.3	0.00014	0.00034
30-Jul-14	2	3	400	295	8.3	938	#N/A	0.036	3.0	3.5	0.11	0.0053	0.0044	3.1	0.00013	0.000096	0.00027	0.00028	0.00000010	0.00000010	0.00033	0.000000044	0.73	0.000013	0.000013
13-Aug-14	3	5	400	300	8.2	720	#N/A	0.051	3.1	1.9	0.039	0.0048	0.0045	2.5	0.000033	0.000090	0.00022	0.00036	0.00000011	0.00000011	0.00036	0.000000045	0.59	0.000011	0.0000057
27-Aug-14	4	7	400	315	8.2	551	#N/A	0.13	2.9	1.4	0.032	0.0063	0.0047	2.1	0.00010	0.000082	0.00023	0.00034	0.00000011	0.00000011	0.00045	0.000000047	0.50	0.0000099	0.0000032
10-Sep-14	5	9	400	310	8.2	497	#N/A	0.058	2.8	1.0	0.0078	0.0067	0.0047	1.8	0.000074	0.000076	0.00024	0.00038	0.00000011	0.00000011	0.00036	0.000000047	0.45	0.000010	0.0000023
24-Sep-14	6	11	400	215	8.2	476	#N/A	0.050	2.1	0.61	0.0032	0.0039	0.0032	1.4	0.000025	0.000053	0.00012	0.00034	0.000000075	0.000000075	0.00022	0.000000032	0.34	0.0000080	0.0000021
8-Oct-14	7	13	300	200	8.2	426	#N/A	0.042	1.6	0.48	0.010	0.0042	0.0030	1.3	0.000066	0.000043	0.00015	0.00031	0.000000070	0.000000070	0.00019	0.000000030	0.32	0.0000072	0.0000011
22-Oct-14	8	15	400	260	8.2	385	#N/A	0.080	2.1	0.55	0.013	0.0057	0.0039	1.6	0.00010	0.000056	0.00017	0.00044	0.000000091	0.000000091	0.00027	0.00000018	0.38	0.0000099	0.0000011
5-Nov-14	9	17	400	270		378	#N/A	#N/A	2.4	0.49	0.014	0.0053	0.0041	1.9	0.000068	0.000053	0.00015	0.00054	0.000000095	0.000000095	0.00029	0.000000041	0.44	0.000011	0.0000014
19-Nov-14	10	19	400	260	8.1	351	#N/A	0.088	2.0	0.38	0.0026	0.0051	0.0039	1.9	0.000064	0.000047	0.00015	0.00062	0.000000091	0.000000091	0.00028	0.000000039	0.44	0.0000095	0.0000011
3-Dec-14	11	21	400	335	8.2	342	#N/A	0.046	2.7	0.45	0.017	0.0059	0.0050	2.7	0.000080	0.000060	0.00018	0.00086	0.00000012	0.00000012	0.00033	0.000000067	0.65	0.000012	0.0000012
17-Dec-14	12	23	400	280	8.2	362	#N/A	0.042	2.3	0.29	0.0028	0.0053	0.0042	2.3	0.000073	0.000052	0.00016	0.00082	0.000000098	0.000000098	0.00030	0.000000042	0.52	0.0000080	0.00000094
31-Dec-14	13	25	400	280	8.4	353	#N/A	#N/A	3.0	0.28	0.014	0.0052	0.0042	2.2	0.00011	0.000049	0.00017	0.00080	0.000000098	0.000000098	0.00029	0.000000042	0.51	0.000013	0.0000015
14-Jan-15	14	27	400	265	8.2	311	#N/A	0.045	1.9	0.28	0.013	0.0058	0.0040	1.9	0.000081	0.000053	0.00018	0.00068	0.000000093	0.000000093	0.00026	0.000000066	0.45	0.000012	0.00000097
28-Jan-15	15	29	400	275	8.2	334	#N/A	0.045	2.1	0.25	0.014	0.0052	0.0041	2.1	0.00012	0.000048	0.00015	0.00082	0.000000096	0.00000012	0.00024	0.00000041	0.50	0.000012	0.00000072
11-Feb-15	16	31	400	255	8.2	357	#N/A	0.041	2.1	0.27	0.013	0.0052	0.0038	2.1	0.000078	0.000051	0.00014	0.00079	0.000000089	0.000000089	0.00027	0.00000010	0.50	0.0000099	0.00000084
25-Feb-15	17	33	400	235	8.2	343	#N/A	0.049	2.0	0.18	0.012	0.0040	0.0035	1.9	0.000028	0.000040	0.000083	0.00077	0.000000082	0.000000082	0.00023	0.000000035	0.48	0.0000089	0.00000058
11-Mar-15	18	35	400	295	8.2	349	#N/A	0.042	2.6	0.25	0.015	0.0058	0.0044	2.5	0.000078	0.000052	0.00011	0.00099	0.00000010	0.00000010	0.00027	0.000000044	0.62	0.000013	0.0000011
25-Mar-15	19	37	400	260	8.1	366	#N/A	0.066	2.4	0.17	0.013	0.0048	0.0039	2.3	0.000066	0.000052	0.00011	0.0010	0.000000091	0.000000091	0.00024	0.000000039	0.54	0.000012	0.00000061
8-Apr-15	20	39	400	315	8.1	354	#N/A	0.078	2.9	0.20	0.016	0.0058	0.0047	2.7	0.000060	0.000071	0.00018	0.0012	0.00000011	0.00000011	0.00030	0.000000047	0.68	0.0000099	0.00000077
22-Apr-15	21	41	400	275	8.1	324	#N/A	0.074	2.3	0.19	0.014	0.0058	0.0041	2.2	0.000070	0.000054	0.00012	0.00094	0.000000096	0.000000096	0.00029	0.00000039	0.54	0.000011	0.00000044
6-May-15	22	43	400	265	8.1	318	#N/A	0.052	2.3	0.15	0.013	0.0049	0.0040	2.1	0.000072	0.000052	0.00011	0.00099	0.000000093	0.000000093	0.00025	0.000000040	0.52	0.0000080	0.00000040
20-May-15	23	45	500	420																					
3-Jun-15	24	47	420	295	8.1	283	#N/A	0.035	0.99	0.081	0.0074	0.0034	0.0022	1.00	0.000060	0.000025	0.000063	0.00048	0.000000052	0.000000052	0.00012	0.000000022	0.24	0.0000055	0.00000019
17-Jun-15	25	49	500	420																					
1-Jul-15	26	51	420	280	8.1	304	#N/A	0.039	0.98	0.070	0.0070	0.0032	0.0021	0.95	0.000031	0.000029	0.000095	0.00054	0.000000049	0.000000049	0.00013	0.000000028	0.23	0.0000057	0.00000029
15-Jul-15	27	53	500	360																					
29-Jul-15	28	55	360	280	8.2	269	#N/A	0.015	0.92	0.084	0.0070	0.0035	0.0021	0.88	0.000046	0.000025	0.000069	0.00049	0.000000049	0.000000049	0.00012	0.000000021	0.21	0.0000059	0.00000025
12-Aug-15	29	57	500	400																					
26-Aug-15	30	59	400	270	8.2	259	#N/A	0.013	0.89	0.068	0.0068	0.0031	0.0020	0.84	0.000053	0.000026	0.000075	0.00053	0.000000047	0.000000047	0.00011	0.000000041	0.21	0.0000065	0.00000026
9-Sep-15	31	61	500	400																					
23-Sep-15	32	63	400	340																					
7-Oct-15	33	65	340	230	8.2	273	#N/A	0.013	0.53	0.031		0.0018		0.47	0.000032	0.000016	0.000045	0.00029	0.000000027	0.000000027	0.000058	0.000000012	0.11	0.0000031	0.000000100
21-Oct-15	34	67	500	450																					
4-Nov-15	35	69	450	420																					
18-Nov-15	36	71	420	305	8.4	264	#N/A		0.76	0.036		0.0026		0.64	0.000020	0.000019	0.000045	0.00040	0.000000036	0.000000036	0.000055	0.000000015	0.15	0.0000046	0.00000012
2-Dec-15	37	73	500	460																					
16-Dec-15	38	75	460	405																					
30-Dec-15	39	77	405	380	8.3	263	#N/A		0.76	0.044		0.0030		0.78	0.000039	0.000022	0.000061	0.00052	0.000000044	0.000000044	0.000087	0.000000019	0.19	0.0000053	0.00000032
6-Jan-16	40	78	400	330	8.3	255	#N/A	0.015	2.0	0.13		0.0089		2.2	0.000094	0.000063	0.00018	0.0014	0.00000012	0.00000012	0.00025	0.000000050	0.52	0.000016	0.00000051
20-Jan-16	41	80	400	260	8.3	255	#N/A	0.022	1.6	0.10		0.0069		1.7	0.000070	0.000056	0.00015	0.0012	0.000000091	0.000000091	0.00018	0.000000052	0.42	0.000013	0.0000016
3-Feb-16	42	82	400	375	8.2	245	#N/A	0.037	2.2	0.13		0.0069		2.3	0.000077	0.000075	0.00018	0.0017	0.00000013	0.00000013	0.00023	0.000000056	0.56	0.000017	0.00000043
17-Feb-16	43	84	400	285	8.2	262	#N/A	0.057	1.7	0.100		0.0084		1.9	0.000026	0.000057	0.00014	0.0014	0.000000100	0.000000100	0.00017	0.000000043	0.46	0.000015	0.00000030
2-Mar-16	44	86	400	350	8.2	251	#N/A	0.023	2.0	0.12		0.0098		2.2	0.000039	0.000075	0.00020	0.0016	0.00000012	0.00000012	0.00019	0.000000053	0.51	0.000018	0.00000070

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 3 (SO)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1500	440	7.9	0.0019	0.00066	0.0000040	0.00089	3.0	0.0023	0.015	0.00017	0.00070	0.0022	0.93	0.00036	0.22	0.00000092	10	0.041	9.5	0.0000082	0.000037	0.000024	0.0011	0.00032	0.00070	0.000088
30-Jul-14	2	3	400	295	8.3	0.00012	0.039	0.00000015	0.00017	0.30	0.00043	0.00089	0.000068	0.000062	0.00013	0.14	0.000051	0.071	0.000000030	1.5	0.0042	1.4	0.0000014	0.00000074	0.0000058	0.00020	0.000014	0.000044	0.000030
13-Aug-14	3	5	400	300	8.2	0.000037	0.000030	0.00000015	0.00017	0.24	0.00017	0.00030	0.000075	0.000032	0.00014	0.12	0.000029	0.075	0.000000030	0.69	0.0034	0.74	0.0000012	0.00000030	0.0000030	0.00017	0.00000030	0.000015	0.000030
27-Aug-14	4	7	400	315	8.2	0.000023	0.000032	0.00000032	0.00014	0.20	0.000063	0.00016	0.000077	0.000019	0.00020	0.12	0.000020	0.077	0.000000032	0.79	0.0029	0.52	0.0000013	0.0000038	0.0000011	0.00014	0.0000030	0.000016	0.000032
10-Sep-14	5	9	400	310	8.2	0.000019	0.00011	0.00000016	0.00013	0.17	0.000032	0.00016	0.000078	0.000016	0.000047	0.100	0.000017	0.089	0.000000031	0.87	0.0030	0.41	0.0000011	0.0000026	0.00000078	0.00011	0.0000023	0.000016	0.000031
24-Sep-14	6	11	400	215	8.2	0.000016	0.000022	0.00000043	0.000098	0.14	0.000025	0.00011	0.000037	0.000015	0.00014	0.078	0.0000048	0.053	0.00000042	0.48	0.0021	0.19	0.00000086	0.00000054	0.0000035	0.000068	0.0000012	0.000022	0.000022
8-Oct-14	7	13	300	200	8.2	0.0000098	0.000070	0.0000012	0.000090	0.12	0.000011	0.00010	0.000046	0.0000070	0.000030	0.065	0.0000080	0.051	0.000000020	0.40	0.0021	0.16	0.00000077	0.00000060	0.00000090	0.000066	0.0000014	0.000010	0.000020
22-Oct-14	8	15	400	260	8.2	0.000013	0.000091	0.00000039	0.00010	0.16	0.000022	0.00013	0.000056	0.0000091	0.000039	0.096	0.0000083	0.070	0.000000026	0.39	0.0025	0.20	0.0000010	0.00000078	0.0000016	0.000075	0.0000023	0.000013	0.000026
5-Nov-14	9	17	400	270		0.000011	0.00035	0.00000081	0.00011	0.19	0.000021	0.00014	0.000055	0.0000081	0.000041	0.085	0.0000077	0.068	0.000000027	0.32	0.0033	0.16	0.0000011	0.00000041	0.0000014	0.000078	0.0000012	0.000014	0.000027
19-Nov-14	10	19	400	260	8.1	0.000012	0.000091	0.00000013	0.00011	0.20	0.0000033	0.00013	0.000048	0.0000065	0.000078	0.085	0.0000065	0.069	0.000000026	0.22	0.0034	0.12	0.0000014	0.00000091	0.0000014	0.000075	0.0000014	0.000013	0.000026
3-Dec-14	11	21	400	335	8.2	0.000018	0.00012	0.00000017	0.00012	0.26	0.000022	0.00017	0.000054	0.000010	0.000050	0.11	0.0000072	0.083	0.000000034	0.20	0.0047	0.15	0.0000015	0.00000034	0.0000012	0.000094	0.0000017	0.000017	0.000034
17-Dec-14	12	23	400	280	8.2	0.000012	0.000098	0.00000014	0.00011	0.23	0.0000025	0.00014	0.000051	0.0000070	0.000042	0.10	0.0000055	0.073	0.000000028	0.13	0.0040	0.11	0.0000012	0.00000014	0.00000084	0.000081	0.0000022	0.000014	0.000028
31-Dec-14	13	25	400	280	8.4	0.000011	0.000098	0.0000066	0.000099	0.21	0.000019	0.00014	0.000058	0.0000070	0.000042	0.094	0.0000049	0.072	0.000000028	0.089	0.0039	0.10	0.0000013	0.00000098	0.0000013	0.000078	0.0000017	0.000028	0.000028
14-Jan-15	14	27	400	265	8.2	0.000020	0.000093	0.00000066	0.000085	0.19	0.000015	0.00013	0.000062	0.0000066	0.000040	0.089	0.0000044	0.069	0.000000027	0.070	0.0033	0.091	0.0000010	0.00000093	0.0000012	0.000070	0.0000019	0.000027	0.000027
28-Jan-15	15	29	400	275	8.2	0.0000098	0.000096	0.0000011	0.000079	0.22	0.000010	0.00014	0.000057	0.0000069	0.000041	0.094	0.0000059	0.065	0.000000028	0.064	0.0030	0.092	0.0000011	0.0000014	0.0000017	0.000071	0.0000030	0.000028	0.000028
11-Feb-15	16	31	400	255	8.2	0.0000085	0.000089	0.0000011	0.000085	0.20	0.0000083	0.00013	0.000046	0.0000064	0.000038	0.084	0.000013	0.064	0.000000026	0.046	0.0035	0.082	0.0000011	0.0000050	0.00000064	0.000068	0.0000015	0.000013	0.000026
25-Feb-15	17	33	400	235	8.2	0.000015	0.000082	0.00000024	0.000079	0.18	0.0000073	0.00012	0.000030	0.0000047	0.000035	0.083	0.000012	0.059	0.000000024	0.036	0.0032	0.063	0.0000010	0.0000015	0.00000059	0.000061	0.0000011	0.000012	0.000024
11-Mar-15	18	35	400	295	8.2	0.000023	0.00010	0.00000044	0.00010	0.23	0.000012	0.00015	0.000042	0.0000089	0.000044	0.098	0.000015	0.067	0.000000030	0.038	0.0042	0.078	0.0000012	0.00000030	0.00000074	0.000075	0.0000018	0.000030	0.000030
25-Mar-15	19	37	400	260	8.1	0.000027	0.000091	0.00000013	0.000087	0.24	0.0000078	0.00013	0.000041	0.0000078	0.000039	0.10	0.000013	0.075	0.000000026	0.035	0.0040	0.072	0.0000012	0.0000088	0.00000065	0.000075	0.0000018	0.000013	0.000026
8-Apr-15	20	39	400	315	8.1	0.000018	0.00011	0.00000016	0.00010	0.25	0.0000061	0.00016	0.000054	0.0000063	0.000047	0.11	0.000016	0.092	0.000000032	0.030	0.0049	0.069	0.0000013	0.0000020	0.00000079	0.000086	0.0000017	0.000016	0.000032
22-Apr-15	21	41	400	275	8.1	0.000015	0.000096	0.0000037	0.000081	0.21	0.000010	0.00014	0.000047	0.0000055	0.000041	0.097	0.0000040	0.073	0.000000055	0.024	0.0038	0.065	0.0000012	0.0000014	0.00000069	0.000071	0.0000018	0.000014	0.000028
6-May-15	22	43	400	265	8.1	0.000020	0.000093	0.00000013	0.000080	0.20	0.0000073	0.00013	0.000041	0.0000053	0.000040	0.095	0.000013	0.071	0.000000040	0.020	0.0035	0.058	0.00000094	0.00000053	0.0000016	0.000063	0.0000024	0.000013	0.000027
20-May-15	23	45	500	420																									
3-Jun-15	24	47	420	295	8.1	0.000015	0.000052	0.00000066	0.000035	0.094	0.0000018	0.000074	0.000025	0.0000022	0.000022	0.048	0.0000011	0.036	0.000000015	0.0080	0.0017	0.033	0.00000048	0.000000074	0.00000037	0.000032	0.0000011	0.0000074	0.000015
17-Jun-15	25	49	500	420																									
1-Jul-15	26	51	420	280	8.1	0.000031	0.000049	0.00000035	0.000036	0.095	0.0000097	0.000070	0.000029	0.0000021	0.000021	0.045	0.0000020	0.036	0.000000014	0.0069	0.0017	0.029	0.00000052	0.0000053	0.00000056	0.000036	0.00000084	0.000021	0.000014
15-Jul-15	27	53	500	360																									
29-Jul-15	28	55	360	280	8.2	0.0000032	0.000049	0.00000042	0.000034	0.084	0.0000015	0.000070	0.000030	0.0000014	0.000021	0.041	0.00000084	0.031	0.000000014	0.0058	0.0015	0.027	0.00000044	0.00000035	0.00000035	0.000033	0.00000091	0.0000070	0.000014
12-Aug-15	29	57	500	400																									
26-Aug-15	30	59	400	270	8.2	0.0000068	0.000047	0.00000068	0.000029	0.080	0.0000080	0.000068	0.000081	0.0000014	0.000020	0.040	0.0000012	0.031	0.00000059	0.0059	0.0015	0.026	0.00000055	0.00000061	0.00000034	0.000031	0.0000011	0.000014	0.000014
9-Sep-15	31	61	500	400																									
23-Sep-15	32	63	400	340																									
7-Oct-15	33	65	340	230	8.2	0.000024	0.000027	0.0000025	0.000015	0.046	0.0000020	0.000077	0.000014	0.0000012	0.000012	0.022	0.00000065	0.016	0.0000000077	0.0025	0.00076	0.013	0.00000023	0.0000012	0.00000019	0.000018	0.00000061	0.0000038	0.0000077
21-Oct-15	34	67	500	450																									
4-Nov-15	35	69	450	420																									
18-Nov-15	36	71	420	305	8.4	0.0000028	0.000036	0.00000031	0.000019	0.062	0.0000012	0.000051	0.000016	0.00000051	0.000015	0.031	0.0000013	0.022	0.000000010	0.0030	0.0010	0.016	0.00000031	0.00000015	0.00000025	0.000018	0.00000041	0.0000051	0.000010
2-Dec-15	37	73	500	460																									
16-Dec-15	38	75	460	405																									
30-Dec-15	39	77	405	380	8.3	0.0000062	0.000044	0.0000027	0.000021	0.076	0.0000011	0.000063	0.000025	0.0000013	0.000019	0.037	0.00000082	0.027	0.000000013	0.0038	0.0011	0.018	0.00000027	0.00000082	0.00000038	0.000026	0.00000082	0.0000063	0.000013
6-Jan-16	40	78	400	330	8.3	0.000020	0.00012	0.0000079	0.000060	0.22	0.0000094	0.00017	0.000063	0.0000033	0.000050	0.11	0.000012	0.075	0.000000033	0.010	0.0032	0.051	0.00000038	0.0000050	0.00000083	0.000074	0.0000017	0.000017	0.000033
20-Jan-16	41	80	400	260	8.3	0.0000090	0.000091	0.0000025	0.000048	0.16	0.000080	0.00013	0.000057	0.0000039	0.000039	0.080	0.0000043	0.063	0.000000026	0.0074	0.0029	0.040	0.0000014	0.0000013	0.00000065	0.000064	0.0000014	0.000026	0.000026
3-Feb-16	42	82	400	375	8.2	0.000016	0.00013	0.0000015	0.000068	0.21	0.00000075	0.00019	0.000073	0.0000038	0.000056	0.11	0.0000068	0.083	0.00000021	0.011	0.0041	0.056	0.0000013	0.00000075	0.00000094	0.000080	0.0000019	0.000019	0.000038
17-Feb-16	43	84	400	285	8.2	0.0000064	0.000100	0.00000071	0.000051	0.18	0.0000033	0.00014	0.000058	0.0000029	0.000071	0.089	0.0000011	0.065	0.000000029	0.0087	0.0030	0.043	0.00000098	0.00000014	0.00000071	0.000063	0.00000100	0.000014	0.000029
2-Mar-16	44	86	400	350	8.2	0.0000042	0.00012	0.0000012	0.000064	0.22	0.0000044	0.00018	0.000071	0.0000035	0.000053	0.11	0.0000014	0.079	0.000000035	0.010	0.0036	0.058	0.0000013	0.00000018	0.00000088	0.000083	0.0000012	0.000018	0.000035

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 4 (ST)

Date	Cycle	Weeks	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
	No.		Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1300	315	7.8	3419	#N/A	9.6	138	1704	24	0.27	0.40	1720	0.062	0.0032	0.021	0.071	*< 0.000007*	*< 0.000007*	0.038	0.000018	360	0.0017	0.0084
30-Jul-14	2	3	400	335	8.0	1594	#N/A	4.4	116	711	3.0	0.34	*< 0.3*	615	0.0057	0.0026	0.014	0.021	*< 0.000007*	*< 0.000007*	0.033	0.0000030	135	0.00029	0.0017
13-Aug-14	3	5	400	340	8.0	1176	#N/A	5.2	113	434	1.2	0.38	*< 0.3*	403	0.0022	0.0025	0.010	0.022	*< 0.000007*	*< 0.000007*	0.036	0.0000070	86	0.00022	0.00089
27-Aug-14	4	7	400	340	8.1	882	#N/A	7.3	125	333	0.60	0.41	*< 0.3*	304	0.0037	0.0023	0.0089	0.019	*< 0.000007*	*< 0.000007*	0.040	0.0000060	65	0.00015	0.00053
10-Sep-14	5	9	400	355	8.1	756	#N/A	6.7	126	237	0.20	0.49	*< 0.3*	285	0.0081	0.0020	0.0093	0.022	*< 0.000007*	*< 0.000007*	0.036	0.000018	71	0.00021	0.00037
24-Sep-14	6	11	400	255	8.2	671	#N/A	5.8	163	183	0.20	0.44	*< 0.3*	205	0.0017	0.0022	0.0092	0.026	*< 0.000007*	*< 0.000007*	0.036	0.0000060	43	0.00026	0.00045
8-Oct-14	7	13	300	225	8.1	673	#N/A	5.4	163	170	*< 1*	0.42	*< 0.3*	275	0.0059	0.0020	0.0098	0.027	*< 0.000007*	*< 0.000007*	0.036	*< 0.000003*	71	0.00021	0.00030
22-Oct-14	8	15	400	315	8.2	653	#N/A	7.7	188	142	*< 1*	0.43	*< 0.3*	217	0.0042	0.0021	0.0082	0.030	*< 0.000007*	*< 0.000007*	0.041	0.000052	45	0.00017	0.00027
5-Nov-14	9	17	400	320	-	561	#N/A	#N/A	170	119	*< 1*	0.48	*< 0.3*	166	0.0045	0.0021	0.0084	0.028	*< 0.000007*	*< 0.000007*	0.037	0.0000060	35	0.00024	0.00021
19-Nov-14	10	19	400	290	8.0	521	#N/A	7.1	154	118	*< 0.2*	0.57	*< 0.3*	153	0.0047	0.0022	0.0087	0.028	*< 0.000007*	*< 0.000007*	0.036	0.000047	31	0.00028	0.00018
3-Dec-14	11	21	400	350	8.2	481	#N/A	2.5	151	109	*< 0.2*	0.53	*< 0.3*	146	0.0056	0.0022	0.0073	0.029	*< 0.000007*	*< 0.000007*	0.032	0.000012	32	0.00032	0.00015
17-Dec-14	12	23	400	310	8.2	502	#N/A	3.0	141	99	*< 0.2*	0.66	*< 0.3*	143	0.0073	0.0023	0.0083	0.030	*< 0.000007*	*< 0.000007*	0.035	0.000012	29	0.00026	0.00013
31-Dec-14	13	25	400	300	8.3	475	#N/A	1.0	183	78	*< 1*	0.57	*< 0.3*	135	0.0076	0.0021	0.0069	0.030	*< 0.000007*	*< 0.000007*	0.030	0.000013	29	0.00023	0.00013
14-Jan-15	14	27	400	300	8.2	457	#N/A	2.9	155	81	*< 1*	0.56	*< 0.3*	146	0.0056	0.0022	0.0065	0.033	*< 0.000007*	*< 0.000007*	0.032	0.000017	32	0.00040	0.00011
28-Jan-15	15	29	400	295	8.1	461	#N/A	3.4	149	85	*< 1*	0.55	*< 0.3*	142	0.0069	0.0021	0.0069	0.030	*< 0.000007*	*< 0.000007*	0.026	0.0000070	29	0.00049	0.000089
11-Feb-15	16	31	400	270	8.2	454	#N/A	3.6	136	87	*< 1*	0.61	*< 0.3*	139	0.0070	0.0025	0.0078	0.030	*< 0.000007*	*< 0.000007*	0.032	0.000012	29	0.00045	0.000096
25-Feb-15	17	33	400	270	8.1	420	#N/A	4.2	147	65	*< 1*	0.50	*< 0.3*	144	0.0025	0.0019	0.0051	0.034	*< 0.000007*	*< 0.000007*	0.028	0.0000070	32	0.00047	0.000083
11-Mar-15	18	35	400	305	8.2	412	#N/A	3.1	149	69	*< 1*	0.57	*< 0.3*	150	0.0047	0.0019	0.0055	0.032	*< 0.000007*	*< 0.000007*	0.025	0.0000040	34	0.00050	0.000080
25-Mar-15	19	37	400	280	8.1	437	#N/A	4.8	158	67	*< 1*	0.53	*< 0.3*	177	0.0044	0.0022	0.0066	0.039	*< 0.000007*	*< 0.000007*	0.025	0.0000040	37	0.00062	0.000092
8-Apr-15	20	39	400	370	8.1	417	#N/A	5.7	164	60	*< 1*	0.51	*< 0.3*	167	0.0041	0.0025	0.0063	0.039	*< 0.000007*	*< 0.000007*	0.026	*< 0.000003*	38	0.00040	0.000087
22-Apr-15	21	41	400	260	8.1	380	#N/A	5.0	140	65	*< 1*	0.60	*< 0.3*	156	0.0054	0.0022	0.0061	0.033	*< 0.000007*	*< 0.000007*	0.027	0.000022	33	0.00051	0.000065
6-May-15	22	43	400	325	8.1	375	#N/A	4.3	140	57	*< 1*	0.61	*< 0.3*	157	0.0064	0.0022	0.0063	0.035	*< 0.000007*	*< 0.000007*	0.024	0.0000030	33	0.00044	0.000070
20-May-15	23	45	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	445	340	8.1	348	#N/A	4.4	124	47	*< 1*	0.58	*< 0.3*	146	0.0087	0.0017	0.0054	0.037	*< 0.000007*	*< 0.000007*	0.023	0.0000090	32	0.00054	0.000056
17-Jun-15	25	49	500	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	440	315	8.1	378	#N/A	5.7	124	55	*< 1*	0.55	*< 0.3*	145	0.0064	0.0018	0.0072	0.038	*< 0.000007*	*< 0.000007*	0.021	0.0000090	31	0.00063	0.000064
15-Jul-15	27	53	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	420	325	8.1	346	#N/A	3.6	121	56	*< 1*	0.56	*< 0.3*	146	0.0054	0.0017	0.0057	0.035	*< 0.000007*	*< 0.000007*	0.020	0.0000050	31	0.00061	0.000039
12-Aug-15	29	57	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	450	335	8.2	350	#N/A	2.2	120	60	*< 1*	0.53	*< 0.3*	147	0.0080	0.0017	0.0060	0.038	*< 0.000007*	*< 0.000007*	0.018	0.000010	32	0.00062	0.000055
9-Sep-15	31	61	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	445	395	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	395	305	8.1	378	#N/A	3.3	130	63		0.50		149	0.0073	0.0017	0.0058	0.035	*< 0.000007*	*< 0.000007*	0.015	0.0000040	32	0.00057	0.000037
21-Oct-15	34	67	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	450	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	440	350	8.3	368	#N/A	#N/A	139	64		0.48		158	0.0051	0.0014	0.0054	0.036	*< 0.000007*	*< 0.000007*	0.010	0.0000040	33	0.00061	0.000032
2-Dec-15	37	73	500	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	460	430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	430	425	8.3	365	#N/A	#N/A	112	53	-	0.47	-	151	0.0051	0.0014	0.0049	0.036	*< 0.000007*	*< 0.000007*	0.013	*< 0.000003*	33	0.00059	0.000019
6-Jan-16	40	78	400	330	8.3	366	#N/A	1.1	114	60	-	0.42	-	168	0.0054	0.0016	0.0055	0.042	*< 0.000007*	*< 0.000007*	0.014	0.000056	36	0.00064	0.000025
20-Jan-16	41	80	400	310	8.2	366	#N/A	2.0	109	65	-	0.44	-	169	0.0045	0.0016	0.0064	0.042	*< 0.000007*	*< 0.000007*	0.012	0.000010	36	0.00073	0.000053
3-Feb-16	42	82	400	340	8.2	336	#N/A	2.1	111	52	-	0.44	-	146	0.0042	0.0016	0.0059	0.038	*< 0.000007*	*< 0.000007*	0.011	0.0000030	32	0.00066	0.000035
17-Feb-16	43	84	400	330	8.2	335	#N/A	3.8	119	42	-	0.50	-	155	0.0019	0.0016	0.0057	0.040	*< 0.000007*	*< 0.000007*	0.010	*< 0.000003*	34	0.00079	0.000034
2-Mar-16	44	86	400	360	8.3	318	#N/A	1.3	116	41	-	0.49	-	142	0.0027	0.0017	0.0072	0.038	*< 0.000007*	*< 0.000007*	0.010	0.0000080	30	0.00084	0.000066

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 4 (ST)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1300	315	7.8	0.056	0.017	0.00010	0.037	200	0.14	0.040	0.018	0.054	0.040	37	0.039	5.5	0.000035	187	7.1	632	0.000053	0.00036	0.00060	0.18	0.0045	0.016	< 0.002
30-Jul-14	2	3	400	335	8.0	0.0093	1.0	0.000020	0.020	68	0.084	< 0.01	0.019	0.023	0.012	22	0.011	5.2	< 0.000002	95	3.9	263	0.000038	< 0.00001	0.00051	0.074	0.00051	0.0030	< 0.002
13-Aug-14	3	5	400	340	8.0	0.0054	< 0.002	0.000010	0.019	46	0.046	< 0.01	0.023	0.013	< 0.009	18	0.0052	5.2	< 0.000002	46	3.6	164	0.000024	< 0.00001	0.00023	0.063	0.00013	0.0020	< 0.002
27-Aug-14	4	7	400	340	8.1	0.0032	< 0.002	0.000010	0.015	34	0.028	< 0.01	0.029	0.0067	< 0.009	17	0.0023	5.3	< 0.000002	50	3.3	115	0.000025	0.00021	0.000070	0.054	0.00027	< 0.001	< 0.002
10-Sep-14	5	9	400	355	8.1	0.0030	< 0.007	0.000020	0.014	26	0.017	< 0.01	0.034	0.0037	< 0.003	14	0.0014	6.0	< 0.000002	57	3.9	93	0.000018	0.00016	0.000080	0.048	0.00031	< 0.001	< 0.002
24-Sep-14	6	11	400	255	8.2	0.0029	< 0.002	0.000070	0.014	24	0.018	< 0.01	0.030	0.0039	< 0.009	14	0.00086	5.1	0.000016	47	3.1	60	0.000019	0.000040	0.00041	0.047	0.00029	0.0020	< 0.002
8-Oct-14	7	13	300	225	8.1	0.0025	< 0.007	0.000020	0.017	24	0.016	< 0.01	0.027	0.0032	< 0.003	14	0.00098	5.5	< 0.000002	52	4.3	59	0.000021	0.000040	0.00011	0.051	0.00029	< 0.001	< 0.002
22-Oct-14	8	15	400	315	8.2	0.0021	< 0.007	0.00059	0.015	25	0.018	< 0.01	0.027	0.0029	< 0.003	15	0.00084	6.1	< 0.000002	51	4.2	55	0.000020	0.000020	0.00014	0.055	0.00030	0.0010	< 0.002
5-Nov-14	9	17	400	320	-	0.0019	< 0.007	0.000050	0.013	20	0.011	< 0.01	0.030	0.0023	< 0.003	12	0.00070	5.3	< 0.000002	44	3.5	42	0.000020	0.0098	0.00012	0.047	0.00028	< 0.001	< 0.002
19-Nov-14	10	19	400	290	8.0	0.0018	< 0.007	0.00020	0.014	19	0.0064	< 0.01	0.038	0.0022	0.0050	11	0.00059	5.5	< 0.000002	44	3.5	40	0.000042	0.0018	0.000090	0.048	0.00033	< 0.001	< 0.002
3-Dec-14	11	21	400	350	8.2	0.0025	< 0.007	0.000040	0.011	16	0.0062	< 0.01	0.034	0.0020	< 0.003	11	0.00056	5.0	< 0.000002	39	3.4	36	0.000018	0.00098	0.000060	0.043	0.00034	0.0010	< 0.002
17-Dec-14	12	23	400	310	8.2	0.0019	< 0.007	< 0.00001	0.013	17	0.0019	< 0.01	0.038	0.0018	< 0.003	13	0.00055	5.1	< 0.000002	40	3.6	37	0.000013	0.00058	0.00014	0.046	0.00046	< 0.001	< 0.002
31-Dec-14	13	25	400	300	8.3	0.0014	< 0.007	0.000050	0.011	15	0.0037	< 0.01	0.032	0.0016	< 0.003	11	0.00055	5.2	0.0000020	33	3.4	29	0.000020	0.00048	0.00015	0.039	0.00040	< 0.001	< 0.002
14-Jan-15	14	27	400	300	8.2	0.0014	< 0.007	0.000020	0.011	17	0.0042	< 0.01	0.030	0.0017	< 0.003	11	0.00064	5.4	0.0000030	32	3.6	27	0.000014	0.00040	0.000080	0.040	0.00035	< 0.001	< 0.002
28-Jan-15	15	29	400	295	8.1	0.0013	< 0.007	0.000020	0.0097	17	0.0030	< 0.01	0.031	0.0013	< 0.003	12	0.00060	4.8	0.0000020	32	2.9	27	0.000014	0.00040	0.000080	0.045	0.00037	0.0010	< 0.002
11-Feb-15	16	31	400	270	8.2	0.0020	< 0.007	0.00018	0.011	16	0.0022	< 0.01	0.031	0.0015	< 0.003	12	< 0.001	4.9	0.0000020	27	3.7	30	0.000021	0.00055	0.000070	0.041	0.00039	0.0020	< 0.002
25-Feb-15	17	33	400	270	8.1	0.0016	< 0.007	0.000010	0.011	15	0.0021	< 0.01	0.024	0.0014	< 0.003	12	< 0.001	4.9	< 0.000002	21	3.7	22	0.000012	0.00038	< 0.00005	0.042	0.00031	< 0.001	< 0.002
11-Mar-15	18	35	400	305	8.2	0.0016	< 0.007	0.000040	0.012	16	0.0022	< 0.01	0.024	0.0014	< 0.003	11	< 0.001	4.5	0.0000040	16	3.8	23	< 0.000005	0.0058	0.00010	0.039	0.00032	0.0010	< 0.002
25-Mar-15	19	37	400	280	8.1	0.0016	< 0.007	< 0.00001	0.011	20	0.0029	< 0.01	0.027	0.0019	< 0.003	13	< 0.001	5.9	0.0000020	16	4.5	23	< 0.000005	0.00069	0.000090	0.041	0.00040	< 0.001	< 0.002
8-Apr-15	20	39	400	370	8.1	0.0013	< 0.007	< 0.00001	0.012	18	0.0025	< 0.01	0.020	0.0015	< 0.003	13	< 0.001	5.8	< 0.000002	9.3	4.7	20	< 0.000005	0.00039	< 0.00005	0.041	0.00031	< 0.001	< 0.002
22-Apr-15	21	41	400	260	8.1	0.0016	< 0.007	0.00020	0.011	18	0.0013	< 0.01	0.026	0.0013	< 0.003	13	0.00046	5.3	0.0000070	8.1	4.4	21	0.0000090	0.0047	0.00010	0.041	0.00042	0.0020	< 0.002
6-May-15	22	43	400	325	8.1	0.0017	< 0.007	0.000030	0.011	18	0.0013	< 0.01	0.026	0.0013	< 0.003	14	< 0.001	5.4	0.0000080	6.3	4.3	23	< 0.000005	0.00052	0.000090	0.038	0.00035	0.0010	< 0.002
20-May-15	23	45	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	445	340	8.1	0.00097	0.013	0.00012	0.0099	16	0.00086	< 0.01	0.023	0.0011	< 0.003	12	0.00035	5.1	0.0000080	3.4	4.2	18	< 0.000005	0.00067	0.000060	0.035	0.00038	0.0070	< 0.002
17-Jun-15	25	49	500	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	440	315	8.1	0.0017	< 0.007	< 0.00001	0.0100	17	0.0011	0.010	0.022	0.0011	< 0.003	12	0.00045	5.2	0.0000050	2.5	4.3	18	0.000011	0.00034	0.00017	0.036	0.00041	0.0030	< 0.002
15-Jul-15	27	53	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	420	325	8.1	0.00078	< 0.007	0.000060	0.011	16	0.00050	< 0.01	0.018	0.0010	< 0.003	11	0.00030	4.7	0.0000030	1.9	4.4	19	< 0.000005	0.00014	< 0.00005	0.036	0.00035	0.0010	< 0.002
12-Aug-15	29	57	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	450	335	8.2	0.0015	< 0.007	0.000080	0.0098	16	0.00094	0.010	0.022	0.00090	< 0.003	12	0.00036	5.0	0.000065	1.7	4.4	19	0.000012	0.00017	< 0.00005	0.036	0.00040	0.0010	< 0.002
9-Sep-15	31	61	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	445	395	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	395	305	8.1	0.0013	< 0.007	0.000060	0.0092	17	0.00034	0.030	0.013	0.0010	< 0.003	11	0.00038	4.4	< 0.000002	1.4	4.3	20	0.0000070	0.00085	< 0.00005	0.036	0.00030	0.0010	< 0.002
21-Oct-15	34	67	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	450	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	440	350	8.3	0.0011	< 0.007	0.000030	0.0090	18	0.00040	< 0.01	0.014	0.00080	< 0.003	13	0.00053	4.7	< 0.000002	1.4	4.6	23	0.000020	0.00012	< 0.00005	0.035	0.00030	< 0.001	< 0.002
2-Dec-15	37	73	500	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	460	430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	430	425	8.3	0.0010	< 0.007	0.00033	0.0086	17	0.00021	< 0.01	0.013	0.00080	< 0.003	12	0.00033	4.5	< 0.000002	1.3	3.6	20	< 0.000005	0.00012	< 0.00005	0.036	0.00029	< 0.001	< 0.002
6-Jan-16	40	78	400	330	8.3	0.0020	< 0.007	0.00028	0.0097	19	0.00048	< 0.01	0.012	0.00090	< 0.003	13	0.0018	4.9	< 0.000002	1.5	4.4	23	< 0.000005	0.00037	< 0.00005	0.035	0.00030	< 0.001	< 0.002
20-Jan-16	41	80	400	310	8.2	0.0011	< 0.007	0.00012	0.010	19	0.0018	< 0.01	0.014	0.0010	< 0.003	13	0.00056	5.1	< 0.000002	1.5	5.1	23	0.000027	0.00013	< 0.00005	0.039	0.00034	0.0020	< 0.002
3-Feb-16	42	82	400	340	8.2	0.0012	< 0.007	0.000090	0.0097	16	0.00010	< 0.01	0.015	0.00090	< 0.003	12	0.00052	4.6	0.000015	1.4	4.6	19	0.0000080	0.00012	< 0.00005	0.034	0.00032	< 0.001	< 0.002
17-Feb-16	43	84	400	330	8.2	0.00079	< 0.007	0.000010	0.0091	17	0.00032	< 0.01	0.016	0.00090	< 0.003	13	0.00020	4.8	< 0.000002	1.5	4.3	16	0.000010	0.000050	< 0.00005	0.033	0.00029	< 0.001	< 0.002
2-Mar-16	44	86	400	360	8.3	0.00068	< 0.007	0.000040	0.0094	17	0.0015	< 0.01	0.016	0.00090	< 0.003	12	0.00018	4.8	< 0.000002	1.5	4.3	14	0.000013	0.000090	< 0.00005	0.031	0.00033	0.0020	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 4 (ST)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1300	315	7.8	3419	#N/A	0.30	4.4	54	0.76	0.0085	0.013	54	0.0019	0.00010	0.00067	0.0022	0.00000022	0.00000022	0.0012	0.00000057	11	0.000053	0.00027
30-Jul-14	2	3	400	335	8.0	1594	#N/A	0.073	1.9	12	0.050	0.0057	0.0050	10	0.000095	0.000044	0.00024	0.00035	0.00000012	0.00000012	0.00054	0.000000050	2.3	0.0000049	0.000028
13-Aug-14	3	5	400	340	8.0	1176	#N/A	0.088	1.9	7.4	0.020	0.0065	0.0051	6.9	0.000037	0.000043	0.00018	0.00038	0.00000012	0.00000012	0.00062	0.00000012	1.5	0.0000037	0.000015
27-Aug-14	4	7	400	340	8.1	882	#N/A	0.12	2.1	5.7	0.010	0.0070	0.0051	5.2	0.000063	0.000039	0.00015	0.00032	0.00000012	0.00000012	0.00068	0.00000010	1.1	0.0000026	0.0000090
10-Sep-14	5	9	400	355	8.1	756	#N/A	0.12	2.2	4.2	0.0036	0.0087	0.0053	5.1	0.00014	0.000036	0.00017	0.00039	0.00000012	0.00000012	0.00064	0.00000032	1.3	0.0000037	0.0000066
24-Sep-14	6	11	400	255	8.2	671	#N/A	0.074	2.1	2.3	0.0026	0.0056	0.0038	2.6	0.000022	0.000028	0.00012	0.00033	0.000000089	0.000000089	0.00046	0.000000077	0.55	0.0000033	0.0000057
8-Oct-14	7	13	300	225	8.1	673	#N/A	0.061	1.8	1.9	0.011	0.0047	0.0034	3.1	0.000066	0.000023	0.00011	0.00031	0.000000079	0.000000079	0.00041	0.000000034	0.80	0.0000024	0.0000033
22-Oct-14	8	15	400	315	8.2	653	#N/A	0.12	3.0	2.2	0.016	0.0068	0.0047	3.4	0.000066	0.000033	0.00013	0.00048	0.00000011	0.00000011	0.00064	0.00000082	0.71	0.0000027	0.0000042
5-Nov-14	9	17	400	320		561	#N/A	#N/A	2.7	1.9	0.016	0.0077	0.0048	2.7	0.000072	0.000034	0.00013	0.00044	0.00000011	0.00000011	0.00060	0.000000096	0.55	0.0000038	0.0000034
19-Nov-14	10	19	400	290	8.0	521	#N/A	0.10	2.2	1.7	0.0029	0.0083	0.0044	2.2	0.000068	0.000032	0.00013	0.00040	0.00000010	0.00000010	0.00052	0.00000068	0.45	0.0000041	0.0000026
3-Dec-14	11	21	400	350	8.2	481	#N/A	0.044	2.6	1.9	0.0035	0.0093	0.0053	2.6	0.000098	0.000039	0.00013	0.00050	0.00000012	0.00000012	0.00055	0.00000021	0.55	0.0000056	0.0000026
17-Dec-14	12	23	400	310	8.2	502	#N/A	0.047	2.2	1.5	0.0031	0.010	0.0047	2.2	0.00011	0.000036	0.00013	0.00047	0.00000011	0.00000011	0.00053	0.00000019	0.45	0.0000040	0.0000020
31-Dec-14	13	25	400	300	8.3	475	#N/A	0.015	2.7	1.2	0.015	0.0086	0.0045	2.0	0.00011	0.000032	0.00010	0.00045	0.00000011	0.00000011	0.00045	0.00000020	0.44	0.0000035	0.0000020
14-Jan-15	14	27	400	300	8.2	457	#N/A	0.044	2.3	1.2	0.015	0.0084	0.0045	2.2	0.000084	0.000033	0.000098	0.00049	0.00000011	0.00000011	0.00049	0.00000026	0.47	0.0000060	0.0000017
28-Jan-15	15	29	400	295	8.1	461	#N/A	0.051	2.2	1.3	0.015	0.0081	0.0044	2.1	0.00010	0.000031	0.00010	0.00045	0.00000010	0.00000010	0.00039	0.00000010	0.42	0.0000072	0.0000013
11-Feb-15	16	31	400	270	8.2	454	#N/A	0.049	1.8	1.2	0.014	0.0082	0.0041	1.9	0.000095	0.000034	0.00011	0.00041	0.000000095	0.000000095	0.00043	0.00000016	0.39	0.0000061	0.0000013
25-Feb-15	17	33	400	270	8.1	420	#N/A	0.056	2.0	0.88	0.014	0.0068	0.0041	1.9	0.000034	0.000026	0.000069	0.00046	0.000000095	0.000000095	0.00038	0.000000095	0.43	0.0000063	0.0000011
11-Mar-15	18	35	400	305	8.2	412	#N/A	0.047	2.3	1.1	0.015	0.0087	0.0046	2.3	0.000072	0.000029	0.000084	0.00049	0.00000011	0.00000011	0.00038	0.000000061	0.52	0.0000076	0.0000012
25-Mar-15	19	37	400	280	8.1	437	#N/A	0.067	2.2	0.94	0.014	0.0074	0.0042	2.5	0.000062	0.000031	0.000092	0.00055	0.000000098	0.000000098	0.00034	0.000000056	0.52	0.0000087	0.0000013
8-Apr-15	20	39	400	370	8.1	417	#N/A	0.10	3.0	1.1	0.019	0.0094	0.0056	3.1	0.000076	0.000046	0.00012	0.00071	0.00000013	0.00000013	0.00047	0.000000056	0.70	0.0000074	0.0000016
22-Apr-15	21	41	400	260	8.1	380	#N/A	0.065	1.8	0.85	0.013	0.0078	0.0039	2.0	0.000070	0.000029	0.000079	0.00043	0.000000091	0.000000091	0.00036	0.00000029	0.43	0.0000066	0.00000085
6-May-15	22	43	400	325	8.1	375	#N/A	0.070	2.3	0.93	0.016	0.0099	0.0049	2.6	0.00010	0.000036	0.00010	0.00057	0.00000011	0.00000011	0.00039	0.000000049	0.54	0.0000072	0.0000011
20-May-15	23	45	500	445																					
3-Jun-15	24	47	445	340	8.1	348	#N/A	0.037	1.1	0.40	0.0085	0.0049	0.0026	1.2	0.000074	0.000014	0.000046	0.00032	0.000000060	0.000000060	0.00019	0.000000077	0.28	0.0000046	0.00000048
17-Jun-15	25	49	500	440																					
1-Jul-15	26	51	440	315	8.1	378	#N/A	0.045	0.98	0.43	0.0079	0.0043	0.0024	1.1	0.000050	0.000014	0.000057	0.00030	0.000000055	0.000000055	0.00016	0.000000071	0.24	0.0000050	0.00000050
15-Jul-15	27	53	500	420																					
29-Jul-15	28	55	420	325	8.1	346	#N/A	0.029	0.98	0.46	0.0081	0.0046	0.0024	1.2	0.000044	0.000014	0.000046	0.00029	0.000000057	0.000000057	0.00016	0.000000041	0.26	0.0000050	0.00000032
12-Aug-15	29	57	500	450																					
26-Aug-15	30	59	450	335	8.2	350	#N/A	0.019	1.0	0.50	0.0084	0.0044	0.0025	1.2	0.000067	0.000014	0.000050	0.00032	0.000000059	0.000000059	0.00015	0.000000084	0.27	0.0000052	0.00000046
9-Sep-15	31	61	500	445																					
23-Sep-15	32	63	445	395																					
7-Oct-15	33	65	395	305	8.1	378	#N/A	0.017	0.66	0.32		0.0025		0.76	0.000037	0.0000086	0.000029	0.00018	0.000000036	0.000000036	0.000077	0.000000020	0.16	0.0000029	0.00000019
21-Oct-15	34	67	500	450																					
4-Nov-15	35	69	450	440																					
18-Nov-15	36	71	440	350	8.3	368	#N/A	#N/A	0.81	0.37		0.0028		0.92	0.000030	0.0000082	0.000032	0.00021	0.000000041	0.000000041	0.000060	0.000000023	0.19	0.0000036	0.00000019
2-Dec-15	37	73	500	460																					
16-Dec-15	38	75	460	430																					
30-Dec-15	39	77	430	425	8.3	365	#N/A	#N/A	0.79	0.38		0.0033		1.1	0.000036	0.0000099	0.000035	0.00026	0.000000050	0.000000050	0.000089	0.000000021	0.23	0.0000042	0.00000013
6-Jan-16	40	78	400	330	8.3	366	#N/A	0.018	1.9	0.99		0.0069		2.8	0.000089	0.000026	0.000091	0.00069	0.00000012	0.00000012	0.00023	0.00000092	0.59	0.000011	0.00000041
20-Jan-16	41	80	400	310	8.2	366	#N/A	0.030	1.7	1.0		0.0068		2.6	0.000070	0.000025	0.000099	0.00065	0.00000011	0.00000011	0.00019	0.00000016	0.56	0.000011	0.00000082
3-Feb-16	42	82	400	340	8.2	336	#N/A	0.036	1.9	0.88		0.0075		2.5	0.000071	0.000027	0.00010	0.00065	0.00000012	0.00000012	0.00019	0.000000051	0.54	0.000011	0.00000060
17-Feb-16	43	84	400	330	8.2	335	#N/A	0.063	2.0	0.69		0.0083		2.6	0.000031	0.000026	0.000094	0.00065	0.00000012	0.00000012	0.00017	0.000000050	0.56	0.000013	0.00000056
2-Mar-16	44	86	400	360	8.3	318	#N/A	0.024	2.1	0.74		0.0088		2.6	0.000049	0.000031	0.00013	0.00069	0.00000013	0.00000013	0.00018	0.00000014	0.53	0.000015	0.0000012

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 4 (ST)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1300	315	7.8	0.0017	0.00054	0.0000032	0.0012	6.3	0.0043	0.0013	0.00056	0.0017	0.0013	1.2	0.0012	0.17	0.0000011	5.9	0.22	20	0.0000017	0.000011	0.000019	0.0057	0.00014	0.00050	0.000063
30-Jul-14	2	3	400	335	8.0	0.00016	0.017	0.00000034	0.00034	1.1	0.0014	0.00017	0.00032	0.00039	0.00020	0.37	0.00018	0.088	0.000000034	1.6	0.065	4.4	0.00000064	0.00000017	0.0000085	0.0012	0.0000085	0.000050	0.000034
13-Aug-14	3	5	400	340	8.0	0.000092	0.000034	0.00000017	0.00032	0.78	0.00078	0.00017	0.00038	0.00022	0.00015	0.31	0.000088	0.088	0.000000034	0.78	0.062	2.8	0.00000041	0.00000017	0.0000039	0.0011	0.0000022	0.000034	0.000034
27-Aug-14	4	7	400	340	8.1	0.000055	0.000034	0.00000017	0.00026	0.58	0.00048	0.00017	0.00049	0.00011	0.00015	0.29	0.000038	0.089	0.000000034	0.86	0.055	2.0	0.00000043	0.0000036	0.0000012	0.00092	0.0000046	0.000017	0.000034
10-Sep-14	5	9	400	355	8.1	0.000053	0.00012	0.00000036	0.00024	0.46	0.00031	0.00018	0.00060	0.000066	0.000053	0.24	0.000025	0.11	0.000000036	1.0	0.069	1.7	0.00000032	0.0000028	0.0000014	0.00084	0.0000055	0.000018	0.000036
24-Sep-14	6	11	400	255	8.2	0.000037	0.000026	0.00000089	0.00018	0.30	0.00023	0.00013	0.00038	0.000050	0.00011	0.18	0.000011	0.065	0.00000020	0.60	0.040	0.77	0.00000024	0.00000051	0.0000052	0.00060	0.0000037	0.000026	0.000026
8-Oct-14	7	13	300	225	8.1	0.000028	0.000079	0.00000023	0.00019	0.27	0.00018	0.00011	0.00030	0.000036	0.000034	0.15	0.000011	0.062	0.000000023	0.58	0.048	0.67	0.00000024	0.00000045	0.0000012	0.00057	0.0000033	0.000011	0.000023
22-Oct-14	8	15	400	315	8.2	0.000032	0.00011	0.0000093	0.00023	0.40	0.00028	0.00016	0.00043	0.000046	0.000047	0.23	0.000013	0.096	0.000000032	0.81	0.067	0.86	0.00000032	0.00000032	0.0000022	0.00086	0.0000047	0.000016	0.000032
5-Nov-14	9	17	400	320		0.000031	0.00011	0.00000080	0.00021	0.31	0.00018	0.00016	0.00049	0.000037	0.000048	0.18	0.000011	0.085	0.000000032	0.70	0.056	0.66	0.00000032	0.00016	0.0000019	0.00075	0.0000045	0.000016	0.000032
19-Nov-14	10	19	400	290	8.0	0.000027	0.00010	0.0000029	0.00020	0.27	0.000093	0.00015	0.00055	0.000032	0.000073	0.17	0.0000086	0.079	0.000000029	0.64	0.051	0.58	0.00000061	0.000025	0.0000013	0.00070	0.0000048	0.000015	0.000029
3-Dec-14	11	21	400	350	8.2	0.000043	0.00012	0.00000070	0.00020	0.29	0.00011	0.00018	0.00059	0.000035	0.000053	0.19	0.0000098	0.087	0.000000035	0.68	0.060	0.62	0.00000032	0.000017	0.0000011	0.00075	0.0000060	0.000018	0.000035
17-Dec-14	12	23	400	310	8.2	0.000029	0.00011	0.00000016	0.00020	0.26	0.000030	0.00016	0.00059	0.000028	0.000047	0.19	0.0000085	0.080	0.000000031	0.63	0.056	0.58	0.00000020	0.0000090	0.0000022	0.00071	0.0000071	0.000016	0.000031
31-Dec-14	13	25	400	300	8.3	0.000021	0.00011	0.00000075	0.00016	0.23	0.000056	0.00015	0.00048	0.000024	0.000045	0.16	0.0000083	0.078	0.000000030	0.50	0.051	0.43	0.00000030	0.0000072	0.0000023	0.00059	0.0000060	0.000015	0.000030
14-Jan-15	14	27	400	300	8.2	0.000021	0.00011	0.00000030	0.00017	0.25	0.000063	0.00015	0.00045	0.000026	0.000045	0.17	0.0000096	0.081	0.000000045	0.49	0.054	0.40	0.00000021	0.0000060	0.0000012	0.00061	0.0000053	0.000015	0.000030
28-Jan-15	15	29	400	295	8.1	0.000020	0.00010	0.00000030	0.00014	0.25	0.000044	0.00015	0.00046	0.000019	0.000044	0.17	0.0000089	0.070	0.000000030	0.48	0.042	0.40	0.00000021	0.0000059	0.0000012	0.00066	0.0000055	0.000015	0.000030
11-Feb-15	16	31	400	270	8.2	0.000027	0.000095	0.0000024	0.00015	0.22	0.000029	0.00014	0.00041	0.000020	0.000041	0.16	0.000014	0.066	0.000000027	0.36	0.050	0.40	0.00000028	0.0000074	0.00000095	0.00055	0.0000053	0.000027	0.000027
25-Feb-15	17	33	400	270	8.1	0.000022	0.000095	0.00000014	0.00015	0.21	0.000028	0.00014	0.00032	0.000019	0.000041	0.16	0.000014	0.066	0.000000027	0.28	0.049	0.29	0.00000016	0.0000051	0.00000068	0.00056	0.0000042	0.000014	0.000027
11-Mar-15	18	35	400	305	8.2	0.000025	0.00011	0.00000061	0.00018	0.24	0.000033	0.00015	0.00036	0.000021	0.000046	0.17	0.000015	0.068	0.000000061	0.24	0.058	0.35	0.000000076	0.000089	0.0000015	0.00060	0.0000049	0.000015	0.000031
25-Mar-15	19	37	400	280	8.1	0.000023	0.000098	0.00000014	0.00016	0.29	0.000041	0.00014	0.00038	0.000027	0.000042	0.18	0.000014	0.083	0.000000028	0.22	0.062	0.32	0.000000070	0.0000097	0.0000013	0.00057	0.0000056	0.000014	0.000028
8-Apr-15	20	39	400	370	8.1	0.000025	0.00013	0.00000019	0.00022	0.33	0.000046	0.00019	0.00037	0.000028	0.000056	0.23	0.000019	0.11	0.000000037	0.17	0.088	0.37	0.000000093	0.0000072	0.00000093	0.00075	0.0000057	0.000019	0.000037
22-Apr-15	21	41	400	260	8.1	0.000021	0.000091	0.0000026	0.00015	0.23	0.000016	0.00013	0.00034	0.000017	0.000039	0.17	0.0000060	0.068	0.000000091	0.11	0.057	0.27	0.00000012	0.000061	0.0000013	0.00053	0.0000055	0.000026	0.000026
6-May-15	22	43	400	325	8.1	0.000027	0.00011	0.00000049	0.00018	0.29	0.000021	0.00016	0.00043	0.000021	0.000049	0.22	0.000016	0.088	0.00000013	0.10	0.069	0.37	0.000000081	0.0000085	0.0000015	0.00061	0.0000057	0.000016	0.000033
20-May-15	23	45	500	445																									
3-Jun-15	24	47	445	340	8.1	0.0000082	0.00011	0.0000010	0.000084	0.13	0.0000073	0.000085	0.00019	0.0000094	0.000026	0.11	0.0000030	0.043	0.000000068	0.029	0.036	0.15	0.000000043	0.0000057	0.00000051	0.00030	0.0000032	0.000060	0.000017
17-Jun-15	25	49	500	440																									
1-Jul-15	26	51	440	315	8.1	0.000013	0.000055	0.000000079	0.000078	0.13	0.0000084	0.000079	0.00017	0.0000087	0.000024	0.091	0.0000035	0.041	0.000000039	0.020	0.034	0.14	0.000000087	0.0000027	0.0000013	0.00029	0.0000032	0.000024	0.000016
15-Jul-15	27	53	500	420																									
29-Jul-15	28	55	420	325	8.1	0.0000063	0.000057	0.00000049	0.000088	0.13	0.0000041	0.000081	0.00015	0.0000081	0.000024	0.093	0.0000024	0.038	0.000000024	0.016	0.036	0.16	0.000000041	0.0000011	0.00000041	0.00029	0.0000028	0.0000081	0.000016
12-Aug-15	29	57	500	450																									
26-Aug-15	30	59	450	335	8.2	0.000013	0.000059	0.00000067	0.000082	0.14	0.0000079	0.000084	0.00018	0.0000075	0.000025	0.100	0.0000030	0.042	0.00000054	0.014	0.037	0.16	0.00000010	0.0000014	0.00000042	0.00030	0.0000034	0.0000084	0.000017
9-Sep-15	31	61	500	445																									
23-Sep-15	32	63	445	395																									
7-Oct-15	33	65	395	305	8.1	0.0000065	0.000036	0.00000031	0.000047	0.084	0.0000017	0.00015	0.000067	0.0000051	0.000015	0.057	0.0000019	0.023	0.000000010	0.0069	0.022	0.10	0.000000036	0.0000043	0.00000025	0.00018	0.0000015	0.0000051	0.000010
21-Oct-15	34	67	500	450																									
4-Nov-15	35	69	450	440																									
18-Nov-15	36	71	440	350	8.3	0.0000066	0.000041	0.00000018	0.000053	0.11	0.0000023	0.000058	0.000083	0.0000047	0.000018	0.077	0.0000031	0.027	0.000000012	0.0081	0.027	0.13	0.00000012	0.00000070	0.00000029	0.00020	0.0000018	0.0000058	0.000012
2-Dec-15	37	73	500	460																									
16-Dec-15	38	75	460	430																									
30-Dec-15	39	77	430	425	8.3	0.0000071	0.000050	0.0000023	0.000061	0.12	0.0000015	0.000071	0.000092	0.0000057	0.000021	0.084	0.0000023	0.032	0.000000014	0.0094	0.026	0.14	0.000000035	0.00000085	0.00000035	0.00025	0.0000021	0.0000071	0.000014
6-Jan-16	40	78	400	330	8.3	0.000033	0.00012	0.0000046	0.00016	0.31	0.0000079	0.00017	0.00020	0.000015	0.000050	0.22	0.000030	0.081	0.000000033	0.025	0.073	0.38	0.000000083	0.0000061	0.00000083	0.00057	0.0000050	0.000017	0.000033
20-Jan-16	41	80	400	310	8.2	0.000017	0.00011	0.0000019	0.00016	0.29	0.000028	0.00016	0.00022	0.000016	0.000047	0.21	0.0000087	0.079	0.000000031	0.023	0.079	0.35	0.00000042	0.0000020	0.00000078	0.00060	0.0000053	0.000031	0.000031
3-Feb-16	42	82	400	340	8.2	0.000020	0.00012	0.0000015	0.00017	0.28	0.0000017	0.00017	0.00025	0.000015	0.000051	0.21	0.0000088	0.078	0.00000026	0.023	0.079	0.32	0.00000014	0.0000020	0.00000085	0.00058	0.0000054	0.000017	0.000034
17-Feb-16	43	84	400	330	8.2	0.000013	0.00012	0.00000017	0.00015	0.28	0.0000053	0.00017	0.00026	0.000015	0.000050	0.21	0.0000033	0.079	0.000000033	0.024	0.071	0.26	0.00000017	0.00000083	0.00000083	0.00055	0.0000048	0.000017	0.000033
2-Mar-16	44	86	400	360	8.3	0.000012	0.00013	0.00000072	0.00017	0.30	0.000027	0.00018	0.00029	0.000016	0.000054	0.22	0.0000032	0.087	0.000000036	0.026	0.078	0.26	0.00000023	0.0000016	0.00000090	0.00056	0.0000059	0.000036	0.000036

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 5 (GO)

Date	Cycle	Weeks	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
	No.		Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1500	280	8.2	1228	#N/A	2.7	218	145	58	0.31	0.90	219	0.045	0.0049	0.045	0.073	0.000012	*< 0.000007*	0.059	*< 0.000003*	55	0.0028	0.0040
30-Jul-14	2	3	400	290	8.3	667	#N/A	#N/A	264	68	6.6	0.37	*< 0.3*	89	0.0061	0.0047	0.038	0.016	*< 0.000007*	*< 0.000007*	0.052	*< 0.000003*	22	0.0012	0.00060
13-Aug-14	3	5	400	305	8.3	525	#N/A	#N/A	226	32	1.6	0.42	*< 0.3*	69	0.0046	0.0040	0.032	0.031	*< 0.000007*	*< 0.000007*	0.055	*< 0.000003*	17	0.00058	0.00042
27-Aug-14	4	7	400	305	8.3	465	#N/A	#N/A	219	27	0.70	0.44	*< 0.3*	66	0.0078	0.0036	0.031	0.029	*< 0.000007*	*< 0.000007*	0.061	0.000012	16	0.00060	0.00028
10-Sep-14	5	9	400	265	8.3	445	#N/A	#N/A	213	17	0.40	0.46	*< 0.3*	61	0.0079	0.0034	0.033	0.032	*< 0.000007*	*< 0.000007*	0.052	0.000020	15	0.00057	0.00022
24-Sep-14	6	11	400	240	8.3	455	#N/A	4.1	232	17	0.30	0.39	*< 0.3*	72	0.0024	0.0035	0.025	0.040	*< 0.000007*	*< 0.000007*	0.052	*< 0.000003*	18	0.00064	0.00027
8-Oct-14	7	13	300	225	8.3	477	#N/A	4.1	212	12	*< 1*	0.35	*< 0.3*	84	0.0060	0.0031	0.021	0.048	*< 0.000007*	*< 0.000007*	0.054	0.0000040	21	0.00047	0.00017
22-Oct-14	8	15	400	290	8.3	492	#N/A	5.2	245	13	*< 1*	0.33	*< 0.3*	92	0.0067	0.0030	0.020	0.055	*< 0.000007*	*< 0.000007*	0.061	0.000023	23	0.00046	0.00015
5-Nov-14	9	17	400	275		463	#N/A	#N/A	245	10	*< 1*	0.35	*< 0.3*	89	0.0044	0.0030	0.019	0.056	*< 0.000007*	*< 0.000007*	0.060	0.0000050	22	0.00044	0.00014
19-Nov-14	10	19	400	275	8.3	437	#N/A	#N/A	202	11	*< 0.2*	0.35	*< 0.3*	93	0.0040	0.0029	0.018	0.060	*< 0.000007*	*< 0.000007*	0.057	0.000026	23	0.00041	0.00012
3-Dec-14	11	21	400	345	8.3	401	#N/A	#N/A	210	9.0	*< 0.2*	0.32	*< 0.3*	96	0.0038	0.0029	0.016	0.062	*< 0.000007*	*< 0.000007*	0.049	0.0000090	25	0.00039	0.00011
17-Dec-14	12	23	400	285	8.3	394	#N/A	2.7	193	8.0	*< 0.2*	0.34	*< 0.3*	96	0.0044	0.0028	0.016	0.065	*< 0.000007*	*< 0.000007*	0.046	0.0000030	24	0.00028	0.000099
31-Dec-14	13	25	400	295	8.4	398	#N/A	#N/A	240	5.0	*< 1*	0.31	*< 0.3*	103	0.0062	0.0026	0.015	0.066	*< 0.000007*	*< 0.000007*	0.045	0.000011	26	0.00057	0.000093
14-Jan-15	14	27	400	285	8.2	368	#N/A	2.7	188	8.0	*< 1*	0.31	*< 0.3*	108	0.0082	0.0029	0.014	0.075	*< 0.000007*	*< 0.000007*	0.046	0.000015	27	0.00038	0.000082
28-Jan-15	15	29	400	280	8.2	375	#N/A	3.5	186	8.0	*< 1*	0.29	*< 0.3*	113	0.0060	0.0026	0.013	0.076	*< 0.000007*	*< 0.000007*	0.035	0.0000080	27	0.00035	0.000069
11-Feb-15	16	31	400	275	8.2	374	#N/A	3.5	181	8.0	*< 1*	0.29	*< 0.3*	119	0.0064	0.0029	0.013	0.078	*< 0.000007*	*< 0.000007*	0.047	0.000011	30	0.00032	0.000082
25-Feb-15	17	33	400	255	8.2	348	#N/A	3.7	180	6.0	*< 1*	0.27	*< 0.3*	125	0.0022	0.0027	0.011	0.086	*< 0.000007*	*< 0.000007*	0.041	0.000018	32	0.00030	0.000072
11-Mar-15	18	35	400	265	8.2	352	#N/A	2.6	183	7.0	*< 1*	0.31	*< 0.3*	133	0.0049	0.0026	0.012	0.086	*< 0.000007*	*< 0.000007*	0.038	0.0000050	34	0.00036	0.000069
25-Mar-15	19	37	400	280	8.1	356	#N/A	4.1	183	7.0	*< 1*	0.28	*< 0.3*	152	0.0039	0.0028	0.012	0.096	*< 0.000007*	*< 0.000007*	0.036	0.0000040	38	0.00045	0.000072
8-Apr-15	20	39	400	350	8.1	336	#N/A	5.6	179	5.0	*< 1*	0.29	*< 0.3*	143	0.0062	0.0032	0.011	0.095	*< 0.000007*	*< 0.000007*	0.039	*< 0.000003*	37	0.00038	0.000067
22-Apr-15	21	41	400	270	8.1	288	#N/A	5.9	151	9.0	*< 1*	0.36	*< 0.3*	127	0.0043	0.0031	0.015	0.075	*< 0.000007*	*< 0.000007*	0.038	0.000027	32	0.00044	0.000057
6-May-15	22	43	400	290	8.1	278	#N/A	4.1	148	7.0	*< 1*	0.32	*< 0.3*	123	0.0051	0.0028	0.012	0.077	*< 0.000007*	*< 0.000007*	0.033	0.0000030	31	0.00059	0.000056
20-May-15	23	45	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	445	340	8.1	259	#N/A	4.7	123	7.0	*< 1*	0.40	*< 0.3*	118	0.0068	0.0026	0.015	0.071	*< 0.000007*	*< 0.000007*	0.034	0.0000080	31	0.00043	0.000047
17-Jun-15	25	49	500	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	440	335	8.1	267	#N/A	5.2	122	9.0	*< 1*	0.39	*< 0.3*	107	0.0051	0.0027	0.016	0.071	*< 0.000007*	*< 0.000007*	0.030	0.000010	27	0.00046	0.000054
15-Jul-15	27	53	500	380	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	380	280	8.1	243	#N/A	3.2	118	10	*< 1*	0.41	*< 0.3*	109	0.0069	0.0024	0.014	0.066	*< 0.000007*	0.0000070	0.028	0.000013	28	0.00061	0.000051
12-Aug-15	29	57	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	425	305	8.2	240	#N/A	2.0	117	9.0	*< 1*	0.39	*< 0.3*	110	0.0066	0.0025	0.016	0.070	*< 0.000007*	*< 0.000007*	0.027	0.000015	28	0.00059	0.000050
9-Sep-15	31	61	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	420	345	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	345	305	8.1	260	#N/A	3.0	129	8.0		0.36		109	0.0073	0.0025	0.014	0.066	*< 0.000007*	*< 0.000007*	0.022	0.000022	28	0.00058	0.000037
21-Oct-15	34	67	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	480	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	435	335	8.3	255	#N/A	1.2	142	8.0		0.36		115	0.0038	0.0024	0.016	0.061	*< 0.000007*	*< 0.000007*	0.018	*< 0.000003*	28	0.00062	0.000046
2-Dec-15	37	73	500	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	475	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	425	410	8.3	256	#N/A	#N/A	114	8.0	-	0.33	-	113	0.0058	0.0022	0.012	0.070	*< 0.000007*	*< 0.000007*	0.021	*< 0.000003*	28	0.00062	0.000028
6-Jan-16	40	78	400	340	8.3	244	#N/A	1.0	110	8.0	-	0.33	-	117	0.0044	0.0023	0.014	0.074	*< 0.000007*	*< 0.000007*	0.022	0.0000030	30	0.00063	0.000018
20-Jan-16	41	80	400	280	8.2	239	#N/A	1.9	111	7.0	-	0.35	-	118	0.0049	0.0026	0.016	0.079	*< 0.000007*	*< 0.000007*	0.020	0.0000070	30	0.00068	0.000068
3-Feb-16	42	82	400	325	8.2	228	#N/A	2.3	107	6.0	-	0.36	-	104	0.0058	0.0025	0.016	0.076	*< 0.000007*	*< 0.000007*	0.018	*< 0.000003*	27	0.00058	0.000032
17-Feb-16	43	84	400	300	8.2	234	#N/A	3.5	109	6.0	-	0.37	-	111	0.0040	0.0024	0.017	0.077	*< 0.000007*	*< 0.000007*	0.018	0.0000060	29	0.00070	0.000037
2-Mar-16	44	86	400	330	8.2	231	#N/A	1.4	109	6.0	-	0.37	-	110	0.0021	0.0026	0.019	0.077	*< 0.000007*	*< 0.000007*	0.017	0.000010	28	0.00063	0.000041

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 5 (GO)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
16-Jul-14	1	1	1500	280	8.2	0.029	0.024	0.000040	0.0080	20	0.056	0.19	0.037	0.0095	0.062	12	0.0068	5.8	*< 0.000002*	153	0.27	54	0.000048	0.00033	0.00057	0.17	0.0025	0.0070	*< 0.002*
30-Jul-14	2	3	400	290	8.3	0.0069	1.9	*< 0.00001*	0.0053	8.5	0.018	0.040	0.054	0.0046	0.018	7.8	0.0026	5.9	*< 0.000002*	100	0.12	29	0.000014	*< 0.00001*	0.00051	0.15	0.00027	*< 0.001*	*< 0.002*
13-Aug-14	3	5	400	305	8.3	0.0092	0.0020	0.000020	0.0048	6.4	0.0042	*< 0.01*	0.050	0.0026	0.021	6.6	0.00073	5.7	*< 0.000002*	46	0.092	13	0.000029	0.000050	0.00019	0.14	0.00012	*< 0.001*	*< 0.002*
27-Aug-14	4	7	400	305	8.3	0.0029	*< 0.002*	*< 0.00001*	0.0042	6.1	0.0020	*< 0.01*	0.054	0.0015	0.011	6.8	0.00034	5.9	*< 0.000002*	53	0.089	9.0	0.000026	0.00021	*< 0.00005*	0.13	0.00024	*< 0.001*	*< 0.002*
10-Sep-14	5	9	400	265	8.3	0.0024	*< 0.007*	0.000020	0.0037	5.4	0.00066	*< 0.01*	0.054	0.0010	0.012	6.1	0.00031	6.8	*< 0.000002*	74	0.086	8.1	0.000028	0.00011	0.000060	0.12	0.00025	*< 0.001*	*< 0.002*
24-Sep-14	6	11	400	240	8.3	0.0024	*< 0.002*	0.000020	0.0044	6.6	0.0013	0.010	0.043	0.0012	*< 0.009*	7.1	*< 0.00004*	5.9	0.0000090	52	0.099	5.9	0.000029	0.000080	0.00011	0.11	0.00019	0.0020	*< 0.002*
8-Oct-14	7	13	300	225	8.3	0.0018	*< 0.007*	*< 0.00001*	0.0056	7.6	0.00070	*< 0.01*	0.035	0.0011	*< 0.003*	7.0	0.00016	6.3	*< 0.000002*	73	0.12	5.2	0.000032	0.000020	0.00012	0.12	0.00018	*< 0.001*	*< 0.002*
22-Oct-14	8	15	400	290	8.3	0.0019	*< 0.007*	0.000020	0.0049	8.5	0.00089	*< 0.01*	0.032	0.00080	*< 0.003*	7.9	0.00024	7.1	*< 0.000002*	73	0.13	5.6	0.000036	0.000020	0.00018	0.13	0.00020	*< 0.001*	*< 0.002*
5-Nov-14	9	17	400	275		0.0017	*< 0.007*	0.000040	0.0049	8.4	0.0012	*< 0.01*	0.028	0.00070	*< 0.003*	6.7	0.00019	6.4	*< 0.000002*	68	0.14	4.1	0.000035	0.00013	0.00012	0.12	0.00017	*< 0.001*	*< 0.002*
19-Nov-14	10	19	400	275	8.3	0.0018	*< 0.007*	0.00022	0.0055	8.9	0.00020	*< 0.01*	0.027	0.00060	0.014	6.9	0.00013	6.9	*< 0.000002*	65	0.16	4.0	0.000042	0.000040	0.00021	0.12	0.00017	*< 0.001*	*< 0.002*
3-Dec-14	11	21	400	345	8.3	0.0015	*< 0.007*	0.000020	0.0046	8.5	0.00059	*< 0.01*	0.025	0.00060	0.0030	6.8	0.00014	6.1	*< 0.000002*	53	0.16	3.9	0.000035	0.000030	0.000090	0.11	0.00016	*< 0.001*	*< 0.002*
17-Dec-14	12	23	400	285	8.3	0.0014	*< 0.007*	*< 0.00001*	0.0046	9.0	0.00021	*< 0.01*	0.024	0.00060	0.0030	7.6	0.00020	6.0	*< 0.000002*	48	0.15	3.7	0.000031	0.000010	0.00010	0.11	0.00018	*< 0.001*	*< 0.002*
31-Dec-14	13	25	400	295	8.4	0.0011	*< 0.007*	0.00031	0.0045	9.1	0.00099	*< 0.01*	0.023	0.00050	0.0060	7.1	0.00014	6.7	*< 0.000002*	42	0.17	3.4	0.000034	0.000050	0.000070	0.098	0.00019	*< 0.001*	*< 0.002*
14-Jan-15	14	27	400	285	8.2	0.0019	*< 0.007*	0.000020	0.0045	9.9	0.00051	*< 0.01*	0.024	0.00050	0.0030	7.4	0.00016	6.6	0.0000020	36	0.17	3.0	0.000035	0.000060	0.00014	0.10	0.00016	0.0010	*< 0.002*
28-Jan-15	15	29	400	280	8.2	0.00090	*< 0.007*	0.000060	0.0039	11	0.0010	*< 0.01*	0.021	0.00040	0.0040	7.6	0.00025	5.7	*< 0.000002*	33	0.15	3.3	0.000031	0.000040	0.00012	0.10	0.00018	0.0020	*< 0.002*
11-Feb-15	16	31	400	275	8.2	0.0016	*< 0.007*	0.00015	0.0045	11	0.00065	*< 0.01*	0.019	0.00050	0.0040	7.5	*< 0.001*	6.2	*< 0.000002*	25	0.20	3.0	0.000035	0.00015	0.00015	0.099	0.00021	*< 0.001*	*< 0.002*
25-Feb-15	17	33	400	255	8.2	0.0012	*< 0.007*	0.00015	0.0046	11	0.0012	*< 0.01*	0.017	0.00040	0.0050	8.4	*< 0.001*	6.0	*< 0.000002*	20	0.20	2.6	0.000041	0.00010	0.000090	0.11	0.00014	0.0030	*< 0.002*
11-Mar-15	18	35	400	265	8.2	0.0011	*< 0.007*	*< 0.00001*	0.0046	12	0.00051	*< 0.01*	0.018	0.00050	*< 0.003*	8.0	*< 0.001*	5.3	*< 0.000002*	16	0.21	2.8	0.000025	0.000050	0.000080	0.100	0.00017	*< 0.001*	*< 0.002*
25-Mar-15	19	37	400	280	8.1	0.0025	*< 0.007*	0.000040	0.0045	14	0.00089	*< 0.01*	0.020	0.00050	*< 0.003*	9.0	*< 0.001*	7.3	*< 0.000002*	14	0.23	3.0	0.000038	0.00044	0.00012	0.096	0.00019	*< 0.001*	*< 0.002*
8-Apr-15	20	39	400	350	8.1	0.0011	*< 0.007*	*< 0.00001*	0.0046	12	0.00094	*< 0.01*	0.017	0.00040	*< 0.003*	8.3	*< 0.001*	7.2	*< 0.000002*	8.8	0.22	2.5	0.000026	0.00011	0.000060	0.095	0.00016	0.0010	*< 0.002*
22-Apr-15	21	41	400	270	8.1	0.0080	*< 0.007*	0.00036	0.0039	11	0.00027	*< 0.01*	0.024	0.00040	*< 0.003*	8.5	0.000090	6.3	0.0000050	7.5	0.18	3.2	0.000030	0.0067	*< 0.00005*	0.099	0.00017	0.0060	*< 0.002*
6-May-15	22	43	400	290	8.1	0.0012	*< 0.007*	*< 0.00001*	0.0038	11	0.00061	*< 0.01*	0.021	0.00040	*< 0.003*	8.2	*< 0.001*	6.1	0.0000040	5.5	0.18	2.9	0.000026	0.00019	0.00012	0.081	0.00021	0.0010	*< 0.002*
20-May-15	23	45	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	24	47	445	340	8.1	0.0022	*< 0.007*	0.000050	0.0032	10	0.00043	*< 0.01*	0.026	0.00030	*< 0.003*	7.9	0.000060	6.2	0.0000070	3.7	0.17	3.3	0.000015	0.0037	0.00011	0.085	0.00016	*< 0.001*	*< 0.002*
17-Jun-15	25	49	500	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	26	51	440	335	8.1	0.00085	*< 0.007*	*< 0.00001*	0.0030	9.5	0.00094	0.010	0.026	0.00030	0.0040	6.9	0.000070	6.0	0.0000020	2.7	0.17	3.1	0.000028	0.0016	0.00010	0.084	0.00016	*< 0.001*	*< 0.002*
15-Jul-15	27	53	500	380	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	28	55	380	280	8.1	0.00092	*< 0.007*	0.000050	0.0030	9.6	0.00025	0.020	0.027	0.00030	*< 0.003*	6.9	*< 0.00004*	5.6	0.0000040	2.3	0.18	3.4	0.000020	0.0011	0.000080	0.089	0.00020	*< 0.001*	*< 0.002*
12-Aug-15	29	57	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	30	59	425	305	8.2	0.0011	*< 0.007*	0.00016	0.0027	9.6	0.00062	0.010	0.029	0.00020	*< 0.003*	7.0	0.000070	6.0	0.000040	2.3	0.17	3.6	0.000027	0.0012	*< 0.00005*	0.083	0.00016	*< 0.001*	*< 0.002*
9-Sep-15	31	61	500	420	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	32	63	420	345	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	33	65	345	305	8.1	0.0011	*< 0.007*	0.000020	0.0024	9.8	0.00027	0.020	0.021	0.00020	*< 0.003*	6.7	0.000050	5.1	*< 0.000002*	1.9	0.16	3.1	0.000022	0.00069	0.000060	0.084	0.00020	*< 0.001*	*< 0.002*
21-Oct-15	34	67	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	35	69	480	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	36	71	435	335	8.3	0.00072	*< 0.007*	0.00012	0.0023	11	0.00020	*< 0.01*	0.023	*< 0.0001*	*< 0.003*	7.5	0.00017	5.6	*< 0.000002*	1.9	0.16	3.2	0.000022	0.00047	*< 0.00005*	0.074	0.00014	*< 0.001*	*< 0.002*
2-Dec-15	37	73	500	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	38	75	475	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	39	77	425	410	8.3	0.0011	*< 0.007*	0.00035	0.0023	10	0.00019	*< 0.01*	0.022	0.00020	*< 0.003*	7.3	0.000070	5.4	*< 0.000002*	1.7	0.14	3.0	*< 0.000005*	0.00045	*< 0.00005*	0.082	0.00016	*< 0.001*	*< 0.002*
6-Jan-16	40	78	400	340	8.3	0.0012	*< 0.007*	0.000020	0.0023	10	0.00017	*< 0.01*	0.019	0.00020	0.0060	8.0	0.00025	5.8	0.0000020	1.9	0.15	2.9	*< 0.000005*	0.00051	*< 0.00005*	0.076	0.00014	*< 0.001*	*< 0.002*
20-Jan-16	41	80	400	280	8.2	0.00091	*< 0.007*	0.000040	0.0025	10	0.0021	*< 0.01*	0.023	0.00030	0.0050	7.6	0.000080	6.1	0.0000020	1.8	0.17	3.1	0.000042	0.00040	*< 0.00005*	0.090	0.00017	*< 0.001*	*< 0.002*
3-Feb-16	42	82	400	325	8.2	0.0011	*< 0.007*	0.000030	0.0024	9.2	*< 0.00001*	*< 0.01*	0.022	0.00020	*< 0.003*	7.4	0.00015	5.5	0.000013	1.7	0.16	2.7	0.000026	0.00031	*< 0.00005*	0.081	0.00016	*< 0.001*	*< 0.002*
17-Feb-16	43	84	400	300	8.2	0.00090	*< 0.007*	*< 0.00001*	0.0022	9.7	0.00014	*< 0.01*	0.024	0.00020	0.0060	7.5	*< 0.00004*	5.5	*< 0.000002*	1.8	0.15	2.4	0.000028	0.00030	*< 0.00005*	0.082	0.00016	*< 0.001*	*< 0.002*
2-Mar-16	44	86	400	330	8.2	0.00052	*< 0.007*	0.000030	0.0023	10	0.00050	*< 0.01*	0.024	0.00020	*< 0.003*	7.6	*< 0.00004*	5.7	*< 0.000002*	1.8	0.16	2.9	0.000026	0.00026	*< 0.00005*	0.082	0.00015	*< 0.001*	*< 0.002*

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 5 (GO)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1500	280	8.2	1228	#N/A	0.074	6.1	4.1	1.6	0.0087	0.025	6.1	0.0013	0.00014	0.0013	0.0020	0.00000034	0.00000020	0.0016	0.000000084	1.5	0.000078	0.00011
30-Jul-14	2	3	400	290	8.3	667	#N/A	#N/A	3.8	0.99	0.096	0.0054	0.0044	1.3	0.000088	0.000068	0.00055	0.00023	0.00000010	0.00000010	0.00076	0.000000044	0.32	0.000017	0.0000087
13-Aug-14	3	5	400	305	8.3	525	#N/A	#N/A	3.4	0.49	0.024	0.0064	0.0046	1.0	0.000070	0.000061	0.00049	0.00048	0.00000011	0.00000011	0.00084	0.000000046	0.26	0.0000088	0.0000064
27-Aug-14	4	7	400	305	8.3	465	#N/A	#N/A	3.3	0.41	0.011	0.0067	0.0046	1.0	0.00012	0.000055	0.00047	0.00044	0.00000011	0.00000011	0.00094	0.00000018	0.25	0.0000092	0.0000043
10-Sep-14	5	9	400	265	8.3	445	#N/A	#N/A	2.8	0.23	0.0053	0.0061	0.0040	0.80	0.00010	0.000045	0.00044	0.00043	0.000000093	0.000000093	0.00068	0.00000027	0.20	0.0000076	0.0000030
24-Sep-14	6	11	400	240	8.3	455	#N/A	0.049	2.8	0.20	0.0036	0.0047	0.0036	0.86	0.000029	0.000042	0.00030	0.00048	0.000000084	0.000000084	0.00063	0.000000036	0.22	0.0000077	0.0000032
8-Oct-14	7	13	300	225	8.3	477	#N/A	0.046	2.4	0.14	0.011	0.0039	0.0034	0.95	0.000068	0.000035	0.00024	0.00054	0.000000079	0.000000079	0.00060	0.000000045	0.24	0.0000053	0.0000019
22-Oct-14	8	15	400	290	8.3	492	#N/A	0.075	3.6	0.19	0.015	0.0048	0.0044	1.3	0.000097	0.000044	0.00029	0.00079	0.00000010	0.00000010	0.00088	0.00000033	0.33	0.0000066	0.0000021
5-Nov-14	9	17	400	275		463	#N/A	#N/A	3.4	0.14	0.014	0.0048	0.0041	1.2	0.000061	0.000041	0.00026	0.00077	0.000000096	0.000000096	0.00082	0.000000069	0.30	0.0000061	0.0000019
19-Nov-14	10	19	400	275	8.3	437	#N/A	#N/A	2.8	0.15	0.0028	0.0048	0.0041	1.3	0.000055	0.000040	0.00024	0.00083	0.000000096	0.000000096	0.00079	0.00000036	0.31	0.0000056	0.0000016
3-Dec-14	11	21	400	345	8.3	401	#N/A	#N/A	3.6	0.16	0.0035	0.0055	0.0052	1.7	0.000066	0.000050	0.00028	0.0011	0.00000012	0.00000012	0.00084	0.00000016	0.42	0.0000067	0.0000018
17-Dec-14	12	23	400	285	8.3	394	#N/A	0.038	2.8	0.11	0.0029	0.0048	0.0043	1.4	0.000063	0.000040	0.00023	0.00093	0.000000100	0.000000100	0.00065	0.000000043	0.34	0.0000040	0.0000014
31-Dec-14	13	25	400	295	8.4	398	#N/A	#N/A	3.5	0.074	0.015	0.0046	0.0044	1.5	0.000091	0.000038	0.00022	0.00097	0.00000010	0.00000010	0.00066	0.00000016	0.38	0.0000084	0.0000014
14-Jan-15	14	27	400	285	8.2	368	#N/A	0.038	2.7	0.11	0.014	0.0044	0.0043	1.5	0.00012	0.000041	0.00020	0.0011	0.000000100	0.000000100	0.00066	0.00000021	0.38	0.0000054	0.0000012
28-Jan-15	15	29	400	280	8.2	375	#N/A	0.049	2.6	0.11	0.014	0.0041	0.0042	1.6	0.000084	0.000036	0.00018	0.0011	0.000000098	0.000000098	0.00049	0.00000011	0.38	0.0000049	0.00000097
11-Feb-15	16	31	400	275	8.2	374	#N/A	0.048	2.5	0.11	0.014	0.0040	0.0041	1.6	0.000088	0.000040	0.00018	0.0011	0.000000096	0.000000096	0.00064	0.00000015	0.41	0.0000044	0.0000011
25-Feb-15	17	33	400	255	8.2	348	#N/A	0.047	2.3	0.077	0.013	0.0034	0.0038	1.6	0.000028	0.000034	0.00014	0.0011	0.000000089	0.000000089	0.00052	0.00000023	0.40	0.0000038	0.00000092
11-Mar-15	18	35	400	265	8.2	352	#N/A	0.034	2.4	0.093	0.013	0.0041	0.0040	1.8	0.000065	0.000034	0.00015	0.0011	0.000000093	0.000000093	0.00050	0.000000066	0.44	0.0000048	0.00000091
25-Mar-15	19	37	400	280	8.1	356	#N/A	0.057	2.6	0.098	0.014	0.0039	0.0042	2.1	0.000055	0.000039	0.00017	0.0013	0.000000098	0.000000098	0.00050	0.000000056	0.53	0.0000063	0.0000010
8-Apr-15	20	39	400	350	8.1	336	#N/A	0.098	3.1	0.088	0.018	0.0051	0.0053	2.5	0.00011	0.000056	0.00020	0.0017	0.00000012	0.00000012	0.00069	0.000000053	0.65	0.0000067	0.0000012
22-Apr-15	21	41	400	270	8.1	288	#N/A	0.079	2.0	0.12	0.014	0.0049	0.0041	1.7	0.000058	0.000042	0.00021	0.0010	0.000000095	0.000000095	0.00052	0.00000036	0.43	0.0000059	0.00000077
6-May-15	22	43	400	290	8.1	278	#N/A	0.060	2.1	0.10	0.015	0.0046	0.0044	1.8	0.000074	0.000041	0.00017	0.0011	0.00000010	0.00000010	0.00047	0.000000044	0.45	0.0000086	0.00000081
20-May-15	23	45	500	455																					
3-Jun-15	24	47	445	340	8.1	259	#N/A	0.040	1.0	0.060	0.0085	0.0034	0.0026	1.0	0.000058	0.000022	0.00013	0.00061	0.000000060	0.000000060	0.00029	0.000000068	0.26	0.0000037	0.00000040
17-Jun-15	25	49	500	440																					
1-Jul-15	26	51	440	335	8.1	267	#N/A	0.043	1.0	0.075	0.0084	0.0033	0.0025	0.90	0.000043	0.000023	0.00014	0.00060	0.000000059	0.000000059	0.00025	0.000000084	0.23	0.0000039	0.00000045
15-Jul-15	27	53	500	380																					
29-Jul-15	28	55	380	280	8.1	243	#N/A	0.022	0.83	0.070	0.0070	0.0029	0.0021	0.76	0.000048	0.000017	0.000099	0.00046	0.000000049	0.000000049	0.00019	0.000000091	0.19	0.0000043	0.00000036
12-Aug-15	29	57	500	425																					
26-Aug-15	30	59	425	305	8.2	240	#N/A	0.015	0.89	0.069	0.0076	0.0030	0.0023	0.84	0.000050	0.000019	0.00012	0.00054	0.000000053	0.000000053	0.00020	0.00000011	0.22	0.0000045	0.00000038
9-Sep-15	31	61	500	420																					
23-Sep-15	32	63	420	345																					
7-Oct-15	33	65	345	305	8.1	260	#N/A	0.015	0.66	0.041		0.0018		0.55	0.000037	0.000013	0.000073	0.00034	0.000000036	0.000000036	0.00011	0.00000011	0.14	0.0000029	0.00000019
21-Oct-15	34	67	500	480																					
4-Nov-15	35	69	480	435																					
18-Nov-15	36	71	435	335	8.3	255	#N/A	0.0064	0.79	0.045		0.0020		0.64	0.000021	0.000013	0.000087	0.00034	0.000000039	0.000000039	0.00010	0.000000017	0.16	0.0000035	0.00000026
2-Dec-15	37	73	500	475																					
16-Dec-15	38	75	475	425																					
30-Dec-15	39	77	425	410	8.3	256	#N/A	#N/A	0.78	0.055		0.0023		0.77	0.000040	0.000015	0.000084	0.00048	0.000000048	0.000000048	0.00014	0.000000021	0.19	0.0000042	0.00000019
6-Jan-16	40	78	400	340	8.3	244	#N/A	0.017	1.9	0.14		0.0056		2.0	0.000075	0.000039	0.00024	0.0013	0.00000012	0.00000012	0.00037	0.000000051	0.50	0.000011	0.00000031
20-Jan-16	41	80	400	280	8.2	239	#N/A	0.026	1.6	0.098		0.0049		1.7	0.000069	0.000036	0.00022	0.0011	0.000000098	0.000000098	0.00028	0.000000098	0.42	0.0000095	0.00000095
3-Feb-16	42	82	400	325	8.2	228	#N/A	0.037	1.7	0.098		0.0059		1.7	0.000094	0.000041	0.00026	0.0012	0.00000011	0.00000011	0.00029	0.000000049	0.43	0.0000094	0.00000052
17-Feb-16	43	84	400	300	8.2	234	#N/A	0.052	1.6	0.090		0.0056		1.7	0.000060	0.000036	0.00025	0.0012	0.00000011	0.00000011	0.00027	0.000000090	0.43	0.000011	0.00000056
2-Mar-16	44	86	400	330	8.2	231	#N/A	0.023	1.8	0.099		0.0061		1.8	0.000035	0.000043	0.00031	0.0013	0.00000012	0.00000012	0.00028	0.00000017	0.45	0.000010	0.00000068

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 5 (GO)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
16-Jul-14	1	1	1500	280	8.2	0.00081	0.00067	0.0000011	0.00023	0.55	0.0016	0.0053	0.0010	0.00027	0.0017	0.33	0.00019	0.16	0.000000056	4.3	0.0077	1.5	0.0000013	0.0000092	0.000016	0.0047	0.000069	0.00020	0.000056
30-Jul-14	2	3	400	290	8.3	0.00010	0.027	0.00000015	0.000077	0.12	0.00027	0.00058	0.00078	0.000067	0.00026	0.11	0.000038	0.086	0.000000029	1.5	0.0017	0.42	0.00000020	0.00000015	0.0000074	0.0022	0.0000039	0.000015	0.000029
13-Aug-14	3	5	400	305	8.3	0.00014	0.000031	0.00000031	0.000073	0.097	0.000064	0.00015	0.00075	0.000040	0.00032	0.10	0.000011	0.086	0.000000031	0.70	0.0014	0.19	0.00000044	0.00000076	0.0000029	0.0021	0.0000018	0.000015	0.000031
27-Aug-14	4	7	400	305	8.3	0.000043	0.000031	0.00000015	0.000064	0.093	0.000031	0.00015	0.00082	0.000023	0.00017	0.10	0.0000052	0.090	0.000000031	0.81	0.0014	0.14	0.00000040	0.0000032	0.00000076	0.0019	0.0000037	0.000015	0.000031
10-Sep-14	5	9	400	265	8.3	0.000032	0.000093	0.00000027	0.000049	0.072	0.0000087	0.00013	0.00072	0.000013	0.00016	0.081	0.0000041	0.090	0.000000027	0.98	0.0011	0.11	0.00000037	0.0000015	0.00000080	0.0016	0.0000033	0.000013	0.000027
24-Sep-14	6	11	400	240	8.3	0.000029	0.000024	0.00000024	0.000053	0.079	0.000016	0.00012	0.00051	0.000014	0.00011	0.085	0.00000048	0.070	0.00000011	0.63	0.0012	0.070	0.00000035	0.00000096	0.0000013	0.0013	0.0000023	0.000024	0.000024
8-Oct-14	7	13	300	225	8.3	0.000021	0.000079	0.00000011	0.000063	0.085	0.0000079	0.00011	0.00039	0.000012	0.000034	0.079	0.0000018	0.071	0.000000023	0.82	0.0014	0.059	0.00000036	0.00000023	0.0000014	0.0014	0.0000020	0.000011	0.000023
22-Oct-14	8	15	400	290	8.3	0.000028	0.00010	0.00000029	0.000072	0.12	0.000013	0.00015	0.00046	0.000012	0.000044	0.11	0.0000035	0.10	0.000000029	1.1	0.0018	0.081	0.00000052	0.00000029	0.0000026	0.0019	0.0000029	0.000015	0.000029
5-Nov-14	9	17	400	275		0.000023	0.000096	0.00000055	0.000068	0.12	0.000017	0.00014	0.00039	0.0000096	0.000041	0.092	0.0000026	0.088	0.000000028	0.93	0.0020	0.056	0.00000048	0.0000018	0.0000017	0.0017	0.0000023	0.000014	0.000028
19-Nov-14	10	19	400	275	8.3	0.000024	0.000096	0.0000030	0.000075	0.12	0.0000028	0.00014	0.00037	0.0000083	0.00019	0.095	0.0000018	0.094	0.000000028	0.89	0.0021	0.055	0.00000058	0.00000055	0.0000029	0.0017	0.0000023	0.000014	0.000028
3-Dec-14	11	21	400	345	8.3	0.000026	0.00012	0.00000035	0.000079	0.15	0.000010	0.00017	0.00042	0.000010	0.000052	0.12	0.0000024	0.11	0.000000035	0.92	0.0027	0.067	0.00000060	0.00000052	0.0000016	0.0020	0.0000028	0.000017	0.000035
17-Dec-14	12	23	400	285	8.3	0.000020	0.000100	0.00000014	0.000066	0.13	0.0000030	0.00014	0.00034	0.0000086	0.000043	0.11	0.0000029	0.086	0.000000029	0.68	0.0021	0.053	0.00000044	0.00000014	0.0000014	0.0015	0.0000026	0.000014	0.000029
31-Dec-14	13	25	400	295	8.4	0.000016	0.00010	0.0000046	0.000066	0.13	0.000015	0.00015	0.00033	0.0000074	0.000089	0.11	0.0000021	0.099	0.000000030	0.61	0.0024	0.050	0.00000050	0.00000074	0.0000010	0.0015	0.0000028	0.000015	0.000030
14-Jan-15	14	27	400	285	8.2	0.000028	0.000100	0.00000029	0.000065	0.14	0.0000073	0.00014	0.00034	0.0000071	0.000043	0.10	0.0000023	0.094	0.000000029	0.52	0.0025	0.043	0.00000050	0.00000086	0.0000020	0.0014	0.0000023	0.000014	0.000029
28-Jan-15	15	29	400	280	8.2	0.000013	0.000098	0.00000084	0.000055	0.15	0.000014	0.00014	0.00030	0.0000056	0.000056	0.11	0.0000035	0.080	0.000000028	0.46	0.0021	0.046	0.00000043	0.00000056	0.0000017	0.0014	0.0000025	0.000028	0.000028
11-Feb-15	16	31	400	275	8.2	0.000021	0.000096	0.0000021	0.000062	0.15	0.0000089	0.00014	0.00026	0.0000069	0.000055	0.10	0.000014	0.085	0.000000028	0.35	0.0027	0.041	0.00000048	0.0000021	0.0000021	0.0014	0.0000029	0.000014	0.000028
25-Feb-15	17	33	400	255	8.2	0.000015	0.000089	0.0000019	0.000058	0.14	0.000015	0.00013	0.00022	0.0000051	0.000064	0.11	0.000013	0.077	0.000000026	0.26	0.0026	0.033	0.00000052	0.0000013	0.0000011	0.0014	0.0000018	0.000038	0.000026
11-Mar-15	18	35	400	265	8.2	0.000015	0.000093	0.00000013	0.000061	0.16	0.0000068	0.00013	0.00024	0.0000066	0.000040	0.11	0.000013	0.070	0.000000027	0.21	0.0028	0.037	0.00000033	0.00000066	0.0000011	0.0013	0.0000023	0.000013	0.000027
25-Mar-15	19	37	400	280	8.1	0.000036	0.000098	0.00000056	0.000063	0.19	0.000012	0.00014	0.00028	0.0000070	0.000042	0.13	0.000014	0.10	0.000000028	0.20	0.0032	0.042	0.00000053	0.0000062	0.0000017	0.0013	0.0000027	0.000014	0.000028
8-Apr-15	20	39	400	350	8.1	0.000020	0.00012	0.00000018	0.000080	0.21	0.000016	0.00018	0.00029	0.0000070	0.000053	0.15	0.000018	0.13	0.000000035	0.15	0.0038	0.044	0.00000046	0.0000019	0.0000011	0.0017	0.0000028	0.000018	0.000035
22-Apr-15	21	41	400	270	8.1	0.00011	0.000095	0.0000049	0.000052	0.15	0.0000036	0.00014	0.00032	0.0000054	0.000041	0.11	0.0000012	0.084	0.000000068	0.10	0.0025	0.043	0.00000041	0.000090	0.00000068	0.0013	0.0000023	0.000081	0.000027
6-May-15	22	43	400	290	8.1	0.000017	0.00010	0.00000015	0.000055	0.16	0.0000088	0.00015	0.00030	0.0000058	0.000044	0.12	0.000015	0.088	0.000000058	0.079	0.0026	0.042	0.00000038	0.0000028	0.0000017	0.0012	0.0000030	0.000015	0.000029
20-May-15	23	45	500	455																									
3-Jun-15	24	47	445	340	8.1	0.000019	0.000060	0.00000043	0.000027	0.086	0.0000037	0.000085	0.00022	0.0000026	0.000026	0.067	0.00000051	0.053	0.000000060	0.032	0.0015	0.028	0.00000013	0.000031	0.00000094	0.00072	0.0000014	0.0000085	0.000017
17-Jun-15	25	49	500	440																									
1-Jul-15	26	51	440	335	8.1	0.0000071	0.000059	0.000000084	0.000025	0.079	0.0000079	0.000084	0.00022	0.0000025	0.000034	0.057	0.00000059	0.050	0.000000017	0.022	0.0014	0.026	0.00000023	0.000013	0.00000084	0.00070	0.0000013	0.0000084	0.000017
15-Jul-15	27	53	500	380																									
29-Jul-15	28	55	380	280	8.1	0.0000064	0.000049	0.00000035	0.000021	0.067	0.0000018	0.00014	0.00019	0.0000021	0.000021	0.048	0.00000028	0.039	0.000000028	0.016	0.0012	0.024	0.00000014	0.0000078	0.00000056	0.00063	0.0000014	0.0000070	0.000014
12-Aug-15	29	57	500	425																									
26-Aug-15	30	59	425	305	8.2	0.0000086	0.000053	0.0000012	0.000021	0.073	0.0000047	0.000076	0.00022	0.0000015	0.000023	0.053	0.00000053	0.046	0.00000031	0.017	0.0013	0.027	0.00000021	0.0000093	0.00000038	0.00063	0.0000012	0.0000076	0.000015
9-Sep-15	31	61	500	420																									
23-Sep-15	32	63	420	345																									
7-Oct-15	33	65	345	305	8.1	0.0000056	0.000036	0.00000010	0.000012	0.050	0.0000014	0.00010	0.00011	0.0000010	0.000015	0.034	0.00000025	0.026	0.000000010	0.0096	0.00080	0.016	0.00000011	0.0000035	0.00000031	0.00043	0.0000010	0.0000051	0.000010
21-Oct-15	34	67	500	480																									
4-Nov-15	35	69	480	435																									
18-Nov-15	36	71	435	335	8.3	0.0000040	0.000039	0.00000067	0.000013	0.060	0.0000011	0.000056	0.00013	0.00000056	0.000017	0.042	0.00000095	0.031	0.000000011	0.011	0.00091	0.018	0.00000012	0.0000026	0.00000028	0.00042	0.00000078	0.0000056	0.000011
2-Dec-15	37	73	500	475																									
16-Dec-15	38	75	475	425																									
30-Dec-15	39	77	425	410	8.3	0.0000077	0.000048	0.0000024	0.000015	0.069	0.0000013	0.000068	0.00015	0.0000014	0.000021	0.050	0.00000048	0.037	0.000000014	0.012	0.00092	0.021	0.000000034	0.0000031	0.00000034	0.00056	0.0000011	0.0000068	0.000014
6-Jan-16	40	78	400	340	8.3	0.000020	0.00012	0.00000034	0.000040	0.18	0.0000029	0.00017	0.00033	0.0000034	0.00010	0.14	0.0000043	0.099	0.000000034	0.031	0.0026	0.049	0.000000085	0.0000087	0.00000085	0.0013	0.0000024	0.000017	0.000034
20-Jan-16	41	80	400	280	8.2	0.000013	0.000098	0.00000056	0.000035	0.15	0.000029	0.00014	0.00032	0.0000042	0.000070	0.11	0.0000011	0.085	0.000000028	0.025	0.0024	0.043	0.00000059	0.0000056	0.00000070	0.0013	0.0000024	0.000014	0.000028
3-Feb-16	42	82	400	325	8.2	0.000019	0.00011	0.00000049	0.000039	0.15	0.00000016	0.00016	0.00035	0.0000033	0.000049	0.12	0.0000024	0.090	0.00000021	0.027	0.0026	0.044	0.00000042	0.0000050	0.00000081	0.0013	0.0000026	0.000016	0.000033
17-Feb-16	43	84	400	300	8.2	0.000014	0.00011	0.00000015	0.000033	0.15	0.0000021	0.00015	0.00036	0.0000030	0.000090	0.11	0.00000060	0.082	0.000000030	0.027	0.0023	0.036	0.00000042	0.0000045	0.00000075	0.0012	0.0000024	0.000015	0.000030
2-Mar-16	44	86	400	330	8.2	0.0000086	0.00012	0.00000050	0.000038	0.17	0.0000083	0.00017	0.00039	0.0000033	0.000050	0.13	0.00000066	0.094	0.000000033	0.029	0.0026	0.048	0.00000043	0.0000043	0.00000083	0.0013	0.0000025	0.000017	0.000033

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 6 (GT)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/L	mg$CaCO_3$/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
30-Jul-14	1	1	1200	370	8.1	1431	#N/A	4.8	197	443	23	0.35	0.30	366	0.010	0.011	0.078	0.029	< 0.000007	0.000012	0.040	< 0.000003	83	0.00095	0.0015
13-Aug-14	2	3	400	300	8.2	776	#N/A	4.2	172	180	4.3	0.41	< 0.3	165	0.0039	0.012	0.084	0.022	< 0.000007	< 0.000007	0.036	< 0.000003	36	0.00033	0.00069
27-Aug-14	3	5	400	310	8.2	576	#N/A	4.9	174	120	< 2	0.45	< 0.3	135	0.0066	0.011	0.083	0.024	< 0.000007	< 0.000007	0.044	0.000010	30	0.000050	0.00035
10-Sep-14	4	7	400	310	8.3	492	#N/A	3.8	174	73	0.50	0.51	< 0.3	119	0.0067	0.0098	0.088	0.030	< 0.000007	< 0.000007	0.035	0.000022	27	0.00010	0.00024
24-Sep-14	5	9	400	240	8.2	449	#N/A	4.4	181	65	0.20	0.50	< 0.3	127	0.0039	0.010	0.074	0.038	< 0.000007	< 0.000007	0.033	< 0.000003	28	0.00012	0.00027
8-Oct-14	6	11	300	220	8.2	424	#N/A	6.5	158	43	< 1	0.46	< 0.3	140	0.0076	0.0093	0.069	0.041	< 0.000007	< 0.000007	0.035	0.000018	32	0.000080	0.00014
22-Oct-14	7	13	400	295	8.3	491	#N/A	5.6	245	45	< 1	0.48	< 0.3	138	0.0068	0.0091	0.069	0.044	< 0.000007	< 0.000007	0.036	0.000048	30	0.000033	0.00014
5-Nov-14	8	15	400	275		366	#N/A	#N/A	165	40	< 1	0.50	< 0.3	139	0.0067	0.0091	0.064	0.046	< 0.000007	< 0.000007	0.034	0.000017	29	0.000080	0.00012
19-Nov-14	9	17	400	270	8.3	368	#N/A	#N/A	204	33	< 0.2	0.50	< 0.3	153	0.0065	0.0088	0.062	0.054	< 0.000007	< 0.000007	0.035	0.00010	32	0.000050	0.000072
3-Dec-14	10	19	400	335	8.3	335	#N/A	2.9	155	30	< 0.2	0.45	< 0.3	151	0.0065	0.0086	0.058	0.056	< 0.000007	< 0.000007	0.028	0.000015	34	0.000060	0.000081
17-Dec-14	11	21	400	290	8.2	346	#N/A	2.9	150	27	< 1	0.54	< 0.3	156	0.0065	0.0091	0.061	0.053	< 0.000007	< 0.000007	0.029	0.0000080	35	< 0.00003	0.000065
31-Dec-14	12	23	400	290	8.2	333	#N/A	3.7	151	24	< 1	0.50	< 0.3	150	0.0090	0.0089	0.058	0.056	< 0.000007	< 0.000007	0.027	0.000015	33	< 0.00003	0.000083
14-Jan-15	13	25	400	275	8.2	351	#N/A	3.2	154	24	< 1	0.52	< 0.3	153	0.0069	0.0099	0.059	0.060	< 0.000007	< 0.000007	0.029	0.000018	33	0.000070	0.000070
28-Jan-15	14	27	400	285	8.2	347	#N/A	3.1	150	24	< 1	0.52	< 0.3	151	0.010	0.0090	0.055	0.059	< 0.000007	< 0.000007	0.022	0.000010	31	0.000090	0.000053
11-Feb-15	15	29	400	300	8.2	334	#N/A	4.2	157	26	< 1	0.52	< 0.3	151	0.0097	0.010	0.061	0.058	< 0.000007	< 0.000007	0.027	0.000015	33	0.000090	0.000058
25-Feb-15	16	31	400	275	8.2	335	#N/A	2.6	160	24	< 1	0.46	< 0.3	156	0.0040	0.0093	0.051	0.063	< 0.000007	< 0.000007	0.025	0.000019	35	0.00024	0.000058
11-Mar-15	17	33	400	300	8.3	355	#N/A	#N/A	184	20	< 1	0.53	< 0.3	148	0.0075	0.0096	0.051	0.058	< 0.000007	< 0.000007	0.021	0.000010	34	0.000090	0.000052
25-Mar-15	18	35	400	275	8.2	331	#N/A	3.8	151	21	< 1	0.50	< 0.3	154	0.0069	0.011	0.061	0.065	< 0.000007	< 0.000007	0.021	0.0000090	32	0.00014	0.000056
8-Apr-15	19	37	400	335	8.1	322	#N/A	4.3	153	25	< 1	0.50	< 0.3	146	0.0062	0.013	0.056	0.060	< 0.000007	< 0.000007	0.024	0.0000040	34	0.000070	0.000050
22-Apr-15	20	39	400	270	8.1	338	#N/A	5.2	165	25	< 1	0.47	< 0.3	164	0.0062	0.011	0.048	0.066	< 0.000007	< 0.000007	0.025	0.0000070	38	0.000080	0.000046
6-May-15	21	41	400	240	8.2	343	#N/A	4.4	170	23	< 1	0.39	< 0.3	163	0.0085	0.010	0.042	0.066	< 0.000007	< 0.000007	0.022	< 0.000003	37	< 0.00003	0.000039
20-May-15	22	43	500	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	23	45	435	315	8.1	307	#N/A	4.9	138	21	< 1	0.45	< 0.3	142	0.011	0.010	0.046	0.057	< 0.000007	< 0.000007	0.022	< 0.000003	33	0.000060	0.000037
17-Jun-15	24	47	500	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	25	49	435	315	8.1	319	#N/A	4.6	135	22	< 1	0.42	< 0.3	136	0.0081	0.011	0.053	0.059	< 0.000007	< 0.000007	0.017	0.0000060	31	0.000080	0.000052
15-Jul-15	26	51	500	375	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	27	53	375	270	8.1	298	#N/A	3.0	133	27	< 1	0.42	< 0.3	135	0.0087	0.010	0.045	0.054	< 0.000007	< 0.000007	0.018	0.0000070	31	0.000080	0.000035
12-Aug-15	28	55	500	430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	29	57	430	270	8.2	299	#N/A	1.9	133	26	< 1	0.41	< 0.3	135	0.010	0.010	0.048	0.056	< 0.000007	< 0.000007	0.016	0.0000060	31	0.00010	0.000045
9-Sep-15	30	59	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	31	61	425	335	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	32	63	335	245	8.2	321	#N/A	3.2	148	23		0.39		137	0.0085	0.011	0.045	0.049	< 0.000007	< 0.000007	0.013	0.0000090	31	0.00013	0.000029
21-Oct-15	33	65	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	34	67	485	375	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	35	69	375	280	8.4	310	#N/A	#N/A	159	21		0.35		140	0.0086	0.0099	0.051	0.044	< 0.000007	< 0.000007	0.0098	0.0000090	32	0.00010	0.00045
2-Dec-15	36	71	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	37	73	455	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	38	75	410	350	8.4	316	#N/A	#N/A	130	22	-	0.32	-	143	0.0075	0.0094	0.039	0.051	< 0.000007	< 0.000007	0.012	< 0.000003	33	0.00010	0.000019
6-Jan-16	39	76	400	355	8.3	315	#N/A	#N/A	131	28	-	0.29	-	156	0.0065	0.0097	0.043	0.058	< 0.000007	< 0.000007	0.013	0.000026	36	0.000070	< 0.000004
20-Jan-16	40	78	400	255	8.3	321	#N/A	1.6	132	32	-	0.33	-	157	0.0059	0.012	0.052	0.059	< 0.000007	< 0.000007	0.012	0.0000060	36	0.000080	0.000042
3-Feb-16	41	80	400	310	8.3	292	#N/A	1.9	128	20	-	0.32	-	142	0.0067	0.011	0.052	0.053	< 0.000007	< 0.000007	0.011	0.0000060	32	0.000070	0.000033
17-Feb-16	42	82	400	285	8.3	318	#N/A	3.2	142	18	-	0.34	-	160	0.0064	0.012	0.055	0.072	< 0.000007	< 0.000007	0.012	0.0000030	37	0.00012	0.000028
2-Mar-16	43	84	400	335	8.3	296	#N/A	1.1	131	14	-	0.35	-	146	0.0044	0.011	0.060	0.061	< 0.000007	< 0.000007	0.010	0.000013	32	0.00012	0.000027

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 6 (GT)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
30-Jul-14	1	1	1200	370	8.1	0.016	0.31	0.000070	0.011	39	0.070	0.41	0.054	0.0086	0.051	24	0.0065	4.6	0.000084	146	0.42	169	0.00021	0.00051	0.00059	0.44	0.00038	0.0030	< 0.002
13-Aug-14	2	3	400	300	8.2	0.0059	< 0.002	0.000070	0.0073	18	0.026	< 0.01	0.065	0.0072	0.024	14	0.0022	4.5	< 0.000002	43	0.21	67	0.00015	0.000030	0.00019	0.41	0.000050	0.0010	< 0.002
27-Aug-14	3	5	400	310	8.2	0.0027	< 0.002	0.000040	0.0060	15	0.010	< 0.01	0.068	0.0039	0.026	13	0.0012	4.6	< 0.000002	51	0.18	40	0.00014	0.00019	0.000050	0.33	0.00014	0.0010	< 0.002
10-Sep-14	4	7	400	310	8.3	0.0020	< 0.007	0.000030	0.0053	13	0.0070	< 0.01	0.064	0.0014	0.020	11	0.00076	5.5	< 0.000002	53	0.19	29	0.00016	0.000060	0.000050	0.28	0.00017	< 0.001	< 0.002
24-Sep-14	5	9	400	240	8.2	0.0020	< 0.002	0.000030	0.0060	14	0.0052	< 0.01	0.057	0.0017	0.013	12	0.00034	4.5	0.0000070	42	0.18	19	0.00016	0.00012	0.00033	0.25	0.00015	0.0030	< 0.002
8-Oct-14	6	11	300	220	8.2	0.0015	< 0.007	0.000080	0.0066	15	0.0028	< 0.01	0.050	0.00090	0.015	11	0.00034	4.6	< 0.000002	32	0.22	17	0.00016	0.000040	0.00010	0.25	0.00015	< 0.001	< 0.002
22-Oct-14	7	13	400	295	8.3	0.0012	< 0.007	0.00019	0.0051	15	0.0046	< 0.01	0.050	0.00080	0.015	12	0.00029	5.1	< 0.000002	26	0.20	16	0.00016	< 0.00001	0.00011	0.25	0.00014	< 0.001	< 0.002
5-Nov-14	8	15	400	275		0.0013	< 0.007	0.000060	0.0051	16	0.0036	< 0.01	0.048	0.00070	0.011	10	0.00024	4.7	< 0.000002	17	0.24	13	0.00015	0.000060	0.00013	0.25	0.00013	< 0.001	< 0.002
19-Nov-14	9	17	400	270	8.3	0.0011	< 0.007	0.00013	0.0057	18	0.00018	< 0.01	0.042	0.00060	0.014	11	0.00020	4.9	< 0.000002	13	0.25	12	0.00023	0.000030	0.000090	0.26	0.00014	0.0020	< 0.002
3-Dec-14	10	19	400	335	8.3	0.0015	< 0.007	< 0.00001	0.0046	16	0.0018	< 0.01	0.038	0.00070	0.0090	10	0.00019	4.5	< 0.000002	8.9	0.26	10	0.00016	0.000020	0.000090	0.23	0.00014	0.0010	< 0.002
17-Dec-14	11	21	400	290	8.2	0.0011	< 0.007	< 0.00001	0.0048	17	0.00010	< 0.01	0.040	0.00060	0.0040	12	0.00018	4.5	< 0.000002	7.6	0.26	10	0.00015	< 0.00001	0.000080	0.24	0.00016	< 0.001	< 0.002
31-Dec-14	12	23	400	290	8.2	0.0010	< 0.007	< 0.00001	0.0044	17	0.0014	< 0.01	0.038	0.00060	0.013	11	0.00016	4.8	< 0.000002	5.9	0.26	8.9	0.00015	0.000080	0.00011	0.24	0.00015	< 0.001	< 0.002
14-Jan-15	13	25	400	275	8.2	0.00083	< 0.007	0.000030	0.0045	17	0.0013	< 0.01	0.040	0.00060	0.0030	11	0.00016	4.8	0.0000020	4.9	0.26	8.3	0.00015	0.000050	0.000090	0.25	0.00015	0.0010	< 0.002
28-Jan-15	14	27	400	285	8.2	0.00063	< 0.007	0.00012	0.0037	18	0.0011	< 0.01	0.036	0.00040	< 0.003	11	0.00018	4.3	< 0.000002	4.5	0.20	8.1	0.00014	0.000060	0.00012	0.25	0.00022	0.0020	< 0.002
11-Feb-15	15	29	400	300	8.2	0.0012	< 0.007	< 0.00001	0.0043	17	0.00069	0.010	0.034	0.00050	0.0060	11	< 0.001	4.4	< 0.000002	3.8	0.26	8.7	0.00014	0.00018	0.00010	0.25	0.00018	< 0.001	< 0.002
25-Feb-15	16	31	400	275	8.2	0.0011	< 0.007	0.000030	0.0044	17	0.00075	< 0.01	0.031	0.00050	< 0.003	11	< 0.001	4.7	< 0.000002	3.4	0.26	7.9	0.00017	0.00013	0.000060	0.27	0.00011	0.0010	< 0.002
11-Mar-15	17	33	400	300	8.3	0.0023	< 0.007	< 0.00001	0.0041	16	0.00048	< 0.01	0.031	0.00050	0.0080	10	< 0.001	3.9	< 0.000002	2.7	0.25	7.8	0.00015	0.000020	0.000060	0.25	0.00017	0.0020	< 0.002
25-Mar-15	18	35	400	275	8.2	0.0011	< 0.007	0.000010	0.0040	18	0.00044	< 0.01	0.036	0.00050	0.0070	11	< 0.001	4.8	< 0.000002	3.1	0.26	8.3	0.00016	0.00018	0.00011	0.25	0.00021	< 0.001	< 0.002
8-Apr-15	19	37	400	335	8.1	0.00062	< 0.007	< 0.00001	0.0040	15	0.00025	< 0.01	0.028	0.00040	0.011	11	< 0.001	5.0	< 0.000002	2.2	0.25	7.7	0.00015	0.000060	0.000070	0.25	0.00014	< 0.001	< 0.002
22-Apr-15	20	39	400	270	8.1	0.0019	< 0.007	0.00021	0.0042	17	0.00046	< 0.01	0.025	0.00050	0.0090	11	0.00017	4.9	0.0000030	2.2	0.28	7.6	0.00017	0.00041	0.000070	0.25	0.00016	< 0.001	< 0.002
6-May-15	21	41	400	240	8.2	0.0012	< 0.007	< 0.00001	0.0043	17	0.00073	< 0.01	0.022	0.00050	0.0050	11	< 0.001	4.8	0.0000030	2.0	0.27	8.0	0.00015	< 0.00001	0.000060	0.24	0.00021	0.0010	< 0.002
20-May-15	22	43	500	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	23	45	435	315	8.1	0.0013	< 0.007	0.00013	0.0037	15	0.00030	< 0.01	0.023	0.00040	0.010	10	0.00014	4.6	0.0000020	1.5	0.24	7.7	0.00012	0.000030	0.000070	0.24	0.00017	< 0.001	< 0.002
17-Jun-15	24	47	500	435	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	25	49	435	315	8.1	0.00060	< 0.007	< 0.00001	0.0034	15	0.00079	0.010	0.021	0.00030	0.012	9.1	0.00014	4.6	< 0.000002	1.3	0.23	7.5	0.00015	0.000080	0.000070	0.25	0.00016	0.0010	< 0.002
15-Jul-15	26	51	500	375	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	27	53	375	270	8.1	0.00091	< 0.007	0.000070	0.0035	14	0.00017	0.010	0.020	0.00030	0.0040	9.1	0.00010	4.1	< 0.000002	1.2	0.24	8.7	0.00014	0.000050	< 0.00005	0.27	0.00017	0.0010	< 0.002
12-Aug-15	28	55	500	430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	29	57	430	270	8.2	0.00058	< 0.007	0.000060	0.0032	14	0.00056	< 0.01	0.023	0.00030	0.0060	8.7	0.00013	4.3	0.000026	1.2	0.24	8.5	0.00013	0.000020	< 0.00005	0.25	0.00018	< 0.001	< 0.002
9-Sep-15	30	59	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	31	61	425	335	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	32	63	335	245	8.2	0.00058	< 0.007	< 0.00001	0.0028	15	0.00016	< 0.01	0.015	0.00030	0.0050	8.4	0.00010	3.9	< 0.000002	1.1	0.22	7.7	0.000096	0.00013	< 0.00005	0.23	0.00017	0.0020	< 0.002
21-Oct-15	33	65	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	34	67	485	375	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	35	69	375	280	8.4	0.0014	0.017	0.00028	0.0026	15	0.0078	< 0.01	0.018	0.00080	0.0070	8.8	0.00027	4.1	0.000012	1.1	0.23	8.7	0.00012	0.000060	< 0.00005	0.21	0.00016	0.0010	< 0.002
2-Dec-15	36	71	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	37	73	455	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	38	75	410	350	8.4	0.00070	< 0.007	0.00028	0.0025	15	0.00010	< 0.01	0.016	0.00020	0.0090	8.2	0.00011	4.0	< 0.000002	1.0	0.19	7.4	0.000095	0.00011	< 0.00005	0.24	0.00014	< 0.001	< 0.002
6-Jan-16	39	76	400	355	8.3	0.0010	< 0.007	0.00011	0.0027	16	0.000080	< 0.01	0.014	0.00020	0.0070	9.1	0.00032	4.5	0.0000020	1.1	0.22	9.3	0.000085	0.00032	< 0.00005	0.25	0.00011	< 0.001	< 0.002
20-Jan-16	40	78	400	255	8.3	0.00054	< 0.007	0.000050	0.0028	16	0.0011	< 0.01	0.018	0.00030	0.0060	8.9	0.00014	4.7	< 0.000002	1.1	0.26	9.6	0.00013	0.000030	< 0.00005	0.31	0.00014	< 0.001	< 0.002
3-Feb-16	41	80	400	310	8.3	0.00065	< 0.007	0.000030	0.0027	15	< 0.00001	< 0.01	0.015	0.00030	0.0080	8.8	0.00021	4.4	0.000014	1.0	0.24	7.9	0.00014	0.000040	< 0.00005	0.24	0.00014	< 0.001	< 0.002
17-Feb-16	42	82	400	285	8.3	0.00074	< 0.007	< 0.00001	0.0030	17	0.00014	< 0.01	0.017	0.00030	0.010	9.3	0.000070	4.5	< 0.000002	1.2	0.25	6.9	0.00016	0.000080	< 0.00005	0.28	0.00014	< 0.001	< 0.002
2-Mar-16	43	84	400	335	8.3	0.00036	< 0.007	0.00017	0.0026	16	0.00013	< 0.01	0.017	0.00020	0.0040	8.8	0.000070	4.5	< 0.000002	1.1	0.23	6.4	0.00014	0.000020	< 0.00005	0.22	0.00012	< 0.001	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 6 (GT)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
30-Jul-14	1	1	1200	370	8.1	1431	#N/A	0.18	7.3	16	0.85	0.013	0.011	14	0.00037	0.00041	0.0029	0.0011	0.00000026	0.00000044	0.0015	0.00000011	3.1	0.000035	0.000054
13-Aug-14	2	3	400	300	8.2	776	#N/A	0.062	2.6	2.7	0.065	0.0062	0.0045	2.5	0.000059	0.00017	0.0013	0.00033	0.00000011	0.00000011	0.00054	0.000000045	0.54	0.0000050	0.000010
27-Aug-14	3	5	400	310	8.2	576	#N/A	0.076	2.7	1.9	0.031	0.0070	0.0047	2.1	0.00010	0.00016	0.0013	0.00037	0.00000011	0.00000011	0.00068	0.00000016	0.46	0.00000078	0.0000054
10-Sep-14	4	7	400	310	8.3	492	#N/A	0.058	2.7	1.1	0.0078	0.0079	0.0047	1.8	0.00010	0.00015	0.0014	0.00047	0.00000011	0.00000011	0.00053	0.00000034	0.41	0.0000016	0.0000037
24-Sep-14	5	9	400	240	8.2	449	#N/A	0.052	2.2	0.78	0.0024	0.0060	0.0036	1.5	0.000047	0.00012	0.00089	0.00045	0.000000084	0.000000084	0.00040	0.000000036	0.33	0.0000014	0.0000032
8-Oct-14	6	11	300	220	8.2	424	#N/A	0.072	1.7	0.47	0.011	0.0051	0.0033	1.5	0.000084	0.00010	0.00076	0.00045	0.000000077	0.000000077	0.00039	0.00000020	0.35	0.00000088	0.0000015
22-Oct-14	7	13	400	295	8.3	491	#N/A	0.082	3.6	0.66	0.015	0.0071	0.0044	2.0	0.00010	0.00013	0.0010	0.00064	0.00000010	0.00000010	0.00053	0.00000071	0.44	0.00000049	0.0000020
5-Nov-14	8	15	400	275		366	#N/A	#N/A	2.3	0.55	0.014	0.0069	0.0041	1.9	0.000092	0.00013	0.00087	0.00064	0.000000096	0.000000096	0.00046	0.00000023	0.40	0.0000011	0.0000017
19-Nov-14	9	17	400	270	8.3	368	#N/A	#N/A	2.7	0.45	0.0027	0.0068	0.0041	2.1	0.000088	0.00012	0.00083	0.00072	0.000000095	0.000000095	0.00047	0.0000014	0.43	0.00000068	0.00000097
3-Dec-14	10	19	400	335	8.3	335	#N/A	0.049	2.6	0.50	0.0034	0.0075	0.0050	2.5	0.00011	0.00014	0.00097	0.00093	0.00000012	0.00000012	0.00046	0.00000025	0.56	0.0000010	0.0000014
17-Dec-14	11	21	400	290	8.2	346	#N/A	0.042	2.2	0.39	0.015	0.0078	0.0044	2.3	0.000094	0.00013	0.00088	0.00077	0.00000010	0.00000010	0.00042	0.00000012	0.50	0.00000044	0.00000094
31-Dec-14	12	23	400	290	8.2	333	#N/A	0.054	2.2	0.35	0.015	0.0073	0.0044	2.2	0.00013	0.00013	0.00084	0.00082	0.00000010	0.00000010	0.00039	0.00000022	0.48	0.00000044	0.0000012
14-Jan-15	13	25	400	275	8.2	351	#N/A	0.044	2.1	0.33	0.014	0.0072	0.0041	2.1	0.000095	0.00014	0.00082	0.00082	0.000000096	0.000000096	0.00039	0.00000025	0.46	0.00000096	0.00000096
28-Jan-15	14	27	400	285	8.2	347	#N/A	0.045	2.1	0.34	0.014	0.0074	0.0043	2.2	0.00014	0.00013	0.00078	0.00084	0.000000100	0.000000100	0.00031	0.00000014	0.44	0.0000013	0.00000076
11-Feb-15	15	29	400	300	8.2	334	#N/A	0.063	2.4	0.39	0.015	0.0078	0.0045	2.3	0.00015	0.00016	0.00091	0.00087	0.00000011	0.00000011	0.00040	0.00000023	0.49	0.0000014	0.00000087
25-Feb-15	16	31	400	275	8.2	335	#N/A	0.035	2.2	0.33	0.014	0.0063	0.0041	2.1	0.000055	0.00013	0.00070	0.00086	0.000000096	0.000000096	0.00034	0.00000026	0.49	0.0000033	0.00000080
11-Mar-15	17	33	400	300	8.3	355	#N/A	#N/A	2.8	0.30	0.015	0.0080	0.0045	2.2	0.00011	0.00014	0.00077	0.00087	0.00000011	0.00000011	0.00032	0.00000015	0.50	0.0000014	0.00000078
25-Mar-15	18	35	400	275	8.2	331	#N/A	0.052	2.1	0.29	0.014	0.0069	0.0041	2.1	0.000095	0.00015	0.00084	0.00089	0.000000096	0.000000096	0.00029	0.00000012	0.44	0.0000019	0.00000077
8-Apr-15	19	37	400	335	8.1	322	#N/A	0.072	2.6	0.42	0.017	0.0084	0.0050	2.4	0.00010	0.00022	0.00093	0.00100	0.00000012	0.00000012	0.00041	0.000000067	0.56	0.0000012	0.00000084
22-Apr-15	20	39	400	270	8.1	338	#N/A	0.070	2.2	0.34	0.014	0.0063	0.0041	2.2	0.000084	0.00015	0.00065	0.00090	0.000000095	0.000000095	0.00034	0.000000095	0.51	0.0000011	0.00000062
6-May-15	21	41	400	240	8.2	343	#N/A	0.053	2.0	0.28	0.012	0.0047	0.0036	2.0	0.00010	0.00012	0.00050	0.00079	0.000000084	0.000000084	0.00026	0.000000036	0.44	0.00000036	0.00000047
20-May-15	22	43	500	435																					
3-Jun-15	23	45	435	315	8.1	307	#N/A	0.039	1.1	0.17	0.0079	0.0035	0.0024	1.1	0.000083	0.000080	0.00036	0.00045	0.000000055	0.000000055	0.00017	0.000000024	0.26	0.00000047	0.00000029
17-Jun-15	24	47	500	435																					
1-Jul-15	25	49	435	315	8.1	319	#N/A	0.036	1.1	0.17	0.0079	0.0033	0.0024	1.1	0.000064	0.000087	0.00042	0.00046	0.000000055	0.000000055	0.00013	0.000000047	0.24	0.00000063	0.00000041
15-Jul-15	26	51	500	375																					
29-Jul-15	27	53	375	270	8.1	298	#N/A	0.020	0.90	0.18	0.0068	0.0028	0.0020	0.91	0.000059	0.000070	0.00030	0.00037	0.000000047	0.000000047	0.00012	0.000000047	0.21	0.00000054	0.00000024
12-Aug-15	28	55	500	430																					
26-Aug-15	29	57	430	270	8.2	299	#N/A	0.013	0.90	0.18	0.0068	0.0028	0.0020	0.91	0.000070	0.000070	0.00032	0.00038	0.000000047	0.000000047	0.00011	0.000000041	0.21	0.00000068	0.00000030
9-Sep-15	30	59	500	425																					
23-Sep-15	31	61	425	335																					
7-Oct-15	32	63	335	245	8.2	321	#N/A	0.013	0.60	0.094	0.00	0.0016	0.00	0.56	0.000035	0.000045	0.00018	0.00020	0.000000029	0.000000029	0.000054	0.000000037	0.13	0.00000053	0.00000012
21-Oct-15	33	65	500	485																					
4-Nov-15	34	67	485	375																					
18-Nov-15	35	69	375	280	8.4	310	#N/A	#N/A	0.74	0.098	0.00	0.0016	0.00	0.65	0.000040	0.000046	0.00024	0.00021	0.000000033	0.000000033	0.000046	0.000000042	0.15	0.00000047	0.0000021
2-Dec-15	36	71	500	455																					
16-Dec-15	37	73	455	410																					
30-Dec-15	38	75	410	350	8.4	316	#N/A	#N/A	0.76	0.13	0.00	0.0019	0.00	0.83	0.000044	0.000055	0.00023	0.00030	0.000000041	0.000000041	0.000072	0.000000018	0.19	0.00000058	0.00000011
6-Jan-16	39	76	400	355	8.3	315	#N/A	#N/A	0.77	0.17	0.00	0.0017	0.00	0.92	0.000038	0.000057	0.00026	0.00034	0.000000041	0.000000041	0.000077	0.00000015	0.21	0.00000041	0.000000024
20-Jan-16	40	78	400	255	8.3	321	#N/A	0.0067	0.56	0.14	0.00	0.0014	0.00	0.67	0.000025	0.000049	0.00022	0.00025	0.000000030	0.000000030	0.000051	0.000000026	0.15	0.00000034	0.00000018
3-Feb-16	41	80	400	310	8.3	292	#N/A	0.030	2.0	0.31	0.00	0.0050	0.00	2.2	0.00010	0.00017	0.00081	0.00082	0.00000011	0.00000011	0.00017	0.000000093	0.50	0.0000011	0.00000051
17-Feb-16	42	82	400	285	8.3	318	#N/A	0.046	2.0	0.26	0.00	0.0048	0.00	2.3	0.000091	0.00017	0.00078	0.0010	0.000000100	0.000000100	0.00017	0.000000043	0.52	0.0000017	0.00000040
2-Mar-16	43	84	400	335	8.3	296	#N/A	0.018	2.2	0.23	0.00	0.0059	0.00	2.4	0.000074	0.00019	0.0010	0.0010	0.00000012	0.00000012	0.00017	0.00000022	0.54	0.0000020	0.00000045

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for Col 6 (GT)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
30-Jul-14	1	1	1200	370	8.1	0.00060	0.011	0.0000026	0.00041	1.4	0.0026	0.015	0.0020	0.00032	0.0019	0.88	0.00024	0.17	0.0000031	5.4	0.016	6.3	0.0000077	0.000019	0.000022	0.016	0.000014	0.00011	0.000074
13-Aug-14	2	3	400	300	8.2	0.000088	0.000030	0.0000011	0.00011	0.28	0.00039	0.00015	0.00097	0.00011	0.00036	0.21	0.000033	0.068	0.000000030	0.65	0.0032	1.0	0.0000023	0.00000045	0.0000029	0.0062	0.00000075	0.000015	0.000030
27-Aug-14	3	5	400	310	8.2	0.000042	0.000031	0.00000062	0.000093	0.23	0.00016	0.00016	0.0011	0.000060	0.00040	0.20	0.000019	0.071	0.000000031	0.78	0.0028	0.63	0.0000021	0.0000029	0.00000078	0.0051	0.0000022	0.000016	0.000031
10-Sep-14	4	7	400	310	8.3	0.000031	0.00011	0.00000047	0.000082	0.20	0.00011	0.00016	0.00100	0.000022	0.00031	0.17	0.000012	0.085	0.000000031	0.82	0.0029	0.44	0.0000024	0.00000093	0.00000078	0.0043	0.0000026	0.000016	0.000031
24-Sep-14	5	9	400	240	8.2	0.000024	0.000024	0.00000036	0.000072	0.17	0.000062	0.00012	0.00068	0.000020	0.00016	0.14	0.0000041	0.054	0.000000084	0.51	0.0021	0.23	0.0000020	0.0000014	0.0000040	0.0030	0.0000018	0.000036	0.000024
8-Oct-14	6	11	300	220	8.2	0.000016	0.000077	0.00000088	0.000073	0.16	0.000030	0.00011	0.00055	0.0000099	0.00017	0.12	0.0000037	0.051	0.000000022	0.36	0.0025	0.18	0.0000018	0.00000044	0.0000011	0.0028	0.0000017	0.000011	0.000022
22-Oct-14	7	13	400	295	8.3	0.000018	0.00010	0.0000028	0.000075	0.23	0.000068	0.00015	0.00074	0.000012	0.00022	0.17	0.0000043	0.075	0.000000030	0.39	0.0030	0.23	0.0000023	0.00000015	0.0000016	0.0037	0.0000021	0.000015	0.000030
5-Nov-14	8	15	400	275		0.000018	0.000096	0.00000083	0.000070	0.22	0.000049	0.00014	0.00066	0.0000096	0.00015	0.14	0.0000033	0.064	0.000000028	0.24	0.0032	0.17	0.0000021	0.00000083	0.0000018	0.0034	0.0000018	0.000014	0.000028
19-Nov-14	9	17	400	270	8.3	0.000015	0.000095	0.0000018	0.000077	0.24	0.0000024	0.00014	0.00057	0.0000081	0.00019	0.15	0.0000027	0.066	0.000000027	0.17	0.0034	0.16	0.0000032	0.00000041	0.0000012	0.0035	0.0000019	0.000027	0.000027
3-Dec-14	10	19	400	335	8.3	0.000026	0.00012	0.00000017	0.000077	0.27	0.000029	0.00017	0.00063	0.000012	0.00015	0.17	0.0000032	0.075	0.000000034	0.15	0.0043	0.17	0.0000026	0.00000034	0.0000015	0.0038	0.0000023	0.000017	0.000034
17-Dec-14	11	21	400	290	8.2	0.000016	0.00010	0.00000015	0.000069	0.25	0.0000015	0.00015	0.00057	0.0000087	0.000058	0.17	0.0000026	0.065	0.000000029	0.11	0.0038	0.15	0.0000022	0.00000015	0.0000012	0.0035	0.0000023	0.000015	0.000029
31-Dec-14	12	23	400	290	8.2	0.000015	0.00010	0.00000015	0.000063	0.24	0.000020	0.00015	0.00055	0.0000087	0.00019	0.15	0.0000023	0.069	0.000000029	0.085	0.0037	0.13	0.0000022	0.0000012	0.0000016	0.0035	0.0000022	0.000015	0.000029
14-Jan-15	13	25	400	275	8.2	0.000011	0.000096	0.00000041	0.000062	0.24	0.000018	0.00014	0.00055	0.0000083	0.000041	0.15	0.0000022	0.065	0.000000028	0.067	0.0036	0.11	0.0000021	0.00000069	0.0000012	0.0034	0.0000021	0.000014	0.000028
28-Jan-15	14	27	400	285	8.2	0.0000090	0.000100	0.0000017	0.000053	0.25	0.000016	0.00014	0.00051	0.0000057	0.000043	0.15	0.0000026	0.061	0.000000029	0.064	0.0029	0.12	0.0000020	0.00000086	0.0000017	0.0036	0.0000031	0.000029	0.000029
11-Feb-15	15	29	400	300	8.2	0.000018	0.00011	0.00000015	0.000064	0.26	0.000010	0.00015	0.00051	0.0000075	0.000090	0.16	0.000015	0.066	0.000000030	0.057	0.0038	0.13	0.0000021	0.0000027	0.0000015	0.0037	0.0000027	0.000015	0.000030
25-Feb-15	16	31	400	275	8.2	0.000015	0.000096	0.00000041	0.000060	0.23	0.000010	0.00014	0.00043	0.0000069	0.000041	0.16	0.000014	0.065	0.000000028	0.046	0.0036	0.11	0.0000023	0.0000018	0.00000083	0.0037	0.0000015	0.000014	0.000028
11-Mar-15	17	33	400	300	8.3	0.000034	0.00011	0.00000015	0.000062	0.23	0.0000072	0.00015	0.00047	0.0000075	0.00012	0.15	0.000015	0.058	0.000000030	0.040	0.0037	0.12	0.0000023	0.00000030	0.00000090	0.0038	0.0000026	0.000030	0.000030
25-Mar-15	18	35	400	275	8.2	0.000015	0.000096	0.00000014	0.000054	0.24	0.0000061	0.00014	0.00049	0.0000069	0.000096	0.15	0.000014	0.066	0.000000028	0.042	0.0035	0.11	0.0000022	0.0000025	0.0000015	0.0035	0.0000029	0.000014	0.000028
8-Apr-15	19	37	400	335	8.1	0.000010	0.00012	0.00000017	0.000067	0.25	0.0000042	0.00017	0.00047	0.0000067	0.00018	0.18	0.000017	0.084	0.000000034	0.037	0.0042	0.13	0.0000025	0.0000010	0.0000012	0.0043	0.0000023	0.000017	0.000034
22-Apr-15	20	39	400	270	8.1	0.000025	0.000095	0.0000028	0.000057	0.23	0.0000062	0.00014	0.00034	0.0000068	0.00012	0.15	0.0000023	0.066	0.000000041	0.030	0.0037	0.10	0.0000023	0.0000055	0.00000095	0.0034	0.0000022	0.000014	0.000027
6-May-15	21	41	400	240	8.2	0.000014	0.000084	0.00000012	0.000051	0.21	0.0000088	0.00012	0.00027	0.0000060	0.000060	0.13	0.000012	0.058	0.000000036	0.024	0.0032	0.096	0.0000018	0.00000012	0.00000072	0.0029	0.0000025	0.000012	0.000024
20-May-15	22	43	500	435																									
3-Jun-15	23	45	435	315	8.1	0.000010	0.000055	0.0000010	0.000029	0.12	0.0000024	0.000079	0.00018	0.0000032	0.000079	0.079	0.0000011	0.036	0.000000016	0.012	0.0019	0.061	0.00000098	0.00000024	0.00000055	0.0019	0.0000013	0.0000079	0.000016
17-Jun-15	24	47	500	435																									
1-Jul-15	25	49	435	315	8.1	0.0000047	0.000055	0.000000079	0.000027	0.11	0.0000062	0.000079	0.00017	0.0000024	0.000095	0.072	0.0000011	0.036	0.000000016	0.010	0.0018	0.059	0.0000012	0.00000063	0.00000055	0.0019	0.0000013	0.0000079	0.000016
15-Jul-15	26	51	500	375																									
29-Jul-15	27	53	375	270	8.1	0.0000061	0.000047	0.00000047	0.000024	0.097	0.0000011	0.000068	0.00014	0.0000020	0.000027	0.061	0.00000068	0.028	0.000000014	0.0078	0.0016	0.059	0.00000092	0.00000034	0.00000034	0.0018	0.0000011	0.0000068	0.000014
12-Aug-15	28	55	500	430																									
26-Aug-15	29	57	430	270	8.2	0.0000039	0.000047	0.00000041	0.000021	0.096	0.0000038	0.000068	0.00015	0.0000020	0.000041	0.059	0.00000088	0.029	0.00000018	0.0080	0.0016	0.057	0.00000088	0.00000014	0.00000034	0.0017	0.0000012	0.0000068	0.000014
9-Sep-15	30	59	500	425																									
23-Sep-15	31	61	425	335																									
7-Oct-15	32	63	335	245	8.2	0.0000024	0.000029	0.000000041	0.000011	0.060	0.00000065	0.000041	0.000060	0.0000012	0.000020	0.034	0.00000041	0.016	0.0000000082	0.0043	0.00088	0.031	0.00000039	0.00000053	0.00000020	0.00095	0.00000069	0.0000082	0.0000082
21-Oct-15	33	65	500	485																									
4-Nov-15	34	67	485	375																									
18-Nov-15	35	69	375	280	8.4	0.0000066	0.000079	0.0000013	0.000012	0.069	0.000037	0.000047	0.000082	0.0000037	0.000033	0.041	0.0000013	0.019	0.000000056	0.0051	0.0011	0.041	0.00000056	0.00000028	0.00000023	0.00096	0.00000075	0.0000047	0.0000093
2-Dec-15	36	71	500	455																									
16-Dec-15	37	73	455	410																									
30-Dec-15	38	75	410	350	8.4	0.0000041	0.000041	0.0000016	0.000014	0.087	0.00000058	0.000058	0.000094	0.0000012	0.000053	0.048	0.00000064	0.024	0.000000012	0.0060	0.0011	0.043	0.00000055	0.00000064	0.00000029	0.0014	0.00000082	0.0000058	0.000012
6-Jan-16	39	76	400	355	8.3	0.0000059	0.000041	0.00000065	0.000016	0.096	0.00000047	0.000059	0.000083	0.0000012	0.000041	0.054	0.0000019	0.027	0.000000012	0.0062	0.0013	0.055	0.00000050	0.0000019	0.00000030	0.0015	0.00000065	0.0000059	0.000012
20-Jan-16	40	78	400	255	8.3	0.0000023	0.000030	0.00000021	0.000012	0.070	0.0000045	0.000043	0.000075	0.0000013	0.000026	0.038	0.00000060	0.020	0.0000000085	0.0046	0.0011	0.041	0.00000057	0.00000013	0.00000021	0.0013	0.00000060	0.0000043	0.0000085
3-Feb-16	41	80	400	310	8.3	0.000010	0.00011	0.00000047	0.000042	0.23	0.00000016	0.00016	0.00023	0.0000047	0.00012	0.14	0.0000033	0.068	0.00000022	0.016	0.0036	0.12	0.0000021	0.00000062	0.00000078	0.0038	0.0000022	0.000016	0.000031
17-Feb-16	42	82	400	285	8.3	0.000011	0.000100	0.00000014	0.000043	0.24	0.0000020	0.00014	0.00025	0.0000043	0.00014	0.13	0.00000100	0.064	0.000000029	0.017	0.0035	0.098	0.0000023	0.0000011	0.00000071	0.0039	0.0000020	0.000014	0.000029
2-Mar-16	43	84	400	335	8.3	0.0000060	0.00012	0.0000028	0.000044	0.26	0.0000022	0.00017	0.00028	0.0000034	0.000067	0.15	0.0000012	0.075	0.000000034	0.019	0.0039	0.11	0.0000023	0.00000034	0.00000084	0.0038	0.0000020	0.000017	0.000034

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 13 (OKY Master)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/L	mg$CaCO_3$/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
20-May-15	1	1	2000	415	7.0	1431	#N/A	9.4	80	333	36	#N/A	*< 0.3*	272	0.012	0.0046	0.057	0.031	0.000037	*< 0.000007*	0.12	0.000062	77	0.000060	0.020
3-Jun-15	2	3	400	360	7.7	301	#N/A	6.8	83	67	6.0	0.18	*< 0.3*	29	0.0050	0.0069	0.20	0.0034	0.0000090	*< 0.000007*	0.16	*< 0.000003*	8.2	0.000060	0.0025
17-Jun-15	3	5	300	260	7.7	282	#N/A	5.2	85	45	*< 1*	0.18	*< 0.3*	30	0.0042	0.0071	0.23	0.0034	0.000010	*< 0.000007*	0.14	0.0000040	8.5	0.000040	0.0026
1-Jul-15	4	7	300	280	7.8	300	#N/A	6.6	78	52	8.0	0.20	*< 0.3*	31	0.0050	0.0066	0.14	0.0033	0.0000090	*< 0.000007*	0.16	0.000012	8.5	0.000080	0.0028
15-Jul-15	5	9	300	265	7.8	293	#N/A	5.8	70	66	4.0	0.20	*< 0.3*	32	0.0043	0.0064	0.10	0.0038	*< 0.000007*	*< 0.000007*	0.16	0.0000040	8.8	0.000060	0.0034
29-Jul-15	6	11	300	250	7.7	307	#N/A	3.5	57	87	2.0	0.20	*< 0.3*	35	0.0049	0.0060	0.081	0.0036	0.0000070	*< 0.000007*	0.13	0.000010	10	0.00011	0.0032
12-Aug-15	7	13	300	295	7.7	301	#N/A	3.8	51	90	*< 1*	0.19	*< 0.3*	36	0.0044	0.0060	0.086	0.0037	*< 0.000007*	0.0000090	0.13	0.000011	10	0.00024	0.0033
26-Aug-15	8	15	300	250	7.6	262	#N/A	3.8	40	81	*< 1*	0.22	*< 0.3*	29	0.0043	0.0066	0.096	0.0028	*< 0.000007*	*< 0.000007*	0.13	0.000012	8.2	*< 0.00003*	0.0023
9-Sep-15	9	17	300	235	7.5	230	#N/A	3.9	31	69	*< 1*	0.25	*< 0.3*	24	0.0038	0.0071	0.11	0.0023	*< 0.000007*	*< 0.000007*	0.12	0.0000030	6.8	0.000050	0.0018
23-Sep-15	10	19	300	250	7.5	197	#N/A	3.0	23	63	*< 1*	0.25	-	19	0.0039	0.0076	0.12	0.0018	*< 0.000007*	*< 0.000007*	0.12	*< 0.000003*	5.5	0.00017	0.0013
7-Oct-15	11	21	300	230	7.5	181	#N/A	3.1	22	55	*< 1*	0.27	-	15	0.0047	0.0077	0.10	0.0014	*< 0.000007*	*< 0.000007*	0.089	0.0000040	4.3	0.000030	0.0011
21-Oct-15	12	23	350	275	7.8	164	#N/A	1.5	24	41	*< 1*	0.28	-	14	0.0075	0.0069	0.11	0.0016	*< 0.000007*	*< 0.000007*	0.070	0.0000050	3.9	0.00020	0.00095
4-Nov-15	13	25	300	230	7.4	152	#N/A	2.3	17	39	*< 1*	0.26	-	15	0.0073	0.0076	0.12	0.0015	*< 0.000007*	*< 0.000007*	0.091	0.0000070	4.2	0.000070	0.0013
18-Nov-15	14	27	300	245	7.6	146	#N/A	1.4	22	42	*< 1*	0.26	-	13	0.0025	0.0070	0.11	0.0011	*< 0.000007*	*< 0.000007*	0.068	*< 0.000003*	3.6	*< 0.00003*	0.0012
2-Dec-15	15	29	300	240	7.3	137	#N/A	3.6	17	39	*< 1*	0.29	-	13	0.0052	0.0077	0.13	0.0015	*< 0.000007*	*< 0.000007*	0.063	0.000010	3.6	0.00028	0.00098
16-Dec-15	16	31	300	235	7.6	129	#N/A	4.1	18	39	*< 1*	0.24	-	13	0.0039	0.0073	0.11	0.0014	*< 0.000007*	*< 0.000007*	0.066	0.0000070	3.6	0.000060	0.0012
30-Dec-15	17	33	300	385	7.5	126	#N/A	2.8	16	31	*< 1*	0.28	-	13	0.0039	0.0073	0.12	0.0014	*< 0.000007*	*< 0.000007*	0.070	0.0000040	3.5	0.000040	0.0011
13-Jan-16	18	35	300	290	7.4	118	#N/A	2.8	17	31	*< 1*	0.26	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	19	37	300	300	7.5	120	#N/A	3.7	21	32	*< 1*	0.29	-	12	0.020	0.0069	0.10	0.0016	*< 0.000007*	*< 0.000007*	0.057	0.0000080	3.3	*< 0.00003*	0.00095
10-Feb-16	20	39	300	275	7.5	119	#N/A	3.4	23	30	*< 1*	0.26	-	13	0.0033	0.0073	0.11	0.0013	*< 0.000007*	*< 0.000007*	0.047	0.0000050	3.6	*< 0.00003*	0.0011
24-Feb-16	21	41	300	300	7.5	119	#N/A	3.4	22	28	*< 1*	0.26	-	12	0.0022	0.0073	0.11	0.0013	*< 0.000007*	*< 0.000007*	0.050	0.0000060	3.3	*< 0.00003*	0.0011
9-Mar-16	22	43	300	335	7.5	119	#N/A	3.0	22	23															

Calculated Loading Rates for Col 13 (OKY Master)

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
20-May-15	1	1	2000	415	7.0	1431	#N/A	0.39	3.3	14	1.5	#N/A	0.012	11	0.00048	0.00019	0.0023	0.0013	0.0000015	0.00000029	0.0049	0.0000026	3.2	0.0000025	0.00081
3-Jun-15	2	3	400	360	7.7	301	#N/A	0.12	1.5	1.2	0.11	0.0032	0.0054	0.52	0.000090	0.00012	0.0036	0.000062	0.00000016	0.00000013	0.0028	0.000000054	0.15	0.0000011	0.000045
17-Jun-15	3	5	300	260	7.7	282	#N/A	0.067	1.1	0.59	0.013	0.0023	0.0039	0.39	0.000055	0.000092	0.0029	0.000044	0.00000013	0.000000091	0.0018	0.000000052	0.11	0.00000052	0.000034
1-Jul-15	4	7	300	280	7.8	300	#N/A	0.093	1.1	0.73	0.11	0.0028	0.0042	0.43	0.000070	0.000092	0.0020	0.000046	0.00000013	0.000000098	0.0022	0.00000017	0.12	0.0000011	0.000040
15-Jul-15	5	9	300	265	7.8	293	#N/A	0.077	0.92	0.87	0.053	0.0027	0.0040	0.43	0.000057	0.000085	0.0014	0.000050	0.000000093	0.000000093	0.0021	0.000000053	0.12	0.00000080	0.000045
29-Jul-15	6	11	300	250	7.7	307	#N/A	0.044	0.71	1.1	0.025	0.0025	0.0038	0.44	0.000061	0.000075	0.0010	0.000045	0.000000088	0.000000088	0.0017	0.00000013	0.13	0.0000014	0.000040
12-Aug-15	7	13	300	295	7.7	301	#N/A	0.056	0.75	1.3	0.015	0.0028	0.0044	0.53	0.000065	0.000089	0.0013	0.000054	0.00000010	0.00000013	0.0018	0.00000016	0.15	0.0000035	0.000049
26-Aug-15	8	15	300	250	7.6	262	#N/A	0.048	0.50	1.0	0.013	0.0028	0.0038	0.36	0.000054	0.000083	0.0012	0.000035	0.000000088	0.000000088	0.0016	0.00000015	0.10	0.00000038	0.000029
9-Sep-15	9	17	300	235	7.5	230	#N/A	0.045	0.36	0.81	0.012	0.0029	0.0035	0.28	0.000045	0.000083	0.0013	0.000027	0.000000082	0.000000082	0.0015	0.000000035	0.080	0.00000059	0.000022
23-Sep-15	10	19	300	250	7.5	197	#N/A	0.037	0.29	0.79	0.013	0.0031	0.00	0.24	0.000049	0.000095	0.0015	0.000023	0.000000088	0.000000088	0.0015	0.000000038	0.068	0.0000021	0.000017
7-Oct-15	11	21	300	230	7.5	181	#N/A	0.035	0.25	0.63	0.012	0.0031	0.00	0.17	0.000054	0.000089	0.0012	0.000016	0.000000081	0.000000081	0.0010	0.000000046	0.049	0.00000035	0.000012
21-Oct-15	12	23	350	275	7.8	164	#N/A	0.020	0.32	0.56	0.014	0.0039	0.00	0.19	0.00010	0.000095	0.0015	0.000022	0.000000096	0.000000096	0.00096	0.000000069	0.054	0.0000028	0.000013
4-Nov-15	13	25	300	230	7.4	152	#N/A	0.027	0.20	0.45	0.012	0.0030	0.00	0.17	0.000084	0.000087	0.0013	0.000018	0.000000081	0.000000081	0.0010	0.000000081	0.049	0.00000081	0.000015
18-Nov-15	14	27	300	245	7.6	146	#N/A	0.018	0.27	0.51	0.012	0.0032	0.00	0.16	0.000031	0.000086	0.0014	0.000014	0.000000086	0.000000086	0.00083	0.000000037	0.044	0.00000037	0.000015
2-Dec-15	15	29	300	240	7.3	137	#N/A	0.043	0.21	0.47	0.012	0.0035	0.00	0.16	0.000062	0.000092	0.0015	0.000017	0.000000084	0.000000084	0.00075	0.00000012	0.043	0.0000034	0.000012
16-Dec-15	16	31	300	235	7.6	129	#N/A	0.048	0.21	0.46	0.012	0.0028	0.00	0.15	0.000046	0.000086	0.0013	0.000017	0.000000082	0.000000082	0.00077	0.000000082	0.042	0.00000071	0.000014
30-Dec-15	17	33	300	385	7.5	126	#N/A	0.054	0.31	0.60	0.019	0.0054	0.00	0.24	0.000075	0.00014	0.0022	0.000028	0.00000013	0.00000013	0.0014	0.000000077	0.068	0.00000077	0.000021
13-Jan-16	18	35	300	290	7.4	118	#N/A	0.041	0.24	0.45	0.015	0.0038	0.00												
27-Jan-16	19	37	300	300	7.5	120	#N/A	0.056	0.31	0.48	0.015	0.0044	0.00	0.18	0.00030	0.00010	0.0016	0.000024	0.00000011	0.00000011	0.00086	0.00000012	0.050	0.00000045	0.000014
10-Feb-16	20	39	300	275	7.5	119	#N/A	0.047	0.31	0.41	0.014	0.0036	0.00	0.17	0.000045	0.00010	0.0016	0.000018	0.000000096	0.000000096	0.00065	0.000000069	0.050	0.00000041	0.000015
24-Feb-16	21	41	300	300	7.5	119	#N/A	0.051	0.33	0.42	0.015	0.0039	0.00	0.18	0.000033	0.00011	0.0017	0.000019	0.00000011	0.00000011	0.00075	0.000000090	0.050	0.00000045	0.000016
9-Mar-16	22	43	300	335	7.5	119	#N/A	0.050	0.36	0.39															

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 13 (OKY Master)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
20-May-15	1	1	2000	415	7.0	0.0011	0.056	0.00014	0.023	19	2.3	0.050	0.0011	0.0042	0.023	31	0.0020	14	0.000056	120	0.36	125	0.00024	0.000070	0.00020	0.0030	0.00010	0.049	*< 0.002*
3-Jun-15	2	3	400	360	7.7	0.0013	*< 0.007*	0.000070	0.0096	2.1	0.54	0.030	0.0015	0.00080	0.0080	12	*< 0.001*	14	0.000032	42	0.036	22	0.000070	0.00011	0.00017	0.0029	0.00013	0.0070	*< 0.002*
17-Jun-15	3	5	300	260	7.7	0.00059	*< 0.007*	*< 0.00001*	0.0085	2.1	0.66	*< 0.01*	0.0023	0.00070	0.0060	12	0.00021	15	0.000010	40	0.038	26	0.000078	0.000090	0.00021	0.0037	0.00011	0.0060	*< 0.002*
1-Jul-15	4	7	300	280	7.8	0.00077	*< 0.007*	*< 0.00001*	0.0093	2.3	0.79	0.020	0.0022	0.00080	*< 0.003*	11	0.00020	15	0.000017	39	0.041	26	0.000074	0.00015	0.00022	0.0037	0.00013	0.0060	*< 0.002*
15-Jul-15	5	9	300	265	7.8	0.0034	*< 0.007*	0.000060	0.0099	2.5	1.0	*< 0.01*	0.0022	0.00090	*< 0.003*	11	0.00019	15	0.000017	41	0.045	29	0.000082	0.00044	0.00025	0.0038	0.00012	0.0070	*< 0.002*
29-Jul-15	6	11	300	250	7.7	0.00059	*< 0.007*	0.000020	0.011	2.5	1.1	0.010	0.0023	0.00080	*< 0.003*	12	0.00014	14	0.000010	37	0.046	30	0.000069	0.000060	*< 0.00005*	0.0035	0.00011	0.0050	*< 0.002*
12-Aug-15	7	13	300	295	7.7	0.00055	*< 0.007*	0.000010	0.0095	2.6	1.1	*< 0.01*	0.0025	0.00090	0.0030	12	0.00013	15	0.000012	36	0.047	27	0.000087	0.000090	*< 0.00005*	0.0026	0.00010	0.0050	*< 0.002*
26-Aug-15	8	15	300	250	7.6	0.00090	*< 0.007*	0.00010	0.0091	1.9	0.90	0.010	0.0022	0.00060	0.0040	10	0.00013	15	0.0000090	31	0.037	24	0.000065	0.00013	*< 0.00005*	0.0021	0.00012	0.0040	*< 0.002*
9-Sep-15	9	17	300	235	7.5	0.00093	*< 0.007*	0.000040	0.0071	1.7	0.75	*< 0.01*	0.0038	0.00060	*< 0.003*	10	0.00010	14	0.0000080	28	0.029	27	0.000066	0.00015	*< 0.00005*	0.0015	0.00014	0.0030	*< 0.002*
23-Sep-15	10	19	300	250	7.5	0.00092	*< 0.007*	0.000020	0.0065	1.3	0.60	*< 0.01*	0.0021	0.00040	*< 0.003*	8.6	0.000090	15	0.000086	24	0.024	21	0.000042	0.00010	0.00015	0.0011	0.00010	0.0030	*< 0.002*
7-Oct-15	11	21	300	230	7.5	0.00061	*< 0.007*	0.000020	0.0057	1.1	0.51	*< 0.01*	0.0037	0.00040	*< 0.003*	7.5	0.000050	13	0.000010	20	0.019	18	0.000059	0.00016	*< 0.00005*	0.0012	0.000090	0.0020	*< 0.002*
21-Oct-15	12	23	350	275	7.8	0.0014	*< 0.007*	0.000030	0.0047	0.97	0.45	*< 0.01*	0.0034	0.00040	0.0050	7.3	*< 0.00004*	14	0.0000060	17	0.016	15	0.000066	0.00016	0.000070	0.00087	0.00018	0.0020	*< 0.002*
4-Nov-15	13	25	300	230	7.4	0.00065	*< 0.007*	*< 0.00001*	0.0057	1.1	0.53	*< 0.01*	0.0040	0.00040	*< 0.003*	6.9	0.000070	14	0.0000020	18	0.019	17	0.000067	0.00016	0.00013	0.0012	0.00030	0.0030	*< 0.002*
18-Nov-15	14	27	300	245	7.6	0.00096	*< 0.007*	0.000070	0.0052	0.95	0.46	*< 0.01*	0.0039	0.00040	*< 0.003*	7.2	0.00011	14	*< 0.000002*	17	0.017	15	0.000052	0.000090	*< 0.00005*	0.0011	0.00010	0.0030	*< 0.002*
2-Dec-15	15	29	300	240	7.3	0.0013	*< 0.007*	0.000060	0.0050	0.98	0.45	*< 0.01*	0.0046	0.00030	0.0030	7.6	0.000090	14	0.0000020	18	0.016	15	0.000037	0.00018	*< 0.00005*	0.0010	0.00014	0.0040	*< 0.002*
16-Dec-15	16	31	300	235	7.6	0.00043	*< 0.007*	0.00017	0.0054	0.95	0.49	*< 0.01*	0.0043	0.00040	*< 0.003*	7.2	0.000060	15	*< 0.000002*	16	0.017	13	0.000075	0.000080	*< 0.00005*	0.0016	0.00012	0.0030	*< 0.002*
30-Dec-15	17	33	300	385	7.5	0.00061	*< 0.007*	0.00015	0.0058	0.94	0.49	0.010	0.0039	0.00040	0.0040	7.0	*< 0.00004*	14	0.0000030	16	0.016	12	0.000051	0.000040	0.000090	0.0012	0.00012	0.0030	*< 0.002*
13-Jan-16	18	35	300	290	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	19	37	300	300	7.5	0.00056	*< 0.007*	0.000030	0.0047	0.84	0.46	*< 0.01*	0.0021	0.00030	0.0060	6.7	*< 0.00004*	15	0.0000020	14	0.015	11	0.000046	0.00014	*< 0.00005*	0.00084	0.00012	0.0030	*< 0.002*
10-Feb-16	20	39	300	275	7.5	0.0026	*< 0.007*	0.00013	0.0050	0.85	0.48	*< 0.01*	0.0023	0.00030	0.0030	6.6	0.00017	16	*< 0.000002*	13	0.016	10	0.000043	0.00011	*< 0.00005*	0.00080	0.00012	0.0040	*< 0.002*
24-Feb-16	21	41	300	300	7.5	0.00054	*< 0.007*	0.000040	0.0051	0.86	0.49	0.020	0.0022	0.00040	0.0070	6.8	0.000040	16	0.0000020	12	0.015	9.6	0.000041	0.000050	0.000060	0.00089	0.000080	0.0050	*< 0.002*
9-Mar-16	22	43	300	335	7.5																								

Calculated Loading Rates for Col 13 (OKY Master)

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
20-May-15	1	1	2000	415	7.0	0.000046	0.0023	0.0000058	0.00097	0.80	0.096	0.0021	0.000045	0.00017	0.00095	1.3	0.000083	0.60	0.0000023	5.0	0.015	5.2	0.000010	0.0000029	0.0000083	0.00012	0.0000042	0.0020	0.000083
3-Jun-15	2	3	400	360	7.7	0.000023	0.00013	0.0000013	0.00017	0.037	0.0097	0.00054	0.000028	0.000014	0.00014	0.21	0.000018	0.25	0.00000058	0.76	0.00065	0.39	0.0000013	0.0000020	0.0000031	0.000052	0.0000023	0.00013	0.000036
17-Jun-15	3	5	300	260	7.7	0.0000077	0.000091	0.00000013	0.00011	0.027	0.0086	0.00013	0.000030	0.0000091	0.000078	0.15	0.0000027	0.19	0.00000013	0.52	0.00049	0.34	0.0000010	0.0000012	0.0000027	0.000048	0.0000014	0.000078	0.000026
1-Jul-15	4	7	300	280	7.8	0.000011	0.000098	0.00000014	0.00013	0.032	0.011	0.00028	0.000031	0.000011	0.000042	0.16	0.0000028	0.21	0.00000024	0.55	0.00058	0.36	0.0000010	0.0000021	0.0000031	0.000052	0.0000018	0.000084	0.000028
15-Jul-15	5	9	300	265	7.8	0.000045	0.000093	0.00000080	0.00013	0.034	0.014	0.00013	0.000029	0.000012	0.000040	0.14	0.0000025	0.20	0.00000023	0.54	0.00059	0.38	0.0000011	0.0000058	0.0000033	0.000050	0.0000016	0.000093	0.000027
29-Jul-15	6	11	300	250	7.7	0.0000074	0.000088	0.00000025	0.00013	0.031	0.014	0.00013	0.000029	0.000010	0.000038	0.15	0.0000018	0.18	0.00000013	0.46	0.00057	0.38	0.00000086	0.00000075	0.00000063	0.000044	0.0000014	0.000063	0.000025
12-Aug-15	7	13	300	295	7.7	0.0000081	0.00010	0.00000015	0.00014	0.038	0.017	0.00015	0.000037	0.000013	0.000044	0.18	0.0000019	0.22	0.00000018	0.53	0.00069	0.40	0.0000013	0.0000013	0.00000074	0.000038	0.0000015	0.000074	0.000030
26-Aug-15	8	15	300	250	7.6	0.000011	0.000088	0.0000013	0.00011	0.024	0.011	0.00013	0.000028	0.0000075	0.000050	0.13	0.0000016	0.18	0.00000011	0.39	0.00046	0.29	0.00000081	0.0000016	0.00000063	0.000027	0.0000015	0.000050	0.000025
9-Sep-15	9	17	300	235	7.5	0.000011	0.000082	0.00000047	0.000083	0.020	0.0089	0.00012	0.000044	0.0000071	0.000035	0.12	0.0000012	0.16	0.000000094	0.32	0.00034	0.32	0.00000078	0.0000018	0.00000059	0.000018	0.0000016	0.000035	0.000024
23-Sep-15	10	19	300	250	7.5	0.000012	0.000088	0.00000025	0.000081	0.016	0.0075	0.00013	0.000026	0.0000050	0.000038	0.11	0.0000011	0.19	0.0000011	0.30	0.00030	0.27	0.00000053	0.0000013	0.0000019	0.000014	0.0000013	0.000038	0.000025
7-Oct-15	11	21	300	230	7.5	0.0000070	0.000081	0.00000023	0.000066	0.012	0.0058	0.00012	0.000043	0.0000046	0.000035	0.087	0.00000058	0.15	0.00000012	0.23	0.00022	0.21	0.00000068	0.0000018	0.00000058	0.000014	0.0000010	0.000023	0.000023
21-Oct-15	12	23	350	275	7.8	0.000019	0.000096	0.00000041	0.000064	0.013	0.0061	0.00014	0.000047	0.0000055	0.000069	0.100	0.00000055	0.19	0.000000083	0.24	0.00022	0.21	0.00000091	0.0000022	0.00000096	0.000012	0.0000025	0.000028	0.000028
4-Nov-15	13	25	300	230	7.4	0.0000075	0.000081	0.00000012	0.000065	0.013	0.0061	0.00012	0.000046	0.0000046	0.000035	0.079	0.00000081	0.16	0.000000023	0.21	0.00022	0.19	0.00000077	0.0000018	0.0000015	0.000014	0.0000035	0.000035	0.000023
18-Nov-15	14	27	300	245	7.6	0.000012	0.000086	0.00000086	0.000063	0.012	0.0056	0.00012	0.000047	0.0000049	0.000037	0.088	0.0000013	0.17	0.000000025	0.20	0.00020	0.18	0.00000064	0.0000011	0.00000061	0.000013	0.0000012	0.000037	0.000025
2-Dec-15	15	29	300	240	7.3	0.000015	0.000084	0.00000072	0.000060	0.012	0.0054	0.00012	0.000055	0.0000036	0.000036	0.091	0.0000011	0.17	0.000000024	0.21	0.00020	0.18	0.00000044	0.0000022	0.00000060	0.000012	0.0000017	0.000048	0.000024
16-Dec-15	16	31	300	235	7.6	0.0000051	0.000082	0.0000020	0.000063	0.011	0.0057	0.00012	0.000051	0.0000047	0.000035	0.084	0.00000071	0.18	0.000000024	0.18	0.00020	0.15	0.00000088	0.00000094	0.00000059	0.000018	0.0000014	0.000035	0.000024
30-Dec-15	17	33	300	385	7.5	0.000012	0.00013	0.0000029	0.00011	0.018	0.0094	0.00019	0.000075	0.0000077	0.000077	0.13	0.00000077	0.27	0.000000058	0.30	0.00031	0.22	0.00000098	0.00000077	0.0000017	0.000023	0.0000023	0.000058	0.000039
13-Jan-16	18	35	300	290	7.4																								
27-Jan-16	19	37	300	300	7.5	0.0000084	0.00011	0.00000045	0.000071	0.013	0.0070	0.00015	0.000031	0.0000045	0.000090	0.10	0.00000060	0.23	0.000000030	0.20	0.00023	0.16	0.00000069	0.0000021	0.00000075	0.000013	0.0000018	0.000045	0.000030
10-Feb-16	20	39	300	275	7.5	0.000036	0.000096	0.0000018	0.000069	0.012	0.0066	0.00014	0.000032	0.0000041	0.000041	0.091	0.0000023	0.22	0.000000028	0.18	0.00021	0.14	0.00000059	0.0000015	0.00000069	0.000011	0.0000017	0.000055	0.000028
24-Feb-16	21	41	300	300	7.5	0.0000081	0.00011	0.00000060	0.000077	0.013	0.0073	0.00030	0.000033	0.0000060	0.00011	0.10	0.00000060	0.24	0.000000030	0.18	0.00023	0.14	0.00000062	0.00000075	0.00000090	0.000013	0.0000012	0.000075	0.000030
9-Mar-16	22	43	300	335	7.5																								

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 14 (OKY Master (Fresh))

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/L	mg$CaCO_3$/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg$CaCO_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
20-May-15	1	1	2000	575	8.0	782	#N/A	7.5	210	431	48	#N/A	*< 0.3*	569	0.0057	0.0062	0.050	0.043	*< 0.000007*	*< 0.000007*	0.048	0.000034	174	0.000050	0.0068
3-Jun-15	2	3	400	395	8.1	556	#N/A	6.0	200	78	9.0	0.80	*< 0.3*	119	0.0070	0.0085	0.057	0.022	*< 0.000007*	*< 0.000007*	0.075	0.000014	35	0.000060	0.0014
17-Jun-15	3	5	300	270	8.1	582	#N/A	5.4	193	79	*< 1*	0.70	*< 0.3*	140	0.0044	0.0085	0.048	0.027	*< 0.000007*	*< 0.000007*	0.074	0.000019	43	0.000050	0.0016
1-Jul-15	4	7	300	230	8.1	666	#N/A	6.1	187	126	7.0	0.70	*< 0.3*	159	0.0068	0.0076	0.041	0.032	*< 0.000007*	*< 0.000007*	0.084	0.000013	48	0.000040	0.0022
15-Jul-15	5	9	300	300	8.1	701	#N/A	6.0	192	175	*< 1*	0.65	*< 0.3*	188	0.0065	0.0071	0.034	0.041	*< 0.000007*	*< 0.000007*	0.092	0.000018	54	0.000090	0.0030
29-Jul-15	6	11	300	240	8.1	700	#N/A	5.1	181	173	*< 1*	0.66	*< 0.3*	202	0.0057	0.0065	0.025	0.037	0.0000070	*< 0.000007*	0.073	*< 0.000003*	61	0.00012	0.0027
12-Aug-15	7	13	300	335	8.1	665	#N/A	5.2	179	159	*< 1*	0.65	*< 0.3*	201	0.0055	0.0066	0.025	0.035	*< 0.000007*	*< 0.000007*	0.076	0.000025	59	0.000090	0.0029
26-Aug-15	8	15	300	280	8.1	572	#N/A	3.5	152	133	*< 1*	0.87	*< 0.3*	166	0.0077	0.0068	0.032	0.027	*< 0.000007*	*< 0.000007*	0.074	0.000019	50	*< 0.00003*	0.0015
9-Sep-15	9	17	300	285	8.1	354	#N/A	2.0	118	57	-	1.2	-	115	0.13	0.0072	0.031	0.019	*< 0.000007*	*< 0.000007*	0.059	0.000016	35	0.00015	0.00098
23-Sep-15	10	19	300	290	8.2	353	#N/A	1.4	134	53	-	1.2	-	113	0.0042	0.0062	0.033	0.014	*< 0.000007*	*< 0.000007*	0.045	0.0000090	34	0.000050	0.00081
7-Oct-15	11	21	300	280	8.2	342	#N/A	2.0	115	48	-	1.3	-	126	0.0076	0.0066	0.032	0.019	*< 0.000007*	*< 0.000007*	0.045	0.000012	38	0.00020	0.0010
21-Oct-15	12	23	300	290	8.3	333	#N/A	3.5	109	48	-	1.3	-	125	0.0059	0.0066	0.032	0.020	*< 0.000007*	*< 0.000007*	0.049	0.0000080	38	0.000050	0.00092
4-Nov-15	13	25	300	285	8.2	340	#N/A	1.4	109	40	-	1.3	-	131	0.0038	0.0066	0.032	0.021	*< 0.000007*	*< 0.000007*	0.050	0.000012	39	0.000040	0.0010
18-Nov-15	14	27	300	295	8.2	315	#N/A	1.2	107	45	-	1.3	-	121	0.0050	0.0061	0.026	0.018	0.0000080	*< 0.000007*	0.041	0.0000070	37	*< 0.00003*	0.00083
2-Dec-15	15	29	300	260	8.1	308	#N/A	3.0	105	46	-	1.4	-	114	0.0074	0.0061	0.030	0.020	*< 0.000007*	*< 0.000007*	0.043	0.000016	34	*< 0.00003*	0.00079
16-Dec-15	16	31	300	290	8.3	333	#N/A	3.5	109	48	-	1.3	-	125	0.0059	0.0066	0.032	0.020	*< 0.000007*	*< 0.000007*	0.049	0.0000080	38	0.000050	0.00092
30-Dec-15	17	33	300	285	8.2	340	#N/A	1.4	109	40	-	1.3	-	131	0.0038	0.0066	0.032	0.021	*< 0.000007*	*< 0.000007*	0.050	0.000012	39	0.000040	0.0010
13-Jan-16	18	35	300	295	8.2	315	#N/A	1.2	107	45	-	1.3	-	121	0.0050	0.0061	0.026	0.018	0.0000080	*< 0.000007*	0.041	0.0000070	37	*< 0.00003*	0.00083
27-Jan-16	19	37	300	260	8.1	308	#N/A	3.0	105	46	-	1.4	-	114	0.0074	0.0061	0.030	0.020	*< 0.000007*	*< 0.000007*	0.043	0.000016	34	*< 0.00003*	0.00079
10-Feb-16	20	39	300	280	8.2	300	#N/A	2.4	103	42	-	1.5	-	112	0.0057	0.0067	0.034	0.020	*< 0.000007*	*< 0.000007*	0.033	0.0000080	34	*< 0.00003*	0.00083
24-Feb-16	21	41	300	290	8.1	301	#N/A	2.2	100	42	-	1.5	-	119	0.0042	0.0065	0.034	0.020	*< 0.000007*	*< 0.000007*	0.036	0.000010	36	0.000050	0.00075
9-Mar-16	22	43	301	265	8.1	291	#N/A	2.3	97	40															

Calculated Loading Rates for Col 14 (OKY Master (Fresh))

Date	**Cycle**	**Weeks**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
	No.		Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
20-May-15	1	1	2000	575	8.0	782	#N/A	0.43	12	25	2.8	#N/A	0.017	33	0.00033	0.00036	0.0029	0.0025	0.00000040	0.00000040	0.0028	0.0000020	10	0.0000029	0.00039
3-Jun-15	2	3	400	395	8.1	556	#N/A	0.12	3.9	1.5	0.18	0.016	0.0059	2.4	0.00014	0.00017	0.0011	0.00044	0.00000014	0.00000014	0.0015	0.00000028	0.70	0.0000012	0.000028
17-Jun-15	3	5	300	270	8.1	582	#N/A	0.073	2.6	1.1	0.014	0.0095	0.0041	1.9	0.000059	0.00011	0.00065	0.00037	0.000000095	0.000000095	0.00099	0.00000026	0.58	0.00000068	0.000022
1-Jul-15	4	7	300	230	8.1	666	#N/A	0.070	2.1	1.4	0.081	0.0081	0.0035	1.8	0.000078	0.000087	0.00047	0.00037	0.000000081	0.000000081	0.00096	0.00000015	0.55	0.00000046	0.000025
15-Jul-15	5	9	300	300	8.1	701	#N/A	0.090	2.9	2.6	0.015	0.0098	0.0045	2.8	0.000098	0.00011	0.00051	0.00061	0.00000011	0.00000011	0.0014	0.00000027	0.81	0.0000014	0.000045
29-Jul-15	6	11	300	240	8.1	700	#N/A	0.061	2.2	2.1	0.012	0.0079	0.0036	2.4	0.000068	0.000078	0.00030	0.00044	0.000000084	0.000000084	0.00087	0.000000036	0.73	0.0000014	0.000033
12-Aug-15	7	13	300	335	8.1	665	#N/A	0.087	3.0	2.7	0.017	0.011	0.0050	3.4	0.000092	0.00011	0.00042	0.00059	0.00000012	0.00000012	0.0013	0.00000042	0.99	0.0000015	0.000048
26-Aug-15	8	15	300	280	8.1	572	#N/A	0.049	2.1	1.9	0.014	0.012	0.0042	2.3	0.00011	0.000095	0.00044	0.00038	0.000000098	0.000000098	0.0010	0.00000027	0.70	0.00000042	0.000021
9-Sep-15	9	17	300	285	8.1	354	#N/A	0.028	1.7	0.81		0.017	0.00	1.6	0.0019	0.00010	0.00044	0.00027	0.000000100	0.000000100	0.00084	0.00000023	0.50	0.0000021	0.000014
23-Sep-15	10	19	300	290	8.2	353	#N/A	0.020	1.9	0.77		0.018	0.00	1.6	0.000061	0.000090	0.00047	0.00020	0.00000010	0.00000010	0.00065	0.00000013	0.49	0.00000073	0.000012
7-Oct-15	11	21	300	280	8.2	342	#N/A	0.028	1.6	0.67		0.018	0.00	1.8	0.00011	0.000092	0.00045	0.00026	0.000000098	0.000000098	0.00063	0.00000017	0.53	0.0000028	0.000014
21-Oct-15	12	23	300	290	8.3	333	#N/A	0.050	1.6	0.70		0.019	0.00	1.8	0.000086	0.000096	0.00046	0.00029	0.00000010	0.00000010	0.00070	0.00000012	0.55	0.00000073	0.000013
4-Nov-15	13	25	300	285	8.2	340	#N/A	0.019	1.6	0.57		0.018	0.00	1.9	0.000054	0.000094	0.00045	0.00030	0.000000100	0.000000100	0.00071	0.00000017	0.56	0.00000057	0.000014
18-Nov-15	14	27	300	295	8.2	315	#N/A	0.018	1.6	0.66		0.019	0.00	1.8	0.000074	0.000090	0.00038	0.00027	0.00000012	0.00000010	0.00060	0.00000010	0.54	0.00000044	0.000012
2-Dec-15	15	29	300	260	8.1	308	#N/A	0.039	1.4	0.60		0.018	0.00	1.5	0.000096	0.000079	0.00039	0.00026	0.000000091	0.000000091	0.00056	0.00000021	0.45	0.00000039	0.000010
16-Dec-15	16	31	300	290	8.3	333	#N/A	0.050	1.6	0.70		0.019	0.00	1.8	0.000086	0.000096	0.00046	0.00029	0.00000010	0.00000010	0.00070	0.00000012	0.55	0.00000073	0.000013
30-Dec-15	17	33	300	285	8.2	340	#N/A	0.019	1.6	0.57		0.018	0.00	1.9	0.000054	0.000094	0.00045	0.00030	0.000000100	0.000000100	0.00071	0.00000017	0.56	0.00000057	0.000014
13-Jan-16	18	35	300	295	8.2	315	#N/A	0.018	1.6	0.66		0.019	0.00	1.8	0.000074	0.000090	0.00038	0.00027	0.00000012	0.00000010	0.00060	0.00000010	0.54	0.00000044	0.000012
27-Jan-16	19	37	300	260	8.1	308	#N/A	0.039	1.4	0.60		0.018	0.00	1.5	0.000096	0.000079	0.00039	0.00026	0.000000091	0.000000091	0.00056	0.00000021	0.45	0.00000039	0.000010
10-Feb-16	20	39	300	280	8.2	300	#N/A	0.033	1.4	0.59		0.021	0.00	1.6	0.000080	0.000094	0.00047	0.00027	0.000000098	0.000000098	0.00046	0.00000011	0.47	0.00000042	0.000012
24-Feb-16	21	41	300	290	8.1	301	#N/A	0.031	1.4	0.61		0.021	0.00	1.7	0.000061	0.000094	0.00049	0.00028	0.00000010	0.00000010	0.00052	0.00000015	0.52	0.00000073	0.000011
9-Mar-16	22	43	301	265	8.1	291	#N/A	0.030	1.3	0.53															

Note:
Values in grey italics are below the analytical detection limit

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Col 14 (OKY Master (Fresh))

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
20-May-15	1	1	2000	575	8.0	0.0021	*< 0.007*	0.000040	0.058	33	1.5	0.010	0.024	0.0024	0.025	31	*< 0.001*	6.9	0.000068	107	0.46	165	0.00014	*< 0.00001*	0.00015	0.40	0.00043	0.0020	*< 0.002*
3-Jun-15	2	3	400	395	8.1	0.0012	*< 0.007*	0.000060	0.037	7.4	0.47	*< 0.01*	0.038	0.00080	0.0070	17	*< 0.001*	6.7	0.000046	58	0.097	32	0.000075	0.000030	0.00012	0.084	0.00050	0.0010	*< 0.002*
17-Jun-15	3	5	300	270	8.1	0.0013	*< 0.007*	0.000010	0.033	8.1	0.64	*< 0.01*	0.036	0.00080	0.0090	18	0.00014	7.5	0.000010	53	0.11	44	0.000098	0.00011	0.00017	0.13	0.00042	0.0020	*< 0.002*
1-Jul-15	4	7	300	230	8.1	0.00081	*< 0.007*	0.000010	0.035	9.7	0.86	0.030	0.033	0.00090	0.0050	18	0.00011	7.6	0.000016	53	0.14	47	0.000094	0.00010	0.00012	0.21	0.00040	0.0010	*< 0.002*
15-Jul-15	5	9	300	300	8.1	0.0015	*< 0.007*	0.000060	0.037	13	1.3	*< 0.01*	0.028	0.0011	*< 0.003*	18	0.000080	8.0	0.0000050	57	0.17	56	0.00012	0.00022	0.00018	0.34	0.00042	0.0020	*< 0.002*
29-Jul-15	6	11	300	240	8.1	0.00092	*< 0.007*	0.000030	0.038	12	1.3	*< 0.01*	0.026	0.00090	*< 0.003*	19	0.000070	7.4	0.000034	50	0.18	59	0.00011	0.000060	0.000060	0.33	0.00039	0.0020	*< 0.002*
12-Aug-15	7	13	300	335	8.1	0.00045	*< 0.007*	0.000020	0.030	13	1.4	*< 0.01*	0.025	0.00090	0.0030	21	0.000070	8.0	0.000013	50	0.17	54	0.00011	0.000040	0.000090	0.26	0.00037	0.0020	*< 0.002*
26-Aug-15	8	15	300	280	8.1	0.0011	*< 0.007*	0.00015	0.027	9.7	1.0	*< 0.01*	0.027	0.00050	0.0040	17	0.000070	7.3	0.0000060	40	0.14	41	0.000096	0.00019	*< 0.00005*	0.21	0.00040	0.0020	*< 0.002*
9-Sep-15	9	17	300	285	8.1	0.0012	*< 0.007*	0.000010	0.016	6.7	0.72	*< 0.01*	0.026	0.00030	0.0030	12	0.000060	6.5	0.0000030	18	0.090	24	0.000082	0.00018	*< 0.00005*	0.083	0.00044	0.0040	*< 0.002*
23-Sep-15	10	19	300	290	8.2	0.00043	*< 0.007*	0.000030	0.014	7.1	0.73	*< 0.01*	0.020	*< 0.0001*	*< 0.003*	14	0.00017	6.6	*< 0.000002*	16	0.091	19	0.000059	0.000050	*< 0.00005*	0.055	0.00035	*< 0.001*	*< 0.002*
7-Oct-15	11	21	300	280	8.2	0.00057	*< 0.007*	0.00017	0.014	7.7	0.80	*< 0.01*	0.020	0.00030	*< 0.003*	14	0.000050	6.5	0.0000020	16	0.095	19	0.000060	0.000080	*< 0.00005*	0.070	0.00042	0.0020	*< 0.002*
21-Oct-15	12	23	300	290	8.3	0.00052	*< 0.007*	0.00038	0.014	7.4	0.82	*< 0.01*	0.018	0.00030	0.0060	14	0.000070	7.0	*< 0.000002*	14	0.096	17	0.000081	0.00011	0.000080	0.068	0.00035	0.0010	*< 0.002*
4-Nov-15	13	25	300	285	8.2	0.00067	*< 0.007*	0.00013	0.015	8.0	0.93	0.010	0.010	0.00040	0.0030	14	*< 0.00004*	6.8	*< 0.000002*	14	0.10	16	0.000065	*< 0.00001*	*< 0.00005*	0.047	0.00033	0.0020	*< 0.002*
18-Nov-15	14	27	300	295	8.2	0.00046	*< 0.007*	0.00025	0.014	7.3	0.83	*< 0.01*	0.012	0.00020	0.0030	14	0.00020	6.9	0.000012	12	0.086	15	0.000042	0.00018	*< 0.00005*	0.057	0.00032	0.0010	*< 0.002*
2-Dec-15	15	29	300	260	8.1	0.00047	*< 0.007*	0.000040	0.012	6.8	0.78	*< 0.01*	0.012	0.00020	0.0040	13	*< 0.00004*	6.7	0.0000020	10	0.092	15	0.000075	0.00011	0.000090	0.062	0.00035	0.0010	*< 0.002*
16-Dec-15	16	31	300	290	8.3	0.00052	*< 0.007*	0.00038	0.014	7.4	0.82	*< 0.01*	0.018	0.00030	0.0060	14	0.000070	7.0	*< 0.000002*	14	0.096	17	0.000081	0.00011	0.000080	0.068	0.00035	0.0010	*< 0.002*
30-Dec-15	17	33	300	285	8.2	0.00067	*< 0.007*	0.00013	0.015	8.0	0.93	0.010	0.010	0.00040	0.0030	14	*< 0.00004*	6.8	*< 0.000002*	14	0.10	16	0.000065	*< 0.00001*	*< 0.00005*	0.047	0.00033	0.0020	*< 0.002*
13-Jan-16	18	35	300	295	8.2	0.00046	*< 0.007*	0.00025	0.014	7.3	0.83	*< 0.01*	0.012	0.00020	0.0030	14	0.00020	6.9	0.000012	12	0.086	15	0.000042	0.00018	*< 0.00005*	0.057	0.00032	0.0010	*< 0.002*
27-Jan-16	19	37	300	260	8.1	0.00047	*< 0.007*	0.000040	0.012	6.8	0.78	*< 0.01*	0.012	0.00020	0.0040	13	*< 0.00004*	6.7	0.0000020	10	0.092	15	0.000075	0.00011	0.000090	0.062	0.00035	0.0010	*< 0.002*
10-Feb-16	20	39	300	280	8.2	0.0018	*< 0.007*	0.00014	0.012	6.8	0.80	*< 0.01*	0.012	0.00020	0.0060	13	0.000060	6.6	*< 0.000002*	9.6	0.090	15	0.000070	0.000080	*< 0.00005*	0.055	0.00037	0.0020	*< 0.002*
24-Feb-16	21	41	300	290	8.1	0.00019	*< 0.007*	0.000050	0.012	7.2	0.81	0.020	0.011	0.00020	0.0080	13	*< 0.00004*	7.1	*< 0.000002*	8.3	0.089	13	0.000073	0.000020	*< 0.00005*	0.056	0.00034	0.0010	*< 0.002*
9-Mar-16	22	43	301	265	8.1																								

Calculated Loading Rates for Col 14 (OKY Master (Fresh))

Date	Cycle	Weeks	Volume (mL)		pH	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
20-May-15	1	1	2000	575	8.0	0.00012	0.00040	0.0000023	0.0033	1.9	0.089	0.00058	0.0014	0.00014	0.0014	1.8	0.000058	0.40	0.0000039	6.2	0.027	9.5	0.0000082	0.00000058	0.0000086	0.023	0.000025	0.00012	0.00012
3-Jun-15	2	3	400	395	8.1	0.000024	0.00014	0.0000012	0.00073	0.15	0.0093	0.00020	0.00075	0.000016	0.00014	0.34	0.000020	0.13	0.00000091	1.1	0.0019	0.63	0.0000015	0.00000059	0.0000024	0.0017	0.0000099	0.000020	0.000040
17-Jun-15	3	5	300	270	8.1	0.000018	0.000095	0.00000014	0.00045	0.11	0.0087	0.00014	0.00048	0.000011	0.00012	0.24	0.0000019	0.10	0.00000014	0.71	0.0015	0.59	0.0000013	0.0000015	0.0000023	0.0017	0.0000057	0.000027	0.000027
1-Jul-15	4	7	300	230	8.1	0.0000093	0.000081	0.00000012	0.00040	0.11	0.0099	0.00035	0.00038	0.000010	0.000058	0.21	0.0000013	0.087	0.00000018	0.61	0.0016	0.54	0.0000011	0.0000012	0.0000014	0.0024	0.0000046	0.000012	0.000023
15-Jul-15	5	9	300	300	8.1	0.000023	0.00011	0.00000090	0.00055	0.19	0.020	0.00015	0.00042	0.000017	0.000045	0.27	0.0000012	0.12	0.000000075	0.86	0.0025	0.83	0.0000018	0.0000033	0.0000027	0.0051	0.0000063	0.000030	0.000030
29-Jul-15	6	11	300	240	8.1	0.000011	0.000084	0.00000036	0.00045	0.15	0.016	0.00012	0.00031	0.000011	0.000036	0.23	0.00000084	0.089	0.00000041	0.60	0.0021	0.71	0.0000013	0.00000072	0.00000072	0.0040	0.0000047	0.000024	0.000024
12-Aug-15	7	13	300	335	8.1	0.0000075	0.00012	0.00000034	0.00051	0.22	0.024	0.00017	0.00042	0.000015	0.000050	0.36	0.0000012	0.13	0.00000022	0.83	0.0029	0.90	0.0000019	0.00000067	0.0000015	0.0043	0.0000062	0.000034	0.000034
26-Aug-15	8	15	300	280	8.1	0.000016	0.000098	0.0000021	0.00037	0.14	0.014	0.00014	0.00038	0.0000070	0.000056	0.24	0.00000098	0.10	0.000000084	0.55	0.0019	0.58	0.0000013	0.0000027	0.00000070	0.0029	0.0000056	0.000028	0.000028
9-Sep-15	9	17	300	285	8.1	0.000018	0.000100	0.00000014	0.00022	0.096	0.010	0.00014	0.00037	0.0000043	0.000043	0.18	0.00000086	0.092	0.000000043	0.26	0.0013	0.34	0.0000012	0.0000026	0.00000071	0.0012	0.0000063	0.000057	0.000029
23-Sep-15	10	19	300	290	8.2	0.0000062	0.00010	0.00000044	0.00020	0.10	0.011	0.00015	0.00029	0.0000015	0.000044	0.20	0.0000025	0.096	0.000000029	0.23	0.0013	0.28	0.00000086	0.00000073	0.00000073	0.00080	0.0000051	0.000015	0.000029
7-Oct-15	11	21	300	280	8.2	0.0000080	0.000098	0.0000024	0.00019	0.11	0.011	0.00014	0.00028	0.0000042	0.000042	0.20	0.00000070	0.091	0.000000028	0.23	0.0013	0.26	0.00000084	0.0000011	0.00000070	0.00098	0.0000059	0.000028	0.000028
21-Oct-15	12	23	300	290	8.3	0.0000075	0.00010	0.0000055	0.00021	0.11	0.012	0.00015	0.00025	0.0000044	0.000087	0.20	0.0000010	0.10	0.000000029	0.20	0.0014	0.24	0.0000012	0.0000016	0.0000012	0.00099	0.0000051	0.000015	0.000029
4-Nov-15	13	25	300	285	8.2	0.0000095	0.000100	0.0000019	0.00022	0.11	0.013	0.00014	0.00015	0.0000057	0.000043	0.20	0.00000057	0.097	0.000000029	0.20	0.0015	0.23	0.00000093	0.00000014	0.00000071	0.00067	0.0000047	0.000029	0.000029
18-Nov-15	14	27	300	295	8.2	0.0000068	0.00010	0.0000037	0.00020	0.11	0.012	0.00015	0.00018	0.0000030	0.000044	0.20	0.0000030	0.10	0.00000018	0.17	0.0013	0.22	0.00000062	0.0000027	0.00000074	0.00085	0.0000047	0.000015	0.000030
2-Dec-15	15	29	300	260	8.1	0.0000061	0.000091	0.00000052	0.00016	0.088	0.010	0.00013	0.00016	0.0000026	0.000052	0.17	0.00000052	0.087	0.000000026	0.13	0.0012	0.20	0.00000098	0.0000014	0.0000012	0.00081	0.0000046	0.000013	0.000026
16-Dec-15	16	31	300	290	8.3	0.0000075	0.00010	0.0000055	0.00021	0.11	0.012	0.00015	0.00025	0.0000044	0.000087	0.20	0.0000010	0.10	0.000000029	0.20	0.0014	0.24	0.0000012	0.0000016	0.0000012	0.00099	0.0000051	0.000015	0.000029
30-Dec-15	17	33	300	285	8.2	0.0000095	0.000100	0.0000019	0.00022	0.11	0.013	0.00014	0.00015	0.0000057	0.000043	0.20	0.00000057	0.097	0.000000029	0.20	0.0015	0.23	0.00000093	0.00000014	0.00000071	0.00067	0.0000047	0.000029	0.000029
13-Jan-16	18	35	300	295	8.2	0.0000068	0.00010	0.0000037	0.00020	0.11	0.012	0.00015	0.00018	0.0000030	0.000044	0.20	0.0000030	0.10	0.00000018	0.17	0.0013	0.22	0.00000062	0.0000027	0.00000074	0.00085	0.0000047	0.000015	0.000030
27-Jan-16	19	37	300	260	8.1	0.0000061	0.000091	0.00000052	0.00016	0.088	0.010	0.00013	0.00016	0.0000026	0.000052	0.17	0.00000052	0.087	0.000000026	0.13	0.0012	0.20	0.00000098	0.0000014	0.0000012	0.00081	0.0000046	0.000013	0.000026
10-Feb-16	20	39	300	280	8.2	0.000026	0.000098	0.0000020	0.00017	0.096	0.011	0.00014	0.00016	0.0000028	0.000084	0.18	0.00000084	0.092	0.000000028	0.13	0.0013	0.21	0.00000098	0.0000011	0.00000070	0.00077	0.0000052	0.000028	0.000028
24-Feb-16	21	41	300	290	8.1	0.0000028	0.00010	0.00000073	0.00017	0.10	0.012	0.00029	0.00016	0.0000029	0.00012	0.19	0.00000058	0.10	0.000000029	0.12	0.0013	0.19	0.0000011	0.00000029	0.00000073	0.00081	0.0000049	0.000015	0.000029
9-Mar-16	22	43	301	265	8.1																								

Note:
Values in grey italics are below the analytical detection limit

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC1 (ST)

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	345	7.7	484	#N/A	6.4	54	136	2.2	0.38	*< 0.3*	137	0.018	0.0011	0.011	0.036	*< 0.000007*	*< 0.000007*	0.020	*< 0.000003*	31	0.00015	0.00048	0.0064
2-Jul-14	1	500	500	7.7	295	#N/A	8.1	53	77	0.50	0.23	*< 0.3*	107	0.018	0.0013	0.0086	0.025	*< 0.000007*	*< 0.000007*	0.014	*< 0.000003*	24	0.00019	0.00064	0.0026
9-Jul-14	2	500	485	7.9	192	#N/A	2.5	48	39	*< 0.2*	0.18	*< 0.3*	59	0.023	0.00060	0.0071	0.032	*< 0.000007*	*< 0.000007*	0.012	*< 0.000003*	14	0.000040	0.00010	0.0010
16-Jul-14	3	500	485	7.8	146	#N/A	2.4	46	19	*< 0.2*	0.13	*< 0.3*	47	0.023	0.0011	0.0062	0.032	*< 0.000007*	*< 0.000007*	0.0080	0.0000030	11	0.00021	0.00046	0.00081
23-Jul-14	4	500	485	7.8	108	#N/A	2.3	39	11	*< 0.2*	0.10	*< 0.3*	40	0.027	0.00050	0.0048	0.042	*< 0.000007*	*< 0.000007*	0.0066	*< 0.000003*	9.8	*< 0.00003*	0.00017	0.0014
30-Jul-14	5	500	480	8.1	79	#N/A	1.6	37	6.0	*< 0.2*	*< 0.06*	*< 0.3*	30	0.034	0.00060	0.0051	0.034	*< 0.000007*	*< 0.000007*	0.0043	*< 0.000003*	7.8	0.00020	0.00030	0.0015
6-Aug-14	6	500	485	7.8	76	#N/A	2.1	30	5.0	*< 0.2*	*< 0.06*	*< 0.3*	29	0.038	0.00030	0.0034	0.036	*< 0.000007*	*< 0.000007*	0.0068	*< 0.000003*	7.6	0.000030	0.000032	0.00037
13-Aug-14	7	500	490	8.2	109	#N/A	2.2	43	9.0	*< 0.2*	0.10	*< 0.3*	42	0.057	0.00040	0.0053	0.061	*< 0.000007*	*< 0.000007*	0.0067	*< 0.000003*	10	0.00026	0.000056	0.00053
20-Aug-14	8	500	485	7.9	85	#N/A	1.8	36	8.0	*< 0.2*	0.060	*< 0.3*	36	0.044	*< 0.0002*	0.0048	0.049	*< 0.000007*	*< 0.000007*	0.0048	*< 0.000003*	9.2	0.000090	0.000057	0.00091
27-Aug-14	9	500	500	8.1	117	#N/A	3.9	49	9.0	*< 0.2*	0.11	*< 0.3*	44	0.036	0.00040	0.0049	0.053	*< 0.000007*	*< 0.000007*	0.011	*< 0.000003*	11	0.00010	0.000035	0.00038
3-Sep-14	10	500	490	7.8	101	#N/A	4.4	42	9.0	*< 0.2*	0.090	*< 0.3*	53	0.030	0.0011	0.0060	0.052	*< 0.000007*	*< 0.000007*	0.0076	0.0000030	15	*< 0.00003*	0.000032	0.00072
10-Sep-14	11	500	500	8.2	98	#N/A	3.0	41	5.0	*< 0.2*	0.080	*< 0.3*	44	0.039	0.00040	0.0041	0.051	*< 0.000007*	*< 0.000007*	0.0064	*< 0.000003*	13	0.00010	0.000025	0.00037
17-Sep-14	12	500	475	8.0	77	#N/A	7.3	37	4.0	*< 0.2*	*< 0.06*	*< 0.3*	28	0.037	0.00020	0.0031	0.044	*< 0.000007*	*< 0.000007*	0.0062	*< 0.000003*	7.5	0.000070	0.000017	0.00025
24-Sep-14	13	500	485	8.2	75	#N/A	3.1	36	5.0	*< 0.2*	*< 0.06*	*< 0.3*	30	0.029	*< 0.0002*	0.0028	0.040	*< 0.000007*	*< 0.000007*	0.0035	*< 0.000003*	7.8	*< 0.00003*	0.00011	0.00044
1-Oct-14	14	500	485	7.8	72	#N/A	9.4	37	3.0	*< 0.2*	*< 0.06*	*< 0.3*	30	0.034	*< 0.0002*	0.0025	0.040	*< 0.000007*	*< 0.000007*	0.0030	0.000044	8.0	*< 0.00003*	0.00	*< 0.00002*
8-Oct-14	15	500	480	8.1	87	#N/A	2.7	35	4.0	*< 0.2*	0.060	*< 0.3*	44	0.036	0.00030	0.0036	0.052	*< 0.000007*	*< 0.000007*	0.024	*< 0.000003*	13	0.000070	0.000025	0.00031
15-Oct-14	16	500	485	7.7	94	#N/A	5.8	38	5.0	*< 0.2*	0.060	*< 0.3*	48	0.028	0.00040	0.0037	0.047	*< 0.000007*	*< 0.000007*	0.0057	0.000011	14	0.000040	0.000018	0.00034
22-Oct-14	17	500	490	8.1	92	#N/A	4.1	41	5.0	*< 0.2*	0.060	*< 0.3*	37	0.024	0.00040	0.0035	0.050	*< 0.000007*	*< 0.000007*	0.016	0.0000030	9.5	0.000040	0.000019	0.00032
29-Oct-14	18	500	495	7.8	89	#N/A	8.9	43	3.0	*< 0.2*	*< 0.06*	*< 0.3*	35	0.024	0.00040	0.0036	0.047	*< 0.000007*	*< 0.000007*	0.015	*< 0.000003*	9.3	0.00012	0.000018	0.00024
5-Nov-14	19	500	490	7.9	81	#N/A	#N/A	46	2.0	*< 0.2*	*< 0.06*	*< 0.3*	32	0.024	0.00030	0.0030	0.046	*< 0.000007*	*< 0.000007*	0.0060	0.000016	8.5	0.000060	0.000023	0.00054
12-Nov-14	20	500	485	7.6	88	#N/A	6.6	34	3.0	*< 0.2*	0.070	*< 0.3*	37	0.047	0.00040	0.0037	0.052	*< 0.000007*	*< 0.000007*	0.0058	0.0000030	9.9	0.00019	0.000031	0.00045
19-Nov-14	21	500	485	7.7	89	#N/A	6.7	35	2.0	*< 0.2*	0.060	*< 0.3*	36	0.027	0.00040	0.0033	0.058	*< 0.000007*	*< 0.000007*	0.0032	0.0000080	9.3	0.000060	0.000023	0.00047
26-Nov-14	22	500	490	8.1	88	#N/A	1.9	39	3.0	*< 0.2*	0.060	*< 0.3*	37	0.028	0.00040	0.0036	0.054	*< 0.000007*	*< 0.000007*	0.0023	*< 0.000003*	9.9	0.000050	0.000018	0.00029
3-Dec-14	23	500	475	8.0	75	#N/A	2.9	37	*< 2*	*< 0.2*	*< 0.06*	*< 0.3*	35	0.027	0.00040	0.0039	0.056	*< 0.000007*	*< 0.000007*	0.0049	*< 0.000003*	9.4	0.000050	0.000016	0.00031
10-Dec-14	24	500	495	7.9	63	#N/A	4.6	34	*< 2*	*< 0.2*	*< 0.06*	*< 0.3*	27	0.023	*< 0.0002*	0.0024	0.044	*< 0.000007*	*< 0.000007*	0.0029	*< 0.000003*	7.5	0.000060	0.000010	0.00030
17-Dec-14	25	500	495	7.7	74	#N/A	4.4	35	3.0	*< 0.2*	*< 0.06*	*< 0.3*	31	0.031	0.00020	0.0029	0.053	*< 0.000007*	*< 0.000007*	0.0022	*< 0.000003*	8.4	*< 0.00003*	0.000013	0.00040
24-Dec-14	26	500	495	7.7	75	#N/A	3.6	35	*< 2*	*< 0.2*	*< 0.06*	*< 0.3*	32	0.031	0.00030	0.0031	0.058	*< 0.000007*	*< 0.000007*	0.0063	*< 0.000003*	8.8	*< 0.00003*	0.000012	0.00022
31-Dec-14	27	500	495	7.9	88	#N/A	1.3	37	2.0	*< 0.2*	*< 0.06*	*< 0.3*	38	0.026	0.00080	0.0063	0.063	*< 0.000007*	*< 0.000007*	0.0028	*< 0.000003*	11	*< 0.00003*	0.0000060	0.00022
7-Jan-15	28	500	485	7.5	71	#N/A	3.1	34	2.0	*< 1*	*< 0.06*	*< 0.3*	33	0.026	0.00030	0.0025	0.048	*< 0.000007*	*< 0.000007*	0.0047	*< 0.000003*	9.1	0.000060	0.000015	0.00036
14-Jan-15	29	500	495	7.9	77	#N/A	2.4	38	3.0	*< 1*	*< 0.06*	*< 0.3*	39	0.022	0.00030	0.0030	0.051	*< 0.000007*	*< 0.000007*	0.0040	0.0000050	11	0.000060	0.000010	0.00038
21-Jan-15	30	500	485	7.8	83	#N/A	4.7	43	2.0	*< 1*	*< 0.06*	*< 0.3*	35	0.026	0.00040	0.0030	0.063	*< 0.000007*	*< 0.000007*	0.0037	*< 0.000003*	9.3	0.000080	0.000015	0.00064
28-Jan-15	31	500	495	7.8	75	#N/A	1.7	37	2.0	*< 1*	*< 0.06*	*< 0.3*	33	0.026	0.00030	0.0026	0.054	*< 0.000007*	*< 0.000007*	0.0044	0.0000040	9.0	0.00010	0.0000090	0.00021
4-Feb-15	32	500	490	7.8	77	#N/A	2.6	36	2.0	*< 1*	*< 0.06*	*< 0.3*	32	0.022	0.00030	0.0027	0.055	*< 0.000007*	*< 0.000007*	0.0051	0.0000030	8.7	0.00020	0.0000070	0.00067
11-Feb-15	33	500	490	8.0	74	#N/A	2.0	37	3.0	*< 1*	*< 0.06*	*< 0.3*	32	0.025	0.00040	0.0026	0.051	*< 0.000007*	*< 0.000007*	0.0039	*< 0.000003*	8.8	0.000050	0.000012	0.00067
18-Feb-15	34	500	485	7.8	73	#N/A	2.3	36	2.0	1.0	0.070	*< 0.3*	33	0.026	0.00050	0.0027	0.051	*< 0.000007*	*< 0.000007*	0.0029	*< 0.000003*	9.1	0.000040	0.000016	0.00042
25-Feb-15	35	500	490	7.8	76	#N/A	3.1	38	*< 2*	*< 1*	*< 0.06*	*< 0.3*	32	0.022	0.00040	0.0025	0.057	*< 0.000007*	*< 0.000007*	0.0015	0.0000060	9.0	0.000080	0.000017	0.0011
4-Mar-15	36	500	480	7.7	62	#N/A	2.1	31	*< 2*	*< 1*	*< 0.06*	*< 0.3*	30	0.020	0.00020	0.0018	0.047	*< 0.000007*	*< 0.000007*	0.0027	*< 0.000003*	9.1	0.00011	0.0000070	0.00048
11-Mar-15	37	500	480	8.0	64	#N/A	1.6	34	2.0	*< 1*	0.080	*< 0.3*	28	0.021	0.00030	0.0021	0.048	*< 0.000007*	*< 0.000007*	0.0053	*< 0.000003*	7.9	0.000090	0.0000060	0.00080
18-Mar-15	38	500	500	7.8	65	#N/A	2.6	33	2.0	*< 1*	*< 0.06*	*< 0.3*	31	0.021	0.00030	0.0017	0.047	0.000014	*< 0.000007*	0.0022	*< 0.000003*	9.5	0.00010	0.000013	0.0011
25-Mar-15	39	500	485	7.8	65	#N/A	2.9	34	*< 2*	*< 1*	*< 0.06*	*< 0.3*	29	0.026	0.00030	0.0024	0.055	*< 0.000007*	*< 0.000007*	0.0052	*< 0.000003*	8.3	0.00013	0.0000040	0.0020
1-Apr-15	40	500	500	7.7	66	#N/A	3.7	36	2.0	*< 1*	*< 0.06*	*< 0.3*	25	0.023	0.00030	0.0016	0.061	0.000012	*< 0.000007*	0.0027	*< 0.000003*	6.8	0.000060	*< 0.000004*	0.00037
8-Apr-15	41	500	490	7.9	71	#N/A	2.8	38	2.0	*< 1*	*< 0.06*	*< 0.3*	30	0.022	0.00040	0.0022	0.056	*< 0.000007*	*< 0.000007*	0.0050	*< 0.000003*	8.6	0.000060	0.000016	0.00098
15-Apr-15	42	500	485	7.7	61	#N/A	3.8	34	*< 2*	*< 1*	*< 0.06*	*< 0.3*	26	0.022	0.00030	0.0018	0.050	*< 0.000007*	*< 0.000007*	0.0065	*< 0.000003*	7.6	0.000060	*< 0.000004*	0.00097
22-Apr-15	43	500	490	7.6	60	#N/A	3.1	34	3.0	*< 1*	*< 0.06*	*< 0.3*	26	0.019	0.00020	0.0015	0.046	*< 0.000007*	*< 0.000007*	0.0089	*< 0.000003*	7.5	0.000040	0.0000060	0.0011
29-Apr-15	44	500	490	7.8	80	#N/A	2.1	39	3.0	*< 1*	*< 0.06*	*< 0.3*	40	0.026	0.00040	0.0029	0.068	*< 0.000007*	*< 0.000007*	0.0036	0.0000050	12	0.000090	0.000020	0.00054
6-May-15	45	500	500	8.0	73	#N/A	2.4	39	*< 2*	*< 1*	*< 0.06*	*< 0.3*	32	0.026	0.00030	0.0064	0.055	*< 0.000007*	*< 0.000007*	0.0045	*< 0.000003*	9.2	*< 0.00003*	0.000017	0.00033
13-May-15	46	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	475	470	8.2	161	#N/A	2.8	76	6.0	*< 1*	0.060	*< 0.3*	75	0.0097	0.00060	0.0024	0.16	*< 0.000007*	*< 0.000007*	0.0041	*< 0.000003*	22	0.00016	0.000022	0.00034
10-Jun-15	50	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	470	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	460	465	8.1	166	#N/A	3.6	76	4.0	*< 1*	*< 0.06*	*< 0.3*	66	0.016	0.00050	0.0028	0.14	*< 0.000007*	*< 0.000007*	0.014	0.0000030	19	0.00020	0.000037	0.00035
8-Jul-15	54	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	480	470	8.1	161	#N/A	1.9	78	5.0	*< 1*	*< 0.06*	*< 0.3*	70	0.015	0.00050	0.0025	0.14	*< 0.000007*	*< 0.000007*	0.0074	0.0000030	20	0.00021	0.000028	0.00022
5-Aug-15	58	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	480	470	8.0	158	#N/A	2.0	76	5.0	*< 1*	*< 0.06*	*< 0.3*	70	0.0090	0.00060	0.0028	0.15	*< 0.000007*	*< 0.000007*	0.0062	0.0000080	20	0.00017	0.000025	0.00046
2-Sep-15	62	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	490	470	8.1	163	#N/A	2.1	77	5.0				73	0.010	0.00060	0.0028	0.16	*< 0.000007*	*< 0.000007*	0.0072	0.0000040	21	0.00020	0.000025	0.00025
30-Sep-15	66	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	480	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	460	450	8.1	149	#N/A	1.6	75	5.0				70	0.0099	0.00050	0.0026	0.14	*< 0.000007*	*< 0.000007*	0.0066	0.000035	20	0.00024	0.000036	0.0016
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	470	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	460	460	8.0	138	#N/A	1.1	74	4.0				58	0.019	0.00040	0.0020	0.13	*< 0.000007*	*< 0.000007*	0.0033	*< 0.000003*	17	0.00023	0.000080	0.00062
25-Nov-15	74	500	485	8.0	69	#N/A	0.40	40	2.0				33	0.031	0.00030	0.0025	0.062	*< 0.000007*	*< 0.000007*	0.0032	*< 0.000003*	10	0.00016	0.00018	0.00078
2-Dec-15	75	500	495	8.0	68	#N/A	1.4	35	2.0				30	0.029	0.00030	0.0023	0.062	*< 0.000007*	*< 0.000007*	0.0028	0.0000070	8.7	0.000050	0.000014	0.00056
9-Dec-15	76	500	505	8.1	67	#N/A	2.4	34	2.0				28	0.030	0.00040	0.0031	0.062	0.000010	*< 0.000007*	0.0090	0.000013	8.4	0.00010	0.0000040	0.00035
16-Dec-15	77	500	495	7.9	63	#N/A	1.7	30	2.0				30	0.051	*< 0.0002*	0.0022	0.063	*< 0.000007*	*< 0.000007*	0.0020	0.0000040	8.9	0.00020	0.000016	0.00042
23-Dec-15	78	500	500	7.9	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	485	7.9	62	#N/A	1.3	31	3.0				28	0.026	*< 0.0002*	0.0015	0.059	*< 0.000007*	*< 0.000007*	0.0024	0.0000040	8.5	0.00010	*< 0.000004*	0.00022
6-Jan-16	80	500	495	7.9	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	495	7.8	68	#N/A	1.5	32	3.0				29	0.022	0.00020	0.0018	0.061	*< 0.000007*	*< 0.000007*	0.0050	*< 0.000003*	8.5	0.000080	*< 0.000004*	0.00024
20-Jan-16	82	500	495	7.9	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	490	7.9	73	#N/A	2.5	35	2.0				32	0.026	*< 0.0002*	0.0022	0.073	*< 0.000007*	*< 0.000007*	*< 0.002*	0.0000030	9.2	0.000080	0.000018	0.00020
3-Feb-16	84	500	490	7.9	74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.8	70	#N/A	2.3	34	2.0				30	0.025	0.00020	0.0022	0.076	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	9.1	0.000090	0.0000080	0.00075
17-Feb-16	86	500	500	7.8	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.8	69	#N/A	2.3	32	*< 2*				31	0.028	0.00020	0.0020	0.070	*< 0.000007*	*< 0.000007*	*< 0.002*	0.0000030	9.0	0.000030	*< 0.000004*	0.00015

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC1 (ST)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	345	7.7	0.0090	0.000010	0.0085	15	0.011	0.020	0.015	0.0053	0.025	9.5	0.0035	2.8	< 0.000002	35	1.1	55	0.000026	0.00013	0.00018	0.012	0.00073	0.0020	< 0.002
2-Jul-14	1	500	500	7.7	< 0.002	< 0.00001	0.0067	12	0.016	< 0.01	0.0096	0.0042	< 0.009	7.7	0.0013	2.4	< 0.000002	21	1.1	35	0.000021	0.0072	0.00020	0.018	0.00048	0.0010	< 0.002
9-Jul-14	2	500	485	7.9	0.0060	< 0.00001	0.0044	6.0	0.0098	< 0.01	0.0062	0.0019	< 0.009	5.8	0.00032	2.0	< 0.000002	8.8	0.82	14	0.000013	0.0033	0.00015	0.0081	0.00048	< 0.001	< 0.002
16-Jul-14	3	500	485	7.8	0.011	< 0.00001	0.0034	4.8	0.0065	< 0.01	0.0075	0.0012	< 0.009	4.5	0.00018	1.5	0.0000060	5.6	0.75	7.5	0.000018	0.00024	0.000090	0.011	0.00037	< 0.001	< 0.002
23-Jul-14	4	500	485	7.8	0.0020	0.000020	0.0026	3.8	0.0078	< 0.01	0.0032	0.00070	< 0.009	3.9	0.00011	1.3	0.0000040	3.4	0.66	5.2	0.0000090	0.0032	0.000080	0.0050	0.00033	< 0.001	< 0.002
30-Jul-14	5	500	480	8.1	0.0050	< 0.00001	0.0019	2.6	0.0066	< 0.01	0.0052	0.00040	0.015	2.7	0.000090	0.84	< 0.000002	1.8	0.51	2.9	0.000011	0.00021	0.00023	0.0071	0.00029	< 0.001	< 0.002
6-Aug-14	6	500	485	7.8	0.0080	0.000030	0.0015	2.5	0.0057	< 0.01	0.0019	< 0.0001	0.011	2.8	0.00012	0.86	< 0.000002	1.5	0.53	2.6	0.0000070	0.00011	0.00026	0.0036	0.00081	0.0020	< 0.002
13-Aug-14	7	500	490	8.2	0.018	0.000020	0.0027	4.1	0.0062	< 0.01	0.0034	0.00030	0.010	4.4	0.00012	1.5	< 0.000002	2.7	0.77	4.3	0.000010	0.0012	0.00082	0.0058	0.00034	< 0.001	< 0.002
20-Aug-14	8	500	485	7.9	0.0060	0.000040	0.0019	3.2	0.0064	< 0.01	0.0024	0.00030	< 0.009	3.4	0.00031	1.1	< 0.000002	1.5	0.66	2.9	0.0000060	0.0020	0.00037	0.0048	0.00037	< 0.001	< 0.002
27-Aug-14	9	500	500	8.1	0.0060	< 0.00001	0.0026	4.1	0.0076	< 0.01	0.0039	0.00030	< 0.009	4.4	0.00011	1.5	< 0.000002	2.1	0.87	3.6	0.000016	0.0014	0.00032	0.0064	0.00039	< 0.001	< 0.002
3-Sep-14	10	500	490	7.8	< 0.007	0.000040	0.0024	3.7	0.0060	< 0.01	0.0031	0.00030	0.0050	4.6	0.00028	1.5	0.000013	1.6	0.94	4.0	0.000018	0.00019	0.000060	0.0053	0.00039	< 0.001	< 0.002
10-Sep-14	11	500	500	8.2	0.010	< 0.00001	0.0019	2.9	0.0060	< 0.01	0.0025	0.00020	< 0.003	3.6	0.000090	1.3	< 0.000002	1.2	0.81	2.3	0.000015	0.0015	0.00032	0.0045	0.00031	< 0.001	< 0.002
17-Sep-14	12	500	475	8.0	< 0.007	< 0.00001	0.0014	2.4	0.0052	< 0.01	0.0017	0.00010	< 0.003	2.9	0.00010	0.82	< 0.000002	0.69	0.66	2.1	< 0.000005	0.000090	0.00017	0.0033	0.00027	< 0.001	< 0.002
24-Sep-14	13	500	485	8.2	< 0.002	0.000010	0.0015	2.5	0.0045	< 0.01	0.0017	0.00020	< 0.009	2.8	< 0.00004	0.82	0.0000050	0.70	0.58	1.6	< 0.000005	0.00010	< 0.00005	0.0034	0.00024	< 0.001	< 0.002
1-Oct-14	14	500	485	7.8	0.040	0.000040	0.0013	2.5	0.011	< 0.01	0.0021	0.00010	< 0.009	2.9	< 0.00004	0.88	< 0.000002	0.58	0.63	2.0	< 0.000005	0.000060	0.00030	0.0033	0.00025	< 0.002	< 0.002
8-Oct-14	15	500	480	8.1	0.010	0.000020	0.0018	2.7	0.0056	< 0.01	0.0034	0.00020	< 0.003	3.4	< 0.00004	1.0	< 0.000002	0.66	0.79	2.4	0.000017	0.00048	0.00041	0.0042	0.00036	< 0.001	< 0.002
15-Oct-14	16	500	485	7.7	< 0.007	< 0.00001	0.0021	3.2	0.0047	< 0.01	0.0022	0.00020	< 0.003	3.8	0.000070	1.1	< 0.000002	0.75	0.89	2.4	0.000010	0.0014	0.00010	0.0046	0.00028	< 0.001	< 0.002
22-Oct-14	17	500	490	8.1	0.010	0.000010	0.0019	3.3	0.0054	< 0.01	0.0022	0.00020	< 0.003	4.0	0.000070	1.1	< 0.000002	0.68	0.89	2.2	0.000022	0.00019	0.000080	0.0047	0.00026	< 0.001	< 0.002
29-Oct-14	18	500	495	7.8	< 0.007	< 0.00001	0.0018	3.0	0.0042	< 0.01	0.0019	0.00010	< 0.003	3.4	0.000060	1.0	< 0.000002	0.53	0.84	1.8	0.000014	0.00096	< 0.00005	0.0041	0.00027	< 0.001	< 0.002
5-Nov-14	19	500	490	7.9	< 0.007	0.00030	0.0015	2.7	0.0039	< 0.01	0.0024	0.00020	< 0.003	3.0	< 0.00004	0.93	< 0.000002	0.46	0.78	1.7	0.000022	0.00026	0.00013	0.0039	0.00023	< 0.001	< 0.002
12-Nov-14	20	500	485	7.6	0.017	0.000040	0.0016	3.0	0.0049	< 0.01	0.0027	0.00020	< 0.003	3.3	0.000070	1.1	< 0.000002	0.53	0.90	1.8	0.000013	0.0010	0.00076	0.0044	0.00034	< 0.001	< 0.002
19-Nov-14	21	500	485	7.7	< 0.007	0.00013	0.0016	3.0	0.0052	< 0.01	0.0017	0.00020	< 0.003	3.3	0.000080	0.93	0.0000020	0.43	0.91	1.6	0.000025	0.00054	0.000050	0.0041	0.00027	0.0020	< 0.002
26-Nov-14	22	500	490	8.1	< 0.007	< 0.00001	0.0018	3.1	0.0042	< 0.01	0.0019	< 0.0001	0.010	3.4	0.00022	1.1	< 0.000002	0.41	0.89	1.5	0.000014	0.00013	0.00011	0.0043	0.00030	< 0.001	< 0.002
3-Dec-14	23	500	475	8.0	< 0.007	< 0.00001	0.0016	2.8	0.0049	0.010	0.0016	0.00010	< 0.003	3.1	0.000070	0.81	< 0.000002	0.33	0.75	1.4	0.000016	0.00097	0.00010	0.0041	0.00032	< 0.001	< 0.002
10-Dec-14	24	500	495	7.9	< 0.007	< 0.00001	0.0011	2.0	0.0039	< 0.01	0.0013	< 0.0001	< 0.003	2.3	0.000060	0.60	< 0.000002	0.21	0.65	1.1	0.000013	0.00058	< 0.00005	0.0028	0.00019	< 0.001	< 0.002
17-Dec-14	25	500	495	7.7	< 0.007	< 0.00001	0.0014	2.6	0.0045	< 0.01	0.0012	< 0.0001	< 0.003	3.1	0.000050	0.86	< 0.000002	0.28	0.79	1.2	0.000011	0.00085	0.00040	0.0034	0.00028	0.0010	< 0.002
24-Dec-14	26	500	495	7.7	< 0.007	< 0.00001	0.0015	2.5	0.0039	< 0.01	0.0014	0.00010	< 0.003	2.8	0.00016	0.78	< 0.000002	0.27	0.78	1.3	0.0000090	0.00074	0.00010	0.0034	0.00029	< 0.001	< 0.002
31-Dec-14	27	500	495	7.9	< 0.007	< 0.00001	0.0017	3.0	0.0043	< 0.01	0.0020	0.00010	< 0.003	3.5	0.00023	1.2	< 0.000002	0.31	0.96	1.8	0.000021	0.00053	0.000060	0.0045	0.00029	< 0.001	< 0.002
7-Jan-15	28	500	485	7.5	< 0.007	0.000020	0.0013	2.5	0.0038	< 0.01	0.0019	0.00010	< 0.003	2.8	0.00012	0.71	< 0.000002	0.21	0.75	0.90	0.000039	0.00036	0.000050	0.0032	0.00023	< 0.001	< 0.002
14-Jan-15	29	500	495	7.9	< 0.007	0.000020	0.0012	2.5	0.0036	< 0.01	0.0021	0.00010	< 0.003	2.9	0.00011	1.0	0.0000020	0.21	0.86	1.0	0.000028	0.00063	< 0.00005	0.0033	0.00022	< 0.001	< 0.002
21-Jan-15	30	500	485	7.8	< 0.007	0.000030	0.0016	2.8	0.0039	< 0.01	0.0023	0.00010	< 0.003	3.2	0.00010	0.88	0.0000020	0.24	0.93	1.0	0.000017	0.00068	0.000080	0.0043	0.00030	< 0.001	< 0.002
28-Jan-15	31	500	495	7.8	< 0.007	< 0.00001	0.0011	2.7	0.0037	< 0.01	0.0065	< 0.0001	< 0.003	3.1	0.00014	0.89	0.0000040	0.20	0.68	1.6	0.0000090	0.00025	0.00011	0.0032	0.00024	< 0.001	< 0.002
4-Feb-15	32	500	490	7.8	< 0.007	0.000030	0.0014	2.6	0.0038	< 0.01	0.0013	0.00010	< 0.003	2.9	0.000060	0.84	< 0.000002	0.18	0.78	1.3	0.0000090	0.00051	< 0.00005	0.0032	0.00025	0.0010	< 0.002
11-Feb-15	33	500	490	8.0	< 0.007	0.000010	0.0012	2.3	0.0033	< 0.01	0.0017	0.00010	< 0.003	2.8	< 0.001	0.77	< 0.000002	0.16	0.77	1.1	0.000013	0.0010	0.000090	0.0029	0.00025	< 0.001	< 0.002
18-Feb-15	34	500	485	7.8	< 0.007	< 0.00001	0.0014	2.6	0.0036	0.010	0.0011	0.00010	< 0.003	3.0	< 0.001	0.81	0.0000030	0.18	0.92	1.1	0.000012	0.00059	0.000070	0.0033	0.00027	< 0.001	< 0.002
25-Feb-15	35	500	490	7.8	< 0.007	0.000020	0.0012	2.4	0.0031	< 0.01	0.0013	0.00010	< 0.003	3.1	< 0.001	0.83	< 0.000002	0.14	0.81	0.60	0.000014	0.00050	0.00013	0.0036	0.00023	< 0.001	< 0.002
4-Mar-15	36	500	480	7.7	< 0.007	0.000020	0.0010	1.7	0.0035	< 0.01	0.00091	< 0.0001	< 0.003	2.2	< 0.001	0.65	< 0.000002	0.11	0.56	1.0	< 0.000005	0.00058	0.000080	0.0026	0.00021	< 0.001	< 0.002
11-Mar-15	37	500	480	8.0	< 0.007	0.000050	0.0011	2.0	0.0036	< 0.01	0.00084	< 0.0001	< 0.003	2.2	< 0.001	0.55	0.0000070	0.080	0.61	0.10	0.0000070	0.00065	< 0.00005	0.0024	0.00019	0.0010	< 0.002
18-Mar-15	38	500	500	7.8	0.013	0.000010	0.00098	1.8	0.0038	< 0.01	0.00085	0.00010	< 0.003	2.5	< 0.001	0.57	< 0.000002	0.10	0.67	1.0	< 0.000005	0.00083	0.00020	0.0023	0.00018	< 0.001	< 0.002
25-Mar-15	39	500	485	7.8	< 0.007	0.000030	0.00084	2.1	0.0036	< 0.01	0.0022	0.00020	< 0.003	2.6	< 0.001	0.65	0.0000020	0.18	0.65	1.0	< 0.000005	0.00083	0.000090	0.0027	0.00031	< 0.001	< 0.002
1-Apr-15	40	500	500	7.7	< 0.007	< 0.00001	0.00080	1.8	0.011	< 0.01	0.00072	0.00010	< 0.003	2.6	< 0.001	0.44	< 0.000002	0.79	0.67	0.50	0.000010	0.00056	< 0.00005	0.0033	0.00017	< 0.001	< 0.002
8-Apr-15	41	500	490	7.9	< 0.007	< 0.00001	0.0011	2.0	0.0031	< 0.01	0.0013	< 0.0001	< 0.003	2.8	< 0.001	0.74	< 0.000002	0.11	0.75	0.60	< 0.000005	0.00075	< 0.00005	0.0027	0.00022	< 0.001	< 0.002
15-Apr-15	42	500	485	7.7	0.010	< 0.00001	0.00098	1.8	0.0030	< 0.01	0.0012	< 0.0001	< 0.003	2.4	< 0.001	0.58	0.0000040	0.13	0.66	0.90	< 0.000005	0.0010	< 0.00005	0.0023	0.00026	< 0.001	< 0.002
22-Apr-15	43	500	490	7.6	< 0.007	0.000020	0.00088	1.7	0.0032	< 0.01	0.00077	< 0.0001	< 0.003	2.3	< 0.001	0.55	0.000011	0.070	0.62	0.60	0.000017	0.00095	0.000090	0.0020	0.00019	< 0.001	< 0.002
29-Apr-15	44	500	490	7.8	< 0.007	0.00010	0.0013	2.5	0.0033	< 0.01	0.0013	0.00010	< 0.003	3.5	< 0.001	0.83	< 0.000002	0.12	0.84	1.1	0.0000080	0.00071	< 0.00005	0.0033	0.00025	< 0.001	< 0.002
6-May-15	45	500	500	8.0	< 0.007	< 0.00001	0.0012	2.2	0.0032	< 0.01	0.0015	0.00010	< 0.003	3.0	< 0.001	0.79	< 0.000002	0.14	0.74	0.90	< 0.000005	0.00057	0.00012	0.0033	0.00025	0.0010	< 0.002
13-May-15	46	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	475	470	8.2	< 0.007	< 0.00001	0.0026	5.0	0.0045	< 0.01	0.0024	0.00020	< 0.003	5.6	0.00011	1.9	< 0.000002	0.21	1.8	2.5	0.000021	0.0012	0.000070	0.0070	0.00019	< 0.001	< 0.002
10-Jun-15	50	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	470	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	460	465	8.1	0.011	< 0.00001	0.0024	4.7	0.0048	0.010	0.0020	0.00030	< 0.003	4.8	0.00039	1.6	0.0000040	0.22	1.7	3.3	0.000017	0.0010	0.00025	0.0067	0.00022	0.0010	< 0.002
8-Jul-15	54	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	480	470	8.1	< 0.007	< 0.00001	0.0027	5.1	0.0039	< 0.01	0.0025	0.00030	< 0.003	5.1	0.00013	1.7	< 0.000002	0.23	1.8	2.5	0.0000050	0.00079	0.00019	0.0070	0.00026	< 0.001	< 0.002
5-Aug-15	58	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	480	470	8.0	< 0.007	0.00011	0.0026	4.7	0.0037	< 0.01	0.0028	0.00020	< 0.003	5.0	0.00013	1.8	< 0.000002	0.21	1.8	2.2	0.000014	0.00095	0.000070	0.0065	0.00028	< 0.001	< 0.002
2-Sep-15	62	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	490	470	8.1	< 0.007	< 0.00001	0.0025	5.2	0.0028	< 0.01	0.0031	0.00030	< 0.003	5.4	0.00015	1.8	< 0.000002	0.22	1.8	2.5	0.000017	0.0013	0.00013	0.0061	0.00023	< 0.001	< 0.002
30-Sep-15	66	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	480	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	460	450	8.1	< 0.007	0.000080	0.0024	4.9	0.0038	< 0.01	0.0018	0.00020	< 0.003	5.2	0.00052	1.6	0.00010	0.40	1.6	2.5	0.000020	0.0013	0.00012	0.0057	0.00018	0.0010	< 0.002
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	470	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	460	460	8.0	0.0080	0.000020	0.0017	4.0	0.0050	< 0.01	0.0030	< 0.0001	< 0.003	4.5	0.00024	1.2	0.0000013	0.20	1.3	1.4	0.000075	0.0012	0.00048	0.0049	0.00021	0.0020	< 0.002
25-Nov-15	74	500	485	8.0	< 0.007	0.00023	0.00100	1.8	0.0027	< 0.01	0.0013	0.00010	0.020	2.8	0.00084	0.65	0.00047	0.14	0.67	0.90	0.000080	0.00038	0.000090	0.0023	0.00030	< 0.001	< 0.002
2-Dec-15	75	500	495	8.0	< 0.007	0.00038	0.00094	2.0	0.0035	< 0.01	0.0013	< 0.0001	< 0.003	2.9	0.00023	0.70	0.0000020	0.11	0.64	0.80	< 0.000005	0.00042	0.00010	0.0025	0.00023	0.0010	< 0.002
9-Dec-15	76	500	505	8.1	< 0.007	< 0.00001	0.00098	1.8	0.0029	< 0.01	0.00094	< 0.0001	< 0.003	2.6	0.00033	0.62	0.0000090	0.090	0.64	0.70	0.000020	0.00041	0.00010	0.0023	0.00026	< 0.001	< 0.002
16-Dec-15	77	500	495	7.9	0.015	0.00012	0.00096	1.8	0.0032	< 0.01	0.00061	0.00010	0.0040	2.8	< 0.00004	0.71	< 0.000002	0.10	0.64	0.50	0.000014	0.00035	0.00041	0.0022	0.00027	< 0.001	< 0.002
23-Dec-15	78	500	500	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	485	7.9	< 0.007	< 0.00001	0.00086	1.7	0.0032	0.010	0.00052	< 0.0001	< 0.003	2.4	0.000050	0.56	0.0000030	0.11	0.59	1.1	< 0.000005	0.00024	0.00016	0.0020	0.00025	< 0.001	< 0.002
6-Jan-16	80	500	495	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	495	7.8	< 0.007	< 0.00001	0.00090	1.8	0.0036	< 0.01	0.0015	< 0.0001	< 0.003	2.7	0.00024	0.63	< 0.000002	0.070	0.63	0.40	< 0.000005	0.00028	< 0.00005	0.0026	0.00017	< 0.001	< 0.002
20-Jan-16	82	500	495	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	490	7.9	< 0.007	< 0.00001	0.0011	2.1	0.0033	< 0.01	0.00063	< 0.0001	< 0.003	3.0	< 0.00004	0.70	< 0.000002	0.080	0.75	0.50	0.000011	0.00042	0.00016	0.0029	0.00020	< 0.001	< 0.002
3-Feb-16	84	500	490	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.8	< 0.007	< 0.00001	0.00086	1.9	0.0038	< 0.01	0.00058	< 0.0001	< 0.003	2.6	0.000090	0.60	< 0.000002	0.11	0.68	1.1	0.0000090	0.00045	0.00010	0.0019	0.00018	< 0.001	< 0.002
17-Feb-16	86	500	500	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.8	< 0.007	< 0.00001	0.00097	2.0	0.0033	< 0.01	0.00096	< 0.0001	< 0.003	2.9	0.00017	0.45	0.000014	0.080	0.71	0.80	< 0.000005	0.00026	0.00010	0.0020	0.00019	< 0.001	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Calculated Loading Rates for HC1 (ST)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	345	7.7	484	#N/A	2.2	19	47	0.76	0.13	0.10	47	0.0062	0.00038	0.0038	0.012	0.0000024	0.0000024	0.0067	0.0000010	11	0.000052	0.00016	0.0022
2-Jul-14	1	500	500	7.7	295	#N/A	4.1	26	39	0.25	0.12	0.15	54	0.0090	0.00065	0.0043	0.012	0.0000035	0.0000035	0.0071	0.0000015	12	0.000095	0.00032	0.0013
9-Jul-14	2	500	485	7.9	192	#N/A	1.2	23	19	0.097	0.087	0.15	28	0.011	0.00029	0.0034	0.015	0.0000034	0.0000034	0.0059	0.0000015	6.6	0.000019	0.000050	0.00050
16-Jul-14	3	500	485	7.8	146	#N/A	1.1	22	9.2	0.097	0.063	0.15	23	0.011	0.00053	0.0030	0.015	0.0000034	0.0000034	0.0039	0.0000015	5.4	0.00010	0.00022	0.00039
23-Jul-14	4	500	485	7.8	108	#N/A	1.1	19	5.3	0.097	0.049	0.15	19	0.013	0.00024	0.0023	0.020	0.0000034	0.0000034	0.0032	0.0000015	4.7	0.000015	0.000083	0.00067
30-Jul-14	5	500	480	8.1	79	#N/A	0.76	18	2.9	0.096	0.029	0.14	14	0.016	0.00029	0.0024	0.016	0.0000034	0.0000034	0.0021	0.0000014	3.7	0.000096	0.00014	0.00072
6-Aug-14	6	500	485	7.8	76	#N/A	1.0	15	2.4	0.097	0.029	0.15	14	0.019	0.00015	0.0016	0.018	0.0000034	0.0000034	0.0033	0.0000015	3.7	0.000015	0.000016	0.00018
13-Aug-14	7	500	490	8.2	109	#N/A	1.1	21	4.4	0.098	0.049	0.15	21	0.028	0.00020	0.0026	0.030	0.0000034	0.0000034	0.0033	0.0000015	4.9	0.00013	0.000027	0.00026
20-Aug-14	8	500	485	7.9	85	#N/A	0.85	17	3.9	0.097	0.029	0.15	17	0.021	0.000097	0.0023	0.024	0.0000034	0.0000034	0.0023	0.0000015	4.4	0.000044	0.000028	0.00044
27-Aug-14	9	500	500	8.1	117	#N/A	1.9	24	4.5	0.10	0.055	0.15	22	0.018	0.00020	0.0025	0.027	0.0000035	0.0000035	0.0055	0.0000015	5.5	0.000050	0.000018	0.00019
3-Sep-14	10	500	490	7.8	101	#N/A	2.2	21	4.4	0.098	0.044	0.15	26	0.015	0.00054	0.0029	0.025	0.0000034	0.0000034	0.0037	0.0000015	7.4	0.000015	0.000016	0.00035
10-Sep-14	11	500	500	8.2	98	#N/A	1.5	21	2.5	0.10	0.040	0.15	22	0.019	0.00020	0.0021	0.026	0.0000035	0.0000035	0.0032	0.0000015	6.3	0.000050	0.000013	0.00019
17-Sep-14	12	500	475	8.0	77	#N/A	3.4	17	1.9	0.095	0.029	0.14	13	0.018	0.000095	0.0015	0.021	0.0000033	0.0000033	0.0029	0.0000014	3.6	0.000033	0.0000081	0.00012
24-Sep-14	13	500	485	8.2	75	#N/A	1.5	18	2.4	0.097	0.029	0.15	14	0.014	0.000097	0.0014	0.019	0.0000034	0.0000034	0.0017	0.0000015	3.8	0.000015	0.000053	0.00021
1-Oct-14	14	500	485	7.8	72	#N/A	4.6	18	1.5	0.097	0.029	0.15	15	0.016	0.000097	0.0012	0.019	0.0000034	0.0000034	0.0015	0.000021	3.9	0.000015	0.00	0.0000097
8-Oct-14	15	500	480	8.1	87	#N/A	1.3	17	1.9	0.096	0.029	0.14	21	0.017	0.00014	0.0017	0.025	0.0000034	0.0000034	0.011	0.0000014	6.2	0.000034	0.000012	0.00015
15-Oct-14	16	500	485	7.7	94	#N/A	2.8	18	2.4	0.097	0.029	0.15	23	0.013	0.00019	0.0018	0.023	0.0000034	0.0000034	0.0028	0.0000053	6.8	0.000019	0.0000087	0.00016
22-Oct-14	17	500	490	8.1	92	#N/A	2.0	20	2.5	0.098	0.029	0.15	18	0.012	0.00020	0.0017	0.024	0.0000034	0.0000034	0.0076	0.0000015	4.6	0.000020	0.0000093	0.00016
29-Oct-14	18	500	495	7.8	89	#N/A	4.4	21	1.5	0.099	0.030	0.15	17	0.012	0.00020	0.0018	0.023	0.0000035	0.0000035	0.0073	0.0000015	4.6	0.000059	0.0000089	0.00012
5-Nov-14	19	500	490	7.9	81	#N/A	#N/A	23	0.98	0.098	0.029	0.15	16	0.012	0.00015	0.0015	0.022	0.0000034	0.0000034	0.0029	0.0000078	4.1	0.000029	0.000011	0.00026
12-Nov-14	20	500	485	7.6	88	#N/A	3.2	17	1.5	0.097	0.034	0.15	18	0.023	0.00019	0.0018	0.025	0.0000034	0.0000034	0.0028	0.0000015	4.8	0.000092	0.000015	0.00022
19-Nov-14	21	500	485	7.7	89	#N/A	3.2	17	0.97	0.097	0.029	0.15	17	0.013	0.00019	0.0016	0.028	0.0000034	0.0000034	0.0016	0.0000039	4.5	0.000029	0.000011	0.00023
26-Nov-14	22	500	490	8.1	88	#N/A	0.95	19	1.5	0.098	0.029	0.15	18	0.014	0.00020	0.0018	0.027	0.0000034	0.0000034	0.0011	0.0000015	4.8	0.000025	0.0000088	0.00014
3-Dec-14	23	500	475	8.0	75	#N/A	1.4	17	0.95	0.095	0.029	0.14	16	0.013	0.00019	0.0019	0.027	0.0000033	0.0000033	0.0023	0.0000014	4.4	0.000024	0.0000076	0.00015
10-Dec-14	24	500	495	7.9	63	#N/A	2.3	17	0.99	0.099	0.030	0.15	13	0.011	0.000099	0.0012	0.022	0.0000035	0.0000035	0.0014	0.0000015	3.7	0.000030	0.0000050	0.00015
17-Dec-14	25	500	495	7.7	74	#N/A	2.2	17	1.5	0.099	0.030	0.15	16	0.015	0.000099	0.0014	0.026	0.0000035	0.0000035	0.0011	0.0000015	4.1	0.000015	0.0000064	0.00020
24-Dec-14	26	500	495	7.7	75	#N/A	1.8	17	0.99	0.099	0.030	0.15	16	0.015	0.00015	0.0015	0.029	0.0000035	0.0000035	0.0031	0.0000015	4.4	0.000015	0.0000059	0.00011
31-Dec-14	27	500	495	7.9	88	#N/A	0.65	18	0.99	0.099	0.030	0.15	19	0.013	0.00040	0.0031	0.031	0.0000035	0.0000035	0.0014	0.0000015	5.2	0.000015	0.0000030	0.00011
7-Jan-15	28	500	485	7.5	71	#N/A	1.5	16	0.97	0.49	0.029	0.15	16	0.013	0.00015	0.0012	0.023	0.0000034	0.0000034	0.0023	0.0000015	4.4	0.000029	0.0000073	0.00017
14-Jan-15	29	500	495	7.9	77	#N/A	1.2	19	1.5	0.50	0.030	0.15	19	0.011	0.00015	0.0015	0.025	0.0000035	0.0000035	0.0020	0.0000025	5.5	0.000030	0.0000050	0.00019
21-Jan-15	30	500	485	7.8	83	#N/A	2.3	21	0.97	0.49	0.029	0.15	17	0.013	0.00019	0.0015	0.031	0.0000034	0.0000034	0.0018	0.0000015	4.5	0.000039	0.0000073	0.00031
28-Jan-15	31	500	495	7.8	75	#N/A	0.83	18	0.99	0.50	0.030	0.15	16	0.013	0.00015	0.0013	0.027	0.0000035	0.0000035	0.0022	0.0000020	4.5	0.000050	0.0000045	0.00010
4-Feb-15	32	500	490	7.8	77	#N/A	1.3	18	0.98	0.49	0.029	0.15	16	0.011	0.00015	0.0013	0.027	0.0000034	0.0000034	0.0025	0.0000015	4.2	0.000098	0.0000034	0.00033
11-Feb-15	33	500	490	8.0	74	#N/A	0.96	18	1.5	0.49	0.029	0.15	15	0.012	0.00020	0.0013	0.025	0.0000034	0.0000034	0.0019	0.0000015	4.3	0.000025	0.0000059	0.00033
18-Feb-15	34	500	485	7.8	73	#N/A	1.1	18	0.97	0.49	0.034	0.15	16	0.012	0.00024	0.0013	0.024	0.0000034	0.0000034	0.0014	0.0000015	4.4	0.000019	0.0000078	0.00020
25-Feb-15	35	500	490	7.8	76	#N/A	1.5	19	0.98	0.49	0.029	0.15	16	0.011	0.00020	0.0012	0.028	0.0000034	0.0000034	0.00074	0.0000029	4.4	0.000039	0.0000083	0.00054
4-Mar-15	36	500	480	7.7	62	#N/A	1.0	15	0.96	0.48	0.029	0.14	14	0.0094	0.000096	0.00086	0.022	0.0000034	0.0000034	0.0013	0.0000014	4.4	0.000053	0.0000034	0.00023
11-Mar-15	37	500	480	8.0	64	#N/A	0.74	16	0.96	0.48	0.038	0.14	13	0.010	0.00014	0.0010	0.023	0.0000034	0.0000034	0.0025	0.0000014	3.8	0.000043	0.0000029	0.00038
18-Mar-15	38	500	500	7.8	65	#N/A	1.3	17	1.0	0.50	0.030	0.15	16	0.011	0.00015	0.00085	0.023	0.0000070	0.0000035	0.0011	0.0000015	4.7	0.000050	0.0000065	0.00053
25-Mar-15	39	500	485	7.8	65	#N/A	1.4	17	0.97	0.49	0.029	0.15	14	0.013	0.00015	0.0012	0.027	0.0000034	0.0000034	0.0025	0.0000015	4.0	0.000063	0.0000019	0.00095
1-Apr-15	40	500	500	7.7	66	#N/A	1.9	18	1.0	0.50	0.030	0.15	12	0.011	0.00015	0.00080	0.030	0.0000060	0.0000035	0.0014	0.0000015	3.4	0.000030	0.0000020	0.00019
8-Apr-15	41	500	490	7.9	71	#N/A	1.4	18	0.98	0.49	0.029	0.15	15	0.011	0.00020	0.0011	0.027	0.0000034	0.0000034	0.0025	0.0000015	4.2	0.000029	0.0000078	0.00048
15-Apr-15	42	500	485	7.7	61	#N/A	1.8	16	0.97	0.49	0.029	0.15	13	0.011	0.00015	0.00087	0.024	0.0000034	0.0000034	0.0032	0.0000015	3.7	0.000029	0.0000019	0.00047
22-Apr-15	43	500	490	7.6	60	#N/A	1.5	16	1.5	0.49	0.029	0.15	13	0.0091	0.000098	0.00074	0.023	0.0000034	0.0000034	0.0044	0.0000015	3.7	0.000020	0.0000029	0.00054
29-Apr-15	44	500	490	7.8	80	#N/A	1.0	19	1.5	0.49	0.029	0.15	20	0.013	0.00020	0.0014	0.034	0.0000034	0.0000034	0.0018	0.0000025	5.8	0.000044	0.0000098	0.00026
6-May-15	45	500	500	8.0	73	#N/A	1.2	20	1.0	0.50	0.030	0.15	16	0.013	0.00015	0.0032	0.027	0.0000035	0.0000035	0.0023	0.0000015	4.6	0.000015	0.0000085	0.00017
13-May-15	46	500	490																						
20-May-15	47	490	480																						
27-May-15	48	480	475																						
3-Jun-15	49	475	470	8.2	161	#N/A	1.3	8.9	0.71	0.12	0.0071	0.035	8.9	0.0011	0.000071	0.00028	0.019	0.00000082	0.00000082	0.00048	0.00000035	2.6	0.000019	0.0000026	0.000040
10-Jun-15	50	500	480																						
17-Jun-15	51	480	470																						
24-Jun-15	52	470	460																						
1-Jul-15	53	460	465	8.1	166	#N/A	1.7	8.8	0.47	0.12	0.0070	0.035	7.7	0.0018	0.000058	0.00033	0.016	0.00000081	0.00000081	0.0017	0.00000035	2.2	0.000023	0.0000043	0.000041
8-Jul-15	54	500	490																						
15-Jul-15	55	490	480																						
22-Jul-15	56	480	480																						
29-Jul-15	57	480	470	8.1	161	#N/A	0.91	9.1	0.59	0.12	0.0071	0.035	8.2	0.0017	0.000059	0.00029	0.017	0.00000082	0.00000082	0.00087	0.00000035	2.3	0.000025	0.0000033	0.000026
5-Aug-15	58	500	495																						
12-Aug-15	59	495	490																						
19-Aug-15	60	490	480																						
26-Aug-15	61	480	470	8.0	158	#N/A	0.92	9.0	0.59	0.12	0.0071	0.035	8.2	0.0011	0.000071	0.00033	0.018	0.00000082	0.00000082	0.00073	0.00000094	2.4	0.000020	0.0000029	0.000054
2-Sep-15	62	500	495																						
9-Sep-15	63	495	490																						
16-Sep-15	64	490	490																						
23-Sep-15	65	490	470	8.1	163	#N/A	1.0	9.0	0.59	0.00	0.00	0.00	8.6	0.0012	0.000071	0.00033	0.019	0.00000082	0.00000082	0.00085	0.00000047	2.5	0.000024	0.0000029	0.000029
30-Sep-15	66	500	500																						
7-Oct-15	67	500	480																						
14-Oct-15	68	480	460																						
21-Oct-15	69	460	450	8.1	149	#N/A	0.70	8.5	0.56	0.00	0.00	0.00	7.9	0.0011	0.000056	0.00029	0.016	0.00000079	0.00000079	0.00074	0.0000039	2.2	0.000027	0.0000041	0.00018
28-Oct-15	70	500	490																						
4-Nov-15	71	490	470																						
11-Nov-15	72	470	460																						
18-Nov-15	73	460	460	8.0	138	#N/A	0.52	8.5	0.46	0.00	0.00	0.00	6.7	0.0022	0.000046	0.00023	0.015	0.00000081	0.00000081	0.00038	0.00000035	1.9	0.000026	0.0000092	0.000071
25-Nov-15	74	500	485	8.0	69	#N/A	0.20	19	0.97	0.00	0.00	0.00	16	0.015	0.00015	0.0012	0.030	0.0000034	0.0000034	0.0016	0.0000015	4.9	0.000078	0.000087	0.00038
2-Dec-15	75	500	495	8.0	68	#N/A	0.68	17	0.99	0.00	0.00	0.00	15	0.014	0.00015	0.0011	0.031	0.0000035	0.0000035	0.0014	0.0000035	4.3	0.000025	0.0000069	0.00028
9-Dec-15	76	500	505	8.1	67	#N/A	1.2	17	1.0	0.00	0.00	0.00	14	0.015	0.00020	0.0016	0.031	0.0000051	0.0000035	0.0045	0.0000066	4.2	0.000051	0.0000020	0.00018
16-Dec-15	77	500	495	7.9	63	#N/A	0.85	15	0.99	0.00	0.00	0.00	15	0.025	0.000099	0.0011	0.031	0.0000035	0.0000035	0.00099	0.0000020	4.4	0.000099	0.0000079	0.00021
23-Dec-15	78	500	500	7.9	71	-	0.75	15	1.2	0.00	0.00	0.00	14	0.019	0.000098	0.00091	0.030	0.0000034	0.0000034	0.0011	0.0000020	4.3	0.000074	0.0000049	0.00016
30-Dec-15	79	500	485	7.9	62	#N/A	0.65	15	1.5	0.00	0.00	0.00	14	0.013	0.000097	0.00073	0.029	0.0000034	0.0000034	0.0012	0.0000019	4.1	0.000049	0.0000019	0.00011
6-Jan-16	80	500	495	7.9	70	-	0.69	15	1.5	0.00	0.00	0.00	14	0.012	0.000098	0.00081	0.029	0.0000034	0.0000034	0.0018	0.0000017	4.2	0.000044	0.0000020	0.00011
13-Jan-16	81	500	495	7.8	68	#N/A	0.74	16	1.5	0.00	0.00	0.00	14	0.011	0.000099	0.00089	0.030	0.0000035	0.0000035	0.0025	0.0000015	4.2	0.000040	0.0000020	0.00012
20-Jan-16	82	500	495	7.9	80	-	0.97	17	1.2	0.00	0.00	0.00	15	0.012	0.000099	0.00098	0.033	0.0000034	0.0000034	0.0017	0.0000015	4.4	0.000039	0.0000054	0.00011
27-Jan-16	83	500	490	7.9	73	#N/A	1.2	17	0.98	0.00	0.00	0.00	15	0.012	0.000098	0.0011	0.036	0.0000034	0.0000034	0.00098	0.0000015	4.5	0.000039	0.0000088	0.000098
3-Feb-16	84	500	490	7.9	74	-	1.2	17	0.99	0.00	0.00	0.00	15	0.012	0.000099	0.0011	0.037	0.0000035	0.0000035	0.00099	0.0000015	4.5	0.000042	0.0000064	0.00024
10-Feb-16	85	500	500	7.8	70	#N/A	1.1	17	1.0	0.00	0.00	0.00	15	0.013	0.00010	0.0011	0.038	0.0000035	0.0000035	0.0010	0.0000015	4.5	0.000045	0.0000040	0.00038
17-Feb-16	86	500	500	7.8	73	-	1.1	17	1.0	0.00	0.00	0.00	15	0.013	0.00010	0.0011	0.037	0.0000035	0.0000035	0.0010	0.0000015	4.5	0.000030	0.0000030	0.00023
24-Feb-16	87	500	500	7.8	69	#N/A	1.1	16	1.0	0.00	0.00	0.00	15	0.014	0.00010	0.0010	0.035	0.0000035	0.0000035	0.0010	0.0000015	4.5	0.000015	0.0000020	0.000075

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Calculated Loading Rates for HC1 (ST)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	345	7.7	0.0031	0.0000035	0.0029	5.1	0.0038	0.0069	0.0050	0.0018	0.0086	3.3	0.0012	0.96	0.00000069	12	0.37	19	0.0000090	0.000045	0.000062	0.0042	0.00025	0.00069	0.00069
2-Jul-14	1	500	500	7.7	0.0010	0.0000050	0.0033	5.8	0.0081	0.0050	0.0048	0.0021	0.0045	3.9	0.00064	1.2	0.0000010	10	0.57	18	0.000011	0.0036	0.00010	0.0089	0.00024	0.00050	0.0010
9-Jul-14	2	500	485	7.9	0.0029	0.0000049	0.0022	2.9	0.0048	0.0049	0.0030	0.00092	0.0044	2.8	0.00016	0.98	0.00000097	4.3	0.40	6.7	0.0000063	0.0016	0.000073	0.0039	0.00023	0.00049	0.00097
16-Jul-14	3	500	485	7.8	0.0053	0.0000049	0.0017	2.3	0.0032	0.0049	0.0037	0.00058	0.0044	2.2	0.000087	0.72	0.0000029	2.7	0.36	3.6	0.0000087	0.00012	0.000044	0.0054	0.00018	0.00049	0.00097
23-Jul-14	4	500	485	7.8	0.00097	0.0000097	0.0013	1.8	0.0038	0.0049	0.0015	0.00034	0.0044	1.9	0.000053	0.61	0.0000019	1.7	0.32	2.5	0.0000044	0.0016	0.000039	0.0024	0.00016	0.00049	0.00097
30-Jul-14	5	500	480	8.1	0.0024	0.0000048	0.00089	1.2	0.0032	0.0048	0.0025	0.00019	0.0072	1.3	0.000043	0.40	0.00000096	0.85	0.25	1.4	0.0000053	0.00010	0.00011	0.0034	0.00014	0.00048	0.00096
6-Aug-14	6	500	485	7.8	0.0039	0.000015	0.00075	1.2	0.0028	0.0049	0.00091	0.000049	0.0053	1.4	0.000058	0.42	0.00000097	0.74	0.26	1.3	0.0000034	0.000053	0.00013	0.0018	0.00039	0.00097	0.00097
13-Aug-14	7	500	490	8.2	0.0088	0.0000098	0.0013	2.0	0.0030	0.0049	0.0017	0.00015	0.0049	2.1	0.000059	0.71	0.00000098	1.3	0.38	2.1	0.0000049	0.00060	0.00040	0.0029	0.00017	0.00049	0.00098
20-Aug-14	8	500	485	7.9	0.0029	0.000019	0.00092	1.5	0.0031	0.0049	0.0011	0.00015	0.0044	1.6	0.00015	0.52	0.00000097	0.72	0.32	1.4	0.0000029	0.00097	0.00018	0.0023	0.00018	0.00049	0.00097
27-Aug-14	9	500	500	8.1	0.0030	0.0000050	0.0013	2.1	0.0038	0.0050	0.0019	0.00015	0.0045	2.2	0.000055	0.73	0.0000010	1.1	0.43	1.8	0.0000080	0.00069	0.00016	0.0032	0.00020	0.00050	0.0010
3-Sep-14	10	500	490	7.8	0.0034	0.000020	0.0012	1.8	0.0029	0.0049	0.0015	0.00015	0.0025	2.2	0.00014	0.74	0.0000064	0.78	0.46	2.0	0.0000088	0.000093	0.000029	0.0026	0.00019	0.00049	0.00098
10-Sep-14	11	500	500	8.2	0.0050	0.0000050	0.00093	1.5	0.0030	0.0050	0.0013	0.00010	0.0015	1.8	0.000045	0.65	0.0000010	0.59	0.41	1.2	0.0000075	0.00073	0.00016	0.0023	0.00016	0.00050	0.0010
17-Sep-14	12	500	475	8.0	0.0033	0.0000048	0.00066	1.1	0.0025	0.0048	0.00081	0.000048	0.0014	1.4	0.000048	0.39	0.00000095	0.33	0.31	1.00	0.0000024	0.000043	0.000081	0.0016	0.00013	0.00048	0.00095
24-Sep-14	13	500	485	8.2	0.00097	0.0000049	0.00072	1.2	0.0022	0.0049	0.00081	0.000097	0.0044	1.4	0.000019	0.40	0.0000024	0.34	0.28	0.75	0.0000024	0.000049	0.000024	0.0017	0.00012	0.00049	0.00097
1-Oct-14	14	500	485	7.8	0.019	0.000019	0.00065	1.2	0.0053	0.0049	0.0010	0.000049	0.0044	1.4	0.000019	0.43	0.00000097	0.28	0.30	0.96	0.0000024	0.000029	0.00015	0.0016	0.00012	0.00097	0.00097
8-Oct-14	15	500	480	8.1	0.0048	0.0000096	0.00088	1.3	0.0027	0.0048	0.0016	0.000096	0.0014	1.6	0.000019	0.48	0.00000096	0.32	0.38	1.2	0.0000082	0.00023	0.00020	0.0020	0.00017	0.00048	0.00096
15-Oct-14	16	500	485	7.7	0.0034	0.0000049	0.0010	1.5	0.0023	0.0049	0.0011	0.000097	0.0015	1.9	0.000034	0.53	0.00000097	0.36	0.43	1.2	0.0000049	0.00066	0.000049	0.0022	0.00014	0.00049	0.00097
22-Oct-14	17	500	490	8.1	0.0049	0.0000049	0.00092	1.6	0.0027	0.0049	0.0011	0.000098	0.0015	2.0	0.000034	0.52	0.00000098	0.33	0.43	1.1	0.000011	0.000093	0.000039	0.0023	0.00013	0.00049	0.00098
29-Oct-14	18	500	495	7.8	0.0035	0.0000050	0.00089	1.5	0.0021	0.0050	0.00093	0.000050	0.0015	1.7	0.000030	0.51	0.00000099	0.26	0.41	0.89	0.0000069	0.00048	0.000025	0.0020	0.00013	0.00050	0.00099
5-Nov-14	19	500	490	7.9	0.0034	0.00015	0.00071	1.3	0.0019	0.0049	0.0012	0.000098	0.0015	1.5	0.000020	0.46	0.00000098	0.23	0.38	0.83	0.000011	0.00013	0.000064	0.0019	0.00011	0.00049	0.00098
12-Nov-14	20	500	485	7.6	0.0082	0.000019	0.00076	1.5	0.0024	0.0049	0.0013	0.000097	0.0015	1.6	0.000034	0.51	0.00000097	0.26	0.43	0.87	0.0000063	0.00050	0.00037	0.0021	0.00016	0.00049	0.00097
19-Nov-14	21	500	485	7.7	0.0034	0.000063	0.00077	1.4	0.0025	0.0049	0.00084	0.000097	0.0015	1.6	0.000039	0.45	0.00000097	0.21	0.44	0.78	0.000012	0.00026	0.000024	0.0020	0.00013	0.00097	0.00097
26-Nov-14	22	500	490	8.1	0.0034	0.0000049	0.00089	1.5	0.0021	0.0049	0.00092	0.000049	0.0049	1.7	0.00011	0.56	0.00000098	0.20	0.44	0.74	0.0000069	0.000064	0.000054	0.0021	0.00015	0.00049	0.00098
3-Dec-14	23	500	475	8.0	0.0033	0.0000048	0.00077	1.3	0.0023	0.0048	0.00076	0.000048	0.0014	1.5	0.000033	0.38	0.00000095	0.16	0.36	0.67	0.0000076	0.00046	0.000048	0.0019	0.00015	0.00048	0.00095
10-Dec-14	24	500	495	7.9	0.0035	0.0000050	0.00052	1.00	0.0019	0.0050	0.00063	0.000050	0.0015	1.1	0.000030	0.30	0.00000099	0.10	0.32	0.54	0.0000064	0.00029	0.000025	0.0014	0.000094	0.00050	0.00099
17-Dec-14	25	500	495	7.7	0.0035	0.0000050	0.00071	1.3	0.0022	0.0050	0.00058	0.000050	0.0015	1.5	0.000025	0.43	0.00000099	0.14	0.39	0.59	0.0000054	0.00042	0.00020	0.0017	0.00014	0.00050	0.00099
24-Dec-14	26	500	495	7.7	0.0035	0.0000050	0.00072	1.2	0.0019	0.0050	0.00069	0.000050	0.0015	1.4	0.000079	0.39	0.00000099	0.13	0.39	0.64	0.0000045	0.00037	0.000050	0.0017	0.00014	0.00050	0.00099
31-Dec-14	27	500	495	7.9	0.0035	0.0000050	0.00085	1.5	0.0021	0.0050	0.00098	0.000050	0.0015	1.7	0.00011	0.59	0.00000099	0.15	0.47	0.89	0.000010	0.00026	0.000030	0.0022	0.00014	0.00050	0.00099
7-Jan-15	28	500	485	7.5	0.0034	0.0000097	0.00061	1.2	0.0018	0.0049	0.00090	0.000049	0.0015	1.3	0.000058	0.34	0.00000097	0.10	0.37	0.44	0.000019	0.00017	0.000024	0.0015	0.00011	0.00049	0.00097
14-Jan-15	29	500	495	7.9	0.0035	0.0000099	0.00061	1.3	0.0018	0.0050	0.0011	0.000050	0.0015	1.4	0.000054	0.50	0.00000099	0.10	0.42	0.50	0.000014	0.00031	0.000025	0.0016	0.00011	0.00050	0.00099
21-Jan-15	30	500	485	7.8	0.0034	0.000015	0.00078	1.3	0.0019	0.0049	0.0011	0.000049	0.0015	1.6	0.000049	0.43	0.00000097	0.12	0.45	0.49	0.0000082	0.00033	0.000039	0.0021	0.00015	0.00049	0.00097
28-Jan-15	31	500	495	7.8	0.0035	0.0000050	0.00052	1.3	0.0018	0.0050	0.0032	0.000050	0.0015	1.5	0.000069	0.44	0.0000020	0.099	0.34	0.79	0.0000045	0.00012	0.000054	0.0016	0.00012	0.00050	0.00099
4-Feb-15	32	500	490	7.8	0.0034	0.000015	0.00070	1.3	0.0019	0.0049	0.00066	0.000049	0.0015	1.4	0.000029	0.41	0.00000098	0.088	0.38	0.64	0.0000044	0.00025	0.000025	0.0016	0.00012	0.00049	0.00098
11-Feb-15	33	500	490	8.0	0.0034	0.0000049	0.00057	1.1	0.0016	0.0049	0.00083	0.000049	0.0015	1.4	0.00049	0.38	0.00000098	0.078	0.38	0.54	0.0000064	0.00049	0.000044	0.0014	0.00012	0.00049	0.00098
18-Feb-15	34	500	485	7.8	0.0034	0.0000049	0.00067	1.2	0.0017	0.0049	0.00053	0.000049	0.0015	1.5	0.00049	0.39	0.0000015	0.087	0.45	0.53	0.0000058	0.00029	0.000034	0.0016	0.00013	0.00049	0.00097
25-Feb-15	35	500	490	7.8	0.0034	0.0000098	0.00061	1.2	0.0015	0.0049	0.00061	0.000049	0.0015	1.5	0.00049	0.41	0.00000098	0.069	0.40	0.29	0.0000069	0.00025	0.000064	0.0018	0.00011	0.00049	0.00098
4-Mar-15	36	500	480	7.7	0.0034	0.0000096	0.00048	0.83	0.0017	0.0048	0.00044	0.000048	0.0014	1.0	0.00048	0.31	0.00000096	0.053	0.27	0.48	0.0000024	0.00028	0.000038	0.0013	0.00010	0.00048	0.00096
11-Mar-15	37	500	480	8.0	0.0034	0.000024	0.00050	0.95	0.0017	0.0048	0.00040	0.000048	0.0014	1.1	0.00048	0.26	0.0000034	0.038	0.29	0.048	0.0000034	0.00031	0.000024	0.0012	0.000091	0.00048	0.00096
18-Mar-15	38	500	500	7.8	0.0065	0.0000050	0.00049	0.91	0.0019	0.0050	0.00043	0.000050	0.0015	1.2	0.00050	0.29	0.0000010	0.050	0.33	0.50	0.0000025	0.00042	0.00010	0.0012	0.000090	0.00050	0.0010
25-Mar-15	39	500	485	7.8	0.0034	0.000015	0.00041	1.0	0.0017	0.0049	0.0010	0.000097	0.0015	1.2	0.00049	0.32	0.00000097	0.087	0.31	0.49	0.0000024	0.00040	0.000044	0.0013	0.00015	0.00049	0.00097
1-Apr-15	40	500	500	7.7	0.0035	0.0000050	0.00040	0.92	0.0057	0.0050	0.00036	0.000050	0.0015	1.3	0.00050	0.22	0.0000010	0.40	0.33	0.25	0.0000050	0.00028	0.000025	0.0016	0.000085	0.00050	0.0010
8-Apr-15	41	500	490	7.9	0.0034	0.0000049	0.00053	0.98	0.0015	0.0049	0.00064	0.000049	0.0015	1.4	0.00049	0.36	0.00000098	0.054	0.37	0.29	0.0000025	0.00037	0.000025	0.0013	0.00011	0.00049	0.00098
15-Apr-15	42	500	485	7.7	0.0049	0.0000049	0.00048	0.89	0.0014	0.0049	0.00059	0.000049	0.0015	1.2	0.00049	0.28	0.0000019	0.063	0.32	0.44	0.0000024	0.00050	0.000024	0.0011	0.00013	0.00049	0.00097
22-Apr-15	43	500	490	7.6	0.0034	0.0000098	0.00043	0.83	0.0016	0.0049	0.00038	0.000049	0.0015	1.1	0.00049	0.27	0.0000054	0.034	0.30	0.29	0.0000083	0.00047	0.000044	0.00100	0.000093	0.00049	0.00098
29-Apr-15	44	500	490	7.8	0.0034	0.000049	0.00063	1.2	0.0016	0.0049	0.00065	0.000049	0.0015	1.7	0.00049	0.41	0.00000098	0.059	0.41	0.54	0.0000039	0.00035	0.000025	0.0016	0.00012	0.00049	0.00098
6-May-15	45	500	500	8.0	0.0035	0.0000050	0.00060	1.1	0.0016	0.0050	0.00077	0.000050	0.0015	1.5	0.00050	0.40	0.0000010	0.070	0.37	0.45	0.0000025	0.00029	0.000060	0.0017	0.00013	0.00050	0.0010
13-May-15	46	500	490																								
20-May-15	47	490	480																								
27-May-15	48	480	475																								
3-Jun-15	49	475	470	8.2	0.00082	0.0000012	0.00031	0.59	0.00053	0.0012	0.00028	0.000024	0.00035	0.65	0.000013	0.22	0.00000024	0.025	0.22	0.29	0.0000025	0.00014	0.0000082	0.00082	0.000022	0.00012	0.00024
10-Jun-15	50	500	480																								
17-Jun-15	51	480	470																								
24-Jun-15	52	470	460																								
1-Jul-15	53	460	465	8.1	0.0013	0.0000012	0.00028	0.55	0.00055	0.0012	0.00023	0.000035	0.00035	0.56	0.000045	0.19	0.00000047	0.026	0.19	0.38	0.0000020	0.00012	0.000029	0.00078	0.000026	0.00012	0.00023
8-Jul-15	54	500	490																								
15-Jul-15	55	490	480																								
22-Jul-15	56	480	480																								
29-Jul-15	57	480	470	8.1	0.00082	0.0000012	0.00032	0.60	0.00046	0.0012	0.00029	0.000035	0.00035	0.60	0.000015	0.20	0.00000024	0.027	0.21	0.29	0.00000059	0.000093	0.000022	0.00082	0.000031	0.00012	0.00024
5-Aug-15	58	500	495																								
12-Aug-15	59	495	490																								
19-Aug-15	60	490	480																								
26-Aug-15	61	480	470	8.0	0.00082	0.000013	0.00031	0.56	0.00043	0.0012	0.00032	0.000024	0.00035	0.59	0.000015	0.21	0.00000024	0.025	0.21	0.26	0.0000016	0.00011	0.0000082	0.00076	0.000033	0.00012	0.00024
2-Sep-15	62	500	495																								
9-Sep-15	63	495	490																								
16-Sep-15	64	490	490																								
23-Sep-15	65	490	470	8.1	0.00082	0.0000012	0.00029	0.61	0.00033	0.0012	0.00036	0.000035	0.00035	0.63	0.000018	0.22	0.00000024	0.026	0.21	0.29	0.0000020	0.00016	0.000015	0.00072	0.000027	0.00012	0.00024
30-Sep-15	66	500	500																								
7-Oct-15	67	500	480																								
14-Oct-15	68	480	460																								
21-Oct-15	69	460	450	8.1	0.00079	0.0000090	0.00027	0.55	0.00042	0.0011	0.00020	0.000023	0.00034	0.59	0.000059	0.18	0.000012	0.045	0.18	0.28	0.0000023	0.00015	0.000014	0.00064	0.000020	0.00011	0.00023
28-Oct-15	70	500	490																								
4-Nov-15	71	490	470																								
11-Nov-15	72	470	460																								
18-Nov-15	73	460	460	8.0	0.00092	0.0000023	0.00020	0.45	0.00058	0.0012	0.00035	0.000012	0.00035	0.52	0.000028	0.14	0.0000015	0.023	0.15	0.16	0.0000086	0.00013	0.000055	0.00056	0.000024	0.00023	0.00023
25-Nov-15	74	500	485	8.0	0.0034	0.00011	0.00048	0.89	0.0013	0.0049	0.00063	0.000049	0.0097	1.3	0.00041	0.32	0.00023	0.068	0.32	0.44	0.000039	0.00018	0.000044	0.0011	0.00015	0.00049	0.00097
2-Dec-15	75	500	495	8.0	0.0035	0.00019	0.00047	0.98	0.0017	0.0050	0.00063	0.000050	0.0015	1.5	0.00011	0.35	0.00000099	0.054	0.32	0.40	0.0000025	0.00021	0.000050	0.0012	0.00011	0.00050	0.00099
9-Dec-15	76	500	505	8.1	0.0035	0.0000051	0.00049	0.91	0.0014	0.0051	0.00047	0.000051	0.0015	1.3	0.00017	0.31	0.0000045	0.045	0.32	0.35	0.000010	0.00021	0.000051	0.0012	0.00013	0.00051	0.0010
16-Dec-15	77	500	495	7.9	0.0074	0.000059	0.00047	0.89	0.0016	0.0050	0.00030	0.000050	0.0020	1.4	0.000020	0.35	0.00000099	0.050	0.32	0.25	0.0000069	0.00017	0.00020	0.0011	0.00013	0.00050	0.00099
23-Dec-15	78	500	500	7.9	0.0054	0.000032	0.00045	0.87	0.0016	0.0049	0.00028	0.000049	0.0017	1.3	0.000022	0.31	0.0000012	0.051	0.30	0.39	0.0000047	0.00014	0.00014	0.0010	0.00013	0.00049	0.00098
30-Dec-15	79	500	485	7.9	0.0034	0.0000049	0.00042	0.84	0.0016	0.0049	0.00025	0.000049	0.0015	1.2	0.000024	0.27	0.0000015	0.053	0.28	0.53	0.0000024	0.00012	0.000078	0.00098	0.00012	0.00049	0.00097
6-Jan-16	80	500	495	7.9	0.0034	0.0000049	0.00043	0.87	0.0017	0.0049	0.00050	0.000049	0.0015	1.2	0.000072	0.29	0.0000012	0.044	0.30	0.37	0.0000025	0.00013	0.000051	0.0011	0.00010	0.00049	0.00098
13-Jan-16	81	500	495	7.8	0.0035	0.0000050	0.00044	0.89	0.0018	0.0050	0.00075	0.000050	0.0015	1.3	0.00012	0.31	0.00000099	0.035	0.31	0.20	0.0000025	0.00014	0.000025	0.0013	0.000084	0.00050	0.00099
20-Jan-16	82	500	495	7.9	0.0034	0.0000049	0.00048	0.96	0.0017	0.0049	0.00053	0.000049	0.0015	1.4	0.000069	0.33	0.00000099	0.037	0.34	0.22	0.0000039	0.00017	0.000052	0.0014	0.000091	0.00049	0.00099
27-Jan-16	83	500	490	7.9	0.0034	0.0000049	0.00051	1.0	0.0016	0.0049	0.00031	0.000049	0.0015	1.5	0.000020	0.34	0.00000098	0.039	0.37	0.25	0.0000054	0.00021	0.000078	0.0014	0.000098	0.00049	0.00098
3-Feb-16	84	500	490	7.9	0.0035	0.0000050	0.00047	0.97	0.0018	0.0050	0.00030	0.000050	0.0015	1.4	0.000032	0.32	0.00000099	0.047	0.35	0.40	0.0000049	0.00022	0.000064	0.0012	0.000094	0.00050	0.00099
10-Feb-16	85	500	500	7.8	0.0035	0.0000050	0.00043	0.93	0.0019	0.0050	0.00029	0.000050	0.0015	1.3	0.000045	0.30	0.0000010	0.055	0.34	0.55	0.0000045	0.00023	0.000050	0.00095	0.000090	0.00050	0.0010
17-Feb-16	86	500	500	7.8	0.0035	0.0000050	0.00046	0.95	0.0018	0.0050	0.00039	0.000050	0.0015	1.4	0.000065	0.26	0.0000040	0.048	0.35	0.48	0.0000035	0.00018	0.000050	0.00098	0.000093	0.00050	0.0010
24-Feb-16	87	500	500	7.8	0.0035	0.0000050	0.00048	0.98	0.0017	0.0050	0.00048	0.000050	0.0015	1.5	0.000085	0.23	0.0000070	0.040	0.35	0.40	0.0000025	0.00013	0.000050	0.0010	0.000095	0.00050	0.0010

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC2 (SS)

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	330	8.0	464	#N/A	6.8	88	101	3.3	0.59	< 0.3	126	0.038	0.032	0.064	0.034	0.0000080	< 0.000007	0.019	0.0000090	24	0.00021	0.00044	0.0060
2-Jul-14	1	500	485	8.0	255	#N/A	8.2	74	49	0.80	0.29	< 0.3	83	0.036	0.028	0.063	0.043	< 0.000007	< 0.000007	0.012	< 0.000003	16	0.000040	0.00031	0.0017
9-Jul-14	2	500	490	8.0	220	#N/A	2.4	77	27	< 0.2	0.28	< 0.3	72	0.043	0.031	0.048	0.068	< 0.000007	< 0.000007	0.013	0.0000030	14	< 0.00003	0.00013	0.00092
16-Jul-14	3	500	480	8.0	177	#N/A	2.4	69	12	< 0.2	0.20	< 0.3	64	0.043	0.025	0.036	0.063	< 0.000007	< 0.000007	0.0085	< 0.000003	13	0.00019	0.00046	0.00073
23-Jul-14	4	500	500	8.0	118	#N/A	2.1	50	7.0	< 0.2	0.10	< 0.3	50	0.069	0.015	0.025	0.081	< 0.000007	< 0.000007	0.0059	0.0000030	11	< 0.00003	0.00016	0.0010
30-Jul-14	5	500	485	8.1	160	#N/A	1.9	77	9.0	< 0.2	0.18	< 0.3	66	0.051	0.025	0.034	0.074	< 0.000007	< 0.000007	0.0079	< 0.000003	13	0.00020	0.00020	0.0015
6-Aug-14	6	500	480	8.0	142	#N/A	2.6	64	5.0	< 0.2	0.15	< 0.3	60	0.050	0.021	0.028	0.069	< 0.000007	< 0.000007	0.0070	< 0.000003	12	< 0.00003	0.000088	0.00035
13-Aug-14	7	500	490	8.0	125	#N/A	2.4	58	7.0	< 0.2	0.11	< 0.3	55	0.045	0.018	0.020	0.082	< 0.000007	< 0.000007	0.0060	< 0.000003	12	0.000050	0.000084	0.00035
20-Aug-14	8	500	490	8.0	103	#N/A	1.9	48	6.0	< 0.2	0.070	< 0.3	48	0.057	0.012	0.016	0.074	< 0.000007	< 0.000007	0.0046	< 0.000003	11	< 0.00003	0.000084	0.00038
27-Aug-14	9	500	495	8.0	130	#N/A	4.5	58	5.0	< 0.2	0.10	< 0.3	56	0.045	0.017	0.020	0.080	< 0.000007	< 0.000007	0.010	< 0.000003	12	< 0.00003	0.000068	0.00027
3-Sep-14	10	500	490	7.9	121	#N/A	4.6	54	7.0	< 0.2	0.070	< 0.3	68	0.060	0.018	0.022	0.098	< 0.000007	< 0.000007	0.0052	< 0.000003	18	< 0.00003	0.000066	0.00033
10-Sep-14	11	500	500	8.0	111	#N/A	3.3	50	5.0	< 0.2	0.060	< 0.3	54	0.057	0.014	0.015	0.081	< 0.000007	< 0.000007	0.0062	0.000021	14	< 0.00003	0.000050	0.00029
17-Sep-14	12	500	495	7.9	112	#N/A	8.3	53	6.0	< 0.2	0.060	< 0.3	47	0.058	0.016	0.014	0.076	< 0.000007	< 0.000007	0.0047	< 0.000003	11	0.000040	0.000059	0.00041
24-Sep-14	13	500	480	8.0	95	#N/A	3.7	45	8.0	< 0.2	< 0.06	< 0.3	42	0.048	0.015	0.010	0.068	< 0.000007	< 0.000007	0.0036	0.0000060	9.6	< 0.00003	0.00014	0.00018
1-Oct-14	14	500	470	7.9	96	#N/A	6.7	48	6.0	< 0.2	< 0.06	< 0.3	42	0.052	0.020	0.0097	0.061	< 0.000007	< 0.000007	0.0027	0.0000030	9.8	< 0.00003	0.00	< 0.00002
8-Oct-14	15	500	490	7.9	90	#N/A	3.0	37	4.0	< 0.2	< 0.06	< 0.3	46	0.048	0.012	0.0099	0.059	< 0.000007	< 0.000007	0.016	< 0.000003	13	< 0.00003	0.000040	0.00019
15-Oct-14	16	500	495	7.9	110	#N/A	5.4	43	7.0	< 0.2	< 0.06	< 0.3	57	0.051	0.016	0.012	0.077	< 0.000007	< 0.000007	0.0051	< 0.000003	16	< 0.00003	0.000055	0.00026
22-Oct-14	17	500	505	8.0	102	#N/A	5.0	46	5.0	< 0.2	< 0.06	< 0.3	44	0.049	0.016	0.012	0.071	< 0.000007	< 0.000007	0.011	0.0000050	10	0.00015	0.000058	0.00037
29-Oct-14	18	500	490	7.9	84	#N/A	8.4	39	3.0	< 0.2	< 0.06	< 0.3	37	0.037	0.011	0.0079	0.053	< 0.000007	< 0.000007	0.0075	< 0.000003	9.2	0.000040	0.000040	0.00037
5-Nov-14	19	500	485	7.7	85	#N/A	#N/A	48	3.0	< 0.2	< 0.06	< 0.3	37	0.053	0.011	0.0093	0.062	< 0.000007	< 0.000007	0.0035	0.000019	8.8	< 0.00003	0.000045	0.00052
12-Nov-14	20	500	495	7.6	89	#N/A	6.7	34	2.0	< 0.2	< 0.06	< 0.3	41	0.058	0.012	0.011	0.066	< 0.000007	< 0.000007	0.0048	< 0.000003	10	0.000050	0.000054	0.00043
19-Nov-14	21	500	475	7.6	93	#N/A	6.5	34	2.0	< 0.2	< 0.06	< 0.3	40	0.052	0.013	0.010	0.070	< 0.000007	< 0.000007	0.0027	0.000013	9.8	< 0.00003	0.000052	0.00057
26-Nov-14	22	500	500	7.9	78	#N/A	1.8	35	2.0	< 0.2	< 0.06	< 0.3	35	0.051	0.010	0.0090	0.059	< 0.000007	< 0.000007	0.0021	< 0.000003	8.5	< 0.00003	0.000042	0.00014
3-Dec-14	23	500	495	7.8	71	#N/A	3.0	34	< 2	< 0.2	< 0.06	< 0.3	36	0.047	0.0089	0.0088	0.061	< 0.000007	< 0.000007	0.0032	< 0.000003	9.5	< 0.00003	0.000034	0.00023
10-Dec-14	24	500	495	7.9	71	#N/A	5.1	37	2.0	< 0.2	< 0.06	< 0.3	34	0.051	0.0087	0.0079	0.061	< 0.000007	< 0.000007	0.0023	0.0000030	8.7	< 0.00003	0.000030	0.00035
17-Dec-14	25	500	500	8.0	91	#N/A	3.9	42	3.0	< 0.2	< 0.06	< 0.3	41	0.075	0.012	0.010	0.077	< 0.000007	< 0.000007	0.0023	0.0000030	10	< 0.00003	0.000076	0.00026
24-Dec-14	26	500	495	7.9	87	#N/A	3.3	42	< 2	< 0.2	< 0.06	< 0.3	39	0.057	0.012	0.0092	0.079	< 0.000007	< 0.000007	0.0017	0.0000040	9.9	< 0.00003	0.000048	0.00024
31-Dec-14	27	500	495	7.9	88	#N/A	1.3	30	3.0	< 0.2	< 0.06	< 0.3	41	0.046	0.012	0.0094	0.074	< 0.000007	< 0.000007	0.0016	0.0000030	11	< 0.00003	0.000040	0.00018
7-Jan-15	28	500	500	7.8	68	#N/A	2.7	34	2.0	< 1	< 0.06	< 0.3	33	0.040	0.0073	0.0059	0.056	< 0.000007	< 0.000007	0.0028	< 0.000003	9.0	< 0.00003	0.000038	0.00027
14-Jan-15	29	500	480	7.8	68	#N/A	2.7	34	2.0	< 1	< 0.06	< 0.3	32	0.037	0.0081	0.0057	0.057	< 0.000007	< 0.000007	0.0028	0.0000070	8.5	< 0.00003	0.000035	0.00019
21-Jan-15	30	500	485	8.0	75	#N/A	4.3	42	2.0	< 1	< 0.06	< 0.3	34	0.052	0.0096	0.0076	0.064	< 0.000007	< 0.000007	0.0020	< 0.000003	8.9	< 0.00003	0.000037	0.00031
28-Jan-15	31	500	495	7.9	76	#N/A	1.7	36	2.0	< 1	< 0.06	< 0.3	36	0.050	0.0082	0.0068	0.066	< 0.000007	< 0.000007	0.0032	0.000025	9.0	< 0.00003	0.000035	0.00021
4-Feb-15	32	500	495	7.9	72	#N/A	2.3	34	< 2	< 1	< 0.06	< 0.3	32	0.041	0.0079	0.0063	0.061	< 0.000007	< 0.000007	0.0027	0.0000040	8.0	0.00	0.000028	0.00032
11-Feb-15	33	500	490	7.9	76	#N/A	2.1	36	3.0	< 1	< 0.06	< 0.3	34	0.045	0.0094	0.0066	0.065	< 0.000007	< 0.000007	0.0029	0.0000070	8.6	< 0.00003	0.000039	0.000030
18-Feb-15	34	500	485	7.9	67	#N/A	2.2	35	2.0	< 1	< 0.06	< 0.3	32	0.043	0.0077	0.0058	0.057	< 0.000007	< 0.000007	0.0026	< 0.000003	8.6	< 0.00003	0.000040	0.00036
25-Feb-15	35	500	480	7.9	80	#N/A	3.0	40	< 2	< 1	< 0.06	< 0.3	37	0.033	0.0086	0.0053	0.062	< 0.000007	< 0.000007	0.00090	0.0000050	9.7	0.000030	0.000045	0.00049
4-Mar-15	36	500	490	7.8	68	#N/A	2.0	34	2.0	< 1	< 0.06	< 0.3	33	0.035	0.0070	0.0047	0.054	< 0.000007	< 0.000007	0.0014	< 0.000003	9.4	0.000060	0.000036	0.00019
11-Mar-15	37	500	490	7.9	73	#N/A	1.7	38	< 2	< 1	< 0.06	< 0.3	33	0.029	0.0073	0.0048	0.063	< 0.000007	< 0.000007	0.0024	< 0.000003	9.0	0.000050	0.000037	0.00061
18-Mar-15	38	500	490	7.9	68	#N/A	2.5	37	2.0	< 1	< 0.06	< 0.3	33	0.028	0.0066	0.0038	0.056	< 0.000007	< 0.000007	0.0014	< 0.000003	9.3	< 0.00003	0.000040	0.00031
25-Mar-15	39	500	485	7.8	73	#N/A	3.0	37	< 2	< 1	< 0.06	< 0.3	34	0.029	0.0091	0.0050	0.071	< 0.000007	< 0.000007	0.0040	0.0000040	8.9	0.000080	0.000045	0.00044
1-Apr-15	40	500	490	7.8	64	#N/A	3.7	36	< 2	< 1	< 0.06	< 0.3	24	0.028	0.0064	0.0034	0.062	0.000013	< 0.000007	0.0018	< 0.000003	6.3	< 0.00003	0.000021	0.00088
8-Apr-15	41	500	485	7.8	78	#N/A	2.8	41	< 2	< 1	< 0.06	< 0.3	35	0.032	0.011	0.0051	0.068	< 0.000007	< 0.000007	0.0022	< 0.000003	9.5	< 0.00003	0.000054	0.00074
15-Apr-15	42	500	495	7.8	66	#N/A	3.9	37	< 2	< 1	< 0.06	< 0.3	30	0.029	0.0067	0.0043	0.055	< 0.000007	< 0.000007	0.0042	< 0.000003	8.0	< 0.00003	0.000012	0.00099
22-Apr-15	43	500	485	7.8	53	#N/A	3.4	31	3.0	< 1	< 0.06	< 0.3	25	0.026	0.0043	0.0034	0.047	< 0.000007	< 0.000007	0.0047	< 0.000003	7.0	0.000060	0.000028	0.00082
29-Apr-15	44	500	490	7.9	80	#N/A	2.2	42	< 2	< 1	< 0.06	< 0.3	40	0.047	0.0082	0.0055	0.083	< 0.000007	< 0.000007	0.0030	< 0.000003	11	0.000040	0.000054	0.00048
6-May-15	45	500	495	7.9	73	#N/A	2.8	41	< 2	< 1	< 0.06	< 0.3	34	0.040	0.0074	0.0067	0.067	< 0.000007	< 0.000007	0.0015	< 0.000003	9.1	< 0.00003	0.000048	0.00041
13-May-15	46	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	505	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	480	490	8.1	181	#N/A	4.0	87	5.0	< 1	< 0.06	< 0.3	88	0.014	0.017	0.0047	0.21	< 0.000007	< 0.000007	0.0042	< 0.000003	23	< 0.00003	0.00015	0.00069
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	485	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	480	480	8.0	192	#N/A	4.5	89	4.0	< 1	< 0.06	< 0.3	83	0.012	0.018	0.0051	0.19	< 0.000007	< 0.000007	0.0067	< 0.000003	22	< 0.00003	0.00018	0.00032
8-Jul-15	54	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	485	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	480	470	8.1	176	#N/A	2.7	89	4.0	< 1	< 0.06	< 0.3	83	0.016	0.014	0.0045	0.16	0.0000090	< 0.000007	0.0056	0.0000070	22	< 0.00003	0.00016	0.00035
5-Aug-15	58	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	495	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	480	470	8.0	172	#N/A	1.9	87	4.0	< 1	< 0.06	< 0.3	83	0.016	0.014	0.0037	0.19	< 0.000007	< 0.000007	0.0050	< 0.000003	22	< 0.00003	0.00020	0.00040
2-Sep-15	62	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	470	460	8.1	167	#N/A	2.4	81	4.0				81	0.013	0.013	0.0043	0.18	< 0.000007	< 0.000007	0.0059	< 0.000003	22	< 0.00003	0.00015	0.00045
30-Sep-15	66	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	485	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	475	455	8.1	155	#N/A	1.3	81	4.0				78	0.012	0.012	0.0031	0.17	< 0.000007	< 0.000007	0.0043	0.0000050	20	< 0.00003	0.00016	0.00080
28-Oct-15	70	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	485	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	470	450	8.1	172	#N/A	1.2	97	4.0				79	0.011	0.011	0.0032	0.20	< 0.000007	< 0.000007	0.0024	< 0.000003	21	0.000030	0.00018	0.0011
25-Nov-15	74	500	500	8.1	92	#N/A	0.80	52	2.0				46	0.059	0.0066	0.0041	0.092	< 0.000007	< 0.000007	0.0027	0.0000090	13	0.00011	0.00011	0.00058
2-Dec-15	75	500	490	8.0	85	#N/A	1.6	44	2.0				41	0.056	0.0058	0.0041	0.087	< 0.000007	< 0.000007	0.0024	< 0.000003	11	0.000060	0.000067	0.00044
9-Dec-15	76	500	500	8.1	76	#N/A	2.5	40	2.0				35	0.045	0.0049	0.0039	0.079	0.000031	0.000031	0.0053	0.000017	9.8	0.000060	0.000059	0.00027
16-Dec-15	77	500	495	8.0	76	#N/A	2.0	38	2.0				40	0.048	0.0053	0.0043	0.089	0.000013	< 0.000007	0.0023	0.0000050	11	0.000070	0.000064	0.00037
23-Dec-15	78	500	485	8.2	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	495	7.9	70	#N/A	1.3	34	3.0				34	0.035	0.0039	0.0027	0.069	< 0.000007	< 0.000007	0.0020	< 0.000003	9.2	0.000070	0.000036	0.00020
6-Jan-16	80	500	490	7.8	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	490	7.8	75	#N/A	1.5	36	2.0				35	0.033	0.0042	0.0029	0.073	< 0.000007	< 0.000007	0.0020	< 0.000003	9.5	< 0.00003	0.000025	0.00034
20-Jan-16	82	500	490	8.0	77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	495	7.9	78	#N/A	2.7	38	2.0				37	0.036	0.0044	0.0028	0.087	< 0.000007	< 0.000007	< 0.002	0.0000050	10	< 0.00003	0.000054	0.00031
3-Feb-16	84	500	490	8.0	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.9	78	#N/A	2.2	39	2.0				36	0.031	0.0040	0.0028	0.086	< 0.000007	< 0.000007	< 0.002	< 0.000003	10.0	< 0.00003	0.000046	0.00014
17-Feb-16	86	500	490	7.8	66	-	-	-	< 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.8	74	#N/A	2.1	35	< 2				35	0.037	0.0036	0.0024	0.079	< 0.000007	< 0.000007	< 0.002	< 0.000003	9.5	< 0.00003	0.000039	0.00013

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC2 (SS)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	330	8.0	0.0080	0.000020	0.010	16	0.0097	< 0.01	0.0068	0.014	0.020	21	0.0012	2.2	0.0000090	34	1.1	37	0.000044	0.00011	0.00022	0.023	0.0024	0.0040	< 0.002
2-Jul-14	1	500	485	8.0	< 0.002	< 0.00001	0.0057	11	0.010	< 0.01	0.0040	0.0084	< 0.009	12	0.00049	1.7	< 0.000002	12	1.1	17	0.000019	0.00034	0.000060	0.024	0.0014	< 0.001	< 0.002
9-Jul-14	2	500	490	8.0	< 0.002	< 0.00001	0.0049	8.9	0.0091	< 0.01	0.0024	0.0041	< 0.009	9.9	0.00011	1.8	< 0.000002	7.4	1.0	9.6	0.000014	0.00018	0.000090	0.018	0.0013	0.0010	< 0.002
16-Jul-14	3	500	480	8.0	0.0080	< 0.00001	0.0038	7.8	0.0072	< 0.01	0.0022	0.0025	< 0.009	7.7	0.000050	1.5	0.0000040	3.5	1.00	5.3	0.000018	0.000050	0.000090	0.015	0.0010	< 0.001	< 0.002
23-Jul-14	4	500	500	8.0	0.0050	0.000040	0.0022	5.6	0.010	< 0.01	0.00087	0.0011	< 0.009	4.8	0.000080	1.0	0.0000020	1.5	0.74	3.5	0.0000080	0.00024	0.00036	0.0097	0.00071	< 0.001	< 0.002
30-Jul-14	5	500	485	8.1	0.0020	< 0.00001	0.0039	7.9	0.0089	< 0.01	0.0016	0.0019	0.0090	7.3	0.000060	1.5	< 0.000002	1.8	1.1	4.3	0.000016	< 0.00001	0.00021	0.013	0.00099	< 0.001	< 0.002
6-Aug-14	6	500	480	8.0	< 0.002	< 0.00001	0.0030	7.2	0.0078	< 0.01	0.00053	0.0010	< 0.009	6.9	< 0.00004	1.5	< 0.000002	1.0	1.0	3.3	0.000010	0.000030	0.000060	0.012	0.0012	< 0.001	< 0.002
13-Aug-14	7	500	490	8.0	< 0.002	< 0.00001	0.0024	6.3	0.0092	< 0.01	0.00059	0.0010	< 0.009	5.4	0.000040	1.2	< 0.000002	0.68	0.87	2.8	0.0000070	0.00021	0.000060	0.010	0.00057	< 0.001	< 0.002
20-Aug-14	8	500	490	8.0	< 0.002	< 0.00001	0.0017	5.1	0.011	< 0.01	0.00041	0.00070	< 0.009	3.9	0.000050	0.90	< 0.000002	0.42	0.75	2.2	0.0000060	0.00013	0.000090	0.0093	0.00064	0.0010	< 0.002
27-Aug-14	9	500	495	8.0	< 0.002	< 0.00001	0.0022	6.1	0.011	< 0.01	0.00046	0.0010	0.010	5.0	0.000060	1.2	< 0.000002	0.47	0.90	2.6	0.0000010	0.00011	< 0.00005	0.011	0.00071	< 0.001	< 0.002
3-Sep-14	10	500	490	7.9	< 0.007	0.000010	0.0019	5.8	0.012	< 0.01	0.00034	0.00090	0.0060	4.8	0.00020	1.3	0.000017	0.39	1.0	3.7	0.0000012	0.000020	< 0.00005	0.012	0.00079	< 0.001	< 0.002
10-Sep-14	11	500	500	8.0	< 0.007	0.000010	0.0015	4.5	0.011	< 0.01	0.00027	0.00070	< 0.003	3.6	0.000060	1.0	< 0.000002	0.28	0.85	2.3	0.0000012	0.00015	0.00011	0.0096	0.00061	< 0.001	< 0.002
17-Sep-14	12	500	495	7.9	< 0.007	0.000020	0.0015	4.9	0.010	< 0.01	0.00028	0.00080	< 0.003	3.7	0.00014	0.89	< 0.000002	0.27	0.94	3.1	< 0.000005	0.000040	0.00019	0.010	0.00055	< 0.001	< 0.002
24-Sep-14	13	500	480	8.0	< 0.002	0.000020	0.0013	4.3	0.010	< 0.01	0.00032	0.00020	< 0.009	2.9	< 0.00004	0.73	0.0000040	0.27	0.66	2.1	< 0.000005	0.000020	< 0.00005	0.0088	0.00044	< 0.001	< 0.002
1-Oct-14	14	500	470	7.9	0.026	< 0.00001	0.0012	4.4	0.015	< 0.01	0.0010	< 0.0001	< 0.009	3.0	< 0.00004	0.80	< 0.000002	0.19	0.70	2.6	< 0.000005	0.000070	0.00034	0.0088	0.00046	< 0.002	< 0.002
8-Oct-14	15	500	490	7.9	< 0.007	0.000040	0.0011	3.5	0.010	< 0.01	0.00045	0.00050	< 0.003	2.4	< 0.00004	0.60	< 0.000002	0.16	0.65	2.5	0.0000080	0.000080	< 0.00005	0.0078	0.00045	< 0.001	< 0.002
15-Oct-14	16	500	495	7.9	< 0.007	0.000010	0.0015	4.5	0.012	< 0.01	0.00032	0.00070	< 0.003	3.2	0.000050	0.82	< 0.000002	0.22	0.84	2.8	0.0000090	0.00010	< 0.00005	0.0094	0.00046	< 0.001	< 0.002
22-Oct-14	17	500	505	8.0	< 0.007	0.000050	0.0012	4.3	0.012	< 0.01	0.00030	0.00080	< 0.003	3.3	0.000050	0.79	< 0.000002	0.21	0.78	2.5	0.0000010	0.000040	0.00026	0.0092	0.00045	< 0.001	< 0.002
29-Oct-14	18	500	490	7.9	< 0.007	0.000010	0.00092	3.3	0.010	< 0.01	0.00024	0.00050	< 0.003	2.0	< 0.00004	0.55	< 0.000002	0.14	0.60	1.7	0.0000010	0.000090	0.000090	0.0064	0.00030	< 0.001	< 0.002
5-Nov-14	19	500	485	7.7	< 0.007	0.000040	0.00089	3.5	0.0099	< 0.01	0.00042	0.00040	< 0.003	2.1	< 0.00004	0.61	< 0.000002	0.16	0.63	1.8	0.0000023	0.000040	0.00019	0.0069	0.00039	< 0.001	< 0.002
12-Nov-14	20	500	495	7.6	< 0.007	0.000020	0.00096	3.7	0.012	< 0.01	0.00069	0.00060	< 0.003	2.3	0.000040	0.65	< 0.000002	0.19	0.70	1.8	0.0000080	0.00014	0.00020	0.0074	0.00044	< 0.001	< 0.002
19-Nov-14	21	500	475	7.6	< 0.007	0.000030	0.0010	3.7	0.012	< 0.01	0.00082	0.00060	< 0.003	2.3	0.000060	0.64	< 0.000002	0.16	0.72	1.7	0.000032	0.00019	< 0.00005	0.0071	0.00042	0.0020	< 0.002
26-Nov-14	22	500	500	7.9	< 0.007	< 0.00001	0.00092	3.3	0.010	< 0.01	0.00034	0.00040	0.0080	2.0	< 0.00004	0.57	< 0.000002	0.13	0.59	1.4	0.0000080	0.000050	0.00017	0.0066	0.00039	0.0020	< 0.002
3-Dec-14	23	500	495	7.8	< 0.007	0.000020	0.00078	2.9	0.011	< 0.01	0.00025	0.00040	< 0.003	1.6	0.000050	0.47	< 0.000002	0.12	0.50	1.3	0.0000070	0.000050	0.000080	0.0062	0.00042	< 0.001	< 0.002
10-Dec-14	24	500	495	7.9	< 0.007	< 0.00001	0.00077	2.8	0.011	< 0.01	0.00029	0.00030	< 0.003	1.7	< 0.00004	0.46	< 0.000002	0.12	0.56	1.4	0.0000070	0.00010	0.000060	0.0057	0.00034	< 0.001	< 0.002
17-Dec-14	25	500	500	8.0	0.0070	0.000020	0.0012	3.7	0.014	< 0.01	0.00023	0.00060	< 0.003	2.5	< 0.00004	0.74	< 0.000002	0.13	0.74	1.5	0.0000070	0.00017	0.00067	0.0075	0.00046	< 0.001	< 0.002
24-Dec-14	26	500	495	7.9	< 0.007	0.000010	0.0010	3.5	0.013	< 0.01	0.00013	0.00050	< 0.003	2.0	< 0.00004	0.59	< 0.000002	0.14	0.68	1.5	0.0000070	0.000030	< 0.00005	0.0071	0.00043	< 0.001	< 0.002
31-Dec-14	27	500	495	7.9	< 0.007	< 0.00001	0.00097	3.5	0.012	< 0.01	0.00026	0.00050	< 0.003	2.1	< 0.00004	0.68	< 0.000002	0.13	0.69	1.5	0.0000090	0.000050	0.00016	0.0073	0.00038	< 0.001	< 0.002
7-Jan-15	28	500	500	7.8	< 0.007	0.000030	0.00067	2.5	0.011	< 0.01	0.00025	0.00040	< 0.003	1.4	< 0.00004	0.39	< 0.000002	0.090	0.51	0.80	0.0000026	0.000040	0.00012	0.0051	0.00032	< 0.001	< 0.002
14-Jan-15	29	500	480	7.8	< 0.007	0.000010	0.00059	2.6	0.011	< 0.01	0.00086	0.00040	< 0.003	1.4	0.000070	0.42	< 0.000002	0.090	0.52	0.80	0.000017	0.000060	0.000070	0.0046	0.00028	< 0.001	< 0.002
21-Jan-15	30	500	485	8.0	< 0.007	0.000040	0.00080	2.9	0.012	< 0.01	0.00031	0.00040	< 0.003	1.7	0.000040	0.48	< 0.000002	0.11	0.57	0.90	0.0000050	0.000040	0.000090	0.0059	0.00043	< 0.001	< 0.002
28-Jan-15	31	500	495	7.9	< 0.007	< 0.00001	0.00063	3.2	0.012	< 0.01	0.0011	0.00040	< 0.003	1.8	0.000090	0.53	< 0.000002	0.11	0.49	1.5	0.000028	0.000080	0.00011	0.0054	0.00032	< 0.001	< 0.002
4-Feb-15	32	500	495	7.9	< 0.007	0.000020	0.00077	2.8	0.010	< 0.01	0.00039	0.00040	< 0.003	1.6	< 0.00004	0.47	< 0.000002	0.10	0.57	1.2	0.0000050	0.00014	0.000080	0.0048	0.00032	< 0.001	< 0.002
11-Feb-15	33	500	490	7.9	< 0.007	0.000030	0.00076	3.0	0.012	< 0.01	0.00053	0.00040	< 0.003	1.7	< 0.001	0.47	< 0.000002	0.10	0.59	1.0	0.000028	0.00042	0.000070	0.0054	0.00035	< 0.001	< 0.002
18-Feb-15	34	500	485	7.9	< 0.007	< 0.00001	0.00078	2.6	0.011	< 0.01	0.00016	0.00040	< 0.003	1.5	< 0.001	0.44	0.0000020	0.090	0.59	1.0	0.0000060	0.000050	0.000060	0.0051	0.00033	< 0.001	< 0.002
25-Feb-15	35	500	480	7.9	< 0.007	0.00048	0.00077	3.0	0.012	< 0.01	0.00018	0.00050	< 0.003	2.0	< 0.001	0.53	< 0.000002	0.10	0.63	0.90	0.000010	0.00017	< 0.00005	0.0057	0.00028	< 0.001	< 0.002
4-Mar-15	36	500	490	7.8	< 0.007	0.000010	0.00071	2.4	0.011	< 0.01	0.000080	0.00050	< 0.003	1.4	< 0.001	0.48	< 0.000002	0.080	0.48	1.2	< 0.000005	0.000060	0.00010	0.0051	0.00029	< 0.001	< 0.002
11-Mar-15	37	500	490	7.9	< 0.007	0.000060	0.00074	2.7	0.012	< 0.01	0.00014	0.00040	< 0.003	1.5	< 0.001	0.40	< 0.000002	0.080	0.55	0.20	< 0.000005	0.00011	< 0.00005	0.0048	0.00030	< 0.001	< 0.002
18-Mar-15	38	500	490	7.9	< 0.007	0.000010	0.00067	2.4	0.012	< 0.01	0.00011	0.00040	< 0.003	1.5	< 0.001	0.38	< 0.000002	0.070	0.54	0.90	< 0.000005	0.000070	0.000060	0.0046	0.00024	< 0.001	< 0.002
25-Mar-15	39	500	485	7.8	< 0.007	< 0.00001	0.00072	3.0	0.013	< 0.01	0.00035	0.00060	< 0.003	1.6	< 0.001	0.45	< 0.000002	0.16	0.58	1.0	< 0.000005	0.00054	0.000090	0.0062	0.00034	< 0.001	< 0.002
1-Apr-15	40	500	490	7.8	< 0.007	0.000040	0.00048	2.1	0.019	< 0.01	0.000080	0.00040	< 0.003	1.2	< 0.001	0.24	< 0.000002	0.72	0.47	0.30	< 0.000005	0.00015	0.000080	0.0053	0.00020	< 0.001	< 0.002
8-Apr-15	41	500	485	7.8	< 0.007	< 0.00001	0.00076	2.8	0.012	< 0.01	0.00026	0.00050	< 0.003	1.8	< 0.001	0.54	< 0.000002	0.080	0.62	0.60	< 0.000005	0.00030	0.00011	0.0052	0.00031	< 0.001	< 0.002
15-Apr-15	42	500	495	7.8	< 0.007	< 0.00001	0.00063	2.5	0.011	< 0.01	0.00026	0.00040	< 0.003	1.4	< 0.001	0.39	0.0000020	0.090	0.53	0.80	< 0.000005	0.00026	< 0.00005	0.0044	0.00026	< 0.001	< 0.002
22-Apr-15	43	500	485	7.8	< 0.007	0.000030	0.00044	1.7	0.011	< 0.01	0.00012	0.00030	< 0.003	0.93	< 0.001	0.29	0.0000040	0.050	0.37	0.40	0.0000090	0.00032	0.000070	0.0029	0.00020	< 0.001	< 0.002
29-Apr-15	44	500	490	7.9	< 0.007	0.00013	0.00083	3.0	0.015	< 0.01	0.00021	0.00040	< 0.003	1.9	< 0.001	0.48	< 0.000002	0.10	0.60	1.3	< 0.000005	0.000080	0.000090	0.0060	0.00032	< 0.001	< 0.002
6-May-15	45	500	495	7.9	< 0.007	0.000020	0.00074	2.7	0.013	< 0.01	0.00010	0.00040	< 0.003	1.6	< 0.001	0.47	0.0000020	0.080	0.53	0.80	< 0.000005	0.00063	0.000050	0.0051	0.00030	0.0030	< 0.002
13-May-15	46	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	505	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	480	490	8.1	< 0.007	< 0.00001	0.0017	7.1	0.032	< 0.01	0.00034	0.0017	< 0.003	3.6	< 0.00004	1.2	< 0.000002	0.18	1.5	2.6	0.0000050	0.000090	0.000080	0.012	0.00025	< 0.001	< 0.002
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	485	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	480	480	8.0	< 0.007	< 0.00001	0.0016	7.0	0.031	0.010	0.00028	0.0019	< 0.003	3.0	0.000090	1.1	< 0.000002	0.22	1.5	2.2	0.000011	0.00020	< 0.00005	0.013	0.00024	0.0010	< 0.002
8-Jul-15	54	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	485	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	480	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	480	470	8.1	< 0.007	0.000020	0.0016	7.1	0.032	< 0.01	0.00044	0.0017	< 0.003	3.0	< 0.00004	0.99	< 0.000002	0.20	1.5	2.1	< 0.000005	0.000050	0.00013	0.011	0.00025	0.0010	< 0.002
5-Aug-15	58	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	495	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	480	470	8.0	< 0.007	0.00013	0.0015	7.2	0.038	0.010	0.00077	0.0019	< 0.003	3.1	0.000050	1.0	0.0000020	0.19	1.5	2.6	0.0000080	0.00012	< 0.00005	0.011	0.00027	0.0020	< 0.002
2-Sep-15	62	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	470	460	8.1	< 0.007	< 0.00001	0.0014	6.6	0.028	< 0.01	0.0011	0.0017	< 0.003	2.9	0.000060	1.0	< 0.000002	0.26	1.3	2.1	0.0000080	0.000030	< 0.00005	0.010	0.00022	< 0.001	< 0.002
30-Sep-15	66	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	485	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	475	455	8.1	< 0.007	0.000050	0.0013	6.6	0.030	< 0.01	0.00024	0.0016	< 0.003	2.9	0.00020	0.89	0.000040	0.27	1.2	2.0	0.000011	0.00016	0.000050	0.0096	0.00018	< 0.001	< 0.002
28-Oct-15	70	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	485	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	470	450	8.1	0.040	0.000040	0.0012	6.7	0.030	< 0.01	0.0015	0.0015	< 0.003	2.9	0.00011	0.91	0.0000030	0.19	1.3	1.2	0.000029	0.00013	0.00013	0.011	0.00017	0.0020	< 0.002
25-Nov-15	74	500	500	8.1	0.0070	0.000090	0.00092	3.5	0.017	< 0.01	0.00037	0.00060	0.0070	2.1	0.00050	0.56	0.00028	0.12	0.71	1.0	0.0000013	< 0.00001	0.00047	0.0059	0.00030	< 0.001	< 0.002
2-Dec-15	75	500	490	8.0	0.0090	0.000080	0.00082	3.5	0.015	< 0.01	0.00039	0.00060	< 0.003	1.9	0.000040	0.57	< 0.000002	0.11	0.63	0.90	< 0.000005	0.000080	0.00049	0.0056	0.00029	< 0.001	< 0.002
9-Dec-15	76	500	500	8.1	< 0.007	0.000030	0.00073	2.7	0.013	< 0.01	0.00033	0.00050	0.0080	1.6	0.000090	0.43	0.000017	0.090	0.56	0.80	0.0000035	0.00014	0.00017	0.0050	0.00028	< 0.001	< 0.002
16-Dec-15	77	500	495	8.0	< 0.007	0.00017	0.00079	3.2	0.016	< 0.01	0.00018	0.00050	0.0040	1.9	< 0.00004	0.50	0.0000040	0.10	0.61	0.80	0.0000070	0.00016	< 0.00005	0.0054	0.00028	< 0.001	< 0.002
23-Dec-15	78	500	485	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	495	7.9	< 0.007	< 0.00001	0.00065	2.6	0.013	0.010	0.00014	0.00040	< 0.003	1.4	< 0.00004	0.35	0.0000030	0.12	0.52	1.1	< 0.000005	< 0.00001	0.00015	0.0041	0.00020	< 0.001	< 0.002
6-Jan-16	80	500	490	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	490	7.8	< 0.007	< 0.00001	0.00061	2.7	0.013	< 0.01	0.00044	0.00040	< 0.003	1.5	0.00015	0.40	0.0000020	0.060	0.50	0.40	< 0.000005	0.000060	0.00025	0.0041	0.00019	< 0.001	< 0.002
20-Jan-16	82	500	490	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	495	7.9	< 0.007	< 0.00001	0.00066	2.8	0.015	< 0.01	0.000070	0.00050	< 0.003	1.6	< 0.00004	0.43	< 0.000002	0.070	0.55	0.40	< 0.000005	0.00011	0.00014	0.0049	0.00019	0.0010	< 0.002
3-Feb-16	84	500	490	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.9	< 0.007	< 0.00001	0.00064	2.6	0.015	< 0.01	0.000090	0.00040	< 0.003	1.4	0.000090	0.37	< 0.000002	0.090	0.54	1.3	< 0.000005	0.000030	< 0.00005	0.0040	0.00017	< 0.001	< 0.002
17-Feb-16	86	500	490	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.8	< 0.007	< 0.00001	0.00064	2.8	0.014	< 0.01	0.00011	0.00040	< 0.003	1.5	< 0.00004	0.14	0.0000030	0.040	0.52	0.80	< 0.000005	0.000020	< 0.00005	0.0037	0.00018	< 0.001	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for HC2 (SS)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg$CaCO_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	330	8.0	464	#N/A	2.2	29	33	1.1	0.19	0.099	42	0.013	0.011	0.021	0.011	0.0000026	0.0000023	0.0062	0.0000030	7.9	0.000069	0.00014	0.0020
2-Jul-14	1	500	485	8.0	255	#N/A	4.0	36	24	0.39	0.14	0.15	40	0.017	0.013	0.031	0.021	0.0000034	0.0000034	0.0058	0.0000015	7.8	0.000019	0.00015	0.00080
9-Jul-14	2	500	490	8.0	220	#N/A	1.2	37	13	0.098	0.14	0.15	35	0.021	0.015	0.023	0.033	0.0000034	0.0000034	0.0061	0.0000015	7.0	0.000015	0.000064	0.00045
16-Jul-14	3	500	480	8.0	177	#N/A	1.1	33	5.8	0.096	0.096	0.14	31	0.020	0.012	0.017	0.030	0.0000034	0.0000034	0.0041	0.0000014	6.2	0.000091	0.00022	0.00035
23-Jul-14	4	500	500	8.0	118	#N/A	1.1	25	3.5	0.10	0.050	0.15	25	0.035	0.0076	0.013	0.040	0.0000035	0.0000035	0.0030	0.0000015	5.5	0.000015	0.000082	0.00051
30-Jul-14	5	500	485	8.1	160	#N/A	0.90	37	4.4	0.097	0.087	0.15	32	0.025	0.012	0.016	0.036	0.0000034	0.0000034	0.0038	0.0000015	6.4	0.000097	0.000097	0.00071
6-Aug-14	6	500	480	8.0	142	#N/A	1.3	31	2.4	0.096	0.072	0.14	29	0.024	0.010	0.014	0.033	0.0000034	0.0000034	0.0034	0.0000014	5.8	0.000014	0.000042	0.00017
13-Aug-14	7	500	490	8.0	125	#N/A	1.2	28	3.4	0.098	0.054	0.15	27	0.022	0.0088	0.0100	0.040	0.0000034	0.0000034	0.0029	0.0000015	5.7	0.000025	0.000041	0.00017
20-Aug-14	8	500	490	8.0	103	#N/A	0.94	24	2.9	0.098	0.034	0.15	23	0.028	0.0057	0.0078	0.036	0.0000034	0.0000034	0.0023	0.0000015	5.2	0.000015	0.000041	0.00019
27-Aug-14	9	500	495	8.0	130	#N/A	2.2	29	2.5	0.099	0.050	0.15	28	0.022	0.0084	0.0099	0.040	0.0000035	0.0000035	0.0050	0.0000015	6.0	0.000015	0.000034	0.00013
3-Sep-14	10	500	490	7.9	121	#N/A	2.3	26	3.4	0.098	0.034	0.15	33	0.029	0.0088	0.011	0.048	0.0000034	0.0000034	0.0025	0.0000015	8.6	0.000015	0.000032	0.00016
10-Sep-14	11	500	500	8.0	111	#N/A	1.7	25	2.5	0.10	0.030	0.15	27	0.029	0.0072	0.0077	0.041	0.0000035	0.0000035	0.0031	0.000011	7.1	0.000015	0.000025	0.00015
17-Sep-14	12	500	495	7.9	112	#N/A	4.1	26	3.0	0.099	0.030	0.15	23	0.028	0.0077	0.0070	0.038	0.0000035	0.0000035	0.0023	0.0000015	5.3	0.000020	0.000029	0.00020
24-Sep-14	13	500	480	8.0	95	#N/A	1.8	21	3.8	0.096	0.029	0.14	20	0.023	0.0072	0.0049	0.033	0.0000034	0.0000034	0.0017	0.0000029	4.6	0.000014	0.000068	0.000086
1-Oct-14	14	500	470	7.9	96	#N/A	3.1	23	2.8	0.094	0.028	0.14	20	0.024	0.0093	0.0046	0.029	0.0000033	0.0000033	0.0013	0.0000014	4.6	0.000014	0.00	0.0000094
8-Oct-14	15	500	490	7.9	90	#N/A	1.5	18	2.0	0.098	0.029	0.15	23	0.024	0.0059	0.0049	0.029	0.0000034	0.0000034	0.0076	0.0000015	6.3	0.000015	0.000020	0.000093
15-Oct-14	16	500	495	7.9	110	#N/A	2.7	21	3.5	0.099	0.030	0.15	28	0.025	0.0081	0.0060	0.038	0.0000035	0.0000035	0.0025	0.0000015	7.7	0.000015	0.000027	0.00013
22-Oct-14	17	500	505	8.0	102	#N/A	2.5	23	2.5	0.10	0.030	0.15	22	0.025	0.0079	0.0060	0.036	0.0000035	0.0000035	0.0055	0.0000025	5.3	0.000076	0.000029	0.00019
29-Oct-14	18	500	490	7.9	84	#N/A	4.1	19	1.5	0.098	0.029	0.15	18	0.018	0.0054	0.0039	0.026	0.0000034	0.0000034	0.0037	0.0000015	4.5	0.000020	0.000020	0.00018
5-Nov-14	19	500	485	7.7	85	#N/A	#N/A	23	1.5	0.097	0.029	0.15	18	0.025	0.0055	0.0045	0.030	0.0000034	0.0000034	0.0017	0.0000092	4.3	0.000015	0.000022	0.00025
12-Nov-14	20	500	495	7.6	89	#N/A	3.3	17	0.99	0.099	0.030	0.15	20	0.029	0.0061	0.0054	0.033	0.0000035	0.0000035	0.0024	0.0000015	5.0	0.000025	0.000027	0.00021
19-Nov-14	21	500	475	7.6	93	#N/A	3.1	16	0.95	0.095	0.029	0.14	19	0.025	0.0060	0.0048	0.033	0.0000033	0.0000033	0.0013	0.0000062	4.6	0.000014	0.000025	0.00027
26-Nov-14	22	500	500	7.9	78	#N/A	0.91	18	1.0	0.10	0.030	0.15	17	0.025	0.0051	0.0045	0.030	0.0000035	0.0000035	0.0011	0.0000015	4.2	0.000015	0.000021	0.000070
3-Dec-14	23	500	495	7.8	71	#N/A	1.5	17	0.99	0.099	0.030	0.15	18	0.023	0.0044	0.0044	0.030	0.0000035	0.0000035	0.0016	0.0000015	4.7	0.000015	0.000017	0.00011
10-Dec-14	24	500	495	7.9	71	#N/A	2.5	18	0.99	0.099	0.030	0.15	17	0.025	0.0043	0.0039	0.030	0.0000035	0.0000035	0.0011	0.0000015	4.3	0.000015	0.000015	0.00017
17-Dec-14	25	500	500	8.0	91	#N/A	2.0	21	1.5	0.10	0.030	0.15	20	0.037	0.0060	0.0052	0.039	0.0000035	0.0000035	0.0012	0.0000015	5.1	0.000015	0.000038	0.00013
24-Dec-14	26	500	495	7.9	87	#N/A	1.6	21	0.99	0.099	0.030	0.15	19	0.028	0.0057	0.0046	0.039	0.0000035	0.0000035	0.00084	0.0000020	4.9	0.000015	0.000024	0.00012
31-Dec-14	27	500	495	7.9	88	#N/A	0.66	15	1.5	0.099	0.030	0.15	20	0.023	0.0058	0.0047	0.036	0.0000035	0.0000035	0.00079	0.0000015	5.2	0.000015	0.000020	0.000089
7-Jan-15	28	500	500	7.8	68	#N/A	1.3	17	1.0	0.50	0.030	0.15	16	0.020	0.0037	0.0030	0.028	0.0000035	0.0000035	0.0014	0.0000015	4.5	0.000015	0.000019	0.00014
14-Jan-15	29	500	480	7.8	68	#N/A	1.3	16	0.96	0.48	0.029	0.14	15	0.018	0.0039	0.0027	0.027	0.0000034	0.0000034	0.0013	0.0000034	4.1	0.000014	0.000017	0.000091
21-Jan-15	30	500	485	8.0	75	#N/A	2.1	20	0.97	0.49	0.029	0.15	16	0.025	0.0047	0.0037	0.031	0.0000034	0.0000034	0.00097	0.0000015	4.3	0.000015	0.000018	0.00015
28-Jan-15	31	500	495	7.9	76	#N/A	0.82	18	0.99	0.50	0.030	0.15	18	0.025	0.0041	0.0034	0.032	0.0000035	0.0000035	0.0016	0.000012	4.5	0.000015	0.000017	0.00010
4-Feb-15	32	500	495	7.9	72	#N/A	1.1	17	0.99	0.50	0.030	0.15	16	0.020	0.0039	0.0031	0.030	0.0000035	0.0000035	0.0013	0.0000020	4.0	0.00	0.000014	0.00016
11-Feb-15	33	500	490	7.9	76	#N/A	1.0	18	1.5	0.49	0.029	0.15	17	0.022	0.0046	0.0032	0.032	0.0000034	0.0000034	0.0014	0.0000034	4.2	0.000015	0.000019	0.000015
18-Feb-15	34	500	485	7.9	67	#N/A	1.0	17	0.97	0.49	0.029	0.15	16	0.021	0.0037	0.0028	0.028	0.0000034	0.0000034	0.0013	0.0000015	4.2	0.000015	0.000019	0.00017
25-Feb-15	35	500	480	7.9	80	#N/A	1.4	19	0.96	0.48	0.029	0.14	18	0.016	0.0041	0.0025	0.030	0.0000034	0.0000034	0.00043	0.0000024	4.7	0.000014	0.000022	0.00024
4-Mar-15	36	500	490	7.8	68	#N/A	0.98	17	0.98	0.49	0.029	0.15	16	0.017	0.0034	0.0023	0.027	0.0000034	0.0000034	0.00069	0.0000015	4.6	0.000029	0.000018	0.000093
11-Mar-15	37	500	490	7.9	73	#N/A	0.85	18	0.98	0.49	0.029	0.15	16	0.014	0.0036	0.0024	0.031	0.0000034	0.0000034	0.0012	0.0000015	4.4	0.000025	0.000018	0.00030
18-Mar-15	38	500	490	7.9	68	#N/A	1.2	18	0.98	0.49	0.029	0.15	16	0.014	0.0032	0.0019	0.027	0.0000034	0.0000034	0.00069	0.0000015	4.6	0.000015	0.000020	0.00015
25-Mar-15	39	500	485	7.8	73	#N/A	1.5	18	0.97	0.49	0.029	0.15	17	0.014	0.0044	0.0024	0.034	0.0000034	0.0000034	0.0019	0.0000019	4.3	0.000039	0.000022	0.00021
1-Apr-15	40	500	490	7.8	64	#N/A	1.8	18	0.98	0.49	0.029	0.15	12	0.014	0.0031	0.0017	0.030	0.0000064	0.0000034	0.00088	0.0000015	3.1	0.000015	0.000010	0.00043
8-Apr-15	41	500	485	7.8	78	#N/A	1.3	20	0.97	0.49	0.029	0.15	17	0.016	0.0052	0.0025	0.033	0.0000034	0.0000034	0.0011	0.0000015	4.6	0.000015	0.000026	0.00036
15-Apr-15	42	500	495	7.8	66	#N/A	1.9	18	0.99	0.50	0.030	0.15	15	0.014	0.0033	0.0021	0.027	0.0000035	0.0000035	0.0021	0.0000015	4.0	0.000015	0.0000059	0.00049
22-Apr-15	43	500	485	7.8	53	#N/A	1.7	15	1.5	0.49	0.029	0.15	12	0.013	0.0021	0.0016	0.023	0.0000034	0.0000034	0.0023	0.0000015	3.4	0.000029	0.000014	0.00040
29-Apr-15	44	500	490	7.9	80	#N/A	1.1	21	0.98	0.49	0.029	0.15	20	0.023	0.0040	0.0027	0.041	0.0000034	0.0000034	0.0015	0.0000015	5.5	0.000020	0.000026	0.00024
6-May-15	45	500	495	7.9	73	#N/A	1.4	20	0.99	0.50	0.030	0.15	17	0.020	0.0037	0.0033	0.033	0.0000035	0.0000035	0.00074	0.0000015	4.5	0.000015	0.000024	0.00020
13-May-15	46	500	505																						
20-May-15	47	505	480																						
27-May-15	48	480	480																						
3-Jun-15	49	480	490	8.1	181	#N/A	0.49	11	0.61	0.12	0.0074	0.037	11	0.0017	0.0021	0.00058	0.025	0.00000086	0.00000086	0.00051	0.00000037	2.9	0.0000037	0.000018	0.000085
10-Jun-15	50	500	490																						
17-Jun-15	51	490	485																						
24-Jun-15	52	485	480																						
1-Jul-15	53	480	480	8.0	192	#N/A	0.54	11	0.48	0.12	0.0072	0.036	9.9	0.0015	0.0021	0.00061	0.022	0.00000084	0.00000084	0.00080	0.00000036	2.6	0.0000036	0.000021	0.000038
8-Jul-15	54	500	485																						
15-Jul-15	55	485	480																						
22-Jul-15	56	480	480																						
29-Jul-15	57	480	470	8.1	176	#N/A	0.31	10	0.47	0.12	0.0071	0.035	9.8	0.0018	0.0016	0.00053	0.019	0.0000011	0.00000082	0.00066	0.00000082	2.5	0.0000035	0.000019	0.000041
5-Aug-15	58	500	500																						
12-Aug-15	59	500	495																						
19-Aug-15	60	495	480																						
26-Aug-15	61	480	470	8.0	172	#N/A	0.23	10	0.47	0.12	0.0071	0.035	9.8	0.0019	0.0016	0.00043	0.022	0.00000082	0.00000082	0.00059	0.00000035	2.5	0.0000035	0.000023	0.000047
2-Sep-15	62	500	490																						
9-Sep-15	63	490	480																						
16-Sep-15	64	480	470																						
23-Sep-15	65	470	460	8.1	167	#N/A	0.27	9.3	0.46				9.3	0.0014	0.0015	0.00049	0.020	0.00000081	0.00000081	0.00068	0.00000035	2.5	0.0000035	0.000018	0.000052
30-Sep-15	66	500	495																						
7-Oct-15	67	495	485																						
14-Oct-15	68	485	475																						
21-Oct-15	69	475	455	8.1	155	#N/A	0.15	9.2	0.46				8.9	0.0014	0.0014	0.00035	0.019	0.00000080	0.00000080	0.00049	0.00000057	2.3	0.0000034	0.000018	0.000091
28-Oct-15	70	500	495																						
4-Nov-15	71	495	485																						
11-Nov-15	72	485	470																						
18-Nov-15	73	470	450	8.1	172	#N/A	0.14	11	0.45				8.9	0.0012	0.0012	0.00036	0.023	0.00000079	0.00000079	0.00027	0.00000034	2.3	0.0000034	0.000020	0.00012
25-Nov-15	74	500	500	8.1	92	#N/A	0.41	26	1.0				23	0.030	0.0033	0.0021	0.046	0.0000035	0.0000035	0.0014	0.0000045	6.4	0.000055	0.000055	0.00029
2-Dec-15	75	500	490	8.0	85	#N/A	0.78	21	0.98				20	0.028	0.0028	0.0020	0.042	0.0000034	0.0000034	0.0012	0.0000015	5.3	0.000029	0.000033	0.00022
9-Dec-15	76	500	500	8.1	76	#N/A	1.2	20	1.0				18	0.022	0.0025	0.0020	0.039	0.000016	0.000016	0.0027	0.0000085	4.9	0.000030	0.000030	0.00014
16-Dec-15	77	500	495	8.0	76	#N/A	0.97	19	0.99				20	0.024	0.0026	0.0021	0.044	0.0000064	0.0000035	0.0011	0.0000025	5.4	0.000035	0.000032	0.00018
23-Dec-15	78	500	485	8.2	65	#N/A	0.79	18	1.2				18	0.021	0.0023	0.0017	0.039	0.0000050	0.0000035	0.0011	0.0000020	5.0	0.000035	0.000025	0.00014
30-Dec-15	79	500	495	7.9	70	#N/A	0.62	17	1.5				17	0.018	0.0019	0.0013	0.034	0.0000035	0.0000035	0.00099	0.0000015	4.6	0.000035	0.000018	0.000099
6-Jan-16	80	500	490	7.8	67	#N/A	0.68	17	1.2				17	0.017	0.0020	0.0014	0.035	0.0000034	0.0000034	0.00099	0.0000015	4.6	0.000025	0.000015	0.00013
13-Jan-16	81	500	490	7.8	75	#N/A	0.74	17	0.98				17	0.016	0.0021	0.0014	0.036	0.0000034	0.0000034	0.00098	0.0000015	4.7	0.000015	0.000012	0.00017
20-Jan-16	82	500	490	8.0	77	#N/A	1.0	18	0.99				18	0.017	0.0021	0.0014	0.039	0.0000034	0.0000034	0.00099	0.0000020	4.8	0.000015	0.000019	0.00016
27-Jan-16	83	500	495	7.9	78	#N/A	1.3	19	0.99				18	0.018	0.0022	0.0014	0.043	0.0000035	0.0000035	0.00099	0.0000025	5.0	0.000015	0.000027	0.00015
3-Feb-16	84	500	490	8.0	85	#N/A	1.2	19	1.00				18	0.017	0.0021	0.0014	0.043	0.0000035	0.0000035	0.00100	0.0000020	5.0	0.000015	0.000025	0.00011
10-Feb-16	85	500	500	7.9	78	#N/A	1.1	19	1.0				18	0.016	0.0020	0.0014	0.043	0.0000035	0.0000035	0.0010	0.0000015	5.0	0.000015	0.000023	0.000070
17-Feb-16	86	500	490	7.8	66	#N/A	1.1	19	0.98				18	0.017	0.0019	0.0013	0.041	0.0000035	0.0000035	0.0010	0.0000015	4.9	0.000015	0.000021	0.000068
24-Feb-16	87	500	500	7.8	74	#N/A	1.1	18	1.0				18	0.018	0.0018	0.0012	0.040	0.0000035	0.0000035	0.0010	0.0000015	4.8	0.000015	0.000020	0.000065

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for HC2 (SS)

Date	**Cycle**	**Volume** (mL)		**pH**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	330	8.0	0.0026	0.0000066	0.0034	5.3	0.0032	0.0033	0.0022	0.0046	0.0066	7.0	0.00040	0.72	0.0000030	11	0.35	12	0.000015	0.000036	0.000073	0.0075	0.00078	0.0013	0.00066
2-Jul-14	1	500	485	8.0	0.00097	0.0000049	0.0028	5.1	0.0049	0.0049	0.0019	0.0041	0.0044	5.6	0.00024	0.82	0.00000097	6.0	0.51	8.4	0.0000092	0.00016	0.000029	0.012	0.00070	0.00049	0.00097
9-Jul-14	2	500	490	8.0	0.00098	0.0000049	0.0024	4.4	0.0045	0.0049	0.0012	0.0020	0.0044	4.9	0.000054	0.90	0.00000098	3.6	0.51	4.7	0.0000069	0.000088	0.000044	0.0087	0.00064	0.00049	0.00098
16-Jul-14	3	500	480	8.0	0.0038	0.0000048	0.0018	3.8	0.0035	0.0048	0.0011	0.0012	0.0043	3.7	0.000024	0.70	0.0000019	1.7	0.48	2.5	0.0000086	0.000024	0.000043	0.0074	0.00050	0.00048	0.00096
23-Jul-14	4	500	500	8.0	0.0025	0.000020	0.0011	2.8	0.0052	0.0050	0.00044	0.00055	0.0045	2.4	0.000040	0.51	0.0000010	0.74	0.37	1.7	0.0000040	0.00012	0.00018	0.0049	0.00036	0.00050	0.0010
30-Jul-14	5	500	485	8.1	0.00097	0.0000049	0.0019	3.8	0.0043	0.0049	0.00078	0.00092	0.0044	3.6	0.000029	0.74	0.00000097	0.86	0.52	2.1	0.0000078	0.0000049	0.00010	0.0063	0.00048	0.00049	0.00097
6-Aug-14	6	500	480	8.0	0.00096	0.0000048	0.0014	3.5	0.0037	0.0048	0.00025	0.00048	0.0043	3.3	0.000019	0.70	0.00000096	0.50	0.48	1.6	0.0000048	0.000014	0.000029	0.0055	0.00056	0.00048	0.00096
13-Aug-14	7	500	490	8.0	0.00098	0.0000049	0.0012	3.1	0.0045	0.0049	0.00029	0.00049	0.0044	2.6	0.000020	0.56	0.00000098	0.33	0.42	1.3	0.0000034	0.00010	0.000029	0.0050	0.00028	0.00049	0.00098
20-Aug-14	8	500	490	8.0	0.00098	0.0000049	0.00082	2.5	0.0054	0.0049	0.00020	0.00034	0.0044	1.9	0.000025	0.44	0.00000098	0.21	0.37	1.1	0.0000029	0.000064	0.000044	0.0046	0.00031	0.00049	0.00098
27-Aug-14	9	500	495	8.0	0.00099	0.0000050	0.0011	3.0	0.0055	0.0050	0.00023	0.00050	0.0050	2.5	0.000030	0.58	0.00000099	0.23	0.45	1.3	0.0000050	0.000054	0.000025	0.0054	0.00035	0.00050	0.00099
3-Sep-14	10	500	490	7.9	0.0034	0.0000049	0.00093	2.8	0.0059	0.0049	0.00017	0.00044	0.0029	2.3	0.000098	0.62	0.0000083	0.19	0.51	1.8	0.0000059	0.0000098	0.000025	0.0056	0.00039	0.00049	0.00098
10-Sep-14	11	500	500	8.0	0.0035	0.0000050	0.00073	2.2	0.0056	0.0050	0.00014	0.00035	0.0015	1.8	0.000030	0.50	0.0000010	0.14	0.43	1.2	0.0000060	0.000075	0.000055	0.0048	0.00031	0.00050	0.0010
17-Sep-14	12	500	495	7.9	0.0035	0.0000099	0.00074	2.4	0.0051	0.0050	0.00014	0.00040	0.0015	1.8	0.000069	0.44	0.00000099	0.13	0.47	1.5	0.0000025	0.000020	0.000094	0.0050	0.00027	0.00050	0.00099
24-Sep-14	13	500	480	8.0	0.00096	0.0000096	0.00063	2.0	0.0049	0.0048	0.00015	0.000096	0.0043	1.4	0.000019	0.35	0.0000019	0.13	0.31	0.99	0.0000024	0.0000096	0.000024	0.0042	0.00021	0.00048	0.00096
1-Oct-14	14	500	470	7.9	0.012	0.0000047	0.00054	2.0	0.0069	0.0047	0.00047	0.000047	0.0042	1.4	0.000019	0.38	0.00000094	0.089	0.33	1.2	0.0000024	0.000033	0.00016	0.0041	0.00022	0.00094	0.00094
8-Oct-14	15	500	490	7.9	0.0034	0.000020	0.00053	1.7	0.0050	0.0049	0.00022	0.00025	0.0015	1.2	0.000020	0.29	0.00000098	0.078	0.32	1.2	0.0000039	0.000039	0.000025	0.0038	0.00022	0.00049	0.00098
15-Oct-14	16	500	495	7.9	0.0035	0.0000050	0.00073	2.2	0.0060	0.0050	0.00016	0.00035	0.0015	1.6	0.000025	0.41	0.00000099	0.11	0.42	1.4	0.0000045	0.000050	0.000025	0.0046	0.00023	0.00050	0.00099
22-Oct-14	17	500	505	8.0	0.0035	0.000025	0.00060	2.2	0.0062	0.0051	0.00015	0.00040	0.0015	1.7	0.000025	0.40	0.0000010	0.11	0.39	1.3	0.0000051	0.000020	0.00013	0.0046	0.00023	0.00051	0.0010
29-Oct-14	18	500	490	7.9	0.0034	0.0000049	0.00045	1.6	0.0050	0.0049	0.00012	0.00025	0.0015	1.00	0.000020	0.27	0.00000098	0.069	0.29	0.83	0.0000049	0.000044	0.000044	0.0031	0.00015	0.00049	0.00098
5-Nov-14	19	500	485	7.7	0.0034	0.000019	0.00043	1.7	0.0048	0.0049	0.00020	0.00019	0.0015	1.0	0.000019	0.30	0.00000097	0.078	0.31	0.87	0.000011	0.000019	0.000092	0.0033	0.00019	0.00049	0.00097
12-Nov-14	20	500	495	7.6	0.0035	0.0000099	0.00048	1.8	0.0058	0.0050	0.00034	0.00030	0.0015	1.1	0.000020	0.32	0.00000099	0.094	0.35	0.89	0.0000040	0.000069	0.000099	0.0037	0.00022	0.00050	0.00099
19-Nov-14	21	500	475	7.6	0.0033	0.000014	0.00048	1.8	0.0055	0.0048	0.00039	0.00029	0.0014	1.1	0.000029	0.30	0.00000095	0.076	0.34	0.81	0.000015	0.000090	0.000024	0.0034	0.00020	0.00095	0.00095
26-Nov-14	22	500	500	7.9	0.0035	0.0000050	0.00046	1.6	0.0052	0.0050	0.00017	0.00020	0.0040	0.98	0.000020	0.29	0.0000010	0.065	0.30	0.70	0.0000040	0.000025	0.000085	0.0033	0.00020	0.0010	0.0010
3-Dec-14	23	500	495	7.8	0.0035	0.0000099	0.00039	1.4	0.0054	0.0050	0.00012	0.00020	0.0015	0.81	0.000025	0.23	0.00000099	0.059	0.25	0.64	0.0000035	0.000025	0.000040	0.0031	0.00021	0.00050	0.00099
10-Dec-14	24	500	495	7.9	0.0035	0.0000050	0.00038	1.4	0.0054	0.0050	0.00014	0.00015	0.0015	0.82	0.000020	0.23	0.00000099	0.059	0.28	0.69	0.0000035	0.000050	0.000030	0.0028	0.00017	0.00050	0.00099
17-Dec-14	25	500	500	8.0	0.0035	0.000010	0.00058	1.9	0.0070	0.0050	0.00012	0.00030	0.0015	1.2	0.000020	0.37	0.0000010	0.065	0.37	0.75	0.0000035	0.000085	0.00034	0.0037	0.00023	0.00050	0.0010
24-Dec-14	26	500	495	7.9	0.0035	0.0000050	0.00051	1.7	0.0066	0.0050	0.000064	0.00025	0.0015	0.99	0.000020	0.29	0.00000099	0.069	0.34	0.74	0.0000035	0.000015	0.000025	0.0035	0.00021	0.00050	0.00099
31-Dec-14	27	500	495	7.9	0.0035	0.0000050	0.00048	1.7	0.0061	0.0050	0.00013	0.00025	0.0015	1.0	0.000020	0.34	0.00000099	0.064	0.34	0.74	0.0000045	0.000025	0.000079	0.0036	0.00019	0.00050	0.00099
7-Jan-15	28	500	500	7.8	0.0035	0.000015	0.00033	1.3	0.0055	0.0050	0.00013	0.00020	0.0015	0.70	0.000020	0.20	0.0000010	0.045	0.25	0.40	0.000013	0.000020	0.000060	0.0026	0.00016	0.00050	0.0010
14-Jan-15	29	500	480	7.8	0.0034	0.0000048	0.00029	1.2	0.0052	0.0048	0.00041	0.00019	0.0014	0.67	0.000034	0.20	0.00000096	0.043	0.25	0.38	0.0000082	0.000029	0.000034	0.0022	0.00013	0.00048	0.00096
21-Jan-15	30	500	485	8.0	0.0034	0.000019	0.00039	1.4	0.0056	0.0049	0.00015	0.00019	0.0015	0.81	0.000019	0.23	0.00000097	0.053	0.27	0.44	0.0000024	0.000019	0.000044	0.0029	0.00021	0.00049	0.00097
28-Jan-15	31	500	495	7.9	0.0035	0.0000050	0.00031	1.6	0.0059	0.0050	0.00056	0.00020	0.0015	0.87	0.000045	0.26	0.00000099	0.054	0.24	0.74	0.000014	0.000040	0.000054	0.0027	0.00016	0.00050	0.00099
4-Feb-15	32	500	495	7.9	0.0035	0.0000099	0.00038	1.4	0.0051	0.0050	0.00019	0.00020	0.0015	0.78	0.000020	0.23	0.00000099	0.050	0.28	0.59	0.0000025	0.000069	0.000040	0.0024	0.00016	0.00050	0.00099
11-Feb-15	33	500	490	7.9	0.0034	0.000015	0.00037	1.5	0.0056	0.0049	0.00026	0.00020	0.0015	0.81	0.00049	0.23	0.00000098	0.049	0.29	0.49	0.000014	0.00021	0.000034	0.0026	0.00017	0.00049	0.00098
18-Feb-15	34	500	485	7.9	0.0034	0.0000049	0.00038	1.3	0.0053	0.0049	0.000078	0.00019	0.0015	0.74	0.00049	0.21	0.00000097	0.044	0.29	0.49	0.0000029	0.000024	0.000029	0.0025	0.00016	0.00049	0.00097
25-Feb-15	35	500	480	7.9	0.0034	0.00023	0.00037	1.4	0.0056	0.0048	0.000086	0.00024	0.0014	0.96	0.00048	0.25	0.00000096	0.048	0.30	0.43	0.0000048	0.000082	0.000024	0.0027	0.00013	0.00048	0.00096
4-Mar-15	36	500	490	7.8	0.0034	0.0000049	0.00035	1.2	0.0052	0.0049	0.000039	0.00025	0.0015	0.67	0.00049	0.24	0.00000098	0.039	0.23	0.59	0.0000025	0.000029	0.000049	0.0025	0.00014	0.00049	0.00098
11-Mar-15	37	500	490	7.9	0.0034	0.000029	0.00036	1.3	0.0059	0.0049	0.000069	0.00020	0.0015	0.73	0.00049	0.20	0.00000098	0.039	0.27	0.098	0.0000025	0.000054	0.000025	0.0023	0.00015	0.00049	0.00098
18-Mar-15	38	500	490	7.9	0.0034	0.0000049	0.00033	1.2	0.0060	0.0049	0.000054	0.00020	0.0015	0.72	0.00049	0.19	0.00000098	0.034	0.26	0.44	0.0000025	0.000034	0.000029	0.0022	0.00012	0.00049	0.00098
25-Mar-15	39	500	485	7.8	0.0034	0.0000049	0.00035	1.4	0.0063	0.0049	0.00017	0.00029	0.0015	0.79	0.00049	0.22	0.00000097	0.078	0.28	0.49	0.0000024	0.00026	0.000044	0.0030	0.00016	0.00049	0.00097
1-Apr-15	40	500	490	7.8	0.0034	0.000020	0.00024	1.0	0.0093	0.0049	0.000039	0.00020	0.0015	0.60	0.00049	0.12	0.00000098	0.35	0.23	0.15	0.0000025	0.000074	0.000039	0.0026	0.000098	0.00049	0.00098
8-Apr-15	41	500	485	7.8	0.0034	0.0000049	0.00037	1.3	0.0059	0.0049	0.00013	0.00024	0.0015	0.85	0.00049	0.26	0.00000097	0.039	0.30	0.29	0.0000024	0.00015	0.000053	0.0025	0.00015	0.00049	0.00097
15-Apr-15	42	500	495	7.8	0.0035	0.0000050	0.00031	1.2	0.0053	0.0050	0.00013	0.00020	0.0015	0.70	0.00050	0.19	0.00000099	0.045	0.26	0.40	0.0000025	0.00013	0.000025	0.0022	0.00013	0.00050	0.00099
22-Apr-15	43	500	485	7.8	0.0034	0.000015	0.00021	0.83	0.0053	0.0049	0.000058	0.00015	0.0015	0.45	0.00049	0.14	0.0000019	0.024	0.18	0.19	0.0000044	0.00016	0.000034	0.0014	0.000097	0.00049	0.00097
29-Apr-15	44	500	490	7.9	0.0034	0.000064	0.00040	1.5	0.0073	0.0049	0.00010	0.00020	0.0015	0.91	0.00049	0.24	0.00000098	0.049	0.29	0.64	0.0000025	0.000039	0.000044	0.0030	0.00016	0.00049	0.00098
6-May-15	45	500	495	7.9	0.0035	0.0000099	0.00037	1.3	0.0064	0.0050	0.000050	0.00020	0.0015	0.81	0.00050	0.23	0.00000099	0.040	0.26	0.40	0.0000025	0.00031	0.000025	0.0025	0.00015	0.0015	0.00099
13-May-15	46	500	505																								
20-May-15	47	505	480																								
27-May-15	48	480	480																								
3-Jun-15	49	480	490	8.1	0.00086	0.0000012	0.00021	0.87	0.0039	0.0012	0.000042	0.00021	0.00037	0.44	0.0000049	0.14	0.00000025	0.022	0.19	0.32	0.00000061	0.000011	0.0000098	0.0014	0.000031	0.00012	0.00025
10-Jun-15	50	500	490																								
17-Jun-15	51	490	485																								
24-Jun-15	52	485	480																								
1-Jul-15	53	480	480	8.0	0.00084	0.0000012	0.00019	0.84	0.0038	0.0012	0.000034	0.00023	0.00036	0.36	0.000011	0.14	0.00000024	0.026	0.18	0.26	0.0000013	0.000024	0.0000060	0.0016	0.000029	0.00012	0.00024
8-Jul-15	54	500	485																								
15-Jul-15	55	485	480																								
22-Jul-15	56	480	480																								
29-Jul-15	57	480	470	8.1	0.00082	0.0000024	0.00018	0.84	0.0037	0.0012	0.000052	0.00020	0.00035	0.35	0.0000047	0.12	0.00000024	0.024	0.18	0.25	0.00000059	0.0000059	0.000015	0.0013	0.000029	0.00012	0.00024
5-Aug-15	58	500	500																								
12-Aug-15	59	500	495																								
19-Aug-15	60	495	480																								
26-Aug-15	61	480	470	8.0	0.00082	0.000015	0.00017	0.84	0.0045	0.0012	0.000090	0.00022	0.00035	0.36	0.0000059	0.12	0.00000024	0.022	0.18	0.31	0.00000094	0.000014	0.0000059	0.0013	0.000032	0.00024	0.00024
2-Sep-15	62	500	490																								
9-Sep-15	63	490	480																								
16-Sep-15	64	480	470																								
23-Sep-15	65	470	460	8.1	0.00081	0.0000012	0.00016	0.76	0.0033	0.0012	0.00013	0.00020	0.00035	0.33	0.0000069	0.12	0.00000023	0.030	0.15	0.24	0.00000092	0.0000035	0.0000058	0.0012	0.000025	0.00012	0.00023
30-Sep-15	66	500	495																								
7-Oct-15	67	495	485																								
14-Oct-15	68	485	475																								
21-Oct-15	69	475	455	8.1	0.00080	0.0000057	0.00015	0.75	0.0034	0.0011	0.000027	0.00018	0.00034	0.33	0.000023	0.10	0.0000046	0.031	0.14	0.23	0.0000013	0.000018	0.0000057	0.0011	0.000020	0.00011	0.00023
28-Oct-15	70	500	495																								
4-Nov-15	71	495	485																								
11-Nov-15	72	485	470																								
18-Nov-15	73	470	450	8.1	0.0045	0.0000045	0.00013	0.75	0.0034	0.0011	0.00017	0.00017	0.00034	0.33	0.000012	0.10	0.00000034	0.021	0.15	0.14	0.0000033	0.000015	0.000015	0.0012	0.000019	0.00023	0.00023
25-Nov-15	74	500	500	8.1	0.0035	0.000045	0.00046	1.8	0.0083	0.0050	0.00019	0.00030	0.0035	1.0	0.00025	0.28	0.00014	0.060	0.35	0.50	0.0000065	0.0000050	0.00024	0.0030	0.00015	0.00050	0.0010
2-Dec-15	75	500	490	8.0	0.0044	0.000039	0.00040	1.7	0.0074	0.0049	0.00019	0.00029	0.0015	0.94	0.000020	0.28	0.00000098	0.054	0.31	0.44	0.0000025	0.000039	0.00024	0.0028	0.00014	0.00049	0.00098
9-Dec-15	76	500	500	8.1	0.0035	0.000015	0.00037	1.3	0.0067	0.0050	0.00017	0.00025	0.0040	0.80	0.000045	0.22	0.0000085	0.045	0.28	0.40	0.000018	0.000070	0.000085	0.0025	0.00014	0.00050	0.0010
16-Dec-15	77	500	495	8.0	0.0035	0.000084	0.00039	1.6	0.0081	0.0050	0.000089	0.00025	0.0020	0.92	0.000020	0.25	0.0000020	0.050	0.30	0.40	0.0000035	0.000079	0.000025	0.0027	0.00014	0.00050	0.00099
23-Dec-15	78	500	485	8.2	0.0035	0.000045	0.00036	1.4	0.0073	0.0050	0.000079	0.00022	0.0017	0.81	0.000020	0.21	0.0000017	0.054	0.28	0.47	0.0000030	0.000042	0.000050	0.0023	0.00012	0.00050	0.00099
30-Dec-15	79	500	495	7.9	0.0035	0.0000050	0.00032	1.3	0.0065	0.0050	0.000069	0.00020	0.0015	0.70	0.000020	0.17	0.0000015	0.059	0.26	0.54	0.0000025	0.0000050	0.000074	0.0020	0.000099	0.00050	0.00099
6-Jan-16	80	500	490	7.8	0.0034	0.0000049	0.00031	1.3	0.0065	0.0049	0.00014	0.00020	0.0015	0.73	0.000047	0.18	0.0000012	0.044	0.25	0.37	0.0000025	0.000017	0.000098	0.0020	0.000096	0.00049	0.00099
13-Jan-16	81	500	490	7.8	0.0034	0.0000049	0.00030	1.3	0.0064	0.0049	0.00022	0.00020	0.0015	0.75	0.000074	0.20	0.00000098	0.029	0.25	0.20	0.0000025	0.000029	0.00012	0.0020	0.000093	0.00049	0.00098
20-Jan-16	82	500	490	8.0	0.0034	0.0000049	0.00031	1.4	0.0068	0.0049	0.00013	0.00022	0.0015	0.77	0.000047	0.20	0.00000099	0.032	0.26	0.20	0.0000025	0.000042	0.000096	0.0022	0.000094	0.00049	0.00099
27-Jan-16	83	500	495	7.9	0.0035	0.0000050	0.00032	1.4	0.0072	0.0050	0.000035	0.00025	0.0015	0.79	0.000020	0.21	0.00000099	0.035	0.27	0.20	0.0000025	0.000054	0.000069	0.0024	0.000094	0.00050	0.00099
3-Feb-16	84	500	490	8.0	0.0035	0.0000050	0.00032	1.4	0.0072	0.0050	0.000040	0.00022	0.0015	0.75	0.000032	0.20	0.00000100	0.040	0.27	0.42	0.0000025	0.000035	0.000047	0.0022	0.000090	0.00050	0.00100
10-Feb-16	85	500	500	7.9	0.0035	0.0000050	0.00032	1.3	0.0073	0.0050	0.000045	0.00020	0.0015	0.71	0.000045	0.19	0.0000010	0.045	0.27	0.65	0.0000025	0.000015	0.000025	0.0020	0.000085	0.00050	0.0010
17-Feb-16	86	500	490	7.8	0.0035	0.0000050	0.00032	1.3	0.0072	0.0050	0.000050	0.00020	0.0015	0.72	0.000033	0.13	0.0000013	0.033	0.27	0.53	0.0000025	0.000013	0.000025	0.0019	0.000088	0.00050	0.0010
24-Feb-16	87	500	500	7.8	0.0035	0.0000050	0.00032	1.4	0.0071	0.0050	0.000055	0.00020	0.0015	0.74	0.000020	0.070	0.0000015	0.020	0.26	0.40	0.0000025	0.000010	0.000025	0.0018	0.000090	0.00050	0.0010

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC3 (GT)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	400	8.1	121	#N/A	4.8	34	5.0	1.3	0.24	< 0.3	25	0.065	0.0032	0.066	0.042	0.0000080	< 0.000007	0.011	0.0000060	6.5	0.000080	0.00017	0.0021
2-Jul-14	1	500	480	7.9	107	#N/A	5.7	40	13	0.70	0.13	< 0.3	29	0.044	0.0025	0.043	0.045	< 0.000007	< 0.000007	0.0081	< 0.000003	7.5	0.000050	0.00016	0.0012
9-Jul-14	2	500	495	7.9	91	#N/A	1.7	35	8.0	0.30	0.11	< 0.3	26	0.034	0.0024	0.034	0.045	< 0.000007	< 0.000007	0.0075	< 0.000003	6.8	< 0.00003	0.000054	0.00066
16-Jul-14	3	500	485	7.9	80	#N/A	2.0	34	5.0	< 0.2	0.10	< 0.3	26	0.048	0.0025	0.031	0.055	< 0.000007	< 0.000007	0.0069	< 0.000003	6.7	0.00018	0.00029	0.00076
23-Jul-14	4	500	500	7.9	67	#N/A	2.1	32	4.0	< 0.2	0.080	< 0.3	26	0.055	0.0019	0.027	0.069	< 0.000007	< 0.000007	0.0064	< 0.000003	6.9	0.000080	0.00014	0.0012
30-Jul-14	5	500	490	7.8	60	#N/A	2.4	31	4.0	< 0.2	0.060	< 0.3	23	0.052	0.0019	0.022	0.051	< 0.000007	< 0.000007	0.0047	0.0000030	5.8	0.00010	0.00010	0.0013
6-Aug-14	6	500	490	7.8	60	#N/A	2.1	29	3.0	< 0.2	0.070	< 0.3	24	0.030	0.0018	0.020	0.047	< 0.000007	< 0.000007	0.0050	< 0.000003	6.1	< 0.00003	0.000038	0.00029
13-Aug-14	7	500	480	7.8	55	#N/A	2.5	29	5.0	< 0.2	0.070	< 0.3	23	0.061	0.0015	0.018	0.053	< 0.000007	< 0.000007	0.0053	< 0.000003	5.9	0.000070	0.000048	0.00032
20-Aug-14	8	500	500	7.8	52	#N/A	1.8	29	4.0	< 0.2	0.060	< 0.3	24	0.026	0.0012	0.016	0.050	< 0.000007	< 0.000007	0.0055	< 0.000003	6.3	0.000040	0.000063	0.00033
27-Aug-14	9	500	505	7.9	59	#N/A	4.3	31	2.0	< 0.2	< 0.06	< 0.3	25	0.023	0.0013	0.014	0.065	< 0.000007	< 0.000007	0.011	< 0.000003	6.9	< 0.00003	0.000030	0.00029
3-Sep-14	10	500	480	7.8	50	#N/A	4.2	27	5.0	< 0.2	< 0.06	< 0.3	23	0.026	0.0014	0.015	0.050	< 0.000007	< 0.000007	0.0041	0.0000030	6.2	< 0.00003	0.000032	0.00068
10-Sep-14	11	500	515	7.9	54	#N/A	3.2	28	3.0	< 0.2	< 0.06	< 0.3	22	0.046	0.0011	0.013	0.065	< 0.000007	< 0.000007	0.0058	< 0.000003	6.1	< 0.00003	0.000035	0.00041
17-Sep-14	12	500	490	7.9	49	#N/A	6.4	28	4.0	< 0.2	< 0.06	< 0.3	20	0.025	0.0011	0.011	0.043	< 0.000007	< 0.000007	0.0046	0.0000090	5.1	< 0.00003	0.000034	0.00014
24-Sep-14	13	500	480	7.9	48	#N/A	3.7	27	3.0	< 0.2	< 0.06	< 0.3	20	0.034	0.0012	0.012	0.041	< 0.000007	< 0.000007	0.0032	0.0000030	5.3	< 0.00003	0.00010	0.00015
1-Oct-14	14	500	480	7.9	42	#N/A	6.1	28	< 2	< 0.2	< 0.06	< 0.3	19	0.032	0.0012	0.0098	0.038	< 0.000007	< 0.000007	0.0030	0.000051	4.9	< 0.00003	0.00010	< 0.00002
8-Oct-14	15	500	500	7.7	47	#N/A	3.1	23	< 2	< 0.2	< 0.06	< 0.3	20	0.021	0.0010	0.0096	0.047	< 0.000007	< 0.000007	0.013	< 0.000003	5.5	< 0.00003	0.000029	0.00013
15-Oct-14	16	500	490	7.9	52	#N/A	4.6	26	3.0	< 0.2	< 0.06	< 0.3	23	0.051	0.0010	0.013	0.057	< 0.000007	< 0.000007	0.0049	0.000012	6.2	< 0.00003	0.000025	0.00022
22-Oct-14	17	500	510	7.8	52	#N/A	4.1	27	< 2	< 0.2	< 0.06	< 0.3	23	0.024	0.0010	0.0096	0.059	< 0.000007	< 0.000007	0.0059	0.000010	6.3	< 0.00003	0.000027	0.000080
29-Oct-14	18	500	490	7.9	42	#N/A	6.9	27	< 2	< 0.2	< 0.06	< 0.3	19	0.024	0.0010	0.0089	0.044	< 0.000007	< 0.000007	0.0062	< 0.000003	5.1	< 0.00003	0.000020	0.00024
5-Nov-14	19	500	505	7.9	45	#N/A	#N/A	32	< 2	< 0.2	< 0.06	< 0.3	20	0.019	0.00090	0.0081	0.049	< 0.000007	< 0.000007	0.0038	0.000012	5.3	< 0.00003	0.000027	0.00055
12-Nov-14	20	500	505	7.4	48	#N/A	6.8	34	< 2	< 0.2	< 0.06	< 0.3	22	0.024	0.00090	0.0088	0.056	< 0.000007	< 0.000007	0.0045	< 0.000003	6.2	< 0.00003	0.000031	0.00025
19-Nov-14	21	500	490	7.6	57	#N/A	6.6	34	2.0	< 0.2	< 0.06	< 0.3	20	0.034	0.00090	0.0077	0.052	< 0.000007	< 0.000007	0.0031	0.0000040	5.2	< 0.00003	0.000041	0.00031
26-Nov-14	22	500	505	7.7	43	#N/A	2.0	23	2.0	< 0.2	< 0.06	< 0.3	20	0.022	0.00090	0.0081	0.050	< 0.000007	< 0.000007	0.0025	< 0.000003	5.1	< 0.00003	0.000030	0.00012
3-Dec-14	23	500	500	7.8	71	#N/A	3.0	34	< 2	< 0.2	< 0.06	< 0.3	21	0.017	0.00090	0.0081	0.052	< 0.000007	< 0.000007	0.0034	< 0.000003	5.5	< 0.00003	0.000031	0.00015
10-Dec-14	24	500	485	7.8	37	#N/A	4.6	22	2.0	< 0.2	< 0.06	< 0.3	21	0.017	0.00070	0.0066	0.045	< 0.000007	< 0.000007	0.0025	< 0.000003	6.2	< 0.00003	0.000026	0.00021
17-Dec-14	25	500	500	7.8	41	#N/A	3.8	24	< 2	< 0.2	< 0.06	< 0.3	19	0.033	0.00080	0.0079	0.058	< 0.000007	< 0.000007	0.0025	< 0.000003	5.1	< 0.00003	0.000016	0.00016
24-Dec-14	26	500	485	7.8	39	#N/A	3.1	22	< 2	< 0.2	< 0.06	< 0.3	18	0.030	0.00080	0.0063	0.051	< 0.000007	< 0.000007	0.0017	< 0.000003	5.0	< 0.00003	0.000021	0.00017
31-Dec-14	27	500	505	7.6	44	#N/A	1.5	27	< 2	< 0.2	< 0.06	< 0.3	20	0.019	0.00090	0.0067	0.055	< 0.000007	< 0.000007	0.0018	< 0.000003	5.6	< 0.00003	0.000018	0.00015
7-Jan-15	28	500	505	7.7	40	#N/A	2.6	23	< 2	< 1	< 0.06	< 0.3	21	0.016	0.00090	0.0058	0.050	< 0.000007	< 0.000007	0.0021	< 0.000003	5.6	< 0.00003	0.000032	0.00035
14-Jan-15	29	500	495	7.7	36	#N/A	2.2	21	< 2	< 1	< 0.06	< 0.3	17	0.018	0.00080	0.0063	0.042	< 0.000007	< 0.000007	0.0024	< 0.000003	4.7	< 0.00003	0.000020	0.0012
21-Jan-15	30	500	500	8.0	37	#N/A	4.2	26	< 2	< 1	< 0.06	< 0.3	18	0.020	0.00080	0.0052	0.044	< 0.000007	< 0.000007	0.0018	0.0000040	4.8	< 0.00003	0.000024	0.00031
28-Jan-15	31	500	490	7.6	38	#N/A	1.6	21	< 2	< 1	< 0.06	< 0.3	19	0.020	0.0010	0.0059	0.047	< 0.000007	< 0.000007	0.0027	0.0000030	5.0	< 0.00003	0.000019	0.00022
4-Feb-15	32	500	485	7.7	35	#N/A	2.2	20	< 2	< 1	< 0.06	< 0.3	16	0.018	0.00080	0.0053	0.039	< 0.000007	< 0.000007	0.0024	< 0.000003	4.0	< 0.00003	0.000015	0.00074
11-Feb-15	33	500	500	7.6	36	#N/A	1.9	20	< 2	< 1	< 0.06	< 0.3	18	0.020	0.00090	0.0052	0.041	< 0.000007	< 0.000007	0.0025	< 0.000003	4.8	< 0.00003	0.000023	0.00016
18-Feb-15	34	500	485	7.7	35	#N/A	2.3	21	< 2	< 1	< 0.06	< 0.3	17	0.019	0.00090	0.0052	0.042	< 0.000007	< 0.000007	0.0026	< 0.000003	4.7	< 0.00003	0.000024	0.00031
25-Feb-15	35	500	475	7.9	37	#N/A	3.1	23	< 2	< 1	< 0.06	< 0.3	16	0.013	0.00090	0.0047	0.040	< 0.000007	< 0.000007	0.0011	0.0000090	4.2	< 0.00003	0.000023	0.00055
4-Mar-15	36	500	485	7.6	36	#N/A	2.3	22	< 2	< 1	< 0.06	< 0.3	16	0.015	0.00070	0.0046	0.039	< 0.000007	< 0.000007	0.0013	< 0.000003	4.3	0.000050	0.000014	0.00033
11-Mar-15	37	500	510	7.6	35	#N/A	1.9	21	< 2	< 1	< 0.06	< 0.3	16	0.013	0.00080	0.0042	0.041	< 0.000007	< 0.000007	0.0021	0.000036	4.4	0.000060	0.000035	0.0015
18-Mar-15	38	500	490	7.7	37	#N/A	2.5	22	< 2	< 1	< 0.06	< 0.3	17	0.019	0.00080	0.0040	0.039	< 0.000007	< 0.000007	0.0013	0.0000030	4.7	< 0.00003	0.000024	0.00017
25-Mar-15	39	500	485	7.7	37	#N/A	2.7	23	< 2	< 1	< 0.06	< 0.3	19	0.014	0.00090	0.0049	0.043	< 0.000007	< 0.000007	0.0024	< 0.000003	4.8	0.000080	0.000013	0.0013
1-Apr-15	40	500	495	7.8	35	#N/A	3.5	24	< 2	< 1	< 0.06	< 0.3	14	0.016	0.00080	0.0036	0.044	0.000013	< 0.000007	0.0020	0.0000060	3.5	< 0.00003	0.0000060	0.00032
8-Apr-15	41	500	475	7.6	38	#N/A	2.7	23	< 2	< 1	< 0.06	< 0.3	17	0.018	0.0011	0.0044	0.042	< 0.000007	< 0.000007	0.0015	< 0.000003	4.6	< 0.00003	0.000032	0.00042
15-Apr-15	42	500	480	7.8	37	#N/A	4.0	26	< 2	< 1	< 0.06	< 0.3	17	0.016	0.00080	0.0041	0.041	< 0.000007	< 0.000007	0.0041	< 0.000003	4.4	< 0.00003	< 0.000004	0.00099
22-Apr-15	43	500	495	7.7	37	#N/A	3.3	23	3.0	< 1	< 0.06	< 0.3	17	0.016	0.00070	0.0039	0.040	< 0.000007	< 0.000007	0.0035	< 0.000003	4.4	< 0.00003	0.000015	0.00051
29-Apr-15	44	500	500	7.6	34	#N/A	2.1	21	< 2	< 1	< 0.06	< 0.3	16	0.019	0.00080	0.0036	0.041	< 0.000007	< 0.000007	0.0024	< 0.000003	4.4	< 0.00003	0.000021	0.00027
6-May-15	45	500	510	7.7	38	#N/A	2.4	24	< 2	< 1	< 0.06	< 0.3	17	0.019	0.00090	0.0058	0.041	< 0.000007	< 0.000007	0.0017	< 0.000003	4.5	< 0.00003	0.000017	0.00064
13-May-15	46	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	505	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	490	510	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	510	500	7.9	106	#N/A	3.1	54	< 2	< 1	< 0.06	< 0.3	52	0.011	0.0015	0.0049	0.12	< 0.000007	< 0.000007	0.0049	< 0.000003	15	< 0.00003	0.000042	0.0022
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	480	495	7.9	116	#N/A	3.6	56	< 2	< 1	< 0.06	< 0.3	50	0.015	0.0018	0.0063	0.12	< 0.000007	< 0.000007	0.0047	< 0.000003	14	< 0.00003	0.000041	0.00050
8-Jul-15	54	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	490	485	8.0	108	#N/A	2.3	56																	
5-Aug-15	58	500	510	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	510	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	485	490	8.0	106	#N/A	1.7	54	< 2	< 1	< 0.06	< 0.3	50	0.015	0.0015	0.0049	0.13	< 0.000007	< 0.000007	0.0049	0.000010	14	0.000060	0.000045	0.00067
2-Sep-15	62	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	485	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	460	460	7.9	109	#N/A	2.0	52	< 2				52	0.011	0.0016	0.0050	0.13	< 0.000007	< 0.000007	0.0051	< 0.000003	15	< 0.00003	0.000040	0.00037
30-Sep-15	66	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	505	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	490	470	8.0	99	#N/A	1.4	52	2.0				49	0.012	0.0014	0.0043	0.12	< 0.000007	< 0.000007	0.0041	< 0.000003	14	< 0.00003	0.000036	0.00033
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	485	485	8.0	98	#N/A	1.2	55	2.0				44	0.012	0.0014	0.0041	0.094	< 0.000007	< 0.000007	0.0022	< 0.000003	12	0.000050	0.000052	0.00039
25-Nov-15	74	500	500	7.7	37	#N/A	0.70	24	2.0				18	0.021	0.00070	0.0041	0.045	< 0.000007	< 0.000007	0.0021	< 0.000003	4.9	< 0.00003	0.000047	0.00038
2-Dec-15	75	500	500	7.5	36	#N/A	2.4	21	< 2				18	0.017	0.00070	0.0036	0.046	< 0.000007	< 0.000007	0.0019	< 0.000003	4.8	< 0.00003	0.000018	0.00022
9-Dec-15	76	500	505	7.7	36	#N/A	3.0	22	2.0				17	0.021	0.00070	0.0036	0.047	0.000015	0.0000090	0.0039	0.0000070	4.7	< 0.00003	0.000023	0.00032
16-Dec-15	77	500	500	7.7	35	#N/A	2.6	17	2.0				19	0.024	0.00060	0.0042	0.051	< 0.000007	< 0.000007	0.0023	0.000026	5.3	0.000050	0.000017	0.00046
23-Dec-15	78	500	505	8.1	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	505	7.5	33	#N/A	1.6	17	2.0				17	0.014	0.00050	0.0031	0.044	< 0.000007	< 0.000007	0.0017	< 0.000003	4.6	< 0.00003	0.0000080	0.00023
6-Jan-16	80	500	505	7.4	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	505	7.4	34	#N/A	1.8	17	2.0				16	0.014	0.00060	0.0030	0.042	< 0.000007	< 0.000007	< 0.002	< 0.000003	4.4	< 0.00003	< 0.000004	0.00036
20-Jan-16	82	500	500	7.6	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	505	7.6	34	#N/A	3.1	18	2.0				16	0.014	0.00050	0.0031	0.046	< 0.000007	< 0.000007	< 0.002	0.0000030	4.6	< 0.00003	0.000016	0.00024
3-Feb-16	84	500	505	7.7	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.5	38	#N/A	2.4	20	2.0				17	0.015	0.00060	0.0032	0.051	< 0.000007	< 0.000007	< 0.002	< 0.000003	4.7	< 0.00003	0.000019	0.00027
17-Feb-16	86	500	505	7.7	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.5	32	#N/A	2.4	17	< 2				16	0.014	0.00050	0.0028	0.044	< 0.000007	< 0.000007	< 0.002	< 0.000003	4.3	< 0.00003	0.0000090	0.00012

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC3 (GT)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	400	8.1	0.012	0.000030	0.0021	2.2	0.0063	0.030	0.013	0.0010	0.028	5.0	0.00042	1.4	< 0.000002	11	0.041	8.2	0.000084	0.00010	0.00033	0.0096	0.00035	0.0020	< 0.002
2-Jul-14	1	500	480	7.9	0.0060	0.000010	0.0019	2.5	0.010	0.020	0.0070	0.0010	0.012	3.8	0.00023	1.1	< 0.000002	7.9	0.046	5.8	0.000059	0.0038	0.00019	0.029	0.00025	< 0.001	< 0.002
9-Jul-14	2	500	495	7.9	< 0.002	< 0.00001	0.0016	2.2	0.0086	< 0.01	0.0058	0.00060	0.016	3.3	0.000090	1.0	< 0.000002	5.2	0.040	3.6	0.000050	0.00090	< 0.00005	0.032	0.00019	< 0.001	< 0.002
16-Jul-14	3	500	485	7.9	0.016	0.000010	0.0014	2.2	0.0075	< 0.01	0.0056	0.00050	< 0.009	2.9	0.000060	0.98	0.0000020	3.7	0.041	2.4	0.000050	0.00014	0.00026	0.032	0.00021	< 0.001	< 0.002
23-Jul-14	4	500	500	7.9	0.024	0.000050	0.0012	2.1	0.0095	< 0.01	0.0036	0.00030	< 0.009	2.4	< 0.00004	0.96	< 0.000002	2.3	0.042	1.5	0.000043	0.0021	0.00031	0.028	0.00018	< 0.001	< 0.002
30-Jul-14	5	500	490	7.8	0.015	0.000020	0.0011	1.9	0.0092	< 0.01	0.0036	0.00020	< 0.009	2.1	< 0.00004	0.83	< 0.000002	1.8	0.036	1.1	0.000041	0.00011	0.00049	0.028	0.00023	< 0.001	< 0.002
6-Aug-14	6	500	490	7.8	0.0020	< 0.00001	0.0011	2.1	0.0078	< 0.01	0.0034	0.00020	0.0090	2.2	< 0.00004	0.87	< 0.000002	1.5	0.039	1.0	0.000039	0.00017	0.000060	0.031	0.00024	< 0.001	< 0.002
13-Aug-14	7	500	480	7.8	0.010	0.000020	0.00099	1.9	0.0084	< 0.01	0.0030	0.00020	0.015	1.9	< 0.00004	0.85	< 0.000002	1.1	0.036	0.78	0.000037	0.00086	0.00048	0.030	0.000080	< 0.001	< 0.002
20-Aug-14	8	500	500	7.8	< 0.002	0.000010	0.00087	2.0	0.0092	< 0.01	0.0026	0.00010	< 0.009	1.9	< 0.00004	0.79	< 0.000002	0.88	0.040	0.69	0.000030	0.0012	< 0.00005	0.031	0.00015	0.0010	< 0.002
27-Aug-14	9	500	505	7.9	< 0.002	< 0.00001	0.00076	1.8	0.011	< 0.01	0.0025	< 0.0001	< 0.009	1.7	< 0.00004	0.74	< 0.000002	0.60	0.039	0.63	0.000037	0.00095	0.00011	0.030	0.00014	< 0.001	< 0.002
3-Sep-14	10	500	480	7.8	< 0.007	0.000050	0.00077	1.8	0.0093	< 0.01	0.0023	0.00010	0.010	1.8	0.000090	0.82	0.000019	0.57	0.036	1.2	0.000039	0.00010	0.00037	0.030	0.00016	< 0.001	< 0.002
10-Sep-14	11	500	515	7.9	0.011	0.000060	0.00067	1.7	0.0099	< 0.01	0.0018	< 0.0001	< 0.003	1.6	< 0.00004	0.77	< 0.000002	0.44	0.035	0.50	0.000038	0.00077	0.00031	0.026	0.00016	< 0.001	< 0.002
17-Sep-14	12	500	490	7.9	< 0.007	< 0.00001	0.00068	1.7	0.0086	< 0.01	0.0019	< 0.0001	< 0.003	1.5	0.000040	0.68	< 0.000002	0.42	0.032	0.90	0.000025	0.00014	0.000050	0.029	0.00013	< 0.001	< 0.002
24-Sep-14	13	500	480	7.9	0.0020	0.000020	0.00066	1.7	0.0061	< 0.01	0.0019	0.00010	< 0.009	1.4	< 0.00004	0.65	0.0000050	0.35	0.033	0.46	0.000025	0.000080	< 0.00005	0.032	0.00014	< 0.001	< 0.002
1-Oct-14	14	500	480	7.9	0.022	< 0.00001	0.00049	1.6	0.012	< 0.01	0.0016	< 0.0001	< 0.009	1.4	< 0.00004	0.69	< 0.000002	0.27	0.032	0.72	0.000010	0.00015	0.00019	0.027	0.00013	< 0.002	< 0.002
8-Oct-14	15	500	500	7.7	< 0.007	< 0.00001	0.00062	1.6	0.0086	< 0.01	0.0015	< 0.0001	< 0.003	1.4	< 0.00004	0.59	< 0.000002	0.25	0.032	0.90	0.000026	0.00048	< 0.00005	0.026	0.00014	< 0.001	< 0.002
15-Oct-14	16	500	490	7.9	0.0080	0.00031	0.00064	1.7	0.0072	< 0.01	0.0016	< 0.0001	< 0.003	1.4	< 0.00004	0.66	< 0.000002	0.28	0.034	0.70	0.000032	0.00040	0.00024	0.030	0.00017	0.0020	< 0.002
22-Oct-14	17	500	510	7.8	< 0.007	0.000020	0.00054	1.9	0.0092	< 0.01	0.0015	< 0.0001	< 0.003	1.4	< 0.00004	0.69	< 0.000002	0.23	0.035	0.60	0.000037	0.00034	0.000050	0.030	0.00011	< 0.001	< 0.002
29-Oct-14	18	500	490	7.9	< 0.007	0.00014	0.00051	1.5	0.0071	< 0.01	0.0013	< 0.0001	< 0.003	1.1	< 0.00004	0.55	< 0.000002	0.18	0.029	0.30	0.000030	0.00026	0.000080	0.026	0.00010	< 0.001	< 0.002
5-Nov-14	19	500	505	7.9	< 0.007	0.000020	0.00045	1.6	0.0069	< 0.01	0.0015	< 0.0001	< 0.003	1.1	< 0.00004	0.59	< 0.000002	0.20	0.030	0.40	0.000038	0.0010	0.00012	0.028	0.000090	< 0.001	< 0.002
12-Nov-14	20	500	505	7.4	< 0.007	< 0.00001	0.00044	1.6	0.0094	< 0.01	0.0016	< 0.0001	< 0.003	1.1	< 0.00004	0.59	< 0.000002	0.17	0.043	0.40	0.000029	0.00096	0.000080	0.028	0.00011	< 0.001	< 0.002
19-Nov-14	21	500	490	7.6	0.010	0.000030	0.00047	1.6	0.0091	< 0.01	0.0012	< 0.0001	< 0.003	1.1	< 0.00004	0.56	< 0.000002	0.17	0.031	0.30	0.000029	0.00055	0.00031	0.026	0.00011	0.0010	< 0.002
26-Nov-14	22	500	505	7.7	< 0.007	< 0.00001	0.00050	1.7	0.0089	< 0.01	0.0012	< 0.0001	0.010	1.1	< 0.00004	0.60	< 0.000002	0.15	0.031	0.40	0.000028	0.00029	0.00010	0.027	0.00010	< 0.001	< 0.002
3-Dec-14	23	500	500	7.8	< 0.007	< 0.00001	0.00048	1.7	0.0084	< 0.01	0.0011	< 0.0001	< 0.003	1.1	< 0.00004	0.51	< 0.000002	0.16	0.029	0.40	0.000026	0.00016	0.000060	0.028	0.00011	0.0010	< 0.002
10-Dec-14	24	500	485	7.8	< 0.007	< 0.00001	0.00037	1.4	0.0081	< 0.01	0.0010	< 0.0001	< 0.003	0.89	< 0.00004	0.57	< 0.000002	0.12	0.026	0.60	0.000023	0.00029	0.000050	0.024	0.000070	0.0010	< 0.002
17-Dec-14	25	500	500	7.8	< 0.007	< 0.00001	0.00043	1.5	0.0089	< 0.01	0.0011	< 0.0001	< 0.003	1.00	< 0.00004	0.50	< 0.000002	0.12	0.030	0.30	0.000026	0.00048	0.000090	0.023	0.00014	< 0.001	< 0.002
24-Dec-14	26	500	485	7.8	< 0.007	< 0.00001	0.00037	1.4	0.0077	< 0.01	0.00087	< 0.0001	< 0.003	0.90	< 0.00004	0.47	< 0.000002	0.11	0.028	0.30	0.000023	0.00021	0.000080	0.024	0.00013	< 0.001	< 0.002
31-Dec-14	27	500	505	7.6	< 0.007	< 0.00001	0.00041	1.6	0.0077	< 0.01	0.00092	< 0.0001	< 0.003	1.0	< 0.00004	0.59	< 0.000002	0.11	0.032	0.40	0.000022	0.00019	0.000060	0.029	0.000090	< 0.001	< 0.002
7-Jan-15	28	500	505	7.7	< 0.007	0.000010	0.00038	1.6	0.0079	< 0.01	0.00090	< 0.0001	< 0.003	0.97	< 0.00004	0.49	< 0.000002	0.10	0.031	0.20	0.000024	0.00021	< 0.00005	0.024	0.00010	< 0.001	< 0.002
14-Jan-15	29	500	495	7.7	< 0.007	0.00013	0.00031	1.4	0.0069	< 0.01	0.00094	< 0.0001	< 0.003	0.87	< 0.00004	0.46	0.0000040	0.090	0.026	0.10	0.000019	0.00018	< 0.00005	0.022	0.00010	0.0010	< 0.002
21-Jan-15	30	500	500	8.0	< 0.007	0.000060	0.00033	1.3	0.0066	< 0.01	0.00088	< 0.0001	< 0.003	0.85	< 0.00004	0.45	< 0.000002	0.090	0.026	< 0.1	0.000019	0.00012	0.000080	0.022	0.00010	< 0.001	< 0.002
28-Jan-15	31	500	490	7.6	< 0.007	< 0.00001	0.00030	1.6	0.0069	< 0.01	0.0017	< 0.0001	< 0.003	0.99	0.000080	0.55	0.0000020	0.10	0.024	0.80	0.000027	0.00019	0.000070	0.025	0.000090	< 0.001	< 0.002
4-Feb-15	32	500	485	7.7	< 0.007	0.000020	0.00035	1.4	0.0060	< 0.01	0.00088	< 0.0001	< 0.003	0.83	< 0.00004	0.43	< 0.000002	0.090	0.028	0.50	0.000019	0.00020	0.000070	0.021	0.000090	0.0010	< 0.002
11-Feb-15	33	500	500	7.6	< 0.007	< 0.00001	0.00031	1.4	0.0065	< 0.01	0.00099	< 0.0001	< 0.003	0.86	< 0.001	0.44	< 0.000002	0.080	0.026	0.20	0.000022	0.00026	0.000050	0.022	0.00014	< 0.001	< 0.002
18-Feb-15	34	500	485	7.7	< 0.007	< 0.00001	0.00037	1.4	0.0069	< 0.01	0.00075	< 0.0001	< 0.003	0.86	< 0.001	0.46	< 0.000002	0.080	0.028	0.20	0.000024	0.00023	0.000060	0.024	0.000090	< 0.001	< 0.002
25-Feb-15	35	500	475	7.9	< 0.007	0.00012	0.00029	1.4	0.0057	< 0.01	0.00080	< 0.0001	< 0.003	0.84	< 0.001	0.43	< 0.000002	0.080	0.026	0.10	0.000032	0.00021	< 0.00005	0.023	0.000070	0.0030	< 0.002
4-Mar-15	36	500	485	7.6	< 0.007	< 0.00001	0.00032	1.3	0.0054	< 0.01	0.00079	< 0.0001	< 0.003	0.79	< 0.001	0.49	< 0.000002	0.070	0.025	0.70	0.000019	0.00020	< 0.00005	0.023	0.000080	< 0.001	< 0.002
11-Mar-15	37	500	510	7.6	0.011	0.00013	0.00037	1.3	0.0060	< 0.01	0.00072	< 0.0001	< 0.003	0.72	< 0.001	0.37	< 0.000002	0.050	0.024	< 0.1	0.000012	0.00036	< 0.00005	0.020	0.00010	0.016	< 0.002
18-Mar-15	38	500	490	7.7	< 0.007	< 0.00001	0.00030	1.3	0.0067	< 0.01	0.00071	< 0.0001	< 0.003	0.80	< 0.001	0.43	< 0.000002	0.060	0.026	0.60	0.000015	0.00018	0.000070	0.021	0.000080	< 0.001	< 0.002
25-Mar-15	39	500	485	7.7	< 0.007	< 0.00001	0.00025	1.6	0.0063	< 0.01	0.00089	< 0.0001	< 0.003	0.86	< 0.001	0.46	< 0.000002	0.15	0.029	0.60	0.000010	0.00042	0.00020	0.024	0.00018	0.0010	< 0.002
1-Apr-15	40	500	495	7.8	< 0.007	0.000020	0.00022	1.2	0.014	< 0.01	0.00060	< 0.0001	< 0.003	0.77	< 0.001	0.28	< 0.000002	0.72	0.025	0.10	0.000015	0.00023	< 0.00005	0.028	0.000060	< 0.001	< 0.002
8-Apr-15	41	500	475	7.6	< 0.007	< 0.00001	0.00027	1.3	0.0066	< 0.01	0.00071	< 0.0001	< 0.003	0.75	< 0.001	0.49	< 0.000002	0.070	0.026	< 0.1	0.000011	0.00031	< 0.00005	0.022	0.00010	< 0.001	< 0.002
15-Apr-15	42	500	480	7.8	< 0.007	< 0.00001	0.00026	1.4	0.0059	< 0.01	0.00069	< 0.0001	< 0.003	0.78	< 0.001	0.40	0.0000020	0.070	0.026	0.30	0.0000060	0.00064	0.00013	0.022	0.000090	< 0.001	< 0.002
22-Apr-15	43	500	495	7.7	< 0.007	0.000040	0.00027	1.4	0.0057	< 0.01	0.00056	< 0.0001	< 0.003	0.76	< 0.001	0.43	0.0000040	0.050	0.025	0.40	0.000025	0.00054	< 0.00005	0.021	0.00010	< 0.001	< 0.002
29-Apr-15	44	500	500	7.6	< 0.007	0.000020	0.00027	1.3	0.0068	< 0.01	0.00061	< 0.0001	< 0.003	0.77	< 0.001	0.38	< 0.000002	0.040	0.024	0.60	0.000017	0.00027	0.000080	0.019	0.000070	< 0.001	< 0.002
6-May-15	45	500	510	7.7	< 0.007	0.000020	0.00026	1.3	0.0066	< 0.01	0.00060	< 0.0001	< 0.003	0.78	< 0.001	0.44	< 0.000002	0.060	0.025	0.30	0.000016	0.00028	0.00010	0.021	0.00012	0.0020	< 0.002
13-May-15	46	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	505	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	490	510	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	510	500	7.9	< 0.007	0.000030	0.00056	3.9	0.016	< 0.01	0.0014	< 0.0001	< 0.003	1.8	< 0.00004	1.1	< 0.000002	0.14	0.073	0.80	0.000033	0.0015	< 0.00005	0.059	0.00014	0.0020	< 0.002
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	480	495	7.9	< 0.007	< 0.00001	0.00059	3.9	0.016	< 0.01	0.0015	< 0.0001	< 0.003	1.7	0.000050	1.2	< 0.000002	0.16	0.076	0.80	0.000041	0.00076	< 0.00005	0.062	0.00010	0.0010	< 0.002
8-Jul-15	54	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	490	485	8.0																							
5-Aug-15	58	500	510	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	510	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	495	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	485	490	8.0	< 0.007	0.00013	0.00056	3.8	0.014	< 0.01	0.0017	< 0.0001	< 0.003	1.7	< 0.00004	1.1	< 0.000002	0.11	0.074	1.0	0.000042	0.00051	< 0.00005	0.059	0.00012	0.0020	< 0.002
2-Sep-15	62	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	485	460	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	460	460	7.9	< 0.007	< 0.00001	0.00051	3.7	0.013	< 0.01	0.0017	< 0.0001	< 0.003	1.7	< 0.00004	1.2	< 0.000002	0.14	0.069	0.80	0.000032	0.0010	< 0.00005	0.051	0.000080	< 0.001	< 0.002
30-Sep-15	66	500	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	505	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	495	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	490	470	8.0	< 0.007	0.000020	0.00052	3.8	0.011	< 0.01	0.0010	< 0.0001	< 0.003	1.8	0.00010	1.1	0.000028	0.21	0.066	0.80	0.000034	0.00075	0.000070	0.050	0.000090	< 0.001	< 0.002
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	490	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	485	485	8.0	0.018	< 0.00001	0.00045	3.5	0.012	< 0.01	0.0020	< 0.0001	< 0.003	1.6	0.00014	0.95	0.0000030	0.15	0.060	0.60	0.000033	0.00072	0.000070	0.042	0.000090	0.0010	< 0.002
25-Nov-15	74	500	500	7.7	< 0.007	0.000020	0.00025	1.3	0.0071	< 0.01	0.00079	< 0.0001	< 0.003	0.91	0.00032	0.41	0.0081	0.070	0.025	0.40	0.000023	0.00024	0.00010	0.017	0.000080	< 0.001	< 0.002
2-Dec-15	75	500	500	7.5	< 0.007	0.000030	0.00025	1.4	0.0061	< 0.01	0.00042	< 0.0001	< 0.003	0.85	0.000040	0.44	< 0.000002	0.050	0.024	0.50	< 0.000005	0.00023	< 0.00005	0.018	0.000070	< 0.001	< 0.002
9-Dec-15	76	500	505	7.7	< 0.007	< 0.00001	0.00024	1.3	0.0067	< 0.01	0.00059	< 0.0001	0.0030	0.80	0.000060	0.38	0.0000070	0.050	0.024	0.30	0.000037	0.00026	0.000060	0.018	0.000090	< 0.001	< 0.002
16-Dec-15	77	500	500	7.7	< 0.007	0.00017	0.00027	1.4	0.0073	< 0.01	0.00052	< 0.0001	< 0.003	0.90	< 0.00004	0.45	< 0.000002	0.050	0.026	0.20	0.000024	0.00026	< 0.00005	0.019	0.00011	0.0060	< 0.002
23-Dec-15	78	500	505	8.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	505	7.5	< 0.007	< 0.00001	0.00022	1.3	0.0055	< 0.01	0.00036	< 0.0001	< 0.003	0.74	< 0.00004	0.34	< 0.000002	0.10	0.022	0.70	0.0000060	0.00011	< 0.00005	0.016	0.000070	< 0.001	< 0.002
6-Jan-16	80	500	505	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	505	7.4	< 0.007	< 0.00001	0.00020	1.2	0.0059	< 0.01	0.00054	< 0.0001	< 0.003	0.75	0.00013	0.36	0.0000020	0.040	0.021	< 0.1	< 0.000005	0.00020	< 0.00005	0.015	0.000040	< 0.001	< 0.002
20-Jan-16	82	500	500	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	505	7.6	< 0.007	< 0.00001	0.00019	1.2	0.0062	< 0.01	0.00040	< 0.0001	< 0.003	0.72	< 0.00004	0.38	< 0.000002	0.040	0.024	< 0.1	0.000019	0.00018	< 0.00005	0.017	0.000070	< 0.001	< 0.002
3-Feb-16	84	500	505	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	500	7.5	< 0.007	< 0.00001	0.00020	1.4	0.0070	< 0.01	0.00043	< 0.0001	< 0.003	0.76	0.000060	0.37	0.000051	0.070	0.025	0.80	0.000022	0.00021	0.000090	0.016	0.000070	< 0.001	< 0.002
17-Feb-16	86	500	505	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	500	7.5	< 0.007	< 0.00001	0.00019	1.2	0.0059	0.010	0.00037	< 0.0001	< 0.003	0.66	< 0.00004	0.13	0.0000020	0.020	0.021	0.50	0.000012	0.00014	< 0.00005	0.013	0.000050	< 0.001	< 0.002

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Calculated Loading Rates for HC3 (GT)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	400	8.1	121	#N/A	1.9	14	2.0	0.52	0.096	0.12	10	0.026	0.0013	0.026	0.017	0.0000032	0.0000028	0.0044	0.0000024	2.6	0.000032	0.000067	0.00084
2-Jul-14	1	500	480	7.9	107	#N/A	2.7	19	6.2	0.34	0.062	0.14	14	0.021	0.0012	0.021	0.022	0.0000034	0.0000034	0.0039	0.0000014	3.6	0.000024	0.000076	0.00055
9-Jul-14	2	500	495	7.9	91	#N/A	0.82	17	4.0	0.15	0.054	0.15	13	0.017	0.0012	0.017	0.022	0.0000035	0.0000035	0.0037	0.0000015	3.4	0.000015	0.000027	0.00033
16-Jul-14	3	500	485	7.9	80	#N/A	0.96	16	2.4	0.097	0.049	0.15	13	0.023	0.0012	0.015	0.027	0.0000034	0.0000034	0.0033	0.0000015	3.3	0.000087	0.00014	0.00037
23-Jul-14	4	500	500	7.9	67	#N/A	1.0	16	2.0	0.10	0.040	0.15	13	0.027	0.00095	0.014	0.034	0.0000035	0.0000035	0.0032	0.0000015	3.5	0.000040	0.000071	0.00059
30-Jul-14	5	500	490	7.8	60	#N/A	1.2	15	2.0	0.098	0.029	0.15	11	0.025	0.00093	0.011	0.025	0.0000034	0.0000034	0.0023	0.0000015	2.8	0.000049	0.000049	0.00064
6-Aug-14	6	500	490	7.8	60	#N/A	1.0	14	1.5	0.098	0.034	0.15	12	0.015	0.00088	0.0099	0.023	0.0000034	0.0000034	0.0025	0.0000015	3.0	0.000015	0.000019	0.00014
13-Aug-14	7	500	480	7.8	55	#N/A	1.2	14	2.4	0.096	0.034	0.14	11	0.029	0.00072	0.0085	0.025	0.0000034	0.0000034	0.0025	0.0000014	2.8	0.000034	0.000023	0.00015
20-Aug-14	8	500	500	7.8	52	#N/A	0.91	14	2.0	0.10	0.030	0.15	12	0.013	0.00060	0.0081	0.025	0.0000035	0.0000035	0.0028	0.0000015	3.1	0.000020	0.000032	0.00017
27-Aug-14	9	500	505	7.9	59	#N/A	2.2	16	1.0	0.10	0.030	0.15	13	0.012	0.00066	0.0072	0.033	0.0000035	0.0000035	0.0054	0.0000015	3.5	0.000015	0.000015	0.00015
3-Sep-14	10	500	480	7.8	50	#N/A	2.0	13	2.4	0.096	0.029	0.14	11	0.013	0.00067	0.0070	0.024	0.0000034	0.0000034	0.0020	0.0000014	3.0	0.000014	0.000015	0.00033
10-Sep-14	11	500	515	7.9	54	#N/A	1.6	14	1.5	0.10	0.031	0.15	11	0.023	0.00057	0.0068	0.033	0.0000036	0.0000036	0.0030	0.0000015	3.1	0.000015	0.000018	0.00021
17-Sep-14	12	500	490	7.9	49	#N/A	3.2	13	2.0	0.098	0.029	0.15	9.6	0.012	0.00054	0.0055	0.021	0.0000034	0.0000034	0.0023	0.0000044	2.5	0.000015	0.000017	0.000069
24-Sep-14	13	500	480	7.9	48	#N/A	1.8	13	1.4	0.096	0.029	0.14	9.6	0.016	0.00058	0.0059	0.020	0.0000034	0.0000034	0.0015	0.0000014	2.5	0.000014	0.000048	0.000072
1-Oct-14	14	500	480	7.9	42	#N/A	2.9	13	0.96	0.096	0.029	0.14	9.1	0.015	0.00058	0.0047	0.018	0.0000034	0.0000034	0.0014	0.000024	2.4	0.000014	0.000048	0.0000096
8-Oct-14	15	500	500	7.7	47	#N/A	1.6	12	1.0	0.10	0.030	0.15	10	0.011	0.00050	0.0048	0.024	0.0000035	0.0000035	0.0066	0.0000015	2.7	0.000015	0.000015	0.000065
15-Oct-14	16	500	490	7.9	52	#N/A	2.3	13	1.5	0.098	0.029	0.15	11	0.025	0.00049	0.0065	0.028	0.0000034	0.0000034	0.0024	0.0000059	3.0	0.000015	0.000012	0.00011
22-Oct-14	17	500	510	7.8	52	#N/A	2.1	14	1.0	0.10	0.031	0.15	12	0.012	0.00051	0.0049	0.030	0.0000036	0.0000036	0.0030	0.0000051	3.2	0.000015	0.000014	0.000041
29-Oct-14	18	500	490	7.9	42	#N/A	3.4	13	0.98	0.098	0.029	0.15	9.2	0.012	0.00049	0.0044	0.022	0.0000034	0.0000034	0.0030	0.0000015	2.5	0.000015	0.0000098	0.00012
5-Nov-14	19	500	505	7.9	45	#N/A	#N/A	16	1.0	0.10	0.030	0.15	9.9	0.0097	0.00045	0.0041	0.025	0.0000035	0.0000035	0.0019	0.0000061	2.7	0.000015	0.000014	0.00028
12-Nov-14	20	500	505	7.4	48	#N/A	3.4	17	1.0	0.10	0.030	0.15	11	0.012	0.00045	0.0044	0.028	0.0000035	0.0000035	0.0023	0.0000015	3.1	0.000015	0.000016	0.00013
19-Nov-14	21	500	490	7.6	57	#N/A	3.2	16	0.98	0.098	0.029	0.15	9.6	0.016	0.00044	0.0038	0.026	0.0000034	0.0000034	0.0015	0.0000020	2.5	0.000015	0.000020	0.00015
26-Nov-14	22	500	505	7.7	43	#N/A	0.99	12	1.0	0.10	0.030	0.15	9.8	0.011	0.00045	0.0041	0.025	0.0000035	0.0000035	0.0013	0.0000015	2.6	0.000015	0.000015	0.000061
3-Dec-14	23	500	500	7.8	71	#N/A	1.5	17	1.0	0.10	0.030	0.15	10	0.0083	0.00045	0.0041	0.026	0.0000035	0.0000035	0.0017	0.0000015	2.7	0.000015	0.000016	0.000075
10-Dec-14	24	500	485	7.8	37	#N/A	2.2	11	0.97	0.097	0.029	0.15	10	0.0084	0.00034	0.0032	0.022	0.0000034	0.0000034	0.0012	0.0000015	3.0	0.000015	0.000013	0.00010
17-Dec-14	25	500	500	7.8	41	#N/A	1.9	12	1.0	0.10	0.030	0.15	9.5	0.017	0.00040	0.0040	0.029	0.0000035	0.0000035	0.0013	0.0000015	2.6	0.000015	0.0000080	0.000080
24-Dec-14	26	500	485	7.8	39	#N/A	1.5	11	0.97	0.097	0.029	0.15	8.9	0.015	0.00039	0.0031	0.025	0.0000034	0.0000034	0.00082	0.0000015	2.4	0.000015	0.000010	0.000082
31-Dec-14	27	500	505	7.6	44	#N/A	0.77	14	1.0	0.10	0.030	0.15	10	0.0095	0.00045	0.0034	0.028	0.0000035	0.0000035	0.00091	0.0000015	2.8	0.000015	0.0000091	0.000076
7-Jan-15	28	500	505	7.7	40	#N/A	1.3	12	1.0	0.51	0.030	0.15	10	0.0079	0.00045	0.0029	0.025	0.0000035	0.0000035	0.0011	0.0000015	2.8	0.000015	0.000016	0.00018
14-Jan-15	29	500	495	7.7	36	#N/A	1.1	11	0.99	0.50	0.030	0.15	8.6	0.0090	0.00040	0.0031	0.021	0.0000035	0.0000035	0.0012	0.0000015	2.3	0.000015	0.0000099	0.00057
21-Jan-15	30	500	500	8.0	37	#N/A	2.1	13	1.0	0.50	0.030	0.15	8.8	0.0099	0.00040	0.0026	0.022	0.0000035	0.0000035	0.00090	0.0000020	2.4	0.000015	0.000012	0.00016
28-Jan-15	31	500	490	7.6	38	#N/A	0.77	10	0.98	0.49	0.029	0.15	9.3	0.0099	0.00049	0.0029	0.023	0.0000034	0.0000034	0.0013	0.0000015	2.4	0.000015	0.0000093	0.00011
4-Feb-15	32	500	485	7.7	35	#N/A	1.1	9.8	0.97	0.49	0.029	0.15	7.6	0.0085	0.00039	0.0026	0.019	0.0000034	0.0000034	0.0012	0.0000015	1.9	0.000015	0.0000073	0.00036
11-Feb-15	33	500	500	7.6	36	#N/A	0.94	10	1.0	0.50	0.030	0.15	8.9	0.0098	0.00045	0.0026	0.020	0.0000035	0.0000035	0.0013	0.0000015	2.4	0.000015	0.000012	0.000080
18-Feb-15	34	500	485	7.7	35	#N/A	1.1	10	0.97	0.49	0.029	0.15	8.4	0.0092	0.00044	0.0025	0.020	0.0000034	0.0000034	0.0013	0.0000015	2.3	0.000015	0.000012	0.00015
25-Feb-15	35	500	475	7.9	37	#N/A	1.5	11	0.95	0.48	0.029	0.14	7.6	0.0063	0.00043	0.0022	0.019	0.0000033	0.0000033	0.00052	0.0000043	2.0	0.000014	0.000011	0.00026
4-Mar-15	36	500	485	7.6	36	#N/A	1.1	11	0.97	0.49	0.029	0.15	7.8	0.0075	0.00034	0.0022	0.019	0.0000034	0.0000034	0.00063	0.0000015	2.1	0.000024	0.0000068	0.00016
11-Mar-15	37	500	510	7.6	35	#N/A	0.96	11	1.0	0.51	0.031	0.15	8.2	0.0068	0.00041	0.0021	0.021	0.0000036	0.0000036	0.0011	0.000018	2.2	0.000031	0.000018	0.00079
18-Mar-15	38	500	490	7.7	37	#N/A	1.2	11	0.98	0.49	0.029	0.15	8.4	0.0095	0.00039	0.0020	0.019	0.0000034	0.0000034	0.00064	0.0000015	2.3	0.000015	0.000012	0.000083
25-Mar-15	39	500	485	7.7	37	#N/A	1.3	11	0.97	0.49	0.029	0.15	9.0	0.0068	0.00044	0.0024	0.021	0.0000034	0.0000034	0.0012	0.0000015	2.3	0.000039	0.0000063	0.00065
1-Apr-15	40	500	495	7.8	35	#N/A	1.7	12	0.99	0.50	0.030	0.15	6.8	0.0081	0.00040	0.0018	0.022	0.0000064	0.0000035	0.00099	0.0000030	1.7	0.000015	0.0000030	0.00016
8-Apr-15	41	500	475	7.6	38	#N/A	1.3	11	0.95	0.48	0.029	0.14	7.9	0.0087	0.00052	0.0021	0.020	0.0000033	0.0000033	0.00071	0.0000014	2.2	0.000014	0.000015	0.00020
15-Apr-15	42	500	480	7.8	37	#N/A	1.9	12	0.96	0.48	0.029	0.14	8.1	0.0078	0.00038	0.0020	0.019	0.0000034	0.0000034	0.0020	0.0000014	2.1	0.000014	0.0000019	0.00048
22-Apr-15	43	500	495	7.7	37	#N/A	1.6	12	1.5	0.50	0.030	0.15	8.3	0.0080	0.00035	0.0019	0.020	0.0000035	0.0000035	0.0017	0.0000015	2.2	0.000015	0.0000074	0.00025
29-Apr-15	44	500	500	7.6	34	#N/A	1.0	10	1.0	0.50	0.030	0.15	8.2	0.0097	0.00040	0.0018	0.021	0.0000035	0.0000035	0.0012	0.0000015	2.2	0.000015	0.000011	0.00014
6-May-15	45	500	510	7.7	38	#N/A	1.2	12	1.0	0.51	0.031	0.15	8.4	0.0096	0.00046	0.0030	0.021	0.0000036	0.0000036	0.00087	0.0000015	2.3	0.000015	0.0000087	0.00033
13-May-15	46	500	505																						
20-May-15	47	505	490																						
27-May-15	48	490	510																						
3-Jun-15	49	510	500	7.9	106	#N/A	1.6	6.8	0.25	0.13	0.0075	0.038	6.5	0.0014	0.00019	0.00061	0.015	0.00000088	0.00000088	0.00061	0.00000038	1.8	0.0000038	0.0000053	0.00028
10-Jun-15	50	500	490																						
17-Jun-15	51	490	500																						
24-Jun-15	52	500	480																						
1-Jul-15	53	480	495	7.9	116	#N/A	1.8	7.0	0.25	0.12	0.0074	0.037	6.2	0.0019	0.00022	0.00078	0.015	0.00000087	0.00000087	0.00058	0.00000037	1.7	0.0000037	0.0000051	0.000062
8-Jul-15	54	500	490																						
15-Jul-15	55	490	490																						
22-Jul-15	56	490	490																						
29-Jul-15	57	490	485	8.0	108	#N/A	1.1	6.8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-Aug-15	58	500	510																						
12-Aug-15	59	510	495																						
19-Aug-15	60	495	485																						
26-Aug-15	61	485	490	8.0	106	#N/A	0.83	6.7	0.25	0.12	0.0074	0.037	6.1	0.0018	0.00018	0.00060	0.016	0.00000086	0.00000086	0.00060	0.0000012	1.7	0.0000074	0.0000055	0.000082
2-Sep-15	62	500	490																						
9-Sep-15	63	490	485																						
16-Sep-15	64	485	460																						
23-Sep-15	65	460	460	7.9	109	#N/A	0.92	6.0	0.23				5.9	0.0012	0.00018	0.00058	0.015	0.00000081	0.00000081	0.00059	0.00000035	1.7	0.0000035	0.0000046	0.000043
30-Sep-15	66	500	505																						
7-Oct-15	67	505	495																						
14-Oct-15	68	495	490																						
21-Oct-15	69	490	470	8.0	99	#N/A	0.63	6.1	0.24				5.8	0.0014	0.00016	0.00051	0.014	0.00000082	0.00000082	0.00048	0.00000035	1.6	0.0000035	0.0000042	0.000039
28-Oct-15	70	500	490																						
4-Nov-15	71	490	490																						
11-Nov-15	72	490	485																						
18-Nov-15	73	485	485	8.0	98	#N/A	0.60	6.7	0.24				5.3	0.0015	0.00017	0.00050	0.011	0.00000085	0.00000085	0.00027	0.00000036	1.4	0.0000061	0.0000063	0.000047
25-Nov-15	74	500	500	7.7	37	#N/A	0.34	12	1.0				8.8	0.011	0.00035	0.0021	0.023	0.0000035	0.0000035	0.0011	0.0000015	2.4	0.0000015	0.000024	0.00019
2-Dec-15	75	500	500	7.5	36	#N/A	1.2	10	1.0				8.9	0.0085	0.00035	0.0018	0.023	0.0000035	0.0000035	0.00095	0.0000015	2.4	0.0000015	0.0000090	0.00011
9-Dec-15	76	500	505	7.7	36	#N/A	1.5	11	1.0				8.6	0.011	0.00035	0.0018	0.024	0.0000076	0.0000045	0.0020	0.0000035	2.4	0.0000015	0.000012	0.00016
16-Dec-15	77	500	500	7.7	35	#N/A	1.3	8.6	1.0				9.5	0.012	0.00030	0.0021	0.025	0.0000035	0.0000035	0.0012	0.000013	2.6	0.0000025	0.0000085	0.00023
23-Dec-15	78	500	505	8.1	34	#N/A	1.1	8.5	1.0				8.9	0.0096	0.00028	0.0018	0.024	0.0000035	0.0000035	0.0010	0.0000073	2.5	0.0000020	0.0000063	0.00017
30-Dec-15	79	500	505	7.5	33	#N/A	0.83	8.5	1.0				8.4	0.0072	0.00025	0.0016	0.022	0.0000035	0.0000035	0.00086	0.0000015	2.3	0.0000015	0.0000040	0.00012
6-Jan-16	80	500	505	7.4	36	#N/A	0.86	8.6	1.0				8.2	0.0071	0.00028	0.0015	0.022	0.0000035	0.0000035	0.00093	0.0000015	2.3	0.0000015	0.0000030	0.00015
13-Jan-16	81	500	505	7.4	34	#N/A	0.89	8.7	1.0				8.0	0.0071	0.00030	0.0015	0.021	0.0000035	0.0000035	0.0010	0.0000015	2.2	0.0000015	0.0000020	0.00018
20-Jan-16	82	500	500	7.6	37	#N/A	1.2	9.0	1.0				8.2	0.0071	0.00028	0.0015	0.022	0.0000035	0.0000035	0.0010	0.0000015	2.3	0.0000015	0.0000051	0.00015
27-Jan-16	83	500	505	7.6	34	#N/A	1.6	9.2	1.0				8.3	0.0072	0.00025	0.0016	0.023	0.0000035	0.0000035	0.0010	0.0000015	2.3	0.0000015	0.0000081	0.00012
3-Feb-16	84	500	505	7.7	38	#N/A	1.4	9.6	1.0				8.5	0.0074	0.00028	0.0016	0.024	0.0000035	0.0000035	0.0010	0.0000015	2.3	0.0000015	0.0000088	0.00013
10-Feb-16	85	500	500	7.5	38	#N/A	1.2	10	1.0				8.7	0.0076	0.00030	0.0016	0.025	0.0000035	0.0000035	0.0010	0.0000015	2.3	0.0000015	0.0000095	0.00014
17-Feb-16	86	500	505	7.7	39	#N/A	1.2	9.3	1.0				8.2	0.0073	0.00028	0.0015	0.024	0.0000035	0.0000035	0.0010	0.0000015	2.3	0.0000015	0.0000070	0.000098
24-Feb-16	87	500	500	7.5	32	#N/A	1.2	8.5	1.0				7.8	0.0070	0.00025	0.0014	0.022	0.0000035	0.0000035	0.0010	0.0000015	2.2	0.0000015	0.0000045	0.000060

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Calculated Loading Rates for HC3 (GT)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	400	8.1	0.0048	0.000012	0.00083	0.87	0.0025	0.012	0.0053	0.00040	0.011	2.0	0.00017	0.57	0.00000080	4.4	0.016	3.3	0.000034	0.000040	0.00013	0.0038	0.00014	0.00080	0.00080
2-Jul-14	1	500	480	7.9	0.0029	0.0000048	0.00089	1.2	0.0049	0.0096	0.0034	0.00048	0.0058	1.8	0.00011	0.52	0.00000096	3.8	0.022	2.8	0.000028	0.0018	0.000091	0.014	0.00012	0.00048	0.00096
9-Jul-14	2	500	495	7.9	0.00099	0.0000050	0.00079	1.1	0.0043	0.0050	0.0029	0.00030	0.0079	1.6	0.000045	0.51	0.00000099	2.6	0.020	1.8	0.000025	0.00045	0.000025	0.016	0.0000094	0.00050	0.00099
16-Jul-14	3	500	485	7.9	0.0078	0.0000049	0.00068	1.1	0.0036	0.0049	0.0027	0.00024	0.0044	1.4	0.000029	0.48	0.00000097	1.8	0.020	1.1	0.000024	0.000068	0.00013	0.015	0.00010	0.00049	0.00097
23-Jul-14	4	500	500	7.9	0.012	0.000025	0.00062	1.0	0.0048	0.0050	0.0018	0.00015	0.0045	1.2	0.000020	0.48	0.0000010	1.2	0.021	0.76	0.000022	0.0010	0.00016	0.014	0.0000090	0.00050	0.0010
30-Jul-14	5	500	490	7.8	0.0074	0.0000098	0.00056	0.95	0.0045	0.0049	0.0018	0.000098	0.0044	1.0	0.000020	0.41	0.00000098	0.86	0.018	0.56	0.000020	0.000054	0.00024	0.014	0.00011	0.00049	0.00098
6-Aug-14	6	500	490	7.8	0.00098	0.0000049	0.00051	1.0	0.0038	0.0049	0.0016	0.000098	0.0044	1.1	0.000020	0.43	0.00000098	0.72	0.019	0.49	0.000019	0.000083	0.000029	0.015	0.00012	0.00049	0.00098
13-Aug-14	7	500	480	7.8	0.0048	0.0000096	0.00048	0.93	0.0040	0.0048	0.0015	0.000096	0.0072	0.92	0.000019	0.41	0.00000096	0.52	0.017	0.37	0.000018	0.00041	0.00023	0.014	0.000038	0.00048	0.00096
20-Aug-14	8	500	500	7.8	0.0010	0.0000050	0.00044	1.0	0.0046	0.0050	0.0013	0.000050	0.0045	0.96	0.000020	0.40	0.0000010	0.44	0.020	0.35	0.000015	0.00062	0.000025	0.016	0.0000075	0.00050	0.0010
27-Aug-14	9	500	505	7.9	0.0010	0.0000051	0.00038	0.93	0.0057	0.0051	0.0013	0.000051	0.0045	0.83	0.000020	0.37	0.0000010	0.30	0.020	0.32	0.000019	0.00048	0.000056	0.015	0.0000071	0.00051	0.0010
3-Sep-14	10	500	480	7.8	0.0034	0.000024	0.00037	0.87	0.0045	0.0048	0.0011	0.000048	0.0048	0.85	0.000043	0.39	0.0000091	0.27	0.017	0.58	0.000019	0.000048	0.00018	0.014	0.0000077	0.00048	0.00096
10-Sep-14	11	500	515	7.9	0.0057	0.000031	0.00035	0.88	0.0051	0.0052	0.00093	0.000052	0.0015	0.80	0.000021	0.40	0.0000010	0.23	0.018	0.26	0.000020	0.00040	0.00016	0.013	0.000082	0.00052	0.0010
17-Sep-14	12	500	490	7.9	0.0034	0.0000049	0.00033	0.81	0.0042	0.0049	0.00092	0.000049	0.0015	0.73	0.000020	0.33	0.00000098	0.21	0.016	0.44	0.000012	0.000069	0.000025	0.014	0.0000064	0.00049	0.00098
24-Sep-14	13	500	480	7.9	0.00096	0.0000096	0.00032	0.81	0.0029	0.0048	0.00091	0.000048	0.0043	0.69	0.000019	0.31	0.0000024	0.17	0.016	0.22	0.000012	0.000038	0.000024	0.015	0.0000067	0.00048	0.00096
1-Oct-14	14	500	480	7.9	0.011	0.0000048	0.00024	0.78	0.0057	0.0048	0.00077	0.000048	0.0043	0.65	0.000019	0.33	0.00000096	0.13	0.015	0.35	0.0000048	0.000072	0.000091	0.013	0.0000062	0.00096	0.00096
8-Oct-14	15	500	500	7.7	0.0035	0.0000050	0.00031	0.81	0.0043	0.0050	0.00075	0.000050	0.0015	0.68	0.000020	0.30	0.0000010	0.13	0.016	0.45	0.000013	0.00024	0.000025	0.013	0.0000070	0.00050	0.0010
15-Oct-14	16	500	490	7.9	0.0039	0.00015	0.00031	0.83	0.0035	0.0049	0.00077	0.000049	0.0015	0.66	0.000020	0.32	0.00000098	0.14	0.017	0.34	0.000016	0.00020	0.00012	0.015	0.0000083	0.00098	0.00098
22-Oct-14	17	500	510	7.8	0.0036	0.000010	0.00028	0.95	0.0047	0.0051	0.00077	0.000051	0.0015	0.69	0.000020	0.35	0.0000010	0.12	0.018	0.31	0.000019	0.00017	0.000026	0.016	0.0000056	0.00051	0.0010
29-Oct-14	18	500	490	7.9	0.0034	0.000069	0.00025	0.73	0.0035	0.0049	0.00063	0.000049	0.0015	0.55	0.000020	0.27	0.00000098	0.088	0.014	0.15	0.000015	0.00013	0.000039	0.013	0.0000049	0.00049	0.00098
5-Nov-14	19	500	505	7.9	0.0035	0.000010	0.00023	0.80	0.0035	0.0051	0.00074	0.000051	0.0015	0.56	0.000020	0.30	0.0000010	0.10	0.015	0.20	0.000019	0.00052	0.000061	0.014	0.0000045	0.00051	0.0010
12-Nov-14	20	500	505	7.4	0.0035	0.0000051	0.00022	0.83	0.0048	0.0051	0.00080	0.000051	0.0015	0.57	0.000020	0.30	0.0000010	0.086	0.022	0.20	0.000015	0.00048	0.000040	0.014	0.0000056	0.00051	0.0010
19-Nov-14	21	500	490	7.6	0.0049	0.000015	0.00023	0.80	0.0044	0.0049	0.00059	0.000049	0.0015	0.54	0.000020	0.27	0.00000098	0.083	0.015	0.15	0.000014	0.00027	0.00015	0.013	0.0000054	0.00049	0.00098
26-Nov-14	22	500	505	7.7	0.0035	0.0000051	0.00025	0.83	0.0045	0.0051	0.00058	0.000051	0.0051	0.55	0.000020	0.30	0.0000010	0.076	0.016	0.20	0.000014	0.00015	0.000051	0.013	0.0000051	0.00051	0.0010
3-Dec-14	23	500	500	7.8	0.0035	0.0000050	0.00024	0.86	0.0042	0.0050	0.00057	0.000050	0.0015	0.53	0.000020	0.26	0.0000010	0.080	0.015	0.20	0.000013	0.000080	0.000030	0.014	0.0000055	0.00050	0.0010
10-Dec-14	24	500	485	7.8	0.0034	0.0000049	0.00018	0.67	0.0039	0.0049	0.00049	0.000049	0.0015	0.43	0.000019	0.28	0.00000097	0.058	0.013	0.29	0.000011	0.00014	0.000024	0.011	0.0000034	0.00049	0.00097
17-Dec-14	25	500	500	7.8	0.0035	0.0000050	0.00022	0.75	0.0044	0.0050	0.00053	0.000050	0.0015	0.50	0.000020	0.25	0.0000010	0.060	0.015	0.15	0.000013	0.00024	0.000045	0.012	0.0000070	0.00050	0.0010
24-Dec-14	26	500	485	7.8	0.0034	0.0000049	0.00018	0.70	0.0037	0.0049	0.00042	0.000049	0.0015	0.44	0.000019	0.23	0.00000097	0.053	0.013	0.15	0.000011	0.00010	0.000039	0.011	0.0000063	0.00049	0.00097
31-Dec-14	27	500	505	7.6	0.0035	0.0000051	0.00021	0.80	0.0039	0.0051	0.00046	0.000051	0.0015	0.52	0.000020	0.30	0.0000010	0.056	0.016	0.20	0.000011	0.000096	0.000030	0.014	0.0000045	0.00051	0.0010
7-Jan-15	28	500	505	7.7	0.0035	0.0000051	0.00019	0.81	0.0040	0.0051	0.00045	0.000051	0.0015	0.49	0.000020	0.25	0.0000010	0.051	0.016	0.10	0.000012	0.00011	0.000025	0.012	0.0000051	0.00051	0.0010
14-Jan-15	29	500	495	7.7	0.0035	0.000064	0.00015	0.69	0.0034	0.0050	0.00047	0.000050	0.0015	0.43	0.000020	0.23	0.0000020	0.045	0.013	0.050	0.0000094	0.000089	0.000025	0.011	0.0000050	0.00050	0.00099
21-Jan-15	30	500	500	8.0	0.0035	0.000030	0.00016	0.67	0.0033	0.0050	0.00044	0.000050	0.0015	0.43	0.000020	0.23	0.0000010	0.045	0.013	0.050	0.0000095	0.000060	0.000040	0.011	0.0000050	0.00050	0.0010
28-Jan-15	31	500	490	7.6	0.0034	0.0000049	0.00015	0.78	0.0034	0.0049	0.00084	0.000049	0.0015	0.48	0.000039	0.27	0.00000098	0.049	0.012	0.39	0.000013	0.000093	0.000034	0.012	0.0000044	0.00049	0.00098
4-Feb-15	32	500	485	7.7	0.0034	0.0000097	0.00017	0.66	0.0029	0.0049	0.00043	0.000049	0.0015	0.40	0.000019	0.21	0.00000097	0.044	0.013	0.24	0.0000092	0.000097	0.000034	0.010	0.0000044	0.00049	0.00097
11-Feb-15	33	500	500	7.6	0.0035	0.0000050	0.00016	0.69	0.0032	0.0050	0.00050	0.000050	0.0015	0.43	0.00050	0.22	0.0000010	0.040	0.013	0.10	0.000011	0.00013	0.000025	0.011	0.0000070	0.00050	0.0010
18-Feb-15	34	500	485	7.7	0.0034	0.0000049	0.00018	0.67	0.0033	0.0049	0.00036	0.000049	0.0015	0.42	0.00049	0.22	0.00000097	0.039	0.014	0.097	0.000012	0.00011	0.000029	0.012	0.0000044	0.00049	0.00097
25-Feb-15	35	500	475	7.9	0.0033	0.000057	0.00014	0.64	0.0027	0.0048	0.00038	0.000048	0.0014	0.40	0.00048	0.20	0.00000095	0.038	0.012	0.048	0.000015	0.000100	0.000024	0.011	0.0000033	0.0014	0.00095
4-Mar-15	36	500	485	7.6	0.0034	0.0000049	0.00015	0.61	0.0026	0.0049	0.00038	0.000049	0.0015	0.38	0.00049	0.24	0.00000097	0.034	0.012	0.34	0.0000092	0.000097	0.000024	0.011	0.0000039	0.00049	0.00097
11-Mar-15	37	500	510	7.6	0.0056	0.000066	0.00019	0.64	0.0031	0.0051	0.00037	0.000051	0.0015	0.37	0.00051	0.19	0.0000010	0.026	0.012	0.051	0.0000061	0.00018	0.000026	0.010	0.0000051	0.0082	0.0010
18-Mar-15	38	500	490	7.7	0.0034	0.0000049	0.00015	0.66	0.0033	0.0049	0.00035	0.000049	0.0015	0.39	0.00049	0.21	0.00000098	0.029	0.013	0.29	0.0000074	0.000088	0.000034	0.010	0.0000039	0.00049	0.00098
25-Mar-15	39	500	485	7.7	0.0034	0.0000049	0.00012	0.77	0.0030	0.0049	0.00043	0.000049	0.0015	0.42	0.00049	0.22	0.00000097	0.073	0.014	0.29	0.0000049	0.00020	0.000097	0.012	0.0000087	0.00049	0.00097
1-Apr-15	40	500	495	7.8	0.0035	0.0000099	0.00011	0.61	0.0067	0.0050	0.00030	0.000050	0.0015	0.38	0.00050	0.14	0.00000099	0.36	0.012	0.050	0.0000074	0.00011	0.000025	0.014	0.0000030	0.00050	0.00099
8-Apr-15	41	500	475	7.6	0.0033	0.0000048	0.00013	0.60	0.0031	0.0048	0.00034	0.000048	0.0014	0.36	0.00048	0.23	0.00000095	0.033	0.012	0.048	0.0000052	0.00015	0.000024	0.010	0.0000048	0.00048	0.00095
15-Apr-15	42	500	480	7.8	0.0034	0.0000048	0.00013	0.69	0.0028	0.0048	0.00033	0.000048	0.0014	0.37	0.00048	0.19	0.00000096	0.034	0.013	0.14	0.0000029	0.00031	0.000062	0.011	0.0000043	0.00048	0.00096
22-Apr-15	43	500	495	7.7	0.0035	0.000020	0.00013	0.68	0.0028	0.0050	0.00028	0.000050	0.0015	0.37	0.00050	0.21	0.0000020	0.025	0.013	0.20	0.000012	0.00027	0.000025	0.010	0.0000050	0.00050	0.00099
29-Apr-15	44	500	500	7.6	0.0035	0.000010	0.00014	0.67	0.0034	0.0050	0.00031	0.000050	0.0015	0.39	0.00050	0.19	0.0000010	0.020	0.012	0.30	0.0000085	0.00014	0.000040	0.0093	0.0000035	0.00050	0.0010
6-May-15	45	500	510	7.7	0.0036	0.000010	0.00013	0.67	0.0034	0.0051	0.00031	0.000051	0.0015	0.40	0.00051	0.22	0.0000010	0.031	0.013	0.15	0.0000082	0.00014	0.000051	0.010	0.0000061	0.0010	0.0010
13-May-15	46	500	505																								
20-May-15	47	505	490																								
27-May-15	48	490	510																								
3-Jun-15	49	510	500	7.9	0.00088	0.0000038	0.000070	0.48	0.0020	0.0013	0.00017	0.000013	0.00038	0.23	0.0000050	0.14	0.00000025	0.018	0.0091	0.10	0.0000041	0.00019	0.0000063	0.0074	0.000018	0.00025	0.00025
10-Jun-15	50	500	490																								
17-Jun-15	51	490	500																								
24-Jun-15	52	500	480																								
1-Jul-15	53	480	495	7.9	0.00087	0.0000012	0.000073	0.48	0.0019	0.0012	0.00019	0.000012	0.00037	0.21	0.0000062	0.14	0.00000025	0.020	0.0094	0.099	0.0000051	0.000094	0.0000062	0.0076	0.000012	0.00012	0.00025
8-Jul-15	54	500	490																								
15-Jul-15	55	490	490																								
22-Jul-15	56	490	490																								
29-Jul-15	57	490	485	8.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5-Aug-15	58	500	510																								
12-Aug-15	59	510	495																								
19-Aug-15	60	495	485																								
26-Aug-15	61	485	490	8.0	0.00086	0.000016	0.000068	0.46	0.0017	0.0012	0.00021	0.000012	0.00037	0.21	0.0000049	0.14	0.00000025	0.013	0.0091	0.12	0.0000051	0.000062	0.0000061	0.0073	0.000015	0.00025	0.00025
2-Sep-15	62	500	490																								
9-Sep-15	63	490	485																								
16-Sep-15	64	485	460																								
23-Sep-15	65	460	460	7.9	0.00081	0.0000012	0.000059	0.43	0.0015	0.0012	0.00020	0.000012	0.00035	0.20	0.0000046	0.13	0.00000023	0.016	0.0079	0.092	0.0000037	0.00012	0.0000058	0.0059	0.0000092	0.00012	0.00023
30-Sep-15	66	500	505																								
7-Oct-15	67	505	495																								
14-Oct-15	68	495	490																								
21-Oct-15	69	490	470	8.0	0.00082	0.0000024	0.000061	0.45	0.0013	0.0012	0.00012	0.000012	0.00035	0.21	0.000012	0.13	0.0000033	0.025	0.0078	0.094	0.0000040	0.000088	0.0000082	0.0059	0.000011	0.00012	0.00024
28-Oct-15	70	500	490																								
4-Nov-15	71	490	490																								
11-Nov-15	72	490	485																								
18-Nov-15	73	485	485	8.0	0.0022	0.0000012	0.000055	0.42	0.0015	0.0012	0.00024	0.000012	0.00036	0.20	0.000017	0.12	0.00000036	0.018	0.0073	0.073	0.0000040	0.000087	0.0000085	0.0051	0.000011	0.00012	0.00024
25-Nov-15	74	500	500	7.7	0.0035	0.000010	0.00013	0.67	0.0036	0.0050	0.00040	0.000050	0.0015	0.46	0.00016	0.21	0.0040	0.035	0.013	0.20	0.0000012	0.00012	0.000050	0.0085	0.0000040	0.00050	0.0010
2-Dec-15	75	500	500	7.5	0.0035	0.000015	0.00013	0.68	0.0031	0.0050	0.00021	0.000050	0.0015	0.43	0.000020	0.22	0.0000010	0.025	0.012	0.25	0.0000025	0.00012	0.000025	0.0090	0.000035	0.00050	0.0010
9-Dec-15	76	500	505	7.7	0.0035	0.0000051	0.00012	0.65	0.0034	0.0051	0.00030	0.000051	0.0015	0.41	0.000030	0.19	0.0000035	0.025	0.012	0.15	0.000019	0.00013	0.000030	0.0091	0.000045	0.00051	0.0010
16-Dec-15	77	500	500	7.7	0.0035	0.000085	0.00014	0.71	0.0036	0.0050	0.00026	0.000050	0.0015	0.45	0.000020	0.23	0.0000010	0.025	0.013	0.10	0.000012	0.00013	0.000025	0.0097	0.000055	0.0030	0.0010
23-Dec-15	78	500	505	8.1	0.0035	0.000045	0.00012	0.67	0.0032	0.0050	0.00022	0.000050	0.0015	0.41	0.000020	0.20	0.0000010	0.038	0.012	0.23	0.0000075	0.000093	0.000025	0.0089	0.000045	0.0018	0.0010
30-Dec-15	79	500	505	7.5	0.0035	0.0000051	0.00011	0.63	0.0028	0.0051	0.00018	0.000051	0.0015	0.37	0.000020	0.17	0.0000010	0.051	0.011	0.35	0.0000030	0.000056	0.000025	0.0080	0.000035	0.00051	0.0010
6-Jan-16	80	500	505	7.4	0.0035	0.0000051	0.00011	0.62	0.0029	0.0051	0.00023	0.000051	0.0015	0.38	0.000043	0.18	0.0000010	0.035	0.011	0.20	0.0000028	0.000078	0.000025	0.0078	0.000028	0.00051	0.0010
13-Jan-16	81	500	505	7.4	0.0035	0.0000051	0.00010	0.61	0.0030	0.0051	0.00027	0.000051	0.0015	0.38	0.000066	0.18	0.0000010	0.020	0.011	0.051	0.0000025	0.00010	0.000025	0.0076	0.000020	0.00051	0.0010
20-Jan-16	82	500	500	7.6	0.0035	0.0000051	0.000099	0.61	0.0030	0.0051	0.00024	0.000051	0.0015	0.37	0.000043	0.19	0.0000010	0.020	0.011	0.051	0.0000061	0.000096	0.000025	0.0080	0.000028	0.00051	0.0010
27-Jan-16	83	500	505	7.6	0.0035	0.0000051	0.000096	0.62	0.0031	0.0051	0.00020	0.000051	0.0015	0.36	0.000020	0.19	0.0000010	0.020	0.012	0.051	0.0000096	0.000091	0.000025	0.0083	0.000035	0.00051	0.0010
3-Feb-16	84	500	505	7.7	0.0035	0.0000050	0.000099	0.65	0.0033	0.0050	0.00021	0.000050	0.0015	0.37	0.000025	0.19	0.000013	0.028	0.012	0.23	0.000010	0.000098	0.000035	0.0081	0.000035	0.00050	0.0010
10-Feb-16	85	500	500	7.5	0.0035	0.0000050	0.00010	0.69	0.0035	0.0050	0.00022	0.000050	0.0015	0.38	0.000030	0.19	0.000026	0.035	0.012	0.40	0.000011	0.00011	0.000045	0.0079	0.000035	0.00050	0.0010
17-Feb-16	86	500	505	7.7	0.0035	0.0000050	0.000098	0.64	0.0032	0.0050	0.00020	0.000050	0.0015	0.35	0.000025	0.13	0.000013	0.023	0.012	0.33	0.0000085	0.000088	0.000035	0.0072	0.000030	0.00050	0.0010
24-Feb-16	87	500	500	7.5	0.0035	0.0000050	0.000095	0.58	0.0030	0.0050	0.00019	0.000050	0.0015	0.33	0.000020	0.065	0.0000010	0.010	0.011	0.25	0.0000060	0.000070	0.000025	0.0066	0.000025	0.00050	0.0010

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Leachate Concentrations for HC4 (GS)

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	335	7.8	547	#N/A	7.1	53	163	1.7	0.19	< 0.3	194	0.029	0.0045	0.028	0.020	< 0.000007	< 0.000007	0.011	< 0.000003	39	0.000080	0.00025	0.0031
2-Jul-14	1	500	505	7.8	446	#N/A	7.8	59	144	0.60	0.16	< 0.3	168	0.024	0.0066	0.032	0.015	< 0.000007	< 0.000007	0.0093	< 0.000003	34	< 0.00003	0.00022	0.0015
9-Jul-14	2	500	475	7.9	258	#N/A	2.1	60	58	< 0.2	0.16	< 0.3	93	0.031	0.0074	0.023	0.019	< 0.000007	< 0.000007	0.0096	< 0.000003	19	< 0.00003	0.000098	0.00079
16-Jul-14	3	500	500	8.0	176	#N/A	2.6	60	17	< 0.2	0.12	< 0.3	67	0.037	0.0068	0.019	0.018	< 0.000007	< 0.000007	0.0067	< 0.000003	14	0.00020	0.00027	0.00065
23-Jul-14	4	500	495	8.0	124	#N/A	2.3	50	9.0	< 0.2	0.10	< 0.3	53	0.044	0.0054	0.018	0.018	< 0.000007	< 0.000007	0.0059	< 0.000003	11	0.000090	0.00014	0.00045
30-Jul-14	5	500	480	8.0	121	#N/A	1.7	59	8.0	< 0.2	0.090	< 0.3	51	0.050	0.0055	0.017	0.018	< 0.000007	< 0.000007	0.0053	< 0.000003	11	0.00010	0.00010	0.0013
6-Aug-14	6	500	485	7.9	104	#N/A	2.0	47	5.0	< 0.2	0.080	< 0.3	46	0.048	0.0048	0.013	0.017	< 0.000007	< 0.000007	0.0044	< 0.000003	9.9	< 0.00003	0.000041	0.00048
13-Aug-14	7	500	485	7.9	85	#N/A	2.3	41	6.0	< 0.2	< 0.06	< 0.3	38	0.058	0.0035	0.011	0.017	< 0.000007	< 0.000007	0.0039	< 0.000003	8.5	0.000050	0.000043	0.00047
20-Aug-14	8	500	480	7.9	78	#N/A	1.9	38	5.0	< 0.2	< 0.06	< 0.3	36	0.055	0.0029	0.011	0.015	< 0.000007	< 0.000007	0.0036	< 0.000003	8.2	0.000070	0.000053	0.00042
27-Aug-14	9	500	500	7.9	103	#N/A	5.3	46	4.0	< 0.2	0.060	< 0.3	44	0.049	0.0041	0.011	0.020	< 0.000007	< 0.000007	0.0075	< 0.000003	10	< 0.00003	0.000025	0.00023
3-Sep-14	10	500	475	7.8	99	#N/A	4.8	45	5.0	< 0.2	< 0.06	< 0.3	44	0.051	0.0040	0.013	0.021	< 0.000007	< 0.000007	0.0033	< 0.000003	11	< 0.00003	0.000027	0.00077
10-Sep-14	11	500	505	7.9	93	#N/A	3.7	42	4.0	< 0.2	< 0.06	< 0.3	38	0.057	0.0038	0.011	0.019	< 0.000007	< 0.000007	0.0040	< 0.000003	9.2	< 0.00003	0.000021	0.00040
17-Sep-14	12	500	490	7.9	93	#N/A	7.3	45	5.0	< 0.2	< 0.06	< 0.3	38	0.057	0.0039	0.010	0.020	< 0.000007	< 0.000007	0.0037	0.0000040	9.0	< 0.00003	0.000021	0.00016
24-Sep-14	13	500	485	7.9	78	#N/A	3.4	38	6.0	< 0.2	< 0.06	< 0.3	34	0.054	0.0040	0.0082	0.016	< 0.000007	< 0.000007	0.0025	< 0.000003	8.0	< 0.00003	0.00011	0.00017
1-Oct-14	14	500	480	7.8	63	#N/A	6.2	35	3.0	< 0.2	< 0.06	< 0.3	29	0.047	0.0038	0.0063	0.014	< 0.000007	< 0.000007	0.0019	< 0.000003	7.0	< 0.00003	0.00	< 0.00002
8-Oct-14	15	500	490	7.7	65	#N/A	3.0	27	< 2	< 0.2	< 0.06	< 0.3	28	0.041	0.0028	0.0065	0.013	< 0.000007	< 0.000007	0.0098	< 0.000003	6.9	< 0.00003	0.000015	0.00014
15-Oct-14	16	500	480	7.8	68	#N/A	4.9	29	3.0	< 0.2	< 0.06	< 0.3	29	0.045	0.0032	0.0068	0.014	< 0.000007	< 0.000007	0.0042	< 0.000003	7.3	< 0.00003	0.000017	0.00012
22-Oct-14	17	500	500	7.8	87	#N/A	5.0	39	4.0	< 0.2	< 0.06	< 0.3	38	0.047	0.0047	0.0083	0.022	< 0.000007	< 0.000007	0.0050	< 0.000003	9.2	< 0.00003	0.000025	0.00011
29-Oct-14	18	500	490	7.7	63	#N/A	7.5	31	2.0	< 0.2	< 0.06	< 0.3	28	0.046	0.0030	0.0055	0.013	< 0.000007	< 0.000007	0.0047	< 0.000003	6.9	< 0.00003	0.000016	0.00055
5-Nov-14	19	500	475	7.8	57	#N/A	#N/A	36	< 2	< 0.2	< 0.06	< 0.3	25	0.036	0.0027	0.0050	0.013	< 0.000007	< 0.000007	0.0026	0.000016	6.3	< 0.00003	0.000019	0.00052
12-Nov-14	20	500	505	7.8	89	#N/A	6.5	34	2.0	< 0.2	< 0.06	< 0.3	41	0.048	0.0049	0.0089	0.020	< 0.000007	< 0.000007	0.0033	< 0.000003	10	< 0.00003	0.000022	0.00028
19-Nov-14	21	500	480	7.9	94	#N/A	6.5	34	< 2	< 0.2	< 0.06	< 0.3	29	0.052	0.0029	0.0064	0.014	< 0.000007	< 0.000007	0.0021	< 0.000003	7.4	< 0.00003	0.000020	0.00033
26-Nov-14	22	500	490	7.8	62	#N/A	2.0	29	< 2	< 0.2	< 0.06	< 0.3	28	0.045	0.0031	0.0061	0.017	< 0.000007	< 0.000007	0.0023	0.0000030	7.1	< 0.00003	0.000018	0.00029
3-Dec-14	23	500	485	7.7	59	#N/A	2.9	29	< 2	< 0.2	< 0.06	< 0.3	29	0.049	0.0029	0.0064	0.015	< 0.000007	< 0.000007	0.0027	< 0.000003	7.5	< 0.00003	0.000014	0.00016
10-Dec-14	24	500	500	7.8	56	#N/A	4.9	29	< 2	< 0.2	< 0.06	< 0.3	26	0.043	0.0029	0.0054	0.013	< 0.000007	< 0.000007	0.0021	0.0000030	6.7	< 0.00003	0.000012	0.00024
17-Dec-14	25	500	485	7.8	64	#N/A	3.8	31	< 2	< 0.2	< 0.06	< 0.3	30	0.061	0.0032	0.0078	0.016	< 0.000007	< 0.000007	0.0019	< 0.000003	7.7	< 0.00003	0.000011	0.00029
24-Dec-14	26	500	480	7.8	74	#N/A	3.3	36	< 2	< 0.2	< 0.06	< 0.3	34	0.060	0.0041	0.0078	0.020	< 0.000007	< 0.000007	0.0016	< 0.000003	8.8	< 0.00003	0.000015	0.00020
31-Dec-14	27	500	500	7.8	71	#N/A	1.4	48	< 2	< 0.2	< 0.06	< 0.3	35	0.047	0.0040	0.0067	0.020	< 0.000007	< 0.000007	0.0015	< 0.000003	9.0	< 0.00003	0.000010	0.00047
7-Jan-15	28	500	495	7.7	69	#N/A	2.7	34	2.0	< 1	< 0.06	< 0.3	31	0.039	0.0038	0.0058	0.018	< 0.000007	< 0.000007	0.0023	< 0.000003	7.9	< 0.00003	0.000021	0.00016
14-Jan-15	29	500	490	7.7	72	#N/A	2.8	37	< 2	< 1	< 0.06	< 0.3	34	0.039	0.0046	0.0069	0.019	< 0.000007	< 0.000007	0.0024	0.0000030	8.6	< 0.00003	0.000015	0.00046
21-Jan-15	30	500	485	7.9	62	#N/A	5.5	36	< 2	< 1	< 0.06	< 0.3	30	0.047	0.0033	0.0054	0.016	< 0.000007	< 0.000007	0.0016	< 0.000003	7.9	< 0.00003	0.000013	0.00037
28-Jan-15	31	500	485	7.7	61	#N/A	1.5	31	< 2	< 1	< 0.06	< 0.3	28	0.045	0.0033	0.0052	0.017	< 0.000007	< 0.000007	0.0025	< 0.000003	7.0	0.00010	0.000010	0.00017
4-Feb-15	32	500	485	7.8	59	#N/A	2.2	30	< 2	< 1	< 0.06	< 0.3	27	0.036	0.0031	0.0045	0.018	< 0.000007	< 0.000007	0.0021	< 0.000003	6.7	< 0.00003	0.0000090	0.00038
11-Feb-15	33	500	475	7.7	55	#N/A	2.2	29	2.0	< 1	< 0.06	< 0.3	25	0.041	0.0028	0.0043	0.014	< 0.000007	< 0.000007	0.0021	< 0.000003	6.6	< 0.00003	0.000014	0.00025
18-Feb-15	34	500	500	7.7	61	#N/A	2.2	31	< 2	< 1	< 0.06	< 0.3	30	0.036	0.0033	0.0048	0.017	< 0.000007	< 0.000007	0.0024	< 0.000003	7.8	< 0.00003	0.000014	0.00051
25-Feb-15	35	500	480	7.8	72	#N/A	3.5	37	< 2	< 1	< 0.06	< 0.3	31	0.036	0.0036	0.0048	0.021	< 0.000007	< 0.000007	0.00080	0.0000040	7.9	0.000060	0.000016	0.00059
4-Mar-15	36	500	490	7.7	58	#N/A	2.3	30	< 2	< 1	< 0.06	< 0.3	26	0.041	0.0024	0.0042	0.015	< 0.000007	< 0.000007	0.00080	< 0.000003	6.8	0.000060	0.000012	0.00014
11-Mar-15	37	500	485	7.7	54	#N/A	1.8	29	2.0	< 1	< 0.06	< 0.3	24	0.031	0.0026	0.0036	0.014	0.0000070	< 0.000007	0.0016	0.000020	6.5	0.000060	0.000026	0.00088
18-Mar-15	38	500	490	7.7	50	#N/A	2.4	27	< 2	< 1	< 0.06	< 0.3	23	0.032	0.0021	0.0030	0.015	< 0.000007	< 0.000007	0.0011	< 0.000003	6.1	< 0.00003	0.000017	0.00037
25-Mar-15	39	500	490	7.7	45	#N/A	2.7	26	< 2	< 1	< 0.06	< 0.3	22	0.030	0.0022	0.0032	0.013	< 0.000007	< 0.000007	0.00090	< 0.000003	5.7	0.000090	0.0000060	0.00076
1-Apr-15	40	500	485	7.9	44	#N/A	4.0	27	< 2	< 1	< 0.06	< 0.3	18	0.028	0.0021	0.0022	0.015	0.000012	< 0.000007	0.0016	0.0000040	4.4	< 0.00003	< 0.000004	0.00026
8-Apr-15	41	500	485	7.6	45	#N/A	2.6	26	< 2	< 1	< 0.06	< 0.3	20	0.026	0.0026	0.0028	0.013	< 0.000007	< 0.000007	0.00080	< 0.000003	5.4	< 0.00003	0.000019	0.00022
15-Apr-15	42	500	475	7.7	57	#N/A	3.7	32	< 2	< 1	< 0.06	< 0.3	26	0.035	0.0026	0.0040	0.016	< 0.000007	< 0.000007	0.0034	< 0.000003	6.9	< 0.00003	< 0.000004	0.0027
22-Apr-15	43	500	505	7.8	65	#N/A	3.2	35	3.0	< 1	< 0.06	< 0.3	29	0.045	0.0029	0.0053	0.019	< 0.000007	< 0.000007	0.0029	< 0.000003	7.7	0.000050	0.000010	0.00095
29-Apr-15	44	500	495	7.8	68	#N/A	2.1	36	< 2	< 1	< 0.06	< 0.3	32	0.049	0.0031	0.0053	0.021	< 0.000007	< 0.000007	0.0021	< 0.000003	8.3	< 0.00003	0.000022	0.00066
6-May-15	45	500	495	7.7	62	#N/A	2.6	34	< 2	< 1	< 0.06	< 0.3	28	0.043	0.0030	0.0063	0.017	< 0.000007	< 0.000007	0.0019	< 0.000003	7.3	< 0.00003	0.000018	0.00040
13-May-15	46	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	495	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	475	475	8.0	172	#N/A	3.8	85	4.0	< 1	0.060	< 0.3	84	0.014	0.0082	0.0068	0.063	< 0.000007	< 0.000007	0.0036	< 0.000003	22	< 0.00003	0.000033	0.00017
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	482	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	480	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	450	445	8.0	186	#N/A	5.0	89	3.0	< 1	< 0.06	< 0.3	83	0.013	0.0070	0.0062	0.069	< 0.000007	< 0.000007	0.0035	< 0.000003	21	< 0.00003	0.000047	0.00037
8-Jul-15	54	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	485	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	470	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	455	445	8.0	175	#N/A	2.8	90	3.0	< 1	< 0.06	< 0.3	86	0.011	0.0064	0.0049	0.066	< 0.000007	< 0.000007	0.0034	0.000010	22	0.000040	0.000038	0.000080
5-Aug-15	58	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	490	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	475	465	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	465	445	8.1	177	#N/A	1.8	92	3.0	< 1	< 0.06	< 0.3	94	0.014	0.0063	0.0047	0.073	< 0.000007	< 0.000007	0.0037	0.0000090	26	0.00011	0.000041	0.00061
2-Sep-15	62	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	480	465	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	465	465	8.1	171	#N/A	2.2	86	3.0				86	0.012	0.0064	0.0055	0.073	< 0.000007	< 0.000007	0.0040	< 0.000003	22	< 0.00003	0.000038	0.00024
30-Sep-15	66	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	495	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	475	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	470	455	8.1	156	#N/A	1.3	82	3.0				80	0.014	0.0049	0.0037	0.066	< 0.000007	< 0.000007	0.0036	< 0.000003	21	< 0.00003	0.000041	0.00035
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	470	455	8.1	145	#N/A	1.2	84	2.0	-	-	-	68	0.012	0.0040	0.0039	0.049	< 0.000007	< 0.000007	0.0016	< 0.000003	18	0.000070	0.000072	0.00038
25-Nov-15	74	500	490	7.9	72	#N/A	0.90	43	2.0	-	-	-	34	0.041	0.0021	0.0039	0.030	< 0.000007	< 0.000007	0.0014	< 0.000003	9.1	< 0.00003	0.000023	0.00021
2-Dec-15	75	500	490	8.0	85	#N/A	1.7	44	2.0	-	-	-	43	0.037	0.0028	0.0041	0.036	< 0.000007	< 0.000007	0.00090	0.0000030	11	< 0.00003	0.000016	0.00034
9-Dec-15	76	500	495	7.9	70	#N/A	2.8	37	2.0	-	-	-	33	0.037	0.0020	0.0039	0.030	0.0000090	< 0.000007	0.0030	0.000012	8.6	< 0.00003	0.000015	0.00034
16-Dec-15	77	500	495	8.1	77	#N/A	1.5	38	2.0	-	-	-	38	0.051	0.0023	0.0046	0.034	0.0000070	< 0.000007	0.0021	< 0.000003	10.0	0.000050	0.000020	0.00035
23-Dec-15	78	500	485	8.1	62	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	490	7.8	55	#N/A	1.3	29	2.0	-	-	-	28	0.034	0.0012	0.0025	0.024	< 0.000007	< 0.000007	0.0014	< 0.000003	7.4	0.000050	0.0000060	0.00022
6-Jan-16	80	500	490	7.6	53	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	495	7.6	55	#N/A	1.7	29	2.0	-	-	-	26	0.033	0.0013	0.0024	0.022	< 0.000007	< 0.000007	< 0.002	< 0.000003	7.0	< 0.00003	< 0.000004	0.00048
20-Jan-16	82	500	495	7.8	71	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	495	7.8	62	#N/A	2.8	33	2.0	-	-	-	30	0.036	0.0014	0.0027	0.029	< 0.000007	< 0.000007	< 0.002	0.000010	8.2	< 0.00003	0.000024	0.00052
3-Feb-16	84	500	495	7.8	70	-	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	480	7.7	67	#N/A	2.6	34	2.0	-	-	-	32	0.028	0.0015	0.0028	0.030	< 0.000007	< 0.000007	< 0.002	< 0.000003	8.8	< 0.00003	0.000016	0.000090
17-Feb-16	86	500	505	7.7	64	-	-	-	< 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	480	7.8	70	#N/A	2.3	35	< 2	-	-	-	34	0.034	0.0016	0.0028	0.030	< 0.000007	< 0.000007	< 0.002	< 0.000003	9.0	< 0.00003	0.000010	0.000080

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC4 (GS)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
25-Jun-14	0	500	335	7.8	0.0050	*< 0.00001*	0.0064	23	0.022	*< 0.01*	0.0061	0.0012	0.015	11	0.00082	1.9	*< 0.000002*	24	0.30	65	0.000036	0.00017	0.00011	0.032	0.00044	0.0020	*< 0.002*
2-Jul-14	1	500	505	7.8	*< 0.002*	*< 0.00001*	0.0051	21	0.028	*< 0.01*	0.0046	0.0023	*< 0.009*	8.2	0.00054	2.1	*< 0.000002*	16	0.26	52	0.000022	0.0012	0.000060	0.060	0.00033	0.0020	*< 0.002*
9-Jul-14	2	500	475	7.9	*< 0.002*	*< 0.00001*	0.0038	11	0.015	*< 0.01*	0.0047	0.0010	0.020	6.3	0.00015	2.2	*< 0.000002*	7.9	0.14	20	0.000017	0.0029	0.000080	0.034	0.00043	*< 0.001*	*< 0.002*
16-Jul-14	3	500	500	8.0	0.0070	*< 0.00001*	0.0028	7.8	0.011	*< 0.01*	0.0037	0.00080	*< 0.009*	4.6	0.000050	1.7	0.0000020	4.1	0.11	7.8	0.000015	0.00015	0.000070	0.019	0.00040	*< 0.001*	*< 0.002*
23-Jul-14	4	500	495	8.0	0.013	*< 0.00001*	0.0022	6.1	0.010	*< 0.01*	0.0024	0.00040	*< 0.009*	3.8	*< 0.00004*	1.5	*< 0.000002*	2.4	0.085	4.6	0.000010	0.0016	0.000080	0.012	0.00037	*< 0.001*	*< 0.002*
30-Jul-14	5	500	480	8.0	*< 0.002*	*< 0.00001*	0.0023	5.8	0.0083	*< 0.01*	0.0024	0.00050	*< 0.009*	3.6	0.000070	1.5	0.0000020	1.8	0.083	3.3	0.000018	0.000040	0.00015	0.011	0.00043	*< 0.001*	*< 0.002*
6-Aug-14	6	500	485	7.9	0.0020	0.000050	0.0018	5.2	0.0072	*< 0.01*	0.0015	*< 0.0001*	*< 0.009*	3.3	0.000050	1.4	*< 0.000002*	1.3	0.075	2.4	0.0000080	0.000030	0.000060	0.0094	0.00039	*< 0.001*	*< 0.002*
13-Aug-14	7	500	485	7.9	0.0020	*< 0.00001*	0.0013	4.1	0.0083	*< 0.01*	0.0011	0.00020	*< 0.009*	2.5	*< 0.00004*	1.0	*< 0.000002*	0.76	0.060	1.6	0.0000050	0.000010	0.00018	0.0074	0.00019	*< 0.001*	*< 0.002*
20-Aug-14	8	500	480	7.9	*< 0.002*	*< 0.00001*	0.0012	3.8	0.0078	*< 0.01*	0.0011	0.00020	0.0090	2.4	0.000060	0.98	*< 0.000002*	0.65	0.058	1.6	*< 0.000005*	0.0013	0.00017	0.0078	0.00036	*< 0.001*	*< 0.002*
27-Aug-14	9	500	500	7.9	*< 0.002*	0.000010	0.0013	4.7	0.0086	*< 0.01*	0.0012	0.00020	0.012	2.7	0.000050	1.2	*< 0.000002*	0.72	0.071	1.9	0.000012	0.000090	0.000080	0.0096	0.00034	*< 0.001*	*< 0.002*
3-Sep-14	10	500	475	7.8	*< 0.007*	0.000060	0.0013	4.3	0.0096	*< 0.01*	0.0010	0.00010	0.0060	2.7	0.000090	1.4	0.000018	0.58	0.071	2.4	0.000013	0.00020	*< 0.00005*	0.0092	0.00036	*< 0.001*	*< 0.002*
10-Sep-14	11	500	505	7.9	*< 0.007*	0.000010	0.0011	3.7	0.0087	*< 0.01*	0.00084	0.00010	*< 0.003*	2.4	0.000050	1.2	*< 0.000002*	0.45	0.063	1.5	0.000010	0.000060	0.000090	0.0087	0.00034	*< 0.001*	*< 0.002*
17-Sep-14	12	500	490	7.9	*< 0.007*	*< 0.00001*	0.0012	3.9	0.0071	*< 0.01*	0.00084	0.00010	*< 0.003*	2.6	0.000050	1.1	*< 0.000002*	0.45	0.063	2.1	*< 0.000005*	0.000020	0.00015	0.0097	0.00036	0.0010	*< 0.002*
24-Sep-14	13	500	485	7.9	*< 0.002*	0.000010	0.00099	3.5	0.0065	*< 0.01*	0.00076	0.00020	*< 0.009*	2.1	*< 0.00004*	0.94	0.0000050	0.35	0.055	1.4	*< 0.000005*	0.000020	*< 0.00005*	0.0087	0.00029	0.0010	*< 0.002*
1-Oct-14	14	500	480	7.8	0.0090	*< 0.00001*	0.00066	2.8	0.012	*< 0.01*	0.00080	*< 0.0001*	*< 0.009*	1.7	*< 0.00004*	0.78	*< 0.000002*	0.23	0.047	1.5	*< 0.000005*	0.000030	0.000060	0.0071	0.00026	*< 0.002*	*< 0.002*
8-Oct-14	15	500	490	7.7	*< 0.007*	*< 0.00001*	0.00072	2.5	0.0075	*< 0.01*	0.00056	*< 0.0001*	*< 0.003*	1.7	*< 0.00004*	0.70	*< 0.000002*	0.23	0.043	1.8	0.0000080	0.0011	*< 0.00005*	0.0072	0.00026	*< 0.001*	*< 0.002*
15-Oct-14	16	500	480	7.8	*< 0.007*	*< 0.00001*	0.00087	2.7	0.0081	*< 0.01*	0.00064	*< 0.0001*	*< 0.003*	1.8	*< 0.00004*	0.74	*< 0.000002*	0.24	0.045	1.8	0.0000090	0.00075	0.00016	0.0076	0.00024	*< 0.001*	*< 0.002*
22-Oct-14	17	500	500	7.8	*< 0.007*	0.000060	0.0010	3.7	0.011	*< 0.01*	0.00091	0.00010	*< 0.003*	2.2	*< 0.00004*	1.0	*< 0.000002*	0.29	0.058	2.1	0.000011	0.000040	*< 0.00005*	0.011	0.00028	*< 0.001*	*< 0.002*
29-Oct-14	18	500	490	7.7	*< 0.007*	*< 0.00001*	0.00062	2.5	0.0087	*< 0.01*	0.00055	*< 0.0001*	*< 0.003*	1.4	*< 0.00004*	0.60	*< 0.000002*	0.18	0.040	1.2	0.0000080	0.00089	0.000060	0.0065	0.00018	*< 0.001*	*< 0.002*
5-Nov-14	19	500	475	7.8	*< 0.007*	0.000010	0.00056	2.3	0.0085	*< 0.01*	0.00063	*< 0.0001*	*< 0.003*	1.3	*< 0.00004*	0.60	*< 0.000002*	0.18	0.038	1.2	0.000011	0.00094	0.000070	0.0063	0.00018	*< 0.001*	*< 0.002*
12-Nov-14	20	500	505	7.8	*< 0.007*	*< 0.00001*	0.00088	3.8	0.0093	*< 0.01*	0.0013	0.00010	*< 0.003*	2.1	0.000050	0.99	*< 0.000002*	0.33	0.063	1.9	0.000011	0.00011	*< 0.00005*	0.011	0.00030	*< 0.001*	*< 0.002*
19-Nov-14	21	500	480	7.9	*< 0.007*	0.000020	0.00062	2.6	0.0083	*< 0.01*	0.00062	*< 0.0001*	*< 0.003*	1.4	*< 0.00004*	0.65	*< 0.000002*	0.17	0.045	1.0	0.0000090	0.00030	*< 0.00005*	0.0066	0.00025	0.0010	*< 0.002*
26-Nov-14	22	500	490	7.8	*< 0.007*	*< 0.00001*	0.00064	2.6	0.0100	*< 0.01*	0.00069	*< 0.0001*	0.0090	1.4	*< 0.00004*	0.67	*< 0.000002*	0.17	0.044	1.1	0.000016	0.00079	0.00013	0.0074	0.00025	*< 0.001*	*< 0.002*
3-Dec-14	23	500	485	7.7	*< 0.007*	0.000040	0.00057	2.4	0.011	0.010	0.00072	*< 0.0001*	*< 0.003*	1.3	*< 0.00004*	0.57	*< 0.000002*	0.18	0.038	1.1	0.0000060	0.00026	*< 0.00005*	0.0073	0.00030	*< 0.001*	*< 0.002*
10-Dec-14	24	500	500	7.8	*< 0.007*	*< 0.00001*	0.00056	2.3	0.0094	*< 0.01*	0.00079	*< 0.0001*	*< 0.003*	1.3	*< 0.00004*	0.57	*< 0.000002*	0.14	0.040	1.1	0.000010	0.00038	0.000070	0.0065	0.00021	*< 0.001*	*< 0.002*
17-Dec-14	25	500	485	7.8	*< 0.007*	*< 0.00001*	0.00067	2.6	0.011	*< 0.01*	0.00074	*< 0.0001*	*< 0.003*	1.4	*< 0.00004*	0.73	*< 0.000002*	0.16	0.045	0.90	0.0000090	0.00074	*< 0.00005*	0.0081	0.00029	*< 0.001*	*< 0.002*
24-Dec-14	26	500	480	7.8	*< 0.007*	*< 0.00001*	0.00079	2.9	0.011	*< 0.01*	0.00090	*< 0.0001*	*< 0.003*	1.7	0.000080	0.80	*< 0.000002*	0.18	0.052	1.1	0.000012	0.00041	0.00018	0.0088	0.00033	*< 0.001*	*< 0.002*
31-Dec-14	27	500	500	7.8	*< 0.007*	0.00011	0.00072	3.0	0.011	*< 0.01*	0.00095	*< 0.0001*	*< 0.003*	1.6	*< 0.00004*	0.92	*< 0.000002*	0.17	0.053	1.2	0.000010	0.00035	*< 0.00005*	0.0090	0.00025	*< 0.001*	*< 0.002*
7-Jan-15	28	500	495	7.7	*< 0.007*	0.000020	0.00069	2.8	0.011	*< 0.01*	0.00094	*< 0.0001*	*< 0.003*	1.5	*< 0.00004*	0.71	*< 0.000002*	0.15	0.049	0.80	0.000010	0.00054	0.000080	0.0081	0.00024	*< 0.001*	*< 0.002*
14-Jan-15	29	500	490	7.7	*< 0.007*	0.000020	0.00067	3.1	0.0087	*< 0.01*	0.0011	*< 0.0001*	*< 0.003*	1.7	*< 0.00004*	0.89	*< 0.000002*	0.18	0.051	0.80	0.0000090	0.00017	0.000070	0.0079	0.00026	*< 0.001*	*< 0.002*
21-Jan-15	30	500	485	7.9	*< 0.007*	0.000030	0.00057	2.5	0.0094	*< 0.01*	0.0011	*< 0.0001*	*< 0.003*	1.3	*< 0.00004*	0.66	*< 0.000002*	0.12	0.043	0.50	*< 0.000005*	0.00026	0.00018	0.0071	0.00025	*< 0.001*	*< 0.002*
28-Jan-15	31	500	485	7.7	*< 0.007*	*< 0.00001*	0.00051	2.6	0.0081	*< 0.01*	0.0010	*< 0.0001*	*< 0.003*	1.4	0.000080	0.70	*< 0.000002*	0.16	0.036	1.1	0.0000060	0.00012	0.000060	0.0072	0.00026	*< 0.001*	*< 0.002*
4-Feb-15	32	500	485	7.8	*< 0.007*	0.000020	0.00060	2.5	0.0086	*< 0.01*	0.00086	*< 0.0001*	*< 0.003*	1.3	*< 0.00004*	0.66	*< 0.000002*	0.14	0.045	1.0	*< 0.000005*	0.00024	0.00014	0.0062	0.00022	*< 0.001*	*< 0.002*
11-Feb-15	33	500	475	7.7	*< 0.007*	*< 0.00001*	0.00049	2.1	0.0090	*< 0.01*	0.00079	*< 0.0001*	*< 0.003*	1.2	*< 0.001*	0.58	*< 0.000002*	0.11	0.037	0.50	0.0000060	0.00045	0.00034	0.0054	0.00026	*< 0.001*	*< 0.002*
18-Feb-15	34	500	500	7.7	*< 0.007*	*< 0.00001*	0.00064	2.5	0.0081	*< 0.01*	0.00076	*< 0.0001*	*< 0.003*	1.4	*< 0.001*	0.70	*< 0.000002*	0.12	0.048	0.70	0.0000080	0.00013	0.000060	0.0072	0.00025	*< 0.001*	*< 0.002*
25-Feb-15	35	500	480	7.8	*< 0.007*	0.000020	0.00064	2.9	0.0076	*< 0.01*	0.00083	*< 0.0001*	*< 0.003*	1.7	*< 0.001*	0.71	*< 0.000002*	0.14	0.051	0.70	0.0000080	0.00011	*< 0.00005*	0.0084	0.00024	*< 0.001*	*< 0.002*
4-Mar-15	36	500	490	7.7	*< 0.007*	*< 0.00001*	0.00052	2.2	0.0077	*< 0.01*	0.00063	*< 0.0001*	*< 0.003*	1.2	*< 0.001*	0.68	*< 0.000002*	0.11	0.039	0.90	*< 0.000005*	0.000030	0.000090	0.0065	0.00023	*< 0.001*	*< 0.002*
11-Mar-15	37	500	485	7.7	0.010	0.00010	0.00050	2.0	0.0083	*< 0.01*	0.00060	*< 0.0001*	*< 0.003*	1.0	*< 0.001*	0.49	*< 0.000002*	0.070	0.037	*< 0.1*	*< 0.000005*	0.00057	0.000090	0.0057	0.00020	0.012	*< 0.002*
18-Mar-15	38	500	490	7.7	*< 0.007*	*< 0.00001*	0.00047	1.9	0.0094	*< 0.01*	0.00056	*< 0.0001*	*< 0.003*	1.1	*< 0.001*	0.50	*< 0.000002*	0.080	0.035	0.90	*< 0.000005*	0.00041	0.00021	0.0051	0.00016	*< 0.001*	*< 0.002*
25-Mar-15	39	500	490	7.7	*< 0.007*	*< 0.00001*	0.00033	2.0	0.0088	*< 0.01*	0.00058	0.00010	*< 0.003*	1.0	*< 0.001*	0.49	*< 0.000002*	0.13	0.034	0.70	*< 0.000005*	0.00048	0.000080	0.0052	0.00025	0.0010	*< 0.002*
1-Apr-15	40	500	485	7.9	*< 0.007*	*< 0.00001*	0.00032	1.6	0.016	*< 0.01*	0.00042	*< 0.0001*	*< 0.003*	0.90	*< 0.001*	0.30	*< 0.000002*	0.68	0.030	*< 0.1*	*< 0.000005*	0.00047	*< 0.00005*	0.0062	0.00014	*< 0.001*	*< 0.002*
8-Apr-15	41	500	485	7.6	*< 0.007*	*< 0.00001*	0.00037	1.6	0.0085	*< 0.01*	0.00049	*< 0.0001*	*< 0.003*	0.93	*< 0.001*	0.53	*< 0.000002*	0.070	0.031	0.10	*< 0.000005*	0.00039	0.000050	0.0046	0.00018	*< 0.001*	*< 0.002*
15-Apr-15	42	500	475	7.7	*< 0.007*	*< 0.00001*	0.00050	2.2	0.0090	*< 0.01*	0.00062	*< 0.0001*	*< 0.003*	1.2	*< 0.001*	0.58	*< 0.000002*	0.10	0.039	0.70	*< 0.000005*	0.00098	0.00012	0.0065	0.00025	0.0010	*< 0.002*
22-Apr-15	43	500	505	7.8	*< 0.007*	0.000060	0.00055	2.4	0.0090	*< 0.01*	0.00067	*< 0.0001*	*< 0.003*	1.4	*< 0.001*	0.71	0.0000040	0.11	0.044	0.60	0.000013	0.00036	0.000050	0.0076	0.00027	*< 0.001*	*< 0.002*
29-Apr-15	44	500	495	7.8	*< 0.007*	0.000020	0.00054	2.7	0.010	*< 0.01*	0.00077	*< 0.0001*	*< 0.003*	1.6	*< 0.001*	0.69	*< 0.000002*	0.090	0.047	0.80	*< 0.000005*	0.00038	0.000080	0.0078	0.00027	*< 0.001*	*< 0.002*
6-May-15	45	500	495	7.7	*< 0.007*	0.000010	0.00054	2.3	0.0095	*< 0.01*	0.00064	*< 0.0001*	*< 0.003*	1.3	*< 0.001*	0.70	0.0000020	0.090	0.041	0.70	*< 0.000005*	0.00055	0.00010	0.0069	0.00024	*< 0.001*	*< 0.002*
13-May-15	46	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20-May-15	47	495	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-May-15	48	480	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	49	475	475	8.0	*< 0.007*	*< 0.00001*	0.0014	7.2	0.012	*< 0.01*	0.0022	0.00020	*< 0.003*	3.6	*< 0.00004*	2.1	*< 0.000002*	0.25	0.13	1.8	0.000010	0.00038	0.000090	0.022	0.00031	*< 0.001*	*< 0.002*
10-Jun-15	50	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17-Jun-15	51	490	482	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Jun-15	52	480	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	53	450	445	8.0	*< 0.007*	*< 0.00001*	0.0012	7.2	0.017	0.010	0.0020	0.00020	*< 0.003*	2.9	0.000080	1.9	0.0000020	0.26	0.13	1.6	0.000013	0.00090	*< 0.00005*	0.024	0.00027	0.0010	*< 0.002*
8-Jul-15	54	500	485	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15-Jul-15	55	485	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22-Jul-15	56	470	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	57	455	445	8.0	*< 0.007*	*< 0.00001*	0.0013	7.6	0.018	*< 0.01*	0.0013	0.00020	*< 0.003*	2.9	0.000060	1.8	0.000013	0.25	0.14	1.6	*< 0.000005*	0.00042	*< 0.00005*	0.012	0.00018	*< 0.001*	*< 0.002*
5-Aug-15	58	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	59	490	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19-Aug-15	60	475	465	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	61	465	445	8.1	*< 0.007*	0.00011	0.0012	7.4	0.017	*< 0.01*	0.0021	0.00020	*< 0.003*	3.0	0.000070	2.2	*< 0.000002*	0.22	0.14	1.6	0.000015	0.00097	*< 0.00005*	0.024	0.00029	0.0020	*< 0.002*
2-Sep-15	62	500	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	63	500	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Sep-15	64	480	465	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	65	465	465	8.1	*< 0.007*	*< 0.00001*	0.0012	7.5	0.013	*< 0.01*	0.0016	0.00020	*< 0.003*	3.1	0.000080	1.9	0.000015	0.24	0.14	1.7	0.0000080	0.00081	0.000070	0.020	0.00023	*< 0.001*	*< 0.002*
30-Sep-15	66	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	67	495	475	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14-Oct-15	68	475	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	69	470	455	8.1	*< 0.007*	0.000020	0.0010	6.8	0.014	*< 0.01*	0.0012	0.00020	*< 0.003*	2.7	0.000090	1.6	0.000024	0.25	0.11	1.3	0.000014	0.0012	*< 0.00005*	0.019	0.00019	*< 0.001*	*< 0.002*
28-Oct-15	70	500	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	71	490	480	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11-Nov-15	72	480	470	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	73	470	455	8.1	0.022	*< 0.00001*	0.00083	5.8	0.016	*< 0.01*	0.0022	*< 0.0001*	*< 0.003*	2.4	0.00018	1.3	*< 0.000002*	0.21	0.099	0.90	0.000016	0.0011	*< 0.00005*	0.016	0.00020	*< 0.001*	*< 0.002*
25-Nov-15	74	500	490	7.9	*< 0.007*	0.000020	0.00054	2.7	0.0083	*< 0.01*	0.00081	*< 0.0001*	*< 0.003*	1.5	0.00029	0.71	0.00014	0.12	0.049	0.50	0.0000050	0.00047	*< 0.00005*	0.0095	0.00027	*< 0.001*	*< 0.002*
2-Dec-15	75	500	490	8.0	*< 0.007*	0.000030	0.00059	3.9	0.0090	*< 0.01*	0.00088	0.00010	*< 0.003*	1.9	0.000040	0.96	0.0000020	0.12	0.062	0.80	*< 0.000005*	0.00041	0.000080	0.011	0.00025	*< 0.001*	*< 0.002*
9-Dec-15	76	500	495	7.9	*< 0.007*	*< 0.00001*	0.00055	2.7	0.0063	*< 0.01*	0.00062	*< 0.0001*	*< 0.003*	1.5	0.000050	0.69	0.0000040	0.080	0.049	0.30	0.000020	0.00040	0.00014	0.0089	0.00024	*< 0.001*	*< 0.002*
16-Dec-15	77	500	495	8.1	*< 0.007*	0.00013	0.00064	3.3	0.0075	*< 0.01*	0.00058	*< 0.0001*	0.012	1.8	*< 0.00004*	0.88	*< 0.000002*	0.10	0.058	0.20	0.0000070	0.00064	0.00014	0.011	0.00029	*< 0.001*	*< 0.002*
23-Dec-15	78	500	485	8.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	79	500	490	7.8	*< 0.007*	*< 0.00001*	0.00047	2.2	0.0062	*< 0.01*	0.00035	*< 0.0001*	*< 0.003*	1.2	*< 0.00004*	0.52	*< 0.000002*	0.10	0.040	0.80	*< 0.000005*	0.00022	0.00012	0.0069	0.00019	*< 0.001*	*< 0.002*
6-Jan-16	80	500	490	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	81	500	495	7.6	*< 0.007*	0.000020	0.00036	2.1	0.0064	*< 0.01*	0.00049	*< 0.0001*	*< 0.003*	1.2	0.00013	0.55	*< 0.000002*	0.060	0.036	*< 0.1*	*< 0.000005*	0.00028	0.00012	0.0060	0.00015	*< 0.001*	*< 0.002*
20-Jan-16	82	500	495	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	83	500	495	7.8	*< 0.007*	*< 0.00001*	0.00044	2.4	0.0074	*< 0.01*	0.00036	*< 0.0001*	*< 0.003*	1.2	*< 0.00004*	0.63	*< 0.000002*	0.070	0.044	*< 0.1*	0.0000050	0.00049	0.00011	0.0080	0.00018	*< 0.001*	*< 0.002*
3-Feb-16	84	500	495	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	85	500	480	7.7	*< 0.007*	*< 0.00001*	0.00042	2.5	0.0085	*< 0.01*	0.00037	*< 0.0001*	*< 0.003*	1.2	0.000070	0.59	*< 0.000002*	0.10	0.045	0.60	0.0000070	0.00034	0.00014	0.0069	0.00016	*< 0.001*	*< 0.002*
17-Feb-16	86	500	505	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	87	500	480	7.8	*< 0.007*	*< 0.00001*	0.00048	2.7	0.0068	*< 0.01*	0.00042	*< 0.0001*	*< 0.003*	1.4	*< 0.00004*	0.47	*< 0.000002*	0.050	0.047	0.50	0.0000050	0.00030	0.00014	0.0079	0.00017	*< 0.001*	*< 0.002*

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Calculated Loading Rates for HC4 (GS)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	335	7.8	547	#N/A	2.4	18	55	0.57	0.064	0.10	65	0.0098	0.0015	0.0094	0.0066	0.0000023	0.0000023	0.0036	0.0000010	13	0.000027	0.000083	0.0010
2-Jul-14	1	500	505	7.8	446	#N/A	4.0	30	73	0.30	0.081	0.15	85	0.012	0.0033	0.016	0.0077	0.0000035	0.0000035	0.0047	0.0000015	17	0.000015	0.00011	0.00074
9-Jul-14	2	500	475	7.9	258	#N/A	1.0	28	28	0.095	0.076	0.14	44	0.015	0.0035	0.011	0.0088	0.0000033	0.0000033	0.0046	0.0000014	9.0	0.000014	0.000047	0.00038
16-Jul-14	3	500	500	8.0	176	#N/A	1.3	30	8.5	0.10	0.060	0.15	33	0.018	0.0034	0.0094	0.0089	0.0000035	0.0000035	0.0034	0.0000015	7.0	0.00010	0.00014	0.00033
23-Jul-14	4	500	495	8.0	124	#N/A	1.1	25	4.5	0.099	0.050	0.15	26	0.022	0.0027	0.0087	0.0089	0.0000035	0.0000035	0.0029	0.0000015	5.6	0.000045	0.000068	0.00022
30-Jul-14	5	500	480	8.0	121	#N/A	0.81	28	3.8	0.096	0.043	0.14	24	0.024	0.0026	0.0081	0.0087	0.0000034	0.0000034	0.0025	0.0000014	5.2	0.000048	0.000048	0.00062
6-Aug-14	6	500	485	7.9	104	#N/A	0.97	23	2.4	0.097	0.039	0.15	22	0.023	0.0023	0.0065	0.0084	0.0000034	0.0000034	0.0021	0.0000015	4.8	0.000015	0.000020	0.00023
13-Aug-14	7	500	485	7.9	85	#N/A	1.1	20	2.9	0.097	0.029	0.15	18	0.028	0.0017	0.0053	0.0081	0.0000034	0.0000034	0.0019	0.0000015	4.1	0.000024	0.000021	0.00023
20-Aug-14	8	500	480	7.9	78	#N/A	0.90	18	2.4	0.096	0.029	0.14	17	0.026	0.0014	0.0054	0.0072	0.0000034	0.0000034	0.0017	0.0000014	3.9	0.000034	0.000025	0.00020
27-Aug-14	9	500	500	7.9	103	#N/A	2.6	23	2.0	0.10	0.030	0.15	22	0.024	0.0021	0.0054	0.010	0.0000035	0.0000035	0.0038	0.0000015	5.0	0.000015	0.000013	0.00012
3-Sep-14	10	500	475	7.8	99	#N/A	2.3	21	2.4	0.095	0.029	0.14	21	0.024	0.0019	0.0060	0.010	0.0000033	0.0000033	0.0016	0.0000014	5.0	0.000014	0.000013	0.00037
10-Sep-14	11	500	505	7.9	93	#N/A	1.8	21	2.0	0.10	0.030	0.15	19	0.029	0.0019	0.0054	0.0096	0.0000035	0.0000035	0.0020	0.0000015	4.6	0.000015	0.000011	0.00020
17-Sep-14	12	500	490	7.9	93	#N/A	3.6	22	2.5	0.098	0.029	0.15	19	0.028	0.0019	0.0050	0.0096	0.0000034	0.0000034	0.0018	0.0000020	4.4	0.000015	0.000010	0.000078
24-Sep-14	13	500	485	7.9	78	#N/A	1.7	18	2.9	0.097	0.029	0.15	17	0.026	0.0019	0.0040	0.0078	0.0000034	0.0000034	0.0012	0.0000015	3.9	0.000015	0.000053	0.000082
1-Oct-14	14	500	480	7.8	63	#N/A	3.0	17	1.4	0.096	0.029	0.14	14	0.023	0.0018	0.0030	0.0065	0.0000034	0.0000034	0.00091	0.0000014	3.3	0.000014	0.00	0.0000096
8-Oct-14	15	500	490	7.7	65	#N/A	1.5	13	0.98	0.098	0.029	0.15	14	0.020	0.0014	0.0032	0.0064	0.0000034	0.0000034	0.0048	0.0000015	3.4	0.000015	0.0000074	0.000069
15-Oct-14	16	500	480	7.8	68	#N/A	2.3	14	1.4	0.096	0.029	0.14	14	0.022	0.0015	0.0033	0.0067	0.0000034	0.0000034	0.0020	0.0000014	3.5	0.000014	0.0000082	0.000058
22-Oct-14	17	500	500	7.8	87	#N/A	2.5	19	2.0	0.10	0.030	0.15	19	0.023	0.0024	0.0042	0.011	0.0000035	0.0000035	0.0025	0.0000015	4.6	0.000015	0.000013	0.000055
29-Oct-14	18	500	490	7.7	63	#N/A	3.7	15	0.98	0.098	0.029	0.15	14	0.022	0.0015	0.0027	0.0064	0.0000034	0.0000034	0.0023	0.0000015	3.4	0.000015	0.0000078	0.00027
5-Nov-14	19	500	475	7.8	57	#N/A	#N/A	17	0.95	0.095	0.029	0.14	12	0.017	0.0013	0.0024	0.0063	0.0000033	0.0000033	0.0012	0.0000076	3.0	0.000014	0.0000090	0.00025
12-Nov-14	20	500	505	7.8	89	#N/A	3.3	17	1.0	0.10	0.030	0.15	21	0.024	0.0025	0.0045	0.0099	0.0000035	0.0000035	0.0017	0.0000015	5.1	0.000015	0.000011	0.00014
19-Nov-14	21	500	480	7.9	94	#N/A	3.1	16	0.96	0.096	0.029	0.14	14	0.025	0.0014	0.0031	0.0069	0.0000034	0.0000034	0.0010	0.0000014	3.6	0.000014	0.0000096	0.00016
26-Nov-14	22	500	490	7.8	62	#N/A	0.96	14	0.98	0.098	0.029	0.15	14	0.022	0.0015	0.0030	0.0085	0.0000034	0.0000034	0.0011	0.0000015	3.5	0.000015	0.0000088	0.00014
3-Dec-14	23	500	485	7.7	59	#N/A	1.4	14	0.97	0.097	0.029	0.15	14	0.024	0.0014	0.0031	0.0072	0.0000034	0.0000034	0.0013	0.0000015	3.6	0.000015	0.0000068	0.000078
10-Dec-14	24	500	500	7.8	56	#N/A	2.4	14	1.0	0.10	0.030	0.15	13	0.022	0.0015	0.0027	0.0067	0.0000035	0.0000035	0.0011	0.0000015	3.3	0.000015	0.0000060	0.00012
17-Dec-14	25	500	485	7.8	64	#N/A	1.8	15	0.97	0.097	0.029	0.15	14	0.030	0.0016	0.0038	0.0078	0.0000034	0.0000034	0.00092	0.0000015	3.7	0.000015	0.0000053	0.00014
24-Dec-14	26	500	480	7.8	74	#N/A	1.6	17	0.96	0.096	0.029	0.14	16	0.029	0.0020	0.0037	0.0096	0.0000034	0.0000034	0.00077	0.0000014	4.2	0.000014	0.0000072	0.000096
31-Dec-14	27	500	500	7.8	71	#N/A	0.72	24	1.0	0.10	0.030	0.15	17	0.024	0.0020	0.0034	0.0099	0.0000035	0.0000035	0.00075	0.0000015	4.5	0.000015	0.0000050	0.00024
7-Jan-15	28	500	495	7.7	69	#N/A	1.3	17	0.99	0.50	0.030	0.15	16	0.019	0.0019	0.0029	0.0089	0.0000035	0.0000035	0.0011	0.0000015	3.9	0.000015	0.000010	0.000079
14-Jan-15	29	500	490	7.7	72	#N/A	1.4	18	0.98	0.49	0.029	0.15	17	0.019	0.0023	0.0034	0.0095	0.0000034	0.0000034	0.0012	0.0000015	4.2	0.000015	0.0000074	0.00023
21-Jan-15	30	500	485	7.9	62	#N/A	2.7	17	0.97	0.49	0.029	0.15	15	0.023	0.0016	0.0026	0.0078	0.0000034	0.0000034	0.00078	0.0000015	3.8	0.000015	0.0000063	0.00018
28-Jan-15	31	500	485	7.7	61	#N/A	0.71	15	0.97	0.49	0.029	0.15	14	0.022	0.0016	0.0025	0.0083	0.0000034	0.0000034	0.0012	0.0000015	3.4	0.000049	0.0000049	0.000082
4-Feb-15	32	500	485	7.8	59	#N/A	1.1	15	0.97	0.49	0.029	0.15	13	0.017	0.0015	0.0022	0.0088	0.0000034	0.0000034	0.0010	0.0000015	3.3	0.000015	0.0000044	0.00018
11-Feb-15	33	500	475	7.7	55	#N/A	1.0	14	0.95	0.48	0.029	0.14	12	0.020	0.0013	0.0020	0.0067	0.0000033	0.0000033	0.00100	0.0000014	3.1	0.000014	0.0000067	0.00012
18-Feb-15	34	500	500	7.7	61	#N/A	1.1	16	1.0	0.50	0.030	0.15	15	0.018	0.0017	0.0024	0.0086	0.0000035	0.0000035	0.0012	0.0000015	3.9	0.000015	0.0000070	0.00026
25-Feb-15	35	500	480	7.8	72	#N/A	1.7	18	0.96	0.48	0.029	0.14	15	0.017	0.0017	0.0023	0.0098	0.0000034	0.0000034	0.00038	0.0000019	3.8	0.000029	0.0000077	0.00028
4-Mar-15	36	500	490	7.7	58	#N/A	1.1	15	0.98	0.49	0.029	0.15	13	0.020	0.0012	0.0021	0.0072	0.0000034	0.0000034	0.00039	0.0000015	3.3	0.000029	0.0000059	0.000069
11-Mar-15	37	500	485	7.7	54	#N/A	0.88	14	0.97	0.49	0.029	0.15	12	0.015	0.0013	0.0017	0.0070	0.0000034	0.0000034	0.00078	0.0000097	3.1	0.000029	0.000013	0.00043
18-Mar-15	38	500	490	7.7	50	#N/A	1.2	13	0.98	0.49	0.029	0.15	11	0.015	0.0010	0.0015	0.0071	0.0000034	0.0000034	0.00054	0.0000015	3.0	0.000015	0.0000083	0.00018
25-Mar-15	39	500	490	7.7	45	#N/A	1.3	13	0.98	0.49	0.029	0.15	11	0.015	0.0011	0.0016	0.0065	0.0000034	0.0000034	0.00044	0.0000015	2.8	0.000044	0.0000029	0.00037
1-Apr-15	40	500	485	7.9	44	#N/A	1.9	13	0.97	0.49	0.029	0.15	8.5	0.014	0.0010	0.0011	0.0071	0.0000058	0.0000034	0.00078	0.0000019	2.2	0.000015	0.0000019	0.00013
8-Apr-15	41	500	485	7.6	45	#N/A	1.3	12	0.97	0.49	0.029	0.15	9.7	0.013	0.0013	0.0014	0.0065	0.0000034	0.0000034	0.00039	0.0000015	2.6	0.000015	0.0000092	0.00011
15-Apr-15	42	500	475	7.7	57	#N/A	1.8	15	0.95	0.48	0.029	0.14	12	0.017	0.0012	0.0019	0.0076	0.0000033	0.0000033	0.0016	0.0000014	3.3	0.000014	0.0000019	0.0013
22-Apr-15	43	500	505	7.8	65	#N/A	1.6	18	1.5	0.51	0.030	0.15	15	0.023	0.0015	0.0027	0.0095	0.0000035	0.0000035	0.0015	0.0000015	3.9	0.000025	0.0000051	0.00048
29-Apr-15	44	500	495	7.8	68	#N/A	1.0	18	0.99	0.50	0.030	0.15	16	0.024	0.0015	0.0026	0.010	0.0000035	0.0000035	0.0010	0.0000015	4.1	0.000015	0.000011	0.00033
6-May-15	45	500	495	7.7	62	#N/A	1.3	17	0.99	0.50	0.030	0.15	14	0.021	0.0015	0.0031	0.0083	0.0000035	0.0000035	0.00094	0.0000015	3.6	0.000015	0.0000089	0.00020
13-May-15	46	500	495																						
20-May-15	47	495	480																						
27-May-15	48	480	475																						
3-Jun-15	49	475	475	8.0	172	#N/A	1.8	10	0.48	0.12	0.0071	0.036	10.0	0.0017	0.00097	0.00081	0.0075	0.00000083	0.00000083	0.00043	0.00000036	2.6	0.0000036	0.0000039	0.000020
10-Jun-15	50	500	490																						
17-Jun-15	51	490	482																						
24-Jun-15	52	480	450																						
1-Jul-15	53	450	445	8.0	186	#N/A	2.2	9.9	0.33	0.11	0.0067	0.033	9.3	0.0015	0.00078	0.00069	0.0076	0.00000078	0.00000078	0.00039	0.00000033	2.4	0.0000033	0.0000052	0.000041
8-Jul-15	54	500	485																						
15-Jul-15	55	485	470																						
22-Jul-15	56	470	455																						
29-Jul-15	57	455	445	8.0	175	#N/A	1.2	10	0.33	0.11	0.0067	0.033	9.5	0.0012	0.00071	0.00055	0.0073	0.00000078	0.00000078	0.00038	0.0000011	2.4	0.0000045	0.0000042	0.0000089
5-Aug-15	58	500	490																						
12-Aug-15	59	490	475																						
19-Aug-15	60	475	465																						
26-Aug-15	61	465	445	8.1	177	#N/A	0.79	10	0.33	0.11	0.0067	0.033	10	0.0015	0.00070	0.00052	0.0081	0.00000078	0.00000078	0.00041	0.0000010	2.8	0.000012	0.0000046	0.000068
2-Sep-15	62	500	500																						
9-Sep-15	63	500	480																						
16-Sep-15	64	480	465																						
23-Sep-15	65	465	465	8.1	171	#N/A	1.0	9.9	0.35				10	0.0014	0.00074	0.00064	0.0085	0.00000081	0.00000081	0.00047	0.00000035	2.6	0.0000035	0.0000044	0.000028
30-Sep-15	66	500	495																						
7-Oct-15	67	495	475																						
14-Oct-15	68	475	470																						
21-Oct-15	69	470	455	8.1	156	#N/A	0.59	9.3	0.34				9.1	0.0016	0.00056	0.00042	0.0075	0.00000080	0.00000080	0.00041	0.00000034	2.4	0.0000034	0.0000047	0.000040
28-Oct-15	70	500	490																						
4-Nov-15	71	490	480																						
11-Nov-15	72	480	470																						
18-Nov-15	73	470	455	8.1	145	#N/A	0.54	9.5	0.23				7.7	0.0014	0.00046	0.00044	0.0055	0.00000080	0.00000080	0.00018	0.00000034	2.0	0.0000080	0.0000082	0.000043
25-Nov-15	74	500	490	7.9	72	#N/A	0.42	21	0.98				16	0.020	0.0010	0.0019	0.015	0.0000034	0.0000034	0.00069	0.0000015	4.4	0.000015	0.000011	0.00010
2-Dec-15	75	500	490	8.0	85	#N/A	0.82	21	0.98				21	0.018	0.0014	0.0020	0.018	0.0000034	0.0000034	0.00044	0.0000015	5.2	0.000015	0.0000078	0.00017
9-Dec-15	76	500	495	7.9	70	#N/A	1.4	18	0.99				16	0.018	0.00099	0.0019	0.015	0.0000045	0.0000035	0.0015	0.0000059	4.3	0.000015	0.0000074	0.00017
16-Dec-15	77	500	495	8.1	77	#N/A	0.73	19	0.99				19	0.025	0.0011	0.0023	0.017	0.0000035	0.0000035	0.0010	0.0000015	4.9	0.000025	0.0000099	0.00017
23-Dec-15	78	500	485	8.1	62	#N/A	0.69	16	0.97				16	0.021	0.00086	0.0018	0.014	0.0000034	0.0000034	0.00086	0.0000015	4.3	0.000025	0.0000064	0.00014
30-Dec-15	79	500	490	7.8	55	#N/A	0.66	14	0.98				14	0.017	0.00059	0.0012	0.012	0.0000034	0.0000034	0.00069	0.0000015	3.6	0.000025	0.0000029	0.00011
6-Jan-16	80	500	490	7.6	53	#N/A	0.75	14	0.98				13	0.016	0.00062	0.0012	0.011	0.0000034	0.0000034	0.00084	0.0000015	3.5	0.000020	0.0000025	0.00017
13-Jan-16	81	500	495	7.6	55	#N/A	0.84	14	0.99				13	0.016	0.00064	0.0012	0.011	0.0000035	0.0000035	0.00099	0.0000015	3.5	0.000015	0.0000020	0.00024
20-Jan-16	82	500	495	7.8	71	#N/A	1.1	15	0.99				14	0.017	0.00067	0.0013	0.013	0.0000035	0.0000035	0.00099	0.0000032	3.7	0.000015	0.0000069	0.00025
27-Jan-16	83	500	495	7.8	62	#N/A	1.4	16	0.99				15	0.018	0.00069	0.0013	0.014	0.0000035	0.0000035	0.00099	0.0000050	4.0	0.000015	0.000012	0.00026
3-Feb-16	84	500	495	7.8	70	#N/A	1.3	16	0.99				15	0.016	0.00071	0.0013	0.014	0.0000034	0.0000034	0.00098	0.0000032	4.1	0.000015	0.0000098	0.00015
10-Feb-16	85	500	480	7.7	67	#N/A	1.2	16	0.96				15	0.014	0.00072	0.0013	0.014	0.0000034	0.0000034	0.00096	0.0000014	4.2	0.000014	0.0000077	0.000043
17-Feb-16	86	500	505	7.7	64	#N/A	1.2	17	1.0				16	0.015	0.00074	0.0013	0.014	0.0000034	0.0000034	0.00096	0.0000014	4.3	0.000014	0.0000062	0.000041
24-Feb-16	87	500	480	7.8	70	#N/A	1.1	17	0.96				16	0.016	0.00077	0.0013	0.014	0.0000034	0.0000034	0.00096	0.0000014	4.3	0.000014	0.0000048	0.000038

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Calculated Loading Rates for HC4 (GS)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
25-Jun-14	0	500	335	7.8	0.0017	0.0000034	0.0021	7.8	0.0072	0.0034	0.0020	0.00040	0.0050	3.7	0.00027	0.64	0.00000067	8.0	0.10	22	0.000012	0.000057	0.000037	0.011	0.00015	0.00067	0.00067
2-Jul-14	1	500	505	7.8	0.0010	0.0000051	0.0026	10	0.014	0.0051	0.0023	0.0012	0.0045	4.1	0.00027	1.0	0.0000010	7.8	0.13	26	0.000011	0.00059	0.000030	0.031	0.00017	0.0010	0.0010
9-Jul-14	2	500	475	7.9	0.00095	0.0000048	0.0018	5.3	0.0070	0.0048	0.0022	0.00048	0.0095	3.0	0.000071	1.0	0.00000095	3.7	0.067	9.6	0.0000081	0.0014	0.000038	0.016	0.00020	0.00048	0.00095
16-Jul-14	3	500	500	8.0	0.0035	0.0000050	0.0014	3.9	0.0054	0.0050	0.0019	0.00040	0.0045	2.3	0.000025	0.87	0.0000010	2.1	0.053	3.9	0.0000075	0.000075	0.000035	0.0096	0.00020	0.00050	0.0010
23-Jul-14	4	500	495	8.0	0.0064	0.0000050	0.0011	3.0	0.0051	0.0050	0.0012	0.00020	0.0045	1.9	0.000020	0.75	0.00000099	1.2	0.042	2.3	0.0000050	0.00081	0.000040	0.0057	0.00018	0.00050	0.00099
30-Jul-14	5	500	480	8.0	0.00096	0.0000048	0.0011	2.8	0.0040	0.0048	0.0012	0.00024	0.0043	1.7	0.000034	0.70	0.00000096	0.84	0.040	1.6	0.0000086	0.000019	0.000072	0.0051	0.00021	0.00048	0.00096
6-Aug-14	6	500	485	7.9	0.00097	0.000024	0.00086	2.5	0.0035	0.0049	0.00074	0.000049	0.0044	1.6	0.000024	0.67	0.00000097	0.61	0.036	1.2	0.0000039	0.000015	0.000029	0.0045	0.00019	0.00049	0.00097
13-Aug-14	7	500	485	7.9	0.00097	0.0000049	0.00065	2.0	0.0040	0.0049	0.00054	0.000097	0.0044	1.2	0.000019	0.50	0.00000097	0.37	0.029	0.78	0.0000024	0.0000049	0.000087	0.0036	0.000092	0.00049	0.00097
20-Aug-14	8	500	480	7.9	0.00096	0.0000048	0.00058	1.8	0.0037	0.0048	0.00050	0.000096	0.0043	1.2	0.000029	0.47	0.00000096	0.31	0.028	0.75	0.0000024	0.00064	0.000082	0.0037	0.00017	0.00048	0.00096
27-Aug-14	9	500	500	7.9	0.0010	0.0000050	0.00067	2.3	0.0043	0.0050	0.00058	0.00010	0.0060	1.4	0.000025	0.62	0.0000010	0.36	0.035	0.95	0.0000060	0.000045	0.000040	0.0048	0.00017	0.00050	0.0010
3-Sep-14	10	500	475	7.8	0.0033	0.000029	0.00062	2.1	0.0045	0.0048	0.00049	0.000048	0.0029	1.3	0.000043	0.67	0.0000086	0.28	0.034	1.1	0.0000062	0.000095	0.000024	0.0044	0.00017	0.00048	0.00095
10-Sep-14	11	500	505	7.9	0.0035	0.0000051	0.00057	1.9	0.0044	0.0051	0.00042	0.000051	0.0015	1.2	0.000025	0.61	0.0000010	0.23	0.032	0.76	0.0000051	0.000030	0.000045	0.0044	0.00017	0.00051	0.0010
17-Sep-14	12	500	490	7.9	0.0034	0.0000049	0.00057	1.9	0.0035	0.0049	0.00041	0.000049	0.0015	1.3	0.000025	0.54	0.00000098	0.22	0.031	1.0	0.0000025	0.0000098	0.000074	0.0048	0.00018	0.00049	0.00098
24-Sep-14	13	500	485	7.9	0.00097	0.0000049	0.00048	1.7	0.0032	0.0049	0.00037	0.000097	0.0044	1.0	0.000019	0.46	0.0000024	0.17	0.027	0.68	0.0000024	0.0000097	0.000024	0.0042	0.00014	0.00049	0.00097
1-Oct-14	14	500	480	7.8	0.0043	0.0000048	0.00032	1.3	0.0056	0.0048	0.00038	0.000048	0.0043	0.83	0.000019	0.37	0.00000096	0.11	0.023	0.73	0.0000024	0.000014	0.000029	0.0034	0.00012	0.00096	0.00096
8-Oct-14	15	500	490	7.7	0.0034	0.0000049	0.00035	1.2	0.0037	0.0049	0.00027	0.000049	0.0015	0.81	0.000020	0.34	0.00000098	0.11	0.021	0.88	0.0000039	0.00052	0.000025	0.0035	0.00013	0.00049	0.00098
15-Oct-14	16	500	480	7.8	0.0034	0.0000048	0.00042	1.3	0.0039	0.0048	0.00031	0.000048	0.0014	0.84	0.000019	0.36	0.00000096	0.12	0.022	0.86	0.0000043	0.00036	0.000077	0.0036	0.00012	0.00048	0.00096
22-Oct-14	17	500	500	7.8	0.0035	0.000030	0.00050	1.9	0.0053	0.0050	0.00046	0.000050	0.0015	1.1	0.000020	0.52	0.0000010	0.15	0.029	1.1	0.0000055	0.000020	0.000025	0.0054	0.00014	0.00050	0.0010
29-Oct-14	18	500	490	7.7	0.0034	0.0000049	0.00030	1.2	0.0043	0.0049	0.00027	0.000049	0.0015	0.69	0.000020	0.29	0.00000098	0.088	0.020	0.59	0.0000039	0.00044	0.000029	0.0032	0.000088	0.00049	0.00098
5-Nov-14	19	500	475	7.8	0.0033	0.0000048	0.00027	1.1	0.0040	0.0048	0.00030	0.000048	0.0014	0.59	0.000019	0.29	0.00000095	0.086	0.018	0.57	0.0000052	0.00045	0.000033	0.0030	0.000086	0.00048	0.00095
12-Nov-14	20	500	505	7.8	0.0035	0.0000051	0.00044	1.9	0.0047	0.0051	0.00067	0.000051	0.0015	1.0	0.000025	0.50	0.0000010	0.17	0.032	0.96	0.0000056	0.000056	0.000025	0.0054	0.00015	0.00051	0.0010
19-Nov-14	21	500	480	7.9	0.0034	0.0000096	0.00030	1.2	0.0040	0.0048	0.00030	0.000048	0.0014	0.68	0.000019	0.31	0.00000096	0.082	0.022	0.48	0.0000043	0.00014	0.000024	0.0032	0.00012	0.00048	0.00096
26-Nov-14	22	500	490	7.8	0.0034	0.0000049	0.00031	1.3	0.0049	0.0049	0.00034	0.000049	0.0044	0.69	0.000020	0.33	0.00000098	0.083	0.022	0.54	0.0000078	0.00039	0.000064	0.0036	0.00012	0.00049	0.00098
3-Dec-14	23	500	485	7.7	0.0034	0.000019	0.00028	1.2	0.0053	0.0049	0.00035	0.000049	0.0015	0.61	0.000019	0.28	0.00000097	0.087	0.018	0.53	0.0000029	0.00013	0.000024	0.0036	0.00015	0.00049	0.00097
10-Dec-14	24	500	500	7.8	0.0035	0.0000050	0.00028	1.1	0.0047	0.0050	0.00040	0.000050	0.0015	0.66	0.000020	0.29	0.0000010	0.070	0.020	0.55	0.0000050	0.00019	0.000035	0.0033	0.00011	0.00050	0.0010
17-Dec-14	25	500	485	7.8	0.0034	0.0000049	0.00032	1.2	0.0052	0.0049	0.00036	0.000049	0.0015	0.68	0.000019	0.35	0.00000097	0.078	0.022	0.44	0.0000044	0.00036	0.000024	0.0039	0.00014	0.00049	0.00097
24-Dec-14	26	500	480	7.8	0.0034	0.0000048	0.00038	1.4	0.0054	0.0048	0.00043	0.000048	0.0014	0.80	0.000038	0.38	0.00000096	0.086	0.025	0.53	0.0000058	0.00020	0.000086	0.0042	0.00016	0.00048	0.00096
31-Dec-14	27	500	500	7.8	0.0035	0.000055	0.00036	1.5	0.0053	0.0050	0.00048	0.000050	0.0015	0.81	0.000020	0.46	0.0000010	0.085	0.027	0.60	0.0000050	0.00018	0.000025	0.0045	0.00013	0.00050	0.0010
7-Jan-15	28	500	495	7.7	0.0035	0.0000099	0.00034	1.4	0.0052	0.0050	0.00047	0.000050	0.0015	0.76	0.000020	0.35	0.00000099	0.074	0.024	0.40	0.0000050	0.00027	0.000040	0.0040	0.00012	0.00050	0.00099
14-Jan-15	29	500	490	7.7	0.0034	0.0000098	0.00033	1.5	0.0043	0.0049	0.00053	0.000049	0.0015	0.85	0.000020	0.44	0.00000098	0.088	0.025	0.39	0.0000044	0.000083	0.000034	0.0039	0.00013	0.00049	0.00098
21-Jan-15	30	500	485	7.9	0.0034	0.000015	0.00028	1.2	0.0046	0.0049	0.00052	0.000049	0.0015	0.65	0.000019	0.32	0.00000097	0.058	0.021	0.24	0.0000024	0.00013	0.000087	0.0035	0.00012	0.00049	0.00097
28-Jan-15	31	500	485	7.7	0.0034	0.0000049	0.00025	1.3	0.0039	0.0049	0.00049	0.000049	0.0015	0.67	0.000039	0.34	0.00000097	0.078	0.017	0.53	0.0000029	0.000058	0.000029	0.0035	0.00013	0.00049	0.00097
4-Feb-15	32	500	485	7.8	0.0034	0.0000097	0.00029	1.2	0.0042	0.0049	0.00042	0.000049	0.0015	0.64	0.000019	0.32	0.00000097	0.068	0.022	0.49	0.0000024	0.00012	0.000068	0.0030	0.00011	0.00049	0.00097
11-Feb-15	33	500	475	7.7	0.0033	0.0000048	0.00023	1.0	0.0043	0.0048	0.00038	0.000048	0.0014	0.57	0.00048	0.28	0.00000095	0.052	0.018	0.24	0.0000029	0.00021	0.00016	0.0026	0.00012	0.00048	0.00095
18-Feb-15	34	500	500	7.7	0.0035	0.0000050	0.00032	1.3	0.0040	0.0050	0.00038	0.000050	0.0015	0.69	0.00050	0.35	0.0000010	0.060	0.024	0.35	0.0000040	0.000065	0.000030	0.0036	0.00013	0.00050	0.0010
25-Feb-15	35	500	480	7.8	0.0034	0.0000096	0.00030	1.4	0.0036	0.0048	0.00040	0.000048	0.0014	0.82	0.00048	0.34	0.00000096	0.067	0.025	0.34	0.0000038	0.000053	0.000024	0.0040	0.00012	0.00048	0.00096
4-Mar-15	36	500	490	7.7	0.0034	0.0000049	0.00026	1.1	0.0038	0.0049	0.00031	0.000049	0.0015	0.61	0.00049	0.33	0.00000098	0.054	0.019	0.44	0.0000025	0.000015	0.000044	0.0032	0.00011	0.00049	0.00098
11-Mar-15	37	500	485	7.7	0.0049	0.000049	0.00024	0.96	0.0040	0.0049	0.00029	0.000049	0.0015	0.50	0.00049	0.24	0.00000097	0.034	0.018	0.049	0.0000024	0.00028	0.000044	0.0028	0.000097	0.0058	0.00097
18-Mar-15	38	500	490	7.7	0.0034	0.0000049	0.00023	0.94	0.0046	0.0049	0.00027	0.000049	0.0015	0.53	0.00049	0.25	0.00000098	0.039	0.017	0.44	0.0000025	0.00020	0.00010	0.0025	0.000078	0.00049	0.00098
25-Mar-15	39	500	490	7.7	0.0034	0.0000049	0.00016	0.98	0.0043	0.0049	0.00028	0.000049	0.0015	0.51	0.00049	0.24	0.00000098	0.064	0.017	0.34	0.0000025	0.00024	0.000039	0.0025	0.00012	0.00049	0.00098
1-Apr-15	40	500	485	7.9	0.0034	0.0000049	0.00015	0.76	0.0080	0.0049	0.00020	0.000049	0.0015	0.44	0.00049	0.15	0.00000097	0.33	0.014	0.049	0.0000024	0.00023	0.000024	0.0030	0.000068	0.00049	0.00097
8-Apr-15	41	500	485	7.6	0.0034	0.0000049	0.00018	0.79	0.0041	0.0049	0.00024	0.000049	0.0015	0.45	0.00049	0.26	0.00000097	0.034	0.015	0.049	0.0000024	0.00019	0.000024	0.0022	0.000087	0.00049	0.00097
15-Apr-15	42	500	475	7.7	0.0033	0.0000048	0.00024	1.0	0.0043	0.0048	0.00029	0.000048	0.0014	0.58	0.00048	0.28	0.00000095	0.048	0.019	0.33	0.0000024	0.00047	0.000057	0.0031	0.00012	0.00048	0.00095
22-Apr-15	43	500	505	7.8	0.0035	0.000030	0.00028	1.2	0.0045	0.0051	0.00034	0.000051	0.0015	0.69	0.00051	0.36	0.0000020	0.056	0.022	0.30	0.0000066	0.00018	0.000025	0.0038	0.00014	0.00051	0.0010
29-Apr-15	44	500	495	7.8	0.0035	0.0000099	0.00027	1.3	0.0050	0.0050	0.00038	0.000050	0.0015	0.77	0.00050	0.34	0.00000099	0.045	0.023	0.40	0.0000025	0.00019	0.000040	0.0038	0.00013	0.00050	0.00099
6-May-15	45	500	495	7.7	0.0035	0.0000050	0.00027	1.1	0.0047	0.0050	0.00032	0.000050	0.0015	0.66	0.00050	0.35	0.00000099	0.045	0.020	0.35	0.0000025	0.00027	0.000050	0.0034	0.00012	0.00050	0.00099
13-May-15	46	500	495																								
20-May-15	47	495	480																								
27-May-15	48	480	475																								
3-Jun-15	49	475	475	8.0	0.00083	0.0000012	0.00016	0.86	0.0014	0.0012	0.00026	0.000024	0.00036	0.42	0.0000048	0.25	0.00000024	0.030	0.015	0.21	0.0000012	0.000045	0.000011	0.0026	0.000037	0.00012	0.00024
10-Jun-15	50	500	490																								
17-Jun-15	51	490	482																								
24-Jun-15	52	480	450																								
1-Jul-15	53	450	445	8.0	0.00078	0.0000011	0.00014	0.81	0.0019	0.0011	0.00022	0.000022	0.00033	0.32	0.0000089	0.21	0.00000022	0.029	0.015	0.18	0.0000014	0.00010	0.0000056	0.0026	0.000030	0.00011	0.00022
8-Jul-15	54	500	485																								
15-Jul-15	55	485	470																								
22-Jul-15	56	470	455																								
29-Jul-15	57	455	445	8.0	0.00078	0.0000011	0.00014	0.85	0.0020	0.0011	0.00015	0.000022	0.00033	0.32	0.0000067	0.20	0.0000014	0.028	0.016	0.18	0.00000056	0.000047	0.0000056	0.0013	0.000020	0.00011	0.00022
5-Aug-15	58	500	490																								
12-Aug-15	59	490	475																								
19-Aug-15	60	475	465																								
26-Aug-15	61	465	445	8.1	0.00078	0.000012	0.00013	0.82	0.0019	0.0011	0.00024	0.000022	0.00033	0.33	0.0000078	0.25	0.00000022	0.024	0.015	0.18	0.0000017	0.00011	0.0000056	0.0027	0.000032	0.00022	0.00022
2-Sep-15	62	500	500																								
9-Sep-15	63	500	480																								
16-Sep-15	64	480	465																								
23-Sep-15	65	465	465	8.1	0.00081	0.0000012	0.00014	0.88	0.0015	0.0012	0.00018	0.000023	0.00035	0.36	0.0000093	0.22	0.0000017	0.028	0.016	0.20	0.00000093	0.000094	0.0000081	0.0023	0.000027	0.00012	0.00023
30-Sep-15	66	500	495																								
7-Oct-15	67	495	475																								
14-Oct-15	68	475	470																								
21-Oct-15	69	470	455	8.1	0.00080	0.0000023	0.00012	0.77	0.0016	0.0011	0.00014	0.000023	0.00034	0.31	0.000010	0.19	0.0000027	0.028	0.013	0.15	0.0000016	0.00014	0.0000057	0.0022	0.000022	0.00011	0.00023
28-Oct-15	70	500	490																								
4-Nov-15	71	490	480																								
11-Nov-15	72	480	470																								
18-Nov-15	73	470	455	8.1	0.0025	0.0000011	0.000094	0.66	0.0018	0.0011	0.00025	0.000011	0.00034	0.27	0.000020	0.15	0.00000023	0.024	0.011	0.10	0.0000018	0.00013	0.0000057	0.0018	0.000023	0.00011	0.00023
25-Nov-15	74	500	490	7.9	0.0034	0.0000098	0.00027	1.3	0.0041	0.0049	0.00040	0.000049	0.0015	0.73	0.00014	0.35	0.000068	0.059	0.024	0.25	0.0000025	0.00023	0.000025	0.0047	0.00013	0.00049	0.00098
2-Dec-15	75	500	490	8.0	0.0034	0.000015	0.00029	1.9	0.0044	0.0049	0.00043	0.000049	0.0015	0.95	0.000020	0.47	0.00000098	0.059	0.030	0.39	0.0000025	0.00020	0.000039	0.0055	0.00012	0.00049	0.00098
9-Dec-15	76	500	495	7.9	0.0035	0.0000050	0.00027	1.3	0.0031	0.0050	0.00031	0.000050	0.0015	0.73	0.000025	0.34	0.0000020	0.040	0.024	0.15	0.0000099	0.00020	0.000069	0.0044	0.00012	0.00050	0.00099
16-Dec-15	77	500	495	8.1	0.0035	0.000064	0.00032	1.6	0.0037	0.0050	0.00029	0.000050	0.0059	0.88	0.000020	0.44	0.00000099	0.050	0.028	0.099	0.0000035	0.00032	0.000069	0.0052	0.00014	0.00050	0.00099
23-Dec-15	78	500	485	8.1	0.0034	0.000035	0.00027	1.4	0.0034	0.0049	0.00023	0.000049	0.0037	0.72	0.000020	0.35	0.00000099	0.049	0.024	0.25	0.0000030	0.00021	0.000064	0.0043	0.00012	0.00049	0.00099
30-Dec-15	79	500	490	7.8	0.0034	0.0000049	0.00023	1.1	0.0030	0.0049	0.00017	0.000049	0.0015	0.57	0.000020	0.25	0.00000098	0.049	0.019	0.39	0.0000025	0.00011	0.000059	0.0034	0.000093	0.00049	0.00098
6-Jan-16	80	500	490	7.6	0.0034	0.0000074	0.00020	1.1	0.0031	0.0049	0.00021	0.000049	0.0015	0.58	0.000042	0.26	0.00000099	0.039	0.019	0.22	0.0000025	0.00012	0.000059	0.0032	0.000084	0.00049	0.00099
13-Jan-16	81	500	495	7.6	0.0035	0.0000099	0.00018	1.0	0.0031	0.0050	0.00024	0.000050	0.0015	0.58	0.000064	0.27	0.00000099	0.030	0.018	0.050	0.0000025	0.00014	0.000059	0.0030	0.000074	0.00050	0.00099
20-Jan-16	82	500	495	7.8	0.0035	0.0000074	0.00020	1.1	0.0034	0.0050	0.00021	0.000050	0.0015	0.60	0.000042	0.29	0.00000099	0.032	0.020	0.050	0.0000025	0.00019	0.000057	0.0035	0.000082	0.00050	0.00099
27-Jan-16	83	500	495	7.8	0.0035	0.0000050	0.00022	1.2	0.0036	0.0050	0.00018	0.000050	0.0015	0.61	0.000020	0.31	0.00000099	0.035	0.022	0.050	0.0000025	0.00024	0.000054	0.0040	0.000089	0.00050	0.00099
3-Feb-16	84	500	495	7.8	0.0034	0.0000049	0.00021	1.2	0.0039	0.0049	0.00018	0.000049	0.0015	0.60	0.000027	0.30	0.00000098	0.041	0.022	0.17	0.0000029	0.00020	0.000061	0.0036	0.000083	0.00049	0.00098
10-Feb-16	85	500	480	7.7	0.0034	0.0000048	0.00020	1.2	0.0041	0.0048	0.00018	0.000048	0.0014	0.59	0.000034	0.28	0.00000096	0.048	0.022	0.29	0.0000034	0.00016	0.000067	0.0033	0.000077	0.00048	0.00096
17-Feb-16	86	500	505	7.7	0.0034	0.0000048	0.00022	1.2	0.0037	0.0048	0.00019	0.000048	0.0014	0.62	0.000026	0.25	0.00000096	0.036	0.022	0.26	0.0000029	0.00015	0.000067	0.0035	0.000079	0.00048	0.00096
24-Feb-16	87	500	480	7.8	0.0034	0.0000048	0.00023	1.3	0.0033	0.0048	0.00020	0.000048	0.0014	0.66	0.000019	0.23	0.00000096	0.024	0.022	0.24	0.0000024	0.00014	0.000067	0.0038	0.000082	0.00048	0.00096

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC5 (OKY Master)

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	mgCaCO3/L	mgCaCO3/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mgCaCO3/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
6-May-15	0	500	290	7.5	232	#N/A	4.4	26	57	5.0	0.23	< 0.3	28	0.14	0.010	0.093	0.0064	0.000028	< 0.000007	0.075	0.000019	7.9	< 0.00003	0.0026	0.0029
13-May-15	1	500	485	7.6	70	#N/A	5.0	17	10	1.0	0.54	< 0.3	3.2	0.50	0.015	0.24	0.0050	0.000037	0.000013	0.053	< 0.000003	0.87	0.000050	0.00049	0.0017
20-May-15	2	500	495	7.4	35	#N/A	3.5	9.7	3.0	1.0	0.82	< 0.3	1.0	0.20	0.011	0.29	0.0018	0.000018	< 0.000007	0.022	< 0.000003	0.28	< 0.00003	0.00014	0.0010
27-May-15	3	500	435	7.3	31	#N/A	2.5	9.2	4.0	1.0	0.72	< 0.3	1.1	0.24	0.010	0.27	0.0018	0.000012	< 0.000007	0.019	< 0.000003	0.29	< 0.00003	0.00012	0.00037
3-Jun-15	4	500	520	7.4	25	#N/A	2.8	7.7	2.0	< 1	0.70	< 0.3	0.87	0.37	0.0078	0.29	0.0029	0.000019	< 0.000007	0.011	0.0000040	0.24	< 0.00003	0.00010	0.00048
10-Jun-15	5	500	495	7.3	23	#N/A	3.0	8.2	3.0	< 1	0.55	< 0.3	0.74	0.052	0.0059	0.27	0.00060	< 0.000007	< 0.000007	0.013	< 0.000003	0.21	< 0.00003	0.000096	0.00089
17-Jun-15	6	500	490	7.4	19	#N/A	3.0	7.3	3.0	< 1	0.41	< 0.3	0.78	0.28	0.0056	0.30	0.0025	0.000019	< 0.000007	0.014	0.0000060	0.22	< 0.00003	0.00011	0.00047
24-Jun-15	7	500	490	7.2	19	#N/A	3.2	5.8	< 2	< 1	0.40	< 0.3	0.76	0.20	0.0053	0.27	0.0015	0.000015	< 0.000007	0.0083	< 0.000003	0.20	< 0.00003	0.00011	0.00029
1-Jul-15	8	500	480	7.6	16	#N/A	3.1	6.5	< 2	< 1	0.33	< 0.3	0.72	0.21	0.0044	0.25	0.0017	0.000015	< 0.000007	0.0049	< 0.000003	0.19	0.000040	0.00010	0.00074
8-Jul-15	9	500	495	7.5	15	#N/A	2.6	5.8	3.0	< 1	0.33	< 0.3	0.70	0.046	0.0039	0.22	0.00049	< 0.000007	< 0.000007	0.0065	< 0.000003	0.20	< 0.00003	0.000091	0.00032
15-Jul-15	10	500	490	7.2	12	#N/A	3.4	5.1	2.0	< 1	0.25	< 0.3	0.61	0.088	0.0032	0.22	0.00072	< 0.000007	< 0.000007	0.0093	< 0.000003	0.16	0.000030	0.000096	0.00052
22-Jul-15	11	500	495	7.0	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	12	500	495	7.3	12	#N/A	2.3	5.1	< 2	< 1	0.18	< 0.3	0.59	0.031	0.0026	0.17	0.00032	0.0000070	< 0.000007	0.0038	< 0.000003	0.16	< 0.00003	0.000073	0.00075
5-Aug-15	13	500	490	6.9	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	14	500	495	6.8	10	#N/A	1.7	3.9	< 2	< 1	0.15	< 0.3	0.76	0.088	0.0022	0.14	0.00067	< 0.000007	0.0000070	0.0090	< 0.000003	0.20	0.000030	0.000090	0.00028
19-Aug-15	15	500	475	7.0	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	16	500	515	7.4	11	#N/A	2.6	4.6	2.0	< 1	0.12	< 0.3	0.88	0.068	0.0020	0.11	0.00050	< 0.000007	< 0.000007	0.0032	0.0000060	0.24	< 0.00003	0.00011	0.00012
2-Sep-15	17	500	490	7.0	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	18	500	500	7.0	10	#N/A	1.9	3.4	< 2	< 1	0.11	< 0.3	0.87	0.034	0.0016	0.100	0.00033	< 0.000007	< 0.000007	0.0040	< 0.000003	0.24	0.000040	0.000092	0.00044
16-Sep-15	19	500	495	6.9	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	20	500	500	7.1	8.0	#N/A	1.5	3.8	< 2		0.060		0.85	0.020	0.0012	0.065	0.00024	< 0.000007	< 0.000007	0.0022	0.000018	0.23	< 0.00003	0.000079	0.000070
30-Sep-15	21	500	490	6.9	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	22	500	495	7.4	10	#N/A	2.0	5.2	< 2		0.070		1.5	0.041	0.0014	0.052	0.00040	< 0.000007	< 0.000007	0.0027	< 0.000003	0.42	0.000040	0.00011	0.00042
14-Oct-15	23	500	500	7.1	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	24	500	505	7.3	7.0	#N/A	0.80	4.0	2.0		0.070		1.1	0.029	0.0011	0.054	0.00090	< 0.000007	< 0.000007	0.0023	< 0.000003	0.29	< 0.00003	0.00011	0.00040
28-Oct-15	25	500	490	7.3	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	26	500	475	7.3	8.0	#N/A	1.2	4.4	2.0		< 0.06		1.1	0.046	0.0011	0.049	0.00044	< 0.000007	< 0.000007	0.0042	0.0000050	0.30	< 0.00003	0.00011	0.00043
11-Nov-15	27	500	500	7.3	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	28	500	500	7.2	8.0	#N/A	1.4	4.7	2.0		< 0.06		1.1	0.019	0.0010	0.045	0.00021	< 0.000007	< 0.000007	0.00050	< 0.000003	0.31	0.000040	0.00012	0.00048
25-Nov-15	29	500	490	7.1	9.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	30	500	490	6.8	8.0	#N/A	3.0	4.0	2.0		0.070		1.2	0.11	0.0011	0.059	0.00090	< 0.000007	< 0.000007	0.0010	< 0.000003	0.34	< 0.00003	0.00012	0.00015
9-Dec-15	31	500	490	7.3	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	32	500	495	7.3	7.0	#N/A	3.2	3.5	2.0		< 0.06		1.4	0.056	0.00090	0.058	0.00075	0.000017	0.000012	0.0020	0.000030	0.39	0.00024	0.00014	0.00052
23-Dec-15	33	500	490	7.9	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	34	500	505	6.7	4.0	#N/A	2.3	3.6	2.0		< 0.06		1.1	0.040	0.00080	0.045	0.00043	< 0.000007	< 0.000007	0.0016	< 0.000003	0.31	0.000060	0.000094	0.0015
6-Jan-16	35	500	485	6.6	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	36	500	490	6.4	5.0	#N/A	2.4	2.7	2.0		< 0.06		1.2	0.024	0.00060	0.025	0.00036	< 0.000007	< 0.000007	< 0.002	< 0.000003	0.33	< 0.00003	0.000096	0.00044
20-Jan-16	37	500	485	7.3	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	38	500	505	7.2	6.0	#N/A	3.3	3.5	2.0		< 0.06		1.1	0.014	0.00060	0.029	0.00064	< 0.000007	< 0.000007	< 0.002	0.000023	0.30	< 0.00003	0.00013	0.00058
3-Feb-16	39	500	480	7.2	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	40	500	505	6.6	5.0	#N/A	2.5	3.0	2.0		< 0.06		0.98	0.0063	0.00050	0.026	0.00017	< 0.000007	< 0.000007	< 0.002	< 0.000003	0.27	0.000040	0.000097	0.00080
17-Feb-16	41	500	490	7.5	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	42	500	490	6.9	4.0	#N/A	2.4	3.3	< 2		< 0.06		1.2	0.0071	0.00060	0.029	0.00031	< 0.000007	< 0.000007	< 0.002	0.0000050	0.32	< 0.00003	0.00010	0.000060
2-Mar-16	43	500	495	6.7	6.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	44	500	495	6.9	6.0	#N/A	3.3	4.5	< 2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC5 (OKY Master)

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	mgCaCO3/kg/wk	mgCaCO3/kg/wk	mgCaCO3/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO3/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
6-May-15	0	500	290	7.5	232	#N/A	1.3	7.5	17	1.5	0.067	0.087	8.0	0.039	0.0030	0.027	0.0019	0.0000081	0.0000020	0.022	0.0000055	2.3	0.0000087	0.00074	0.00083
13-May-15	1	500	485	7.6	70	#N/A	2.4	8.2	4.9	0.49	0.26	0.15	1.6	0.24	0.0071	0.12	0.0024	0.000018	0.0000063	0.025	0.0000015	0.42	0.000024	0.00024	0.00082
20-May-15	2	500	495	7.4	35	#N/A	1.8	4.8	1.5	0.50	0.41	0.15	0.50	0.098	0.0052	0.14	0.00091	0.0000089	0.0000035	0.011	0.0000015	0.14	0.000015	0.000070	0.00051
27-May-15	3	500	435	7.3	31	#N/A	1.1	4.0	1.7	0.44	0.31	0.13	0.48	0.10	0.0044	0.12	0.00078	0.0000052	0.0000030	0.0081	0.0000013	0.13	0.000013	0.000053	0.00016
3-Jun-15	4	500	520	7.4	25	#N/A	1.4	4.0	1.0	0.52	0.36	0.16	0.45	0.19	0.0041	0.15	0.0015	0.0000099	0.0000036	0.0059	0.0000021	0.12	0.000016	0.000053	0.00025
10-Jun-15	5	500	495	7.3	23	#N/A	1.5	4.0	1.5	0.50	0.27	0.15	0.37	0.026	0.0029	0.13	0.00030	0.0000035	0.0000035	0.0063	0.0000015	0.10	0.000015	0.000048	0.00044
17-Jun-15	6	500	490	7.4	19	#N/A	1.5	3.6	1.5	0.49	0.20	0.15	0.38	0.14	0.0027	0.15	0.0012	0.0000093	0.0000034	0.0069	0.0000029	0.11	0.000015	0.000055	0.00023
24-Jun-15	7	500	490	7.2	19	#N/A	1.6	2.8	0.98	0.49	0.20	0.15	0.37	0.098	0.0026	0.13	0.00073	0.0000074	0.0000034	0.0041	0.0000015	0.098	0.000015	0.000052	0.00014
1-Jul-15	8	500	480	7.6	16	#N/A	1.5	3.1	0.96	0.48	0.16	0.14	0.35	0.10	0.0021	0.12	0.00080	0.0000072	0.0000034	0.0024	0.0000014	0.091	0.000019	0.000049	0.00036
8-Jul-15	9	500	495	7.5	15	#N/A	1.3	2.9	1.5	0.50	0.16	0.15	0.35	0.023	0.0019	0.11	0.00024	0.0000035	0.0000035	0.0032	0.0000015	0.099	0.000015	0.000045	0.00016
15-Jul-15	10	500	490	7.2	12	#N/A	1.7	2.5	0.98	0.49	0.12	0.15	0.30	0.043	0.0016	0.11	0.00035	0.0000034	0.0000034	0.0046	0.0000015	0.078	0.000015	0.000047	0.00025
22-Jul-15	11	500	495	7.0	12	#N/A	1.4	2.5	0.99	0.49	0.11	0.15	0.30	0.029	0.0014	0.095	0.00026	0.0000034	0.0000034	0.0032	0.0000015	0.079	0.000015	0.000042	0.00031
29-Jul-15	12	500	495	7.3	12	#N/A	1.1	2.5	0.99	0.50	0.089	0.15	0.29	0.015	0.0013	0.082	0.00016	0.0000035	0.0000035	0.0019	0.0000015	0.079	0.000015	0.000036	0.00037
5-Aug-15	13	500	490	6.9	11	#N/A	0.99	2.2	0.99	0.50	0.082	0.15	0.33	0.029	0.0012	0.076	0.00025	0.0000035	0.0000035	0.0032	0.0000015	0.089	0.000015	0.000040	0.00025
12-Aug-15	14	500	495	6.8	10	#N/A	0.85	1.9	0.99	0.50	0.074	0.15	0.38	0.043	0.0011	0.070	0.00033	0.0000035	0.0000035	0.0045	0.0000015	0.099	0.000015	0.000045	0.00014
19-Aug-15	15	500	475	7.0	10	#N/A	1.1	2.1	1.0	0.51	0.068	0.15	0.41	0.039	0.0011	0.064	0.00029	0.0000035	0.0000035	0.0031	0.0000023	0.11	0.000015	0.000050	0.00010
26-Aug-15	16	500	515	7.4	11	#N/A	1.3	2.4	1.0	0.52	0.062	0.15	0.45	0.035	0.0010	0.059	0.00026	0.0000036	0.0000036	0.0016	0.0000031	0.12	0.000015	0.000055	0.000062
2-Sep-15	17	500	490	7.0	10	#N/A	1.1	2.0	1.0	0.51	0.058	0.15	0.44	0.026	0.00092	0.054	0.00021	0.0000036	0.0000036	0.0018	0.0000023	0.12	0.000018	0.000050	0.00014
9-Sep-15	18	500	500	7.0	10	#N/A	0.95	1.7	1.0	0.50	0.055	0.15	0.44	0.017	0.00080	0.050	0.00017	0.0000035	0.0000035	0.0020	0.0000015	0.12	0.000020	0.000046	0.00022
16-Sep-15	19	500	495	6.9	9.7	#N/A	0.84	1.8	1.0	0.25	0.043	0.075	0.43	0.014	0.00070	0.041	0.00014	0.0000035	0.0000035	0.0016	0.0000053	0.12	0.000018	0.000043	0.00013
23-Sep-15	20	500	500	7.1	8.0	#N/A	0.74	1.9	1.0	0.00	0.030	0.00	0.43	0.010	0.00060	0.033	0.00012	0.0000035	0.0000035	0.0011	0.0000090	0.12	0.000015	0.000040	0.000035
30-Sep-15	21	500	490	6.9	4.9	#N/A	0.86	2.2	1.00	0.00	0.032	0.00	0.58	0.015	0.00065	0.029	0.00016	0.0000035	0.0000035	0.0012	0.0000052	0.16	0.000017	0.000047	0.00012
7-Oct-15	22	500	495	7.4	10	#N/A	0.98	2.6	0.99	0.00	0.035	0.00	0.74	0.020	0.00069	0.026	0.00020	0.0000035	0.0000035	0.0013	0.0000015	0.21	0.000020	0.000055	0.00021
14-Oct-15	23	500	500	7.1	7.8	#N/A	0.68	2.3	1.0	0.00	0.035	0.00	0.65	0.017	0.00062	0.026	0.00033	0.0000035	0.0000035	0.0012	0.0000015	0.18	0.000017	0.000057	0.00020
21-Oct-15	24	500	505	7.3	7.1	#N/A	0.38	2.0	1.0	0.00	0.035	0.00	0.56	0.015	0.00056	0.027	0.00045	0.0000035	0.0000035	0.0012	0.0000015	0.15	0.000015	0.000058	0.00020
28-Oct-15	25	500	490	7.3	8.4	#N/A	0.47	2.1	0.98	0.00	0.032	0.00	0.54	0.018	0.00054	0.025	0.00033	0.0000034	0.0000034	0.0016	0.0000019	0.14	0.000015	0.000056	0.00020
4-Nov-15	26	500	475	7.3	8.0	#N/A	0.55	2.1	0.95	0.00	0.029	0.00	0.52	0.022	0.00052	0.023	0.00021	0.0000033	0.0000033	0.0020	0.0000024	0.14	0.000014	0.000054	0.00020
11-Nov-15	27	500	500	7.3	5.8	#N/A	0.62	2.2	0.98	0.00	0.029	0.00	0.53	0.016	0.00051	0.023	0.00016	0.0000034	0.0000034	0.0011	0.0000019	0.15	0.000017	0.000057	0.00022
18-Nov-15	28	500	500	7.2	7.8	#N/A	0.69	2.3	1.0	0.00	0.030	0.00	0.55	0.0095	0.00050	0.022	0.00011	0.0000035	0.0000035	0.00025	0.0000015	0.16	0.000020	0.000061	0.00024
25-Nov-15	29	500	490	7.1	8.7	#N/A	1.1	2.1	0.99	0.00	0.032	0.00	0.57	0.033	0.00052	0.026	0.00027	0.0000035	0.0000035	0.00037	0.0000015	0.16	0.000017	0.000060	0.00016
2-Dec-15	30	500	490	6.8	7.5	#N/A	1.5	2.0	0.98	0.00	0.034	0.00	0.59	0.056	0.00054	0.029	0.00044	0.0000034	0.0000034	0.00049	0.0000015	0.17	0.000015	0.000059	0.000074
9-Dec-15	31	500	490	7.3	5.3	#N/A	1.5	1.9	0.99	0.00	0.032	0.00	0.64	0.042	0.00049	0.029	0.00041	0.0000059	0.0000047	0.00074	0.0000082	0.18	0.000067	0.000064	0.00017
16-Dec-15	32	500	495	7.3	6.6	#N/A	1.6	1.7	0.99	0.00	0.030	0.00	0.69	0.028	0.00045	0.029	0.00037	0.0000084	0.0000059	0.00099	0.000015	0.19	0.00012	0.000068	0.00026
23-Dec-15	33	500	490	7.9	4.5	#N/A	1.4	1.8	1.0	0.00	0.030	0.00	0.62	0.024	0.00042	0.026	0.00029	0.0000060	0.0000047	0.00090	0.0000082	0.17	0.000075	0.000058	0.00051
30-Dec-15	34	500	505	6.7	4.5	#N/A	1.1	1.8	1.0	0.00	0.030	0.00	0.56	0.020	0.00040	0.023	0.00022	0.0000035	0.0000035	0.00081	0.0000015	0.16	0.000030	0.000047	0.00076
6-Jan-16	35	500	485	6.6	6.5	#N/A	1.2	1.6	1.00	0.00	0.030	0.00	0.57	0.016	0.00035	0.017	0.00020	0.0000035	0.0000035	0.00089	0.0000015	0.16	0.000023	0.000047	0.00049
13-Jan-16	36	500	490	6.4	5.2	#N/A	1.2	1.3	0.98	0.00	0.029	0.00	0.58	0.012	0.00029	0.012	0.00018	0.0000034	0.0000034	0.00098	0.0000015	0.16	0.000015	0.000047	0.00022
20-Jan-16	37	500	485	7.3	8.0	#N/A	1.4	1.5	1.00	0.00	0.030	0.00	0.57	0.0095	0.00030	0.013	0.00025	0.0000035	0.0000035	0.00100	0.0000065	0.16	0.000015	0.000057	0.00025
27-Jan-16	38	500	505	7.2	5.8	#N/A	1.7	1.7	1.0	0.00	0.030	0.00	0.56	0.0072	0.00030	0.015	0.00032	0.0000035	0.0000035	0.0010	0.000012	0.15	0.000015	0.000067	0.00029
3-Feb-16	39	500	480	7.2	2.7	#N/A	1.5	1.6	1.0	0.00	0.030	0.00	0.53	0.0052	0.00028	0.014	0.00020	0.0000035	0.0000035	0.0010	0.0000066	0.14	0.000018	0.000058	0.00035
10-Feb-16	40	500	505	6.6	4.6	#N/A	1.3	1.5	1.0	0.00	0.030	0.00	0.49	0.0032	0.00025	0.013	0.000086	0.0000035	0.0000035	0.0010	0.0000015	0.14	0.000020	0.000049	0.00040
17-Feb-16	41	500	490	7.5	4.5	#N/A	1.2	1.6	1.00	0.00	0.030	0.00	0.54	0.0033	0.00027	0.014	0.00012	0.0000035	0.0000035	0.00100	0.0000020	0.15	0.000017	0.000049	0.00022
24-Feb-16	42	500	490	6.9	3.6	#N/A	1.2	1.6	0.98	0.00	0.029	0.00	0.59	0.0035	0.00029	0.014	0.00015	0.0000034	0.0000034	0.00098	0.0000025	0.16	0.000015	0.000050	0.000029

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC5 (OKY Master)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
6-May-15	0	500	290	7.5	0.042	0.00041	0.0086	1.9	0.27	0.040	0.0012	0.00060	0.022	9.5	< 0.001	11	0.000046	28	0.034	20	0.000085	0.000080	0.0018	0.00074	0.00021	0.019	< 0.002
13-May-15	1	500	485	7.6	0.26	0.0023	0.0032	0.26	0.082	0.020	0.0044	0.00020	0.036	4.2	< 0.001	11	0.000011	11	0.0048	2.7	0.000037	0.000070	0.0068	0.0010	0.00039	0.0040	< 0.002
20-May-15	2	500	495	7.4	0.098	0.0012	0.0016	0.082	0.031	0.010	0.0066	< 0.0001	0.044	2.3	0.000050	9.4	0.0000030	5.1	0.0015	1.6	0.000016	0.00011	0.0024	0.00086	0.00028	0.0010	< 0.002
27-May-15	3	500	435	7.3	0.11	0.00062	0.0014	0.083	0.030	< 0.01	0.0058	< 0.0001	0.038	2.1	< 0.001	11	0.0000040	4.8	0.0015	0.90	0.000010	0.00013	0.0037	0.00038	0.00032	0.0020	< 0.002
3-Jun-15	4	500	520	7.4	0.17	0.0012	0.0012	0.067	0.026	< 0.01	0.0060	< 0.0001	0.046	2.0	< 0.00004	8.7	0.000011	3.7	0.0015	1.1	0.000012	< 0.00001	0.0060	0.00053	0.00038	0.0010	< 0.002
10-Jun-15	5	500	495	7.3	0.026	0.00044	0.0010	0.052	0.024	< 0.01	0.0050	< 0.0001	0.038	1.9	0.000060	7.2	< 0.000002	3.1	0.00087	0.90	0.0000070	0.000080	0.00071	0.00030	0.00022	0.0020	< 0.002
17-Jun-15	6	500	490	7.4	0.15	0.0011	0.0010	0.057	0.026	< 0.01	0.0048	< 0.0001	0.048	1.8	0.000050	7.4	0.0000030	2.5	0.0011	1.0	0.000017	0.000040	0.0048	0.00073	0.00031	0.0020	< 0.002
24-Jun-15	7	500	490	7.2	0.095	0.00066	0.00098	0.062	0.027	< 0.01	0.0033	< 0.0001	0.037	1.9	< 0.00004	6.9	0.0000030	2.4	0.0012	0.80	0.000011	0.000060	0.0031	0.00033	0.00027	0.0010	< 0.002
1-Jul-15	8	500	480	7.6	0.11	0.00072	0.00091	0.057	0.025	0.020	0.0030	< 0.0001	0.032	1.7	< 0.00004	6.7	0.0000050	1.9	0.0012	0.60	0.000011	0.00013	0.0026	0.00045	0.00028	0.0020	< 0.002
8-Jul-15	9	500	495	7.5	0.025	0.00029	0.00080	0.051	0.024	< 0.01	0.0024	< 0.0001	0.026	1.6	0.000060	7.0	0.0000040	1.6	0.00098	1.2	0.000013	0.000040	0.00054	0.00019	0.00016	< 0.001	< 0.002
15-Jul-15	10	500	490	7.2	0.035	0.00023	0.00089	0.051	0.023	< 0.01	0.0029	< 0.0001	0.023	1.4	< 0.00004	5.7	< 0.000002	1.5	0.00091	0.20	0.0000090	0.00014	0.00075	0.00086	0.00021	0.0010	< 0.002
22-Jul-15	11	500	495	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	12	500	495	7.3	0.011	0.000080	0.00078	0.047	0.023	< 0.01	0.0017	< 0.0001	0.024	1.5	< 0.00004	4.9	0.000015	1.0	0.00087	0.50	< 0.000005	0.000050	0.00017	0.0022	0.00017	0.0010	< 0.002
5-Aug-15	13	500	490	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	14	500	495	6.8	0.033	0.00021	0.00070	0.060	0.028	< 0.01	0.0023	< 0.0001	0.022	1.7	< 0.00004	4.9	< 0.000002	0.87	0.0011	0.50	0.000017	0.000040	0.0015	0.0012	0.00018	0.0010	< 0.002
19-Aug-15	15	500	475	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	16	500	515	7.4	0.023	0.00023	0.00075	0.068	0.034	< 0.01	0.0013	< 0.0001	0.016	1.7	< 0.00004	4.4	< 0.000002	0.61	0.0012	0.70	0.0000090	< 0.00001	0.00036	0.00038	0.00014	< 0.001	< 0.002
2-Sep-15	17	500	490	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	18	500	500	7.0	0.011	0.000080	0.00068	0.067	0.032	< 0.01	0.0029	< 0.0001	0.013	1.6	< 0.00004	3.5	0.0000020	0.60	0.0010	3.3	0.000013	0.00016	0.00035	0.0012	0.00016	< 0.001	< 0.002
16-Sep-15	19	500	495	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	20	500	500	7.1	0.0080	0.000040	0.00056	0.064	0.032	< 0.01	0.00070	< 0.0001	0.0050	1.4	< 0.00004	2.8	0.000013	0.38	0.0010	0.50	0.0000070	< 0.00001	0.00025	0.00055	0.000090	< 0.001	< 0.002
30-Sep-15	21	500	490	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	22	500	495	7.4	0.013	0.00010	0.00061	0.10	0.047	< 0.01	0.0024	< 0.0001	0.0090	1.5	< 0.00004	3.4	< 0.000002	0.46	0.0016	0.40	0.0000060	0.000080	0.00033	0.0029	0.00010	< 0.001	< 0.002
14-Oct-15	23	500	500	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	24	500	505	7.3	0.012	0.000090	0.00055	0.080	0.040	< 0.01	0.0036	< 0.0001	0.0090	1.4	0.000040	3.1	0.000019	0.35	0.0015	0.40	0.000010	0.000060	0.00046	0.00045	0.00010	< 0.001	< 0.002
28-Oct-15	25	500	490	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	26	500	475	7.3	0.018	0.00011	0.00048	0.083	0.042	< 0.01	0.013	< 0.0001	0.0040	1.4	< 0.00004	2.9	< 0.000002	0.31	0.0014	0.30	0.0000050	0.000050	0.00061	0.00018	0.00014	0.0010	< 0.002
11-Nov-15	27	500	500	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	28	500	500	7.2	0.033	0.000030	0.00044	0.084	0.042	< 0.01	0.0013	< 0.0001	< 0.003	1.2	0.00013	2.8	< 0.000002	0.30	0.0016	0.20	0.0000080	0.000080	0.00049	0.00032	0.000080	0.0020	< 0.002
25-Nov-15	29	500	490	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	30	500	490	6.8	0.047	0.00019	0.00047	0.097	0.049	< 0.01	0.00065	< 0.0001	0.0050	1.5	< 0.00004	3.2	< 0.000002	0.30	0.0016	0.70	< 0.000005	< 0.00001	0.00079	0.00033	0.00013	< 0.001	< 0.002
9-Dec-15	31	500	490	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	32	500	495	7.3	0.023	0.00024	0.00053	0.12	0.046	< 0.01	0.00054	0.00010	0.010	1.3	0.00012	2.8	0.000019	0.26	0.0022	0.50	0.0000016	0.00012	0.00034	0.00046	0.00012	0.0090	< 0.002
23-Dec-15	33	500	490	7.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	34	500	505	6.7	0.020	0.00016	0.00052	0.087	0.047	< 0.01	0.00037	< 0.0001	0.0040	1.3	< 0.00004	2.3	< 0.000002	0.25	0.0016	0.80	< 0.000005	0.00039	0.00032	0.00060	0.0000090	0.0020	< 0.002
6-Jan-16	35	500	485	6.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	36	500	490	6.4	0.0090	0.00011	0.00037	0.088	0.049	< 0.01	0.00036	< 0.0001	< 0.003	0.95	0.00011	2.0	0.0000020	0.15	0.0015	< 0.1	< 0.000005	0.000040	0.00058	0.00029	0.0000040	< 0.001	< 0.002
20-Jan-16	37	500	485	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	38	500	505	7.2	< 0.007	0.000050	0.00038	0.077	0.044	< 0.01	0.00024	0.00010	< 0.003	0.89	< 0.00004	2.1	< 0.000002	0.24	0.0015	< 0.1	< 0.000005	0.000070	0.00013	0.00021	0.00010	0.010	< 0.002
3-Feb-16	39	500	480	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	40	500	505	6.6	< 0.007	0.000040	0.00032	0.074	0.045	< 0.01	0.00022	< 0.0001	< 0.003	0.78	0.000050	1.5	< 0.000002	0.17	0.0013	0.60	0.0000050	0.000040	0.000070	0.00032	0.0000030	0.0010	< 0.002
17-Feb-16	41	500	490	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	42	500	490	6.9	< 0.007	0.000020	0.00034	0.087	0.051	0.030	0.00027	0.00020	< 0.003	0.92	< 0.00004	1.8	< 0.000002	0.13	0.0015	0.50	< 0.000005	< 0.00001	< 0.00005	0.00027	0.0000040	0.0020	< 0.002
2-Mar-16	43	500	495	6.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	44	500	495	6.9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC5 (OKY Master)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
6-May-15	0	500	290	7.5	0.012	0.00012	0.0025	0.55	0.077	0.012	0.00036	0.00017	0.0064	2.7	0.00029	3.1	0.000013	8.1	0.0097	5.8	0.000025	0.000023	0.00052	0.00021	0.000061	0.0055	0.00058
13-May-15	1	500	485	7.6	0.12	0.0011	0.0015	0.12	0.040	0.0097	0.0021	0.000097	0.017	2.0	0.00049	5.4	0.0000053	5.2	0.0023	1.3	0.000018	0.000034	0.0033	0.00049	0.00019	0.0019	0.00097
20-May-15	2	500	495	7.4	0.049	0.00058	0.00080	0.041	0.015	0.0050	0.0033	0.000050	0.022	1.1	0.000025	4.6	0.0000015	2.5	0.00076	0.79	0.0000079	0.000054	0.0012	0.00042	0.00014	0.00050	0.00099
27-May-15	3	500	435	7.3	0.046	0.00027	0.00061	0.036	0.013	0.0044	0.0025	0.000044	0.017	0.91	0.00044	4.6	0.0000017	2.1	0.00065	0.39	0.0000044	0.000057	0.0016	0.00017	0.00014	0.00087	0.00087
3-Jun-15	4	500	520	7.4	0.088	0.00060	0.00063	0.035	0.014	0.0052	0.0031	0.000052	0.024	1.1	0.000021	4.5	0.0000057	1.9	0.00077	0.57	0.0000062	0.0000052	0.0031	0.00027	0.00020	0.00052	0.0010
10-Jun-15	5	500	495	7.3	0.013	0.00022	0.00051	0.026	0.012	0.0050	0.0025	0.000050	0.019	0.94	0.000030	3.6	0.00000099	1.5	0.00043	0.45	0.0000035	0.000040	0.00035	0.00015	0.00011	0.00099	0.00099
17-Jun-15	6	500	490	7.4	0.073	0.00054	0.00049	0.028	0.013	0.0049	0.0024	0.000049	0.024	0.90	0.000025	3.6	0.0000015	1.2	0.00055	0.49	0.0000083	0.000020	0.0024	0.00036	0.00015	0.00098	0.00098
24-Jun-15	7	500	490	7.2	0.047	0.00032	0.00048	0.030	0.013	0.0049	0.0016	0.000049	0.018	0.91	0.000020	3.4	0.0000015	1.2	0.00057	0.39	0.0000054	0.000029	0.0015	0.00016	0.00013	0.00049	0.00098
1-Jul-15	8	500	480	7.6	0.052	0.00035	0.00044	0.027	0.012	0.0096	0.0014	0.000048	0.015	0.80	0.000019	3.2	0.0000024	0.91	0.00056	0.29	0.0000053	0.000062	0.0013	0.00022	0.00013	0.00096	0.00096
8-Jul-15	9	500	495	7.5	0.012	0.00014	0.00040	0.025	0.012	0.0050	0.0012	0.000050	0.013	0.81	0.000030	3.4	0.0000020	0.80	0.00049	0.59	0.0000064	0.000020	0.00027	0.000095	0.000079	0.00050	0.00099
15-Jul-15	10	500	490	7.2	0.017	0.00011	0.00044	0.025	0.011	0.0049	0.0014	0.000049	0.011	0.70	0.000020	2.8	0.00000098	0.74	0.00045	0.098	0.0000044	0.000069	0.00037	0.00042	0.00010	0.00049	0.00098
22-Jul-15	11	500	495	7.0	0.011	0.000076	0.00041	0.024	0.011	0.0049	0.0011	0.000049	0.012	0.71	0.000020	2.6	0.0000042	0.63	0.00044	0.17	0.0000034	0.000047	0.00023	0.00076	0.000094	0.00049	0.00099
29-Jul-15	12	500	495	7.3	0.0054	0.000040	0.00039	0.023	0.011	0.0050	0.00083	0.000050	0.012	0.73	0.000020	2.4	0.0000074	0.51	0.00043	0.25	0.0000025	0.000025	0.000084	0.0011	0.00084	0.00050	0.00099
5-Aug-15	13	500	490	6.9	0.011	0.000072	0.00037	0.026	0.012	0.0050	0.00098	0.000050	0.011	0.79	0.000020	2.4	0.0000042	0.47	0.00048	0.25	0.0000054	0.000022	0.00041	0.00085	0.000087	0.00050	0.00099
12-Aug-15	14	500	495	6.8	0.016	0.00010	0.00035	0.030	0.014	0.0050	0.0011	0.000050	0.011	0.85	0.000020	2.4	0.00000099	0.43	0.00052	0.25	0.0000084	0.000020	0.00074	0.00060	0.000089	0.00050	0.00099
19-Aug-15	15	500	475	7.0	0.014	0.00011	0.00037	0.032	0.016	0.0051	0.00090	0.000051	0.0096	0.85	0.000020	2.4	0.0000010	0.37	0.00056	0.30	0.0000065	0.000012	0.00046	0.00040	0.000081	0.00051	0.0010
26-Aug-15	16	500	515	7.4	0.012	0.00012	0.00039	0.035	0.018	0.0052	0.00066	0.000052	0.0082	0.85	0.000021	2.3	0.0000010	0.31	0.00060	0.36	0.0000046	0.0000052	0.00019	0.00020	0.000072	0.00052	0.0010
2-Sep-15	17	500	490	7.0	0.0087	0.000079	0.00036	0.034	0.017	0.0051	0.0010	0.000051	0.0074	0.82	0.000020	2.0	0.0000010	0.31	0.00056	1.0	0.0000056	0.000043	0.00018	0.00040	0.000076	0.00051	0.0010
9-Sep-15	18	500	500	7.0	0.0055	0.000040	0.00034	0.034	0.016	0.0050	0.0014	0.000050	0.0065	0.79	0.000020	1.8	0.0000010	0.30	0.00052	1.7	0.0000065	0.000080	0.00018	0.00060	0.000080	0.00050	0.0010
16-Sep-15	19	500	495	6.9	0.0048	0.000030	0.00031	0.033	0.016	0.0050	0.00089	0.000050	0.0045	0.74	0.000020	1.6	0.0000038	0.25	0.00052	0.95	0.0000050	0.000043	0.00015	0.00044	0.000063	0.00050	0.0010
23-Sep-15	20	500	500	7.1	0.0040	0.000020	0.00028	0.032	0.016	0.0050	0.00035	0.000050	0.0025	0.70	0.000020	1.4	0.0000065	0.19	0.00051	0.25	0.0000035	0.0000050	0.00013	0.00027	0.000045	0.00050	0.0010
30-Sep-15	21	500	490	6.9	0.0052	0.000035	0.00029	0.041	0.019	0.0050	0.00077	0.000050	0.0035	0.73	0.000020	1.6	0.0000037	0.21	0.00066	0.22	0.0000032	0.000022	0.00014	0.00086	0.000047	0.00050	0.00100
7-Oct-15	22	500	495	7.4	0.0064	0.000050	0.00030	0.050	0.023	0.0050	0.0012	0.000050	0.0045	0.76	0.000020	1.7	0.00000099	0.23	0.00081	0.20	0.0000030	0.000040	0.00016	0.0014	0.000050	0.00050	0.00099
14-Oct-15	23	500	500	7.1	0.0062	0.000047	0.00029	0.045	0.022	0.0050	0.0015	0.000050	0.0044	0.73	0.000020	1.6	0.0000053	0.20	0.00079	0.20	0.0000040	0.000035	0.00020	0.00083	0.000050	0.00050	0.0010
21-Oct-15	24	500	505	7.3	0.0061	0.000045	0.00028	0.040	0.020	0.0051	0.0018	0.000051	0.0044	0.71	0.000020	1.6	0.0000096	0.18	0.00078	0.20	0.0000051	0.000030	0.00023	0.00023	0.000051	0.00051	0.0010
28-Oct-15	25	500	490	7.3	0.0073	0.000049	0.00025	0.040	0.020	0.0049	0.0039	0.000049	0.0031	0.68	0.000020	1.5	0.0000053	0.16	0.00072	0.17	0.0000037	0.000027	0.00026	0.00016	0.000059	0.00049	0.00098
4-Nov-15	26	500	475	7.3	0.0086	0.000052	0.00023	0.039	0.020	0.0048	0.0061	0.000048	0.0019	0.65	0.000019	1.4	0.00000095	0.15	0.00066	0.14	0.0000024	0.000024	0.00029	0.000084	0.000067	0.00048	0.00095
11-Nov-15	27	500	500	7.3	0.013	0.000034	0.00022	0.041	0.020	0.0049	0.0034	0.000049	0.0017	0.63	0.000042	1.4	0.00000098	0.15	0.00073	0.12	0.0000032	0.000032	0.00027	0.00012	0.000053	0.00074	0.00098
18-Nov-15	28	500	500	7.2	0.017	0.000015	0.00022	0.042	0.021	0.0050	0.00066	0.000050	0.0015	0.61	0.000065	1.4	0.0000010	0.15	0.00081	0.10	0.0000040	0.000040	0.00025	0.00016	0.000040	0.0010	0.0010
25-Nov-15	29	500	490	7.1	0.020	0.000054	0.00023	0.045	0.023	0.0050	0.00049	0.000050	0.0020	0.66	0.000042	1.5	0.00000099	0.15	0.00079	0.22	0.0000032	0.000022	0.00032	0.00016	0.000052	0.00075	0.00099
2-Dec-15	30	500	490	6.8	0.023	0.000093	0.00023	0.048	0.024	0.0049	0.00032	0.000049	0.0025	0.71	0.000020	1.5	0.00000098	0.15	0.00077	0.34	0.0000025	0.0000049	0.00039	0.00016	0.000064	0.00049	0.00098
9-Dec-15	31	500	490	7.3	0.017	0.00011	0.00025	0.052	0.023	0.0049	0.00029	0.000049	0.0037	0.69	0.000040	1.5	0.0000052	0.14	0.00094	0.30	0.0000052	0.000032	0.00028	0.00020	0.000062	0.0025	0.00099
16-Dec-15	32	500	495	7.3	0.011	0.00012	0.00026	0.057	0.023	0.0050	0.00027	0.000050	0.0050	0.66	0.000059	1.4	0.0000094	0.13	0.0011	0.25	0.0000079	0.000059	0.00017	0.00023	0.000059	0.0045	0.00099
23-Dec-15	33	500	490	7.9	0.011	0.000100	0.00026	0.051	0.023	0.0050	0.00023	0.000050	0.0035	0.65	0.000040	1.3	0.0000052	0.13	0.00095	0.33	0.0000052	0.00013	0.00016	0.00026	0.000052	0.0027	0.0010
30-Dec-15	34	500	505	6.7	0.010	0.000081	0.00026	0.044	0.024	0.0051	0.00019	0.000051	0.0020	0.63	0.000020	1.2	0.0000010	0.13	0.00078	0.40	0.0000025	0.00020	0.00016	0.00030	0.000045	0.0010	0.0010
6-Jan-16	35	500	485	6.6	0.0073	0.000067	0.00022	0.044	0.024	0.0050	0.00018	0.000050	0.0017	0.55	0.000037	1.1	0.00000100	0.100	0.00075	0.23	0.0000025	0.00011	0.00022	0.00022	0.000033	0.00075	0.00100
13-Jan-16	36	500	490	6.4	0.0044	0.000054	0.00018	0.043	0.024	0.0049	0.00018	0.000049	0.0015	0.47	0.000054	0.97	0.00000098	0.074	0.00072	0.049	0.0000025	0.000020	0.00028	0.00014	0.000020	0.00049	0.00098
20-Jan-16	37	500	485	7.3	0.0040	0.000040	0.00019	0.041	0.023	0.0050	0.00015	0.000050	0.0015	0.46	0.000037	1.0	0.00000100	0.097	0.00073	0.050	0.0000025	0.000027	0.00017	0.00012	0.000035	0.0028	0.00100
27-Jan-16	38	500	505	7.2	0.0035	0.000025	0.00019	0.039	0.022	0.0051	0.00012	0.000051	0.0015	0.45	0.000020	1.0	0.0000010	0.12	0.00073	0.051	0.0000025	0.000035	0.000066	0.00010	0.000051	0.0051	0.0010
3-Feb-16	39	500	480	7.2	0.0035	0.000023	0.00018	0.038	0.022	0.0051	0.00012	0.000051	0.0015	0.42	0.000023	0.90	0.0000010	0.10	0.00068	0.18	0.0000025	0.000028	0.000051	0.00013	0.000033	0.0028	0.0010
10-Feb-16	40	500	505	6.6	0.0035	0.000020	0.00016	0.037	0.023	0.0051	0.00011	0.000051	0.0015	0.39	0.000025	0.76	0.0000010	0.086	0.00063	0.30	0.0000025	0.000020	0.000035	0.00016	0.000015	0.00051	0.0010
17-Feb-16	41	500	490	7.5	0.0035	0.000015	0.00016	0.040	0.024	0.0099	0.00012	0.000074	0.0015	0.42	0.000022	0.82	0.00000100	0.075	0.00067	0.27	0.0000025	0.000013	0.000030	0.00015	0.000017	0.00074	0.00100
24-Feb-16	42	500	490	6.9	0.0034	0.0000098	0.00016	0.043	0.025	0.015	0.00013	0.000098	0.0015	0.45	0.000020	0.89	0.00000098	0.064	0.00072	0.25	0.0000025	0.0000049	0.000025	0.00013	0.000020	0.00098	0.00098

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC6 (OKY Master (Fresh))

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
6-May-15	0	500	320	7.9	385	#N/A	3.6	96	77	7.0	1.8	< 0.3	85	0.021	0.0056	0.061	0.015	0.0000080	< 0.000007	0.041	0.0000070	26	< 0.00003	0.0014	0.0020
13-May-15	1	500	495	7.6	146	#N/A	6.6	48	13	2.0	1.1	< 0.3	34	0.023	0.0049	0.064	0.0075	< 0.000007	< 0.000007	0.030	0.0000030	10	0.000050	0.00034	0.00080
20-May-15	2	500	490	7.5	95	#N/A	3.7	34	3.0	2.0	0.65	< 0.3	27	0.025	0.0034	0.082	0.0062	< 0.000007	< 0.000007	0.015	< 0.000003	8.4	< 0.00003	0.00014	0.00050
27-May-15	3	500	490	7.6	73	#N/A	2.6	29	3.0	1.0	0.37	< 0.3	23	0.12	0.0030	0.096	0.0062	< 0.000007	< 0.000007	0.012	< 0.000003	7.0	< 0.00003	0.00011	0.00025
3-Jun-15	4	500	490	7.4	65	#N/A	3.3	27	3.0	< 1	0.26	< 0.3	21	0.047	0.0024	0.091	0.0049	< 0.000007	< 0.000007	0.0085	< 0.000003	6.4	0.000030	0.000089	0.00021
10-Jun-15	5	500	495	7.4	59	#N/A	3.6	26	3.0	< 1	0.22	< 0.3	21	0.044	0.0020	0.087	0.0046	< 0.000007	< 0.000007	0.0080	< 0.000003	6.5	< 0.00003	0.000077	0.00017
17-Jun-15	6	500	490	7.3	52	#N/A	3.7	25	3.0	< 1	0.17	< 0.3	18	0.052	0.0020	0.092	0.0044	< 0.000007	< 0.000007	0.0090	< 0.000003	5.7	< 0.00003	0.000075	0.00016
24-Jun-15	7	500	485	7.5	52	#N/A	3.2	22	< 2	< 1	0.16	< 0.3	17	0.041	0.0018	0.083	0.0040	< 0.000007	< 0.000007	0.0060	< 0.000003	5.4	< 0.00003	0.000076	0.00015
1-Jul-15	8	500	485	7.3	43	#N/A	3.8	17	2.0	< 1	0.12	< 0.3	14	0.058	0.0015	0.079	0.0034	< 0.000007	< 0.000007	0.0024	0.0000030	4.2	< 0.00003	0.000065	0.00044
8-Jul-15	9	500	485	7.4	41	#N/A	2.5	17	2.0	< 1	< 0.06	< 0.3	15	0.055	0.0014	0.060	0.0034	< 0.000007	< 0.000007	0.0049	< 0.000003	4.6	< 0.00003	0.000065	0.00066
15-Jul-15	10	500	490	7.3	34	#N/A	3.6	16	< 2	< 1	0.10	< 0.3	12	0.072	0.0012	0.059	0.0030	< 0.000007	< 0.000007	0.0059	< 0.000003	3.8	< 0.00003	0.000059	0.00020
22-Jul-15	11	500	485	7.4	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	12	500	490	7.3	32	#N/A	2.0	14	< 2	< 1	0.090	< 0.3	12	0.068	0.0011	0.043	0.0026	< 0.000007	< 0.000007	0.0029	< 0.000003	3.6	< 0.00003	0.000049	0.00014
5-Aug-15	13	500	480	7.3	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	14	500	495	7.3	28	#N/A	1.7	12	< 2	< 1	0.080	< 0.3	11	0.067	0.00090	0.042	0.0026	< 0.000007	< 0.000007	0.0047	< 0.000003	3.3	< 0.00003	0.000051	0.00033
19-Aug-15	15	500	505	7.3	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	16	500	500	7.5	28	#N/A	1.5	13	< 2	< 1	0.070	< 0.3	10	0.052	0.00090	0.028	0.0025	< 0.000007	< 0.000007	0.0022	0.0000060	3.3	< 0.00003	0.000054	0.00013
2-Sep-15	17	500	490	7.3	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	18	500	485	7.3	28	#N/A	2.0	12	< 2	< 1	0.070	< 0.3	11	0.045	0.00080	0.023	0.0025	< 0.000007	< 0.000007	0.0020	< 0.000003	3.4	< 0.00003	0.000049	0.00025
16-Sep-15	19	500	495	7.3	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	20	500	490	7.3	26	#N/A	1.4	11	< 2		0.070		9.7	0.043	0.0010	0.025	0.0022	< 0.000007	< 0.000007	0.0019	< 0.000003	3.1	0.000050	0.000045	0.000090
30-Sep-15	21	500	495	7.2	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	22	500	495	7.4	23	#N/A	2.1	12	< 2		0.060		8.8	0.032	0.00070	0.014	0.0019	< 0.000007	< 0.000007	0.0015	< 0.000003	2.8	< 0.00003	0.000043	0.00036
14-Oct-15	23	500	505	7.4	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	24	500	505	7.3	20	#N/A	1.2	9.5	2.0		0.060		8.3	0.059	0.00070	0.016	0.0025	0.0000070	< 0.000007	0.0016	0.0000050	2.6	< 0.00003	0.000068	0.00042
28-Oct-15	25	500	510	7.4	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	26	500	485	7.4	26	#N/A	1.6	12	2.0		0.060		10	0.026	0.00080	0.016	0.0023	< 0.000007	< 0.000007	0.0023	< 0.000003	3.3	< 0.00003	0.000046	0.00033
11-Nov-15	27	500	485	7.3	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	28	500	505	7.3	19	#N/A	1.5	10	2.0		< 0.06		7.3	0.024	0.00070	0.013	0.0014	< 0.000007	< 0.000007	< 0.0002	< 0.000003	2.3	< 0.00003	0.000050	0.00061
25-Nov-15	29	500	485	7.3	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	30	500	485	7.2	23	#N/A	3.0	12	2.0		0.060		9.6	0.12	0.00090	0.017	0.0035	0.0000070	< 0.000007	0.00080	0.0000030	3.0	< 0.00003	0.000071	0.00025
9-Dec-15	31	500	485	7.2	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	32	500	495	7.1	17	#N/A	2.6	9.0	2.0		< 0.06		8.1	0.017	0.00060	0.014	0.0031	0.000010	< 0.000007	0.0016	0.000014	2.5	0.000070	0.000076	0.00023
23-Dec-15	33	500	490	7.5	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	34	500	490	7.1	18	#N/A	1.9	9.9	3.0		< 0.06		8.4	0.023	0.00050	0.012	0.0021	< 0.000007	< 0.000007	0.0010	0.0000040	2.6	< 0.00003	0.000061	0.00026
6-Jan-16	35	500	490	7.1	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	36	500	495	7.0	19	#N/A	2.2	9.9	2.0		< 0.06		7.8	0.011	0.00050	0.0067	0.0021	< 0.000007	< 0.000007	< 0.002	< 0.000003	2.5	< 0.00003	0.000043	0.00033
20-Jan-16	37	500	490	7.1	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	38	500	485	7.1	21	#N/A	3.1	10	2.0		< 0.06		8.6	0.019	0.00050	0.0096	0.0027	< 0.000007	< 0.000007	< 0.002	0.0000030	2.7	< 0.00003	0.000077	0.00045
3-Feb-16	39	500	485	7.0	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	40	500	490	6.9	16	#N/A	2.5	9.3	2.0		< 0.06		6.6	0.032	0.00050	0.0079	0.0021	< 0.000007	< 0.000007	< 0.002	< 0.000003	2.1	< 0.00003	0.000067	0.00015
17-Feb-16	41	500	495	7.2	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	42	500	490	7.0	16	#N/A	2.7	8.3	2.0		< 0.06		6.7	0.016	0.00060	0.011	0.0019	< 0.000007	< 0.000007	< 0.002	0.000011	2.1	< 0.00003	0.000066	0.000040
2-Mar-16	43	500	485	7.0	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	44	500	490	7.1	16	#N/A	3.1	8.8	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC6 (OKY Master (Fresh))

Date	Cycle	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co	Cu
	No.	Input	Output		umhos/cm	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
6-May-15	0	500	320	7.9	385	#N/A	1.2	31	25	2.2	0.59	0.096	27	0.0068	0.0018	0.020	0.0049	0.0000026	0.0000022	0.013	0.0000022	8.3	0.0000096	0.00044	0.00063
13-May-15	1	500	495	7.6	146	#N/A	3.3	24	6.4	0.99	0.56	0.15	17	0.012	0.0024	0.032	0.0037	0.0000035	0.0000035	0.015	0.0000015	5.1	0.000025	0.00017	0.00040
20-May-15	2	500	490	7.5	95	#N/A	1.8	17	1.5	0.98	0.32	0.15	13	0.012	0.0017	0.040	0.0030	0.0000034	0.0000034	0.0071	0.0000015	4.1	0.000015	0.000071	0.00025
27-May-15	3	500	490	7.6	73	#N/A	1.3	14	1.5	0.49	0.18	0.15	11	0.056	0.0015	0.047	0.0030	0.0000034	0.0000034	0.0059	0.0000015	3.4	0.000015	0.000052	0.00012
3-Jun-15	4	500	490	7.4	65	#N/A	1.6	13	1.5	0.49	0.13	0.15	10	0.023	0.0012	0.045	0.0024	0.0000034	0.0000034	0.0042	0.0000015	3.1	0.000015	0.000044	0.00010
10-Jun-15	5	500	495	7.4	59	#N/A	1.8	13	1.5	0.50	0.11	0.15	10	0.022	0.00099	0.043	0.0023	0.0000035	0.0000035	0.0040	0.0000015	3.2	0.000015	0.000038	0.000084
17-Jun-15	6	500	490	7.3	52	#N/A	1.8	12	1.5	0.49	0.083	0.15	8.9	0.025	0.00098	0.045	0.0022	0.0000034	0.0000034	0.0044	0.0000015	2.8	0.000015	0.000037	0.000078
24-Jun-15	7	500	485	7.5	52	#N/A	1.5	11	0.97	0.49	0.078	0.15	8.4	0.020	0.00087	0.040	0.0019	0.0000034	0.0000034	0.0029	0.0000015	2.6	0.000015	0.000037	0.000073
1-Jul-15	8	500	485	7.3	43	#N/A	1.8	8.2	0.97	0.49	0.058	0.15	6.7	0.028	0.00073	0.038	0.0016	0.0000034	0.0000034	0.0012	0.0000015	2.1	0.000015	0.000032	0.00021
8-Jul-15	9	500	485	7.4	41	#N/A	1.2	8.2	0.97	0.49	0.029	0.15	7.2	0.027	0.00068	0.029	0.0017	0.0000034	0.0000034	0.0024	0.0000015	2.2	0.000015	0.000032	0.00032
15-Jul-15	10	500	490	7.3	34	#N/A	1.8	7.8	0.98	0.49	0.049	0.15	6.0	0.035	0.00059	0.029	0.0015	0.0000034	0.0000034	0.0029	0.0000015	1.9	0.000015	0.000029	0.000098
22-Jul-15	11	500	485	7.4	36	#N/A	1.4	7.3	0.98	0.49	0.047	0.15	5.9	0.034	0.00056	0.025	0.0014	0.0000034	0.0000034	0.0022	0.0000015	1.8	0.000015	0.000026	0.000083
29-Jul-15	12	500	490	7.3	32	#N/A	0.98	6.9	0.98	0.49	0.044	0.15	5.7	0.033	0.00054	0.021	0.0013	0.0000034	0.0000034	0.0014	0.0000015	1.8	0.000015	0.000024	0.000069
5-Aug-15	13	500	480	7.3	31	#N/A	0.91	6.4	0.99	0.49	0.042	0.15	5.4	0.033	0.00049	0.021	0.0013	0.0000034	0.0000034	0.0019	0.0000015	1.7	0.000015	0.000025	0.00012
12-Aug-15	14	500	495	7.3	28	#N/A	0.83	6.0	0.99	0.50	0.040	0.15	5.2	0.033	0.00045	0.021	0.0013	0.0000035	0.0000035	0.0023	0.0000015	1.6	0.000015	0.000025	0.00016
19-Aug-15	15	500	505	7.3	29	#N/A	0.80	6.2	1.00	0.50	0.037	0.15	5.2	0.030	0.00045	0.017	0.0012	0.0000035	0.0000035	0.0017	0.0000022	1.6	0.000015	0.000026	0.00011
26-Aug-15	16	500	500	7.5	28	#N/A	0.76	6.4	1.0	0.50	0.035	0.15	5.2	0.026	0.00045	0.014	0.0012	0.0000035	0.0000035	0.0011	0.0000030	1.7	0.000015	0.000027	0.000065
2-Sep-15	17	500	490	7.3	32	#N/A	0.86	6.2	0.99	0.49	0.034	0.15	5.2	0.024	0.00042	0.013	0.0012	0.0000034	0.0000034	0.0010	0.0000022	1.7	0.000015	0.000025	0.000093
9-Sep-15	18	500	485	7.3	28	#N/A	0.95	6.0	0.97	0.49	0.034	0.15	5.2	0.022	0.00039	0.011	0.0012	0.0000034	0.0000034	0.00097	0.0000015	1.6	0.000015	0.000024	0.00012
16-Sep-15	19	500	495	7.3	27	#N/A	0.82	5.7	0.98	0.24	0.034	0.073	5.0	0.022	0.00044	0.012	0.0012	0.0000034	0.0000034	0.00095	0.0000015	1.6	0.000020	0.000023	0.000083
23-Sep-15	20	500	490	7.3	26	#N/A	0.68	5.3	0.98	0.00	0.034	0.00	4.8	0.021	0.00049	0.012	0.0011	0.0000034	0.0000034	0.00093	0.0000015	1.5	0.000025	0.000022	0.000044
30-Sep-15	21	500	495	7.2	24	#N/A	0.87	5.6	0.99	0.00	0.032	0.00	4.6	0.019	0.00042	0.0097	0.0010	0.0000034	0.0000034	0.00084	0.0000015	1.4	0.000020	0.000022	0.00011
7-Oct-15	22	500	495	7.4	23	#N/A	1.1	5.9	0.99	0.00	0.030	0.00	4.4	0.016	0.00035	0.0071	0.00093	0.0000035	0.0000035	0.00074	0.0000015	1.4	0.000015	0.000021	0.00018
14-Oct-15	23	500	505	7.4	24	#N/A	0.83	5.4	1.0	0.00	0.030	0.00	4.3	0.023	0.00035	0.0075	0.0011	0.0000035	0.0000035	0.00078	0.0000020	1.3	0.000015	0.000028	0.00020
21-Oct-15	24	500	505	7.3	20	#N/A	0.60	4.8	1.0	0.00	0.030	0.00	4.2	0.030	0.00035	0.0079	0.0012	0.0000035	0.0000035	0.00081	0.0000025	1.3	0.000015	0.000034	0.00021
28-Oct-15	25	500	510	7.4	22	#N/A	0.69	5.4	0.99	0.00	0.030	0.00	4.6	0.021	0.00037	0.0077	0.0012	0.0000035	0.0000035	0.00096	0.0000020	1.5	0.000015	0.000028	0.00019
4-Nov-15	26	500	485	7.4	26	#N/A	0.79	5.9	0.97	0.00	0.029	0.00	5.0	0.013	0.00039	0.0076	0.0011	0.0000034	0.0000034	0.0011	0.0000015	1.6	0.000015	0.000022	0.00016
11-Nov-15	27	500	485	7.3	23	#N/A	0.77	5.6	0.99	0.00	0.030	0.00	4.4	0.012	0.00037	0.0070	0.00092	0.0000035	0.0000035	0.00061	0.0000015	1.4	0.000015	0.000024	0.00023
18-Nov-15	28	500	505	7.3	19	#N/A	0.76	5.2	1.0	0.00	0.030	0.00	3.7	0.012	0.00035	0.0064	0.00072	0.0000035	0.0000035	0.00010	0.0000015	1.2	0.000015	0.000025	0.00031
25-Nov-15	29	500	485	7.3	27	#N/A	1.1	5.5	0.99	0.00	0.030	0.00	4.2	0.036	0.00040	0.0074	0.0012	0.0000035	0.0000035	0.00024	0.0000015	1.3	0.000015	0.000030	0.00021
2-Dec-15	30	500	485	7.2	23	#N/A	1.4	5.8	0.97	0.00	0.029	0.00	4.7	0.060	0.00044	0.0084	0.0017	0.0000034	0.0000034	0.00039	0.0000015	1.5	0.000015	0.000034	0.00012
9-Dec-15	31	500	485	7.2	20	#N/A	1.4	5.1	0.98	0.00	0.029	0.00	4.3	0.034	0.00037	0.0076	0.0016	0.0000042	0.0000034	0.00059	0.0000042	1.4	0.000025	0.000036	0.00012
16-Dec-15	32	500	495	7.1	17	#N/A	1.3	4.5	0.99	0.00	0.030	0.00	4.0	0.0086	0.00030	0.0067	0.0015	0.0000050	0.0000035	0.00079	0.0000069	1.3	0.000035	0.000038	0.00011
23-Dec-15	33	500	490	7.5	19	#N/A	1.1	4.6	1.2	0.00	0.030	0.00	4.1	0.0099	0.00027	0.0064	0.0013	0.0000042	0.0000034	0.00064	0.0000044	1.3	0.000025	0.000034	0.00012
30-Dec-15	34	500	490	7.1	18	#N/A	0.92	4.8	1.5	0.00	0.029	0.00	4.1	0.011	0.00025	0.0061	0.0010	0.0000034	0.0000034	0.00049	0.0000020	1.3	0.000015	0.000030	0.00013
6-Jan-16	35	500	490	7.1	21	#N/A	1.00	4.9	1.2	0.00	0.030	0.00	4.0	0.0083	0.00025	0.0047	0.0010	0.0000034	0.0000034	0.00074	0.0000017	1.3	0.000015	0.000026	0.00015
13-Jan-16	36	500	495	7.0	19	#N/A	1.1	4.9	0.99	0.00	0.030	0.00	3.9	0.0054	0.00025	0.0033	0.0010	0.0000035	0.0000035	0.00099	0.0000015	1.2	0.000015	0.000021	0.00016
20-Jan-16	37	500	490	7.1	17	#N/A	1.3	4.9	0.98	0.00	0.029	0.00	4.0	0.0074	0.00025	0.0040	0.0012	0.0000034	0.0000034	0.00098	0.0000015	1.3	0.000015	0.000029	0.00019
27-Jan-16	38	500	485	7.1	21	#N/A	1.5	5.0	0.97	0.00	0.029	0.00	4.2	0.0094	0.00024	0.0047	0.0013	0.0000034	0.0000034	0.00097	0.0000015	1.3	0.000015	0.000037	0.00022
3-Feb-16	39	500	485	7.0	17	#N/A	1.4	4.8	0.98	0.00	0.029	0.00	3.7	0.012	0.00024	0.0043	0.0012	0.0000034	0.0000034	0.00098	0.0000015	1.2	0.000015	0.000035	0.00015
10-Feb-16	40	500	490	6.9	16	#N/A	1.2	4.6	0.98	0.00	0.029	0.00	3.2	0.016	0.00025	0.0039	0.0010	0.0000034	0.0000034	0.00098	0.0000015	1.0	0.000015	0.000033	0.000074
17-Feb-16	41	500	495	7.2	16	#N/A	1.3	4.3	0.98	0.00	0.029	0.00	3.3	0.012	0.00027	0.0045	0.00097	0.0000034	0.0000034	0.00098	0.0000034	1.0	0.000015	0.000033	0.000047
24-Feb-16	42	500	490	7.0	16	#N/A	1.3	4.1	0.98	0.00	0.029	0.00	3.3	0.0080	0.00029	0.0051	0.00092	0.0000034	0.0000034	0.00098	0.0000054	1.0	0.000015	0.000032	0.000020

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC6 (OKY Master (Fresh))

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
6-May-15	0	500	320	7.9	< 0.007	0.000030	0.026	4.9	0.24	0.020	0.014	0.00050	0.028	16	< 0.001	5.3	0.000033	35	0.065	26	0.000070	0.000080	0.000090	0.026	0.00059	0.0040	< 0.002
13-May-15	1	500	495	7.6	0.011	0.000030	0.011	2.1	0.11	0.010	0.011	0.00030	0.022	8.9	< 0.001	4.6	0.000017	11	0.027	4.9	0.000033	0.000090	0.00034	0.0080	0.00066	0.0010	< 0.002
20-May-15	2	500	490	7.5	0.0070	0.000020	0.0063	1.4	0.074	< 0.01	0.0060	< 0.0001	0.025	6.3	< 0.00004	5.1	0.0000090	3.9	0.020	2.9	0.000022	0.000090	0.00044	0.0020	0.00087	< 0.001	< 0.002
27-May-15	3	500	490	7.6	0.043	0.00011	0.0042	1.3	0.067	0.010	0.0035	< 0.0001	0.030	4.7	< 0.001	5.1	0.0000050	2.4	0.017	1.6	0.000016	0.000080	0.0017	0.0019	0.0010	< 0.001	< 0.002
3-Jun-15	4	500	490	7.4	0.021	0.000070	0.0034	1.2	0.062	< 0.01	0.0024	< 0.0001	0.032	4.6	< 0.00004	4.3	0.0000030	1.7	0.016	1.8	0.000012	< 0.00001	0.00072	0.0022	0.0011	< 0.001	< 0.002
10-Jun-15	5	500	495	7.4	0.021	0.000070	0.0028	1.1	0.061	< 0.01	0.0019	< 0.0001	0.028	4.2	< 0.00004	4.0	< 0.000002	1.3	0.015	1.5	0.000013	0.000020	0.00072	0.0022	0.0011	< 0.001	< 0.002
17-Jun-15	6	500	490	7.3	0.020	0.000070	0.0024	0.95	0.056	< 0.01	0.0016	< 0.0001	0.028	3.4	0.000040	3.9	0.0000020	0.97	0.014	1.6	0.000018	0.000050	0.00078	0.0022	0.0011	< 0.001	< 0.002
24-Jun-15	7	500	485	7.5	0.018	0.000080	0.0022	0.94	0.059	< 0.01	0.0012	< 0.0001	0.026	3.0	< 0.00004	3.7	< 0.000002	0.89	0.013	1.1	0.000014	0.000050	0.00032	0.0020	0.0010	< 0.001	< 0.002
1-Jul-15	8	500	485	7.3	0.018	0.000050	0.0019	0.79	0.053	0.020	0.00093	< 0.0001	0.025	2.4	< 0.00004	3.3	0.0000020	0.73	0.012	1.0	0.000010	0.00015	0.00048	0.0017	0.0010	< 0.001	< 0.002
8-Jul-15	9	500	485	7.4	0.020	0.000090	0.0018	0.82	0.054	< 0.01	0.00085	< 0.0001	0.017	2.4	< 0.00004	3.7	< 0.000002	0.63	0.011	1.6	0.000012	0.00023	0.00046	0.0016	0.00098	< 0.001	< 0.002
15-Jul-15	10	500	490	7.3	0.022	0.000080	0.0016	0.69	0.051	< 0.01	0.00089	< 0.0001	0.013	1.9	< 0.00004	3.2	< 0.000002	0.62	0.0096	0.70	0.000013	0.000070	0.00085	0.0016	0.0010	< 0.001	< 0.002
22-Jul-15	11	500	485	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	12	500	490	7.3	0.019	0.000080	0.0014	0.61	0.048	< 0.01	0.00061	< 0.0001	0.0090	1.7	< 0.00004	2.7	0.0000050	0.46	0.0091	0.70	< 0.000005	0.000020	0.00067	0.0013	0.00078	< 0.001	< 0.002
5-Aug-15	13	500	480	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12-Aug-15	14	500	495	7.3	0.015	0.000090	0.0011	0.56	0.044	< 0.01	0.00071	< 0.0001	0.012	1.6	< 0.00004	2.9	< 0.000002	0.42	0.0081	0.50	0.000013	0.000080	0.00057	0.0010	0.00077	< 0.001	< 0.002
19-Aug-15	15	500	505	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	16	500	500	7.5	0.011	0.00013	0.0011	0.52	0.053	< 0.01	0.00058	< 0.0001	0.012	1.3	< 0.00004	2.8	0.0000020	0.34	0.0079	0.70	0.000010	< 0.00001	0.00030	0.00092	0.00057	< 0.001	< 0.002
2-Sep-15	17	500	490	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Sep-15	18	500	485	7.3	0.0080	0.000040	0.00098	0.56	0.058	< 0.01	0.00097	< 0.0001	0.0080	1.3	< 0.00004	2.4	0.0000030	0.40	0.0077	3.2	0.000011	0.00013	0.00026	0.00095	0.00047	< 0.001	< 0.002
16-Sep-15	19	500	495	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	20	500	490	7.3	0.010	< 0.00001	0.00089	0.49	0.057	< 0.01	0.00044	< 0.0001	0.0030	1.1	< 0.00004	2.8	0.000010	0.38	0.0072	0.70	0.0000060	< 0.00001	0.00035	0.00082	0.00044	< 0.001	< 0.002
30-Sep-15	21	500	495	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	22	500	495	7.4	0.0080	0.000050	0.00066	0.45	0.058	< 0.01	0.0011	< 0.0001	0.0030	0.84	< 0.00004	1.9	< 0.000002	0.31	0.0066	0.30	< 0.000005	0.00012	0.00030	0.0012	0.00031	< 0.001	< 0.002
14-Oct-15	23	500	505	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21-Oct-15	24	500	505	7.3	0.029	0.00017	0.00072	0.44	0.063	< 0.01	0.0025	< 0.0001	0.0060	0.95	< 0.00004	2.3	0.000018	0.31	0.0061	0.50	0.000011	0.000070	0.00064	0.00081	0.00036	0.0020	< 0.002
28-Oct-15	25	500	510	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	26	500	485	7.4	0.0080	0.000040	0.00076	0.54	0.074	0.010	0.0035	< 0.0001	0.0080	1.1	< 0.00004	2.4	< 0.000002	0.33	0.0079	0.60	0.0000090	0.000080	0.00021	0.00084	0.00038	< 0.001	< 0.002
11-Nov-15	27	500	485	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	28	500	505	7.3	0.019	0.000020	0.00052	0.38	0.058	< 0.01	0.00090	< 0.0001	< 0.003	0.81	0.00010	2.1	< 0.000002	0.28	0.0056	0.30	0.0000070	0.000090	0.00022	0.00060	0.00028	0.0010	< 0.002
25-Nov-15	29	500	485	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	30	500	485	7.2	0.042	0.00018	0.00064	0.53	0.080	< 0.01	0.00051	< 0.0001	< 0.003	1.1	< 0.00004	3.0	< 0.000002	0.34	0.0073	0.90	< 0.000005	0.000030	0.0013	0.00079	0.00038	0.0020	< 0.002
9-Dec-15	31	500	485	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	32	500	495	7.1	< 0.007	0.00017	0.00057	0.43	0.076	< 0.01	0.00031	< 0.0001	< 0.003	0.87	< 0.00004	2.4	0.0000040	0.29	0.0067	0.60	0.000012	0.00013	0.0010	0.00089	0.00027	< 0.001	< 0.002
23-Dec-15	33	500	490	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	34	500	490	7.1	0.0070	0.000030	0.00058	0.44	0.078	0.010	0.00021	< 0.0001	< 0.003	0.83	< 0.00004	2.2	0.0000020	0.30	0.0067	0.70	< 0.000005	< 0.00001	0.00011	0.00072	0.00026	< 0.001	< 0.002
6-Jan-16	35	500	490	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	36	500	495	7.0	< 0.007	0.000020	0.00048	0.42	0.082	< 0.01	0.00025	< 0.0001	< 0.003	0.74	0.00011	1.8	0.0000020	0.22	0.0057	0.20	< 0.000005	0.000040	< 0.00005	0.00061	0.00014	< 0.001	< 0.002
20-Jan-16	37	500	490	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	38	500	485	7.1	< 0.007	0.000020	0.00051	0.45	0.088	< 0.01	0.00021	< 0.0001	< 0.003	0.80	< 0.00004	2.5	< 0.000002	0.25	0.0069	0.40	0.0000050	0.000040	0.000090	0.00081	0.00020	< 0.001	< 0.002
3-Feb-16	39	500	485	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	40	500	490	6.9	0.014	0.00012	0.00038	0.36	0.079	< 0.01	0.00019	< 0.0001	< 0.003	0.64	0.000050	1.7	< 0.000002	0.25	0.0052	0.90	0.0000060	0.000020	0.00045	0.00060	0.00015	0.0010	< 0.002
17-Feb-16	41	500	495	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	42	500	490	7.0	< 0.007	0.000020	0.00044	0.35	0.075	0.030	0.00020	0.00020	< 0.003	0.72	< 0.00004	2.1	< 0.000002	0.19	0.0052	0.60	0.0000050	0.000040	0.00010	0.00063	0.00019	0.0010	< 0.002
2-Mar-16	43	500	485	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	44	500	490	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC6 (OKY Master (Fresh))

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
6-May-15	0	500	320	7.9	0.0022	0.0000096	0.0082	1.6	0.077	0.0064	0.0045	0.00016	0.0090	5.0	0.00032	1.7	0.000011	11	0.021	8.3	0.000022	0.000026	0.000029	0.0082	0.00019	0.0013	0.00064
13-May-15	1	500	495	7.6	0.0054	0.000015	0.0054	1.0	0.053	0.0050	0.0056	0.00015	0.011	4.4	0.00050	2.3	0.0000084	5.2	0.014	2.4	0.000016	0.000045	0.00017	0.0039	0.00033	0.00050	0.00099
20-May-15	2	500	490	7.5	0.0034	0.0000098	0.0031	0.71	0.036	0.0049	0.0029	0.000049	0.012	3.1	0.000020	2.5	0.0000044	1.9	0.0096	1.4	0.000011	0.000044	0.00022	0.00099	0.00043	0.00049	0.00098
27-May-15	3	500	490	7.6	0.021	0.000054	0.0021	0.61	0.033	0.0049	0.0017	0.000049	0.015	2.3	0.00049	2.5	0.0000025	1.2	0.0082	0.78	0.0000078	0.000039	0.00082	0.00091	0.00050	0.00049	0.00098
3-Jun-15	4	500	490	7.4	0.010	0.000034	0.0017	0.56	0.030	0.0049	0.0012	0.000049	0.016	2.3	0.000020	2.1	0.0000015	0.81	0.0077	0.88	0.0000059	0.0000049	0.00035	0.0011	0.00054	0.00049	0.00098
10-Jun-15	5	500	495	7.4	0.010	0.000035	0.0014	0.54	0.030	0.0050	0.00094	0.000050	0.014	2.1	0.000020	2.0	0.00000099	0.62	0.0072	0.74	0.0000064	0.0000099	0.00036	0.0011	0.00053	0.00050	0.00099
17-Jun-15	6	500	490	7.3	0.0098	0.000034	0.0012	0.47	0.027	0.0049	0.00079	0.000049	0.014	1.7	0.000020	1.9	0.00000098	0.48	0.0067	0.78	0.0000088	0.000025	0.00038	0.0011	0.00053	0.00049	0.00098
24-Jun-15	7	500	485	7.5	0.0087	0.000039	0.0011	0.46	0.029	0.0049	0.00060	0.000049	0.013	1.4	0.000019	1.8	0.00000097	0.43	0.0065	0.53	0.0000068	0.000024	0.00016	0.00098	0.00050	0.00049	0.00097
1-Jul-15	8	500	485	7.3	0.0087	0.000024	0.00094	0.39	0.026	0.0097	0.00045	0.000049	0.012	1.2	0.000019	1.6	0.00000097	0.35	0.0056	0.49	0.0000049	0.000073	0.00023	0.00083	0.00050	0.00049	0.00097
8-Jul-15	9	500	485	7.4	0.0097	0.000044	0.00085	0.40	0.026	0.0049	0.00041	0.000049	0.0082	1.1	0.000019	1.8	0.00000097	0.31	0.0055	0.78	0.0000058	0.00011	0.00022	0.00077	0.00048	0.00049	0.00097
15-Jul-15	10	500	490	7.3	0.011	0.000039	0.00077	0.34	0.025	0.0049	0.00044	0.000049	0.0064	0.91	0.000020	1.5	0.00000098	0.30	0.0047	0.34	0.0000064	0.000034	0.00042	0.00076	0.00050	0.00049	0.00098
22-Jul-15	11	500	485	7.4	0.010	0.000039	0.00074	0.32	0.024	0.0049	0.00037	0.000049	0.0054	0.86	0.000020	1.4	0.0000017	0.26	0.0046	0.34	0.0000044	0.000022	0.00037	0.00070	0.00044	0.00049	0.00098
29-Jul-15	12	500	490	7.3	0.0093	0.000039	0.00070	0.30	0.024	0.0049	0.00030	0.000049	0.0044	0.81	0.000020	1.3	0.0000025	0.23	0.0044	0.34	0.0000025	0.0000098	0.00033	0.00064	0.00038	0.00049	0.00098
5-Aug-15	13	500	480	7.3	0.0084	0.000042	0.00063	0.29	0.023	0.0049	0.00033	0.000049	0.0052	0.80	0.000020	1.4	0.0000017	0.22	0.0042	0.30	0.0000044	0.000025	0.00031	0.00058	0.00038	0.00049	0.00099
12-Aug-15	14	500	495	7.3	0.0074	0.000045	0.00055	0.28	0.022	0.0050	0.00035	0.000050	0.0059	0.79	0.000020	1.4	0.00000099	0.21	0.0040	0.25	0.0000064	0.000040	0.00028	0.00051	0.00038	0.00050	0.00099
19-Aug-15	15	500	505	7.3	0.0065	0.000055	0.00054	0.27	0.024	0.0050	0.00032	0.000050	0.0060	0.72	0.000020	1.4	0.00000100	0.19	0.0040	0.30	0.0000057	0.000022	0.00022	0.00048	0.00033	0.00050	0.00100
26-Aug-15	16	500	500	7.5	0.0055	0.000065	0.00053	0.26	0.027	0.0050	0.00029	0.000050	0.0060	0.65	0.000020	1.4	0.0000010	0.17	0.0040	0.35	0.0000050	0.0000050	0.00015	0.00046	0.00029	0.00050	0.0010
2-Sep-15	17	500	490	7.3	0.0047	0.000042	0.00050	0.27	0.027	0.0049	0.00038	0.000049	0.0049	0.64	0.000020	1.3	0.0000012	0.18	0.0038	0.95	0.0000052	0.000034	0.00014	0.00046	0.00026	0.00049	0.00099
9-Sep-15	18	500	485	7.3	0.0039	0.000019	0.00048	0.27	0.028	0.0049	0.00047	0.000049	0.0039	0.63	0.000019	1.2	0.0000015	0.19	0.0037	1.6	0.0000053	0.000063	0.00013	0.00046	0.00023	0.00049	0.00097
16-Sep-15	19	500	495	7.3	0.0044	0.000012	0.00046	0.26	0.028	0.0049	0.00034	0.000049	0.0027	0.59	0.000020	1.3	0.0000032	0.19	0.0036	0.95	0.0000041	0.000034	0.00015	0.00043	0.00022	0.00049	0.00098
23-Sep-15	20	500	490	7.3	0.0049	0.0000049	0.00043	0.24	0.028	0.0049	0.00022	0.000049	0.0015	0.55	0.000020	1.4	0.0000049	0.19	0.0035	0.34	0.0000029	0.0000049	0.00017	0.00040	0.00022	0.00049	0.00098
30-Sep-15	21	500	495	7.2	0.0044	0.000015	0.00038	0.23	0.028	0.0049	0.00039	0.000049	0.0015	0.48	0.000020	1.1	0.0000029	0.17	0.0034	0.25	0.0000027	0.000032	0.00016	0.00050	0.00018	0.00049	0.00099
7-Oct-15	22	500	495	7.4	0.0040	0.000025	0.00033	0.22	0.029	0.0050	0.00056	0.000050	0.0015	0.42	0.000020	0.94	0.00000099	0.15	0.0033	0.15	0.0000025	0.000059	0.00015	0.00061	0.00015	0.00050	0.00099
14-Oct-15	23	500	505	7.4	0.0093	0.000055	0.00034	0.22	0.030	0.0050	0.00092	0.000050	0.0022	0.45	0.000020	1.0	0.0000050	0.16	0.0032	0.20	0.0000040	0.000047	0.00024	0.00051	0.00017	0.00075	0.0010
21-Oct-15	24	500	505	7.3	0.015	0.000086	0.00036	0.22	0.032	0.0051	0.0013	0.000051	0.0029	0.48	0.000020	1.1	0.0000091	0.16	0.0031	0.25	0.0000056	0.000035	0.00032	0.00041	0.00018	0.0010	0.0010
28-Oct-15	25	500	510	7.4	0.0093	0.000053	0.00036	0.24	0.034	0.0050	0.0015	0.000050	0.0034	0.50	0.000020	1.2	0.0000050	0.16	0.0035	0.27	0.0000050	0.000037	0.00021	0.00041	0.00018	0.00075	0.00099
4-Nov-15	26	500	485	7.4	0.0039	0.000019	0.00037	0.26	0.036	0.0049	0.0017	0.000049	0.0039	0.52	0.000019	1.2	0.00000097	0.16	0.0038	0.29	0.0000044	0.000039	0.00010	0.00041	0.00018	0.00049	0.00097
11-Nov-15	27	500	485	7.3	0.0067	0.000015	0.00032	0.23	0.033	0.0050	0.0011	0.000050	0.0027	0.46	0.000035	1.1	0.00000099	0.15	0.0033	0.22	0.0000040	0.000042	0.00011	0.00035	0.00016	0.00050	0.00099
18-Nov-15	28	500	505	7.3	0.0096	0.000010	0.00026	0.19	0.029	0.0051	0.00045	0.000051	0.0015	0.41	0.000051	1.1	0.0000010	0.14	0.0028	0.15	0.0000035	0.000045	0.00011	0.00030	0.00014	0.00051	0.0010
25-Nov-15	29	500	485	7.3	0.015	0.000049	0.00029	0.22	0.034	0.0050	0.00035	0.000050	0.0015	0.46	0.000035	1.3	0.00000099	0.15	0.0032	0.29	0.0000030	0.000030	0.00037	0.00034	0.00016	0.00074	0.00099
2-Dec-15	30	500	485	7.2	0.020	0.000087	0.00031	0.26	0.039	0.0049	0.00025	0.000049	0.0015	0.52	0.000019	1.5	0.00000097	0.16	0.0036	0.44	0.0000024	0.000015	0.00064	0.00038	0.00018	0.00097	0.00097
9-Dec-15	31	500	485	7.2	0.012	0.000086	0.00030	0.23	0.038	0.0049	0.00020	0.000049	0.0015	0.48	0.000020	1.3	0.0000015	0.15	0.0034	0.37	0.0000042	0.000039	0.00057	0.00041	0.00016	0.00073	0.00098
16-Dec-15	32	500	495	7.1	0.0035	0.000084	0.00028	0.21	0.038	0.0050	0.00015	0.000050	0.0015	0.43	0.000020	1.2	0.0000020	0.14	0.0033	0.30	0.0000059	0.000064	0.00050	0.00044	0.00013	0.00050	0.00099
23-Dec-15	33	500	490	7.5	0.0034	0.000049	0.00028	0.21	0.038	0.0049	0.00013	0.000049	0.0015	0.42	0.000020	1.1	0.0000015	0.15	0.0033	0.32	0.0000042	0.000035	0.00028	0.00040	0.00013	0.00049	0.00099
30-Dec-15	34	500	490	7.1	0.0034	0.000015	0.00028	0.21	0.038	0.0049	0.00010	0.000049	0.0015	0.41	0.000020	1.1	0.00000098	0.15	0.0033	0.34	0.0000025	0.0000049	0.000054	0.00035	0.00013	0.00049	0.00098
6-Jan-16	35	500	490	7.1	0.0034	0.000012	0.00026	0.21	0.039	0.0049	0.00011	0.000049	0.0015	0.39	0.000037	1.0	0.00000099	0.13	0.0031	0.22	0.0000025	0.000012	0.000039	0.00033	0.000098	0.00049	0.00099
13-Jan-16	36	500	495	7.0	0.0035	0.0000099	0.00024	0.21	0.040	0.0050	0.00012	0.000050	0.0015	0.37	0.000054	0.91	0.00000099	0.11	0.0028	0.099	0.0000025	0.000020	0.000025	0.00030	0.000069	0.00050	0.00099
20-Jan-16	37	500	490	7.1	0.0034	0.0000098	0.00024	0.21	0.042	0.0049	0.00011	0.000049	0.0015	0.38	0.000037	1.1	0.00000098	0.12	0.0031	0.15	0.0000025	0.000020	0.000034	0.00035	0.000083	0.00049	0.00098
27-Jan-16	38	500	485	7.1	0.0034	0.0000097	0.00024	0.22	0.043	0.0049	0.00010	0.000049	0.0015	0.39	0.000019	1.2	0.00000097	0.12	0.0033	0.19	0.0000024	0.000019	0.000044	0.00039	0.000097	0.00049	0.00097
3-Feb-16	39	500	485	7.0	0.0051	0.000034	0.00021	0.20	0.041	0.0049	0.000097	0.000049	0.0015	0.35	0.000022	1.0	0.00000098	0.12	0.0030	0.32	0.0000027	0.000015	0.00013	0.00034	0.000085	0.00049	0.00098
10-Feb-16	40	500	490	6.9	0.0069	0.000059	0.00018	0.18	0.039	0.0049	0.000093	0.000049	0.0015	0.31	0.000025	0.84	0.00000098	0.12	0.0026	0.44	0.0000029	0.0000098	0.00022	0.00029	0.000074	0.00049	0.00098
17-Feb-16	41	500	495	7.2	0.0051	0.000034	0.00020	0.17	0.038	0.0098	0.000096	0.000074	0.0015	0.33	0.000022	0.94	0.00000098	0.11	0.0026	0.37	0.0000027	0.000015	0.00013	0.00030	0.000083	0.00049	0.00098
24-Feb-16	42	500	490	7.0	0.0034	0.0000098	0.00022	0.17	0.037	0.015	0.000098	0.000098	0.0015	0.35	0.000020	1.0	0.00000098	0.093	0.0025	0.29	0.0000025	0.000020	0.000049	0.00031	0.000093	0.00049	0.00098

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC7 (KAM036824)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
12-Aug-15	0	500	415	7.4	598	#N/A	3.7	32	244	3.0	0.11	*< 0.3*	247	0.0092	0.016	0.038	0.013	*< 0.000007*	0.000010	0.0062	0.0000080	59	0.000060	0.0048	0.0044
19-Aug-15	1	500	495	7.4	219	#N/A	1.9	17	83	1.0	*< 0.06*	*< 0.3*	79	0.014	0.0092	0.033	0.011	*< 0.000007*	*< 0.000007*	0.0040	*< 0.000003*	18	*< 0.00003*	0.0014	0.00064
26-Aug-15	2	500	505	7.5	138	#N/A	1.6	17	42	1.0	*< 0.06*	*< 0.3*	51	0.016	0.0090	0.036	0.011	*< 0.000007*	*< 0.000007*	0.0022	0.0000070	12	*< 0.00003*	0.00089	0.00049
2-Sep-15	3	500	475	7.5	109	#N/A	1.7	16	32	*< 1*	0.060	*< 0.3*	40	0.037	0.0084	0.036	0.011	*< 0.000007*	*< 0.000007*	0.0019	0.0000040	9.6	0.000050	0.00059	0.00061
9-Sep-15	4	500	490	7.9	93	#N/A	1.5	23	21	*< 1*	0.060	*< 0.3*	32	0.017	0.0085	0.041	0.0073	*< 0.000007*	*< 0.000007*	0.0018	*< 0.000003*	7.5	*< 0.00003*	0.00058	0.00056
16-Sep-15	5	500	480	7.5	81	#N/A	1.5	18	17	*< 1*	0.060	*< 0.3*	30	0.019	0.0085	0.036	0.0067	*< 0.000007*	*< 0.000007*	0.0017	*< 0.000003*	7.4	0.000060	0.00045	0.00041
23-Sep-15	6	500	495	7.5	76	#N/A	1.6	20	13	*< 1*	*< 0.06*	*< 0.3*	30	0.017	0.0086	0.033	0.0068	*< 0.000007*	*< 0.000007*	0.0014	*< 0.000003*	7.1	*< 0.00003*	0.00049	0.00045
30-Sep-15	7	500	485	7.5	65	#N/A	1.9	21	12	*< 1*	0.060	*< 0.3*	26	0.017	0.0079	0.034	0.0052	*< 0.000007*	*< 0.000007*	0.0026	0.0000050	6.1	*< 0.00003*	0.00040	0.00033
7-Oct-15	8	500	480	7.6	56	#N/A	1.9	17	7.0	*< 1*	*< 0.06*	*< 0.3*	22	0.016	0.0071	0.023	0.0052	*< 0.000007*	*< 0.000007*	0.00090	*< 0.000003*	5.1	*< 0.00003*	0.00037	0.00019
14-Oct-15	9	500	475	7.7	64	#N/A	1.7	23	8.0	*< 1*	0.060	*< 0.3*	25	0.021	0.0078	0.029	0.0069	*< 0.000007*	*< 0.000007*	0.0038	*< 0.000003*	5.8	*< 0.00003*	0.00027	0.00038
21-Oct-15	10	500	495	7.6	63	#N/A	1.2	23	8.0	*< 1*	0.060	*< 0.3*	28	0.019	0.0084	0.022	0.0071	*< 0.000007*	*< 0.000007*	0.0014	*< 0.000003*	6.6	*< 0.00003*	0.00042	0.00050
28-Oct-15	11	500	505	7.7	59	#N/A	2.3	26	7.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	12	500	480	7.6	51	#N/A	1.1	18	5.0	*< 1*	*< 0.06*	*< 0.3*	22	0.020	0.0066	0.021	0.0053	*< 0.000007*	*< 0.000007*	0.00090	*< 0.000003*	5.1	*< 0.00003*	0.00030	0.00037
11-Nov-15	13	500	465	7.6	52	#N/A	1.5	20	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	14	500	495	7.7	58	#N/A	1.0	28	5.0	*< 1*	*< 0.06*	*< 0.3*	24	0.017	0.0073	0.022	0.0064	*< 0.000007*	*< 0.000007*	*< 0.0002*	*< 0.000003*	5.8	0.000030	0.00034	0.00041
25-Nov-15	15	500	465	7.6	46	#N/A	1.0	22	4.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	16	500	485	7.5	51	#N/A	2.4	23	4.0	*< 1*	*< 0.06*	*< 0.3*	24	0.020	0.0069	0.021	0.0076	*< 0.000007*	*< 0.000007*	0.00030	0.0000070	5.7	*< 0.00003*	0.00034	0.00044
9-Dec-15	17	500	470	7.7	45	#N/A	2.9	21	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	18	500	500	7.6	50	#N/A	2.4	22	4.0	*< 1*	*< 0.06*	*< 0.3*	25	0.017	0.0073	0.021	0.0088	0.0000080	*< 0.000007*	0.0012	0.0000040	6.0	0.000040	0.00034	0.00032
23-Dec-15	19	500	485	8.0	43	#N/A	3.5	21	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	20	500	490	7.5	43	#N/A	1.6	18	4.0	*< 1*	*< 0.06*	*< 0.3*	21	0.015	0.0054	0.017	0.0074	*< 0.000007*	*< 0.000007*	0.00070	0.0000030	5.1	0.000040	0.00026	0.00019
6-Jan-16	21	500	465	7.4	43	#N/A	1.7	17	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	22	500	490	7.5	48	#N/A	1.6	22	4.0	*< 1*	*< 0.06*	*< 0.3*	23	0.014	0.0062	0.015	0.0077	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	5.4	*< 0.00003*	0.00028	0.00016
20-Jan-16	23	500	475	7.5	42	#N/A	2.6	17	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	24	500	490	7.6	49	#N/A	2.8	23	3.0	*< 1*	*< 0.06*	*< 0.3*	23	0.013	0.0062	0.015	0.0085	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	5.5	*< 0.00003*	0.00027	0.00030
3-Feb-16	25	500	480	7.5	41	#N/A	2.9	18	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	26	500	495	7.5	52	#N/A	2.4	24	3.0	*< 1*	*< 0.06*	*< 0.3*	24	0.010	0.0061	0.016	0.0091	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	5.7	*< 0.00003*	0.00033	0.00011
17-Feb-16	27	500	490	7.6	45	#N/A	4.6	22	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	28	500	490	7.6	49	#N/A	2.2	22	2.0	*< 1*	*< 0.06*	*< 0.3*	24	0.014	0.0059	0.015	0.0090	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	5.6	*< 0.00003*	0.00028	0.000080
2-Mar-16	29	500	485	7.5	46	#N/A	2.1	22	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	30	500	495	7.5	48	#N/A	2.5	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC7 (KAM036824)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
12-Aug-15	0	500	415	7.4	598	#N/A	1.6	13	101	1.2	0.046	0.12	103	0.0038	0.0067	0.016	0.0054	0.0000029	0.0000042	0.0026	0.0000033	24	0.000025	0.0020	0.0018
19-Aug-15	1	500	495	7.4	219	#N/A	0.96	8.3	41	0.50	0.030	0.15	39	0.0068	0.0046	0.016	0.0054	0.0000035	0.0000035	0.0020	0.0000015	8.9	0.000015	0.00070	0.00032
26-Aug-15	2	500	505	7.5	138	#N/A	0.81	8.5	21	0.51	0.030	0.15	26	0.0083	0.0045	0.018	0.0057	0.0000035	0.0000035	0.0011	0.0000035	6.3	0.000015	0.00045	0.00025
2-Sep-15	3	500	475	7.5	109	#N/A	0.80	7.8	15	0.48	0.029	0.14	19	0.017	0.0040	0.017	0.0050	0.0000033	0.0000033	0.00090	0.0000019	4.5	0.000024	0.00028	0.00029
9-Sep-15	4	500	490	7.9	93	#N/A	0.72	11	10	0.49	0.029	0.15	16	0.0081	0.0042	0.020	0.0036	0.0000034	0.0000034	0.00088	0.0000015	3.7	0.000015	0.00029	0.00027
16-Sep-15	5	500	480	7.5	81	#N/A	0.74	8.4	8.2	0.48	0.029	0.14	15	0.0091	0.0041	0.017	0.0032	0.0000034	0.0000034	0.00082	0.0000014	3.6	0.000029	0.00021	0.00020
23-Sep-15	6	500	495	7.5	76	#N/A	0.79	10.0	6.4	0.50	0.030	0.15	15	0.0086	0.0043	0.016	0.0034	0.0000035	0.0000035	0.00069	0.0000015	3.5	0.000015	0.00024	0.00022
30-Sep-15	7	500	485	7.5	65	#N/A	0.93	10	5.8	0.49	0.029	0.15	13	0.0081	0.0038	0.016	0.0025	0.0000034	0.0000034	0.0013	0.0000024	3.0	0.000015	0.00019	0.00016
7-Oct-15	8	500	480	7.6	56	#N/A	0.92	8.3	3.4	0.48	0.029	0.14	10	0.0075	0.0034	0.011	0.0025	0.0000034	0.0000034	0.00043	0.0000014	2.4	0.000014	0.00018	0.000091
14-Oct-15	9	500	475	7.7	64	#N/A	0.81	11	3.8	0.48	0.029	0.14	12	0.0099	0.0037	0.014	0.0033	0.0000033	0.0000033	0.0018	0.0000014	2.7	0.000014	0.00013	0.00018
21-Oct-15	10	500	495	7.6	63	#N/A	0.57	11	4.0	0.50	0.030	0.15	14	0.0094	0.0042	0.011	0.0035	0.0000035	0.0000035	0.00069	0.0000015	3.3	0.000015	0.00021	0.00025
28-Oct-15	11	500	505	7.7	59	#N/A	1.2	13	3.5	0.49	0.029	0.15	12	0.0096	0.0037	0.011	0.0030	0.0000034	0.0000034	0.00056	0.0000015	2.9	0.000015	0.00017	0.00021
4-Nov-15	12	500	480	7.6	51	#N/A	0.54	8.5	2.4	0.48	0.029	0.14	10	0.0097	0.0032	0.010	0.0025	0.0000034	0.0000034	0.00043	0.0000014	2.4	0.000014	0.00014	0.00018
11-Nov-15	13	500	465	7.6	52	#N/A	0.70	9.4	1.9	0.49	0.029	0.15	11	0.0091	0.0034	0.010	0.0029	0.0000034	0.0000034	0.00027	0.0000015	2.6	0.000015	0.00015	0.00019
18-Nov-15	14	500	495	7.7	58	#N/A	0.48	14	2.5	0.50	0.030	0.15	12	0.0086	0.0036	0.011	0.0032	0.0000035	0.0000035	0.000099	0.0000015	2.9	0.000015	0.00017	0.00020
25-Nov-15	15	500	465	7.6	46	#N/A	0.48	10	1.9	0.49	0.029	0.15	12	0.0092	0.0035	0.010	0.0034	0.0000034	0.0000034	0.00012	0.0000024	2.8	0.000015	0.00017	0.00021
2-Dec-15	16	500	485	7.5	51	#N/A	1.2	11	1.9	0.49	0.029	0.15	12	0.0097	0.0033	0.010	0.0037	0.0000034	0.0000034	0.00015	0.0000034	2.7	0.000015	0.00016	0.00021
9-Dec-15	17	500	470	7.7	45	#N/A	1.4	9.8	1.4	0.49	0.030	0.15	12	0.0090	0.0035	0.010	0.0040	0.0000037	0.0000034	0.00037	0.0000027	2.9	0.000017	0.00017	0.00019
16-Dec-15	18	500	500	7.6	50	#N/A	1.2	11	2.0	0.50	0.030	0.15	13	0.0084	0.0037	0.010	0.0044	0.0000040	0.0000035	0.00060	0.0000020	3.0	0.000020	0.00017	0.00016
23-Dec-15	19	500	485	8.0	43	#N/A	1.7	10	1.5	0.50	0.030	0.15	11	0.0078	0.0031	0.0093	0.0040	0.0000037	0.0000035	0.00047	0.0000017	2.7	0.000020	0.00015	0.00013
30-Dec-15	20	500	490	7.5	43	#N/A	0.77	8.7	2.0	0.49	0.029	0.15	10	0.0072	0.0026	0.0081	0.0036	0.0000034	0.0000034	0.00034	0.0000015	2.5	0.000020	0.00013	0.000093
6-Jan-16	21	500	465	7.4	43	#N/A	0.77	8.0	1.4	0.49	0.029	0.15	11	0.0070	0.0028	0.0078	0.0037	0.0000034	0.0000034	0.00066	0.0000015	2.6	0.000017	0.00013	0.000086
13-Jan-16	22	500	490	7.5	48	#N/A	0.79	11	2.0	0.49	0.029	0.15	11	0.0068	0.0030	0.0075	0.0038	0.0000034	0.0000034	0.00098	0.0000015	2.6	0.000015	0.00014	0.000078
20-Jan-16	23	500	475	7.5	42	#N/A	1.2	8.2	1.4	0.49	0.029	0.15	11	0.0066	0.0030	0.0075	0.0040	0.0000034	0.0000034	0.00098	0.0000015	2.7	0.000015	0.00014	0.00011
27-Jan-16	24	500	490	7.6	49	#N/A	1.4	11	1.5	0.49	0.029	0.15	11	0.0064	0.0030	0.0075	0.0042	0.0000034	0.0000034	0.00098	0.0000015	2.7	0.000015	0.00013	0.00015
3-Feb-16	25	500	480	7.5	41	#N/A	1.4	8.6	0.96	0.49	0.030	0.15	12	0.0058	0.0030	0.0077	0.0043	0.0000034	0.0000034	0.00099	0.0000015	2.8	0.000015	0.00015	0.00010
10-Feb-16	26	500	495	7.5	52	#N/A	1.2	12	1.5	0.50	0.030	0.15	12	0.0051	0.0030	0.0078	0.0045	0.0000035	0.0000035	0.00099	0.0000015	2.8	0.000015	0.00016	0.000054
17-Feb-16	27	500	490	7.6	45	#N/A	2.2	11	0.98	0.49	0.030	0.15	12	0.0060	0.0030	0.0075	0.0045	0.0000034	0.0000034	0.00099	0.0000015	2.8	0.000015	0.00015	0.000047
24-Feb-16	28	500	490	7.6	49	#N/A	1.1	11	0.98	0.49	0.029	0.15	12	0.0069	0.0029	0.0072	0.0044	0.0000034	0.0000034	0.00098	0.0000015	2.7	0.000015	0.00014	0.000039

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC7 (KAM036824)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
12-Aug-15	0	500	415	7.4	0.0070	0.00011	0.0050	24	0.10	< 0.01	0.0020	0.036	0.0080	6.1	0.00020	0.67	0.0000016	18	0.30	86	0.0000035	0.0022	< 0.00005	0.024	0.00027	0.0040	< 0.002
19-Aug-15	1	500	495	7.4	0.034	0.000020	0.0020	8.4	0.031	< 0.01	0.00066	0.012	< 0.003	2.7	< 0.00004	0.42	< 0.000002	5.6	0.095	26	0.0000080	< 0.00001	0.00023	0.0097	0.00030	< 0.001	< 0.002
26-Aug-15	2	500	505	7.5	< 0.007	0.00012	0.0016	4.8	0.022	< 0.01	0.00055	0.0075	0.0040	2.1	0.000080	0.40	0.0000030	3.2	0.058	15	0.0000080	0.000020	< 0.00005	0.0097	0.00035	< 0.001	< 0.002
2-Sep-15	3	500	475	7.5	0.012	0.00012	0.0013	3.8	0.014	< 0.01	0.00031	0.0049	< 0.003	1.8	< 0.00004	0.36	0.0000040	2.2	0.044	12	0.0000070	< 0.00001	0.00018	0.0077	0.00038	< 0.001	< 0.002
9-Sep-15	4	500	490	7.9	< 0.007	0.000030	0.0011	3.2	0.014	< 0.01	0.0022	0.0039	< 0.003	1.7	0.000070	0.35	0.0000050	1.7	0.035	11	0.000011	0.000080	0.000070	0.0090	0.00033	< 0.001	< 0.002
16-Sep-15	5	500	480	7.5	< 0.007	0.000080	0.0013	2.9	0.011	< 0.01	0.00023	0.0028	< 0.003	1.6	< 0.00004	0.34	0.0000050	1.4	0.030	7.0	0.0000070	0.000060	< 0.00005	0.0066	0.00033	< 0.001	< 0.002
23-Sep-15	6	500	495	7.5	< 0.007	< 0.00001	0.0010	2.9	0.013	< 0.01	0.00033	0.0032	< 0.003	1.5	< 0.00004	0.39	0.000020	1.1	0.030	5.2	< 0.000005	< 0.00001	0.000080	0.0062	0.00031	< 0.001	< 0.002
30-Sep-15	7	500	485	7.5	0.0070	0.000040	0.00093	2.6	0.011	< 0.01	0.00027	0.0032	< 0.003	1.4	< 0.00004	0.27	< 0.000002	0.91	0.027	4.4	< 0.000005	0.000070	0.00010	0.0055	0.00034	0.0040	< 0.002
7-Oct-15	8	500	480	7.6	< 0.007	0.000020	0.00081	2.2	0.0095	< 0.01	0.00047	0.0023	< 0.003	1.1	< 0.00004	0.26	< 0.000002	0.60	0.022	3.5	< 0.000005	0.000040	< 0.00005	0.0048	0.00025	< 0.001	< 0.002
14-Oct-15	9	500	475	7.7	< 0.007	0.000010	0.00099	2.5	0.0097	< 0.01	0.00046	0.0018	< 0.003	1.4	< 0.00004	0.35	0.0000020	0.66	0.026	4.2	0.0000060	0.000090	< 0.00005	0.0055	0.00040	< 0.001	< 0.002
21-Oct-15	10	500	495	7.6	< 0.007	0.000040	0.00094	2.8	0.012	< 0.01	0.0019	0.0023	< 0.003	1.4	0.000040	0.37	0.000013	0.60	0.029	3.4	0.0000070	0.00013	0.00037	0.0064	0.00027	< 0.001	< 0.002
28-Oct-15	11	500	505	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	12	500	480	7.6	< 0.007	0.000020	0.00072	2.2	0.0089	< 0.01	0.0014	0.0017	0.0080	1.2	< 0.00004	0.27	< 0.000002	0.39	0.023	2.4	< 0.000005	< 0.00001	< 0.00005	0.0052	0.00025	< 0.001	< 0.002
11-Nov-15	13	500	465	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	14	500	495	7.7	0.019	0.000030	0.00072	2.4	0.012	< 0.01	0.00068	0.0016	< 0.003	1.1	0.00013	0.32	< 0.000002	0.35	0.026	2.2	< 0.000005	0.000050	< 0.00005	0.0042	0.00026	< 0.001	< 0.002
25-Nov-15	15	500	465	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	16	500	485	7.5	< 0.007	0.000080	0.00066	2.4	0.010	< 0.01	0.00028	0.0018	< 0.003	1.1	< 0.00004	0.31	< 0.000002	0.27	0.024	2.2	< 0.000005	0.000060	0.00022	0.0053	0.00031	< 0.001	< 0.002
9-Dec-15	17	500	470	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	18	500	500	7.6	< 0.007	0.00012	0.00070	2.5	0.012	< 0.01	0.00013	0.0017	< 0.003	1.1	< 0.00004	0.34	0.0000030	0.23	0.026	1.8	< 0.000005	0.000070	0.00010	0.0052	0.00025	< 0.001	< 0.002
23-Dec-15	19	500	485	8.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	20	500	490	7.5	< 0.007	0.000030	0.00062	2.1	0.010	0.010	0.00036	0.0014	< 0.003	0.92	< 0.00004	0.24	< 0.000002	0.20	0.021	1.9	< 0.000005	< 0.00001	0.00010	0.0040	0.00022	< 0.001	< 0.002
6-Jan-16	21	500	465	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	22	500	490	7.5	< 0.007	0.000030	0.00056	2.2	0.011	< 0.01	0.00018	0.0013	< 0.003	0.95	0.00017	0.28	0.0000030	0.15	0.021	1.1	< 0.000005	0.000030	< 0.00005	0.0043	0.00021	< 0.001	< 0.002
20-Jan-16	23	500	475	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	24	500	490	7.6	< 0.007	< 0.00001	0.00054	2.2	0.012	< 0.01	0.000060	0.0013	< 0.003	0.89	< 0.00004	0.27	< 0.000002	0.16	0.023	1.2	< 0.000005	0.000030	< 0.00005	0.0049	0.00026	< 0.001	< 0.002
3-Feb-16	25	500	480	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	26	500	495	7.5	< 0.007	0.000040	0.00053	2.4	0.013	< 0.01	0.000080	0.0015	< 0.003	0.86	0.000050	0.26	< 0.000002	0.15	0.024	1.6	< 0.000005	< 0.00001	< 0.00005	0.0041	0.00017	< 0.001	< 0.002
17-Feb-16	27	500	490	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	28	500	490	7.6	< 0.007	0.000030	0.00055	2.4	0.013	0.020	0.000090	0.0013	< 0.003	0.83	< 0.00004	0.040	< 0.000002	0.070	0.022	1.3	< 0.000005	0.000090	0.000070	0.0039	0.00020	< 0.001	< 0.002
2-Mar-16	29	500	485	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	30	500	495	7.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC7 (KAM036824)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
12-Aug-15	0	500	415	7.4	0.0029	0.000046	0.0021	10	0.042	0.0042	0.00084	0.015	0.0033	2.5	0.000083	0.28	0.0000066	7.4	0.12	35	0.000015	0.00092	0.000021	0.0098	0.00011	0.0017	0.00083
19-Aug-15	1	500	495	7.4	0.017	0.0000099	0.00098	4.1	0.016	0.0050	0.00033	0.0060	0.0015	1.4	0.000020	0.21	0.00000099	2.8	0.047	13	0.0000040	0.0000050	0.00011	0.0048	0.00015	0.00050	0.00099
26-Aug-15	2	500	505	7.5	0.0035	0.000061	0.00082	2.4	0.011	0.0051	0.00028	0.0038	0.0020	1.1	0.000040	0.20	0.0000015	1.6	0.029	7.4	0.0000040	0.000010	0.000025	0.0049	0.00018	0.00051	0.0010
2-Sep-15	3	500	475	7.5	0.0057	0.000057	0.00062	1.8	0.0068	0.0048	0.00015	0.0023	0.0014	0.87	0.000019	0.17	0.0000019	1.0	0.021	5.9	0.0000033	0.0000048	0.000086	0.0036	0.00018	0.00048	0.00095
9-Sep-15	4	500	490	7.9	0.0034	0.000015	0.00056	1.6	0.0070	0.0049	0.0011	0.0019	0.0015	0.82	0.000034	0.17	0.0000025	0.82	0.017	5.2	0.0000054	0.000039	0.000034	0.0044	0.00016	0.00049	0.00098
16-Sep-15	5	500	480	7.5	0.0034	0.000038	0.00064	1.4	0.0054	0.0048	0.00011	0.0013	0.0014	0.76	0.000019	0.16	0.0000024	0.65	0.014	3.4	0.0000034	0.000029	0.000024	0.0032	0.00016	0.00048	0.00096
23-Sep-15	6	500	495	7.5	0.0035	0.0000050	0.00050	1.4	0.0065	0.0050	0.00016	0.0016	0.0015	0.74	0.000020	0.19	0.0000099	0.55	0.015	2.6	0.0000025	0.0000050	0.000040	0.0031	0.00015	0.00050	0.00099
30-Sep-15	7	500	485	7.5	0.0034	0.000019	0.00045	1.2	0.0051	0.0049	0.00013	0.0016	0.0015	0.69	0.000019	0.13	0.00000097	0.44	0.013	2.1	0.0000024	0.000034	0.000049	0.0026	0.00016	0.0019	0.00097
7-Oct-15	8	500	480	7.6	0.0034	0.0000096	0.00039	1.1	0.0046	0.0048	0.00023	0.0011	0.0014	0.55	0.000019	0.12	0.00000096	0.29	0.011	1.7	0.0000024	0.000019	0.000024	0.0023	0.00012	0.00048	0.00096
14-Oct-15	9	500	475	7.7	0.0033	0.0000048	0.00047	1.2	0.0046	0.0048	0.00022	0.00086	0.0014	0.65	0.000019	0.17	0.00000095	0.31	0.012	2.0	0.0000029	0.000043	0.000024	0.0026	0.00019	0.00048	0.00095
21-Oct-15	10	500	495	7.6	0.0035	0.000020	0.00046	1.4	0.0061	0.0050	0.00096	0.0011	0.0015	0.68	0.000020	0.18	0.0000064	0.30	0.014	1.7	0.0000035	0.000064	0.00018	0.0032	0.00013	0.00050	0.00099
28-Oct-15	11	500	505	7.7	0.0034	0.000015	0.00040	1.2	0.0052	0.0049	0.00081	0.00098	0.0027	0.62	0.000020	0.16	0.0000037	0.24	0.013	1.4	0.0000029	0.000035	0.00010	0.0028	0.00013	0.00049	0.00098
4-Nov-15	12	500	480	7.6	0.0034	0.0000096	0.00034	1.0	0.0042	0.0048	0.00065	0.00082	0.0038	0.55	0.000019	0.13	0.00000096	0.19	0.011	1.2	0.0000024	0.0000048	0.000024	0.0025	0.00012	0.00048	0.00096
11-Nov-15	13	500	465	7.6	0.0064	0.000012	0.00035	1.1	0.0050	0.0049	0.00049	0.00080	0.0027	0.55	0.000042	0.14	0.00000098	0.18	0.012	1.1	0.0000024	0.000015	0.000024	0.0023	0.00012	0.00049	0.00098
18-Nov-15	14	500	495	7.7	0.0094	0.000015	0.00036	1.2	0.0057	0.0050	0.00034	0.00079	0.0015	0.55	0.000064	0.16	0.00000099	0.17	0.013	1.1	0.0000025	0.000025	0.000025	0.0021	0.00013	0.00050	0.00099
25-Nov-15	15	500	465	7.6	0.0064	0.000027	0.00034	1.2	0.0054	0.0049	0.00024	0.00083	0.0015	0.55	0.000042	0.15	0.00000098	0.15	0.012	1.1	0.0000025	0.000027	0.000066	0.0023	0.00014	0.00049	0.00098
2-Dec-15	16	500	485	7.5	0.0034	0.000039	0.00032	1.2	0.0050	0.0049	0.00014	0.00087	0.0015	0.55	0.000019	0.15	0.00000097	0.13	0.011	1.1	0.0000024	0.000029	0.00011	0.0026	0.00015	0.00049	0.00097
9-Dec-15	17	500	470	7.7	0.0034	0.000049	0.00034	1.2	0.0056	0.0049	0.00010	0.00086	0.0015	0.55	0.000020	0.16	0.0000012	0.12	0.012	0.98	0.0000025	0.000032	0.000078	0.0026	0.00014	0.00049	0.00099
16-Dec-15	18	500	500	7.6	0.0035	0.000060	0.00035	1.2	0.0061	0.0050	0.000065	0.00085	0.0015	0.56	0.000020	0.17	0.0000015	0.12	0.013	0.90	0.0000025	0.000035	0.000050	0.0026	0.00013	0.00050	0.0010
23-Dec-15	19	500	485	8.0	0.0035	0.000037	0.00033	1.1	0.0055	0.0050	0.00012	0.00077	0.0015	0.50	0.000020	0.14	0.0000012	0.11	0.012	0.92	0.0000025	0.000020	0.000050	0.0023	0.00012	0.00050	0.00099
30-Dec-15	20	500	490	7.5	0.0034	0.000015	0.00030	1.0	0.0050	0.0049	0.00018	0.00069	0.0015	0.45	0.000020	0.12	0.00000098	0.098	0.010	0.93	0.0000025	0.0000049	0.000049	0.0020	0.00011	0.00049	0.00098
6-Jan-16	21	500	465	7.4	0.0034	0.000015	0.00029	1.1	0.0052	0.0049	0.00013	0.00066	0.0015	0.46	0.000051	0.13	0.0000012	0.086	0.010	0.74	0.0000025	0.0000098	0.000037	0.0020	0.00011	0.00049	0.00098
13-Jan-16	22	500	490	7.5	0.0034	0.000015	0.00027	1.1	0.0054	0.0049	0.000088	0.00064	0.0015	0.47	0.000083	0.14	0.0000015	0.074	0.010	0.54	0.0000025	0.000015	0.000025	0.0021	0.00010	0.00049	0.00098
20-Jan-16	23	500	475	7.5	0.0034	0.0000098	0.00027	1.1	0.0055	0.0049	0.000059	0.00064	0.0015	0.45	0.000051	0.13	0.0000012	0.076	0.011	0.56	0.0000025	0.000015	0.000025	0.0023	0.00012	0.00049	0.00098
27-Jan-16	24	500	490	7.6	0.0034	0.0000049	0.00026	1.1	0.0057	0.0049	0.000029	0.00064	0.0015	0.44	0.000020	0.13	0.00000098	0.078	0.011	0.59	0.0000025	0.000015	0.000025	0.0024	0.00013	0.00049	0.00098
3-Feb-16	25	500	480	7.5	0.0034	0.000012	0.00026	1.1	0.0061	0.0049	0.000035	0.00069	0.0015	0.43	0.000022	0.13	0.00000099	0.076	0.011	0.69	0.0000025	0.0000098	0.000025	0.0022	0.00011	0.00049	0.00099
10-Feb-16	26	500	495	7.5	0.0035	0.000020	0.00026	1.2	0.0066	0.0050	0.000040	0.00074	0.0015	0.42	0.000025	0.13	0.00000099	0.074	0.012	0.79	0.0000025	0.0000050	0.000025	0.0020	0.000084	0.00050	0.00099
17-Feb-16	27	500	490	7.6	0.0034	0.000017	0.00026	1.2	0.0064	0.0074	0.000042	0.00069	0.0015	0.42	0.000022	0.074	0.00000099	0.054	0.011	0.71	0.0000025	0.000025	0.000030	0.0020	0.000091	0.00049	0.00099
24-Feb-16	28	500	490	7.6	0.0034	0.000015	0.00027	1.2	0.0062	0.0098	0.000044	0.00064	0.0015	0.41	0.000020	0.020	0.00000098	0.034	0.011	0.64	0.0000025	0.000044	0.000034	0.0019	0.000098	0.00049	0.00098

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC8 (KAM092488)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
12-Aug-15	0	500	410	7.6	128	#N/A	2.5	22	29	*< 1*	0.080	*< 0.3*	24	0.075	0.0037	0.13	0.0077	0.000014	0.000010	0.016	0.000025	5.7	0.00011	0.00031	0.016
19-Aug-15	1	500	505	7.5	68	#N/A	1.9	15	13	*< 1*	*< 0.06*	*< 0.3*	16	0.024	0.0030	0.063	0.0084	*< 0.000007*	*< 0.000007*	0.0084	0.0000040	3.8	*< 0.00003*	0.00017	0.0032
26-Aug-15	2	500	495	7.5	38	#N/A	1.3	12	3.0	*< 1*	*< 0.06*	*< 0.3*	9.3	0.021	0.0025	0.050	0.0049	*< 0.000007*	*< 0.000007*	0.0053	0.0000090	2.3	*< 0.00003*	0.000070	0.0020
2-Sep-15	3	500	500	7.5	32	#N/A	1.6	12	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.5	0.018	0.0025	0.043	0.0045	*< 0.000007*	*< 0.000007*	0.0047	0.0000060	2.1	*< 0.00003*	0.000053	0.0014
9-Sep-15	4	500	495	7.5	25	#N/A	1.6	11	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.2	0.019	0.0021	0.038	0.0045	*< 0.000007*	*< 0.000007*	0.0039	*< 0.000003*	1.9	*< 0.00003*	0.000048	0.0011
16-Sep-15	5	500	495	7.4	24	#N/A	1.5	11	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.3	0.017	0.0021	0.038	0.0049	*< 0.000007*	*< 0.000007*	0.0037	0.0000060	2.0	*< 0.00003*	0.000030	0.00082
23-Sep-15	6	500	495	7.4	24	#N/A	1.4	12	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.9	0.014	0.0021	0.035	0.0056	*< 0.000007*	*< 0.000007*	0.0030	*< 0.000003*	2.1	*< 0.00003*	0.000034	0.00081
30-Sep-15	7	500	490	7.4	21	#N/A	1.5	12	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.7	0.012	0.0018	0.032	0.0054	*< 0.000007*	*< 0.000007*	0.0032	0.0000050	2.0	*< 0.00003*	0.000037	0.00086
7-Oct-15	8	500	500	7.5	19	#N/A	1.5	10	2.0	*< 1*	*< 0.06*	*< 0.3*	8.0	0.011	0.0016	0.022	0.0052	*< 0.000007*	*< 0.000007*	0.0018	*< 0.000003*	1.9	*< 0.00003*	0.000024	0.00059
14-Oct-15	9	500	490	7.6	19	#N/A	1.5	11	2.0	*< 1*	*< 0.06*	*< 0.3*	8.1	0.012	0.0016	0.027	0.0052	*< 0.000007*	*< 0.000007*	0.0031	*< 0.000003*	1.9	*< 0.00003*	0.000027	0.00052
21-Oct-15	10	500	495	7.5	21	#N/A	1.2	11	2.0	*< 1*	*< 0.06*	*< 0.3*	9.4	0.014	0.0016	0.022	0.0065	*< 0.000007*	*< 0.000007*	0.0022	0.0000050	2.2	*< 0.00003*	0.000025	0.00065
28-Oct-15	11	500	510	7.7	21	#N/A	2.4	13	3.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	12	500	495	7.4	20	#N/A	1.1	11	*< 2*	*< 1*	*< 0.06*	*< 0.3*	8.4	0.012	0.0013	0.018	0.0061	*< 0.000007*	*< 0.000007*	0.00080	*< 0.000003*	2.0	0.000040	0.000017	0.00045
11-Nov-15	13	500	480	7.4	19	#N/A	1.6	10	*< 2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	14	500	505	7.5	22	#N/A	0.80	13	2.0	*< 1*	*< 0.06*	*< 0.3*	9.6	0.013	0.0014	0.020	0.0069	*< 0.000007*	*< 0.000007*	*< 0.0002*	*< 0.000003*	2.3	*< 0.00003*	0.000024	0.00055
25-Nov-15	15	500	475	7.3	17	#N/A	1.0	9.7	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	16	500	490	7.1	18	#N/A	2.8	11	2.0	*< 1*	*< 0.06*	*< 0.3*	8.7	0.017	0.0013	0.018	0.0056	*< 0.000007*	*< 0.000007*	0.00060	0.0000050	2.1	*< 0.00003*	0.000016	0.00059
9-Dec-15	17	500	495	7.6	19	#N/A	3.1	11	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	18	500	490	7.6	18	#N/A	2.7	9.9	2.0	*< 1*	*< 0.06*	*< 0.3*	9.3	0.015	0.0013	0.018	0.0061	0.0000080	*< 0.000007*	0.0015	0.0000060	2.3	0.00012	0.000027	0.00065
23-Dec-15	19	500	495	8.1	15	#N/A	3.9	11	*< 2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	20	500	495	7.2	16	#N/A	1.3	9.5	2.0	*< 1*	*< 0.06*	*< 0.3*	8.7	0.0091	0.0011	0.013	0.0062	*< 0.000007*	*< 0.000007*	0.0010	*< 0.000003*	2.1	*< 0.00003*	0.000017	0.00021
6-Jan-16	21	500	485	7.1	17	#N/A	1.7	9.2	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	22	500	490	7.2	19	#N/A	1.8	10	2.0	*< 1*	*< 0.06*	*< 0.3*	8.9	0.011	0.0013	0.014	0.0061	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	2.2	*< 0.00003*	0.0000040	0.00027
20-Jan-16	23	500	485	7.4	17	#N/A	2.5	9.6	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	24	500	490	7.5	20	#N/A	2.8	11	2.0	*< 1*	*< 0.06*	*< 0.3*	8.8	0.012	0.0013	0.016	0.0060	*< 0.000007*	*< 0.000007*	*< 0.002*	0.0000050	2.1	*< 0.00003*	0.000016	0.00034
3-Feb-16	25	500	500	7.4	18	#N/A	3.5	10	2.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	26	500	495	7.3	20	#N/A	2.0	11	2.0	*< 1*	*< 0.06*	*< 0.3*	9.3	0.0080	0.0014	0.017	0.0057	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	2.3	*< 0.00003*	0.000023	0.00024
17-Feb-16	27	500	490	7.6	15	#N/A	4.0	11	*< 2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	28	500	500	7.4	17	#N/A	2.6	11	2.0	*< 1*	*< 0.06*	*< 0.3*	9.1	0.013	0.0013	0.016	0.0061	*< 0.000007*	*< 0.000007*	*< 0.002*	*< 0.000003*	2.3	*< 0.00003*	0.0000080	0.0020
2-Mar-16	29	500	500	7.2	19	#N/A	2.2	11	*< 2*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	30	500	500	7.4	19	#N/A	2.5	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC8 (KAM092488)

Date	**Cycle**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**	**Cu**
	No.	Input	Output		umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
12-Aug-15	0	500	410	7.6	128	#N/A	1.0	9.2	12	0.41	0.033	0.12	9.7	0.031	0.0015	0.055	0.0031	0.0000057	0.0000041	0.0066	0.000010	2.3	0.000045	0.00013	0.0064
19-Aug-15	1	500	505	7.5	68	#N/A	0.94	7.7	6.6	0.51	0.030	0.15	8.1	0.012	0.0015	0.032	0.0042	0.0000035	0.0000035	0.0042	0.0000020	1.9	0.000015	0.000085	0.0016
26-Aug-15	2	500	495	7.5	38	#N/A	0.66	6.2	1.5	0.50	0.030	0.15	4.6	0.010	0.0012	0.025	0.0024	0.0000035	0.0000035	0.0026	0.0000045	1.1	0.000015	0.000035	0.0010
2-Sep-15	3	500	500	7.5	32	#N/A	0.82	6.1	1.0	0.50	0.030	0.15	4.3	0.0090	0.0013	0.022	0.0023	0.0000035	0.0000035	0.0024	0.0000030	1.0	0.000015	0.000027	0.00069
9-Sep-15	4	500	495	7.5	25	#N/A	0.78	5.4	0.99	0.50	0.030	0.15	4.1	0.0094	0.0010	0.019	0.0022	0.0000035	0.0000035	0.0019	0.0000015	0.96	0.000015	0.000024	0.00052
16-Sep-15	5	500	495	7.4	24	#N/A	0.72	5.6	0.99	0.50	0.030	0.15	4.1	0.0086	0.0010	0.019	0.0024	0.0000035	0.0000035	0.0018	0.0000030	0.99	0.000015	0.000015	0.00041
23-Sep-15	6	500	495	7.4	24	#N/A	0.67	5.7	0.99	0.50	0.030	0.15	4.4	0.0067	0.0010	0.017	0.0028	0.0000035	0.0000035	0.0015	0.0000015	1.0	0.000015	0.000017	0.00040
30-Sep-15	7	500	490	7.4	21	#N/A	0.74	5.8	0.98	0.49	0.029	0.15	4.2	0.0060	0.00088	0.016	0.0026	0.0000034	0.0000034	0.0016	0.0000025	0.98	0.000015	0.000018	0.00042
7-Oct-15	8	500	500	7.5	19	#N/A	0.77	5.2	1.0	0.50	0.030	0.15	4.0	0.0057	0.00080	0.011	0.0026	0.0000035	0.0000035	0.00090	0.0000015	0.96	0.000015	0.000012	0.00030
14-Oct-15	9	500	490	7.6	19	#N/A	0.75	5.4	0.98	0.49	0.029	0.15	4.0	0.0058	0.00078	0.013	0.0026	0.0000034	0.0000034	0.0015	0.0000015	0.93	0.000015	0.000013	0.00025
21-Oct-15	10	500	495	7.5	21	#N/A	0.59	5.6	0.99	0.50	0.030	0.15	4.7	0.0068	0.00079	0.011	0.0032	0.0000035	0.0000035	0.0011	0.0000025	1.1	0.000015	0.000012	0.00032
28-Oct-15	11	500	510	7.7	21	#N/A	1.2	6.8	1.5	0.50	0.030	0.15	4.4	0.0064	0.00072	0.0097	0.0031	0.0000035	0.0000035	0.00074	0.0000020	1.0	0.000017	0.000010	0.00027
4-Nov-15	12	500	495	7.4	20	#N/A	0.52	5.2	0.99	0.50	0.030	0.15	4.2	0.0060	0.00064	0.0087	0.0030	0.0000035	0.0000035	0.00040	0.0000015	0.99	0.000020	0.0000084	0.00022
11-Nov-15	13	500	480	7.4	19	#N/A	0.77	4.9	0.96	0.50	0.030	0.15	4.5	0.0063	0.00068	0.0093	0.0033	0.0000035	0.0000035	0.00025	0.0000015	1.1	0.000017	0.000010	0.00025
18-Nov-15	14	500	505	7.5	22	#N/A	0.40	6.6	1.0	0.51	0.030	0.15	4.8	0.0066	0.00071	0.0098	0.0035	0.0000035	0.0000035	0.00010	0.0000015	1.2	0.000015	0.000012	0.00028
25-Nov-15	15	500	475	7.3	17	#N/A	0.48	4.6	0.95	0.50	0.030	0.15	4.6	0.0074	0.00067	0.0093	0.0031	0.0000035	0.0000035	0.00020	0.0000020	1.1	0.000015	0.0000100	0.00028
2-Dec-15	16	500	490	7.1	18	#N/A	1.4	5.2	0.98	0.49	0.029	0.15	4.3	0.0081	0.00064	0.0088	0.0027	0.0000034	0.0000034	0.00029	0.0000025	1.0	0.000015	0.0000078	0.00029
9-Dec-15	17	500	495	7.6	19	#N/A	1.5	5.6	0.99	0.49	0.029	0.15	4.4	0.0076	0.00064	0.0089	0.0029	0.0000037	0.0000034	0.00051	0.0000027	1.1	0.000037	0.000011	0.00030
16-Dec-15	18	500	490	7.6	18	#N/A	1.3	4.8	0.98	0.49	0.029	0.15	4.6	0.0072	0.00064	0.0090	0.0030	0.0000039	0.0000034	0.00074	0.0000029	1.1	0.000059	0.000013	0.00032
23-Dec-15	19	500	495	8.1	15	#N/A	1.9	5.3	0.99	0.49	0.030	0.15	4.4	0.0059	0.00059	0.0078	0.0030	0.0000037	0.0000034	0.00062	0.0000022	1.1	0.000037	0.000011	0.00021
30-Dec-15	20	500	495	7.2	16	#N/A	0.65	4.7	0.99	0.50	0.030	0.15	4.3	0.0045	0.00054	0.0066	0.0030	0.0000035	0.0000035	0.00050	0.0000015	1.0	0.000015	0.0000084	0.00010
6-Jan-16	21	500	485	7.1	17	#N/A	0.84	4.5	0.97	0.49	0.030	0.15	4.3	0.0049	0.00059	0.0067	0.0030	0.0000034	0.0000034	0.00074	0.0000015	1.1	0.000015	0.0000052	0.00012
13-Jan-16	22	500	490	7.2	19	#N/A	0.87	5.0	0.98	0.49	0.029	0.15	4.4	0.0054	0.00064	0.0069	0.0030	0.0000034	0.0000034	0.00098	0.0000015	1.1	0.000015	0.0000020	0.00013
20-Jan-16	23	500	485	7.4	17	#N/A	1.2	4.6	0.97	0.49	0.029	0.15	4.3	0.0057	0.00064	0.0073	0.0030	0.0000034	0.0000034	0.00098	0.0000020	1.1	0.000015	0.0000049	0.00015
27-Jan-16	24	500	490	7.5	20	#N/A	1.4	5.3	0.98	0.49	0.029	0.15	4.3	0.0059	0.00064	0.0076	0.0029	0.0000034	0.0000034	0.00098	0.0000025	1.0	0.000015	0.0000078	0.00017
3-Feb-16	25	500	500	7.4	18	#N/A	1.7	5.1	1.0	0.49	0.030	0.15	4.5	0.0049	0.00067	0.0080	0.0029	0.0000034	0.0000034	0.00099	0.0000020	1.1	0.000015	0.0000096	0.00014
10-Feb-16	26	500	495	7.3	20	#N/A	0.98	5.4	0.99	0.50	0.030	0.15	4.6	0.0040	0.00069	0.0084	0.0028	0.0000035	0.0000035	0.00099	0.0000015	1.1	0.000015	0.000011	0.00012
17-Feb-16	27	500	490	7.6	15	#N/A	1.9	5.3	0.98	0.50	0.030	0.15	4.6	0.0051	0.00067	0.0081	0.0029	0.0000035	0.0000035	0.00100	0.0000015	1.1	0.000015	0.0000077	0.00057
24-Feb-16	28	500	500	7.4	17	#N/A	1.3	5.3	1.0	0.50	0.030	0.15	4.6	0.0063	0.00065	0.0079	0.0031	0.0000035	0.0000035	0.0010	0.0000015	1.1	0.000015	0.0000040	0.0010

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for HC8 (KAM092488)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
12-Aug-15	0	500	410	7.6	0.021	0.00061	0.0049	2.3	0.012	*< 0.01*	0.0033	0.0018	0.025	3.7	0.00067	0.92	0.0000040	14	0.096	10	0.000017	0.0021	0.00063	0.024	0.00038	0.0070	*< 0.002*
19-Aug-15	1	500	505	7.5	0.013	0.000070	0.0019	1.6	0.013	*< 0.01*	0.0015	0.0011	*< 0.003*	2.4	0.00024	0.60	*< 0.000002*	5.2	0.062	4.1	0.0000070	*< 0.00001*	0.00015	0.017	0.00014	*< 0.001*	*< 0.002*
26-Aug-15	2	500	495	7.5	*< 0.007*	0.00014	0.0013	0.88	0.0082	*< 0.01*	0.0011	0.00060	*< 0.003*	1.6	0.00014	0.45	0.0000050	2.5	0.036	1.9	0.0000060	0.000020	*< 0.00005*	0.021	0.00012	*< 0.001*	*< 0.002*
2-Sep-15	3	500	500	7.5	*< 0.007*	0.000090	0.0012	0.84	0.0063	*< 0.01*	0.00074	0.00040	*< 0.003*	1.5	0.000080	0.43	0.0000020	1.7	0.033	1.5	0.0000050	*< 0.00001*	*< 0.00005*	0.022	0.00011	*< 0.001*	*< 0.002*
9-Sep-15	4	500	495	7.5	*< 0.007*	0.000020	0.00096	0.82	0.0056	*< 0.01*	0.0016	0.00030	*< 0.003*	1.3	0.000080	0.40	0.0000040	1.1	0.031	4.0	0.0000080	0.00010	*< 0.00005*	0.020	0.00011	*< 0.001*	*< 0.002*
16-Sep-15	5	500	495	7.4	*< 0.007*	0.000020	0.0012	0.80	0.0048	*< 0.01*	0.00037	*< 0.0001*	*< 0.003*	1.3	0.000060	0.45	0.0000020	0.81	0.030	1.3	*< 0.000005*	0.000050	*< 0.00005*	0.020	0.000090	*< 0.001*	*< 0.002*
23-Sep-15	6	500	495	7.4	*< 0.007*	*< 0.00001*	0.00088	0.89	0.0051	0.010	0.00037	0.00020	*< 0.003*	1.2	*< 0.00004*	0.43	0.0000070	0.56	0.033	0.50	*< 0.000005*	*< 0.00001*	0.000060	0.019	0.000090	*< 0.001*	*< 0.002*
30-Sep-15	7	500	490	7.4	*< 0.007*	0.000010	0.00077	0.89	0.0047	*< 0.01*	0.00032	0.00030	*< 0.003*	1.1	*< 0.00004*	0.32	*< 0.000002*	0.43	0.030	0.90	*< 0.000005*	0.000080	0.000060	0.018	0.000080	*< 0.001*	*< 0.002*
7-Oct-15	8	500	500	7.5	*< 0.007*	0.000010	0.00067	0.79	0.0046	*< 0.01*	0.00042	0.00020	*< 0.003*	0.92	*< 0.00004*	0.31	*< 0.000002*	0.25	0.029	0.50	*< 0.000005*	0.000050	0.000070	0.017	0.000080	*< 0.001*	*< 0.002*
14-Oct-15	9	500	490	7.6	*< 0.007*	0.000060	0.00071	0.81	0.0042	*< 0.01*	0.00043	0.00020	*< 0.003*	0.90	*< 0.00004*	0.36	*< 0.000002*	0.21	0.029	0.40	*< 0.000005*	0.000050	*< 0.00005*	0.018	0.000070	0.0010	*< 0.002*
21-Oct-15	10	500	495	7.5	*< 0.007*	0.000050	0.00072	0.94	0.0046	*< 0.01*	0.0014	0.00020	*< 0.003*	0.93	*< 0.00004*	0.39	0.000010	0.19	0.033	0.40	*< 0.000005*	0.00013	0.000050	0.020	0.000070	*< 0.001*	*< 0.002*
28-Oct-15	11	500	510	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	12	500	495	7.4	*< 0.007*	0.000010	0.00054	0.84	0.0045	0.020	0.00088	0.00020	0.0030	0.79	*< 0.00004*	0.30	*< 0.000002*	0.11	0.030	0.30	*< 0.000005*	0.000020	*< 0.00005*	0.019	0.000070	*< 0.001*	*< 0.002*
11-Nov-15	13	500	480	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	14	500	505	7.5	0.0090	0.000010	0.00053	0.94	0.0053	*< 0.01*	0.00055	*< 0.0001*	*< 0.003*	0.74	0.00012	0.34	*< 0.000002*	0.090	0.034	0.10	*< 0.000005*	0.000030	0.000050	0.021	0.000050	*< 0.001*	*< 0.002*
25-Nov-15	15	500	475	7.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Dec-15	16	500	490	7.1	*< 0.007*	0.000060	0.00044	0.87	0.0049	*< 0.01*	0.00026	0.00020	*< 0.003*	0.64	*< 0.00004*	0.31	*< 0.000002*	0.050	0.029	0.70	*< 0.000005*	0.000040	*< 0.00005*	0.021	0.000070	*< 0.001*	*< 0.002*
9-Dec-15	17	500	495	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	18	500	490	7.6	*< 0.007*	0.00023	0.00050	0.89	0.0054	*< 0.01*	0.00015	0.00020	*< 0.003*	0.61	*< 0.00004*	0.31	*< 0.000002*	0.060	0.032	0.20	*< 0.000005*	0.000080	*< 0.00005*	0.022	0.000080	0.0010	*< 0.002*
23-Dec-15	19	500	495	8.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	20	500	495	7.2	*< 0.007*	0.000050	0.00043	0.84	0.0054	0.010	0.00032	*< 0.0001*	*< 0.003*	0.50	*< 0.00004*	0.26	0.0000020	0.060	0.029	0.80	*< 0.000005*	*< 0.00001*	*< 0.00005*	0.019	0.000050	*< 0.001*	*< 0.002*
6-Jan-16	21	500	485	7.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13-Jan-16	22	500	490	7.2	*< 0.007*	0.000040	0.00035	0.84	0.0055	*< 0.01*	0.00016	*< 0.0001*	*< 0.003*	0.48	0.00013	0.27	*< 0.000002*	0.030	0.028	*< 0.1*	*< 0.000005*	0.000030	*< 0.00005*	0.019	0.000040	*< 0.001*	*< 0.002*
20-Jan-16	23	500	485	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27-Jan-16	24	500	490	7.5	*< 0.007*	*< 0.00001*	0.00034	0.85	0.0060	*< 0.01*	0.000060	*< 0.0001*	*< 0.003*	0.43	*< 0.00004*	0.27	*< 0.000002*	0.050	0.029	0.10	*< 0.000005*	0.000040	*< 0.00005*	0.021	0.000060	*< 0.001*	*< 0.002*
3-Feb-16	25	500	500	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10-Feb-16	26	500	495	7.3	*< 0.007*	0.000010	0.00033	0.88	0.0066	*< 0.01*	0.00010	*< 0.0001*	*< 0.003*	0.40	0.000050	0.26	*< 0.000002*	0.050	0.030	0.70	*< 0.000005*	*< 0.00001*	*< 0.00005*	0.019	0.000030	*< 0.001*	*< 0.002*
17-Feb-16	27	500	490	7.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24-Feb-16	28	500	500	7.4	*< 0.007*	0.000020	0.00032	0.84	0.0059	0.030	0.00011	*< 0.0001*	*< 0.003*	0.36	*< 0.00004*	0.040	*< 0.000002*	*< 0.01*	0.027	0.50	*< 0.000005*	0.000070	*< 0.00005*	0.020	0.000020	*< 0.001*	*< 0.002*
2-Mar-16	29	500	500	7.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9-Mar-16	30	500	500	7.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Calculated Loading Rates for HC8 (KAM092488)

Date	Cycle	Volume (mL)		pH	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.	Input	Output		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
12-Aug-15	0	500	410	7.6	0.0086	0.00025	0.0020	0.95	0.0048	0.0041	0.0014	0.00074	0.010	1.5	0.00027	0.38	0.0000016	5.5	0.039	4.2	0.0000070	0.00087	0.00026	0.0096	0.00016	0.0029	0.00082
19-Aug-15	1	500	505	7.5	0.0066	0.000035	0.00095	0.80	0.0066	0.0051	0.00075	0.00056	0.0015	1.2	0.00012	0.30	0.0000010	2.6	0.031	2.1	0.0000035	0.0000051	0.000076	0.0085	0.000071	0.00051	0.0010
26-Aug-15	2	500	495	7.5	0.0035	0.000069	0.00065	0.43	0.0040	0.0050	0.00052	0.00030	0.0015	0.81	0.000069	0.22	0.0000025	1.3	0.018	0.94	0.0000030	0.0000099	0.000025	0.010	0.000059	0.00050	0.00099
2-Sep-15	3	500	500	7.5	0.0035	0.000045	0.00058	0.42	0.0031	0.0050	0.00037	0.00020	0.0015	0.73	0.000040	0.22	0.0000010	0.83	0.016	0.75	0.0000025	0.0000050	0.000025	0.011	0.000055	0.00050	0.0010
9-Sep-15	4	500	495	7.5	0.0035	0.0000099	0.00048	0.41	0.0028	0.0050	0.00081	0.00015	0.0015	0.66	0.000040	0.20	0.0000020	0.54	0.015	2.0	0.0000040	0.000050	0.000025	0.010	0.000054	0.00050	0.00099
16-Sep-15	5	500	495	7.4	0.0035	0.0000099	0.00057	0.40	0.0024	0.0050	0.00018	0.000050	0.0015	0.65	0.000030	0.22	0.00000099	0.40	0.015	0.64	0.0000025	0.000025	0.000025	0.0097	0.000045	0.00050	0.00099
23-Sep-15	6	500	495	7.4	0.0035	0.0000050	0.00044	0.44	0.0025	0.0050	0.00018	0.000099	0.0015	0.58	0.000020	0.21	0.0000035	0.28	0.016	0.25	0.0000025	0.0000050	0.000030	0.0092	0.000045	0.00050	0.00099
30-Sep-15	7	500	490	7.4	0.0034	0.0000049	0.00038	0.44	0.0023	0.0049	0.00016	0.00015	0.0015	0.56	0.000020	0.16	0.00000098	0.21	0.015	0.44	0.0000025	0.000039	0.000029	0.0090	0.000039	0.00049	0.00098
7-Oct-15	8	500	500	7.5	0.0035	0.0000050	0.00034	0.40	0.0023	0.0050	0.00021	0.00010	0.0015	0.46	0.000020	0.16	0.0000010	0.13	0.015	0.25	0.0000025	0.000025	0.000035	0.0087	0.000040	0.00050	0.0010
14-Oct-15	9	500	490	7.6	0.0034	0.000029	0.00035	0.40	0.0021	0.0049	0.00021	0.000098	0.0015	0.44	0.000020	0.18	0.00000098	0.10	0.014	0.20	0.0000025	0.000025	0.000025	0.0090	0.000034	0.00049	0.00098
21-Oct-15	10	500	495	7.5	0.0035	0.000025	0.00035	0.46	0.0023	0.0050	0.00071	0.000099	0.0015	0.46	0.000020	0.19	0.0000050	0.094	0.016	0.20	0.0000025	0.000064	0.000025	0.0100	0.000035	0.00050	0.00099
28-Oct-15	11	500	510	7.7	0.0035	0.000015	0.00031	0.44	0.0022	0.0074	0.00057	0.000099	0.0015	0.42	0.000020	0.17	0.0000030	0.074	0.016	0.17	0.0000025	0.000037	0.000025	0.0097	0.000035	0.00050	0.00099
4-Nov-15	12	500	495	7.4	0.0035	0.0000050	0.00027	0.41	0.0022	0.0099	0.00044	0.000099	0.0015	0.39	0.000020	0.15	0.00000099	0.054	0.015	0.15	0.0000025	0.0000099	0.000025	0.0095	0.000035	0.00050	0.00099
11-Nov-15	13	500	480	7.4	0.0040	0.0000050	0.00027	0.44	0.0024	0.0075	0.00036	0.000075	0.0015	0.38	0.000040	0.16	0.0000010	0.050	0.016	0.100	0.0000025	0.000013	0.000025	0.0100	0.000030	0.00050	0.0010
18-Nov-15	14	500	505	7.5	0.0045	0.0000051	0.00027	0.47	0.0027	0.0051	0.00028	0.000051	0.0015	0.37	0.000061	0.17	0.0000010	0.045	0.017	0.051	0.0000025	0.000015	0.000025	0.011	0.000025	0.00051	0.0010
25-Nov-15	15	500	475	7.3	0.0040	0.000017	0.00024	0.45	0.0025	0.0050	0.00020	0.000074	0.0015	0.34	0.000040	0.16	0.00000100	0.035	0.016	0.20	0.0000025	0.000017	0.000025	0.010	0.000030	0.00050	0.00100
2-Dec-15	16	500	490	7.1	0.0034	0.000029	0.00021	0.43	0.0024	0.0049	0.00013	0.000098	0.0015	0.31	0.000020	0.15	0.00000098	0.025	0.014	0.34	0.0000025	0.000020	0.000025	0.010	0.000034	0.00049	0.00098
9-Dec-15	17	500	495	7.6	0.0034	0.000071	0.00023	0.43	0.0025	0.0049	0.00010	0.000098	0.0015	0.31	0.000020	0.15	0.00000098	0.027	0.015	0.22	0.0000025	0.000029	0.000025	0.010	0.000037	0.00049	0.00098
16-Dec-15	18	500	490	7.6	0.0034	0.00011	0.00025	0.44	0.0026	0.0049	0.000074	0.000098	0.0015	0.30	0.000020	0.15	0.00000098	0.029	0.016	0.098	0.0000025	0.000039	0.000025	0.011	0.000039	0.00049	0.00098
23-Dec-15	19	500	495	8.1	0.0034	0.000069	0.00023	0.43	0.0026	0.0049	0.00012	0.000074	0.0015	0.27	0.000020	0.14	0.00000099	0.030	0.015	0.25	0.0000025	0.000022	0.000025	0.0100	0.000032	0.00049	0.00099
30-Dec-15	20	500	495	7.2	0.0035	0.000025	0.00021	0.41	0.0026	0.0050	0.00016	0.000050	0.0015	0.25	0.000020	0.13	0.00000099	0.030	0.014	0.40	0.0000025	0.0000050	0.000025	0.0094	0.000025	0.00050	0.00099
6-Jan-16	21	500	485	7.1	0.0034	0.000022	0.00019	0.41	0.0027	0.0049	0.00012	0.000049	0.0015	0.24	0.000042	0.13	0.00000099	0.022	0.014	0.22	0.0000025	0.0000098	0.000025	0.0093	0.000022	0.00049	0.00099
13-Jan-16	22	500	490	7.2	0.0034	0.000020	0.00017	0.41	0.0027	0.0049	0.000078	0.000049	0.0015	0.24	0.000064	0.13	0.00000098	0.015	0.014	0.049	0.0000025	0.000015	0.000025	0.0093	0.000020	0.00049	0.00098
20-Jan-16	23	500	485	7.4	0.0034	0.000012	0.00017	0.41	0.0028	0.0049	0.000054	0.000049	0.0015	0.22	0.000042	0.13	0.00000098	0.020	0.014	0.049	0.0000025	0.000017	0.000025	0.0099	0.000025	0.00049	0.00098
27-Jan-16	24	500	490	7.5	0.0034	0.0000049	0.00017	0.42	0.0029	0.0049	0.000029	0.000049	0.0015	0.21	0.000020	0.13	0.00000098	0.025	0.014	0.049	0.0000025	0.000020	0.000025	0.010	0.000029	0.00049	0.00098
3-Feb-16	25	500	500	7.4	0.0034	0.0000049	0.00016	0.43	0.0031	0.0049	0.000039	0.000049	0.0015	0.20	0.000022	0.13	0.00000099	0.025	0.015	0.20	0.0000025	0.000012	0.000025	0.0099	0.000022	0.00049	0.00099
10-Feb-16	26	500	495	7.3	0.0035	0.0000050	0.00016	0.43	0.0033	0.0050	0.000050	0.000050	0.0015	0.20	0.000025	0.13	0.00000099	0.025	0.015	0.35	0.0000025	0.0000050	0.000025	0.0094	0.000015	0.00050	0.00099
17-Feb-16	27	500	490	7.6	0.0035	0.0000075	0.00016	0.43	0.0031	0.0100	0.000052	0.000050	0.0015	0.19	0.000022	0.074	0.00000100	0.015	0.014	0.30	0.0000025	0.000020	0.000025	0.0097	0.000012	0.00050	0.00100
24-Feb-16	28	500	500	7.4	0.0035	0.000010	0.00016	0.42	0.0029	0.015	0.000055	0.000050	0.0015	0.18	0.000020	0.020	0.0000010	0.0050	0.014	0.25	0.0000025	0.000035	0.000025	0.0099	0.000010	0.00050	0.0010

Notes:

Values in grey italics are below the analytical detection limit

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests

Leachate Concentrations for Waste Rock Field Kinetic Tests

Sample ID		**FB-GO**				**FB-GT**				**FB-GS**				**FB-SO**				**FB-ST**				**FB-SS**				**FB-GGT**		**FB-GGS**	
Date Sampled		**17-Jun-14**	**25-Sep-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-14**	**6-Oct-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-14**	**6-Oct-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-14**	**25-Sep-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-14**	**25-Sep-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-14**	**25-Sep-14**	**4-Jun-15**	**22-Oct-15**	**17-Jun-15**	**22-Oct-15**	**17-Jun-15**	**22-Oct-15**
Weeks		**0**	**14**	**50**	**70**	**0**	**16**	**50**	**70**	**0**	**16**	**50**	**70**	**0**	**14**	**50**	**70**	**0**	**14**	**50**	**70**	**0**	**14**	**50**	**70**	**0**	**18**	**0**	**18**
Volume	L	4	0.55	8.2	5	4	1.5	3.8	4	4	1.5	8	4	4	2	7.8	4	4	2	6.2	3	4	2	7.8	3	1.5	5	4	6
Conductivity	uS/cm	1000	633	323	304	1100	1250	781	1230	1920	3310	1970	2110	2360	382	516	412	1130	1260	924	1200	1370	2810	1320	1710	991	1450	1530	1090
Hardness (as CaCO3)	mg/L	222		34.5	45.3	299	428	227	527	1160	2070	1090	1200	927	96	87.3	122	518	598	399	571	629		614	892	230	-	643	448
pH		7.8	8.19	8.34	8.18	7.68	8.06	8.04	7.89	7.61	7.66	7.94	7.97	7.86	7.68	8.19	8.13	7.77	7.75	8.02	7.88	7.65	7.81	8.07	8.08	7.94	6.43	8.27	7.69
TDS	mg/L	978		234	211	734	963	552	909	2060	3540	1730	1750	2380	294	330	265	874	1040	677	909	1300		1030	1350	758	1110	1210	785
Anions and Nutrients																													
T-Alkalinity (as CaCO3)	mg/L	339	148	114	75.6	243	91	69	62.7	251	97.4	61.8	75.7	499	41	88.9	84.5	118	45.6	70.1	50.7	294	146	78.6	91.4	123	1.2	227	41.4
T-Ammonia-N	mg/L	0.0261		0.01	*< 0.005*	0.0086	0.0254	0.0097	*< 0.005*	0.167	0.0117	0.0366	*< 0.005*	0.166	*< 0.005*	*< 0.005*	*< 0.005*	0.0444	*< 0.005*	*< 0.005*	*< 0.005*	0.293		0.0211	-	1.58	0.725	0.417	0.185
Nitrate-N	mg/L	3.62	0.0839	0.0081	0.218	0.431	*< 0.05*	*< 0.005*	0.041	2.43	1.53	0.722	1.08	3.15	*< 0.005*	*< 0.005*	*< 0.005*	0.97	*< 0.05*	*< 0.005*	0.26	0.947	*< 0.1*	*< 0.025*	0.025 *	1.23	0.015	0.403	0.066
Nitrite-N	mg/L	0.141		*< 0.001*	0.0011	0.023		0.0012	0.0020 *	0.045		*< 0.01*	0.0050 *	0.219		*< 0.001*	*< 0.001*	0.014		*< 0.001*	0.0020 *	0.013		*< 0.005*	0.0050 *	0.165	0.0020 *	0.0296	0.0698
Br	mg/L	*< 0.5*		*< 0.05*	*< 0.05*	*< 0.5*		*< 0.1*	*< 0.25*	*< 1*		*< 0.5*	*< 0.5*	*< 1*		*< 0.05*	*< 0.05*	*< 0.5*		*< 0.1*	*< 0.25*	*< 0.5*		*< 0.25*	*< 0.25*	*< 0.1*	*< 0.25*	*< 0.25*	*< 0.25*
Cl	mg/L	44.2	13.5	2.34	2.37	19.6	12.8	5.29	5.4	17	17	*< 5*	2.8	68	5.94	3.82	2.89	15	5.5	1.68	4.4	23.6	24	3.8	6.9	26.4	6	24.4	5
F	mg/L	0.7		0.581	0.868	0.51		0.373	0.345	*< 0.4*		0.43	0.19	0.69		0.471	0.52	0.5		0.409	0.217	0.83		0.36	0.25	*< 0.2*	0.095	*< 0.8*	0.861
S(6)	mg/L	109	150	51.8	63.9	301	572	310	570	1060	2280	1120	1180	732	133	158	109	516	633	416	575	451	1660	679	882	317	708	597	497
Cyanides																													
WAD Cyanide	mg/L	-	-	-	-	-	0.005	-	-	-	0.005	-	-	-	0.005	-	-	-	0.0148	-	-	-	-	-	-	-	-	-	-
T-Cyanide	mg/L	-	-	-	-	-	0.005	-	-	-	0.005	-	-	-	0.005	-	-	-	0.016	-	-	-	-	-	-	-	-	-	-
Organic / Inorganic Carbon																													
DOC	mg/L	147	-	-	6.61	54	9.5	-	7.13	109	8.23	-	2.7	350	27.2	-	5.41	45.6	15.9	-	-	161	-	-	-	-	4.68	-	3.27
Total Metals																													
Al	mg/L	-	-	-	-	-	0.155	-	-	-	0.0252	-	-	-	0.198	-	-	-	0.128	-	-	-	-	-	-	-	-	-	-
Sb	mg/L	-	-	-	-	-	0.0103	-	-	-	0.0123	-	-	-	0.00336	-	-	-	0.00152	-	-	-	-	-	-	-	-	-	-
As	mg/L	-	-	-	-	-	0.0487	-	-	-	0.0147	-	-	-	0.0229	-	-	-	0.00301	-	-	-	-	-	-	-	-	-	-
Ba	mg/L	-	-	-	-	-	0.037	-	-	-	*< 0.02*	-	-	-	0.058	-	-	-	0.033	-	-	-	-	-	-	-	-	-	-
Be	mg/L	-	-	-	-	-	*< 0.001*	-	-	-	*< 0.001*	-	-	-	*< 0.001*	-	-	-	*< 0.001*	-	-	-	-	-	-	-	-	-	-
B	mg/L	-	-	-	-	-	*< 0.1*	-	-	-	*< 0.1*	-	-	-	*< 0.1*	-	-	-	*< 0.1*	-	-	-	-	-	-	-	-	-	-
Cd	mg/L	-	-	-	-	-	0.000015	-	-	-	*< 2E-05*	-	-	-	0.000041	-	-	-	0.000021	-	-	-	-	-	-	-	-	-	-
Ca	mg/L	-	-	-	-	-	96.3	-	-	-	376	-	-	-	22.9	-	-	-	124	-	-	-	-	-	-	-	-	-	-
Cr	mg/L	-	-	-	-	-	*< 0.001*	-	-	-	*< 0.001*	-	-	-	0.0019	-	-	-	0.0012	-	-	-	-	-	-	-	-	-	-
Co	mg/L	-	-	-	-	-	0.00071	-	-	-	0.00144	-	-	-	0.00116	-	-	-	0.00046	-	-	-	-	-	-	-	-	-	-
Cu	mg/L	-	-	-	-	-	0.0027	-	-	-	0.0023	-	-	-	0.004	-	-	-	0.002	-	-	-	-	-	-	-	-	-	-
Fe	mg/L	-	-	-	-	-	0.236	-	-	-	0.032	-	-	-	1.07	-	-	-	0.206	-	-	-	-	-	-	-	-	-	-
Pb	mg/L	-	-	-	-	-	*< 0.0005*	-	-	-	*< 0.0005*	-	-	-	0.00307	-	-	-	0.00114	-	-	-	-	-	-	-	-	-	-
Li	mg/L	-	-	-	-	-	0.0058	-	-	-	0.0125	-	-	-	*< 0.005*	-	-	-	0.012	-	-	-	-	-	-	-	-	-	-
Mg	mg/L	-	-	-	-	-	43.9	-	-	-	265	-	-	-	9.02	-	-	-	67.7	-	-	-	-	-	-	-	-	-	-
Mn	mg/L	-	-	-	-	-	0.0259	-	-	-	0.0449	-	-	-	0.118	-	-	-	0.0406	-	-	-	-	-	-	-	-	-	-
Hg	mg/L	0.000261	-	-	-	0.000211	0.000016	-	-	*< 0.00005*	*< 1E-05*	-	-	0.000365	0.000189	-	-	*< 0.00005*	*< 0.00001*	-	-	*< 0.00005*	-	-	-	-	-	-	-
Mo	mg/L	-	-	-	-	-	0.0512	-	-	-	0.0169	-	-	-	0.0014	-	-	-	0.0156	-	-	-	-	-	-	-	-	-	-
Ni	mg/L	-	-	-	-	-	0.0014	-	-	-	0.008	-	-	-	0.0019	-	-	-	0.0029	-	-	-	-	-	-	-	-	-	-
K	mg/L	-	-	-	-	-	22.1	-	-	-	28	-	-	-	4.4	-	-	-	15.5	-	-	-	-	-	-	-	-	-	-
Se	mg/L	-	-	-	-	-	0.00216	-	-	-	0.00625	-	-	-	0.00109	-	-	-	0.00695	-	-	-	-	-	-	-	-	-	-
Ag	mg/L	-	-	-	-	-	*< 2E-05*	-	-	-	*< 2E-05*	-	-	-	*< 0.00002*	-	-	-	*< 0.00002*	-	-	-	-	-	-	-	-	-	-
Na	mg/L	-	-	-	-	-	120	-	-	-	165	-	-	-	39.9	-	-	-	63	-	-	-	-	-	-	-	-	-	-
Tl	mg/L	-	-	-	-	-	0.00029	-	-	-	*< 0.0002*	-	-	-	*< 0.0002*	-	-	-	*< 0.0002*	-	-	-	-	-	-	-	-	-	-
Sn	mg/L	-	-	-	-	-	*< 0.0005*	-	-	-	*< 0.0005*	-	-	-	*< 0.0005*	-	-	-	*< 0.0005*	-	-	-	-	-	-	-	-	-	-
Ti	mg/L	-	-	-	-	-	0.019	-	-	-	0.03	-	-	-	*< 0.01*	-	-	-	0.025	-	-	-	-	-	-	-	-	-	-
U	mg/L	-	-	-	-	-	0.601	-	-	-	0.773	-	-	-	0.00394	-	-	-	0.0647	-	-	-	-	-	-	-	-	-	-
V	mg/L	-	-	-	-	-	*< 0.001*	-	-	-	*< 0.002*	-	-	-	0.0015	-	-	-	*< 0.001*	-	-	-	-	-	-	-	-	-	-
Zn	mg/L	-	-	-	-	-	0.0116	-	-	-	*< 0.005*	-	-	-	0.557	-	-	-	0.216	-	-	-	-	-	-	-	-	-	-

Appendix D.1-3: Leachate Concentrations and Calculated Loading Rates for Kinetic Tests
Leachate Concentrations for Waste Rock Field Kinetic Tests

Sample ID		FB-GO				FB-GT				FB-GS				FB-SO				FB-ST				FB-SS				FB-GGT		FB-GGS	
Dissolved Metals																													
Al	mg/L	0.008	0.006	0.017	0.0479	0.009	0.005	0.003	0.0049	0.009	0.005	0.002	0.0091	0.006	0.024	0.003	0.003	0.011	0.014	0.003	0.0023	0.013	< 0.005	0.002	0.0037	0.012	0.0284	0.006	0.0037
Sb	mg/L	0.008	0.004	0.004	0.0041	0.018	0.01	0.01	0.00727	0.017	0.012	0.012	0.0102	0.009	0.001	0.003	0.00296	0.002	0.001	0.002	0.0013	0.059	0.043	0.041	0.0248	0.016	0.00887	0.009	0.0073
As	mg/L	0.047	0.032	0.041	0.0663	0.088	0.045	0.043	0.0354	0.066	0.015	0.013	0.0117	0.031	0.004	0.01	0.00915	0.013	0.003	0.003	0.00215	0.088	0.019	0.014	0.00924	0.639	0.154	0.126	0.0806
Ba	mg/L	0.107	0.044	0.015	0.0289	0.077	0.03	0.02	0.0262	0.049	< 0.02	0.011	0.0294	0.089	0.03	0.013	0.0541	0.052	0.029	0.023	0.0336	0.055	0.025	0.015	0.0229	0.049	0.0266	0.083	0.03
Be	mg/L	< 0.0001	< 0.001	< 0.00002	< 0.00002	< 0.0001	< 0.001	< 0.00002	< 0.00002	< 0.0001	< 0.001	< 0.00002	< 0.00002	< 0.0001	< 0.001	< 0.00002	< 0.00002	< 0.0001	< 0.001	< 0.00002	< 0.00002	< 0.0001	< 0.001	< 0.00002	< 0.00002	0	0.00014	< 0.00002	< 0.00002
Bi	mg/L	< 0.0005	-	< 0.00005	< 0.00005	< 0.0005	-	< 0.00005	< 0.00005	< 0.0005	-	< 0.00005	< 0.00005	< 0.0005	-	< 0.00005	< 0.00005	< 0.0005	-	< 0.00005	< 0.00005	< 0.0005	-	< 0.00005	< 0.00005	< 0.00005	0.00025 *	< 0.00005	< 0.00005
B	mg/L	0.077	< 0.1	0.023	0.02	0.068	< 0.1	0.026	0.021	0.036	< 0.1	0.022	0.038	0.044	< 0.1	0.012	< 0.01	0.035	< 0.1	0.029	0.021	0.033	< 0.1	0.018	0.015	0.225	0.171	0.105	0.064
Cd	mg/L	< 0.00002	< 0.00001	< 5E-06	< 5E-06	< 0.00002	0.000014	< 5E-06	0.0000185	0.000012	< 2E-05	< 5E-06	0.0000073	0.000013	0.000023	< 5E-06	0.0000061	< 0.00001	0.000021	< 5E-06	0.0000134	0.000011	< 0.00002	< 5E-06	< 5E-06	0.000111	0.000201	0.000091	0.0000728
Ca	mg/L	55.7	26.3	7.92	11.6	67.6	97.4	46.3	122	218	384	194	239	215	23.3	15.4	28.4	112	127	79	124	118	271	104	168	66.5	139	187	140
Cr	mg/L	0.001	0.002	0	0.00332	0	< 0.001	< 0.0001	0.00022	< 0.0001	< 0.001	0	< 0.0001	0.002	< 0.001	0.001	0.00229	< 0.0001	< 0.001	0	0.00052	0	< 0.001	< 0.0001	< 0.0001	< 0.0001	0.00050 *	< 0.0001	< 0.0001
Co	mg/L	0.001	< 0.0003	0	0.00016	0.001	0.001	0	0.00029	0.002	0.001	0	0.00035	0.001	0.001	< 0.0001	0.00012	0.001	0	0	0.00018	0.002	0.004	0.001	0.00114	0.021	0.0739	0.029	0.00535
Cu	mg/L	0.007	0.003	0.001	0.00216	0.01	0.002	0.001	0.00178	0.007	0.002	0.001	0.00126	0.006	0.003	0.001	0.00063	0.006	0.002	0.001	0.00087	0.011	0.003	0.001	0.00096	0.001	0.0011	0.003	0.00048
Fe	mg/L	< 0.01	< 0.03	< 0.01	0.044	< 0.01	< 0.03	< 0.01	< 0.01	< 0.01	< 0.03	< 0.01	< 0.01	< 0.01	0.07	< 0.01	< 0.01	< 0.01	0.03	< 0.01	< 0.01	< 0.01	< 0.03	< 0.01	< 0.01	< 0.01	0.013	< 0.01	< 0.01
Pb	mg/L	< 0.00005	< 0.0005	< 0.00005	0.000155	< 0.00005	< 0.0005	< 0.00005	0.000085	< 0.00005	< 0.0005	< 0.00005	< 0.00005	< 0.00005	0.00084	< 0.00005	0.000126	< 0.00005	0.00067	< 0.00005	0.000053	< 0.00005	< 0.0005	< 0.00005	< 0.00005	< 0.00005	< 0.00025	0.000053	< 0.00005
Li	mg/L	0.017	< 0.005	0.002	< 0.001	0.024	0.006	0.005	0.0034	0.023	0.012	0.008	0.0072	0.04	< 0.005	0.005	0.003	0.026	0.012	0.014	0.0115	0.025	0.015	0.011	0.009	0.028	0.0315	0.072	0.0184
Mg	mg/L	20.2	9.45	3.58	3.98	31.5	44.8	26.9	54	150	270	147	146	95	9.16	11.8	12.3	57.9	67.9	49	63.4	81.4	195	85.7	115	15.5	32.1	42.4	23.8
Mn	mg/L	0.027	0.007	0	0.00583	0.065	0.016	0.001	0.00753	0.141	0.044	0.006	0.0131	0.036	0.096	0.001	0.0114	0.049	0.036	0.002	0.0195	0.053	0.149	0.014	0.0527	3.73	24.8	3.73	3.09
Hg	mg/L	0.000232	0.000021	0.000008	0.000011	0.000195	< 1E-05	< 5E-06	0.000007	0.00002	< 1E-05	< 5E-06	< 5E-06	0.000309	0.000059	0.000009	0.0000052	0.000019	< 0.00001	< 5E-06	< 5E-06	< 0.00001	< 0.00001	< 5E-06	< 5E-06	0.000046	< 5E-06	< 5E-06	< 5E-06
Mo	mg/L	0.036	0.056	0.058	0.155	0.044	0.049	0.046	0.049	0.017	0.016	0.013	0.023	0.004	0.001	0.005	0.0059	0.023	0.015	0.022	0.0162	0.012	0.017	0.008	0.00719	0.001	0.00045	0.02	0.0195
Ni	mg/L	0.004	0.001	< 0.0005	< 0.0005	0.007	0.001	0.001	0.00071	0.011	0.008	0.004	0.00284	0.005	< 0.001	< 0.0005	< 0.0005	0.012	0.002	0.001	0.00131	0.063	0.058	0.021	0.0153	0.005	0.02	0.003	0.00068
P	mg/L	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
K	mg/L	20.1	8	5.1	5.64	30.8	22.3	16.6	21.6	29.2	28.6	19	22.3	30.3	4.5	6.7	6.53	21.1	15.9	16.1	18.5	40.8	40.9	26.6	32.9	28.3	40.6	44.6	25.6
Se	mg/L	0.005	0.002	0	0.00033	0.004	0.002	0.001	0.000441	0.005	0.006	0.001	0.000603	0.008	0.001	0.001	0.000314	0.013	0.007	0.002	0.00236	0.005	0.006	0.001	0.000487	0.001	0.00049	0.001	0.000186
Si	mg/L	7.1	-	4.1	4.48	5.5	-	3.67	3.36	4.83	-	2.93	3.01	6.17	-	3.12	2.93	4.61	-	3.85	2.74	3.72	-	2.09	1.52	16.4	19.9	7.89	6.78
Ag	mg/L	< 0.00001	< 0.00002	< 0.00001	< 0.00001	< 0.00001	< 2E-05	< 0.00001	< 0.00001	< 0.00001	< 2E-05	< 0.00001	< 0.00001	< 0.00001	< 0.00002	< 0.00001	< 0.00001	< 0.00001	< 0.00002	< 0.00001	< 0.00001	0	< 0.00002	< 0.00001	< 0.00001	< 0.00001	< 0.00005	< 0.00001	< 0.00001
Na	mg/L	142	98.2	56.2	43.6	118	120	74.1	71.3	104	168	83.7	70	241	41	71.3	38.5	68.2	64.7	52.1	49.8	95.5	148	64.3	60.7	105	94.5	89.4	59.3
Sr	mg/L	0.291	-	0.046	0.0609	0.374	-	0.258	0.578	1.67	-	1.49	1.72	1.27	-	0.127	0.183	3.04	-	3.67	7.37	4.01	-	5.92	9.87	0.259	0.498	0.586	0.318
Tl	mg/L	0	< 0.0002	0	0.000018	0	0	0	0.000157	0	< 0.0002	0	0.000054	0	< 0.0002	0	0.000066	0	< 0.0002	0	0.000014	0	< 0.0002	0	0.00005	0	0.000362	0	0.000063
Sn	mg/L	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0005	< 0.0001	< 0.0001	0	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0005	< 0.0001	< 0.0001	< 0.0001	< 0.0005	< 0.0001	< 0.0001	0	< 0.0005	< 0.0001	< 0.0001
Ti	mg/L	< 0.01	< 0.01	< 0.0003	0.00104	< 0.01	0.017	< 0.0003	< 0.0003	< 0.01	0.028	< 0.0003	< 0.0003	< 0.01	< 0.01	< 0.0003	< 0.0003	< 0.01	0.019	< 0.0003	< 0.0003	< 0.01	0.026	< 0.0003	< 0.0003	< 0.0003	< 0.0015	< 0.0003	< 0.0003
U	mg/L	0.133	0.164	0.075	0.0674	0.439	0.591	0.39	0.572	0.402	0.752	0.433	0.491	0.032	0.004	0.005	0.00624	0.047	0.064	0.044	0.0454	0.132	0.573	0.223	0.245	0.006	0.000797	0.526	0.123
V	mg/L	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.002	< 0.0005	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	< 0.001	< 0.001	< 0.0005	< 0.0005	0.001	< 0.002	< 0.0005	< 0.0005	< 0.0005	< 0.0025	< 0.0005	< 0.0005
Zn	mg/L	0.004	0.019	< 0.001	0.0091	0.005	0.01	0.005	0.105	0.001	< 0.005	0.002	0.0762	0.003	0.56	0.024	0.152	< 0.001	0.214	0.03	0.107	0.002	0.012	0.001	0.0878	0.141	0.247	0.007	0.0075
Radioisotopes																													
Ra-226	Bq/L	-	-	0.026	0.026	-	-	0.026	0.026	-	-	0.06	0.057	-	-	<0.0100	0.011	-	-	0.025	0.023	-	-	0.016	0.028	-	0.028	0.39	0.099

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.1-4: Shake Flask Extraction Results for Waste Rock Kinetic Test Samples

Sample ID	Kinetic Test IDs	Volume Nanopure Water	Sample Weight	pH	Redox	Conductivity	Acidity (to pH 4.5)	Total Acidity (to pH 8.3)	Alkalinity	Sulphate
				meter	meter	meter	titration	titration	titration	Turbidity
		mL	g		mV	uS/cm	mg CaCO3/L	mg CaCO3/L	mg CaCO3/L	mg/L
GO	FB-GO, Col 5	750	250	7.88	384.27	101.19	#N/A	2.35	47.85	3
GS	FB-GS, HC3	750	250	7.84	375	198.51	#N/A	2.61	44.06	36
GT	FB-GT, Col6, HC3	750	250	7.76	381.34	89.22	#N/A	2.59	35.63	5
SO	FB-SO, Col3	750	250	7.96	371.58	142.46	#N/A	2.33	52.46	12
SS	FB-SS, HC2	750	250	7.98	368.65	156.94	#N/A	2.29	54.15	14
ST	FB-ST, HC1, Col 3	750	250	7.98	372.07	196.53	#N/A	2.3	47.91	36
KAM036824	HC7	750	250	7.65	364.74	204.91	#N/A	3.05	39.83	60
OKY Master	Col 13, HC5, FB-GGT	750	250	7.49	292.96	41.26	#N/A	2.63	9.69	6
OKY Master Sulphide	Col 14, HC6, FB-GGS	750	250	7.55	294.92	98.09	#N/A	3.02	34.85	11
KAM092488	HC8- No SFE performed due to limited sample size									

Appendix D.1-4: Shake Flask Extraction Results for Waste Rock Kinetic Test Samples

Sample ID	Ion Balance	Major Anions	Major Cations	Difference	Balance (%)	Dissolved Metals	Hardness CaCO3	Aluminum Al	Antimony Sb	Arsenic As	Barium Ba	Beryllium Be	Bismuth Bi
		Calc	Calc	Calc	Calc			ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
		meq/L	meq/L	meq/L	%		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
GO		1.0195	1.022534239	-0.003034239	-0.001485891		24.2	0.119	0.0039	0.0615	0.027	< 0.000007	< 0.000007
GS		1.6312	1.87800014	-0.24680014	-0.070329457		72.2	0.072	0.0076	0.0379	0.0324	< 0.000007	< 0.000007
GT		0.816766667	0.871236699	-0.054470032	-0.032268912		28.4	0.155	0.0038	0.0757	0.0999	< 0.000007	< 0.000007
SO		1.2992	1.4093294	-0.1101294	-0.040660219		48	0.0541	0.0086	0.0257	0.0906	< 0.000007	< 0.000007
SS		1.374666667	1.534757719	-0.160091052	-0.055024991		51.8	0.115	0.0297	0.0674	0.113	< 0.000007	< 0.000007
ST		1.7082	1.829127954	-0.120927954	-0.034186243		61	0.053	0.0016	0.0157	0.0759	< 0.000007	< 0.000007
KAM036824		2.0466	1.913945841	0.132654159	0.033493908		77.5	0.105	0.0221	0.0655	0.0232	0.000008	< 0.000007
OKY Master		0.321219355	0.403744358	-0.082525003	-0.113833288		0.89	0.183	0.0071	0.167	0.00162	0.000012	< 0.000007
OKY Master Sulphide		0.927424731	0.933909099	-0.006484368	-0.003483721		25.1	0.108	0.003	0.0423	0.0077	0.000008	< 0.000007
KAM092488													

Appendix D.1-4: Shake Flask Extraction Results for Waste Rock Kinetic Test Samples

Sample ID	Boron B	Cadmium Cd	Calcium Ca	Chromium Cr	Cobalt Co	Copper Cu	Iron Fe	Lead Pb	Lithium Li	Magnesium Mg	Manganese Mn	Mercury Hg	Molybdenum Mo	Nickel Ni
	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L
GO	0.0173	0.000009	6.96	0.00025	0.000099	0.0017	0.033	0.00005	0.00156	1.65	0.0022	0.02	0.0146	0.0009
GS	0.0081	0.000006	16.3	< 0.00003	0.000072	0.00109	< 0.002	< 0.00001	0.00292	7.67	0.0092	< 0.01	0.00359	0.0006
GT	0.0095	0.000007	7.5	< 0.00003	0.000091	0.00114	0.012	0.00003	0.00164	2.36	0.0036	0.01	0.00709	0.0007
SO	0.0095	0.000004	13.9	0.00027	0.000079	0.00094	0.006	0.00001	0.00283	3.23	0.0019	0.02	0.00494	0.0006
SS	0.0086	0.000004	11.5	0.00009	0.000077	0.00126	0.004	0.00002	0.00324	5.6	0.0049	< 0.01	0.00149	0.0024
ST	0.0132	0.000004	15.2	0.00017	0.000115	0.00203	0.01	0.00001	0.00363	5.6	0.0041	< 0.01	0.0076	0.0022
KAM036824	0.0093	< 0.000003	18.4	0.00017	0.000587	0.00085	0.024	0.0001	0.00337	7.64	0.0233	< 0.01	0.00063	0.0067
OKY Master	0.0246	0.000005	0.24	0.00005	0.00009	0.00162	0.103	0.00075	0.00281	0.069	0.0215	0.01	0.00282	< 0.0001
OKY Master Sulphide	0.021	< 0.000003	7.82	0.00004	0.000122	0.00074	0.033	0.0001	0.00744	1.35	0.0814	< 0.01	0.00513	< 0.0001
KAM092488														

Appendix D.1-4: Shake Flask Extraction Results for Waste Rock Kinetic Test Samples

Sample ID	Phosphorus P	Potassium K	Selenium Se	Silicon Si	Silver Ag	Sodium Na	Strontium Sr	Sulphur (S)	Thallium Tl	Tin Sn	Titanium Ti	Uranium U	Vanadium V	Zinc Zn	Zirconium Zr
	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
GO	0.044	3.51	0.00012	3.97	< 0.000002	9.83	0.0345	1.26	0.000026	0.00009	0.00091	0.0106	0.00079	< 0.001	< 0.002
GS	< 0.009	5.73	0.00007	2.59	< 0.000002	6.35	0.119	16.5	0.00002	0.00003	0.00012	0.0101	0.00083	0.001	< 0.002
GT	0.018	3.65	0.00014	2.4	< 0.000002	4.42	0.0504	3.01	0.000087	0.0001	0.0003	0.0108	0.00053	< 0.001	< 0.002
SO	< 0.009	3.67	0.00026	2.82	< 0.000002	8.05	0.0803	5.63	0.000071	0.00007	0.00021	0.00125	0.00028	< 0.001	< 0.002
SS	< 0.009	8.23	0.00021	2.2	< 0.000002	5.97	0.68	6.98	0.000022	0.00007	0.00039	0.0072	0.00304	< 0.001	< 0.002
ST	< 0.009	6.54	0.00075	3.45	< 0.000002	9.55	0.936	15.1	0.00002	0.00005	0.00064	0.00453	0.00098	0.001	< 0.002
KAM036824	< 0.003	4.68	0.0001	1.19	0.000033	5.26	0.0945	19.3	0.000038	0.00004	0.00039	0.00766	0.00102	< 0.001	< 0.002
OKY Master	0.025	3.98	< 0.001	7.14	0.000003	5.79	0.00119	2.5	0.000033	0.00004	0.00327	0.000469	0.00037	0.001	< 0.002
OKY Master Sulphide	0.013	6.16	< 0.001	5.26	0.000002	5.97	0.0185	3.9	0.000044	< 0.00001	0.0011	0.00191	0.00103	< 0.001	< 0.002
KAM092488															

APPENDIX D.2: KINETIC TEST RESULTS FOR ORE

Appendix D.2-1: Overview of Operating Procedures for the Coffee Gold Mine Ore Kinetic Tests

Kinetic Test ID	Test Sample ID	Sample Description	Type of Test	Lithology	Weathering Facies	Column Dimensions		Dry Wt. of Sample (kg)	Temp (°C)	Operation Procedure	Sampling Frequency	Total Volume of Initial Flushings (mL)	Flushing Rate/ Weekly Input* (mL)	Start Date	Test Status	Cycles/ Weeks
						Inner Diameter (cm)	Length (cm)									
Col 7	72139B	Kona Oxide Ore	Unsaturated Column	Granite	Oxide	21.0	20.5	4.39	4°	Trickle Leach	Biweekly	750	variable	22-Apr-15	active	45
Col 8	72140B	Kona Transition Ore	Unsaturated Column	Granite	Transition	21.0	20.5	4.35	4°	Trickle Leach	Biweekly	700	variable	22-Apr-15	active	45
Col 9	50% 72135B, 50% 72136B	Latte Oxide Ore	Unsaturated Column	Schist	Oxide	21.0	20.5	5	4°	Trickle Leach	Biweekly	700	variable	22-Apr-15	active	45
Col 10	50% 72137B, 50% 72138B	Latte Transition Ore	Unsaturated Column	Schist	Transition	21.0	20.5	5	4°	Trickle Leach	Biweekly	700	variable	22-Apr-15	active	45
Col 11	50% 72144B, 50% 72145B	Supremo Oxide Ore	Unsaturated Column	Gneiss	Oxide	21.0	20.5	5	4°	Trickle Leach	Biweekly	700	variable	22-Apr-15	active	45
Col 12	72146B	Supremo Transition Ore	Unsaturated Column	Gneiss	Transition	21.0	20.5	4.33	4°	Trickle Leach	Biweekly	750	variable	22-Apr-15	active	45

Notes:
Columns and humidity cells are composed of Plexiglas with an acrylic perforated disk & nylon mesh
No sample preparation was conducted prior to leachate sampling for any tests
* generally 400-500 mL, see individual leachate results in Appendix D.2-3 for specific input volumes

Appendix D.2-2 Static Test Results for Ore Kinetic Test Samples

Acid-Base Accounting Results

Kinetic Tests	Description	Test Sample ID	Lithology	Weathering Facies	Rinse pH	Paste pH	TIC	CaNP	Total C	Total S	S(SO4)	S(S-2)	Insoluble S	AP	Sobek NP	Siderite NP	Sobek NNP	Siderite NNP	Fizz Test
					s.u.	s.u.	%	kg $CaCO_3$/t	%	%	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	
				Method Code	*Sobek*	*Sobek*	*CSB02V*	*Calc.*	*CSA06V*	*CSA06V*	*CSA07V*	*CSA08D*	*Calc.*	*Calc.*	*Sobek*	*Siderite Corr.*	*Calc.*	*Calc.*	*Sobek*
				Limit of Detection	*0.20*	*0.20*	*0.01*	*#N/A*	*0.005*	*0.005*	*0.01*	*0.01*	*#N/A*	*#N/A*	*0.5*	*0.5*	*#N/A*	*#N/A*	*#N/A*
Col 7	Kona Oxide	72139B	Granite	Oxide	5.7	5.9	0.020	1.7	0.024	0.027	*<0.01*	0.010	0.017	0.31	0.73	7.1	0.41	6.8	none
Col 8	Kona 80% CN	72140B	Granite	Transition	4.4	4.9	0.020	1.7	0.039	0.15	0.020	0.11	0.021	3.4	0.48	7.0	-3.0	3.6	none
Col 9	Latte Oxide Ore	50% 72135B, 50% 72136B	Schist	Oxide	7.4	7.5	1.5	125	1.6	0.14	0.035	0.090	0.017	2.8	79	105	76	102	moderate
Col 10	Latte Transition Ore	50% 72137B, 50% 72138B	Schist	Transition	7.4	7.4	1.8	148	1.8	0.54	0.050	0.44	0.052	14	100	129	86	115	moderate
Col 11	Supremo Oxide Ore	50% 72144B, 50% 72145B	Gneiss	Oxide	7.4	7.3	0.060	5.0	0.082	0.024	*<0.01*	*<0.01*	0.024	0.31	8.5	15	8.5	15	none
Col 12	Supremo 80%	72146B	Gneiss	Transition	7.3	7.5	0.40	33	0.44	0.13	0.020	0.090	0.018	2.8	38	44	35	42	slight

Notes:
Values in grey italics are below the analytical detection limit
CaNP = carbonate NP calculated from total inorganic carbon (TIC)
NNP = net neutralization potential, derived by subtracting acid potential (AP) from NP

Appendix D.2-2 Static Test Results for Ore Kinetic Test Samples

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Description	Test Sample ID	Lithology	Weathering Facies	Ag	Al	As	B	Ba	Be	Bi	Ca	Flushing Rate/ Weekly Input* (mL)	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Lu	Mg	Mn
					ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm
				Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
				Limit of Detection	*0.01*	*0.01*	*1*	*10*	*5*	*0.1*	*0.02*	*0.01*	*0.01*	*0.05*	*0.1*	*1*	*0.05*	*0.5*	*0.01*	*0.1*	*0.1*	*0.05*	*0.01*	*0.02*	*0.01*	*0.1*	*1*	*0.01*	*0.01*	*2*
Col 7	Kona Oxide	72139B	Granite	Oxide	0.080	0.41	3080	*<10*	64	0.50	0.080	0.050	0.060	26	1.2	77	1.5	0.80	1.3	1.4	*<0.1*	0.32	0.83	*<0.02*	0.13	15	*<1*	0.13	0.020	114
Col 8	Kona 80% CN	72140B	Granite	Transition	0.090	0.34	5770	*<10*	44	0.40	0.10	0.050	0.040	24	1.9	76	1.4	3.8	1.5	1.2	*<0.1*	0.27	4.0	*<0.02*	0.12	14	*<1*	0.11	0.010	217
Col 9	Latte Oxide Ore	50% 72135B, 50% 72136B	Schist	Oxide	0.25	0.44	1265	*<10*	548	1.1	0.52	3.9	0.10	52	11	86	2.1	20	2.7	1.5	*<0.1*	0.13	0.48	0.020	0.21	28	1.0	0.20	0.73	545
Col 10	Latte Transition Ore	50% 72137B, 50% 72138B	Schist	Transition	0.29	0.65	1215	*<10*	313	0.85	0.48	4.0	0.090	52	11	83	2.5	21	2.6	2.2	*<0.1*	0.11	0.47	0.020	0.27	29	2.5	0.20	1.2	502
Col 11	Supremo Oxide Ore	50% 72144B, 50% 72145B	Gneiss	Oxide	0.11	0.43	940	*<10*	198	0.95	0.21	0.32	0.060	54	5.6	84	1.9	4.1	1.6	1.3	*<0.1*	0.17	0.96	*<0.02*	0.20	32	1.0	0.17	0.10	300
Col 12	Supremo 80%	72146B	Gneiss	Transition	0.16	0.56	1700	*<10*	191	0.90	0.30	1.1	0.040	57	6.6	107	2.4	3.5	1.8	1.9	*<0.1*	0.17	1.2	*<0.02*	0.26	34	2.0	0.17	0.42	396

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.2-2 Static Test Results for Ore Kinetic Test Samples

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Description	Test Sample ID	Lithology	Weathering Facies	Mo	Na	Nb	Ni	P	Pb	Rb	S	Sb	Sc	Se	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	U	V	W	Y	Yb	Zn	Zr
					ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
				Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
				Limit of Detection	*0.05*	*0.01*	*0.05*	*0.5*	*0.005*	*0.2*	*0.2*	*0.01*	*0.05*	*0.1*	*1*	*0.3*	*0.5*	*0.05*	*0.02*	*0.05*	*0.1*	*0.01*	*0.02*	*0.05*	*1*	*0.1*	*0.05*	*0.1*	*1*	*0.5*
Col 7	Kona Oxide	72139B	Granite	Oxide	1.9	*<0.01*	0.41	1.9	0.013	15	11	0.020	37	2.5	*<1*	*<0.3*	18	*<0.05*	0.24	*<0.05*	18	*<0.01*	0.56	9.6	10	0.20	7.2	0.80	18	12
Col 8	Kona 80% CN	72140B	Granite	Transition	2.3	*<0.01*	0.34	2.3	0.014	16	8.8	0.14	128	2.3	*<1*	0.30	21	*<0.05*	0.22	*<0.05*	17	*<0.01*	1.2	9.7	8.0	0.10	6.3	0.70	19	11
Col 9	Latte Oxide Ore	50% 72135B, 50% 72136B	Schist	Oxide	1.5	0.010	*<0.05*	52	0.043	17	12	0.14	21	4.8	*<1*	0.40	135	*<0.05*	0.50	0.060	12	*<0.01*	0.33	2.8	18	0.70	14	1.3	55	4.4
Col 10	Latte Transition Ore	50% 72137B, 50% 72138B	Schist	Transition	2.8	0.015	0.070	44	0.043	17	16	0.54	36	5.2	*<1*	0.45	165	*<0.05*	0.51	0.070	12	0.010	0.57	2.6	23	0.25	14	1.4	48	3.4
Col 11	Supremo Oxide Ore	50% 72144B, 50% 72145B	Gneiss	Oxide	2.0	0.010	*<0.05*	17	0.026	13	12	0.010	40	2.9	*<1*	0.55	24	*<0.05*	0.38	*<0.05*	25	*<0.01*	0.68	13	15	0.45	11	1.1	26	5.7
Col 12	Supremo 80%	72146B	Gneiss	Transition	3.1	0.010	0.070	12	0.030	14	17	0.12	20	2.8	*<1*	0.30	49	*<0.05*	0.40	0.060	25	*<0.01*	1.2	11	14	0.20	11	1.1	27	6.1

Notes:

Values in grey italics are below the analytical detection limit

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 7 (Kona Granite Oxide Ore)

Date	Cycle	Week	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Flushing Rate/ Weekly Input* (mL)	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
	No.		Input	Output		umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	750	300	7.6	622	#N/A	5.9	43	242	23	0.090	*< 0.3*	159	0.0084	0.028	0.30	0.00032	*< 7E-06*	*< 7E-06*	0.028	0.000011	45	0.000040	0.0080
6-May-15	2	3	400	350	7.6	281	#N/A	3.0	20	96	6.0	0.18	*< 0.3*	49	0.10	0.029	0.28	0.00088	*< 7E-06*	*< 7E-06*	0.019	*< 3E-06*	14	*< 3E-05*	0.0013
20-May-15	3	5	400	390	7.7	167	#N/A	2.9	16	45	3.0	0.23	*< 0.3*	22	0.052	0.028	0.41	0.00024	*< 7E-06*	*< 7E-06*	0.018	*< 3E-06*	6.0	*< 3E-05*	0.00040
3-Jun-15	4	7	400	270	7.7	128	#N/A	3.3	21	32	2.0	0.25	*< 0.3*	16	0.24	0.030	0.47	0.00086	0.0000070	*< 7E-06*	0.021	*< 3E-06*	4.4	0.000040	0.00024
17-Jun-15	5	9	500	470	7.5	85	#N/A	3.2	18	18	1.2	0.25	*< 0.3*	9.0	0.11	0.032	0.70	0.00043	*< 7E-06*	*< 7E-06*	0.018	0.0000050	2.5	0.000030	0.00016
1-Jul-15	6	11	500	475	7.8	69	#N/A	3.0	18	11	*< 1*	0.26	*< 0.3*	7.0	0.16	0.031	0.71	0.00050	*< 7E-06*	*< 7E-06*	0.015	*< 3E-06*	2.0	*< 3E-05*	0.00011
15-Jul-15	7	13	500	460	7.5	61	#N/A	3.2	21	8.0	*< 1*	0.25	*< 0.3*	7.5	0.20	0.027	0.59	0.00063	*< 7E-06*	*< 7E-06*	0.017	*< 3E-06*	2.0	0.000030	0.00014
29-Jul-15	8	15	400	375	7.6	60	#N/A	2.0	17	9.0	1.0	0.44	*< 0.3*	6.8	0.34	0.027	0.55	0.0011	0.000015	0.000012	0.020	*< 3E-06*	1.9	0.00011	0.00020
12-Aug-15	9	17	400	405	7.4	56	#N/A	1.9	16	8.0	*< 1*	0.24	*< 0.3*	7.4	0.12	0.025	0.53	0.00037	*< 7E-06*	*< 7E-06*	0.016	*< 3E-06*	2.1	0.000040	0.000096
26-Aug-15	10	19	500	470	7.4	53	#N/A	2.0	14	7.0	1.0	0.25	0.30	6.9	0.26	0.025	0.54	0.0010	0.000012	0.0000070	0.015	0.0000030	1.9	0.000055	0.000093
9-Sep-15	11	21	500	485	7.4	46	#N/A	2.1	13	6.0	*< 1*	0.25	*< 0.3*	6.3	0.41	0.025	0.56	0.0017	0.000016	*< 7E-06*	0.014	*< 3E-06*	1.8	0.000070	0.000089
23-Sep-15	12	23	500	475	7.4	49	#N/A	1.5	14	5.0	1.0	0.24	0.30	6.7	0.26	0.024	0.51	0.0010	0.000012	0.0000070	0.012	0.0000030	1.9	0.000065	0.000074
7-Oct-15	13	25	500	385	7.6	46	#N/A	1.8	16	5.0	*< 1*	0.23	-	7.1	0.10	0.024	0.46	0.00033	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	2.0	0.000060	0.000059
21-Oct-15	14	27	400	400	7.5	42	#N/A	1.4	12	5.0	*< 1*	0.23	-	6.9	0.017	0.022	0.44	0.00018	*< 7E-06*	*< 7E-06*	0.014	*< 3E-06*	1.9	0.000070	0.000075
4-Nov-15	15	29	400	385	7.4	42	#N/A	1.8	11	5.0	*< 1*	0.22	-	7.1	0.024	0.017	0.43	0.00018	*< 7E-06*	*< 7E-06*	0.0067	*< 3E-06*	2.0	0.000040	0.0000050
18-Nov-15	16	31	400	385	7.7	42	#N/A	0.90	13	5.0	*< 1*	0.22	-	7.3	0.16	0.018	0.44	0.00065	*< 7E-06*	*< 7E-06*	0.0084	*< 3E-06*	2.0	0.000040	0.000080
2-Dec-15	17	33	400	380	7.1	45	#N/A	2.9	11	4.0	*< 1*	0.20	-	9.2	0.055	0.018	0.42	0.00095	*< 7E-06*	*< 7E-06*	0.011	0.0000030	2.6	0.000050	0.00041
16-Dec-15	18	35	400	370	8.1	43	#N/A	3.1	13	4.0	*< 1*	0.19	-	9.0	0.36	0.019	0.42	0.0012	0.000017	*< 7E-06*	0.012	*< 3E-06*	2.5	0.000060	0.000082
30-Dec-15	19	37	400	375	7.1	41	#N/A	2.1	9.1	4.0	*< 1*	0.20	-	8.8	0.12	0.016	0.37	0.00046	*< 7E-06*	*< 7E-06*	0.0086	0.0000050	2.4	0.000070	0.000082
13-Jan-16	20	39	400	360	7.0	46	#N/A	2.2	9.0	4.0	*< 1*	0.18	-	9.5	0.067	0.016	0.31	0.00031	0.000031	*< 7E-06*	0.015	0.000010	2.6	0.000050	0.00010
27-Jan-16	21	41	400	370	6.9	44	#N/A	3.6	9.6	3.0	*< 1*	0.19	-	9.6	0.068	0.016	0.35	0.00063	*< 7E-06*	*< 7E-06*	0.0090	0.0000040	2.6	*< 3E-05*	0.000081
10-Feb-16	22	43	400	400	7.0	43	#N/A	2.7	9.8	3.0	*< 1*	0.16	-	9.4	0.10	0.016	0.37	0.00061	*< 7E-06*	*< 7E-06*	0.0070	0.0000050	2.6	*< 3E-05*	0.000069
24-Feb-16	23	45	400	355	7.1	44	#N/A	3.0	9.0	3.0															
9-Mar-16	24	47	400	375	7.1	40	#N/A	3.0	9.4	3.0															

Calculated Loading Rates for Col 7

Date	Cycle	Week	Volume (mL)		pH	Cond.	Acidity (pH 4.5)	Acidity (pH 8.3)	Alkalinity	Sulphate	Chloride	Fluoride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr	Co
-	No.	-	Input	Output	-	umhos/cm	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	750	300	7.6	622	#N/A	0.40	2.9	17	1.6	0.0062	0.021	11	0.00057	0.0019	0.021	0.000022	0.00000048	0.00000048	0.0019	0.00000075	3.1	0.0000027	0.00055
6-May-15	2	3	400	350	7.6	281	#N/A	0.12	0.81	3.8	0.24	0.0072	0.012	1.9	0.0041	0.0012	0.011	0.000035	0.00000028	0.00000028	0.00077	0.00000012	0.55	0.0000012	0.000050
20-May-15	3	5	400	390	7.7	167	#N/A	0.13	0.70	2.0	0.13	0.010	0.013	0.96	0.0023	0.0013	0.018	0.000011	0.00000031	0.00000031	0.00080	0.00000013	0.27	0.0000013	0.000018
3-Jun-15	4	7	400	270	7.7	128	#N/A	0.10	0.66	0.98	0.062	0.0077	0.0092	0.49	0.0075	0.00093	0.014	0.000026	0.00000022	0.00000022	0.00065	0.000000092	0.14	0.0000012	0.0000073
17-Jun-15	5	9	500	470	7.5	85	#N/A	0.17	0.95	0.96	0.064	0.013	0.016	0.48	0.0056	0.0017	0.037	0.000023	0.00000037	0.00000037	0.00098	0.00000027	0.14	0.0000016	0.0000086
1-Jul-15	6	11	500	475	7.8	69	#N/A	0.16	0.95	0.60	0.054	0.014	0.016	0.38	0.0084	0.0017	0.038	0.000027	0.00000038	0.00000038	0.00080	0.00000016	0.11	0.0000016	0.0000062
15-Jul-15	7	13	500	460	7.5	61	#N/A	0.17	1.1	0.42	0.052	0.013	0.016	0.39	0.011	0.0014	0.031	0.000033	0.00000037	0.00000037	0.00091	0.00000016	0.11	0.0000016	0.0000075
29-Jul-15	8	15	400	375	7.6	60	#N/A	0.085	0.73	0.38	0.043	0.019	0.013	0.29	0.015	0.0011	0.024	0.000046	0.00000064	0.00000051	0.00086	0.00000013	0.081	0.0000047	0.0000085
12-Aug-15	9	17	400	405	7.4	56	#N/A	0.089	0.74	0.37	0.046	0.011	0.014	0.34	0.0053	0.0011	0.024	0.000017	0.00000032	0.00000032	0.00076	0.00000014	0.095	0.0000018	0.0000044
26-Aug-15	10	19	500	470	7.4	53	0.00	0.11	0.77	0.37	0.054	0.013	0.016	0.37	0.014	0.0013	0.029	0.000056	0.00000062	0.00000037	0.00082	0.00000016	0.10	0.0000029	0.0000050
9-Sep-15	11	21	500	485	7.4	46	#N/A	0.11	0.70	0.33	0.055	0.014	0.017	0.35	0.023	0.0014	0.031	0.000095	0.00000088	0.00000039	0.00078	0.00000017	0.097	0.0000039	0.0000049
23-Sep-15	12	23	500	475	7.4	49	#N/A	0.083	0.74	0.27	0.054	0.013	0.016	0.36	0.014	0.0013	0.028	0.000055	0.00000062	0.00000038	0.00067	0.00000016	0.10	0.0000035	0.0000040
7-Oct-15	13	25	500	385	7.6	46	#N/A	0.079	0.68	0.22	0.044	0.010		0.31	0.0046	0.0010	0.020	0.000014	0.00000031	0.00000031	0.00047	0.00000013	0.086	0.0000026	0.0000026
21-Oct-15	14	27	400	400	7.5	42	#N/A	0.063	0.56	0.23	0.046	0.010		0.31	0.00076	0.00099	0.020	0.0000082	0.00000032	0.00000032	0.00062	0.00000014	0.087	0.0000032	0.0000034
4-Nov-15	15	29	400	385	7.4	42	#N/A	0.081	0.49	0.22	0.044	0.0096		0.31	0.0010	0.00076	0.019	0.0000079	0.00000031	0.00000031	0.00029	0.00000013	0.086	0.0000018	0.00000022
18-Nov-15	16	31	400	385	7.7	42	#N/A	0.040	0.56	0.22	0.044	0.0096		0.32	0.0070	0.00079	0.019	0.000029	0.00000031	0.00000031	0.00037	0.00000013	0.087	0.0000018	0.0000035
2-Dec-15	17	33	400	380	7.1	45	#N/A	0.12	0.49	0.17	0.043	0.0087		0.40	0.0024	0.00079	0.018	0.000041	0.00000030	0.00000030	0.00047	0.00000013	0.11	0.0000022	0.000018
16-Dec-15	18	35	400	370	8.1	43	#N/A	0.13	0.55	0.17	0.042	0.0080		0.38	0.015	0.00078	0.018	0.000048	0.00000072	0.00000029	0.00052	0.00000013	0.10	0.0000025	0.0000035
30-Dec-15	19	37	400	375	7.1	41	#N/A	0.090	0.39	0.17	0.043	0.0085		0.38	0.0051	0.00066	0.016	0.000020	0.00000030	0.00000030	0.00037	0.00000021	0.10	0.0000030	0.0000035
13-Jan-16	20	39	400	360	7.0	46	#N/A	0.090	0.37	0.16	0.041	0.0074		0.39	0.0027	0.00064	0.013	0.000013	0.0000013	0.00000029	0.00062	0.00000041	0.11	0.0000021	0.0000042
27-Jan-16	21	41	400	370	6.9	44	#N/A	0.15	0.40	0.13	0.042	0.0080		0.40	0.0028	0.00067	0.015	0.000027	0.00000029	0.00000029	0.00038	0.00000017	0.11	0.0000013	0.0000034
10-Feb-16	22	43	400	400	7.0	43	#N/A	0.12	0.44	0.14	0.046	0.0073		0.43	0.0047	0.00071	0.017	0.000028	0.00000032	0.00000032	0.00032	0.00000023	0.12	0.0000014	0.0000031
24-Feb-16	23	45	400	355	7.1	44	#N/A	0.12	0.36	0.12															
9-Mar-16	24	47	400	375	7.1	40	#N/A	0.13	0.40	0.13															

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 7 (Kona Granite Oxide Ore)

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	750	300	0.0069	*< 0.007*	0.00018	0.0035	11	0.75	0.28	0.00044	0.0039	0.015	7.4	0.0019	5.7	0.000088	67	0.36	85	0.00025	0.00014	0.000080	0.0015	0.00014	0.0080	*< 0.002*
6-May-15	2	3	400	350	0.0039	0.0090	0.000020	0.0011	3.4	0.15	0.030	0.0020	0.0013	0.0050	3.8	*< 0.001*	2.7	0.000014	32	0.091	35	0.000094	*< 1E-05*	0.00020	0.00096	0.00015	0.0030	*< 0.002*
20-May-15	3	5	400	390	0.0028	*< 0.007*	0.000020	0.00066	1.6	0.058	0.020	0.0071	0.00080	0.010	2.5	0.00029	2.4	0.000017	19	0.040	15	0.000066	0.000060	0.00016	0.00050	0.00012	*< 0.001*	*< 0.002*
3-Jun-15	4	7	400	270	0.0031	0.028	0.00013	0.00061	1.2	0.035	0.020	0.0032	0.00050	0.010	2.2	0.00018	2.6	0.000013	16	0.029	11	0.000056	0.00034	0.00063	0.0012	0.00033	0.0020	*< 0.002*
17-Jun-15	5	9	500	470	0.0012	0.013	0.000030	0.00044	0.65	0.021	0.010	0.0075	0.00030	0.025	1.6	0.00022	2.2	0.000011	12	0.017	6.9	0.000054	0.000030	0.00025	0.00041	0.00018	*< 0.001*	*< 0.002*
1-Jul-15	6	11	500	475	0.00091	0.016	0.000020	0.00041	0.52	0.015	0.030	0.0034	0.00020	0.027	1.4	0.00010	2.2	0.0000040	9.8	0.013	4.0	0.000048	0.000060	0.00098	0.0013	0.00018	*< 0.001*	*< 0.002*
15-Jul-15	7	13	500	460	0.0014	0.025	0.00012	0.00039	0.59	0.019	0.020	0.0021	0.00020	0.019	1.4	0.000070	2.3	0.000010	9.8	0.014	3.1	0.000053	0.000060	0.00065	0.00049	0.00020	*< 0.001*	*< 0.002*
29-Jul-15	8	15	400	375	0.0011	0.046	0.00015	0.00045	0.50	0.015	0.010	0.0024	0.00020	0.024	1.4	0.00011	2.5	0.0000040	8.5	0.013	3.3	0.000048	0.000070	0.00086	0.00043	0.00029	*< 0.001*	*< 0.002*
12-Aug-15	9	17	400	405	0.0012	0.013	0.000040	0.00040	0.56	0.015	0.010	0.0025	0.00020	0.020	1.5	0.00010	2.3	0.0000050	8.3	0.014	2.9	0.000055	0.00010	0.00032	0.00042	0.00020	*< 0.001*	*< 0.002*
26-Aug-15	10	19	500	470	0.0014	0.033	0.00011	0.00038	0.52	0.014	0.015	0.0023	0.00020	0.021	1.5	0.000085	2.4	0.0000070	7.3	0.012	4.0	0.000051	0.00011	0.00069	0.00040	0.00024	0.0015	0.0020
9-Sep-15	11	21	500	485	0.0015	0.053	0.00017	0.00037	0.47	0.012	0.020	0.0021	0.00020	0.022	1.4	0.000070	2.5	0.0000090	6.4	0.011	5.1	0.000046	0.00012	0.0011	0.00037	0.00028	0.0020	*< 0.002*
23-Sep-15	12	23	500	475	0.0012	0.033	0.00013	0.00034	0.50	0.013	0.015	0.0017	0.00015	0.018	1.4	0.000055	2.3	0.0000060	6.2	0.012	3.7	0.000036	0.00010	0.00064	0.00056	0.00022	0.0015	0.0020
7-Oct-15	13	25	500	385	0.00076	0.012	0.000080	0.00031	0.54	0.014	0.010	0.0014	0.00010	0.013	1.3	*< 4E-05*	2.1	0.0000030	6.1	0.013	2.3	0.000026	0.000080	0.00022	0.00075	0.00015	*< 0.001*	*< 0.002*
21-Oct-15	14	27	400	400	0.0023	*< 0.007*	0.000060	0.00032	0.52	0.015	*< 0.01*	0.0040	0.00010	0.011	1.2	0.000060	2.1	0.0000040	5.0	0.012	1.8	0.000046	0.00058	*< 5E-05*	0.00029	0.00014	*< 0.001*	*< 0.002*
4-Nov-15	15	29	400	385	0.0018	0.0090	0.000050	0.00022	0.52	0.012	0.010	0.0012	0.00010	0.0090	1.3	*< 4E-05*	1.8	*< 2E-06*	4.9	0.012	1.7	0.000049	0.00021	*< 5E-05*	0.00024	0.00019	0.0010	*< 0.002*
18-Nov-15	16	31	400	385	0.00059	0.028	0.000070	0.00032	0.56	0.013	0.030	0.0031	*< 0.0001*	0.010	1.3	0.00013	2.1	0.0000040	4.9	0.015	1.6	0.000040	0.000020	0.00091	0.0027	0.00018	*< 0.001*	*< 0.002*
2-Dec-15	17	33	400	380	0.0014	0.010	0.000020	0.00029	0.67	0.021	*< 0.01*	0.0023	0.00080	0.013	1.4	0.00014	2.1	0.0000030	5.4	0.016	2.4	0.000023	0.000050	0.000070	0.00023	0.00016	0.0090	*< 0.002*
16-Dec-15	18	35	400	370	0.0011	0.051	0.00011	0.00037	0.68	0.021	0.020	0.0015	0.00020	0.015	1.5	0.000080	2.7	0.0000020	5.0	0.016	1.3	0.000028	0.000070	0.0011	0.00027	0.00027	0.0030	*< 0.002*
30-Dec-15	19	37	400	375	0.0010	0.020	0.000070	0.00034	0.69	0.019	0.020	0.0012	0.00020	0.0060	1.3	*< 4E-05*	2.0	0.0000050	4.5	0.016	2.0	0.000027	*< 1E-05*	0.00033	0.0012	0.00016	0.0020	*< 0.002*
13-Jan-16	20	39	400	360	0.00070	0.011	0.000030	0.00033	0.73	0.022	0.010	0.0020	0.00010	0.0040	1.4	0.00019	2.2	0.0000020	4.4	0.015	1.3	*< 5E-06*	0.000060	0.00024	0.00019	0.00011	0.0010	*< 0.002*
27-Jan-16	21	41	400	370	0.00063	0.012	*< 1E-05*	0.00033	0.74	0.023	0.010	0.00092	0.00010	0.011	1.4	*< 4E-05*	2.2	0.0000020	4.0	0.017	1.4	0.000035	0.000050	0.000070	0.00041	0.00011	0.0010	*< 0.002*
10-Feb-16	22	43	400	400	0.00076	0.014	0.00011	0.00033	0.72	0.019	0.020	0.00080	0.00020	0.0060	1.3	0.000060	2.2	*< 2E-06*	3.6	0.016	1.9	0.000037	0.00029	0.00018	0.00075	0.00013	0.0010	*< 0.002*
24-Feb-16	23	45	400	355																								
9-Mar-16	24	47	400	375																								

Calculated Loading Rates for Col 7

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	750	300	0.00047	0.00048	0.000012	0.00024	0.77	0.051	0.019	0.000030	0.00027	0.0010	0.51	0.00013	0.39	0.0000060	4.6	0.025	5.8	0.000017	0.0000096	0.0000055	0.00011	0.0000096	0.00055	0.00014
6-May-15	2	3	400	350	0.00015	0.00036	0.00000080	0.000043	0.13	0.0059	0.0012	0.000078	0.000052	0.00020	0.15	0.000040	0.11	0.00000056	1.3	0.0036	1.4	0.0000037	0.00000040	0.0000080	0.000038	0.0000060	0.00012	0.000080
20-May-15	3	5	400	390	0.00012	0.00031	0.00000089	0.000029	0.069	0.0026	0.00089	0.00032	0.000036	0.00044	0.11	0.000013	0.11	0.00000076	0.85	0.0018	0.67	0.0000029	0.0000027	0.0000071	0.000022	0.0000053	0.000044	0.000089
3-Jun-15	4	7	400	270	0.000096	0.00086	0.0000040	0.000019	0.036	0.0011	0.00062	0.000097	0.000015	0.00031	0.068	0.0000055	0.079	0.00000040	0.50	0.00090	0.34	0.0000017	0.000010	0.000019	0.000038	0.000010	0.000062	0.000062
17-Jun-15	5	9	500	470	0.000065	0.00070	0.0000016	0.000023	0.035	0.0011	0.00054	0.00040	0.000016	0.0013	0.086	0.000012	0.12	0.00000059	0.64	0.00090	0.37	0.0000029	0.0000016	0.000013	0.000022	0.0000096	0.000054	0.00011
1-Jul-15	6	11	500	475	0.000049	0.00087	0.0000011	0.000022	0.028	0.00083	0.0016	0.00018	0.000011	0.0015	0.074	0.0000054	0.12	0.00000022	0.53	0.00072	0.22	0.0000026	0.0000032	0.000053	0.000070	0.0000097	0.000054	0.00011
15-Jul-15	7	13	500	460	0.000073	0.0013	0.0000063	0.000020	0.031	0.0010	0.0010	0.00011	0.000010	0.00100	0.074	0.0000037	0.12	0.00000052	0.51	0.00075	0.16	0.0000028	0.0000031	0.000034	0.000026	0.000010	0.000052	0.00010
29-Jul-15	8	15	400	375	0.000046	0.0020	0.0000064	0.000019	0.021	0.00063	0.00043	0.00010	0.0000085	0.0010	0.058	0.0000047	0.10	0.00000017	0.36	0.00054	0.14	0.0000021	0.0000030	0.000037	0.000019	0.000012	0.000043	0.000085
12-Aug-15	9	17	400	405	0.000056	0.00060	0.0000018	0.000019	0.026	0.00069	0.00046	0.00012	0.0000092	0.00092	0.069	0.0000046	0.10	0.00000023	0.38	0.00062	0.13	0.0000025	0.0000046	0.000015	0.000020	0.0000092	0.000046	0.000092
26-Aug-15	10	19	500	470	0.000074	0.0018	0.0000056	0.000021	0.028	0.00073	0.00080	0.00012	0.000011	0.0011	0.079	0.0000046	0.13	0.00000037	0.39	0.00067	0.21	0.0000027	0.0000059	0.000037	0.000021	0.000013	0.000080	0.00011
9-Sep-15	11	21	500	485	0.000085	0.0029	0.0000094	0.000020	0.026	0.00067	0.0011	0.00011	0.000011	0.0012	0.080	0.0000039	0.14	0.00000050	0.35	0.00063	0.28	0.0000025	0.0000066	0.000059	0.000020	0.000015	0.00011	0.00011
23-Sep-15	12	23	500	475	0.000062	0.0018	0.0000068	0.000018	0.027	0.00071	0.00081	0.000093	0.0000081	0.00095	0.074	0.0000030	0.12	0.00000032	0.34	0.00066	0.20	0.0000019	0.0000054	0.000035	0.000030	0.000012	0.000081	0.00011
7-Oct-15	13	25	500	385	0.000033	0.00053	0.0000035	0.000013	0.024	0.00062	0.00044	0.000061	0.0000044	0.00057	0.057	0.0000018	0.091	0.00000013	0.27	0.00057	0.10	0.0000011	0.0000035	0.0000096	0.000033	0.0000066	0.000044	0.000088
21-Oct-15	14	27	400	400	0.00010	0.00032	0.0000027	0.000014	0.024	0.00067	0.00046	0.00018	0.0000046	0.00050	0.056	0.0000027	0.094	0.00000018	0.23	0.00055	0.082	0.0000021	0.000026	0.0000023	0.000013	0.0000064	0.000046	0.000091
4-Nov-15	15	29	400	385	0.000078	0.00039	0.0000022	0.0000097	0.023	0.00053	0.00044	0.000054	0.0000044	0.00039	0.055	0.0000018	0.081	0.000000088	0.22	0.00052	0.075	0.0000021	0.0000092	0.0000022	0.000011	0.0000083	0.000044	0.000088
18-Nov-15	16	31	400	385	0.000026	0.0012	0.0000031	0.000014	0.025	0.00057	0.0013	0.00014	0.0000044	0.00044	0.058	0.0000057	0.093	0.00000018	0.21	0.00064	0.070	0.0000018	0.00000088	0.000040	0.00012	0.0000079	0.000044	0.000088
2-Dec-15	17	33	400	380	0.000062	0.00043	0.00000087	0.000013	0.029	0.00090	0.00043	0.00010	0.000035	0.00056	0.061	0.0000061	0.093	0.00000013	0.23	0.00068	0.10	0.00000100	0.0000022	0.0000030	0.000010	0.0000069	0.00039	0.000087
16-Dec-15	18	35	400	370	0.000046	0.0021	0.0000046	0.000016	0.029	0.00086	0.00084	0.000064	0.0000084	0.00063	0.062	0.0000034	0.11	0.000000084	0.21	0.00068	0.055	0.0000012	0.0000029	0.000046	0.000011	0.000011	0.00013	0.000084
30-Dec-15	19	37	400	375	0.000044	0.00085	0.0000030	0.000014	0.029	0.00083	0.00085	0.000049	0.0000085	0.00026	0.057	0.0000017	0.086	0.00000021	0.19	0.00067	0.085	0.0000012	0.00000043	0.000014	0.000050	0.0000068	0.000085	0.000085
13-Jan-16	20	39	400	360	0.000029	0.00045	0.0000012	0.000014	0.030	0.00089	0.00041	0.000083	0.0000041	0.00016	0.055	0.0000078	0.089	0.000000082	0.18	0.00063	0.053	0.00000021	0.0000025	0.0000098	0.0000079	0.0000045	0.000041	0.000082
27-Jan-16	21	41	400	370	0.000027	0.00051	0.00000042	0.000014	0.031	0.00097	0.00042	0.000039	0.0000042	0.00046	0.057	0.0000017	0.092	0.000000084	0.17	0.00073	0.059	0.0000015	0.0000021	0.0000029	0.000017	0.0000046	0.000042	0.000084
10-Feb-16	22	43	400	400	0.000035	0.00064	0.0000050	0.000015	0.033	0.00086	0.00091	0.000036	0.0000091	0.00027	0.058	0.0000027	0.10	0.000000091	0.16	0.00074	0.087	0.0000017	0.000013	0.0000082	0.000034	0.0000059	0.000046	0.000091
24-Feb-16	23	45	400	355																								
9-Mar-16	24	47	400	375																								

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 8 (Kona Granite Transition Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	$mgCaCO_3/L$	$mgCaCO_3/L$	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	375	4.7	1588	#N/A	50	*< 0.1*	1056	17	0.59	*< 0.3*	739	6.6	0.0090	5.4	0.0040	0.0035	*< 7E-06*	0.055	0.00051	216	0.00051	0.83
6-May-15	2	3	400	370	4.8	1162	#N/A	38	*< 0.1*	641	11	0.48	*< 0.3*	454	2.9	0.0067	53	0.0016	0.0021	*< 7E-06*	0.047	0.00028	129	0.00013	0.55
20-May-15	3	5	400	380	5.1	666	#N/A	27	0.30	307	13	0.23	*< 0.3*	226	0.97	0.0051	65	0.00069	0.0011	*< 7E-06*	0.036	0.00015	65	0.000090	0.28
3-Jun-15	4	7	400	290	5.2	499	#N/A	21	0.80	230	12	0.18	*< 0.3*	163	0.61	0.0054	65	0.00066	0.00088	*< 7E-06*	0.039	0.00011	47	0.000060	0.20
17-Jun-15	5	9	500	450	5.1	360	#N/A	19	0.40	164	*< 1*	0.13	*< 0.3*	123	0.45	0.0057	63	0.00035	0.00077	*< 7E-06*	0.026	0.00010	35	0.000060	0.15
1-Jul-15	6	11	500	470	5.5	281	#N/A	14	0.90	121	*< 1*	0.10	*< 0.3*	85	0.30	0.0066	45	0.00031	0.00065	*< 7E-06*	0.019	0.000076	24	0.000040	0.11
15-Jul-15	7	13	500	465	5.2	247	#N/A	16	0.30	95	*< 1*	0.090	*< 0.3*	74	0.28	0.0073	28	0.00030	0.00055	*< 7E-06*	0.020	0.000065	20	0.000050	0.10
29-Jul-15	8	15	400	385	5.2	238	#N/A	8.8	0.60	99	*< 1*	0.11	*< 0.3*	77	0.27	0.0075	19	0.00077	0.00059	*< 7E-06*	0.020	0.000059	22	0.000080	0.100
12-Aug-15	9	17	400	405	4.8	227	#N/A	10	*< 0.1*	89	1.0	0.10	*< 0.3*	74	0.26	0.0072	15	0.00021	0.00056	*< 7E-06*	0.017	0.000069	21	0.000060	0.093
26-Aug-15	10	19	500	455	5.2	223	-	9.6	0.10	79	1.0	0.090	0.30	68	0.24	0.0075	13	0.00063	0.00053	0.0000070	0.015	0.000066	20	0.000055	0.088
9-Sep-15	11	21	500	495	4.9	186	#N/A	9.1	*< 0.1*	74	*< 1*	0.080	*< 0.3*	63	0.22	0.0078	12	0.0011	0.00049	*< 7E-06*	0.013	0.000063	18	0.000050	0.082
23-Sep-15	12	23	500	480	5.1	176	#N/A	8.5	0.070	68	1.0	0.080	-	60	0.20	0.0076	12	0.00065	0.00047	0.0000070	0.012	0.000062	17	0.000070	0.074
7-Oct-15	13	25	400	390	5.1	180	#N/A	8.2	0.50	65	*< 1*	0.080	-	57	0.19	0.0074	12	0.00025	0.00045	*< 7E-06*	0.0096	0.000060	16	0.000090	0.065
21-Oct-15	14	27	400	400	5.0	177	#N/A	8.6	*< 0.1*	59	*< 1*	0.080	-	56	0.21	0.0075	12	0.00023	0.00048	*< 7E-06*	0.011	0.000054	16	0.000090	0.074
4-Nov-15	15	29	400	405	4.7	181	#N/A	9.3	*< 0.1*	63	*< 1*	0.090	-	60	0.21	0.0065	11	0.00021	0.00043	*< 7E-06*	0.0076	0.000076	17	0.000040	0.073
18-Nov-15	16	31	400	385	5.2	178	#N/A	7.8	*< 0.1*	56	*< 1*	0.080	-	53	0.18	0.0066	11	0.0011	0.00043	*< 7E-06*	0.0069	0.000094	15	0.000060	0.065
2-Dec-15	17	33	401	385	4.5	168	#N/A	14	0.10	58	*< 1*	0.080	-	57	0.19	0.0071	11	0.00035	0.00044	*< 7E-06*	0.0089	0.000078	16	0.000080	0.071
16-Dec-15	18	35	401	380	4.6	165	#N/A	14	*< 0.1*	64	*< 1*	0.080	-	58	0.20	0.0070	11	0.00027	0.00049	*< 7E-06*	0.0096	0.00012	16	0.000040	0.073
30-Dec-15	19	37	402	395	4.5	161	#N/A	12	*< 0.1*	59	*< 1*	0.080	-	54	0.19	0.0064	9.7	0.00031	0.00049	*< 7E-06*	0.0075	0.000067	16	0.00010	0.066
13-Jan-16	20	39	402	375	4.4	160	0.90	12	0.10	60	*< 1*	0.080	-	52	0.17	0.0067	11	0.00083	0.00044	*< 7E-06*	0.010	0.000072	15	0.000040	0.061
27-Jan-16	21	41	403	405	4.5	155	#N/A	14	*< 0.1*	52	*< 1*	0.080	-	49	0.17	0.0068	10	0.00092	0.00045	*< 7E-06*	0.0070	0.000063	14	0.000060	0.061
10-Feb-16	22	43	404	400	4.5	149	0.90	14	0.10	52	*< 1*	0.080	-	47	0.16	0.0069	9.7	0.00028	0.00045	*< 7E-06*	0.0050	0.000056	13	0.000040	0.059
24-Feb-16	23	45	405	375	4.5	158	#N/A	13	*< 0.1*	54	*< 1*	0.11	-	53	0.18	0.0066	10	0.00094	0.00050	*< 7E-06*	0.0050	0.000067	15	0.000050	0.061
9-Mar-16	24	47	405	385	4.5	151	#N/A	13	*< 0.1*	57															

Calculated Loading Rates for Col 8

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	375	4.7	1588	#N/A	4.3	0.0086	91	1.5	0.051	0.026	64	0.57	0.00078	0.47	0.00034	0.00030	0.00000060	0.0047	0.000044	19	0.000044	0.071
6-May-15	2	3	400	370	4.8	1162	#N/A	1.6	0.0043	27	0.47	0.020	0.013	19	0.12	0.00028	2.3	0.000066	0.000091	0.00000030	0.0020	0.000012	5.5	0.0000055	0.024
20-May-15	3	5	400	380	5.1	666	#N/A	1.2	0.014	13	0.57	0.010	0.013	9.9	0.042	0.00022	2.8	0.000030	0.000050	0.00000031	0.0016	0.0000067	2.8	0.0000039	0.012
3-Jun-15	4	7	400	290	5.2	499	#N/A	0.71	0.028	7.7	0.40	0.0060	0.010	5.4	0.020	0.00018	2.2	0.000022	0.000029	0.00000023	0.0013	0.0000035	1.6	0.0000020	0.0067
17-Jun-15	5	9	500	450	5.1	360	#N/A	0.97	0.018	8.5	0.052	0.0067	0.016	6.4	0.023	0.00029	3.2	0.000018	0.000040	0.00000036	0.0013	0.0000053	1.8	0.0000031	0.0078
1-Jul-15	6	11	500	470	5.5	281	#N/A	0.75	0.046	6.5	0.054	0.0054	0.016	4.6	0.016	0.00036	2.4	0.000017	0.000035	0.00000038	0.0010	0.0000041	1.3	0.0000022	0.0058
15-Jul-15	7	13	500	465	5.2	247	#N/A	0.83	0.016	5.1	0.053	0.0048	0.016	3.9	0.015	0.00039	1.5	0.000016	0.000029	0.00000037	0.0011	0.0000035	1.1	0.0000027	0.0054
29-Jul-15	8	15	400	385	5.2	238	#N/A	0.39	0.026	4.4	0.044	0.0049	0.013	3.4	0.012	0.00033	0.83	0.000034	0.000026	0.00000031	0.00089	0.0000026	0.97	0.0000035	0.0044
12-Aug-15	9	17	400	405	4.8	227	#N/A	0.47	0.0047	4.1	0.047	0.0047	0.014	3.4	0.012	0.00034	0.68	0.0000098	0.000026	0.00000033	0.00077	0.0000032	0.98	0.0000028	0.0043
26-Aug-15	10	19	500	455	5.2	223	#N/A	0.50	0.0052	4.1	0.052	0.0047	0.016	3.6	0.012	0.00039	0.70	0.000033	0.000028	0.00000037	0.00078	0.0000035	1.0	0.0000029	0.0046
9-Sep-15	11	21	500	495	4.9	186	#N/A	0.52	0.0057	4.2	0.057	0.0046	0.017	3.6	0.012	0.00044	0.69	0.000060	0.000028	0.00000040	0.00076	0.0000036	1.0	0.0000028	0.0047
23-Sep-15	12	23	500	480	5.1	176	#N/A	0.47	0.0039	3.8	0.055	0.0044		3.3	0.011	0.00042	0.67	0.000036	0.000026	0.00000039	0.00063	0.0000034	0.95	0.0000039	0.0041
7-Oct-15	13	25	400	390	5.1	180	#N/A	0.37	0.020	2.9	0.045	0.0036		2.6	0.0084	0.00033	0.55	0.000011	0.000020	0.00000031	0.00043	0.0000027	0.74	0.0000040	0.0029
21-Oct-15	14	27	400	400	5.0	177	#N/A	0.40	0.0046	2.7	0.046	0.0037		2.6	0.0096	0.00034	0.53	0.000011	0.000022	0.00000032	0.00052	0.0000025	0.74	0.0000041	0.0034
4-Nov-15	15	29	400	405	4.7	181	#N/A	0.43	0.0047	2.9	0.047	0.0042		2.8	0.0096	0.00030	0.50	0.0000098	0.000020	0.00000033	0.00035	0.0000035	0.81	0.0000019	0.0034
18-Nov-15	16	31	400	385	5.2	178	#N/A	0.34	0.0044	2.5	0.044	0.0035		2.4	0.0079	0.00029	0.50	0.000047	0.000019	0.00000031	0.00031	0.0000042	0.66	0.0000027	0.0029
2-Dec-15	17	33	401	385	4.5	168	#N/A	0.60	0.0044	2.6	0.044	0.0035		2.5	0.0083	0.00031	0.48	0.000015	0.000019	0.00000031	0.00039	0.0000035	0.70	0.0000035	0.0032
16-Dec-15	18	35	401	380	4.6	165	#N/A	0.63	0.0044	2.8	0.044	0.0035		2.5	0.0088	0.00031	0.47	0.000012	0.000021	0.00000031	0.00042	0.0000050	0.71	0.0000017	0.0032
30-Dec-15	19	37	402	395	4.5	161	#N/A	0.56	0.0045	2.7	0.045	0.0036		2.5	0.0084	0.00029	0.44	0.000014	0.000022	0.00000032	0.00034	0.0000030	0.70	0.0000045	0.0030
13-Jan-16	20	39	402	375	4.4	160	0.86	0.53	0.0043	2.6	0.043	0.0034		2.2	0.0072	0.00029	0.48	0.000036	0.000019	0.00000030	0.00043	0.0000031	0.63	0.0000017	0.0026
27-Jan-16	21	41	403	405	4.5	155	#N/A	0.63	0.0047	2.4	0.047	0.0037		2.3	0.0078	0.00032	0.48	0.000043	0.000021	0.00000033	0.00033	0.0000029	0.65	0.0000028	0.0028
10-Feb-16	22	43	404	400	4.5	149	0.89	0.64	0.0046	2.4	0.046	0.0037		2.2	0.0073	0.00032	0.45	0.000013	0.000021	0.00000032	0.00023	0.0000026	0.62	0.0000018	0.0027
24-Feb-16	23	45	405	375	4.5	158	#N/A	0.54	0.0043	2.3	0.043	0.0047		2.3	0.0078	0.00028	0.44	0.000041	0.000021	0.00000030	0.00022	0.0000029	0.66	0.0000022	0.0026
9-Mar-16	24	47	405	385	4.5	151	#N/A	0.58	0.0044	2.5															

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 8 (Kona Granite Transition Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	375	0.17	11	0.00030	0.076	49	25	0.43	0.000040	0.19	0.0070	26	0.0092	8.5	0.000035	62	1.1	337	0.0030	0.000080	0.00010	0.033	0.00014	0.78	*< 0.002*
6-May-15	2	3	400	370	0.060	7.6	0.00012	0.046	32	17	0.11	0.00031	0.13	*< 0.003*	18	0.0050	14	0.000011	29	0.73	234	0.0016	0.000070	0.00012	0.018	0.000070	0.50	*< 0.002*
20-May-15	3	5	400	380	0.028	3.2	0.000040	0.026	15	8.5	0.080	0.0012	0.064	*< 0.003*	12	0.0027	13	0.000010	13	0.37	110	0.0011	0.000090	0.00023	0.0084	0.000050	0.26	*< 0.002*
3-Jun-15	4	7	400	290	0.021	2.1	0.000030	0.019	11	6.1	0.080	0.00036	0.046	*< 0.003*	10	0.0020	12	0.0000040	8.4	0.27	86	0.00092	0.000010	0.00013	0.0054	0.000090	0.19	*< 0.002*
17-Jun-15	5	9	500	450	0.019	1.4	0.000040	0.012	8.6	4.9	0.050	0.0011	0.037	*< 0.003*	8.3	0.0018	10	0.0000060	5.4	0.19	62	0.00073	0.00014	0.00016	0.0040	0.000080	0.18	*< 0.002*
1-Jul-15	6	11	500	470	0.015	0.85	*< 1E-05*	0.0091	6.0	3.6	0.040	0.000050	0.027	0.0050	6.4	0.0013	8.8	0.0000020	3.2	0.14	37	0.00057	0.000040	0.00013	0.0022	0.00010	0.13	*< 0.002*
15-Jul-15	7	13	500	465	0.016	0.61	0.000030	0.0074	5.6	3.3	0.020	0.00016	0.024	0.0040	5.6	0.00094	8.7	0.0000050	2.4	0.11	31	0.00056	0.000050	0.00017	0.0018	0.00010	0.12	*< 0.002*
29-Jul-15	8	15	400	385	0.016	0.43	0.00015	0.0074	5.3	3.5	*< 0.01*	0.00023	0.023	0.0080	5.7	0.00086	8.7	0.0000020	1.8	0.12	32	0.00053	*< 1E-05*	*< 5E-05*	0.0017	0.00010	0.11	*< 0.002*
12-Aug-15	9	17	400	405	0.016	0.35	0.000030	0.0061	5.2	3.3	0.020	0.00039	0.023	0.014	5.8	0.00080	9.2	*< 2E-06*	1.5	0.11	28	0.00044	0.000060	0.000050	0.0015	0.00010	0.12	*< 0.002*
26-Aug-15	10	19	500	455	0.015	0.28	0.000025	0.0053	4.8	3.1	0.015	0.00042	0.021	0.016	5.6	0.00071	8.1	0.0000030	1.2	0.10	28	0.00042	0.000050	0.000050	0.0013	0.00013	0.11	0.0020
9-Sep-15	11	21	500	495	0.015	0.21	0.000020	0.0045	4.4	2.9	0.010	0.00045	0.020	0.018	5.3	0.00062	7.0	0.0000040	0.99	0.090	29	0.00039	0.000040	*< 5E-05*	0.0012	0.00015	0.098	*< 0.002*
23-Sep-15	12	23	500	480	0.014	0.18	0.000020	0.0041	4.2	2.7	0.010	0.00027	0.018	0.019	4.9	0.00060	6.8	0.0000050	0.83	0.085	25	0.00035	0.000030	0.000050	0.0011	0.00012	0.094	0.0020
7-Oct-15	13	25	400	390	0.012	0.14	0.000020	0.0036	4.0	2.5	*< 0.01*	0.000090	0.016	0.020	4.4	0.00057	6.5	0.0000060	0.66	0.079	22	0.00030	0.000020	*< 5E-05*	0.0011	0.000080	0.090	*< 0.002*
21-Oct-15	14	27	400	400	0.015	0.15	0.000030	0.0035	3.7	2.5	*< 0.01*	0.0013	0.019	0.014	4.3	0.00050	6.6	0.0000020	0.61	0.083	22	0.00041	0.000050	0.000080	0.0013	0.00012	0.099	*< 0.002*
4-Nov-15	15	29	400	405	0.015	0.15	0.000050	0.0028	4.1	2.6	0.010	0.00016	0.020	0.018	4.5	0.00050	6.4	0.0000030	0.55	0.080	22	0.00038	0.000080	*< 5E-05*	0.0012	0.00015	0.097	*< 0.002*
18-Nov-15	16	31	400	385	0.015	0.13	0.00032	0.0030	3.8	2.6	*< 0.01*	0.00098	0.016	0.018	4.2	0.00060	5.9	*< 2E-06*	0.48	0.078	22	0.00027	0.000020	*< 5E-05*	0.0013	0.00013	0.10	*< 0.002*
2-Dec-15	17	33	401	385	0.020	0.13	0.0011	0.0028	4.3	2.6	*< 0.01*	0.00095	0.019	0.020	4.4	0.00059	5.7	*< 2E-06*	0.49	0.083	22	0.00033	0.000050	0.000060	0.0012	0.00011	0.11	*< 0.002*
16-Dec-15	18	35	401	380	0.024	0.12	0.0028	0.0029	4.1	2.8	*< 0.01*	0.00044	0.019	0.022	4.4	0.00047	6.3	*< 2E-06*	0.42	0.084	22	0.00033	0.000060	*< 5E-05*	0.0012	0.00010	0.11	*< 0.002*
30-Dec-15	19	37	402	395	0.015	0.11	0.00056	0.0027	3.8	2.5	0.020	0.00034	0.017	0.019	3.9	0.00042	5.4	0.0000070	0.43	0.076	18	0.00033	*< 1E-05*	*< 5E-05*	0.0013	0.00012	0.096	*< 0.002*
13-Jan-16	20	39	402	375	0.013	0.10	0.00015	0.0024	3.7	2.5	*< 0.01*	0.00057	0.016	0.022	4.0	0.00056	5.8	0.0000020	0.37	0.070	19	0.00026	0.000060	*< 5E-05*	0.0011	0.000090	0.093	*< 0.002*
27-Jan-16	21	41	403	405	0.014	0.11	0.00013	0.0022	3.5	2.4	*< 0.01*	0.000080	0.015	0.022	3.9	0.00032	5.2	*< 2E-06*	0.32	0.075	20	0.00034	0.000020	*< 5E-05*	0.0012	0.000090	0.092	*< 0.002*
10-Feb-16	22	43	404	400	0.015	0.096	0.000090	0.0020	3.3	2.4	*< 0.01*	0.000070	0.015	0.023	3.7	0.00037	4.8	*< 2E-06*	0.31	0.070	19	0.00030	0.000070	*< 5E-05*	0.0012	0.000090	0.10	*< 0.002*
24-Feb-16	23	45	405	375	0.015	0.10	0.000040	0.0020	3.7	2.5	0.020	0.000070	0.016	0.025	3.8	0.00035	5.2	*< 2E-06*	0.25	0.072	18	0.00030	0.000080	*< 5E-05*	0.0011	0.000070	0.11	*< 0.002*
9-Mar-16	24	47	405	385																								

Calculated Loading Rates for Col 8

Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	375	0.014	0.92	0.000026	0.0066	4.2	2.1	0.037	0.0000034	0.016	0.00060	2.2	0.00079	0.73	0.0000030	5.4	0.091	29	0.00026	0.0000069	0.0000086	0.0029	0.0000012	0.068	0.00017
6-May-15	2	3	400	370	0.0025	0.32	0.0000051	0.0020	1.4	0.72	0.0047	0.000013	0.0057	0.00013	0.76	0.00021	0.58	0.00000047	1.2	0.031	10.0	0.000069	0.0000030	0.0000051	0.00077	0.0000030	0.021	0.000085
20-May-15	3	5	400	380	0.0012	0.14	0.0000017	0.0011	0.67	0.37	0.0035	0.000051	0.0028	0.00013	0.52	0.00012	0.55	0.00000044	0.56	0.016	4.8	0.000048	0.0000039	0.000010	0.00037	0.0000022	0.011	0.000087
3-Jun-15	4	7	400	290	0.00070	0.068	0.0000010	0.00064	0.37	0.20	0.0027	0.000012	0.0015	0.00010	0.34	0.000067	0.40	0.00000013	0.28	0.0090	2.9	0.000031	0.00000033	0.0000043	0.00018	0.0000030	0.0063	0.000067
17-Jun-15	5	9	500	450	0.00098	0.074	0.0000021	0.00064	0.45	0.25	0.0026	0.000058	0.0019	0.00016	0.43	0.000092	0.52	0.00000031	0.28	0.010	3.2	0.000038	0.0000072	0.0000083	0.00021	0.0000041	0.0091	0.00010
1-Jul-15	6	11	500	470	0.00079	0.046	0.00000054	0.00049	0.32	0.20	0.0022	0.0000027	0.0015	0.00027	0.34	0.000069	0.48	0.00000011	0.17	0.0075	2.0	0.000031	0.0000022	0.0000070	0.00012	0.0000054	0.0072	0.00011
15-Jul-15	7	13	500	465	0.00084	0.032	0.0000016	0.00040	0.30	0.18	0.0011	0.0000086	0.0013	0.00021	0.30	0.000050	0.46	0.00000027	0.13	0.0060	1.7	0.000030	0.0000027	0.0000091	0.000094	0.0000053	0.0062	0.00011
29-Jul-15	8	15	400	385	0.00070	0.019	0.0000066	0.00033	0.23	0.15	0.00044	0.000010	0.0010	0.00035	0.25	0.000038	0.38	0.000000089	0.080	0.0053	1.4	0.000023	0.00000044	0.0000022	0.000073	0.0000044	0.0050	0.000089
12-Aug-15	9	17	400	405	0.00073	0.016	0.0000014	0.00029	0.24	0.15	0.00093	0.000018	0.0011	0.00065	0.27	0.000037	0.43	0.000000093	0.068	0.0052	1.3	0.000021	0.0000028	0.0000023	0.000069	0.0000047	0.0054	0.000093
26-Aug-15	10	19	500	455	0.00079	0.015	0.0000013	0.00028	0.25	0.16	0.00078	0.000022	0.0011	0.00084	0.29	0.000037	0.42	0.00000016	0.064	0.0053	1.5	0.000022	0.0000026	0.0000026	0.000070	0.0000065	0.0056	0.00010
9-Sep-15	11	21	500	495	0.00084	0.012	0.0000011	0.00026	0.25	0.17	0.00057	0.000026	0.0011	0.0010	0.30	0.000035	0.40	0.00000023	0.056	0.0051	1.6	0.000022	0.0000023	0.0000028	0.000067	0.0000085	0.0056	0.00011
23-Sep-15	12	23	500	480	0.00075	0.0097	0.0000011	0.00022	0.23	0.15	0.00055	0.000015	0.00100	0.0010	0.27	0.000033	0.37	0.00000028	0.046	0.0047	1.4	0.000019	0.0000017	0.0000028	0.000062	0.0000063	0.0052	0.00011
7-Oct-15	13	25	400	390	0.00056	0.0063	0.00000090	0.00016	0.18	0.11	0.00045	0.0000040	0.00074	0.00090	0.20	0.000026	0.29	0.00000027	0.030	0.0036	0.98	0.000014	0.00000090	0.0000022	0.000048	0.0000036	0.0040	0.000090
21-Oct-15	14	27	400	400	0.00070	0.0070	0.0000014	0.00016	0.17	0.11	0.00046	0.000057	0.00089	0.00064	0.20	0.000023	0.30	0.000000092	0.028	0.0038	1.00	0.000019	0.0000023	0.0000037	0.000058	0.0000055	0.0046	0.000092
4-Nov-15	15	29	400	405	0.00069	0.0070	0.0000023	0.00013	0.19	0.12	0.00047	0.0000074	0.00092	0.00084	0.21	0.000023	0.30	0.00000014	0.026	0.0037	1.0	0.000018	0.0000037	0.0000023	0.000054	0.0000070	0.0045	0.000093
18-Nov-15	16	31	400	385	0.00065	0.0055	0.000014	0.00013	0.17	0.12	0.00044	0.000043	0.00069	0.00080	0.19	0.000027	0.26	0.000000089	0.021	0.0034	0.96	0.000012	0.00000089	0.0000022	0.000057	0.0000058	0.0044	0.000089
2-Dec-15	17	33	401	385	0.00087	0.0058	0.000049	0.00012	0.19	0.12	0.00044	0.000042	0.00084	0.00089	0.20	0.000026	0.25	0.000000089	0.022	0.0037	0.96	0.000015	0.0000022	0.0000027	0.000052	0.0000049	0.0049	0.000089
16-Dec-15	18	35	401	380	0.0010	0.0051	0.00012	0.00013	0.18	0.12	0.00044	0.000019	0.00085	0.00096	0.19	0.000021	0.28	0.000000087	0.018	0.0037	0.95	0.000014	0.0000026	0.0000022	0.000051	0.0000044	0.0048	0.000087
30-Dec-15	19	37	402	395	0.00069	0.0050	0.000025	0.00012	0.17	0.12	0.00091	0.000015	0.00076	0.00086	0.18	0.000019	0.24	0.00000032	0.020	0.0034	0.81	0.000015	0.00000045	0.0000023	0.000059	0.0000054	0.0044	0.000091
13-Jan-16	20	39	402	375	0.00056	0.0045	0.0000065	0.00010	0.16	0.11	0.00043	0.000025	0.00068	0.00095	0.17	0.000024	0.25	0.000000086	0.016	0.0030	0.81	0.000011	0.0000026	0.0000022	0.000045	0.0000039	0.0040	0.000086
27-Jan-16	21	41	403	405	0.00064	0.0050	0.0000061	0.00010	0.16	0.11	0.00047	0.0000037	0.00071	0.0010	0.18	0.000015	0.24	0.000000093	0.015	0.0035	0.92	0.000016	0.00000093	0.0000023	0.000056	0.0000042	0.0043	0.000093
10-Feb-16	22	43	404	400	0.00070	0.0044	0.0000041	0.000091	0.15	0.11	0.00046	0.0000032	0.00071	0.0011	0.17	0.000017	0.22	0.000000092	0.014	0.0032	0.85	0.000014	0.0000032	0.0000023	0.000054	0.0000041	0.0047	0.000092
24-Feb-16	23	45	405	375	0.00064	0.0044	0.0000017	0.000088	0.16	0.11	0.00086	0.0000030	0.00069	0.0011	0.16	0.000015	0.23	0.000000086	0.011	0.0031	0.79	0.000013	0.0000034	0.0000022	0.000049	0.0000030	0.0045	0.000086
9-Mar-16	24	47	405	385																								

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 9 (Latte Schist Oxide Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	360	7.6	3083	#N/A	12	139	2100	33	0.34	*< 0.3*	1890	0.0037	0.0070	0.11	0.024	*< 7E-06*	*< 7E-06*	0.022	0.000018	442	0.00029	0.0027
6-May-15	2	3	400	355	7.7	1878	#N/A	7.0	80	1352	10	0.37	*< 0.3*	1200	0.0028	0.0044	0.095	0.011	*< 7E-06*	*< 7E-06*	0.017	0.000010	293	*< 3E-05*	0.0015
20-May-15	3	5	400	375	7.8	1274	#N/A	7.1	73	720	2.0	0.37	*< 0.3*	712	0.0014	0.0031	0.081	0.0079	*< 7E-06*	*< 7E-06*	0.013	0.0000040	183	0.00011	0.00081
3-Jun-15	4	7	400	255	7.8	1162	#N/A	6.7	82	560	1.0	0.43	*< 0.3*	542	0.0053	0.0032	0.087	0.0086	*< 7E-06*	*< 7E-06*	0.017	0.0000030	137	0.000060	0.00055
17-Jun-15	5	9	500	445	7.9	776	#N/A	7.0	85	353	*< 1*	0.42	*< 0.3*	374	0.0048	0.0032	0.096	0.0081	*< 7E-06*	*< 7E-06*	0.014	0.0000030	96	0.000060	0.00034
1-Jul-15	6	11	500	390	7.9	687	#N/A	7.0	90	235	*< 1*	0.47	*< 0.3*	276	0.0038	0.0030	0.097	0.0097	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	68	0.000080	0.00023
15-Jul-15	7	13	500	455	7.9	521	#N/A	5.8	93	182	*< 1*	0.50	*< 0.3*	230	0.0047	0.0031	0.093	0.011	*< 7E-06*	*< 7E-06*	0.015	*< 3E-06*	54	0.000090	0.00021
29-Jul-15	8	15	400	375	7.9	490	#N/A	3.9	93	155	*< 1*	0.51	*< 0.3*	219	0.0036	0.0033	0.085	0.011	*< 7E-06*	*< 7E-06*	0.014	0.0000080	54	0.000080	0.00015
12-Aug-15	9	17	400	395	7.9	440	#N/A	4.4	94	122	*< 1*	0.50	*< 0.3*	197	0.0025	0.0032	0.079	0.012	*< 7E-06*	*< 7E-06*	0.010	*< 3E-06*	48	0.000070	0.00011
26-Aug-15	10	19	500	460	7.6	408	#N/A	4.2	94	100	1.0	0.51	0.30	189	0.0039	0.0033	0.086	0.014	0.0000070	0.0000070	0.010	0.0000040	45	0.000075	0.00010
9-Sep-15	11	21	500	450	7.9	374	#N/A	4.0	94	89	-	0.52	-	180	0.0050	0.0034	0.10	0.016	*< 7E-06*	*< 7E-06*	0.011	0.0000050	43	0.000080	0.00010
23-Sep-15	12	23	500	465	8.0	346	#N/A	3.4	98	79	-	0.51	-	171	0.0046	0.0036	0.11	0.016	0.0000070	0.0000070	0.0098	0.0000045	41	0.000095	0.000080
7-Oct-15	13	25	400	370	7.9	349	#N/A	3.2	107	70	-	0.49	-	161	0.0038	0.0037	0.12	0.016	*< 7E-06*	*< 7E-06*	0.0091	0.0000040	40	0.00011	0.000066
21-Oct-15	14	27	400	385	8.1	321	#N/A	2.1	102	56	-	0.47	-	150	0.0051	0.0037	0.11	0.018	*< 7E-06*	*< 7E-06*	0.010	*< 3E-06*	38	0.00010	0.000058
4-Nov-15	15	29	400	385	8.0	316	#N/A	2.3	107	54	-	0.48	-	155	0.0097	0.0031	0.12	0.019	*< 7E-06*	*< 7E-06*	0.0068	0.000011	39	0.000070	0.000042
18-Nov-15	16	31	400	370	8.1	316	#N/A	1.4	117	49	-	0.48	-	149	0.0036	0.0032	0.12	0.015	*< 7E-06*	*< 7E-06*	0.0066	*< 3E-06*	37	0.00011	0.000055
2-Dec-15	17	33	400	375	8.2	306	#N/A	1.8	105	46	-	0.48	-	158	0.0036	0.0033	0.11	0.021	*< 7E-06*	*< 7E-06*	0.0077	0.0000070	39	0.000080	0.000091
16-Dec-15	18	35	400	360	8.2	296	#N/A	2.1	97	44	-	0.46	-	155	0.0030	0.0035	0.14	0.022	*< 7E-06*	*< 7E-06*	0.0092	0.0000080	38	0.000060	0.000076
30-Dec-15	19	37	400	385	8.2	288	#N/A	1.4	95	45	-	0.47	-	146	0.0052	0.0030	0.12	0.022	*< 7E-06*	*< 7E-06*	0.0078	0.000011	36	0.00014	0.000054
13-Jan-16	20	39	400	355	8.2	285	#N/A	1.5	98	46	-	0.45	-	143	0.0022	0.0032	0.11	0.021	*< 7E-06*	*< 7E-06*	0.0090	*< 3E-06*	35	0.00015	0.000082
27-Jan-16	21	41	400	370	8.1	276	#N/A	2.8	98	44	-	0.47	-	136	0.0030	0.0033	0.088	0.024	*< 7E-06*	*< 7E-06*	0.0070	0.000010	33	0.000070	0.000058
10-Feb-16	22	43	400	385	8.1	276	#N/A	2.4	101	38	-	0.42	-	139	0.0031	0.0033	0.083	0.025	0.000011	*< 7E-06*	0.0060	*< 3E-06*	34	0.000070	0.000045
24-Feb-16	23	45	400	360	8.1	285	#N/A	2.2	101	38	-	0.41	-	148	0.0012	0.0032	0.094	0.026	*< 7E-06*	*< 7E-06*	0.0050	0.0000040	36	0.00012	0.000058
9-Mar-16	24	47	400	365	8.1	270	#N/A	2.0	97	33															

Calculated Loading Rates for Col 9

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	360	7.6	3083	#N/A	0.88	10	151	2.4	0.024	0.022	136	0.00027	0.00050	0.0079	0.0017	0.00000050	0.00000050	0.0015	0.0000013	32	0.000021	0.00020
6-May-15	2	3	400	355	7.7	1878	#N/A	0.25	2.8	48	3.6	0.013	0.011	43	0.000099	0.00016	0.0034	0.00038	0.00000025	0.00000025	0.00061	0.00000036	10	0.0000011	0.000053
20-May-15	3	5	400	375	7.8	1274	#N/A	0.27	2.7	27	0.75	0.014	0.011	27	0.000053	0.00012	0.0030	0.00029	0.00000026	0.00000026	0.00049	0.00000015	6.9	0.0000041	0.000030
3-Jun-15	4	7	400	255	7.8	1162	#N/A	0.17	2.1	14	0.26	0.011	0.0077	14	0.00014	0.000082	0.0022	0.00022	0.00000018	0.00000018	0.00043	0.000000077	3.5	0.0000015	0.000014
17-Jun-15	5	9	500	445	7.9	776	#N/A	0.31	3.8	16	0.45	0.019	0.013	17	0.00021	0.00014	0.0043	0.00036	0.00000031	0.00000031	0.00061	0.00000013	4.3	0.0000027	0.000015
1-Jul-15	6	11	500	390	7.9	687	#N/A	0.27	3.5	9.2	0.39	0.018	0.012	11	0.00015	0.00012	0.0038	0.00038	0.00000027	0.00000027	0.00041	0.00000012	2.7	0.0000031	0.0000090
15-Jul-15	7	13	500	455	7.9	521	#N/A	0.26	4.2	8.3	0.46	0.023	0.014	10	0.00021	0.00014	0.0042	0.00049	0.00000032	0.00000032	0.00069	0.00000014	2.5	0.0000041	0.0000096
29-Jul-15	8	15	400	375	7.9	490	#N/A	0.15	3.5	5.8	0.38	0.019	0.011	8.2	0.00014	0.00012	0.0032	0.00041	0.00000026	0.00000026	0.00051	0.00000030	2.0	0.0000030	0.0000057
12-Aug-15	9	17	400	395	7.9	440	#N/A	0.18	3.7	4.8	0.40	0.020	0.012	7.8	0.000099	0.00013	0.0031	0.00047	0.00000028	0.00000028	0.00040	0.00000012	1.9	0.0000028	0.0000045
26-Aug-15	10	19	500	460	7.6	408	0.00	0.19	4.3	4.6	0.46	0.023	0.014	8.7	0.00018	0.00015	0.0040	0.00063	0.00000032	0.00000032	0.00048	0.00000018	2.1	0.0000035	0.0000048
9-Sep-15	11	21	500	450	7.9	374	#N/A	0.18	4.2	4.6	0.00	0.027	0.00	9.3	0.00027	0.00018	0.0048	0.00080	0.00000036	0.00000036	0.00054	0.00000026	2.2	0.0000041	0.0000049
23-Sep-15	12	23	500	465	8.0	346	#N/A	0.16	4.6	4.2	0.00	0.027		9.1	0.00024	0.00019	0.0056	0.00084	0.00000037	0.00000037	0.00052	0.00000024	2.2	0.0000051	0.0000043
7-Oct-15	13	25	400	370	7.9	349	#N/A	0.12	4.0	3.0	0.00	0.021		6.8	0.00016	0.00016	0.0050	0.00068	0.00000030	0.00000030	0.00039	0.00000017	1.7	0.0000047	0.0000028
21-Oct-15	14	27	400	385	8.1	321	#N/A	0.081	3.9	2.5	0.00	0.021		6.6	0.00023	0.00016	0.0050	0.00078	0.00000031	0.00000031	0.00044	0.00000013	1.7	0.0000044	0.0000026
4-Nov-15	15	29	400	385	8.0	316	#N/A	0.089	4.1	2.4	0.00	0.021		6.9	0.00043	0.00014	0.0054	0.00084	0.00000031	0.00000031	0.00030	0.00000049	1.7	0.0000031	0.0000019
18-Nov-15	16	31	400	370	8.1	316	#N/A	0.053	4.3	2.1	0.00	0.020		6.3	0.00015	0.00014	0.0049	0.00065	0.00000030	0.00000030	0.00028	0.00000013	1.6	0.0000047	0.0000023
2-Dec-15	17	33	400	375	8.2	306	#N/A	0.068	3.9	2.0	0.00	0.021		6.8	0.00016	0.00014	0.0048	0.00090	0.00000030	0.00000030	0.00033	0.00000030	1.7	0.0000034	0.0000039
16-Dec-15	18	35	400	360	8.2	296	#N/A	0.075	3.5	1.8	0.00	0.019		6.4	0.00012	0.00014	0.0056	0.00093	0.00000029	0.00000029	0.00038	0.00000033	1.6	0.0000025	0.0000031
30-Dec-15	19	37	400	385	8.2	288	#N/A	0.054	3.7	2.0	0.00	0.021		6.5	0.00023	0.00013	0.0054	0.00099	0.00000031	0.00000031	0.00035	0.00000049	1.6	0.0000062	0.0000024
13-Jan-16	20	39	400	355	8.2	285	#N/A	0.054	3.5	1.9	0.00	0.018		5.8	0.000090	0.00013	0.0045	0.00087	0.00000029	0.00000029	0.00037	0.00000012	1.4	0.0000061	0.0000033
27-Jan-16	21	41	400	370	8.1	276	#N/A	0.11	3.6	1.9	0.00	0.020		5.8	0.00013	0.00014	0.0037	0.0010	0.00000030	0.00000030	0.00030	0.00000043	1.4	0.0000030	0.0000025
10-Feb-16	22	43	400	385	8.1	276	#N/A	0.092	3.9	1.7	0.00	0.019		6.2	0.00014	0.00015	0.0037	0.0011	0.00000049	0.00000031	0.00027	0.00000013	1.5	0.0000031	0.0000020
24-Feb-16	23	45	400	360	8.1	285	#N/A	0.078	3.6	1.6	0.00	0.017		6.1	0.000050	0.00013	0.0039	0.0011	0.00000029	0.00000029	0.00021	0.00000017	1.5	0.0000050	0.0000024
9-Mar-16	24	47	400	365	8.1	270	#N/A	0.073	3.5	1.4															

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 9 (Latte Schist Oxide Ore)

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
-	No.	-	Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	360	0.0087	*< 0.007*	*< 1E-05*	0.020	192	0.13	0.26	0.0030	0.029	0.017	17	0.019	4.8	0.000046	131	3.0	672	0.00033	0.00012	0.00013	0.069	0.00013	0.0030	*< 0.002*
6-May-15	2	3	400	355	0.0034	*< 0.007*	*< 1E-05*	0.012	114	0.094	0.050	0.0026	0.017	*< 0.003*	11	0.015	4.2	0.000014	67	1.8	467	0.00017	*< 1E-05*	0.000050	0.031	0.00010	0.0020	*< 0.002*
20-May-15	3	5	400	375	0.0020	0.010	*< 1E-05*	0.0088	62	0.049	0.010	0.0031	0.0084	*< 0.003*	7.8	0.0077	4.3	0.000015	34	1.1	237	0.00014	0.00018	0.000060	0.018	0.000040	0.0020	*< 0.002*
3-Jun-15	4	7	400	255	0.0012	*< 0.007*	*< 1E-05*	0.0078	48	0.029	*< 0.01*	0.0028	0.0061	*< 0.003*	7.2	0.0056	4.2	0.000011	26	0.85	189	0.00012	0.000050	*< 5E-05*	0.014	0.000080	0.0010	*< 0.002*
17-Jun-15	5	9	500	445	0.0011	*< 0.007*	*< 1E-05*	0.0059	33	0.016	*< 0.01*	0.0030	0.0039	*< 0.003*	5.7	0.0037	4.0	0.000010	16	0.56	121	0.00012	0.000090	0.00010	0.0099	0.00010	0.0010	*< 0.002*
1-Jul-15	6	11	500	390	0.0013	*< 0.007*	*< 1E-05*	0.0054	26	0.0093	0.020	0.0027	0.0027	*< 0.003*	4.9	0.0027	4.0	0.0000080	12	0.45	76	0.00010	0.000080	*< 5E-05*	0.0078	0.000060	0.0020	*< 0.002*
15-Jul-15	7	13	500	455	0.00074	*< 0.007*	0.000010	0.0049	23	0.010	*< 0.01*	0.0026	0.0021	*< 0.003*	4.4	0.0017	3.8	0.0000080	8.8	0.38	60	0.00011	0.000080	0.000090	0.0063	0.000090	0.0010	*< 0.002*
29-Jul-15	8	15	400	375	0.00074	*< 0.007*	0.000010	0.0047	21	0.0073	*< 0.01*	0.0028	0.0017	*< 0.003*	4.3	0.0013	3.5	*< 2E-06*	6.7	0.37	52	0.000090	0.000080	*< 5E-05*	0.0053	0.000070	0.0010	*< 0.002*
12-Aug-15	9	17	400	395	0.00049	*< 0.007*	*< 1E-05*	0.0041	19	0.0048	*< 0.01*	0.0026	0.0015	*< 0.003*	4.4	0.0010	3.7	0.000018	5.2	0.34	40	0.000064	0.000040	*< 5E-05*	0.0040	0.000060	0.0010	*< 0.002*
26-Aug-15	10	19	500	460	0.00065	0.0070	0.000015	0.0039	18	0.0048	0.010	0.0026	0.0015	0.0040	4.5	0.00093	3.6	0.000013	4.4	0.32	40	0.000066	0.000085	0.000050	0.0033	0.000070	0.0010	0.0020
9-Sep-15	11	21	500	450	0.00080	*< 0.007*	0.000020	0.0036	18	0.00	*< 0.01*	0.0027	0.0014	0.0050	4.5	0.00082	3.4	0.0000070	3.7	0.31	40	0.000068	0.00013	*< 5E-05*	0.0026	0.000080	0.0010	*< 0.002*
23-Sep-15	12	23	500	465	0.00073	0.0070	0.000015	0.0035	16	0.0039	0.010	0.0024	0.0013	0.0040	4.1	0.00075	3.4	0.0000065	3.0	0.28	32	0.000066	0.000080	0.000050	0.0023	0.000070	0.0010	0.0020
7-Oct-15	13	25	400	370	0.00064	*< 0.007*	*< 1E-05*	0.0033	15	0.0029	*< 0.01*	0.0021	0.0011	*< 0.003*	3.7	0.00067	3.4	0.0000060	2.3	0.26	25	0.000064	0.000030	*< 5E-05*	0.0021	0.000060	*< 0.001*	*< 0.002*
21-Oct-15	14	27	400	385	0.00067	*< 0.007*	*< 1E-05*	0.0030	13	0.0024	*< 0.01*	0.0029	0.0012	*< 0.003*	3.5	0.00059	3.5	0.0000030	1.9	0.24	22	0.000096	0.000060	*< 5E-05*	0.0021	0.000060	*< 0.001*	*< 0.002*
4-Nov-15	15	29	400	385	0.0031	*< 0.007*	0.00021	0.0025	14	0.0020	*< 0.01*	0.0027	0.0012	0.0050	3.5	0.00054	3.3	0.0000030	1.8	0.24	21	0.000095	0.00072	*< 5E-05*	0.0018	0.00017	0.0030	*< 0.002*
18-Nov-15	16	31	400	370	0.00066	0.013	0.00015	0.0028	14	0.0017	*< 0.01*	0.0027	0.00080	*< 0.003*	3.5	0.00066	3.3	*< 2E-06*	1.5	0.24	20	0.000066	0.000040	*< 5E-05*	0.0015	0.000080	0.0010	*< 0.002*
2-Dec-15	17	33	400	375	0.00069	*< 0.007*	0.000020	0.0027	15	0.0050	*< 0.01*	0.0029	0.0012	*< 0.003*	3.7	0.00066	3.3	*< 2E-06*	1.5	0.25	19	0.000059	0.000060	0.000070	0.0016	0.000060	0.0010	*< 0.002*
16-Dec-15	18	35	400	360	0.00077	*< 0.007*	0.000060	0.0028	15	0.0054	*< 0.01*	0.0025	0.0011	*< 0.003*	3.7	0.00056	3.5	*< 2E-06*	1.3	0.25	18	0.000082	0.00013	0.000070	0.0016	0.000040	*< 0.001*	*< 0.002*
30-Dec-15	19	37	400	385	0.00060	0.0070	0.00013	0.0028	14	0.0046	0.010	0.0025	0.0010	*< 0.003*	3.4	0.00050	3.0	0.0000040	1.2	0.24	15	0.000076	0.000020	0.000060	0.0015	0.000080	0.0010	*< 0.002*
13-Jan-16	20	39	400	355	0.00089	*< 0.007*	0.000050	0.0026	14	0.0055	*< 0.01*	0.0025	0.00090	*< 0.003*	3.5	0.00064	3.4	0.0000030	1.0	0.22	15	0.000038	0.000060	*< 5E-05*	0.0012	0.000050	*< 0.001*	*< 0.002*
27-Jan-16	21	41	400	370	0.00069	*< 0.007*	0.000010	0.0026	13	0.0027	*< 0.01*	0.0024	0.00080	*< 0.003*	3.5	0.00043	3.3	*< 2E-06*	0.93	0.24	15	0.000064	0.000060	*< 5E-05*	0.0013	0.000050	0.0020	*< 0.002*
10-Feb-16	22	43	400	385	0.00053	*< 0.007*	0.000060	0.0025	13	0.0018	*< 0.01*	0.0023	0.00090	*< 0.003*	3.4	0.00049	3.2	*< 2E-06*	0.88	0.23	14	0.000057	0.000040	*< 5E-05*	0.0011	0.000050	*< 0.001*	*< 0.002*
24-Feb-16	23	45	400	360	0.00035	*< 0.007*	*< 1E-05*	0.0026	14	0.0033	0.020	0.0023	0.00090	*< 0.003*	3.5	0.00045	3.2	*< 2E-06*	0.73	0.23	13	0.000060	0.000010	*< 5E-05*	0.0011	0.000040	0.0010	*< 0.002*
9-Mar-16	24	47	400	365																								

Calculated Loading Rates for Col 9

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	360	0.00063	0.00050	0.00000072	0.0014	14	0.0093	0.019	0.00021	0.0021	0.0012	1.2	0.0014	0.34	0.0000033	9.4	0.21	48	0.000024	0.0000086	0.0000094	0.0049	0.0000094	0.00022	0.00014
6-May-15	2	3	400	355	0.00012	0.00025	0.00000036	0.00043	4.0	0.0033	0.0018	0.000092	0.00062	0.00011	0.39	0.00053	0.15	0.00000050	2.4	0.062	17	0.0000061	0.00000036	0.0000018	0.0011	0.0000036	0.000071	0.000071
20-May-15	3	5	400	375	0.000075	0.00038	0.00000038	0.00033	2.3	0.0018	0.00038	0.00012	0.00032	0.00011	0.29	0.00029	0.16	0.00000056	1.3	0.040	8.9	0.0000053	0.0000068	0.0000023	0.00068	0.0000015	0.000075	0.000075
3-Jun-15	4	7	400	255	0.000031	0.00018	0.00000026	0.00020	1.2	0.00073	0.00026	0.000071	0.00016	0.000077	0.18	0.00014	0.11	0.00000028	0.65	0.022	4.8	0.0000031	0.0000013	0.0000013	0.00036	0.0000020	0.000026	0.000051
17-Jun-15	5	9	500	445	0.000047	0.00031	0.00000045	0.00026	1.5	0.00071	0.00045	0.00013	0.00017	0.00013	0.25	0.00017	0.18	0.00000045	0.73	0.025	5.4	0.0000052	0.0000040	0.0000045	0.00044	0.0000045	0.000045	0.000089
1-Jul-15	6	11	500	390	0.000052	0.00027	0.00000039	0.00021	1.0	0.00036	0.00078	0.00010	0.00011	0.00012	0.19	0.00011	0.16	0.00000031	0.46	0.018	3.0	0.0000040	0.0000031	0.0000020	0.00030	0.0000023	0.000078	0.000078
15-Jul-15	7	13	500	455	0.000034	0.00032	0.00000046	0.00022	1.0	0.00046	0.00046	0.00012	0.000096	0.00014	0.20	0.000078	0.17	0.00000036	0.40	0.017	2.7	0.0000049	0.0000036	0.0000041	0.00029	0.0000041	0.000046	0.000091
29-Jul-15	8	15	400	375	0.000028	0.00026	0.00000038	0.00018	0.77	0.00027	0.00038	0.00010	0.000064	0.00011	0.16	0.000047	0.13	0.000000075	0.25	0.014	2.0	0.0000034	0.0000030	0.0000019	0.00020	0.0000026	0.000038	0.000075
12-Aug-15	9	17	400	395	0.000019	0.00028	0.00000040	0.00016	0.73	0.00019	0.00040	0.00010	0.000059	0.00012	0.17	0.000041	0.14	0.00000071	0.20	0.013	1.6	0.0000025	0.0000016	0.0000020	0.00016	0.0000024	0.000040	0.000079
26-Aug-15	10	19	500	460	0.000030	0.00032	0.00000069	0.00018	0.84	0.00022	0.00046	0.00012	0.000067	0.00018	0.21	0.000043	0.16	0.00000058	0.20	0.015	1.8	0.0000030	0.0000039	0.0000023	0.00015	0.0000032	0.000046	0.000092
9-Sep-15	11	21	500	450	0.000042	0.00036	0.0000010	0.00019	0.93	0.00025	0.00052	0.00014	0.000072	0.00026	0.23	0.000042	0.18	0.00000036	0.19	0.016	2.1	0.0000035	0.0000067	0.0000026	0.00013	0.0000041	0.000052	0.00010
23-Sep-15	12	23	500	465	0.000039	0.00037	0.00000080	0.00019	0.88	0.00021	0.00053	0.00013	0.000067	0.00021	0.22	0.000040	0.18	0.00000035	0.16	0.015	1.7	0.0000035	0.0000043	0.0000027	0.00013	0.0000037	0.000053	0.00011
7-Oct-15	13	25	400	370	0.000027	0.00030	0.00000043	0.00014	0.64	0.00013	0.00043	0.000087	0.000047	0.00013	0.16	0.000028	0.14	0.00000026	0.097	0.011	1.1	0.0000027	0.0000013	0.0000021	0.000089	0.0000026	0.000043	0.000085
21-Oct-15	14	27	400	385	0.000030	0.00031	0.00000044	0.00013	0.59	0.00011	0.00044	0.00013	0.000053	0.00013	0.16	0.000026	0.15	0.00000013	0.085	0.011	0.98	0.0000042	0.0000027	0.0000022	0.000093	0.0000027	0.000044	0.000089
4-Nov-15	15	29	400	385	0.00014	0.00031	0.0000093	0.00011	0.62	0.000090	0.00044	0.00012	0.000053	0.00022	0.16	0.000024	0.15	0.00000013	0.079	0.010	0.92	0.0000042	0.000032	0.0000022	0.000081	0.0000075	0.00013	0.000089
18-Nov-15	16	31	400	370	0.000028	0.00055	0.0000064	0.00012	0.59	0.000072	0.00043	0.00011	0.000034	0.00013	0.15	0.000028	0.14	0.000000085	0.065	0.0100	0.84	0.0000028	0.0000017	0.0000021	0.000065	0.0000034	0.000043	0.000085
2-Dec-15	17	33	400	375	0.000030	0.00030	0.00000086	0.00012	0.64	0.00022	0.00043	0.00012	0.000052	0.00013	0.16	0.000028	0.14	0.000000086	0.066	0.011	0.81	0.0000025	0.0000026	0.0000030	0.000070	0.0000026	0.000043	0.000086
16-Dec-15	18	35	400	360	0.000032	0.00029	0.0000025	0.00012	0.60	0.00022	0.00041	0.00010	0.000046	0.00012	0.15	0.000023	0.14	0.000000083	0.055	0.010	0.74	0.0000034	0.0000054	0.0000029	0.000067	0.0000017	0.000041	0.000083
30-Dec-15	19	37	400	385	0.000027	0.00031	0.0000058	0.00012	0.61	0.00020	0.00044	0.00011	0.000044	0.00013	0.15	0.000022	0.13	0.00000018	0.054	0.011	0.66	0.0000034	0.00000089	0.0000027	0.000065	0.0000035	0.000044	0.000089
13-Jan-16	20	39	400	355	0.000036	0.00029	0.0000020	0.00011	0.55	0.00022	0.00041	0.00010	0.000037	0.00012	0.14	0.000026	0.14	0.00000012	0.042	0.0090	0.59	0.0000016	0.0000024	0.0000020	0.000050	0.0000020	0.000041	0.000082
27-Jan-16	21	41	400	370	0.000029	0.00030	0.00000043	0.00011	0.54	0.00011	0.00043	0.00010	0.000034	0.00013	0.15	0.000018	0.14	0.000000085	0.040	0.010	0.62	0.0000027	0.0000026	0.0000021	0.000056	0.0000021	0.000085	0.000085
10-Feb-16	22	43	400	385	0.000023	0.00031	0.0000027	0.00011	0.58	0.000077	0.00044	0.00010	0.000040	0.00013	0.15	0.000022	0.14	0.000000089	0.039	0.010	0.61	0.0000025	0.0000018	0.0000022	0.000050	0.0000022	0.000044	0.000089
24-Feb-16	23	45	400	360	0.000014	0.00029	0.00000041	0.00011	0.58	0.00013	0.00083	0.000097	0.000037	0.00012	0.15	0.000019	0.13	0.000000083	0.030	0.0096	0.54	0.0000025	0.00000041	0.0000021	0.000047	0.0000017	0.000041	0.000083
9-Mar-16	24	47	400	365																								

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 10 (Latte Schist Transition Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	435	7.7	3558	#N/A	13	142	2538	31	0.31	*< 0.3*	2390	0.0027	0.027	0.18	0.013	*< 7E-06*	*< 7E-06*	0.014	0.000018	507	0.000050	0.0069
6-May-15	2	3	400	355	7.6	2779	#N/A	7.8	70	1837	14	0.33	*< 0.3*	1740	0.0026	0.018	0.14	0.0054	*< 7E-06*	*< 7E-06*	0.010	0.0000080	425	*< 3E-05*	0.0041
20-May-15	3	5	400	360	7.7	2305	#N/A	9.0	60	1421	1.0	0.34	*< 0.3*	1340	0.0052	0.014	0.12	0.0046	*< 7E-06*	*< 7E-06*	0.0070	0.0000040	351	0.000050	0.0030
3-Jun-15	4	7	400	270	7.7	2125	#N/A	8.2	63	1280	*< 1*	0.36	*< 0.3*	1277	0.0049	0.015	0.12	0.0048	*< 7E-06*	*< 7E-06*	0.011	0.0000040	348	0.000040	0.0026
17-Jun-15	5	9	500	455	7.8	1396	#N/A	8.1	65	848	*< 1*	0.37	*< 0.3*	826	0.0044	0.014	0.12	0.0041	*< 7E-06*	*< 7E-06*	0.0084	0.0000040	229	0.000080	0.0017
1-Jul-15	6	11	500	470	7.8	873	#N/A	7.1	66	639	*< 1*	0.38	*< 0.3*	611	0.0040	0.014	0.12	0.0043	*< 7E-06*	*< 7E-06*	0.0053	*< 3E-06*	168	*< 3E-05*	0.0013
15-Jul-15	7	13	500	450	7.8	825	#N/A	5.6	69	521	*< 1*	0.41	*< 0.3*	530	0.0060	0.014	0.11	0.0046	*< 7E-06*	0.0000070	0.0097	*< 3E-06*	140	*< 3E-05*	0.0013
29-Jul-15	8	15	400	365	7.8	988	#N/A	4.6	69	485	*< 1*	0.41	*< 0.3*	516	0.0051	0.014	0.10	0.0051	*< 7E-06*	*< 7E-06*	0.0089	*< 3E-06*	141	0.00013	0.0010
12-Aug-15	9	17	400	375	7.8	788	#N/A	4.8	71	396	*< 1*	0.39	*< 0.3*	448	0.0047	0.014	0.11	0.0051	*< 7E-06*	*< 7E-06*	0.0063	0.0000050	123	0.00014	0.00082
26-Aug-15	10	19	500	445	7.7	788	#N/A	4.5	70	343	1.0	0.41	0.30	396	0.0048	0.015	0.11	0.0056	0.0000070	0.0000070	0.0061	0.0000040	109	0.000085	0.00070
9-Sep-15	11	21	500	450	7.9	602	#N/A	4.2	70	283	*< 1*	0.42	*< 0.3*	344	0.0049	0.017	0.11	0.0062	*< 7E-06*	*< 7E-06*	0.0058	*< 3E-06*	96	*< 3E-05*	0.00058
23-Sep-15	12	23	500	465	7.9	586	#N/A	3.6	74	251	-	0.41	-	322	0.0043	0.017	0.11	0.0063	0.0000070	0.0000070	0.0054	0.0000030	89	0.000055	0.00052
7-Oct-15	13	25	400	360	7.9	630	#N/A	3.9	81	241	-	0.39	-	299	0.0036	0.018	0.11	0.0065	*< 7E-06*	*< 7E-06*	0.0050	*< 3E-06*	83	0.000080	0.00045
21-Oct-15	14	27	400	360	8.0	583	#N/A	2.1	79	178	-	0.39	-	267	0.0060	0.018	0.12	0.0076	*< 7E-06*	*< 7E-06*	0.0064	0.0000030	76	0.000050	0.00041
4-Nov-15	15	29	400	375	8.0	585	#N/A	2.9	84	225	-	0.38	-	284	0.0051	0.016	0.12	0.0085	*< 7E-06*	*< 7E-06*	0.0043	*< 3E-06*	80	*< 3E-05*	0.00036
18-Nov-15	16	31	400	360	8.1	534	#N/A	1.7	90	168	-	0.39	-	244	0.0037	0.015	0.12	0.0056	*< 7E-06*	*< 7E-06*	0.0029	*< 3E-06*	69	0.000040	0.00032
2-Dec-15	17	33	400	375	8.1	492	#N/A	2.4	81	136	-	0.39	-	250	0.0048	0.017	0.12	0.0086	*< 7E-06*	*< 7E-06*	0.0050	0.0000070	69	0.000040	0.00049
16-Dec-15	18	35	400	355	8.1	438	#N/A	2.3	75	144	-	0.37	-	246	0.0037	0.017	0.14	0.0099	*< 7E-06*	*< 7E-06*	0.0056	0.0000050	69	*< 3E-05*	0.00043
30-Dec-15	19	37	400	345	8.1	443	#N/A	1.8	77	120	-	0.37	-	222	0.0043	0.016	0.13	0.0094	*< 7E-06*	*< 7E-06*	0.0047	*< 3E-06*	62	0.000070	0.00039
13-Jan-16	20	39	400	365	8.1	403	#N/A	1.7	77	112	-	0.36	-	196	0.0032	0.016	0.12	0.0095	*< 7E-06*	*< 7E-06*	0.0060	*< 3E-06*	54	*< 3E-05*	0.00031
27-Jan-16	21	41	400	365	8.0	386	#N/A	3.4	77	108	-	0.42	-	188	0.0040	0.017	0.13	0.011	*< 7E-06*	*< 7E-06*	0.0040	0.0000030	53	*< 3E-05*	0.00032
10-Feb-16	22	43	401	375	8.1	380	#N/A	2.5	81	103	-	0.36	-	183	0.0049	0.017	0.14	0.011	*< 7E-06*	*< 7E-06*	0.0030	*< 3E-06*	51	*< 3E-05*	0.00028
24-Feb-16	23	45	402	350	8.1	397	#N/A	2.5	82	103	-	0.37	-	201	0.0020	0.017	0.14	0.011	*< 7E-06*	*< 7E-06*	0.0020	0.0000040	56	*< 3E-05*	0.00031
9-Mar-16	24	47	403	370	8.1	379	#N/A	2.3	78	79															

Calculated Loading Rates for Col 10

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	435	7.7	3558	#N/A	1.1	12	221	2.7	0.027	0.026	208	0.00023	0.0024	0.015	0.0011	0.00000061	0.00000061	0.0012	0.0000016	44	0.0000044	0.00060
6-May-15	2	3	400	355	7.6	2779	#N/A	0.28	2.5	65	0.50	0.012	0.011	62	0.000092	0.00063	0.0049	0.00019	0.00000025	0.00000025	0.00036	0.00000028	15	0.0000011	0.00015
20-May-15	3	5	400	360	7.7	2305	#N/A	0.33	2.1	51	0.036	0.012	0.011	48	0.00019	0.00050	0.0043	0.00016	0.00000025	0.00000025	0.00025	0.00000014	13	0.0000018	0.00011
3-Jun-15	4	7	400	270	7.7	2125	#N/A	0.22	1.7	35	0.027	0.0097	0.0081	34	0.00013	0.00040	0.0032	0.00013	0.00000019	0.00000019	0.00030	0.00000011	9.4	0.0000011	0.000070
17-Jun-15	5	9	500	455	7.8	1396	#N/A	0.37	3.0	39	0.046	0.017	0.014	38	0.00020	0.00065	0.0056	0.00018	0.00000032	0.00000032	0.00038	0.00000018	10	0.0000036	0.000077
1-Jul-15	6	11	500	470	7.8	873	#N/A	0.33	3.1	30	0.047	0.018	0.014	29	0.00019	0.00067	0.0055	0.00020	0.00000033	0.00000033	0.00025	0.00000014	7.9	0.0000014	0.000062
15-Jul-15	7	13	500	450	7.8	825	#N/A	0.25	3.1	23	0.045	0.018	0.014	24	0.00027	0.00063	0.0051	0.00021	0.00000032	0.00000032	0.00044	0.00000014	6.3	0.0000014	0.000057
29-Jul-15	8	15	400	365	7.8	988	#N/A	0.17	2.5	18	0.037	0.015	0.011	19	0.00019	0.00051	0.0037	0.00019	0.00000026	0.00000026	0.00032	0.00000011	5.1	0.0000047	0.000038
12-Aug-15	9	17	400	375	7.8	788	#N/A	0.18	2.7	15	0.038	0.015	0.011	17	0.00018	0.00053	0.0039	0.00019	0.00000026	0.00000026	0.00024	0.00000019	4.6	0.0000053	0.000031
26-Aug-15	10	19	500	445	7.7	788	0.00	0.20	3.1	15	0.045	0.018	0.013	18	0.00021	0.00068	0.0048	0.00025	0.00000031	0.00000031	0.00027	0.00000018	4.9	0.0000038	0.000031
9-Sep-15	11	21	500	450	7.9	602	#N/A	0.19	3.1	15	0.045	0.022	0.016	18	0.00025	0.00086	0.0056	0.00032	0.00000036	0.00000036	0.00030	0.00000016	5.0	0.0000016	0.000030
23-Sep-15	12	23	500	465	7.9	586	#N/A	0.17	3.4	13	0.00	0.022		17	0.00023	0.00092	0.0060	0.00034	0.00000037	0.00000037	0.00029	0.00000016	4.8	0.0000029	0.000028
7-Oct-15	13	25	400	360	7.9	630	#N/A	0.14	2.9	10.0	0.00	0.016		12	0.00015	0.00074	0.0047	0.00027	0.00000029	0.00000029	0.00021	0.00000012	3.4	0.0000033	0.000019
21-Oct-15	14	27	400	360	8.0	583	#N/A	0.077	2.8	7.4	0.00	0.016		11	0.00025	0.00072	0.0050	0.00031	0.00000029	0.00000029	0.00026	0.00000012	3.1	0.0000021	0.000017
4-Nov-15	15	29	400	375	8.0	585	#N/A	0.11	3.2	9.7	0.00	0.016		12	0.00022	0.00067	0.0053	0.00037	0.00000030	0.00000030	0.00019	0.00000013	3.4	0.0000013	0.000015
18-Nov-15	16	31	400	360	8.1	534	#N/A	0.060	3.3	7.0	0.00	0.016		10	0.00015	0.00064	0.0050	0.00023	0.00000029	0.00000029	0.00012	0.00000012	2.8	0.0000017	0.000013
2-Dec-15	17	33	400	375	8.1	492	#N/A	0.088	3.0	5.9	0.00	0.017		11	0.00021	0.00073	0.0050	0.00037	0.00000030	0.00000030	0.00022	0.00000030	3.0	0.0000017	0.000021
16-Dec-15	18	35	400	355	8.1	438	#N/A	0.082	2.6	5.9	0.00	0.015		10	0.00015	0.00071	0.0056	0.00041	0.00000029	0.00000029	0.00023	0.00000020	2.8	0.0000012	0.000017
30-Dec-15	19	37	400	345	8.1	443	#N/A	0.062	2.6	4.8	0.00	0.015		8.8	0.00017	0.00063	0.0051	0.00037	0.00000028	0.00000028	0.00019	0.00000012	2.5	0.0000028	0.000015
13-Jan-16	20	39	400	365	8.1	403	#N/A	0.062	2.8	4.7	0.00	0.015		8.2	0.00013	0.00068	0.0048	0.00040	0.00000029	0.00000029	0.00025	0.00000013	2.3	0.0000013	0.000013
27-Jan-16	21	41	400	365	8.0	386	#N/A	0.12	2.8	4.5	0.00	0.018		7.9	0.00017	0.00070	0.0053	0.00044	0.00000029	0.00000029	0.00017	0.00000013	2.2	0.0000013	0.000013
10-Feb-16	22	43	401	375	8.1	380	#N/A	0.095	3.0	4.4	0.00	0.016		7.9	0.00021	0.00073	0.0060	0.00046	0.00000030	0.00000030	0.00013	0.00000013	2.2	0.0000013	0.000012
24-Feb-16	23	45	402	350	8.1	397	#N/A	0.088	2.9	4.1	0.00	0.015		8.1	0.000080	0.00069	0.0055	0.00046	0.00000028	0.00000028	0.000080	0.00000016	2.2	0.0000012	0.000012
9-Mar-16	24	47	403	370	8.1	379	#N/A	0.084	2.9	3.4	0.00														

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 10 (Latte Schist Transition Ore)

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
-	No.	-	Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	435	0.0085	*< 0.007*	*< 1E-05*	0.020	272	0.41	0.26	0.0049	0.048	0.014	21	0.028	3.9	0.00020	68	3.8	807	0.00065	0.000080	0.000060	0.065	0.00015	0.0020	*< 0.002*
6-May-15	2	3	400	355	0.0037	*< 0.007*	0.000020	0.011	164	0.33	0.040	0.0047	0.033	*< 0.003*	14	0.018	3.1	0.000012	31	2.6	720	0.00042	*< 1E-05*	*< 5E-05*	0.042	0.00013	0.0030	*< 0.002*
20-May-15	3	5	400	360	0.0018	*< 0.007*	0.000010	0.0088	112	0.27	*< 0.01*	0.0046	0.022	*< 0.003*	11	0.0089	3.3	0.0000060	17	2.0	447	0.00039	0.00013	0.00012	0.031	0.00014	0.0010	*< 0.002*
3-Jun-15	4	7	400	270	0.010	*< 0.007*	0.00016	0.0085	99	0.23	*< 0.01*	0.0051	0.019	*< 0.003*	11	0.0064	3.3	0.0000060	13	1.9	434	0.00036	0.0020	*< 5E-05*	0.029	0.00013	0.0090	*< 0.002*
17-Jun-15	5	9	500	455	0.0012	*< 0.007*	*< 1E-05*	0.0062	62	0.13	*< 0.01*	0.0039	0.013	*< 0.003*	8.1	0.0042	3.0	0.0000060	7.5	1.2	285	0.00029	0.000050	0.000060	0.018	0.00011	0.0010	*< 0.002*
1-Jul-15	6	11	500	470	0.00093	*< 0.007*	*< 1E-05*	0.0054	47	0.10	*< 0.01*	0.0036	0.0098	*< 0.003*	6.8	0.0032	2.9	0.0000030	5.0	0.91	195	0.00025	0.000050	*< 5E-05*	0.015	0.00011	0.0010	*< 0.002*
15-Jul-15	7	13	500	450	0.0011	*< 0.007*	0.000020	0.0051	44	0.099	*< 0.01*	0.0034	0.0087	*< 0.003*	5.9	0.0024	3.1	0.0000030	4.2	0.77	171	0.00024	0.000070	*< 5E-05*	0.014	0.00014	0.0010	*< 0.002*
29-Jul-15	8	15	400	365	0.0014	*< 0.007*	0.000030	0.0049	40	0.082	*< 0.01*	0.0038	0.0068	*< 0.003*	6.2	0.0019	2.6	*< 2E-06*	3.3	0.78	167	0.00021	0.00015	*< 5E-05*	0.014	0.00013	*< 0.001*	*< 0.002*
12-Aug-15	9	17	400	375	0.00043	*< 0.007*	*< 1E-05*	0.0042	34	0.067	*< 0.01*	0.0036	0.0060	*< 0.003*	6.0	0.0015	2.9	0.0000080	2.7	0.68	130	0.00018	0.000040	0.000080	0.011	0.00012	*< 0.001*	*< 0.002*
26-Aug-15	10	19	500	445	0.00056	0.0070	0.000010	0.0038	30	0.057	0.010	0.0033	0.0051	0.0030	5.6	0.0014	2.7	0.0000055	2.2	0.59	118	0.00017	0.000085	0.000065	0.0096	0.00015	0.0010	0.0020
9-Sep-15	11	21	500	450	0.00068	*< 0.007*	*< 1E-05*	0.0035	26	0.047	*< 0.01*	0.0031	0.0042	*< 0.003*	5.2	0.0012	2.5	0.0000030	1.8	0.50	105	0.00016	0.00013	*< 5E-05*	0.0082	0.00018	*< 0.001*	*< 0.002*
23-Sep-15	12	23	500	465	0.00060	0.0070	0.000010	0.0033	24	0.044	0.010	0.0028	0.0040	0.0030	4.9	0.0012	2.4	0.0000025	1.6	0.48	94	0.00014	0.000070	0.000050	0.0080	0.00014	0.0010	0.0020
7-Oct-15	13	25	400	360	0.00051	*< 0.007*	*< 1E-05*	0.0031	22	0.041	*< 0.01*	0.0025	0.0037	*< 0.003*	4.5	0.0012	2.4	0.0000020	1.4	0.46	83	0.00012	0.000010	*< 5E-05*	0.0077	0.00010	0.0010	*< 0.002*
21-Oct-15	14	27	400	360	0.00060	*< 0.007*	0.000010	0.0030	19	0.037	*< 0.01*	0.0034	0.0036	*< 0.003*	4.2	0.0011	2.5	*< 2E-06*	1.3	0.40	74	0.00016	0.000040	*< 5E-05*	0.0079	0.00011	0.0080	*< 0.002*
4-Nov-15	15	29	400	375	0.0013	*< 0.007*	0.000070	0.0025	21	0.036	*< 0.01*	0.0030	0.0039	*< 0.003*	4.4	0.0010	2.4	*< 2E-06*	1.2	0.40	74	0.00017	0.000070	*< 5E-05*	0.0081	0.00012	0.0010	*< 0.002*
18-Nov-15	16	31	400	360	0.00035	*< 0.007*	*< 1E-05*	0.0027	18	0.030	*< 0.01*	0.0032	0.0028	*< 0.003*	4.0	0.0012	2.3	*< 2E-06*	0.98	0.36	63	0.00012	0.000030	*< 5E-05*	0.0050	0.00011	*< 0.001*	*< 0.002*
2-Dec-15	17	33	400	375	0.00089	*< 0.007*	0.000040	0.0026	19	0.038	*< 0.01*	0.0033	0.0033	*< 0.003*	4.3	0.0011	2.4	*< 2E-06*	1.0	0.35	58	0.00012	0.000040	*< 5E-05*	0.0061	0.00012	0.0020	*< 0.002*
16-Dec-15	18	35	400	355	0.00048	*< 0.007*	*< 1E-05*	0.0027	18	0.042	*< 0.01*	0.0032	0.0032	*< 0.003*	4.2	0.0010	2.5	*< 2E-06*	0.89	0.36	57	0.00013	0.000040	*< 5E-05*	0.0062	0.00012	*< 0.001*	*< 0.002*
30-Dec-15	19	37	400	345	0.00071	*< 0.007*	0.000040	0.0027	16	0.035	0.010	0.0031	0.0029	*< 0.003*	3.9	0.00090	2.2	0.0000030	0.85	0.32	44	0.00012	0.000020	0.000050	0.0053	0.00017	0.0010	*< 0.002*
13-Jan-16	20	39	400	365	0.00064	*< 0.007*	0.000070	0.0024	15	0.031	*< 0.01*	0.0028	0.0025	*< 0.003*	3.8	0.0010	2.3	0.0000020	0.69	0.28	41	0.000085	0.000040	*< 5E-05*	0.0043	0.00011	*< 0.001*	*< 0.002*
27-Jan-16	21	41	400	365	0.00035	*< 0.007*	0.00020	0.0023	14	0.028	*< 0.01*	0.0027	0.0022	*< 0.003*	3.8	0.00078	2.2	*< 2E-06*	0.63	0.29	41	0.00012	0.000040	*< 5E-05*	0.0045	0.00011	*< 0.001*	*< 0.002*
10-Feb-16	22	43	401	375	0.00044	*< 0.007*	0.000080	0.0023	14	0.025	*< 0.01*	0.0027	0.0023	*< 0.003*	3.6	0.00088	2.2	*< 2E-06*	0.61	0.28	37	0.00012	0.000030	*< 5E-05*	0.0039	0.00013	*< 0.001*	*< 0.002*
24-Feb-16	23	45	402	350	0.00037	*< 0.007*	0.000030	0.0025	15	0.027	0.020	0.0029	0.0024	*< 0.003*	4.0	0.00091	2.2	*< 2E-06*	0.52	0.29	37	0.00011	0.000010	*< 5E-05*	0.0043	0.00011	*< 0.001*	*< 0.002*
9-Mar-16	24	47	403	370																								

Calculated Loading Rates for Col 10

Date	Cycle	Week	Volume (mL)		Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	435	0.00074	0.00061	0.00000087	0.0017	24	0.036	0.023	0.00043	0.0042	0.0012	1.8	0.0024	0.34	0.000017	6.0	0.33	70	0.000057	0.0000070	0.0000052	0.0056	0.000013	0.00017	0.00017
6-May-15	2	3	400	355	0.00013	0.00025	0.00000071	0.00039	5.8	0.012	0.0014	0.00017	0.0012	0.00011	0.48	0.00064	0.11	0.00000043	1.1	0.091	26	0.000015	0.00000036	0.0000018	0.0015	0.0000046	0.00011	0.000071
20-May-15	3	5	400	360	0.000063	0.00025	0.00000036	0.00032	4.0	0.0096	0.00036	0.00016	0.00077	0.00011	0.40	0.00032	0.12	0.00000022	0.63	0.071	16	0.000014	0.0000047	0.0000043	0.0011	0.0000050	0.000036	0.000072
3-Jun-15	4	7	400	270	0.00028	0.00019	0.0000043	0.00023	2.7	0.0062	0.00027	0.00014	0.00050	0.000081	0.29	0.00017	0.090	0.00000016	0.35	0.050	12	0.0000097	0.000054	0.0000014	0.00077	0.0000035	0.00024	0.000054
17-Jun-15	5	9	500	455	0.000053	0.00032	0.00000046	0.00028	2.8	0.0060	0.00046	0.00018	0.00057	0.00014	0.37	0.00019	0.14	0.00000027	0.34	0.052	13	0.000013	0.0000023	0.0000027	0.00084	0.0000050	0.000046	0.000091
1-Jul-15	6	11	500	470	0.000044	0.00033	0.00000047	0.00025	2.2	0.0048	0.00047	0.00017	0.00046	0.00014	0.32	0.00015	0.14	0.00000014	0.23	0.043	9.2	0.000012	0.0000024	0.0000024	0.00072	0.0000052	0.000047	0.000094
15-Jul-15	7	13	500	450	0.000047	0.00032	0.00000090	0.00023	2.0	0.0045	0.00045	0.00015	0.00039	0.00014	0.27	0.00011	0.14	0.00000014	0.19	0.035	7.7	0.000011	0.0000032	0.0000023	0.00063	0.0000063	0.000045	0.000090
29-Jul-15	8	15	400	365	0.000050	0.00026	0.0000011	0.00018	1.5	0.0030	0.00037	0.00014	0.00025	0.00011	0.23	0.000069	0.096	0.000000073	0.12	0.028	6.1	0.0000078	0.0000055	0.0000018	0.00050	0.0000047	0.000037	0.000073
12-Aug-15	9	17	400	375	0.000016	0.00026	0.00000038	0.00016	1.3	0.0025	0.00038	0.00013	0.00023	0.00011	0.22	0.000057	0.11	0.00000030	0.10	0.026	4.9	0.0000069	0.0000015	0.0000030	0.00041	0.0000045	0.000038	0.000075
26-Aug-15	10	19	500	445	0.000025	0.00031	0.00000045	0.00017	1.3	0.0025	0.00045	0.00015	0.00023	0.00013	0.25	0.000061	0.12	0.00000024	0.100	0.026	5.2	0.0000077	0.0000038	0.0000029	0.00043	0.0000067	0.000045	0.000089
9-Sep-15	11	21	500	450	0.000035	0.00036	0.00000052	0.00018	1.3	0.0024	0.00052	0.00016	0.00022	0.00016	0.27	0.000063	0.13	0.00000016	0.094	0.026	5.4	0.0000083	0.0000067	0.0000026	0.00042	0.0000093	0.000052	0.00010
23-Sep-15	12	23	500	465	0.000032	0.00037	0.00000053	0.00018	1.3	0.0023	0.00053	0.00015	0.00021	0.00016	0.26	0.000065	0.13	0.00000013	0.086	0.026	5.0	0.0000075	0.0000037	0.0000027	0.00043	0.0000075	0.000053	0.00011
7-Oct-15	13	25	400	360	0.000021	0.00029	0.00000041	0.00013	0.92	0.0017	0.00041	0.00010	0.00015	0.00012	0.19	0.000050	0.100	0.000000083	0.057	0.019	3.5	0.0000050	0.00000041	0.0000021	0.00032	0.0000041	0.000041	0.000083
21-Oct-15	14	27	400	360	0.000025	0.00029	0.00000041	0.00012	0.79	0.0015	0.00041	0.00014	0.00015	0.00012	0.17	0.000044	0.11	0.000000083	0.053	0.016	3.0	0.0000067	0.0000017	0.0000021	0.00032	0.0000046	0.00033	0.000083
4-Nov-15	15	29	400	375	0.000054	0.00030	0.0000030	0.00011	0.89	0.0016	0.00043	0.00013	0.00017	0.00013	0.19	0.000044	0.10	0.000000086	0.050	0.017	3.2	0.0000072	0.0000030	0.0000022	0.00035	0.0000052	0.000043	0.000086
18-Nov-15	16	31	400	360	0.000014	0.00029	0.00000041	0.00011	0.73	0.0012	0.00041	0.00013	0.00012	0.00012	0.17	0.000048	0.095	0.000000083	0.041	0.015	2.6	0.0000048	0.0000012	0.0000021	0.00021	0.0000046	0.000041	0.000083
2-Dec-15	17	33	400	375	0.000038	0.00030	0.0000017	0.00011	0.81	0.0016	0.00043	0.00014	0.00014	0.00013	0.19	0.000046	0.10	0.000000086	0.044	0.015	2.5	0.0000053	0.0000017	0.0000022	0.00026	0.0000052	0.000086	0.000086
16-Dec-15	18	35	400	355	0.000020	0.00029	0.00000041	0.00011	0.73	0.0017	0.00041	0.00013	0.00013	0.00012	0.17	0.000041	0.10	0.000000082	0.036	0.015	2.3	0.0000054	0.0000016	0.0000020	0.00025	0.0000049	0.000041	0.000082
30-Dec-15	19	37	400	345	0.000028	0.00028	0.0000016	0.00011	0.64	0.0014	0.00040	0.00012	0.00012	0.00012	0.15	0.000036	0.089	0.00000012	0.034	0.013	1.7	0.0000049	0.00000079	0.0000020	0.00021	0.0000067	0.000040	0.000079
13-Jan-16	20	39	400	365	0.000027	0.00029	0.0000029	0.00010	0.62	0.0013	0.00042	0.00012	0.00010	0.00013	0.16	0.000043	0.095	0.000000084	0.029	0.012	1.7	0.0000036	0.0000017	0.0000021	0.00018	0.0000046	0.000042	0.000084
27-Jan-16	21	41	400	365	0.000015	0.00029	0.0000084	0.000096	0.58	0.0012	0.00042	0.00011	0.000092	0.00013	0.16	0.000033	0.094	0.000000084	0.026	0.012	1.7	0.0000050	0.0000017	0.0000021	0.00019	0.0000046	0.000042	0.000084
10-Feb-16	22	43	401	375	0.000019	0.00030	0.0000034	0.000100	0.58	0.0011	0.00043	0.00012	0.000099	0.00013	0.16	0.000038	0.093	0.000000086	0.026	0.012	1.6	0.0000050	0.0000013	0.0000022	0.00017	0.0000056	0.000043	0.000086
24-Feb-16	23	45	402	350	0.000015	0.00028	0.0000012	0.00010	0.60	0.0011	0.00080	0.00012	0.000097	0.00012	0.16	0.000037	0.088	0.000000080	0.021	0.012	1.5	0.0000044	0.00000040	0.0000020	0.00017	0.0000044	0.000040	0.000080
9-Mar-16	24	47	403	370																								

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 11 (Supremo Gneiss Oxide Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	360	8.0	538	#N/A	6.0	165	54	14	0.20	*< 0.3*	178	0.0060	0.010	0.082	0.15	*< 7E-06*	*< 7E-06*	0.019	0.0000030	49	0.00027	0.0022
6-May-15	2	3	400	335	8.0	301	#N/A	4.4	98	51	4.0	0.33	*< 0.3*	88	0.0029	0.0092	0.13	0.048	*< 7E-06*	*< 7E-06*	0.013	0.0000030	23	0.000060	0.00097
20-May-15	3	5	400	380	8.1	269	#N/A	4.2	86	37	1.0	0.35	*< 0.3*	80	0.0040	0.0067	0.13	0.041	*< 7E-06*	*< 7E-06*	0.0097	0.0000070	22	0.00023	0.00050
3-Jun-15	4	7	400	275	8.0	242	#N/A	4.4	94	28	*< 1*	0.35	*< 0.3*	80	0.0054	0.0068	0.14	0.045	*< 7E-06*	*< 7E-06*	0.014	0.0000070	22	0.00016	0.00030
17-Jun-15	5	9	500	465	8.1	212	#N/A	4.5	87	21	*< 1*	0.32	*< 0.3*	70	0.0043	0.0066	0.15	0.037	*< 7E-06*	*< 7E-06*	0.012	0.000015	19	0.00015	0.00022
1-Jul-15	6	11	500	475	8.0	206	#N/A	4.8	84	16	*< 1*	0.34	*< 0.3*	69	0.0040	0.0064	0.15	0.040	*< 7E-06*	*< 7E-06*	0.0088	0.0000030	19	0.00016	0.00014
15-Jul-15	7	13	500	475	8.0	184	#N/A	4.2	86	14	*< 1*	0.34	*< 0.3*	72	0.0041	0.0059	0.14	0.044	*< 7E-06*	*< 7E-06*	0.013	0.0000060	19	0.00016	0.00014
29-Jul-15	8	15	400	380	8.0	188	#N/A	3.5	86	12	*< 1*	0.33	*< 0.3*	75	0.0043	0.0054	0.13	0.043	*< 7E-06*	*< 7E-06*	0.012	*< 3E-06*	21	0.00015	0.000093
12-Aug-15	9	17	400	390	8.0	186	#N/A	3.1	86	10	*< 1*	0.31	*< 0.3*	77	0.0025	0.0053	0.13	0.045	*< 7E-06*	*< 7E-06*	0.0092	0.0000090	21	0.00016	0.000073
26-Aug-15	10	19	500	465	7.5	184	#N/A	3.0	83	10	1.0	0.32	0.30	76	0.0034	0.0055	0.13	0.046	0.0000070	0.0000070	0.0090	0.0000060	21	0.00015	0.000069
9-Sep-15	11	21	500	475	8.0	175	#N/A	3.0	80	8.0	*< 1*	0.32	*< 0.3*	75	0.0043	0.0057	0.13	0.046	*< 7E-06*	*< 7E-06*	0.0087	*< 3E-06*	21	0.00014	0.000064
23-Sep-15	12	23	500	470	8.0	176	#N/A	2.4	82	8.0	-	0.30	-	79	0.0041	0.0058	0.13	0.046	0.0000070	0.0000070	0.0079	0.0000040	22	0.00013	0.000056
7-Oct-15	13	25	400	380	8.0	186	#N/A	3.1	89	7.0	-	0.28	-	82	0.0038	0.0058	0.12	0.046	*< 7E-06*	*< 7E-06*	0.0071	0.0000050	23	0.00012	0.000047
21-Oct-15	14	27	400	390	8.1	173	#N/A	1.4	84	7.0	-	0.27	-	76	0.0036	0.0058	0.13	0.053	*< 7E-06*	*< 7E-06*	0.0083	0.0000040	21	0.00017	0.000049
4-Nov-15	15	29	400	390	8.1	177	#N/A	2.3	88	7.0	-	0.28	-	83	0.0039	0.0049	0.12	0.055	*< 7E-06*	*< 7E-06*	0.0055	0.0000070	23	0.00029	*< 4E-06*
18-Nov-15	16	31	400	380	8.2	176	#N/A	1.0	95	7.0	-	0.27	-	79	0.0030	0.0047	0.13	0.042	*< 7E-06*	*< 7E-06*	0.0046	*< 3E-06*	21	0.00012	0.000067
2-Dec-15	17	33	400	380	8.1	178	#N/A	2.0	83	6.0	-	0.26	-	87	0.0032	0.0051	0.11	0.057	*< 7E-06*	*< 7E-06*	0.0061	*< 3E-06*	23	0.00017	0.000050
16-Dec-15	18	35	400	360	8.1	174	#N/A	2.0	77	7.0	-	0.26	-	87	0.0032	0.0054	0.13	0.059	*< 7E-06*	*< 7E-06*	0.0075	*< 3E-06*	24	0.00014	0.000053
30-Dec-15	19	37	400	385	8.1	170	#N/A	1.7	74	5.0	-	0.25	-	88	0.0030	0.0047	0.13	0.056	*< 7E-06*	*< 7E-06*	0.0062	0.0000030	24	0.00022	0.000048
13-Jan-16	20	39	400	370	8.1	172	#N/A	1.7	78	7.0	-	0.23	-	83	0.0022	0.0050	0.11	0.052	*< 7E-06*	*< 7E-06*	0.0070	*< 3E-06*	23	0.00013	0.000021
27-Jan-16	21	41	400	385	8.0	171	#N/A	2.8	77	6.0	-	0.28	-	84	0.013	0.0051	0.12	0.059	*< 7E-06*	*< 7E-06*	0.0060	0.0000040	23	0.00018	0.000042
10-Feb-16	22	43	400	350	8.1	173	#N/A	2.4	77	7.0	-	0.23	-	80	0.0029	0.0051	0.12	0.057	*< 7E-06*	*< 7E-06*	0.0040	*< 3E-06*	22	0.00014	0.000055
24-Feb-16	23	45	400	380	8.1	178	#N/A	2.1	77	4.0	-	0.25	-	90	0.0015	0.0049	0.12	0.060	*< 7E-06*	*< 7E-06*	0.0030	*< 3E-06*	25	0.00019	0.000038
9-Mar-16	24	47	400	380	8.1	172	#N/A	2.0	74	4.0															

Calculated Loading Rates for Col 11

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	360	8.0	538	#N/A	0.43	12	3.9	1.0	0.014	0.022	13	0.00043	0.00073	0.0059	0.011	0.00000050	0.00000050	0.0014	0.00000022	3.5	0.000019	0.00015
6-May-15	2	3	400	335	8.0	301	#N/A	0.15	3.3	1.7	0.13	0.011	0.010	2.9	0.000097	0.00031	0.0042	0.0016	0.00000023	0.00000023	0.00044	0.00000010	0.78	0.0000020	0.000033
20-May-15	3	5	400	380	8.1	269	#N/A	0.16	3.3	1.4	0.038	0.013	0.011	3.0	0.00015	0.00025	0.0048	0.0016	0.00000027	0.00000027	0.00037	0.00000027	0.82	0.0000087	0.000019
3-Jun-15	4	7	400	275	8.0	242	#N/A	0.12	2.6	0.77	0.028	0.0096	0.0083	2.2	0.00015	0.00019	0.0037	0.0012	0.00000019	0.00000019	0.00039	0.00000019	0.59	0.0000044	0.0000082
17-Jun-15	5	9	500	465	8.1	212	#N/A	0.21	4.0	0.98	0.047	0.015	0.014	3.2	0.00020	0.00031	0.0068	0.0017	0.00000033	0.00000033	0.00053	0.00000070	0.89	0.0000070	0.000010
1-Jul-15	6	11	500	475	8.0	206	#N/A	0.23	4.0	0.76	0.048	0.016	0.014	3.3	0.00019	0.00030	0.0072	0.0019	0.00000033	0.00000033	0.00042	0.00000014	0.88	0.0000076	0.0000067
15-Jul-15	7	13	500	475	8.0	184	#N/A	0.20	4.1	0.67	0.048	0.016	0.014	3.4	0.00019	0.00028	0.0067	0.0021	0.00000033	0.00000033	0.00059	0.00000029	0.88	0.0000076	0.0000064
29-Jul-15	8	15	400	380	8.0	188	#N/A	0.13	3.3	0.46	0.038	0.013	0.011	2.9	0.00016	0.00021	0.0048	0.0016	0.00000027	0.00000027	0.00045	0.00000011	0.78	0.0000057	0.0000035
12-Aug-15	9	17	400	390	8.0	186	#N/A	0.12	3.4	0.39	0.039	0.012	0.012	3.0	0.000098	0.00021	0.0049	0.0018	0.00000027	0.00000027	0.00036	0.00000035	0.82	0.0000062	0.0000028
26-Aug-15	10	19	500	465	7.5	184	0.00	0.14	3.9	0.47	0.047	0.015	0.014	3.5	0.00016	0.00026	0.0060	0.0021	0.00000033	0.00000033	0.00042	0.00000028	0.96	0.0000070	0.0000032
9-Sep-15	11	21	500	475	8.0	175	#N/A	0.14	3.8	0.44	0.048	0.017	0.016	4.1	0.00023	0.00031	0.0072	0.0025	0.00000038	0.00000038	0.00048	0.00000016	1.1	0.0000076	0.0000035
23-Sep-15	12	23	500	470	8.0	176	#N/A	0.11	3.8	0.43	0.00	0.016		4.3	0.00022	0.00031	0.0068	0.0025	0.00000038	0.00000038	0.00043	0.00000022	1.2	0.0000070	0.0000030
7-Oct-15	13	25	400	380	8.0	186	#N/A	0.12	3.4	0.31	0.00	0.012		3.6	0.00017	0.00025	0.0052	0.0020	0.00000031	0.00000031	0.00031	0.00000022	1.00	0.0000052	0.0000021
21-Oct-15	14	27	400	390	8.1	173	#N/A	0.055	3.3	0.31	0.00	0.012		3.4	0.00016	0.00026	0.0057	0.0024	0.00000031	0.00000031	0.00037	0.00000018	0.95	0.0000076	0.0000022
4-Nov-15	15	29	400	390	8.1	177	#N/A	0.090	3.4	0.31	0.00	0.013		3.7	0.00017	0.00022	0.0055	0.0025	0.00000031	0.00000031	0.00025	0.00000031	1.0	0.000013	0.00000018
18-Nov-15	16	31	400	380	8.2	176	#N/A	0.040	3.6	0.31	0.00	0.012		3.4	0.00013	0.00021	0.0056	0.0018	0.00000031	0.00000031	0.00020	0.00000013	0.93	0.0000052	0.0000029
2-Dec-15	17	33	400	380	8.1	178	#N/A	0.076	3.2	0.26	0.00	0.011		3.8	0.00014	0.00022	0.0050	0.0025	0.00000031	0.00000031	0.00027	0.00000013	1.0	0.0000074	0.0000022
16-Dec-15	18	35	400	360	8.1	174	#N/A	0.071	2.8	0.29	0.00	0.011		3.6	0.00013	0.00022	0.0053	0.0024	0.00000029	0.00000029	0.00031	0.00000012	0.98	0.0000058	0.0000022
30-Dec-15	19	37	400	385	8.1	170	#N/A	0.065	2.9	0.22	0.00	0.011		3.9	0.00013	0.00021	0.0057	0.0025	0.00000031	0.00000031	0.00027	0.00000013	1.1	0.0000097	0.0000021
13-Jan-16	20	39	400	370	8.1	172	#N/A	0.062	2.9	0.30	0.00	0.0098		3.5	0.000094	0.00021	0.0046	0.0022	0.00000030	0.00000030	0.00030	0.00000013	0.97	0.0000055	0.00000089
27-Jan-16	21	41	400	385	8.0	171	#N/A	0.11	3.0	0.27	0.00	0.012		3.7	0.00058	0.00023	0.0052	0.0026	0.00000031	0.00000031	0.00027	0.00000018	1.0	0.0000080	0.0000019
10-Feb-16	22	43	400	350	8.1	173	#N/A	0.085	2.7	0.28	0.00	0.0093		3.2	0.00012	0.00021	0.0049	0.0023	0.00000028	0.00000028	0.00016	0.00000012	0.87	0.0000056	0.0000022
24-Feb-16	23	45	400	380	8.1	178	#N/A	0.080	2.9	0.17	0.00	0.011		3.9	0.000066	0.00021	0.0052	0.0026	0.00000031	0.00000031	0.00013	0.00000013	1.1	0.0000083	0.0000017
9-Mar-16	24	47	400	380	8.1	172	#N/A	0.077	2.8	0.17	0.00														

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 11 (Supremo Gneiss Oxide Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	700	360	0.0030	*< 0.007*	*< 1E-05*	0.018	14	0.041	9.2	0.0074	0.0015	0.019	7.7	0.00079	6.1	0.0000080	39	0.25	19	0.00031	0.00030	*< 5E-05*	0.11	0.00012	0.0020	*< 0.002*
6-May-15	2	3	400	335	0.0013	*< 0.007*	*< 1E-05*	0.0082	7.1	0.013	0.82	0.018	0.00080	0.023	4.9	*< 0.001*	4.8	0.0000050	26	0.11	18	0.00013	*< 1E-05*	0.000070	0.084	0.00010	*< 0.001*	*< 0.002*
20-May-15	3	5	400	380	0.00079	*< 0.007*	*< 1E-05*	0.0062	6.3	0.0014	0.10	0.018	0.00060	0.030	4.5	0.00038	5.2	0.0000050	19	0.098	12	0.00014	0.00016	0.00013	0.070	0.00012	*< 0.001*	*< 0.002*
3-Jun-15	4	7	400	275	0.00076	*< 0.007*	*< 1E-05*	0.0059	6.2	0.00032	0.040	0.018	0.00040	0.028	4.2	0.00020	4.9	0.0000060	16	0.10	9.4	0.00013	0.000040	0.000080	0.063	0.00012	0.0010	*< 0.002*
17-Jun-15	5	9	500	465	0.0016	*< 0.007*	0.00090	0.0046	5.4	0.0015	0.020	0.017	0.00040	0.080	4.2	0.00019	4.5	0.0000080	13	0.090	8.1	0.00014	0.00013	0.00011	0.046	0.000090	0.0040	*< 0.002*
1-Jul-15	6	11	500	475	0.0013	*< 0.007*	*< 1E-05*	0.0044	5.6	0.00051	0.030	0.016	0.00030	0.033	3.7	0.00012	4.5	0.0000060	10	0.093	5.3	0.00014	0.00021	0.000060	0.041	0.00012	*< 0.001*	*< 0.002*
15-Jul-15	7	13	500	475	0.00050	*< 0.007*	*< 1E-05*	0.0042	6.1	0.0026	0.020	0.014	0.00030	0.028	3.4	0.00011	4.6	0.0000050	8.9	0.095	4.7	0.00014	0.000030	0.00012	0.039	0.00013	0.0010	*< 0.002*
29-Jul-15	8	15	400	380	0.00049	*< 0.007*	*< 1E-05*	0.0043	5.9	0.00011	0.010	0.014	0.00020	0.035	3.6	0.000090	4.3	0.0000030	6.6	0.097	4.2	0.00013	0.000010	*< 5E-05*	0.040	0.00012	*< 0.001*	*< 0.002*
12-Aug-15	9	17	400	390	0.00043	*< 0.007*	0.000030	0.0036	6.0	0.00012	*< 0.01*	0.013	0.00020	0.032	3.7	0.000080	4.6	0.000010	5.6	0.098	3.7	0.00013	0.000030	*< 5E-05*	0.035	0.000090	*< 0.001*	*< 0.002*
26-Aug-15	10	19	500	465	0.00045	0.0070	0.000020	0.0034	5.9	0.00017	0.010	0.012	0.00020	0.033	3.7	0.000070	4.3	0.0000070	4.7	0.095	5.1	0.00013	0.000065	0.000050	0.033	0.00011	0.0010	0.0020
9-Sep-15	11	21	500	475	0.00046	*< 0.007*	*< 1E-05*	0.0031	5.8	0.00022	0.010	0.011	0.00020	0.033	3.6	0.000060	4.0	0.0000040	3.9	0.091	6.5	0.00012	0.00010	0.000050	0.030	0.00013	*< 0.001*	*< 0.002*
23-Sep-15	12	23	500	470	0.00040	0.0070	0.000010	0.0029	6.0	0.00027	0.010	0.010	0.00015	0.029	3.5	0.000065	4.0	0.0000040	3.3	0.095	4.7	0.00012	0.000075	0.000050	0.031	0.00011	0.0010	0.0020
7-Oct-15	13	25	400	380	0.00033	*< 0.007*	*< 1E-05*	0.0028	6.1	0.00031	*< 0.01*	0.0088	0.00010	0.024	3.3	0.000070	3.9	0.0000040	2.7	0.100	2.8	0.00011	0.000050	*< 5E-05*	0.031	0.000090	*< 0.001*	*< 0.002*
21-Oct-15	14	27	400	390	0.00062	*< 0.007*	*< 1E-05*	0.0027	5.6	0.00019	*< 0.01*	0.011	0.00020	0.020	3.3	0.000090	4.0	0.0000020	2.2	0.099	3.1	0.00013	0.000070	0.00012	0.030	0.00010	*< 0.001*	*< 0.002*
4-Nov-15	15	29	400	390	0.00054	*< 0.007*	*< 1E-05*	0.0022	6.0	0.00030	*< 0.01*	0.0100	0.00020	0.034	3.4	*< 4E-05*	3.9	*< 2E-06*	2.1	0.095	3.1	0.00013	0.000040	*< 5E-05*	0.029	0.000090	*< 0.001*	*< 0.002*
18-Nov-15	16	31	400	380	0.00027	*< 0.007*	*< 1E-05*	0.0024	6.3	0.00074	*< 0.01*	0.0099	*< 0.0001*	0.031	3.3	0.00013	3.9	*< 2E-06*	1.8	0.10	2.9	0.000097	0.000040	*< 5E-05*	0.025	0.000070	*< 0.001*	*< 0.002*
2-Dec-15	17	33	400	380	0.00058	*< 0.007*	*< 1E-05*	0.0023	7.0	0.0011	*< 0.01*	0.0096	0.00020	0.034	3.6	0.000080	3.7	*< 2E-06*	1.8	0.11	3.1	0.00010	0.000050	*< 5E-05*	0.032	0.000080	*< 0.001*	*< 0.002*
16-Dec-15	18	35	400	360	0.00048	*< 0.007*	*< 1E-05*	0.0025	6.7	0.0017	*< 0.01*	0.0097	0.00010	0.036	3.6	0.000080	4.0	0.0000020	1.6	0.11	2.9	0.00012	0.00011	*< 5E-05*	0.032	0.000070	*< 0.001*	*< 0.002*
30-Dec-15	19	37	400	385	0.00034	*< 0.007*	0.000030	0.0024	6.7	0.0014	0.020	0.0092	0.00010	0.028	3.4	*< 4E-05*	3.7	0.0000020	1.4	0.11	2.8	0.00011	*< 1E-05*	0.000070	0.030	0.000090	*< 0.001*	*< 0.002*
13-Jan-16	20	39	400	370	0.00047	*< 0.007*	0.000040	0.0022	6.2	0.0013	*< 0.01*	0.0083	0.00010	0.032	3.4	0.00020	3.8	0.0000020	1.2	0.098	2.3	0.000071	0.000050	*< 5E-05*	0.027	0.000070	*< 0.001*	*< 0.002*
27-Jan-16	21	41	400	385	0.00031	*< 0.007*	*< 1E-05*	0.0021	6.2	0.00078	*< 0.01*	0.0089	0.00010	0.035	3.3	*< 4E-05*	3.9	*< 2E-06*	1.1	0.11	2.5	0.00011	0.000050	*< 5E-05*	0.030	0.000070	*< 0.001*	*< 0.002*
10-Feb-16	22	43	400	350	0.00054	*< 0.007*	0.000070	0.0020	6.3	0.0020	*< 0.01*	0.0088	0.00010	0.044	3.4	0.000080	3.4	*< 2E-06*	1.1	0.11	2.8	0.00010	0.000060	*< 5E-05*	0.028	0.000090	*< 0.001*	*< 0.002*
24-Feb-16	23	45	400	380	0.00017	*< 0.007*	0.000030	0.0021	6.6	0.00093	*< 0.01*	0.0087	0.00010	0.036	3.4	*< 4E-05*	3.8	*< 2E-06*	0.83	0.11	2.6	0.00011	0.000040	*< 5E-05*	0.029	0.000040	0.0010	*< 0.002*
9-Mar-16	24	47	400	380																								

Calculated Loading Rates for Col 11

Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	700	360	0.00021	0.00050	0.00000072	0.0013	0.99	0.0030	0.66	0.00053	0.00011	0.0014	0.56	0.000057	0.44	0.00000058	2.8	0.018	1.4	0.000022	0.000022	0.0000036	0.0076	0.0000086	0.00014	0.00014
6-May-15	2	3	400	335	0.000043	0.00023	0.00000034	0.00028	0.24	0.00044	0.027	0.00060	0.000027	0.00077	0.16	0.000034	0.16	0.00000017	0.87	0.0037	0.61	0.0000044	0.00000034	0.0000023	0.0028	0.0000034	0.000034	0.000067
20-May-15	3	5	400	380	0.000030	0.00027	0.00000038	0.00024	0.24	0.000052	0.0038	0.00067	0.000023	0.0011	0.17	0.000014	0.20	0.00000019	0.73	0.0037	0.44	0.0000051	0.0000061	0.0000049	0.0027	0.0000046	0.000038	0.000076
3-Jun-15	4	7	400	275	0.000021	0.00019	0.00000028	0.00016	0.17	0.0000088	0.0011	0.00048	0.000011	0.00077	0.12	0.0000055	0.14	0.00000017	0.44	0.0028	0.26	0.0000036	0.0000011	0.0000022	0.0017	0.0000033	0.000028	0.000055
17-Jun-15	5	9	500	465	0.000076	0.00033	0.000042	0.00021	0.25	0.000070	0.00093	0.00078	0.000019	0.0037	0.20	0.0000088	0.21	0.00000037	0.59	0.0042	0.38	0.0000064	0.0000060	0.0000051	0.0022	0.0000042	0.00019	0.000093
1-Jul-15	6	11	500	475	0.000059	0.00033	0.00000048	0.00021	0.27	0.000024	0.0014	0.00074	0.000014	0.0016	0.18	0.0000057	0.21	0.00000029	0.48	0.0044	0.25	0.0000066	0.0000100	0.0000029	0.0020	0.0000057	0.000048	0.000095
15-Jul-15	7	13	500	475	0.000024	0.00033	0.00000048	0.00020	0.29	0.00012	0.00095	0.00067	0.000014	0.0013	0.16	0.0000052	0.22	0.00000024	0.42	0.0045	0.22	0.0000066	0.0000014	0.0000057	0.0019	0.0000062	0.000048	0.000095
29-Jul-15	8	15	400	380	0.000019	0.00027	0.00000038	0.00016	0.22	0.0000042	0.00038	0.00052	0.0000076	0.0013	0.14	0.0000034	0.16	0.00000011	0.25	0.0037	0.16	0.0000049	0.00000038	0.0000019	0.0015	0.0000046	0.000038	0.000076
12-Aug-15	9	17	400	390	0.000017	0.00027	0.0000012	0.00014	0.23	0.0000047	0.00039	0.00051	0.0000078	0.0012	0.14	0.0000031	0.18	0.00000039	0.22	0.0038	0.14	0.0000050	0.0000012	0.0000020	0.0014	0.0000035	0.000039	0.000078
26-Aug-15	10	19	500	465	0.000021	0.00033	0.00000093	0.00016	0.27	0.0000079	0.00047	0.00057	0.0000093	0.0015	0.17	0.0000033	0.20	0.00000033	0.22	0.0044	0.24	0.0000059	0.0000030	0.0000023	0.0015	0.0000051	0.000047	0.000093
9-Sep-15	11	21	500	475	0.000025	0.00038	0.00000055	0.00017	0.32	0.000012	0.00055	0.00062	0.000011	0.0018	0.20	0.0000033	0.22	0.00000022	0.21	0.0050	0.35	0.0000067	0.0000055	0.0000027	0.0016	0.0000071	0.000055	0.00011
23-Sep-15	12	23	500	470	0.000021	0.00038	0.00000054	0.00016	0.32	0.000014	0.00054	0.00055	0.0000081	0.0015	0.19	0.0000035	0.21	0.00000022	0.18	0.0052	0.25	0.0000063	0.0000041	0.0000027	0.0017	0.0000059	0.000054	0.00011
7-Oct-15	13	25	400	380	0.000014	0.00031	0.00000044	0.00012	0.27	0.000014	0.00044	0.00039	0.0000044	0.0010	0.15	0.0000031	0.17	0.00000017	0.12	0.0044	0.12	0.0000049	0.0000022	0.0000022	0.0014	0.0000039	0.000044	0.000087
21-Oct-15	14	27	400	390	0.000028	0.00031	0.00000045	0.00012	0.25	0.0000085	0.00045	0.00049	0.0000090	0.00090	0.15	0.0000040	0.18	0.000000090	0.10	0.0044	0.14	0.0000059	0.0000031	0.0000054	0.0013	0.0000045	0.000045	0.000090
4-Nov-15	15	29	400	390	0.000024	0.00031	0.00000045	0.00010	0.27	0.000013	0.00045	0.00045	0.0000090	0.0015	0.15	0.0000018	0.17	0.000000090	0.094	0.0043	0.14	0.0000057	0.0000018	0.0000022	0.0013	0.0000040	0.000045	0.000090
18-Nov-15	16	31	400	380	0.000012	0.00031	0.00000044	0.00010	0.27	0.000032	0.00044	0.00043	0.0000044	0.0014	0.15	0.0000057	0.17	0.000000087	0.080	0.0044	0.13	0.0000042	0.0000017	0.0000022	0.0011	0.0000031	0.000044	0.000087
2-Dec-15	17	33	400	380	0.000025	0.00031	0.00000044	0.00010	0.31	0.000050	0.00044	0.00042	0.0000087	0.0015	0.16	0.0000035	0.16	0.000000087	0.079	0.0046	0.14	0.0000044	0.0000022	0.0000022	0.0014	0.0000035	0.000044	0.000087
16-Dec-15	18	35	400	360	0.000020	0.00029	0.00000041	0.00010	0.28	0.000072	0.00041	0.00040	0.0000041	0.0015	0.15	0.0000033	0.17	0.000000083	0.065	0.0044	0.12	0.0000051	0.0000046	0.0000021	0.0013	0.0000029	0.000041	0.000083
30-Dec-15	19	37	400	385	0.000015	0.00031	0.0000013	0.00011	0.30	0.000060	0.00089	0.00041	0.0000044	0.0012	0.15	0.0000018	0.16	0.000000089	0.062	0.0046	0.12	0.0000050	0.00000044	0.0000031	0.0013	0.0000040	0.000044	0.000089
13-Jan-16	20	39	400	370	0.000020	0.00030	0.0000017	0.000094	0.26	0.000056	0.00043	0.00035	0.0000043	0.0014	0.14	0.0000085	0.16	0.000000085	0.051	0.0042	0.098	0.0000030	0.0000021	0.0000021	0.0012	0.0000030	0.000043	0.000085
27-Jan-16	21	41	400	385	0.000014	0.00031	0.00000044	0.000092	0.28	0.000035	0.00044	0.00039	0.0000044	0.0015	0.15	0.0000018	0.17	0.000000089	0.048	0.0046	0.11	0.0000050	0.0000022	0.0000022	0.0013	0.0000031	0.000044	0.000089
10-Feb-16	22	43	400	350	0.000022	0.00028	0.0000028	0.000081	0.26	0.000080	0.00040	0.00036	0.0000040	0.0018	0.14	0.0000032	0.14	0.000000080	0.045	0.0042	0.11	0.0000041	0.0000024	0.0000020	0.0011	0.0000036	0.000040	0.000080
24-Feb-16	23	45	400	380	0.0000074	0.00031	0.0000013	0.000092	0.29	0.000041	0.00044	0.00038	0.0000044	0.0016	0.15	0.0000017	0.16	0.000000087	0.036	0.0047	0.11	0.0000047	0.0000017	0.0000022	0.0012	0.0000017	0.000044	0.000087
9-Mar-16	24	47	400	380																								

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 12 (Supremo Gneiss Transition Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/L	mgCaCO$_3$/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mgCaCO$_3$/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	750	305	7.8	2557	#N/A	11	145	1561	62	0.26	*< 0.3*	1450	0.0033	0.013	0.15	0.011	*< 7E-06*	*< 7E-06*	0.022	0.0000080	385	0.000040	0.011
6-May-15	2	3	400	365	7.6	1465	#N/A	7.5	75	816	22	0.36	*< 0.3*	751	0.0021	0.0087	0.14	0.0042	*< 7E-06*	*< 7E-06*	0.014	*< 3E-06*	199	*< 3E-05*	0.0026
20-May-15	3	5	400	375	7.8	915	#N/A	6.0	69	393	2.0	0.40	*< 0.3*	405	0.0022	0.0074	0.15	0.0036	*< 7E-06*	*< 7E-06*	0.011	0.0000080	109	0.000040	0.0013
3-Jun-15	4	7	400	260	7.8	704	#N/A	5.9	77	274	*< 1*	0.46	*< 0.3*	323	0.0051	0.0082	0.17	0.0049	*< 7E-06*	*< 7E-06*	0.015	0.0000030	88	0.000040	0.00088
17-Jun-15	5	9	500	485	7.8	555	#N/A	7.0	81	206	*< 1*	0.45	*< 0.3*	245	0.0051	0.0086	0.20	0.0036	*< 7E-06*	*< 7E-06*	0.012	0.0000080	67	0.000050	0.00062
1-Jul-15	6	11	500	485	7.9	395	#N/A	5.7	81	136	*< 1*	0.51	*< 0.3*	184	0.0047	0.0090	0.22	0.0039	*< 7E-06*	*< 7E-06*	0.010	0.000013	48	*< 3E-05*	0.00041
15-Jul-15	7	13	500	490	7.9	339	#N/A	5.4	87	103	*< 1*	0.54	*< 0.3*	162	0.0047	0.0091	0.22	0.0041	*< 7E-06*	*< 7E-06*	0.014	0.000010	42	0.000030	0.00039
29-Jul-15	8	15	400	390	7.9	347	#N/A	3.5	88	88	*< 1*	0.57	*< 0.3*	152	0.0038	0.0093	0.21	0.0042	*< 7E-06*	*< 7E-06*	0.013	0.0000070	40	0.000050	0.00025
12-Aug-15	9	17	400	400	7.9	334	#N/A	4.1	90	77	*< 1*	0.51	*< 0.3*	152	0.0041	0.0093	0.22	0.0043	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	40	*< 3E-05*	0.00018
26-Aug-15	10	19	500	465	7.6	320	#N/A	3.7	89	72	1.0	0.53	0.30	147	0.0060	0.011	0.23	0.0047	0.0000070	0.0000070	0.011	0.0000040	39	0.000045	0.00016
9-Sep-15	11	21	500	470	7.9	307	#N/A	3.3	89	67	*< 1*	0.55	*< 0.3*	141	0.0079	0.013	0.23	0.0050	*< 7E-06*	*< 7E-06*	0.011	0.0000050	38	0.000060	0.00014
23-Sep-15	12	23	500	480	8.0	285	#N/A	3.3	89	57	1.0	0.52	0.30	135	0.0058	0.015	0.23	0.0047	0.0000070	0.0000070	0.0096	0.0000050	36	0.000055	0.00010
7-Oct-15	13	25	400	390	8.0	298	#N/A	3.5	96	54	-	0.49	-	128	0.0037	0.017	0.23	0.0043	*< 7E-06*	*< 7E-06*	0.0081	0.0000050	34	0.000050	0.000059
21-Oct-15	14	27	400	390	8.1	288	#N/A	1.6	92	44	-	0.49	-	128	0.0058	0.020	0.25	0.0049	*< 7E-06*	*< 7E-06*	0.0087	*< 3E-06*	35	*< 3E-05*	0.000075
4-Nov-15	15	29	400	400	8.1	287	#N/A	3.0	97	50	-	0.47	-	138	0.0085	0.022	0.25	0.0050	*< 7E-06*	*< 7E-06*	0.0063	*< 3E-06*	38	0.00011	0.000027
18-Nov-15	16	31	400	380	8.1	288	#N/A	1.1	103	50	-	0.47	-	131	0.0031	0.026	0.26	0.0036	*< 7E-06*	*< 7E-06*	0.0053	0.0000060	35	0.000030	0.000044
2-Dec-15	17	33	400	390	8.1	282	#N/A	2.0	91	46	-	0.46	-	143	0.0041	0.031	0.28	0.0054	*< 7E-06*	*< 7E-06*	0.0070	0.0000030	38	0.000030	0.00017
16-Dec-15	18	35	400	360	8.1	278	#N/A	2.0	85	50	-	0.44	-	138	0.0035	0.035	0.29	0.0054	*< 7E-06*	*< 7E-06*	0.0081	0.0000070	37	0.000090	0.00014
30-Dec-15	19	37	400	390	8.1	269	#N/A	1.8	83	38	-	0.46	-	137	0.0039	0.035	0.29	0.0052	*< 7E-06*	*< 7E-06*	0.0072	*< 3E-06*	37	0.000050	0.00011
13-Jan-16	20	39	400	365	8.1	268	#N/A	1.6	86	47	-	0.41	-	131	0.0034	0.039	0.26	0.0047	*< 7E-06*	*< 7E-06*	0.0080	*< 3E-06*	35	*< 3E-05*	0.000095
27-Jan-16	21	41	400	385	8.0	266	#N/A	3.1	85	46	-	0.44	-	126	0.0067	0.042	0.28	0.0054	*< 7E-06*	*< 7E-06*	0.0060	0.0000040	34	*< 3E-05*	0.000096
10-Feb-16	22	43	400	360	8.1	258	#N/A	2.6	88	42	-	0.40	-	127	0.0038	0.044	0.31	0.0054	*< 7E-06*	*< 7E-06*	0.0050	0.0000030	34	*< 3E-05*	0.000080
24-Feb-16	23	45	400	395	8.1	266	#N/A	2.3	86	42	-	0.36	-	136	0.0017	0.045	0.30	0.0053	*< 7E-06*	*< 7E-06*	0.0040	0.0000040	36	*< 3E-05*	0.00012
9-Mar-16	24	47	400	385	8.1	258	#N/A	2.3	85	34															

Calculated Loading Rates for Col 12

Date	**Cycle**	**Week**	**Volume** (mL)		**pH**	**Cond.**	**Acidity** (pH 4.5)	**Acidity** (pH 8.3)	**Alkalinity**	**Sulphate**	**Chloride**	**Fluoride**	**Bromide**	**Hardness**	**Al**	**Sb**	**As**	**Ba**	**Be**	**Bi**	**B**	**Cd**	**Ca**	**Cr**	**Co**
-	No.	-	Input	Output	-	umhos/cm	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mgCaCO$_3$/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	750	305	7.8	2557	#N/A	0.78	10	110	4.4	0.018	0.021	102	0.00023	0.00090	0.011	0.00075	0.00000049	0.00000049	0.0015	0.00000056	27	0.0000028	0.00076
6-May-15	2	3	400	365	7.6	1465	#N/A	0.32	3.1	34	0.93	0.015	0.013	32	0.000089	0.00037	0.0060	0.00018	0.00000030	0.00000030	0.00059	0.00000013	8.4	0.0000013	0.00011
20-May-15	3	5	400	375	7.8	915	#N/A	0.26	3.0	17	0.087	0.017	0.013	18	0.000095	0.00032	0.0063	0.00016	0.00000030	0.00000030	0.00047	0.00000035	4.7	0.0000017	0.000056
3-Jun-15	4	7	400	260	7.8	704	#N/A	0.18	2.3	8.2	0.030	0.014	0.0090	9.7	0.00015	0.00025	0.0051	0.00015	0.00000021	0.00000021	0.00045	0.000000090	2.6	0.0000012	0.000026
17-Jun-15	5	9	500	485	7.8	555	#N/A	0.39	4.5	12	0.056	0.025	0.017	14	0.00029	0.00048	0.011	0.00020	0.00000039	0.00000039	0.00068	0.00000045	3.8	0.0000028	0.000035
1-Jul-15	6	11	500	485	7.9	395	#N/A	0.32	4.5	7.6	0.056	0.029	0.017	10	0.00026	0.00050	0.012	0.00022	0.00000039	0.00000039	0.00058	0.00000073	2.7	0.0000017	0.000023
15-Jul-15	7	13	500	490	7.9	339	#N/A	0.31	4.9	5.8	0.057	0.031	0.017	9.2	0.00027	0.00051	0.013	0.00023	0.00000040	0.00000040	0.00076	0.00000057	2.4	0.0000017	0.000022
29-Jul-15	8	15	400	390	7.9	347	#N/A	0.16	3.9	4.0	0.045	0.026	0.014	6.8	0.00017	0.00042	0.0092	0.00019	0.00000032	0.00000032	0.00057	0.00000032	1.8	0.0000023	0.000011
12-Aug-15	9	17	400	400	7.9	334	#N/A	0.19	4.1	3.6	0.046	0.024	0.014	7.0	0.00019	0.00043	0.010	0.00020	0.00000032	0.00000032	0.00048	0.00000014	1.9	0.0000014	0.0000084
26-Aug-15	10	19	500	465	7.6	320	0.00	0.20	4.8	3.9	0.054	0.028	0.016	7.9	0.00032	0.00059	0.012	0.00025	0.00000038	0.00000038	0.00058	0.00000021	2.1	0.0000024	0.0000087
9-Sep-15	11	21	500	470	7.9	307	#N/A	0.18	4.8	3.6	0.054	0.030	0.016	7.6	0.00043	0.00068	0.012	0.00027	0.00000038	0.00000038	0.00059	0.00000027	2.0	0.0000032	0.0000078
23-Sep-15	12	23	500	480	8.0	285	#N/A	0.18	4.9	3.1	0.055	0.029		7.4	0.00032	0.00082	0.013	0.00026	0.00000039	0.00000039	0.00053	0.00000028	2.0	0.0000030	0.0000056
7-Oct-15	13	25	400	390	8.0	298	#N/A	0.16	4.3	2.4	0.00	0.022		5.7	0.00017	0.00078	0.010	0.00019	0.00000031	0.00000031	0.00036	0.00000022	1.5	0.0000022	0.0000026
21-Oct-15	14	27	400	390	8.1	288	#N/A	0.070	4.1	2.0	0.00	0.022		5.7	0.00026	0.00089	0.011	0.00022	0.00000031	0.00000031	0.00039	0.00000013	1.6	0.0000013	0.0000034
4-Nov-15	15	29	400	400	8.1	287	#N/A	0.14	4.5	2.3	0.00	0.022		6.3	0.00039	0.0010	0.011	0.00023	0.00000032	0.00000032	0.00029	0.00000014	1.7	0.0000051	0.0000012
18-Nov-15	16	31	400	380	8.1	288	#N/A	0.050	4.5	2.2	0.00	0.021		5.7	0.00014	0.0011	0.011	0.00016	0.00000031	0.00000031	0.00023	0.00000026	1.5	0.0000013	0.0000019
2-Dec-15	17	33	400	390	8.1	282	#N/A	0.091	4.1	2.1	0.00	0.021		6.4	0.00018	0.0014	0.013	0.00024	0.00000031	0.00000031	0.00031	0.00000013	1.7	0.0000013	0.0000075
16-Dec-15	18	35	400	360	8.1	278	#N/A	0.083	3.5	2.1	0.00	0.018		5.7	0.00014	0.0015	0.012	0.00022	0.00000029	0.00000029	0.00034	0.00000029	1.5	0.0000037	0.0000058
30-Dec-15	19	37	400	390	8.1	269	#N/A	0.082	3.7	1.7	0.00	0.021		6.1	0.00017	0.0016	0.013	0.00023	0.00000031	0.00000031	0.00032	0.00000013	1.6	0.0000022	0.0000047
13-Jan-16	20	39	400	365	8.1	268	#N/A	0.069	3.6	2.0	0.00	0.017		5.5	0.00014	0.0016	0.011	0.00020	0.00000029	0.00000029	0.00034	0.00000013	1.5	0.0000013	0.0000040
27-Jan-16	21	41	400	385	8.0	266	#N/A	0.14	3.8	2.0	0.00	0.019		5.6	0.00030	0.0018	0.012	0.00024	0.00000031	0.00000031	0.00027	0.00000018	1.5	0.0000013	0.0000042
10-Feb-16	22	43	400	360	8.1	258	#N/A	0.11	3.7	1.7	0.00	0.017		5.3	0.00016	0.0018	0.013	0.00022	0.00000029	0.00000029	0.00021	0.00000012	1.4	0.0000012	0.0000033
24-Feb-16	23	45	400	395	8.1	266	#N/A	0.11	3.9	1.9	0.00	0.016		6.2	0.000077	0.0020	0.014	0.00024	0.00000032	0.00000032	0.00018	0.00000018	1.6	0.0000014	0.0000053
9-Mar-16	24	47	400	385	8.1	258	#N/A	0.10	3.8	1.5	0.00														

Appendix D.2-3 Leachate Results and Calculated Loading Rates (Data Tables)

Leachate Concentrations for Col 12 (Supremo Gneiss Transition Ore)

Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
22-Apr-15	1	1	750	305	0.0046	*< 0.007*	*< 1E-05*	0.025	119	0.54	2.2	0.011	0.014	0.030	20	0.011	5.5	0.000089	61	1.8	475	0.00058	0.000080	0.00010	0.64	0.00011	0.0020	*< 0.002*
6-May-15	2	3	400	365	0.0016	*< 0.007*	*< 1E-05*	0.013	62	0.29	0.13	0.016	0.0038	*< 0.003*	13	0.0060	4.0	0.0000040	28	0.89	284	0.00029	*< 1E-05*	0.000070	0.24	0.000070	0.0020	*< 0.002*
20-May-15	3	5	400	375	0.00069	*< 0.007*	0.000050	0.0084	32	0.16	0.010	0.019	0.0018	*< 0.003*	9.7	0.0025	4.1	0.0000040	14	0.49	127	0.00024	0.00013	0.00011	0.15	0.000060	*< 0.001*	*< 0.002*
3-Jun-15	4	7	400	260	0.00072	*< 0.007*	*< 1E-05*	0.0070	25	0.11	*< 0.01*	0.021	0.0014	*< 0.003*	8.5	0.0016	4.1	0.0000050	11	0.41	97	0.00020	0.000040	0.000050	0.12	0.00010	0.0010	*< 0.002*
17-Jun-15	5	9	500	485	0.00072	*< 0.007*	*< 1E-05*	0.0055	19	0.083	*< 0.01*	0.019	0.0011	0.0060	7.1	0.0012	4.0	0.0000040	7.1	0.29	71	0.00019	0.000070	0.000070	0.081	0.000080	0.0010	*< 0.002*
1-Jul-15	6	11	500	485	0.00039	*< 0.007*	*< 1E-05*	0.0048	15	0.057	0.010	0.022	0.00090	*< 0.003*	6.2	0.00077	4.1	0.0000030	4.9	0.23	42	0.00016	0.000060	*< 5E-05*	0.056	0.000090	*< 0.001*	*< 0.002*
15-Jul-15	7	13	500	490	0.00038	*< 0.007*	*< 1E-05*	0.0044	14	0.059	*< 0.01*	0.020	0.00080	0.0040	5.5	0.00054	4.2	0.0000030	3.7	0.21	33	0.00016	0.000030	0.000090	0.047	0.00010	*< 0.001*	*< 0.002*
29-Jul-15	8	15	400	390	0.00032	*< 0.007*	*< 1E-05*	0.0045	13	0.039	*< 0.01*	0.020	0.00060	0.0050	5.5	0.00044	3.7	*< 2E-06*	2.6	0.20	29	0.00014	*< 1E-05*	*< 5E-05*	0.043	0.000070	*< 0.001*	*< 0.002*
12-Aug-15	9	17	400	400	0.00043	*< 0.007*	*< 1E-05*	0.0038	12	0.024	*< 0.01*	0.019	0.00050	0.0040	5.7	0.00040	4.1	0.0000050	2.2	0.19	25	0.00015	0.000060	0.000050	0.038	0.00010	*< 0.001*	*< 0.002*
26-Aug-15	10	19	500	465	0.00042	0.0070	0.000010	0.0036	12	0.023	0.010	0.018	0.00050	0.0040	5.6	0.00036	4.0	0.0000035	1.9	0.18	25	0.00015	0.000055	0.000050	0.033	0.000090	0.0010	0.0020
9-Sep-15	11	21	500	470	0.00040	*< 0.007*	*< 1E-05*	0.0035	11	0.023	*< 0.01*	0.017	0.00050	0.0040	5.4	0.00031	3.8	0.0000020	1.5	0.17	25	0.00014	0.000050	*< 5E-05*	0.029	0.000080	*< 0.001*	*< 0.002*
23-Sep-15	12	23	500	480	0.00044	0.0070	0.000015	0.0032	11	0.015	0.010	0.015	0.00055	0.0035	5.1	0.00028	3.7	0.0000020	1.3	0.16	22	0.00013	0.000080	0.000050	0.026	0.000065	0.0010	0.0020
7-Oct-15	13	25	400	390	0.00047	*< 0.007*	0.000020	0.0029	10	0.0081	*< 0.01*	0.013	0.00060	0.0030	4.8	0.00024	3.5	0.0000020	1.1	0.15	19	0.00011	0.00011	*< 5E-05*	0.024	0.000050	0.0010	*< 0.002*
21-Oct-15	14	27	400	390	0.00049	*< 0.007*	*< 1E-05*	0.0027	9.9	0.015	*< 0.01*	0.016	0.00050	*< 0.003*	4.7	0.00026	3.8	*< 2E-06*	0.98	0.16	19	0.00015	0.000060	0.000060	0.026	0.000080	*< 0.001*	*< 0.002*
4-Nov-15	15	29	400	400	0.00060	*< 0.007*	0.000010	0.0023	11	0.0094	*< 0.01*	0.016	0.00040	0.0050	5.0	0.00024	3.8	*< 2E-06*	0.88	0.15	19	0.00015	0.00028	0.00011	0.026	0.00010	0.0010	*< 0.002*
18-Nov-15	16	31	400	380	0.00017	*< 0.007*	*< 1E-05*	0.0026	11	0.0040	*< 0.01*	0.014	0.00010	*< 0.003*	4.8	0.00032	3.8	*< 2E-06*	0.76	0.15	18	0.00010	0.000020	*< 5E-05*	0.019	0.000080	*< 0.001*	*< 0.002*
2-Dec-15	17	33	400	390	0.00045	*< 0.007*	*< 1E-05*	0.0025	12	0.026	*< 0.01*	0.016	0.00040	0.011	5.3	0.00038	3.9	*< 2E-06*	0.80	0.17	19	0.00013	0.000050	*< 5E-05*	0.026	0.000090	*< 0.001*	*< 0.002*
16-Dec-15	18	35	400	360	0.00053	*< 0.007*	*< 1E-05*	0.0026	11	0.025	*< 0.01*	0.014	0.00040	0.012	5.0	0.00028	4.1	*< 2E-06*	0.69	0.17	18	0.00012	0.00014	*< 5E-05*	0.026	0.000060	*< 0.001*	*< 0.002*
30-Dec-15	19	37	400	390	0.00051	*< 0.007*	*< 1E-05*	0.0026	11	0.021	0.010	0.014	0.00030	0.0030	4.8	0.00024	3.8	*< 2E-06*	0.66	0.16	16	0.00013	*< 1E-05*	0.00010	0.024	0.000080	0.0010	*< 0.002*
13-Jan-16	20	39	400	365	0.00042	*< 0.007*	0.000020	0.0024	11	0.020	*< 0.01*	0.012	0.00030	0.0030	5.0	0.00045	4.0	0.0000020	0.57	0.15	16	0.000084	0.000080	*< 5E-05*	0.021	0.000050	0.0020	*< 0.002*
27-Jan-16	21	41	400	385	0.00044	*< 0.007*	*< 1E-05*	0.0021	10	0.017	*< 0.01*	0.012	0.00030	0.0080	4.7	0.00019	4.0	*< 2E-06*	0.50	0.15	16	0.00014	0.000050	*< 5E-05*	0.022	0.000070	*< 0.001*	*< 0.002*
10-Feb-16	22	43	400	360	0.00024	*< 0.007*	0.000070	0.0021	10	0.013	*< 0.01*	0.012	0.00030	0.0060	4.6	0.00026	3.8	*< 2E-06*	0.50	0.16	15	0.00013	0.000040	0.000080	0.020	0.000070	*< 0.001*	*< 0.002*
24-Feb-16	23	45	400	395	0.00022	*< 0.007*	0.000010	0.0023	11	0.020	0.010	0.012	0.00030	0.013	4.8	0.00025	3.9	*< 2E-06*	0.40	0.16	14	0.00012	0.000020	*< 5E-05*	0.022	0.000070	*< 0.001*	*< 0.002*
9-Mar-16	24	47	400	385																								

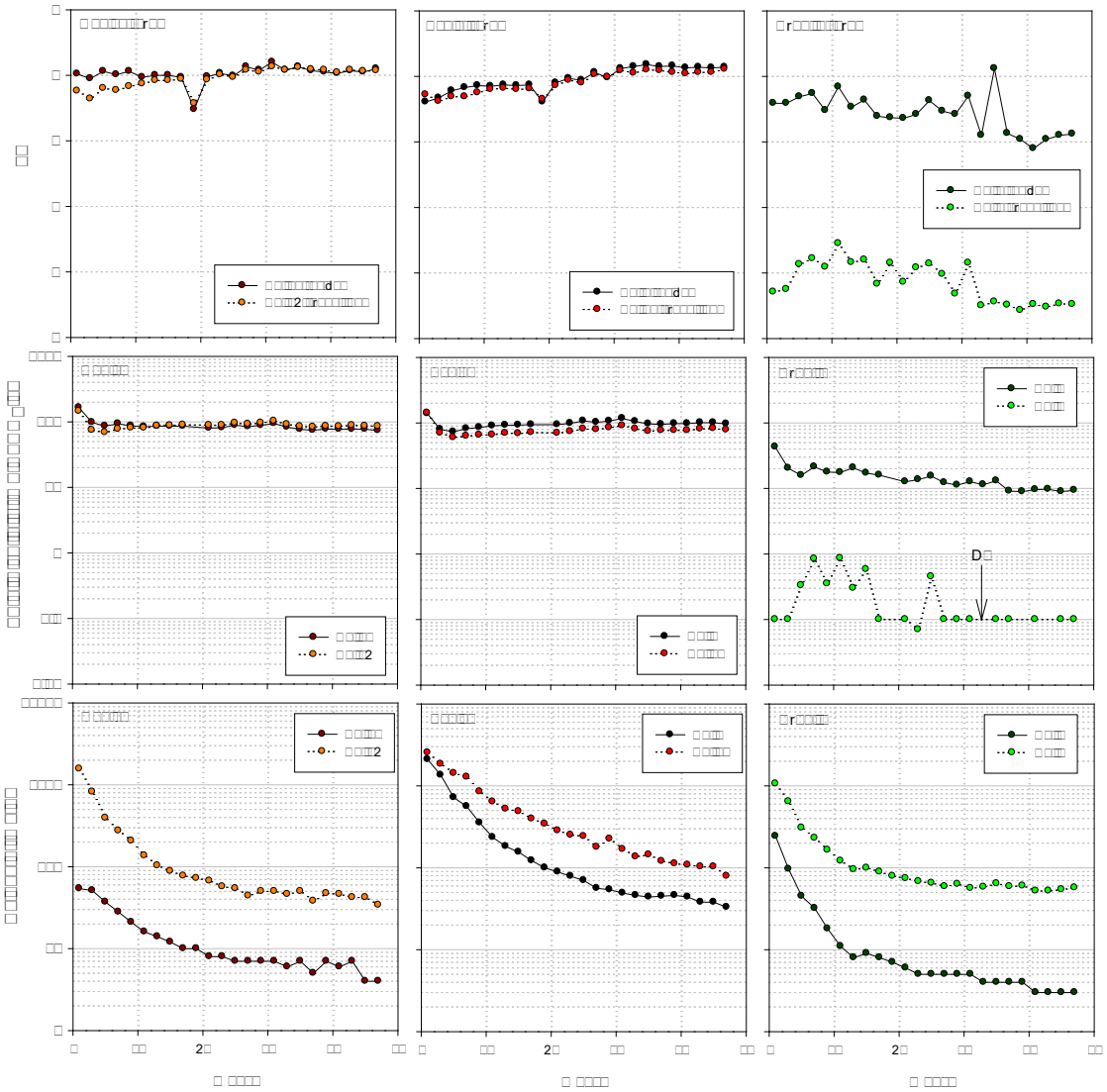
Calculated Loading Rates for Col 12

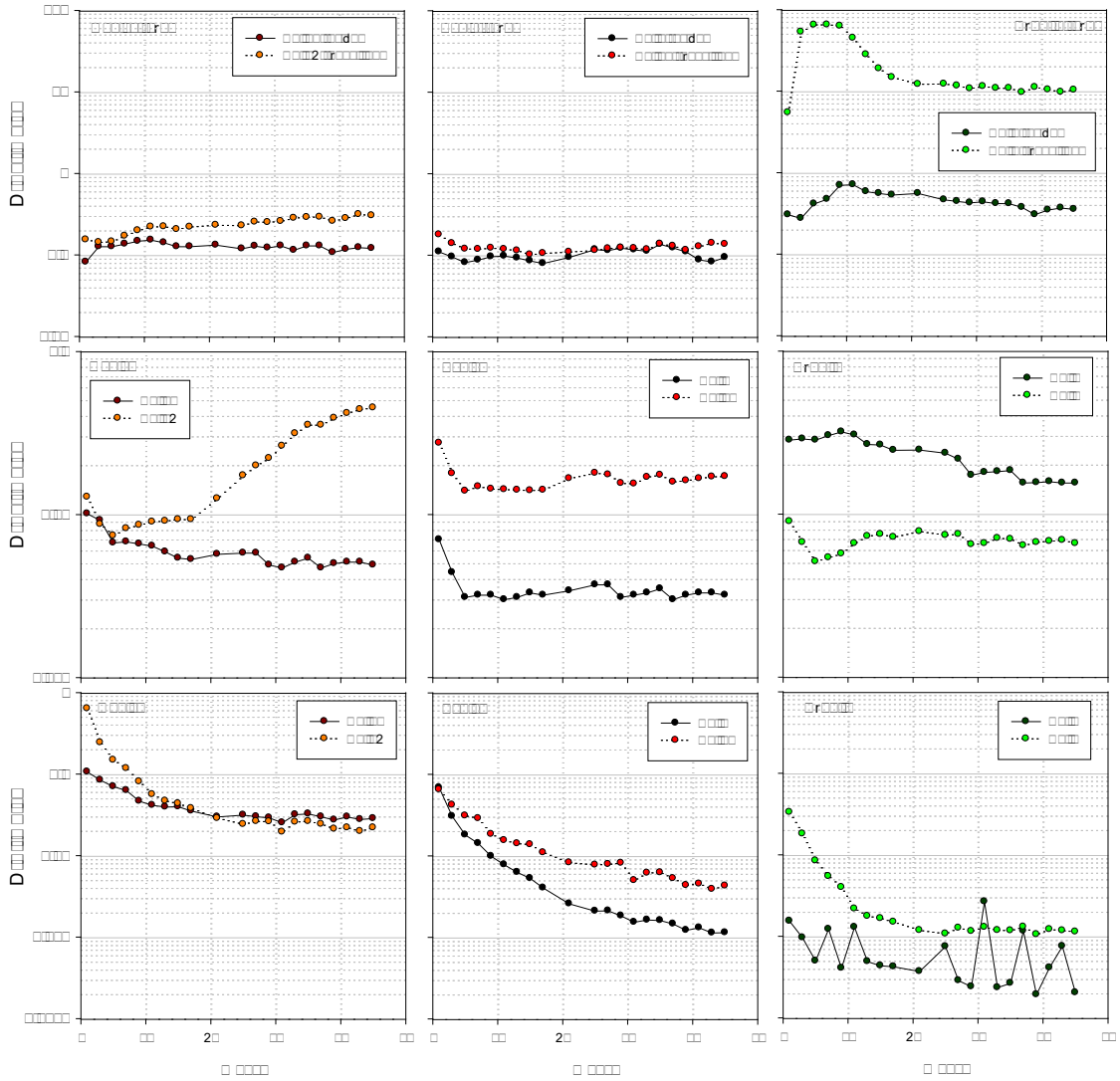
Date	**Cycle**	**Week**	**Volume** (mL)		**Cu**	**Fe**	**Pb**	**Li**	**Mg**	**Mn**	**Hg**	**Mo**	**Ni**	**P**	**K**	**Se**	**Si**	**Ag**	**Na**	**Sr**	**S**	**Tl**	**Sn**	**Ti**	**U**	**V**	**Zn**	**Zr**
-	No.	-	Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
22-Apr-15	1	1	750	305	0.00033	0.00049	0.00000070	0.0018	8.4	0.038	0.16	0.00075	0.0010	0.0021	1.4	0.00078	0.39	0.0000063	4.3	0.13	33	0.000041	0.0000056	0.0000070	0.045	0.0000077	0.00014	0.00014
6-May-15	2	3	400	365	0.000067	0.00030	0.00000042	0.00053	2.6	0.012	0.0055	0.00068	0.00016	0.00013	0.56	0.00025	0.17	0.00000017	1.2	0.038	12	0.000012	0.00000042	0.0000030	0.010	0.0000030	0.000084	0.000084
20-May-15	3	5	400	375	0.000030	0.00030	0.0000022	0.00036	1.4	0.0068	0.00043	0.00081	0.000078	0.00013	0.42	0.00011	0.18	0.00000017	0.62	0.021	5.5	0.000010	0.0000056	0.0000048	0.0064	0.0000026	0.000043	0.000087
3-Jun-15	4	7	400	260	0.000022	0.00021	0.00000030	0.00021	0.76	0.0033	0.00030	0.00062	0.000042	0.000090	0.26	0.000049	0.12	0.00000015	0.32	0.012	2.9	0.0000061	0.0000012	0.0000015	0.0035	0.0000030	0.000030	0.000060
17-Jun-15	5	9	500	485	0.000040	0.00039	0.00000056	0.00031	1.1	0.0047	0.00056	0.0011	0.000062	0.00034	0.40	0.000067	0.23	0.00000022	0.40	0.016	4.0	0.000011	0.0000039	0.0000039	0.0045	0.0000045	0.000056	0.00011
1-Jul-15	6	11	500	485	0.000022	0.00039	0.00000056	0.00027	0.86	0.0032	0.00056	0.0012	0.000050	0.00017	0.35	0.000043	0.23	0.00000017	0.28	0.013	2.3	0.0000090	0.0000034	0.0000028	0.0031	0.0000050	0.000056	0.00011
15-Jul-15	7	13	500	490	0.000022	0.00040	0.00000057	0.00025	0.79	0.0034	0.00057	0.0011	0.000045	0.00023	0.31	0.000031	0.24	0.00000017	0.21	0.012	1.9	0.0000090	0.0000017	0.0000051	0.0026	0.0000057	0.000057	0.00011
29-Jul-15	8	15	400	390	0.000014	0.00032	0.00000045	0.00020	0.56	0.0017	0.00045	0.00088	0.000027	0.00023	0.25	0.000020	0.16	0.000000090	0.12	0.0091	1.3	0.0000063	0.00000045	0.0000023	0.0020	0.0000032	0.000045	0.000090
12-Aug-15	9	17	400	400	0.000020	0.00032	0.00000046	0.00017	0.57	0.0011	0.00046	0.00086	0.000023	0.00018	0.26	0.000018	0.19	0.00000023	0.10	0.0085	1.2	0.0000068	0.0000028	0.0000023	0.0017	0.0000046	0.000046	0.000092
26-Aug-15	10	19	500	465	0.000022	0.00038	0.00000054	0.00019	0.64	0.0012	0.00054	0.00096	0.000027	0.00021	0.30	0.000019	0.21	0.00000019	0.100	0.0096	1.4	0.0000078	0.0000030	0.0000027	0.0018	0.0000048	0.000054	0.00011
9-Sep-15	11	21	500	470	0.000022	0.00038	0.00000054	0.00019	0.61	0.0012	0.00054	0.00092	0.000027	0.00022	0.29	0.000017	0.21	0.00000011	0.083	0.0092	1.4	0.0000078	0.0000027	0.0000027	0.0015	0.0000043	0.000054	0.00011
23-Sep-15	12	23	500	480	0.000024	0.00039	0.00000083	0.00017	0.60	0.00085	0.00055	0.00083	0.000030	0.00019	0.28	0.000015	0.20	0.00000011	0.072	0.0090	1.2	0.0000070	0.0000044	0.0000028	0.0015	0.0000036	0.000055	0.00011
7-Oct-15	13	25	400	390	0.000021	0.00031	0.00000090	0.00013	0.47	0.00036	0.00045	0.00059	0.000027	0.00013	0.22	0.000011	0.16	0.000000090	0.048	0.0069	0.83	0.0000048	0.0000049	0.0000022	0.0011	0.0000022	0.000045	0.000090
21-Oct-15	14	27	400	390	0.000022	0.00031	0.00000045	0.00012	0.44	0.00069	0.00045	0.00073	0.000022	0.00013	0.21	0.000012	0.17	0.000000090	0.044	0.0071	0.84	0.0000068	0.0000027	0.0000027	0.0012	0.0000036	0.000045	0.000090
4-Nov-15	15	29	400	400	0.000028	0.00032	0.00000046	0.00011	0.50	0.00043	0.00046	0.00072	0.000018	0.00023	0.23	0.000011	0.17	0.000000092	0.040	0.0070	0.88	0.0000070	0.000013	0.0000051	0.0012	0.0000046	0.000046	0.000092
18-Nov-15	16	31	400	380	0.0000074	0.00031	0.00000044	0.00011	0.47	0.00018	0.00044	0.00061	0.0000044	0.00013	0.21	0.000014	0.17	0.000000087	0.033	0.0066	0.78	0.0000045	0.00000087	0.0000022	0.00085	0.0000035	0.000044	0.000087
2-Dec-15	17	33	400	390	0.000020	0.00031	0.00000045	0.00011	0.53	0.0012	0.00045	0.00071	0.000018	0.00049	0.24	0.000017	0.18	0.000000090	0.036	0.0074	0.85	0.0000059	0.0000022	0.0000022	0.0012	0.0000040	0.000045	0.000090
16-Dec-15	18	35	400	360	0.000022	0.00029	0.00000041	0.00011	0.45	0.0010	0.00041	0.00059	0.000017	0.00050	0.21	0.000012	0.17	0.000000083	0.029	0.0069	0.73	0.0000048	0.0000058	0.0000021	0.0011	0.0000025	0.000041	0.000083
30-Dec-15	19	37	400	390	0.000023	0.00031	0.00000045	0.00012	0.50	0.00095	0.00045	0.00064	0.000013	0.00013	0.21	0.000011	0.17	0.000000090	0.030	0.0074	0.70	0.0000058	0.00000045	0.0000045	0.0011	0.0000036	0.000045	0.000090
13-Jan-16	20	39	400	365	0.000018	0.00029	0.00000084	0.000099	0.45	0.00085	0.00042	0.00052	0.000013	0.00013	0.21	0.000019	0.17	0.000000084	0.024	0.0062	0.65	0.0000035	0.0000034	0.0000021	0.00089	0.0000021	0.000084	0.000084
27-Jan-16	21	41	400	385	0.000019	0.00031	0.00000044	0.000095	0.45	0.00077	0.00044	0.00054	0.000013	0.00035	0.21	0.0000084	0.18	0.000000089	0.022	0.0068	0.69	0.0000062	0.0000022	0.0000022	0.00097	0.0000031	0.000044	0.000089
10-Feb-16	22	43	400	360	0.0000099	0.00029	0.0000029	0.000087	0.42	0.00054	0.00041	0.00051	0.000012	0.00025	0.19	0.000011	0.16	0.000000083	0.021	0.0065	0.63	0.0000055	0.0000017	0.0000033	0.00082	0.0000029	0.000041	0.000083
24-Feb-16	23	45	400	395	0.0000100	0.00032	0.00000045	0.00010	0.49	0.00090	0.00045	0.00056	0.000014	0.00059	0.22	0.000011	0.18	0.000000091	0.018	0.0070	0.65	0.0000056	0.00000091	0.0000023	0.00099	0.0000032	0.000045	0.000091
9-Mar-16	24	47	400	385																								

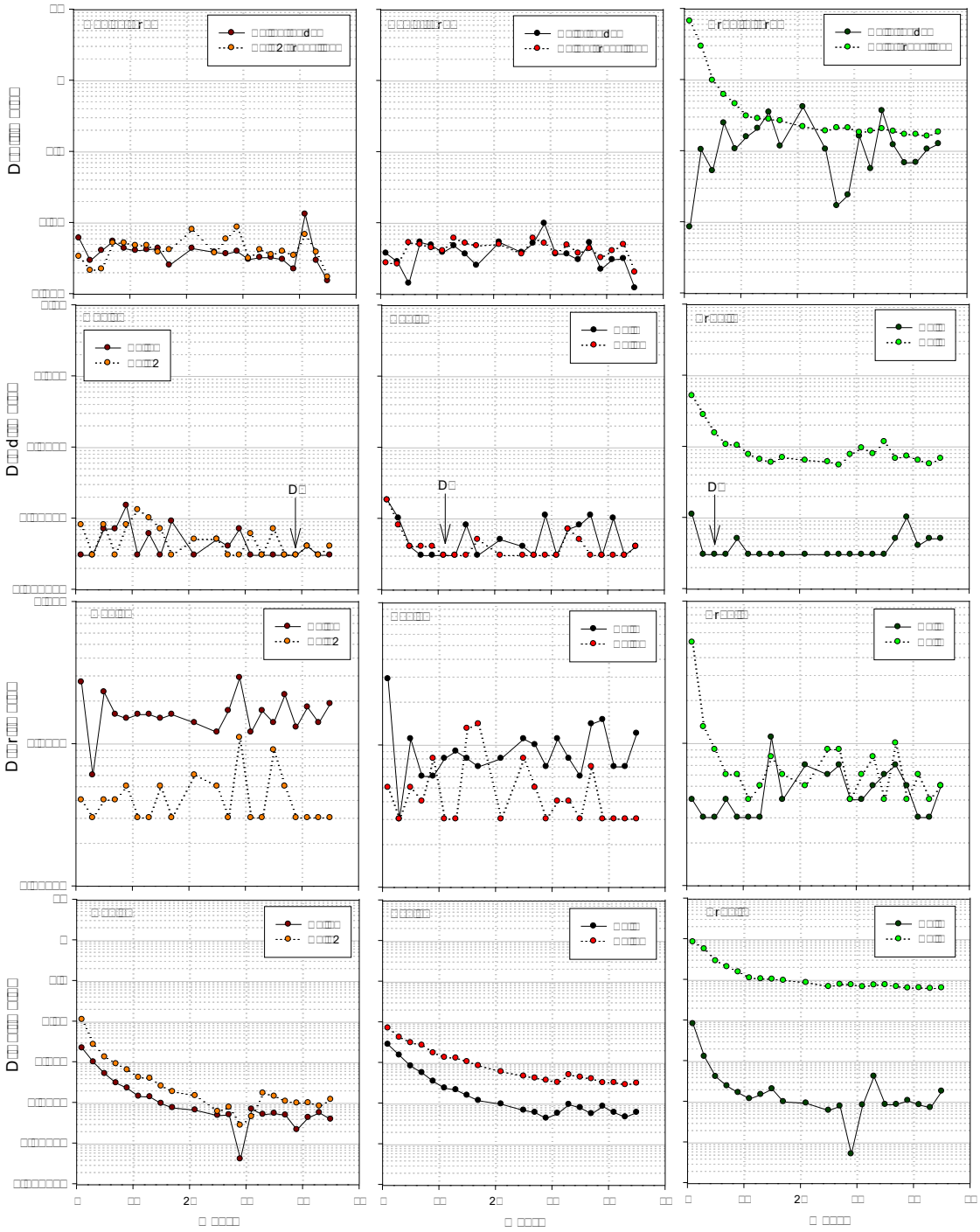
Notes:
Values in grey italics are below the analytical detection limit

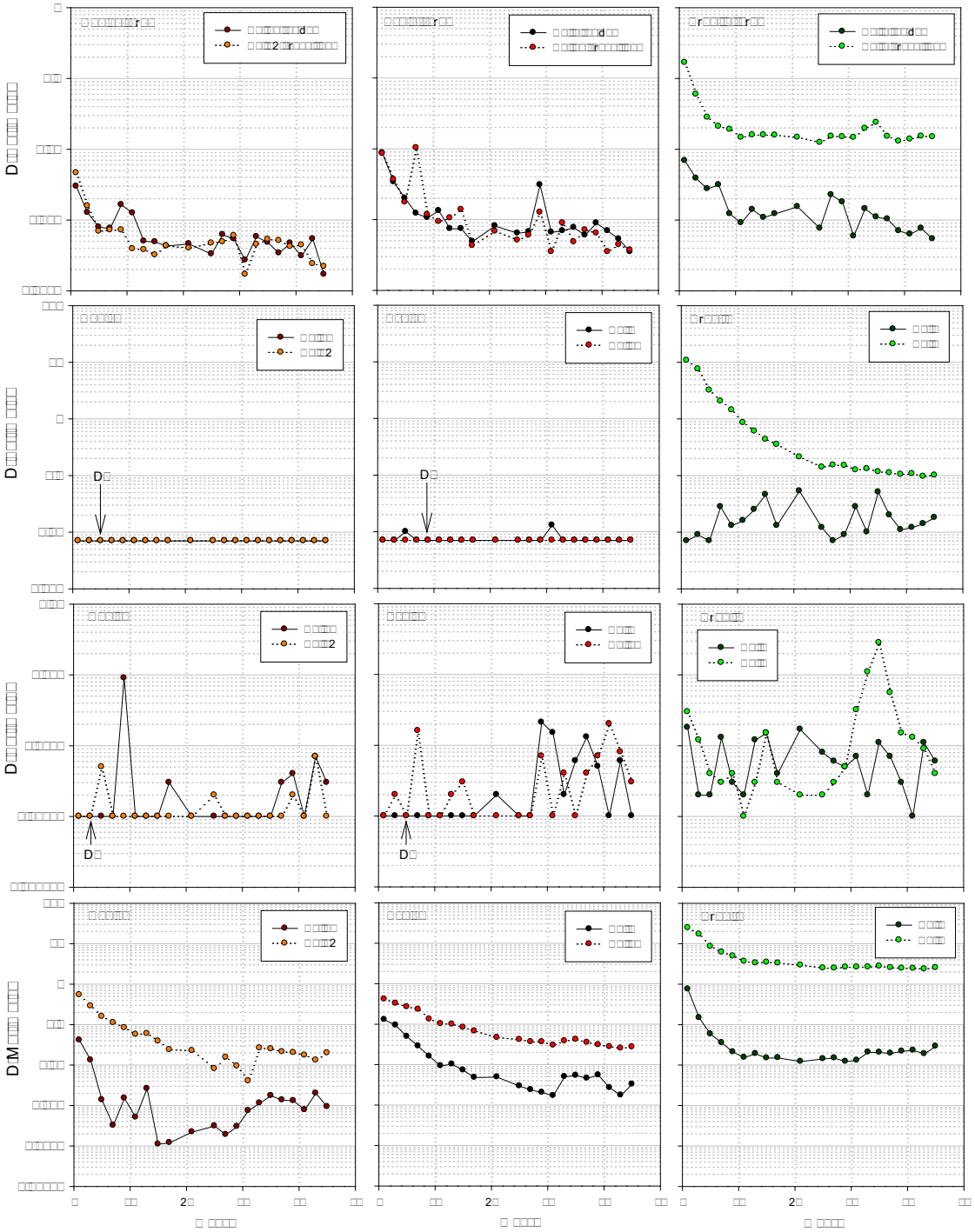
Appendix D.2-4: Time Series Profiles for Ore Kinetic Tests Leachate Concentrations and Loading Rates

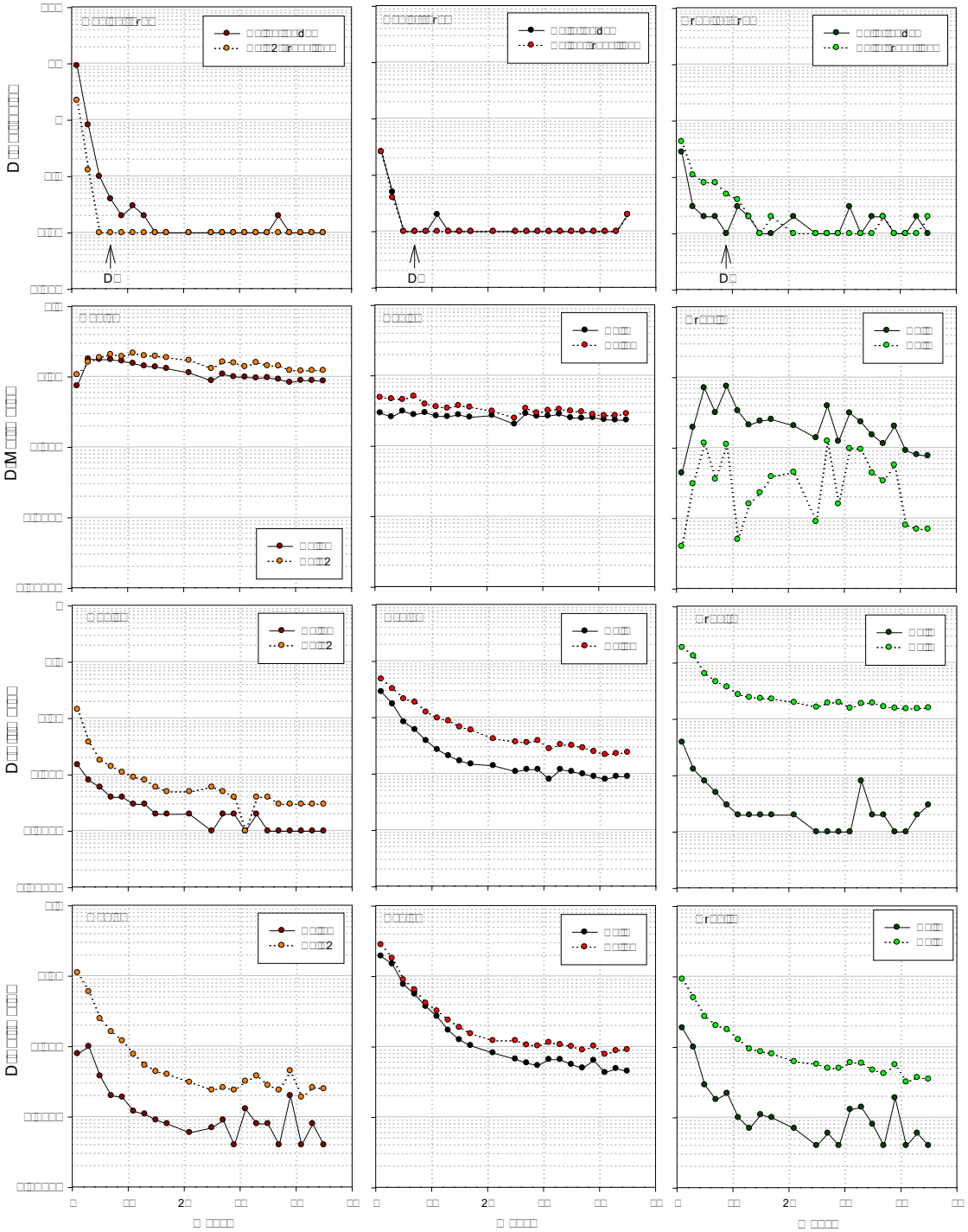
Leachate Concentrations for Ore Unsaturated Columns

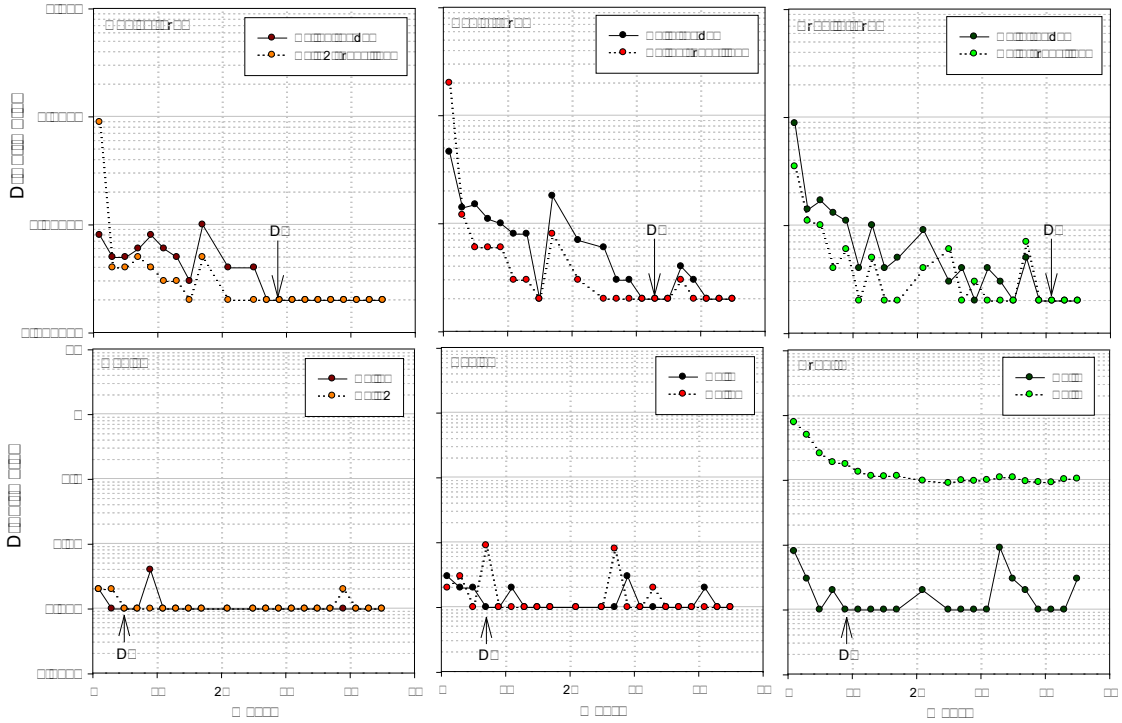




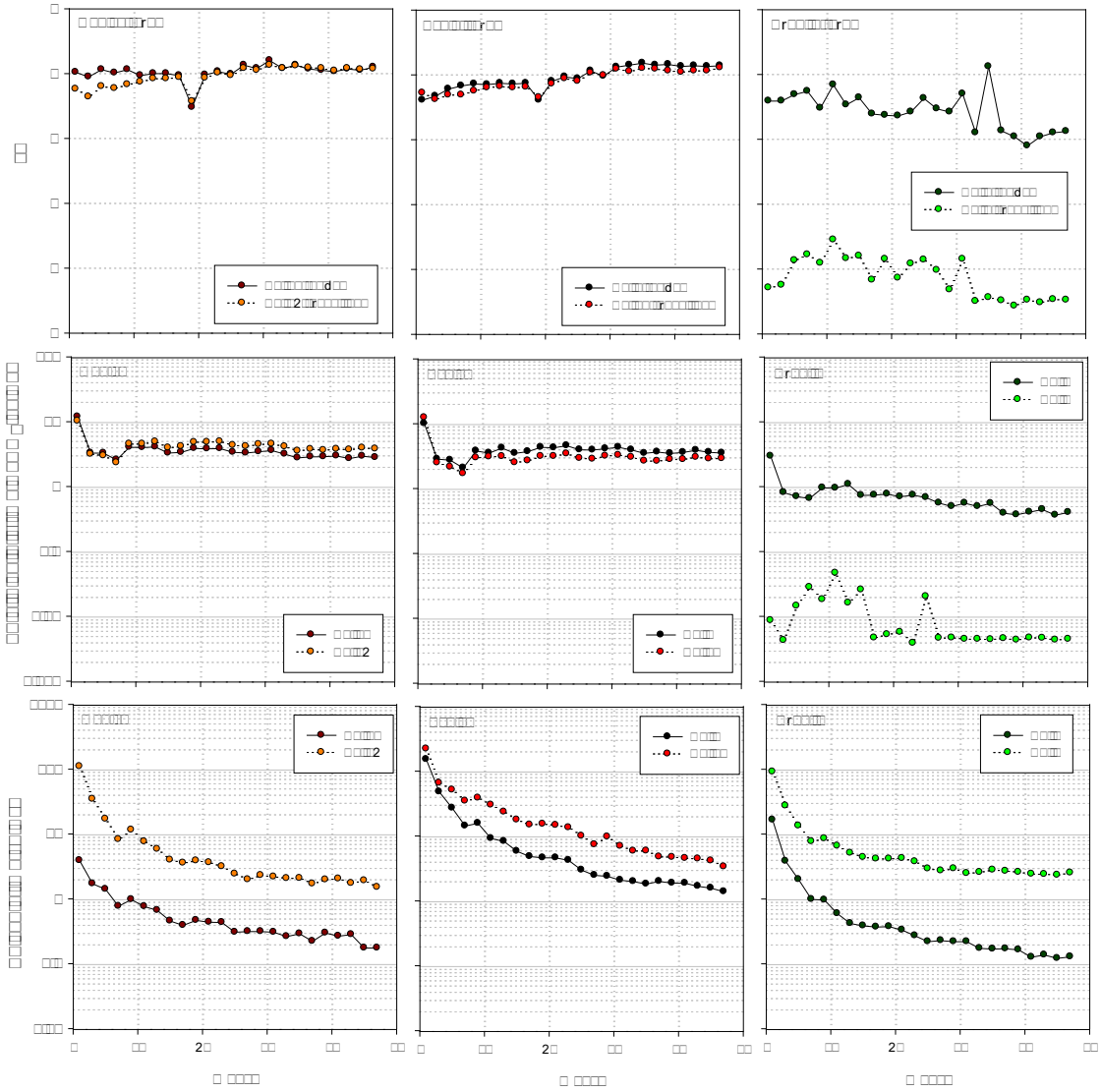


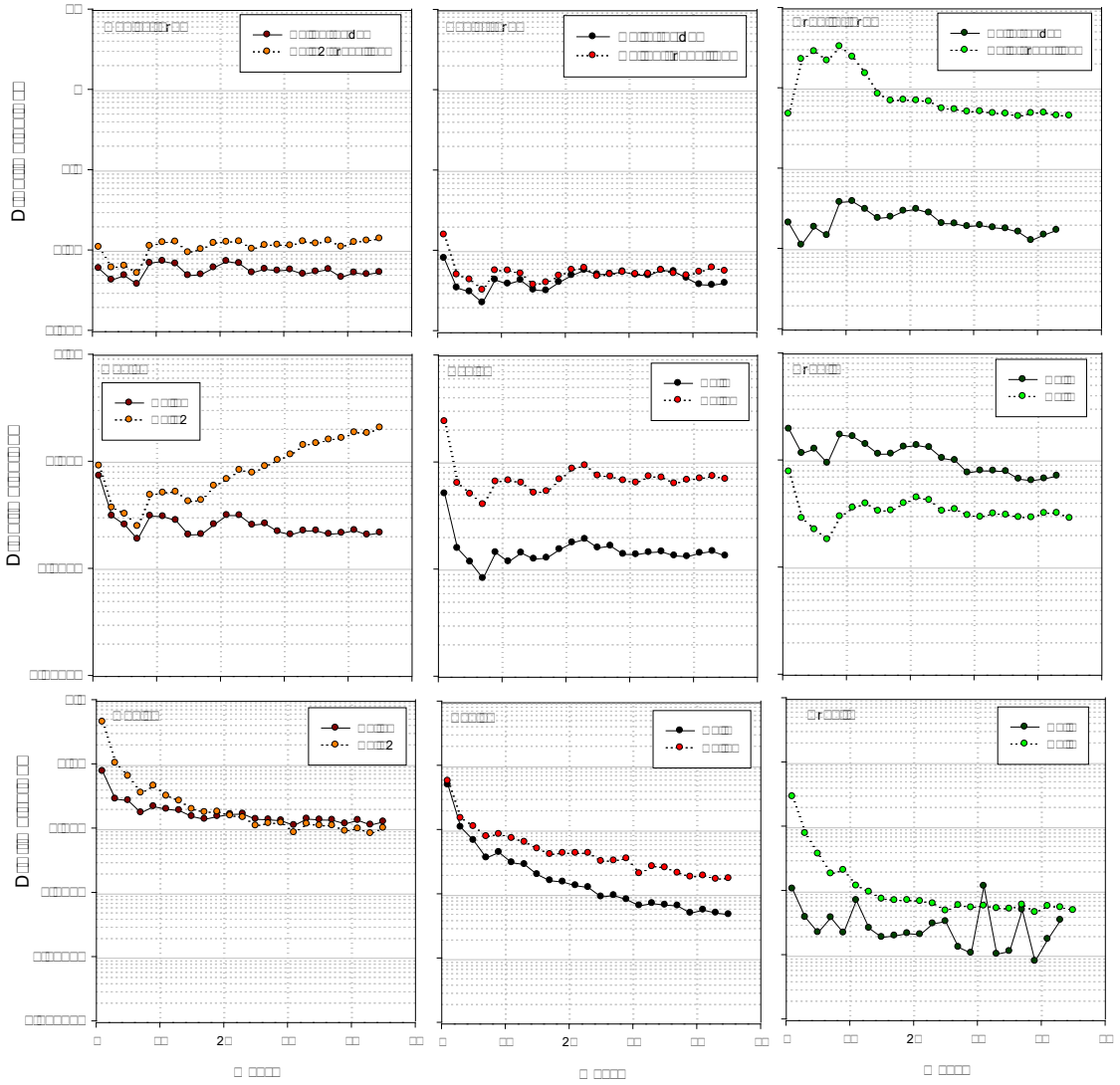


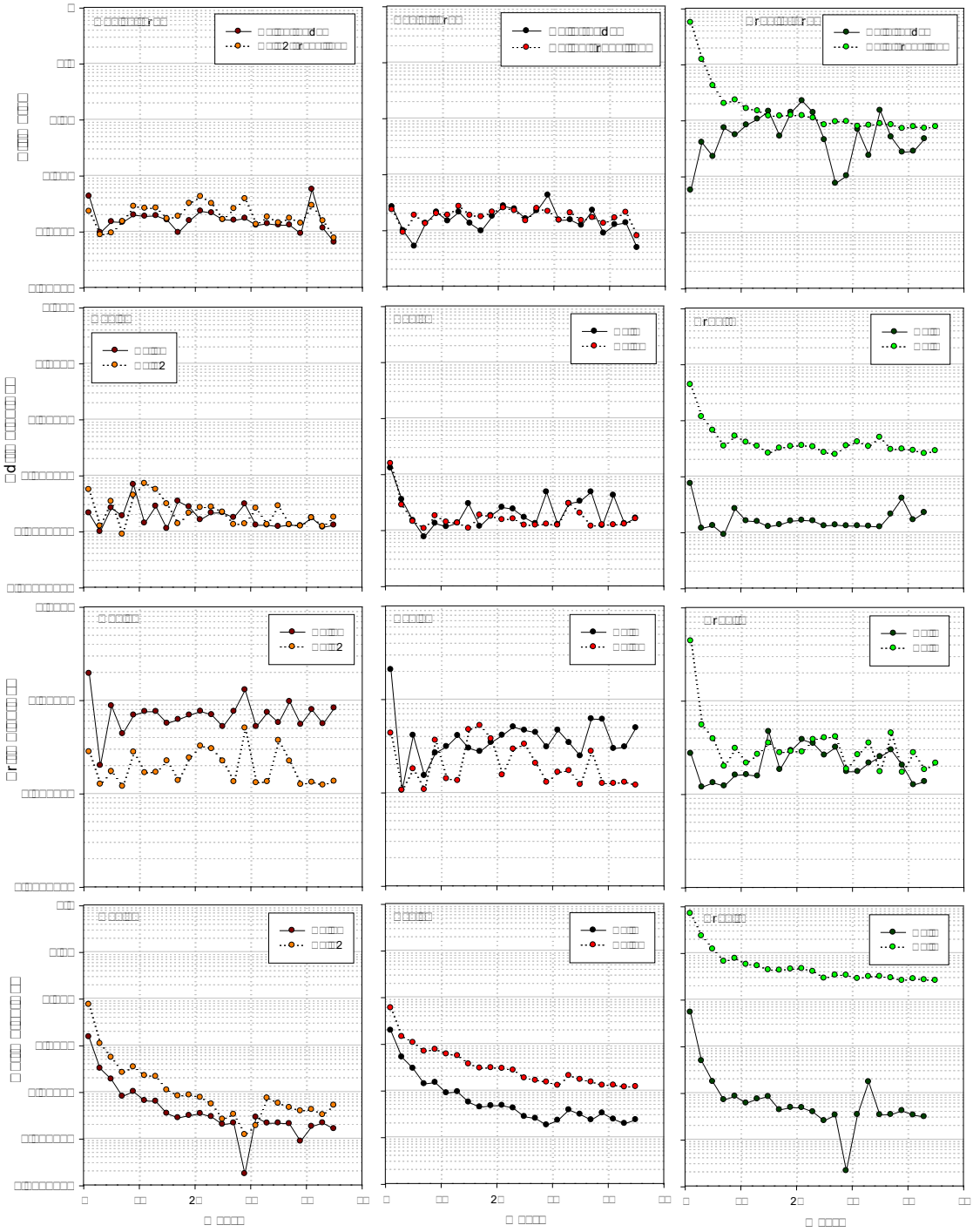


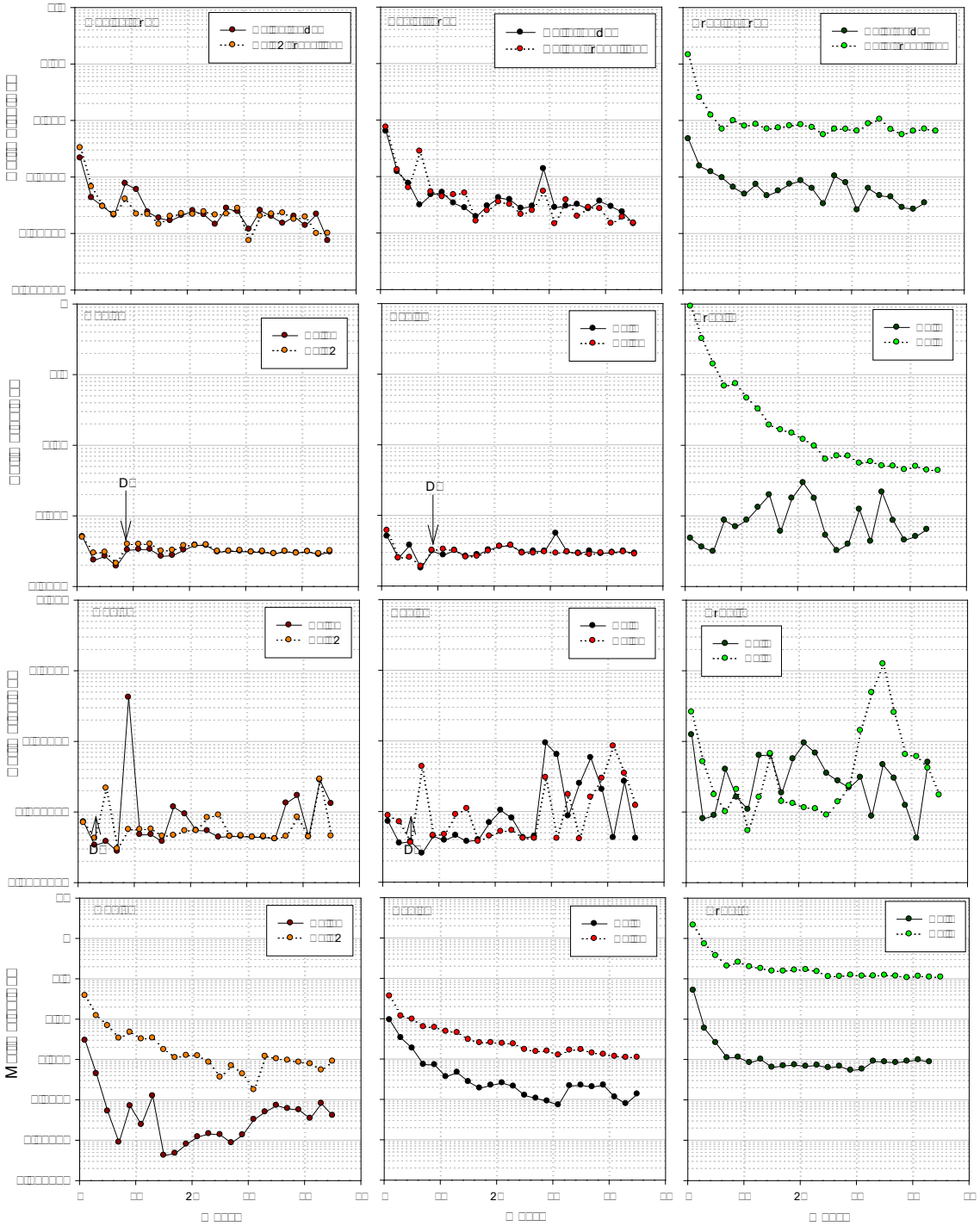


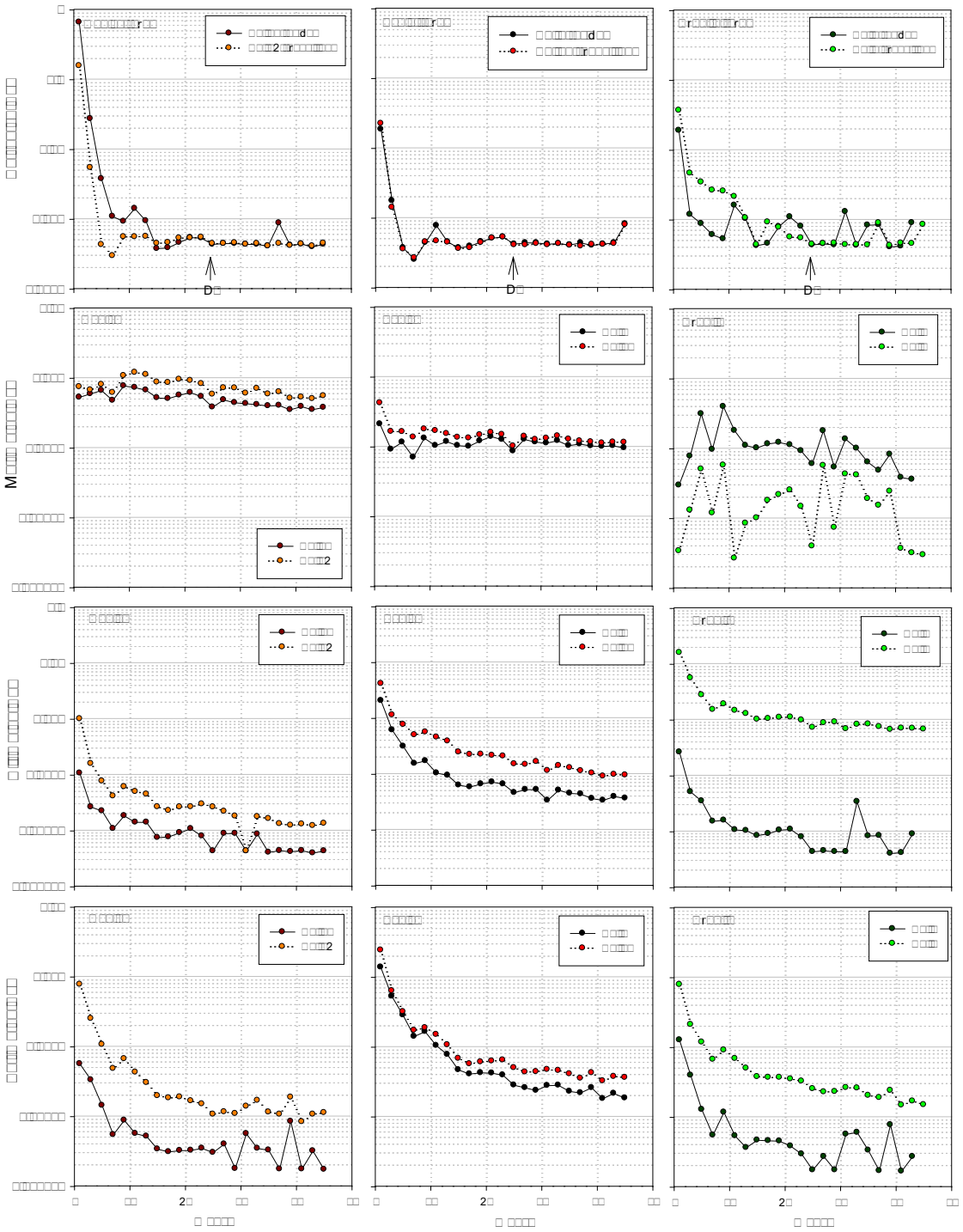
Loading Rates for Ore Unsaturated Columns

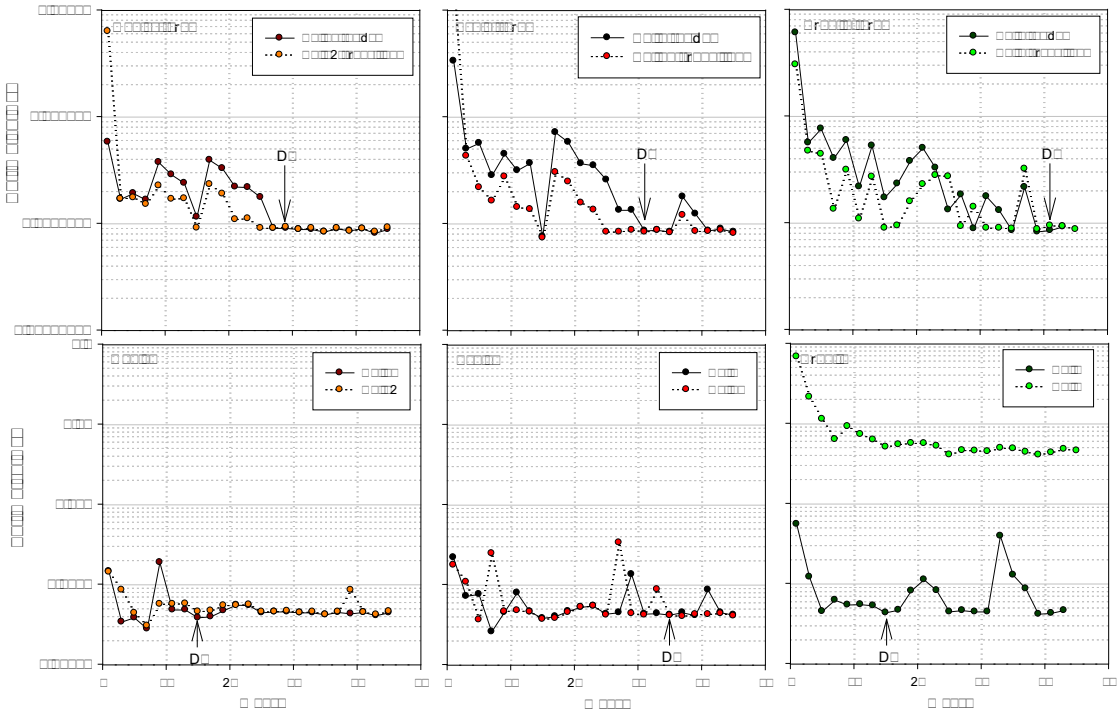












APPENDIX D3: KINETIC TEST RESULTS FOR LEACH TAILINGS

Appendix D.3-1: Overview of Operating Procedures for the Coffee Gold Mine Leach Tailings Kinetic Tests

Test ID	Test Sample Description	Duplicate Tests	Type of Test	Lithology	Weathering Facies	Metallurgical Column ID	Column Dimensions			Dry Wt. of Sample (kg)	Temp (°C)	Operation Procedure	Sampling Frequency	Total Volume of Initial Flushings (mL)	Flushing Rate/ Weekly Input* (mL)	Start Date	Test Status	Cycles/ Weeks	Recirculation Cycles
							Inner Diameter (cm)	Length (cm)	Height (cm)										
Col 1	"A" Bag		Unsaturated Column	82% Gneiss, 23% Schist	90% Oxide, 10% Transition	70340	10.5			10	4°	Trickle Leach	Biweekly	1210	variable	10-Apr-14	active	98	57-89
Col 2	"B" Bag	Col 1	Unsaturated Column	82% Gneiss, 23% Schist	90% Oxide, 10% Transition	70340	10.5			20	4°	Trickle Leach	Biweekly	2355	variable	10-Apr-14	active	98	57-89
Col 15	Latte Composite		Unsaturated Column	Schist	40% Oxide, 60% Transition	20%72162, 20% 72168, 30% 72150, 30% 72156	10.5			5	4°	Trickle Leach	Biweekly	700	variable	3-Jun-15	active	39	-
Col 16	Supremo Composite		Unsaturated Column	Gneiss	80% Oxide, 20% Transition	40% 73028, 40% 73034, 20% 73040	10.5			5	4°	Trickle Leach	Biweekly	700	variable	3-Jun-15	active	39	-
Col 17	Supremo/Kona Composite		Unsaturated Column	90% Gneiss, 10% Granite	80% Oxide, 20% Transition	35% 73028, 35% 73034, 18% 73040, 7% 72174, 3% 72180	10.5			5	4°	Trickle Leach	Biweekly	700	variable	3-Jun-15	active	39	-
FB-LT1		Col 1 & Col 2	Field Bin	82% Gneiss, 23% Schist	90% Oxide, 10% Transition	70340	45.0		80	76.3	site conditions	natural precipitation	3x's / field season	7	natural precipitation	17-Jun-14	active	70	-
FB-LT2			Field Bin	Schist	Oxide	50% 73007 50% 73016	45.0		80	200				15		10-Aug-15	active	10	-
FB-LT3			Field Bin	Gneiss	Oxide	50% 72108 50% 72111	45.0		80	200				19		10-Aug-15	active	10	-

Notes:
Columns and humidity cells are composed of Plexiglas with an acrylic perforated disk & nylon mesh
No sample preparation was conducted prior to leachate sampling for any tests
* generally 400-500 mL for columns, see individual leachate results in Appendix D.3-3 for specific input volumes

APPENDIX D.3-2: X-RAY DIFFRACTION ANALYSES FOR LEACH TAILINGS KINETIC TEST SUB-SAMPLE

Quantitative X-Ray Diffraction by Rietveld Refinement

Report Prepared for:	*SGS Canada Inc*
Project Number/ LIMS No.	*14094-101A/MI4512-APR14*
Batch No.	*1416 Kaminak Coffee Project*
Reporting Date:	*April 29, 2014*

Instrument:	BRUKER AXS D8 Advance Diffractometer
Test Conditions:	Co radiation, 40 kV, 35 mA Regular Scanning: Step: 0.02°, Step time: 1s, 2θ range: 3-80°
Interpretations :	PDF2/PDF4 powder diffraction databases issued by the International Center for Diffraction Data (ICDD). DiffracPlus Eva and Topas software.
Detection Limit :	0.5-2%. Strongly dependent on crystallinity.

Contents:

1) Method Summary
2) Summary of Mineral Asemblages
3) Semi-Quantitative XRD Results
4) XRD Pattern(s)

Bernie C. Yeung, B.Sc.
Mineralogist

Huyun Zhou, Ph.D., P.Geo.
Senior Mineralogist

Report Prepared by: Kim Gibbs

SGS Minerals
a division of SGS Canada Inc.
P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

SGS

Method Summary

Mineral Identification and Interpretation:

Mineral identification and interpretation involves matching the diffraction pattern of an unknown material to patterns of single-phase reference materials. The reference patterns are compiled by the Joint Committee on Powder Diffraction Standards - International Center for Diffraction Data (JCPDS-ICDD) database and released on software as Powder Diffraction Files (PDF).

Interpretations do not reflect the presence of non-crystalline and/or amorphous compounds, except when internal standards have been added by request. Mineral proportions may be strongly influenced by crystallinity, crystal structure and preferred orientations. Mineral or compound identification and quantitative analysis results should be accompanied by supporting chemical assay data or other additional tests.

Quantitative Rietveld Analysis:

Quantitative Rietveld Analysis is performed by using Topas 4.2 (Bruker AXS), a graphics based profile analysis program built around a non-linear least squares fitting system, to determine the amount of different phases present in a multicomponent sample. Whole pattern analyses are predicated by the fact that the X-ray diffraction pattern is a total sum of both instrumental and specimen factors. Unlike other peak intensity-based methods, the Rietveld method uses a least squares approach to refine a theoretical line profile until it matches the obtained experimental patterns.

Rietveld refinement is completed with a set of minerals specifically identified for the sample. Zero values indicate that the mineral was included in the refinement calculations, but the calculated concentration was less than 0.05wt%. Minerals not identified by the analyst are not included in refinement calculations for specific samples and are indicated with a dash.

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a division of SGS Canada Inc.
P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0
Tel: (705) 652-2000 Fax: (705) 652-6365 www.sgs.com www.sgs.com/met
Member of the SGS Group (SGS SA)

Summary of Rietveld Quantitative Analysis X-ray Diffraction Results

Quantitative X-ray Diffraction Results

Mineral/Compound	70340 A APR4512-01 (wt %)	70340 B APR4512-02 (wt %)
Quartz	56.3	55.7
Phlogopite	3.1	2.8
Dolomite	4.6	2.8
Kaolinite	6.8	9.0
Muscovite	14.8	17.9
Calcite	1.4	1.4
Anorthite	0.0	-
Biotite	0.5	0.7
Orthoclase	1.6	1.3
Chlorite	6.4	5.8
Albite	4.6	2.6
TOTAL	100	100

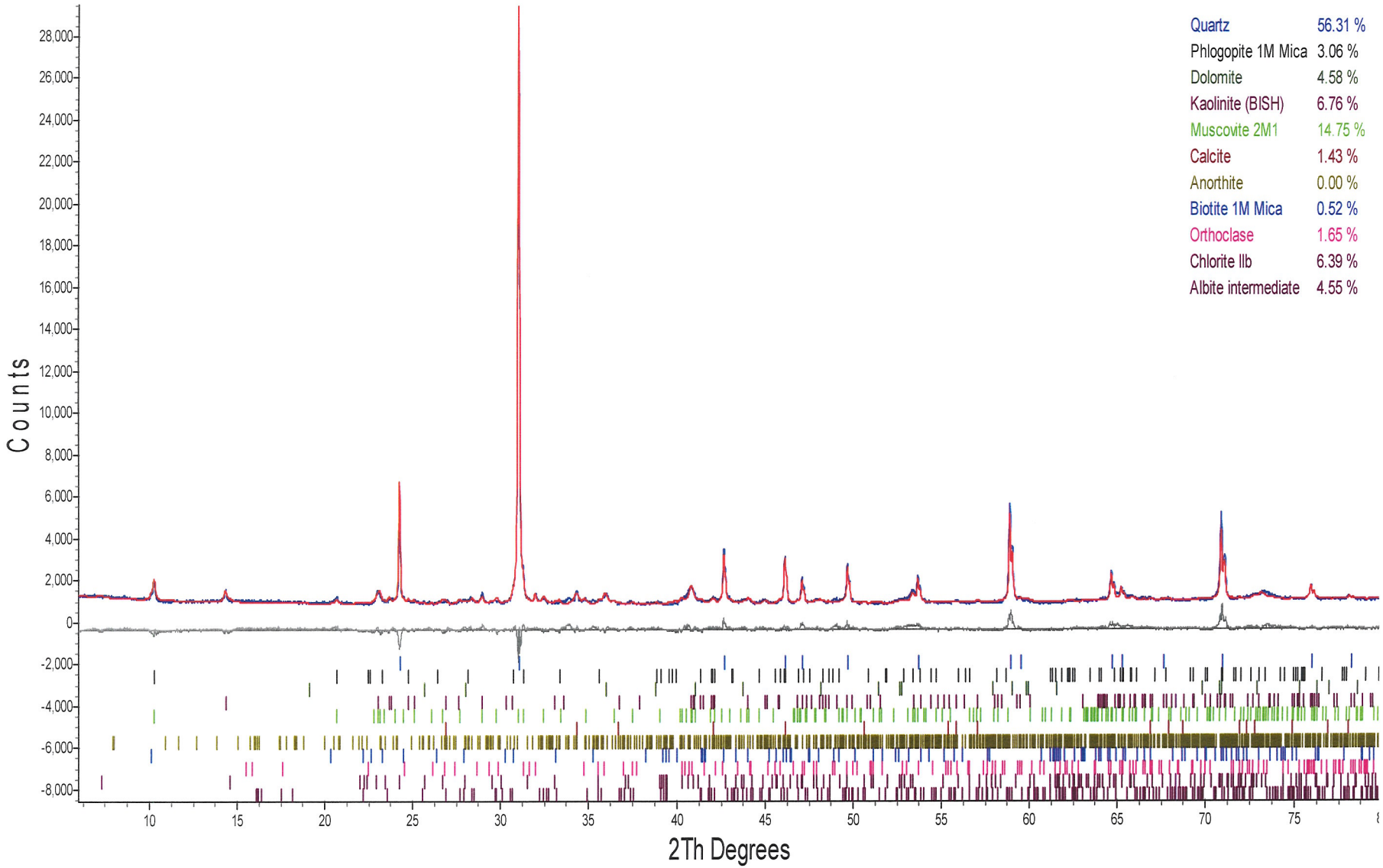
Zero values indicate that the mineral was included in the refinement, but the calculated concentration is below a measurable value.

Dashes indicate that the mineral was not identifed by the analyst and not included in the refinement calculation for the sample.

Mineral/Compound	Formula
Quartz	SiO_2
Phlogopite	$KMg_3(AlSi_3O_{10})(OH)$
Dolomite	$CaMg(CO_3)_2$
Kaolinite	$Al_2Si_2O_5(OH)_4$
Muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
Calcite	$CaCO_3$
Anorthite	$CaAl_2Si_2O_8$
Biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
Orthoclase	$KAlSi_3O_8$
Chlorite	$(Fe,(Mg,Mn)_5,Al)(Si_3Al)O_{10}(OH)_8$
Albite	$NaAlSi_3O_8$

SGS Canada Inc
14094-101A/MI4512-APR14
29-Apr-14

Apr4512-1 re-run.raw_1



The Qualitative XRD method (METH # 8-8-1) used by SGS Minerals Services, P.O. Box 4300, 185 Concession Street, Lakefield, Ontario, Canada K0L 2H0.
Tel: (705) 652-2000 Fax: (705) 652-6365 Mini-method available upon request.

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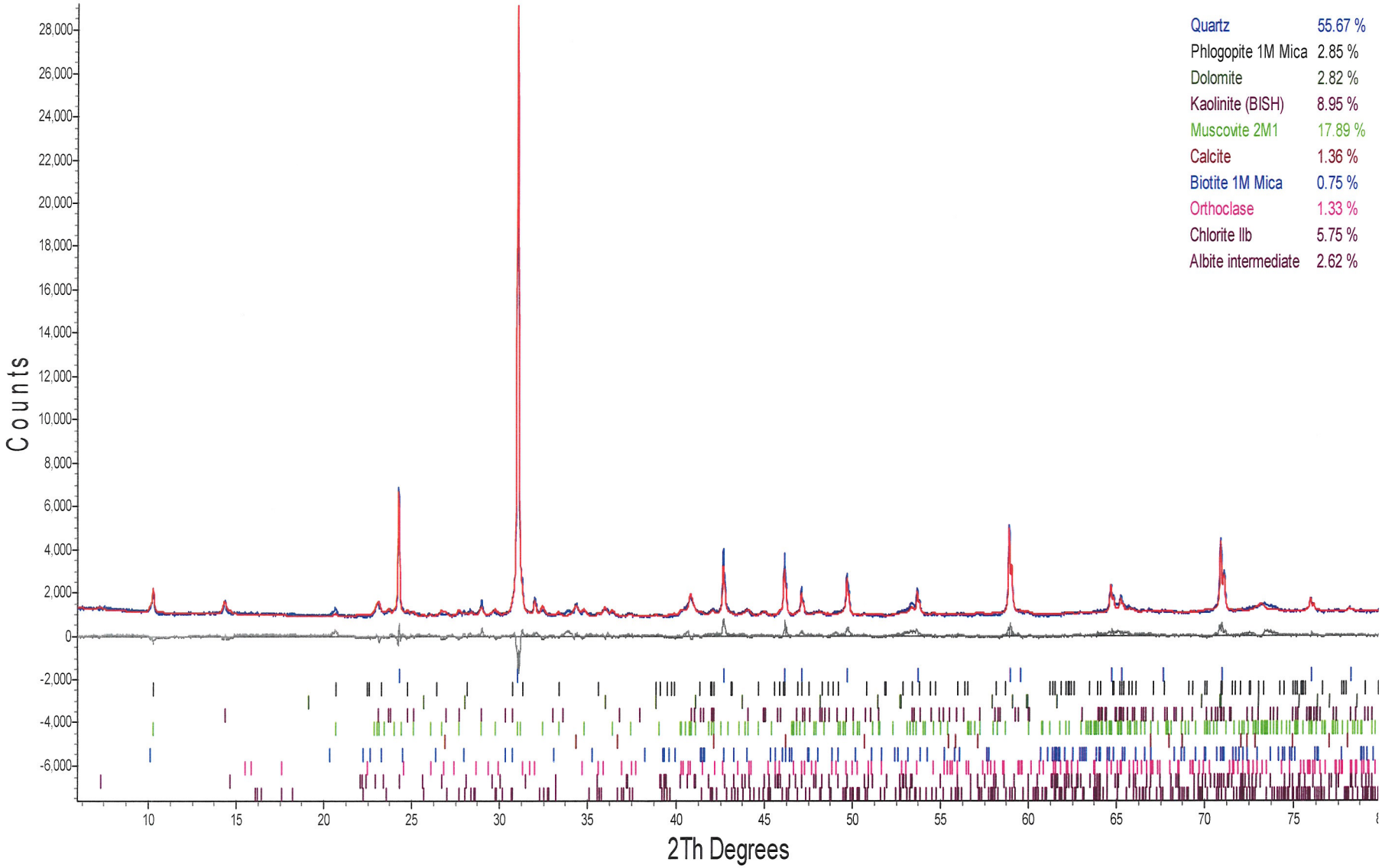
14094-101A/MI4512-APR14
29-Apr-14

Apr4512-2 re-run.raw_1



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Appendix D.3-2: Static Test Results for Leach Tailings Kinetic Test Sub-Samples

Acid-Base Accounting Results

Kinetic Tests	Lithology	Weathering Facies	Rinse pH	Paste pH	TIC	CaNP	Total C	Total S	S(SO4)	S(S-2)	Insoluble S	AP	Sobek NP	Siderite NP	Sobek NNP	Siderite NNP	Fizz Test
			s.u.	s.u.	%	kg $CaCO_3$/t	%	%	%	%	%	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	kg $CaCO_3$/t	
		Method Code	*Sobek*	*Sobek*	*CSB02V*	*Calc.*	*CSA06V*	*CSA06V*	*CSA07V*	*CSA08D*	*Calc.*	*Calc.*	*Sobek*	*Siderite Corr.*	*Calc.*	*Calc.*	*Sobek*
		Limit of Detection	*0.20*	*0.20*	*0.01*	*#N/A*	*0.005*	*0.005*	*0.01*	*0.01*	*#N/A*	*#N/A*	*0.5*	*0.5*	*#N/A*	*#N/A*	*#N/A*
Col 1, Col 2 & FB-LT1	82% Gneiss, 23% Schist	90% Oxide, 10% Transition		8.4	0.56	47	0.60	0.080	0.020	0.040	0.020	1.3	48	47	*ND*	*ND*	Slight
Col 15	Schist	40% Oxide, 60% Transition	9.4	8.8	0.71	59	0.76	0.24	0.020	0.19	0.029	6.0	55	71	49	65	Slight
Col 16	Gneiss	80% Oxide, 20% Transition	9.6	9.2	0.27	23	0.28	0.041	0.012	0.018	0.019	0.56	24	30	24	30	Slight
Col 17	90% Gneiss, 10% Granite	80% Oxide, 20% Transition	9.4	9.0	0.24	20	0.25	0.044	0.012	0.022	0.019	0.68	21	28	21	27	Slight
FB-LT3	Schist	Oxide	9.6	9.1	0.97	81	1.0	0.042	0.020	0.020	0.012	0.63	80	94	80	94	Moderate
FB-LT2	Gneiss	Oxide	9.6	9.3	0.020	1.7	0.041	0.015	*<0.01*	*<0.01*	0.015	0.31	4.2	11	4.2	11	None

Notes:
Values in grey italics are below the analytical detection limit
CaNP = carbonate NP calculated from total inorganic carbon (TIC)
NNP = net neutralization potential, derived by subtracting acid potential (AP) from NP

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Lithology	Weathering Facies	Ag	Al	As	B	Ba	Be	Bi	Ca	Cd	Ce	Co	Cr	Cs	Cu	Fe	Ga	Ge	Hf	Hg	In	K	La	Li	Lu	Mg	Mn
			ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	%	ppm
		Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
		Limit of Detection	*0.010*	*0.010*	*1.0*	*10*	*5.0*	*0.10*	*0.020*	*0.010*	*0.010*	*0.050*	*0.10*	*1.0*	*0.050*	*0.50*	*0.010*	*0.10*	*0.10*	*0.050*	*0.010*	*0.020*	*0.010*	*0.10*	*1.0*	*0.010*	*0.010*	*2.0*
Col 1, Col 2 & FB-LT1	82% Gneiss, 23% Schist	90% Oxide, 10% Transition	0.13	0.33	1690	20	201	1.1	0.29	1.6	0.090	46	8.2	123	1.8	15	2.3	1.0	*<0.1*	0.21	0.57	0.020	0.20	26	1.0	0.17	0.34	402
Col 15	Schist	40% Oxide, 60% Transition	0.065	0.53	3543	*<10*	175	0.61	0.24	1.8	0.065	39	5.5	97	1.7	7.9	1.9	1.8	*<0.1*	0.23	1.2	*<0.02*	0.21	20	2.2	0.14	0.43	284
Col 16	Gneiss	80% Oxide, 20% Transition	0.11	0.52	1156	*<10*	214	1.1	0.31	0.90	0.076	61	6.5	108	1.9	6.2	1.9	1.7	*<0.1*	0.16	0.89	*<0.02*	0.27	34	2.0	0.17	0.22	412
Col 17	90% Gneiss, 10% Granite	80% Oxide, 20% Transition	0.099	0.50	1488	*<10*	196	0.98	0.29	0.81	0.072	57	5.9	105	1.8	5.6	1.8	1.6	*<0.1*	0.17	0.91	*<0.02*	0.25	32	1.9	0.16	0.20	376
FB-LT3	Schist	Oxide	0.075	0.65	1350	*<10*	874	0.75	0.66	3.0	0.12	68	14	95	1.9	29	3.3	2.3	*<0.1*	0.13	0.39	0.025	0.29	35	3.0	0.22	0.49	638
FB-LT2	Gneiss	Oxide	0.090	0.63	824	*<10*	242	0.85	0.36	0.17	0.095	48	9.8	115	1.3	9.8	2.4	2.0	*<0.1*	0.18	0.35	0.030	0.23	26	2.5	0.15	0.19	537

Notes:
Values in grey italics are below the analytical detection limit

Solid Phase Elements by Aqua Regia Digestion

Kinetic Tests	Lithology	Weathering Facies	Mo	Na	Nb	Ni	P	Pb	Rb	S	Sb	Sc	Se	Sn	Sr	Ta	Tb	Te	Th	Ti	Tl	U	V	W	Y	Yb	Zn	Zr
			ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
		Method Code	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*	*ICM14B*
		Limit of Detection	*0.050*	*0.010*	*0.050*	*0.50*	*0.0050*	*0.20*	*0.20*	*0.010*	*0.050*	*0.10*	*1.0*	*0.30*	*0.50*	*0.050*	*0.020*	*0.050*	*0.10*	*0.010*	*0.020*	*0.050*	*1.0*	*0.10*	*0.050*	*0.10*	*1.0*	*0.50*
Col 1, Col 2 & FB-LT1	82% Gneiss, 23% Schist	90% Oxide, 10% Transition	4.5	0.030	*<0.05*	14	0.031	15	11	0.080	37	3.8	*<1*	0.30	61	*<0.05*	0.43	0.060	17	*<0.01*	0.59	10	16	0.70	11	1.2	33	7.0
Col 15	Schist	40% Oxide, 60% Transition	4.6	0.038	0.22	23	0.026	16	12	0.24	55	3.6	*<1*	0.41	69	*<0.05*	0.32	*<0.05*	18	*<0.01*	0.74	5.8	16	0.28	8.8	0.91	29	8.0
Col 16	Gneiss	80% Oxide, 20% Transition	5.3	0.036	0.076	16	0.028	13	15	0.038	39	3.2	*<1*	0.92	38	*<0.05*	0.39	*<0.05*	26	*<0.01*	1.0	14	18	0.56	11	1.2	31	5.5
Col 17	90% Gneiss, 10% Granite	80% Oxide, 20% Transition	5.2	0.036	0.098	15	0.026	13	14	0.041	40	3.2	*<1*	0.85	36	*<0.05*	0.36	*<0.05*	25	*<0.01*	0.99	14	17	0.51	11	1.1	28	6.0
FB-LT3	Schist	Oxide	3.7	0.045	0.070	36	0.064	14	14	0.040	95	5.2	*<1*	0.30	76	*<0.05*	0.58	0.075	13	0.010	0.61	1.9	27	0.65	16	1.5	60	4.9
FB-LT2	Gneiss	Oxide	4.8	0.040	0.075	41	0.034	13	13	0.010	41	6.2	*<1*	0.45	19	*<0.05*	0.35	0.14	20	0.010	0.92	13	31	0.40	9.9	1.1	32	7.1

Notes:
Values in grey italics are below the analytical detection limit

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 1 (LT1, Sample 'A')

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
23-Apr-14	1	1	1210	385	8.4	496	412	9.8	0.50	*< 10*	*< 3*	3.7	4.0	10.0	87	0.70	134	0.062	0.061	0.11	0.058	0.0000070	*< 7E-06*	0.080	0.00016	40	0.089
7-May-14	2	3	400	455	8.5	394	251	4.4	0.22	*< 5*	*< 3*	1.3	1.8	4.2	31	*< 0.3*	46	0.012	0.080	2.0	0.022	0.000014	*< 7E-06*	0.050	0.00033	13	0.040
21-May-14	3	5	450	385	8.6	406	219	2.0	0.070	*< 2*	*< 1*	0.70	0.56	1.2	10	*< 0.3*	33	0.014	0.056	2.0	0.017	0.000079	0.00044	0.041	*< 3E-06*	9.2	0.021
4-Jun-14	4	7	400	325	8.6	396	181	1.4	0.040	*< 2*	*< 1*	0.60	0.21	0.41	3.1	*< 0.3*	29	0.0084	0.052	2.3	0.012	*< 7E-06*	*< 7E-06*	0.020	*< 3E-06*	8.2	0.012
18-Jun-14	5	9	400	335	8.6	399	95	0.84	0.030	*< 2*	*< 1*	0.50	0.17	0.14	1.6	*< 0.3*	25	0.0095	0.047	2.7	0.012	*< 7E-06*	*< 7E-06*	0.020	*< 3E-06*	7.0	0.0091
2-Jul-14	6	11	400	340	8.5	411	101	0.65	0.040	*< 2*	*< 1*	0.50	*< 0.06*	0.090	0.90	*< 0.3*	25	0.018	0.052	2.5	0.013	*< 7E-06*	*< 7E-06*	0.018	0.000021	6.9	0.0065
16-Jul-14	7	13	400	340	8.5	374	69	0.44	0.020	*< 2*	*< 1*	0.80	*< 0.06*	0.060	0.60	*< 0.3*	22	0.011	0.051	2.6	0.012	0.000014	0.000013	0.020	*< 3E-06*	6.3	0.0057
30-Jul-14	8	15	400	330	8.5	361	58	0.38	0.020	*< 2*	*< 1*	0.50	*< 0.06*	0.050	0.40	*< 0.3*	18	0.037	0.052	2.9	0.011	*< 7E-06*	*< 7E-06*	0.020	*< 3E-06*	5.1	0.0049
13-Aug-14	9	17	400	325	8.4	345	51	0.38	0.020	*< 2*	*< 1*	0.50	*< 0.06*	0.040	*< 0.3*	0.40	21	0.011	0.050	2.4	0.013	*< 7E-06*	*< 7E-06*	0.024	*< 3E-06*	5.8	0.0038
27-Aug-14	10	19	400	325	8.4	329	47	0.21	0.010	-	-	0.40	*< 0.06*	0.040	*< 1*	*< 0.3*	20	0.023	0.045	2.3	0.012	*< 7E-06*	*< 7E-06*	0.033	0.0000070	5.7	0.0032
10-Sep-14	11	21	400	315	8.4	317	35	0.23	0.010	-	-	0.30	*< 0.06*	*< 0.03*	*< 0.2*	*< 0.3*	19	0.021	0.042	2.3	0.012	*< 7E-06*	*< 7E-06*	0.027	0.000014	5.2	0.0029
24-Sep-14	12	23	400	340	8.4	319	42	0.19	*< 0.01*	-	-	0.40	*< 0.06*	0.030	*< 1*	*< 0.3*	33	0.0082	0.047	2.2	0.013	*< 7E-06*	*< 7E-06*	0.021	*< 3E-06*	5.1	0.0026
8-Oct-14	13	25	400	305	8.4	284	39	0.17	0.020	-	-	0.70	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	21	0.012	0.038	2.2	0.013	*< 7E-06*	*< 7E-06*	0.018	0.0000030	5.7	0.0025
22-Oct-14	14	27	400	325	8.3	273	33	0.18	0.010	-	-	0.40	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	20	0.019	0.039	2.2	0.015	*< 7E-06*	*< 7E-06*	0.030	0.000013	5.5	0.0022
5-Nov-14	15	29	400	325	-	275	32	0.12	*< 0.01*	-	-	0.30	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	20	0.015	0.038	2.1	0.014	*< 7E-06*	*< 7E-06*	0.024	0.0000050	5.4	0.0020
19-Nov-14	16	31	400	315	8.3	260	30	0.11	0.020	-	-	0.60	*< 0.06*	0.040	*< 1*	*< 0.3*	22	0.0095	0.036	1.9	0.016	*< 7E-06*	*< 7E-06*	0.020	0.000013	5.8	0.0019
3-Dec-14	17	33	400	285	8.4	256	29	0.10	*< 0.01*	-	-	0.40	*< 0.06*	0.030	*< 1*	*< 0.3*	22	0.014	0.034	1.8	0.016	*< 7E-06*	*< 7E-06*	0.019	0.0000080	6.1	0.0017
17-Dec-14	18	35	400	365	8.4	233	23	0.10	*< 0.01*	-	-	1.8	*< 0.06*	0.080	*< 1*	*< 0.3*	21	0.017	0.036	1.7	0.015	*< 7E-06*	*< 7E-06*	0.019	0.0000080	5.4	0.0014
31-Dec-14	19	37	400	335	8.5	273	19	0.080	0.010	-	-	0.50	*< 0.06*	0.060	*< 1*	*< 0.3*	20	0.021	0.034	1.6	0.017	*< 7E-06*	*< 7E-06*	0.018	0.0000030	5.4	0.0013
14-Jan-15	20	39	400	325	8.3	220	20	0.080	*< 0.01*	-	-	0.40	*< 0.06*	0.050	*< 1*	*< 0.3*	23	0.022	0.034	1.6	0.017	*< 7E-06*	*< 7E-06*	0.019	0.000017	6.3	0.0066
28-Jan-15	21	41	400	340	8.3	232	21	0.060	*< 0.01*	-	-	0.40	*< 0.06*	0.11	*< 1*	*< 0.3*	27	0.015	0.030	1.4	0.017	*< 7E-06*	0.000044	0.016	0.0000040	7.4	0.0014
11-Feb-15	22	43	400	325	8.2	206	21	0.050	*< 0.01*	-	-	0.40	*< 0.06*	0.070	*< 1*	*< 0.3*	26	0.012	0.032	1.3	0.018	*< 7E-06*	*< 7E-06*	0.020	0.0000060	7.0	0.0012
25-Feb-15	23	45	400	320	8.2	202	18	0.050	*< 0.01*	-	-	0.40	*< 0.06*	0.080	*< 1*	*< 0.3*	32	0.0038	0.026	0.97	0.022	*< 7E-06*	*< 7E-06*	0.018	0.0000060	8.7	0.0011
11-Mar-15	24	47	400	315	8.2	194	20	0.040	0.010	-	-	0.50	*< 0.06*	0.060	*< 1*	*< 0.3*	36	0.0049	0.025	0.87	0.023	*< 7E-06*	*< 7E-06*	0.017	0.0000050	9.8	0.0011
25-Mar-15	25	49	400	325	8.1	178	13	0.010	*< 0.01*	-	-	0.40	*< 0.06*	0.070	*< 1*	*< 0.3*	41	0.0059	0.025	0.90	0.027	*< 7E-06*	*< 7E-06*	0.016	*< 3E-06*	11	0.0013
8-Apr-15	26	51	400	350	8.1	172	14	0.050	0.010	-	-	0.60	*< 0.06*	0.10	*< 1*	*< 0.3*	45	0.0073	0.028	0.75	0.030	*< 7E-06*	*< 7E-06*	0.014	*< 3E-06*	12	0.00090
22-Apr-15	27	53	400	320	8.0	158	16	0.030	*< 0.01*	-	-	0.80	*< 0.06*	0.15	*< 1*	*< 0.3*	50	0.0097	0.025	0.70	0.031	*< 7E-06*	*< 7E-06*	0.022	0.000014	13	0.00091
6-May-15	28	55	400	325	8.1	160	13	0.020	*< 0.01*	-	-	0.40	*< 0.06*	0.25	*< 1*	*< 0.3*	55	0.0065	0.021	0.59	0.033	*< 7E-06*	*< 7E-06*	0.018	*< 3E-06*	15	0.00077
20-May-15	29	57	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	30	59	445	380	8.1	144	9.0	0.67	0.020	-	-	0.60	*< 0.06*	*< 0.01*	*< 1*	*< 0.3*	66	0.0089	0.016	0.48	0.041	*< 7E-06*	*< 7E-06*	0.020	0.0000040	18	0.00084
17-Jun-15	31	61	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	32	63	445	385	8.0	140	11	0.020	*< 0.01*	-	-	0.70	0.060	2.0	*< 1*	*< 0.3*	79	0.0051	0.016	0.46	0.049	*< 7E-06*	*< 7E-06*	0.015	0.0000030	21	0.00069
15-Jul-15	33	65	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	34	67	425	355	8.0	131	11	0.020	0.040	-	-	0.80	0.10	5.7	*< 1*	*< 0.3*	97	0.0063	0.014	0.36	0.052	*< 7E-06*	0.000011	0.017	*< 3E-06*	26	0.00075
12-Aug-15	35	69	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	36	71	455	375	8.0	121	9.0	0.020	0.020	-	-	0.90	0.17	13	*< 1*	*< 0.3*	109	0.0050	0.013	0.33	0.061	*< 7E-06*	*< 7E-06*	0.016	0.000028	29	0.00065
9-Sep-15	37	73	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	38	75	445	390	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	39	77	390	320	7.9	121	8.0	0.020	*< 0.01*	-	-	0.50	0.28	21			139	0.0075	0.014	0.28	0.070	*< 7E-06*	*< 7E-06*	0.016	0.0000030	36	0.00060
21-Oct-15	40	79	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	41	81	450	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	42	83	425	360	8.2	132	7.0	0.010	*< 0.01*	-	-	0.20	0.28	17			137	0.0044	0.011	0.29	0.060	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	36	0.00060
2-Dec-15	43	85	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	44	87	450	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	45	89	400	360	8.3	111	9.0	0.020	*< 0.01*	-	-	0.10	0.30	13	-	-	129	0.0035	0.011	0.24	0.060	*< 7E-06*	*< 7E-06*	0.013	*< 3E-06*	34	0.00053
6-Jan-16	46	90	400	340	8.2	112	9.0	0.020	*< 0.01*	-	-	0.20	0.24	12	-	-	134	0.0049	0.012	0.27	0.062	*< 7E-06*	*< 7E-06*	0.013	0.0000030	35	0.00057
20-Jan-16	47	92	400	355	8.2	108	9.0	0.020	*< 0.01*	-	-	*< 0.1*	0.20	8.4	-	-	123	0.0042	0.013	0.32	0.057	*< 7E-06*	*< 7E-06*	0.022	0.0000060	33	0.00060
3-Feb-16	48	94	400	350	8.1	109	9.0	0.010	*< 0.01*	-	-	*< 0.1*	0.13	5.1	-	-	107	0.0035	0.012	0.33	0.054	*< 7E-06*	*< 7E-06*	0.012	*< 3E-06*	28	0.00060
17-Feb-16	49	96	400	330	8.1	116	8.0	0.020	0.040	-	-	*< 0.1*	0.10	3.2	-	-	115	0.0036	0.012	0.34	0.054	*< 7E-06*	*< 7E-06*	0.013	*< 3E-06*	31	0.00067
2-Mar-16	50	98	400	350	8.2	112	9.0	0.010	*< 0.01*	-	-	*< 0.1*	0.060	1.9	-	-	104	0.0016	0.013	0.38	0.051	*< 7E-06*	*< 7E-06*	0.011	0.0000050	27	0.00067

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 1 (LT1, Sample 'A')

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
23-Apr-14	1	1	1210	385	0.32	0.025	2.9	0.00013	0.015	8.1	0.012	7.8	0.22	0.25	0.52	27	0.00060	5.6	0.0062	550	0.17	201	0.00053	0.00078	0.0012	1.1	0.00048	0.0090	< 0.002
7-May-14	2	3	400	455	0.19	0.0079	1.6	0.00013	0.0075	3.4	0.0066	0.65	0.37	0.056	0.43	15	0.0047	5.8	< 2E-06	329	0.062	128	0.00031	0.000050	0.0013	0.99	< 1E-05	0.0030	< 0.002
21-May-14	3	5	450	385	0.092	0.0043	0.82	0.00049	0.0069	2.5	0.0044	0.11	0.14	0.0026	0.42	10	0.0023	4.9	0.000063	294	0.045	78	0.00022	0.000060	0.0015	0.69	0.00010	0.0020	< 0.002
4-Jun-14	4	7	400	325	0.041	0.010	0.47	0.00027	0.0053	2.1	0.0031	0.050	0.14	0.0010	0.44	9.3	0.0013	5.3	0.000014	253	0.038	57	0.00018	0.00018	0.00064	0.56	0.000060	0.0050	< 0.002
18-Jun-14	5	9	400	335	0.029	0.017	0.31	0.000020	0.0052	1.9	0.0021	0.050	0.088	0.00080	0.45	8.4	0.0011	5.3	< 2E-06	221	0.034	43	0.00016	0.000090	0.00045	0.56	0.000080	< 0.001	< 0.002
2-Jul-14	6	11	400	340	0.022	0.0042	0.22	0.000070	0.0050	1.8	0.0016	0.030	0.070	0.00090	0.46	8.3	0.00080	5.6	< 2E-06	206	0.033	37	0.00015	0.00013	0.00043	0.49	0.000060	0.0020	< 0.002
16-Jul-14	7	13	400	340	0.018	0.0017	0.17	0.000030	0.0050	1.6	0.0012	0.020	0.063	0.00060	0.45	7.7	0.00061	5.1	0.000015	190	0.030	29	0.00016	0.00011	0.00032	0.40	0.00020	< 0.001	< 0.002
30-Jul-14	8	15	400	330	0.013	0.0037	0.14	0.000030	0.0047	1.3	0.0012	< 0.01	0.068	0.00050	0.47	6.5	0.00060	4.8	0.0000020	160	0.024	23	0.00013	0.000020	0.00087	0.33	0.00031	< 0.001	< 0.002
13-Aug-14	9	17	400	325	0.011	0.0014	0.075	0.000020	0.0050	1.5	0.00080	< 0.01	0.046	0.00040	0.46	6.6	0.00052	5.1	< 2E-06	169	0.028	20	0.00012	0.000050	0.00029	0.32	0.00012	< 0.001	< 0.002
27-Aug-14	10	19	400	325	0.010	0.0012	0.080	0.000020	0.0048	1.5	0.00090	< 0.01	0.045	0.00040	0.43	6.9	0.00043	5.3	0.0000020	157	0.027	18	0.00014	0.00035	0.00010	0.29	0.00023	< 0.001	< 0.002
10-Sep-14	11	21	400	315	0.0084	0.00098	0.081	0.000020	0.0044	1.4	0.00050	< 0.01	0.040	0.00030	0.44	5.7	0.00049	6.4	< 2E-06	151	0.026	16	0.00012	0.00027	0.000090	0.25	0.00021	< 0.001	< 0.002
24-Sep-14	12	23	400	340	0.0072	0.0012	0.036	0.00013	0.0048	1.4	0.00060	0.010	0.044	0.00040	0.39	6.6	0.00021	5.1	0.000010	128	0.025	13	0.00015	0.00026	0.00026	0.23	0.00019	< 0.001	< 0.002
8-Oct-14	13	25	400	305	0.0071	0.00097	0.061	< 1E-05	0.0056	1.6	0.00028	< 0.01	0.033	0.00030	0.39	5.8	0.00034	5.2	< 2E-06	151	0.029	12	0.00012	0.000040	0.00012	0.23	0.00019	< 0.001	< 0.002
22-Oct-14	14	27	400	325	0.0063	0.00074	0.054	0.000020	0.0057	1.6	0.00064	< 0.01	0.029	0.00020	0.46	5.9	0.00043	5.1	< 2E-06	140	0.026	13	0.00013	0.000030	0.00012	0.20	0.00022	0.0010	< 0.002
5-Nov-14	15	29	400	325	0.0054	0.0010	0.048	0.000070	0.0049	1.6	0.00033	0.010	0.028	0.00020	0.38	5.3	0.00035	5.2	0.0000030	132	0.028	10	0.00011	0.000060	0.00018	0.19	0.00020	< 0.001	< 0.002
19-Nov-14	16	31	400	315	0.0050	0.0014	0.037	0.000030	0.0056	1.8	0.00084	< 0.01	0.024	0.00020	0.37	5.6	0.00027	5.7	0.0000020	132	0.032	9.5	0.00015	0.000060	0.00017	0.18	0.00017	< 0.001	< 0.002
3-Dec-14	17	33	400	285	0.0044	0.020	0.034	0.000020	0.0049	1.6	0.00054	< 0.01	0.021	0.00030	0.34	5.4	0.00027	5.2	< 2E-06	115	0.032	8.8	0.00013	0.000040	0.00015	0.16	0.00018	0.0030	< 0.002
17-Dec-14	18	35	400	365	0.0040	0.0013	0.030	< 1E-05	0.0050	1.8	0.00071	< 0.01	0.019	0.00020	0.34	6.2	0.00030	5.2	< 2E-06	112	0.030	8.3	0.00012	0.000030	0.00016	0.15	0.00019	< 0.001	< 0.002
31-Dec-14	19	37	400	335	0.0036	0.0012	0.031	0.00012	0.0051	1.7	0.00054	< 0.01	0.018	0.00030	0.33	5.4	0.00028	5.5	< 2E-06	103	0.030	7.7	0.00012	0.00014	0.00016	0.15	0.00020	< 0.001	< 0.002
14-Jan-15	20	39	400	325	0.0033	0.00065	0.028	0.00056	0.0051	1.9	0.00062	< 0.01	0.018	0.00020	0.31	5.8	0.00025	5.7	0.0000020	98	0.032	6.9	0.00012	0.000090	0.00019	0.13	0.00018	< 0.001	< 0.002
28-Jan-15	21	41	400	340	0.0028	0.00061	0.025	< 1E-05	0.0049	2.2	0.00055	< 0.01	0.018	0.00020	0.27	6.4	0.00035	5.4	0.0000030	106	0.029	7.2	0.00012	0.00032	0.00018	0.13	0.00021	< 0.001	< 0.002
11-Feb-15	22	43	400	325	0.0027	0.00044	0.046	< 1E-05	0.0059	2.1	0.00060	0.010	0.015	0.00020	0.26	6.2	< 0.001	5.4	< 2E-06	88	0.039	7.0	0.00012	0.00019	0.00012	0.11	0.00018	< 0.001	< 0.002
25-Feb-15	23	45	400	320	0.0027	0.00082	0.016	< 1E-05	0.0063	2.4	0.00028	< 0.01	0.012	0.00010	0.20	6.9	< 0.001	5.5	< 2E-06	80	0.045	6.0	0.00014	0.00015	< 5E-05	0.10	0.00011	< 0.001	< 0.002
11-Mar-15	24	47	400	315	0.0025	0.00084	0.017	< 1E-05	0.0064	2.7	0.00032	< 0.01	0.012	0.00020	0.16	6.6	< 0.001	4.7	0.0000040	69	0.051	6.1	0.00013	0.000080	0.000050	0.094	0.00013	< 0.001	< 0.002
25-Mar-15	25	49	400	325	0.0027	0.0024	0.017	0.000050	0.0064	3.5	0.00042	< 0.01	0.013	0.00020	0.17	7.8	< 0.001	6.0	0.0000030	76	0.061	6.1	0.00016	0.0012	0.00012	0.085	0.00014	0.0010	< 0.002
8-Apr-15	26	51	400	350	0.0020	0.00092	0.012	< 1E-05	0.0066	3.3	0.00061	< 0.01	0.0095	0.00010	0.15	7.8	< 0.001	6.1	0.0000020	56	0.064	5.1	0.00014	0.00014	0.000090	0.076	0.00010	< 0.001	< 0.002
22-Apr-15	27	53	400	320	0.0019	0.00059	0.012	0.00036	0.0065	4.1	0.00073	< 0.01	0.011	0.00010	0.14	8.9	0.00017	5.4	0.000046	54	0.073	5.3	0.00017	0.000080	0.000070	0.071	0.00012	< 0.001	< 0.002
6-May-15	28	55	400	325	0.0018	0.00095	0.013	0.000030	0.0067	4.2	0.00091	0.020	0.0091	0.00010	0.11	8.8	< 0.001	5.8	0.000058	46	0.074	4.9	0.00016	0.000020	0.000080	0.067	0.00014	< 0.001	< 0.002
20-May-15	29	57	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	30	59	445	380	0.0016	0.0038	0.018	0.000070	0.0068	5.3	0.00065	< 0.01	0.012	0.00010	0.092	9.5	0.00017	5.5	0.000012	33	0.093	4.3	0.00016	0.00016	0.000080	0.064	0.00012	0.0010	< 0.002
17-Jun-15	31	61	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	32	63	445	385	0.0016	0.00050	0.011	< 1E-05	0.0069	6.4	0.00083	0.020	0.0066	0.00010	0.089	9.6	0.00016	5.7	0.000020	26	0.12	3.7	0.00019	0.000070	0.000070	0.063	0.00010	< 0.001	< 0.002
15-Jul-15	33	65	500	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	34	67	425	355	0.0015	0.00070	0.011	0.000010	0.0072	7.5	0.0018	< 0.01	0.0067	0.00010	0.073	9.9	0.00011	5.7	0.0000090	21	0.14	3.6	0.00020	0.000050	< 5E-05	0.063	0.00013	< 0.001	< 0.002
12-Aug-15	35	69	500	455	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	36	71	455	375	0.0014	0.0018	0.0080	0.000060	0.0072	8.8	0.00091	< 0.01	0.0069	0.00010	0.054	11	0.00032	5.8	0.00026	19	0.17	3.5	0.00021	0.00011	< 5E-05	0.051	0.00011	< 0.001	< 0.002
9-Sep-15	37	73	500	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	38	75	445	390	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	39	77	390	320	0.0013	0.00061	0.0080	0.000020	0.0074	12	0.00098	< 0.01	0.0041	0.00020	0.057	12	0.00012	5.3	0.0000070	17	0.20	3.7	0.00021	0.00016	0.00011	0.053	0.00013	< 0.001	< 0.002
21-Oct-15	40	79	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	41	81	450	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	42	83	425	360	0.0014	0.00079	0.014	< 1E-05	0.0061	12	0.0028	< 0.01	0.0048	< 0.0001	0.057	11	0.00021	5.5	0.0000070	14	0.18	3.5	0.00015	0.000070	0.000070	0.046	0.000080	< 0.001	< 0.002
2-Dec-15	43	85	500	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	44	87	450	400	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	45	89	400	360	0.0012	0.00046	0.017	0.000020	0.0056	11	0.00042	< 0.01	0.0057	0.00010	0.056	9.3	0.00015	5.3	0.0000090	13	0.15	3.3	0.00012	0.000040	0.00031	0.049	0.000070	< 0.001	< 0.002
6-Jan-16	46	90	400	340	0.0013	0.0010	0.010	< 1E-05	0.0059	11	0.0013	< 0.01	0.0057	0.00010	0.063	10	0.0012	5.6	0.000012	13	0.17	3.2	0.00011	0.00027	< 5E-05	0.047	0.000090	< 0.001	< 0.002
20-Jan-16	47	92	400	355	0.0015	0.00037	0.010	0.000060	0.0057	9.7	0.0011	< 0.01	0.0061	0.00020	0.061	9.0	0.00015	5.9	0.000012	11	0.17	3.6	0.00029	0.000050	0.000050	0.053	0.000070	0.0020	< 0.002
3-Feb-16	48	94	400	350	0.0014	0.0010	0.012	0.000020	0.0053	8.8	0.00060	< 0.01	0.0057	0.00010	0.069	8.7	0.00029	5.4	0.000022	10	0.15	3.7	0.00013	0.000090	< 5E-05	0.051	0.000060	< 0.001	< 0.002
17-Feb-16	49	96	400	330	0.0015	0.00076	0.0080	0.000030	0.0053	9.3	0.00091	< 0.01	0.0060	0.00020	0.068	9.0	0.000090	5.6	< 2E-06	11	0.15	3.4	0.00012	0.00012	< 5E-05	0.051	0.000080	< 0.001	< 0.002
2-Mar-16	50	98	400	350	0.0015	0.00039	0.0080	0.000030	0.0054	9.1	0.0016	< 0.01	0.0062	0.00010	0.070	8.6	0.000080	5.5	0.0000040	9.6	0.14	3.9	0.00012	0.000020	< 5E-05	0.052	0.000040	< 0.001	< 0.002

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 1

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
23-Apr-14	1	1	1210	385	8.4	19	16	0.38	0.019	0.39	0.12	0.14	0.15	0.38	3.3	0.027	5.2	0.0024	0.0024	0.0042	0.0022	0.00000027	0.00000027	0.0031	0.0000060	1.5	0.0034
7-May-14	2	3	400	455	8.5	9.0	5.7	0.100	0.0050	0.11	0.068	0.030	0.040	0.096	0.71	0.0068	1.0	0.00027	0.0018	0.045	0.00051	0.00000032	0.00000016	0.0011	0.0000076	0.29	0.00091
21-May-14	3	5	450	385	8.6	7.8	4.2	0.039	0.0013	0.039	0.019	0.013	0.011	0.023	0.19	0.0058	0.64	0.00028	0.0011	0.038	0.00033	0.0000015	0.0000085	0.00078	0.000000058	0.18	0.00040
4-Jun-14	4	7	400	325	8.6	6.4	2.9	0.022	0.00065	0.033	0.016	0.0098	0.0034	0.0067	0.050	0.0049	0.47	0.00014	0.00084	0.037	0.00020	0.00000011	0.00000011	0.00032	0.000000049	0.13	0.00020
18-Jun-14	5	9	400	335	8.6	6.7	1.6	0.014	0.00050	0.034	0.017	0.0084	0.0028	0.0023	0.027	0.0050	0.42	0.00016	0.00079	0.045	0.00020	0.00000012	0.00000012	0.00033	0.000000050	0.12	0.00015
2-Jul-14	6	11	400	340	8.5	7.0	1.7	0.011	0.00068	0.034	0.017	0.0085	0.0010	0.0015	0.015	0.0051	0.42	0.00031	0.00089	0.043	0.00021	0.00000012	0.00000012	0.00031	0.00000036	0.12	0.00011
16-Jul-14	7	13	400	340	8.5	6.4	1.2	0.0075	0.00034	0.034	0.017	0.014	0.0010	0.0010	0.010	0.0051	0.38	0.00018	0.00087	0.044	0.00020	0.00000024	0.00000022	0.00035	0.000000051	0.11	0.000097
30-Jul-14	8	15	400	330	8.5	5.9	0.96	0.0063	0.00033	0.033	0.017	0.0083	0.00099	0.00083	0.0066	0.0050	0.30	0.00060	0.00086	0.047	0.00018	0.00000012	0.00000012	0.00034	0.000000050	0.084	0.000081
13-Aug-14	9	17	400	325	8.4	5.6	0.83	0.0062	0.00033	0.033	0.016	0.0081	0.00098	0.00065	0.0049	0.0065	0.34	0.00017	0.00081	0.039	0.00021	0.00000011	0.00000011	0.00039	0.000000049	0.095	0.000062
27-Aug-14	10	19	400	325	8.4	5.3	0.76	0.0034	0.00016			0.0065	0.00098	0.00065	0.016	0.0049	0.33	0.00038	0.00073	0.037	0.00019	0.00000011	0.00000011	0.00054	0.00000011	0.093	0.000052
10-Sep-14	11	21	400	315	8.4	5.0	0.55	0.0036	0.00016			0.0047	0.00095	0.00047	0.0032	0.0047	0.29	0.00033	0.00066	0.037	0.00018	0.00000011	0.00000011	0.00042	0.00000022	0.082	0.000046
24-Sep-14	12	23	400	340	8.4	5.4	0.71	0.0032	0.00017			0.0068	0.0010	0.00051	0.017	0.0051	0.55	0.00014	0.00079	0.037	0.00022	0.00000012	0.00000012	0.00036	0.000000051	0.087	0.000044
8-Oct-14	13	25	400	305	8.4	4.3	0.59	0.0026	0.00031			0.011	0.00092	0.00046	0.015	0.0046	0.32	0.00018	0.00058	0.034	0.00020	0.00000011	0.00000011	0.00027	0.000000046	0.086	0.000038
22-Oct-14	14	27	400	325	8.3	4.4	0.54	0.0029	0.00016			0.0065	0.00098	0.00049	0.016	0.0049	0.33	0.00030	0.00063	0.035	0.00024	0.00000011	0.00000011	0.00049	0.00000021	0.090	0.000035
5-Nov-14	15	29	400	325		4.5	0.52	0.0020	0.00016			0.0049	0.00098	0.00049	0.016	0.0049	0.32	0.00024	0.00061	0.033	0.00022	0.00000011	0.00000011	0.00038	0.000000081	0.088	0.000033
19-Nov-14	16	31	400	315	8.3	4.1	0.47	0.0017	0.00032			0.0095	0.00095	0.00063	0.016	0.0047	0.34	0.00015	0.00057	0.030	0.00025	0.00000011	0.00000011	0.00032	0.00000020	0.092	0.000029
3-Dec-14	17	33	400	285	8.4	3.7	0.41	0.0014	0.00014			0.0057	0.00086	0.00043	0.014	0.0043	0.31	0.00020	0.00048	0.026	0.00022	0.000000100	0.000000100	0.00026	0.00000011	0.087	0.000024
17-Dec-14	18	35	400	365	8.4	4.3	0.42	0.0018	0.00018			0.033	0.0011	0.0015	0.018	0.0055	0.38	0.00031	0.00065	0.031	0.00026	0.00000013	0.00000013	0.00035	0.00000015	0.098	0.000026
31-Dec-14	19	37	400	335	8.5	4.6	0.32	0.0013	0.00017			0.0084	0.0010	0.0010	0.017	0.0050	0.34	0.00035	0.00056	0.027	0.00028	0.00000012	0.00000012	0.00030	0.000000050	0.090	0.000022
14-Jan-15	20	39	400	325	8.3	3.6	0.33	0.0013	0.00016			0.0065	0.00098	0.00081	0.016	0.0049	0.38	0.00036	0.00055	0.025	0.00027	0.00000011	0.00000011	0.00031	0.00000028	0.10	0.00011
28-Jan-15	21	41	400	340	8.3	3.9	0.36	0.0010	0.00017			0.0068	0.0010	0.0019	0.017	0.0051	0.46	0.00026	0.00050	0.023	0.00030	0.00000012	0.00000075	0.00027	0.000000068	0.13	0.000023
11-Feb-15	22	43	400	325	8.2	3.4	0.34	0.00081	0.00016			0.0065	0.00098	0.0011	0.016	0.0049	0.43	0.00020	0.00051	0.021	0.00029	0.00000011	0.00000011	0.00033	0.000000098	0.11	0.000019
25-Feb-15	23	45	400	320	8.2	3.2	0.29	0.00080	0.00016			0.0064	0.00096	0.0013	0.016	0.0048	0.51	0.000061	0.00042	0.016	0.00035	0.00000011	0.00000011	0.00029	0.000000096	0.14	0.000018
11-Mar-15	24	47	400	315	8.2	3.1	0.32	0.00063	0.00016			0.0079	0.00095	0.00095	0.016	0.0047	0.56	0.000077	0.00039	0.014	0.00036	0.00000011	0.00000011	0.00027	0.000000079	0.15	0.000017
25-Mar-15	25	49	400	325	8.1	2.9	0.21	0.00016	0.00016			0.0065	0.00098	0.0011	0.016	0.0049	0.67	0.000096	0.00041	0.015	0.00044	0.00000011	0.00000011	0.00025	0.000000049	0.18	0.000021
8-Apr-15	26	51	400	350	8.1	3.0	0.25	0.00088	0.00018			0.011	0.0011	0.0018	0.018	0.0053	0.78	0.00013	0.00049	0.013	0.00052	0.00000012	0.00000012	0.00025	0.000000053	0.22	0.000016
22-Apr-15	27	53	400	320	8.0	2.5	0.26	0.00048	0.00016			0.013	0.00096	0.0024	0.016	0.0048	0.80	0.00016	0.00039	0.011	0.00050	0.00000011	0.00000011	0.00035	0.00000022	0.21	0.000015
6-May-15	28	55	400	325	8.1	2.6	0.21	0.00033	0.00016			0.0065	0.00098	0.0041	0.016	0.0049	0.89	0.00011	0.00034	0.0095	0.00053	0.00000011	0.00000011	0.00030	0.000000049	0.24	0.000013
20-May-15	29	57	500	445																							
3-Jun-15	30	59	445	380	8.1	1.4	0.086	0.0064	0.00019			0.0057	0.00057	0.000095	0.0095	0.0029	0.63	0.000085	0.00015	0.0045	0.00039	0.000000067	0.000000067	0.00019	0.000000038	0.17	0.0000080
17-Jun-15	31	61	500	445																							
1-Jul-15	32	63	445	385	8.0	1.4	0.11	0.00019	0.000096			0.0067	0.00058	0.019	0.0096	0.0029	0.76	0.000049	0.00015	0.0044	0.00048	0.000000067	0.000000067	0.00014	0.000000029	0.20	0.0000066
15-Jul-15	33	65	500	425																							
29-Jul-15	34	67	425	355	8.0	1.2	0.098	0.00018	0.00036			0.0071	0.00089	0.050	0.0089	0.0027	0.86	0.000056	0.00012	0.0032	0.00046	0.000000062	0.000000098	0.00015	0.000000027	0.23	0.0000067
12-Aug-15	35	69	500	455																							
26-Aug-15	36	71	455	375	8.0	1.1	0.084	0.00019	0.00019			0.0084	0.0016	0.12	0.0094	0.0028	1.0	0.000047	0.00012	0.0031	0.00057	0.000000066	0.000000066	0.00015	0.00000026	0.27	0.0000061
9-Sep-15	37	73	500	445																							
23-Sep-15	38	75	445	390																							
7-Oct-15	39	77	390	320	7.9	0.65	0.043	0.00011	0.000053			0.0027	0.0015	0.11	0.00	0.00	0.74	0.000040	0.000072	0.0015	0.00038	0.000000037	0.000000037	0.000084	0.000000016	0.19	0.0000032
21-Oct-15	40	79	500	450																							
4-Nov-15	41	81	450	425																							
18-Nov-15	42	83	425	360	8.2	0.79	0.042	0.000060	0.000060			0.0012	0.0017	0.10	0.00	0.00	0.82	0.000026	0.000067	0.0017	0.00036	0.000000042	0.000000042	0.000064	0.000000018	0.22	0.0000036
2-Dec-15	43	85	500	450																							
16-Dec-15	44	87	450	400																							
30-Dec-15	45	89	400	360	8.3	0.67	0.054	0.00012	0.000060			0.00060	0.0018	0.077			0.77	0.000021	0.000065	0.0014	0.00036	0.000000042	0.000000042	0.000078	0.000000018	0.20	0.0000032
6-Jan-16	46	90	400	340	8.2	3.8	0.31	0.00068	0.00034			0.0068	0.0082	0.40			4.6	0.00017	0.00039	0.0091	0.0021	0.00000024	0.00000024	0.00044	0.00000010	1.2	0.000019
20-Jan-16	47	92	400	355	8.2	1.9	0.16	0.00036	0.00018			0.0018	0.0036	0.15			2.2	0.000075	0.00024	0.0056	0.0010	0.00000012	0.00000012	0.00039	0.00000011	0.59	0.000011
3-Feb-16	48	94	400	350	8.1	1.9	0.16	0.00018	0.00018			0.0018	0.0023	0.090			1.9	0.000061	0.00021	0.0058	0.00095	0.00000012	0.00000012	0.00021	0.000000053	0.50	0.000011
17-Feb-16	49	96	400	330	8.1	1.9	0.13	0.00033	0.00066			0.0017	0.0017	0.052			1.9	0.000059	0.00020	0.0056	0.00089	0.00000012	0.00000012	0.00021	0.000000050	0.50	0.000011
2-Mar-16	50	98	400	350	8.2	2.0	0.16	0.00018	0.00018			0.0018	0.0011	0.033			1.8	0.000028	0.00023	0.0067	0.00089	0.00000012	0.00000012	0.00019	0.000000088	0.47	0.000012

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 1

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
23-Apr-14	1	1	1210	385	0.012	0.00095	0.11	0.0000050	0.00057	0.31	0.00045	0.30	0.0084	0.0096	0.020	1.0	0.000023	0.22	0.00024	21	0.0066	7.7	0.000020	0.000030	0.000046	0.043	0.000018	0.00035	0.000077
7-May-14	2	3	400	455	0.0044	0.00018	0.037	0.0000030	0.00017	0.076	0.00015	0.015	0.0085	0.0013	0.0098	0.33	0.00011	0.13	0.000000046	7.5	0.0014	2.9	0.0000069	0.0000011	0.000030	0.022	0.00000023	0.000068	0.000046
21-May-14	3	5	450	385	0.0018	0.000082	0.016	0.0000094	0.00013	0.048	0.000085	0.0021	0.0027	0.000050	0.0081	0.20	0.000045	0.095	0.0000012	5.7	0.00086	1.5	0.0000043	0.0000012	0.000029	0.013	0.0000019	0.000039	0.000039
4-Jun-14	4	7	400	325	0.00066	0.00016	0.0077	0.0000044	0.000086	0.035	0.000050	0.00081	0.0023	0.000016	0.0072	0.15	0.000020	0.085	0.00000023	4.1	0.00062	0.93	0.0000030	0.0000029	0.000010	0.0091	0.00000098	0.000081	0.000033
18-Jun-14	5	9	400	335	0.00048	0.00028	0.0052	0.00000034	0.000087	0.031	0.000035	0.00084	0.0015	0.000013	0.0076	0.14	0.000018	0.089	0.000000034	3.7	0.00056	0.73	0.0000026	0.0000015	0.0000075	0.0094	0.0000013	0.000017	0.000034
2-Jul-14	6	11	400	340	0.00037	0.000071	0.0037	0.0000012	0.000085	0.031	0.000027	0.00051	0.0012	0.000015	0.0078	0.14	0.000014	0.095	0.000000034	3.5	0.00056	0.63	0.0000025	0.0000022	0.0000073	0.0083	0.0000010	0.000034	0.000034
16-Jul-14	7	13	400	340	0.00031	0.000029	0.0029	0.0000051	0.000084	0.028	0.000020	0.00034	0.0011	0.000010	0.0077	0.13	0.000010	0.086	0.00000026	3.2	0.00050	0.49	0.0000027	0.0000019	0.0000054	0.0067	0.0000034	0.000017	0.000034
30-Jul-14	8	15	400	330	0.00022	0.000060	0.0023	0.00000050	0.000077	0.022	0.000020	0.00017	0.0011	0.00000083	0.0077	0.11	0.0000099	0.079	0.000000033	2.6	0.00040	0.38	0.0000021	0.00000033	0.000014	0.0054	0.0000051	0.000017	0.000033
13-Aug-14	9	17	400	325	0.00017	0.000022	0.0012	0.00000033	0.000081	0.024	0.000013	0.00016	0.00075	0.0000065	0.0075	0.11	0.0000085	0.084	0.000000033	2.7	0.00045	0.33	0.0000020	0.00000081	0.0000047	0.0051	0.0000020	0.000016	0.000033
27-Aug-14	10	19	400	325	0.00016	0.000019	0.0013	0.00000033	0.000077	0.024	0.000015	0.00016	0.00073	0.0000065	0.0069	0.11	0.0000070	0.086	0.000000033	2.6	0.00044	0.29	0.0000022	0.0000057	0.0000016	0.0048	0.0000037	0.000016	0.000033
10-Sep-14	11	21	400	315	0.00013	0.000015	0.0013	0.00000032	0.000069	0.022	0.0000079	0.00016	0.00063	0.0000047	0.0070	0.090	0.0000077	0.10	0.000000032	2.4	0.00041	0.25	0.0000019	0.0000043	0.0000014	0.0039	0.0000033	0.000016	0.000032
24-Sep-14	12	23	400	340	0.00012	0.000020	0.00061	0.0000022	0.000082	0.024	0.000010	0.00017	0.00074	0.0000068	0.0066	0.11	0.0000036	0.086	0.00000017	2.2	0.00042	0.22	0.0000026	0.0000044	0.0000044	0.0039	0.0000032	0.000017	0.000034
8-Oct-14	13	25	400	305	0.00011	0.000015	0.00093	0.00000015	0.000085	0.024	0.0000043	0.00015	0.00051	0.0000046	0.0060	0.088	0.0000052	0.079	0.000000031	2.3	0.00044	0.19	0.0000019	0.00000061	0.0000018	0.0035	0.0000029	0.000015	0.000031
22-Oct-14	14	27	400	325	0.00010	0.000012	0.00088	0.00000033	0.000093	0.026	0.000010	0.00016	0.00046	0.0000033	0.0075	0.095	0.0000070	0.083	0.000000033	2.3	0.00042	0.21	0.0000020	0.00000049	0.0000020	0.0033	0.0000036	0.000016	0.000033
5-Nov-14	15	29	400	325	0.000087	0.000017	0.00078	0.0000011	0.000079	0.026	0.0000054	0.00016	0.00046	0.0000033	0.0062	0.085	0.0000057	0.084	0.000000049	2.1	0.00045	0.16	0.0000019	0.00000098	0.0000029	0.0031	0.0000033	0.000016	0.000033
19-Nov-14	16	31	400	315	0.000079	0.000022	0.00058	0.00000047	0.000088	0.028	0.000013	0.00016	0.00038	0.0000032	0.0059	0.089	0.0000043	0.090	0.000000032	2.1	0.00050	0.15	0.0000023	0.00000095	0.0000027	0.0029	0.0000027	0.000016	0.000032
3-Dec-14	17	33	400	285	0.000062	0.00028	0.00048	0.00000029	0.000070	0.023	0.0000077	0.00014	0.00030	0.0000043	0.0048	0.076	0.0000038	0.074	0.000000029	1.6	0.00045	0.13	0.0000018	0.00000057	0.0000021	0.0022	0.0000026	0.000043	0.000029
17-Dec-14	18	35	400	365	0.000073	0.000023	0.00055	0.00000018	0.000091	0.032	0.000013	0.00018	0.00035	0.0000037	0.0062	0.11	0.0000055	0.095	0.000000037	2.0	0.00055	0.15	0.0000022	0.00000055	0.0000029	0.0027	0.0000035	0.000018	0.000037
31-Dec-14	19	37	400	335	0.000060	0.000021	0.00052	0.0000020	0.000085	0.028	0.0000090	0.00017	0.00031	0.0000050	0.0055	0.091	0.0000047	0.093	0.000000034	1.7	0.00050	0.13	0.0000020	0.0000023	0.0000027	0.0026	0.0000034	0.000017	0.000034
14-Jan-15	20	39	400	325	0.000054	0.000011	0.00046	0.0000091	0.000083	0.030	0.000010	0.00016	0.00029	0.0000033	0.0050	0.094	0.0000041	0.093	0.000000033	1.6	0.00052	0.11	0.0000020	0.0000015	0.0000031	0.0020	0.0000029	0.000016	0.000033
28-Jan-15	21	41	400	340	0.000047	0.000010	0.00043	0.00000017	0.000083	0.037	0.0000094	0.00017	0.00031	0.0000034	0.0046	0.11	0.0000060	0.091	0.000000051	1.8	0.00049	0.12	0.0000020	0.0000054	0.0000031	0.0022	0.0000036	0.000017	0.000034
11-Feb-15	22	43	400	325	0.000045	0.0000072	0.00075	0.00000016	0.000096	0.034	0.0000098	0.00016	0.00024	0.0000033	0.0043	0.100	0.000016	0.088	0.000000033	1.4	0.00063	0.11	0.0000019	0.0000031	0.0000020	0.0017	0.0000029	0.000016	0.000033
25-Feb-15	23	45	400	320	0.000043	0.000013	0.00026	0.00000016	0.00010	0.038	0.0000045	0.00016	0.00020	0.0000016	0.0032	0.11	0.000016	0.088	0.000000032	1.3	0.00072	0.096	0.0000022	0.0000024	0.00000080	0.0016	0.0000018	0.000016	0.000032
11-Mar-15	24	47	400	315	0.000040	0.000013	0.00027	0.00000016	0.00010	0.043	0.0000050	0.00016	0.00019	0.0000032	0.0026	0.10	0.000016	0.075	0.000000063	1.1	0.00080	0.096	0.0000020	0.0000013	0.00000079	0.0015	0.0000020	0.000016	0.000032
25-Mar-15	25	49	400	325	0.000044	0.000040	0.00028	0.00000081	0.00010	0.056	0.0000068	0.00016	0.00022	0.0000033	0.0027	0.13	0.000016	0.098	0.000000049	1.2	0.00099	0.099	0.0000026	0.000019	0.0000020	0.0014	0.0000023	0.000016	0.000033
8-Apr-15	26	51	400	350	0.000035	0.000016	0.00021	0.00000018	0.00012	0.057	0.000011	0.00018	0.00017	0.0000018	0.0026	0.14	0.000018	0.11	0.000000035	0.98	0.0011	0.089	0.0000025	0.0000025	0.0000016	0.0013	0.0000018	0.000018	0.000035
22-Apr-15	27	53	400	320	0.000031	0.0000094	0.00019	0.0000058	0.00010	0.066	0.000012	0.00016	0.00018	0.0000016	0.0023	0.14	0.0000027	0.086	0.00000074	0.86	0.0012	0.085	0.0000027	0.0000013	0.0000011	0.0011	0.0000019	0.000016	0.000032
6-May-15	28	55	400	325	0.000028	0.000015	0.00021	0.00000049	0.00011	0.069	0.000015	0.00033	0.00015	0.0000016	0.0017	0.14	0.000016	0.094	0.00000094	0.75	0.0012	0.080	0.0000026	0.00000033	0.0000013	0.0011	0.0000023	0.000016	0.000033
20-May-15	29	57	500	445																									
3-Jun-15	30	59	445	380	0.000015	0.000036	0.00017	0.00000067	0.000065	0.050	0.0000062	0.000095	0.00012	0.00000095	0.00087	0.090	0.0000016	0.052	0.00000011	0.31	0.00089	0.041	0.0000015	0.0000015	0.00000076	0.00061	0.0000011	0.0000095	0.000019
17-Jun-15	31	61	500	445																									
1-Jul-15	32	63	445	385	0.000015	0.0000048	0.00011	0.000000096	0.000066	0.062	0.0000080	0.00019	0.000064	0.00000096	0.00086	0.092	0.0000015	0.055	0.00000019	0.25	0.0011	0.036	0.0000018	0.00000067	0.00000067	0.00060	0.00000096	0.0000096	0.000019
15-Jul-15	33	65	500	425																									
29-Jul-15	34	67	425	355	0.000013	0.0000062	0.000098	0.000000089	0.000064	0.067	0.000016	0.000089	0.000059	0.00000089	0.00065	0.088	0.00000098	0.050	0.000000080	0.19	0.0013	0.032	0.0000018	0.00000044	0.00000044	0.00056	0.0000012	0.0000089	0.000018
12-Aug-15	35	69	500	455																									
26-Aug-15	36	71	455	375	0.000013	0.000017	0.000075	0.00000056	0.000067	0.082	0.0000085	0.000094	0.000065	0.00000094	0.00051	0.099	0.0000030	0.054	0.0000025	0.17	0.0016	0.033	0.0000020	0.0000010	0.00000047	0.00048	0.0000010	0.0000094	0.000019
9-Sep-15	37	73	500	445																									
23-Sep-15	38	75	445	390																									
7-Oct-15	39	77	390	320	0.0000070	0.0000033	0.000043	0.00000011	0.000040	0.064	0.0000052	0.000053	0.000022	0.0000011	0.00030	0.061	0.00000064	0.028	0.000000037	0.092	0.0011	0.020	0.0000011	0.00000085	0.00000059	0.00028	0.00000069	0.0000053	0.000011
21-Oct-15	40	79	500	450																									
4-Nov-15	41	81	450	425																									
18-Nov-15	42	83	425	360	0.0000086	0.0000047	0.000084	0.000000060	0.000037	0.069	0.000017	0.000060	0.000029	0.00000060	0.00034	0.063	0.0000013	0.033	0.000000042	0.085	0.0011	0.021	0.00000092	0.00000042	0.00000042	0.00027	0.00000048	0.0000060	0.000012
2-Dec-15	43	85	500	450																									
16-Dec-15	44	87	450	400																									
30-Dec-15	45	89	400	360	0.0000073	0.0000028	0.00010	0.00000012	0.000033	0.065	0.0000025	0.000060	0.000034	0.00000060	0.00034	0.056	0.00000090	0.032	0.000000054	0.077	0.00088	0.020	0.00000071	0.00000024	0.0000019	0.00029	0.00000042	0.0000060	0.000012
6-Jan-16	46	90	400	340	0.000043	0.000034	0.00034	0.00000034	0.00020	0.38	0.000043	0.00034	0.00019	0.0000034	0.0021	0.34	0.000041	0.19	0.00000041	0.44	0.0056	0.11	0.0000036	0.0000092	0.0000017	0.0016	0.0000031	0.000034	0.000068
20-Jan-16	47	92	400	355	0.000026	0.0000066	0.00018	0.0000011	0.00010	0.17	0.000019	0.00018	0.00011	0.0000036	0.0011	0.16	0.0000027	0.10	0.00000021	0.20	0.0030	0.064	0.0000051	0.00000089	0.00000089	0.00093	0.0000012	0.000036	0.000036
3-Feb-16	48	94	400	350	0.000024	0.000018	0.00021	0.00000035	0.000093	0.15	0.000011	0.00018	0.000099	0.0000018	0.0012	0.15	0.0000051	0.094	0.00000039	0.18	0.0027	0.065	0.0000023	0.0000016	0.00000088	0.00090	0.0000011	0.000018	0.000035
17-Feb-16	49	96	400	330	0.000025	0.000013	0.00013	0.00000050	0.000088	0.15	0.000015	0.00017	0.000099	0.0000033	0.0011	0.15	0.0000015	0.092	0.000000033	0.18	0.0024	0.056	0.0000020	0.0000020	0.00000083	0.00084	0.0000013	0.000017	0.000033
2-Mar-16	50	98	400	350	0.000025	0.0000068	0.00014	0.00000053	0.000094	0.16	0.000029	0.00018	0.00011	0.0000018	0.0012	0.15	0.0000014	0.096	0.000000070	0.17	0.0025	0.068	0.0000021	0.00000035	0.00000088	0.00091	0.00000070	0.000018	0.000035

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 2 (LT1, Sample 'B')

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
23-Apr-14	1	1	2355	590	8.5	475	598	14	0.50	< 10	< 5	5.2	1.8	12	130	0.80	206	0.027	0.056	0.087	0.080	< 7E-06	< 7E-06	0.082	< 4E-06	63	0.13
7-May-14	2	3	450	340	8.5	424	374	6.7	0.24	< 5	< 3	1.9	2.4	5.9	46	< 0.3	61	0.013	0.079	1.8	0.028	0.000022	< 7E-06	0.054	0.00037	17	0.065
21-May-14	3	5	550	380	8.7	415	291	3.6	0.080	< 2	< 1	1.0	1.0	2.3	18	< 0.3	45	0.28	0.059	1.8	0.019	0.000046	0.00027	0.033	< 3E-06	13	0.031
4-Jun-14	4	7	450	350	8.6	422	274	1.8	0.050	< 2	< 1	1.0	0.50	1.1	7.7	< 0.3	41	0.0097	0.052	2.1	0.016	< 7E-06	< 7E-06	0.021	< 3E-06	12	0.020
18-Jun-14	5	9	450	325	8.6	447	204	1.5	0.030	< 2	< 1	0.70	0.56	0.28	4.6	< 0.3	36	0.017	0.053	2.4	0.016	< 7E-06	< 7E-06	0.025	< 3E-06	10	0.017
2-Jul-14	6	11	450	350	8.6	485	179	1.3	0.040	< 2	< 1	0.80	0.16	0.28	2.5	< 0.3	34	0.012	0.054	2.5	0.014	< 7E-06	< 7E-06	0.019	0.000029	9.4	0.011
16-Jul-14	7	13	450	295	8.6	464	132	0.95	0.020	< 2	< 1	1.0	0.11	0.18	1.6	< 0.3	32	0.0084	0.054	2.6	0.014	0.0000070	0.0000070	0.021	< 3E-06	9.0	0.010
30-Jul-14	8	15	450	340	8.6	504	119	0.84	0.030	< 2	< 1	0.80	0.070	0.12	1.1	< 0.3	28	0.022	0.054	2.7	0.013	< 7E-06	< 7E-06	0.023	< 3E-06	7.9	0.0088
13-Aug-14	9	17	450	350	8.6	448	107	0.98	0.030	< 2	< 1	0.70	< 0.06	0.090	0.80	< 0.3	27	0.012	0.053	2.5	0.013	< 7E-06	< 7E-06	0.023	< 3E-06	7.5	0.0066
27-Aug-14	10	19	450	350	8.6	439	89	0.50	0.020	-	-	0.60	< 0.06	0.070	0.70	< 0.3	27	0.016	0.048	2.5	0.012	< 7E-06	< 7E-06	0.031	0.000015	7.5	0.0056
10-Sep-14	11	21	450	340	8.6	437	70	0.51	0.030	-	-	0.50	< 0.06	0.060	0.50	< 0.3	25	0.012	0.045	2.7	0.012	< 7E-06	< 7E-06	0.026	0.000022	6.9	0.0049
24-Sep-14	12	23	450	305	8.6	442	65	0.49	0.020	-	-	0.50	< 0.06	0.070	< 1	< 0.3	24	0.0073	0.051	2.5	0.012	< 7E-06	< 7E-06	0.021	< 3E-06	6.6	0.0043
8-Oct-14	13	25	450	350	8.6	381	64	0.55	0.020	-	-	0.80	< 0.06	0.050	< 1	< 0.3	24	0.013	0.045	2.7	0.013	< 7E-06	< 7E-06	0.020	0.000017	6.7	0.0041
22-Oct-14	14	27	450	345	8.6	409	57	0.40	0.020	-	-	0.60	< 0.06	0.050	< 1	< 0.3	25	0.011	0.047	2.8	0.013	< 7E-06	< 7E-06	0.029	0.000033	6.8	0.0041
5-Nov-14	15	29	450	335	-	405	53	0.34	0.010	-	-	0.40	< 0.06	0.040	< 1	< 0.3	22	0.012	0.044	2.6	0.012	< 7E-06	< 7E-06	0.022	0.000015	5.9	0.0035
19-Nov-14	16	31	450	340	8.5	397	46	0.33	0.020	-	-	0.50	< 0.06	0.060	< 1	< 0.3	23	0.0072	0.043	2.6	0.014	< 7E-06	< 7E-06	0.024	0.000019	6.2	0.0034
3-Dec-14	17	33	450	350	8.6	377	42	0.28	< 0.01	-	-	0.40	< 0.06	0.050	< 1	< 0.3	23	0.0099	0.044	2.7	0.014	< 7E-06	< 7E-06	0.021	0.000014	6.4	0.0032
17-Dec-14	18	35	450	335	8.6	368	41	0.31	< 0.01	-	-	0.60	< 0.06	0.10	< 1	< 0.3	21	0.0077	0.046	2.6	0.013	< 7E-06	< 7E-06	0.022	0.000014	5.5	0.0030
31-Dec-14	19	37	650	355	8.5	431	36	0.21	0.020	-	-	0.50	< 0.06	0.070	< 1	< 0.3	21	0.014	0.046	2.6	0.014	< 7E-06	< 7E-06	0.021	0.000014	5.5	0.0029
14-Jan-15	20	39	450	335	8.5	319	31	0.14	0.020	-	-	0.50	< 0.06	0.050	< 1	< 0.3	19	0.012	0.047	2.5	0.014	< 7E-06	< 7E-06	0.021	0.000016	5.2	0.0027
28-Jan-15	21	41	450	335	8.5	333	34	0.16	< 0.01	-	-	0.40	< 0.06	0.060	1.0	< 0.3	22	0.013	0.038	2.3	0.015	< 7E-06	0.000021	0.018	0.000011	5.9	0.0026
11-Feb-15	22	43	450	335	8.5	325	33	0.14	< 0.01	-	-	0.40	< 0.06	0.080	1.0	< 0.3	21	0.0093	0.044	2.2	0.016	< 7E-06	< 7E-06	0.023	0.000010	5.6	0.0023
25-Feb-15	23	45	450	345	8.5	340	30	0.12	0.010	-	-	0.40	< 0.06	0.14	< 1	< 0.3	23	0.0080	0.039	1.9	0.017	< 7E-06	< 7E-06	0.023	0.000014	6.3	0.0023
11-Mar-15	24	47	450	330	8.5	337	31	0.12	0.010	-	-	0.40	< 0.06	0.16	< 1	< 0.3	23	0.0086	0.041	2.0	0.016	< 7E-06	< 7E-06	0.020	0.000013	6.2	0.0023
25-Mar-15	25	49	450	355	8.4	309	23	0.11	0.010	-	-	0.40	0.060	0.23	< 1	< 0.3	23	0.011	0.041	2.1	0.017	< 7E-06	< 7E-06	0.020	0.000011	6.1	0.0025
8-Apr-15	26	51	450	370	8.4	310	24	0.11	< 0.01	-	-	0.30	0.21	0.27	< 1	< 0.3	22	0.0075	0.047	2.1	0.018	< 7E-06	0.000010	0.020	< 3E-06	6.1	0.0021
22-Apr-15	27	53	450	330	8.4	303	27	0.10	0.020	-	-	0.50	0.58	0.19	< 1	< 0.3	23	0.0067	0.042	1.9	0.015	< 7E-06	< 7E-06	0.021	0.000038	6.1	0.0021
6-May-15	28	55	450	325	8.4	289	20	0.080	< 0.01	-	-	0.20	1.1	0.060	< 1	< 0.3	22	0.0093	0.039	1.7	0.018	< 7E-06	< 7E-06	0.021	0.0000030	5.8	0.0018
20-May-15	29	57	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	30	59	410	300	8.4	248	17	0.070	0.070	-	-	0.40	2.8	< 0.01	< 1	< 0.3	29	0.0086	0.029	1.4	0.023	< 7E-06	< 7E-06	0.025	0.0000070	8.1	0.0016
17-Jun-15	31	61	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	32	63	410	310	8.3	226	16	0.070	0.010	-	-	0.40	7.9	< 0.03	< 1	< 0.3	27	0.010	0.028	1.4	0.024	< 7E-06	< 7E-06	0.021	0.0000060	7.2	0.0015
15-Jul-15	33	65	500	385	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	34	67	385	300	8.3	202	14	0.040	0.040	-	-	0.50	17	0.040	< 1	< 0.3	34	0.0057	0.023	1.00	0.027	< 7E-06	< 7E-06	0.021	0.000011	9.5	0.0013
12-Aug-15	35	69	500	385	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	36	71	385	285	8.3	176	12	0.040	0.010	-	-	0.60	24	0.050	< 1	< 0.3	45	0.0060	0.020	0.74	0.039	< 7E-06	< 7E-06	0.022	0.000015	12	0.0012
9-Sep-15	37	73	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	38	75	495	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	39	77	410	310	8.1	154	11	0.030	< 0.01	-	-	0.20	26	0.030	-	-	66	0.0048	0.019	0.48	0.047	< 7E-06	< 7E-06	0.019	0.0000030	18	0.00097
21-Oct-15	40	79	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	41	81	410	335	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	42	83	335	255	8.0	160	10	0.020	0.010	-	-	< 0.1	26	< 0.03	-	-	88	0.0041	0.014	0.44	0.047	< 7E-06	< 7E-06	0.016	< 3E-06	23	0.0011
2-Dec-15	43	85	500	415	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	44	87	415	345	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	45	89	345	285	8.3	135	10	0.030	< 0.01	-	-	< 0.1	22	< 0.03	-	-	98	0.0048	0.014	0.33	0.058	< 7E-06	< 7E-06	0.019	0.0000040	26	0.00096
6-Jan-16	46	90	400	310	8.3	134	12	0.020	< 0.01	-	-	< 0.1	21	< 0.03	-	-	105	0.0053	0.014	0.36	0.064	< 7E-06	< 7E-06	0.018	0.000037	28	0.0011
20-Jan-16	47	92	400	305	8.3	132	9.0	0.020	0.020	-	-	< 0.1	20	< 0.03	-	-	105	0.0040	0.016	0.41	0.066	< 7E-06	< 7E-06	0.019	< 3E-06	28	0.0012
3-Feb-16	48	94	400	285	8.3	133	12	0.020	< 0.01	-	-	< 0.1	18	< 0.03	-	-	97	0.0053	0.014	0.43	0.063	< 7E-06	< 7E-06	0.016	< 3E-06	26	0.0011
17-Feb-16	49	96	400	300	8.2	139	12	0.030	0.040	-	-	< 0.1	14	< 0.03	-	-	99	0.0037	0.014	0.43	0.061	< 7E-06	< 7E-06	0.017	0.000022	27	0.0013
2-Mar-16	50	98	400	320	8.3	142	14	0.030	< 0.01	-	-	0.10	11	< 0.03	-	-	93	0.0020	0.015	0.51	0.057	< 7E-06	< 7E-06	0.016	0.0000030	24	0.0013

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 2 (LT1, Sample 'B')

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
23-Apr-14	1	1	2355	590	0.50	0.024	5.3	0.00083	0.019	12	0.011	7.9	0.20	0.40	0.40	35	0.00070	5.6	0.0082	721	0.26	279	0.00072	0.00023	0.00088	1.4	< 1E-05	0.0080	< 0.002
7-May-14	2	3	450	340	0.27	0.011	2.5	0.00032	0.0090	4.5	0.011	1.2	0.28	0.12	0.42	18	0.0059	6.1	< 2E-06	424	0.083	179	0.00037	0.000060	0.0016	1.2	< 1E-05	0.0040	< 0.002
21-May-14	3	5	550	380	0.15	0.0064	1.4	0.00050	0.0068	3.2	0.0067	0.30	0.19	0.021	0.38	12	0.0031	5.0	0.000066	347	0.059	112	0.00025	0.00027	0.00094	0.82	0.00014	0.0020	< 0.002
4-Jun-14	4	7	450	350	0.079	0.0095	0.89	0.000030	0.0063	2.8	0.0049	0.13	0.15	0.0020	0.42	11	0.0022	5.4	0.0000050	314	0.052	90	0.00022	0.00011	0.00062	0.68	< 1E-05	0.0030	< 0.002
18-Jun-14	5	9	450	325	0.075	0.039	0.66	0.000070	0.0065	2.6	0.0038	0.090	0.18	0.0013	0.42	11	0.0019	5.4	< 2E-06	285	0.047	75	0.00022	< 1E-05	0.00043	0.84	< 1E-05	0.0030	< 0.002
2-Jul-14	6	11	450	350	0.045	0.0036	0.46	0.000030	0.0059	2.5	0.0031	0.070	0.11	0.0011	0.45	10	0.0015	5.5	< 2E-06	264	0.044	63	0.00019	0.00016	0.00055	0.62	< 1E-05	0.0010	< 0.002
16-Jul-14	7	13	450	295	0.040	0.0031	0.39	0.000020	0.0059	2.3	0.0039	0.060	0.12	0.0011	0.47	9.8	0.0013	5.1	0.0000030	254	0.041	51	0.00019	0.00012	0.00048	0.56	0.00015	< 0.001	< 0.002
30-Jul-14	8	15	450	340	0.030	0.0040	0.30	0.000020	0.0064	2.1	0.0025	0.030	0.11	0.00090	0.48	9.0	0.0013	5.1	< 2E-06	238	0.037	42	0.00018	< 1E-05	0.0010	0.50	0.00037	< 0.001	< 0.002
13-Aug-14	9	17	450	350	0.024	0.0023	0.20	0.000020	0.0059	2.0	0.0026	< 0.01	0.089	0.00070	0.48	8.2	0.0015	5.2	< 2E-06	243	0.035	36	0.00016	0.000040	0.00048	0.48	0.000080	< 0.001	< 0.002
27-Aug-14	10	19	450	350	0.022	0.0024	0.20	0.000050	0.0054	2.0	0.0018	< 0.01	0.086	0.00050	0.48	8.7	0.00085	5.5	0.0000020	223	0.035	32	0.00016	0.00038	0.000070	0.45	0.00027	< 0.001	< 0.002
10-Sep-14	11	21	450	340	0.018	0.0014	0.19	< 1E-05	0.0051	1.8	0.00089	0.020	0.077	0.00050	0.49	6.6	0.0011	6.2	< 2E-06	216	0.034	29	0.00015	0.00015	0.000090	0.39	0.00023	< 0.001	< 0.002
24-Sep-14	12	23	450	305	0.015	0.0018	0.092	0.000060	0.0055	1.8	0.0010	0.020	0.071	0.00060	0.46	8.2	0.00089	5.1	0.0000040	219	0.031	23	0.00016	0.000080	0.00045	0.37	0.00021	0.0030	< 0.002
8-Oct-14	13	25	450	350	0.015	0.0019	0.14	0.000040	0.0061	1.8	0.00066	0.030	0.066	0.00040	0.48	6.4	0.00080	5.2	< 2E-06	210	0.033	21	0.00014	0.000080	0.00020	0.35	0.00022	< 0.001	< 0.002
22-Oct-14	14	27	450	345	0.014	0.0011	0.14	0.000020	0.0059	2.0	0.00072	< 0.01	0.062	0.00040	0.57	6.8	0.00077	5.3	< 2E-06	217	0.033	23	0.00014	0.000030	0.00014	0.35	0.00027	< 0.001	< 0.002
5-Nov-14	15	29	450	335	0.012	0.0014	0.12	0.000050	0.0053	1.8	0.00044	0.040	0.058	0.00040	0.47	5.8	0.00074	5.4	< 2E-06	199	0.031	18	0.00014	0.000050	0.00016	0.33	0.00020	< 0.001	< 0.002
19-Nov-14	16	31	450	340	0.011	0.0013	0.097	< 1E-05	0.0060	1.9	0.00073	< 0.01	0.054	0.00030	0.47	6.0	0.00062	5.8	< 2E-06	206	0.034	16	0.00016	0.000040	0.00011	0.32	0.00019	< 0.001	< 0.002
3-Dec-14	17	33	450	350	0.0099	0.0017	0.093	< 1E-05	0.0049	1.7	0.00046	< 0.01	0.050	0.00030	0.47	5.7	0.00070	5.2	< 2E-06	181	0.033	16	0.00014	0.000040	0.00014	0.30	0.00021	0.0010	< 0.002
17-Dec-14	18	35	450	335	0.0094	0.0013	0.079	< 1E-05	0.0056	1.8	0.00056	0.010	0.045	0.00030	0.45	6.4	0.00060	5.2	< 2E-06	182	0.031	14	0.00013	0.000040	0.00014	0.28	0.00019	< 0.001	< 0.002
31-Dec-14	19	37	650	355	0.0087	0.0011	0.084	0.000030	0.0055	1.8	0.00058	< 0.01	0.046	0.00030	0.49	5.9	0.00065	5.7	0.0000020	176	0.031	14	0.00013	0.000090	0.00013	0.28	0.00023	< 0.001	< 0.002
14-Jan-15	20	39	450	335	0.0073	0.0011	0.070	0.000020	0.0048	1.5	0.00073	< 0.01	0.042	0.00030	0.47	5.4	0.00064	5.6	0.0000030	152	0.026	11	0.00013	0.000040	0.00015	0.23	0.00022	< 0.001	< 0.002
28-Jan-15	21	41	450	335	0.0057	0.0013	0.066	< 1E-05	0.0044	1.8	0.00063	< 0.01	0.040	0.00020	0.42	5.8	0.0012	4.8	0.0000020	172	0.024	11	0.00012	0.00022	0.00015	0.22	0.00025	< 0.001	< 0.002
11-Feb-15	22	43	450	335	0.0059	0.0010	0.053	0.000020	0.0053	1.6	0.00053	0.020	0.032	0.00020	0.42	5.5	< 0.001	5.2	0.0000020	149	0.031	10	0.00013	0.00087	0.000090	0.20	0.00022	< 0.001	< 0.002
25-Feb-15	23	45	450	345	0.0062	0.00088	0.053	0.000030	0.0057	1.8	0.00048	< 0.01	0.030	0.00020	0.37	6.2	< 0.001	5.4	< 2E-06	148	0.033	9.4	0.00014	0.00012	0.00011	0.21	0.00016	< 0.001	< 0.002
11-Mar-15	24	47	450	330	0.0059	0.00099	0.048	0.000020	0.0058	1.7	0.00054	< 0.01	0.031	0.00020	0.34	5.6	< 0.001	4.7	0.00010	140	0.032	8.8	0.00012	0.000060	< 5E-05	0.20	0.00016	< 0.001	< 0.002
25-Mar-15	25	49	450	355	0.0063	0.0010	0.056	< 1E-05	0.0056	1.9	0.00062	< 0.01	0.034	0.00020	0.38	6.0	< 0.001	5.8	< 2E-06	159	0.034	9.2	0.00014	0.00052	0.00018	0.18	0.00024	< 0.001	< 0.002
8-Apr-15	26	51	450	370	0.0049	0.0012	0.039	< 1E-05	0.0056	1.7	0.00044	0.010	0.027	0.00020	0.38	5.8	< 0.001	6.1	< 2E-06	132	0.033	8.0	0.00013	0.00018	0.000060	0.17	0.00016	< 0.001	< 0.002
22-Apr-15	27	53	450	330	0.0047	0.0012	0.035	0.00022	0.0050	1.8	0.00050	0.020	0.027	0.00020	0.34	6.2	0.00032	5.3	0.000044	138	0.034	7.8	0.00011	0.00011	0.00014	0.14	0.00022	< 0.001	< 0.002
6-May-15	28	55	450	325	0.0040	0.0015	0.032	0.000020	0.0055	1.7	0.00070	0.010	0.024	0.00020	0.31	6.0	< 0.001	5.5	0.000052	123	0.032	7.3	0.00013	< 1E-05	0.00011	0.15	0.00019	< 0.001	< 0.002
20-May-15	29	57	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3-Jun-15	30	59	410	300	0.0034	0.0013	0.024	0.000050	0.0059	2.2	0.00074	< 0.01	0.020	0.00010	0.28	6.4	0.00040	5.6	0.000014	102	0.040	6.3	0.00013	0.000050	0.00011	0.12	0.00018	< 0.001	< 0.002
17-Jun-15	31	61	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1-Jul-15	32	63	410	310	0.0031	0.0017	0.022	< 1E-05	0.0064	2.1	0.0012	0.020	0.016	0.00020	0.24	6.0	0.00030	5.6	0.000026	105	0.041	5.1	0.00015	0.00032	0.000090	0.11	0.00017	< 0.001	< 0.002
15-Jul-15	33	65	500	385	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29-Jul-15	34	67	385	300	0.0026	0.00072	0.016	0.000020	0.0076	2.6	0.00047	< 0.01	0.014	0.00010	0.19	6.7	0.00021	5.3	0.000011	101	0.051	4.7	0.00016	0.00012	< 5E-05	0.093	0.00016	< 0.001	< 0.002
12-Aug-15	35	69	500	385	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26-Aug-15	36	71	385	285	0.0022	0.0013	0.011	0.000040	0.0082	3.4	0.0010	0.010	0.028	0.00010	0.14	7.6	0.00025	5.8	0.00012	96	0.066	4.1	0.00019	0.00012	< 5E-05	0.070	0.00013	< 0.001	< 0.002
9-Sep-15	37	73	500	495	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23-Sep-15	38	75	495	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7-Oct-15	39	77	410	310	0.0018	0.00085	0.0080	0.000020	0.0085	5.2	0.00061	< 0.01	0.0064	0.00020	0.10	8.3	0.00017	5.5	0.0000050	77	0.095	3.9	0.00018	0.00016	0.00010	0.057	0.000090	< 0.001	< 0.002
21-Oct-15	40	79	500	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4-Nov-15	41	81	410	335	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18-Nov-15	42	83	335	255	0.0020	0.0016	0.020	0.000090	0.0090	7.3	0.0017	< 0.01	0.0072	< 0.0001	0.089	9.3	0.00027	5.7	0.0000030	67	0.12	4.1	0.00015	0.00015	< 5E-05	0.047	0.00010	0.0010	< 0.002
2-Dec-15	43	85	500	415	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Dec-15	44	87	415	345	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30-Dec-15	45	89	345	285	0.0017	0.00062	0.013	0.000020	0.0083	8.1	0.0017	< 0.01	0.0067	0.00010	0.092	9.3	0.00019	5.6	0.0000070	56	0.11	4.3	0.00014	0.000030	< 5E-05	0.060	0.000070	< 0.001	< 0.002
6-Jan-16	46	90	400	310	0.0019	0.0014	0.011	0.000090	0.0086	8.7	0.0024	< 0.01	0.0066	0.00010	0.091	10	0.00070	6.0	0.000012	57	0.13	4.5	0.00014	0.00033	< 5E-05	0.058	0.000090	< 0.001	< 0.002
20-Jan-16	47	92	400	305	0.0021	0.00064	0.011	0.000040	0.0088	8.3	0.0022	< 0.01	0.0077	0.00020	0.088	9.5	0.00030	6.3	0.000016	51	0.15	4.5	0.00022	0.000050	< 5E-05	0.069	0.00016	0.0010	< 0.002
3-Feb-16	48	94	400	285	0.0022	0.0017	0.012	0.000050	0.0085	7.9	0.0017	< 0.01	0.0075	0.00020	0.088	9.7	0.00034	5.5	0.000019	49	0.14	4.8	0.00017	0.00011	< 5E-05	0.066	0.00010	< 0.001	< 0.002
17-Feb-16	49	96	400	300	0.0023	0.00091	0.010	0.00011	0.0080	7.9	0.0020	< 0.01	0.0079	0.00020	0.099	9.1	0.00016	5.8	< 2E-06	46	0.13	4.6	0.00016	0.000090	< 5E-05	0.069	0.000090	0.0020	< 0.002
2-Mar-16	50	98	400	320	0.0025	0.00042	0.011	0.000090	0.0082	7.9	0.0059	< 0.01	0.0086	0.00020	0.10	9.2	0.00022	6.0	0.0000030	47	0.13	5.5	0.00016	0.000030	< 5E-05	0.072	0.000050	0.0010	< 0.002

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
23-Apr-14	1	1	2355	590	8.5	14	18	0.40	0.015	0.30	0.15	0.15	0.054	0.35	3.8	0.024	6.1	0.00080	0.0016	0.0026	0.0024	0.00000021	0.00000021	0.0024	0.00000012	1.8	0.0038
7-May-14	2	3	450	340	8.5	3.6	3.2	0.057	0.0020	0.043	0.026	0.016	0.021	0.050	0.39	0.0026	0.52	0.00011	0.00067	0.015	0.00024	0.00000019	0.000000060	0.00046	0.0000032	0.15	0.00055
21-May-14	3	5	550	380	8.7	3.9	2.8	0.034	0.00076	0.019	0.0095	0.0095	0.0095	0.022	0.17	0.0029	0.42	0.0026	0.00056	0.017	0.00018	0.00000044	0.0000026	0.00031	0.000000029	0.12	0.00030
4-Jun-14	4	7	450	350	8.6	3.7	2.4	0.016	0.00044	0.018	0.0088	0.0088	0.0044	0.0096	0.067	0.0026	0.35	0.000085	0.00046	0.018	0.00014	0.000000061	0.000000061	0.00018	0.000000026	0.10	0.00017
18-Jun-14	5	9	450	325	8.6	3.6	1.7	0.012	0.00024	0.016	0.0081	0.0057	0.0046	0.0023	0.037	0.0024	0.29	0.00014	0.00043	0.020	0.00013	0.000000057	0.000000057	0.00020	0.000000024	0.082	0.00014
2-Jul-14	6	11	450	350	8.6	4.2	1.6	0.012	0.00035	0.018	0.0088	0.0070	0.0014	0.0025	0.022	0.0026	0.29	0.00010	0.00047	0.022	0.00012	0.000000061	0.000000061	0.00017	0.00000025	0.082	0.000096
16-Jul-14	7	13	450	295	8.6	3.4	0.97	0.0070	0.00015	0.015	0.0074	0.0074	0.00081	0.0013	0.012	0.0022	0.24	0.000062	0.00040	0.019	0.00010	0.000000052	0.000000052	0.00015	0.000000022	0.066	0.000075
30-Jul-14	8	15	450	340	8.6	4.3	1.0	0.0071	0.00026	0.017	0.0085	0.0068	0.00060	0.0010	0.0094	0.0026	0.24	0.00019	0.00046	0.023	0.00011	0.000000060	0.000000060	0.00019	0.000000026	0.067	0.000075
13-Aug-14	9	17	450	350	8.6	3.9	0.94	0.0086	0.00026	0.018	0.0088	0.0061	0.00053	0.00079	0.0070	0.0026	0.23	0.00011	0.00047	0.022	0.00012	0.000000061	0.000000061	0.00020	0.000000026	0.066	0.000058
27-Aug-14	10	19	450	350	8.6	3.8	0.78	0.0044	0.00018			0.0053	0.00053	0.00061	0.0061	0.0026	0.24	0.00014	0.00042	0.022	0.00010	0.000000061	0.000000061	0.00027	0.00000013	0.066	0.000049
10-Sep-14	11	21	450	340	8.6	3.7	0.60	0.0043	0.00026			0.0043	0.00051	0.00051	0.0043	0.0026	0.21	0.000099	0.00039	0.023	0.00010	0.000000060	0.000000060	0.00022	0.00000019	0.059	0.000042
24-Sep-14	12	23	450	305	8.6	3.4	0.50	0.0037	0.00015			0.0038	0.00046	0.00053	0.0076	0.0023	0.18	0.000056	0.00039	0.019	0.000093	0.000000053	0.000000053	0.00016	0.000000023	0.051	0.000033
8-Oct-14	13	25	450	350	8.6	3.3	0.56	0.0048	0.00018			0.0070	0.00053	0.00044	0.0088	0.0026	0.21	0.00012	0.00040	0.023	0.00011	0.000000061	0.000000061	0.00017	0.00000015	0.059	0.000036
22-Oct-14	14	27	450	345	8.6	3.5	0.49	0.0035	0.00017			0.0052	0.00052	0.00043	0.0086	0.0026	0.22	0.000098	0.00041	0.024	0.00011	0.000000060	0.000000060	0.00025	0.00000028	0.059	0.000035
5-Nov-14	15	29	450	335		3.4	0.44	0.0028	0.000084			0.0034	0.00050	0.00034	0.0084	0.0025	0.19	0.000100	0.00037	0.022	0.00010	0.000000059	0.000000059	0.00018	0.00000013	0.050	0.000029
19-Nov-14	16	31	450	340	8.5	3.4	0.39	0.0028	0.00017			0.0043	0.00051	0.00051	0.0085	0.0026	0.20	0.000061	0.00036	0.022	0.00012	0.000000060	0.000000060	0.00020	0.00000016	0.052	0.000029
3-Dec-14	17	33	450	350	8.6	3.3	0.37	0.0025	0.000088			0.0035	0.00053	0.00044	0.0088	0.0026	0.20	0.000087	0.00038	0.024	0.00013	0.000000061	0.000000061	0.00018	0.00000012	0.056	0.000028
17-Dec-14	18	35	450	335	8.6	3.1	0.34	0.0026	0.000084			0.0050	0.00050	0.00084	0.0084	0.0025	0.18	0.000064	0.00038	0.021	0.00011	0.000000059	0.000000059	0.00019	0.00000012	0.046	0.000025
31-Dec-14	19	37	650	355	8.5	3.8	0.32	0.0019	0.00018			0.0044	0.00053	0.00062	0.0089	0.0027	0.19	0.00012	0.00041	0.023	0.00013	0.000000062	0.000000062	0.00019	0.00000012	0.049	0.000026
14-Jan-15	20	39	450	335	8.5	2.7	0.26	0.0012	0.00017			0.0042	0.00050	0.00042	0.0084	0.0025	0.16	0.000096	0.00040	0.021	0.00011	0.000000059	0.000000059	0.00018	0.00000013	0.044	0.000022
28-Jan-15	21	41	450	335	8.5	2.8	0.28	0.0013	0.000084			0.0034	0.00050	0.00050	0.0084	0.0025	0.18	0.00011	0.00032	0.019	0.00013	0.000000059	0.00000018	0.00015	0.000000092	0.049	0.000022
11-Feb-15	22	43	450	335	8.5	2.7	0.28	0.0012	0.000084			0.0034	0.00050	0.00067	0.0084	0.0025	0.17	0.000078	0.00037	0.019	0.00013	0.000000059	0.000000059	0.00019	0.000000084	0.047	0.000019
25-Feb-15	23	45	450	345	8.5	2.9	0.26	0.0010	0.000086			0.0035	0.00052	0.0012	0.0086	0.0026	0.20	0.000069	0.00034	0.017	0.00014	0.000000060	0.000000060	0.00020	0.00000012	0.054	0.000020
11-Mar-15	24	47	450	330	8.5	2.8	0.26	0.00099	0.000083			0.0033	0.00050	0.0013	0.0083	0.0025	0.19	0.000071	0.00034	0.016	0.00013	0.000000058	0.000000058	0.00017	0.00000011	0.051	0.000019
25-Mar-15	25	49	450	355	8.4	2.7	0.20	0.00098	0.000089			0.0036	0.00053	0.0020	0.0089	0.0027	0.20	0.000099	0.00036	0.018	0.00015	0.000000062	0.000000062	0.00018	0.000000098	0.054	0.000023
8-Apr-15	26	51	450	370	8.4	2.9	0.22	0.0010	0.000093			0.0028	0.0019	0.0025	0.0093	0.0028	0.20	0.000069	0.00044	0.020	0.00016	0.000000065	0.000000093	0.00018	0.000000028	0.056	0.000019
22-Apr-15	27	53	450	330	8.4	2.5	0.22	0.00083	0.00017			0.0041	0.0048	0.0016	0.0083	0.0025	0.19	0.000055	0.00034	0.016	0.00012	0.000000058	0.000000058	0.00017	0.00000031	0.051	0.000018
6-May-15	28	55	450	325	8.4	2.3	0.16	0.00065	0.000081			0.0016	0.0092	0.00049	0.0081	0.0024	0.18	0.000076	0.00031	0.014	0.00015	0.000000057	0.000000057	0.00017	0.000000024	0.047	0.000014
20-May-15	29	57	500	410																							
3-Jun-15	30	59	410	300	8.4	1.9	0.13	0.00053	0.00053			0.0015	0.011	0.000038	0.0038	0.0011	0.11	0.000032	0.00011	0.0054	0.000084	0.000000026	0.000000026	0.000092	0.000000026	0.031	0.0000059
17-Jun-15	31	61	500	410																							
1-Jul-15	32	63	410	310	8.3	1.8	0.12	0.00054	0.000078			0.0016	0.031	0.00012	0.0039	0.0012	0.10	0.000040	0.00011	0.0052	0.000091	0.000000027	0.000000027	0.000079	0.000000023	0.028	0.0000057
15-Jul-15	33	65	500	385																							
29-Jul-15	34	67	385	300	8.3	1.5	0.11	0.00030	0.00030			0.0019	0.064	0.00015	0.0038	0.0011	0.13	0.000021	0.000087	0.0037	0.00010	0.000000026	0.000000026	0.000080	0.000000041	0.036	0.0000048
12-Aug-15	35	69	500	385																							
26-Aug-15	36	71	385	285	8.3	1.3	0.086	0.00029	0.000071			0.0021	0.087	0.00018	0.0036	0.0011	0.16	0.000021	0.000073	0.0026	0.00014	0.000000025	0.000000025	0.000077	0.000000053	0.044	0.0000043
9-Sep-15	37	73	500	495																							
23-Sep-15	38	75	495	410																							
7-Oct-15	39	77	410	310	8.1	1.2	0.085	0.00023	0.000078			0.00078	0.10	0.00012	0.00	0.00	0.25	0.000019	0.000072	0.0019	0.00018	0.000000027	0.000000027	0.000073	0.000000012	0.069	0.0000038
21-Oct-15	40	79	500	410																							
4-Nov-15	41	81	410	335																							
18-Nov-15	42	83	335	255	8.0	1.0	0.064	0.00013	0.000064			0.00032	0.082	0.000096	0.00	0.00	0.28	0.000013	0.000046	0.0014	0.00015	0.000000022	0.000000022	0.000051	0.0000000096	0.074	0.0000034
2-Dec-15	43	85	500	415																							
16-Dec-15	44	87	415	345																							
30-Dec-15	45	89	345	285	8.3	0.96	0.071	0.00021	0.000071			0.00036	0.079	0.00011	0.00	0.00	0.35	0.000017	0.000048	0.0012	0.00021	0.000000025	0.000000025	0.000066	0.000000014	0.092	0.0000034
6-Jan-16	46	90	400	310	8.3	1.0	0.093	0.00016	0.000078			0.00039	0.081	0.00012	0.00	0.00	0.41	0.000021	0.000053	0.0014	0.00025	0.000000027	0.000000027	0.000070	0.00000014	0.11	0.0000041
20-Jan-16	47	92	400	305	8.3	1.0	0.069	0.00015	0.00015			0.00038	0.075	0.00011	0.00	0.00	0.40	0.000015	0.000059	0.0016	0.00025	0.000000027	0.000000027	0.000072	0.0000000011	0.11	0.0000044
3-Feb-16	48	94	400	285	8.3	0.95	0.086	0.00014	0.000071			0.00036	0.062	0.00011	0.00	0.00	0.35	0.000019	0.000051	0.0015	0.00023	0.000000025	0.000000025	0.000057	0.0000000011	0.093	0.0000040
17-Feb-16	49	96	400	300	8.2	1.0	0.090	0.00023	0.00030			0.00038	0.053	0.00011	0.00	0.00	0.37	0.000014	0.000054	0.0016	0.00023	0.000000026	0.000000026	0.000064	0.000000083	0.10	0.0000047
2-Mar-16	50	98	400	320	8.3	1.1	0.11	0.00024	0.000080			0.00040	0.043	0.00012	0.00	0.00	0.37	0.0000080	0.000061	0.0020	0.00023	0.000000028	0.000000028	0.000064	0.000000012	0.097	0.0000054

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
23-Apr-14	1	1	2355	590	0.015	0.00070	0.16	0.000024	0.00056	0.35	0.00032	0.23	0.0060	0.012	0.012	1.0	0.000021	0.17	0.00024	21	0.0077	8.2	0.000021	0.0000068	0.000026	0.040	0.00000030	0.00024	0.000059
7-May-14	2	3	450	340	0.0023	0.000090	0.022	0.0000027	0.000076	0.038	0.000094	0.011	0.0024	0.0010	0.0036	0.15	0.000050	0.052	0.000000017	3.6	0.00070	1.5	0.0000031	0.00000051	0.000013	0.010	0.000000085	0.000034	0.000017
21-May-14	3	5	550	380	0.0015	0.000061	0.013	0.0000048	0.000064	0.030	0.000064	0.0029	0.0018	0.00020	0.0036	0.11	0.000029	0.048	0.00000063	3.3	0.00056	1.1	0.0000024	0.0000026	0.0000089	0.0078	0.0000013	0.000019	0.000019
4-Jun-14	4	7	450	350	0.00069	0.000083	0.0078	0.00000026	0.000055	0.025	0.000043	0.0011	0.0013	0.000018	0.0037	0.100	0.000020	0.048	0.000000044	2.7	0.00046	0.79	0.0000020	0.00000096	0.0000054	0.0060	0.000000088	0.000026	0.000018
18-Jun-14	5	9	450	325	0.00061	0.00032	0.0054	0.00000057	0.000053	0.021	0.000031	0.00073	0.0014	0.000011	0.0034	0.087	0.000015	0.044	0.000000016	2.3	0.00038	0.61	0.0000018	0.000000081	0.0000035	0.0068	0.000000081	0.000024	0.000016
2-Jul-14	6	11	450	350	0.00039	0.000031	0.0041	0.00000026	0.000052	0.021	0.000027	0.00061	0.00099	0.0000096	0.0039	0.090	0.000013	0.048	0.000000018	2.3	0.00038	0.55	0.0000017	0.0000014	0.0000048	0.0055	0.000000088	0.0000088	0.000018
16-Jul-14	7	13	450	295	0.00030	0.000023	0.0029	0.00000015	0.000044	0.017	0.000029	0.00044	0.00086	0.0000081	0.0035	0.072	0.0000096	0.038	0.000000022	1.9	0.00030	0.38	0.0000014	0.00000089	0.0000035	0.0042	0.0000011	0.0000074	0.000015
30-Jul-14	8	15	450	340	0.00025	0.000034	0.0026	0.00000017	0.000055	0.018	0.000021	0.00026	0.00089	0.0000077	0.0041	0.076	0.000011	0.044	0.000000017	2.0	0.00032	0.36	0.0000015	0.000000085	0.0000085	0.0042	0.0000031	0.0000085	0.000017
13-Aug-14	9	17	450	350	0.00021	0.000020	0.0017	0.00000018	0.000052	0.017	0.000023	0.000088	0.00078	0.0000061	0.0042	0.071	0.000013	0.045	0.000000018	2.1	0.00031	0.32	0.0000014	0.00000035	0.0000042	0.0042	0.00000070	0.0000088	0.000018
27-Aug-14	10	19	450	350	0.00019	0.000021	0.0018	0.00000044	0.000047	0.017	0.000016	0.000088	0.00075	0.0000044	0.0042	0.076	0.0000074	0.048	0.000000018	2.0	0.00031	0.28	0.0000014	0.0000033	0.00000061	0.0040	0.0000024	0.0000088	0.000018
10-Sep-14	11	21	450	340	0.00016	0.000012	0.0016	0.000000085	0.000043	0.016	0.0000076	0.00017	0.00065	0.0000043	0.0042	0.056	0.0000089	0.053	0.000000017	1.8	0.00029	0.24	0.0000013	0.0000013	0.00000077	0.0033	0.0000020	0.0000085	0.000017
24-Sep-14	12	23	450	305	0.00012	0.000013	0.00070	0.00000046	0.000042	0.014	0.0000076	0.00015	0.00054	0.0000046	0.0035	0.062	0.0000068	0.039	0.000000031	1.7	0.00024	0.18	0.0000012	0.00000061	0.0000034	0.0028	0.0000016	0.000023	0.000015
8-Oct-14	13	25	450	350	0.00013	0.000017	0.0012	0.00000035	0.000054	0.016	0.0000058	0.00026	0.00058	0.0000035	0.0042	0.056	0.0000070	0.046	0.000000018	1.8	0.00029	0.19	0.0000012	0.00000070	0.0000018	0.0031	0.0000019	0.0000088	0.000018
22-Oct-14	14	27	450	345	0.00012	0.0000097	0.0012	0.00000017	0.000051	0.017	0.0000062	0.000086	0.00053	0.0000035	0.0049	0.059	0.0000066	0.046	0.000000017	1.9	0.00028	0.20	0.0000012	0.00000026	0.0000012	0.0030	0.0000023	0.0000086	0.000017
5-Nov-14	15	29	450	335	0.000097	0.000011	0.0010	0.00000042	0.000044	0.015	0.0000037	0.00034	0.00049	0.0000034	0.0039	0.049	0.0000062	0.045	0.000000017	1.7	0.00026	0.15	0.0000011	0.00000042	0.0000013	0.0027	0.0000017	0.0000084	0.000017
19-Nov-14	16	31	450	340	0.000094	0.000011	0.00082	0.000000085	0.000051	0.016	0.0000062	0.000085	0.00046	0.0000026	0.0040	0.051	0.0000053	0.049	0.000000017	1.8	0.00029	0.14	0.0000014	0.00000034	0.00000094	0.0027	0.0000016	0.0000085	0.000017
3-Dec-14	17	33	450	350	0.000087	0.000015	0.00081	0.000000088	0.000043	0.015	0.0000040	0.000088	0.00043	0.0000026	0.0041	0.050	0.0000061	0.045	0.000000018	1.6	0.00029	0.14	0.0000012	0.00000035	0.0000012	0.0026	0.0000018	0.0000088	0.000018
17-Dec-14	18	35	450	335	0.000079	0.000011	0.00066	0.000000084	0.000047	0.015	0.0000047	0.000084	0.00038	0.0000025	0.0038	0.053	0.0000050	0.044	0.000000017	1.5	0.00026	0.12	0.0000011	0.00000034	0.0000012	0.0023	0.0000016	0.0000084	0.000017
31-Dec-14	19	37	650	355	0.000077	0.0000099	0.00075	0.00000027	0.000048	0.016	0.0000051	0.000089	0.00041	0.0000027	0.0043	0.052	0.0000058	0.051	0.000000018	1.6	0.00028	0.12	0.0000011	0.00000080	0.0000012	0.0025	0.0000020	0.0000089	0.000018
14-Jan-15	20	39	450	335	0.000061	0.0000093	0.00059	0.00000017	0.000040	0.013	0.0000061	0.000084	0.00035	0.0000025	0.0039	0.045	0.0000054	0.047	0.000000025	1.3	0.00022	0.095	0.0000011	0.00000034	0.0000013	0.0019	0.0000018	0.0000084	0.000017
28-Jan-15	21	41	450	335	0.000047	0.000010	0.00055	0.000000084	0.000037	0.015	0.0000053	0.000084	0.00034	0.0000017	0.0035	0.048	0.000010	0.041	0.000000017	1.4	0.00020	0.091	0.00000096	0.0000018	0.0000013	0.0018	0.0000021	0.0000084	0.000017
11-Feb-15	22	43	450	335	0.000049	0.0000084	0.00044	0.00000017	0.000044	0.013	0.0000044	0.00017	0.00027	0.0000017	0.0035	0.046	0.0000084	0.043	0.000000017	1.2	0.00026	0.086	0.0000011	0.0000073	0.00000075	0.0017	0.0000018	0.0000084	0.000017
25-Feb-15	23	45	450	345	0.000053	0.0000076	0.00046	0.00000026	0.000049	0.015	0.0000041	0.000086	0.00026	0.0000017	0.0032	0.053	0.0000086	0.046	0.000000017	1.3	0.00028	0.081	0.0000012	0.0000010	0.00000095	0.0018	0.0000014	0.0000086	0.000017
11-Mar-15	24	47	450	330	0.000048	0.0000082	0.00040	0.00000017	0.000048	0.014	0.0000045	0.000083	0.00026	0.0000017	0.0028	0.046	0.0000083	0.039	0.00000083	1.2	0.00027	0.073	0.00000100	0.00000050	0.00000041	0.0016	0.0000013	0.0000083	0.000017
25-Mar-15	25	49	450	355	0.000056	0.0000092	0.00050	0.000000089	0.000050	0.017	0.0000055	0.000089	0.00030	0.0000018	0.0033	0.053	0.0000089	0.051	0.000000018	1.4	0.00030	0.082	0.0000012	0.0000046	0.0000016	0.0016	0.0000021	0.0000089	0.000018
8-Apr-15	26	51	450	370	0.000046	0.000011	0.00036	0.000000093	0.000052	0.015	0.0000041	0.000093	0.00025	0.0000019	0.0035	0.054	0.0000093	0.056	0.000000019	1.2	0.00030	0.074	0.0000012	0.0000017	0.00000056	0.0016	0.0000015	0.0000093	0.000019
22-Apr-15	27	53	450	330	0.000039	0.000010	0.00029	0.0000018	0.000041	0.015	0.0000041	0.00017	0.00022	0.0000017	0.0028	0.051	0.0000026	0.044	0.00000036	1.1	0.00028	0.064	0.00000092	0.00000091	0.0000012	0.0011	0.0000018	0.0000083	0.000017
6-May-15	28	55	450	325	0.000033	0.000012	0.00026	0.00000016	0.000045	0.014	0.0000057	0.000081	0.00020	0.0000016	0.0025	0.049	0.0000081	0.044	0.00000042	1.00	0.00026	0.059	0.0000010	0.000000081	0.00000089	0.0012	0.0000015	0.0000081	0.000016
20-May-15	29	57	500	410																									
3-Jun-15	30	59	410	300	0.000013	0.0000050	0.000090	0.00000019	0.000022	0.0081	0.0000028	0.000038	0.000074	0.00000038	0.0010	0.024	0.0000015	0.021	0.000000053	0.38	0.00015	0.024	0.00000049	0.00000019	0.00000041	0.00047	0.00000068	0.0000038	0.0000075
17-Jun-15	31	61	500	410																									
1-Jul-15	32	63	410	310	0.000012	0.0000067	0.000085	0.000000039	0.000025	0.0081	0.0000048	0.000078	0.000063	0.00000078	0.00095	0.023	0.0000012	0.022	0.00000010	0.41	0.00016	0.020	0.00000058	0.0000012	0.00000035	0.00042	0.00000066	0.0000039	0.0000078
15-Jul-15	33	65	500	385																									
29-Jul-15	34	67	385	300	0.0000097	0.0000027	0.000060	0.000000075	0.000028	0.0097	0.0000018	0.000038	0.000052	0.00000038	0.00071	0.025	0.00000079	0.020	0.000000041	0.38	0.00019	0.018	0.00000059	0.00000045	0.00000019	0.00035	0.00000060	0.0000038	0.0000075
12-Aug-15	35	69	500	385																									
26-Aug-15	36	71	385	285	0.0000078	0.0000045	0.000039	0.00000014	0.000029	0.012	0.0000036	0.000036	0.000098	0.00000036	0.00050	0.027	0.00000089	0.021	0.00000042	0.34	0.00024	0.015	0.00000068	0.00000043	0.00000018	0.00025	0.00000046	0.0000036	0.0000071
9-Sep-15	37	73	500	495																									
23-Sep-15	38	75	495	410																									
7-Oct-15	39	77	410	310	0.0000069	0.0000033	0.000031	0.000000078	0.000033	0.020	0.0000024	0.000039	0.000025	0.00000078	0.00039	0.032	0.00000066	0.021	0.000000019	0.30	0.00037	0.015	0.00000070	0.00000062	0.00000039	0.00022	0.00000035	0.0000039	0.0000078
21-Oct-15	40	79	500	410																									
4-Nov-15	41	81	410	335																									
18-Nov-15	42	83	335	255	0.0000063	0.0000051	0.000064	0.00000029	0.000029	0.023	0.0000055	0.000032	0.000023	0.00000032	0.00028	0.030	0.00000086	0.018	0.0000000096	0.21	0.00039	0.013	0.00000047	0.00000048	0.00000016	0.00015	0.00000032	0.0000032	0.0000064
2-Dec-15	43	85	500	415																									
16-Dec-15	44	87	415	345																									
30-Dec-15	45	89	345	285	0.0000061	0.0000022	0.000046	0.000000071	0.000029	0.029	0.0000061	0.000036	0.000024	0.00000036	0.00033	0.033	0.00000068	0.020	0.000000025	0.20	0.00040	0.015	0.00000051	0.00000011	0.00000018	0.00021	0.00000025	0.0000036	0.0000071
6-Jan-16	46	90	400	310	0.0000074	0.0000053	0.000043	0.00000035	0.000033	0.034	0.0000094	0.000039	0.000026	0.00000039	0.00035	0.039	0.0000027	0.023	0.000000047	0.22	0.00050	0.017	0.00000054	0.0000013	0.00000019	0.00023	0.00000035	0.0000039	0.0000078
20-Jan-16	47	92	400	305	0.0000082	0.0000024	0.000042	0.00000015	0.000033	0.031	0.0000085	0.000038	0.000029	0.00000076	0.00034	0.036	0.0000011	0.024	0.000000061	0.19	0.00057	0.017	0.00000082	0.00000019	0.00000019	0.00026	0.00000061	0.0000038	0.0000076
3-Feb-16	48	94	400	285	0.0000077	0.0000060	0.000043	0.00000018	0.000030	0.028	0.0000061	0.000036	0.000027	0.00000071	0.00031	0.034	0.0000012	0.020	0.000000068	0.17	0.00051	0.017	0.00000059	0.00000039	0.00000018	0.00023	0.00000036	0.0000036	0.0000071
17-Feb-16	49	96	400	300	0.0000085	0.0000034	0.000038	0.00000041	0.000030	0.030	0.0000074	0.000038	0.000030	0.00000075	0.00037	0.034	0.00000060	0.022	0.0000000075	0.17	0.00047	0.017	0.00000060	0.00000034	0.00000019	0.00026	0.00000034	0.0000075	0.0000075
2-Mar-16	50	98	400	320	0.0000099	0.0000017	0.000044	0.00000036	0.000033	0.031	0.000023	0.000040	0.000034	0.00000080	0.00040	0.037	0.00000088	0.024	0.000000012	0.19	0.00052	0.022	0.00000064	0.00000012	0.00000020	0.00029	0.00000020	0.0000040	0.0000080

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 15 (Latte Composite)

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	350	8.0	141	2258	14	2.6	25	1.7	2.4	3.0	*< 0.06*	44	*< 0.3*	684	0.015	0.065	1.3	0.026	*< 7E-06*	0.000030	0.12	0.000036	213	0.0079
17-Jun-15	2	3	600	565	8.2	156	825	2.9	0.86	5.6	*< 1*	0.70	0.33	0.53	15	*< 0.3*	224	0.0065	0.060	1.5	0.0093	*< 7E-06*	0.00016	0.015	0.0000050	68	0.0013
1-Jul-15	3	5	550	535	8.2	160	433	1.1	0.15	*< 2*	*< 1*	0.40	0.070	0.10	5.0	*< 0.3*	116	0.0068	0.062	1.4	0.0083	*< 7E-06*	*< 7E-06*	0.023	0.0000090	32	0.00049
15-Jul-15	4	7	550	525	8.2	142	262	1.1	0.050	*< 2*	*< 1*	0.20	*< 0.06*	0.030	1.0	*< 0.3*	100	0.0074	0.055	1.2	0.0089	*< 7E-06*	*< 7E-06*	0.064	0.00012	27	0.00028
29-Jul-15	5	9	500	490	8.1	141	229	0.60	0.060	*< 2*	*< 1*	0.20	*< 0.06*	*< 0.03*	1.0	*< 0.3*	110	0.0091	0.048	0.86	0.010	*< 7E-06*	*< 7E-06*	0.021	*< 3E-06*	30	0.00019
12-Aug-15	6	11	500	490	8.2	124	172	0.48	0.030	*< 2*	*< 1*	0.30	*< 0.06*	*< 0.03*	1.0	*< 0.3*	111	0.0054	0.041	0.79	0.011	*< 7E-06*	*< 7E-06*	0.017	0.0000060	29	0.00020
26-Aug-15	7	13	600	560	7.9	155	161	0.40	0.030	2.0	1.0	0.30	0.060	0.030	1.0	0.30	122	0.0054	0.040	0.70	0.013	0.0000070	0.0000070	0.017	0.0000055	32	0.00022
9-Sep-15	8	15	600	580	8.1	118	129	0.31	0.030	*< 2*	*< 1*	0.30	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	132	0.0053	0.038	0.61	0.014	*< 7E-06*	*< 7E-06*	0.017	0.0000050	34	0.00024
23-Sep-15	9	17	600	575	8.1	118	105	0.25	0.025	2.0	1.0	0.25	0.060	0.030	1.0	0.30	136	0.0059	0.035	0.53	0.014	0.0000070	0.0000070	0.017	0.0000045	35	0.00017
7-Oct-15	10	19	500	470	8.1	127	107	0.18	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	139	0.0065	0.033	0.46	0.014	*< 7E-06*	*< 7E-06*	0.016	0.0000040	35	0.000090
21-Oct-15	11	21	500	485	8.1	118	93	0.20	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	143	0.0074	0.033	0.49	0.016	*< 7E-06*	*< 7E-06*	0.018	*< 3E-06*	37	0.00014
4-Nov-15	12	23	500	475	8.2	123	86	0.26	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	157	0.0068	0.028	0.45	0.018	*< 7E-06*	*< 7E-06*	0.014	*< 3E-06*	40	0.00011
18-Nov-15	13	25	500	485	8.3	130	82	0.18	0.010	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	147	0.0033	0.027	0.45	0.014	0.0000080	*< 7E-06*	0.018	0.000021	36	0.000080
2-Dec-15	14	27	500	475	8.2	116	76	0.16	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	161	0.0040	0.029	0.46	0.019	*< 7E-06*	*< 7E-06*	0.010	*< 3E-06*	41	0.00014
16-Dec-15	15	29	500	475	8.2	112	71	0.15	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	150	0.012	0.028	0.43	0.021	0.000013	0.000015	0.012	0.00017	37	0.00018
30-Dec-15	16	31	500	490	8.2	105	56	0.14	*< 0.01*	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	155	0.0058	0.027	0.43	0.020	*< 7E-06*	*< 7E-06*	0.020	*< 3E-06*	38	0.00018
13-Jan-16	17	33	500	450	8.2	107	54	0.13	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	144	0.0042	0.025	0.34	0.019	*< 7E-06*	*< 7E-06*	0.012	*< 3E-06*	35	0.00011
27-Jan-16	18	35	500	460	8.2	106	54	0.13	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	140	0.0039	0.025	0.38	0.020	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	35	0.00012
10-Feb-16	19	37	500	475	8.2	108	49	0.14	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	138	0.0035	0.025	0.41	0.022	*< 7E-06*	*< 7E-06*	0.0080	*< 3E-06*	35	0.00012
24-Feb-16	20	39	500	470	8.2	109	46	0.10	0.010	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	150	0.0021	0.024	0.39	0.023	*< 7E-06*	*< 7E-06*	0.010	*< 3E-06*	37	0.00016
9-Mar-16	21	41	501	455	8.2	104	39																				

Calculated Loading Rates for Col 15

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	350	8.0	9.8	158	0.95	0.18	1.8	0.12	0.17	0.21	0.0042	3.1	0.021	48	0.0010	0.0045	0.089	0.0018	0.00000049	0.0000021	0.0084	0.0000025	15	0.00055
17-Jun-15	2	3	600	565	8.2	8.8	47	0.17	0.049	0.32	0.057	0.040	0.019	0.030	0.85	0.017	13	0.00037	0.0034	0.085	0.00052	0.00000040	0.0000089	0.00084	0.00000028	3.8	0.000072
1-Jul-15	3	5	550	535	8.2	8.6	23	0.059	0.0080	0.11	0.054	0.021	0.0037	0.0054	0.27	0.016	6.2	0.00036	0.0033	0.076	0.00044	0.00000037	0.00000037	0.0012	0.00000048	1.7	0.000026
15-Jul-15	4	7	550	525	8.2	7.5	14	0.055	0.0026	0.11	0.053	0.011	0.0032	0.0016	0.053	0.016	5.3	0.00039	0.0029	0.060	0.00047	0.00000037	0.00000037	0.0033	0.0000060	1.4	0.000015
29-Jul-15	5	9	500	490	8.1	6.9	11	0.029	0.0029	0.098	0.049	0.0098	0.0029	0.0015	0.049	0.015	5.4	0.00045	0.0023	0.042	0.00049	0.00000034	0.00000034	0.0010	0.00000015	1.5	0.0000093
12-Aug-15	6	11	500	490	8.2	6.1	8.4	0.024	0.0015	0.098	0.049	0.015	0.0029	0.0015	0.049	0.015	5.4	0.00026	0.0020	0.038	0.00052	0.00000034	0.00000034	0.00081	0.00000029	1.4	0.0000098
26-Aug-15	7	13	600	560	7.9	8.7	9.0	0.022	0.0017	0.11	0.056	0.017	0.0034	0.0017	0.056	0.017	6.8	0.00030	0.0022	0.039	0.00070	0.00000039	0.00000039	0.00095	0.00000031	1.8	0.000012
9-Sep-15	8	15	600	580	8.1	6.8	7.5	0.018	0.0017	0.12	0.058	0.017	0.0035	0.0017	0.058	0.017	7.7	0.00031	0.0022	0.035	0.00083	0.00000041	0.00000041	0.0010	0.00000029	2.0	0.000014
23-Sep-15	9	17	600	575	8.1	6.8	6.0	0.014	0.0014	0.12	0.058	0.014	0.0035	0.0017	0.058	0.017	7.8	0.00034	0.0020	0.031	0.00081	0.00000040	0.00000040	0.00095	0.00000026	2.0	0.0000095
7-Oct-15	10	19	500	470	8.1	6.0	5.0	0.0085	0.00094			0.0094	0.0028	0.0014	0.047	0.00	6.5	0.00031	0.0015	0.021	0.00066	0.00000033	0.00000033	0.00074	0.00000019	1.6	0.0000042
21-Oct-15	11	21	500	485	8.1	5.7	4.5	0.0097	0.00097			0.0097	0.0029	0.0015	0.049	0.00	6.9	0.00036	0.0016	0.024	0.00079	0.00000034	0.00000034	0.00087	0.00000015	1.8	0.0000068
4-Nov-15	12	23	500	475	8.2	5.9	4.1	0.012	0.00095			0.0095	0.0029	0.0014	0.048	0.00	7.5	0.00032	0.0013	0.021	0.00085	0.00000033	0.00000033	0.00066	0.00000014	1.9	0.0000052
18-Nov-15	13	25	500	485	8.3	6.3	4.0	0.0087	0.00049			0.0049	0.0029	0.0015	0.049	0.00	7.1	0.00016	0.0013	0.022	0.00069	0.00000039	0.00000034	0.00085	0.0000010	1.7	0.0000039
2-Dec-15	14	27	500	475	8.2	5.5	3.6	0.0076	0.00095			0.0095	0.0029	0.0014	0.048	0.00	7.6	0.00019	0.0014	0.022	0.00091	0.00000033	0.00000033	0.00049	0.00000014	1.9	0.0000067
16-Dec-15	15	29	500	475	8.2	5.3	3.4	0.0071	0.00095			0.0095	0.0029	0.0014	0.048	0.00	7.1	0.00055	0.0013	0.020	0.00097	0.00000062	0.00000071	0.00055	0.0000083	1.7	0.0000086
30-Dec-15	16	31	500	490	8.2	5.1	2.7	0.0069	0.00049			0.0049	0.0029	0.0015	0.049	0.00	7.6	0.00028	0.0013	0.021	0.00098	0.00000034	0.00000034	0.00096	0.00000015	1.9	0.0000088
13-Jan-16	17	33	500	450	8.2	4.8	2.4	0.0059	0.00090			0.0090	0.0027	0.0014	0.045	0.00	6.5	0.00019	0.0011	0.015	0.00086	0.00000032	0.00000032	0.00054	0.00000014	1.6	0.0000050
27-Jan-16	18	35	500	460	8.2	4.9	2.5	0.0060	0.00092			0.0092	0.0028	0.0014	0.046	0.00	6.4	0.00018	0.0012	0.017	0.00093	0.00000032	0.00000032	0.00051	0.00000014	1.6	0.0000055
10-Feb-16	19	37	500	475	8.2	5.1	2.3	0.0067	0.00048			0.0095	0.0029	0.0014	0.048	0.00	6.6	0.00017	0.0012	0.019	0.0010	0.00000033	0.00000033	0.00038	0.00000014	1.6	0.0000057
24-Feb-16	20	39	500	470	8.2	5.1	2.2	0.0047	0.00047			0.0094	0.0028	0.0014	0.047	0.00	7.1	0.000099	0.0011	0.018	0.0011	0.00000033	0.00000033	0.00047	0.00000014	1.7	0.0000075
9-Mar-16	21	41	501	455	8.2	4.7	1.8																				

Leachate Concentrations for Col 16 (Supremo Composite)

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	320	8.9	418	150	3.3	0.25	6.9	*< 1*	1.0	2.2	0.76	19	*< 0.3*	28	0.043	0.064	3.7	0.016	*< 7E-06*	0.000010	0.079	0.000044	8.8	0.0085
17-Jun-15	2	3	600	550	8.8	413	60	1.6	0.070	*< 2*	*< 1*	0.30	0.28	0.34	7.0	*< 0.3*	18	0.085	0.061	4.7	0.0090	*< 7E-06*	0.000080	0.019	0.000028	5.6	0.0029
1-Jul-15	3	5	550	510	8.7	377	28	0.98	0.040	*< 2*	*< 1*	0.20	0.10	0.060	3.0	*< 0.3*	16	0.022	0.057	4.5	0.0099	*< 7E-06*	*< 7E-06*	0.023	0.000015	4.8	0.0014
15-Jul-15	4	7	550	535	8.6	311	18	1.1	0.060	*< 2*	*< 1*	*< 0.1*	0.060	*< 0.03*	1.0	*< 0.3*	12	0.047	0.054	4.3	0.0092	*< 7E-06*	*< 7E-06*	0.040	0.000012	3.5	0.00095
29-Jul-15	5	9	500	465	8.6	318	16	0.48	0.040	*< 2*	*< 1*	0.20	*< 0.06*	*< 0.03*	1.0	*< 0.3*	16	0.030	0.043	3.0	0.012	*< 7E-06*	*< 7E-06*	0.020	*< 3E-06*	4.7	0.00068
12-Aug-15	6	11	500	490	8.6	298	12	0.46	0.13	*< 2*	*< 1*	0.10	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	14	0.10	0.039	2.7	0.014	*< 7E-06*	*< 7E-06*	0.018	0.0000090	4.3	0.00062
26-Aug-15	7	13	600	565	8.2	308	9.0	0.38	0.080	2.0	1.0	0.10	0.060	0.030	1.0	0.30	14	0.071	0.037	2.5	0.014	0.0000070	0.0000070	0.017	0.0000060	4.3	0.00055
9-Sep-15	8	15	600	560	8.5	224	8.0	0.29	0.030	*< 2*	*< 1*	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	14	0.038	0.036	2.2	0.014	*< 7E-06*	*< 7E-06*	0.016	*< 3E-06*	4.3	0.00048
23-Sep-15	9	17	600	560	8.5	218	7.0	0.21	0.030	2.0	1.0	0.10	0.060	0.030	1.0	0.30	15	0.030	0.032	1.8	0.014	0.0000070	0.0000070	0.014	0.0000030	4.6	0.00042
7-Oct-15	10	19	500	475	8.4	224	5.0	0.12	0.030	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	16	0.021	0.028	1.4	0.015	*< 7E-06*	*< 7E-06*	0.012	0.0000030	4.9	0.00036
21-Oct-15	11	21	500	465	8.5	206	5.0	0.15	0.020	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	18	0.018	0.027	1.4	0.018	*< 7E-06*	*< 7E-06*	0.014	*< 3E-06*	5.1	0.00046
4-Nov-15	12	23	500	485	8.5	197	6.0	0.16	0.020	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	21	0.024	0.022	1.2	0.021	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	6.2	0.00047
18-Nov-15	13	25	500	460	8.6	204	5.0	0.13	*< 0.01*	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	21	0.015	0.021	1.1	0.019	0.000015	0.000010	0.012	*< 3E-06*	6.2	0.00040
2-Dec-15	14	27	500	470	8.5	170	4.0	0.10	0.010	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	27	0.022	0.021	0.99	0.027	*< 7E-06*	*< 7E-06*	0.0095	*< 3E-06*	7.8	0.00040
16-Dec-15	15	29	500	460	8.5	157	4.0	0.090	*< 0.01*	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	28	0.013	0.019	0.82	0.030	0.000021	0.000023	0.010	0.000035	8.1	0.00049
30-Dec-15	16	31	500	460	8.4	131	4.0	0.060	*< 0.01*	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	34	0.027	0.019	0.81	0.035	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	10	0.00046
13-Jan-16	17	33	500	445	8.3	131	4.0	0.060	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	33	0.012	0.016	0.57	0.032	*< 7E-06*	*< 7E-06*	0.010	*< 3E-06*	9.2	0.00038
27-Jan-16	18	35	500	475	8.3	122	4.0	0.060	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	37	0.0082	0.015	0.57	0.039	*< 7E-06*	*< 7E-06*	0.0090	*< 3E-06*	11	0.00036
10-Feb-16	19	37	500	460	8.3	118	4.0	0.050	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	43	0.0059	0.015	0.52	0.046	*< 7E-06*	*< 7E-06*	0.0070	*< 3E-06*	12	0.00037
24-Feb-16	20	39	500	455	8.3	116	3.0	0.040	0.020	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	52	0.0032	0.014	0.46	0.051	*< 7E-06*	*< 7E-06*	0.0070	*< 3E-06*	15	0.00035
9-Mar-16	21	41	501	450	8.3	108	3.0																				

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Leachate Concentrations for Col 15 (Latte Composite)

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	350	0.37	0.079	4.1	0.00024	0.013	37	0.011	0.23	0.044	1.6	0.023	28	0.0080	4.3	0.017	780	1.0	748	0.00040	< 1E-05	0.00019	0.12	0.00033	0.0010	< 0.002
17-Jun-15	2	3	600	565	0.097	0.0074	0.90	< 1E-05	0.0065	13	0.013	0.030	0.020	0.37	0.059	15	0.0038	5.3	0.00066	316	0.36	282	0.00020	0.00040	0.000080	0.036	0.00023	< 0.001	< 0.002
1-Jul-15	3	5	550	535	0.035	0.0024	0.34	< 1E-05	0.0056	8.6	0.013	0.020	0.014	0.068	0.026	10	0.0017	5.3	0.000056	187	0.19	128	0.00015	0.000050	0.000070	0.027	0.00025	< 0.001	< 0.002
15-Jul-15	4	7	550	525	0.020	0.0028	0.25	0.00054	0.0050	8.3	0.011	< 0.01	0.011	0.0089	0.047	9.7	0.00083	5.4	0.000041	139	0.15	98	0.00015	0.00055	0.00013	0.019	0.00024	0.0030	< 0.002
29-Jul-15	5	9	500	490	0.013	0.00098	0.20	< 0.00001	0.0056	8.8	0.0096	< 0.01	0.0089	0.0024	0.0090	9.6	0.00055	4.8	0.000018	105	0.18	78	0.00013	0.000050	< 0.00005	0.018	0.00021	< 0.001	< 0.002
12-Aug-15	6	11	500	490	0.0084	0.00087	0.14	0.000010	0.0045	9.2	0.0087	< 0.01	0.0063	0.0018	0.016	10	0.00060	4.9	0.000012	81	0.17	59	0.00013	0.000050	< 0.00005	0.014	0.00021	< 0.001	< 0.002
26-Aug-15	7	13	600	560	0.0070	0.00094	0.12	0.000010	0.0043	10	0.0090	0.010	0.014	0.0016	0.013	10	0.00078	4.8	0.000050	63	0.19	54	0.00015	0.00012	0.000050	0.013	0.00020	0.0010	0.0020
9-Sep-15	8	15	600	580	0.0057	0.0010	0.092	< 1E-05	0.0041	11	0.0094	< 0.01	0.023	0.0013	0.0090	11	0.00095	4.7	0.000088	45	0.20	49	0.00017	0.00018	< 5E-05	0.011	0.00018	< 0.001	< 0.002
23-Sep-15	9	17	600	575	0.0046	0.00083	0.080	0.000010	0.0040	12	0.0087	0.010	0.014	0.0012	0.0060	10	0.00068	4.5	0.000047	36	0.21	42	0.00015	0.00013	0.000050	0.011	0.00018	0.0010	0.0020
7-Oct-15	10	19	500	470	0.0036	0.00065	0.067	< 1E-05	0.0040	13	0.0080	< 0.01	0.0049	0.0011	< 0.003	9.6	0.00040	4.3	0.0000060	26	0.21	34	0.00012	0.000070	< 5E-05	0.011	0.00017	< 0.001	< 0.002
21-Oct-15	11	21	500	485	0.0040	0.00088	0.082	< 1E-05	0.0039	13	0.0083	< 0.01	0.0056	0.0012	< 0.003	9.3	0.00041	4.7	0.0000070	21	0.22	33	0.00017	0.00016	0.000080	0.011	0.00021	< 0.001	< 0.002
4-Nov-15	12	23	500	475	0.0037	0.0011	0.080	0.000040	0.0035	14	0.0068	< 0.01	0.0045	0.0011	0.0050	10	0.00041	4.5	0.0000040	19	0.22	31	0.00016	0.00020	< 5E-05	0.010	0.00019	< 0.001	< 0.002
18-Nov-15	13	25	500	485	0.0030	0.00055	0.066	0.000070	0.0037	14	0.0064	< 0.01	0.0026	0.00070	0.0030	10	0.0011	4.6	0.000012	16	0.21	32	0.00016	0.00010	< 5E-05	0.0073	0.00017	< 0.001	< 0.002
2-Dec-15	14	27	500	475	0.0028	0.00036	0.064	0.000070	0.0036	15	0.0060	< 0.01	0.0025	0.0010	< 0.003	10	0.00038	4.7	0.0000020	15	0.23	26	0.00013	0.000090	< 5E-05	0.0079	0.00018	< 0.002	< 0.002
16-Dec-15	15	29	500	475	0.0025	0.00080	0.058	0.0026	0.0037	14	0.0064	< 0.01	0.0026	0.0011	0.086	10	0.00041	5.8	0.000021	12	0.23	26	0.00013	0.00016	0.00026	0.0076	0.00021	0.020	< 0.002
30-Dec-15	16	31	500	490	0.0025	0.00078	0.053	0.00017	0.0037	14	0.0055	0.010	0.0033	0.00090	< 0.003	10	0.00036	4.4	0.0000090	11	0.23	23	0.00014	0.000040	0.000070	0.0074	0.00021	< 0.001	< 0.002
13-Jan-16	17	33	500	450	0.0022	0.00075	0.056	0.00014	0.0033	14	0.0049	< 0.01	0.0026	0.00080	< 0.003	9.8	0.0026	4.4	0.0000020	8.6	0.20	20	0.000084	0.000060	< 5E-05	0.0060	0.00014	< 0.001	< 0.002
27-Jan-16	18	35	500	460	0.0021	0.00047	0.045	0.000010	0.0032	13	0.0043	< 0.01	0.0024	0.00070	< 0.003	9.1	0.00029	4.5	< 2E-06	7.1	0.22	20	0.00014	0.000090	< 5E-05	0.0061	0.00015	< 0.001	< 0.002
10-Feb-16	19	37	500	475	0.0019	0.00051	0.035	0.00015	0.0032	13	0.0040	< 0.01	0.0023	0.00080	< 0.003	8.9	0.00038	4.4	< 2E-06	6.2	0.21	17	0.00013	0.000070	< 5E-05	0.0052	0.00016	< 0.001	< 0.002
24-Feb-16	20	39	500	470	0.0021	0.00023	0.047	0.000050	0.0033	14	0.0041	0.040	0.0024	0.00070	0.0040	9.5	0.00034	4.4	< 2E-06	5.4	0.22	17	0.00012	0.000020	< 5E-05	0.0055	0.00014	< 0.001	< 0.002
9-Mar-16	21	41	501	455																									

Calculated Loading Rates for Col 15

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	350	0.026	0.0056	0.29	0.000017	0.00088	2.6	0.00076	0.016	0.0030	0.11	0.0016	2.0	0.00056	0.30	0.0012	55	0.073	52	0.000028	0.00000070	0.000013	0.0084	0.000023	0.000070	0.00014
17-Jun-15	2	3	600	565	0.0055	0.00042	0.051	0.00000057	0.00037	0.75	0.00076	0.0017	0.0011	0.021	0.0033	0.82	0.00022	0.30	0.000037	18	0.020	16	0.000011	0.000023	0.0000045	0.0020	0.000013	0.000057	0.00011
1-Jul-15	3	5	550	535	0.0019	0.00013	0.018	0.00000054	0.00030	0.46	0.00067	0.0011	0.00077	0.0036	0.0014	0.56	0.000090	0.28	0.0000030	10	0.010	6.8	0.0000079	0.0000027	0.0000037	0.0014	0.000013	0.000054	0.00011
15-Jul-15	4	7	550	525	0.0010	0.00014	0.013	0.000028	0.00026	0.44	0.00058	0.00053	0.00056	0.00047	0.0025	0.51	0.000044	0.28	0.0000022	7.3	0.0081	5.1	0.0000080	0.000029	0.0000068	0.0010	0.000013	0.00016	0.00011
29-Jul-15	5	9	500	490	0.00062	0.000048	0.0098	0.00000049	0.00028	0.43	0.00047	0.00049	0.00043	0.00012	0.00044	0.47	0.000027	0.23	0.00000088	5.1	0.0090	3.8	0.0000063	0.0000025	0.0000025	0.00089	0.000010	0.000049	0.000098
12-Aug-15	6	11	500	490	0.00041	0.000043	0.0069	0.00000049	0.00022	0.45	0.00043	0.00049	0.00031	0.000088	0.00078	0.49	0.000029	0.24	0.00000059	3.9	0.0083	2.9	0.0000063	0.0000025	0.0000025	0.00067	0.000010	0.000049	0.000098
26-Aug-15	7	13	600	560	0.00039	0.000052	0.0065	0.00000056	0.00024	0.57	0.00051	0.00056	0.00081	0.000087	0.00070	0.58	0.000043	0.27	0.0000028	3.5	0.010	3.0	0.0000085	0.0000064	0.0000028	0.00070	0.000011	0.000056	0.00011
9-Sep-15	8	15	600	580	0.00033	0.000058	0.0053	0.00000058	0.00024	0.66	0.00054	0.00058	0.0013	0.000075	0.00052	0.62	0.000055	0.27	0.0000051	2.6	0.012	2.8	0.000010	0.000010	0.0000029	0.00066	0.000010	0.000058	0.00012
23-Sep-15	9	17	600	575	0.00027	0.000047	0.0046	0.00000058	0.00023	0.68	0.00050	0.00058	0.00079	0.000069	0.00035	0.58	0.000039	0.26	0.0000027	2.1	0.012	2.4	0.0000085	0.0000072	0.0000029	0.00063	0.000010	0.000058	0.00012
7-Oct-15	10	19	500	470	0.00017	0.000031	0.0031	0.00000047	0.00019	0.59	0.00038	0.00047	0.00023	0.000052	0.00014	0.45	0.000019	0.20	0.00000028	1.2	0.0098	1.6	0.0000057	0.0000033	0.0000024	0.00050	0.0000080	0.000047	0.000094
21-Oct-15	11	21	500	485	0.00020	0.000043	0.0040	0.00000049	0.00019	0.61	0.00040	0.00049	0.00027	0.000058	0.00015	0.45	0.000020	0.23	0.00000034	1.0	0.010	1.6	0.0000081	0.0000078	0.0000039	0.00055	0.000010	0.000049	0.000097
4-Nov-15	12	23	500	475	0.00018	0.000051	0.0038	0.0000019	0.00017	0.66	0.00032	0.00048	0.00021	0.000052	0.00024	0.48	0.000019	0.21	0.00000019	0.90	0.010	1.5	0.0000077	0.0000095	0.0000024	0.00048	0.0000090	0.000048	0.000095
18-Nov-15	13	25	500	485	0.00015	0.000027	0.0032	0.0000034	0.00018	0.68	0.00031	0.00049	0.00013	0.000034	0.00015	0.49	0.000051	0.22	0.00000058	0.79	0.010	1.5	0.0000077	0.0000049	0.0000024	0.00035	0.0000082	0.000049	0.000097
2-Dec-15	14	27	500	475	0.00013	0.000017	0.0030	0.0000033	0.00017	0.69	0.00029	0.00048	0.00012	0.000048	0.00014	0.49	0.000018	0.22	0.000000095	0.70	0.011	1.3	0.0000061	0.0000043	0.0000024	0.00038	0.0000086	0.000095	0.000095
16-Dec-15	15	29	500	475	0.00012	0.000038	0.0028	0.00012	0.00017	0.67	0.00031	0.00048	0.00012	0.000052	0.0041	0.49	0.000019	0.28	0.00000100	0.57	0.011	1.2	0.0000062	0.0000076	0.000012	0.00036	0.0000100	0.00095	0.000095
30-Dec-15	16	31	500	490	0.00012	0.000038	0.0026	0.0000083	0.00018	0.71	0.00027	0.00049	0.00016	0.000044	0.00015	0.49	0.000018	0.22	0.00000044	0.52	0.011	1.1	0.0000070	0.0000020	0.0000034	0.00036	0.000010	0.000049	0.000098
13-Jan-16	17	33	500	450	0.000099	0.000034	0.0025	0.0000063	0.00015	0.62	0.00022	0.00045	0.00012	0.000036	0.00014	0.44	0.00011	0.20	0.000000090	0.39	0.0089	0.88	0.0000038	0.0000027	0.0000023	0.00027	0.0000063	0.000045	0.000090
27-Jan-16	18	35	500	460	0.000096	0.000022	0.0021	0.00000046	0.00014	0.59	0.00020	0.00046	0.00011	0.000032	0.00014	0.42	0.000013	0.21	0.000000092	0.33	0.0099	0.91	0.0000064	0.0000041	0.0000023	0.00028	0.0000069	0.000046	0.000092
10-Feb-16	19	37	500	475	0.000091	0.000024	0.0017	0.0000071	0.00015	0.60	0.00019	0.00048	0.00011	0.000038	0.00014	0.42	0.000018	0.21	0.000000095	0.29	0.010	0.82	0.0000062	0.0000033	0.0000024	0.00025	0.0000076	0.000048	0.000095
24-Feb-16	20	39	500	470	0.000096	0.000011	0.0022	0.0000024	0.00015	0.66	0.00019	0.0019	0.00011	0.000033	0.00019	0.45	0.000016	0.21	0.000000094	0.25	0.010	0.80	0.0000058	0.00000094	0.0000024	0.00026	0.0000066	0.000047	0.000094
9-Mar-16	21	41	501	455																									

Leachate Concentrations for Col 16 (Supremo Composite)

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	320	0.23	0.0042	1.3	0.00029	0.0043	1.5	0.00053	0.65	0.18	0.10	1.1	7.3	0.0020	4.1	0.0013	270	0.029	56	0.00014	< 1E-05	0.00033	2.2	0.00076	0.0020	< 0.002
17-Jun-15	2	3	600	550	0.069	0.0015	0.55	0.0000010	0.0026	0.96	0.0028	0.16	0.084	0.014	1.5	6.0	0.00083	4.9	0.000036	204	0.018	21	0.00014	0.00034	0.00056	1.6	0.00066	< 0.001	< 0.002
1-Jul-15	3	5	550	510	0.029	0.0013	0.33	< 1E-05	0.0027	0.95	0.00041	0.050	0.051	0.0016	1.3	5.5	0.00053	5.0	0.000012	178	0.018	9.6	0.00013	0.00011	0.00029	1.2	0.00056	< 0.001	< 0.002
15-Jul-15	4	7	550	535	0.016	0.0012	0.29	0.000020	0.0025	0.79	0.00070	0.040	0.032	0.00060	1.1	4.6	0.00041	4.6	0.000044	150	0.015	6.9	0.00013	0.000040	0.00038	0.94	0.00062	< 0.001	< 0.002
29-Jul-15	5	9	500	465	0.0095	0.00091	0.18	0.0000010	0.0028	0.91	0.00038	0.020	0.022	0.00020	0.93	4.9	0.00028	4.6	0.000013	136	0.018	5.3	0.00011	0.000050	0.00017	0.69	0.00042	< 0.001	< 0.002
12-Aug-15	6	11	500	490	0.0073	0.00065	0.16	0.000030	0.0025	0.88	0.00070	0.030	0.018	0.00020	0.86	5.3	0.00034	5.1	0.000015	127	0.018	4.1	0.00019	0.000070	0.00056	0.51	0.00057	< 0.001	< 0.002
26-Aug-15	7	13	600	565	0.0059	0.00082	0.12	0.000025	0.0023	0.86	0.00066	0.020	0.016	0.00015	0.77	5.0	0.00030	4.8	0.000024	112	0.017	4.9	0.00016	0.00011	0.00040	0.43	0.00046	0.0010	0.0020
9-Sep-15	8	15	600	560	0.0045	0.00099	0.087	0.000020	0.0022	0.84	0.00062	< 0.01	0.015	< 0.0001	0.68	4.7	0.00026	4.4	0.000033	97	0.017	5.7	0.00012	0.00015	0.00023	0.35	0.00035	< 0.001	< 0.002
23-Sep-15	9	17	600	560	0.0036	0.00070	0.068	0.0000015	0.0023	0.92	0.00040	0.010	0.011	0.00010	0.57	4.8	0.00020	4.3	0.000020	91	0.018	4.0	0.00012	0.00011	0.00023	0.29	0.00031	0.0010	0.0020
7-Oct-15	10	19	500	475	0.0027	0.00041	0.048	< 1E-05	0.0024	0.99	0.00017	< 0.01	0.0068	< 0.0001	0.47	4.8	0.00014	4.2	0.0000070	85	0.020	2.2	0.00011	0.000060	0.00022	0.23	0.00026	< 0.001	< 0.002
21-Oct-15	11	21	500	465	0.0030	0.00054	0.057	< 1E-05	0.0024	1.1	0.00030	< 0.01	0.0073	< 0.0001	0.43	4.9	0.000090	4.6	0.0000050	76	0.021	2.2	0.00012	0.00023	0.000070	0.20	0.00030	< 0.001	< 0.002
4-Nov-15	12	23	500	485	0.0025	0.00052	0.051	< 1E-05	0.0023	1.3	0.00079	< 0.01	0.0063	< 0.0001	0.37	5.4	0.00010	4.4	0.0000030	78	0.023	2.5	0.00014	0.00011	0.000090	0.17	0.00026	< 0.001	< 0.002
18-Nov-15	13	25	500	460	0.0021	0.00067	0.044	0.000060	0.0026	1.4	0.0010	< 0.01	0.0053	< 0.0001	0.39	5.4	0.00062	4.6	0.000010	71	0.025	2.5	0.00016	0.00017	0.000070	0.15	0.00024	< 0.001	< 0.002
2-Dec-15	14	27	500	470	0.0022	0.00042	0.045	< 1E-05	0.0027	1.8	0.0026	< 0.01	0.0049	< 0.0001	0.32	6.3	0.00010	4.6	0.0000040	75	0.032	2.2	0.00012	0.000010	0.00014	0.15	0.00023	< 0.002	< 0.002
16-Dec-15	15	29	500	460	0.0019	0.00064	0.033	0.00027	0.0028	1.9	0.0020	< 0.01	0.0045	< 0.0001	0.27	6.6	0.00018	6.1	0.000021	63	0.033	1.4	0.00015	0.00026	0.00017	0.13	0.00024	0.0010	< 0.002
30-Dec-15	16	31	500	460	0.0016	0.00071	0.033	0.00013	0.0034	2.2	0.0017	0.010	0.0041	< 0.0001	0.26	6.8	0.00014	5.0	0.000061	59	0.040	1.5	0.00021	0.000080	0.00013	0.13	0.00023	< 0.001	< 0.002
13-Jan-16	17	33	500	445	0.0014	0.00086	0.028	0.000040	0.0029	2.3	0.0019	< 0.01	0.0037	< 0.0001	0.20	7.2	0.0014	4.4	< 2E-06	50	0.038	1.6	0.00013	0.000080	< 5E-05	0.096	0.00014	< 0.001	< 0.002
27-Jan-16	18	35	500	475	0.0012	0.00037	0.018	< 1E-05	0.0029	2.5	0.0016	< 0.01	0.0032	< 0.0001	0.19	7.1	< 4E-05	4.8	0.0000020	41	0.046	1.6	0.00017	0.000060	< 5E-05	0.094	0.00014	< 0.001	< 0.002
10-Feb-16	19	37	500	460	0.0011	0.00044	0.013	0.000090	0.0032	3.0	0.0014	< 0.01	0.0029	< 0.0001	0.16	7.4	0.000090	4.6	< 2E-06	36	0.053	1.8	0.00018	0.000070	< 5E-05	0.080	0.00013	< 0.001	< 0.002
24-Feb-16	20	39	500	455	0.0011	0.00021	0.016	0.000020	0.0034	3.7	0.0028	< 0.01	0.0029	< 0.0001	0.16	8.5	0.000050	4.8	< 2E-06	30	0.063	1.7	0.00018	0.000010	< 5E-05	0.082	0.00010	< 0.001	< 0.002
9-Mar-16	21	41	501	450																									

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	320	8.9	27	9.6	0.21	0.016	0.44	0.064	0.064	0.14	0.049	1.2	0.019	1.8	0.0027	0.0041	0.24	0.0010	0.00000045	0.00000064	0.0050	0.0000028	0.56	0.00055
17-Jun-15	2	3	600	550	8.8	23	3.3	0.089	0.0039	0.11	0.055	0.017	0.015	0.019	0.39	0.017	0.99	0.0047	0.0034	0.26	0.00050	0.00000039	0.0000044	0.0010	0.0000015	0.31	0.00016
1-Jul-15	3	5	550	510	8.7	19	1.4	0.050	0.0020	0.10	0.051	0.010	0.0051	0.0031	0.15	0.015	0.81	0.0011	0.0029	0.23	0.00050	0.00000036	0.00000036	0.0012	0.00000077	0.24	0.000069
15-Jul-15	4	7	550	535	8.6	17	0.96	0.061	0.0032	0.11	0.054	0.0054	0.0032	0.0016	0.054	0.016	0.64	0.0025	0.0029	0.23	0.00049	0.00000037	0.00000037	0.0021	0.00000064	0.19	0.000051
29-Jul-15	5	9	500	465	8.6	15	0.74	0.022	0.0019	0.093	0.047	0.0093	0.0028	0.0014	0.047	0.014	0.72	0.0014	0.0020	0.14	0.00055	0.00000033	0.00000033	0.00092	0.00000014	0.22	0.000032
12-Aug-15	6	11	500	490	8.6	15	0.59	0.023	0.0064	0.098	0.049	0.0049	0.0029	0.0015	0.049	0.015	0.70	0.0050	0.0019	0.13	0.00071	0.00000034	0.00000034	0.00088	0.00000044	0.21	0.000030
26-Aug-15	7	13	600	565	8.2	17	0.51	0.021	0.0045	0.11	0.057	0.0057	0.0034	0.0017	0.057	0.017	0.81	0.0040	0.0021	0.14	0.00079	0.00000040	0.00000040	0.00096	0.00000034	0.24	0.000031
9-Sep-15	8	15	600	560	8.5	13	0.45	0.016	0.0017	0.11	0.056	0.0056	0.0034	0.0017	0.056	0.017	0.80	0.0022	0.0020	0.12	0.00076	0.00000039	0.00000039	0.00090	0.00000017	0.24	0.000027
23-Sep-15	9	17	600	560	8.5	12	0.39	0.011	0.0017	0.11	0.056	0.0056	0.0034	0.0017	0.056	0.017	0.86	0.0017	0.0018	0.10	0.00078	0.00000039	0.00000039	0.00080	0.00000017	0.26	0.000024
7-Oct-15	10	19	500	475	8.4	11	0.24	0.0057	0.0014			0.0048	0.0029	0.0014	0.048	0.00	0.78	0.00099	0.0013	0.065	0.00069	0.00000033	0.00000033	0.00059	0.00000014	0.23	0.000017
21-Oct-15	11	21	500	465	8.5	9.6	0.23	0.0070	0.00093			0.0047	0.0028	0.0014	0.047	0.00	0.81	0.00081	0.0013	0.064	0.00084	0.00000033	0.00000033	0.00065	0.00000014	0.24	0.000021
4-Nov-15	12	23	500	485	8.5	9.6	0.29	0.0078	0.00097			0.0049	0.0029	0.0015	0.049	0.00	1.0	0.0011	0.0011	0.057	0.0010	0.00000034	0.00000034	0.00051	0.00000015	0.30	0.000023
18-Nov-15	13	25	500	460	8.6	9.4	0.23	0.0060	0.00046			0.0046	0.0028	0.0014	0.046	0.00	0.97	0.00067	0.00097	0.051	0.00085	0.00000069	0.00000046	0.00056	0.00000014	0.28	0.000018
2-Dec-15	14	27	500	470	8.5	8.0	0.19	0.0047	0.00047			0.0094	0.0028	0.0014	0.047	0.00	1.3	0.0010	0.00098	0.047	0.0013	0.00000033	0.00000033	0.00045	0.00000014	0.36	0.000019
16-Dec-15	15	29	500	460	8.5	7.2	0.18	0.0041	0.00046			0.0046	0.0028	0.0014	0.046	0.00	1.3	0.00058	0.00088	0.038	0.0014	0.00000097	0.0000011	0.00046	0.0000016	0.37	0.000023
30-Dec-15	16	31	500	460	8.4	6.0	0.18	0.0028	0.00046			0.0046	0.0028	0.0014	0.046	0.00	1.6	0.0012	0.00086	0.037	0.0016	0.00000032	0.00000032	0.00051	0.00000014	0.46	0.000021
13-Jan-16	17	33	500	445	8.3	5.8	0.18	0.0027	0.00045			0.0089	0.0027	0.0013	0.045	0.00	1.4	0.00053	0.00071	0.025	0.0014	0.00000031	0.00000031	0.00045	0.00000013	0.41	0.000017
27-Jan-16	18	35	500	475	8.3	5.8	0.19	0.0029	0.00048			0.0095	0.0029	0.0014	0.048	0.00	1.7	0.00039	0.00072	0.027	0.0018	0.00000033	0.00000033	0.00043	0.00000014	0.50	0.000017
10-Feb-16	19	37	500	460	8.3	5.4	0.18	0.0023	0.00046			0.0092	0.0028	0.0014	0.046	0.00	2.0	0.00027	0.00067	0.024	0.0021	0.00000032	0.00000032	0.00032	0.00000014	0.57	0.000017
24-Feb-16	20	39	500	455	8.3	5.3	0.14	0.0018	0.00091			0.0091	0.0027	0.0014	0.046	0.00	2.4	0.00015	0.00062	0.021	0.0023	0.00000032	0.00000032	0.00032	0.00000014	0.67	0.000016
9-Mar-16	21	41	501	450	8.3	4.9	0.14																				

Leachate Concentrations for Col 17 (Supremo/Kone Composite)

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	$mgCaCO_3/L$	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	315	8.9	404	135	4.6	0.26	6.8	*< 1*	0.90	1.4	0.66	17	*< 0.3*	24	0.054	0.11	8.9	0.0084	*< 7E-06*	*< 7E-06*	0.054	0.000033	7.5	0.0064
17-Jun-15	2	3	600	560	8.8	395	60	1.9	0.090	*< 2*	*< 1*	0.30	0.28	0.41	8.0	*< 0.3*	20	0.099	0.089	7.9	0.0065	*< 7E-06*	0.0000070	0.017	0.000022	6.6	0.0020
1-Jul-15	3	5	550	520	8.7	364	32	1.2	0.040	*< 2*	*< 1*	0.20	0.090	0.11	3.0	*< 0.3*	16	0.076	0.082	6.9	0.0061	*< 7E-06*	*< 7E-06*	0.020	0.000014	5.2	0.0010
15-Jul-15	4	7	550	515	8.7	302	23	1.2	0.060	*< 2*	*< 1*	0.10	*< 0.06*	0.030	1.0	*< 0.3*	12	0.20	0.072	5.9	0.0056	0.0000070	*< 7E-06*	0.030	0.0000050	3.6	0.00066
29-Jul-15	5	9	500	475	8.6	297	15	0.52	0.060	*< 2*	*< 1*	0.20	*< 0.06*	*< 0.03*	1.0	*< 0.3*	14	0.13	0.062	4.9	0.0071	0.000012	*< 7E-06*	0.018	*< 3E-06*	4.5	0.00045
12-Aug-15	6	11	500	485	8.6	268	19	0.48	0.040	*< 2*	*< 1*	0.20	*< 0.06*	0.030	1.0	*< 0.3*	14	0.18	0.051	4.0	0.0094	*< 7E-06*	*< 7E-06*	0.016	0.0000040	4.1	0.00051
26-Aug-15	7	13	600	555	8.1	273	13	0.38	0.035	2.0	1.0	0.15	0.060	0.030	1.0	0.30	14	0.12	0.048	3.6	0.0089	0.0000070	0.0000070	0.014	0.0000035	4.2	0.00040
9-Sep-15	8	15	600	570	8.6	214	10	0.28	0.030	*< 2*	*< 1*	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	*< 0.3*	14	0.062	0.045	3.2	0.0084	*< 7E-06*	*< 7E-06*	0.013	*< 3E-06*	4.2	0.00029
23-Sep-15	9	17	600	560	8.5	201	9.0	0.22	0.025	-	-	0.10	0.060	0.030	1.0	-	15	0.052	0.041	2.7	0.0092	0.0000070	0.0000070	0.012	0.0000030	4.6	0.00027
7-Oct-15	10	19	500	460	8.4	202	7.0	0.16	0.020	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	17	0.043	0.037	2.1	0.0100	*< 7E-06*	*< 7E-06*	0.011	*< 3E-06*	5.1	0.00025
21-Oct-15	11	21	500	475	8.5	187	8.0	0.17	0.020	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	17	0.018	0.035	2.1	0.012	*< 7E-06*	*< 7E-06*	0.012	*< 3E-06*	5.1	0.00031
4-Nov-15	12	23	500	485	8.5	180	7.0	0.15	0.020	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	20	0.026	0.029	1.8	0.013	*< 7E-06*	*< 7E-06*	0.0086	0.0000080	6.1	0.00033
18-Nov-15	13	25	500	465	8.5	187	6.0	0.10	*< 0.01*	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	21	0.033	0.027	1.6	0.014	*< 7E-06*	*< 7E-06*	0.0073	0.0000040	6.3	0.00023
2-Dec-15	14	27	500	460	8.4	155	6.0	0.12	0.010	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	28	0.068	0.026	1.4	0.020	*< 7E-06*	*< 7E-06*	0.0081	*< 3E-06*	8.3	0.00023
16-Dec-15	15	29	500	465	8.4	145	6.0	0.10	0.010	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	31	0.017	0.024	1.2	0.023	0.000020	0.000025	0.0085	0.0000040	9.3	0.00031
30-Dec-15	16	31	500	475	8.4	123	5.0	0.070	*< 0.01*	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	37	0.033	0.026	1.3	0.027	*< 7E-06*	*< 7E-06*	0.011	0.0000070	11	0.00033
13-Jan-16	17	33	500	445	8.3	126	5.0	0.090	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	34	0.012	0.021	0.88	0.022	*< 7E-06*	*< 7E-06*	0.0080	*< 3E-06*	10.0	0.00027
27-Jan-16	18	35	500	455	8.3	120	6.0	0.080	*< 0.01*	-	-	*< 0.1*	*< 0.06*	*< 0.03*	*< 1*	-	39	0.023	0.020	0.86	0.027	*< 7E-06*	*< 7E-06*	0.0080	*< 3E-06*	11	0.00024
10-Feb-16	19	37	500	465	8.2	114	5.0	0.060	*< 0.01*	-	-	0.10	*< 0.06*	*< 0.03*	*< 1*	-	43	0.0079	0.020	0.85	0.029	*< 7E-06*	*< 7E-06*	0.0060	*< 3E-06*	13	0.00023
24-Feb-16	20	39	500	465	8.3	112	4.0	0.050	*< 0.01*	-	-	0.20	*< 0.06*	*< 0.03*	*< 1*	-	51	0.0052	0.018	0.77	0.033	*< 7E-06*	*< 7E-06*	0.0050	*< 3E-06*	15	0.00027
9-Mar-16	21	41	501	455	8.3	106	4.0																				

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		pH	Alkalinity	Sulphate	Total CN	WAD CN	SCN	CNO	Ammonia-N	Nitrate-N	Nitrite-N	Chloride	Bromide	Hardness	Al	Sb	As	Ba	Be	Bi	B	Cd	Ca	Cr
	No.		Input	Output		$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	$mgCaCO_3/kg/wk$	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	315	8.9	25	8.5	0.29	0.016	0.43	0.063	0.057	0.088	0.042	1.1	0.019	1.5	0.0034	0.0066	0.56	0.00053	0.00000044	0.00000044	0.0034	0.0000021	0.47	0.00040
17-Jun-15	2	3	600	560	8.8	22	3.4	0.11	0.0050	0.11	0.056	0.017	0.016	0.023	0.45	0.017	1.1	0.0055	0.0050	0.44	0.00036	0.00000039	0.00000039	0.00094	0.0000012	0.37	0.00011
1-Jul-15	3	5	550	520	8.7	19	1.7	0.064	0.0021	0.10	0.052	0.010	0.0047	0.0057	0.16	0.016	0.85	0.0040	0.0043	0.36	0.00032	0.00000036	0.00000036	0.0011	0.00000073	0.27	0.000054
15-Jul-15	4	7	550	515	8.7	16	1.2	0.064	0.0031	0.10	0.052	0.0052	0.0031	0.0015	0.052	0.015	0.61	0.010	0.0037	0.30	0.00029	0.00000036	0.00000036	0.0015	0.00000026	0.19	0.000034
29-Jul-15	5	9	500	475	8.6	14	0.71	0.025	0.0029	0.095	0.048	0.0095	0.0029	0.0014	0.048	0.014	0.68	0.0061	0.0029	0.23	0.00034	0.00000057	0.00000033	0.00086	0.00000014	0.21	0.000021
12-Aug-15	6	11	500	485	8.6	13	0.92	0.023	0.0019	0.097	0.049	0.0097	0.0029	0.0015	0.049	0.015	0.65	0.0086	0.0025	0.20	0.00046	0.00000034	0.00000034	0.00077	0.00000019	0.20	0.000025
26-Aug-15	7	13	600	555	8.1	15	0.72	0.021	0.0019	0.11	0.056	0.0083	0.0033	0.0017	0.056	0.017	0.75	0.0066	0.0027	0.20	0.00050	0.00000039	0.00000039	0.00080	0.00000019	0.23	0.000022
9-Sep-15	8	15	600	570	8.6	12	0.57	0.016	0.0017	0.11	0.057	0.0057	0.0034	0.0017	0.057	0.017	0.78	0.0035	0.0026	0.18	0.00048	0.00000040	0.00000040	0.00075	0.00000017	0.24	0.000017
23-Sep-15	9	17	600	560	8.5	11	0.50	0.012	0.0014			0.0056	0.0034	0.0017	0.056		0.84	0.0029	0.0023	0.15	0.00052	0.00000039	0.00000039	0.00066	0.00000017	0.26	0.000015
7-Oct-15	10	19	500	460	8.4	9.3	0.32	0.0074	0.00092			0.0046	0.0028	0.0014	0.046		0.76	0.0020	0.0017	0.098	0.00046	0.00000032	0.00000032	0.00048	0.00000014	0.23	0.000012
21-Oct-15	11	21	500	475	8.5	8.9	0.38	0.0081	0.00095			0.0048	0.0029	0.0014	0.048		0.80	0.00086	0.0016	0.100	0.00055	0.00000033	0.00000033	0.00055	0.00000014	0.24	0.000015
4-Nov-15	12	23	500	485	8.5	8.7	0.34	0.0073	0.00097			0.0049	0.0029	0.0015	0.049		0.97	0.0013	0.0014	0.087	0.00064	0.00000034	0.00000034	0.00042	0.00000039	0.30	0.000016
18-Nov-15	13	25	500	465	8.5	8.7	0.28	0.0047	0.00047			0.0047	0.0028	0.0014	0.047		0.98	0.0015	0.0012	0.074	0.00065	0.00000033	0.00000033	0.00034	0.00000019	0.29	0.000011
2-Dec-15	14	27	500	460	8.4	7.1	0.28	0.0055	0.00046			0.0092	0.0028	0.0014	0.046		1.3	0.0031	0.0012	0.065	0.00093	0.00000032	0.00000032	0.00037	0.00000014	0.38	0.000011
16-Dec-15	15	29	500	465	8.4	6.7	0.28	0.0047	0.00047			0.0047	0.0028	0.0014	0.047		1.4	0.00079	0.0011	0.057	0.0011	0.00000093	0.0000012	0.00040	0.0000019	0.43	0.000014
30-Dec-15	16	31	500	475	8.4	5.8	0.24	0.0033	0.00048			0.0048	0.0029	0.0014	0.048		1.7	0.0016	0.0012	0.060	0.0013	0.00000033	0.00000033	0.00051	0.00000033	0.51	0.000016
13-Jan-16	17	33	500	445	8.3	5.6	0.22	0.0040	0.00045			0.0089	0.0027	0.0013	0.045		1.5	0.00055	0.00094	0.039	0.00099	0.00000031	0.00000031	0.00036	0.00000013	0.44	0.000012
27-Jan-16	18	35	500	455	8.3	5.5	0.27	0.0036	0.00046			0.0046	0.0027	0.0014	0.046		1.8	0.0011	0.00092	0.039	0.0012	0.00000032	0.00000032	0.00036	0.00000014	0.52	0.000011
10-Feb-16	19	37	500	465	8.2	5.3	0.23	0.0028	0.00047			0.0047	0.0028	0.0014	0.047		2.0	0.00037	0.00092	0.039	0.0014	0.00000033	0.00000033	0.00028	0.00000014	0.60	0.000011
24-Feb-16	20	39	500	465	8.3	5.2	0.19	0.0023	0.00047			0.0093	0.0028	0.0014	0.047		2.4	0.00024	0.00086	0.036	0.0015	0.00000033	0.00000033	0.00023	0.00000014	0.69	0.000013
9-Mar-16	21	41	501	455	8.3	4.8	0.18																				

Appendix D.3-3: Leachate Concentrations and Calculated Loading Rates for Leach Tailings Kinetic Tests

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	320	0.015	0.00027	0.084	0.000019	0.00028	0.097	0.000034	0.042	0.011	0.0065	0.070	0.46	0.00013	0.26	0.000080	17	0.0018	3.6	0.0000090	0.00000064	0.000021	0.14	0.000049	0.00013	0.00013
17-Jun-15	2	3	600	550	0.0038	0.000085	0.030	0.00000055	0.00014	0.053	0.00016	0.0088	0.0046	0.00077	0.081	0.33	0.000046	0.27	0.0000020	11	0.0010	1.1	0.0000075	0.000019	0.000031	0.087	0.000036	0.000055	0.00011
1-Jul-15	3	5	550	510	0.0015	0.000066	0.017	0.00000051	0.00014	0.048	0.000021	0.0026	0.0026	0.000082	0.064	0.28	0.000027	0.25	0.00000061	9.1	0.00093	0.49	0.0000065	0.0000056	0.000015	0.059	0.000029	0.000051	0.00010
15-Jul-15	4	7	550	535	0.00088	0.000066	0.016	0.0000011	0.00013	0.042	0.000037	0.0021	0.0017	0.000032	0.058	0.25	0.000022	0.25	0.0000024	8.0	0.00081	0.37	0.0000072	0.0000021	0.000020	0.050	0.000033	0.000054	0.00011
29-Jul-15	5	9	500	465	0.00044	0.000042	0.0083	0.00000047	0.00013	0.042	0.000018	0.00093	0.0010	0.0000093	0.043	0.23	0.000013	0.21	0.00000060	6.3	0.00085	0.25	0.0000053	0.0000023	0.0000079	0.032	0.000020	0.000047	0.000093
12-Aug-15	6	11	500	490	0.00036	0.000032	0.0078	0.0000015	0.00012	0.043	0.000034	0.0015	0.00087	0.0000098	0.042	0.26	0.000017	0.25	0.00000074	6.2	0.00089	0.20	0.0000092	0.0000034	0.000027	0.025	0.000028	0.000049	0.000098
26-Aug-15	7	13	600	565	0.00033	0.000046	0.0070	0.0000014	0.00013	0.049	0.000037	0.0011	0.00092	0.0000085	0.043	0.28	0.000017	0.27	0.0000014	6.3	0.00098	0.28	0.0000088	0.0000062	0.000022	0.024	0.000026	0.000057	0.00011
9-Sep-15	8	15	600	560	0.00025	0.000055	0.0049	0.0000011	0.00012	0.047	0.000035	0.00056	0.00082	0.0000056	0.038	0.27	0.000015	0.25	0.0000018	5.4	0.00094	0.32	0.0000069	0.0000084	0.000013	0.019	0.000020	0.000056	0.00011
23-Sep-15	9	17	600	560	0.00020	0.000039	0.0038	0.00000084	0.00013	0.051	0.000022	0.00056	0.00060	0.0000056	0.032	0.27	0.000011	0.24	0.0000011	5.1	0.0010	0.22	0.0000066	0.0000059	0.000013	0.016	0.000017	0.000056	0.00011
7-Oct-15	10	19	500	475	0.00013	0.000019	0.0023	0.00000048	0.00011	0.047	0.0000081	0.00048	0.00032	0.0000048	0.022	0.23	0.0000067	0.20	0.00000033	4.0	0.00093	0.10	0.0000053	0.0000029	0.000010	0.011	0.000012	0.000048	0.000095
21-Oct-15	11	21	500	465	0.00014	0.000025	0.0027	0.00000047	0.00011	0.053	0.000014	0.00047	0.00034	0.0000047	0.020	0.23	0.0000042	0.21	0.00000023	3.5	0.00096	0.10	0.0000057	0.000011	0.0000033	0.0095	0.000014	0.000047	0.000093
4-Nov-15	12	23	500	485	0.00012	0.000025	0.0025	0.00000049	0.00011	0.063	0.000038	0.00049	0.00030	0.0000049	0.018	0.26	0.0000049	0.21	0.00000015	3.8	0.0011	0.12	0.0000066	0.0000053	0.0000044	0.0082	0.000013	0.000049	0.000097
18-Nov-15	13	25	500	460	0.000098	0.000031	0.0020	0.0000028	0.00012	0.063	0.000046	0.00046	0.00024	0.0000046	0.018	0.25	0.000029	0.21	0.00000046	3.3	0.0011	0.12	0.0000075	0.0000078	0.0000032	0.0071	0.000011	0.000046	0.000092
2-Dec-15	14	27	500	470	0.00010	0.000020	0.0021	0.00000047	0.00013	0.085	0.00012	0.00047	0.00023	0.0000047	0.015	0.30	0.0000047	0.22	0.00000019	3.5	0.0015	0.10	0.0000058	0.00000047	0.0000066	0.0068	0.000011	0.000094	0.000094
16-Dec-15	15	29	500	460	0.000087	0.000029	0.0015	0.000012	0.00013	0.087	0.000090	0.00046	0.00020	0.0000046	0.013	0.30	0.0000083	0.28	0.00000097	2.9	0.0015	0.064	0.0000068	0.000012	0.0000078	0.0059	0.000011	0.000046	0.000092
30-Dec-15	16	31	500	460	0.000073	0.000033	0.0015	0.0000060	0.00016	0.10	0.000080	0.00046	0.00019	0.0000046	0.012	0.31	0.0000064	0.23	0.0000028	2.7	0.0018	0.069	0.0000095	0.0000037	0.0000060	0.0058	0.000011	0.000046	0.000092
13-Jan-16	17	33	500	445	0.000061	0.000038	0.0012	0.0000018	0.00013	0.10	0.000083	0.00045	0.00017	0.0000045	0.0089	0.32	0.000062	0.20	0.000000089	2.2	0.0017	0.071	0.0000056	0.0000036	0.0000022	0.0043	0.0000062	0.000045	0.000089
27-Jan-16	18	35	500	475	0.000057	0.000018	0.00086	0.00000048	0.00014	0.12	0.000074	0.00048	0.00015	0.0000048	0.0091	0.34	0.0000019	0.23	0.000000095	2.0	0.0022	0.076	0.0000083	0.0000029	0.0000024	0.0045	0.0000067	0.000048	0.000095
10-Feb-16	19	37	500	460	0.000052	0.000020	0.00060	0.0000041	0.00015	0.14	0.000065	0.00046	0.00013	0.0000046	0.0075	0.34	0.0000041	0.21	0.000000092	1.7	0.0024	0.083	0.0000082	0.0000032	0.0000023	0.0037	0.0000060	0.000046	0.000092
24-Feb-16	20	39	500	455	0.000052	0.0000096	0.00073	0.00000091	0.00016	0.17	0.00013	0.00046	0.00013	0.0000046	0.0071	0.38	0.0000023	0.22	0.000000091	1.4	0.0028	0.077	0.0000080	0.00000046	0.0000023	0.0037	0.0000046	0.000046	0.000091
9-Mar-16	21	41	501	450																									

Leachate Concentrations for Col 17 (Supremo/Kone Composite)

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
3-Jun-15	1	1	700	315	0.20	0.0055	1.8	0.00026	0.0032	1.2	0.00031	0.54	0.14	0.075	1.4	7.0	0.0010	3.9	0.00076	262	0.023	52	0.00014	*< 1E-05*	0.00031	2.5	0.0011	0.0020	*< 0.002*
17-Jun-15	2	3	600	560	0.072	0.0020	0.69	0.00032	0.0021	0.94	0.0014	0.14	0.076	0.016	1.7	6.1	0.00091	4.5	0.000052	200	0.019	22	0.00016	0.00014	0.00069	1.8	0.00081	*< 0.001*	*< 0.002*
1-Jul-15	3	5	550	520	0.033	0.0012	0.41	*< 1E-05*	0.0021	0.82	0.00083	0.050	0.047	0.0028	1.4	5.3	0.00057	4.7	0.0000080	173	0.017	10	0.00014	0.000080	0.00032	1.3	0.00069	*< 0.001*	*< 0.002*
15-Jul-15	4	7	550	515	0.018	0.0014	0.36	0.000040	0.0019	0.68	0.0011	0.040	0.028	0.00070	1.2	4.7	0.00055	4.7	0.000029	144	0.014	7.9	0.00013	0.000070	0.00083	1.0	0.00081	*< 0.001*	*< 0.002*
29-Jul-15	5	9	500	475	0.011	0.0015	0.22	0.000040	0.0021	0.79	0.00058	0.020	0.021	0.00030	1.0	4.8	0.00032	4.3	0.0000060	130	0.016	6.2	0.00011	0.00023	0.00039	0.77	0.00054	*< 0.001*	*< 0.002*
12-Aug-15	6	11	500	485	0.011	0.00085	0.19	0.000040	0.0019	0.78	0.00080	0.040	0.018	0.00020	0.84	5.4	0.00030	4.7	0.000016	121	0.017	5.9	0.00023	0.000070	0.00069	0.55	0.00069	*< 0.001*	*< 0.002*
26-Aug-15	7	13	600	555	0.0078	0.00091	0.15	0.000030	0.0017	0.77	0.00081	0.025	0.015	0.00015	0.76	5.0	0.00027	4.3	0.000017	106	0.016	6.4	0.00018	0.00013	0.00050	0.47	0.00058	0.0010	0.0020
9-Sep-15	8	15	600	570	0.0049	0.00097	0.10	0.000020	0.0015	0.77	0.00081	*< 0.01*	0.012	*< 0.0001*	0.69	4.6	0.00024	3.9	0.000017	92	0.015	6.8	0.00013	0.00018	0.00031	0.38	0.00047	*< 0.001*	*< 0.002*
23-Sep-15	9	17	600	560	0.0039	0.00074	0.079	0.000015	0.0016	0.85	0.00051	0.010	0.0091	0.00010	0.59	4.7	0.00018	3.9	0.000012	86	0.017	5.0	0.00012	0.00013	0.00027	0.32	0.00038	0.0010	0.0020
7-Oct-15	10	19	500	460	0.0030	0.00051	0.056	0.000010	0.0017	0.92	0.00021	*< 0.01*	0.0064	*< 0.0001*	0.49	4.8	0.00011	3.9	0.0000060	80	0.019	3.2	0.00011	0.000080	0.00023	0.25	0.00028	*< 0.001*	*< 0.002*
21-Oct-15	11	21	500	475	0.0033	0.00066	0.062	*< 1E-05*	0.0017	1.0	0.00012	*< 0.01*	0.0069	*< 0.0001*	0.43	4.7	0.00013	3.9	0.0000020	69	0.019	2.9	0.00015	0.00014	0.000060	0.23	0.00036	*< 0.001*	*< 0.002*
4-Nov-15	12	23	500	485	0.0028	0.00063	0.056	*< 1E-05*	0.0016	1.2	0.00036	*< 0.01*	0.0061	*< 0.0001*	0.39	5.2	0.00013	3.8	0.0000020	71	0.021	3.1	0.00014	0.000090	0.00011	0.19	0.00029	*< 0.001*	*< 0.002*
18-Nov-15	13	25	500	465	0.0023	0.00098	0.049	0.00020	0.0018	1.3	0.0017	*< 0.01*	0.0044	*< 0.0001*	0.37	5.3	0.00035	4.0	0.000015	65	0.024	2.8	0.00015	0.00011	0.00010	0.18	0.00022	*< 0.001*	*< 0.002*
2-Dec-15	14	27	500	460	0.0022	0.00048	0.054	*< 1E-05*	0.0020	1.7	0.0015	0.010	0.0049	0.00010	0.31	6.2	0.00010	4.1	*< 2E-06*	65	0.031	2.8	0.00015	0.000080	0.00017	0.16	0.00024	*< 0.002*	*< 0.002*
16-Dec-15	15	29	500	465	0.0022	0.00055	0.047	0.00025	0.0020	1.9	0.0011	*< 0.01*	0.0048	*< 0.0001*	0.26	6.6	0.00018	5.5	0.000024	57	0.036	2.3	0.00017	0.00027	0.000060	0.14	0.00022	*< 0.001*	*< 0.002*
30-Dec-15	16	31	500	475	0.0020	0.00063	0.039	0.00014	0.0026	2.3	0.0020	0.010	0.0046	*< 0.0001*	0.25	7.4	0.00010	4.3	0.000017	58	0.043	2.1	0.00023	0.000090	*< 5E-05*	0.15	0.00024	*< 0.001*	*< 0.002*
13-Jan-16	17	33	500	445	0.0016	0.00054	0.029	0.000050	0.0021	2.2	0.00070	*< 0.01*	0.0035	*< 0.0001*	0.20	7.2	0.0010	4.1	*< 2E-06*	48	0.038	2.0	0.00013	0.000050	*< 5E-05*	0.11	0.00014	*< 0.001*	*< 0.002*
27-Jan-16	18	35	500	455	0.0015	0.00042	0.024	0.000020	0.0021	2.5	0.00070	*< 0.01*	0.0032	*< 0.0001*	0.19	7.0	*< 4E-05*	4.2	*< 2E-06*	40	0.048	2.2	0.00018	0.000070	*< 5E-05*	0.11	0.00015	*< 0.001*	*< 0.002*
10-Feb-16	19	37	500	465	0.0013	0.00037	0.016	0.00010	0.0022	2.7	0.00079	*< 0.01*	0.0029	*< 0.0001*	0.18	7.2	0.000090	4.0	*< 2E-06*	35	0.052	2.3	0.00019	0.000060	*< 5E-05*	0.094	0.00014	*< 0.001*	*< 0.002*
24-Feb-16	20	39	500	465	0.0013	0.00032	0.021	0.000030	0.0024	3.4	0.00095	0.020	0.0029	*< 0.0001*	0.17	7.9	0.000050	4.2	*< 2E-06*	31	0.058	2.3	0.00019	0.000050	*< 5E-05*	0.100	0.00010	*< 0.001*	*< 0.002*
9-Mar-16	21	41	501	455																									

Calculated Loading Rates for Col 2

Date	Cycle	Weeks	Volume (mL)		Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo	Ni	P	K	Se	Si	Ag	Na	Sr	S	Tl	Sn	Ti	U	V	Zn	Zr
	No.		Input	Output	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
3-Jun-15	1	1	700	315	0.013	0.00034	0.12	0.000016	0.00020	0.076	0.000020	0.034	0.0089	0.0047	0.091	0.44	0.000063	0.25	0.000048	17	0.0015	3.2	0.0000087	0.00000063	0.000020	0.15	0.000066	0.00013	0.00013
17-Jun-15	2	3	600	560	0.0040	0.00011	0.039	0.000018	0.00011	0.053	0.000077	0.0078	0.0042	0.00087	0.092	0.34	0.000051	0.25	0.0000029	11	0.0011	1.2	0.0000091	0.0000078	0.000039	0.10	0.000045	0.000056	0.00011
1-Jul-15	3	5	550	520	0.0017	0.000063	0.021	0.00000052	0.00011	0.043	0.000043	0.0026	0.0024	0.00015	0.071	0.28	0.000030	0.25	0.00000042	9.0	0.00090	0.54	0.0000074	0.0000042	0.000017	0.068	0.000036	0.000052	0.00010
15-Jul-15	4	7	550	515	0.00093	0.000074	0.018	0.0000021	0.000097	0.035	0.000055	0.0021	0.0014	0.000036	0.059	0.24	0.000028	0.24	0.0000015	7.4	0.00070	0.41	0.0000065	0.0000036	0.000043	0.052	0.000042	0.000052	0.00010
29-Jul-15	5	9	500	475	0.00051	0.000071	0.010	0.0000019	0.00010	0.038	0.000028	0.00095	0.00098	0.0000014	0.048	0.23	0.000015	0.21	0.00000029	6.2	0.00077	0.29	0.0000054	0.000011	0.000019	0.036	0.000026	0.000048	0.000095
12-Aug-15	6	11	500	485	0.00052	0.000041	0.0092	0.0000019	0.000091	0.038	0.000039	0.0019	0.00086	0.0000097	0.041	0.26	0.000015	0.23	0.00000078	5.9	0.00082	0.29	0.000011	0.0000034	0.000033	0.027	0.000033	0.000049	0.000097
26-Aug-15	7	13	600	555	0.00043	0.000051	0.0081	0.0000017	0.000094	0.043	0.000045	0.0014	0.00082	0.0000083	0.042	0.28	0.000015	0.24	0.00000092	5.9	0.00089	0.35	0.0000100	0.0000069	0.000028	0.026	0.000032	0.000056	0.00011
9-Sep-15	8	15	600	570	0.00028	0.000055	0.0058	0.0000011	0.000086	0.044	0.000046	0.00057	0.00067	0.0000057	0.039	0.26	0.000014	0.22	0.00000097	5.2	0.00087	0.39	0.0000073	0.000010	0.000018	0.022	0.000027	0.000057	0.00011
23-Sep-15	9	17	600	560	0.00022	0.000041	0.0044	0.00000084	0.000089	0.047	0.000029	0.00056	0.00051	0.0000056	0.033	0.26	0.0000098	0.22	0.00000064	4.8	0.00095	0.28	0.0000066	0.0000073	0.000015	0.018	0.000021	0.000056	0.00011
7-Oct-15	10	19	500	460	0.00014	0.000023	0.0026	0.00000046	0.000078	0.043	0.0000097	0.00046	0.00029	0.0000046	0.022	0.22	0.0000051	0.18	0.00000028	3.7	0.00086	0.15	0.0000050	0.0000037	0.000011	0.011	0.000013	0.000046	0.000092
21-Oct-15	11	21	500	475	0.00016	0.000031	0.0029	0.00000048	0.000079	0.048	0.0000057	0.00048	0.00033	0.0000048	0.020	0.22	0.0000062	0.19	0.000000095	3.3	0.00092	0.14	0.0000071	0.0000067	0.0000029	0.011	0.0000017	0.000048	0.000095
4-Nov-15	12	23	500	485	0.00013	0.000031	0.0027	0.00000049	0.000076	0.057	0.000017	0.00049	0.00029	0.0000049	0.019	0.25	0.0000063	0.18	0.000000097	3.5	0.0010	0.15	0.0000070	0.0000044	0.0000053	0.0093	0.000014	0.000049	0.000097
18-Nov-15	13	25	500	465	0.00011	0.000046	0.0023	0.0000093	0.000084	0.060	0.000078	0.00047	0.00020	0.0000047	0.017	0.25	0.000016	0.18	0.00000070	3.0	0.0011	0.13	0.0000071	0.0000051	0.0000047	0.0083	0.000010	0.000047	0.000093
2-Dec-15	14	27	500	460	0.00010	0.000022	0.0025	0.00000046	0.000090	0.078	0.000067	0.00046	0.00022	0.0000046	0.014	0.28	0.0000046	0.19	0.000000092	3.0	0.0014	0.13	0.0000070	0.0000037	0.0000078	0.0075	0.000011	0.000092	0.000092
16-Dec-15	15	29	500	465	0.00010	0.000026	0.0022	0.000012	0.000093	0.086	0.000050	0.00047	0.00022	0.0000047	0.012	0.31	0.0000084	0.25	0.0000011	2.6	0.0017	0.11	0.0000079	0.000013	0.0000028	0.0066	0.000010	0.000047	0.000093
30-Dec-15	16	31	500	475	0.000094	0.000030	0.0019	0.0000067	0.00012	0.11	0.000097	0.00048	0.00022	0.0000048	0.012	0.35	0.0000048	0.20	0.00000081	2.8	0.0020	0.100	0.000011	0.0000043	0.0000024	0.0071	0.000011	0.000048	0.000095
13-Jan-16	17	33	500	445	0.000069	0.000024	0.0013	0.0000022	0.000093	0.099	0.000031	0.00045	0.00016	0.0000045	0.0088	0.32	0.000046	0.18	0.000000089	2.1	0.0017	0.089	0.0000056	0.0000022	0.0000022	0.0049	0.0000062	0.000045	0.000089
27-Jan-16	18	35	500	455	0.000066	0.000019	0.0011	0.00000091	0.000096	0.11	0.000032	0.00046	0.00015	0.0000046	0.0088	0.32	0.0000018	0.19	0.000000091	1.8	0.0022	0.10	0.0000080	0.0000032	0.0000023	0.0050	0.0000068	0.000046	0.000091
10-Feb-16	19	37	500	465	0.000059	0.000017	0.00074	0.0000047	0.000100	0.13	0.000037	0.00047	0.00014	0.0000047	0.0081	0.33	0.0000042	0.18	0.000000093	1.6	0.0024	0.11	0.0000087	0.0000028	0.0000023	0.0043	0.0000065	0.000047	0.000093
24-Feb-16	20	39	500	465	0.000062	0.000015	0.00098	0.0000014	0.00011	0.16	0.000044	0.00093	0.00014	0.0000047	0.0077	0.37	0.0000023	0.20	0.000000093	1.4	0.0027	0.11	0.0000088	0.0000023	0.0000023	0.0046	0.0000047	0.000047	0.000093
9-Mar-16	21	41	501	455																									

Notes:
Values in grey italics are below the analytical detection limit

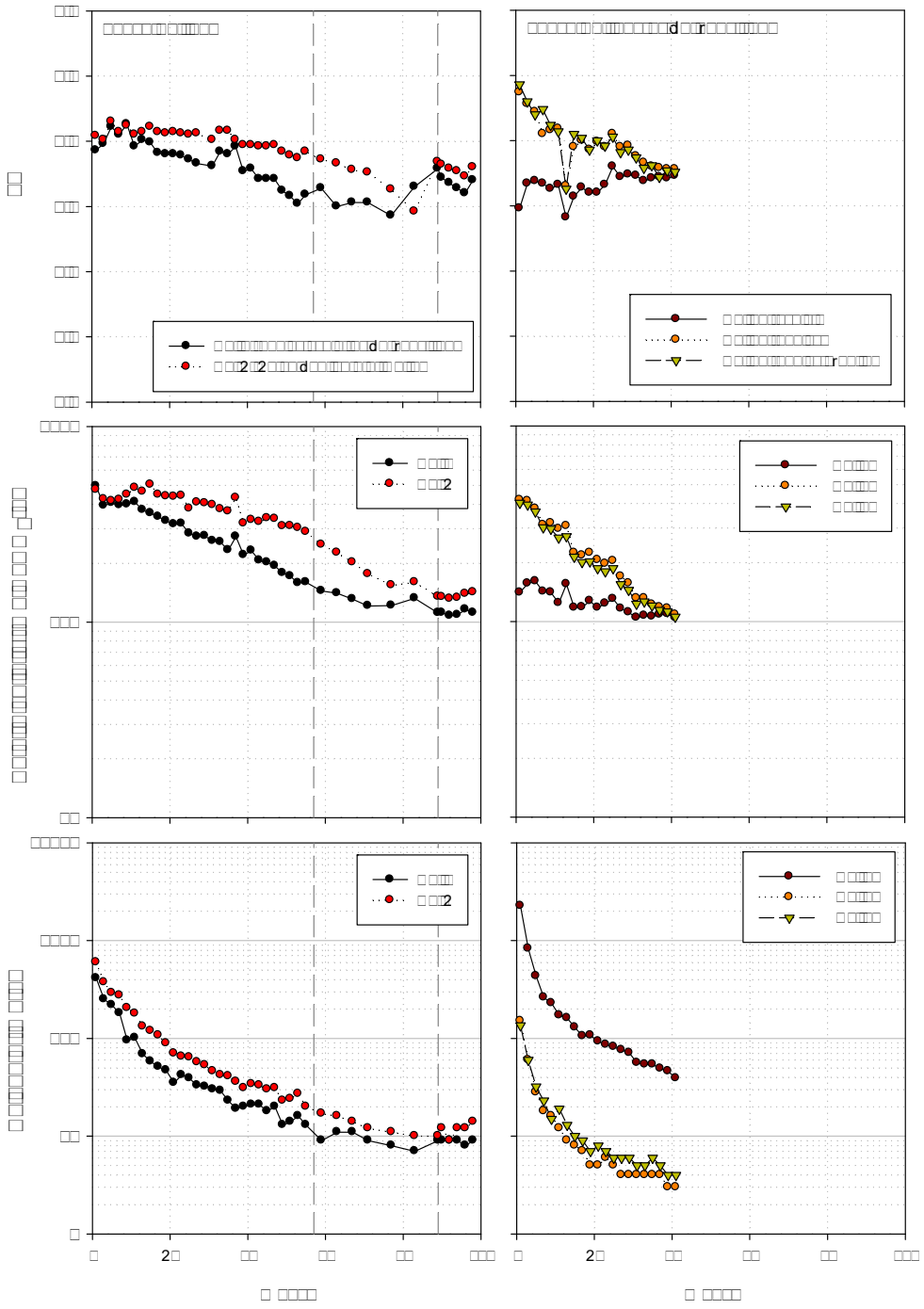
Leachate Concentrations for Leach Tailings Field Kinetic Tests

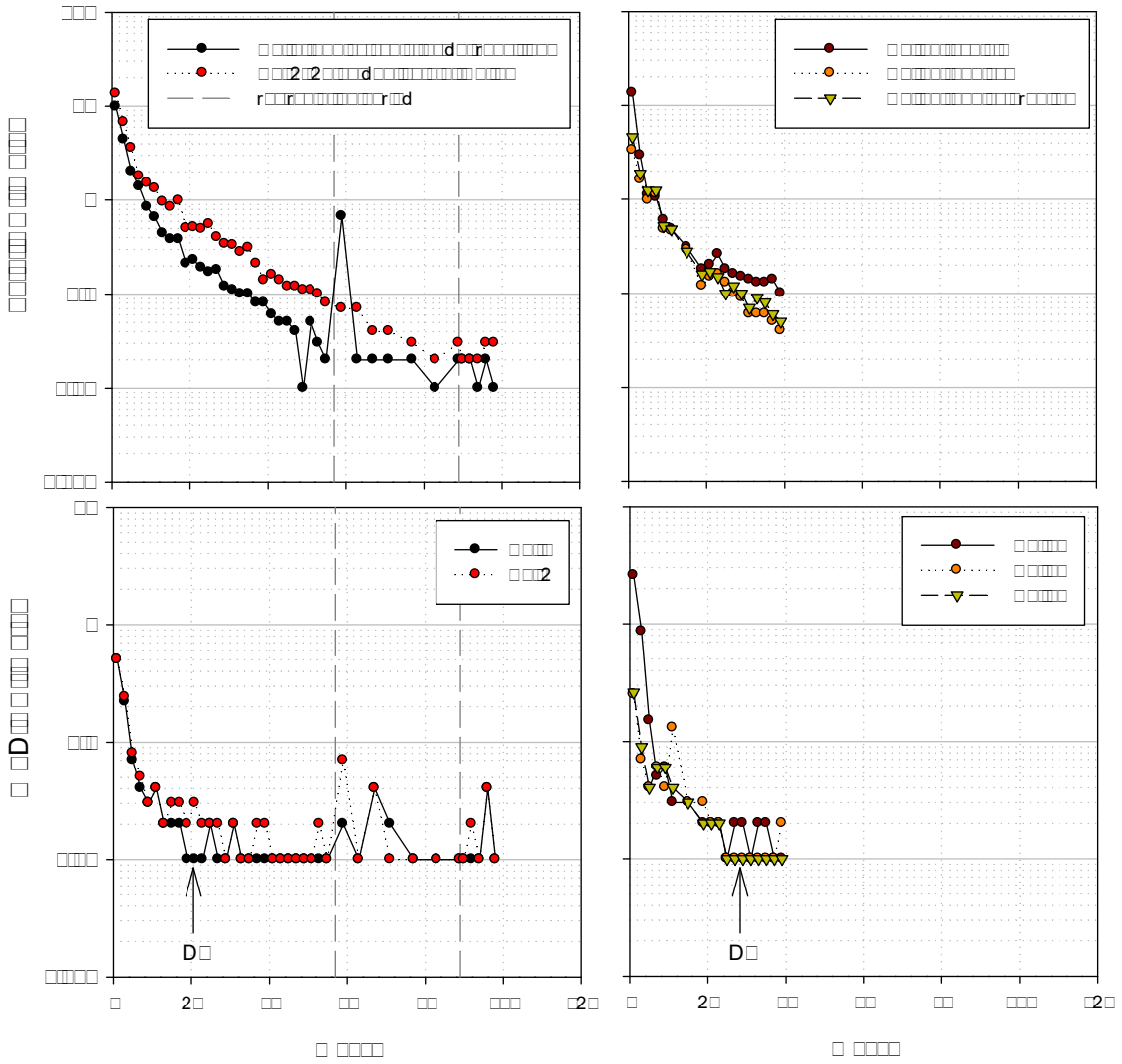
Sample ID		FB-LT1					FB-LT2		FB-LT3	
Date Sampled		17-Jun-14	25-Sep-14	4-Jun-15	10-Aug-15	22-Oct-15	10-Aug-15	22-Oct-15	10-Aug-15	22-Oct-15
Weeks		0.00	14	50	60	70	*0.00*	10	*0.00*	10
Volume	L	5.0	7.0	5.8	2.0	5.0	*0.50*	8.0	*0.50*	8.0
Conductivity	uS/cm	716	991	709	529	692	*595*	490	*780*	734
Hardness (as CaCO3)	mg/L	39	38	17	26	29	*51*	22	*21*	23
pH		8.5	8.5	8.6	8.4	8.5	*8.7*	9.2	*8.9*	8.6
TDS	mg/L	529	669	471	356	429	*953*	985	*680*	1120
Anions and Nutrients										
T-Alkalinity (as CaCO3)	mg/L	227	15	193	-	197	-	254	-	235
T-Ammonia-N	mg/L	0.71	0.29	0.036	-	*< 0.005*	-	5.0	-	1.9
Nitrate-N	mg/L	0.94	4.2	3.9	3.6	5.2	*0.14*	0.16	*< 0.005*	0.85
Nitrite-N	mg/L	2.0	-	0.95	0.34	0.0046	*0.18*	0.080	*< 0.001*	25
Br	mg/L	*< 0.25*	-	*< 0.1*	*< 0.05*	*< 0.25*	*< 0.05*	*< 0.05*	*< 0.25*	*< 0.25*
Cl	mg/L	20	18	8.4	2.1	3.7	*8.3*	6.2	*15*	16
F	mg/L	0.43		0.31	0.36	0.35	*0.35*	0.27	*0.54*	0.60
S(6)	mg/L	119	243	135	88	118	*9.9*	6.2	*18*	24
Cyanides										
WAD Cyanide	mg/L	0.18	0.019	0.34	0.010	0.017	*0.047*	0.052	-	0.17
T-Cyanide	mg/L	1.6	0.34	0.83	0.27	0.38	*1.5*	2.6	-	2.2
Organic / Inorganic Carbon										
DOC	mg/L	9.0	11	-	-	6.0	-	26	-	48
Radioisotopes										
Ra-226	Bq/L	-	-	0.012	0.020	0.012	-	0.42	-	0.030
Dissolved Metals										
Al	mg/L	0.49	0.0080	0.0080	0.0080	0.012	*10*	0.85	*0.30*	1.7
Sb	mg/L	0.046	0.035	0.027	0.030	0.024	*0.11*	0.021	*0.070*	0.057
As	mg/L	1.2	1.8	1.6	1.3	1.4	*1.2*	1.1	*2.3*	3.2
Ba	mg/L	0.048	0.023	0.011	0.029	0.025	*0.19*	0.039	*0.044*	0.080
Be	mg/L	*< 0.0001*	*< 0.001*	*< 0.00002*	*< 0.00002*	*< 0.00002*	*0.0010*	0.000039	*< 0.00002*	0.00010
Bi	mg/L	*< 0.0005*	-	*< 0.00005*	*< 0.00005*	*< 0.00005*	*0.00*	*< 0.00005*	*< 0.00005*	*< 0.00005*
B	mg/L	0.028	*< 0.1*	0.016	0.017	0.016	*0.022*	*< 0.01*	*0.018*	0.019
Cd	mg/L	0.000020	*< 0.00001*	*< 5E-06*	*< 5E-06*	*< 5E-06*	*< 0.00005*	0.0000089	*< 5E-06*	0.0000057
Ca	mg/L	12	11	4.1	7.4	8.1	*17*	8.1	*8.1*	8.3
Cr	mg/L	0.020	0.010	0.0020	0.0030	0.0044	*0.031*	0.015	*0.0020*	0.0050
Co	mg/L	0.077	0.10	0.043	0.021	0.024	*0.57*	0.46	*0.12*	0.20
Cu	mg/L	0.0060	0.0020	0.0020	0.0020	0.0014	*0.016*	0.010	*0.063*	0.042
Fe	mg/L	1.0	0.81	0.24	0.12	0.19	*15*	2.2	*0.32*	2.9
Pb	mg/L	0.00053	*< 0.0005*	*< 0.00005*	0.00010	0.000070	*0.0073*	0.00049	*0.000073*	0.00088
Li	mg/L	0.0050	*< 0.005*	0.0040	0.0040	0.0041	*0.0030*	*< 0.001*	*< 0.001*	*< 0.001*
Mg	mg/L	2.4	2.4	1.6	1.7	2.1	*1.9*	0.28	*0.24*	0.55
Mn	mg/L	0.033	0.0090	0.010	0.013	0.0042	*0.30*	0.022	*0.0080*	0.085
Hg	mg/L	0.00042	0.000052	0.000039	0.000019	0.000018	-	0.00064	-	0.00038
Mo	mg/L	0.054	0.089	0.043	0.058	0.061	*0.22*	0.17	*0.034*	0.048
Ni	mg/L	0.042	*< 0.001*	0.0010	*< 0.0005*	*< 0.0005*	*0.061*	0.016	*0.26*	0.085
P	mg/L	0.24	-	0.23	0.21	0.21	*0.69*	0.53	*0.14*	0.39
K	mg/L	8.5	7.2	4.8	5.3	5.8	*5.0*	1.6	*1.3*	2.2
Se	mg/L	0.0020	0.0020	0.0010	0.0010	0.00082	*0.0020*	0.0017	*0.0030*	0.0024
Si	mg/L	5.2	-	3.2	3.8	3.9	*24*	4.8	*6.3*	8.9
Ag	mg/L	0.00	*< 0.00002*	0.00	*< 0.00001*	*< 0.00001*	*0.00*	0.000033	*0.00*	0.00030
Na	mg/L	138	216	154	108	144	*114*	110	*195*	150
Sr	mg/L	0.052	-	0.024	0.039	0.041	*0.043*	0.016	*0.017*	0.023
Tl	mg/L	0.00	0.00	0.00	0.00	0.00010	*0.0010*	0.00021	*0.00*	0.00038
Sn	mg/L	*< 0.0001*	*< 0.0005*	*< 0.0001*	*< 0.0001*	*< 0.0001*	*0.0010*	*< 0.0001*	*0.00*	0.00035
Ti	mg/L	*< 0.01*	*< 0.01*	*< 0.0003*	*< 0.0003*	*< 0.0003*	*0.17*	0.013	*0.0010*	0.017
U	mg/L	0.21	0.36	0.23	0.16	0.21	*0.46*	0.67	*0.036*	0.027
V	mg/L	*< 0.001*	*< 0.001*	*< 0.0005*	*< 0.0005*	*< 0.0005*	*0.023*	0.0029	*0.0020*	0.0041
Zn	mg/L	0.0020	0.019	0.0070	0.047	0.021	*0.019*	0.0019	*< 0.001*	0.0066
Total Metals										
Al	mg/L	-	0.13	-	-	-	-	-	-	-
Sb	mg/L	-	0.037	-	-	-	-	-	-	-
As	mg/L	-	1.8	-	-	-	-	-	-	-
Ba	mg/L	-	0.025	-	-	-	-	-	-	-
Be	mg/L	-	*< 0.001*	-	-	-	-	-	-	-
B	mg/L	-	*< 0.1*	-	-	-	-	-	-	-
Cd	mg/L	-	*< 0.00001*	-	-	-	-	-	-	-
Ca	mg/L	-	11	-	-	-	-	-	-	-
Cr	mg/L	-	0.0098	-	-	-	-	-	-	-
Co	mg/L	-	0.11	-	-	-	-	-	-	-
Cu	mg/L	-	0.0025	-	-	-	-	-	-	-
Fe	mg/L	-	0.99	-	-	-	-	-	-	-
Pb	mg/L	-	*< 0.0005*	-	-	-	-	-	-	-
Li	mg/L	-	*< 0.005*	-	-	-	-	-	-	-
Mg	mg/L	-	2.4	-	-	-	-	-	-	-
Mn	mg/L	-	0.014	-	-	-	-	-	-	-
Hg	mg/L	0.0096	0.000062	-	-	-	-	-	-	-
Mo	mg/L	-	0.092	-	-	-	-	-	-	-
Ni	mg/L	-	0.0011	-	-	-	-	-	-	-
K	mg/L	-	7.2	-	-	-	-	-	-	-
Se	mg/L	-	0.0020	-	-	-	-	-	-	-
Ag	mg/L	-	*< 0.00002*	-	-	-	-	-	-	-
Na	mg/L	-	216	-	-	-	-	-	-	-
Tl	mg/L	-	0.00021	-	-	-	-	-	-	-
Sn	mg/L	-	*< 0.0005*	-	-	-	-	-	-	-
Ti	mg/L	-	*< 0.01*	-	-	-	-	-	-	-
U	mg/L	-	0.36	-	-	-	-	-	-	-
V	mg/L	-	*< 0.001*	-	-	-	-	-	-	-
Zn	mg/L	-	0.028	-	-	-	-	-	-	-

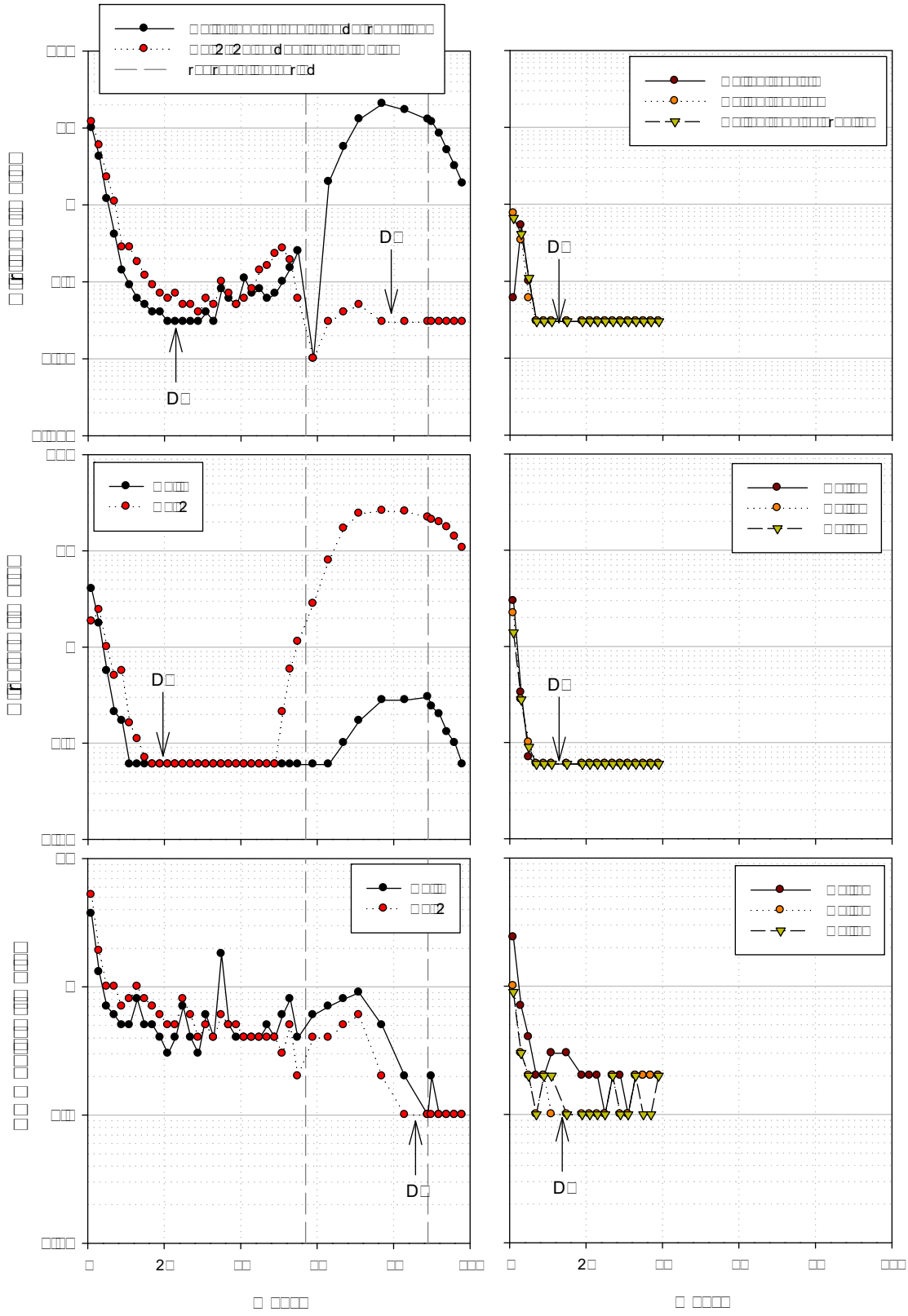
Notes:
Values in grey italics are below the analytical detection limit

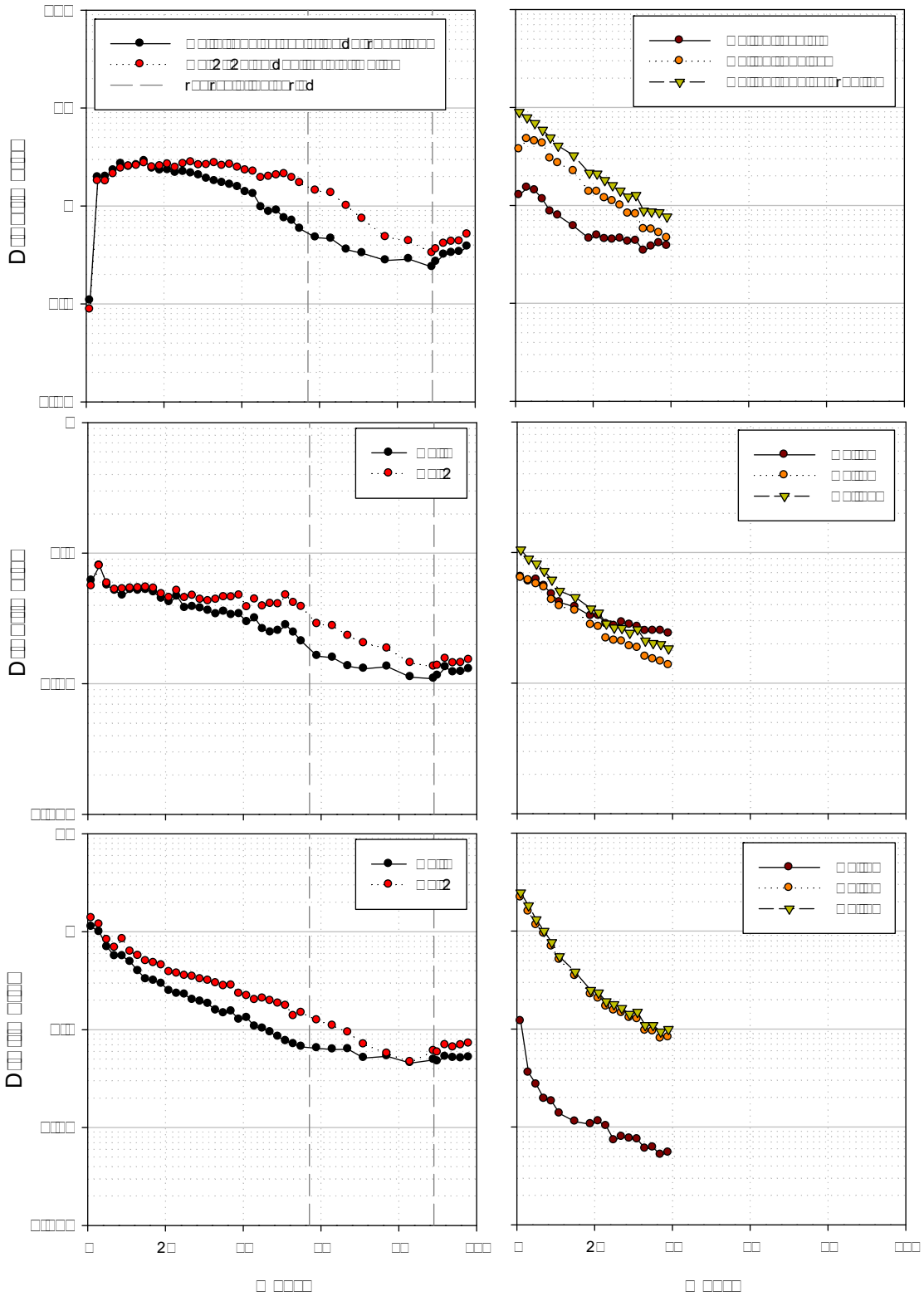
Appendix D.3-4: Time Series Profiles for Leach Tailings Kinetic Tests

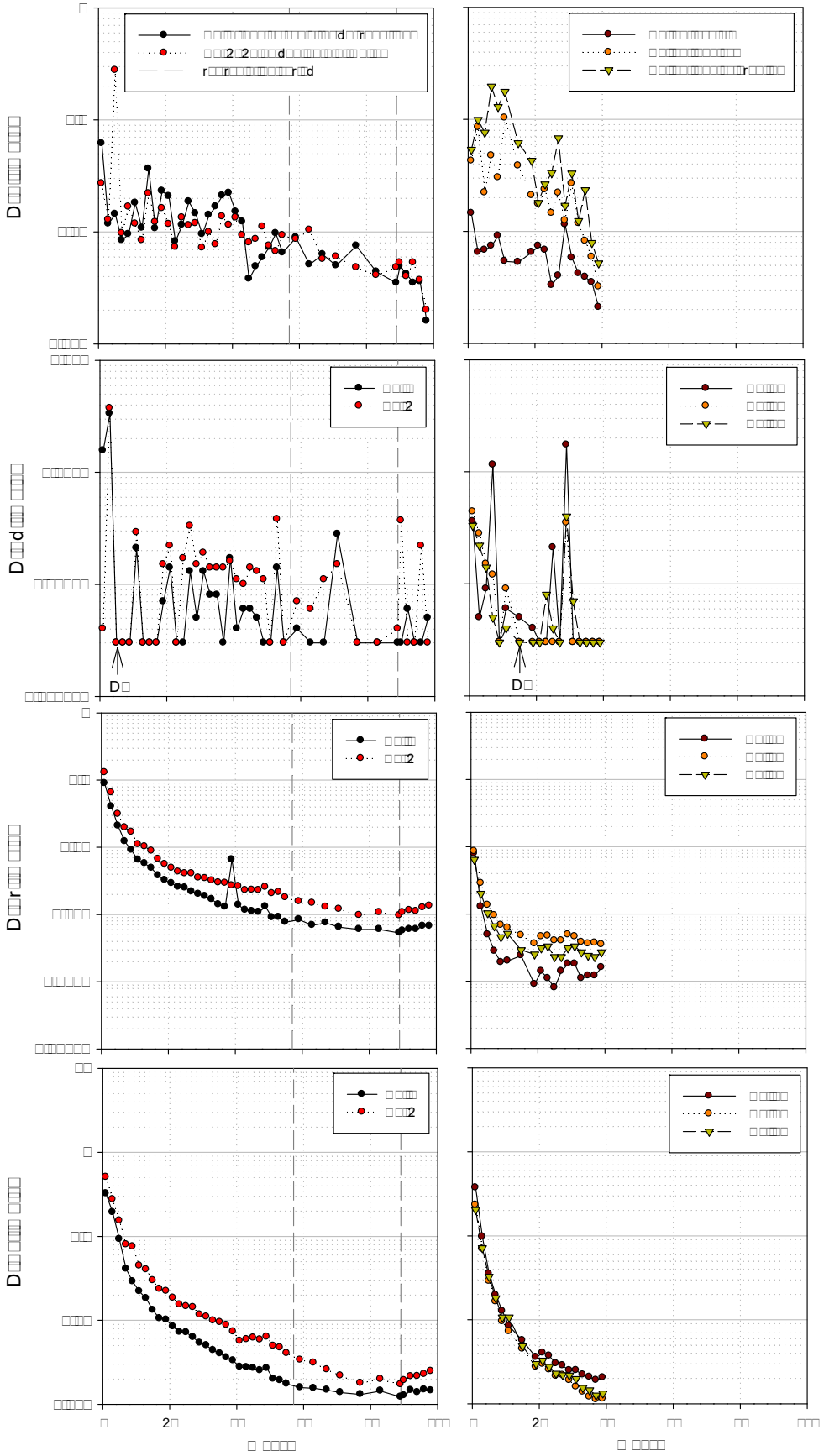
Leachate Concentrations for Leach Tailings Unsaturated Columns

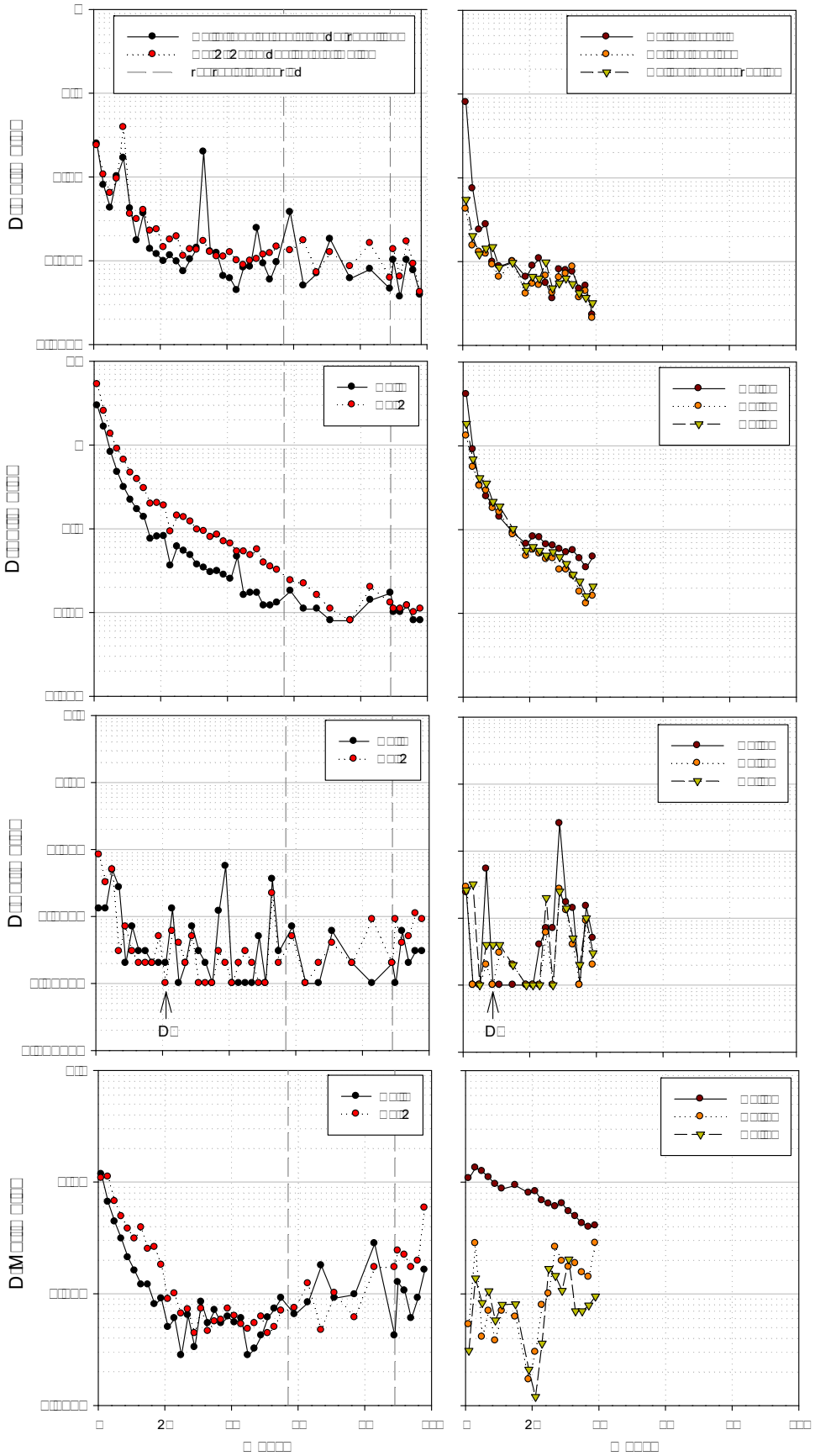


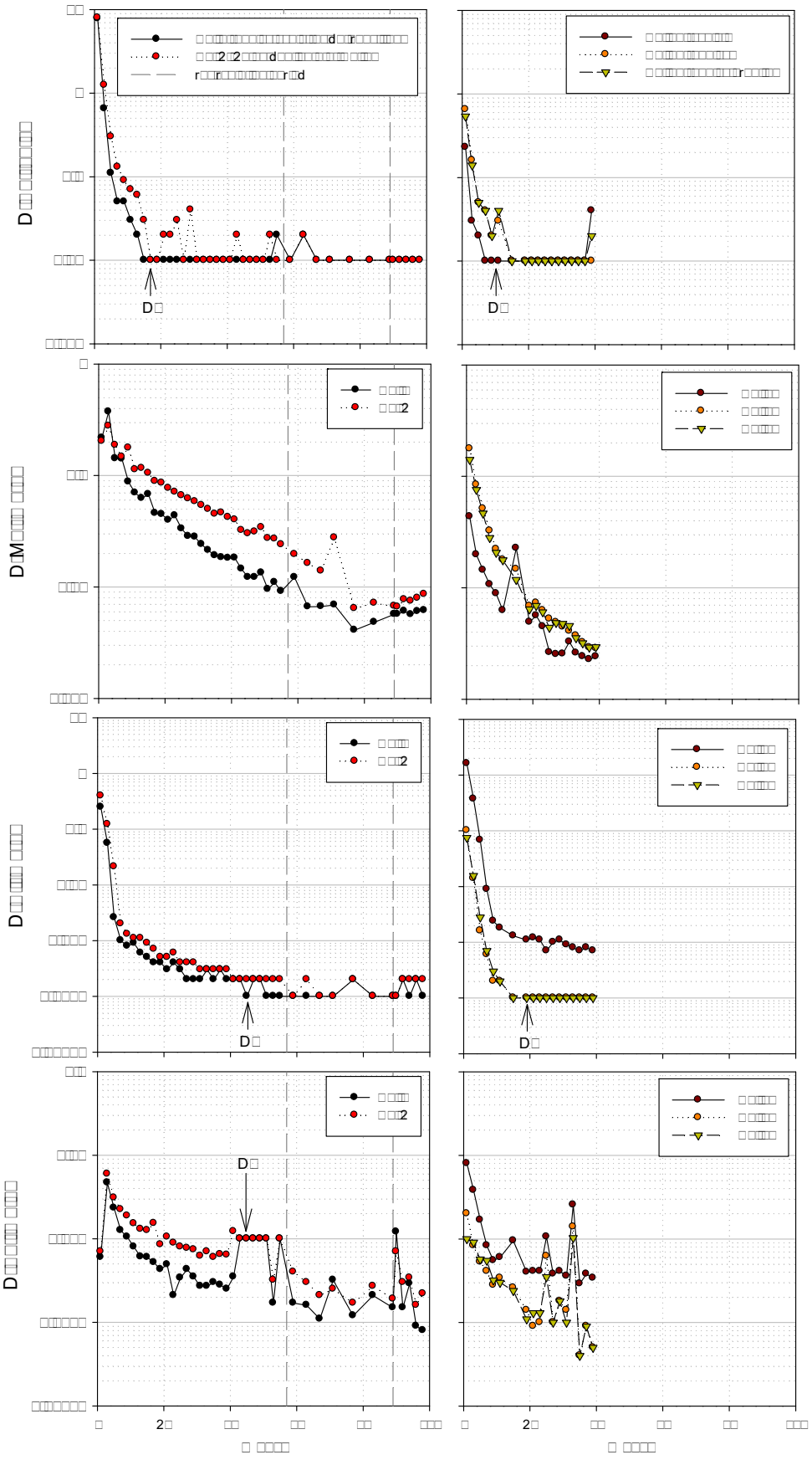


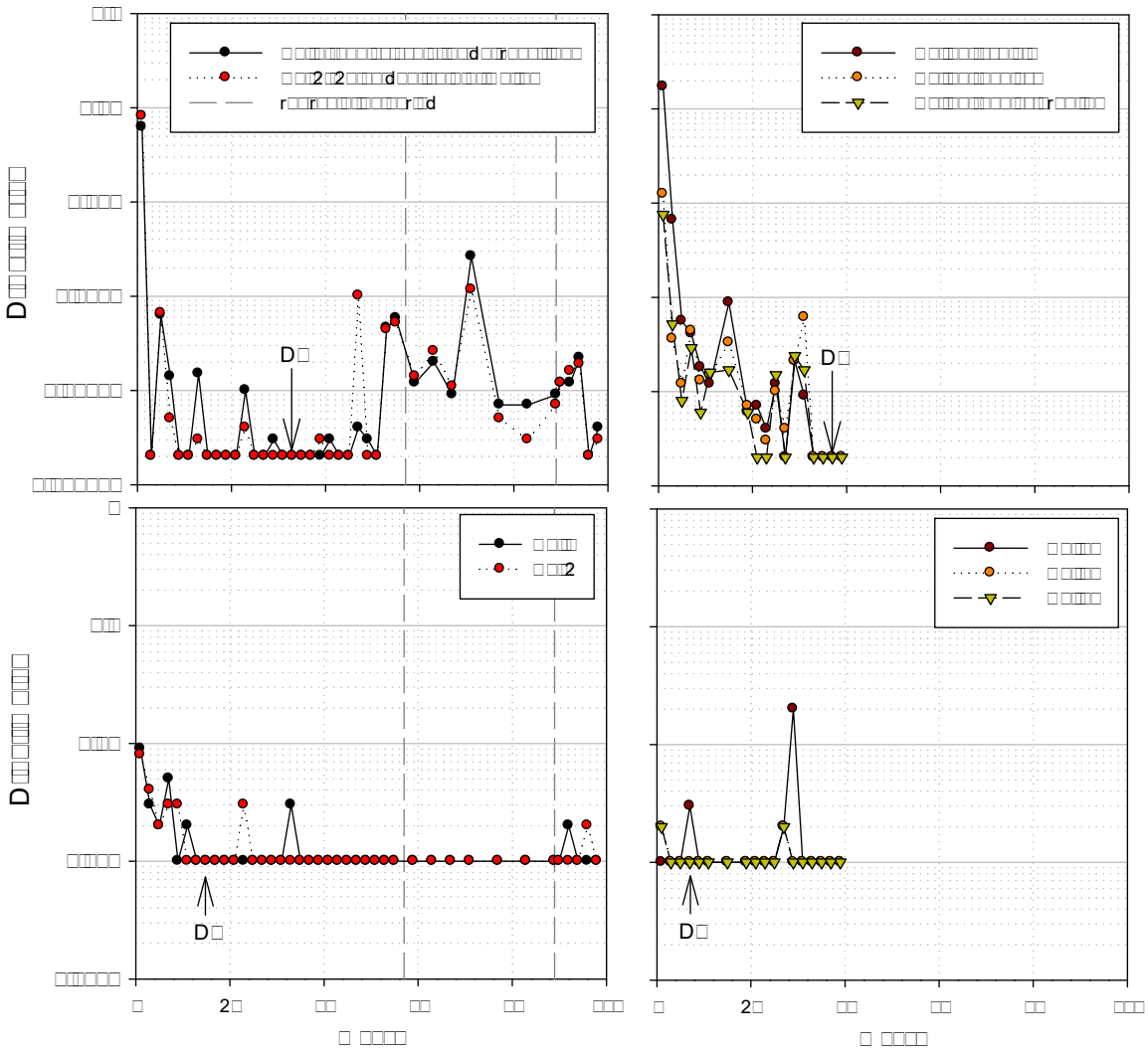




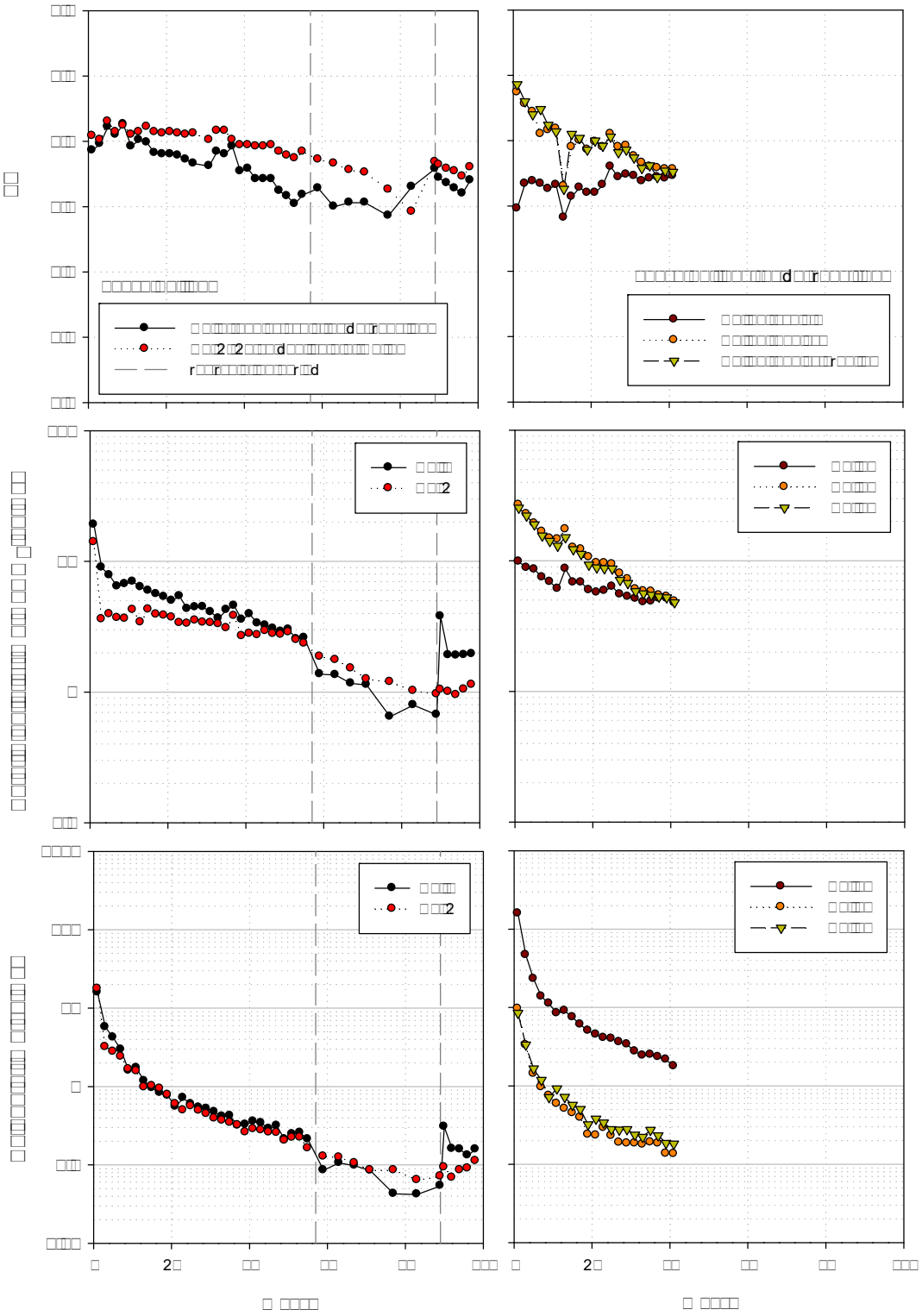


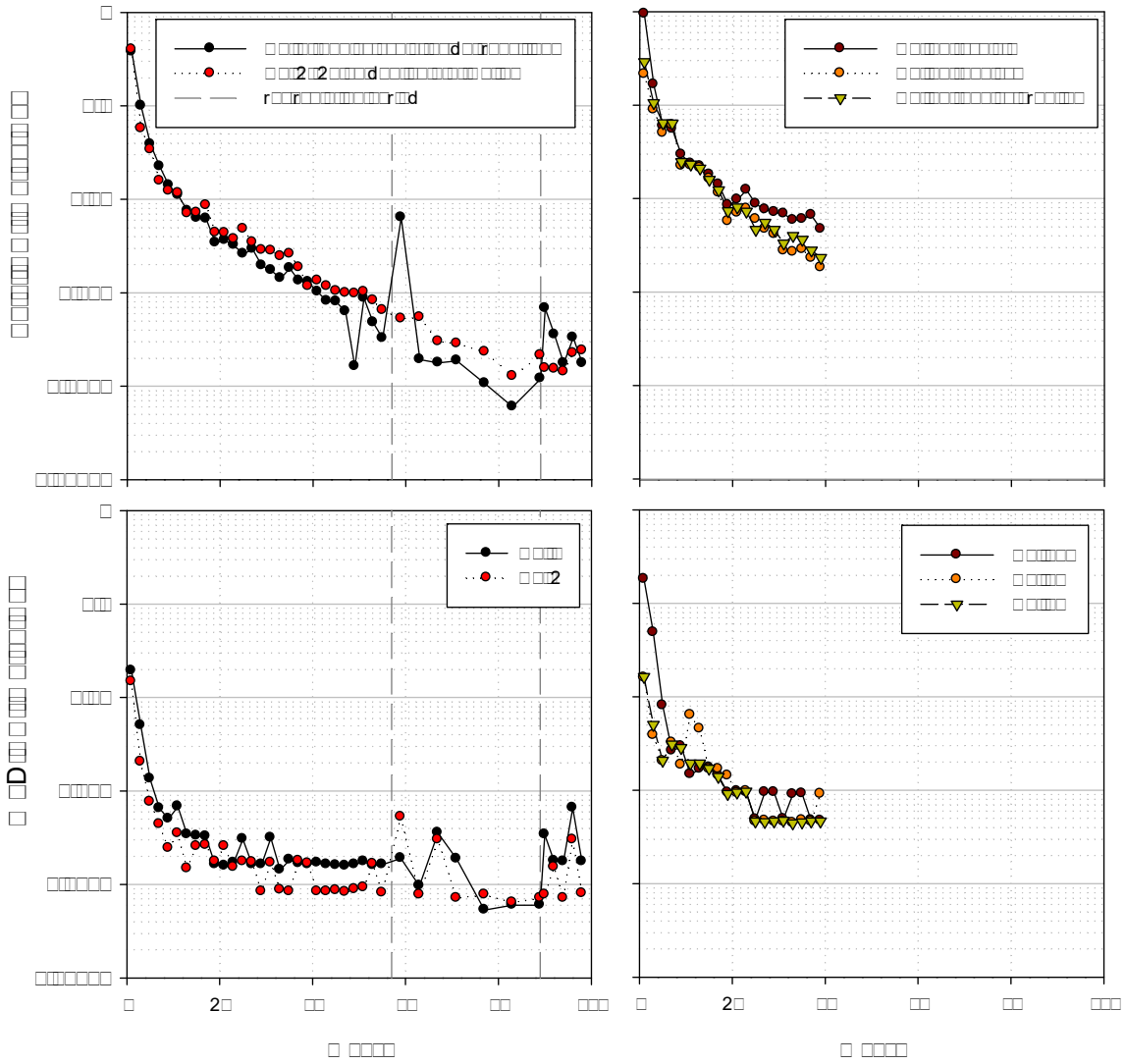


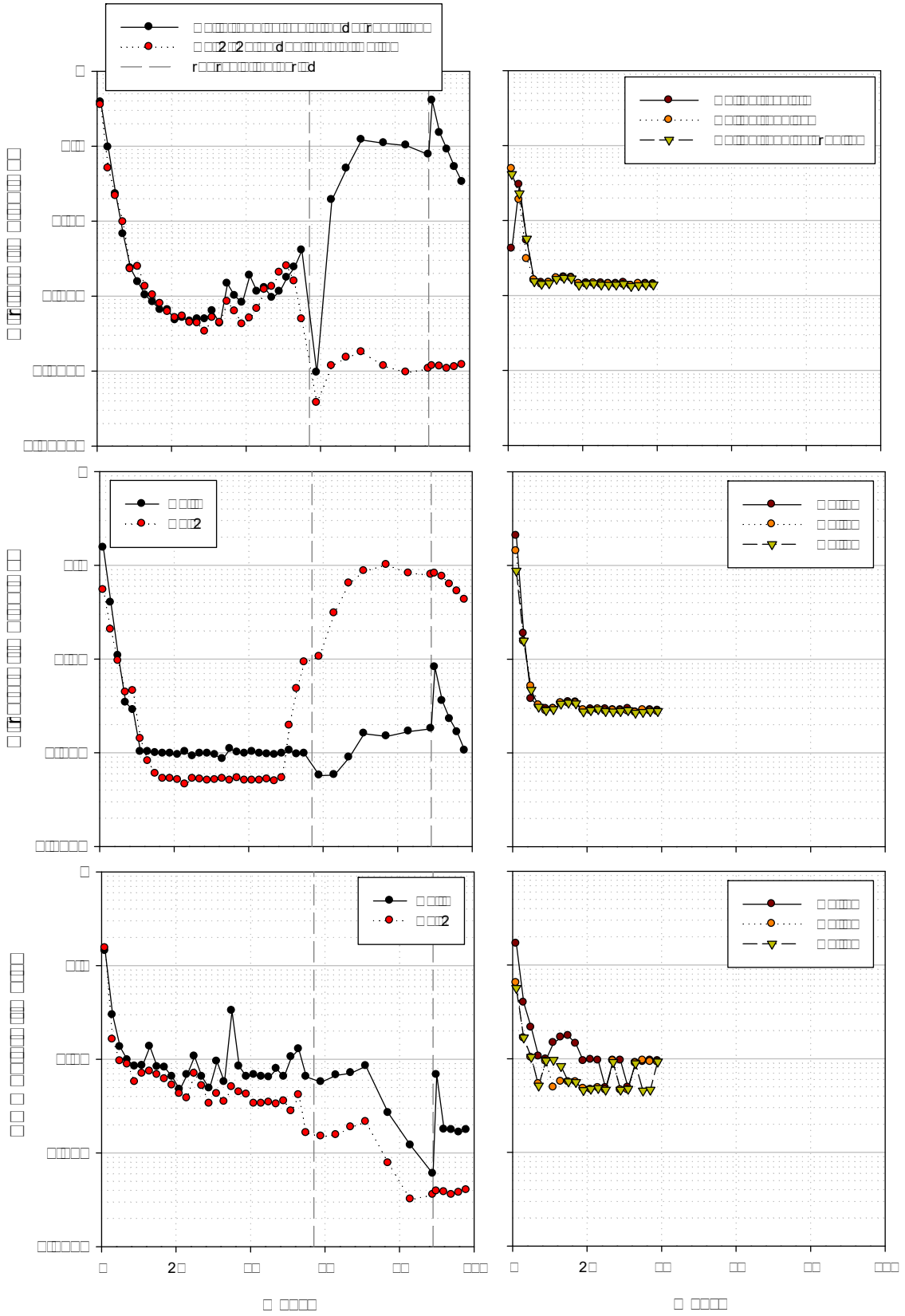


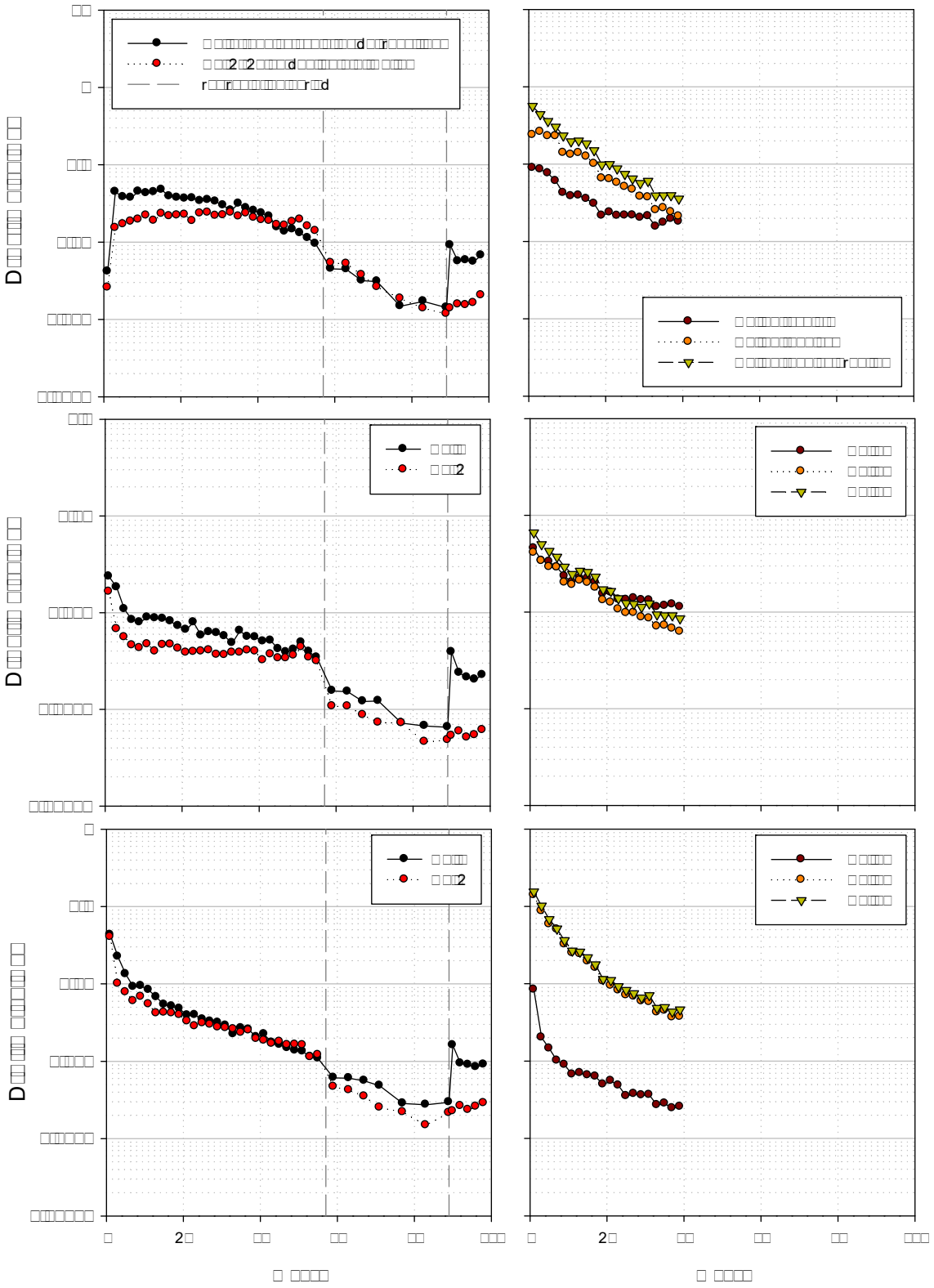


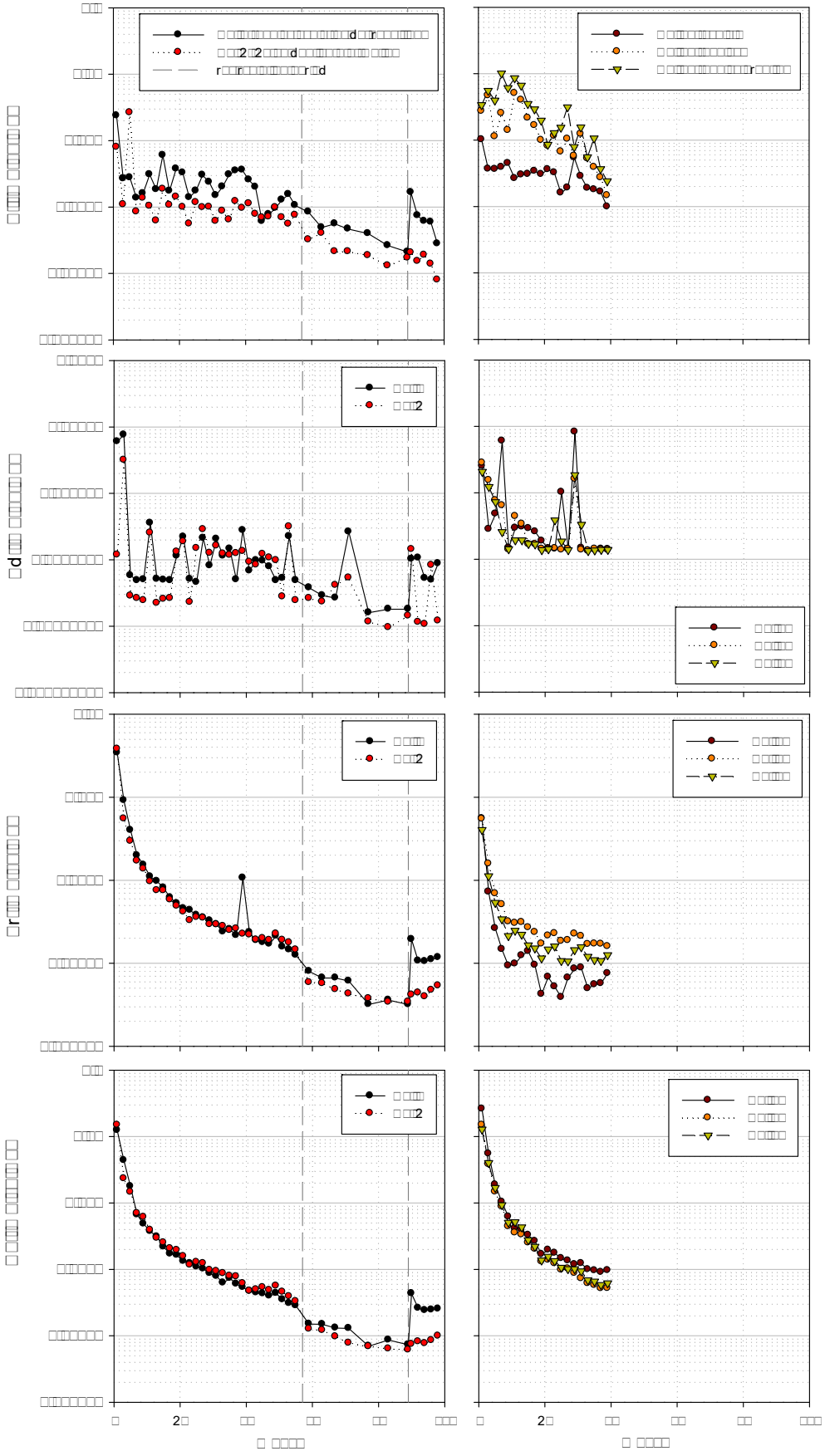
Loading Rates for Leach Tailings Unsaturated Columns

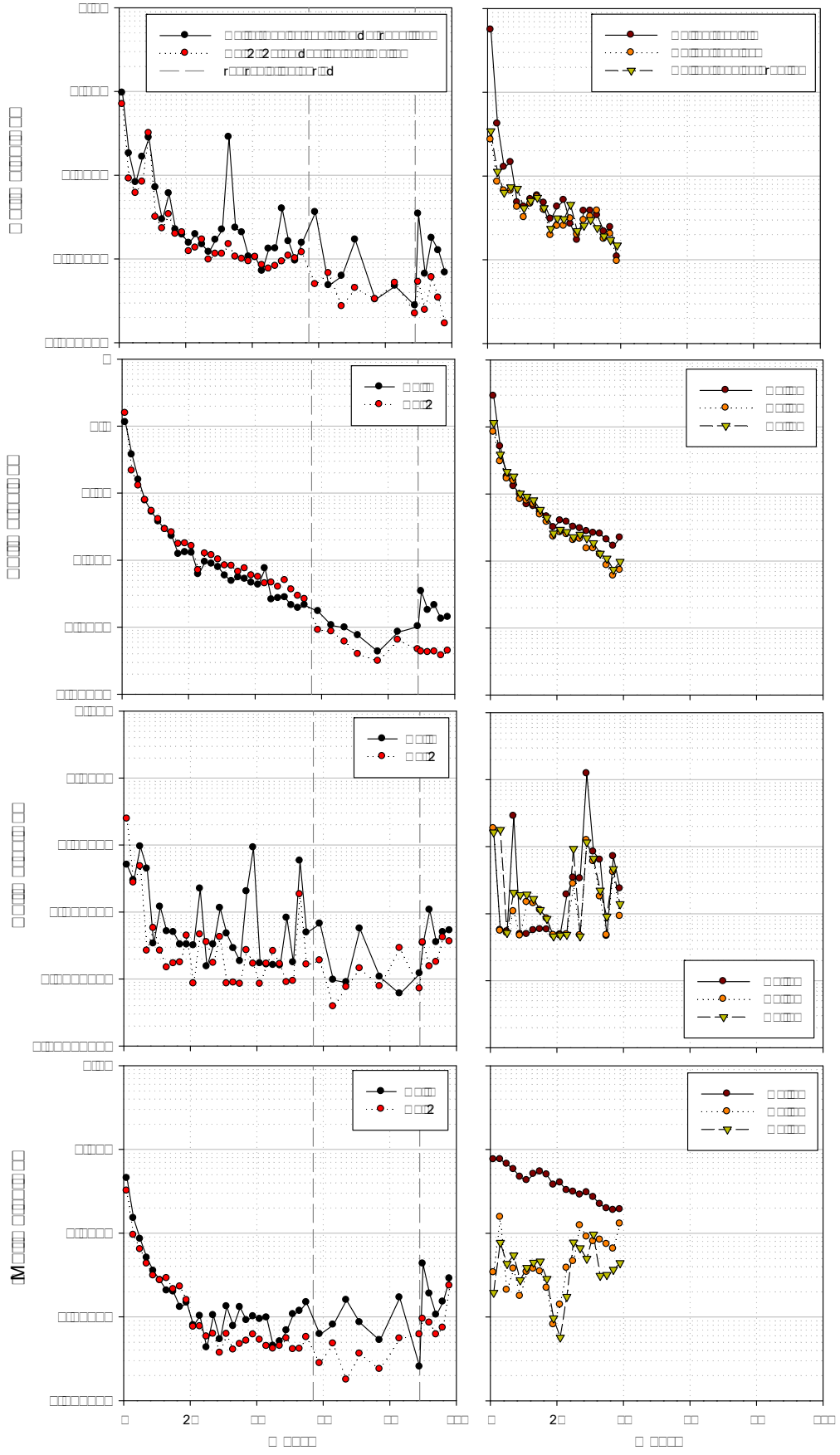


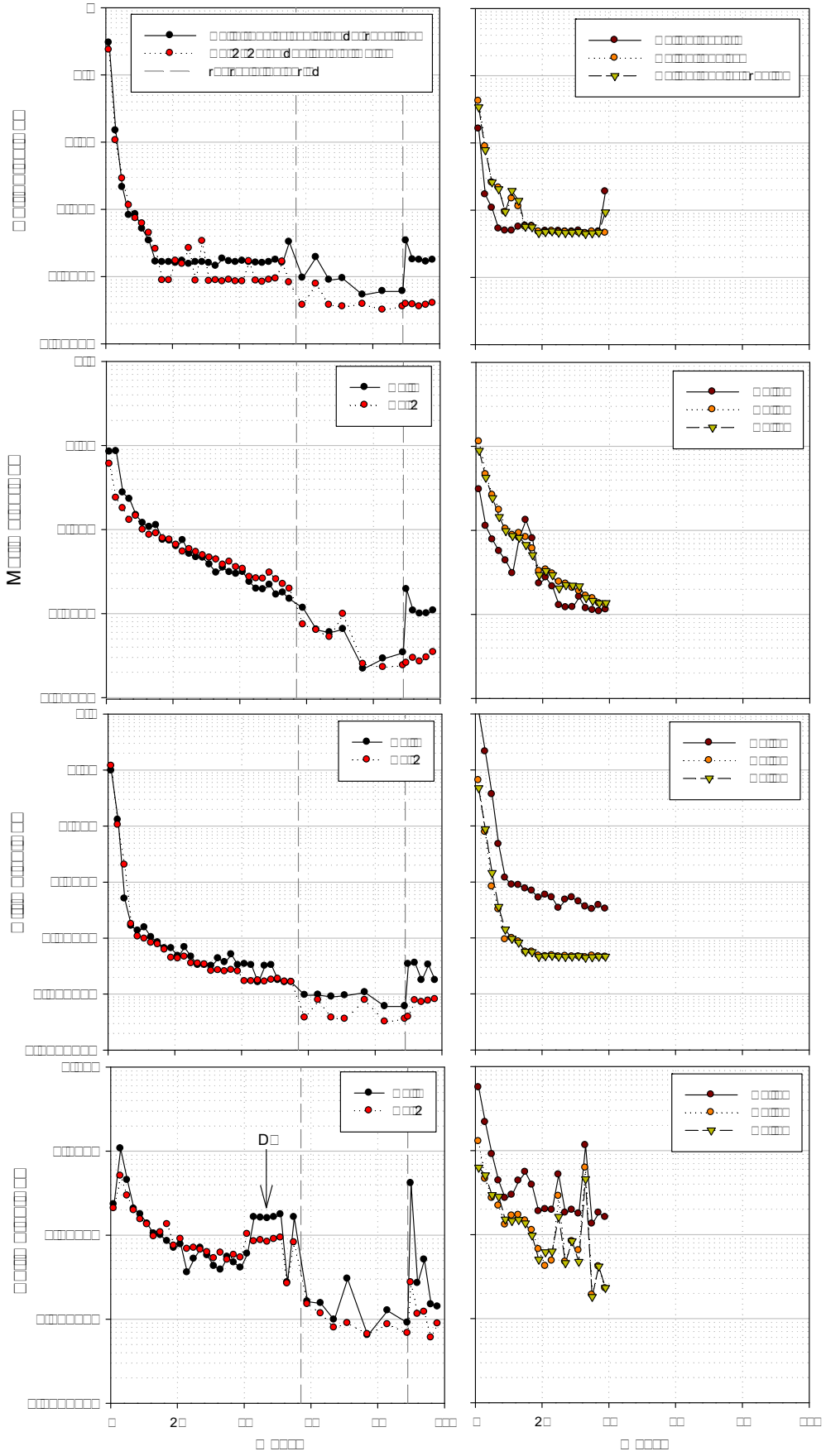


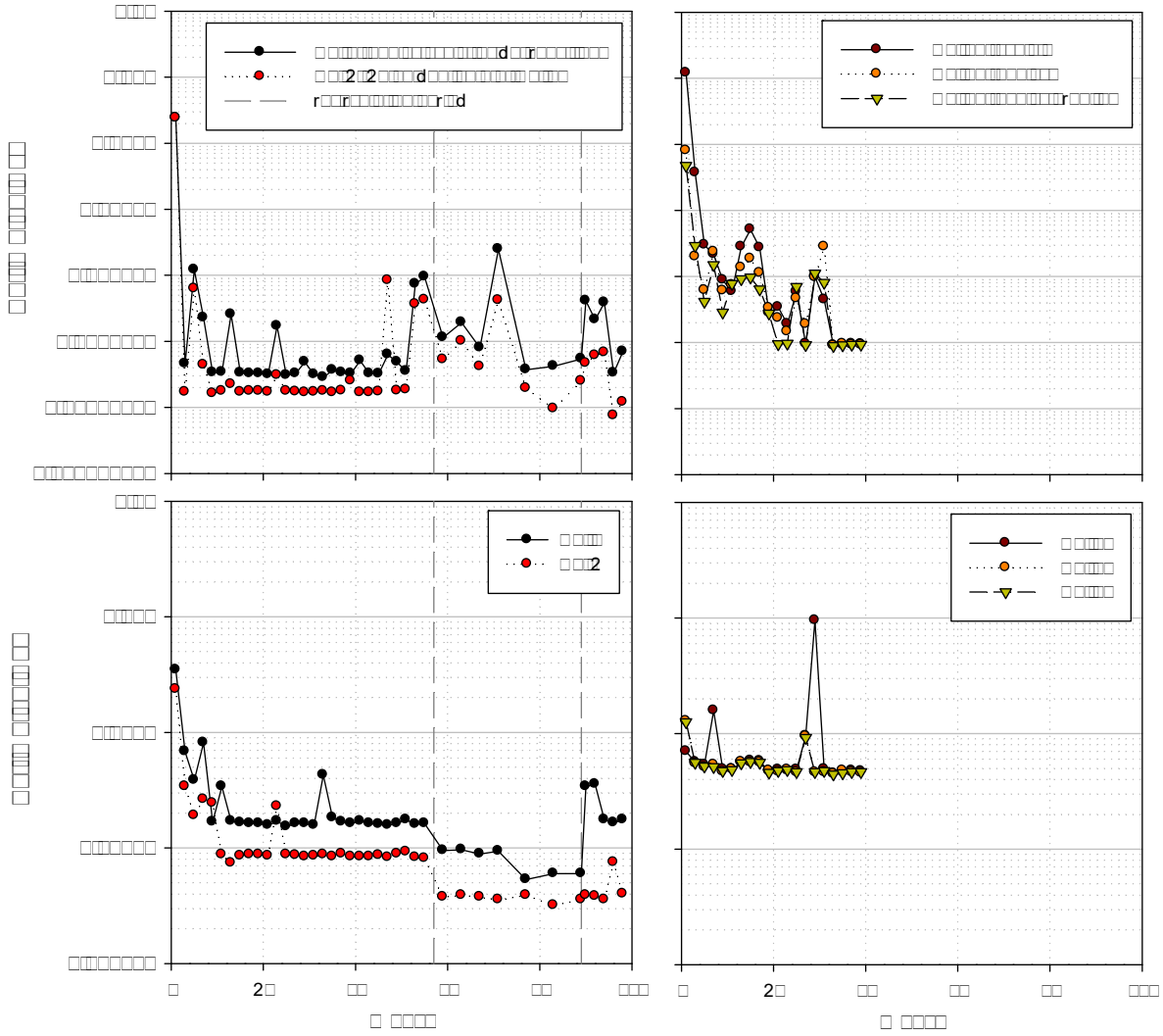












Appendix E: Additional Data to Support Source Term Predictions

Appendix E.1: Nitrogen Loadings

Appendix E.2: PHREEQC Geochemical Modelling Input

Appendix E.3: Geochemical Source Terms

Appendix E.4: Bench-Scale Testwork for HLF Water Treatment System (INOTEC Report)

GOLDCORP

APPENDIX E.1: NITROGEN LOADINGS

Appendix E.1: Nitrogen Loadings

1. Overview

Explosive residue and associated combustion products on blasted rock surfaces are the primary sources of ammonia (NH_3 and NH_4^+), nitrate (NO_3^-), and nitrite (NO_2^-) associated with runoff from active mining and blasting operations (Pommen, 1983). The export of nitrogen (N) from blasting is therefore linked to the quantity and types of explosives used, in addition to the detonation efficiency.

Ammonium nitrate fuel oil (ANFO) is the primary component of explosives used in mining and blasting related operations. Ideally the explosive reaction converts nitrogen species, in this case ammonia and nitrate, to nitrogen gas. In practice, the detonation efficiency, and thus conversion of nitrogen species to nitrogen gas, are dictated by the handling procedures of the explosives and the blasting conditions (Forsyth *et al.,* 1995; Revey, 1996). Wet blasting conditions may result in the leaching of N from explosives prior to detonation. Wet conditions may also result in inefficient or incomplete detonation and/or misfires, which in turn yields excess N residue available for leaching (Mueller *et al,* 2015). Nitrogen compounds in explosive mixtures are readily water soluble, with solubility rates varying from minutes for ANFO to weeks for water resistant ANFO emulsion mixtures as described by Revy (1996). Emulsion products continue to be developed to mitigate the effects of wet-blasting conditions on N leaching and overall blasting efficiency. The application of emulsion products continues to be more common as their costs decrease and their benefits to overall operational efficiency are realized.

The primary pathway of nitrogen associated with blasting residue is via seepage from excavated waste rock, which is deposited in waste rock storage facilities. The release of nitrogen compounds is directly related to the volume of blasted rock and the rate of water infiltration into the waste rock facilities. Water percolation rates through waste rock piles is variable and leads to a time lag between rock deposition and observed release of nitrogen at significant concentrations (Bailey, 2013; Mueller *et al,* 2015). Preferential flow paths develop within a rock pile leading to partial and gradual wetting from the outer to the inner portions of the pile. The nitrogen available for leaching is limited to the wetted areas of the pile and over time newly wetted areas will release stored nitrogen, therefore nitrogen release from a large rock pile can persist for years or decades after rock placement. Microbial activity along the flow paths can mediate nitrification reactions which act to oxidize ammonia and nitrite to nitrate. For open pit mining operations, which are typically

oxidizing environments, the export of nitrogen to the receiving environment has been observed to be predominantly in the form of nitrate, and to a lesser extent, nitrite and ammonia (Ferguson and Leask, 1988).

The export of aqueous nitrogen species can also occur via mine pit water, particularly during dewatering of active pit development (Cameron, 2007). Infiltration of water into loaded blast patterns can lead to nitrogen release prior to blasting from explosives loaded into boreholes or from explosives spilled on the pit floor. Subsequent to blasting, infiltration water in contact with blasted rock on the pit floor can mobilize residual nitrogen species. There is limited storage of nitrogen within the pit as the majority of explosives residuals are excavated with the blasted rock. As a result, the export of nitrogen from mine pit contact water is typically associated with operations.

The processes that result in the distribution of water soluble N species are not immediately quantifiable, nor are they predictable, as each blast is unique with respect to detonation efficiency, residue amount and type, as well as microbial activity. Consequently, empirical methods have been developed to predict N loadings from mining activity and are based on explosive type, explosive quantity, and pit dewatering conditions (*e.g.*, wet versus dry) as presented in Mueller *et al*. (2015). Model assumptions and methodologies for the derivation of nitrogen species source terms are presented in the sections below. Source terms are derived for application in the water quality model for the Project and are used to predict Project effects on surface and groundwater quality.

2. Assumptions

Nitrogen source terms were derived for contact water associated with pit wall runoff and waste rock seepage. Source terms were calculated based on projected explosive use and waste rock deposition plans. Source term loadings are estimated as a percentage of the total explosives used for blasting over a specified time period and incorporate the following assumptions:

- Mining, explosive use, waste rock production and placement will proceed as per the mine plan;
- Explosive types to be used are ANFO (34% N) and Emulsion (27.5% N; Orica Fortis® or Fortan® products);
- Best explosive use and blasting practices will be implemented to maximize explosive consumption and minimize explosive residue as a result of blasting;
- Over the operational mine life, 15% of blast holes were assumed to be wet, were used as a proxy for less efficient detonation, and are assumed to apply to approximately 15% of the total explosives used;

- Nitrogen is exported to the aqueous downstream receiving environment in species that are proportional to average distributions observed by Ferguson and Leask (1988) when T-N is greater than 3 mg/L, with nitrate, ammonia and nitrite respectively representing 95%, 4% and 1% of the total nitrogen release, respectively;
- The observations of nitrogen loadings from pit walls and waste rock at the Aitik Mine, Thompson Creek Mine, and Minto Mine are reasonably representative examples of open pit mining and blasting conditions that will be encountered at the Project; and,
- For the purpose of source term derivation, the baseline levels for nitrate, ammonia and nitrite are assumed to be zero.

3. Methodology

A desktop review of the Aitik, Thompson Creek, and Minto mines was conducted to document N loading associated with well-managed open pit mining operations. Mine development, waste rock production rates, and/or climatic settings for these projects are relatively similar to the proposed Coffee Creek Mine and are considered reasonable analogs for comparison to the Coffee Gold Mine. Associated N loading rates observed from these analog sites are therefore used to constrain nitrogen source terms for the Project.

Boliden's Aitik Mine is an open pit hard-rock mine in northern Sweden. Production began in the 1960s and is currently operating with an annual ore production rate of approximately 39 Mtonnes (2014). Climatic conditions at Aitik are similar to the Coffee Gold Mine. Sources of N loading at Aitik include pit walls and waste rock dumps.

The Thompson Creek Mine (TCM) is an open pit molybdenum mine located in Idaho, United States of America. The Thompson Creek Mine is owned and operated by the Thompson Creek Metals Company Inc. and operated from 1983 to 2014. Production at Thompson Creek reached up to 9 Mtonnes per year. While not at a northern latitude, the Thompson Creek mine is located at in the Rocky Mountains at a high elevation (2,200 masl) and experiences extreme, continental conditions not dissimilar from Coffee. Further, the open pit blasting conditions at TCM are relatively dry and are considered a reasonable proxy for the relatively dry conditions expected at Coffee, where open pits development is predominantly above the water table. With decades of water quality data with nitrogen species measurements associated with the waste rock seepage and pit wall contact water seepage, TCM is an ideal site for comparison to Coffee.

Capstone Mining Corporation's Minto Mine is an open pit copper mine located north of Whitehorse in central Yukon, Canada. Yearly production reached nearly 17 Mt in 2015,

with approximately 7 years of operations remaining. The Minto site, like Aitik, is within a region of similar conditions to the Project. and has been collecting operational water quality data that includes pit wall and waste rock seepage sampling. The benefits of Minto as an analogue for N species source term loadings are two-fold: site climate conditions are expected to be reasonably similar to the Project; and Minto is a relatively modern, operating, open-pit mine with a supporting, up to date monitoring plan and water quality database.

3.1 Source Term Development

Methods used to develop N source terms for waste rock seepage, pit wall runoff, and draindown quality from the heap leach facility are described below.

3.1.1 Waste Rock Seepage

Annual waste rock deposition schedules are not available for the Project. Therefore, an annual accumulation and release of residual nitrogen from waste rock facilities cannot be calculated as per the Ferguson and Leask (1988) approach. Rather, the range of N concentrations that may be produced from mine waste facilities is taken from observations at analogue sites, which include Aitik, Thompson Creek, and the Minto Mine. Observations from analogue sites function as proxies for expected N concentrations from active, well managed mine sites and are applied as capping terms for the N source terms.

Water quality datasets were developed for each analogue and included NH_3, NO_3^-, and NO_2^- concentrations. Median and 90th percentile or maximum N species concentrations were calculated for each of the analogue waste rock dumps (Table 1). A Base Case estimate and an Upper estimate for NH_3, NO_3^- and NO_2^- concentrations were developed. Median and 90th percentile or maximum values were considered from each facility for the Base Case and Upper estimate, respectively. The highest value was selected for each term. In this case, the median and 90th percentile values from the Minto Mine were consistently highest from the analogue sites and were selected as the Base Case and Upper Estimate N source terms for waste rock seepage (Table 1). The final N source terms are based on the Base Case and Upper Estimate concentrations presented in (Table 1) for all waste rock storage facilities at the Project.

□

□

□

Table 1:
Median, 90th Percentile, and maximum nitrate, nitrite, and ammonia concentrations for seepages associated with waste rock dumps from each of Aitik Mine, Thompson Creek Mine, and Minto Mine

Location	Rock Mass	NO_3-N (mg/L)			NO_2-N (mg/L)			NH_3-N (mg/L)		
	(MT)	Median	P90 or Max*	n	Median	P90 or Max*	n	Median	P90 or Max*	n
Aitik (WRD T6)	225	30	43	3	-	-	-	0.003	0.006	3
Thompson Creek (Buck C)	310	7	15	45	<0.010	0.11	42	<0.050	<0.050	23
Thompson Creek (PH Toe)	45	8.5	10	32	0.01	0.01	31	0.05	0.05	31
Minto (Southwest Dump)	21	30	45	42	0.1	0.3	42	0.06	0.2	42
Source Term		Base Case Estimate	Upper Estimate		Base Case Estimate	Upper Estimate		Base Case Estimate	Upper Estimate	
		30	45		0.1	0.3		0.06	0.2	

Note: *P90 values calculated for samples with N>10; max values calculated for samples with N<10.

3.1.2 Pit Wall Seepage

Pit water quality from analogue sites was used as a proxy for N pit wall seepage source terms and include pit lakes at Aitik and Thompson Creek mine sites. Similar to the waste rock seepage capping terms, median and 90th percentile or maximum N species concentrations were calculated for each analogue pit lake (Table 2). Maximum concentrations were selected for populations <10, and 90th percentile concentrations were calculated for populations >10. Base Case and Upper Estimate source terms for NH3, NO3-, and NO2- were derived (Table 2). The higher median value was selected for the Base Case estimate. Similarly, the higher 90th percentile or maximum value was selected for the Upper Estimate.

Table 2:
Median, 90th Percentile, and maximum nitrate, nitrite, and ammonia concentrations for seepages associated with pit wall from each of Aitik Mine, Thompson Creek Mine, and Minto Mine.

Location	NO_3-N (mg/L)			NO_2-N (mg/L)			NH_3-N (mg/L)		
	Median	**P90 or Max***	**n**	**Median**	**P90 or Max***	**n**	**Median**	**P90 or Max***	**n**
Aitik	5.6	8.4	28	0.007	0.03	28	0.3	1.6	28
Thompson Creek	5.6	29	26	0.01	0.52	6	0.19	5.7	6
Source Term	Base Case Estimate	Upper Estimate		Base Case Estimate	Upper Estimate		Base Case Estimate	Upper Estimate	
	5.6	29		0.01	0.52		0.3	5.7	

Note: *P90 values calculated for samples with N>10; max values calculated for samples with N<10.

3.1.3 Heap Leach Facility

Following operations, heap leach facility (HLF) drainage will be treated with an electro bioreactor (EBR) system before being discharged. This facility will treat a variety of chemical species, including NO_3^-. The efficacy of the EBR system at treating HLF drainage was demonstrated with bench scale testing, as described in Appendix E.4. During the EBR bench scale test work, nutrients such as ammonia and phosphate were added to stimulate microbial growth. The duration of the experiment was not sufficient to optimize nutrient addition rates, resulting in excess nutrient addition which in turn induced artificially high effluent concentrations of N parameters. The bio-treatment process is designed to denitrify the influent and as a result, effluent nitrogen concentrations are expected to be low. As a conservative assumption, NH_3 concentrations in EBR effluent were assumed to be equal to NO_3^-. Source term concentrations of NO_3^- and NO_2^- were set to observed concentrations in EBR bench test effluent (median and 75th percentile) for Base Case and Upper estimate source terms, respectively (Table 3).

Elevated concentrations of nitrogen species are expected to be present in HLF drainage in post closure. Unlike other sources of nitrogen loading at the minesite, the primary source of nitrogen species in the HLF is from degradation of CN. Hence, nitrogen concentrations cannot be calculated based on an estimate of explosive use as is it is for waste rock storage facilities. Nitrogen loadings in the HLF will depend in large part on the rate of CN degradation during mine life and the effectiveness of rinsing closed sections of the heap during progressive reclamation. For the purposes of source term prediction, nitrogen concentrations produced at the closed heap leach facility at an analogue mine site, Brewery

Creek are applied. The median and 90th percentile concentrations observed 1 to 10 years after closure are used as the Base Case and Upper source term concentrations for nitrogen species (Table 3).

In the Base Case scenario, it is assumed that in-situ degradation of nitrogen species will be partially successful, and that nitrogen species will be degraded within the HLF (Table 3). The In-situ treatment of nitrogen species within the HLF is described in the Conceptual Reclamation and Closure of Mine Facilities (Appendix 31-R)

Table 3:
Nitrogen source term estimates for the Heap Leach Facility during Closure (treated EBR effluent) and Post Closure.

Parameter	Units	Closure		Post Closure		
		Base Case Estimate	Upper Estimate	Base Case Estimate (no in-situ treatment)	Base Case Estimate (in situ treatment)	Upper Estimate
NH_3-N	mg/L	0.13	0.25	0.050	0.050	9.0
NO_3-N	mg/L	0.13	0.25	317	50	375
NO_2-N	mg/L	0.025	0.050	5.3	0.20	6.7

References

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APPENDIX E.2: PHREEQC GEOCHEMICAL MODELLING INPUT

Appendix E.2: PHREEQC Geochemical Modelling Input

Alkalinity at Calcite Equilibrium as a Function of CO_2 (g), High TDS and High Temperature

SELECTED_OUTPUT 1		
-file selected_output_1.sel		
-pH true		
-alkalinity true		
-molalities CO_3^{-2}		
-saturation_indices CO_2(g)		
Solution		
Temp	10	
pH	7	
redox pe		
units mg/L		
density 1		
S(6)	2000.0	
Ca	338.0	
Mg	167.6	
Na	868.0	
-water 1 # kg		
save solution 1		
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
CO_2(g)	-3.5	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
CO_2(g)	-3.45	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
CO_2(g)	-3.4	
end		
Use Solution 1		

SELECTED_OUTPUT 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.35	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.3	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.25	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.2	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.15	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.1	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3.05	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-3	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.95	
end		
Use Solution 1		

SELECTED_OUTPUT 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.9	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.85	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.8	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.75	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.7	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.65	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.6	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.55	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.5	
end		
Use Solution 1		

SELECTED_OUTPUT 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.4	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.3	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	$-2._2$	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2.1	
end		
Use Solution 1		
equilibrium_phases		
calcite	0	10
$CO_2(g)$	-2	
end		

Alkalinity at Calcite Equilibrium as a Function of CO_2 (g), Low TDS and Low Temperature

SELECTED_OUTPUT 1			
-file selected_output_1.sel			
-pH true			
-alkalinity true			
-charge_balance true			
-molalities CO_3^{-2}			
-saturation_indices calcite CO_2(g)			
Solution			
Temp	0.1		
pH	7		
redox pe			
units mg/L			
density 1			
S(6)	500.0		
Ca	84.5		
Mg	41.9		
Na	217.0		
-water 1 # kg			
save solution 1			
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
CO_2(g)	-3.5		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
CO_2(g)	-3.45		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
CO_2(g)	-3.4		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
CO_2(g)	-3.35		
end			

SELECTED_OUTPUT 1			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.3		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.25		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.2		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.15		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.1		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3.05		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-3		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.95		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.9		

SELECTED_OUTPUT 1			
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.85		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.8		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.75		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.7		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.65		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.6		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.55		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.5		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	

SELECTED_OUTPUT 1			
$CO_2(g)$	-2.4		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.3		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.2		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2.1		
end			
Use Solution 1			
equilibrium_phases			
calcite	0	10	
$CO_2(g)$	-2		
end			

Barium Concentration at Barite Saturation Indices (SI) 0.55

SELECTED_OUTPUT		
-totals Ba		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	40	
Ca	12.5	
Mg	2.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	50	
Ca	15.625	
Mg	3.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	60	
Ca	18.75	
Mg	3.75	

SELECTED_OUTPUT		
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	70	
Ca	21.875	
Mg	4.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	80	
Ca	25	
Mg	5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	90	

SELECTED_OUTPUT		
Ca	28.125	
Mg	5.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	100	
Ca	31.25	
Mg	6.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	110	
Ca	34.375	
Mg	6.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	

SELECTED_OUTPUT		
S(6)	120	
Ca	37.5	
Mg	7.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	130	
Ca	40.625	
Mg	8.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	135	
Ca	42.1875	
Mg	8.4375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		

SELECTED_OUTPUT		
density 1		
Alkalinity	100	
S(6)	140	
Ca	43.75	
Mg	8.75	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	145	
Ca	45.3125	
Mg	9.0625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	155	
Ca	48.4375	
Mg	9.6875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	

SELECTED_OUTPUT		
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	165	
Ca	51.5625	
Mg	10.3125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	175	
Ca	54.6875	
Mg	10.9375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	185	
Ca	57.8125	
Mg	11.5625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	

SELECTED_OUTPUT		
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	195	
Ca	60.9375	
Mg	12.1875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	205	
Ca	64.0625	
Mg	12.8125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	215	
Ca	67.1875	
Mg	13.4375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		

SELECTED_OUTPUT		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	225	
Ca	70.3125	
Mg	14.0625	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	235	
Ca	73.4375	
Mg	14.6875	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	245	
Ca	76.5625	
Mg	15.3125	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		

SELECTED_OUTPUT		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	255	
Ca	79.6875	
Mg	15.9375	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	265	
Ca	82.8125	
Mg	16.5625	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	275	
Ca	85.9375	
Mg	17.1875	
Ba	0.1	barite 0.55

SELECTED_OUTPUT		
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	285	
Ca	89.0625	
Mg	17.8125	
Ba	0.1	barite 0.55
#Cl	1	charge
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	290	
Ca	90.625	
Mg	18.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	295	
Ca	92.1875	

SELECTED_OUTPUT		
Mg	18.4375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	300	
Ca	93.75	
Mg	18.75	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	310	
Ca	96.875	
Mg	19.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	

SELECTED_OUTPUT		
S(6)	320	
Ca	100	
Mg	20	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	330	
Ca	103.125	
Mg	20.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	340	
Ca	106.25	
Mg	21.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		

SELECTED_OUTPUT		
density 1		
Alkalinity	100	
S(6)	350	
Ca	109.375	
Mg	21.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	360	
Ca	112.5	
Mg	22.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	410	
Ca	128.125	
Mg	25.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	

SELECTED_OUTPUT		
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	460	
Ca	143.75	
Mg	28.75	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	510	
Ca	159.375	
Mg	31.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	560	
Ca	175	
Mg	35	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	

SELECTED_OUTPUT		
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	610	
Ca	190.625	
Mg	38.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	660	
Ca	206.25	
Mg	41.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	710	
Ca	221.875	
Mg	44.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		

SELECTED_OUTPUT		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	760	
Ca	237.5	
Mg	47.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	810	
Ca	253.125	
Mg	50.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	860	
Ca	268.75	
Mg	53.75	
Ba	0.1	barite 0.55
-water 1 # kg		

SELECTED_OUTPUT		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	910	
Ca	284.375	
Mg	56.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	960	
Ca	300	
Mg	60	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1010	
Ca	315.625	
Mg	63.125	
Ba	0.1	barite 0.55

SELECTED_OUTPUT		
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1060	
Ca	331.25	
Mg	66.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1110	
Ca	346.875	
Mg	69.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1160	
Ca	362.5	
Mg	72.5	

SELECTED_OUTPUT		
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1210	
Ca	378.125	
Mg	75.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1260	
Ca	393.75	
Mg	78.75	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1310	

SELECTED_OUTPUT		
Ca	409.375	
Mg	81.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1360	
Ca	425	
Mg	85	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1410	
Ca	440.625	
Mg	88.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	

SELECTED_OUTPUT		
S(6)	1460	
Ca	456.25	
Mg	91.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1510	
Ca	471.875	
Mg	94.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1560	
Ca	487.5	
Mg	97.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		

SELECTED_OUTPUT		
density 1		
Alkalinity	100	
S(6)	1610	
Ca	503.125	
Mg	100.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1660	
Ca	518.75	
Mg	103.75	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1710	
Ca	534.375	
Mg	106.875	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	

SELECTED_OUTPUT		
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1760	
Ca	550	
Mg	110	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1810	
Ca	565.625	
Mg	113.125	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1860	
Ca	581.25	
Mg	116.25	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	

SELECTED_OUTPUT		
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1910	
Ca	596.875	
Mg	119.375	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	1960	
Ca	612.5	
Mg	122.5	
Ba	0.1	barite 0.55
-water 1 # kg		
end		
Solution	1	Upper
temp	25	
pH	8.3	
redox pe		
units mg/L		
density 1		
Alkalinity	100	
S(6)	2010	
Ca	628.125	
Mg	125.625	
Ba	0.1	barite 0.55
-water 1 # kg		
end		

Mount Nansen Field Bin and Waste Rock Seep Saturation Indices

SELECTED_OUTPUT 1		
-file selected_output_1.sel		
-saturation_indices Gypsum Calcite		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.3	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	515	
Alkalinity	46	
Ca	185	
Mg	41.6	
Cl	0.63	
K	3.1	
Na	2.6	
Sr	0.423	
Si	2.6	
N(5)	0.32	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.91	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	863	
Alkalinity	54	
Ca	313	
Mg	86.1	
Cl	3.7	
K	3.6	

Na	4.3	
Sr	0.854	
Si	3.36	
N(5)	0.55	
N(3)	0.01	
N(-3)	0.1	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	8.13	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1150	
Alkalinity	51	
Ca	367	
Mg	88.2	
Cl	0.17	
K	3.8	
Na	4.8	
Sr	0.911	
Si	2.95	
N(5)	0.01	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.82	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1120	
Alkalinity	64	
Ca	353	

Mg	82.9	
Cl	0.07	
K	3.8	
Na	4.6	
Sr	0.874	
Si	3.42	
N(5)	0.06	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.89	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1290	
Alkalinity	59	
Ca	407	
Mg	93.6	
Cl	0.17	
K	0	
Na	4.4	
Sr	1.13	
Si	3.35	
N(5)	0.01	
N(3)	0.04	
N(-3)	0.1	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.88	
pe 4		
redox pe		
units mg/L		
density 1		

S(6)	1300	
Alkalinity	63	
Ca	463	
Mg	121	
Cl	0.36	
K	5.2	
Na	5.7	
Sr	1.21	
Si	3.73	
N(5)	0.01	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.72	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1070	
Alkalinity	58	
Ca	373	
Mg	92.7	
Cl	0.11	
K	3.8	
Na	4.6	
Sr	0.814	
Si	2.75	
N(5)	0.14	
N(3)	0.05	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.75	
pe 4		

redox pe		
units mg/L		
density 1		
S(6)	1040	
Alkalinity	62	
Ca	343	
Mg	86.8	
Cl	0.11	
K	3.3	
Na	4.2	
Sr	0.826	
Si	2.89	
N(5)	0.31	
N(3)	0.04	
N(-3)	0.08	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.57	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	887	
Alkalinity	44	
Ca	201	
Mg	49.8	
Cl	0.48	
K	3	
Na	2.2	
Sr	0.673	
Si	2.52	
N(5)	0.48	
N(3)	0.08	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01

temp 25		
pH	7.63	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	883	
Alkalinity	47	
Ca	359	
Mg	75.2	
Cl	0.35	
K	3.6	
Na	3.7	
Sr	0.939	
Si	3.55	
N(5)	0.4	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	NW Seep-01
temp 25		
pH	7.54	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	820	
Alkalinity	47	
Ca	294	
Mg	70	
Cl	0.32	
K	2	
Na	2	
Sr	0.647	
Si	3.5	
N(5)	0.49	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		

end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.96	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1120	
Alkalinity	58	
Ca	346	
Mg	125	
Cl	0.53	
K	2	
Na	8.8	
Sr	0.92	
Si	4.44	
N(5)	8.19	
N(3)	0.03	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.7	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1690	
Alkalinity	41	
Ca	371	
Mg	90.5	
Cl	0.83	
K	1.5	
Na	10.1	
Sr	0.972	
Si	4.43	
N(5)	9.96	

N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.66	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1740	
Alkalinity	38	
Ca	370	
Mg	203	
Cl	1.1	
K	0	
Na	9.9	
Sr	0.963	
Si	5.09	
N(5)	9.13	
N(3)	0.02	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.62	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1450	
Alkalinity	41	
Ca	377	
Mg	194	
Cl	1.25	
K	1.9	
Na	12.9	

Sr	1.11	
Si	6.31	
N(5)	9.86	
N(3)	0.04	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.66	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1450	
Alkalinity	36	
Ca	385	
Mg	182	
Cl	1.38	
K	1.6	
Na	11.5	
Sr	0.892	
Si	5.92	
N(5)	9.55	
N(3)	0.06	
N(-3)	0.2	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.62	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1610	
Alkalinity	31	
Ca	395	
Mg	201	

Cl	1.03	
K	1.1	
Na	7.3	
Sr	0.951	
Si	4.1	
N(5)	8.16	
N(3)	0.06	
N(-3)	0.36	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.49	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1680	
Alkalinity	28	
Ca	420	
Mg	219	
Cl	0.91	
K	1.9	
Na	8.8	
Sr	0.958	
Si	4.22	
N(5)	8.09	
N(3)	0.08	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1	#	LW Seep-01
temp 25		
pH	6.86	
pe 4		
redox pe		
units mg/L		
density 1		
S(6)	1330	

Alkalinity	54	
Ca	368	
Mg	173	
Cl	1.04	
K	1	
Na	11	
Sr	0.884	
Si	5.4	
N(5)	6.35	
N(3)	0.01	
N(-3)	0.01	
-water 1 # kg		
end		
SOLUTION 1 # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	6.29	
S(6)	1890	
N(-3)	0.005	
N(5)	0.5	
N(3)	0.1	
Mg	191	
Ca	337	
Mn	1.79	
Na	2	
Sr	0.799	
Cl		
F	0.152	
-water 1 # kg		
end		
SOLUTION 1 # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		

density 1		
pH	7.43	
S(6)	1710	
N(-3)	0.044	
N(5)	0.75	
N(3)	0.32	
Mg	139	
Ca	355	
Mn	0.242	
Na	2	
Sr	0.546	
Cl		
F	0.167	
Alkalinity	39.6	
-water 1 # kg		
end		
SOLUTION 1 # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	6.47	
S(6)	1360	
N(-3)	0.0079	
N(5)	6.24	
N(3)	0.05	
Mg	110	
Ca	416	
Mn	0.0669	
Na	0.8	
Sr	0.615	
Cl		
F	0.165	
Alkalinity	34	
-water 1 # kg		
end		
SOLUTION # Field Bin		

temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	7.35	
S(6)	1280	
N(-3)	0.01	
N(5)	0.15	
N(3)	0.01	
Mg	159	
Ca	496	
Mn	0.167	
Na	1	
Sr	0.705	
Cl	0.45	
F		
Alkalinity	16	
-water 1 # kg		
end		
SOLUTION 1 # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	5.21	
S(6)	1410	
N(-3)	0.01	
N(5)	0.1	
N(3)	0.1	
Mg	250	
Ca	446	
Mn	0.0538	
Na	2	
Sr	0.936	
Cl	2.3	
F		
Alkalinity	24	
-water 1 # kg		

end		
SOLUTION 1 # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	7.3	
S(6)	1870	
N(-3)	0.01	
N(5)	0.01	
N(3)	0.01	
Mg	212	
Ca	542	
Mn	0.119	
Na	1.8	
Sr	0.74	
Cl	0.58	
F		
Alkalinity	47	
-water 1 # kg		
end		
SOLUTION # Field Bin		
temp 25		
pe 4		
redox pe		
units mg/L		
density 1		
pH	6.5	
S(6)	1690	
N(-3)	0.01	
N(5)	0.11	
N(3)	0.01	
Mg	265	
Ca	446	
Mn	0.075	
Na	6	
Sr	0.76	
Cl	0.52	
F		
Alkalinity	47	
-water 1 # kg		
end		

APPENDIX E3: GEOCHEMICAL SOURCE TERMS

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Waste Rock Facilities

		SO4	P	WADCN	Al	Ag	As	Ca	Cd	Co	Cr	Cu	Fe
Upper Case		**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Alpha Dump	mg/L	2091.2	0.050	0	0.014958694	5.6615E-05	0.028160118	390.9132182	3.5251E-05	0.001651238	0.004278068	0.005805372	0.03355218
Kona Backfill	mg/L	401.3	0.078	0	0.020954087	2.64439E-05	0.595158603	92.58863484	0.000105599	0.027041502	0.000621828	0.000874274	0.019852145
in Pit Latte	mg/L	1103.9	0.050	0	0.014544095	2.90632E-05	0.031079887	207.1123022	1.84624E-05	0.000819286	0.002271572	0.00305103	0.031984318
in Pit Supremo	mg/L	1212.5	0.050	0	0.014544095	3.19224E-05	0.031079887	227.4878768	2.02787E-05	0.000899886	0.002495048	0.003351188	0.031984318
in Pit Double Double	mg/L	1081.2	0.050	0	0.014544095	2.84653E-05	0.031079887	202.8517515	1.80826E-05	0.000802432	0.002224843	0.002988266	0.031984318
Alpha Under Drain	mg/m/yr	439478.1	40.064	0	9.545812723	0.011897884	28.59983113	82152.08323	0.007408155	0.347014638	0.899054172	1.220023767	17.11447871
Base Case													
Alpha Dump	mg/L	1429.8	0.025	0	0.007931028	3.87082E-05	0.006309529	267.2712253	2.41015E-05	0.001128967	0.002924957	0.00396919	0.021483066
Kona Backfill	mg/L	274.3	0.027	0	0.014326516	1.808E-05	0.011367883	63.30376342	7.21989E-05	0.018488542	0.00042515	0.00059775	0.013573107
in Pit Latte	mg/L	754.8	0.025	0	0.007925593	1.98708E-05	0.007023385	141.604725	1.26229E-05	0.000560154	0.001553096	0.002086019	0.02141737
in Pit Supremo	mg/L	829.0	0.025	0	0.007925593	2.18257E-05	0.007023385	155.5357065	1.38648E-05	0.000615261	0.001705889	0.00229124	0.02141737
in Pit Double Double	mg/L	739.2	0.025	0	0.007925593	1.9462E-05	0.007023385	138.6917445	1.23633E-05	0.000548631	0.001521147	0.002043107	0.02141737
Alpha Under Drain	mg/m/yr	439478.1	40.064	0	9.545812723	0.011897884	28.59983113	82152.08323	0.007408155	0.347014638	0.899054172	1.220023767	17.11447871

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Waste Rock Facilities

		Hg	Mg	Mn	Mo	Ni	Pb	Sb	Se	Tl	U	Zn	Ra-226
Upper Case		**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**Bq/L**
Alpha Dump	mg/L	2.44545E-05	236.3178529	0.026333133	0.19936325	0.009311543	0.001110593	0.033511708	0.003007408	0.000592658	0.768802979	0.131336918	0.019458122
Kona Backfill	mg/L	4.22151E-06	17.71184274	10.24834406	0.006387923	0.007276152	0.000310914	0.006337664	0.000179391	0.000211464	0.2538	0.092088334	0.091868435
in Pit Latte	mg/L	1.19937E-05	124.2728387	0.009462993	0.115349487	0.003390183	0.00054362	0.016634375	0.001331929	0.00030723	0.8601	0.06088923	0.029531715
in Pit Supremo	mg/L	1.31736E-05	136.4987203	0.010393956	0.126697495	0.003723707	0.000597101	0.018270854	0.001462964	0.000337455	0.8601	0.066879473	0.028246982
in Pit Double Double	mg/L	1.17469E-05	121.716396	0.009268328	0.112976608	0.003320442	0.000532437	0.016292186	0.00130453	0.00030091	0.8601	0.059636665	0.029824113
Alpha Under Drain	mg/m/yr	0.005139219	49663.20662	5.534020424	41.89703895	1.956860602	0.233395855	7.04262873	0.632019597	0.12454954	244.9084392	27.60101451	18.2469385
Base Case													
Alpha Dump	mg/L	6.15571E-06	161.5728483	0.018004223	0.136306622	0.006366394	0.000759323	0.022912286	0.002056194	0.000405206	0.3322803	0.089796347	0.011430937
Kona Backfill	mg/L	2.88629E-06	12.10976168	7.006893979	0.004367486	0.004974777	0.000212575	0.004333123	0.000122651	0.00014458	0.1316	0.062961703	0.06293025
in Pit Latte	mg/L	6.19083E-06	84.96656627	0.006469942	0.078865583	0.002317901	0.000371678	0.011373086	0.000910653	0.000210056	0.376	0.041630567	0.017430422
in Pit Supremo	mg/L	6.19083E-06	93.32552223	0.00710645	0.086624328	0.002545935	0.000408244	0.012491963	0.001000243	0.000230721	0.376	0.045726156	0.016672138
in Pit Double Double	mg/L	6.19083E-06	83.21870116	0.006336847	0.077243222	0.002270219	0.000364032	0.011139128	0.00089192	0.000205735	0.376	0.040774176	0.017603003
Alpha Under Drain	mg/m/yr	0.005139219	49663.20662	5.534020424	41.89703895	1.956860602	0.233395855	7.04262873	0.632019597	0.12454954	244.9084392	27.60101451	18.2469385

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Pit Walls

		Sulphate	P	WADCN	Al	Ag	As	Ca	Cd	Co	Cr	Cu	Fe	Hg
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
BASE CASE														
	No Lake, end of mine life	39.5	0.022		0.007579785	2.67503E-05	0.0218188	119.8747943	4.27048E-05	0.000233268	0.000470768	0.001032277	0.01354255	9.71543E-06
SU4 NORTH DRAINAGE	Lake at Spillway	39.2	0.021		0.007553	2.83741E-05	0.016925249	124.3338875	4.51458E-05	0.000240817	0.000487968	0.001027645	0.01349781	8.96182E-06
	No Lake, end of mine life	33.8	0.025		0.007254123	2.28453E-05	0.030761285	106.1695308	3.67724E-05	0.000207336	0.000460916	0.001046771	0.01304087	1.05856E-05
SU4 South Drainage	Lake at Spillway	34.8	0.023		0.007276872	2.39643E-05	0.028033791	109.7152072	3.84626E-05	0.000214108	0.000469496	0.001046055	0.0130645	1.01505E-05
	No Lake, end of mine life	32.5	0.024		0.007206479	2.02657E-05	0.027662804	97.38669749	3.33154E-05	0.000188369	0.000407477	0.001017084	0.01239871	1.06777E-05
SU3-SU5	Lake at Spillway	32.6	0.020		0.007121952	2.04886E-05	0.021461531	97.23526494	3.38659E-05	0.000186802	0.000394704	0.000997096	0.01193362	9.86321E-06
	No Lake, end of mine life	34.8	0.017		0.0069612	1.83991E-05	0.019931562	90.45877204	3.09495E-05	0.000174593	0.000349478	0.000967061	0.01128195	9.73437E-06
SU1-SU2	Lake at Spillway	34.8	0.017		0.006970164	1.99328E-05	0.018311175	95.1082941	3.31196E-05	0.000183336	0.000372962	0.000970429	0.01149204	9.41358E-06
	No Lake, end of mine life	124.0	0.013		0.009498723	2.72829E-05	0.046935134	171.5623593	4.25431E-05	0.000772375	0.000578783	0.001218503	0.01501509	1.09331E-05
LA	Lake at Spillway	73.9	0.014		0.009069345	3.06462E-05	0.018338371	165.4825758	4.78974E-05	0.000712404	0.000671474	0.001162373	0.01396896	7.7216E-06
UPPER CASE														
	No Lake, end of mine life	41.1	0.034		0.006679299	2.71523E-05	0.03908585	133.5414043	4.63571E-05	0.000299127	0.000499808	0.001128243	0.01376482	1.00419E-05
SU4 NORTH DRAINAGE	Lake at Spillway	40.7	0.033		0.006389203	2.87929E-05	0.030176418	138.7227773	4.8736E-05	0.000309754	0.000515611	0.00111851	0.01371032	9.27255E-06
	No Lake, end of mine life	35.2	0.035		0.006702487	2.3219E-05	0.047779356	117.8325752	4.03828E-05	0.00026302	0.000502879	0.001158838	0.01333661	1.10217E-05
SU4 South Drainage	Lake at Spillway	36.2	0.034		0.006605632	2.43486E-05	0.042994886	121.9352495	4.20644E-05	0.000272779	0.000510951	0.001153503	0.01335095	1.05713E-05
	No Lake, end of mine life	33.9	0.033		0.006819829	2.06263E-05	0.046550415	107.755702	3.71711E-05	0.000237446	0.000442466	0.001135147	0.01268598	1.11012E-05
SU3-SU5	Lake at Spillway	34.0	0.030		0.006616528	2.08586E-05	0.036464621	107.6838099	3.77996E-05	0.000236515	0.000427189	0.001111001	0.01220973	1.02672E-05
	No Lake, end of mine life	36.7	0.026		0.006724836	1.87595E-05	0.036257204	100.020386	3.4991E-05	0.000221687	0.000381894	0.001080895	0.01154371	1.01149E-05
SU1-SU2	Lake at Spillway	36.5	0.027		0.006537048	2.03051E-05	0.033123576	105.3740252	3.70351E-05	0.000233333	0.000405004	0.001081005	0.01174557	9.78242E-06
	No Lake, end of mine life	183.6	0.023		0.007489689	2.79199E-05	0.092292251	188.5271773	6.46309E-05	0.00095657	0.000866042	0.001442626	0.01529846	1.23118E-05
LA	Lake at Spillway	104.4	0.026		0.006146484	3.13333E-05	0.03752014	178.8204119	7.31469E-05	0.000890581	0.001004133	0.001335457	0.01419015	9.2014E-06

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Pit Walls

		Mg	Mn	Mo	Ni	Pb	Sb	Se	Tl	U	Zn	Ra-226
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
BASE CASE												
	No Lake, end of mine life	41.21473248	0.108042224	0.024756661	0.001508038	0.000137072	0.012374961	0.000759226	0.000175483	0.061476085	0.013370523	0.019898998
SU4 NORTH DRAINAGE	Lake at Spillway	42.81880431	0.114915327	0.024455768	0.001581627	0.000145292	0.011385813	0.000792029	0.00017027	0.060874474	0.014182761	0.019139064
	No Lake, end of mine life	36.31296642	0.089958078	0.024141059	0.001306363	0.000118975	0.010833936	0.000658812	0.000167911	0.06457882	0.011418889	0.023664288
SU4 South Drainage	Lake at Spillway	37.56812092	0.095157079	0.024105996	0.001363745	0.000124607	0.010906124	0.000686957	0.000165739	0.064045589	0.011978742	0.022717963
	No Lake, end of mine life	33.87882088	0.0787191	0.02497052	0.001197192	0.000105277	0.010854165	0.000597287	0.000170343	0.063985095	0.010127734	0.023116159
SU3-SU5	Lake at Spillway	34.18352572	0.080143691	0.025054885	0.001218556	0.000106323	0.010501085	0.000602658	0.00016413	0.062824583	0.010239402	0.021453189
	No Lake, end of mine life	32.22143643	0.072580151	0.025206824	0.001154918	9.57599E-05	0.011949623	0.000571932	0.000160723	0.059619437	0.009194365	0.018991411
SU1-SU2	Lake at Spillway	33.69244127	0.078885791	0.024781908	0.001220407	0.000103519	0.011221928	0.000603943	0.000158906	0.059098994	0.009961312	0.018897304
	No Lake, end of mine life	52.9721605	0.171852255	0.010536621	0.007181217	0.000152065	0.034478896	0.00161127	0.000159953	0.00783896	0.013618984	0.00054742
LA	Lake at Spillway	52.89728217	0.182029823	0.011114635	0.00686225	0.000166411	0.031625875	0.001353312	0.000125651	0.008093155	0.01530365	0.000562541
UPPER CASE												
	No Lake, end of mine life	44.87257517	0.122094167	0.028987995	0.001581606	0.000277882	0.015679025	0.000777102	0.00022251	0.158274806	0.013550946	0.062767209
SU4 NORTH DRAINAGE	Lake at Spillway	46.65357393	0.129805945	0.028700814	0.001645598	0.000294148	0.014510892	0.000787375	0.000218385	0.161188362	0.014370689	0.062752664
	No Lake, end of mine life	39.50069382	0.101741261	0.027935404	0.001388938	0.000241428	0.013515833	0.000738935	0.000209805	0.147281855	0.01158685	0.066473643
SU4 South Drainage	Lake at Spillway	40.88422951	0.107584717	0.027968401	0.001441931	0.000252376	0.013686779	0.000752708	0.000208706	0.149188648	0.01215177	0.065630589
	No Lake, end of mine life	36.77893446	0.089067327	0.02884185	0.001277826	0.000215253	0.013380132	0.000751223	0.000208374	0.153417538	0.010284571	0.065138244
SU3-SU5	Lake at Spillway	37.10504353	0.090635792	0.028999469	0.001289324	0.000217262	0.012978291	0.000775772	0.000201188	0.158008795	0.01039832	0.063155702
	No Lake, end of mine life	34.9102509	0.082121873	0.029254767	0.00123142	0.00019628	0.014802821	0.000785842	0.000195011	0.155052279	0.009343595	0.057483364
SU1-SU2	Lake at Spillway	36.54997811	0.089216516	0.028810114	0.001293637	0.000211743	0.013948139	0.00077961	0.000194916	0.154663365	0.010116482	0.058013927
	No Lake, end of mine life	62.59136004	0.198158138	0.013001839	0.008876746	0.00045016	0.025012242	0.001294683	0.000227635	0.035632282	0.013925996	0.004151265
LA	Lake at Spillway	62.45485766	0.209739341	0.013885277	0.008487134	0.000491538	0.020302083	0.000952132	0.000187434	0.038045137	0.01557562	0.002792895

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Treated Heap Leach Facility Drainage

	Ammonia	NO3	NO2	Sulphate	P	WADCN	Al	Ag	As	Ca	Cd	Co	Cr
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Base Case	0.125	0.125	0.025	67	0.188	0.0069	0.0198	0.000059	0.0134	37.4	0.00001	0.0941	0.00056
Upper Case	0.25	0.25	0.05	73	0.197	0.0104	0.0257	0.000074	0.0155	38.9	0.00001	0.0974	0.0007

	Cu	Fe	Hg	Mg	Mn	Mo	Ni	Pb	Sb	Se	Tl	U	Zn	Ra-226
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	0.0023	0.288	0.000037	12.9	0.159	0.00017	0.0011	0.0001	0.00021	0.00176	0.00002	0.000914	0.0295	0.023
Upper Case	0.0026	0.305	0.0000405	13.6	0.198	0.00051	0.0012	0.00016	0.00023	0.00228	0.00002	0.00119	0.0456	0.032

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Heap Leach Facility Drainage at Closure

Solution	T-CN	Ammonia	NO3	NO2	Sulphate	P	WADCN	Al	Ag	As	Ca	Cd	Co	Cr
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Base Case	mg/L	0.05	316.5	5.3	562.2	0.227	0.09685	0.0084	0.000162522	0.292817364	171.1679146	8.50018E-05	0.05995	0.00651
Upper Case	mg/L	9.02	375.4	6.68	1914.5	0.244	0.2	0.1288	0.00074925	0.691268883	460.6481141	0.000268486	0.101	0.0195
Base Case (Passive Discharge)														
	Cu	Fe	Hg	Mg	Mn	Mo	Ni	Pb	Sb	Se	Tl	U	Zn	Ra-226
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	0.002335	0.522	0.00004565	52.23898228	0.03293246	0.254461526	0.005859489	0.000369563	0.03275	0.006591223	0.002255966	0.291774839	0.015872223	0.020897299
Upper Case	0.0064	1.01	0.000423	140.301542	0.100733031	0.900113335	0.019799156	0.001623678	0.0802	0.019829836	0.005938213	0.68162509	0.044042277	0.029774847
Base Case (Passive Discharge)														

Appendix E.3: Geochemical Source Terms

Geochemical Source Terms for Plantsite Area

Solution	Ammonia	NO3	NO2	Sulphate	P	WADCN	Al	Ag	As	Ca	Cd	Co	Cr	
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	
Base Case	0.005	0.0025	0.001	0.25	0.025	0	0.0169	0.000025	0.0023	0.94	0.000025	0.00059	0.00294	
Upper Case	0.01	0.0089	0.0017	0.855	0.025	0	0.0479	0.0000605	0.00335	1.415	0.00005	0.000915	0.003485	
	Cu	Fe	Hg	Mg	Mn	Mo	Ni	Pb	Sb	Se	Tl	U	Zn	Ra-226
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Bq/L
Base Case	0.0052	0.03	0.000025	0.351	0.0535	0.00108	0.00221	0.0007	0.00025	0.00025	0.00005	0.00159	0.005	0.011951644
Upper Case	0.00735	0.044	0.00005	0.514	0.0812	0.001535	0.003085	0.00107	0.00027	0.0005	0.0001	0.002435	0.01	0.018187508

Appendix E.3: Geochemical Source Terms
Geochemical Source Terms for Nitrogen Species

	Ammonia	NO3	NO2
	mg/L	mg/L	mg/L
BASE CASE			
Alpha	0.06	30.00	0.10
Kona in-pit Dump	0.06	30.00	0.10
In-pit Latte WRSF	0.06	30.00	0.10
In-pit Supremo WRSF	0.06	30.00	0.10
In-pit Double Double WRSF	0.06	30.00	0.10
PIT WALLS Active	1.8	17	0.030
PIT WALLS Inactive	0.00	0.00	0.00
UPPER CASE			
Alpha	0.20	45.00	0.30
Kona- In Pit Dump	0.20	45.00	0.30
North Dump	0.20	45.00	0.30
In-pit Latte WRSF	0.20	45.00	0.30
In-pit Supremo WRSF	0.20	45.00	0.30
In-pit Double Double WRSF	0.20	45.00	0.30
PIT WALLS Active	5.5	34	3.6
PIT WALLS Inactive	0.00	0.00	0.00

APPENDIX E4: BENCH-SCALE TESTWORK FOR HLF WATER TREATMENT SYSTEM (INOTEC REPORT)

LORAX ENVIRONMENTAL

COFFEE GOLD PROJECT

Bench-Scale EBR Testing: Nitrate, Arsenic, and Uranium Removal from the Coffee Gold Mine Leach Waters

Final Report

April, 2016

Lorax Environmental Services

David Flather, M.Sc.
Principal and Senior Environmental Geoscientist
Tel. (604) 688-7173
Email: David.Flather@lorax.ca

INOTEC
2712 S. 3600 W., Suite A
Salt Lake City, UT 84119
(801) 966-9694
www.inotec.us

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1. Executive Summary

The Coffee Gold project is located in the west-central Yukon Territory, approximately 130 km south of Dawson City. Lorax Environmental Services (Lorax) has contracted with Inotec LLC (Inotec) to perform treatability studies. This report summarizes results of preliminary bench-scale laboratory evaluations of contaminant removal efficiency using Electro-Biochemical Reactor (EBR) technology.

A microbial population was screened and selected that is expected to exhibit stable nitrate, uranium, and arsenic removal characteristics within the Coffee Gold leach waters and indigenous microbial population. Optimized EBR system achieved 99.9%, 98.8%, and 99.1% removals for nitrate-N, arsenic, and uranium, respectively. Additionally, sixteen other metals as well as total and WAD cyanide were removed by the EBR treatment.

The preliminary bench-scale testing successfully validated the EBR technology as a treatment option for the Coffee Gold leach waters.

2. Introduction

2.1. Coffee Gold Project Description

The Coffee Gold project is located in the west-central Yukon Territory, approximately 130 km south of Dawson City. Exploration drilling has led to the discovery of gold mineralization in 19 areas.

Lorax Environmental Services (Lorax) has contracted with Inotec LLC (Inotec) to perform treatability studies. This report summarizes results of preliminary bench-scale laboratory evaluations of contaminant removal efficiency using Electro-Biochemical Reactor technology.

2.2. Electro-Biochemical Reactor (EBR)

Microbes mediate the removal of metal and inorganic contaminants through electron transfer (redox processes). For example, nitrate reduction can be described by the following redox reaction:

$$NO_3^- + 5e^- + 6H^+ \rightarrow \frac{1}{2}N_2 + 3H_2O \quad (1)$$

The biotransformation shown in reaction 1 occurs under anaerobic, reductive conditions, and thus requires low dissolved oxygen (DO) levels and a negative ORP environment. Five electrons are needed to reduce one molecule of nitrate to nitrogen gas. Other co-contaminants, such as arsenate, uranium, etc., would add to the electron demand. One molecule of glucose, often used as a cost-effective nutrient in the form of molasses, can provide up to 24 electrons under optimal conditions and complete glucose metabolism (usually measured in hours). In environmental applications, this efficiency or the amount of electrons actually realized is usually considerably less; only a few of these electrons are available within 4 to 6 hours time.

In conventional biological treatment systems, electrons are supplied from excess nutrients added to the system. Excess nutrients/chemicals are typically required to compensate for inefficient and variable electron availability needed to adjust the reactor chemistry, microbial growth, contaminant removal, and to compensate for system sensitivity. However, these excess nutrients lead to additional capital and operational expenses, due to higher nutrient consumption and excessive biomass production.

The Electro-Biochemical Reactor (EBR) technology overcomes these shortcomings by directly supplying needed electrons to the reactor and microbes, using a low applied potential across the reactor cell (1-3 V). For a comparison with a conventional nutrient electron donor, the current of 1 mA provides 6.2×10^{15} electrons per second. These electrons replace and supplement the electrons normally supplied to the reactor/microbial system by excess nutrients, at a considerable monetary savings and reactor, microbial, and environmental benefits. The directly supplied electrons are readily available to the microbes in a consistent controllable manner without metabolic energy expenditure. The excess electron provision in the EBR systems allows for a better control of the ORP conditions, without the need to add chemicals, such as bisulfide to adjust the ORP. Moreover, those "free electrons", from the microbes' metabolic standpoint, make the EBR bioreactors more robust and less sensitive to wide fluctuations in water chemistries than the past generations of biotreatments.

2.3. Test Goals

The Coffee Gold treatability tests consisted of the following tasks:

- Task 1 – Spent Ore Column Leaching Tests. Task 1 was used to generate leach waters for Tasks 2 through 4.
- Task 2 – Microbial Screening and Treatability Assessment. The goal of Task 2 was to develop microbial consortia for Tasks 3 and 4.
- Task 3 – EBR Validation Testing. The goal of Task 3 was to provide preliminary evaluation of the EBR technology for treatment of the Coffee Gold leach waters.
- Task 4 – In Situ Testing. The goal of Task 4 was to evaluate microbial in situ treatment of the Coffee Gold spent ore materials.

This report focuses on results obtained during Tasks 2 and 3 of testing. The main goal of the EBR bench-study was to provide a preliminary assessment and validation of the Electro-Biochemical Reactor Technology for arsenic, uranium, and nitrate removal from the Coffee Gold leach waters. Nitrate-N removal is important because it is a co-contaminant and a preferred electron acceptor that needs to be reduced or removed before other metals can be effectively targeted. Treatability assessment, microbial assessment and bench-scale testing was performed on Coffee Gold waters, generated in the lab via Coffee Gold spent ore leaching.

3. Experimental Design and Procedures

3.1. Microbial Screening

Microbial isolation and screening tests were conducted on solutions received and initial column materials at 5ºC and 20 ºC. Microbes isolated from the Coffee Gold waters and spent ore materials were tested for their ability to remove arsenic, uranium, and nitrate from solution. These isolates were tested in direct comparative screening tests alongside Inotec's repository microbes in order to select a site-specific inoculum for removal of contaminants of interest.

These tests provided the microbes for the EBR treatability assessment. A microbial population screened to be effective at removing arsenic, uranium, and nitrate were grown into an inoculum for the EBR testing.

3.2. EBR Bench-Scale Testing

The process flow diagram for the bench-scale EBR testing is shown in Figure 1. The bench-scale setup consisted of a two-stage, up-flow, fixed bed EBR system. The tests were conducted under continuous flow conditions, i.e., the water was treated 24 hours per day. The system was operated using a total hydraulic retention time of 44 hours.

The EBR column tests were conducted continuously for two months for process assessment and validation testing. The goal of validation testing was to generate sufficient compliance data (i.e., nitrate, arsenic, and uranium concentrations in the EBR treatment effluent below desired levels). The EBR system initially treated leach waters pumped twice through the Coffee Gold spent ore columns. However, since uranium concentrations have decreased after the second pass through the spent ore columns, it was decided for the EBR to treat first pass leach solutions instead.

Prior to the EBR treatment, cyanide destruction in the leachate solutions was performed using hydrogen peroxide treatment; nitrate-N was readjusted to at least 150 mg/L, and pH of the water was dropped to about 6.5.

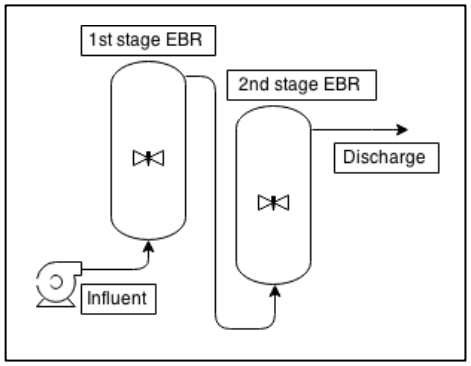

Figure 1. Process flow diagram of a bench-scale EBR system.

3.3. Sampling and Analysis

Daily Inotec in-house measurements included flowrate, pH, ORP, DO, temperature, nutrient addition, conductivity, and nitrate-N. Influent and EBR effluent samples were collected in 5-day intervals and sent out to ALS Vancouver for a complete suite analysis (Table 1).

Table 1. Analytes and analytical methods used in the EBR bench-scale tests.

Analyte	Method	Method Number
Hardness	EDTA Titration	APHA 2340B
pH	Automated pH meter	APHA 4500-H pH Value
TDS	Gravimetric	APHA 2540 C
Alkalinity	Titration	APHA 2320 Alkalinity
Bromide	Ion Chromatography (IC)	EPA 300.1
Chloride	Ion Chromatography (IC)	EPA 300.1
Fluoride	Ion Chromatography (IC)	EPA 300.1
Total Nitrogen	Colorimetric	APHA Method 4500-P (J) / NEMI 5735
Ammonia-Nitrogen	Fluorescence	J. ENVIRON. MONIT., 2005
Nitrite-Nitrogen	Ion Chromatography (IC)	EPA 300.1
Nitrate-Nitrogen	Ion Chromatography (IC)	EPA 300.1
Total Phosphorus	Colorimetric	APHA 4500-P Phosphorus
Orthophosphate	Colorimetric	APHA 4500-P Phosphorus
Sulfate	Ion Chromatography (IC)	EPA 300.1
Total Cyanide	Continuous Flow Analyzer (CFA)	ISO 14403:2002
WAD Cyanide	Continuous Flow Analyzer (CFA)	APHA 4500-CN CYANIDE
Total Metals	Collision/Reaction Cell – Inductively Coupled Plasma (CRC-ICP)	EPA 200.2/6020A
Total Mercury	Cold Vapor Atomic Absorption Spectrophotometry (CVAAS)	EPA 1631E

4. Results

4.1. Chemistry and Treatability Assessment

The leachate solution chemistry treated by the EBR system is shown in Table 2. Nitrate as well as arsenic (1.1 mg/L) and uranium (144 μg/L) concentrations were well within the EBR treatability range. Compounds that often compete with nitrate, arsenic, and uranium for electrons during biotreatments, e.g., nitrite, and other metal oxyanions, such as selenate or chromate, were not present at concentrations that would impact EBR performance.

Inorganic parameters that often have an inhibitory effect on microbial metabolism, such as chlorides, were present at low levels. Total and WAD cyanides were elevated and needed to be destroyed prior to EBR treatment. Due to the nature of the spent ore, the generated leach solutions had pH of about 8.7 and needed to be adjusted to 6.5 for optimal denitrification and As/U removal.

Water chemistry assessment strongly suggests that the EBR technology will be effective at removing the contaminants of concern. Additionally, the EBR technology should also reduce the concentration of some other metals, such as aluminum, antimony, cadmium, chromium, copper, mercury, molybdenum, nickel, and tin.

4.2. Microbial Screening and Assessment Results

Nitrate-, arsenic-, and uranium-reducing microorganisms were isolated from the Coffee Gold waters and spent ore materials received and screened with Inotec's repository strains to examine their bioremediation potential in the site waters at 5°C and 20°C. The microbial screening is used to 1) determine whether a given contaminant is easy or difficult to remove in a given water chemistry using the EBR technology; 2) identify a best performing microbial population in the given water chemistry (contaminant transformation, temperature dependence, performance robustness); 3) selection of an adjusted/enhanced microbial consortium that is the most compatible with the unadjusted native population; and 4) condition the selected microbial consortia for optimal EBR performance.

With an evaluation of the obtained wastewater chemistry, good positive denitrification and microbial arsenic/uranium reduction screening results were obtained. Selected microbes were further screened and characterized to develop the inocula for EBR tests. From the various consortia tested in the Coffee Gold waters, the best inoculum for the bench-scale tests was selected based on:

- Nitrate/As/U reduction potential at low and high temperatures.
- Robustness in the Coffee Gold waters at low and high temperatures.
- Compatibility with indigenous microbes present in the Coffee Gold waters.
- The ability to maintain an integrated biofilm with desired contaminant removal characteristics.

Table 2. Water chemistry of Coffee Gold leach solutions.

Parameter	Concentration
Metals	
Aluminum	1.5 mg/L
Antimony	30.8 µg/L
Arsenic	1.1 mg/L
Barium	70.5 µg/L
Cadmium	3.7 µg/L
Calcium	37.5 mg/L
Chromium	10.3 µg/L
Cobalt	239 µg/L
Copper	0.5 mg/L
Iron	0.5 mg/L
Lead	1.1 µg/L
Magnesium	5.9 mg/L
Manganese	32 µg/L
Mercury	3.7 µg/L
Molybdenum	75 µg/L
Nickel	118 µg/L
Potassium	83 mg/L
Selenium	2.1 µg/L
Silver	5.2 µg/L
Sodium	234 mg/L
Strontium	186 µg/L
Thallium	0.88 µg/L
Tin	7.7 µg/L
Titanium	9.3 µg/L
Uranium	144 µg/L
Vanadium	1.2 µg/L
Zinc	187 µg/L
Inorganics	
pH	8.7
Hardness, Total (as $CaCO_3$)	118 mg/L
Alkalinity, Total (as $CaCO_3$)	188 mg/L
Ammonia as N	13 mg/L
Chloride	6.8 mg/L
Fluoride	0.35 mg/L
Cyanide, Total	24 mg/L
Cyanide, WAD	25 mg/L
Nitrate as N	105 mg/L
Nitrite as N	0.3 mg/L
Total N	130 mg/L
Sulfate	160 mg/L
Dissolved Orthophosphate	0.13 mg/L

4.3. Removal of Contaminants of Interest

The bench-scale testing validated the EBR technology for removal of nitrate, arsenic, and uranium from Coffee Gold leach waters. Figures 2 and 3 show removal of nitrate-N and nitrite-N by the bench-scale EBR system. Nitrate-N concentrations were adjusted to a minimum of 150 mg/L in the influent waters and averaged 188 mg/L during the 2-month test period. The EBR system consistently removed both nitrate-N and nitrite-N to below detection limits (0.19 mg/L and 0.04 mg/L, respectively).

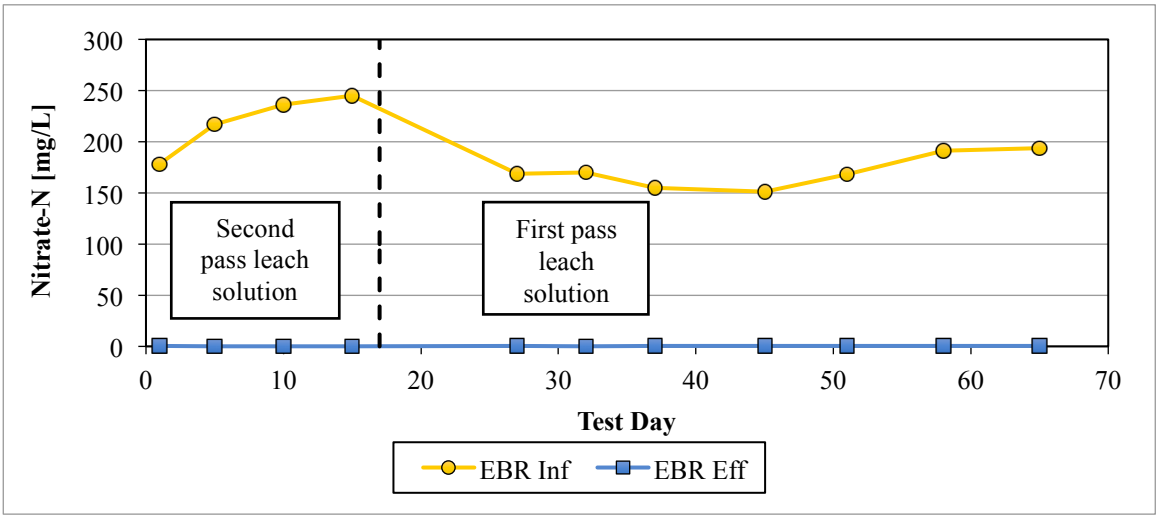

Figure 2. EBR nitrate-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

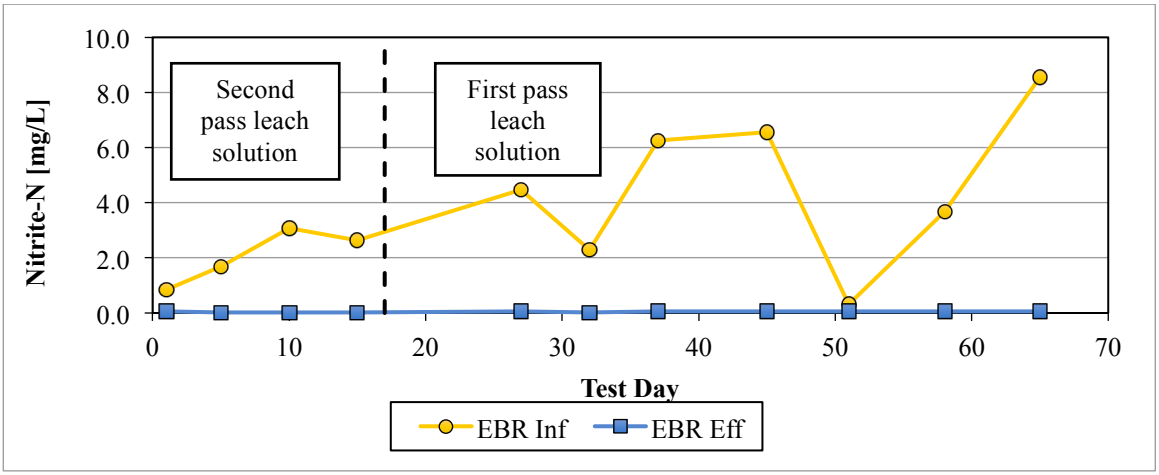

Figure 3. EBR nitrite-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

Arsenic removal by the EBR Coffee Gold system for the initial two weeks averaged 60% (Figure 4). Process and bioreactor operation were adjusted to improve the EBR performance. After system modifications were implemented, the EBR As removal increased to an average of 98.8%. Total arsenic was removed from the average of 1,113 µg/L in the leach waters to average of 12.9 µg/L in the EBR system effluent.

Uranium removal averaged 99.1%, with the EBR system effluent concentrations averaging 0.8 µg/L (Figure 5). Influent uranium levels varied between 34 µg/L and 154 µg/L, with the average concentrations of 92.5 µg/L. Table 3 summarizes EBR performance.

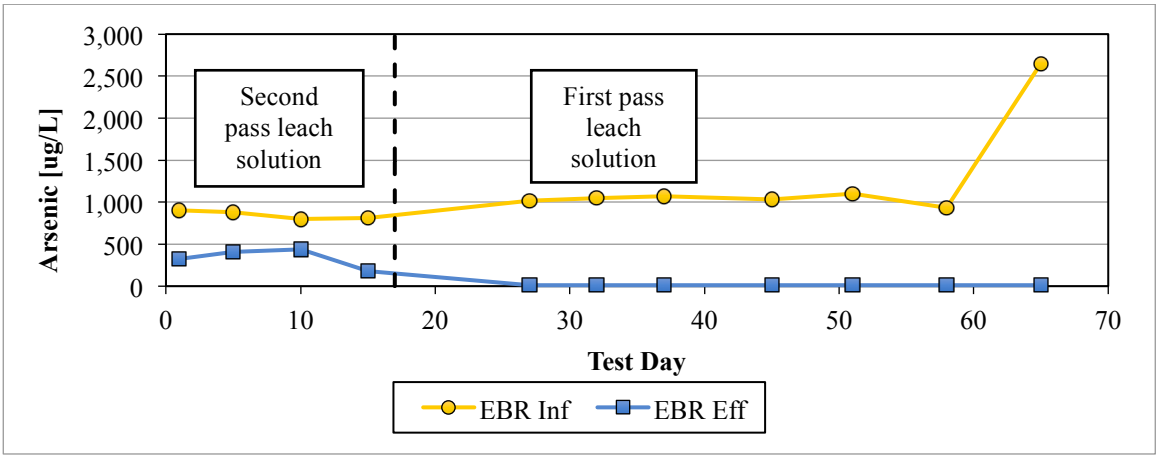

Figure 4. EBR arsenic removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

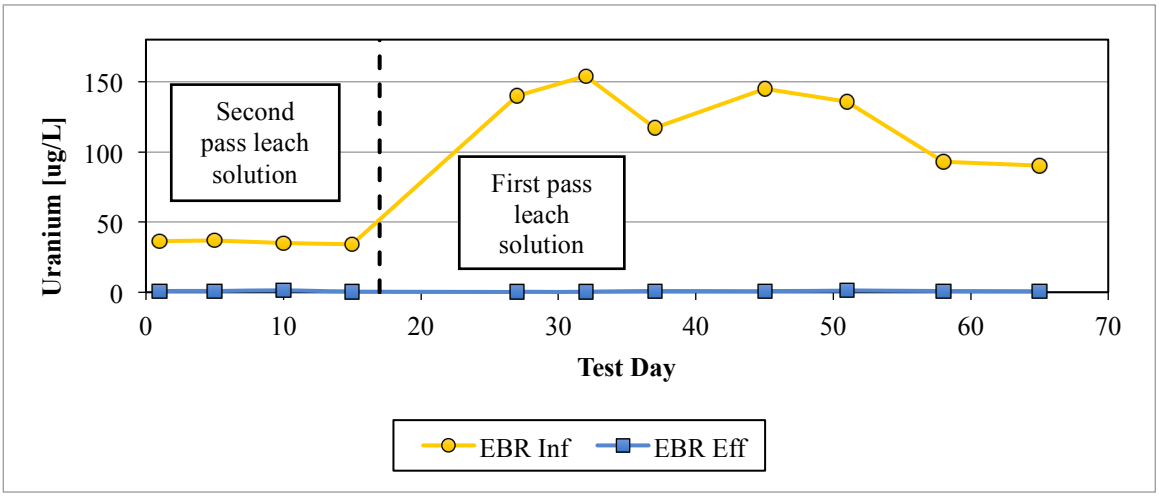

Figure 5. EBR uranium removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

Table 3. Average EBR treatment performance.

Parameter	Average EBR Influent	Average EBR Effluent	% Removal
Nitrate-N [mg/L]	188	< 0.19	> 99.9%
Nitrite-N [mg/L]	3.7	< 0.04	> 98.9%
As [µg/L]	1,113	12.9*	98.8%
U [µg/L]	92.5	0.8	99.1%
Al [µg/L]	737	< 35.8	> 95.1%
Sb [µg/L]	33.2	< 0.35	> 98.9%
Cd [µg/L]	1.3	< 0.02	> 98.5%
Cr [µg/L]	10.7	< 0.66	> 93.8%
Co [µg/L]	269	122	54.6%
Cu [µg/L]	267	< 2.4	> 99.1%
Fe [µg/L]	2.2	0.23	89.5%
Pb [µg/L]	1.9	< 0.17	> 91.0%
Hg [µg/L]	1.6	0.03	98.1%
Mo [µg/L]	59.5	< 6.9	> 88.4%
Ni [µg/L]	75.1	< 2.3	> 96.9%
Se [µg/L]	2.9	1.2	58.6%
Ag [µg/L]	3.9	< 0.06	> 98.5%
Tl [µg/L]	0.8	< 0.03	> 96.2%
Sn [µg/L]	32.5	0.8	97.5%
Zn [µg/L]	76.1	38.1	49.9%
WAD Cyanide [mg/L]	0.03	< 0.007	> 76.7%
Total Cyanide [mg/L]	0.48	0.16	66.7%
Ammonia-N [mg/L]	15.3	208	NA
Orthophosphate [mg/L]	0.2	47.1	NA

*after process adjustment

NA – not applicable

4.4. Removal of Other Contaminants

Beside arsenic and uranium, the EBR system removed other metals to various degrees as well (Table 3). Over 90% average removal efficiencies were achieved for Al, Sb, Cd, Cr, Cu, Pb, Hg, Ni, Sn, Ag, and Tl. Total and WAD cyanide were still present in the leach waters after peroxide cyanide destruction, albeit at much lower concentrations (0.48 mg/L and 0.03 mg/L, respectively). The EBR system degraded WAD cyanide to below the detection limit of 0.007 mg/L and total cyanide to average levels of 0.16 mg/L (Table 3). Complete analytical data tables are given in Appendix A.

As expected in this preliminary treatability evaluation, nutrient levels (e.g., ammonia-N and orthophosphate) were elevated in the EBR system effluent. The scope of work for this project

was focused on the initial validation of the EBR process for removal of contaminants of interest and not on process optimization. In field applications, minimum nutrient additions to the EBR system are established and balanced, often resulting in minimal (if any) increases in the system effluent. However, if ultra-low levels of ammonia or BOD are required in the system effluent, a conventional aerobic bioreactor polishing step can be used. Aerobic bioreactors are a well-established technology for nutrient removal from municipal wastewaters, where they have been successfully implemented for over a century.

5. Conclusions

The preliminary bench-scale testing successfully validated EBR technology for removal of nitrate, arsenic, and uranium from Coffee Gold leach waters. Nitrate-N was removed from an average of 188 mg/L to below detection limit of 0.19 mg/L. After process adjustments, average removals of 98.8% and 99.1% were achieved for arsenic and uranium, respectively. Furthermore, sixteen other metals as well as total and WAD cyanides were removed by the EBR system.

In order to develop process requirements and design parameters for a Coffee Gold site-specific EBR system, additional bench-scale and/or pilot-scale testing is required. Testing duration of a minimum of 14-16 weeks is required for process assessment and to develop validation data, nutrient and hydraulic retention time requirements, as well as evaluation of post-treatment needs, if any.

Thank you for your consideration of INOTEC's EBR technology for evaluation.

Sincerely,

INOTEC, INC.

Jack Adams, Ph.D.
President, INOTEC

Ola Opara, Ph.D.
Vice President, INOTEC

Appendix A.

Analytical Data Tables

	Hardness [mg/L as CaCO3]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	95.5	145	135	282	111
5		148	141	176	122
10		135	151	147	114
15	77.4	136	152	177	109
27	110			107	154
32	108			114	149
37	106			130	147
45	110			115	148
51	109			101	128
58	121			116	150
65	145			146	144

	pH				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	8.64	8.31	8.3	6.55	7.98
5		8.36	8.32	7.38	8.08
10		8.34	8.33	6.78	8.06
15	8.78	8.30	8.38	7.27	8.01
27	8.29			7.16	7.91
32	8.34			6.62	7.93
37	8.32			6.46	7.88
45	8.29			6.24	7.73
51	8.31			6.65	7.83
58	8.31			6.49	7.87
65	8.16			6.25	7.97

	TDS [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	1390	1450	1330	1680	3190
5		1480	1560	1830	2400
10		1560	1650	1840	2170
15	1620	1560	1670	2000	1910
27	1110			1280	1980
32	1160			1630	2040
37	1160			1560	2090
45	1160			1540	2600
51	1170			1690	2130
58	1290			1730	2230
65	1320			1780	2280

	Alkalinity [mg/L as CaCO3]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	140	182	168	43.8	1890
5		190	174	64.8	1530
10		187	190	32.1	1410
15	131	165	200	47.5	1260
27	157			106	852
32	158			65.4	775
37	164			41.8	772
45	167			44.9	739
51	179			70.9	680
58	176			65.9	689
65	166			57.1	682

	Ammonia-N [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	17.1	9.5	10.1	9.91	314
5		9.3	10.7	9.38	192
10		10.4	12.4	10.5	149
15	19.4	12.2	14.3	12.0	144
27	18.2			21.8	178
32	18.5			21.5	206
37	19.6			21.1	218
45	19.0			20.6	210
51	19.9			20.7	215
58	12.4			13.0	234
65	8.97			7.94	231

	Chloride [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	<10	6.7	6.9	215	733
5		<10	6.7	127	488
10		<10	<10	142	424
15	<10	6.3	<10	158	433
27	6.3			177	1020
32	7.0			114	1010
37	6.5			184	1060
45	6.5			160	1060
51	6.8			89	1060
58	7.0			92	1180
65	6.8			100	1160

	Nitrate-N [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	206	159	161	178	<0.25
5		194	180	217	<0.1
10		205	195	236	<0.1
15	178	184	197	245	<0.1
27	94.6			169	<0.25
32	103			170	<0.1
37	101			155	<0.25
45	100			151	<0.25
51	98.1			168	<0.25
58	125			191	<0.25
65	127			194	<0.25

	Nitrite-N [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.328	1.82	0.94	0.84	<0.05
5		2.26	3.49	1.68	<0.02
10		0.899	6.64	3.07	<0.02
15	0.319	0.571	16.4	2.64	<0.02
27	0.281			4.46	<0.05
32	0.300			2.28	<0.02
37	0.325			6.25	<0.05
45	0.303			6.56	<0.05
51	0.298			0.30	<0.05
58	4.1			3.68	<0.05
65	8.73			8.55	<0.05

	Total N [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	216	178	165	186	346
5		190	181	223	205
10		199	209	239	166
15	192	203	216	248	149
27	122			259	195
32	124			190	210
37	118			177	224
45	120			171	223
51	120			185	216
58	147			213	247
65	141			212	243

	Orthophosphate-P [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.074	0.08	0.07	0.368	78.3
5		0.071	0.087	0.198	51.7
10		0.076	0.0862	0.138	50
15	0.032	0.062	0.112	0.193	41.6
27	0.141			0.266	41
32	0.131			0.184	44
37	0.124			0.197	42.1
45	0.128			0.188	44.3
51	0.117			0.169	39.6
58	0.128			0.184	43.9
65	0.150			0.193	42.1

	Sulfate [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	160	163	167	223	<15
5		171	158	166	<6
10		158	144	144	<6
15	152	151	154	178	<6
27	143			168	<15
32	156			155	50.2
37	147			158	39
45	150			159	67
51	149			150	57
58	166			166	73
65	165			163	69

	Sulfide-S [mg/L]		
Test Day	**Leach Columns Influent**	**EBR Influent**	**EBR Effluent**
27	<0.0015	<0.0015	0.611
32	<0.0015	<0.0015	3.48
37	<0.0015	<0.0015	1.96
45	0.0026	<0.0015	3.99
51	<0.0015	<0.006	3.36
58	<0.0015	<0.0015	2.42
65	<0.0015	<0.0015	4.42

	Cyanide WAD [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	11.3	0.0201	0.054	0.0188	<0.005
5		0.0193	0.0232	0.0143	<0.005
10		0.0155	0.0136	0.0087	<0.005
15	9.7	0.0245	0.0208	0.0161	0.0084
27	6.71			0.0479	0.013
32	6.62			0.0908	0.0098
37	5.76			0.0083	0.0104
45	4.09			0.0623	0.0067
51	2.21			0.0085	0.0069
58	0.73			<0.005	0.0051
65	0.364			0.0302	0.0077

	Cyanide Total [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	11.7	0.529	0.505	0.558	0.374
5		0.448	0.37	0.452	0.355
10		0.518	0.342	0.355	0.24
15	10.4	0.493	0.334	0.353	0.0997
27	7.04			0.696	0.0975
32	7.4			0.693	0.11
37	6.18			0.0979	0.0964
45	4.73			0.521	0.0959
51	2.92			0.779	0.104
58	1.37			0.376	0.0811
65	0.749			0.363	0.0816

	Aluminum [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	32.2	19.6	8.8	51.1	74.3
5		<6	6.6	61.8	62.9
10		<6	<6	9.9	59.8
15	81.9	<6	7.4	15.7	46
27	114			214	<15
32	131			128	<30
37	97.5			84.7	17.2
45	93.1			50.9	19.5
51	382			163	23.2
58	260			356	25.7
65	6430			6970	19.8

	Antimony [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	28.7	31.3	32.2	35	0.38
5		32.8	33.8	32.7	<0.2
10		36.9	33.5	32.7	<0.2
15	29.1	30.9	31.2	30.7	<0.5
27	30.5			28.9	<0.5
32	30.3			31	<1
37	25.5			29.7	0.23
45	29			28.4	<0.2
51	31.1			28.9	0.22
58	32.1			32.1	<0.2
65	65.3			54.9	0.21

	Arsenic [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	1040	864	866	903	321
5		916	869	877	405
10		875	786	800	440
15	951	891	767	813	179
27	1060			1020	10.1
32	1080			1050	13.2
37	1090			1070	11.7
45	1100			1030	12.2
51	1170			1100	13.4
58	942			934	14.3
65	2620			2650	15.5

	Barium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	51.8	52.1	40.2	60.7	188
5		47.0	40.9	51.2	498
10		41.7	42.0	42.6	350
15	34.1	41.2	49.6	47.6	207
27	61.7			60.5	550
32	61			64	351
37	63.1			68.6	423
45	63.5			63.4	426
51	69.7			67.1	384
58	52.8			52.2	332
65	254			268	350

	Beryllium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	<0.04	<0.04	<0.04	<0.04	<0.04
5		<0.04	<0.04	<0.04	<0.04
10		<0.04	<0.04	<0.04	<0.04
15	<0.02	<0.04	<0.04	<0.04	<0.01
27	<0.02			<0.04	<0.1
32	<0.02			<0.02	<0.02
37	<0.02			<0.02	<0.04
45	<0.02			<0.02	<0.04
51	0.021			<0.02	<0.04
58	0.02			0.041	<0.04
65	1.26			1.13	<0.04

	Bismuth [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	<0.1	<0.1	<0.1	<0.1	<0.1
5		<0.1	<0.1	<0.1	<0.1
10		<0.1	<0.1	<0.1	<0.1
15	<0.05	<0.1	<0.1	<0.1	<0.25
27	<0.05			<0.1	<0.25
32	<0.05			<0.05	<0.05
37	<0.05			<0.05	<0.1
45	<0.05			<0.05	<0.1
51	<0.05			<0.05	<0.1
58	<0.05			<0.05	<0.1
65	0.425			0.376	<0.1

	Boron [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.028	0.023	0.025	0.050	0.231
5		0.024	0.026	0.030	0.279
10		0.022	0.020	0.022	0.272
15	0.022	0.023	0.024	0.028	0.237
27	0.022			0.022	0.144
32	0.023			0.025	0.170
37	0.019			0.027	0.149
45	0.021			0.024	0.135
51	0.024			0.023	0.131
58	0.022			0.021	0.107
65	0.027			0.025	0.096

	Cadmium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	2.06	0.044	0.046	0.157	<0.01
5		0.021	0.03	0.103	<0.01
10		0.015	0.012	0.041	0.014
15	1.64	0.016	0.011	0.072	<0.025
27	1.2			1.29	<0.025
32	0.939			0.964	<0.05
37	0.521			0.888	<0.01
45	0.300			0.589	<0.01
51	0.370			0.544	<0.01
58	0.333			0.505	<0.01
65	9.06			9.38	<0.01

	Calcium [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	29.1	41.4	37.4	98.1	29.6
5		41.4	38.5	53.7	30.1
10		37.4	40.0	41.6	28.9
15	21.6	37.5	39.3	53.5	26.0
27	34.6			33.5	37.7
32	33.9			36.3	35.7
37	33.4			42.8	36.6
45	34.3			37.0	37.8
51	33.9			31.5	32.7
58	35.3			34.0	38.9
65	40.8			41.6	37.4

	Chromium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	10.3	7.25	6.54	5.4	0.93
5		7.14	6.6	6.87	0.76
10		6.69	6.57	6.19	0.60
15	10.3	6.99	6.07	6.24	0.71
27	9.39			9.11	<0.5
32	10.5			8.59	<1
37	10.2			8.38	0.46
45	10.6			7.95	0.51
51	11.7			11.0	<0.7
58	6.89			8.82	0.57
65	39.8			39.2	0.56

	Cobalt [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	261	285	289	350	194
5		285	285	284	173
10		268	272	258	147
15	255	277	273	266	153
27	248			244	95.8
32	266			239	112
37	259			254	89.1
45	266			248	92.5
51	279			260	96.8
58	265			270	97.4
65	281			282	94.1

	Copper [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	607	9.2	10	58.4	2.3
5		4.8	4.3	40.7	<1.0
10		3.4	3.7	5.8	1.5
15	579	3.1	6.4	6.7	<2.5
27	561			497	<2.5
32	631			446	<5.0
37	606			403	2.6
45	631			387	2.0
51	671			523	2.3
58	162			179	2.3
65	444			389	2.5

	Iron [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.258	0.259	0.191	0.338	0.158
5		0.241	0.198	0.389	0.202
10		0.244	0.194	0.202	0.177
15	0.288	0.257	0.203	0.203	0.194
27	0.33			0.404	0.242
32	0.357			0.278	0.173
37	0.337			0.214	0.242
45	0.355			0.192	0.282
51	0.544			0.445	0.288
58	0.475			0.788	0.305
65	21.7			21	0.291

	Lead [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	<0.1	<0.1	<0.1	<0.1	<0.1
5		<0.1	<0.1	<0.25	<0.1
10		<0.1	<0.1	<0.1	<0.1
15	0.052	<0.1	<0.1	<0.1	<0.25
27	0.075			0.22	<0.25
32	0.113			0.117	<0.5
37	0.07			0.079	<0.1
45	0.065			0.058	<0.1
51	0.245			0.23	<0.1
58	0.270			0.595	0.16
65	20.9			19.1	0.14

	Lithium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	3.8	7.3	7.5	7.3	26.1
5		7.4	8.1	7.0	20.6
10		5.9	9.2	7.6	34.7
15	4.9	8.1	9.4	7.7	93.1
27	4.5			4.2	55.1
32	4.5			4.4	45.0
37	4.0			4.6	27.2
45	4.7			4.6	28.0
51	5.0			5.0	26.3
58	6.5			6.1	22.9
65	7.0			6.4	19.7

	Magnesium [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	5.52	10.2	9.98	9.04	8.99
5		10.8	10.9	10.1	11.4
10		10.2	12.3	10.5	10.1
15	5.68	10.3	13.1	10.6	10.8
27	5.82			5.59	14.6
32	5.77			5.6	14.5
37	5.61			5.49	13.6
45	5.90			5.54	13.1
51	5.87			5.47	11.3
58	7.93			7.59	12.9
65	10.4			10.3	12.4

	Manganese [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	4.88	32.1	12.9	176	36.1
5		20	12.9	70.7	31
10		16.9	12.6	28.3	38.9
15	4.74	19.7	12.7	68	106
27	14.2			20.3	108
32	16.2			24.6	133
37	15.8			44.2	148
45	17.0			26.6	146
51	21.8			21.8	159
58	22.7			32.7	177
65	628			668	198

	Mercury [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.591	0.0746	0.0378	0.201	0.033
5		0.0312	0.0241	0.117	<0.025
10		0.0248	0.0185	0.0309	0.0263
15	0.505	0.0142	0.0295	0.0268	0.0087
27	0.588			0.708	0.0462
32	0.564			0.607	0.0409
37	0.489			0.637	0.0405
45	0.651			0.602	0.0325
51	0.657			0.497	0.0352
58	1.12			1.27	0.039
65	12.8			13.4	0.037

	Molybdenum [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	78	40.4	46	52.6	18.3
5		40.4	42	42.5	23.5
10		43.8	38.5	38.5	23.1
15	77.2	34.2	34.6	36.6	8.68
27	81.6			75	<0.25
32	80.5			80.4	<0.5
37	68.2			79.6	0.51
45	78.8			77.0	0.20
51	81.6			75.1	0.13
58	64.1			60.6	0.14
65	44.5			37.0	0.17

	Nickel [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	131	3.6	4.8	62.6	4.0
5		2.6	2.1	23.3	2.7
10		2.2	1.7	3.0	2.6
15	122	2.2	1.7	4.1	2.9
27	120			115	<2.5
32	127			113	<5.0
37	125			120	1.2
45	127			111	1.1
51	132			117	1.2
58	62.6			53.1	1.1
65	121			104	1.0

	Phosphorus [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.051	<0.05	<0.05	0.363	72
5		<0.05	<0.05	0.204	49.1
10		<0.05	<0.05	0.095	49.2
15	<0.05	<0.05	<0.05	0.140	43.3
27	0.097			0.219	42.7
32	0.095			0.22	45.1
37	0.09			0.216	43.1
45	0.095			0.198	43.5
51	0.151			0.241	35.3
58	0.061			0.187	41.2
65	0.349			0.470	43.0

	Potassium [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	314	54.8	68.2	228	455
5		61.3	76	204	351
10		63.8	87.5	191	308
15	267	68.8	91.9	189	232
27	79.3			473	272
32	81.6			269	275
37	76.4			240	320
45	81.9			231	340
51	77.6			250	312
58	72.7			235	343
65	75.8			242	336

	Selenium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	2.95	2.15	2.12	3.79	0.5
5		2.18	2.17	3.11	0.28
10		2.25	2.24	2.47	0.34
15	2.51	2.20	2.05	3.67	<0.25
27	2.39			2.83	0.88
32	2.65			2.89	2.46
37	2.36			3.28	1.21
45	2.48			2.82	1.76
51	2.54			2.41	1.56
58	2.32			2.15	2.28
65	2.54			2.47	2.25

	Silicon [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	4.76	5.06	5.47	5.68	25.5
5		5.43	5.71	5.51	23
10		5.27	5.62	5.24	26.5
15	5.12	5.59	6.18	5.22	41.5
27	5.42			5.4	25.5
32	5.34			5.18	22.7
37	5.11			5.06	17.3
45	5.31			5.00	18.4
51	5.83			5.07	17.6
58	5.82			5.73	18.5
65	18.7			19.5	18.3

	Silver [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	7.07	0.027	0.111	1.04	0.086
5		<0.020	0.037	0.811	0.031
10		<0.020	0.030	0.094	0.026
15	7.76	<0.020	0.023	0.100	<0.05
27	7.75			7.21	<0.05
32	8.35			6.22	<0.1
37	6.63			6.22	0.054
45	7.81			4.74	0.048
51	8.93			7.81	0.066
58	2.16			4.03	0.059
65	5.63			4.83	0.074

	Sodium [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	264	350	335	260	587
5		377	376	343	467
10		354	371	338	423
15	261	365	384	367	433
27	251			239	367
32	266			240	453
37	271			273	435
45	264			250	438
51	269			254	439
58	272			260	451
65	274			276	485

	Strontium [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.177	0.275	0.253	0.388	0.23
5		0.287	0.269	0.299	0.218
10		0.309	0.293	0.282	0.211
15	0.168	0.262	0.299	0.306	0.162
27	0.197			0.185	0.165
32	0.196			0.207	0.207
37	0.162			0.212	0.204
45	0.190			0.196	0.209
51	0.202			0.188	0.213
58	0.231			0.220	0.245
65	0.248			0.219	0.249

	Sulfur [mg/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	46.7	51.4	50.7	69.4	5.5
5		54.5	52.4	54.6	0.81
10		53.5	53.3	52.6	0.61
15	49.9	53.3	52.0	54.9	1.54
27	50.8			49.1	8.06
32	48.1			48.8	18.2
37	50.1			52.6	15.5
45	52.3			52.2	24.4
51	51.6			48.3	20.6
58	51.0			48.9	23.2
65	53.8			53.1	23.5

	Thallium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	0.787	0.685	0.678	0.409	<0.02
5		0.707	0.711	0.698	<0.02
10		0.804	0.761	0.694	<0.02
15	0.786	0.707	0.790	0.657	<0.05
27	0.869			0.86	<0.05
32	0.833			0.851	<0.10
37	0.711			0.824	<0.02
45	0.829			0.773	<0.02
51	0.902			0.791	<0.02
58	0.729			0.655	<0.02
65	1.96			1.46	<0.02

	Tin [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	2.45	0.29	18	22.9	1.02
5		0.23	14.7	31.9	0.8
10		<0.20	12.0	18.0	0.87
15	3.01	0.22	23.4	8.66	0.53
27	3.91			50.7	0.93
32	3.53			40.7	1.1
37	2.28			28.5	0.97
45	2.67			27.0	0.75
51	3.96			46.5	0.62
58	5.50			54.1	0.45
65	9.69			29.0	0.46

	Titanium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	<0.6	<0.6	<0.6	<1.2	<0.6
5		<0.6	<0.6	<1.5	<0.6
10		<0.6	<0.6	<0.6	<0.6
15	<0.99	<0.6	<0.6	<0.6	<1.5
27	<1.2			<2.4	<1.5
32	<1.5			0.83	<3
37	<1.2			<0.9	<0.6
45	0.75			<0.9	<0.6
51	<3.0			1.61	<0.6
58	<6.0			4.3	<0.6
65	77.3			81.6	<0.6

	Uranium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	137	41.4	29.4	36.4	1.02
5		45.9	29.4	37.1	0.983
10		66.4	34.9	34.9	1.40
15	132	60.3	36.5	34.0	0.601
27	158			140	0.23
32	150			154	0.41
37	124			117	0.935
45	147			145	0.741
51	154			136	1.19
58	97.3			92.9	0.914
65	103			90.3	0.741

	Vanadium [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	1.4	<1.0	<1.0	0.5	<1.0
5		<1.0	<1.0	<1.0	<1.0
10		<1.0	<1.0	<1.0	<1.0
15	0.8	<1.0	<1.0	<1.0	2.5
27	0.5			<1.0	2.5
32	0.6			0.55	5.0
37	0.5			0.53	<1.0
45	0.5			0.5	<1.0
51	0.8			0.66	<1.0
58	0.6			1.01	<1.0
65	23.0			23.1	<1.0

	Zinc [ug/L]				
Test Day	**Leach Columns Influent**	**Leach Column A Effluent**	**Leach Column B Effluent**	**EBR Influent**	**EBR Effluent**
1	185	<6	<6	14.0	43.2
5		<6	<6	9.1	48.9
10		<6	<6	<6	30.5
15	171	<6	<6	<6	69.0
27	161			153.0	28.0
32	159			130.0	45.0
37	142			111.0	21.9
45	92.1			107.0	36.0
51	53.7			78.7	29.5
58	15.1			26.9	22.0
65	184			196.0	45.6

Appendix C: Saturated Column Report

Newmont™ COFFEE

1 Introduction and Objectives

This appendix describes sample collection, methods and results of saturated column experiments conducted as a component of the geochemical characterization program of the Coffee Gold Mine (the Project). Saturated column results have been initiated to provide information on the geochemical behaviour of geologic material which may become flooded as a result of mining activities. Specifically, wall rock and waste rock backfill below mine pit spillway elevations may become flooded once pit lakes form. Understanding how saturated conditions will affect the release and attenuation of metals will help inform mine waste management plans and water quality predictions. A summary of saturated column tests which have been initiated for the Project is provided in Table 1-1.

In this report, the methods and sample selection are described in Chapter 2. The results and discussion are presented in Chapter 3. This section includes both static test characterization of column material, visual observations of secondary precipitates forming within columns, and column effluent results. Finally, a summary of the most salient results of the column experiment are provided in Chapter 4.

Table 1-1:
Summary of Saturated Column Tests Initiated for the Coffee Gold Mine

Test ID	Sample Source	Material	Lithology	Weathering Facies	Start Date	Termination Date
Saturated Columns						
Kona 1	Col 13,14 and 8 Residue	Waste rock/ore	Granite	Tran./Fresh	07-Jul-17	24-May-19
Kona 2	Col 13,14 and 7 Residue	Waste rock/ore	Granite	Oxide/Tran./Fresh	07-Jul-17	24-May-19
Kona 3	Col 13 Residue	Waste Rock	Granite	Transition	07-Jul-17	24-May-19
Kona 4	Col 14 Residue	Waste Rock	Granite	Fresh	07-Jul-17	24-May-19
Sat-GO	FB-GO Residue	Waste Rock	Gneiss	Oxide	29-Sept-17	24-May-19
Sat-GT	FB-GT Residue	Waste Rock	Gneiss	Transition	29-Sept-17	24-May-19
Sat-GS	FB-GS Residue	Waste Rock	Gneiss	Fresh	29-Sept-17	24-May-19
Sat-SO	FB-SO Residue	Waste Rock	Schist	Oxide	29-Sept-17	24-May-19
Sat-ST	FB-ST Residue	Waste Rock	Schist	Transition	29-Sept-17	24-May-19
Sat-SS	FB-SS Residue	Waste Rock	Schist	Fresh	29-Sept-17	24-May-19

2 Laboratory and Analytical Methodology

2.1 *Sample Collection*

Rock samples for the saturated column experiments were collected from field bins and unsaturated column residues. Collecting saturated column test samples from unsaturated kinetic test residues is preferred over fresh drill core, as it reflects a period of unsaturated weathering which mined materials will experience prior to submergence by pit lakes which only form after mining operations in a pit are terminated. These unsaturated kinetic tests were initiated between June 2014 and May 2015 as part of the geochemical characterization program for the Project. A complete discussion regarding setup and operation of unsaturated kinetic tests can be found in *Coffee Gold Project: Metal Leaching and Acid Rock Drainage Characterization* (Lorax, 2017). A summary of kinetic tests from which residue samples were collected is provided in Table 2-1.

Waste rock samples were selected which where representative of the three major lithologies (granite, gneiss and schist) and a range of weathering facies (oxide, transition, and fresh). Granite ore samples were also selected for saturated column studies. This ore sample only represents a small percentage of the overall mine waste that will be produced (<1%); however, the transition granite ore has an in-situ mildly acidic pH and elevated metal leaching potential. Its behaviour under flooded conditions is of particular interest as flooding this material type is a potential strategy to mitigate acid rock drainage potential.

Granite samples for Kona 1-4 columns were sourced from unsaturated column residues, while gneiss and schist samples for GS/GT/GO/SS/ST/SO columns were sourced from field bin residues. The unsaturated column were being conducted at SGS Burnaby Laboratories. The unsaturated column tests were terminated and the residues homogenized to generate saturated column samples. The field bin samples were collected from a depth of 20cm within field bin to avoid surface weathering effects.

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Saturated Column Report

Table 2-1: Summary of unsaturated kinetic tests from which residue samples were collected for saturated column construction.

Test ID	Ore/Waste	Lithology	Weathering	Mass (kg)	Start Date	Residue Collected
Col 13	Waste	Granite	Transition	10.0	20-May-15	19-Apr-17
Col 14	Waste	Granite	Fresh	10.0	20-May-15	19-Apr-17
Col 7	Ore	Granite	Oxide	4.4	22-Apr-15	19-Apr-17
Col 8	Ore	Granite	Transition	4.4	22-Apr-15	19-Apr-17
FB-GS	Waste	Gneiss	Fresh	190.1	17-Jun-14	23-Aug-17
FB-GT	Waste	Gneiss	Transition	229.4	17-Jun-14	23-Aug-17
FB-GO	Waste	Gneiss	Oxide	183.1	17-Jun-14	23-Aug-17
FB-SS	Waste	Schist	Fresh	201.5	17-Jun-14	23-Aug-17
FB-ST	Waste	Schist	Transition	164.8	17-Jun-14	23-Aug-17
FB-SO	Waste	Schist	Oxide	171.3	17-Jun-14	23-Aug-17

Note: *FB – Field bin; Col xx – Unsaturated Column*

2.2 *Column Design and Operation*

2.2.1 Column Construction

Saturated columns were constructed from Plexiglass cylinders (15.0 cm inside diameter, 20.0 cm length). The initial stage of column construction included washing of all parts prior to assembly with deionized water. Before the addition of any column substrates, the bottom of the column was lined with a dispersion plate (perforated disk), a sheet of non-reactive mesh fabric, and a layer of silica sand (200-600 g) to allow for the even distribution of water over the surface area of the column bottom before contacting the ore and waste rock samples.

Each column was equipped with an inlet at the base of the column and one port at the top of the column for sampling. Note that the experiment was designed so that influent entered from the bottom of the column and flowed upward. In other words, the bottom of the column is effectively upgradient and the top of the column is downgradient. This is a standard measure to ensure even flow through the column materials and minimize the risk of uncontrolled gravity-driven drainage and development of preferential flow paths (Jurjovec *et al.,* 2002; Petrunic *et al.,* 2005; Al *et al.,* 2006).

Granite (Kona 1-4) columns were constructed on June 15th, 2017 and allowed to settle for one week before being sealed on June 22nd, 2017. Approximately 12 weeks later, gneiss and schist (GS, GT, GO, SS, ST, SO) columns were constructed and sealed on September 18th and 19th, 2017. Column materials were coned and quartered to collect 6-8 kg of dry weight for construction. Saturated column material, mass and initiation dates are shown in Table 2-2. Materials were

made into a slurry with the influent for the experiment before being added to the columns in ~3 cm layers to produce a homogeneous mixture. Columns were filled with as much material available to reduce headspace. Due to limited amounts of kinetic tests residues, some headspace (up to 3 cm) is present in the granite columns. Minimal headspace (< 1 cm) is present in the gneiss and schist columns.

Table 2-2: Characteristics of column materials and initiation of saturated column testwork.

Column	Column Composition	Lithology	Weathering	Ore/Waste	Mass (kg)	Sample Source	Sealed	Start
Kona 1	Top Half	Granite	50% Fresh, 50% Transition	Waste	2.60	Col 13 and Col 14 Residue	22-Jun-17	07-Jul-17
	Bottom Half	Granite	Transition	Ore	2.60	Col 8 Residue		
Kona 2	Top Half	Granite	50% Fresh, 50% Transition	Waste	2.48	Col 13 and Col 14 Residue	22-Jun-17	07-Jul-17
	Bottom Half	Granite	Oxide	Ore	2.60	Col 7 Residue		
Kona 3	Whole column	Granite	Transition	Waste	5.99	Col 13 Residue	22-Jun-17	07-Jul-17
Kona 4	Whole column	Granite	Fresh	Waste	6.04	Col 14 Residue	22-Jun-17	07-Jul-17
GS	Whole column	Gneiss	Fresh	Waste	7.27	FB-GS Residue	18-Sep-17	29-Sep-17
GT	Whole column	Gneiss	Transition	Waste	6.13	FB-GT Residue	18-Sep-17	29-Sep-17
GO	Whole column	Gneiss	Oxide	Waste	6.63	FB-GO Residue	19-Sep-17	29-Sep-17
SS	Whole column	Schist	Fresh	Waste	7.17	FB-SS Residue	19-Sep-17	29-Sep-17
ST	Whole column	Schist	Transition	Waste	7.19	FB-ST Residue	19-Sep-17	29-Sep-17
SO	Whole column	Schist	Oxide	Waste	8.20	FB-SO Residue	19-Sep-17	29-Sep-17

Note: *FB – Field bin; Col xx – Unsaturated Column*

2.2.2 Column Operation

Influent chemistry consisted of deionized (DI) water amended with a small amount of Na-lactate to provide an organic carbon supply. Dissolved organic carbon (DOC) was added to achieve similar concentrations as observed in ambient groundwater at the Project site (~10 mg/L) and to stimulate microbial activity and redox reactions in the columns. Sodium-lactate was chosen as the DOC source for this work since lactate has been cited as a suitable electron donor to stimulate microbial growth compared to other organic carbon sources such as ethanol, acetic acid, propionate and acetate (Nagpal *et al.*, 2000). Influent was made by adding 51.8 mg/L of 60% w/w Na-lactate in large batches (5 gallons) to ensure minimal variability in solution chemistry.

Flow to the granite columns was initiated on July 4th, 2017 and the first effluent sample was collected on July 7th, 2017. Similarly, flow to the gneiss and schist columns was initiated on

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September 27th, 2017 and the first effluent sample was collected on September 29th, 2017. Frequency of sample collection was identical between all columns, with the second effluent sample being collected four weeks later, and subsequent sampling occurring biweekly for the rest of the experimental period. Approximately 200-250 mL of effluent were collected over 24 hours for each sampling event. To collect a sample representative of porewater conditions in granite columns, ~350 mL was removed from the headspace prior to collecting an effluent sample.

Leachate was collected from the top port of the columns and passed through a 0.45 µm cellulose acetate filter before being collected in high-density polyethylene sample bottles. To preserve redox speciation and minimize the potential for oxidation artifacts, sample bottles were purged with nitrogen gas to displace oxygen from the bottles prior to sampling. Following collection, samples were preserved and submitted to ALS Laboratories for analysis.

Monthly flow rates from each column are provided in Table 2-3. The increase to monthly flow rates in the end of December 2018 across all columns was to ensure pore volume (PV) replacement following the introduction of $CaSO_4$ in column influent during Phase 3 of the experiment, as described below. Replacement of 15-22 PVs occurred throughout the experimental period for granite, gneiss, and schist columns.

Table 2-3: Monthly flow rates of saturated columns (up to end of April 2019)

Month-year	Kona 1	Kona 2	Kona 3	Kona 4	GS	GT	GO	SS	ST	SO
					mL/month					
Jul-17	561	526	583	524						
Aug-17	1777	1780	1741	1764						
Sep-17	1246	1201	1198	1235	421	415	326	416	441	433
Oct-17	994	973	981	775	264	259	262	262	262	258
Nov-17	1165	1123	1120	1129	566	563	571	533	592	553
Dec-17	1273	1241	1211	1129	528	488	514	537	525	530
Jan-18	1026	1059	1076	973	520	522	523	533	583	523
Feb-18	1104	1083	1104	1058	562	538	549	566	563	564
Mar-18	1520	1506	1495	1471	803	809	804	839	816	810
Apr-18	1129	1094	1133	1128	519	515	496	543	512	519
May-18	1097	1048	1058	1047	530	527	521	550	533	534
Jun-18	999	982	904	985	558	670	389	601	616	560
Jul-18	1009	998	992	975	553	467	411	557	579	537
Aug-18	1538	1511	1547	1467	833	1074	604	836	821	782
Sep-18	1060	1015	1113	1046	637	699	429	649	650	614
Oct-18	1037	995	1052	1038	419	681	391	421	416	402
Nov-18	1074	1010	1079	1071	632	709	420	636	627	599
Dec-18	1370	1298	1444	1394	705	894	622	713	702	662
Jan-19	2337	2458	2402	2376	1261	1655	1028	1312	1145	1092
Feb-19	1480	1421	1555	1470	887	1131	730	928	874	824

Mar-19	1453	1272	1502	1422	893	1150	714	935	832	838
Apr-19	1463	1423	1342	1437	814	1117	710	800	844	794
Cumulative Volume Removed from Column (mL)	27712	27017	27632	26914	12905	14883	11014	13167	12933	12428
Pore volume (mL)	1510	1635	1252	1565	837	677	720	732	704	742
Pore volumes replaced	18.4	16.5	22.1	17.2	15.4	22.0	15.3	18.0	18.4	16.7

Note: *Pore volume was estimated by the volume of influent added to turn dry materials into a slurry in addition to the volume of influent used to fill the column. This may be an overestimation for Kona 1, Kona 2, Kona 3, and Kona 4, which had headspace in the columns.*

2.2.3 **Experimental Phases**

The column experiment was conducted in three phases that are depicted in Figure 2-1 and summarized as follows:

- Standard operation (*Phase 1*): Columns receive DOC amended DI water as influent and effluent is sampled or discarded. This phase of the experiment characterizes the range of metal leaching potential of individual material types under mildly reducing conditions.
- Column sequencing (*Phase 2*): Effluent of columns with elevated As are used as influent for columns with low As. This phase of the experiment provides information on how sequential deposition of different rock types can impact metal mobility.
- Calcium sulphate addition (*Phase 3*): Influent is spiked with calcium and sulphate and columns continued to operate in sequence. This phase of the experiment provides data on how elevated SO_4 and Ca generated from subaerial portions of backfilled waste dumps may impact metal mobility and release in saturated sections of the backfill dump.

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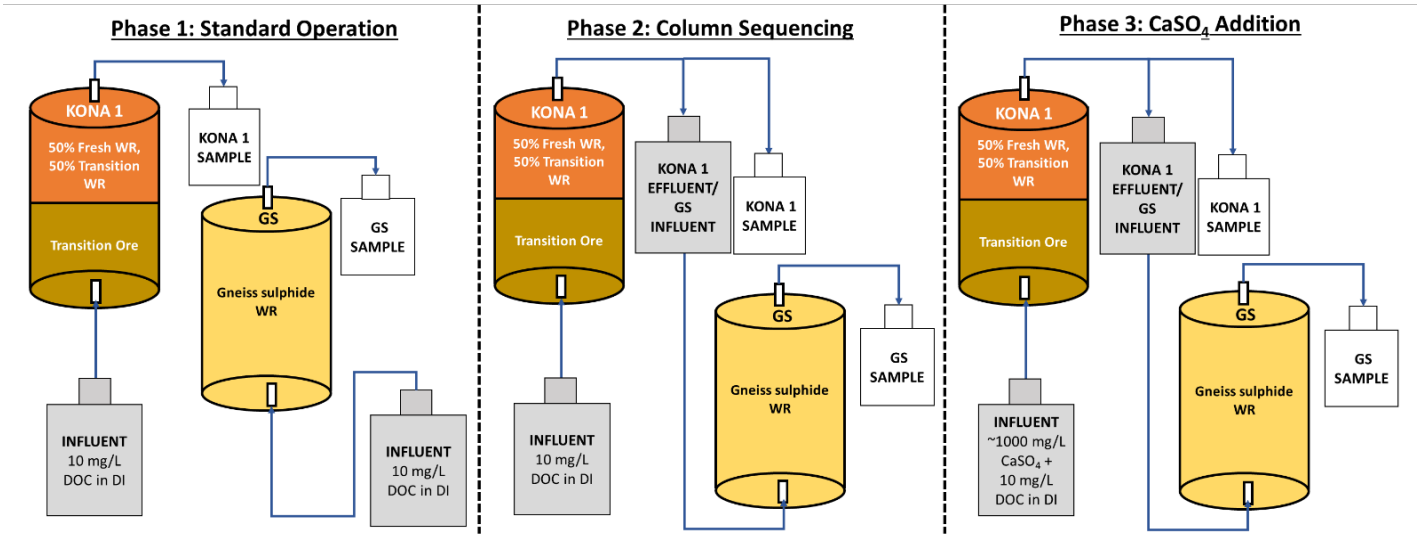

Figure 2-1: Schematic of column configuration during the three phases of column operation, using the Kona 1 and GS columns to demonstrate changes in influent, effluent, and sample collection. Arrows indicate flow direction.

Columns were initially operated independently (i.e., no sequencing) from July 2017 to June 2018 to assess leachate chemistry and metal mobility of the varying individual lithologies under suboxic conditions. Initial standard operation is depicted in Phase 1 of the schematic (Figure 2-1).

Column sequencing was introduced in June 2018 to evaluate the geochemistry of leachate produced from layering of different lithologies, particularly in the context of As and U attenuation. Column sequencing is depicted in Phase 2 of the schematic (Figure 2-1) for Kona 1 and GS columns, with the notable change being influent for the GS columns while influent for the Kona 1 column remained unchanged (10 mg/L DOC in deionized water). Sequencing pairs are listed below:

Primary Column → Secondary Column

1. Kona 1 Effluent→ Influent for GS
2. Kona 2 Effluent→ Influent for ST
3. Kona 3 Effluent→ Influent for SS
4. Kona 4 Effluent→ Influent for SO
5. GT Effluent→ Influent for GO

Phase 3 of column operation was initiated in December 2018 to assess the effect of infiltration water containing elevated levels of calcium and sulphate on the release and attenuation of metals from mixed lithologies. As depicted in Figure 2-1, influent used for primary columns was altered in Phase 3 to contain 10 mg/L DOC + 1000 mg/L SO_4 and 413 mg/L Ca. This change affected

leachate chemistry produced by primary columns, and by extension the influent used for secondary columns. In this phase of the experiment, flow rates were increased up to 50% to ensure pore volume replacement within two cycles. This is reflected in increased monthly flow rates from December 2018 to January 2019 (Table 2-3). For the granite columns, 750 mL was collected as part of effluent collection for sequencing and sampling. For the gneiss and schist columns, 500 mL is collected for sequencing and sampling from column GT, while 400 mL is collected from columns GS, GO, SS, ST, and SO.

Initiation of gneiss and schist columns commenced 12 weeks following initiation of granite columns. While the experimental period for Phase 1 differs between columns, sequencing during Phase 2 and 3 requires a parallel discussion of primary and secondary columns. For the purposes of this report, specific terminology will be used to describe Phase 1 through 3, which correspond to the overall experimental period (Table 2-4). Time periods prior to sequencing will be referred to as Week *xx* (pre-seq.), while time periods following sequencing will be referred to as Week *xx* (post-seq.).

Effluent results up to April 25th, 2019 or Week 46 (post-seq.) are included in this report. This time period corresponds to overall column operation of 94 weeks for granite columns and 82 weeks for gneiss and schist columns.

Table 2-4: Overall experimental periods and corresponding experimental periods as referenced in the report for operation Phases 1 through 3 for granite, gneiss and schist columns.

Experimental Phases	Overall Experimental Period		Experimental Period as Referenced in Report	
	Granite Columns	Gneiss and Schist Columns	Granite Columns	Gneiss and Schist Columns
Phase 1: Standard Operation	Week 0 to 46	Week 0 to 34	Week 0 to 46 (pre-seq.)	Week 0 to 34 (pre-seq.)
Phase 2: Column Sequencing	Week 48 to 74	Week 36 to 62	Week 0 to 26 (post-seq.)	
Phase 3: $CaSO_4$ Addition	Week 76 to 94	Week 64 to 82	Week 28 to 46 (post-seq.)	

2.3 *Analytical Methods*

2.3.1 Solid Phase Characterization

Static were conducted on a subsample of materials used for column construction and saturated column residues upon completion of testwork. The testing consisted of acid base accounting (ABA), shake flask extractions (SFE) and metals by aqua regia digestion and ICP-MS analysis as

per MEND (2009). Acid-base accounting consists of a series of tests to determine the paste pH, sulphur species and carbonate content. Total elemental abundance was determined by aqua-regia digestion and analysis by ICP-MS. Shake flask extractions were conducted using a 24-hour NanoPure water leach extraction test at a 3:1 liquid to solid ratio and leachates were submitted for analysis.

Mineralogic characterization was conducted using QEMSCAN. Samples analyzed by QEMSCAN included both residue samples used in saturated column tests, and cuts of test samples collected prior to unsaturated testing. Materials were stage pulverized to 80% passing of 106 microns prior to analysis. Samples were then micro-riffled with subsamples taken for graphite impregnated polished section preparation and submitted for QEMSCAN using Particle Mineral Analysis (PMA) and Specific Mineral Search (SMS) analyses.

2.3.2 **Water Quality**

Saturated column leachates and influent samples were sent to ALS Environmental Laboratories (ALS) in Vancouver for the following analyses:

- Nitrate, nitrite, sulfate, chloride, bromide, fluoride;
- Dissolved organic carbon (DOC), phosphorus, ammonia;
- Dissolved sulfide; and
- Dissolved metals.

Alkalinity, pH and conductivity were measured in-house at the Lorax laboratory. All water quality results are reported in Appendix A.

2.4 *Quality Assurance and Quality Control*

Quality control (QC) measures for column testwork include method and experimental blanks collected at the Lorax laboratory, and ALS specific method blanks, sample duplicates and certified reference materials.

For the method blank analysis, a ‘blank column’ is constructed using the same material (*i.e.* Plexiglass) as the experimental columns and is filled with DI water. This column is then sampled and tested monthly, using the same procedure outlined above for the saturated columns. Results for method blank analysis during the period of column operation (July 2017 to April 2019) are reported in Appendix B. Overall, the results indicate good contamination control for most parameters with exception to minor detectable levels of P, Al, Ba, Cu, and Zn. Concentrations of P and Zn in column leachates are on average 11x and 6x greater, respectively, than concentrations observed in the method blank. This demonstrates that any potential leaching from column

materials does not have significant bearing on experimental results. Average concentrations of Al, Ba, and Cu in column effluents are similar in magnitude to maximum concentrations found in the method blank, indicating some potential for experimental artifacts.

Experimental or 'bottle' blanks of deionized water were tested weekly for dissolved metals and anions to evaluate potential sources of contamination during sample preservation. This test also served to monitor the quality of deionized water used to make the column influent. Across all parameters, only 1.7% of values were above the MDL, indicating excellent contamination control. Complete results for bottle blank analysis during the column operating period can be found in Appendix B.

For submissions to ALS, hold time targets were met and QC results demonstrated conformity to data quality objectives, indicating good precision, accuracy and contamination control in test procedures. Examples where data quality objectives fell out of the acceptable range include 1) exceedances of the method blank resulting in adjustment of the limits of reporting for applicable parameters; and 2) inaccurate matrix spike recovery due to elevated background analyte concentrations.

2.5 *Geochemical Equilibrium Modelling*

Saturation indices (SIs) were calculated using the USGS geochemical modeling program PHREEQC coupled to the Lawrence Livermore National Laboratory database (llnl.dat) (Parkhurst and Apello, 1999). An SI of 0 indicates that a mineral is in equilibrium with the solution; a mineral may be dissolving or precipitating to achieve equilibrium. A positive SI denotes that a mineral is oversaturated and therefore may be precipitated from solution. A negative SI denotes that a mineral is unsaturated; if the solid phase is present it will dissolve until equilibrium is reached. Saturation indices are based on the thermodynamics of mineral formation/dissolution and do not account for kinetic limitations that affect mineral formation and dissolution.

3 Results and Discussion

3.1 *Visual Observations*

Columns were regularly inspected throughout the duration of the experiment to evaluate changes to column materials. Column photos from throughout Phases 1 to 3 can be found in Appendix D.

Granite, gneiss and schist columns showed minimal alteration in Phases 1 and 2. The only exception to this is Kona 1, where black precipitate was observed above the sand layer in Week 11 (post-seq.). Following addition of $CaSO_4$ to influent, significant changes were observed in most columns. Discoloration of column materials was observed in Kona 1, Kona 3, Kona 4, GS, GT, and SO columns. Photographs of selected columns are presented in Figure 3-1 and Figure 3-2.

Dark staining of column materials occurred throughout the vertical profile of Kona 3, GS and SO columns which may be indicative of precipitate formation (Figure 3-2). In contrast, discoloration mainly occurred in the bottom 5 cm of the Kona 1 and Kona 4 columns. Staining also occurred at the top of column materials in Kona 1, Kona 3, Kona 4, GS, GT, SO, SS, and ST columns (Figure xx). The formation of an orange-black crust is visible in the Kona 1, Kona 3 and Kona 4 columns, while dark-brown pigmentation occurred in the GS, GT, SO, SS and ST columns. Photographs of the tops of selected columns are presented in Figure 3-3.

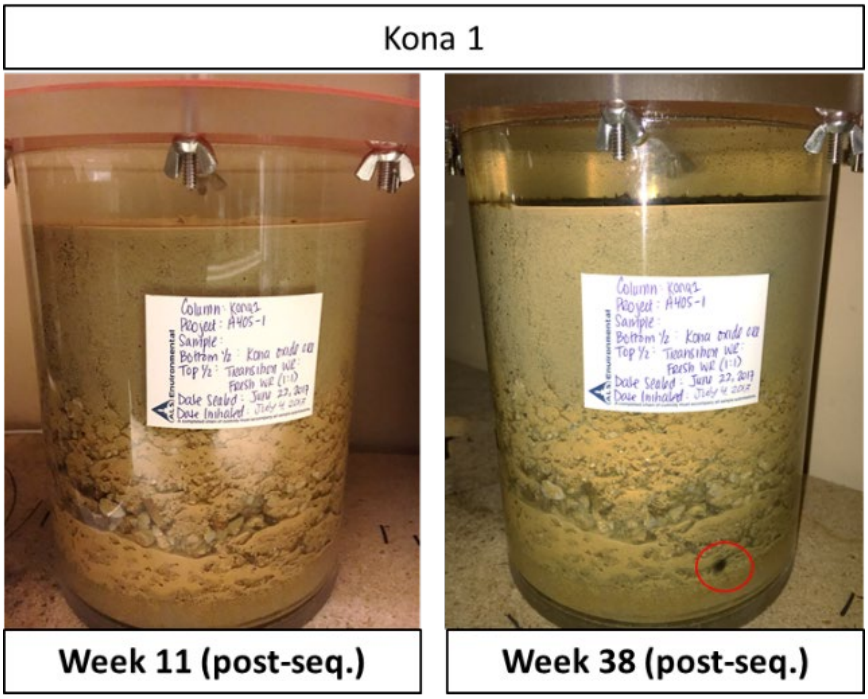

Figure 3-1: Photographs of Kona 1 column from Phase 1 (Week 12 pre-seq.) and from Phase 2 (Week 11 post-seq.).

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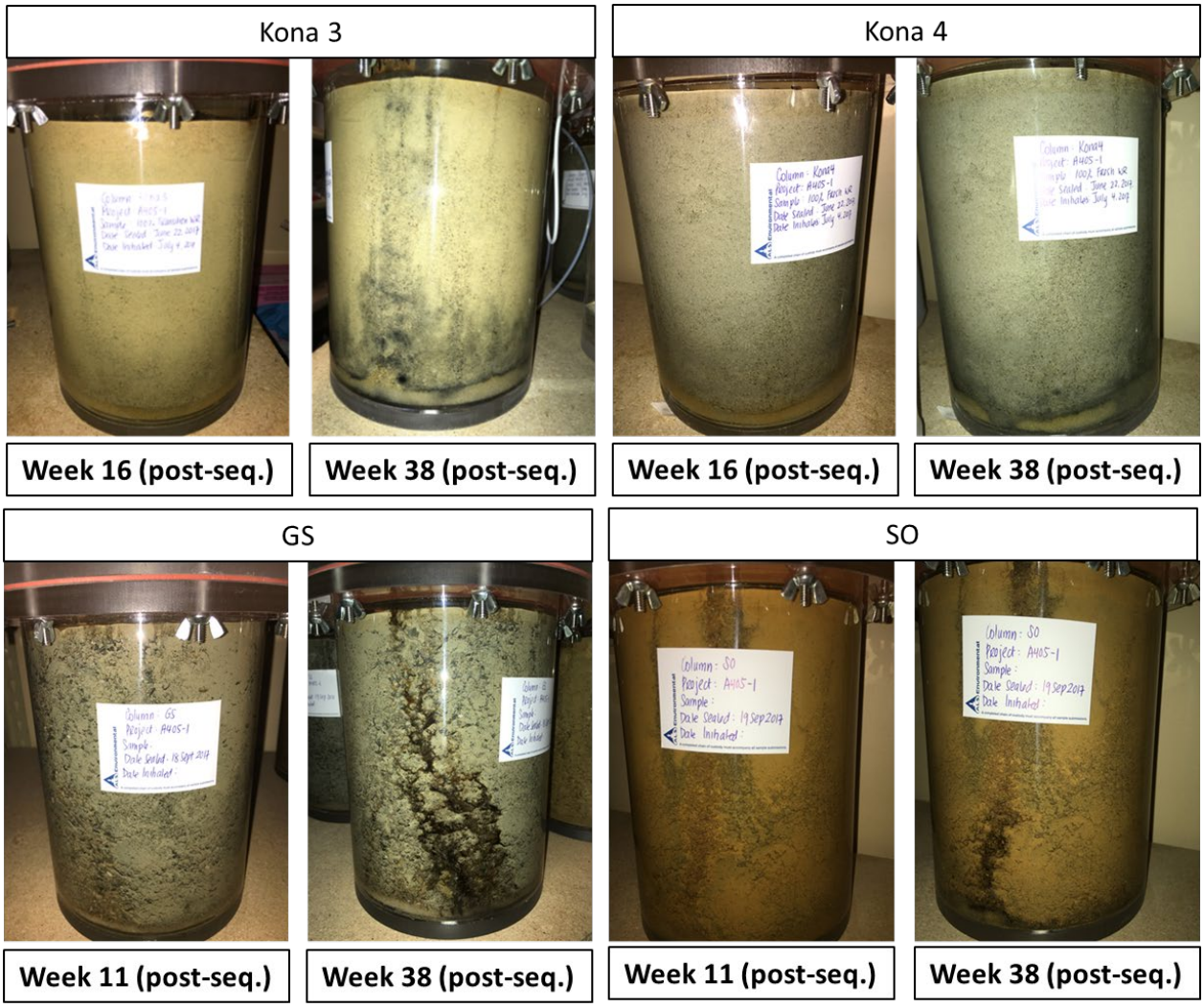

Figure 3-2: Photographs of selected columns from Phase 2 (Week 11 and 16 post-seq.) (left image) are compared to those from Phase 3 (Week 38 post-seq.) (right image).

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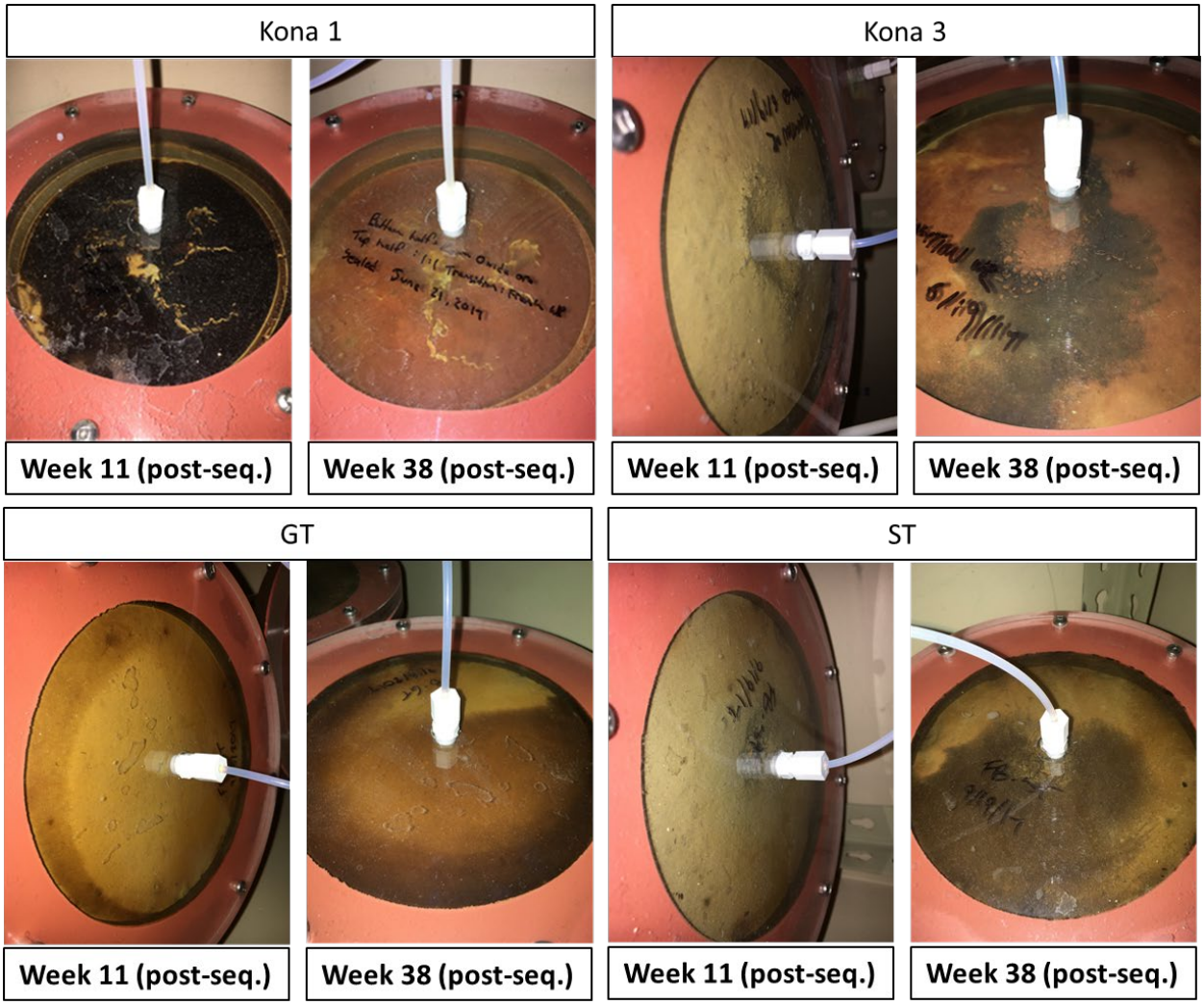

Figure 3-3: Photographs of the tops of selected columns from Phase 2 (Week 11 post-seq.) (left image) are compared to those from Phase 3 (Week 38 post-seq.) (right image).

3.2 *Solid Phase Characterization*

3.2.1 Static Test Results

3.2.1.1 Acid Base Accounting

Acid base accounting (ABA) results summarized in Table 3-2 for the column materials are primarily differentiated by lithology and secondarily by weathering facies. Complete ABA results are presented in Appendix C. Paste pH is near neutral to alkaline (7.4 to 8.3) for all WR samples across lithologies and is slightly acidic (5.5 to 6.6) in granite transition and oxide ores (Col 7 and

8 residues). Carbonate NP is consistently highest in schist WR (FB-SS, FB-ST, and FB-SO residues), moderate in gneiss WR (FB-GS, FB-GT, and FB-GO residues), and lowest in granite samples (Col 7, 8, 13, and 14 residues). Carbonate NP and sulphur content generally increases with increasing oxidation.

Across all lithologies, results for total S range from 0.017 to 0.41%, and is highest in schist WR residues and relatively comparable in gneiss and granite residue samples. Sulfur concentrations consistently decrease with increased weathering of ore and WR. Notably, sulphate measurements from the hydrochloric acid leach were either below or slightly above detection limit (< 0.01%) for all samples, affirming that most sulphur are present as sulphide. Results for total C are consistent with total S as increased weathering is associated with acidification and leaching of carbonate minerals from WR and ore.

Table 3-1: ABA results of kinetic test residues used in column experiments

Parameter	Unit	Col 13 Residue	Col 14 Residue	Col 7 Residue	Col 8 Residue	FB-GS Residue	FB-GT Residue	FB-GO Residue	FB-SS Residue	FB-ST Residue	FB-SO Residue
Paste pH	units	7.40	8.26	6.62	5.49	7.86	7.88	8.01	8.15	8.28	8.04
CaNP	$tCaCO_3/1000t$	*<0.8*	8.3	0.8	*<0.8*	48.3	35.0	20.0	178.3	120.8	75.0
Total S	wt.%	0.017	0.031	0.022	0.154	0.177	0.084	0.012	0.414	0.088	0.035
SO_4-S	wt.%	*<0.01*	*<0.01*	*<0.01*	0.01	0.02	0.01	*<0.01*	0.02	0.01	0.01
Sulfide S	wt.%	0.01	0.03	*<0.01*	0.11	0.16	0.07	0.01	0.35	0.06	0.02
Total Carbon	wt.%	0.014	0.111	0.018	0.027	0.569	0.419	0.237	2.18	1.46	0.921

Note: NPR calculated from CaNP and AP values (i.e. NPR = CaNP/AP)

3.2.1.2 Metal Content

Metal results from aqua regia digestion are summarized in Table 3-2 and complete results are presented in Appendix C. Overall, the results showed some variation in metal concentrations with weathering zone, lithology and ore vs waste. Divalent metal cations such as Zn, Cu and Pg are highest in schist WR. These metals are commonly associated with sulphide minerals. The elevated concentrations of these metals in schist is consistent with this rock type containing the highest sulphide content.

Arsenic concentrations ranged from 23 to 6310 mg/kg across lithologies and tended to have greater accumulation in oxidized samples (oxide > transition > fresh) in granite, gneiss and schist WR. However, As content in granite transition ore (Col 8 residue) is nearly double the As content in the granite oxide ore (Col 7 residue). Uranium content ranged from 2.78 to 11 mg/kg and is consistently higher in granite and gneiss relative to schist samples. There is no consistent trend for weathering state and U content.

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The highest As and U concentrations are present in the two grnite ore samples (Col 7 and 8 residue). These samples had As concentrations which were up to 100x that which was observed in granite waste samples. The difference in U concentrations between waste rock and ore was significantly lower, with ore containing U concentrations which are only up to 1.8x that observed in waste.

Table 3-2: Aqua regia metal results of kinetic test residues used in column experiments

Parameter	Unit	Col 13 Residue	Col 14 Residue	Col 7 Residue	Col 8 Residue	FB-GS Residue	FB-GT Residue	FB-GO Residue	FB-SS Residue	FB-ST Residue	FB-SO Residue
Al	**wt.%**	0.05	*<0.01*	0.1	0.07	1.02	0.53	0.48	1.19	1.15	0.47
Ca	**wt.%**	0.04	0.09	0.05	0.03	1.54	0.91	0.7	5.86	5	2.46
Fe	**wt.%**	0.84	1.09	1.47	1.38	1.85	1.22	1.27	2.5	2.1	2.66
K	**wt.%**	0.15	0.19	0.13	0.14	0.49	0.18	0.17	0.77	0.69	0.15
Mg	**wt.%**	0.06	0.11	0.02	0.01	0.69	0.33	0.19	1.39	1.01	0.4
Na	**wt.%**	0.01	0.02	*<0.01*	*<0.01*	0.03	0.02	0.01	0.04	0.04	0.01
As	**ppm**	265	53	3240	6310	59	167	168	23	42	348
Ba	**ppm**	49	60	67	46	135	202	92	357	350	358
Cd	**ppm**	0.08	0.04	0.25	0.03	0.01	0.03	0.03	0.08	0.05	0.14
Co	**ppm**	1.5	1.7	1.7	1.6	7.8	3.7	4.5	12.4	11	11.7
Cr	**ppm**	126	122	106	116	89	77	84	107	137	79
Cu	**ppm**	4	4.2	6.5	4.1	8.4	8.7	10.5	18.6	15.9	31.1
Hg	**ppm**	0.15	0.07	0.82	4.67	0.08	0.23	0.15	0.12	0.08	0.45
Li	**ppm**	6	8	2	2	6	1	1	12	14	1
Mn	**ppm**	334	679	187	201	350	278	278	666	572	535
Mo	**ppm**	3.3	3.29	3.41	3.75	2.85	3.26	2.1	2.43	2.76	1.8
Ni	**ppm**	2.9	2.4	3.1	2.6	13.9	5.6	9.1	54.3	40.4	29.9
P	**ppm**	0.01	0.02	0.01	0.01	0.04	0.02	0.03	0.06	0.04	0.05
Pb	**ppm**	19.3	10.2	36.5	17	5.2	7.7	9.7	13.2	7.8	19.7
Sb	**ppm**	1.75	0.57	38.7	162	1.88	7.52	8.7	2.25	1.73	37.6
Se	**ppm**	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*	*<1*
Sn	**ppm**	0.6	0.8	0.4	0.3	1.1	0.9	0.8	1.3	1.3	0.6
Sr	**ppm**	7.4	3.7	16.2	16.9	60.2	38.4	21.7	202	689	65.5
Tl	**ppm**	0.21	0.3	0.66	1.53	0.3	0.26	0.24	0.33	0.43	0.4
U	**ppm**	7.12	5.96	11	9	5.63	7.14	5.15	3.07	3.21	2.78
V	**ppm**	5	7	9	9	24	9	14	43	38	33
W	**ppm**	*<0.1*	*<0.1*	0.3	0.1	0.2	0.2	1	2.4	0.7	0.3
Zn	**ppm**	31	31	44	15	21	19	19	54	39	45

3.2.1.3 Shake Flask Extractions

Shake flask extractions (SFE) results are summarized in Table 3-3 and complete SFE results are presented in Appendix C. Solution pH across lithologies ranged from 4.8 to 8.2, being near neutral to alkaline in granite, gneiss and schist waste rock. The acidic solution pH of the granite transition ore (Col 8 residue) is consistent with its rinse-pH result (Table 3-2). Alkalinity is notably greater in gneiss and schist samples relative to granite WR and ore, which may be attributed to greater carbonate content compared to granite samples.

Major ion concentrations and conductivity tended to be greater in gneiss and schist WR compared to granite. Calcium and Mg ranged from 14 to 38 mg/L and 4 to 15 mg/L, respectively, relative to much lower concentrations of Ca (0.49 to 3.4 mg/L) and Mg (0.15 to 0.63 mg/L) leached from granite samples. Other major cations, Na and K were also leached in greater concentrations in gneiss and schist samples relative to granite (Col 7, 8, 13, and 14 residues). Sulphate content ranged from 5 to 145 mg/L across lithologies and was highest in gneiss followed by schist and granite. In gneiss and schist WR, sulphate concentrations were greater in fresh (GS and SS) relative to oxidized samples (GO and SO), likely reflecting the relative solid-phase sulphur content. There is minimal leachable sulphate in granite WR and ore (Col 7, 8, 13, and 14 residues).

Arsenic and uranium concentrations varied with lithology and weathering. The highest As concentrations are associated with the granite ore samples (2.47 mg/L to 0.47 mg/L), with intermediate concentrations found in granite waste (0.037 mg/L to 0.14 mg/L) and gneiss waste (0.023 to 0.065 mg/L), and the lowest concentrations found in schist waste (0.0071 to 0.025 mg/L). Arsenic also showed an association with weathering state, with highest concentrations generally associated with more oxidized samples of a given lithology. Uranium concentrations were greatest in gneiss waste (0.012 mg/L to 0.027 mg/L), with similarly low concentrations in schist waste (0.00089 mg/L to 0.0058 mg/L) and granite samples (0.00029 to 0.0015 mg/L). Uranium concentrations tended be lowest in the most weathered rock types.

Table 3-3: SFE results of kinetic test residues used in column experiments

Parameter	Unit	Col 13 Residue	Col 14 Residue	Col 7 Residue	Col 8 Residue	FB-GS Residue	FB-GT Residue	FB-GO Residue	FB-SS Residue	FB-ST Residue	FB-SO Residue
pH		7.14	7.22	7.53	4.80	8.21	7.98	8.20	8.14	8.13	8.00
Conductivity	**uS/cm**	25	39	11	25	111	211	110	258	165	126
Total Acidity	**mg CaCO3/L**	4.5	4.0	4.5	8.3	2.6	3.6	2.7	3.0	2.8	3.1
Alkalinity	**mg CaCO3/L**	6.4	15.1	6.6	0.1	39.8	34.1	40.3	47.4	41.4	46.3
Sulphate	**mg/L**	6	6	5	5	145	64	13	79	39	13
Dissolved Metals											

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D-Al	**mg/L**	0.003	*<0.001*	0.005	*<0.001*	0.030	0.051	0.068	0.033	0.056	0.025
D-Sb	**mg/L**	0.0040	0.0020	0.0203	0.0175	0.0059	0.0039	0.0026	0.0096	0.0009	0.0070
D-As	**mg/L**	0.135	0.0369	0.469	2.47	0.0229	0.0609	0.0647	0.0071	0.0098	0.0247
D-Ba	**mg/L**	0.00121	0.00439	0.00147	0.00028	0.0172	0.0414	0.0206	0.0406	0.0409	0.0604
D-Be	**mg/L**	0.000016	0.000018	0.000019	0.000113	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*
D-Bi	**mg/L**	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*	*<0.0000 07*
D-B	**mg/L**	0.031	0.031	0.025	0.016	0.009	0.020	0.015	0.009	0.011	0.020
D-Cd	**mg/L**	0.000004	0.000004	0.000003	0.000017	0.000013	0.000038	0.000013	0.000009	0.000006	*<0.0000 03*
D-Ca	**mg/L**	0.49	3.40	0.64	0.88	38.8	22.6	9.63	27.4	20.0	13.7
D-Cr	**mg/L**	*<0.0000 3*	0.00011	0.00008	0.00009	*<0.0000 3*	0.00006	0.00035	0.00006	0.00021	0.00083
D-Co	**mg/L**	0.000176	0.000179	0.000065	0.00384	0.000014	0.000014	0.000025	0.000017	0.000021	0.000018
D-Cu	**mg/L**	0.00041	0.00037	0.00086	0.00294	0.00096	0.00092	0.00129	0.00066	0.00098	0.00080
D-Fe	**mg/L**	0.083	0.129	0.120	0.112	*<0.007*	*<0.007*	0.027	*<0.007*	0.022	0.009
D-Pb	**mg/L**	0.00178	0.00048	0.00028	0.00008	0.00016	0.00046	0.00006	0.00002	0.00005	0.00001
D-Li	**mg/L**	0.0019	0.0018	0.0004	0.0004	0.0022	0.0012	0.0011	0.0030	0.0028	0.0017
D-Mg	**mg/L**	0.150	0.630	0.210	0.238	15.4	6.97	2.61	12.6	5.67	3.94
D-Mn	**mg/L**	0.0284	0.0754	0.670	0.105	0.00522	0.00203	0.00110	0.00433	0.00158	0.00021
D-Hg	**mg/L**	*<0.01*	*<0.01*	0.04	0.02	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*	*<0.01*
D-Mo	**mg/L**	0.00156	0.00063	0.00035	0.00004	0.00941	0.0111	0.0109	0.00221	0.00556	0.00340
D-Ni	**mg/L**	*<0.0001*	*<0.0001*	*<0.0001*	0.0012	0.0002	*<0.0001*	0.0002	0.0004	0.0002	*<0.0001*
D-P	**mg/L**	0.015	*<0.003*	0.018	0.014	*<0.003*	0.010	0.034	*<0.003*	*<0.003*	*<0.003*
D-K	**mg/L**	3.35	3.04	1.11	0.984	7.27	5.38	3.62	9.46	6.32	3.08
D-Se	**mg/L**	0.00008	0.00007	0.00004	0.00009	0.00013	0.00014	0.00008	0.00009	0.00022	0.00008
D-Si	**mg/L**	5.09	4.86	2.14	0.78	1.78	2.35	3.34	0.86	2.36	2.44
D-Ag	**mg/L**	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*	*<0.0000 5*
D-Na	**mg/L**	1.66	1.72	0.71	0.32	6.33	3.07	6.00	4.01	4.52	4.83
D-Sr	**mg/L**	0.00240	0.00964	0.00448	0.00415	0.245	0.111	0.0483	1.33	1.43	0.0852
D-S	**mg/L**	1.5	1.0	0.4	2.0	46.7	21.1	4.1	24.1	12.1	4.6
D-Tl	**mg/L**	0.000034	0.000045	0.000039	0.000211	0.000031	0.000151	0.000020	0.000027	*<0.0000 05*	0.000036
D-Sn	**mg/L**	0.00007	0.00010	0.00007	0.00005	*<0.0000 1*	0.00010	0.00003	0.00002	0.00002	*<0.0000 1*
D-Ti	**mg/L**	0.00285	0.00440	0.00576	0.00014	0.00010	0.00017	0.00059	0.00011	0.00095	0.00011
D-U	**mg/L**	0.000310	0.001519	0.000292	0.000766	0.0267	0.0266	0.0124	0.00584	0.00338	0.000894
D-V	**mg/L**	0.00027	0.00066	0.00038	0.00014	0.00059	0.00025	0.00052	0.00034	0.00131	0.00019
D-Zn	**mg/L**	*<0.002*	*<0.002*	*<0.002*	0.012	*<0.002*	0.005	*<0.002*	*<0.002*	*<0.002*	*<0.002*
D-Zr	**mg/L**	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*	*<0.002*

3.2.2 QEMSCAN Results

Selective QEMSCAN results are presented in Table 3-4. Complete QEMSCAN results can be found in Appendix C. Samples submitted for QEMSCAN analysis included both kinetic test residue samples (used in saturated column experiments) and splits collected during initial setup of the unsaturated kinetic tests in 2014/2015. A comparison of mineral abundance for GS (FB-GS-Residue & GS-2) and SS (FB-SS-Residue & SS) was done to examine how sample mineralogy evolves during unsaturated kinetic testing. In general, bulk mineral alteration from several 2 to 3 years of weathering during kinetic testing is expected to be minimal. The average relative percent difference (RPD) between pre-test and residual samples was 29% for GS and 41% for SS. For dominant minerals (quartz, feldspar, clays, and other silicates) that account for 82 to 94% of mineral abundance, RPD ranged from <1 to 16% for GS and from 1 to 28% for SS. The variability in these relatively inert minerals can largely be attributed to sample heterogeneity and analytical precision. RPD of carbonate minerals, which make up 5-16% of mineral abundance, was 6 to 14% for GS and 9 to 13% for SS. This given that this is within the range of RPD found for relatively inert minerals, it is assumed that the carbonate content is essentially unchanged during several years of field bin exposure.

As depicted in Figure 3-4, the dominant mineral groups present across granite, gneiss, and schist materials include quartz, feldspar, micas, chlorite, clays, amphiboles, and other silicates. They account for 82% to 88% of schist samples (FB-SS residue, SS, ST, SO), and 94 to 99 % of granite and gneiss samples (Col 7, 8, 13, and 14 residues; FB-GS residue, GS-2, GT, and GO-3). Carbonate minerals present in the lithologies include calcite, dolomite and ankerite, all of which were present in greater proportions in schist (8% to 16%) and gneiss (2% to 5%) relative to granite (< 1%). Oxide mineral abundance (Fe-oxides, goethite, As-Fe oxyhydroxide, Fe-Sb oxide, other oxide) ranged from 0.34% to 3.8%, with the highest values observed in gneiss oxide and schist oxide. Sulfur minerals present ranged from 0.02 to 0.93 % across lithologies, and were highest in the schist sulphide WR (FB-SS residue and SS), followed by the gneiss sulphide WR (FB-GS residue and GS-2) and the granite transition ore (Col 8 residue). Pyrite, arsenopyrite, other (unidentified) sulphides, and sulphates make up the majority of sulfur minerals present, while chalcopyrite, galena, sphalerite and stibnite were present in much smaller fractions. Phosphate minerals (apatite with trace monazite) ranged from 0.02 to 0.45 %, being highest in schist followed by gneiss and granite.

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Table 3-4: QEMSCAN results for relative mineral abundance in kinetic test residues and fresh samples

Mineral Mass (wt. %)	Col 13 Residue	Col 14 Residue	Col 7 Residue	Col 8 Residue	FB-GS-Residue	GS-2	GT	GO-3	FB-SS-Residue	SS	ST	SO
Pyrite	0.17	0.050	0.010	0.18	0.25	0.55	0.22	0.010	0.72	0.80	0.14	0.00
Arsenopyrite	0.040	0.020	0.020	0.18	0.030	0.010	0.010	0.00	0.00	0.010	0.00	0.00
Chalcopyrite	0.00070	0.00060	0.00	0.0011	0.0025	0.0021	0.00020	0.0011	0.0021	0.0024	0.0025	0.0010
Galena	0.00080	0.00010	0.00020	0.00020	0.00040	0.00050	0.00010	0.00040	0.00060	0.018	0.00020	0.00
Sphalerite	0.0011	0.00070	0.00	0.00060	0.00050	0.0014	0.00	0.00	0.0017	0.0040	0.0020	0.0011
Stibnite	0.00089	0.00020	0.00	0.00	0.0013	0.0016	0.00033	0.00039	0.0014	0.0024	0.0024	0.00
Other Sulphides	0.010	0.00	0.00	0.00	0.010	0.010	0.00	0.00	0.010	0.030	0.010	0.00
Quartz /Feldspar	89.7	87.5	65.6	67.1	67.2	65.8	71.9	74.6	50.6	49.9	57.7	56.2
Mica	3.62	5.74	18.5	20.4	17.0	17.4	11.3	11.3	22.1	21.1	16.1	16.6
Chlorite	0.20	0.25	0.65	0.56	1.1	1.0	0.33	0.43	1.8	2.1	3.1	0.74
Clays	4.58	5.20	12.6	7.92	6.81	6.77	9.86	8.94	4.17	5.01	1.90	11.5
Amphibole	0.010	0.00	0.00	0.00	0.25	0.29	0.30	0.040	0.73	0.97	3.0	0.37
Other Silicates	0.50	0.60	1.39	1.12	2.07	2.42	1.36	1.15	2.48	2.97	5.30	2.57
Fe-Oxides	0.050	0.073	0.12	0.044	0.036	0.040	0.043	0.15	0.024	0.023	0.10	0.51
Goethite	0.53	0.24	0.63	0.68	0.15	0.24	0.36	0.79	0.28	0.26	0.32	2.84
Other Oxides	0.33	0.18	0.24	0.33	0.15	0.17	0.13	0.18	0.36	0.19	0.27	0.44
Calcite	0.030	0.020	0.010	0.010	2.28	2.51	0.75	1.23	10.5	9.53	11.1	4.36
Dolomite	0.00	0.00	0.00	0.00	0.97	0.91	1.49	0.45	3.54	4.05	0.51	1.29
Ankerite	0.060	0.00	0.00	0.020	1.45	1.67	1.91	0.51	2.29	2.62	0.31	2.20
As-Fe Oxyhydroxide	0.00	0.010	0.24	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Apatite	0.16	0.050	0.00	0.010	0.15	0.20	0.11	0.15	0.45	0.41	0.17	0.25
Monazite	0.00	0.020	0.020	0.010	0.010	0.010	0.00	0.040	0.00	0.00	0.00	0.010
Sulphates	0.010	0.010	0.00	0.00	0.050	0.010	0.010	0.010	0.070	0.060	0.010	0.15
Fe-Sb Oxide	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.020	0.010	0.030	0.00	0.00	0.00	0.00	0.010	0.010	0.00	0.00
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

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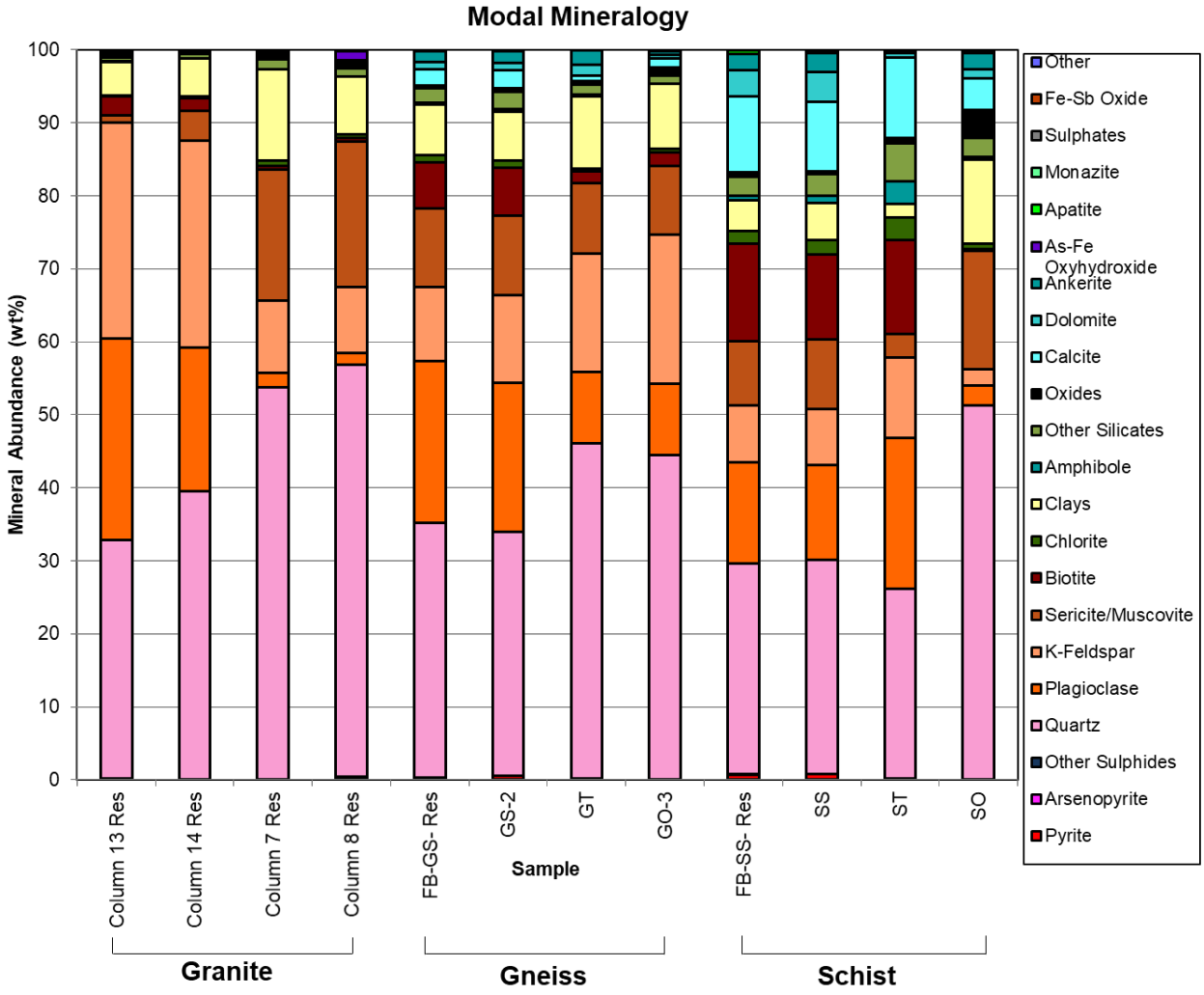

Figure 3-4: Relative mineral abundance in kinetic test residues and fresh samples

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Iron deportment in granite, gneiss, and schist lithologies are shown in Figure 3-5. In most cases, the majority of Fe present (51% to 76 %) is associated with rock forming silicate minerals such as mica, chlorite and amphibole. As expected, proportions of Fe associated with oxides were higher in oxidized samples. Across lithologies, 0.05% to 11% of Fe is associated with sulphide minerals, predominantly as pyrite. Iron associated with carbonate minerals is only significant for gneiss and schist samples, comprising 2% to 24% of total Fe.

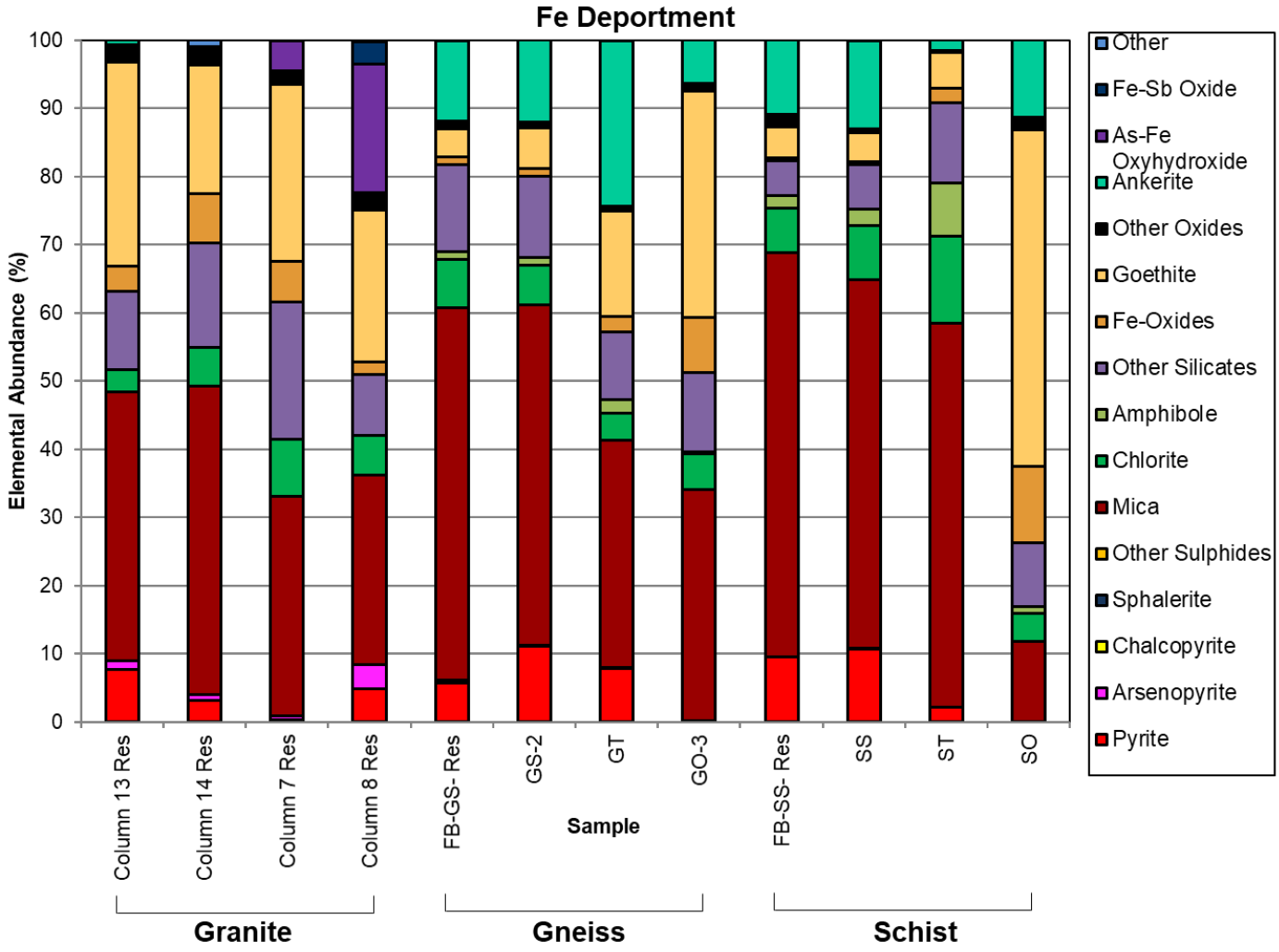

Figure 3-5: Relative elemental abundance of Fe in minerals present in kinetic test residues and fresh samples

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Arsenic deportment is shown in Figure 3-6. For granite ore (Col 7 and 8 residues), As-Fe oxyhydroxide accounts for the majority of As present (80%), while a smaller fraction is associated with arsenopyrite (10 to 15%) and oxides (2 to 10%). For fresh gneiss WR (FB-GS residue and GS-2), arsenopyrite is the dominant mineral form of As (96 to 98%), followed by a combination of As-Fe oxyhydroxide and Fe-Sb oxide (2 to 4%). In the schist oxide WR (SO), the majority of As is associated with oxides (97%), while no As minerals were characterized in the gneiss oxide WR (GO-3), likely due to low elemental abundance.

There is a notable discrepancy in As abundance in pre-test and residual fresh schist samples (FB-GS Residue & SS). In the residual SS sample, As is predominantly associated with As-Fe oxyhydroxide (74%) and Fe-Sb oxide (26%); while in the pre-test sample, As is mainly found as arsenopyrite (91%) and present in smaller fractions as As-Fe oxyhydroxide (4%) and Fe-Sb oxide (4%). This discrepancy in results may be due to both weathering of primary arsenopyrite and sample heterogeneity. Note that similar values of arsnopyrite are found in GS and FB-GS residue.

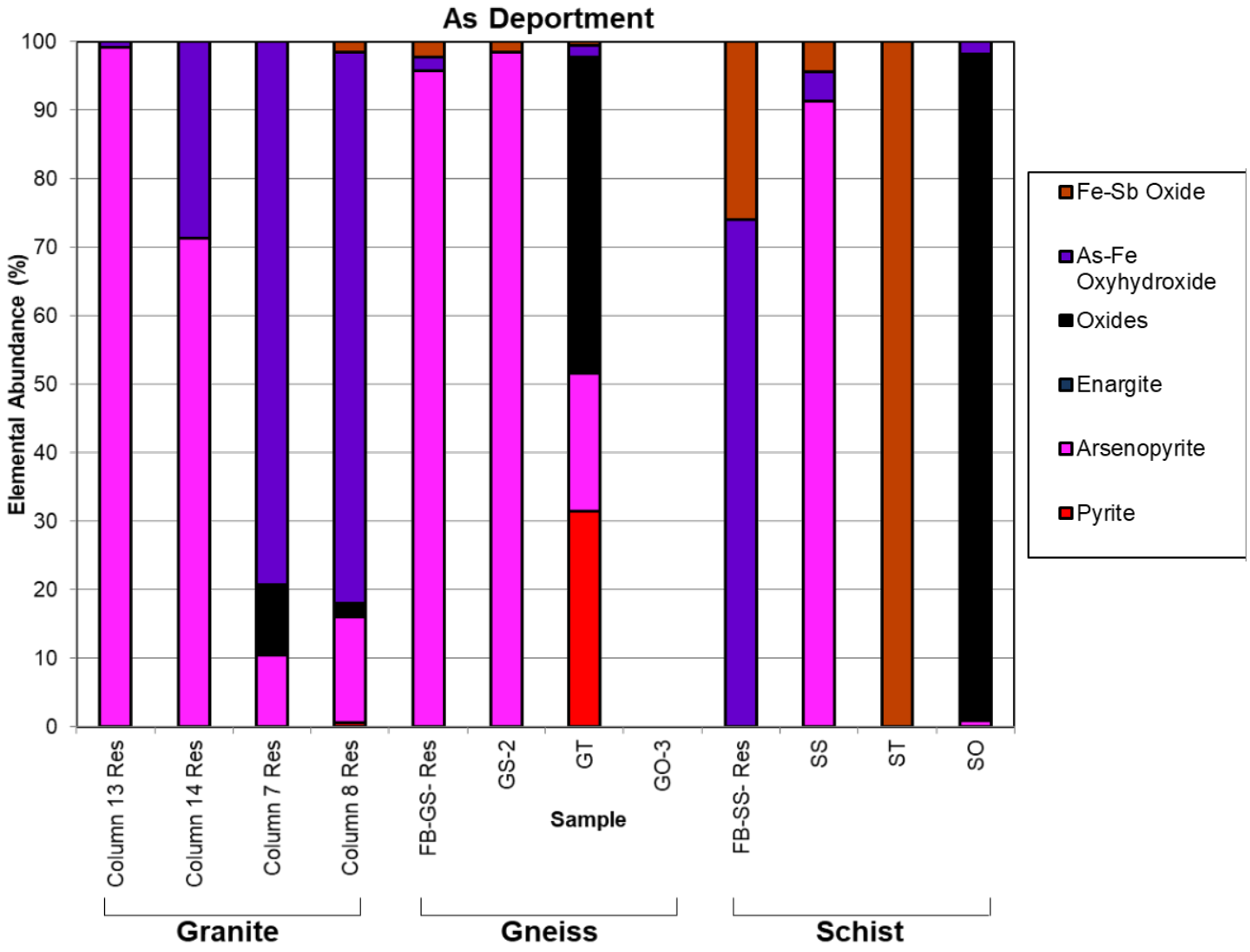

Figure 3-6: Relative elemental abundance of As in minerals present in kinetic test residues and fresh samples

3.3 *Column Influent*

Column influent in Phase 1 and Phase 2 of the experiment consisted of DI water amended with 51.8 mg/L of Na-lactate. The influent was analyzed in order to confirm that target concentrations had been achieved and confirm that the solution was trace metal free. The results show that the target DOC concentration (10 mg/L) was achieved in this phase of the experiment and that trace amounts of Ba, Pb and Al were present in the influent (Figure 3-5). Regular monitoring of DOC indicated relatively little variability throughout the entire course of the experiment with DOC concentrations ranging from 9.46 mg/L to 11.4 mg/L and a mean value of 10.3 mg/L (Appendix A).

In phase 3 of the experiment, $CaSO_4$ was introduced to column influent in addition to Na-lactate. Phase 3 influent was analyzed for a full suite of parameters each time a new batch of influent was made-up in addition to monitoring DOC, dissolved metal, and anion concentrations every 4 weeks (Appendix A). The first batch of Phase 3 influent was only used during the Week 28 (post-seq.) sampling event as the SO_4 concentration was 700 mg/L. The following two batches of column influent had SO_4 concentrations of 1010 mg/L and 1030 mg/L, respectively, and were used successively through the final phase of the experiment. Increases in many of the trace element concentrations in the Phase 3 influent are suspected to have been contributions from impurities in the $CaSO_4$ powder used to spike the influent. Parameters that were elevated to concentrations similar in magnitude to those of column effluent include Al, Ba, Cu, Fe, Pb, Mn, and Sr.

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Table 3-5: Composition of Column Influent

Parameter	Unit	Phase 1 and 2	Phase 3			
		17-Aug-17	11-Dec-18	05-Jan-18	14-Feb-18	Mean Value*
T-Alk	mg/L	13	23	21	24	22
pH	s.u.	5.86	6.43	6.43	6.38	6.41
Conductivity	uS/cm	24.82	1234	1619	1625	1622
DOC	mg/L	10.8	10.5	10.2	10.4	10.3
NH_3	mg/L	*<0.005*	*<0.005*	*<0.005*	*<0.005*	*<0.05*
NO_3-N	mg/L	*<0.005*	*<0.025*	*<0.025*	*<0.05*	*<0.05*
NO_2-N	mg/L	*<0.001*	*<0.005*	*<0.005*	*<0.01*	*<0.01*
T-PO_4	mg/L	*<0.002*	0.0051	0.0099	0.0119	0.011
SO_4	mg/L	*<0.3*	699	1010	1030	1020
D-Na	mg/L	6.79	6.36	5.96	7.03	6.50
D-Ca	mg/L	*<0.02*	271	386	395	391
D-K	mg/L	*<0.05*	*<0.1*	*<0.1*	*<0.1*	*<0.1*
D-Cl	mg/L	*<0.5*	*<2.5*	*<2.5*	*<5*	*<5*
D-Mg	mg/L	*<0.005*	0.328	0.485	0.712	0.599
D-Si	mg/L	*<0.05*	0.17	0.27	0.42	0.35
D-F	mg/L	*<0.02*	*<0.1*	*<0.1*	*<0.2*	*<0.2*
D-Al	mg/L	0.00056	0.0728	0.114	0.181	0.148
D-Sb	mg/L	*<0.00002*	*<0.00004*	*<0.00004*	*<0.00004*	*<0.00004*
D-As	mg/L	*<0.00002*	0.000059	0.000096	0.000066	0.000081
D-Ba	mg/L	0.000047	0.00225	0.00694	0.01150	0.0092
D-Cd	mg/L	*<0.000005*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
D-Cr	mg/L	*<0.0001*	*<0.0002*	*<0.0002*	0.00028	0.00024
D-Co	mg/L	*<0.000005*	0.000054	0.000058	0.000105	0.000082
D-Cu	mg/L	*<0.0001*	0.00070	0.00144	0.00253	0.00199
D-Fe	mg/L	*<0.001*	0.0253	0.0397	0.0708	0.0553
D-Pb	mg/L	0.0000071	0.000070	0.000104	0.000133	0.000119
D-Li	mg/L	*<0.0005*	*<0.001*	0.0013	0.0014	0.0014
D-Mn	mg/L	*<0.005*	0.00330	0.00746	0.01540	0.0114
D-Hg	mg/L	*<0.00005*	*ND*	*ND*	*ND*	*ND*
D-Mo	mg/L	*<0.00005*	*<0.0001*	*<0.0001*	*<0.0001*	*<0.0001*
D-Ni	mg/L	*<0.00005*	0.00012	*<0.0001*	0.0002	0.0002
D-Se	mg/L	*<0.00004*	*<0.00008*	*<0.00008*	*<0.00008*	*<0.00008*
D-Ag	mg/L	*<0.000005*	*<0.00001*	*<0.00001*	*<0.00001*	*<0.00001*
D-Sr	mg/L	*<0.0001*	0.737	1.63	2.29	1.96
D-Tl	mg/L	*<0.000002*	*<0.000004*	*<0.000004*	*<0.000004*	*<0.000004*

D-V	mg/L	*<0.00005*	0.00018	0.00023	0.00037	0.00030
D-Zn	mg/L	*<0.0005*	*<0.002*	*<0.002*	*<0.002*	*<0.002*

Note: Mean value determined from January 5, 2018 and February 14, 2018 influent samples.

3.4 *Column Effluent*

3.4.1 **Phase 1**

3.4.1.1 pH and Major Ions

Column effluent pH remained steady throughout phase 1 of the experiment. Gneiss and schist columns produced slightly higher pH (median pH of 8.02) than the granite columns (median pH of 6.92) (Figure 3-7 and Figure 3-8). The granite column Kona 4 produced significantly higher alkalinity compared to other granite columns, with all values generally declining in the first 15 week before stabilizing (Figure 3-7). Conversely, gneiss and schist column alkalinity increases for the first 10 weeks before stabilizing. The highest alkalinity values were generally observed in fresh weathering types (Kona 4, SS and GS).

Most major ions reach peak concentrations in the first four weeks and then decline for the duration of Phase 1. The fresh weathering types generally produce higher major ion concentrations than more oxidized samples. Columns GS and SS (fresh) consistently produced significantly higher major ion concentrations (*e.g.* Ca, K, Mg, Na, and SO_4), particularly in the first ~15 weeks, compared to columns GO and SO (oxide) and columns GT and ST (transition weathered).

Calcium concentrations in the columns decrease over time, most notably in the GS column where concentrations decline to roughly half of the initial porewater concentrations (~160 mg/L to ~80 mg/L) by Week 15 (Figure 3-9 and Figure 3-10). The declines in Ca concentrations are driven by much lower values can be related to calcite ($CaCO_3$) solubility. Saturation indices (SI) calculated in PHREEQC suggest that calcite is saturated in all gneiss and schist columns (SI = 0.11 – 0.78). Conversely, SI for granite columns indicate $CaCO_3$ is undersaturated and is not likely to control Ca concentrations, with the exception of Kona 4 which is near calcite equilibrium in the first 14 weeks.

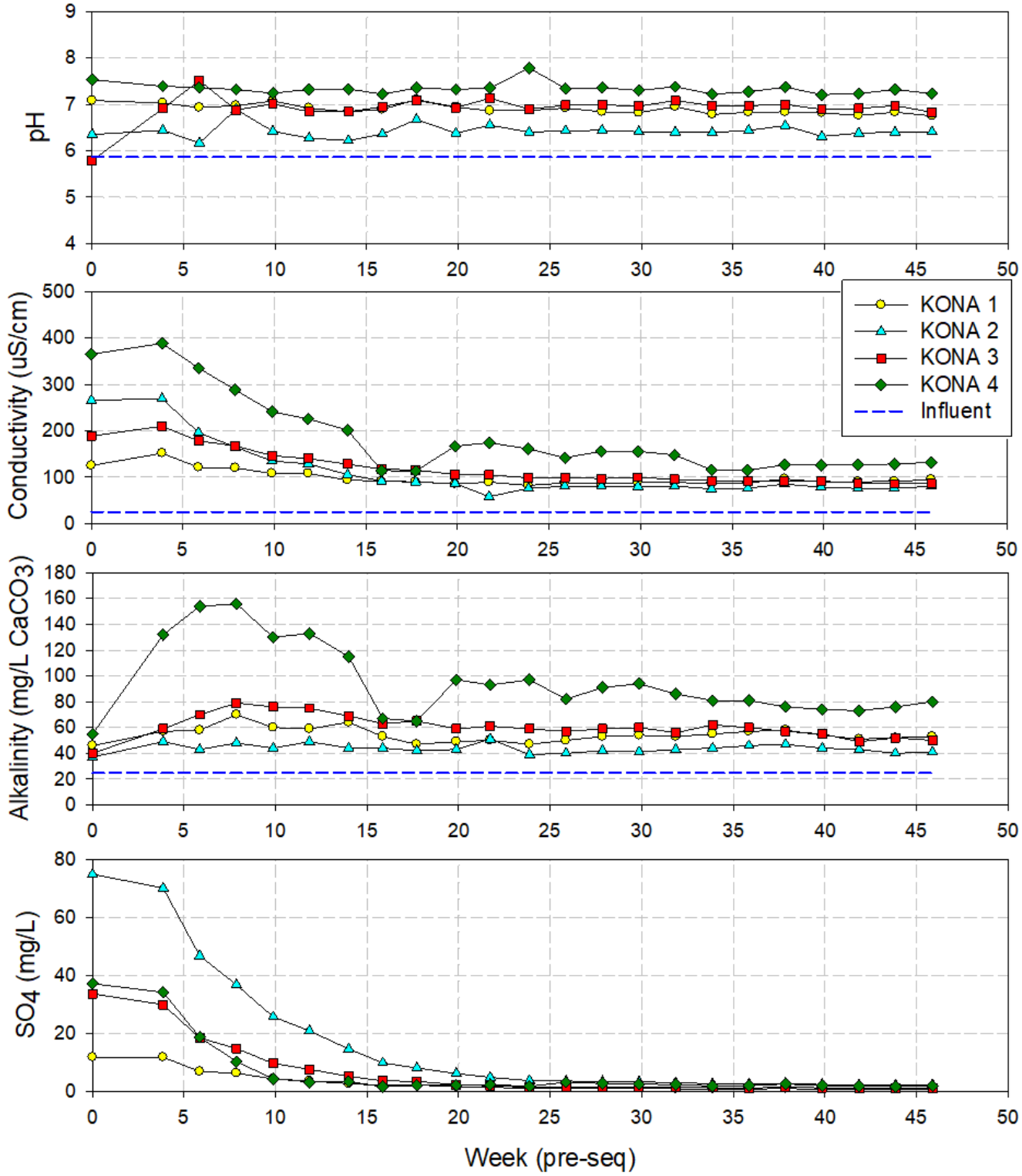

Figure 3-7: Time series profiles of pH, Conductivity, Total Alkalinity, and SO_4 in granite column effluent in Phase 1.

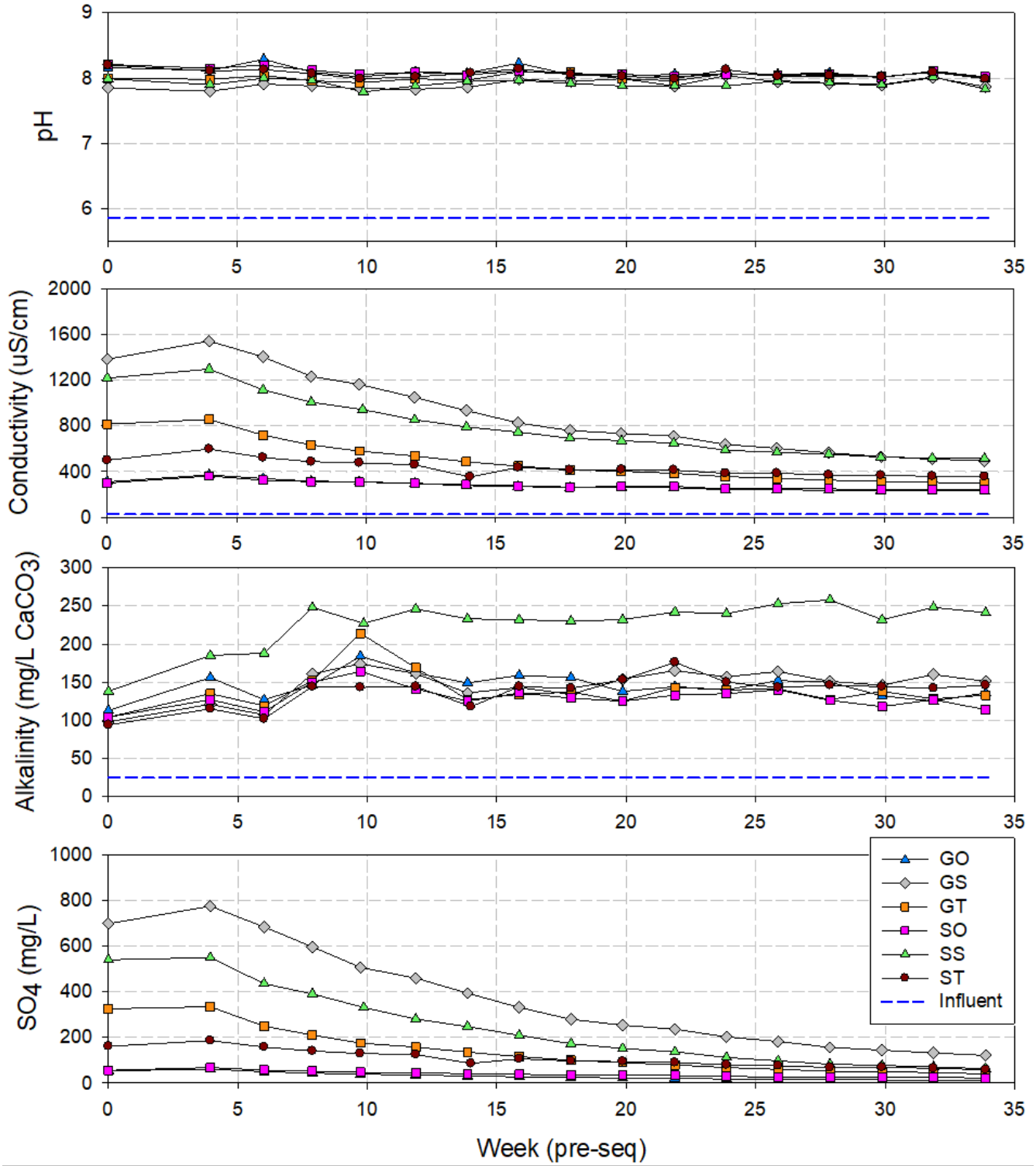

Figure 3-8: Time series profiles of pH, Conductivity, Total Alkalinity, and SO_4 in gneiss and schist column effluent in Phase 1.

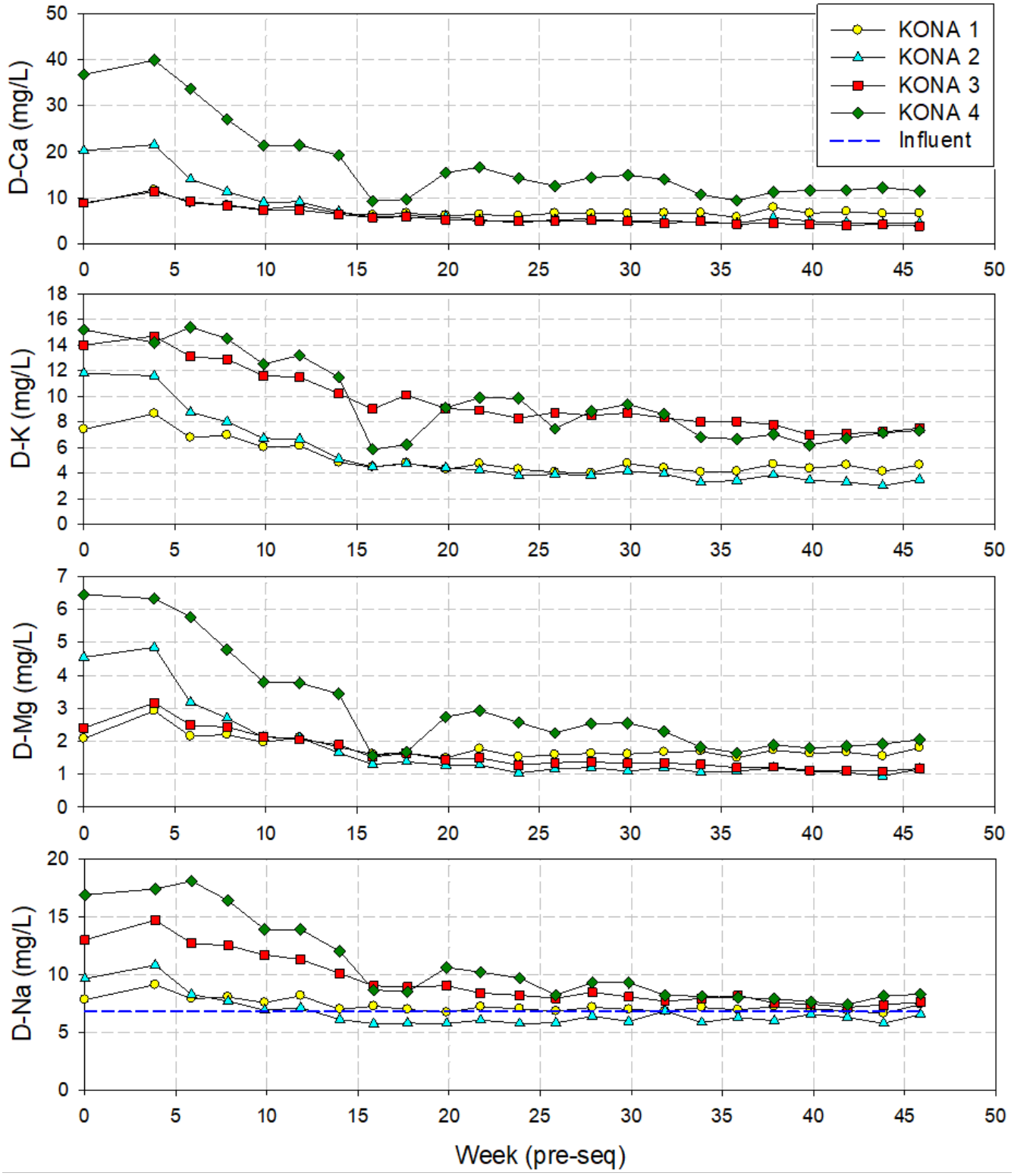

Figure 3-9: **Time series profiles of D-Ca, D-K, D-Mg, and D-Na in granite column effluent in Phase 1.**

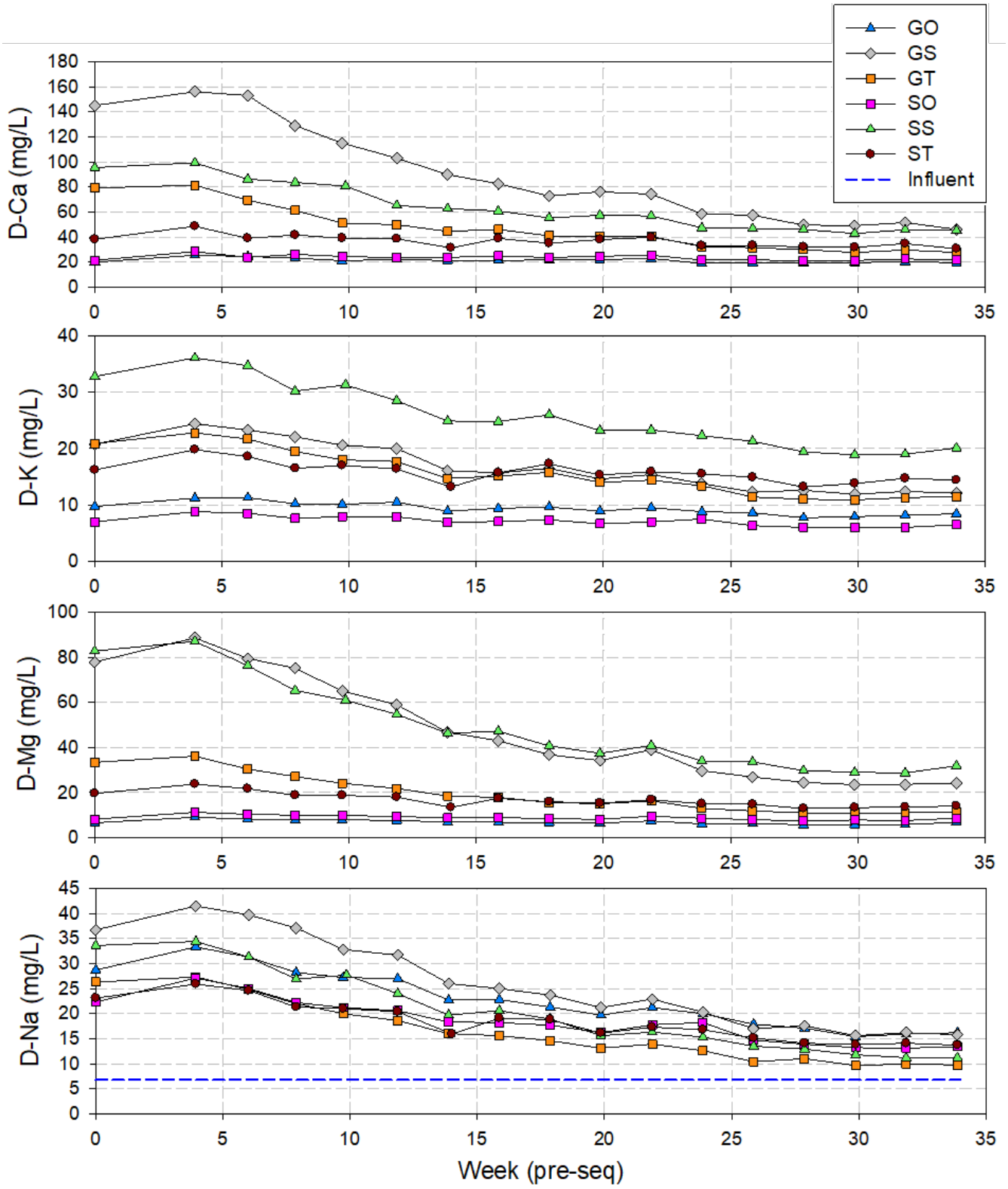

Figure 3-10: **Time series profiles of D-Ca, D-K, D-Mg, and D-Na in gneiss and schist column effluent in Phase 1.**

3.4.1.2 Redox Indicators

Reducing conditions in column substrate are driven by the oxidation (decomposition) of organic compounds. As there is minimal organic carbon expected in rock samples sourced from drill core, the primary source of DOC to the column is from influent which has been spiked with Na-lactate to achieve a concentration of 10 mg/L of DOC. For the entirety of Phase 1, DOC in leachates is consistently below the influent level in all columns, reaching levels near to or below 1 mg/L (Figure 3-11 and Figure 3-12). This indicates that decomposition of DOC by microbial activity is occurring within the columns.

The first terminal electron acceptor to be utilized in the absence of O_2 is NO_3. Since NO_3 is below method detection limit (MDL) in column influent and is consistently near or below MDL values (< 0.005 to 0.025 mg/L) in effluents, it is not an effective redox indicator in this experiment. The dominant nitrogen species in column effluent is NH_4, which is a reduced species that typically dominates nitrogen speciation under anaerobic conditions. The persistence of NH_4 in column leachate (0.005 to 1.89 mg/L) indicates that conditions are sufficiently reducing (i.e., oxygen is absent) to favor NO_3 reduction and NH_4 stability (Figure 3-11 and Figure 3-12).

There is evidence for reductive dissolution of Mn-oxides in granite, gneiss and schist materials (Figure 3-11 and Figure 3-12). This is shown by the increase in Mn concentrations between column influent (< 0.00005 mg/L) and compared to leachates (maximum values of 4.42 to 0.26 mg/L). Mn concentrations gradually decline over time, likely illustrating the progressive depletion of labile Mn-oxide phases.

Distinct trends in Fe concentrations are observed in Kona columns versus the gneiss and schist columns (Figure 3-11 and Figure 3-12). Kona leachates show evidence of reductive dissolution of Fe oxides, specifically Kona 2 where a maximum Fe concentration of 3.5 mg/L was reached. While GS and GO effluents have occasional detectable Fe concentrations (maximum of 0.0076 mg/L), values are consistently below MDL in GT and all schist columns, indicating that reductive dissolution of Fe is not occurring to any significant extent. This may be due to the availability of more energetically favorable terminal electron acceptors (i.e., Mn) or Fe-oxides being present in crystalline forms that are not easily accessible for microbial respiration.

Dissolved sulphide only appears in Kona 2 effluent (Figure 3-13) and is above MDL (< 1.5 µg/L) between Weeks 7 to 20 (pre-seq.). A maximum D-sulphide value of 64 µg/L is reached in Week 16, suggesting that sulphate reduction is occurring in Kona 2. Similarly, the appearance of a black precipitate on Kona 1 indicates formation of secondary sulphide minerals, suggesting that sulphate reduction is also occurring in this column. D-sulphide values were generally below MDL in Kona 1, suggesting that D-sulphide produced from sulphate reduction was insoluble in Kona 1 pore water.

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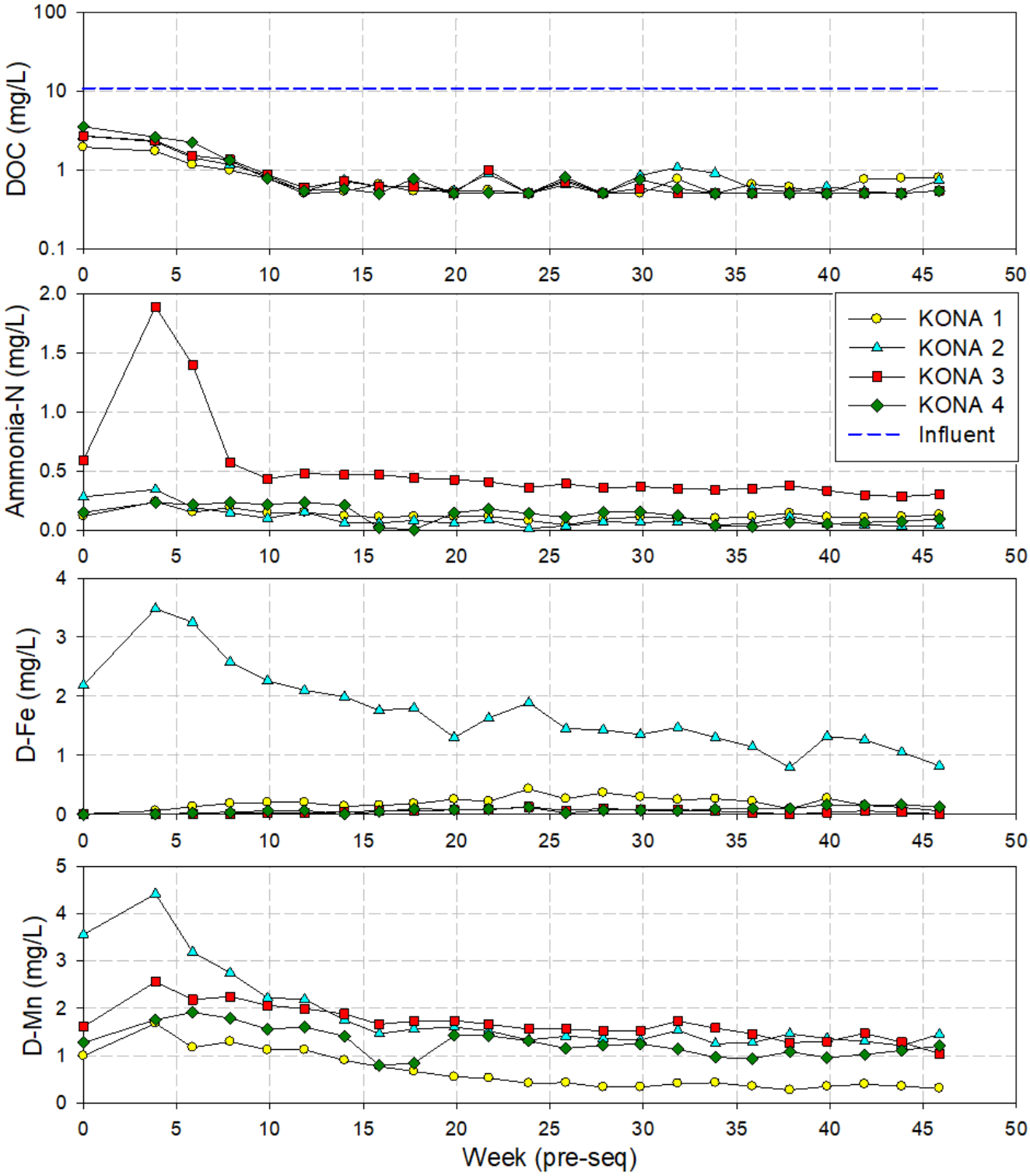

Figure 3-11: Time series profiles of DOC, Ammonia-N, D-Fe, and D-Mn in granite column effluent in Phase 1.

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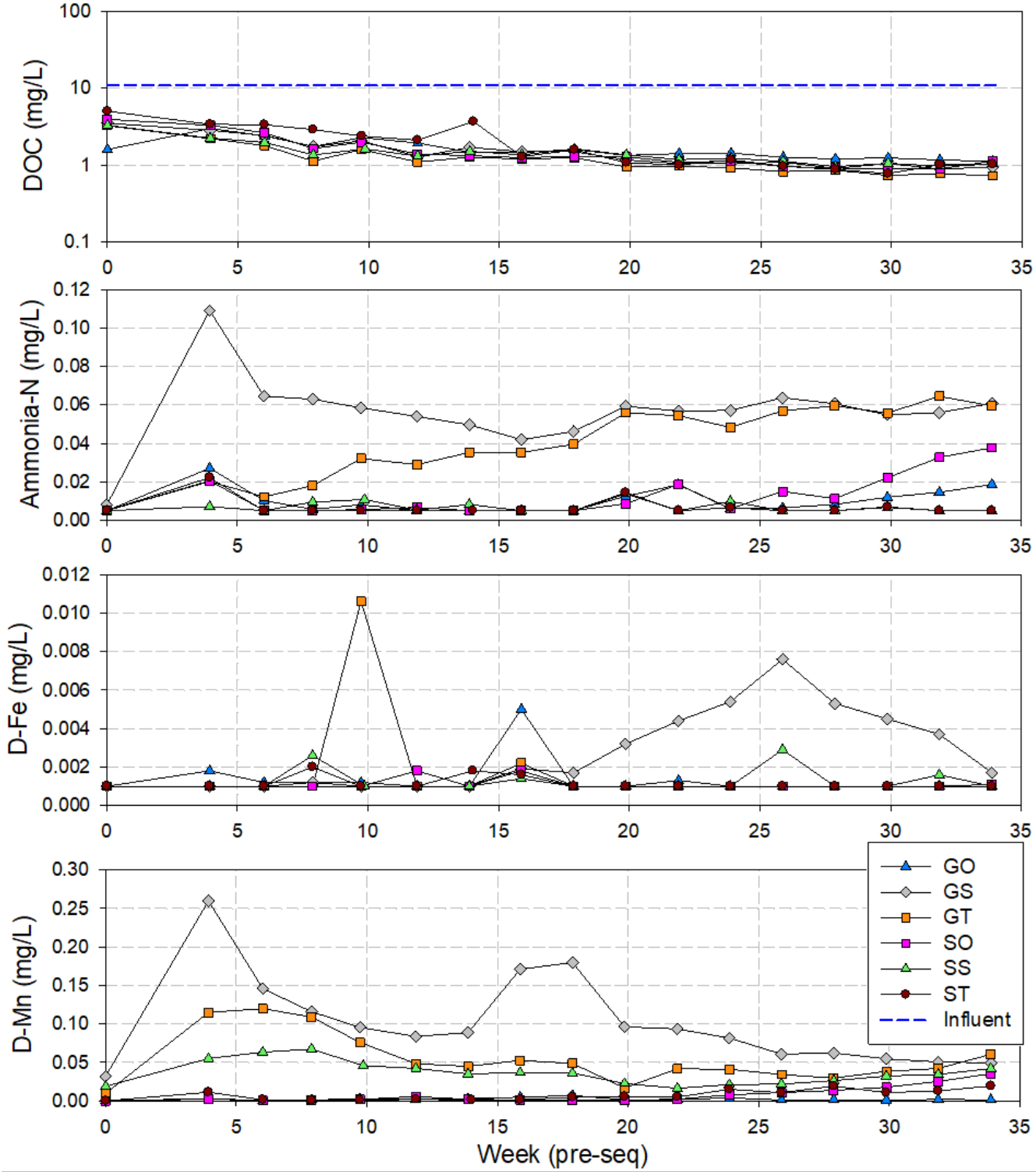

Figure 3-12: Time series profiles of DOC, Ammonia-N, D-Fe, and D-Mn in gneiss and schist column effluent in Phase 1.

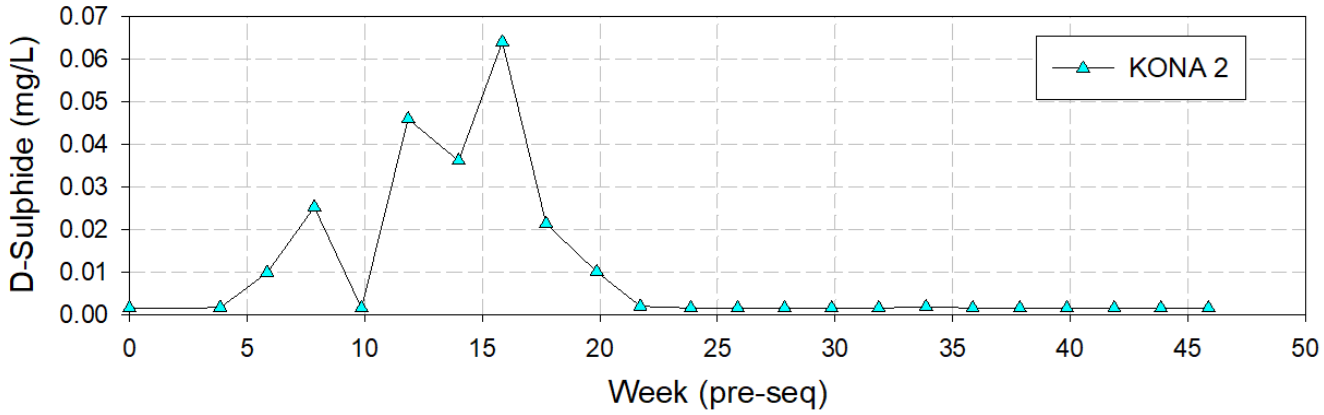

Figure 3-13: Time series profiles of D-Sulphide in the granite KONA 2 column effluent in Phase 1.

3.4.1.3 Trace Elements

Metal cations such as Cd, Co, Cu, Ni, and Zn and metal oxyanions such as Sb, Mo and U either remained relatively stable or showed gradual declines in effluent concentrations (Figure 3-14 through Figure 3-19). Such trends are consistent with the rinsing of water-soluble oxides and mineral surface bound metals through the initial phase of the experiment. Dissolved antimony concentrations in the Kona 2 column were anomalous as concentrations increased from Week 0 to 18 and thereafter gradually declined. Columns GT and GS produced the highest D-U concentrations in Phase 1, reaching maximum values of 0.35 mg/L and 0.29 mg/L, respectively. Maximum D-U concentrations in schist and granite column effluents were significantly lower at 0.089 mg/L and 0.071 mg/L, respectively (Figure 3-14 and Figure 3-15). Uranium concentrations declined over time, similar to other trace metals. Arsenic is unique in that it showed increasing trends in Phase 1, most notably in Kona columns 1 and 2, suggesting conditions in the saturated columns enhanced As release (Figure 3-20 and Figure 3-21).

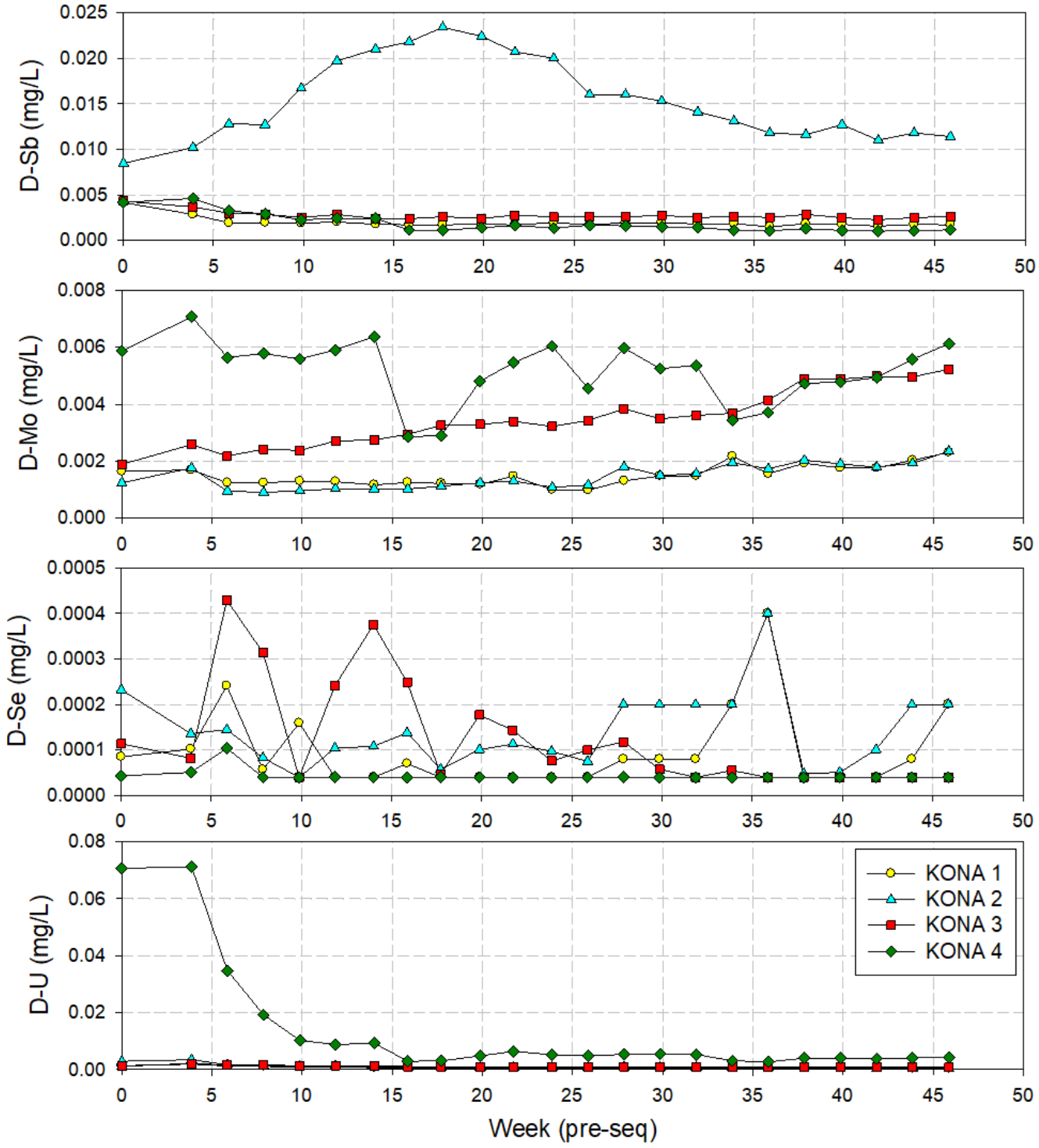

Figure 3-14: Time series profiles of D-Sb, D-Mo, D-Se, and D-U in granite column effluent in Phase 1.

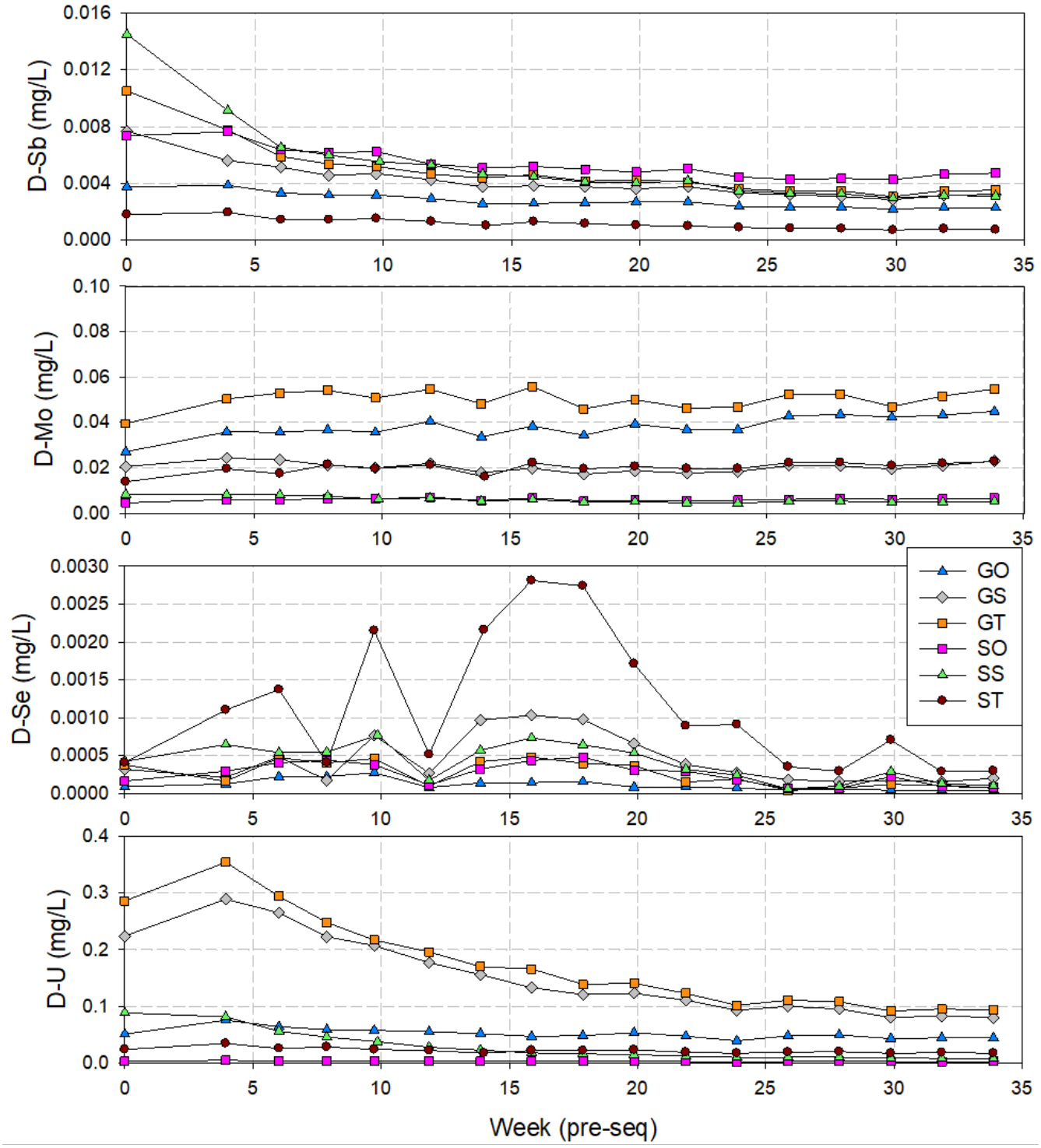

Figure 3-15: Time series profiles of D-Sb, D-Mo, D-Se, and D-U in gneiss and schist column effluent in Phase 1.

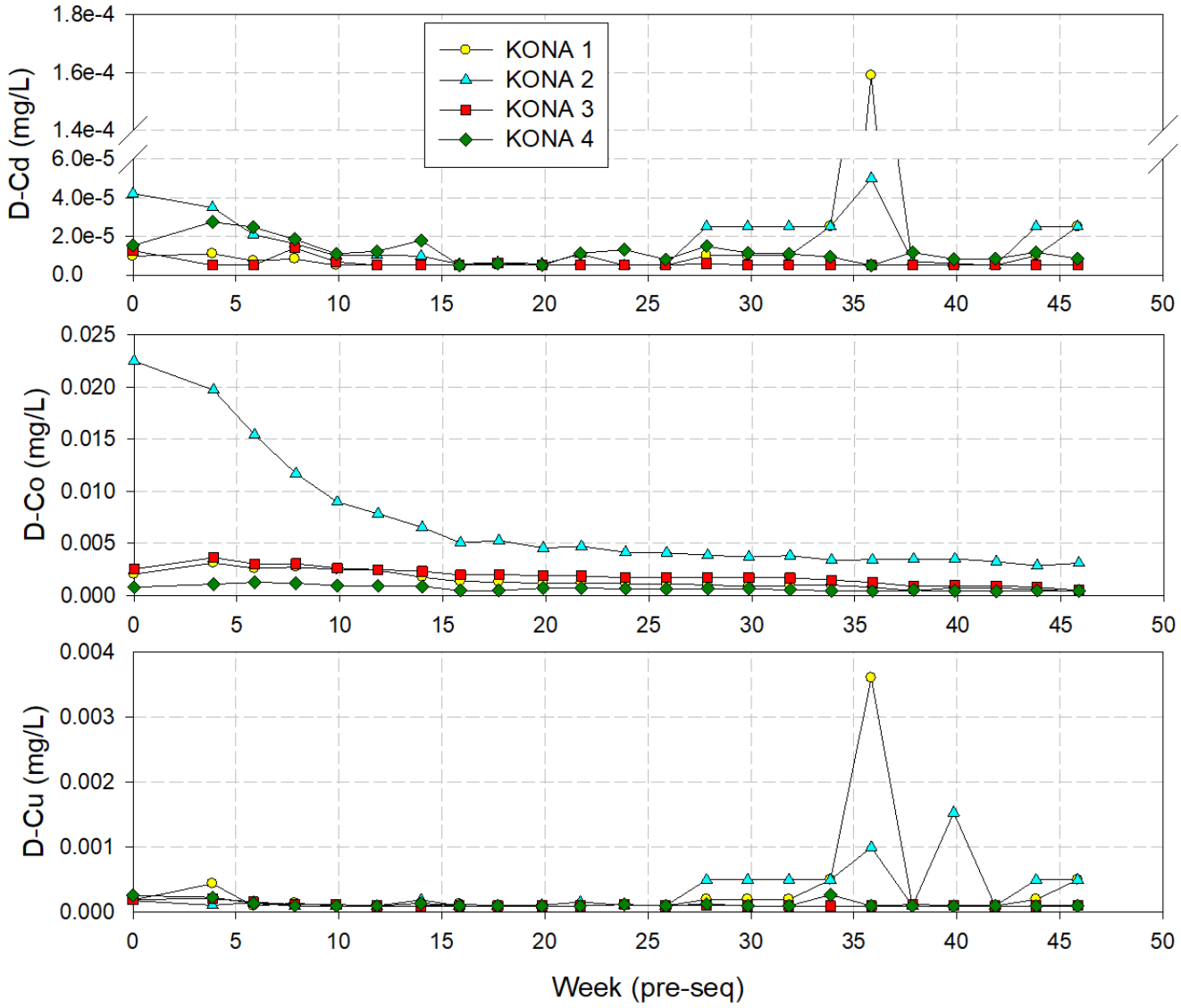

Figure 3-16: Time series profiles of D-Cd, D-Co and D-Cu in granite column effluent in Phase 1.

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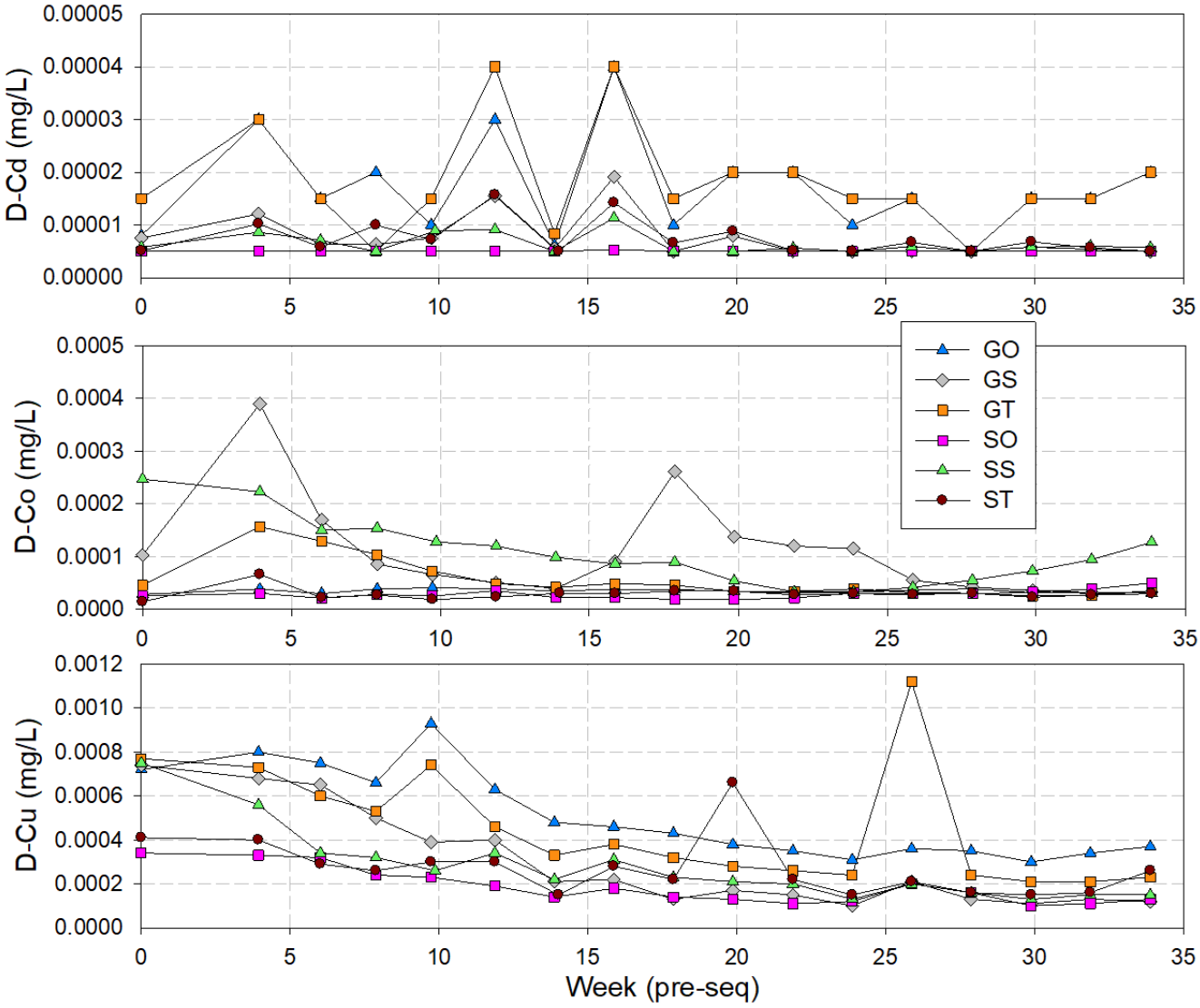

Figure 3-17: Time series profiles of D-Cd, D-Co and D-Cu in gneiss and schist column effluent in Phase 1.

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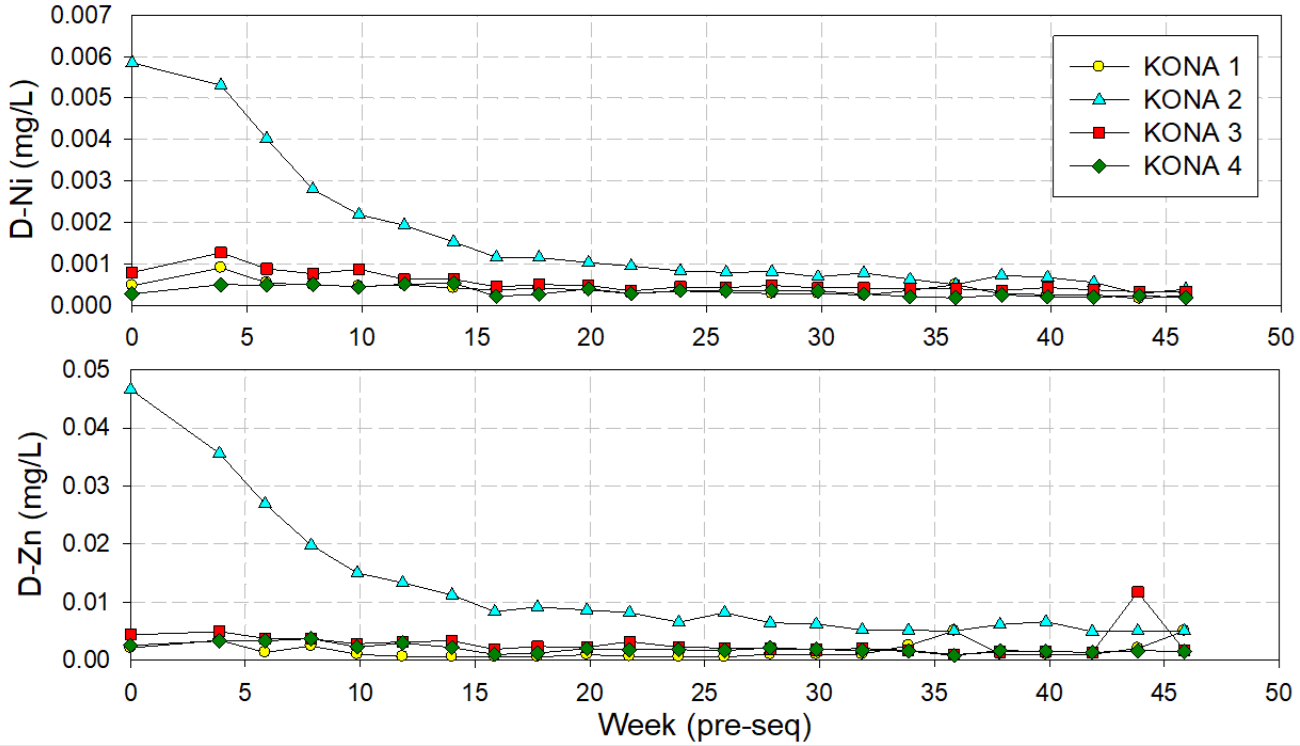

Figure 3-18: Time series profiles of D-Ni and D-Zn in granite column effluent in Phase 1.

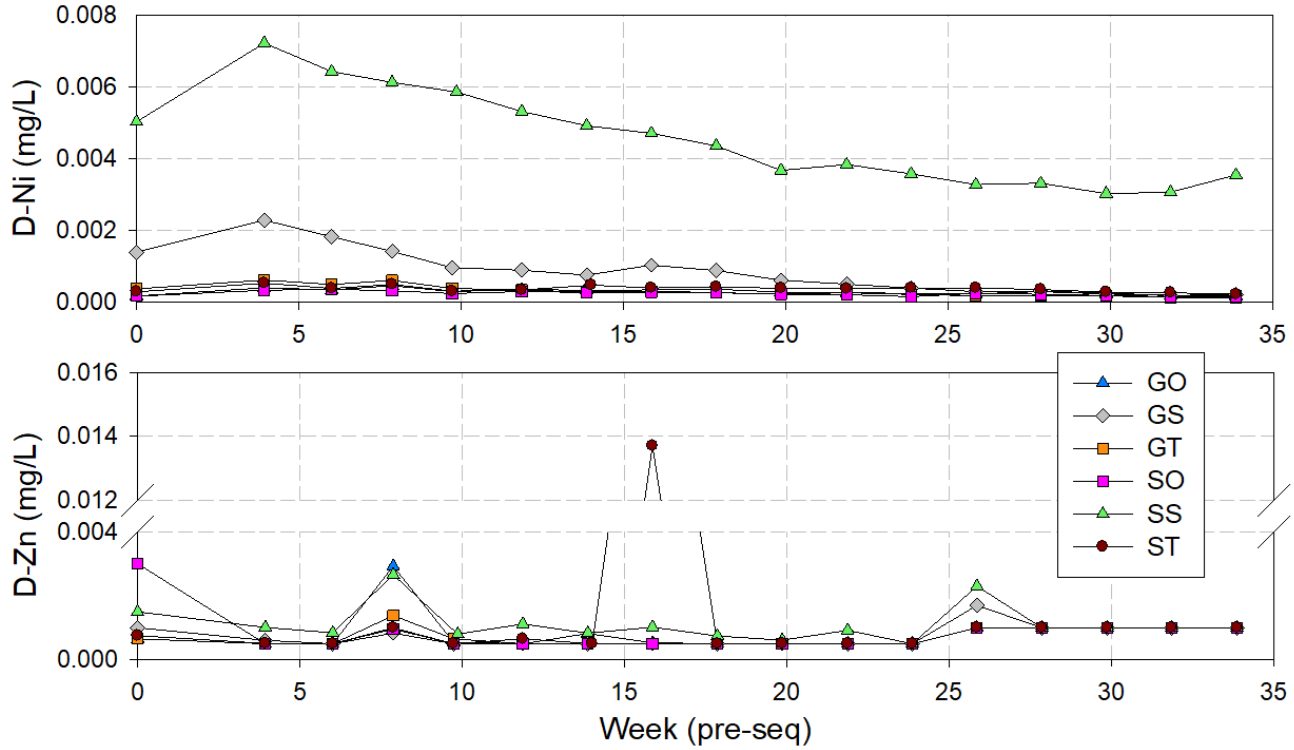

Figure 3-19: Time series profiles of D-Ni and D-Zn in gneiss and schist column effluent in Phase

3.4.1.4 Arsenic Behaviour

A variety of potential mechanism of As release may be occurring within the column materials, which include: reductive dissolution of Fe-oxide minerals; reduction of As(V) to As(III); pH related sorption/desorption on mineral surfaces; and ion exchange of surface complexed As. Arsenic results in granite columns (Kona 1-4) are considerably higher than in gneiss and schist leachates (G&S). In Kona 1, 2 and 3, As is steadily released throughout Phase 1 operation, reaching maximum concentrations of 12.5mg/L, 20.1 mg/L and 3.07 mg/L in Week 46 (pre-seq.), respectively (Figure 3-20). In contrast, As results in Kona 4 remain consistent at a much lower average of 0.348 mg/L. In G&S leachates, As release follows a similar increasing trend throughout Phase 1; values range from 0.0058 to 0.21 mg/L and are highest in GT leachates by up to 10x (Figure 3-21).

In Phase 1, As release can be attributed to several factors. Arsenic is often associated with Fe-oxide minerals as a co-precipitate or sorbed to Fe-oxide surfaces (Bowell, 1994), destabilization of Fe-oxide minerals by anaerobic reduction reactions can lead to the release of As along with any other species associated with Fe-oxides minerals. This mechanism of As release would be expected to result in a correlation between D-Fe and D-As in column effluent. While, reducible As associated with oxides and Fe-oxides does make up a large fraction of As in granite ore WR

and gneiss and schist transition and oxide samples, an Fe-As correlation is not evident in any of the leachates.

A process known to happen concurrently with Fe-oxide reduction is As (V) reduction to As (III). Arsenic can be mobilized by selective reduction of As(V) to more soluble As(III). This reaction occurs at similar redox potential as Fe(III) reduction to Fe(II). Reduction of As(V) can occur in the absence of Fe(III) reduction when Fe-oxide minerals are present as relatively crystalline phase (e.g., goethite and hematite) (Kocar and Fendorf, 2009). QEMSCAN results affirm that across rock types the majority of Fe-oxides is present as goethite. This process can explain how As release is decoupled from Fe release across column leachates.

Arsenic can be mobilized by cation exchange when present as a surface complexed species. The presence of PO_4 can result in the displacement of As(V) and As(III) from Fe-oxide sorption sites, with the magnitude dependent on pH and PO_4 concentrations (Jain and Loeppert, 2000). This process of competitive ion exchange can promote the release of As from mine waste and As-contaminated sediments (Fendorf et al., 2008; Peryea, 1991; Rubinos et al., 2011). In Phase 1, TD-P concentrations range from <0.002 to 0.687 mg/L and demonstrate an increasing trend in Kona, GT and GO leachates. There is no contribution of TD-P in column influent, which suggests that soluble P arises from rinsing of phosphate minerals present in the lithologies. Correlation between TD-P and As (R^2 = 0.54 to 0.82) in the aforementioned leachate samples provides support for the competitive displacement of As(V) and As(III) along with PO_4. Increasing PO_4 concentrations are likely driven by decline in Ca concentrations. Ca is a component ion of apatite [$Ca_5(PO_4)_3(Cl,F,OH)$], hence, declines in Ca concentration can lead to increased apatite dissolution.

Appendix C

Saturated Column Report

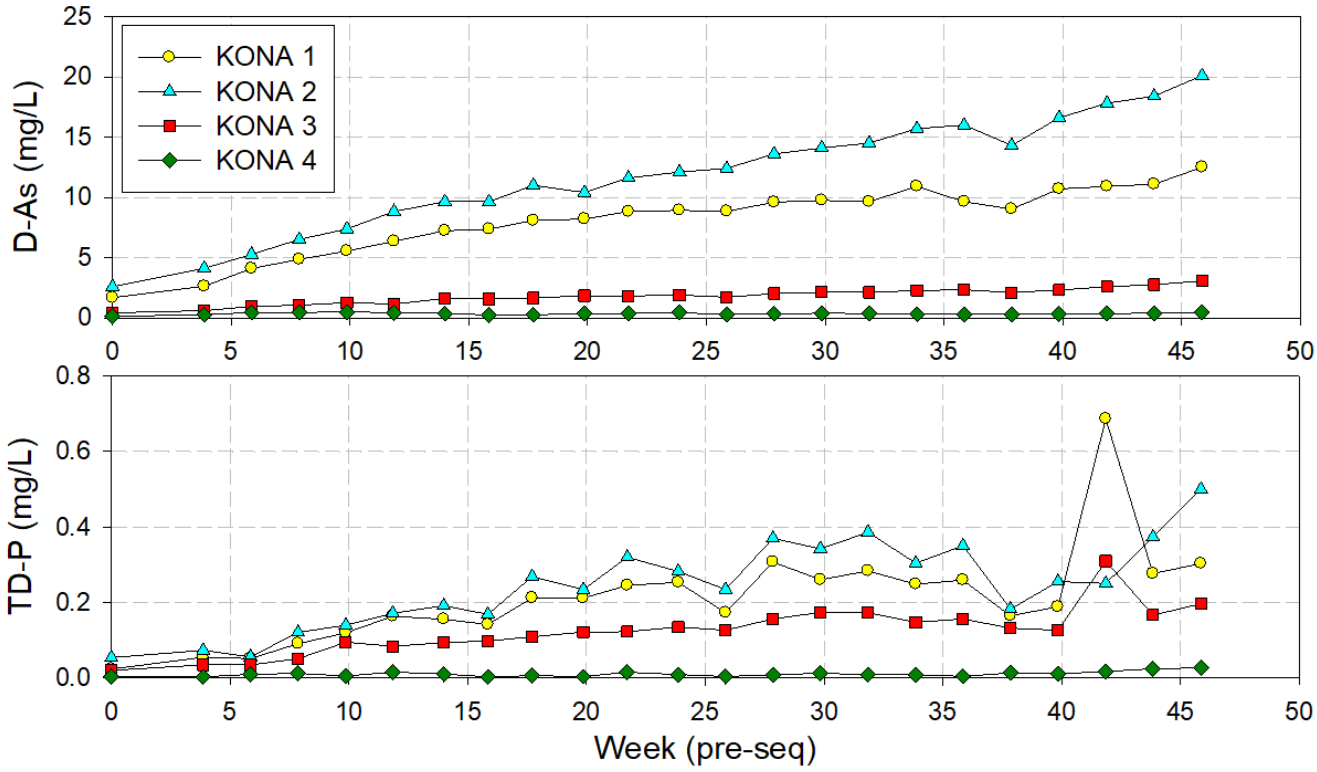

Figure 3-20: Time series profile of D-As and TD-P in granite column effluent in Phase 1.

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Saturated Column Report

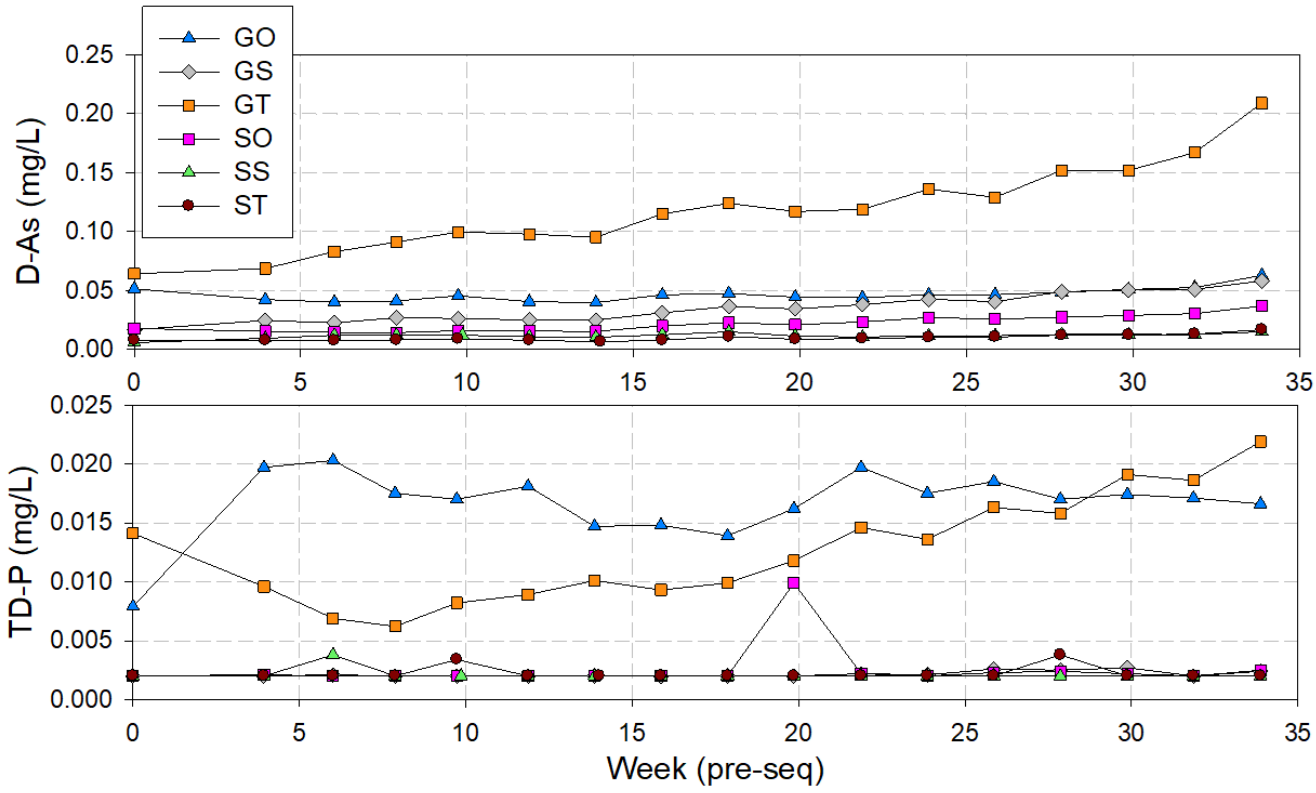

Figure 3-21: Time series profile of D-As and TD-P in gneiss and schist column effluent in Phase 1.

3.4.1.5 Comparison Unsaturated versus Saturated Conditions

The concentrations produced during unsaturated and saturated kinetic testing are compared in Table 3-6, Table 3-7 and Table 3-8. These tables show the final sample from the unsaturated tests, which most closely reflects the chemical conditions of the rock sample prior to submergence in saturated columns. Overall, the results show that saturated columns produce significantly lower concentrations of most major ions and trace metals. The most notable exception to this is As, which is leached in higher concentrations under saturated column conditions.

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Table 3-6: Comparison of Unsaturated Kinetic Tests with Phase 1 Granite Saturated Column Effluent Results

		Col 13, Col 14 and Col 8**	Col Kona 1		Col 13, Col 14, and Col 7**	Col Kona 2		Col 13	Col Kona 3		Col 14	Col Kona 4	
		Final Sample*	P10	P90	Final Sample*	P10	P90	Final Sample*	P10	P90	Final Sample*	P10	P90
pH	**s.u.**		6.79	7.06		6.28	6.55	7.23	6.84	7.09	8.08	7.22	7.39
Conductivity	**uS/cm**	125	85.8	121	79.1	75.5	190	80.2	88.2	176	200	115	326
Alkalinity	**mg CaCO3/L**	21.1	47.4	59.8	25.6	40.0	48.8	8.79	50.4	74.0	75.6	68.2	133
Sulphate	**mg/L**	22.0	0.794	6.76	6.91	2.29	44.8	9	1.15	17.8	13	1.80	17.0
D-Al	**mg/L**	0.0638	0.00246	0.00494	0.0452	0.00165	0.0133	0.002	0.00134	0.00256	0.003	0.00233	0.00427
D-Sb	**mg/L**	0.0058	0.0017	0.0020	0.0091	0.011	0.022	0.0059	0.0024	0.0030	0.0059	0.0011	0.0032
D-As	**mg/L**	2.06	4.25	10.9	0.242	5.52	17.6	0.109	0.972	2.53	0.0523	0.259	0.451
D-Ba	**mg/L**	0.00450	0.000711	0.00176	0.00456	0.00397	0.0148	0.00087	0.00221	0.00551	0.0165	0.0121	0.0385
D-Cd	**mg/L**	4.65E-05	0.000005	2.22E-05	1.41E-05	5.36E-06	0.0000329	*< 0.000003*	0.000005	6.68E-06	0.000015	0.00000522	0.0000184
D-Ca	**mg/L**	11.6	6.19	8.61	7.67	4.5	13.5	2.41	4.18	8.75	25.2	9.85	32.3
D-Co	**mg/L**	0.0203	0.000609	0.00258	0.000314	0.00327	0.0147	0.000838	0.000880	0.00296	0.000358	0.000442	0.00105
D-Cu	**mg/L**	0.00699	0.0001	0.000488	0.000623	0.0001	0.0005	0.00033	0.0001	0.000152	0.00042	0.0001	0.000212
D-Fe	**mg/L**	0.041	0.065	0.29	0.012	1.1	2.5	*< 0.007*	0.0031	0.077	*< 0.007*	0.0055	0.15
D-Pb	**mg/L**	0.000075	7.4E-06	2.7E-05	0.00011	5.2E-06	0.000050	0.00009	0.0000051	0.000020	0.00009	0.0000070	0.000042
D-Mg	**mg/L**	2.52	1.52	2.14	1.57	1.05	3.08	0.634	1.13	2.42	4.75	1.70	5.57
D-Mn	**mg/L**	1.29	0.329	1.16	0.256	1.28	3.10	0.441	1.28	2.16	0.593	0.938	1.73
D-Hg	**mg/L**	0.01	0.000005	6.0E-06	0.01	0.000005	0.000014	*< 0.01*	0.000005	0.000005	*< 0.01*	0.000005	0.000005
D-Mo	**mg/L**	0.00134	0.00117	0.00201	0.00160	0.000972	0.00194	0.00208	0.00239	0.00495	0.0032	0.00349	0.00611
D-Ni	**mg/L**	0.00555	0.000251	0.000498	0.000149	0.000511	0.00378	0.0003	0.000347	0.000853	*< 0.0001*	0.000197	0.000506
D-P	**mg/L**	0.011	0.061	0.30	0.013	0.082	0.37	0.015	0.037	0.17	0.006	0.0026	0.016
D-K	**mg/L**	4.42	4.09	6.93	3.82	3.33	8.60	5.09	7.27	13.1	8.77	6.31	14.4
D-Se	**mg/L**	0.00011	0.00004	0.0002	0.00004	0.000052	0.0002	0.00004	0.00004	0.00030	*< 0.00004*	0.00004	0.000042
D-Na	**mg/L**	2.40	6.81	8.01	2.70	5.75	8.14	6.72	7.45	12.7	2.6	7.91	16.8
D-Sr	**mg/L**	0.0408	0.0300	0.0423	0.0240	0.0177	0.0529	0.0115	0.0203	0.0417	0.0636	0.0282	0.0883
D-Tl	**mg/L**	0.00011	9.6E-05	0.00021	3.8E-05	0.00013	0.00051	0.000029	0.000080	0.00015	0.000056	0.000091	0.00019
D-U	**mg/L**	0.00636	0.000471	0.00123	0.00573	0.000507	0.00168	0.000422	0.000805	0.00156	0.0226	0.00306	0.0317
D-Zn	**mg/L**	0.044	0.0005	0.0032	0.0028	0.005	0.025	0.003	0.0014	0.0042	*< 0.002*	0.0012	0.0032

***Final concentration produced by unsaturated test prior to collection of residues for unsaturated columns.**

****Weighted average shown when multiple unsaturated tests used to generate sample.**

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Table 3-7: Comparison of Unsaturated Kinetic Tests with Phase 1 Gneiss Saturated Column Effluent Results

		FB-GO	Col GO		FB-GT	Col GT		FB-GS	Col GS	
		Final Sample*	P10	P90	Final Sample*	P10	P90	Final Sample*	P10	P90
pH	**s.u.**	8.35	8.02	8.19	7.84	7.96	8.09	7.97	7.84	8.00
Conductivity	**uS/cm**		232.1	325.2		310.8	757.4		522	1392
Alkalinity	**mg CaCO3/L**	59.4	126	160	59.1	122.6	158.8	70.4	115.4	164.4
Sulphate	**mg/L**	98.2	13.6	51.6	638	48.2	279	1010	139	689
D-Al	**mg/L**	0.028	0.0076	0.011	0.0029	0.0075	0.010	0.0016	0.0044	0.0057
D-Sb	**mg/L**	0.00292	0.00230	0.00349	0.00576	0.00344	0.00664	0.00699	0.00311	0.00532
D-As	**mg/L**	0.0425	0.0405	0.0518	0.0299	0.0773	0.158	0.00905	0.0238	0.0506
D-Ba	**mg/L**	0.0382	0.0807	0.103	0.0266	0.0327	0.0775	0.0181	0.0213	0.0299
D-Cd	**mg/L**	*< 0.00003*	7.28E-06	0.00003	*< 0.00002*	7.04E-06	0.000034	*< 0.00002*	0.000005	0.000013
D-Ca	**mg/L**	20	19	24	158	29	73	216	49	148
D-Co	**mg/L**	0.00014	3.0E-05	0.000039	0.00012	2.9E-05	0.00011	*< 0.0001*	0.000035	0.00021
D-Cu	**mg/L**	0.0025	0.00033	0.00077	0.0016	0.00022	0.00075	0.00078	0.00012	0.00066
D-Fe	**mg/L**	0.027	0.001	0.0015	*< 0.01*	0.001	0.0015	*< 0.01*	0.001	0.0053
D-Pb	**mg/L**	*< 0.00005*	0.000005	0.00001	*< 0.00005*	0.000005	0.00001	*< 0.00005*	0.000005	0.00001
D-Mg	**mg/L**	6.8	5.8	8.0	75	11	32	123	24	79
D-Mn	**mg/L**	0.0012	0.00080	0.0045	0.0041	0.025	0.11	0.0016	0.050	0.17
D-Hg	**mg/L**	0.000005	0.000005	0.000005	*< 0.000005*	0.000005	0.000006	*< 0.000005*	0.000005	0.000005
D-Mo	**mg/L**	0.0689	0.0340	0.0433	0.0439	0.0462	0.0546	0.0345	0.0178	0.0231
D-Ni	**mg/L**	*< 0.0005*	0.00019	0.00038	0.00066	0.00016	0.00054	0.0016	0.00024	0.0016
D-P	**mg/L**	*< 0.05*	0.014	0.020	*< 0.05*	0.0077	0.019	*< 0.05*	0.002	0.0025
D-K	**mg/L**	6.73	8.07	10.8	18.4	11.2	21.2	19.6	12.2	22.6
D-Se	**mg/L**	0.000066	0.00004	0.00022	0.00023	0.000068	0.00046	0.00052	0.00016	0.00097
D-Na	**mg/L**	33.8	16.1	29.7	30.5	9.87	25.4	26.6	16.0	38.1
D-Sr	**mg/L**	0.109	0.111	0.149	0.784	0.170	0.384	1.4	0.349	0.964
D-Tl	**mg/L**	0.000016	7.8E-05	0.00010	0.00015	0.00040	0.00050	0.000051	0.000072	0.00014
D-U	**mg/L**	0.0498	0.0439	0.0611	0.585	0.0946	0.289	0.424	0.0822	0.240
D-Zn	**mg/L**	0.0011	0.0005	0.001	0.060	0.0005	0.001	0.015	0.0005	0.001

***Final concentration produced by unsaturated test prior to collection of residues for unsaturated columns.**

Table 3-8: Comparison of Unsaturated Kinetic Tests with Phase 1 Schist Saturated Column Effluent Results

		FB-SO	Col SO		FB-ST	Col ST		FB-SS	Col SS	
		Final Sample*	P10	P90	Final Sample*	P10	P90	Final Sample*	P10	P90
pH	**s.u.**	8.28	8.02	8.17	7.94	7.99	8.13	7.89	7.86	7.99
Conductivity	**uS/cm**		245.6	316.2		357.8	509.2		523.2	1156
Alkalinity	**mg CaCO3/L**	59.8	113	145	53.6	110	151	93.7	187	250
Sulphate	**mg/L**	87.4	25.1	56.5	478	67.3	159	658	74.8	477
D-Al	**mg/L**	0.0063	0.0039	0.0057	0.0031	0.0075	0.012	0.0018	0.0029	0.0051
D-Sb	**mg/L**	0.0047	0.0043	0.0068	0.0012	0.00077	0.0016	0.013	0.0031	0.0076
D-As	**mg/L**	0.0124	0.0150	0.0294	0.00268	0.00765	0.0125	0.00398	0.01	0.0136
D-Ba	**mg/L**	0.0482	0.0575	0.0888	0.0407	0.0463	0.0737	0.0245	0.0306	0.0735

D-Cd	**mg/L**	*< 0.000005*	0.000005	0.000005	0.000013	0.000005	0.000012	0.0000067	0.000005	0.0000090
D-Ca	**mg/L**	23.2	21.4	25.7	107	31.6	40.5	129	45.6	89.9
D-Co	**mg/L**	*< 0.0001*	2.03E-05	3.68E-05	*< 0.0001*	2.09E-05	0.0000347	0.0003	0.0000385	0.000182
D-Cu	**mg/L**	0.00071	0.00011	0.00032	0.00077	0.00015	0.00040	0.0007	0.00014	0.00043
D-Fe	**mg/L**	0.011	0.001	0.0014	*< 0.01*	0.001	0.0017	*< 0.01*	0.001	0.002
D-Pb	**mg/L**	*< 0.00005*	0.000005	1.3E-05	0.000054	0.000005	0.000013	*< 0.00005*	0.000005	0.000017
D-Mg	**mg/L**	9.69	7.71	10.1	56.9	13.4	20.4	114	29.4	78.9
D-Mn	**mg/L**	0.0036	0.00069	0.021	0.0023	0.00079	0.017	0.014	0.020	0.058
D-Hg	**mg/L**	*< 0.000005*	0.000005	5.3E-06	*< 0.000005*	0.000005	0.000005	*< 0.000005*	0.000005	0.000005
D-Mo	**mg/L**	0.007	0.0054	0.0066	0.024	0.017	0.022	0.0088	0.0047	0.0080
D-Ni	**mg/L**	*< 0.0005*	0.00017	0.00033	0.00066	0.00028	0.00049	0.0077	0.0032	0.0063
D-P	**mg/L**	*< 0.05*	0.002	0.0024	*< 0.05*	0.002	0.0026	*< 0.05*	0.002	0.002
D-K	**mg/L**	4.78	6.03	8.166	18.3	13.56	17.82	29.5	19.24	33.56
D-Se	**mg/L**	0.000101	7.22E-05	0.000434	0.000556	0.000293	0.00239	0.000279	9.54E-05	0.000678
D-Na	**mg/L**	21.8	13.3	23.4	26.6	14.0	23.7	25.3	11.6	32.2
D-Sr	**mg/L**	0.15	0.15	0.19	8.9	3.3	4.3	9.8	3.5	6.7
D-Tl	**mg/L**	0.000058	0.00022	0.00026	*< 0.00001*	1.8E-05	0.000023	0.000046	0.000043	0.000089
D-U	**mg/L**	0.00295	0.00287	0.00384	0.0402	0.0176	0.0269	0.141	0.00876	0.0664
D-Zn	**mg/L**	0.0045	0.0005	0.001	0.059	0.0005	0.001	0.029	0.00069	0.0018

***Final concentration produced by unsaturated test prior to collection of residues for unsaturated columns**

3.4.2 **Phase 2 & 3**

Phase 2 (column sequencing) was initiated and operated from Week 0 to 26 (post-seq.) to evaluate leachate chemistry produced from various combinations of lithologies. Phase 3 ($CaSO_4$ amendment) was initiated and operated from Week 28 to 46 (post-seq.) to assess changes in leachate chemistry following exposure to infiltration water. In the section to follow, discussions of effluent results from granite, gneiss, and schist columns are limited to Weeks 0 to 46 (post-seq.). To facilitate discussion of results, Kona columns 1 through 4 and GT are referred to as primary columns while their corresponding column pairs (GS, ST, SS, SO, and GO, respectively) are referenced as secondary columns.

3.4.2.1 pH and Major Ions

Initiation of Phase 2 had no significant effect on pH, conductivity, and alkalinity compared to Phase 1. Conductivity increases significantly in all columns Phase 3, consistent with higher total dissolved solids associated with $CaSO_4$ addition. Divergent results were observed for pH in Phase 3. Granite column pH declined by 0.8 to 1.3 pH units, while pH schist and gneiss columns remained stable.

Major ions concentrations remained relatively unaffected by Phase 2 column sequencing. Initiation of Phase 3 triggered an increase in release of K, Mg, and Na, although negligible in the

GO column (Figure 3-25 through Figure 3-27). Mobilization of K, Mg, and Na may be associated with cation exchange reactions driven by increased Ca supply.

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Saturated Column Report

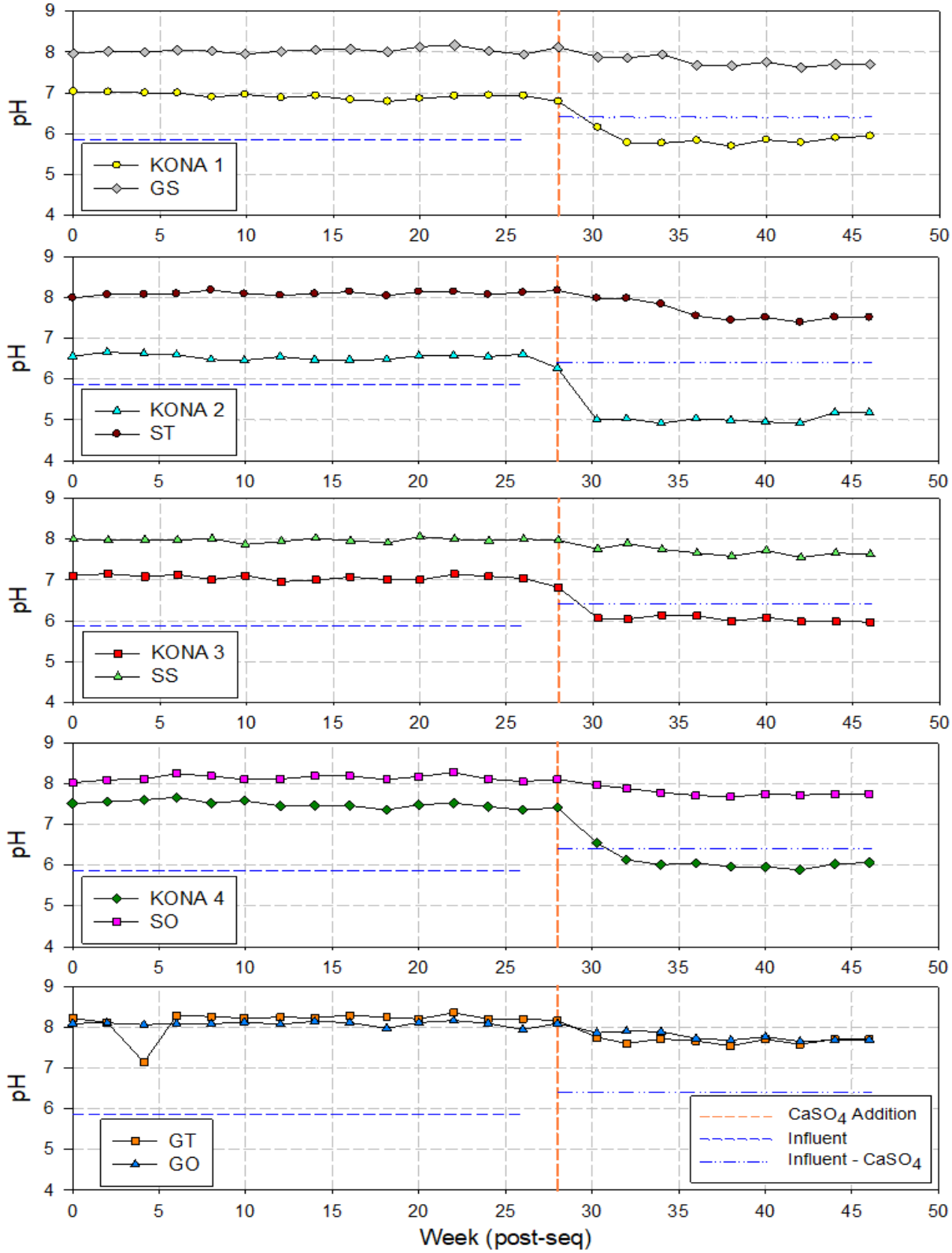

Figure 3-22: Times series profiles of pH in column effluent of sequenced pairs in Phase 2 and 3.

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Saturated Column Report

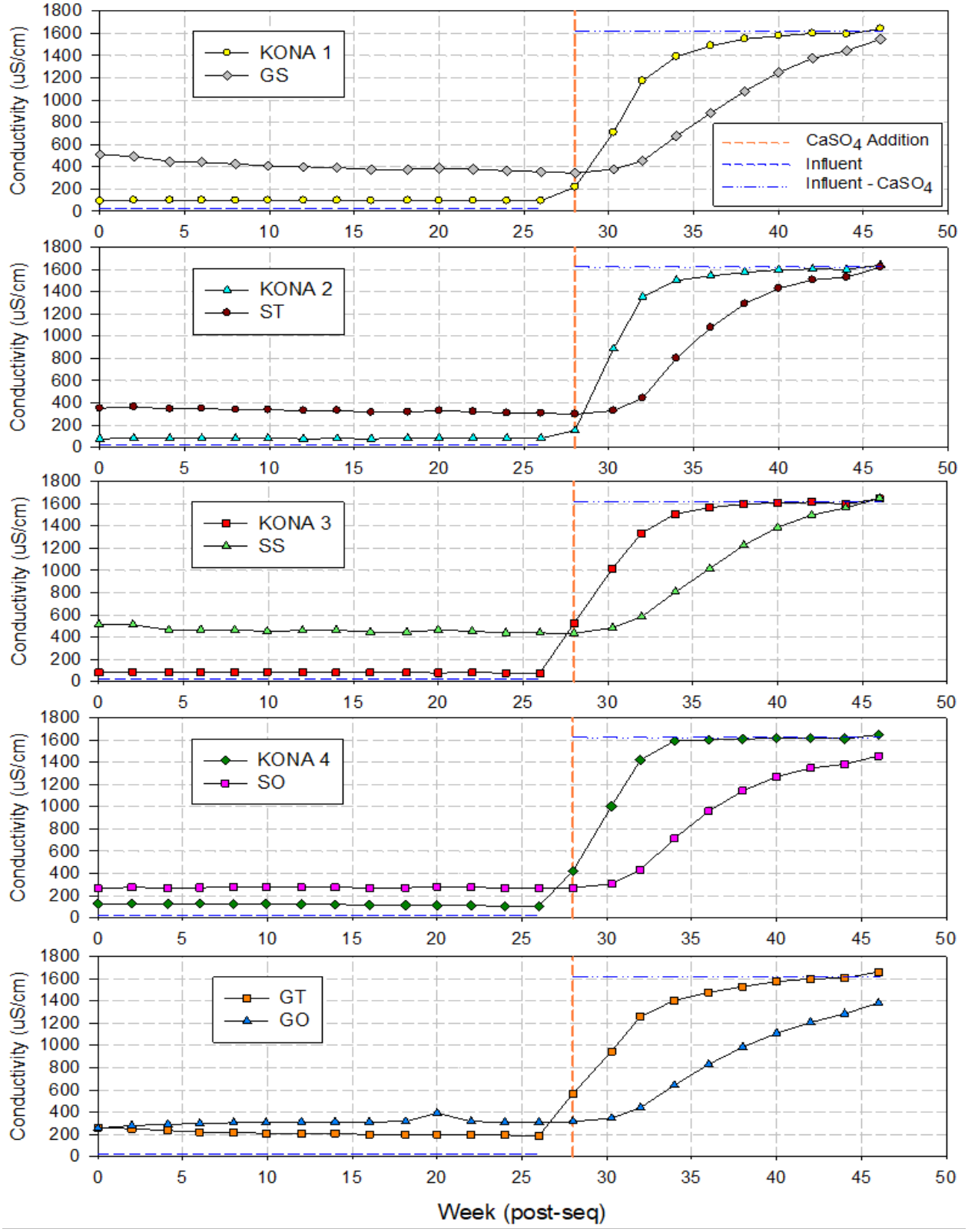

Figure 3-23: Times series profiles of conductivity in column effluent of sequenced pairs in Phase 2 and 3.

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Saturated Column Report

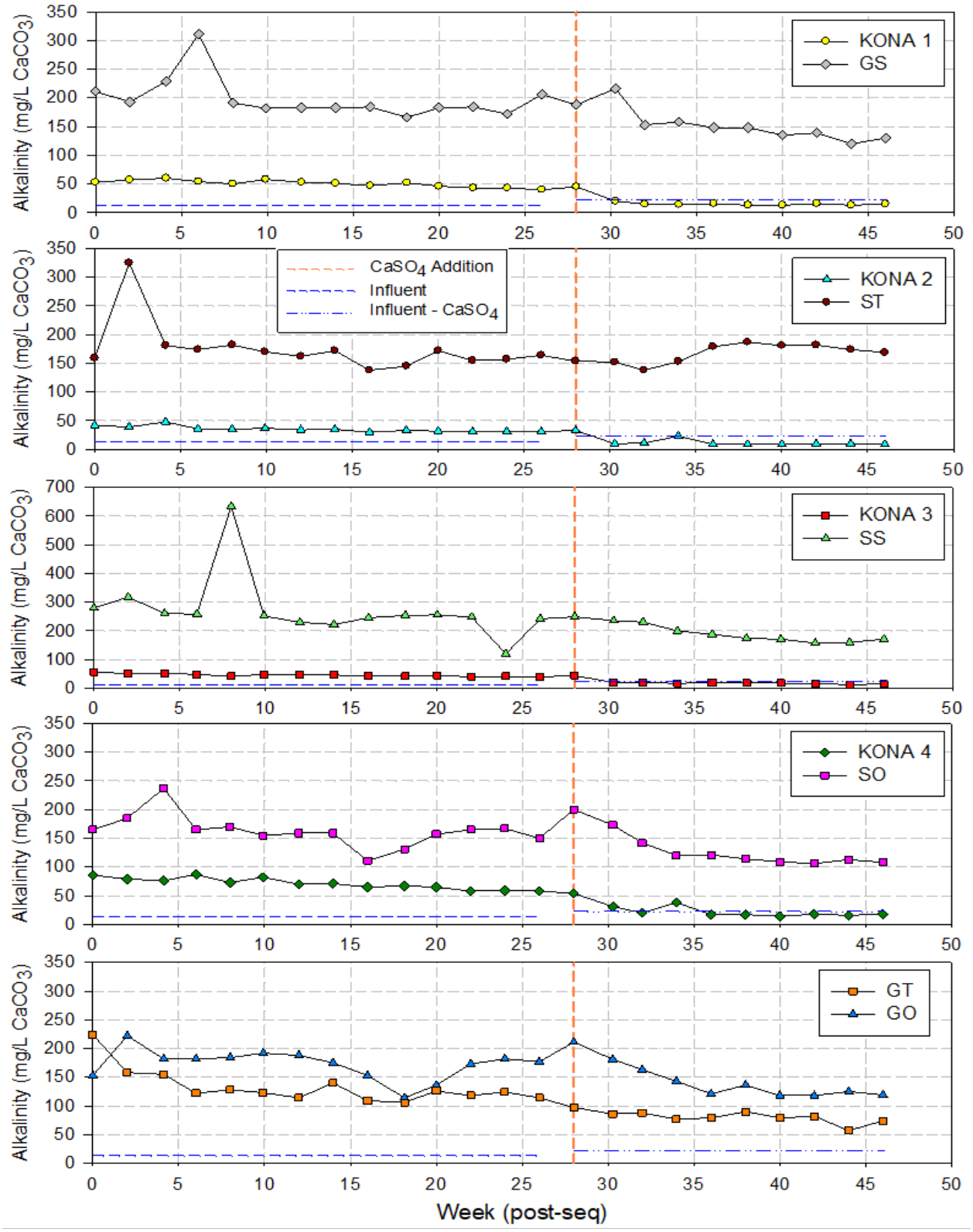

Figure 3-24: Times series profiles of alkalinity in column effluent of sequenced pairs in Phase 2 and 3.

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Saturated Column Report

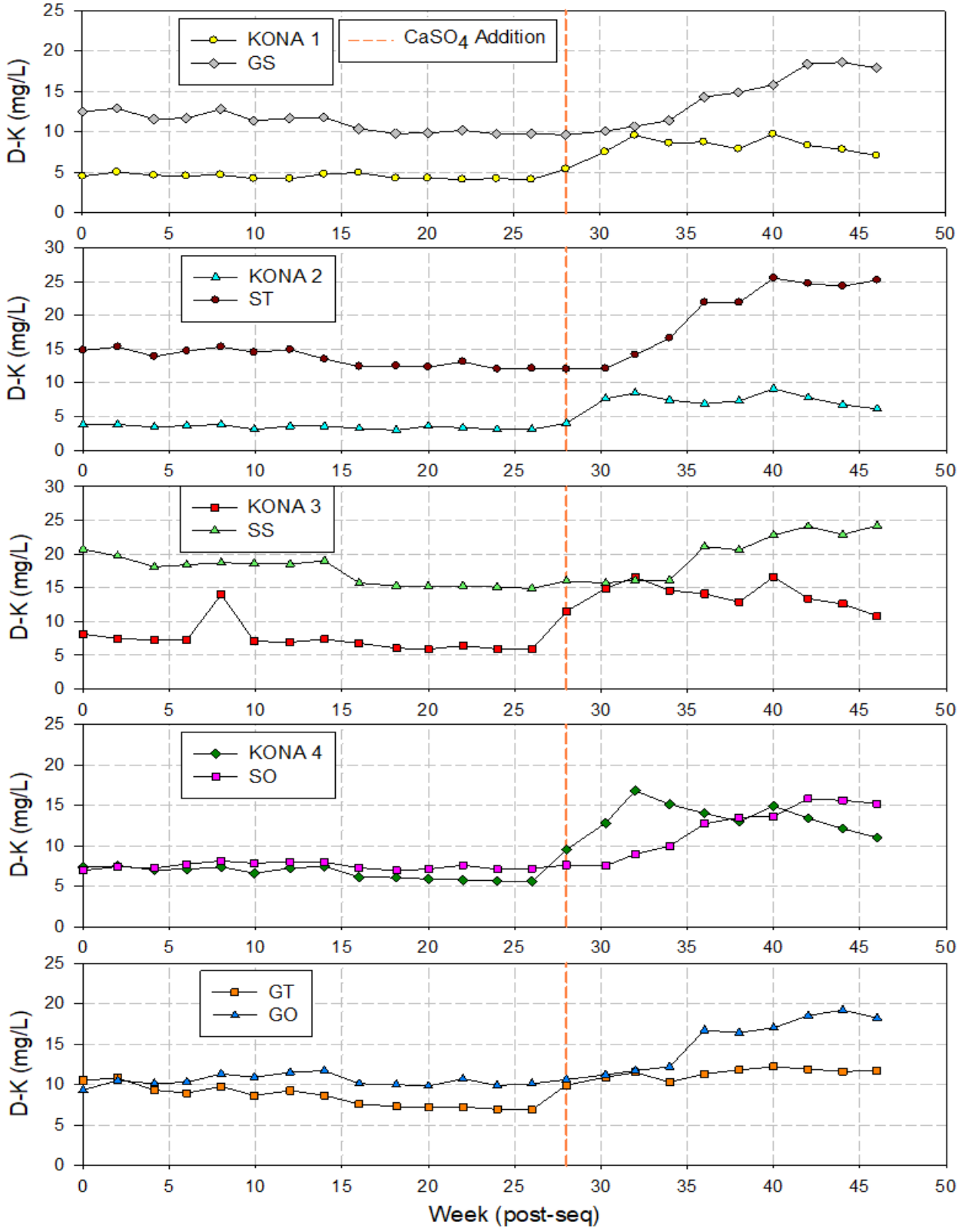

Figure 3-25: Times series profiles of D-K in column effluent of sequenced pairs in Phase 2 and 3.

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Saturated Column Report

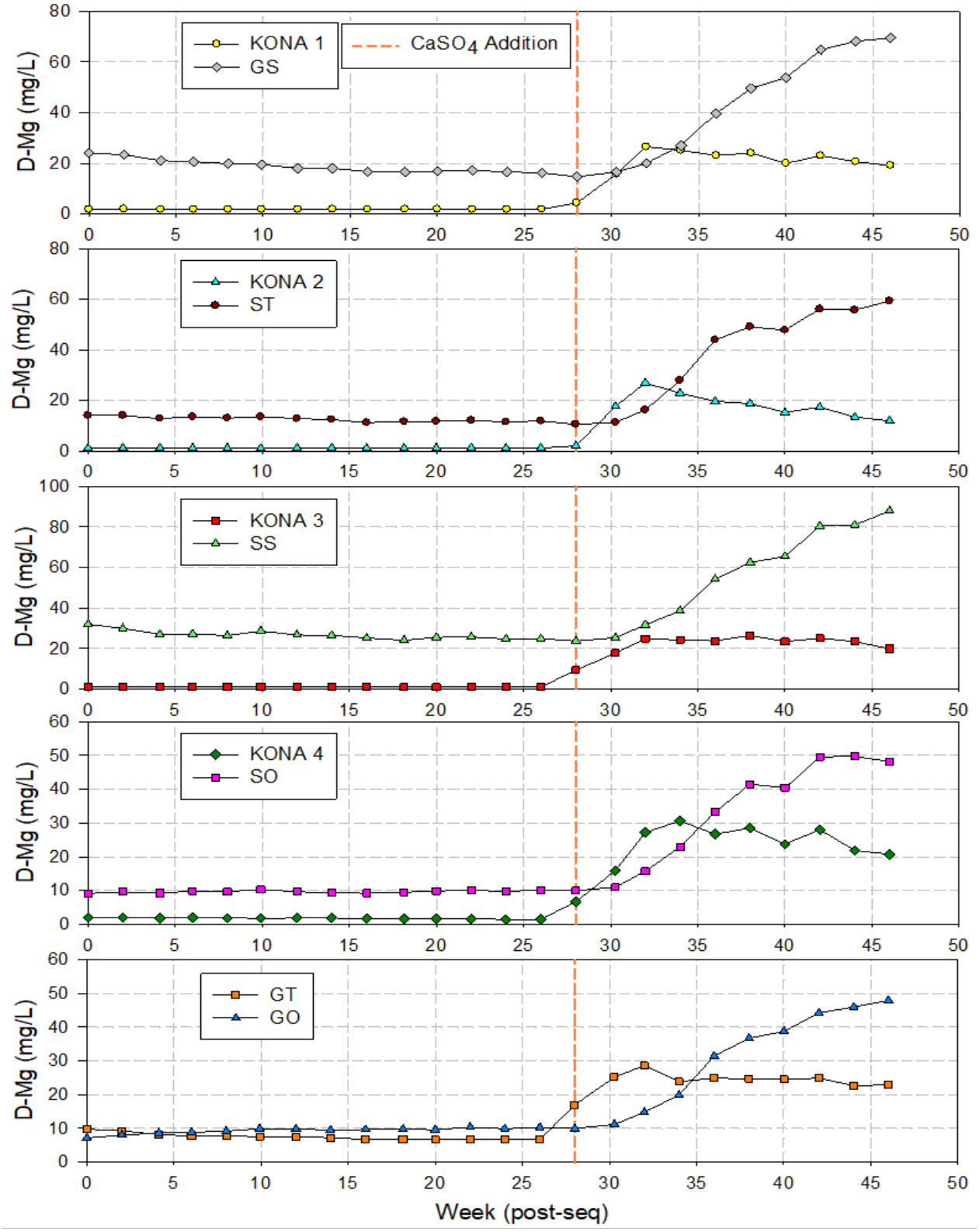

Figure 3-26: Times series profiles of D-Mg in column effluent of sequenced pairs in Phase 2 and 3.

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Saturated Column Report

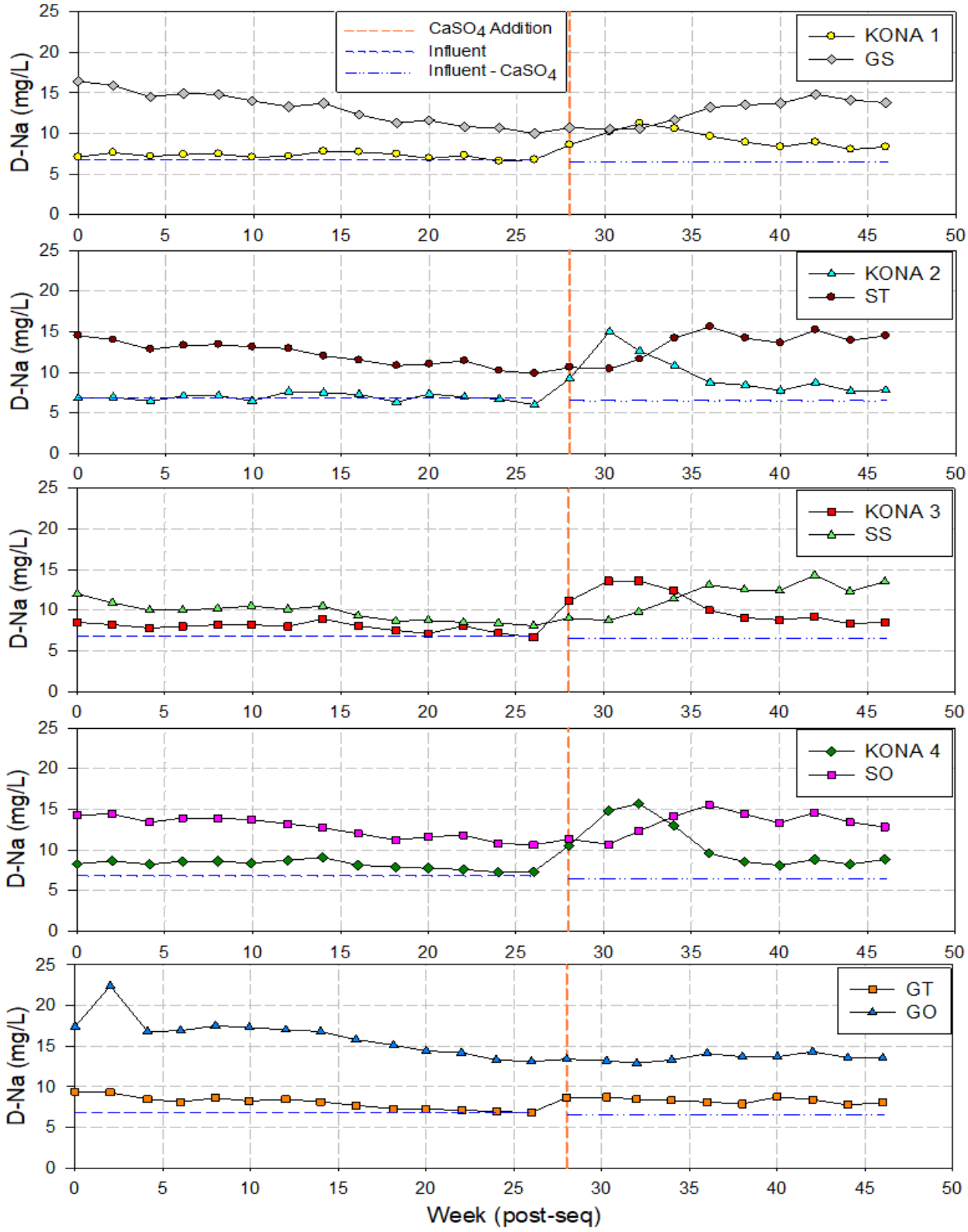

Figure 3-27: Times series profiles of D-Na in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

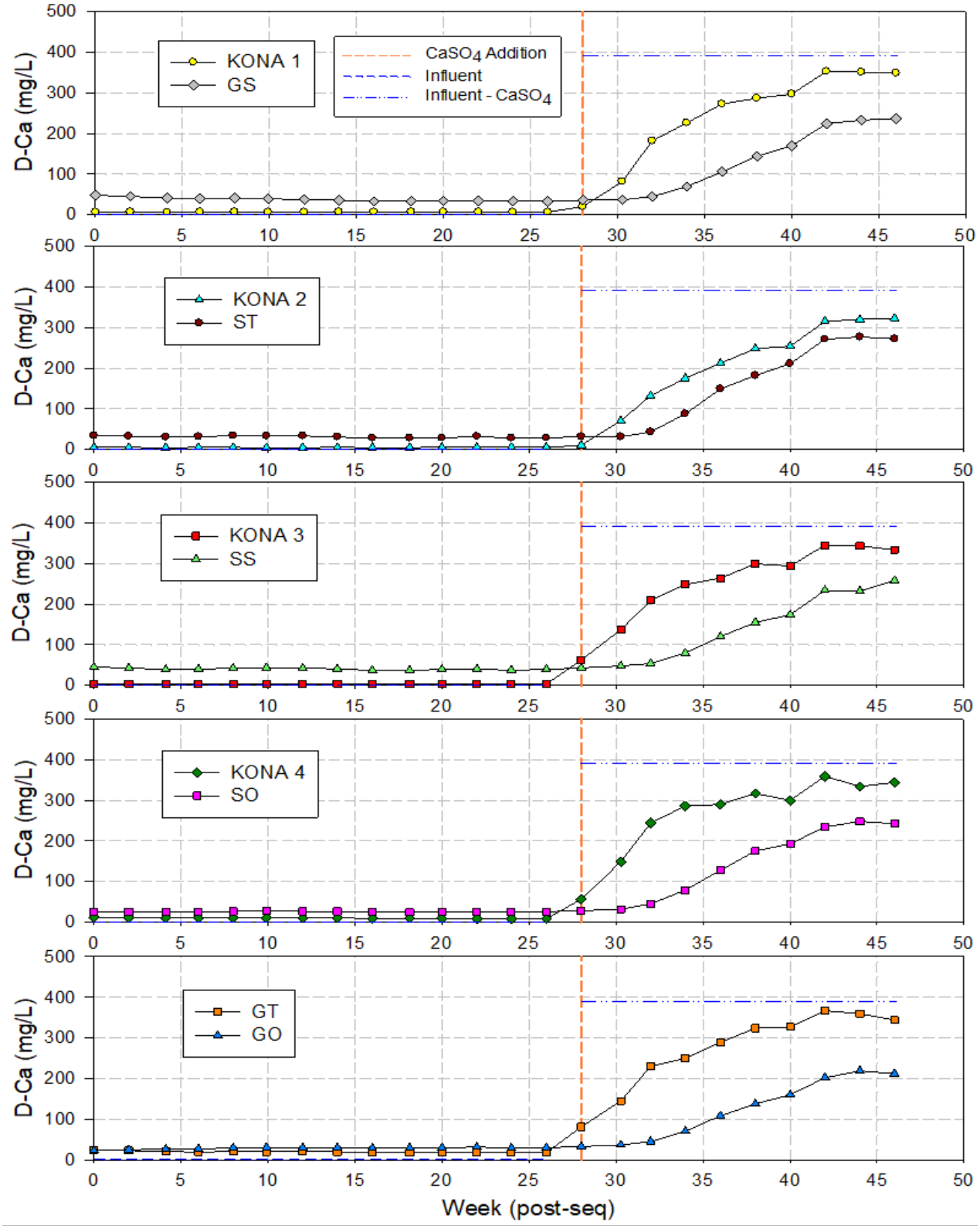

Figure 3-28: Times series profiles of D-Ca in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

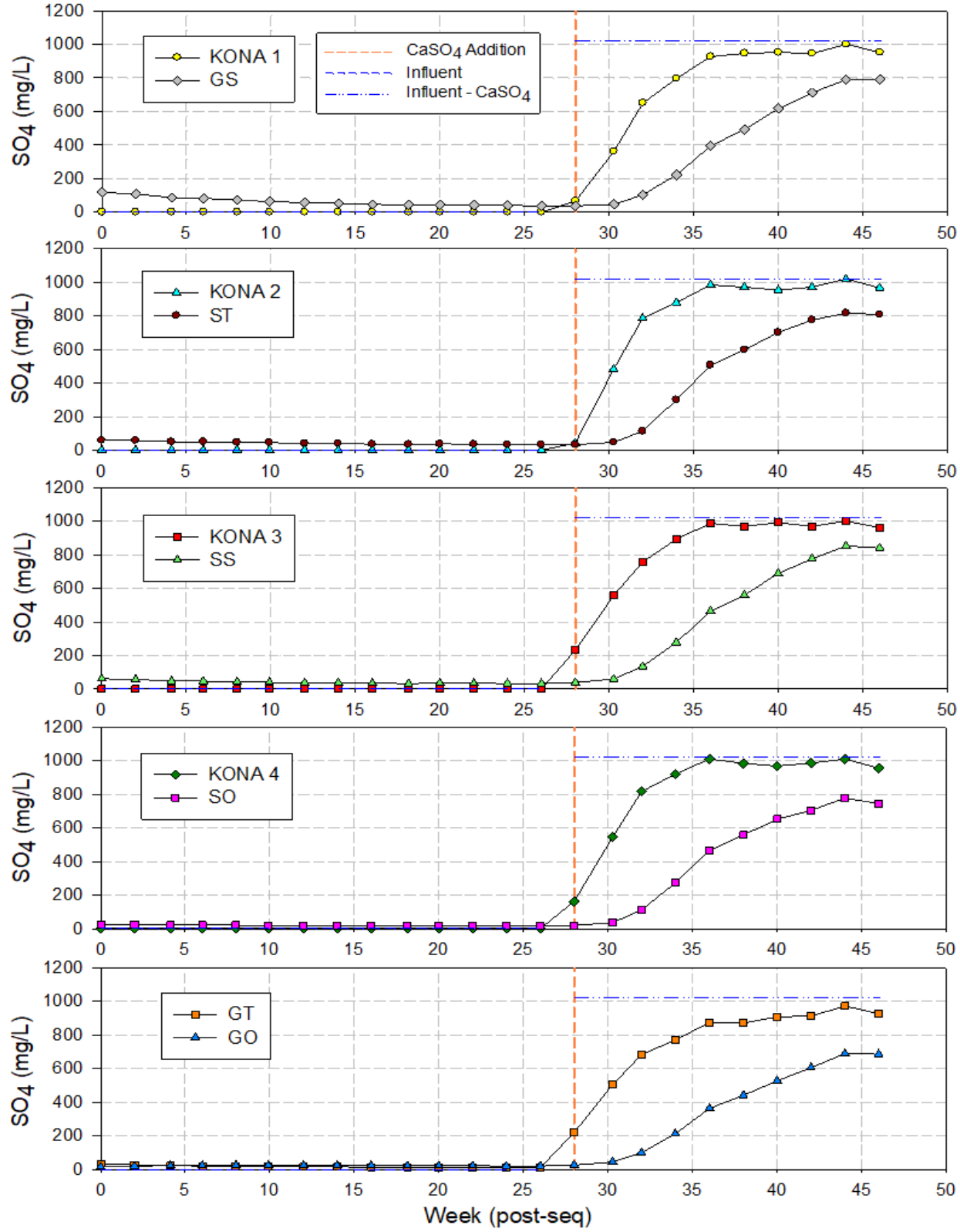

Figure 3-29: Times series profiles of SO_4 in column effluent of sequenced pairs in Phase 2 and 3.

3.4.2.2 Redox Indicators

The primary columns consumed DOC provided in influent to concentrations near or below 1 mg/L. (Figure 3-30). The DOC concentration in secondary column effluent is similar to primary column effluent, indicating the little or no DOC consumption is occurring in secondary columns.

Consistent with Phase 1, NH_3 remains the dominant nitrogen species in column leachates. In most columns, NH_3 concentrations decline in the secondary columns relative to primary column effluent (Figure 3-31). This indicates that some NH_3 may be attenuated in secondary columns. The observed decline is not accompanied by any increase in other nitrogen species (NO_2 or NO_3), indicating that this parameter is likely being attenuated by surface sorption.

Initiation of Phase 3 correlates to an increase in Mn and Fe concentrations in primary columns. This may be related to increased flow rate resulting in higher loading of DOC to primary columns, which could stimulate microbial activity. Release these metals may also be attributed to cation exchange reactions, with Ca^{2+} provided in Phase 3 influent displacing Mn^{2+} and Fe^{2+} from mineral surfaces.

Manganese and Fe attenuation in secondary leachates can be observed in all column pairings (Figure 3-32). In SO and GO leachates, Mn concentrations near the end of Phase 2 approach detection limit values (< 0.00005 mg/L). Similarly, Fe attenuation to near MDL occurs in all secondary leachates. Initiation of Phase 3 results in increased Fe and Mn concentrations in secondary columns; however, the concentrations remain lower than primary column effluent. Speciation in PHREEQC indicates that this attenuation cannot be attributed to secondary mineral solubility constraints. This suggest that Mn and Fe may be attenuated via surface complexation.

Dissolved sulphide concentrations remain below detection limit in Phase 2 and 3 of the column experiments. However, the appearance of a black precipitate on granite and gneiss columns (Figure 3-1, Figure 3-2 and Figure 3-3), indicates that sulphate reducing conditions may have been achieved in these columns.

Appendix C

Saturated Column Report

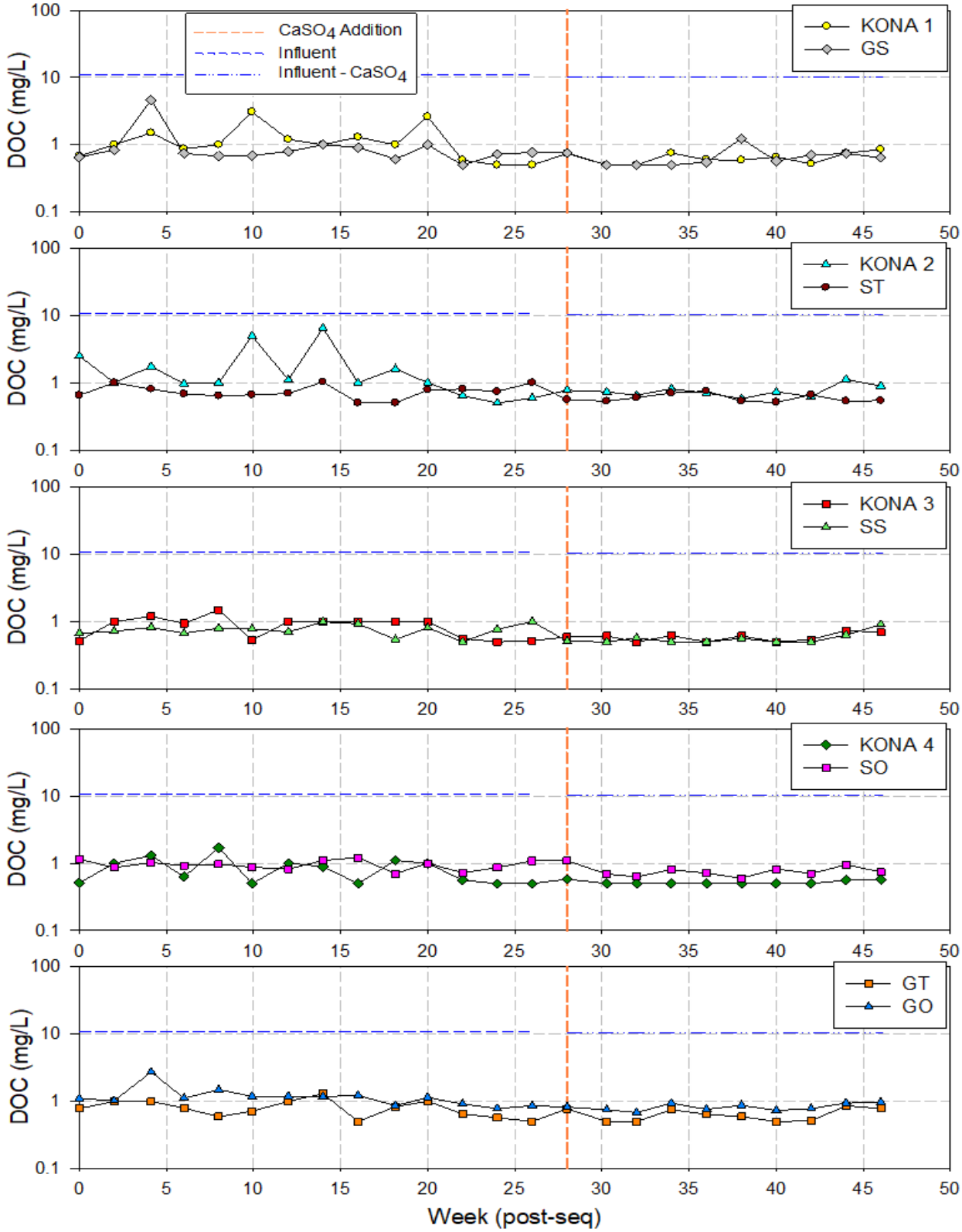

Figure 3-30: Times series profiles of DOC in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

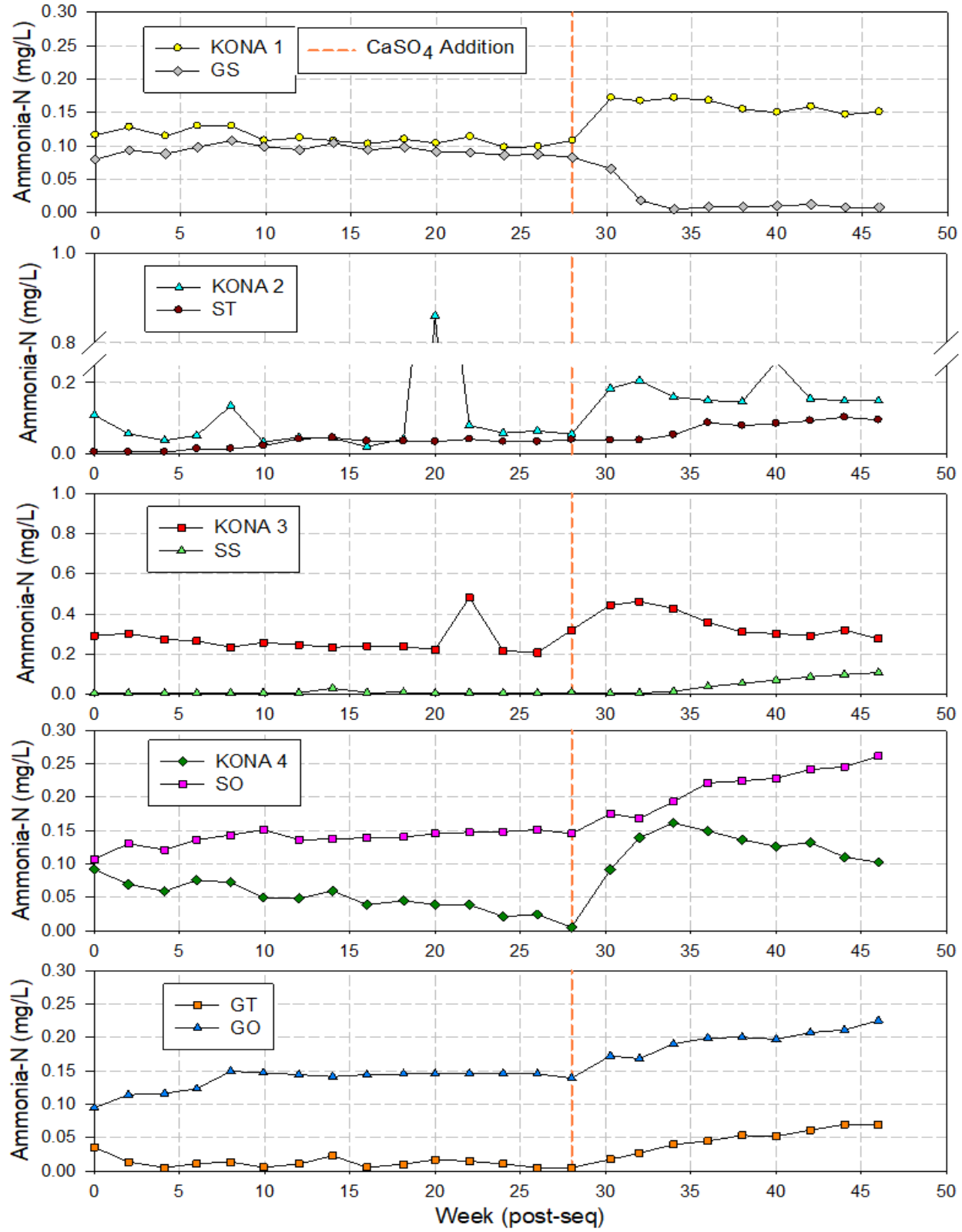

Figure 3-31: Times series profiles of Ammonia-N in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

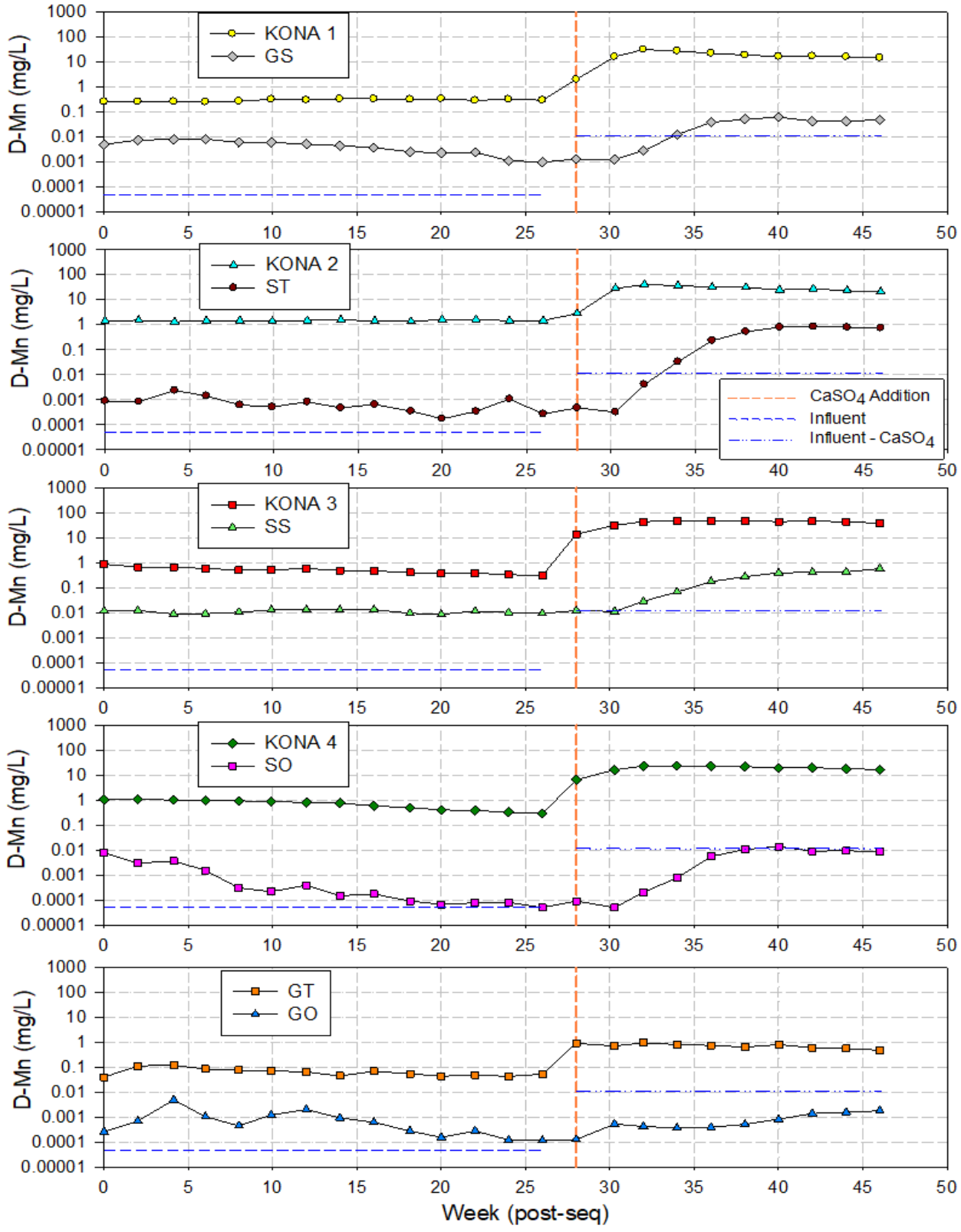

Figure 3-32: Times series profiles of D-Mn in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

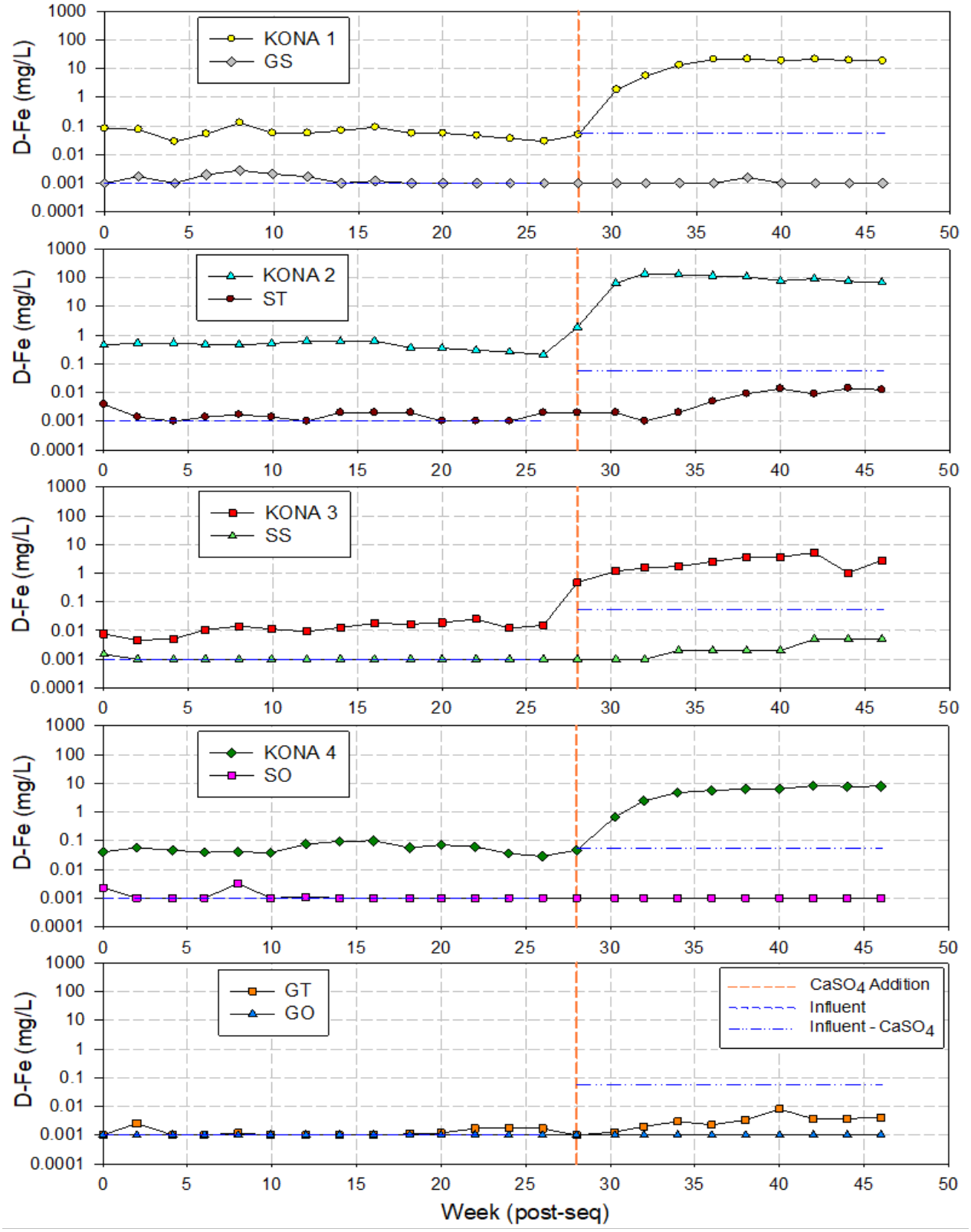

Figure 3-33: Times series profiles of D-Fe in column effluent of sequenced pairs in Phase 2 and 3.

3.4.2.3 Trace Elements

Primary column trace metal trends observed in Phase 2 could generally be characterized as a continuation of what was observed in Phase 1. The secondary columns produced more varied results (Figure 3-34 through Figure 3-41). Arsenic concentrations showed pronounced attenuation in all secondary columns (Figure 3-34). Antimony was attenuated in the ST column and showed evidence of minor attenuation in the SS and GO columns (Figure 3-35). Both U and Mo concentrations in secondary columns were unaffected by sequencing, producing similar concentrations as observed in Phase 1.

Phase 3 prompted a significant change in trace metal concentrations in both secondary and primary columns. Arsenic concentrations declined in all columns in Phase 3, with the exception of Kona 2 and Kona 1. Antimony concentrations decreased in all columns through Phase 3; however, Sb attenuation was no longer observed in the SS and GO columns. All columns showed a decline in Mo concentrations; however, secondary columns showed an increase in remobilisation of U in Phase 3, suggesting that $CaSO_4$ addition to column influent promotes U release.

The release of some metals was enhanced in Phase 3 of the experiment. Specifically, Cd and Zn mobilization occurred in Kona columns, while Co and Ni release was observed in Kona columns and GT. These metals continued to be attenuated in secondary columns throughout Phase 3 of the experiment.

Appendix C

Saturated Column Report

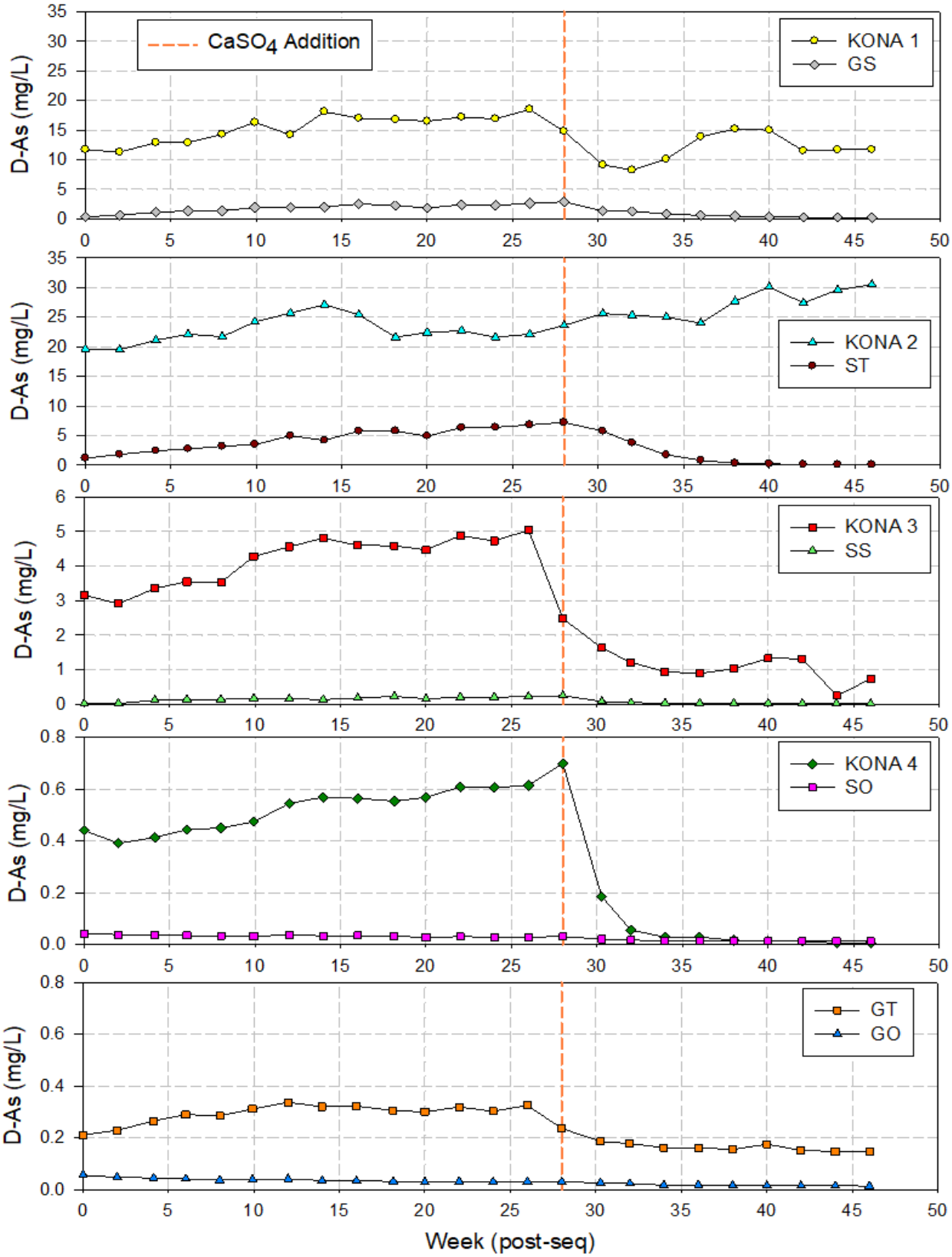

Figure 3-34: Times series profiles of D-As in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

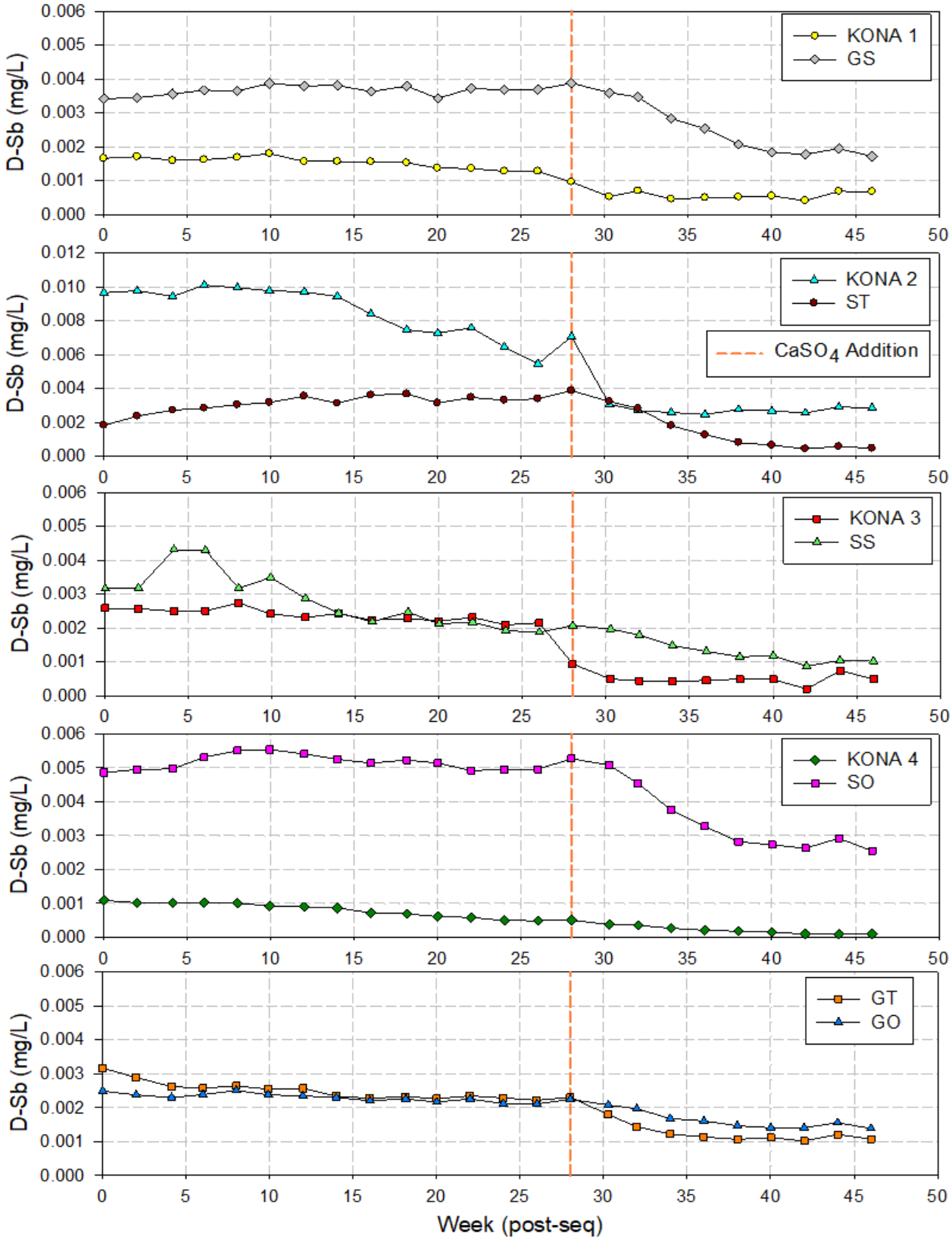

Figure 3-35**: Times series profiles of D-Sb in column effluent of sequenced pairs in Phase 2 and 3.**

Appendix C

Saturated Column Report

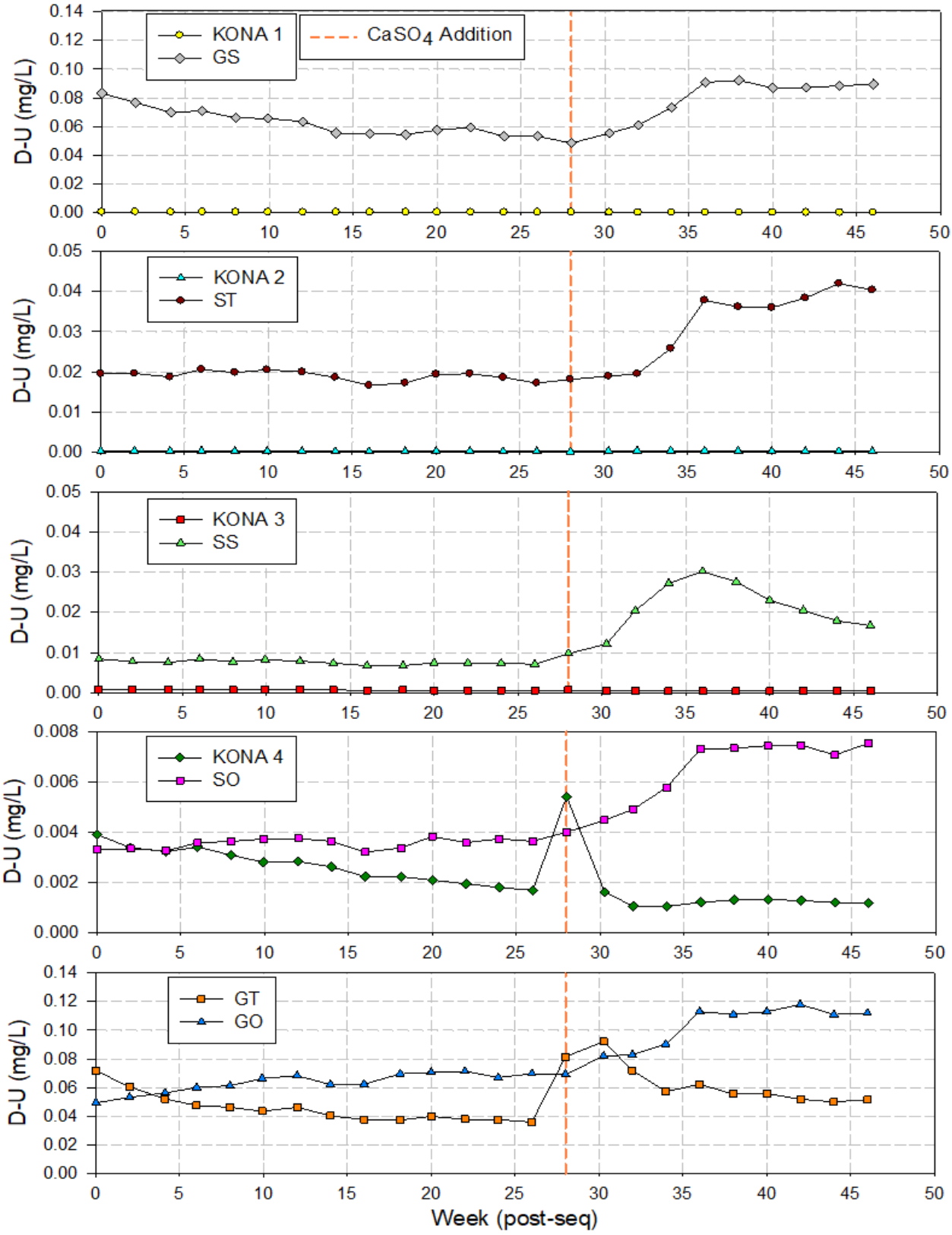

Figure 3-36: Times series profiles of D-U in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

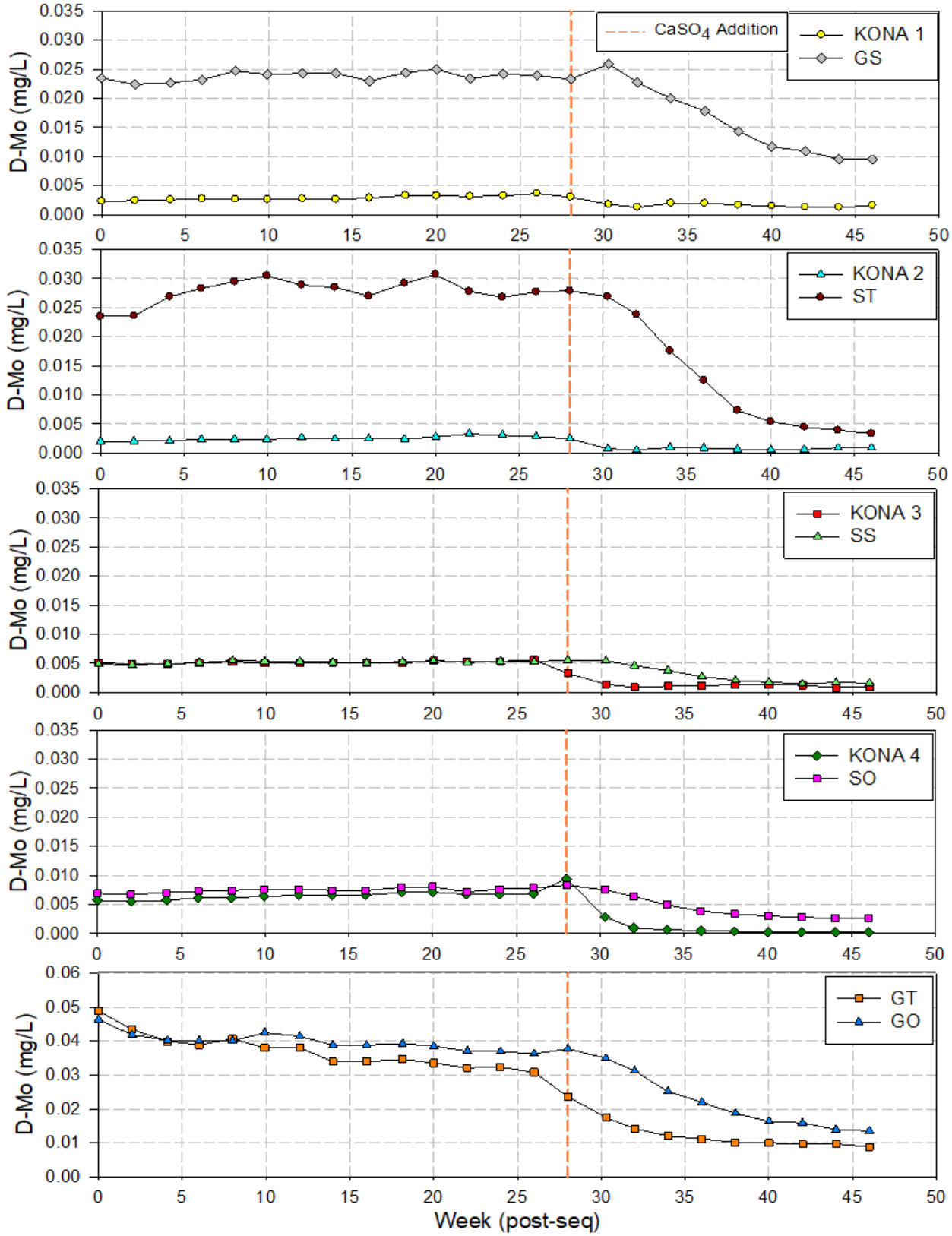

Figure 3-37: Times series profiles of D-Mo in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

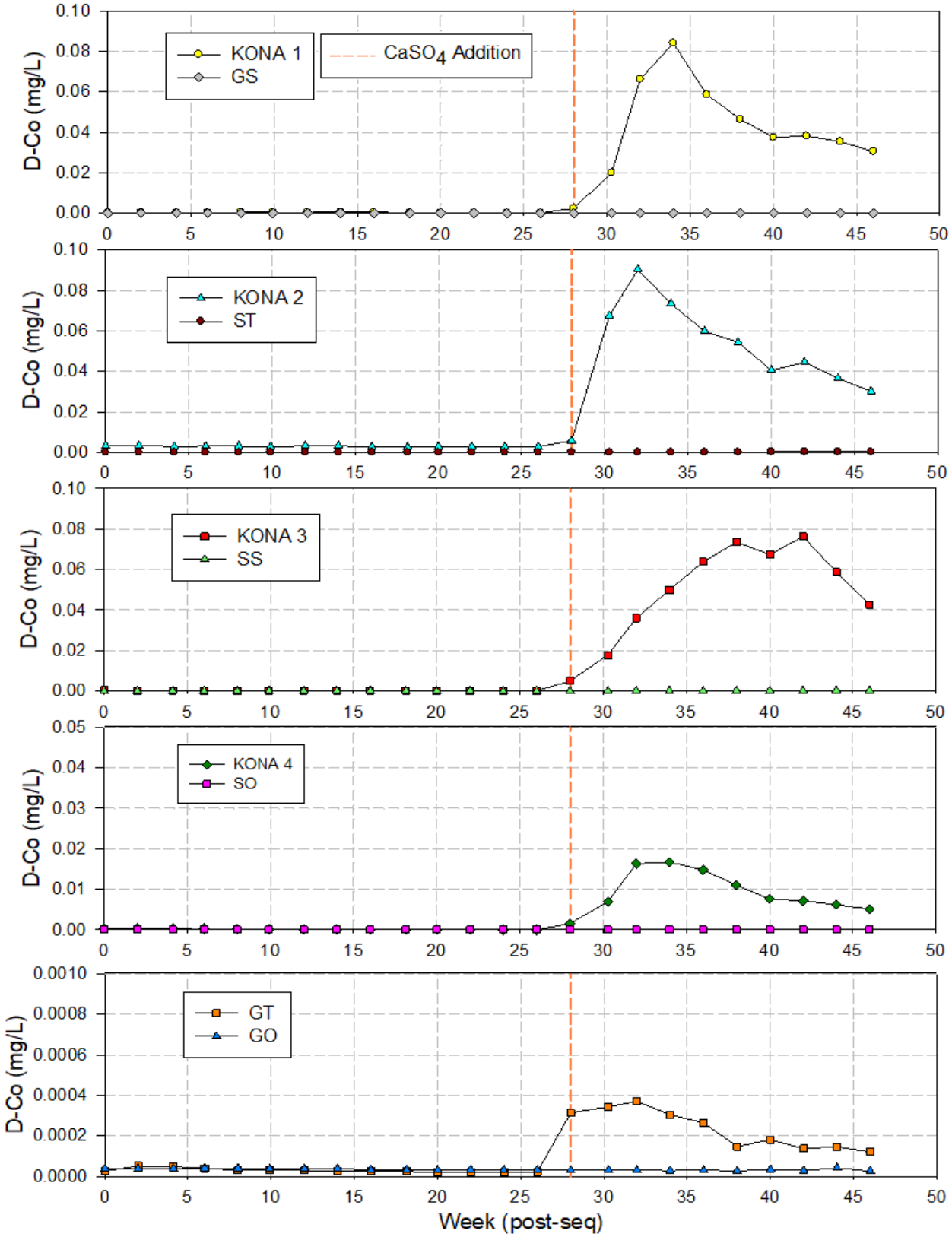

Figure 3-38: Times series profiles of D-Co in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

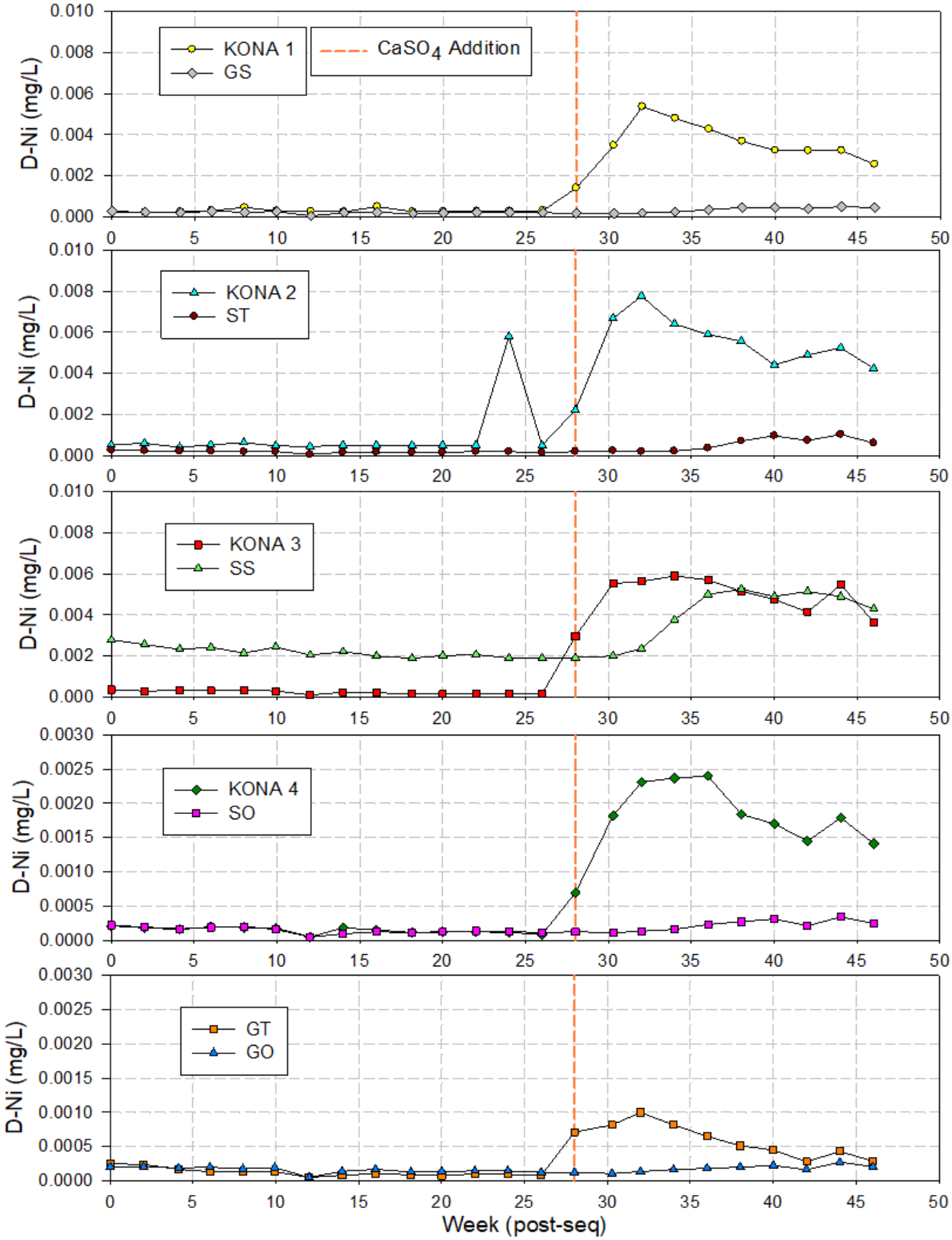

Figure 3-39: Times series profiles of D-Ni in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

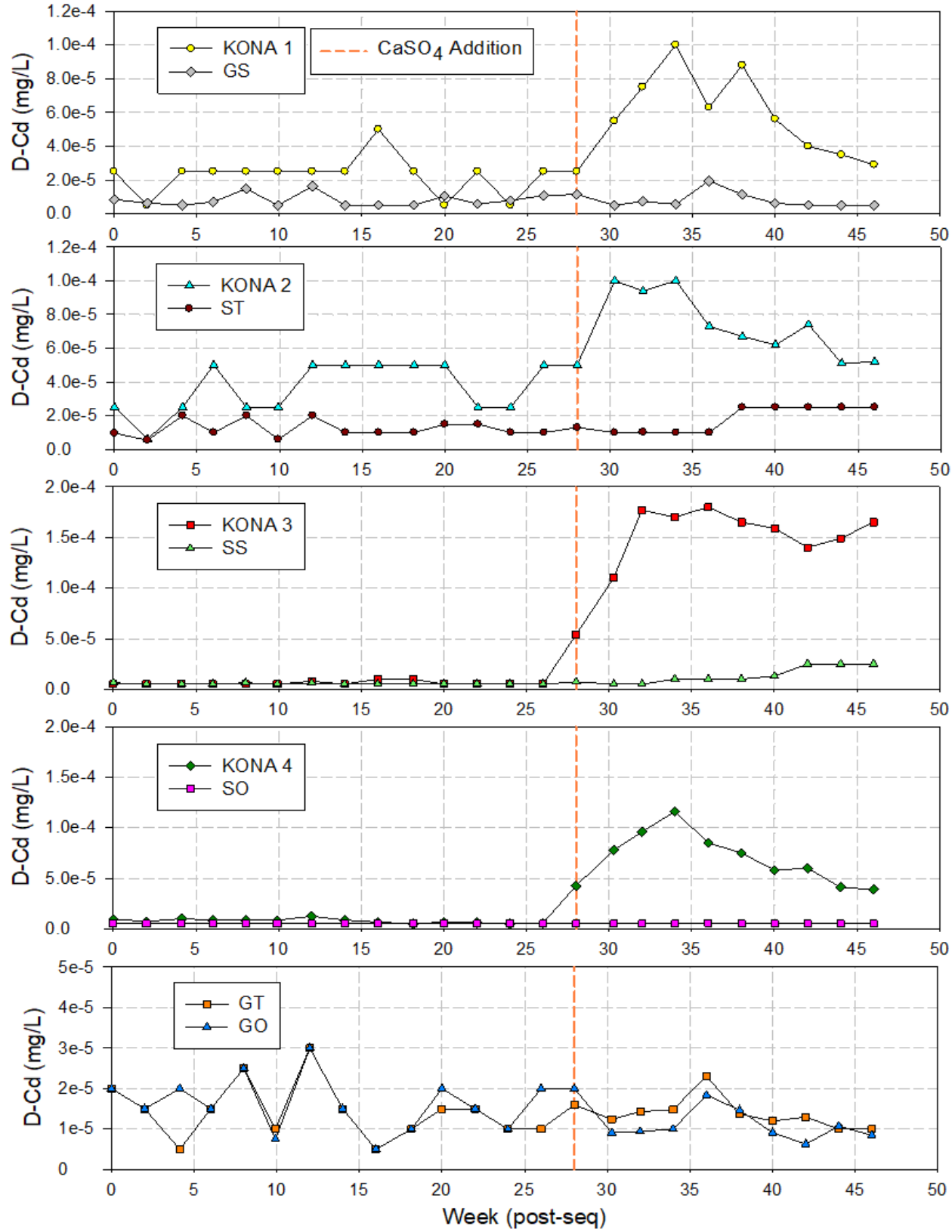

Figure 3-40: Times series profiles of D-Cd in column effluent of sequenced pairs in Phase 2 and 3.

Appendix C

Saturated Column Report

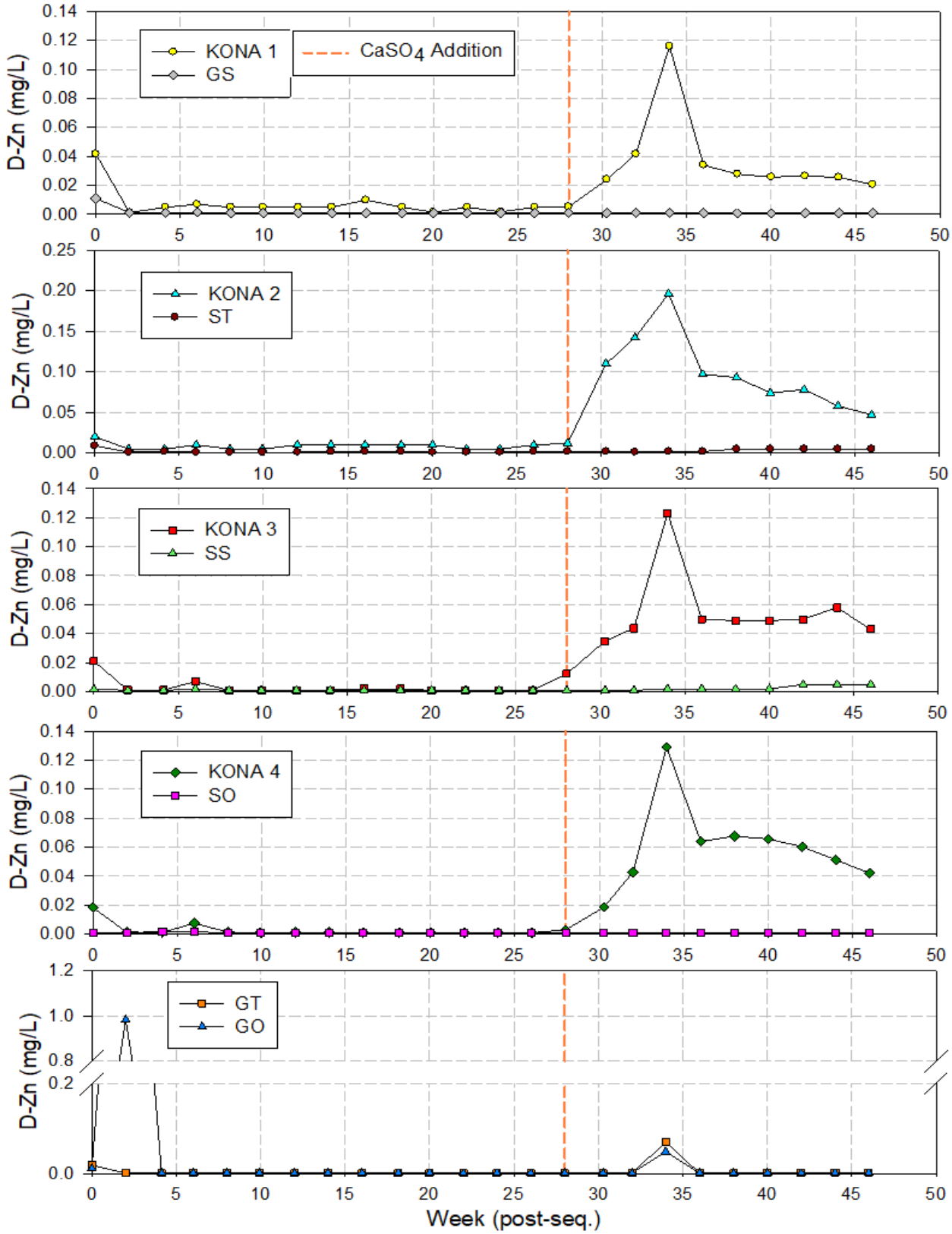

Figure 3-41**: Times series profiles of D-Zn in column effluent of sequenced pairs in Phase 2 and 3.**

3.4.2.4 Arsenic Behaviour

Saturated column results clearly demonstrate non-conservative behaviour of Arsenic. In Phase 2, As is shown to be strongly attenuated in secondary columns (Figure 3-34). Following $CaSO_4$ addition in Phase 3, As concentrations decline substantially in primary and secondary leachates. The attenuation observed in Phase 2 indicate that the solubility controls impacting As concentrations are not significantly impacted when columns are sequenced.

The variety of mechanisms can result in As attenuation and release in saturated columns, as discussed in section 3.4.1.4. The Phase 1 results suggest that As release is being influenced by competition with PO_4 for Fe-oxide sorption sites, as indicated by a strong relationship between PO_4 and As column effluent. Phase 2 and Phase 3 column show a continuation of this relationship, in that a strong correlation between PO_4 on As exists in all secondary columns (Figure 3-42). The decline in As concentrations in Phase 3 can be attributed to a Ca concentrations leading to a decline in PO_4 solubility. That is, Ca is a component ion of apatite [$Ca_5(PO_4)_3(Cl,F,OH)$], hence, declines in Ca concentration can lead to increased apatite dissolution.

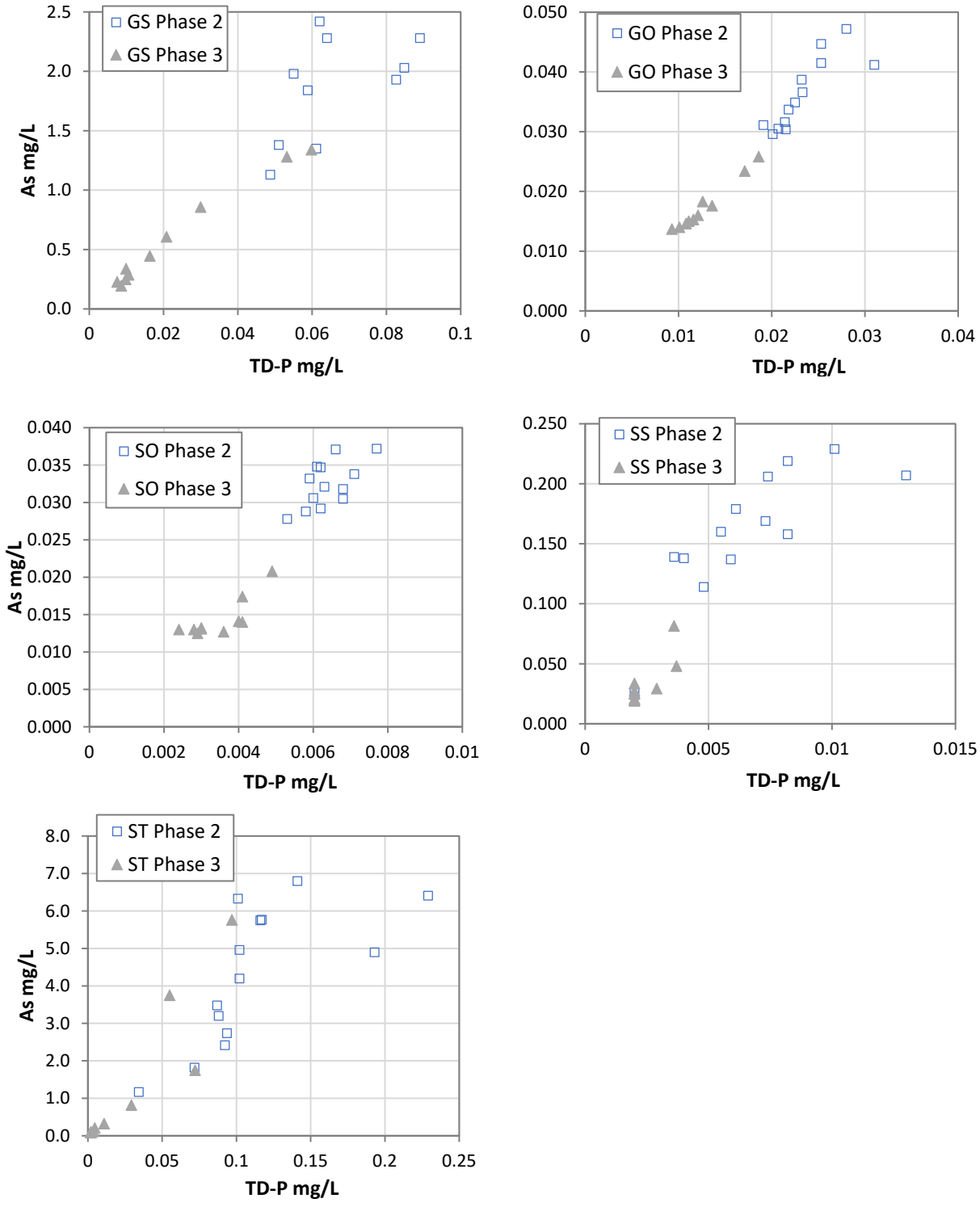

Figure 3-42: Regression of As and TD-P concentrations in secondary columns during Phase 2 and Phase 3 of column experiment.

4 Summary

The saturated column tests were initiated to examine geochemical behaviour and metal mobility in mine waste stored in saturated conditions. The most salient results of the column study with respect to this objective are as follows:

- Most metals concentrations decline during the column experiments, consistent with inhibition of sulphide oxidation, flushing of soluble oxides and rinsing of surface-bound species.
- Uranium concentrations produced by saturated columns are significantly lower than what is observed in unsatruated kinetic tests using the same rock samples.
- Arsenic is unique, in that concentrations increased over the initial phases of the column experiment, and saturated columns produced higher As concentrations then equivalent unsaturated kinetic tests.
- The most significant increase in As concentrations between unsaturated and saturated conditions occurred in granite columns, where saturated columns produced concentrations that were more than 10x those observed in unsaturated kinetic tests.
- Sequencing columns demonstrated that As does not behave conservatively, with significant attenuation occuring in secondary columns receiving effluent from primary columns.
- Addition of $CaSO_4$ in Phase 3 of the experiment corresponds to a significant declines in As concentrations in both primary and secondary columns. This result shows that pore water containing elevated SO_4 and Ca concentrations, which would be typical of waste rock drainage, will inhibit As release and mobility from saturated mine waste.
- A variety of mechanisms can drive As leaching under saturated conditions. Column results indicate that competetive ion exchange with PO_4 as being the most significant process, although other mechanisms (e.g., reduction of As(V) to As(III)) may also be occuring. This mechanism indicates that any process that will modify PO_4 solubility will impact As release.
- The primary source of PO_4 in geologic materials is apatite minerals. Apatite mineral solubility is sensitive to pH and concentratoins of component ions (e.g., Ca). Phase 3 column results show that spiking column influent with Ca reduced apatite solubility, resulting a significant decrease in both PO_4 and As concentratoins in column effluent.

5 Closure

6 References

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Appendix A: Influent and Effluent Results for Saturated Column Experiment

GOLDCORP

APPENDIX A1: INFLUENT RESULTS FOR SATURATED COLUMN EXPERIMENT

Appendix A1: Influent Results for Saturated Column Experiment

			pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**
KONA_INFLUENT	L1977048-5	8/17/2017 12:25	5.86	24.82	13	10.8	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	*< 0.3*	*< 0.0015*	*< 0.05*	*< 0.5*	*< 0.02*
KONA_INFLUENT	L1992087-5	9/14/2017 14:55				10.4									
KONA_INFLUENT	L2007130-5	10/13/2017 11:25	5.76	22.21	15	9.72									
KONA_INFLUENT	L2020126-5	11/8/2017 12:30				9.46									
KONA_INFLUENT	L2032657-2	12/7/2017 11:30				10.9									
KONA_INFLUENT	L2041649-11	1/4/2018 13:05				10.7									
KONA_INFLUENT	L2052061-11	2/1/2018 12:10				11.4									
KONA_INFLUENT	L2063289-1	3/2/2018				10.5									
KONA_INFLUENT	L2074311-11	3/29/2018 12:15				11.1									
KONA_INFLUENT	L2085708-12	4/26/2018 14:00				10.1									
KONA_INFLUENT	L2100224-12	5/24/2018 14:00				10.3									
KONA_INFLUENT	L2116986-11	6/21/2018 14:00				9.97									
KONA_INFLUENT	L2132784-11	7/19/2018 14:45				10.0									
KONA_INFLUENT	L2148482-11	8/16/2018				9.99									
KONA_INFLUENT	L2164110-11	9/14/2018 10:00				10.2									
KONA_INFLUENT	L2180431-11	10/12/2018 14:10				9.67									
KONA_INFLUENT	L2194529-11	11/8/2018 14:10				10.3									
KONA_INFLUENT	L2207335-11	12/6/2018 13:05				10.7									
KONA_INFLUENT-CaSO4	L2208989-1	12/11/2018 14:50	6.43	1234	23	10.5	*< 0.005*	*< 0.005*	*< 0.025*	0.0051	699	*< 0.0015*	*< 0.25*	*< 2.5*	*< 0.1*
KONA_INFLUENT-CaSO4	L2217203-11	1/5/2019 11:35	6.43	1619	21	10.2	*< 0.005*	*< 0.005*	*< 0.025*	0.0099	1010	*< 0.01*	*< 0.25*	*< 2.5*	*< 0.1*
KONA_INFLUENT-CaSO4	L2227544-11	1/31/2019 10:30	6.3	1629	17	10.1		*< 0.01*	*< 0.05*		962		*< 0.5*	*< 5*	4.72
KONA_INFLUENT-CaSO4	L2233141-11	2/14/2019 14:20	6.38	1625	24	10.4	*< 0.005*	*< 0.01*	*< 0.05*	0.0119	1030	*< 0.0015*	*< 0.5*	*< 5*	*< 0.2*
KONA_INFLUENT-CaSO4	L2238565-11	2/28/2019 15:15	6.59	1628	22	10.1		*< 0.005*	*< 0.025*		988		*< 0.25*	*< 2.5*	*< 0.1*
KONA_INFLUENT-CaSO4	L2250817-11	3/28/2019 15:00	6.71	1639	18	10.7		*< 0.005*	*< 0.025*		968		*< 0.25*	*< 2.5*	*< 0.1*
KONA_INFLUENT-CaSO4	L2263301-11	4/25/2019 14:45	6.96	1666	18	10.6		*< 0.005*	*< 0.025*		957		0.28	*< 2.5*	*< 0.1*

Notes:
Results in blue italics are below the indicated detection limit

Appendix A1: Influent Results for Saturated Column Experiment

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**	**D-Cu**
KONA_INFLUENT	L1977048-5	8/17/2017 12:25	*< 0.000005*	0.00056	*< 0.00002*	*< 0.01*	0.000047	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*	*< 0.0001*
KONA_INFLUENT	L1992087-5	9/14/2017 14:55													
KONA_INFLUENT	L2007130-5	10/13/2017 11:25													
KONA_INFLUENT	L2020126-5	11/8/2017 12:30													
KONA_INFLUENT	L2032657-2	12/7/2017 11:30													
KONA_INFLUENT	L2041649-11	1/4/2018 13:05													
KONA_INFLUENT	L2052061-11	2/1/2018 12:10													
KONA_INFLUENT	L2063289-1	3/2/2018													
KONA_INFLUENT	L2074311-11	3/29/2018 12:15													
KONA_INFLUENT	L2085708-12	4/26/2018 14:00													
KONA_INFLUENT	L2100224-12	5/24/2018 14:00													
KONA_INFLUENT	L2116986-11	6/21/2018 14:00													
KONA_INFLUENT	L2132784-11	7/19/2018 14:45													
KONA_INFLUENT	L2148482-11	8/16/2018													
KONA_INFLUENT	L2164110-11	9/14/2018 10:00													
KONA_INFLUENT	L2180431-11	10/12/2018 14:10													
KONA_INFLUENT	L2194529-11	11/8/2018 14:10													
KONA_INFLUENT	L2207335-11	12/6/2018 13:05													
KONA_INFLUENT-CaSO4	L2208989-1	12/11/2018 14:50	*< 0.00001*	0.0728	0.000059	*< 0.02*	0.00225	*< 0.00002*	*< 0.00001*	271	*< 0.00001*	0.000054	*< 0.0002*	*< 0.00002*	0.00070
KONA_INFLUENT-CaSO4	L2217203-11	1/5/2019 11:35	*< 0.00001*	0.114	0.000096	*< 0.02*	0.00694	*< 0.00002*	*< 0.00001*	386	*< 0.00001*	0.000058	*< 0.0002*	*< 0.00002*	0.00144
KONA_INFLUENT-CaSO4	L2227544-11	1/31/2019 10:30	*< 0.00001*	0.380	0.000100	*< 0.02*	0.00637	0.000021	*< 0.00001*	368	*< 0.00001*	0.000177	0.00044	0.000032	0.00501
KONA_INFLUENT-CaSO4	L2233141-11	2/14/2019 14:20	*< 0.00001*	0.181	0.000066	*< 0.02*	0.0115	*< 0.00002*	*< 0.00001*	395	*< 0.00001*	0.000105	0.00028	*< 0.00002*	0.00253
KONA_INFLUENT-CaSO4	L2238565-11	2/28/2019 15:15	*< 0.00001*	0.135	0.000108	*< 0.02*	0.0151	*< 0.00002*	*< 0.00001*	404	*< 0.00001*	0.000080	*< 0.0002*	*< 0.00002*	0.00307
KONA_INFLUENT-CaSO4	L2250817-11	3/28/2019 15:00	*< 0.00001*	0.137	0.000082	*< 0.02*	0.0167	*< 0.00002*	*< 0.00001*	420	*< 0.00001*	0.000069	0.00021	*< 0.00002*	0.00426
KONA_INFLUENT-CaSO4	L2263301-11	4/25/2019 14:45	*< 0.00001*	0.454	0.000144	*< 0.02*	0.0165	*< 0.00002*	*< 0.00001*	417	*< 0.00001*	0.000227	0.00049	0.000034	0.0200

Notes:
Results in blue italics are below the indicated detection limit

Appendix A1: Influent Results for Saturated Column Experiment

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**
KONA_INFLUENT	L1977048-5	8/17/2017 12:25	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	*< 0.005*	*< 0.00005*	*< 0.00005*	6.79	*< 0.00005*	*< 0.05*	0.0000071	*< 0.0002*	*< 0.00002*	*< 0.5*
KONA_INFLUENT	L1992087-5	9/14/2017 14:55														
KONA_INFLUENT	L2007130-5	10/13/2017 11:25														
KONA_INFLUENT	L2020126-5	11/8/2017 12:30														
KONA_INFLUENT	L2032657-2	12/7/2017 11:30														
KONA_INFLUENT	L2041649-11	1/4/2018 13:05														
KONA_INFLUENT	L2052061-11	2/1/2018 12:10														
KONA_INFLUENT	L2063289-1	3/2/2018														
KONA_INFLUENT	L2074311-11	3/29/2018 12:15														
KONA_INFLUENT	L2085708-12	4/26/2018 14:00														
KONA_INFLUENT	L2100224-12	5/24/2018 14:00														
KONA_INFLUENT	L2116986-11	6/21/2018 14:00														
KONA_INFLUENT	L2132784-11	7/19/2018 14:45														
KONA_INFLUENT	L2148482-11	8/16/2018														
KONA_INFLUENT	L2164110-11	9/14/2018 10:00														
KONA_INFLUENT	L2180431-11	10/12/2018 14:10														
KONA_INFLUENT	L2194529-11	11/8/2018 14:10														
KONA_INFLUENT	L2207335-11	12/6/2018 13:05														
KONA_INFLUENT-CaSO4	L2208989-1	12/11/2018 14:50	0.0253		*< 0.1*	*< 0.001*	0.328	0.00330	*< 0.0001*	6.36	0.00012	*< 0.1*	0.000070	*< 0.0004*	*< 0.00004*	265
KONA_INFLUENT-CaSO4	L2217203-11	1/5/2019 11:35	0.0397		*< 0.1*	0.0013	0.485	0.00746	*< 0.0001*	5.96	*< 0.0001*	*< 0.1*	0.000104	*< 0.0004*	*< 0.00004*	343
KONA_INFLUENT-CaSO4	L2227544-11	1/31/2019 10:30	0.145		*< 0.1*	0.0012	0.919	0.0125	*< 0.0001*	6.24	0.00040	*< 0.1*	0.000293	0.00044	*< 0.00004*	327
KONA_INFLUENT-CaSO4	L2233141-11	2/14/2019 14:20	0.0708		*< 0.1*	0.0014	0.712	0.0154	*< 0.0001*	7.03	0.00020	*< 0.1*	0.000133	*< 0.0004*	*< 0.00004*	357
KONA_INFLUENT-CaSO4	L2238565-11	2/28/2019 15:15	0.0598		*< 0.1*	0.0012	0.681	0.0197	*< 0.0001*	6.14	0.00016	*< 0.1*	0.000123	*< 0.0004*	*< 0.00004*	340
KONA_INFLUENT-CaSO4	L2250817-11	3/28/2019 15:00	0.0507		*< 0.1*	0.0012	0.750	0.0248	*< 0.0001*	7.09	*< 0.0001*	*< 0.1*	0.000119	*< 0.0004*	*< 0.00004*	385
KONA_INFLUENT-CaSO4	L2263301-11	4/25/2019 14:45	0.180		*< 0.1*	0.0015	1.49	0.0661	*< 0.0001*	7.14	0.00049	*< 0.1*	0.000489	0.00043	*< 0.00004*	362

Notes:
Results in blue italics are below the indicated detection limit

Appendix A1: Influent Results for Saturated Column Experiment

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
KONA_INFLUENT	L1977048-5	8/17/2017 12:25	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_INFLUENT	L1992087-5	9/14/2017 14:55													
KONA_INFLUENT	L2007130-5	10/13/2017 11:25													
KONA_INFLUENT	L2020126-5	11/8/2017 12:30													
KONA_INFLUENT	L2032657-2	12/7/2017 11:30													
KONA_INFLUENT	L2041649-11	1/4/2018 13:05													
KONA_INFLUENT	L2052061-11	2/1/2018 12:10													
KONA_INFLUENT	L2063289-1	3/2/2018													
KONA_INFLUENT	L2074311-11	3/29/2018 12:15													
KONA_INFLUENT	L2085708-12	4/26/2018 14:00													
KONA_INFLUENT	L2100224-12	5/24/2018 14:00													
KONA_INFLUENT	L2116986-11	6/21/2018 14:00													
KONA_INFLUENT	L2132784-11	7/19/2018 14:45													
KONA_INFLUENT	L2148482-11	8/16/2018													
KONA_INFLUENT	L2164110-11	9/14/2018 10:00													
KONA_INFLUENT	L2180431-11	10/12/2018 14:10													
KONA_INFLUENT	L2194529-11	11/8/2018 14:10													
KONA_INFLUENT	L2207335-11	12/6/2018 13:05													
KONA_INFLUENT-CaSO4	L2208989-1	12/11/2018 14:50	*< 0.00008*	0.17	*< 0.00002*	0.737	*< 0.0004*	*< 0.0002*	0.00125	*< 0.000004*	0.0000150	0.00018	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_INFLUENT-CaSO4	L2217203-11	1/5/2019 11:35	*< 0.00008*	0.27	*< 0.00002*	1.63	*< 0.0004*	*< 0.0002*	*< 0.0006*	*< 0.000004*	0.0000281	0.00023	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_INFLUENT-CaSO4	L2227544-11	1/31/2019 10:30	0.000109	0.84	*< 0.00002*	1.35	*< 0.0004*	*< 0.0002*	*< 0.0057*	*< 0.000004*	0.0000601	0.00049	*< 0.0002*	0.0446	0.00019
KONA_INFLUENT-CaSO4	L2233141-11	2/14/2019 14:20	*< 0.00008*	0.42	*< 0.00002*	2.29	*< 0.0004*	*< 0.0002*	0.00231	*< 0.000004*	0.0000378	0.00037	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_INFLUENT-CaSO4	L2238565-11	2/28/2019 15:15	0.000082	0.31	*< 0.00002*	2.80	*< 0.0004*	*< 0.0002*	*< 0.0012*	0.0000070	0.0000384	0.00028	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_INFLUENT-CaSO4	L2250817-11	3/28/2019 15:00	*< 0.00008*	0.34	*< 0.00002*	2.80	*< 0.0004*	*< 0.0002*	*< 0.0018*	*< 0.000004*	0.0000292	0.00029	*< 0.0002*	0.0020	*< 0.00012*
KONA_INFLUENT-CaSO4	L2263301-11	4/25/2019 14:45	*< 0.00008*	0.63	*< 0.00002*	2.75	*< 0.0004*	*< 0.0002*	0.00278	0.0000049	0.0000935	0.00061	*< 0.0002*	0.0026	0.00014

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX A2: GRANITE COLUMN (KONA 1-4) EFFLUENT RESULTS

Appendix A2: Granite Column (Kona 1-4) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**
KONA_1	L1955323-1	7/7/2017 13:00	0	0		561	7.08	124.9	46	1.93	0.117	0.0011	*< 0.005*	0.0228	11.8	*< 0.0015*	*< 0.05*	4.25	0.215	*< 0.000005*	0.00468	1.67	0.077	0.00142	*< 0.00001*	*< 0.000005*	8.66	0.0000097	0.00205	*< 0.0001*
KONA_1	L1969885-1	8/3/2017 13:50	4	4		466	7.03	151.3	57	1.72	0.240	*< 0.001*	*< 0.005*	0.0542	11.8	*< 0.0015*	*< 0.05*	3.91	0.218	*< 0.000005*	0.00242	2.62	0.089	0.00241	0.000017	*< 0.000005*	11.7	0.0000110	0.00313	*< 0.0001*
KONA_1	L1977048-1	8/17/2017 12:25	6	6		684	6.93	121	58	1.16	0.150	*< 0.001*	*< 0.005*	0.0506	6.88	*< 0.0015*	*< 0.05*	2.35	0.182	*< 0.000005*	0.00329	4.10	0.058	0.00190	*< 0.00001*	*< 0.000005*	8.85	0.0000073	0.00260	*< 0.0001*
KONA_1	L1984769-1	8/31/2017 14:00	8	8		627	6.97	119.8	70	0.98	0.192	*< 0.001*	0.0086	0.090	6.26	*< 0.0015*	*< 0.05*	2.16	0.196	*< 0.000005*	0.00560	4.86	0.055	0.00180	*< 0.00001*	0.0000062	8.40	0.0000083	0.00272	*< 0.0001*
KONA_1	L1992087-1	9/14/2017 14:55	10	10		728	7.07	107.9	60	0.78	0.145	*< 0.001*	*< 0.005*	0.119	4.32	*< 0.0015*	*< 0.05*	1.52	0.205	*< 0.000005*	0.00358	5.54	0.044	0.00159	*< 0.00001*	*< 0.000005*	7.47	*< 0.000005*	0.00249	*< 0.0001*
KONA_1	L1999487-1	9/28/2017 11:25	12	12		518	6.92	107.8	59	*< 0.5*	0.150	*< 0.001*	*< 0.005*	0.163	3.59	*< 0.0015*	*< 0.05*	1.38	0.189	*< 0.000005*	0.00435	6.36	0.041	0.00153	*< 0.00001*	*< 0.000005*	8.24	*< 0.000005*	0.00240	*< 0.0001*
KONA_1	L2007130-1	10/13/2017 11:25	14	14		755	6.84	93.7	64	0.53	0.118	*< 0.001*	*< 0.005*	0.155	2.65	*< 0.0015*	*< 0.05*	1.06	0.203	*< 0.000005*	0.00268	7.23	0.033	0.00115	*< 0.00001*	*< 0.000005*	6.61	*< 0.000005*	0.00176	*< 0.0001*
KONA_1	L2014335-1	10/26/2017 11:50	16	16		239	6.89	91.1	53	0.65	0.111	*< 0.001*	*< 0.005*	0.141	2.12	*< 0.0015*	*< 0.05*	0.84	0.210	*< 0.000005*	0.00366	7.36	0.027	0.00102	*< 0.00001*	*< 0.000005*	6.25	*< 0.000005*	0.00133	*< 0.0001*
KONA_1	L2020126-1	11/8/2017 12:30	18	18		550	7.1	90	47	0.53	0.115	*< 0.001*	*< 0.005*	0.212	2.25	*< 0.0015*	*< 0.05*	0.70	0.229	*< 0.000005*	*< 0.003*	8.08	0.028	0.00134	*< 0.00001*	*< 0.000005*	6.63	*< 0.000005*	0.00130	*< 0.0001*
KONA_1	L2026623-1	11/23/2017 14:15	20	20		615	6.94	85.3	49	0.53	0.113	*< 0.001*	*< 0.005*	0.211	1.59	*< 0.0015*	*< 0.05*	0.56	0.215	*< 0.000005*	0.00273	8.20	0.025	0.00117	*< 0.00001*	*< 0.000005*	6.17	*< 0.000005*	0.00114	*< 0.0001*
KONA_1	L2031965-1	12/6/2017 14:05	22	22		532	6.86	89.1	50	0.55	0.116	*< 0.001*	*< 0.005*	0.245	1.42	*< 0.0015*	*< 0.05*	0.68	0.210	*< 0.000005*	0.00266	8.82	0.023	0.00130	*< 0.00001*	*< 0.000005*	6.36	*< 0.000005*	0.00121	*< 0.0001*
KONA_1	L2038563-1	12/21/2017 13:50	24	24		741	6.87	82.3	47	*< 0.5*	0.0808	*< 0.001*	*< 0.005*	0.253	1.06	*< 0.0015*	*< 0.05*	*< 0.5*	0.208	*< 0.000005*	0.00355	8.92	0.022	0.00120	*< 0.00001*	*< 0.000005*	6.06	*< 0.000005*	0.00112	*< 0.0001*
KONA_1	L2041649-1	1/4/2018 13:05	26	26		467	6.92	87.4	50	0.74	0.0446	*< 0.001*	*< 0.005*	0.172	1.10	*< 0.0015*	*< 0.05*	*< 0.5*	0.207	*< 0.000005*	0.00260	8.83	0.020	0.00103	0.000012	*< 0.000005*	6.64	*< 0.000005*	0.00112	*< 0.0001*
KONA_1	L2046871-1	1/18/2018 11:25	28	28		559	6.84	85.9	53	0.51	0.0915	*< 0.001*	*< 0.005*	0.307	1.00	*< 0.0015*	*< 0.05*	*< 0.5*	0.216	*< 0.00001*	0.0038	9.59	0.022	0.000899	*< 0.00002*	*< 0.00001*	6.54	*< 0.00001*	0.000996	*< 0.0002*
KONA_1	L2052061-1	2/1/2018 12:10	30	30		575	6.82	88.1	54	*< 0.5*	0.112	*< 0.001*	*< 0.005*	0.26	1.10	*< 0.0015*	*< 0.05*	*< 0.5*	0.231	*< 0.00001*	0.0026	9.74	*< 0.02*	0.000835	*< 0.00002*	*< 0.00001*	6.57	*< 0.00001*	0.000857	*< 0.0002*
KONA_1	L2057381-1	2/15/2018 11:35	32	32		529	6.95	88.9	53	0.76	0.0994	*< 0.001*	*< 0.005*	0.283	0.92	*< 0.0015*	*< 0.05*	*< 0.5*	0.225	*< 0.00001*	0.0017	9.64	*< 0.02*	0.000955	*< 0.00002*	*< 0.00001*	6.69	*< 0.00001*	0.000953	*< 0.0002*
KONA_1	L2062788-1	3/1/2018 13:25	34	34		572	6.78	85.8	55	*< 0.5*	0.100	*< 0.001*	*< 0.005*	0.248	0.89	*< 0.0015*	*< 0.05*	*< 0.5*	0.226	*< 0.000025*	0.0040	10.9	*< 0.05*	0.00075	*< 0.00005*	*< 0.000025*	6.70	*< 0.000025*	0.000990	*< 0.0005*
KONA_1	L2068449-1	3/15/2018 11:40	36	36		568	6.83	87.8	57	0.65	0.113	*< 0.001*	*< 0.005*	0.259	0.87	*< 0.0015*	*< 0.05*	*< 0.5*	0.237	*< 0.00005*	*< 0.005*	9.64	*< 0.1*	0.00089	*< 0.0001*	*< 0.00005*	5.75	0.000159	0.000795	*< 0.001*
KONA_1	L2074311-1	3/29/2018 11:20	38	38		380	6.84	96.1	58	0.60	0.143	*< 0.001*	*< 0.005*	0.164	1.00	*< 0.0015*	*< 0.05*	*< 0.5*	0.249	*< 0.000005*	0.00387	9.03	0.022	0.000701	*< 0.00001*	0.0000117	7.87	*< 0.000005*	0.000452	*< 0.0001*
KONA_1	L2079620-1	4/12/2018 11:00	40	40		573	6.82	89.8	54	*< 0.5*	0.110	*< 0.001*	*< 0.005*	0.188	0.76	*< 0.0015*	*< 0.05*	*< 0.5*	0.255	*< 0.000005*	0.00308	10.7	0.016	0.000844	*< 0.00001*	*< 0.000005*	6.62	*< 0.000005*	0.000765	*< 0.0001*
KONA_1	L2085708-1	4/26/2018 13:00	42	42		556	6.76	89.9	51	0.75	0.105	*< 0.001*	*< 0.005*	0.687	0.79	*< 0.0015*	*< 0.05*	*< 0.5*	0.253	*< 0.000005*	0.00202	10.9	0.017	0.000788	*< 0.00001*	*< 0.000005*	7.00	*< 0.000005*	0.000733	*< 0.0001*
KONA_1	L2092801-1	5/10/2018 11:15	44	44		601	6.83	90.8	52	0.78	0.114	*< 0.001*	*< 0.005*	0.276	0.79	*< 0.0015*	*< 0.05*	*< 0.5*	0.250	*< 0.00001*	0.0033	11.1	*< 0.02*	0.000565	*< 0.00002*	*< 0.00001*	6.54	*< 0.00001*	0.000578	*< 0.0002*
KONA_1	L2100224-1	5/24/2018 14:00	46	46		496	6.75	94.5	53	0.79	0.131	*< 0.001*	*< 0.005*	0.303	0.81	*< 0.0015*	*< 0.05*	*< 0.5*	0.277	*< 0.000025*	0.0053	12.5	*< 0.05*	0.00050	*< 0.00005*	*< 0.000025*	6.61	*< 0.000025*	0.000404	*< 0.0005*
KONA_1	L2108434-1	6/7/2018 13:30	48		0	502	7.03	91	53	0.68	0.116	*< 0.001*	*< 0.005*	0.349	0.77	*< 0.0015*	*< 0.05*	*< 0.5*	0.271	*< 0.000025*	0.0071	11.7	*< 0.05*	0.00051	*< 0.00005*	*< 0.000025*	6.43	*< 0.000025*	0.000373	*< 0.0005*
KONA_1	L2116986-1	6/21/2018 14:00	50		2	497	7.02	100.7	57	*< 1*	0.128	*< 0.001*	*< 0.005*	0.359	0.80	*< 0.0015*	*< 0.05*	*< 0.5*	0.291	*< 0.000005*	0.00579	11.3	0.019	0.000556	*< 0.00001*	*< 0.000005*	7.33	*< 0.000005*	0.000349	*< 0.0001*
KONA_1	L2125321-1	7/6/2018 11:30	52		4	494	7	100.6	60	1.5	0.115	*< 0.001*	*< 0.005*	0.380	0.73	*< 0.0015*	*< 0.05*	*< 0.5*	0.289	*< 0.000025*	0.0034	12.9	*< 0.05*	0.00052	*< 0.00005*	*< 0.000025*	6.54	*< 0.000025*	0.000278	*< 0.0005*
KONA_1	L2132784-1	7/19/2018 14:45	54		6	515	7	99	54	0.87	0.130	*< 0.001*	*< 0.005*	0.368	0.71	*< 0.0015*	*< 0.05*	*< 0.5*	0.294	*< 0.000025*	0.0089	12.9	*< 0.05*	0.00059	*< 0.00005*	*< 0.000025*	6.92	*< 0.000025*	0.000319	*< 0.0005*
	L2140795-1	8/2/2018 13:30	56		8	512	6.89	96.7	50	*< 1*	0.130	*< 0.001*	*< 0.005*	0.363	0.70	*< 0.0015*	*< 0.05*	*< 0.5*	0.286	*< 0.000025*	0.0079	14.3	*< 0.05*	0.00076	*< 0.00005*	*< 0.000025*	6.99	*< 0.000025*	0.000396	*< 0.0005*
KONA_1	L2148482-1	8/16/2018	58		10	522	6.96	98.2	58	3.08	0.108	*< 0.001*	*< 0.005*	0.491	0.54	*< 0.0015*	*< 0.05*	*< 0.5*	0.298	*< 0.000025*	0.0056	16.3	*< 0.05*	0.00050	*< 0.00005*	*< 0.000025*	6.42	*< 0.000025*	0.000413	*< 0.0005*
KONA_1	L2156461-1	8/30/2018 14:20	60		12	504	6.88	97.8	53	1.2	0.112	*< 0.001*	*< 0.005*	0.308	0.51	*< 0.0015*	*< 0.05*	*< 0.5*	0.291	*< 0.000025*	0.00638	14.2	*< 0.05*	0.00063	*< 0.00005*	*< 0.000025*	6.70	*< 0.000025*	0.000384	*< 0.0005*
KONA_1	L2164110-1	9/13/2018 11:45	62		14	509	6.93	97.2	51	*< 1*	0.108	*< 0.001*	*< 0.005*	0.503	0.56	*< 0.0015*	*< 0.05*	*< 0.5*	0.285	*< 0.000025*	0.0052	18.1	*< 0.05*	0.00052	*< 0.00005*	*< 0.000025*	6.93	*< 0.000025*	0.000574	*< 0.0005*
KONA_1	L2172409-1	9/27/2018 14:00	64		16	551	6.83	94.9	47	1.3	0.103	*< 0.001*	*< 0.005*	0.587	0.49	*< 0.0015*	*< 0.05*	*< 0.5*	0.295	*< 0.00005*	*< 0.005*	17.0	*< 0.1*	0.00052	*< 0.0001*	*< 0.00005*	6.78	*< 0.00005*	0.000493	*< 0.001*
KONA_1	L2180431-1	10/12/2018 14:10	66		18	547	6.79	97.5	52	*< 1*	0.110	*< 0.001*	*< 0.005*	0.550	0.41	*< 0.0015*	*< 0.05*	*< 0.5*	0.275	*< 0.000025*	0.0072	16.8	*< 0.05*	0.00046	*< 0.00005*	*< 0.000025*	7.19	*< 0.000025*	0.000278	*< 0.0005*
KONA_1	L2187510-1	10/25/2018 14:00	68		20	490	6.86	97	46	2.6	0.104	*< 0.001*	*< 0.005*	0.47	0.35	*< 0.0015*	*< 0.05*	*< 0.5*	0.287	*< 0.000005*	0.00925	16.5	0.013	0.000403	*< 0.00001*	*< 0.000005*	6.71	*< 0.000005*	0.000229	*< 0.0001*
KONA_1	L2194529-1	11/8/2018 13:40	70		22	540	6.92	96.8	43	0.59	0.114	*< 0.001*	*< 0.005*	0.553	0.38	*< 0.0015*	*< 0.05*	*< 0.5*	0.296	*< 0.000025*	0.0133	17.2	*< 0.05*	0.00041	*< 0.00005*	*< 0.000025*	6.96	*< 0.000025*	0.000139	*< 0.0005*
KONA_1	L2200705-1	11/22/2018 10:30	72		24	534	6.94	93.3	43	*< 0.5*	0.0980	*< 0.001*	0.0095	0.794	0.33	*< 0.0015*	*< 0.05*	*< 0.5*	0.302	*< 0.000005*	0.00609	16.9	0.011	0.000271	*< 0.00001*	*< 0.000005*	6.62	*< 0.000005*	0.000137	*< 0.0001*
KONA_1	L2207335-1	12/6/2018 14:45	74		26	527	6.93	93.4	40	*< 0.5*	0.0990	*< 0.001*	*< 0.005*	0.667	*< 0.3*	*< 0.0015*	*< 0.05*	*< 0.5*	0.306	*< 0.000025*	0.0136	18.5	*< 0.05*	0.00034	*< 0.00005*	*< 0.000025*	6.86	*< 0.000025*	0.000094	*< 0.0005*
KONA_1	L2213525-1	12/20/2018 14:25	76		28	843	6.79	218	45	0.74	0.108	*< 0.001*	*< 0.005*	0.352	66.3	*< 0.0015*	*< 0.05*	*< 0.5*	0.249	*< 0.000025*	0.0091	14.8	*< 0.05*	0.00076	*< 0.00005*	*< 0.000025*	20.0	*< 0.000025*	0.00240	*< 0.0005*
KONA_1	L2217203-1	1/5/2019 11:35	78		30	793	6.15	709	20	*< 0.5*	0.172	*< 0.005*	*< 0.025*	0.144	362	*< 0.01*	*< 0.25*	*< 2.5*	0.16	*< 0.000025*	*< 0.0025*	9.13	*< 0.05*	0.00566	*< 0.00005*	*< 0.000025*	81.8	0.000055	0.0200	*< 0.0005*
KONA_1	L2222132-1	1/17/2019 11:45	80		32	781	5.78	1173	15	*< 0.5*	0.167	*< 0.005*	*< 0.025*	0.106	650	*< 0.01*	*< 0.25*	*< 2.5*	0.12	*< 0.000005*	0.00090	8.28	*< 0.01*	0.0200	0.000020	*< 0.000005*	182	0.0000751	0.0661	*< 0.0001*
KONA_1	L2227544-1	1/31/2019 10:30	82		34	763	5.77	1391	14	0.75	0.172	*< 0.005*	*< 0.025*	0.317	797	*< 0.0015*	*< 0.25*	*< 2.5*	0.14	*< 0.0001*	*< 0.01*	10.1	*< 0.2*	0.0221	*< 0.0002*	*< 0.0001*	226	*< 0.0001*	0.0840	*< 0.002*
KONA_1	L2233141-1	2/14/2019 14:20	84		36	745	5.83	1488	16	0.60	0.168	*< 0.01*	*< 0.05*	0.286	926	*< 0.0015*	*< 0.5*	*< 5*	*< 0.2*	*< 0.00005*	*< 0.005*	13.9	*< 0.1*	0.0146	*< 0.0001*	*< 0.00005*	273	0.000063	0.0586	*< 0.001*
KONA_1	L2238565-1	2/28/2019 15:15	86		38	735	5.69	1550	13	0.59	0.155	*< 0.005*	*< 0.025*	0.436	946	*< 0.0015*	*< 0.25*	*< 2.5*	0.12	*< 0.000025*	0.0034	15.2	*< 0.05*	0.0102	*< 0.00005*	0.000066	287	0.000088	0.0464	*< 0.0005*
KONA_1	L2244540-1	3/14/2019 14:30	88		40	719	5.85	1576	13	0.66	0.150	*< 0.005*	*< 0.025*	*< 0.2*	952	*< 0.0015*	*< 0.25*	*< 2.5*	0.11	*< 0.000025*	0.0032	15.0	*< 0.05*	0.00848	*< 0.00005*	*< 0.000025*	297	0.000056	0.0374	*< 0.0005*
KONA_1	L2250817-1	3/28/2019 15:00	90		42	734	5.78	1599	16	0.52	0.159	*< 0.005*	*< 0.025*	0.244	945	*< 0.01*	*< 0.25*	*< 2.5*	0.12	*< 0.000025*	0.0036	11.5	*< 0.05*	0.00740	*< 0.00005*	*< 0.000025*	353	0.000040	0.0381	*< 0.0005*
KONA_1	L2257457-1	4/11/2019 15:00	92		44	725	5.9	1593	13	0.75	0.147	0.019	*< 0.05*	0.375	1000	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.000025*	*< 0.0025*	11.7	*< 0.05*	0.00677	*< 0.00005*	*< 0.000025*	351	0.000035	0.0354	*< 0.0005*
KONA_1	L2263301-1	4/25/2019 14:45	94		46	738	5.94	1641	15	0.85	0.151	*< 0.005*	*< 0.025*	0.270	952	*< 0.0015*	*< 0.25*	*< 2.5*	0.12	*< 0.000025*	0.0029	11.7	*< 0.05*	0.00656	*< 0.00005*	*< 0.000025*	349	0.000029	0.0305	*< 0.0005*
KONA_2	L1955323-2	7/7/2017 13:00	0	0		526	6.35	265.3	37	2.67	0.281	*< 0.001*	*< 0.005*	0.053	74.9	*< 0.0015*	*< 0.05*	6.78	0.184	*< 0.000005*	0.0388	2.58	0.098	0.0204	0.000227	*< 0.000005*	20.2	0.0000422	0.0225	*< 0.0001*
KONA_2	L1969885-2	8/3/2017 13:50	4	4		464	6.44	269.4	49	2.27	0.343	*< 0.001*	*< 0.005*	0.0726	70.1	0.0016	*< 0.05*	4.90	0.186	*< 0.000005*	0.0224	4.11	0.103	0.0214	0.000139	*< 0.000005*	21.5	0.0000349	0.0197	*< 0.0001*
KONA_2	L1977048-2	8/17/2017 12:25	6	6		684	6.17	196	43	1.42	0.192	*< 0.001*	*< 0.005*	0.0547	46.8	0.0098	*< 0.05*	2.47	0.117	*< 0.000005*	0.0143	5.27	0.063	0.0153	0.000092	*< 0.000005*	14.0	0.0000209	0.0154	*< 0.0001*
KONA_2	L1984769-2	8/31/2017 14:00	8	8		632	6.89	164.5	48	1.16	0.147	*< 0.001*	*< 0.005*	0.12	36.8	0.0252	*< 0.05*	1.75	0.120	*< 0.000005*	0.00913	6.51	0.055	0.0130	0.000064	0.0000060	11.3	0.0000162	0.0117	*< 0.0001*
KONA_2	L1992087-2	9/14/2017 14:55	10	10		702	6.42	134.6	44	0.84	0.0995	0.0021	*< 0.005*	0.139	25.7	*< 0.0015*	*< 0.05*	0.83	0.118	*< 0.000005*	0.00425	7.38	0.045	0.00978	0.000053	*< 0.000005*	8.99	0.0000100	0.00898	*< 0.0001*
KONA_2	L1999487-2	9/28/2017 11:25	12	12		499	6.27	128.4	49	0.53	0.154	*< 0.001*	*< 0.005*	0.171	20.9	0.0459	*< 0.05*	0.74	0.116	*< 0.000005*	0.00416	8.82	0.040	0.00984	0.000034	*< 0.000005*	9.14	0.0000103	0.00784	*< 0.0001*
KONA_2	L2007130-2	10/13/2017 11:25	14	14		754	6.22	105.3	44	0.74	0.0597	*< 0.001*	*< 0.005*	0.191	14.6	0.0361	*< 0.05*	*< 0.5*	0.117	*< 0.000005*	0.00269	9.64	0.033	0.00760	0.000037	*< 0.000005*	6.99	0.0000098	0.00653	*< 0.0001*
KONA_2	L2014335-2	10/26/2017 11:50	16	16		219	6.36	91.7	44	0.61	0.0606	*< 0.001*	*< 0.005*	0.168	9.83	0.0640	*< 0.05*	*< 0.5*	0.117	*< 0.000005*	0.00262	9.63	0.026	0.00507	0.000034	*< 0.000005*	5.74	0.0000056	0.00505	*< 0.0001*
KONA_2	L2020126-2	11/8/2017 12:30	18	18		525	6.67	89.5	42	0.61	0.0826	*< 0.001*	*< 0.005*	0.268	8.07	0.0213	*< 0.05*	*< 0.5*	0.131	*< 0.000005*	*< 0.003*	11.0	0.028	0.00625	0.000029	*< 0.000005*	6.09	0.0000066	0.00527	*< 0.0001*
KONA_2	L2026623-2	11/23/2017 14:15	20	20		598	6.38	86.2	43	0.54	0.0568	*< 0.001*	*< 0.005*	0.234	6.19	0.0100	*< 0.05*	*< 0.5*	0.131	*< 0.000005*	0.00210	10.4	0.022	0.00562	0.000026	*< 0.000005*	5.85	0.0000057	0.00455	*< 0.0001*
KONA_2	L2031965-2	12/6/2017 14:05	22	22		525	6.55	58	51	0.88	0.0839	*< 0.001*	*< 0.005*	0.32	4.89	0.0019	*< 0.05*	*< 0.5*	0.128	*< 0.000005*	0.00261	11.6	0.018	0.00530	0.000027	*< 0.000005*	5.20	0.0000107	0.00472	*< 0.0001*
KONA_2	L2038563-2	12/21/2017 13:50	24	24		716	6.4	75.5	39	*< 0.5*	0.0138	*< 0.001*	*< 0.005*	0.282	3.74	*< 0.0015*	*< 0.05*	*< 0.5*	0.129	*< 0.000005*	0.00121	12.1	0.017	0.00448	0.000023	*< 0.000005*	4.60	*< 0.000005*	0.00415	*< 0.0001*
KONA_2	L2041649-2	1/4/2018 13:05	26	26		512	6.43	80.4	40	0.64	0.0356	*< 0.001*	*< 0.005*	0.234	3.58	*< 0.0015*	*< 0.05*	*< 0.5*	0.134	*< 0.000005*	0.00154	12.4	0.016	0.00503	0.000022	*< 0.000005*	5.25	0.0000053	0.00410	*< 0.0001*
KONA_2	L2046871-2	1/18/2018 11:25	28	28		547	6.44	80.4	42	*< 0.5*	0.0688	*< 0.001*	*< 0.005*	0.37	3.47	*< 0.0015*	*< 0.05*	*< 0.5*	0.145	*< 0.000025*	*< 0.0025*	13.6	*< 0.05*	0.00429	*< 0.00005*	*< 0.000025*	5.39	*< 0.000025*	0.00387	*< 0.0005*
KONA_2	L2052061-2	2/1/2018 12:10	30	30		560	6.41	79.8	41	0.84	0.0653	*< 0.001*	*< 0.005*	0.342	3.29	*< 0.0015*	*< 0.05*	*< 0.5*	0.150	*< 0.000025*	0.0027	14.1	*< 0.05*	0.00403	*< 0.00005*	*< 0.000025*	4.89	*< 0.000025*	0.00369	*< 0.0005*
KONA_2	L2057381-2	2/15/2018 11:35	32	32		523	6.4	80.6	43	1.07	0.0715	*< 0.001*	*< 0.005*	0.386	3.07	*< 0.0015*	*< 0.05*	*< 0.5*	0.145	*< 0.000025*	*< 0.0025*	14.5	*< 0.05*	0.00474	*< 0.00005*	*< 0.000025*	5.10	*< 0.000025*	0.00382	*< 0.0005*
KONA_2	L2062788-2	3/1/2018 13:25	34	34		565	6.39	74.8	44	0.90	0.0433	*< 0.001*	*< 0.005*	0.304	2.62	0.0018	*< 0.05*	*< 0.5*	0.147	*< 0.000025*	*< 0.0025*	15.7	*< 0.05*	0.00424	*< 0.00005*	*< 0.000025*	4.58	*< 0.000025*	0.00340	*< 0.0005*

Appendix A2: Granite Column (Kona 1-4) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**
KONA_2	L2068449-2	3/15/2018 11:40	36	36		564	6.44	76.2	46	0.58	0.0555	*< 0.001*	*< 0.005*	0.35	2.56	*< 0.0015*	*< 0.05*	*< 0.5*	0.156	*< 0.00005*	*< 0.005*	16.0	*< 0.1*	0.00395	*< 0.0001*	*< 0.00005*	4.44	*< 0.00005*	0.00343	*< 0.001*
KONA_2	L2074311-2	3/29/2018 11:20	38	38		377	6.54	85	47	0.52	0.115	*< 0.001*	*< 0.005*	0.182	2.86	*< 0.0015*	*< 0.05*	*< 0.5*	0.172	*< 0.000005*	0.00362	14.3	0.014	0.00462	0.000022	*< 0.000005*	5.69	0.0000071	0.00350	*< 0.0001*
KONA_2	L2079620-2	4/12/2018 11:00	40	40		554	6.31	78.3	44	0.61	0.0516	*< 0.001*	*< 0.005*	0.255	2.36	*< 0.0015*	*< 0.05*	*< 0.5*	0.169	*< 0.000005*	0.00233	16.6	0.011	0.00431	0.000013	0.0000076	4.89	0.0000059	0.00352	*< 0.0001*
KONA_2	L2085708-2	4/26/2018 13:40	42	42		540	6.38	75.7	43	0.53	0.0434	*< 0.001*	*< 0.005*	0.25	2.27	*< 0.0015*	*< 0.05*	*< 0.5*	0.162	*< 0.000005*	0.00112	17.8	0.010	0.00363	0.000016	*< 0.000005*	4.61	*< 0.000005*	0.00324	*< 0.0001*
KONA_2	L2092801-2	5/10/2018 11:15	44	44		568	6.4	75.8	40	0.50	0.0345	*< 0.001*	*< 0.005*	0.373	2.19	*< 0.0015*	*< 0.05*	*< 0.5*	0.167	*< 0.000025*	0.0028	18.4	*< 0.05*	0.00345	*< 0.00005*	*< 0.000025*	4.36	*< 0.000025*	0.00286	*< 0.0005*
KONA_2	L2100224-2	5/24/2018 14:00	46	46		480	6.41	80.2	41	0.73	0.0371	*< 0.001*	*< 0.005*	0.500	2.25	*< 0.0015*	*< 0.05*	*< 0.5*	0.185	*< 0.000025*	0.0029	20.1	*< 0.05*	0.00417	*< 0.00005*	*< 0.000025*	4.48	*< 0.000025*	0.00311	*< 0.0005*
KONA_2	L2108434-2	6/7/2018 13:30	48		0	490	6.56	76.6	42	*< 2.5*	0.109	*< 0.001*	*< 0.005*	0.442	2.24	*< 0.0015*	*< 0.05*	*< 0.5*	0.192	*< 0.000025*	0.0051	19.6	*< 0.05*	0.00356	*< 0.00005*	*< 0.000025*	4.79	*< 0.000025*	0.00319	*< 0.0005*
KONA_2	L2116986-2	6/21/2018 14:00	50		2	492	6.66	82.2	39	*< 1*	0.0567	*< 0.001*	*< 0.005*	0.478	2.16	*< 0.0015*	*< 0.05*	*< 0.5*	0.200	*< 0.000005*	0.00206	19.5	0.011	0.00341	*< 0.00001*	0.0000237	4.95	0.0000061	0.00327	*< 0.0001*
KONA_2	L2125321-2	7/6/2018 11:30	52		4	499	6.62	80.8	48	1.74	0.0378	*< 0.001*	*< 0.005*	0.481	2.16	0.0024	*< 0.05*	*< 0.5*	0.198	*< 0.000025*	*< 0.0025*	21.1	*< 0.05*	0.00309	*< 0.00005*	*< 0.000025*	4.39	*< 0.000025*	0.00297	*< 0.0005*
KONA_2	L2132784-2	7/19/2018 14:45	54		6	499	6.59	79.5	36	0.97	0.0519	*< 0.001*	*< 0.005*	0.430	2.11	*< 0.0015*	*< 0.05*	*< 0.5*	0.209	*< 0.00005*	*< 0.005*	22.1	*< 0.1*	0.00303	*< 0.0001*	*< 0.00005*	4.78	*< 0.00005*	0.00313	*< 0.001*
KONA_2	L2140795-2	8/2/2018 13:30	56		8	494	6.48	80.7	35	*< 1*	0.135	*< 0.001*	*< 0.005*	0.409	2.23	*< 0.0015*	*< 0.05*	*< 0.5*	0.208	*< 0.000025*	0.0072	21.7	*< 0.05*	0.00361	*< 0.00005*	*< 0.000025*	4.90	*< 0.000025*	0.00305	*< 0.0005*
KONA_2	L2148482-2	8/16/2018	58		10	520	6.46	82.2	37	4.93	0.0334	*< 0.001*	*< 0.005*	0.561	1.90	*< 0.0015*	*< 0.05*	*< 0.5*	0.224	*< 0.000025*	0.0047	24.2	*< 0.05*	0.00283	*< 0.00005*	*< 0.000025*	4.12	*< 0.000025*	0.00278	*< 0.0005*
KONA_2	L2156461-2	8/30/2018 14:20	60		12	497	6.55	77.4	34	1.1	0.0465	*< 0.001*	*< 0.005*	0.418	1.85	*< 0.0015*	*< 0.05*	*< 0.5*	0.207	*< 0.00005*	0.00552	25.7	*< 0.1*	0.00318	*< 0.0001*	*< 0.00005*	4.65	*< 0.00005*	0.00323	*< 0.001*
KONA_2	L2164110-2	9/13/2018 11:45	62		14	496	6.47	78.8	35	6.5	0.0436	*< 0.001*	*< 0.005*	0.648	2.00	*< 0.0015*	*< 0.05*	*< 0.5*	0.215	*< 0.00005*	0.0095	27.1	*< 0.1*	0.00285	*< 0.0001*	*< 0.00005*	4.69	*< 0.00005*	0.00315	*< 0.001*
KONA_2	L2172409-2	9/27/2018 14:00	64		16	519	6.47	78.3	30	*< 1*	0.0206	*< 0.001*	*< 0.005*	0.492	1.84	*< 0.0015*	*< 0.05*	3.89	0.223	*< 0.00005*	*< 0.005*	25.4	*< 0.1*	0.00283	*< 0.0001*	*< 0.00005*	4.58	*< 0.00005*	0.00280	*< 0.001*
KONA_2	L2180431-2	10/12/2018 14:10	66		18	527	6.48	81.1	33	1.6	0.0420	*< 0.001*	*< 0.005*	0.534	1.71	*< 0.0015*	*< 0.05*	*< 0.5*	0.212	*< 0.00005*	0.0070	21.6	*< 0.1*	0.00276	*< 0.0001*	*< 0.00005*	4.56	*< 0.00005*	0.00262	*< 0.001*
KONA_2	L2187510-2	10/25/2018 14:00	68		20	468	6.57	83	32	*< 1*	0.860	*< 0.001*	*< 0.005*	0.51	1.49	*< 0.0015*	*< 0.05*	*< 0.5*	0.225	*< 0.00005*	0.0092	22.4	*< 0.1*	0.00329	*< 0.0001*	*< 0.00005*	5.12	*< 0.00005*	0.00290	*< 0.001*
KONA_2	L2194529-2	11/8/2018 13:40	70		22	506	6.58	84.5	31	0.64	0.080	*< 0.001*	*< 0.005*	0.498	1.54	*< 0.0015*	*< 0.05*	*< 0.5*	0.239	*< 0.000025*	0.0175	22.7	*< 0.05*	0.00314	*< 0.00005*	*< 0.000025*	5.11	*< 0.000025*	0.00282	*< 0.0005*
KONA_2	L2200705-2	11/22/2018 10:30	72		24	504	6.55	81.8	31	*< 0.5*	0.0588	*< 0.001*	*< 0.005*	0.858	1.39	*< 0.0015*	*< 0.05*	*< 0.5*	0.237	*< 0.000025*	0.0142	21.6	*< 0.05*	0.00284	*< 0.00005*	*< 0.000025*	5.05	*< 0.000025*	0.00272	*< 0.0005*
KONA_2	L2207335-2	12/6/2018 14:45	74		26	500	6.61	82.2	31	0.59	0.0645	*< 0.001*	*< 0.005*	0.600	1.29	*< 0.0015*	*< 0.05*	*< 0.5*	0.243	*< 0.00005*	0.0141	22.1	*< 0.1*	0.00291	*< 0.0001*	*< 0.00005*	4.84	*< 0.00005*	0.00267	*< 0.001*
KONA_2	L2213525-2	12/20/2018 14:25	76		28	798	6.27	151	33	0.77	0.0557	*< 0.001*	*< 0.005*	0.332	42.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.194	*< 0.00005*	0.0131	23.6	*< 0.1*	0.00756	*< 0.0001*	*< 0.00005*	9.99	*< 0.00005*	0.00582	*< 0.001*
KONA_2	L2217203-2	1/5/2019 11:35	78		30	835	5	886	10	0.73	0.184	*< 0.005*	*< 0.025*	0.446	482	*< 0.01*	*< 0.25*	*< 2.5*	*< 0.1*	*< 0.000025*	0.0328	25.6	*< 0.05*	0.0528	0.000097	*< 0.000025*	70.4	0.000100	0.0675	*< 0.0005*
KONA_2	L2222132-2	1/17/2019 11:45	80		32	813	5.03	1354	11	0.65	0.206	*< 0.005*	*< 0.025*	0.482	786	*< 0.01*	*< 0.25*	*< 2.5*	0.10	*< 0.000005*	0.0598	25.3	*< 0.01*	0.0744	0.000213	*< 0.000005*	132	0.0000940	0.0903	*< 0.0001*
KONA_2	L2227544-2	1/31/2019 10:30	82		34	810	4.92	1501	23	0.81	0.160	*< 0.005*	*< 0.025*	0.83	879	0.0068	*< 0.25*	*< 2.5*	*< 0.1*	*< 0.0001*	0.051	25.0	*< 0.2*	0.0601	0.00021	*< 0.0001*	175	*< 0.0001*	0.0734	*< 0.002*
KONA_2	L2233141-2	2/14/2019 14:20	84		36	716	5.03	1543	9	0.70	0.150	*< 0.01*	*< 0.05*	0.661	984	0.0064	*< 0.5*	*< 5*	*< 0.2*	*< 0.00005*	0.0426	24.0	*< 0.1*	0.0535	0.00020	*< 0.00005*	212	0.000073	0.0598	*< 0.001*
KONA_2	L2238565-2	2/28/2019 15:15	86		38	705	4.99	1573	9	0.58	0.146	*< 0.005*	*< 0.025*	0.828	971	0.0075	*< 0.25*	*< 2.5*	*< 0.1*	*< 0.00005*	0.0420	27.7	*< 0.1*	0.0504	*< 0.0001*	*< 0.00005*	248	0.000067	0.0544	*< 0.001*
KONA_2	L2244540-2	3/14/2019 14:30	88		40	692	4.95	1596	9	0.73	0.259	*< 0.005*	*< 0.025*	*< 0.9*	954	0.0120	*< 0.25*	*< 2.5*	*< 0.1*	*< 0.00005*	0.0341	30.1	*< 0.1*	0.0377	*< 0.0001*	*< 0.00005*	254	0.000062	0.0405	*< 0.001*
KONA_2	L2250817-2	3/28/2019 15:00	90		42	580	4.92	1603	10	0.62	0.155	*< 0.005*	*< 0.025*	0.676	971	0.019	*< 0.25*	*< 2.5*	*< 0.1*	*< 0.00005*	0.0500	27.4	*< 0.1*	0.0326	*< 0.0001*	*< 0.00005*	315	0.000074	0.0445	*< 0.001*
KONA_2	L2257457-2	4/11/2019 15:00	92		44	702	5.18	1600	10	1.12	0.149	*< 0.01*	*< 0.05*	0.991	1020	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.00005*	0.0199	29.6	*< 0.1*	0.0189	*< 0.0001*	*< 0.00005*	320	0.000051	0.0365	*< 0.001*
KONA_2	L2263301-2	4/25/2019 14:45	94		46	721	5.18	1640	9	0.89	0.149	*< 0.005*	*< 0.025*	0.83	966	0.0399	*< 0.25*	*< 2.5*	0.11	*< 0.00005*	0.0373	30.5	*< 0.1*	0.0110	*< 0.0001*	*< 0.00005*	323	0.000052	0.0302	*< 0.001*
KONA_3	L1955323-3	7/7/2017 13:00	0	0		583	5.79	188.6	40	2.68	0.592	*< 0.001*	*< 0.005*	0.0192	33.7	*< 0.0015*	*< 0.05*	9.08	0.275	*< 0.000005*	0.00183	0.419	0.155	0.00506	0.000013	*< 0.000005*	8.87	0.0000126	0.00254	*< 0.0001*
KONA_3	L1969885-3	8/3/2017 13:50	4	4		464	6.91	209.9	59	2.33	1.89	*< 0.001*	*< 0.005*	0.0336	29.9	*< 0.0015*	*< 0.05*	7.83	0.284	*< 0.000005*	0.00158	0.601	0.158	0.00673	0.000015	*< 0.000005*	11.3	*< 0.000005*	0.00363	*< 0.0001*
KONA_3	L1977048-3	8/17/2017 12:25	6	6		672	7.51	177.9	70	1.51	1.40	*< 0.001*	*< 0.005*	0.0336	18.5	*< 0.0015*	*< 0.05*	4.44	0.278	*< 0.000005*	0.00156	0.950	0.107	0.00585	*< 0.00001*	*< 0.000005*	9.19	*< 0.000005*	0.00304	*< 0.0001*
KONA_3	L1984769-3	8/31/2017 14:00	8	8		605	6.88	167.7	79	1.34	0.570	*< 0.001*	*< 0.005*	0.050	14.8	*< 0.0015*	*< 0.05*	3.16	0.285	*< 0.000005*	0.00380	1.06	0.103	0.00562	0.000010	*< 0.000005*	8.27	0.0000140	0.00305	*< 0.0001*
KONA_3	L1992087-3	9/14/2017 14:55	10	10		695	7.01	146.1	76	0.87	0.435	*< 0.001*	*< 0.005*	0.0942	9.68	*< 0.0015*	*< 0.05*	0.87	0.291	*< 0.000005*	0.00105	1.26	0.086	0.00482	0.000011	*< 0.000005*	7.28	0.0000068	0.00262	*< 0.0001*
KONA_3	L1999487-3	9/28/2017 11:25	12	12		503	6.84	140	75	0.59	0.480	*< 0.001*	*< 0.005*	0.083	7.63	*< 0.0015*	*< 0.05*	1.08	0.295	*< 0.000005*	0.00263	1.15	0.077	0.00490	*< 0.00001*	*< 0.000005*	7.34	*< 0.000005*	0.00247	*< 0.0001*
KONA_3	L2007130-3	10/13/2017 11:25	14	14		758	6.84	127.9	69	0.71	0.467	*< 0.001*	*< 0.005*	0.093	5.23	*< 0.0015*	*< 0.05*	0.58	0.333	*< 0.000005*	0.00173	1.60	0.068	0.00482	*< 0.00001*	*< 0.000005*	6.40	*< 0.000005*	0.00232	*< 0.0001*
KONA_3	L2014335-3	10/26/2017 11:50	16	16		223	6.95	117.6	63	0.61	0.470	*< 0.001*	*< 0.005*	0.097	3.63	*< 0.0015*	*< 0.05*	*< 0.5*	0.354	*< 0.000005*	0.00206	1.57	0.054	0.00344	*< 0.00001*	*< 0.000005*	5.72	*< 0.000005*	0.00197	*< 0.0001*
KONA_3	L2020126-3	11/8/2017 12:30	18	18		530	7.09	115	65	0.61	0.441	*< 0.001*	*< 0.005*	0.108	3.49	*< 0.0015*	*< 0.05*	*< 0.5*	0.385	*< 0.000005*	*< 0.002*	1.65	0.048	0.00407	*< 0.00001*	*< 0.000005*	5.84	0.0000062	0.00202	*< 0.0001*
KONA_3	L2026623-3	11/23/2017 14:15	20	20		590	6.93	105.9	59	*< 0.5*	0.427	*< 0.001*	*< 0.005*	0.121	2.30	*< 0.0015*	*< 0.05*	*< 0.5*	0.365	*< 0.000005*	0.00190	1.84	0.043	0.00365	*< 0.00001*	*< 0.000005*	5.24	*< 0.000005*	0.00189	*< 0.0001*
KONA_3	L2031965-3	12/6/2017 14:05	22	22		506	7.13	104.7	61	0.98	0.409	*< 0.001*	*< 0.005*	0.122	1.94	*< 0.0015*	*< 0.05*	*< 0.5*	0.365	*< 0.000005*	0.00226	1.81	0.033	0.00350	*< 0.00001*	*< 0.000005*	5.03	*< 0.000005*	0.00186	*< 0.0001*
KONA_3	L2038563-3	12/21/2017 13:50	24	24		705	6.9	98.4	59	*< 0.5*	0.361	*< 0.001*	*< 0.005*	0.134	1.49	*< 0.0015*	*< 0.05*	*< 0.5*	0.374	*< 0.000005*	0.00164	1.90	0.031	0.00306	*< 0.00001*	*< 0.000005*	4.94	*< 0.000005*	0.00172	*< 0.0001*
KONA_3	L2041649-3	1/4/2018 13:05	26	26		509	6.98	99.3	57	0.70	0.392	*< 0.001*	*< 0.005*	0.126	1.60	*< 0.0015*	*< 0.05*	*< 0.5*	0.374	*< 0.000005*	0.00139	1.72	0.028	0.00283	*< 0.00001*	*< 0.000005*	4.91	*< 0.000005*	0.00170	*< 0.0001*
KONA_3	L2046871-3	1/18/2018 11:25	28	28		567	6.99	96.8	59	*< 0.5*	0.356	*< 0.001*	*< 0.005*	0.156	1.51	*< 0.0015*	*< 0.05*	*< 0.5*	0.391	*< 0.000005*	0.00183	2.02	0.034	0.00302	*< 0.00001*	*< 0.000005*	5.12	0.0000060	0.00170	*< 0.0001*
KONA_3	L2052061-3	2/1/2018 12:10	30	30		575	6.96	99.6	60	0.58	0.367	*< 0.001*	*< 0.005*	0.173	1.52	*< 0.0015*	*< 0.05*	*< 0.5*	0.399	*< 0.000005*	0.00177	2.13	0.024	0.00287	*< 0.00001*	*< 0.000005*	4.87	*< 0.000005*	0.00171	*< 0.0001*
KONA_3	L2057381-3	2/15/2018 11:35	32	32		529	7.08	95.2	56	*< 0.5*	0.352	*< 0.001*	*< 0.005*	0.172	1.35	*< 0.0015*	*< 0.05*	*< 0.5*	0.388	*< 0.000005*	0.00133	2.12	0.022	0.00329	*< 0.00001*	*< 0.000005*	4.49	0.0000054	0.00169	*< 0.0001*
KONA_3	L2062788-3	3/1/2018 13:25	34	34		567	6.97	92.3	62	*< 0.5*	0.343	*< 0.001*	*< 0.005*	0.147	1.30	*< 0.0015*	*< 0.05*	*< 0.5*	0.393	*< 0.000005*	0.00137	2.26	0.021	0.00263	*< 0.00001*	*< 0.000005*	4.85	*< 0.000005*	0.00148	*< 0.0001*
KONA_3	L2068449-3	3/15/2018 11:40	36	36		556	6.97	91.2	60	*< 0.5*	0.349	*< 0.001*	*< 0.005*	0.156	1.23	*< 0.0015*	*< 0.05*	*< 0.5*	0.407	*< 0.000005*	0.00143	2.34	0.020	0.00257	*< 0.00001*	*< 0.000005*	4.35	*< 0.000005*	0.00124	*< 0.0001*
KONA_3	L2074311-3	3/29/2018 11:20	38	38		372	7	91.7	57	*< 0.5*	0.376	*< 0.001*	*< 0.005*	0.131	1.46	*< 0.0015*	*< 0.05*	*< 0.5*	0.402	*< 0.000005*	0.00115	2.10	0.020	0.00217	*< 0.00001*	*< 0.000005*	4.41	*< 0.000005*	0.000868	*< 0.0001*
KONA_3	L2079620-3	4/12/2018 11:00	40	40		567	6.89	91.2	55	*< 0.5*	0.334	*< 0.001*	*< 0.005*	0.126	1.25	*< 0.0015*	*< 0.05*	*< 0.5*	0.422	*< 0.000005*	0.00212	2.31	0.017	0.00243	*< 0.00001*	*< 0.000005*	4.24	*< 0.000005*	0.000944	*< 0.0001*
KONA_3	L2085708-3	4/26/2018 13:40	42	42		566	6.91	87.4	49	*< 0.5*	0.297	*< 0.001*	*< 0.005*	0.309	1.08	*< 0.0015*	*< 0.05*	*< 0.5*	0.405	*< 0.000005*	0.00208	2.58	0.015	0.00237	*< 0.00001*	*< 0.000005*	4.09	0.0000055	0.000930	*< 0.0001*
KONA_3	L2092801-3	5/10/2018 11:15	44	44		572	6.97	85.6	52	*< 0.5*	0.285	*< 0.001*	*< 0.005*	0.166	1.04	*< 0.0015*	*< 0.05*	*< 0.5*	0.412	*< 0.000005*	0.00213	2.75	0.016	0.00207	*< 0.00001*	*< 0.000005*	4.16	0.0000052	0.000786	*< 0.0001*
KONA_3	L2100224-3	5/24/2018 14:00	46	46		486	6.83	86	50	0.54	0.304	*< 0.001*	*< 0.005*	0.196	1.13	*< 0.0015*	*< 0.05*	*< 0.5*	0.431	*< 0.000005*	0.00486	3.07	0.015	0.00188	*< 0.00001*	*< 0.000005*	3.88	*< 0.000005*	0.000509	*< 0.0001*
KONA_3	L2108434-3	6/7/2018 13:30	48		0	496	7.11	81.5	57	0.52	0.291	*< 0.001*	*< 0.005*	0.217	1.05	*< 0.0015*	*< 0.05*	*< 0.5*	0.421	*< 0.000005*	0.00563	3.16	0.016	0.00153	*< 0.00001*	*< 0.000005*	3.98	*< 0.000005*	0.000358	*< 0.0001*
KONA_3	L2116986-3	6/21/2018 14:00	50		2	408	7.15	88.8	51	*< 1*	0.302	*< 0.001*	*< 0.005*	0.193	1.09	*< 0.003*	*< 0.05*	*< 0.5*	0.455	*< 0.000005*	0.00417	2.91	0.015	0.00126	*< 0.00001*	*< 0.000005*	3.82	*< 0.000005*	0.000247	*< 0.0001*
KONA_3	L2125321-3	7/6/2018 11:30	52		4	498	7.08	88.7	53	1.2	0.273	*< 0.001*	*< 0.005*	0.205	1.05	*< 0.0015*	*< 0.05*	*< 0.5*	0.440	*< 0.000005*	0.00688	3.35	0.015	0.00123	*< 0.00001*	*< 0.000005*	3.75	0.0000057	0.000261	*< 0.0001*
KONA_3	L2132784-3	7/19/2018 14:45	54		6	494	7.13	87.2	48	0.94	0.265	*< 0.001*	*< 0.005*	0.231	0.99	*< 0.0015*	*< 0.05*	*< 0.5*	0.453	*< 0.000005*	0.0127	3.55	0.014	0.00116	*< 0.00001*	*< 0.000005*	3.74	*< 0.000005*	0.000219	*< 0.0001*
KONA_3	L2140795-3	8/2/2018 13:30	56		8	483	7.01	86.2	42	1.5	0.235	*< 0.001*	*< 0.005*	0.216	1.14	*< 0.0015*	*< 0.05*	*< 0.5*	0.444	*< 0.000005*	0.00915	3.53	0.015	0.00118	*< 0.00001*	*< 0.000005*	3.91	*< 0.000005*	0.000164	*< 0.0001*
KONA_3	L2148482-3	8/16/2018	58		10	531	7.11	87.6	48	0.53	0.257	*< 0.001*	*< 0.005*	0.269	0.79	*< 0.0015*	*< 0.05*	*< 0.5*	0.474	*< 0.000005*	0.0121	4.28	0.013	0.00109	*< 0.00001*	*< 0.000005*	3.68	*< 0.000005*	0.000225	*< 0.0001*
KONA_3	L2156461-3	8/30/2018 14:20	60		12	533	6.96	83.5	47	*< 1*	0.246	*< 0.001*	*< 0.005*	0.219	0.71	*< 0.0015*	*< 0.05*	*< 0.5*	0.460	*< 0.000005*	0.00662	4.56	0.013	0.00111	*< 0.00001*	*< 0.000005*	3.51	0.0000079	0.000323	*< 0.0001*
KONA_3	L2164110-3	9/13/2018 11:45	62		14	548	7	83.2	46	*< 1*	0.234	*< 0.001*	*< 0.005*	0.282	0.84	*< 0.0015*	*< 0.05*	*< 0.5*	0.455	*< 0.000005*	0.0139	4.81	0.012	0.00116	*< 0.00001*	*< 0.000005*	3.62	*< 0.000005*	0.000256	*< 0.0001*
KONA_3	L2172409-3	9/27/2018 14:00	64		16	565	7.07	82.7	43	*< 1*	0.240	*< 0.001*	*< 0.005*	0.268	0.80	*< 0.0015*	*< 0.05*	*< 0.5*	0.472	*< 0.00001*	0.0108	4.60	*< 0.02*	0.00112	*< 0.00002*	*< 0.00001*	3.44	*< 0.00001*	0.000258	*< 0.0002*
KONA_3	L2180431-3	10/12/2018 14:10	66		18	555	7.01	81.6	42	*< 1*	0.236	*< 0.001*	*< 0.005*	0.277	0.67	*< 0.0015*	*< 0.05*	*< 0.5*	0.431	*< 0.00001*	0.0108	4.59	*< 0.02*	0.00106	*< 0.00002*	*< 0.00001*	3.46	*< 0.00001*	0.000235	*< 0.0002*
KONA_3	L2187510-3	10/25/2018 14:00	68		20	497	7	80	45	*< 1*	0.223	*< 0.001*	*< 0.005*	0.434	0.58	*< 0.0015*	*< 0.05*	*< 0.5*	0.445	*< 0.000005*	0.0226	4.47	0.010	0.00101	*< 0.00001*	*< 0.000005*	3.26	*< 0.000005*	0.000206	*< 0.0001*
KONA_3	L2194529-3	11/8/2018 13:40	70		22	544	7.14	82	40	0.56	0.481	0.0010	0.0217	0.46	0.63	*< 0.0015*	*< 0.05*	*< 0.5*	0.470	*< 0.000005*	0.0308	4.88	0.011	0.00116	*< 0.00001*	*< 0.000005*	3.52	0.0000051	0.000200	*< 0.0001*
KONA_3	L2200705-3	11/22/2018 10:30	72		24	535	7.09	78.6	42	*< 0.5*	0.216	*< 0.001*	*< 0.005*	0.373	0.58	*< 0.0015*	*< 0.05*	*< 0.5*	0.464	*< 0.000005*	0.0144	4.73	*< 0.01*	0.000859	*< 0.00001*	*< 0.000005*	3.20	*< 0.000005*	0.000174	*< 0.0001*
KONA_3	L2207335-3	12/6/2018 14:45	74		26	543	7.04	78.2	40	0.52	0.207	*< 0.001*	*< 0.005*	0.328	0.53	*< 0.0015*	*< 0.05*	*< 0.5*	0.465	*< 0.000005*	0.0219	5.04	*< 0.01*	0.000975	*< 0.00001*	*< 0.000005*	3.26	*< 0.000005*	0.000155	*< 0.0001*
KONA_3	L2213525-3	12/20/2018 14:25	76		28	901	6.82	524	44	0.59	0.320	*< 0.001*	*< 0.005*	0.083	232	*< 0.0015*	*< 0.05*	*< 0.5*	0.267	*< 0.00001*	0.0024	2.48	*< 0.02*	0.0189	*< 0.00002*	*< 0.00001*	62.5	0.000054	0.00493	*< 0.0002*
KONA_3	L2217203-3	1/5/2019 11:35	78		30	859	6.06	1020	20	0.61	0.444	*< 0.005*	*< 0.025*	0.020	557	*< 0.01*	*< 0.25*	*< 2.5*	0.13	*< 0.00005*	*< 0.005*	1.63	*< 0.1*	0.0526	*< 0.0001*	*< 0.00005*	137	0.000110	0.0177	*< 0.001*
KONA_3	L2222132-3	1/17/2019 11:45	80		32	772	6.04	1336	20	*< 0.5*	0.462	*< 0.005*	*< 0.025*	0.0056	756	*< 0.0067*	*< 0.25*	*< 2.5*	0.14	*< 0.000005*	0.00587	1.21	*< 0.01*	0.0808	0.000053	*< 0.000005*	209	0.000177	0.0360	*< 0.0001*
KONA_3	L2227544-3	1/31/2019 10:30	82		34	771	6.14	1509	17	0.62	0.427	*< 0.005*	*< 0.025*	0.0194	893	*< 0.0015*	*< 0.25*	*< 2.5*	0.14	*< 0.0001*	*< 0.01*	0.939	*< 0.2*	0.0884	*< 0.0002*	*< 0.0001*	248	0.00017	0.0499	*< 0.002*

Appendix A2: Granite Column (Kona 1-4) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**
KONA_3	L2233141-3	2/14/2019 14:20	84		36	770	6.12	1566	20	*< 0.5*	0.358	*< 0.01*	*< 0.05*	0.014	987	*< 0.0015*	*< 0.5*	*< 5*	*< 0.2*	*< 0.0001*	0.010	0.890	*< 0.2*	0.0897	*< 0.0002*	*< 0.0001*	264	0.00018	0.0638	*< 0.002*
KONA_3	L2238565-3	2/28/2019 15:15	86		38	785	5.99	1596	19	0.61	0.310	*< 0.005*	*< 0.025*	0.0324	969	*< 0.0015*	*< 0.25*	*< 2.5*	0.12	*< 0.00005*	0.0300	1.03	*< 0.1*	0.0974	*< 0.0001*	*< 0.00005*	299	0.000165	0.0735	*< 0.001*
KONA_3	L2244540-3	3/14/2019 14:30	88		40	764	6.08	1610	18	*< 0.5*	0.301	*< 0.005*	*< 0.025*	*< 0.02*	991	*< 0.0015*	*< 0.25*	*< 2.5*	0.10	*< 0.00005*	0.0053	1.33	*< 0.1*	0.106	*< 0.0001*	*< 0.00005*	294	0.000159	0.0674	*< 0.001*
KONA_3	L2250817-3	3/28/2019 15:00	90		42	738	5.98	1614	16	0.54	0.292	*< 0.005*	*< 0.025*	0.0547	969	*< 0.01*	*< 0.25*	*< 2.5*	0.12	*< 0.00005*	0.0090	1.32	*< 0.1*	0.0968	*< 0.0001*	*< 0.00005*	345	0.000140	0.0762	*< 0.001*
KONA_3	L2257457-3	4/11/2019 15:00	92		44	577	5.98	1597	13	0.74	0.320	*< 0.01*	*< 0.05*	0.0059	1000	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.00005*	0.0124	0.251	*< 0.1*	0.0943	*< 0.0001*	*< 0.00005*	343	0.000149	0.0588	*< 0.001*
KONA_3	L2263301-3	4/25/2019 14:45	94		46	765	5.97	1646	15	0.69	0.275	*< 0.005*	*< 0.025*	0.0131	962	*< 0.0015*	*< 0.25*	*< 2.5*	0.14	*< 0.00005*	0.0163	0.731	*< 0.1*	0.0769	*< 0.0001*	*< 0.00005*	334	0.000165	0.0427	*< 0.001*
KONA_4	L1955323-4	7/7/2017 13:00	0	0		524	7.53	365	55	3.50	0.150	*< 0.001*	*< 0.005*	0.0026	37.2	*< 0.0015*	*< 0.05*	20.5	0.331	*< 0.000005*	0.00393	0.132	0.177	0.0390	*< 0.00001*	*< 0.000005*	36.7	0.0000152	0.000788	*< 0.0001*
KONA_4	L1969885-4	8/3/2017 13:50	4	4		467	7.39	388	132	2.59	0.234	*< 0.001*	*< 0.005*	0.0021	34.2	*< 0.0015*	*< 0.05*	16.5	0.329	*< 0.000005*	0.00271	0.259	0.182	0.0415	0.000014	*< 0.000005*	39.8	0.0000275	0.00108	*< 0.0001*
KONA_4	L1977048-4	8/17/2017 12:25	6	6		674	7.36	335	154	2.22	0.214	*< 0.001*	*< 0.005*	0.0084	18.7	*< 0.0015*	*< 0.05*	9.16	0.327	*< 0.000005*	0.00315	0.452	0.139	0.0428	*< 0.00001*	*< 0.000005*	33.6	0.0000247	0.00126	*< 0.0001*
KONA_4	L1984769-4	8/31/2017 14:00	8	8		623	7.32	288.1	156	1.31	0.234	*< 0.001*	*< 0.005*	0.0111	10.3	*< 0.0015*	*< 0.05*	4.85	0.354	*< 0.000005*	0.00494	0.445	0.119	0.0363	*< 0.00001*	*< 0.000005*	27.0	0.0000185	0.00118	*< 0.0001*
KONA_4	L1992087-4	9/14/2017 14:55	10	10		723	7.24	240.9	130	0.77	0.216	*< 0.001*	*< 0.005*	0.0041	4.39	*< 0.0015*	*< 0.05*	*< 0.5*	0.391	*< 0.000005*	0.00329	0.489	0.087	0.0286	0.000012	*< 0.000005*	21.3	0.0000110	0.000938	*< 0.0001*
KONA_4	L1999487-4	9/28/2017 11:25	12	12		512	7.32	225.6	133	0.54	0.235	*< 0.001*	*< 0.005*	0.0147	3.30	*< 0.0015*	*< 0.05*	0.94	0.395	*< 0.000005*	0.00405	0.429	0.071	0.0299	*< 0.00001*	*< 0.000005*	21.4	0.0000123	0.000930	*< 0.0001*
KONA_4	L2007130-4	10/13/2017 11:25	14	14		547	7.33	201.2	115	0.57	0.209	*< 0.001*	*< 0.005*	0.0094	3.40	*< 0.0015*	*< 0.05*	0.62	0.416	*< 0.000005*	0.00286	0.369	0.059	0.0271	*< 0.00001*	*< 0.000005*	19.2	0.0000179	0.000878	*< 0.0001*
KONA_4	L2014335-4	10/26/2017 11:50	16	16		228	7.22	114.1	67	*< 0.5*	0.0186	*< 0.001*	*< 0.005*	*< 0.002*	1.65	*< 0.0015*	*< 0.05*	*< 0.5*	0.224	*< 0.000005*	0.00297	0.247	0.023	0.0113	0.000010	*< 0.000005*	9.31	*< 0.000005*	0.000473	*< 0.0001*
KONA_4	L2020126-4	11/8/2017 12:30	18	18		534	7.35	113.2	65	0.77	*< 0.005*	*< 0.001*	*< 0.005*	0.0050	2.15	*< 0.0015*	*< 0.05*	*< 0.5*	0.283	*< 0.000005*	*< 0.003*	0.260	0.023	0.0137	0.000010	*< 0.000005*	9.64	0.0000061	0.000483	*< 0.0001*
KONA_4	L2026623-4	11/23/2017 14:15	20	20		595	7.32	166.5	97	*< 0.5*	0.145	*< 0.001*	*< 0.005*	0.0028	2.14	*< 0.0015*	*< 0.05*	*< 0.5*	0.352	*< 0.000005*	0.00296	0.334	0.031	0.0179	*< 0.00001*	*< 0.000005*	15.4	*< 0.000005*	0.000705	*< 0.0001*
KONA_4	L2031965-4	12/6/2017 14:05	22	22		513	7.35	174.3	93	0.51	0.179	*< 0.001*	*< 0.005*	0.0142	2.39	*< 0.0015*	*< 0.05*	*< 0.5*	0.387	*< 0.000005*	0.00250	0.368	0.027	0.0197	*< 0.00001*	*< 0.000005*	16.6	0.0000113	0.000709	*< 0.0001*
KONA_4	L2038563-4	12/21/2017 13:50	24	24		616	7.78	160.8	97	*< 0.5*	0.140	*< 0.001*	*< 0.005*	0.0081	1.78	*< 0.0015*	*< 0.05*	*< 0.5*	0.415	*< 0.000005*	0.00185	0.429	0.024	0.0201	*< 0.00001*	*< 0.000005*	14.2	0.0000131	0.000647	*< 0.0001*
KONA_4	L2041649-4	1/4/2018 13:05	26	26		442	7.34	141.6	82	0.80	0.109	*< 0.001*	*< 0.005*	0.0028	3.21	*< 0.0015*	*< 0.05*	*< 0.5*	0.352	*< 0.000005*	0.00243	0.268	0.020	0.0157	*< 0.00001*	*< 0.000005*	12.6	0.0000080	0.000625	*< 0.0001*
KONA_4	L2046871-4	1/18/2018 11:25	28	28		531	7.36	155.5	91	*< 0.5*	0.152	*< 0.001*	*< 0.005*	0.0073	2.72	*< 0.0015*	*< 0.05*	*< 0.5*	0.392	*< 0.000005*	0.00312	0.351	0.021	0.0179	*< 0.00001*	*< 0.000005*	14.4	0.0000149	0.000649	*< 0.0001*
KONA_4	L2052061-4	2/1/2018 12:10	30	30		547	7.3	155.6	94	0.75	0.155	*< 0.001*	*< 0.005*	0.0117	2.48	*< 0.0015*	*< 0.05*	*< 0.5*	0.420	*< 0.000005*	0.00248	0.384	0.019	0.0171	0.000011	*< 0.000005*	14.9	0.0000114	0.000640	*< 0.0001*
KONA_4	L2057381-4	2/15/2018 11:35	32	32		511	7.38	147.4	86	0.58	0.122	*< 0.001*	*< 0.005*	0.0076	2.42	*< 0.0015*	*< 0.05*	*< 0.5*	0.406	*< 0.000005*	0.00231	0.366	0.017	0.0164	*< 0.00001*	*< 0.00001*	14.0	0.0000108	0.000549	*< 0.0001*
KONA_4	L2062788-4	3/1/2018 13:25	34	34		559	7.22	116	81	*< 0.5*	0.0390	*< 0.001*	*< 0.005*	0.0076	1.90	*< 0.0015*	*< 0.05*	*< 0.5*	0.339	*< 0.000005*	0.00331	0.314	0.013	0.0118	*< 0.00001*	*< 0.000005*	10.7	0.0000094	0.000452	*< 0.0001*
KONA_4	L2068449-4	3/15/2018 11:40	36	36		548	7.27	114.9	81	*< 0.5*	0.0306	*< 0.001*	*< 0.005*	0.0034	1.95	*< 0.0015*	*< 0.05*	*< 0.5*	0.332	*< 0.000005*	0.00403	0.295	0.011	0.0116	*< 0.00001*	*< 0.000005*	9.39	*< 0.000005*	0.000425	*< 0.0001*
KONA_4	L2074311-4	3/29/2018 11:20	38	38		364	7.37	126.3	76	*< 0.5*	0.0646	*< 0.001*	*< 0.005*	0.0125	2.58	*< 0.0015*	*< 0.05*	*< 0.5*	0.354	*< 0.000005*	0.00201	0.283	0.012	0.0137	0.000014	0.0000095	11.2	0.0000116	0.000509	*< 0.0001*
KONA_4	L2079620-4	4/12/2018 11:00	40	40		576	7.21	125.4	74	*< 0.5*	0.0535	*< 0.001*	*< 0.005*	0.0098	2.02	*< 0.0015*	*< 0.05*	*< 0.5*	0.366	*< 0.000005*	0.00332	0.320	0.013	0.0133	*< 0.00001*	*< 0.000005*	11.6	0.0000083	0.000439	*< 0.0001*
KONA_4	L2085708-4	4/26/2018 13:40	42	42		552	7.23	126.8	73	*< 0.5*	0.0660	*< 0.001*	*< 0.005*	0.0162	1.89	*< 0.0015*	*< 0.05*	*< 0.5*	0.370	*< 0.000005*	0.00364	0.354	0.012	0.0138	*< 0.00001*	*< 0.000005*	11.6	0.0000084	0.000426	*< 0.0001*
KONA_4	L2092801-4	5/10/2018 11:15	44	44		571	7.32	128.3	76	*< 0.5*	0.0735	*< 0.001*	*< 0.005*	0.0235	1.72	*< 0.0015*	*< 0.05*	*< 0.5*	0.389	*< 0.000005*	0.00691	0.391	0.013	0.0138	*< 0.00001*	*< 0.000005*	12.2	0.0000117	0.000464	*< 0.0001*
KONA_4	L2100224-4	5/24/2018 14:00	46	46		476	7.23	131.8	80	0.54	0.0937	*< 0.001*	*< 0.005*	0.0259	2.01	*< 0.0015*	*< 0.05*	*< 0.5*	0.423	*< 0.000005*	0.00432	0.455	0.012	0.0150	*< 0.00001*	*< 0.000005*	11.5	0.0000084	0.000458	*< 0.0001*
KONA_4	L2108434-4	6/7/2018 13:30	48		0	499	7.51	126.8	86	0.51	0.0916	*< 0.001*	*< 0.005*	0.0187	1.78	*< 0.0015*	*< 0.05*	*< 0.5*	0.429	*< 0.000005*	0.00365	0.440	0.014	0.0136	*< 0.00001*	*< 0.000005*	11.5	0.0000095	0.000433	*< 0.0001*
KONA_4	L2116986-4	6/21/2018 14:00	50		2	486	7.55	128.4	79	*< 1*	0.0691	*< 0.001*	*< 0.005*	0.0412	1.78	*< 0.0015*	*< 0.05*	*< 0.5*	0.436	*< 0.000005*	0.00565	0.391	0.011	0.0129	*< 0.00001*	*< 0.000005*	10.8	0.0000074	0.000379	*< 0.0001*
KONA_4	L2125321-4	7/6/2018 11:30	52		4	487	7.6	128	76	1.3	0.0591	*< 0.001*	*< 0.005*	0.0214	1.85	*< 0.0015*	*< 0.05*	*< 0.5*	0.434	*< 0.000005*	0.00492	0.413	0.011	0.0126	*< 0.00001*	*< 0.000005*	10.5	0.0000100	0.000307	*< 0.0001*
KONA_4	L2132784-4	7/19/2018 14:45	54		6	488	7.66	127.7	87	0.63	0.0754	*< 0.001*	*< 0.005*	0.0246	1.75	*< 0.0015*	*< 0.05*	*< 0.5*	0.455	*< 0.000005*	0.00695	0.444	0.011	0.0120	*< 0.00001*	*< 0.000005*	10.7	0.0000088	0.000233	*< 0.0001*
KONA_4	L2140795-4	8/2/2018 13:30	56		8	482	7.52	125.7	73	1.7	0.0721	0.0015	*< 0.005*	0.0187	1.77	*< 0.0015*	*< 0.05*	*< 0.5*	0.449	*< 0.000005*	0.00501	0.450	0.012	0.0122	*< 0.00001*	*< 0.000005*	10.8	0.0000086	0.000169	*< 0.0001*
KONA_4	L2148482-4	8/16/2018	58		10	496	7.58	127.8	82	*< 0.5*	0.0499	*< 0.001*	*< 0.005*	0.0287	1.41	*< 0.0015*	*< 0.05*	*< 0.5*	0.458	*< 0.000005*	0.00487	0.474	0.011	0.0112	*< 0.00001*	*< 0.000005*	9.93	0.0000085	0.000112	*< 0.0001*
KONA_4	L2156461-4	8/30/2018 14:20	60		12	489	7.45	121.6	70	*< 1*	0.0483	*< 0.001*	0.0061	0.0319	1.36	*< 0.0015*	*< 0.05*	*< 0.5*	0.449	*< 0.000005*	0.00541	0.545	0.011	0.0113	*< 0.00001*	*< 0.000005*	9.83	0.0000125	0.0000758	*< 0.0001*
KONA_4	L2164110-4	9/13/2018 11:45	62		14	496	7.46	121.1	71	0.89	0.0594	*< 0.001*	*< 0.005*	0.0299	1.47	*< 0.0015*	*< 0.05*	*< 0.5*	0.454	*< 0.000005*	0.00380	0.569	0.010	0.0106	*< 0.00001*	*< 0.000005*	10.2	0.0000088	0.0000659	*< 0.0001*
KONA_4	L2172409-4	9/27/2018 14:00	64		16	550	7.46	115.8	65	*< 0.5*	0.0389	*< 0.001*	*< 0.005*	0.0392	1.21	*< 0.0015*	*< 0.05*	*< 0.5*	0.474	*< 0.000005*	0.00513	0.564	*< 0.01*	0.00877	*< 0.00001*	*< 0.000005*	9.10	0.0000068	0.0000468	*< 0.0001*
KONA_4	L2180431-4	10/12/2018 14:10	66		18	548	7.35	114.8	67	1.1	0.0447	*< 0.001*	*< 0.005*	0.0415	1.00	*< 0.0015*	*< 0.05*	*< 0.5*	0.438	*< 0.000005*	0.00635	0.554	*< 0.01*	0.00812	*< 0.00001*	*< 0.000005*	9.17	*< 0.000005*	0.0000360	*< 0.0001*
KONA_4	L2187510-4	10/25/2018 14:00	68		20	490	7.48	114	65	*< 1*	0.0389	*< 0.001*	*< 0.005*	0.0316	0.87	*< 0.0015*	*< 0.05*	*< 0.5*	0.462	*< 0.000005*	0.00837	0.568	*< 0.01*	0.00732	*< 0.00001*	*< 0.000005*	8.76	0.0000068	0.0000412	0.00022
KONA_4	L2194529-4	11/8/2018 13:40	70		22	540	7.52	111.5	58	0.56	0.0386	0.0011	*< 0.005*	0.0376	0.92	*< 0.0015*	*< 0.05*	*< 0.5*	0.472	*< 0.000005*	0.00852	0.609	*< 0.01*	0.00733	*< 0.00001*	*< 0.000005*	8.42	0.0000061	0.0000270	*< 0.0001*
KONA_4	L2200705-4	11/22/2018 10:30	72		24	531	7.43	105.5	59	*< 0.5*	0.0212	*< 0.001*	*< 0.005*	0.0538	0.82	*< 0.0015*	*< 0.05*	*< 0.5*	0.462	*< 0.000005*	0.00728	0.606	*< 0.01*	0.00651	*< 0.00001*	*< 0.000005*	7.99	*< 0.000005*	0.0000249	*< 0.0001*
KONA_4	L2207335-4	12/6/2018 14:45	74		26	529	7.35	105.2	58	*< 0.5*	0.0240	*< 0.001*	*< 0.005*	0.0436	0.80	*< 0.0015*	*< 0.05*	*< 0.5*	0.467	*< 0.000005*	0.00618	0.614	*< 0.01*	0.00689	*< 0.00001*	*< 0.000005*	8.28	0.0000056	0.0000258	*< 0.0001*
KONA_4	L2213525-4	12/20/2018 14:25	76		28	865	7.41	423	54	0.58	*< 0.005*	*< 0.001*	*< 0.005*	0.0180	162	*< 0.0015*	*< 0.05*	*< 0.5*	0.371	*< 0.000005*	0.00134	0.699	*< 0.01*	0.0428	*< 0.00001*	*< 0.000005*	56.3	0.0000426	0.00157	*< 0.0001*
KONA_4	L2217203-4	1/5/2019 11:35	78		30	799	6.54	1004	31	*< 0.5*	0.0913	*< 0.005*	*< 0.025*	*< 0.01*	545	*< 0.0067*	*< 0.25*	*< 2.5*	0.20	*< 0.000025*	0.0026	0.185	*< 0.05*	0.154	*< 0.00005*	*< 0.000025*	149	0.000078	0.00692	*< 0.0005*
KONA_4	L2222132-4	1/17/2019 11:45	80		32	791	6.13	1421	20	*< 0.5*	0.139	*< 0.005*	*< 0.025*	*< 0.002*	816	*< 0.0067*	*< 0.25*	*< 2.5*	0.13	*< 0.000005*	0.00106	0.0558	*< 0.01*	0.250	0.000066	*< 0.000005*	244	0.0000959	0.0163	*< 0.0001*
KONA_4	L2227544-4	1/31/2019 10:30	82		34	786	6.01	1591	38	*< 0.5*	0.161	*< 0.01*	*< 0.05*	*< 0.003*	920	*< 0.0015*	*< 0.5*	*< 5*	*< 0.2*	*< 0.00005*	0.0069	0.0287	*< 0.1*	0.138	0.00012	*< 0.00005*	286	0.000116	0.0167	*< 0.001*
KONA_4	L2233141-4	2/14/2019 14:20	84		36	735	6.05	1601	17	*< 0.5*	0.149	*< 0.01*	*< 0.05*	0.0020	1010	*< 0.0015*	*< 0.5*	*< 5*	*< 0.2*	*< 0.00005*	0.0068	0.0287	*< 0.1*	0.0891	0.00022	*< 0.00005*	290	0.000085	0.0148	*< 0.001*
KONA_4	L2238565-4	2/28/2019 15:15	86		38	735	5.96	1609	17	*< 0.5*	0.136	*< 0.005*	*< 0.025*	*< 0.002*	984	*< 0.0015*	*< 0.25*	*< 2.5*	0.13	*< 0.000025*	0.0135	0.0162	*< 0.05*	0.0760	0.000186	*< 0.000025*	317	0.000075	0.0110	*< 0.0005*
KONA_4	L2244540-4	3/14/2019 14:30	88		40	720	5.96	1616	14	*< 0.5*	0.126	*< 0.005*	*< 0.025*	*< 0.002*	968	*< 0.0015*	*< 0.25*	*< 2.5*	0.13	*< 0.000025*	0.0083	0.0142	*< 0.05*	0.0726	0.000153	*< 0.000025*	300	0.000058	0.00760	0.00050
KONA_4	L2250817-4	3/28/2019 15:00	90		42	702	5.88	1619	18	*< 0.5*	0.132	*< 0.005*	*< 0.025*	*< 0.002*	986	*< 0.01*	*< 0.25*	*< 2.5*	0.14	*< 0.000025*	0.0102	0.0115	*< 0.05*	0.0589	0.000158	*< 0.000025*	359	0.000060	0.00718	*< 0.0005*
KONA_4	L2257457-4	4/11/2019 15:00	92		44	707	6.03	1611	16	0.56	0.110	*< 0.01*	*< 0.05*	*< 0.002*	1010	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.000025*	0.0054	0.00598	*< 0.05*	0.0520	0.000158	*< 0.000025*	334	0.000041	0.00618	*< 0.0005*
KONA_4	L2263301-4	4/25/2019 14:45	94		46	730	6.06	1648	18	0.57	0.102	*< 0.005*	*< 0.025*	*< 0.002*	956	*< 0.0015*	*< 0.25*	*< 2.5*	0.14	*< 0.000025*	0.0048	0.00674	*< 0.05*	0.0495	0.000110	*< 0.000025*	344	0.000039	0.00513	*< 0.0005*

Notes:
Results in blue italics are below the indicated detection limit

Appendix A2: Granite Column (Kona 1-4) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cs**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
KONA_1	L1955323-1	7/7/2017 13:00	0.000429	0.00019	0.0064	0.0000106	7.42	0.00284	2.08	0.994	0.00164	7.81	0.000477	*< 0.05*	0.0000181	0.0130	0.00415	4.23	0.000085	7.05	0.000021	0.0427	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000213	0.00125	0.000150	0.00012	0.00209	*< 0.00006*
KONA_1	L1969885-1	8/3/2017 13:50	0.000517	0.00044	0.0580	*< 0.000005*	8.64	0.00303	2.92	1.68	0.00169	9.11	0.000903	*< 0.05*	0.000157	0.0166	0.00285	3.82	0.000102	9.77	0.000014	0.0541	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000274	0.00197	0.000185	0.00011	0.00339	*< 0.00006*
KONA_1	L1977048-1	8/17/2017 12:25	0.000396	*< 0.0001*	0.130	0.0000061	6.77	0.00251	2.15	1.17	0.00124	7.89	0.000546	*< 0.05*	0.0000087	0.0128	0.00192	2.56	0.000241	7.59	*< 0.00001*	0.0439	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000215	0.00125	0.000125	*< 0.0001*	0.00132	*< 0.00006*
KONA_1	L1984769-1	8/31/2017 14:00	0.000399	0.00014	0.181	*< 0.000005*	6.97	0.00214	2.20	1.29	0.00124	8.04	0.000487	*< 0.05*	0.0000136	0.0127	0.00194	1.73	0.000057	8.22	*< 0.00001*	0.0408	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000209	0.00113	0.000150	*< 0.0001*	0.00241	*< 0.00006*
KONA_1	L1992087-1	9/14/2017 14:55	0.000334	*< 0.0001*	0.201	*< 0.000005*	6.03	0.00195	1.97	1.12	0.00130	7.55	0.000458	*< 0.05*	0.0000084	0.0107	0.00190	1.52	0.000159	6.70	*< 0.00001*	0.0372	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000198	0.000981	0.000148	*< 0.0001*	0.00097	*< 0.00006*
KONA_1	L1999487-1	9/28/2017 11:25	0.000330	*< 0.0001*	0.200	0.0000100	6.13	0.00197	2.11	1.12	0.00128	8.15	0.000490	*< 0.05*	0.0000154	0.0111	0.00202	1.33	*< 0.00004*	7.55	*< 0.00001*	0.0397	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000203	0.000910	0.000146	*< 0.0001*	0.00060	*< 0.00006*
KONA_1	L2007130-1	10/13/2017 11:25	0.000257	*< 0.0001*	0.138	*< 0.000005*	4.83	0.00150	1.82	0.898	0.00117	6.97	0.000417	*< 0.05*	0.0000104	0.00913	0.00177	0.81	*< 0.00004*	6.23	*< 0.00001*	0.0329	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000158	0.000664	0.000125	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_1	L2014335-1	10/26/2017 11:50	0.000235	0.00013	0.152	*< 0.000005*	4.48	0.00137	1.61	0.766	0.00125	7.25	0.000373	*< 0.05*	0.0000274	0.00814	0.00171	*< 0.5*	0.000070	5.93	*< 0.00001*	0.0319	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000142	0.000526	0.000180	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_1	L2020126-1	11/8/2017 12:30	0.000229	*< 0.0001*	0.178	0.0000050	4.79	*< 0.0025*	1.64	0.664	0.00122	6.96	0.000413	*< 0.05*	*< 0.000005*	0.00850	0.00172	0.66	*< 0.00004*	6.94	*< 0.00001*	0.0341	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000148	0.000563	0.000114	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_1	L2026623-1	11/23/2017 14:15	0.000208	*< 0.0001*	0.255	0.0000055	4.28	0.00142	1.49	0.547	0.00119	6.71	0.000371	*< 0.05*	0.0000074	0.00781	0.00177	*< 0.5*	*< 0.00004*	6.42	*< 0.00001*	0.0318	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000131	0.000542	0.000094	*< 0.0001*	0.00092	*< 0.00006*
KONA_1	L2031965-1	12/6/2017 14:05	0.000205	*< 0.0001*	0.218	0.0000058	4.74	0.00175	1.77	0.521	0.00147	7.19	0.000283	*< 0.05*	0.0000100	0.00883	0.00172	*< 1*	*< 0.00004*	6.82	*< 0.00001*	0.0327	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000141	0.000528	0.000159	*< 0.0001*	0.00061	*< 0.00006*
KONA_1	L2038563-1	12/21/2017 13:50	0.000209	0.00012	0.429	*< 0.000005*	4.30	0.00153	1.52	0.413	0.00100	7.03	0.000345	*< 0.05*	0.0000074	0.00771	0.00195	*< 0.5*	*< 0.00004*	6.15	*< 0.00001*	0.0311	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000113	0.000580	0.000089	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_1	L2041649-1	1/4/2018 13:05	0.000207	*< 0.0001*	0.261	*< 0.000005*	4.08	0.00116	1.59	0.422	0.000983	6.80	0.000322	*< 0.05*	*< 0.00002*	0.00748	0.00171	*< 0.5*	*< 0.00004*	6.50	*< 0.00002*	0.0309	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000124	0.000486	0.000068	*< 0.0001*	*< 0.0005*	*< 0.00006*
KONA_1	L2046871-1	1/18/2018 11:25	0.000209	*< 0.0002*	0.365	*< 0.000005*	4.01	0.0012	1.63	0.329	0.00131	7.16	0.00028	*< 0.1*	*< 0.00001*	0.00769	0.00194	*< 1*	*< 0.00008*	6.61	*< 0.00002*	0.0306	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000110	0.000513	0.00016	*< 0.0002*	*< 0.001*	*< 0.00012*
KONA_1	L2052061-1	2/1/2018 12:10	0.000234	*< 0.0002*	0.295	*< 0.000005*	4.75	*< 0.001*	1.61	0.331	0.00148	6.96	0.00029	*< 0.1*	*< 0.00001*	0.00789	0.00195	*< 1*	*< 0.00008*	7.17	*< 0.00002*	0.0320	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000117	0.000515	0.00011	*< 0.0002*	*< 0.001*	*< 0.00012*
KONA_1	L2057381-1	2/15/2018 11:35	0.000210	*< 0.0002*	0.248	*< 0.000005*	4.39	0.0018	1.67	0.407	0.00149	6.83	0.00025	*< 0.1*	*< 0.00001*	0.00794	0.00180	*< 1*	*< 0.00008*	7.25	*< 0.00002*	0.0315	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000105	0.000489	0.00012	*< 0.0002*	*< 0.001*	*< 0.00012*
KONA_1	L2062788-1	3/1/2018 13:25	0.000204	*< 0.0005*	0.262	*< 0.000005*	4.08	*< 0.0025*	1.70	0.424	0.00217	7.14	0.00036	*< 0.25*	*< 0.000025*	0.0080	0.00184	*< 2.5*	*< 0.0002*	7.07	*< 0.00005*	0.0303	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000112	0.000625	*< 0.00025*	*< 0.0005*	*< 0.00025*	*< 0.0003*
KONA_1	L2068449-1	3/15/2018 11:40	0.00020	0.0036	0.216	*< 0.000005*	4.13	*< 0.005*	1.50	0.347	0.00156	6.93	*< 0.0005*	*< 0.5*	*< 0.00005*	0.0078	0.00150	*< 5*	*< 0.0004*	7.35	*< 0.0001*	0.0317	*< 0.002*	*< 0.001*	*< 0.003*	0.000067	0.000674	*< 0.0005*	*< 0.001*	*< 0.005*	*< 0.0006*
KONA_1	L2074311-1	3/29/2018 11:20	0.000247	*< 0.0001*	0.0920	*< 0.000005*	4.69	0.00144	1.73	0.268	0.00193	7.21	0.000271	0.051	0.0000084	0.00878	0.00182	*< 0.5*	*< 0.00004*	9.19	*< 0.00001*	0.0342	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000110	0.000529	0.000185	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_1	L2079620-1	4/12/2018 11:00	0.000220	*< 0.0001*	0.270	*< 0.000005*	4.37	0.00091	1.63	0.346	0.00176	6.98	0.000262	*< 0.05*	*< 0.000015*	0.00827	0.00176	*< 0.5*	*< 0.00004*	7.43	0.000012	0.0299	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000107	0.000504	0.000131	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_1	L2085708-1	4/26/2018 13:00	0.000229	*< 0.0001*	0.152	*< 0.000005*	4.64	0.00089	1.67	0.392	0.00176	6.86	0.000256	*< 0.05*	*< 0.000005*	0.00857	0.00157	*< 0.5*	*< 0.00004*	8.00	*< 0.00001*	0.0296	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000954	0.000442	0.000162	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_1	L2092801-1	5/10/2018 11:15	0.000212	*< 0.0002*	0.119	*< 0.000005*	4.13	0.0014	1.54	0.345	0.00203	6.61	0.00016	*< 0.1*	0.000015	0.00797	0.00176	*< 1*	*< 0.00008*	8.79	*< 0.00002*	0.0271	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000888	0.000467	0.00036	*< 0.0002*	*< 0.002*	*< 0.00012*
KONA_1	L2100224-1	5/24/2018 14:00	0.000239	*< 0.0005*	0.0567	*< 0.000005*	4.64	*< 0.0025*	1.80	0.306	0.00231	7.40	*< 0.00025*	*< 0.25*	*< 0.000025*	0.0096	0.00172	*< 2.5*	*< 0.0002*	9.63	*< 0.00005*	0.0306	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000099	0.000452	0.00029	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2108434-1	6/7/2018 13:30	0.000216	*< 0.0005*	0.0802		4.52	*< 0.0025*	1.73	0.267	0.00231	7.10	*< 0.00025*	*< 0.25*	*< 0.000025*	0.0084	0.00166	*< 2.5*	*< 0.0002*	10.5	*< 0.00005*	0.0289	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000093	0.000397	*< 0.00025*	*< 0.0005*	0.0417	*< 0.0003*
KONA_1	L2116986-1	6/21/2018 14:00	0.000260	*< 0.0001*	0.0745		5.04	0.00148	1.90	0.266	0.00244	7.63	0.000221	0.060	0.0000097	0.0100	0.00171	*< 0.5*	*< 0.00004*	10.8	*< 0.00001*	0.0317	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000104	0.000408	0.000155	*< 0.0001*	0.0013	*< 0.00006*
KONA_1	L2125321-1	7/6/2018 11:30	0.000225	*< 0.0005*	0.0283		4.63	*< 0.0025*	1.72	0.266	0.00258	7.18	*< 0.00025*	*< 0.25*	*< 0.000025*	0.0088	0.00160	*< 2.5*	*< 0.0002*	11.7	*< 0.00005*	0.0302	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000091	0.000378	0.00032	*< 0.0005*	*< 0.005*	*< 0.0003*
	L2140795-1	8/2/2018 13:30	0.000229	0.00093	0.128		4.69	*< 0.0025*	1.80	0.279	0.00270	7.46	0.00046	*< 0.25*	*< 0.000025*	0.0093	0.00169	*< 2.5*	*< 0.0002*	10.6	*< 0.00005*	0.0307	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000094	0.000363	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2148482-1	8/16/2018	0.000216	*< 0.0005*	0.0566		4.23	*< 0.0025*	1.75	0.328	0.00263	7.07	0.00029	*< 0.25*	*< 0.000025*	0.0088	0.00180	*< 2.5*	*< 0.0002*	11.1	*< 0.00005*	0.0269	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000085	0.000321	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2156461-1	8/30/2018 14:20	0.000222	*< 0.0005*	0.0555		4.22	*< 0.0025*	1.75	0.308	0.00274	7.18	0.000260	*< 0.25*	0.0000054	0.0083	0.00157	*< 2.5*	*< 0.0002*	10.2	*< 0.00005*	0.0299	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000090	0.000308	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2164110-1	9/13/2018 11:45	0.000207	*< 0.0005*	0.0682		4.78	*< 0.0025*	1.85	0.343	0.00268	7.79	*< 0.00025*	*< 0.25*	*< 0.000025*	0.0097	0.00157	*< 2.5*	*< 0.0002*	11.2	*< 0.00005*	0.0302	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000082	0.000269	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2172409-1	9/27/2018 14:00	0.00020	*< 0.001*	0.089		4.97	*< 0.005*	1.78	0.340	0.00286	7.71	*< 0.0005*	*< 0.5*	*< 0.00005*	0.0084	0.00156	*< 5*	*< 0.0004*	11.1	*< 0.0001*	0.0286	*< 0.002*	*< 0.001*	*< 0.003*	0.000086	0.000249	*< 0.0005*	*< 0.001*	*< 0.01*	*< 0.0006*
KONA_1	L2180431-1	10/12/2018 14:10	0.000201	*< 0.0005*	0.0551		4.28	*< 0.0025*	1.83	0.328	0.00332	7.44	*< 0.00025*	*< 0.25*	*< 0.000025*	0.0085	0.00153	*< 2.5*	*< 0.0002*	12.3	*< 0.00005*	0.0296	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000081	0.000277	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2187510-1	10/25/2018 14:00	0.000187	0.00011	0.0550		4.29	0.00128	1.89	0.346	0.00326	6.92	0.000255	0.082	0.0000128	0.00794	0.00137	*< 0.5*	*< 0.00004*	11.4	*< 0.00001*	0.0297	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000767	0.000270	0.000085	*< 0.0001*	0.0015	*< 0.00006*
KONA_1	L2194529-1	11/8/2018 13:40	0.000166	*< 0.0005*	0.0455		4.14	*< 0.0025*	1.80	0.299	0.00315	7.28	0.00027	*< 0.25*	*< 0.000025*	0.0080	0.00136	*< 2.5*	*< 0.0002*	12.3	*< 0.00005*	0.0278	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000062	0.000241	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2200705-1	11/22/2018 10:30	0.000181	*< 0.0001*	0.0358		4.24	0.00122	1.74	0.328	0.00324	6.56	0.000291	0.089	0.0000106	0.00816	0.00128	*< 0.5*	*< 0.00004*	12.1	*< 0.00001*	0.0286	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000667	0.000216	0.000117	*< 0.0001*	0.0018	*< 0.00006*
KONA_1	L2207335-1	12/6/2018 14:45	0.000187	*< 0.0005*	0.0291		4.13	*< 0.0025*	1.84	0.306	0.00368	6.77	0.00031	*< 0.25*	*< 0.000025*	0.0082	0.00128	*< 2.5*	*< 0.0002*	12.7	*< 0.00005*	0.0274	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000063	0.000214	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
KONA_1	L2213525-1	12/20/2018 14:25	0.000241	*< 0.0005*	0.0485		5.40	*< 0.0025*	4.33	2.03	0.00302	8.59	0.00141	*< 0.25*	*< 0.000025*	0.0105	0.00096	19.5	*< 0.0002*	11.4	*< 0.00005*	0.0872	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000099	0.000166	*< 0.00025*	*< 0.0005*	0.0053	*< 0.0003*
KONA_1	L2217203-1	1/5/2019 11:35	0.000361	*< 0.0005*	1.83		7.54	*< 0.0025*	15.7	16.5	0.00178	10.2	0.00348	*< 0.25*	*< 0.000025*	0.0172	0.00053	111	*< 0.0002*	8.74	*< 0.00005*	0.355	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000205	0.000085	*< 0.00025*	*< 0.0005*	0.0241	*< 0.0003*
KONA_1	L2222132-1	1/17/2019 11:45	0.000437	0.00011	5.48		9.58	0.00285	26.5	32.2	0.00128	11.2	0.00537	*< 0.05*	0.0000095	0.0201	0.000704	242	*< 0.00004*	7.20	*< 0.00001*	0.766	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000419	0.0000591	*< 0.00005*	*< 0.0001*	0.0416	*< 0.00006*
KONA_1	L2227544-1	1/31/2019 10:30	0.00043	*< 0.002*	12.9		8.6	*< 0.01*	25.1	28.2	0.0020	10.6	0.0048	*< 1*	*< 0.0001*	0.0200	0.00046	252	*< 0.0008*	6.9	*< 0.0002*	0.868	*< 0.004*	*< 0.002*	*< 0.006*	0.000478	*< 0.00004*	*< 0.001*	*< 0.002*	0.116	*< 0.0012*
KONA_1	L2233141-1	2/14/2019 14:20	0.00038	*< 0.001*	20.7		8.74	*< 0.005*	23.1	22.7	0.00197	9.65	0.00427	*< 0.5*	*< 0.00005*	0.0201	0.00050	308	*< 0.0004*	6.86	*< 0.0001*	0.941	*< 0.002*	*< 0.001*	*< 0.003*	0.000384	0.000044	*< 0.0005*	*< 0.001*	0.034	*< 0.0006*
KONA_1	L2238565-1	2/28/2019 15:15	0.000420	*< 0.0005*	21.4		7.92	0.0025	24.0	19.3	0.00168	8.90	0.00368	*< 0.25*	0.000071	0.0186	0.00052	311	*< 0.0002*	6.21	*< 0.00005*	1.12	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000456	0.000018	*< 0.00025*	*< 0.0005*	0.0278	*< 0.0003*
KONA_1	L2244540-1	3/14/2019 14:30	0.000434	*< 0.0005*	18.4		9.74	*< 0.0025*	20.0	17.1	0.00149	8.36	0.00324	*< 0.25*	*< 0.000025*	0.0186	0.00055	321	*< 0.0002*	6.33	*< 0.00005*	1.22	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000326	0.000019	*< 0.00025*	*< 0.0005*	0.0258	*< 0.0003*
KONA_1	L2250817-1	3/28/2019 15:00	0.000384	*< 0.0005*	21.0		8.35	0.0028	23.0	17.5	0.00133	8.93	0.00322	*< 0.25*	*< 0.000025*	0.0188	0.00041	350	*< 0.0002*	6.78	*< 0.00005*	1.15	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000282	0.000011	*< 0.00025*	*< 0.0005*	0.0265	*< 0.0003*
KONA_1	L2257457-1	4/11/2019 15:00	0.000412	*< 0.0005*	19.1		7.83	0.0028	20.6	16.5	0.00126	8.02	0.00323	*< 0.25*	*< 0.000025*	0.0199	0.00069	350	*< 0.0002*	6.65	*< 0.00005*	1.33	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000279	0.000020	*< 0.00025*	*< 0.0005*	0.0256	*< 0.0003*
KONA_1	L2263301-1	4/25/2019 14:45	0.000417	*< 0.0005*	18.1		7.08	0.0030	19.1	14.9	0.00159	8.32	0.00256	*< 0.25*	*< 0.000025*	0.0179	0.00068	356	*< 0.0002*	6.52	*< 0.00005*	1.44	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000237	0.000023	*< 0.00025*	*< 0.0005*	0.0206	*< 0.0003*
KONA_2	L1955323-2	7/7/2017 13:00	0.000963	0.00018	2.19	0.0000131	11.8	0.00905	4.55	3.56	0.00124	9.63	0.00585	*< 0.05*	0.000125	0.0241	0.00846	24.8	0.000232	13.7	0.000014	0.0799	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000597	0.00292	0.000195	0.00014	0.0466	*< 0.00006*
KONA_2	L1969885-2	8/3/2017 13:50	0.00103	0.00011	3.48	0.0000074	11.6	0.00709	4.85	4.42	0.00176	10.8	0.00531	*< 0.05*	0.0000346	0.0258	0.0102	22.5	0.000136	14.5	*< 0.00001*	0.0828	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000599	0.00348	0.000234	*< 0.0001*	0.0356	*< 0.00006*
KONA_2	L1977048-2	8/17/2017 12:25	0.000763	0.00015	3.25	0.0000107	8.74	0.00504	3.18	3.19	0.000952	8.26	0.00402	*< 0.05*	0.0000094	0.0192	0.0128	14.9	0.000145	11.1	*< 0.00001*	0.0552	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000528	0.00176	0.000232	*< 0.0001*	0.0269	*< 0.00006*
KONA_2	L1984769-2	8/31/2017 14:00	0.000664	*< 0.0001*	2.58	0.0000116	8.02	0.00407	2.70	2.75	0.000904	7.67	0.00280	*< 0.05*	0.0000496	0.0173	0.0127	11.8	0.000083	11.3	*< 0.00001*	0.0439	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000419	0.00138	0.000220	*< 0.0001*	0.0198	*< 0.00006*
KONA_2	L1992087-2	9/14/2017 14:55	0.000587	*< 0.0001*	2.26	0.0000167	6.71	0.00331	2.12	2.22	0.000960	6.89	0.00219	*< 0.05*	0.0000060	0.0141	0.0167	8.09	*< 0.00004*	9.35	*< 0.00001*	0.0348	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000391	0.00116	0.000221	*< 0.0001*	0.0150	*< 0.00006*
KONA_2	L1999487-2	9/28/2017 11:25	0.000566	*< 0.0001*	2.10	0.0000136	6.66	0.00293	2.11	2.19	0.00103	7.11	0.00193	*< 0.05*	0.0000071	0.0146	0.0197	7.07	0.000104	10.7	*< 0.00001*	0.0341	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000365	0.00121	0.000254	*< 0.0001*	0.0133	*< 0.00006*
KONA_2	L2007130-2	10/13/2017 11:25	0.000434	0.00019	1.99	0.0000122	5.13	0.00229	1.65	1.75	0.00102	6.10	0.00153	*< 0.05*	0.0000328	0.0120	0.0210	4.64	0.000108	8.69	*< 0.00001*	0.0271	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000285	0.00101	0.000235	*< 0.0001*	0.0112	*< 0.00006*
KONA_2	L2014335-2	10/26/2017 11:50	0.000370	*< 0.0001*	1.76	0.0000137	4.49	0.00195	1.30	1.46	0.00102	5.73	0.00116	*< 0.05*	0.0000093	0.00948	0.0218	2.99	0.000138	7.91	*< 0.00001*	0.0218	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000252	0.000844	0.000297	*< 0.0001*	0.00833	*< 0.00006*
KONA_2	L2020126-2	11/8/2017 12:30	0.000383	*< 0.0001*	1.80	0.0000110	4.74	*< 0.0025*	1.38	1.56	0.00112	5.78	0.00115	*< 0.05*	*< 0.000005*	0.0103	0.0234	2.55	0.000058	8.35	*< 0.00001*	0.0229	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000235	0.000837	0.000196	*< 0.0001*	0.00914	*< 0.00006*
KONA_2	L2026623-2	11/23/2017 14:15	0.000329	0.00011	1.30	0.0000112	4.43	0.00176	1.27	1.60	0.00124	5.75	0.00103	*< 0.05*	0.0000172	0.0100	0.0224	1.62	0.000101	8.30	*< 0.00001*	0.0227	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000181	0.000777	0.000241	*< 0.0001*	0.00860	*< 0.00006*
KONA_2	L2031965-2	12/6/2017 14:05	0.000328	0.00016	1.63	0.0000121	4.24	0.00177	1.28	1.52	0.00130	6.03	0.000946	*< 0.05*	0.0000272	0.00987	0.0207	*< 2*	0.000113	8.13	0.000014	0.0214	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000242	0.000841	0.000283	*< 0.0001*	0.00818	*< 0.00006*
KONA_2	L2038563-2	12/21/2017 13:50	0.000334	0.00011	1.89	0.0000082	3.81	0.00156	1.04	1.33	0.00108	5.75	0.000831	*< 0.05*	*< 0.000005*	0.00855	0.0200	1.01	0.000097	7.12	*< 0.00001*	0.0190	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000189	0.000755	0.000193	*< 0.0001*	0.00651	*< 0.00006*
KONA_2	L2041649-2	1/4/2018 13:05	0.000317	*< 0.0001*	1.45	*< 0.000005*	3.91	0.00113	1.16	1.41	0.00116	5.79	0.000796	*< 0.05*	*< 0.00001*	0.00865	0.0160	0.81	0.000075	7.87	*< 0.00001*	0.0203	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000168	0.000683	0.000207	*< 0.0001*	0.00818	*< 0.00006*
KONA_2	L2046871-2	1/18/2018 11:25	0.000333	*< 0.0005*	1.43	0.0000050	3.85	*< 0.0025*	1.20	1.36	0.00181	6.37	0.00081	*< 0.25*	*< 0.000025*	0.0086	0.0160	*< 2.5*	*< 0.0002*	8.05	*< 0.00005*	0.0261	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000174	0.000842	0.00033	0.00163	0.0064	*< 0.0003*
KONA_2	L2052061-2	2/1/2018 12:10	0.000323	*< 0.0005*	1.35	0.0000054	4.18	*< 0.0025*	1.09	1.33	0.00150	5.92	0.00069	*< 0.25*	*< 0.000025*	0.0084	0.0153	*< 2.5*	*< 0.0002*	7.51	*< 0.00005*	0.0193	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000164	0.000711	*< 0.00025*	*< 0.0005*	0.0062	*< 0.0003*
KONA_2	L2057381-2	2/15/2018 11:35	0.000286	*< 0.0005*	1.47	0.0000082	3.95	0.0027	1.20	1.53	0.00156	6.81	0.00078	*< 0.25*	*< 0.000025*	0.0083	0.0141	*< 2.5*	*< 0.0002*	8.00	*< 0.00005*	0.0203	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000164	0.000683	*< 0.00025*	*< 0.0005*	0.0052	*< 0.0003*
KONA_2	L2062788-2	3/1/2018 13:25	0.000289	*< 0.0005*	1.30	0.0000078	3.28	*< 0.0025*	1.06	1.25	0.00194	5.84	0.00063	*< 0.25*	*< 0.000025*	0.0074	0.0131	*< 2.5*	*< 0.0002*	7.19	*< 0.00005*	0.0175	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000148	0.000657	*< 0.00025*	*< 0.0005*	0.0051	*< 0.0003*

Appendix A2: Granite Column (Kona 1-4) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cs**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
KONA_2	L2068449-2	3/15/2018 11:40	0.00028	< 0.001	1.14	0.0000069	3.43	< 0.005	1.09	1.27	0.00173	6.25	< 0.0005	< 0.5	< 0.00005	0.0082	0.0118	< 5	< 0.0004	7.53	< 0.0001	0.0187	< 0.002	< 0.001	< 0.003	0.000128	0.000720	< 0.0005	< 0.001	< 0.005	< 0.0006
KONA_2	L2074311-2	3/29/2018 11:20	0.000328	< 0.0001	0.793	< 0.000005	3.87	0.00143	1.19	1.46	0.00204	5.99	0.000725	< 0.05	0.0000157	0.00883	0.0116	0.87	0.000048	9.52	< 0.00001	0.0230	< 0.0002	< 0.0001	< 0.0003	0.000146	0.000558	0.000387	< 0.0001	0.0061	< 0.00006
KONA_2	L2079620-2	4/12/2018 11:00	0.000304	0.00153	1.32	< 0.000005	3.45	0.00092	1.08	1.36	0.00190	6.55	0.000673	< 0.05	0.0000842	0.00795	0.0127	0.72	0.000051	7.64	0.000021	0.0185	< 0.0002	< 0.0001	< 0.0003	0.000156	0.000608	0.000267	< 0.0001	0.0066	< 0.00006
KONA_2	L2085708-2	4/26/2018 13:40	0.000284	< 0.0001	1.26	< 0.000005	3.30	0.00158	1.05	1.30	0.00179	6.27	0.000555	< 0.05	< 0.000005	0.00772	0.0110	< 0.5	0.000101	7.64	< 0.00001	0.0174	< 0.0002	< 0.0001	< 0.0003	0.000137	0.000489	0.000253	< 0.0001	0.0049	< 0.00006
KONA_2	L2092801-2	5/10/2018 11:15	0.000266	< 0.0005	1.05	0.0000057	3.02	< 0.0025	0.944	1.21	0.00193	5.76	0.00028	< 0.25	< 0.000025	0.0071	0.0118	< 2.5	< 0.0002	7.77	< 0.00005	0.0156	< 0.001	< 0.0005	< 0.0015	0.000120	0.000494	0.00070	< 0.0005	< 0.005	< 0.0003
KONA_2	L2100224-2	5/24/2018 14:00	0.000309	< 0.0005	0.822	< 0.000005	3.51	< 0.0025	1.16	1.45	0.00235	6.54	0.00039	< 0.25	< 0.000025	0.0086	0.0114	< 2.5	< 0.0002	8.73	< 0.00005	0.0184	< 0.001	< 0.0005	< 0.0015	0.000117	0.000394	0.00039	< 0.0005	< 0.005	< 0.0003
KONA_2	L2108434-2	6/7/2018 13:30	0.000284	< 0.0005	0.455		3.78	< 0.0025	1.19	1.46	0.00202	6.80	0.00052	< 0.25	< 0.000025	0.0090	0.00965	< 2.5	< 0.0002	9.59	< 0.00005	0.0182	< 0.001	< 0.0005	< 0.0015	0.000122	0.000251	< 0.00025	< 0.0005	0.0201	< 0.0003
KONA_2	L2116986-2	6/21/2018 14:00	0.000323	< 0.0001	0.530		3.81	0.00129	1.18	1.52	0.00206	6.91	0.000600	< 0.05	0.0000059	0.00934	0.00977	0.54	< 0.00004	9.09	< 0.00001	0.0186	< 0.0002	< 0.0001	< 0.0003	0.000140	0.000266	0.000306	< 0.0001	0.0050	< 0.00006
KONA_2	L2125321-2	7/6/2018 11:30	0.000275	< 0.0005	0.531		3.39	< 0.0025	1.06	1.35	0.00207	6.46	0.00040	< 0.25	< 0.000025	0.0078	0.00944	< 2.5	< 0.0002	8.98	< 0.00005	0.0167	< 0.001	< 0.0005	< 0.0015	0.000129	0.000232	0.00047	< 0.0005	< 0.005	< 0.0003
KONA_2	L2132784-2	7/19/2018 14:45	0.00028	< 0.001	0.477		3.62	< 0.005	1.16	1.46	0.00241	7.09	0.00052	< 0.5	< 0.00005	0.0083	0.0101	< 5	< 0.0004	9.45	< 0.0001	0.0183	< 0.002	< 0.001	< 0.003	0.000117	0.000244	< 0.0005	< 0.001	0.010	< 0.0006
KONA_2	L2140795-2	8/2/2018 13:30	0.000308	< 0.0005	0.459		3.78	< 0.0025	1.18	1.49	0.00240	7.10	0.00063	< 0.25	< 0.000025	0.0085	0.00995	< 2.5	< 0.0002	9.29	< 0.00005	0.0183	< 0.001	< 0.0005	< 0.0015	0.000137	0.000210	0.00035	< 0.0005	< 0.005	< 0.0003
KONA_2	L2148482-2	8/16/2018	0.000261	< 0.0005	0.514		3.08	< 0.0025	1.03	1.37	0.00236	6.48	0.00047	< 0.25	< 0.000025	0.0075	0.00977	< 2.5	< 0.0002	8.65	< 0.00005	0.0150	< 0.001	< 0.0005	< 0.0015	0.000118	0.000202	< 0.00025	< 0.0005	< 0.005	< 0.0003
KONA_2	L2156461-2	8/30/2018 14:20	0.00030	< 0.001	0.614		3.55	< 0.005	1.21	1.51	0.00268	7.61	0.000436	< 0.5	< 0.00005	0.0089	0.00970	< 5	< 0.0004	9.03	< 0.0001	0.0182	< 0.002	< 0.001	< 0.003	0.000118	0.000203	< 0.0005	< 0.001	< 0.01	< 0.0006
KONA_2	L2164110-2	9/13/2018 11:45	0.00028	< 0.001	0.607		3.55	< 0.005	1.16	1.59	0.00246	7.47	< 0.0005	< 0.5	0.000075	0.0089	0.00943	< 5	< 0.0004	9.44	< 0.0001	0.0176	< 0.002	< 0.001	< 0.003	0.000120	0.000174	0.00052	< 0.001	< 0.01	< 0.0006
KONA_2	L2172409-2	9/27/2018 14:00	0.00024	< 0.001	0.630		3.23	< 0.005	1.11	1.42	0.00248	7.26	< 0.0005	< 0.5	< 0.00005	0.0076	0.00839	< 5	< 0.0004	9.33	< 0.0001	0.0163	< 0.002	< 0.001	< 0.003	0.000104	0.000142	< 0.0005	< 0.001	< 0.01	< 0.0006
KONA_2	L2180431-2	10/12/2018 14:10	0.00025	< 0.001	0.362		2.96	< 0.005	1.06	1.38	0.00244	6.32	< 0.0005	< 0.5	< 0.00005	0.0073	0.00746	< 5	< 0.0004	9.45	< 0.0001	0.0162	< 0.002	< 0.001	< 0.003	0.000083	0.000163	< 0.0005	< 0.001	< 0.01	< 0.0006
KONA_2	L2187510-2	10/25/2018 14:00	0.00029	< 0.001	0.352		3.56	< 0.005	1.22	1.62	0.00280	7.34	< 0.0005	< 0.5	< 0.00005	0.0081	0.00727	< 5	< 0.0004	9.90	< 0.0001	0.0190	< 0.002	< 0.001	< 0.003	0.000103	0.000208	< 0.0005	< 0.001	< 0.01	< 0.0006
KONA_2	L2194529-2	11/8/2018 13:40	0.000242	< 0.0005	0.297		3.31	< 0.0025	1.24	1.63	0.00330	6.94	0.00051	< 0.25	< 0.000025	0.0081	0.00758	< 2.5	< 0.0002	11.4	< 0.00005	0.0218	< 0.001	< 0.0005	< 0.0015	0.000098	0.000248	0.00035	< 0.0005	< 0.005	< 0.0003
KONA_2	L2200705-2	11/22/2018 10:30	0.000243	< 0.0005	0.261		3.09	< 0.0025	1.17	1.46	0.00308	6.71	0.00579	< 0.25	< 0.000025	0.0075	0.00645	< 2.5	< 0.0002	10.3	< 0.00005	0.0182	< 0.001	< 0.0005	< 0.0015	0.000095	0.000188	< 0.00025	< 0.0005	< 0.005	< 0.0003
KONA_2	L2207335-2	12/6/2018 14:45	0.00022	< 0.001	0.209		3.06	< 0.005	1.19	1.50	0.00285	6.00	< 0.0005	< 0.5	< 0.00005	0.0078	0.00546	< 5	< 0.0004	10.6	< 0.0001	0.0170	< 0.002	< 0.001	< 0.003	0.000095	0.000186	< 0.0005	< 0.001	< 0.01	< 0.0006
KONA_2	L2213525-2	12/20/2018 14:25	0.00033	< 0.001	1.89		4.00	< 0.005	2.05	2.86	0.00249	9.20	0.00221	< 0.5	0.000060	0.0100	0.00706	11.9	< 0.0004	9.50	< 0.0001	0.0334	< 0.002	< 0.001	< 0.003	0.000131	0.000129	< 0.0005	< 0.001	0.012	< 0.0006
KONA_2	L2217203-2	1/5/2019 11:35	0.000630	< 0.0005	64.5		7.64	0.0027	17.6	28.4	0.00074	15.0	0.00668	< 0.25	< 0.000025	0.0212	0.00308	150	< 0.0002	6.66	< 0.00005	0.246	< 0.001	< 0.0005	< 0.0015	0.000319	0.000274	< 0.00025	< 0.0005	0.110	< 0.0003
KONA_2	L2222132-2	1/17/2019 11:45	0.000677	< 0.0001	139		8.45	0.00295	26.9	40.9	0.000506	12.6	0.00776	< 0.05	< 0.000005	0.0222	0.00270	290	0.000521	5.87	< 0.00001	0.402	< 0.0002	< 0.0001	< 0.0003	0.000344	0.000356	< 0.00005	< 0.0001	0.142	< 0.00006
KONA_2	L2227544-2	1/31/2019 10:30	0.00065	< 0.002	128		7.4	< 0.01	22.8	37.1	< 0.001	10.8	0.0064	< 1	< 0.0001	0.0214	0.00258	292	< 0.0008	5.4	< 0.0002	0.478	< 0.004	< 0.002	< 0.006	0.000324	0.000318	< 0.001	< 0.002	0.196	< 0.0012
KONA_3	L2233141-2	2/14/2019 14:20	0.00054	< 0.001	116		6.88	< 0.005	19.6	32.6	0.00086	8.73	0.00589	< 0.5	< 0.00005	0.0208	0.00247	311	< 0.0004	5.50	< 0.0001	0.514	< 0.002	< 0.001	< 0.003	0.000279	0.000281	< 0.0005	< 0.001	0.097	< 0.0006
KONA_3	L2238565-2	2/28/2019 15:15	0.00065	< 0.001	107		7.28	< 0.005	18.7	31.6	0.00067	8.41	0.00557	< 0.5	< 0.00005	0.0214	0.00276	303	< 0.0004	5.43	< 0.0001	0.619	< 0.002	< 0.001	< 0.003	0.000318	0.000265	< 0.0005	< 0.001	0.093	< 0.0006
KONA_2	L2244540-2	3/14/2019 14:30	0.00061	< 0.001	77.7		9.12	< 0.005	15.3	25.3	0.00055	7.75	0.00441	< 0.5	< 0.00005	0.0204	0.00268	321	< 0.0004	5.64	< 0.0001	0.653	< 0.002	< 0.001	< 0.003	0.000285	0.000246	< 0.0005	< 0.001	0.074	< 0.0006
KONA_2	L2250817-2	3/28/2019 15:00	0.00066	< 0.001	91.8		7.79	< 0.005	17.3	27.7	0.00061	8.71	0.00489	< 0.5	< 0.00005	0.0210	0.00256	353	0.00071	6.75	< 0.0001	0.752	< 0.002	< 0.001	< 0.003	0.000260	0.000242	< 0.0005	< 0.001	0.078	< 0.0006
KONA_2	L2257457-2	4/11/2019 15:00	0.00065	< 0.001	74.8		6.74	< 0.005	13.4	23.2	0.00091	7.66	0.00524	< 0.5	< 0.00005	0.0194	0.00291	351	< 0.0004	6.15	< 0.0001	0.806	< 0.002	< 0.001	< 0.003	0.000236	0.000169	< 0.0005	< 0.001	0.058	< 0.0006
KONA_2	L2263301-2	4/25/2019 14:45	0.00063	< 0.001	67.6		6.11	< 0.005	11.9	20.8	0.00088	7.78	0.00424	< 0.5	< 0.00005	0.0162	0.00285	357	< 0.0004	6.17	< 0.0001	0.889	< 0.002	< 0.001	< 0.003	0.000216	0.000179	< 0.0005	< 0.001	0.047	< 0.0006
KONA_3	L1955323-3	7/7/2017 13:00	0.000662	0.00020	0.0017	0.0000059	14.0	0.00605	2.40	1.61	0.00189	13.0	0.000793	< 0.05	0.0000335	0.0206	0.00431	10.7	0.000114	14.6	0.000018	0.0420	< 0.0002	< 0.0001	< 0.0003	0.000141	0.00135	0.000126	< 0.0001	0.00434	< 0.00006
KONA_3	L1969885-3	8/3/2017 13:50	0.000701	0.00021	0.0026	< 0.000005	14.7	0.00507	3.17	2.56	0.00258	14.7	0.00127	< 0.05	0.0000189	0.0235	0.00367	9.92	0.000082	18.4	0.000012	0.0537	< 0.0002	< 0.0001	< 0.0003	0.000176	0.00208	0.000133	< 0.0001	0.00490	< 0.00006
KONA_3	L1977048-3	8/17/2017 12:25	0.000564	0.00016	0.0088	< 0.000005	13.1	0.00407	2.49	2.18	0.00218	12.7	0.000882	< 0.05	0.0000310	0.0202	0.00299	6.25	0.000429	16.1	< 0.00001	0.0434	< 0.0002	< 0.0001	< 0.0003	0.000150	0.00165	0.000185	< 0.0001	0.00374	< 0.00006
KONA_3	L1984769-3	8/31/2017 14:00	0.000550	0.00012	0.0132	< 0.000005	12.9	0.00349	2.43	2.25	0.00242	12.5	0.000761	< 0.05	0.0000194	0.0195	0.00287	4.47	0.000314	18.3	< 0.00001	0.0403	< 0.0002	< 0.0001	< 0.0003	0.000150	0.00160	0.000187	< 0.0001	0.00361	< 0.00006
KONA_3	L1992087-3	9/14/2017 14:55	0.000486	0.00012	0.0232	< 0.000005	11.6	0.00327	2.14	2.06	0.00238	11.7	0.000868	< 0.05	0.0000193	0.0175	0.00252	2.90	< 0.00004	15.9	0.000012	0.0347	< 0.0002	< 0.0001	< 0.0003	0.000148	0.00138	0.000250	< 0.0001	0.00280	< 0.00006
KONA_3	L1999487-3	9/28/2017 11:25	0.000462	0.00010	0.0216	< 0.000005	11.5	0.00299	2.05	1.99	0.00271	11.3	0.000630	0.056	0.0000148	0.0173	0.00284	2.53	0.000241	17.7	< 0.00001	0.0345	< 0.0002	< 0.0001	< 0.0003	0.000143	0.00133	0.000181	< 0.0001	0.00314	< 0.00006
KONA_3	L2007130-3	10/13/2017 11:25	0.000391	< 0.0001	0.0423	< 0.000005	10.2	0.00262	1.89	1.88	0.00275	10.1	0.000632	0.070	0.0000143	0.0160	0.00240	1.66	0.000375	18.0	< 0.00001	0.0315	< 0.0002	< 0.0001	< 0.0003	0.000130	0.00130	0.000191	< 0.0001	0.00329	< 0.00006
KONA_3	L2014335-3	10/26/2017 11:50	0.000347	< 0.0001	0.0565	< 0.000005	9.00	0.00249	1.52	1.66	0.00294	9.01	0.000446	0.065	0.0000115	0.0135	0.00237	0.77	0.000249	18.3	< 0.00001	0.0273	< 0.0002	< 0.0001	< 0.0003	0.000118	0.00106	0.000307	< 0.0001	0.00185	< 0.00006
KONA_3	L2020126-3	11/8/2017 12:30	0.000339	< 0.0001	0.0544	< 0.000005	10.1	0.00233	1.64	1.73	0.00326	8.91	0.000501	0.082	< 0.000005	0.0144	0.00259	0.95	0.000047	18.5	< 0.00001	0.0290	< 0.0002	< 0.0001	< 0.0003	0.000106	0.00103	0.000195	< 0.0001	0.00232	< 0.00006
KONA_3	L2026623-3	11/23/2017 14:15	0.000302	< 0.0001	0.0728	< 0.000005	9.04	0.00213	1.45	1.74	0.00329	9.02	0.000485	0.083	0.0000121	0.0133	0.00242	< 0.5	0.000177	19.5	< 0.00001	0.0266	< 0.0002	< 0.0001	< 0.0003	0.000107	0.000968	0.000173	0.00010	0.00219	< 0.00006
KONA_3	L2031965-3	12/6/2017 14:05	0.000308	< 0.0001	0.0775	< 0.000005	8.91	0.00213	1.49	1.66	0.00340	8.38	0.000344	0.090	0.0000181	0.0135	0.00278	< 1	0.000143	18.2	< 0.00001	0.0273	< 0.0002	< 0.0001	< 0.0003	0.000112	0.000938	0.000232	< 0.0001	0.00319	< 0.00006
KONA_3	L2038563-3	12/21/2017 13:50	0.000301	0.00012	0.125	< 0.000005	8.30	0.00207	1.28	1.56	0.00322	8.19	0.000446	0.075	0.0000089	0.0119	0.00258	< 0.5	0.000076	17.8	< 0.00001	0.0245	< 0.0002	< 0.0001	< 0.0003	0.0000953	0.000907	0.000101	< 0.0001	0.00219	< 0.00006
KONA_3	L2041649-3	1/4/2018 13:05	0.000297	< 0.0001	0.0650	< 0.000005	8.73	0.00128	1.35	1.56	0.00343	7.93	0.000429	0.081	< 0.000015	0.0120	0.00261	< 0.5	0.000100	18.5	< 0.00001	0.0249	< 0.0002	< 0.0001	< 0.0003	0.0000949	0.000914	0.000172	< 0.0001	0.00209	< 0.00006
KONA_3	L2046871-3	1/18/2018 11:25	0.000302	0.00011	0.0980	< 0.000005	8.50	0.00200	1.37	1.52	0.00384	8.46	0.000479	0.086	0.0000058	0.0123	0.00260	< 0.5	0.000118	18.0	< 0.00001	0.0351	< 0.0002	< 0.0001	< 0.0003	0.0000933	0.000951	0.000200	0.00035	0.00191	< 0.00006
KONA_3	L2052061-3	2/1/2018 12:10	0.000305	< 0.0001	0.0725	< 0.000005	8.70	0.00129	1.33	1.53	0.00349	8.06	0.000421	0.076	0.0000054	0.0119	0.00275	< 0.5	0.000058	17.9	< 0.00001	0.0247	< 0.0002	< 0.0001	< 0.0003	0.000102	0.000932	0.000205	< 0.0001	0.00176	< 0.00006
KONA_3	L2057381-3	2/15/2018 11:35	0.000252	< 0.0001	0.0764	< 0.000005	8.32	0.00147	1.34	1.73	0.00361	7.67	0.000417	0.080	0.0000086	0.0114	0.00251	< 0.5	< 0.00004	18.1	< 0.00001	0.0268	< 0.0002	< 0.0001	< 0.0003	0.0000928	0.000904	0.000183	0.00012	0.00200	< 0.00006
KONA_3	L2062788-3	3/1/2018 13:25	0.000262	< 0.0001	0.0544	< 0.000005	8.00	0.00132	1.29	1.58	0.00368	7.92	0.000411	0.099	0.0000072	0.0109	0.00262	< 0.5	0.000055	17.9	< 0.00001	0.0226	< 0.0002	< 0.0001	< 0.0003	0.0000925	0.000794	0.000198	< 0.0001	0.00166	< 0.00006
KONA_3	L2068449-3	3/15/2018 11:40	0.000254	< 0.0001	0.0302	< 0.000005	8.04	0.00162	1.20	1.46	0.00414	8.17	0.000399	0.095	0.0000083	0.0112	0.00253	< 0.5	< 0.00004	18.2	< 0.00001	0.0207	< 0.0002	< 0.0001	< 0.0003	0.0000982	0.000734	0.000184	< 0.0001	0.00092	< 0.00006
KONA_3	L2074311-3	3/29/2018 11:20	0.000270	0.00012	< 0.001	< 0.000005	7.80	0.00137	1.22	1.27	0.00490	7.53	0.000360	0.104	< 0.000005	0.0103	0.00286	0.56	< 0.00004	18.8	< 0.00001	0.0220	< 0.0002	< 0.0001	< 0.0003	0.0000787	0.000887	0.000316	< 0.0001	0.0014	< 0.00006
KONA_3	L2079620-3	4/12/2018 11:00	0.000249	0.00011	0.0307	< 0.000005	6.99	0.00118	1.12	1.30	0.00488	7.43	0.000429	0.090	< 0.00002	0.0104	0.00248	< 0.5	< 0.00004	16.8	0.000012	0.0202	< 0.0002	< 0.0001	< 0.0003	0.0000830	0.000949	0.000206	< 0.0001	0.0015	< 0.00006
KONA_3	L2085708-3	4/26/2018 13:40	0.000243	< 0.0001	0.0551	< 0.000005	7.09	0.00136	1.10	1.47	0.00498	7.15	0.000374	0.091	< 0.000005	0.00973	0.00226	< 0.5	< 0.00004	16.7	< 0.00001	0.0196	< 0.0002	< 0.0001	< 0.0003	0.0000796	0.000831	0.000169	< 0.0001	0.0013	< 0.00006
KONA_3	L2092801-3	5/10/2018 11:15	0.000247	< 0.0001	0.0345	< 0.000005	7.21	0.00150	1.09	1.28	0.00496	7.37	0.000330	0.083	0.0000101	0.00998	0.00250	< 0.5	< 0.00004	17.0	< 0.00001	0.0193	< 0.0002	< 0.0001	< 0.0003	0.0000832	0.000864	0.000299	< 0.0001	0.0117	< 0.00006
KONA_3	L2100224-3	5/24/2018 14:00	0.000270	0.00011	0.0052	< 0.000005	7.52	0.00132	1.17	1.04	0.00523	7.60	0.000338	0.116	0.0000067	0.0109	0.00262	< 0.5	< 0.00004	17.8	< 0.00001	0.0208	< 0.0002	< 0.0001	< 0.0003	0.0000691	0.000799	0.000319	< 0.0001	0.0017	< 0.00006
KONA_3	L2108434-3	6/7/2018 13:30	0.000271	< 0.0001	0.0076		8.14	0.00142	1.22	0.857	0.00515	8.49	0.000360	0.123	0.0000069	0.0114	0.00258	< 0.5	< 0.00004	19.6	< 0.00001	0.0203	< 0.0002	< 0.0001	< 0.0003	0.0000712	0.000765	0.000252	< 0.0001	0.0210	< 0.00006
KONA_3	L2116986-3	6/21/2018 14:00	0.000256	< 0.0001	0.0046		7.44	0.00134	1.10	0.669	0.00485	8.21	0.000296	0.118	0.0000183	0.0108	0.00257	< 0.5	< 0.00004	18.9	< 0.00001	0.0183	< 0.0002	< 0.0001	< 0.0003	0.0000698	0.000737	0.000287	< 0.0001	0.0012	< 0.00006
KONA_3	L2125321-3	7/6/2018 11:30	0.000250	< 0.0001	0.0052		7.26	0.00138	1.08	0.645	0.00491	7.80	0.000328	0.105	0.0000124	0.0100	0.00249	< 0.5	< 0.00004	19.4	< 0.00001	0.0189	< 0.0002	< 0.0001	< 0.0003	0.0000614	0.000707	0.000296	< 0.0001	0.0012	< 0.00006
KONA_3	L2132784-3	7/19/2018 14:45	0.000238	< 0.0001	0.0106		7.25	0.00141	1.08	0.584	0.00508	8.00	0.000312	0.098	0.0000168	0.0103	0.00250	< 0.5	< 0.00004	19.5	0.000023	0.0181	< 0.0002	< 0.0001	< 0.0003	0.0000624	0.000737	0.000252	< 0.0001	0.0070	< 0.00006
KONA_3	L2140795-3	8/2/2018 13:30	0.000258	< 0.0001	0.0142		14.0	0.00140	1.08	0.504	0.00525	8.19	0.000325	0.107	0.0000094	0.0105	0.00274	< 0.5	0.000049	19.6	< 0.00001	0.0192	< 0.0002	< 0.0001	< 0.0003	0.0000652	0.000683	0.000383	< 0.0001	< 0.001	< 0.00006
KONA_3	L2148482-3	8/16/2018	0.000228	< 0.0001	0.0113		7.06	0.00134	1.08	0.510	0.00509	8.20	0.000302	0.125	0.0000154	0.00990	0.00241	< 0.5	< 0.00004	17.9	< 0.00001	0.0184	< 0.0002	< 0.0001	< 0.0003	0.0000635	0.000717	0.000300	< 0.0001	< 0.001	< 0.00006
KONA_3	L2156461-3	8/30/2018 14:20	0.000202	< 0.0001	0.0092		6.93	0.00128	1.04	0.577	0.00501	8.00	< 0.0001	0.107	< 0.000015	0.00985	0.00231	< 0.5	0.000049	18.9	< 0.00001	0.0180	< 0.0002	< 0.0001	< 0.0003	0.0000603	0.000663	0.000271	< 0.0001	0.0011	< 0.00006
KONA_3	L2164110-3	9/13/2018 11:45	0.000227	< 0.0001	0.0127		7.36	0.00133	1.08	0.480	0.00517	8.93	0.000240	0.137	0.0000157	0.0107	0.00242	< 0.5	< 0.00004	19.3	< 0.00001	0.0186	< 0.0002	< 0.0001	< 0.0003	0.0000598	0.000638	0.000329	< 0.0001	0.0011	< 0.00006
KONA_3	L2172409-3	9/27/2018 14:00	0.000195	< 0.0002	0.0179		6.77	0.0012	1.00	0.466	0.00503	8.05	0.00021	0.11	0.0000023	0.00873	0.00223	< 1	< 0.00008	19.4	< 0.00002	0.0162	< 0.0004	< 0.0002	< 0.0006	0.0000531	0.000578	0.00026	< 0.0002	< 0.002	< 0.00012
KONA_3	L2180431-3	10/12/2018 14:10	0.000188	< 0.0002	0.0168		6.04	0.0011	0.970	0.398	0.00511	7.50	0.00015	< 0.1	0.000022	0.00885	0.00228	< 1	< 0.00008	19.1	< 0.00002	0.0163	< 0.0004	< 0.0002	< 0.0006	0.0000506	0.000614	0.00031	< 0.0002	< 0.002	< 0.00012
KONA_3	L2187510-3	10/25/2018 14:00	0.000181	< 0.0001	0.0190		5.89	0.00104	0.929	0.365	0.00541	7.12	0.000151	0.118	0.0000347	0.00802	0.00220	< 0.5	< 0.00004	18.3	< 0.00001	0.0163	< 0.0002	< 0.0001	< 0.0003	0.0000455	0.000584	0.000316	< 0.0001	< 0.001	< 0.00006
KONA_3	L2194529-3	11/8/2018 13:40	0.000171	< 0.0001	0.0249		6.41	0.00115	0.981	0.382	0.00538	8.06	0.000177	0.147	0.0000428	0.00881	0.00231	< 0.5	< 0.00004	20.2	< 0.00001	0.0177	< 0.0002	< 0.0001	< 0.0003	0.0000493	0.000587	0.000335	< 0.0001	< 0.001	< 0.00006
KONA_3	L2200705-3	11/22/2018 10:30	0.000174	< 0.0001	0.0121		5.93	0.00095	0.917	0.328	0.00535	7.17	0.000171	0.146	0.0000290	0.00796	0.00209	< 0.5	< 0.00004	18.4	< 0.00001	0.0162	< 0.0002	< 0.0001	< 0.0003	0.0000443	0.000538	0.000349	< 0.0001	< 0.001	< 0.00006
KONA_3	L2207335-3	12/6/2018 14:45	0.000168	< 0.0001	0.0153		5.85	0.00099	0.937	0.310	0.00558	6.68	0.000169	0.146	0.0000490	0.00786	0.00215	< 0.5	0.000051	18.2	< 0.00001	0.0156	< 0.0002	< 0.0001	< 0.0003	0.0000444	0.000566	0.000342	< 0.0001	< 0.001	< 0.00006
KONA

Appendix A2: Granite Column (Kona 1-4) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cs**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
KONA_3	L2233141-3	2/14/2019 14:20	0.00046	*< 0.002*	2.52		14.1	*< 0.01*	23.8	48.2	0.0012	9.99	0.0057	*< 1*	0.00039	0.0229	0.00045	311	*< 0.0008*	11.4	*< 0.0002*	1.28	*< 0.004*	*< 0.002*	*< 0.006*	0.000300	0.000418	*< 0.001*	*< 0.002*	0.050	*< 0.0012*
KONA_3	L2238565-3	2/28/2019 15:15	0.00046	*< 0.001*	3.67		12.9	*< 0.005*	26.5	47.5	0.00133	9.05	0.00515	*< 0.5*	*< 0.00005*	0.0234	0.00049	329	*< 0.0004*	11.7	*< 0.0001*	1.50	*< 0.002*	*< 0.001*	*< 0.003*	0.000357	0.000394	*< 0.0005*	*< 0.001*	0.049	*< 0.0006*
KONA_3	L2244540-3	3/14/2019 14:30	0.00044	*< 0.001*	3.71		16.6	*< 0.005*	23.4	43.5	0.00132	8.79	0.00475	*< 0.5*	*< 0.00005*	0.0234	0.00048	334	*< 0.0004*	11.4	*< 0.0001*	1.56	*< 0.002*	*< 0.001*	*< 0.003*	0.000354	0.000384	*< 0.0005*	*< 0.001*	0.049	*< 0.0006*
KONA_3	L2250817-3	3/28/2019 15:00	0.00039	*< 0.001*	5.19		13.4	*< 0.005*	25.1	46.1	0.00126	9.16	0.00414	*< 0.5*	*< 0.00005*	0.0240	*< 0.0002*	355	*< 0.0004*	12.3	*< 0.0001*	1.56	*< 0.002*	*< 0.001*	*< 0.003*	0.000305	0.000360	*< 0.0005*	*< 0.001*	0.050	*< 0.0006*
KONA_3	L2257457-3	4/11/2019 15:00	0.00051	*< 0.001*	1.02		12.6	*< 0.005*	23.4	42.6	0.00084	8.33	0.00547	*< 0.5*	*< 0.00005*	0.0253	0.00074	352	*< 0.0004*	13.5	*< 0.0001*	1.65	*< 0.002*	*< 0.001*	*< 0.003*	0.000352	0.000413	*< 0.0005*	*< 0.001*	0.058	*< 0.0006*
KONA_3	L2263301-3	4/25/2019 14:45	0.00045	*< 0.001*	2.81		10.8	*< 0.005*	19.9	37.7	0.00104	8.52	0.00365	*< 0.5*	*< 0.00005*	0.0226	0.00049	356	*< 0.0004*	12.8	*< 0.0001*	1.79	*< 0.002*	*< 0.001*	*< 0.003*	0.000260	0.000491	*< 0.0005*	*< 0.001*	0.043	*< 0.0006*
KONA_4	L1955323-4	7/7/2017 13:00	0.00155	0.00026	*< 0.001*	*< 0.000005*	15.2	0.00822	6.45	1.27	0.00587	16.9	0.000274	*< 0.05*	0.0000929	0.0368	0.00418	12.1	0.000043	11.3	0.000019	0.0978	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000174	0.0707	0.000826	0.00032	0.00253	*< 0.00006*
KONA_4	L1969885-4	8/3/2017 13:50	0.00174	0.00023	0.0024	*< 0.000005*	14.2	0.00798	6.33	1.76	0.00707	17.4	0.000500	*< 0.05*	0.0000623	0.0374	0.00461	11.4	0.000051	14.2	0.000017	0.107	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000230	0.0712	0.000866	0.00024	0.00330	*< 0.00006*
KONA_4	L1977048-4	8/17/2017 12:25	0.00155	0.00014	0.0195	*< 0.000005*	15.4	0.00698	5.77	1.91	0.00565	18.1	0.000489	*< 0.05*	0.0000461	0.0394	0.00326	6.19	0.000104	14.4	*< 0.00001*	0.0916	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000199	0.0348	0.000859	0.00019	0.00330	*< 0.00006*
KONA_4	L1984769-4	8/31/2017 14:00	0.00143	0.00010	0.0353	*< 0.000005*	14.5	0.00636	4.78	1.79	0.00578	16.4	0.000508	*< 0.05*	0.0000237	0.0366	0.00290	3.03	*< 0.00004*	15.6	*< 0.00001*	0.0753	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000188	0.0192	0.000733	0.00016	0.00368	*< 0.00006*
KONA_4	L1992087-4	9/14/2017 14:55	0.00134	*< 0.0001*	0.0583	*< 0.000005*	12.5	0.00595	3.80	1.56	0.00559	13.9	0.000443	*< 0.05*	0.0000157	0.0316	0.00227	1.27	*< 0.00004*	14.3	*< 0.00001*	0.0613	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000182	0.0103	0.000630	0.00018	0.00222	*< 0.00006*
KONA_4	L1999487-4	9/28/2017 11:25	0.00124	*< 0.0001*	0.0639	*< 0.000005*	13.2	0.00571	3.77	1.60	0.00591	13.9	0.000510	*< 0.05*	0.0000157	0.0336	0.00240	0.90	*< 0.00004*	16.3	*< 0.00001*	0.0589	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000173	0.00878	0.000743	0.00017	0.00293	*< 0.00006*
KONA_4	L2007130-4	10/13/2017 11:25	0.00103	0.00014	*< 0.001*	*< 0.000005*	11.5	0.00509	3.44	1.41	0.00637	12.0	0.000536	*< 0.05*	0.0000177	0.0304	0.00241	1.09	*< 0.00004*	14.8	*< 0.00001*	0.0519	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000166	0.00934	0.000922	0.00018	0.00217	*< 0.00006*
KONA_4	L2014335-4	10/26/2017 11:50	0.000546	*< 0.0001*	0.0453	*< 0.000005*	5.86	0.00246	1.56	0.793	0.00286	8.64	0.000219	*< 0.05*	0.0000169	0.0155	0.00114	*< 0.5*	*< 0.00004*	7.97	*< 0.00001*	0.0255	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000837	0.00295	0.000434	*< 0.0001*	0.00095	*< 0.00006*
KONA_4	L2020126-4	11/8/2017 12:30	0.000530	*< 0.0001*	0.0932	*< 0.000005*	6.22	0.00236	1.68	0.839	0.00290	8.50	0.000268	*< 0.05*	0.0000051	0.0157	0.00111	0.53	*< 0.00004*	8.21	*< 0.00001*	0.0281	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000736	0.00305	0.000418	*< 0.0001*	0.00120	*< 0.00006*
KONA_4	L2026623-4	11/23/2017 14:15	0.000743	*< 0.0001*	0.0812	*< 0.000005*	9.10	0.00382	2.74	1.42	0.00481	10.6	0.000399	*< 0.05*	0.0000115	0.0229	0.00140	*< 0.5*	*< 0.00004*	15.1	*< 0.00001*	0.0434	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000116	0.00484	0.000413	0.00013	0.00197	*< 0.00006*
KONA_4	L2031965-4	12/6/2017 14:05	0.000786	*< 0.0001*	0.0883	*< 0.000005*	9.88	0.00354	2.93	1.42	0.00546	10.2	0.000285	*< 0.05*	0.0000131	0.0251	0.00165	*< 1*	*< 0.00004*	15.2	*< 0.00001*	0.0484	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000138	0.00641	0.000609	0.00015	0.00175	*< 0.00006*
KONA_4	L2038563-4	12/21/2017 13:50	0.000752	0.00012	0.121	*< 0.000005*	9.83	0.00290	2.57	1.31	0.00604	9.68	0.000358	*< 0.05*	0.0000231	0.0236	0.00135	0.56	*< 0.00004*	15.7	*< 0.00001*	0.0421	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000112	0.00524	0.000510	*< 0.0001*	0.00179	*< 0.00006*
KONA_4	L2041649-4	1/4/2018 13:05	0.000682	*< 0.0001*	0.0178	*< 0.000005*	7.46	0.00276	2.25	1.15	0.00455	8.22	0.000353	*< 0.05*	*< 0.000015*	0.0184	0.00168	0.69	*< 0.00004*	13.2	*< 0.00001*	0.0379	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000110	0.00477	0.000574	0.00011	0.00165	*< 0.00006*
KONA_4	L2046871-4	1/18/2018 11:25	0.000808	0.00013	0.0721	*< 0.000005*	8.83	0.00329	2.54	1.22	0.00597	9.30	0.000355	*< 0.05*	0.0000137	0.0226	0.00159	0.68	*< 0.00004*	15.0	*< 0.00001*	0.0413	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000124	0.00542	0.000668	0.00016	0.00211	*< 0.00006*
KONA_4	L2052061-4	2/1/2018 12:10	0.000832	*< 0.0001*	0.0725	*< 0.000005*	9.38	0.00294	2.55	1.24	0.00525	9.30	0.000343	*< 0.05*	0.0000051	0.0223	0.00149	*< 0.5*	*< 0.00004*	15.4	*< 0.00001*	0.0424	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000124	0.00548	0.000681	0.00013	0.00180	*< 0.00006*
KONA_4	L2057381-4	2/15/2018 11:35	0.000751	*< 0.0001*	0.0588	*< 0.000005*	8.59	0.00308	2.30	1.13	0.00536	8.20	0.000275	*< 0.05*	0.0000070	0.0189	0.00143	0.77	*< 0.00004*	14.5	*< 0.00001*	0.0379	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000122	0.00529	0.000539	0.00015	0.00166	*< 0.00006*
KONA_4	L2062788-4	3/1/2018 13:25	0.000563	0.00027	0.0878	*< 0.000005*	6.82	0.00228	1.82	0.962	0.00344	8.09	0.000212	*< 0.05*	0.0000072	0.0170	0.00111	*< 0.5*	*< 0.00004*	11.7	*< 0.00001*	0.0292	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000899	0.00311	0.000271	0.00010	0.00153	*< 0.00006*
KONA_4	L2068449-4	3/15/2018 11:40	0.000501	*< 0.0001*	0.0957	*< 0.000005*	6.66	0.00244	1.65	0.934	0.00371	7.98	0.000179	*< 0.05*	0.0000082	0.0166	0.00107	*< 0.5*	*< 0.00004*	11.5	*< 0.00001*	0.0276	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000938	0.00270	0.000370	*< 0.0001*	0.00080	*< 0.00006*
KONA_4	L2074311-4	3/29/2018 11:20	0.000588	*< 0.0001*	0.0964	*< 0.000005*	7.03	0.00248	1.89	1.08	0.00473	7.89	0.000254	*< 0.05*	0.0000088	0.0165	0.00129	0.89	*< 0.00004*	12.2	*< 0.00001*	0.0315	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000996	0.00405	0.000569	0.00012	0.0016	*< 0.00006*
KONA_4	L2079620-4	4/12/2018 11:00	0.000604	*< 0.0001*	0.161	*< 0.000005*	6.18	0.00264	1.79	0.954	0.00478	7.62	0.000207	*< 0.05*	*< 0.000015*	0.0161	0.00109	0.71	*< 0.00004*	11.7	0.000010	0.0287	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000103	0.00405	0.000441	0.00013	0.0015	*< 0.00006*
KONA_4	L2085708-4	4/26/2018 13:40	0.000598	*< 0.0001*	0.151	*< 0.000005*	6.73	0.00271	1.85	1.02	0.00494	7.40	0.000195	*< 0.05*	0.0000081	0.0165	0.00101	*< 0.5*	*< 0.00004*	13.2	*< 0.00001*	0.0306	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000101	0.00385	0.000507	0.00014	0.0013	*< 0.00006*
KONA_4	L2092801-4	5/10/2018 11:15	0.000636	*< 0.0001*	0.161	*< 0.000005*	7.16	0.00305	1.92	1.11	0.00558	8.12	0.000238	*< 0.05*	0.0000086	0.0178	0.00105	*< 0.5*	*< 0.00004*	14.0	*< 0.00001*	0.0325	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000120	0.00414	0.000724	0.00018	0.0016	*< 0.00006*
KONA_4	L2100224-4	5/24/2018 14:00	0.000690	*< 0.0001*	0.124	*< 0.000005*	7.33	0.00263	2.05	1.20	0.00613	8.29	0.000179	*< 0.05*	0.0000102	0.0188	0.00116	*< 0.5*	*< 0.00004*	14.5	0.000011	0.0348	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000119	0.00419	0.000595	0.00016	0.0015	*< 0.00006*
KONA_4	L2108434-4	6/7/2018 13:30	0.000648	*< 0.0001*	0.0403		7.31	0.00296	2.01	1.06	0.00574	8.27	0.000210	*< 0.05*	0.0000092	0.0180	0.00109	*< 0.5*	*< 0.00004*	16.4	*< 0.00001*	0.0316	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000124	0.00388	0.000545	0.00017	0.0183	*< 0.00006*
KONA_4	L2116986-4	6/21/2018 14:00	0.000638	*< 0.0001*	0.0572		7.50	0.00265	1.98	1.09	0.00548	8.61	0.000183	*< 0.05*	0.0000141	0.0189	0.00102	*< 0.5*	*< 0.00004*	15.2	*< 0.00001*	0.0305	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000120	0.00337	0.000521	0.00015	0.0014	*< 0.00006*
KONA_4	L2125321-4	7/6/2018 11:30	0.000615	*< 0.0001*	0.0461		7.02	0.00265	1.84	1.01	0.00574	8.23	0.000159	*< 0.05*	0.0000093	0.0176	0.00101	*< 0.5*	*< 0.00004*	15.4	*< 0.00001*	0.0297	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000113	0.00321	0.000519	0.00014	0.0011	*< 0.00006*
KONA_4	L2132784-4	7/19/2018 14:45	0.000615	*< 0.0001*	0.0394		7.09	0.00288	1.95	0.979	0.00612	8.59	0.000198	*< 0.05*	0.0000128	0.0178	0.00102	*< 0.5*	*< 0.00004*	16.2	*< 0.00001*	0.0294	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000112	0.00339	0.000549	0.00015	0.0076	*< 0.00006*
KONA_4	L2140795-4	8/2/2018 13:30	0.000641	*< 0.0001*	0.0406		7.38	0.00281	1.86	0.938	0.00614	8.60	0.000187	*< 0.05*	0.0000584	0.0177	0.00101	0.54	*< 0.00004*	15.7	*< 0.00001*	0.0308	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000119	0.00307	0.000618	0.00015	0.0014	*< 0.00006*
KONA_4	L2148482-4	8/16/2018	0.000577	*< 0.0001*	0.0382		6.59	0.00265	1.78	0.879	0.00641	8.36	0.000181	*< 0.05*	0.0000077	0.0169	0.000928	*< 0.5*	*< 0.00004*	15.0	*< 0.00001*	0.0289	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000115	0.00279	0.000471	0.00012	0.0010	*< 0.00006*
KONA_4	L2156461-4	8/30/2018 14:20	0.000599	*< 0.0001*	0.0753		7.22	0.00275	1.82	0.812	0.00657	8.73	*< 0.00005*	*< 0.05*	*< 0.000015*	0.0178	0.000902	*< 0.5*	*< 0.00004*	15.9	*< 0.00001*	0.0295	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000115	0.00282	0.000491	0.00013	0.0013	*< 0.00006*
KONA_4	L2164110-4	9/13/2018 11:45	0.000585	*< 0.0001*	0.0946		7.46	0.00272	1.83	0.766	0.00661	9.05	0.000184	*< 0.05*	0.0000103	0.0185	0.000869	*< 0.5*	*< 0.00004*	16.5	0.000024	0.0298	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000107	0.00260	0.000603	0.00012	0.0013	*< 0.00006*
KONA_4	L2172409-4	9/27/2018 14:00	0.000497	*< 0.0001*	0.0994		6.11	0.00247	1.69	0.584	0.00661	8.12	0.000152	*< 0.05*	0.0000115	0.0151	0.000722	*< 0.5*	*< 0.00004*	16.3	*< 0.00001*	0.0258	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000886	0.00222	0.000465	0.00011	0.0011	*< 0.00006*
KONA_4	L2180431-4	10/12/2018 14:10	0.000477	*< 0.0001*	0.0567		6.06	0.00248	1.59	0.509	0.00707	7.87	0.000115	*< 0.05*	0.0000094	0.0144	0.000694	0.50	*< 0.00004*	16.3	*< 0.00001*	0.0266	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000891	0.00221	0.000533	0.00010	0.0010	*< 0.00006*
KONA_4	L2187510-4	10/25/2018 14:00	0.000468	0.00011	0.0714		5.87	0.00236	1.60	0.405	0.00715	7.74	0.000124	*< 0.05*	0.0000144	0.0139	0.000617	*< 0.5*	*< 0.00004*	16.2	*< 0.00001*	0.0261	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000854	0.00207	0.000547	0.00015	*< 0.001*	*< 0.00006*
KONA_4	L2194529-4	11/8/2018 13:40	0.000412	*< 0.0001*	0.0619		5.77	0.00227	1.57	0.384	0.00678	7.57	0.000127	*< 0.05*	0.0000120	0.0141	0.000588	*< 0.5*	*< 0.00004*	16.1	*< 0.00001*	0.0239	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000767	0.00193	0.000528	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_4	L2200705-4	11/22/2018 10:30	0.000422	*< 0.0001*	0.0355		5.64	0.00216	1.44	0.328	0.00677	7.25	0.000113	*< 0.05*	0.0000132	0.0135	0.000497	0.51	*< 0.00004*	16.2	*< 0.00001*	0.0226	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000729	0.00178	0.000525	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_4	L2207335-4	12/6/2018 14:45	0.000380	*< 0.0001*	0.0287		5.58	0.00224	1.46	0.292	0.00688	7.29	0.000087	*< 0.05*	0.0000107	0.0131	0.000490	*< 0.5*	*< 0.00004*	15.9	*< 0.00001*	0.0232	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000706	0.00167	0.000543	*< 0.0001*	*< 0.001*	*< 0.00006*
KONA_4	L2213525-4	12/20/2018 14:25	0.000686	*< 0.0001*	0.0466		9.50	0.00354	6.66	6.54	0.00940	10.5	0.000695	*< 0.05*	*< 0.000005*	0.0237	0.000511	53.7	*< 0.00004*	14.0	*< 0.00001*	0.167	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000149	0.00540	0.000113	*< 0.0001*	0.0030	*< 0.00006*
KONA_4	L2217203-4	1/5/2019 11:35	0.000978	*< 0.0005*	0.660		12.8	0.0063	15.9	16.4	0.00284	14.8	0.00182	*< 0.25*	*< 0.000025*	0.0348	0.00038	166	*< 0.0002*	13.5	*< 0.00005*	0.472	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000266	0.00160	*< 0.00025*	*< 0.0005*	0.0187	*< 0.0003*
KONA_4	L2222132-4	1/17/2019 11:45	0.00117	*< 0.0001*	2.43		16.8	0.00792	27.2	23.2	0.000975	15.7	0.00231	*< 0.05*	*< 0.000005*	0.0427	0.000355	304	*< 0.00004*	13.7	*< 0.00001*	0.755	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000359	0.00103	*< 0.00005*	*< 0.0001*	0.0427	*< 0.00006*
KONA_4	L2227544-4	1/31/2019 10:30	0.00111	*< 0.001*	4.69		15.1	0.0081	30.6	23.8	0.00067	13.0	0.00237	*< 0.5*	*< 0.00005*	0.0403	0.00027	319	*< 0.0004*	13.8	*< 0.0001*	0.788	*< 0.002*	*< 0.001*	*< 0.003*	0.000329	0.00103	*< 0.0005*	*< 0.001*	0.129	*< 0.0006*
KONA_4	L2233141-4	2/14/2019 14:20	0.00101	*< 0.001*	5.62		14.0	0.0085	26.7	23.3	*< 0.0005*	9.56	0.00240	*< 0.5*	*< 0.00005*	0.0364	0.00021	331	*< 0.0004*	13.0	*< 0.0001*	0.883	*< 0.002*	*< 0.001*	*< 0.003*	0.000306	0.00119	*< 0.0005*	*< 0.001*	0.064	*< 0.0006*
KONA_4	L2238565-4	2/28/2019 15:15	0.00104	*< 0.0005*	6.29		13.0	0.0077	28.5	21.9	0.00037	8.55	0.00184	*< 0.25*	*< 0.000025*	0.0370	0.00018	327	*< 0.0002*	12.6	*< 0.00005*	1.01	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000272	0.00128	*< 0.00025*	*< 0.0005*	0.0675	*< 0.0003*
KONA_4	L2244540-4	3/14/2019 14:30	0.000999	*< 0.0005*	6.37		14.9	0.0080	23.8	19.8	*< 0.00025*	8.09	0.00170	*< 0.25*	*< 0.000025*	0.0365	0.00015	327	*< 0.0002*	12.7	*< 0.00005*	1.08	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000268	0.00130	*< 0.00025*	*< 0.0005*	0.0656	*< 0.0003*
KONA_4	L2250817-4	3/28/2019 15:00	0.000897	*< 0.0005*	8.16		13.4	0.0087	28.0	19.9	*< 0.00025*	8.81	0.00145	*< 0.25*	*< 0.000025*	0.0362	*< 0.0001*	360	*< 0.0002*	14.1	*< 0.00005*	1.12	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000229	0.00126	*< 0.00025*	*< 0.0005*	0.0603	*< 0.0003*
KONA_4	L2257457-4	4/11/2019 15:00	0.000856	*< 0.0005*	7.76		12.1	0.0078	21.9	18.0	*< 0.00025*	8.21	0.00179	*< 0.25*	*< 0.000025*	0.0347	0.00010	337	*< 0.0002*	12.9	*< 0.00005*	1.16	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000229	0.00118	*< 0.00025*	*< 0.0005*	0.0512	*< 0.0003*
KONA_4	L2263301-4	4/25/2019 14:45	0.000879	*< 0.0005*	7.86		11.0	0.0079	20.7	16.9	*< 0.00025*	8.82	0.00141	*< 0.25*	*< 0.000025*	0.0352	*< 0.0001*	348	*< 0.0002*	13.5	*< 0.00005*	1.33	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000210	0.00115	*< 0.00025*	*< 0.0005*	0.0421	*< 0.0003*

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX A3: GNEISS COLUMN (GO, GS, GT) EFFLUENT RESULTS

Appendix A3: Gneiss Column (GO, GS, GT) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**
GO	L2000226-1	9/29/2017 10:50	0	0		326	8.16	310	113	1.58	*< 0.005*	*< 0.001*	*< 0.005*	0.0079	53.8	*< 0.0015*	*< 0.05*	1.66	0.363	*< 0.000005*	0.0133	0.0514	0.039	0.0756	*< 0.00001*	*< 0.000005*	19.9	*< 0.000008*	0.0000286	0.00078	0.000013
GO	L2014692-1	10/27/2017	4	4		262	8.12	371	156	2.97	0.0271	*< 0.001*	*< 0.005*	0.0197	61.0	0.0020	*< 0.05*	1.60	0.351	*< 0.000005*	0.0108	0.0424	0.047	0.105	*< 0.00001*	*< 0.000005*	25.4	*< 0.00003*	0.0000384	0.00016	0.000018
GO	L2021295-1	11/10/2017 13:30	6	6		256	8.29	339	127	2.38	0.0103	*< 0.001*	*< 0.005*	0.0203	50.1	*< 0.0015*	*< 0.05*	1.34	0.372	*< 0.000005*	0.0093	0.0403	0.043	0.0943	*< 0.00001*	*< 0.000005*	24.4	*< 0.000015*	0.0000300	*< 0.0001*	0.000015
GO	L2026623-5	11/23/2017 14:40	8	8		315	8.09	316	146	1.73	0.0057	*< 0.001*	*< 0.005*	0.0175	43.7	*< 0.0015*	*< 0.05*	1.10	0.385	*< 0.000005*	0.0108	0.0411	0.042	0.0893	*< 0.00001*	*< 0.000005*	23.1	*< 0.00002*	0.0000387	0.00013	0.000016
GO	L2031965-5	12/6/2017 14:05	10	10		255	8.02	311	184	2.26	0.0081	*< 0.001*	*< 0.005*	0.0170	39.0	*< 0.0015*	*< 0.05*	0.95	0.392	*< 0.000005*	0.0103	0.0455	0.034	0.0951	*< 0.00001*	*< 0.000005*	21.1	*< 0.00001*	0.0000409	0.00018	0.000016
GO	L2038563-5	12/21/2017 13:10	12	12		259	8.09	296.1	162	1.92	*< 0.005*	*< 0.001*	*< 0.005*	0.0181	35.5	*< 0.0015*	*< 0.05*	0.80	0.375	*< 0.000005*	0.0082	0.0406	0.037	0.102	*< 0.00001*	*< 0.000005*	22.1	*< 0.00003*	0.0000390	0.00024	0.000016
GO	L2041649-5	1/4/2018 13:05	14	14		257	8.08	277.5	149	1.46	0.0050	*< 0.001*	*< 0.005*	0.0147	30.8	*< 0.0015*	*< 0.05*	0.72	0.373	*< 0.000005*	0.0087	0.0397	0.034	0.0892	*< 0.00001*	*< 0.000005*	21.2	0.0000062	0.0000350	0.00023	0.000012
GO	L2046871-5	1/18/2018 12:10	16	16		266	8.23	268.8	159	1.45	*< 0.005*	*< 0.001*	*< 0.005*	0.0148	27.5	*< 0.0015*	*< 0.05*	0.65	0.382	*< 0.000005*	0.0115	0.0464	0.033	0.0878	*< 0.00001*	*< 0.000005*	21.3	*< 0.00004*	0.0000379	0.00040	0.000013
GO	L2052061-5	2/1/2018 12:35	18	18		287	8.05	262.1	156	1.58	*< 0.005*	*< 0.001*	*< 0.005*	0.0139	24.8	*< 0.0015*	*< 0.05*	0.55	0.384	*< 0.000005*	0.00890	0.0474	0.031	0.0797	*< 0.00001*	*< 0.000005*	21.7	*< 0.00001*	0.0000375	0.00021	0.000014
GO	L2057381-5	2/15/2018 11:35	20	20		262	8.03	261.2	138	1.33	0.0125	*< 0.001*	*< 0.005*	0.0162	22.3	*< 0.0015*	*< 0.05*	*< 0.5*	0.383	*< 0.000005*	0.0075	0.0444	0.029	0.0861	*< 0.00001*	*< 0.000005*	21.9	*< 0.00002*	0.0000343	0.00014	0.000016
GO	L2062788-5	3/1/2018 14:20	22	22		238	8.06	260	144	1.40	0.0185	*< 0.001*	*< 0.005*	0.0197	21.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.387	*< 0.000005*	0.0086	0.0440	0.033	0.0883	*< 0.00001*	*< 0.000005*	22.9	*< 0.00002*	0.0000314	0.00024	0.000017
GO	L2068449-5	3/15/2018 12:25	24	24		294	8.07	240.5	140	1.42	0.0059	*< 0.001*	*< 0.005*	0.0175	17.7	*< 0.0015*	*< 0.05*	*< 0.5*	0.383	*< 0.000005*	0.0081	0.0464	0.027	0.0814	*< 0.00001*	*< 0.000005*	18.9	*< 0.00001*	0.0000330	0.00014	0.000012
GO	L2074311-5	3/29/2018 12:15	26	26		272	8.06	238.2	152	1.25	0.0065	*< 0.001*	*< 0.005*	0.0185	16.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.379	*< 0.000005*	0.0084	0.0465	0.027	0.0844	*< 0.00001*	0.0000050	19.5	*< 0.000015*	0.0000361	0.00026	0.000013
GO	L2079620-5	4/12/2018 11:30	28	28		245	8.08	237.7	150	1.20	0.0082	*< 0.001*	*< 0.005*	0.0170	14.4	*< 0.0015*	*< 0.05*	*< 0.5*	0.399	*< 0.000005*	0.0082	0.0485	0.027	0.0935	*< 0.00001*	*< 0.000005*	19.2	*< 0.000005*	0.0000390	0.00021	0.000012
GO	L2085708-5	4/26/2018 14:00	30	30		251	8.02	232.5	132	1.23	0.0120	*< 0.001*	*< 0.005*	0.0174	14.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.396	*< 0.000005*	0.0077	0.0509	0.027	0.0900	*< 0.00001*	*< 0.000005*	19.5	*< 0.000015*	0.0000318	0.00025	0.000012
GO	L2092801-5	5/10/2018 11:15	32	32		254	8.1	231.6	125	1.16	0.0146	*< 0.001*	*< 0.005*	0.0171	13.1	*< 0.0015*	*< 0.05*	*< 0.5*	0.377	*< 0.000005*	0.0074	0.0525	0.029	0.0880	*< 0.00001*	*< 0.000005*	20.3	*< 0.000015*	0.0000307	0.00028	0.000014
GO	L2100224-5	5/24/2018 14:00	34	34		267	8	230.6	136	1.11	0.0186	*< 0.001*	*< 0.005*	0.0166	12.2	*< 0.0015*	*< 0.05*	*< 0.5*	0.392	*< 0.000005*	0.0084	0.0629	0.026	0.107	*< 0.00001*	*< 0.000005*	19.5	*< 0.00002*	0.0000314	0.00032	0.000015
GO	L2108434-5	6/7/2018 14:00	36		0	187	8.09	255.3	153	1.10	0.0944	*< 0.001*	*< 0.005*	0.0275	14.9	*< 0.0015*	*< 0.05*	*< 0.5*	0.425	*< 0.000005*	0.0061	0.0559	0.034	0.115	*< 0.00001*	*< 0.000005*	22.8	*< 0.00002*	0.0000382	0.00036	0.000019
GO	L2116986-5	6/21/2018 14:00	38		2	202	8.1	279.6	222	1.02	0.114	*< 0.001*	*< 0.005*	0.0280	19.9	*< 0.0015*	*< 0.05*	*< 0.5*	0.430	0.0000942	0.0058	0.0472	0.033	0.131	*< 0.00001*	*< 0.000005*	24.9	*< 0.000015*	0.0000385	0.00039	0.000018
GO	L2125321-5	7/6/2018 11:50	40		4	205	8.06	290.9	182	2.73	0.116	*< 0.001*	*< 0.005*	0.0253	22.2	*< 0.0015*	*< 0.05*	*< 0.5*	0.412	*< 0.000005*	0.0048	0.0447	0.032	0.146	*< 0.00001*	*< 0.000005*	26.0	*< 0.00002*	0.0000391	0.00042	0.000020
GO	L2132784-5	7/19/2018 15:15	42		6	206	8.08	297	182	1.11	0.123	*< 0.001*	*< 0.005*	0.0253	23.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.423	*< 0.000005*	0.0049	0.0415	0.033	0.142	*< 0.00001*	*< 0.000005*	26.8	*< 0.000015*	0.0000407	0.00043	0.000021
GO	L2140795-5	8/2/2018 13:45	44		8	195	8.08	305	184	1.49	0.149	*< 0.001*	*< 0.005*	0.0233	24.1	*< 0.0015*	*< 0.05*	0.58	0.417	*< 0.000005*	0.0053	0.0366	0.035	0.160	*< 0.00001*	*< 0.000005*	29.3	*< 0.000025*	0.0000394	0.00041	0.000022
GO	L2148482-5	8/16/2018	46		10	211	8.12	306	192	1.18	0.147	*< 0.001*	*< 0.005*	0.0232	24.0	*< 0.0015*	*< 0.05*	0.65	0.443	*< 0.000005*	0.0048	0.0387	0.034	0.174	*< 0.00001*	*< 0.000005*	30.5	*< 7.5E-06*	0.0000362	0.00042	0.000022
GO	L2156461-5	8/30/2018 14:20	48		12	198	8.07	312	188	1.19	0.144	*< 0.001*	*< 0.005*	0.0310	23.5	*< 0.0015*	*< 0.05*	0.75	0.410	*< 0.000005*	0.0043	0.0412	0.037	0.172	*< 0.00001*	*< 0.000005*	29.9	*< 0.00003*	0.0000372	0.00042	0.000025
GO	L2164110-5	9/13/2018 11:45	50		14	196	8.14	314	175	1.17	0.141	*< 0.001*	*< 0.005*	0.0225	23.8	*< 0.0015*	*< 0.05*	0.86	0.404	*< 0.000005*	0.0045	0.0349	0.034	0.171	*< 0.00001*	*< 0.000005*	29.8	*< 0.000015*	0.0000392	0.00048	0.000021
GO	L2172409-5	9/27/2018 14:00	52		16	233	8.11	312	153	1.22	0.144	*< 0.001*	*< 0.005*	0.0218	23.5	*< 0.0015*	*< 0.05*	1.46	0.416	*< 0.000005*	0.0037	0.0337	0.035	0.169	*< 0.00001*	*< 0.000005*	28.1	*< 0.000005*	0.0000304	0.00042	0.000018
GO	L2180431-5	10/12/2018 14:10	54		18	231	7.97	316	114	0.86	0.145	*< 0.001*	*< 0.005*	0.0214	21.7	*< 0.0015*	*< 0.05*	1.13	0.372	*< 0.000005*	0.00389	0.0316	0.035	0.167	*< 0.00001*	*< 0.000005*	29.2	*< 0.00001*	0.0000310	0.00044	0.000019
	L2187510-5	10/25/2018 14:00	56		20	160	8.11	391	136	1.14	0.145	*< 0.001*	*< 0.005*	0.0201	21.5	*< 0.0015*	*< 0.05*	1.38	0.391	*< 0.000005*	0.00336	0.0296	0.034	0.153	*< 0.00001*	*< 0.000005*	29.3	*< 0.00002*	0.0000305	0.00050	0.000019
GO	L2194529-5	11/8/2018 14:10	58		22	213	8.16	316	173	0.91	0.146	*< 0.001*	*< 0.005*	0.0191	21.4	*< 0.0015*	*< 0.05*	1.46	0.411	*< 0.000005*	0.0037	0.0311	0.034	0.165	*< 0.00001*	*< 0.000005*	31.6	*< 0.000015*	0.0000332	0.00050	0.000019
GO	L2200705-5	11/22/2018 11:55	60		24	207	8.09	310	182	0.78	0.146	*< 0.001*	*< 0.005*	0.0215	20.7	*< 0.0015*	*< 0.05*	1.47	0.391	*< 0.000005*	0.0031	0.0304	0.031	0.159	*< 0.00001*	*< 0.000005*	28.9	*< 0.00001*	0.0000311	0.00044	0.000018
GO	L2207335-5	12/6/2018 13:05	62		26	213	7.94	309	177	0.86	0.145	*< 0.001*	*< 0.005*	0.0207	20.0	*< 0.0015*	*< 0.05*	1.53	0.396	*< 0.000005*	0.0037	0.0305	0.031	0.168	*< 0.00001*	*< 0.000005*	29.6	*< 0.00002*	0.0000316	0.00051	0.000017
GO	L2213525-5	12/20/2018 14:45	64		28	409	8.09	315	211	0.82	0.139	*< 0.001*	*< 0.005*	0.0196	25.6	*< 0.0015*	*< 0.05*	1.60	0.408	*< 0.000005*	0.0041	0.0302	0.034	0.173	*< 0.00001*	*< 0.000005*	32.7	*< 0.00002*	0.0000301	0.00051	0.000020
GO	L2217203-5	1/5/2019 11:35	66		30	315	7.86	346	181	0.75	0.172	*< 0.001*	*< 0.005*	0.0186	43.7	*< 0.0067*	*< 0.05*	1.50	0.393	*< 0.000005*	0.0034	0.0258	0.029	0.197	*< 0.00001*	*< 0.000005*	36.7	0.0000091	0.0000324	0.00051	0.000023
GO	L2222132-5	1/17/2019 11:45	68		32	349	7.9	441	163	0.68	0.168	*< 0.001*	*< 0.005*	0.0171	100	*< 0.0067*	*< 0.05*	1.26	0.384	*< 0.000005*	0.0029	0.0234	0.029	0.249	*< 0.00001*	*< 0.000005*	44.8	0.0000094	0.0000306	0.00048	0.000021
GO	L2227544-5	1/31/2019 10:30	70		34	364	7.89	642	143	0.94	0.190	*< 0.001*	*< 0.005*	0.0136	212	*< 0.0015*	*< 0.05*	1.05	0.304	*< 0.000005*	0.002	0.0176	0.026	0.166	*< 0.00001*	*< 0.000005*	70.4	*< 0.00001*	0.0000289	0.00044	0.000030
GO	L2233141-5	2/14/2019 14:20	72		36	367	7.72	830	121	0.76	0.199	*< 0.005*	*< 0.025*	0.0126	363	*< 0.0015*	*< 0.25*	*< 2.5*	0.29	*< 0.000005*	0.00230	0.0183	0.026	0.117	*< 0.00001*	*< 0.000005*	108	0.0000184	0.0000312	0.00042	0.000027
GO	L2238565-5	2/28/2019 15:15	74		38	363	7.68	984	136	0.87	0.200	*< 0.005*	*< 0.025*	0.0121	441	*< 0.0015*	*< 0.25*	*< 2.5*	0.26	*< 0.000005*	0.0019	0.0160	0.024	0.101	*< 0.00001*	*< 0.000005*	138	0.0000147	0.0000273	0.00037	0.000031
GO	L2244540-5	3/14/2019 14:30	76		40	363	7.76	1110	118	0.73	0.197	*< 0.005*	*< 0.025*	0.0111	527	*< 0.0015*	*< 0.25*	*< 2.5*	0.23	0.0000061	0.0021	0.0150	0.025	0.0819	*< 0.00001*	*< 0.000005*	160	0.0000091	0.0000343	0.00039	0.000034
GO	L2250817-5	3/28/2019 15:00	78		42	351	7.65	1206	118	0.78	0.207	*< 0.005*	*< 0.025*	0.0116	605	*< 0.01*	*< 0.25*	*< 2.5*	0.23	*< 0.000005*	0.0022	0.0153	0.026	0.0774	*< 0.00001*	*< 0.000005*	202	0.0000063	0.0000291	0.00038	0.000031
GO	L2257457-5	4/11/2019 15:00	80		44	360	7.68	1285	125	0.94	0.211	*< 0.005*	*< 0.025*	0.0108	689	*< 0.01*	*< 0.25*	*< 2.5*	0.22	*< 0.000005*	0.0018	0.0146	0.025	0.0700	*< 0.00001*	*< 0.000005*	219	0.0000107	0.0000419	0.00041	0.000034
GO	L2263301-5	4/25/2019 14:45	82		46	350	7.69	1380	119	0.97	0.225	*< 0.005*	*< 0.025*	0.0101	686	*< 0.0015*	*< 0.25*	*< 2.5*	0.21	*< 0.000005*	0.002	0.0140	0.022	0.0615	*< 0.00001*	*< 0.000005*	212	0.0000085	0.0000258	0.00036	0.000040
GS	L2000226-2	9/29/2017 10:50	0	0		421	7.85	1384	98	3.48	0.0081	*< 0.005*	0.064	*< 0*	697	*< 0.0015*	*< 0.25*	3.1	1.28	*< 0.000005*	0.0127	0.0168	0.024	0.0206	*< 0.00001*	*< 0.000005*	145	*< 7.5E-06*	0.000103	*< 0.0001*	0.00139
GS	L2014692-2	10/27/2017	4	4		264	7.8	1541	121	2.81	0.109	*< 0.005*	*< 0.025*	*< 0*	774	*< 0.0015*	*< 0.25*	3.4	0.18	0.0000061	0.0058	0.0246	0.025	0.0226	*< 0.00001*	*< 0.000005*	156	0.0000121	0.000389	*< 0.0001*	0.00159
GS	L2021295-2	11/10/2017 13:30	6	6		260	7.91	1403	107	2.40	0.0645	*< 0.005*	*< 0.025*	0.0021	683	*< 0.0015*	*< 0.25*	2.9	0.16	*< 0.000005*	0.0051	0.0225	0.027	0.0202	*< 0.00001*	*< 0.000005*	153	0.0000063	0.000169	*< 0.0001*	0.00136
GS	L2026623-6	11/23/2017 14:40	8	8		306	7.88	1232	161	1.73	0.0630	*< 0.005*	*< 0.025*	*< 0*	596	*< 0.0015*	*< 0.25*	*< 2.5*	0.18	*< 0.000005*	0.0052	0.0269	0.022	0.0234	*< 0.00001*	*< 0.000005*	129	0.0000063	0.0000857	*< 0.0001*	0.00118
GS	L2031965-6	12/6/2017 14:05	10	10		257	7.84	1163	174	2.05	0.0584	*< 0.005*	*< 0.025*	*< 0*	506	*< 0.0015*	*< 0.25*	*< 2.5*	0.16	*< 0.000005*	0.0045	0.0263	0.021	0.0217	*< 0.00001*	*< 0.000005*	115	0.0000075	0.0000661	*< 0.0001*	0.00113
GS	L2038563-6	12/21/2017 13:10	12	12		271	7.83	1048	161	1.28	0.0540	*< 0.005*	*< 0.025*	*< 0*	459	*< 0.0015*	*< 0.25*	*< 2.5*	0.15	*< 0.000005*	0.0039	0.0250	0.023	0.0249	*< 0.00001*	*< 0.000005*	103	0.0000155	0.0000508	*< 0.0001*	0.00110
GS	L2041649-6	1/4/2018 13:05	14	14		255	7.86	933	136	1.69	0.0496	*< 0.005*	*< 0.025*	0.0020	393	*< 0.0015*	*< 0.25*	*< 2.5*	0.16	*< 0.000005*	0.0046	0.0250	0.020	0.0220	*< 0.00001*	*< 0.000005*	89.8	0.0000055	0.0000399	*< 0.0001*	0.000933
GS	L2046871-6	1/18/2018 12:10	16	16		265	7.98	826	143	1.48	0.0419	*< 0.005*	*< 0.025*	*< 0*	331	*< 0.0015*	*< 0.25*	*< 2.5*	0.18	*< 0.000005*	0.0057	0.0311	0.019	0.0231	*< 0.00001*	*< 0.000005*	82.6	0.0000191	0.0000911	*< 0.0001*	0.000940
GS	L2052061-6	2/1/2018 12:35	18	18		289	7.95	759	134	1.48	0.0462	*< 0.001*	*< 0.005*	*< 0*	279	*< 0.0015*	*< 0.05*	0.97	0.180	*< 0.000005*	0.0051	0.0365	0.018	0.0224	*< 0.00001*	*< 0.000005*	72.7	*< 0.000005*	0.000261	*< 0.0001*	0.000895
GS	L2057381-6	2/15/2018 11:35	20	20		273	7.99	733	154	1.16	0.0593	*< 0.001*	*< 0.005*	*< 0*	253	*< 0.0015*	*< 0.05*	0.79	0.177	*< 0.000005*	0.0042	0.0344	0.018	0.0257	*< 0.00001*	*< 0.000005*	76.1	0.0000079	0.000138	*< 0.0001*	0.000832
GS	L2062788-6	3/1/2018 14:20	22	22		239	7.88	711	165	1.04	0.0568	*< 0.001*	*< 0.005*	0.0022	236	*< 0.0015*	*< 0.05*	0.73	0.189	*< 0.000005*	0.0056	0.0381	0.020	0.0251	*< 0.00001*	*< 0.000005*	74.2	*< 0.000005*	0.000120	*< 0.0001*	0.000817
GS	L2068449-6	3/15/2018 12:25	24	24		295	8.04	637	157	1.04	0.0571	*< 0.001*	*< 0.005*	0.0021	202	*< 0.0015*	*< 0.05*	0.61	0.193	*< 0.000005*	0.0049	0.0426	0.018	0.0244	*< 0.00001*	*< 0.000005*	58.6	*< 0.000005*	0.000115	*< 0.0001*	0.000713
GS	L2074311-6	3/29/2018 12:15	26	26		269	7.94	603	164	1.08	0.0637	*< 0.001*	*< 0.005*	0.0026	182	*< 0.0015*	*< 0.05*	0.54	0.189	*< 0.000005*	0.0048	0.0406	0.017	0.0246	*< 0.00001*	0.0000056	57.4	*< 0.000005*	0.0000553	*< 0.0001*	0.000736
GS	L2079620-6	4/12/2018 11:30	28	28		258	7.92	564	151	0.90	0.0606	*< 0.001*	*< 0.005*	0.0025	156	*< 0.0015*	*< 0.05*	*< 0.5*	0.305	*< 0.000005*	0.0051	0.0489	0.016	0.0283	*< 0.00001*	*< 0.000005*	49.5	*< 0.000005*	0.0000420	*< 0.0001*	0.000716
GS	L2085708-6	4/26/2018 14:00	30	30		261	7.89	532	146	1.04	0.0548	*< 0.001*	*< 0.005*	0.0027	144	0.0026	*< 0.05*	*< 0.5*	0.201	*< 0.000005*	0.0046	0.0503	0.017	0.0294	*< 0.00001*	*< 0.000005*	49.0	0.0000058	0.0000359	*< 0.0001*	0.000698
GS	L2092801-6	5/10/2018 11:15	32	32		259	8.01	507	160	0.88	0.0560	*< 0.001*	*< 0.005*	*< 0*	132	*< 0.0015*	*< 0.05*	*< 0.5*	0.198	*< 0.000005*	0.0054	0.0511	0.018	0.0307	*< 0.00001*	*< 0.000005*	51.5	0.0000054	0.0000318	*< 0.0001*	0.000742
GS	L2100224-6	5/24/2018 14:00	34	34		271	7.87	496	151	0.94	0.0607	*< 0.001*	*< 0.005*	0.0024	121	*< 0.0015*	*< 0.05*	*< 0.5*	0.209	*< 0.000005*	0.0056	0.0582	0.016	0.0381	*< 0.00001*	*< 0.000005*	46.1	*< 0.000005*	0.0000333	*< 0.0001*	0.000782
GS	L2108434-6	6/7/2018 14:00	36		0	207	7.96	510	211	0.65	0.0798	*< 0.001*	*< 0.005*	0.0103	119	*< 0.0015*	*< 0.05*	*< 0.5*	0.240	*< 0.000005*	0.0047	0.361	0.023	0.0374	*< 0.00001*	*< 0.000005*	47.7	0.0000084	0.0000111	*< 0.0001*	0.000813
GS	L2116986-6	6/21/2018 14:00	38		2	351	8.02	493	193	0.84	0.0936	*< 0.001*	*< 0.005*	0.0243	109	*< 0.0015*	*< 0.05*	*< 0.5*	0.258	*< 0.000005*	0.0046	0.637	0.022	0.0391	*< 0.00001*	*< 0.000005*	45.3	0.0000063	0.0000107	*< 0.0001*	0.000861
GS	L2125321-6	7/6/2018 11:50	40		4	216	8	448	229	4.61	0.0882	*< 0.001*	*< 0.005*	0.0487	87.5	*< 0.0015*	*< 0.05*	0.62	0.261	*< 0.000005*	0.0044	1.13	0.022	0.0431	*< 0.00001*	*< 0.000005*	40.5	0.0000051	0.0000089	*< 0.0001*	0.000773
GS	L2132784-6	7/19/2018 15:15	42		6	337	8.05	441	311	0.74	0.0985	*< 0.001*	*< 0.005*	0.0611	82.9	*< 0.0015*	*< 0.05*	0.62	0.274	*< 0.000005*	0.0047	1.35	0.023	0.0414	*< 0.00001*	*< 0.000005*	39.8	0.0000070	0.0000227	*< 0.0001*	0.000767
GS	L2140795-6	8/2/2018 13:45	44		8	184	8.02	425	191	0.68	0.108	*< 0.001*	*< 0.005*	0.0510	73.2	*< 0.0015*	*< 0.05*	0.93	0.282	*< 0.000005*	0.0051	1.38	0.024	0.0485	*< 0.00001*	*< 0.000005*	41.4	0.0000148	0.0000156	*< 0.0001*	0.000840

Appendix A3: Gneiss Column (GO, GS, GT) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**
GS	L2148482-6	8/16/2018	46		10	335	7.95	409	182	0.69	0.0991	*< 0.001*	*< 0.005*	0.0826	63.0	*< 0.0015*	*< 0.05*	1.37	0.295	*< 0.000005*	0.00490	1.93	0.023	0.0500	*< 0.00001*	*< 0.000005*	39.0	*< 0.000005*	0.0000124	*< 0.0001*	0.000772
GS	L2156461-6	8/30/2018 14:20	48		12	314	8.02	399	183	0.79	0.0942	*< 0.001*	*< 0.005*	0.055	57.3	*< 0.0015*	*< 0.05*	1.63	0.290	*< 0.000005*	0.0047	1.98	0.024	0.0519	*< 0.00001*	*< 0.000005*	37.6	0.0000163	0.0000151	*< 0.0001*	0.000770
GS	L2164110-6	9/13/2018 11:45	50		14	304	8.05	393	183	1.0	0.104	*< 0.001*	*< 0.005*	0.0848	53.4	*< 0.0015*	*< 0.05*	1.66	0.290	*< 0.000005*	0.0042	2.03	0.023	0.0541	*< 0.00001*	*< 0.000005*	35.6	*< 0.000005*	0.0000115	*< 0.0001*	0.000764
GS	L2172409-6	9/27/2018 14:00	52		16	333	8.07	374	184	0.91	0.0940	*< 0.001*	*< 0.005*	0.062	47.6	*< 0.0015*	*< 0.05*	1.64	0.307	*< 0.000005*	0.0041	2.53	0.023	0.0505	*< 0.00001*	*< 0.000005*	33.0	*< 0.000005*	0.0000147	*< 0.0001*	0.000640
GS	L2180431-6	10/12/2018 14:10	54		18	208	8.01	375	166	0.61	0.0985	*< 0.001*	*< 0.005*	0.064	43.8	*< 0.0015*	*< 0.05*	1.60	0.279	*< 0.000005*	0.0038	2.28	0.024	0.0521	*< 0.00001*	*< 0.000005*	33.1	*< 0.000005*	0.0000112	*< 0.0001*	0.000657
GS	L2187510-6	10/25/2018 14:00	56		20	211	8.13	388	183	0.99	0.0911	*< 0.001*	*< 0.005*	0.0588	45.2	*< 0.0015*	*< 0.05*	1.70	0.292	*< 0.000005*	0.0032	1.84	0.023	0.0521	*< 0.00001*	*< 0.000005*	34.0	0.0000105	0.0000104	*< 0.0001*	0.000647
GS	L2194529-6	11/8/2018 14:10	58		22	328	8.17	376	184	*< 1*	0.0900	*< 0.001*	*< 0.005*	0.062	43.3	*< 0.0015*	*< 0.05*	1.62	0.300	*< 0.000005*	0.0037	2.42	0.024	0.0537	*< 0.00001*	*< 0.000005*	34.7	0.0000058	0.0000118	*< 0.0001*	0.000573
GS	L2200705-6	11/22/2018 11:55	60		24	304	8.03	364	172	0.72	0.0864	*< 0.001*	*< 0.005*	0.089	40.9	*< 0.0015*	*< 0.05*	1.54	0.305	*< 0.000005*	0.0037	2.28	0.022	0.0514	*< 0.00001*	*< 0.000005*	33.7	0.0000078	0.0000109	*< 0.0001*	0.000640
GS	L2207335-6	12/6/2018 13:05	62		26	292	7.94	355	206	0.77	0.0871	*< 0.001*	*< 0.005*	0.069	38.1	*< 0.0015*	*< 0.05*	1.47	0.313	*< 0.000005*	0.0150	2.63	0.022	0.0596	*< 0.00001*	*< 0.000005*	33.0	0.0000108	0.0000144	*< 0.0001*	0.000598
GS	L2213525-6	12/20/2018 14:45	64		28	413	8.12	344	188	0.76	0.0830	*< 0.001*	0.0073	0.057	37.9	*< 0.0015*	*< 0.05*	1.45	0.332	*< 0.000005*	0.004	2.89	0.022	0.0608	*< 0.00001*	*< 0.000005*	36.3	0.0000115	0.0000114	*< 0.0001*	0.000600
GS	L2217203-6	1/5/2019 11:35	66		30	437	7.88	377	216	*< 1*	0.0657	*< 0.001*	0.0743	0.0598	47.1	*< 0.0067*	*< 0.05*	1.46	0.327	*< 0.000005*	0.0034	1.34	0.020	0.0672	*< 0.00001*	*< 0.000005*	36.9	*< 0.000005*	0.0000109	*< 0.0001*	0.000632
GS	L2222132-6	1/17/2019 11:45	68		32	423	7.86	453	153	*< 1*	0.0186	*< 0.001*	0.172	0.0532	104	*< 0.0067*	*< 0.05*	1.23	0.322	*< 0.000005*	0.0037	1.28	0.019	0.0794	*< 0.00001*	*< 0.000005*	44.9	0.0000074	0.0000141	*< 0.0001*	0.000570
GS	L2227544-6	1/31/2019 10:30	70		34	401	7.94	676	158	*< 1*	*< 0.005*	*< 0.001*	0.181	0.0300	223	*< 0.0015*	*< 0.05*	0.95	0.256	*< 0.000005*	0.0022	0.857	0.017	0.0762	*< 0.00001*	*< 0.000005*	69.4	0.0000055	0.0000147	*< 0.0001*	0.000706
GS	L2233141-6	2/14/2019 14:20	72		36	430	7.68	882	148	0.55	0.0087	*< 0.005*	0.161	0.0208	396	*< 0.0015*	*< 0.25*	*< 2.5*	0.25	*< 0.000005*	0.0021	0.607	0.018	0.0638	*< 0.00001*	*< 0.000005*	106	0.0000195	0.0000185	*< 0.0001*	0.000749
GS	L2238565-6	2/28/2019 15:15	74		38	457	7.66	1080	148	1.23	0.0089	*< 0.005*	0.130	0.0163	493	*< 0.0015*	*< 0.25*	*< 2.5*	0.21	*< 0.000005*	0.002	0.446	0.017	0.0570	*< 0.00001*	*< 0.000005*	144	0.0000114	0.0000251	*< 0.0001*	0.000814
GS	L2244540-6	3/14/2019 14:30	76		40	466	7.76	1248	135	0.57	0.0104	*< 0.005*	0.136	0.0099	617	*< 0.0015*	*< 0.25*	*< 2.5*	0.19	*< 0.000005*	0.0016	0.338	0.016	0.0495	*< 0.00001*	*< 0.000005*	170	0.0000061	0.0000278	*< 0.0001*	0.000875
GS	L2250817-6	3/28/2019 15:00	78		42	427	7.62	1375	139	0.70	0.0125	*< 0.005*	0.139	0.0106	712	*< 0.01*	*< 0.25*	*< 2.5*	0.19	*< 0.000005*	0.002	0.287	0.017	0.0482	*< 0.00001*	*< 0.000005*	224	0.0000051	0.0000269	*< 0.0001*	0.000930
GS	L2257457-6	4/11/2019 15:00	80		44	406	7.7	1444	120	0.74	0.0078	*< 0.01*	0.128	0.0098	790	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.000005*	0.0017	0.249	0.017	0.0426	*< 0.00001*	*< 0.000005*	233	*< 0.000005*	0.0000360	*< 0.0001*	0.00101
GS	L2263301-6	4/25/2019 14:45	82		46	408	7.7	1547	130	0.64	0.0082	*< 0.005*	0.127	0.0075	792	*< 0.0015*	*< 0.25*	*< 2.5*	0.18	*< 0.000005*	0.0017	0.227	0.017	0.0373	*< 0.00001*	*< 0.000005*	237	*< 0.000005*	0.0000230	*< 0.0001*	0.00103
GT	L2000226-3	9/29/2017 10:50	0	0		415	8	815	104	3.24	*< 0.005*	*< 0.005*	*< 0.025*	0.0141	325	*< 0.0015*	*< 0.25*	*< 2.5*	1.30	*< 0.000005*	0.0122	0.0643	0.036	0.0289	*< 0.00001*	*< 0.000005*	79.1	*< 0.000015*	0.0000457	*< 0.0001*	0.000553
GT	L2014692-3	10/27/2017	4	4		259	7.98	856	135	2.19	0.0202	*< 0.005*	*< 0.025*	0.0096	334	*< 0.0015*	*< 0.25*	*< 2.5*	0.47	*< 0.000005*	0.00860	0.0687	0.039	0.0328	*< 0.00001*	*< 0.000005*	81.4	*< 0.00003*	0.000157	*< 0.0001*	0.000602
GT	L2021295-3	11/10/2017 13:30	6	6		255	8.04	719	119	1.78	0.0122	*< 0.001*	*< 0.005*	0.0069	249	*< 0.0015*	*< 0.05*	1.68	0.522	*< 0.000005*	0.0086	0.0830	0.037	0.0326	*< 0.00001*	*< 0.000005*	69.4	*< 0.000015*	0.000129	*< 0.0001*	0.000502
GT	L2026623-7	11/23/2017 14:40	8	8		308	7.96	633	152	1.12	0.0180	*< 0.001*	*< 0.005*	0.0062	210	*< 0.0015*	*< 0.05*	1.37	0.525	*< 0.000005*	0.00880	0.0911	0.037	0.0352	*< 0.00001*	*< 0.000005*	61.2	*< 0.000005*	0.000104	*< 0.0001*	0.000488
GT	L2031965-7	12/6/2017 14:05	10	10		232	7.93	579	214	1.58	0.0321	*< 0.001*	*< 0.005*	0.0082	175	*< 0.0015*	*< 0.05*	1.08	0.542	*< 0.000005*	0.0098	0.0997	0.030	0.0387	*< 0.00001*	*< 0.000005*	51.1	*< 0.000015*	0.0000727	*< 0.0001*	0.000425
GT	L2038563-7	12/21/2017 13:10	12	12		256	7.99	536	169	1.09	0.0289	*< 0.001*	*< 0.005*	0.0089	158	*< 0.0015*	*< 0.05*	0.91	0.533	*< 0.000005*	0.0072	0.0979	0.032	0.0424	*< 0.00001*	*< 0.000005*	49.8	*< 0.00004*	0.0000489	*< 0.0001*	0.000416
GT	L2041649-7	1/4/2018 13:05	14	14		257	7.97	485	127	1.26	0.0353	*< 0.001*	*< 0.005*	0.0101	135	*< 0.0015*	*< 0.05*	0.77	0.543	*< 0.000005*	0.0078	0.0953	0.028	0.0416	*< 0.00001*	*< 0.000005*	44.5	0.0000084	0.0000416	*< 0.0001*	0.000394
GT	L2046871-7	1/18/2018 12:10	16	16		265	8.1	448	134	1.19	0.0353	*< 0.001*	*< 0.005*	0.0093	116	*< 0.0015*	*< 0.05*	0.65	0.559	*< 0.000005*	0.0100	0.115	0.031	0.0454	*< 0.00001*	*< 0.000005*	46.1	*< 0.00004*	0.0000490	*< 0.0001*	0.000434
GT	L2052061-7	2/1/2018 12:35	18	18		283	8.09	415	137	1.24	0.0395	*< 0.001*	*< 0.005*	0.0099	100	*< 0.0015*	*< 0.05*	0.54	0.572	*< 0.000005*	0.0085	0.124	0.026	0.0484	*< 0.00001*	*< 0.000005*	40.9	*< 0.000015*	0.0000460	*< 0.0001*	0.000377
GT	L2057381-7	2/15/2018 11:35	20	20		255	7.99	403	125	0.94	0.0559	*< 0.001*	*< 0.005*	0.0118	89.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.570	*< 0.000005*	0.0076	0.117	0.026	0.0547	*< 0.00001*	*< 0.000005*	40.4	*< 0.00002*	0.0000343	*< 0.0001*	0.000368
GT	L2062788-7	3/1/2018 14:20	22	22		239	7.96	385	143	0.97	0.0544	*< 0.001*	*< 0.005*	0.0146	79.8	*< 0.0015*	*< 0.05*	*< 0.5*	0.561	*< 0.000005*	0.0084	0.119	0.027	0.0645	*< 0.00001*	*< 0.000005*	40.4	*< 0.00002*	0.0000343	*< 0.0001*	0.000334
GT	L2068449-7	3/15/2018 12:25	24	24		298	8.07	355	140	0.91	0.0483	*< 0.001*	*< 0.005*	0.0136	68.3	*< 0.0015*	*< 0.05*	*< 0.5*	0.576	*< 0.000005*	0.0110	0.136	0.025	0.0610	*< 0.00001*	*< 0.000005*	32.3	*< 0.000015*	0.0000387	*< 0.0001*	0.000302
GT	L2074311-7	3/29/2018 12:15	26	26		272	8.04	341	141	0.82	0.0569	*< 0.001*	*< 0.005*	0.0163	60.1	*< 0.0015*	*< 0.05*	*< 0.5*	0.563	*< 0.000005*	0.00740	0.129	0.023	0.0675	*< 0.00001*	0.0000057	31.5	*< 0.000015*	0.0000319	*< 0.0001*	0.000303
GT	L2079620-7	4/12/2018 11:30	28	28		255	8.03	326	127	0.85	0.0595	*< 0.001*	*< 0.005*	0.0158	52.1	*< 0.0015*	*< 0.05*	*< 0.5*	0.594	*< 0.000005*	0.0088	0.152	0.023	0.0731	*< 0.00001*	*< 0.000005*	29.9	*< 0.000005*	0.0000308	*< 0.0001*	0.000300
GT	L2085708-7	4/26/2018 14:00	30	30		260	8.02	314	138	0.73	0.0558	*< 0.001*	*< 0.005*	0.0191	49.8	*< 0.0015*	*< 0.05*	*< 0.5*	0.587	*< 0.000005*	0.008	0.152	0.022	0.0748	*< 0.00001*	*< 0.000005*	27.6	*< 0.000015*	0.0000255	*< 0.0001*	0.000288
GT	L2092801-7	5/10/2018 11:15	32	32		257	8.09	306	128	0.77	0.0644	*< 0.001*	*< 0.005*	0.0186	45.8	*< 0.0015*	*< 0.05*	*< 0.5*	0.568	*< 0.000005*	0.0086	0.167	0.024	0.0816	*< 0.00001*	*< 0.000005*	29.6	*< 0.000015*	0.0000262	*< 0.0001*	0.000288
GT	L2100224-7	5/24/2018 14:00	34	34		270	8.01	296	133	0.72	0.0595	*< 0.001*	*< 0.005*	0.0219	40.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.583	*< 0.000005*	0.0101	0.209	0.022	0.105	*< 0.00001*	*< 0.000005*	27.7	*< 0.00002*	0.0000346	*< 0.0001*	0.000316
GT	L2108434-7	6/7/2018 13:30	36		0	340	8.22	262.4	224	0.78	0.0357	*< 0.001*	*< 0.005*	0.0150	32.4	*< 0.0015*	*< 0.05*	*< 0.5*	0.570	*< 0.000005*	0.0109	0.211	0.023	0.0911	*< 0.00001*	*< 0.000005*	24.3	*< 0.00002*	0.0000257	*< 0.0001*	0.000293
GT	L2116986-7	6/21/2018 14:00	38		2	330	8.11	250.4	158	*< 1*	0.0133	*< 0.001*	*< 0.005*	0.0145	27.7	*< 0.006*	*< 0.05*	*< 0.5*	0.566	*< 0.000005*	0.0107	0.229	0.020	0.112	*< 0.00001*	*< 0.000005*	22.8	*< 0.000015*	0.0000518	0.00027	0.000283
GT	L2125321-7	7/6/2018 11:50	40		4	106	7.14	234.6	155	*< 1*	*< 0.005*	*< 0.001*	*< 0.005*	0.0194	23.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.516	*< 0.000005*	0.0111	0.265	0.018	0.118	*< 0.00001*	*< 0.000005*	20.7	*< 0.000005*	0.0000491	*< 0.0001*	0.000257
GT	L2132784-7	7/19/2018 15:15	42		6	361	8.28	220.8	122	0.79	0.0108	*< 0.001*	*< 0.005*	0.0234	20.2	*< 0.0015*	*< 0.05*	*< 0.5*	0.509	*< 0.000005*	0.0107	0.290	0.017	0.118	*< 0.00001*	*< 0.000005*	19.0	*< 0.000015*	0.0000393	*< 0.0001*	0.000231
GT	L2140795-7	8/2/2018 13:45	44		8	358	8.26	219.6	128	0.59	0.0134	*< 0.001*	*< 0.005*	0.0184	19.2	*< 0.0015*	*< 0.05*	*< 0.5*	0.514	*< 0.000005*	0.0109	0.285	0.018	0.132	*< 0.00001*	*< 0.000005*	20.8	*< 0.000025*	0.0000310	*< 0.0001*	0.000267
GT	L2148482-7	8/16/2018	46		10	367	8.22	208.5	123	0.71	0.0054	*< 0.001*	*< 0.005*	0.0221	16.6	*< 0.0015*	*< 0.05*	*< 0.5*	0.481	*< 0.000005*	0.0119	0.311	0.016	0.147	*< 0.00001*	*< 0.000005*	19.7	*< 0.00001*	0.0000310	*< 0.0001*	0.000242
GT	L2156461-7	8/30/2018 14:20	48		12	349	8.24	209.7	114	*< 1*	0.0104	*< 0.001*	*< 0.005*	0.0221	15.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.464	*< 0.000005*	0.0108	0.337	0.017	0.162	*< 0.00001*	*< 0.000005*	19.9	*< 0.00003*	0.0000302	*< 0.0001*	0.000244
GT	L2164110-7	9/13/2018 11:45	50		14	329	8.23	208.3	140	1.3	0.0225	*< 0.001*	*< 0.005*	0.0233	15.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.453	*< 0.000005*	0.0115	0.320	0.016	0.146	*< 0.00001*	*< 0.000005*	19.7	*< 0.000015*	0.0000250	*< 0.0001*	0.000229
GT	L2172409-7	9/27/2018 14:00	52		16	370	8.29	198.3	109	*< 1*	0.0053	*< 0.001*	*< 0.005*	0.0243	13.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.441	*< 0.000005*	0.0104	0.322	0.015	0.146	*< 0.00001*	*< 0.000005*	17.5	*< 0.000005*	0.0000291	*< 0.0001*	0.000199
GT	L2180431-7	10/12/2018 14:10	54		18	365	8.24	197.8	106	0.83	0.0102	*< 0.001*	*< 0.005*	0.0361	12.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.388	*< 0.000005*	0.0095	0.305	0.014	0.157	*< 0.00001*	*< 0.000005*	17.7	*< 0.00001*	0.0000249	*< 0.0001*	0.000197
GT	L2187510-7	10/25/2018 14:00	56		20	316	8.2	200	126	*< 1*	0.0169	*< 0.001*	*< 0.005*	0.0197	11.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.404	*< 0.000005*	0.0091	0.300	0.014	0.149	*< 0.00001*	*< 0.000005*	17.3	*< 0.000015*	0.0000186	*< 0.0001*	0.000193
GT	L2194529-7	11/8/2018 13:40	58		22	349	8.35	195.6	118	0.65	0.0146	*< 0.001*	*< 0.005*	0.0246	11.3	*< 0.0015*	*< 0.05*	*< 0.5*	0.422	*< 0.000005*	0.009	0.319	0.014	0.170	*< 0.00001*	*< 0.000005*	18.7	*< 0.000015*	0.0000205	*< 0.0001*	0.000173
GT	L2200705-7	11/22/2018 10:30	60		24	360	8.2	192.3	124	0.57	0.0103	*< 0.001*	*< 0.005*	0.0322	10.9	*< 0.0015*	*< 0.05*	*< 0.5*	0.389	*< 0.000005*	0.0095	0.302	0.013	0.152	*< 0.00001*	*< 0.000005*	17.7	*< 0.00001*	0.0000213	*< 0.0001*	0.000196
GT	L2207335-7	12/6/2018 14:45	62		26	362	8.2	187.9	114	*< 1*	*< 0.005*	*< 0.001*	*< 0.005*	0.0285	10.1	*< 0.0015*	*< 0.05*	*< 0.5*	0.374	*< 0.000005*	0.0091	0.325	0.013	0.170	*< 0.00001*	*< 0.000005*	17.6	*< 0.00001*	0.0000215	*< 0.0001*	0.000169
GT	L2213525-7	12/20/2018 14:45	64		28	532	8.16	567	97	0.77	*< 0.005*	*< 0.001*	*< 0.005*	0.0109	220	*< 0.0015*	*< 0.05*	*< 0.5*	0.295	*< 0.000005*	0.0121	0.236	0.011	0.288	0.000011	*< 0.000005*	81.0	0.0000160	0.000314	*< 0.0001*	0.000260
GT	L2217203-7	1/5/2019 11:35	66		30	513	7.75	947	86	*< 1*	0.0171	*< 0.005*	*< 0.025*	0.0054	504	*< 0.01*	*< 0.25*	*< 2.5*	0.24	*< 0.000005*	0.0048	0.186	0.010	0.0717	*< 0.00001*	*< 0.000005*	145	0.0000124	0.000344	*< 0.0001*	0.000293
GT	L2222132-7	1/17/2019 11:45	68		32	564	7.6	1260	88	*< 1*	0.0269	*< 0.005*	*< 0.025*	0.0034	683	*< 0.01*	*< 0.25*	*< 2.5*	0.19	*< 0.000005*	0.0046	0.178	0.010	0.0431	*< 0.00001*	*< 0.000005*	230	0.0000143	0.000371	*< 0.0001*	0.000309
GT	L2227544-7	1/31/2019 10:30	70		34	578	7.71	1405	77	0.75	0.0394	*< 0.005*	*< 0.025*	0.0041	771	*< 0.0015*	*< 0.25*	*< 2.5*	0.18	*< 0.000005*	0.0029	0.162	*< 0.01*	0.0270	*< 0.00001*	*< 0.000005*	250	0.0000148	0.000305	*< 0.0001*	0.000350
GT	L2233141-7	2/14/2019 14:20	72		36	565	7.66	1477	79	0.64	0.0447	*< 0.01*	*< 0.05*	0.0055	873	*< 0.0015*	*< 0.5*	*< 5*	*< 0.2*	*< 0.000005*	0.0025	0.162	*< 0.01*	0.0250	*< 0.00001*	*< 0.000005*	289	0.0000231	0.000265	*< 0.0001*	0.000332
GT	L2238565-7	2/28/2019 15:15	74		38	566	7.54	1529	90	0.59	0.0532	*< 0.005*	*< 0.025*	0.0065	871	*< 0.0015*	*< 0.25*	*< 2.5*	0.15	*< 0.000005*	0.0031	0.155	*< 0.01*	0.0232	*< 0.00001*	*< 0.000005*	324	0.0000137	0.000148	*< 0.0001*	0.000358
GT	L2244540-7	3/14/2019 14:30	76		40	579	7.7	1574	79	0.50	0.0516	*< 0.005*	*< 0.025*	0.0021	909	*< 0.0015*	*< 0.25*	*< 2.5*	0.13	*< 0.00001*	0.0040	0.175	*< 0.02*	0.0241	*< 0.00002*	*< 0.00001*	327	0.000012	0.000181	*< 0.0002*	0.000360
GT	L2250817-7	3/28/2019 15:00	78		42	571	7.58	1599	82	0.51	0.0611	*< 0.005*	*< 0.025*	0.0077	913	*< 0.01*	*< 0.25*	*< 2.5*	0.14	*< 0.00001*	0.0038	0.152	*< 0.02*	0.0233	*< 0.00002*	*< 0.00001*	367	0.000013	0.000138	*< 0.0002*	0.000361
GT	L2257457-7	4/11/2019 15:00	80		44	568	7.7	1605	57	0.86	0.0695	*< 0.01*	*< 0.05*	0.0053	972	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.00001*	0.0032	0.147	*< 0.02*	0.0215	*< 0.00002*	*< 0.00001*	360	0.000010	0.000147	*< 0.0002*	0.000411
GT	L2263301-7	4/25/2019 14:45	82		46	549	7.7	1661	74	0.78	0.0692	*< 0.005*	*< 0.025*	0.0060	928	*< 0.0015*	*< 0.25*	*< 2.5*	0.12	*< 0.00001*	0.0035	0.148	*< 0.02*	0.0200	*< 0.00002*	*< 0.00001*	344	*< 0.00001*	0.000121	*< 0.0002*	0.000407

Notes:
Results in blue italics are below the indicated detection limit

Appendix A3: Gneiss Column (GO, GS, GT) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
GO	L2000226-1	9/29/2017 10:50	0.00072	*< 0.001*	0.0000086	9.73	0.00221	6.59	0.000142	0.0270	28.7	0.000179	*< 0.05*	*< 0.000005*	0.00137	0.00374	17.5	0.000085	6.85	0.000026	0.119	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000357	0.0513	0.000465	0.0285	*< 0.00065*	*< 0.00006*
GO	L2014692-1	10/27/2017	0.00080	0.0018	*< 0.000005*	11.2	0.00313	9.00	0.00307	0.0358	33.3	0.000409	*< 0.05*	0.0000061	0.00176	0.00386	21.9	0.000121	8.63	0.000016	0.158	*< 0.0002*	*< 0.0001*	0.00043	0.0000813	0.0757	0.000447	0.0278	*< 0.0005*	*< 0.00006*
GO	L2021295-1	11/10/2017 13:30	0.00075	0.0012	*< 0.000005*	11.3	0.00325	8.18	0.000449	0.0356	31.3	0.000349	*< 0.05*	*< 0.000005*	0.00161	0.00332	16.1	0.000217	7.34	0.000012	0.153	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000726	0.0642	0.000425	0.0260	*< 0.0005*	*< 0.00006*
GO	L2026623-5	11/23/2017 14:40	0.00066	0.0012	*< 0.000005*	10.2	0.00275	7.94	0.00125	0.0367	28.2	0.000465	*< 0.05*	0.0000073	0.00160	0.00318	13.5	0.000220	7.53	0.000010	0.146	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000817	0.0590	0.000401	0.0272	0.00293	0.000108
GO	L2031965-5	12/6/2017 14:05	0.00093	0.0012	*< 0.000005*	10.1	0.00263	7.89	0.00270	0.0356	27.2	0.000304	*< 0.05*	0.0000212	0.00165	0.00317	13.2	0.000271	7.52	*< 0.00001*	0.141	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000962	0.0578	0.000476	0.0274	0.00055	*< 0.00006*
GO	L2038563-5	12/21/2017 13:10	0.00063	0.0010	*< 0.000005*	10.5	0.00207	7.55	0.00215	0.0404	27.0	0.000363	*< 0.05*	0.0000081	0.00161	0.00292	12.5	0.000076	7.35	*< 0.00001*	0.137	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000920	0.0555	0.000465	0.0271	*< 0.0005*	*< 0.00006*
GO	L2041649-5	1/4/2018 13:05	0.00048	*< 0.001*	*< 0.000005*	8.89	0.00209	6.93	0.00299	0.0336	22.7	0.000339	*< 0.05*	*< 0.00001*	0.00139	0.00256	9.35	0.000137	6.85	*< 0.00001*	0.125	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000925	0.0521	0.000392	0.0237	0.00082	*< 0.00006*
GO	L2046871-5	1/18/2018 12:10	0.00046	0.0050	*< 0.000005*	9.41	0.00227	6.79	0.00495	0.0383	22.8	0.000351	*< 0.05*	*< 0.000005*	0.00157	0.00259	8.64	0.000140	7.05	*< 0.00001*	0.125	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000923	0.0473	0.000441	0.0263	0.00053	*< 0.00006*
GO	L2052061-5	2/1/2018 12:35	0.00043	*< 0.001*	*< 0.000005*	9.62	0.00194	6.66	0.00703	0.0343	21.3	0.000367	*< 0.05*	*< 0.000005*	0.00151	0.00262	7.94	0.000154	6.87	*< 0.00001*	0.126	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000103	0.0485	0.000458	0.0253	*< 0.0005*	*< 0.00006*
GO	L2057381-5	2/15/2018 11:35	0.00038	*< 0.001*	*< 0.000005*	8.92	0.00217	6.43	0.00161	0.0392	19.7	0.000289	*< 0.05*	*< 0.000005*	0.00124	0.00268	7.71	0.000080	6.73	*< 0.00001*	0.128	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000965	0.0537	0.000398	0.0267	*< 0.0005*	*< 0.00006*
GO	L2062788-5	3/1/2018 14:20	0.00035	0.0013	*< 0.000005*	9.50	0.00207	7.43	0.00156	0.0368	21.2	0.000270	*< 0.05*	0.0000050	0.00144	0.00269	7.12	0.000082	7.37	*< 0.00001*	0.135	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000938	0.0476	0.000375	0.0222	*< 0.0005*	*< 0.00006*
GO	L2068449-5	3/15/2018 12:25	0.00031	*< 0.001*	*< 0.000005*	8.81	0.00220	6.07	0.00412	0.0368	20.0	0.000252	*< 0.05*	*< 0.000005*	0.00145	0.00236	5.81	0.000067	6.77	*< 0.00001*	0.110	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000942	0.0396	0.000385	0.0267	*< 0.0005*	*< 0.00006*
GO	L2074311-5	3/29/2018 12:15	0.00036	*< 0.001*	*< 0.000005*	8.60	0.00204	6.21	0.00129	0.0428	17.9	0.000241	*< 0.05*	*< 0.000005*	0.00136	0.00231	5.21	*< 0.00004*	6.36	*< 0.00001*	0.118	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000976	0.0479	0.000428	0.0280	*< 0.001*	*< 0.00006*
GO	L2079620-5	4/12/2018 11:30	0.00035	*< 0.001*	*< 0.000005*	7.72	0.00167	5.68	0.00167	0.0435	17.1	0.000302	*< 0.05*	*< 0.00001*	0.00148	0.00233	4.79	0.000053	6.40	*< 0.00001*	0.112	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000106	0.0496	0.000358	0.0273	*< 0.001*	*< 0.00006*
GO	L2085708-5	4/26/2018 14:00	0.00030	*< 0.001*	*< 0.000005*	7.92	0.00213	5.69	0.00104	0.0423	15.4	0.000237	*< 0.05*	*< 0.000005*	0.00134	0.00217	4.35	*< 0.00004*	6.58	*< 0.00001*	0.110	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000101	0.0433	0.000365	0.0260	*< 0.001*	*< 0.00006*
GO	L2092801-5	5/10/2018 11:15	0.00034	*< 0.001*	*< 0.000005*	8.17	0.00223	5.84	0.00188	0.0432	15.9	0.000192	*< 0.05*	*< 0.000005*	0.00143	0.00230	3.48	*< 0.00004*	6.57	*< 0.00001*	0.115	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000108	0.0446	0.000490	0.0259	*< 0.001*	*< 0.00006*
GO	L2100224-5	5/24/2018 14:00	0.00037	*< 0.001*	*< 0.000005*	8.42	0.00199	6.75	0.00159	0.0449	16.2	0.000179	*< 0.05*	*< 0.000005*	0.00159	0.00229	3.62	*< 0.00004*	6.65	*< 0.00001*	0.124	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000103	0.0443	0.000407	0.0254	*< 0.001*	*< 0.00006*
GO	L2108434-5	6/7/2018 14:00	0.00034	*< 0.001*		9.32	0.00241	7.19	0.000266	0.0463	17.4	0.000207	*< 0.05*	*< 0.000005*	0.00171	0.00249	4.77	*< 0.00004*	8.19	*< 0.00001*	0.134	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000110	0.0493	0.000454	0.0227	0.0113	*< 0.00006*
GO	L2116986-5	6/21/2018 14:00	0.00036	*< 0.001*		10.5	0.00239	8.04	0.000719	0.0418	22.4	0.000207	*< 0.05*	0.0000124	0.00197	0.00238	9.51	*< 0.00004*	7.66	*< 0.00001*	0.151	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000129	0.0533	0.000405	0.0199	0.982	*< 0.00006*
GO	L2125321-5	7/6/2018 11:50	0.00029	*< 0.001*		10.1	0.00251	8.66	0.00499	0.0402	16.8	0.000190	*< 0.05*	0.0000054	0.00187	0.00230	7.10	0.000053	7.82	*< 0.00001*	0.161	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000133	0.0563	0.000410	0.0167	*< 0.001*	*< 0.00006*
GO	L2132784-5	7/19/2018 15:15	0.00038	*< 0.001*		10.3	0.00266	8.89	0.00106	0.0401	16.9	0.000199	*< 0.05*	*< 0.000005*	0.00192	0.00239	7.75	0.000050	8.39	*< 0.00001*	0.161	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000136	0.0601	0.000408	0.0161	0.0017	*< 0.00006*
GO	L2140795-5	8/2/2018 13:45	0.00038	*< 0.001*		11.3	0.00281	9.21	0.000459	0.0401	17.5	0.000176	*< 0.05*	*< 0.000005*	0.00202	0.00251	7.60	0.000079	8.17	*< 0.00001*	0.180	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000136	0.0613	0.000439	0.0149	*< 0.001*	*< 0.00006*
GO	L2148482-5	8/16/2018	0.00035	*< 0.001*		10.9	0.00279	9.92	0.00125	0.0424	17.3	0.000192	*< 0.05*	*< 0.000005*	0.00214	0.00238	7.56	*< 0.00004*	8.30	*< 0.00001*	0.188	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000155	0.0664	0.000427	0.0164	*< 0.001*	*< 0.00006*
GO	L2156461-5	8/30/2018 14:20	0.00041	*< 0.001*		11.5	0.00273	9.85	0.00207	0.0414	17.0	*< 0.00005*	*< 0.05*	*< 0.000005*	0.00211	0.00235	7.58	*< 0.00004*	8.32	*< 0.00001*	0.186	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000160	0.0683	0.000397	0.0143	*< 0.001*	*< 0.00006*
GO	L2164110-5	9/13/2018 11:45	0.00039	*< 0.001*		11.7	0.00274	9.55	0.000945	0.0388	16.8	0.000140	*< 0.05*	*< 0.000005*	0.00213	0.00230	7.43	*< 0.00004*	8.18	*< 0.00001*	0.185	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000143	0.0621	0.000441	0.0127	*< 0.001*	*< 0.00006*
GO	L2172409-5	9/27/2018 14:00	0.00042	*< 0.001*		10.1	0.00257	9.69	0.000639	0.0388	15.8	0.000168	*< 0.05*	*< 0.000005*	0.00188	0.00221	8.02	0.000069	8.63	*< 0.00001*	0.173	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000131	0.0624	0.000374	0.0119	*< 0.001*	*< 0.00006*
GO	L2180431-5	10/12/2018 14:10	0.00034	*< 0.001*		10.0	0.00260	9.77	0.000282	0.0392	15.1	0.000131	*< 0.05*	*< 0.000005*	0.00181	0.00226	8.17	0.000051	8.47	*< 0.00001*	0.180	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000119	0.0696	0.000421	0.0117	*< 0.001*	*< 0.00006*
	L2187510-5	10/25/2018 14:00	0.00035	*< 0.001*		9.81	0.00249	9.63	0.000159	0.0385	14.4	0.000141	*< 0.05*	*< 0.000005*	0.00192	0.00217	7.87	0.000054	8.42	*< 0.00001*	0.179	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000105	0.0707	0.000405	0.0117	*< 0.001*	*< 0.00006*
GO	L2194529-5	11/8/2018 14:10	0.00030	*< 0.001*		10.7	0.00249	10.4	0.000290	0.0370	14.2	0.000144	*< 0.05*	*< 0.000005*	0.00196	0.00226	7.76	0.000053	8.69	*< 0.00001*	0.180	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000106	0.0714	0.000386	0.0107	*< 0.001*	*< 0.00006*
GO	L2200705-5	11/22/2018 11:55	0.00031	*< 0.001*		9.88	0.00240	9.95	0.000124	0.0369	13.3	0.000146	*< 0.05*	*< 0.000005*	0.00192	0.00212	7.63	0.000060	8.40	*< 0.00001*	0.181	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000971	0.0670	0.000407	0.0104	*< 0.001*	*< 0.00006*
GO	L2207335-5	12/6/2018 13:05	0.00036	*< 0.001*		10.1	0.00242	10.3	0.000120	0.0362	13.1	0.000126	*< 0.05*	*< 0.000005*	0.00185	0.00211	7.69	0.000113	8.41	*< 0.00001*	0.177	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000909	0.0698	0.000409	0.0103	*< 0.001*	*< 0.00006*
GO	L2213525-5	12/20/2018 14:45	0.00028	*< 0.001*		10.6	0.00260	10.0	0.000131	0.0377	13.4	0.000127	*< 0.05*	*< 0.000005*	0.00207	0.00225	8.85	0.000048	8.89	*< 0.00001*	0.191	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000963	0.0692	0.000387	0.00981	*< 0.001*	*< 0.00006*
GO	L2217203-5	1/5/2019 11:35	0.00026	*< 0.001*		11.2	0.00262	11.2	0.000544	0.0349	13.2	0.000107	*< 0.05*	*< 0.000005*	0.00217	0.00208	13.7	0.000083	8.12	*< 0.00001*	0.216	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000982	0.0820	0.000333	0.0105	*< 0.001*	*< 0.00006*
GO	L2222132-5	1/17/2019 11:45	0.00035	*< 0.001*		11.7	0.00271	14.8	0.000433	0.0312	12.9	0.000136	*< 0.05*	*< 0.000005*	0.00231	0.00197	34.9	0.000052	8.04	*< 0.00001*	0.276	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000102	0.0829	0.000302	0.00859	*< 0.001*	*< 0.00006*
GO	L2227544-5	1/31/2019 10:30	0.00034	*< 0.001*		12.2	0.00299	19.9	0.000376	0.0251	13.3	0.000165	*< 0.05*	*< 0.000005*	0.00249	0.00168	70.7	0.000062	7.62	*< 0.00001*	0.400	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000111	0.0904	0.000229	0.00629	0.0488	*< 0.00006*
GO	L2233141-5	2/14/2019 14:20	0.00032	*< 0.001*		16.7	0.00376	31.5	0.000401	0.0219	14.1	0.000184	*< 0.05*	*< 0.000005*	0.00301	0.00161	127	0.000044	8.63	*< 0.00001*	0.517	*< 0.0002*	*< 0.0001*	0.00034	0.000126	0.113	0.000219	0.00554	*< 0.001*	*< 0.00006*
GO	L2238565-5	2/28/2019 15:15	0.00037	*< 0.001*		16.4	0.00359	36.7	0.000532	0.0187	13.7	0.000199	*< 0.05*	*< 0.000005*	0.00318	0.00147	152	0.000045	8.15	*< 0.00001*	0.637	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000140	0.111	0.000193	0.00458	*< 0.001*	*< 0.00006*
GO	L2244540-5	3/14/2019 14:30	0.00041	*< 0.001*		17.0	0.00399	38.8	0.000846	0.0163	13.7	0.000225	*< 0.05*	*< 0.000005*	0.00350	0.00141	218	0.000047	8.34	*< 0.00001*	0.671	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000153	0.113	0.000232	0.00410	*< 0.001*	*< 0.00006*
GO	L2250817-5	3/28/2019 15:00	0.00041	*< 0.001*		18.5	0.00458	44.2	0.00143	0.0159	14.3	0.000163	*< 0.05*	*< 0.000005*	0.00395	0.00141	239	0.000064	8.92	*< 0.00001*	0.778	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000162	0.118	0.000206	0.00378	*< 0.001*	*< 0.00006*
GO	L2257457-5	4/11/2019 15:00	0.00039	*< 0.001*		19.2	0.00482	46.0	0.00159	0.0139	13.6	0.000274	*< 0.05*	0.0000085	0.00438	0.00156	237	0.000082	8.88	*< 0.00001*	0.873	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000173	0.111	0.000155	0.00341	*< 0.001*	*< 0.00006*
GO	L2263301-5	4/25/2019 14:45	0.00038	*< 0.001*		18.2	0.00434	47.9	0.00183	0.0135	13.5	0.000208	*< 0.05*	*< 0.000005*	0.00427	0.00139	251	0.000049	8.42	*< 0.00001*	0.857	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000165	0.112	0.000193	0.00319	*< 0.001*	*< 0.00006*
GS	L2000226-2	9/29/2017 10:50	0.00074	*< 0.001*	0.0000079	20.8	0.00670	77.9	0.0322	0.0205	36.7	0.00140	*< 0.05*	0.0000105	0.0236	0.00768	239	0.000316	3.58	0.000030	0.934	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000119	0.224	0.000571	0.00067	*< 0.001*	*< 0.00006*
GS	L2014692-2	10/27/2017	0.00068	*< 0.001*	*< 0.000005*	24.4	0.00801	88.6	0.260	0.0242	41.5	0.00229	*< 0.05*	*< 0.000005*	0.0273	0.00561	280	0.000209	4.50	0.000016	1.01	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000172	0.289	0.000538	0.00068	0.00060	*< 0.00006*
GS	L2021295-2	11/10/2017 13:30	0.00065	*< 0.001*	*< 0.000005*	23.3	0.00868	79.5	0.146	0.0235	39.7	0.00183	*< 0.05*	*< 0.000005*	0.0248	0.00513	229	0.000481	4.07	0.000014	1.04	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000143	0.265	0.000443	0.00052	*< 0.0005*	*< 0.00006*
GS	L2026623-6	11/23/2017 14:40	0.00050	0.0012	*< 0.000005*	22.1	0.00613	75.2	0.116	0.0211	37.1	0.00142	*< 0.05*	0.0000086	0.0250	0.00455	198	0.000170	4.32	0.00245	0.818	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000128	0.223	0.000449	0.00038	0.00083	*< 0.00006*
GS	L2031965-6	12/6/2017 14:05	0.00039	*< 0.001*	*< 0.000005*	20.6	0.00606	65.0	0.0954	0.0199	32.8	0.000966	*< 0.05*	0.0000089	0.0233	0.00468	177	0.000765	4.10	0.000012	0.846	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000138	0.207	0.000466	0.00035	*< 0.0005*	*< 0.00006*
GS	L2038563-6	12/21/2017 13:10	0.00040	*< 0.001*	*< 0.000005*	20.0	0.00505	59.0	0.0837	0.0219	31.7	0.000897	*< 0.05*	0.0000097	0.0222	0.00425	166	0.000263	4.17	0.000011	0.718	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000109	0.177	0.000423	0.00043	*< 0.0005*	*< 0.00006*
GS	L2041649-6	1/4/2018 13:05	0.00021	*< 0.001*	*< 0.000005*	16.1	0.00475	46.7	0.0889	0.0179	26.0	0.000760	*< 0.05*	*< 0.000005*	0.0180	0.00375	132	0.000966	3.97	*< 0.00002*	0.622	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000973	0.156	0.000368	0.00046	*< 0.0005*	*< 0.00006*
GS	L2046871-6	1/18/2018 12:10	0.00022	0.0019	*< 0.000005*	15.7	0.00509	43.0	0.171	0.0197	25.0	0.00104	*< 0.05*	0.0000290	0.0184	0.00381	116	0.00103	4.01	0.000011	0.551	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000994	0.133	0.000391	0.00043	*< 0.0005*	*< 0.00006*
GS	L2052061-6	2/1/2018 12:35	0.00013	0.0017	*< 0.000005*	16.5	0.00407	36.8	0.180	0.0171	23.7	0.000887	*< 0.05*	*< 0.000005*	0.0168	0.00374	99.1	0.000973	3.93	*< 0.00001*	0.511	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000808	0.121	0.000391	0.00061	*< 0.0005*	*< 0.00006*
GS	L2057381-6	2/15/2018 11:35	0.00017	0.0032	*< 0.000005*	14.6	0.00467	34.2	0.0962	0.0187	21.2	0.000620	*< 0.05*	*< 0.000005*	0.0147	0.00362	90.4	0.000657	3.85	*< 0.00001*	0.489	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000739	0.123	0.000318	0.00047	*< 0.0005*	*< 0.00006*
GS	L2062788-6	3/1/2018 14:20	0.00015	0.0044	*< 0.000005*	15.4	0.00461	39.0	0.0935	0.0176	22.9	0.000509	*< 0.05*	*< 0.000005*	0.0167	0.00375	89.7	0.000380	4.11	*< 0.00001*	0.507	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000806	0.111	0.000388	0.00050	*< 0.0005*	*< 0.00006*
GS	L2068449-6	3/15/2018 12:25	*< 0.0001*	0.0054	*< 0.000005*	13.8	0.00444	29.7	0.0817	0.0183	20.3	0.000400	*< 0.05*	*< 0.000005*	0.0157	0.00333	78.8	0.000274	4.01	*< 0.00001*	0.401	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000723	0.0933	0.000321	0.00052	*< 0.0005*	*< 0.00006*
GS	L2074311-6	3/29/2018 12:15	0.00021	0.0076	*< 0.000005*	12.3	0.00413	26.9	0.0609	0.0209	17.0	0.000301	*< 0.05*	*< 0.000005*	0.0128	0.00320	57.2	0.000178	3.58	*< 0.00001*	0.407	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000718	0.100	0.000390	0.00044	0.0017	*< 0.00006*
GS	L2079620-6	4/12/2018 11:30	0.00013	0.0053	*< 0.000005*	12.6	0.00333	24.5	0.0622	0.0208	17.6	0.000319	*< 0.05*	*< 0.000015*	0.0142	0.00306	53.1	0.000156	3.79	0.000011	0.347	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000758	0.0956	0.000397	0.00050	*< 0.001*	*< 0.00006*
GS	L2085708-6	4/26/2018 14:00	0.00011	0.0045	*< 0.000005*	11.9	0.00328	23.5	0.0546	0.0194	15.6	0.000256	*< 0.05*	*< 0.000005*	0.0132	0.00285	47.9	0.000165	3.86	*< 0.00001*	0.318	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000662	0.0806	0.000394	0.00045	*< 0.001*	*< 0.00006*
GS	L2092801-6	5/10/2018 11:15	0.00013	0.0037	*< 0.000005*	12.4	0.00430	23.6	0.0507	0.0210	16.2	0.000198	*< 0.05*	*< 0.000005*	0.0139	0.00314	38.6	0.000153	3.88	*< 0.00001*	0.350	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000741	0.0832	0.000508	0.00052	*< 0.001*	*< 0.00006*
GS	L2100224-6	5/24/2018 14:00	0.00012	0.0017	*< 0.000005*	12.1	0.00360	24.2	0.0493	0.0229	15.8	0.000213	*< 0.05*	*< 0.000005*	0.0140	0.00323	37.6	0.000194	3.88	*< 0.00001*	0.355	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000729	0.0805	0.000517	0.00049	*< 0.001*	0.000074
GS	L2108434-6	6/7/2018 14:00	0.00024	*< 0.001*		12.5	0.00422	24.0	0.00512	0.0235	16.4	0.000265	*< 0.05*	*< 0.000005*	0.0142	0.00342	42.9	0.000113	5.17	0.000015	0.333	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000782	0.0833	0.000573	0.00047	0.0110	*< 0.00006*
GS	L2116986-6	6/21/2018 14:00	0.00025	0.0017		12.9	0.00395	23.4	0.00765	0.0224	15.9	0.000234	*< 0.05*	*< 0.000005*	0.0152	0.00345	35.2	0.000149	5.20	*< 0.00001*	0.330	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000769	0.0767	0.000679	0.00053	0.0012	*< 0.00006*
GS	L2125321-6	7/6/2018 11:50	0.00013	*< 0.001*		11.6	0.00373	21.0	0.00816	0.0227	14.5	0.000201	*< 0.05*	*< 0.000005*	0.0138	0.00356	28.6	0.000153	5.40	*< 0.00001*	0.303	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000695	0.0699	0.000923	0.00056	*< 0.001*	*< 0.00006*
GS	L2132784-6	7/19/2018 15:15	0.00023	0.0020		11.7	0.00377	20.6	0.00840	0.0232	14.9	0.000278	*< 0.05*	*< 0.000005*	0.0137	0.00367	27.0	0.000279	5.71	0.000024	0.285	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000676	0.0709	0.000971	0.00055	0.0016	*< 0.00006*
GS	L2140795-6	8/2/2018 13:45	0.00024	0.0028		12.8	0.00402	19.8	0.00622	0.0247	14.8	0.000234	*< 0.05*	*< 0.000005*	0.0140	0.00365	24.8	0.000188	5.59	*< 0.00001*	0.308	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000756	0.0660	0.00119	0.00063	*< 0.001*	*< 0.00006*

Appendix A3: Gneiss Column (GO, GS, GT) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
GS	L2148482-6	8/16/2018	0.00021	0.0021		11.4	0.00374	19.5	0.00621	0.0241	14.0	0.000260	*< 0.05*	*< 0.000005*	0.0140	0.00387	21.5	0.000124	5.95	*< 0.00001*	0.298	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000693	0.0656	0.00127	0.00066	*< 0.001*	*< 0.00006*
GS	L2156461-6	8/30/2018 14:20	0.00026	0.0017		11.7	0.00374	18.0	0.00523	0.0243	13.3	*< 0.00005*	*< 0.05*	*< 0.000005*	0.0135	0.00380	18.5	0.000103	5.76	*< 0.00001*	0.286	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000675	0.0635	0.00139	0.00071	*< 0.001*	*< 0.00006*
GS	L2164110-6	9/13/2018 11:45	0.00020	*< 0.001*		11.8	0.00370	18.0	0.00455	0.0243	13.7	0.000207	*< 0.05*	*< 0.000005*	0.0141	0.00381	17.4	0.000076	5.94	*< 0.00001*	0.286	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000625	0.0554	0.00153	0.00071	*< 0.001*	*< 0.00006*
GS	L2172409-6	9/27/2018 14:00	0.00022	0.0012		10.4	0.00337	16.7	0.00382	0.0230	12.3	0.000217	*< 0.05*	*< 0.000005*	0.0117	0.00363	17.2	0.000138	6.20	*< 0.00001*	0.250	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000538	0.0550	0.00146	0.00076	*< 0.001*	*< 0.00006*
GS	L2180431-6	10/12/2018 14:10	0.00020	*< 0.001*		9.81	0.00338	16.5	0.00259	0.0244	11.3	0.000168	*< 0.05*	*< 0.000005*	0.0115	0.00379	15.8	0.000096	5.96	*< 0.00001*	0.245	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000502	0.0545	0.00159	0.00075	*< 0.001*	*< 0.00006*
GS	L2187510-6	10/25/2018 14:00	0.00020	*< 0.001*		9.85	0.00337	16.8	0.00237	0.0250	11.6	0.000194	*< 0.05*	*< 0.000005*	0.0117	0.00343	16.3	0.000116	5.61	0.000020	0.251	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000480	0.0575	0.00160	0.00075	*< 0.001*	*< 0.00006*
GS	L2194529-6	11/8/2018 14:10	0.00014	*< 0.001*		10.2	0.00328	17.2	0.00249	0.0234	10.8	0.000230	*< 0.05*	*< 0.000005*	0.0115	0.00372	15.8	0.000102	6.16	*< 0.00001*	0.250	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000440	0.0595	0.00162	0.00077	*< 0.001*	*< 0.00006*
GS	L2200705-6	11/22/2018 11:55	0.00019	*< 0.001*		9.75	0.00324	16.6	0.00115	0.0242	10.7	0.000213	*< 0.05*	*< 0.000005*	0.0114	0.00368	15.2	0.000092	5.96	*< 0.00001*	0.243	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000416	0.0532	0.00183	0.00075	*< 0.001*	*< 0.00006*
GS	L2207335-6	12/6/2018 13:05	0.00036	*< 0.001*		9.78	0.00314	16.2	0.00100	0.0239	10.0	0.000202	*< 0.05*	0.0000051	0.0110	0.00369	14.3	0.000126	5.99	*< 0.00001*	0.238	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000382	0.0532	0.00197	0.00081	*< 0.001*	*< 0.00006*
GS	L2213525-6	12/20/2018 14:45	0.00014	*< 0.001*		9.65	0.00320	14.7	0.00132	0.0233	10.7	0.000179	*< 0.05*	*< 0.000005*	0.0109	0.00388	12.9	0.000094	6.51	*< 0.00001*	0.231	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000388	0.0485	0.00192	0.00085	*< 0.001*	*< 0.00006*
GS	L2217203-6	1/5/2019 11:35	0.00017	*< 0.001*		10.1	0.00336	16.5	0.00128	0.0259	10.5	0.000168	*< 0.05*	*< 0.000005*	0.0124	0.00360	14.6	0.000046	5.54	*< 0.00001*	0.266	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000348	0.0553	0.00206	0.00078	*< 0.001*	*< 0.00006*
GS	L2222132-6	1/17/2019 11:45	0.00022	*< 0.001*		10.7	0.00341	20.0	0.00289	0.0227	10.6	0.000196	*< 0.05*	*< 0.000005*	0.0118	0.00347	37.1	0.000116	5.61	0.000013	0.314	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000392	0.0610	0.00210	0.00073	*< 0.001*	*< 0.00006*
GS	L2227544-6	1/31/2019 10:30	0.00024	*< 0.001*		11.4	0.00374	27.0	0.0126	0.0200	11.7	0.000251	*< 0.05*	*< 0.000005*	0.0135	0.00283	74.1	0.000097	5.16	*< 0.00001*	0.469	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000398	0.0733	0.00159	0.00041	*< 0.001*	*< 0.00006*
GS	L2233141-6	2/14/2019 14:20	0.00020	*< 0.001*		14.3	0.00472	39.7	0.0393	0.0178	13.2	0.000344	*< 0.05*	*< 0.000005*	0.0150	0.00254	126	0.000088	5.51	*< 0.00001*	0.640	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000462	0.0909	0.00142	0.00020	*< 0.001*	*< 0.00006*
GS	L2238565-6	2/28/2019 15:15	0.00025	0.0016		14.9	0.00471	49.6	0.0521	0.0143	13.5	0.000459	*< 0.05*	*< 0.000005*	0.0165	0.00207	170	0.000059	5.56	*< 0.00001*	0.841	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000515	0.0922	0.00119	0.00011	*< 0.001*	*< 0.00006*
GS	L2244540-6	3/14/2019 14:30	0.00027	*< 0.001*		15.8	0.00564	53.8	0.0629	0.0117	13.7	0.000465	*< 0.05*	*< 0.000005*	0.0183	0.00184	238	0.000066	5.57	*< 0.00001*	0.933	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000551	0.0870	0.00111	*< 0.0001*	*< 0.001*	*< 0.00006*
GS	L2250817-6	3/28/2019 15:00	0.00030	*< 0.001*		18.4	0.00595	64.8	0.0440	0.0109	14.8	0.000403	*< 0.05*	*< 0.000005*	0.0209	0.00178	274	0.000083	5.88	*< 0.00001*	1.08	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000595	0.0873	0.00109	*< 0.0001*	*< 0.001*	*< 0.00006*
GS	L2257457-6	4/11/2019 15:00	0.00033	*< 0.001*		18.6	0.00633	68.2	0.0436	0.00956	14.1	0.000498	*< 0.05*	0.0000986	0.0223	0.00195	275	0.000124	5.73	*< 0.00001*	1.18	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000604	0.0884	0.00102	*< 0.0001*	*< 0.001*	*< 0.00006*
GS	L2263301-6	4/25/2019 14:45	0.00021	*< 0.001*		17.9	0.00611	69.5	0.0497	0.00950	13.8	0.000455	*< 0.05*	*< 0.000005*	0.0207	0.00172	296	0.000109	5.53	*< 0.00001*	1.20	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000513	0.0895	0.000951	*< 0.0001*	*< 0.001*	*< 0.00006*
GT	L2000226-3	9/29/2017 10:50	0.00077	*< 0.001*	0.0000094	20.9	0.00371	33.4	0.0100	0.0394	26.3	0.000377	*< 0.05*	0.0000081	0.0119	0.0105	107	0.000375	6.44	0.000017	0.388	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000422	0.286	0.000192	0.00108	*< 0.00065*	*< 0.00006*
GT	L2014692-3	10/27/2017	0.00073	*< 0.001*	*< 0.000005*	22.8	0.00411	36.1	0.115	0.0503	27.3	0.000624	*< 0.05*	0.0000056	0.0132	0.00776	114	0.000158	7.57	0.000012	0.409	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000542	0.354	0.000208	0.00126	*< 0.0005*	*< 0.00006*
GT	L2021295-3	11/10/2017 13:30	0.00060	*< 0.001*	0.0000055	21.7	0.00420	30.4	0.120	0.0529	24.8	0.000499	*< 0.05*	*< 0.000005*	0.0120	0.00589	83.5	0.000467	6.75	*< 0.00001*	0.381	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000474	0.294	0.000182	0.00120	*< 0.0005*	*< 0.00006*
GT	L2026623-7	11/23/2017 14:40	0.00053	*< 0.001*	*< 0.000005*	19.5	0.00394	27.1	0.109	0.0541	22.0	0.000613	*< 0.05*	*< 0.000005*	0.0113	0.00536	69.6	0.000401	6.96	0.000033	0.333	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000491	0.248	0.000209	0.00127	0.00138	*< 0.00006*
GT	L2031965-7	12/6/2017 14:05	0.00074	0.0106	0.0000056	18.0	0.00314	24.1	0.0761	0.0507	20.0	0.000388	*< 0.05*	0.0000169	0.0112	0.00519	61.0	0.000457	6.77	*< 0.00001*	0.296	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000505	0.217	0.000247	0.00109	0.00065	*< 0.00006*
GT	L2038563-7	12/21/2017 13:10	0.00046	*< 0.001*	*< 0.000005*	17.7	0.00255	21.8	0.0483	0.0546	18.6	0.000347	*< 0.05*	0.0000052	0.0106	0.00465	54.2	0.000094	6.70	*< 0.00001*	0.262	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000452	0.196	0.000224	0.00095	*< 0.0005*	*< 0.00006*
GT	L2041649-7	1/4/2018 13:05	0.00033	*< 0.001*	*< 0.000005*	14.7	0.00253	18.5	0.0449	0.0482	16.0	0.000287	*< 0.05*	*< 0.000005*	0.00879	0.00438	43.1	0.000415	6.30	*< 0.00001*	0.251	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000430	0.170	0.000203	0.00092	*< 0.0005*	*< 0.00006*
GT	L2046871-7	1/18/2018 12:10	0.00038	0.0022	*< 0.000005*	15.1	0.00328	17.8	0.0526	0.0558	15.6	0.000312	*< 0.05*	*< 0.000005*	0.00962	0.00460	39.1	0.000478	6.50	*< 0.00001*	0.249	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000457	0.166	0.000266	0.00106	*< 0.0005*	*< 0.00006*
GT	L2052061-7	2/1/2018 12:35	0.00032	*< 0.001*	*< 0.000005*	15.8	0.00208	15.6	0.0487	0.0460	14.6	0.000276	*< 0.05*	*< 0.000005*	0.00876	0.00416	33.9	0.000395	6.45	*< 0.00001*	0.224	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000439	0.139	0.000292	0.00101	*< 0.0005*	*< 0.00006*
GT	L2057381-7	2/15/2018 11:35	0.00028	*< 0.001*	*< 0.000005*	14.0	0.00275	15.0	0.0170	0.0500	13.1	0.000228	*< 0.05*	*< 0.000005*	0.00767	0.00425	30.2	0.000365	6.18	*< 0.00001*	0.214	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000407	0.141	0.000258	0.00087	*< 0.0005*	*< 0.00006*
GT	L2062788-7	3/1/2018 14:20	0.00026	*< 0.001*	*< 0.000005*	14.4	0.00261	16.3	0.0417	0.0463	13.9	0.000272	*< 0.05*	*< 0.000005*	0.00789	0.00409	29.6	0.000147	6.65	*< 0.00001*	0.217	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000421	0.123	0.000264	0.00085	*< 0.0005*	*< 0.00006*
GT	L2068449-7	3/15/2018 12:25	0.00024	*< 0.001*	*< 0.000005*	13.4	0.00275	13.0	0.0411	0.0467	12.6	0.000222	*< 0.05*	*< 0.000005*	0.00810	0.00362	25.5	0.000189	6.54	*< 0.00001*	0.180	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000423	0.102	0.000263	0.00100	*< 0.0005*	*< 0.00006*
GT	L2074311-7	3/29/2018 12:15	0.00112	*< 0.001*	*< 0.000005*	11.4	0.00245	11.8	0.0343	0.0523	10.4	0.000189	*< 0.05*	0.0000058	0.00640	0.00343	18.3	*< 0.00004*	5.81	*< 0.00001*	0.189	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000407	0.111	0.000304	0.00102	*< 0.001*	*< 0.00006*
GT	L2079620-7	4/12/2018 11:30	0.00024	*< 0.001*	*< 0.000005*	11.0	0.00199	11.0	0.0297	0.0525	11.0	0.000183	*< 0.05*	*< 0.00002*	0.00693	0.00345	18.1	0.000069	6.10	*< 0.00001*	0.168	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000402	0.108	0.000302	0.00098	*< 0.001*	*< 0.00006*
GT	L2085708-7	4/26/2018 14:00	0.00021	*< 0.001*	*< 0.000005*	10.9	0.00282	10.9	0.0384	0.0469	9.63	0.000181	*< 0.05*	*< 0.000005*	0.00667	0.00306	16.6	0.000115	6.27	*< 0.00001*	0.158	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000380	0.0920	0.000291	0.00099	*< 0.001*	*< 0.00006*
GT	L2092801-7	5/10/2018 11:15	0.00021	*< 0.001*	*< 0.000005*	11.3	0.00268	11.0	0.0420	0.0516	9.95	0.000139	*< 0.05*	*< 0.000005*	0.00675	0.00349	13.5	0.000106	6.33	*< 0.00001*	0.172	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000402	0.0953	0.000444	0.00108	*< 0.001*	*< 0.00006*
GT	L2100224-7	5/24/2018 14:00	0.00023	*< 0.001*	*< 0.000005*	11.5	0.00246	11.4	0.0606	0.0547	9.75	0.000115	*< 0.05*	*< 0.000005*	0.00696	0.00350	12.5	0.000067	6.34	*< 0.00001*	0.185	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000404	0.0936	0.000391	0.00112	*< 0.001*	*< 0.00006*
GT	L2108434-7	6/7/2018 13:30	0.00023	*< 0.001*		10.5	0.00244	9.78	0.0410	0.0488	9.39	0.000249	*< 0.05*	0.0000060	0.00661	0.00317	11.2	0.000054	6.91	0.000016	0.151	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000369	0.0718	0.000422	0.00116	0.0191	*< 0.00006*
GT	L2116986-7	6/21/2018 14:00	0.00021	0.0026		10.8	0.00232	9.31	0.115	0.0434	9.29	0.000241	*< 0.05*	*< 0.000005*	0.00665	0.00289	8.31	*< 0.00004*	6.32	*< 0.00001*	0.151	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000386	0.0606	0.000383	0.00141	*< 0.001*	*< 0.00006*
GT	L2125321-7	7/6/2018 11:50	0.00010	*< 0.001*		9.30	0.00220	8.20	0.123	0.0399	8.46	0.000168	*< 0.05*	0.0000068	0.00575	0.00262	7.84	*< 0.00004*	6.29	*< 0.00001*	0.144	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000330	0.0522	0.000387	0.00139	*< 0.001*	0.000108
GT	L2132784-7	7/19/2018 15:15	0.00018	*< 0.001*		8.95	0.00222	7.75	0.0864	0.0389	8.15	0.000135	*< 0.05*	*< 0.000005*	0.00549	0.00258	6.64	0.000051	6.27	*< 0.00001*	0.130	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000309	0.0475	0.000347	0.00139	0.0029	*< 0.00006*
GT	L2140795-7	8/2/2018 13:45	0.00019	0.0012		9.76	0.00230	7.83	0.0778	0.0406	8.60	0.000136	*< 0.05*	*< 0.000005*	0.00581	0.00264	6.47	0.000105	6.10	*< 0.00001*	0.147	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000352	0.0463	0.000436	0.00153	*< 0.001*	*< 0.00006*
GT	L2148482-7	8/16/2018	0.00014	*< 0.001*		8.65	0.00218	7.57	0.0728	0.0380	8.25	0.000137	*< 0.05*	*< 0.000005*	0.00576	0.00255	5.45	0.000047	6.14	*< 0.00001*	0.141	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000315	0.0435	0.000435	0.00146	*< 0.001*	*< 0.00006*
GT	L2156461-7	8/30/2018 14:20	0.00019	*< 0.001*		9.23	0.00217	7.60	0.0661	0.0380	8.46	*< 0.00005*	*< 0.05*	*< 0.000005*	0.00572	0.00257	5.11	0.000053	5.98	*< 0.00001*	0.146	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000311	0.0463	0.000402	0.00143	*< 0.001*	*< 0.00006*
GT	L2164110-7	9/13/2018 11:45	0.00014	*< 0.001*		8.66	0.00208	7.27	0.0458	0.0339	8.15	0.000082	*< 0.05*	*< 0.000005*	0.00546	0.00234	4.99	*< 0.00004*	5.94	*< 0.00001*	0.140	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000282	0.0403	0.000452	0.00130	*< 0.001*	*< 0.00006*
GT	L2172409-7	9/27/2018 14:00	0.00018	0.0010		7.58	0.00194	6.78	0.0694	0.0339	7.71	0.000107	*< 0.05*	0.0000059	0.00470	0.00228	4.55	0.000046	5.98	*< 0.00001*	0.126	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000243	0.0377	0.000407	0.00138	*< 0.001*	*< 0.00006*
GT	L2180431-7	10/12/2018 14:10	0.00015	0.0011		7.28	0.00193	6.79	0.0563	0.0346	7.30	0.000089	*< 0.05*	0.0000165	0.00466	0.00233	4.33	0.000052	5.93	*< 0.00001*	0.132	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000238	0.0373	0.000431	0.00131	*< 0.001*	*< 0.00006*
GT	L2187510-7	10/25/2018 14:00	0.00016	0.0012		7.19	0.00182	6.65	0.0446	0.0335	7.26	0.000076	*< 0.05*	0.0000069	0.00456	0.00227	4.13	0.000073	5.76	*< 0.00001*	0.126	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000232	0.0399	0.000478	0.00127	*< 0.001*	*< 0.00006*
GT	L2194529-7	11/8/2018 13:40	*< 0.0001*	0.0017		7.21	0.00179	6.67	0.0504	0.0321	7.10	0.000104	*< 0.05*	*< 0.000005*	0.00465	0.00235	4.00	0.000076	5.99	*< 0.00001*	0.127	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000212	0.0379	0.000474	0.00128	*< 0.001*	*< 0.00006*
GT	L2200705-7	11/22/2018 10:30	0.00012	0.0018		6.95	0.00178	6.68	0.0439	0.0323	6.97	0.000095	*< 0.05*	0.0000051	0.00430	0.00229	4.44	0.000102	6.00	*< 0.00001*	0.128	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000200	0.0376	0.000502	0.00126	*< 0.001*	*< 0.00006*
GT	L2207335-7	12/6/2018 14:45	0.00013	0.0017		6.86	0.00175	6.73	0.0538	0.0308	6.82	0.000080	*< 0.05*	0.0000072	0.00414	0.00222	3.73	0.000095	5.61	*< 0.00001*	0.125	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000188	0.0360	0.000478	0.00129	*< 0.001*	*< 0.00006*
GT	L2213525-7	12/20/2018 14:45	0.00020	*< 0.001*		9.93	0.00261	17.0	0.922	0.0236	8.68	0.000711	*< 0.05*	0.0000183	0.00688	0.00231	74.7	0.000069	5.58	*< 0.00001*	0.428	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000399	0.0816	0.000314	0.00278	*< 0.001*	*< 0.00006*
GT	L2217203-7	1/5/2019 11:35	0.00029	0.0013		10.9	0.00319	25.2	0.716	0.0175	8.72	0.000817	*< 0.05*	0.0000069	0.00840	0.00180	156	0.000056	5.49	*< 0.00001*	0.593	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000426	0.0921	0.000280	0.00070	*< 0.001*	*< 0.00006*
GT	L2222132-7	1/17/2019 11:45	0.00029	0.0020		11.5	0.00363	28.6	0.970	0.0142	8.46	0.000999	*< 0.05*	0.0000075	0.00916	0.00144	250	0.000104	5.22	*< 0.00001*	0.854	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000445	0.0721	0.000210	0.00037	*< 0.001*	*< 0.00006*
GT	L2227544-7	1/31/2019 10:30	0.00024	0.0030		10.3	0.00326	23.9	0.819	0.0120	8.33	0.000817	*< 0.05*	0.0000055	0.00958	0.00122	276	0.000131	4.83	*< 0.00001*	0.992	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000415	0.0573	0.000169	0.00021	0.0697	*< 0.00006*
GT	L2233141-7	2/14/2019 14:20	0.00016	0.0023		11.3	0.00375	24.9	0.761	0.0112	8.12	0.000652	*< 0.05*	*< 0.000005*	0.0103	0.00114	303	0.000122	5.12	*< 0.00001*	1.16	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000429	0.0623	0.000179	0.00017	*< 0.001*	*< 0.00006*
GT	L2238565-7	2/28/2019 15:15	0.00021	0.0034		11.8	0.00356	24.7	0.657	0.0101	7.89	0.000514	*< 0.05*	*< 0.000005*	0.0117	0.00107	270	0.000094	5.07	*< 0.00001*	1.35	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000397	0.0555	0.000177	0.00012	*< 0.001*	*< 0.00006*
GT	L2244540-7	3/14/2019 14:30	*< 0.0002*	0.0081		12.2	0.0036	24.5	0.814	0.00996	8.76	0.00045	*< 0.1*	*< 0.00001*	0.0126	0.00112	334	*< 0.00008*	5.09	*< 0.00002*	1.37	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000439	0.0560	0.00017	*< 0.0002*	*< 0.002*	*< 0.00012*
GT	L2250817-7	3/28/2019 15:00	0.00021	0.0037		11.9	0.0040	24.9	0.618	0.00956	8.41	0.00028	*< 0.1*	*< 0.00001*	0.0128	0.00102	354	0.000119	5.42	*< 0.00002*	1.49	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000408	0.0519	0.00020	*< 0.0002*	*< 0.002*	*< 0.00012*
GT	L2257457-7	4/11/2019 15:00	*< 0.0002*	0.0038		11.6	0.0041	22.7	0.572	0.00971	7.76	0.00043	*< 0.1*	*< 0.00001*	0.0134	0.00121	339	*< 0.00008*	5.30	*< 0.00002*	1.63	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000419	0.0501	0.00013	*< 0.0002*	*< 0.002*	*< 0.00012*
GT	L2263301-7	4/25/2019 14:45	*< 0.0002*	0.0041		11.7	0.0039	22.9	0.490	0.00884	8.06	0.00029	*< 0.1*	*< 0.00001*	0.0136	0.00108	343	*< 0.00008*	5.33	*< 0.00002*	1.64	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.000376	0.0516	0.00020	*< 0.0002*	*< 0.002*	*< 0.00012*

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX A4: SCHIST COLUMN (SO, SS, ST) EFFLUENT RESULTS

Appendix A4: Schist Column (SO, SS, ST) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**
SO	L2000226-4	9/29/2017 10:50	0	0		433	8.21	299	104	3.90	< 0.005	< 0.001	< 0.005	< 0.002	55.9	< 0.0015	< 0.05	2.34	1.62	< 0.000005	0.00919	0.0179	0.023	0.0466	< 0.00001	< 0.000005	21.4	< 0.000005	0.0000255	0.00097	0.000085
SO	L2014692-4	10/27/2017	4	4		258	8.15	361	127	3.26	0.0205	< 0.001	< 0.005	0.0021	68.3	< 0.0015	< 0.05	2.39	0.529	< 0.000005	0.00466	0.0153	0.028	0.0645	< 0.00001	< 0.000005	28.3	< 0.000005	0.0000305	0.00047	0.000123
SO	L2021295-4	11/10/2017 13:30	6	6		258	8.2	324	111	2.61	0.0051	< 0.001	< 0.005	< 0.002	57.3	< 0.0015	< 0.05	1.94	0.500	< 0.000005	0.00525	0.0146	0.024	0.0571	< 0.00001	< 0.000005	23.8	< 0.000005	0.0000211	< 0.0001	0.000099
SO	L2026623-8	11/23/2017 14:40	8	8		295	8.12	311	150	1.63	< 0.005	< 0.001	< 0.005	< 0.002	51.9	< 0.0015	< 0.05	1.62	0.508	< 0.000005	0.00523	0.0143	0.025	0.0577	< 0.00001	< 0.000005	26.1	< 0.000005	0.0000284	0.00028	0.000093
SO	L2031965-8	12/6/2017 14:05	10	10		262	8.06	308	164	1.97	0.0056	< 0.001	< 0.005	< 0.002	47.5	< 0.0015	< 0.05	1.39	0.546	< 0.000005	0.00534	0.0159	0.020	0.0630	< 0.00001	< 0.000005	24.5	< 0.000005	0.0000253	0.00036	0.000091
SO	L2038563-8	12/21/2017 13:10	12	12		268	8.09	297.4	141	1.38	0.0067	< 0.001	< 0.005	< 0.002	44.4	< 0.0015	< 0.05	1.48	0.510	< 0.000005	0.00520	0.0155	0.022	0.0720	< 0.00001	< 0.000005	23.4	< 0.000005	0.0000357	0.00042	0.000094
SO	L2041649-8	1/4/2018 13:05	14	14		254	8.05	286.4	125	1.32	< 0.005	< 0.001	< 0.005	< 0.002	41.8	< 0.0015	< 0.05	1.07	0.508	< 0.000005	0.00506	0.0153	0.019	0.0663	< 0.00001	< 0.000005	23.8	< 0.000005	0.0000221	0.00035	0.000087
SO	L2046871-8	1/18/2018 12:10	16	16		269	8.11	274.5	136	1.24	< 0.005	< 0.001	< 0.005	< 0.002	38.5	< 0.0015	< 0.05	0.92	0.505	< 0.000005	0.00556	0.0200	0.021	0.0678	< 0.00001	< 0.000005	24.8	0.0000053	0.0000221	0.00040	0.000097
SO	L2052061-8	2/1/2018 12:35	18	18		290	8.06	265.1	129	1.29	< 0.005	< 0.001	< 0.005	< 0.002	35.5	0.0032	< 0.05	0.78	0.500	< 0.000005	0.00504	0.0226	0.018	0.0685	< 0.00001	< 0.000005	23.7	< 0.000005	0.0000192	0.00039	0.000089
SO	L2057381-8	2/15/2018 11:35	20	20		274	8.06	268.1	125	1.27	0.0086	< 0.001	< 0.005	0.0099	33.8	< 0.0015	< 0.05	0.64	0.493	< 0.000005	0.00421	0.0210	0.018	0.0768	< 0.00001	< 0.000005	24.6	< 0.000005	0.0000186	0.00028	0.000088
SO	L2062788-8	3/1/2018 14:20	22	22		236	8.02	270.1	133	1.08	0.0186	< 0.001	< 0.005	0.0022	33.5	< 0.0015	< 0.05	0.61	0.506	< 0.000005	0.00434	0.0234	0.020	0.0809	< 0.00001	< 0.000005	25.4	< 0.000005	0.0000217	0.00043	0.000091
SO	L2068449-8	3/15/2018 12:25	24	24		299	8.06	248.8	135	1.12	0.0061	< 0.001	< 0.005	< 0.002	28.8	< 0.0015	< 0.05	< 0.5	0.489	< 0.000005	0.00582	0.0271	0.017	0.0819	< 0.00001	< 0.000005	21.6	< 0.000005	0.0000306	0.00034	0.000077
SO	L2074311-8	3/29/2018 12:15	26	26		275	8.05	249.2	140	0.95	0.0150	< 0.001	< 0.005	0.0023	27.5	< 0.0015	< 0.05	< 0.5	0.494	< 0.000005	0.00479	0.0257	0.016	0.0834	< 0.00001	0.0000058	21.6	< 0.000005	0.0000311	0.00039	0.000081
SO	L2079620-8	4/12/2018 11:30	28	28		260	8.06	248.1	126	0.91	0.0113	< 0.001	< 0.005	0.0024	25.4	< 0.0015	< 0.05	< 0.5	0.519	< 0.000005	0.00402	0.0274	0.017	0.0887	< 0.00001	0.0000177	21.3	< 0.000005	0.0000294	0.00031	0.000087
SO	L2085708-8	4/26/2018 14:00	30	30		259	8.01	244.5	118	0.88	0.0221	< 0.001	< 0.005	0.0022	25.5	< 0.0015	< 0.05	< 0.5	0.517	< 0.000005	0.00375	0.0288	0.017	0.0876	< 0.00001	< 0.000005	21.3	< 0.000005	0.0000328	0.00038	0.000089
SO	L2092801-8	5/10/2018 11:15	32	32		261	8.11	244.6	127	0.89	0.0327	< 0.001	< 0.005	< 0.002	24.6	< 0.0015	< 0.05	< 0.5	0.503	< 0.000005	< 0.004	0.0304	0.019	0.0890	< 0.00001	< 0.000005	22.4	< 0.000005	0.0000385	0.00036	0.000094
SO	L2100224-8	5/24/2018 14:00	34	34		273	8.02	246.2	114	1.12	0.0377	< 0.001	< 0.005	0.0025	22.6	< 0.0015	< 0.05	< 0.5	0.513	< 0.000005	0.00386	0.0369	0.017	0.111	< 0.00001	0.0000213	22.1	< 0.000005	0.0000500	0.00040	0.000107
SO	L2108434-8	6/7/2018 14:00	36		0	205	8.02	264.2	165	1.15	0.107	< 0.001	< 0.005	0.0038	24.1	< 0.0015	< 0.05	< 0.5	0.555	< 0.000005	0.00377	0.0431	0.022	0.121	< 0.00001	< 0.000005	24.6	< 0.000005	0.0000247	0.00045	0.000118
SO	L2116986-8	6/21/2018 14:00	38		2	355	8.09	275	185	0.86	0.130	< 0.001	< 0.005	0.0051	24.6	< 0.0015	< 0.05	< 0.5	0.584	< 0.000005	0.00309	0.0383	0.022	0.124	< 0.00001	< 0.000005	25.2	< 0.000005	0.0000190	0.00051	0.000130
SO	L2125321-8	7/6/2018 11:50	40		4	206	8.11	268.3	237	1.02	0.121	< 0.001	< 0.005	0.0066	21.4	< 0.0015	< 0.05	< 0.5	0.577	< 0.000005	0.00283	0.0371	0.021	0.134	< 0.00001	< 0.000005	24.5	0.0000056	0.0000205	0.00056	0.000127
SO	L2132784-8	7/19/2018 15:15	42		6	331	8.24	272.6	165	0.92	0.136	< 0.001	< 0.005	0.0061	21.7	< 0.0015	< 0.05	< 0.5	0.588	< 0.000005	0.00311	0.0348	0.022	0.131	< 0.00001	< 0.000005	25.3	< 0.000005	0.0000172	0.00054	0.000139
SO	L2140795-8	8/2/2018 13:45	44		8	175	8.18	275.6	170	0.97	0.143	< 0.001	< 0.005	0.0059	20.9	< 0.0015	< 0.05	< 0.5	0.588	< 0.000005	< 0.004	0.0332	0.024	0.138	< 0.00001	< 0.000005	26.6	< 0.000005	0.0000229	0.00057	0.000141
SO	L2148482-8	8/16/2018	46		10	283	8.1	277.1	155	0.87	0.151	< 0.001	< 0.005	0.0063	20.1	< 0.0015	< 0.05	0.79	0.589	< 0.000005	0.00275	0.0321	0.023	0.152	< 0.00001	< 0.000005	27.6	< 0.000005	0.0000199	0.00054	0.000149
SO	L2156461-8	8/30/2018 14:20	48		12	324	8.11	272.8	159	0.82	0.136	< 0.001	< 0.005	0.0077	18.2	< 0.0015	< 0.05	1.05	0.582	< 0.000005	0.00267	0.0372	0.024	0.150	< 0.00001	< 0.000005	26.3	< 0.000005	0.0000193	0.00057	0.000149
SO	L2164110-8	9/13/2018 11:45	50		14	295	8.18	277.2	159	1.1	0.137	< 0.001	< 0.005	0.0071	18.6	< 0.0015	< 0.05	1.22	0.584	< 0.000005	0.00282	0.0338	0.023	0.145	< 0.00001	< 0.000005	26.6	< 0.000005	0.0000214	0.00054	0.000142
SO	L2172409-8	9/27/2018 14:00	52		16	319	8.18	267.8	111	1.21	0.139	< 0.001	< 0.005	0.0062	17.3	< 0.0015	< 0.05	1.34	0.598	< 0.000005	0.00247	0.0347	0.022	0.139	< 0.00001	< 0.000005	24.5	< 0.000005	0.0000208	0.00048	0.000129
SO	L2180431-8	10/12/2018 14:10	54		18	205	8.1	270.5	131	0.70	0.140	< 0.001	< 0.005	0.0068	16.0	< 0.0015	< 0.05	1.39	0.549	< 0.000005	0.00222	0.0318	0.022	0.147	< 0.00001	< 0.000005	24.2	< 0.000005	0.0000205	0.00049	0.000125
	L2187510-8	10/25/2018 14:00	56		20	197	8.17	282	157	< 1	0.145	< 0.001	< 0.005	0.0053	16.8	< 0.0015	< 0.05	1.51	0.585	< 0.000005	0.00212	0.0278	0.023	0.142	< 0.00001	< 0.000005	25.3	< 0.000005	0.0000194	0.00058	0.000135
SO	L2194529-8	11/8/2018 14:10	58		22	312	8.27	275.3	165	0.72	0.147	< 0.001	< 0.005	0.0060	16.6	< 0.0015	< 0.05	1.50	0.592	< 0.000005	0.00198	0.0306	0.021	0.155	< 0.00001	< 0.000005	25.4	< 0.000005	0.0000184	0.00055	0.000113
SO	L2200705-8	11/22/2018 11:55	60		24	287	8.11	268.8	167	0.86	0.148	< 0.001	< 0.005	0.0058	15.9	< 0.0015	< 0.05	1.43	0.590	< 0.000005	0.00169	0.0288	0.022	0.131	< 0.00001	< 0.000005	25.6	< 0.000005	0.0000171	0.00054	0.000128
SO	L2207335-8	12/6/2018 13:05	62		26	274	8.05	268.2	150	1.08	0.151	< 0.001	< 0.005	0.0062	15.5	< 0.0015	< 0.05	1.39	0.599	< 0.000005	0.00233	0.0292	0.021	0.153	< 0.00001	< 0.000005	25.8	< 0.000005	0.0000171	0.00059	0.000124
SO	L2213525-8	12/20/2018 14:45	64		28	388	8.1	271	200	1.09	0.145	< 0.001	< 0.005	0.0068	19.6	< 0.0015	< 0.05	1.42	0.619	< 0.000005	0.00215	0.0305	0.022	0.157	< 0.00001	< 0.000005	28.3	< 0.000005	0.0000180	0.00053	0.000144
SO	L2217203-8	1/5/2019 11:35	66		30	350	7.96	305	173	0.69	0.175	< 0.001	< 0.005	0.0049	36.2	< 0.0067	< 0.05	1.33	0.605	< 0.000005	0.00232	0.0208	0.020	0.157	< 0.00001	< 0.000005	31.6	< 0.000005	0.0000203	0.00059	0.000142
SO	L2222132-8	1/17/2019 11:45	68		32	376	7.88	432	142	0.63	0.168	< 0.001	< 0.005	0.0041	112	< 0.01	< 0.05	1.09	0.560	< 0.000005	0.00157	0.0174	0.020	0.149	< 0.00001	< 0.000005	44.8	< 0.000005	0.0000254	0.00046	0.000164
SO	L2227544-8	1/31/2019 10:30	70		34	366	7.78	714	120	0.80	0.193	< 0.005	< 0.025	0.0040	273	< 0.0015	< 0.25	< 2.5	0.44	< 0.000005	0.00123	0.0141	0.018	0.0431	< 0.00001	< 0.000005	78.9	< 0.000005	0.0000213	0.00046	0.000204
SO	L2233141-8	2/14/2019 14:20	72		36	397	7.71	959	121	0.71	0.221	< 0.005	< 0.025	0.0041	465	< 0.0015	< 0.25	< 2.5	0.40	< 0.000005	0.00099	0.0140	0.019	0.0339	< 0.00001	< 0.000005	128	0.0000058	0.0000290	0.00045	0.000199
SO	L2238565-8	2/28/2019 15:15	74		38	427	7.67	1142	114	0.60	0.224	< 0.005	< 0.025	0.0030	558	< 0.0015	< 0.25	< 2.5	0.36	< 0.000005	0.00098	0.0132	0.018	0.0314	< 0.00001	< 0.000005	175	< 0.000005	0.0000272	0.00041	0.000234
SO	L2244540-8	3/14/2019 14:30	76		40	433	7.74	1270	109	0.82	0.228	< 0.005	< 0.025	0.0036	652	< 0.0015	< 0.25	< 2.5	0.33	< 0.000005	0.00106	0.0127	0.017	0.0275	< 0.00001	< 0.000005	193	< 0.000005	0.0000292	0.00045	0.000234
SO	L2250817-8	3/28/2019 15:00	78		42	405	7.72	1346	106	0.70	0.241	< 0.005	< 0.025	0.0030	704	< 0.01	< 0.25	< 2.5	0.32	< 0.000005	0.00133	0.0131	0.019	0.0291	< 0.00001	< 0.000005	234	< 0.000005	0.0000299	0.00048	0.000238
SO	L2257457-8	4/11/2019 15:00	80		44	397	7.74	1382	113	0.95	0.245	< 0.005	< 0.025	0.0028	778	< 0.01	< 0.25	< 2.5	0.31	< 0.000005	0.00105	0.0130	0.019	0.0262	< 0.00001	< 0.000005	248	< 0.000005	0.0000372	0.00051	0.000269
SO	L2263301-8	4/25/2019 14:45	82		46	397	7.75	1456	108	0.74	0.261	< 0.005	< 0.025	0.0024	744	< 0.0015	< 0.25	< 2.5	0.30	< 0.000005	0.00128	0.0130	0.018	0.0252	< 0.00001	< 0.000005	242	< 0.000005	0.0000245	0.00045	0.000267
SS	L2000226-5	9/29/2017 10:50	0	0		416	7.99	1218	138	3.26	< 0.005	< 0.005	< 0.025	< 0.002	539	< 0.0015	< 0.25	3.8	1.24	0.0000067	0.00830	0.00583	0.038	0.0313	< 0.00001	< 0.000005	95.5	0.0000058	0.000247	< 0.0001	0.00352
SS	L2014692-5	10/27/2017	4	4		262	7.9	1296	185	2.23	0.0071	< 0.005	< 0.025	< 0.002	549	< 0.0015	< 0.25	3.7	0.27	0.0000304	0.00464	0.00940	0.043	0.0284	< 0.00001	< 0.000005	99.2	0.0000086	0.000223	< 0.0001	0.00351
SS	L2021295-5	11/10/2017 13:30	6	6		211	8	1115	188	1.96	< 0.005	< 0.005	< 0.025	0.0038	435	< 0.0015	< 0.25	2.9	0.26	< 0.000005	0.00436	0.0121	0.045	0.0295	< 0.00001	< 0.000005	86.2	0.0000071	0.000150	< 0.0001	0.00303
SS	L2026623-9	11/23/2017 14:40	8	8		322	7.97	1007	248	1.35	0.0095	< 0.005	< 0.025	< 0.002	390	< 0.0015	< 0.25	< 2.5	0.28	< 0.000005	0.00399	0.0122	0.044	0.0318	< 0.00001	< 0.000005	83.6	< 0.000005	0.000154	< 0.0001	0.00289
SS	L2032657-1	12/7/2017 11:30	10	10		267	7.79	942	227	1.61	0.0108	< 0.005	< 0.025	< 0.002	331	< 0.0015	< 0.25	< 2.5	0.24	0.0000057	0.00378	0.0121	0.048	0.0313	< 0.00001	< 0.000005	80.7	0.0000089	0.000128	< 0.0001	0.00256
SS	L2038563-9	12/21/2017 13:10	12	12		270	7.88	853	246	1.30	0.0053	0.0052	< 0.025	< 0.002	280	< 0.0015	< 0.25	< 2.5	0.22	0.0000052	0.00327	0.0108	0.037	0.0375	< 0.00001	< 0.000005	65.2	0.0000091	0.000120	< 0.0001	0.00241
SS	L2041649-9	1/4/2018 13:05	14	14		259	7.95	790	233	1.50	0.0082	< 0.005	< 0.025	< 0.002	247	< 0.0015	< 0.25	< 2.5	0.25	< 0.000005	0.00262	0.0104	0.035	0.0368	< 0.00001	< 0.000005	62.6	< 0.000005	0.0000988	< 0.0001	0.00225
SS	L2046871-9	1/18/2018 12:10	16	16		274	7.97	745	232	1.35	< 0.005	< 0.005	< 0.025	< 0.002	209	< 0.0015	< 0.25	< 2.5	0.27	< 0.000005	0.00376	0.0124	0.035	0.0371	< 0.00001	< 0.000005	60.7	0.0000113	0.0000863	< 0.0001	0.00225
SS	L2052061-9	2/1/2018 12:35	18	18		291	7.92	691	230	1.62	< 0.005	< 0.001	< 0.005	< 0.002	172	< 0.0015	< 0.05	0.64	0.278	< 0.000005	0.00341	0.0149	0.031	0.0413	< 0.00001	< 0.000005	55.3	< 0.000005	0.0000897	< 0.0001	0.00216
SS	L2057381-9	2/15/2018 11:35	20	20		275	7.88	669	232	1.35	0.0137	< 0.001	< 0.005	< 0.002	151	< 0.0015	< 0.05	< 0.5	0.269	< 0.000005	0.00317	0.0114	0.032	0.0453	< 0.00001	< 0.000005	57.4	< 0.000005	0.0000538	< 0.0001	0.00194
SS	L2062788-9	3/1/2018 14:20	22	22		245	7.88	649	242	1.17	< 0.005	< 0.001	< 0.005	< 0.002	137	< 0.0015	< 0.05	< 0.5	0.279	< 0.000005	0.00280	0.0106	0.034	0.0455	< 0.00001	< 0.000005	56.9	0.0000056	0.0000336	< 0.0001	0.00187
SS	L2068449-9	3/15/2018 12:25	24	24		306	7.88	587	240	1.22	0.0098	< 0.001	< 0.005	< 0.002	112	< 0.0015	< 0.05	< 0.5	0.283	< 0.000005	0.00344	0.0116	0.031	0.0512	< 0.00001	< 0.000005	47.4	< 0.000005	0.0000333	< 0.0001	0.00160
SS	L2074311-9	3/29/2018 12:15	26	26		288	7.96	568	253	1.11	< 0.005	< 0.001	< 0.005	< 0.002	97.2	< 0.0015	< 0.05	< 0.5	0.281	< 0.000005	0.00573	0.0116	0.029	0.0581	< 0.00001	0.000113	46.8	0.0000059	0.0000418	< 0.0001	0.00165
SS	L2079620-9	4/12/2018 11:30	28	28		271	7.93	551	258	0.95	< 0.005	< 0.001	< 0.005	< 0.002	83.0	< 0.0015	< 0.05	< 0.5	0.427	< 0.000005	0.00367	0.0127	0.032	0.0690	< 0.00001	< 0.000005	46.0	< 0.000005	0.0000556	< 0.0001	0.00169
SS	L2085708-9	4/26/2018 14:00	30	30		272	7.9	526	232	1.05	0.0067	< 0.001	< 0.005	< 0.002	77.4	< 0.0015	< 0.05	< 0.5	0.294	< 0.000005	0.00296	0.0127	0.029	0.0723	< 0.00001	0.0000071	42.8	0.0000058	0.0000729	< 0.0001	0.00160
SS	L2092801-9	5/10/2018 11:15	32	32		268	8.02	519	248	0.96	< 0.005	< 0.001	< 0.005	< 0.002	70.9	< 0.0015	< 0.05	< 0.5	0.290	< 0.000005	< 0.004	0.0126	0.031	0.0753	< 0.00001	0.0000076	45.8	0.0000060	0.0000944	< 0.0001	0.00162
SS	L2100224-9	5/24/2018 14:00	34	34		282	7.83	515	241	1.02	< 0.005	< 0.001	< 0.005	< 0.002	63.1	< 0.0015	< 0.05	< 0.5	0.299	< 0.000005	0.00364	0.0149	0.028	0.0996	< 0.00001	< 0.000005	45.2	0.0000057	0.000127	< 0.0001	0.00168
SS	L2108434-9	6/7/2018 14:00	36		0	216	8	517	280	0.67	< 0.005	< 0.001	< 0.005	0.0021	61.7	< 0.0015	< 0.05	< 0.5	0.305	< 0.000005	0.00362	0.0143	0.035	0.0951	< 0.00001	< 0.000005	44.9	0.0000063	0.0000255	< 0.0001	0.00164
SS	L2116986-9	6/21/2018 14:00	38		2	385	7.97	512	318	0.72	< 0.005	< 0.001	< 0.005	< 0.002	58.1	< 0.0015	< 0.05	< 0.5	0.325	< 0.000005	0.00302	0.0256	0.033	0.0958	< 0.00001	< 0.000005	42.9	< 0.000005	0.0000252	< 0.0001	0.00167
SS	L2125321-9	7/6/2018 11:50	40		4	217	7.98	466	260	0.82	< 0.005	< 0.001	< 0.005	0.0048	47.1	< 0.0015	< 0.05	< 0.5	0.343	< 0.000005	0.00295	0.114	0.030	0.107	< 0.00001	< 0.000005	38.6	< 0.000005	0.0000181	< 0.0001	0.00152
SS	L2132784-9	7/19/2018 15:15	42		6	340	7.98	468	259	0.67	< 0.005	< 0.001	< 0.005	0.0059	47.5	< 0.0015	< 0.05	< 0.5	0.354	< 0.000005	0.00348	0.137	0.030	0.106	< 0.00001	< 0.000005	40.1	< 0.000005	0.0000165	< 0.0001	0.00152
SS	L2140795-9	8/2/2018 13:45	44		8	179	8.01	465	634	0.80	< 0.005	< 0.001	< 0.005	0.0036	43.6	< 0.0015	< 0.05	0.68	0.357	< 0.000005	< 0.004	0.139	0.031	0.123	< 0.00001	< 0.000005	42.2	0.0000063	0.0000175	< 0.0001	0.00153

Appendix A4: Schist Column (SO, SS, ST) Effluent Results

						mL	pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**Week (Overall Experimental Period)**	**Week (Pre-Sequencing)**	**Week (Post-Sequencing)**	**Total-Vol-Leachate**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**SO4**	**D-Sulphide**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**
SS	L2148482-9	8/16/2018	46		10	340	7.87	454	252	0.78	0.0059	*< 0.001*	*< 0.005*	0.0073	40.7	*< 0.0015*	*< 0.05*	1.04	0.360	*< 0.000005*	0.00339	0.169	0.030	0.139	*< 0.00001*	*< 0.000005*	43.4	*< 0.000005*	0.0000193	*< 0.0001*	0.00160
SS	L2156461-9	8/30/2018 14:20	48		12	317	7.94	461	230	0.70	0.0064	*< 0.001*	*< 0.005*	0.0082	38.0	*< 0.0015*	*< 0.05*	1.24	0.362	0.0000050	0.00263	0.158	0.031	0.143	*< 0.00001*	*< 0.000005*	42.3	0.0000061	0.0000197	*< 0.0001*	0.00146
SS	L2164110-9	9/13/2018 11:45	50		14	307	8.02	464	222	0.99	0.029	*< 0.001*	*< 0.005*	0.0040	37.8	*< 0.0015*	*< 0.05*	1.33	0.355	*< 0.000005*	0.00288	0.138	0.030	0.140	*< 0.00001*	*< 0.000005*	40.7	0.0000051	0.0000158	*< 0.0001*	0.00147
SS	L2172409-9	9/27/2018 14:00	52		16	342	7.96	447	246	0.93	0.0082	*< 0.001*	*< 0.005*	0.0061	35.3	*< 0.0015*	*< 0.05*	1.37	0.371	*< 0.000005*	0.00273	0.179	0.030	0.138	*< 0.00001*	*< 0.000005*	36.7	*< 0.000005*	0.0000214	*< 0.0001*	0.00124
SS	L2180431-9	10/12/2018 14:10	54		18	209	7.91	446	254	0.54	0.0083	*< 0.001*	*< 0.005*	0.0101	32.7	*< 0.0015*	*< 0.05*	1.27	0.341	*< 0.000005*	0.00232	0.229	0.029	0.127	*< 0.00001*	*< 0.000005*	37.0	*< 0.000005*	0.0000171	*< 0.0001*	0.00122
SS	L2187510-9	10/25/2018 14:00	56		20	212	8.06	465	256	0.81	*< 0.005*	*< 0.001*	*< 0.005*	0.0055	35.2	0.0016	*< 0.05*	1.36	0.359	*< 0.000005*	0.00247	0.160	0.029	0.131	*< 0.00001*	*< 0.000005*	39.3	*< 0.000005*	0.0000121	*< 0.0001*	0.00127
SS	L2194529-9	11/8/2018 14:10	58		22	330	8	454	248	*< 0.5*	0.0076	*< 0.001*	*< 0.005*	0.0074	35.0	*< 0.0015*	*< 0.05*	1.31	0.364	*< 0.000005*	0.00249	0.206	0.027	0.139	*< 0.00001*	*< 0.000005*	40.0	0.0000051	0.0000233	*< 0.0001*	0.00112
SS	L2200705-9	11/22/2018 11:55	60		24	306	7.96	438	120	0.77	0.0051	*< 0.001*	*< 0.005*	0.0130	33.1	*< 0.0015*	*< 0.05*	1.23	0.368	*< 0.000005*	0.00213	0.207	0.027	0.128	*< 0.00001*	*< 0.000005*	37.4	*< 0.000005*	0.0000149	*< 0.0001*	0.00120
SS	L2207335-9	12/6/2018 13:05	62		26	296	8	439	242	*< 1*	*< 0.005*	*< 0.001*	*< 0.005*	0.0082	33.3	*< 0.0015*	*< 0.05*	1.21	0.381	*< 0.000005*	0.00264	0.219	0.027	0.139	*< 0.00001*	*< 0.000005*	39.2	*< 0.000005*	0.0000159	*< 0.0001*	0.00112
SS	L2213525-9	12/20/2018 14:45	64		28	417	7.97	435	249	0.51	0.0083	*< 0.001*	0.0066	0.0122	38.7	*< 0.0015*	*< 0.05*	1.22	0.395	0.0000057	0.00246	0.251	0.026	0.147	*< 0.00001*	*< 0.000005*	43.0	0.0000072	0.0000207	*< 0.0001*	0.00126
SS	L2217203-9	1/5/2019 11:35	66		30	449	7.76	484	236	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0036	60.2	*< 0.0067*	*< 0.05*	1.17	0.384	*< 0.000005*	0.00129	0.0815	0.024	0.128	*< 0.00001*	*< 0.000005*	47.7	*< 0.000005*	0.0000170	*< 0.0001*	0.00126
SS	L2222132-9	1/17/2019 11:45	68		32	446	7.89	584	231	0.57	0.0055	*< 0.001*	*< 0.005*	0.0037	135	*< 0.0067*	*< 0.05*	0.90	0.391	*< 0.000005*	0.00212	0.0480	0.023	0.0866	*< 0.00001*	*< 0.000005*	53.6	*< 0.000005*	0.0000150	*< 0.0001*	0.00126
SS	L2227544-9	1/31/2019 10:30	70		34	417	7.75	808	200	*< 0.5*	0.0136	*< 0.005*	*< 0.025*	*< 0.002*	278	*< 0.0015*	*< 0.25*	*< 2.5*	0.33	*< 0.00001*	0.0023	0.0336	0.021	0.0479	*< 0.00002*	*< 0.00001*	79.6	*< 0.00001*	0.000030	*< 0.0002*	0.00155
SS	L2233141-9	2/14/2019 14:20	72		36	451	7.66	1016	188	*< 0.5*	0.0376	*< 0.005*	*< 0.025*	0.0029	464	*< 0.0015*	*< 0.25*	*< 2.5*	0.31	*< 0.00001*	0.0024	0.0293	0.021	0.0394	*< 0.00002*	*< 0.00001*	120	*< 0.00001*	0.000054	*< 0.0002*	0.00156
SS	L2238565-9	2/28/2019 15:15	74		38	477	7.58	1227	174	0.56	0.0539	*< 0.005*	*< 0.025*	*< 0.002*	560	*< 0.0015*	*< 0.25*	*< 2.5*	0.27	*< 0.00001*	0.0024	0.0253	0.020	0.0338	*< 0.00002*	*< 0.00001*	155	*< 0.00001*	0.000097	*< 0.0002*	0.00175
SS	L2244540-9	3/14/2019 14:30	76		40	483	7.72	1388	171	*< 0.5*	0.0697	*< 0.005*	*< 0.025*	*< 0.002*	689	*< 0.0015*	*< 0.25*	*< 2.5*	0.25	*< 0.00001*	0.0023	0.0273	*< 0.02*	0.0345	*< 0.00002*	*< 0.00001*	174	0.000013	0.000127	*< 0.0002*	0.00195
SS	L2250817-9	3/28/2019 15:00	78		42	452	7.55	1499	157	0.50	0.0862	*< 0.005*	*< 0.025*	*< 0.002*	775	*< 0.01*	*< 0.25*	*< 2.5*	0.24	*< 0.000025*	0.0036	0.0208	*< 0.05*	0.0304	*< 0.00005*	*< 0.000025*	234	*< 0.000025*	0.000143	*< 0.0005*	0.00198
SS	L2257457-9	4/11/2019 15:00	80		44	362	7.66	1562	160	0.63	0.0978	*< 0.01*	*< 0.05*	*< 0.002*	852	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.000025*	*< 0.003*	0.0190	*< 0.05*	0.0257	*< 0.00005*	*< 0.000025*	232	*< 0.000025*	0.000168	*< 0.0005*	0.00210
SS	L2263301-9	4/25/2019 14:45	82		46	438	7.63	1650	171	0.91	0.107	*< 0.005*	*< 0.025*	*< 0.002*	840	*< 0.0015*	*< 0.25*	*< 2.5*	0.24	*< 0.000025*	0.0032	0.0200	*< 0.05*	0.0254	*< 0.00005*	*< 0.000025*	258	*< 0.000025*	0.000219	*< 0.0005*	0.00230
ST	L2000226-6	9/29/2017 10:50	0	0		441	8.2	500	94	4.98	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	161	*< 0.0015*	*< 0.05*	1.46	2.18	*< 0.000005*	0.0213	0.00778	0.029	0.0424	*< 0.00001*	*< 0.000005*	38.1	0.0000051	0.0000143	0.00092	0.000025
ST	L2014692-6	10/27/2017	4	4		262	8.11	597	115	3.36	0.0222	*< 0.001*	*< 0.005*	*< 0.002*	186	*< 0.0015*	*< 0.05*	1.40	0.393	0.0000221	0.0101	0.00777	0.038	0.0531	*< 0.00001*	*< 0.000005*	48.5	0.0000102	0.0000662	0.00072	0.000029
ST	L2021295-6	11/10/2017 13:30	6	6		261	8.13	523	102	3.32	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	158	*< 0.0015*	*< 0.05*	1.16	0.369	*< 0.000005*	0.0107	0.00746	0.032	0.0471	*< 0.00001*	*< 0.000005*	38.9	0.0000058	0.0000223	0.00022	0.000020
ST	L2026623-10	11/23/2017 14:40	8	8		331	8.07	486	144	2.87	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	140	*< 0.0015*	*< 0.05*	0.96	0.364	*< 0.00001*	0.0120	0.00801	0.034	0.0452	*< 0.00002*	*< 0.00001*	41.6	*< 0.00001*	0.000027	0.00045	0.000026
ST	L2031965-9	12/6/2017 14:05	10	10		262	7.99	477	143	2.37	*< 0.005*	*< 0.001*	*< 0.005*	0.0034	129	*< 0.0015*	*< 0.05*	0.82	0.368	*< 0.000005*	0.0115	0.00908	0.027	0.0522	*< 0.00001*	*< 0.000005*	39.0	0.0000072	0.0000187	0.00046	0.000021
ST	L2038563-10	12/21/2017 13:10	12	12		263	8.02	459	144	2.09	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	125	*< 0.0015*	*< 0.05*	0.72	0.350	0.0000053	0.00957	0.00780	0.028	0.0567	*< 0.00001*	*< 0.000005*	38.5	0.0000157	0.0000235	0.00029	0.000025
ST	L2042065-1	1/5/2018 11:50	14	14		314	8.08	353	118	3.66	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	86.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.307	*< 0.000005*	0.0123	0.00655	0.018	0.0489	*< 0.00001*	*< 0.000005*	31.3	*< 0.000005*	0.0000307	0.00021	0.000015
ST	L2046871-10	1/18/2018 12:10	16	16		269	8.14	436	144	1.28	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	106	*< 0.0015*	*< 0.05*	0.53	0.390	*< 0.000005*	0.0103	0.00793	0.026	0.0632	*< 0.00001*	*< 0.000005*	38.8	0.0000142	0.0000296	0.00060	0.000023
ST	L2052061-10	2/1/2018 12:35	18	18		292	8.06	414	142	1.57	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	96.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.399	*< 0.000005*	0.00975	0.0109	0.024	0.0615	*< 0.00001*	*< 0.000005*	35.1	0.0000066	0.0000351	0.00043	0.000021
ST	L2057381-10	2/15/2018 11:35	20	20		271	8.03	418	153	1.07	0.0144	*< 0.001*	*< 0.005*	*< 0.002*	93.9	*< 0.0015*	*< 0.05*	*< 0.5*	0.388	*< 0.000005*	0.00701	0.00867	0.025	0.0606	*< 0.00001*	*< 0.000005*	37.9	0.0000088	0.0000345	0.00029	0.000020
ST	L2062788-10	3/1/2018 14:20	22	22		243	7.99	413	176	1.00	*< 0.005*	*< 0.001*	*< 0.005*	0.0020	90.1	*< 0.0015*	*< 0.05*	*< 0.5*	0.389	*< 0.000005*	0.0113	0.00929	0.027	0.0616	*< 0.00001*	*< 0.000005*	39.7	0.0000051	0.0000276	0.00040	0.000023
ST	L2068449-10	3/15/2018 12:25	24	24		298	8.13	385	150	1.16	0.0066	*< 0.001*	*< 0.005*	*< 0.002*	80.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.379	*< 0.000005*	0.00853	0.0103	0.024	0.0628	*< 0.00001*	*< 0.000005*	33.1	*< 0.000005*	0.0000296	0.00027	0.000020
ST	L2074311-10	3/29/2018 12:15	26	26		275	8.03	385	143	0.96	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	76.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.376	*< 0.000005*	0.00775	0.0105	0.022	0.0673	*< 0.00001*	*< 0.000005*	33.2	0.0000067	0.0000283	0.00031	0.000021
ST	L2079620-10	4/12/2018 11:30	28	28		260	8.04	371	146	0.87	*< 0.005*	*< 0.001*	*< 0.005*	0.0038	68.8	*< 0.0015*	*< 0.05*	*< 0.5*	0.381	*< 0.000005*	0.00819	0.0120	0.022	0.0718	*< 0.00001*	*< 0.000005*	32.1	*< 0.000005*	0.0000307	0.00027	0.000020
ST	L2085708-10	4/26/2018 14:00	30	30		252	8.02	367	144	0.77	0.0069	*< 0.001*	*< 0.005*	*< 0.002*	69.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.381	*< 0.000005*	0.00750	0.0122	0.022	0.0741	*< 0.00001*	*< 0.000005*	31.8	0.0000068	0.0000229	0.00031	0.000020
ST	L2092801-10	5/10/2018 11:15	32	32		261	8.09	359	142	1.01	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	65.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.365	*< 0.000005*	0.00749	0.0130	0.023	0.0735	*< 0.00001*	0.0000182	34.7	0.0000057	0.0000273	0.00027	0.000021
ST	L2100224-10	5/24/2018 14:00	34	34		272	7.99	356	146	1.02	*< 0.005*	*< 0.001*	*< 0.005*	*< 0.002*	58.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.366	*< 0.000005*	0.00847	0.0168	0.021	0.0865	*< 0.00001*	*< 0.000005*	30.7	*< 0.000005*	0.0000296	0.00030	0.000018
ST	L2108434-10	6/7/2018 14:00	36		0	226	7.99	352	159	0.65	*< 0.005*	*< 0.001*	*< 0.005*	0.0342	59.4	*< 0.0015*	*< 0.05*	*< 0.5*	0.388	*< 0.000005*	0.00836	1.17	0.026	0.0875	*< 0.00001*	*< 0.000005*	33.7	0.0000097	0.0000206	0.00034	0.000024
ST	L2116986-10	6/21/2018 14:00	38		2	390	8.07	364	325	*< 1*	*< 0.005*	*< 0.001*	*< 0.005*	0.0717	58.3	*< 0.0015*	*< 0.05*	*< 0.5*	0.417	*< 0.000005*	0.00730	1.82	0.025	0.0865	*< 0.00001*	*< 0.000005*	32.4	0.0000055	0.0000125	0.00032	0.000021
ST	L2125321-10	7/6/2018 11:50	40		4	224	8.07	345	181	0.80	*< 0.005*	*< 0.001*	*< 0.005*	0.0922	50.6	*< 0.0015*	*< 0.05*	*< 0.5*	0.408	*< 0.000005*	0.00695	2.42	0.024	0.0971	*< 0.00001*	*< 0.000005*	30.1	*< 0.00002*	0.0000145	0.00036	0.000019
ST	L2132784-10	7/19/2018 15:15	42		6	355	8.09	350	174	0.68	0.0145	*< 0.001*	*< 0.005*	0.0936	51.2	*< 0.0015*	*< 0.05*	*< 0.5*	0.423	*< 0.000005*	0.00735	2.74	0.025	0.0925	*< 0.00001*	*< 0.000005*	31.3	*< 0.00001*	0.0000160	0.00039	0.000022
ST	L2140795-10	8/2/2018 13:45	44		8	187	8.18	339	182	0.64	0.0146	*< 0.001*	*< 0.005*	0.088	47.3	*< 0.0015*	*< 0.05*	*< 0.5*	0.428	*< 0.000005*	0.00770	3.20	0.026	0.0979	*< 0.00001*	*< 0.000005*	33.7	*< 0.00002*	0.0000173	0.00031	0.000024
ST	L2148482-10	8/16/2018	46		10	297	8.09	338	170	0.66	0.0227	*< 0.001*	*< 0.005*	0.087	45.8	*< 0.0015*	*< 0.05*	*< 0.5*	0.430	*< 0.000005*	0.00812	3.48	0.025	0.104	*< 0.00001*	*< 0.000005*	33.3	*< 0.000006*	0.0000139	0.00038	0.000021
ST	L2156461-10	8/30/2018 14:20	48		12	337	8.05	330	162	0.69	0.0423	*< 0.001*	*< 0.005*	0.102	40.7	*< 0.0015*	*< 0.05*	*< 0.5*	0.418	0.0000054	0.00751	4.96	0.026	0.103	*< 0.00001*	0.0000139	33.2	*< 0.00002*	0.0000235	0.00029	0.000029
ST	L2164110-10	9/13/2018 11:45	50		14	304	8.09	332	172	1.03	0.0456	*< 0.001*	*< 0.005*	0.102	40.7	*< 0.0015*	*< 0.05*	*< 0.5*	0.428	*< 0.00001*	0.0073	4.20	0.025	0.0934	*< 0.00002*	*< 0.00001*	30.5	*< 0.00001*	0.000013	0.00036	0.000023
ST	L2172409-10	9/27/2018 14:00	52		16	346	8.14	314	138	*< 0.5*	0.0361	*< 0.001*	*< 0.005*	0.116	37.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.433	*< 0.00001*	0.0062	5.75	0.025	0.0903	*< 0.00002*	*< 0.00001*	27.6	*< 0.00001*	0.000017	0.00037	*< 0.00002*
ST	L2180431-10	10/12/2018 14:10	54		18	208	8.04	318	145	*< 0.5*	0.0363	*< 0.001*	*< 0.005*	0.117	35.5	*< 0.0015*	*< 0.05*	*< 0.5*	0.394	*< 0.00001*	0.0059	5.77	0.024	0.0865	*< 0.00002*	*< 0.00001*	28.0	*< 0.00001*	0.000024	0.00043	0.000023
ST	L2187510-10	10/25/2018 14:00	56		20	208	8.14	330	172	0.78	0.0346	*< 0.001*	*< 0.005*	0.193	37.8	*< 0.0015*	*< 0.05*	*< 0.5*	0.419	*< 0.000005*	0.00494	4.90	0.024	0.0896	*< 0.00001*	*< 0.000005*	28.3	*< 0.000015*	0.0000194	0.00046	0.000021
ST	L2194529-10	11/8/2018 14:10	58		22	326	8.14	321	155	0.80	0.0414	*< 0.001*	*< 0.005*	0.101	37.0	*< 0.0015*	*< 0.05*	*< 0.5*	0.418	*< 0.000005*	0.00576	6.33	0.025	0.0953	*< 0.00001*	*< 0.000005*	31.8	*< 0.000015*	0.0000189	0.00044	0.000020
ST	L2200705-10	11/22/2018 11:55	60		24	301	8.07	308	157	0.74	0.0342	*< 0.001*	*< 0.005*	0.229	34.7	*< 0.0015*	*< 0.05*	0.57	0.422	*< 0.000005*	0.00587	6.41	0.023	0.0866	*< 0.00001*	*< 0.000005*	27.7	*< 0.00001*	0.0000182	0.00048	0.000022
ST	L2207335-10	12/6/2018 13:05	62		26	289	8.12	307	164	*< 1*	0.0346	*< 0.001*	*< 0.005*	0.141	33.6	*< 0.0015*	*< 0.05*	0.77	0.429	*< 0.00001*	0.0062	6.80	0.023	0.0907	*< 0.00002*	*< 0.00001*	28.3	*< 0.00001*	0.000021	0.00048	*< 0.00002*
ST	L2213525-10	12/20/2018 14:45	64		28	413	8.17	299	154	0.56	0.0402	*< 0.001*	0.0343	0.107	33.8	*< 0.0015*	*< 0.05*	0.98	0.443	*< 0.00001*	0.0055	7.20	0.023	0.0913	*< 0.00002*	*< 0.00001*	31.6	0.000013	0.000022	0.00047	0.000024
ST	L2217203-10	1/5/2019 11:35	66		30	371	7.98	330	152	0.53	0.0386	*< 0.001*	*< 0.005*	0.097	47.5	*< 0.0067*	*< 0.05*	1.13	0.443	*< 0.00001*	0.0053	5.76	0.021	0.0963	*< 0.00002*	*< 0.00001*	31.0	*< 0.00001*	0.000012	0.00050	0.000021
ST	L2222132-10	1/17/2019 11:45	68		32	398	7.98	443	138	0.60	0.0390	*< 0.001*	*< 0.005*	0.055	114	*< 0.01*	*< 0.05*	1.08	0.417	*< 0.000005*	0.00379	3.75	0.020	0.134	*< 0.00001*	*< 0.000005*	43.2	0.0000103	0.0000199	0.00046	0.000024
ST	L2227544-10	1/31/2019 10:30	70		34	376	7.84	801	153	0.70	0.0534	*< 0.005*	*< 0.025*	0.0722	300	*< 0.0015*	*< 0.25*	*< 2.5*	0.30	*< 0.00001*	0.0031	1.75	*< 0.02*	0.0962	*< 0.00002*	*< 0.00001*	87.5	*< 0.00001*	0.000023	0.00057	0.000038
ST	L2233141-10	2/14/2019 14:20	72		36	422	7.55	1078	179	0.75	0.0875	*< 0.005*	*< 0.025*	0.0293	506	*< 0.0015*	*< 0.25*	*< 2.5*	0.25	0.000021	0.0026	0.819	0.020	0.0675	*< 0.00002*	*< 0.00001*	149	*< 0.00001*	0.000076	0.00036	0.000045
ST	L2238565-10	2/28/2019 15:15	74		38	452	7.44	1291	187	0.53	0.0796	*< 0.005*	*< 0.025*	0.0109	598	*< 0.0015*	*< 0.25*	*< 2.5*	0.20	*< 0.000025*	*< 0.003*	0.323	*< 0.05*	0.0467	*< 0.00005*	*< 0.000025*	182	*< 0.000025*	0.000160	*< 0.0005*	0.000061
ST	L2244540-10	3/14/2019 14:30	76		40	460	7.51	1430	181	0.51	0.0855	*< 0.005*	*< 0.025*	0.0046	701	*< 0.0015*	*< 0.25*	*< 2.5*	0.18	*< 0.000025*	*< 0.003*	0.207	*< 0.05*	0.0461	*< 0.00005*	*< 0.000025*	211	*< 0.000025*	0.000248	0.00056	0.000062
ST	L2250817-10	3/28/2019 15:00	78		42	372	7.39	1506	182	0.66	0.0932	*< 0.005*	*< 0.025*	0.0038	775	*< 0.01*	*< 0.25*	*< 2.5*	0.18	*< 0.000025*	0.0038	0.116	*< 0.05*	0.0384	*< 0.00005*	*< 0.000025*	271	*< 0.000025*	0.000269	*< 0.0005*	0.000052
ST	L2257457-10	4/11/2019 15:00	80		44	434	7.52	1530	174	0.53	0.103	*< 0.01*	*< 0.05*	*< 0.002*	816	*< 0.01*	*< 0.5*	*< 5*	*< 0.2*	*< 0.000025*	*< 0.003*	0.103	*< 0.05*	0.0332	*< 0.00005*	*< 0.000025*	277	*< 0.000025*	0.000328	*< 0.0005*	0.000074
ST	L2263301-10	4/25/2019 14:45	82		46	410	7.51	1621	169	0.54	0.0954	*< 0.005*	*< 0.025*	*< 0.002*	808	*< 0.0015*	0.27	*< 2.5*	0.18	*< 0.000025*	0.0034	0.0887	*< 0.05*	0.0312	*< 0.00005*	*< 0.000025*	272	*< 0.000025*	0.000265	*< 0.0005*	0.000089

Notes:
Results in blue italics are below the indicated detection limit

Appendix A4: Schist Column (SO, SS, ST) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
SO	L2000226-4	9/29/2017 10:50	0.00034	*< 0.001*	*< 0.000005*	6.99	0.00306	8.19	0.000104	0.00457	22.3	0.000172	*< 0.05*	0.0000086	0.00240	0.00736	17.9	0.000161	4.15	0.000016	0.146	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000159	0.00313	0.000179	0.00043	*< 0.003*	*< 0.00006*
SO	L2014692-4	10/27/2017	0.00033	*< 0.001*	*< 0.000005*	8.80	0.00478	11.2	0.00238	0.00600	27.1	0.000340	*< 0.05*	*< 0.000005*	0.00321	0.00763	23.8	0.000291	5.39	*< 0.00001*	0.192	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000259	0.00517	0.000180	0.00041	*< 0.0005*	*< 0.00006*
SO	L2021295-4	11/10/2017 13:30	0.00032	*< 0.001*	*< 0.000005*	8.52	0.00444	10.4	0.000765	0.00596	25.0	0.000368	*< 0.05*	*< 0.000005*	0.00298	0.00635	18.4	0.000402	4.67	*< 0.00001*	0.190	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000216	0.00363	0.000176	0.00044	*< 0.0005*	*< 0.00006*
SO	L2026623-8	11/23/2017 14:40	0.00024	*< 0.001*	*< 0.000005*	7.62	0.00435	9.92	0.000898	0.00633	22.2	0.000322	*< 0.05*	0.0000073	0.00284	0.00616	16.2	0.000436	4.59	0.000015	0.182	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000237	0.00369	0.000159	0.00048	0.00096	*< 0.00006*
SO	L2031965-8	12/6/2017 14:05	0.00023	*< 0.001*	0.0000060	7.93	0.00345	9.80	0.00197	0.00623	21.2	0.000249	*< 0.05*	0.0000112	0.00294	0.00623	16.5	0.000377	4.63	*< 0.00001*	0.186	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000267	0.00393	0.000209	0.00046	*< 0.0005*	*< 0.00006*
SO	L2038563-8	12/21/2017 13:10	0.00019	0.0018	*< 0.000005*	7.90	0.00310	9.44	0.00566	0.00701	20.6	0.000300	*< 0.05*	0.0000059	0.00281	0.00535	15.2	0.000109	4.43	*< 0.00001*	0.172	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000245	0.00378	0.000167	0.00043	*< 0.0005*	*< 0.00006*
SO	L2041649-8	1/4/2018 13:05	0.00014	*< 0.001*	*< 0.000005*	6.90	0.00285	8.67	0.00200	0.00554	18.3	0.000278	*< 0.05*	*< 0.000005*	0.00250	0.00508	13.2	0.000318	4.14	*< 0.00001*	0.165	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000240	0.00356	0.000152	0.00038	*< 0.0005*	*< 0.00006*
SO	L2046871-8	1/18/2018 12:10	0.00018	0.0018	*< 0.000005*	7.07	0.00366	8.93	0.00146	0.00665	18.2	0.000287	*< 0.05*	*< 0.000005*	0.00260	0.00519	12.7	0.000432	4.23	*< 0.00001*	0.167	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000259	0.00355	0.000165	0.00043	*< 0.0005*	*< 0.00006*
SO	L2052061-8	2/1/2018 12:35	0.00014	*< 0.001*	*< 0.000005*	7.36	0.00248	8.34	0.000870	0.00535	17.7	0.000271	*< 0.05*	*< 0.000005*	0.00251	0.00499	11.9	0.000477	4.10	*< 0.00001*	0.162	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000249	0.00328	0.000182	0.00036	*< 0.0005*	*< 0.00006*
SO	L2057381-8	2/15/2018 11:35	0.00013	*< 0.001*	*< 0.000005*	6.66	0.00337	8.14	0.000582	0.00567	16.2	0.000225	*< 0.05*	*< 0.000005*	0.00226	0.00478	11.6	0.000302	4.03	*< 0.00001*	0.163	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000258	0.00338	0.000145	0.00036	*< 0.0005*	*< 0.00006*
SO	L2062788-8	3/1/2018 14:20	0.00011	*< 0.001*	*< 0.000005*	6.97	0.00341	9.52	0.00247	0.00549	17.8	0.000214	*< 0.05*	*< 0.000005*	0.00256	0.00502	11.8	0.000294	4.41	*< 0.00001*	0.177	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000258	0.00294	0.000139	0.00030	*< 0.0005*	*< 0.00006*
SO	L2068449-8	3/15/2018 12:25	0.00012	*< 0.001*	*< 0.000005*	7.50	0.00311	8.58	0.00779	0.00567	18.2	0.000162	*< 0.05*	*< 0.000005*	0.00260	0.00445	10.2	0.000179	4.08	*< 0.00001*	0.148	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000259	0.00259	0.000151	0.00035	*< 0.0005*	*< 0.00006*
SO	L2074311-8	3/29/2018 12:15	0.00020	*< 0.001*	*< 0.000005*	6.31	0.00326	7.98	0.0109	0.00610	14.7	0.000252	*< 0.05*	0.0000239	0.00221	0.00426	8.92	0.000058	3.77	*< 0.00001*	0.156	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000246	0.00302	0.000192	0.00033	0.0010	*< 0.00006*
SO	L2079620-8	4/12/2018 11:30	0.00016	*< 0.001*	*< 0.000005*	6.02	0.00267	7.30	0.0136	0.00630	13.9	0.000229	*< 0.05*	*< 0.000015*	0.00234	0.00434	8.33	0.000065	3.87	*< 0.00001*	0.144	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000255	0.00330	0.000146	0.00034	*< 0.001*	*< 0.00006*
SO	L2085708-8	4/26/2018 14:00	0.00010	*< 0.001*	*< 0.000005*	6.03	0.00335	7.79	0.0178	0.00610	13.2	0.000191	*< 0.05*	*< 0.000005*	0.00232	0.00425	8.24	0.000219	4.07	*< 0.00001*	0.147	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000228	0.00289	0.000131	0.00032	*< 0.001*	*< 0.00006*
SO	L2092801-8	5/10/2018 11:15	0.00011	*< 0.001*	0.0000058	6.03	0.00366	7.58	0.0252	0.00629	13.1	0.000160	*< 0.05*	0.0000079	0.00236	0.00463	7.31	0.000090	4.10	*< 0.00001*	0.153	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000237	0.00285	0.000238	0.00033	*< 0.001*	*< 0.00006*
SO	L2100224-8	5/24/2018 14:00	0.00013	0.0011	*< 0.000005*	6.46	0.00332	8.62	0.0355	0.00658	13.4	0.000169	*< 0.05*	*< 0.000005*	0.00268	0.00471	7.40	0.000077	4.11	*< 0.00001*	0.167	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000245	0.00297	0.000165	0.00033	*< 0.001*	*< 0.00006*
SO	L2108434-8	6/7/2018 14:00	0.00014	0.0023		6.95	0.00399	9.10	0.00798	0.00691	14.3	0.000221	*< 0.05*	0.0000135	0.00271	0.00486	8.27	0.000094	5.90	*< 0.00001*	0.172	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000246	0.00329	0.000155	0.00028	*< 0.001*	*< 0.00006*
SO	L2116986-8	6/21/2018 14:00	0.00014	*< 0.001*		7.41	0.00403	9.61	0.00298	0.00672	14.4	0.000194	*< 0.05*	*< 0.000005*	0.00323	0.00495	7.67	0.000112	6.08	*< 0.00001*	0.182	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000275	0.00332	0.000173	0.00027	*< 0.001*	*< 0.00006*
SO	L2125321-8	7/6/2018 11:50	0.00011	*< 0.001*		7.22	0.00397	9.21	0.00371	0.00707	13.4	0.000167	*< 0.05*	0.0000200	0.00303	0.00497	6.98	0.000073	6.82	*< 0.00001*	0.179	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000272	0.00324	0.000241	0.00024	0.0017	*< 0.00006*
SO	L2132784-8	7/19/2018 15:15	0.00017	*< 0.001*		7.74	0.00429	9.84	0.00155	0.00730	13.9	0.000188	*< 0.05*	*< 0.000005*	0.00331	0.00531	6.65	0.000090	6.84	*< 0.00001*	0.181	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000304	0.00356	0.000219	0.00027	0.0016	*< 0.00006*
SO	L2140795-8	8/2/2018 13:45	0.00021	0.0032		8.10	0.00445	9.65	0.000306	0.00743	13.9	0.000202	*< 0.05*	*< 0.000005*	0.00340	0.00551	7.46	0.000126	6.93	*< 0.00001*	0.196	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000306	0.00362	0.000246	0.00028	*< 0.001*	*< 0.00006*
SO	L2148482-8	8/16/2018	0.00014	*< 0.001*		7.85	0.00435	10.3	0.000220	0.00763	13.7	0.000160	*< 0.05*	0.0000216	0.00364	0.00554	6.18	0.000071	7.26	*< 0.00001*	0.211	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000312	0.00371	0.000237	0.00029	*< 0.001*	*< 0.00006*
SO	L2156461-8	8/30/2018 14:20	0.00018	0.0011		8.01	0.00437	9.65	0.000398	0.00764	13.2	*< 0.00005*	*< 0.05*	*< 0.00001*	0.00354	0.00541	6.39	0.000069	7.73	*< 0.00001*	0.195	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000316	0.00373	0.000269	0.00026	0.0011	*< 0.00006*
SO	L2164110-8	9/13/2018 11:45	0.00015	*< 0.001*		7.96	0.00426	9.32	0.000150	0.00744	12.7	0.000095	*< 0.05*	*< 0.000005*	0.00355	0.00525	5.89	*< 0.00004*	7.40	*< 0.00001*	0.194	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000285	0.00362	0.000264	0.00025	*< 0.001*	*< 0.00006*
SO	L2172409-8	9/27/2018 14:00	0.00018	*< 0.001*		7.27	0.00395	9.20	0.000176	0.00740	12.0	0.000126	*< 0.05*	0.0000242	0.00320	0.00514	5.77	0.000073	7.75	*< 0.00001*	0.174	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000267	0.00319	0.000239	0.00025	*< 0.001*	*< 0.00006*
SO	L2180431-8	10/12/2018 14:10	0.00015	*< 0.001*		6.92	0.00400	9.47	0.000091	0.00798	11.2	0.000112	*< 0.05*	0.0000058	0.00303	0.00523	5.97	*< 0.00004*	7.63	*< 0.00001*	0.180	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000258	0.00336	0.000281	0.00024	*< 0.001*	*< 0.00006*
	L2187510-8	10/25/2018 14:00	0.00019	*< 0.001*		7.12	0.00397	9.82	0.000067	0.00807	11.6	0.000121	*< 0.05*	0.0000077	0.00320	0.00514	6.28	0.000057	7.29	*< 0.00001*	0.191	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000241	0.00381	0.000268	0.00024	*< 0.001*	*< 0.00006*
SO	L2194529-8	11/8/2018 14:10	0.00011	*< 0.001*		7.58	0.00372	10.1	0.000077	0.00716	11.8	0.000137	*< 0.05*	*< 0.000005*	0.00319	0.00492	5.90	0.000052	7.73	*< 0.00001*	0.173	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000238	0.00357	0.000276	0.00023	*< 0.001*	*< 0.00006*
SO	L2200705-8	11/22/2018 11:55	0.00015	*< 0.001*		7.08	0.00397	9.68	0.000081	0.00765	10.8	0.000129	*< 0.05*	*< 0.000005*	0.00313	0.00495	6.15	0.000110	7.62	*< 0.00001*	0.185	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000221	0.00372	0.000262	0.00023	*< 0.001*	*< 0.00006*
SO	L2207335-8	12/6/2018 13:05	0.00019	*< 0.001*		7.19	0.00391	10.2	*< 0.00005*	0.00789	10.6	0.000111	*< 0.05*	0.0000141	0.00311	0.00496	5.63	0.000155	7.47	*< 0.00001*	0.186	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000212	0.00362	0.000274	0.00025	*< 0.001*	*< 0.00006*
SO	L2213525-8	12/20/2018 14:45	0.00012	*< 0.001*		7.61	0.00410	9.95	0.000092	0.00832	11.3	0.000127	*< 0.05*	*< 0.000005*	0.00340	0.00527	6.39	0.000071	7.84	*< 0.00001*	0.200	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000246	0.00399	0.000223	0.00025	*< 0.001*	*< 0.00006*
SO	L2217203-8	1/5/2019 11:35	0.00017	*< 0.001*		7.51	0.00413	11.0	*< 0.00005*	0.00753	10.7	0.000110	*< 0.05*	*< 0.000005*	0.00362	0.00508	11.6	0.000063	7.05	*< 0.00001*	0.216	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000213	0.00446	0.000211	0.00025	*< 0.001*	*< 0.00006*
SO	L2222132-8	1/17/2019 11:45	0.00018	*< 0.001*		8.97	0.00477	15.7	0.000207	0.00639	12.3	0.000133	*< 0.05*	*< 0.000005*	0.00366	0.00454	38.4	0.000091	7.20	*< 0.00001*	0.294	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000258	0.00490	0.000177	0.00019	*< 0.001*	*< 0.00006*
SO	L2227544-8	1/31/2019 10:30	0.00020	*< 0.001*		9.97	0.00543	22.9	0.000776	0.00492	14.1	0.000159	*< 0.05*	*< 0.000005*	0.00461	0.00375	87.2	0.000067	7.18	*< 0.00001*	0.425	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000291	0.00577	0.000147	0.00013	*< 0.001*	*< 0.00006*
SO	L2233141-8	2/14/2019 14:20	0.00017	*< 0.001*		12.7	0.00709	33.3	0.00558	0.00387	15.5	0.000233	*< 0.05*	*< 0.000005*	0.00583	0.00327	151	0.000045	7.96	*< 0.00001*	0.556	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000374	0.00731	0.000124	*< 0.0001*	*< 0.001*	*< 0.00006*
SO	L2238565-8	2/28/2019 15:15	0.00123	*< 0.001*		13.5	0.00703	41.5	0.0106	0.00338	14.4	0.000272	*< 0.05*	0.0000271	0.00667	0.00282	196	0.000053	8.29	*< 0.00001*	0.726	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000407	0.00733	0.000112	*< 0.0001*	*< 0.001*	*< 0.00006*
SO	L2244540-8	3/14/2019 14:30	0.00019	*< 0.001*		13.6	0.00888	40.4	0.0140	0.00303	13.3	0.000311	*< 0.05*	*< 0.000005*	0.00696	0.00273	227	0.000053	8.14	*< 0.00001*	0.765	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000465	0.00743	0.000134	*< 0.0001*	*< 0.001*	*< 0.00006*
SO	L2250817-8	3/28/2019 15:00	0.00019	*< 0.001*		15.8	0.00883	49.6	0.00898	0.00278	14.6	0.000213	*< 0.05*	*< 0.000005*	0.00811	0.00263	274	0.000061	9.16	*< 0.00001*	0.841	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000483	0.00745	0.000131	*< 0.0001*	*< 0.001*	*< 0.00006*
SO	L2257457-8	4/11/2019 15:00	0.00019	*< 0.001*		15.6	0.00925	49.7	0.00955	0.00269	13.4	0.000342	*< 0.05*	*< 0.000005*	0.00885	0.00292	262	0.000083	8.89	*< 0.00001*	0.955	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000513	0.00706	0.000119	*< 0.0001*	*< 0.001*	*< 0.00006*
SO	L2263301-8	4/25/2019 14:45	0.00017	*< 0.001*		15.2	0.00886	48.2	0.00830	0.00261	12.8	0.000245	*< 0.05*	*< 0.000005*	0.00821	0.00255	277	0.000056	8.90	*< 0.00001*	0.934	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.000488	0.00753	0.000124	*< 0.0001*	*< 0.001*	*< 0.00006*
SS	L2000226-5	9/29/2017 10:50	0.00075	*< 0.001*	*< 0.000005*	32.8	0.0122	82.8	0.0190	0.00822	33.6	0.00503	*< 0.05*	0.0000193	0.0486	0.0145	185	0.000420	2.22	0.000027	6.67	0.00042	*< 0.0001*	*< 0.0003*	0.000110	0.0886	0.000358	0.00041	*< 0.0015*	*< 0.00006*
SS	L2014692-5	10/27/2017	0.00056	*< 0.001*	*< 0.000005*	36.1	0.0134	87.0	0.0552	0.00804	34.4	0.00722	*< 0.05*	0.0000121	0.0507	0.00913	200	0.000644	2.95	0.000015	6.82	0.00036	*< 0.0001*	*< 0.0003*	0.000102	0.0816	0.000320	0.00038	0.00101	*< 0.00006*
SS	L2021295-5	11/10/2017 13:30	0.00034	*< 0.001*	*< 0.000005*	34.7	0.0139	76.3	0.0634	0.00801	31.3	0.00643	*< 0.05*	0.0000086	0.0466	0.00652	144	0.000536	2.64	0.000013	6.64	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000800	0.0562	0.000255	0.00042	0.00084	*< 0.00006*
SS	L2026623-9	11/23/2017 14:40	0.00032	0.0026	*< 0.000005*	30.2	0.0125	65.3	0.0673	0.00744	26.9	0.00613	*< 0.05*	0.0000093	0.0431	0.00598	125	0.000545	2.80	0.000015	6.27	0.00029	*< 0.0001*	*< 0.0003*	0.0000736	0.0459	0.000222	0.00044	0.00266	*< 0.00006*
SS	L2032657-1	12/7/2017 11:30	0.00026	*< 0.001*	*< 0.000005*	31.3	0.0120	60.9	0.0459	0.00611	27.7	0.00586	*< 0.05*	0.0000080	0.0436	0.00552	127	0.000770	2.89	*< 0.00001*	5.40	0.00043	*< 0.0001*	*< 0.0003*	0.0000727	0.0377	0.000266	0.00038	*< 0.0008*	*< 0.00006*
SS	L2038563-9	12/21/2017 13:10	0.00034	*< 0.001*	*< 0.000005*	28.5	0.00871	54.7	0.0422	0.00669	24.0	0.00532	*< 0.05*	0.0000084	0.0402	0.00529	96.1	0.000170	2.64	*< 0.00001*	5.02	0.00027	*< 0.0001*	*< 0.0003*	0.0000700	0.0281	0.000196	0.00035	0.00112	*< 0.00006*
SS	L2041649-9	1/4/2018 13:05	0.00022	*< 0.001*	*< 0.000005*	24.9	0.00894	46.3	0.0351	0.00526	19.7	0.00492	*< 0.05*	*< 0.00001*	0.0340	0.00464	77.1	0.000566	2.48	*< 0.00001*	4.61	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000634	0.0231	0.000211	0.00031	0.00083	*< 0.00006*
SS	L2046871-9	1/18/2018 12:10	0.00031	0.0014	*< 0.000005*	24.8	0.00928	47.2	0.0368	0.00596	20.6	0.00471	*< 0.05*	0.0000062	0.0374	0.00446	66.2	0.000729	2.51	0.000010	4.50	0.00022	*< 0.0001*	*< 0.0003*	0.0000565	0.0181	0.000216	0.00037	0.00102	*< 0.00006*
SS	L2052061-9	2/1/2018 12:35	0.00023	*< 0.001*	*< 0.000005*	26.0	0.00754	40.7	0.0361	0.00485	18.9	0.00436	*< 0.05*	*< 0.000005*	0.0342	0.00409	61.9	0.000639	2.64	*< 0.00001*	4.36	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000568	0.0165	0.000225	0.00039	0.00074	*< 0.00006*
SS	L2057381-9	2/15/2018 11:35	0.00021	*< 0.001*	*< 0.000005*	23.2	0.00885	37.4	0.0225	0.00506	15.6	0.00368	*< 0.05*	*< 0.000005*	0.0292	0.00402	53.4	0.000531	2.53	*< 0.00001*	4.07	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000531	0.0151	0.000187	0.00034	0.00061	*< 0.00006*
SS	L2062788-9	3/1/2018 14:20	0.00020	*< 0.001*	*< 0.000005*	23.3	0.00902	40.9	0.0165	0.00456	16.3	0.00384	*< 0.05*	0.0000056	0.0304	0.00418	49.4	0.000316	2.66	*< 0.00001*	4.25	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000521	0.0124	0.000195	0.00026	0.00092	*< 0.00006*
SS	L2068449-9	3/15/2018 12:25	0.00013	*< 0.001*	*< 0.000005*	22.3	0.00801	34.0	0.0213	0.00439	15.3	0.00358	*< 0.05*	*< 0.000005*	0.0313	0.00347	43.8	0.000237	2.71	*< 0.00001*	3.53	0.00026	*< 0.0001*	*< 0.0003*	0.0000489	0.0102	0.000154	0.00036	*< 0.0005*	*< 0.00006*
SS	L2074311-9	3/29/2018 12:15	0.00020	0.0029	*< 0.000005*	21.3	0.00832	33.6	0.0219	0.00519	13.5	0.00328	*< 0.05*	0.0000217	0.0274	0.00329	31.8	0.000057	2.48	*< 0.00001*	3.77	0.00021	*< 0.0001*	*< 0.0003*	0.0000436	0.0105	0.000230	0.00038	0.0023	*< 0.00006*
SS	L2079620-9	4/12/2018 11:30	0.00016	*< 0.001*	*< 0.000005*	19.4	0.00815	29.7	0.0264	0.00526	12.9	0.00332	*< 0.05*	*< 0.000015*	0.0281	0.00326	28.6	0.000093	2.55	*< 0.00001*	3.69	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000480	0.0105	0.000199	0.00039	*< 0.001*	*< 0.00006*
SS	L2085708-9	4/26/2018 14:00	0.00013	*< 0.001*	*< 0.000005*	18.9	0.00677	29.0	0.0323	0.00472	11.8	0.00303	*< 0.05*	*< 0.000005*	0.0263	0.00296	26.5	0.000283	2.61	*< 0.00001*	3.30	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000418	0.00895	0.000157	0.00040	*< 0.001*	*< 0.00006*
SS	L2092801-9	5/10/2018 11:15	0.00015	0.0016	*< 0.000005*	19.0	0.00858	28.7	0.0344	0.00474	11.2	0.00307	*< 0.05*	0.0000059	0.0267	0.00314	21.4	0.000128	2.66	*< 0.00001*	3.53	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000452	0.00844	0.000243	0.00041	*< 0.001*	*< 0.00006*
SS	L2100224-9	5/24/2018 14:00	0.00015	*< 0.001*	*< 0.000005*	20.1	0.00788	31.9	0.0420	0.00503	11.2	0.00355	*< 0.05*	0.0000066	0.0287	0.00310	20.0	0.000097	2.67	*< 0.00001*	3.69	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000420	0.00848	0.000209	0.00046	*< 0.001*	*< 0.00006*
SS	L2108434-9	6/7/2018 14:00	0.00023	0.0015		20.7	0.00842	32.0	0.0117	0.00486	12.0	0.00279	*< 0.05*	0.0000067	0.0280	0.00316	21.5	0.000072	3.19	*< 0.00001*	3.51	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000455	0.00839	0.000200	0.00035	0.0018	*< 0.00006*
SS	L2116986-9	6/21/2018 14:00	0.00020	*< 0.001*		19.7	0.00777	29.9	0.0121	0.00474	10.9	0.00256	*< 0.05*	0.0000065	0.0286	0.00318	19.0	0.000084	3.33	*< 0.00001*	3.45	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000436	0.00772	0.000186	0.00040	*< 0.001*	*< 0.00006*
SS	L2125321-9	7/6/2018 11:50	*< 0.0001*	*< 0.001*		18.1	0.00715	27.0	0.00878	0.00491	10.0	0.00232	*< 0.05*	*< 0.000005*	0.0254	0.00431	16.6	0.000086	4.30	*< 0.00001*	3.14	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000396	0.00747	0.000416	0.00043	*< 0.001*	*< 0.00006*
SS	L2132784-9	7/19/2018 15:15	0.00025	*< 0.001*		18.4	0.00749	27.2	0.00903	0.00511	10.0	0.00242	*< 0.05*	0.0000146	0.0261	0.00429	15.5	0.000075	4.38	*< 0.00001*	3.12	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000436	0.00839	0.000377	0.00042	0.0018	*< 0.00006*
SS	L2140795-9	8/2/2018 13:45	0.00021	0.0010		18.7	0.00763	26.4	0.0104	0.00546	10.2	0.00214	*< 0.05*	0.0000082	0.0258	0.00317	15.7	0.000079	4.28	*< 0.00001*	3.35	0.00021	*< 0.0001*	*< 0.0003*	0.0000377	0.00766	0.000291	0.00045	*< 0.001*	*< 0.00006*

Appendix A4: Schist Column (SO, SS, ST) Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-S**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
SS	L2148482-9	8/16/2018	0.00018	*< 0.001*		18.6	0.00746	28.6	0.0126	0.00537	10.5	0.00243	*< 0.05*	0.0000051	0.0275	0.00349	13.0	0.000042	4.57	*< 0.00001*	3.51	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000422	0.00820	0.000320	0.00052	*< 0.001*	*< 0.00006*
SS	L2156461-9	8/30/2018 14:20	0.00023	*< 0.001*		18.5	0.00731	26.7	0.0132	0.00536	10.1	0.00204	*< 0.05*	*< 0.000005*	0.0261	0.00287	13.1	*< 0.00004*	4.37	*< 0.00001*	3.31	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000341	0.00783	0.000280	0.00051	*< 0.001*	*< 0.00006*
SS	L2164110-9	9/13/2018 11:45	0.00019	*< 0.001*		19.0	0.00725	26.5	0.0128	0.00520	10.5	0.00221	*< 0.05*	0.0000439	0.0272	0.00244	12.4	*< 0.00004*	4.25	*< 0.00001*	3.38	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000322	0.00733	0.000296	0.00044	*< 0.001*	*< 0.00006*
SS	L2172409-9	9/27/2018 14:00	0.00042	*< 0.001*		15.7	0.00672	25.2	0.0132	0.00503	9.31	0.00200	*< 0.05*	*< 0.000005*	0.0226	0.00218	12.5	*< 0.00004*	4.53	*< 0.00001*	3.01	0.00024	*< 0.0001*	*< 0.0003*	0.0000283	0.00671	0.000249	0.00047	*< 0.001*	*< 0.00006*
SS	L2180431-9	10/12/2018 14:10	0.00017	*< 0.001*		15.3	0.00664	24.1	0.00942	0.00526	8.69	0.00189	*< 0.05*	*< 0.000005*	0.0217	0.00247	12.3	*< 0.00004*	4.75	*< 0.00001*	3.02	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000297	0.00674	0.000290	0.00044	*< 0.001*	*< 0.00006*
SS	L2187510-9	10/25/2018 14:00	0.00016	*< 0.001*		15.2	0.00673	25.5	0.00848	0.00544	8.73	0.00202	*< 0.05*	*< 0.000005*	0.0224	0.00212	13.2	0.000061	4.30	*< 0.00001*	3.17	0.00033	*< 0.0001*	*< 0.0003*	0.0000304	0.00742	0.000306	0.00043	*< 0.001*	*< 0.00006*
SS	L2194529-9	11/8/2018 14:10	*< 0.0001*	*< 0.001*		15.3	0.00639	25.7	0.0114	0.00515	8.50	0.00207	*< 0.05*	*< 0.000005*	0.0226	0.00217	13.1	0.000040	4.66	*< 0.00001*	3.09	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000309	0.00737	0.000273	0.00043	*< 0.001*	*< 0.00006*
SS	L2200705-9	11/22/2018 11:55	0.00013	*< 0.001*		15.1	0.00641	24.7	0.0101	0.00535	8.41	0.00190	*< 0.05*	*< 0.000005*	0.0214	0.00192	12.6	0.000044	4.68	*< 0.00001*	3.01	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000291	0.00731	0.000327	0.00043	*< 0.001*	*< 0.00006*
SS	L2207335-9	12/6/2018 13:05	0.00014	*< 0.001*		14.9	0.00642	24.9	0.00924	0.00527	8.08	0.00190	*< 0.05*	*< 0.000005*	0.0206	0.00187	12.4	0.000058	4.53	*< 0.00001*	2.97	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000277	0.00709	0.000321	0.00043	*< 0.001*	*< 0.00006*
SS	L2213525-9	12/20/2018 14:45	*< 0.0001*	*< 0.001*		16.0	0.00642	23.7	0.0120	0.00557	9.01	0.00192	*< 0.05*	*< 0.000005*	0.0225	0.00207	13.2	*< 0.00004*	5.06	*< 0.00001*	3.12	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000303	0.00974	0.000316	0.00044	*< 0.001*	*< 0.00006*
SS	L2217203-9	1/5/2019 11:35	*< 0.0001*	*< 0.001*		15.7	0.00662	25.3	0.0111	0.00543	8.72	0.00200	*< 0.05*	*< 0.000005*	0.0230	0.00197	19.3	0.000054	3.97	*< 0.00001*	3.40	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000348	0.0121	0.000373	0.00031	*< 0.001*	*< 0.00006*
SS	L2222132-9	1/17/2019 11:45	0.00020	*< 0.001*		16.1	0.00655	31.7	0.0285	0.00460	9.80	0.00236	*< 0.05*	*< 0.000005*	0.0230	0.00179	48.7	0.000041	4.01	*< 0.00001*	3.85	0.00028	*< 0.0001*	*< 0.0003*	0.0000368	0.0204	0.000374	0.00023	*< 0.001*	*< 0.00006*
SS	L2227544-9	1/31/2019 10:30	0.00024	*< 0.002*		16.1	0.0068	38.6	0.0673	0.00379	11.4	0.00376	*< 0.1*	*< 0.00001*	0.0254	0.00148	93.2	*< 0.00008*	3.90	*< 0.00002*	5.16	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000381	0.0272	0.00030	*< 0.0002*	*< 0.002*	*< 0.00012*
SS	L2233141-9	2/14/2019 14:20	*< 0.0002*	*< 0.002*		21.1	0.0082	54.2	0.173	0.00270	13.1	0.00500	*< 0.1*	*< 0.00001*	0.0290	0.00131	148	*< 0.00008*	4.21	*< 0.00002*	6.45	0.00061	*< 0.0002*	*< 0.0006*	0.0000486	0.0302	0.00029	*< 0.0002*	*< 0.002*	*< 0.00012*
SS	L2238565-9	2/28/2019 15:15	0.00025	*< 0.002*		20.6	0.0080	62.5	0.276	0.00210	12.5	0.00525	*< 0.1*	*< 0.00001*	0.0305	0.00115	198	*< 0.00008*	4.32	*< 0.00002*	8.02	0.00069	*< 0.0002*	*< 0.0006*	0.0000468	0.0276	0.00026	*< 0.0002*	*< 0.002*	*< 0.00012*
SS	L2244540-9	3/14/2019 14:30	0.00025	*< 0.002*		22.8	0.0094	65.4	0.388	0.00178	12.4	0.00490	*< 0.1*	*< 0.00001*	0.0338	0.00118	232	*< 0.00008*	4.48	*< 0.00002*	8.98	0.00042	*< 0.0002*	*< 0.0006*	0.0000551	0.0230	0.00033	*< 0.0002*	*< 0.002*	*< 0.00012*
SS	L2250817-9	3/28/2019 15:00	*< 0.0005*	*< 0.005*		24.1	0.0099	80.5	0.408	0.00148	14.3	0.00514	*< 0.25*	*< 0.000025*	0.0372	0.00087	268	*< 0.0002*	4.37	*< 0.00005*	9.45	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000043	0.0205	0.00032	*< 0.0005*	*< 0.005*	*< 0.0003*
SS	L2257457-9	4/11/2019 15:00	*< 0.0005*	*< 0.005*		22.9	0.0098	81.0	0.426	0.00172	12.3	0.00489	*< 0.25*	*< 0.000025*	0.0372	0.00104	284	*< 0.0002*	4.47	*< 0.00005*	9.93	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000055	0.0179	*< 0.00025*	*< 0.0005*	*< 0.005*	*< 0.0003*
SS	L2263301-9	4/25/2019 14:45	*< 0.0005*	*< 0.005*		24.2	0.0107	87.9	0.575	0.00161	13.5	0.00429	*< 0.25*	*< 0.000025*	0.0386	0.00102	305	*< 0.0002*	4.76	*< 0.00005*	10.9	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000057	0.0167	0.00038	*< 0.0005*	*< 0.005*	*< 0.0003*
ST	L2000226-6	9/29/2017 10:50	0.00041	*< 0.001*	*< 0.000005*	16.2	0.00892	19.6	0.000159	0.0138	23.1	0.000298	*< 0.05*	0.0000051	0.00161	0.00179	54.8	0.000405	5.15	0.000032	3.90	0.00025	*< 0.0001*	*< 0.0003*	0.0000136	0.0241	0.00135	0.00040	*< 0.00075*	*< 0.00006*
ST	L2014692-6	10/27/2017	0.00040	*< 0.001*	*< 0.000005*	19.8	0.0121	23.7	0.0114	0.0195	25.9	0.000537	*< 0.05*	0.0000124	0.00203	0.00194	66.6	0.00110	6.57	0.000019	4.95	0.00027	*< 0.0001*	*< 0.0003*	0.0000233	0.0347	0.00122	0.00045	0.00051	*< 0.00006*
ST	L2021295-6	11/10/2017 13:30	0.00029	*< 0.001*	*< 0.000005*	18.6	0.0112	21.7	0.00165	0.0174	24.6	0.000392	*< 0.05*	*< 0.000005*	0.00192	0.00142	51.6	0.00137	5.66	*< 0.00001*	4.29	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000175	0.0259	0.00121	0.00037	*< 0.0005*	*< 0.00006*
ST	L2026623-10	11/23/2017 14:40	0.00026	*< 0.002*	*< 0.000005*	16.5	0.0105	18.8	0.00064	0.0213	21.3	0.00050	*< 0.1*	*< 0.00001*	0.00170	0.00142	46.8	0.000405	5.73	*< 0.00002*	4.26	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000184	0.0285	0.00122	0.00052	*< 0.001*	*< 0.00012*
ST	L2031965-9	12/6/2017 14:05	0.00030	*< 0.001*	*< 0.000005*	17.0	0.00873	18.7	0.000889	0.0196	21.0	0.000317	*< 0.05*	0.0000147	0.00202	0.00150	45.9	0.00215	5.68	0.000011	4.27	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000225	0.0241	0.00132	0.00043	*< 0.0005*	*< 0.00006*
ST	L2038563-10	12/21/2017 13:10	0.00030	*< 0.001*	*< 0.000005*	16.4	0.00796	18.0	0.00208	0.0212	20.4	0.000344	*< 0.05*	0.0000086	0.00190	0.00130	43.9	0.000511	5.59	*< 0.00001*	4.09	0.00024	*< 0.0001*	*< 0.0003*	0.0000207	0.0223	0.00117	0.00038	0.00065	*< 0.00006*
ST	L2042065-1	1/5/2018 11:50	0.00015	0.0018	*< 0.000005*	13.2	0.00729	13.4	0.00125	0.0160	15.9	0.000483	*< 0.05*	*< 0.000005*	0.00149	0.00101	28.1	0.00216	4.29	*< 0.00001*	3.14	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000227	0.0175	0.00103	0.00024	*< 0.0005*	*< 0.00006*
ST	L2046871-10	1/18/2018 12:10	0.00028	0.0016	*< 0.000005*	15.7	0.00911	17.4	0.00164	0.0222	19.1	0.000402	*< 0.05*	*< 0.000005*	0.00206	0.00129	35.3	0.00281	5.72	*< 0.00001*	3.94	0.00023	*< 0.0001*	*< 0.0003*	0.0000222	0.0223	0.00118	0.00042	0.0137	*< 0.00006*
ST	L2052061-10	2/1/2018 12:35	0.00022	*< 0.001*	*< 0.000005*	17.3	0.00820	15.9	0.00489	0.0195	18.8	0.000435	*< 0.05*	*< 0.000005*	0.00198	0.00115	33.8	0.00274	5.70	*< 0.00001*	3.95	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000201	0.0220	0.00110	0.00044	*< 0.0005*	*< 0.00006*
ST	L2057381-10	2/15/2018 11:35	0.00066	*< 0.001*	*< 0.000005*	15.3	0.00886	15.3	0.00561	0.0205	16.1	0.000394	*< 0.05*	0.0000081	0.00169	0.00104	32.0	0.00171	5.49	*< 0.00001*	3.78	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000229	0.0234	0.000844	0.00044	0.00050	*< 0.00006*
ST	L2062788-10	3/1/2018 14:20	0.00022	*< 0.001*	*< 0.000005*	15.9	0.00913	16.8	0.00497	0.0196	17.3	0.000381	*< 0.05*	*< 0.000005*	0.00182	0.000979	31.9	0.000890	5.61	*< 0.00001*	4.09	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000203	0.0190	0.000836	0.00039	*< 0.0005*	*< 0.00006*
ST	L2068449-10	3/15/2018 12:25	0.00015	*< 0.001*	*< 0.000005*	15.5	0.00790	15.0	0.0151	0.0196	16.8	0.000403	*< 0.05*	*< 0.000005*	0.00202	0.000886	30.6	0.000906	5.69	*< 0.00001*	3.47	0.00024	*< 0.0001*	*< 0.0003*	0.0000191	0.0176	0.000844	0.00043	*< 0.0005*	*< 0.00006*
ST	L2074311-10	3/29/2018 12:15	0.00021	*< 0.001*	*< 0.000005*	14.9	0.00846	14.8	0.0106	0.0222	15.1	0.000403	*< 0.05*	*< 0.000005*	0.00180	0.000826	25.2	0.000349	5.29	*< 0.00001*	3.72	0.00021	*< 0.0001*	*< 0.0003*	0.0000198	0.0196	0.000832	0.00043	*< 0.001*	*< 0.00006*
ST	L2079620-10	4/12/2018 11:30	0.00016	*< 0.001*	*< 0.000005*	13.2	0.00749	12.9	0.0192	0.0223	14.1	0.000358	*< 0.05*	*< 0.000015*	0.00180	0.000796	23.9	0.000290	5.22	0.000011	3.28	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000217	0.0201	0.000742	0.00046	*< 0.001*	*< 0.00006*
ST	L2085708-10	4/26/2018 14:00	0.00015	*< 0.001*	*< 0.000005*	13.8	0.00683	13.3	0.0108	0.0209	13.8	0.000289	*< 0.05*	*< 0.000005*	0.00176	0.000700	23.1	0.000703	5.41	*< 0.00001*	3.29	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000202	0.0176	0.000767	0.00038	*< 0.001*	*< 0.00006*
ST	L2092801-10	5/10/2018 11:15	0.00016	*< 0.001*	*< 0.000005*	14.7	0.00845	13.5	0.0130	0.0219	14.1	0.000271	*< 0.05*	0.0000050	0.00199	0.000784	18.6	0.000283	5.37	*< 0.00001*	3.60	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000213	0.0184	0.000887	0.00040	*< 0.001*	*< 0.00006*
ST	L2100224-10	5/24/2018 14:00	0.00026	*< 0.001*	*< 0.000005*	14.4	0.00729	14.0	0.0194	0.0227	13.7	0.000229	*< 0.05*	*< 0.000005*	0.00204	0.000737	19.8	0.000295	5.55	*< 0.00001*	3.44	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000198	0.0177	0.000827	0.00040	*< 0.001*	*< 0.00006*
ST	L2108434-10	6/7/2018 14:00	0.00018	0.0039		14.8	0.00801	14.0	0.000888	0.0235	14.5	0.000267	*< 0.05*	0.0000116	0.00207	0.00183	20.7	0.000233	7.04	*< 0.00001*	3.59	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000209	0.0195	0.00134	0.00047	0.0090	*< 0.00006*
ST	L2116986-10	6/21/2018 14:00	0.00019	0.0014		15.3	0.00761	14.0	0.000836	0.0236	14.0	0.000235	*< 0.05*	0.0000074	0.00220	0.00237	18.2	0.000292	7.08	*< 0.00001*	3.56	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000215	0.0196	0.00264	0.00049	*< 0.001*	*< 0.00006*
ST	L2125321-10	7/6/2018 11:50	0.00012	0.0010		13.9	0.00706	12.8	0.00237	0.0269	12.8	0.000226	*< 0.05*	*< 0.000005*	0.00197	0.00272	17.3	0.000330	7.67	*< 0.00001*	3.36	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000197	0.0187	0.00314	0.00057	0.0020	*< 0.00006*
ST	L2132784-10	7/19/2018 15:15	0.00022	0.0014		14.7	0.00752	13.6	0.00144	0.0283	13.3	0.000224	*< 0.05*	*< 0.000005*	0.00216	0.00284	16.7	0.000371	7.78	*< 0.00001*	3.42	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000184	0.0206	0.00298	0.00063	*< 0.001*	*< 0.00006*
ST	L2140795-10	8/2/2018 13:45	0.00026	0.0017		15.3	0.00780	13.0	0.000619	0.0295	13.4	0.000177	*< 0.05*	*< 0.000005*	0.00236	0.00304	16.7	0.000444	7.56	*< 0.00001*	3.65	0.00023	*< 0.0001*	*< 0.0003*	0.0000192	0.0198	0.00363	0.00080	*< 0.001*	*< 0.00006*
ST	L2148482-10	8/16/2018	0.00023	0.0014		14.5	0.00737	13.6	0.000521	0.0305	13.1	0.000196	*< 0.05*	*< 0.000005*	0.00244	0.00317	14.8	0.000321	7.93	*< 0.00001*	3.75	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000209	0.0205	0.00378	0.00084	*< 0.001*	*< 0.00006*
ST	L2156461-10	8/30/2018 14:20	0.00029	*< 0.001*		14.9	0.00722	12.8	0.000824	0.0289	12.9	*< 0.00005*	*< 0.05*	*< 0.000015*	0.00245	0.00355	13.9	0.000403	8.38	0.000014	3.52	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000299	0.0200	0.00383	0.00091	*< 0.001*	*< 0.00006*
ST	L2164110-10	9/13/2018 11:45	0.00023	*< 0.002*		13.5	0.0070	12.4	0.00048	0.0285	12.0	0.00016	*< 0.1*	*< 0.00001*	0.00222	0.00313	14.1	0.000308	7.99	*< 0.00002*	3.29	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000164	0.0186	0.00392	0.00098	*< 0.002*	*< 0.00012*
ST	L2172409-10	9/27/2018 14:00	0.00030	*< 0.002*		12.4	0.0064	11.2	0.00065	0.0270	11.5	0.00017	*< 0.1*	*< 0.00001*	0.00189	0.00361	12.3	0.000354	8.40	*< 0.00002*	3.06	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000126	0.0166	0.00397	0.00095	*< 0.002*	*< 0.00012*
ST	L2180431-10	10/12/2018 14:10	0.00025	*< 0.002*		12.5	0.0063	11.6	0.00035	0.0292	10.8	0.00015	*< 0.1*	*< 0.00001*	0.00216	0.00368	12.9	0.000351	8.51	*< 0.00002*	3.18	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000100	0.0172	0.00454	0.00098	*< 0.002*	*< 0.00012*
ST	L2187510-10	10/25/2018 14:00	0.00028	*< 0.001*		12.3	0.00645	11.7	0.000174	0.0307	11.0	0.000165	*< 0.05*	*< 0.000005*	0.00207	0.00315	13.7	0.000360	8.25	*< 0.00001*	3.30	0.00022	*< 0.0001*	*< 0.0003*	0.0000087	0.0194	0.00455	0.00102	*< 0.001*	*< 0.00006*
ST	L2194529-10	11/8/2018 14:10	0.00024	*< 0.001*		13.1	0.00659	12.1	0.000343	0.0278	11.4	0.000191	*< 0.05*	*< 0.000005*	0.00211	0.00347	13.6	0.000362	8.98	*< 0.00001*	3.20	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000097	0.0195	0.00464	0.00097	*< 0.001*	*< 0.00006*
ST	L2200705-10	11/22/2018 11:55	0.00031	*< 0.001*		12.0	0.00625	11.5	0.00108	0.0268	10.2	0.000190	*< 0.05*	*< 0.000005*	0.00206	0.00331	12.9	0.000527	8.94	*< 0.00001*	3.05	*< 0.0002*	*< 0.0001*	*< 0.0003*	0.0000087	0.0186	0.00509	0.00099	*< 0.001*	*< 0.00006*
ST	L2207335-10	12/6/2018 13:05	0.00036	*< 0.002*		12.1	0.0060	11.9	0.00027	0.0277	9.83	0.00014	*< 0.1*	*< 0.00001*	0.00204	0.00339	12.3	0.000384	8.63	*< 0.00002*	3.10	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000050	0.0172	0.00541	0.00105	*< 0.002*	*< 0.00012*
ST	L2213525-10	12/20/2018 14:45	0.00026	*< 0.002*		12.0	0.0060	10.5	0.00048	0.0279	10.6	0.00019	*< 0.1*	*< 0.00001*	0.00208	0.00388	11.6	0.000301	9.29	*< 0.00002*	3.07	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000075	0.0181	0.00534	0.00109	*< 0.002*	*< 0.00012*
ST	L2217203-10	1/5/2019 11:35	0.00034	*< 0.002*		12.1	0.0062	11.3	0.00032	0.0269	10.4	0.00024	*< 0.1*	*< 0.00001*	0.00230	0.00323	15.2	0.000331	8.57	*< 0.00002*	3.28	*< 0.0004*	*< 0.0002*	*< 0.0006*	0.0000052	0.0189	0.00534	0.00106	*< 0.002*	*< 0.00012*
ST	L2222132-10	1/17/2019 11:45	0.00034	*< 0.001*		14.1	0.00696	16.2	0.00414	0.0238	11.6	0.000193	*< 0.05*	*< 0.000005*	0.00263	0.00282	39.9	0.000369	8.20	*< 0.00001*	4.64	0.00036	*< 0.0001*	*< 0.0003*	0.0000065	0.0195	0.00470	0.00082	*< 0.001*	*< 0.00006*
ST	L2227544-10	1/31/2019 10:30	0.00026	*< 0.002*		16.6	0.0086	27.9	0.0338	0.0176	14.2	0.00022	*< 0.1*	*< 0.00001*	0.00401	0.00181	99.1	0.000253	7.91	*< 0.00002*	8.67	0.00048	*< 0.0002*	*< 0.0006*	0.0000176	0.0258	0.00287	*< 0.0002*	*< 0.002*	*< 0.00012*
ST	L2233141-10	2/14/2019 14:20	*< 0.0002*	0.0049		21.9	0.0116	43.9	0.235	0.0125	15.6	0.00036	*< 0.1*	*< 0.00001*	0.00540	0.00127	171	0.000194	8.85	*< 0.00002*	12.5	0.00127	*< 0.0002*	*< 0.0006*	0.0000315	0.0378	0.00190	*< 0.0002*	*< 0.002*	*< 0.00012*
ST	L2238565-10	2/28/2019 15:15	*< 0.0005*	0.0091		21.9	0.0111	49.1	0.535	0.00735	14.2	0.00071	*< 0.25*	*< 0.000025*	0.0064	0.00081	204	*< 0.0002*	8.07	*< 0.00005*	15.3	0.0012	*< 0.0005*	*< 0.0015*	0.000052	0.0362	0.00089	*< 0.0005*	*< 0.005*	*< 0.0003*
ST	L2244540-10	3/14/2019 14:30	*< 0.0005*	0.0136		25.5	0.0121	47.7	0.803	0.00541	13.6	0.00096	*< 0.25*	*< 0.000025*	0.0078	0.00066	241	0.00020	7.91	*< 0.00005*	17.1	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000053	0.0360	0.00074	*< 0.0005*	*< 0.005*	*< 0.0003*
ST	L2250817-10	3/28/2019 15:00	*< 0.0005*	0.0089		24.7	0.0130	56.1	0.845	0.00447	15.2	0.00073	*< 0.25*	*< 0.000025*	0.0091	0.00044	274	0.00027	8.31	*< 0.00005*	17.8	*< 0.001*	*< 0.0005*	*< 0.0015*	0.000044	0.0384	0.00049	*< 0.0005*	*< 0.005*	*< 0.0003*
ST	L2257457-10	4/11/2019 15:00	*< 0.0005*	0.0140		24.3	0.0131	55.7	0.803	0.00394	13.9	0.00103	*< 0.25*	*< 0.000025*	0.0097	0.00058	282	*< 0.0002*	8.43	*< 0.00005*	19.0	0.0013	*< 0.0005*	*< 0.0015*	0.000050	0.0420	0.00041	*< 0.0005*	*< 0.005*	*< 0.0003*
ST	L2263301-10	4/25/2019 14:45	*< 0.0005*	0.0124		25.2	0.0129	59.2	0.745	0.00335	14.5	0.00061	*< 0.25*	*< 0.000025*	0.0106	0.00048	294	*< 0.0002*	8.34	*< 0.00005*	19.2	0.0015	*< 0.0005*	*< 0.0015*	0.000054	0.0404	0.00049	*< 0.0005*	*< 0.005*	*< 0.0003*

Notes:
Results in blue italics are below the indicated detection limit

Appendix B: Quality Assurance and Quality Control

GOLDCORP

APPENDIX B1: METHOD BLANK EFFLUENT RESULTS

Appendix B1: Method Blank Effluent Results

			pH	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**pH-LE**	**Cond-LE**	**T-Alk-LE**	**DOC**	**NH3**	**NO2-N**	**NO3-N**	**TD-P**	**D-S**	**D-Sulphide**	**SO4**	**D-Br**	**D-Cl**
COL100	L1955324-1	7/7/2017 13:00	6.16	4.85	10	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0115	*< 0.5*	*< 0.0015*	0.44	*< 0.05*	*< 0.5*
COL100	L1969886-1	8/3/2017 13:50	6.18	5.01	37	*< 0.5*	0.0074	*< 0.001*	*< 0.005*	0.0119	*< 0.5*	*< 0.0015*	0.41	*< 0.05*	*< 0.5*
COL100	L1984768-1	8/31/2017 14:00	6.15	4.61	56	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0119	*< 0.5*	*< 0.0015*	0.43	*< 0.05*	*< 0.5*
COL100	L2000225-1	9/29/2017 10:50	6.11	4.67	44	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0127	*< 0.5*	*< 0.0015*	0.42	*< 0.05*	*< 0.5*
COL100	L2014332-1	10/26/2017 11:50	6.07	5.39	10	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0119	*< 0.5*	*< 0.0015*	0.43	*< 0.05*	*< 0.5*
COL100	L2027123-1	11/24/2017 14:35	6.2	5.35	10	0.66	*< 0.005*	*< 0.001*	*< 0.005*	0.0105	*< 0.5*	*< 0.0015*	0.48	*< 0.05*	*< 0.5*
COL100	L2038562-1	12/21/2017 13:50	6.03	4.47	9	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0115	*< 0.5*	*< 0.0015*	0.50	*< 0.05*	*< 0.5*
COL100	L2046870-1	1/18/2018 11:25	6.05	4.32	12	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0097	*< 0.5*	*< 0.0015*	0.53	*< 0.05*	*< 0.5*
COL100	L2057384-1	2/15/2018 11:35	5.97	4.3	10	0.81	*< 0.005*	*< 0.001*	*< 0.005*	0.0105	*< 0.5*	*< 0.0015*	0.51	*< 0.05*	*< 0.5*
COL100	L2068450-1	3/15/2018 11:40	5.99	4.07	10	*< 0.5*	0.0091	*< 0.001*	*< 0.005*	0.0119	*< 0.5*	*< 0.0015*	0.46	*< 0.05*	*< 0.5*
COL100	L2079621-1	4/12/2018 11:00	5.85	3.74	10	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0107	*< 0.5*	*< 0.0015*	0.45	*< 0.05*	*< 0.5*
COL100	L2092802-1	5/10/2018 11:15	5.9	3.13	13	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0079	*< 0.5*	*< 0.0015*	0.40	*< 0.05*	*< 0.5*
COL100	L2109214-1	6/8/2018 12:30	5.83	3.24	14	0.57	*< 0.005*	*< 0.001*	*< 0.005*	0.0097	*< 0.5*	*< 0.0015*	0.38	*< 0.05*	*< 0.5*
COL100	L2125319-1	7/6/2018 11:30	5.78	3.45	19	1.01	*< 0.005*	*< 0.001*	*< 0.005*	0.0110	*< 0.5*	*< 0.0015*	0.38	*< 0.05*	*< 0.5*
COL100	L2140796-1	8/2/2018 13:30	5.85	3.10	13	0.71	*< 0.005*	0.0011	*< 0.005*	0.0097	*< 0.5*	*< 0.0015*	0.35	*< 0.05*	*< 0.5*
COL100	L2156463-1	8/30/2018 14:20	5.73	3.11	7	0.54	*< 0.005*	*< 0.001*	*< 0.005*	0.0108	*< 0.5*	*< 0.0015*	0.30	*< 0.05*	*< 0.5*
COL100	L2171505-1	9/26/2018 15:20	5.77	3.73	6	*< 1*	*< 0.005*	*< 0.001*	*< 0.005*	0.0082	*< 0.5*	*< 0.0015*	0.32	*< 0.05*	*< 0.5*
COL100	L2186829-1	10/24/2018 13:40	5.82	3.23	7	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0086	*< 0.5*	*< 0.0015*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2200706-1	11/22/2018 10:45	5.7	3.81	5	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0095	*< 0.5*	*< 0.0015*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2213526-1	12/20/2018 14:45	5.86	2.78	6	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0107	*< 0.5*	*< 0.0015*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2222133-1	1/17/2019 11:45	5.73	2.89	7	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0093	*< 0.5*	*< 0.0067*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2233140-1	2/14/2019 14:20	5.79	2.69	5	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0071	*< 0.5*	*< 0.0015*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2244815-1	3/14/2019 14:30	5.7	2.58	5	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0079	*< 0.5*	*< 0.0015*	*< 0.3*	*< 0.05*	*< 0.5*
COL100	L2257455-1	4/11/2019 15:00	5.6	2.9	6	*< 0.5*	*< 0.005*	*< 0.001*	*< 0.005*	0.0084	*< 0.5*	*< 0.01*	*< 0.3*	*< 0.05*	*< 0.5*

Notes:
Results in blue italics are below the indicated detection limit

Appendix B1: Method Blank Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**
COL100	L1955324-1	7/7/2017 13:00	0.025	*< 0.000005*	0.00494	*< 0.00002*	*< 0.01*	0.576	*< 0.00001*	*< 0.000005*	0.330	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L1969886-1	8/3/2017 13:50	0.024	*< 0.000005*	0.00474	*< 0.00002*	*< 0.01*	0.550	*< 0.00001*	*< 0.000005*	0.334	*< 0.000005*	0.0000060	*< 0.0001*	*< 0.00001*
COL100	L1984768-1	8/31/2017 14:00	0.022	*< 0.000005*	0.00444	0.000216	*< 0.01*	0.590	*< 0.00001*	*< 0.000005*	0.301	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2000225-1	9/29/2017 10:50	0.031	*< 0.000005*	0.00502	*< 0.00002*	*< 0.01*	0.573	*< 0.00001*	*< 0.000005*	0.280	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2014332-1	10/26/2017 11:50	0.022	*< 0.000005*	0.00595	*< 0.00002*	*< 0.01*	0.577	*< 0.00001*	*< 0.000005*	0.266	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2027123-1	11/24/2017 14:35	0.052	*< 0.000005*	0.00424	*< 0.00002*	*< 0.01*	0.735	*< 0.00001*	0.0000062	0.382	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2038562-1	12/21/2017 13:50	0.024	*< 0.000005*	0.00545	*< 0.00002*	*< 0.01*	0.639	*< 0.00001*	*< 0.000005*	0.284	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2046870-1	1/18/2018 11:25	0.021	*< 0.000005*	0.00492	*< 0.00002*	*< 0.01*	0.755	*< 0.00001*	*< 0.000005*	0.238	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2057384-1	2/15/2018 11:35	*< 0.02*	*< 0.000005*	0.00479	*< 0.00002*	*< 0.01*	0.650	*< 0.00001*	*< 0.000005*	0.214	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2068450-1	3/15/2018 11:40	*< 0.02*	*< 0.000005*	0.00574	*< 0.00002*	*< 0.01*	0.647	*< 0.00001*	*< 0.000005*	0.178	*< 0.000005*	0.0000109	*< 0.0001*	*< 0.00001*
COL100	L2079621-1	4/12/2018 11:00	*< 0.02*	*< 0.000005*	0.00561	*< 0.00002*	*< 0.01*	0.552	*< 0.00001*	*< 0.000005*	0.175	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2092802-1	5/10/2018 11:15	*< 0.02*	*< 0.000005*	0.00783	0.000024	*< 0.01*	0.557	*< 0.00001*	*< 0.000005*	0.139	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2109214-1	6/8/2018 12:30	*< 0.02*	*< 0.000005*	0.00615	*< 0.00002*	*< 0.01*	0.534	*< 0.00001*	0.0000062	0.134	*< 0.000005*	0.0000056	*< 0.0001*	*< 0.00001*
COL100	L2125319-1	7/6/2018 11:30	*< 0.02*	*< 0.000005*	0.00405	*< 0.00002*	*< 0.01*	0.479	*< 0.00001*	*< 0.000005*	0.146	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2140796-1	8/2/2018 13:30	*< 0.02*	*< 0.000005*	0.00342	0.000028	*< 0.01*	0.401	*< 0.00001*	*< 0.000005*	0.163	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2156463-1	8/30/2018 14:20	*< 0.02*	*< 0.000005*	0.00402	*< 0.00002*	*< 0.01*	0.403	*< 0.00001*	*< 0.000005*	0.120	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2171505-1	9/26/2018 15:20	*< 0.02*	*< 0.000005*	0.00191	0.000040	*< 0.01*	0.372	*< 0.00001*	*< 0.000005*	0.114	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2186829-1	10/24/2018 13:40	*< 0.02*	*< 0.000005*	0.00224	*< 0.00002*	*< 0.01*	0.317	*< 0.00001*	*< 0.000005*	0.107	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2200706-1	11/22/2018 10:45	*< 0.02*	*< 0.000005*	0.00219	*< 0.00002*	*< 0.01*	0.370	*< 0.00001*	*< 0.000005*	0.102	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2213526-1	12/20/2018 14:45	*< 0.02*	*< 0.000005*	0.00216	*< 0.00002*	*< 0.01*	0.296	*< 0.00001*	*< 0.000005*	0.096	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2222133-1	1/17/2019 11:45	*< 0.02*	*< 0.000005*	0.00276	*< 0.00002*	*< 0.01*	0.276	*< 0.00001*	*< 0.000005*	0.087	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2233140-1	2/14/2019 14:20	*< 0.02*	*< 0.000005*	0.00217	0.000020	*< 0.01*	0.245	*< 0.00001*	*< 0.000005*	0.084	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2244815-1	3/14/2019 14:30	*< 0.02*	*< 0.000005*	0.00166	*< 0.00002*	*< 0.01*	0.236	*< 0.00001*	*< 0.000005*	0.077	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*
COL100	L2257455-1	4/11/2019 15:00	*< 0.02*	*< 0.000005*	0.00218	*< 0.00002*	*< 0.01*	0.228	*< 0.00001*	*< 0.000005*	0.075	*< 0.000005*	*< 5E-06*	*< 0.0001*	*< 0.00001*

Notes:
Results in blue italics are below the indicated detection limit

Appendix B1: Method Blank Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Cu**	**D-Fe**	**D-Hg**	**D-K**	**D-Li**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**
COL100	L1955324-1	7/7/2017 13:00	0.00023	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.167	0.000068	*< 0.00005*	0.064	*< 0.00005*	*< 0.05*	0.0000544	*< 0.0002*	*< 0.00002*
COL100	L1969886-1	8/3/2017 13:50	0.00024	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.167	0.000055	*< 0.00005*	0.077	*< 0.00005*	*< 0.05*	0.0000064	*< 0.0002*	*< 0.00002*
COL100	L1984768-1	8/31/2017 14:00	0.00021	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.160	0.000489	*< 0.00005*	0.067	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2000225-1	9/29/2017 10:50	0.00020	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.148	*< 0.00005*	*< 0.00005*	0.067	*< 0.00005*	*< 0.05*	0.0000097	*< 0.0002*	*< 0.00002*
COL100	L2014332-1	10/26/2017 11:50	0.00022	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.135	*< 0.00005*	*< 0.00005*	0.058	0.000158	*< 0.05*	0.0000209	*< 0.0002*	*< 0.00002*
COL100	L2027123-1	11/24/2017 14:35	0.00011	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.238	0.00168	*< 0.00005*	0.091	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2038562-1	12/21/2017 13:50	0.00017	0.0049	*< 0.000005*	*< 0.05*	*< 0.0005*	0.152	0.000099	*< 0.00005*	0.149	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2046870-1	1/18/2018 11:25	*< 0.0001*	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.142	*< 0.00005*	*< 0.00005*	0.048	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2057384-1	2/15/2018 11:35	*< 0.0001*	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.133	*< 0.00005*	*< 0.00005*	0.062	*< 0.00005*	*< 0.05*	0.0000075	*< 0.0002*	*< 0.00002*
COL100	L2068450-1	3/15/2018 11:40	*< 0.0001*	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.117	0.000067	*< 0.00005*	0.043	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2079621-1	4/12/2018 11:00	0.00012	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.105	0.000068	*< 0.00005*	0.040	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2092802-1	5/10/2018 11:15	0.00015	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0876	0.000088	*< 0.00005*	0.037	*< 0.00005*	*< 0.05*	0.0000095	*< 0.0002*	0.000025
COL100	L2109214-1	6/8/2018 12:30	0.00024	0.0047	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0836	0.000120	*< 0.00005*	0.176	0.000054	*< 0.05*	0.0000145	*< 0.0002*	*< 0.00002*
COL100	L2125319-1	7/6/2018 11:30	0.00019	0.0013	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0898	*< 0.00005*	*< 0.00005*	0.131	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2140796-1	8/2/2018 13:30	0.00024	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.100	0.000078	*< 0.00005*	0.039	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2156463-1	8/30/2018 14:20	0.00025	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0865	0.000061	*< 0.00005*	0.073	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2171505-1	9/26/2018 15:20	0.00038	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0722	0.000086	*< 0.00005*	0.029	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2186829-1	10/24/2018 13:40	0.00022	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0702	0.000074	*< 0.00005*	0.028	*< 0.00005*	*< 0.05*	0.0000059	*< 0.0002*	*< 0.00002*
COL100	L2200706-1	11/22/2018 10:45	0.00023	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0705	0.000083	*< 0.00005*	0.030	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2213526-1	12/20/2018 14:45	0.00024	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0646	0.000062	*< 0.00005*	0.026	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2222133-1	1/17/2019 11:45	0.00025	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0592	0.000077	*< 0.00005*	0.021	*< 0.00005*	*< 0.05*	0.0000057	*< 0.0002*	*< 0.00002*
COL100	L2233140-1	2/14/2019 14:20	0.00022	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0556	0.000083	*< 0.00005*	0.029	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2244815-1	3/14/2019 14:30	0.00026	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0511	0.000089	*< 0.00005*	0.035	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*
COL100	L2257455-1	4/11/2019 15:00	0.00027	*< 0.001*	*< 0.000005*	*< 0.05*	*< 0.0005*	0.0568	*< 0.00005*	*< 0.00005*	0.030	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*

Notes:
Results in blue italics are below the indicated detection limit

Appendix B1: Method Blank Effluent Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
COL100	L1955324-1	7/7/2017 13:00	*< 0.00004*	0.085	0.000012	0.00624	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00139	*< 0.00006*
COL100	L1969886-1	8/3/2017 13:50	*< 0.00004*	0.116	0.000014	0.00677	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	0.0000241	*< 0.00005*	*< 0.0001*	0.00127	*< 0.00006*
COL100	L1984768-1	8/31/2017 14:00	*< 0.00004*	0.092	*< 0.00001*	0.00643	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	0.0000027	*< 0.00005*	*< 0.0001*	0.00125	*< 0.00006*
COL100	L2000225-1	9/29/2017 10:50	*< 0.00004*	0.099	0.000011	0.00658	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0015*	*< 0.00006*
COL100	L2014332-1	10/26/2017 11:50	*< 0.00004*	0.088	0.000019	0.00603	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00105	*< 0.00006*
COL100	L2027123-1	11/24/2017 14:35	*< 0.00004*	0.109	0.000010	0.00746	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	0.0000021	*< 0.00005*	*< 0.0001*	0.00187	*< 0.00006*
COL100	L2038562-1	12/21/2017 13:50	*< 0.00004*	0.104	0.000010	0.00768	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00151	*< 0.00006*
COL100	L2046870-1	1/18/2018 11:25	*< 0.00004*	0.090	*< 0.00001*	0.00842	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00130	*< 0.00006*
COL100	L2057384-1	2/15/2018 11:35	*< 0.00004*	0.101	0.000012	0.00753	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00129	*< 0.00006*
COL100	L2068450-1	3/15/2018 11:40	*< 0.00004*	0.098	*< 0.00001*	0.00709	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00093	*< 0.00006*
COL100	L2079621-1	4/12/2018 11:00	*< 0.00004*	0.092	*< 0.00001*	0.00645	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0011	*< 0.00006*
COL100	L2092802-1	5/10/2018 11:15	*< 0.00004*	0.080	0.000011	0.00641	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	0.000097	*< 0.0001*	*< 0.001*	0.000323
COL100	L2109214-1	6/8/2018 12:30	*< 0.00004*	0.083	*< 0.00001*	0.00582	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0053	*< 0.00006*
COL100	L2125319-1	7/6/2018 11:30	*< 0.00004*	0.097	*< 0.00001*	0.00562	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2140796-1	8/2/2018 13:30	0.000088	0.093	0.000011	0.00504	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0012	*< 0.00006*
COL100	L2156463-1	8/30/2018 14:20	*< 0.00004*	0.098	0.000010	0.00447	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2171505-1	9/26/2018 15:20	*< 0.00004*	0.101	0.000010	0.00404	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2186829-1	10/24/2018 13:40	*< 0.00004*	0.093	*< 0.00001*	0.00391	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2200706-1	11/22/2018 10:45	*< 0.00004*	0.099	*< 0.00001*	0.00367	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2213526-1	12/20/2018 14:45	*< 0.00004*	0.104	*< 0.00001*	0.00348	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2222133-1	1/17/2019 11:45	*< 0.00004*	0.095	0.000010	0.00310	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2233140-1	2/14/2019 14:20	*< 0.00004*	0.099	*< 0.00001*	0.00272	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2244815-1	3/14/2019 14:30	*< 0.00004*	0.087	*< 0.00001*	0.00254	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
COL100	L2257455-1	4/11/2019 15:00	*< 0.00004*	0.097	*< 0.00001*	0.00260	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX B2: BOTTLE BLANK RESULTS

Appendix B2: Bottle Blank Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**NO2-N**	**NO3-N**	**D-S**	**SO4**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**	**D-Cu**	**D-Fe**	**D-K**	**D-Li**
Bottle-BL	L1955323-5	7/7/2017 13:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1961404-11	7/19/2017 10:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1966755-5	7/28/2017 12:25	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L1969885-5	8/3/2017 13:50	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	0.000028	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1973928-5	8/11/2017 13:40	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L1977047-11	8/17/2017 12:25	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1981592-5	8/25/2017 10:50	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L1984769-5	8/31/2017 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1988664-5	9/8/2017 14:50	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L1992088-11	9/14/2017 14:55	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L1996212-5	9/22/2017 14:20	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L2000226-7	9/29/2017 10:50	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.00075*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2003949-5	10/6/2017 11:25	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L2006427-11	10/12/2017 12:25	*< 0.001*	0.0062	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2009523-4	10/18/2017 14:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2014692-7	10/27/2017	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L2018104-2	11/3/2017 13:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	0.000024	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2021295-7	11/10/2017 13:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2023647-3	11/16/2017 15:30	*< 0.001*	*< 0.005*		*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*																
Bottle-BL	L2026623-11	11/23/2017 14:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00067	*< 0.00002*	*< 0.01*	0.000024	*< 0.00001*	*< 0.000005*	0.038	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2032658-6	12/7/2017 11:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2038563-11	12/21/2017 13:50	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	0.00051
Bottle-BL	L2041649-10	1/4/2018 13:05	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00006*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2044152-2	1/11/2018 10:40	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.03*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	0.0120	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2046871-11	1/18/2018 11:25	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2049910-2	1/26/2018 9:50	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2052061-12	2/1/2018 12:10	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2057381-11	2/15/2018 11:35	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2062788-11	3/1/2018 13:25	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2065563-2	3/8/2018 11:10	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2068449-11	3/15/2018 11:40	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2074311-12	3/29/2018 11:20	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2077059-5	4/5/2018 14:35	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00060	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2079620-11	4/12/2018 11:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	0.0000070	0.00061	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2082507-5	4/19/2018 13:40	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2085708-11	4/26/2018 13:40	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2092801-11	5/10/2018 11:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2096840-5	5/17/2018 11:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.001*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2100224-11	5/24/2018 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2108434-11	6/7/2018 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	0.00033	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2116986-12	6/21/2018 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00110	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2119305-8	6/26/2018 15:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00050	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2122741-8	7/3/2018 15:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00053	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	0.0015	*< 0.05*	*< 0.0005*
Bottle-BL	L2126886-8	7/10/2018 14:20	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	0.000026	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2132784-12	7/19/2018 14:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2136922-5	7/26/2018 11:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2140794-23	8/1/2018 19:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	0.0070	*< 0.05*	*< 0.0005*
Bottle-BL	L2144304-5	8/9/2018 8:05	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2148482-12	8/16/2018	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00072	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2156461-11	8/30/2018 14:20	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2160020-5	9/6/2018 9:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.00001*	*< 0.001*	*< 0.0001*	*< 0.01*	*< 0.0001*	*< 0.00002*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0001*	*< 0.0001*		*< 0.0002*	*< 0.01*	*< 0.1*	*< 0.001*
Bottle-BL	L2164110-12	9/13/2018 11:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*

Appendix B2: Bottle Blank Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**NO2-N**	**NO3-N**	**D-S**	**SO4**	**D-Br**	**D-Cl**	**D-F**	**D-Ag**	**D-Al**	**D-As**	**D-B**	**D-Ba**	**D-Be**	**D-Bi**	**D-Ca**	**D-Cd**	**D-Co**	**D-Cr**	**D-Cs**	**D-Cu**	**D-Fe**	**D-K**	**D-Li**
Bottle-BL	L2168278-5	9/20/2018 14:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.00001*	*< 0.001*	*< 0.0001*	*< 0.01*	*< 0.0001*	*< 0.00002*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0001*	*< 0.0001*		*< 0.0002*	*< 0.01*	*< 0.1*	*< 0.001*
Bottle-BL	L2172409-11	9/27/2018 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2178842-8	10/10/2018 10:25	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2187510-11	10/25/2018 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2191054-5	11/1/2018 12:20	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2194529-12	11/8/2018 13:40	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2200705-11	11/22/2018 10:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2203820-5	11/29/2018 13:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00263	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2207335-12	12/6/2018 13:05	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2210418-5	12/13/2018 14:26	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2213525-11	12/20/2018 14:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2215086-5	12/28/2018 11:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2217203-12	1/5/2019 11:35	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2222132-11	1/17/2019 11:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2224812-5	1/24/2019 15:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00061	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2227544-12	1/31/2019 10:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2230256-5	2/7/2019 14:05	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2233141-12	2/14/2019 14:20	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2235634-5	2/21/2019	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2238565-12	2/28/2019 15:15	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2241519-5	3/7/2019 10:50	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2244540-11	3/14/2019 14:30	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2247733-5	3/21/2019 14:05	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2250817-12	3/28/2019 15:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	0.00080	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2253941-5	4/4/2019 15:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2257457-11	4/11/2019 15:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2259905-6	4/17/2019 14:00	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*
Bottle-BL	L2263301-12	4/25/2019 14:45	*< 0.001*	*< 0.005*	*< 0.5*	*< 0.3*	*< 0.05*	*< 0.5*	*< 0.02*	*< 0.000005*	*< 0.0005*	*< 0.00002*	*< 0.01*	*< 0.00002*	*< 0.00001*	*< 0.000005*	*< 0.02*	*< 0.000005*	*< 0.000005*	*< 0.0001*	*< 0.00001*	*< 0.0001*	*< 0.001*	*< 0.05*	*< 0.0005*

Notes:
Results in blue italics are below the indicated detection limit

Appendix B2: Bottle Blank Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
Bottle-BL	L1955323-5	7/7/2017 13:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1961404-11	7/19/2017 10:30	*< 0.005*	*< 0.00005*	*< 0.00005*	0.011	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1966755-5	7/28/2017 12:25																						
Bottle-BL	L1969885-5	8/3/2017 13:50	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1973928-5	8/11/2017 13:40																						
Bottle-BL	L1977047-11	8/17/2017 12:25	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1981592-5	8/25/2017 10:50																						
Bottle-BL	L1984769-5	8/31/2017 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	0.0000060	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1988664-5	9/8/2017 14:50																						
Bottle-BL	L1992088-11	9/14/2017 14:55	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L1996212-5	9/22/2017 14:20																						
Bottle-BL	L2000226-7	9/29/2017 10:50	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	0.000013	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2003949-5	10/6/2017 11:25																						
Bottle-BL	L2006427-11	10/12/2017 12:25	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2009523-4	10/18/2017 14:15	*< 0.005*	*< 0.00005*	*< 0.00005*	0.017	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2014692-7	10/27/2017																						
Bottle-BL	L2018104-2	11/3/2017 13:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2021295-7	11/10/2017 13:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2023647-3	11/16/2017 15:30																						
Bottle-BL	L2026623-11	11/23/2017 14:15	*< 0.005*	0.000069	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	0.0000057	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	0.00017	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00056	*< 0.00006*
Bottle-BL	L2032658-6	12/7/2017 11:30	*< 0.005*	*< 0.00006*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2038563-11	12/21/2017 13:50	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.03*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2041649-10	1/4/2018 13:05	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.00003*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2044152-2	1/11/2018 10:40	*< 0.005*	*< 0.00005*	0.000097	*< 0.01*	0.000093	*< 0.05*	0.000646	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	0.00012	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.00910	*< 0.00006*
Bottle-BL	L2046871-11	1/18/2018 11:25	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2049910-2	1/26/2018 9:50	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2052061-12	2/1/2018 12:10	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2057381-11	2/15/2018 11:35	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2062788-11	3/1/2018 13:25	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2065563-2	3/8/2018 11:10	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2068449-11	3/15/2018 11:40	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	0.0000055	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.0005*	*< 0.00006*
Bottle-BL	L2074311-12	3/29/2018 11:20	*< 0.005*	*< 0.00005*	*< 0.00005*	0.015	*< 0.00005*	*< 0.05*	0.0000135	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2077059-5	4/5/2018 14:35	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	0.000051	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2079620-11	4/12/2018 11:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2082507-5	4/19/2018 13:40	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.03*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	0.0000021	0.000053	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2085708-11	4/26/2018 13:40	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2092801-11	5/10/2018 11:15	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2096840-5	5/17/2018 11:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2100224-11	5/24/2018 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2108434-11	6/7/2018 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	0.019	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2116986-12	6/21/2018 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2119305-8	6/26/2018 15:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2122741-8	7/3/2018 15:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2126886-8	7/10/2018 14:20	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	0.00012	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2132784-12	7/19/2018 14:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0011	*< 0.00006*
Bottle-BL	L2136922-5	7/26/2018 11:15	*< 0.005*	*< 0.00005*	*< 0.00005*	0.014	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2140794-23	8/1/2018 19:15	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2144304-5	8/9/2018 8:05	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2148482-12	8/16/2018	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2156461-11	8/30/2018 14:20	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2160020-5	9/6/2018 9:30	*< 0.1*	*< 0.0001*	*< 0.00005*	*< 0.05*	*< 0.0005*	*< 0.05*	*< 0.00005*		*< 0.0001*	*< 0.00005*	*< 0.05*	*< 0.0001*	*< 0.0002*			*< 0.0003*	*< 0.00001*	*< 0.00001*	*< 0.0005*		*< 0.001*	*< 0.0003*
Bottle-BL	L2164110-12	9/13/2018 11:45	*< 0.005*	*< 0.00005*	*< 0.00005*	0.795	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.134	*< 0.00006*

Appendix B2: Bottle Blank Results

			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Stn.Code	**Sample No.**	**Collect Date/Time**	**D-Mg**	**D-Mn**	**D-Mo**	**D-Na**	**D-Ni**	**D-P**	**D-Pb**	**D-Rb**	**D-Sb**	**D-Se**	**D-Si**	**D-Sn**	**D-Sr**	**D-Te**	**D-Th**	**D-Ti**	**D-Tl**	**D-U**	**D-V**	**D-W**	**D-Zn**	**D-Zr**
Bottle-BL	L2168278-5	9/20/2018 14:30	*< 0.1*	*< 0.0001*	*< 0.00005*	*< 0.05*	*< 0.0005*	*< 0.05*	*< 0.00005*		*< 0.0001*	*< 0.00005*	*< 0.05*	*< 0.0001*	*< 0.0002*			*< 0.0003*	*< 0.00001*	*< 0.00001*	*< 0.0005*		*< 0.001*	*< 0.0003*
Bottle-BL	L2172409-11	9/27/2018 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2178842-8	10/10/2018 10:25	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2187510-11	10/25/2018 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2191054-5	11/1/2018 12:20	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2194529-12	11/8/2018 13:40	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2200705-11	11/22/2018 10:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2203820-5	11/29/2018 13:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2207335-12	12/6/2018 13:05	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2210418-5	12/13/2018 14:26	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2213525-11	12/20/2018 14:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2215086-5	12/28/2018 11:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2217203-12	1/5/2019 11:35	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2222132-11	1/17/2019 11:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2224812-5	1/24/2019 15:00	*< 0.005*	*< 0.00005*	*< 0.00005*	0.019	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0043	*< 0.00006*
Bottle-BL	L2227544-12	1/31/2019 10:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	0.0000060	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0030	*< 0.00006*
Bottle-BL	L2230256-5	2/7/2019 14:05	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2233141-12	2/14/2019 14:20	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2235634-5	2/21/2019	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2238565-12	2/28/2019 15:15	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2241519-5	3/7/2019 10:50	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0011	*< 0.00006*
Bottle-BL	L2244540-11	3/14/2019 14:30	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2247733-5	3/21/2019 14:05	*< 0.005*	*< 0.00005*	*< 0.00005*	0.029	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	0.0036	*< 0.00006*
Bottle-BL	L2250817-12	3/28/2019 15:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2253941-5	4/4/2019 15:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2257457-11	4/11/2019 15:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2259905-6	4/17/2019 14:00	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	*< 0.0001*	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*
Bottle-BL	L2263301-12	4/25/2019 14:45	*< 0.005*	*< 0.00005*	*< 0.00005*	*< 0.01*	*< 0.00005*	*< 0.05*	*< 0.000005*	*< 0.0002*	*< 0.00002*	*< 0.00004*	*< 0.05*	*< 0.00001*	0.00011	*< 0.0002*	*< 0.0001*	*< 0.0003*	*< 0.000002*	*< 0.000002*	*< 0.00005*	*< 0.0001*	*< 0.001*	*< 0.00006*

Notes:
Results in blue italics are below the indicated detection limit

Appendix C: Solid Phase Analytical Data

GOLDCORP

APPENDIX C1: ABA RESULTS OF SATURATED COLUMN SOLID PHASE

Appendix C1: ABA Results of Saturated Column Solid Phase

Sample ID	Final Dry Wt (kg)	Paste pH	TIC %	CaCO3 NP	C(T) %	S(T) %	S(SO4) %	S(S-2) %	Insoluble S %	AP	Sobek NP	Net Sobek NP	Fizz Test
Method Code	Sobek	Sobek	CSB02V	Calc.	CSA06V	CSA06V	CSA07V	CSA08D	Calc.	Calc.	Sobek	Calc.	Sobek
LOD	0.20	0.20	0.01		0.005	0.005	0.01	0.01			0.5	Sobek	
Col 7	4.33	6.62	0.01	0.8	0.018	0.022	*< 0.01*	*< 0.01*	0.02	*< 0.3*	1.5	1.5	None
Col 8	4.36	5.49	*< 0.01*	*< 0.8*	0.027	0.154	0.01	0.11	0.03	3.4	1.0	-2.4	None
Col 13	9.97	7.40	*< 0.01*	*< 0.8*	0.014	0.017	*< 0.01*	0.01	*< 0.01*	0.3	3.4	3.1	None
Col 14	9.94	8.26	0.1	8.3	0.111	0.031	*< 0.01*	0.03	*< 0.01*	0.9	6.3	5.4	None

Duplicates													
Col 7		6.70			0.014	0.019					1.6		None
Col 8			*< 0.01*				0.01						
Col 13								0.01					

Sample ID	Rinse pH	Paste pH	TIC %	CaCO3 NP	C(T) %	S(T) %	S(SO4) %	S(S-2) %	Insoluble S %	AP	Siderite Corr. NP	Net Siderite Corr. NP	Sobek NP	Net Sobek NP	Fizz Test
Method Code	Sobek	Sobek	CSB02V	Calc.	CSA06V	CSA06V	CSA07V	CSA08D	Calc.	Calc.	Siderite Corr.	Calc.	Sobek	Calc.	Sobek
LOD	0.20	0.20	0.01		0.005	0.005	0.01	0.01			0.5	Sobek	0.5	Sobek	
FB-GS-res	8.12	7.86	0.58	48.3	0.569	0.177	0.02	0.16	*< 0.01*	5.0	55.2	50.2	52.0	47.0	Slight
FB-GT-res	8.30	7.88	0.42	35.0	0.419	0.084	0.01	0.07	*< 0.01*	2.2	38.5	36.3	36.2	34.0	Slight
FB-GO-res	8.39	8.01	0.24	20.0	0.237	0.012	*< 0.01*	0.01	*< 0.01*	0.3	27.1	26.8	23.6	23.3	Slight
FB-SS-res	8.27	8.15	2.14	178.3	2.18	0.414	0.02	0.35	0.04	10.9	212.3	201.4	200.6	189.7	Moderate
FB-ST-res	8.33	8.28	1.45	120.8	1.46	0.088	0.01	0.06	0.02	1.9	171.6	169.7	158.0	156.1	Moderate
FB-SO-res	8.09	8.04	0.9	75.0	0.921	0.035	0.01	0.02	*< 0.01*	0.6	78.3	77.7	76.2	75.6	Slight

Duplicates															
GS	8.22	8.28	0.66	55.0	0.672	0.21	*< 0.01*	0.18	0.03	5.6	51.7	56.9	46.1	51.3	Slight
GT	8.00	8.59	0.48	40.0	0.488	0.083	*< 0.01*	0.07	0.013	2.2	32.9	40.8	30.7	38.6	Slight
GO	8.46	8.43	0.23	19.2	0.258	0.016	*< 0.01*	0.01	0.006	0.3	22.7	26.5	22.4	26.2	Slight
SS	8.49	8.40	2.09	174.2	2.13	0.421	*< 0.01*	0.35	0.071	10.9	180.5	200.1	169.6	189.2	Moderate
ST	8.41	8.28	1.58	131.7	1.62	0.101	0.01	0.05	0.041	1.6	172.9	192.6	171.3	191.0	Moderate
SO	8.35	8.25	0.93	77.5	0.958	0.031	*< 0.01*	0.01	0.021	0.3	74.9	75.9	74.6	75.6	Slight

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX C2: AQUA REGIA METALS RESULTS OF SATURATED COLUMN SOLID PHASE

Appendix C2: Aqua Regia Metals Results of Saturated Column Solid Phase

Sample ID	Ag	Al	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	Ni	P	S	Sr	Ti
	ppm	%	ppm	%	ppm	ppm	%	%	ppm	%	ppm	%	ppm	%	%	ppm	%
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
LOD	0.01	0.01	5	0.01	1	0.5	0.01	0.01	1	0.01	2	0.01	0.5	0.005	0.01	0.5	0.01
Col 7	0.1	0.42	67	0.05	106	6.5	1.47	0.13	2	0.02	187	*< 0.01*	3.1	0.01	0.02	16.2	*< 0.01*
Col 8	0.07	0.35	46	0.03	116	4.1	1.38	0.14	2	0.01	201	*< 0.01*	2.6	0.01	0.16	16.9	*< 0.01*
Col 13	0.05	0.38	49	0.04	126	4	0.84	0.15	6	0.06	334	0.01	2.9	0.01	0.02	7.4	0.02
Col 14	*< 0.01*	0.37	60	0.09	122	4.2	1.09	0.19	8	0.11	679	0.02	2.4	0.02	0.04	3.7	0.03
FB-SO-res	0.21	0.47	358	2.46	79	31.1	2.66	0.15	1	0.4	535	0.01	29.9	0.05	0.04	65.5	*< 0.01*
FB-ST-res	0.04	1.15	350	5	137	15.9	2.1	0.69	14	1.01	572	0.04	40.4	0.04	0.09	689	0.1
FB-SS-res	0.13	1.19	357	5.86	107	18.6	2.5	0.77	12	1.39	666	0.04	54.3	0.06	0.43	202	0.08
FB-GO-res	0.15	0.48	92	0.7	84	10.5	1.27	0.17	1	0.19	278	0.01	9.1	0.03	0.02	21.7	*< 0.01*
FB-GT-res	0.04	0.53	202	0.91	77	8.7	1.22	0.18	1	0.33	278	0.02	5.6	0.02	0.08	38.4	0.01
FB-GS-res	0.08	1.02	135	1.54	89	8.4	1.85	0.49	6	0.69	350	0.03	13.9	0.04	0.18	60.2	0.05

Duplicates

Sample ID	Ag	Al	Ba	Ca	Cr	Cu	Fe	K	Li	Mg	Mn	Na	Ni	P	S	Sr	Ti
	ppm	%	ppm	%	ppm	ppm	%	%	ppm	%	ppm	%	ppm	%	%	ppm	%
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
Col 13	0.03	0.38	49	0.04	123	5.8	0.84	0.16	6	0.06	338	0.01	2.6	0.01	0.02	7.4	0.02
SO	0.17	0.49	336	2.33	125	24.1	2.89	0.16	2	0.48	530	0.01	27.4	0.048	0.01	56.9	*< 0.01*
ST	0.05	1.52	542	4.86	190	16.1	2.57	0.83	13	1.21	589	0.04	49.6	0.048	0.09	778	0.11
SS	0.11	1.37	327	5.03	145	18	2.87	0.68	10	1.44	660	0.03	53.9	0.063	0.43	243	0.06
GO	0.17	0.58	106	0.68	142	9.8	1.5	0.21	2	0.21	339	0.02	9.7	0.03	0.01	25	*< 0.01*
GT	0.03	0.47	162	0.96	122	5.9	1.18	0.19	2	0.35	280	0.02	5.7	0.022	0.07	38.1	*< 0.01*
GS	0.03	0.92	120	1.57	112	6.7	1.81	0.41	5	0.6	373	0.02	12.8	0.034	0.2	55.3	0.03

Notes:
Results in blue italics are below the indicated detection limit

Appendix C2: Aqua Regia Metals Results of Saturated Column Solid Phase

Sample ID	V	Zn	Zr	As	Be	Bi	Cd	Ce	Co	Cs	Ga	Ge	Hf	Hg	In	La	Lu
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
LOD	1	1	0.5	1	0.1	0.02	0.01	0.05	0.1	0.05	0.1	0.1	0.05	0.01	0.02	0.1	0.01
Col 7	9	44	10.1	3240	0.6	0.1	0.25	26.2	1.7	1.29	1.6	*< 0.1*	0.31	0.82	0.02	14	0.15
Col 8	9	15	9.3	6310	0.3	0.12	0.03	24.5	1.6	1.13	1.4	*< 0.1*	0.26	4.67	0.03	13	0.11
Col 13	5	31	8.7	265	0.4	0.22	0.08	45.6	1.5	2.73	2	*< 0.1*	0.37	0.15	*< 0.02*	24.7	0.21
Col 14	7	31	8.9	53	0.3	0.11	0.04	47.2	1.7	2.91	2.4	*< 0.1*	0.38	0.07	*< 0.02*	25.5	0.22
FB-SO-res	33	45	5.3	348	0.8	0.49	0.14	58.5	11.7	1.13	1.8	*< 0.1*	0.14	0.45	0.03	29.4	0.24
FB-ST-res	38	39	6.4	42	0.7	0.18	0.05	38.4	11	3.6	4.9	*< 0.1*	0.26	0.08	*< 0.02*	20.7	0.19
FB-SS-res	43	54	3.9	23	0.8	0.4	0.08	58.9	12.4	3.32	5.7	*< 0.1*	0.09	0.12	0.03	29.7	0.21
FB-GO-res	14	19	11	168	0.8	0.35	0.03	57.6	4.5	1.19	1.8	*< 0.1*	0.31	0.15	*< 0.02*	33.3	0.2
FB-GT-res	9	19	9.7	167	0.7	0.23	0.03	73.2	3.7	1.27	1.9	*< 0.1*	0.33	0.23	*< 0.02*	41.7	0.2
FB-GS-res	24	21	6.8	59	0.9	0.48	0.01	61.1	7.8	2.42	4	*< 0.1*	0.22	0.08	0.02	33.7	0.22

Duplicates

Sample ID	V	Zn	Zr	As	Be	Bi	Cd	Ce	Co	Cs	Ga	Ge	Hf	Hg	In	La	Lu
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
Col 13	6	26	8.4	257	0.4	0.2	0.07	45.6	1.5	2.88	2	*< 0.1*	0.34	0.14	*< 0.02*	24.8	0.2
SO	32	41	4.5	369	0.8	0.48	0.14	55.6	12.6	1.21	1.9	*< 0.1*	0.14	0.44	0.03	27.3	0.24
ST	42	43	4.8	67	0.7	0.25	0.07	38.7	15.1	3.7	5.8	*< 0.1*	0.17	0.03	0.02	22.7	0.19
SS	43	58	3	30	0.9	0.45	0.1	57.5	14.2	3.62	5.9	*< 0.1*	0.08	0.12	0.04	28	0.23
GO	17	21	11.2	218	0.8	0.35	0.07	62.7	6.2	1.57	2.3	*< 0.1*	0.32	0.15	*< 0.02*	33.3	0.23
GT	9	16	8.9	182	0.7	0.2	0.05	58.8	4.1	1.21	1.9	*< 0.1*	0.28	0.24	*< 0.02*	32.1	0.19
GS	18	19	6.7	86	0.7	0.47	0.03	65.4	8	2.07	3.6	*< 0.1*	0.22	0.07	*< 0.02*	33.4	0.22

Notes:
Results in blue italics are below the indicated detection limit

Appendix C2: Aqua Regia Metals Results of Saturated Column Solid Phase

Sample ID	Mo	Nb	Pb	Rb	Sb	Sc	Se	Sn	Ta	Tb	Te	Th	Tl	U	W	Y	Yb
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
LOD	0.05	0.05	0.2	0.2	0.05	0.1	1	0.3	0.05	0.02	0.05	0.1	0.02	0.05	0.1	0.05	0.1
Col 7	3.41	0.27	36.5	12	38.7	2.6	*< 1*	0.4	*< 0.05*	0.25	*< 0.05*	20.6	0.66	11	0.3	7.55	0.9
Col 8	3.75	0.25	17	10.3	162	2.5	*< 1*	0.3	*< 0.05*	0.2	0.05	18.2	1.53	9	0.1	6.14	0.7
Col 13	3.3	0.99	19.3	18.5	1.75	1.4	*< 1*	0.6	*< 0.05*	0.39	*< 0.05*	29.2	0.21	7.12	*< 0.1*	12.2	1.4
Col 14	3.29	1.63	10.2	26.6	0.57	1.8	*< 1*	0.8	*< 0.05*	0.41	*< 0.05*	29.3	0.3	5.96	*< 0.1*	12.9	1.5
FB-SO-res	1.8	*< 0.05*	19.7	7.8	37.6	6.4	*< 1*	0.6	*< 0.05*	0.62	*< 0.05*	13.2	0.4	2.78	0.3	15.3	1.6
FB-ST-res	2.76	0.82	7.8	48	1.73	5.2	*< 1*	1.3	*< 0.05*	0.4	*< 0.05*	17.3	0.43	3.21	0.7	11.7	1.3
FB-SS-res	2.43	0.38	13.2	46.8	2.25	5.9	*< 1*	1.3	*< 0.05*	0.58	*< 0.05*	13.2	0.33	3.07	2.4	15.9	1.5
FB-GO-res	2.1	0.07	9.7	14.1	8.7	2.4	*< 1*	0.8	*< 0.05*	0.42	0.13	32	0.24	5.15	1	11.9	1.3
FB-GT-res	3.26	0.15	7.7	16.5	7.52	1.9	*< 1*	0.9	*< 0.05*	0.44	*< 0.05*	33.6	0.26	7.14	0.2	12.1	1.3
FB-GS-res	2.85	0.33	5.2	34.8	1.88	4.3	*< 1*	1.1	*< 0.05*	0.53	0.07	23.3	0.3	5.63	0.2	14.6	1.4

Duplicates

Sample ID	Mo	Nb	Pb	Rb	Sb	Sc	Se	Sn	Ta	Tb	Te	Th	Tl	U	W	Y	Yb
	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
Method Code	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B	ICM14B
Col 13	3.64	1.02	20.1	19	1.7	1.5	*< 1*	0.6	*< 0.05*	0.38	*< 0.05*	29.1	0.22	6.99	*< 0.1*	11.6	1.3
SO	3.84	*< 0.05*	17	8.4	32.6	7	*< 1*	0.4	*< 0.05*	0.63	0.06	11.8	0.44	2.55	0.4	15	1.6
ST	5.49	0.73	9.3	52.2	1.86	5.7	*< 1*	1.1	*< 0.05*	0.41	0.07	15.1	0.48	2.71	1.4	11.9	1.3
SS	3.25	0.29	15	43.1	2.59	6.8	*< 1*	1.1	*< 0.05*	0.61	*< 0.05*	12.3	0.37	3.24	0.6	16.2	1.6
GO	4.98	0.1	10.8	18	12.1	3	*< 1*	0.6	*< 0.05*	0.49	0.1	35.2	0.32	5.53	1.3	13	1.5
GT	4.89	0.11	7.4	15.7	6.89	2	*< 1*	0.6	*< 0.05*	0.41	*< 0.05*	30.6	0.26	6.32	0.2	11	1.3
GS	4.49	0.27	6	29.9	2.58	3.7	*< 1*	0.7	*< 0.05*	0.55	0.13	21.5	0.27	6.05	0.2	14.3	1.5

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX C3: SFE RESULTS OF SATURATED COLUMN SOLID PHASE

Appendix C3: SFE Results of Saturated Column Solid Phase

Sample ID			Col 7	Col 8	Col 13	Col 14	FB-SO-res	FB-ST-res	FB-SS-res	FB-GO-res	FB-GT-res	FB-GS-res
Parameter	**Method**	**Units**										
Volume Nanopure Water		mL	750	750	750	750	750	750	750	750	750	750
Sample Weight		g	250	250	250	250	250	250	250	250	250	250
pH	meter		7.53	4.80	7.14	7.22	8.00	8.13	8.14	8.20	7.98	8.21
Redox	meter	mV	509	595	509	518	338	341	341	341	357	344
Conductivity	meter	uS/cm	11	25	25	39	126	165	258	110	211	111
Acidity (to pH 4.5)	titration	mg CaCO3/L	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
Total Acidity (to pH 8.3)	titration	mg CaCO3/L	4.5	8.3	4.5	4.0	3.1	2.8	3.0	2.7	3.6	2.6
Alkalinity	titration	mg CaCO3/L	6.6	0.1	6.4	15.1	46.3	41.4	47.4	40.3	34.1	39.8
Sulphate	Turbidity	mg/L	5	5	6	6	13	39	79	13	64	145
Ion Balance												
Major Anions	Calc	meq/L	0.24	0.11	0.25	0.43	1.20	1.64	2.59	1.08	2.02	3.82
Major Cations	Calc	meq/L	0.17	0.21	0.21	0.39	1.30	1.86	2.85	1.05	1.98	3.67
Difference	Calc	meq/L	0.07	-0.11	0.04	0.03	-0.10	-0.21	-0.26	0.03	0.04	0.14
Balance (%)	Calc	%	17.4%	-33.6%	8.1%	4.1%	-4.0%	-6.1%	-4.7%	1.3%	1.0%	1.9%
Dissolved Metals												
Hardness CaCO3		mg/L	2.5	3.2	1.8	11.1	50.3	73.2	120	34.8	85.0	160
Aluminum Al	ICP-MS	mg/L	0.005	*< 0.001*	0.003	*< 0.001*	0.025	0.056	0.033	0.068	0.051	0.030
Antimony Sb	ICP-MS	mg/L	0.0203	0.0175	0.0040	0.0020	0.0070	0.0009	0.0096	0.0026	0.0039	0.0059
Arsenic As	ICP-MS	mg/L	0.469	2.47	0.135	0.0369	0.0247	0.0098	0.0071	0.0647	0.0609	0.0229
Barium Ba	ICP-MS	mg/L	0.00147	0.00028	0.00121	0.00439	0.0604	0.0409	0.0406	0.0206	0.0414	0.0172
Beryllium Be	ICP-MS	mg/L	0.000019	0.000113	0.000016	0.000018	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*
Bismuth Bi	ICP-MS	mg/L	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*	*< 0.000007*
Boron B	ICP-MS	mg/L	0.025	0.016	0.031	0.031	0.020	0.011	0.009	0.015	0.020	0.009
Cadmium Cd	ICP-MS	mg/L	0.000003	0.000017	0.000004	0.000004	*< 0.000003*	0.000006	0.000009	0.000013	0.000038	0.000013
Calcium Ca	ICP-MS	mg/L	0.64	0.88	0.49	3.40	13.7	20.0	27.4	9.63	22.6	38.8
Chromium Cr	ICP-MS	mg/L	0.00008	0.00009	*< 0.00003*	0.00011	0.00083	0.00021	0.00006	0.00035	0.00006	*< 0.00003*
Cobalt Co	ICP-MS	mg/L	0.000065	0.00384	0.000176	0.000179	0.000018	0.000021	0.000017	0.000025	0.000014	0.000014
Copper Cu	ICP-MS	mg/L	0.00086	0.00294	0.00041	0.00037	0.00080	0.00098	0.00066	0.00129	0.00092	0.00096
Iron Fe	ICP-MS	mg/L	0.120	0.112	0.083	0.129	0.009	0.022	*< 0.007*	0.027	*< 0.007*	*< 0.007*
Lead Pb	ICP-MS	mg/L	0.00028	0.00008	0.00178	0.00048	0.00001	0.00005	0.00002	0.00006	0.00046	0.00016
Lithium Li	ICP-MS	mg/L	0.0004	0.0004	0.0019	0.0018	0.0017	0.0028	0.0030	0.0011	0.0012	0.0022
Magnesium Mg	ICP-MS	mg/L	0.210	0.238	0.150	0.630	3.94	5.67	12.6	2.61	6.97	15.4
Manganese Mn	ICP-MS	mg/L	0.670	0.105	0.0284	0.0754	0.00021	0.00158	0.00433	0.00110	0.00203	0.00522
Mercury Hg	ICP-MS	ug/L	0.04	0.02	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*	*< 0.01*
Molybdenum Mo	ICP-MS	mg/L	0.00035	0.00004	0.00156	0.00063	0.00340	0.00556	0.00221	0.0109	0.0111	0.00941
Nickel Ni	ICP-MS	mg/L	*< 0.0001*	0.0012	*< 0.0001*	*< 0.0001*	*< 0.0001*	0.0002	0.0004	0.0002	*< 0.0001*	0.0002
Phosphorus P	ICP-MS	mg/L	0.018	0.014	0.015	*< 0.003*	*< 0.003*	*< 0.003*	*< 0.003*	0.034	0.010	*< 0.003*
Potassium K	ICP-MS	mg/L	1.11	0.984	3.35	3.04	3.08	6.32	9.46	3.62	5.38	7.27
Selenium Se	ICP-MS	mg/L	0.00004	0.00009	0.00008	0.00007	0.00008	0.00022	0.00009	0.00008	0.00014	0.00013
Silicon Si	ICP-MS	mg/L	2.14	0.78	5.09	4.86	2.44	2.36	0.86	3.34	2.35	1.78
Silver Ag	ICP-MS	mg/L	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*	*< 0.00005*
Sodium Na	ICP-MS	mg/L	0.71	0.32	1.66	1.72	4.83	4.52	4.01	6.00	3.07	6.33
Strontium Sr	ICP-MS	mg/L	0.00448	0.00415	0.00240	0.00964	0.0852	1.43	1.33	0.0483	0.111	0.245
Sulphur (S)	ICP-MS	mg/L	0.4	2.0	1.5	1.0	4.6	12.1	24.1	4.1	21.1	46.7
Thallium Tl	ICP-MS	mg/L	0.000039	0.000211	0.000034	0.000045	0.000036	*< 0.000005*	0.000027	0.000020	0.000151	0.000031
Tin Sn	ICP-MS	mg/L	0.00007	0.00005	0.00007	0.00010	*< 0.00001*	0.00002	0.00002	0.00003	0.00010	*< 0.00001*
Titanium Ti	ICP-MS	mg/L	0.00576	0.00014	0.00285	0.00440	0.00011	0.00095	0.00011	0.00059	0.00017	0.00010
Uranium U	ICP-MS	mg/L	0.000292	0.000766	0.000310	0.001519	0.000894	0.00338	0.00584	0.0124	0.0266	0.0267
Vanadium V	ICP-MS	mg/L	0.00038	0.00014	0.00027	0.00066	0.00019	0.00131	0.00034	0.00052	0.00025	0.00059
Zinc Zn	ICP-MS	mg/L	*< 0.002*	0.012	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	0.005	*< 0.002*
Zirconium Zr	ICP-MS	mg/L	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*	*< 0.002*

Notes:
Results in blue italics are below the indicated detection limit

APPENDIX C4: QEMSCAN RESULTS OF SATURATED COLUMN SOLID PHASE

QEMSCAN DATA

prepared for:

Lorax Enviromental Services

16607-101
MI7007-MAR18
May 27, 2019

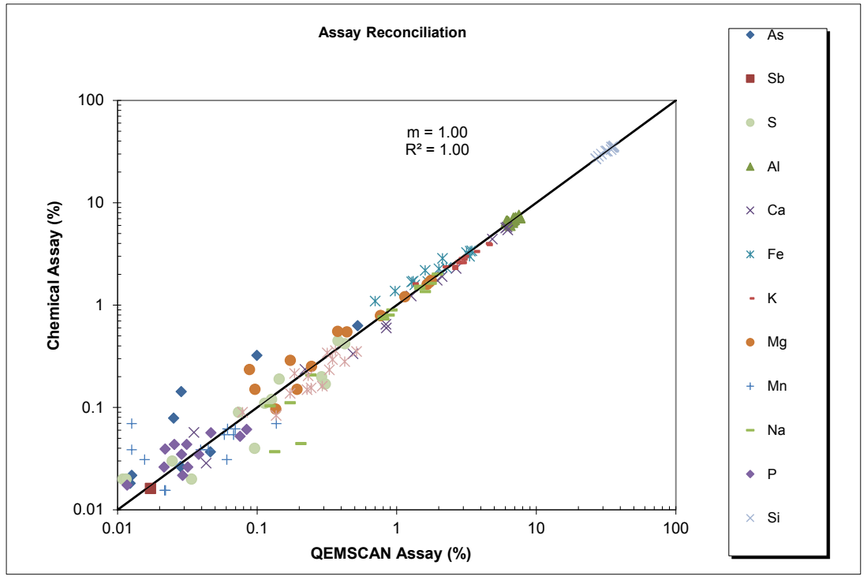
Prepared by:

Lain Glossop/Sarah Prout
Senior Mineralogist/Senior Mineralogist

SGS Canada
3260 Production Way
Burnaby, BC
Canada, V5A 4W4

Lorax Enviromental Services
16607-101
MI7007-MAR18

Elemental Mass (%)



Elemental Mass (%) Absolute

	Client Assays		Client Assays											
	Arsenic		**Antimony**		**Sulphur**		**Aluminum**		**Calcium**		**Iron**		**Potassium**	
Mineral Name	As (QEMSCAN)	As (Chemical)	Sb (QEMSCAN)	Sb (Chemical)	S (QEMSCAN)	S (Chemical)	Al (QEMSCAN)	Al (Chemical)	Ca (QEMSCAN)	Ca (Chemical)	Fe (QEMSCAN)	Fe (Chemical)	K (QEMSCAN)	K (Chemical)
GT	0.01	0.02	0.00	0.00	0.11	0.11	6.81	6.72	1.27	1.23	1.28	1.69	3.01	3.01
SO	0.05	0.04	0.00	0.00	0.02	0.03	6.32	6.51	2.66	2.29	3.16	3.27	1.31	1.62
SS	0.02	0.00	0.00	0.00	0.42	0.42	6.28	6.35	6.04	5.69	3.36	3.38	2.70	2.60
ST	0.01	0.01	0.00	0.00	0.07	0.09	6.18	6.67	6.16	5.79	3.32	3.01	2.90	2.61
GS-2	0.02	0.01	0.00	0.00	0.29	0.20	7.64	7.15	2.11	1.91	2.26	2.33	2.93	2.81
GO-3	0.01	0.02	0.00	0.00	0.00	0.03	6.94	6.88	0.84	0.65	1.31	1.72	3.60	3.35
Column 7 Res	0.10	0.32	0.00	0.00	0.01	0.02	7.49	7.57	0.04	0.06	1.34	1.58	2.52	2.40
Column 8 Res	0.52	0.63	0.02	0.02	0.13	0.12	6.75	6.46	0.04	0.03	1.67	1.71	2.51	2.28
Column 13 Res	0.03	0.03	0.00	0.00	0.10	0.04	7.08	7.20	0.84	0.60	0.97	1.38	4.45	3.91
Column 14 Res	0.02	0.01	0.00	0.00	0.03	0.02	6.84	7.09	0.49	0.34	0.70	1.10	4.38	4.01
FB-GS- Res	0.02	0.00	0.00	0.00	0.14	0.19	7.59	7.30	1.95	1.75	2.01	2.27	2.64	2.66
FB-SS- Res	0.02	0.00	0.00	0.00	0.38	0.45	6.08	6.62	6.23	5.43	3.45	3.40	2.84	2.62
72135B (SO-ORE)	0.03	0.14	0.00	0.00	0.31	0.17	6.48	6.03	4.83	4.42	2.13	2.87	2.15	2.37
72144B (GO-ORE)	0.03	0.08	0.00	0.00	0.01	0.02	7.54	7.15	0.22	0.24	1.60	2.19	2.81	2.86

	Magnesium		**Manganese**		**Sodium**		**Phosphorus**		**Silicon**		**Titanium**	
Mineral Name	Mg (QEMSCAN)	Mg (Chemical)	Mn (QEMSCAN)	Mn (Chemical)	Na (QEMSCAN)	Na (Chemical)	P (QEMSCAN)	P (Chemical)	Si (QEMSCAN)	Si (Chemical)	Ti (QEMSCAN)	Ti (Chemical)
GT	0.44	0.55	0.06	0.03	0.80	0.77	0.02	0.03	34.3	33.1	0.17	0.14
SO	0.38	0.55	0.07	0.05	0.21	0.04	0.05	0.06	32.3	32.0	0.52	0.35
SS	1.77	1.76	0.07	0.06	0.88	0.80	0.08	0.05	26.7	27.0	0.32	0.34
ST	1.65	1.60	0.01	0.07	1.46	1.53	0.03	0.04	27.8	28.5	0.35	0.29
GS-2	0.77	0.79	0.04	0.04	1.60	1.36	0.04	0.03	31.4	32.0	0.23	0.20
GO-3	0.25	0.25	0.02	0.02	0.81	0.73	0.03	0.03	34.7	35.0	0.23	0.15
Column 7 Res	0.10	0.15	0.02	0.02	0.17	0.11	0.00	0.02	35.7	35.1	0.24	0.16
Column 8 Res	0.09	0.24	0.03	0.01	0.12	0.10	0.00	0.02	36.0	36.0	0.29	0.16
Column 13 Res	0.19	0.15	0.14	0.07	1.95	2.01	0.03	0.02	34.7	34.9	0.08	0.09
Column 14 Res	0.14	0.10	0.02	0.03	1.46	1.46	0.01	0.02	35.7	35.3	0.14	0.08
FB-GS- Res	0.76	0.79	0.04	0.04	1.76	1.64	0.03	0.03	32.0	32.1	0.19	0.22
FB-SS- Res	1.73	1.69	0.06	0.06	0.92	0.90	0.08	0.06	26.6	26.9	0.36	0.36
72135B (SO-ORE)	1.14	1.21	0.06	0.05	0.13	0.04	0.03	0.04	29.3	30.0	0.42	0.28
72144B (GO-ORE)	0.17	0.29	0.01	0.04	0.24	0.21	0.02	0.04	35.1	34.8	0.33	0.23

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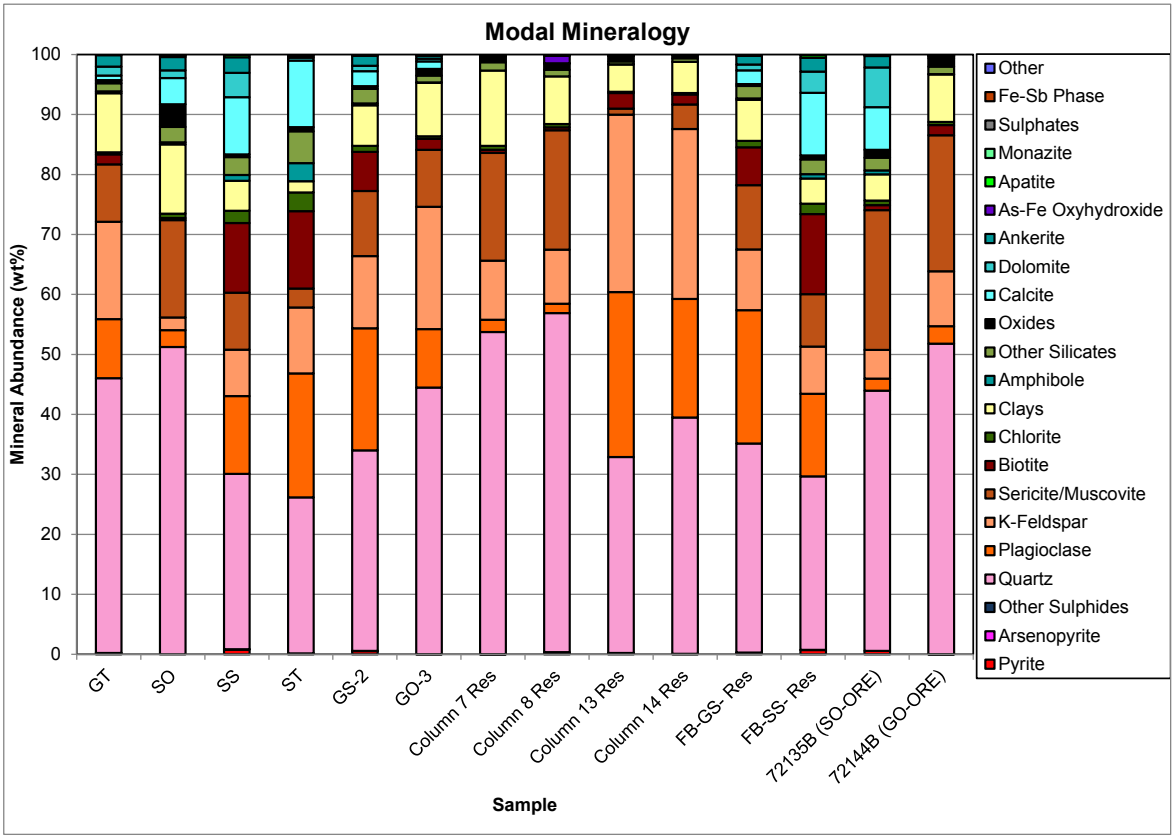
Mineral Mass %	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	0.22	0.00	0.80	0.14	0.55	0.01	0.01	0.18	0.17	0.05	0.25	0.72	0.57	0.01
Arsenopyrite	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.18	0.04	0.02	0.03	0.00	0.00	0.02
Other Sulphides	0.00	0.00	0.03	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.00
Quartz	45.8	51.2	29.2	26.0	33.4	44.5	53.7	56.5	32.7	39.4	34.9	28.9	43.4	51.8
Plagioclase	9.84	2.79	13.0	20.7	20.4	9.75	2.04	1.54	27.5	19.8	22.2	13.8	2.00	2.89
K-Feldspar	16.2	2.15	7.71	11.0	12.0	20.4	9.86	9.04	29.6	28.4	10.1	7.88	4.78	9.16
Sericite/Muscovite	9.59	16.2	9.53	3.18	10.9	9.52	17.9	19.9	1.02	4.06	10.7	8.73	23.3	22.7
Biotite	1.67	0.33	11.6	12.9	6.51	1.81	0.55	0.49	2.60	1.68	6.30	13.4	0.85	1.69
Chlorite	0.33	0.74	2.05	3.10	1.01	0.43	0.65	0.56	0.20	0.25	1.09	1.75	0.77	0.51
Clays	9.86	11.5	5.01	1.90	6.77	8.94	12.6	7.92	4.58	5.20	6.81	4.17	4.36	7.97
Amphibole	0.30	0.37	0.97	3.02	0.29	0.04	0.00	0.00	0.01	0.00	0.25	0.73	0.64	0.01
Other Silicates	1.36	2.57	2.97	5.30	2.42	1.15	1.39	1.12	0.50	0.60	2.07	2.48	2.14	1.24
Oxides	0.52	3.78	0.46	0.68	0.45	1.11	0.99	1.04	0.88	0.49	0.34	0.65	1.32	1.43
Calcite	0.75	4.36	9.53	11.1	2.51	1.23	0.01	0.01	0.03	0.02	2.28	10.5	7.11	0.31
Dolomite	1.49	1.29	4.05	0.51	0.91	0.45	0.00	0.00	0.00	0.00	0.97	3.54	6.61	0.09
Ankerite	1.91	2.20	2.62	0.31	1.67	0.51	0.00	0.02	0.06	0.00	1.45	2.29	1.91	0.06
As-Fe Oxyhydroxide	0.00	0.00	0.00	0.00	0.00	0.00	0.24	1.30	0.00	0.01	0.00	0.00	0.00	0.00
Apatite	0.11	0.25	0.41	0.17	0.20	0.15	0.00	0.01	0.16	0.05	0.15	0.45	0.13	0.09
Monazite	0.00	0.01	0.00	0.00	0.01	0.04	0.02	0.01	0.00	0.02	0.01	0.00	0.01	0.04
Sulphates	0.01	0.15	0.06	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.05	0.07	0.08	0.01
Fe-Sb Phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.03	0.00	0.02	0.00	0.01	0.01	0.02
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**



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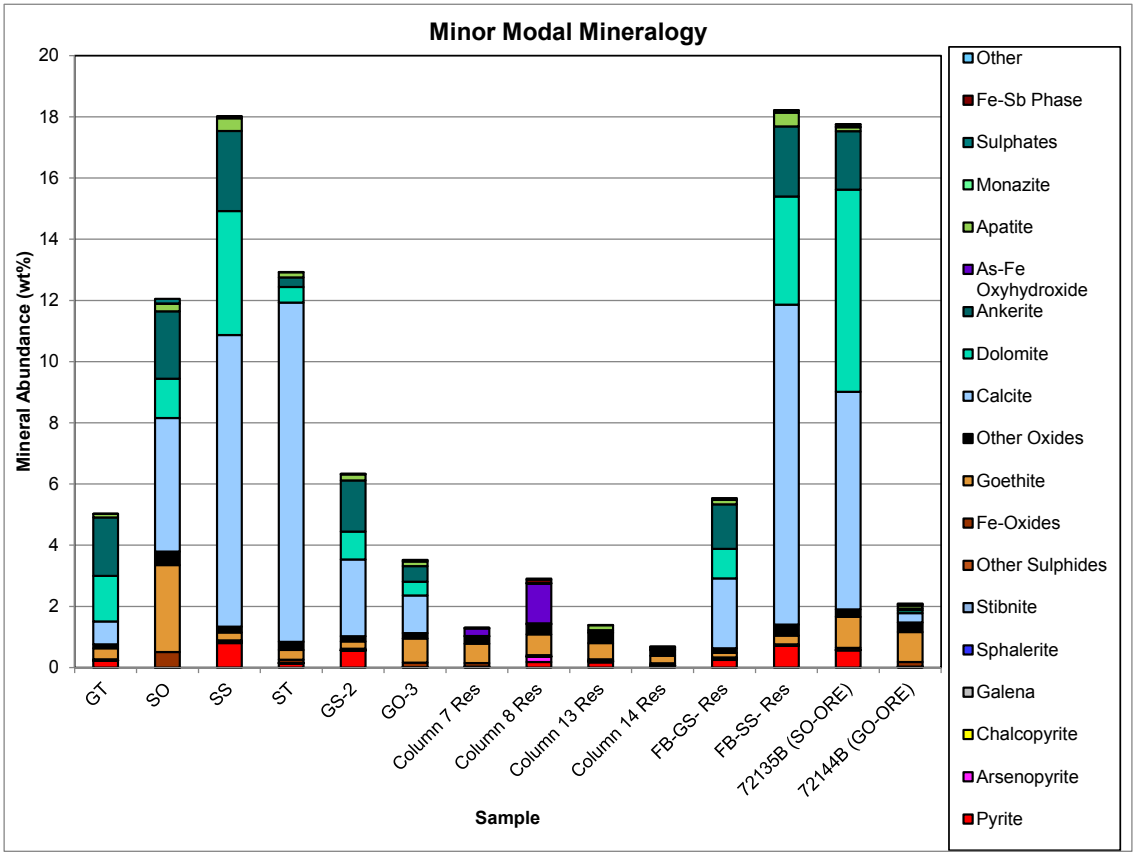
Mineral Mass %	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	0.22	0.00	0.80	0.14	0.55	0.01	0.01	0.18	0.17	0.05	0.25	0.72	0.57	0.01
Arsenopyrite	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.18	0.04	0.02	0.03	0.00	0.00	0.02
Chalcopyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Galena	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sphalerite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Stibnite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Sulphides	0.00	0.00	0.03	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.00
Quartz/Feldspar	71.9	56.2	49.9	57.7	65.8	74.6	65.6	67.1	89.7	87.5	67.2	50.6	50.2	63.8
Mica	11.3	16.6	21.1	16.1	17.4	11.3	18.5	20.4	3.62	5.74	17.0	22.1	24.2	24.4
Chlorite	0.33	0.74	2.05	3.10	1.01	0.43	0.65	0.56	0.20	0.25	1.09	1.75	0.77	0.51
Clays	9.86	11.5	5.01	1.90	6.77	8.94	12.6	7.92	4.58	5.20	6.81	4.17	4.36	7.97
Amphibole	0.30	0.37	0.97	3.02	0.29	0.04	0.00	0.00	0.01	0.00	0.25	0.73	0.64	0.01
Other Silicates	1.36	2.57	2.97	5.30	2.42	1.15	1.39	1.12	0.50	0.60	2.07	2.48	2.14	1.24
Fe-Oxides	0.04	0.51	0.02	0.10	0.04	0.15	0.12	0.04	0.05	0.07	0.04	0.02	0.07	0.15
Goethite	0.36	2.84	0.26	0.32	0.24	0.79	0.63	0.68	0.53	0.24	0.15	0.28	1.01	0.98
Other Oxides	0.13	0.44	0.19	0.27	0.17	0.18	0.24	0.33	0.33	0.18	0.15	0.36	0.24	0.31
Calcite	0.75	4.36	9.53	11.1	2.51	1.23	0.01	0.01	0.03	0.02	2.28	10.5	7.11	0.31
Dolomite	1.49	1.29	4.05	0.51	0.91	0.45	0.00	0.00	0.00	0.00	0.97	3.54	6.61	0.09
Ankerite	1.91	2.20	2.62	0.31	1.67	0.51	0.00	0.02	0.06	0.00	1.45	2.29	1.91	0.06
As-Fe Oxyhydroxide	0.00	0.00	0.00	0.00	0.00	0.00	0.24	1.30	0.00	0.01	0.00	0.00	0.00	0.00
Apatite	0.11	0.25	0.41	0.17	0.20	0.15	0.00	0.01	0.16	0.05	0.15	0.45	0.13	0.09
Monazite	0.00	0.01	0.00	0.00	0.01	0.04	0.02	0.01	0.00	0.02	0.01	0.00	0.01	0.04
Sulphates	0.01	0.15	0.06	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.05	0.07	0.08	0.01
Fe-Sb Phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.03	0.00	0.02	0.00	0.01	0.01	0.02
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**



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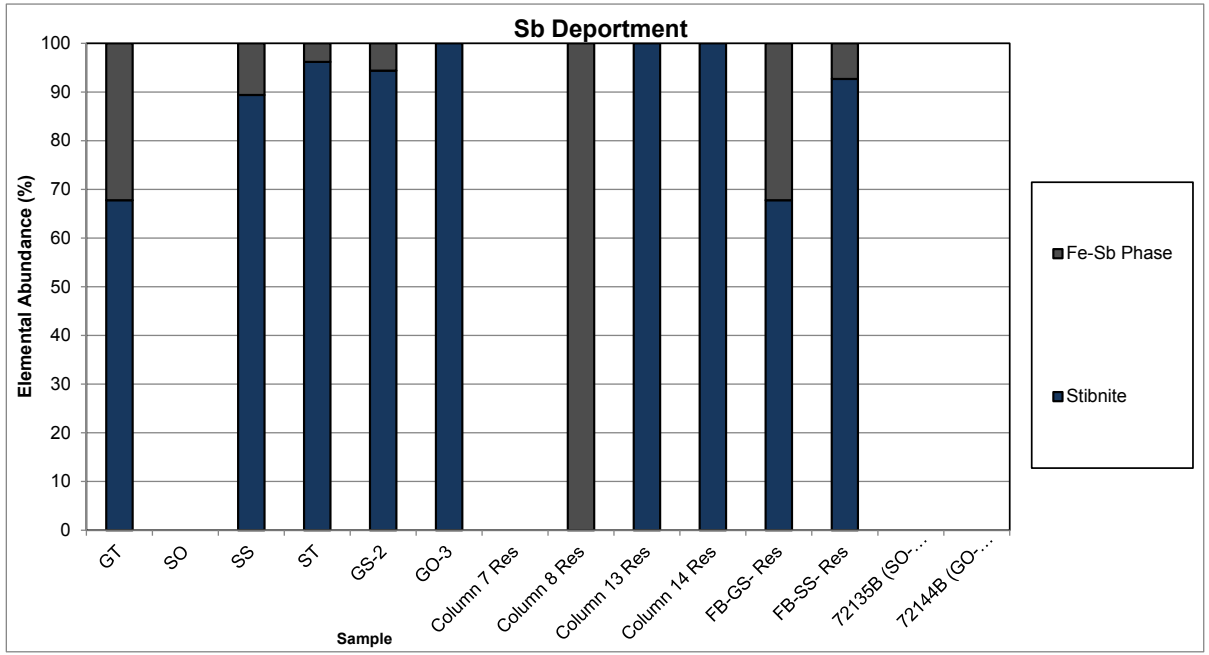
Sb Deportment

Absolute

Mineral Mass	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Stibnite	0.00033	0.00000	0.00244	0.00241	0.00157	0.00039	0.00000	0.00000	0.00089	0.00020	0.00127	0.00143	0.00000	0.00000
Fe-Sb Phase	0.00016	0.00000	0.00029	0.00010	0.00009	0.00000	0.00000	0.01718	0.00000	0.00000	0.00061	0.00011	0.00000	0.00000
Total	0.00048	0.00000	0.00273	0.00250	0.00166	0.00039	0.00000	0.01718	0.00089	0.00020	0.00188	0.00155	0.00000	0.00000

Normalized

Mineral Mass	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Stibnite	67.8	0.00	89.4	96.2	94.4	100.0	0.00	0.00	100.0	100.0	67.8	92.7	0.00	0.00
Fe-Sb Phase	32.2	0.00	10.6	3.81	5.61	0.00	0.00	100.0	0.00	0.00	32.2	7.34	0.00	0.00
Total	100	0	100	100	100	100	0	100	100	100	100	100	0	0



Lorax Enviromental Services
16607-101
MI7007-MAR18

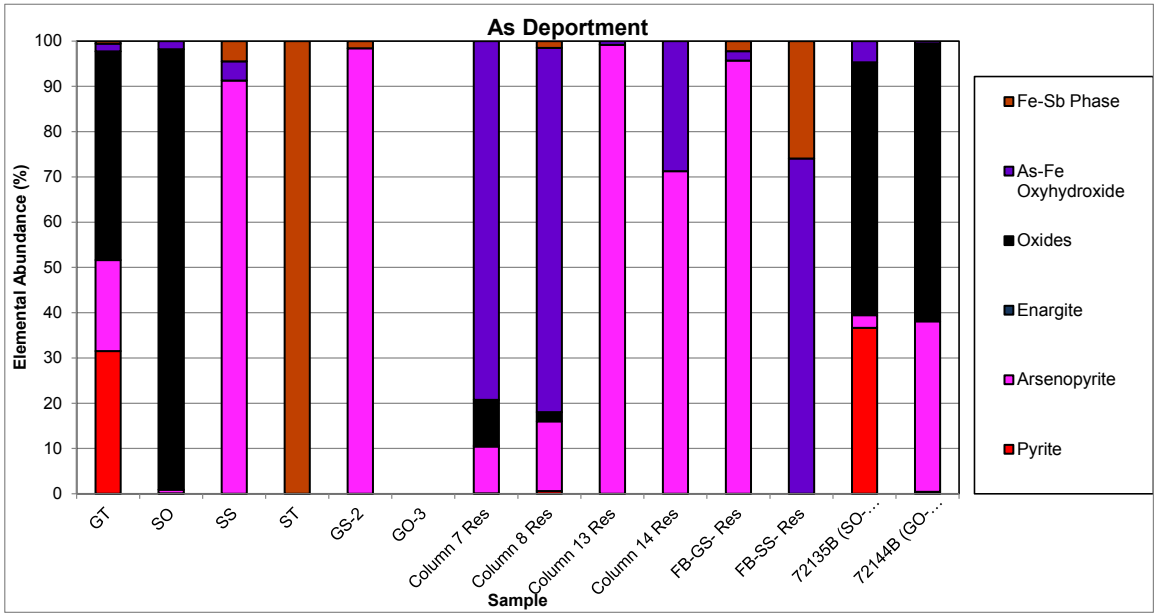
As Deportment

Absolute

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	0.00389	0.00004	0.00000	0.00000	0.00000	0.00008	0.00010	0.00307	0.00000	0.00000	0.00000	0.00000	0.01046	0.00010
Arsenopyrite	0.00248	0.00037	0.00274	0.00000	0.00264	0.00000	0.01028	0.08088	0.01680	0.00810	0.01216	0.00000	0.00080	0.00951
Enargite	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00023	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Oxides	0.00570	0.04492	0.00000	0.00000	0.00000	0.01250	0.01003	0.01072	0.00000	0.00000	0.00000	0.00000	0.01595	0.01547
As-Fe Oxyhydroxide	0.00020	0.00083	0.00013	0.00000	0.00000	0.00000	0.07877	0.42211	0.00014	0.00327	0.00027	0.00015	0.00133	0.00013
Fe-Sb Phase	0.00007	0.00000	0.00013	0.00004	0.00004	0.00000	0.00000	0.00793	0.00000	0.00000	0.00028	0.00005	0.00000	0.00000
Total	0.00845	0.04613	0.00300	0.00004	0.00269	0.01250	0.09932	0.52164	0.01694	0.01137	0.01270	0.00020	0.01808	0.02511

Normalized

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	31.5	0.09	0.00	0.00	0.00	0.00	0.10	0.58	0.00	0.00	0.00	0.00	36.7	0.41
Arsenopyrite	20.1	0.81	91.3	0.00	98.4	0.00	10.3	15.4	99.2	71.3	95.7	0.00	2.79	37.7
Enargite	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Oxides	46.1	97.3	0.00	0.00	0.00	0.00	10.1	2.04	0.00	0.00	0.00	0.00	55.9	61.4
As-Fe Oxyhydroxide	1.66	1.81	4.24	0.00	0.00	0.00	79.2	80.4	0.82	28.7	2.09	74.1	4.67	0.52
Fe-Sb Phase	0.58	0.00	4.46	100.0	1.60	0.00	0.00	1.51	0.00	0.00	2.20	25.9	0.00	0.00
	100	100	100	100	100	0	100	100	100	100	100	100	100	100



Lorax Enviromental Services
16607-101
MI7007-MAR18

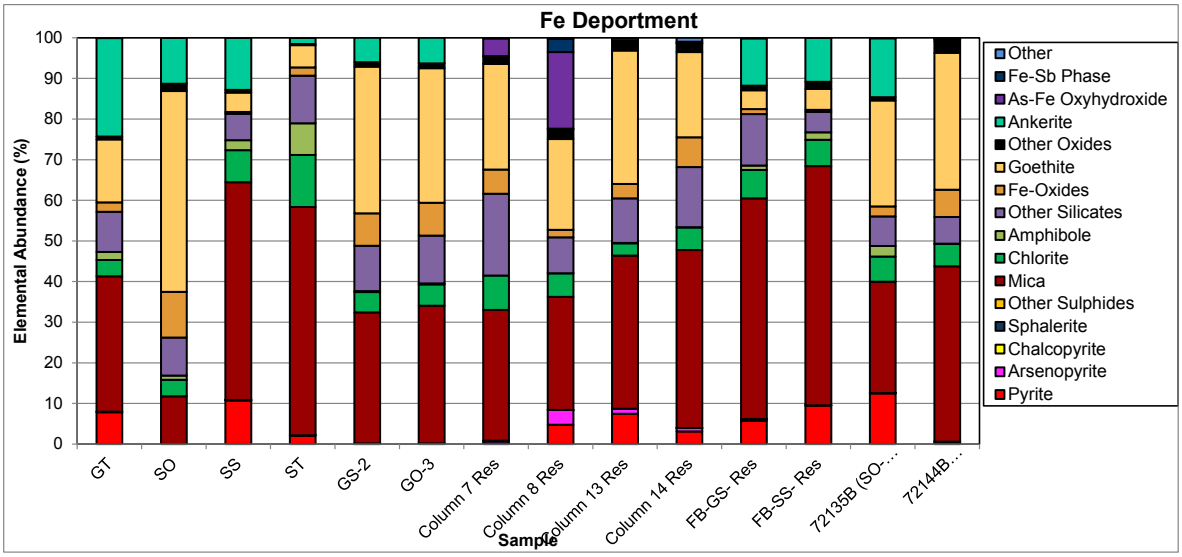
Fe Deportment

Absolute

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	0.100	0.001	0.364	0.071	0.002	0.002	0.003	0.080	0.076	0.022	0.115	0.331	0.266	0.002
Arsenopyrite	0.002	0.000	0.002	0.000	0.000	0.000	0.008	0.060	0.013	0.006	0.009	0.000	0.001	0.007
Chalcopyrite	0.000	0.000	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001	0.000	0.000
Sphalerite	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Other Sulphides	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mica	0.426	0.369	1.815	1.870	0.444	0.444	0.433	0.465	0.384	0.316	1.097	2.045	0.583	0.689
Chlorite	0.051	0.130	0.267	0.426	0.069	0.069	0.113	0.097	0.031	0.040	0.142	0.225	0.132	0.088
Amphibole	0.026	0.032	0.083	0.259	0.003	0.003	0.000	0.000	0.001	0.000	0.022	0.063	0.055	0.000
Other Silicates	0.126	0.296	0.220	0.390	0.154	0.154	0.271	0.148	0.112	0.107	0.255	0.174	0.155	0.105
Fe-Oxides	0.030	0.355	0.016	0.068	0.110	0.106	0.080	0.031	0.036	0.053	0.026	0.018	0.052	0.107
Goethite	0.198	1.562	0.162	0.181	0.497	0.435	0.349	0.373	0.335	0.151	0.093	0.179	0.555	0.538
Other Oxides	0.009	0.057	0.022	0.010	0.015	0.015	0.026	0.041	0.026	0.016	0.023	0.061	0.017	0.045
Ankerite	0.310	0.356	0.434	0.051	0.083	0.083	0.000	0.002	0.006	0.000	0.236	0.376	0.309	0.008
As-Fe Oxyhydroxide	0.000	0.001	0.000	0.000	0.000	0.000	0.059	0.315	0.000	0.002	0.000	0.000	0.001	0.000
Fe-Sb Phase	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.054	0.000	0.000	0.002	0.000	0.000	0.000
Other	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.005	0.000	0.007	0.000	0.000	0.002	0.006
Total	1.278	3.158	3.387	3.327	1.377	1.310	1.344	1.670	1.020	0.721	2.021	3.473	2.127	1.596

Normalized

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	7.83	0.03	10.8	2.14	0.18	0.18	0.24	4.77	7.44	3.11	5.70	9.53	12.5	0.15
Arsenopyrite	0.14	0.01	0.06	0.00	0.00	0.00	0.57	3.61	1.23	0.84	0.45	0.00	0.03	0.44
Chalcopyrite	0.00	0.01	0.02	0.02	0.01	0.01	0.00	0.02	0.01	0.02	0.04	0.02	0.01	0.00
Sphalerite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other Sulphides	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Mica	33.3	11.7	53.6	56.2	32.2	33.8	32.2	27.8	37.7	43.8	54.3	58.9	27.4	43.1
Chlorite	4.02	4.10	7.87	12.8	5.01	5.27	8.44	5.79	3.02	5.54	7.04	6.48	6.21	5.52
Amphibole	2.00	1.00	2.45	7.80	0.23	0.24	0.00	0.01	0.11	0.04	1.08	1.81	2.59	0.03
Other Silicates	9.85	9.36	6.48	11.7	11.2	11.7	20.1	8.85	10.9	14.8	12.6	5.02	7.27	6.60
Fe-Oxides	2.36	11.3	0.49	2.04	7.97	8.08	5.98	1.84	3.57	7.32	1.27	0.51	2.43	6.70
Goethite	15.5	49.5	4.78	5.45	36.1	33.2	26.0	22.3	32.9	21.0	4.61	5.16	26.1	33.7
Other Oxides	0.71	1.80	0.65	0.29	1.10	1.16	1.93	2.46	2.53	2.20	1.13	1.74	0.78	2.83
Ankerite	24.2	11.3	12.8	1.52	6.00	6.30	0.02	0.11	0.57	0.03	11.7	10.8	14.5	0.49
As-Fe Oxyhydroxide	0.01	0.02	0.00	0.00	0.00	0.00	4.37	18.8	0.01	0.34	0.01	0.00	0.05	0.01
Fe-Sb Phase	0.04	0.00	0.03	0.01	0.00	0.00	0.00	3.23	0.00	0.00	0.09	0.01	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.29	0.00	0.96	0.00	0.00	0.07	0.36
	100	100	100	100	100	100	100	100	100	100	100	100	100	100



Lorax Enviromental Services
16607-101
MI7007-MAR18

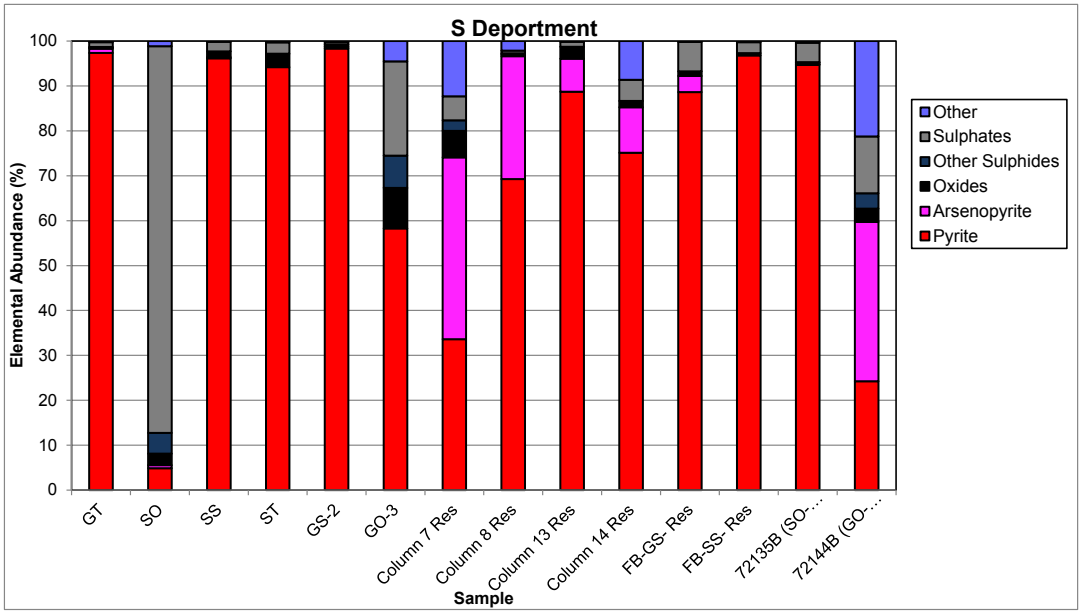
S Deportment

Absolute

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	0.11007	0.00120	0.41704	0.07036	0.29144	0.00256	0.00365	0.08774	0.08649	0.02577	0.12978	0.37625	0.29088	0.00278
Arsenopyrite	0.00106	0.00016	0.00117	0.00000	0.00113	0.00000	0.00440	0.03462	0.00719	0.00347	0.00520	0.00000	0.00034	0.00407
Other Sulphides	0.00022	0.00063	0.00558	0.00224	0.00171	0.00040	0.00064	0.00053	0.00256	0.00049	0.00154	0.00195	0.00103	0.00034
Oxides	0.00014	0.00114	0.00000	0.00000	0.00000	0.00032	0.00025	0.00027	0.00000	0.00000	0.00000	0.00000	0.00040	0.00039
Sulphates	0.00121	0.02116	0.00916	0.00191	0.00149	0.00092	0.00058	0.00078	0.00109	0.00161	0.00954	0.00949	0.01331	0.00145
Other	0.00034	0.00028	0.00078	0.00021	0.00059	0.00020	0.00134	0.00270	0.00017	0.00296	0.00033	0.00092	0.00114	0.00243
Total	0.11304	0.02457	0.43373	0.07472	0.29636	0.00440	0.01087	0.12664	0.09749	0.03430	0.14639	0.38861	0.30710	0.01146

Normalized

Mineral	GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Pyrite	97.4	4.89	96.2	94.2	98.3	58.3	33.6	69.3	88.7	75.1	88.7	96.8	94.7	24.2
Arsenopyrite	0.94	0.65	0.27	0.00	0.38	0.00	40.5	27.3	7.37	10.1	3.55	0.00	0.11	35.5
Oxides	0.19	2.57	1.29	2.99	0.58	9.03	5.89	0.42	2.63	1.44	1.05	0.50	0.33	2.96
Other Sulphides	0.19	4.62	0.00	0.00	0.00	7.18	2.34	0.21	0.00	0.00	0.00	0.00	0.13	3.41
Sulphates	1.07	86.1	2.11	2.56	0.50	21.0	5.38	0.62	1.12	4.69	6.52	2.44	4.33	12.7
Other	0.30	1.16	0.18	0.27	0.20	4.53	12.3	2.13	0.17	8.63	0.22	0.24	0.37	21.2
	100	100	100	100	100	100	100	100	100	100	100	100	100	100



Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)
Accelerating potential = 15 kV; beam current = 20 nA; focused beam.
Standards for pyrite: natural pyrite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Standards for arsenopyrite: synthetic pyrrhotite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Precision and detection limit are calculated at far right of sheet.

Pyrite

	Element Weight %									Normalised Weight %							
Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total	Fe	Co	Ni	As	S	Si	Ca	Total
	DL	0.07	0.03	0.04	0.03	0.03	0.03	0.03		0.07	0.03	0.04	0.03	0.03	0.03	0.03	
1	GT pyrite 01	44.3	0.00	0.00	3.79	50.7	0.32	0.00	99.1	44.7	0.00	0.00	3.82	51.1	0.32	0.00	100.0
2	GT pyrite 02	46.0	0.00	0.02	0.35	52.8	0.07	0.02	99.3	46.4	0.00	0.02	0.35	53.2	0.07	0.02	100.0
3	GT pyrite 03	43.8	0.00	0.00	6.03	48.6	0.06	0.05	98.6	44.4	0.00	0.00	6.12	49.3	0.06	0.05	100.0
4	GT pyrite 04	45.4	0.00	0.00	0.02	53.0	0.18	0.01	98.6	46.0	0.00	0.00	0.02	53.8	0.18	0.01	100.0
5	GT pyrite 05	46.4	0.01	0.00	0.36	53.3	0.00	0.01	100.0	46.4	0.01	0.00	0.36	53.3	0.00	0.01	100.0
6	GT pyrite 06	44.0	0.00	0.01	6.01	48.1	0.23	0.02	98.3	44.7	0.00	0.01	6.11	48.9	0.24	0.02	100.0
7	GT pyrite 07	46.7	0.01	0.00	0.00	53.8	0.00	0.03	100.5	46.5	0.01	0.00	0.00	53.5	0.00	0.03	100.0
8	GT pyrite 08	41.3	0.02	0.01	7.49	47.0	0.39	0.00	96.2	42.9	0.03	0.01	7.79	48.9	0.41	0.00	100.0
9	GT pyrite 09	46.4	0.00	0.05	0.03	53.6	0.01	0.00	100.2	46.3	0.00	0.05	0.03	53.6	0.01	0.00	100.0
10	GT pyrite 10	45.4	0.00	0.02	1.26	52.9	0.14	0.18	99.9	45.5	0.00	0.02	1.26	52.9	0.14	0.18	100.0
11	GT pyrite 11	46.9	0.01	0.00	0.40	53.0	0.01	0.02	100.3	46.8	0.01	0.00	0.40	52.8	0.01	0.02	100.0
12	GT pyrite 12	46.6	0.00	0.02	0.59	52.5	0.01	0.00	99.8	46.7	0.00	0.02	0.59	52.6	0.01	0.00	100.0
13	GT pyrite 13	44.6	0.00	0.00	4.49	49.6	0.07	0.00	98.8	45.2	0.00	0.00	4.55	50.2	0.07	0.00	100.0
14	GT pyrite 14	46.7	0.00	0.00	0.02	53.4	0.02	0.00	100.2	46.6	0.00	0.00	0.02	53.3	0.02	0.00	100.0
15	GT pyrite 15	42.7	0.00	0.00	7.63	46.9	0.89	0.00	98.1	43.5	0.00	0.00	7.78	47.8	0.91	0.00	100.0
16	GT pyrite 16	45.9	0.01	0.02	0.62	52.9	0.00	0.00	99.4	46.2	0.01	0.02	0.63	53.2	0.00	0.00	100.0
17	GT pyrite 17	47.3	0.04	0.01	0.00	53.3	0.00	0.00	100.7	47.0	0.04	0.01	0.00	53.0	0.00	0.00	100.0
18	GT pyrite 18	46.5	0.00	0.00	0.05	53.4	0.01	0.00	99.9	46.5	0.00	0.00	0.05	53.4	0.01	0.00	100.0
19	GT pyrite 19	45.6	0.02	0.00	2.91	51.6	0.02	0.02	100.1	45.5	0.02	0.00	2.91	51.5	0.02	0.02	100.0
20	GT pyrite 20	46.2	0.00	0.03	0.00	53.3	0.05	0.00	99.6	46.4	0.00	0.03	0.00	53.5	0.05	0.00	100.0
21	GT pyrite 21	46.6	0.00	0.00	0.01	53.6	0.03	0.01	100.2	46.5	0.00	0.00	0.01	53.5	0.03	0.01	100.0
22	GT pyrite 22	45.1	0.03	0.04	0.88	52.3	0.06	0.01	98.4	45.8	0.03	0.04	0.90	53.2	0.06	0.01	100.0
23	GT pyrite 23	46.0	0.00	0.02	0.36	53.1	0.03	0.02	99.6	46.2	0.00	0.02	0.36	53.3	0.03	0.02	100.0
24	GT pyrite 24	44.3	0.02	0.01	6.61	48.3	0.02	0.04	99.3	44.6	0.02	0.01	6.66	48.6	0.02	0.04	100.0
25	GT pyrite 25	46.5	0.01	0.00	0.27	53.3	0.00	0.00	100.1	46.4	0.01	0.00	0.27	53.3	0.00	0.00	100.0
	Max	47.3	0.04	0.05	7.63	53.8	0.89	0.18	100.7	47.0	0.04	0.05	7.79	53.8	0.91	0.18	100.0
	Min	41.3	0.00	0.00	0.00	46.9	0.00	0.00	96.2	42.9	0.00	0.00	0.00	47.8	0.00	0.00	100.0
	Ave	45.5	0.01	0.01	2.01	51.8	0.11	0.02	99.4	45.8	0.01	0.01	2.04	52.1	0.11	0.02	100.0

Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total	Fe	Co	Ni	As	S	Si	Ca	Total
	DL	0.07	0.03	0.04	0.03	0.03	0.03	0.03		0.07	0.03	0.04	0.03	0.03	0.03	0.03	
26	ST pyrite 01	46.4	0.01	0.40	0.04	53.7	0.01	0.01	100.5	46.1	0.01	0.40	0.04	53.4	0.01	0.01	100.0
27	ST pyrite 02	47.1	0.12	0.04	0.01	53.8	0.02	0.00	101.0	46.6	0.12	0.04	0.01	53.2	0.02	0.00	100.0
28	ST pyrite 03	46.9	0.02	0.00	0.00	53.5	0.01	0.01	100.4	46.7	0.02	0.00	0.00	53.2	0.01	0.00	100.0
29	ST pyrite 04	46.5	0.00	0.08	0.02	53.6	0.01	0.01	100.2	46.4	0.00	0.08	0.02	53.5	0.01	0.01	100.0
30	ST pyrite 05	46.5	0.01	0.11	0.00	53.6	0.03	0.03	100.3	46.3	0.01	0.11	0.00	53.5	0.03	0.03	100.0
31	ST pyrite 06	46.0	0.04	0.02	0.00	53.6	0.02	0.02	99.7	46.2	0.04	0.02	0.00	53.7	0.02	0.02	100.0
32	ST pyrite 07	46.3	0.03	0.43	0.03	53.3	0.00	0.01	100.1	46.2	0.03	0.43	0.03	53.3	0.00	0.01	100.0
33	ST pyrite 08	46.4	0.00	0.05	0.12	53.3	0.02	0.08	100.0	46.4	0.00	0.05	0.12	53.3	0.02	0.08	100.0
34	ST pyrite 09	45.7	0.00	0.04	0.41	53.3	0.06	0.00	99.5	46.0	0.00	0.04	0.42	53.5	0.06	0.00	100.0
35	ST pyrite 10	46.5	0.09	0.04	0.00	53.8	0.01	0.05	100.5	46.3	0.09	0.04	0.00	53.5	0.01	0.05	100.0
36	ST pyrite 11	46.4	0.01	0.03	0.00	53.6	0.00	0.03	100.0	46.3	0.01	0.03	0.00	53.6	0.00	0.03	100.0
37	ST pyrite 12	46.5	0.20	0.03	0.01	53.6	0.02	0.02	100.4	46.3	0.20	0.03	0.01	53.4	0.02	0.02	100.0
38	ST pyrite 13	46.9	0.01	0.04	0.09	53.7	0.01	0.02	100.8	46.5	0.01	0.04	0.09	53.3	0.01	0.01	100.0
39	ST pyrite 14	46.2	0.01	0.02	0.00	53.6	0.04	0.27	100.1	46.1	0.01	0.02	0.00	53.5	0.04	0.27	100.0
40	ST pyrite 15	45.7	0.14	0.04	0.01	53.5	0.01	0.02	99.4	45.9	0.14	0.04	0.01	53.8	0.01	0.02	100.0
	Max	47.1	0.20	0.43	0.41	53.8	0.06	0.27	101.0	46.7	0.20	0.43	0.42	53.8	0.06	0.27	100.0
	Min	45.7	0.00	0.00	0.00	53.3	0.00	0.00	99.4	45.9	0.00	0.00	0.00	53.2	0.00	0.00	100.0
	Ave	46.4	0.05	0.09	0.05	53.6	0.02	0.04	100.2	46.3	0.05	0.09	0.05	53.5	0.02	0.04	100.0

Pyrite

	Element Weight %								Normalised Weight %							
Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total	Fe	Co	Ni	As	S	Si	Ca	Total
Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total	Fe	Co	Ni	As	S	Si	Ca	Total
	DL	0.07	0.03	0.04	0.03	0.03	0.03	0.03		0.07	0.03	0.04	0.03	0.03	0.03	0.03	
41	Column 13 pyrite 01	45.6	0.00	0.00	0.06	52.2	0.11	0.00	97.9	46.5	0.00	0.00	0.06	53.3	0.12	0.00	100.0
42	Column 13 pyrite 02	45.5	0.00	0.01	0.01	53.7	0.09	0.00	99.3	45.8	0.00	0.01	0.01	54.1	0.09	0.00	100.0
43	Column 13 pyrite 03	45.4	0.00	0.00	0.58	53.0	0.09	0.01	99.1	45.8	0.00	0.00	0.59	53.5	0.09	0.01	100.0
44	Column 13 pyrite 04	46.2	0.01	0.00	0.99	53.1	0.02	0.00	100.4	46.1	0.01	0.00	0.99	52.9	0.02	0.00	100.0
45	Column 13 pyrite 05	45.5	0.00	0.00	0.19	52.8	0.20	0.04	98.7	46.1	0.00	0.00	0.20	53.5	0.20	0.04	100.0
46	Column 13 pyrite 06	46.0	0.00	0.01	0.14	53.6	0.06	0.00	99.8	46.1	0.00	0.01	0.14	53.7	0.06	0.00	100.0
47	Column 13 pyrite 07	46.0	0.00	0.03	0.03	53.9	0.01	0.00	100.0	46.0	0.00	0.03	0.03	53.9	0.01	0.00	100.0
	Max	46.2	0.01	0.03	0.99	53.9	0.20	0.04	100.4	46.5	0.01	0.03	0.99	54.1	0.20	0.04	100.0
	Min	45.4	0.00	0.00	0.01	52.2	0.01	0.00	97.9	45.8	0.00	0.00	0.01	52.9	0.01	0.00	100.0
	Ave	45.7	0.00	0.01	0.29	53.2	0.08	0.01	99.3	46.1	0.00	0.01	0.29	53.6	0.08	0.01	100.0

Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total	Fe	Co	Ni	As	S	Si	Ca	Total
	DL	0.07	0.03	0.04	0.03	0.03	0.03	0.03		0.07	0.03	0.04	0.03	0.03	0.03	0.03	
48	SS pyrite 01	46.5	0.10	0.02	0.00	53.9	0.00	0.00	100.5	46.2	0.10	0.02	0.00	53.7	0.00	0.00	100.0
49	SS pyrite 02	46.2	0.08	0.05	0.00	54.3	0.00	0.01	100.6	45.9	0.08	0.05	0.00	53.9	0.00	0.01	100.0
50	SS pyrite 03	46.3	0.40	0.02	0.00	53.6	0.00	0.04	100.3	46.1	0.40	0.02	0.00	53.4	0.00	0.04	100.0
51	SS pyrite 04	46.3	0.21	0.03	0.00	53.7	0.01	0.00	100.3	46.2	0.21	0.03	0.00	53.6	0.01	0.00	100.0
52	SS pyrite 05	46.9	0.01	0.11	0.00	53.6	0.01	0.02	100.6	46.6	0.01	0.11	0.00	53.3	0.01	0.02	100.0
53	SS pyrite 06	44.0	0.00	0.85	1.75	52.4	0.08	0.00	99.0	44.4	0.00	0.86	1.77	52.9	0.08	0.00	100.0
54	SS pyrite 07	46.1	0.04	0.01	0.01	53.7	0.00	0.00	99.9	46.2	0.04	0.01	0.01	53.8	0.00	0.00	100.0
55	SS pyrite 08	46.1	0.01	0.01	0.02	54.0	0.00	0.03	100.1	46.0	0.01	0.01	0.02	53.9	0.00	0.03	100.0
56	SS pyrite 09	45.7	0.02	0.00	0.87	52.6	0.08	0.02	99.2	46.0	0.02	0.00	0.87	53.0	0.08	0.02	100.0
57	SS pyrite 10	45.8	0.01	0.00	0.01	53.7	0.01	0.01	99.6	46.0	0.01	0.00	0.01	53.9	0.01	0.01	100.0
58	SS pyrite 11	45.9	0.00	0.01	0.00	53.9	0.01	0.02	99.9	46.0	0.00	0.01	0.00	54.0	0.01	0.02	100.0
59	SS pyrite 12	46.7	0.03	0.04	0.00	53.9	0.01	0.00	100.7	46.4	0.03	0.04	0.00	53.5	0.01	0.00	100.0
60	SS pyrite 13	45.7	0.00	0.00	1.73	52.7	0.02	0.02	100.2	45.6	0.00	0.00	1.73	52.6	0.02	0.02	100.0
61	SS pyrite 14	46.2	0.00	0.00	0.00	53.6	0.00	0.03	99.8	46.3	0.00	0.00	0.00	53.7	0.00	0.03	100.0
62	SS pyrite 15	46.2	0.56	0.02	0.00	53.6	0.01	0.02	100.4	46.0	0.56	0.02	0.00	53.4	0.01	0.02	100.0
63	SS pyrite 16	46.0	0.07	0.00	0.00	53.5	0.00	0.01	99.6	46.2	0.07	0.00	0.00	53.7	0.00	0.01	100.0
64	SS pyrite 17	46.5	0.01	0.05	0.00	54.2	0.00	0.07	100.8	46.1	0.01	0.05	0.00	53.7	0.00	0.07	100.0
65	SS pyrite 18	46.7	0.01	0.01	0.00	53.7	0.00	0.01	100.5	46.5	0.01	0.01	0.00	53.5	0.00	0.01	100.0
66	SS pyrite 19	46.6	0.01	0.01	0.00	54.0	0.00	0.01	100.6	46.4	0.01	0.01	0.00	53.6	0.00	0.01	100.0
67	SS pyrite 20	46.3	0.03	0.01	0.00	53.9	0.00	0.01	100.2	46.2	0.03	0.01	0.00	53.7	0.00	0.01	100.0
68	SS pyrite 21	46.5	0.00	0.09	0.02	53.7	0.03	0.04	100.4	46.3	0.00	0.09	0.02	53.5	0.02	0.04	100.0
	Max	46.9	0.56	0.85	1.75	54.3	0.08	0.07	100.8	46.6	0.56	0.86	1.77	54.0	0.08	0.07	100.0
	Min	44.0	0.00	0.00	0.00	52.4	0.00	0.00	99.0	44.4	0.00	0.00	0.00	52.6	0.00	0.00	100.0
	Ave	46.1	0.08	0.06	0.21	53.6	0.01	0.02	100.2	46.1	0.08	0.06	0.21	53.5	0.01	0.02	100.0

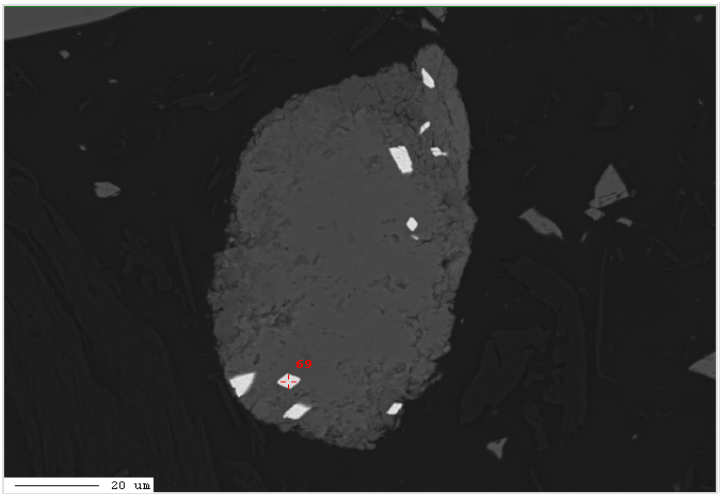
Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)

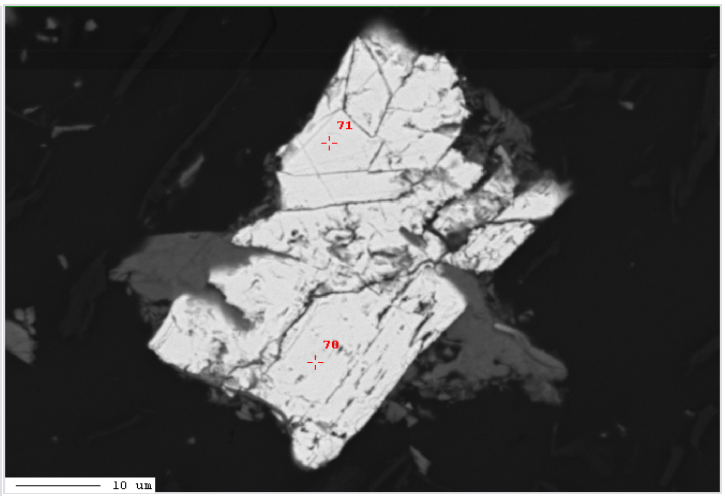
Accelerating potential = 15 kV; beam current = 20 nA; focused beam.
Standards for pyrite: natural pyrite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Standards for arsenopyrite: synthetic pyrrhotite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Precision and detection limit are calculated at far right of sheet.

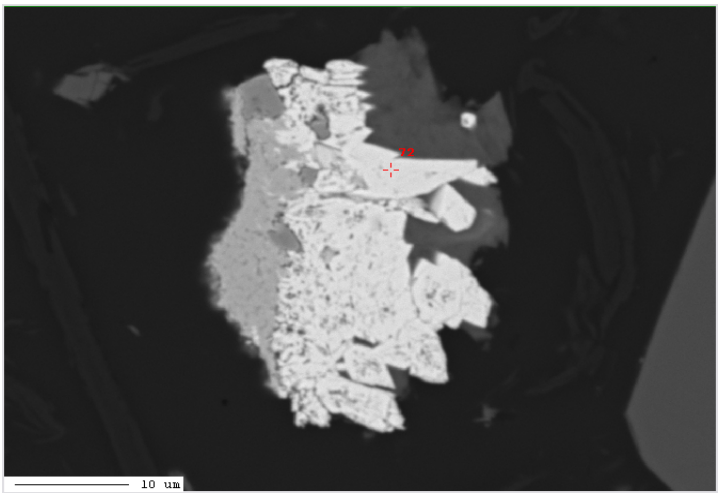
0.07 0.03 0.04 0.11 0.03 0.04 0.03

Arsenopyrite:

		Element Weight %									Normalised Weight %						
Point	Comment	Fe	Co	Ni	As	S	Si	Ca	Total		Fe	Co	Ni	As	S	Si	Ca	Total
	DL	0.07	0.03	0.04	0.11	0.03	0.04	0.03			0.07	0.03	0.04	0.11	0.03	0.04	0.03	
69	Column 13 arsenopyrite 01	33.6	0.00	0.01	44.7	20.9	0.14	0.00	99.4		33.8	0.00	0.01	45.0	21.0	0.14	0.00	100.0
70	Column 13 arsenopyrite 02	34.9	0.00	0.02	44.7	20.6	0.01	0.00	100.3		34.8	0.00	0.02	44.6	20.6	0.01	0.00	100.0
71	Column 13 arsenopyrite 03	35.5	0.02	0.00	42.9	22.2	0.02	0.00	100.6		35.3	0.02	0.00	42.6	22.1	0.02	0.00	100.0
72	Column 13 arsenopyrite 04	34.3	0.00	0.00	45.2	20.5	0.02	0.00	100.1		34.3	0.00	0.00	45.2	20.5	0.02	0.00	100.0
73	Column 13 arsenopyrite 05	34.2	0.00	0.00	44.3	20.9	0.00	0.00	99.4		34.4	0.00	0.00	44.6	21.0	0.00	0.00	100.0
74	Column 13 arsenopyrite 06	34.3	0.00	0.02	44.7	20.8	0.01	0.00	99.8		34.3	0.00	0.02	44.8	20.8	0.01	0.00	100.0
75	Column 13 arsenopyrite 07	35.0	0.00	0.00	43.2	21.7	0.02	0.01	99.8		35.0	0.00	0.00	43.2	21.7	0.02	0.01	100.0
76	Column 13 arsenopyrite 08	34.7	0.00	0.00	44.5	21.6	0.10	0.00	100.8		34.4	0.00	0.00	44.1	21.4	0.10	0.00	100.0
77	Column 13 arsenopyrite 09	34.6	0.01	0.00	44.3	21.3	0.03	0.01	100.2		34.6	0.01	0.00	44.2	21.2	0.03	0.01	100.0
	Max	35.5	0.02	0.02	45.2	22.2	0.14	0.01	100.8		35.3	0.02	0.02	45.2	22.1	0.14	0.01	100.0
	Min	33.6	0.00	0.00	42.9	20.5	0.00	0.00	99.4		33.8	0.00	0.00	42.6	20.5	0.00	0.00	100.0
	Ave	34.6	0.00	0.01	44.3	21.2	0.04	0.00	100.0		34.5	0.00	0.01	44.3	21.2	0.04	0.00	100.0

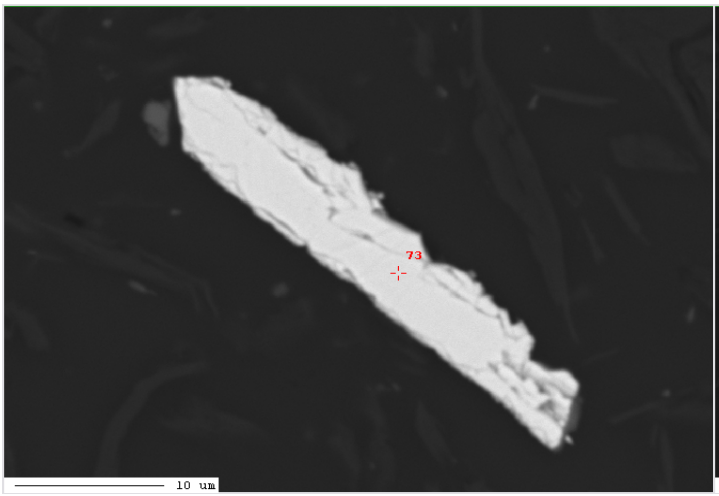


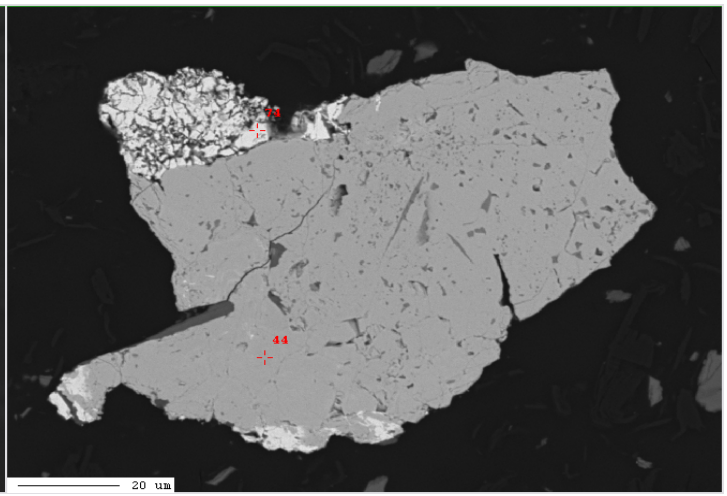


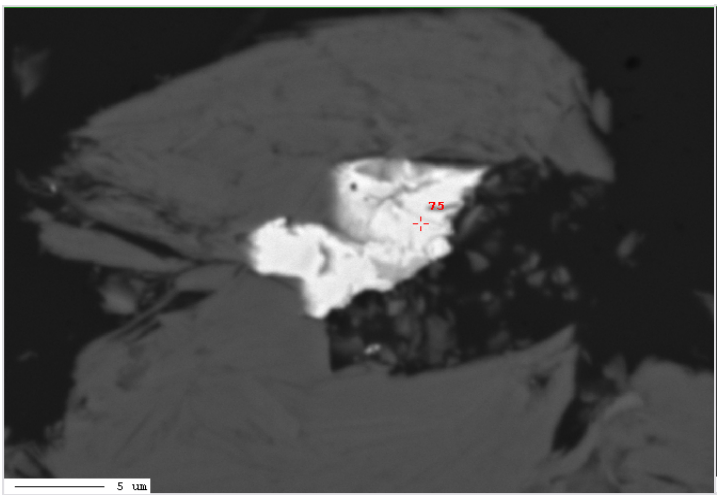


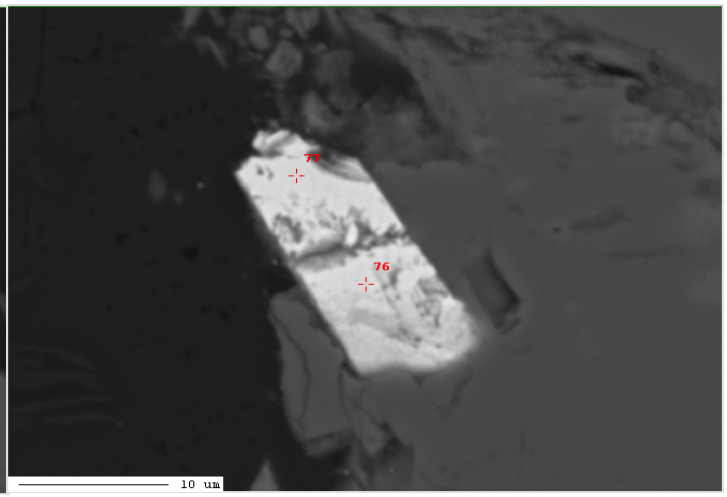
Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)

Accelerating potential = 15 kV; beam current = 20 nA; focused beam.
Standards for pyrite: natural pyrite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Standards for arsenopyrite: synthetic pyrrhotite (Fe, S), natural cobaltite (Co), natural millerite (Ni), synthetic loellingite (As)
Precision and detection limit are calculated at far right of sheet.









Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)
Accelerating potential = 15 kV; beam current = 20 nA; beam diameter = 5 microns.
Standards: natural forsterite (Si, Mg), natural rutile (Ti), natural anorthite (Al, Ca), synthetic magnetite (Fe), natural rhodonite (Mn), natural albite (Na), natural adularia (K), synthetic Ca2P2O7 (P), synthetic loellingite (As), natural anhydrite (S)
Precision and detection limit are calculated at far right of sheet.

		Oxide Weight %														Normalised Weight %												Oxide Mole % excluding H2O											
Point	Comment	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	As2O5	SO3	H2O (by difference)	Total	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	As2O5	SO3	H2O (by difference)	Total	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	As2O5	SO3	Total
1	GT Fe oxide 01	6.22	0.00	0.91	78.1	0.06	0.38	0.49	0.04	0.03	0.44	1.35	0.02	12.0	100.0	6.22	0.00	0.91	78.1	0.06	0.38	0.49	0.04	0.03	0.44	1.35	0.02	12.0	100.0	9.09	0.00	1.56	85.9	0.08	0.83	0.77	0.12	0.05	0.55	1.03	0.02	100.0
2	GT Fe oxide 02	3.37	0.84	1.25	88.8	0.00	0.01	0.07	0.09	0.06	0.00	0.49	0.02	4.98	100.0	3.37	0.84	1.25	88.8	0.00	0.01	0.07	0.09	0.06	0.00	0.49	0.02	4.98	100.0	4.62	0.87	2.02	91.6	0.00	0.01	0.11	0.24	0.11	0.00	0.35	0.02	100.0
3	GT Fe oxide 03	4.46	0.00	2.48	74.0	0.05	0.42	0.48	0.03	0.06	0.44	0.92	0.14	16.5	100.0	4.46	0.00	2.48	74.0	0.05	0.42	0.48	0.03	0.06	0.44	0.92	0.14	16.5	100.0	6.83	0.00	4.47	85.2	0.06	0.95	0.79	0.10	0.12	0.57	0.74	0.17	100.0
4	GT Fe oxide 04	8.00	0.00	3.74	67.9	0.07	0.45	1.01	0.01	0.51	0.12	2.85	0.11	15.3	100.0	8.00	0.00	3.74	67.8	0.07	0.45	1.01	0.01	0.51	0.12	2.85	0.11	15.3	100.0	11.8	0.00	6.51	75.5	0.09	0.99	1.61	0.03	0.96	0.15	2.20	0.12	100.0
5	GT Fe oxide 05	3.07	0.00	0.33	83.4	0.03	0.67	0.36	0.02	0.00	0.36	0.50	0.16	11.1	100.0	3.07	0.00	0.33	83.4	0.03	0.67	0.36	0.02	0.00	0.36	0.50	0.16	11.1	100.0	4.50	0.00	0.57	91.8	0.04	1.46	0.56	0.05	0.00	0.44	0.38	0.18	100.0
6	GT Fe oxide 06	2.87	0.00	1.15	75.4	0.04	0.35	0.87	0.04	0.00	0.44	2.81	0.07	15.9	100.0	2.87	0.00	1.15	75.4	0.04	0.35	0.87	0.04	0.00	0.44	2.81	0.07	15.9	100.0	4.44	0.00	2.10	88.1	0.05	0.81	1.44	0.13	0.01	0.58	2.28	0.08	100.0
7	GT Fe oxide 07	2.82	0.00	0.84	72.6	0.02	0.34	1.31	0.07	0.01	0.99	4.29	0.09	16.7	100.0	2.82	0.00	0.84	72.6	0.02	0.34	1.31	0.07	0.01	0.99	4.29	0.09	16.6	100.0	4.43	0.00	1.56	85.8	0.03	0.79	2.21	0.22	0.01	1.32	3.52	0.11	100.0
8	GT Fe oxide 08	5.30	0.02	2.74	75.5	0.04	0.35	0.24	0.01	0.06	0.20	0.37	0.04	15.1	100.0	5.30	0.02	2.74	75.5	0.04	0.35	0.24	0.01	0.06	0.20	0.37	0.04	15.1	100.0	7.95	0.02	4.84	85.3	0.05	0.79	0.38	0.02	0.11	0.25	0.29	0.04	100.0
9	GT Fe oxide 09	6.04	0.00	0.76	73.6	0.02	0.25	0.83	0.02	0.04	0.44	2.57	0.00	15.4	100.0	6.04	0.00	0.76	73.6	0.02	0.25	0.83	0.02	0.04	0.44	2.57	0.00	15.4	100.0	9.22	0.00	1.38	84.7	0.03	0.58	1.36	0.05	0.09	0.57	2.05	0.00	100.0
10	GT Fe oxide 10	3.25	0.02	0.16	86.6	0.01	0.26	0.49	0.00	0.01	0.33	0.76	0.36	7.74	100.0	3.25	0.02	0.16	86.6	0.01	0.26	0.49	0.00	0.01	0.33	0.76	0.36	7.74	100.0	4.61	0.02	0.27	92.4	0.01	0.55	0.74	0.00	0.02	0.39	0.56	0.39	100.0
11	GT Fe oxide 11	1.41	0.00	2.46	72.7	0.19	0.77	1.22	0.03	0.02	0.56	4.06	0.04	16.6	100.0	1.41	0.00	2.46	72.7	0.19	0.77	1.22	0.03	0.02	0.56	4.06	0.04	16.5	100.0	2.20	0.00	4.51	85.0	0.25	1.78	2.04	0.10	0.04	0.74	3.29	0.05	100.0
12	GT Fe oxide 12	8.16	0.01	0.65	78.5	0.24	0.49	0.97	0.01	0.09	0.10	0.28	0.15	10.4	100.0	8.16	0.01	0.65	78.4	0.24	0.49	0.97	0.01	0.09	0.10	0.28	0.15	10.4	100.0	11.6	0.01	1.09	83.8	0.29	1.04	1.48	0.02	0.16	0.12	0.20	0.16	100.0
13	GT Fe oxide 13	0.49	0.88	0.24	95.1	0.03	0.13	0.03	0.03	0.04	0.00	0.00	0.02	3.06	100.0	0.49	0.88	0.24	95.1	0.03	0.13	0.03	0.03	0.04	0.00	0.00	0.02	3.05	100.0	0.67	0.91	0.39	97.5	0.03	0.26	0.04	0.07	0.07	0.00	0.00	0.02	100.0
14	GT Fe oxide 14	2.72	0.01	1.34	74.0	0.05	0.34	1.60	0.01	0.08	0.45	4.50	0.13	14.7	100.0	2.72	0.01	1.34	74.0	0.05	0.34	1.60	0.01	0.08	0.45	4.50	0.13	14.7	100.0	4.17	0.02	2.43	85.4	0.07	0.78	2.62	0.04	0.17	0.59	3.60	0.15	100.0
15	GT Fe oxide 15	0.14	0.00	0.00	101.3	0.03	0.00	0.01	0.01	0.02	0.00	0.01	0.01	0.00	101.6	0.14	0.00	0.00	99.8	0.03	0.00	0.01	0.01	0.02	0.00	0.01	0.01	0.00	100.0	0.19	0.00	0.00	99.7	0.04	0.00	0.02	0.02	0.03	0.00	0.01	0.01	100.0
16	GT Fe oxide 16	2.51	0.00	0.04	84.5	0.04	0.52	0.64	0.01	0.01	0.04	0.36	0.26	11.1	100.0	2.51	0.00	0.04	84.5	0.04	0.52	0.64	0.01	0.01	0.04	0.36	0.26	11.1	100.0	3.68	0.00	0.07	93.4	0.04	1.14	1.01	0.03	0.02	0.05	0.28	0.28	100.0
17	GT Fe oxide 17	1.56	0.00	1.69	71.0	0.16	0.31	1.62	0.03	0.00	1.29	5.40	0.09	16.9	100.0	1.56	0.00	1.69	71.0	0.16	0.31	1.62	0.03	0.00	1.29	5.40	0.09	16.9	100.0	2.46	0.00	3.14	84.3	0.21	0.73	2.73	0.10	0.01	1.73	4.46	0.10	100.0
18	GT Fe oxide 18	1.45	0.00	1.52	71.6	0.14	0.32	1.55	0.07	0.01	1.14	5.26	0.11	16.8	100.0	1.45	0.00	1.52	71.6	0.14	0.32	1.55	0.07	0.01	1.14	5.26	0.11	16.8	100.0	2.29	0.01	2.82	85.1	0.19	0.74	2.63	0.22	0.03	1.53	4.34	0.13	100.0
19	GT Fe oxide 19	4.86	0.00	1.33	72.6	0.06	0.54	0.64	0.00	0.03	0.58	2.01	0.02	17.4	100.0	4.86	0.00	1.33	72.6	0.06	0.54	0.64	0.00	0.03	0.58	2.01	0.02	17.3	100.0	7.57	0.00	2.45	85.1	0.07	1.26	1.06	0.00	0.06	0.77	1.64	0.02	100.0
20	GT Fe oxide 20	4.45	0.01	0.98	76.3	0.09	0.57	1.10	0.00	0.03	0.55	3.07	0.16	12.7	100.0	4.45	0.01	0.98	76.3	0.09	0.57	1.10	0.00	0.03	0.55	3.07	0.16	12.7	100.0	6.60	0.01	1.72	85.3	0.11	1.25	1.74	0.00	0.07	0.69	2.38	0.18	100.0
	Max	8.16	0.88	3.74	101.3	0.24	0.77	1.62	0.09	0.51	1.29	5.40	0.36	17.4	101.6	8.16	0.88	3.74	99.8	0.24	0.77	1.62	0.09	0.51	1.29	5.40	0.36	17.3	100.0	11.8	0.91	6.51	99.7	0.29	1.78	2.73	0.24	0.96	1.73	4.46	0.39	100.0
	Min	0.14	0.00	0.00	67.9	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	100.0	0.14	0.00	0.00	67.8	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	100.0	0.19	0.00	0.00	75.5	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	100.0
	Ave	3.66	0.09	1.23	78.7	0.07	0.37	0.78	0.03	0.06	0.42	2.09	0.10	12.5	100.1	3.66	0.09	1.23	78.6	0.07	0.37	0.78	0.03	0.06	0.42	2.09	0.10	12.5	100.0	5.45	0.09	2.19	87.5	0.09	0.84	1.27	0.08	0.11	0.55	1.68	0.11	100.0

Point	Comment	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	As2O5	SO3	H2O (by difference)	Total	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	As2O5	SO3	H2O (by difference)	Total	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	As2O5	SO3	Total
21	ST Fe oxide 01	2.91	0.00	0.00	83.4	0.00	0.26	0.37	0.00	0.01	0.01	0.02	2.84	10.2	100.0	2.91	0.00	0.00	83.4	0.00	0.26	0.37	0.00	0.01	0.01	0.02	2.84	10.2	100.0	4.25	0.00	0.00	91.5	0.00	0.56	0.58	0.00	0.02	0.01	0.01	3.11	100.0
22	ST Fe oxide 02	3.37	0.00	0.31	87.5	0.00	0.21	0.45	0.03	0.01	0.03	0.24	0.14	7.69	100.0	3.37	0.00	0.31	87.5	0.00	0.21	0.45	0.03	0.01	0.03	0.24	0.14	7.69	100.0	4.76	0.00	0.51	93.1	0.00	0.44	0.69	0.07	0.02	0.03	0.18	0.15	100.0
23	ST Fe oxide 03	6.99	0.01	1.22	73.3	0.12	0.40	0.61	0.05	0.00	0.03	0.75	0.18	16.3	100.0	6.99	0.01	1.22	73.3	0.12	0.40	0.61	0.05	0.00	0.03	0.75	0.18	16.3	100.0	10.7	0.02	2.19	84.1	0.16	0.91	0.99	0.15	0.00	0.04	0.60	0.20	100.0
24	ST Fe oxide 04	4.62	0.04	0.72	84.1	0.00	0.17	0.45	0.00	0.02	0.03	0.33	0.20	9.37	100.0	4.62	0.04	0.72	84.1	0.00	0.17	0.45	0.00	0.02	0.03	0.33	0.20	9.37	100.0	6.62	0.05	1.21	90.5	0.00	0.37	0.68	0.00	0.04	0.03	0.24	0.22	100.0
25	ST Fe oxide 05	7.08	0.09	0.63	70.3	2.56	1.03	0.53	0.00	0.04	0.29	0.10	0.03	17.3	100.0	7.08	0.09	0.63	70.3	2.56	1.03	0.53	0.00	0.04	0.29	0.10	0.03	17.3	100.0	10.8	0.10	1.14	80.8	3.32	2.36	0.86	0.00	0.08	0.38	0.08	0.03	100.0
26	ST Fe oxide 06	0.06	0.00	0.02	101.1	0.02	0.01	0.05	0.00	0.01	0.01	0.02	0.00	0.00	101.3	0.06	0.00	0.02	99.8	0.02	0.01	0.05	0.00	0.01	0.01	0.02	0.00	0.00	100.0	0.08	0.00	0.03	99.7	0.02	0.02	0.07	0.00	0.02	0.01	0.02	0.00	100.0
27	ST Fe oxide 08	2.97	0.02	0.21	86.7	0.08	0.13	0.60	0.05	0.01	0.06	1.19	0.13	7.84	100.0	2.97	0.02	0.21	86.7	0.08	0.13	0.60	0.05	0.01	0.06	1.19	0.13	7.84	100.0	4.22	0.02	0.34	92.9	0.10	0.27	0.92	0.13	0.02	0.07	0.88	0.14	100.0
28	ST Fe oxide 09	3.12	0.00	0.10	84.1	0.05	0.19	0.40	0.00	0.02	0.04	0.02	0.08	11.9	100.0	3.12	0.00	0.10	84.0	0.05	0.19	0.40	0.00	0.02	0.04	0.02	0.08	11.9	100.0	4.63	0.00	0.17	93.9	0.06	0.41	0.64	0.00	0.05	0.05	0.02	0.09	100.0
29	ST Fe oxide 10	4.10	0.01	0.09	84.6	0.19	0.26	0.54	0.08	0.01	0.15	0.09	0.37	9.57	100.0	4.10	0.01	0.09	84.6	0.19	0.26	0.54	0.08	0.01	0.15	0.09	0.37	9.57	100.0	5.88	0.01	0.15	91.5	0.23	0.56	0.83	0.22	0.02	0.18	0.07	0.40	100.0
30	ST Fe oxide 11	17.1	0.20	1.92	44.8	0.05	0.00	1.08	0.03	0.24	0.24	0.00	0.01	34.4	100.0	17.1	0.20	1.92	44.8	0.05	0.00	1.08	0.02	0.24	0.24	0.00	0.01	34.4	100.0	31.1	0.27	4.10	61.3	0.07	0.01	2.10	0.09	0.55	0.37	0.00	0.01	100.0
31	ST Fe oxide 12	3.71	0.00	0.20	85.7	0.13	0.13	0.49	0.02	0.02	0.14	0.30	0.07	9.10	100.0	3.71	0.00	0.20	85.7	0.13	0.13	0.49	0.02	0.02	0.14	0.30	0.07	9.10	100.0	5.34	0.00	0.33	92.6	0.16	0.27	0.75	0.04	0.03	0.17	0.22	0.07	100.0
32	ST Fe oxide 13	4.54	0.01	0.80	75.6	0.75	0.54	0.32	0.01	0.00	0.05	0.19	0.07	17.1	100.0	4.54	0.01	0.80	75.6	0.75	0.54	0.32	0.01	0.00	0.05	0.19	0.07	17.1	100.0	7.06	0.02	1.47	88.4	0.98	1.24	0.53	0.04	0.00	0.07	0.15	0.08	100.0
33	ST Fe oxide 14	3.07	0.02	0.16	83.5	0.07	0.23	0.42	0.02	0.00	0.06	0.09	0.14	12.2	100.0	3.07	0.02	0.16	83.5	0.07	0.23	0.42	0.02	0.00	0.06	0.09	0.14	12.2	100.0	4.57	0.02	0.28	93.5	0.09	0.50	0.67	0.05	0.01	0.07	0.07	0.16	100.0
34	ST Fe oxide 15	5.46	0.02	0.43	75.2	0.07	0.55	0.37	0.00	0.03	0.02	0.23	0.18	17.5	100.0	5.46	0.02	0.43	75.2	0.07	0.55	0.37	0.00	0.03	0.02	0.23	0.18	17.5	100.0	8.52	0.02	0.80	88.2	0.09	1.28	0.62	0.00	0.06	0.03	0.19	0.22	100.0
35	ST Fe oxide 16	3.89	0.00	0.08	85.0	0.05	0.21	0.41	0.00	0.00	0.06	0.05	0.11	10.2	100.0	3.89	0.00	0.08	85.0	0.05	0.21	0.41	0.00	0.00	0.06	0.05	0.11	10.2	100.0	5.65	0.00	0.13	92.9	0.06	0.45	0.63	0.00	0.00	0.07	0.04	0.12	100.0
36	ST Fe oxide 17	3.66	0.00	0.00	84.6	0.00	0.23	0.60	0.04	0.02	0.03	0.00	0.47	10.4	100.0	3.66	0.00	0.00	84.6	0.00	0.23	0.60	0.04	0.02	0.03	0.00	0.47	10.4	100.0	5.32	0.00	0.00	92.6	0.00	0.49	0.93	0.11	0.03	0.04	0.00	0.51	100.0
37	ST Fe oxide 18	0.13	0.33	0.07	0.33	89.2	2.59	2.99	0.19	1.77	0.04	0.00	0.06	2.28	100.0	0.13	0.33	0.07	0.33	89.2	2.59	2.99	0.19	1.77	0.04	0.00	0.06	2.27	100.0	0.16	0.29	0.09	0.29	87.8	4.48	3.72	0.43	2.63	0.04	0.00	0.05	100.0
38	ST Fe oxide 19	3.61	0.02	0.07	85.7	0.08	0.11	0.45	0.00	0.01	0.03	0.08	0.08	9.74	100.0	3.61	0.02	0.07	85.7	0.08	0.11	0.45	0.00	0.01	0.03	0.08	0.08	9.74	100.0	5.23	0.02	0.11	93.4	0.10	0.25	0.70	0.00	0.01	0.04	0.06	0.08	100.0
39	ST Fe oxide 20	2.58	0.02	0.19	83.9	0.21	0.53	0.48	0.00	0.01	0.03	0.20	0.21	11.7	100.0	2.58	0.02	0.19	83.9	0.21	0.53	0.48	0.00	0.01	0.03	0.20	0.21	11.7	100.0	3.81	0.02	0.32	93.2	0.26	1.16	0.76	0.00	0.02	0.04	0.16	0.23	100.0
40	ST Fe oxide 21	2.89	0.00	0.00	81.0	0.02	0.16	0.28	0.03	0.01	0.01	0.03	0.23	15.4	100.0	2.89	0.00	0.00	81.0	0.02	0.16	0.28	0.03	0.01	0.01	0.03	0.23	15.3	100.0	4.47	0.00	0.00	94.3	0.03	0.36	0.47	0.09	0.02	0.01	0.03	0.27	100.0
41	ST Fe oxide 22	3.98	0.01	0.68	84.5	0.07	0.12	0.45	0.00	0.00	0.03	0.03	0.09	10.0	100.0	3.98	0.01	0.68	84.5	0.07	0.12	0.45	0.00	0.00	0.03	0.03	0.09	10.00	100.0	5.75	0.01	1.16	91.9	0.09	0.27	0.69	0.00	0.00	0.04	0.02	0.10	100.0
42	ST Fe oxide 23	3.50	0.02	0.42	82.9	0.03	0.28	0.41	0.01	0.01	0.06	0.21	0.22	11.9	100.0	3.50	0.02	0.42	82.9	0.03	0.28	0.41	0.01	0.01	0.06	0.21	0.22	11.9	100.0	5.18	0.02	0.73	92.3	0.04	0.62	0.65	0.01	0.01	0.07	0.16	0.24	100.0
	Max	17.1	0.33	1.92	101.1	89.2	2.59	2.99	0.19	1.77	0.29	1.19	2.84	34.4	101.3	17.1	0.33	1.92	99.8	89.2	2.59	2.99	0.19	1.77	0.29	1.19	2.84	34.4	100.0	31.1	0.29	4.10	99.7	87.8	4.48	3.72	0.43	2.63	0.38	0.88	3.11	100.0
	Min	0.06	0.00	0.00	0.33	0.00	0.00	0.05	0.00	0.00	0.01	0.00	0.00	0.00	100.0	0.06	0.00	0.00	0.33	0.00	0.00	0.05	0.00	0.00	0.01	0.00	0.00	0.00	100.0	0.08	0.29	0.00	0.29	0.00	0.01	0.07	0.00	0.00	0.01	0.00	0.00	100.0
	Ave	4.24	0.04	0.38	77.6	4.26	0.38	0.58	0.02	0.10	0.06	0.19	0.27	11.9	100.1	4.24	0.04	0.38	77.6	4.26	0.38	0.58	0.02	0.10	0.06	0.19	0.27	11.9	100.0	6.55	0.04	0.69	86.0	4.26	0.79	0.89	0.07	0.17	0.08	0.15	0.29	100.0

Point	Comment	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	As2O5	SO3	H2O (by difference)	Total	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	As2O5	SO3	H2O (by difference)	Total	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	As2O5	SO3	Total
43	Column 13 Fe oxide 01	3.18	0.10	0.12	92.9	0.16	0.00	0.05	0.00	0.00	0.04	0.00	0.01	3.42	100.0	3.18	0.10	0.12	92.9	0.16	0.00	0.05	0.00	0.00	0.04	0.00	0.01	3.42	100.0	4.32	0.11	0.19	95.1	0.18	0.00	0.07	0.00	0.00	0.04	0.00	0.01	100.0
44	Column 13 Fe oxide 02	0.03	0.05	0.13	98.7	0.10	0.00	0.03	0.03	0.00	0.01	0.00	0.00	0.91	100.0	0.03	0.05	0.13	98.7	0.10	0.00	0.03	0.03	0.00	0.01	0.00	0.00	0.91	100.0	0.04	0.05	0.20	99.5	0.11	0.00	0.04	0.08	0.00	0.01	0.00	0.00	100.0
45	Column 13 Fe oxide 03	0.25	0.05	0.20	92.0	1.47	0.05	0.17	0.01	0.00	0.00	0.00	0.01	5.82	100.0	0.25	0.05	0.20	92.0	1.47	0.05	0.17	0.01	0.00	0.00	0.00	0.01	5.82	100.0	0.35	0.05	0.34	97.1	1.75	0.10	0.25	0.02	0.00	0.00	0.00	0.01	100.0
46	Column 13 Fe oxide 04	0.49	0.24	0.48	95.6	0.10	0.00	0.03	0.01	0.01	0.05	0.09	0.00	2.96	100.0	0.49	0.24	0.48	95.5	0.10	0.00	0.03	0.01	0.01	0.05	0.09	0.00	2.96	100.0	0.66	0.24	0.76	98.0	0.12	0.00	0.04	0.02	0.02	0.06	0.07	0.00	100.0
47	Column 13 Fe oxide 05	4.75	0.14	0.16	90.2	0.40	0.10	0.26	0.00	0.04	0.03	0.03	0.02	3.90	100.0	4.75	0.14	0.16	90.2	0.40	0.10	0.26	0.00	0.04	0.03	0.03	0.02	3.90	100.0	6.44	0.14	0.26	92.0	0.46	0.21	0.37	0.00	0.07	0.03	0.02	0.02	100.0
48	Column 13 Fe oxide 06	0.10	0.04	0.19	98.4	0.07	0.02	0.00	0.00	0.03	0.04	0.00	0.00	1.14	100.0	0.10	0.04	0.19	98.4	0.07	0.02	0.00	0.00	0.03	0.04	0.00	0.00	1.14	100.0	0.13	0.04	0.30	99.3	0.07	0.03	0.00	0.00	0.04	0.04	0.00	0.00	100.0
49	Column 13 Fe oxide 07	9.71	0.00	3.94	55.8	0.11	0.14	0.52	2.54	4.45	2.67	0.17	2.19	17.7	100.0	9.71	0.00	3.94	55.8	0.11	0.14	0.52	2.54	4.45	2.67	0.17	2.19	17.7	100.0	13.5	0.00	6.47	58.5	0.13	0.29	0.77	6.85	7.90	3.15	0.12	2.29	100.0
50	Column 13 Fe oxide 08	3.74	0.03	0.12	91.6	0.13	0.00	0.28	0.07	0.02	0.03	0.03	0.01	3.93	100.0	3.74	0.03	0.12	91.6	0.13	0.00	0.28	0.

Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)
ım current = 20 nA; beam diameter = 5 microns.
rhodonite (Mn), natural albite (Na), natural adularia (K), synthetic Ca2P2O7 (P), synthetic loellingite (As), natural anhydrite (S)
mit are calculated at far right of sheet.

		Oxide Weight %														Normalised Weight %												
Point	Comment	Si	Ti	Al	Fe	Mn	Mg	Ca	Na	K	P	As	S	H	Total	Si	Ti	Al	Fe	Mn	Mg	Ca	Na	K	P	As	S	H	Total
1	GT Fe oxide 01	2.91	0.00	0.48	54.6	0.05	0.23	0.35	0.03	0.02	0.19	1.02	0.01	1.34	61.2	2.91	0.00	0.48	54.6	0.05	0.23	0.35	0.03	0.02	0.19	1.02	0.01	1.34	61.2
2	GT Fe oxide 02	1.58	0.51	0.66	62.1	0.00	0.00	0.05	0.07	0.05	0.00	0.37	0.01	0.56	66.0	1.58	0.51	0.66	62.1	0.00	0.00	0.05	0.07	0.05	0.00	0.37	0.01	0.56	66.0
3	GT Fe oxide 03	2.08	0.00	1.31	51.8	0.04	0.25	0.35	0.02	0.05	0.19	0.70	0.06	1.84	58.7	2.08	0.00	1.31	51.8	0.04	0.25	0.35	0.02	0.05	0.19	0.70	0.06	1.84	58.7
4	GT Fe oxide 04	3.74	0.00	1.98	47.5	0.06	0.27	0.72	0.01	0.42	0.05	2.16	0.04	1.71	58.6	3.74	0.00	1.98	47.5	0.06	0.27	0.72	0.01	0.42	0.05	2.16	0.04	1.71	58.6
5	GT Fe oxide 05	1.44	0.00	0.17	58.3	0.02	0.40	0.26	0.01	0.00	0.16	0.38	0.06	1.24	62.5	1.44	0.00	0.17	58.3	0.02	0.40	0.26	0.01	0.00	0.16	0.38	0.06	1.24	62.5
6	GT Fe oxide 06	1.34	0.00	0.61	52.8	0.03	0.21	0.62	0.03	0.00	0.19	2.13	0.03	1.78	59.7	1.34	0.00	0.61	52.8	0.03	0.21	0.62	0.03	0.00	0.19	2.13	0.03	1.78	59.7
7	GT Fe oxide 07	1.32	0.00	0.44	50.8	0.02	0.20	0.94	0.05	0.00	0.43	3.25	0.04	1.86	59.3	1.32	0.00	0.44	50.8	0.02	0.20	0.94	0.05	0.00	0.43	3.25	0.04	1.86	59.3
8	GT Fe oxide 08	2.48	0.01	1.45	52.8	0.03	0.21	0.17	0.00	0.05	0.09	0.28	0.02	1.69	59.3	2.48	0.01	1.45	52.8	0.03	0.21	0.17	0.00	0.05	0.09	0.28	0.02	1.69	59.3
9	GT Fe oxide 09	2.82	0.00	0.40	51.5	0.02	0.15	0.59	0.01	0.04	0.19	1.95	0.00	1.72	59.4	2.82	0.00	0.40	51.5	0.02	0.15	0.59	0.01	0.04	0.19	1.95	0.00	1.72	59.4
10	GT Fe oxide 10	1.52	0.01	0.09	60.6	0.01	0.16	0.35	0.00	0.01	0.14	0.58	0.15	0.86	64.4	1.52	0.01	0.09	60.6	0.01	0.16	0.35	0.00	0.01	0.14	0.58	0.15	0.86	64.4
11	GT Fe oxide 11	0.66	0.00	1.30	50.8	0.15	0.46	0.87	0.02	0.02	0.25	3.08	0.02	1.85	59.5	0.66	0.00	1.30	50.8	0.15	0.46	0.87	0.02	0.02	0.25	3.07	0.02	1.85	59.5
12	GT Fe oxide 12	3.81	0.01	0.34	54.9	0.19	0.30	0.70	0.01	0.07	0.04	0.21	0.06	1.16	61.8	3.81	0.01	0.34	54.9	0.19	0.30	0.70	0.01	0.07	0.04	0.21	0.06	1.16	61.8
13	GT Fe oxide 13	0.23	0.53	0.13	66.5	0.02	0.08	0.02	0.02	0.04	0.00	0.00	0.01	0.34	67.9	0.23	0.53	0.13	66.5	0.02	0.08	0.02	0.02	0.04	0.00	0.00	0.01	0.34	67.9
14	GT Fe oxide 14	1.27	0.01	0.71	51.8	0.04	0.21	1.14	0.01	0.07	0.20	3.41	0.05	1.65	60.5	1.27	0.01	0.71	51.8	0.04	0.21	1.14	0.01	0.07	0.20	3.41	0.05	1.65	60.5
15	GT Fe oxide 15	0.07	0.00	0.00	70.9	0.03	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.00	71.0	0.07	0.00	0.00	69.8	0.03	0.00	0.01	0.01	0.01	0.00	0.01	0.00	0.00	69.9
16	GT Fe oxide 16	1.17	0.00	0.02	59.1	0.03	0.31	0.46	0.01	0.01	0.02	0.27	0.10	1.24	62.7	1.17	0.00	0.02	59.1	0.03	0.31	0.46	0.01	0.01	0.02	0.27	0.10	1.24	62.7
17	GT Fe oxide 17	0.73	0.00	0.89	49.6	0.12	0.19	1.16	0.03	0.00	0.57	4.09	0.03	1.89	59.3	0.73	0.00	0.89	49.6	0.12	0.19	1.16	0.03	0.00	0.57	4.09	0.03	1.89	59.3
18	GT Fe oxide 18	0.68	0.00	0.80	50.1	0.11	0.19	1.11	0.05	0.01	0.50	3.98	0.04	1.88	59.4	0.68	0.00	0.80	50.1	0.11	0.19	1.11	0.05	0.01	0.50	3.98	0.04	1.88	59.4
19	GT Fe oxide 19	2.27	0.00	0.71	50.8	0.04	0.33	0.46	0.00	0.03	0.25	1.52	0.01	1.94	58.3	2.27	0.00	0.71	50.8	0.04	0.33	0.46	0.00	0.03	0.25	1.52	0.01	1.94	58.3
20	GT Fe oxide 20	2.08	0.01	0.52	53.4	0.07	0.34	0.78	0.00	0.03	0.24	2.33	0.06	1.42	61.3	2.08	0.01	0.52	53.4	0.07	0.34	0.78	0.00	0.03	0.24	2.32	0.06	1.42	61.3
	Max	3.81	0.53	1.98	70.9	0.19	0.46	1.16	0.07	0.42	0.57	4.09	0.15	1.94	71.0	3.81	0.53	1.98	69.8	0.19	0.46	1.16	0.07	0.42	0.57	4.09	0.15	1.94	69.9
	Min	0.07	0.00	0.00	47.5	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	58.3	0.07	0.00	0.00	47.5	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	58.3
	Ave	1.71	0.05	0.65	55.0	0.05	0.22	0.56	0.02	0.05	0.19	1.58	0.04	1.40	61.5	1.71	0.05	0.65	55.0	0.05	0.22	0.56	0.02	0.05	0.19	1.58	0.04	1.40	61.5

Point	Comment	Si	Ti	Al	Fe	Mn	Mg	Ca	Na	K	P	As	S	H	Total	Si	Ti	Al	Fe	Mn	Mg	Ca	Na	K	P	As	S	H	Total
21	ST Fe oxide 01	1.36	0.00	0.00	58.3	0.00	0.16	0.26	0.00	0.01	0.00	0.01	1.14	1.14	62.4	1.36	0.00	0.00	58.3	0.00	0.16	0.26	0.00	0.01	0.00	0.01	1.14	1.14	62.4
22	ST Fe oxide 02	1.58	0.00	0.16	61.2	0.00	0.13	0.32	0.02	0.01	0.01	0.18	0.05	0.86	64.6	1.58	0.00	0.16	61.2	0.00	0.13	0.32	0.02	0.01	0.01	0.18	0.05	0.86	64.5
23	ST Fe oxide 03	3.27	0.01	0.64	51.3	0.09	0.24	0.43	0.04	0.00	0.01	0.57	0.07	1.82	58.5	3.27	0.01	0.64	51.3	0.09	0.24	0.43	0.04	0.00	0.01	0.57	0.07	1.82	58.5
24	ST Fe oxide 04	2.16	0.03	0.38	58.8	0.00	0.11	0.32	0.00	0.02	0.01	0.25	0.08	1.05	63.2	2.16	0.03	0.38	58.8	0.00	0.11	0.32	0.00	0.02	0.01	0.25	0.08	1.05	63.2
25	ST Fe oxide 05	3.31	0.05	0.34	49.2	1.98	0.62	0.38	0.00	0.03	0.13	0.08	0.01	1.93	58.0	3.31	0.05	0.34	49.2	1.98	0.62	0.38	0.00	0.03	0.13	0.08	0.01	1.93	58.0
26	ST Fe oxide 06	0.03	0.00	0.01	70.7	0.01	0.01	0.04	0.00	0.01	0.00	0.02	0.00	0.00	70.9	0.03	0.00	0.01	69.8	0.01	0.01	0.03	0.00	0.01	0.00	0.02	0.00	0.00	69.9
27	ST Fe oxide 08	1.39	0.01	0.11	60.6	0.07	0.08	0.43	0.04	0.01	0.02	0.90	0.05	0.88	64.6	1.39	0.01	0.11	60.6	0.07	0.08	0.43	0.04	0.01	0.02	0.90	0.05	0.88	64.6
28	ST Fe oxide 09	1.46	0.00	0.05	58.8	0.04	0.11	0.29	0.00	0.02	0.02	0.02	0.03	1.33	62.2	1.46	0.00	0.05	58.8	0.04	0.11	0.29	0.00	0.02	0.02	0.02	0.03	1.33	62.2
29	ST Fe oxide 10	1.92	0.01	0.05	59.1	0.15	0.16	0.38	0.06	0.01	0.06	0.07	0.15	1.07	63.2	1.92	0.01	0.05	59.1	0.15	0.16	0.38	0.06	0.01	0.06	0.07	0.15	1.07	63.2
30	ST Fe oxide 11	7.99	0.12	1.02	31.3	0.04	0.00	0.77	0.02	0.20	0.11	0.00	0.00	3.84	45.4	7.99	0.12	1.02	31.3	0.04	0.00	0.77	0.02	0.20	0.11	0.00	0.00	3.84	45.4
31	ST Fe oxide 12	1.73	0.00	0.10	59.9	0.10	0.08	0.35	0.01	0.02	0.06	0.22	0.03	1.02	63.7	1.73	0.00	0.10	59.9	0.10	0.08	0.35	0.01	0.02	0.06	0.22	0.03	1.02	63.7
32	ST Fe oxide 13	2.12	0.01	0.43	52.9	0.58	0.32	0.23	0.01	0.00	0.02	0.14	0.03	1.91	58.7	2.12	0.01	0.43	52.9	0.58	0.32	0.23	0.01	0.00	0.02	0.14	0.03	1.91	58.7
33	ST Fe oxide 14	1.44	0.01	0.08	58.4	0.05	0.14	0.30	0.01	0.00	0.03	0.07	0.06	1.36	62.0	1.44	0.01	0.08	58.4	0.05	0.14	0.30	0.01	0.00	0.03	0.07	0.06	1.36	62.0
34	ST Fe oxide 15	2.55	0.01	0.23	52.6	0.05	0.33	0.27	0.00	0.02	0.01	0.18	0.07	1.95	58.2	2.55	0.01	0.23	52.6	0.05	0.33	0.27	0.00	0.02	0.01	0.18	0.07	1.95	58.2
35	ST Fe oxide 16	1.82	0.00	0.04	59.5	0.04	0.12	0.29	0.00	0.00	0.02	0.04	0.04	1.13	63.0	1.82	0.00	0.04	59.5	0.04	0.12	0.29	0.00	0.00	0.02	0.04	0.04	1.13	63.0
36	ST Fe oxide 17	1.71	0.00	0.00	59.1	0.00	0.14	0.43	0.03	0.01	0.01	0.00	0.19	1.16	62.8	1.71	0.00	0.00	59.1	0.00	0.14	0.43	0.03	0.01	0.01	0.00	0.19	1.16	62.8
38	ST Fe oxide 19	1.69	0.01	0.04	60.0	0.06	0.07	0.32	0.00	0.01	0.01	0.06	0.03	1.09	63.3	1.69	0.01	0.04	60.0	0.06	0.07	0.32	0.00	0.01	0.01	0.06	0.03	1.09	63.3
39	ST Fe oxide 20	1.21	0.01	0.10	58.7	0.16	0.32	0.35	0.00	0.01	0.01	0.15	0.08	1.30	62.4	1.21	0.01	0.10	58.7	0.16	0.32	0.35	0.00	0.01	0.01	0.15	0.08	1.30	62.4
40	ST Fe oxide 21	1.35	0.00	0.00	56.6	0.02	0.09	0.20	0.02	0.01	0.00	0.02	0.09	1.71	60.2	1.35	0.00	0.00	56.6	0.02	0.09	0.20	0.02	0.01	0.00	0.02	0.09	1.71	60.2
41	ST Fe oxide 22	1.86	0.01	0.36	59.1	0.05	0.07	0.32	0.00	0.00	0.01	0.02	0.04	1.12	63.0	1.86	0.01	0.36	59.1	0.05	0.07	0.32	0.00	0.00	0.01	0.02	0.04	1.12	63.0
42	ST Fe oxide 23	1.64	0.01	0.22	58.0	0.03	0.17	0.29	0.00	0.01	0.02	0.16	0.09	1.33	62.0	1.64	0.01	0.22	58.0	0.03	0.17	0.29	0.00	0.01	0.02	0.16	0.09	1.33	62.0
	Max	7.99	0.12	1.02	70.7	1.98	0.62	0.77	0.06	0.20	0.13	0.90	1.14	3.84	70.9	7.99	0.12	1.02	69.8	1.98	0.62	0.77	0.06	0.20	0.13	0.90	1.14	3.84	69.9
	Min	0.03	0.00	0.00	31.3	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	45.4	0.03	0.00	0.00	31.3	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	45.4
	Ave	2.07	0.01	0.21	56.9	0.17	0.16	0.33	0.01	0.02	0.03	0.15	0.11	1.38	61.5	2.07	0.01	0.21	56.8	0.17	0.16	0.33	0.01	0.02	0.03	0.15	0.11	1.38	61.5

Point	Comment	Si	Ti	Al	Fe	Mn	Mg	Ca	Na	K	P	As	S	H	Total	Si	Ti	Al	Fe	Mn	Mg	Ca	Na	K	P	As	S	H	Total
43	Column 13 Fe oxide 01	1.49	0.06	0.06	65.0	0.12	0.00	0.03	0.00	0.00	0.02	0.00	0.01	0.38	67.2	1.49	0.06	0.06	65.0	0.12	0.00	0.03	0.00	0.00	0.02	0.00	0.01	0.38	67.2
44	Column 13 Fe oxide 02	0.01	0.03	0.07	69.0	0.08	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.10	69.4	0.01	0.03	0.07	69.0	0.08	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.10	69.4
45	Column 13 Fe oxide 03	0.11	0.03	0.11	64.3	1.14	0.03	0.12	0.01	0.00	0.00	0.00	0.00	0.65	66.5	0.11	0.03	0.11	64.3	1.14	0.03	0.12	0.01	0.00	0.00	0.00	0.00	0.65	66.5
46	Column 13 Fe oxide 04	0.23	0.14	0.25	66.8	0.08	0.00	0.02	0.01	0.01	0.02	0.07	0.00	0.33	68.0	0.23	0.14	0.25	66.8	0.08	0.00	0.02	0.01	0.01	0.02	0.07	0.00	0.33	68.0
47	Column 13 Fe oxide 05	2.22	0.08	0.09	63.1	0.31	0.06	0.18	0.00	0.03	0.01	0.02	0.01	0.44	66.5	2.22	0.08	0.09	63.1	0.31	0.06	0.18	0.00	0.03	0.01	0.02	0.01	0.44	66.5
48	Column 13 Fe oxide 06	0.05	0.03	0.10	68.8	0.05	0.01	0.00	0.00	0.02	0.02	0.00	0.00	0.13	69.2	0.05	0.03	0.10	68.8	0.05	0.01	0.00	0.00	0.02	0.02	0.00	0.00	0.13	69.2
49	Column 13 Fe oxide 07	4.54	0.00	2.09	39.0	0.09	0.08	0.37	1.88	3.69	1.17	0.13	0.88	1.98	55.9	4.54	0.00	2.09	39.0	0.09	0.08	0.37	1.88	3.69	1.17	0.13	0.88	1.98	55.9
50	Column 13 Fe oxide 08	1.75	0.02	0.06	64.1	0.10	0.00	0.20	0.05	0.02	0.01	0.02	0.00	0.44	66.8	1.75	0.02	0.06	64.1	0.10	0.00	0.20	0.05	0.02	0.01	0.02	0.00	0.44	66.8
51	Column 13 Fe oxide 09	0.74	0.10	0.14	65.5	0.09	0.00	0.07	0.00	0.03	0.14	0.02	0.01	0.42	67.2	0.74	0.10	0.14	65.5	0.09	0.00	0.07	0.00	0.03	0.14	0.02	0.01	0.42	67.2
52	Column 13 Fe oxide 10	1.08	0.28	0.19	64.9	0.07	0.03	0.07	0.06	0.05	0.03	0.02	0.00	0.40	67.2	1.08	0.28	0.19	64.9	0.07	0.03	0.07	0.06	0.05	0.03	0.02	0.00	0.40	67.2
53	Column 13 Fe oxide 11	6.75	0.14	5.61	43.1	0.01	0.02	0.28	0.06	0.03	0.24	0.10	0.01	1.32	57.7	6.75	0.14	5.61	43.1	0.01	0.02	0.28	0.06	0.03	0.24	0.10	0.01	1.32	57.7
54	Column 13 Fe oxide 12	0.64	0.07	0.48	63.5	0.04	0.01	0.02	0.01	0.02	0.02	0.01	0.02	0.74	65.6	0.64	0.07	0.48	63.5	0.04	0.01	0.02	0.01	0.02	0.02	0.01	0.02	0.74	65.6
55	Column 13 Fe oxide 13	0.86	0.06	0.04	67.3	0.08	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.18	68.5	0.86	0.06	0.04	67.2	0.08	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.18	68.5
	Max	6.75	0.28	5.61	69.0	1.14	0.08	0.37	1.88	3.69	1.17	0.13	0.88	1.98	70.9	6.75	0.28	5.61	69.0	1.14	0.08	0.37	1.88	3.69	1.17	0.13	0.88	1.98	69.9
	Min	0.01	0.00	0.04	39.0	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	45.4	0.01	0.00	0.04	39.0	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	45.4
	Ave	1.57	0.08	0.71	61.9	0.17	0.02	0.11	0.16	0.30	0.13	0.03	0.07	0.58	64.0	1.57	0.08	0.71	61.9	0.17	0.02	0.11	0.16	0.30	0.13	0.03	0.07	0.58	64.0

Point	Comment	Si	Ti	Al	Fe	Mn	Mg	Ca	Na	K	P	As	S	H	Total	Si	Ti	Al	Fe	Mn	Mg	Ca	Na	K	P	As	S	H	Total
56	SS Fe oxide 01	2.34	0.37	1.12	60.1	0.02	0.01	0.15	0.03	0.09	0.03	0.30	0.00	0.61	65.2	2.34	0.37	1.12	60.1	0.02	0.01	0.15	0.03	0.09	0.03	0.30	0.00	0.61	65.2
57	SS Fe oxide 02	0.02	0.02	0.01	72.1	0.04	0.00	0.04	0.00	0.03	0.01	0.01	0.00	0.00	72.3	0.02	0.02	0.01	69.8	0.04	0.00	0.04	0.00	0.03	0.01	0.01	0.00	0.00	69.9
58	SS Fe oxide 03	2.42	0.62	1.48	58.1	0.00	0.17	0.08	0.07	0.46	0.05	0.06	0.02	0.74	64.3	2.42	0.62	1.48	58.1	0.00	0.17	0.08	0.07	0.46	0.05	0.06	0.02	0.74	64.3
59	SS Fe oxide 04	3.29	0.56	2.31	58.0	0.03	0.10	0.15	0.05	0.25	0.01	0.17	0.00	0.41	65.3	3.29	0.56	2.31	58.0	0.03	0.10	0.15	0.05	0.25	0.01	0.17	0.00	0.41	65.3
	Max	3.29	0.62	2.31	72.1	0.04	0.17	0.15	0.07	0.46	0.05	0.30	0.02	0.74	72.3	6.75	0.62	5.61	69.8	1.14	0.17	0.37	1.88	3.69	1.17	0.30	0.88	1.98	69.9
	Min	0.02	0.02	0.01	58.0	0.00	0.00	0.04	0.00	0.03	0.01	0.01	0.00	0.00	64.3	0.01	0.00	0.01	39.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.4
	Ave	2.02	0.39	1.23	62.1	0.02	0.07	0.10	0.04	0.21	0.03	0.13	0.01	0.44	66.8	1.84	0.15	1.03	61.0	0.18	0.03	0.11	0.21	0.44	0.15	0.05	0.10	0.60	65.0

Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)
Accelerating potential = 15 kV; beam current = 40 nA; beam diameter = 5 microns.
Standards: natural zircon NMNH 117288-3 (Si, Zr, Hf), synthetic UO2 (U), synthetic YPO4 USNM 168499 (Y), synthetic CeO2 (Ce), natural hematite (Fe), natural apatite (Ca)
Precision and detection limit are calculated at far right of sheet.

Zircon:

	Oxide Weight %										Normalised Oxide Weight %									
Point	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**	**Point**	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**
	DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03			DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03	
1	GT zircon 01	32.5	66.4	1.29	0.20	0.11	0.04	0.09	0.02	100.7	1	GT zircon 01	32.3	66.0	1.28	0.20	0.11	0.04	0.09	0.02	100.0
2	GT zircon 02	32.3	65.8	2.12	0.51	0.10	0.02	0.07	0.02	100.9	2	GT zircon 02	32.0	65.2	2.10	0.51	0.10	0.02	0.07	0.02	100.0
3	GT zircon 03	32.7	66.5	1.61	0.06	0.03	0.00	0.10	0.02	101.0	3	GT zircon 03	32.4	65.8	1.59	0.06	0.03	0.00	0.10	0.02	100.0
4	GT zircon 04	29.8	62.5	1.38	0.69	0.94	0.13	0.29	0.67	96.3	4	GT zircon 04	30.9	64.8	1.43	0.72	0.97	0.13	0.30	0.70	100.0
5	GT zircon 05	32.6	67.0	1.31	0.01	0.00	0.00	0.01	0.03	101.0	5	GT zircon 05	32.3	66.3	1.30	0.01	0.00	0.00	0.01	0.03	100.0
6	GT zircon 06	32.5	66.4	1.20	0.15	0.20	0.00	0.04	0.01	100.4	6	GT zircon 06	32.3	66.1	1.20	0.15	0.20	0.00	0.04	0.01	100.0
7	GT zircon 07	32.0	64.6	0.94	0.48	1.18	0.07	0.05	0.01	99.4	7	GT zircon 07	32.2	65.1	0.95	0.48	1.18	0.07	0.05	0.01	100.0
8	GT zircon 08	32.5	65.9	1.32	0.15	0.15	0.01	0.06	0.01	100.1	8	GT zircon 08	32.5	65.8	1.32	0.15	0.15	0.01	0.06	0.01	100.0
9	GT zircon 09	32.6	65.9	1.19	0.10	0.07	0.01	0.02	0.01	99.9	9	GT zircon 09	32.6	66.0	1.19	0.10	0.07	0.01	0.02	0.01	100.0
10	GT zircon 10	31.8	64.9	1.41	0.33	0.43	0.02	0.11	0.11	99.1	10	GT zircon 10	32.1	65.5	1.42	0.33	0.43	0.02	0.11	0.11	100.0
11	GT zircon 11	32.5	65.4	1.53	0.28	0.15	0.02	0.10	0.02	100.0	11	GT zircon 11	32.5	65.4	1.53	0.28	0.15	0.02	0.10	0.02	100.0
12	GT zircon 12	32.4	65.9	1.33	0.24	0.16	0.03	0.06	0.03	100.1	12	GT zircon 12	32.3	65.8	1.33	0.24	0.16	0.03	0.06	0.03	100.0
13	GT zircon 13	32.6	65.8	1.12	0.16	0.17	0.00	0.04	0.00	99.8	13	GT zircon 13	32.6	65.9	1.12	0.16	0.17	0.00	0.04	0.00	100.0
14	GT zircon 14	32.3	64.9	2.06	0.30	0.09	0.00	0.03	0.02	99.7	14	GT zircon 14	32.4	65.1	2.07	0.31	0.09	0.00	0.03	0.02	100.0
15	GT zircon 15	32.5	66.3	1.15	0.13	0.13	0.00	0.08	0.00	100.3	15	GT zircon 15	32.5	66.1	1.14	0.13	0.13	0.00	0.08	0.00	100.0
	Max	32.7	67.0	2.12	0.69	1.18	0.13	0.29	0.67	101.0		Max	32.6	66.3	2.10	0.72	1.18	0.13	0.30	0.70	100.0
	Min	29.8	62.5	0.94	0.01	0.00	0.00	0.01	0.00	96.3		Min	30.9	64.8	0.95	0.01	0.00	0.00	0.01	0.00	100.0
	Ave	32.2	65.6	1.40	0.25	0.26	0.02	0.08	0.07	99.9		Ave	32.3	65.7	1.40	0.25	0.26	0.02	0.08	0.07	100.0

Point	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**	**Point**	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**
	DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03			DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03	
16	ST zircon 02	33.0	66.4	1.27	0.10	0.12	0.02	0.13	0.01	101.0	16	ST zircon 02	32.6	65.8	1.26	0.10	0.12	0.02	0.13	0.01	100.0
17	ST zircon 03	32.5	66.4	1.32	0.05	0.08	0.01	0.07	0.00	100.5	17	ST zircon 03	32.4	66.1	1.31	0.05	0.08	0.01	0.07	0.00	100.0
18	ST zircon 04	32.6	66.6	1.06	0.06	0.35	0.01	0.06	0.01	100.7	18	ST zircon 04	32.3	66.1	1.05	0.06	0.34	0.01	0.06	0.01	100.0
19	ST zircon 06	32.8	66.4	1.56	0.03	0.01	0.03	0.05	0.01	100.9	19	ST zircon 06	32.5	65.8	1.55	0.03	0.01	0.03	0.05	0.01	100.0
20	ST zircon 07	33.3	65.5	1.52	0.07	0.05	0.01	0.04	0.00	100.5	20	ST zircon 07	33.1	65.2	1.51	0.07	0.05	0.01	0.04	0.00	100.0
21	ST zircon 08	32.5	65.8	1.48	0.50	0.25	0.01	0.05	0.03	100.6	21	ST zircon 08	32.3	65.4	1.47	0.49	0.25	0.01	0.05	0.03	100.0
22	ST zircon 10	32.5	66.2	1.24	0.11	0.14	0.00	0.09	0.03	100.3	22	ST zircon 10	32.4	66.0	1.24	0.11	0.14	0.00	0.09	0.03	100.0
	Max	33.3	66.6	1.56	0.50	0.35	0.03	0.13	0.03	101.0		Max	33.1	66.1	1.55	0.49	0.34	0.03	0.13	0.03	100.0
	Min	32.5	65.5	1.06	0.03	0.01	0.00	0.04	0.00	100.3		Min	32.3	65.2	1.05	0.03	0.01	0.00	0.04	0.00	100.0
	Ave	32.7	66.2	1.35	0.13	0.14	0.01	0.07	0.02	100.7		Ave	32.5	65.8	1.34	0.13	0.14	0.01	0.07	0.01	100.0

Point	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**	**Point**	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**
	DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03			DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03	
23	Column 13 zircon 01	31.3	63.8	1.51	0.79	0.61	0.04	0.07	0.05	98.2	23	Column 13 zircon 01	31.9	65.0	1.54	0.80	0.62	0.04	0.07	0.05	100.0
24	Column 13 zircon 02	32.6	64.9	1.34	0.32	0.23	0.00	0.07	0.05	99.5	24	Column 13 zircon 02	32.7	65.3	1.35	0.32	0.23	0.00	0.07	0.05	100.0
25	Column 13 zircon 03	32.7	65.7	1.22	0.18	0.18	0.00	0.04	0.02	100.0	25	Column 13 zircon 03	32.7	65.7	1.22	0.18	0.18	0.00	0.04	0.02	100.0
26	Column 13 zircon 04	32.0	65.5	1.34	0.18	0.17	0.00	0.03	0.03	99.3	26	Column 13 zircon 04	32.2	66.0	1.35	0.18	0.17	0.00	0.03	0.03	100.0
27	Column 13 zircon 05	32.0	64.1	1.52	0.78	0.64	0.01	0.02	0.00	99.0	27	Column 13 zircon 05	32.3	64.7	1.54	0.78	0.64	0.01	0.02	0.00	100.0
28	Column 13 zircon 06	32.1	64.1	0.88	0.46	0.92	0.02	0.86	0.07	99.4	28	Column 13 zircon 06	32.3	64.4	0.88	0.46	0.93	0.02	0.87	0.07	100.0
29	Column 13 zircon 07	30.6	60.4	1.24	1.13	1.86	0.10	1.22	0.50	97.1	29	Column 13 zircon 07	31.5	62.2	1.28	1.16	1.92	0.11	1.26	0.51	100.0
30	Column 13 zircon 08	32.1	64.0	1.58	0.96	0.52	0.00	0.04	0.06	99.3	30	Column 13 zircon 08	32.4	64.4	1.59	0.97	0.52	0.00	0.04	0.06	100.0
	Max	32.7	65.7	1.58	1.13	1.86	0.10	1.22	0.50	100.0		Max	32.7	66.0	1.59	1.16	1.92	0.11	1.26	0.51	100.0
	Min	30.6	60.4	0.88	0.18	0.17	0.00	0.02	0.00	97.1		Min	31.5	62.2	0.88	0.18	0.17	0.00	0.02	0.00	100.0
	Ave	31.9	64.1	1.33	0.60	0.64	0.02	0.30	0.10	99.0		Ave	32.2	64.7	1.34	0.61	0.65	0.02	0.30	0.10	100.0

Point	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**	**Point**	**Comment**	**SiO2**	**ZrO2**	**HfO2**	**UO2**	**Y2O3**	**Ce2O3**	**FeO**	**CaO**	**Total**
	DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03			DL	0.05	0.10	0.03	0.02	0.03	0.05	0.03	0.03	
31	SS zircon 01	32.6	65.8	1.09	0.20	0.46	0.01	0.06	0.02	100.2	31	SS zircon 01	32.5	65.7	1.09	0.20	0.46	0.01	0.06	0.02	100.0
32	SS zircon 02	32.4	66.1	1.10	0.13	0.24	0.00	0.05	0.02	100.0	32	SS zircon 02	32.4	66.0	1.10	0.13	0.24	0.00	0.05	0.02	100.0
33	SS zircon 03	32.9	66.8	1.14	0.06	0.13	0.02	0.23	0.09	101.4	33	SS zircon 03	32.5	65.9	1.13	0.06	0.12	0.01	0.23	0.09	100.0
34	SS zircon 04	32.7	66.3	1.29	0.14	0.14	0.00	0.04	0.02	100.6	34	SS zircon 04	32.5	65.8	1.28	0.13	0.14	0.00	0.04	0.02	100.0
35	SS zircon 05	32.8	66.0	1.44	0.19	0.25	0.00	0.03	0.01	100.8	35	SS zircon 05	32.6	65.5	1.43	0.19	0.25	0.00	0.03	0.01	100.0
36	SS zircon 06	32.7	66.3	1.31	0.00	0.03	0.00	0.05	0.01	100.3	36	SS zircon 06	32.5	66.1	1.31	0.00	0.03	0.00	0.05	0.01	100.0
37	SS zircon 07	32.5	65.3	0.98	0.24	0.77	0.00	0.15	0.03	99.9	37	SS zircon 07	32.5	65.3	0.98	0.24	0.77	0.00	0.15	0.03	100.0
38	SS zircon 08	33.5	66.4	0.89	0.02	0.15	0.00	0.30	0.07	101.3	38	SS zircon 08	33.0	65.6	0.88	0.02	0.14	0.00	0.29	0.07	100.0
39	SS zircon 09	32.7	66.1	1.64	0.08	0.20	0.00	0.06	0.04	100.8	39	SS zircon 09	32.4	65.6	1.63	0.08	0.20	0.00	0.06	0.04	100.0
40	SS zircon 10	33.0	66.6	1.44	0.03	0.03	0.01	0.19	0.04	101.2	40	SS zircon 10	32.5	65.7	1.42	0.03	0.03	0.01	0.19	0.04	100.0
41	SS zircon 11	32.9	65.9	1.05	0.20	0.41	0.03	0.03	0.03	100.6	41	SS zircon 11	32.7	65.6	1.04	0.19	0.40	0.03	0.03	0.03	100.0
	Max	33.5	66.8	1.64	0.24	0.77	0.03	0.30	0.09	101.4		Max	33.0	66.1	1.63	0.24	0.77	0.03	0.29	0.09	100.0
	Min	32.4	65.3	0.89	0.00	0.03	0.00	0.03	0.01	99.9		Min	32.4	65.3	0.88	0.00	0.03	0.00	0.03	0.01	100.0
	Ave	32.8	66.1	1.21	0.12	0.25	0.01	0.11	0.04	100.7		Ave	32.6	65.7	1.21	0.12	0.25	0.01	0.11	0.04	100.0

Matrix corrections: JEOL PC-EPMA version 1.11.2.0: atomic number/absorption correction = XPP (Pouchou and Pichoir - exponential $\varphi(\rho z)$ function). MAC database = FFAST (Chantler *et al*. 2005). Fluorescence correction = Reed (1965)
Accelerating potential = 15 kV; beam current = 20 nA; beam diameter = 10 microns.
Standards: natural zircon NMNH 117288-3 (Si), synthetic ThO2 (Th), synthetic UO2 (U), synthetic YPO4 USNM 168499 (Y), synthetic CeO2 (Ce), natural hematite (Fe), natural rhodonite Harvard 104791 (Mn), synthetic Ca2P2O7 (Ca, P), natural albite (Na), synthetic loellingite (As), natural apatite (F), natural tugtupite ROM M32790 (Cl)
Precision and detection limit are calculated at far right of sheet.

		Weight % oxide or element															
Point	Comment	SiO2	ThO2	UO2	Y2O3	Ce2O3	FeO	MnO	CaO	Na2O	P2O5	As2O5	F	Cl	O = F	O = Cl	Total
	DL	0.03	0.07	0.03	0.05	0.09	0.04	0.04	0.05	0.05	0.06	0.05	0.15	0.01			
1	GT apatite 01	0.09	0.01	0.00	0.09	0.00	0.03	0.08	55.2	0.00	42.1	0.00	3.86	0.00	1.63	0.00	99.8
2	GT apatite 02	0.45	0.01	0.00	0.51	0.17	0.05	0.13	55.0	0.01	41.7	0.00	3.64	0.00	1.53	0.00	100.2
3	GT apatite 03	0.04	0.00	0.00	0.15	0.02	0.03	0.04	55.4	0.00	42.3	0.00	4.27	0.01	1.80	0.00	100.4
4	GT apatite 04	0.00	0.00	0.00	0.00	0.02	0.01	0.02	55.8	0.00	42.6	0.01	3.59	0.03	1.51	0.01	100.6
5	GT apatite 05	0.01	0.01	0.00	0.02	0.00	0.05	0.10	55.3	0.01	42.5	0.00	3.35	0.01	1.41	0.00	99.9
6	GT apatite 06	0.02	0.00	0.00	0.02	0.00	0.01	0.03	55.2	0.00	42.2	0.00	3.19	0.02	1.34	0.00	99.3
7	GT apatite 07	0.03	0.02	0.03	0.06	0.02	0.02	0.04	55.5	0.00	41.9	0.05	4.13	0.01	1.74	0.00	100.1
8	ST apatite 01	0.04	0.03	0.02	0.00	0.03	0.08	0.03	55.7	0.00	42.6	0.00	3.14	0.03	1.32	0.01	100.3
9	ST apatite 02	0.00	0.00	0.00	0.00	0.00	0.02	0.02	55.6	0.00	42.6	0.02	3.87	0.05	1.63	0.01	100.5
10	ST apatite 03	0.02	0.00	0.00	0.03	0.02	0.04	0.00	55.6	0.02	42.5	0.01	3.75	0.01	1.58	0.00	100.4
11	Column 13 apatite 01	0.27	0.00	0.00	0.42	0.07	0.11	0.25	53.7	0.07	42.1	0.02	4.28	0.01	1.80	0.00	99.4
12	Column 13 apatite 02	0.51	0.02	0.00	0.77	0.02	0.04	0.13	54.3	0.05	41.7	0.02	4.36	0.02	1.84	0.00	100.1
13	Column 13 apatite 03	0.72	0.04	0.01	0.86	0.33	0.07	0.36	53.6	0.09	40.8	0.00	3.78	0.02	1.59	0.01	99.1
14	Column 13 apatite 04	0.18	0.01	0.00	0.43	0.01	0.04	0.20	54.3	0.07	42.0	0.01	4.41	0.03	1.86	0.01	99.9
15	SS apatite 01	0.03	0.00	0.00	0.00	0.00	0.05	0.08	55.3	0.00	42.4	0.00	3.98	0.01	1.68	0.00	100.2
16	SS apatite 02	0.04	0.00	0.00	0.05	0.05	0.05	0.03	55.2	0.00	42.4	0.01	3.45	0.02	1.45	0.01	99.9
17	SS apatite 03	0.00	0.00	0.00	0.01	0.00	0.05	0.00	55.4	0.00	42.3	0.00	3.89	0.05	1.64	0.01	100.0
18	SS apatite 04	0.06	0.01	0.00	0.01	0.00	0.10	0.06	55.2	0.00	42.3	0.00	4.46	0.01	1.88	0.00	100.3
19	SS apatite 05	0.02	0.00	0.01	0.04	0.00	0.04	0.04	55.8	0.00	42.7	0.02	3.56	0.03	1.50	0.01	100.7
29	SS apatite 06	0.01	0.00	0.00	0.01	0.04	0.00	0.03	55.6	0.00	42.6	0.00	4.46	0.01	1.88	0.00	100.9
21	SS apatite 07	0.00	0.00	0.00	0.00	0.00	0.07	0.02	55.8	0.00	42.5	0.00	3.74	0.04	1.57	0.01	100.6
22	SS apatite 08	0.00	0.00	0.00	0.05	0.03	0.07	0.05	55.5	0.00	42.6	0.00	3.14	0.02	1.32	0.00	100.1
23	SS apatite 09	0.00	0.03	0.00	0.03	0.00	0.05	0.03	55.2	0.02	42.3	0.00	4.56	0.02	1.92	0.00	100.3
24	SS apatite 10	0.02	0.00	0.00	0.00	0.00	0.06	0.02	55.6	0.00	42.5	0.00	3.93	0.02	1.65	0.00	100.5
	Max	0.72	0.04	0.03	0.86	0.33	0.11	0.36	55.8	0.09	42.7	0.05	4.56	0.05	1.92	0.01	100.9
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53.6	0.00	40.8	0.00	3.14	0.00	1.32	0.00	99.1
	Ave	0.11	0.01	0.00	0.15	0.03	0.05	0.08	55.2	0.01	42.3	0.01	3.87	0.02	1.63	0.00	100.1

		Normalised weight % oxide or element															
Point	Comment	SiO2	ThO2	UO2	Y2O3	Ce2O3	FeO	MnO	CaO	Na2O	P2O5	As2O5	F	Cl	O = F	O = Cl	Total
	DL	0.03	0.07	0.03	0.05	0.09	0.04	0.04	0.05	0.05	0.06	0.05	0.15	0.01			
1	GT apatite 01	0.09	0.01	0.00	0.09	0.00	0.03	0.08	55.3	0.00	42.2	0.00	3.87	0.00	1.63	0.00	100.0
2	GT apatite 02	0.45	0.01	0.00	0.51	0.17	0.05	0.13	54.9	0.01	41.7	0.00	3.63	0.00	1.53	0.00	100.0
3	GT apatite 03	0.04	0.00	0.00	0.15	0.02	0.03	0.04	55.1	0.00	42.1	0.00	4.25	0.01	1.79	0.00	100.0
4	GT apatite 04	0.00	0.00	0.00	0.00	0.02	0.01	0.02	55.5	0.00	42.4	0.01	3.57	0.03	1.50	0.01	100.0
5	GT apatite 05	0.01	0.01	0.00	0.02	0.00	0.05	0.10	55.3	0.01	42.5	0.00	3.35	0.01	1.41	0.00	100.0
6	GT apatite 06	0.02	0.00	0.00	0.02	0.00	0.01	0.03	55.6	0.00	42.5	0.00	3.21	0.02	1.35	0.00	100.0
7	GT apatite 07	0.03	0.02	0.03	0.06	0.02	0.02	0.04	55.4	0.00	41.9	0.05	4.13	0.01	1.74	0.00	100.0
8	ST apatite 01	0.04	0.03	0.02	0.00	0.03	0.08	0.03	55.5	0.00	42.5	0.00	3.13	0.03	1.32	0.01	100.0
9	ST apatite 02	0.00	0.00	0.00	0.00	0.00	0.02	0.02	55.3	0.00	42.4	0.02	3.85	0.05	1.62	0.01	100.0
10	ST apatite 03	0.02	0.00	0.00	0.03	0.02	0.04	0.00	55.4	0.02	42.3	0.01	3.73	0.01	1.57	0.00	100.0
11	Column 13 apatite 01	0.27	0.00	0.00	0.42	0.07	0.11	0.26	54.0	0.07	42.3	0.02	4.30	0.01	1.81	0.00	100.0
12	Column 13 apatite 02	0.51	0.02	0.00	0.77	0.02	0.04	0.13	54.3	0.05	41.6	0.02	4.35	0.02	1.83	0.00	100.0
13	Column 13 apatite 03	0.72	0.04	0.01	0.87	0.33	0.08	0.37	54.1	0.10	41.2	0.00	3.82	0.02	1.61	0.01	100.0
14	Column 13 apatite 04	0.18	0.01	0.00	0.43	0.01	0.04	0.20	54.4	0.07	42.1	0.01	4.42	0.03	1.86	0.01	100.0
15	SS apatite 01	0.03	0.00	0.00	0.00	0.00	0.05	0.08	55.2	0.00	42.3	0.00	3.97	0.01	1.67	0.00	100.0
16	SS apatite 02	0.04	0.00	0.00	0.05	0.05	0.05	0.03	55.3	0.00	42.5	0.01	3.45	0.02	1.45	0.01	100.0
17	SS apatite 03	0.00	0.00	0.00	0.01	0.00	0.05	0.00	55.4	0.00	42.3	0.00	3.89	0.05	1.64	0.01	100.0
18	SS apatite 04	0.06	0.01	0.00	0.01	0.00	0.10	0.06	55.0	0.00	42.2	0.00	4.45	0.01	1.87	0.00	100.0
19	SS apatite 05	0.02	0.00	0.01	0.04	0.00	0.04	0.04	55.4	0.00	42.4	0.02	3.53	0.03	1.49	0.01	100.0
29	SS apatite 06	0.01	0.00	0.00	0.01	0.04	0.00	0.03	55.1	0.00	42.2	0.00	4.42	0.01	1.86	0.00	100.0
21	SS apatite 07	0.00	0.00	0.00	0.00	0.00	0.07	0.02	55.4	0.00	42.3	0.00	3.72	0.04	1.56	0.01	100.0
22	SS apatite 08	0.00	0.00	0.00	0.05	0.03	0.07	0.05	55.4	0.00	42.5	0.00	3.14	0.02	1.32	0.00	100.0
23	SS apatite 09	0.00	0.03	0.00	0.03	0.00	0.05	0.03	55.0	0.02	42.2	0.00	4.54	0.02	1.91	0.00	100.0
24	SS apatite 10	0.02	0.00	0.00	0.00	0.00	0.06	0.02	55.4	0.00	42.3	0.00	3.91	0.02	1.65	0.00	100.0
	Max	0.72	0.04	0.03	0.87	0.33	0.11	0.37	55.6	0.10	42.5	0.05	4.54	0.05	1.91	0.01	100.0
	Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	54.0	0.00	41.2	0.00	3.13	0.00	1.32	0.00	100.0
	Ave	0.11	0.01	0.00	0.15	0.03	0.05	0.08	55.1	0.01	42.2	0.01	3.86	0.02	1.63	0.00	100.0

Lorax Enviromental Services
16607-101
MI7007-MAR18
5/5/2018

	Sample	+x µm	+x µm	+x µm	+x µm

Data															
		GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
Modals	Pyrite	0.22	0	0.8	0.14	0.55	0.01	0.01	0.18	0.17	0.05	0.25	0.72	0.57	0.01
	Arsenopyrite	0.01	0	0.01	0	0.01	0	0.02	0.18	0.04	0.02	0.03	0	0	0.02
	Other Sulphides	0	0	0.03	0.01	0.01	0	0	0	0.01	0	0.01	0.01	0	0
	Quartz	45.8	51.24	29.23	26.03	33.43	44.45	53.71	56.54	32.68	39.4	34.87	28.92	43.39	51.77
	Plagioclase	9.84	2.79	12.99	20.66	20.37	9.75	2.04	1.54	27.5	19.78	22.21	13.79	2	2.89
	K-Feldspar	16.23	2.15	7.71	10.98	12.03	20.4	9.86	9.04	29.56	28.35	10.14	7.88	4.78	9.16
	Sericite/Muscovite	9.59	16.22	9.53	3.18	10.86	9.52	17.94	19.89	1.02	4.06	10.72	8.73	23.31	22.7
	Biotite	1.67	0.33	11.6	12.89	6.51	1.81	0.55	0.49	2.6	1.68	6.3	13.35	0.85	1.69
	Chlorite	0.33	0.74	2.05	3.1	1.01	0.43	0.65	0.56	0.2	0.25	1.09	1.75	0.77	0.51
	Clays	9.86	11.53	5.01	1.9	6.77	8.94	12.56	7.92	4.58	5.2	6.81	4.17	4.36	7.97
	Amphibole	0.3	0.37	0.97	3.02	0.29	0.04	0	0	0.01	0	0.25	0.73	0.64	0.01
	Other Silicates	1.36	2.57	2.97	5.3	2.42	1.15	1.39	1.12	0.5	0.6	2.07	2.48	2.14	1.24
	Oxides	0.52	3.78	0.46	0.68	0.45	1.11	0.99	1.04	0.88	0.49	0.34	0.65	1.32	1.43
	Calcite	0.75	4.36	9.53	11.09	2.51	1.23	0.01	0.01	0.03	0.02	2.28	10.45	7.11	0.31
	Dolomite	1.49	1.29	4.05	0.51	0.91	0.45	0	0	0	0	0.97	3.54	6.61	0.09
	Ankerite	1.91	2.2	2.62	0.31	1.67	0.51	0	0.02	0.06	0	1.45	2.29	1.91	0.06
	As-Fe Oxyhydroxide	0	0	0	0	0	0	0.24	1.3	0	0.01	0	0	0	0
	Apatite	0.11	0.25	0.41	0.17	0.2	0.15	0	0.01	0.16	0.05	0.15	0.45	0.13	0.09
	Monazite	0	0.01	0	0	0.01	0.04	0.02	0.01	0	0.02	0.01	0	0.01	0.04
	Sulphates	0.01	0.15	0.06	0.01	0.01	0.01	0	0	0.01	0.01	0.05	0.07	0.08	0.01
	Fe-Sb Phase	0	0	0	0	0	0	0	0.11	0	0	0	0	0	0
	Other	0	0	0.01	0	0	0	0.01	0.03	0	0.02	0	0.01	0.01	0.02
As Deportment															
	Pyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
	Arsenopyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.08	0.02	0.01	0.01	0.00	0.00	0.01
	Enargite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Oxides	0.01	0.04	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.02	0.02
	As-Fe Oxyhydroxide	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.42	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sb Phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
S Deportment															
	Pyrite	0.11	0.00	0.42	0.07	0.29	0.00	0.00	0.09	0.09	0.03	0.13	0.38	0.29	0.00
	Arsenopyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.01	0.00	0.00	0.00
	Other Sulphides	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Oxides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sulphates	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00
	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sb Deportment															
	Stibnite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sb Phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	Al (QEMSCAN)	6.81	6.32	6.28	6.18	7.64	6.94	7.49	6.75	7.08	6.84	7.59	6.08	6.48	7.54
	Al (Chemical)	6.72	6.51	6.35	6.67	7.15	6.88	7.57	6.46	7.20	7.09	7.30	6.62	6.03	7.15
Elemental Mass (%)	As (QEMSCAN)	0.01	0.05	0.02	0.01	0.02	0.01	0.10	0.52	0.03	0.02	0.02	0.02	0.03	0.03
	As (Chemical)	0.02	0.04	0.00	0.01	0.01	0.02	0.32	0.63	0.03	0.01	0.00		0.14	0.08
	Ca (QEMSCAN)	1.27	2.66	6.04	6.16	2.11	0.84	0.04	0.04	0.84	0.49	1.95	6.23	4.83	0.22
	Ca (Chemical)	1.23	2.29	5.69	5.79	1.91	0.65	0.06	0.03	0.60	0.34	1.75	5.43	4.42	0.24
	Fe (QEMSCAN)	1.28	3.16	3.36	3.32	2.26	1.31	1.34	1.67	0.97	0.70	2.01	3.45	2.13	1.60
	Fe (Chemical)	1.69	3.27	3.38	3.01	2.33	1.72	1.58	1.71	1.38	1.10	2.27	3.40	2.87	2.19
	K (QEMSCAN)	3.01	1.31	2.70	2.90	2.93	3.60	2.52	2.51	4.45	4.38	2.64	2.84	2.15	2.81
	K (Chemical)	3.01	1.62	2.60	2.61	2.81	3.35	2.40	2.28	3.91	4.01	2.66	2.62	2.37	2.86
	Mg (QEMSCAN)	0.44	0.38	1.77	1.65	0.77	0.25	0.10	0.09	0.19	0.14	0.76	1.73	1.14	0.17
	Mg (Chemical)	0.55	0.55	1.76	1.60	0.79	0.25	0.15	0.24	0.15	0.10	0.79	1.69	1.21	0.29
	Mn (QEMSCAN)	0.06	0.07	0.07	0.01	0.04	0.02	0.02	0.03	0.14	0.02	0.04	0.06	0.06	0.01
	Mn (Chemical)	0.03	0.05	0.06	0.07	0.04	0.02	0.02	0.01	0.07	0.03	0.04	0.06	0.05	0.04
	Na (QEMSCAN)	0.80	0.21	0.88	1.46	1.60	0.81	0.17	0.12	1.95	1.46	1.76	0.92	0.13	0.24
	Na (Chemical)	0.77	0.04	0.80	1.53	1.36	0.73	0.11	0.10	2.01	1.46	1.64	0.90	0.04	0.21
	P (QEMSCAN)	0.02	0.05	0.08	0.03	0.04	0.03	0.00	0.00	0.03	0.01	0.03	0.08	0.03	0.02
	P (Chemical)	0.03	0.06	0.05	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.06	0.04	0.04
	S (QEMSCAN)	0.11	0.02	0.42	0.07	0.29	0.00	0.01	0.13	0.10	0.03	0.14	0.38	0.31	0.01
	S (Chemical)	0.11	0.03	0.42	0.09	0.20	0.03	0.02	0.12	0.04	0.02	0.19	0.45	0.17	0.02
	Sb (QEMSCAN)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
	Sb (Chemical)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00		0.00	0.00
	Si (QEMSCAN)	34.33	32.33	26.70	27.82	31.42	34.68	35.73	36.00	34.70	35.68	31.97	26.64	29.28	35.11
	Si (Chemical)	33.14	32.02	27.02	28.51	31.97	34.96	35.06	36.04	34.91	35.34	32.11	26.88	30.01	34.82
	Ti (QEMSCAN)	0.17	0.52	0.32	0.35	0.23	0.23	0.24	0.29	0.08	0.14	0.19	0.36	0.42	0.33

Lorax Enviromental Services
16607-101
MI7007-MAR18
5/5/2018

Sample +x µm +x µm +x µm +x µm

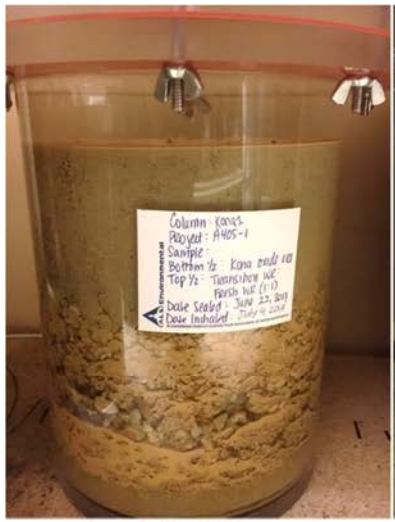
Data															
		GT	SO	SS	ST	GS-2	GO-3	Column 7 Res	Column 8 Res	Column 13 Res	Column 14 Res	FB-GS- Res	FB-SS- Res	72135B (SO-ORE)	72144B (GO-ORE)
	Ti (Chemical)	0.14	0.35	0.34	0.29	0.20	0.15	0.16	0.16	0.09	0.08	0.22	0.36	0.28	0.23
	Pyrite	0.2193	0.0025	0.7952	0.1431	0.5505	0.0052	0.0078	0.1751	0.1687	0.0486	0.2529	0.7187	0.5744	0.0055
	Arsenopyrite	0.0054	0.0008	0.0059	0.0000	0.0057	0.0000	0.0224	0.1758	0.0365	0.0176	0.0264	0.0000	0.0017	0.0207
	Chalcopyrite	0.0002	0.0010	0.0024	0.0025	0.0021	0.0011	0.0000	0.0011	0.0007	0.0006	0.0025	0.0021	0.0007	0.0003
	Galena	0.0001	0.0000	0.0182	0.0002	0.0005	0.0004	0.0002	0.0002	0.0008	0.0001	0.0004	0.0006	0.0006	0.0004
	Sphalerite	0.0000	0.0011	0.0040	0.0020	0.0014	0.0000	0.0000	0.0006	0.0011	0.0007	0.0005	0.0017	0.0017	0.0000
	Stibnite	0.0005	0.0000	0.0034	0.0034	0.0022	0.0005	0.0000	0.0000	0.0012	0.0003	0.0018	0.0020	0.0000	0.0000
	Other Sulphides	0.0000	0.0000	0.0018	0.0000	0.0000	0.0000	0.0019	0.0000	0.0074	0.0000	0.0000	0.0000	0.0004	0.0006
	Quartz/Feldspar	71.8587	56.1869	49.9289	57.6690	65.8253	74.5950	65.6127	67.1276	89.7397	87.5266	67.2129	50.5928	50.1616	63.8208
	Mica	11.2639	16.5504	21.1246	16.0714	17.3769	11.3369	18.4834	20.3880	3.6194	5.7353	17.0137	22.0764	24.1593	24.3862
	Chlorite	0.3305	0.7403	2.0454	3.1032	1.0097	0.4334	0.6456	0.5628	0.1985	0.2502	1.0939	1.7548	0.7731	0.5125
	Clays	9.8577	11.5331	5.0103	1.9014	6.7690	8.9435	12.5579	7.9184	4.5785	5.2015	6.8088	4.1705	4.3586	7.9665
	Amphibole	0.2986	0.3693	0.9683	3.0235	0.2896	0.0367	0.0000	0.0028	0.0130	0.0031	0.2549	0.7330	0.6419	0.0054
	Other Silicates	1.3608	2.5746	2.9674	5.3023	2.4151	1.1541	1.3856	1.1158	0.4957	0.5989	2.0722	2.4816	2.1387	1.2400
	Fe-Oxides	0.0432	0.5091	0.0227	0.0971	0.0402	0.1516	0.1152	0.0440	0.0502	0.0729	0.0356	0.0244	0.0742	0.1532
	Goethite	0.3602	2.8399	0.2555	0.3193	0.2408	0.7901	0.6344	0.6783	0.5305	0.2396	0.1479	0.2849	1.0093	0.9781
	Other Oxides	0.1256	0.4420	0.1936	0.2673	0.1686	0.1754	0.2444	0.3316	0.3293	0.1768	0.1541	0.3636	0.2434	0.3102
	Calcite	0.7497	4.3558	9.5260	11.0865	2.5062	1.2312	0.0070	0.0124	0.0286	0.0156	2.2845	10.4500	7.1127	0.3115
	Dolomite	1.4883	1.2919	4.0452	0.5107	0.9117	0.4456	0.0000	0.0000	0.0034	0.0002	0.9683	3.5357	6.6146	0.0866
	Ankerite	1.9040	2.1875	2.6053	0.3118	1.6628	0.5078	0.0017	0.0066	0.0308	0.0010	1.4501	2.2726	1.8985	0.0436
	As-Fe Oxyhydroxide	0.0006	0.0026	0.0004	0.0000	0.0000	0.0000	0.2426	1.3003	0.0004	0.0101	0.0008	0.0005	0.0041	0.0004
	Apatite	0.1140	0.2456	0.4075	0.1667	0.2017	0.1471	0.0034	0.0120	0.1570	0.0510	0.1516	0.4543	0.1329	0.0905
	Monazite	0.0030	0.0090	0.0000	0.0031	0.0055	0.0356	0.0176	0.0071	0.0014	0.0177	0.0053	0.0000	0.0066	0.0389
	Sulphates	0.0072	0.1503	0.0595	0.0138	0.0084	0.0063	0.0031	0.0042	0.0058	0.0090	0.0536	0.0680	0.0795	0.0081
	Fe-Sb Phase	0.0010	0.0000	0.0018	0.0006	0.0006	0.0000	0.0000	0.1079	0.0000	0.0000	0.0038	0.0007	0.0000	0.0000
	Other	0.0074	0.0063	0.0067	0.0013	0.0054	0.0025	0.0132	0.0275	0.0011	0.0227	0.0034	0.0108	0.0115	0.0200
Fe Deportment															
	Pyrite	0.10	0.00	0.36	0.07	0.25	0.00	0.00	0.08	0.07	0.02	0.11	0.33	0.27	0.00
	Arsenopyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.01	0.01	0.01	0.00	0.00	0.01
	Chalcopyrite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sphalerite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Other Sulphides	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Mica	0.43	0.37	1.82	1.87	1.13	0.44	0.43	0.47	0.38	0.32	1.10	2.05	0.58	0.69
	Chlorite	0.05	0.13	0.27	0.43	0.13	0.07	0.11	0.10	0.03	0.04	0.14	0.22	0.13	0.09
	Amphibole	0.03	0.03	0.08	0.26	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.06	0.06	0.00
	Other Silicates	0.13	0.30	0.22	0.39	0.27	0.15	0.27	0.15	0.11	0.11	0.26	0.17	0.15	0.11
	Fe-Oxides	0.03	0.36	0.02	0.07	0.03	0.11	0.08	0.03	0.04	0.05	0.02	0.02	0.05	0.11
	Goethite	0.20	1.56	0.14	0.18	0.13	0.43	0.35	0.37	0.29	0.13	0.08	0.16	0.56	0.54
	Other Oxides	0.01	0.06	0.02	0.01	0.02	0.02	0.03	0.04	0.03	0.02	0.02	0.06	0.02	0.05
	Ankerite	0.31	0.36	0.43	0.05	0.27	0.08	0.00	0.00	0.01	0.00	0.24	0.38	0.31	0.01
	As-Fe Oxyhydroxide	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.31	0.00	0.00	0.00	0.00	0.00	0.00
	Fe-Sb Phase	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00
	Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01
	Total	1.28	3.16	3.36	3.32	2.26	1.31	1.34	1.67	0.97	0.70	2.01	3.45	2.13	1.60

Mineral List	Sample ID	Data Values
Pyrite	GT	Sb Deportment
Arsenopyrite	SO	
Other Sulphides	SS	
Quartz	ST	
Plagioclase	GS-2	
K-Feldspar	GO-3	
Sericite/Muscovite	Column 7 Res	
Biotite	Column 8 Res	
Chlorite	Column 13 Res	
Clays	Column 14 Res	
Amphibole	FB-GS- Res	
Other Silicates	FB-SS- Res	
Oxides	72135B (SO-ORE)	
Calcite	72144B (GO-ORE)	
Dolomite		
Ankerite		
As-Fe Oxyhydroxide		
Apatite		
Monazite		
Sulphates		
Fe-Sb Phase		
Other		
Al (QEMSCAN)		
Al (Chemical)		
As (QEMSCAN)		
As (Chemical)		
Ca (QEMSCAN)		
Ca (Chemical)		
Fe (QEMSCAN)		
Fe (Chemical)		
K (QEMSCAN)		
K (Chemical)		
Mg (QEMSCAN)		
Mg (Chemical)		
Mn (QEMSCAN)		
Mn (Chemical)		
Na (QEMSCAN)		
Na (Chemical)		
P (QEMSCAN)		
P (Chemical)		
S (QEMSCAN)		
S (Chemical)		
Sb (QEMSCAN)		
Sb (Chemical)		
Si (QEMSCAN)		
Si (Chemical)		
Ti (QEMSCAN)		
Ti (Chemical)		
Mass %		
Stibnite		
Fe-Sb Phase		
Pyrite		
Arsenopyrite		
Enargite		
Oxides		
As-Fe Oxyhydroxide		
Fe-Sb Phase		
Pyrite		
Arsenopyrite		
Other Sulphides		
Oxides		
Sulphates		
Other		
Pyrite		
Arsenopyrite		
Chalcopyrite		
Galena		
Sphalerite		
Stibnite		
Other Sulphides		
Quartz/Feldspar		
Mica		
Chlorite		
Clays		
Amphibole		
Other Silicates		
Fe-Oxides		
Goethite		
Other Oxides		
Calcite		
Dolomite		
Ankerite		
As-Fe Oxyhydroxide		
Apatite		
Monazite		
Sulphates		
Fe-Sb Phase		
Other		
Pyrite		
Arsenopyrite		
Chalcopyrite		
Sphalerite		
Other Sulphides		
Mica		
Chlorite		
Amphibole		
Other Silicates		
Fe-Oxides		
Goethite		
Other Oxides		
Ankerite		
As-Fe Oxyhydroxide		
Fe-Sb Phase		
Other		

Appendix D: Photographs of Saturated Columns in Phase 1 through 3

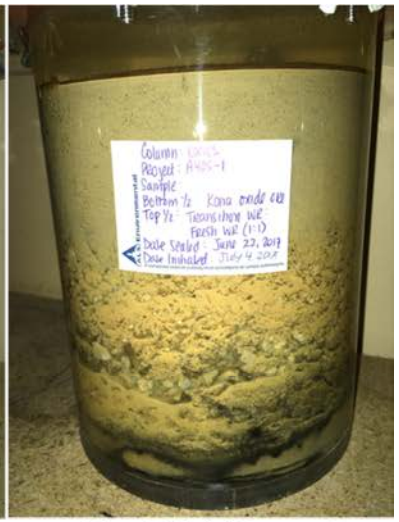
GOLDCORP

KONA 1


Phase 1: Week 12 (pre-seq.)


Phase 2: Week 11 (post-seq.)


Phase 3: Week 38 (post-seq.)


Phase 3: Week 46 (post-seq.)

KONA 2


Phase 1: Week 12 (pre-seq.)


Phase 2: Week 11 (post-seq.)


Phase 3: Week 38 (post-seq.)


Phase 3: Week 46 (post-seq.)

KONA 3



Phase 1: Week 12 (pre-seq.)



Phase 2: Week 16 (post-seq.)



Phase 3: Week 38 (post-seq.)

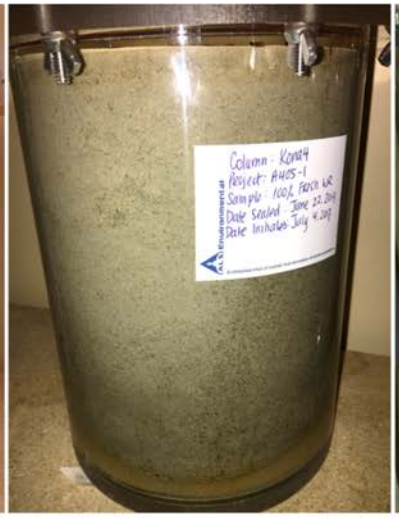


Phase 3: Week 46 (post-seq.)

KONA 4



Phase 1: Week 12 (pre-seq.)



Phase 2: Week 16 (post-seq.)



Phase 3: Week 38 (post-seq.)



Phase 3: Week 46 (post-seq.)

GO



Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)

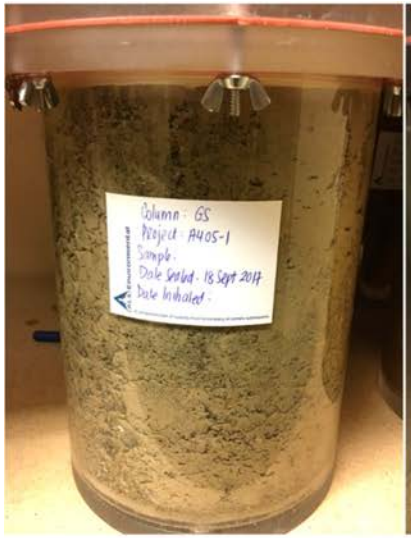


Phase 3: Week 38 (post-seq.)

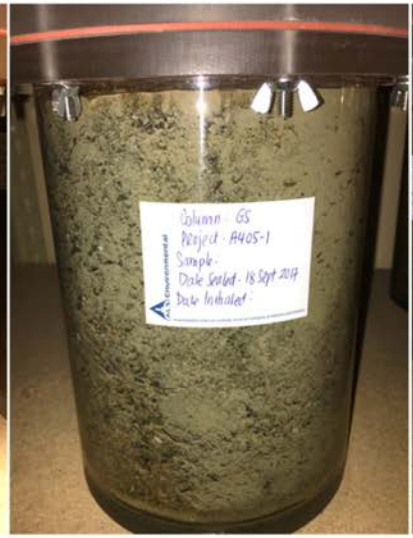


Phase 3: Week 46 (post-seq.)

GS



Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)

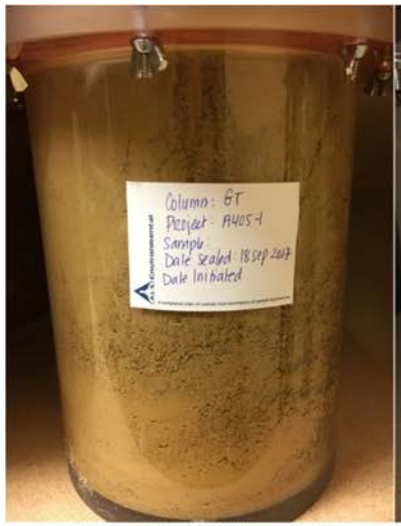


Phase 3: Week 38 (post-seq.)

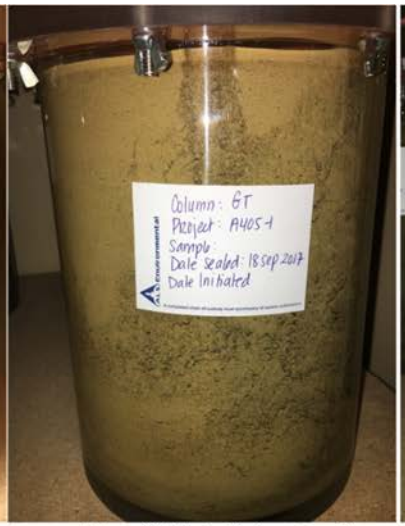


Phase 3: Week 46 (post-seq.)

GT



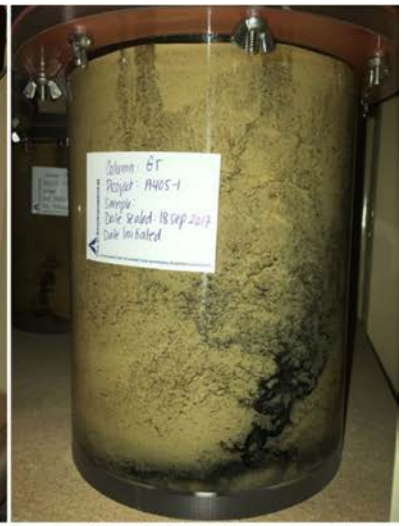
Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)



Phase 3: Week 38 (post-seq.)



Phase 3: Week 46 (post-seq.)

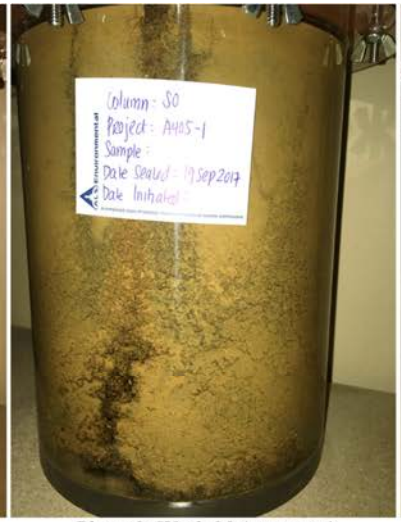
SO



Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)

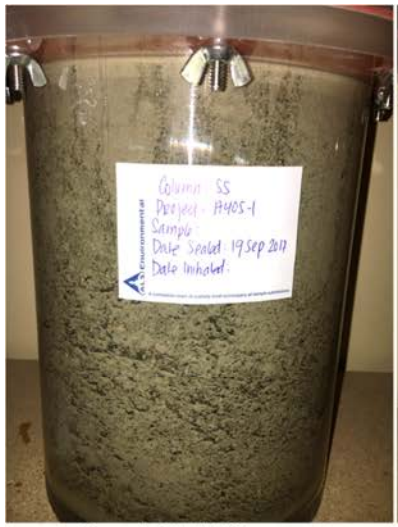


Phase 3: Week 38 (post-seq.)



Phase 3: Week 46 (post-seq.)

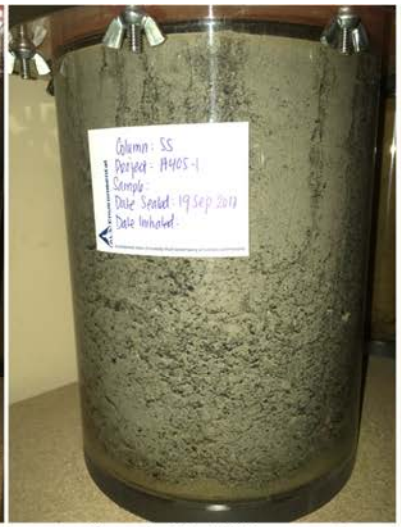
SS



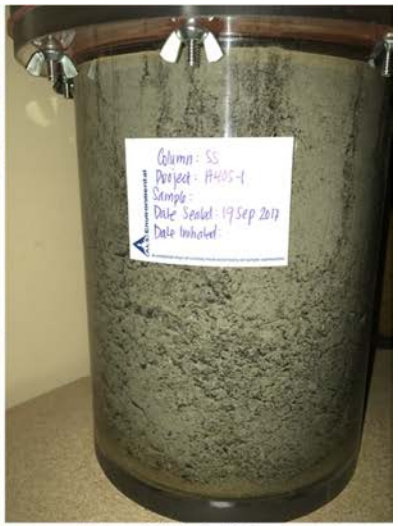
Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)

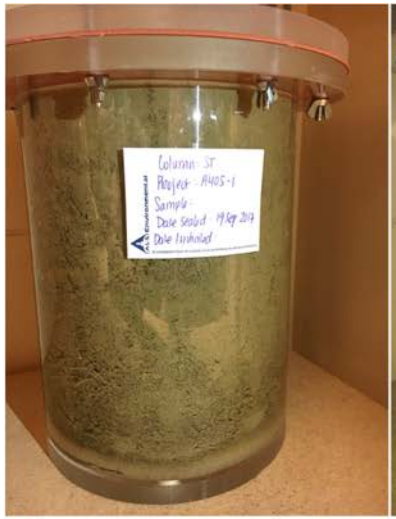


Phase 3: Week 38 (post-seq.)

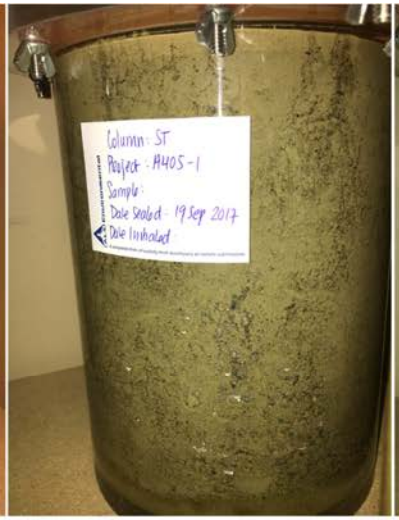


Phase 3: Week 46 (post-seq.)

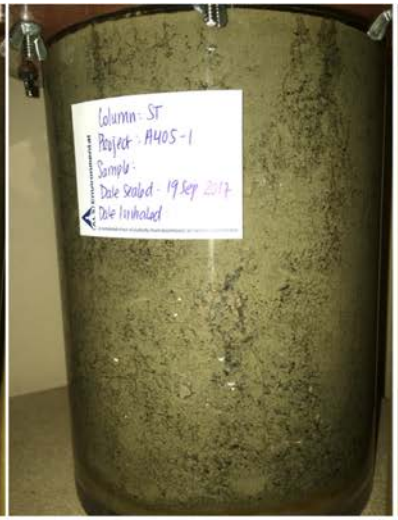
ST



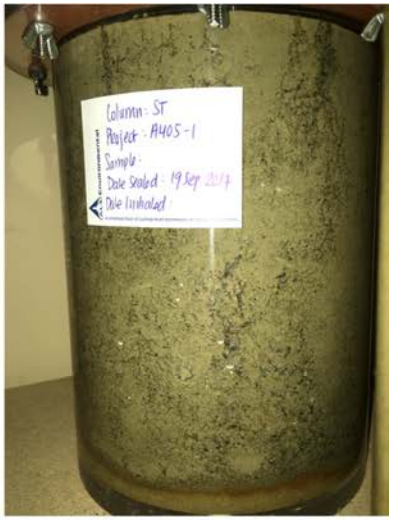
Phase 1: Week 12 (pre-seq.)



Phase 2: Week 11 (post-seq.)



Phase 3: Week 38 (post-seq.)



Phase 3: Week 46 (post-seq.)

Appendix E: PHREEQC Input File

GOLDCORP

Appendix E: Phreeqc Input

```
SELECTED_OUTPUT 1
   -file              selected.out
   -pH                 true
   -pe                true
   -charge_balance      true
   -totals             Fe(2) Fe(3) Mn(2) Mn(6) U(4) U(6) As(3)
                      As(5)
   -saturation_indices  Gypsum Fe(OH)3 Dolomite Jarosite
                      Siderite Rhodochrosite Manganite Gibbsite
                      Alunite SiO2(am) Celestite Goethite
                      Hydroxylapatite

SOLUTION                          1
   temp      25
pH                              7.08
   pe        4
   redox
   units     mg/l
   density   1

N(-3)                          0.117
Br                              0.05
Cl                              4.25
F                              0.215
P                             0.0228
S(6)                            11.8
S(-2)                         0.0015
Al                           0.00468
Sb                           0.00415
As                              1.67
Ba                           0.00142
Be                           0.00001
B                              0.077
Cd                         0.0000097
Ca                              8.66
Cr                            0.0001
Co                           0.00205
Cu                           0.00019
Fe                            0.0064
Pb                         0.0000181
Mg                              2.08
Mn                             0.994
Hg                         0.0000106
Mo                           0.00164
Ni                          0.000477
N(5)                           0.005
N(3)                          0.0011
K                               7.42
Se                          0.000085
Si                              7.05
Na                              7.81
Sr                            0.0427
U                            0.00125
Zn                           0.00209
Alkalinity                        46
 -water    1 # kg
end
```

Appendix D: Loading Rates

Newmont™
COFFEE

Test ID	Statistic	Sulphate	Al	Ag	As	Ca	Cd	Co	Cr	Cu	Fe	Hg	K
		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
FB-GO	Cumulative	1.14E-01	5.36E-05	2.24E-08	8.52E-05	2.05E-02	2.26E-08	4.42E-07	3.05E-06	2.98E-06	3.75E-05	1.03E-08	9.70E-03
FB-GS	Cumulative	2.98E-01	3.08E-06	9.24E-09	2.48E-05	6.47E-02	1.15E-08	1.95E-07	3.29E-07	1.04E-06	1.21E-05	3.64E-09	1.19E-02
FB-GT	Cumulative	9.97E-01	3.43E-06	1.30E-08	1.06E-05	1.96E-01	1.28E-08	3.19E-07	5.47E-07	8.62E-07	1.52E-05	4.99E-09	1.94E-02
FB-SO	Cumulative	6.53E-02	7.68E-06	9.79E-09	5.77E-06	1.37E-02	4.76E-09	1.85E-07	8.43E-07	7.17E-07	1.68E-05	7.21E-09	3.39E-03
FB-SS	Cumulative	5.38E-01	6.54E-06	1.72E-08	3.52E-06	1.10E-01	1.26E-08	2.65E-07	8.60E-07	1.15E-06	2.07E-05	6.19E-09	2.16E-02
FB-ST	Cumulative	6.95E-01	4.53E-06	1.35E-08	7.89E-06	1.21E-01	6.24E-09	5.93E-07	6.82E-07	8.59E-07	1.59E-05	5.00E-09	2.84E-02
FB-GGT	Cumulative	7.59E-01	1.58E-04	6.56E-08	1.01E-04	1.53E-01	3.72E-07	7.40E-05	1.02E-06	4.87E-05	4.00E-05	6.24E-09	4.12E-02
FB-GGS	Cumulative	4.73E-01	1.68E-05	2.14E-08	6.32E-05	1.24E-01	8.94E-08	3.93E-06	8.09E-07	1.23E-06	2.58E-05	7.29E-09	2.51E-02
HC 2	P75	2.44E+00	2.50E-02	1.00E-06	5.30E-03	5.37E+00	1.98E-06	3.06E-05	2.45E-05	2.25E-04	3.47E-03	4.95E-03	1.40E+00
HC 4	P75	1.48E+00	2.37E-02	9.90E-07	3.88E-03	4.42E+00	1.50E-06	1.12E-05	1.74E-05	2.47E-04	3.47E-03	4.95E-03	9.92E-01
HC 6	P75	1.07E+00	2.48E-02	5.88E-06	7.56E-03	1.37E+00	2.44E-06	3.68E-05	2.54E-05	1.52E-04	7.63E-03	4.95E-03	4.76E-01
Col 3	P75	1.52E-01	6.19E-05	8.13E-07	1.80E-04	5.41E-01	9.10E-08	7.29E-07	2.08E-05	1.55E-05	1.18E-04	1.68E-04	1.05E-01
Col 4	P75	9.59E-01	6.31E-05	8.41E-07	1.23E-04	7.06E-01	1.59E-07	1.20E-06	1.90E-05	2.27E-05	1.25E-04	1.78E-04	2.41E-01
Col 5	P75	2.03E-01	6.08E-05	7.75E-07	2.99E-04	4.82E-01	2.17E-07	9.27E-07	1.54E-05	1.85E-05	1.16E-04	1.66E-04	1.37E-01
Col 6	P75	2.92E-01	8.81E-05	7.88E-07	8.53E-04	5.69E-01	1.33E-07	7.73E-07	4.77E-06	1.50E-05	1.16E-04	1.65E-04	1.43E-01
Col 7	P75	9.63E-02	3.17E-03	2.52E-07	8.44E-03	4.57E-02	9.69E-08	1.90E-06	2.06E-06	2.35E-05	5.06E-04	3.08E-04	2.55E-02
Col 8	P75	1.27E+00	4.17E-03	1.51E-07	2.23E-01	3.43E-01	1.56E-06	1.52E-03	1.77E-06	3.08E-04	3.04E-03	2.28E-04	8.73E-02
Col 9	P75	1.58E+00	9.94E-05	1.90E-06	3.80E-03	1.32E+00	2.27E-07	2.15E-06	9.38E-06	2.55E-05	2.98E-04	3.85E-04	1.28E-01
Col 10	P75	3.94E+00	1.31E-04	1.85E-06	4.93E-03	1.95E+00	1.44E-07	1.14E-05	5.97E-06	2.21E-05	2.63E-04	3.75E-04	1.39E-01
Col 11	P75	2.28E-01	1.06E-04	1.88E-06	4.79E-03	8.81E-01	2.49E-07	1.62E-06	1.28E-05	1.99E-05	2.73E-04	3.95E-04	1.29E-01
Col 12	P75	1.92E+00	1.43E-04	2.25E-06	1.55E-02	1.55E+00	2.94E-07	3.38E-06	9.79E-06	2.16E-05	3.25E-04	4.56E-04	2.12E-01
Col 13	P75	5.15E-01	8.44E-05	5.76E-07	1.80E-03	5.01E-02	9.10E-08	1.48E-05	2.39E-06	1.10E-05	9.80E-05	1.40E-04	1.03E-01
HC 2	P50	1.00E+00	2.21E-02	9.90E-07	3.32E-03	4.84E+00	1.49E-06	2.30E-05	1.49E-05	1.62E-04	3.45E-03	4.93E-03	9.07E-01
HC 4	P50	9.90E-01	2.02E-02	9.80E-07	2.68E-03	3.91E+00	1.47E-06	7.84E-06	1.49E-05	1.73E-04	3.43E-03	4.90E-03	6.92E-01
HC 6	P50	9.90E-01	1.39E-02	1.49E-06	3.85E-03	9.09E-01	1.49E-06	3.02E-05	1.49E-05	1.11E-04	4.75E-03	4.90E-03	3.10E-01
Col 3	P50	9.93E-02	3.30E-05	4.76E-08	1.66E-04	5.00E-01	4.99E-08	3.64E-07	1.71E-05	9.58E-06	1.12E-04	1.60E-04	9.65E-02
Col 4	P50	8.24E-01	3.98E-05	7.60E-08	1.05E-04	5.61E-01	9.46E-08	4.48E-07	1.51E-05	1.51E-05	1.21E-04	1.70E-04	2.29E-01
Col 5	P50	1.30E-01	3.38E-05	4.68E-08	2.77E-04	4.60E-01	1.36E-07	4.79E-07	1.14E-05	1.24E-05	1.10E-04	1.59E-04	1.30E-01
Col 6	P50	1.57E-01	6.60E-05	3.83E-08	7.81E-04	5.26E-01	8.25E-08	3.43E-07	2.21E-06	9.93E-06	1.10E-04	1.58E-04	1.25E-01
Col 7	P50	5.78E-02	2.19E-03	7.70E-08	7.43E-03	3.96E-02	5.85E-08	6.65E-07	1.33E-06	1.38E-05	3.80E-04	1.90E-04	2.24E-02
Col 8	P50	1.01E+00	3.12E-03	4.03E-08	1.68E-01	2.58E-01	1.36E-06	1.08E-03	1.41E-06	2.79E-04	1.91E-03	1.96E-04	6.76E-02
Col 9	P50	6.46E-01	7.40E-05	5.13E-07	3.12E-03	1.20E+00	1.33E-07	1.13E-06	4.91E-06	1.65E-05	2.66E-04	3.78E-04	1.13E-01
Col 10	P50	2.11E+00	7.50E-05	2.73E-07	4.63E-03	1.49E+00	1.13E-07	7.66E-06	2.41E-06	1.59E-05	2.59E-04	3.70E-04	1.20E-01
Col 11	P50	1.55E-01	7.13E-05	2.90E-07	4.39E-03	8.40E-01	1.50E-07	1.03E-06	7.21E-06	1.31E-05	2.66E-04	3.80E-04	1.19E-01
Col 12	P50	1.05E+00	9.12E-05	2.31E-07	1.46E-02	1.42E+00	1.80E-07	1.57E-06	2.74E-06	1.96E-05	3.15E-04	4.50E-04	1.69E-01
Col 13	P50	3.50E-01	5.46E-05	5.03E-08	1.69E-03	3.84E-02	5.30E-08	1.06E-05	8.25E-07	7.02E-06	9.19E-05	1.31E-04	8.42E-02

Test ID	Statistic	Mg	Mn	Mo	Na	Ni	Pb	Sb	Se	Tl	U	Zn
		mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk	mg/kg/wk
FB-GO	Cumulative	7.34E-03	4.91E-06	1.40E-04	6.57E-02	1.12E-06	5.16E-06	5.87E-06	2.09E-07	1.86E-07	9.82E-05	6.48E-06
FB-GS	Cumulative	3.04E-02	2.09E-06	3.28E-05	3.15E-02	5.51E-07	1.52E-07	5.34E-06	2.53E-07	1.21E-07	3.06E-04	3.32E-05
FB-GT	Cumulative	1.22E-01	5.05E-06	2.57E-05	4.96E-02	2.52E-06	1.54E-06	9.23E-06	7.19E-07	1.14E-07	4.08E-04	2.14E-05
FB-SO	Cumulative	5.99E-03	1.06E-05	2.83E-06	2.49E-02	4.90E-07	8.17E-07	1.85E-06	3.12E-07	9.51E-08	2.63E-06	6.11E-05
FB-SS	Cumulative	5.94E-02	6.21E-06	2.58E-05	4.61E-02	1.32E-06	2.41E-06	1.82E-06	1.33E-06	1.30E-07	4.80E-05	5.43E-05
FB-ST	Cumulative	9.62E-02	1.67E-05	8.32E-06	4.45E-02	1.27E-05	1.75E-06	2.29E-05	6.22E-07	1.18E-07	1.81E-04	2.51E-05
FB-GGT	Cumulative	3.38E-02	4.32E-02	8.32E-07	6.89E-02	3.20E-05	5.81E-07	7.21E-06	3.95E-07	3.67E-07	3.43E-06	4.50E-04
FB-GGS	Cumulative	2.15E-02	5.34E-03	1.15E-05	4.88E-02	1.13E-06	4.39E-07	7.51E-06	1.08E-07	2.02E-07	4.49E-05	1.69E-05
HC 2	P75	2.05E+00	6.67E-03	2.18E-04	1.07E-01	3.00E-04	1.49E-05	6.64E-03	1.68E-04	5.00E-06	4.17E-03	4.96E-04
HC 4	P75	1.75E+00	4.71E-03	4.70E-04	1.56E-01	5.00E-05	9.80E-06	1.91E-03	1.07E-04	5.00E-06	4.39E-03	4.95E-04
HC 6	P75	2.28E-01	4.66E-02	4.18E-04	1.55E-01	4.95E-05	4.91E-05	3.71E-04	3.45E-05	5.21E-06	4.08E-04	9.85E-04
Col 3	P75	2.16E-01	8.32E-06	6.71E-05	2.09E-02	4.93E-06	8.82E-07	8.09E-05	6.22E-06	1.26E-06	8.05E-05	3.30E-05
Col 4	P75	2.95E-01	2.79E-05	3.20E-04	1.04E-01	1.74E-05	6.18E-07	3.30E-05	9.04E-06	2.43E-07	5.77E-04	3.55E-05
Col 5	P75	1.70E-01	7.22E-06	3.66E-04	8.46E-02	5.18E-06	4.91E-07	4.31E-05	2.31E-06	4.52E-07	1.36E-03	3.33E-05
Col 6	P75	2.34E-01	4.90E-06	2.81E-04	2.05E-02	5.19E-06	4.90E-07	1.66E-04	3.33E-06	2.25E-06	3.38E-03	3.28E-05
Col 7	P75	1.27E-02	3.64E-04	4.22E-05	1.01E-01	4.03E-06	2.33E-06	4.25E-04	1.87E-06	7.63E-07	1.36E-05	4.22E-05
Col 8	P75	8.27E-02	5.25E-02	8.01E-06	1.24E-02	3.91E-04	2.75E-06	1.44E-04	1.14E-05	7.70E-06	2.63E-05	2.12E-03
Col 9	P75	5.08E-01	9.88E-05	9.59E-05	3.44E-02	3.24E-05	1.54E-06	1.26E-04	2.06E-05	2.29E-06	4.35E-05	7.70E-05
Col 10	P75	5.37E-01	1.00E-03	1.05E-04	2.30E-02	8.88E-05	1.64E-06	6.30E-04	3.59E-05	4.14E-06	1.58E-04	7.50E-05
Col 11	P75	2.33E-01	3.90E-05	3.31E-04	4.16E-02	3.90E-06	1.49E-06	2.00E-04	3.04E-06	3.73E-06	1.02E-03	7.60E-05
Col 12	P75	4.56E-01	6.67E-04	5.38E-04	2.22E-02	1.33E-05	1.37E-06	2.06E-03	1.23E-05	5.18E-06	8.94E-04	9.01E-05
Col 13	P75	1.30E-02	6.96E-03	4.43E-05	2.19E-01	5.00E-06	1.04E-06	1.10E-04	1.35E-06	7.71E-07	1.43E-05	5.50E-05
HC 2	P50	1.47E+00	5.84E-03	1.44E-04	5.94E-02	2.40E-04	5.00E-06	4.41E-03	2.97E-05	3.47E-06	2.85E-03	4.95E-04
HC 4	P50	1.28E+00	4.17E-03	3.69E-04	7.43E-02	4.90E-05	4.95E-06	1.47E-03	2.50E-05	2.96E-06	3.64E-03	4.90E-04
HC 6	P50	1.53E-01	3.81E-02	1.64E-04	9.63E-02	4.91E-05	2.91E-05	2.48E-04	1.98E-05	3.43E-06	2.71E-04	9.60E-04
Col 3	P50	2.04E-01	3.64E-06	6.31E-05	7.21E-03	2.93E-06	4.52E-07	7.18E-05	2.83E-06	1.18E-06	7.36E-05	3.10E-05
Col 4	P50	2.83E-01	3.37E-06	2.16E-04	2.02E-02	1.30E-05	3.38E-07	2.94E-05	3.94E-06	1.74E-07	5.28E-04	3.40E-05
Col 5	P50	1.64E-01	3.11E-06	2.94E-04	2.03E-02	3.20E-06	3.00E-07	3.99E-05	1.01E-06	4.01E-07	1.30E-03	3.15E-05
Col 6	P50	2.19E-01	2.13E-06	1.84E-04	1.05E-02	3.30E-06	2.47E-07	1.45E-04	2.06E-06	2.07E-06	2.86E-03	3.11E-05
Col 7	P50	1.09E-02	2.05E-04	1.82E-05	5.45E-02	1.93E-06	1.64E-06	3.08E-04	1.20E-06	5.18E-07	8.14E-06	3.70E-05
Col 8	P50	6.22E-02	4.56E-02	2.66E-06	4.64E-03	2.86E-04	1.42E-06	1.30E-04	6.96E-06	4.68E-06	2.31E-05	1.97E-03
Col 9	P50	4.37E-01	5.03E-05	7.72E-05	9.25E-03	2.56E-05	7.50E-07	1.16E-04	1.52E-05	1.63E-06	2.09E-05	7.50E-05
Col 10	P50	4.13E-01	6.96E-04	8.33E-05	9.36E-03	6.57E-05	1.20E-06	5.44E-04	2.85E-05	3.30E-06	7.62E-05	7.30E-05
Col 11	P50	2.22E-01	1.80E-05	2.48E-04	9.13E-03	3.80E-06	8.23E-07	1.79E-04	2.12E-06	3.28E-06	7.84E-04	7.50E-05
Col 12	P50	3.95E-01	1.80E-04	3.37E-04	9.82E-03	6.44E-06	6.76E-07	1.78E-03	1.01E-05	4.12E-06	4.65E-04	8.89E-05
Col 13	P50	1.06E-02	5.62E-03	3.68E-05	1.56E-01	3.60E-06	7.50E-07	9.50E-05	9.10E-07	5.92E-07	1.20E-05	4.05E-05

Appendix E:
Active Treatment Testing Report

Newmont™
COFFEE



COFFEE PROJECT WATER TREATMENT:

FROM FEASIBILITY STUDIES TO A CONCEPTUAL SYSTEM DESIGN

Comprehensive Report

Prepared For:
Newmont Mining

Prepared By:
WesTech Engineering

September 2021

WESTECH®

ENVIRONMENTAL INNOVATIONS INOTEC

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EXECUTIVE SUMMARY

WesTech Engineering (formerly Inotec) was contracted to develop a conceptual water treatment system for the Coffee Mine's heap leach rinse waters. In order to increase confidence in the proposed treatment, reduce uncertainty and risks, and develop a site-specific approach for the treatment of the Coffee waters, the testing was designed in three phases. This report conglomerates the results of Phase I feasibility evaluations and Phase II bench-scale laboratory testing and summarizes the feedback obtained from the stakeholders (Newmont, Tr'ondek Hwech'in, and the Canadian regulatory agencies). Once the mine is operational, and heap waters are available, the system design and expected performance will be demonstrated during the Phase III pilot-scale trial.

The Phase I feasibility testing successfully demonstrated the removal of nitrate, arsenic, and uranium from Coffee Gold leach waters. Even though arsenic removal was demonstrated with the biological treatment, the feasibility testing proved that long retention times and high nutrient doses would be required to meet the required discharge levels. The Phase I recommendation was to investigate phys-chem arsenic removal options.

Upon completing Phase I feasibility testing, WesTech and Newmont sought out feedback from the stakeholders through a series of water-treatment-focused workshops. The consultations yielded positive feedback, identified additional contaminants of interest, and resulted in the addition of several analytical parameters to the monitoring list, strengthening the testing design and outcomes. Sulfate and antimony were identified as potential additional contaminants of interest. Thiocyanate, sulfide, arsenic and selenium speciation, and radiochemistry were added to the analytical schedule.

The Phase II bench-scale testing removed all contaminants of interest to below their respective discharge targets. The best approach for the Coffee Mine water treatment was confirmed to be a multi-stage treatment train, consisting of a phys-chem pretreatment for arsenic and sulfate precipitation, biological EBR treatment for denitrification and metals polishing, and a small aerobic post-treatment for removal of residual nutrients and reintroduction of dissolved oxygen. **The demonstrated benefits of the tested treatment train included:**

1) **a significantly smaller biological EBR system footprint;**
2) **no need for complex organic nutrient addition;**
3) **lower organic carbon requirement, thus lower residual nutrient concentrations; and**
4) **continuous removal of some radioisotopes in the pretreatment, which resulted in little to no accumulation of gross radiation within the EBR bioreactor matrix.**

Arsenic was removed to below the discharge target of 0.035 mg/L using ferric co-precipitation. Barium precipitation of sulfate was demonstrated to be dose-dependent and was optimized to target sulfate discharge target of 1,500 mg/L. The limited evaluation of only two barium salts resulted in residual chloride concentrations; further jar tests will be required once the mine is operational and actual site waters are available to establish the most suitable reagent dose to avoid generating excess chlorides.

The EBR treatment successfully removed nitrate-N to below the detection limit of 0.3 mg/L and uranium to less than 0.1 mg/L (its discharge target) with ethanol as a sole nutrient source and a hydraulic retention time of 7 to 11 hours. Once optimized to target only nitrate and uranium, the EBR system was demonstrated to allow residual arsenic and sulfate to pass through without further reducing either one. The speciation results showed that the EBR system did not produce any methylated arsenic species, even during the preliminary testing stages, when residual arsenic was biologically removed. Several other metals (Sb, Cu, Hg, Mo, and Ni) were reduced by the EBR system from elevated levels to below

their discharge targets, while some multivalent metals (Fe and Mn) were not targeted and passed through the EBR system unchanged. Hardness minerals (Ca, Mg) were shown to be present at elevated concentrations in the Coffee waters and will likely need to be removed by a water softening pretreatment to meet their discharge limits. The EBR system also polished WAD cyanide to below the detection limit of 0.006 mg/L.

Once the pretreatment was optimized, ethanol was used as a sole nutrient source for the EBR treatment, resulting in a low residual nutrient generation. BOD and ammonia were removed in the aerobic post-treatment step, but a spike of phosphate and manganese was experienced in the aerobic column effluent, which can only be attributed to the leaching of these metals from the pumice support matrix. Quality control will be conducted on the media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of metals occurs.

A set of preliminary design and operational parameters was developed for a pilot-scale trial based on the results obtained from bench-scale testing. Conducted over a minimum of three months, the on-site demonstration trial is a required last step before the preliminary engineering of the water treatment plant can be completed. The testwork and analytical plan will include, at the minimum, the same level of detail as the Phase II bench-scale program.

INTRODUCTION

TIMELINE OF EVALUATIONS, TESTING, CONSULTATIONS, AND PROCESS DESIGN

The proposed Coffee Gold project is located in the west-central Yukon Territory, approximately 130 km south of Dawson City. Acquired in 2016 by Goldcorp (subsequently, Newmont), Coffee is a high-grade potential open pit and heap leach development project that lies within the traditional territory of Tr'ondek Hwech'in (TH).

WesTech Engineering (formerly Inotec) was contracted to develop a treatment system for the Coffee Mine's heap leach rinse waters. In order to increase confidence in the proposed treatment, reduce uncertainty and risks, and develop a site-specific treatment approach for the treatment of the Coffee waters, the testing was designed in three phases.

Phase I - Treatability assessment and proof-of-concept, conducted in 2016, consisted of laboratory assessment tests and evaluation of site water chemistry. Tests included column heap leach to generate water for treatment, site water chemistry evaluation, microbial screening tests, and treatment effectiveness assessment.

Phase II - Continuous flow laboratory column tests, conducted in 2020, were used to develop an overall treatment approach for the Coffee Gold heap leach rinse waters and to develop operational parameters for on-site pilot-scale tests.

Phase III – On-site pilot tests, to be conducted once mine is operational, are needed to validate the selected unit processes for treatment of all the contaminants of interest in the actual Coffee Gold heap leach rinse waters and to develop operational parameters, design criteria, and preliminary CAPEX/OPEX estimates for a full-scale facility.

This tiered approach was developed based on the EPA's Guide for Conducting Treatability Studies Under CERCLA: Biodegradation Remedy Selection (EPA/540/R-93/519b). The specific characteristics of each phase are provided in Table 1.

WesTech has worked with the project since 2015. Our main objective has been to design a water treatment system that meets the discharge limits using a phased feasibility testing approach that de-risks the process and considers input from all the stakeholders. Several treatment methods have been considered to meet the treatment objectives, and the resulting treatment train utilizes multiple unit processes, including phys-chem and biological methods. The overall timeline of feasibility testing and consultations is summarized in Figure 1. Ample time was allocated after each testing phase for consultations with Tr'ondek Hwech'in and the Canadian regulatory agencies to identify areas of concern and develop appropriate protocols for future testing to address them.

Table 1. Criteria for a three-phase water treatment technology selection process.

Phase/Scale	Phase I: Feasibility Study (completed)	Phase II: Lab Bench-Scale Test (completed)	Phase III: On-Site Pilot Demo (to be completed)
Goal	Process screening	Process selection	Process design
Degradation of the contaminant of interest	Positive degradation	Meets effluent compliance standards under test conditions	Meets compliance standards under site conditions
Extent of treatment	Estimate/ Qualitative	Measure/ Quantitative	Measure/ Quantitative
Biodegradation rate	Crude estimate	Defensible estimate	Quantified
Process control and reliability	Not available	Assess potential	Demonstrate
Process optimization	Not available	Estimate	Refined estimate/ Demonstrate
Study time	2-8 weeks	2-6 months	2-6 months
Full-scale cost estimate	Not available	Rough	Detailed/ Refined

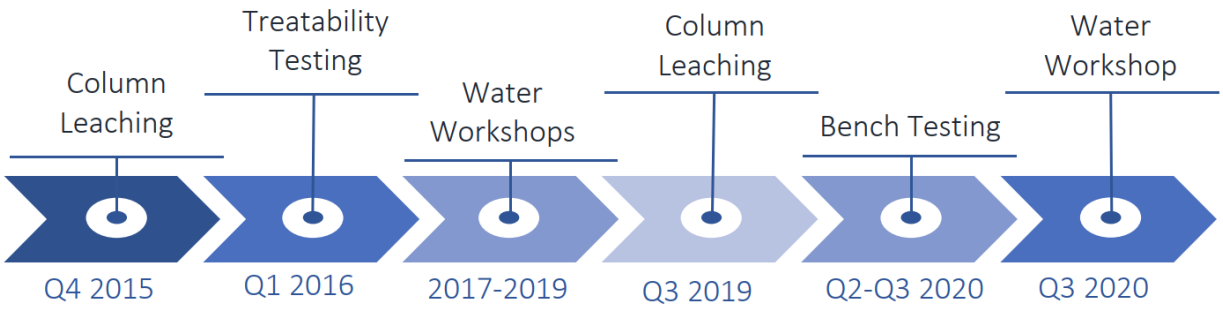

Figure 1. Feasibility testing and consultations timeline.

Predicted Water Quality and Treatment Needs

Developing a conceptual water treatment design for a prospective mine is challenging as without an operational mine, no heap leach rinse waters exist for treatment evaluations. Predicting water quality generated by the heap leach facility (HLF) during rinsing is crucial for identifying the parameters of concern and developing a treatment system with appropriate unit processes. Water modeling, performed by Lorax Environmental Services, identified the target parameters for Phase I treatability testing as nitrate/nitrite, arsenic, and uranium (Table 2). Additionally, sulfate and antimony were added to the list of target parameters for Phase II bench-scale testing based on the input from TH. The treatment targets were based on a back-calculation approach to arrive at allowable concentrations in the discharge to achieve Use-Protection water quality objectives in Halfway Creek.

Table 2. Water quality predictions of the HLF rinse solutions.

Parameter [mg/L]	HLF Rinse Modeling	Treatment Target
NH_3-N	0.025-0.06	8
NO_3-N	275-307	3
NO_2-N	1.6-1.9	0.09
Cl	115-123	290
SO_4	2300-2516	1500
Alkalinity, as $CaCO_3$	47-87	500
WAD-CN	0.09-0.2	0.025
Al	0.06-0.2	0.06
Ag	0.00009-0.00125	0.00009
As	0.66-2	0.035
Ca	204-350	180
Cd	0.00004-0.00013	0.00004
Cr	0.004-0.014	0.001
Cu	0.004-0.014	0.004
Fe	0.15-0.5	0.05
Hg	0.0001-0.00026	0.0001
Mg	117-155	50
Mn	0.016-0.06	0.016
Mo	0.033-0.105	0.033
Na	890-1168	890
K	8-11	8
Ni	0.002-0.006	0.002
Pb	0.00032-0.0013	0.0032
Sb	0.17-0.5	0.07
Se	0.0015-0.005	0.0015
Tl	0.0015-0.004	0.0015
U	0.3-0.685	0.1
Zn	0.02-0.052	0.02

TREATMENT PROCESSES

ELECTRO-BIOCHEMICAL REACTOR

Microbes mediate the removal of metal and inorganic contaminants through electron transfer (redox processes). For example, denitrification can be described by the following redox reaction:

$$NO_3^- + 5e^- + 6H^+ \rightarrow \frac{1}{2}N_2 + 3H_2O \quad (1)$$

The biotransformation shown in Reaction 1 occurs under anaerobic, reductive conditions, requiring low dissolved oxygen (DO) levels and a negative oxidation-reduction potential (ORP) environment. Five electrons are needed to reduce one molecule of nitrate to nitrogen gas. Other constituents, such as dissolved oxygen, nitrite, arsenate, selenate, chromate, sulfate, etc., add to the electron demand.

In conventional biological treatment systems, the electrons required for contaminant transformation are supplied in the form of excess nutrients added to the system. Conventional biotreatment systems require excess nutrients/chemicals to compensate for inefficient and variable electron availability to adjust reactor ORP chemistry and for contaminant removal (electron release from organic nutrients requires nutrient metabolism that proceeds at a variable rate). Excess nutrients used to compensate for system sensitivity lead to significantly increased biomass production, resulting in additional CAPEX and OPEX (higher nutrient consumption and management of the excess biomass production).

The Electro-Biochemical Reactor (EBR) technology overcomes these shortcomings by decoupling the electron provision from organic carbon metabolism. The electrons are directly supplied to the reactor and microbes, using a low applied potential (1-3V) across the bioreactor at low milli-Amp levels. The current of 1 mA provides 6.2×10^{15} electrons per second. In contrast, one molecule of acetic acid, commonly used as a nutrient in the water treatment processes, provides only eight electrons under complete metabolism. These electrons replace and supplement the electrons customarily supplied to the conventional bioreactor system by excess nutrients, with considerable savings and multiple reactor, microbial, and environmental benefits. The directly supplied electrons are readily available to the microbes in a consistent, controllable manner without metabolic energy expenditure. Moreover, these "free electrons," from the microbes' standpoint, make the EBR bioreactors more robust and less sensitive to wide fluctuations in water chemistries than the past generations of conventional biotreatments.

ARSENIC REMOVAL BY FERRIC COAGULATION/PRECIPITATION

Even though the EBR technology was validated for arsenic removal to concentrations of less than 0.015 mg/L from initial values in excess of 1.0 mg/L (i.e., > 98.8% removal), evaluation of other arsenic removal methods and integration into the proposed treatment train was recommended. The initial bench-scale treatability assessments indicated that a relatively long retention time and high nutrient loading would be required to target arsenic biologically.

Ferric-based coagulation and flocculation is a widely used arsenic removal method in wastewater and drinking water treatment. It uses a metal-based coagulant, such as ferric chloride ($FeCl_3$), which hydrolyzes in water to form positively charged ferric hydroxide [$Fe(OH)_3$]. Dissolved arsenic oxyanions are negatively charged and readily sorb to the positively charged ferric hydroxide particles. The process is sensitive to the oxidative state of arsenic; if any reduced arsenic oxyanions, such as arsenite, are present, they must be oxidized to arsenate first for the ferric coagulation step to be effective.

Sulfate Precipitation

In contrast to contaminants such as nitrate, arsenic, and heavy metals, sulfate has no primary standard for drinking water or aquatic life. Numerous treatment technologies for efficient sulfate removal exist, including biological and physical processes. As an alternative option for biological sulfate removal, sulfate precipitation using physicochemical methods was evaluated. The most commonly used technology for reducing high sulfate concentrations is lime precipitation, which generates calcium sulfate (gypsum). This method is effective for sulfate concentrations higher than the gypsum solubility limit of 1,500-2,000 mg/L. As a polishing step for sulfate removal, barium sulfate precipitation can be applied. Barium sulfate has very low solubility in water (~ 2.5 mg/L), with the final sulfate concentration limited only by the amount of barium added and reaction time.

In-Situ Bioremediation

The basic premise of bioremediation is to accelerate microbial activity using nutrients (carbon, phosphorus, nitrogen, etc.) to create conditions conducive to biodegradation of target contaminants. In general, in-situ bioremediation is designed to modify the environmental conditions, typically through oxidation/reduction manipulation, to create an environment that stimulates the growth of indigenous and added microbes and the subsequent degradation of the target contaminants via microbial catalyzed reactions.

This testing focused on in-situ denitrification (nitrate reduction). Nitrate is an important co-contaminant because it is a preferred electron acceptor that needs to be reduced or removed before metal removal is effectively targeted. Nitrate is the most ubiquitous groundwater contaminant in North America and is common at many mining sites due to the use of ammonium nitrate in blasting. Nitrate is non-sorptive and does not exchange on many surfaces. It has a very low probability of retardation onto soil colloids. Nitrate reduction occurs during anaerobic respiration; in the absence of oxygen (<2 mg/L dissolved oxygen) and the presence of a carbon source, bacteria utilize nitrates as electron acceptors during respiration.

In mining waters, nitrate-N is typically found at tens or hundreds ppm levels as compared to ppb concentrations most metals like arsenic and uranium are present at. Since nitrate is a preferred electron acceptor and is typically present in mining waters several orders of magnitude higher than dissolved metals, the majority of the retention time required for an active biological treatment is spent on denitrification. Longer retention times require larger bioreactors, which in turn means higher CAPEX (capital expenditures). A holistic mine site water management and treatment should include in-situ denitrification within the heap followed by a smaller active treatment for metals removal.

TESTWORK

TESTING PHASES AND OBJECTIVES

WesTech has completed Phases I and II of feasibility and system design stages. The objectives of the two phases were as follows:

Phase I:

Provide **a proof-of-concept** for removal of nitrate, arsenic, and uranium from the Coffee Mine heap leach rinse waters.

- Task 1 – Spent Ore Column Leaching Tests. Task 1 was used to generate leach waters for Tasks 2 through 4.
- Task 2 – Microbial Screening and Treatability Assessment. The goal of Task 2 was to develop microbial consortia for Tasks 3 and 4.
- Task 3 – EBR Validation Testing. The goal of Task 3 was to provide a proof-of-concept evaluation of the EBR technology for the treatment of the Coffee Gold leach waters.
- Task 4 – In-Situ Testing. The goal of Task 4 was to evaluate microbial in-situ denitrification of the Coffee Gold spent ore materials.

Phase II:

Develop and **optimize a systems approach** to treating all parameters present above the discharge standards in the Coffee Mine heap leach rinse waters

- Task 1 – Side-by-side evaluations of two treatment approaches. The goal was to determine the optimal process design for nitrate, uranium, sulfate, and arsenic removal to below the discharge objectives.
- Task 2 – System stress-testing to determine the optimal system configuration and operational conditions (including required chemical doses and hydraulic retention times).
- Task 3 – Treatment train design to meet all discharge requirements (including required pretreatment, e.g., for cyanide destruction, and any needed post-treatment, e.g., for aeration and BOD and ammonia oxidation).
- Task 4 – Development of the required design information for Phase III testing.

Experimental Design and Procedures

Microbial Screening

Microbial isolation and screening tests were conducted on solutions received and initial column materials at 5ºC and 20 ºC. Microbes isolated from the Coffee Mine waters and spent ore materials were tested for their ability to remove arsenic, uranium, nitrate, sulfate, and antimony. These isolates were tested in direct comparative screening tests alongside WesTech's repository microbes to select a site-specific inoculum for the removal of contaminants of interest.

These tests provided the microbes for Phase I and Phase II testing. A microbial population screened to be effective at removing arsenic, uranium, nitrate, sulfate, and antimony was grown into an inoculum for feasibility and bench-scale testing.

Phase I Feasibility Testing

The process flow diagram for the feasibility testing is shown in Figure 2. The feasibility setup consisted of a two-stage, up-flow, fixed bed EBR system. The tests were conducted under continuous flow conditions, i.e., the water was treated 24 hours per day, seven days per week. The system was operated using a total hydraulic retention time (HRT) of 44 hours. The bioreactors were provided with laboratory-grade nutrients (tryptic soy broth) rich in macro- and micro-elements. The long HRT and laboratory-grade nutrients were chosen to ensure that no limiting conditions (e.g., nutrient-limited) occurred that could affect the proof-of-concept testing.

The column tests were conducted continuously for two months for process assessment and validation testing. The goal of validation testing was to generate sufficient compliance data (i.e., nitrate, arsenic, and uranium concentrations in the treatment effluent below desired levels). The system initially treated leach waters pumped twice through the Coffee Gold spent ore columns. However, since uranium concentrations have decreased after the second pass through the spent ore columns, it was decided to treat first pass leach solutions instead.

Prior to the biological EBR treatment, cyanide destruction in the leachate solutions was performed using hydrogen peroxide treatment; nitrate-N was readjusted to at least 150 mg/L, and pH of the water was dropped to about 6.5.

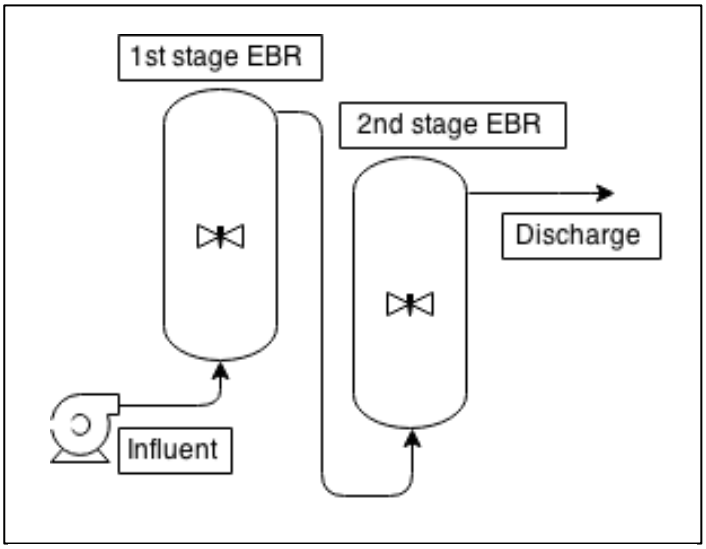

Figure 2. Process flow diagram of the Phase I feasibility test system.

Phase I In-Situ Feasibility Testing

Two 100-kg test columns were constructed, each containing three lithologies and two weathering zones of mined materials that represent thoroughly mixed Coffee Gold leach pad materials in the following percentages: 80% Supremo, 18% Latte, and 2% Kona. The columns went through a series of conditioning steps to ensure the effluent water chemistries from both columns were similar. One of the constructed columns was used as a test column; the other one was used as a control (baseline) column. The in-situ testing progressed in two testing stages:

1. Application of the EBR effluent spiked with 150 mg/L nitrate-N at a flowrate of 1L per day. The in-situ column influent was supplemented with nutrients, while the control column influent was filtered to remove microbial cells and residual nutrients. The process flow diagram is shown in Figure 3.
2. Application of DI water spiked with 150 mg/L nitrate-N at a flowrate of 1L per day. The in-situ column influent was supplemented with nutrients, but the control column was not. The process flow diagram is shown in Figure 4.

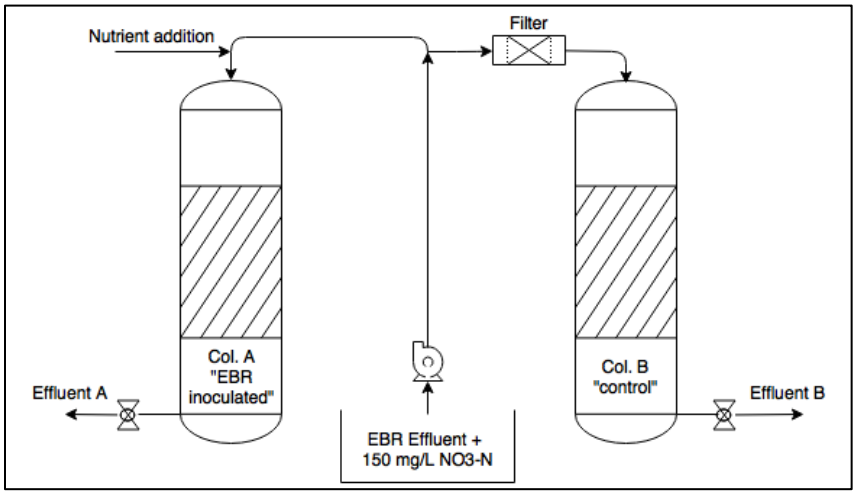

Figure 3. Process flow diagram of a Phase I feasibility in-situ testing; test stage #1.

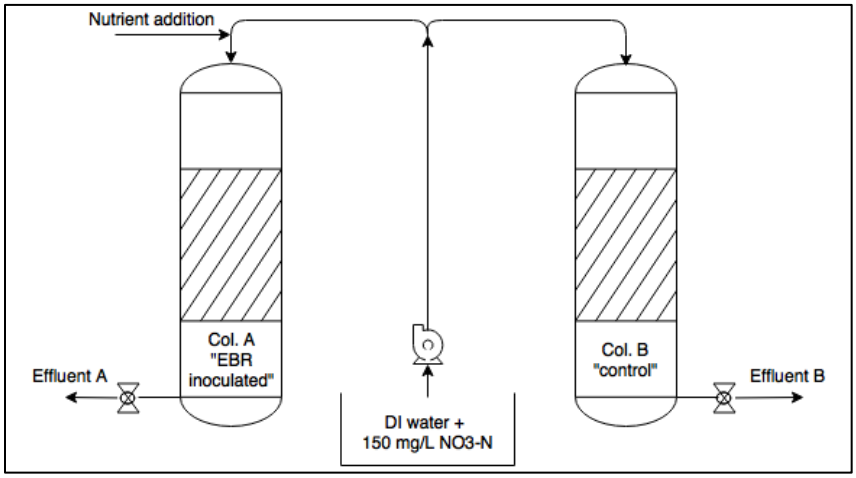

Figure 4. Process flow diagram of a Phase I feasibility in-situ testing; test stage #2.

Phase II Bench-Scale Testing

Leach and rinse waters were generated by Kappes, Cassiday & Associates at their metallurgical laboratory in Reno, NV, and shipped to WesTech. The process flow diagram for the bench-scale setup is shown in Figure 5. The required pretreatments included cyanide destruction and pH adjustment; both were performed as batch treatments. Two treatment trains were evaluated concurrently as a core treatment. In system A, chemical precipitation methods (ferric coagulation for arsenic removal and barium precipitation of sulfate) were tested in conjunction with a two-stage EBR system for denitrification, uranium reduction, and metals polishing. System B targeted all contaminants with the EBR treatment alone. Following the core treatments, aerobic post-treatments were tested for the removal of residual nutrients.

Both treatment trains utilized up-flow, fixed bed EBR bioreactors. Each EBR column was equipped with sampling ports halfway up the column and at the effluent point. The tests were conducted under continuous flow conditions, and the systems were initially operated using a 24-hr HRT per reactor, with samples collected from sampling ports correlating to 12-hr HRT intervals. The bench-scale EBRs had an empty bed volume of 1,610 mL (per reactor). The activated carbon used to fill the columns had a pore space of 42%.

The photograph in Figure 6 shows the bench-scale setup for treatment train A. Not pictured are the chemical pretreatments that were performed in batches. The system was initially designed to use only one pump and gravity flow between the reactor stages (as can be still seen in Figure 6 from the differences in elevation between the test columns). However, since large sample volumes were required for the routine internal and external analyses, and the forward flow was only 1.0 - 1.5 mL/min, an intermediary sample storage jug was placed between the reactor stages and a second pump was installed.

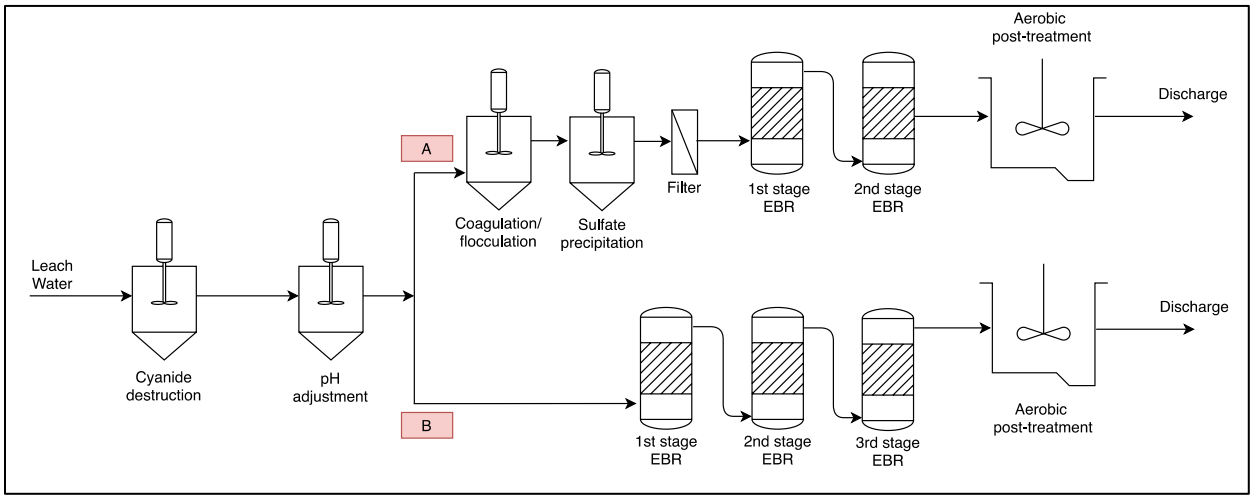

Figure 5. Process flow diagram of the Phase II bench-scale Coffee treatment systems.



Figure 6. Phase II bench-scale setup of treatment train A.

SAMPLING AND ANALYSIS

Feasibility Testing

Daily in-house measurements included flowrate, pH, ORP, DO, temperature, nutrient addition, conductivity, and nitrate-N. Influent and EBR effluent samples were collected in 5-day intervals and sent out to ALS Analytical Laboratories in Vancouver, Canada, for a complete suite analysis (Table 3).

Table 3. Analytes and analytical methods used in the EBR bench-scale tests.

Analyte	Method	Method Number
Hardness	EDTA Titration	APHA 2340B
pH	Automated pH meter	APHA 4500-H pH Value
TDS	Gravimetric	APHA 2540 C
Alkalinity	Titration	APHA 2320 Alkalinity
Bromide	Ion Chromatography (IC)	EPA 300.1
Chloride	Ion Chromatography (IC)	EPA 300.1
Fluoride	Ion Chromatography (IC)	EPA 300.1

Analyte	Method	Method Number
Total Nitrogen	Colorimetric	APHA Method 4500-P (J) / NEMI 5735
Ammonia-Nitrogen	Fluorescence	J. ENVIRON. MONIT., 2005
Nitrite-Nitrogen	Ion Chromatography (IC)	EPA 300.1
Nitrate-Nitrogen	Ion Chromatography (IC)	EPA 300.1
Total Phosphorus	Colorimetric	APHA 4500-P Phosphorus
Orthophosphate	Colorimetric	APHA 4500-P Phosphorus
Sulfate	Ion Chromatography (IC)	EPA 300.1
Total Cyanide	Continuous Flow Analyzer (CFA)	ISO 14403:2002
WAD Cyanide	Continuous Flow Analyzer (CFA)	APHA 4500-CN CYANIDE
Total Metals	Collision/Reaction Cell – Inductively Coupled Plasma (CRC-ICP)	EPA 200.2/6020A
Total Mercury	Cold Vapor Atomic Absorption Spectrophotometry (CVAAS)	EPA 1631E

Bench-Scale Testing

Sampling locations are marked in Figure 7. For process assessment, raw waters, pretreated waters, EBR sampling locations, and post-treatment were analyzed. The in-house analysis included pH, ORP, DO, conductivity, temperature, nitrate, nitrite, sulfate, and COD. These measurements were taken three times a week. Routine metals analyses were performed by a certified independent analytical laboratory, American West Analytical Labs (AWAL) in Salt Lake City, UT, using Ion-Coupled Plasma/Mass-Spec (ICP-MS), method EPA 200.8. In addition to these frequently monitored parameters, a chemistry suite analysis was performed on system influents and effluents once per month by AWAL. Samples for arsenic and selenium speciation were submitted once per month to Brooks Applied Labs in Bothell, WA. Upon completion of testing, the system was taken apart, and any accumulated or generated solids, including the activated carbon media, were sampled and sent to AWAL for TCLP analysis and Pace Analytical Laboratories for rad-chemistry analysis.

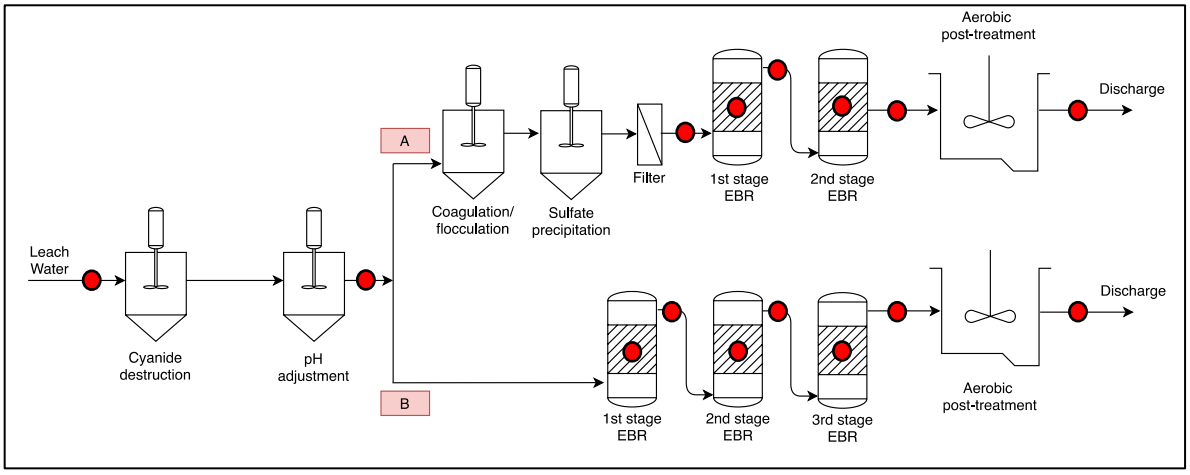

Figure 7. Phase II bench-scale sampling locations.

Data Analysis, Interpretation, and Quality Control

The influent and effluent nitrate, sulfate, uranium, and arsenic concentrations were measured, which allowed the calculation of percent removals and treatment efficiencies. A 30-day continuous operation was required to demonstrate the repeatability of results and reliability of the treatment process. Taking measurements at different sampling points (corresponding to different retention times) determined the removal kinetics.

Quality control was performed on all analyses. As part of the internal quality control testing, AWAL Laboratories performed method blanks (MB), laboratory control samples (LCS), matrix spikes (MS), and matrix spike duplicates (MSD) on the submitted samples. The recoveries of the spiked analyte are evaluated to determine the accuracy in a given matrix, while the comparison between the MS and MSD shows how precise the procedure is in a given matrix.

RESULTS

PHASE I FEASIBILITY RESULTS

Chemistry and Treatability Assessment

The leachate solution chemistry treated by the feasibility test system is shown in Table 4. Nitrate-N (105 mg/L) and uranium (144 µg/L) concentrations were within the biological treatability range. Arsenic levels of 1.1 mg/L were at the upper limit of biological treatability. Compounds that often compete with nitrate, arsenic, and uranium for electrons during biotreatments, e.g., nitrite, and other metal oxyanions, such as selenate or chromate, were not present at concentrations that would impact the biological treatment performance.

Inorganic parameters that often have an inhibitory effect on microbial metabolism, such as chlorides, were present at low levels. Total and WAD cyanides were elevated and needed to be destroyed prior to the biological treatment. Due to the nature of the spent ore, the generated leach solutions had pH of about 8.7 and needed to be adjusted to 6.5 for optimal denitrification and As/U removal.

Water chemistry assessment strongly suggested that the biological treatment would be effective at removing the contaminants of concern. Additionally, the EBR technology also reduced the concentration of some other metals, such as aluminum, antimony, cadmium, chromium, copper, mercury, molybdenum, nickel, and tin.

Microbial Screening and Assessment Results

Nitrate-, arsenic-, and uranium-reducing microorganisms were isolated from the Coffee Gold waters and spent ore materials received and screened with WesTech's repository strains to examine their bioremediation potential in the site waters at 5°C and 20°C. The microbial screening is used to 1) determine whether a given contaminant is easy or difficult to remove in given water chemistry using the EBR technology; 2) identify a best performing microbial population in the given water chemistry (contaminant transformation, temperature dependence, performance robustness); 3) select an adjusted/enhanced microbial consortium that is the most compatible with the unadjusted native population; and 4) condition the selected microbial consortia for optimal biological performance.

With an evaluation of the obtained wastewater chemistry, good positive denitrification and microbial arsenic/uranium reduction screening results were obtained. Selected microbes were further screened, conditioned, and characterized to develop the inocula for the feasibility tests. From the various consortia tested in the Coffee Gold waters, the best inoculum was selected based on:

- Nitrate/As/U reduction potential at low and high temperatures.
- Robustness in the Coffee Gold waters at low and high temperatures.
- Compatibility with indigenous microbes present in the Coffee Gold waters.
- The ability to maintain an integrated biofilm with desired contaminant removal characteristics.

Table 4. Water chemistry of Coffee Gold leach solutions used during feasibility testing.

Parameter	Concentration
Metals	
Aluminum	1.5 mg/L
Antimony	30.8 µg/L
Arsenic	1.1 mg/L
Barium	70.5 µg/L
Cadmium	3.7 µg/L
Calcium	37.5 mg/L
Chromium	10.3 µg/L
Cobalt	239 µg/L
Copper	0.5 mg/L
Iron	0.5 mg/L
Lead	1.1 µg/L
Magnesium	5.9 mg/L
Manganese	32 µg/L
Mercury	3.7 µg/L
Molybdenum	75 µg/L
Nickel	118 µg/L
Potassium	83 mg/L
Selenium	2.1 µg/L
Silver	5.2 µg/L
Sodium	234 mg/L
Strontium	186 µg/L
Thallium	0.88 µg/L
Tin	7.7 µg/L
Titanium	9.3 µg/L
Uranium	144 µg/L
Vanadium	1.2 µg/L
Zinc	187 µg/L
Inorganics	
pH	8.7
Hardness, Total (as $CaCO_3$)	118 mg/L
Alkalinity, Total (as $CaCO_3$)	188 mg/L
Ammonia as N	13 mg/L
Chloride	6.8 mg/L
Fluoride	0.35 mg/L
Cyanide, Total	24 mg/L
Cyanide, WAD	25 mg/L
Nitrate as N	105 mg/L
Nitrite as N	0.3 mg/L
Total N	130 mg/L
Sulfate	160 mg/L
Dissolved Orthophosphate	0.13 mg/L

Feasibility Treatment of Contaminants of Interest

The feasibility testing validated the biological treatment for the removal of nitrate, arsenic, and uranium from Coffee Gold heap leach rinse waters. Figure 8 and Figure 9 show the reduction of nitrate-N and nitrite-N by the feasibility test system. Nitrate-N concentrations were spiked to a minimum of 150 mg/L in the influent waters and averaged 188 mg/L during the 2-month test period. **The feasibility EBR system consistently removed both nitrate-N and nitrite-N to below detection limits** (0.19 mg/L and 0.04 mg/L, respectively).

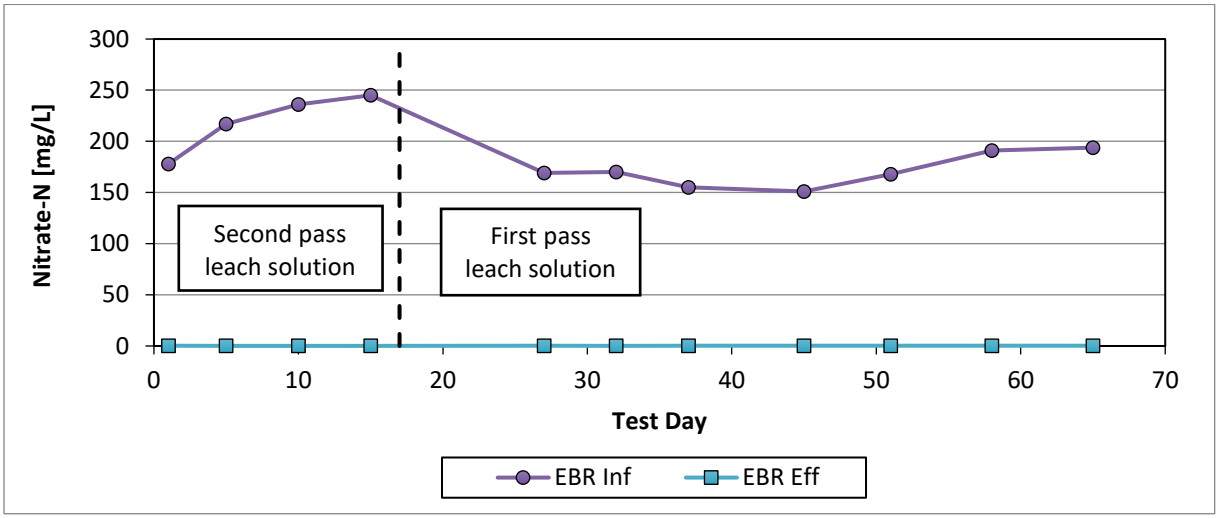

Figure 8. Phase I feasibility EBR nitrate-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

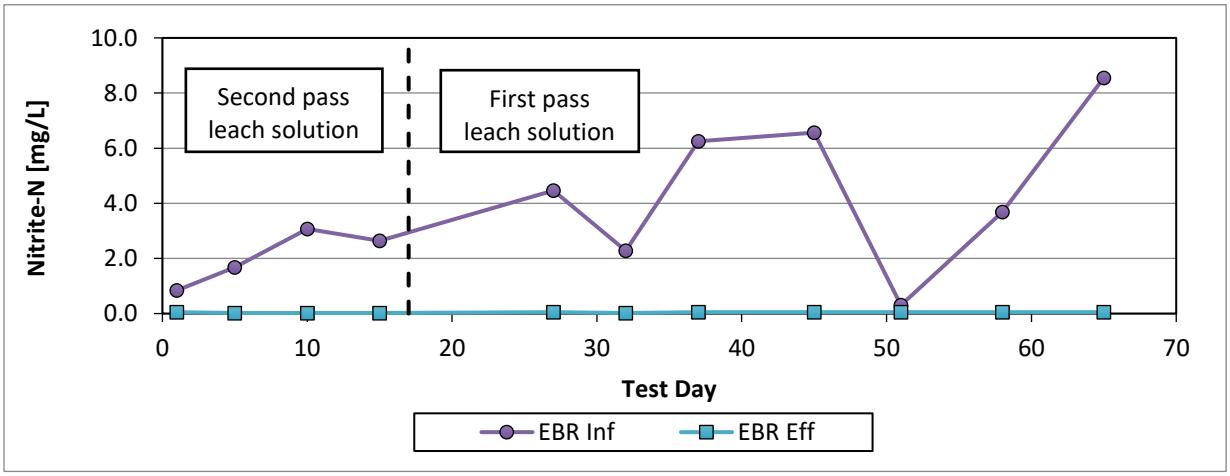

Figure 9. Phase I feasibility EBR nitrite-N removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

Arsenic removal for the initial two weeks averaged 60% (Figure 10). Process and bioreactor operation were adjusted to improve the EBR performance. **After system modifications were implemented, arsenic removal increased to an average of 98.8%.** Total arsenic was removed from the average of 1,113 µg/L in the leach waters to an average of 12.9 µg/L in the EBR system effluent.

Uranium removal averaged 99.1%, with the EBR system effluent concentrations averaging 0.8 µg/L (Figure 11). Influent uranium levels varied between 34 µg/L and 154 µg/L, with the average concentrations of 92.5 µg/L. Table 5 summarizes the feasibility performance.

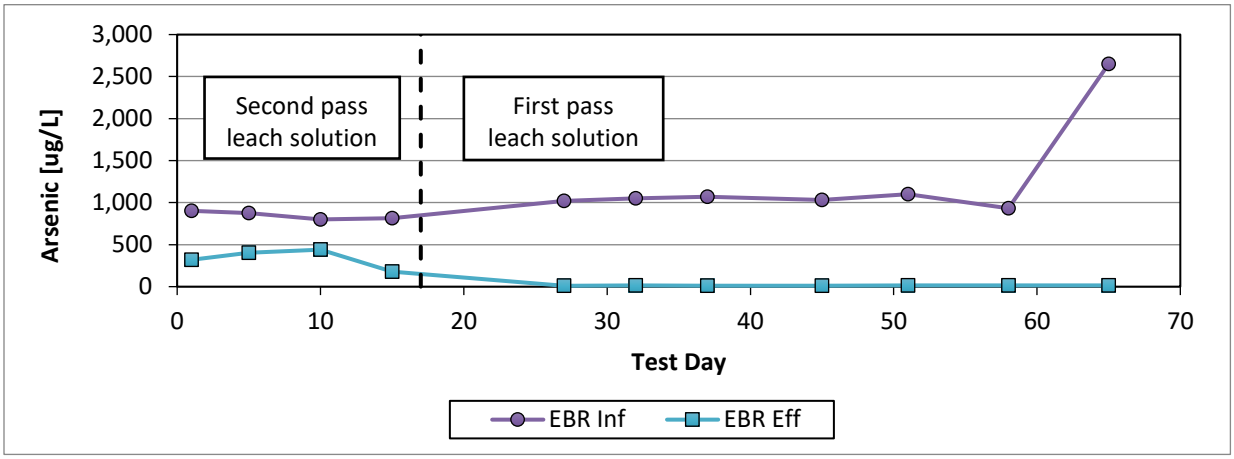

Figure 10. Phase I feasibility EBR arsenic removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

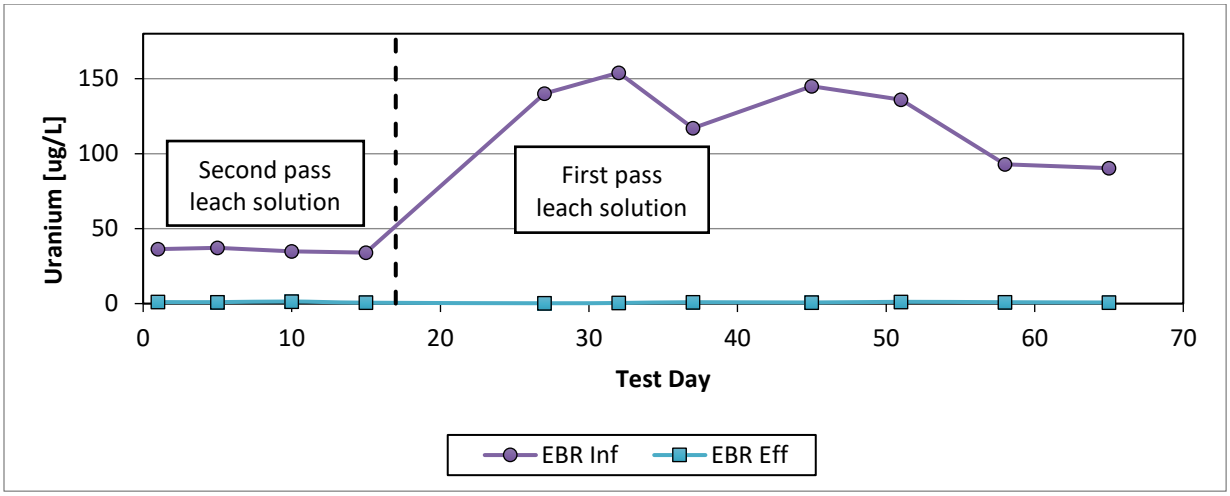

Figure 11. Phase I feasibility EBR uranium removal from Coffee Gold leach waters. The dashed vertical line corresponds to the day when the EBR system influent was changed from leach waters pumped through the spent ore columns twice to the leach waters that were pumped through the spent ore columns once.

Table 5. Average Phase I feasibility treatment performance.

Parameter	Average Influent	Average Effluent	% Removal
Nitrate-N [mg/L]	188	< 0.19	> 99.9%
Nitrite-N [mg/L]	3.7	< 0.04	> 98.9%
As [µg/L]	1,113	12.9*	98.8%
U [µg/L]	92.5	0.8	99.1%
Al [µg/L]	737	< 35.8	> 95.1%
Sb [µg/L]	33.2	< 0.35	> 98.9%
Cd [µg/L]	1.3	< 0.02	> 98.5%
Cr [µg/L]	10.7	< 0.66	> 93.8%
Co [µg/L]	269	122	54.6%
Cu [µg/L]	267	< 2.4	> 99.1%
Fe [µg/L]	2.2	0.23	89.5%
Pb [µg/L]	1.9	< 0.17	> 91.0%
Hg [µg/L]	1.6	0.03	98.1%
Mo [µg/L]	59.5	< 6.9	> 88.4%
Ni [µg/L]	75.1	< 2.3	> 96.9%
Se [µg/L]	2.9	1.2	58.6%
Ag [µg/L]	3.9	< 0.06	> 98.5%
Tl [µg/L]	0.8	< 0.03	> 96.2%
Sn [µg/L]	32.5	0.8	97.5%
Zn [µg/L]	76.1	38.1	49.9%
WAD Cyanide [mg/L]	0.03	< 0.007	> 76.7%
Total Cyanide [mg/L]	0.48	0.16	66.7%
Ammonia-N [mg/L]	15.3	208	NA
Orthophosphate [mg/L]	0.2	47.1	NA

*after process adjustment

NA – not applicable

Feasibility Treatment of Other Contaminants and By-Product Formation

Besides arsenic and uranium, the feasibility test system removed other metals to various degrees (Table 5). **Over 90% average removal efficiencies were achieved for Al, Sb, Cd, Cr, Cu, Pb, Hg, Ni, Sn, Ag, and Tl.** Total and WAD cyanide were still present in the leach waters after cyanide destruction with peroxide, albeit at much lower concentrations (0.48 mg/L and 0.03 mg/L, respectively). The EBR system degraded WAD cyanide to below the detection limit of 0.007 mg/L and total cyanide to average levels of 0.16 mg/L (Table 5).

As expected in this preliminary treatability evaluation, nutrient levels (e.g., ammonia-N and orthophosphate) were elevated in the test system effluent. The scope of work for the feasibility phase was focused on the initial validation of the biological process for removal of contaminants of interest (i.e., proof-of-concept) and not on process optimization. In field applications, minimum nutrient additions to the biological system are established and balanced, often resulting in minimal (if any) increases in residual nutrients in the system effluent. However, if ultra-low levels of ammonia or BOD are required in the system effluent, a conventional aerobic bioreactor polishing step can be used. Aerobic bioreactors are a well-established technology for nutrient removal from municipal wastewaters, where they have been successfully implemented for over a century. Phase II bench-scale testing will investigate the optimal nutrient composition and dosage to more accurately define what levels of residual nutrients can be expected in the full-scale plant effluent.

Feasibility of In-Situ Denitrification

Table 6 summarizes average nitrate-N concentrations during two in-situ testing phases. Figure 12 shows the results of in-situ denitrification in the Coffee Gold spent ore materials.

For the initial three weeks of operation, both columns were irrigated with 1 L/day of the EBR effluent spiked with about 150 mg/L nitrate-N; the influent to the control column was filtered before it was applied to the top of the column. During test stage 1, the average in situ test column effluent contained 13.9 mg/L NO_3-N, while the average control column effluent was 103 mg/L NO_3-N. It should be noted that nitrate-N concentrations in the control column decreased with time to about 50 mg/L, which can be explained by the fact that the EBR effluent applied to the top of this column, although filtered, still contained excess nutrients in the form of organic carbon, nitrogen, and phosphorus, that allowed the native denitrifying population to carry out partial denitrification.

For the following four weeks, both columns were irrigated with 1 L/day of deionized (DI) water spiked with about 150 mg/L nitrate-N. The in-situ test column was provided with the required nutrients daily. During test stage 2, the average in-situ test column effluent contained 26.4 mg/L NO_3-N, while the average control column effluent was 146 mg/L NO_3-N. The negligible nitrate removal in the control column as compared to the in-situ column demonstrated the effectiveness of in-situ denitrification.

The feasibility testing proved the in-situ treatment to be a feasible approach to controlling nitrates within the heap environment. Lowering the nitrate concentrations in the heap leach rinse solutions in-situ would significantly impact the size, capital cost, and operating expenditures of the active water treatment system.

Table 6. Average Phase I feasibility in-situ denitrification performance.

	Control	In Situ	Control	In Situ
	EBR Effluent + 150 mg/L NO_3-N		DI Water + 150 mg/L NO_3-N	
NO_3-N [mg/L]	103	13.9	146	26.4

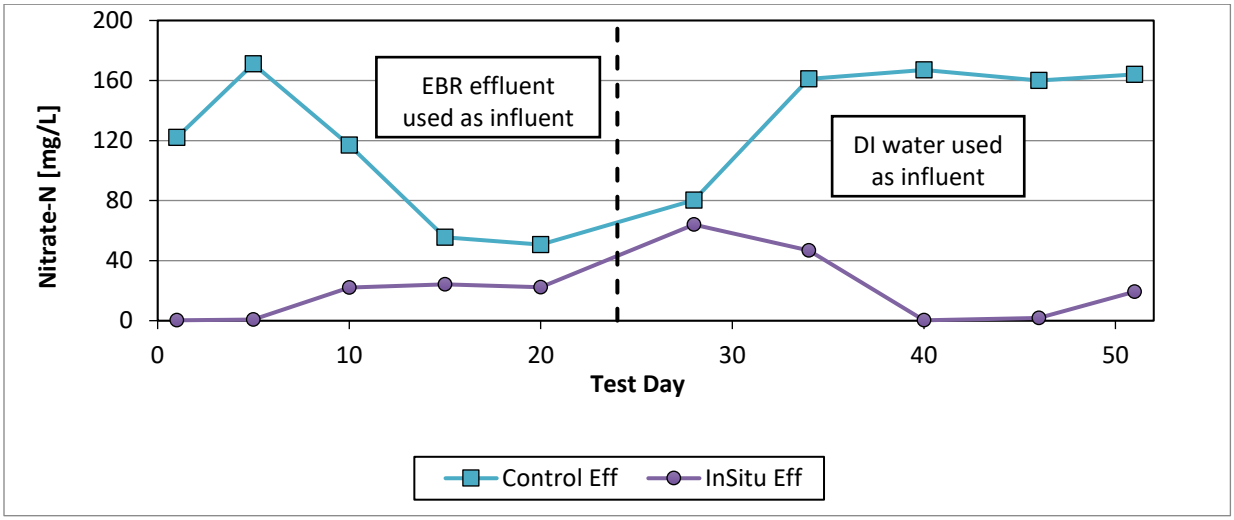

Figure 12. Phase I feasibility in-situ denitrification from Coffee Gold spent ore and water. The dashed vertical line corresponds to the day when the column influent was switched from the EBR effluent to deionized water.

Phase I Feasibility Consultations, Feedback, and Information Requests

The feasibility testing concluded with a final report submitted to Newmont (then Goldcorp) in August 2016. Following the report submittal, Newmont elicited feedback from the stakeholders, most notably the First Nations and their representatives (Tr'ondek Hwech'in and Source Environmental Associates) in 2017, as well as the Canadian and local regulatory agencies through the YESAB review process in 2018. Several technical meetings and workshops were held for consultations. WesTech participated in the meetings to provide clarifications and adjust the planned Phase II testwork based on the feedback. Table 7 lists the feedback and action items identified through the process.

Table 7. Feedback and information requests, obtained through consultations with the stakeholders.

Requested by/ Reference	Issue and Rationale	Feedback and Information Request	Solution & Action Item
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Will the Heap Leach Facility pose a concern for long-term water quality downstream of the proposed project? Are water treatment plans for the active closure phase and the post-closure phase sufficient?	The information provided is not adequate to assess the short-term and long-term water quality associated with the Heap Leach Facility. Additional information is required. The descriptions of the active and passive treatment design plans in the submission are not sufficient for EA-level review.	Phase I Feasibility was a "proof-of-concept" test focused on establishing whether or not the waters can be treated and on identifying suitable treatment options. Phase II testing will define the required treatment train in more detail.

Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Residual Ammonia and Ortho-phosphate across Active Treatment. Appendix A of the EBR feasibility report shows the change in concentrations of a variety of constituents across the system.	What level of residual orthophosphate and ammonia could be expected in the EBR effluent after nutrient dosage has been optimized?	The goal of Phase I Feasibility testing was not to evaluate the nutrient requirements, and thus, a laboratory-grade nutrient was used. It ensured that nutrient limitations would not affect the evaluated treatment approach. Data from other testing were shared to show what residual nutrient levels were generated in the past by the EBR system. Phase II testing will use commercial-grade nutrients and will optimize nutrient addition to demonstrate what residual nutrient levels can be expected from a full-scale treatment system at the Coffee Mine.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Residue Characterization and Management. The EBR system is a biological system and so biosolids waste residue will be generated. No information on the characterization and handling of this waste is presented in the documentation.	Elaborate on the residue characterization, geochemical stability, disposal/handling plan, and long-term management plan.	The preliminary residue characterization will be performed in the form of TCLP testing of the reactor's support media upon the completion of Phase II testing. On-site Phase II pilot-scale demonstration testing will define the volume and inform a long-term management plan.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Adaptability. Three things must be achieved for the water treatment to be a success - denitrification with no residual ammonia/other	The level of nitrate in the plant feed will decrease over time as CN is washed out of the HLF as there is a finite load of N on site. On the other hand, As and U will persist on a longer time scale. As such, it is likely that later in the	From the ORP-ladder perspective, uranium bioreduction occurs at similar if not more energetically favorable ORP ranges than denitrification. The process will be staged, and the denitrification reactor-stage will never be driven to low

	nutrients, metal reduction, and conversion of sufficient sulphate to sulphide to precipitate metals without leaving residual sulphide in solution.	project, the influent concentration of NO3 will be low while influent As and U will be high. Can the EBR system effectively achieve the three goals described with only a single lever of control, ORP?	enough ORPs to generate ammonia. After cyanides/nitrates are washed out from the HLF, the redundant denitrification reactors can either be taken offline, adapted to treat more volume for uranium removal, or used for other metals polishing. Phase II bench-scale testing will also evaluate alternative treatment options for Arsenic removal.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Residual Chloride from Active Treatment. Appendix A of the EBR feasibility report shows an increase in chloride.	Why is chloride being added across the circuit? Can this addition be mitigated in some way? Is there a minimum level of chloride that must be present for the EBR system to be effective?	Chlorides are not required for the bioreactors and were a byproduct of a laboratory-grade nutrient mixture used. The goal of Phase I Feasibility testing was not to evaluate the nutrient requirements, and thus, a laboratory-grade nutrient was used. It ensured that nutrient limitations would not affect the evaluated treatment approach, but it resulted in increases in parameters, such as chlorides, that will not be present in commercial-grade nutrients. Phase II bench-scale testing will use commercial-grade nutrients to demonstrate that no chloride increases are expected from the full-scale facility.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Sulphur Deportment across Active Treatment. Appendix A of the EBR feasibility report shows sulphate removal of 100-150 mg/L across the system	What is the form of the sulphur removed from the system using the SBR?	Sulfur undergoes a number of biochemical transformations within the bioreactor, depending on the treatment conditions, with hydrogen sulfide gas generation as the most dominant pathway. Phase II bench-scale testing will evaluate two options for

	and simultaneous generation of 3-4 mg/L of sulphide. Given that only trace levels of metals are removed by the system, there is a gap between the influent and effluent total sulphur.		sulfate removal: 1) EBR treatment with expected H_2S gas generation, and 2) chemical precipitation pre-treatment.
Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Bioavailability of Metals across Active Treatment. The bioavailability of dissolved metals can be enhanced through contact with reductive biological treatment systems which generate species such as methylated arsenic species. These organic-metal complexes can be significantly more bioavailable than their inorganic counterparts.	Has Inotec analyzed the speciation of residual metal that is not removed through the EBR for this project or any others? Particularly arsenic, as this is a key constituent of concern in the project.	Arsenic and selenium speciation will be included in the Phase II bench-scale testing analytical plan. Methylated arsenic species have never been observed in our past testing.
Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Deportment of Cyanide Residue across Active Treatment. Oxidative treatment of cyanide can lead to the formation of cyanate, and reductive treatment of cyanide and cyanide degradation products can lead to formation of thiocyanate.	How do cyanate/thiocyanate behave in the EBR system? Are either removed/generated in the process? Given the amount of sulphate reduction occurring in the system (see previous point about sulphur deportment), the formation of thiocyanate may be occurring simultaneously.	Thiocyanate analysis will be included in the Phase II bench-scale testing analytical plan.

Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Startup/Shutdown. The EBR system is a biological system that is to be run seasonally for 6 months of the year. The startup/shutdown of biological processes can be lengthy.	How long is the startup period before the EBR is system is generating effluent meeting discharge targets? Does plant shutdown have an impact on effluent discharge quality?	Generally, the EBR system has been shown to require 5-14 days to reach steady-state during the initial start-up of a new facility and less than an hour to 7 days after long-term shutdowns. Shutdowns are not expected to have an impact on the effluent discharge quality
Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, 06/2017	Active Treatment Variability with Flow. The rate of EBR treatment is expected to vary between 4 and 10 L/s. The Inotec document describes a 44h hydraulic retention time (HRT) in the system.	How sensitive to HRT is the discharge quality of the plant? Will performance change if HRT varies because there is excess water on site (or not enough)? If this risk is significant, is a surge pond available to modulate variability in water availability?	Phase I Feasibility was a "proof-of-concept" test focused on establishing whether or not the waters can be treated and on identifying suitable treatment options. The HRTs used were far from optimized and were long enough as not to affect the treatment efficacy. Phase II bench-scale testing will optimize the HRT range, which we expect to be several times shorter. Based on the variable flow expectations, an equilibration basin or tank is expected to be required for a full-scale facility.
Environment and Climate Change Canada – YESAB, 02/2018	The Proponent states that for heap leach solutions only, cyanide destruction followed by an Electrochemical Biological Reactor (EBR) will be employed to treat water to discharge quality. EBRs have not typically been proposed nor used for Yukon projects and their suitability	Clarify whether the proposed water treatment system has been tested (bench-scale) using a synthesized heap leach solution (of the characteristics expected for this project) to proof of concept level and its applicability in a Northern context. If this has yet to be demonstrated, provide clarification whether the Proponent is planning on conducting bench-scale	The proposed phased testing approach includes feasibility (proof-of-concept) testing and bench-scale testing on heap leach solutions generated from the Coffee Project ore materials. The on-site pilot-scale demonstration will be conducted as a final step of a full-scale water treatment design. The phased testing and process development approach minimizes the risks associated with technology

	/ performance in a Northern context remains uncertain. It is not clear what testing has been conducted to suggest suitability for this aspect of the project in particular.	testing as part of the water treatment system finalization, as well as characterizing the resulting effluent prior to implementation.	selection and treatment implementation.
Environment and Climate Change Canada – YESAB, 02/2018	Elevated uranium concentrations in both groundwater quality and surface water quality baseline have been identified. Radium 226 (Ra226) is a daughter isotope resulting from the radioactive disintegration series (decay) of uranium. Given that uranium is a parameter of concern and has been shown to be present and in exceedance as per the above-mentioned, it is not without reason to assume that Ra226 concentrations may end up in the receiving environment throughout the life of the project.	Ra226 is a deleterious substance as set out in Schedule 4 of the MMER. Predictions for Ra226 have been generated by the water quality model for pit lakes and settling ponds. Demonstrate that a non-acutely toxic effluent as required by the MMER will be met throughout the life of the project (i.e. construction, operation, and closure).	Radium-226, as well as other radiochemistry parameters, will be included in the Phase II bench-scale testing analytical plan.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in,	The test work for the biological treatment proposed (EBR) shows a very significant increase in phosphate,	The Inotec EBR work plan authored Oct 30, 2017 included an objective in Phase 2 of determining the optimal dosage of nutrients to minimize	The goal of Phase I Feasibility testing was not to evaluate the nutrient requirements, and thus, a laboratory-grade nutrient was used. It ensured that nutrient limitations

Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	ammonia and chloride across the treatment system. These increases are not accounted for in the WQ model. These will be ecologically significant because of the low nutrient levels in northern water courses. The increase in chloride across the system is relevant both because of the direct toxicity of salinity on freshwater species and the corrosive impact for metal release in the rock drain.	residual nutrients in the effluent. Phase 2 also includes development of an integrated treatment train include pre-treatment (ex. cyanide destruction) and post-treatment (nutrient polishing). The minimum residual nutrient levels in EBR effluent while still reaching nitrate/arsenic/uranium levels can be assessed. Following this, the requirement of nutrient polishing systems can be evaluated and supported through testing or other reference sites.	would not affect the evaluated treatment approach, but it resulted in increases in parameters, such as chlorides, that will not be present in commercial-grade nutrients. Phase II testing will use commercial-grade nutrients to demonstrate ammonia, phosphate, and chloride levels more representative of the proposed full-scale treatment system.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	The active water treatment system will produce some quantity of waste biomass and carbon, likely both as a periodic bleed from the system and during the final reclamation of the system after shutdown of the EBR. Plans for characterizing this material were not covered in the EBR workplan.	The upcoming Phase 2 EBR test work is a good opportunity to characterize waste and help inform disposal plans. TCLP is one option for characterization, but depending on residue disposal options that are on the table and the amount of material generated during Phase 2 testing, different characterization could be done.	TCLP analysis will be added to the Phase 2 test work, but the pilot test materials would provide better data as they would represent testing conducted with actual wastewaters. TCLP tests will be done on both sets of test materials.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in,	Arsenic speciation in the feed	The Phase II work plan describes use of ferric coagulation to remove arsenic from water. Arsenic removal in this way will depend on	Arsenic speciation of the influent waters will be included in Phase II testing.

Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018		arsenic speciation – As(V) is more amenable to ferric than As(III). Arsenic in the HLF water may be more reduced (from the reductive conditions in the heap) or more oxidized (from use of peroxide to destroy cyanide upsteam of the EBR) or a mix of the two. Consideration of speciation in the test plan/analytics is recommended.	
BQE and Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	Organo-arsenic complexes in EBR effluent	The EBR systems involve biological activity and therefore have the potential to convert inorganic arsenic species to organic species. Organic arsenic species can be more bio-accumulative. It is recommended that arsenic speciation analysis be conducted on treatment effluent in future testing campaigns so as to better evaluate the impact of the project on biota in the receiving environment.	Arsenic speciation of the effluent waters will be included in Phase II testing.
BQE and Source Environmental Associates/ Tr'ondek Hwech'in, Technical Memorandum, Coffee Gold Upcoming Water Treatment Workshop Discussion, 05/2018	Cyanate formation potential	Cyanate is a likely byproduct of cyanide destruction with peroxide and so should be expected in the EBR feed. It is recommended that cyanate assay be incorporated into the Phase 2 laboratory program (in addition to the thiocyanate as was noted in the Oct 30, 2017 Phase 2 EBR workplan).	Thiocyanate analysis will be included in Phase II testing. Cyanate analysis is not available through the selected analytical laboratory. Cyanate will be added to the pilot-scale analytical plan.

PHASE II BENCH-SCALE TESTING RESULTS

Preliminary Assessments

The Obtained Leach Water Chemistry and Experimental Implications

The chemistry of the waters generated by Kappes, Cassiday & Associates in the leach testing differed from the water modeling performed by Lorax Environmental (Table 8), as was discussed by WesTech and Lorax when deciding how to best approach the needed chemistry adjustments. Limitations of an accelerated leaching procedure, as well as scaling issues of a small-scale leach column, likely contributed to the discrepancies.

Batches of the waters delivered to WesTech's laboratories were spiked with the parameters of concern (NO_3, SO_4, As, U, and Sb) to match the upper modeling predictions. These parameters are highlighted in blue in Table 8. Counter ions were chosen with a goal to balance the major ion chemistry and included Ca, Mg, Na, and Cl.

Certain other influent water chemistry parameters exceeded the predicted levels by up to several orders of magnitude (NH_3, alkalinity, Al, Ag, and Cu). They are highlighted in yellow in Table 8. Except for alkalinity, **these concentrations in the generated waters exceeded their respective treatment targets. Water chemistry was not adjusted to lower their concentrations.**

Table 8. Water chemistry comparison of the modeling predictions and the received solutions. Treatment targets are provided as a reference.

Parameter [mg/L]	HLF Rinse Modeling	Coffee Waters	Treatment Target
NH_3-N	0.025-0.06	19	8
NO_3-N	275-307	117	3
NO_2-N	1.6-1.9	0.9	0.09
Cl	115-123	12	290
SO_4	2300-2516	105	1500
Alkalinity, as $CaCO_3$	47-87	284	500
WAD-CN	0.09-0.2	0.03	0.025
Al	0.06-0.2	5.7	0.06
Ag	0.00009-0.00125	0.027	0.00009
As	0.66-2	0.559	0.035
Ca	204-350	12	180
Cd	0.00004-0.00013	0.00012	0.00004
Cr	0.004-0.014	0.0012	0.001
Cu	0.004-0.014	0.029	0.004
Fe	0.15-0.5	0.077	0.05
Hg	0.0001-0.00026	0.000013	0.0001
Mg	117-155	1.6	50
Mn	0.016-0.06	0.025	0.016
Mo	0.033-0.105	0.035	0.033
Na	890-1168	238	890
K	8-11	6.5	8

Parameter [mg/L]	HLF Rinse Modeling	Coffee Waters	Treatment Target
Ni	0.002-0.006	0.006	0.002
Pb	0.00032-0.0013	0.0006	0.0032
Sb	0.17-0.5	0.084	0.07
Se	0.0015-0.005	0.0008	0.0015
Tl	0.0015-0.004	0.0006	0.0015
U	0.3-0.685	0.306	0.1
Zn	0.02-0.052	0.005	0.02

Chemistry Assessment

Evaluation of the chemistries suggested that most of the parameters of interest were well within the treatability range. A discussion of the treatability assessment and the identified potential issues are presented below.

Nitrate-N, uranium, and sulfate concentrations of 300 mg/L, 600 µg/L, and 2,500 mg/L, respectively, were within the biological treatability range. Inorganic parameters, such as chlorides and cyanides, which often have an inhibitory effect on microbial metabolism, were present at low levels. Additionally, the elevated alkalinity and presence of nitrates would benefit the biological treatment approach, maintaining an optimum pH of the system. No microbial inhibitory parameters were identified.

In terms of potential issues, as demonstrated in the Phase I feasibility testing, arsenic concentrations were present at the upper margin of biological treatability. What is more, the compounds that often compete for electrons during biotreatments, e.g., nitrate, nitrite, sulfate, and other metal oxyanions, such as arsenate, were present at elevated concentrations, complicating the treatment approach. Finally, from the system design perspective, due to the concentrations of sulfate, aluminum, calcium, and other water hardness parameters, bioreactor operation must be conducted within design specifications to prevent the potential for excessive precipitation formation. **The chemistry assessment concluded that, while treatable, the complexity of the Coffee waters presents a challenging scenario for full-scale system design based solely on biological treatment.**

Jar Testing

The generated waters contained only 0.5 mg/L total As. The solutions were spiked with sodium arsenite to reach the forecasted As levels of 2 mg/L. Arsenite is the less oxidized species of As, and it is more difficult to remove using ferric co-precipitation. **Arsenite was chosen for this testing as "the worst-case scenario" for chemical pretreatment.** The actual As speciation in the future Coffee waters is uncertain, but arsenate is generally a more prevalent species in mining environments.

Ferric co-precipitation tests demonstrated the impact of arsenic speciation on the performance (Figure 13). When no oxidizing agent was present, negligible arsenic removal was achieved. **Once arsenic was oxidized, ferric co-precipitation decreased As concentrations to at or below the treatment target.** Permanganate was used in the jar testing procedure as a strong oxidizer. Since the proposed treatment includes the destruction of cyanide by oxidation with hydrogen peroxide, it is expected that most of arsenic present will be converted to arsenate, rendering the ferric co-precipitation a suitable option for As pretreatment.

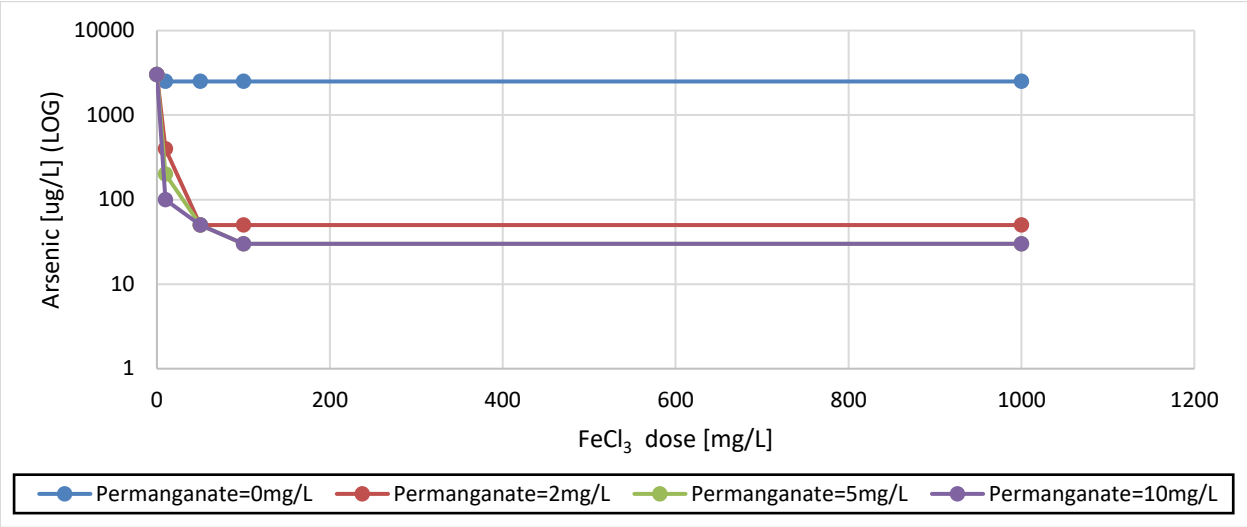

Figure 13. Arsenic ferric co-precipitation jar test results.

Sulfate is forecasted to be present at approximately 2,300-2,500 mg/L in Coffee Mine waters, which is a threshold of gypsum solubility. At such high concentrations, under specific conditions, a portion of sulfate might be expected to precipitate out of solution within the bioreactor – a scenario that should be avoided.

Sulfate precipitation pretreatment with barium salts (barium chloride and barium hydroxide) was investigated in the absence and presence of lime additions (Figure 14).

- **Treatment efficiency was shown to be directly proportional to the barium dose.**
- **Lime additions improved sulfate precipitation, but only at higher Ba doses. With the sulfate treatment target of 1,500 mg/L, lime addition was shown not to be needed.**

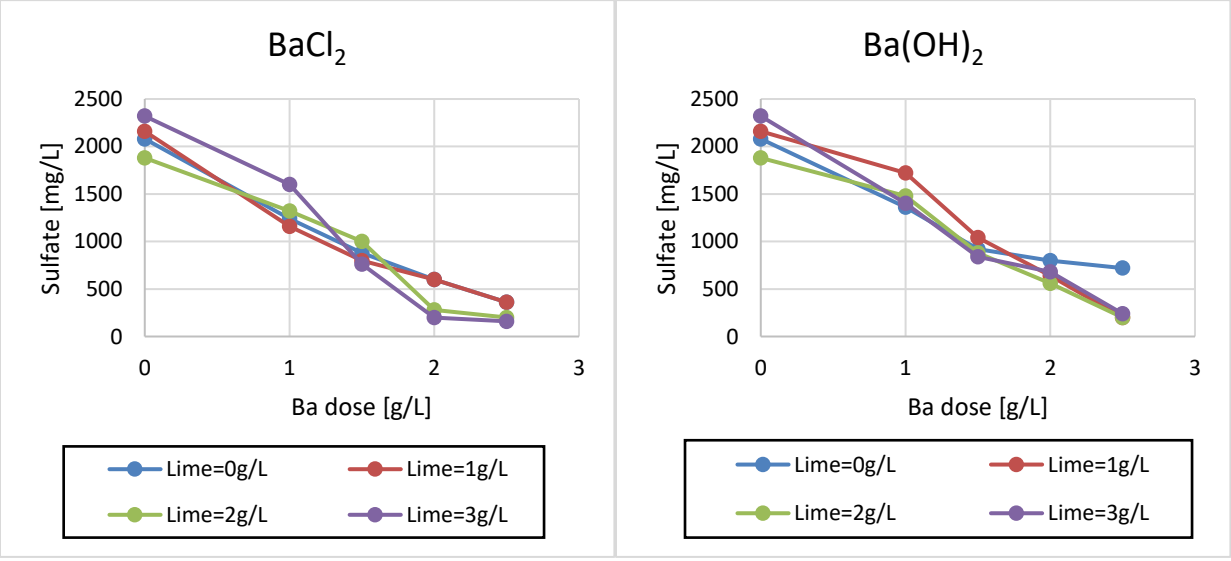

Figure 14. Sulfate precipitation jar tests with barium chloride and barium hydroxide salts.

As both evaluated barium salts proved to be effective for sulfate precipitation from the Coffee waters, other treatment parameters were considered (Table 9). Precipitated sludge resulting from barium hydroxide addition was more amorphous, took longer to settle, and generated more sludge volume than barium chloride treatment. **Barium chloride was initially chosen as a precipitation reagent for the bench-scale testing** because it yielded better results per Ba dose than $Ba(OH)_2$, the produced sludge had more beneficial characteristics, and barium chloride addition would not require an additional pH adjustment step.

Table 9. Sulfate precipitation with barium salts. Reagent dosage, sludge volume, and water loss comparison.

	$BaCl_2$	**$Ba(OH)_2$**
Min. Ba dose to meet discharge target	0.72 g/L	0.83 g/L
Equivalent reagent dose	1.28 g/L	1.91 g/L
Sludge volume	10 mL/L treated	23 mL/ L treated
Sludge volume (extrapolated)	10 L/m^3 treated	23 L/m^3 treated
Sludge weight (extrapolated)	12.6 kg/m^3 treated	25.6 kg/m^3 treated
Dry sludge weight (extrapolated)	3.5 kg/m^3 treated	4.2 kg/m^3 treated
Water loss (extrapolated)	9.1 kg/m^3 treated	21.5 kg/m^3 treated

Microbial Screening and Assessment

Microbes present in the received water samples were cultured. This task provided information about concentrations and colony types of microbes present (i.e., microbial diversity). Understanding the native population is as crucial as understanding water chemistry since indigenous microbes can either hinder or enhance the biotreatment.

The microorganisms isolated from the waters received were screened with WesTech's repository strains to examine their contaminant-reducing potential in the site waters. The microbial screening was performed as a batch, qualitative assessment toward a selection of a robust microbial population. It was used 1) to determine whether a given contaminant was easy or difficult to remove in the given water chemistry using biological treatment; 2) to identify the best performing microbial population in the given water chemistry (contaminant transformation, performance robustness, etc.); 3) to select an adjusted/enhanced microbial consortium that was the most compatible with the unadjusted native population; and 4) to condition the selected microbial consortia for optimal EBR performance.

The microbes screened included denitrifiers, uranium reducers, arsenic reducers, antimony reducers, and sulfate reducers, matched with the indigenous microbial population. **With an evaluation of the obtained water chemistry, microbial screening tests demonstrated favorable biological treatment of all contaminants of concern.** Figure 15 shows a snapshot of the screening results of denitrification and sulfate reduction. Only a few microbial strains tested are shown in the figures to help with legibility. Out of dozens of microbial strains tested, selected few were further screened to develop the inocula for bench-scale tests.

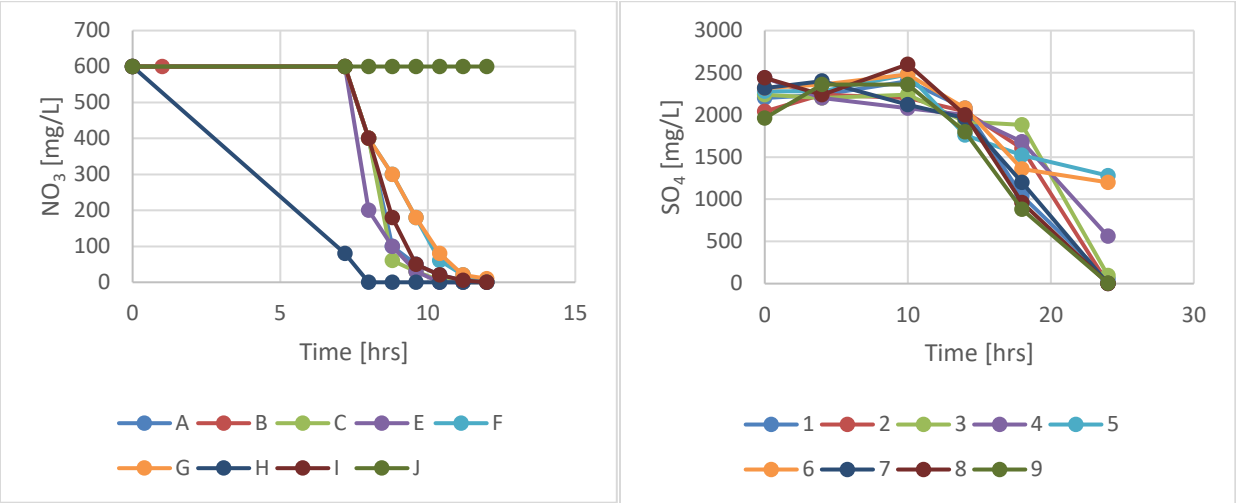

Figure 15. Selected snapshots of denitrification and sulfate reduction microbial screening tests using various denitrifying (A – J) and sulfate-reducing (1 – 9) strains.

Bench-Scale Testing

System A: Validation Results of Contaminants of Interest

The validation phase of the bench-scale EBR testing with System A was completed successfully for all contaminants of concern. Nitrate-N was consistently removed to below the detection limit of 0.5 mg/L within the first EBR stage and remained nondetectable throughout the treatment (Figure 16).

Sulfate was successfully removed to below the discharge target of 1,500 mg/L in the phys-chem pretreatment stage and remained within compliance throughout the treatment (Figure 17). Sulfate removal in the pretreatment can be adjusted further based on Ba dose. The increase in sulfate concentration observed in the aerobic column during the post-treatment optimization was expected. The post-treatment's main goal was residual COD/BOD oxidation; once that goal was achieved, system optimization in terms of the HRT and the required aeration was performed to avoid re-oxidizing reduced species.

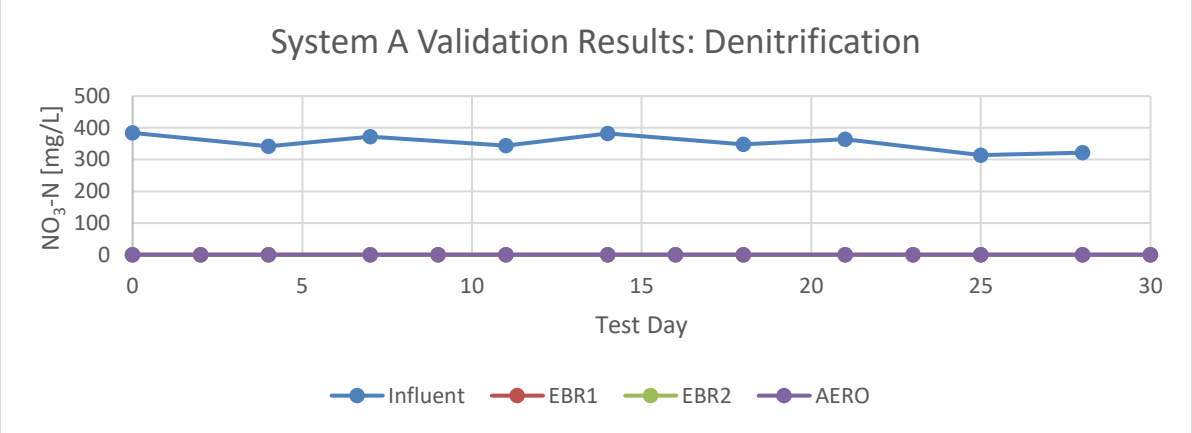

Figure 16. Phase II bench-scale denitrification results: System A validation.

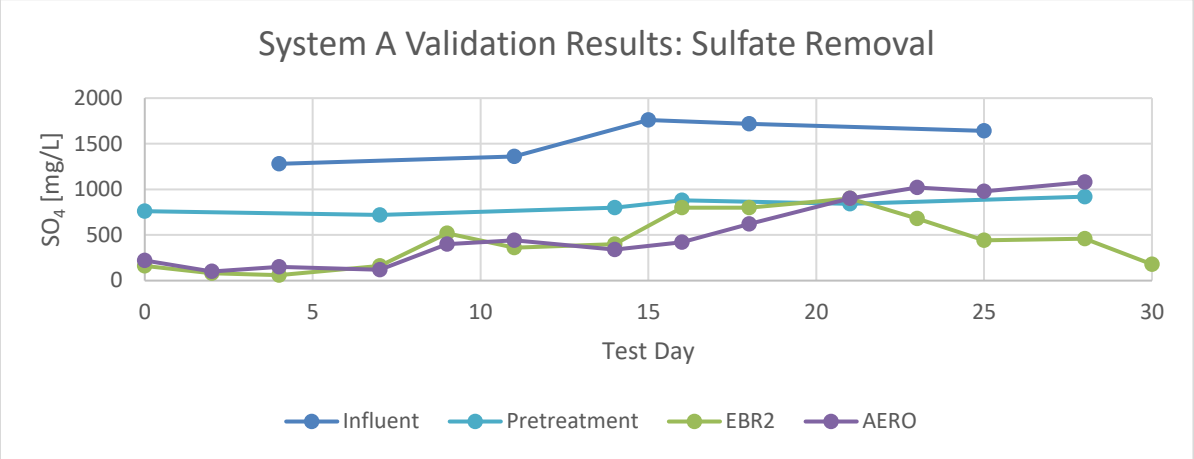

Figure 17. Phase II bench-scale sulfate results: System A validation.

A 30% total uranium reduction was achieved in the phys-chem pretreatment. The EBR system further reduced uranium to below the detection limit of 0.002 mg/L (Figure 18). Uranium removal kinetics followed linear fit in the first-stage EBR, designed for denitrification, and an exponential fit in the second-stage EBR, designed for metals removal.

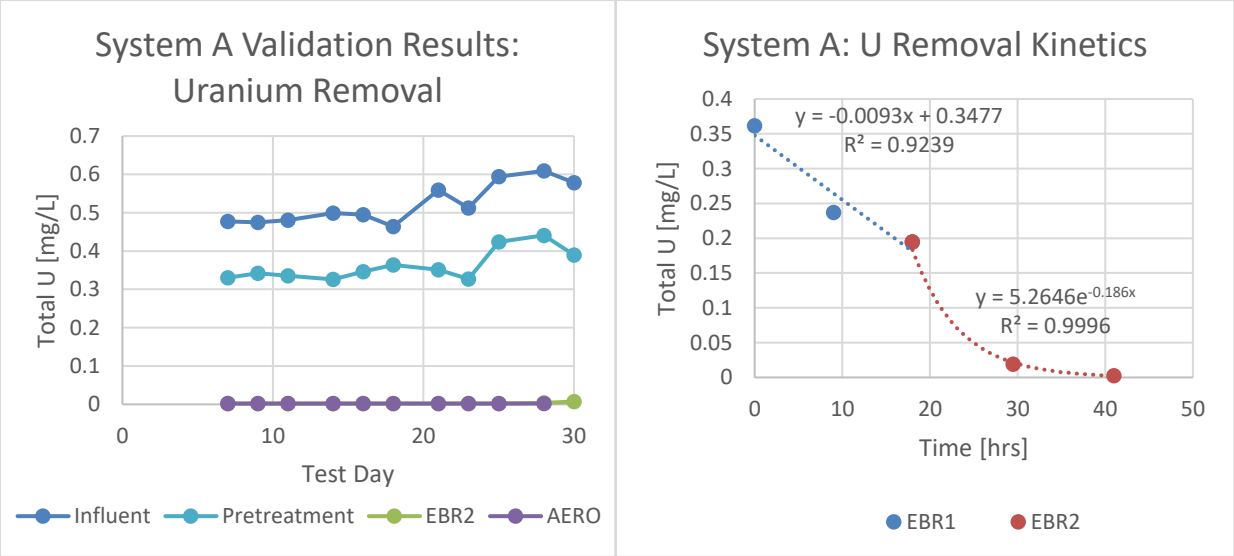

Figure 18. Phase II bench-scale uranium results: System A validation.

Total arsenic was removed to an average of 0.4 mg/L in the phys-chem pretreatment using a 20 mg/L $FeCl_3$ dose (Figure 19). Further pretreatment optimization was needed to lower the As level in the pretreatment step. The goal of the optimization was to demonstrate that the arsenic discharge target can be achieved with the ferric co-precipitation alone, without the need for a biological polishing step. The EBR system polished arsenic levels to an average of 0.009 mg/L.

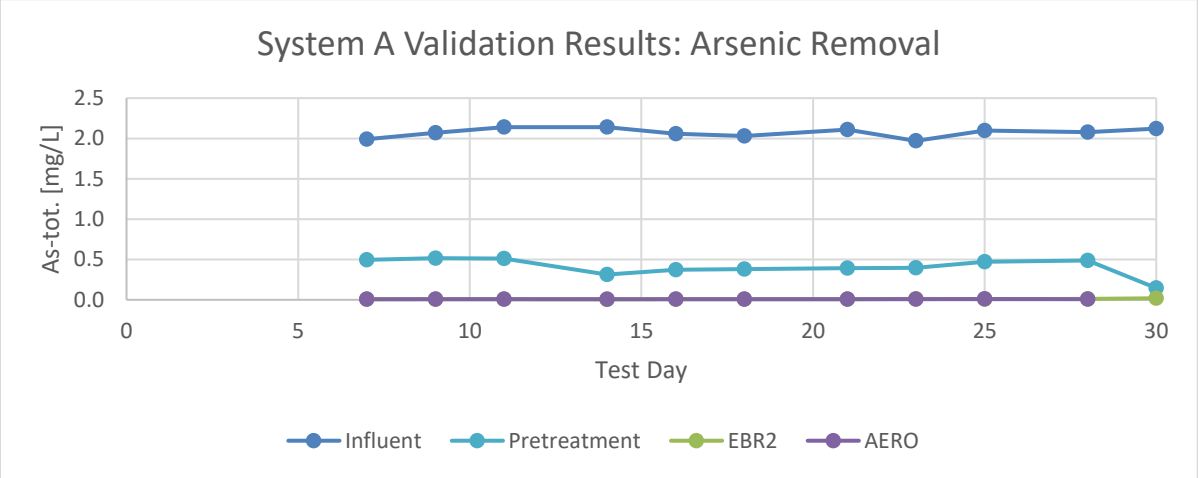

Figure 19. Phase II bench-scale arsenic results: System A validation.

System B: Validation Results of Contaminants of Interest

The validation phase of the bench-scale EBR testing with System B was completed successfully for nitrate, sulfate, and uranium removal. Successful arsenic removal was achieved during start-up and the first couple of weeks of steady-state operation, but a troubling upward trend in As concentrations was observed with time.

Nitrate-N was removed on average to 1.6 mg/L within the first EBR stage (average 16-hr HRT) and remained nondetectable throughout the rest of the treatment (Figure 20).

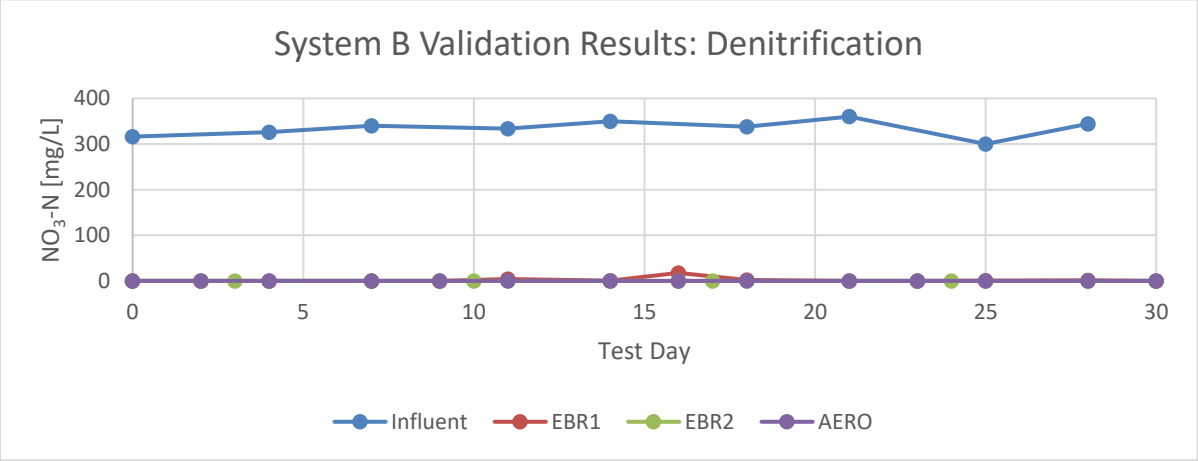

Figure 20. Phase II bench-scale denitrification results: System B validation.

Sulfate was successfully removed to below the discharge target of 1,500 mg/L in the second EBR stage (average 30-hr HRT) and remained within compliance throughout the treatment (Figure 21). Based on the first month of data, the influent's sulfate spike was adjusted further to match the upper modeling predictions.

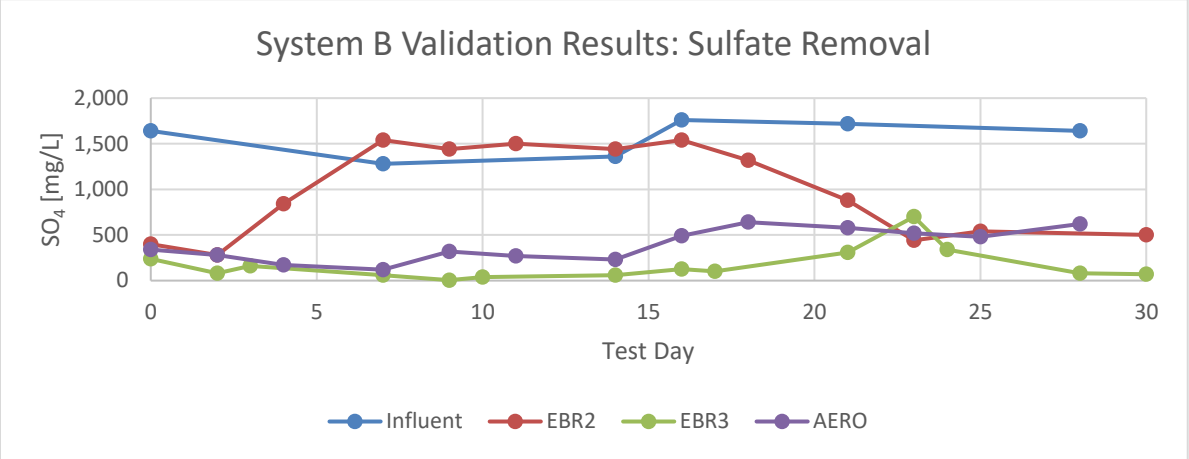

Figure 21. Phase II bench-scale sulfate results: System B validation.

The EBR system consistently reduced total uranium to below the detection limit of 0.002 mg/L (Figure 22). Average U-total concentrations of 0.14 mg/L, 0.007 mg/L, and <0.002 mg/L were achieved in the consecutive EBR reactor stages.

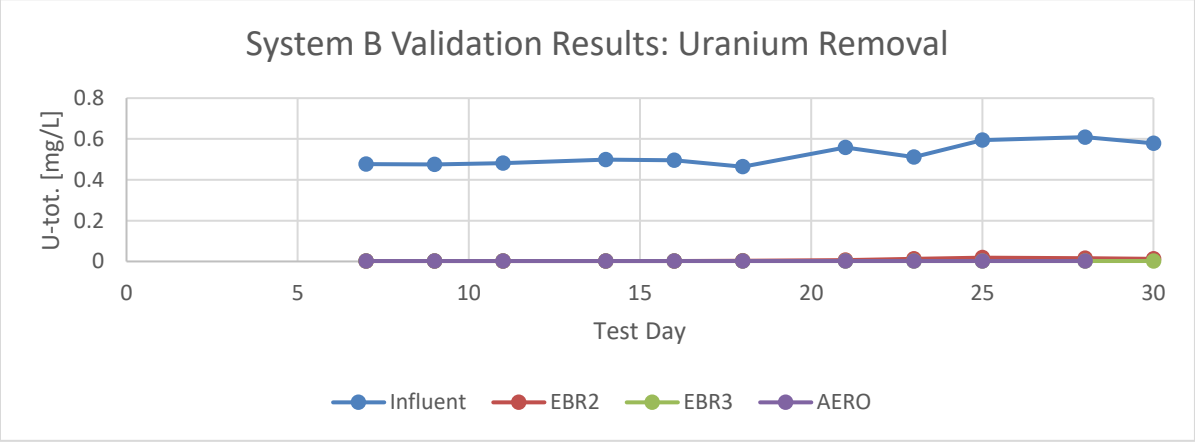

Figure 22. Phase II bench-scale uranium results: System B validation.

Total arsenic was removed to an average of 0.03 mg/L in the EBR system effluent; however, As concentrations had steadily increased throughout the validation phase (Figure 23). Arsenic levels in the system effluent during the last week of validation testing averaged 0.048 mg/L.

Based on the chemistry assessment results indicating a high load of oxyanions acting as competing electron-acceptors and the degrading As removal performance in the continuous-flow bench tests, System B treatment approach was deemed unsuitable for the Coffee Gold waters. Testing of System B was discontinued, and further testing focused on optimization and stress-testing of System A.

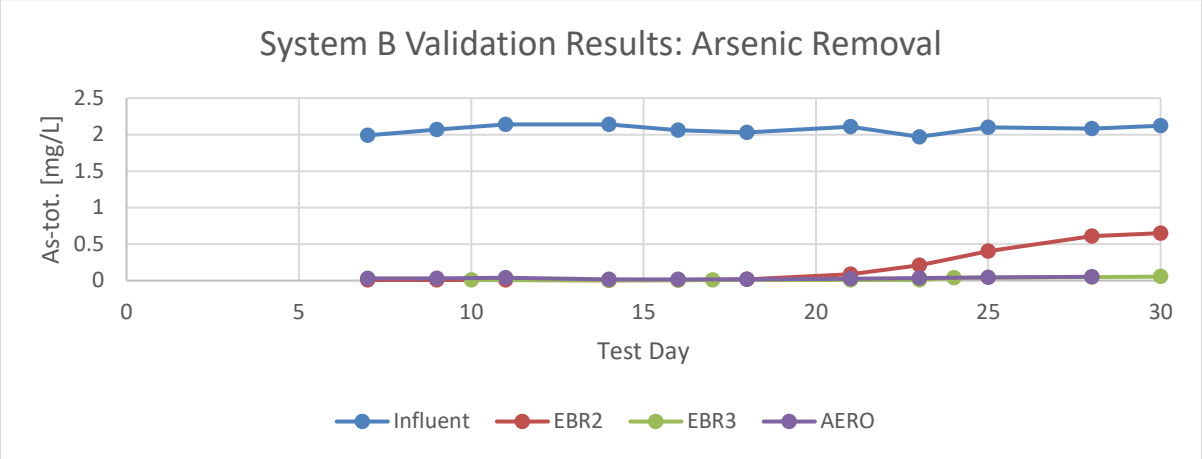

Figure 23. Phase II bench-scale arsenic results: System B validation.

System A: Stress-Testing Results of Contaminants of Interest

System stress-testing included changing the nutrient type and concentration (from the mixture of molasses and ethanol to ethanol alone) and increasing flowrates to evaluate different hydraulic retention times.

The stress-testing events yielded observable responses in nitrate concentrations in the mid-point sampling port of the first-stage EBR but had little to no effect on EBR1 effluent concentrations (Figure 24). Even though the denitrification performance was not driven to failure during stress-testing, the obtained data is sufficient to aid the pilot-scale system design. During the final four weeks of testing, the first stage EBR was operated at an average HRT of 7-hours and provided with average ethanol (nutrient) concentration of 0.6 mL/L. **Except for a stress response on test day 88, the average resulting nitrate-N concentrations in EBR1 effluent were non-detectable (<0.3 mg/L), meeting the discharge target of 3 mg/L.**

Each EBR stress-testing event affected the aerobic post-treatment performance and required system optimization (bottom graph in Figure 24). For example, as nutrient additions were lowered, the BOD loading into the aerobic column decreased as well, rendering it oversized. With extra dissolved oxygen no longer consumed by residual organics, the intermediary denitrification by-products (e.g., NO_2^-, NO, N_2O) were oxidized back to nitrate. Since reducing the aerobic post-treatment size was not feasible on the bench-scale once the columns were constructed, the post-treatment was optimized by balancing the frequency and intensity of oxygen gas additions. At the end of the testing, the aeration was only turned on for one minute every three hours instead of running continuously, meaning that the aerobic post-treatment column was significantly oversized.

Nitrite removal followed a similar trend to nitrate (Figure 25). **While the samples collected from the mid-point EBR1 showed elevated nitrite-N concentration in response to stress-testing events, the average EBR1 effluent was 0.037 mg/L, and the EBR2 effluent was non-detectable (<0.01 mg/L).** During the final four weeks of testing, after the required oxygen gas addition optimization, the average nitrite-N discharge from the aerobic post-treatment column was 0.02 mg/L. The treatment target for NO_2-N is 0.09 mg/L.

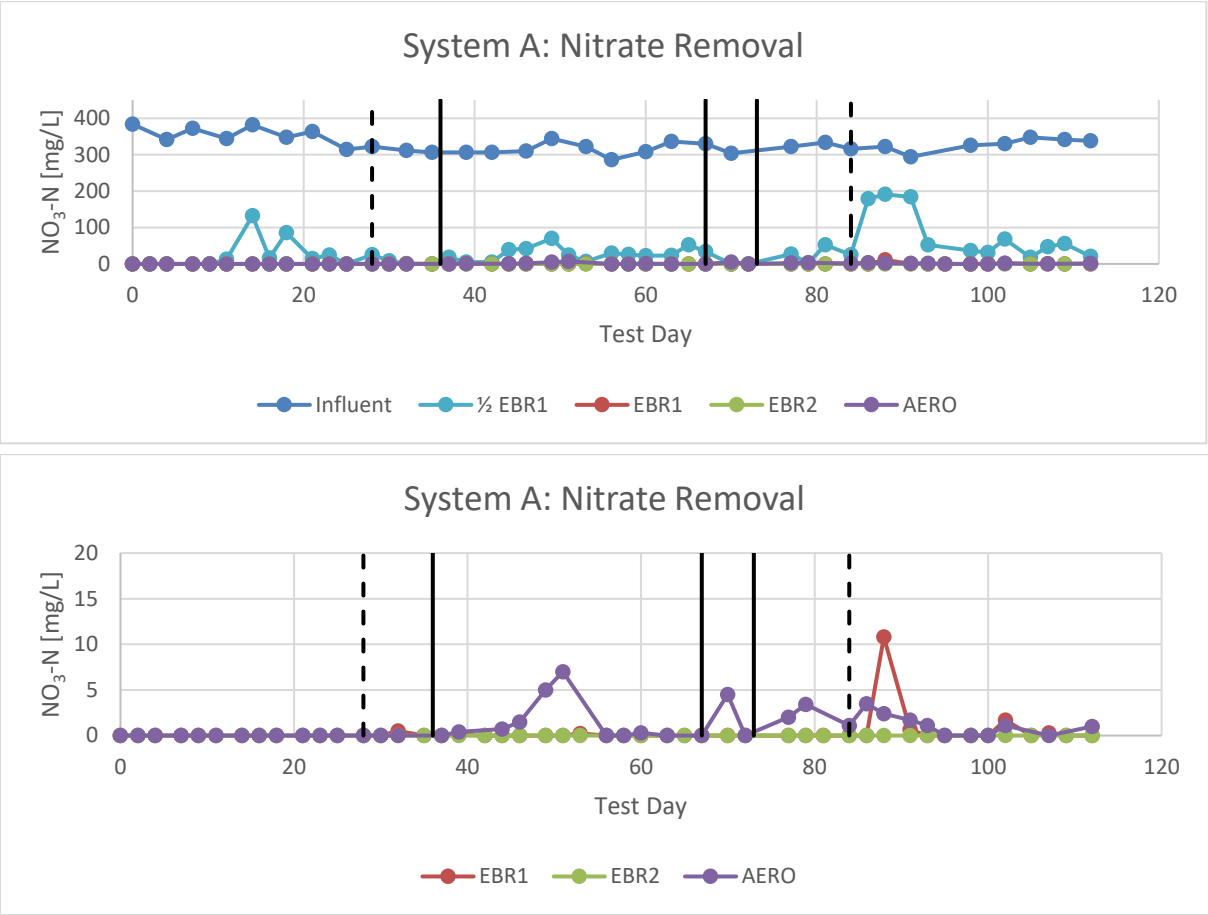

Figure 24. Phase II bench-scale denitrification results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments. The bottom graph focuses on nitrate-N results below 20 mg/L.

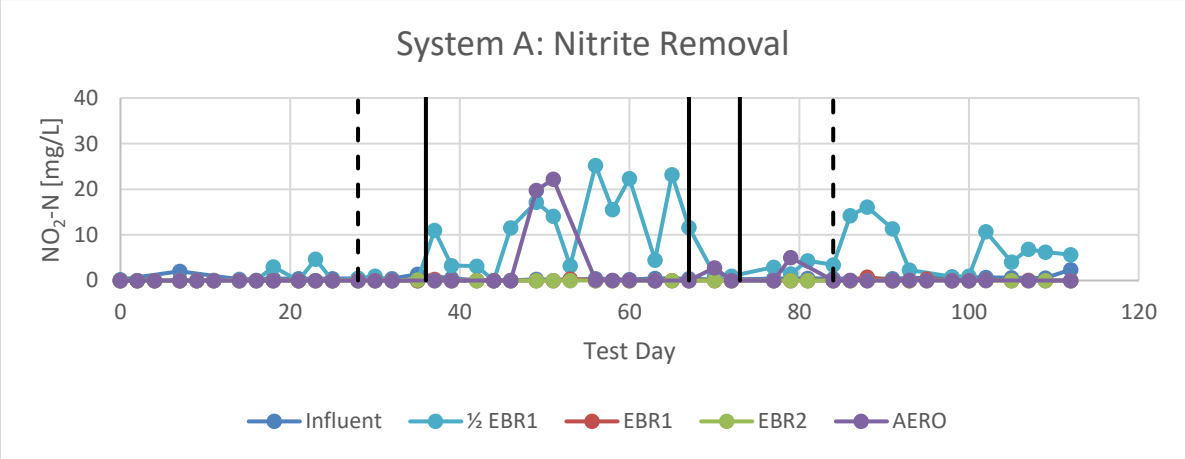

Figure 25. Phase II bench-scale nitrite results: System A overall nitrite results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

The sulfate spike in the influent waters was increased after the initial 30-day operation period to match the upper modeling predictions. After the adjustment, influent sulfate levels varied between 2,340-3,350 mg/L. The average influent concentration of 2,820 mg/L slightly exceeded the upper modeling prediction of 2,500 mg/L.

Barium precipitation pretreatment target was set at 1,500 mg/L - the treatment target. **The average sulfate concentration in the pretreatment effluent was 1,513 mg/L** (Figure 26). The preliminary jar test experiments showed that the final sulfate concentration was directly correlated to the barium dose, i.e., lower sulfate concentrations can be achieved with higher barium doses if needed.

During stress-testing, various operating conditions were evaluated to establish the optimal conditions to ensure that the EBR system reduced no or little additional sulfate. Short HRT, lack of complex nutrient additions, and balanced nutrient concentrations were found to be the most optimal operating conditions to limit sulfate bioreduction. **Since both arsenic and sulfate were removed to below their respective discharge limits in the chemical pretreatment steps, biological EBR treatment could be maintained at higher ORP ranges without using excess nutrients and thus limiting the creation of problematic by-products, such as hydrogen sulfide or methyl-arsonic acids.**

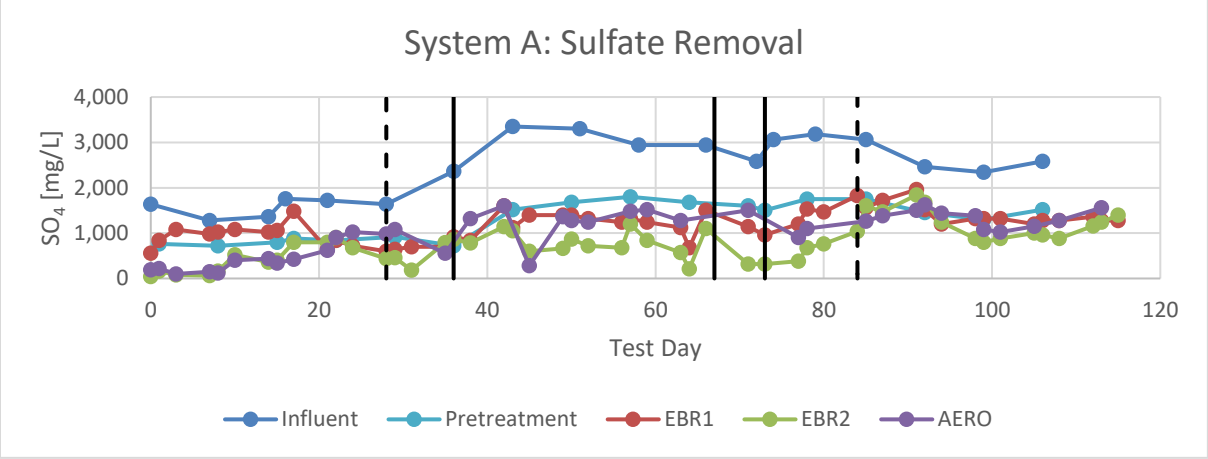

Figure 26. Phase II bench-scale sulfate results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

An average total uranium removal of 39% was achieved with the chemical precipitation pretreatment alone (Figure 27). The average total uranium influent concentrations were reduced from 0.56 mg/L in the raw Coffee water (after spiking) to an average of 0.34 mg/L in the pretreatment effluent. Uranium co-precipitation with barium sulfate has been known and studied for decades. The proposed chemical structure of the resulting precipitate is a double potassium sulfate complex of U(IV) or $K_2Ba[U(SO_4)_4]$. That is supported by a decrease in potassium concentrations in the pretreatment effluents. Since the co-precipitation mechanisms depend on uranium speciation, the actual pretreatment efficiency for uranium removal will be determined during on-site pilot-scale testing of the Coffee Mine waters.

Further removal of total uranium to below the discharge target 0.1 mg/L was achieved with the first-stage EBR treatment during test days 37 through 79 (Figure 27). The average HRT of EBR1 during that time was 11 hours, and the average ethanol nutrient concentration was 0.9 mL/L. Once the nutrient

additions to EBR1 were lowered to 0.6 mL/L and the HRT of the system was reduced to 7 hours, the resulting EBR1 effluent contained, on average, 0.17 mg/L total uranium. The second EBR stage maintained total uranium concentrations at or below the discharge target throughout the test's entire duration. The aerobic post-treatment did not affect total uranium concentrations.

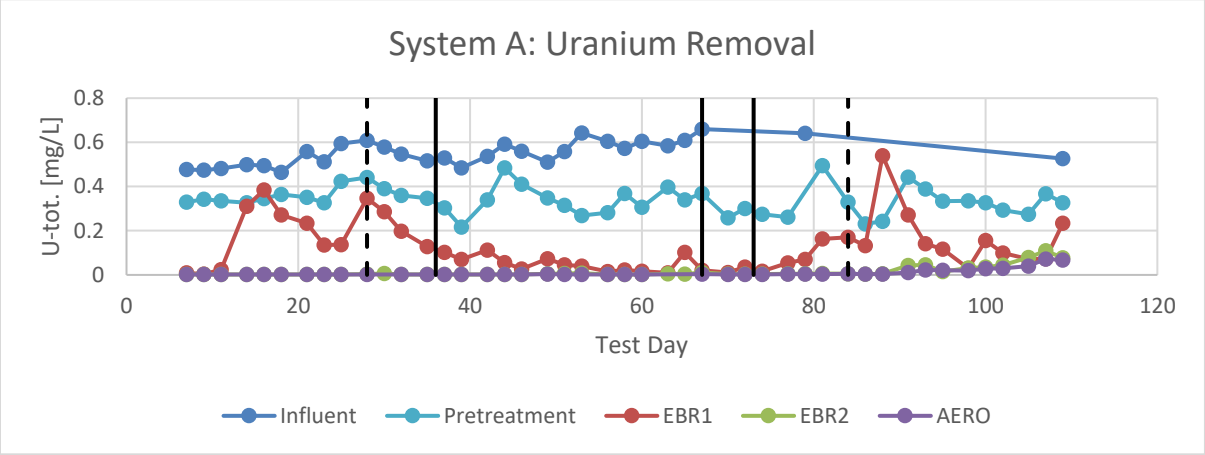

Figure 27. Phase II bench-scale uranium results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

Ferric arsenic co-precipitation pretreatment was optimized after the first four weeks of operation (Figure 28). **On average, the initial 79% removal efficiency was improved to 98.4%, removing total arsenic to 0.035 mg/L.** The factors affecting the pretreatment efficiency were the ferric chloride dose, as well as the type of barium pretreatment used for sulfate precipitation since barium sulfate sludge acted as coagulant/flocculant for arsenic co-precipitation. Increasing ferric chloride dose from 20 mg/L to 30 mg/L on test day 30 improved the system efficiency; the resulting total arsenic concentrations in the pretreatment effluent decreased from 0.43 mg/L to 0.077 mg/L. When barium hydroxide was used for sulfate precipitation instead of barium chloride, starting on test day 50, total arsenic concentrations dropped further to 0.029 mg/L. A short-lived evaluation of barium carbonate between test days 77 and 82 showed to be detrimental to both arsenic and uranium removal in the pretreatment; total arsenic concentrations peaked at 0.411 mg/L during that test.

Whenever arsenic concentrations spiked in the pretreatment effluent, a similar spike was observed later in the first-stage EBR effluent. Once the pretreatment was optimized, the EBR configuration and operating conditions were to specifically not target any arsenic reduction.

Arsenic speciation was performed three times throughout the bench trial – at the end of validation testing (day 28), early on during stress-testing when arsenic removal was still in steady-state operation (day 70), and at the end of stress-testing (day 113). The predominant arsenic species in the influent water was arsenate, as expected due to the use of hydrogen peroxide for cyanide destruction (Table 10). After arsenic precipitation pretreatment, arsenate remained the predominant species. The EBR system generated progressively more reduced arsenic species but never produced any methylated arsenic by-products. Depending on the operating conditions, the aerobic post-treatment re-oxidized most of the arsenic remaining in the system into the least bioavailable and less toxic As(V).

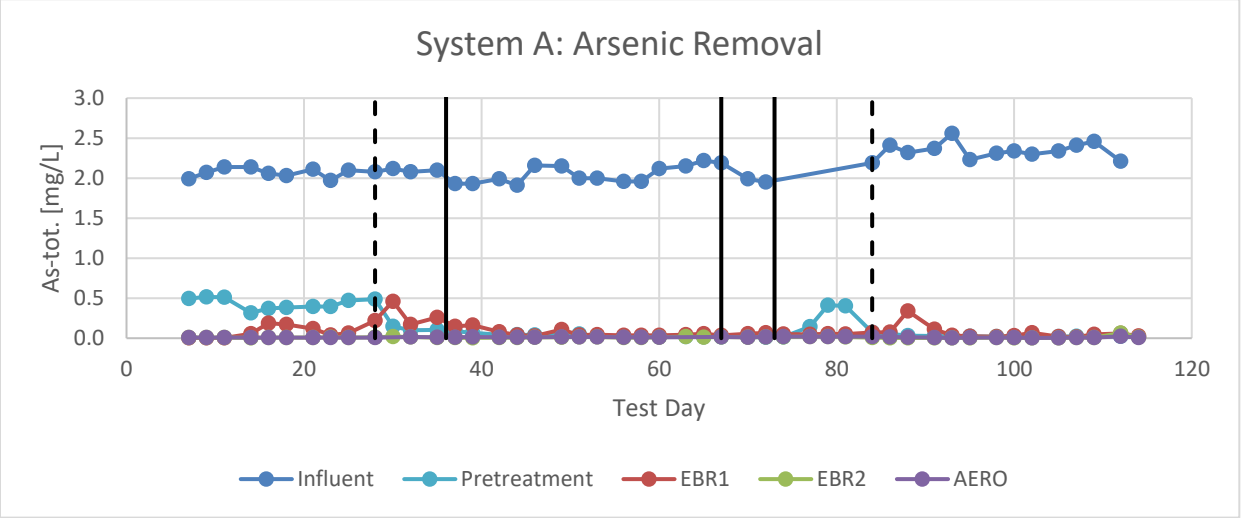

Figure 28. Phase II bench-scale arsenic results: System A overall results. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

Table 10. Arsenic speciation results, including the following arsenic species: As(V) – arsenate, As(III) – arsenite, MM-As – monomethylarsonic acid, DM-As – dimethylarsonic acid, and a sum of unknown species.

Test Day	As Species	Influent	Pretreatment	EBR1	EBR2	Aerobic
28	**As(V)**	2170 µg/L	119 µg/L	2.34 µg/L	3.16 µg/L	6.44 µg/L
	As(III)	<2.0 µg/L	<0.80 µg/L	200 µg/L	4.88 µg/L	1.77 µg/L
	MM-As	<4.5 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L
	DM-As	<2.5 µg/L	<1.0 µg/L	<1.0 µg/L	<1.0 µg/L	1.06 µg/L
	Unknown	7.8 µg/L	7.5 µg/L	12.9 µg/L	1.48 µg/L	<1.0 µg/L
70	**As(V)**	2,000 µg/L	12.4 µg/L	1.55 µg/L	<0.80 µg/L	6.25 µg/L
	As(III)	<0.80 µg/L	<0.80 µg/L	31 µg/L	2.31 µg/L	<0.80 µg/L
	MM-As	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L	<1.80 µg/L
	DM-As	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L
	Unknown	13.2 µg/L	<1.00 µg/L	19.2 µg/L	12.5 µg/L	1.17 µg/L
113	**As(V)**	1730 µg/L	11.2 µg/L	0.821 µg/L	2.03 µg/L	17.8 µg/L
	As(III)	<0.80 µg/L	<0.80 µg/L	25.3 µg/L	5.29 µg/L	<0.80 µg/L
	MM-As	1.21 µg/L	1.21 µg/L	<0.80 µg/L	<0.80 µg/L	<0.80 µg/L
	DM-As	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L	<1.00 µg/L
	Unknown	6.47µg/L	<1.00 µg/L	1.05 µg/L	11.4 µg/L	<1.00 µg/L

Arsenic species concentrations varied between testing stages and operating conditions. To illustrate the speciation transformations, Figure 29 shows average arsenic species concentrations across the treatment system.

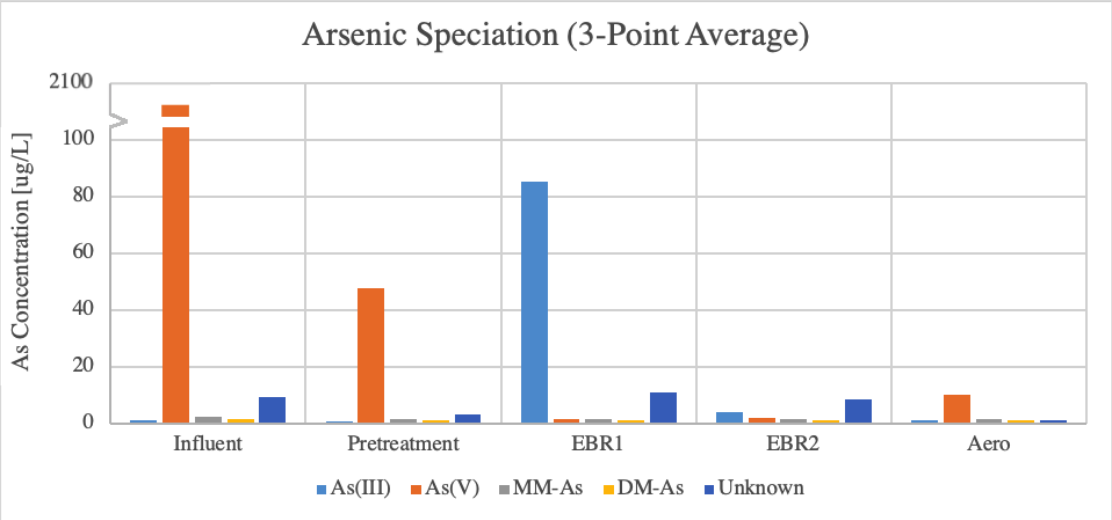

Figure 29. Phase II bench-scale arsenic speciation results: System A. Values averaged over three data points.

System A: Anions

Analytical suite chemistry scans were performed three times throughout the test – at the end of validation testing (day 28), early on during stress-testing when arsenic removal was still in steady-state operation (day 70), and at the end of stress-testing (day 113). **Because of the different testing-stage goals and changing operating conditions across all the treatment units, many of the evaluated parameters were never in a true steady-state. Drawing conclusions based on a limited set of three data points collected during various operating conditions has a number of limitations.**

Table 11 summarizes the results of major ions analysis. Nitrate-N, nitrate-N, and sulfate concentrations obtained from the analytical laboratory support the routine in-house analysis performed at WesTech's labs.

Table 11. The average concentration of anions throughout the Phase II bench-scale testing. Three-point average.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
Nitrate-N [mg/L]	335	303	0.034	<0.01	<0.01	3.0
Nitrite-N [mg/L]	1.04	1.57	<0.04	<0.02	<0.02	0.09
Sulfate [mg/L]	2,703	1,530	1,397	902	1,237	1,500
Sulfide [mg/L]	<0.016	<0.01	0.38	0.24	<0.01	N/A
Chloride [mg/L]	138	577	665	648	695	290

The average sulfide concentrations remained nondetectable in the influent and chemical pretreatment effluent, increased to 0.38 mg/L and 0.24 mg/L in the EBR stages, and were oxidized to below the detection limit of 0.01 mg/L in the aerobic post-treatment. While higher than the odor threshold of 0.5 μg/L, the average sulfide concentrations generated within the EBR reactors were orders of magnitude lower than the US OSHA health and safety standards. US OSHA defines sulfide exposure ranges as 100 mg/L (immediately dangerous to life or health), 50 mg/L (maximum peak for 10 minutes), 30 mg/L (maximum concentration below which it is believed that nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or serious health effects).

Because of the reagents used in the chemical precipitation steps, chloride levels spiked in the pretreatment effluent and remained elevated throughout the system. The highest chloride concentration in the pretreatment (836 mg/L) was detected when barium chloride was used as a sulfate precipitation reagent. Due to that high concentration, an adjustment was made to use barium hydroxide as a sulfate precipitant instead. However, since hydrochloric acid was used twice in the treatment train following this change (once to adjust the pH after cyanide destruction and the second time to neutralize the pH after barium hydroxide addition), chloride levels remained elevated at 307 mg/L. **We recommend performing additional sulfate precipitation jar tests with different barium salts that would not cause chloride increases (such as barium carbonate) once the mine is operational and actual site waters are available.**

System A: Metals

The average concentrations of metals collected throughout the individual treatment units are summarized in Table 12. For ease of interpretation, these results can be divided into five categories:

1. **Metals present in the influent waters within the forecasted ranges that were already below the discharge targets.**
    - Lead: present below the detection limit of 0.002 mg/L in the influent and throughout the treatment stages.
2. **Metals present in the influent waters within the forecasted ranged but exceeding the discharge targets.**

    2.1. Metals treated to below their respective discharge targets.
    - Molybdenum: present at 0.048 mg/L in the influent, removed to 0.04 mg/L in the pretreatment. The discharge goal of 0.033 mg/L was met within the first-stage EBR.
    - Nickel: present at 0.0053 mg/L in the influent, removed to less than 0.003 mg/L in the chemical pretreatment. The discharge goal of 0.002 mg/L was met within the first-stage EBR.
    - Calcium: present at 261 mg/L in the influent, removed to less than 90 mg/L in the final effluent. Calcium treatment target is 180 mg/L.

    2.2. Metals not treated to below their respective discharge targets.
    - Manganese: present at 0.029 mg/L in the influent. The initial spike of manganese concentrations observed throughout the EBR system was attributed to the addition of molasses as a nutrient source. Stress-testing with ethanol as the sole nutrient demonstrated that manganese could be maintained at or below the influent concentrations throughout the EBR treatment. Since no nutrients or reagents were added to the aerobic post-treatment column, a further spike discovered in the aerobic system effluent can only be

attributed to the microbial support media – in this case, pumice was used as a cost-effective alternative to activated carbon. Quality control will be conducted on media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of manganese occurs.

Table 12. The average concentration of metals throughout the Phase II bench-scale testing. Three-point average.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
Aluminum-tot. [mg/L]	<0.1	<0.1	<0.1	<0.1	<0.1	0.06
Antimony-tot. [mg/L]	0.61	0.38	0.06	0.02	<0.008	0.07
Arsenic-dis. [mg/L]	2.05	0.16	0.15	0.02	0.01	N/A
Barium-tot. [mg/L]	0.17	0.10	0.04	0.06	0.09	N/A
Cadmium-tot. [mg/L]	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.00004
Calcium-tot. [mg/L]	261	259	98	58	87	180
Chromium-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.001
Copper-tot. [mg/L]	0.018	0.006	<0.003	<0.003	<0.004	0.004
Iron-tot. [mg/L]	0.105	<0.1	0.23	0.12	<0.16	0.05
Lead-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.0032
Magnesium-tot. [mg/L]	195	121	124	114	112	50
Manganese-tot. [mg/L]	0.029	0.024	0.062	0.064	0.271	0.016
Mercury-tot. [mg/L]	0.0034	0.00013	<0.0001	<0.00009	<0.00009	0.0001
Molybdenum-tot. [mg/L]	0.048	0.040	0.02	<0.005	<0.002	0.033
Nickel-tot. [mg/L]	0.0053	<0.003	<0.002	<0.002	<0.002	0.002
Potassium-tot. [mg/L]	16.2	12.1	14.7	14	13.7	8
Selenium-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.0015
Silver-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.00009
Sodium-tot. [mg/L]	1500	1433	1460	1443	1430	890
Thallium-tot. [mg/L]	<0.002	<0.002	<0.002	<0.002	<0.002	0.0015
Uranium-dis. [mg/L]	0.61	0.35	0.22	0.004	<0.002	N/A
Zinc-tot. [mg/L]	<0.008	<0.006	<0.01	<0.006	<0.006	0.02

3. Metals present in the influent waters outside of the forecasted ranges.

3.1. Metals present in the influent waters at higher concentrations than forecasted and removed by the treatment to below their respective discharge targets.

- Antimony: influent concentrations of 0.61 mg/L reduced to 0.38 mg/L in the chemical pretreatment and reduced further by the biological treatment to 0.06 mg/L and 0.02 mg/L in the consecutive EBR stages. The discharge target of 0.07 mg/L was met in EBR1.
- Copper: present at 0.018 mg/L in the system influent, reduced by 66.7% in the pretreatment, and removed further biologically to below the detection limit of 0.003 mg/L. The discharge goal of 0.004 mg/L was met in the first EBR stage.

- Mercury: present at 0.0034 mg/L in the influent, reduced to 0.00013 mg/L in the chemical pretreatment. The discharge limit of 0.0001 mg/L was met within the first-stage EBR.

3.2. Metals present in the influent waters at higher concentrations than forecasted and not removed by the treatment to below their respective discharge targets.

- Magnesium: present at 195 mg/L in the influent, removed in the chemical pretreatment to 121 mg/L. It remained at a similar level throughout the biological treatment, exceeding the discharge limit of 50 mg/L. Water softening pretreatment step should be added to remove excess hardness minerals during pilot-scale testing.
- Potassium: present at 16.2 mg/L in the influent, removed to 12.1 mg/L in the pretreatment, and varied between 13.7-14.7 mg/L in the biological treatment. The upper-level prediction for potassium in Coffee waters is 11 mg/L. The discharge target is 8 mg/L.
- Sodium: present at 1,500 mg/L in the influent and not removed by any treatment stages. The upper-level prediction for sodium in Coffee waters is 1,168 mg/L.

3.3. Metals present in the influent waters at lower concentrations than forecasted.

- Iron: present in the influent at 0.105 mg/L. The initial spike of iron concentrations observed throughout the EBR system was attributed to the addition of molasses as a nutrient source. Stress-testing with ethanol as the sole nutrient demonstrated that iron remained at or below the influent concentrations.
- Zinc: present in the influent below the detection limit of 0.008 mg/L. Remained nondetectable throughout the treatment.

4. Metals with analytical detection limits higher than the discharge target.

- Aluminum: present below the detection limit of 0.1 mg/L.
- Cadmium: present below the detection limit of 0.0005 mg/L.
- Chromium: present below the detection limit of 0.002 mg/L.
- Selenium: present below the detection limit of 0.002 mg/L. Selenium speciation results are shown in Table 13, indicating that the influent concentrations averaged about 1 μg/L, with a somewhat even distribution between selenate and selenite. The EBR system removed both selenate and selenite below the detections limits. No other (often more bioavailable and/or more toxic) species of selenium were detected throughout the treatment.
- Silver: present below the detection limit of 0.002 mg/L.
- Thallium: present below the detection limit of 0.002 mg/L.

5. Metals with no specified discharge targets.

- Dissolved arsenic: present at 2.05 mg/L in the influent, reduced to 0.16 mg/L in the pretreatment, and further reduced biologically to 0.02 mg/L in the EBR treatment.
- Barium: present at 0.17 mg/L in the influent, reduced to 0.10 mg/L in the pretreatment, remained at similar levels throughout the rest of the treatment.
- Dissolved uranium: present at 0.61 mg/L in the influent, removed to 0.35 mg/L in the pretreatment. Reduced biologically to 0.004 mg/L.

Table 13. Selenium speciation results, including the following arsenic species: Se(VI) – selenate, Se(IV) – selenite, Se-CN – selenocyanate, MeSe(IV) – methylselenic acid, Se-Met – selenomethionine, $SeSO_3$ – selenosulfate, and a sum of unknown species.

Test Day	Se Species	Influent	Pretreatment	EBR1	EBR2	Aerobic
28	**Se(VI)**	0.403 µg/L	0.365 µg/L	<0.06 µg/L	<0.06 µg/L	<0.06 µg/L
	Se(IV)	0.789 µg/L	0.173 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
	Se-CN	<0.25 µg/L	<0.05 µg/L	<0.05 µg/L	<0.05 µg/L	<0.05 µg/L
	Me-Se(IV)	<0.35 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
	Se-Met	<0.35 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
	Se-SO_3	<0.30 µg/L	<0.06 µg/L	<0.06 µg/L	<0.06 µg/L	<0.06 µg/L
	Unknown	<0.35 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L	<0.07 µg/L
113	**Se(VI)**	0.507 µg/L	0.395 µg/L	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L
	Se(IV)	0.252 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L
	Se-CN	<0.125 µg/L	<0.125 µg/L	<0.125 µg/L	<0.125 µg/L	<0.125 µg/L
	Me-Se(IV)	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L
	Se-Met	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L
	Se-SO_3	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L	<0.150 µg/L
	Unknown	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L	<0.175 µg/L

System A: Cyanides

The average concentrations of cyanides are summarized in Table 14. The biological treatment removed total cyanide from 0.35 mg/L to 0.16 mg/L. WAD cyanide's elevated levels in the influent (0.04 mg/L), while lower than the predicted levels of 0.09-0.2 mg/L, exceeded the discharge target of 0.025 mg/L; **the EBR system removed WAD cyanide to below the detection limit of 0.006 mg/L. Thiocyanates remained relatively stable throughout the treatment.**

Table 14. The average concentration of cyanides throughout the Phase II bench-scale testing. Three-point average.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
Total CN [mg/L]	0.35	0.40	0.22	0.17	0.16	N/A
WAD CN [mg/L]	0.041	0.038	<0.015	<0.006	<0.006	0.025
Thiocyanate [mg/L]	0.40	0.33	0.24	0.40	0.22	N/A

System A: Residual Nutrients

While Table 15 provides a summary of residual nutrients results from the entire duration of bench-scale testing, some of the averaged data might be misleading. The residual nutrient parameters were monitored throughout the testing, and their concentrations changed depending on the operating

conditions and the goals of a given testing stage. All residual nutrient parameters, except for total organic carbon (TOC), were monitored twice a week.

Ammonia-N and organic carbon were present in the Coffee waters at significantly higher concentrations than the modeling had forecasted for the on-site chemistry. This was likely caused by natural cyanide bio-attenuation in Coffee solutions during storage since several biochemical metabolic pathways of cyanide biodegradation produce organic carbon and ammonia. When received at WesTech's Labs in October 2019, WAD cyanide concentration in the leach solution was 0.691 mg/L; by the time the rinse solutions were delivered in February 2020, WAD cyanide concentration in the leach solution dropped to 0.116 mg/L, indicating that natural biodegradation was occurring in the barrels. In the same period, ammonia-N increased in the leach solution from 68 mg/L to 83.4 mg/L.

Such high ammonia and organics concentrations are not expected to be present during normal operation of the mine and only occurred because of the prolonged storage of the generated leach waters. Ammonia-N is expected to be found at 0.025-0.06 mg/L in the heap leach rinse solutions, which is considerably lower than the discharge target of 8 mg/L. Even though the average ammonia-N concentrations in the system effluent were at 27.9 mg/L, the EBR system removed it to less than 20 mg/L through cell assimilation, while the aerobic post-treatment decreased it further to 7 mg/L. Conditions in the aerobic post-treatment had to be closely controlled to limit available oxygen that could lead to nitrate/nitrite production.

Organic carbon indicators, i.e., biological oxygen demand (BOD), chemical oxygen demand (COD), and total organic carbon (TOC), all followed the same trend. Medium concentrations of organics were found in the system influent, then increased in the biological EBR system before being oxidized to CO_2 and removed in the aerobic post-treatment. The average organics concentrations given in Table 15 can be misleading since they disregard a bench-scale project's optimization, adjustments, and stress-testing conditions. Figure 30 and Figure 31 illustrate the organics loading changes throughout the testing stages, using BOD and COD as examples. During the first month of operation, both the anaerobic and aerobic unit processes were in start-up and equilibration modes; the elevated nutrient levels in the EBR system were expected during start-up. The aerobic post-treatment needed time to establish a high-density biofilm on the support media to sustain the needed oxidation kinetics. **When the aerobic biofilm was well-established in the last 45 days of operation, the effluent BOD concentrations were typically below the detection limit of 5 mg/L.**

Table 15. The average concentration of nutrients throughout the Phase II bench-scale testing.

	Influent	Pretreatment	EBR1	EBR2	Aerobic	Target
BOD [mg/L]	21.7	17.3	312	517	582	N/A
COD [mg/L]	104	112	307	704	498	N/A
TOC [mg/L]	5.2	4.0	96	69	116	N/A
Ammonia-N [mg/L]	27.9	22.3	21.2	19.7	7.0	8
Phosphate-P [mg/L]	0.41	0.33	0.54	1.93	5.85	0.14

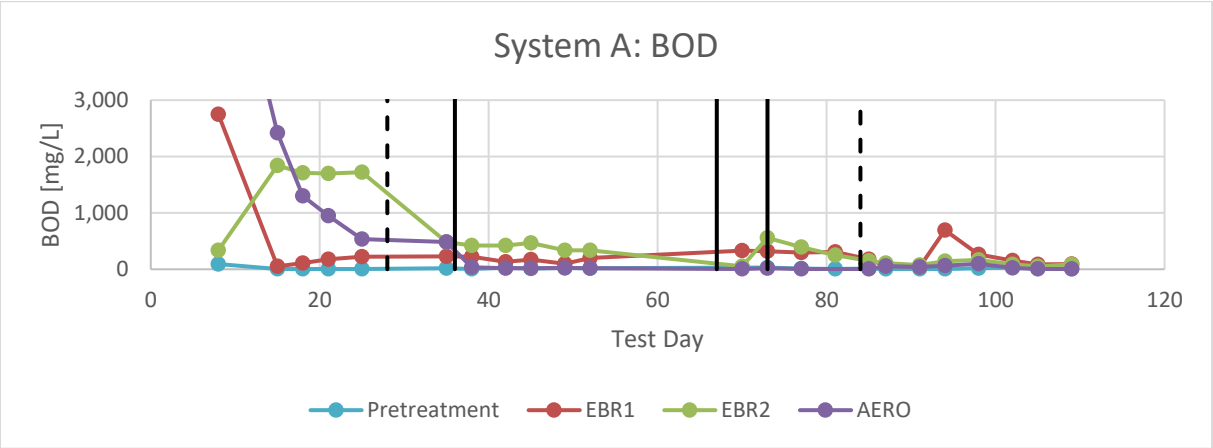

Figure 30. Phase II bench-scale results: System A overall BOD data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

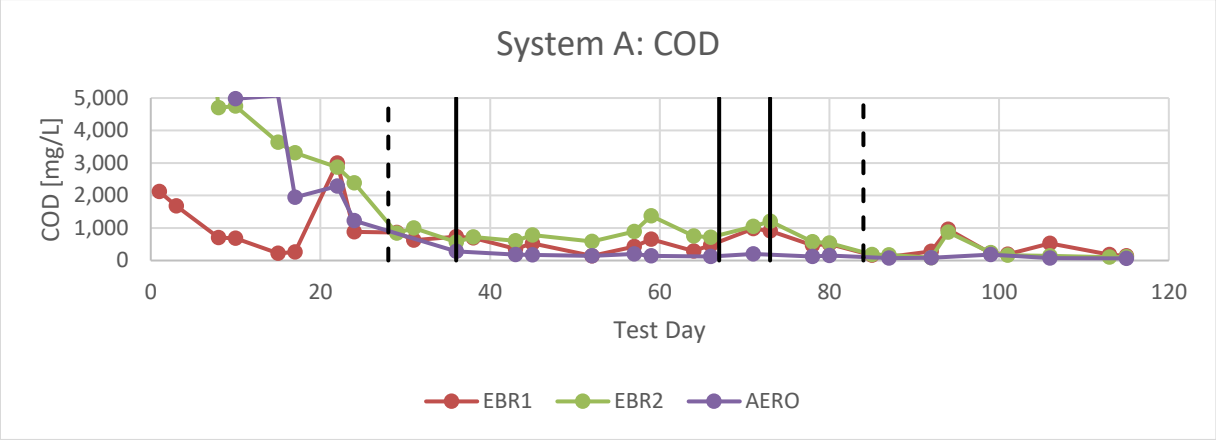

Figure 31. Phase II bench-scale results: System A overall COD data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

Total phosphate-P was present in the influent waters at 0.41 mg/L – a level twice as high as the water quality modeling had forecasted. As a residual nutrient, phosphate followed a similar trend throughout the EBR treatment system as the residual organics (Figure 32). Initial elevated concentrations can be attributed to start-up and steady-state operation using molasses/ethanol mixture as a nutrient. During the last two weeks of operation, once the system was stabilized and ethanol was used as a sole carbon source, the average EBR effluent PO_4-P concentrations were 0.18 mg/L for EBR1 and 0.35 mg/L for EBR2, when the average system influent carried 0.25 mg/L PO_4-P. With no external source of phosphorus, the slightly elevated levels detected in the second-stage EBR as compared to the system influent can only be explained by residual concentrations still being rinsed out from the preliminary testing stages. **A pilot- and full-scale installation is expected to not require any external phosphate additions and that the EBR system would remove some of the PO_4-P present in the influent waters through assimilatory pathways.**

Since no nutrients or reagents were added to the aerobic post-treatment column, the continuously elevated phosphate levels discovered in the aerobic system effluent can be attributed to the microbial support media – in this case, pumice was used as a cost-effective alternative to activated carbon. Quality control will be conducted on media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of phosphate occurs.

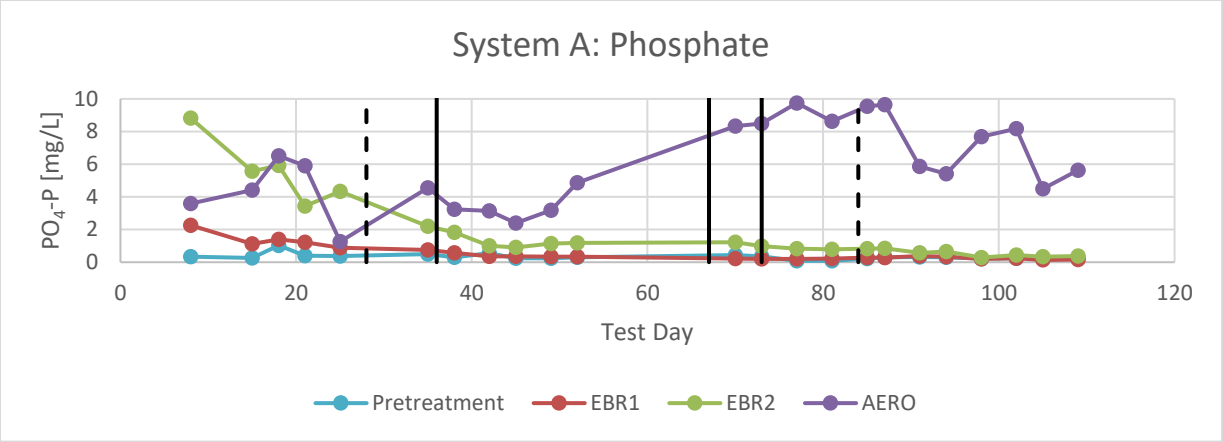

Figure 32. Phase II bench-scale results: System A overall phosphate-P data. Dashed vertical lines represent the major HRT reduction events, while solid vertical lines indicate the major nutrient adjustments.

System A: Radiochemistry

Water samples from System A were sent for radiochemistry analysis to Pace Analytical Laboratories. The general trend can be illustrated by the gross radiation graph, shown in Figure 33. Table 16 shows the detailed results of the radiochemical analysis. Most of the analyzed radioisotopes were present at concentrations lower than their respective uncertainty errors. Gross alpha and beta radiation spiked in the pretreatment effluent waters before dropping back down in the biological treatment effluents.

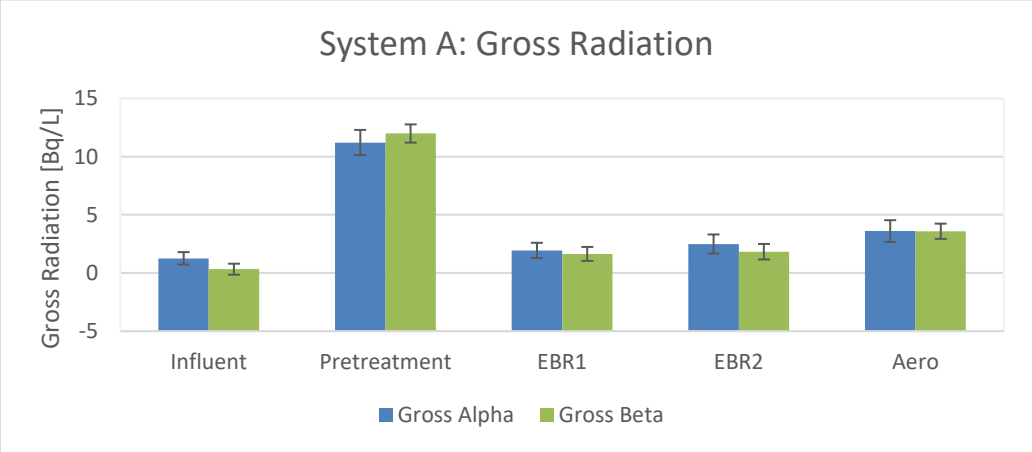

Figure 33. Phase II bench-scale results: System A gross radiation results.

Table 16. Phase II bench-scale results: Radiochemistry analysis of water samples collected from all the treatment stages. One data point.

	Influent	Pretreatment	EBR1	EBR2	Aero
Gross Alpha [pCi/L]	33.9 ±14.5	303 ±29.3	52.3 ±17.8	67.3 ±22.1	97.3 ±25.3
Gross Beta [pCi/L]	8.64 ±12.8	324 ±21.2	44.2 ±16.2	49.4 ±18.0	96.9 ±17.7
Ra-226 [pCi/L]	0.207 ±0.233	1.21 ±0.407	0.212 ±0.188	0.03 ±0.102	-0.0056 ±0.176
Ac-228 [pCi/L]	4.34 ±10.4	-3.90 ±12.6	4.38 ±10.7	6.78 ±9.97	1.43 ±10.1
Am-241 [pCi/L]	-23 ±13.9	-9.36 ±22.1	-13.5 ±13.5	-14.2 ±13.3	-12.9 ±13.2
Sb-124 [pCi/L]	-0.385 ±3.19	-3.29 ±4.19	0.399 ±3.32	1.52 ±3.28	3.86 ±3.34
Be-7 [pCi/L]	33.9 ±45.5	11.1 ±35.9	24.3 ±47.1	-11.7 ±49.6	13.7 ±51.6
Bi-212 [pCi/L]	-19.7 ±43.5	-29.6 ±57.1	23.7 ±45.2	-11.6 ±44.8	43.4 ±43.9
Bi-214 [pCi/L]	12.1 ±7.16	16.3 ±9.14	48.8 ±9.59	8.7 ±6.69	8.79 ±6.65
Ce-137 [pCi/L]	2.09 ±3.66	-1.75 ±4.42	1.67 ±3.64	0.352 ±3.49	-1.98 ±3.69
Co-60 [pCi/L]	0.435 ±2.51	0.429 ±3.32	-0.255 ±2.46	1.8 ±2.49	0.211 ±2.51
Ir-192 [pCi/L]	-0.658 ±3.68	-0.0703 ±3.55	0.251 ±4.01	-5.54 ±3.88	-4.38 ±3.97
Pb-212 [pCi/L]	-2.20 ±6.69	6.68 ±6.96	3.69 ±6.97	3.98 ±6.48	7.61 ±6.80
Pb-214 [pCi/L]	6.7 ±8.66	6.22 ±7.87	21.3 ±9.35	2.62 ±8.56	9.59 ±8.75
K-40 [pCi/L]	-12.3 ±45.5	31.3 ±53.9	7.76 ±45.6	-0.959 ±47.8	4.97 ±47.1
Sc-46 [pCi/L]	-0.117 ±3.66	-3.65 ±4.37	-1.03 ±3.75	1.65 ±3.79	2.7 ±3.92
Tl-208 [pCi/L]	-0.723 ±3.33	1.97 ±4.43	3.66 ±3.57	0.429 ±3.37	4.3 ±3.55
U-235 [pCi/L]	4.77 ±23.9	0.975 ±5.11	0.766 ±4.75	-10.8 ±23.4	-4.35 ±23.9
U-238 [pCi/L]	155 ±84.6	-21.7 ±54.1	14.4 ±50.0	29.8 ±51.5	26.1 ±50.9
Ce-134 [pCi/L]	-0.709 ±2.20	0.121 ±2.80	-1.07 ±2.34	0.35 ±2.20	1.53 ±2.14

In terms of compliance with the proposed water discharge standards, Figure 34 shows radium-226 analysis results. Ra-226 has a discharge target of 0.016 Bq/L (corresponding to 0.432 pCi/L), which was met throughout all treatment stages, except for the pretreatment effluent.

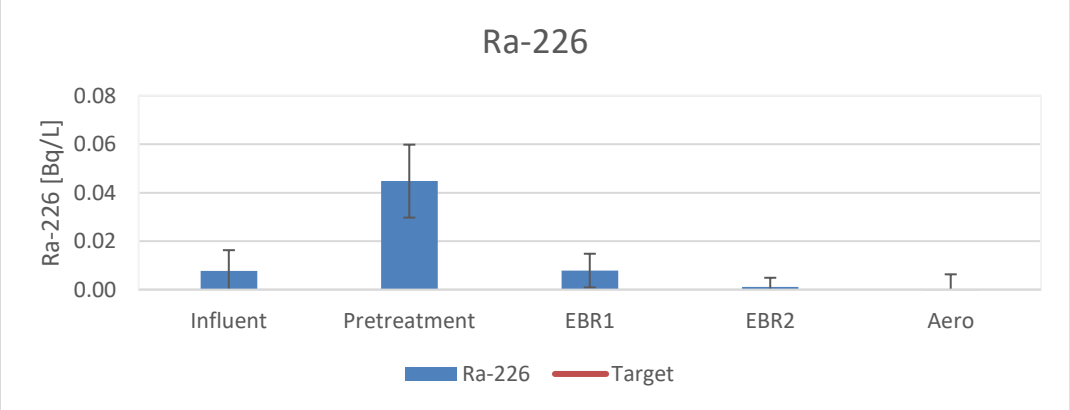

Figure 34. Phase II bench-scale results: System A radium-226 results.

At the conclusion of bench-scale testing, the columns were taken apart, and solids were collected from each treatment stage. This included the dewatered pretreatment sludge, activated carbon support media with any residual precipitates and microbial biofilm from the EBR columns, and the pumice support media with any residual precipitates and microbial biofilm from the aerobic post-treatment. **Except for Pb-214, Tl-208, U-235, and U-238, most of the analyzed radioisotopes were present at concentrations lower than their respective uncertainty errors (Table 17).**

Table 17. Phase II bench-scale results: Radiochemistry analysis of solids samples collected from all the treatment stages. One data point.

	Pretreatment Sludge	EBR1 Solids	EBR2 Solids	Aero Solids
Gross Alpha [pCi/g]	29 ±2.76	8.83 ±1.53	9.57 ±1.63	3.71 ±2.19
Gross Beta [pCi/g]	17.8 ±2.10	11.6 ±1.66	8.01 ±1.87	8.2 ±2.06
Ra-226 [pCi/g]	0.472 ±0.157	0.25 ±0.09	0.204 ±0.0821	0.434 ±0.115
Ra-228 [pCi/g]	0.165 ±0.169	0.112 ±0.106	0.0344 ±0.109	0.354 ±0.158
Bi-212 [pCi/g]	0.0469 ±0.65	0.54 ±0.389	0.0452 ±0.324	0.662 ±0.488
Pb-212 [pCi/g]	0.0146 ±0.101	0.175 ±0.0648	0.12 ±0.0581	0.554 ±0.0974
Pb-214 [pCi/g]	0.445 ±0.128	0.299 ±0.0757	0.222 ±0.0678	0.382 ±0.103
K-40 [pCi/g]	0.649 ±0.692	0.276 ±0.319	0.166 ±0.341	12 ±1.74
Tl-208 [pCi/g]	0.0175 ±0.0605	0.068 ±0.0361	0.0645 ±0.043	0.153 ±0.050
U-235 [pCi/g]	0.389 ±0.364	0.0441 ±0.0347	0.0761 ±0.039	0.13 ±0.232
U-238 [pCi/g]	5.05 ±2.26	3.79 ±1.54	4.27 ±1.62	0.193 ±0.487

As a point of reference, the US EPA does not consider radium as a "source material," and therefore, it would not be considered a by-product if present in the water treatment residuals. Uranium, however, is considered a "source material." The US EPA classifies any waste (solid or liquid) containing more than 0.05% by weight uranium, a low-level radioactive waste. That weight percentage corresponds to approximately 335 pCi/g for uranium.

The low concentration of radioisotopes in the Coffee waters implies a risk that they might be concentrated in one or multiple stages of the treatment, producing a radioactive by-product or waste that will be difficult to dispose of. Utilizing an optimized chemical pretreatment step removes both uranium isotopes (U-235 and U-238) from the influent waters continuously without generating even low-level radioactive sludge. U-238 concentrations in the influent waters were reduced from 155 ±84.6 pCi/L to levels below the uncertainty errors in the pretreatment step (Table 16), while only generating 5.05 ±2.26 pCi/g of U-238 in the sludge (Table 17). This point is also illustrated by the gross radiation detected in solids collected from the treatment stages (Figure 35). **A low-level peak of gross radioactivity in the pretreatment sludge suggests a concentration of the radioisotopes that can be safely disposed.**

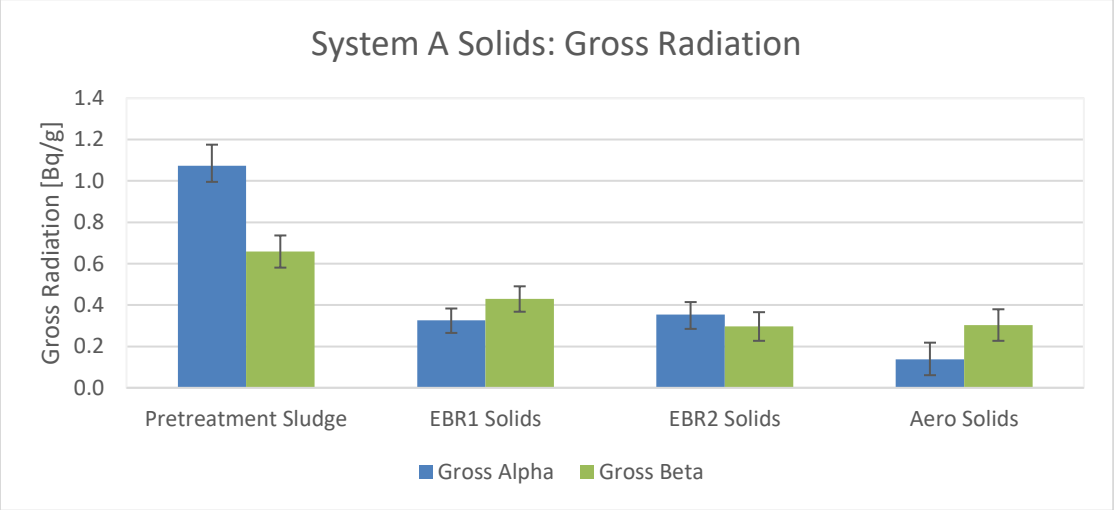

Figure 35. Phase II bench-scale results: System A solids radiation results.

System A: Toxicity Characteristic Leaching Procedure

At the conclusion of bench-scale testing, the columns were taken apart, and solids were collected from each treatment stage. This included the dewatered pretreatment sludge, activated carbon support media with any residual precipitates and microbial biofilm from the EBR columns, and the pumice support media with any residual precipitates and microbial biofilm from the aerobic post-treatment. The solids were submitted to AWAL laboratories for toxicity characteristic leaching procedure (TCLP) analysis.

All the collected solids passed the TCLP analysis (Table 18). Most metals were not leached in detectable quantities from any generated solids. The only exceptions were arsenic (leached out of the pretreatment sludge at 0.128 mg/L – well below the allowable limit of 5 mg/L) and barium (leached out of the EBR1 solids at 0.34 mg/L – well below the allowable limit of 100 mg/L). Since the ferric co-precipitation is a one-pass system, similar TCLP results from the pretreatment sludge can be expected from the pilot-scale test and full-scale installation. The EBR system has the potential of concentrating the contaminants with time. Assuming a linear accumulation and leachability of barium in the first-stage EBR, it would take 33,823 days of continuous operation (or about 93 years) to reach the allowable limit of 100 mg/L in the EBR solids.

Table 18. Toxicity characteristic leaching procedure (TCLP) results.

	Pretreatment Sludge	EBR1 Solids	EBR2 Solids	Aero Solids	Limit
As [mg/L]	0.128	<0.02	<0.02	<0.02	5.0
Ba [mg/L]	<0.3	0.34	<0.3	<0.3	100.0
Cd [mg/L]	<0.0035	<0.0035	<0.0035	<0.0035	1.0
Cr [mg/L]	<0.2	<0.2	<0.2	<0.2	5.0
Pb [mg/L]	<0.01	<0.01	<0.01	<0.01	5.0
Hg [mg/L]	<0.01	<0.01	<0.01	<0.01	0.2
Se [mg/L]	<0.01	<0.01	<0.01	<0.01	1.0
Ag [mg/L]	<0.01	<0.01	<0.01	<0.01	5.0

Quality Control Results

As part of the internal quality control testing, AWAL Labs performed method blanks (MB), laboratory control samples (LCS), matrix spikes (MS), and matrix spike duplicates (MSD) on the submitted samples. Method blanks use an analyte-free matrix, such as deionized water, through the complete procedure; it is used to evaluate contamination potential due to sample preparation and analytical procedure. Laboratory control sample uses the same analyte-free matrix as MB but is spiked with a known concentration of the analyte of interest; it is used to determine if the procedure is working within the established control limits, without the interference from the sample matrix. Finally, matrix spike uses an aliquot of the sample spiked with a known concentration of the analyte of interest; it is used to determine whether the procedure works within the established control limits, including sample matrix interferences. The matrix spike is routinely performed in duplicate as the MSD. The recoveries of the spiked analyte are evaluated to determine the accuracy in a given matrix, while the comparison between the MS and MSD shows how precise the procedure is in a given matrix.

For total metals analysis, the acceptable recovery control limits for the QC samples must be within 75%-125%. The recoveries of both total arsenic (Figure 36) and total uranium (Figure 37) were well within the acceptable recovery limits. Based on the standard deviations obtained from matrix spikes and matrix spike duplicates, the precision of total arsenic measurements was defined as ±0.0028 mg/L, while the accuracy was ±0.0068 mg/L (Table 19). For total uranium, the precision and accuracy were ±0.0061 mg/L and ±0.0111 mg/L, respectively. **The established precisions and accuracies of the total metals analyses were an order of magnitude lower than their respective discharge targets, giving us high confidence in the obtained results.**

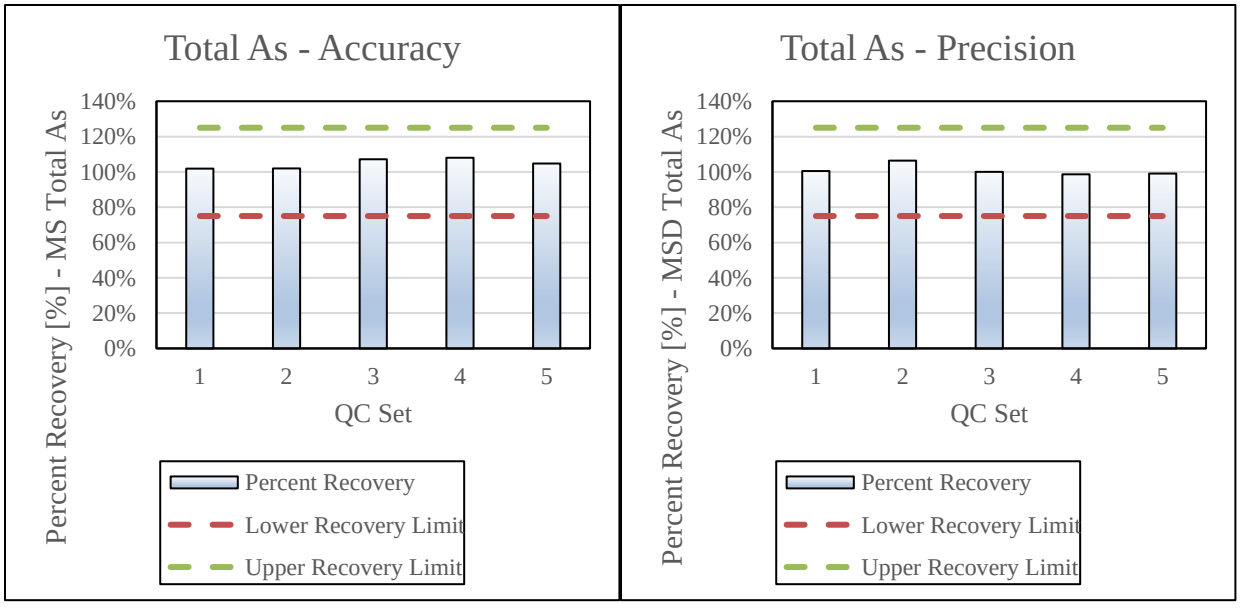

Figure 36. Quality control results for total arsenic analysis.

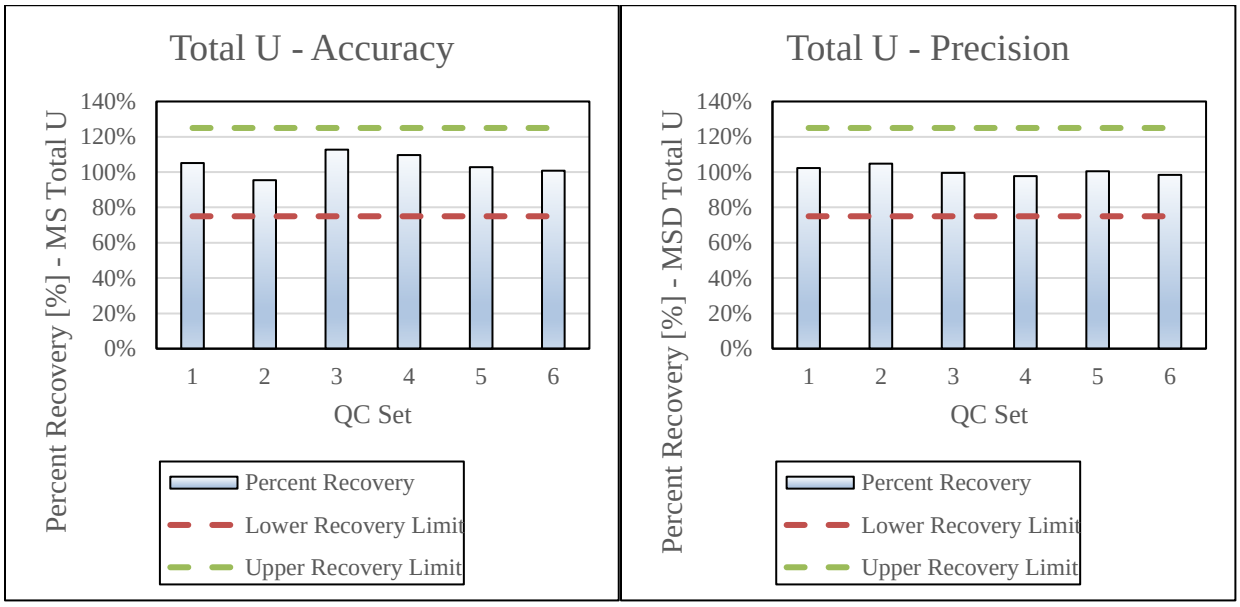

Figure 37. Quality control results for total uranium analysis.

Table 19. Analytical precision and accuracy during bench-scale testing of Coffee waters.

	Average Precision [mg/L]	Average Accuracy [mg/L]
Arsenic-tot.	±0.0028	±0.0068
Uranium-tot.	±0.0061	±0.0111
Nitrate-N	±0.01	±0.04
Sulfate	±11.7	±61.9

For anions, the acceptable recovery control limits must be within 90%-110%. The recoveries of nitrate-N and sulfate were shown to be within these limits (Figure 38 and Figure 39). Very high precision (±0.01 mg/L) and accuracy (±0.04 mg/L) were established for nitrate-N analysis (Table 19). Sulfate analysis carried a ±11.7 mg/L precision and ±61.9 mg/L accuracy, providing very high confidence in the obtained results compared to the 1,500 mg/L discharge target.

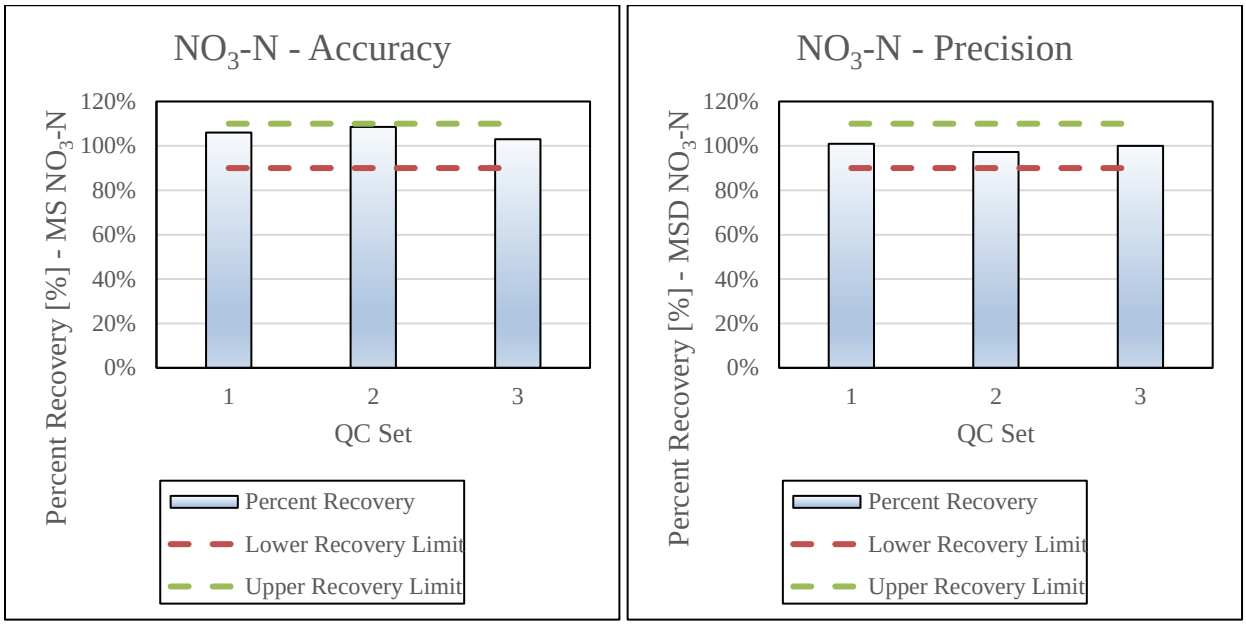

Figure 38. Quality control results for nitrate-N analysis.

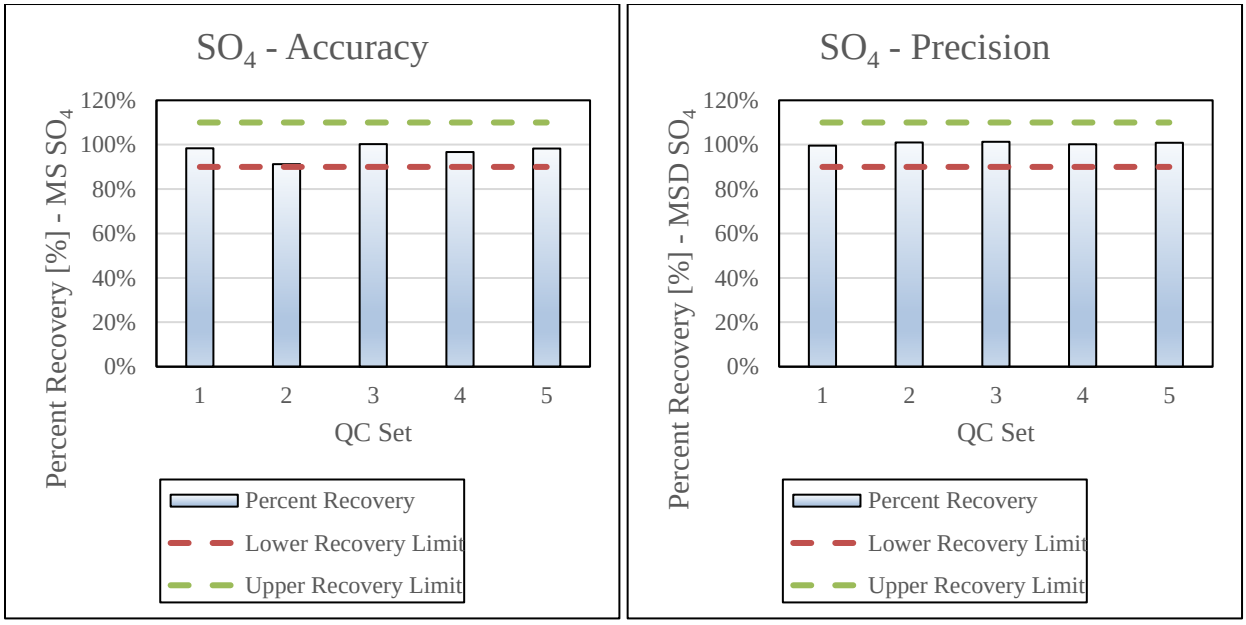

Figure 39. Quality control results for sulfate analysis.

Preliminary Design and Operational Parameters

Based on the results obtained from bench-scale testing, a set of preliminary design and operational parameters was developed for a pilot-scale demonstration trial (Table 20). It is recommended that the pilot be conducted once the Coffee Mine is operating and actual leach waters are generated.

The pilot demonstration is a required last step before preliminary engineering of the water treatment plant can be completed. The on-site demonstration will be conducted over at least a three-month period with a seasonal temperature change. The testwork and analytical plan will be developed prior to the pilot demonstration and will include at the minimum the same level of detail as the Phase II bench-scale program.

Table 20. Summary of the design and operational parameters for pilot-scale testing.

Unit process	Retention time	Reagent dose
Ferric Co-precipitation	~ 1hr	~ 30 mg/L $FeCl_3$
Sulfate Precipitation	~1 hr	~ 2 g/L Ba
EBR Treatment	7-10 hrs	0.6-0.9 mL/L ethanol
Aerobic Post-treatment	< 1hr	Continuous air addition

CONCLUSIONS

The Phase I feasibility testing successfully demonstrated the removal of nitrate, arsenic, and uranium from Coffee Gold leach waters. Nitrate-N was removed from an average of 188 mg/L to below the detection limit of 0.19 mg/L. After process adjustments, average removals of 98.8% and 99.1% were achieved for arsenic and uranium, respectively. Furthermore, sixteen other metals, as well as total and WAD cyanides, were removed by the EBR system.

Even though arsenic removal was demonstrated with the biological treatment, the feasibility testing proved that long retention times and high nutrient doses would be required to meet the required discharge levels. The Phase I recommendation was to investigate phys-chem arsenic removal options.

The in-situ feasibility tests demonstrated enhanced denitrification upon inoculation with the EBR effluent and nutrient additions. Natural nitrate reduction occurred in the control column upon nutrient additions due to the presence of a native denitrifying microbial population. However, inoculation with the EBR microbial population enhanced the denitrifying performance. Nitrate-N was reduced in the in-situ test column from approximately 150 mg/L to 13.9 mg/L when the EBR effluent was used to irrigate the columns, and it was reduced to 26.4 mg/L when DI water was used as column influent.

In line with the Phase I findings, the Phase II bench-scale testing demonstrated that the best approach for the Coffee Mine water treatment is a multi-stage treatment train that consists of a phys-chem pretreatment for arsenic and sulfate precipitation, biological EBR treatment for denitrification and metals polishing, and a small aerobic post-treatment for removal of residual nutrients and reintroduction of dissolved oxygen. The list below presents the detailed findings pertaining to each unit process.

1. Chemical pretreatment

- **The pretreatment design took advantage of combining three steps to benefit the overall system performance.** The cyanide destruction step aided the oxidation of more reduced arsenic species and converted them into arsenate, which is the most amenable form of arsenic to ferric co-precipitation. Instead of further reagent additions after ferric dosing, barium salts that were used to precipitate sulfate also acted as coagulants and flocculants for the already formed arsenic precipitates.
- **System optimization demonstrated that arsenic could be removed to below the discharge target of 0.035 mg/L with ferric co-precipitation alone.**
  - Arsenic analysis had an accuracy of ±0.0068 mg/L.
- **Sulfate was shown to be removed from the Coffee waters to below the discharge target of 1,500 mg/L with barium precipitation alone.** Jar tests demonstrated that barium dose is directly proportionate to the amount of sulfate precipitated; greater or lower sulfate removal can be achieved with an adjusted Ba dose.
  - Sulfate analysis had an accuracy of ±61.9 mg/L.
  - The evaluated barium salts (barium chloride and barium hydroxide) resulted in elevated chloride concentrations passing through the treatment system. A jar test examination of

different barium salts alone and in combination is recommended once the mine is operational and actual site waters are available to establish the most suitable reagent dose to avoid generating excess chlorides.

- **The implications of the successfully demonstrated pretreatment of both arsenic and sulfate include the need for a significantly smaller biological EBR system, no requirement for the addition of complex organic nutrients, and a lower organic carbon addition, resulting in lower residual nutrient concentrations.**

- **A 39% removal of total uranium was achieved on average with the chemical precipitation pretreatment.**
  - The pretreatment sludge removed the radioisotopes, rendering the following EBR treatment less likely to accumulate them. The average gross alpha radiation in the pretreatment sludge was 29 ±2.76 pCi/g, while gross beta radiation was 17.8 ±2.10 pCi/g.
- **Sludge generated in the pretreatment passed the TCLP analysis.**

2. EBR treatment

- **A single-stage EBR treatment operated with a 7-hr HRT and a 0.6 mL/L ethanol dose removed nitrate-N to below the detection limit of 0.3 mg/L.**
  - Nitrate-N analysis had an accuracy of ±0.004 mg/L.
  - Average nitrite-N concentration (an intermediary denitrification by-product) in EBR1 was 0.037 mg/L, meeting the discharge target of 0.09 mg/L.
- **Total uranium removal to below the discharge target 0.1 mg/L was achieved with the first-stage EBR treatment using an 11-hour HRT and 0.9 mL/L ethanol dose.**
  - Total uranium analysis had an accuracy of ±0.0111 mg/L
- Once optimized to target only nitrate and uranium, the EBR system was demonstrated to allow residual arsenic and sulfate to pass through without further reducing either one.
  - The speciation results show that the EBR system did not produce any methylated arsenic species, even during the preliminary testing stages, when residual arsenic was removed biologically.
- **In addition to the contaminants of interest, the EBR system removed the following metals from elevated concentrations in the influent waters to below their respective discharge targets: antimony, copper, mercury, molybdenum, and nickel.**
  - The EBR system removed all selenium species to below detection, including organo-selenium species that are more bioavailable in the natural environment.
  - Iron and manganese were present in the influent waters above their discharge targets and passed through the EBR system largely unchanged after the system was provided with ethanol as a sole nutrient source.
  - If present above their respective discharge targets, magnesium and calcium will need to be removed through an additional softening pretreatment step prior to EBR treatment. Although possible, removing hardness minerals in the EBR system is not advised because their elevated concentrations would load the bioreactor bed with solids and blind the activated carbon media in a relatively short amount of time (a few years).

- Monovalent cations, such as potassium and sodium, were present at higher levels than forecasted by the water quality models and exceeded their respective discharge targets. The EBR system cannot be used to target them.

- **The EBR system polished WAD cyanide to below the detection limit of 0.006 mg/L.**
- **Once the pretreatment was optimized, ethanol was used as a sole nutrient source for the EBR treatment, resulting in low residual nutrient generation.**
  - Ammonia-N concentrations of several mg/L were removed through an assimilatory pathway in the EBR treatment. However, since the influent NH_3-N concentrations were 465-times higher than forecasted (27.9 mg/L, instead of 0.06 mg/L), elevated ammonia still passed through the EBR system.
  - Average BOD concentrations stabilized at about 100 mg/L in the EBR system effluent.
  - Phosphate concentrations of 0.18 mg/L and 0.35 mg/L were generated from EBR1 and EBR2, respectively, when the average system influent carried 0.25 mg/L PO_4-P. A pilot- and full-scale installation is expected to not require any external phosphate additions and that the EBR system would remove some of the PO_4-P present in the influent waters through assimilatory pathways.
- **Neither the EBR treated effluents nor the EBR solids, including the activated carbon matrix as well as any precipitated residues and biofilm, accumulated gross radiation.**
- **EBR solids, including the activated carbon matrix as well as any precipitated residues and biofilm, passed the TCLP test.**

3. Aerobic post-treatment

- **Once optimized, the aerobic post-treatment removed BOD to below the detection limit of 5 mg/L.**
- **On average, the aerobic column removed ammonia-N to 7 mg/L, meeting the discharge goal of 8 mg/L while not generating excess nitrate/nitrite species.** The influent ammonia-N concentrations are forecasted to be present at 465-times lower concentrations (up to 0.06 mg/L) in the Coffee waters.
- **A significant spike of phosphate-P (5.85 mg/L on average) detected in the aerobic post-treatment effluent is attributed to phosphorus leaching out of the microbial support media (pumice) since no nutrients or reagents were added to the system.**
  - Quality control will be conducted on media used in pilot-scale tests and the full-scale installation to ensure no unexpected leaching of phosphate occurs.
- The aerobic post-treatment did not negatively affect any parameters removed by the EBR treatment upstream, except for manganese.
  - Manganese concentrations spiked in the post-treatment effluent to an average concentration of 0.271 mg/L – over 4.2x increase from the EBR system effluent. Since no nutrients or reagents were added to the post-treatment, the source of manganese can only be attributed to the pumice used as a support matrix inside the column.